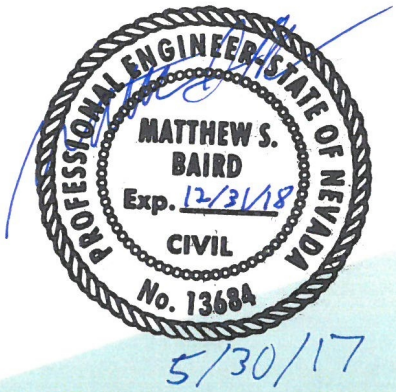
Flamingo – Boulder Highway North - Boulder Hwy, Sahara to Charleston

(Boulder Highway Storm Drain)

Draft Design Report (Volume 1)
70% Plans (Volume 2)

May 30, 2017



Prepared for the City of Las Vegas



ATKINS

ATKINS

May 30, 2017

Anita Marquez, P.E.
Engineering Project Manager
City of Las Vegas
Department of Public Works
333 Rancho Drive
Las Vegas, Nevada 89107

RE: Draft Design Report for Boulder Highway Storm Drain

Dear Ms. Marquez

Transmitted herewith are the Draft Design Report (Volume 1) and the 70% Design Plans (Volume 2, under separate cover) for the Flamingo - Boulder Highway North - Boulder Hwy, Sahara to Charleston (Boulder Highway Storm Drain).

Please feel free to contact me if you have any questions.

Sincerely,



Matt Baird, PE, CFM
Project Manager

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Executive Summary

This Draft Design Report (DDR) has been prepared to describe the 70% design and analysis of the Flamingo - Boulder Highway North – Boulder Hwy, Sahara to Charleston (hereafter referred to as the Boulder Highway Storm Drain - BHSD). The project improvements extend from Boulder Highway (Fremont Street) just north of Sahara Avenue to Charleston Boulevard and terminate half way between Fremont Street and Eastern Avenue on Charleston Boulevard. The regional facilities encompassed in this project are described in the 2013 Las Vegas Valley Flood Control Master Plan Update (MPU) as facility numbers FLBN 0038 and 0167.

The project involves installation of 6,600 feet of trunk line storm drain in Fremont Street and Charleston Boulevard as well as appurtenant lateral collection facilities. The storm drain varies in size from a 14' x 8' RCB at the upstream end (Charleston) to a 15' x 10' RCB at the downstream end (Fremont Street near Sahara Ave.). At the downstream end the proposed storm drain will connect to the existing 15' x 10' RCB just north of the Fremont Street and Sahara Avenue intersection that was constructed by Clark County Public Works in 2013. The existing 15' x 10' RCB continues south in Boulder Highway to its discharge point into Flamingo Wash at Boulder Highway. The project entails the construction of the trunk line facilities and associated collection system including, but not limited to: laterals, drop inlets, manholes, and all necessary appurtenances.

Major lateral collection storm drains are proposed in St. Louis Avenue, Oakey Boulevard and Atlantic Street on the west (upstream) side of Fremont Street as well as a small storm drain system in the vicinity of Olive Street/Russell Avenue/Euclid Avenue/Eastwood Drive/Ballard Drive to address a problem flooding area. There are two other major laterals recommended, Eastern South and Eastern North. Both of these laterals are proposed to connect to the mainline Phase 2 storm drain in Charleston Boulevard at Eastern Avenue. The design of this next phase of the facility began in early May 2017 and will extend the trunk line in Charleston west to Maryland Parkway.

This report and the 70% plans provide the results of the progress completed to date on the project, which includes the following:

1. 1 foot contour topography for the project area has been completed along with extensive field survey to locate utilities, including dipping all sanitary sewer and storm drain manholes.
2. A Record of Survey has been completed and recorded for the project.
3. Collection of all available existing utility information has been completed and included on the 70% plans as well as the 70% SUE plans.
4. Existing utilities have been potholed (to date over 100 potholes have been completed) and the associated information obtained has been incorporated into the 70% plans.
5. Existing ROW limits have been developed and included in the 70% plans as well as identification of ROW acquisition needs for the project (1 permanent drainage easement and one AEP).
6. Draft geotechnical and groundwater reports and associated field work has been completed and included in this submittal.
7. The detailed hydrologic analysis for the project is complete, all flows, drainage patterns, collection facility locations and sizes have been identified and included on the 70% plans.
8. Detailed hydraulic analysis (WSPG) has been completed for all proposed storm drain conveyance facilities. Drop inlets have been sized using standard methods.
9. A utility conflict matrix has been developed and known utility conflicts identified.
10. Horizontal Control and Alignment Control of the storm drain facilities has been developed and included in the 70% plans along with plan and profile of all storm drain facilities proposed

with the project. Typical sections, removal sheets, roadway (pavement) sheets, striping sheets, detour sheets, sanitary sewer relocation sheets, waterline relocation sheets and detail sheets are also included in the 70% plans.

11. A summary of required permits has been developed and included in this report.
12. A Chapter 8 Resource Screening Analysis has been completed and a draft copy of the associated report was submitted for review under separate cover at the same time as this 70% submittal.
13. Estimated construction cost of the proposed facilities has been developed.

The total estimated construction cost of the project with 10% contingency is $22.5 million, Phase 1 construction to Atlantic is $18.4 million with an additional $4.1 million for the reach north of Atlantic.

Based on the information collected to date, analysis completed and information presented in this report and the 70% plans the project appears feasible and constructible and can meet the intended purpose of collection and conveyance of the 100-year flood event as originally intended. In addition to continued advancement of the design towards final plans and specifications the critical action items to address as the project continues are as follows:

1. Continued coordination with entities having existing facilities that will be impacted by the placement of the proposed infrastructure, which include:
    a. Las Vegas Valley Water District – close proximity to relatively large diameter waterlines and some required relocations/remove and replace of small to medium diameter waterlines.
    b. Clark County Water Reclamation District – relocation of sewer on west side of Fremont
    c. NV Energy (distribution) – required relocation of an underground powerline at several locations near Fremont and Oakey.
    d. Southwest Gas – multiple required relocations throughout the project (no high pressure gas line or large diameter relocations required)
    e. Century Link – relocation of telephone conduit at several locations on the east side of Fremont Street.
2. Obtain permits/approvals from:
    a. City of Las Vegas
    b. Clark County Regional Flood Control District – Chapter 8 and Funding
    c. Nevada Department of Transportation – Encroachment Permit
    d. Clark County Development Services/Clark County Public Works
    e. Nevada Department of Environmental Protection – Groundwater Discharge Permit
3. Obtain permanent drainage easement and AEP between Eastwood Drive and Euclid Avenue for the proposed lateral storm drain.
4. Resolve abandonment or removal of obsolete existing storm drain and sewer pipes in NDOT ROW and resolve associated pavement rehab requirements.

Atkins has prepared this report and the 70% plans to compile all necessary information to summarize the progress to date and allow the City (with input from Atkins and stakeholders) to make the decisions necessary to advance the project in an efficient and timely manner. We appreciate the opportunity to work together to advance this project to completion and provide the needed infrastructure to help protect our community from the damaging effects of flooding.

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- Appendix A-3: HEC-1 Model
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- Appendix A-5: Hydrologic Parameters
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Appendix B Hydraulic Analysis

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- Draft Geotechnical Evaluation Report
- Draft Groundwater Sampling, Slug tests and Groundwater modeling Report

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- Appendix E-3: Utility Pothole Reports

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Appendix G Comment Matrix and Correspondence

Electronic Data CD

- Hydrologic/Hydraulic Models (Appendix A and B)
- Geotechnical Reports (Appendix C)
- Project topography
- PDF version of the Draft Design Report
- PDF version of the 70% Design Plans

1. Introduction

1.1. Purpose

The purpose of this Draft Design Report (DDR) is to describe the criteria, parameters, considerations, assumptions, and methodology used in the design and analysis of the Flamingo - Boulder Highway North – Boulder Hwy, Sahara to Charleston System (hereafter referred to as Boulder Highway Storm Drain - BHSD). This DDR includes pertinent aspects of the project explored to date and facilitates review of the design by the City of Las Vegas (City), the Clark County Regional Flood Control District (CCRFCD), Nevada Department of Transportation (NDOT), Clark County as well as other stakeholders.

It is important to note that the proposed drainage system and the associated analysis presented in this DDR is still a work in progress and represents the latest information corresponding to the 70% milestone submittal. Comments and feedback on the Preliminary Design Report (PDR) are incorporated in this report as well as advancement of the design to a 70% level of completion. The comments and Atkins responses on the PDR and 30% design are included **Appendix G**. The analysis, design, and information presented herein are subject to amendments, additions, and revisions in the future as comments are received and more analyses are completed throughout the final design phase. The content presented herein will later be updated as necessary and incorporated into the Final Design Report at the 90% milestone.

1.2. Project Description and Location

This Draft Design Report (DDR) has been prepared to describe the 70% design and analysis of the Boulder Highway Storm Drain (BHSD). The proposed project improvements are located in Boulder Highway (Fremont Street) from just north of the Sahara Avenue intersection to the intersection with Charleston Boulevard as well as the appurtenant lateral collection facilities, see **Figures 1, 2 and 3**. The regional facilities encompassed in this project are described in the 2013 Las Vegas Valley Flood Control Master Plan Update (MPU) as facility numbers FLBN 0038 and 0167.

Previously Clark County Public Works constructed the downstream end of the BHSD from the Flamingo Wash north in Boulder Highway (Fremont Street) to just north of the Boulder Highway/Sahara Avenue intersection. This existing 15’ x 10’ RCB is the downstream connection/terminus of the current project. The current project includes extending the BHSD north in Fremont Street to Charleston Boulevard where it will turn west and continue another 300 feet in Charleston Boulevard, this is the upstream terminus of this phase of the BHSD. Future phases of the BHSD will extend the facility west in Charleston Boulevard all the way to Main Street.

The mainline storm drain in Fremont Street and Charleston Boulevard is approximately 6,600 feet long and varies in size from a 15’ x 10’ RCB to a 14’ x 8’ RCB. As a result of the analysis completed in the PDR and subsequent discussion with the City and CCRFCD the first phase of construction will end just north of Atlantic Street (Phase 1 construction terminus, see **Figure 3**). The remainder of the mainline storm drain from Atlantic to 300 feet west of Fremont Street in Charleston will be included in the next construction package, Phase 2 construction. The Phase 2 construction will include extending the facility west in Charleston to Maryland Parkway as well as a major lateral in Maryland Parkway from Charleston to Stewart, this phase of the project is called the Charleston Storm Drain. The Phase 1 construction terminus was established to avoid impacting the Fremont Street and Charleston Boulevard intersection during two different construction phases.

Per agreement with the City, this report and the 70% plans will include the hydrologic/hydraulic analysis and design of the full 6,600 feet. The portion that is north of Atlantic will be added to the design package of the Phase 2 Charleston Storm Drain (from Fremont Street to Maryland Parkway). The design of the Charleston Storm Drain started at the beginning of May 2017. The current plan is to have the design of the Charleston Storm Drain complete and ready to begin construction by the time the Phase 1 construction (to Atlantic) is complete. The Phase 1 construction also includes the lateral storm drains shown on **Figure 3** in St. Louis Avenue, Oakey Boulevard, Atlantic Street and the segment from Atlantic Street northwest to Eastwood Drive/Ballard Drive.

Detailed sizes, locations, and alignments of the proposed storm drain facilities are shown on the 70% Design Plans that accompany this report and will be described later in this DDR.

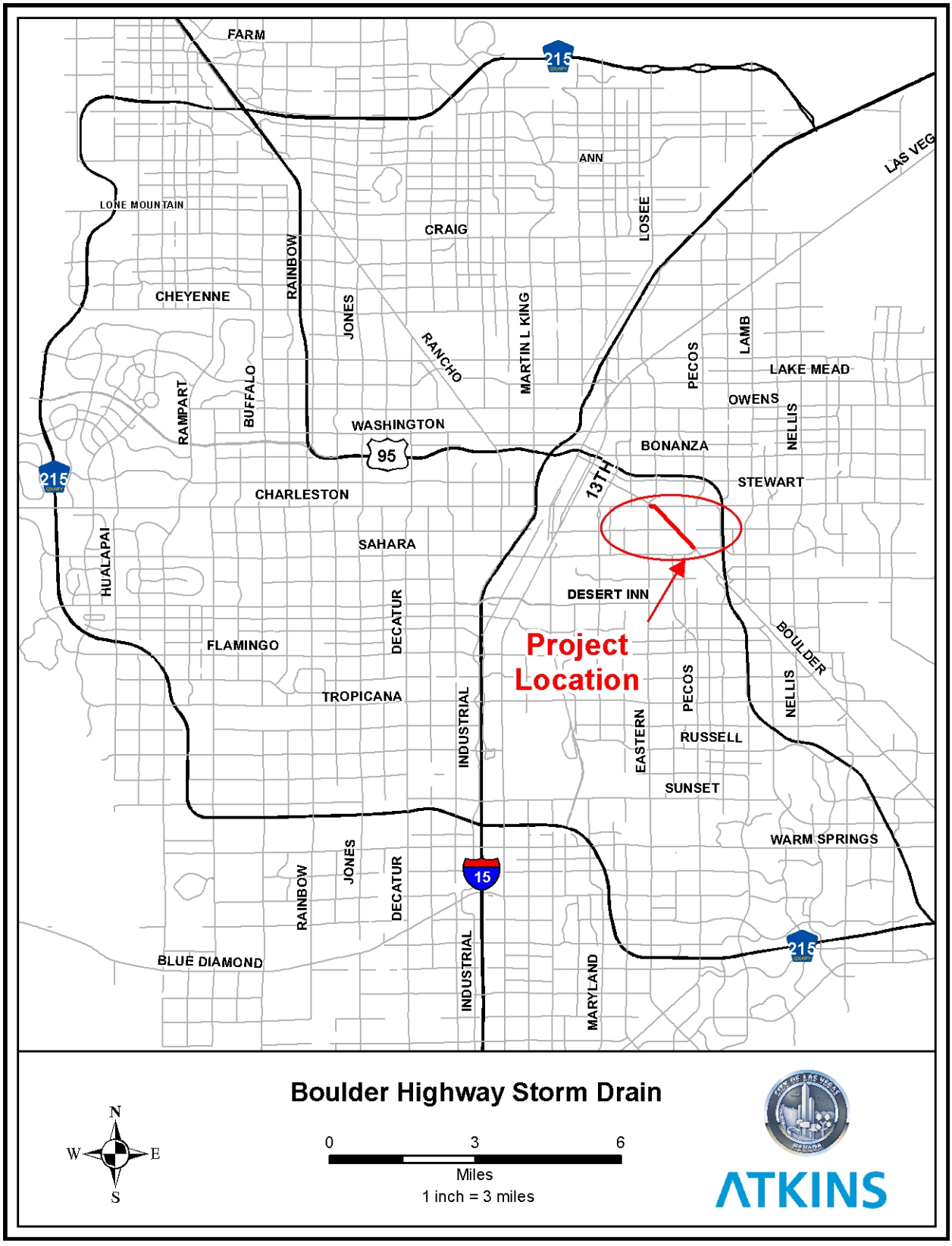


Figure 1. Boulder Highway Storm Drain Vicinity Map

REGIONAL FLOOD CONTROL DISTRICT

2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F- 32
FLOOD CONTROL FACILITIES

LEGEND

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

Remove & Replace/Parallel Facilities

Category A	Category B
Channel	Channel
Stormdrain	Stormdrain

N

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

Scale: 1 inch = 2,000 feet

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

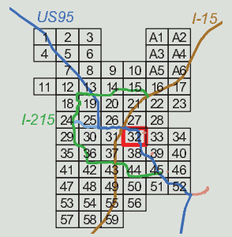


Figure 2

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

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

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

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

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

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

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

REGIONAL FLOOD CONTROL DISTRICT

2013 LAS VEGAS VALLEY FLOOD CONTROL MASTER PLAN UPDATE

FACILITY INVENTORY FIGURE F - 32

LEGEND

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

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

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

Bottom Width.....W

Depth.....D

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

Construction Features

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

Figure 2A

Figure 3 Boulder Highway Storm Drain Alignment

Legend

Proposed Mainline Storm Drain

- PH1 Construction
- PH 2 Construction

- **Proposed Lateral Storm Drain**
- **Existing MPU Facilities**
- **Future MPU Facilities**
- **Local Storm Drain Facilities**

N

ATKINS

0 600 1,200 Feet

1 inch = 600 feet

Charleston Blvd
Ballard Drive
Russell Ave
Olive St
Eastwood Dr
Euclid Ave
Eastern Ave
Wengert Ave
Atlantic St
Mojave Rd
Fremont St
Wyoming Ave
Oakey Blvd
St. Louis Ave
Mcleod St
Sahara Ave
Boulder Hwy

1.3. Inventory of the Existing Condition

The watershed area impacting the BHSD encompasses approximately 3.0-square-miles of urbanized area in the central portion of the City. The watershed is generally bounded by UPRR railroad on the west, Fremont Street on the North, Sahara Avenue on the south, and Fremont Street/ Boulder Highway on the east. The overall drainage pattern in the study area is from west to east, with runoff being conveyed on the surface in streets and in minor storm drain facilities. Future phases of this project will extend the mainline storm drain west within Charleston Boulevard and then south on Main Street.

Panel 32003C2186F and 32003C2190F of Federal Emergency Management Agency's (FEMA's) Flood Insurance Rate Maps (FIRMs) shows the project area is not within a Special Flood Hazard Area. FIRMettes showing the flood zone boundaries in the study area in included in **Appendix A (Figures A-1 and A-2)**.

During early phases of the project, field investigations were performed in the study area to assess drainage patterns, confirm the desktop data collected, and evaluate the current condition of the project site and tributary areas. Detailed topography, aerial photos, and previously completed drainage studies were also reviewed and relevant information extracted in order to inventory the existing condition and understand constraints and design considerations in the study area. In addition, photos were taken during field investigations and compiled in a photo library included in **Appendix A**.

A few observations regarding the existing condition are summarized in the following paragraphs.

Charleston Boulevard is the conveyance for a majority of the watershed. The future phase of this storm drain system will extend along Charleston Boulevard collecting the existing flows. During the existing condition local storm drains in Charleston Boulevard convey some of the flow with most conveyed on the road surface. Similarly other major east to west roads convey flows to the Fremont Street corridor where the proposed storm will intercept this flow. Major laterals and collection facilities are proposed in St Louis Avenue, Oakey Boulevard and Atlantic Street.

The overall intent of the project is to collect as much of the 100-year flow as possible in Fremont Street/Boulder Highway and convey it in the proposed storm drain. This proposed facility is intended to be a 100-year flow cut-off.

1.4. Existing Facilities

There are completed storm drain facilities in the study area that are related to this project and may impact the storm drain design considerations/constraints. The major facilities are briefly described below.

1.4.1. Boulder Highway Storm Drain (Sahara Avenue to Flamingo Wash)

There is an existing segment of 15'x10' RCB storm drain in Boulder Highway at Sahara Avenue, which is the downstream connection point for the BHSD project. The storm drain has a flat slope (0.25%). It was design to convey 2,706 cfs. At Sahara Avenue, a branch is extended a short distance along Sahara Avenue. This will be a connection point for a future regional facility in Sahara Avenue (BHSA 0000 through BHSA 0331)

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1.4.2. Fremont Street

There are many small storm drain systems along Fremont Street between Sahara Avenue and Charleston Boulevard. There are drop inlets on the east side, middle, and the west side of Fremont Street. These small storm drain systems generally connect these inlets from west to east. These storm drains discharge east of Fremont Street.

1.4.3. Olive Street and Atlantic Street

There is an existing 24-inch and 30-ich storm drain system in Atlantic Avenue that extends from Fremont Street to Wengert Avenue. The storm drain continues west in Wengert Avenue to Eastern Avenue. An 18-inch lateral connects to this storm drain at Olive Street. The lateral continues northwest in Russell Avenue and crosses through an easement to a drop inlet in Euclid Avenue. It is also believed that there is a connection from this lateral storm drain to the intersection of Russell Avenue and Euclid Avenue, which then turns west through a drainage easement and collects flow from two small drop inlets at the intersection of Eastwood Drive and Ballard Drive. The City has identified this area as a location for potential drainage improvements and/or repair.

1.4.4. Charleston Boulevard

There are drop inlets and storm drain in Charleston Boulevard. The storm drain is continuous from I-15 to Pecos Road. In the area near the intersection with Fremont Street /Eastern Avenue the storm drain size ranges from 36 inch to 39 inch. There are drop inlets on the north and south sides of the road.

1.4.5. Eastern Avenue

There are drop inlets and storm drain in Eastern Avenue from Oakey Boulevard to Fremont Street. The drop inlets are on the west side of Eastern Avenue. The storm drain begins as an 18 inch and increases to a 27 inch south of Charleston Boulevard. This storm drain continues north past Charleston Boulevard.

1.4.6. McLeod Drive

There are two valley gutters that cross McLeod Street south of St Louis Avenue. These valley gutters convey flow across McLeod Street to two residential streets Scarlet Oak Avenue and Holly Hill Avenue. The City has identified this area as a location for potential drainage improvements.

1.5. Report Organization

The technical information compiled and presented in this report will facilitate review of the drainage analysis/design and is based on best available data at the time of the 70% milestone submittal. The report has been organized into six main sections: Section 1 serves as an overall introduction; Section 2 contains detailed information about the hydrologic analysis. Section 3 describes the proposed drainage facilities, major constrains and hydraulic analysis completed to date. Section 4 includes summaries of several other design considerations and activities, including the geotechnical and groundwater investigations, survey summary, right-of-way summary, Chapter 8 Resource Screening Analysis etc.; Section 5 summarizes the utility conflicts and utility coordination effort that has taken

place to date; Section 6 is the final section and includes the construction cost estimate and conclusion.

A technical appendix is included at the end of the report with all supporting documentation and analysis. In addition, an electronic Data CD is also provided at the end of report with a pdf version of the entire report, the 70% design plans in pdf format, and other electronic files related to this submittal. The 70% design plans also accompany this report as volume II and include pertinent information for review, such as proposed facility sizes, horizontal/vertical alignments, utility conflicts, lateral locations, etc.

2. Hydrologic Analysis

2.1. General

This section includes information about the criteria and methodology used in the hydrologic analysis for the BHSD. The criteria, methodology, and analyses are consistent with the Clark County Regional Flood Control District's (CCRFCD) Hydrologic Criteria and Drainage Design Manual (hereafter referred to as the Design Manual).

2.2. Previous and/or Related Drainage Studies

Several drainage studies, hydrologic models, and reports were reviewed in conjunction with this project. Many of the drainage studies and improvement plans were obtained by Atkins from the City for small or local developments in the study area. These were all reviewed and incorporated as necessary. The major drainage study used as a reference is:

- **2008 Las Vegas Valley Flood Control Master Plan Update**, prepared by PBS&J, September 2008. This study was reviewed and used as a reference for the hydrologic analysis and parameterization (CN methodology, land use, soils, routing, lag time, etc.). The 2008 MPU HEC-1 model developed for the Central Watershed was used as a base model for this project.

The 2013 update and ongoing 2018 update to the Las Vegas Valley Flood Control Master Plan were also reviewed and any relevant updated information was considered for inclusion in this project as appropriate.

2.3. Topography Data and Survey

Detailed 1-foot aerial topography data was obtained for the study area with this project. In general, the 1-foot topography data extends along Fremont Street from 500'southeast of Sahara Avenue to 1300-ft northwest of Eastern Avenue. The width of the 1-foot topography is approximately 300-ft east of Fremont Street and 1300-ft west Fremont Street. The 1-foot topography is included on the data CD at the end of this report. 5-ft contour data from Clark County was used for watershed areas outside of the detailed topography extents.

Detailed field survey (and manhole dipping) was also performed to determine accurate horizontal and vertical information for the manholes, sanitary sewers, storm drains, and other utilities.

2.4. Hydrologic Design Scenarios

Atkins performed hydrologic analysis to determine the peak 100-year design flows in the study area in the ultimate condition. The hydrologic analysis and the storm drain recommendations described in this report are based on the ultimate condition, which assumes that the project watershed is fully developed and that all proposed regional facilities are built and functioning. This is the condition represented in the HEC-1 model and fully described in this DDR that will be used as the basis of design throughout the project.

The main difference between the watershed today and the ultimate condition is the future extension of the mainline storm drain along Charleston Boulevard from Eastern Avenue to Main Street (FLBN

00180-281). This future facility turns south in Main Street (FLBN 0342). There is also a planned lateral regional facility extending north in Maryland Parkway (FLMR 0000).

Since the watershed area is more than 95% developed, any other changes in land use, impervious areas, and flow rates between the existing and ultimate (future) condition are considered negligible.

Qualitative assessments of the existing condition flow have also been made, but detailed HEC-1 modeling of the existing condition was not required for this project.

2.5. Hydrologic Analysis and Parameterization

The methodology used to develop the hydrologic model and input parameters is discussed in detail in **Appendix A** with all supporting information and tables. A brief description of methods is provided in summary below:

2.5.1. Models

Both a mainline and collection hydrologic models are provided with this submittal. The mainline model has subbasins that are sized consistent with the MPU. This model is used to generate flows for the mainline storm drain. The collection model has subbasins that are further subdivided especially near the proposed storm drain to aid with the design of storm drain laterals and surface flow collection. Utilizing both hydrologic models for the design is consistent with guidance given in Section 4.3.7 of the 2008 MPU, Volume 1.

2.5.2. Subbasin Delineation

The 2008/2013 MPU subbasin delineations were used as a starting point and were modified and subdivided as necessary based on field investigations, aerial photos, drainage studies, and the detailed 1-ft topography data that was obtained for the project. The collection subbasins used in this design project were more refined than the MPU subbasins in order to analyse and evaluate detailed roadway drainage patterns, storm drain sizes, and street flow capacities needed for the design. The subbasins used in the HEC-1 model are shown on the Hydrologic Summary Maps (**Figure 4** and **Figure 5)** at the end of this section of the report.

2.5.3. Hydrologic Parameters

- **Rainfall** – The 6-hour, 100-year and 10-year precipitation depth were used in the model based on the McCarran Airport Rainfall Area from the Design Manual. The SDN3 storm distribution was used since the watershed area is less than 8 square miles.

- **Depth-Area Reduction Factor –** The depth-area reduction factors (DARFs) from Table 503 in the Design Manual were applied to the rainfall depths in the HEC-1 models at each subbasin and concentration point based on upstream tributary area.

- **Soils** – Soils data in the hydrologic analysis was based on the same soils information that was used in the 2008 MPU, which is the Soil Survey of the Las Vegas Valley Area by the National Conservation Resources Service (NRCS), dated July 1985. It should be noted that NRCS has updated the available soils data since that time; however, in an effort to be consistent with the MPU and other design projects that have been completed in the area, the 2008 MPU soils data was used in the BHSD hydrologic analysis.

The City commented on the implications of the using the older soils data during the review of the PDR. Atkins evaluated the difference at the request of the City. The use of the revised soil reduces the design flows slightly. Therefore, a decision was made to continue using the older soil data to be conservative. The reduction in flow would not likely change any of the proposed infrastructure.

- **Land Use** – Land use data was based on the 2008 MPU and updated as needed. Minor updates and revisions were made to the land use data to increase the accuracy of the GIS land use layer. These updates did not make any recognizable changes to the land use. A map of the land use used for the watershed is provided in **Appendix A, Figure A-3.**

- **Curve Numbers** – Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the NRCS curve number (CN) method described in the Design Manual. Curve number information was compiled for each subbasin using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers.

- **Lag Time** – All subbasins within the project watershed are less than 0.5 square miles. The time of concentration for subbasins of this size is computed with the time of concentration equation (velocity method) from the CCRFCD Design Manual.

- **Routing** – The routings in the HEC-1 model through streets or storm drains were performed using the Muskingum-Cunge method for floodwave routing to be consistent with the 2008 MPU.

Detailed summary tables and supporting calculations for all parameters listed above are provided in **Appendix A**.

2.5.4. Computer Modeling

HEC-1 Version 4.1 (dated June 1998) was used for the BHSD hydrologic modeling in order to be consistent with the MPU process. Descriptive information has been included in the HEC-1 input file on the “ID” and “KM” cards. The HEC-1 model is included in **Appendix A** and electronic model files are also provided on the Data CD that accompanies this report.

2.5.5. Concentration Points

Peak flows were combined in HEC-1 using concentration points that were inserted into the HEC-1 model. Several concentration points are located at the mainline storm drain and along the major laterals proposed (as shown in **Figure 4** and **Figure 5**) since these are the main design locations in the study area.

2.5.6. Flow Diversions

There is a diversion in the Hydrologic model for subbasin CH59-C. This diversion was included in the MPU model. The diversion is based on the capacity of the existing storm drain facilities in the downtown area, which convey flow north in Las Vegas Boulevard to the Washington Avenue Channel (LVWH 0305). Therefore, it is not tributary to the BHSD.

The flow not collected in the local storm drains is conveyed on the roadway surface into the BHSD watershed. The flow diversion remains unchanged from the MPU model.

2.6. Hydrologic Analysis Results

The 100-year peak flows from the ultimate condition HEC-1 model for the subbasins, diversions, and combination points are summarized on the Hydrologic Summary Maps (**Figure 4** and **Figure 5**) at the end of this section. **Table 1** below summarizes the main design flows at key locations. The table also includes the MPU Flows from the 2008 MPU model for comparison purposes. Note that in round numbers the BHSD will collect approximately 1,000 cfs, the Charleston Storm Drain (as described earlier and including the Maryland lateral) will collect another 1,000 cfs and the remaining 500 cfs will be collected in the future (Phase 3) with the extension of the Charleston Storm Drain west to Main Street. This means that at the conclusion of the Phase 1 construction there will still be approximately 1,500 cfs reaching the intersection of Fremont Street and Charleston Boulevard in a 100-year event, with that flow being reduced to approximately 500 cfs after the Phase 2 – Charleston Storm Drain is constructed.

Table 1. Summary of Design Flows at Key Locations

Location	HEC-1 Combo Point	Ultimate Flow (cfs)	HEC-1 Model	MPU Flow (cfs)
Eastern north Lateral**	CC68-4A	156	Collection	-
Eastern South lateral**	CCH67C2	118	Collection	-
Charleston at Eastern/Fremont	CCH68-C	1801	Mainline	1797
Fremont at Atlantic	N/A*	2010	Mainline	-
Fremont at Oakey	CFR04-C	2275	Mainline	2292
Atlantic lateral	CFR04A	226	Collection	-
Oakey lateral	CFR04C11	283	Collection	-
St Louis lateral	CCH63-C	151	Collection	-
Fremont at St Louis	CFR03	2413	Mainline	2448

*Interpolated point - flow determined by using ratio of Atlantic and Oakey lateral peak flows from the collection model. This ratio was then applied to the difference in peaks between CFR04-C and CCH68-C from Mainline model.

** To be designed and constructed as part of Phase 2 – Charleston Storm Drain

HEC-1 Node	Type	Area (sq mi)	Flow (cfs)
CH59-C	Subbasin	0.34	338
DFLAM	Diversion (remain)	0.34	116
DCH59-C	Diversion (out)	0.34	222
CH51	Subbasin	0.27	267
CH52-C	Subbasin	0.32	369
CCH52	Combination Point	0.6	605
CH56-C	Subbasin	0.34	315
CH60A-C	Subbasin	0.42	509
CCH60A-C	Combination Point	0.76	775
CCH56	Combination Point	1.35	1293
CH63-C	Subbasin	0.26	252
CCH63-C	Combination Point	1.62	1525
CH68	Subbasin	0.29	316
CCH68-C	Combination Point	1.9	1801
CH64-C	Subbasin	0.29	230
CH67-C	Subbasin	0.35	315
CCH67-C	Combination Point	0.64	412
FR04-C	Subbasin	0.24	276
CFR04	Combination Point	2.79	2275
FR03-1	Subbasin	0.19	183
CFR03	Combination Point	2.97	2413

Boulder Highway Storm Drain
Figure 4: Hydrology Summary Map- Mainline

Note: Only 116 CFS from CH59-C remains in the model.
222 CFS is diverted north in the existing 42" RCP on
Las Vegas Boulevard.

Legend

- Flow Arrows
- Combination Points
- Proposed Mainline Storm Drain
- Existing 5' Contours

MainlineSubbasins

- To Fremont
- To Oakey
- To Charleston
- To Fremont/Charleston

N

0 600 1,200
Feet

1 inch = 600 feet

ATKINS

CH59-C
CH60A-C
CH68
CH63-C
CH52-C
CH56-C
CH67-C
CH64-C
CH51
FR04-C
FR03-1
CCH52
CCH60A-C CCH56
CCH63-C CCH68
CCH67-C
CFR04C
CFR03
CCFR03
CFR03-1
FLBN0023
Charleston Blvd
Oakey Blvd
Sahara Ave
St. Louis Ave
Wyoming Ave
Boulder Hwy
Las Vegas Blvd
4th St
Fremont St
Stewart Ave
Bruce St
15th St
Commerce St
Main St
Industrial Rd
Maryland Pkwy
Spencer St
Paradise Rd
Vegas Valley Dr
McLeod Dr
Mojave Rd

Boulder Highway Storm Drain
Figure 5: Hydrology Workmap - Collection

Legend

- Flow Arrows
- Combination Points
- Proposed Lateral Storm Drain
- Proposed Mainline Storm Drain
- Existing 5' Contours

Collection Subbasins

- To Boulder Highway Lateral
- To Olive/Atlantic Lateral
- To Oakey Lateral
- To St. Louis Lateral
- To Charleston Lateral
- To Eastern South Lateral
- To Eastern North Lateral

N

0 600 1,200 Feet

1 inch = 600 feet

ATKINS

HEC-1 Node	Type	Area (sq mi)	Flow (cfs)
CH59-C	Subbasin	0.34	342
DFLAM	Diversion (remain)	0.34	120
DCH59-C	Diversion (out)	0.34	222
CH51	Subbasin	0.27	270
CH52-C2	Subbasin	0.23	265
CCH52C2	Combination Point	0.5	501
CH52-C1	Subbasin	0.09	147
CCH52	Combination Point	0.6	586
CH56-C2	Subbasin	0.18	166
CH56-C1	Subbasin	0.16	169
CCH56	Combination Point	0.34	331
CH60A-C2	Subbasin	0.26	280
CCH6AC2	Combination Point	0.26	312
CH60A-C3	Subbasin	0.16	228
CCH6AC3	Combination Point	0.42	470
CCH60A	Combination Point	1.35	1271
CH60A-C1	Subbasin	0.05	66
CH60A-C4	Subbasin	0.03	48
CCH60AC4	Combination Point	0.08	111
CCH60B	Combination Point	1.43	1336
CH63-C1	Subbasin	0.06	82
CCCH56	Combination Point	1.49	1389
CH68-3	Subbasin	0.07	78
CCH68-3	Combination Point	1.56	1445
CH63-C4	Subbasin	0.12	167
CCH68-4	Combination Point	1.68	1566
CH68-5	Subbasin	0.02	33
CH67-C1	Subbasin	0.01	23
CCH67	Combination Point	1.71	1591
CH68-1	Subbasin	0.06	87
CH68-4	Subbasin	0.05	83
CCH68-4a	Combination Point	0.11	156
CH63-C2	Subbasin	0.03	46
CH67-C3	Subbasin	0.1	97
CCH67C3	Combination Point	0.13	99
CH67-C2	Subbasin	0.02	24
CCH67C2	Combination Point	0.15	118
CCH67	Combination Point	1.98	1822
FR04-C1	Subbasin	0	7
CH68-6	Subbasin	0.01	10
CBH1	Combination Point	1.99	1830
CH63-C3	Subbasin	0.02	23
CH67-C4	Subbasin	0.11	111
CCH67C4	Combination Point	0.12	112
FR04-C8	Subbasin	0.05	52
CFR04C8	Combination Point	0.17	164
FR04-C6	Subbasin	0.01	11
FR04-C7	Subbasin	0.01	17
CFR04C7	Combination Point	0.02	29
CCFR04C7	Combination Point	0.19	189
FR04-C5	Subbasin	0.01	10
CCH04C5	Combination Point	0.2	200
FR04-C2	Subbasin	0.01	18
FR04-C4	Subbasin	0	9
CFR04C4	Combination Point	0.02	27
CFR04A	Combination Point	0.22	226
FR04-C3	Subbasin	0.01	21
CBH2	Combination Point	2.22	1934
CH64-C	Subbasin	0.29	254
CH67-C5	Subbasin	0.15	132
CCH67C5	Combination Point	0.44	288
FR04-C11	Subbasin	0.07	66
CFR04C11	Combination Point	0.5	283
FR04-C9	Subbasin	0.05	76
FR04-C10	Subbasin	0.01	12
CBH3	Combination Point	2.78	2123
FR03-6	Subbasin	0.01	14
DCFR03E	Diversion	0.01	7
DCFR03	Diversion	0.01	7
FR03-5	Subbasin	0.01	16
CFR03-5	Combination Point	0.03	22
FR04-C12	Subbasin	0.01	14
FR04-C14	Subbasin	0.03	36
CFR04C14	Combination Point	0.04	48
FR04-C15	Subbasin	0.01	12
CFR04C15	Combination Point	0.05	57
FR03-2	Subbasin	0.07	43
FR03-3	Subbasin	0.03	36
FR03-1	Subbasin	0.03	32
CFR03-2	Combination Point	0.12	105
CFR03A	Combination Point	0.08	88
FR04-C13	Subbasin	0.03	26
CFR03B	Combination Point	0.1	114
CFR03C	Combination Point	0.012	134
FR03-4	Subbasin	0.02	20
CCH63-C	Combination Point	0.14	151
FR04-C16	Subbasin	0.03	40
FR04-C17	Subbasin	0.01	10
CBH4	Combination Point	3.05	2263
FR03-8	Subbasin	0	5
FR03-7	Subbasin	0.02	24
CBH5	Combination Point	2.97	2272

3. Proposed Facilities, Constraints and Hydraulic Analysis

3.1. Proposed Facilities

This section includes general information regarding the proposed storm drain facilities and some of the associated constraints and conflicts as well as information regarding the hydraulic analyses that have been completed to date. Additional information regarding the design constrains and conflicts is further described in Sections 4 and 5.

The mainline storm drain begins in Charleston Boulevard as a 14' x 8' RCB and increases in size at various locations to the existing 15' x 10' RCB at the downstream end near Sahara Ave., see **Figure 6** for a schematic layout and the 70% plans for the plan and profile.

The project also includes major lateral storm drain collection facilities in St Louis Avenue, Oakey Boulevard and Atlantic Street west of Boulder Highway as well as a small storm drain in Olive Street – Russell Avenue - Euclid Avenue - Eastwood Drive - Ballard Drive that will connect to the proposed storm drain in Atlantic. Although it is currently beyond the limits of this phase, it has been identified that major lateral storm drains are also needed both north and south of Charleston Boulevard in Eastern Avenue. The Eastern Avenue Laterals are being designed as part of Phase 2 – Charleston Storm Drain.

The major laterals in St Louis, Oakey and Atlantic capture the 100-year flow currently conveyed in the street towards Fremont Street and convey it to the mainline storm drain. The proposed storm drain facilities for the major laterals are shown schematically on **Figure 7.** Please see the 70% plans for more detailed information.

The following sections provide an overview of the proposed storm drain facilities.

3.1.1. Mainline Storm Drain Horizontal and Vertical Alignment

Mainline Storm Drain Horizontal Alignment

The horizontal alignment of the existing downstream storm drain at Sahara is just west of the Boulder Highway/Fremont Street median in the first/second southbound through lanes adjacent to the median. This alignment was perpetuated with the proposed storm drain as it proceeds north towards St Louis Avenue. This appears to be the most viable alignment in this reach considering the existence of a 51" diameter sanitary sewer within the median and the existence of many commercial businesses that front on the west side of Fremont Street. This alignment avoids horizontal conflict with the 51" sewer and would likely allow continuous access to the businesses on the west side of the street during construction.

In the vicinity of the St. Louis intersection the storm drain alignment was modified (moved slightly east) to improve constructability at the crossing of the 51" diameter sewer, which is encased in a 72" steel casing at this location. The revised horizontal alignment of the storm drain should allow the 72" steel casing to be embedded in either side of the storm drain trench and help with the structural support of the sewer during construction as the storm drain crosses under the sewer.



Figure 6. Proposed Mainline System Design

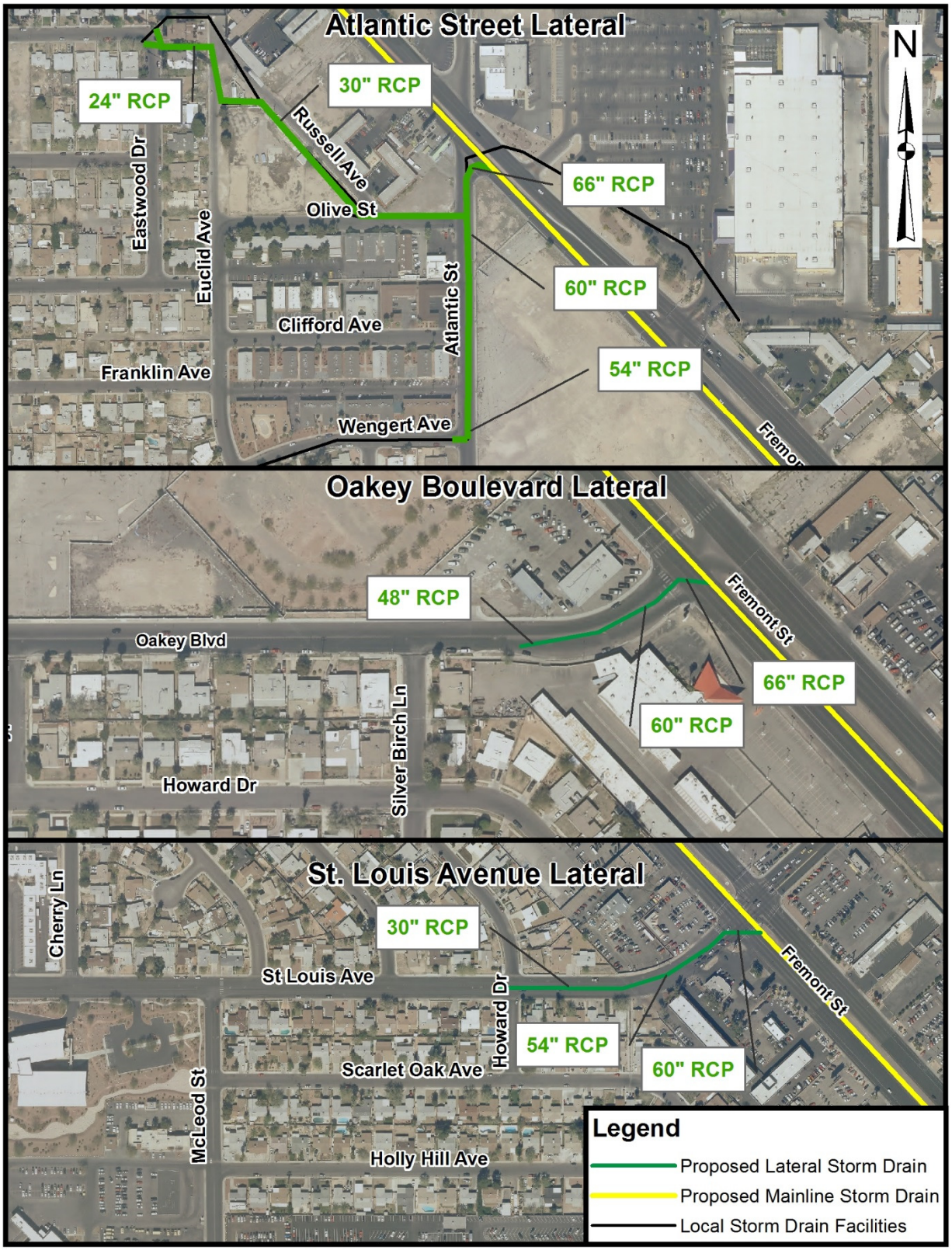


Figure 7. Proposed Major Lateral Storm Drains

North of St. Louis Avenue the horizontal alignment shifts back to the same alignment used between Sahara and St. Louis. North of St. Louis there is no longer the sanitary sewer in the median, but there are traffic signal and street light (combination) poles in the median at major intersections. To avoid these conflicts the alignment adjacent to the west side of the median was perpetuated. It should be noted however, that the City's sewer master plan includes a future large sanitary sewer that enters Fremont Street at Oakey Boulevard from the west and turns south in Fremont Street towards St. Louis Ave. Keeping the median open for this future sanitary sewer between Oakey and St. Louis seems prudent. As Fremont Street approaches the intersection with Atlantic Street the road narrows significantly and the proposed storm drain transitions to the middle of Fremont Street and appears to be the most viable alignment in this reach.

Per discussion with the City and CCRFCD after the Preliminary Design Report (PDR), the Phase 1 construction terminus is just north of Atlantic Avenue. Per agreement with the City the remainder of the originally scoped Phase 1 design, beyond the terminus, is to be designed and hydraulically modeled with Phase 1. The improvement plans will later be incorporated with the Phase 2 construction package (Charleston Storm Drain). At Charleston Boulevard, the storm drain turns west and is located in the center of the street. This center alignment on Charleston Boulevard will require the removal and reconstruction of an 18" diameter sanitary sewer that is currently located in the center of Charleston Boulevard. There is an existing 24" diameter waterline on the north side of Charleston Boulevard and an existing 21" diameter sanitary sewer on the south side of Charleston Boulevard.

Placing the storm drain in the center of the street, removing the 18" sanitary sewer and connecting all sewer laterals from the 18" sanitary sewer to the 21" sanitary sewer appears to be the most viable option at this point and is what is presented in the 70% plans. The City has modeled this scenario on the 21" sanitary sewer between Fremont Street and Maryland Parkway and it appears viable. The only section of the 21" sanitary sewer that requires upsizing due to the increased flows is the section between Eastern and Fremont. The remainder of the system between Eastern and Maryland appears to have adequate capacity for the additional flow from the removal of the 18" sanitary sewer. This will be analyzed further with the Charleston Storm Drain. This potential conflict/challenge further supports the location of the Phase 1 construction terminus at Atlantic, if this center alignment for the storm drain incurs some fatal flaw as the design of the Charleston Storm Drain progresses, ending the Phase 1 construction at Atlantic will allow more flexibility in the Charleston Storm Drain design.

Mainline Storm Drain Vertical Alignment

There are six primary driving constrains relative to the vertical profile of the storm drain, these are as follows:

1. The topographic relief is generally from west to east and with the storm drain alignment being southeast to northwest in Fremont Street the existing ground slope is relatively flat, approximately 0.6%.
2. Existing large water (30") and sewer (18" and 21") crossings at Charleston and Fremont.
3. Existing sewer crossings (12" and 8") in Fremont at Atlantic.
4. Existing large sewer crossing (51") in Fremont at St. Louis.

5. Existing large waterline (30”) on the west side of Fremont for the entire project length as well as a parallel CCWRD sewer (10”) from Sahara to half way between Atlantic and Oakey and the potential conflict between these existing utilities and the major lateral collection storm drains in St. Louis, Oakey and Atlantic.
6. Downstream connection to the existing 15’ x 10’ RCB.

The 70% plans included with this submittal avoid direct conflict with all of the above existing utilities based on the available and collected data and will allow connection to the existing downstream 10’ x 15’ RCB. One exception to this is the 18” VCP sanitary sewer in the middle of Charleston. Although direct conflict is avoided, the storm drain is proposed directly under the sewer requiring relocation and is proposed to be consolidated with the existing 21” sewer and upsized to a 24” pipe between Eastern and Fremont (see discussion on previous page).

Items 4, 5 and 6 above have been the most difficult to address (primarily the intersection of St. Louis Avenue and Fremont Street). There are 3 potential options for the storm drain crossing of the 51” diameter sanitary sewer at St. Louis: 1) construct the storm drain over the top of the sewer 2) construct the storm drain under the bottom of the sewer 3) relocate and re-profile the sewer in the vicinity of St. Louis to provide more clearance for either the over or under option of the storm drain crossing. Since relocation/re-profiling of the sewer will be very expensive, options 1 (over) and 2 (under) above have been the primary focus.

Since the Preliminary Design Report (PDR) was submitted, option 2 (under sewer) was chosen as the final profile and was selected based on input from the City’s constructability review consultant. This was chosen by the City after receiving input from Atkins, the constructability review consultant, and more extensive pothole information. The SUE plans in this report and the 70% design plans provide more detailed information on the potholes completed on the 51” sanitary sewer and the vertical alignment of the storm drain in this area, respectively.

3.1.2. St. Louis Avenue Lateral

Since the Preliminary Design Report (PDR), the City has decided not to include the extension of the St. Louis lateral to McCleod Street as part of this project. The St. Louis lateral is proposed to end just west of Howard Drive with a stubbed RCP at the last manhole to allow for future extension further west. In addition, a lateral could be installed in McLeod from Sahara north with the future Sahara Avenue Storm Drain, which is also a CCRFCD master plan facility.

St. Louis Avenue is severely congested with existing utilities including a 45” diameter sanitary sewer, 8” diameter sanitary sewer and an 8”/6” diameter water line. In addition, there are residential homes that front on St. Louis on both the north and south sides of the street, so there are many water and sewer service laterals throughout. Note that the water service laterals and sanitary sewer service laterals are shown in the plan view on the 70% plans. As currently proposed the new storm drain will be located near the centerline of St. Louis adjacent to the alignment of the existing 8” sewer and the 8” sewer will be relocated north towards the waterline. The relocated 8” sewer will discharge to the 45”/51” sewer east of Howard Drive and just west of the curve in St. Louis as it approaches Fremont Street. This will allow the 10” sanitary sewer that crosses the mainline storm drain at station 129+43 to be abandoned as there are no live connections

to this section of the sewer with the relocated 8” sewer connecting to the 45”/51” where indicated above.

See **Figure 7** for the schematic layout and the 70% plans for the plan and profile.

3.1.3. Oakey Boulevard Lateral

The Oakey Boulevard lateral begins with a series of drop inlets approximately 500 feet west of Fremont Street and continues east in Oakey to the connection with the mainline. The proposed Oakey lateral has been located on the south side of the street to provide a corridor on the north side of the street for the future large sanitary sewer that is planned down Oakey Boulevard from the west and turns south on Fremont Street. This facility was briefly discussed on the preceding pages in the Mainline Storm Drain Horizontal Alignment section. The north half of Oakey Boulevard west of the proposed storm drain is clear of existing utilities, which is why that side of the street was left for the future sewer.

There is an existing dead end driveway between the first two upstream drop inlets on the south side of Oakey Boulevard. This driveway is located within City of Las Vegas public ROW. It has been requested that during construction of the storm drain this driveway be removed to allow construction and proper hydraulic function of the two drop inlets on either side as currently located.

See **Figure 7** for the schematic layout and the 70% plans for the preliminary plan and profile.

3.1.4. Atlantic Street Lateral

The Atlantic Street lateral begins at Wengert Avenue with a series of drop inlets. It also intercepts an existing 24” diameter storm drain in Wengert Avenue from the west. The storm drain then turns north on Atlantic and continues to Fremont where it connects to the mainline. It is important to note that the existing storm drain in Olive Street is removed and replaced to accommodate the proposed storm drain for the Euclid/Eastwood/Ballard area, see Section 3.1.5. See **Figure 7** for the schematic layout and the 70% plans for the preliminary plan and profile.

3.1.5. Olive/Russell/Euclid/Eastwood/Ballard System

There are two existing drop inlets on either side of the street at the corner of Ballard Drive and Eastwood Drive. These drop inlets discharge to dual 15” CMPs that are located in a 10’ wide drainage easement between the two homes at the northeast corner of the two streets (see **Figure 14** in Section 4.4). The two CMPs connect to a third drop inlet at the east end of the drainage easement located on the west side of the Euclid Avenue and Russell Avenue intersection. It is believed that this storm drain proceeds down Russell Avenue and eventually connects to the 18” storm drain in Olive Street.

The dual 15” CMP pipes within the drainage easement between the homes are in need of extensive repair, replacement or abandonment. The pipes are completely corroded through on either side at the pipe haunch. The CMP pipes are collapsing and filling with soil and debris. The storm drains were inspected and evaluated by Brown and Caldwell as part of the Storm Drain Condition Assessment –Year 1 Report dated June 2016. Photos from the video inspection of the pipes are included in the photo log in **Appendix A (Photos 14, 15 and 16)**.

Several alternatives were evaluated to determine the most viable option for addressing the poor condition of the existing 15" CMPs. Simply removing and replacing the existing storm drain in its existing location was considered, however, the house and block wall appear to be immediately adjacent to and possibly encroach into the 10' wide drainage easement limiting access for excavation. In addition, there are large trees growing within the easement further complicating the excavation, see **Photos 1 and 2** in the photo log in **Appendix A**. Another option is to acquire a new easement on the south side of the same home that is adjacent to the existing easement (see **Figure 14** in Section 4.4). It appears that there is sufficient space between this home and the next home to the south on Eastwood Drive to acquire an easement and install a new storm drain.

It is worth noting that the Ballard/Eastwood intersection is a low point with no emergency overflow/outlet (other than through or around the existing homes between Euclid Avenue and Eastwood Drive). The 100-year flow impacting this area is well beyond the capacity of the existing storm drain (about 3 times as much) even if it was in good condition.

The selected option from the PDR includes extending a storm drain south in Eastern Avenue from Charleston Boulevard (Eastern South lateral) to cut off most of the flow (about 70%) reaching the corner of Ballard and Eastwood. This option also has the added benefit of collecting additional flow draining to Eastern Avenue from the west in Franklin Avenue and Houston Drive, which in the existing condition would continue east and impact the residential area between Eastern Avenue and Atlantic Street. See the next section for more discussion on the Eastern South lateral. The selected option also includes extending a new storm drain west in Olive Street from Atlantic Street (will connect to the proposed Atlantic Lateral), then northwest in Russell Avenue, west to Euclid Avenue through an existing drainage easement to a low point in Euclid where the existing drop inlet will be replaced, then north in Euclid to the proposed drainage easement (see **Figure 14** in Section 4.4) between the existing homes, then west to Eastwood Drive where new drop inlets will be installed at the low point in the intersection with Ballard Drive. This new system will have 100-year collection and conveyance capacity (after flows in Eastern are cut off by the Eastern South Lateral) for this area, including Euclid Avenue and Olive Street.

3.1.6. Eastern North and Eastern South Laterals

There are two other major laterals recommended, Eastern South and Eastern North. Both of these laterals are proposed to connect to the mainline storm drain in Charleston Boulevard at Eastern Avenue. Since these laterals are beyond the limits of the mainline facility proposed with this phase of the project they have only been evaluated at a conceptual level. The design of both of these laterals is included in the Charleston Storm Drain project which started at the beginning of May 2017.

3.1.6.1. Eastern South Lateral

There is a small existing storm drain in Eastern Avenue south of Charleston Boulevard. As discussed in the previous section it is recommended that this storm drain be replaced with a major lateral that would collect the 100-year flow from the west and convey it to the mainline storm drain in Charleston Boulevard (see **Figure 8**). Some of the existing drop inlets will be utilized with the addition of several more to increase collection capacity. Preliminary analysis of this lateral shows that following the alignment of the existing storm drain is feasible and can be connected to the mainline in Charleston Boulevard. Preliminary sizing of the facility shows that the maximum pipe size required is a 60" RCP.

The installation of this lateral will eliminate overtopping of Eastern Avenue during large storm events and prevents these flows from traveling through the residential neighborhoods east of Eastern Avenue. This lateral also reduces the lateral size and collection required in the Atlantic Street Lateral.

3.1.6.2. Eastern North Lateral

During the original scoping of this project a lateral was proposed in Fremont Street north of Charleston Boulevard to collect flows in Fremont Street from the northwest. Based on the topography obtained with this project and field investigation it has been determined that this lateral needs to extend past (northwest of) the Eastern Avenue/Fremont Street intersection. This is required because this intersection is a high point and would allow any flow entering the intersection to split in three directions (north in Eastern, south in Eastern and southeast in Fremont). Any of the flow splitting north in Eastern Avenue would escape collection by the BHSD. After reviewing existing utility information in the area, it was determined that the Fremont Street corridor between Eastern Avenue and Charleston Boulevard is congested with several existing utilities. As a result, it is recommended that the lateral be constructed in Eastern Avenue from Charleston Boulevard to Fremont Street with collection facilities in Fremont Street upstream (northwest) of the Eastern Avenue intersection. This is the Eastern North lateral (see **Figure 8**).

There is an existing storm drain in Eastern Avenue between Charleston Boulevard and Fremont Street. This storm drain will no longer be needed with the completion of the Eastern North lateral and its connection to the proposed storm drain mainline. Preliminary analysis of this lateral shows that following the alignment of the existing storm drain is feasible and can be connected to the mainline in Charleston Boulevard. Preliminary sizing of the facility shows that the maximum pipe size required is a 54” RCP. The Eastern North lateral is approximately half as long as the original option to utilize Fremont Street from Charleston Boulevard.

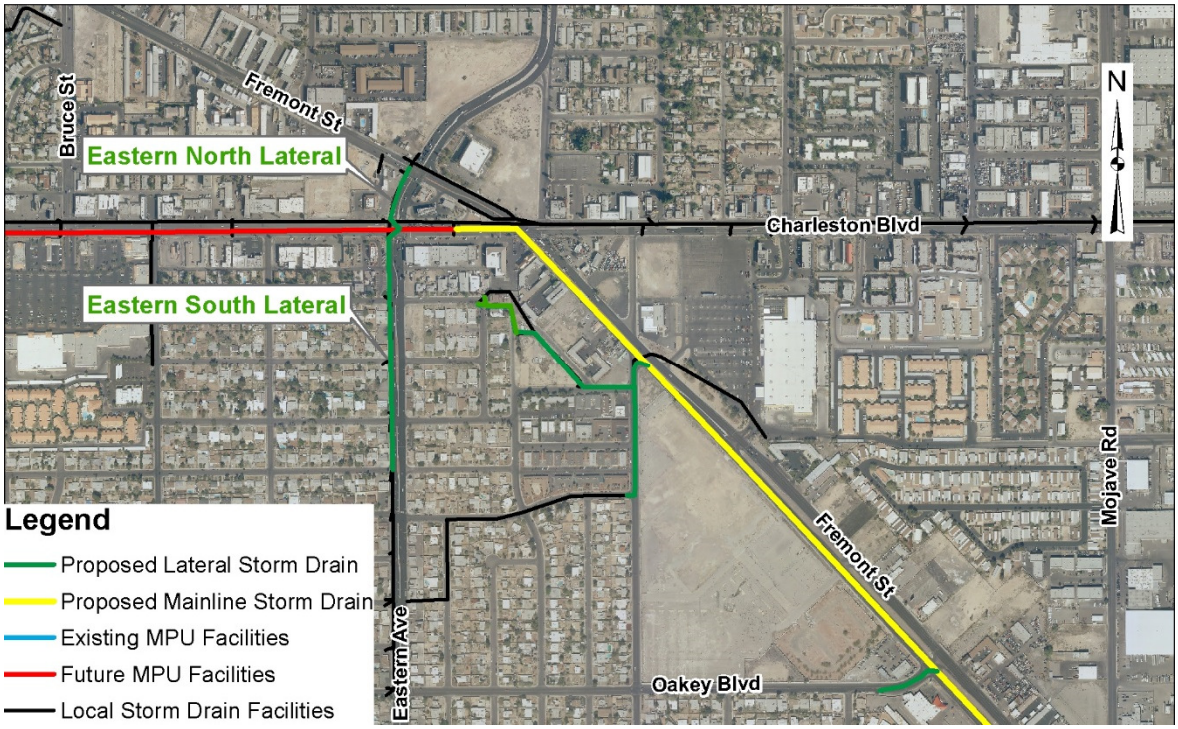


Figure 8. Future Laterals Recommended

3.1.7. Future Mainline Extension (Charleston Storm Drain – Phase 2)

At Charleston Boulevard and Eastern Avenue there is approximately 1,800 cfs draining towards Fremont in a 100-year event that is not collected with the proposed Phase 1 improvements. There was no attempt to collect this flow in the interim because the future phases will provide collection and conveyance of this flow. In addition, the design of the Phase 2 – Charleston Storm Drain from Eastern Avenue to Maryland Parkway was kicked off at the beginning of May 2017. The existing storm drain pipes and drop inlets in Charleston Boulevard are connected to the proposed Phase 1 storm drain where practical. Installation of the current phase improvements will not make flooding conditions worse in Charleston Boulevard.

The Charleston Boulevard corridor is congested with many utilities. There are two sanitary sewers for the full length of Charleston Boulevard between Fremont Street and Main Street with lateral connections to these sewers at almost every north and south side street. In addition, there is a large waterline that runs along the north side of Charleston Boulevard as well. The horizontal and vertical alignment of the extension of the BHSD west in Charleston Boulevard to Main Street will be driven largely by avoidance of conflicts with these existing utilities to the fullest extent possible. It is highly probable that at least one of the existing sewers in Charleston Boulevard will need to be removed and reconstructed or consolidated with the other sewer to create a corridor for the extension of the BHSD. See Section 3.1.1 for a description of the current approach proposed for the short segment of the Charleston Storm Drain included in the 70% plans from Fremont Street to 300' west of Fremont. The limits of the future extension of the proposed BHSD/Charleston Strom Drain are shown on **Figure 9**, along with the proposed limits of

the Phase 2 construction package/Charleston Storm Drain design that began at the beginning of May 2017.

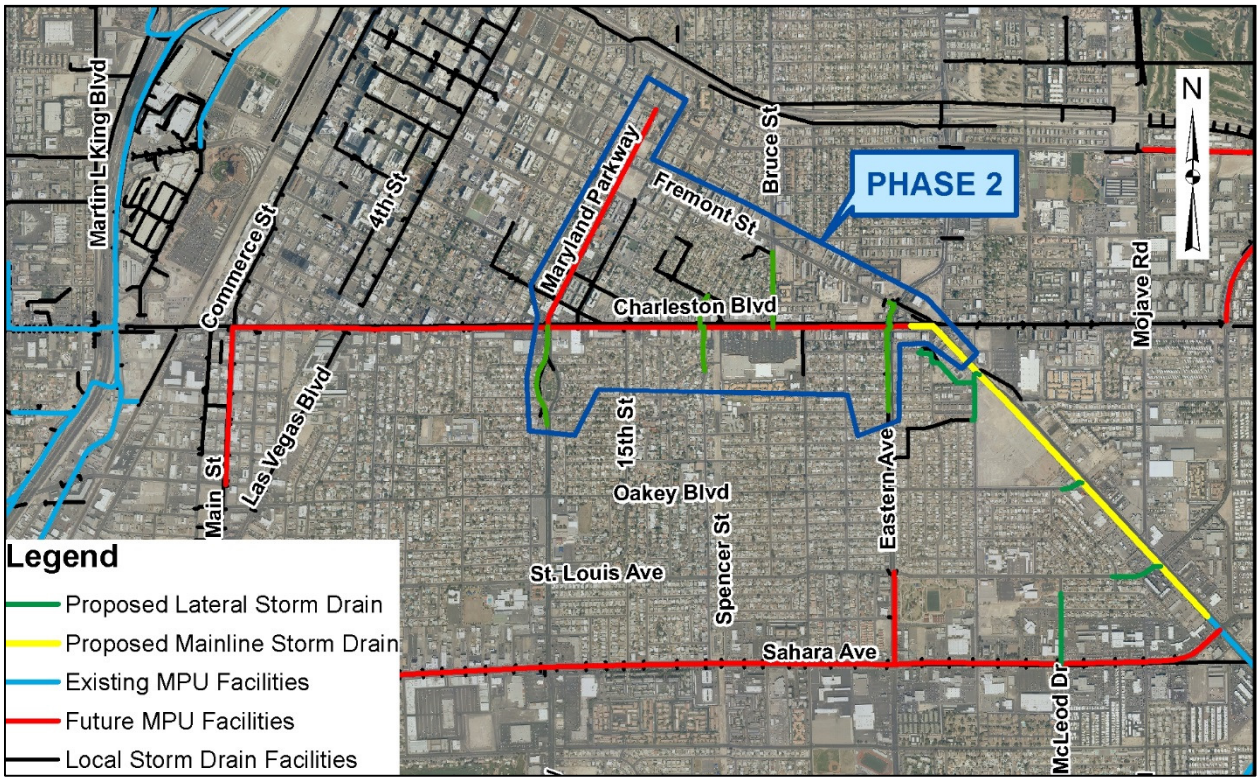


Figure 9. Future Regional Facility in Charleston

3.2. Hydraulic Analysis Methodology and Results

3.2.1. Mainline Storm Drain System

WSPG Model and Facility Sizing

The Fremont Street mainline was analysed and sized using the Water Surface Pressure Gradient (WSPG) computer program. The latest version WSPG2010 was used. The computational procedure used in WSPG is based on solving Bernoulli's equation for the total energy at each section and Manning's equation for friction losses between sections in a reach. The program accounts for energy losses at junctions, angle points, and transitions and uses basic hydraulic principles to calculate hydraulic data such as flow area, wetted perimeter, critical depth, hydraulic grade line, Froude number, momentum, etc. The geometry, slopes, and sizes of the mainline were input into WSPG along with the design flows, and the model was run in order to ensure that the hydraulic grade line (HGL) or depth of flow remain at least 1 foot below final grade at all locations.

The mainline WSPG model is included in **Appendix B**. The names and locations of the WSPG models are shown on **Figure 10**.

The hydraulic grade lines from the WSPG analysis are shown on the storm drain plan and profile included in the 70% plans.

3.2.2. Lateral Design

The lateral storm drains and other minor facilities were sized using WSPG. The mainline of the major laterals on St. Louis Avenue, Oakey Boulevard and Atlantic Street have been sized and analysed using WSPG and the HGLs are shown on the plan and profile included in the 70% plans. The individual drop inlet laterals are also sized and analysed using WSPG with HGLs shown on the 70% plans. The individual drop inlet laterals are also checked against inlet control nomographs to ensure proper inlet capacity is accounted for based on the size of pipe and allowable headwater within each drop inlet at the lateral pipe connections. The WSPG models and inlet control nomographs are included in **Appendix B**. The names and locations of the WSPG models are shown on **Figure 10**.

3.3. Drop Inlets

Drop inlet flow capture analysis has been performed to determine the anticipated collection at each drop inlet location. The drop inlet locations have been selected to avoid utility conflicts where possible and to efficiently collect the surface flow. A summary table and individual drop inlet calculations are included in **Appendix B**. The proposed drop inlet locations are shown on **Figure 11** and **Figure 12.**

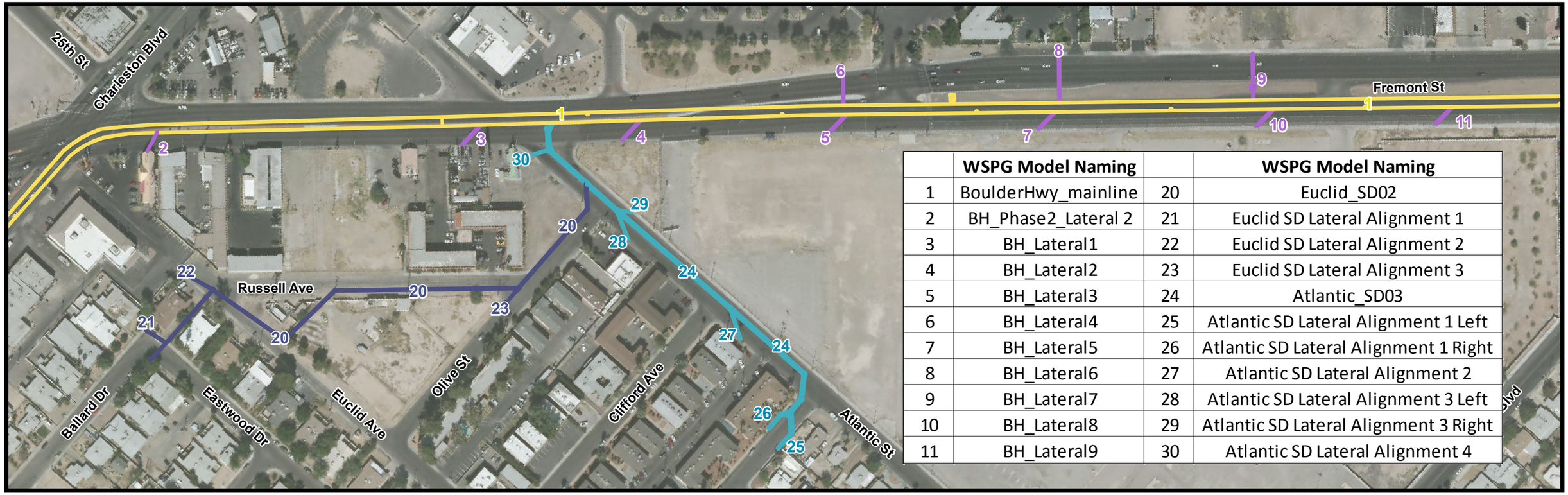
3.4. Street Criteria and Spread

The design scenario for this project is the ultimate condition as represented in the CCRFCD Las Vegas Valley Flood Control Master Plan, which assumes full buildout conditions with all CCRFCD Master Plan facilities constructed. Under this ultimate condition scenario Fremont Street will meet street criteria in the 10 and 100-year storm event. An extensive assessment of street criteria is not provided with this project since the proposed facility is considered a 100-year event cutoff with no flow escaping to the east of Fremont Street, which is the surface topography downslope direction. A qualitative approach is taken to demonstrate compliance with local street criteria and NDOT spread criteria. Pertinent road section calculations are provided in **Appendix B**.

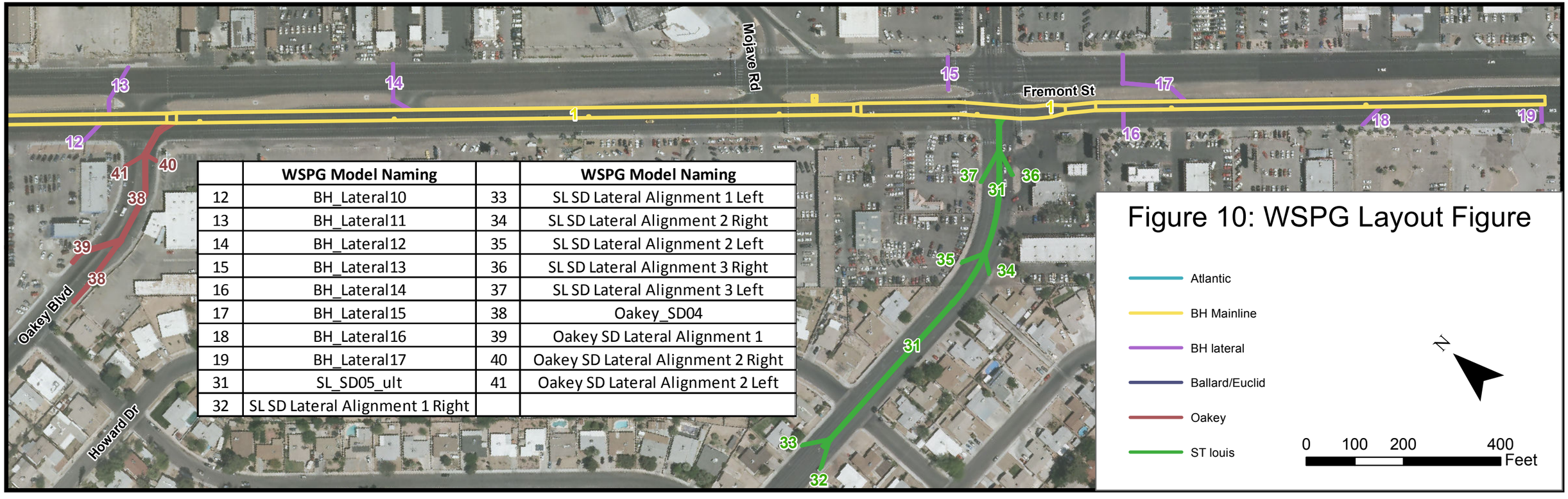
Fremont Street is NDOT ROW and needs to comply with NDOT spread criteria. The functional classification of Fremont Street north of Sahara Avenue is a Minor Arterial. Per NDOT spread criteria, the outer most travel lane may be 1/2 inundated with storm flows during the 10-year storm. The bike lane and bus lane may be used as shoulder in the spread calculations. The bike lane and bus lane are 6.3 and 12 feet, respectively. The travel lane is 12 feet in width. Therefore, allowable spread is 24.3 feet in the 10-year storm. A typical street section in Fremont Street/Boulder Highway will convey approximately 20 cfs and still meet the spread width of 24 feet.

The CCRFCD HCDDM street criteria is D*V less than 6 in the 10-year event and 8 in the 100-year event. The corresponding maximum depths are 1 and 2 feet, respectively. In the 10-year storm there is also a requirement to maintain the center most travel lane free from storm flows. The north and south bound sections of Fremont Street are crowned in the center (2 center lanes in each direction drain towards the median). The width of road to the crown is approximately 30 feet from back of curb. If the outside lanes are filled with storm flows to the crown elevation, then 2 lanes are still available for vehicles to travel. The street can convey approximately 38 cfs and not overtop the crown. The D*V for this cross-section is 3.

The maximum flow in Fremont Street in the ultimate condition is 19 cfs in the 100-year event as shown on **Figure 11** and **Figure 12**. Therefore, if the maximum flow rate allowable is 20 cfs and 38 cfs for NDOT spread and CCRFCD HCDDM dry lane, respectively, for the 10-year event and the maximum flow rate is less than that for the 100-year ultimate condition event then one can conclude that the requirements are satisfied.



	WSPG Model Naming		WSPG Model Naming
1	BoulderHwy_mainline	20	Euclid_SD02
2	BH_Phase2_Lateral 2	21	Euclid SD Lateral Alignment 1
3	BH_Lateral1	22	Euclid SD Lateral Alignment 2
4	BH_Lateral2	23	Euclid SD Lateral Alignment 3
5	BH_Lateral3	24	Atlantic_SD03
6	BH_Lateral4	25	Atlantic SD Lateral Alignment 1 Left
7	BH_Lateral5	26	Atlantic SD Lateral Alignment 1 Right
8	BH_Lateral6	27	Atlantic SD Lateral Alignment 2
9	BH_Lateral7	28	Atlantic SD Lateral Alignment 3 Left
10	BH_Lateral8	29	Atlantic SD Lateral Alignment 3 Right
11	BH_Lateral9	30	Atlantic SD Lateral Alignment 4



	WSPG Model Naming		WSPG Model Naming
12	BH_Lateral10	33	SL SD Lateral Alignment 1 Left
13	BH_Lateral11	34	SL SD Lateral Alignment 2 Right
14	BH_Lateral12	35	SL SD Lateral Alignment 2 Left
15	BH_Lateral13	36	SL SD Lateral Alignment 3 Right
16	BH_Lateral14	37	SL SD Lateral Alignment 3 Left
17	BH_Lateral15	38	Oakey_SD04
18	BH_Lateral16	39	Oakey SD Lateral Alignment 1
19	BH_Lateral17	40	Oakey SD Lateral Alignment 2 Right
31	SL_SD05_ult	41	Oakey SD Lateral Alignment 2 Left
32	SL SD Lateral Alignment 1 Right		

Figure 10: WSPG Layout Figure

Atlantic
BH Mainline
BH lateral
Ballard/Euclid
Oakey
ST louis

N

0 100 200 400 Feet

DI ID	DI# in Plans	General Location	Type C: curb length Gr: grate size	Slope / Sump	Qstr (cfs)	Qint (cfs)	Qbyp (cfs)
B-S-2	1 (phase2)	Boulder, Charleston to Atlantic	C: 10' Gr: 1.5' x 7.5'	0.70%	8.0	4.8	3.3
B-S-3	1	Boulder, Charleston to Atlantic	C: 20' Gr: 1.5' x 17.5'	0.70%	13.6	12.9	0.7
J-N-1	30	Ballard and Eastwood	C: 3' Gr: 1.5' x 3'	sump	5.7	5.7	0.0
J-S-1	32	Ballard and Eastwood	C: 3' Gr: 1.5' x 3'	sump	5.7	5.7	0.0
J-W-1	-	Eastwood near Ballard	C: 3' Gr: 1.5' x 3'		Nuisance Flow		
J-W-2	33	Euclid and Russell	C: 3' Gr: 1.5' x 3'	0.50%	4.8	2.5	2.3
J-W-3	34	Euclid and Russell	C: 0 Gr: 3.5' x 3.5'	sump	13.0	13.0	0.0
C-N-3	-	Atlantic Lateral	C: 2.5' Gr: 1.5' x 2.5'	0.89%	7.4	2.8	4.6
C-N-4	-	Atlantic Lateral	C: 2.5' Gr: 1.5' x 2.5'	0.53%	4.6	2.7	1.9
C-N-1	42	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	76.0	48.5	27.5
C-N-2	43	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	27.5	22.4	5.1
C-S-1	40	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	76.0	48.5	27.5
C-S-2	41	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	27.5	22.4	5.1
C-W-2	44	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.90%	13.9	9.2	4.7
C-W-3	45	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.40%	16.2	11.4	4.9
C-W-4	47	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	0.30%	19.2	18.4	0.8
C-E-1	46	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.30%	4.0	3.9	0.1
D-Wa-1	2	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	6.2	6.2	0.0
D-W-1	3	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	12.7	12.3	0.4
D-Wa-2	5	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	15.6	14.8	0.8
D-W-3	9	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	16	15.2	0.8
D-W-5	10	Boulder, Atlantic to Oakey	C: 15' Gr: 1.5' x 12.5'	0.42%	19.8	18.6	1.2
D-W-7	11	Boulder, Atlantic to Oakey	C: 15' Gr: 1.5' x 12.5'	0.62%	15.1	12.9	2.2
D-E-1	4	Boulder Highway	C: 7.5' Gr: 1.5' x 7.5'	0.59%	18.6	8.5	10.2
D-Ea-1	6	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.75%	13.3	5.9	7.3
D-E-2	7	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.50%	10.4	5.3	5.1
D-E-3	-	Boulder Highway	C: 3' Gr: 1.5' x 3'	0.80%	7.4	3.3	4.1
D-E-4	13	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.58%	7.7	4.3	3.4
D-Ca-1	8	Boulder, Atlantic to Oakey	C: none Gr: 2.5' x5'	0.50%	12.5	8.2	4.3
D-C-1	12	Boulder, Atlantic to Oakey	C: none Gr: 2.5' x5'	sump	16.8	16.8	0.0

Boulder Highway Storm Drain
Figure 11: Drop Inlet Locations (1)

Proposed Mainline Storm Drain

Proposed Lateral Storm Drain

Drop Inlets

Proposed

Existing

0 125 250 Feet

1 inch = 125 feet

N

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DI #	DI# in Plans	General Location	Type C: curb length Gr: grate size	Slope / Sump	Qstr (cfs)	Qint (cfs)	Qbyp (cfs)
E-S-1	50	Oakey Lateral	C: 15' Gr: 1.5' x 12.5'	0.77%	141.5	61.7	79.8
E-S-2	51	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	79.78	54.5	25.3
E-S-3	54	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	26.3	22.6	3.7
E-N-1	52	Oakey Lateral	C: 15' Gr: 1.5' x 12.5'	0.77%	141.5	61.7	79.8
E-N-2	53	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	79.78	54.5	25.3
E-N-3	55	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	26.3	22.6	3.7
F-W-1	-	Boulder,Oakey to St Louis	C: none Gr: 12' x 3'	0.67%	19.3	19.0	0.0
F-W-2*	-	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.67%	11.6	0.0	0.0
F-W-3*	-	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.67%	11.6	0.0	0.0
F-W-4*	-	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.70%	19.4	0.0	0.0
F-W-5**	-	Boulder,Oakey to St Louis	C: none Gr: 2.5' x 5'	sump	19.4	10.0	9.4
F-E-1	14	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.58%	7.0	4.1	2.9
F-E-3	15	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.50%	10.9	5.5	5.5
F-C-1	-	Boulder,Oakey to St Louis	C: none Gr: 4' x 3'	0.84%	5.0	3.0	2.0
F-C-2	-	Boulder,Oakey to St Louis	C: none Gr: 2.5' x 3'	0.64%	5.0	1.9	3.1
F-C-3	-	Boulder,Oakey to St Louis	C: none Gr: 2.5' X 5'	sump	12.0	12.0	0.0
F-C-4	-	Boulder,Oakey to St Louis	C: none Gr: 2.5' x 3'	sump	8.0	8.0	0.0
G-N-1	61	St Louis Lateral	C: 10' Gr: 1.5' x 7.5'	1.00%	44.0	17.9	26.2
G-N-2	63	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	58.2	39.3	18.9
G-N-3	65	St Louis Lateral	C: 20 Gr: 1.5' x 17.5'	sump	18.9	18.9	0.0
G-S-1	60	St Louis Lateral	C: 10' Gr: 1.5' x 7.5'	1.00%	44.0	17.9	26.2
G-S-2	62	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	58.2	39.3	18.9
G-S-3	64	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	18.9	16.8	2.1
H-W-1	16	Boulder, St Louis to Sahara	C: 5' Gr: 1.5' x 5'	0.90%	15.6	6.5	9.2
H-W-2	19	Boulder, St Louis to Sahara	C: 15' Gr: 1.5' x 12.5'	0.80%	18.8	14.9	3.9
H-W-3	20	Boulder, St Louis to Sahara	C: 20' Gr: 1.5' x 17.5'	0.80%	14.3	15.0	1.3
H-E-1	18	Boulder, St Louis to Sahara	C: 5' Gr: 1.5' x 5'	0.50%	1.3	1.1	0.2
H-E-3	-	Boulder, St Louis to Sahara	C: NONE Gr: 2' x 3'		Nuisance Flow		
H-C-1	17	Boulder, St Louis to Sahara	C: NONE Gr: 2.5' x 2.5'	0.48%	6.0	2.6	3.5
H-C-2	-	Boulder, St Louis to Sahara	C: NONE Gr: 2.5' x 5'	0.70%	3.5	2.0	1.5
H-C-3	-	Boulder, St Louis to Sahara	C: NONE Gr: 2.5' x10'	sump	1.5	1.5	0.0

* 18" RCP SD assumed full with 19 cfs

** 24" RCP SD assumed full with 29 cfs

Boulder Highway Storm Drain
Figure 12: Drop Inlet Locations (2)

Proposed Mainline Storm Drain

Proposed lateral Storm Drain

Drop Inlets

- Proposed
- Existing
- Existing, but Remove

0 125 250 Feet

1 inch = 125 feet

N

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4. Other Design Considerations

This section has been included in the DDR to summarize key considerations and factors that influenced the 70% design of the BHSD. This information has been provided for reference and to aid with decision making as the project progresses towards the 90% and final plan submittals. This section also includes a summary of other activities that were performed for the project to date.

4.1. Groundwater and Geotechnical

GES completed geotechnical investigations during the 30% design phase. The results of these investigations are summarized in the *Groundwater Impact Evaluation, Draft Geotechnical Evaluation Report*, and *Draft Groundwater Sampling, Slug testing and Groundwater Modeling Report.* The main sections of these three reports are provided in **Appendix C**. All of the supporting data and appendix material is only included on the PDF versions of the reports on the Data CD.

The *Groundwater Impact Evaluation* presented information based on a search of available groundwater Literature. The report identified and described historic information regarding past known/suspected release of contaminants to soil and groundwater in the project vicinity (see Figure 2 in Appendix A of the Groundwater Impact Evaluation report). This information was used to help locate borings and monitoring wells in critical areas where groundwater contamination may be present. The report also identified historic information regarding the depth of groundwater in the vicinity of the project.

The *Draft Geotechnical Evaluation Report* includes the findings of the field exploration and laboratory testing of soils in the project area. The report describes the subsurface investigation from 13 borings conducted for the BHSD project. The report also provided data on the pavement thickness and depths at which groundwater was encountered in BHSD project area. The excavated soil from the borings was logged and tested. Recommendations were provided on excavation, fill, and soil strength as well as other soil related design parameters. Some of the key findings include:

1. Weakly to moderately cemented soils encountered in 4 of the 13 borings and strongly cemented hard soil (Caliche) encountered in 1 boring, all at depths above the anticipated excavation depth required for the storm drain construction.
2. The soils sampled and tested from the borings generally do not meet the requirements for Select or Granular Backfill.

Draft Groundwater Sampling, Slug testing and Groundwater Modeling Report contains results of groundwater testing for the BHSD project. Samples of groundwater were tested for various contaminants. Slug tests and groundwater modeling was performed to estimate anticipated groundwater pumping rates required to facilitate construction of the proposed improvements.

The groundwater sample tests revealed no reportable concentrations of groundwater contaminants at the 3 locations sampled (B-1, B-4 and B-8 – MW-1, MW-2 and MW-3 respectively), which are located at the downstream, upstream and middle of the mainline storm drain alignment in Fremont Street. These boring/monitoring well locations were selected based on their close proximity to historic known/suspected areas of contaminant release immediately adjacent to the project alignment as well as providing a good spread across the geographic extent of the proposed project.

Slug tests were performed at two of the monitoring wells (MW-1 and MW-3) to develop basic information regarding the aquifer recharge rate and hydraulic conductivity. This information was then used in computer models to estimate anticipated pumping rates for areas of the project that are

anticipated to require dewatering for construction. It is anticipated based on the groundwater depths recorded at each boring location and the proposed depth of the proposed facilities that much of the proposed storm drain construction will require construction dewatering. The anticipated dewatering well spacing is estimate at 50-60 feet with total pumping rates estimated at 180 gpm to 600 gpm depending on the depth of required drawdown (approximately 0.5 to 20 feet) and the length of open trench/active construction limits (500 to 1,000 feet was used in the analysis).

Based on the above information and the information included in the associated reports completed by GES it appears that dewatering will be a significant component of the construction effort. Atkins has been directed by the City to obtain a groundwater discharge permit(s) for the project from the Nevada Department of Environmental Protection (NDEP) prior to the advertisement for bid. With the completion of the 70% plans the process for obtaining the NDEP permits can begin in earnest as the locations and depths of the proposed facilities are well defined.

4.2. Record of Survey

The Record of Survey (ROS) establishes the horizontal and vertical control for the project from which the alignment/location of the proposed facilities will be established as well as recordation of existing monuments in the project area that can be used during construction for such purposes and should be protected/replaced if necessary. Research of available record information, parcel maps, subdivisions maps, and other records of survey as well as field locating activities was performed to create the ROS for this project.

The ROS has been submitted and recorded with the Clark County Recorder. A copy of the recorded ROS is included in **Appendix D**.

4.3. Summary of Permits

A draft summary of the permits and approvals needed for this project has been compiled into a summary matrix shown in **Table 2**. This list is preliminary and may be revised as the project moves forward. Further coordination and effort will be required in future design phases to complete permit applications and assist the City in obtaining required permits for the project.

Table 2. Summary Matrix of Required Permits

Permit	Issuing Agency	Regulated Activity	Phase
City of Las Vegas - Excavation Permit	CLV Department of Public Works Land Development Services	Underground construction on private property or within CLV ROW	Construction
City of Las Vegas - Soils Report Submittal	CLV Department of Public Works Land Development Services	Soils associated with construction activity within CLV ROW (required for off-site construction projects)	Construction
City of Las Vegas - Construction Permit	CLV Department of Public Works Land Development Services	Off-site improvements within a City of Las Vegas ROW	Construction
City of Las Vegas - Grading Permit	CLV Department of Building and Safety	On-site grading activities	Construction
City of Las Vegas - Temporary Stock Pile Permit	CLV Department of Building and Safety	Temporary stock piling of earth materials on private or BLM parcels not covered by grading permit	Construction
City of Las Vegas - Traffic Barricade Plan Approval	CLV Construction Services	Traffic barricade plan associated with construction or discharge activity impacting a CLV ROW	Construction
Dust Control Permit	Clark County Department of Air Quality Management (DAQM)	In accordance with DAQM Regulations, dust control permit required for grading or other land-disturbance activities in Clark County.	Construction
NPDES General Storm Water Permit for Construction	NDEP Bureau of Water Pollution Control	Activity that disturbs 1 acre or greater and discharges storm water runoff from the construction site into a municipal separate storm water sewer system, or “waters of the US” as defined by Section 404 of the CWA.	Construction
NPDES Discharge Permit	NDEP Bureau of Water Pollution Control	Point source discharge to surface water, i.e. natural channel, roadway or storm drain. Required for dewatering during construction.	Design or Construction
NDOT ROW Encroachment Permit	Nevada Department of Transportation (NDOT)	NDOT requires this permit for construction activities in NDOT ROW.	Design
CCRFCD Chapter 8 Resource Screening Analysis	Clark County Regional Flood Control District	U.S. BLM requires each new regional facility be reviewed to ensure full compliance with environmental regulatory requirements	Design
OTHER AGENCY APPROVALS AND COORDINATION:			
Entity	**Issuing Agency**	**Regulated Activity**	**Phase**
City of Las Vegas Department of Public Works Flood Control Section	City of Las Vegas	Design Plan/Drainage Study Review/Approval	Design
Clark County Regional Flood Control District	Clark County Regional Flood Control District	Design Plan/Drainage Study Review/Approval, also check of Federal Emergency Management Agency (FEMA) maps	Design
Utility Services Coordination	Various (Refer to Section 5 of this PDR for more information)	Coordination required with utilities and agencies having facilities within the limits of or adjacent to the project. Identify and resolve potential utility conflicts.	Design
Clark County Public Works	Clark County Public Works	Coordination/Design Plan. CCPW installed and maintains the downstream connection Point.	Design

Clark County Public Works Development Review	Clark County Public Works	Design Plan/Drainage Study Review/Approval. There are areas of Clark County Jurisdiction adjacent to project	Design

4.4. Right-of-Way Summary

Atkins performed a review of the existing right-of-way in the study area and possible acquisition requirements based on the proposed alignment and facilities identified in this report. The 70% design plans show the right-of-way boundary based on research performed and widths for all streets pertinent to construction of new storm drain facilities.

The proposed improvements are primarily located within existing City of Las Vegas and NDOT public right-of-way and fall in the jurisdiction of both City of Las Vegas and Clark County, see **Figure 13** for more detail. Fremont Street and Charleston Boulevard are both NDOT owned and maintained right-of-way. Initial coordination with NDOT has already taken place and coordination will continue during the future design phases.

Coordination with NDOT and NDOT Encroachment Permits will be required in Charleston Boulevard and Fremont Street in order to obtain approval for construct of the proposed facilities in these areas. It is intended that this permit be prepared and submitted with the 90% submittal. In addition, Atkins will submit the 70% documents to NDOT for review and comment.

Based on the new storm drain proposed in the 70% plans for the area near Ballard Drive, Eastwood Drive and Euclid Avenue (See Section 3.1.5 of this report) a permanent drainage easement is required for acquisition between two existing residential homes. The new storm drain and drainage easement is located between two homes where the impact to existing structures and landscaping would be minimized. The minimum recommended permanent drainage easement width is 10' for this new easement. An additional 5' minimum Authorization to Enter Property (AEP) easement is also recommend adjacent to the permanent easement to accommodate construction. This easement location appears to be the best option available in the area. The land appears to have no permanent structures on it. However, small trees, grass landscaping and fencing will be impacted during construction. The location of the existing and proposed easements are shown on **Figure 14** and on the 70% plans**.** The proposed storm drain is shown on the 70% plans. This was identified during the 30% design phase and the City is in the process of acquiring the permanent easement and the AEP.

At this time one permanent drainage easement and one Authorization to Enter Property (AEP) are required, as discussed above for the area between Eastwood Drive and Euclid Avenue.

4.5. Draft Chapter 8 Resource Screening Analysis

The Chapter 8 Resource Screening Analysis was completed during the 70% design phase and is being submitted for review to the City and CCRFCD at the same time as the 70% submittal. The draft Chapter 8 report is a standalone document and is being submitted for review under a separate cover. The resource screening analysis was conducted in accordance with Chapter 8 of the CCRFCD Supplemental Environmental Impact Statement (SEIS) for the Flood Control Master Plan. The analysis was performed to assess the impacts to any environmental resources in the project area and to determine whether a project-specific Environmental Assessment (EA) or Environmental

Impact Statement (EIS) is warranted. **Table 3** summarizes the draft mitigation measures that would be incorporated into the Proposed Action to reduce or minimize potential impacts.

Table 3. Chapter 8 Mitigation Measures

Surface Water Quality	• The contractor will develop, implement, and maintain a SWPPP. • BMPs will be developed and implemented to minimize offsite runoff, erosion, and sediment transport.
Groundwater Resources	• Dewatering may be required, depending on conditions encountered during construction. • The construction contractor shall obtain a Stormwater Discharge Permit from NDEP.
Biological Resources	• If construction occurs during the typical breeding season for migratory birds (March through July), then a survey for nesting birds will be conducted by a qualified biologist prior to initiating ground disturbing activities.
Cultural Resources	• If previously undiscovered cultural resources are encountered during construction, then the contractor shall cease activities immediately and notify SHPO.
Air Quality	• The contractor will be required to obtain and comply with a Dust Control Permit for Construction Activities issued by the Clark County Department of Air Quality and Environmental Management. • The contractor must comply with all federal, state, and local laws, ordinances, and regulations governing air pollution control.
Hazardous Materials	• Conduct additional investigation of sites listed in Table 4 to determine the actual risk to receptors during excavation and construction activities. Additional investigation may include site reconnaissance, property owner/occupant interviews, review of historic records, review of regulatory files, interviews with NDEP and other agencies, and/or further subsurface sampling. The City shall consult with NDEP to determine whether a remediation plan for the handling and disposal of contaminated groundwater shall be developed; otherwise, should groundwater encountered during construction & dewatering be suspected of contamination, one of the following two options will be implemented to prevent hazardous materials impacts to human health or the environment: o A permit from the Nevada Department of Environmental Protection will be obtained to discharge the groundwater dewatering during construction as surface water (discharge to existing storm drains) any required treatment prior to discharge will be a condition of the permit as required by NDEP. o The groundwater dewatering will be discharged to the City sanitary sewer system and covered under the City's discharge permit with NDEP at their wastewater treatment facility. In this scenario, the City treatment plant operators would review groundwater samples and any associated contamination to ensure they can handle the water at the treatment plant and the conditions of their discharge permit with NDEP. • Debris encountered during construction activities will be properly disposed of in accordance with applicable local, state, and federal laws.

With the incorporation of the above mitigation measures, the proposed Boulder Highway Storm Drain project would not have a significant impact on the environment. Compliance with existing county, state, and federal regulations and permitting requirements would reduce the potential for any impacts to insignificant, minor, and/or temporary. Therefore, the Proposed Action meets the requirements for categorical exclusion from further review in accordance with the National Environmental Policy Act of 1969.

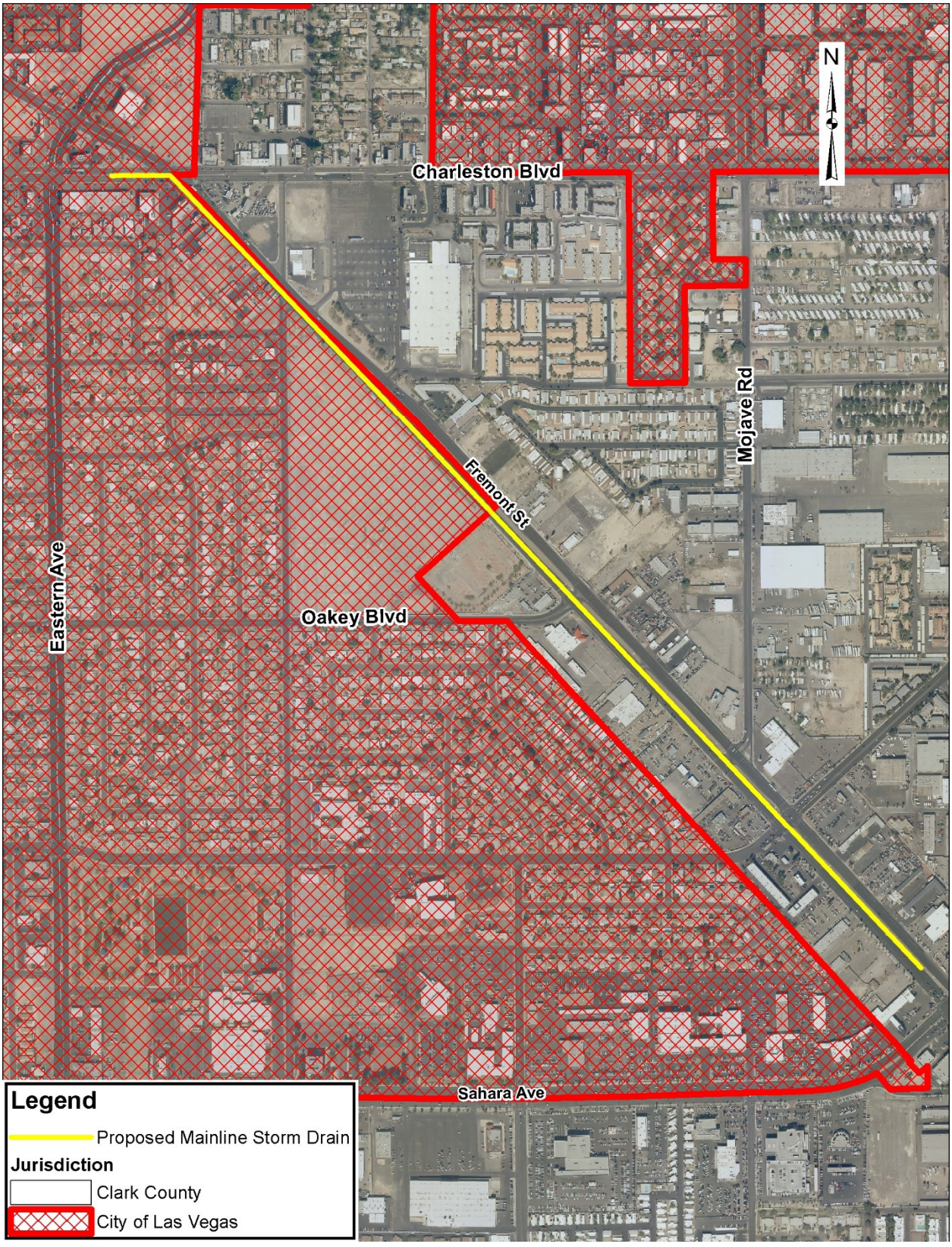


Figure 13. City of Las Vegas Jurisdiction



Figure 14. Easement Exhibit

5. Utility Issues and Conflicts Summary

5.1. Utility Data Collection and Conflicts

This section includes discussion regarding the utility research, coordination and development of the existing utility database used for development of the project design. The proposed project alignment runs through a well-established area mainly consisting of collector and arterial streets.

Research of the underground utilities was based on obtaining and reviewing design and as-built drawings from utility companies and the City of Las Vegas, which dated as far back as the 1960s. This information along with the surface features identified in the aerial topography was used to develop the preliminary utility database within the CAD design files. This preliminary database was then supplemented with field observations, other sources of surface observation, field survey of surface features and manhole dipping. In addition, potholing was completed to obtain more detailed information on the horizontal and vertical alignment of known underground utilities to guide locating the proposed improvements, avoid conflicts where possible and identify existing infrastructure that requires relocation, removal, replacement or abandonment. It should be noted that all existing sanitary sewer and storm drain manholes in the vicinity of the proposed storm drain improvements have been surveyed and dipped and the horizontal and vertical location of those facilities on the 70% plans is based on this information. In addition, over 100 potholes on existing utilities have been completed for the project and the associated information collected has been used in the development of the 70% plans.

The following utilities and agencies were contacted for information regarding existing infrastructure in the project area:

- AT&T Cable Maintenance
- CenturyLink
- City of Las Vegas
- Clark County Public Works
- Clark County Water Reclamation District
- Cox Communications
- Extenet Systems, Inc.
- Freeway Arterials System of Transportation (FAST)
- Kern River Gas Transmission Company
- Kinder Morgan Energy Partners
- Level 3 Communications, LLC
- Las Vegas Valley Water District (LVVWD)
- Nevada Department of Transportation (NDOT)
- NV Energy (Distribution)
- NV Energy (Transmission)
- Qwest Comm
- Southern Nevada Water Authority (SNWA)
- Southwest Gas Corporation
- Sprint LD
- Sprint Nextel Engineering
- Sunrise Acres Water
- Verizon Business Communications
- Zayo (formerly American Fiber Systems, Inc.)

The following is an inventory of the significant existing utilities that are in close proximity to the proposed storm drain improvements as well as some of the more significant utility relocations required for the project. For the purpose of organizing the information below, the utility conflicts are discussed either by the mainline or the individual collection lateral. The list below is not a comprehensive list of all existing utilities. A more comprehensive list is included in the utility conflict matrix provided in **Appendix E** of this report. The known existing utilities are also shown on the 70% plans that accompany this report and have been updated to account for all potholes completed to date (106 potholes).

Mainline – Sahara to Charleston

- The mainline is proposed to avoid the existing 51" RCP sanitary sewer with 72" steel casing at St. Louis Avenue by going under as shown in the 70% plans, estimated vertical clear distance is approximately 16 inches.
- The mainline is in conflict with a 12" ACP waterline with 24" steel casing near Mojave.
- The mainline is in conflict with an underground electric conduit bank at Oakey.
- The mainline crosses under an 8" ACP water and 8" and 12" VCP sanitary sewers at Atlantic Street. In addition, DI#1 – Lateral 1 in this vicinity requires the relocation of approximately 400 feet of 8" VCP sanitary sewer in this same vicinity.
- The 30" MLCP waterline on the west side of Fremont from Sahara to Charleston is in close proximity to all 10 proposed drop inlets on that side of the street, but is not in direct conflict. All the drop inlets except 2 have at least 5 feet clear distance between the edge of pipe and wall of the DI. Further coordination with LVVWD is required.
- The mainline drop inlets and laterals are in conflict with an 8"/10" sanitary sewer (CCWRD) north of Oakey and a 10" sanitary sewer (CCWRD) south of St. Louis on the west side of Fremont.
- The mainline drop inlets on the east side of Fremont are in conflict with an underground telephone conduit bank at 3 locations between Oakey and St. Louis.

Mainline – Charleston Boulevard

- The mainline crosses under a 30" MLCP waterline, 8" ACP waterline, 6" PE Gas and 18" and 21" VCP sanitary sewers.
- The 18" sanitary sewer is above the proposed alignment of the storm drain and is proposed to be removed and consolidated with the 21" sanitary sewer in a new upsized 24" sanitary sewer.

Lateral – St. Louis Avenue

- There are numerous existing utilities in St. Louis Avenue including a 45" – 51" RCP sanitary sewer, 8" VCP sanitary sewer, 6" – 8" water, 2" PE gas as well as water and sewer service laterals to each residence that fronts on St. Louis, see the 70% plans and Section 3.1.2 for more information.

- The 8” sanitary sewer is proposed to be relocated to the north of its current alignment to create a corridor for the proposed storm drain.
- The lateral crosses under the 30” MLCP waterline and 10” VCP sanitary sewer (CCWRD) at Fremont St.
- The 2” PE gas requires relocation at two locations.

Lateral – Oakey Boulevard

- A future sanitary sewer interceptor is planned in Oakey. The storm drain is located on the south side of the street to provide a corridor for this future system on the north side of the street.
- The lateral crosses under a 30” MLCP waterline and 10” VCP sanitary sewer (CCWRD) at Fremont Street.
- The underground electric conduit bank on the north side of Oakey is conflict with Laterals 1 and 2.
- The 4”/2” PE gas requires relocation at two locations.

Lateral – Atlantic Street/Wengert Avenue

- There are two relocations of the 8” ACP waterline (Laterals 1 and 4) and one relocation of the 6” ACP waterline (Lateral 3) that are required.
- The storm drain is placed in a narrow corridor between a 12” VCP sanitary sewer and the 16” ACP waterline along Atlantic Street between Olive Street and Fremont Street. In this reach the storm drain also crosses under the 16” ACP waterline at Olive and the 30” MLCP waterline at Fremont Street.
- The 2” PE gas requires relocation at two locations.

Lateral – Olive/Russell/Euclid/Eastwood/Ballard

- The 2” PVC gas in a 3” sleeve requires relocation at four locations.

The above summary and the utility conflict matrix in **Appendix E** represent the best available information at the time of this submittal. The 70% Subsurface Utility Engineering (SUE) plans are included in **Appendix E**. Sanitary sewer and storm drain that have had the manholes surveyed and dipped are shown as Quality Level C. Quality Level A is shown where potholes have been successfully performed, see Section 5.2 of this report.

5.2. Utility Potholing

Test holes have been completed throughout the project area prior to the preparation of this report, the 70% design plans and SUE plans. A total of 106 potholes have been successfully performed for this project, see SUE plans in **Appendix E** for locations and test hole data sheets.

6. Construction Cost, Key Issues and Conclusion

6.1. Construction Cost Estimate

It is estimated that the project will have a total construction cost of **$22,559,000**. The estimate includes a 10% contingency. The estimated construction cost for the Phase 1 improvements from Sahara to Atlantic, including the laterals in St. Louis, Oakey, Atlantic and Olive to Eastwood is $18,432,000 with an additional $4,127,000 for the reach north of Atlantic to 300 feet west of Fremont in Charleston.

All the improvements are proposed to be funded by the Clark County Regional Flood Control District. Note that construction costs for the relocation of Southwest Gas, NV Energy and Century Link facilities has not been included in the construction cost at this time, as it is assumed these relocations will be paid for by the utility owner. This may be subject to change as the coordination with the utility owners continues. The estimate above also assumes that obsolete storm drain and sewer in NDOT ROW can be abandoned in place and will not require removal and pavement replacement.

The unit prices for the estimated construction cost are based on review of recent bid tabulations for other similar projects in Clark County. A 10-percent contingency has been added to the cost estimate to reflect the current level of design completeness and to account for currently unknown costs and uncertainty with some aspects of the construction such as dewatering.

The detailed construction cost estimate and associated quantities are provided in **Appendix F**.

6.2. Conclusion

Based on the information collected to date, analysis completed and information presented in this report and the 70% plans the project appears feasible and constructible and can meet the intended purpose of collection and conveyance of the 100-year flood event as originally intended. In addition to continued advancement of the design towards final plans and specifications the critical action items to address as the project continues are as follows:

1. Continued coordination with entities having existing facilities that will be impacted by the placement of the proposed infrastructure, which include:
    a. Las Vegas Valley Water District – close proximity to relatively large diameter waterlines and some required relocations/remove and replace of small to medium diameter waterlines.
    b. Clark County Water Reclamation District – relocation of sewer on west side of Fremont
    c. NV Energy (distribution) – required relocation of an underground powerline at several locations near Fremont and Oakey.
    d. Soutwest Gas – multiple required relocations throughout the project (no high pressure gas line or large diameter relocations required)
    e. Century Link – relocation of telephone conduit at several locations on the east side of Fremont Street.
2. Obtain permits/approvals from:
    a. City of Las Vegas
    b. Clark County Regional Flood Control District – Chapter 8 and Funding

   c. Nevada Department of Transportation – Encroachment Permit
   d. Clark County Development Services/Clark County Public Works
   e. Nevada Department of Environmental Protection – Groundwater Discharge Permit
3. Obtain permanent drainage easement and AEP between Eastwood Drive and Euclid Avenue for the proposed lateral storm drain.
4. Resolve abandonment or removal of obsolete existing storm drain and sewer pipes in NDOT ROW and resolve associated pavement rehab requirements.

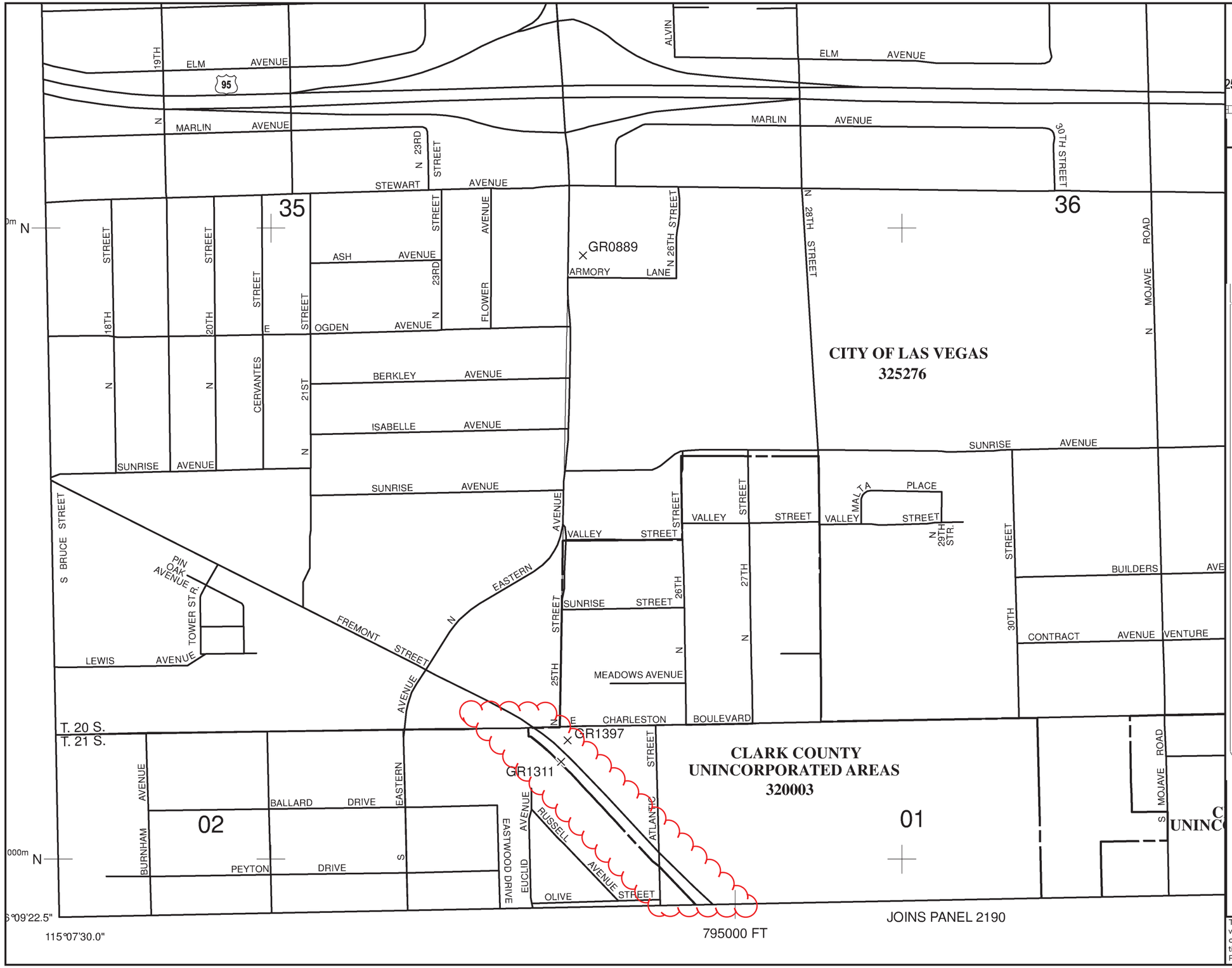
Appendix A

Hydrologic Analysis

- Appendix A-1: FEMA FIRMette
- Appendix A-2: Existing Condition Photo Library
- Appendix A-3: HEC-1 Model
- Appendix A-4: CCRFCD Design Manual Criteria
- Appendix A-5: Hydrologic Parameters
- Appendix A-6: Land Use Map and Soils Map

Appendix A-1

FEMA FIRMette



PANEL 2186F

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA

AND INCORPORATED AREAS

PANEL 2186 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2186	F
LAS VEGAS, CITY OF	325276	2186	F
NORTH LAS VEGAS, CITY OF	320007	2186	F

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

MAP NUMBER
32003C2186F

MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

Figure A-1

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

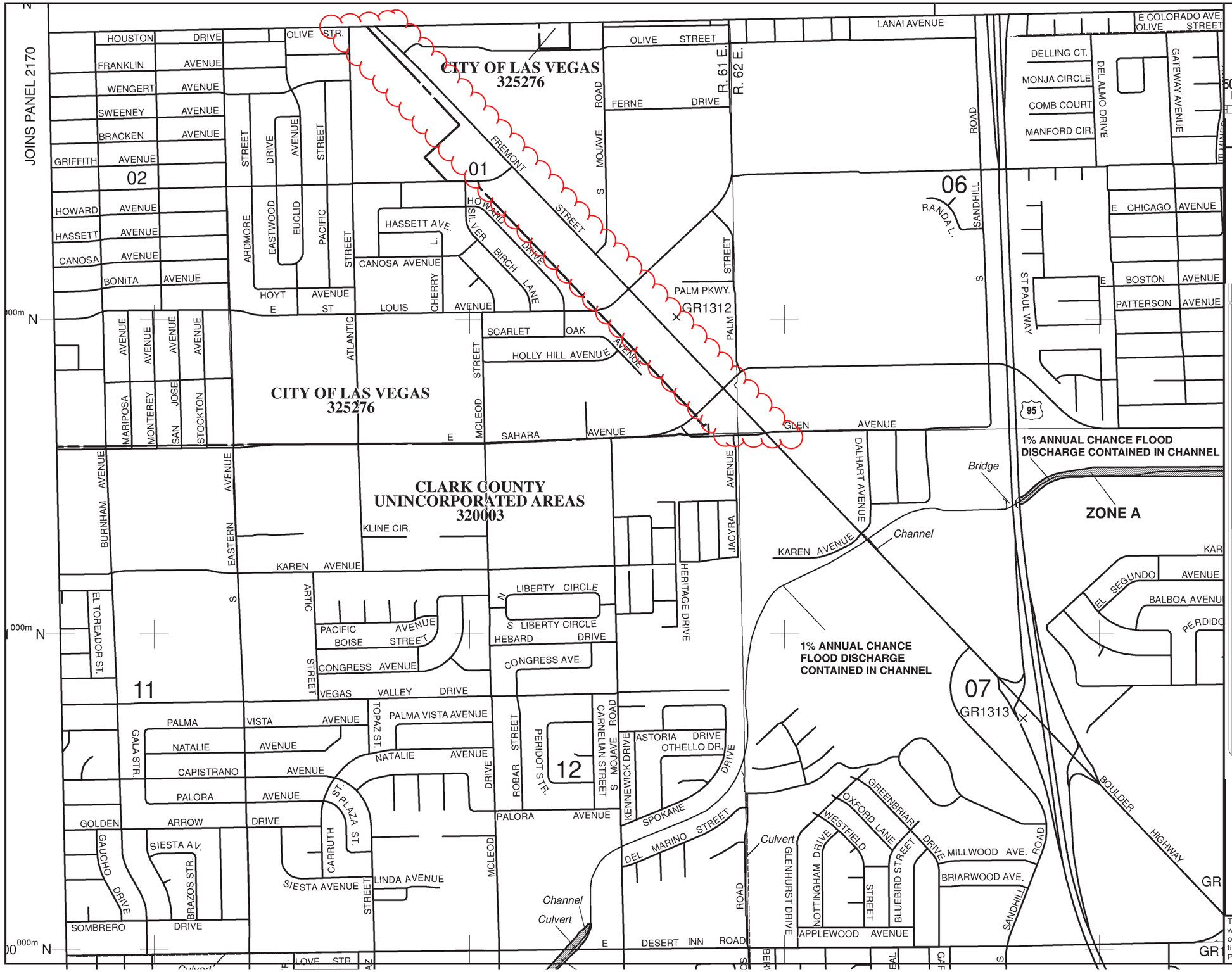


Figure A-2

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

Appendix A-2

Existing Condition Photo Library

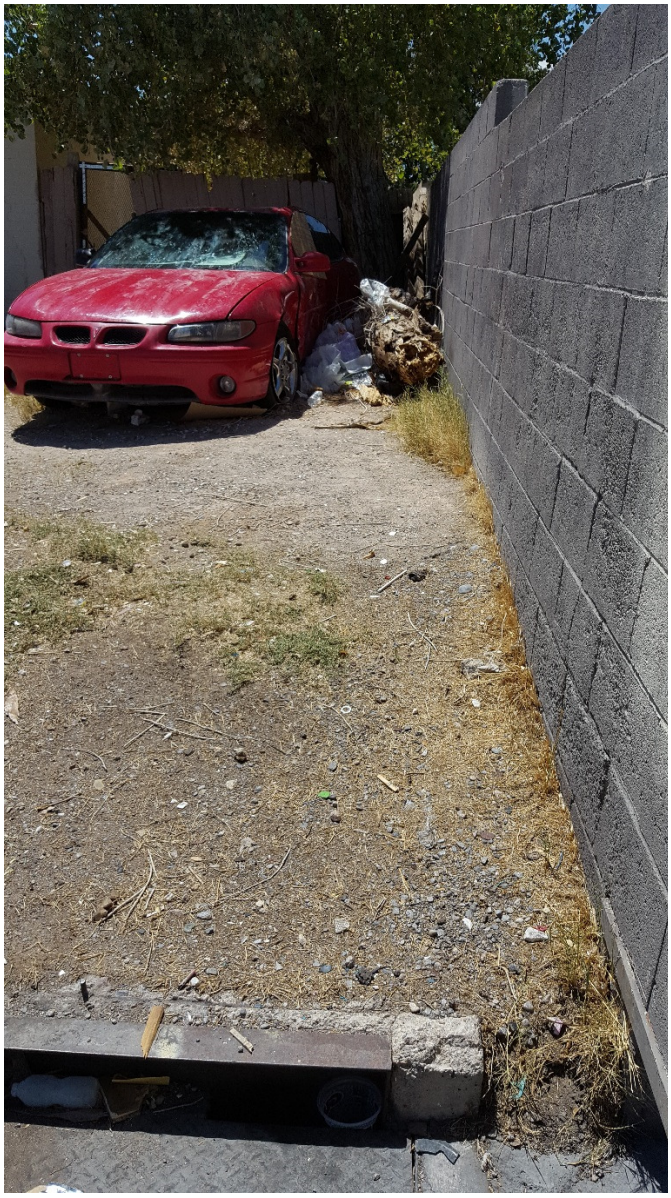


Photo 1: looking west, Euclid Ave Drop Inlet and 10’ Drainage Easement



Photo 2: Looking northeast at 10’ Drainage easement behind Ballard Drive Drop Inlet



Photo 3: Looking west, valley gutter crossing Mcleod Street at Scarlet Oak Street



Photo 4: Looking southeast drop inlet on the east side of Eulcid Avenue between Olive street and Russell Avenue



Photo 5: Looking south on Atlantic Street near olive Street



Photo 6: Looking northwest at the Fremont Street from Atlatic Street



Photo 7: Looking northwest at Fremont Street from Oakey Boulevard



Photo 8: Looking southeast at the Fremont Street from Oakey Boulevard



Photo 9: Looking west at Oakey Boulevard near Fremont Street



Photo 10: Looking northwest at the Fremont Street from St. Loius Avenue



Photo 11: Looking southeast at Fremont Street from St. Louis Avenue



Photo 12: Looking west at St. Louis Avneue near Fremont Street



Photo 13: Looking northwest at Fremont Street from Sahara Avenue



Photo 14: Corroded CMP Pipe in Ballard Dr and Eastwood Dr.



Photo 15: Corroded CMP Pipe in Ballard Dr and Eastwood Dr.



Photo 16: Corroded CMP Pipe in Ballard Dr and Eastwood Dr.

Appendix A-3

HEC- 1 Model

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1****************************************                    ****************************************
 *                                      *                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                    *          609 SECOND STREET           *
 *                                      *                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   31JAN17  TIME  10:21:15  *                    *           (916) 756-1104             *
 *                                      *                    *                                      *
 ****************************************                    ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X                X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X                X
                                        X     X  X        X     X          X
                                        X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                  HEC-1 INPUT                                                  PAGE  1

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

                        *DIAGRAM
 *** FREE ***
             1          ID    BOULDER HIGHWAY STORM DRAIN SAHARA TO CHARLESTON (PHASE 1)
             2          ID   DRAFT DESIGN REPORT (30% DESIGN)
             3          ID    COLLECTION MODEL
             4          ID    MODEL INTENDED TO DETERMINE LOCAL FLOWS FOR COLLECTION AND LATERAL DESIGN
             5          ID
             6          ID    MAY 2017
             7          ID    MODELED BY ATKINS (MANOGYA KHANAL, E.I.)
             8          ID    CHECKED BY ATKINS (VANCE SKIDMORE, P.E.)
             9          ID
            10          ID    BASED ON FOLLOWING MODEL:
            11          ID      CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT 2008 MASTER PLAN UPDATE
            12          ID      CENTRAL WATERSHED (SOUTHWEST, SOUTHEAST, NORTHEAST AREAS)
            13          ID      RECOMMENDED DRAINAGE SYSTEM WITH ULTIMATE DEVELOPMENT
            14          ID      INPUT FILE = SW3.DAT
            15          ID      INPUT FILE DATE = MAY 2008
            16          ID      DESIGN STORM = 100-YEAR 6-HR STORM
            17          ID      STORM DISTRIBUTION = SDN #3
            18          ID      MODELED BY PBS&J (BRIAN ROWLEY, E.I., CFM)
            19          ID      CHECKED BY PBS&J (HARSHAL B. DESAI, P.E., CFM)
            20          ID      STORM CENTERING = ENTIRE WATERSHED (SOUTHWESTERN PORTION)
            21          ID
            22          ID
            23          ID
            24          ID      JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
            25          ID
            26          ID                              AREA       DARF
            27          ID                              SQ. MI.
            28          ID                              0-0.5       1.0
            29          ID                              0.5-1      0.975
            30          ID                              1-2         0.95
            31          ID                              2-3        0.925
            32          ID                              3-4        0.915
            33          ID
            34          ID
            35          IT       5       0       0     300
            36          IO       5       0       0
            37          IN       5       0       0
            38          JR    PREC     1.0   0.975    0.95   0.925   0.915
                        *
            39          KK  CH59-C
            40          BA   0.341
            41          PB    2.77
            42          PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
            43          PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
            44          PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
            45          PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
            46          PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
            47          PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
            48          PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
            49          PC   0.998   0.999   1.000
            50          LS       0    94.0
            51          UD   0.489
                        *
1                                                  HEC-1 INPUT                                                  PAGE  2
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  52          KK DCH59-C
  53          KM  FLOW SPLIT TO CH60A-C
  54          KM  SPLIT TO FLAMINGO WASH SYSTEM
  55          KM  DEVELOPED FROM CWH MODEL
  56          KM  CAPACITY = 144 CFS + 78 CFS (100 YR FLOW FROM CWH FOR CH58)
  57          DT   DFLAM
  58          DI       0     222    1000
  59          DQ       0       0     778
              *

  60          KK    CH51
  61          BA   0.273
  62          PB    2.77
  63          LS       0    92.9
  64          UD   0.467
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  65          KK   RCH51
  66          KM  ROUTE CH51 TO CCH52
  67          KM  FACILITY = FLAMINGO - BOULDER NORTH
  68          KM  FACILITY # = FLBN  0342
  69          KM  LINING = RCB
  70          RD    4300  0.0042   0.015       0    TRAP       7       0
              *

  71          KK CH52-C2
  72          BA   0.231
  73          PB    2.77
  74          LS       0    94.5
  75          UD   0.389
              *

  76          KK CCH52C2
  77          KM  COMBINE RCH51 AND CH52-C2
  78          KM  CHARLESTON AND LAS VEGAS BLVD
  79          HC       2
              *

  80          KK CH52-C1
  81          BA   0.092
  82          PB    2.77
  83          LS       0    95.6
  84          UD   0.195
              *

  85          KK   CCH52
  86          KM  COMBINE CCH52C2 AND CCH52-C1
  87          KM  CHARLESTON AND LAS VEGAS BLVD
  88          HC       2
              *
1                                      HEC-1 INPUT                                          PAGE  3

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

  89          KK  RCCH52
  90          KM  ROUTE CCH52 TO CCH56
  91          KM  FACILITY = FLAMINGO - BOULDER NORTH
  92          KM  FACILITY # = FLBN 0281
  93          KM  LINING = RCB
  94          RD    3100  0.0133   0.015       0    TRAP      10       0
              *

  95          KK CH56-C2
  96          BA   0.182
  97          PB    2.77
  98          LS       0    90.5
  99          UD   0.459
              *

 100          KK CH56-C1
 101          BA   0.159
 102          PB    2.77
 103          LS       0      91
 104          UD   0.357
              *

 105          KK   CCH56
 106          KM  COMBINE CH56C2 AND CH56C1
 107          KM  CHARLESTON AND MARYLAND BLVD
 108          HC       2
              *

 109          KK   DFLAM
 110          KM  RETRIEVE DFLAM
 111          DR   DFLAM
              *

 112          KK RDFLAM1
 113          KM  ROUTE DFLAM TO CCH60A-C
 114          KM  ROUTE ON THE STREET
```

```
 115          RD    2650  0.0049   0.016       0    TRAP       0      50
              *

 116          KK RDFLAM2
 117          KM  ROUTE DFLAM TO CCH60A-C
 118          KM  FACILITY = FLAMINGO - MARYLAND PARKWAY
 119          KM  FACILITY # = FLMP 0000
 120          KM  LINING = RCB
 121          RD    2650  0.0049   0.015       0    TRAP       8       0
              *

 122          KKCH60A-C2
 123          BA   0.258
 124          PB    2.77
 125          LS       0      92
 126          UD   0.367
              *
1                                    HEC-1 INPUT                                          PAGE  4

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

 127          KK CCH6AC2
 128          KM  COMBINE CH60A-C2 AND RDFLAM2
 129          HC       2
              *

 130          KKCH60A-C3
 131          BA   0.158
 132          PB    2.77
 133          LS       0    91.9
 134          UD   0.189
              *

 135          KK CCH6AC3
 136          KM  COMBINE CH60A-C3 AND CCH6AC3
 137          HC       2
              *

 138          KK  CCH60A
 139          KM  COMBINE CCH6AC3 AND CCH56
 140          HC       3
              *

 141          KK RCCH60A
 142          KM  ROUTE CCH60A TO CCCH56
 143          KM  FACILITY = FLAMINGO - BOULDER NORTH AT CHARLESTON AND BOULDER
 144          KM  FACILITY # = FLBN 0205
 145          KM  LINING = RCB
 146          RD    1200   0.023   0.015       0    TRAP      10       0
              *

 147          KKCH60A-C1
 148          BA   0.054
 149          PB    2.77
 150          LS       0    87.3
 151          UD   0.184
              *

 152          KKCH60A-C4
 153          BA   0.028
 154          PB    2.77
 155          LS       0    92.9
 156          UD   0.104
              *

 157          KKCCH60AC4
 158          KM  COMBINE CH60A-C4 AND CH60A-C1
 159          HC       2
              *
1                                    HEC-1 INPUT                                          PAGE  5

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

 160          KK  CCH60B
 161          KM  COMBINE CCH60AC4 AND RCCH60A
 162          HC       2
              *

 163          KK CH63-C1
 164          BA   0.058
 165          PB    2.77
 166          LS       0    89.6
 167          UD   0.164
              *

 168          KK  CCCH56
 169          KM  COMBINE CH63-C1 AND CCH60B
 170          HC       2
              *

 171          KK RCCCH56
 172          KM  ROUTE CCCH56 TO CCH68-3
 173          KM  FACILITY = FLAMINGO - BOULDER NORTH AT CHARLESTON AND BRUCE
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```
 174          KM  FACILITY # = FLBN 0205
 175          KM  LINING = RCB
 176          RD    2300   0.023   0.015       0    TRAP      10       0
              *

 177          KK  CH68-3
 178          BA   0.069
 179          PB    2.77
 180          LS       0    87.2
 181          UD   0.222
              *

 182          KK CCH68-3
 183          KM  COMBINE CH68-3 AND CCCH56
 184          HC       2
              *

 185          KKRCCH68-3
 186          KM  ROUTE  CCH68-3 TO CCH68-3
 187          KM  FACILITY = FLAMINGO - BOULDER NORTH AT CHARLESTON AND BURHAM
 188          KM  FACILITY # = FLBN 0205
 189          KM  LINING = RCB
 190          RD     500   0.023   0.015       0    TRAP      10       0
              *

 191          KK CH63-C4
 192          BA   0.120
 193          PB    2.77
 194          LS       0    90.8
 195          UD   0.187
              *
1                                    HEC-1 INPUT                                          PAGE  6

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


 196          KK CCH68-4
 197          KM  COMBINE CH63-C4 AND RCCH68-3
 198          HC       2
              *

 199          KKRCCH68-4
 200          KM  ROUTE  CCH68-3 TO CCH67
 201          KM  FACILITY = FLAMINGO - BOULDER NORTH AT CHARLESTON AND EASTERN
 202          KM  FACILITY # = FLBN 0180
 203          KM  LINING = RCB
 204          RD    1300  0.0131   0.015       0    TRAP      20       0
              *

 205          KK  CH68-5
 206          BA   0.019
 207          PB    2.77
 208          LS       0    95.2
 209          UD   0.144
              *

 210          KK CH67-C1
 211          BA   0.014
 212          PB    2.77
 213          LS       0      92
 214          UD   0.126
              *

 215          KK   CCH67
 216          KM  COMBINE CH68-5 CH67-C1 AND RCCH68-4
 217          HC       3
              *

 218          KK  RCCH67
 219          KM  ROUTE  CCH67 TO CBH1
 220          KM  FACILITY = FLAMINGO - BOULDER NORTH
 221          KM  FACILITY # = FLBN 0167
 222          KM  LINING = RCB
 223          RD     700  0.0114   0.015       0    TRAP      20       0
              *

 224          KK  CH68-1
 225          BA   0.064
 226          PB    2.77
 227          LS       0    88.0
 228          UD   0.147
              *

 229          KK RCH68-1
 230          KM  ROUTE CH68-1 TO CCH68-1
 231          KM  STREET
 232          RD    2150  0.0167   0.016       0    TRAP       0      50
              *
1                                    HEC-1 INPUT                                          PAGE  7

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


 233          KK  CH68-4
 234          BA   0.047
```

```
 235          PB    2.77
 236          LS       0    95.8
 237          UD   0.141
              *

 238          KKCCH68-4a
 239          KM  COMBINE RCH68-1 AND CH68-4
 240          HC       2
              *

 241          KKRCCH684a
 242          KM  ROUTE CCH68-4 TO CCH68-6
 243          KM  STREET
 244          RD     700   0.008   0.016       0    TRAP       0      50
              *

 245          KK CH63-C2
 246          BA   0.033
 247          PB    2.77
 248          LS       0    89.2
 249          UD   0.156
              *

 250          KK RCH63C2
 251          KM  ROUTE CH63-C2 TO CCH67C3
 252          RD    4875   0.002   0.016       0    TRAP       0      50
              *

 253          KK CH67-C3
 254          BA   0.098
 255          PB    2.77
 256          LS       0    85.5
 257          UD   0.257
              *

 258          KK CCH67C3
 259          KM  COMBINE CH67-C3 AND CH63-C2
 260          HC       2
              *

 261          KK RCH67C3
 262          KM  ROUTE CH63-C2 TO CCH67C3
 263          RD     800   0.005   0.013       0    CIRC       4       0
              *

 264          KK CH67-C2
 265          BA   0.020
 266          PB    2.77
 267          LS       0    85.7
 268          UD   0.167
              *
```



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

 269          KK CCH67C2
 270          KM  COMBINE CCH67-C3 AND CH67-C2
 271          HC       2
              *

 272          KK RCH67C3
 273          KM  ROUTE CH63-C2 TO CCH67C3
 274          RD     400   0.005   0.013       0    CIRC       4       0
              *

 275          KK   CCH67
 276          KM  COMBINE RCH68-1 AND CH68-6 AND RCCH67
 277          HC       3
              *

 278          KK FR04-C1
 279          BA   0.004
 280          PB    2.77
 281          LS       0    94.1
 282          UD   0.106
              *

 283          KK  CH68-6
 284          BA   0.006
 285          PB    2.77
 286          LS       0    92.4
 287          UD   0.117
              *

 288          KK    CBH1
 289          KM  COMBINE CCH68-6 AND FR04-C1
 290          KM  COMBINE AT cHARLESTON AND BOULDER HWY
 291          HC       3
              *

 292          KK   RCBH1
 293          KM  ROUTE CBH1 TO CBH2
 294          RD    1000  0.0036   0.015       0    TRAP      20       0
              *
```

```
 295          KK CH63-C3
 296          BA   0.018
 297          PB    2.77
 298          LS       0    88.2
 299          UD   0.178
              *

 300          KK RCH63C3
 301          KM  ROUTE CH63-C3 TO CCH67C4
 302          RD    4100   0.002   0.016       0    TRAP       0      50
              *
1                                      HEC-1 INPUT                                              PAGE  9

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


 303          KK CH67-C4
 304          BA   0.106
 305          PB    2.77
 306          LS       0    85.2
 307          UD   0.208
              *

 308          KK CCH67C4
 309          KM  COMBINE CH67-C4 AND RCH67C3
 310          HC       2
              *

 311          KK RCH67C4
 312          KM  ROUTE CCH67C4 TO CFR04C8
 313          RD    1700   0.011   0.016       0    TRAP       0      50
              *

 314          KK FR04-C8
 315          BA   0.049
 316          PB    2.77
 317          LS       0    85.6
 318          UD   0.214
              *

 319          KK CFR04C8
 320          KM  COMBINE FR04-C8 AND CH67-C4
 321          HC       2
              *

 322          KKRCFR04C8
 323          KM  ROUTE CFR04C8 TO CCFR04C7
 324          RD     460   0.006   0.016       0    TRAP       0      50
              *

 325          KK FR04-C6
 326          BA   0.009
 327          PB    2.77
 328          LS       0    85.6
 329          UD   0.116
              *

 330          KKDFR04-C6
 331          KM  FLOW SPLIT TO FR04-C5
 332          KM  SPLIT TO THE LOW POINT ON EUCLID
 333          DT   ECLD1
 334          DI       0       7      14      30
 335          DQ       0       7       7       7
              *
1                                      HEC-1 INPUT                                              PAGE 10

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


 336          KK FR04-C7
 337          BA   0.009
 338          PB    2.77
 339          LS       0    87.1
 340          UD   0.149
              *

 341          KK CFR04C7
 342          KM  COMBINE RFR04-C7 AND FR04-C7
 343          HC       2
              *

 344          KKCCFR04C7
 345          KM  COMBINE CFR04C8 AND CFR04C7
 346          HC       2
              *

 347          KK   ECLD1
 348          KM  RETRIEVE ECL01
 349          DR   ECLD1
              *

 350          KK FR04-C5
 351          BA   0.008
 352          PB    2.77
```

```
 353          LS       0    85.6
 354          UD   0.121
              *

 355          KKCCH04C5A
 356          KM  COMBINE FR04-C5 AND ECL01
 357          HC       2
              *

 358          KKDCH04C5A
 359          KM  FLOW SPLIT TO FR04-C5
 360          KM  SPLIT TO THE LOW POINT ON EUCLID
 361          DT   ECLD2
 362          DI       0       7      14      30
 363          DQ       0       7       7       7
              *

 364          KKRDCH04C5A
 365          KM  ROUTE CCH04C5 TO CFR04A
 366          RD     630   0.009   0.016       0    TRAP       0      50
              *

 367          KK FR04-C2
 368          BA   0.013
 369          PB    2.77
 370          LS       0    87.9
 371          UD   0.107
              *
1                                     HEC-1 INPUT                                          PAGE 11

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


 372          KK   ECLD2
 373          KM  RETRIEVE ECL01
 374          DR   ECLD2
              *

 375          KK  CECLD2
 376          KM  COMBINE ECLD2 AND FR04-C2
 377          HC       2
              *

 378          KK RCECLD2
 379          KM  ROUTE CCH04C5 TO CFR04A
 380          RD     630   0.005   0.013       0    circ       2       0
              *

 381          KK FR04-C4
 382          BA   0.008
 383          PB    2.77
 384          LS       0    91.0
 385          UD   0.104
              *

 386          KK CFR04C4
 387          KM  COMBINE FR04-C4 AND RCECLD2
 388          HC       2
              *

 389          KK  CFR04A
 390          KM  COMBINE CFR04-C4 AND CCFR04C5
 391          HC       2
              *

 392          KK  CFR04B
 393          KM  COMBINE CFR04A AND CCFR04C7
 394          HC       2
              *

 395          KK FR04-C3
 396          BA   0.012
 397          PB    2.77
 398          LS       0    94.2
 399          UD   0.120
              *

 400          KK   CFR04
 401          KM  COMBINE CFR04B AND FR04-C3
 402          HC       2
              *
1                                     HEC-1 INPUT                                          PAGE 12

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


 403          KK    CBH2
 404          KM  COMBINE CFR04 AND CBH1
 405          KM  WHERE OLIVE/ATLANTIC LATERAL COMES IN ON BOULDER HIGHWAY
 406          HC       2
              *

 407          KK   RCBH2
 408          KM  ROUTE CBH2 TO CBH3
 409          RD    1500  0.0036   0.015       0    TRAP      20       0
```

```
                *
  410           KK  CH64-C
  411           BA   0.286
  412           PB    2.77
  413           LS       0    90.0
  414           UD   0.470
                *
  415           KK RCH64-C
  416           KM  ROUTE CH64-C to CCH67C5
  417           RD    3925   0.001   0.016       0    TRAP       0      50
                *
  418           KK CH67-C5
  419           BA   0.150
  420           PB    2.77
  421           LS       0    85.3
  422           UD   0.324
                *
  423           KK CCH67C5
  424           KM  COMBINE RCH64-C and CCH67C5
  425           HC       2
                *
  426           KKRCCH67C5
  427           KM  ROUTE CCH67C5
  428           RD    2500   0.001   0.016       0    TRAP       0      50
                *
  429           KKFR04-C11
  430           BA   0.067
  431           PB    2.77
  432           LS       0    86.5
  433           UD   0.286
                *
  434           KKCFR04C11
  435           KM  COMBINE FR04-C11 AND RCCH67C5
  436           HC       2
                *
1                                    HEC-1 INPUT                                          PAGE 13

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

  437           KK FR04-C9
  438           BA   0.051
  439           PB    2.77
  440           LS       0    95.4
  441           UD   0.229
                *
  442           KKFR04-C10
  443           BA   0.009
  444           PB    2.77
  445           LS       0      91
  446           UD   0.228
                *
  447           KK    CBH3
  448           KM  COMBINE RCBH2, CFR04C11 AND FR04-C9
  449           HC       4
                *
  450           KK   RCBH3
  451           KM  ROUTE CBH3 TO CBH4
  452           RD    1800  0.0036   0.015       0    TRAP      20       0
                *
  453           KK  FR03-5
  454           BA   0.019
  455           PB    2.77
  456           LS       0    84.9
  457           UD   0.187
                *
  458           KKFR04-C12
  459           BA   0.011
  460           PB    2.77
  461           LS       0    85.8
  462           UD   0.142
                *
  463           KKRFR04C12
  464           KM  ROUTE FR04-C12
  465           RD    1140   0.012   0.016       0    TRAP       0      50
                *
  466           KKFR04-C14
  467           BA   0.029
  468           PB    2.77
  469           LS       0    85.7
  470           UD   0.145
```

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

 471          KKCFR04C14
 472          KM  COMBINE RFR04C12 AND FR04-C14
 473          HC       2
              *
 474          KKRCFR4C14
 475          KM  ROUTE CFR04C14 TO CFR04C15
 476          RD     950   0.007   0.016       0    TRAP       0      50
              *
 477          KKFR04-C15
 478          BA   0.010
 479          PB    2.77
 480          LS       0    84.9
 481          UD   0.147
              *
 482          KKCFR04C15
 483          KM  COMBINE FR04-C15 AND RCFR4C14
 484          HC       2
              *
 485          KK  FR03-1
 486          BA   0.027
 487          PB    2.77
 488          LS       0    87.1
 489          UD   0.190
              *
 490          KK  CFR03A
 491          KM  COMBINE CFR03-2 AND CFR04C15
 492          HC       2
              *
 493          KKFR04-C13
 494          BA   0.025
 495          PB    2.77
 496          LS       0    85.1
 497          UD   0.219
              *
 498          KK  CFR03B
 499          KM  COMBINE FR04-C13 AND CFR03A
 500          HC       2
              *
 501          KK  CFR03C
 502          KM  COMBINE CFR03B AND CFR03-5
 503          HC       2
              *
```



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

 504          KK  FR03-4
 505          BA   0.016
 506          PB    2.77
 507          LS       0    86.3
 508          UD   0.161
              *
 509          KK CCH63-C
 510          KM  COMBINE FR03-4 AND CFR03C
 511          HC       2
              *
 512          KKFR04-C16
 513          BA   0.025
 514          PB    2.77
 515          LS       0    94.2
 516          UD   0.173
              *
 517          KKFR04-C17
 518          BA   0.007
 519          PB    2.77
 520          LS       0    91.7
 521          UD   0.180
              *
 522          KK    CBH4
 523          KM  COMBINE CBH3 FR04-C17 FR04-C16 AND CCH63-C
 524          HC       4
              *
 525          KK   RCBH4
 526          KM  ROUTE CBH3 TO CBH4
 527          RD    1100   0.016   0.015       0    TRAP      24       0
```

```
                  *

            528   KK  FR03-8
            529   BA   0.004
            530   PB    2.77
            531   LS       0      88
            532   UD   0.174
                  *

            533   KK  FR03-7
            534   BA   0.016
            535   PB    2.77
            536   LS       0    92.2
            537   UD   0.174
                  *
```



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


            538   KK    CBH5
            539   KM  COMBINE CBH4 FR03-8 FR03-7
            540   HC       3
                  *
            541   ZZ
```

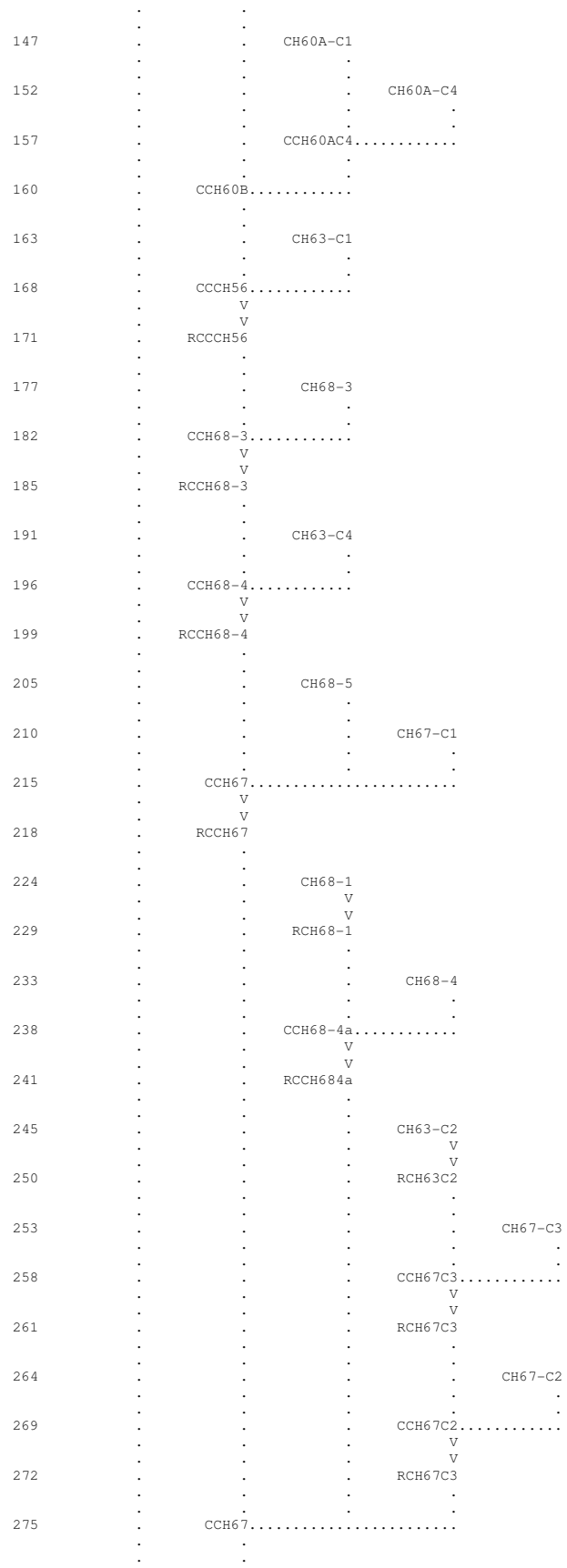
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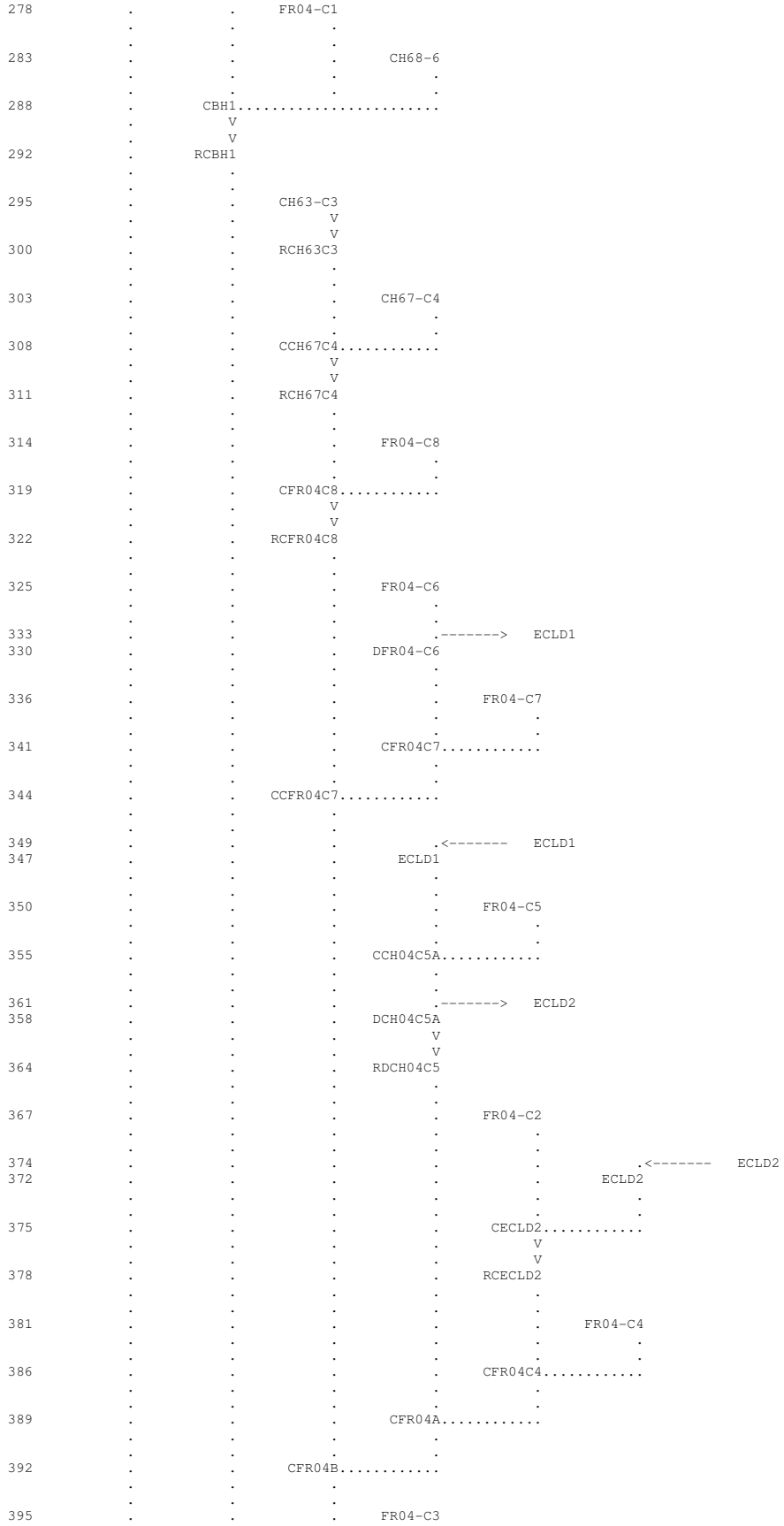
SCHEMATIC DIAGRAM OF STREAM NETWORK

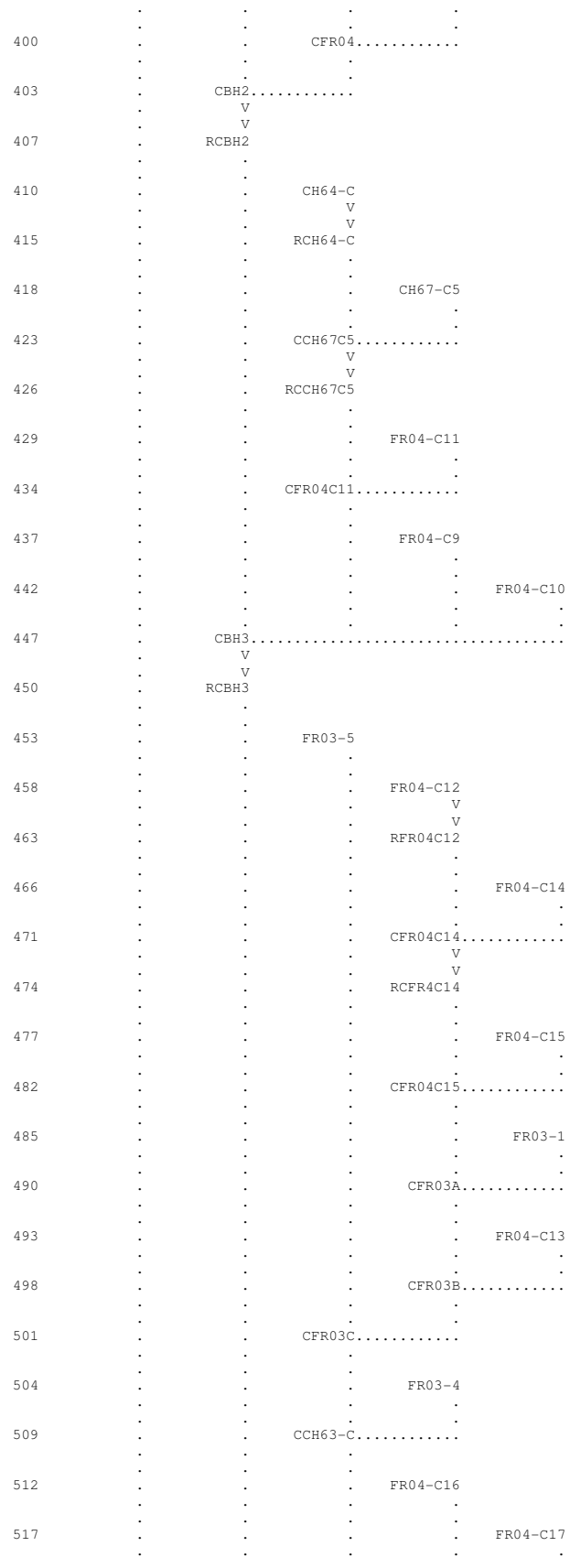
```
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

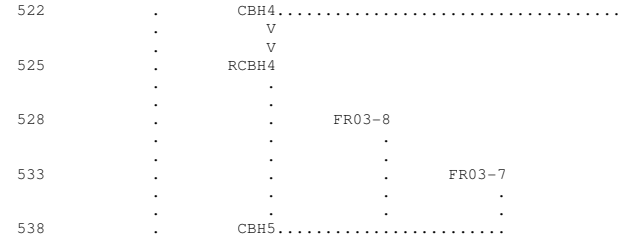
   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    39      CH59-C
                .
                .
    57          .-------->   DFLAM
    52      DCH59-C
                .
                .
    60          .        CH51
                .          V
                .          V
    65          .       RCH51
                .          .
                .          .
    71          .          .     CH52-C2
                .          .          .
                .          .          .
    76          .     CCH52C2.....    .
                .          .          .
                .          .          .
    80          .          .     CH52-C1
                .          .          .
                .          .          .
    85          .       CCH52.....    .
                .          V          .
                .          V          .
    89          .      RCCH52          .
                .          .          .
                .          .          .
    95          .          .     CH56-C2
                .          .          .
                .          .          .
   100          .          .          .     CH56-C1
                .          .          .          .
                .          .          .          .
   105          .          .       CCH56.....    .
                .          .          .          .
                .          .          .          .
   111          .          .          .          .<--------   DFLAM
   109          .          .          .       DFLAM
                .          .          .          V
                .          .          .          V
   112          .          .          .     RDFLAM1
                .          .          .          V
                .          .          .          V
   116          .          .          .     RDFLAM2
                .          .          .          .
                .          .          .          .
   122          .          .          .          .    CH60A-C2
                .          .          .          .          .
                .          .          .          .          .
   127          .          .          .     CCH6AC2.....    .
                .          .          .          .          .
                .          .          .          .          .
   130          .          .          .          .    CH60A-C3
                .          .          .          .          .
                .          .          .          .          .
   135          .          .          .     CCH6AC3.....    .
                .          .          .          .          .
                .          .          .          .          .
   138          .      CCH60A.....................    .
                .          V          .          .
                .          V          .          .
   141          .     RCCH60A         .          .
```


147 CH60A-C1
152 CH60A-C4
157 CCH60AC4
160 CCH60B
163 CH63-C1
168 CCCH56
171 RCCCH56
177 CH68-3
182 CCH68-3
185 RCCH68-3
191 CH63-C4
196 CCH68-4
199 RCCH68-4
205 CH68-5
210 CH67-C1
215 CCH67
218 RCCH67
224 CH68-1
229 RCH68-1
233 CH68-4
238 CCH68-4a
241 RCCH684a
245 CH63-C2
250 RCH63C2
253 CH67-C3
258 CCH67C3
261 RCH67C3
264 CH67-C2
269 CCH67C2
272 RCH67C3
275 CCH67


278 FR04-C1
283 CH68-6
288 CBH1
292 RCBH1
295 CH63-C3
300 RCH63C3
303 CH67-C4
308 CCH67C4
311 RCH67C4
314 FR04-C8
319 CFR04C8
322 RCFR04C8
325 FR04-C6
333 ECLD1
330 DFR04-C6
336 FR04-C7
341 CFR04C7
344 CCFR04C7
349 ECLD1
347 ECLD1
350 FR04-C5
355 CCH04C5A
361 ECLD2
358 DCH04C5A
364 RDCH04C5
367 FR04-C2
374 ECLD2
372 ECLD2
375 CECLD2
378 RCECLD2
381 FR04-C4
386 CFR04C4
389 CFR04A
392 CFR04B
395 FR04-C3


CFR04
CBH2
RCBH2
CH64-C
RCH64-C
CH67-C5
CCH67C5
RCCH67C5
FR04-C11
CFR04C11
FR04-C9
FR04-C10
CBH3
RCBH3
FR03-5
FR04-C12
RFR04C12
FR04-C14
CFR04C14
RCFR4C14
FR04-C15
CFR04C15
FR03-1
CFR03A
FR04-C13
CFR03B
CFR03C
FR03-4
CCH63-C
FR04-C16
FR04-C17



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************                    *****************************************
*                                       *                    *                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
*               JUN   1998              *                    *    HYDROLOGIC ENGINEERING CENTER      *
*            VERSION 4.1                *                    *         609 SECOND STREET             *
*                                       *                    *       DAVIS, CALIFORNIA 95616         *
*  RUN DATE   31JAN17  TIME  10:21:15   *                    *           (916) 756-1104              *
*                                       *                    *                                       *
*****************************************                    *****************************************
```

BOULDER HIGHWAY STORM DRAIN SAHARA TO CHARLESTON (PHASE 1)
PRELIMINARY DESIGN REPORT (30% DESIGN)
COLLECTION MODEL
MODEL INTENDED TO DETERMINE LOCAL FLOWS FOR COLLECTION AND LATERAL DESIGN

SEPTEMBER 2016
MODELED BY ATKINS (MANOGYA KHANAL, E.I.)
CHECKED BY ATKINS (VANCE SKIDMORE, P.E.)

BASED ON FOLLOWING MODEL:
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT 2008 MASTER PLAN UPDATE
CENTRAL WATERSHED (SOUTHWEST, SOUTHEAST, NORTHEAST AREAS)
RECOMMENDED DRAINAGE SYSTEM WITH ULTIMATE DEVELOPMENT
INPUT FILE = SW3.DAT
INPUT FILE DATE = MAY 2008
DESIGN STORM = 100-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY PBS&J (BRIAN ROWLEY, E.I., CFM)
CHECKED BY PBS&J (HARSHAL B. DESAI, P.E., CFM)
STORM CENTERING = ENTIRE WATERSHED (SOUTHWESTERN PORTION)

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

AREA SQ. MI.	DARF
0-0.5	1.0
0.5-1	0.975
1-2	0.95
2-3	0.925
3-4	0.915

```
36 IO          OUTPUT CONTROL VARIABLES
                    IPRNT           5  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                     NMIN           5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1    0  STARTING DATE
                    ITIME         0000  STARTING TIME
                       NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      2    0  ENDING DATE
                   NDTIME         0055  ENDING TIME
                   ICENT           19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   24.92 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

   JP          MULTI-PLAN OPTION
                    NPLAN           1  NUMBER OF PLANS

   JR          MULTI-RATIO OPTION
                   RATIOS OF PRECIPITATION
```

1.00 .98 .95 .93 .92

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	RATIO 2	RATIO 3	RATIO 4	RATIO 5
					1.00	.98	.95	.93	.92
HYDROGRAPH AT									
+	CH59-C	.34	1	FLOW	342.	332.	322.	311.	307.
				TIME	3.92	3.92	3.92	3.92	3.92
DIVERSION TO									
+	DFLAM	.34	1	FLOW	120.	110.	100.	89.	85.
				TIME	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT									
+	DCH59-C	.34	1	FLOW	222.	222.	222.	222.	222.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	CH51	.27	1	FLOW	270.	262.	253.	245.	242.
				TIME	3.92	3.92	3.92	3.92	3.92
ROUTED TO									
+	RCH51	.27	1	FLOW	266.	259.	251.	241.	239.
				TIME	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT									
+	CH52-C2	.23	1	FLOW	265.	257.	249.	242.	239.
				TIME	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT									
+	CCH52C2	.50	1	FLOW	515.	501.	486.	469.	464.
				TIME	3.83	3.92	3.92	3.92	3.92
HYDROGRAPH AT									
+	CH52-C1	.09	1	FLOW	147.	143.	139.	135.	133.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCH52	.60	1	FLOW	605.	586.	571.	550.	545.
				TIME	3.83	3.83	3.83	3.83	3.83
ROUTED TO									
+	RCCH52	.60	1	FLOW	601.	582.	566.	546.	541.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT									
+	CH56-C2	.18	1	FLOW	166.	161.	155.	150.	148.
				TIME	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT									
+	CH56-C1	.16	1	FLOW	169.	163.	158.	152.	150.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT									
+	CCH56	.34	1	FLOW	331.	320.	310.	299.	294.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT									
+	DFLAM	.00	1	FLOW	120.	110.	100.	89.	85.
				TIME	3.92	3.92	3.92	3.92	3.92
ROUTED TO									
+	RDFLAM1	.00	1	FLOW	117.	107.	98.	88.	83.
				TIME	4.08	4.08	4.08	4.08	4.08
ROUTED TO									
+	RDFLAM2	.00	1	FLOW	114.	103.	94.	85.	81.
				TIME	4.08	4.17	4.17	4.17	4.17
HYDROGRAPH AT									
+	CH60A-C2	.26	1	FLOW	280.	271.	262.	253.	249.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT									
+	CCH6AC2	.26	1	FLOW	312.	287.	267.	253.	249.
				TIME	4.00	4.00	4.08	3.75	3.75
HYDROGRAPH AT									
+	CH60A-C3	.16	1	FLOW	228.	221.	214.	206.	204.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCH6AC3	.42	1	FLOW	470.	455.	440.	425.	419.
				TIME	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT									
+	CCH60A	1.35	1	FLOW	1357.	1313.	1271.	1228.	1211.
				TIME	3.75	3.75	3.75	3.75	3.75

ROUTED TO									
+	RCCH60A	1.35	1	FLOW	1350.	1307.	1267.	1223.	1208.
				TIME	3.75	3.75	3.83	3.83	3.83
HYDROGRAPH AT									
+	CH60A-C1	.05	1	FLOW	66.	63.	61.	58.	58.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	CH60A-C4	.03	1	FLOW	48.	47.	45.	44.	43.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT									
+	CCH60AC4	.08	1	FLOW	111.	108.	104.	100.	99.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCH60B	1.43	1	FLOW	1426.	1381.	1336.	1290.	1273.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	CH63-C1	.06	1	FLOW	82.	79.	76.	73.	72.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCCH56	1.49	1	FLOW	1483.	1436.	1389.	1341.	1323.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCCCH56	1.49	1	FLOW	1474.	1427.	1380.	1333.	1314.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	CH68-3	.07	1	FLOW	78.	75.	72.	69.	68.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CCH68-3	1.56	1	FLOW	1544.	1495.	1445.	1395.	1376.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCCH68-3	1.56	1	FLOW	1542.	1493.	1443.	1393.	1374.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	CH63-C4	.12	1	FLOW	167.	162.	156.	151.	149.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCH68-4	1.68	1	FLOW	1673.	1619.	1566.	1512.	1491.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCCH68-4	1.68	1	FLOW	1667.	1614.	1560.	1506.	1485.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	CH68-5	.02	1	FLOW	33.	32.	31.	30.	30.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	CH67-C1	.01	1	FLOW	23.	22.	21.	20.	20.
				TIME	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT									
+	CCH67	1.71	1	FLOW	1700.	1646.	1591.	1536.	1514.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCCH67	1.71	1	FLOW	1697.	1643.	1587.	1533.	1511.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	CH68-1	.06	1	FLOW	87.	84.	81.	78.	77.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RCH68-1	.06	1	FLOW	83.	80.	80.	77.	76.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	CH68-4	.05	1	FLOW	83.	81.	79.	76.	75.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCH68-4a	.11	1	FLOW	156.	151.	148.	142.	140.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RCCH684a	.11	1	FLOW	152.	147.	146.	141.	139.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	CH63-C2	.03	1	FLOW	46.	45.	43.	42.	41.

				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RCH63C2	.03	1	FLOW	40.	39.	38.	37.	36.
				TIME	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT									
+	CH67-C3	.10	1	FLOW	97.	93.	89.	85.	84.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CCH67C3	.13	1	FLOW	99.	95.	91.	88.	86.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	RCH67C3	.13	1	FLOW	97.	93.	89.	86.	84.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	CH67-C2	.02	1	FLOW	24.	23.	22.	21.	21.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCH67C2	.15	1	FLOW	118.	114.	109.	104.	102.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	RCH67C3	.15	1	FLOW	117.	112.	108.	103.	101.
				TIME	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT									
+	CCH67	1.98	1	FLOW	1946.	1884.	1822.	1759.	1735.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	FR04-C1	.00	1	FLOW	7.	7.	7.	6.	6.
				TIME	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT									
+	CH68-6	.01	1	FLOW	10.	9.	9.	9.	9.
				TIME	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT									
+	CBH1	1.99	1	FLOW	1954.	1892.	1830.	1767.	1743.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCBH1	1.99	1	FLOW	1950.	1887.	1826.	1761.	1737.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	CH63-C3	.02	1	FLOW	23.	22.	21.	21.	20.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RCH63C3	.02	1	FLOW	21.	20.	20.	19.	20.
				TIME	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT									
+	CH67-C4	.11	1	FLOW	111.	107.	103.	98.	97.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CCH67C4	.12	1	FLOW	112.	108.	104.	99.	98.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	RCH67C4	.12	1	FLOW	113.	109.	104.	100.	98.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	FR04-C8	.05	1	FLOW	52.	50.	48.	46.	45.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CFR04C8	.17	1	FLOW	163.	156.	150.	143.	141.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
+	RCFR04C8	.17	1	FLOW	160.	154.	147.	141.	139.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	FR04-C6	.01	1	FLOW	11.	11.	11.	10.	10.
				TIME	3.58	3.58	3.58	3.58	3.58
DIVERSION TO									
+	ECLD1	.01	1	FLOW	7.	7.	7.	7.	7.
				TIME	3.42	3.42	3.42	3.42	3.50
HYDROGRAPH AT									
+	DFR04-C6	.01	1	FLOW	4.	4.	4.	3.	3.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									

+	FR04-C7	.01	1	FLOW	12.	11.	11.	11.	10.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CFR04C7	.02	1	FLOW	16.	15.	15.	14.	13.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCFR04C7	.19	1	FLOW	168.	161.	155.	148.	146.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	ECLD1	.00	1	FLOW	7.	7.	7.	7.	7.
				TIME	3.42	3.42	3.42	3.42	3.50
HYDROGRAPH AT									
+	FR04-C5	.01	1	FLOW	10.	10.	9.	9.	9.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCH04C5A	.01	1	FLOW	17.	17.	16.	16.	16.
				TIME	3.58	3.58	3.58	3.58	3.58
DIVERSION TO									
+	ECLD2	.01	1	FLOW	7.	7.	7.	7.	7.
				TIME	3.33	3.33	3.33	3.33	3.33
HYDROGRAPH AT									
+	DCH04C5A	.01	1	FLOW	10.	10.	9.	9.	9.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RDCH04C5	.01	1	FLOW	10.	9.	9.	9.	9.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	FR04-C2	.01	1	FLOW	18.	18.	17.	16.	16.
				TIME	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT									
+	ECLD2	.00	1	FLOW	7.	7.	7.	7.	7.
				TIME	3.33	3.33	3.33	3.33	3.33
2 COMBINED AT									
+	CECLD2	.01	1	FLOW	25.	25.	24.	23.	23.
				TIME	3.50	3.50	3.50	3.50	3.50
ROUTED TO									
+	RCECLD2	.01	1	FLOW	25.	24.	24.	23.	23.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	FR04-C4	.01	1	FLOW	13.	12.	12.	12.	11.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT									
+	CFR04C4	.02	1	FLOW	38.	37.	35.	34.	34.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT									
+	CFR04A	.03	1	FLOW	47.	46.	44.	43.	42.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CFR04B	.22	1	FLOW	205.	197.	189.	181.	177.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR04-C3	.01	1	FLOW	21.	20.	19.	19.	19.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CFR04	.23	1	FLOW	220.	212.	203.	195.	191.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CBH2	2.22	1	FLOW	2159.	2089.	2020.	1948.	1921.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCBH2	2.22	1	FLOW	2150.	2081.	2010.	1938.	1912.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	CH64-C	.29	1	FLOW	254.	245.	236.	228.	225.
				TIME	3.92	3.92	3.92	3.92	3.92
ROUTED TO									
+	RCH64-C	.29	1	FLOW	236.	228.	219.	211.	208.
				TIME	4.25	4.25	4.25	4.25	4.25
HYDROGRAPH AT									
+	CH67-C5	.15	1	FLOW	132.	127.	122.	117.	115.
				TIME	3.75	3.75	3.75	3.75	3.75

2 COMBINED AT									
+	CCH67C5	.44	1	FLOW	288.	278.	268.	257.	253.
				TIME	4.17	4.25	4.25	4.25	4.25
ROUTED TO									
+	RCCH67C5	.44	1	FLOW	280.	269.	259.	248.	244.
				TIME	4.42	4.42	4.42	4.42	4.42
HYDROGRAPH AT									
+	FR04-C11	.07	1	FLOW	66.	63.	61.	58.	57.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT									
+	CFR04C11	.50	1	FLOW	294.	283.	272.	261.	256.
				TIME	4.42	4.42	4.42	4.42	4.42
HYDROGRAPH AT									
+	FR04-C9	.05	1	FLOW	76.	74.	72.	69.	69.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR04-C10	.01	1	FLOW	12.	11.	11.	11.	10.
				TIME	3.67	3.67	3.67	3.67	3.67
4 COMBINED AT									
+	CBH3	2.78	1	FLOW	2375.	2296.	2216.	2134.	2104.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCBH3	2.78	1	FLOW	2355.	2273.	2194.	2114.	2083.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	FR03-5	.02	1	FLOW	21.	20.	19.	18.	18.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	FR04-C12	.01	1	FLOW	14.	13.	13.	12.	12.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RFR04C12	.01	1	FLOW	14.	13.	13.	12.	11.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR04-C14	.03	1	FLOW	36.	35.	33.	32.	31.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CFR04C14	.04	1	FLOW	48.	46.	44.	42.	41.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	RCFR4C14	.04	1	FLOW	47.	44.	43.	41.	41.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR04-C15	.01	1	FLOW	12.	12.	11.	11.	10.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CFR04C15	.05	1	FLOW	57.	54.	52.	50.	50.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR03-1	.03	1	FLOW	32.	31.	30.	28.	28.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CFR03A	.08	1	FLOW	88.	84.	81.	77.	77.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR04-C13	.03	1	FLOW	26.	25.	24.	23.	22.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CFR03B	.10	1	FLOW	114.	109.	105.	100.	99.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CFR03C	.12	1	FLOW	134.	128.	123.	118.	117.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR03-4	.02	1	FLOW	20.	19.	18.	18.	17.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCH63-C	.14	1	FLOW	151.	145.	140.	133.	132.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR04-C16	.03	1	FLOW	40.	39.	38.	37.	36.
				TIME	3.58	3.58	3.58	3.58	3.58

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 HYDROGRAPH AT
+              FR04-C17       .01     1   FLOW          10.      10.      10.       9.       9.
                                          TIME         3.58     3.58     3.58     3.58     3.58

  4 COMBINED AT
+                   CBH4      2.95     1   FLOW        2522.    2434.    2349.    2263.    2230.
                                          TIME         3.75     3.75     3.75     3.75     3.75

 ROUTED TO
+                  RCBH4      2.95     1   FLOW        2512.    2424.    2339.    2253.    2220.
                                          TIME         3.75     3.75     3.75     3.75     3.75

 HYDROGRAPH AT
+                  FR03-8       .00     1   FLOW           5.       5.       5.       5.       5.
                                          TIME         3.58     3.58     3.58     3.58     3.58

 HYDROGRAPH AT
+                  FR03-7       .02     1   FLOW          24.      23.      23.      22.      22.
                                          TIME         3.58     3.58     3.58     3.58     3.58

  3 COMBINED AT
+                   CBH5      2.97     1   FLOW        2533.    2445.    2359.    2272.    2239.
                                          TIME         3.75     3.75     3.75     3.75     3.75
1
                                          SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                              (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

           FOR PLAN = 1  RATIO=  .00
              RCH51  MANE         4.31    268.36    236.92      2.03      5.00    265.72    235.00        2.03


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2949E+02 EXCESS= .0000E+00 OUTFLOW= .2950E+02 BASIN STORAGE= .5619E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RCH51  MANE         4.36    260.41    235.52      1.96      5.00    259.06    235.00        1.96


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2853E+02 EXCESS= .0000E+00 OUTFLOW= .2854E+02 BASIN STORAGE= .4854E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RCH51  MANE         4.42    251.77    238.55      1.90      5.00    251.28    235.00        1.90


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2759E+02 EXCESS= .0000E+00 OUTFLOW= .2760E+02 BASIN STORAGE= .5681E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RCH51  MANE         4.48    243.69    237.25      1.83      5.00    240.93    235.00        1.83


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2663E+02 EXCESS= .0000E+00 OUTFLOW= .2663E+02 BASIN STORAGE= .4851E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
              RCH51  MANE         4.50    240.16    238.54      1.80      5.00    239.39    235.00        1.81


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2627E+02 EXCESS= .0000E+00 OUTFLOW= .2627E+02 BASIN STORAGE= .5276E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
             RCCH52  MANE         1.84    602.20    231.29      2.12      5.00    600.84    230.00        2.12


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6752E+02 EXCESS= .0000E+00 OUTFLOW= .6753E+02 BASIN STORAGE= .2976E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
             RCCH52  MANE         1.86    584.12    232.28      2.06      5.00    582.05    230.00        2.06


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6540E+02 EXCESS= .0000E+00 OUTFLOW= .6541E+02 BASIN STORAGE= .2757E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
             RCCH52  MANE         1.88    567.50    231.05      1.99      5.00    566.39    230.00        1.99


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6332E+02 EXCESS= .0000E+00 OUTFLOW= .6333E+02 BASIN STORAGE= .2735E-02 PERCENT ERROR=    .0


           FOR PLAN = 1  RATIO=  .00
             RCCH52  MANE         1.91    547.12    232.57      1.92      5.00    546.04    230.00        1.92


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6117E+02 EXCESS= .0000E+00 OUTFLOW= .6118E+02 BASIN STORAGE= .2782E-02 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
            RCCH52  MANE         1.91    543.01    231.48      1.90      5.00    541.17    230.00        1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6038E+02 EXCESS= .0000E+00 OUTFLOW= .6039E+02 BASIN STORAGE= .2689E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RDFLAM1  MANE         1.00    117.54    244.00     -1.00      5.00    117.38    245.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM1  MANE         1.00    107.49    245.00     -1.00      5.00    107.49    245.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM1  MANE         1.00     97.54    245.00     -1.00      5.00     97.54    245.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM1  MANE         1.00     87.51    245.00     -1.00      5.00     87.51    245.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM1  MANE         1.00     83.48    245.00     -1.00      5.00     83.48    245.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM2  MANE          .75    116.23    247.50     -1.00      5.00    113.65    245.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM2  MANE          .75    106.23    247.50     -1.00      5.00    103.40    250.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM2  MANE          .75     96.35    248.25     -1.00      5.00     94.14    250.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM2  MANE          .50     86.42    248.50     -1.00      5.00     84.72    250.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RDFLAM2  MANE         1.00     82.36    249.00     -1.00      5.00     81.19    250.00       -1.00


          FOR PLAN = 1  RATIO=  .00
           RCCH60A  MANE          .44   1356.64    225.59      2.05      5.00   1350.09    225.00        2.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1481E+03 EXCESS= .0000E+00 OUTFLOW= .1481E+03 BASIN STORAGE= .8660E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCH60A  MANE          .44   1313.47    225.88      1.98      5.00   1307.41    225.00        1.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1430E+03 EXCESS= .0000E+00 OUTFLOW= .1430E+03 BASIN STORAGE= .8939E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCH60A  MANE          .45   1271.32    225.73      1.91      5.00   1266.72    230.00        1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1376E+03 EXCESS= .0000E+00 OUTFLOW= .1376E+03 BASIN STORAGE= .8703E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCH60A  MANE          .45   1228.29    225.67      1.84      5.00   1222.69    230.00        1.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1325E+03 EXCESS= .0000E+00 OUTFLOW= .1325E+03 BASIN STORAGE= .9005E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCH60A  MANE          .46   1211.59    225.54      1.81      5.00   1208.25    230.00        1.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1306E+03 EXCESS= .0000E+00 OUTFLOW= .1306E+03 BASIN STORAGE= .8938E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
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          RCCCH56  MANE          .81   1480.90    225.99      2.02      5.00   1474.12    225.00        2.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1611E+03 EXCESS= .0000E+00 OUTFLOW= .1611E+03 BASIN STORAGE= .1676E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCCH56  MANE          .82   1433.35    225.66      1.95      5.00   1427.32    225.00        1.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1555E+03 EXCESS= .0000E+00 OUTFLOW= .1555E+03 BASIN STORAGE= .1678E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCCH56  MANE          .83   1386.41    226.20      1.88      5.00   1379.92    225.00        1.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1496E+03 EXCESS= .0000E+00 OUTFLOW= .1496E+03 BASIN STORAGE= .1805E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCCH56  MANE          .84   1339.95    225.99      1.81      5.00   1333.00    225.00        1.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1441E+03 EXCESS= .0000E+00 OUTFLOW= .1441E+03 BASIN STORAGE= .1702E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCCH56  MANE          .84   1320.54    226.39      1.78      5.00   1314.46    225.00        1.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1420E+03 EXCESS= .0000E+00 OUTFLOW= .1420E+03 BASIN STORAGE= .1780E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-3  MANE          .17   1543.25    225.12      2.00      5.00   1541.94    225.00        2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1669E+03 EXCESS= .0000E+00 OUTFLOW= .1669E+03 BASIN STORAGE= .3669E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-3  MANE          .17   1493.98    225.27      1.93      5.00   1492.65    225.00        1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1611E+03 EXCESS= .0000E+00 OUTFLOW= .1611E+03 BASIN STORAGE= .3607E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-3  MANE          .18   1444.39    225.16      1.86      5.00   1442.92    225.00        1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1550E+03 EXCESS= .0000E+00 OUTFLOW= .1550E+03 BASIN STORAGE= .3593E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-3  MANE          .18   1394.89    225.25      1.79      5.00   1393.31    225.00        1.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1492E+03 EXCESS= .0000E+00 OUTFLOW= .1492E+03 BASIN STORAGE= .3607E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-3  MANE          .18   1375.38    225.26      1.76      5.00   1373.83    225.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1470E+03 EXCESS= .0000E+00 OUTFLOW= .1470E+03 BASIN STORAGE= .3671E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-4  MANE          .68   1670.03    225.47      1.99      5.00   1667.08    225.00        1.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1787E+03 EXCESS= .0000E+00 OUTFLOW= .1787E+03 BASIN STORAGE= .1460E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-4  MANE          .69   1617.50    225.66      1.92      5.00   1614.29    225.00        1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1725E+03 EXCESS= .0000E+00 OUTFLOW= .1725E+03 BASIN STORAGE= .1557E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-4  MANE          .70   1561.71    225.25      1.85      5.00   1559.78    225.00        1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1660E+03 EXCESS= .0000E+00 OUTFLOW= .1660E+03 BASIN STORAGE= .1506E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH68-4  MANE          .71   1509.63    225.59      1.78      5.00   1506.17    225.00        1.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1598E+03 EXCESS= .0000E+00 OUTFLOW= .1598E+03 BASIN STORAGE= .1492E-02 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
          RCCH68-4  MANE          .71   1487.78    225.44      1.76      5.00   1484.80    225.00        1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1574E+03 EXCESS= .0000E+00 OUTFLOW= .1574E+03 BASIN STORAGE= .1560E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCH67  MANE          .38   1698.34    225.40      2.00      5.00   1696.76    225.00        2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1825E+03 EXCESS= .0000E+00 OUTFLOW= .1825E+03 BASIN STORAGE= .8193E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCH67  MANE          .38   1644.19    225.24      1.93      5.00   1642.56    225.00        1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1762E+03 EXCESS= .0000E+00 OUTFLOW= .1762E+03 BASIN STORAGE= .8179E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCH67  MANE          .39   1588.78    225.24      1.85      5.00   1587.12    225.00        1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1696E+03 EXCESS= .0000E+00 OUTFLOW= .1696E+03 BASIN STORAGE= .8535E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCH67  MANE          .39   1534.27    225.25      1.79      5.00   1532.54    225.00        1.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1633E+03 EXCESS= .0000E+00 OUTFLOW= .1633E+03 BASIN STORAGE= .8304E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCH67  MANE          .40   1513.05    225.34      1.76      5.00   1511.02    225.00        1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1608E+03 EXCESS= .0000E+00 OUTFLOW= .1608E+03 BASIN STORAGE= .8285E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCH68-1  MANE         4.75     83.31    218.50      1.62      5.00     82.54    220.00        1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5510E+01 EXCESS= .0000E+00 OUTFLOW= .5513E+01 BASIN STORAGE= .1078E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RCH68-1  MANE         4.75     80.24    218.50      1.55      5.00     79.59    220.00        1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5304E+01 EXCESS= .0000E+00 OUTFLOW= .5307E+01 BASIN STORAGE= .1059E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RCH68-1  MANE         5.00     80.48    220.00      1.50      5.00     80.48    220.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5102E+01 EXCESS= .0000E+00 OUTFLOW= .5107E+01 BASIN STORAGE= .1469E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RCH68-1  MANE         5.00     77.39    220.00      1.44      5.00     77.39    220.00        1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4898E+01 EXCESS= .0000E+00 OUTFLOW= .4902E+01 BASIN STORAGE= .1439E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
           RCH68-1  MANE         5.00     76.16    220.00      1.41      5.00     76.16    220.00        1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4817E+01 EXCESS= .0000E+00 OUTFLOW= .4821E+01 BASIN STORAGE= .1427E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
          RCCH684a  MANE         2.25    155.19    218.67      1.91      5.00    152.09    220.00        1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1128E+02 EXCESS= .0000E+00 OUTFLOW= .1128E+02 BASIN STORAGE= .4126E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH684a  MANE         2.27    150.11    218.25      1.84      5.00    147.45    220.00        1.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1091E+02 EXCESS= .0000E+00 OUTFLOW= .1091E+02 BASIN STORAGE= .4580E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCH684a  MANE         2.29    147.49    219.59      1.78      5.00    146.30    220.00        1.78
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .1055E+02 EXCESS= .0000E+00 OUTFLOW= .1055E+02 BASIN STORAGE= .4125E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH684a	MANE	2.31	142.38	219.27	1.72	5.00	140.68	220.00	1.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1017E+02 EXCESS= .0000E+00 OUTFLOW= .1017E+02 BASIN STORAGE= .4536E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH684a	MANE	2.32	139.64	217.77	1.69	5.00	139.31	220.00	1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1002E+02 EXCESS= .0000E+00 OUTFLOW= .1003E+02 BASIN STORAGE= .4887E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH63C2	MANE	4.50	42.06	247.50	1.71	5.00	40.37	250.00	1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3007E+01 EXCESS= .0000E+00 OUTFLOW= .3006E+01 BASIN STORAGE= .5180E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCH63C2	MANE	4.50	40.70	247.50	1.65	5.00	39.17	250.00	1.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2898E+01 EXCESS= .0000E+00 OUTFLOW= .2898E+01 BASIN STORAGE= .5119E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCH63C2	MANE	4.50	39.29	247.50	1.59	5.00	37.94	250.00	1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2790E+01 EXCESS= .0000E+00 OUTFLOW= .2790E+01 BASIN STORAGE= .5056E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCH63C2	MANE	4.50	37.84	247.50	1.52	5.00	36.69	250.00	1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2682E+01 EXCESS= .0000E+00 OUTFLOW= .2682E+01 BASIN STORAGE= .4992E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCH63C2	MANE	4.50	37.24	247.50	1.50	5.00	36.18	250.00	1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2639E+01 EXCESS= .0000E+00 OUTFLOW= .2640E+01 BASIN STORAGE= .4966E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCH67C3	MANE	1.25	98.53	222.01	1.50	5.00	96.64	225.00	1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1048E+02 EXCESS= .0000E+00 OUTFLOW= .1048E+02 BASIN STORAGE= .1249E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH67C3	MANE	1.26	94.73	221.29	1.44	5.00	93.01	225.00	1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1007E+02 EXCESS= .0000E+00 OUTFLOW= .1007E+02 BASIN STORAGE= .1193E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH67C3	MANE	1.27	90.82	221.88	1.38	5.00	89.16	225.00	1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9668E+01 EXCESS= .0000E+00 OUTFLOW= .9666E+01 BASIN STORAGE= .1312E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH67C3	MANE	1.28	86.98	221.25	1.33	5.00	85.55	225.00	1.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9267E+01 EXCESS= .0000E+00 OUTFLOW= .9266E+01 BASIN STORAGE= .1237E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH67C3	MANE	1.28	85.46	222.04	1.30	5.00	83.99	225.00	1.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9105E+01 EXCESS= .0000E+00 OUTFLOW= .9104E+01 BASIN STORAGE= .1336E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH67C3	MANE	.60	117.47	221.04	1.49	5.00	116.82	220.00	1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1203E+02 EXCESS= .0000E+00 OUTFLOW= .1202E+02 BASIN STORAGE= .6251E-04 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .00
           RCH67C3  MANE          .61    113.08    220.92      1.44      5.00    112.35    220.00        1.44


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1156E+02 EXCESS= .0000E+00 OUTFLOW= .1156E+02 BASIN STORAGE= .6007E-04 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
           RCH67C3  MANE          .61    108.25    221.02      1.38      5.00    107.54    220.00        1.38


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1109E+02 EXCESS= .0000E+00 OUTFLOW= .1109E+02 BASIN STORAGE= .6251E-04 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
           RCH67C3  MANE          .62    103.86    221.01      1.32      5.00    103.13    220.00        1.32


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1063E+02 EXCESS= .0000E+00 OUTFLOW= .1063E+02 BASIN STORAGE= .6013E-04 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
           RCH67C3  MANE          .62    101.92    220.65      1.30      5.00    101.24    220.00        1.30


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1044E+02 EXCESS= .0000E+00 OUTFLOW= .1044E+02 BASIN STORAGE= .6160E-04 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCBH1  MANE          .72   1949.74    224.92      1.95      5.00   1949.65    225.00        1.95


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2070E+03 EXCESS= .0000E+00 OUTFLOW= .2070E+03 BASIN STORAGE= .1756E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCBH1  MANE          .73   1887.23    224.92      1.88      5.00   1887.17    225.00        1.89


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1997E+03 EXCESS= .0000E+00 OUTFLOW= .1997E+03 BASIN STORAGE= .1747E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCBH1  MANE          .74   1825.73    224.96      1.81      5.00   1825.69    225.00        1.81


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1923E+03 EXCESS= .0000E+00 OUTFLOW= .1923E+03 BASIN STORAGE= .1688E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCBH1  MANE          .75   1762.09    225.15      1.75      5.00   1761.16    225.00        1.75


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1851E+03 EXCESS= .0000E+00 OUTFLOW= .1851E+03 BASIN STORAGE= .1733E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCBH1  MANE          .76   1737.59    225.64      1.72      5.00   1737.08    225.00        1.72


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1824E+03 EXCESS= .0000E+00 OUTFLOW= .1823E+03 BASIN STORAGE= .1731E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
           RCH63C3  MANE         4.50     21.61    247.50      1.63      5.00     21.04    250.00        1.63


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1566E+01 EXCESS= .0000E+00 OUTFLOW= .1566E+01 BASIN STORAGE= .4026E-02 PERCENT ERROR=   -.3


          FOR PLAN = 1  RATIO=  .00
           RCH63C3  MANE         4.75     20.68    247.00      1.57      5.00     20.33    250.00        1.57


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1506E+01 EXCESS= .0000E+00 OUTFLOW= .1507E+01 BASIN STORAGE= .4095E-02 PERCENT ERROR=   -.3


          FOR PLAN = 1  RATIO=  .00
           RCH63C3  MANE         4.75     19.77    247.00      1.51      5.00     19.68    250.00        1.51


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1448E+01 EXCESS= .0000E+00 OUTFLOW= .1449E+01 BASIN STORAGE= .4063E-02 PERCENT ERROR=   -.3


          FOR PLAN = 1  RATIO=  .00
           RCH63C3  MANE         4.75     19.04    251.75      1.45      5.00     18.93    250.00        1.45


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1390E+01 EXCESS= .0000E+00 OUTFLOW= .1391E+01 BASIN STORAGE= .3986E-02 PERCENT ERROR=   -.3


          FOR PLAN = 1  RATIO=  .00
           RCH63C3  MANE         5.00     19.68    250.00      1.43      5.00     19.68    250.00        1.43
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1369E+01 EXCESS= .0000E+00 OUTFLOW= .1370E+01 BASIN STORAGE= .4955E-02 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .00

RCH67C4	MANE	5.00	112.93	225.00	1.44	5.00	112.93	225.00	1.44	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9538E+01 EXCESS= .0000E+00 OUTFLOW= .9542E+01 BASIN STORAGE= .9381E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH67C4	MANE	5.00	108.64	225.00	1.39	5.00	108.64	225.00	1.39	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9160E+01 EXCESS= .0000E+00 OUTFLOW= .9164E+01 BASIN STORAGE= .8551E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH67C4	MANE	5.00	104.36	225.00	1.33	5.00	104.36	225.00	1.33	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8782E+01 EXCESS= .0000E+00 OUTFLOW= .8786E+01 BASIN STORAGE= .1188E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCH67C4	MANE	5.00	100.10	225.00	1.27	5.00	100.10	225.00	1.27	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8408E+01 EXCESS= .0000E+00 OUTFLOW= .8411E+01 BASIN STORAGE= .1169E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCH67C4	MANE	5.00	98.38	225.00	1.25	5.00	98.38	225.00	1.25	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8261E+01 EXCESS= .0000E+00 OUTFLOW= .8265E+01 BASIN STORAGE= .1061E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCFR04C8	MANE	1.63	162.37	222.23	1.44	5.00	159.86	225.00	1.44	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1330E+02 EXCESS= .0000E+00 OUTFLOW= .1330E+02 BASIN STORAGE= .3291E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCFR04C8	MANE	1.65	155.96	222.88	1.38	5.00	153.66	225.00	1.38	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1277E+02 EXCESS= .0000E+00 OUTFLOW= .1277E+02 BASIN STORAGE= .2899E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCFR04C8	MANE	1.67	149.41	221.92	1.33	5.00	147.48	225.00	1.33	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1225E+02 EXCESS= .0000E+00 OUTFLOW= .1225E+02 BASIN STORAGE= .3043E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCFR04C8	MANE	1.69	143.15	222.73	1.27	5.00	141.48	225.00	1.27	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1172E+02 EXCESS= .0000E+00 OUTFLOW= .1172E+02 BASIN STORAGE= .3275E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCFR04C8	MANE	1.70	140.41	222.05	1.25	5.00	138.96	225.00	1.25	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1152E+02 EXCESS= .0000E+00 OUTFLOW= .1152E+02 BASIN STORAGE= .3245E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH04C5	MANE	1.50	9.96	216.00	.72	5.00	9.88	215.00	.73	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3074E+00 EXCESS= .0000E+00 OUTFLOW= .3076E+00 BASIN STORAGE= .3454E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RDCH04C5	MANE	1.50	9.57	216.00	.68	5.00	9.50	215.00	.68	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2899E+00 EXCESS= .0000E+00 OUTFLOW= .2902E+00 BASIN STORAGE= .3500E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RDCH04C5	MANE	1.50	9.19	216.00	.64	5.00	9.11	215.00	.64	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2725E+00 EXCESS= .0000E+00 OUTFLOW= .2728E+00 BASIN STORAGE= .3415E-03 PERCENT ERROR= -.3

```
          FOR PLAN = 1  RATIO=  .00
          RDCH04C5  MANE         1.50      8.82    216.00       .60      5.00      8.73    215.00         .60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2551E+00 EXCESS= .0000E+00 OUTFLOW= .2555E+00 BASIN STORAGE= .5712E-03 PERCENT ERROR=   -.4

          FOR PLAN = 1  RATIO=  .00
          RDCH04C5  MANE         1.50      8.67    216.00       .58      5.00      8.58    215.00         .58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2476E+00 EXCESS= .0000E+00 OUTFLOW= .2479E+00 BASIN STORAGE= .5548E-03 PERCENT ERROR=   -.4

          FOR PLAN = 1  RATIO=  .00
           RCECLD2  MANE          .86     25.31    211.07      2.94      5.00     25.05    215.00        2.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2036E+01 EXCESS= .0000E+00 OUTFLOW= .2036E+01 BASIN STORAGE= .3762E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCECLD2  MANE          .87     24.67    211.59      2.84      5.00     24.46    215.00        2.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1970E+01 EXCESS= .0000E+00 OUTFLOW= .1970E+01 BASIN STORAGE= .3770E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCECLD2  MANE          .88     24.00    211.28      2.75      5.00     23.80    215.00        2.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1904E+01 EXCESS= .0000E+00 OUTFLOW= .1904E+01 BASIN STORAGE= .3766E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCECLD2  MANE          .89     23.35    211.87      2.65      5.00     23.15    215.00        2.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1839E+01 EXCESS= .0000E+00 OUTFLOW= .1839E+01 BASIN STORAGE= .3735E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCECLD2  MANE          .89     23.08    211.95      2.62      5.00     22.90    215.00        2.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1813E+01 EXCESS= .0000E+00 OUTFLOW= .1813E+01 BASIN STORAGE= .3715E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.04   2151.60    225.16      1.91      5.00   2150.28    225.00        1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2257E+03 EXCESS= .0000E+00 OUTFLOW= .2257E+03 BASIN STORAGE= .2495E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.06   2081.42    226.04      1.84      5.00   2080.89    225.00        1.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2177E+03 EXCESS= .0000E+00 OUTFLOW= .2177E+03 BASIN STORAGE= .2680E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.07   2012.48    225.89      1.77      5.00   2010.31    225.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2095E+03 EXCESS= .0000E+00 OUTFLOW= .2095E+03 BASIN STORAGE= .2729E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.09   1940.82    225.93      1.70      5.00   1938.37    225.00        1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2017E+03 EXCESS= .0000E+00 OUTFLOW= .2017E+03 BASIN STORAGE= .2717E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.09   1913.67    226.11      1.68      5.00   1911.78    225.00        1.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1986E+03 EXCESS= .0000E+00 OUTFLOW= .1986E+03 BASIN STORAGE= .2686E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCH64-C  MANE         5.00    235.82    255.00      1.77      5.00    235.82    255.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2706E+02 EXCESS= .0000E+00 OUTFLOW= .2697E+02 BASIN STORAGE= .7093E-02 PERCENT ERROR=    .3

          FOR PLAN = 1  RATIO=  .00
           RCH64-C  MANE         5.00    227.58    255.00      1.71      5.00    227.58    255.00        1.71
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .2610E+02 EXCESS= .0000E+00 OUTFLOW= .2602E+02 BASIN STORAGE= .6959E-02 PERCENT ERROR= .3

FOR PLAN = 1 RATIO= .00

RCH64-C	MANE	5.00	219.37	255.00	1.64	5.00	219.37	255.00	1.64	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2515E+02 EXCESS= .0000E+00 OUTFLOW= .2506E+02 BASIN STORAGE= .5223E-02 PERCENT ERROR= .3

FOR PLAN = 1 RATIO= .00

RCH64-C	MANE	5.00	211.10	255.00	1.58	5.00	211.10	255.00	1.58	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2420E+02 EXCESS= .0000E+00 OUTFLOW= .2412E+02 BASIN STORAGE= .5121E-02 PERCENT ERROR= .3

FOR PLAN = 1 RATIO= .00

RCH64-C	MANE	5.00	207.78	255.00	1.56	5.00	207.78	255.00	1.56	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2382E+02 EXCESS= .0000E+00 OUTFLOW= .2374E+02 BASIN STORAGE= .5080E-02 PERCENT ERROR= .3

FOR PLAN = 1 RATIO= .00

RCCH67C5	MANE	5.00	279.88	265.00	1.65	5.00	279.88	265.00	1.65	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3831E+02 EXCESS= .0000E+00 OUTFLOW= .3826E+02 BASIN STORAGE= .4370E-02 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .00

RCCH67C5	MANE	5.00	269.41	265.00	1.58	5.00	269.41	265.00	1.58	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3690E+02 EXCESS= .0000E+00 OUTFLOW= .3685E+02 BASIN STORAGE= .4294E-02 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .00

RCCH67C5	MANE	5.00	258.80	265.00	1.52	5.00	258.80	265.00	1.52	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3549E+02 EXCESS= .0000E+00 OUTFLOW= .3545E+02 BASIN STORAGE= .3148E-02 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .00

RCCH67C5	MANE	5.00	248.24	265.00	1.46	5.00	248.24	265.00	1.46	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3410E+02 EXCESS= .0000E+00 OUTFLOW= .3405E+02 BASIN STORAGE= .3092E-02 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .00

RCCH67C5	MANE	5.00	244.00	265.00	1.44	5.00	244.00	265.00	1.44	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3354E+02 EXCESS= .0000E+00 OUTFLOW= .3350E+02 BASIN STORAGE= .3069E-02 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .00

RCBH3	MANE	1.20	2366.10	226.38	1.86	5.00	2354.87	225.00	1.86	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2765E+03 EXCESS= .0000E+00 OUTFLOW= .2765E+03 BASIN STORAGE= .3257E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH3	MANE	1.22	2284.94	225.81	1.80	5.00	2273.46	225.00	1.80	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2666E+03 EXCESS= .0000E+00 OUTFLOW= .2666E+03 BASIN STORAGE= .3067E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH3	MANE	1.24	2205.99	226.57	1.73	5.00	2193.65	225.00	1.73	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2566E+03 EXCESS= .0000E+00 OUTFLOW= .2566E+03 BASIN STORAGE= .3108E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH3	MANE	1.26	2127.95	226.22	1.66	5.00	2114.05	225.00	1.67	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2470E+03 EXCESS= .0000E+00 OUTFLOW= .2469E+03 BASIN STORAGE= .3067E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH3	MANE	1.26	2097.98	226.26	1.64	5.00	2083.47	225.00	1.64	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2432E+03 EXCESS= .0000E+00 OUTFLOW= .2432E+03 BASIN STORAGE= .3159E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

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          RFR04C12  MANE         5.00     13.73    220.00      1.45      5.00     13.73    220.00        1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8524E+00 EXCESS= .0000E+00 OUTFLOW= .8532E+00 BASIN STORAGE= .5609E-03 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
          RFR04C12  MANE         5.00     13.21    220.00      1.40      5.00     13.21    220.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8186E+00 EXCESS= .0000E+00 OUTFLOW= .8193E+00 BASIN STORAGE= .5492E-03 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
          RFR04C12  MANE         5.00     12.69    220.00      1.34      5.00     12.69    220.00        1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7849E+00 EXCESS= .0000E+00 OUTFLOW= .7856E+00 BASIN STORAGE= .8784E-03 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
          RFR04C12  MANE         5.00     12.17    220.00      1.28      5.00     12.17    220.00        1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7515E+00 EXCESS= .0000E+00 OUTFLOW= .7522E+00 BASIN STORAGE= .8588E-03 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
          RFR04C12  MANE         4.75     11.47    218.50      1.26      5.00     11.36    220.00        1.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7377E+00 EXCESS= .0000E+00 OUTFLOW= .7381E+00 BASIN STORAGE= .8379E-03 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
          RCFR4C14  MANE         4.32     47.08    220.35      1.45      5.00     46.78    220.00        1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3089E+01 EXCESS= .0000E+00 OUTFLOW= .3090E+01 BASIN STORAGE= .5623E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCFR4C14  MANE         4.36     44.72    218.20      1.39      5.00     44.22    220.00        1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2966E+01 EXCESS= .0000E+00 OUTFLOW= .2966E+01 BASIN STORAGE= .5671E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCFR4C14  MANE         4.41     43.42    220.48      1.33      5.00     43.03    220.00        1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2845E+01 EXCESS= .0000E+00 OUTFLOW= .2845E+01 BASIN STORAGE= .5620E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCFR4C14  MANE         4.46     41.22    218.42      1.28      5.00     40.77    220.00        1.27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2723E+01 EXCESS= .0000E+00 OUTFLOW= .2724E+01 BASIN STORAGE= .8625E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
          RCFR4C14  MANE         4.48     41.14    219.71      1.26      5.00     40.94    220.00        1.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2680E+01 EXCESS= .0000E+00 OUTFLOW= .2681E+01 BASIN STORAGE= .6004E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH4  MANE          .49   2517.07    225.76      1.85      5.00   2511.83    225.00        1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2907E+03 EXCESS= .0000E+00 OUTFLOW= .2907E+03 BASIN STORAGE= .1316E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH4  MANE          .50   2431.81    225.48      1.78      5.00   2424.47    225.00        1.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2803E+03 EXCESS= .0000E+00 OUTFLOW= .2803E+03 BASIN STORAGE= .1252E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH4  MANE          .51   2346.17    225.65      1.71      5.00   2338.92    225.00        1.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2698E+03 EXCESS= .0000E+00 OUTFLOW= .2698E+03 BASIN STORAGE= .1313E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH4  MANE          .52   2260.22    225.44      1.65      5.00   2252.98    225.00        1.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2596E+03 EXCESS= .0000E+00 OUTFLOW= .2596E+03 BASIN STORAGE= .1294E-02 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
             RCBH4  MANE          .52   2227.20    225.71      1.62      5.00   2219.80    225.00        1.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2557E+03 EXCESS= .0000E+00 OUTFLOW= .2557E+03 BASIN STORAGE= .1311E-02 PERCENT ERROR=    .0



*** NORMAL END OF HEC-1 ***
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1****************************************                    ****************************************
 *                                      *                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN  1998               *                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                    *          609 SECOND STREET           *
 *                                      *                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   05JAN17  TIME  17:08:15  *                    *           (916) 756-1104             *
 *                                      *                    *                                      *
 ****************************************                    ****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X        XXXXX  X
                                        X     X  X        X               X
                                        X     X  X        X     X         X
                                        X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


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

                    *DIAGRAM
 *** FREE ***
             1      ID     BOULDER HIGHWAY STORM DRAIN SAHARA TO CHARLESTON (PHASE 1)
             2      ID    DRAFT DESIGN REPORT (30% DESIGN)
             3      ID      MAINLINE MODEL
             4      ID      MAY 2017
             5      ID     MODELED BY ATKINS (MANOGYA KHANAL, E.I.)
             6      ID     CHECKED BY ATKINS (VANCE SKIDMORE, P.E.)
             7      ID
             8      ID    BASED ON FOLLOWING MODEL:
             9      ID
            10      ID    CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT 2008 MASTER PLAN UPDATE
            11      ID    CENTRAL WATERSHED (SOUTHWEST, SOUTHEAST, NORTHEAST AREAS)
            12      ID    RECOMMENDED DRAINAGE SYSTEM WITH ULTIMATE DEVELOPMENT
            13      ID    INPUT FILE = SW3.DAT
            14      ID    INPUT FILE DATE = MAY 2008
            15      ID    DESIGN STORM = 100-YEAR 6-HR STORM
            16      ID    STORM DISTRIBUTION = SDN #3
            17      ID    MODELED BY PBS&J (BRIAN ROWLEY, E.I., CFM)
            18      ID    CHECKED BY PBS&J (HARSHAL B. DESAI, P.E., CFM)
            19      ID    STORM CENTERING = ENTIRE WATERSHED (SOUTHWESTERN PORTION)
            20      ID
            21      ID    REFERENCED HYDROLOGIC MODELS:
            22      ID    CITY OF LAS VEGAS CITY WIDE HYDROLOGY ANALYSIS (PBS&J 1997)
            23      ID    PREDESIGN REPORT FOR I-15 FREEWAY CHANNEL (PARSONS BRINCKERHOFF 1999)
            24      ID    FINAL CENTRAL BASIN ASSESMENT (CARTER-BURGESS 1998)
            25      ID    HYDRAULIC DESIGN REPORT FOR I-15 WIDENING (LOUIS BERGER 1999)
            26      ID    AMENDMENT TO 2002 MPU FOR MEADOWS ALTA PARALLEL FACILITY (CLV, OCT 2006)
            27      ID    US-95 WIDENING PROJECT, FINAL OVERALL PROJECT DRAINAGE DESIGN REPORT
            28      ID    (VTN NEVADA, MAY 2003)
            29      ID    MEADOWS ALTA PARALLEL PROJECT PHASE II, 90% DESIGN (VTN, FEB 2008)
            30      ID    OAKEY MEADOWS STORM DRAIN FINAL DESIGN REPORT (PBS&J, APR 2008)
            31      ID    MASTER PLAN CHANGE FOR THE OAKEY DRAIN FACILITY, (HDR, JULY 2007)
            32      ID    OAKEY DRAIN, BIRCH ST TO CAHLAN DR PRE-FINAL DESIGN PLANS (HDR, JAN 2008)
            33      ID
            34      ID    JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
            35      ID
            36      ID                          AREA       DARF
            37      ID                          SQ. MI.
            38      ID                          0-0.5       0.99
            39      ID                          0.5-1      0.975
            40      ID                          1-2         0.95
            41      ID                          2-3        0.925
            42      ID                          3-4        0.915
            43      ID
            44      IT       5       0       0     300
            45      IO       5       0       0
            46      IN       5       0       0
            47      JR    PREC    0.99   0.975    0.95   0.925   0.915
                    *
```



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


            48      KK  CH59-C
            49      BA   0.341
```

```
 50          PB    2.77
 51          PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
 52          PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
 53          PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
 54          PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
 55          PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
 56          PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
 57          PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
 58          PC   0.998   0.999   1.000
 59          LS       0    94.0
 60          UD   0.489
             *

 61          KK DCH59-C
 62          KM  FLOW SPLIT TO CH60A-C
 63          KM  SPLIT TO FLAMINGO WASH SYSTEM
 64          KM  DEVELOPED FROM CWH MODEL
 65          KM  CAPACITY = 144 CFS + 78 CFS (100 YR FLOW FROM CWH FOR CH58)
 66          DT   DFLAM
 67          DI       0     222    1000
 68          DQ       0       0     778
             *

 69          KK    CH51
 70          BA   0.273
 71          PB    2.77
 72          LS       0    92.9
 73          UD   0.467
             *

 74          KK   RCH51
 75          KM  ROUTE CH51 TO CCH52
 76          KM  FACILITY = FLAMINGO - BOULDER NORTH
 77          KM  FACILITY # = FLBN  0342
 78          KM  LINING = RCB
 79          RD    4300  0.0042   0.015       0    TRAP       7       0
             *

 80          KK  CH52-C
 81          BA   0.323
 82          PB    2.77
 83          LS       0    94.8
 84          UD   0.389
             *

 85          KK   CCH52
 86          KM  COMBINE RCH51 AND CH52-C
 87          KM  CHARLESTON AND LAS VEGAS BLVD
 88          HC       2
             *
```



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

 89          KK  RCCH52
 90          KM  ROUTE CCH52 TO CCH56
 91          KM  FACILITY = FLAMINGO - BOULDER NORTH
 92          KM  FACILITY # = FLBN 0281
 93          KM  LINING = RCB
 94          RD    3100  0.0133   0.015       0    TRAP      10       0
             *

 95          KK  CH56-C
 96          BA   0.341
 97          PB    2.77
 98          LS       0    90.7
 99          UD   0.442
             *

100          KK   DFLAM
101          KM  RETRIEVE DFLAM
102          DR   DFLAM
             *

103          KK RDFLAM1
104          KM  ROUTE DFLAM TO CCH60A-C
105          KM  ROUTE ON THE STREETS
106          RD    2650  0.0049   0.016       0    TRAP       0      50
             *

107          KK RDFLAM2
108          KM  ROUTE DFLAM TO CCH60A-C
109          KM  FACILITY = FLAMINGO - MARYLAND PARKWAY
110          KM  FACILITY # = FLMP 0000
111          KM  LINING = RCB
112          RD    2650  0.0049   0.015       0    TRAP       8       0
             *

113          KK CH60A-C
114          BA   0.416
115          PB    2.77
116          LS       0    91.9
117          UD   0.276
             *
```

```
 118          KKCCH60A-C
 119          KM  COMBINE RDFLAM AND CH60A-C
 120          HC       3
              *

 121          KK   CCH56
 122          KM  COMBINE RCCH52, CH56-C, AND CCH60A-C
 123          KM  MARYLAND PARKWAY AND CHARLESTON
 124          HC       2
              *
1                                   HEC-1 INPUT                                          PAGE  4

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

 125          KK  RCCH56
 126          KM  ROUTE CCH56 TO CCH63-C
 127          KM  FACILITY = FLAMINGO - BOULDER NORTH
 128          KM  FACILITY # = FLBN 0205
 129          KM  LINING = RCB
 130          RD    5000   0.023   0.015       0    TRAP      10       0
              *

 131          KK  CH63-C
 132          BA   0.263
 133          PB    2.77
 134          LS       0    89.8
 135          UD   0.390
              *

 136          KK CCH63-C
 137          KM  COMBINE RCCH56 AND CH63-C
 138          KM  CHARLESTON AND EASTERN
 139          HC       2
              *

 140          KK    CH68
 141          BA   0.289
 142          PB    2.77
 143          LS       0    90.0
 144          UD   0.301
              *

 145          KK CCH68-C
 146          KM  COMBINE RCCH63 AND CH68
 147          KM  CHARLESTON AND EASTERN
 148          HC       2
              *

 149          KK  RCCH68
 150          KM  ROUTE CCH63-C
 151          KM  FACILITY = FLAMINGO - BOULDER NORTH
 152          KM  FACILITY # = FLBN 0167
 153          KM  LINING = RCB
 154          RD     700  0.0125   0.015       0    TRAP      14       0
              *

 155          KKRCCH68-C
 156          KM  ROUTE CCH68-C TO CFR04
 157          KM  FACILITY = FLAMINGO - BOULDER NORTH
 158          KM  FACILITY # = FLBN 0038
 159          KM  LINING = RCB
 160          RD    3500   0.005   0.015       0    TRAP      20       0
              *
1                                   HEC-1 INPUT                                          PAGE  5

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

 161          KK  CH64-C
 162          BA   0.286
 163          PB    2.77
 164          LS       0    90.0
 165          UD   0.544
              *

 166          KK   RCH64
 167          KM  ROUTE CH64 TO CCH67-C
 168          KM  OAKEY TO EASTERN
 169          RD    6500   0.018   0.016       0    TRAP       0      50
              *

 170          KK  CH67-C
 171          BA   0.354
 172          PB    2.77
 173          LS       0    85.3
 174          UD   0.308
              *

 175          KK CCH67-C
 176          KM  COMBINE RCH64 AND CH67-C
 177          HC       2
              *
```

```
            178          KK RCCH67C
            179          KM  ROUTE CCH67-C TO CFR04C
            180          KM  LINING = RCB
            181          RD    3000    0.02   0.016       0    TRAP       0      50
                         *

            182          KK  FR04-C
            183          BA   0.242
            184          PB    2.77
            185          LS       0    89.1
            186          UD   0.257
                         *

            187          KK   CFR04
            188          KM  COMBINE RCCH68-C AND FR04-C and CCh67-C
            189          KM  BOULDER HIGHWAY AND ST. LOUIS
            190          HC       3
                         *

            191          KK  RCFR04
            192          KM  ROUTE CFR04 TO CFR03
            193          KM  FACILITY = FLAMINGO - BOULDER NORTH
            194          KM  FACILITY # = FLBN 0038
            195          KM  LINING = RCB
            196          RD    1800   0.005   0.015       0    TRAP      15       0
                         *
1                                                HEC-1 INPUT                                                PAGE  6

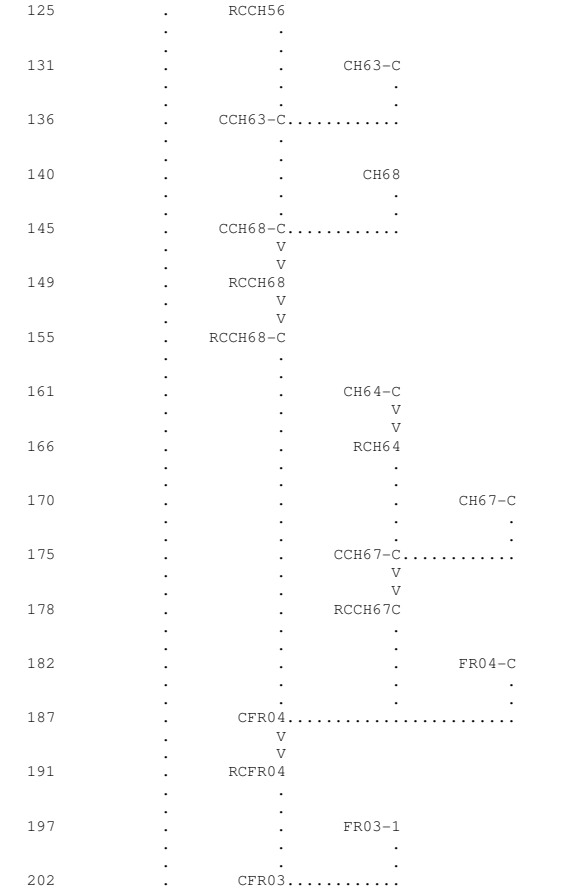
           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            197          KK  FR03-1
            198          BA   0.187
            199          PB    2.77
            200          LS       0    87.7
            201          UD   0.317
                         *

            202          KK   CFR03
            203          KM  COMBINE RCFR04 AND FR03
            204          KM  BOULDER HIGHWAY AND SAHARA
            205          HC       2
                         *
            206          ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    48      CH59-C
                 .
                 .
    66           .-------->   DFLAM
    61      DCH59-C
                 .
                 .
    69           .        CH51
                 .          V
                 .          V
    74           .       RCH51
                 .          .
                 .          .
    80           .          .      CH52-C
                 .          .          .
                 .          .          .
    85           .       CCH52.............
                 .          V
                 .          V
    89           .      RCCH52
                 .          .
                 .          .
    95           .          .      CH56-C
                 .          .          .
                 .          .          .
   102           .          .          .           .<-------   DFLAM
   100           .          .          .       DFLAM
                 .          .          .          V
                 .          .          .          V
   103           .          .          .     RDFLAM1
                 .          .          .          V
                 .          .          .          V
   107           .          .          .     RDFLAM2
                 .          .          .          .
                 .          .          .          .
   113           .          .          .          .     CH60A-C
                 .          .          .          .          .
                 .          .          .          .          .
   118           .          .    CCH60A-C.........................
                 .          .          .
                 .          .          .
   121           .       CCH56.............
                 .          V
                 .          V
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN   1998              *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   05JAN17  TIME  17:08:15   *
*                                       *
*****************************************
```

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

BOULDER HIGHWAY STORM DRAIN SAHARA TO CHARLESTON (PHASE 1)
PRELIMINARY DESIGN REPORT (30% DESIGN)
MAINLINE MODEL
SEPTEMBER 2016
MODELED BY ATKINS (MANOGYA KHANAL, E.I.)
CHECKED BY ATKINS (VANCE SKIDMORE, P.E.)

BASED ON FOLLOWING MODEL:

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT 2008 MASTER PLAN UPDATE
CENTRAL WATERSHED (SOUTHWEST, SOUTHEAST, NORTHEAST AREAS)
RECOMMENDED DRAINAGE SYSTEM WITH ULTIMATE DEVELOPMENT
INPUT FILE = SW3.DAT
INPUT FILE DATE = MAY 2008
DESIGN STORM = 100-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY PBS&J (BRIAN ROWLEY, E.I., CFM)
CHECKED BY PBS&J (HARSHAL B. DESAI, P.E., CFM)
STORM CENTERING = ENTIRE WATERSHED (SOUTHWESTERN PORTION)

REFERENCED HYDROLOGIC MODELS:
CITY OF LAS VEGAS CITY WIDE HYDROLOGY ANALYSIS (PBS&J 1997)
PREDESIGN REPORT FOR I-15 FREEWAY CHANNEL (PARSONS BRINCKERHOFF 1999)
FINAL CENTRAL BASIN ASSESMENT (CARTER-BURGESS 1998)
HYDRAULIC DESIGN REPORT FOR I-15 WIDENING (LOUIS BERGER 1999)
AMENDMENT TO 2002 MPU FOR MEADOWS ALTA PARALLEL FACILITY (CLV, OCT 2006)
US-95 WIDENING PROJECT, FINAL OVERALL PROJECT DRAINAGE DESIGN REPORT
(VTN NEVADA, MAY 2003)
MEADOWS ALTA PARALLEL PROJECT PHASE II, 90% DESIGN (VTN, FEB 2008)
OAKEY MEADOWS STORM DRAIN FINAL DESIGN REPORT (PBS&J, APR 2008)

MASTER PLAN CHANGE FOR THE OAKEY DRAIN FACILITY, (HDR, JULY 2007)
OAKEY DRAIN, BIRCH ST TO CAHLAN DR PRE-FINAL DESIGN PLANS (HDR, JAN 2008)

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

AREA SQ. MI.	DARF
0-0.5	0.99
0.5-1	0.975
1-2	0.95
2-3	0.925
3-4	0.915

```
   45 IO          OUTPUT CONTROL VARIABLES
                       IPRNT           5  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                        NMIN           5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME         0000  STARTING TIME
                          NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME         0055  ENDING TIME
                       ICENT           19  CENTURY MARK

                    COMPUTATION INTERVAL     .08 HOURS
                         TOTAL TIME BASE   24.92 HOURS

           ENGLISH UNITS
                DRAINAGE AREA         SQUARE MILES
                PRECIPITATION DEPTH   INCHES
                LENGTH, ELEVATION     FEET
                FLOW                  CUBIC FEET PER SECOND
                STORAGE VOLUME        ACRE-FEET
                SURFACE AREA          ACRES
                TEMPERATURE           DEGREES FAHRENHEIT

      JP          MULTI-PLAN OPTION
                       NPLAN           1  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                      RATIOS OF PRECIPITATION
                      .99       .98       .95       .93       .92
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 .95	RATIO 4 .93	RATIO 5 .92
HYDROGRAPH AT									
+	CH59-C	.34	1	FLOW	338.	332.	322.	311.	307.
				TIME	3.92	3.92	3.92	3.92	3.92
DIVERSION TO									
+	DFLAM	.34	1	FLOW	116.	110.	100.	89.	85.
				TIME	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT									
+	DCH59-C	.34	1	FLOW	222.	222.	222.	222.	222.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	CH51	.27	1	FLOW	267.	262.	253.	245.	242.
				TIME	3.92	3.92	3.92	3.92	3.92
ROUTED TO									
+	RCH51	.27	1	FLOW	264.	259.	251.	241.	239.
				TIME	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT									
+	CH52-C	.32	1	FLOW	369.	363.	352.	341.	337.
				TIME	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT									
+	CCH52	.60	1	FLOW	618.	605.	589.	567.	562.
				TIME	3.83	3.83	3.83	3.83	3.83
ROUTED TO									
+	RCCH52	.60	1	FLOW	612.	601.	583.	563.	558.
				TIME	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT									
+	CH56-C	.34	1	FLOW	315.	309.	298.	288.	284.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT									
+	DFLAM	.00	1	FLOW	116.	110.	100.	89.	85.

				TIME	3.92	3.92	3.92	3.92	3.92
ROUTED TO										
+	RDFLAM1	.00	1	FLOW	113.	107.	98.	88.	83.
				TIME	4.08	4.08	4.08	4.08	4.08
ROUTED TO										
+	RDFLAM2	.00	1	FLOW	109.	103.	94.	85.	81.
				TIME	4.08	4.17	4.17	4.17	4.17
HYDROGRAPH AT										
+	CH60A-C	.42	1	FLOW	509.	499.	483.	467.	460.
				TIME	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT										
+	CCH60A-C	.76	1	FLOW	791.	775.	750.	724.	713.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT										
+	CCH56	1.35	1	FLOW	1362.	1334.	1293.	1249.	1233.
				TIME	3.83	3.83	3.83	3.83	3.83
ROUTED TO										
+	RCCH56	1.35	1	FLOW	1354.	1327.	1286.	1242.	1225.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	CH63-C	.26	1	FLOW	252.	247.	239.	230.	226.
				TIME	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT										
+	CCH63-C	1.62	1	FLOW	1607.	1574.	1525.	1472.	1451.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	CH68	.29	1	FLOW	316.	310.	299.	289.	284.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT										
+	CCH68-C	1.90	1	FLOW	1898.	1860.	1801.	1738.	1714.
				TIME	3.83	3.83	3.83	3.83	3.83
ROUTED TO										
+	RCCH68	1.90	1	FLOW	1896.	1858.	1799.	1736.	1712.
				TIME	3.83	3.83	3.83	3.83	3.83
ROUTED TO										
+	RCCH68-C	1.90	1	FLOW	1888.	1846.	1791.	1720.	1703.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	CH64-C	.29	1	FLOW	230.	225.	217.	209.	206.
				TIME	4.00	4.00	4.00	4.00	4.00
ROUTED TO										
+	RCH64	.29	1	FLOW	231.	226.	218.	210.	207.
				TIME	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT										
+	CH67-C	.35	1	FLOW	315.	308.	295.	283.	278.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT										
+	CCH67-C	.64	1	FLOW	422.	412.	395.	378.	371.
				TIME	3.92	3.92	3.92	3.92	3.92
ROUTED TO										
+	RCCH67C	.64	1	FLOW	422.	412.	395.	378.	372.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT										
+	FR04-C	.24	1	FLOW	276.	270.	260.	250.	247.
				TIME	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT										
+	CFR04	2.79	1	FLOW	2508.	2451.	2371.	2275.	2249.
				TIME	3.83	3.83	3.83	3.83	3.83
ROUTED TO										
+	RCFR04	2.79	1	FLOW	2489.	2433.	2352.	2256.	2230.
				TIME	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT										
+	FR03-1	.19	1	FLOW	183.	179.	172.	165.	163.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT										
+	CFR03	2.97	1	FLOW	2662.	2602.	2515.	2413.	2385.
				TIME	3.83	3.83	3.83	3.83	3.83

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL		
ISTAQ	ELEMENT	DT	PEAK	TIME TO	VOLUME	DT	PEAK	TIME TO	VOLUME

			PEAK			PEAK		
	(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .00								
RCH51 MANE	4.33	264.75	238.09	2.00	5.00	263.81	235.00	2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2911E+02 EXCESS= .0000E+00 OUTFLOW= .2912E+02 BASIN STORAGE= .4717E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCH51 MANE	4.36	260.41	235.52	1.96	5.00	259.06	235.00	1.96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2853E+02 EXCESS= .0000E+00 OUTFLOW= .2854E+02 BASIN STORAGE= .4854E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCH51 MANE	4.42	251.77	238.55	1.90	5.00	251.28	235.00	1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2759E+02 EXCESS= .0000E+00 OUTFLOW= .2760E+02 BASIN STORAGE= .5681E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCH51 MANE	4.48	243.69	237.25	1.83	5.00	240.93	235.00	1.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2663E+02 EXCESS= .0000E+00 OUTFLOW= .2663E+02 BASIN STORAGE= .4851E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCH51 MANE	4.50	240.16	238.54	1.80	5.00	239.39	235.00	1.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2627E+02 EXCESS= .0000E+00 OUTFLOW= .2627E+02 BASIN STORAGE= .5276E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCCH52 MANE	1.82	618.02	232.84	2.10	5.00	612.39	235.00	2.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6666E+02 EXCESS= .0000E+00 OUTFLOW= .6667E+02 BASIN STORAGE= .2751E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCCH52 MANE	1.84	605.07	233.06	2.06	5.00	600.91	235.00	2.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6537E+02 EXCESS= .0000E+00 OUTFLOW= .6538E+02 BASIN STORAGE= .3007E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCCH52 MANE	1.86	588.98	231.91	1.99	5.00	583.30	235.00	1.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6330E+02 EXCESS= .0000E+00 OUTFLOW= .6330E+02 BASIN STORAGE= .2964E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCCH52 MANE	1.88	567.08	233.46	1.92	5.00	562.84	235.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6114E+02 EXCESS= .0000E+00 OUTFLOW= .6115E+02 BASIN STORAGE= .2997E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCCH52 MANE	1.89	563.00	232.41	1.90	5.00	557.85	235.00	1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6035E+02 EXCESS= .0000E+00 OUTFLOW= .6036E+02 BASIN STORAGE= .2798E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RDFLAM1 MANE	1.00	113.51	244.00	-1.00	5.00	113.43	245.00	-1.00
FOR PLAN = 1 RATIO= .00								
RDFLAM1 MANE	1.00	107.49	245.00	-1.00	5.00	107.49	245.00	-1.00
FOR PLAN = 1 RATIO= .00								
RDFLAM1 MANE	1.00	97.54	245.00	-1.00	5.00	97.54	245.00	-1.00
FOR PLAN = 1 RATIO= .00								
RDFLAM1 MANE	1.00	87.51	245.00	-1.00	5.00	87.51	245.00	-1.00
FOR PLAN = 1 RATIO= .00								

```
          RDFLAM1  MANE         1.00     83.48    245.00     -1.00      5.00     83.48    245.00       -1.00


         FOR PLAN = 1  RATIO=  .00
          RDFLAM2  MANE          .75    112.24    247.50     -1.00      5.00    109.45    245.00       -1.00


         FOR PLAN = 1  RATIO=  .00
          RDFLAM2  MANE          .75    106.23    247.50     -1.00      5.00    103.40    250.00       -1.00


         FOR PLAN = 1  RATIO=  .00
          RDFLAM2  MANE          .75     96.35    248.25     -1.00      5.00     94.14    250.00       -1.00


         FOR PLAN = 1  RATIO=  .00
          RDFLAM2  MANE          .50     86.42    248.50     -1.00      5.00     84.72    250.00       -1.00


         FOR PLAN = 1  RATIO=  .00
          RDFLAM2  MANE         1.00     82.36    249.00     -1.00      5.00     81.19    250.00       -1.00


         FOR PLAN = 1  RATIO=  .00
            RCCH56  MANE         1.82   1355.64    228.73      2.02      5.00   1354.05    230.00        2.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1459E+03 EXCESS= .0000E+00 OUTFLOW= .1459E+03 BASIN STORAGE= .3751E-02 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH56  MANE         1.83   1328.28    228.78      1.98      5.00   1326.72    230.00        1.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1428E+03 EXCESS= .0000E+00 OUTFLOW= .1428E+03 BASIN STORAGE= .4204E-02 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH56  MANE         1.85   1288.74    231.65      1.90      5.00   1286.25    230.00        1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1374E+03 EXCESS= .0000E+00 OUTFLOW= .1374E+03 BASIN STORAGE= .3768E-02 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH56  MANE         1.88   1242.25    231.17      1.83      5.00   1241.84    230.00        1.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1323E+03 EXCESS= .0000E+00 OUTFLOW= .1323E+03 BASIN STORAGE= .3881E-02 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH56  MANE         1.89   1226.79    228.57      1.81      5.00   1225.01    230.00        1.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1304E+03 EXCESS= .0000E+00 OUTFLOW= .1304E+03 BASIN STORAGE= .4249E-02 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH68  MANE          .31   1896.63    230.19      1.94      5.00   1896.31    230.00        1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1972E+03 EXCESS= .0000E+00 OUTFLOW= .1972E+03 BASIN STORAGE= .6943E-03 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH68  MANE          .31   1858.25    230.23      1.90      5.00   1858.03    230.00        1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1929E+03 EXCESS= .0000E+00 OUTFLOW= .1929E+03 BASIN STORAGE= .6960E-03 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH68  MANE          .31   1799.44    230.09      1.83      5.00   1799.05    230.00        1.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1857E+03 EXCESS= .0000E+00 OUTFLOW= .1857E+03 BASIN STORAGE= .6939E-03 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH68  MANE          .32   1736.62    230.21      1.76      5.00   1736.15    230.00        1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1788E+03 EXCESS= .0000E+00 OUTFLOW= .1788E+03 BASIN STORAGE= .6895E-03 PERCENT ERROR=    .0


         FOR PLAN = 1  RATIO=  .00
            RCCH68  MANE          .32   1712.52    230.23      1.73      5.00   1712.14    230.00        1.73
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1761E+03 EXCESS= .0000E+00 OUTFLOW= .1761E+03 BASIN STORAGE= .7109E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH68-C	MANE	2.32	1888.74	229.83	1.94	5.00	1888.21	230.00	1.94	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1972E+03 EXCESS= .0000E+00 OUTFLOW= .1972E+03 BASIN STORAGE= .5458E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH68-C	MANE	2.34	1847.55	229.38	1.90	5.00	1846.36	230.00	1.90	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1930E+03 EXCESS= .0000E+00 OUTFLOW= .1930E+03 BASIN STORAGE= .5573E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH68-C	MANE	2.37	1791.34	229.98	1.83	5.00	1791.29	230.00	1.83	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1858E+03 EXCESS= .0000E+00 OUTFLOW= .1858E+03 BASIN STORAGE= .5804E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH68-C	MANE	2.40	1725.19	230.88	1.76	5.00	1719.79	230.00	1.76	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1788E+03 EXCESS= .0000E+00 OUTFLOW= .1788E+03 BASIN STORAGE= .5739E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH68-C	MANE	2.42	1703.97	229.75	1.73	5.00	1703.30	230.00	1.73	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1762E+03 EXCESS= .0000E+00 OUTFLOW= .1762E+03 BASIN STORAGE= .5345E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH64	MANE	5.00	230.54	250.00	1.75	5.00	230.54	250.00	1.75	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2668E+02 EXCESS= .0000E+00 OUTFLOW= .2669E+02 BASIN STORAGE= .3005E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH64	MANE	5.00	225.77	250.00	1.71	5.00	225.77	250.00	1.71	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2610E+02 EXCESS= .0000E+00 OUTFLOW= .2611E+02 BASIN STORAGE= .2908E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH64	MANE	5.00	217.82	250.00	1.65	5.00	217.82	250.00	1.65	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2515E+02 EXCESS= .0000E+00 OUTFLOW= .2516E+02 BASIN STORAGE= .2804E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCH64	MANE	5.00	209.88	250.00	1.59	5.00	209.88	250.00	1.59	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2420E+02 EXCESS= .0000E+00 OUTFLOW= .2421E+02 BASIN STORAGE= .2749E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCH64	MANE	5.00	206.71	250.00	1.56	5.00	206.71	250.00	1.56	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2382E+02 EXCESS= .0000E+00 OUTFLOW= .2383E+02 BASIN STORAGE= .2727E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCCH67C	MANE	5.00	421.94	240.00	1.55	5.00	421.94	240.00	1.55	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5302E+02 EXCESS= .0000E+00 OUTFLOW= .5303E+02 BASIN STORAGE= .1330E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH67C	MANE	5.00	411.89	240.00	1.52	5.00	411.89	240.00	1.52	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5180E+02 EXCESS= .0000E+00 OUTFLOW= .5181E+02 BASIN STORAGE= .1298E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCH67C	MANE	5.00	395.17	240.00	1.46	5.00	395.17	240.00	1.46	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4978E+02 EXCESS= .0000E+00 OUTFLOW= .4979E+02 BASIN STORAGE= .1259E-02 PERCENT ERROR= .0

```
          FOR PLAN = 1  RATIO=  .00
           RCCH67C  MANE         5.00    378.50    240.00      1.40      5.00    378.50    240.00        1.40


CONTINUITY SUMMARY (AC-FT) - INFLOW= .4777E+02 EXCESS= .0000E+00 OUTFLOW= .4778E+02 BASIN STORAGE= .1236E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
           RCCH67C  MANE         5.00    371.84    240.00      1.38      5.00    371.84    240.00        1.38


CONTINUITY SUMMARY (AC-FT) - INFLOW= .4697E+02 EXCESS= .0000E+00 OUTFLOW= .4698E+02 BASIN STORAGE= .1226E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCFR04  MANE          .95   2499.15    231.25      1.83      5.00   2488.99    230.00        1.83


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2719E+03 EXCESS= .0000E+00 OUTFLOW= .2719E+03 BASIN STORAGE= .2447E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCFR04  MANE          .96   2441.13    231.45      1.79      5.00   2432.58    230.00        1.79


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2660E+03 EXCESS= .0000E+00 OUTFLOW= .2660E+03 BASIN STORAGE= .2543E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCFR04  MANE          .97   2361.90    230.64      1.72      5.00   2351.80    230.00        1.72


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2560E+03 EXCESS= .0000E+00 OUTFLOW= .2560E+03 BASIN STORAGE= .2525E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCFR04  MANE          .99   2266.57    231.52      1.66      5.00   2256.10    230.00        1.66


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2461E+03 EXCESS= .0000E+00 OUTFLOW= .2461E+03 BASIN STORAGE= .2565E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCFR04  MANE          .99   2239.56    230.61      1.63      5.00   2230.08    230.00        1.63


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2425E+03 EXCESS= .0000E+00 OUTFLOW= .2425E+03 BASIN STORAGE= .2394E-02 PERCENT ERROR=    .0



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

Appendix A-4

CCRFCD Design Manual Criteria

Design Storm

The rainfall values used in the hydrologic model are intended to produce runoff discharges for 100-year recurrence interval events. The 100-year recurrence interval is defined as having a 1-percent chance of being equalled or exceeded in any given year. Storm duration of six hours was used in accordance with the Design Manual.

Precipitation Depths

All subbasins contributing runoff to the study area are within the McCarran Airport rainfall area as defined in the Design Manual. Therefore, the 100-year, 6-hour rainfall depth is 2.77 inches for all subbasins (see Figure 506, Figure 513, and Table 505 of the Design Manual in this Appendix).

Storm Distribution

The 100-year, 6-hour rainfall depth was distributed over the 6-hour design storm period using the SDN 3 storm distribution (see Table 503 of the Design Manual in this Appendix). According to established CCRFCD methodology, SDN 3 is used for drainage areas less than 8 square miles which is all combination points and subbasins in the Boulder Highway Storm Drain hydrologic analysis.

Depth-Area Reduction Factors

The precipitation depths obtained for the McCarran Airport Rainfall Area from the Design Manual represent rainfall frequency at isolated points. Storms, however, cause rainfall to occur over widespread areas simultaneously, with the most intense rainfall typically occurring near the center of the storm. To account for the rainfall variation, standard precipitation analysis methods require adjusting point precipitation depths downward in order to better represent the average depth of rainfall over the entire storm area. This is done using depth-area reduction curves that relate point precipitation reduction factors to storm area and duration. The reduction factors cause the rainfall depth to decrease as the tributary area increases.

The six hour depth-area reduction factors (DARFs) from Table 502 in the Design Manual were applied to the rainfall depths in the HEC-1 models at each subbasin and concentration point based on upstream tributary area. Rather than interpolating precise reduction factors at every concentration point, an average DARF value was used for a range of tributary areas to be consistent with the 2008 MPU models and methodology. The DARF values applied to the model are shown below. The depth-area reduction factor table from the Design Manual is included in this Appendix**.**

Depth-Area Reduction Factors

Tributary Area (sq mi)	DARF
0 ≤ Area < 0.5	0.99
0.5 ≤ Area < 1	0.975
1 ≤ Area < 2	0.95
2 ≤ Area < 3	0.925
3 ≤ Area < 4	0.915

Land Use

Land use information was based on the land use data that was compiled for the 2008 MPU. The land use is based on the ultimate condition and assumes that the full "build out" condition has been reached and that available land within the watershed is fully developed. Minor updates and revisions were made to the land use data based on aerial imagery and coordination with the City to reflect changes that have occurred or to better represent actual land use conditions in the watershed.

The land use data consists of 13 categories of land use as defined in table below. Each category is defined by a specified percentage of impervious area, percentage of ground cover in good hydrologic condition, and percentage of desert shrub in poor hydrologic condition. Land use data was obtained in GIS format, with polygon areas delineated to represent specific land use categories in the study area. The land use data is shown in **Figure A-3.**

It should be noted that in the 2008 MPU, land use categories were adjusted to reflect restrictions on the amount of allowable grass landscaping per the Southern Nevada Water Authority drought ordinance. The drought ordinance requirements are only applied to certain areas as determined by CCRFCD. The Boulder Highway Storm Drain study area does not fall within the drought ordinance area, and therefore, the nine additional land use categories from the 2008 MPU representing the drought ordinance revision are not included in this analysis.

Land Use Categories

Land Use Index Number	Description - Typical Land Uses	Directly Connected Impervious (%)	Open Landscaped Good Condition (%)	Open Desert Shrub Poor Condition (%)
1	Undeveloped Land, Open Desert	0	0	100
2	Parks, Golf Courses	5	85	10
5	Medium Density Residential, 2-4 units per acre	29	71	0
6	High Density Residential, 4-8 units per acre	62	38	0
7	Public Facility and Residential, 8-12 units/acre	72	28	0
8	Very High Density Residential, 12 units/acre or more	85	15	0
9	Commercial, Retail, Casino, High Rise Condominiums	90	10	0
10	Light Industrial	70	15	15
12	Schools	50	50	0

Soils

Soils data for the Boulder Highway Storm Drain hydrologic analysis comes from the Soil Survey of the Las Vegas Valley Area by the National Conservation Resources Service (NRCS), dated July 1985. Soils data was obtained in GIS format for the study area, and the limits of each soil type are delineated in the GIS layer and assigned a soil map unit number. NRCS methodology divides soils into four hydrological groups, as defined below:

A. High infiltration rate, low runoff potential

B. Moderate infiltration rate, moderately low runoff potential

C. Slow infiltration rate, moderately high runoff potential

D. Very slow infiltration rate, high runoff potential

Each soil map unit number is made up of a certain percentage of hydrologic soil group A, B, C, and D. Curve number calculations for each of the subbasins were based on the individual breakdown of each soil type into the percentages of the minor hydrologic soil group components (A, B, C, or D). Detailed soils data and the soil boundaries are shown on **Figure A-4**.

Curve Numbers

Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the NRCS curve number (CN) method described in the Design Manual. The curve number method is a function of soil type, land cover, and antecedent moisture condition. Based on the Design Manual, the average antecedent moisture condition (AMC II) is used for computing losses. Curve number information was compiled using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers. To calculate a curve number for a given subbasin, the following procedure was used:

1. Base curve numbers are taken from the CCRFCD Design Manual for the three assumed land cover conditions (directly connected impervious area, open landscaped area in good condition, open desert shrub in poor condition) for each of the four Hydrologic Soil Groups. In addition, a curve number of 90 is assumed for rock outcrop, and directly connected impervious is assumed to have a curve number of 98 for all soil types.
2. A curve number matrix is compiled to calculate a base curve number for a given combination of soil map unit and land use type.
3. The land use, soils, and subbasin polygons were overlaid in GIS to subdivide each subbasin into polygons (subareas) of unique land use and soil type combinations.
4. The curve number matrix is then used to assign a curve number for each subarea, and an area-weighted composite curve number is calculated for the whole subbasin based on the areas of the subdivided polygons and their associated curve numbers. The curve number and total area of each subbasin is then used in the hydrologic models input files.

Supporting information for the curve number calculations (including the curve number matrix) is included in this Appendix**.**

Lag Time

All subbasins within the Boulder Highway Storm Drain watershed are less than 0.5 square miles. The time of concentration for subbasins of this size was computed with the time of concentration equation (velocity method) from the Design Manual. This method is explained below. Note that initial length (overland flow) was set to 100 feet for all subbasins to represent urbanized drainage patterns and to be consistent with the 2008 MPU.

The lag time is related to the time of concentration by the following empirical relationship:

$$T_{lag} = 0.6T_c$$

Where:

T_{lag} = Lag Time
T_c = Time of concentration

The time of concentration is calculated as follows:

$$T_c = T_i + T_t$$

Where:

T_c = Time of concentration
T_i = Initial, inlet, or overland flow time
T_t = Travel time in the ditch, gutter, etc.

Initial flow time is calculated as follows:

$$T_i = 1.8(1.1 - K)L_o^{1/2}/S^{1/3}$$

Where:

T_i = Initial overland flow time (minutes)
K = 0.0132 * CN - 0.39
CN = Curve number
L_o = Length of overland flow (ft, maximum 500 feet)
S = Average basin slope (percent)

Travel time is calculated as follows:

$$T_t = 500/(60\ V_1) + (L_t - 500)/(60\ V_2)$$

Where:

T_t = Travel time in the ditch, gutter, etc. (minutes)
L_t = Travel length (feet)
V_1 = Average velocity of flow for the first 500 feet of travel distance (feet/second)
V_2 = Average velocity of flow for the remaining travel distance (feet/second)

V_1 and V_2 are calculated as follows:

$$V_1 = C_1 * (S/100)^{1/2}$$
$$V_2 = C_2 * (S/100)^{1/2}$$

Where:

C1 = 20.2 for developed areas and 14.8 for undeveloped areas

C2	=	30.6 for developed areas and 29.4 for undeveloped areas
S	=	Average slope for the flow path (percent)

In urbanized areas, the time of concentration calculated above should not exceed the time of concentration calculated by the following equation:

$$T_c = (L / 180) + 10$$

Where:

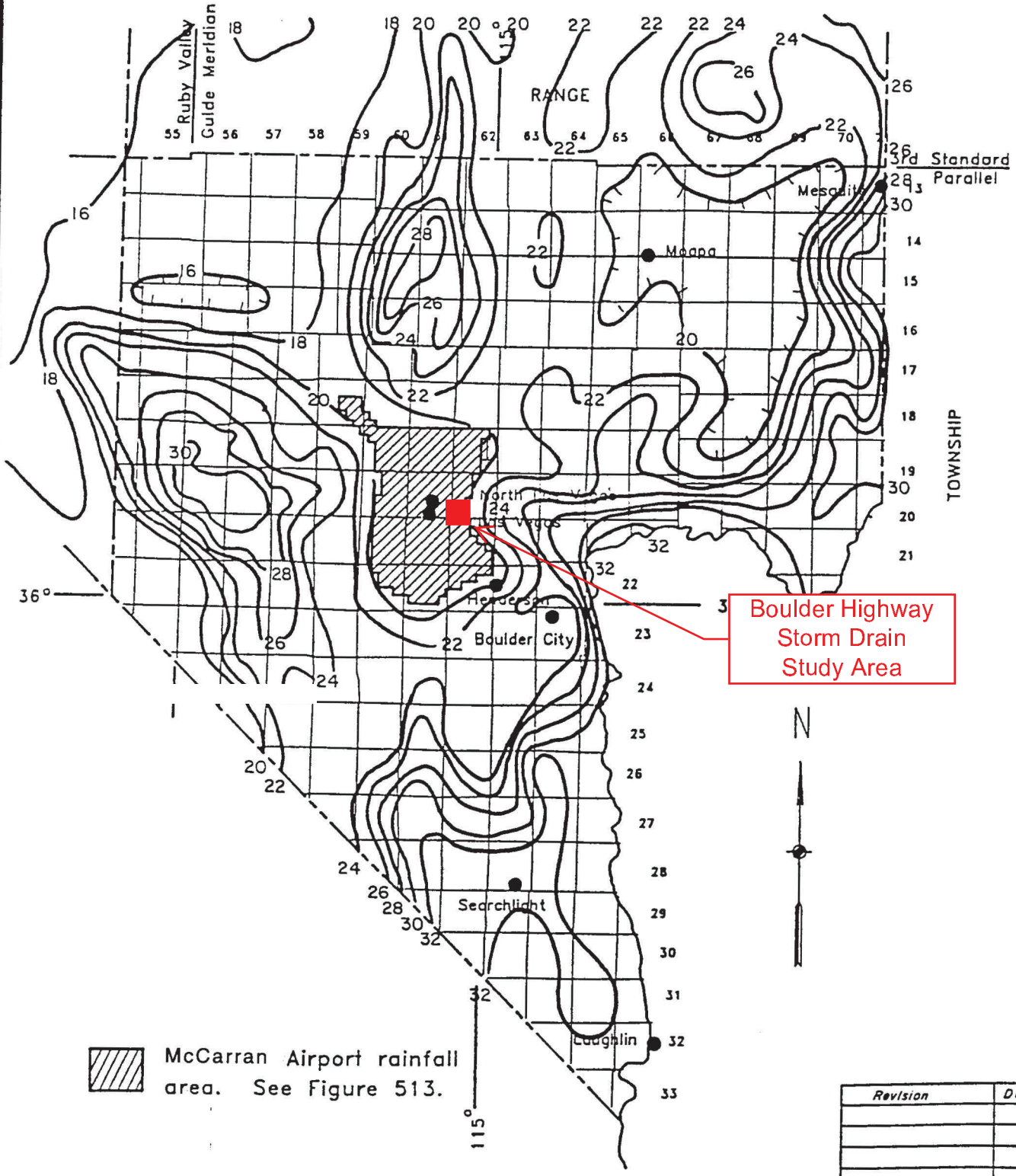
T_c	=	Time of concentration at the first design point in an urban watershed (minutes)
L	=	Watershed length (feet)

The smaller of the two calculations for time of concentration controls minimum T_c for any watershed and should not be less than 5 minutes. Standard Form 4 from the Design Manual was used to compute lag times and is included in this Appendix.

Routing

In this study all routings in the model were through streets or storm drains, and therefore, only Muskingum-Cunge method for floodwave routing was used in the HEC-1 model to be consistent with the 2008 MPU. Muskingum-Cunge routing requires the following input parameters: roughness coefficient, base width, side-slope, slope, and reach length.

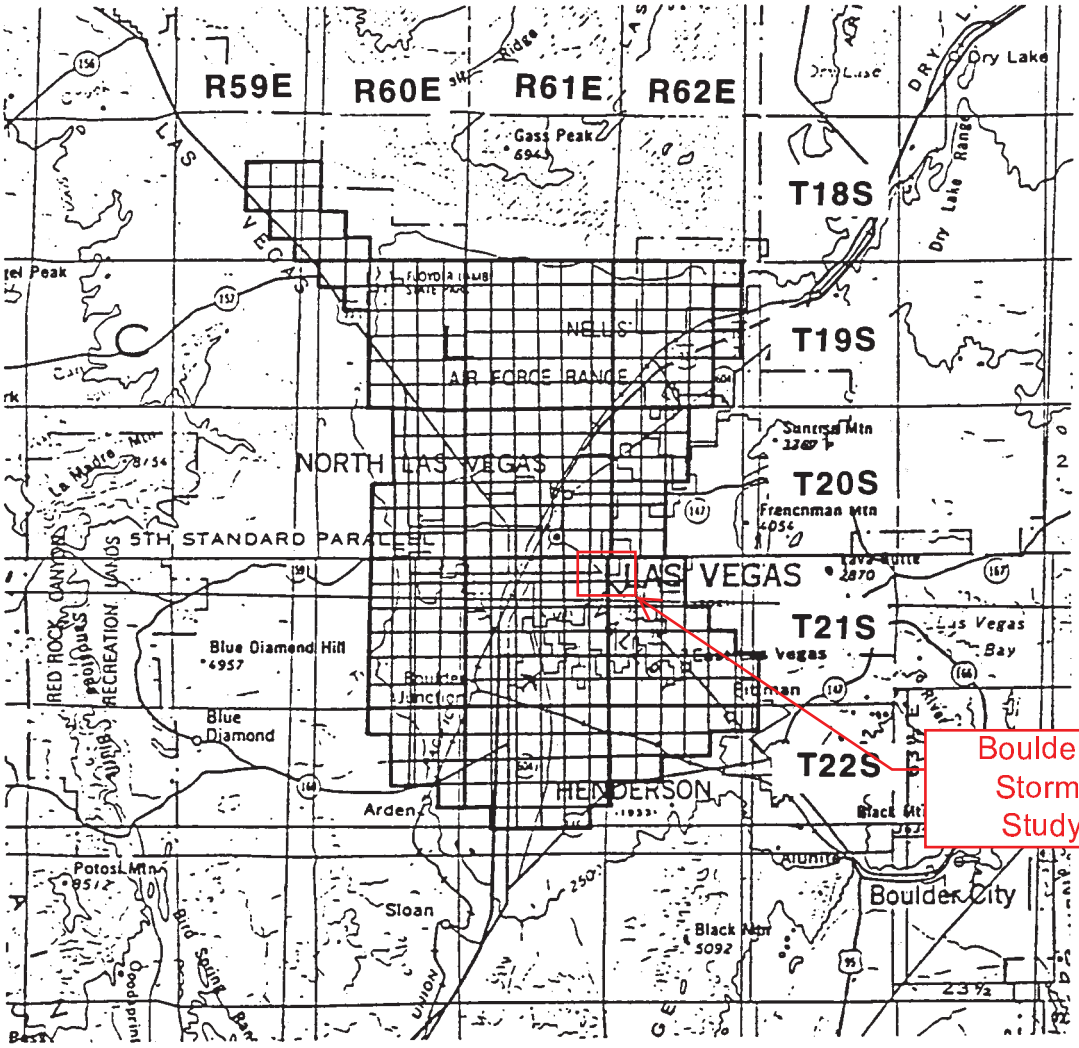
RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



Revision	Date

WRC ENGINEERING	REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973	FIGURE 506

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP	RANGE	SECTIONS	TOWNSHIP	RANGE	SECTIONS
18 South	59 East	13-15,22-26,36	20 South	62 East	4-9,16-20,29-32
18 South	60 East	30-32	21 South	60 East	1-4,9-16,21-28,33-36
19 South	60 East	1-6,8-16,21-28,33-36	21 South	61 East	ALL SECTIONS
19 South	61 East	ALL SECTIONS	21 South	62 East	4-9,15-23, 25-36
19 South	62 East	2-11,14-23,27-34	22 South	60 East	1-4,10-15,24
20 South	60 East	1-3,10-15,21-28,33-36	22 South	61 East	1-24,26-29
20 South	61 East	ALL SECTIONS	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

WRC ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

FIGURE 513

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

SIX-HOUR STORM DISTRIBUTIONS

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

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

SIX HOUR DEPTH-AREA REDUCTION FACTORS

Drainage Area (Square Miles)	Six-Hour Depth-Area Reduction Factor
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

NOTES: 1. A graphical representation of these factors is presented in Figure 514.

2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

Revision	Date

Appendix A-5

Hydrologic Parameters

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

Atkins — **Boulder Highway Storm Drain**

File: FORM4.XLS

BY: MK

Ultimate Condition — **DATE:** 9/1/16

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag	REMARKS
DESIG: (1)	DEV./EX. (D or E)	CN	K (2)	AREA Ac (3)	AREA Mi^2	INITIAL LENGTH Feet (4)	SLOPE % (5)	Ti Min (6)	TRAVEL LENGTH Feet (7)	SLOPE % (8)	V1 VELOCITY FPS (9a)	V2 VELOCITY FPS (9b)	Tt Min (10)	Min (13)	Min (14)	Tlag= 0.6Tc/60 Hours	RAINFALL Q_{100} Inches
CH59-C	D	94.0	0.8513	218.42	0.341	100	1.0	4.5	6900	0.5	1.4	2.1	56.8	61.2	48.9	**0.489**	2.77
CH52-C	D	94.8	0.8609	206.86	0.323	100	1.0	4.3	5100	0.5	1.4	2.1	43.5	47.8	38.9	**0.389**	2.77
CH51	D	92.9	0.8360	174.56	0.273	100	1.0	4.8	6500	0.4	1.3	2.0	57.1	61.9	46.7	**0.467**	2.77
CH60A-C	D	91.9	0.8235	266.18	0.416	100	1.0	5.0	4100	1.1	2.1	3.2	22.7	27.6	33.3	**0.276**	2.77
CH56-C	D	90.7	0.8076	218.32	0.341	100	1.0	5.3	6500	0.9	1.9	2.9	39.0	44.2	46.7	**0.442**	2.77
CH64-C	D	90.0	0.7980	183.06	0.286	100	1.0	5.4	7900	0.6	1.6	2.4	55.8	61.3	54.4	**0.544**	2.77
CH63-C	D	89.8	0.7958	168.63	0.263	100	1.0	5.5	7500	1.6	2.5	3.9	33.5	39.0	52.2	**0.390**	2.77
CH68	D	90.0	0.7976	184.82	0.289	100	1.0	5.4	6000	1.9	2.8	4.2	24.6	30.1	43.9	**0.301**	2.77
CH67-C	D	85.3	0.7366	226.84	0.354	100	1.0	6.5	5000	1.4	2.4	3.6	24.3	30.8	38.3	**0.308**	2.77
FR04-C	D	89.1	0.7862	154.95	0.242	100	1.0	5.6	3950	1.3	2.3	3.5	20.1	25.7	32.5	**0.257**	2.77
FR03-1	D	87.7	0.7676	119.87	0.187	100	1.0	6.0	4700	1.1	2.1	3.2	25.7	31.7	36.7	**0.317**	2.77

Tc = Ti + Tt Tlag = 0.6 Tc

Ti = 1.8 (1.1 - K) L^1/2 / S^1/3

K = 0.0132 (CN) - 0.39

Tc Check = L/180+10

For the travel time (Tt) calculations, V1 applies to the first 500 feet of travel distance; V2 applies to the remaining travel distance.

Existing V1 = 14.8*(S/100)^1/2 Developed V1 = 20.2*(S/100)^1/2

Existing V2 = 29.4*(S/100)^1/2 Developed V2 = 30.6*(S/100)^1/2

REFERENCE : **STANDARD FORM 4**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

Atkins — **Boulder Highway Storm Drain**

File: FORM4.XLS — **Ultimate Condition**

BY: MK

DATE: 9/1/16

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag	REMARKS
DESIG: (1)	DEV./EX. (D or E)	CN	K (2)	AREA Ac (3)	AREA Mi^2	INITIAL LENGTH Feet (4)	SLOPE % (5)	Ti Min (6)	TRAVEL LENGTH Feet (7)	SLOPE % (8)	V1 VELOCITY FPS (9a)	V2 VELOCITY FPS (9b)	Tt Min (10)	Min (13)	Min (14)	Tlag= 0.6Tc/60 Hours	RAINFALL Q_{100} Inches
CH51	D	92.9	0.8360	174.6	0.273	100	1.0	4.8	6500	0.4	1.3	2.0	57.1	61.9	46.7	**0.467**	2.77
CH52-C1	D	95.6	0.8713	58.7	0.092	100	1.0	4.1	1928	0.6	1.6	2.4	15.4	19.5	21.3	**0.195**	2.77
CH52-C2	D	94.5	0.8568	148.1	0.231	100	1.0	4.4	5100	0.5	1.4	2.1	43.5	47.8	38.9	**0.389**	2.77
CH56-C1	D	91.0	0.8111	101.9	0.159	100	1.0	5.2	5050	0.9	1.9	2.9	30.5	35.7	38.6	**0.357**	2.77
CH56-C2	D	90.5	0.8045	116.4	0.182	100	1.0	5.3	6360	0.6	1.6	2.4	46.5	51.8	45.9	**0.459**	2.77
CH59-C	D	94.0	0.8513	218.4	0.341	100	1.0	4.5	6900	0.5	1.4	2.1	56.8	61.2	48.9	**0.489**	2.77
CH60A-C1	D	87.3	0.7620	34.7	0.054	100	1.0	6.1	2311	1.3	2.3	3.5	12.3	18.4	23.4	**0.184**	2.77
CH60A-C2	D	92.0	0.8241	165.0	0.258	100	1.0	5.0	4710	0.7	1.7	2.6	32.3	37.3	36.7	**0.367**	2.77
CH60A-C3	D	91.9	0.8224	101.2	0.158	100	1.0	5.0	2545	1.2	2.2	3.4	13.9	18.9	24.7	**0.189**	2.77
CH60A-C4	D	92.9	0.8367	17.6	0.028	100	1.0	4.7	1186	1.9	2.8	4.2	5.7	10.4	17.1	**0.104**	2.77
CH63-C1	D	89.6	0.7925	37.4	0.058	100	1.0	5.5	2255	1.6	2.6	3.9	10.8	16.4	23.1	**0.164**	2.77
CH63-C2	D	89.2	0.7872	20.9	0.033	100	1.0	5.6	1624	1.0	2.1	3.1	10.0	15.6	19.6	**0.156**	2.77
CH63-C3	D	88.2	0.7740	11.8	0.018	100	1.0	5.9	1310	0.5	1.4	2.1	12.6	18.5	17.8	**0.178**	2.77
CH63-C4	D	90.8	0.8088	76.7	0.120	100	1.0	5.2	3226	2.0	2.9	4.3	13.4	18.7	28.5	**0.187**	2.77
CH64-C	D	90.0	0.7980	183.1	0.286	100	1.0	5.4	6555	0.7	1.7	2.5	44.8	50.2	47.0	**0.470**	2.77
CH67-C1	D	92.0	0.8242	9.3	0.014	100	1.0	5.0	1337	1.3	2.3	3.5	7.6	12.6	18.0	**0.126**	2.77
CH67-C2	D	85.7	0.7411	12.8	0.020	100	1.0	6.5	1535	0.9	1.9	2.9	10.2	16.7	19.1	**0.167**	2.77
CH67-C3	D	85.5	0.7387	62.5	0.098	100	1.0	6.5	4875	2.1	2.9	4.5	19.2	25.7	37.6	**0.257**	2.77
CH67-C4	D	85.2	0.7347	68.1	0.106	100	1.0	6.6	4077	2.8	3.4	5.1	14.2	20.8	33.2	**0.208**	2.77
CH67-C5	D	85.3	0.7366	96.0	0.150	100	1.0	6.5	3925	0.1	0.6	1.0	72.0	78.6	32.4	**0.324**	2.77
CH68-1	D	88.0	0.7714	41.1	0.064	100	1.0	5.9	2492	2.9	3.4	5.2	8.8	14.7	24.4	**0.147**	2.77
CH68-3	D	87.2	0.7604	44.3	0.069	100	1.0	6.1	3116	1.3	2.3	3.5	16.1	22.2	27.9	**0.222**	2.77
CH68-4	D	95.8	0.8748	29.8	0.047	100	1.0	4.1	2149	1.7	2.6	4.0	10.1	14.1	22.5	**0.141**	2.77
CH68-5	D	95.2	0.8666	12.1	0.019	100	1.0	4.2	2040	1.5	2.5	3.7	10.2	14.4	21.9	**0.144**	2.77
CH68-6	D	92.4	0.8301	3.6	0.006	100	1.0	4.9	867	0.8	1.8	2.7	6.8	11.7	15.4	**0.117**	2.77
FR03-1	D	87.1	0.7595	17.1	0.027	100	1.0	6.1	2540	1.4	2.4	3.6	12.9	19.0	24.7	**0.190**	2.77
FR03-4	D	86.3	0.7488	10.5	0.016	100	1.0	6.3	1700	1.2	2.2	3.4	9.7	16.1	20.0	**0.161**	2.77
FR03-5	D	84.9	0.7303	12.0	0.019	100	1.0	6.7	1718	0.8	1.8	2.7	12.0	18.7	20.1	**0.187**	2.77
FR03-7	D	92.2	0.8269	10.4	0.016	100	1.0	4.9	1500	0.6	1.6	2.4	12.0	16.9	18.9	**0.169**	2.77
FR03-8	D	88.0	0.7716	2.7	0.004	100	1.0	5.9	1371	0.6	1.6	2.4	11.5	17.4	18.2	**0.174**	2.77
FR04-C1	D	94.1	0.8520	2.6	0.004	100	1.0	4.5	917	1.1	2.1	3.2	6.1	10.6	15.7	**0.106**	2.77
FR04-C2	D	87.9	0.7709	8.4	0.013	100	1.0	5.9	703	1.2	2.2	3.4	4.8	10.7	14.5	**0.107**	2.77
FR04-C3	D	94.2	0.8531	7.8	0.012	100	1.0	4.4	907	0.7	1.7	2.6	7.6	12.0	15.6	**0.120**	2.77
FR04-C4	D	91.0	0.8115	5.4	0.008	100	1.0	5.2	604	0.8	1.8	2.8	5.2	10.4	13.9	**0.104**	2.77
FR04-C5	D	85.6	0.7394	5.2	0.008	100	1.0	6.5	862	1.2	2.2	3.3	5.7	12.1	15.3	**0.121**	2.77
FR04-C6	D	85.6	0.7397	5.6	0.009	100	1.0	6.5	796	1.3	2.3	3.4	5.1	11.6	15.0	**0.116**	2.77
FR04-C7	D	87.1	0.7604	5.8	0.009	100	1.0	6.1	1116	0.7	1.7	2.6	8.8	14.9	16.8	**0.149**	2.77
FR04-C8	D	85.6	0.7393	31.7	0.049	100	1.0	6.5	1960	0.5	1.4	2.1	17.4	23.9	21.4	**0.214**	2.77
FR04-C9	D	95.4	0.8697	32.9	0.051	100	1.0	4.1	2216	0.5	1.4	2.2	19.1	23.2	22.9	**0.229**	2.77
FR04-C10	D	91.0	0.8112	5.7	0.009	100	1.0	5.2	2210	0.5	1.4	2.2	19.0	24.2	22.8	**0.228**	2.77
FR04-C11	D	86.5	0.7517	42.9	0.067	100	1.0	6.3	3250	1.0	2.0	2.1	26.0	32.3	28.6	**0.286**	2.77
FR04-C12	D	85.8	0.7429	6.9	0.011	100	1.0	6.4	1365	1.3	2.3	3.5	7.8	14.2	18.1	**0.142**	2.77
FR04-C13	D	85.1	0.7336	16.2	0.025	100	1.0	6.6	2400	0.9	1.9	2.9	15.3	21.9	23.9	**0.219**	2.77
FR04-C14	D	85.7	0.7415	18.3	0.029	100	1.0	6.5	1550	1.5	2.5	3.7	8.0	14.5	19.2	**0.145**	2.77
FR04-C15	D	84.9	0.7313	6.4	0.010	100	1.0	6.6	980	0.7	1.7	2.6	8.1	14.7	16.0	**0.147**	2.77
FR04-C16	D	94.2	0.8541	16.0	0.025	100	1.0	4.4	1715	0.7	1.7	2.6	12.8	17.3	20.1	**0.173**	2.77
FR04-C17	D	91.7	0.8206	4.4	0.007	100	1.0	5.0	1734	0.7	1.7	2.6	13.0	18.0	20.2	**0.180**	2.77

Tc = Ti + Tt Tlag = 0.6 Tc

Ti = 1.8 (1.1 - K) L^1/2 / S^1/3

K = 0.0132 (CN) - 0.39

Tc Check = L/180+10

For the travel time (Tt) calculations,
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Existing V1 = 14.8*(S/100)^1/2 Developed V1 = 20.2*(S/100)^1/2

Existing V2 = 29.4*(S/100)^1/2 Developed V2 = 30.6*(S/100)^1/2

REFERENCE :

STANDARD FORM 4

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17417	7603932	0.2%	0.2%	0.22	0.22	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	26420	7603932	0.3%	0.6%	0.33	0.55	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	13668	7603932	0.2%	0.8%	0.17	0.73	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	233747	7603932	3.1%	3.8%	2.95	3.68	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	857339	7603932	11.3%	15.1%	10.82	14.50	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58964	7603932	0.8%	15.9%	0.69	15.19	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	35910	7603932	0.5%	16.4%	0.42	15.61	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	36807	7603932	0.5%	16.8%	0.43	16.04	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60597	7603932	0.8%	17.6%	0.71	16.75	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	86830	7603932	1.1%	18.8%	1.10	17.85	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	263936	7603932	3.5%	22.2%	3.33	21.18	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	6482	7603932	0.1%	22.3%	0.08	21.26	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	462	7603932	0.0%	22.3%	0.01	21.26	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	86649	7603932	1.1%	23.5%	1.01	22.28	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	451	7603932	0.0%	23.5%	0.01	22.28	
CH51	7	Public Facility and Residential, 8-12 units/acre	615	91	30	7603932	0.0%	23.5%	0.00	22.28	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	87313	7603932	1.1%	24.6%	1.10	23.38	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	172398	7603932	2.3%	26.9%	2.02	25.40	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	125984	7603932	1.7%	28.6%	1.47	26.88	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	117338	7603932	1.5%	30.1%	1.37	28.25	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	53744	7603932	0.7%	30.8%	0.68	28.93	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	35948	7603932	0.5%	31.3%	0.42	29.35	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	108388	7603932	1.4%	32.7%	1.27	30.62	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	0	7603932	0.0%	32.7%	0.00	30.62	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	0	7603932	0.0%	32.7%	0.00	30.62	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37	7603932	0.0%	32.7%	0.00	30.62	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	15578	7603932	0.2%	32.9%	0.18	30.80	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	2	7603932	0.0%	32.9%	0.00	30.80	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	190928	7603932	2.5%	35.4%	2.23	33.03	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	140440	7603932	1.8%	37.3%	1.64	34.68	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	507	7603932	0.0%	37.3%	0.01	34.68	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	101	7603932	0.0%	37.3%	0.00	34.69	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	222333	7603932	2.9%	40.2%	2.81	37.49	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	116	7603932	0.0%	40.2%	0.00	37.49	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	120	7603932	0.0%	40.2%	0.00	37.50	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	19593	7603932	0.3%	40.5%	0.23	37.72	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10205	7603932	0.1%	40.6%	0.13	37.85	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	201916	7603932	2.7%	43.2%	2.36	40.22	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	66877	7603932	0.9%	44.1%	0.84	41.06	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	916	7603932	0.0%	44.1%	0.01	41.07	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	13	7603932	0.0%	44.1%	0.00	41.07	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	133	7603932	0.0%	44.1%	0.00	41.07	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	39	7603932	0.0%	44.1%	0.00	41.07	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	10	7603932	0.0%	44.1%	0.00	41.07	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	156	7603932	0.0%	44.1%	0.00	41.08	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	775271	7603932	10.2%	54.3%	9.79	50.86	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37160	7603932	0.5%	54.8%	0.43	51.30	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	159620	7603932	2.1%	56.9%	1.87	53.17	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58156	7603932	0.8%	57.7%	0.68	53.85	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58980	7603932	0.8%	58.5%	0.69	54.54	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	148442	7603932	2.0%	60.4%	1.87	56.41	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60082	7603932	0.8%	61.2%	0.70	57.12	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60639	7603932	0.8%	62.0%	0.71	57.82	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	57834	7603932	0.8%	62.8%	0.68	58.50	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37145	7603932	0.5%	63.3%	0.43	58.94	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37486	7603932	0.5%	63.8%	0.44	59.38	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	7603932	0.0%	63.8%	0.00	59.38	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60461	7603932	0.8%	64.5%	0.71	60.08	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24676	7603932	0.3%	64.9%	0.31	60.39	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15	7603932	0.0%	64.9%	0.00	60.39	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	581640	7603932	7.6%	72.5%	7.34	67.74	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	85711	7603932	1.1%	73.6%	1.00	68.74	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	111823	7603932	1.5%	75.1%	1.41	70.15	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	7603932	0.0%	75.1%	0.00	70.15	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	19832	7603932	0.3%	75.4%	0.25	70.40	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	111598	7603932	1.5%	76.8%	1.41	71.81	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6	7603932	0.0%	76.8%	0.00	71.81	
CH51	7	Public Facility and Residential, 8-12 units/acre	615	91	1760505	7603932	23.2%	100.0%	21.07	92.88	**92.9**
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	151977	9010975	1.7%	1.7%	1.62	1.62	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24493	9010975	0.3%	2.0%	0.26	1.88	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35640	9010975	0.4%	2.4%	0.38	2.26	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	37466	9010975	0.4%	2.8%	0.40	2.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	74	9010975	0.0%	2.8%	0.00	2.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	18	9010975	0.0%	2.8%	0.00	2.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	90	9010975	0.0%	2.8%	0.00	2.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	9010975	0.0%	2.8%	0.00	2.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	9010975	0.0%	2.8%	0.00	2.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	19419	9010975	0.2%	3.0%	0.21	2.87	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10557	9010975	0.1%	3.1%	0.11	2.98	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17043	9010975	0.2%	3.3%	0.18	3.16	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	14968	9010975	0.2%	3.5%	0.16	3.32	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9441	9010975	0.1%	3.6%	0.10	3.42	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5	9010975	0.0%	3.6%	0.00	3.42	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5166	9010975	0.1%	3.6%	0.06	3.48	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16837	9010975	0.2%	3.8%	0.18	3.66	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1	9010975	0.0%	3.8%	0.00	3.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	19704	9010975	0.2%	4.0%	0.21	3.87	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9279	9010975	0.1%	4.1%	0.10	3.97	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	9010975	0.0%	4.1%	0.00	3.97	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4	9010975	0.0%	4.1%	0.00	3.97	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42763	9010975	0.5%	4.6%	0.46	4.42	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55319	9010975	0.6%	5.2%	0.59	5.01	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55281	9010975	0.6%	5.8%	0.59	5.60	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8	9010975	0.0%	5.8%	0.00	5.60	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	53448	9010975	0.6%	6.4%	0.57	6.17	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56688	9010975	0.6%	7.1%	0.60	6.77	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	9010975	0.0%	7.1%	0.00	6.77	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	30	9010975	0.0%	7.1%	0.00	6.77	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	28807	9010975	0.3%	7.4%	0.31	7.08	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	25	9010975	0.0%	7.4%	0.00	7.08	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39832	9010975	0.4%	7.8%	0.42	7.50	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	36819	9010975	0.4%	8.2%	0.39	7.90	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	114	9010975	0.0%	8.2%	0.00	7.90	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	183944	9010975	2.0%	10.3%	1.96	9.86	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	75	9010975	0.0%	10.3%	0.00	9.86	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3838	9010975	0.0%	10.3%	0.04	9.90	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4798	9010975	0.1%	10.4%	0.05	9.95	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	9010975	0.0%	10.4%	0.00	9.95	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17701	9010975	0.2%	10.6%	0.19	10.14	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8931	9010975	0.1%	10.7%	0.10	10.23	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	9010975	0.0%	10.7%	0.00	10.23	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16959	9010975	0.2%	10.8%	0.18	10.41	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	9010975	0.0%	10.8%	0.00	10.41	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57162	9010975	0.6%	11.5%	0.61	11.02	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56720	9010975	0.6%	12.1%	0.60	11.63	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55612	9010975	0.6%	12.7%	0.59	12.22	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55204	9010975	0.6%	13.3%	0.59	12.81	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57292	9010975	0.6%	14.0%	0.61	13.42	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5	9010975	0.0%	14.0%	0.00	13.42	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17544	9010975	0.2%	14.2%	0.19	13.61	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	43	9010975	0.0%	14.2%	0.00	13.61	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17575	9010975	0.2%	14.4%	0.19	13.79	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4736	9010975	0.1%	14.4%	0.05	13.84	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3897	9010975	0.0%	14.5%	0.04	13.89	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7688	9010975	0.1%	14.5%	0.08	13.97	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10	9010975	0.0%	14.5%	0.00	13.97	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10	9010975	0.0%	14.5%	0.00	13.97	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8322	9010975	0.1%	14.6%	0.09	14.06	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8247	9010975	0.1%	14.7%	0.09	14.14	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56005	9010975	0.6%	15.4%	0.60	14.74	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8219	9010975	0.1%	15.4%	0.09	14.83	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55699	9010975	0.6%	16.1%	0.59	15.42	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55862	9010975	0.6%	16.7%	0.60	16.02	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	9010975	0.0%	16.7%	0.00	16.02	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55510	9010975	0.6%	17.3%	0.59	16.61	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57253	9010975	0.6%	17.9%	0.61	17.22	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8332	9010975	0.1%	18.0%	0.09	17.31	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	78	9010975	0.0%	18.0%	0.00	17.31	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7956	9010975	0.1%	18.1%	0.08	17.39	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	9010975	0.0%	18.1%	0.00	17.39	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7767	9010975	0.1%	18.2%	0.08	17.48	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6	9010975	0.0%	18.2%	0.00	17.48	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	9010975	0.0%	18.2%	0.00	17.48	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16194	9010975	0.2%	18.4%	0.17	17.65	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7650	9010975	0.1%	18.5%	0.08	17.73	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7770	9010975	0.1%	18.6%	0.08	17.81	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	9010975	0.0%	18.6%	0.00	17.81	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7582	9010975	0.1%	18.6%	0.08	17.89	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56682	9010975	0.6%	19.3%	0.60	18.50	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56517	9010975	0.6%	19.9%	0.60	19.10	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	9010975	0.0%	19.9%	0.00	19.10	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56129	9010975	0.6%	20.5%	0.60	19.70	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55693	9010975	0.6%	21.1%	0.59	20.29	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56163	9010975	0.6%	21.8%	0.60	20.89	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42	9010975	0.0%	21.8%	0.00	20.89	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8112	9010975	0.1%	21.8%	0.09	20.98	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	27	9010975	0.0%	21.8%	0.00	20.98	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	9010975	0.0%	21.9%	0.00	20.98	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	12131	9010975	0.1%	22.0%	0.13	21.11	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	9010975	0.0%	22.0%	0.00	21.11	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	9010975	0.0%	22.0%	0.00	21.11	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7247	9010975	0.1%	22.1%	0.08	21.18	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10198	9010975	0.1%	22.2%	0.11	21.29	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34922	9010975	0.4%	22.6%	0.37	21.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	9010975	0.0%	22.6%	0.00	21.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34648	9010975	0.4%	23.0%	0.37	22.03	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35100	9010975	0.4%	23.3%	0.37	22.41	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	41067	9010975	0.5%	23.8%	0.44	22.84	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	33	9010975	0.0%	23.8%	0.00	22.84	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7352	9010975	0.1%	23.9%	0.08	22.92	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	40888	9010975	0.5%	24.3%	0.44	23.36	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17177	9010975	0.2%	24.5%	0.18	23.54	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	20233	9010975	0.2%	24.7%	0.22	23.76	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	45318	9010975	0.5%	25.2%	0.48	24.24	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39160	9010975	0.4%	25.7%	0.42	24.66	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1478235	9010975	16.4%	42.1%	15.75	40.41	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	244698	9010975	2.7%	44.8%	2.61	43.01	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	429549	9010975	4.8%	49.6%	4.58	47.59	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5027	9010975	0.1%	49.6%	0.05	47.64	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15738	9010975	0.2%	49.8%	0.17	47.81	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17815	9010975	0.2%	50.0%	0.19	48.00	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	388	9010975	0.0%	50.0%	0.00	48.00	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	3	9010975	0.0%	50.0%	0.00	48.00	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1	9010975	0.0%	50.0%	0.00	48.00	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49701	9010975	0.6%	50.6%	0.53	48.53	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	29857	9010975	0.3%	50.9%	0.32	48.85	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49732	9010975	0.6%	51.4%	0.53	49.38	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	0	9010975	0.0%	51.4%	0.00	49.38	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2152166	9010975	23.9%	75.3%	22.93	72.31	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	52	9010975	0.0%	75.3%	0.00	72.31	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	2220042	9010975	24.6%	100.0%	22.42	94.73	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	135	9010975	0.0%	100.0%	0.00	94.73	
CH52-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1938	9010975	0.0%	100.0%	0.02	94.75	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	299	9010975	0.0%	100.0%	0.00	94.75	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1214	9010975	0.0%	100.0%	0.01	94.77	
CH52-C	7	Public Facility and Residential, 8-12 units/acre	615	91	0	9010975	0.0%	100.0%	0.00	94.77	**94.8**
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6497	9509888	0.1%	0.1%	0.06	0.06	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	12009	9509888	0.1%	0.2%	0.11	0.17	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	13352	9509888	0.1%	0.3%	0.12	0.30	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	33193	9509888	0.3%	0.7%	0.31	0.61	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	15804	9509888	0.2%	0.9%	0.15	0.76	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	7348	9509888	0.1%	0.9%	0.07	0.83	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	76243	9509888	0.8%	1.7%	0.71	1.54	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9180	9509888	0.1%	1.8%	0.09	1.63	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6899	9509888	0.1%	1.9%	0.07	1.70	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	4612	9509888	0.0%	1.9%	0.04	1.74	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	0	9509888	0.0%	1.9%	0.00	1.74	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9651	9509888	0.1%	2.0%	0.09	1.83	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	7015	9509888	0.1%	2.1%	0.07	1.90	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	5346	9509888	0.1%	2.2%	0.05	1.95	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	7056	9509888	0.1%	2.3%	0.07	2.02	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8225	9509888	0.1%	2.3%	0.08	2.10	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6979	9509888	0.1%	2.4%	0.07	2.16	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8305	9509888	0.1%	2.5%	0.08	2.24	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6647	9509888	0.1%	2.6%	0.06	2.31	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	7911	9509888	0.1%	2.7%	0.08	2.38	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6421	9509888	0.1%	2.7%	0.06	2.44	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	85135	9509888	0.9%	3.6%	0.80	3.24	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	64977	9509888	0.7%	4.3%	0.61	3.85	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	83035	9509888	0.9%	5.2%	0.78	4.63	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6641	9509888	0.1%	5.2%	0.06	4.69	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8219	9509888	0.1%	5.3%	0.08	4.77	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	201257	9509888	2.1%	7.4%	1.88	6.65	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	104266	9509888	1.1%	8.5%	0.98	7.63	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6588	9509888	0.1%	8.6%	0.06	7.69	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8210	9509888	0.1%	8.7%	0.08	7.77	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6721	9509888	0.1%	8.8%	0.06	7.83	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8669	9509888	0.1%	8.9%	0.08	7.92	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6567	9509888	0.1%	8.9%	0.06	7.98	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8585	9509888	0.1%	9.0%	0.08	8.06	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6688	9509888	0.1%	9.1%	0.06	8.13	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8749	9509888	0.1%	9.2%	0.08	8.21	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6484	9509888	0.1%	9.2%	0.06	8.27	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	102516	9509888	1.1%	10.3%	0.96	9.23	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	116699	9509888	1.2%	11.6%	1.09	10.32	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	199697	9509888	2.1%	13.7%	1.87	12.19	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8322	9509888	0.1%	13.7%	0.08	12.27	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	70191	9509888	0.7%	14.5%	0.66	12.93	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6823	9509888	0.1%	14.6%	0.07	12.99	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	127383	9509888	1.3%	15.9%	1.19	14.19	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	7233	9509888	0.1%	16.0%	0.07	14.25	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6780	9509888	0.1%	16.0%	0.06	14.32	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	7043	9509888	0.1%	16.1%	0.07	14.39	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8628	9509888	0.1%	16.2%	0.08	14.47	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8919	9509888	0.1%	16.3%	0.09	14.55	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9759	9509888	0.1%	16.4%	0.09	14.65	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	139172	9509888	1.5%	17.9%	1.30	15.95	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	121062	9509888	1.3%	19.1%	1.13	17.08	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	99377	9509888	1.0%	20.2%	1.00	18.09	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	93221	9509888	1.0%	21.2%	0.87	18.96	
CH56-C	12	Schools	390	86	228297	9509888	2.4%	23.6%	2.06	21.02	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138936	9509888	1.5%	25.0%	1.30	22.32	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	108623	9509888	1.1%	26.2%	1.02	23.34	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	194435	9509888	2.0%	28.2%	1.82	25.16	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	195126	9509888	2.1%	30.3%	1.83	26.99	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	14575	9509888	0.2%	30.4%	0.15	27.13	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	18931	9509888	0.2%	30.6%	0.19	27.32	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	221403	9509888	2.3%	32.9%	2.07	29.40	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	256766	9509888	2.7%	35.6%	2.40	31.80	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	29130	9509888	0.3%	35.9%	0.27	32.07	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	173940	9509888	1.8%	37.8%	1.63	33.70	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	638015	9509888	6.7%	44.5%	6.44	40.14	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	178113	9509888	1.9%	46.4%	1.80	41.94	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13550	9509888	0.1%	46.5%	0.14	42.08	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138646	9509888	1.5%	48.0%	1.30	43.37	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	194516	9509888	2.0%	50.0%	1.82	45.19	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	186635	9509888	2.0%	52.0%	1.75	46.94	
CH56-C	2	Parks, Golf Courses	390	76	76947	9509888	0.8%	52.8%	0.61	47.55	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	9237	9509888	0.1%	52.9%	0.09	47.65	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	324738	9509888	3.4%	56.3%	3.04	50.69	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	171651	9509888	1.8%	58.1%	1.61	52.29	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	109723	9509888	1.2%	59.2%	1.03	53.32	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	108327	9509888	1.1%	60.4%	1.01	54.33	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	150104	9509888	1.6%	62.0%	1.40	55.74	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	315878	9509888	3.3%	65.3%	2.96	58.70	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	202273	9509888	2.1%	67.4%	2.04	60.74	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	124594	9509888	1.3%	68.7%	1.26	61.99	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	202937	9509888	2.1%	70.9%	2.05	64.04	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	8258	9509888	0.1%	70.9%	0.08	64.13	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6840	9509888	0.1%	71.0%	0.07	64.20	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	54714	9509888	0.6%	71.6%	0.55	64.75	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	62875	9509888	0.7%	72.3%	0.63	65.38	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	183624	9509888	1.9%	74.2%	1.85	67.24	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	615	91	308275	9509888	3.2%	77.4%	2.95	70.19	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	2126550	9509888	22.4%	99.8%	20.35	90.54	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	10	9509888	0.0%	99.8%	0.00	90.54	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	2	9509888	0.0%	99.8%	0.00	90.54	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	4	9509888	0.0%	99.8%	0.00	90.54	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	615	91	11	9509888	0.0%	99.8%	0.00	90.54	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	10	9509888	0.0%	99.8%	0.00	90.54	
CH56-C	2	Parks, Golf Courses	390	76	1456	9509888	0.0%	99.8%	0.01	90.55	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	3799	9509888	0.0%	99.8%	0.04	90.58	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	289	9509888	0.0%	99.8%	0.00	90.59	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1096	9509888	0.0%	99.9%	0.01	90.60	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	839	9509888	0.0%	99.9%	0.01	90.60	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1437	9509888	0.0%	99.9%	0.01	90.62	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	626	9509888	0.0%	99.9%	0.01	90.62	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	2622	9509888	0.0%	99.9%	0.02	90.65	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	350	9509888	0.0%	99.9%	0.00	90.65	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	314	9509888	0.0%	99.9%	0.00	90.65	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	174	9509888	0.0%	99.9%	0.00	90.66	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	693	9509888	0.0%	99.9%	0.01	90.66	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	526	9509888	0.0%	99.9%	0.00	90.67	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	245	9509888	0.0%	99.9%	0.00	90.67	
CH56-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	268	9509888	0.0%	99.9%	0.00	90.67	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	35	9509888	0.0%	99.9%	0.00	90.67	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1400	9509888	0.0%	100.0%	0.01	90.69	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	1944	9509888	0.0%	100.0%	0.02	90.71	
CH56-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1938	9509888	0.0%	100.0%	0.02	90.72	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	615	91	299	9509888	0.0%	100.0%	0.00	90.73	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	615	91	0	9509888	0.0%	100.0%	0.00	90.73	
CH56-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6	9509888	0.0%	100.0%	0.00	90.73	**90.7**
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	54454	9514385	0.6%	0.6%	0.55	0.55	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55909	9514385	0.6%	1.2%	0.56	1.11	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56486	9514385	0.6%	1.8%	0.57	1.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1899	9514385	0.0%	1.8%	0.02	1.70	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	855	9514385	0.0%	1.8%	0.01	1.71	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	13	9514385	0.0%	1.8%	0.00	1.71	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4	9514385	0.0%	1.8%	0.00	1.71	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4	9514385	0.0%	1.8%	0.00	1.71	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	9514385	0.0%	1.8%	0.00	1.71	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	54837	9514385	0.6%	2.4%	0.55	2.26	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55913	9514385	0.6%	2.9%	0.56	2.83	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	9514385	0.0%	2.9%	0.00	2.83	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24	9514385	0.0%	2.9%	0.00	2.83	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55843	9514385	0.6%	3.5%	0.56	3.39	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	9514385	0.0%	3.5%	0.00	3.39	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	750393	9514385	7.9%	11.4%	7.57	10.96	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56374	9514385	0.6%	12.0%	0.57	11.53	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55701	9514385	0.6%	12.6%	0.56	12.09	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	22851	9514385	0.2%	12.8%	0.23	12.33	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	120	9514385	0.0%	12.8%	0.00	12.33	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	54433	9514385	0.6%	13.4%	0.55	12.88	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55909	9514385	0.6%	14.0%	0.56	13.44	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55887	9514385	0.6%	14.6%	0.56	14.00	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56050	9514385	0.6%	15.2%	0.57	14.57	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56038	9514385	0.6%	15.8%	0.57	15.13	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55980	9514385	0.6%	16.4%	0.56	15.70	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56029	9514385	0.6%	16.9%	0.57	16.26	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55895	9514385	0.6%	17.5%	0.56	16.83	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55788	9514385	0.6%	18.1%	0.56	17.39	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56093	9514385	0.6%	18.7%	0.57	17.96	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56014	9514385	0.6%	19.3%	0.57	18.52	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56022	9514385	0.6%	19.9%	0.57	19.09	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	240592	9514385	2.5%	22.4%	2.30	21.39	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	35638	9514385	0.4%	22.8%	0.34	21.73	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	270	88	32836	9514385	0.3%	23.1%	0.30	22.03	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	200939	9514385	2.1%	25.2%	2.03	24.06	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	104350	9514385	1.1%	26.3%	1.05	25.11	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56071	9514385	0.6%	26.9%	0.57	25.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56997	9514385	0.6%	27.5%	0.58	26.25	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	624	9514385	0.0%	27.5%	0.01	26.26	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	9514385	0.0%	27.5%	0.00	26.26	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56163	9514385	0.6%	28.1%	0.57	26.83	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9	9514385	0.0%	28.1%	0.00	26.83	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	523160	9514385	5.5%	33.6%	5.28	32.11	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56366	9514385	0.6%	34.2%	0.57	32.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	9514385	0.0%	34.2%	0.00	32.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56139	9514385	0.6%	34.8%	0.57	33.24	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57059	9514385	0.6%	35.4%	0.58	33.82	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	66842	9514385	0.7%	36.1%	0.67	34.49	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56876	9514385	0.6%	36.7%	0.57	35.07	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55120	9514385	0.6%	37.3%	0.56	35.62	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	265611	9514385	2.8%	40.1%	2.68	38.30	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34210	9514385	0.4%	40.4%	0.35	38.65	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	37792	9514385	0.4%	40.8%	0.36	39.01	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55775	9514385	0.6%	41.4%	0.56	39.57	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56463	9514385	0.6%	42.0%	0.57	40.14	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	21386	9514385	0.2%	42.2%	0.22	40.36	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120243	9514385	1.3%	43.5%	1.21	41.57	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120066	9514385	1.3%	44.8%	1.21	42.78	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	23477	9514385	0.2%	45.0%	0.24	43.02	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	118261	9514385	1.2%	46.3%	1.19	44.21	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57064	9514385	0.6%	46.9%	0.58	44.79	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	43793	9514385	0.5%	47.3%	0.44	45.23	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	119999	9514385	1.3%	48.6%	1.21	46.44	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39398	9514385	0.4%	49.0%	0.40	46.84	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	119266	9514385	1.3%	50.2%	1.20	48.04	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35590	9514385	0.4%	50.6%	0.36	48.40	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	265122	9514385	2.8%	53.4%	2.68	51.08	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	72492	9514385	0.8%	54.2%	0.73	51.81	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	20694	9514385	0.2%	54.4%	0.21	52.02	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17707	9514385	0.2%	54.6%	0.18	52.19	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	48008	9514385	0.5%	55.1%	0.48	52.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	115955	9514385	1.2%	56.3%	1.17	53.85	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	18657	9514385	0.2%	56.5%	0.19	54.04	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	115187	9514385	1.2%	57.7%	1.16	55.20	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120230	9514385	1.3%	59.0%	1.21	56.41	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120690	9514385	1.3%	60.2%	1.22	57.63	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34223	9514385	0.4%	60.6%	0.35	57.98	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56294	9514385	0.6%	61.2%	0.57	58.54	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56280	9514385	0.6%	61.8%	0.57	59.11	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	68880	9514385	0.7%	62.5%	0.70	59.81	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	62750	9514385	0.7%	63.2%	0.62	60.43	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55924	9514385	0.6%	63.7%	0.56	60.99	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56183	9514385	0.6%	64.3%	0.57	61.56	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56022	9514385	0.6%	64.9%	0.57	62.12	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	3337058	9514385	35.1%	100.0%	31.92	94.04	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	270	88	22	9514385	0.0%	100.0%	0.00	94.04	**94.0**
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	125671	11594922	1.1%	1.1%	1.04	1.04	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	33643	11594922	0.3%	1.4%	0.28	1.32	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	1867	11594922	0.0%	1.4%	0.02	1.33	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	723	11594922	0.0%	1.4%	0.01	1.34	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	8788	11594922	0.1%	1.5%	0.07	1.41	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	6155	11594922	0.1%	1.5%	0.05	1.46	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	3403	11594922	0.0%	1.6%	0.03	1.49	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2732	11594922	0.0%	1.6%	0.02	1.52	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	15491	11594922	0.1%	1.7%	0.13	1.64	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	36121	11594922	0.3%	2.0%	0.30	1.94	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	42068	11594922	0.4%	2.4%	0.35	2.29	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	52182	11594922	0.5%	2.8%	0.43	2.72	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	55725	11594922	0.5%	3.3%	0.46	3.18	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	55715	11594922	0.5%	3.8%	0.46	3.65	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	524299	11594922	4.5%	8.3%	4.34	7.99	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	130332	11594922	1.1%	9.4%	1.08	9.07	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	27111	11594922	0.2%	9.7%	0.22	9.29	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	615	91	73	11594922	0.0%	9.7%	0.00	9.29	
CH60A-C	12	Schools	615	86	529320	11594922	4.6%	14.2%	3.93	13.22	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	50	11594922	0.0%	14.2%	0.00	13.22	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	19316	11594922	0.2%	14.4%	0.15	13.37	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	7155	11594922	0.1%	14.5%	0.05	13.42	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	1529053	11594922	13.2%	27.7%	11.74	25.16	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	414451	11594922	3.6%	31.2%	3.18	28.34	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	94332	11594922	0.8%	32.0%	0.72	29.06	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1764	11594922	0.0%	32.1%	0.01	29.08	
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1056624	11594922	9.1%	41.2%	8.29	37.37	
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	390	91	2219011	11594922	19.1%	60.3%	17.42	54.78	
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1844	11594922	0.0%	60.3%	0.01	54.80	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	57053	11594922	0.5%	60.8%	0.44	55.24	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	55940	11594922	0.5%	61.3%	0.43	55.67	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	703	11594922	0.0%	61.3%	0.01	55.67	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2463	11594922	0.0%	61.3%	0.02	55.69	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	54982	11594922	0.5%	61.8%	0.42	56.11	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34986	11594922	0.3%	62.1%	0.29	56.40	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58959	11594922	0.5%	62.6%	0.45	56.86	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	76709	11594922	0.7%	63.3%	0.64	57.49	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	195336	11594922	1.7%	65.0%	1.62	59.11	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	117836	11594922	1.0%	66.0%	0.90	60.01	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57389	11594922	0.5%	66.5%	0.48	60.49	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	11594922	0.0%	66.5%	0.00	60.49	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57344	11594922	0.5%	67.0%	0.47	60.96	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	584949	11594922	5.0%	72.0%	4.84	65.81	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60441	11594922	0.5%	72.5%	0.46	66.27	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	35539	11594922	0.3%	72.8%	0.27	66.54	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	55885	11594922	0.5%	73.3%	0.43	66.97	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55713	11594922	0.5%	73.8%	0.46	67.43	
CH60A-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	76973	11594922	0.7%	74.5%	0.59	68.02	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55743	11594922	0.5%	74.9%	0.46	68.49	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15856	11594922	0.1%	75.1%	0.13	68.62	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	59439	11594922	0.5%	75.6%	0.49	69.11	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56186	11594922	0.5%	76.1%	0.47	69.57	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15640	11594922	0.1%	76.2%	0.13	69.70	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120611	11594922	1.0%	77.3%	1.00	70.70	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	25845	11594922	0.2%	77.5%	0.21	70.92	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56545	11594922	0.5%	78.0%	0.47	71.38	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56179	11594922	0.5%	78.5%	0.47	71.85	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35256	11594922	0.3%	78.8%	0.29	72.14	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1051236	11594922	9.1%	87.8%	8.70	80.85	
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1050626	11594922	9.1%	96.9%	8.25	89.09	
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	390	91	361361	11594922	3.1%	100.0%	2.84	91.93	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	10	11594922	0.0%	100.0%	0.00	91.93	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	2	11594922	0.0%	100.0%	0.00	91.93	
CH60A-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	4	11594922	0.0%	100.0%	0.00	91.93	
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	615	91	11	11594922	0.0%	100.0%	0.00	91.93	
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	390	91	10	11594922	0.0%	100.0%	0.00	91.93	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	615	91	135	11594922	0.0%	100.0%	0.00	91.93	
CH60A-C	7	Public Facility and Residential, 8-12 units/acre	615	91	0	11594922	0.0%	100.0%	0.00	91.93	**91.9**
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	23241	7345433	0.3%	0.3%	0.28	0.28	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	44961	7345433	0.6%	0.9%	0.51	0.80	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	85998	7345433	1.2%	2.1%	1.04	1.84	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	91193	7345433	1.2%	3.3%	1.04	2.88	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	6382	7345433	0.1%	3.4%	0.07	2.95	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	120979	7345433	1.6%	5.1%	1.47	4.42	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	57060	7345433	0.8%	5.9%	0.65	5.07	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	145201	7345433	2.0%	7.8%	1.76	6.83	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	33463	7345433	0.5%	8.3%	0.38	7.21	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	102296	7345433	1.4%	9.7%	1.34	8.55	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	107684	7345433	1.5%	11.1%	1.30	9.86	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	156259	7345433	2.1%	13.3%	1.89	11.75	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	22496	7345433	0.3%	13.6%	0.26	12.01	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	13470	7345433	0.2%	13.8%	0.15	12.16	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	22	7345433	0.0%	13.8%	0.00	12.16	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	14584	7345433	0.2%	14.0%	0.19	12.35	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	174709	7345433	2.4%	16.3%	2.12	14.47	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27924	7345433	0.4%	16.7%	0.32	14.79	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	1245	7345433	0.0%	16.7%	0.02	14.80	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	5350	7345433	0.1%	16.8%	0.06	14.86	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52514	7345433	0.7%	17.5%	0.60	15.46	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	19913	7345433	0.3%	17.8%	0.26	15.72	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	4260	7345433	0.1%	17.9%	0.05	15.78	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9662	7345433	0.1%	18.0%	0.11	15.89	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	162862	7345433	2.2%	20.2%	1.97	17.86	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	59734	7345433	0.8%	21.0%	0.68	18.54	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	15284	7345433	0.2%	21.2%	0.20	18.74	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	137115	7345433	1.9%	23.1%	1.66	20.40	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	167289	7345433	2.3%	25.4%	1.91	22.32	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	10462	7345433	0.1%	25.5%	0.13	22.44	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	72030	7345433	1.0%	26.5%	0.82	23.27	
CH63-C	2	Parks, Golf Courses	390	76	58485	7345433	0.8%	27.3%	0.61	23.87	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	9952	7345433	0.1%	27.4%	0.13	24.00	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	4699	7345433	0.1%	27.5%	0.06	24.06	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	153967	7345433	2.1%	29.6%	1.76	25.82	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17848	7345433	0.2%	29.8%	0.23	26.05	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	157871	7345433	2.1%	32.0%	1.81	27.85	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	4902	7345433	0.1%	32.0%	0.06	27.91	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	15249	7345433	0.2%	32.2%	0.17	28.09	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	58717	7345433	0.8%	33.0%	0.71	28.80	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	65964	7345433	0.9%	33.9%	0.75	29.55	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	82110	7345433	1.1%	35.1%	0.94	30.49	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	107390	7345433	1.5%	36.5%	1.23	31.72	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	158222	7345433	2.2%	38.7%	1.81	33.53	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7684	7345433	0.1%	38.8%	0.09	33.62	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	14390	7345433	0.2%	39.0%	0.17	33.79	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	65355	7345433	0.9%	39.9%	0.75	34.54	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	22720	7345433	0.3%	40.2%	0.28	34.81	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	55675	7345433	0.8%	40.9%	0.64	35.45	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3241	7345433	0.0%	41.0%	0.04	35.49	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5696	7345433	0.1%	41.1%	0.07	35.57	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	30490	7345433	0.4%	41.5%	0.35	35.92	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	127557	7345433	1.7%	43.2%	1.55	37.46	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	14857	7345433	0.2%	43.4%	0.17	37.63	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	28914	7345433	0.4%	43.8%	0.33	37.96	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	6430	7345433	0.1%	43.9%	0.08	38.04	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	236236	7345433	3.2%	47.1%	2.70	40.75	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	17401	7345433	0.2%	47.3%	0.20	40.94	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	189987	7345433	2.6%	49.9%	2.48	43.43	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	62251	7345433	0.8%	50.8%	0.81	44.24	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	10402	7345433	0.1%	50.9%	0.13	44.37	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17939	7345433	0.2%	51.2%	0.23	44.60	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	43589	7345433	0.6%	51.8%	0.56	45.16	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	9216	7345433	0.1%	51.9%	0.12	45.28	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	46372	7345433	0.6%	52.5%	0.59	45.87	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1416524	7345433	19.3%	71.8%	18.51	64.39	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	61072	7345433	0.8%	72.6%	0.78	65.17	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8394	7345433	0.1%	72.7%	0.11	65.28	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	24731	7345433	0.3%	73.1%	0.32	65.59	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	92698	7345433	1.3%	74.3%	1.21	66.81	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	99907	7345433	1.4%	75.7%	1.31	68.11	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	615	91	305396	7345433	4.2%	79.9%	3.78	71.89	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	390	91	541615	7345433	7.4%	87.2%	6.71	78.60	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	325	88	928991	7345433	12.6%	99.9%	11.13	89.73	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	615	91	4	7345433	0.0%	99.9%	0.00	89.73	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	325	88	26	7345433	0.0%	99.9%	0.00	89.73	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	615	91	179	7345433	0.0%	99.9%	0.00	89.74	
CH63-C	2	Parks, Golf Courses	390	76	1456	7345433	0.0%	99.9%	0.02	89.75	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	390	91	3799	7345433	0.1%	100.0%	0.05	89.80	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	784	7345433	0.0%	100.0%	0.01	89.81	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1523	7345433	0.0%	100.0%	0.02	89.83	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52	7345433	0.0%	100.0%	0.00	89.83	
CH63-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	250	7345433	0.0%	100.0%	0.00	89.83	
CH63-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	260	7345433	0.0%	100.0%	0.00	89.83	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	390	91	190	7345433	0.0%	100.0%	0.00	89.83	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	325	88	156	7345433	0.0%	100.0%	0.00	89.84	
CH63-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6	7345433	0.0%	100.0%	0.00	89.84	**89.8**
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	3092	7974105	0.0%	0.0%	0.04	0.04	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	70115	7974105	0.9%	0.9%	0.78	0.82	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	55546	7974105	0.7%	1.6%	0.62	1.44	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	108744	7974105	1.4%	3.0%	1.21	2.65	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	44009	7974105	0.6%	3.5%	0.49	3.14	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	146491	7974105	1.8%	5.4%	1.64	4.78	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	38652	7974105	0.5%	5.9%	0.43	5.21	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	81882	7974105	1.0%	6.9%	0.86	6.07	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8461	7974105	0.1%	7.0%	0.10	6.17	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	141642	7974105	1.8%	8.8%	1.58	7.75	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6588	7974105	0.1%	8.8%	0.08	7.83	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	108869	7974105	1.4%	10.2%	1.31	9.14	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974105	0.1%	10.3%	0.10	9.24	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9653	7974105	0.1%	10.4%	0.11	9.35	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8412	7974105	0.1%	10.5%	0.10	9.44	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	22860	7974105	0.3%	10.8%	0.26	9.70	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8412	7974105	0.1%	10.9%	0.10	9.80	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	11699	7974105	0.1%	11.1%	0.14	9.94	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	64184	7974105	0.8%	11.9%	0.77	10.71	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8750	7974105	0.1%	12.0%	0.10	10.81	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	73426	7974105	0.9%	12.9%	0.82	11.63	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8412	7974105	0.1%	13.0%	0.10	11.73	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	50386	7974105	0.6%	13.7%	0.56	12.29	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	73911	7974105	0.9%	14.6%	0.82	13.11	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8638	7974105	0.1%	14.7%	0.10	13.21	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	89443	7974105	1.1%	15.8%	1.00	14.21	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8088	7974105	0.1%	15.9%	0.09	14.30	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	16823	7974105	0.2%	16.1%	0.19	14.50	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8223	7974105	0.1%	16.2%	0.09	14.59	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974105	0.1%	16.3%	0.10	14.69	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8171	7974105	0.1%	16.4%	0.09	14.78	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974105	0.1%	16.5%	0.10	14.87	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	145511	7974105	1.8%	18.4%	1.62	16.50	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	41012	7974105	0.5%	18.9%	0.46	16.96	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	40492	7974105	0.5%	19.4%	0.45	17.41	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	102881	7974105	1.3%	20.7%	1.15	18.56	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8393	7974105	0.1%	20.8%	0.10	18.65	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974105	0.1%	20.9%	0.10	18.75	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	176801	7974105	2.2%	23.1%	1.97	20.72	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8313	7974105	0.1%	23.2%	0.09	20.82	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974105	0.1%	23.3%	0.10	20.91	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	219429	7974105	2.8%	26.1%	2.45	23.36	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	35417	7974105	0.4%	26.5%	0.40	23.76	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	31505	7974105	0.4%	26.9%	0.35	24.11	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	4325	7974105	0.1%	27.0%	0.05	24.15	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	34247	7974105	0.4%	27.4%	0.41	24.57	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8342	7974105	0.1%	27.5%	0.10	24.66	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974105	0.1%	27.6%	0.10	24.76	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8205	7974105	0.1%	27.7%	0.09	24.85	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974105	0.1%	27.8%	0.10	24.95	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	217767	7974105	2.7%	30.5%	2.43	27.38	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974105	0.1%	30.7%	0.11	27.49	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974105	0.1%	30.8%	0.11	27.59	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974105	0.1%	30.9%	0.11	27.70	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138285	7974105	1.7%	32.6%	1.54	29.25	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	38669	7974105	0.5%	33.1%	0.44	29.69	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974105	0.1%	33.2%	0.11	29.79	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	44375	7974105	0.6%	33.8%	0.50	30.29	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	217113	7974105	2.7%	36.5%	2.42	32.71	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	30135	7974105	0.4%	36.9%	0.34	33.05	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	89908	7974105	1.1%	38.0%	0.95	34.00	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974105	0.1%	38.1%	0.11	34.10	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	138445	7974105	1.7%	39.9%	1.67	35.77	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	7423	7974105	0.1%	40.0%	0.09	35.86	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	330172	7974105	4.1%	44.1%	3.97	39.84	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	11646	7974105	0.1%	44.3%	0.13	39.97	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	26064	7974105	0.3%	44.6%	0.30	40.27	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138816	7974105	1.7%	46.3%	1.55	41.81	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	177347	7974105	2.2%	48.5%	1.98	43.79	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	160218	7974105	2.0%	50.6%	1.79	45.58	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	159603	7974105	2.0%	52.6%	1.78	47.36	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	38	7974105	0.0%	52.6%	0.00	47.36	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	396243	7974105	5.0%	57.5%	4.42	51.79	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	165300	7974105	2.1%	59.6%	1.84	53.63	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	207308	7974105	2.6%	62.2%	2.31	55.95	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	50963	7974105	0.6%	62.8%	0.54	56.48	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	155047	7974105	1.9%	64.8%	1.63	58.12	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	70224	7974105	0.9%	65.7%	0.74	58.86	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	4176	7974105	0.1%	65.7%	0.05	58.90	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	242	7974105	0.0%	65.7%	0.00	58.91	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	3723	7974105	0.0%	65.8%	0.04	58.95	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	47053	7974105	0.6%	66.4%	0.53	59.47	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	2611	7974105	0.0%	66.4%	0.03	59.50	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	29208	7974105	0.4%	66.8%	0.33	59.83	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13275	7974105	0.2%	66.9%	0.16	59.99	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13867	7974105	0.2%	67.1%	0.17	60.15	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	14631	7974105	0.2%	67.3%	0.16	60.32	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	14974	7974105	0.2%	67.5%	0.17	60.48	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	615	91	168135	7974105	2.1%	69.6%	1.92	62.40	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	2175254	7974105	27.3%	96.8%	24.82	87.23	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	325	88	233721	7974105	2.9%	99.8%	2.58	89.81	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	784	7974105	0.0%	99.8%	0.01	89.81	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1523	7974105	0.0%	99.8%	0.02	89.83	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52	7974105	0.0%	99.8%	0.00	89.83	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	250	7974105	0.0%	99.8%	0.00	89.83	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	260	7974105	0.0%	99.8%	0.00	89.84	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	190	7974105	0.0%	99.8%	0.00	89.84	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	325	88	156	7974105	0.0%	99.8%	0.00	89.84	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	289	7974105	0.0%	99.8%	0.00	89.84	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1096	7974105	0.0%	99.8%	0.01	89.86	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	839	7974105	0.0%	99.8%	0.01	89.87	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1437	7974105	0.0%	99.9%	0.02	89.88	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	626	7974105	0.0%	99.9%	0.01	89.89	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	2622	7974105	0.0%	99.9%	0.03	89.92	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	350	7974105	0.0%	99.9%	0.00	89.92	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	314	7974105	0.0%	99.9%	0.00	89.93	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	174	7974105	0.0%	99.9%	0.00	89.93	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	693	7974105	0.0%	99.9%	0.01	89.94	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	526	7974105	0.0%	99.9%	0.01	89.94	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	245	7974105	0.0%	99.9%	0.00	89.94	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	268	7974105	0.0%	99.9%	0.00	89.95	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	35	7974105	0.0%	99.9%	0.00	89.95	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1400	7974105	0.0%	100.0%	0.02	89.96	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	1944	7974105	0.0%	100.0%	0.02	89.99	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7	7974105	0.0%	100.0%	0.00	89.99	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	325	88	178	7974105	0.0%	100.0%	0.00	89.99	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1214	7974105	0.0%	100.0%	0.01	90.00	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6	7974105	0.0%	100.0%	0.00	90.00	**90.0**
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	71445	9881315	0.7%	0.7%	0.61	0.61	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	61008	9881315	0.6%	1.3%	0.52	1.13	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	89365	9881315	0.9%	2.2%	0.76	1.89	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	95976	9881315	1.0%	3.2%	0.82	2.70	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13263	9881315	0.1%	3.4%	0.13	2.83	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	141396	9881315	1.4%	4.8%	1.20	4.03	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	106655	9881315	1.1%	5.9%	0.91	4.94	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112298	9881315	1.1%	7.0%	0.95	5.89	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	110818	9881315	1.1%	8.1%	0.94	6.83	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13903	9881315	0.1%	8.3%	0.13	6.97	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	141950	9881315	1.4%	9.7%	1.21	8.17	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	106527	9881315	1.1%	10.8%	0.91	9.08	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112751	9881315	1.1%	11.9%	0.96	10.04	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	113127	9881315	1.1%	13.1%	0.96	11.00	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13238	9881315	0.1%	13.2%	0.13	11.12	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	141210	9881315	1.4%	14.6%	1.20	12.32	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	106759	9881315	1.1%	15.7%	0.91	13.23	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111030	9881315	1.1%	16.8%	0.94	14.18	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111728	9881315	1.1%	18.0%	0.95	15.13	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13211	9881315	0.1%	18.1%	0.13	15.25	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11191	9881315	0.1%	18.2%	0.10	15.35	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	30623	9881315	0.3%	18.5%	0.26	15.61	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	85626	9881315	0.9%	19.4%	0.73	16.33	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	136819	9881315	1.4%	20.8%	1.16	17.50	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	57299	9881315	0.6%	21.3%	0.49	17.98	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	142129	9881315	1.4%	22.8%	1.21	19.19	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	107824	9881315	1.1%	23.9%	0.92	20.11	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112380	9881315	1.1%	25.0%	0.96	21.06	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112288	9881315	1.1%	26.1%	0.95	22.02	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12850	9881315	0.1%	26.3%	0.12	22.14	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	136021	9881315	1.4%	27.7%	1.16	23.30	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	102490	9881315	1.0%	28.7%	0.87	24.17	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111202	9881315	1.1%	29.8%	0.95	25.11	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	108169	9881315	1.1%	30.9%	0.92	26.03	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13125	9881315	0.1%	31.0%	0.12	26.16	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	487528	9881315	4.9%	36.0%	4.14	30.30	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	54518	9881315	0.6%	36.5%	0.46	30.77	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	138752	9881315	1.4%	37.9%	1.18	31.95	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	101133	9881315	1.0%	39.0%	0.86	32.81	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	110314	9881315	1.1%	40.1%	0.94	33.74	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	109552	9881315	1.1%	41.2%	0.93	34.67	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12229	9881315	0.1%	41.3%	0.12	34.79	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	139547	9881315	1.4%	42.7%	1.19	35.98	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	101054	9881315	1.0%	43.7%	0.86	36.84	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	109913	9881315	1.1%	44.9%	0.93	37.77	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	109099	9881315	1.1%	46.0%	0.93	38.70	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	11824	9881315	0.1%	46.1%	0.11	38.81	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	80085	9881315	0.8%	46.9%	0.68	39.49	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	44063	9881315	0.4%	47.3%	0.37	39.87	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	49499	9881315	0.5%	47.8%	0.42	40.29	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	103783	9881315	1.1%	48.9%	0.88	41.17	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111845	9881315	1.1%	50.0%	0.95	42.12	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	110373	9881315	1.1%	51.1%	0.94	43.06	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	11157	9881315	0.1%	51.2%	0.11	43.16	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	147561	9881315	1.5%	52.7%	1.25	44.42	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	356139	9881315	3.6%	56.3%	3.03	47.45	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	93782	9881315	0.9%	57.3%	0.80	48.24	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	97600	9881315	1.0%	58.3%	0.83	49.07	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111402	9881315	1.1%	59.4%	0.95	50.02	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111084	9881315	1.1%	60.5%	0.94	50.96	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12175	9881315	0.1%	60.7%	0.12	51.08	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27342	9881315	0.3%	60.9%	0.23	51.31	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	47538	9881315	0.5%	61.4%	0.40	51.72	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	122747	9881315	1.2%	62.7%	1.04	52.76	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13134	9881315	0.1%	62.8%	0.12	52.89	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	124261	9881315	1.3%	64.0%	1.06	53.94	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	169312	9881315	1.7%	65.8%	1.44	55.38	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	142115	9881315	1.4%	67.2%	1.21	56.59	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	154358	9881315	1.6%	68.8%	1.31	57.90	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17222	9881315	0.2%	68.9%	0.16	58.07	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	56293	9881315	0.6%	69.5%	0.48	58.54	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	82725	9881315	0.8%	70.3%	0.70	59.25	
CH67-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5988	9881315	0.1%	70.4%	0.06	59.30	
CH67-C	7	Public Facility and Residential, 8-12 units/acre	325	88	2924011	9881315	29.6%	100.0%	26.04	85.34	
CH67-C	7	Public Facility and Residential, 8-12 units/acre	325	88	377	9881315	0.0%	100.0%	0.00	85.35	
CH67-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7	9881315	0.0%	100.0%	0.00	85.35	
CH67-C	7	Public Facility and Residential, 8-12 units/acre	325	88	178	9881315	0.0%	100.0%	0.00	85.35	**85.3**
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	1468	8050681	0.0%	0.0%	0.02	0.02	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	21	8050681	0.0%	0.0%	0.00	0.02	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	333	8050681	0.0%	0.0%	0.00	0.02	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	793	8050681	0.0%	0.0%	0.01	0.03	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	694	8050681	0.0%	0.0%	0.01	0.04	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	8050681	0.0%	0.0%	0.00	0.04	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	8050681	0.0%	0.0%	0.00	0.04	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39497	8050681	0.5%	0.5%	0.47	0.51	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	80613	8050681	1.0%	1.5%	0.96	1.47	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	304211	8050681	3.8%	5.3%	3.63	5.10	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	373510	8050681	4.6%	10.0%	4.45	9.55	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	369393	8050681	4.6%	14.5%	4.31	13.87	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4972	8050681	0.1%	14.6%	0.06	13.93	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	19	8050681	0.0%	14.6%	0.00	13.93	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	26	8050681	0.0%	14.6%	0.00	13.93	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	26	8050681	0.0%	14.6%	0.00	13.93	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49524	8050681	0.6%	15.2%	0.59	14.52	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	23	8050681	0.0%	15.2%	0.00	14.52	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	2	8050681	0.0%	15.2%	0.00	14.52	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11	8050681	0.0%	15.2%	0.00	14.52	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9	8050681	0.0%	15.2%	0.00	14.52	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	4	8050681	0.0%	15.2%	0.00	14.52	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17474	8050681	0.2%	15.4%	0.20	14.72	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	278	8050681	0.0%	15.4%	0.00	14.72	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1453754	8050681	18.1%	33.5%	17.34	32.06	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	2039	8050681	0.0%	33.5%	0.02	32.08	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	24	8050681	0.0%	33.5%	0.00	32.08	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	87595	8050681	1.1%	34.6%	1.04	33.13	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4101	8050681	0.1%	34.7%	0.05	33.18	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	8050681	0.0%	34.7%	0.00	33.18	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3	8050681	0.0%	34.7%	0.00	33.18	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	40341	8050681	0.5%	35.2%	0.48	33.66	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	101365	8050681	1.3%	36.4%	1.21	34.87	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39676	8050681	0.5%	36.9%	0.47	35.34	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42510	8050681	0.5%	37.4%	0.51	35.85	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	34162	8050681	0.4%	37.9%	0.38	36.22	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6974	8050681	0.1%	38.0%	0.08	36.31	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	73442	8050681	0.9%	38.9%	0.81	37.12	
CH68	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	27	8050681	0.0%	38.9%	0.00	37.12	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	111672	8050681	1.4%	40.3%	1.23	38.35	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	976103	8050681	12.1%	52.4%	10.79	49.14	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	175947	8050681	2.2%	54.6%	1.95	51.09	
CH68	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	2764281	8050681	34.3%	88.9%	28.84	79.93	
CH68	7	Public Facility and Residential, 8-12 units/acre	615	91	671713	8050681	8.3%	97.2%	7.59	87.52	
CH68	7	Public Facility and Residential, 8-12 units/acre	390	91	58431	8050681	0.7%	98.0%	0.66	88.18	
CH68	7	Public Facility and Residential, 8-12 units/acre	325	88	163437	8050681	2.0%	100.0%	1.79	89.97	
CH68	7	Public Facility and Residential, 8-12 units/acre	615	91	179	8050681	0.0%	100.0%	0.00	89.97	**90.0**
FR03-1	2	Parks, Golf Courses	325	64	5032	5221479	0.1%	0.1%	0.06	0.06	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	260486	5221479	5.0%	5.1%	4.19	4.25	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	59209	5221479	1.1%	6.2%	0.95	5.20	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	159666	5221479	3.1%	9.3%	2.57	7.77	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	42290	5221479	0.8%	10.1%	0.68	8.45	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	114510	5221479	2.2%	12.3%	1.84	10.30	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	85568	5221479	1.6%	13.9%	1.38	11.67	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	168623	5221479	3.2%	17.1%	2.71	14.39	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	173289	5221479	3.3%	20.5%	2.79	17.17	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	121242	5221479	2.3%	22.8%	1.95	19.12	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	229708	5221479	4.4%	27.2%	3.70	22.82	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	268056	5221479	5.1%	32.3%	4.31	27.13	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	116647	5221479	2.2%	34.6%	1.88	29.01	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7329	5221479	0.1%	34.7%	0.12	29.13	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	4734	5221479	0.1%	34.8%	0.08	29.20	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	32079	5221479	0.6%	35.4%	0.52	29.72	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	84609	5221479	1.6%	37.0%	1.36	31.08	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	63240	5221479	1.2%	38.2%	1.02	32.10	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	183932	5221479	3.5%	41.8%	2.96	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	50	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	23	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	117	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	24	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	7	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	5	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	39	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	19	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	7	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	81	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	100	5221479	0.0%	41.8%	0.00	35.06	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	1746923	5221479	33.5%	75.2%	29.44	64.50	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	236	88	71171	5221479	1.4%	76.6%	1.20	65.70	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	615	91	324348	5221479	6.2%	82.8%	5.65	71.36	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	319170	5221479	6.1%	88.9%	5.75	77.10	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	236	94	33334	5221479	0.6%	89.5%	0.60	77.70	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17744	5221479	0.3%	89.9%	0.32	78.02	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	123573	5221479	2.4%	92.3%	2.22	80.25	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	373	5221479	0.0%	92.3%	0.01	80.25	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	376497	5221479	7.2%	99.5%	6.92	87.18	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	27625	5221479	0.5%	100.0%	0.51	87.68	**87.7**
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	84260	6749671	1.2%	1.2%	1.17	1.17	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	104436	6749671	1.5%	2.8%	1.30	2.47	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	239154	6749671	3.5%	6.3%	2.98	5.45	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	157179	6749671	2.3%	8.7%	1.96	7.41	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	220531	6749671	3.3%	11.9%	2.74	10.15	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	179846	6749671	2.7%	14.6%	2.24	12.39	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	105702	6749671	1.6%	16.2%	1.32	13.70	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	58868	6749671	0.9%	17.0%	0.73	14.44	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	12515	6749671	0.2%	17.2%	0.16	14.59	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9367	6749671	0.1%	17.4%	0.13	14.73	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3939	6749671	0.1%	17.4%	0.05	14.78	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	615	91	14	6749671	0.0%	17.4%	0.00	14.78	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	615	91	870	6749671	0.0%	17.4%	0.01	14.79	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	248129	6749671	3.7%	21.1%	3.53	18.32	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	135185	6749671	2.0%	23.1%	1.68	20.00	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	70577	6749671	1.0%	24.2%	0.98	20.99	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	91750	6749671	1.4%	25.5%	1.14	22.13	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	229463	6749671	3.4%	28.9%	2.86	24.98	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	213193	6749671	3.2%	32.1%	2.65	27.64	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	206930	6749671	3.1%	35.1%	2.58	30.21	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	7392	6749671	0.1%	35.3%	0.10	30.32	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	114333	6749671	1.7%	36.9%	1.42	31.74	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	325	88	8	6749671	0.0%	36.9%	0.00	31.74	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	325	88	3	6749671	0.0%	36.9%	0.00	31.74	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	8726	6749671	0.1%	37.1%	0.12	31.86	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	72387	6749671	1.1%	38.1%	0.90	32.76	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	10196	6749671	0.2%	38.3%	0.14	32.90	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	49090	6749671	0.7%	39.0%	0.61	33.51	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1139131	6749671	16.9%	55.9%	16.20	49.72	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12667	6749671	0.2%	56.1%	0.18	49.89	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	63016	6749671	0.9%	57.0%	0.90	50.79	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3012	6749671	0.0%	57.1%	0.04	50.83	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	29407	6749671	0.4%	57.5%	0.41	51.24	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	32851	6749671	0.5%	58.0%	0.41	51.65	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	257199	6749671	3.8%	61.8%	3.39	55.04	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	440816	6749671	6.5%	68.3%	5.49	60.53	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2560	6749671	0.0%	68.4%	0.04	60.56	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3663	6749671	0.1%	68.4%	0.05	60.61	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	7034	6749671	0.1%	68.5%	0.09	60.71	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9149	6749671	0.1%	68.7%	0.11	60.82	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	323506	6749671	4.8%	73.5%	4.60	65.42	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	7489	6749671	0.1%	73.6%	0.10	65.53	
FR04-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1936	6749671	0.0%	73.6%	0.03	65.55	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	615	91	721608	6749671	10.7%	84.3%	9.73	75.28	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	325	88	1060172	6749671	15.7%	100.0%	13.82	89.10	
FR04-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	2	6749671	0.0%	100.0%	0.00	89.10	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	325	88	1	6749671	0.0%	100.0%	0.00	89.10	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	615	91	4	6749671	0.0%	100.0%	0.00	89.10	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	325	88	26	6749671	0.0%	100.0%	0.00	89.10	
FR04-C	7	Public Facility and Residential, 8-12 units/acre	325	88	377	6749671	0.0%	100.0%	0.00	89.11	**89.1**

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	86830	7603902	1.1%	1.1%	1.10	1.10	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	263935	7603902	3.5%	4.6%	3.33	4.43	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	6482	7603902	0.1%	4.7%	0.08	4.50	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	462	7603902	0.0%	4.7%	0.01	4.51	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	86648	7603902	1.1%	5.8%	1.01	5.52	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	451	7603902	0.0%	5.8%	0.01	5.53	
CH51	7	Public Facility and Residential, 8-12 units/acre	615	91	30	7603902	0.0%	5.9%	0.00	5.53	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	87313	7603902	1.1%	7.0%	1.10	6.63	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	172398	7603902	2.3%	9.3%	2.02	8.65	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	125984	7603902	1.7%	10.9%	1.47	10.12	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	117337	7603902	1.5%	12.5%	1.37	11.50	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	53744	7603902	0.7%	13.2%	0.68	12.18	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	35947	7603902	0.5%	13.6%	0.42	12.60	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	108387	7603902	1.4%	15.1%	1.27	13.87	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	0	7603902	0.0%	15.1%	0.00	13.87	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	0	7603902	0.0%	15.1%	0.00	13.87	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37	7603902	0.0%	15.1%	0.00	13.87	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	15578	7603902	0.2%	15.3%	0.18	14.05	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	2	7603902	0.0%	15.3%	0.00	14.05	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	190927	7603902	2.5%	17.8%	2.23	16.28	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	140439	7603902	1.8%	19.6%	1.64	17.93	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	507	7603902	0.0%	19.6%	0.01	17.93	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	101	7603902	0.0%	19.6%	0.00	17.93	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	222332	7603902	2.9%	22.6%	2.81	20.74	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	116	7603902	0.0%	22.6%	0.00	20.74	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	120	7603902	0.0%	22.6%	0.00	20.74	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	19593	7603902	0.3%	22.8%	0.23	20.97	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10205	7603902	0.1%	23.0%	0.13	21.10	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	201915	7603902	2.7%	25.6%	2.36	23.47	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	66877	7603902	0.9%	26.5%	0.84	24.31	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	916	7603902	0.0%	26.5%	0.01	24.32	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	13	7603902	0.0%	26.5%	0.00	24.32	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	133	7603902	0.0%	26.5%	0.00	24.32	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	39	7603902	0.0%	26.5%	0.00	24.32	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	10	7603902	0.0%	26.5%	0.00	24.32	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	156	7603902	0.0%	26.5%	0.00	24.32	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	775268	7603902	10.2%	36.7%	9.79	34.11	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37160	7603902	0.5%	37.2%	0.43	34.55	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	159619	7603902	2.1%	39.3%	1.87	36.42	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58156	7603902	0.8%	40.1%	0.68	37.10	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58980	7603902	0.8%	40.8%	0.69	37.79	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58964	7603902	0.8%	41.6%	0.69	38.48	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	35910	7603902	0.5%	42.1%	0.42	38.90	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	36807	7603902	0.5%	42.6%	0.43	39.33	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60597	7603902	0.8%	43.4%	0.71	40.04	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	148441	7603902	2.0%	45.3%	1.87	41.91	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60082	7603902	0.8%	46.1%	0.70	42.61	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60639	7603902	0.8%	46.9%	0.71	43.32	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	57833	7603902	0.8%	47.7%	0.68	44.00	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37145	7603902	0.5%	48.2%	0.43	44.44	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37486	7603902	0.5%	48.6%	0.44	44.87	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	7603902	0.0%	48.6%	0.00	44.87	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60461	7603902	0.8%	49.4%	0.71	45.58	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24676	7603902	0.3%	49.8%	0.31	45.89	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15	7603902	0.0%	49.8%	0.00	45.89	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	581638	7603902	7.6%	57.4%	7.34	53.24	
CH51	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	85711	7603902	1.1%	58.5%	1.00	54.24	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	111823	7603902	1.5%	60.0%	1.41	55.65	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	7603902	0.0%	60.0%	0.00	55.65	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	19832	7603902	0.3%	60.3%	0.25	55.90	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	111597	7603902	1.5%	61.7%	1.41	57.31	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6	7603902	0.0%	61.7%	0.00	57.31	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17417	7603902	0.2%	62.0%	0.22	57.53	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	26420	7603902	0.3%	62.3%	0.33	57.86	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	13668	7603902	0.2%	62.5%	0.17	58.04	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	233746	7603902	3.1%	65.6%	2.95	60.99	
CH51	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	857335	7603902	11.3%	76.8%	10.82	71.81	
CH51	7	Public Facility and Residential, 8-12 units/acre	615	91	1760498	7603902	23.2%	100.0%	21.07	92.88	**92.9**
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	136	2558548	0.0%	0.0%	0.01	0.01	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3224	2558548	0.1%	0.1%	0.12	0.13	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4927	2558548	0.2%	0.3%	0.18	0.31	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2513	2558548	0.1%	0.4%	0.09	0.41	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5027	2558548	0.2%	0.6%	0.19	0.59	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15738	2558548	0.6%	1.2%	0.59	1.18	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17815	2558548	0.7%	1.9%	0.67	1.85	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	388	2558548	0.0%	1.9%	0.01	1.87	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	3	2558548	0.0%	1.9%	0.00	1.87	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	1	2558548	0.0%	1.9%	0.00	1.87	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49701	2558548	1.9%	3.9%	1.86	3.73	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	29856	2558548	1.2%	5.1%	1.12	4.85	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49732	2558548	1.9%	7.0%	1.87	6.72	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	0	2558548	0.0%	7.0%	0.00	6.72	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2152157	2558548	84.1%	91.1%	80.75	87.47	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	52	2558548	0.0%	91.1%	0.00	87.47	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	227112	2558548	8.9%	100.0%	8.08	95.55	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	135	2558548	0.0%	100.0%	0.00	95.55	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	29	2558548	0.0%	100.0%	0.00	95.55	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	0	2558548	0.0%	100.0%	0.00	95.55	**95.6**
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	151976	6452391	2.4%	2.4%	2.26	2.26	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24493	6452391	0.4%	2.7%	0.36	2.63	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35640	6452391	0.6%	3.3%	0.53	3.16	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	37465	6452391	0.6%	3.9%	0.56	3.71	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	74	6452391	0.0%	3.9%	0.00	3.71	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	18	6452391	0.0%	3.9%	0.00	3.71	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	90	6452391	0.0%	3.9%	0.00	3.72	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	6452391	0.0%	3.9%	0.00	3.72	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452391	0.0%	3.9%	0.00	3.72	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	19419	6452391	0.3%	4.2%	0.29	4.00	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10557	6452391	0.2%	4.3%	0.16	4.16	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17043	6452391	0.3%	4.6%	0.25	4.42	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	14968	6452391	0.2%	4.8%	0.22	4.64	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9441	6452391	0.1%	5.0%	0.14	4.78	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5	6452391	0.0%	5.0%	0.00	4.78	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5166	6452391	0.1%	5.1%	0.08	4.86	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16837	6452391	0.3%	5.3%	0.25	5.11	
CH52-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1	6452391	0.0%	5.3%	0.00	5.11	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	19704	6452391	0.3%	5.6%	0.29	5.40	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9279	6452391	0.1%	5.8%	0.14	5.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452391	0.0%	5.8%	0.00	5.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4	6452391	0.0%	5.8%	0.00	5.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42763	6452391	0.7%	6.4%	0.64	6.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55318	6452391	0.9%	7.3%	0.82	7.00	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55280	6452391	0.9%	8.1%	0.82	7.82	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8	6452391	0.0%	8.1%	0.00	7.82	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	53448	6452391	0.8%	9.0%	0.80	8.61	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56687	6452391	0.9%	9.9%	0.84	9.46	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	6452391	0.0%	9.9%	0.00	9.46	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	30	6452391	0.0%	9.9%	0.00	9.46	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	28807	6452391	0.4%	10.3%	0.43	9.89	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	25	6452391	0.0%	10.3%	0.00	9.89	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39831	6452391	0.6%	10.9%	0.59	10.48	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	36819	6452391	0.6%	11.5%	0.55	11.03	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	114	6452391	0.0%	11.5%	0.00	11.03	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	183944	6452391	2.9%	14.3%	2.74	13.77	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	75	6452391	0.0%	14.3%	0.00	13.77	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3838	6452391	0.1%	14.4%	0.06	13.82	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4798	6452391	0.1%	14.5%	0.07	13.90	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	6452391	0.0%	14.5%	0.00	13.90	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17701	6452391	0.3%	14.7%	0.26	14.16	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8931	6452391	0.1%	14.9%	0.13	14.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	6452391	0.0%	14.9%	0.00	14.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16959	6452391	0.3%	15.2%	0.25	14.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	6452391	0.0%	15.2%	0.00	14.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57162	6452391	0.9%	16.0%	0.85	15.39	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56720	6452391	0.9%	16.9%	0.84	16.24	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55612	6452391	0.9%	17.8%	0.83	17.07	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55204	6452391	0.9%	18.6%	0.82	17.89	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57292	6452391	0.9%	19.5%	0.85	18.74	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5	6452391	0.0%	19.5%	0.00	18.74	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17543	6452391	0.3%	19.8%	0.26	19.00	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	43	6452391	0.0%	19.8%	0.00	19.00	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17575	6452391	0.3%	20.1%	0.26	19.26	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4736	6452391	0.1%	20.1%	0.07	19.33	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3897	6452391	0.1%	20.2%	0.06	19.39	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7688	6452391	0.1%	20.3%	0.11	19.51	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10	6452391	0.0%	20.3%	0.00	19.51	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10	6452391	0.0%	20.3%	0.00	19.51	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8321	6452391	0.1%	20.4%	0.12	19.63	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8247	6452391	0.1%	20.6%	0.12	19.75	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56005	6452391	0.9%	21.4%	0.83	20.59	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8219	6452391	0.1%	21.6%	0.12	20.71	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55699	6452391	0.9%	22.4%	0.83	21.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55861	6452391	0.9%	23.3%	0.83	22.37	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	6452391	0.0%	23.3%	0.00	22.37	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55510	6452391	0.9%	24.2%	0.83	23.19	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57253	6452391	0.9%	25.0%	0.85	24.05	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8332	6452391	0.1%	25.2%	0.12	24.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	78	6452391	0.0%	25.2%	0.00	24.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7956	6452391	0.1%	25.3%	0.12	24.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	6452391	0.0%	25.3%	0.00	24.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7767	6452391	0.1%	25.4%	0.12	24.40	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6	6452391	0.0%	25.4%	0.00	24.41	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	6452391	0.0%	25.4%	0.00	24.41	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16194	6452391	0.3%	25.7%	0.24	24.65	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7650	6452391	0.1%	25.8%	0.11	24.76	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7770	6452391	0.1%	25.9%	0.12	24.88	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	6452391	0.0%	25.9%	0.00	24.88	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7582	6452391	0.1%	26.0%	0.11	24.99	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56682	6452391	0.9%	26.9%	0.84	25.83	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56517	6452391	0.9%	27.8%	0.84	26.67	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452391	0.0%	27.8%	0.00	26.67	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56129	6452391	0.9%	28.7%	0.84	27.51	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55692	6452391	0.9%	29.5%	0.83	28.34	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56163	6452391	0.9%	30.4%	0.84	29.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42	6452391	0.0%	30.4%	0.00	29.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8112	6452391	0.1%	30.5%	0.12	29.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	27	6452391	0.0%	30.5%	0.00	29.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452391	0.0%	30.5%	0.00	29.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	12131	6452391	0.2%	30.7%	0.18	29.47	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	6452391	0.0%	30.7%	0.00	29.47	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452391	0.0%	30.7%	0.00	29.47	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7247	6452391	0.1%	30.8%	0.11	29.58	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10198	6452391	0.2%	31.0%	0.15	29.73	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34922	6452391	0.5%	31.5%	0.52	30.25	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	6452391	0.0%	31.5%	0.00	30.25	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34648	6452391	0.5%	32.1%	0.52	30.77	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35100	6452391	0.5%	32.6%	0.52	31.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	41066	6452391	0.6%	33.2%	0.61	31.90	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	33	6452391	0.0%	33.2%	0.00	31.90	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7352	6452391	0.1%	33.3%	0.11	32.01	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	40888	6452391	0.6%	34.0%	0.61	32.62	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17177	6452391	0.3%	34.2%	0.26	32.88	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	20233	6452391	0.3%	34.6%	0.30	33.18	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	45182	6452391	0.7%	35.3%	0.67	33.85	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35936	6452391	0.6%	35.8%	0.53	34.38	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1478229	6452391	22.9%	58.7%	21.99	56.38	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	239770	6452391	3.7%	62.4%	3.57	59.94	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	427034	6452391	6.6%	69.1%	6.35	66.30	
CH52-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1992921	6452391	30.9%	99.9%	28.11	94.40	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1938	6452391	0.0%	100.0%	0.03	94.43	
CH52-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	270	6452391	0.0%	100.0%	0.00	94.44	
CH52-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1214	6452391	0.0%	100.0%	0.02	94.45	**94.5**
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	188453	4437333	4.2%	4.2%	3.78	3.78	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	14292	4437333	0.3%	4.6%	0.31	4.09	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	18931	4437333	0.4%	5.0%	0.41	4.50	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	221402	4437333	5.0%	10.0%	4.44	8.94	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	140072	4437333	3.2%	13.1%	2.81	11.75	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	495	4437333	0.0%	13.2%	0.01	11.76	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	65896	4437333	1.5%	14.6%	1.32	13.08	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	232124	4437333	5.2%	19.9%	5.02	18.10	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	16688	4437333	0.4%	20.2%	0.36	18.46	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13550	4437333	0.3%	20.6%	0.29	18.76	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138646	4437333	3.1%	23.7%	2.78	21.54	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	190848	4437333	4.3%	28.0%	3.83	25.37	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	184006	4437333	4.1%	32.1%	3.69	29.06	
CH56-C1	2	Parks, Golf Courses	390	76	76946	4437333	1.7%	33.9%	1.32	30.37	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	9237	4437333	0.2%	34.1%	0.20	30.57	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	320708	4437333	7.2%	41.3%	6.43	37.01	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	171651	4437333	3.9%	45.2%	3.44	40.45	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	109723	4437333	2.5%	47.6%	2.20	42.65	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	108327	4437333	2.4%	50.1%	2.17	44.82	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	150103	4437333	3.4%	53.5%	3.01	47.83	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	314799	4437333	7.1%	60.6%	6.31	54.15	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	202272	4437333	4.6%	65.1%	4.38	58.52	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	124594	4437333	2.8%	67.9%	2.70	61.22	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	202936	4437333	4.6%	72.5%	4.39	65.61	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	8258	4437333	0.2%	72.7%	0.18	65.79	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6840	4437333	0.2%	72.8%	0.15	65.94	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	54714	4437333	1.2%	74.1%	1.18	67.12	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	62875	4437333	1.4%	75.5%	1.36	68.48	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	183623	4437333	4.1%	79.6%	3.97	72.45	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	146101	4437333	3.3%	82.9%	3.00	75.45	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	753170	4437333	17.0%	99.9%	15.45	90.89	
CH56-C1	2	Parks, Golf Courses	390	76	1456	4437333	0.0%	99.9%	0.02	90.92	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	10	4437333	0.0%	99.9%	0.00	90.92	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	2	4437333	0.0%	99.9%	0.00	90.92	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1938	4437333	0.0%	100.0%	0.04	90.96	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	4	4437333	0.0%	100.0%	0.00	90.96	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	11	4437333	0.0%	100.0%	0.00	90.96	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	10	4437333	0.0%	100.0%	0.00	90.96	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	1323	4437333	0.0%	100.0%	0.03	90.99	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	29	4437333	0.0%	100.0%	0.00	90.99	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	270	4437333	0.0%	100.0%	0.01	91.00	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	0	4437333	0.0%	100.0%	0.00	91.00	**91.0**
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	4612	5072517	0.1%	0.1%	0.08	0.08	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	0	5072517	0.0%	0.1%	0.00	0.08	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	9651	5072517	0.2%	0.3%	0.17	0.26	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7015	5072517	0.1%	0.4%	0.13	0.38	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	5346	5072517	0.1%	0.5%	0.10	0.48	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7056	5072517	0.1%	0.7%	0.13	0.60	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6497	5072517	0.1%	0.8%	0.12	0.72	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	12009	5072517	0.2%	1.0%	0.21	0.93	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	13352	5072517	0.3%	1.3%	0.23	1.17	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	33193	5072517	0.7%	1.9%	0.58	1.75	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	15804	5072517	0.3%	2.3%	0.28	2.03	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7348	5072517	0.1%	2.4%	0.13	2.16	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	76243	5072517	1.5%	3.9%	1.34	3.49	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	9180	5072517	0.2%	4.1%	0.16	3.66	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6899	5072517	0.1%	4.2%	0.12	3.78	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8225	5072517	0.2%	4.4%	0.15	3.93	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6979	5072517	0.1%	4.5%	0.13	4.06	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8305	5072517	0.2%	4.7%	0.15	4.21	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6647	5072517	0.1%	4.8%	0.12	4.32	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7911	5072517	0.2%	5.0%	0.14	4.47	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6421	5072517	0.1%	5.1%	0.12	4.58	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	85134	5072517	1.7%	6.8%	1.49	6.08	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	64977	5072517	1.3%	8.1%	1.14	7.22	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	83035	5072517	1.6%	9.7%	1.46	8.67	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6641	5072517	0.1%	9.8%	0.12	8.79	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8219	5072517	0.2%	10.0%	0.15	8.94	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	201256	5072517	4.0%	14.0%	3.53	12.47	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	104266	5072517	2.1%	16.0%	1.83	14.30	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6588	5072517	0.1%	16.1%	0.12	14.42	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8210	5072517	0.2%	16.3%	0.15	14.56	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6721	5072517	0.1%	16.4%	0.12	14.69	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8669	5072517	0.2%	16.6%	0.16	14.84	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6566	5072517	0.1%	16.7%	0.12	14.96	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8585	5072517	0.2%	16.9%	0.15	15.11	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6688	5072517	0.1%	17.0%	0.12	15.23	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8749	5072517	0.2%	17.2%	0.16	15.39	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6484	5072517	0.1%	17.3%	0.12	15.51	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	102515	5072517	2.0%	19.4%	1.80	17.30	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	116699	5072517	2.3%	21.7%	2.05	19.35	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	199697	5072517	3.9%	25.6%	3.50	22.86	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8322	5072517	0.2%	25.8%	0.15	23.01	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	70191	5072517	1.4%	27.1%	1.23	24.24	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6823	5072517	0.1%	27.3%	0.12	24.36	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	127383	5072517	2.5%	29.8%	2.23	26.59	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7233	5072517	0.1%	29.9%	0.13	26.72	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6780	5072517	0.1%	30.1%	0.12	26.85	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7043	5072517	0.1%	30.2%	0.13	26.97	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8628	5072517	0.2%	30.4%	0.15	27.13	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8919	5072517	0.2%	30.6%	0.16	27.29	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	9759	5072517	0.2%	30.7%	0.18	27.46	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	139172	5072517	2.7%	33.5%	2.44	29.90	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	121062	5072517	2.4%	35.9%	2.12	32.03	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	99376	5072517	2.0%	37.8%	1.88	33.91	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	93221	5072517	1.8%	39.7%	1.64	35.54	
CH56-C2	12	Schools	390	86	228296	5072517	4.5%	44.2%	3.87	39.41	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138935	5072517	2.7%	46.9%	2.44	41.85	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	108623	5072517	2.1%	49.1%	1.91	43.76	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	194435	5072517	3.8%	52.9%	3.41	47.17	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	6672	5072517	0.1%	53.0%	0.12	47.29	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	283	5072517	0.0%	53.0%	0.01	47.29	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	116693	5072517	2.3%	55.3%	2.05	49.34	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	28635	5072517	0.6%	55.9%	0.50	49.84	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	108043	5072517	2.1%	58.0%	1.90	51.74	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	405888	5072517	8.0%	66.0%	7.68	59.42	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	161424	5072517	3.2%	69.2%	3.06	62.47	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	3667	5072517	0.1%	69.3%	0.06	62.54	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	2629	5072517	0.1%	69.3%	0.05	62.58	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	4029	5072517	0.1%	69.4%	0.07	62.66	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1078	5072517	0.0%	69.4%	0.02	62.67	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	162172	5072517	3.2%	72.6%	2.91	65.58	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1373371	5072517	27.1%	99.7%	24.64	90.22	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	350	5072517	0.0%	99.7%	0.01	90.23	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	314	5072517	0.0%	99.7%	0.01	90.23	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	174	5072517	0.0%	99.7%	0.00	90.24	

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BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	289	5072517	0.0%	99.7%	0.01	90.24	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1096	5072517	0.0%	99.7%	0.02	90.26	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	839	5072517	0.0%	99.8%	0.01	90.28	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1437	5072517	0.0%	99.8%	0.03	90.30	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	626	5072517	0.0%	99.8%	0.01	90.31	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	2622	5072517	0.1%	99.9%	0.05	90.36	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	693	5072517	0.0%	99.9%	0.01	90.37	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	526	5072517	0.0%	99.9%	0.01	90.38	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	245	5072517	0.0%	99.9%	0.00	90.38	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	268	5072517	0.0%	99.9%	0.00	90.39	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	35	5072517	0.0%	99.9%	0.00	90.39	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1	5072517	0.0%	99.9%	0.00	90.39	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1400	5072517	0.0%	99.9%	0.03	90.41	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1944	5072517	0.0%	100.0%	0.03	90.45	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1588	5072517	0.0%	100.0%	0.03	90.48	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	887	5072517	0.0%	100.0%	0.02	90.49	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6	5072517	0.0%	100.0%	0.00	90.49	**90.5**
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	9514347	0.0%	0.0%	0.00	0.00	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56139	9514347	0.6%	0.6%	0.57	0.57	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57058	9514347	0.6%	1.2%	0.58	1.14	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	66841	9514347	0.7%	1.9%	0.67	1.82	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56876	9514347	0.6%	2.5%	0.57	2.39	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	54454	9514347	0.6%	3.1%	0.55	2.94	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55909	9514347	0.6%	3.7%	0.56	3.50	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56485	9514347	0.6%	4.2%	0.57	4.07	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1899	9514347	0.0%	4.3%	0.02	4.09	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55120	9514347	0.6%	4.8%	0.56	4.65	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	265610	9514347	2.8%	7.6%	2.68	7.33	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34209	9514347	0.4%	8.0%	0.35	7.67	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	855	9514347	0.0%	8.0%	0.01	7.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	13	9514347	0.0%	8.0%	0.00	7.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4	9514347	0.0%	8.0%	0.00	7.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4	9514347	0.0%	8.0%	0.00	7.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	9514347	0.0%	8.0%	0.00	7.68	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	54837	9514347	0.6%	8.6%	0.55	8.24	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55913	9514347	0.6%	9.2%	0.56	8.80	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	9514347	0.0%	9.2%	0.00	8.80	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24	9514347	0.0%	9.2%	0.00	8.80	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55843	9514347	0.6%	9.8%	0.56	9.36	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	9514347	0.0%	9.8%	0.00	9.36	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	750390	9514347	7.9%	17.6%	7.57	16.94	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56374	9514347	0.6%	18.2%	0.57	17.50	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55701	9514347	0.6%	18.8%	0.56	18.07	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	22851	9514347	0.2%	19.1%	0.23	18.30	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	120	9514347	0.0%	19.1%	0.00	18.30	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	54433	9514347	0.6%	19.6%	0.55	18.85	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55909	9514347	0.6%	20.2%	0.56	19.41	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55887	9514347	0.6%	20.8%	0.56	19.98	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56050	9514347	0.6%	21.4%	0.57	20.54	

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CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56038	9514347	0.6%	22.0%	0.57	21.11	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55980	9514347	0.6%	22.6%	0.56	21.67	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56029	9514347	0.6%	23.2%	0.57	22.24	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55895	9514347	0.6%	23.8%	0.56	22.80	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55787	9514347	0.6%	24.3%	0.56	23.36	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56093	9514347	0.6%	24.9%	0.57	23.93	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56014	9514347	0.6%	25.5%	0.57	24.49	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56022	9514347	0.6%	26.1%	0.57	25.06	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	240591	9514347	2.5%	28.6%	2.30	27.36	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	104350	9514347	1.1%	29.7%	1.05	28.41	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56071	9514347	0.6%	30.3%	0.57	28.98	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56997	9514347	0.6%	30.9%	0.58	29.55	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	624	9514347	0.0%	30.9%	0.01	29.56	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	9514347	0.0%	30.9%	0.00	29.56	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56163	9514347	0.6%	31.5%	0.57	30.13	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9	9514347	0.0%	31.5%	0.00	30.13	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	523158	9514347	5.5%	37.0%	5.28	35.41	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56365	9514347	0.6%	37.6%	0.57	35.98	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55775	9514347	0.6%	38.2%	0.56	36.54	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56463	9514347	0.6%	38.8%	0.57	37.11	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	21386	9514347	0.2%	39.0%	0.22	37.32	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120243	9514347	1.3%	40.3%	1.21	38.54	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120065	9514347	1.3%	41.5%	1.21	39.75	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	23477	9514347	0.2%	41.8%	0.24	39.99	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	118260	9514347	1.2%	43.0%	1.19	41.18	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57064	9514347	0.6%	43.6%	0.58	41.75	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	43793	9514347	0.5%	44.1%	0.44	42.20	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	119998	9514347	1.3%	45.3%	1.21	43.41	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39398	9514347	0.4%	45.8%	0.40	43.80	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	119265	9514347	1.3%	47.0%	1.20	45.01	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35589	9514347	0.4%	47.4%	0.36	45.37	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	265121	9514347	2.8%	50.2%	2.68	48.04	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	72491	9514347	0.8%	50.9%	0.73	48.77	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	20694	9514347	0.2%	51.2%	0.21	48.98	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17707	9514347	0.2%	51.3%	0.18	49.16	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	48008	9514347	0.5%	51.8%	0.48	49.65	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	115955	9514347	1.2%	53.1%	1.17	50.82	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	18657	9514347	0.2%	53.3%	0.19	51.00	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	115186	9514347	1.2%	54.5%	1.16	52.17	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120229	9514347	1.3%	55.7%	1.21	53.38	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120690	9514347	1.3%	57.0%	1.22	54.60	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34223	9514347	0.4%	57.4%	0.35	54.94	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56294	9514347	0.6%	58.0%	0.57	55.51	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56280	9514347	0.6%	58.5%	0.57	56.08	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	68880	9514347	0.7%	59.3%	0.70	56.77	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	62750	9514347	0.7%	59.9%	0.62	57.39	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55924	9514347	0.6%	60.5%	0.56	57.96	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56183	9514347	0.6%	61.1%	0.57	58.52	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56022	9514347	0.6%	61.7%	0.57	59.09	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	35638	9514347	0.4%	62.1%	0.34	59.43	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	270	88	32836	9514347	0.3%	62.4%	0.30	59.73	
CH59-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	200938	9514347	2.1%	64.5%	2.03	61.76	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	37792	9514347	0.4%	64.9%	0.36	62.12	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	615	91	3337045	9514347	35.1%	100.0%	31.92	94.04	
CH59-C	7	Public Facility and Residential, 8-12 units/acre	270	88	22	9514347	0.0%	100.0%	0.00	94.04	**94.0**
CH60A-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	1510838	0.0%	0.0%	0.00	0.00	
CH60A-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3	1510838	0.0%	0.0%	0.00	0.00	
CH60A-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1847	1510838	0.1%	0.1%	0.12	0.12	
CH60A-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1046	1510838	0.1%	0.2%	0.07	0.18	
CH60A-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	1992	1510838	0.1%	0.3%	0.12	0.30	
CH60A-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	891714	1510838	59.0%	59.3%	52.53	52.83	
CH60A-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	542562	1510838	35.9%	95.3%	30.17	83.00	
CH60A-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	49964	1510838	3.3%	98.6%	3.01	86.01	
CH60A-C1	7	Public Facility and Residential, 8-12 units/acre	325	88	21707	1510838	1.4%	100.0%	1.26	87.27	**87.3**
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	117836	7189081	1.6%	1.6%	1.46	1.46	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57388	7189081	0.8%	2.4%	0.77	2.23	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	7189081	0.0%	2.4%	0.00	2.23	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57344	7189081	0.8%	3.2%	0.77	2.99	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	584946	7189081	8.1%	11.4%	7.81	10.80	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60441	7189081	0.8%	12.2%	0.75	11.55	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	35539	7189081	0.5%	12.7%	0.44	11.99	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	55885	7189081	0.8%	13.5%	0.69	12.68	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	125671	7189081	1.7%	15.2%	1.68	14.36	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	33643	7189081	0.5%	15.7%	0.45	14.81	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55713	7189081	0.8%	16.5%	0.74	15.55	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	76972	7189081	1.1%	17.5%	0.95	16.51	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55743	7189081	0.8%	18.3%	0.74	17.25	
CH60A-C2	12	Schools	615	86	495638	7189081	6.9%	25.2%	5.93	23.18	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	50	7189081	0.0%	25.2%	0.00	23.18	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	19316	7189081	0.3%	25.5%	0.24	23.42	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	19	7189081	0.0%	25.5%	0.00	23.42	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	1493616	7189081	20.8%	46.3%	18.49	41.91	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	94332	7189081	1.3%	47.6%	1.17	43.08	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1764	7189081	0.0%	47.6%	0.02	43.10	
CH60A-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	725448	7189081	10.1%	57.7%	9.18	52.28	
CH60A-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1844	7189081	0.0%	57.7%	0.02	52.31	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	57053	7189081	0.8%	58.5%	0.71	53.01	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	55940	7189081	0.8%	59.3%	0.69	53.71	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	703	7189081	0.0%	59.3%	0.01	53.72	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2463	7189081	0.0%	59.3%	0.03	53.75	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	54982	7189081	0.8%	60.1%	0.68	54.43	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34986	7189081	0.5%	60.6%	0.47	54.90	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58959	7189081	0.8%	61.4%	0.73	55.63	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	76709	7189081	1.1%	62.5%	1.02	56.65	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	188218	7189081	2.6%	65.1%	2.51	59.16	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15856	7189081	0.2%	65.3%	0.21	59.38	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	59439	7189081	0.8%	66.1%	0.79	60.17	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56186	7189081	0.8%	66.9%	0.75	60.92	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15640	7189081	0.2%	67.1%	0.21	61.13	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120610	7189081	1.7%	68.8%	1.61	62.74	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	25844	7189081	0.4%	69.2%	0.35	63.09	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56545	7189081	0.8%	70.0%	0.76	63.84	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56179	7189081	0.8%	70.7%	0.75	64.59	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35256	7189081	0.5%	71.2%	0.47	65.06	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1051232	7189081	14.6%	85.9%	14.04	79.10	
CH60A-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1017129	7189081	14.1%	100.0%	12.87	91.97	**92.0**
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	1867	4407529	0.0%	0.0%	0.04	0.04	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	723	4407529	0.0%	0.1%	0.02	0.06	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	8788	4407529	0.2%	0.3%	0.19	0.25	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	6155	4407529	0.1%	0.4%	0.13	0.38	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	3403	4407529	0.1%	0.5%	0.07	0.46	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2732	4407529	0.1%	0.5%	0.06	0.52	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	15491	4407529	0.4%	0.9%	0.34	0.85	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	36121	4407529	0.8%	1.7%	0.79	1.64	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	42068	4407529	1.0%	2.7%	0.92	2.56	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	52181	4407529	1.2%	3.8%	1.14	3.69	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	55725	4407529	1.3%	5.1%	1.21	4.91	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	55715	4407529	1.3%	6.4%	1.21	6.12	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	523741	4407529	11.9%	18.3%	11.41	17.53	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	130332	4407529	3.0%	21.2%	2.84	20.37	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	27111	4407529	0.6%	21.8%	0.59	20.96	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	73	4407529	0.0%	21.8%	0.00	20.96	
CH60A-C3	12	Schools	615	86	33680	4407529	0.8%	22.6%	0.66	21.62	
CH60A-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	46407	4407529	1.1%	23.6%	0.94	22.55	
CH60A-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	418502	4407529	9.5%	33.1%	8.45	31.00	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	331172	4407529	7.5%	40.7%	6.84	37.84	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	2219002	4407529	50.3%	91.0%	45.81	83.66	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7117	4407529	0.2%	91.2%	0.16	83.81	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	28319	4407529	0.6%	91.8%	0.58	84.39	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	360932	4407529	8.2%	100.0%	7.45	91.85	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	10	4407529	0.0%	100.0%	0.00	91.85	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	2	4407529	0.0%	100.0%	0.00	91.85	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	4	4407529	0.0%	100.0%	0.00	91.85	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	11	4407529	0.0%	100.0%	0.00	91.85	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	10	4407529	0.0%	100.0%	0.00	91.85	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	135	4407529	0.0%	100.0%	0.00	91.85	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	0	4407529	0.0%	100.0%	0.00	91.85	**91.9**
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	1468	768280	0.2%	0.2%	0.18	0.18	
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	21	768280	0.0%	0.2%	0.00	0.19	
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	333	768280	0.0%	0.2%	0.04	0.23	
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	374064	768280	48.7%	48.9%	46.74	46.97	
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	86329	768280	11.2%	60.2%	10.56	57.53	
CH60A-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	37208	768280	4.8%	65.0%	4.31	61.84	
CH60A-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	171894	768280	22.4%	87.4%	19.91	81.75	
CH60A-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	29556	768280	3.8%	91.2%	3.23	84.98	
CH60A-C4	7	Public Facility and Residential, 8-12 units/acre	390	91	58859	768280	7.7%	98.9%	6.97	91.96	
CH60A-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	8547	768280	1.1%	100.0%	0.98	92.94	**92.9**

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BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13994	1628608	0.9%	0.9%	0.82	0.82	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	166698	1628608	10.2%	11.1%	9.11	9.93	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27242	1628608	1.7%	12.8%	1.41	11.34	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	19913	1628608	1.2%	14.0%	1.17	12.51	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	162862	1628608	10.0%	24.0%	8.90	21.41	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	59734	1628608	3.7%	27.7%	3.08	24.49	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	15284	1628608	0.9%	28.6%	0.90	25.40	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	137114	1628608	8.4%	37.0%	7.49	32.89	
CH63-C1	2	Parks, Golf Courses	390	76	58485	1628608	3.6%	40.6%	2.73	35.62	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	9952	1628608	0.6%	41.2%	0.59	36.20	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	58717	1628608	3.6%	44.8%	3.21	39.41	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	65964	1628608	4.1%	48.9%	3.40	42.82	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	127557	1628608	7.8%	56.7%	6.97	49.79	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	14856	1628608	0.9%	57.6%	0.77	50.55	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	28344	1628608	1.7%	59.4%	1.46	52.01	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	189986	1628608	11.7%	71.0%	11.20	63.21	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	62251	1628608	3.8%	74.8%	3.67	66.88	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	10402	1628608	0.6%	75.5%	0.60	67.48	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2310	1628608	0.1%	75.6%	0.13	67.62	
CH63-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	284479	1628608	17.5%	93.1%	15.90	83.51	
CH63-C1	7	Public Facility and Residential, 8-12 units/acre	325	88	109641	1628608	6.7%	99.8%	5.92	89.44	
CH63-C1	2	Parks, Golf Courses	390	76	1456	1628608	0.1%	99.9%	0.07	89.50	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	43	1628608	0.0%	99.9%	0.00	89.51	
CH63-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	1	1628608	0.0%	99.9%	0.00	89.51	
CH63-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	1323	1628608	0.1%	100.0%	0.07	89.58	**89.6**
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	100471	910428	11.0%	11.0%	9.82	9.82	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	45725	910428	5.0%	16.1%	4.22	14.04	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	145201	910428	15.9%	32.0%	14.19	28.23	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	33463	910428	3.7%	35.7%	3.09	31.32	
CH63-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	61857	910428	6.8%	42.5%	6.52	37.84	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	66682	910428	7.3%	49.8%	6.52	44.36	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	156259	910428	17.2%	67.0%	15.28	59.64	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	22496	910428	2.5%	69.4%	2.08	61.71	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	12914	910428	1.4%	70.9%	1.19	62.91	
CH63-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	590	910428	0.1%	70.9%	0.06	62.97	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	8011	910428	0.9%	71.8%	0.78	63.75	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	682	910428	0.1%	71.9%	0.06	63.81	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	79	910428	0.0%	71.9%	0.01	63.82	
CH63-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	184799	910428	20.3%	92.2%	18.47	82.29	
CH63-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	69610	910428	7.6%	99.8%	6.73	89.02	
CH63-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1588	910428	0.2%	100.0%	0.16	89.18	**89.2**
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	23240	513776	4.5%	4.5%	4.03	4.03	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	44961	513776	8.8%	13.3%	7.35	11.38	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	85998	513776	16.7%	30.0%	14.90	26.27	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	91192	513776	17.7%	47.8%	14.91	41.18	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	6382	513776	1.2%	49.0%	1.04	42.23	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	20507	513776	4.0%	53.0%	3.55	45.78	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11335	513776	2.2%	55.2%	1.85	47.63	
CH63-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	40439	513776	7.9%	63.1%	7.56	55.19	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	41002	513776	8.0%	71.1%	7.10	62.29	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	555	513776	0.1%	71.2%	0.09	62.38	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	72335	513776	14.1%	85.2%	12.81	75.19	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	325	88	71721	513776	14.0%	99.2%	12.28	87.48	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	784	513776	0.2%	99.4%	0.14	87.61	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1523	513776	0.3%	99.6%	0.25	87.86	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52	513776	0.0%	99.7%	0.01	87.87	
CH63-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	250	513776	0.0%	99.7%	0.05	87.92	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	260	513776	0.1%	99.8%	0.05	87.96	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	887	513776	0.2%	99.9%	0.16	88.12	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	190	513776	0.0%	100.0%	0.03	88.15	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	325	88	156	513776	0.0%	100.0%	0.03	88.18	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	6	513776	0.0%	100.0%	0.00	88.18	**88.2**
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	92	3339900	0.0%	0.0%	0.00	0.00	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	1245	3339900	0.0%	0.0%	0.03	0.04	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	5361	3339900	0.2%	0.2%	0.13	0.17	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52661	3339900	1.6%	1.8%	1.32	1.49	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	4260	3339900	0.1%	1.9%	0.11	1.61	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9662	3339900	0.3%	2.2%	0.24	1.85	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	167288	3339900	5.0%	7.2%	4.21	6.06	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	10462	3339900	0.3%	7.5%	0.28	6.34	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	72076	3339900	2.2%	9.7%	1.81	8.15	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	4699	3339900	0.1%	9.8%	0.13	8.28	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9914	3339900	0.3%	10.1%	0.25	8.52	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	4902	3339900	0.1%	10.3%	0.13	8.66	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	15249	3339900	0.5%	10.7%	0.38	9.04	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	82109	3339900	2.5%	13.2%	2.07	11.10	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	107390	3339900	3.2%	16.4%	2.70	13.80	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	158222	3339900	4.7%	21.1%	3.98	17.78	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7684	3339900	0.2%	21.4%	0.19	17.98	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	2970	3339900	0.1%	21.4%	0.08	18.06	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	4427	3339900	0.1%	21.6%	0.11	18.17	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	30489	3339900	0.9%	22.5%	0.77	18.93	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	28914	3339900	0.9%	23.4%	0.73	19.66	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	6430	3339900	0.2%	23.5%	0.18	19.84	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	207798	3339900	6.2%	29.8%	5.23	25.07	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	17401	3339900	0.5%	30.3%	0.44	25.51	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	15629	3339900	0.5%	30.8%	0.44	25.95	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	43589	3339900	1.3%	32.1%	1.23	27.17	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	9216	3339900	0.3%	32.3%	0.26	27.43	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	46372	3339900	1.4%	33.7%	1.31	28.74	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1416518	3339900	42.4%	76.1%	40.72	69.45	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	61559	3339900	1.8%	78.0%	1.73	71.19	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8394	3339900	0.3%	78.2%	0.24	71.43	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	24731	3339900	0.7%	79.0%	0.70	72.12	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8486	3339900	0.3%	79.2%	0.24	72.37	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	615	91	196731	3339900	5.9%	85.1%	5.36	77.73	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	496712	3339900	14.9%	100.0%	13.09	90.81	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27	3339900	0.0%	100.0%	0.00	90.82	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9	3339900	0.0%	100.0%	0.00	90.82	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	2	3339900	0.0%	100.0%	0.00	90.82	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	18	3339900	0.0%	100.0%	0.00	90.82	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	43	3339900	0.0%	100.0%	0.00	90.82	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16	3339900	0.0%	100.0%	0.00	90.82	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	615	91	127	3339900	0.0%	100.0%	0.00	90.82	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	12	3339900	0.0%	100.0%	0.00	90.82	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	615	91	4	3339900	0.0%	100.0%	0.00	90.82	**90.8**
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9653	7974073	0.1%	0.1%	0.11	0.11	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8412	7974073	0.1%	0.2%	0.10	0.21	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	22860	7974073	0.3%	0.5%	0.26	0.47	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8412	7974073	0.1%	0.6%	0.10	0.56	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	11699	7974073	0.1%	0.8%	0.14	0.70	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	64184	7974073	0.8%	1.6%	0.77	1.48	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8750	7974073	0.1%	1.7%	0.10	1.58	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	73425	7974073	0.9%	2.6%	0.82	2.40	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8412	7974073	0.1%	2.7%	0.10	2.49	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	50386	7974073	0.6%	3.3%	0.56	3.05	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	73911	7974073	0.9%	4.3%	0.82	3.88	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8638	7974073	0.1%	4.4%	0.10	3.98	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	89443	7974073	1.1%	5.5%	1.00	4.98	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8088	7974073	0.1%	5.6%	0.09	5.07	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	16823	7974073	0.2%	5.8%	0.19	5.26	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8223	7974073	0.1%	5.9%	0.09	5.35	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974073	0.1%	6.0%	0.10	5.45	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8171	7974073	0.1%	6.1%	0.09	5.54	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974073	0.1%	6.2%	0.10	5.64	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	145510	7974073	1.8%	8.0%	1.62	7.26	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	41012	7974073	0.5%	8.6%	0.46	7.72	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	40492	7974073	0.5%	9.1%	0.45	8.17	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	102880	7974073	1.3%	10.4%	1.15	9.32	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8393	7974073	0.1%	10.5%	0.10	9.42	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974073	0.1%	10.6%	0.10	9.51	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	176801	7974073	2.2%	12.8%	1.97	11.49	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8313	7974073	0.1%	12.9%	0.09	11.58	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974073	0.1%	13.0%	0.10	11.68	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	219428	7974073	2.8%	15.8%	2.45	14.13	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	35417	7974073	0.4%	16.2%	0.40	14.52	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	31505	7974073	0.4%	16.6%	0.35	14.87	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	4325	7974073	0.1%	16.6%	0.05	14.92	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	34247	7974073	0.4%	17.1%	0.41	15.33	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8342	7974073	0.1%	17.2%	0.10	15.43	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974073	0.1%	17.3%	0.10	15.52	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8205	7974073	0.1%	17.4%	0.09	15.62	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974073	0.1%	17.5%	0.10	15.71	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8461	7974073	0.1%	17.6%	0.10	15.81	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	141641	7974073	1.8%	19.4%	1.58	17.39	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6588	7974073	0.1%	19.5%	0.08	17.47	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	108869	7974073	1.4%	20.8%	1.31	18.78	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	8411	7974073	0.1%	20.9%	0.10	18.88	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	217767	7974073	2.7%	23.7%	2.43	21.31	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974073	0.1%	23.8%	0.11	21.41	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974073	0.1%	23.9%	0.11	21.52	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974073	0.1%	24.0%	0.11	21.63	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138284	7974073	1.7%	25.7%	1.54	23.17	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	38669	7974073	0.5%	26.2%	0.44	23.61	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974073	0.1%	26.4%	0.11	23.72	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	44375	7974073	0.6%	26.9%	0.50	24.22	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	217112	7974073	2.7%	29.6%	2.42	26.64	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	30135	7974073	0.4%	30.0%	0.34	26.98	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	89908	7974073	1.1%	31.1%	0.95	27.92	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	9462	7974073	0.1%	31.3%	0.11	28.03	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	138444	7974073	1.7%	33.0%	1.67	29.70	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	7423	7974073	0.1%	33.1%	0.09	29.79	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	330171	7974073	4.1%	37.2%	3.97	33.76	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	11646	7974073	0.1%	37.4%	0.13	33.90	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	26064	7974073	0.3%	37.7%	0.30	34.19	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138815	7974073	1.7%	39.4%	1.55	35.74	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	177346	7974073	2.2%	41.7%	1.98	37.72	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	160217	7974073	2.0%	43.7%	1.79	39.51	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	159603	7974073	2.0%	45.7%	1.78	41.29	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	38	7974073	0.0%	45.7%	0.00	41.29	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	396241	7974073	5.0%	50.6%	4.42	45.72	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	165300	7974073	2.1%	52.7%	1.84	47.56	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	207308	7974073	2.6%	55.3%	2.31	49.87	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	50963	7974073	0.6%	56.0%	0.54	50.41	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	155047	7974073	1.9%	57.9%	1.63	52.04	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	70223	7974073	0.9%	58.8%	0.74	52.78	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	4176	7974073	0.1%	58.8%	0.05	52.83	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	242	7974073	0.0%	58.8%	0.00	52.83	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	3723	7974073	0.0%	58.9%	0.04	52.88	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	3092	7974073	0.0%	58.9%	0.04	52.91	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	70115	7974073	0.9%	59.8%	0.78	53.69	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	55546	7974073	0.7%	60.5%	0.62	54.31	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	108743	7974073	1.4%	61.9%	1.21	55.53	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	44009	7974073	0.6%	62.4%	0.49	56.02	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	146490	7974073	1.8%	64.2%	1.64	57.65	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	38652	7974073	0.5%	64.7%	0.43	58.09	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	81882	7974073	1.0%	65.8%	0.86	58.95	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	47053	7974073	0.6%	66.4%	0.53	59.47	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	2611	7974073	0.0%	66.4%	0.03	59.50	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	29207	7974073	0.4%	66.8%	0.33	59.83	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13275	7974073	0.2%	66.9%	0.16	59.99	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13867	7974073	0.2%	67.1%	0.17	60.15	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	14631	7974073	0.2%	67.3%	0.16	60.32	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	14974	7974073	0.2%	67.5%	0.17	60.48	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	615	91	168134	7974073	2.1%	69.6%	1.92	62.40	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	2175245	7974073	27.3%	96.8%	24.82	87.23	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH64-C	7	Public Facility and Residential, 8-12 units/acre	325	88	233720	7974073	2.9%	99.8%	2.58	89.81	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	350	7974073	0.0%	99.8%	0.00	89.81	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	314	7974073	0.0%	99.8%	0.00	89.81	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	174	7974073	0.0%	99.8%	0.00	89.82	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	289	7974073	0.0%	99.8%	0.00	89.82	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1096	7974073	0.0%	99.8%	0.01	89.83	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	839	7974073	0.0%	99.8%	0.01	89.84	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1437	7974073	0.0%	99.8%	0.02	89.86	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	626	7974073	0.0%	99.8%	0.01	89.86	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	2622	7974073	0.0%	99.9%	0.03	89.89	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	784	7974073	0.0%	99.9%	0.01	89.90	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1523	7974073	0.0%	99.9%	0.02	89.92	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	693	7974073	0.0%	99.9%	0.01	89.93	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	0	7974073	0.0%	99.9%	0.00	89.93	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7	7974073	0.0%	99.9%	0.00	89.93	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52	7974073	0.0%	99.9%	0.00	89.93	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	526	7974073	0.0%	99.9%	0.01	89.93	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	245	7974073	0.0%	99.9%	0.00	89.93	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	250	7974073	0.0%	99.9%	0.00	89.94	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	260	7974073	0.0%	99.9%	0.00	89.94	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	268	7974073	0.0%	99.9%	0.00	89.94	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	35	7974073	0.0%	99.9%	0.00	89.94	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1400	7974073	0.0%	100.0%	0.02	89.96	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	1944	7974073	0.0%	100.0%	0.02	89.98	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	325	88	178	7974073	0.0%	100.0%	0.00	89.98	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1214	7974073	0.0%	100.0%	0.01	90.00	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	190	7974073	0.0%	100.0%	0.00	90.00	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	325	88	156	7974073	0.0%	100.0%	0.00	90.00	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	6	7974073	0.0%	100.0%	0.00	90.00	**90.0**
CH67-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	11417	403956	2.8%	2.8%	2.52	2.52	
CH67-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	37761	403956	9.3%	12.2%	7.85	10.37	
CH67-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	22720	403956	5.6%	17.8%	5.01	15.37	
CH67-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27958	403956	6.9%	24.7%	5.81	21.19	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3241	403956	0.8%	25.5%	0.77	21.96	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2482	403956	0.6%	26.1%	0.58	22.53	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	84195	403956	20.8%	47.0%	20.01	42.54	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	99907	403956	24.7%	71.7%	23.74	66.29	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	108660	403956	26.9%	98.6%	24.48	90.76	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	325	88	5548	403956	1.4%	100.0%	1.21	91.97	
CH67-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	2	403956	0.0%	100.0%	0.00	91.97	
CH67-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	18	403956	0.0%	100.0%	0.00	91.98	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16	403956	0.0%	100.0%	0.00	91.98	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	4	403956	0.0%	100.0%	0.00	91.98	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	325	88	22	403956	0.0%	100.0%	0.00	91.99	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	4	403956	0.0%	100.0%	0.00	91.99	**92.0**
CH67-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	6	555654	0.0%	0.0%	0.00	0.00	
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	144026	555654	25.9%	25.9%	21.77	21.77	
CH67-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17848	555654	3.2%	29.1%	3.02	24.79	
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	157870	555654	28.4%	57.5%	23.87	48.66	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	23140	555654	4.2%	61.7%	3.50	52.16	
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27716	555654	5.0%	66.7%	4.19	56.35	
CH67-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3214	555654	0.6%	67.3%	0.54	56.89	
CH67-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	181766	555654	32.7%	100.0%	28.79	85.68	
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27	555654	0.0%	100.0%	0.00	85.68	
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9	555654	0.0%	100.0%	0.00	85.68	
CH67-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	4	555654	0.0%	100.0%	0.00	85.68	
CH67-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	12	555654	0.0%	100.0%	0.00	85.69	
CH67-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	16	555654	0.0%	100.0%	0.00	85.69	**85.7**
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9673	2723260	0.4%	0.4%	0.30	0.30	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	5456	2723260	0.2%	0.6%	0.17	0.47	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	16328	2723260	0.6%	1.2%	0.50	0.97	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	57866	2723260	2.1%	3.3%	1.78	2.76	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	55802	2723260	2.0%	5.3%	1.72	4.48	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	49608	2723260	1.8%	7.2%	1.53	6.01	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5253	2723260	0.2%	7.3%	0.18	6.19	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	76303	2723260	2.8%	10.1%	2.35	8.54	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	183698	2723260	6.7%	16.9%	5.67	14.21	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	77403	2723260	2.8%	19.7%	2.39	16.60	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	97599	2723260	3.6%	23.3%	3.01	19.61	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111401	2723260	4.1%	27.4%	3.44	23.04	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111083	2723260	4.1%	31.5%	3.43	26.47	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12175	2723260	0.4%	31.9%	0.42	26.89	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27342	2723260	1.0%	32.9%	0.84	27.73	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	47538	2723260	1.7%	34.7%	1.47	29.20	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	122747	2723260	4.5%	39.2%	3.79	32.98	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13134	2723260	0.5%	39.7%	0.45	33.44	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	124260	2723260	4.6%	44.2%	3.83	37.27	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	169311	2723260	6.2%	50.5%	5.22	42.49	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	142114	2723260	5.2%	55.7%	4.38	46.88	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	154357	2723260	5.7%	61.3%	4.76	51.64	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17216	2723260	0.6%	62.0%	0.59	52.23	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	56293	2723260	2.1%	64.0%	1.74	53.97	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	82724	2723260	3.0%	67.1%	2.55	56.52	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5988	2723260	0.2%	67.3%	0.21	56.73	
CH67-C3	7	Public Facility and Residential, 8-12 units/acre	325	88	890586	2723260	32.7%	100.0%	28.78	85.51	**85.5**
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	67310	2968512	2.3%	2.3%	1.90	1.90	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	49931	2968512	1.7%	3.9%	1.41	3.32	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52843	2968512	1.8%	5.7%	1.50	4.81	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	50121	2968512	1.7%	7.4%	1.42	6.23	
CH67-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5763	2968512	0.2%	7.6%	0.18	6.41	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	381521	2968512	12.9%	20.5%	10.80	17.21	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	42745	2968512	1.4%	21.9%	1.21	18.42	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	138751	2968512	4.7%	26.6%	3.93	22.35	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	101132	2968512	3.4%	30.0%	2.86	25.21	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	110314	2968512	3.7%	33.7%	3.12	28.33	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	109552	2968512	3.7%	37.4%	3.10	31.43	
CH67-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12229	2968512	0.4%	37.8%	0.39	31.82	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	139546	2968512	4.7%	42.5%	3.95	35.76	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	101054	2968512	3.4%	45.9%	2.86	38.62	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	109912	2968512	3.7%	49.6%	3.11	41.73	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	109098	2968512	3.7%	53.3%	3.09	44.82	
CH67-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	11824	2968512	0.4%	53.7%	0.37	45.20	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	70411	2968512	2.4%	56.1%	1.99	47.19	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	38606	2968512	1.3%	57.4%	1.09	48.28	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	33171	2968512	1.1%	58.5%	0.94	49.22	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	45916	2968512	1.5%	60.0%	1.30	50.52	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	56043	2968512	1.9%	61.9%	1.59	52.10	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	60764	2968512	2.0%	64.0%	1.72	53.82	
CH67-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5904	2968512	0.2%	64.2%	0.19	54.01	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	71257	2968512	2.4%	66.6%	2.02	56.03	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	172445	2968512	5.8%	72.4%	4.88	60.91	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	16378	2968512	0.6%	72.9%	0.46	61.37	
CH67-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	803736	2968512	27.1%	100.0%	23.83	85.20	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	0	2968512	0.0%	100.0%	0.00	85.20	
CH67-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	232	2968512	0.0%	100.0%	0.01	85.20	**85.2**
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	71445	4183694	1.7%	1.7%	1.43	1.43	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	61008	4183694	1.5%	3.2%	1.22	2.66	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	89364	4183694	2.1%	5.3%	1.79	4.45	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	95976	4183694	2.3%	7.6%	1.93	6.38	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13263	4183694	0.3%	7.9%	0.30	6.68	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	141396	4183694	3.4%	11.3%	2.84	9.52	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	106655	4183694	2.5%	13.8%	2.14	11.66	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112298	4183694	2.7%	16.5%	2.25	13.91	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	110818	4183694	2.6%	19.2%	2.22	16.14	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13903	4183694	0.3%	19.5%	0.31	16.45	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	141949	4183694	3.4%	22.9%	2.85	19.30	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	106526	4183694	2.5%	25.4%	2.14	21.44	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112751	4183694	2.7%	28.1%	2.26	23.70	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	113126	4183694	2.7%	30.8%	2.27	25.98	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13238	4183694	0.3%	31.2%	0.30	26.27	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	141210	4183694	3.4%	34.5%	2.84	29.11	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	106759	4183694	2.6%	37.1%	2.14	31.25	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111030	4183694	2.7%	39.7%	2.23	33.48	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111727	4183694	2.7%	42.4%	2.24	35.72	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13211	4183694	0.3%	42.7%	0.30	36.02	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11191	4183694	0.3%	43.0%	0.22	36.25	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	30623	4183694	0.7%	43.7%	0.61	36.86	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	85626	4183694	2.0%	45.8%	1.72	38.58	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	136818	4183694	3.3%	49.0%	2.75	41.33	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	57299	4183694	1.4%	50.4%	1.15	42.48	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	142128	4183694	3.4%	53.8%	2.85	45.33	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	107824	4183694	2.6%	56.4%	2.16	47.50	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112379	4183694	2.7%	59.1%	2.26	49.75	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112288	4183694	2.7%	61.8%	2.25	52.01	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12850	4183694	0.3%	62.1%	0.29	52.29	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	68711	4183694	1.6%	63.7%	1.38	53.67	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52559	4183694	1.3%	65.0%	1.06	54.73	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	58359	4183694	1.4%	66.4%	1.17	55.90	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	58047	4183694	1.4%	67.7%	1.17	57.07	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	7362	4183694	0.2%	67.9%	0.17	57.23	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	106009	4183694	2.5%	70.5%	2.13	59.36	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11772	4183694	0.3%	70.7%	0.24	59.60	
CH67-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	1223986	4183694	29.3%	100.0%	25.75	85.34	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7	4183694	0.0%	100.0%	0.00	85.34	
CH67-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	27	4183694	0.0%	100.0%	0.00	85.34	
CH67-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	178	4183694	0.0%	100.0%	0.00	85.35	**85.3**
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1	1790629	0.0%	0.0%	0.00	0.00	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	16	1790629	0.0%	0.0%	0.00	0.00	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	23	1790629	0.0%	0.0%	0.00	0.00	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	2	1790629	0.0%	0.0%	0.00	0.00	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11	1790629	0.0%	0.0%	0.00	0.00	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9	1790629	0.0%	0.0%	0.00	0.00	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	4	1790629	0.0%	0.0%	0.00	0.00	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17474	1790629	1.0%	1.0%	0.92	0.92	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	278	1790629	0.0%	1.0%	0.01	0.93	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4835	1790629	0.3%	1.3%	0.26	1.19	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	24	1790629	0.0%	1.3%	0.00	1.19	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	87594	1790629	4.9%	6.2%	4.70	5.89	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4101	1790629	0.2%	6.4%	0.22	6.11	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	38494	1790629	2.1%	8.5%	2.06	8.17	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	101365	1790629	5.7%	14.2%	5.43	13.60	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	38630	1790629	2.2%	16.4%	2.07	15.67	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42510	1790629	2.4%	18.7%	2.28	17.95	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	34162	1790629	1.9%	20.6%	1.70	19.65	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	73441	1790629	4.1%	24.7%	3.65	23.30	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	116815	1790629	6.5%	31.3%	5.81	29.11	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	7680	1790629	0.4%	31.7%	0.38	29.49	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	918686	1790629	51.3%	83.0%	43.10	72.59	
CH68-1	7	Public Facility and Residential, 8-12 units/acre	615	91	259161	1790629	14.5%	97.5%	13.17	85.76	
CH68-1	7	Public Facility and Residential, 8-12 units/acre	325	88	45314	1790629	2.5%	100.0%	2.23	87.98	**88.0**
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	793	1930761	0.0%	0.0%	0.04	0.04	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	694	1930761	0.0%	0.1%	0.03	0.07	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	1930761	0.0%	0.1%	0.00	0.07	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	1930761	0.0%	0.1%	0.00	0.07	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	165928	1930761	8.6%	8.7%	8.25	8.32	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	283063	1930761	14.7%	23.3%	13.78	22.10	
CH68-3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	18	1930761	0.0%	23.3%	0.00	22.10	
CH68-3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	26	1930761	0.0%	23.3%	0.00	22.11	
CH68-3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	10	1930761	0.0%	23.3%	0.00	22.11	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24906	1930761	1.3%	24.6%	1.24	23.34	
CH68-3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	28522	1930761	1.5%	26.1%	1.31	24.66	
CH68-3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1273466	1930761	66.0%	92.1%	55.40	80.06	
CH68-3	7	Public Facility and Residential, 8-12 units/acre	615	91	65464	1930761	3.4%	95.4%	3.09	83.15	
CH68-3	7	Public Facility and Residential, 8-12 units/acre	325	88	87868	1930761	4.6%	100.0%	4.00	87.15	**87.2**
CH68-4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	66420	1297407	5.1%	5.1%	4.91	4.91	
CH68-4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49524	1297407	3.8%	8.9%	3.66	8.58	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CH68-4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1132597	1297407	87.3%	96.2%	83.81	92.38	
CH68-4	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	2039	1297407	0.2%	96.4%	0.15	92.53	
CH68-4	7	Public Facility and Residential, 8-12 units/acre	615	91	46827	1297407	3.6%	100.0%	3.28	95.82	**95.8**
CH68-5	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	14193	528690	2.7%	2.7%	2.58	2.58	
CH68-5	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	138282	528690	26.2%	28.8%	25.11	27.69	
CH68-5	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	291273	528690	55.1%	83.9%	52.89	80.58	
CH68-5	7	Public Facility and Residential, 8-12 units/acre	615	91	84815	528690	16.0%	100.0%	14.60	95.17	
CH68-5	7	Public Facility and Residential, 8-12 units/acre	615	91	127	528690	0.0%	100.0%	0.02	95.20	**95.2**
CH68-6	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39497	155283	25.4%	25.4%	24.42	24.42	
CH68-6	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4972	155283	3.2%	28.6%	3.07	27.49	
CH68-6	7	Public Facility and Residential, 8-12 units/acre	615	91	110814	155283	71.4%	100.0%	64.94	92.43	**92.4**
FR03-1	2	Parks, Golf Courses	325	64	5395	743565	0.7%	0.7%	0.46	0.46	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	42879	743565	5.8%	6.5%	4.84	5.31	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	51926	743565	7.0%	13.5%	5.87	11.17	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2996	743565	0.4%	13.9%	0.38	11.55	
FR03-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	47036	743565	6.3%	20.2%	5.31	16.87	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	593334	743565	79.8%	100.0%	70.22	87.09	**87.1**
FR03-4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	28056	457819	6.1%	6.1%	5.15	5.15	
FR03-4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	76735	457819	16.8%	22.9%	14.08	19.23	
FR03-4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7379	457819	1.6%	24.5%	1.35	20.58	
FR03-4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	35379	457819	7.7%	32.2%	7.26	27.84	
FR03-4	7	Public Facility and Residential, 8-12 units/acre	325	88	31	457819	0.0%	32.2%	0.01	27.85	
FR03-4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	36295	457819	7.9%	40.2%	6.66	34.51	
FR03-4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	73898	457819	16.1%	56.3%	13.56	48.07	
FR03-4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	18634	457819	4.1%	60.4%	3.42	51.49	
FR03-4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	16095	457819	3.5%	63.9%	2.95	54.44	
FR03-4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	236	457819	0.1%	63.9%	0.05	54.49	
FR03-4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4020	457819	0.9%	64.8%	0.83	55.32	
FR03-4	7	Public Facility and Residential, 8-12 units/acre	325	88	161061	457819	35.2%	100.0%	30.96	86.27	**86.3**
FR03-5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	260486	523465	49.8%	49.8%	41.80	41.80	
FR03-5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	31153	523465	6.0%	55.7%	5.00	46.80	
FR03-5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	82932	523465	15.8%	71.6%	13.31	60.11	
FR03-5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	34786	523465	6.6%	78.2%	5.58	65.69	
FR03-5	7	Public Facility and Residential, 8-12 units/acre	325	88	114108	523465	21.8%	100.0%	19.18	84.87	**84.9**
FR03-7	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	284261	454670	62.5%	62.5%	58.77	58.77	
FR03-7	9	Commercial, Retail, Casino, High Rise Condominiums	236	94	33480	454670	7.4%	69.9%	6.92	65.69	
FR03-7	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	454670	0.0%	69.9%	0.00	65.69	
FR03-7	7	Public Facility and Residential, 8-12 units/acre	325	88	100636	454670	22.1%	92.0%	19.48	85.17	
FR03-7	7	Public Facility and Residential, 8-12 units/acre	236	88	36291	454670	8.0%	100.0%	7.02	92.19	**92.2**
FR03-8	7	Public Facility and Residential, 8-12 units/acre	325	88	81681	116275	70.2%	70.2%	61.82	61.82	
FR03-8	7	Public Facility and Residential, 8-12 units/acre	236	88	34594	116275	29.8%	100.0%	26.18	88.00	**88.0**
FR04-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	70813	114475	61.9%	61.9%	59.38	59.38	
FR04-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	43663	114475	38.1%	100.0%	34.71	94.09	**94.1**
FR04-C10	7	Public Facility and Residential, 8-12 units/acre	615	91	249130	249130	100.0%	100.0%	91.00	91.00	**91.0**
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	84259	1867981	4.5%	4.5%	4.24	4.24	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	104436	1867981	5.6%	10.1%	4.70	8.94	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	239153	1867981	12.8%	22.9%	10.75	19.69	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	157178	1867981	8.4%	31.3%	7.07	26.76	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	220530	1867981	11.8%	43.1%	9.92	36.68	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	179847	1867981	9.6%	52.8%	8.09	44.76	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	105702	1867981	5.7%	58.4%	4.75	49.52	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	58867	1867981	3.2%	61.6%	2.65	52.16	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	12515	1867981	0.7%	62.2%	0.56	52.73	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1143	1867981	0.1%	62.3%	0.06	52.78	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3484	1867981	0.2%	62.5%	0.18	52.96	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1072	1867981	0.1%	62.5%	0.06	53.02	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11648	1867981	0.6%	63.2%	0.52	53.54	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4897	1867981	0.3%	63.4%	0.25	53.79	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	6364	1867981	0.3%	63.8%	0.29	54.07	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	12351	1867981	0.7%	64.4%	0.56	54.63	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11997	1867981	0.6%	65.1%	0.54	55.17	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	11889	1867981	0.6%	65.7%	0.53	55.70	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120265	1867981	6.4%	72.1%	6.18	61.88	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3824	1867981	0.2%	72.3%	0.19	62.07	
FR04-C11	7	Public Facility and Residential, 8-12 units/acre	615	91	53001	1867981	2.8%	75.2%	2.58	64.66	
FR04-C11	7	Public Facility and Residential, 8-12 units/acre	325	88	463559	1867981	24.8%	100.0%	21.84	86.49	**86.5**
FR04-C12	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	71631	301473	23.8%	23.8%	19.96	19.96	
FR04-C12	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	14751	301473	4.9%	28.7%	4.60	24.56	
FR04-C12	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	69614	301473	23.1%	51.7%	19.40	43.95	
FR04-C12	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7331	301473	2.4%	54.2%	2.04	46.00	
FR04-C12	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	4737	301473	1.6%	55.7%	1.32	47.32	
FR04-C12	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	32586	301473	10.8%	66.6%	9.08	56.40	
FR04-C12	7	Public Facility and Residential, 8-12 units/acre	325	88	100822	301473	33.4%	100.0%	29.43	85.83	**85.8**
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	86	705854	0.0%	0.0%	0.01	0.01	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	24	705854	0.0%	0.0%	0.00	0.01	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	50	705854	0.0%	0.0%	0.01	0.02	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	23	705854	0.0%	0.0%	0.00	0.02	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	7	705854	0.0%	0.0%	0.00	0.02	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	5	705854	0.0%	0.0%	0.00	0.02	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	39	705854	0.0%	0.0%	0.00	0.03	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	19	705854	0.0%	0.0%	0.00	0.03	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	7	705854	0.0%	0.0%	0.00	0.03	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	81	705854	0.0%	0.0%	0.01	0.04	
FR04-C13	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	88200	705854	12.5%	12.5%	10.50	10.54	
FR04-C13	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	134023	705854	19.0%	31.5%	15.95	26.49	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	100	705854	0.0%	31.5%	0.01	26.50	
FR04-C13	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	60938	705854	8.6%	40.2%	7.25	33.75	
FR04-C13	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	63251	705854	9.0%	49.1%	7.53	41.28	
FR04-C13	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	167841	705854	23.8%	72.9%	19.97	61.25	
FR04-C13	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4007	705854	0.6%	73.5%	0.53	61.79	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	187153	705854	26.5%	100.0%	23.33	85.12	**85.1**
FR04-C14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	85568	795490	10.8%	10.8%	9.04	9.04	
FR04-C14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	80399	795490	10.1%	20.9%	8.49	17.53	
FR04-C14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27773	795490	3.5%	24.4%	2.93	20.46	
FR04-C14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	121242	795490	15.2%	39.6%	12.80	33.26	
FR04-C14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	114330	795490	14.4%	54.0%	12.07	45.33	
FR04-C14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	24738	795490	3.1%	57.1%	2.61	47.95	
FR04-C14	7	Public Facility and Residential, 8-12 units/acre	325	88	341441	795490	42.9%	100.0%	37.77	85.72	**85.7**

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
FR04-C15	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	71561	279851	25.6%	25.6%	21.48	21.48	
FR04-C15	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27178	279851	9.7%	35.3%	8.16	29.64	
FR04-C15	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	114908	279851	41.1%	76.3%	34.49	64.13	
FR04-C15	7	Public Facility and Residential, 8-12 units/acre	325	88	66205	279851	23.7%	100.0%	20.82	84.95	**84.9**
FR04-C16	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	384696	698780	55.1%	55.1%	52.85	52.85	
FR04-C16	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	114771	698780	16.4%	71.5%	15.44	68.29	
FR04-C16	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1129	698780	0.2%	71.6%	0.16	68.44	
FR04-C16	7	Public Facility and Residential, 8-12 units/acre	615	91	196840	698780	28.2%	99.8%	25.63	94.08	
FR04-C16	7	Public Facility and Residential, 8-12 units/acre	325	88	1344	698780	0.2%	100.0%	0.17	94.25	**94.2**
FR04-C17	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	439	193204	0.2%	0.2%	0.22	0.22	
FR04-C17	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	27625	193204	14.3%	14.5%	13.73	13.94	
FR04-C17	7	Public Facility and Residential, 8-12 units/acre	615	91	164211	193204	85.0%	99.5%	77.34	91.29	
FR04-C17	7	Public Facility and Residential, 8-12 units/acre	325	88	928	193204	0.5%	100.0%	0.42	91.71	**91.7**
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	29407	367104	8.0%	8.0%	7.53	7.53	
FR04-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	32850	367104	8.9%	17.0%	7.52	15.05	
FR04-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	12663	367104	3.4%	20.4%	3.07	18.12	
FR04-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	127340	367104	34.7%	55.1%	29.14	47.25	
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2560	367104	0.7%	55.8%	0.67	47.92	
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3663	367104	1.0%	56.8%	0.94	48.86	
FR04-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	7034	367104	1.9%	58.7%	1.71	50.57	
FR04-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9149	367104	2.5%	61.2%	2.09	52.66	
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39054	367104	10.6%	71.8%	10.21	62.87	
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	6321	367104	1.7%	73.6%	1.62	64.49	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	23061	367104	6.3%	79.8%	5.72	70.21	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	73973	367104	20.2%	100.0%	17.73	87.94	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	4	367104	0.0%	100.0%	0.00	87.94	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	4	367104	0.0%	100.0%	0.00	87.94	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	22	367104	0.0%	100.0%	0.01	87.95	**87.9**
FR04-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	384	337783	0.1%	0.1%	0.11	0.11	
FR04-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	232	337783	0.1%	0.2%	0.06	0.17	
FR04-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	212036	337783	62.8%	63.0%	60.26	60.43	
FR04-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1936	337783	0.6%	63.5%	0.55	60.98	
FR04-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	123196	337783	36.5%	100.0%	33.19	94.17	**94.2**
FR04-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	63016	236347	26.7%	26.7%	25.60	25.60	
FR04-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3012	236347	1.3%	27.9%	1.20	26.79	
FR04-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	99769	236347	42.2%	70.1%	37.57	64.36	
FR04-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	8103	236347	3.4%	73.6%	2.88	67.24	
FR04-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1603	236347	0.7%	74.3%	0.65	67.89	
FR04-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	1168	236347	0.5%	74.8%	0.46	68.36	
FR04-C4	7	Public Facility and Residential, 8-12 units/acre	615	91	35004	236347	14.8%	89.6%	13.48	81.84	
FR04-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	24673	236347	10.4%	100.0%	9.19	91.02	**91.0**
FR04-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	10196	227686	4.5%	4.5%	4.21	4.21	
FR04-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	49090	227686	21.6%	26.0%	18.11	22.32	
FR04-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	105075	227686	46.1%	72.2%	38.77	61.09	
FR04-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	63309	227686	27.8%	100.0%	24.47	85.55	
FR04-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	16	227686	0.0%	100.0%	0.01	85.56	**85.6**
FR04-C6	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3340	244163	1.4%	1.4%	1.29	1.29	
FR04-C6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	51515	244163	21.1%	22.5%	17.72	19.01	
FR04-C6	7	Public Facility and Residential, 8-12 units/acre	325	88	8	244163	0.0%	22.5%	0.00	19.01	

BOULDER HIGHWAY STORM DRAIN

CN Calculation Summary

BASIN ID	INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
FR04-C6	7	Public Facility and Residential, 8-12 units/acre	325	88	3	244163	0.0%	22.5%	0.00	19.01	
FR04-C6	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	8725	244163	3.6%	26.0%	3.36	22.37	
FR04-C6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	72387	244163	29.6%	55.7%	24.90	47.28	
FR04-C6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	40637	244163	16.6%	72.3%	13.98	61.26	
FR04-C6	7	Public Facility and Residential, 8-12 units/acre	325	88	66353	244163	27.2%	99.5%	23.91	85.17	
FR04-C6	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	74	244163	0.0%	99.5%	0.03	85.20	
FR04-C6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	955	244163	0.4%	99.9%	0.33	85.53	
FR04-C6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1	244163	0.0%	99.9%	0.00	85.53	
FR04-C6	7	Public Facility and Residential, 8-12 units/acre	325	88	165	244163	0.1%	100.0%	0.06	85.59	**85.6**
FR04-C7	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	144535	253600	57.0%	57.0%	50.72	50.72	
FR04-C7	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	95904	253600	37.8%	94.8%	31.77	82.49	
FR04-C7	7	Public Facility and Residential, 8-12 units/acre	615	91	9328	253600	3.7%	98.5%	3.35	85.84	
FR04-C7	7	Public Facility and Residential, 8-12 units/acre	325	88	2543	253600	1.0%	99.5%	0.88	86.72	
FR04-C7	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1240	253600	0.5%	100.0%	0.41	87.13	
FR04-C7	7	Public Facility and Residential, 8-12 units/acre	615	91	3	253600	0.0%	100.0%	0.00	87.13	
FR04-C7	7	Public Facility and Residential, 8-12 units/acre	325	88	47	253600	0.0%	100.0%	0.02	87.15	**87.1**
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	123098	1378715	8.9%	8.9%	7.50	7.50	
FR04-C8	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	65515	1378715	4.8%	13.7%	4.47	11.97	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	85174	1378715	6.2%	19.9%	5.19	17.16	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	216676	1378715	15.7%	35.6%	13.20	30.36	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	200766	1378715	14.6%	50.1%	12.23	42.59	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	194612	1378715	14.1%	64.3%	11.86	54.45	
FR04-C8	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3978	1378715	0.3%	64.5%	0.27	54.72	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	61864	1378715	4.5%	69.0%	3.77	58.49	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	62503	1378715	4.5%	73.6%	3.81	62.29	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	615	91	39	1378715	0.0%	73.6%	0.00	62.30	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	361718	1378715	26.2%	99.8%	23.09	85.38	
FR04-C8	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	74	1378715	0.0%	99.8%	0.01	85.39	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	955	1378715	0.1%	99.9%	0.06	85.45	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1240	1378715	0.1%	100.0%	0.08	85.52	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1	1378715	0.0%	100.0%	0.00	85.52	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	615	91	2	1378715	0.0%	100.0%	0.00	85.52	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	25	1378715	0.0%	100.0%	0.00	85.53	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	615	91	3	1378715	0.0%	100.0%	0.00	85.53	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	47	1378715	0.0%	100.0%	0.00	85.53	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	232	1378715	0.0%	100.0%	0.01	85.54	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	27	1378715	0.0%	100.0%	0.00	85.55	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	165	1378715	0.0%	100.0%	0.01	85.56	**85.6**
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	615	91	14	1431051	0.0%	0.0%	0.00	0.00	
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	615	91	870	1431051	0.1%	0.1%	0.06	0.06	
FR04-C9	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	245917	1431051	17.2%	17.2%	16.50	16.55	
FR04-C9	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1018477	1431051	71.2%	88.4%	68.32	84.88	
FR04-C9	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	8843	1431051	0.6%	89.0%	0.58	85.46	
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	615	91	153781	1431051	10.7%	99.8%	9.78	95.24	
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	325	88	3123	1431051	0.2%	100.0%	0.19	95.43	
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	615	91	2	1431051	0.0%	100.0%	0.00	95.43	
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	325	88	25	1431051	0.0%	100.0%	0.00	95.43	**95.4**

Appendix A-6

Land Use Map and Soils Map

Boulder Highway Storm Drain
Figure A-3: Landuse Map

- Collection Subbasins
- Parks, Golf Course
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Public Facility, Residential
- Very High Density Residential
- Commercial, Retail, Casino
- Light Industrial
- Heavy Industrial
- Schools

N

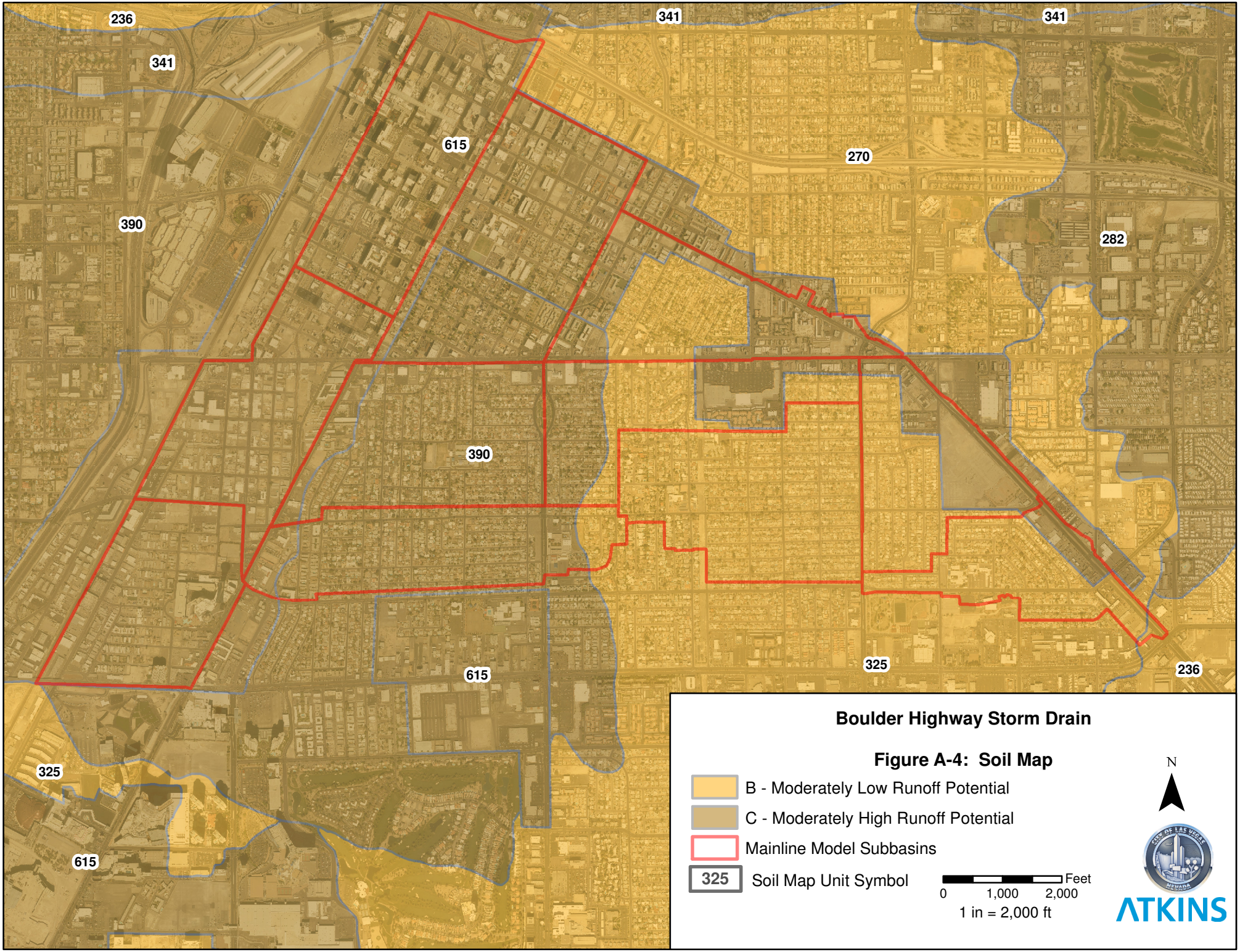
0 0.125 0.25 0.5 Miles

1 inch = 0.25 miles

ATKINS

Alta Dr
Martin L King Blvd
Commerce St
4th St
Bruce St
Eastern Ave
Stewart Ave
Charleston Blvd
Main St
15th St
Fremont St
Wyoming Ave
Oakey Blvd
Industrial Rd
Commerce St
Las Vegas Blvd
Paradise Rd
Maryland Pkwy
Spencer St
Sahara Ave
Mojave Rd
Boulder Hwy
95
15

CH59-C
CH60A-C2
CH60A-C1
CH60A-C3
CH60A-C4
CH68-1
CH68-4
CH68-3
CH68-5
CH68-6
CH67-C1
CH67-C2
CH67-C3
CH67-C4
CH67-C5
CH63-C4
CH63-C1
CH63-C2
CH63-C3
CH64-C
CH52-C1
CH52-C2
CH56-C1
CH56-C2
CH51
FR04-C1
FR04-C2
FR04-C3
FR04-C4
FR04-C5
FR04-C6
FR04-C7
FR04-C8
FR04-C9
FR04-C10
FR04-C11
FR04-C12
FR04-C13
FR04-C14
FR04-C15
FR04-C16
FR04-C17
FR03-1
FR03-4
FR03-5
FR03-7
FR03-8


236
341
341
341
615
270
390
282
390
615
325
236
325
615
Boulder Highway Storm Drain
Figure A-4: Soil Map
B - Moderately Low Runoff Potential
C - Moderately High Runoff Potential
Mainline Model Subbasins
325 Soil Map Unit Symbol
Feet
0 1,000 2,000
1 in = 2,000 ft
N
ATKINS

Appendix B

Hydraulic Analysis

- Appendix B-1: WSPG Models
- Appendix B-2: Lateral Inlet Control
- Appendix B-3: Drop Inlet Calculations and Summary
- Appendix B-4: Street Criteria

Appendix B-1

WSPG Model

```
[TITLE]
 Boulder Highway Storm Drain
Mainline WSPG - under 51" sewer
Draft Design Report

[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Node15"
Reach            "Link14"
Reach            "Link13"
Reach            "Link27"
Reach            "Link4"
Transition       "Link28"
Reach            "Link26"
Reach            "Link25"
Reach            "Link31"
Junction         "Node26"
Reach            "Link30"
Reach            "Link29"
Reach            "Link5"
Reach            "Link21"
Transition       "Link20"
Reach            "Link18"
Junction         "Node4"
Reach            "Link11"
Junction         "Node7"
Reach            "Link9"
Reach            "Link22"
Reach            "Link23"
Transition       "Link24"
Reach            "Link12"
Headwork         "Node13"

**BRANCH DEFINITIONS

[OUTLET]
**NAME             STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                            ELEV       ELEV       ID          ELEV (opt.)
**-------------    ---------  ---------- ---------- ----------  ----------
"Node15"           -14936.5   1802.86    1824       "15 x 10"   1817.73

[HEADWORK]
**NAME             INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                 ELEV       ELEV       ID                     ELEV (opt.)
**-------------    ---------  ---------- ----------  ---------- ----------
"Node13"           1844.5     1870       "14 x 8"    1801       0

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

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

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

**------------ --------- ---------- ---------- --------------

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

[JOIN]
**NAME INVERT ELEV GROUND ELEV CHANNEL ID LENGTH MANNINGS n NUMBER OF BRANCHES CONFLUENCE ANGLE
**------------ --------- ---------- ---------- ---------- ---------- ---------- ----------

[JUNCTION]
**Name INVERT ELEV GROUND ELEV CHANNEL ID LENGTH MANNINGS n NUMBER OF LATERALS CONFLUENCE ANGLE FLOW
**------------ --------- ---------- ---------- ---------- ---------- ---------- ----------
"Node4" 1829.12 1844.84 "18 x 8" 20 0.015 1
"Node4_Lateral1" 1829.67 "66" 30 265.4

"Node7" 1837.59 1858 "18 x 8" 16 0.015 1
"Node7_Lateral1" 1839.11 "66" 30 208.6

"Node26" 1806.65 1832.2 "24 x 6" 8 0.015 1
"Node26_Lateral1" 1806.65 "66" 90 138

[TRANSITION]
**NAME INVERT ELEV GROUND ELEV CHANNEL ID LENGTH MANNINGS n
**------------ --------- ---------- ---------- ---------- ----------
"Link20" 1819.61 1834.61 "20 x 8" 15 0.015
"Link24" 1842 1866 "14 x 8" 16 0.015
"Link28" 1806.44 1831.67 "24 x 6" 30 0.015

[REACH]
**NAME INVERT ELEV GROUND ELEV CHANNEL ID LENGTH MANNINGS n CURVE (opt) ANGLE POINT(opt) NUMBER MANHOLES(opt)
**------------ --------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"Link4" 1806.38 1831.13 "15 x 10" 64 0.015 0 0 0
"Link5" 1819.44 1834.4 "24 x 6" 180 0.015 0 0 0
"Link9" 1840.5 1863 "18 x 8" 897.4 0.015 0 0 0
"Link11" 1837.53 1857.42 "18 x 8" 2395.68 0.015 0 0 0
"Link12" 1844.5 1870 "14 x 8" 200 0.015 0 0 0
"Link13" 1805.45 1827 "15 x 10" 518.15 0.015 0 0 0
"Link14" 1804.41 1826 "15 x 10" 618.35 0.015 0 0 0
"Link18" 1829.05 1844.84 "20 x 8" 1393 0.015 0 0 0
"Link21" 1819.51 1834.51 "24 x 6" 10 0.015 0 0 0
"Link22" 1841.06 1864.5 "18 x 8" 161.83 0.015 46.36 0 0
"Link23" 1841.4 1865.59 "18 x 8" 95.09 0.015 0 0 0
"Link25" 1806.57 1832 "24 x 6" 30 0.015 0 0 0
"Link26" 1806.51 1831.8 "24 x 6" 34 0.015 0 0 0
"Link27" 1806.26 1831.7 "15 x 10" 405 0.015 0 0 0
"Link29" 1806.84 1833 "24 x 6" 10 0.015 0 0 0
"Link30" 1806.82 1832.9 "24 x 6" 85 0.015 0 0 0
"Link31" 1806.63 1832 "24 x 6" 34 0.015 0 0 0

[CHANNEL]
**REGULAR TYPES 1-4
**ID TYPE HEIGHT WIDTH LEFT SLOPE RIGHT SLOPE NUMBER PIERS AVG PIER WIDTH INVERT CROSS FALL
**------ ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"15 x 10" 3 10 15 0 0 0 0 0
"14 x 8" 3 8 14 0 0 0 0 0
"18 x 8" 3 8 18 0 0 0 0 0

```
"66"          4   5         5
"24 x 6"      3   6         24         0          0          0          0          0
"20 x 8"      3   8         20         0          0          0          0          0

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


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

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

 INPUT FILE
 ************************************
 X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\BoulderHwy_mainline.wsx
 Computed  05/24/17  17:09:16

 TITLE INFORMATION
 ************************************
  Boulder Highway Storm Drain
Mainline WSPG - under 51" sewer
Draft Design Report

 WARNING SUMMARY
 ************************************
  WARNING 47: Junction Node4 has a different channel than its direct downstream element.
  WARNING 25: Link type element Link11 has different invert elevation than its upstream node.
  WARNING 25: Link type element Link18 has different invert elevation than its upstream node.
  WARNING 25: Link type element Link31 has different invert elevation than its upstream node.
  WARNING 36: D/S processing stopped in junction Node7 because critical momentum is greater than maximum momentum.
  WARNING 36: D/S processing stopped in junction Node4 because critical momentum is greater than maximum momentum.

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


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

  Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Node15"	Outlet	-14936.50	1802.86	1824.00	1817.730	14.870	2413.00	16.11	4.03	1821.76	0.000	9.299	0.000	0.00000	0.000	Tr./Rect.closed
"Link14"	Reach	-14318.15	1804.41	1826.00	1821.519	17.109	2413.00	16.11	4.03	1825.55	0.000	9.299	0.899	0.00251	10.000	Tr./Rect.closed
"Link13"	Reach	-13800.00	1805.45	1827.00	1824.695	19.245	2413.00	16.11	4.03	1828.73	0.000	9.299	0.899	0.00201	10.000	Tr./Rect.closed
"Link27"	Reach	-13395.00	1806.26	1831.70	1827.177	20.917	2413.00	16.11	4.03	1831.21	0.000	9.299	0.899	0.00200	10.000	Tr./Rect.closed
"Link4"	Reach	-13331.00	1806.38	1831.13	1827.569	21.189	2413.00	16.11	4.03	1831.60	0.000	9.299	0.899	0.00188	10.000	Tr./Rect.closed
"Link28"	Transition	-13301.00	1806.44	1831.67	1827.520	21.080	2413.00	16.79	4.38	1831.90	0.000	6.000	1.209	0.00200	0.000	Tr./Rect.closed
"Link26"	Reach	-13267.00	1806.51	1831.80	1827.825	21.315	2413.00	16.79	4.38	1832.20	0.000	6.000	1.209	0.00206	6.000	Tr./Rect.closed
"Link25"	Reach	-13237.00	1806.57	1832.00	1828.093	21.523	2413.00	16.79	4.38	1832.47	0.000	6.000	1.209	0.00200	6.000	Tr./Rect.closed
"Link31"	Reach	-13203.00	1806.63	1832.00	1828.398	21.768	2413.00	16.79	4.38	1832.77	0.000	6.000	1.209	0.00176	6.000	Tr./Rect.closed
"Node26"	Junction	-13195.00	1806.65	1832.20	1829.438	22.788	2275.00	15.83	3.89	1833.33	0.000	6.000	0.000	0.00250	0.000	Tr./Rect.closed
"Link30"	Reach	-13110.00	1806.82	1832.90	1830.114	23.294	2275.00	15.83	3.89	1834.00	0.000	6.000	1.140	0.00200	6.000	Tr./Rect.closed
"Link29"	Reach	-13100.00	1806.84	1833.00	1830.194	23.354	2275.00	15.83	3.89	1834.08	0.000	6.000	1.140	0.00200	6.000	Tr./Rect.closed
"Link5"	Reach	-12920.00	1819.44	1834.40	1831.627	12.187	2275.00	15.83	3.89	1835.52	0.000	6.000	1.140	0.07000	2.321	Tr./Rect.closed
"Link21"	Reach	-12910.00	1819.51	1834.51	1831.707	12.197	2275.00	15.83	3.89	1835.60	0.000	6.000	1.140	0.00700	4.955	Tr./Rect.closed
"Link20"	Transition	-12895.00	1819.61	1834.61	1832.619	13.009	2275.00	14.24	3.15	1835.77	0.000	7.381	0.888	0.00667	0.000	Tr./Rect.closed
"Link18"	Reach	-11502.00	1829.05	1844.84	1839.734	10.684	2275.00	14.24	3.15	1842.88	0.000	7.381	0.888	0.00678	5.843	Tr./Rect.closed
"Node4"	Junction	-11482.00	1829.12	1844.84	1840.081	10.961	2009.60	13.98	3.03	1843.12	0.000	7.290	0.000	0.00350	0.000	Tr./Rect.closed
"Link11"	Reach	-9086.32	1837.53	1857.42	1852.377	14.847	2009.60	13.98	3.03	1855.41	0.000	7.290	0.872	0.00351	7.453	Tr./Rect.closed
"Node7"	Junction	-9070.32	1837.59	1858.00	1853.231	15.641	1801.00	12.53	2.44	1855.67	0.000	6.776	0.000	0.00375	0.000	Tr./Rect.closed
"Link9"	Reach	-8172.92	1840.50	1863.00	1856.931	16.431	1801.00	12.53	2.44	1859.37	0.000	6.776	0.781	0.00324	7.082	Tr./Rect.closed
"Link22"	Reach	-8011.09	1841.06	1864.50	1857.948	16.888	1801.00	12.53	2.44	1860.39	0.000	6.776	0.781	0.00346	6.917	Tr./Rect.closed
"Link23"	Reach	-7916.00	1841.40	1865.59	1858.340	16.940	1801.00	12.53	2.44	1860.78	0.000	6.776	0.781	0.00358	6.835	Tr./Rect.closed
"Link24"	Transition	-7900.00	1842.00	1866.00	1857.157	15.157	1801.00	16.12	4.03	1861.19	0.000	8.000	1.005	0.03750	0.000	Tr./Rect.closed

"Link12"	Reach	-7700.00	1844.50	1870.00	1858.685	14.185	1801.00	16.12	4.03	1862.72	0.000	8.000	1.005	0.01250	5.490	Tr./Rect.closed
"Node13"	Headwrk	-7700.00	1844.50	1870.00	1858.685	14.185	1801.00	16.12	4.03	1862.72	0.000	8.000	0.000	0.00000	0.000	Tr./Rect.closed

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE          NAME
**-----         -------
Outlet          "Node2"
Reach           "Link1"
Headwork        "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Node2"             0          1848.5     1863       "24 rcp"    1856.5

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1848.71    1862       "24 rcp"    4.8        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_Phase2_Lateral 2

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**----------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Link1"             1848.71    1862       "24 rcp"    47         0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID       TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                    SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**-------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 rcp"       4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Charleston\Charleston Lateral 2.wsx
Computed  05/22/17  17:21:12

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:

ELEMENT    TYPE       STATION    INVERT   GROUND   W.S.      DEPTH    Q        VELOC.  VELOC.  ENERGY     SUPER   CRITICAL FROUDE  SLOPE    NORMAL   CROSS
NAME                             ELEV     ELEV     ELEV                                HEAD    GRADE LN   ELEV    DEPTH    NUMBER           DEPTH    SECTION
---------- ---------- ---------- -------- -------- --------  -------- -------- ------- ------ ---------- ------  -------- ------  -------  ------   ---------
###
"Node2"    Outlet     0.00       1848.50  1863.00  1856.500   8.000    4.80     1.53    0.04   1856.54    0.000   0.771    0.000   0.00000  0.000    Pipe
"Link1"    Reach      47.00      1848.71  1862.00  1856.521   7.811    4.80     1.53    0.04   1856.56    0.000   0.771    0.000   0.00447  0.774    Pipe
"Node1"    Headwrk    47.00      1848.71  1862.00  1856.521   7.811    4.80     1.53    0.04   1856.56    0.000   0.771    0.000   0.00000  0.000    Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1842.63    1857       "24 RCP"    1853.75

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1848.83    1858       "24 RCP"    12.9       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_Lateral1

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1848.83    1858       "24 RCP"    62         0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral1.wsx
Computed  05/24/17  08:32:40

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1842.63	1857.00	1853.750	11.120	12.90	4.11	0.26	1854.01	0.000	1.292	0.000	0.00000	0.000	Pipe
"Reach"	Reach	62.00	1848.83	1858.00	1853.952	5.122	12.90	4.11	0.26	1854.21	0.000	1.292	0.000	0.10000	0.575	Pipe
"Inlet"	Headwrk	62.00	1848.83	1858.00	1853.952	5.122	12.90	4.11	0.26	1854.21	0.000	1.292	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1841.4     1856       "24 RCP"    1851.48

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1844.78    1856       "24 RCP"    6.2        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_Lateral2

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1844.78    1856       "24 RCP"    61.5       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral2.wsx
Computed  05/24/17  08:37:27

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1841.40	1856.00	1851.480	10.080	6.20	1.97	0.06	1851.54	0.000	0.881	0.000	0.00000	0.000	Pipe
"Reach"	Reach	61.50	1844.78	1856.00	1851.526	6.746	6.20	1.97	0.06	1851.59	0.000	0.881	0.000	0.05496	0.462	Pipe
"Inlet"	Headwrk	61.50	1844.78	1856.00	1851.526	6.746	6.20	1.97	0.06	1851.59	0.000	0.881	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1839.42    1855       "30 RCP"    1849

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1844.98    1855       "30 RCP"    12.3       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_Lateral3

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1844.98    1855       "30 RCP"    55.6       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"30 RCP"      4   2.5        2.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral3.wsx
Computed  05/24/17  08:41:57

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1839.42	1855.00	1849.000	9.580	12.30	2.51	0.10	1849.10	0.000	1.177	0.000	0.00000	0.000	Pipe
"Reach"	Reach	55.60	1844.98	1855.00	1849.050	4.070	12.30	2.51	0.10	1849.15	0.000	1.177	0.000	0.10000	0.520	Pipe
"Inlet"	Headwrk	55.60	1844.98	1855.00	1849.050	4.070	12.30	2.51	0.10	1849.15	0.000	1.177	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Link1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1840.44    1854.3     "18 RCP"    1849

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1847.32    1854       "18 RCP"    8.5        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_Lateral4

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Link1"             1847.32    1854.3     "18 RCP"    71.7       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"18 RCP"      4   1.5        1.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral4.wsx
Computed  05/24/17  08:54:20

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1840.44	1854.30	1849.000	8.560	8.50	4.81	0.36	1849.36	0.000	1.129	0.000	0.00000	0.000	Pipe
"Link1"	Reach	71.70	1847.32	1854.30	1849.469	2.149	8.50	4.81	0.36	1849.83	0.000	1.129	0.000	0.09596	0.523	Pipe
"Inlet"	Headwrk	71.70	1847.32	1854.30	1849.469	2.149	8.50	4.81	0.36	1849.83	0.000	1.129	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1838.42    1851.4     "24 RCP"    1846.5

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1843.99    1851.6     "24 RCP"    14.8       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_Lateral5

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1843.99    1852       "24 RCP"    55.7       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral5.wsx
Computed  05/24/17  08:57:31

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1838.42	1851.40	1846.500	8.080	14.80	4.71	0.34	1846.84	0.000	1.386	0.000	0.00000	0.000	Pipe
"Reach"	Reach	55.70	1843.99	1852.00	1846.738	2.748	14.80	4.71	0.34	1847.08	0.000	1.386	0.000	0.10000	0.617	Pipe
"Node1"	Headwrk	55.70	1843.99	1852.00	1846.738	2.748	14.80	4.71	0.34	1847.08	0.000	1.386	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1838.39    1851       "24 RCP"    1846.5

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1842.86    1851.3     "24 RCP"    5.9        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_Lateral6

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1842.86    1851.3     "24 RCP"    99.4       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral6.wsx
Computed  05/24/17  08:59:35

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1838.39	1851.00	1846.500	8.110	5.90	1.88	0.05	1846.55	0.000	0.859	0.000	0.00000	0.000	Pipe
"Reach"	Reach	99.40	1842.86	1851.30	1846.568	3.708	5.90	1.88	0.05	1846.62	0.000	0.859	0.000	0.04497	0.474	Pipe
"Node1"	Headwrk	99.40	1842.86	1851.30	1846.568	3.708	5.90	1.88	0.05	1846.62	0.000	0.859	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach2"
Junction         "DI #8"
Reach            "Reach1"
Headwork         "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1841.21    1850       "24 RCP"    1844

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1845       1849       "18 RCP"    5.3        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"DI #8"             1841.77    1849       "18 RCP"    5          0.013      1
"DI #8_DI8"         1844                  "18 RCP"                                     90         8.2
```

```
[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------

[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach1"            1845       1849       "18 RCP"    69.3       0.013      0          0          0
"Reach2"            1841.35    1849       "24 RCP"    24.7       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2
"18 RCP"      4   1.5        1.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral7.wsx
Computed  05/24/17  09:04:26

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction DI #8 has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach2 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction DI #8 because critical momentum is greater than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1841.21	1850.00	1844.000	2.790	13.50	4.30	0.29	1844.29	0.000	1.323	0.000	0.00000	0.000	Pipe
"Reach2"	Reach	24.70	1841.35	1849.00	1844.088	2.738	13.50	4.30	0.29	1844.37	0.000	1.323	0.000	0.00567	1.344	Pipe
"DI #8"	Junction	29.70	1841.77	1849.00	1844.636	2.866	5.30	3.00	0.14	1844.78	0.000	0.887	0.000	0.08400	0.000	Pipe
HYDRAULIC JUMP at		62.06	of length 0.04													
	"i.p."	60.70	1843.22	1850.45	1844.715	1.500	5.30	3.00	0.14	1844.85	0.000	0.887	0.062	0.04661	0.493	Pipe
	"i.p."	62.06	1843.28	1850.51	1844.715	1.436	5.30	3.04	0.14	1844.86	0.000	0.887	0.316	0.04661	0.493	Pipe
	"i.p."	62.06	1843.28	1850.51	1843.800	0.522	5.30	9.70	1.46	1845.26	0.000	0.887	2.763	0.04661	0.493	Pipe
	"i.p."	67.99	1843.55	1850.78	1844.084	0.529	5.30	9.51	1.40	1845.49	0.000	0.887	2.687	0.04661	0.493	Pipe
	"i.p."	76.29	1843.94	1851.17	1844.490	0.548	5.30	9.07	1.28	1845.77	0.000	0.887	2.512	0.04661	0.493	Pipe
	"i.p."	81.88	1844.20	1851.43	1844.770	0.568	5.30	8.64	1.16	1845.93	0.000	0.887	2.347	0.04661	0.493	Pipe
	"i.p."	85.96	1844.39	1851.62	1844.981	0.588	5.30	8.24	1.05	1846.04	0.000	0.887	2.192	0.04661	0.493	Pipe
	"i.p."	89.07	1844.54	1851.77	1845.147	0.610	5.30	7.86	0.96	1846.11	0.000	0.887	2.047	0.04661	0.493	Pipe
	"i.p."	91.49	1844.65	1851.88	1845.282	0.632	5.30	7.49	0.87	1846.15	0.000	0.887	1.911	0.04661	0.493	Pipe
	"i.p."	93.41	1844.74	1851.97	1845.395	0.655	5.30	7.14	0.79	1846.19	0.000	0.887	1.783	0.04661	0.493	Pipe
	"i.p."	94.94	1844.81	1852.04	1845.490	0.680	5.30	6.81	0.72	1846.21	0.000	0.887	1.663	0.04661	0.493	Pipe
	"i.p."	96.15	1844.87	1852.10	1845.572	0.705	5.30	6.49	0.65	1846.23	0.000	0.887	1.550	0.04661	0.493	Pipe
	"i.p."	97.10	1844.91	1852.14	1845.643	0.732	5.30	6.19	0.60	1846.24	0.000	0.887	1.444	0.04661	0.493	Pipe
	"i.p."	97.82	1844.95	1852.18	1845.704	0.759	5.30	5.90	0.54	1846.25	0.000	0.887	1.345	0.04661	0.493	Pipe
	"i.p."	98.35	1844.97	1852.20	1845.759	0.789	5.30	5.63	0.49	1846.25	0.000	0.887	1.251	0.04661	0.493	Pipe
	"i.p."	98.72	1844.99	1852.22	1845.806	0.819	5.30	5.37	0.45	1846.25	0.000	0.887	1.163	0.04661	0.493	Pipe
	"i.p."	98.93	1845.00	1852.23	1845.848	0.852	5.30	5.12	0.41	1846.26	0.000	0.887	1.080	0.04661	0.493	Pipe
"Reach1"	Reach	99.00	1845.00	1849.00	1845.886	0.886	5.30	4.88	0.37	1846.26	0.000	0.887	1.002	0.04661	0.493	Pipe
"Node1"	Headwrk	99.00	1845.00	1849.00	1845.887	0.887	5.30	4.87	0.37	1846.26	0.000	0.887	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1835.1     1849       "30 RCP"    1844

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1840.6     1849.2     "30 RCP"    15.2       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

[REACH]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n	CURVE (opt)	ANGLE POINT(opt)	NUMBER MANHOLES(opt)
"Reach"	1840.6	1849.2	"30 RCP"	55	0.013	0	0	0

[CHANNEL]

**REGULAR TYPES 1-4

**ID	TYPE	HEIGHT	WIDTH	LEFT SLOPE	RIGHT SLOPE	NUMBER PIERS	AVG PIER WIDTH	INVERT CROSS FALL
"30 RCP"	4	2.5	2.5					

**IRREGULAR TYPES 5-6

**ID	TYPE	NUMBER PIERS	AVG PIER WIDTH	PIER1 ELEV	PIER2 ELEV	PIER3 ELEV	PIER4 ELEV	PIER5 ELEV	PIER6 ELEV	PIER7 ELEV	PIER8 ELEV	PIER9 ELEV	PIER10 ELEV

[POINT]

**ID	XCOORD	YCOORD

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral8.wsx
Computed  05/24/17  09:08:47

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1835.10	1849.00	1844.000	8.900	15.20	3.10	0.15	1844.15	0.000	1.315	0.000	0.00000	0.000	Pipe
"Reach"	Reach	55.00	1840.60	1849.20	1844.076	3.476	15.20	3.10	0.15	1844.22	0.000	1.315	0.000	0.10000	0.578	Pipe
"Inlet"	Headwrk	55.00	1840.60	1849.20	1844.076	3.476	15.20	3.10	0.15	1844.22	0.000	1.315	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1834.33    1847.36    "24 RCP"    1842

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1837.06    1847.2     "24 RCP"    18.6       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1837.06    1847.2     "24 RCP"    54.6       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral9.wsx
Computed  05/24/17  09:19:59

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1834.33	1847.36	1842.000	7.670	18.60	5.92	0.54	1842.54	0.000	1.552	0.000	0.00000	0.000	Pipe
"Reach"	Reach	54.60	1837.06	1847.20	1842.369	5.309	18.60	5.92	0.54	1842.91	0.000	1.552	0.000	0.05000	0.839	Pipe
"Inlet"	Headwrk	54.60	1837.06	1847.20	1842.369	5.309	18.60	5.92	0.54	1842.91	0.000	1.552	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1832.6     1845       "24 RCP"    1841

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1833.64    1845       "24 RCP"    12.9       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_Lateral10

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1833.64    1845       "24 RCP"    52.2       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral10.wsx
Computed  05/24/17  09:22:52

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1832.60	1845.00	1841.000	8.400	12.90	4.11	0.26	1841.26	0.000	1.292	0.000	0.00000	0.000	Pipe
"Reach"	Reach	52.20	1833.64	1845.00	1841.170	7.530	12.90	4.11	0.26	1841.43	0.000	1.292	0.000	0.01992	0.885	Pipe
"Inlet"	Headwrk	52.20	1833.64	1845.00	1841.170	7.530	12.90	4.11	0.26	1841.43	0.000	1.292	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 Lateral 11



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach2"
Junction         "DI#12"
Reach            "Reach1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1832.53    1845       "30 rcp"    1840.9

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1835.96    1844       "18 RCP"    4.3        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
```

BH_Lateral11

```
**                 ELEV       ELEV       ID                            LATERALS   ANGLE
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ----------
"DI#12"            1833.6     1845       "18 RCP"    5          0.013      1
"DI#12_DI12"       1836.23                "18 RCP"                                  90         16.8


[TRANSITION]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                 ELEV       ELEV       ID
**-------------    ---------  ---------- ----------  ---------- ----------

[REACH]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                 ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach1"           1835.96    1844       "18 RCP"    76         0.013      0          0          0
"Reach2"           1833.1     1845       "30 rcp"    25.9       0.013      0          15         0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"30 rcp"      4   2.5        2.5
"18 RCP"      4   1.5        1.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\BH_Lateral11.wsx
Computed  05/30/17  09:52:05

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction DI#12 has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach2 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction DI#12 because critical momentum is greater than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1832.53	1845.00	1840.900	8.370	21.10	4.30	0.29	1841.19	0.000	1.561	0.000	0.00000	0.000	Pipe
"Reach2"	Reach	25.90	1833.10	1845.00	1840.983	7.883	21.10	4.30	0.29	1841.27	0.000	1.561	0.000	0.02201	1.016	Pipe
"DI#12"	Junction	30.90	1833.60	1845.00	1841.740	8.140	4.30	2.43	0.09	1841.83	0.000	0.795	0.000	0.10000	0.000	Pipe
"Reach1"	Reach	106.90	1835.96	1844.00	1841.867	5.907	4.30	2.43	0.09	1841.96	0.000	0.795	0.000	0.03105	0.492	Pipe
"Inlet"	Headwrk	106.90	1835.96	1844.00	1841.867	5.907	4.30	2.43	0.09	1841.96	0.000	0.795	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach2"
Reach            "MH Out"
Junction         "SDMH 8"
Reach            "MH In"
Reach            "Reach1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1829.98    1840.5     "24 RCP"    1837

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1831.81    1840.2     "18 RCP"    4.1        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"SDMH 8"            1831.33    1840.5     "18 RCP"    0          0.013      1
"SDMH 8_Lateral1"   1835                  "24 RCP"                                     90         14
```

[TRANSITION]

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

[REACH]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n	CURVE (opt)	ANGLE POINT(opt)	NUMBER MANHOLES(opt)
"Reach1"	1831.81	1840.2	"18 RCP"	74.2	0.013	0	0	0
"MH In"	1831.43	1840.5	"18 RCP"	2.5	0.013	0	15	0
"MH Out"	1831.33	1840.5	"24 RCP"	2.5	0.013	0	15	0
"Reach2"	1831.23	1840.5	"24 RCP"	39	0.013	0	15	0

[CHANNEL]

**REGULAR TYPES 1-4

**ID	TYPE	HEIGHT	WIDTH	LEFT SLOPE	RIGHT SLOPE	NUMBER PIERS	AVG PIER WIDTH	INVERT CROSS FALL
"24 RCP"	4	2	2					
"18 RCP"	4	1.5	1.5					

**IRREGULAR TYPES 5-6

**ID	TYPE	NUMBER PIERS	AVG PIER WIDTH	PIER1 ELEV	PIER2 ELEV	PIER3 ELEV	PIER4 ELEV	PIER5 ELEV	PIER6 ELEV	PIER7 ELEV	PIER8 ELEV	PIER9 ELEV	PIER10 ELEV

[POINT]

**ID	XCOORD	YCOORD

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral12.wsx
Computed  05/24/17  09:34:03

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction SDMH 8 has a different channel than its direct downstream element.
 WARNING 36: D/S processing stopped in junction SDMH 8 because critical momentum is greater than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1829.98	1840.50	1837.000	7.020	18.10	5.76	0.52	1837.52	0.000	1.532	0.000	0.00000	0.000	Pipe
"Reach2"	Reach	39.00	1831.23	1840.50	1837.275	6.045	18.10	5.76	0.52	1837.79	0.000	1.532	0.000	0.03205	0.937	Pipe
"MH Out"	Reach	41.50	1831.33	1840.50	1837.317	5.987	18.10	5.76	0.52	1837.83	0.000	1.532	0.000	0.04000	0.880	Pipe
"SDMH 8"	Junction	41.50	1831.33	1840.50	1838.516	7.186	4.10	2.32	0.08	1838.60	0.000	0.775	0.000	0.00000	0.000	Pipe
"MH In"	Reach	44.00	1831.43	1840.50	1838.524	7.094	4.10	2.32	0.08	1838.61	0.000	0.775	0.000	0.04000	0.449	Pipe
"Reach1"	Reach	118.20	1831.81	1840.20	1838.637	6.827	4.10	2.32	0.08	1838.72	0.000	0.775	0.000	0.00512	0.790	Pipe
"Inlet"	Headwrk	118.20	1831.81	1840.20	1838.637	6.827	4.10	2.32	0.08	1838.72	0.000	0.775	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1826.9     1832.2     "18 PVC"    1828

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1827.96    1831.9     "18 PVC"    5.5        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

BH_lateral13

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1827.96    1831.9     "18 PVC"    70.4       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"18 PVC"      4   1.5        1.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral13.wsx
Computed  05/24/17  09:50:14

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1826.90	1832.20	1827.588	0.688	5.50	6.96	0.75	1828.34	0.000	0.904	0.000	0.00000	0.000	Pipe
	"i.p."	17.49	1827.16	1832.46	1827.855	0.692	5.50	6.91	0.74	1828.60	0.000	0.904	1.668	0.01506	0.684	Pipe
	"i.p."	46.18	1827.60	1832.90	1828.313	0.718	5.50	6.58	0.67	1828.99	0.000	0.904	1.554	0.01506	0.684	Pipe
	"i.p."	57.25	1827.76	1833.06	1828.507	0.745	5.50	6.28	0.61	1829.12	0.000	0.904	1.448	0.01506	0.684	Pipe
	"i.p."	63.27	1827.85	1833.15	1828.626	0.773	5.50	5.99	0.56	1829.18	0.000	0.904	1.348	0.01506	0.684	Pipe
	"i.p."	66.84	1827.91	1833.21	1828.710	0.803	5.50	5.71	0.51	1829.22	0.000	0.904	1.253	0.01506	0.684	Pipe
	"i.p."	68.96	1827.94	1833.24	1828.773	0.835	5.50	5.44	0.46	1829.23	0.000	0.904	1.165	0.01506	0.684	Pipe
	"i.p."	70.06	1827.95	1833.25	1828.823	0.868	5.50	5.19	0.42	1829.24	0.000	0.904	1.081	0.01506	0.684	Pipe
"Reach"	Reach	70.40	1827.96	1831.90	1828.863	0.903	5.50	4.95	0.38	1829.24	0.000	0.904	1.002	0.01506	0.684	Pipe
"Inlet"	Headwrk	70.40	1827.96	1831.90	1828.864	0.904	5.50	4.94	0.38	1829.24	0.000	0.904	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1812.26    1830       "24 RCP"    1827

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1819.66    1830       "24 RCP"    25.5       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**----------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1819.66    1830       "24 RCP"    37         0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID       TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                    SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**-------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"       4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral14.wsx
Computed  05/24/17  09:52:46

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1812.26	1830.00	1827.000	14.740	25.50	8.12	1.02	1828.02	0.000	1.774	0.000	0.00000	0.000	Pipe
"Reach"	Reach	37.00	1819.66	1830.00	1827.470	7.810	25.50	8.12	1.02	1828.49	0.000	1.774	0.000	0.20000	0.685	Pipe
"Inlet"	Headwrk	37.00	1819.66	1830.00	1827.470	7.810	25.50	8.12	1.02	1828.49	0.000	1.774	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach3"
Junction         "DI#17"
Reach            "Reach2"
Junction         "SDMH 13"
Reach            "Reach1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1809.58    1829       "30 RCP"    1825.4

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1825       1829       "24 RCP"    4.1        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"SDMH 13"           1824.7     1830       "24 RCP"    5          0.013      1
"SDMH 13_24 RCP"    1824.91                "24 RCP"                                     45         25.5
```

```
"DI#17"            1810.18    1828.9     "30 RCP"    5          0.013      1
"DI#17_DI 17"      1810.18               "24 RCP"                                    90         2.6


[TRANSITION]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                 ELEV       ELEV       ID
**-------------    ---------  ---------- ----------  ---------- ----------

[REACH]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                 ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach1"           1825       1829       "24 RCP"    58.3       0.013      0          0          0
"Reach2"           1824.5     1830       "30 RCP"    93.7       0.013      0          15         0
"Reach3"           1810       1828.9     "30 RCP"    39.8       0.013      0          15         0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"30 RCP"      4   2.5        2.5
"24 RCP"      4   2          2

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



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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral15.wsx
Computed  05/24/17  10:20:19

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction SDMH 13 has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach2 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach3 has different invert elevation than its upstream node.
 WARNING 38: U/S processing stopped in junction SDMH 13 because the downstream momentum is less than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1809.58	1829.00	1825.400	15.820	32.20	6.56	0.67	1826.07	0.000	1.932	0.000	0.00000	0.000	Pipe
"Reach3"	Reach	39.80	1810.00	1828.90	1825.678	15.678	32.20	6.56	0.67	1826.35	0.000	1.932	0.000	0.01055	1.637	Pipe
"DI#17"	Junction	44.80	1810.18	1828.90	1825.914	15.734	29.60	6.03	0.56	1826.48	0.000	1.855	0.000	0.03600	0.000	Pipe
HYDRAULIC JUMP at 134.24 of length 0.06																
	"i.p."	134.24	1823.85	1842.57	1826.408	2.558	29.60	6.03	0.56	1826.97	0.000	1.855	0.000	0.15283	0.727	Pipe
	"i.p."	134.24	1823.85	1842.57	1825.151	1.302	29.60	11.46	2.04	1827.19	0.000	1.855	1.985	0.15283	0.727	Pipe
	"i.p."	134.92	1823.95	1842.67	1825.288	1.335	29.60	11.10	1.91	1827.20	0.000	1.855	1.893	0.15283	0.727	Pipe
	"i.p."	135.81	1824.09	1842.81	1825.476	1.387	29.60	10.59	1.74	1827.22	0.000	1.855	1.759	0.15283	0.727	Pipe
	"i.p."	136.55	1824.20	1842.92	1825.644	1.442	29.60	10.10	1.58	1827.23	0.000	1.855	1.633	0.15283	0.727	Pipe
	"i.p."	137.16	1824.30	1843.02	1825.796	1.500	29.60	9.63	1.44	1827.23	0.000	1.855	1.514	0.15283	0.727	Pipe
	"i.p."	137.65	1824.37	1843.09	1825.932	1.562	29.60	9.18	1.31	1827.24	0.000	1.855	1.401	0.15283	0.727	Pipe
	"i.p."	138.02	1824.43	1843.15	1826.054	1.627	29.60	8.75	1.19	1827.24	0.000	1.855	1.294	0.15283	0.727	Pipe
	"i.p."	138.29	1824.47	1843.19	1826.164	1.697	29.60	8.34	1.08	1827.25	0.000	1.855	1.193	0.15283	0.727	Pipe
	"i.p."	138.45	1824.49	1843.21	1826.264	1.772	29.60	7.95	0.98	1827.25	0.000	1.855	1.095	0.15283	0.727	Pipe
"Reach2"	Reach	138.50	1824.50	1830.00	1826.354	1.854	29.60	7.58	0.89	1827.25	0.000	1.855	1.001	0.15283	0.727	Pipe
HYDRAULIC JUMP in the middle: of length -0.00																
"SDMH 13"	Junction	143.50	1824.70	1830.00	1825.385	0.685	4.10	4.31	0.29	1825.67	0.000	0.710	0.000	0.04000	0.000	Pipe
	"i.p."	196.04	1824.97	1830.27	1825.656	0.685	4.10	4.31	0.29	1825.94	0.000	0.710	1.072	0.00515	0.685	Pipe
"Reach1"	Reach	201.80	1825.00	1829.00	1825.709	0.709	4.10	4.11	0.26	1825.97	0.000	0.710	1.003	0.00515	0.685	Pipe
"Inlet"	Headwrk	201.80	1825.00	1829.00	1825.710	0.710	4.10	4.10	0.26	1825.97	0.000	0.710	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1811.59    1827.9     "24 RCP"    1822

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1819.82    1827.9     "24 RCP"    7.8        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1819.82    1827.9     "24 RCP"    56         0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral16.wsx
Computed  05/24/17  10:29:06

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1811.59	1827.90	1822.000	10.410	7.80	2.48	0.10	1822.10	0.000	0.993	0.000	0.00000	0.000	Pipe
"Reach"	Reach	56.00	1819.82	1827.90	1822.067	2.247	7.80	2.48	0.10	1822.16	0.000	0.993	0.000	0.14696	0.405	Pipe
"Inlet"	Headwrk	56.00	1819.82	1827.90	1822.067	2.247	7.80	2.48	0.10	1822.16	0.000	0.993	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1810.92    1826       "24 RCP"    1821.5

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1816.29    1826       "24 RCP"    10.3       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1816.29    1826       "24 RCP"    38.7       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Boulder HW SD01\Lateral17.wsx
Computed  05/24/17  10:31:47

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1810.92	1826.00	1821.500	10.580	10.30	3.28	0.17	1821.67	0.000	1.149	0.000	0.00000	0.000	Pipe
"Reach"	Reach	38.70	1816.29	1826.00	1821.580	5.290	10.30	3.28	0.17	1821.75	0.000	1.149	0.000	0.13876	0.472	Pipe
"Inlet"	Headwrk	38.70	1816.29	1826.00	1821.580	5.290	10.30	3.28	0.17	1821.75	0.000	1.149	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 Euclid lateral
 DI 33 to Atlantic lateral
 100 yr Q

[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach7"
Reach            "MH 3 Out"
Reach            "MH 3 In"
Reach            "Reach6"
Junction         "Lateral 3"
Reach            "Reach5"
WallExit         "SDMH#2 OUT"
Transition       "MH Out 2"
Reach            "MH In 2"
Reach            "Reach4"
Reach            "MH Out 1"
Reach            "MH In 1"
Junction         "SDMH#1IN"
Reach            "Reach3"
Junction         "Lateral 2"
Reach            "Reach2"
Junction         "Lateral 1"
Reach            "Reach1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME             STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                            ELEV       ELEV       ID          ELEV (opt.)
**-------------    ---------  ---------- ---------- ----------  ----------
"Outlet"           -2190.59   1843       1857       "30 RCP"    1854.11

[HEADWORK]
**NAME             INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                 ELEV       ELEV       ID                     ELEV (opt.)
**-------------    ---------  ---------- ----------  ---------- ----------
"Inlet"            1859       1865       "18 RCP"    5.7        0

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

[WALLEXIT]
**NAME             INVERT     GROUND     CHANNEL     LOSS
**                 ELEV       ELEV       ID          COEFFICIENT(opt.)
**-------------    ---------  ---------- ----------  --------------
"SDMH#2 OUT"       1854.88    1862.8     "24 RCP"    0

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

[BRIDGEEXIT]
**NAME             INVERT     GROUND     CHANNEL     REDUCTION
```

```
**                 ELEV       ELEV       ID          FACTOR(opt.)
**-------------    ---------  ---------- ----------  --------------

[JOIN]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                 ELEV       ELEV       ID                                BRANCHES   ANGLE
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                 ELEV       ELEV       ID                                LATERALS   ANGLE
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Lateral 1"        1858.77    1865       "18 RCP"    5          0.013      1
"Lateral 1_Lateral1"1861.81               "18 RCP"                                     90         5.7

"Lateral 2"        1857.83    1863.7     "24 RCP"    5          0.013      1
"Lateral 2_Lateral2"1858.13               "18 RCP"                                     90         2.5

"SDMH#1IN"         1856.73    1864       "24 RCP"    0          0.013      1
"SDMH#1IN_Lateral1" 1856.73               "18 RCP"                                     90         13

"Lateral 3"        1851.11    1860.7     "30 RCP"    5          0.013      1
"Lateral 3_Lateral3"1851.9                "18 RCP"                                     45         5.5


[TRANSITION]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                 ELEV       ELEV       ID
**-------------    ---------  ---------- ----------  ---------- ----------
"MH Out 2"         1854.98    1862.8     "24 RCP"    2.5        0.013

[REACH]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                 ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach1"           1859       1865       "18 RCP"    44.5       0.013      0          0          0
"Reach2"           1858.56    1865       "24 RCP"    141.3      0.013      0          0          0
"Reach3"           1857.63    1863.7     "24 RCP"    175.2      0.013      0          15         0
"MH In 1"          1856.73    1864       "24 RCP"    2.5        0.013      0          15         0
"MH Out 1"         1856.63    1864       "24 RCP"    2.5        0.013      0          15         0
"Reach4"           1856.53    1864       "24 RCP"    140.3      0.013      0          0          0
"MH In 2"          1855.08    1862.8     "24 RCP"    2.5        0.013      0          15         0
"Reach5"           1854.88    1862.8     "30 RCP"    372        0.013      0          15         0
"Reach6"           1850.9     1860.7     "30 RCP"    211        0.013      0          0          0
"MH 3 In"          1846.88    1857       "30 RCP"    2.5        0.013      0          15         0
"MH 3 Out"         1846.78    1857       "30 RCP"    2.5        0.013      0          15         0
"Reach7"           1846.68    1857       "30 RCP"    52.1       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"30 RCP"      4   2.5        2.5
"18 RCP"      4   1.5        1.5
"24 RCP"      4   2          2

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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Euclid SD02\Euclid_SD02.wspg.wsx
Computed  05/23/17  09:39:52

TITLE INFORMATION
************************************
 Euclid lateral
 DI 33 to Atlantic lateral
 100 yr Q

WARNING SUMMARY
************************************
 WARNING 47: Junction Lateral 1 has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach2 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach3 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach6 has different invert elevation than its upstream node.
 WARNING 06: Upstream channel and downstream channel are the same for transition MH Out 2. Use a reach instead?
 WARNING 36: D/S processing stopped in junction Lateral 1 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Lateral 2 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction SDMH#1IN because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Lateral 3 because critical momentum is greater than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	-2190.59	1843.00	1857.00	1854.110	11.110	32.40	6.60	0.68	1854.79	0.000	1.938	0.000	0.00000	0.000	Pipe
"Reach7"	Reach	-2138.49	1846.68	1857.00	1854.435	7.755	32.40	6.60	0.68	1855.11	0.000	1.938	0.000	0.07063	0.934	Pipe
"MH 3 Out"	Reach	-2135.99	1846.78	1857.00	1854.484	7.704	32.40	6.60	0.68	1855.16	0.000	1.938	0.000	0.04000	1.092	Pipe
"MH 3 In"	Reach	-2133.49	1846.88	1857.00	1854.533	7.653	32.40	6.60	0.68	1855.21	0.000	1.938	0.000	0.04000	1.092	Pipe
"Reach6"	Reach	-1922.49	1850.90	1860.70	1855.850	4.950	32.40	6.60	0.68	1856.53	0.000	1.938	0.000	0.01905	1.356	Pipe
"Lateral "	Junction	-1917.49	1851.11	1860.70	1856.220	5.110	26.90	5.48	0.47	1856.69	0.000	1.768	0.000	0.04200	0.000	Pipe
"Reach5"	Reach	-1545.49	1854.88	1862.80	1857.843	2.963	26.90	5.48	0.47	1858.31	0.000	1.768	0.000	0.01013	1.470	Pipe
"SDMH#2 O"	WallExt	-1545.49	1854.88	1862.80	1857.843	2.963	26.90	8.56	1.14	1858.98	0.000	1.806	0.000	0.00000	0.000	Pipe
"MH Out 2"	Transition	-1542.99	1854.98	1862.80	1857.878	2.898	26.90	8.56	1.14	1859.02	0.000	1.806	0.000	0.04000	0.000	Pipe
"MH In 2"	Reach	-1540.49	1855.08	1862.80	1857.970	2.890	26.90	8.56	1.14	1859.11	0.000	1.806	0.000	0.04000	1.110	Pipe
"Reach4"	Reach	-1400.19	1856.53	1864.00	1859.954	3.424	26.90	8.56	1.14	1861.09	0.000	1.806	0.000	0.01033	2.000	Pipe
"MH Out 1"	Reach	-1397.69	1856.63	1864.00	1860.046	3.416	26.90	8.56	1.14	1861.18	0.000	1.806	0.000	0.04000	1.110	Pipe
"MH In 1"	Reach	-1395.19	1856.73	1864.00	1860.137	3.407	26.90	8.56	1.14	1861.28	0.000	1.806	0.000	0.04000	1.110	Pipe
"SDMH#1IN"	Junction	-1395.19	1856.73	1864.00	1861.806	5.076	13.90	4.42	0.30	1862.11	0.000	1.343	0.000	0.00000	0.000	Pipe
"Reach3"	Reach	-1219.99	1857.63	1863.70	1862.483	4.853	13.90	4.42	0.30	1862.79	0.000	1.343	0.000	0.00514	1.426	Pipe
"Lateral "	Junction	-1214.99	1857.83	1863.70	1862.697	4.867	11.40	3.63	0.20	1862.90	0.000	1.212	0.000	0.04000	0.000	Pipe
"Reach2"	Reach	-1073.69	1858.56	1865.00	1863.056	4.496	11.40	3.63	0.20	1863.26	0.000	1.212	0.000	0.00517	1.234	Pipe
"Lateral "	Junction	-1068.69	1858.77	1865.00	1863.361	4.591	5.70	3.23	0.16	1863.52	0.000	0.921	0.000	0.04200	0.000	Pipe
"Reach1"	Reach	-1024.19	1859.00	1865.00	1863.492	4.492	5.70	3.23	0.16	1863.65	0.000	0.921	0.000	0.00517	0.974	Pipe
"Inlet"	Headwrk	-1024.19	1859.00	1865.00	1863.492	4.492	5.70	3.23	0.16	1863.65	0.000	0.921	0.000	0.00000	0.000	Pipe

```
[TITLE]
 DI32 and  J w 2


[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "DI#31"
Reach            "Lateral 1"
Headwork         "DI#32"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"DI#31"             1072.73    1861.81    1865       "18 RCP"    1863.2

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"DI#32"             2862       1865       "18 RCP"    5.7        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

Euclid SD Lateral Alignment 1

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Lateral 1"         1862       1865       "18 RCP"    48.3       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"18 RCP"      4   1.5        1.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Euclid SD02\Euclid SD Lateral Alignment 1.wsx
Computed  05/23/17  10:03:09

TITLE INFORMATION
************************************
 DI32 and  J w 2

WARNING SUMMARY
************************************
 WARNING 25: Link type element Lateral 1 has different invert elevation than its upstream node.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"DI#31"	Outlet	1072.73	1861.81	1865.00	1863.200	1.390	5.70	3.34	0.17	1863.37	0.000	0.921	0.000	0.00000	0.000	Pipe
"Lateral "	Reach	1121.03	1862.00	1865.00	1863.311	1.311	5.70	3.48	0.19	1863.50	0.000	0.921	0.478	0.00393	1.077	Pipe
"DI#32"	Headwrk	1121.03	1862.00	1865.00	1863.311	1.311	5.70	3.48	0.19	1863.50	0.000	0.921	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 DI #33 and J-W-2


[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "SDMH #20"
Reach            "Lateral2"
Headwork         "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"SDMH #20"          0          1858.13    1863.8     "18 RCP"    1862.6

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1858.5     1864       "18 RCP"    2.5        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

Euclid SD lateral Alignment 2

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Lateral2"          1858.5     1864       "18 RCP"    68         0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"18 RCP"      4   1.5        1.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Euclid SD02\Euclid SD lateral Alignment 2.wsx
Computed  05/23/17  09:59:48

TITLE INFORMATION
************************************
 DI #33 and J-W-2

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"SDMH #20"	Outlet	0.00	1858.13	1863.80	1862.600	4.470	2.50	1.41	0.03	1862.63	0.000	0.599	0.000	0.00000	0.000	Pipe
"Lateral2"	Reach	68.00	1858.50	1864.00	1862.639	4.139	2.50	1.41	0.03	1862.67	0.000	0.599	0.000	0.00544	0.586	Pipe
"Node1"	Headwrk	68.00	1858.50	1864.00	1862.639	4.139	2.50	1.41	0.03	1862.67	0.000	0.599	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 EX SDMH [ C-N-3 C-N-4]
 olive and Russell


[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Node2"
Reach            "Lateral 3"
Headwork         "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Node2"             0          1851.9     1860.7     "18 RCP"    1856.03

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1853.6     1861.6     "18 RCP"    5.5        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

Euclid SD lateral Alignment 3

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Lateral 3"         1853.6     1861       "18 RCP"    40         0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"18 RCP"      4   1.5        1.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Euclid SD02\Euclid SD lateral Alignment 3.wsx
Computed  05/23/17  10:06:40

TITLE INFORMATION
************************************
 EX SDMH [ C-N-3 C-N-4]
 olive and Russell

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Node2"	Outlet	0.00	1851.90	1860.70	1856.030	4.130	5.50	3.11	0.15	1856.18	0.000	0.904	0.000	0.00000	0.000	Pipe
"Lateral "	Reach	40.00	1853.60	1861.00	1856.140	2.540	5.50	3.11	0.15	1856.29	0.000	0.904	0.000	0.04250	0.515	Pipe
"Node1"	Headwrk	40.00	1853.60	1861.00	1856.140	2.540	5.50	3.11	0.15	1856.29	0.000	0.904	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 Atlantic Lateral
 Wengert  to Fremont


[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet ML"
Reach            "Reach8"
Reach            "MH 3 OUT"
Reach            "MH 3 IN"
Reach            "Reach7"
Junction         "Lateral4"
Reach            "Reach6"
Junction         "Euclid SD"
Reach            "Reach5"
Junction         "Lateral3"
Reach            "Reach4"
Junction         "Lateral2"
Reach            "Reach3"
Reach            "MH 2 OUT"
Reach            "MH 2 IN"
Reach            "Reach 2"
Reach            "MH 1 OUT"
Reach            "MH 1 IN"
Reach            "Reach1"
Headwork         "Lateral1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet ML"         -1944.9    1839.14    1857.6     "66 RCP"    1852.95

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Lateral1"          1848.99    1860.2     "54 RCP"    141.8      0

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

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

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

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

```
**------------      ---------  ---------- ----------  --------------

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ----------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ----------- ---------- ----------
"Lateral2"          1845.68    1858.3     "54 RCP"    5          0.013      1
"Lateral2_Lateral3" 1847.98               "24 RCP"                                     90         9.2

"Lateral3"          1841.14    1857.3     "54 RCP"    5          0.012      2
"Lateral3_Lateral4Left"1845.13               "24 RCP"                                    90         11.4
"Lateral3_Lateral4Right"1845.63              "18 RCP"                                    90         3.9

"Euclid SD"         1840.52    1857       "60 RCP"    5          0.013      1
"Euclid SD_Lateral5"1843                   "30 RCP"                                     30         18.4

"Lateral4"          1839.81    1856.6     "60 RCP"    5          0.013      1
"Lateral4_Lateral6" 1843.37               "24 RCP"                                     70         18.4


[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------

[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach1"            1848.99    1860.2     "54 RCP"    29.2       0.013      0          0          0
"MH 1 IN"           1848.65    1860       "54 RCP"    2.5        0.012      0          15         0
"MH 1 OUT"          1848.55    1860       "54 RCP"    2.5        0.012      0          15         0
"Reach 2"           1848.45    1860       "54 RCP"    47.4       0.012      0          15         0
"MH 2 IN"           1847.92    1859.2     "54 RCP"    2.5        0.012      0          15         0
"MH 2 OUT"          1847.82    1859.2     "54 RCP"    2.5        0.012      0          15         0
"Reach3"            1847.72    1859.2     "54 RCP"    199        0.012      0          15         0
"Reach4"            1845.48    1858.3     "54 RCP"    303.7      0.013      0          0          0
"Reach5"            1840.94    1857.3     "60 RCP"    79.5       0.013      0          0          0
"Reach6"            1840.32    1857       "60 RCP"    96.3       0.013      0          0          0
"Reach7"            1839.61    1856.6     "66 RCP"    38.8       0.013      0          15         0
"MH 3 IN"           1839.39    1857.6     "66 RCP"    2.5        0.013      0          15         0
"MH 3 OUT"          1839.29    1857.6     "66 RCP"    2.5        0.013      0          15         0
"Reach8"            1839.19    1857.6     "66 RCP"    14         0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"66 RCP"      4   5.5        5.5
"54 RCP"      4   4.5        4.5
"24 RCP"      4   2          2
"18 RCP"      4   1.5        1.5
"60 RCP"      4   5          5
"30 RCP"      4   2.5        2.5

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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Atlantic SD03\Atlantic_SD03.wsx
Computed  05/23/17  12:45:08

TITLE INFORMATION
************************************
 Atlantic Lateral
 Wengert  to Fremont

WARNING SUMMARY
************************************
 WARNING 47: Junction Lateral3 has a different channel than its direct downstream element.
 WARNING 47: Junction Lateral4 has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach4 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach5 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach6 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach7 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction Euclid SD because critical momentum is greater than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet M"	Outlet	-1944.90	1839.14	1857.60	1852.950	13.810	203.10	8.55	1.13	1854.08	0.000	3.990	0.000	0.00000	0.000	Pipe
"Reach8"	Reach	-1930.90	1839.19	1857.60	1853.001	13.811	203.10	8.55	1.13	1854.14	0.000	3.990	0.000	0.00357	4.570	Pipe
"MH 3 OUT"	Reach	-1928.40	1839.29	1857.60	1853.067	13.777	203.10	8.55	1.13	1854.20	0.000	3.990	0.000	0.04000	2.074	Pipe
"MH 3 IN"	Reach	-1925.90	1839.39	1857.60	1853.132	13.742	203.10	8.55	1.13	1854.27	0.000	3.990	0.000	0.04000	2.074	Pipe
"Reach7"	Reach	-1887.10	1839.61	1856.60	1853.330	13.720	203.10	8.55	1.13	1854.46	0.000	3.990	0.000	0.00567	3.732	Pipe
"Lateral4"	Junction	-1882.10	1839.81	1856.60	1853.297	13.487	184.70	9.41	1.37	1854.67	0.000	3.890	0.000	0.04000	0.000	Pipe
"Reach6"	Reach	-1785.80	1840.32	1857.00	1853.782	13.462	184.70	9.41	1.37	1855.16	0.000	3.890	0.000	0.00530	3.988	Pipe
"Euclid S"	Junction	-1780.80	1840.52	1857.00	1854.230	13.710	166.30	8.47	1.11	1855.34	0.000	3.697	0.000	0.04000	0.000	Pipe
"Reach5"	Reach	-1701.30	1840.94	1857.30	1854.554	13.614	166.30	8.47	1.11	1855.67	0.000	3.697	0.000	0.00528	3.635	Pipe
"Lateral3"	Junction	-1696.30	1841.14	1857.30	1854.531	13.391	151.00	9.49	1.40	1855.93	0.000	3.604	0.000	0.04000	0.000	Pipe
"Reach4"	Reach	-1392.60	1845.48	1858.30	1856.322	10.842	151.00	9.49	1.40	1857.72	0.000	3.604	0.000	0.01429	2.623	Pipe
"Lateral2"	Junction	-1387.60	1845.68	1858.30	1856.681	11.001	141.80	8.92	1.23	1857.91	0.000	3.500	0.000	0.04000	0.000	Pipe
"Reach3"	Reach	-1188.60	1847.72	1859.20	1857.623	9.903	141.80	8.92	1.23	1858.86	0.000	3.500	0.000	0.01025	2.662	Pipe
"MH 2 OUT"	Reach	-1186.10	1847.82	1859.20	1857.696	9.876	141.80	8.92	1.23	1858.93	0.000	3.500	0.000	0.04000	1.788	Pipe
"MH 2 IN"	Reach	-1183.60	1847.92	1859.20	1857.768	9.848	141.80	8.92	1.23	1859.00	0.000	3.500	0.000	0.04000	1.788	Pipe
"Reach 2"	Reach	-1136.20	1848.45	1860.00	1858.039	9.589	141.80	8.92	1.23	1859.27	0.000	3.500	0.000	0.01118	2.589	Pipe
"MH 1 OUT"	Reach	-1133.70	1848.55	1860.00	1858.111	9.561	141.80	8.92	1.23	1859.35	0.000	3.500	0.000	0.04000	1.788	Pipe
"MH 1 IN"	Reach	-1131.20	1848.65	1860.00	1858.183	9.533	141.80	8.92	1.23	1859.42	0.000	3.500	0.000	0.04000	1.788	Pipe
"Reach1"	Reach	-1102.00	1848.99	1860.20	1858.335	9.345	141.80	8.92	1.23	1859.57	0.000	3.500	0.000	0.01164	2.691	Pipe
"Lateral1"	Headwrk	-1102.00	1848.99	1860.20	1858.335	9.345	141.80	8.92	1.23	1859.57	0.000	3.500	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 DI 42 & 43 C N 1  & C N 2
 Connects to atlantic lateral
 Wengert Avenue

[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach2"
Junction         "SDMH"
Reach            "Reach1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            1100       1849.7     1860.2     "48 RCP"    1858.33

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1855.7     1861.1     "36 RCP"    48.5       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"SDMH"              1852.29    1860.7     "36 RCP"    5          0.013      1
"SDMH_Lateral1"     1852.29               "36 RCP"                                     0          22.4
```

Atlantic SD Lateral Alignment 1 Left

[TRANSITION]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n
"Reach1"	1855.7	1861.1	"36 RCP"	44.8	0.013
"Reach2"	1852.09	1860.7	"48 RCP"	18.1	0.012

**NAME	CURVE (opt)	ANGLE POINT(opt)	NUMBER MANHOLES(opt)
"Reach1"	0	0	0
"Reach2"	0	0	0

[CHANNEL]

**REGULAR TYPES 1-4

**ID	TYPE	HEIGHT	WIDTH	LEFT SLOPE	RIGHT SLOPE	NUMBER PIERS	AVG PIER WIDTH	INVERT CROSS FALL
"48 RCP"	4	4	4					
"36 RCP"	4	3	3					

**IRREGULAR TYPES 5-6

**ID	TYPE	NUMBER PIERS	AVG PIER WIDTH	PIER1 ELEV	PIER2 ELEV	PIER3 ELEV	PIER4 ELEV	PIER5 ELEV	PIER6 ELEV	PIER7 ELEV	PIER8 ELEV	PIER9 ELEV	PIER10 ELEV

[POINT]

**ID	XCOORD	YCOORD

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Atlantic SD03\Atlantic SD Lateral Alignment 1 Left.wsx
Computed  05/23/17  12:57:00

TITLE INFORMATION
************************************
 DI 42 & 43 C N 1  & C N 2
 Connects to atlantic lateral
 Wengert Avenue

WARNING SUMMARY
************************************
 WARNING 47: Junction SDMH has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach2 has different invert elevation than its upstream node.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	1100.00	1849.70	1860.20	1858.330	8.630	70.90	5.64	0.49	1858.82	0.000	2.546	0.000	0.00000	0.000	Pipe
"Reach2"	Reach	1118.10	1852.09	1860.70	1858.368	6.278	70.90	5.64	0.49	1858.86	0.000	2.546	0.000	0.13204	0.956	Pipe
"SDMH"	Junction	1123.10	1852.29	1860.70	1858.375	6.085	48.50	6.86	0.73	1859.11	0.000	2.268	0.000	0.04000	0.000	Pipe
	"i.p."	1166.66	1855.61	1864.02	1858.605	3.000	48.50	6.86	0.73	1859.34	0.000	2.268	0.085	0.07612	1.051	Pipe
"Reach1"	Reach	1167.90	1855.70	1861.10	1858.595	2.895	48.50	6.94	0.75	1859.34	0.000	2.268	0.486	0.07612	1.051	Pipe
"Inlet"	Headwrk	1167.90	1855.70	1861.10	1858.595	2.895	48.50	6.94	0.75	1859.34	0.000	2.268	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 DI 40 & 41 and C S 1 C S 2
 Connects to Atlantic Avenue lateral
 Wengert Avenue

[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach2"
Junction         "SDDI"
Reach            "Reach1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            -1100      1849.46    1860.2     "48 RCP"    1858.33

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1854       1862       "36 RCP"    48.5       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"SDDI"              1851.7     1861       "36 RCP"    5          0.012      1
"SDDI_Lateral1"     1851.7                "36 RCP"                                     0          22.4
```

[TRANSITION]

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

[REACH]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n	CURVE (opt)	ANGLE POINT(opt)	NUMBER MANHOLES(opt)
"Reach1"	1854	1862	"36 RCP"	48.5	0.013	0	0	0
"Reach2"	1851.5	1862	"48 RCP"	43	0.013	0	0	0

[CHANNEL]

**REGULAR TYPES 1-4

**ID	TYPE	HEIGHT	WIDTH	LEFT SLOPE	RIGHT SLOPE	NUMBER PIERS	AVG PIER WIDTH	INVERT CROSS FALL
"48 RCP"	4	4	4					
"36 RCP"	4	3	3					

**IRREGULAR TYPES 5-6

**ID	TYPE	NUMBER PIERS	AVG PIER WIDTH	PIER1 ELEV	PIER2 ELEV	PIER3 ELEV	PIER4 ELEV	PIER5 ELEV	PIER6 ELEV	PIER7 ELEV	PIER8 ELEV	PIER9 ELEV	PIER10 ELEV

[POINT]

**ID	XCOORD	YCOORD

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Atlantic SD03\Atlantic SD Lateral Alignment 1 Right.wsx
Computed  05/23/17  13:01:15

TITLE INFORMATION
************************************
 DI 40 & 41 and C S 1 C S 2
 Connects to Atlantic Avenue lateral
 Wengert Avenue

WARNING SUMMARY
************************************
 WARNING 47: Junction SDDI has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach2 has different invert elevation than its upstream node.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	-1100.00	1849.46	1860.20	1858.330	8.870	70.90	5.64	0.49	1858.82	0.000	2.546	0.000	0.00000	0.000	Pipe
"Reach2"	Reach	-1057.00	1851.50	1862.00	1858.435	6.935	70.90	5.64	0.49	1858.93	0.000	2.546	0.000	0.04744	1.295	Pipe
"SDDI"	Junction	-1052.00	1851.70	1861.00	1858.439	6.739	48.50	6.86	0.73	1859.17	0.000	2.268	0.000	0.04000	0.000	Pipe
"Reach1"	Reach	-1003.50	1854.00	1862.00	1858.696	4.696	48.50	6.86	0.73	1859.43	0.000	2.268	0.000	0.04742	1.194	Pipe
"Inlet"	Headwrk	-1003.50	1854.00	1862.00	1858.696	4.696	48.50	6.86	0.73	1859.43	0.000	2.268	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 DI-44 and C-W-2
 Connect to Atlantic lateral


[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1847.98    1858.3     "24 RCP"    1856.68

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1851.35    1859       "24 RCP"    9.2        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**----------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1851.35    1859       "24 RCP"    67.4       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID       TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                    SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**-------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"       4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Atlantic SD03\Atlantic SD Lateral Alignment 2.wsx
Computed  05/23/17  14:45:34

TITLE INFORMATION
************************************
 DI-44 and C-W-2
 Connect to Atlantic lateral

WARNING SUMMARY
************************************

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


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

 Composite Profile:

ELEMENT    TYPE       STATION    INVERT   GROUND   W.S.      DEPTH    Q        VELOC.  VELOC.  ENERGY     SUPER   CRITICAL FROUDE  SLOPE    NORMAL   CROSS
NAME                             ELEV     ELEV     ELEV                                HEAD    GRADE LN   ELEV    DEPTH    NUMBER           DEPTH    SECTION
---------- ---------- ---------- -------- -------- --------  -------- -------- ------- ------ ---------- ------  -------- ------  -------  ------   ---------
###
"Outlet"   Outlet     0.00       1847.98  1858.30  1856.680   8.700    9.20     2.93    0.13   1856.81    0.000   1.083    0.000   0.00000  0.000    Pipe
"Reach"    Reach      67.40      1851.35  1859.00  1856.791   5.441    9.20     2.93    0.13   1856.92    0.000   1.083    0.000   0.05000  0.578    Pipe
"Inlet"    Headwrk    67.40      1851.35  1859.00  1856.791   5.441    9.20     2.93    0.13   1856.92    0.000   1.083    0.000   0.00000  0.000    Pipe

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

```
[TITLE]
 Di #45 and C-W-3
 Atlantic Lateral 3


[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1843.64    1857.63    "24 RCP"    1854.53

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1849.08    1857.2     "24 RCP"    11.4       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

Atlantic SD Lateral Alignment 3 Left

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**----------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1849.08    1857.2     "24 RCP"    65.8       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID       TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                    SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**-------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"       4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Atlantic SD03\Atlantic SD Lateral Alignment 3 Left.wsx
Computed  05/23/17  14:46:38

TITLE INFORMATION
************************************
 Di #45 and C-W-3
 Atlantic Lateral 3

WARNING SUMMARY
************************************

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


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

 Composite Profile:

ELEMENT    TYPE       STATION    INVERT   GROUND   W.S.      DEPTH    Q        VELOC.  VELOC.  ENERGY     SUPER   CRITICAL FROUDE  SLOPE    NORMAL   CROSS
NAME                             ELEV     ELEV     ELEV                                HEAD    GRADE LN   ELEV    DEPTH    NUMBER           DEPTH    SECTION
---------- ---------- ---------- -------- -------- --------  -------- -------- ------- ------ ---------- ------  -------- ------  -------  ------   ---------
###
"Outlet"   Outlet     0.00       1843.64  1857.63  1854.530   10.890   11.40    3.63    0.20   1854.73    0.000   1.212    0.000   0.00000  0.000    Pipe
"Reach"    Reach      65.80      1849.08  1857.20  1854.697   5.617    11.40    3.63    0.20   1854.90    0.000   1.212    0.000   0.08267  0.567    Pipe
"Node1"    Headwrk    65.80      1849.08  1857.20  1850.292   1.212    11.40    5.73    0.51   1850.80    0.000   1.212    0.000   0.00000  0.000    Pipe

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

```
[TITLE]
 DI 46 and C E 1
 Atlantic Lateral


[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1844.14    1857.3     "18 RCP"    1854.5

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1847.81    1857.3     "18 RCP"    3.9        0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

Atlantic SD Lateral Alignment 3 Right

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**----------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1847.81    1857.3     "18 RCP"    36.7       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID       TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                    SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"18 RCP"       4   1.5        1.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Atlantic SD03\Atlantic SD Lateral Alignment 3 Right.wsx
Computed  05/23/17  14:47:10

TITLE INFORMATION
************************************
 DI 46 and C E 1
 Atlantic Lateral

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1844.14	1857.30	1854.500	10.360	3.90	2.21	0.08	1854.58	0.000	0.755	0.000	0.00000	0.000	Pipe
"Reach"	Reach	36.70	1847.81	1857.30	1854.551	6.741	3.90	2.21	0.08	1854.63	0.000	0.755	0.000	0.10000	0.347	Pipe
"Inlet"	Headwrk	36.70	1847.81	1857.30	1854.551	6.741	3.90	2.21	0.08	1854.63	0.000	0.755	0.000	0.00000	0.000	Pipe

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

```
[TITLE]
 DI 47 and C-W-4
 Atlantic lateral 4


[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1842.81    1856.6     "24 RCP"    1853.3

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1846.62    1857       "24 RCP"    18.4       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1846.62    1857       "24 RCP"    38.1       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Atlantic SD03\Atlantic SD Lateral Alignment 4.wsx
Computed  05/23/17  14:48:33

TITLE INFORMATION
************************************
 DI 47 and C-W-4
 Atlantic lateral 4

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1842.81	1856.60	1853.300	10.490	18.40	5.86	0.53	1853.83	0.000	1.544	0.000	0.00000	0.000	Pipe
"Reach"	Reach	38.10	1846.62	1857.00	1853.552	6.932	18.40	5.86	0.53	1854.08	0.000	1.544	0.000	0.10000	0.692	Pipe
"Inlet"	Headwrk	38.10	1846.62	1857.00	1853.552	6.932	18.40	5.86	0.53	1854.08	0.000	1.544	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE          NAME
**-----         -------
Outlet          "Outlet"
Reach           "Reach6"
Reach           "Link9"
Reach           "MH 3 IN"
Reach           "Reach5"
Junction        "Lateral 2"
Reach           "Reach4"
Reach           "MH OUT"
Reach           "MH IN"
Reach           "Reach3"
Junction        "Lateral 1"
Reach           "Reach2"
Junction        "DI"
Reach           "Reach1"
Headwork        "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            -1538.99   1829.67    1845.3     "53x66 HERCP"1840.63

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1842.5     1848       "42 RCP"    61.7       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
```

```
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Lateral 1"         1836.4     1846.7     "48 RCP"    5          0.013      1
"Lateral 1_Lateral1"1836.24                "48 RCP"                                     45         116.2

"Lateral 2"         1830.31    1845.2     "60 RCP"    5          0.013      2
"Lateral 2_Lateral2a"1833.29                "24 RCP"                                     30         22.6
"Lateral 2_Lateral2b"1833.29                "24 RCP"                                     30         22.6

"DI"                1842.04    1848       "42 RCP"    20         0.013      1
"DI_Lateral1"       1842.04                "36 RCP"                                     0          54.5


[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------

[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach1"            1842.5     1848       "42 RCP"    29.5       0.013      0          0          0
"Reach2"            1841.84    1848.02    "48 RCP"    114        0.013      0          0          0
"Reach3"            1836.2     1846.7     "60 RCP"    103        0.013      0          15         1
"MH IN"             1832.95    1846       "60 RCP"    2.5        0.013      0          0          0
"MH OUT"            1832.85    1846       "60 RCP"    2.5        0.013      0          0          0
"Reach4"            1832.75    1846       "60 RCP"    76         0.013      0          0          0
"Reach5"            1829.94    1845.2     "53x66 HERCP"50        0.013      0          0          0
"MH 3 IN"           1829.83    1845.3     "53x66 HERCP"2.5       0.013      0          15         0
"Link9"             1829.78    1845.3     "53x66 HERCP"2.5       0.013      0          15         0
"Reach6"            1829.73    1845.3     "53x66 HERCP"31.5      0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"53x66 HERCP" 4   5.5        5.5
"42 RCP"      4   3.5        3.5
"48 RCP"      4   4          4
"60 RCP"      4   5          5
"24 RCP"      4   2          2
"36 RCP"      4   3          3

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



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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Oakey SD04\Oakey_SD04.wsx
Computed  05/23/17  16:06:36

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 45: One of the elevations of junction's Lateral 1 laterals is less than the U/S elevation.
 WARNING 47: Junction Lateral 1 has a different channel than its direct downstream element.
 WARNING 47: Junction Lateral 2 has a different channel than its direct downstream element.
 WARNING 47: Junction DI has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach2 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach3 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach5 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction DI because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Lateral 1 because critical momentum is greater than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	-1538.99	1829.67	1845.30	1840.630	10.960	277.60	11.68	2.12	1842.75	0.000	4.618	0.000	0.00000	0.000	Pipe
"Reach6"	Reach	-1507.49	1829.73	1845.30	1840.845	11.115	277.60	11.68	2.12	1842.97	0.000	4.618	0.000	0.00190	5.500	Pipe
"Link9"	Reach	-1504.99	1829.78	1845.30	1840.967	11.187	277.60	11.68	2.12	1843.09	0.000	4.618	0.000	0.02000	3.021	Pipe
"MH 3 IN"	Reach	-1502.49	1829.83	1845.30	1841.089	11.259	277.60	11.68	2.12	1843.21	0.000	4.618	0.000	0.02000	3.021	Pipe
"Reach5"	Reach	-1452.49	1829.94	1845.20	1841.431	11.491	277.60	11.68	2.12	1843.55	0.000	4.618	0.000	0.00220	5.500	Pipe
"Lateral "	Junction	-1447.49	1830.31	1845.20	1841.770	11.460	232.40	11.84	2.18	1843.95	0.000	4.304	0.000	0.07400	0.000	Pipe
"Reach4"	Reach	-1371.49	1832.75	1846.00	1842.376	9.626	232.40	11.84	2.18	1844.55	0.000	4.304	0.000	0.03211	2.494	Pipe
"MH OUT"	Reach	-1368.99	1832.85	1846.00	1842.395	9.545	232.40	11.84	2.18	1844.57	0.000	4.304	0.000	0.04000	2.340	Pipe
"MH IN"	Reach	-1366.49	1832.95	1846.00	1842.415	9.465	232.40	11.84	2.18	1844.59	0.000	4.304	0.000	0.04000	2.340	Pipe
"Reach3"	Reach	-1263.49	1836.20	1846.70	1843.452	7.252	232.40	11.84	2.18	1845.63	0.000	4.304	0.000	0.03155	2.507	Pipe
"Lateral "	Junction	-1258.49	1836.40	1846.70	1845.256	8.856	116.20	9.25	1.33	1846.58	0.000	3.251	0.000	0.04000	0.000	Pipe
"Reach2"	Reach	-1144.49	1841.84	1848.02	1846.002	4.162	116.20	9.25	1.33	1847.33	0.000	3.251	0.000	0.04772	1.685	Pipe
"DI"	Junction	-1124.49	1842.04	1848.00	1846.829	4.789	61.70	6.41	0.64	1847.47	0.000	2.462	0.000	0.01000	0.000	Pipe
"Reach1"	Reach	-1094.99	1842.50	1848.00	1846.940	4.440	61.70	6.41	0.64	1847.58	0.000	2.462	0.000	0.01559	1.732	Pipe
"Inlet"	Headwrk	-1094.99	1842.50	1848.00	1846.940	4.440	61.70	6.41	0.64	1847.58	0.000	2.462	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach2"
Junction         "Node5"
Reach            "Reach1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1836.24    1847       "60 rcp"    1844.36

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1841.25    1847.6     "42 RCP"    61.7       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Node5"             1840.85    1847       "42 RCP"    14         0.013      1
"Node5_Lateral1"    1840.85               "42 RCP"                                     90         54.5
```

```
[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**----------------  ---------  ---------- ----------  ---------- ----------

[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**----------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach1"            1841.25    1847.6     "42 RCP"    27.4       0.013      0          0          0
"Reach2"            1839.5     1847       "60 rcp"    73.66      0.013      0          15         0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"60 rcp"      4   5          5
"42 RCP"      4   3.5        3.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Oakey SD04\Oakey SD Lateral Alignment 1.wsx
Computed  05/23/17  16:30:33

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction Node5 has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach2 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction Node5 because critical momentum is greater than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1836.24	1847.00	1844.360	8.120	116.20	5.92	0.54	1844.90	0.000	3.078	0.000	0.00000	0.000	Pipe
"Reach2"	Reach	73.66	1839.50	1847.00	1844.534	5.034	116.20	5.92	0.54	1845.08	0.000	3.078	0.000	0.04426	1.563	Pipe
"Node5"	Junction	87.66	1840.85	1847.00	1845.194	4.344	61.70	6.41	0.64	1845.83	0.000	2.462	0.000	0.09643	0.000	Pipe
"Reach1"	Reach	115.06	1841.25	1847.60	1845.297	4.047	61.70	6.41	0.64	1845.94	0.000	2.462	0.000	0.01460	1.766	Pipe
"Inlet"	Headwrk	115.06	1841.25	1847.60	1845.297	4.047	61.70	6.41	0.64	1845.94	0.000	2.462	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Link1"
Headwork         "Node1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1833.29    1845.2     "24 RCP"    1841.77

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Node1"             1838.49    1845.3     "24 RCP"    22.6       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

Oakey SD Lateral Alignment 2 Left

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Link1"             1838.49    1845.3     "24 RCP"    52         0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Oakey SD04\Oakey SD Lateral Alignment 2 Left.wsx
Computed  05/23/17  16:40:21

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1833.29	1845.20	1841.770	8.480	22.60	7.19	0.80	1842.57	0.000	1.694	0.000	0.00000	0.000	Pipe
"Link1"	Reach	52.00	1838.49	1845.30	1842.289	3.799	22.60	7.19	0.80	1843.09	0.000	1.694	0.000	0.10000	0.772	Pipe
"Node1"	Headwrk	52.00	1838.49	1845.30	1842.289	3.799	22.60	7.19	0.80	1843.09	0.000	1.694	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1833.29    1845.2     "24 RCP"    1841.77

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1836.12    1845       "24 RCP"    22.6       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

Oakey SD Lateral Alignment 2 Right

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**-------------     ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1836.12    1845       "24 RCP"    28.3       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\Oakey SD04\Oakey SD Lateral Alignment 2 Right.wsx
Computed  05/23/17  16:42:06

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1833.29	1845.20	1841.770	8.480	22.60	7.19	0.80	1842.57	0.000	1.694	0.000	0.00000	0.000	Pipe
"Reach"	Reach	28.30	1836.12	1845.00	1842.052	5.932	22.60	7.19	0.80	1842.86	0.000	1.694	0.000	0.10000	0.772	Pipe
"Inlet"	Headwrk	28.30	1836.12	1845.00	1842.052	5.932	22.60	7.19	0.80	1842.86	0.000	1.694	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE          NAME
**-----         -------
Outlet          "Outlet"
Reach           "Reach6"
Reach           "MH 3 OUT"
Reach           "MH 3 IN"
Reach           "Reach5"
Junction        "Lateral3"
Reach           "Reach4"
Reach           "MH 2 OUT"
Reach           "MH 2 IN"
Reach           "Reach3"
Junction        "Lateral2"
Reach           "Reach2"
Reach           "MH 1 OUT"
Reach           "MH 1 IN"
Reach           "Reach1"
Headwork        "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME            STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                           ELEV       ELEV       ID          ELEV (opt.)
**------------    ---------  ---------- ---------- ----------  ----------
"Outlet"          -1874.45   1806.65    1832.1     "60 RCP"    1829.43

[HEADWORK]
**NAME            INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                ELEV       ELEV       ID                     ELEV (opt.)
**------------    ---------  ---------- ----------  ---------- ----------
"Inlet"           1824.58    1838.9     "30 RCP"    35.8       0

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

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

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

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

[JOIN]
**NAME            INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
```

**	ELEV	ELEV	ID			BRANCHES	ANGLE

[JUNCTION]

**Name	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n	NUMBER OF LATERALS	CONFLUENCE ANGLE	FLOW
"Lateral2"	1815.9	1833.1	"30 RCP"	5	0.013	2		
"Lateral2_Lateral1"	1820.59		"30 RCP"				30	39.3
"Lateral2_Lateral2"	1817.41		"30 RCP"				30	39.3
"Lateral3"	1810.45	1832.1	"54 rcp"	5	0.013	2		
"Lateral3_Lateral1"	1815.87		"30 RCP"				30	18.9
"Lateral3_Lateral2"	1812.75		"30 RCP"				30	16.8

[TRANSITION]

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

[REACH]

**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	LENGTH	MANNINGS n	CURVE (opt)	ANGLE POINT(opt)	NUMBER MANHOLES(opt)
"Reach1"	1824.58	1838.9	"30 RCP"	375.5	0.013	0	0	0
"MH 1 IN"	1818.16	1834.4	"30 RCP"	2.5	0.013	0	0	0
"MH 1 OUT"	1818.06	1834.4	"30 RCP"	2.5	0.013	0	0	0
"Reach2"	1817.96	1834.4	"30 RCP"	116	0.013	18.3	0	0
"Reach3"	1815.7	1833.1	"54 rcp"	149	0.013	21	0	0
"MH 2 IN"	1813.08	1832.2	"54 rcp"	2.5	0.013	0	0	0
"MH 2 OUT"	1812.98	1832.2	"54 rcp"	2.5	0.013	0	0	0
"Reach4"	1812.88	1832.2	"54 rcp"	58	0.013	0	0	0
"Reach5"	1810.25	1832.1	"60 RCP"	53	0.013	0	0	0
"MH 3 IN"	1807.36	1832.1	"60 RCP"	2.5	0.013	0	15	0
"MH 3 OUT"	1807.26	1832.1	"60 RCP"	2.5	0.013	0	15	0
"Reach6"	1807.16	1832.1	"60 RCP"	11.7	0.013	0	15	0

[CHANNEL]

**REGULAR TYPES 1-4

**ID	TYPE	HEIGHT	WIDTH	LEFT SLOPE	RIGHT SLOPE	NUMBER PIERS	AVG PIER WIDTH	INVERT CROSS FALL
"60 RCP"	4	5	5					
"30 RCP"	4	2.5	2.5					
"54 rcp"	4	4.5	4.5					

**IRREGULAR TYPES 5-6

**ID	TYPE	NUMBER PIERS	AVG PIER WIDTH	PIER1 ELEV	PIER2 ELEV	PIER3 ELEV	PIER4 ELEV	PIER5 ELEV	PIER6 ELEV	PIER7 ELEV	PIER8 ELEV	PIER9 ELEV	PIER10 ELEV

[POINT]

**ID	XCOORD	YCOORD

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\SL SD05\SL_SD05_ult.wsx
Computed  05/23/17  18:51:35

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction Lateral2 has a different channel than its direct downstream element.
 WARNING 47: Junction Lateral3 has a different channel than its direct downstream element.
 WARNING 25: Link type element Reach3 has different invert elevation than its upstream node.
 WARNING 25: Link type element Reach5 has different invert elevation than its upstream node.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	-1874.45	1806.65	1832.10	1829.430	22.780	150.10	7.64	0.91	1830.34	0.000	3.512	0.000	0.00000	0.000	Pipe
"Reach6"	Reach	-1862.75	1807.16	1832.10	1829.514	22.354	150.10	7.64	0.91	1830.42	0.000	3.512	0.000	0.04359	1.796	Pipe
"MH 3 OUT"	Reach	-1860.25	1807.26	1832.10	1829.567	22.307	150.10	7.64	0.91	1830.47	0.000	3.512	0.000	0.04000	1.838	Pipe
"MH 3 IN"	Reach	-1857.75	1807.36	1832.10	1829.620	22.260	150.10	7.64	0.91	1830.53	0.000	3.512	0.000	0.04000	1.838	Pipe
"Reach5"	Reach	-1804.75	1810.25	1832.10	1829.796	19.546	150.10	7.64	0.91	1830.70	0.000	3.512	0.000	0.05453	1.692	Pipe
"Lateral3"	Junction	-1799.75	1810.45	1832.10	1830.183	19.733	114.40	7.19	0.80	1830.99	0.000	3.148	0.000	0.04000	0.000	Pipe
"Reach4"	Reach	-1741.75	1812.88	1832.20	1830.379	17.499	114.40	7.19	0.80	1831.18	0.000	3.148	0.000	0.04190	1.642	Pipe
"MH 2 OUT"	Reach	-1739.25	1812.98	1832.20	1830.388	17.408	114.40	7.19	0.80	1831.19	0.000	3.148	0.000	0.04000	1.662	Pipe
"MH 2 IN"	Reach	-1736.75	1813.08	1832.20	1830.396	17.316	114.40	7.19	0.80	1831.20	0.000	3.148	0.000	0.04000	1.662	Pipe
"Reach3"	Reach	-1587.75	1815.70	1833.10	1830.978	15.278	114.40	7.19	0.80	1831.78	0.000	3.148	0.000	0.01758	2.086	Pipe
"Lateral2"	Junction	-1582.75	1815.90	1833.10	1831.056	15.156	35.80	7.29	0.83	1831.88	0.000	2.030	0.000	0.04000	0.000	Pipe
"Reach2"	Reach	-1466.75	1817.96	1834.40	1832.014	14.054	35.80	7.29	0.83	1832.84	0.000	2.030	0.000	0.01776	1.475	Pipe
"MH 1 OUT"	Reach	-1464.25	1818.06	1834.40	1832.033	13.973	35.80	7.29	0.83	1832.86	0.000	2.030	0.000	0.04000	1.155	Pipe
"MH 1 IN"	Reach	-1461.75	1818.16	1834.40	1832.052	13.892	35.80	7.29	0.83	1832.88	0.000	2.030	0.000	0.04000	1.155	Pipe
"Reach1"	Reach	-1086.25	1824.58	1838.90	1834.913	10.333	35.80	7.29	0.83	1835.74	0.000	2.030	0.000	0.01710	1.494	Pipe
"Inlet"	Headwrk	-1086.25	1824.58	1838.90	1834.913	10.333	35.80	7.29	0.83	1835.74	0.000	2.030	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1826.58    1838.9     "24 RCP"    1834.9

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1834.2     1838.9     "24 RCP"    17.9       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

SL SD Lateral Alignment 1 Left

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1834.2     1838.9     "24 RCP"    66.2       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\SL SD05\SL SD Lateral Alignment 1 Left.wsx
Computed  05/23/17  19:00:48

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1826.58	1838.90	1834.900	8.320	17.90	5.70	0.50	1835.40	0.000	1.524	0.000	0.00000	0.000	Pipe
HYDRAULIC JUMP at		54.48	of length	0.07												
	"i.p."	54.48	1832.85	1845.17	1835.241	2.390	17.90	5.70	0.50	1835.75	0.000	1.524	0.000	0.11511	0.657	Pipe
	"i.p."	54.48	1832.85	1845.17	1833.779	0.928	17.90	12.55	2.45	1836.22	0.000	1.524	2.616	0.11511	0.657	Pipe
	"i.p."	55.28	1832.94	1845.26	1833.883	0.939	17.90	12.35	2.37	1836.25	0.000	1.524	2.555	0.11511	0.657	Pipe
	"i.p."	57.38	1833.18	1845.50	1834.159	0.974	17.90	11.78	2.15	1836.31	0.000	1.524	2.381	0.11511	0.657	Pipe
	"i.p."	59.16	1833.39	1845.71	1834.401	1.012	17.90	11.23	1.96	1836.36	0.000	1.524	2.217	0.11511	0.657	Pipe
	"i.p."	60.66	1833.56	1845.88	1834.613	1.051	17.90	10.71	1.78	1836.39	0.000	1.524	2.063	0.11511	0.657	Pipe
	"i.p."	61.93	1833.71	1846.03	1834.800	1.091	17.90	10.21	1.62	1836.42	0.000	1.524	1.917	0.11511	0.657	Pipe
	"i.p."	63.00	1833.83	1846.15	1834.966	1.134	17.90	9.73	1.47	1836.44	0.000	1.524	1.781	0.11511	0.657	Pipe
	"i.p."	63.89	1833.93	1846.25	1835.114	1.180	17.90	9.28	1.34	1836.45	0.000	1.524	1.652	0.11511	0.657	Pipe
	"i.p."	64.61	1834.02	1846.34	1835.245	1.228	17.90	8.85	1.22	1836.46	0.000	1.524	1.530	0.11511	0.657	Pipe
	"i.p."	65.19	1834.08	1846.40	1835.363	1.279	17.90	8.44	1.11	1836.47	0.000	1.524	1.415	0.11511	0.657	Pipe
	"i.p."	65.63	1834.13	1846.45	1835.468	1.333	17.90	8.04	1.00	1836.47	0.000	1.524	1.305	0.11511	0.657	Pipe
	"i.p."	65.95	1834.17	1846.49	1835.562	1.392	17.90	7.67	0.91	1836.48	0.000	1.524	1.200	0.11511	0.657	Pipe
	"i.p."	66.13	1834.19	1846.51	1835.647	1.455	17.90	7.31	0.83	1836.48	0.000	1.524	1.100	0.11511	0.657	Pipe
"Reach"	Reach	66.20	1834.20	1838.90	1835.723	1.523	17.90	6.97	0.76	1836.48	0.000	1.524	1.001	0.11511	0.657	Pipe
"Inlet"	Headwrk	66.20	1834.20	1838.90	1835.724	1.524	17.90	6.97	0.75	1836.48	0.000	1.524	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1826.58    1838.9     "24 RCP"    1834.9

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1830.84    1839       "24 RCP"    17.9       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

SL SD Lateral Alignment 1 Right

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1830.84    1839       "24 RCP"    60.8       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"24 RCP"      4   2          2

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\SL SD05\SL SD Lateral Alignment 1 Right.wsx
Computed  05/23/17  19:04:52

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1826.58	1838.90	1834.900	8.320	17.90	5.70	0.50	1835.40	0.000	1.524	0.000	0.00000	0.000	Pipe
"Reach"	Reach	60.80	1830.84	1839.00	1835.281	4.441	17.90	5.70	0.50	1835.78	0.000	1.524	0.000	0.07007	0.750	Pipe
"Inlet"	Headwrk	60.80	1830.84	1839.00	1835.281	4.441	17.90	5.70	0.50	1835.78	0.000	1.524	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1820.59    1833.1     "30 RCP"    1831.06

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1828.52    1833.7     "30 RCP"    39.3       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

SL SD Lateral Alignment 2 Left

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1828.52    1833.7     "30 RCP"    44.1       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"30 RCP"      4   2.5        2.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\SL SD05\SL SD Lateral Alignment 2 Left.wsx
Computed  05/23/17  19:08:41

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1820.59	1833.10	1831.060	10.470	39.30	8.01	1.00	1832.06	0.000	2.113	0.000	0.00000	0.000	Pipe
"Reach"	Reach	44.10	1828.52	1833.70	1831.465	2.945	39.30	8.01	1.00	1832.46	0.000	2.113	0.000	0.17982	0.808	Pipe
"Inlet"	Headwrk	44.10	1828.52	1833.70	1831.465	2.945	39.30	8.01	1.00	1832.46	0.000	2.113	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1817.4     1833.1     "30 RCP"    1831.06

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1823.69    1833.2     "30 RCP"    39.3       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

SL SD Lateral Alignment 2 Right

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1823.69    1833.2     "30 RCP"    52.4       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"30 RCP"      4   2.5        2.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\SL SD05\SL SD Lateral Alignment 2 Right.wsx
Computed  05/23/17  19:11:46

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1817.40	1833.10	1831.060	13.660	39.30	8.01	1.00	1832.06	0.000	2.113	0.000	0.00000	0.000	Pipe
"Reach"	Reach	52.40	1823.69	1833.20	1831.541	7.851	39.30	8.01	1.00	1832.54	0.000	2.113	0.000	0.12004	0.899	Pipe
"Inlet"	Headwrk	52.40	1823.69	1833.20	1831.541	7.851	39.30	8.01	1.00	1832.54	0.000	2.113	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach2"
Reach            "Reach1"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1815.87    1832.1     "30 RCP"    1830.2

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1824.41    1832       "30 RCP"    16.8       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                               BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                               LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

SL SD Lateral Alignment 3 Left

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**----------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach1"            1824.41    1832       "30 RCP"    35.7       0.013      0          0          0
"Reach2"            1821.57    1832       "30 RCP"    22.8       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"30 RCP"      4   2.5        2.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\SL SD05\SL SD Lateral Alignment 3 Left.wsx
Computed  05/23/17  19:14:07

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1815.87	1832.10	1830.200	14.330	16.80	3.42	0.18	1830.38	0.000	1.386	0.000	0.00000	0.000	Pipe
"Reach2"	Reach	22.80	1821.57	1832.00	1830.238	8.668	16.80	3.42	0.18	1830.42	0.000	1.386	0.000	0.25000	0.484	Pipe
"Reach1"	Reach	58.50	1824.41	1832.00	1830.298	5.888	16.80	3.42	0.18	1830.48	0.000	1.386	0.000	0.07955	0.644	Pipe
"Inlet"	Headwrk	58.50	1824.41	1832.00	1830.298	5.888	16.80	3.42	0.18	1830.48	0.000	1.386	0.000	0.00000	0.000	Pipe

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

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Outlet"
Reach            "Reach"
Headwork         "Inlet"

**BRANCH DEFINITIONS

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Outlet"            0          1812.75    1832.1     "30 RCP"    1830.2

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                  ELEV       ELEV       ID                     ELEV (opt.)
**------------      ---------  ---------- ----------  ---------- ----------
"Inlet"             1822.65    1832.7     "30 RCP"    18.9       0

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

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

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

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

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------

[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------

[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
```

SL SD Lateral Alignment 3 Right

```
[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Reach"             1822.65    1832.7     "30 RCP"    76.1       0.013      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"30 RCP"      4   2.5        2.5

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


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

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

INPUT FILE
************************************
X:\Projects\100050127_Boulder Hwy SD\HH\hydraulics\WSPG\DFDR\SL SD05\SL SD Lateral Alignment 3 Right.wsx
Computed  05/23/17  19:15:50

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet"	Outlet	0.00	1812.75	1832.10	1830.200	17.450	18.90	3.85	0.23	1830.43	0.000	1.474	0.000	0.00000	0.000	Pipe
"Reach"	Reach	76.10	1822.65	1832.70	1830.362	7.712	18.90	3.85	0.23	1830.59	0.000	1.474	0.000	0.13009	0.603	Pipe
"Inlet"	Headwrk	76.10	1822.65	1832.70	1830.362	7.712	18.90	3.85	0.23	1830.59	0.000	1.474	0.000	0.00000	0.000	Pipe

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

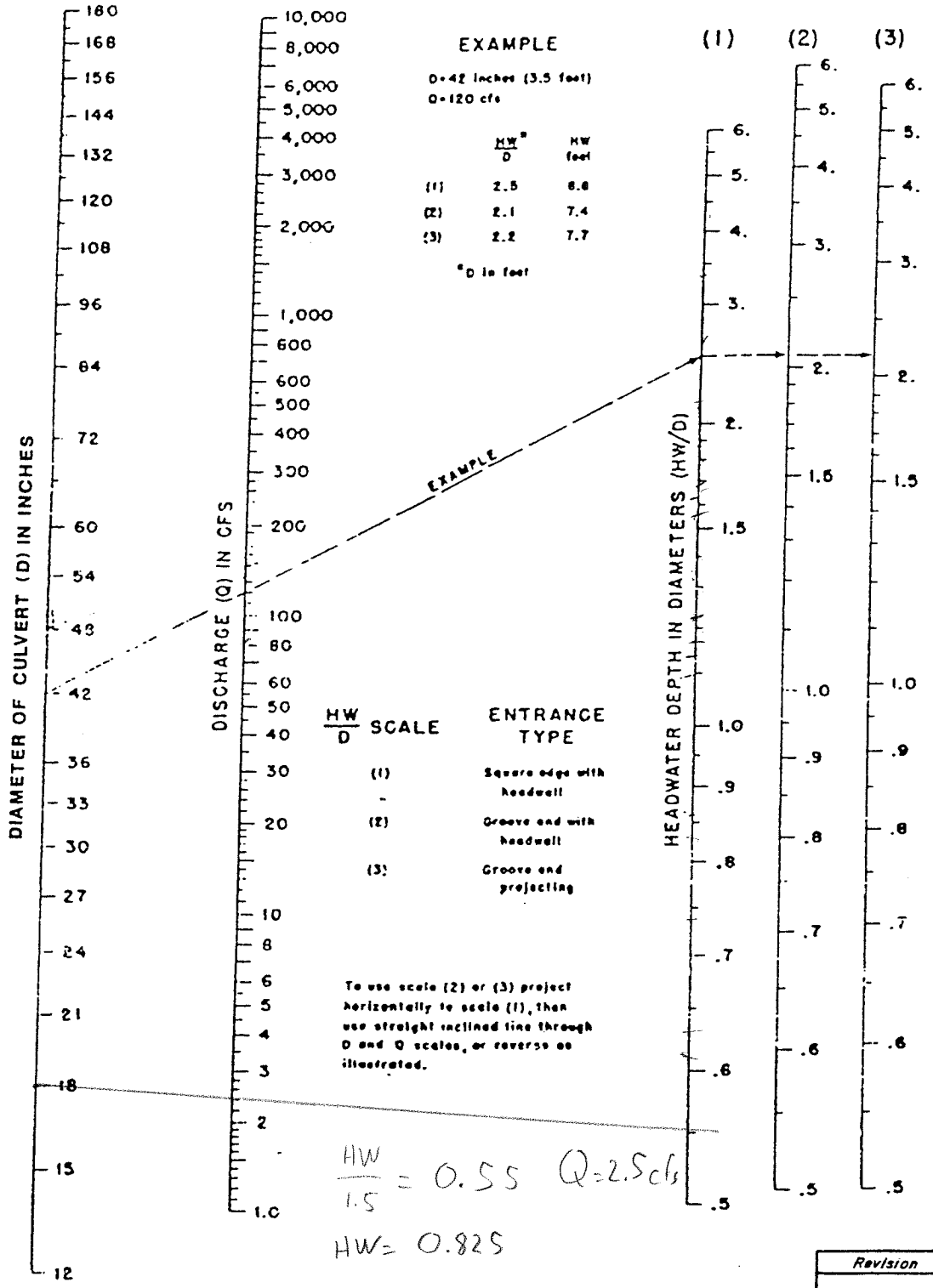
Appendix B-2

Lateral Inlet Control

SD02 STA 12+03 JW 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



Revision	Date

WRC ENGINEERING

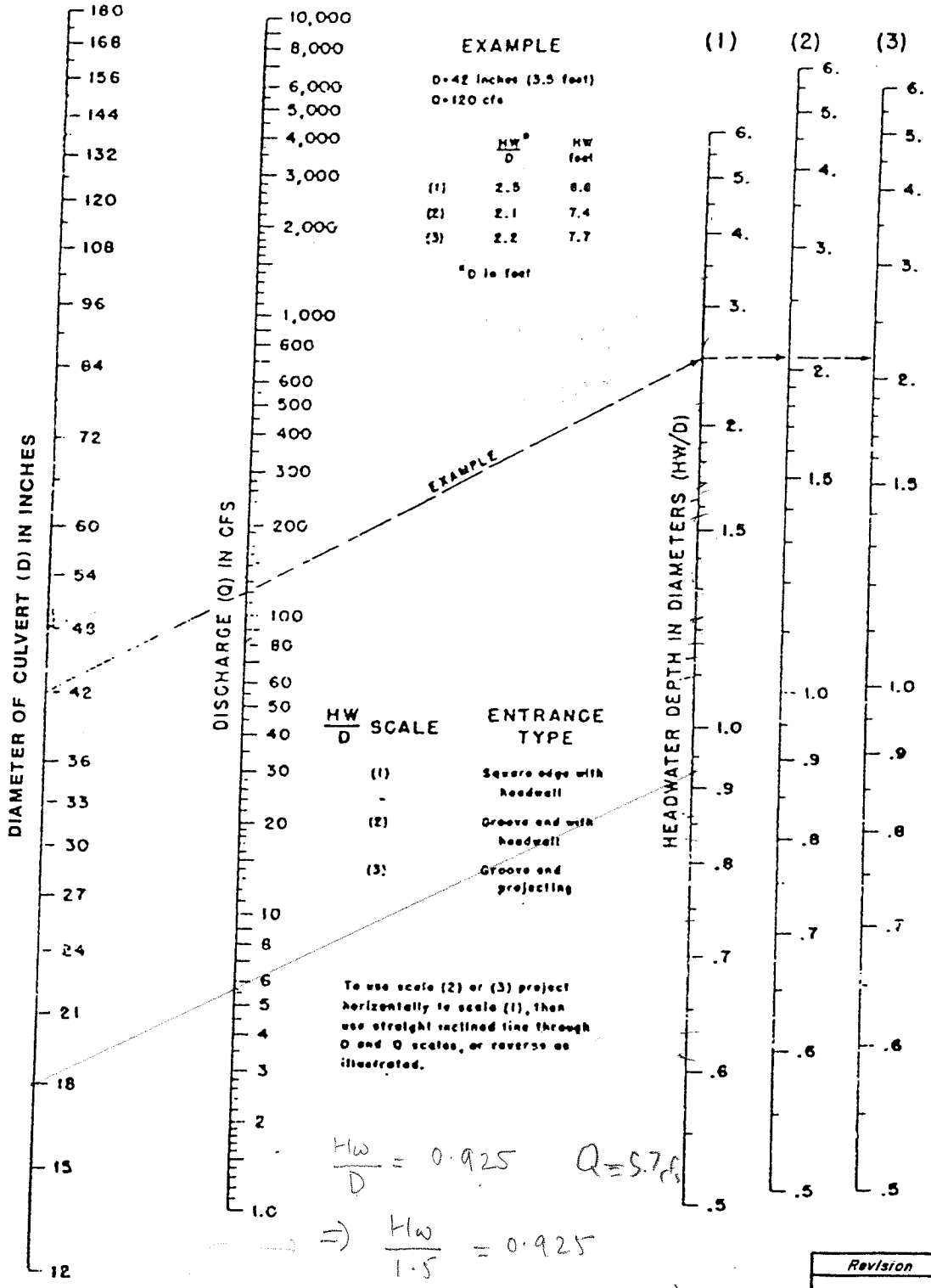
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

SD02 STA 10+25.00 Euclid Avenue Lateral L J-5-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



$\frac{Hw}{D} = 0.925$ $Q = 5.7$ cfs

$\Rightarrow \frac{Hw}{1.5} = 0.925$

$Hw = (1.5)(0.925) =$

headwater = 1.4 ft

Revision	Date

WRC ENGINEERING

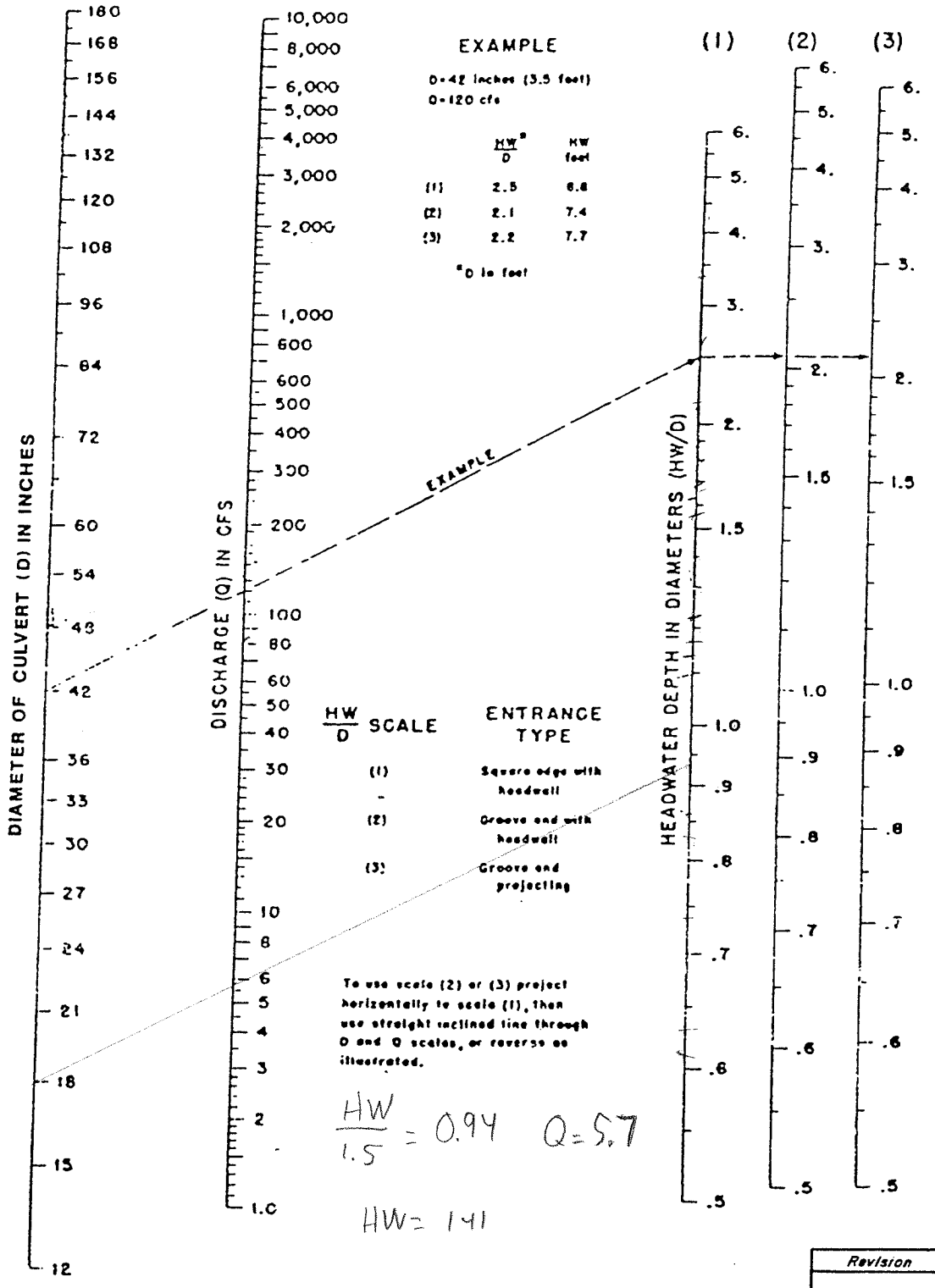
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

SD02 Station 10+72.73 J-N-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



Revision	Date

WRC ENGINEERING

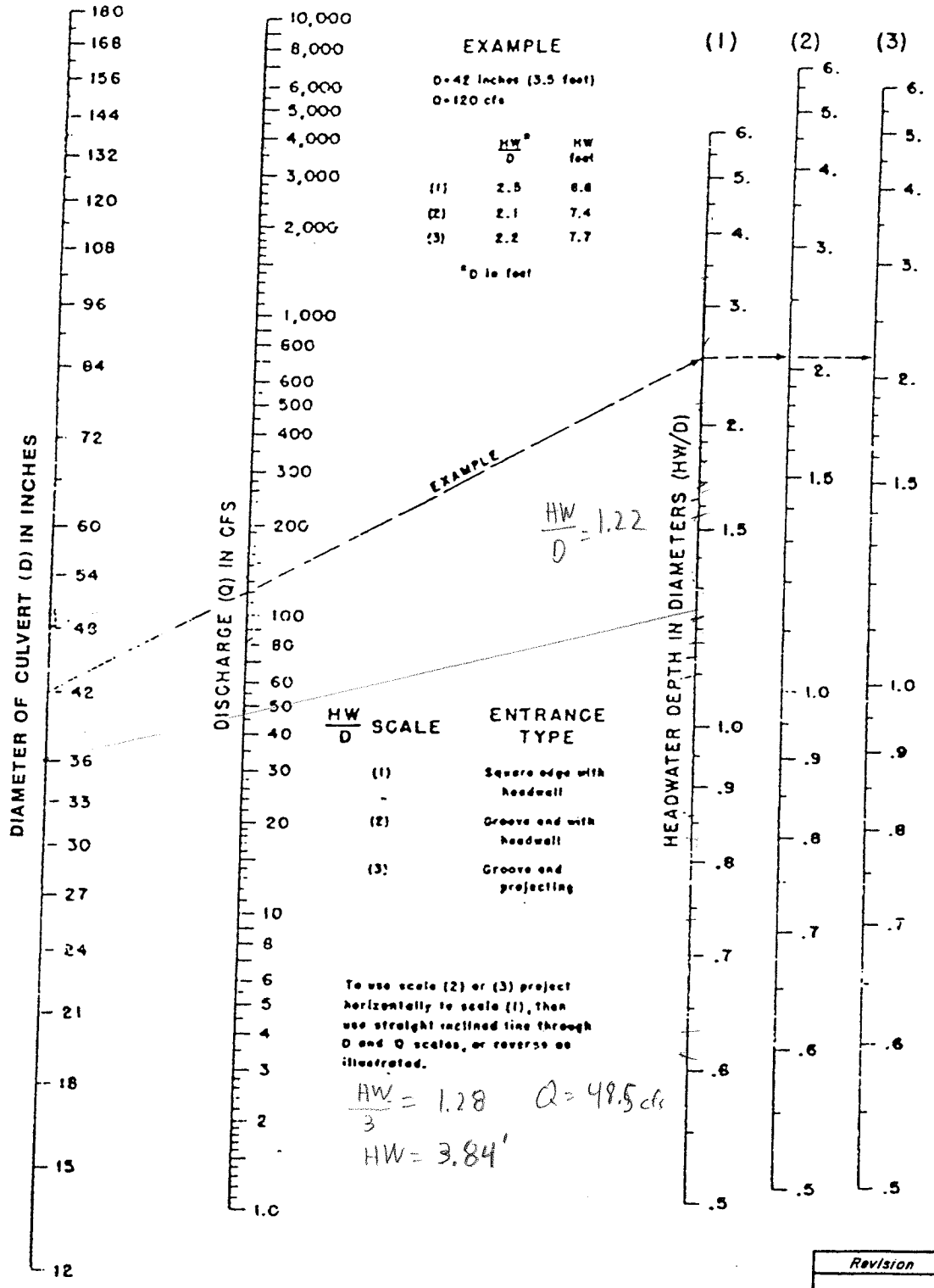
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

Lateral 1 STA 10+34 Left 36" C-S-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



Revision	Date

WRC ENGINEERING

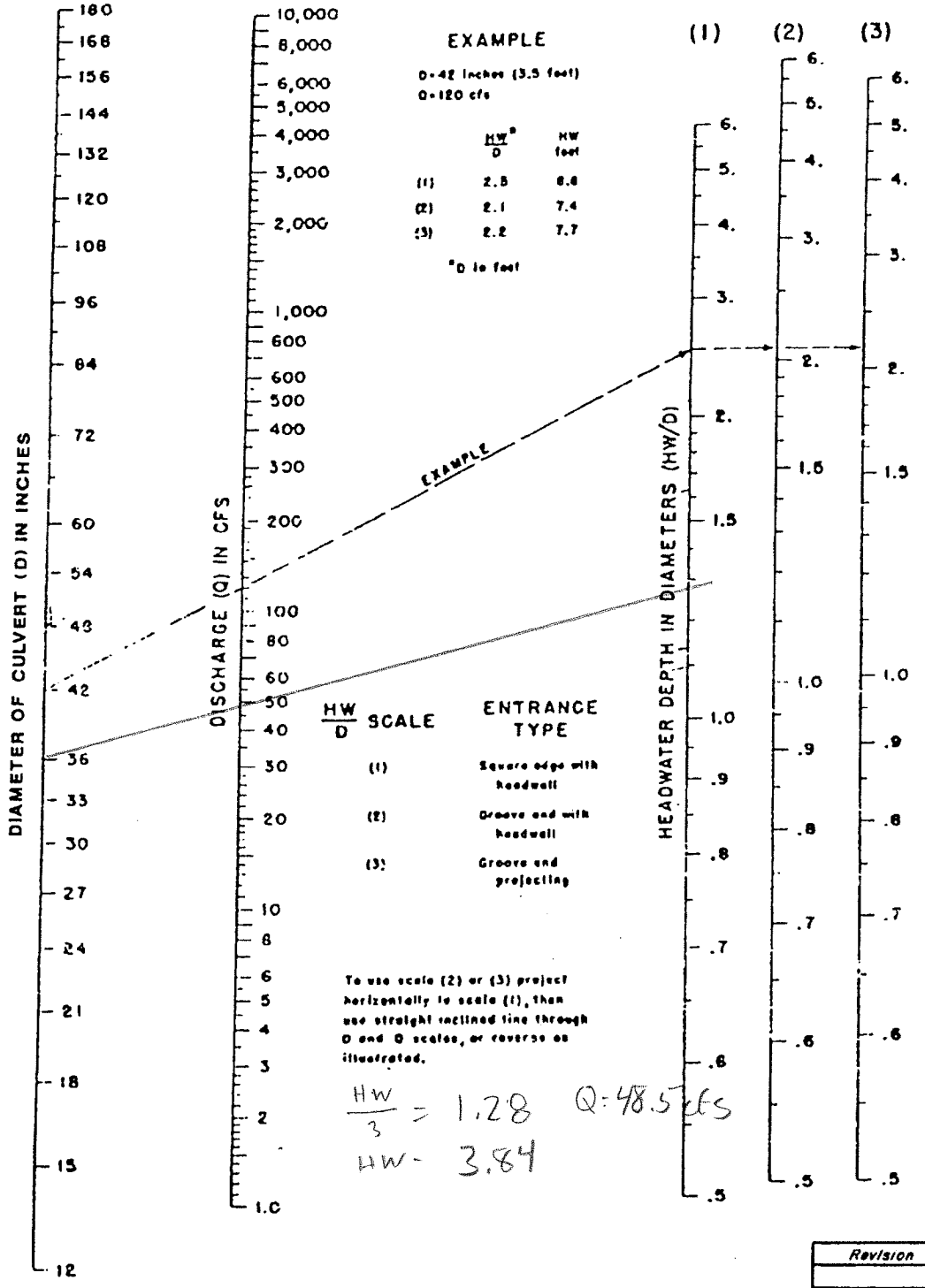
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

Lat 1 STA 10+15 Right 36" C-N-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



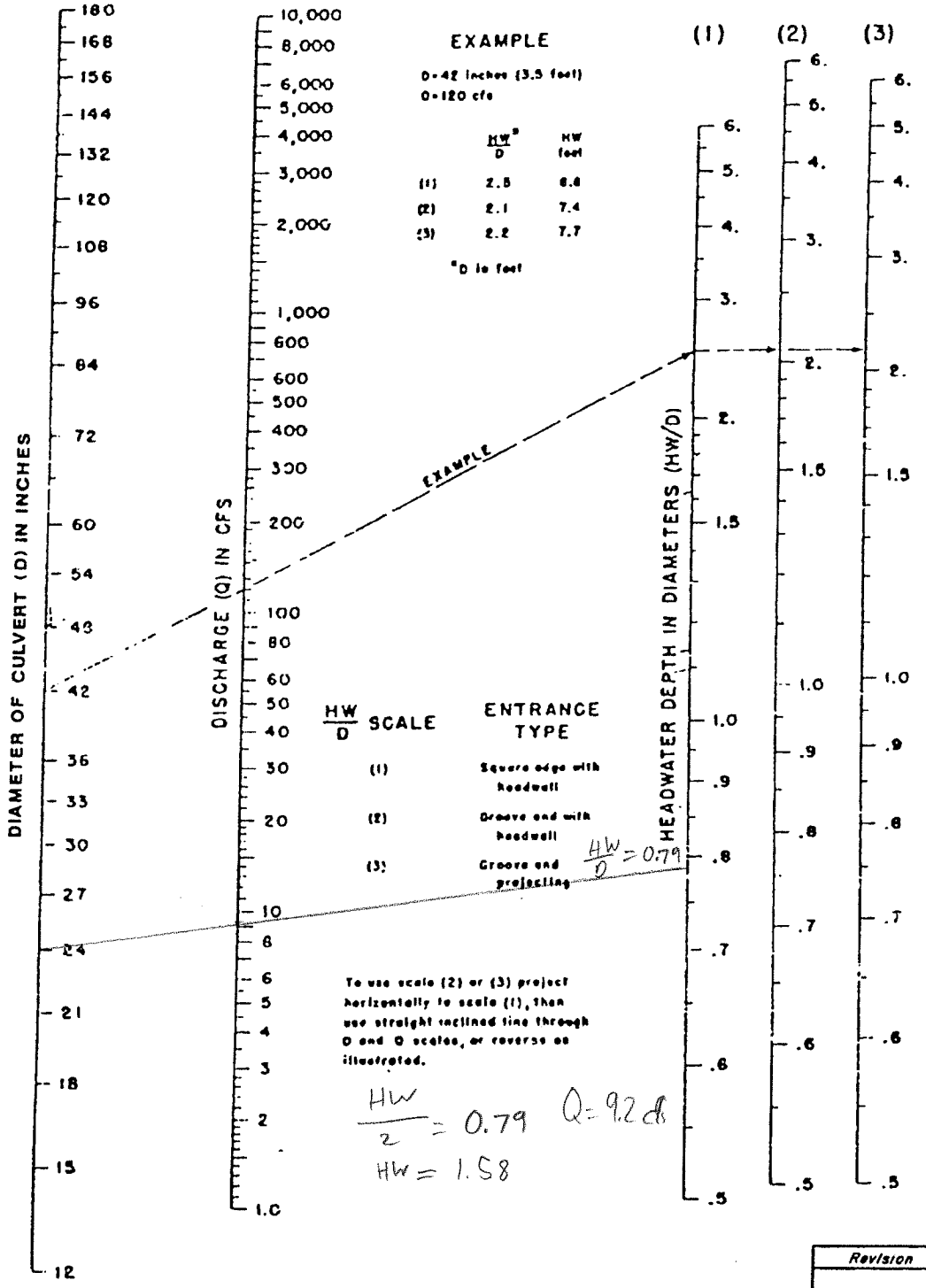
Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

Lat 2 STA 13+90.8 C-W-2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



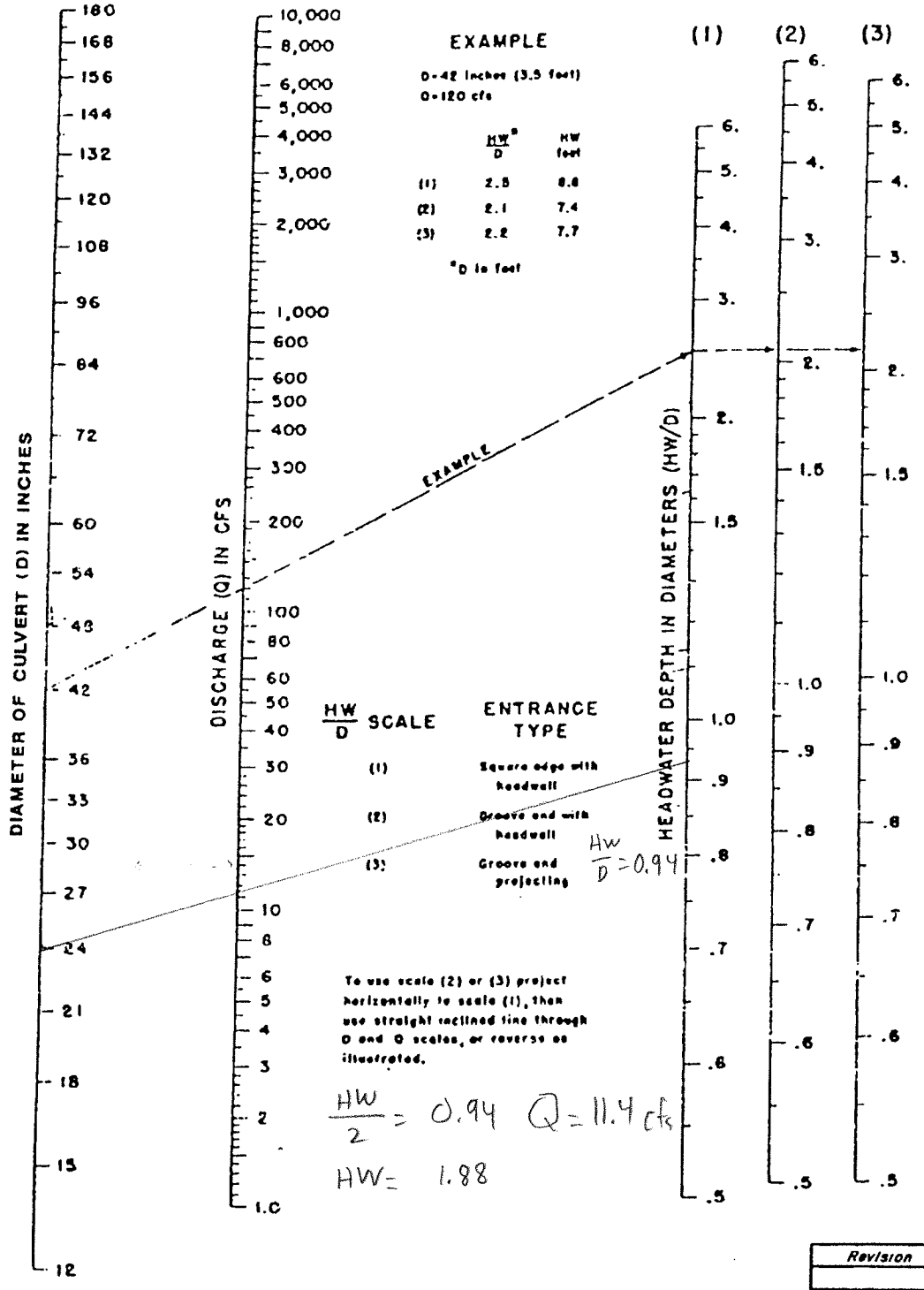
Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

Lat 3 STA: 16+99.27 Left C-W-3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



Revision	Date

WRC ENGINEERING

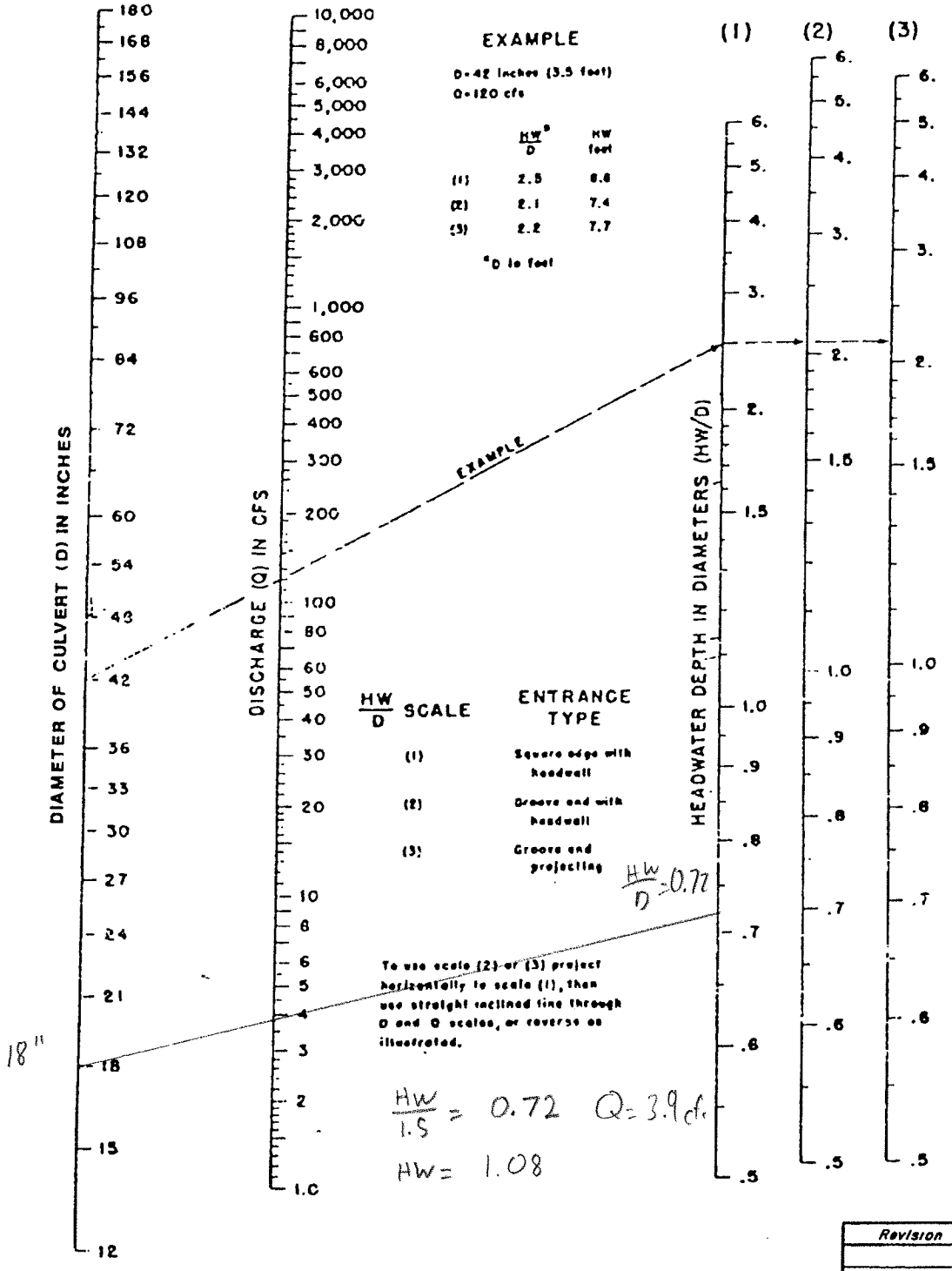
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

Lat 3 STA: 16+67 Right C-E-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



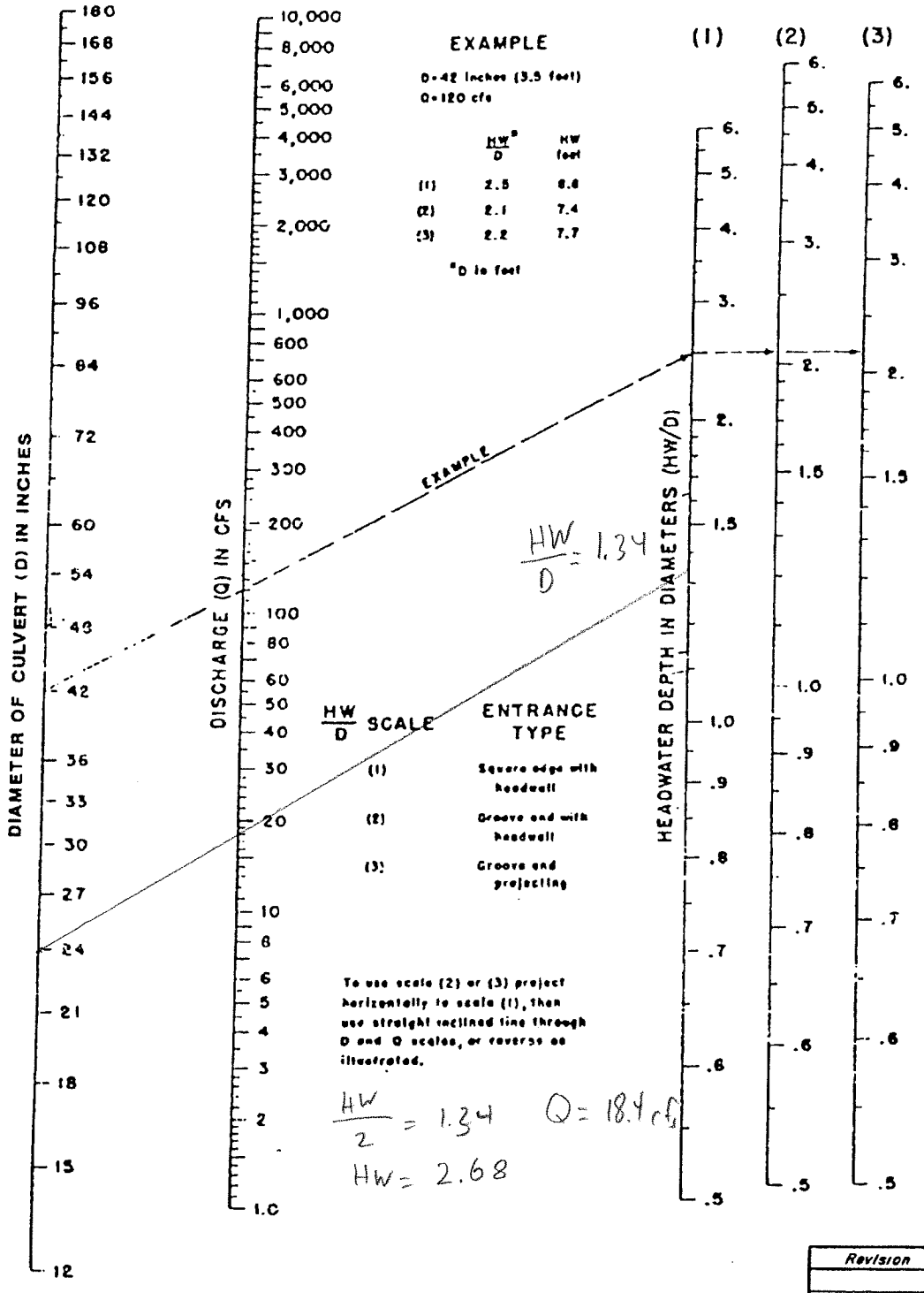
Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

Lat 4 STA: 18+85.10 C-W-4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



Revision	Date

WRC ENGINEERING

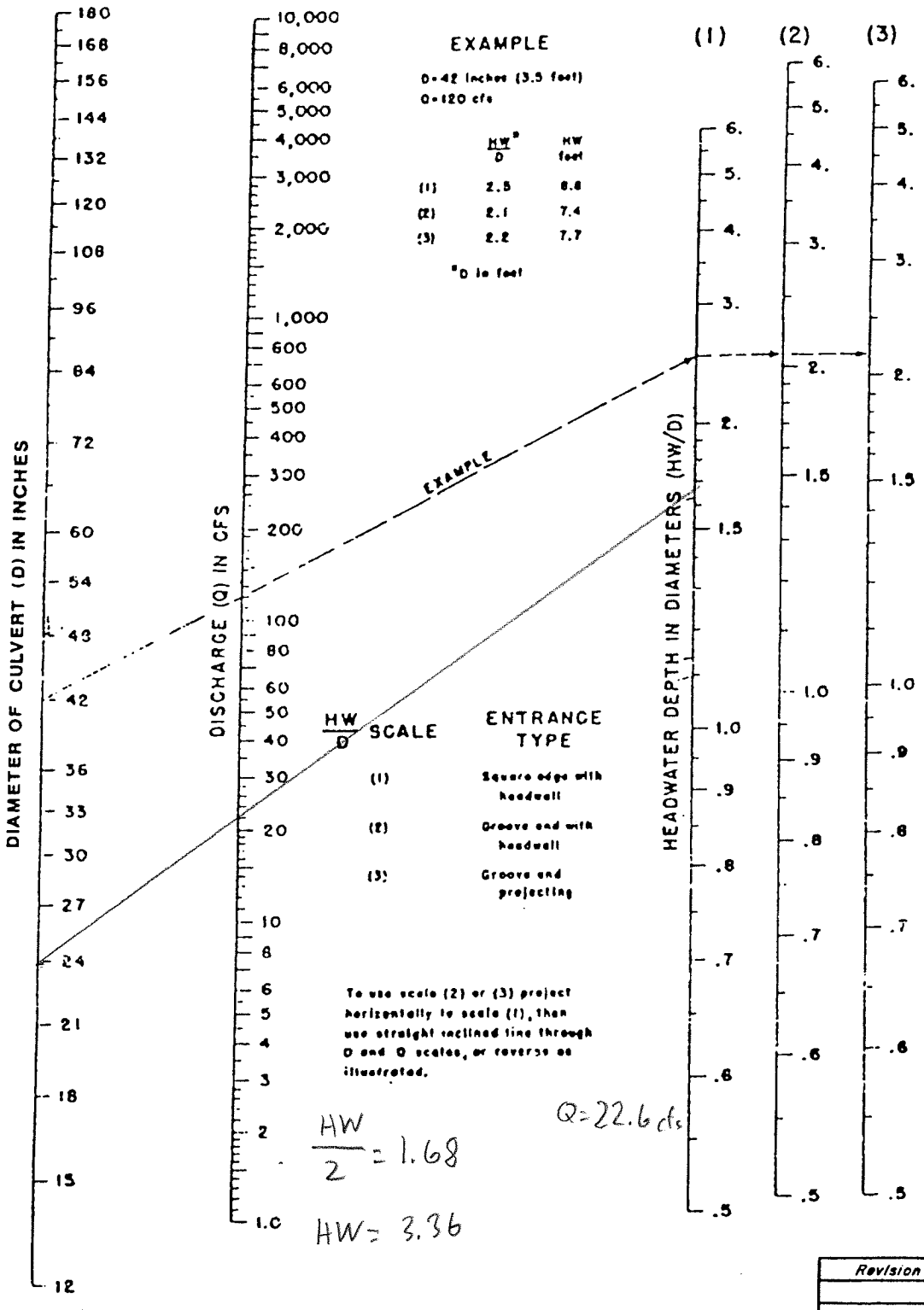
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

Lateral 2 SD04 Oakey DI 54 + 55 EN3 ES3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



Revision	Date

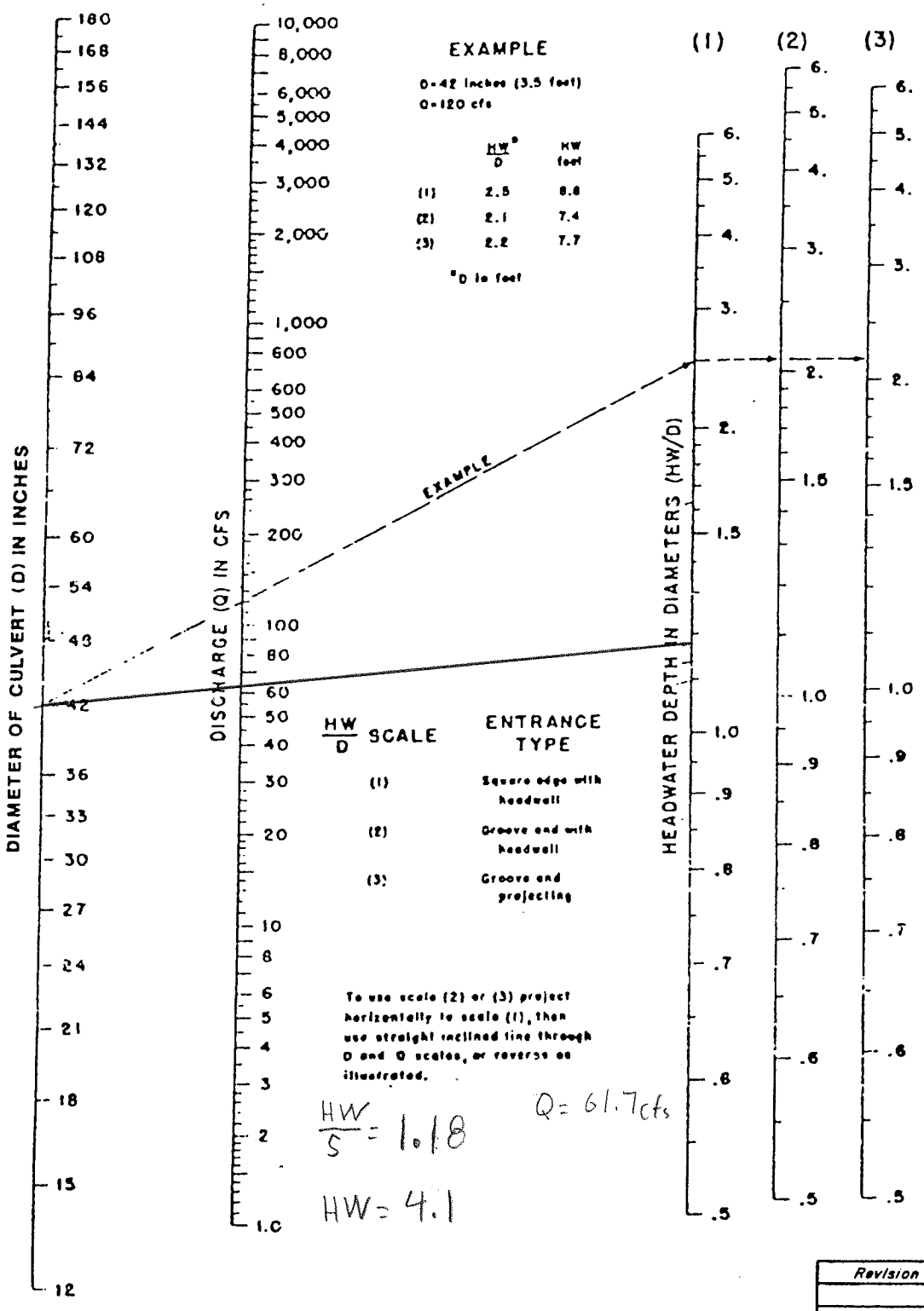
24" RCP

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

Lateral 1 SD04 Oakey (DI #52 + DI #50 EN1 + ES1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



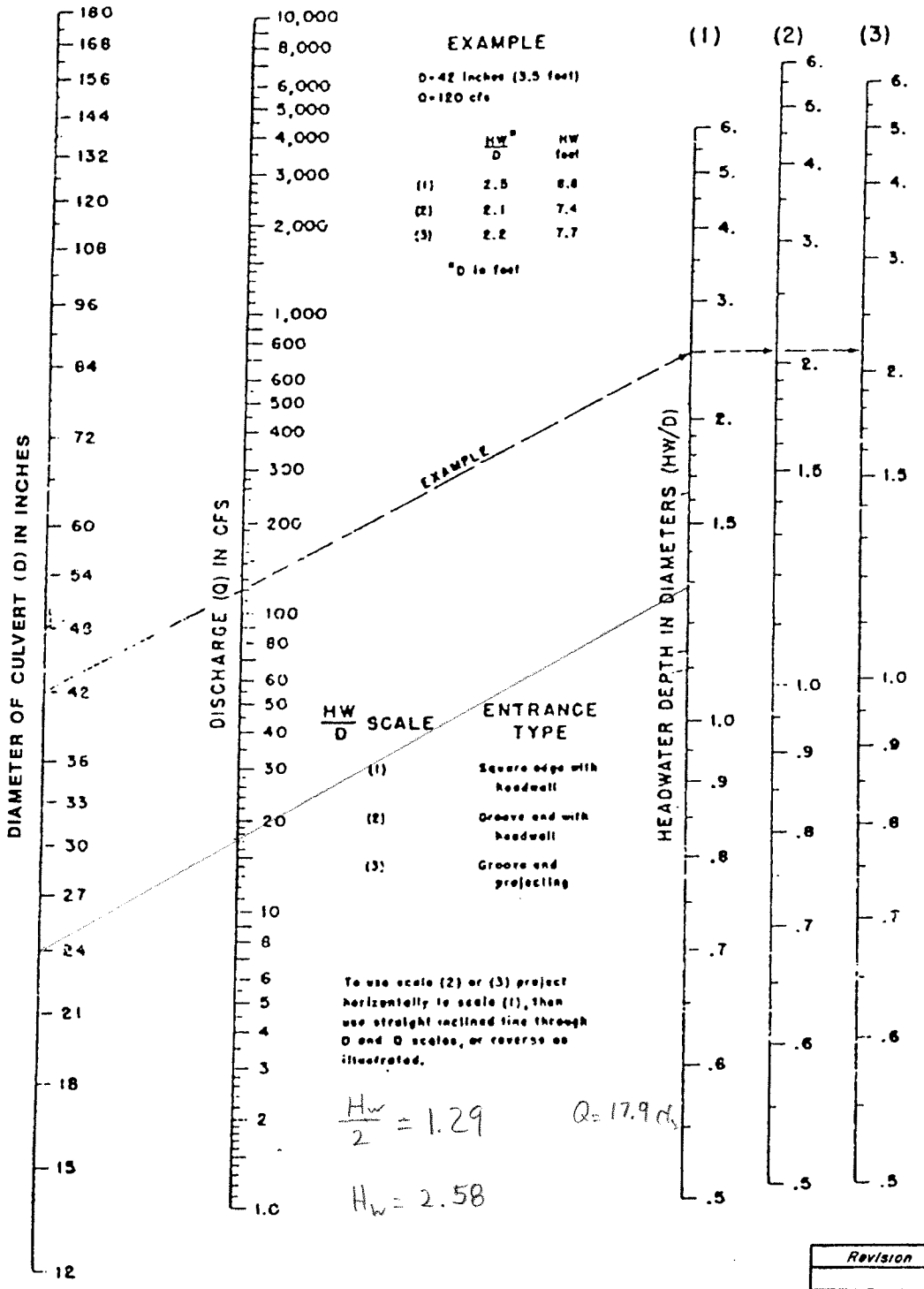
Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

ST Louis STA: 10+86.11 DI-65 GN3 Lateral 3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



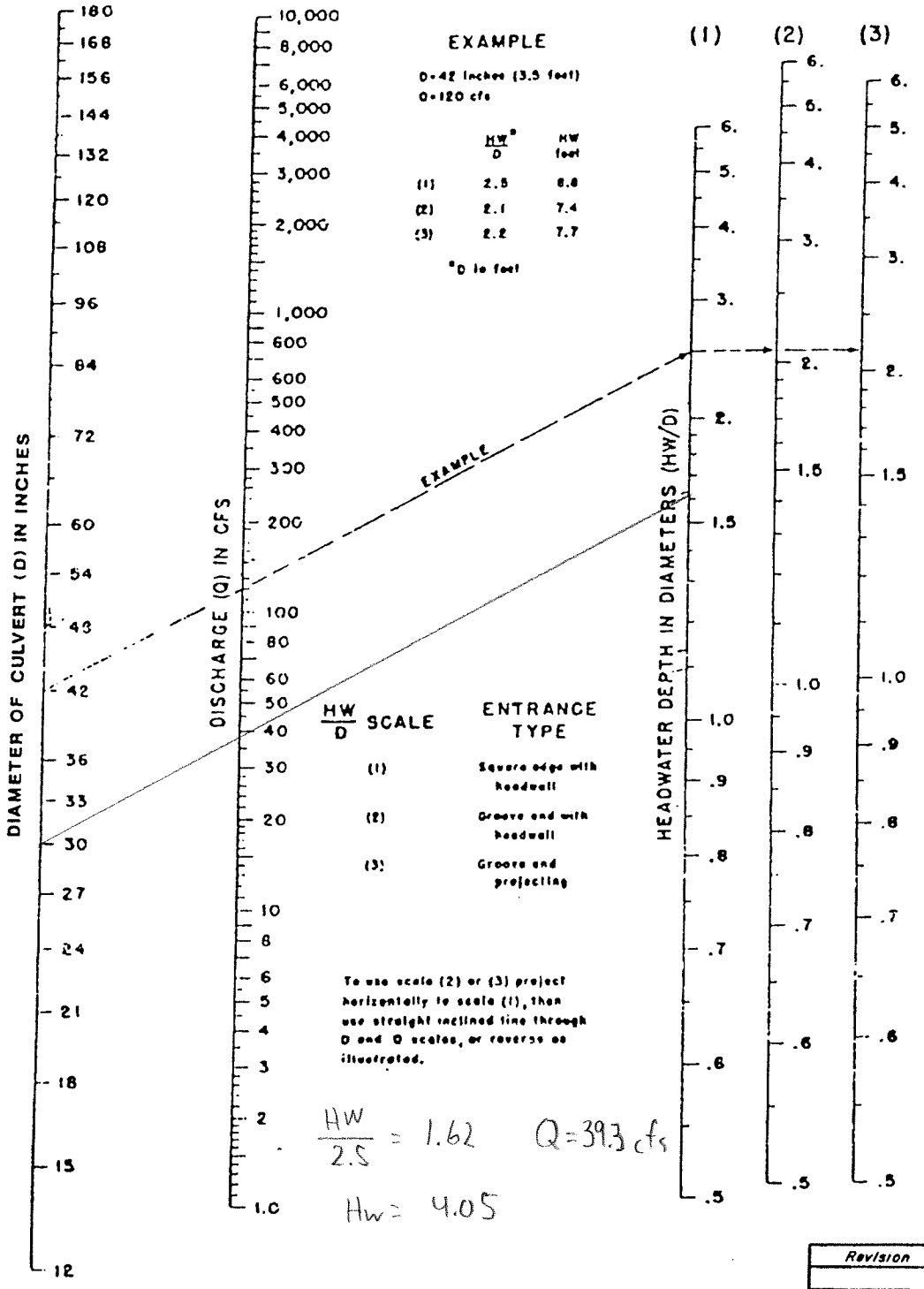
Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

ST Louis STA: 15+85.09 DI 62 + 63 GNZ /652

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP Lateral 2



Revision	Date

WRC ENGINEERING

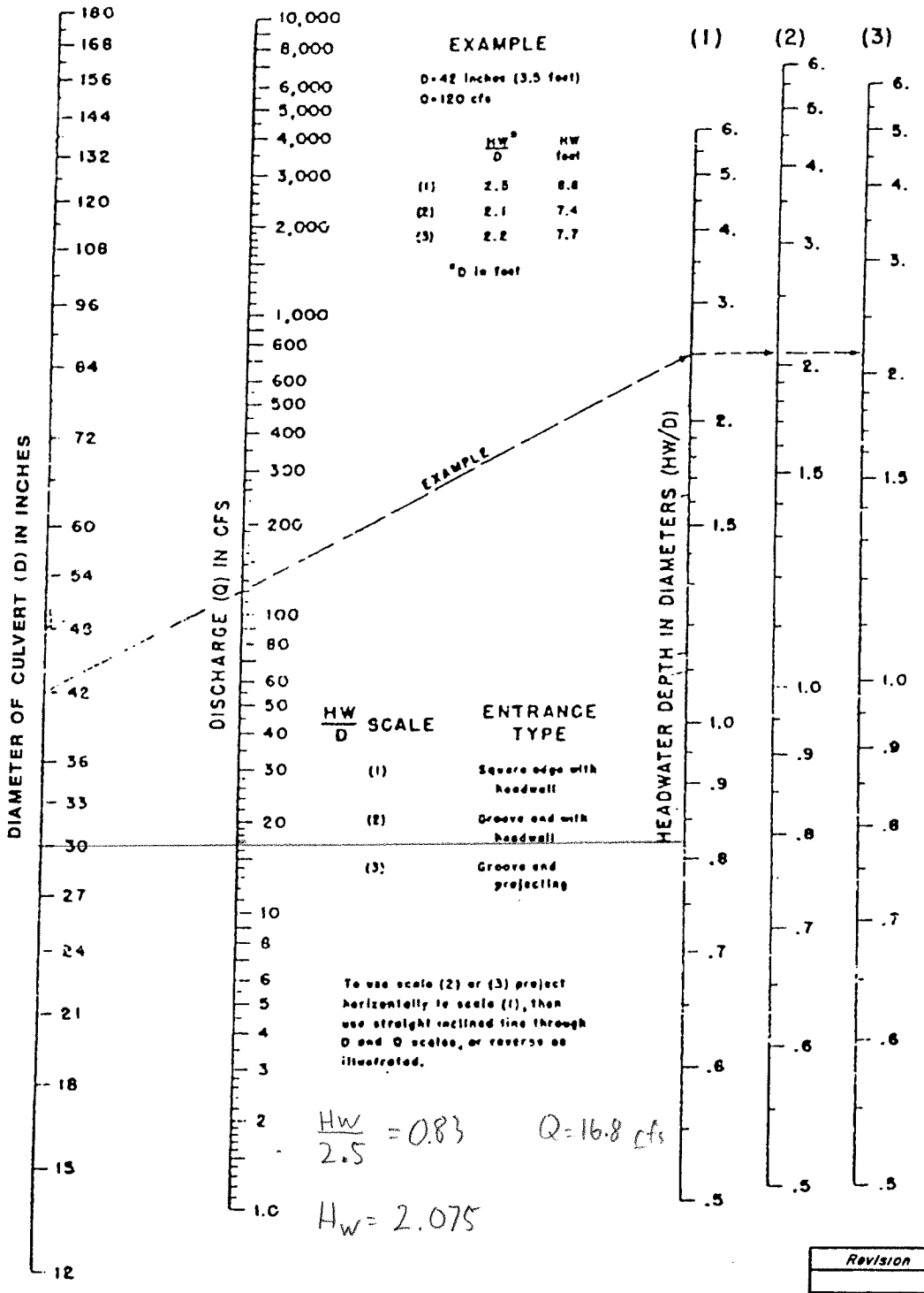
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

ST Louis STA: 18+02.34 (Left) DI 64 653

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



Revision	Date

WRC ENGINEERING

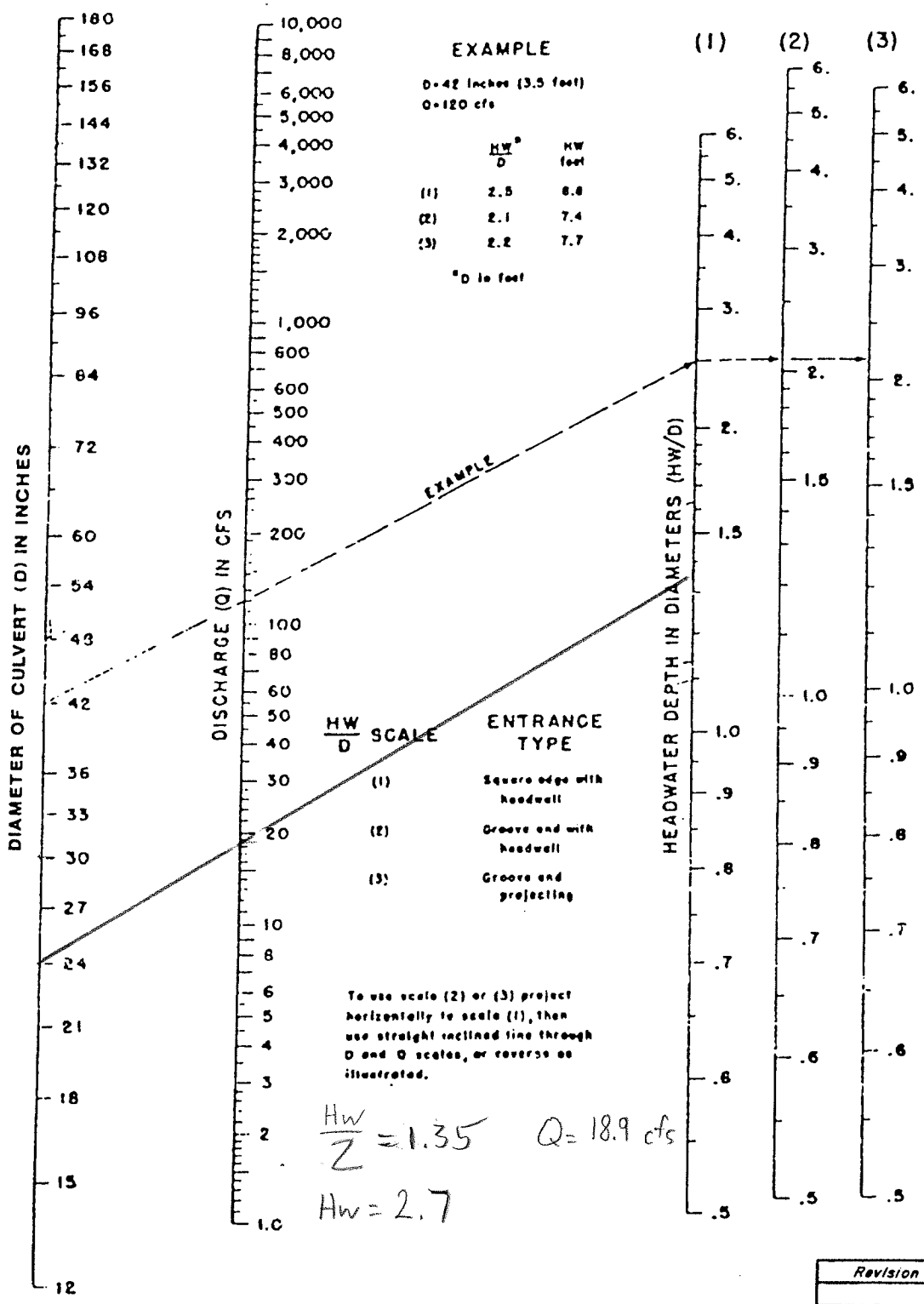
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

ST Louis STA: 18+02.34 (Right) DI 60/61 GNI/651

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP Lateral



$\frac{Hw}{Z} = 1.35$ $Q = 18.9$ cfs

$Hw = 2.7$

Revision	Date

WRC ENGINEERING

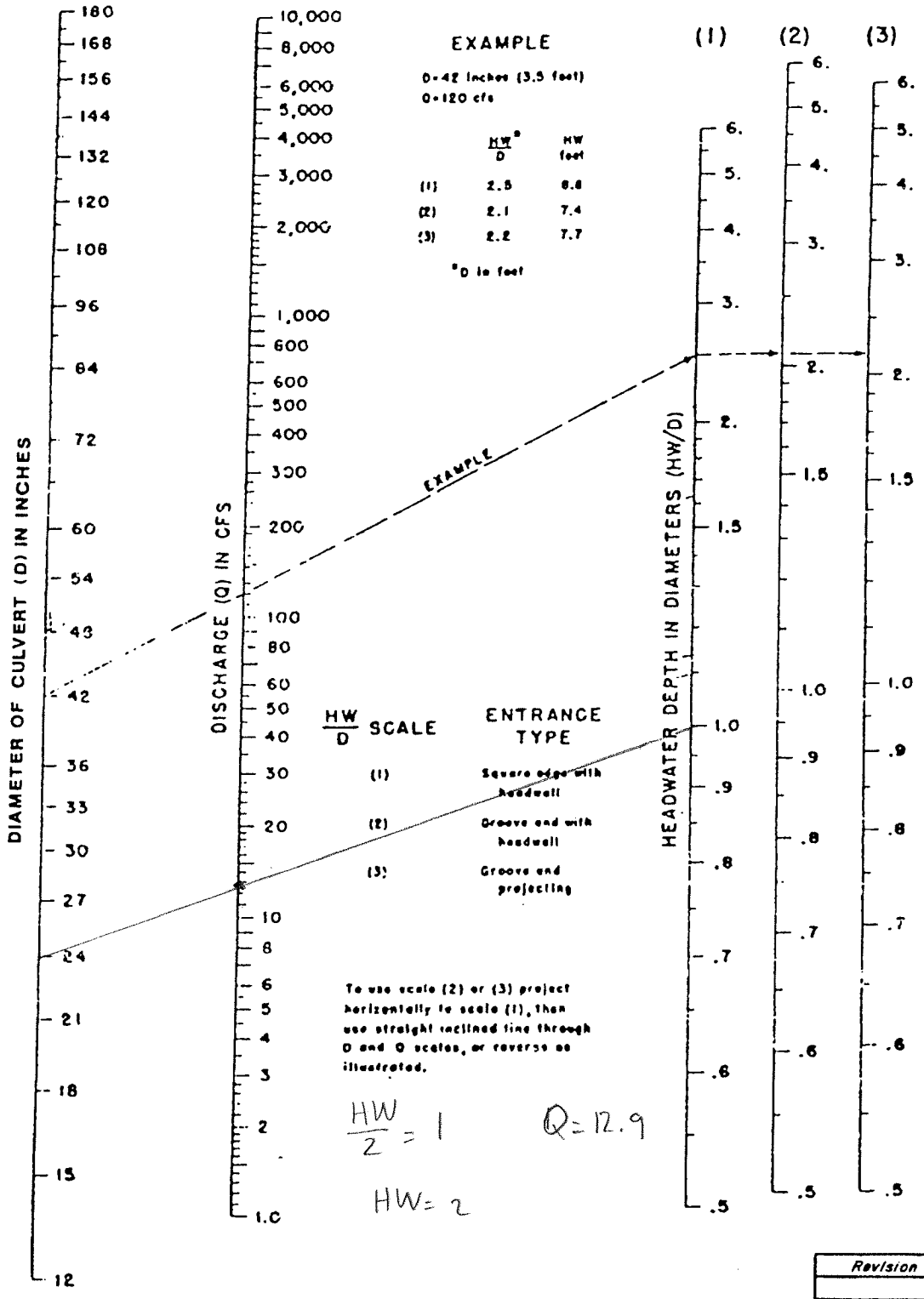
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

Lateral 1 SD01 DI #1 B-5-3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



24" RCP

Revision	Date

WRC ENGINEERING

REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

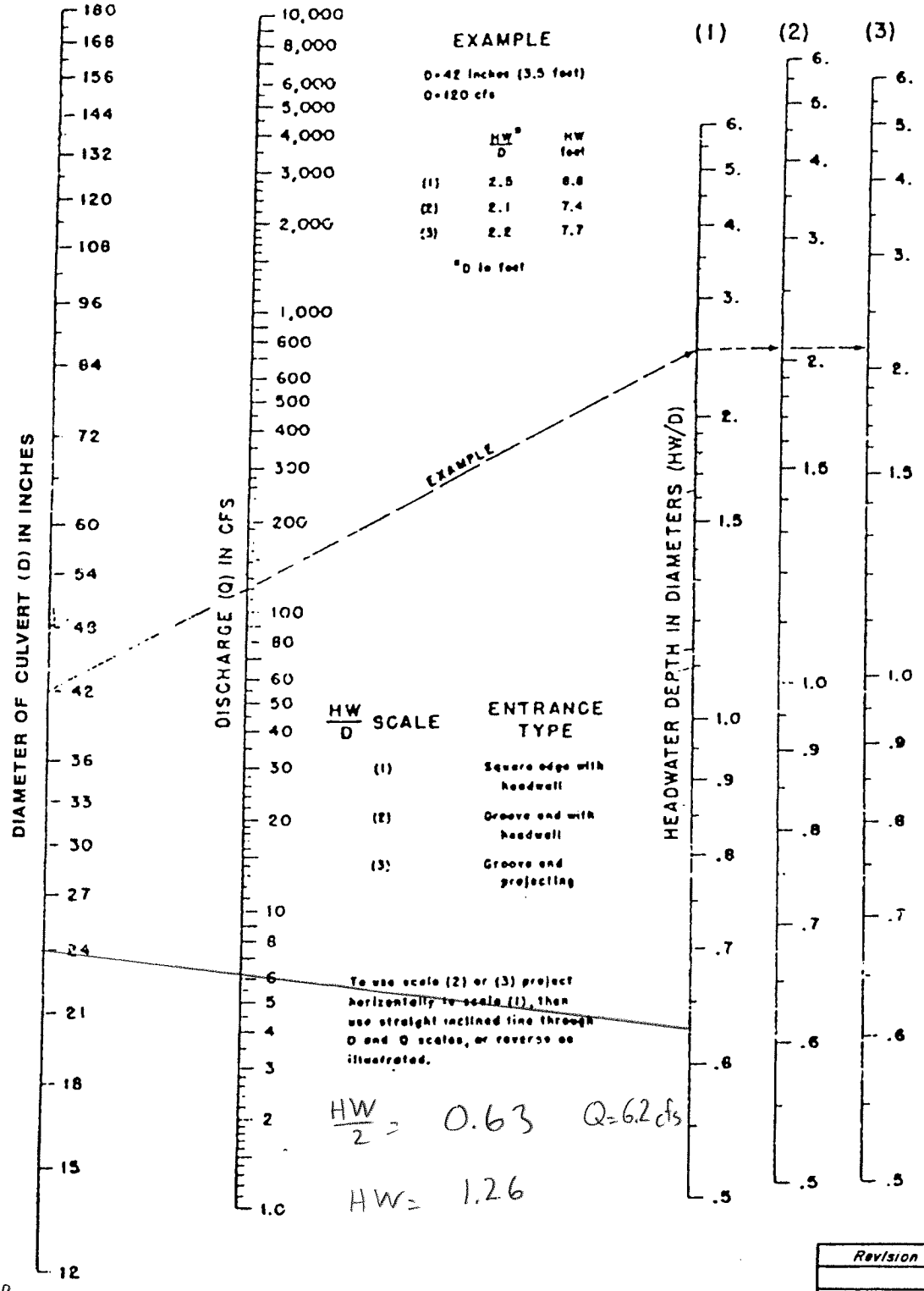
FIGURE 1005

ok

Lateral 2 SD01 DI # 2 D-Wa-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



Revision	Date

WRC ENGINEERING

REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

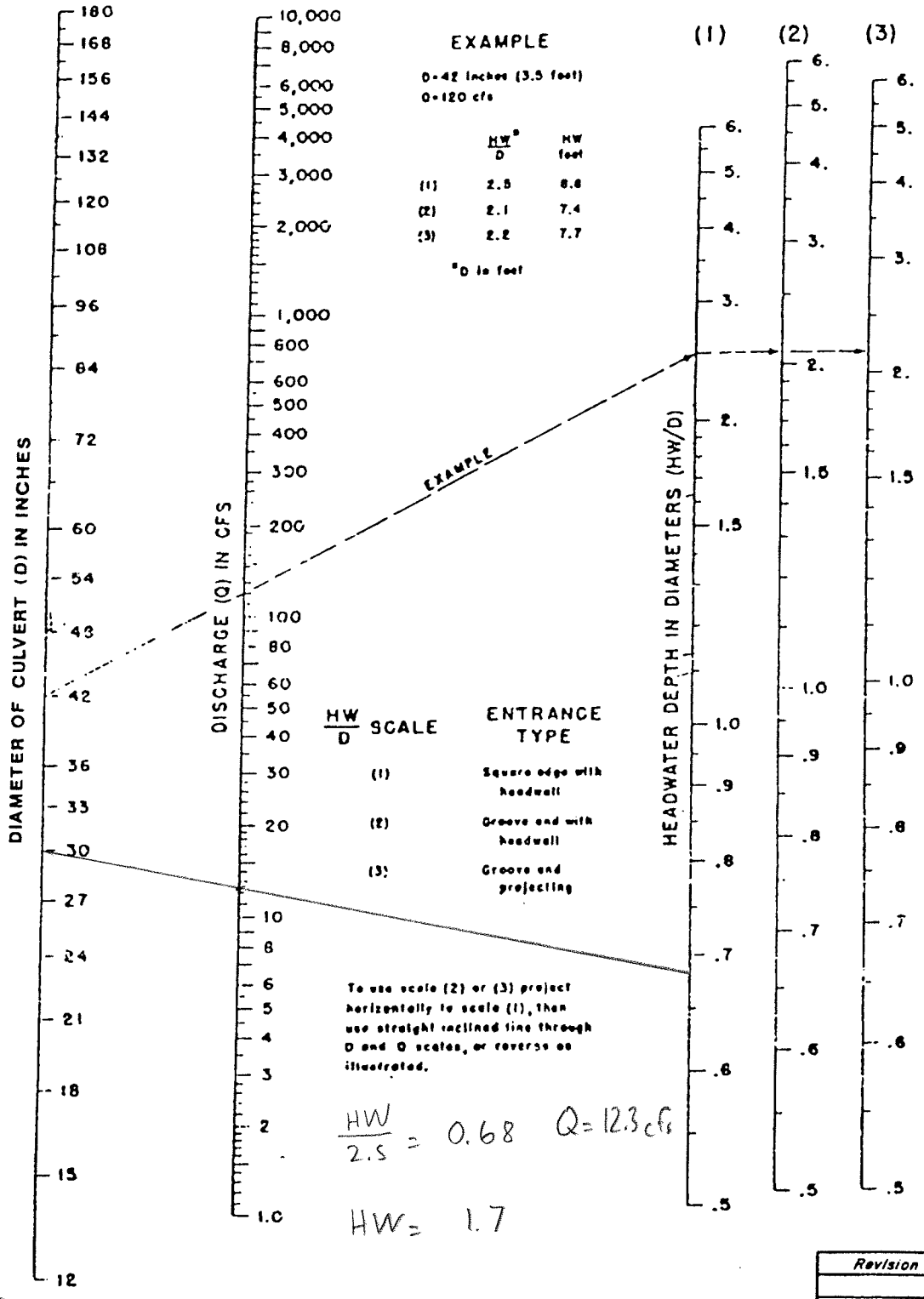
FIGURE 1005

ok

Lateral 3 SD01 OI # 3 O-W-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



30" RCP

Revision	Date

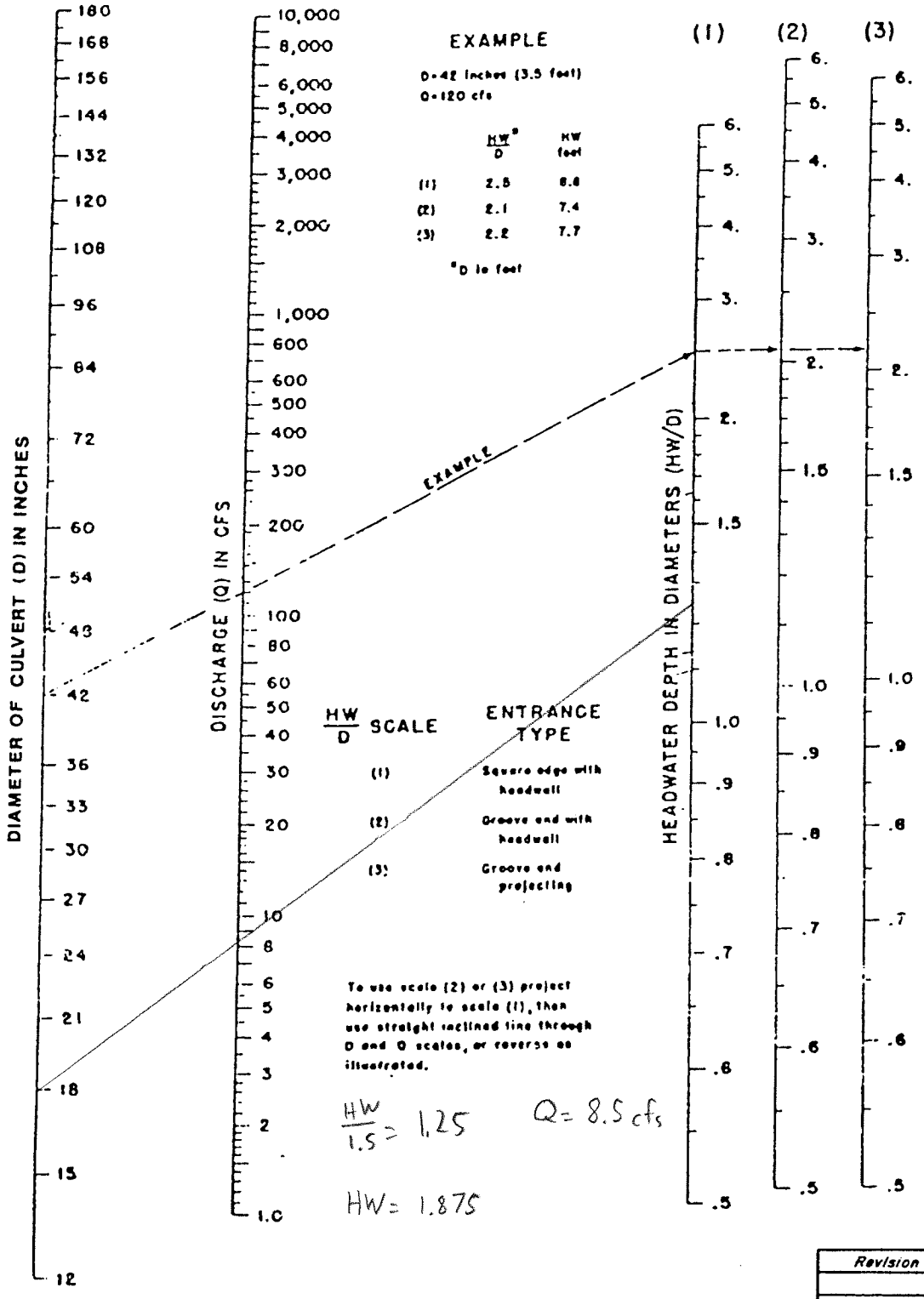
WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

ok

Lateral 4 SD01 DI #4 D - Ea - 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



$\frac{HW}{1.5} = 1.25$ $Q = 8.5$ cfs

$HW = 1.875$

18" RCP

Revision	Date

WRC ENGINEERING

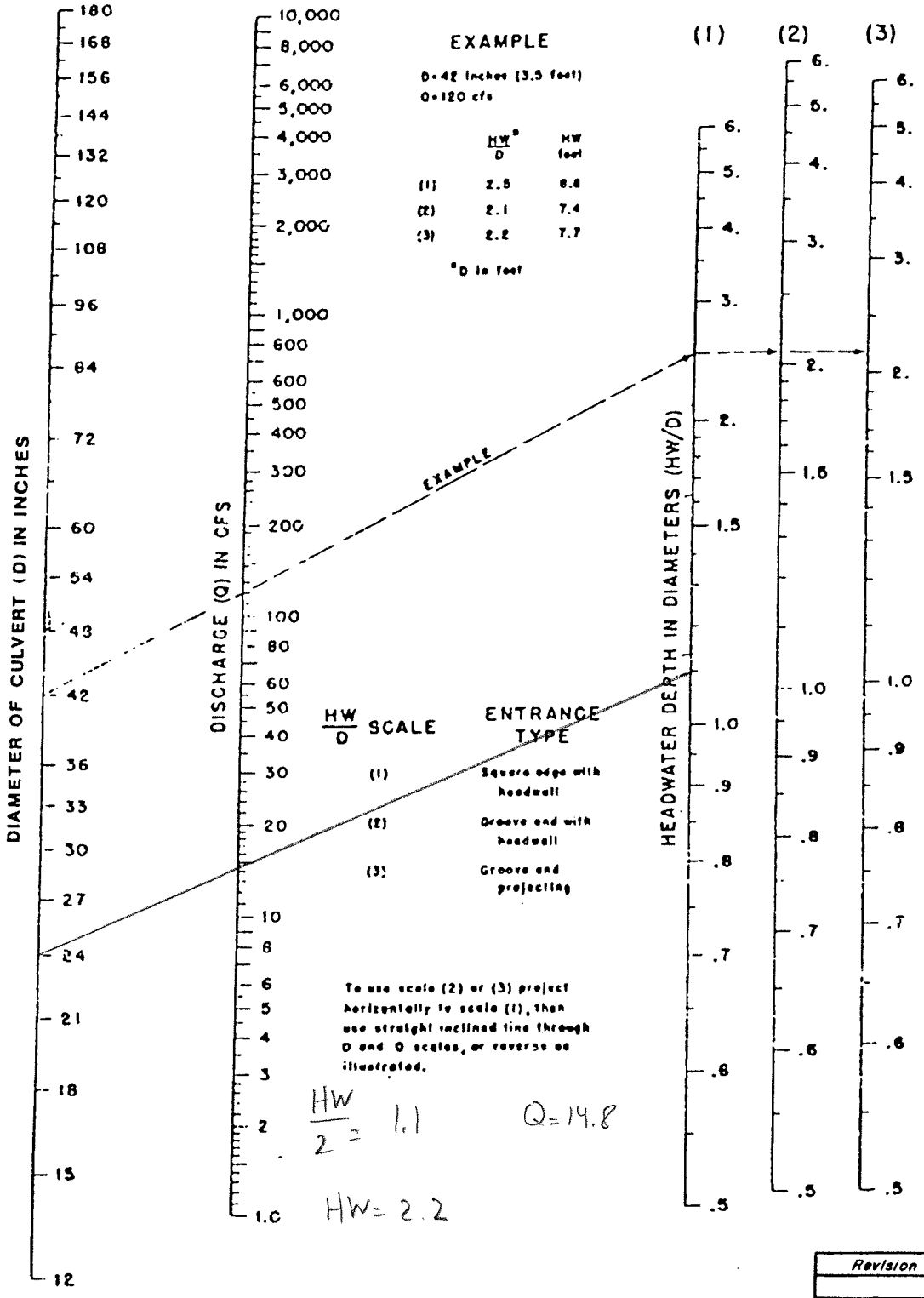
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

Lateral S SD01 DI #5 D-W-3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



24" RCP

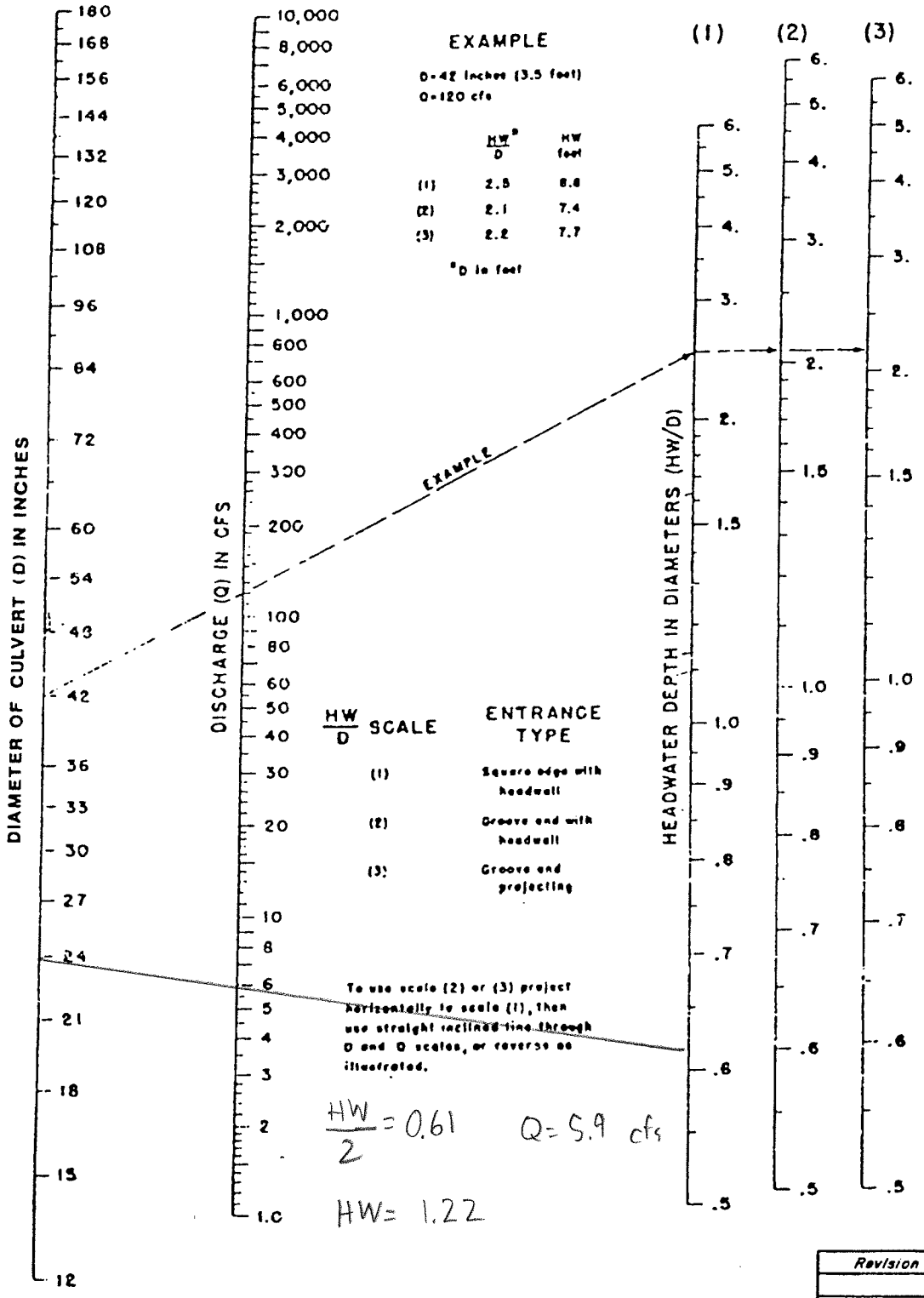
Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

Lateral 6 SD01 DI #6 D-E-3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



$\frac{HW}{2} = 0.61$ $Q = 5.9$ cfs

$HW = 1.22$

24 RCP

Revision	Date

WRC ENGINEERING

REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

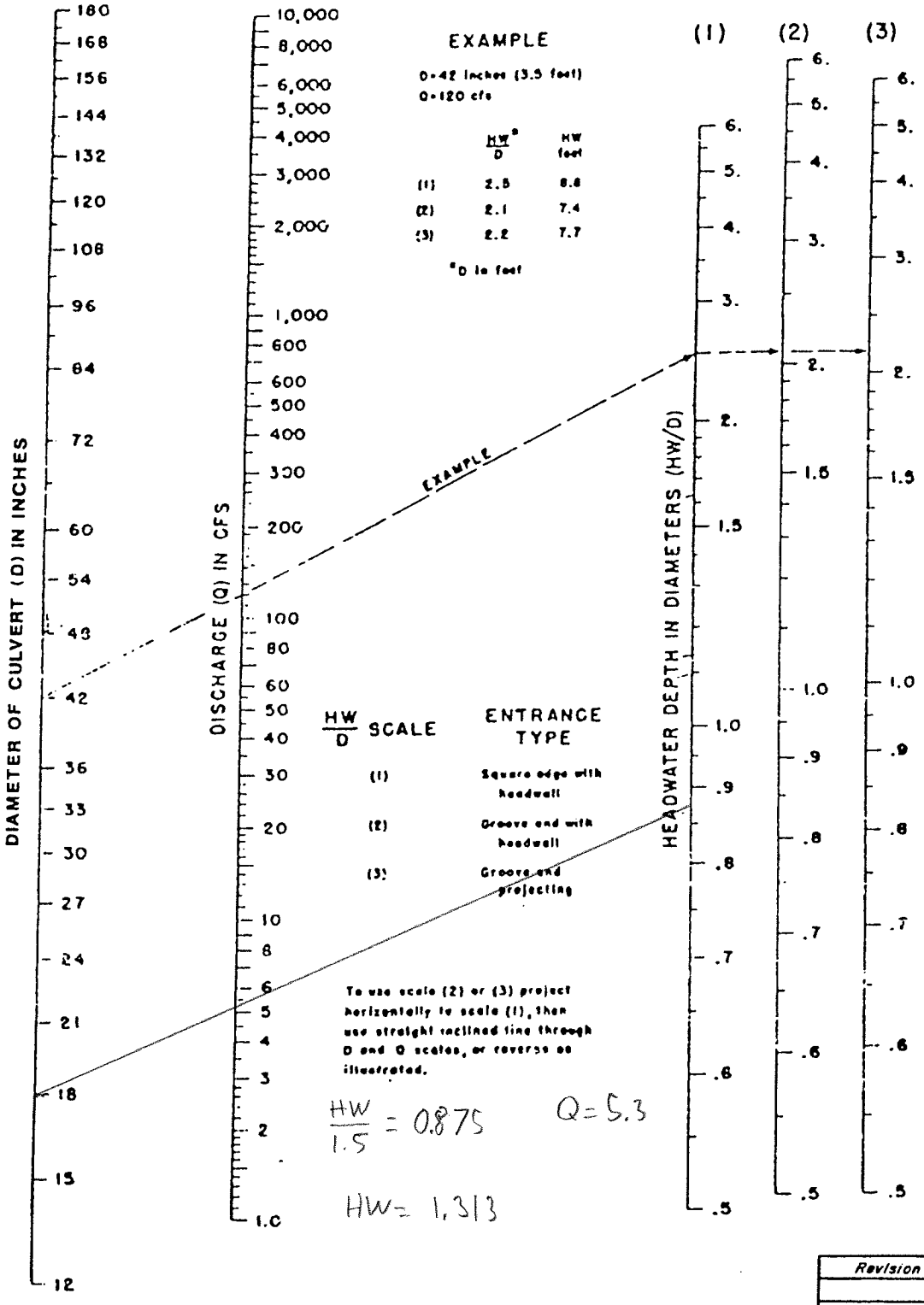
FIGURE 1005

ok

Lateral 7 SD01 (DI #7) D-E-2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



$\frac{HW}{1.5} = 0.875$ $Q = 5.3$

$HW = 1.313$

18" RCP

Revision	Date

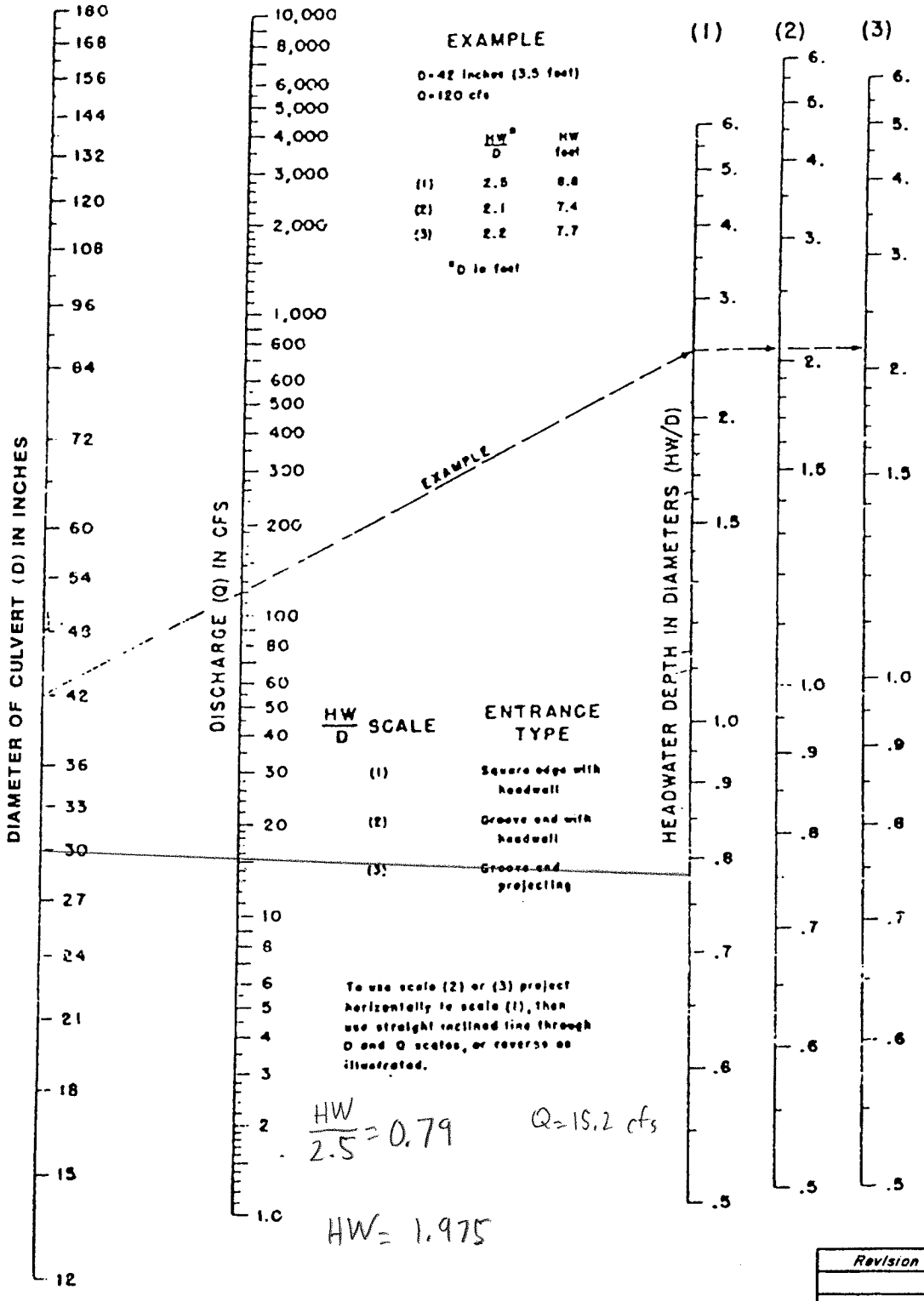
WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

ok

Lateral 8 SD01 DI #9 DW3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



30" RCP

Revision	Date

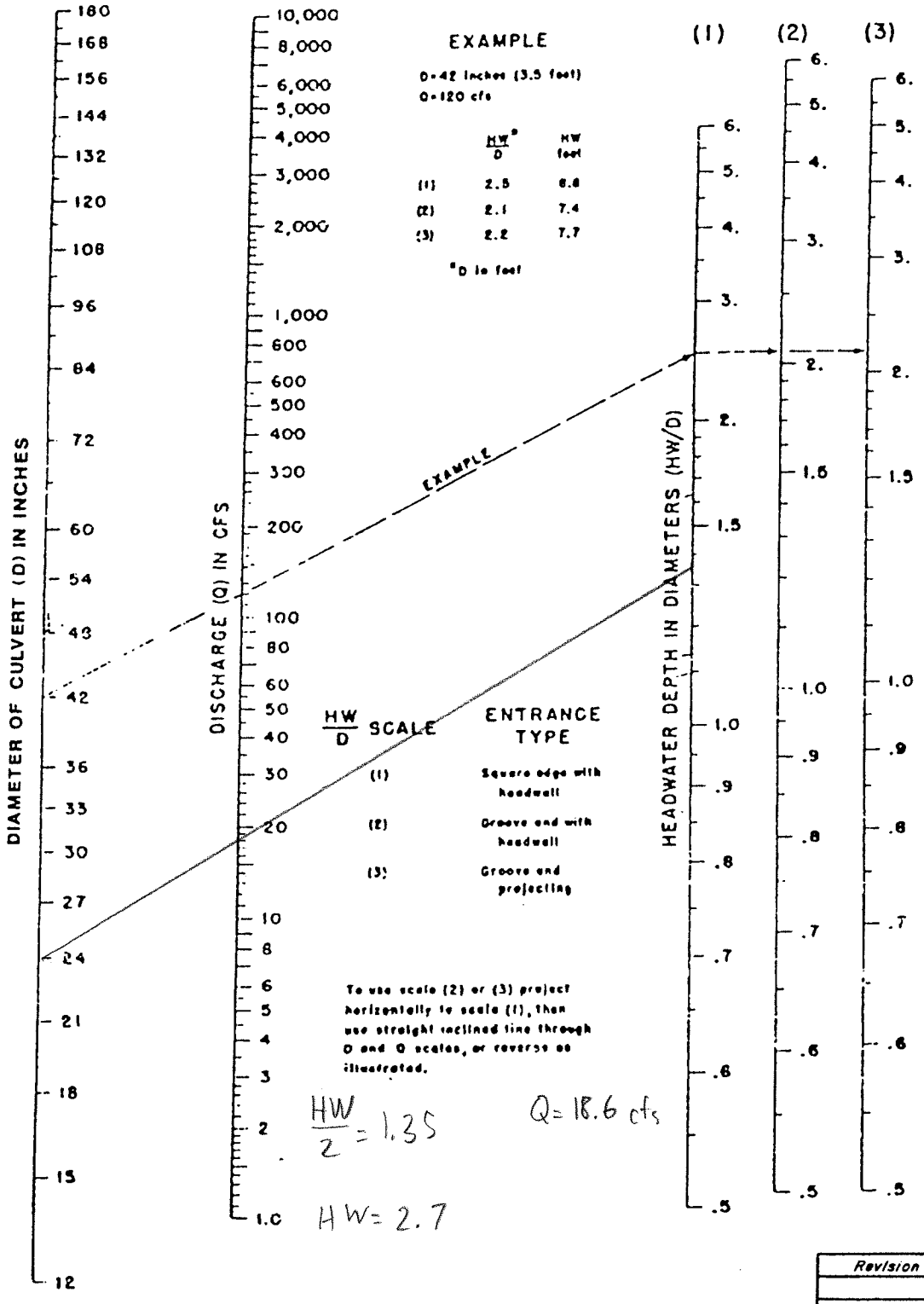
WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

ok

Lateral 9 SD01 DI #10 D-W-5

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



24" RCP

Revision	Date

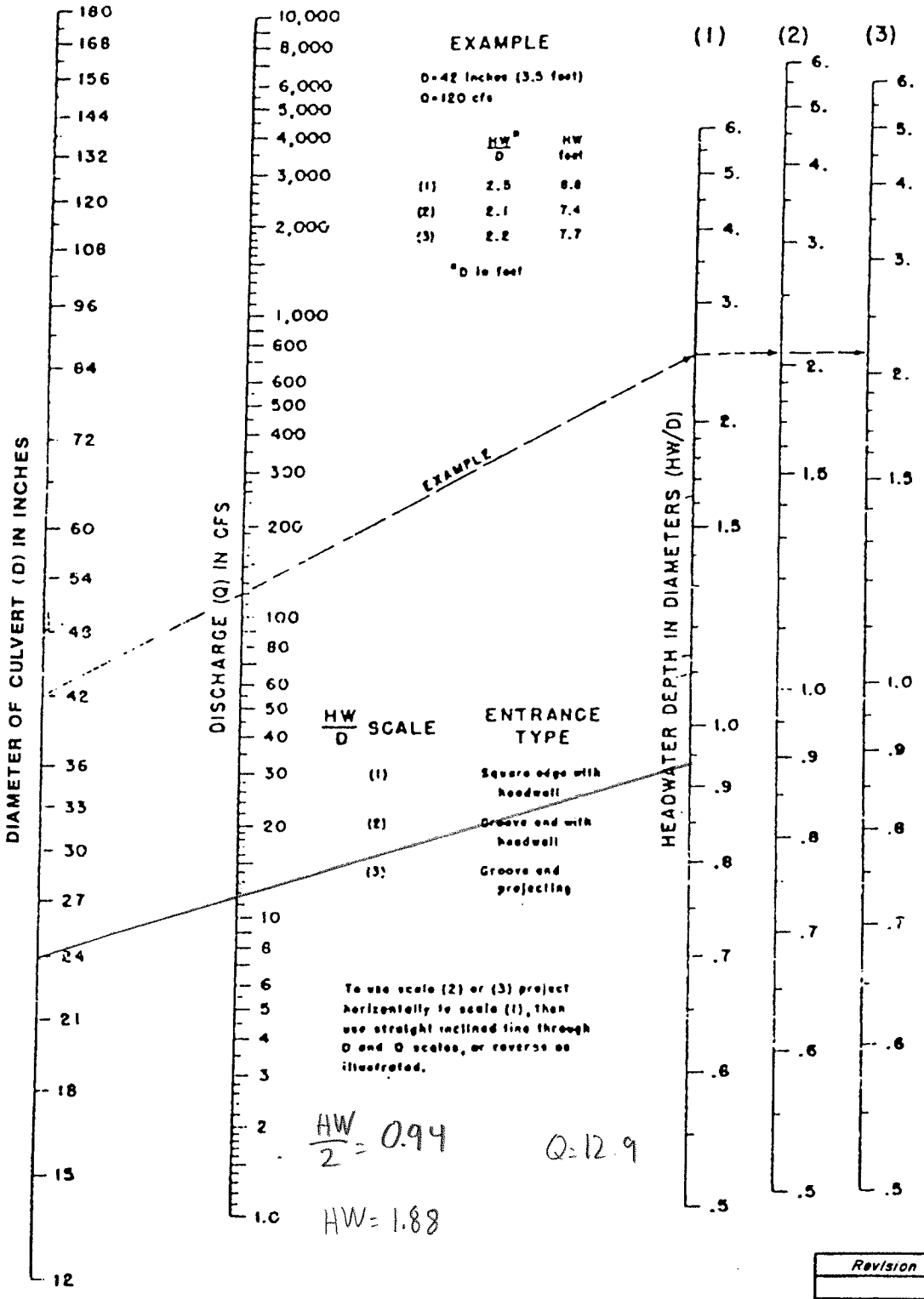
WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

ok

Lateral 10 SD01 DI # 11 D-W-7

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



$\frac{HW}{2} = 0.94$ Q=12.9

HW=1.88

24" RCP

Revision	Date

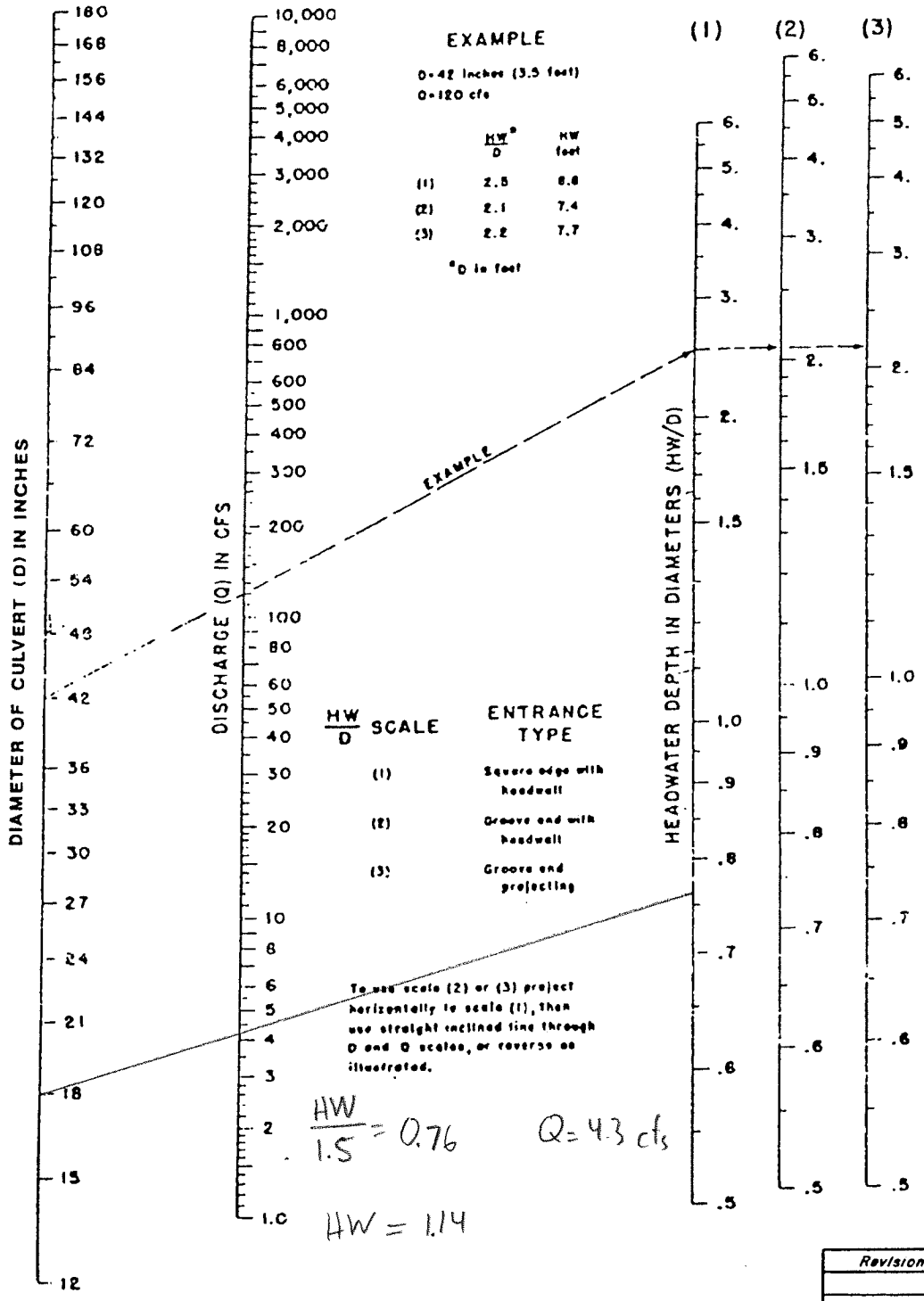
WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

Lateral 11 SD01 (DI #13)

DE-4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



18" RCP

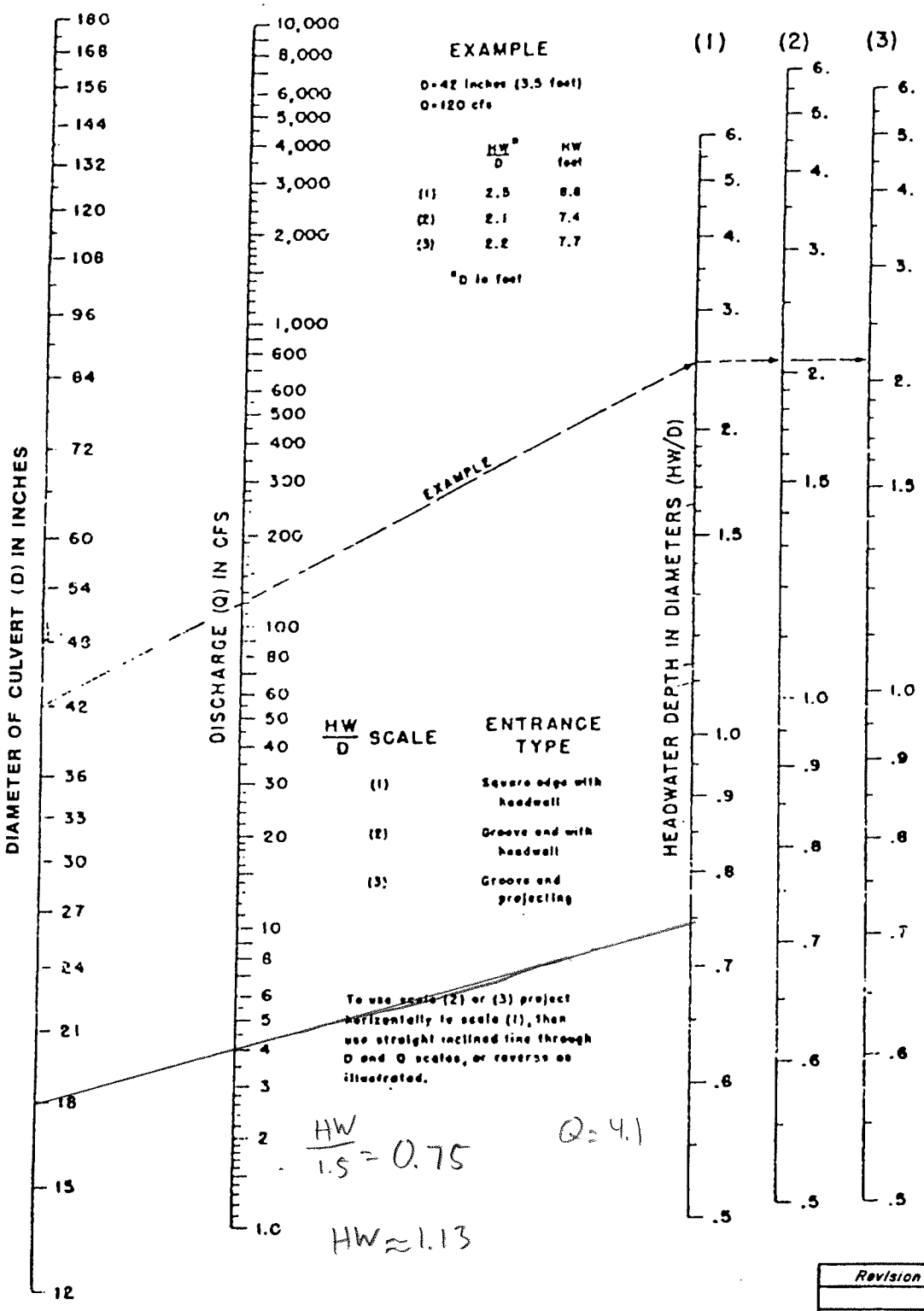
Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

Lateral 12 SD01 (DI # 14) F-E-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



18" RCP

Revision	Date

WRC ENGINEERING

REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

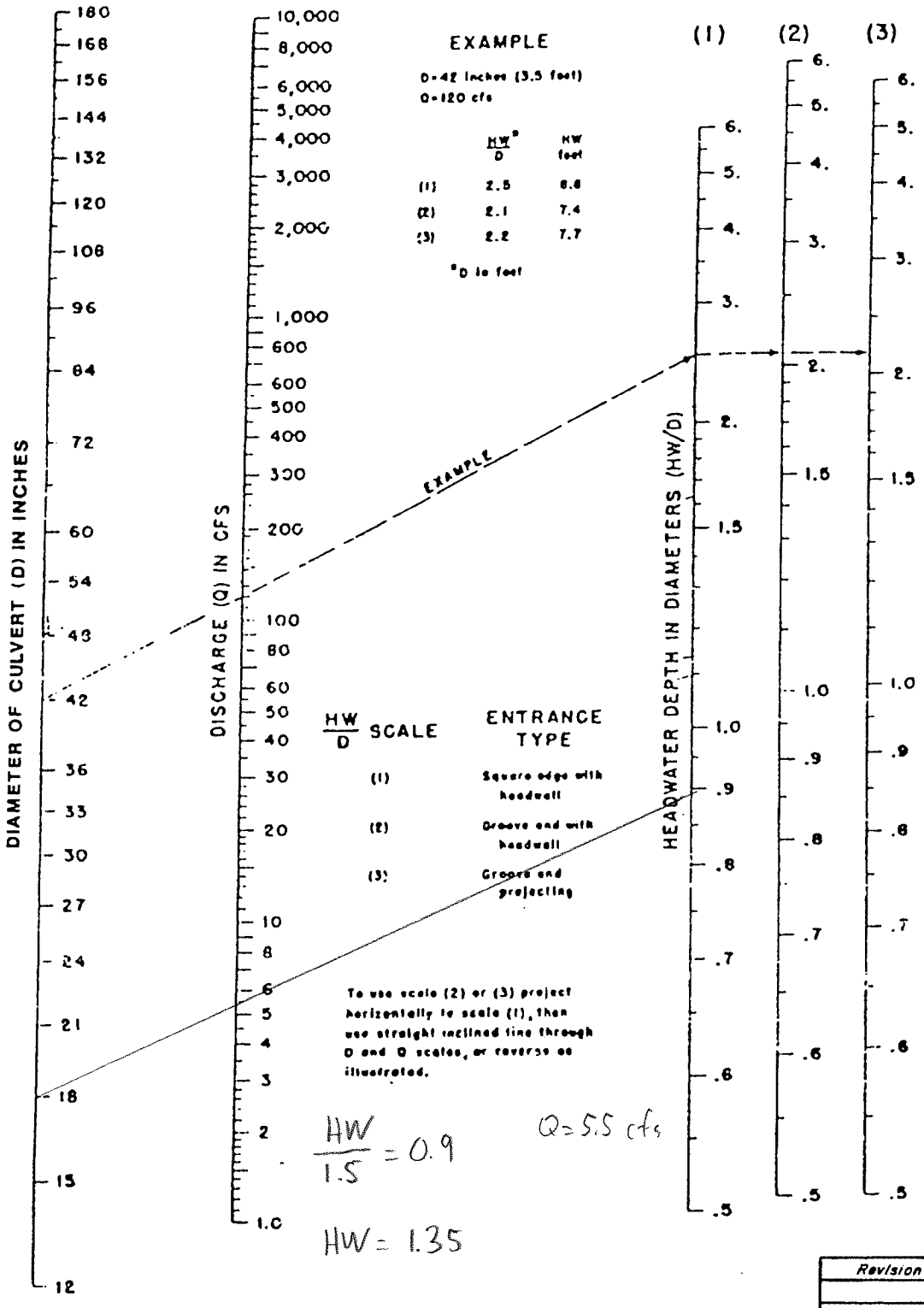
FIGURE 1005

ok

Lateral 13 SD01 DI #15 FE3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



18" RCP

Revision	Date

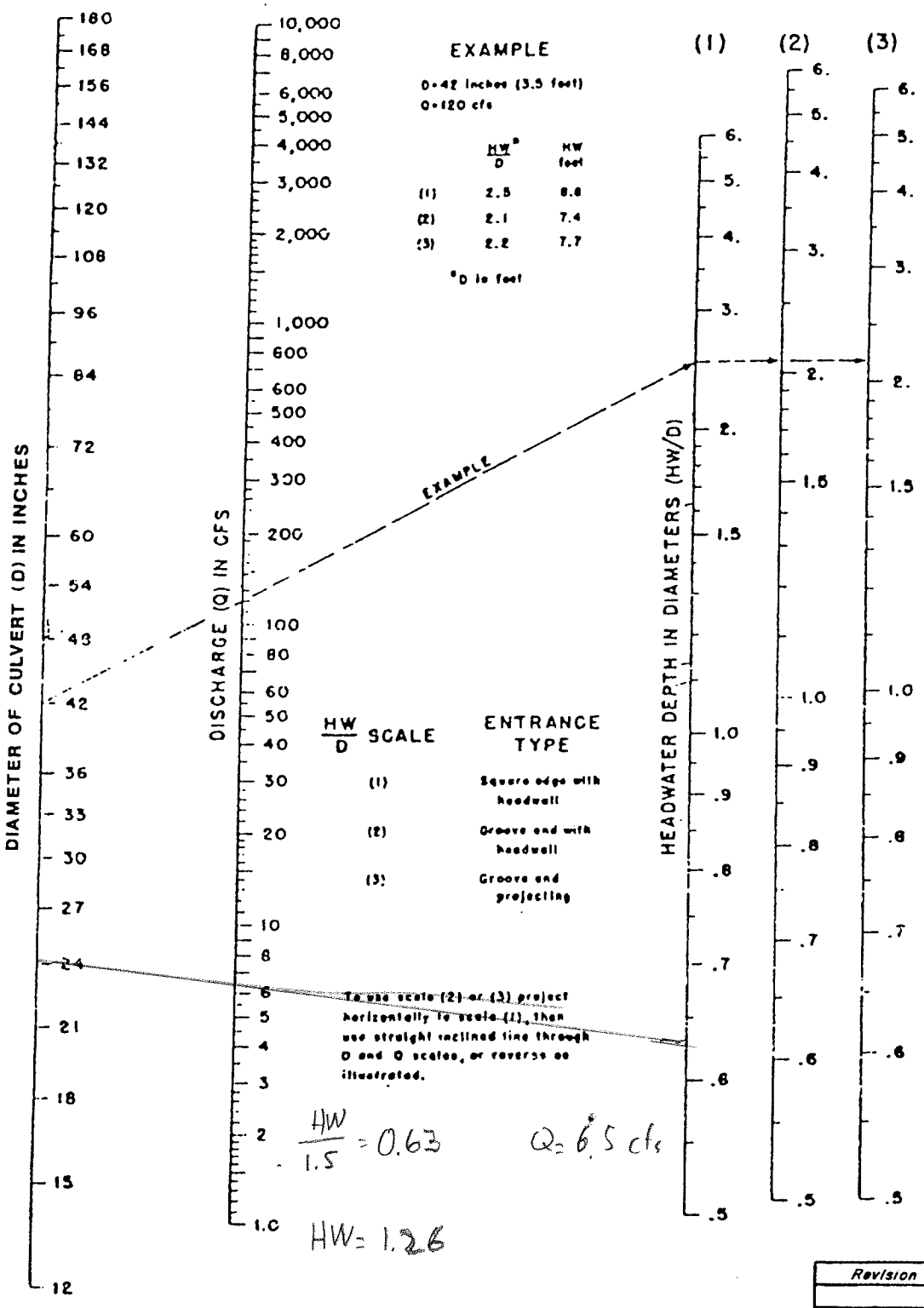
WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

ok

Lateral 14 SD01 DI #16 H-W-1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH - INLET CONTROL RCP



Revision	Date

WRC ENGINEERING

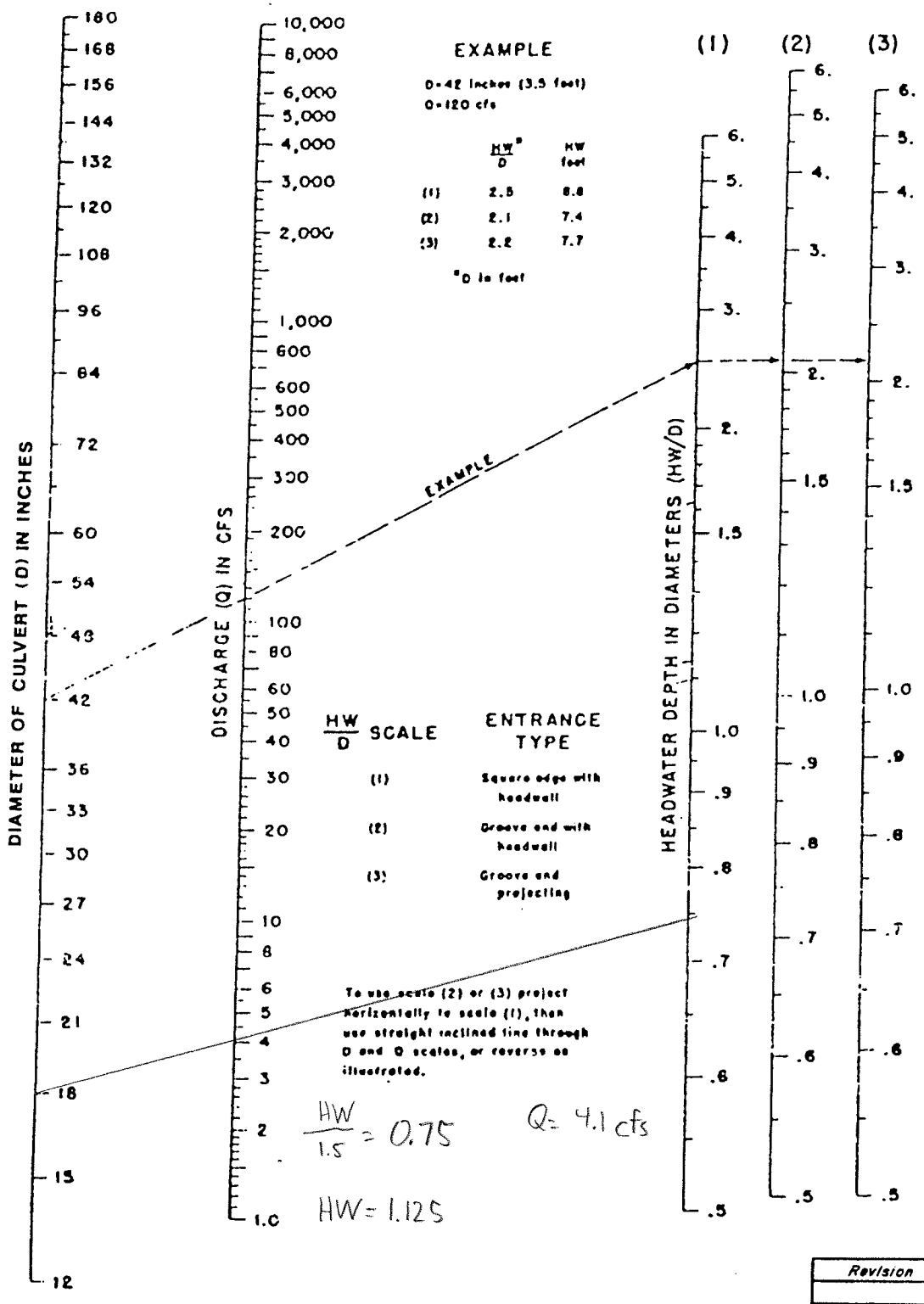
REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

Lateral 1S SD01 DI # 18 HE 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



18" RCP

Revision	Date

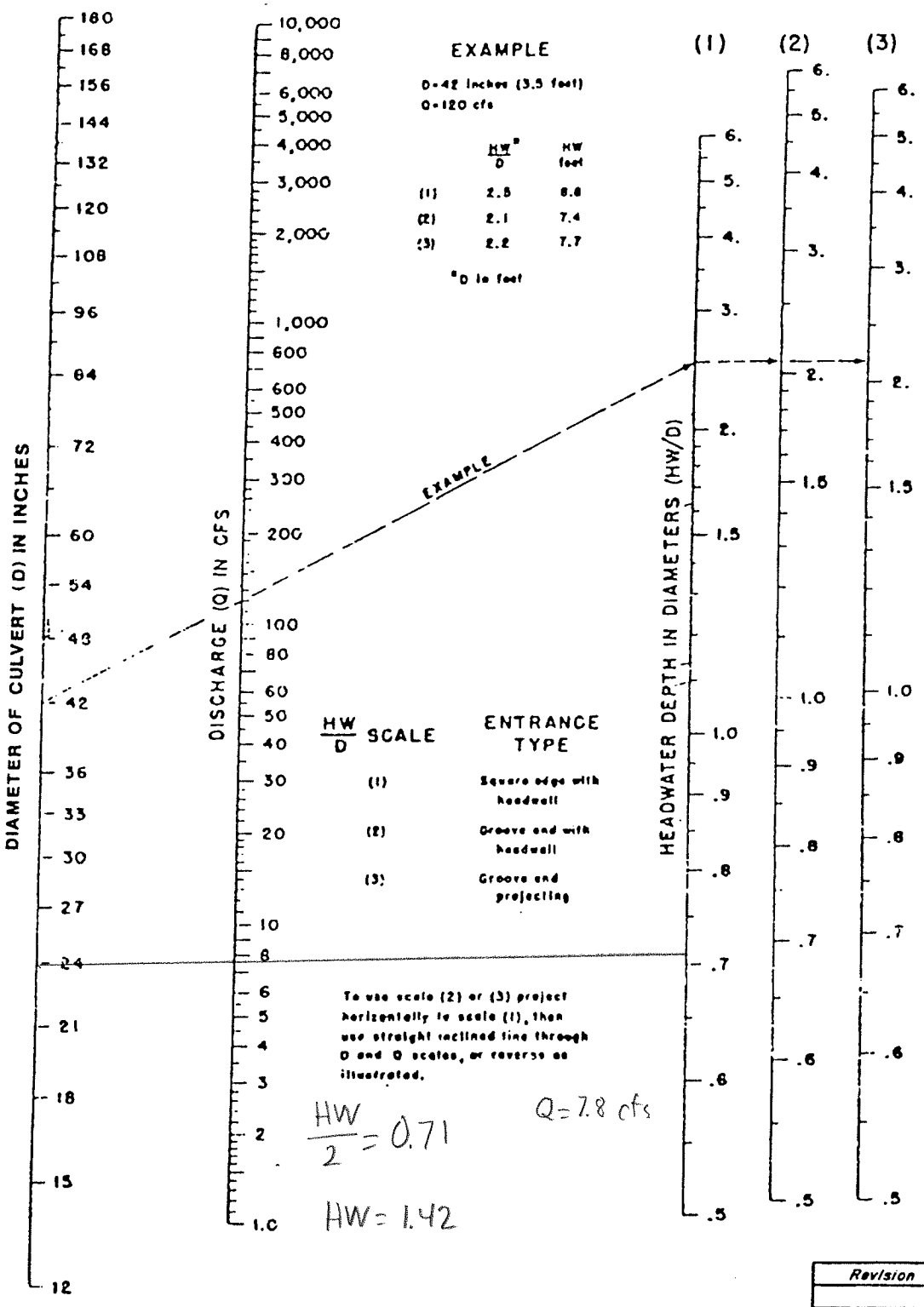
WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

OK (depth 1.58)

Lateral 16 SD01 OI # 19 H-W-2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



24" RCP

Revision	Date

WRC ENGINEERING

REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

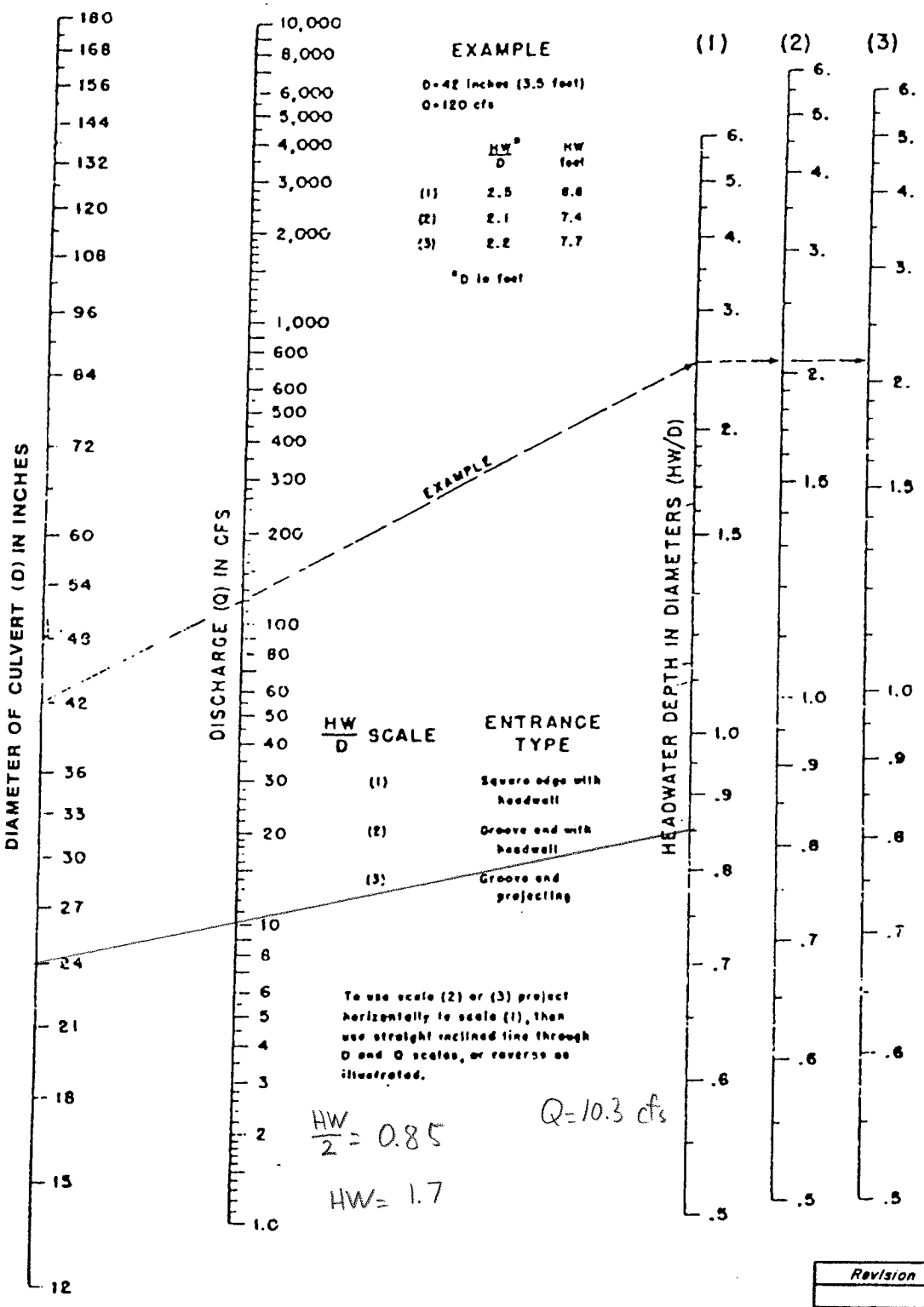
FIGURE 1005

SK

Lateral 17 SD01 DI #20 HW3

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

NOMOGRAPH – INLET CONTROL RCP



24" RCP

Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS, No. 5, 1985	FIGURE 1005

ok

Appendix B-3

Drop Inlet Calculations and Summary

DI ID	DI# in Plans	General Location	Type C: curb length Gr: grate size	Slope / Sump	Qstr (cfs)	Q Source	Qint (cfs)	Qbyp (cfs)
B-S-2	**1 (phase2)**	Boulder, Charleston to Atlantic	C: 10' Gr: 1.5' x 7.5'	0.70%	8.0	FR04-C1 and 1 cfs from FR04-C3 (1/18th of the basin)	4.8	3.3
B-S-3	**1**	Boulder, Charleston to Atlantic	C: 20' Gr: 1.5' x 17.5'	0.70%	13.6	(1/2) of FR04-C3 (10.5 cfs)plus bypass from BS2	12.9	0.7
J-N-1	**30**	Ballard and Eastwood	C: 3' Gr: 1.5' x 3'	sump	5.7	1/2 of 63%FR04-C2	5.7	0.0
J-S-1	**32**	Ballard and Eastwood	C: 3' Gr: 1.5' x 3'	sump	5.7	1/2 of 63%FR04-C2	5.7	0.0
J-W-1	**-**	Eastwood near Ballard	C: 3' Gr: 1.5' x 3'			Nuisance Flow		
J-W-2	**33**	Euclid and Russell	C: 3' Gr: 1.5' x 3'	0.50%	4.8	27% of basin FR04-C2	2.5	2.3
J-W-3	**34**	Euclid and Russell	C: 0 Gr: 3.5' x 3.5'	sump	13.0	10%FR04-C2, Bypass JW2, 18%FR04-C4, 7 cfs from FR04-C5 (half street capacity of Euclid)	13.0	0.0
C-N-3	**-**	Atlantic Lateral	C: 2.5' Gr: 1.5' x 2.5'	0.89%	7.4	(1/2)[FR04-C5 plus (1/6)FR04-C7]	2.8	4.6
C-N-4	**-**	Atlantic Lateral	C: 2.5' Gr: 1.5' x 2.5'	0.53%	4.6	(2/3) of FR04-C4 Anything that goes to the ditch on the west	2.7	1.9
C-N-1	**42**	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	76.0	half of [CFR04C8 minus 10 cfs (assuming 10 cfs comes north on Atlantic)] = 76 cfs	48.5	27.5
C-N-2	**43**	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	27.5	Bypass of C-N-1	22.4	5.1
C-S-1	**40**	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	76.0	half of [CFR04C8 minus10 cfs (assuming 10 cfs comes north on Atlantic)] = 76 cfs	48.5	27.5
C-S-2	**41**	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	27.5	Bypass of C-S-1	22.4	5.1
C-W-2	**44**	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.90%	13.9	(1/3) of 11.3 cfs (fro4-c2 GIS shapefile) plus bypass from CS2 and CN2	9.2	4.7
C-W-3	**45**	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.40%	16.2	(2/3) of 11.3 cfs (fro4-c2 GIS shapefile) plus bypass from CW2 plus 4cfs from FR05c6 (7 cfs goes north on euclid)	11.4	4.9
C-W-4	**47**	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	0.30%	19.2	Bypass of C-W-3, C-N-4 and 5 + 7.4	18.4	0.8
C-E-1	**46**	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.30%	4.0		3.9	0.1
D-Wa-1	**2**	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	6.2	(1/5) of FR04-C3 (4.2) plus bypass of CW4	6.2	0.0
D-W-1	**3**	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	12.7	(1/6) of FR04-C9 (12.7) and bypass of DW1a	12.3	0.4
D-Wa-2	**5**	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	15.6	(1/5) of FR04-C9 and bypass of D-W-1	14.8	0.8
D-W-3	**9**	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	16	(1/5) of FR04-C9 and bypass of D-W-2a	15.2	0.8
D-W-5	**10**	Boulder, Atlantic to Oakey	C: 15' Gr: 1.5' x 12.5'	0.42%	19.8	(1/4) of FR04-C9 and bypass of D-W-3	18.6	1.2
D-W-7	**11**	Boulder, Atlantic to Oakey	C: 15' Gr: 1.5' x 12.5'	0.62%	15.1	Remaining of FR04-Cr (13.9 cfs) and bypass of D-W-5	12.9	2.2
D-E-1	**4**	Boulder Highway	C: 7.5' Gr: 1.5' x 7.5'	0.59%	18.6	Rational Method (Basin10)	8.5	10.2
D-Ea-1	**6**	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.75%	13.3	Bypass plus half of basin 9 (6.12/2)	5.9	7.3
D-E-2	**7**	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.50%	10.4	Bypass plus half of basin 9 (6.12/2)	5.3	5.1
D-E-3	**-**	Boulder Highway	C: 3' Gr: 1.5' x 3'	0.80%	7.4	Bypass plus basin 8(2.3 cfs)	3.3	4.1
D-E-4	**13**	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.58%	7.7	Bypass plus half of basin 2 (7.2/2)	4.3	3.4
D-Ca-1	**8**	Boulder, Atlantic to Oakey	C: none Gr: 2.5' x5'	0.50%	12.5	rational method	8.2	4.3
D-C-1	**12**	Boulder, Atlantic to Oakey	C: none Gr: 2.5' x5'	sump	16.8	rational method + bypass	16.8	0.0
E-S-1	**50**	Oakey Lateral	C: 15' Gr: 1.5' x 12.5'	0.77%	141.5	Oakey south 1/2 street capacity	61.7	79.8
E-S-2	**51**	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	79.78	Bypass	54.5	25.3
E-S-3	**54**	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	26.3	Bypass plus half of (1/20) FR04-C16	22.6	3.7
E-N-1	**52**	Oakey Lateral	C: 15' Gr: 1.5' x 12.5'	0.77%	141.5	Oakey south 1/2 street capacity	61.7	79.8
E-N-2	**53**	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	79.78	Bypass	54.5	25.3
E-N-3	**55**	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	26.3	Bypass plus half of (1/20) FR04-C16	22.6	3.7
F-W-1	**-**	Boulder,Oakey to St Louis	C: none Gr: 12' x 3'	0.67%	19.3	(1/3.5) of FR04-C16 plus bypass from Oakey(7.4)	19.0	0.0
F-W-2	**-**	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.67%	11.6	(1/3.5) of FR04-C16 (assume 18'RCP is full and won't take any flow)	0.0	0.0
F-W-3	**-**	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.67%	11.6	Bypass (assume 18'RCP is full and won't take any flow)	0.0	0.0
F-W-4	**-**	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.70%	19.4	(1/5) of FR04-C16 plus bypass of F-W-3 (assume 18'RCP is full and won't take any flow)	0.0	0.0
F-W-5	**-**	Boulder,Oakey to St Louis	C: none Gr: 2.5' x 5'	sump	19.4	bypass of FW4 (24" RCP takes additional 10 cfs)	10.0	9.4
F-E-1	**14**	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.58%	7.0	Bypass plus half of basin 2 (7.2/2)	4.1	2.9
F-E-3	**15**	Boulder Highway	C: 5' Gr: 1.5' x 5'	0.50%	10.9	Bypass plus basin 3(8 cfs)	5.5	5.5
F-C-1	**-**	Boulder,Oakey to St Louis	C: none Gr: 4' x 3'	0.84%	5.0		3.0	2.0

F-C-2	**-**	Boulder,Oakey to St Louis	C: none Gr: 2.5' x 3'	0.64%	5.0		1.9	3.1
F-C-3	**-**	Boulder,Oakey to St Louis	C: none Gr: 2.5' X 5'	sump	12.0		12.0	0.0
F-C-4	**-**	Boulder,Oakey to St Louis	C: none Gr: 2.5' x 3'	sump	8.0		8.0	0.0
G-N-1	**61**	St Louis Lateral	C: 10' Gr: 1.5' x 7.5'	1.00%	44.0	Half of CFR03A	17.9	26.2
G-N-2	**63**	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	58.2	Bypass and whatever from Howard that stays on N side of the steet	39.3	18.9
G-N-3	**65**	St Louis Lateral	C: 20 Gr: 1.5' x 17.5'	sump	18.9	Bypass plus half of the street basin plus whatever that overtops the crown from the easement	18.9	0.0
G-S-1	**60**	St Louis Lateral	C: 10' Gr: 1.5' x 7.5'	1.00%	44.0	Half of CFR03A	17.9	26.2
G-S-2	**62**	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	58.2	Bypass and whatever that overtops the crown from the nprth side of the street (7 cfs)	39.3	18.9
G-S-3	**64**	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	18.9	Bypass plus half of the street basin plus CFR03-5 that stays on the south side	16.8	2.1
H-W-1	**16**	Boulder, St Louis to Sahara	C: 5' Gr: 1.5' x 5'	0.90%	15.6	(1/6) of FR03-7 plus bypass from St Louis (2.2) and bypass from FW5	6.5	9.2
H-W-2	**19**	Boulder, St Louis to Sahara	C: 15' Gr: 1.5' x 12.5'	0.80%	18.8	(1/2.5) of FR03-7 and bypass of H-W-1	14.9	3.9
H-W-3	**20**	Boulder, St Louis to Sahara	C: 20' Gr: 1.5' x 17.5'	0.80%	14.3	remaining of FR03-7 (10.4 cfs) plus bypass of H-w-3	15.0	1.3
H-E-1	**18**	Boulder, St Louis to Sahara	C: 5' Gr: 1.5' x 5'	0.50%	1.3		1.1	0.2
H-E-3	**-**	Boulder, St Louis to Sahara	C: NONE Gr: 2' x 3'			Nuisance Flow		
H-C-1	**17**	Boulder, St Louis to Sahara	C: NONE Gr: 2.5' x 2.5'	0.48%	6.0		2.6	3.5
H-C-2	**-**	Boulder, St Louis to Sahara	C: NONE Gr: 2.5' x 5'	0.70%	3.5	Bypass	2.0	1.5
H-C-3	**-**	Boulder, St Louis to Sahara	C: NONE Gr: 2.5' x10'	sump	1.5	Bypass	1.5	0.0

Worksheet for B-S-2

Project Description

Solve For	Efficiency

Input Data

Discharge		5.70	ft³/s
Slope		0.00700	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		10.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	88.18	%
Intercepted Flow	5.03	ft³/s
Bypass Flow	0.67	ft³/s
Spread	14.01	ft
Depth	0.38	ft
Flow Area	2.04	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.80	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.30	
Grate Flow Ratio	0.32	
Equivalent Cross Slope	0.08964	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.42	
Total Interception Length	14.86	ft

Worksheet for B-S-2

Messages

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

Worksheet for B-S-3

Project Description

Solve For	Efficiency

Input Data

Discharge		13.60	ft³/s
Slope		0.00700	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	94.85	%
Intercepted Flow	12.90	ft³/s
Bypass Flow	0.70	ft³/s
Spread	19.72	ft
Depth	0.49	ft
Flow Area	3.96	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.43	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.68	
Grate Flow Ratio	0.22	
Equivalent Cross Slope	0.06871	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.45	
Total Interception Length	25.11	ft

Worksheet for B-S-3

Messages

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

Worksheet for C-E-1

Project Description

Solve For	Efficiency

Input Data

Discharge		4.00	ft³/s
Slope		0.00300	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		10.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	97.66	%
Intercepted Flow	3.91	ft³/s
Bypass Flow	0.09	ft³/s
Spread	14.41	ft
Depth	0.39	ft
Flow Area	2.15	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	1.86	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.48	
Grate Flow Ratio	0.31	
Equivalent Cross Slope	0.08767	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.62	
Total Interception Length	10.06	ft

Worksheet for C-E-1

Messages

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

Worksheet for C-N/S-2

Project Description

Solve For	Efficiency

Input Data

Discharge		27.50	ft³/s
Slope		0.01200	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	81.45	%
Intercepted Flow	22.40	ft³/s
Bypass Flow	5.10	ft³/s
Spread	23.31	ft
Depth	0.57	ft
Flow Area	5.51	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	4.99	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.52	
Grate Flow Ratio	0.19	
Equivalent Cross Slope	0.06079	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.26	
Total Interception Length	42.70	ft

Worksheet for C-N/S-2

Messages

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

Worksheet for C-N/S-1

Project Description

Solve For	Efficiency

Input Data

Discharge		76.00	ft³/s
Slope		0.01200	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	63.85	%
Intercepted Flow	48.53	ft³/s
Bypass Flow	27.47	ft³/s
Spread	34.33	ft
Depth	0.79	ft
Flow Area	11.86	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	6.41	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.41	
Grate Flow Ratio	0.12	
Equivalent Cross Slope	0.04708	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.15	
Total Interception Length	76.29	ft

Worksheet for C-N/S-1

Messages

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

Worksheet for C-W-4

Project Description

Solve For	Efficiency

Input Data

Discharge		19.20	ft³/s
Slope		0.00300	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	95.71	%
Intercepted Flow	18.38	ft³/s
Bypass Flow	0.82	ft³/s
Spread	26.48	ft
Depth	0.63	ft
Flow Area	7.09	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.71	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.77	
Grate Flow Ratio	0.16	
Equivalent Cross Slope	0.05563	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.44	
Total Interception Length	25.55	ft

Worksheet for C-W-4

Messages

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

Worksheet for C-W-3

Project Description

Solve For	Efficiency

Input Data

Discharge		16.20	ft³/s
Slope		0.00400	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		10.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	70.05	%
Intercepted Flow	11.35	ft³/s
Bypass Flow	4.85	ft³/s
Spread	23.49	ft
Depth	0.57	ft
Flow Area	5.59	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.90	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.29	
Grate Flow Ratio	0.19	
Equivalent Cross Slope	0.06046	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.25	
Total Interception Length	24.67	ft

Worksheet for C-W-3

Messages

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

Worksheet for C-W-2

Project Description

Solve For	Efficiency

Input Data

Discharge		13.90	ft³/s
Slope		0.00900	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		10.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	66.14	%
Intercepted Flow	9.19	ft³/s
Bypass Flow	4.71	ft³/s
Spread	18.94	ft
Depth	0.48	ft
Flow Area	3.66	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.80	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.20	
Grate Flow Ratio	0.23	
Equivalent Cross Slope	0.07082	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.23	
Total Interception Length	26.84	ft

Worksheet for C-W-2

Messages

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

Worksheet for C-N-4

Project Description

Solve For	Efficiency

Input Data

Discharge	7.40	ft³/s
Slope	0.00530	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.0867	ft/ft
Road Cross Slope	0.0200	ft/ft
Roughness Coefficient	0.015	
Local Depression	4.00	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	2.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	40.72	%
Intercepted Flow	3.01	ft³/s
Bypass Flow	4.39	ft³/s
Spread	16.42	ft
Depth	0.43	ft
Flow Area	2.77	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.67	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.04	
Grate Flow Ratio	0.27	
Equivalent Cross Slope	0.07906	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.08	
Total Interception Length	16.45	ft

Worksheet for C-N-4

Messages

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

Worksheet for C-N-3

Project Description

Solve For	Efficiency

Input Data

Discharge	3.00	ft³/s
Slope	0.00890	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.0867	ft/ft
Road Cross Slope	0.0200	ft/ft
Roughness Coefficient	0.015	
Local Depression	4.00	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	2.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	60.43	%
Intercepted Flow	1.81	ft³/s
Bypass Flow	1.19	ft³/s
Spread	10.25	ft
Depth	0.31	ft
Flow Area	1.13	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.66	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.04	
Grate Flow Ratio	0.44	
Equivalent Cross Slope	0.11523	ft/ft
Active Grate Length	1.25	ft
Length Factor	0.12	
Total Interception Length	10.49	ft

Worksheet for C-N-3

Messages

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

Worksheet for D-Ea-1

Project Description

Solve For	Efficiency

Input Data

Discharge		13.30	ft³/s
Slope		0.00750	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		5.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		5.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	44.65	%
Intercepted Flow	5.94	ft³/s
Bypass Flow	7.36	ft³/s
Spread	19.29	ft
Depth	0.49	ft
Flow Area	3.79	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.50	ft/s
Splash Over Velocity	9.11	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.10	
Grate Flow Ratio	0.23	
Equivalent Cross Slope	0.06985	ft/ft
Active Grate Length	2.50	ft
Length Factor	0.10	
Total Interception Length	25.15	ft

Worksheet for D-Ea-1

Messages

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

Worksheet for D-E-4

Project Description

Solve For	Efficiency

Input Data

Discharge		7.70	ft³/s
Slope		0.00580	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		5.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		5.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	56.31	%
Intercepted Flow	4.34	ft³/s
Bypass Flow	3.36	ft³/s
Spread	16.38	ft
Depth	0.43	ft
Flow Area	2.76	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.79	ft/s
Splash Over Velocity	9.11	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.15	
Grate Flow Ratio	0.27	
Equivalent Cross Slope	0.07919	ft/ft
Active Grate Length	2.50	ft
Length Factor	0.15	
Total Interception Length	17.17	ft

Worksheet for D-E-4

Messages

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

Worksheet for D-E-3

Project Description

Solve For	Efficiency

Input Data

Discharge		7.40	ft³/s
Slope		0.00800	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		3.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		3.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	44.20	%
Intercepted Flow	3.27	ft³/s
Bypass Flow	4.13	ft³/s
Spread	15.14	ft
Depth	0.40	ft
Flow Area	2.37	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.13	ft/s
Splash Over Velocity	6.99	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.04	
Grate Flow Ratio	0.30	
Equivalent Cross Slope	0.08428	ft/ft
Active Grate Length	1.50	ft
Length Factor	0.08	
Total Interception Length	17.91	ft

Worksheet for D-E-3

Messages

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

Worksheet for D-E-2

Project Description

Solve For	Efficiency

Input Data

Discharge		10.36	ft³/s
Slope		0.00500	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		5.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		5.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	50.99	%
Intercepted Flow	5.28	ft³/s
Bypass Flow	5.08	ft³/s
Spread	18.94	ft
Depth	0.48	ft
Flow Area	3.66	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.83	ft/s
Splash Over Velocity	9.11	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.14	
Grate Flow Ratio	0.23	
Equivalent Cross Slope	0.07082	ft/ft
Active Grate Length	2.50	ft
Length Factor	0.13	
Total Interception Length	19.89	ft

Worksheet for D-E-2

Messages

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

Worksheet for D-E-1

Project Description

Solve For	Efficiency

Input Data

Discharge		18.60	ft³/s
Slope		0.05900	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		7.50	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	45.42	%
Intercepted Flow	8.45	ft³/s
Bypass Flow	10.15	ft³/s
Spread	14.68	ft
Depth	0.39	ft
Flow Area	2.23	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	8.34	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.06	
Grate Flow Ratio	0.31	
Equivalent Cross Slope	0.08636	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.08	
Total Interception Length	47.33	ft

Worksheet for D-E-1

Messages

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

Worksheet for D-Ca-1

Project Description

Solve For	Efficiency

Input Data

Discharge		12.50	ft³/s
Slope		0.00500	ft/ft
Gutter Width		5.00	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Grate Width		2.50	ft
Grate Length		5.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	65.87	%
Intercepted Flow	8.23	ft³/s
Bypass Flow	4.27	ft³/s
Spread	16.74	ft
Depth	0.67	ft
Flow Area	3.64	ft²
Gutter Depression	0.33	ft
Total Depression	0.33	ft
Velocity	3.44	ft/s
Splash Over Velocity	9.11	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.34	
Grate Flow Ratio	0.48	
Active Grate Length	2.50	ft

Messages

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

Worksheet for D-C-1

Project Description

Solve For	Spread

Input Data

Discharge		16.80	ft³/s
Gutter Width		5.00	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Grate Width		2.50	ft
Grate Length		5.00	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	33.47	ft
Depth	1.00	ft
Gutter Depression	0.33	ft
Total Depression	0.33	ft
Open Grate Area	5.63	ft²
Active Grate Weir Length	7.50	ft

Worksheet for D-W-5

Project Description

Solve For	Efficiency

Input Data

Discharge		19.80	ft³/s
Slope		0.00420	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	93.85	%
Intercepted Flow	18.58	ft³/s
Bypass Flow	1.22	ft³/s
Spread	25.13	ft
Depth	0.60	ft
Flow Area	6.39	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.10	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.72	
Grate Flow Ratio	0.17	
Equivalent Cross Slope	0.05767	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.40	
Total Interception Length	28.02	ft

Worksheet for D-W-5

Messages

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

Worksheet for D-W-3

Project Description

Solve For	Efficiency

Input Data

Discharge		16.00	ft³/s
Slope		0.00500	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	94.92	%
Intercepted Flow	15.19	ft³/s
Bypass Flow	0.81	ft³/s
Spread	22.40	ft
Depth	0.55	ft
Flow Area	5.09	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.14	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.71	
Grate Flow Ratio	0.20	
Equivalent Cross Slope	0.06256	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.44	
Total Interception Length	25.71	ft

Worksheet for D-W-3

Messages

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

Worksheet for D-W-2a

Project Description

Solve For	Efficiency

Input Data

Discharge		15.60	ft³/s
Slope		0.00500	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	95.14	%
Intercepted Flow	14.84	ft³/s
Bypass Flow	0.76	ft³/s
Spread	22.18	ft
Depth	0.54	ft
Flow Area	5.00	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.12	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.72	
Grate Flow Ratio	0.20	
Equivalent Cross Slope	0.06300	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.44	
Total Interception Length	25.33	ft

Worksheet for D-W-2a

Messages

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

Worksheet for D-W-1a

Project Description

Solve For	Efficiency

Input Data

Discharge		6.20	ft³/s
Slope		0.00500	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	99.87	%
Intercepted Flow	6.19	ft³/s
Bypass Flow	0.01	ft³/s
Spread	15.49	ft
Depth	0.41	ft
Flow Area	2.47	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	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	0.29	
Equivalent Cross Slope	0.08276	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.77	
Total Interception Length	14.60	ft

Worksheet for D-W-1a

Messages

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

Worksheet for D-W-1

Project Description

Solve For	Efficiency

Input Data

Discharge		12.70	ft³/s
Slope		0.00500	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	96.78	%
Intercepted Flow	12.29	ft³/s
Bypass Flow	0.41	ft³/s
Spread	20.49	ft
Depth	0.51	ft
Flow Area	4.27	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.97	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.73	
Grate Flow Ratio	0.22	
Equivalent Cross Slope	0.06676	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.50	
Total Interception Length	22.44	ft

Worksheet for D-W-1

Messages

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

Worksheet for D-W-7

Project Description

Solve For	Efficiency

Input Data

Discharge		15.10	ft³/s
Slope		0.00620	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		12.50	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		15.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	85.71	%
Intercepted Flow	12.94	ft³/s
Bypass Flow	2.16	ft³/s
Spread	21.02	ft
Depth	0.52	ft
Flow Area	4.49	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.36	ft/s
Splash Over Velocity	15.63	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.50	
Grate Flow Ratio	0.21	
Equivalent Cross Slope	0.06553	ft/ft
Active Grate Length	6.25	ft
Length Factor	0.34	
Total Interception Length	26.03	ft

Worksheet for D-W-7

Messages

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

Worksheet for E-S/N-3

Project Description

Solve For	Efficiency

Input Data

Discharge		26.28	ft³/s
Slope		0.00800	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	85.92	%
Intercepted Flow	22.58	ft³/s
Bypass Flow	3.70	ft³/s
Spread	24.76	ft
Depth	0.60	ft
Flow Area	6.20	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	4.24	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.59	
Grate Flow Ratio	0.18	
Equivalent Cross Slope	0.05827	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.30	
Total Interception Length	38.05	ft

Worksheet for E-S/N-3

Messages

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

Worksheet for E-S/N-2

Project Description

Solve For	Efficiency

Input Data

Discharge		79.78	ft³/s
Slope		0.00800	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	68.32	%
Intercepted Flow	54.50	ft³/s
Bypass Flow	25.28	ft³/s
Spread	37.75	ft
Depth	0.86	ft
Flow Area	14.33	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	5.57	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.47	
Grate Flow Ratio	0.11	
Equivalent Cross Slope	0.04450	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.16	
Total Interception Length	71.32	ft

Worksheet for E-S/N-2

Messages

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

Worksheet for E-S/N-1

Project Description

Solve For	Efficiency

Input Data

Discharge		141.50	ft³/s
Slope		0.00770	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		12.50	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		15.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	43.62	%
Intercepted Flow	61.72	ft³/s
Bypass Flow	79.78	ft³/s
Spread	47.20	ft
Depth	1.04	ft
Flow Area	22.35	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	6.33	ft/s
Splash Over Velocity	15.63	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.25	
Grate Flow Ratio	0.09	
Equivalent Cross Slope	0.03938	ft/ft
Active Grate Length	6.25	ft
Length Factor	0.09	
Total Interception Length	96.51	ft

Worksheet for E-S/N-1

Messages

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

Worksheet for F-W-1

Project Description

Solve For	Efficiency

Input Data

Discharge		19.30	ft³/s
Slope		0.00670	ft/ft
Gutter Width		12.00	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Grate Width		12.00	ft
Grate Length		3.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	19.30	ft³/s
Bypass Flow	0.00	ft³/s
Spread	9.20	ft
Depth	0.80	ft
Flow Area	3.67	ft²
Gutter Depression	0.80	ft
Total Depression	0.80	ft
Velocity	5.25	ft/s
Splash Over Velocity	6.99	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.02	
Grate Flow Ratio	1.00	
Active Grate Length	1.50	ft

Worksheet for F-E-3

Project Description

Solve For	Efficiency

Input Data

Discharge		10.90	ft³/s
Slope		0.00500	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		5.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		5.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	50.01	%
Intercepted Flow	5.45	ft³/s
Bypass Flow	5.45	ft³/s
Spread	19.31	ft
Depth	0.49	ft
Flow Area	3.81	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.86	ft/s
Splash Over Velocity	9.11	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.14	
Grate Flow Ratio	0.23	
Equivalent Cross Slope	0.06978	ft/ft
Active Grate Length	2.50	ft
Length Factor	0.12	
Total Interception Length	20.50	ft

Worksheet for F-E-3

Messages

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

Worksheet for F-E-1

Project Description

Solve For	Efficiency

Input Data

Discharge		7.00	ft³/s
Slope		0.00580	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		5.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		5.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	58.34	%
Intercepted Flow	4.08	ft³/s
Bypass Flow	2.92	ft³/s
Spread	15.78	ft
Depth	0.42	ft
Flow Area	2.57	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.73	ft/s
Splash Over Velocity	9.11	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.15	
Grate Flow Ratio	0.28	
Equivalent Cross Slope	0.08155	ft/ft
Active Grate Length	2.50	ft
Length Factor	0.15	
Total Interception Length	16.20	ft

Worksheet for F-E-1

Messages

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

Worksheet for F-C-4

Project Description

Solve For	Spread

Input Data

Discharge		8.00	ft³/s
Gutter Width		2.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Grate Width		2.50	ft
Grate Length		3.00	ft
Local Depression		4.00	in
Local Depression Width		2.50	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	26.72	ft
Depth	0.70	ft
Gutter Depression	0.17	ft
Total Depression	0.50	ft
Open Grate Area	3.38	ft²
Active Grate Weir Length	5.50	ft

Worksheet for F-C-3

Project Description

Solve For	Spread

Input Data

Discharge		12.00	ft³/s
Gutter Width		2.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Grate Width		2.50	ft
Grate Length		5.00	ft
Local Depression		4.00	in
Local Depression Width		2.50	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	30.48	ft
Depth	0.78	ft
Gutter Depression	0.17	ft
Total Depression	0.50	ft
Open Grate Area	5.63	ft²
Active Grate Weir Length	7.50	ft

Worksheet for F-C-2

Project Description

Solve For	Efficiency

Input Data

Discharge		5.00	ft³/s
Slope		0.00640	ft/ft
Gutter Width		2.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Grate Width		2.50	ft
Grate Length		3.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	60.05	%
Intercepted Flow	3.00	ft³/s
Bypass Flow	2.00	ft³/s
Spread	12.63	ft
Depth	0.42	ft
Flow Area	1.80	ft²
Gutter Depression	0.17	ft
Total Depression	0.17	ft
Velocity	2.77	ft/s
Splash Over Velocity	6.99	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.05	
Grate Flow Ratio	0.58	
Active Grate Length	1.50	ft

Worksheet for F-C-1

Project Description

Solve For	Efficiency

Input Data

Discharge		5.00	ft³/s
Slope		0.00840	ft/ft
Gutter Width		3.00	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Grate Width		3.00	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	75.02	%
Intercepted Flow	3.75	ft³/s
Bypass Flow	1.25	ft³/s
Spread	11.14	ft
Depth	0.42	ft
Flow Area	1.54	ft²
Gutter Depression	0.20	ft
Total Depression	0.20	ft
Velocity	3.24	ft/s
Splash Over Velocity	8.13	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.07	
Grate Flow Ratio	0.73	
Active Grate Length	2.00	ft

Worksheet for G-S-3

Project Description

Solve For	Efficiency

Input Data

Discharge		18.90	ft³/s
Slope		0.01000	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	88.79	%
Intercepted Flow	16.78	ft³/s
Bypass Flow	2.12	ft³/s
Spread	20.90	ft
Depth	0.52	ft
Flow Area	4.44	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	4.25	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.59	
Grate Flow Ratio	0.21	
Equivalent Cross Slope	0.06580	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.34	
Total Interception Length	32.94	ft

Worksheet for G-S-3

Messages

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

Worksheet for G-S-2

Project Description

Solve For	Efficiency

Input Data

Discharge		34.40	ft³/s
Slope		0.01300	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	76.81	%
Intercepted Flow	26.42	ft³/s
Bypass Flow	7.98	ft³/s
Spread	25.01	ft
Depth	0.60	ft
Flow Area	6.33	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	5.43	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.48	
Grate Flow Ratio	0.17	
Equivalent Cross Slope	0.05786	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.23	
Total Interception Length	49.50	ft

Worksheet for G-S-2

Messages

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

Worksheet for G-S-1

Project Description

Solve For	Efficiency

Input Data

Discharge		44.00	ft³/s
Slope		0.01300	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		10.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	40.56	%
Intercepted Flow	17.85	ft³/s
Bypass Flow	26.15	ft³/s
Spread	27.47	ft
Depth	0.65	ft
Flow Area	7.62	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	5.77	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.11	
Grate Flow Ratio	0.16	
Equivalent Cross Slope	0.05427	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.11	
Total Interception Length	57.04	ft

Worksheet for G-S-1

Messages

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

Worksheet for G-N-3

Project Description

Solve For	Spread

Input Data

Discharge		18.90	ft³/s
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Local Depression		4.00	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		20.00	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Throat Incline Angle		90.00	degrees

Options

Calculation Option	Use Both

Results

Spread	14.71	ft
Depth	0.39	ft
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Open Grate Area	11.81	ft²
Active Grate Weir Length	19.00	ft

Worksheet for G-N-2

Project Description

Solve For	Efficiency

Input Data

Discharge		58.20	ft³/s
Slope		0.01300	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	67.52	%
Intercepted Flow	39.30	ft³/s
Bypass Flow	18.90	ft³/s
Spread	30.56	ft
Depth	0.71	ft
Flow Area	9.41	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	6.18	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.42	
Grate Flow Ratio	0.14	
Equivalent Cross Slope	0.05063	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.17	
Total Interception Length	66.88	ft

Worksheet for G-N-2

Messages

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

Worksheet for G-N-1

Project Description

Solve For	Efficiency

Input Data

Discharge		44.00	ft³/s
Slope		0.01300	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		10.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	40.56	%
Intercepted Flow	17.85	ft³/s
Bypass Flow	26.15	ft³/s
Spread	27.47	ft
Depth	0.65	ft
Flow Area	7.62	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	5.77	ft/s
Splash Over Velocity	11.14	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.11	
Grate Flow Ratio	0.16	
Equivalent Cross Slope	0.05427	ft/ft
Active Grate Length	3.75	ft
Length Factor	0.11	
Total Interception Length	57.04	ft

Worksheet for G-N-1

Messages

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

Worksheet for H-E-1

Project Description

Solve For	Efficiency

Input Data

Discharge	6.80	ft³/s
Slope	0.00500	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.0867	ft/ft
Road Cross Slope	0.0200	ft/ft
Roughness Coefficient	0.015	
Local Depression	4.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	5.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	5.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	59.67	%
Intercepted Flow	4.06	ft³/s
Bypass Flow	2.74	ft³/s
Spread	16.06	ft
Depth	0.42	ft
Flow Area	2.66	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.56	ft/s
Splash Over Velocity	9.11	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.17	
Grate Flow Ratio	0.28	
Equivalent Cross Slope	0.08042	ft/ft
Active Grate Length	2.50	ft
Length Factor	0.16	
Total Interception Length	15.44	ft

Worksheet for H-E-1

Messages

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

Worksheet for H-C-3

Project Description

Solve For	Spread

Input Data

Discharge		1.50	ft³/s
Gutter Width		2.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Grate Width		2.50	ft
Grate Length		10.00	ft
Local Depression		2.50	in
Local Depression Width		2.50	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	5.48	ft
Depth	0.28	ft
Gutter Depression	0.17	ft
Total Depression	0.38	ft
Open Grate Area	11.25	ft²
Active Grate Weir Length	12.50	ft

Worksheet for H-C-2

Project Description

Solve For	Efficiency

Input Data

Discharge		3.50	ft³/s
Slope		0.00700	ft/ft
Gutter Width		2.00	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Grate Width		2.00	ft
Grate Length		3.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	56.30	%
Intercepted Flow	1.97	ft³/s
Bypass Flow	1.53	ft³/s
Spread	11.04	ft
Depth	0.35	ft
Flow Area	1.35	ft²
Gutter Depression	0.13	ft
Total Depression	0.13	ft
Velocity	2.59	ft/s
Splash Over Velocity	6.99	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.06	
Grate Flow Ratio	0.54	
Active Grate Length	1.50	ft

Worksheet for H-C-1

Project Description

Solve For	Efficiency

Input Data

Discharge		6.00	ft³/s
Slope		0.00480	ft/ft
Gutter Width		2.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Grate Width		2.50	ft
Grate Length		2.50	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	52.82	%
Intercepted Flow	3.17	ft³/s
Bypass Flow	2.83	ft³/s
Spread	14.62	ft
Depth	0.46	ft
Flow Area	2.35	ft²
Gutter Depression	0.17	ft
Total Depression	0.17	ft
Velocity	2.56	ft/s
Splash Over Velocity	6.35	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.04	
Grate Flow Ratio	0.51	
Active Grate Length	1.25	ft

Worksheet for H-W-3

Project Description

Solve For	Efficiency

Input Data

Discharge		14.30	ft³/s
Slope		0.00800	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	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		20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	93.67	%
Intercepted Flow	13.40	ft³/s
Bypass Flow	0.90	ft³/s
Spread	19.59	ft
Depth	0.49	ft
Flow Area	3.91	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.65	ft/s
Splash Over Velocity	25.03	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.65	
Grate Flow Ratio	0.23	
Equivalent Cross Slope	0.06904	ft/ft
Active Grate Length	8.75	ft
Length Factor	0.42	
Total Interception Length	26.62	ft

Worksheet for H-W-3

Messages

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

Worksheet for H-W-2

Project Description

Solve For	Efficiency

Input Data

Discharge	18.80	ft³/s
Slope	0.00800	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.0867	ft/ft
Road Cross Slope	0.0200	ft/ft
Roughness Coefficient	0.015	
Local Depression	4.00	in
Local Depression Width	2.00	ft
Grate Width	1.50	ft
Grate Length	12.50	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	15.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	79.47	%
Intercepted Flow	14.94	ft³/s
Bypass Flow	3.86	ft³/s
Spread	21.77	ft
Depth	0.54	ft
Flow Area	4.82	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.90	ft/s
Splash Over Velocity	15.63	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.44	
Grate Flow Ratio	0.20	
Equivalent Cross Slope	0.06385	ft/ft
Active Grate Length	6.25	ft
Length Factor	0.28	
Total Interception Length	31.29	ft

Worksheet for H-W-2

Messages

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

Worksheet for H-W-1

Project Description

Solve For	Efficiency

Input Data

Discharge		15.60	ft³/s
Slope		0.00900	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0867	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.015	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		5.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		5.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	41.37	%
Intercepted Flow	6.45	ft³/s
Bypass Flow	9.15	ft³/s
Spread	19.80	ft
Depth	0.50	ft
Flow Area	4.00	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	3.90	ft/s
Splash Over Velocity	9.11	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.09	
Grate Flow Ratio	0.22	
Equivalent Cross Slope	0.06848	ft/ft
Active Grate Length	2.50	ft
Length Factor	0.09	
Total Interception Length	28.74	ft

Worksheet for H-W-1

Messages

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

Worksheet for J-W-3

Project Description

Solve For	Spread

Input Data

Discharge		13.00	ft³/s
Left Side Slope		10.00	ft/ft (H:V)
Right Side Slope		10.00	ft/ft (H:V)
Bottom Width		4.00	ft
Grate Width		3.50	ft
Grate Length		3.50	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	15.09	ft
Depth	0.55	ft
Wetted Perimeter	15.14	ft
Top Width	15.09	ft
Open Grate Area	5.51	ft²
Active Grate Weir Length	10.50	ft

Worksheet for J-W-2

Project Description

Solve For	Efficiency

Input Data

Discharge		4.80	ft³/s
Slope		0.00500	ft/ft
Gutter Width		1.50	ft
Gutter Cross Slope		0.0860	ft/ft
Road Cross Slope		0.0200	ft/ft
Roughness Coefficient		0.016	
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		3.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		3.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	52.40	%
Intercepted Flow	2.52	ft³/s
Bypass Flow	2.28	ft³/s
Spread	14.36	ft
Depth	0.39	ft
Flow Area	2.14	ft²
Gutter Depression	0.10	ft
Total Depression	0.43	ft
Velocity	2.25	ft/s
Splash Over Velocity	6.99	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.07	
Grate Flow Ratio	0.31	
Equivalent Cross Slope	0.08759	ft/ft
Active Grate Length	1.50	ft
Length Factor	0.12	
Total Interception Length	12.19	ft

Worksheet for J-S-1

Project Description

Solve For	Spread

Input Data

Discharge		5.70	ft³/s
Gutter Width		1.50	ft
Gutter Cross Slope		0.0800	ft/ft
Road Cross Slope		0.0200	ft/ft
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		3.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		3.00	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Throat Incline Angle		90.00	degrees

Options

Calculation Option	Use Both

Results

Spread	15.49	ft
Depth	0.40	ft
Gutter Depression	0.09	ft
Total Depression	0.42	ft
Open Grate Area	2.03	ft²
Active Grate Weir Length	4.50	ft

Worksheet for J-N-1

Project Description

Solve For	Spread

Input Data

Discharge		5.70	ft³/s
Gutter Width		1.50	ft
Gutter Cross Slope		0.0800	ft/ft
Road Cross Slope		0.0200	ft/ft
Local Depression		4.00	in
Local Depression Width		2.00	ft
Grate Width		1.50	ft
Grate Length		3.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%
Curb Opening Length		3.00	ft
Opening Height		0.50	ft
Curb Throat Type	Horizontal		
Throat Incline Angle		90.00	degrees

Options

Calculation Option	Use Both

Results

Spread		15.49	ft
Depth		0.40	ft
Gutter Depression		0.09	ft
Total Depression		0.42	ft
Open Grate Area		2.03	ft²
Active Grate Weir Length		4.50	ft

Appendix B-4

Street Criteria

Worksheet for 100 yr D*V max

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00800	ft/ft
Discharge	38.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.50
0+01	0.50
0+01	0.00
0+02	0.17
0+30	0.77

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.50)	(0+30, 0.77)	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	0.78	ft
Elevation Range	0.00 to 0.77 ft	
Flow Area	9.85	ft²
Wetted Perimeter	31.10	ft
Hydraulic Radius	0.32	ft
Top Width	30.30	ft
Normal Depth	0.78	ft
Critical Depth	0.82	ft

Worksheet for 100 yr D*V max

Results

Critical Slope		0.00542	ft/ft
Velocity		3.86	ft/s
Velocity Head		0.23	ft
Specific Energy		1.01	ft
Froude Number		1.19	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.78	ft
Critical Depth	0.82	ft
Channel Slope	0.00800	ft/ft
Critical Slope	0.00542	ft/ft

Messages

Notes

This calculation shows the full capacity of Boulder Highway from Back of Curb to crown (+/-30 ft.). The D x V is 3. the depth 0.78 cfs. With this section full 2 travel lanes are dry.

Cross Section for 100 yr D*V max

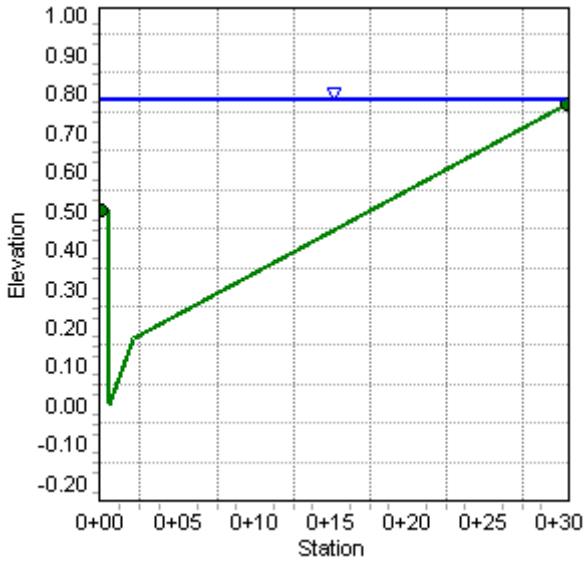
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00800	ft/ft
Normal Depth	0.78	ft
Discharge	38.00	ft³/s

Cross Section Image



Worksheet for NDOT Spread Max

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00800	ft/ft
Discharge	20.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.50
0+01	0.50
0+01	0.00
0+02	0.17
0+30	0.77

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.50)	(0+30, 0.77)	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	0.64	ft
Elevation Range	0.00 to 0.77 ft	
Flow Area	6.13	ft²
Wetted Perimeter	24.86	ft
Hydraulic Radius	0.25	ft
Top Width	24.20	ft
Normal Depth	0.64	ft
Critical Depth	0.67	ft

Worksheet for NDOT Spread Max

Results

Critical Slope		0.00600	ft/ft
Velocity		3.26	ft/s
Velocity Head		0.17	ft
Specific Energy		0.81	ft
Froude Number		1.14	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.64	ft
Critical Depth	0.67	ft
Channel Slope	0.00800	ft/ft
Critical Slope	0.00600	ft/ft

Messages

Notes

The max spread is calculated from Back of Curb to 1/2 inundation of the outside lane (6'). In this calculation, the bike lane (+/-6') and bus lane (12') are considered shoulder. The max spread is +/- 24' (6+12+6). Spread is for 10-year storm flow on minor arterial.

Cross Section for NDOT Spread Max

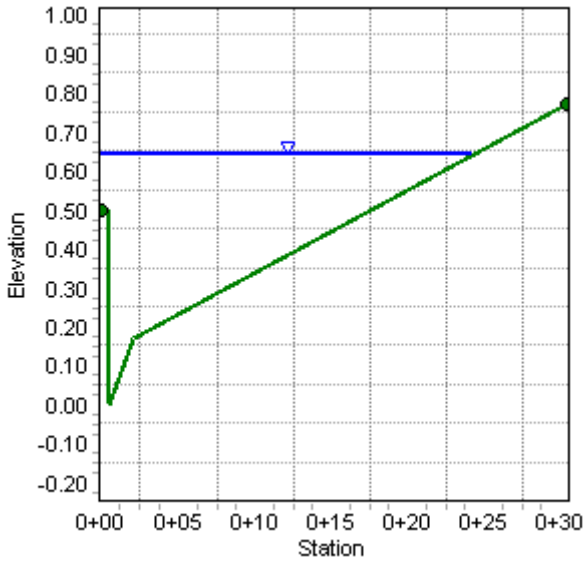
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00800	ft/ft
Normal Depth	0.64	ft
Discharge	20.00	ft³/s

Cross Section Image



Appendix C

Geotechnical Investigations

GROUNDWATER IMPACT EVALUATION
BOULDER HIGHWAY STORM DRAIN
SAHARA TO CHARLESTON
LAS VEGAS, NEVADA

Project No. 20153837E1
June 3, 2016

Prepared for:

ATKINS

Atkins North America, Inc.
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

Prepared by:

GES

Geotechnical & Environmental Services, Inc.
7150 Placid Street
Las Vegas, Nevada 89119

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June 3, 2016
Project No. 20153837E1

Matt Baird, P.E.
Vice President
Atkins North America, Inc.
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

RE: Groundwater Impact Evaluation, Boulder Highway Storm Drain, Sahara to Charleston, Las Vegas, Nevada

Dear Mr. Baird:

Geotechnical & Environmental Services, Inc. (GES) is pleased to present this Groundwater Impact Evaluation for the proposed Boulder Highway Storm Drain, Sahara to Charleston, project located in Las Vegas, Nevada.

This report includes the findings of a review of readily available groundwater literature based on Task 102.5 of the scope-of-services for groundwater services contracted with Atkins North America (Atkins). Task 102.5 describes the following scope-of-services for a groundwater impact evaluation:

- Review of available literature and maps including groundwater flow maps.
- Provide a listing of permitted wells within 500 feet of the proposed storm drain alignment and the anticipated depths to the bottom of the facilities.
- Review the Environmental Corrective Action Site Database Review at the proposed monitoring well locations to identify historic underground storage tanks (USTs) and leaking underground storage tanks (LUSTs).
- Provide recommendations for the placement and depths of monitoring wells based on the findings.

We appreciate this opportunity to provide our professional services. If you have any questions or comments regarding this information, please feel free to contact our office.

Sincerely,
Geotechnical & Environmental Services, Inc.

Brian Loffman, C.E.M.
Environmental Program Manager
C.E.M. #2265 (Expires 9/21/16)

Paul E. Simpson, P.E.
Project Manager

"I, Brian K. Loffman, hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulations and ordinances."

Dist: 3 originals delivered to addressee
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EDR Radius Map and Site Descriptions

GROUNDWATER IMPACT EVALUATION
BOULDER HIGHWAY STORM DRAIN
SAHARA TO CHARLESTON
LAS VEGAS, NEVADA

1. INTRODUCTION

This report presents the findings of a groundwater impact evaluation for the Boulder Highway Storm Drain, Sahara to Charleston project. The project is based on the referenced Attachment B (Atkins) showing the proposed storm drain alignment; a copy of Attachment B is provided as **Figure 1** in **Appendix A**. We anticipate the storm drain will be installed using cut and cover techniques.

1.1. PURPOSE AND SCOPE

The purpose of this review was to evaluate where reported groundwater may be encountered along the alignment during excavations and evaluate where groundwater contaminants may be located and impact temporary construction dewatering operations in close proximity to the project alignment. Geotechnical & Environmental Services, Inc. (GES) reviewed available sources to evaluate whether underground storage tanks (USTs), leaking underground storage tanks (LUSTs), septic systems and/or wells are located in close proximity to the project alignments.

GES evaluated whether reported groundwater contaminants are anticipated to impact the dewatering operations and has provided recommendations for sampling and testing of groundwater to assess this impact.

This impact evaluation was performed as Task 102.5 of our scope-of-services. Based on the findings we are providing recommendations for boring and monitoring well depths and locations. Drilling exploratory borings, laboratory testing of the samples and presentation of geotechnical recommendations for the project will be performed under Tasks 102.6, 102.6.3, and 102.6.4 of our contracted scope-of-services.

1.2. PROJECT DESCRIPTION

The project mainline alignment consists of approximately 1.5 miles of storm drain along the Boulder Highway (Fremont Street) right-of-way from Sahara Avenue, north to Charleston Avenue. In addition, several lateral sections of storm drain will extend from the main line in Boulder Highway to the west on St. Louis Avenue, McLeod Street, Oakey Boulevard, Olive Street, Atlantic Street, and Russell Avenue, and northwest along Fremont Street from Charleston Boulevard to Eastern

Avenue. Within these areas, 13 borings are anticipated for subsurface geotechnical exploration and soil sampling. Three of these borings are anticipated to be converted into groundwater monitoring wells for the collection of groundwater samples, and slug tests performed on up to two of the monitoring wells. Invert elevations are not finalized. However, the southern connection will tie into an existing 15-foot by 10-foot reinforced box culvert (RCB) with an invert approximately 23-feet below grade. Inverts, along the remainder of the alignment, are anticipated to be shallower than 23-feet. The proposed project alignments are presented in **Figures 1 and 2** provided in **Appendix A**.

2. GROUNDWATER IMPACT EVALUATION

The following sections describe our review of selected available literature pertaining to groundwater quality for the project area.

2.1. INFORMATION REVIEWED

GES obtained readily available information in the vicinity of the project alignment for evaluation of potential anthropogenic impacts to groundwater quality, including but not limited to USTs and LUSTs, septic systems, and groundwater extraction wells. GES reviewed information pertaining to standard environmental sources, physical setting sources, and historical land use.

GES performed a search of the current governmental regulatory databases utilizing Environmental Data Resources Inc. (EDR). This service is a GIS database of local, state and Federal environmental agency records. The Nevada Division of Environmental Protection (NDEP), Bureau of Waste Management, and the Bureau of Corrective Actions supplies federal environmental data which is obtained from a search of United States Environmental Protection Agency (U.S. EPA) records for the State of Nevada. A search was performed for the entire project alignment. The Southern Nevada Health District (SNHD) was contacted regarding septic systems and hazardous waste sites. GES estimated the groundwater depths based on the referenced SNWA map. Wells were searched using the Nevada Division of Water Resources (NDWR) computerized Well Log Database. Copies of the EDR Radius Map Report are available upon request.

2.2. SITE RECONNAISSANCE

GES performed a site reconnaissance on May 20, 2016, using the methodology described in this report, to obtain information for identifying potentially impacted sites in the immediate

vicinity of the project area. A site reconnaissance of the subject property was conducted by visually observing, to the extent possible, the property, and adjoining properties. Our site reconnaissance consisted of walking the length of the proposed storm drain route while noting occupants and site usage of adjoining properties in an effort to identify potential sites of concern in the immediate vicinity of the project area. Please refer to **Appendix B - Photographic Log** for site photographs taken during the site reconnaissance.

A public records request was submitted to the SNHD to evaluate if known septic systems were located on or near the project alignment. No reported septic systems were reported by the SNHD in the project area.

2.3. FINDINGS

Based on a review of the referenced SNWA map, we estimate groundwater is less than ten feet from the surface. The alignment location is shown on the referenced SNWA map on **Figure 3** provided in **Appendix A**. In addition, the Nevada Department of Water Resources Well Log Database was reviewed in the areas within 500 feet of the proposed alignment. The project area is located in Section 1, Township 21 South, Range 61 East. Shallow monitoring wells listed in this Section reported static water levels ranging from 7 feet below ground surface (bgs) to 15 feet bgs. The NDRW Well Log Database Report obtained for the project area is provided in **Appendix C**. Groundwater flow direction in the project vicinity is assumed to be east-southeast towards the Las Vegas Wash. Accordingly, we anticipate temporary construction dewatering will be required for open cut trenches along the alignment.

The NDEP, along with various local and county agencies, supply federal environmental data which is obtained from a search of United States Environmental Protection Agency (U.S. EPA) records for the State of Nevada. The results of the environmental database search, the Federal, State, local, tribal and proprietary databases searched, and the search distances specified for each database are summarized as follows:

Table 2.3.1 – Federal Database Results Search

Federal Databases	Search Distance
National Priorities List (NPL)	1.0 mile
Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS)	0.5 mile
No Further Remedial Action Planned Sites (NFRAP)	Subject parcel and adjoining

Federal Databases	Search Distance
Resource Conservation and Recovery Act (RCRA) - Corrective Action Sites (CORRACTS)	1.0 mile
RCRA – Treatment, Storage and Disposal (TSD) Facilities	0.5 mile
RCRA - Large-Quantity Generators (LQGs)	Subject parcel and adjoining
RCRA - Small-Quantity Generators (SQGs)	Subject parcel and adjoining
CONSENT: Superfund (CERCLA) Consent Decrees	1.0 mile
ROD: Records of Decision	1.0 mile
Delisted NPL: National Priority List Deletions	1.0 mile
FINDS: Facility Index System/Facility Identification Initiative Program Summary	Subject parcel only
HMIRS: Hazardous Materials Information Reporting System	Subject parcel only
MLTS: Material Licensing Tracking System	Subject parcel only
MINES: Mines Master Index File	0.25 mile
NPL Liens: Federal Superfund Liens	Subject parcel only
PADS: PCB (Polychlorinated Biphenyl) Activity Database System	Subject parcel only
ODI: Open Dump Inventory	0.5 mile
UMTRA: Uranium Mill Tailings Sites	0.5 mile
FUDS: Formerly Used Defense Sites	1.0 mile
Indian Reserv: Indian Reservations	1.0 mile
DOD: Department of Defense Sites	1.0 mile
RAATS: RCRA Administrative Action Tracking System	Subject parcel only
TRIS: Toxic Chemical Release Inventory System	Subject parcel only
TSCA: Toxic Substances Control Act	Subject parcel only
SSTS: Section 7 Tracking System	Subject parcel only
FTTS: Federal Insecticide, Fungicide & Rodenticide Act (FIFRA)/TSCA Tracking System	Subject parcel only

Table 2.3.2 – State/County Database Result Search

State/County Databases	Search Distance
SWF/LF: Landfill List	0.5 mile
SWRCY: Recycler Database	0.5 mile
LUST: Leaking Underground Storage Tank Database	0.5 mile
UST: Active Underground Storage Tank Facilities	0.25 mile
AST: Aboveground Petroleum Storage Tank Facilities	0.25 mile
SHWS: Corrective Action Sites	1.0 mile

Table 2.3.3 – EDR Proprietary Database Results Search

EDR Proprietary Databases	Search Distance
Manufactured Gas Plants	1.0 mile
Historical Auto Stations	Subject parcel and adjoining
Historical Cleaners	Subject parcel and adjoining

Table 2.3.4 – Tribal Records Database Results Search

Tribal Records	Search Distance
Indian Reservations	1.0 mile
Indian LUST: Leaking Underground Storage Tanks on Indian Land	0.5 mile
Indian UST: Underground Storage Tanks on Indian Land	Subject parcel and adjoining

The results of the database search are summarized as follows:

Subject Parcel:
No results listed – project site is a public right-of-way.

Adjoining or Facilities in Close Proximity:

The EDR Radius Report database (Table 2.3.3) revealed a total of 314 sites mapped within a one-mile radius of the project alignment. A total of 16 sites of concern were listed within the immediate vicinity of the project alignment having a confirmed or suspected release of contaminants to soil and/or groundwater and include:

1. Dob's Tie Shop at 3184 East Fremont Street
2. 1-Day Paint and Body at 3190 East Fremont Street
3. Ted Weins Firestone at 3352 East Fremont Street
4. Texaco Service Station at 2109 East Charleston Blvd
5. Service King Collision Repair at 3024 Fremont Street
6. 7-Eleven #15816 at 3414 East Sahara Avenue
7. Auto World at 3131 East Freemont Street
8. Desert Chrysler Plymouth Inc. at 3115 Fremont Street
9. Union Oil Service at 2600 East Freemont Street
10. Station Casinos, Inc. – Former Castaways Hotel at 2800 Fremont Street
11. Sunland RV at 3333 East Fremont Street
12. Silver State Glass at 2828 Fremont Street
13. GMF Motors, 3340 E. Fremont St.
14. Norm Baker Motor Company, 3020 E. Fremont St.
15. Arco #5319 (a.k.a. Prestige Stations, Inc., 2320 E. Fremont St.
16. Latino Auto Sales, 2527 E. Fremont St.

The sites listed above are highlighted on the EDR radius map located in **Appendix D** along with a detailed site description/environmental history from the EDR database.

Based on available regulatory information, topography, anticipated groundwater flow direction and distance from the subject property, the sits 13 through 16 listed above were identified as having the highest probability to have impacted or potentially impacted groundwater in the immediate vicinity of the project area:

GMF Motors, 3340 E. Fremont St.: According to EDR, GMF Motors is listed on the RGA Leaking Underground Storage Tank (LUST) and Hazardous Waste Sites (HWS) databases. According to documentation obtained from South Nevada Health District (SNHD), GMF Motors was an automotive sales and repair facility and hazardous waste generator from at least 1990 until circa 2010. A Complaint Spill Report Form, dated October 22, 1993 indicates at least twelve 55-gallon drums of sludge were being improperly dumped, spilling, and overflowing at this facility. Heavy soil staining was also noted throughout the property. No documentation of corrective actions was provided in the database review. Additionally, no regulatory information regarding the reported LUST listing was available for review. Based on all available information, the potential for petroleum and/or chlorinated solvent-impacted groundwater at this facility exists. Due to the close proximity of GMF Motors to the project area, groundwater quality impacts may be present within the project area.

Norm Baker Motor Company, 3020 E. Fremont St.: According to EDR, Norm Baker Motor Company (Norm Baker) is listed on the RGA Leaking Underground Storage Tank (LUST), Underground Storage Tank (UST), SHWS (State equivalent CERCLIS) and Hazardous Waste Sites (HWS) databases. The EDR Report indicates soil and groundwater at this facility are contaminated with Total Petroleum Hydrocarbons (TPH) and benzene, ethylbenzene, toluene and total xylenes (BTEX). According to documentation obtained from South Nevada Health District (SNHD), Norm Baker was an automotive sales and repair facility and hazardous waste generator from at least 1994 until circa 2012. No regulatory information regarding the LUST or SHWS listings at Norm Baker were available for review. Based on all available information, the potential for petroleum and/or chlorinated solvent-impacted groundwater at this facility exists. Due to the close proximity of Norm Baker to the project area, the potential for impacted groundwater to be present within the project area also exists.

Arco #5319 (a.k.a. Prestige Stations Inc.), 2320 E. Fremont St.: According to EDR, Arco # 5319 (Arco) is listed on the Nevada Leaking Underground Storage Tank (NV LUST), Underground Storage Tank (UST), and RGA Hazardous Waste Sites (HWS) databases. The

EDR Report indicates soil and groundwater at this facility are contaminated with gasoline. However, closure monitoring at this facility is listed as "completed". No regulatory information regarding the LUST or HWS listings were available for review. Based on all available information, petroleum-impacted groundwater was previously documented at this facility and has since received regulatory closure. However, due to the close proximity of Arco to the project area and since this is currently an active gasoline station, petroleum-impacted groundwater may be present within the project area.

Former Bell S/Hoops Gordon Enco Service Station (currently Latino Auto Sales), 2527 E. Fremont St.: According to EDR, Bell S Enco Service Station and Hoops Gordon Enco Service Station (Bell) are listed on the EDR Historical Auto Station database. These listings indicate a gasoline and/or automotive service station operated at this address from circa 1966 until circa 2012. During site reconnaissance, an automotive dealership (Latino Auto Sales) was observed at this location. No regulatory information regarding these listings were available for review. Based on the reported previous land use as an automotive service station for at least 50 years, groundwater quality at this facility may be impacted by petroleum and/or chlorinated solvents. Due to the close proximity of Bell to the project area, impacted groundwater may also be present within the project area.

The locations of these four facilities are depicted on **Figure 2** provided in **Appendix A**.

Non-Adjoining Facilities within Appropriate Minimum Search Distances:

As detailed in the EDR report, several facilities on various databases are located within the appropriate minimum search distances. Based on factors such as distance to the site, topography, media affected (soil, groundwater, or air), depth to groundwater, and/or anticipated groundwater flow direction, these non-adjoining facilities are unlikely to impact the site and are not considered environmental concerns at this time.

3. RECOMMENDATIONS

Based on our findings we recommend converting three of the proposed borings into groundwater monitoring wells for groundwater measurements the collection of groundwater samples, where temporary construction dewatering is anticipated. Monitor wells will be installed to depths of at least 10-feet below the anticipated temporary construction dewatering depths as

discussed in Section 3.1 below. The proposed boring locations and purpose for each monitoring well are as follows:

B-1: This boring will be installed adjacent east of the former GMF Motors facility, located at 3340 East Fremont Street (Boulder Highway). The groundwater sample collected from this boring will be utilized to assess for potential impacts to groundwater in the project area associated with the LUST listing at GMF Motors.

B-4: This boring will be installed adjacent north-east of the former Norm Baker Motor Company, located at 3020 East Fremont Street (Boulder Highway). The groundwater sample collected from this boring will be utilized to determine if groundwater impacts associated with the LUST listing at Norm Baker are present within the project area.

B-8: This boring will be installed adjacent east of the Arco #5319 gasoline station, located at 2320 East Fremont Street (Boulder Highway). The groundwater sample collected from this boring will be utilized to assess for impacts to groundwater associated with the Arco LUST listing and potential impacts associated with the former Bell Automotive Service Station.

3.1. WELL INSTALLATION AND GROUNDWATER SAMPLING

Soil borings B-1, B-4 and B-8 will be converted to 2-inch diameter Schedule 40 polyvinyl chloride (PVC) groundwater monitoring wells, installed at the bottom of the borings and constructed with approximately 11-feet of 0.020-inch slotted PVC screen or extending at least 10-feet into groundwater and one foot above the encountered groundwater elevation. The remaining portion of the wells will be constructed with blank casing. The annular space will be backfilled with No. 3 Monterey sand (or similar) as a filter pack to at least two feet above the screened section. A 2-foot hydrated bentonite chip seal will be placed above the sand and the remaining annular space will be filled with a bentonite grout slurry mixture. A concrete seal will fill the remainder of the borehole to the ground surface. The wellheads will be completed with a 12-inch diameter, Department of Transportation traffic-rated well box mounted in a concrete collar.

The monitoring wells will be surged and developed shortly following installation. Representative groundwater samples will be collected within one week following monitoring well installation and development using industry standard groundwater purging and sampling procedures (disposable bailers, purge three well volumes, etc.). The groundwater samples will be submitted to a Nevada-

certified analytical laboratory under chain-of-custody protocol and will be analyzed for TPH-gasoline range organics (GRO), diesel range organics (DRO) and oil range organics (ORO) using EPA Method 8015 (Modified), full list Volatile Organic Compounds (VOCs) by EPA Method 8260B and NDEP Profile 1. One additional composite soil sample will be analyzed for VOCs using EPA Method 8260B and Resource Conservation and Recovery Act (RCRA) 8 Metals by EPA Method 6010/7471for soil disposal purposes.

Soil cuttings, development and decontamination water and related drilling materials will be properly disposed of following site field activities and receipt of laboratory analytical reports.

4. LIMITATIONS

The recommendations contained in this report are based on research of readily available maps and literature, and our understanding of the proposed project. No borings or field work were performed as part of this study. It is possible that variations in the soil and groundwater conditions will exist at the locations. If the scope of the proposed project, including the locations, type of rehabilitation, invert depth, or other changes, our firm should be notified.

Our services were performed using that degree of care and skill ordinarily exercised under similar circumstances by reputable engineering firms in this or similar localities. No other warranties, express or implied, are included or intended in this report.

5. REFERENCES

Atkins, Attachment B: Undated

Environmental Data Resources, Inc. (EDR), *EDR Radius Map Report with GeoCheck*

Geotechnical & Environmental Services, Inc., proprietary in-house data

Southern Nevada Health District, Online Public Records Requests

Southern Nevada Water Authority, 2003, Las Vegas Valley Depth to Shallow Groundwater.

Nevada Division of Water Resources (on-line), http://water.nv.gov/ Well log database.

APPENDIX A

Figure 1
Figure 2
Figure 3

FIGURE 1


Attachment B
Legend
Proposed Mainline Storm Drain
Proposed Lateral Storm Drain
Existing 5' Contours
0
800
1,600
Feet
N
FLBN0167
FLBN0038
Fremont St
Bruce St
15th St
Olive St
Eastern Ave
Wengert Ave
Atlantic St
Charleston Blvd
Mojave Rd
Pecos Rd
Wyoming Ave
Oakey Blvd
Maryland Pkwy
Spencer St
Sahara Ave
St Louis Ave
Scarlet Oak Ave
McLeod Dr
Mojave Rd
Boulder Hwy



Legend

- B-13 — Proposed Boring Locations
- B-8 (MW-3) — Proposed Monitoring Well Locations
- Proposed Mainline Storm Drain
- Proposed Lateral Storm Drain
- GMF Motors — Identified Sites Impacting or Potentially Impacting Groundwater
- WL = XX ft — Selected Wells from NDWR Database; WL = XX ft Recorded Water Levels in Wells

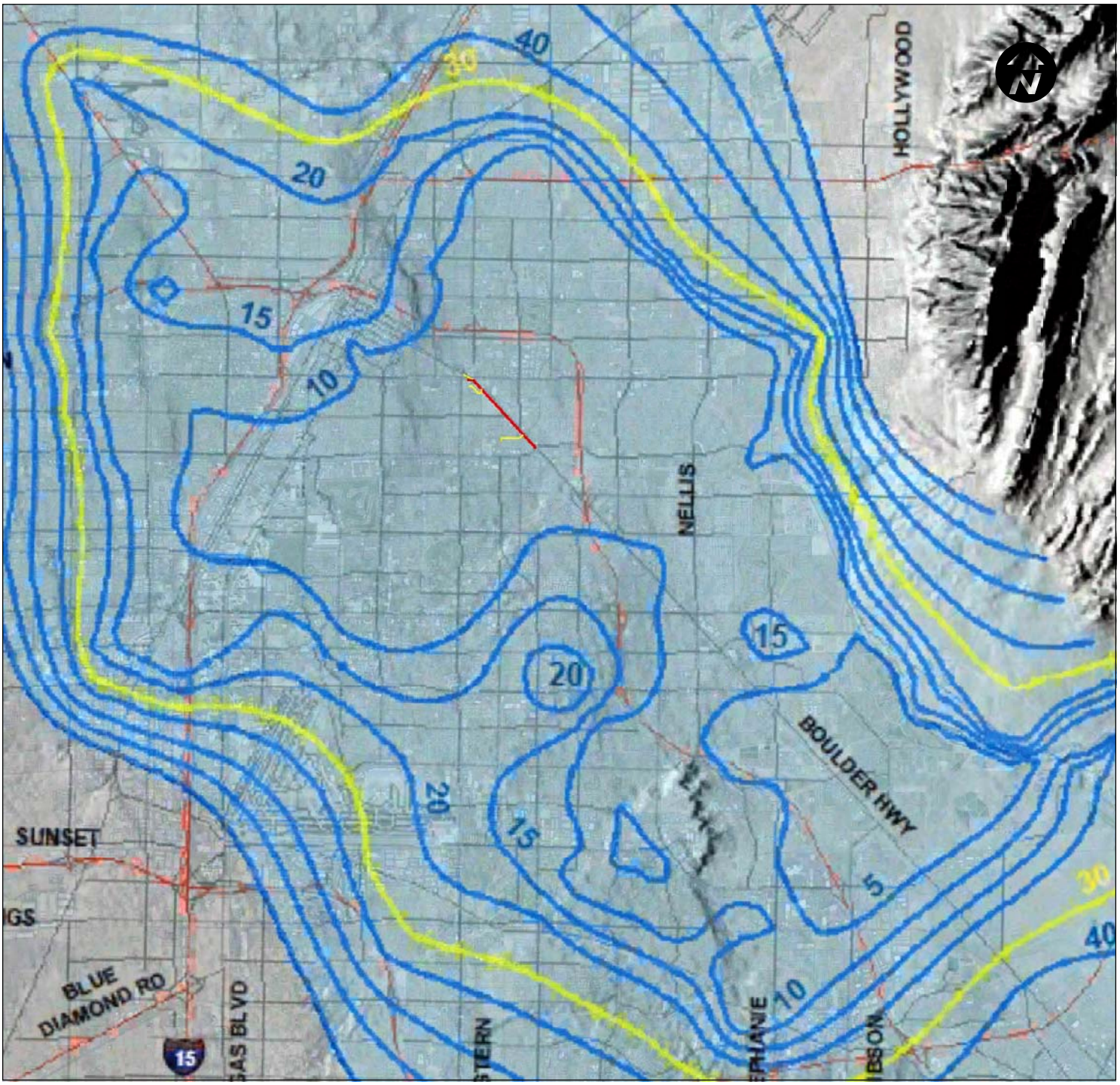
0 225 450 900 1,350 1,800 Feet

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
7150 Placid St.
Las Vegas, NV 89119
702-365-1001
www.gesnevada.com

NOTE: All locations are approximate. TD denotes total depth of exploration in feet. Data presented on this map is a compilation of GIS Metadata extracted from a variety of sources. Major Streets, Airports, and Railroads is data obtained from the Southern Nevada GIS Management Office. This data is downloaded by GES for incorporation into drawings generated by GES. Data contained within this page is to be used for informational purposes only. GES has not modified the data contained herein and uses it as it is acquired from the respective agency.

PROPOSED EXPLORATION LOCATION MAP
BOULDER HIGHWAY STORM DRAIN
LAS VEGAS, NEVADA

Drawn By:	Date Drawn:
PES	6/02/2016
Project No.	Figure No.
20153837E1	2



Legend

Proposed Mainline Storm Drain

Proposed Lateral Storm Drain

Reference: Southern Nevada Water Authority, 2003, Las Vegas Valley Depth to Shallow Groundwater

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NOTE: All locations are approximate. TD denotes total depth of exploration in feet. Data presented on this map is a compilation of GIS Metadata extracted from a variety of sources. Major Streets, Airports, and Railroads is data obtained from the Southern Nevada GIS Management Office. This data is downloaded by GES for incorporation into drawings generated by GES. Data contained within this page is to be used for informational purposes only. GES has not modified the data contained herein and uses it as it is acquired from the respective agency.

SHALLOW GROUNDWATER CONTOUR MAP
BOULDER HIGHWAY STORM DRAIN
LAS VEGAS, NEVADA

Drawn By:	Date Drawn:
PES	6/02/2016
Project No.	Figure No.
20153837E1	3

Note: A portion of this report omitted.

See Data CD for entire report content.

GEOTECHNICAL EVALUATION REPORT
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

Project No. 20153837E1
August 25, 2016

DRAFT

Prepared for:

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

Prepared by:

GES
Geotechnical & Environmental Services, Inc.
7150 Placid Street
Las Vegas, Nevada 89119

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August 25, 2016
Project No. 20153837E1

Mr. Matt Baird, P.E.
Vice President
Integrated Water Resources
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

RE: Geotechnical Evaluation Report, Boulder Highway Storm Drain, Sahara Avenue to Charleston Boulevard, Las Vegas, Nevada

Dear Mr. Baird:

Geotechnical & Environmental Services, Inc. (GES) is pleased to present the Geotechnical Evaluation Report for the proposed Boulder Highway, Sahara Avenue to Charleston Boulevard storm drain project located in central Las Vegas Valley in Nevada.

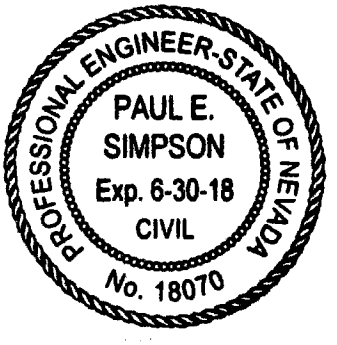
The Geotechnical Evaluation Report includes the findings of the geologic review, the results of the field exploration and laboratory testing programs, presents recommendations for design and construction for the proposed project.

We appreciate this opportunity to provide our professional services. If you have any questions or comments regarding this information, please feel free to contact our office.

Sincerely,

Geotechnical & Environmental Services, Inc.

DRAFT



David H. Tang, P.E.
Project Engineer

Paul E. Simpson, P.E
Project Engineer

DHT:PES:caw

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GEOTECHNICAL EVALUATION REPORT
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULVARD
LAS VEGAS, NEVADA

1. INTRODUCTION

This geotechnical evaluation report presents the findings of a geotechnical study performed by Geotechnical & Environmental Services, Inc. (GES) for improvements to a portion of the Boulder Highway storm drain facilities in Las Vegas, Nevada. The facilities alignment will generally be located in Fremont Street generally between Sahara Avenue and Charleston Boulevard with lateral facilities in some surface streets to the west. Figure A-1 presents a vicinity map showing the approximate location of the project alignment within the Las Vegas Valley. This report includes the findings of boring explorations, results of laboratory tests, conclusions, and recommendations for design and construction of the project. The groundwater impact evaluation for the facilities alignment was covered in Groundwater Impact Evaluation Report for Boulder Highway Storm Drain Project (GES, 2016).

1.1. PURPOSE AND SCOPE

The purposes of our geotechnical study were to evaluate the subsurface soils along the alignment and provide a design level geotechnical evaluation to develop design plans and specifications for the project. The scope of this study included a review of referenced geologic literature and maps, subsurface exploration, soil sampling, laboratory testing of selected soil samples, and engineering evaluations and preparation of this report.

1.2. PROJECT DESCRIPTION

Our understanding of the project is based upon the following: correspondence with ATKINS; a review of an aerial photograph showing the project location; and our experience with similar projects. Our recommendations are primarily based on the Regional Flood Control Manual.

The project mainline alignment consists of approximately 1-1/2 miles of new storm drain along the Boulder Highway (Fremont Street) right-of-way from Sahara Avenue, north to Charleston Boulevard and extending along Charleston Boulevard to Eastern Avenue. In addition, lateral storm drain alignments will extend from the mainline in Fremont Street to the west on St. Louis Avenue and Oakey Boulevard. We understand that the new mainline alignment facilities will consist of various reinforced box culvert (RCB) with dimensions of 14-foot by 8-foot in the

northern end, 18-foot by 8-foot, and 20-foot by 8-foot between Charleston Boulevard and St. Louis Avenue, and 15-foot by 10-foot RCB with the southern connection to be tied into an existing 15-foot by 10-foot RCB with inverts of up to 23-feet below grade.

The project lateral storm drains extend west from the Fremont Street ROW consisting of two alignments with one in St. Louis Avenue to the south and the other at Oakey Boulevard to the north. The lateral storm drains in St. Louis Avenue and McLeod Drive consist of approximately 2,100 feet reinforced concrete pipes (RCPs) with diameters ranging from 36 to 66 inches. The lateral storm drain in Oakey Boulevard consists of approximately 450 feet of RCP with diameters ranging from 24 to 66 inches. The lateral storm drains will have inverts of up to approximately 20 and 25 feet below the top of the pavement in Oakey Boulevard and St. Louis Avenue, respectively. We anticipate that the RCBs and RCPs will be constructed using cut-and-cover techniques, and that the construction will include repaving the ROW where existing pavements are removed. Borings were drilled for lateral segment at Olive Street and Russell Avenue. However, we understand that this segment has been removed from the project.

1.3. ALIGNMENT DESCRIPTION

The portion of Fremont Street through which the subject alignment will extend is classified as a minor arterial by Nevada Department of Transportation (NDOT). The Fremont Street ROW is generally fully improved from curbline to curbline along the proposed alignment with paved and unpaved medians. The proposed lateral alignments west of Fremont Street are fully improved and bordered by a mixture of commercial and residential developments.

The drainage of the existing roadway alignment is generally directed toward the southeast. Underground utilities including gas, electric, water, sewer, communications, and storm drain were observed within or crossing the ROW.

1.4. FIELD EXPLORATION

GES evaluated the subsurface conditions along the proposed alignment by drilling 13 borings. The five borings (B-9 through B-13) located to the west of the Fremont Street for the portions of the lateral storm drain alignments were drilled on July 5 and 6, 2016 to depths of approximately 20 to 25 feet. The seven borings (B-1 through B-7) located in the mainline portions of the alignment at Fremont Street were performed upon the receipt of the permit from the NDOT and were drilled during the period between July 25 and 27, 2016. Among them, five borings (B-2, B-3 and B-5

through B-7) were drilled at the site to depths of approximately 25 to 30 feet. Borings B-1 and B-4 were drilled to a depth of approximately 45 and 40 feet, respectively. Boring B-8 was drilled at the night of August 11, 2016 to a depth of approximately 45 feet. The total footage drilled was approximately 400 lineal feet. Borings B-1, B-4 and B-8 were converted to temporary wells for groundwater sampling.

Where borings were located in paved ROW, the asphalt concrete pavements were cored with an 8-inch nominal diameter core barrel at each boring location prior to advancing the borings. Each boring was also potholed with an air-knife to depths of approximately 5 to 6 feet in order to evaluate potential conflicts with near-surface utility lines. Figure A-2 presents a site plan showing the approximate exploration locations. The exploration locations were recorded by GES staff using a hand held GPS unit at the time the exploration was performed. The ground surface elevations at the boring locations were estimated from topographical information provided by ATKINS (ATKINS, 2016) and are provided on the boring logs.

GES representatives directed and supervised the subsurface explorations, maintaining logs of the subsurface conditions, classifying the soils encountered, and obtaining soil samples. The soils encountered were classified in general accordance with the Unified Soil Classification System (USCS). A Key to Symbols and Terms utilized on the boring logs is presented on Figure A-3. The boring logs are presented on Figures A-4 through A-16.

The borings along the alignment were drilled with Diedrich D-120 truck-mounted drill rig using 6-inch nominal outside diameter hollow stem augers. Driven soil samples and penetration blow counts were obtained with a 3-inch outside diameter ring-lined drive sampler (modified split-spoon sampler) in general accordance with ASTM D 3550. Pocket penetrometer tests were performed in the field on selected fine-grained, clayey specimens as an indication of soil strength. The results of the pocket penetrometer tests are shown on the boring logs at their respective sampling depths. The samplers were driven with a 140-pound automatic trip hammer falling approximately 30 inches. The penetration resistance measured by driving the sampler was used to evaluate the consistency of the in-place soil.

Auger cuttings from the drilling were removed from the alignment for disposal at the end of each work day. The borings in unpaved areas were backfilled with IQAC listed Controlled Low Strength

Material (CLSM). The borings in paved areas were surface completed by replacing the asphalt core with epoxy.

1.5. LIMITED GROUNDWATER SCREENING

As described, borings B-1, B-4 and B-8 were converted to temporary monitoring wells for groundwater sampling. GES obtained groundwater samples from the three temporary monitoring well locations for the purposes of gross characterization of the site groundwater. The samples were obtained to provide a general idea of how the water quality might be characterized for the alignment. The results of the analytical tests will be presented under separate cover.

The temporary monitoring wells were constructed with 2-inch nominal diameter polyvinyl chloride (PVC) pipe; the portion below approximately 15 feet below the ground surface was screened with 0.02 inch slots. The annular space around the pipe was filled with sand to act as filter pack for the temporary monitoring wells. Bentonite was placed on top of the sand pack to reduce the potential for contamination from the ground surface.

1.6. LIMITED HYDRO-GEOLOGICAL STUDY

The project alignment traverses, in a northwest to southeast direction, a portion of the central Las Vegas Valley. The near surface waters within the Las Vegas Valley basin drain through the Las Vegas Wash to Lake Mead and the Colorado River. Groundwater depth varies greatly across the valley, from near the surface in the lower elevations of the valley to hundreds of feet on the upper portions of alluvial fans along the mountain fronts and on pediment surfaces.

Groundwater occurs in four principal aquifers in the Las Vegas Valley (Maxey et al., 1948). Unconfined near surface aquifers extend from near the ground surface to approximately 200 to 300 feet below the surface. Locally, near surface caliche beds may create confined conditions (Kaufmann, 1978). A second shallow aquifer lies below the near surface aquifer and extends to 450 feet below the surface where a clay aquitard separates the shallow aquifer from the middle-confined aquifer (Maxey et al., 1948) which is the primary source of groundwater for the Las Vegas Valley for domestic use. A deep aquifer occurs below 700 feet deep (Maxey et al., 1948). Widespread ground subsidence within the valley is generally attributed to excessive groundwater withdrawal and subsequent compaction of the primary aquifer associated with historic municipal water use (Bell and Price, 1992).

Groundwater was encountered in each of the borings advanced along the alignment. The groundwater levels measured within the borings ranged from approximately 9.0 feet below ground surface (bgs) to 23.7 feet bgs. Table 2.4 presents a summary of the measured groundwater levels.

The groundwater encountered in the borings was in the near surface aquifer, which is fed by both artesian leakage from the confined aquifer below, infiltration of surface runoff, as well as human activities such as over-irrigation. The near surface aquifer generally consists of non-potable water that is high in total dissolved solids due to evapotranspiration and leaching action by irrigation water.

The State of Nevada Division of Water Resources (NDWR) well data listing was reviewed for the location of wells within 500 feet of the subject alignment. The project area is located in Section 1, Township 21 South, Range 61 East. Shallow monitoring wells listed in this Section reported static water levels ranging from 7 feet below ground surface (bgs) to 15 feet bgs. The NDRW Well Log Database Report obtained for the project area is provided in Appendix C of the Groundwater Impact Evaluation Report for Boulder Highway Storm Drain Project (GES, 2016).

Groundwater flow direction in the project vicinity is assumed to be east-southeast towards the Las Vegas Wash, however, micro-gradients in any direction may be present in localized areas (SNWA, 1996).

1.7. SOIL LABORATORY TESTING

The laboratory testing program consisted of tests to classify the alignment soils and to evaluate engineering and physical properties. The tests performed and a summary of the results for the mainline and lateral drains are tabulated below:

Table 1.7.-1 – Laboratory Test Summary – Mainline at Fremont Street

Type of Test		Range of Results	Notes
In-Place Dry Density		70.5 to 131.2 pcf	--
In-Place Moisture Content		4.9 to 53.8 percent	--
Gradation	Percent Gravel	0 to 47	--
	Percent Sand	26 to 73	--
	Percent Fines	6 to 99	--
Liquid Limit		No value to 103	--
Plasticity Index		Non-plastic to 73	--
Swell Potential		0 to 6 percent	Low to moderate swell potential

Type of Test		Range of Results	Notes
Direct Shear	Cohesion	0.0 ksf	--
	Friction Angle	34.0 to 42.0 degrees	--
Chemical Testing	Sodium	ND* to 0.01 percent	--
	Sulfate	0.03 to 0.48 percent	Negligibly to severely deleterious to concrete
	Sodium Sulfate	0.004 to 0.12 percent	Low chemical heave (salt heave) potential
	pH	7.75 to 8.86	--
	Redox	130 to 381 mV	--
	Sulfide	ND* mg/L	Low corrosion potential
	Total Salts (Solubility)	0.1 to 1.45 percent	Low soluble
	Soluble Soil Chlorides	38 to 340 mg/kg	Potentially corrosive to metal

*Not detected

Table 1.7.-2 – Laboratory Test Summary- Lateral Drains west of Fremont Street

Type of Test		Range of Results	Notes
In-Place Dry Density		73.1 to 115.9 pcf	--
In-Place Moisture Content		8.4 to 40.0 percent	--
Gradation	Percent Gravel	0	--
	Percent Sand	32 to 82	--
	Percent Fines	18 to 68	--
Liquid Limit		No value to 47	--
Plasticity Index		Non-plastic to 28	--
Swell Potential		0 to 1 percent	Low swell potential
Direct Shear	Cohesion	N/A	--
	Friction Angle	N/A	--
Chemical Testing	Sodium	ND* to 0.02 percent	--
	Sulfate	0.01 to 0.07 percent	Negligibly deleterious to concrete
	Sodium Sulfate	ND* to 0.06 percent	Low chemical heave (salt heave) potential
	pH	6.99 to 8.54	--
	Redox	163 to 264 mV	--
	Sulfide	ND* mg/L	Low corrosion potential
	Total Salts (Solubility)	0.03 to 0.86 percent	Low soluble
	Soluble Soil Chlorides	86.2 to 227 mg/kg	Potentially corrosive to metal

*Not detected

The test results are presented in Appendix A on the boring logs and on test reports presented in Appendix B. Detailed descriptions of the laboratory tests performed are also presented in Appendix B.

2. DISCUSSION

The following sections describe the geology and seismicity at the site, the encountered subsurface materials and conditions, and trench backfill suitability evaluation.

2.1. GEOLOGY AND SEISMICITY

The project alignment is located in the central portion of the Las Vegas Valley, a fault-bounded graben structure surrounded by mountain ranges. The Las Vegas Valley is physiographically characteristic of the Basin and Range Province with generally northwest-trending parallel mountain ranges and an intervening basin. Unlike many basins within the Basin and Range Province which are internally draining, the Las Vegas Valley is unique in that the basin drains through the Las Vegas Wash to Lake Mead and the Colorado River.

Tertiary and Quaternary unconsolidated alluvial deposits, derived from the surrounding mountain ranges, fill the valley. These deposits may be up to 4,000 feet thick near the center of the valley. The surrounding mountain ranges are comprised of sedimentary and igneous rocks. Alluvial fan deposits, consisting of sand and gravel, slope down from the mountain fronts towards the valley floor. Sediments are typically less coarse, grading from fine sand and silt to clay near the valley bottom. Beds of amorphous and crystalline gypsum are common. Zones of calcareous cemented deposits (caliche) are present at various locations and depths throughout the valley.

The U.S. National Oceanic and Atmospheric Administration Earthquake Catalog lists about 800 events of magnitude greater than or equal to 4 with epicenters within about 120 miles of Las Vegas. Only 19 events greater than or equal to magnitude 4 are estimated to have occurred during the 1881 through 1938 period in the southern Nevada region.

After about 1947, nuclear testing began at the Nevada Test Site. Therefore, many of the recorded earthquakes after about 1947 may be due to nuclear blasts occurring more than about 60 miles from the subject site. Several hundred earthquakes occurred from 1936 to 1965 near Hoover Dam, presumably due to filling of the Lake Mead reservoir, with 24 of these events reportedly greater than or equal to magnitude 4.

Based on a review of referenced geologic maps and literature, the nearest Quaternary-age (last 1.6 million years) fault is located approximately five mile northeast of the alignment (dePolo and Bell, 2000). Other mapped Quaternary-age tectonic faults are the Eglington fault, which

geologists have debated may also be potentially active, and Frenchman Mountain fault located approximately nine miles northwest and five miles northeast of the alignment, respectively. The nearest mapped Holocene active fault (i.e., a fault that has moved within the last 10,000 years) is the Black Hills fault, located approximately 16 miles southeast of the project alignment. Based on the results of our review of available literature, mapped faults do not cross the proposed alignment.

Based on review of the Clark County Expansive Soil Guidelines Map, the project alignment is generally located in a Special Geotechnical Consideration Area having none to low swell potential (less than 4 percent).

Earth fissure zones have developed across the Las Vegas Valley, and are generally attributed to subsidence related to overdrafting of local groundwater aquifers. Many of these earth fissure zones are in close proximity to mapped faults of the Las Vegas Valley fault system. The nearest mapped fissure zone is located about three miles northwest of the project alignment near F Street and Washington Avenue (dePolo and Bell, 2000). No indications of earth fissures were observed along the project alignment at the boring locations during the field evaluation; however, portions of the areas along the alignment have been disturbed by recent construction, including asphalt paving for roadway construction and earthwork for commercial and residential developments.

2.2. EXISTING ASPHALT CONCRETE PAVEMENT

Existing asphalt concrete pavements were penetrated at fivex boring (B-6, B-7, and B-11 through B-13) locations within the alignment. In addition, asphalt and aggregate base conditions were evaluated by hand excavating near borings B-1 to B-5. The thickness for asphalt and aggregate base for these excavations were measured. Based on our field observations, approximately the upper 2-inch of asphalt in Fremont Street consists of newer overlay materials. Aggregate base materials consisted generally of dry, medium dense to dense, brown silty sand with gravel. The approximate thicknesses of the asphalt and aggregate base layers measured in the field and are summarized in Table 2.2.

Table 2.2. – Approximate Asphalt Concrete Pavement Thicknesses

Boring No.	Approximate Asphalt Thickness (inches)	Approximate Aggregate Base Thickness (inches)
B-1	12-½	12
B-2	10	16
B-3	10	10
B-4	10	14
B-5	9-½	13
B-6	12	12
B-7	18	11
B-11	7	17
B-12	9	15
B-13	4-½	7-½

2.3. SUBSURFACE MATERIALS AND CONDITIONS

The following sections describe fill materials and native soils encountered in exploratory borings performed for this study. Detailed information regarding subsurface materials and conditions are presented on the boring logs in Appendix A.

2.3.1. FILL

Fill material was encountered in each of the borings drilled along the alignment with thickness ranging from approximately 1/2 to 8 feet. The fill soils consisted primarily of dry, greyish brown, poorly graded to well-graded gravel with medium dense to dense silt and sand. Fill consisting of asphalt concrete pavement and aggregate base was encountered in six borings (B-6, B-7, B-9, and B-11 through B-13) as previously described. Fill should be anticipated to be encountered at locations beyond and between our borings performed as part of this report. Fill placed without documentation to indicate that the fill soils were placed under the supervision of a Geotechnical Engineer are considered uncontrolled. The term uncontrolled fill soils refers to artificial fill which was placed without engineering observation, testing, or documentation and is considered unsuitable for the support of project improvements. Our scope did not include an evaluation of existing fill soils or certification of existing fill or improvements.

2.3.2. NATIVE SOILS

The native soils encountered in the borings at the Fremont Street ROW generally consisted of medium dense coarse grained soils and firm to very stiff fine grained soils. The native soils encountered in the borings west to the Fremont Street generally consisted of medium dense to very dense coarse grained soils and firm to very stiff fine grained soils.

Weakly to moderately cemented soils were encountered in borings B-1 at depths of approximately 6 and 30 feet below the surface, boring B-6 at depths of approximately 10 and 20 feet, boring B-8 at depths of approximately 25 and 40 feet, and boring B-11 at a depth of approximately 5 feet. Weakly and moderately cemented soil refers to cemented soil that can be crumbled or broken with little or considerable finger pressure, respectively. Strongly cemented hard soil (Caliche) was encountered in boring B-6 at depths between approximately 12 and 14-1/2 feet below ground surface. Strongly cemented soil refers to rock-like soil that will not crumble or break at any finger pressure. In general, dense to very dense weakly to moderately cemented soils can be excavated with a backhoe and medium hard cemented soils can be excavated with a ripper tooth or by a backhoe with extreme difficulty. However, to excavate medium hard to hard, hard, and very hard cemented rock-like materials, a heavy duty excavator or trencher, Caterpillar D-10 Dozer (or equivalent) or larger, ripper, hoe-ram, rock-saw or similar rock excavation techniques will likely be needed. Where thick layers of very hard cemented materials are to be excavated, blasting is sometimes needed for removal.

Due to the inconsistent nature of caliche, medium hard to very hard and difficult to excavate cemented soils may likely be encountered beyond or between our boring locations at varying depths. A detailed excavatability or rippability evaluation was beyond the scope of this study. Further studies, including additional borings or test pits, and refraction surveys, could be performed to evaluate the rippability and excavatability of the on-site cemented soils. The earthwork and underground contractors should perform the independent investigations necessary to determine the type of equipment required to perform the work.

2.4. GROUNDWATER

Groundwater was encountered in each of the boring drilled at depth ranging from about 9.0 to 23.7 feet below the ground surface. The depth at which groundwater was encountered during drilling and the measured depth in the boreholes after drilling are shown on the boring logs. Groundwater levels should be anticipated to fluctuate due to seasonal precipitation, groundwater withdrawal and recharge, irrigation practices, and dewatering efforts within and/or near the subject site. Note that borings B-1, B-4 and B-8 were converted to temporary groundwater monitoring wells. The groundwater depths and elevations measured in the borings are presented in the following table.

Table 2.4. – Groundwater Depths

Boring No.	Approximate Ground Surface Elevation (feet)	Measured Initial Depth to Groundwater During Drilling (feet)	Measured Final Depth to Groundwater After Drilling[a] (feet)	Approximate Elevation of Final Groundwater Measurement (feet)
B-1	1,821	25.0	18.9[b]	1,802.1
B-2	1,835	20.5	17.0	1,818.0
B-3	1,837	16.0	20.0	1,817.0
B-4	1,845	15.0	9.8[c]	1,835.2
B-5	1,828	15.0	13.0	1,815.0
B-6	1,860	20.0	9.0	1,851.0
B-7	1,859	25.0	23.7	1,835.3
B-8	1,868	16.0	11.8[d]	1,856.2
B-9	1,864	21.5	20.2	1,843.8
B-10	1,864	20.0	17.7	1,846.3
B-11	1,848	15.0	14.7	1,833.3
B-12	1,840	21.0	15.5	1,824.5
B-13	1,850	20.0	15.0	1,835.0

[a]Final groundwater depth measured on the same day after drilling unless noted otherwise
[b] Groundwater depth measured 21 days after drilling
[c] Groundwater depth measured 20 days after drilling
[d] Groundwater depth measured 5 days after drilling

Based on the final groundwater elevations measured during the field explorations, temporary dewatering will likely be necessary during construction of the project and should be anticipated. When dewatering is required, the groundwater might have to be treated to remove a portion or all constituents detected, and additional groundwater sampling might be required for the discharge permit and ongoing testing might need to be incorporated into the dewatering process. During the design of dewatering systems, the Nevada Division of Environmental Protection (NDEP) should be consulted to ensure that the discharge of groundwater is performed according to their most current standards. A dewatering plan including settlement monitoring should be designed by qualified persons and should be approved by the governing entity prior to implementation.

Temporary construction dewatering may cause dewatering-induced settlement along the alignment. The dewatering-induced settlement along the alignment is anticipated to be less than 1-inch. A pre-construction video survey of the existing improvements adjacent to areas to be dewatered should be performed prior to the commencement of dewatering operations. Settlement monitoring points should also be established and surveyed in open trench areas prior to commencement of and during dewatering operations.

The settlement monitoring locations and spacing should be determined with input from representatives of the Owner, design team and construction manager. The settlement monitoring points should be surveyed before, during, and at least 30 days after the completion of the dewatering operations to determined settlement of the existing improvements. Dewatering operations should be immediately suspended where threshold settlements are exceeded either within the right-of-way or to structures outside of the right-of-way, and supplemental evaluations should be performed before construction dewatering is given approval to commence.

2.5. TRENCH BACKFILL SUITABILITY

GES evaluated the suitability of non-cemented soil samples collected from the borings for use as Selected Backfill and Granular Backfill, as specified in Section 207.02.01 and Section 207.02.02, respectively, of the Clark County Uniform Standard Specifications for Public Works Construction (USS). Specifications for gradation and plasticity, results of laboratory tests, and an evaluation of suitability are provided in the following tables.

Table 2.5.-1 – Trench Backfill Suitability

			Percent Passing by Weight										Plasticity Index*	Liquid Limit**	Meets Select Backfill Requirement?	Meets Granular Backfill Requirement?
			Sieve Size													
			6-inch		3-inch		No. 4		No. 16		No. 200					
Boring	Depth (ft)	USCS	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max				
Select Backfill			**100**	**100**	**80**	**100**	**35**	**100**	**--**	**--**	**--**	**--**	**Table 2.5-2**	**50 max**	**--**	**--**
Granular Backfill			**--**	**--**	**100**	**100**	**35**	**100**	**25**	**100**	**5**	**15**	**Table 2.5-3**	**--**	**--**	**--**
B-1	10.0-15.0	CL	100		100		100		93		64		15	29	No	No
B-2	10.0-15.0	GW-GC	100		100		53		32		6.3		8	25	Yes	No
B-3	10.0-15.0	CL	100		100		95		90		62		15	29	No	No
B-4	6.0-7.5	SM	100		100		100		98		43		NP	NV	Yes	No
B-5	10.0-11.5	ML	100		100		100		73		27		1	17	Yes	No
B-6	7.0-12.0	CH	100		100		100		97		74		73	103	No	No
B-7	7.0-12.0	CL	100		100		100		98		74		17	35	No	No
B-8	20.0-21.5	CL	100		100		100		100		99		17	38	No	No
B-9	5.0-6.5	CL	100		100		100		94		68		28	47	No	No
B-10	10.0-11.5	CL	100		100		100		100		56		11	27	No	No
B-11	15.0-16.5	CL	100		100		100		88		54		16	33	No	No
B-12	5.0-6.5	SM	100		100		100		97		18		NP	NV	No	No
B-13	10.0-11.5	SM	100		100		100		97		47		NP	NV	No	No

* NP Indicates Non-plastic, **NV indicates No Value

Table 2.5.-2 – Maximum PI for Selected and Granular Backfill

Selected Backfill	
Percent by Weight Passing No. 200 Sieve	**Maximum Plasticity Index**
10-10.0	15
10.1-20.0	12
20.1-50.0	10
50.1-80.0	8
81.1-100.0	6

Granular Backfill	
Percent by Weight Passing No. 200 Sieve	**Maximum Plasticity Index**
0.1 to 3.0	15
3.1 to 4.0	12
4.1 to 5.0	9
5.1 to 8.0	6
8.1 to 11.0	4
11.1 to 15.0	3

3. CONCLUSIONS

Based on the results of our field exploration and laboratory testing programs, it is our opinion that there are no known geologic or geotechnical conditions that would prevent construction of the proposed improvements. It is also our opinion that there are some geotechnical considerations that may affect design and construction of the project elements. The most significant geotechnical considerations are cemented soils, existing fills and improvements, and groundwater described below:

- Weakly to moderately cemented soils were encountered in borings B-1 at depths of approximately 6 and 30 feet below the surface, boring B-6 at depths of approximately 10 and 20 feet, boring B-8 at depths of approximately 25 and 40 feet, and boring B-11 at a depth of approximately 5 feet. Additional cemented soil layers may likely be encountered at different depths and locations between our borings. In general, very dense or weakly to moderately cemented soils can be excavated with a backhoe and medium hard cemented soils can be excavated with a ripper tooth or by a backhoe with extreme difficulty.
- Strongly cemented hard soil (Caliche) was encountered in boring B-6 at depths between approximately 12 and 14-1/2 feet below ground surface. To excavate hard to very hard cemented rock-like materials, a heavy duty excavator or trencher, Caterpillar D-10 Dozer (or equivalent) or larger, ripper, hoe-ram, headache ball, rock-saw, blasting, or similar rock excavation techniques will likely be needed. Where thick layers of hard to very hard cemented rock-like materials are to be excavated, blasting is sometimes needed for the removal.
- Vibrations and ground disturbances caused by the excavation of cemented rock-like soils (caliche) could cause damage and distress to nearby structures. Care should be taken by the contractor when excavating cemented rock-like soils (caliche) to prevent damage to existing structures by reducing ground vibrations transmitted to the existing structures.
- The contractor should perform a pre-construction survey of existing structures, including residences near the alignment to document existing distress and to establish a baseline survey prior to excavating. Ground vibration monitoring at nearby structures should also be considered during construction activities to measure velocity and frequency in comparison to established threshold values.
- The excavation of cemented soils (caliche) may produce oversize materials greater than 3-inches in nominal dimension. Oversize materials greater than 3-inches in nominal dimension will not be suitable for placement as trench backfill.

- Groundwater was measured in each of the borings, at depths between approximately 9.0 feet and 23.7 feet below the existing ground surface. Groundwater and/or pumping subgrade conditions should be anticipated near these depths and measures to lower the groundwater level and/or to mitigate pumping subgrade should be anticipated where excavations are planned in these areas. Groundwater levels should be anticipated to fluctuate due to seasonal precipitation, groundwater withdrawal and recharge, irrigation practices, and potential future dewatering efforts within and/or near the subject site.
- Where temporary construction dewatering is required, a dewatering plan including settlement monitoring should be designed by qualified person and should be approved by the governing entity prior to implementation.
- Based on our understanding of the project and the results of our laboratory tests performed on soil samples, it is our opinion that soil materials at the site classify as Category 4b soils based on Table 1705.6 of the Southern Nevada Amendments to the 2012 International Building Code.
- The alignment through which the RCB storm drain will be constructed is currently improved with asphalt concrete pavement and concrete curbs and gutters. To facilitate the construction of the proposed improvements many of the existing improvements will be demolished; the demolished improvements will not be suitable for incorporation into backfill.
- Based on the results of laboratory testing, the tested soils collected from the borings generally did not meet the USS requirements for Selected Backfill and granular backfill. Soils proposed for trench backfill should be sampled and evaluated by the Geotechnical Engineer, and approved by the governing agency before placing.
- The tested soils have low expansion potential as described in Section 1803.5.3.2 and Table 1808.6.1.1 of the SNA to the 2012 IBC.
- Due to the consistency and moisture content of the soils encountered, it is our opinion that the potential for liquefaction along the project alignment is low.
- Based on the laboratory test results, the tested on-site soils have a low solubility. Table 1804.3.1 of the SNA to the 2012 IBC defines soils as with less than 2.00 percent by dry weight soluble solids as determined by American Water Works Association (AWWA) standard test method 2540 C as having a low solubility.
- The tested soils along the alignment have a negligible to severe concrete sulfate exposure as defined in Tables 4.2.1 and 4.3.1 of American Concrete Institute (ACI) Publication 318-11 per Section 1904.1 and 1904.2 of the 2012 IBC. It is our opinion that concrete in contact with soils along the alignment should be designed for a severe sulfate exposure.
- Based on the Site Class Map of Clark County, the project is located within the Site Class C area. A Seismic Site Class C as defined in Section 1613.3.2 of the 2012 IBC (ICC 2012) is recommended for the project site.

4. RECOMMENDATIONS

The following sections present recommendations concerning the proposed improvements. These recommendations are based upon our understanding of the project, the engineering properties of the tested on-site soils, the geologic conditions that are presented in this report, and the assumption that an adequate number of tests and observations will be made during construction

to evaluate compliance with these recommendations. Earthwork and site preparation along the proposed alignment should be performed in accordance with the requirements and specifications presented in this report and the USS.

4.1. EXCAVATION CONSIDERATIONS

Weakly to moderately cemented soils were encountered in borings B-1, B-6 and B-8 at various depths below ground surface. Strongly cemented hard soil (Caliche) was encountered in boring B-6 at depths between approximately 12 and 14-1/2 feet below ground surface. Additional cemented soil layers may likely be encountered at different depths and locations between our borings.

In general, to excavate medium hard, hard, and very hard cemented rock-like materials, a heavy duty excavator or trencher, Caterpillar D-10 Dozer (or equivalent) or larger, ripper, hoe-ram, headache ball, rock-saw, blasting, or similar rock excavation techniques are typically needed dependent on hardness, thickness, weathering, and fracturing. Where thick layers of hard to very hard cemented rock-like materials are to be excavated, such techniques may be required for removal. If cemented soils are encountered, blasting is not recommended due to the proximity of structures to the alignment. The contactor should perform the necessary subsurface investigations to evaluate the types of excavation techniques required. Excavation techniques should consider the proximity of existing structures and other improvements to the site and methods to reduce the potential for vibrational damage. Dependent upon the excavation techniques and magnitude of vibrations, a pre-excavation survey may be warranted.

Vibrations and ground disturbances caused by the excavation of cemented rock-like soils (caliche) could cause damage and distress to nearby structures. Care should be taken by the contractor when excavating cemented rock-like soils (caliche) to prevent damage to existing structures by reducing ground vibrations transmitted to the existing structures. The contractor should perform a pre-construction survey of existing structures, including residences near the alignment to document existing distress and to establish a baseline survey prior to excavating. Ground vibration monitoring at nearby structures should also be considered during construction activities to measure velocity and frequency in comparison to established threshold values.

The alignment is located in areas with existing roadway improvements, including asphalt concrete pavement and concrete sidewalks, curbs, and gutters. During construction of the proposed

improvements, existing asphalt concrete pavement and concrete sidewalks, curbs and gutters will be removed. Excavated asphalt concrete pavement, and concrete should be removed from the site and are not suitable for reuse as structural fill, roadway embankment, or trench backfill.

On-site safety is the responsibility of the contractor. Excavations for the RCB and RCPs are anticipated to be up to approximately 20 feet deep. Temporary excavations should be performed in accordance with Appendix B to Subpart P of Occupational Safety and Health Standards for the Construction Industry (OSHA) 29 CFR, State of Nevada, Division of Occupational Safety and Health, Part 1926. The soil type definitions in Appendix A to Subpart P of OSHA 29 CFR, Part 1926 should be applied to soils encountered in excavations to determine the maximum allowable slope ratio. Excavations deeper than 4 feet in non-cemented soils should be shored or laid back at a slope no steeper than 1 horizontal to 1 vertical measured from the bottom of the excavation. Alternatively, the excavations could be rigidly braced. Temporary earth retaining systems will be subject to lateral earth pressure loads. An experienced structural engineer should be consulted by the contractor for design and implementation of the bracing system. Worker protection, such as trench boxes, may be needed to protect against minor sloughing and/or falling materials.

Spoils from the excavations, heavy construction equipment, and other surcharge loading should not be placed adjacent to the excavations within a 1 horizontal to 1 vertical plane extending up and back from the bottom of the excavation to the ground surface. Surface drainage should be directed away from the excavations.

4.2. STRUCTURAL FILL

Based on the results of our field exploration and laboratory testing programs and our stated understanding of the proposed project, it is our opinion that the following earthwork recommendations are applicable for soils underlying structures for the project, including the overexcavation of soils for RCBs and RCPs, and other underground improvements.

Any existing uncontrolled fill, deleterious material, loose or disturbed native soils, landscaping and asphalt pavements should be excavated from within the improvement areas to expose stiff to very stiff or dense to very dense native soils and either be removed from the site or processed for use as structural fill as outlined in this report.

After the recommended excavations are performed, the native soils should be scarified to a depth of at least 6 inches, moisture conditioned to between 2 and 4 percent above the optimum moisture content, and compacted to at least 90 percent of the maximum dry density, as determined by AASHTO T 180. The scarification may be terminated on moderately or strongly cemented soil (caliche) at the discretion of the Geotechnical Engineer.

If both cemented soils, including caliche, and uncemented materials are present at the bottom of improvements, the cemented material should be removed to a depth of at least 12 inches below bottom of footing and replaced with compacted structural fill. Cemented soils or cobbles protruding more than 4-inches from the bottom of the excavation should be removed and the resulting void filled with compacted structural fill as described in this report, prior to placement of bedding. As an alternative, the uncemented material may be removed to expose underlying cemented material throughout the improvement areas, if any, and replaced with lean mix concrete.

Excavated on-site soils and imported soils may be used as structural fill after processing in areas underlying improvements, provided that the soils satisfy the following recommendations. Materials should be evaluated during construction by the Geotechnical Engineer prior to their placement as structural fill.

- Structural fill should meet the gradation specifications for “Selected Backfill” or “Granular Backfill” described in the USS.
- Structural fill should be processed to remove materials larger than 3 inches in nominal dimension and all organic and other deleterious materials.
- Structural fill should have a liquid limit of less than 50 and plasticity index of less than 25.
- Structural fill should have a remolded swell potential of less than 8 percent as determined per the procedure outlined in Section 1803.5.3.2 of the Southern Nevada Amendments to the 2012 International Building Code.
- Structural fill should contain less than 1.00 percent by dry weight soluble solids as determined by American Water Works Associated (AWWA) standard test method 2540 C.
- Structural fill should contain less than 2.0 percent by dry weight soluble sulfate as determined by AWWA standard test method 4500 E.

Structural fill should be placed in loose lifts up to 8 inches thick, uniformly moisture conditioned to between 2 and 4 percent above the optimum moisture content and compacted to at least 90 percent of the maximum dry density as determined by AASHTO T180.

In-place density and moisture tests should be performed in accordance with AASHTO T310. The test frequency should be at least one test per 150 linear feet of fill material placed per lift.

4.3. BEDDING

Based on the findings of our subsurface exploration, it is recommended that RCBs, pipes, manholes and drain inlets be supported on a minimum of 4 inches of bedding placed as wide as the trench. Bedding should consist of Type II Aggregate Base or Type III Aggregate Base as described in the USS. As an alternative, Class II controlled low strength material (CLSM) meeting the specifications presented in Section 704.03.07 of the USS may be used for pipe bedding. Pipe bedding materials will need to be imported.

4.4. INITIAL BACKFILL

Initial backfill consists of the fill above the pipe bedding on either side of pipes and above bedding of RCBs extending to at least 1 foot above the top of the pipes and RCBs. Initial backfill for pipes, excluding RCBs, should consist of Type II Aggregate Base or Type III Aggregate Base as described in the USS or alternatively, Class II controlled low strength material (CLSM) meeting the specifications presented in Section 704.03.07 of the USS may be used for pipe bedding and pipe zone. Pipe zone backfill materials will need to be imported.

Initial backfill at the sides of RCBs should be materials meeting the specifications for “Selected Backfill” as described in the USS. Initial backfill placed along the sides of the RCBs should be placed equally in uniform layers such that the top of the backfill at either side does not differ by more than 6-inches in elevation at any given time.

Initial backfill and backfill at the sides of the RCBs should be placed in loose lifts up to 8 inches thick, moisture conditioned to between 2 and 4 percent above optimum, and compacted to at least 90 percent of the maximum laboratory dry density. As an alternative, Class II controlled low strength material (CLSM) meeting the specifications presented in Section 704.03.07 of the USS may be used for pipe bedding and pipe zone.

4.5. FINAL BACKFILL

Final backfill placed above the initial backfill should be free of organic material and debris and be free of material greater than 3 inches in nominal dimension. Material placed as trench backfill should satisfy the following recommendations.

- Trench backfill should meet the gradation specifications for “Selected Backfill” described in the USS.
- Trench backfill should be processed to remove materials larger than 3 inches in nominal dimension and all organic and other deleterious materials.
- Trench backfill should have a liquid limit of less than 50 and plasticity index of less than 25.
- Trench backfill should have a remolded swell potential of less than 8 percent as determined per the procedure outlined in Section 1803.5.3.2 of the Southern Nevada Amendments to the 2012 International Building Code.
- Trench backfill should contain less than 1.00 percent by dry weight soluble solids as determined by American Water Works Associated (AWWA) standard test method 2540 C.
- Trench backfill should contain less than 2.0 percent by dry weight soluble sulfate as determined by AWWA standard test method 4500 E.

Soils proposed for trench backfill should be sampled and evaluated by the Geotechnical Engineer, and approved by the governing agency before placing.

Trench backfill should be placed in loose lifts up to 8 inches thick, moisture conditioned to between 2 and 4 percent above the optimum moisture content, and compacted to a minimum of 90 percent of the soils maximum dry density (AASHTO T180). The contractor should take care not to damage the pipe or RCBs during backfilling. As an alternative, Class II CLSM meeting the specifications presented in Section 704.03.07 of the USS may be used for trench backfill. Pipe bedding, pipe zone, and trench backfill should be compacted by mechanical means only; ponding or jetting should not be used to compact pipe bedding, pipe zone, or trench backfill. The upper 24 inches of backfill below the Type II Aggregate Base supporting the asphalt pavement should be backfilled with CLSM.

In-place density and moisture tests should be performed in accordance with AASHTO T310. The test frequency should be at least one test per 150 linear feet of fill material placed per lift.

4.6. SUBTERANEAN STRUCTURES

Subsurface structures, such as manholes, drain inlets and vaults associated with the proposed alignment should be founded on a zone of dense to very dense or stiff to very stiff native soils that have been scarified, moisture conditioned and recompacted structural fill, as previously described. The bottoms of structures should be underlain by at least 6 inches of Type II Aggregate Base compacted to at least 95 percent of the maximum dry density.

Footings that are located at least 3 feet above groundwater that are founded entirely on a zone of scarified and re-compacted native soils or structural fill as previously described and that are at least 12 inches wide and embedded at least 18 inches may be designed based on an allowable net dead plus sustained live load bearing pressure of 1,900 pounds per square foot (psf). This allowable net bearing capacity may be increased by 1,000 psf for each additional foot of embedment and by 300 psf for each additional foot of width up to a maximum value of 3,000 psf.

Footings that are located within 3 feet of groundwater or that are located within groundwater that are founded entirely on a zone of scarified and re-compacted native soils or structural fill as previously described and that are at least 12 inches wide and embedded at least 18 inches may be designed based on an allowable net dead plus sustained live load bearing pressure of 1,100 pounds per square foot (psf). This allowable net bearing capacity may be increased by 600 psf for each additional foot of embedment and by 200 psf for each additional foot of width up to a maximum value of 3,000 psf.

Foundations supporting these structures should not be founded partially on uncemented soil and partially on cemented soils including caliche. If both cemented and uncemented materials are present at the bottom of the foundation excavation, the cemented material should be removed to a depth of at least 12 inches below bottom of footing and replaced with compacted structural fill. Cemented soils or cobbles protruding more than 2-inches from the bottom of the excavation should be removed and the resulting void filled with compacted structural fill as described in this report, prior to placement of bedding. As an alternative, the uncemented material may be removed to expose underlying cemented material throughout the foundation area, if any, and replaced with lean mix concrete.

Resistance to lateral loads may be calculated using both passive lateral earth support and friction developing between the foundations and underlying soil. Passive resistance may be used if foundation backfill soils in front of the foundation are compacted to at least 90 percent of the maximum laboratory dry density (AASHTO T180) or if the foundation is cast against undisturbed native soils.

The passive lateral earth support for foundations located at least 3 feet above groundwater may be based upon an allowable equivalent fluid density of 230 pounds per cubic foot up to a

maximum allowable passive lateral pressure of up to 2,300 pounds per square foot. The passive lateral earth support for footings located within 3 feet of groundwater or within groundwater may be calculated using passive lateral support based upon an equivalent fluid density of 100 pounds per cubic foot up to a maximum allowable passive lateral pressure of up to 1,000 pounds per square foot.

A base coefficient of friction of 0.24 may be used for the interface between foundations and properly compacted native structural fill. A coefficient of friction of 0.32 may be used for the interface between footings and properly compacted Type II or Type III Aggregate Base, or CLSM. The values for the maximum passive lateral earth pressure and coefficient of friction presented above include a factor of safety of 1.5.

4.7. VERTICAL LOADS

Vertical loads on pipes and RCBs will be influenced by the type and dimensions of pipe, the method of pipe installation, subsurface conditions, the width of the trench, the height of backfill above the pipe, and the method of backfill placement. For calculation of overburden loads, Type II or III Aggregate Base pipe zone and trench final zone backfill soils, when placed and compacted as specified, may be assumed to have a unit weight of approximately 145 pounds per cubic foot (pcf). Native soils used as trench backfill may have a unit weight of approximately 125 pcf. This value is based on soils being compacted to a relative compaction of 90 percent of the maximum dry density (AASHTO T180). CLSM used as pipe zone and trench backfill material is anticipated to have a unit weight of approximately 120 pcf.

4.8. SETTLEMENT

Provided that the recommendations for excavation and backfilling, bedding, initial backfill, and trench backfill are performed as recommended in this report, total and differential settlement of the RCB and RCPs is anticipated to be less than 1-inch. Similarly, settlement of the ground surface above the improvements is anticipated to be less than 1-inch.

4.9. MATERIAL VOLUME CHANGES

It is our opinion that there will be a reduction in volume when the native soils are excavated and compacted. Shrinkage of the native soils not containing oversized materials is estimated to be in the range of 10 to 20 percent when compacted to at least 90 percent of the maximum dry density (AASHTO T180). Accordingly, with shrinkage of 10 to 20 percent, one cubic yard of excavated

native soils compacted to 90 percent relative compaction (AASHTO T180) would generate approximately 0.90 to 0.80 cubic yards of compacted fill, respectively. It is our opinion that excavated cemented soils, including caliche, may increase in volume when excavated. A bulking factor of approximately 20 percent is anticipated when the cemented soils, including caliche, are excavated.

4.10. LATERAL EARTH PRESSURES

Lateral active earth pressures induced by adjacent uniform surface surcharge loads should be estimated as a uniformly distributed lateral load with a magnitude equal to the magnitude of the surface surcharge load multiplied by the earth pressure coefficient. The RCB is rigid and will not deflect to relieve stresses from the backfill and should be designed to resist the lateral earth pressures presented in Figure C-1. Recommendations for backfill against RCBs were provided in Section 4.4. of this report.

GES is also presenting earth pressure coefficients for “Active” and “At-Rest” wall conditions. In the “Active” condition the wall is able to deflect enough to lessen stresses from the adjacent soils. In the “At-Rest” condition the wall is rigid and deflection does not occur to relieve the stress from the wall backfill and adjacent soils. Walls for subterranean structures such as man holes and drain inlets should be designed to resist the lateral earth pressures for the groundwater level below and above the wall base conditions as presented in Figure C-2.

Backfill against walls for subterranean structures such as man holes and drain inlets should be moisture conditioned to between 2 and 4 percent above the optimum moisture content and compacted to at least 90 percent of the maximum dry density (AASHTO T180) using light hand operated equipment. The use of heavy compaction equipment could cause loads exceeding the design lateral pressures and result in distress or failure.

4.11. SEISMIC SITE CLASS

Based on Site Class Map of Clark County, the project site is located within Seismic Site Class C. The following seismic design parameters may be utilized using representative site coordinates of 36.1524 degrees latitude and -115.1090 degrees longitude.

Table 4.11. Spectral Response Accelerations and Site Coefficients

Spectral Response Acceleration at Short Periods, S_s	Spectral Response Acceleration at 1-Second Period, S_1	Spectral Response Coefficient at Short Periods, SD_s	Spectral Response Coefficient at 1-Second Period, SD_1
0.487g	0.163g	0.389g	0.178g

4.12. ASPHALT CONCRETE PAVEMENT SECTIONS

As previously described, asphalt concrete pavement was penetrated in some of the borings drilled along the alignment. The thickness of asphalt concrete and aggregate base measured in the boreholes is provided on the boring logs and in Table 2.2.

Where existing pavement sections are removed to facilitate the installation of the RCBs and RCPs, the trench area should be patched with a replacement pavement section at least be equal to that removed or the minimum section specified for the right-of-way width per Standard Drawing 200 or 200.1 of the USS for City of Las Vegas right-of-ways and Section 401 of the Standard Specifications for Road and Bridge Construction (SSRBC) (NDOT, 2014).

Asphalt concrete material and placement procedures should conform to appropriate sections of the USS and SSRBC. Aggregate materials for asphalt concrete should conform to the requirements for Plant Mix Bituminous Pavements, Section 401 and Section 703 of the USS for City of Las Vegas right-of-ways and the SSRBC for NDOT right-of-ways.

Prior to placing the supportive Aggregate Base, at least the upper 8 inches of subgrade soils should be uniformly moisture conditioned to between 2 and 4 percent above the optimum moisture content, and compacted to at least 95 percent of the maximum dry density. Scarification may be terminated at a shallower depth or omitted entirely if moderately to strongly cemented soil is encountered, at the discretion of the Engineer, based on actual soil conditions observed at the site.

4.13. AGGREGATE BASE FOR PAVEMENT SECTIONS

Aggregate base materials underlying asphalt concrete pavement should consist of Type II Aggregate Base meeting the requirements presented in Subsection 704.03.04 of the USS for City of Las Vegas right-of-ways and Type 2 Aggregate Base meeting the requirements presented in Subsection 704.03. of the SSRBC for NDOT right-of-ways. Aggregate base should be placed in loose layers up to 6 inches thick, moisture conditioned to within 2 percent of the optimum moisture content and compacted to at least 95 percent of the maximum dry density. Compacted thickness

of aggregate base materials must be observed under the direction of the Geotechnical Engineer prior to its incorporation into the pavement structure.

4.14. SOIL CORROSIVITY

Based on the results of chemical testing, the on-site soils have a negligible to severe sulfate exposure as defined in Tables 4.2.1 and 4.3.1 of American Concrete Institute (ACI) Publication 318-11. It is our opinion that concrete that may directly or indirectly contact the on-site soils should be designed for a severe sulfate exposure and contain Type V sulfate resistant cement, have a minimum 28-day compressive strength of 4,500 psi, and have a maximum water to cement ratio of 0.45. We recommend that the design consultant consult a Corrosion Engineer for protection recommendations for any buried pipe.

5. LIMITATIONS

The recommendations contained in this report are based on field exploration, laboratory testing, research of pertinent maps and literature, and our understanding of the proposed construction. The soil data used in the preparation of this report were obtained from thirteen borings performed along the proposed alignment. It is possible that variations in the soil conditions will exist between the locations explored. Therefore, if any soil conditions are encountered at the site that are different from those outlined in this report, Geotechnical & Environmental Services, Inc. should be immediately notified so that we may review the situation that exists and make supplementary recommendations as needed. In addition, if the scope of the proposed construction, including the types of structures, anticipated loads and maximum cut and fill depths, changes from what is described in this report, our firm should be notified.

The recommendations presented in this report are based on the assumption that an adequate number of tests and observations will be made during site construction to evaluate compliance with the recommendations. These tests and observations should be provided under the direction of a qualified Geotechnical Engineer. Such testing and observations should include but not be limited to the following:

- Review of site construction plans for conformance with the soils investigation.
- Observation and testing during site preparation, earthwork, drilled shaft and other excavations, and placement of aggregate base and concrete.
- Consultation as may be required during construction.

Our services were performed using that degree of care and skill ordinarily exercised under similar circumstances by reputable engineering firms in this or similar localities. No other warranties, either express or implied, are included or intended in this report.

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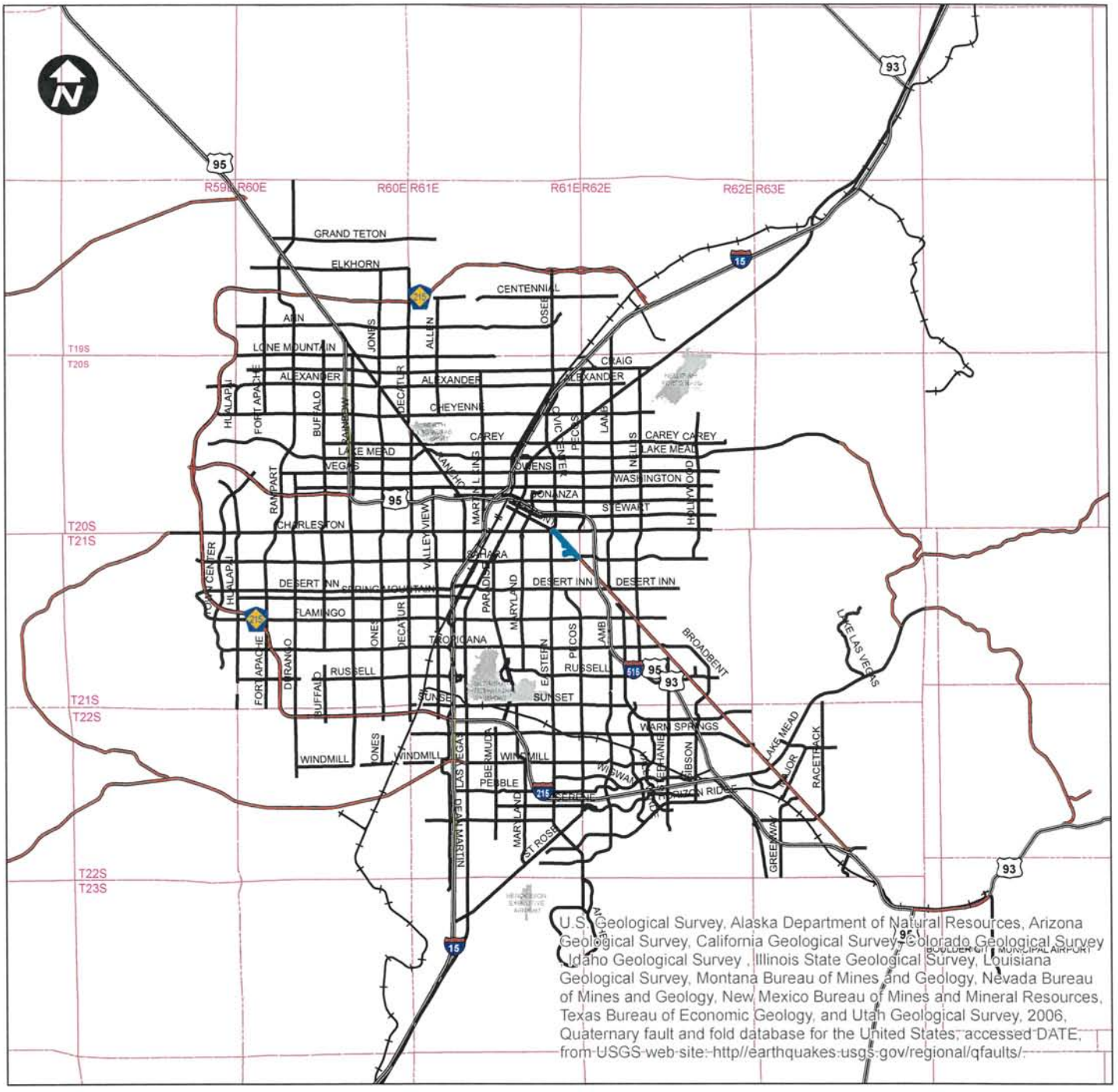
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APPENDIX A
SUBSURFACE STUDY



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0 2.5 5 10 15 20 Miles

Legend

- Approximate Project Alignment
- Airports
- Township & Range
- Interstate
- Major Streets
- Railroad
- State Highway

Faults (USGS, 2010)

Linear Faults

Fault Age

- Class B years
- Less than 1,600,000 years
- Less than 750,000 years
- Less than 130,000 years
- Less than 15,000 years
- Less than 150 years
- Unknown

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NOTE: Data presented on this map is a compilation of GIS Metadata extracted from a variety of sources. Major Streets, Airports, and Railroads is data obtained from the Southern Nevada GIS Management Office. This data is downloaded by GES for incorporation into drawings generated by GES. Data contained within this page is to be used for informational purposes only. GES has not modified the data contained herein and uses it as it is acquired from the respective agency.

VICINITY MAP
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

Drawn By:	Date Drawn:
PES	08/24/2016
Project No.	Figure No.
20153837E1	A-1



Legend

0 250 500 1,000 1,500 2,000 Feet

- B-13 — Approximate Boring Locations
- B-8 (MW-3) — Approximate Monitoring Well Locations
- Approximate Mainline Storm Drain Alignment
- Approximate Lateral Storm Drain Alignment

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NOTE: All locations are approximate. TD denotes total depth of exploration in feet. Data presented on this map is a compilation of GIS Metadata extracted from a variety of sources. Major Streets, Airports, and Railroads is data obtained from the Southern Nevada GIS Management Office. This data is downloaded by GES for incorporation into drawings generated by GES. Data contained within this page is to be used for informational purposes only. GES has not modified the data contained herein and uses it as it is acquired from the respective agency.

EXPLORATION LOCATION MAP
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

Drawn By:	Date Drawn:
PES	8/24/2016
Project No.	Figure No.
20153837E1	A-2

KEY TO SYMBOLS AND TERMS

Terms used according to the Unified Soil Classification System

Consistency or Condition of Soils

Fine-Grained Soils (Silt and Clay): Major portion passing #200 sieve

California Sampler* (blows/foot)	SPT** (blows/foot)	Estimated Consistency	Unconfined Compressive Strength (tsf)	Manual Manipulation
< 2	< 2	Very Soft	< 0.25	Thumb will penetrate soil more than 1 in.
2-5	2-4	Soft	0.25-0.50	Thumb will penetrate soil about 1 in.
5-10	4-8	Firm	0.50-1.00	Thumb will penetrate soil about $\frac{1}{4}$ in.
10-20	8-15	Stiff	1.00-2.00	Thumb will not indent soil but readily indented with thumbnail.
>20	>15	Very Stiff	>2.00	Thumbnail will not indent soil.

*ASTM D 3550 using a 140-pound hammer falling 30 inches.
**ASTM D 1586

Coarse-Grained Soils (Sand and Gravel): Major portion retained on #200 sieve

California Sampler* (blows/foot)	SPT** (blows/foot)	Estimated Consistency	Behavior of $\frac{1}{2}$-inch Diameter Probe Rod
0-7	0-4	Very Loose	Easily penetrated when pushed by hand.
7-18	4-10	Loose	Firmly penetrated when pushed by hand.
18-50	10-30	Medium Dense	Easily penetrated when driven by 1 lb. hammer.
50-90	30-50	Dense	Penetrated less than 1 inch when driven with a 1 lb. hammer.
>90	>50	Very Dense	Penetrated less than $\frac{1}{4}$ inch when driven with a 1 lb. hammer.

*ASTM D 3550 using a 140-pound hammer falling 30 inches.
**ASTM D 1586

Cementation	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Caliche and Cemented Sand and Gravel: Materials classified as medium hard, hard, or very hard caliche or cemented sand and gravel should be treated as rock per Appendix K of the Southern Nevada Amendments to the 2000 International Building Code, published February 11, 2003.

Misc. Symbols

- Exploration continues
- Initial groundwater depth
- Final groundwater depth

Constituent Percentages

- Trace - < 5%
- Few - 5 to 10%
- Little - 15-25%
- Some - 30-45%
- Mostly - 50-100%

Moisture Condition

- Dry - Absence of moisture, dusty, dry to the touch
- Moist - Damp but no visible water
- Wet - Visible free water, usually soil is below water table

Notes

1. Subsurface explorations were performed using the equipment listed on the exploration logs.
2. Subsurface explorations were performed on the date(s) shown on the exploration logs.
3. Soil sampler(s) were driven with a 140 pound hammer falling 30 inches (unless otherwise noted in the text of this report).
4. The transitions between soil types shown on the exploration logs as occuring abruptly at particular depths may in actuality be a gradual progression from one soil type to the next.
5. Exploration logs are subject to the limitations, conclusions, and recomendations presented in this report.

Strata Group Symbols

- Fill
- CL- Low plasticity clay
- CH - High plasticity clay
- ML - Silt
- MH - Elastic Silt
- SP - Poorly graded sand
- SW - Well - graded sand
- GP - Poorly graded gravel
- GW - Well - graded gravel
- Cemented sand and gravel
- Caliche

Soil Sampler Symbols

- Bulk sample
- Sample from auger cutting
- California sampler
- Standard Penetration Test
- Shelby tube
- Air Knife

GES

Disclaimer

This Key to Symbols is part of a report prepared by Geotechnical & Environmental Services, Inc. and should be used with the report. The descriptions on the exploration logs apply only at the specific exploration locations and at the time the explorations were made. They are not warranted to be representative of subsurface conditions at other locations or times.

Figure No. A-3

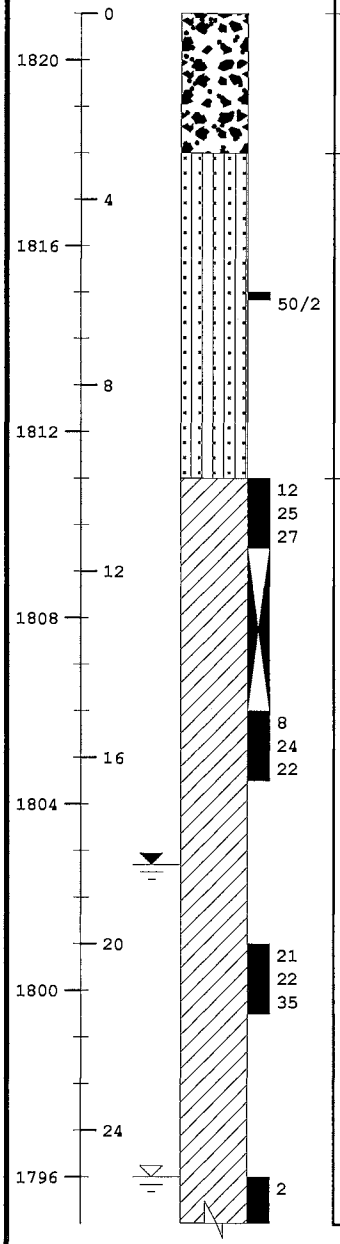
BORING/MONITORING WELL LOG
B-1

PROJECT: Boulder Highway Storm Drain
EXPLORATION LOCATION: N: 36.1462, W: -115.1462
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,821 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/25/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGED BY: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 25.0 Feet
FINAL DEPTH TO WATER: 18.3 Feet

DATE MEASURED: 7/25/2016
DATE MEASURED: 8/16/2016



ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
		GW	FILL: Greyish brown well-graded GRAVEL with sand, dry and medium dense to dense.								
		SP-SM	NATIVE: Whitish brown poorly graded SAND with with silt and gravel, dry, and very dense. ...air-knife to approximately 6-Feet.								
			...weakly to moderately cemented.				7.6	99.3			
		CL	Light brown sandy lean CLAY, dry and very stiff.	15	29		4.9	106.2			
			...moist.				12.8	117.5	R3	>4.5	
			...pinkish brown gravelly lean CLAY with sand.				13.4	115.4			
			...firm to stiff.								

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

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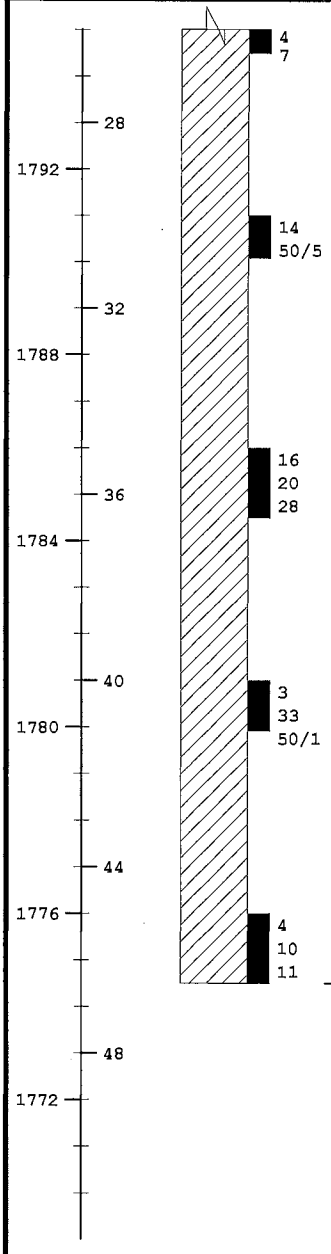
Figure No. A-4

BORING/MONITORING WELL LOG
B-1

PROJECT: Boulder Highway Storm Drain
EXPLORATION LOCATION: N: 36.1462, W: -115.1462
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,821 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/25/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGED BY: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 25.0 Feet
DATE MEASURED: 7/25/2016
FINAL DEPTH TO WATER: 18.3 Feet
DATE MEASURED: 8/16/2016



USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
	...light brown, few gravel, wet, very stiff and weakly to moderately cemented.				27.6	99.0		>4.5	
					19.1	114.0		>4.5	
	...weakly to moderately cemented.				27.1	100.4		4.0	
	...greyish-white to pink.				37.4	89.3			
	END OF BORING AT 46.5 FEET								

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Figure No. A-4

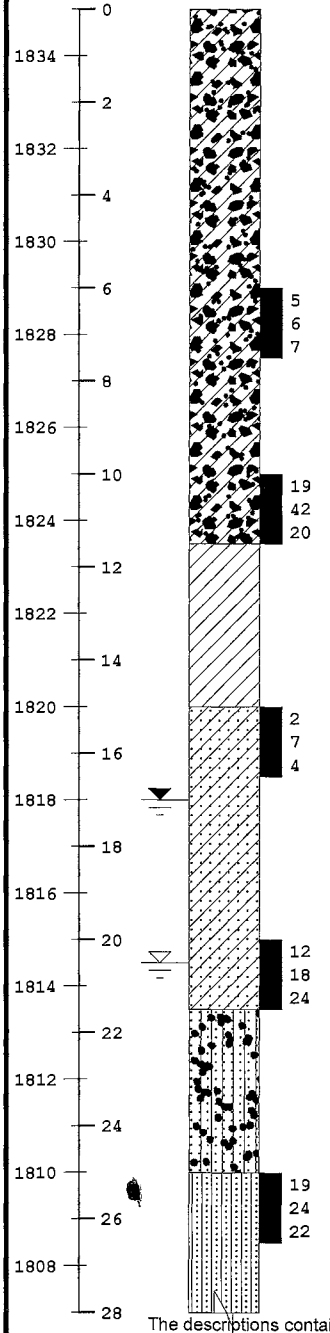
BORING LOG
B-2

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.1488, W: -115.1050
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1835 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/25/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 20.5 Feet
FINAL DEPTH TO WATER: 17.0 Feet

DATE MEASURED: 7/25/2016
DATE MEASURED: 7/25/2016



ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
		GW-GC	FILL: Greyish-brown well-graded GRAVEL with clay and sand, dry and medium dense to dense.						
			...light brown to brown, asphalt chunks in cuttings, loose. ...air-knife to approximately 6-Feet.			14.7	97.7		
			NATIVE: Light brown to brown well-graded GRAVEL with clay and sand, dry and loose.	8	25	14.7	107.3		
		CL	Whitish-brown sandy lean CLAY, moist and very stiff.						
		SC	Greyish white clayey SAND, moist and loose.			18.0	101.1		
			...wet and medium dense.			18.0	113.8		
		GP-GM	Grey, light brown and reddish brown poorly graded GRAVEL with silt and sand, wet and medium dense.						
		SM	Greyish white silty SAND, wet and medium dense.			21.3	118.1		

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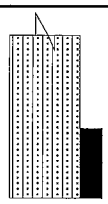
BORING LOG
B-2

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.1488, W: -115.1050
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1835 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/25/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 20.5 Feet
FINAL DEPTH TO WATER: 17.0 Feet

DATE MEASURED: 7/25/2016
DATE MEASURED: 7/25/2016

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
28 / 1806			...trace gravel, and dense.			9.7	131.2		
30 / 1804									
32 / 1802			END OF BORING AT 31.5 FEET						
34 / 1800									
36 / 1798									
38 / 1796									
40 / 1794									
42 / 1792									
44 / 1790									
46 / 1788									
48 / 1786									
50 / 1784									
52 / 1782									
54 / 1780									
56									

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

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Figure No. A-5

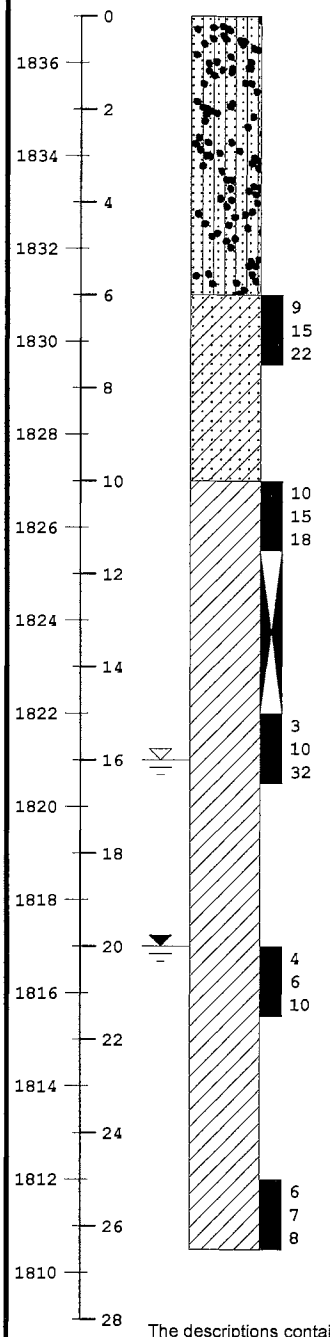
BORING LOG
B-3

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.1507, W: -115.1071
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,837 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/26/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 16.0 Feet
FINAL DEPTH TO WATER: 20.0 Feet

DATE MEASURED: 7/26/2016
DATE MEASURED: 7/26/2016



ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
		GP-GM	FILL: Greyish-Brown poorly graded GRAVEL with silt and sand, dry and medium dense to dense. ...air-knife to approximately 6-Feet.						
		SC	NATIVE: Light brown clayey SAND, few gravel, dry and medium dense to dense.			26.0	80.5		
		CL	Sandy lean CLAY, moist and very stiff.	15	29	26.4	89.0	R4	
			...gravely lean CLAY.			32.8	73.7		2
			...wet and stiff.			37.6	80.4		
			...with some gravel			53.8	70.5		3.5
			END OF BORING AT 26.5 FEET						

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GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

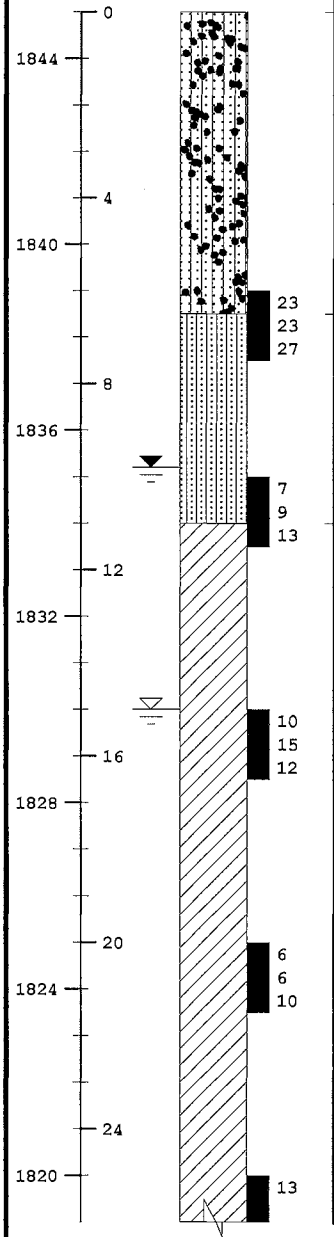
Figure No. A-6

BORING/MONITORING WELL LOG
B-4

PROJECT: Boulder Highway Storm Drain
EXPLORATION LOCATION: N: 36.1524, W: -115.1090
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,845 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/26/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGED BY: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 15.0 Feet
DATE MEASURED: 7/26/2016
FINAL DEPTH TO WATER: 9.8 Feet
DATE MEASURED: 8/16/2016



ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
		GP-GM	FILL: Greyish-brown poorly graded GRAVEL with silt and sand, dry and medium dense to dense. ...air-knife to approximately 6-Feet.								
		SM	NATIVE: Light brown silty SAND, moist and dense.	NP	NV		13.4	103.5			
			...loose.				22.0	105.6			
		CL	Sandy lean CLAY, moist and very stiff.							1.5	
			...reddish-brown, trace to few gravel, and wet.				36.8	93.0		1.5	
			...light brown, stiff.				39.5	82.5		1	
			...very stiff.				37.7	86.5		>4.5	

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-7

BORING/MONITORING WELL LOG
B-4

PROJECT: Boulder Highway Storm Drain
PROJECT NO.: 20153837E1
EXPLORATION LOCATION: N: 36.1524, W: -115.1090
EXPLORATION DATE: 7/26/2016
EXPLORATION SIZE (dia.): 6-Inches
EQUIPMENT: Diedrich D-120 with HSA
ELEVATION: 1,845 Feet (Approximate)
LOGGED BY: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 15.0 Feet
DATE MEASURED: 7/26/2016
FINAL DEPTH TO WATER: 9.8 Feet
DATE MEASURED: 8/16/2016

ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
1816 — 28	15 18										
	3 9 38						25.4	100.6			
1812 — 32											
	8 9 23						29.6	97.2			
1808 — 36		SM	Light brown silty SAND, wet and medium dense.								
1804 — 40	19 49 50/1	CL	Light brown sandy lean CLAY, wet and very stiff.				22.1	109.5			
			END OF BORING AT 41.1 FEET								
1800 — 44											
1796 — 48											

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

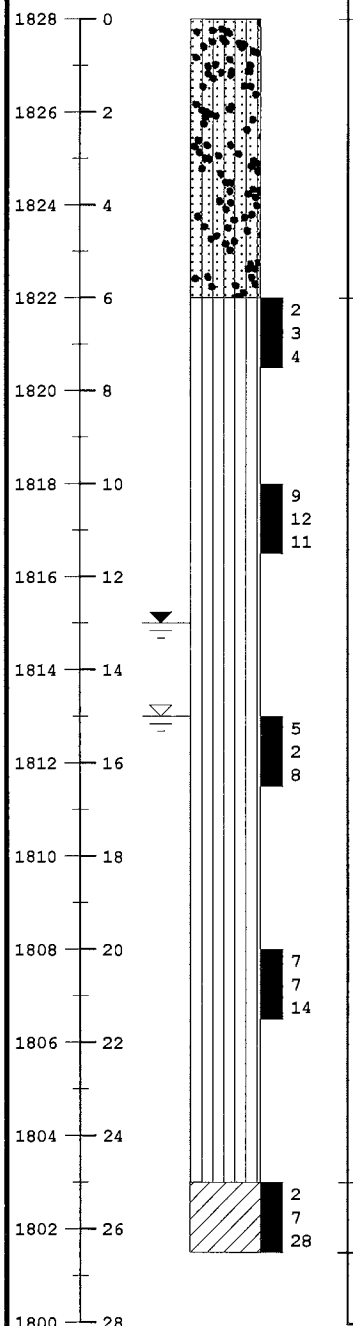
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-7

BORING LOG
B-5

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.1544, W: -115.1030
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,828 Feet (Approximate)
PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/26/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 15.0 Feet
DATE MEASURED: 7/26/2016
FINAL DEPTH TO WATER: 13.0 Feet
DATE MEASURED: 7/26/2016



ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
		GP-GM	FILL: Greyish-brown poorly graded GRAVEL with silt and sand, dry and medium dense to dense. ...air-knife to approximately 6-Feet.						
		ML	NATIVE: Brown sandy SILT, moist and firm.			14.2	105.7	0	3
			...pinkish brown.						
			...reddish brown, trace to few gravel, wet and very stiff.	1	17	12.2	124.7		3
			...less gravel, firm to stiff.			24.5	101.2		4
			...very stiff.			24.4	100.5		>4.5
			...light brown.			14.8	110.9		
			END OF BORING AT 26.5 FEET						

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-8

BORING/MONITORING WELL LOG
B-6

PROJECT: Boulder Highway Storm Drain
PROJECT NO.: 20153837E1
EXPLORATION LOCATION: N: 36.1563, W: -115.1135
EXPLORATION DATE: 7/27/2016
EXPLORATION SIZE (dia.): 6-Inches
EQUIPMENT: Diedrich D-120 with HSA
ELEVATION: 1,860 Feet (Approximate)
LOGGED BY: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 20.0 Feet
DATE MEASURED: 7/27/2016
FINAL DEPTH TO WATER: 9.0 Feet
DATE MEASURED: 7/27/2016

ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
1860 — 0			ASPHALT: Unit is approximately 12-inches thick.								
		GP-GM	AGGREGATE BASE: Greyish-brown poorly graded GRAVEL with silt and sand, dry and medium dense to dense. Unit is approximately 12-inches thick. FILL: Greyish-brown poorly graded GRAVEL with silt and sand, dry and medium dense to dense. ...air-knife to approximately 6-Feet. ...asphalt chunks.								
1856 — 4	5 3 3										
1852 — 8	50/1	CH	NATIVE: Light brown fat CLAY with sand, moist, very dense and moderately cemented.	73	103						
1848 — 12		CALI	Light brown CALICHE, dry, strongly cemented and hard.								
1844 — 16	3 4 3	CL	Light reddish brown CLAY with sand, moist and firm.				29.4	90.2			
1840 — 20	47 50/5		...wet, very stiff and weakly to moderately cemented.				16.9	111.4			
1836 — 24	3		...trace gravel (caliche nodules), firm to loose.				30.8	99.4			

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BORING/MONITORING WELL LOG
B-6

PROJECT: Boulder Highway Storm Drain
PROJECT NO.: 20153837E1
EXPLORATION LOCATION: N: 36.1563, W: -115.1135
EXPLORATION DATE: 7/27/2016
EXPLORATION SIZE (dia.): 6-Inches
EQUIPMENT: Diedrich D-120 with HSA
ELEVATION: 1,860 Feet (Approximate)
LOGGED BY: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 20.0 Feet
DATE MEASURED: 7/27/2016
FINAL DEPTH TO WATER: 9.0 Feet
DATE MEASURED: 7/27/2016

ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
1832 — 28	6 7										
	3 10 29		...moist and stiff.				18.0	114.5			
1828 — 32			END OF BORING AT 31.5 FEET								
1824 — 36											
1820 — 40											
1816 — 44											
1812 — 48											

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

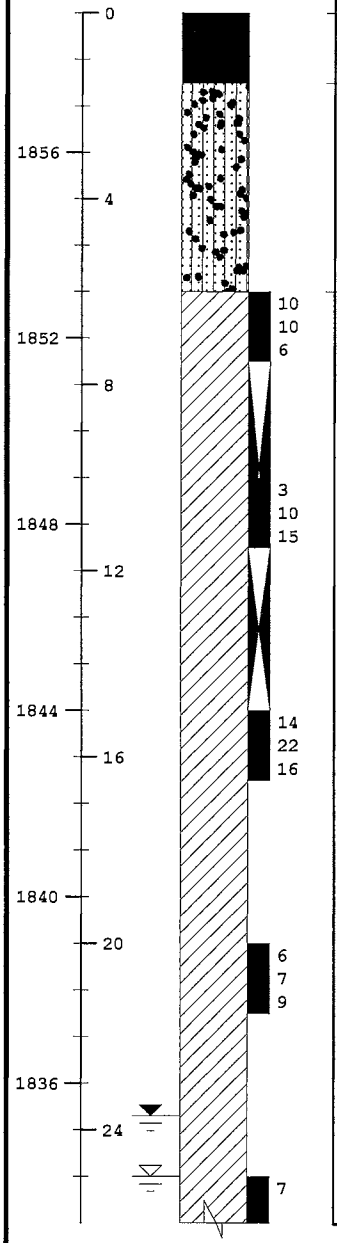
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-9

BORING/MONITORING WELL LOG
B-7

PROJECT: Boulder Highway Storm Drain
EXPLORATION LOCATION: N: 36.1580, W: -115.1155
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,859 Feet (Approximate)
PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/27/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGED BY: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 25.0 Feet
DATE MEASURED: 7/27/2016
FINAL DEPTH TO WATER: 23.7 Feet
DATE MEASURED: 7/27/2016



ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
			ASPHALT: Unit is approximately 18-inches thick.								
		GP-GM	AGGREGATE BASE: Greyish-brown poorly graded GRAVEL with silt and sand, dry and medium dense to dense. Unit is approximately 11 inches thick. FILL: Greyish-brown poorly graded GRAVEL with silt and sand, dry and medium dense to dense. Air-knife to approximately 6-feet.								
		CL	NATIVE: Light grey to light brown sandy CLAY, dry to moist, very stiff.				29.0		0 R3	>4.5	
			...reddish brown, moist and stiff to very stiff .	17	35		18.9	107.4			
			...very stiff.				16.0	114.6		>4.5	
			... firm to stiff.				41.1	78.6		>4.5	
			...stiff to very stiff.				24.2	103.3		4	

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GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-10

BORING/MONITORING WELL LOG
B-7

PROJECT: Boulder Highway Storm Drain
PROJECT NO.: 20153837E1
EXPLORATION LOCATION: N: 36.1580, W: -115.1155
EXPLORATION DATE: 7/27/2016
EXPLORATION SIZE (dia.): 6-Inches
EQUIPMENT: Diedrich D-120 with HSA
ELEVATION: 1,859 Feet (Approximate)
LOGGED BY: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 25.0 Feet
DATE MEASURED: 7/27/2016
FINAL DEPTH TO WATER: 23.7 Feet
DATE MEASURED: 7/27/2016

ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
1832 — 28	12 12										
1828 — 32	3 8 15						28.2	95.9			
			END OF BORING AT 31.5 FEET								
1824 — 36											
1820 — 40											
1816 — 44											
1812 — 48											
1808											

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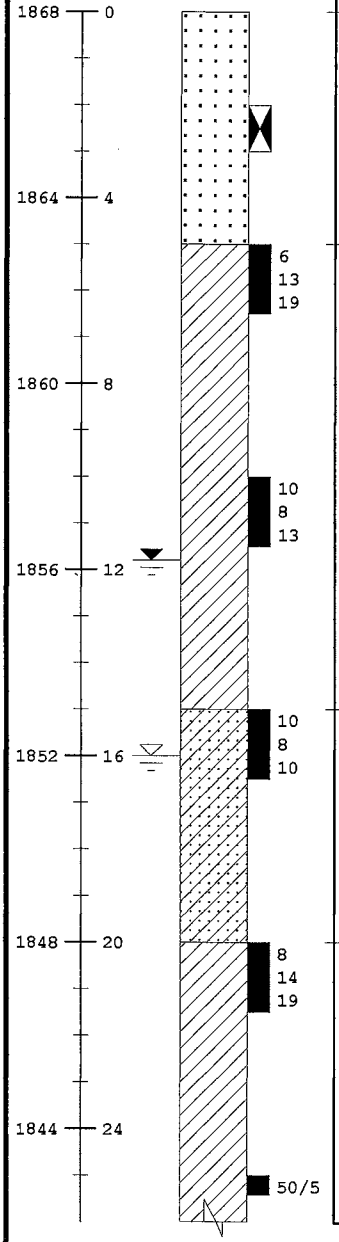
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-10

BORING/MONITORING WELL LOG
B-8

PROJECT: Boulder Highway Storm Drain
EXPLORATION LOCATION: N: 36.1593, W: -115.1176
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,868 Feet (Approximate)
PROJECT NO.: 20153837E1
EXPLORATION DATE: 8/11/2016 & 8/12/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGED BY: Wang/Thompson

INITIAL DEPTH TO WATER: 16.0 Feet
DATE MEASURED: 8/11/2016
FINAL DEPTH TO WATER: 11.8 Feet
DATE MEASURED: 8/16/2016



ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
		SP	FILL: Light brown poorly graded SAND with gravel, dry and medium dense. ...air-knife to approximately 5-feet.								
		CL	NATIVE: Light brown sandy CLAY with gravel, moist, very stiff. ...white.				12.2	114.6		3.5	
			...less gravel. ...whitish-brown.				16.8	106.2			
		SC	Grey, clayey SAND with gravel, wet and medium dense.				16.2	119.5			
		CL	Pinkish-light brown lean CLAY, moist to wet and very stiff.	17	38		27.0	101.0	6	>4.5	
			...weakly to moderately cemented.				23.2	89.6			

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-11

BORING/MONITORING WELL LOG
B-8

PROJECT: Boulder Highway Storm Drain
EXPLORATION LOCATION: N: 36.1593, W: -115.1176
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,868 Feet (Approximate)
PROJECT NO.: 20153837E1
EXPLORATION DATE: 8/11/2016 & 8/12/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGED BY: Wang/Thompson

INITIAL DEPTH TO WATER: 16.0 Feet
DATE MEASURED: 8/11/2016
FINAL DEPTH TO WATER: 11.8 Feet
DATE MEASURED: 8/16/2016

ELEVATION/DEPTH	SOIL & SAMPLE SYMBOLS	USCS	DESCRIPTION	PI	LL	HEADSPACE PID (ppm)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)	WELL CONSTRUCTION
1840 — 28			... white clay lenses.								
	50/4		...weakly to moderately cemented.				23.9	96.4			
1836 — 32											
	2 10 18						36.2	92.6			
1832 — 36											
1828 — 40	12 18 50/4		..grey-pinkish-light brown, weakly to moderately cemented..				18.0	109.6			
1824 — 44											
	12 46 38	SC	Light brown clayey SAND, moist to wet and dense.				23.5	104.4			
1820 — 48			END OF BORING AT 46.5 FEET								

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-11

BORING LOG
B-9

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.15743, W: -115.11665
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,864 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/5/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 21.5 Feet
FINAL DEPTH TO WATER: 20.2 Feet

DATE MEASURED: 7/5/2016
DATE MEASURED: 7/5/2016

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
1864 — 0		SM	AGGREGATE BASE:						
		ML	Brown silty SAND with gravel, dry and medium dense to dense. Trace asphalt. Unit is approximately 6-inches thick.						
1862 — 2			NATIVE:						
1860 — 4		CL	Light brown sandy SILT with gravel, dry and firm to stiff.						
	4 4 6		Light brown sandy lean CLAY, moist and firm to stiff. ...air-knife to 5-Feet.	28	47	23.1	81.4		
1858 — 6									
1856 — 8									
1854 — 10	6 9 10		...whiteish-brown with hints of reddish brown, moist and very stiff.			18.1	100.3		2.5
1852 — 12									
1850 — 14									
1848 — 16	3 5 12		...reddish-light brown, with gravel.			16.6	88.0		2.5
1846 — 18									
1844 — 20	2 5 7		...stiff.			21.8	97.9		2.0
1842 — 22									
1840 — 24									
1838 — 26	24 29 23		...light brown, wet, and very stiff.			23.8	98.8		
1836 — 28			END OF BORING AT 26.5 FEET						

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-12

BORING LOG
B-10

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.15640, W: -115.11560
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,864 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/5/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 20.0 Feet
FINAL DEPTH TO WATER: 17.7 Feet

DATE MEASURED: 7/5/2016
DATE MEASURED: 7/5/2016

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
1864 — 0		ML	NATIVE: Light brown sandy SILT with gravel, dry and medium stiff.						
1862 — 2									
1860 — 4			...air-knife to 5-Feet.						
1858 — 6	5 3 4	CL	Brown sandy lean CLAY, moist and medium stiff.			34.0	73.1		
1856 — 8									
1854 — 10	15 16 19		...light gray with hints of reddish brown, and very stiff.	11	27	16.4	111.3	0	
1852 — 12			...light gray gravelly lean CLAY.						>4.5
1850 — 14									
1848 — 16	3 7 5		...stiff.			11.1	97.3		2.5
1846 — 18	▽								
1844 — 20	▽ 9 10 22		...white, olive green and brown lean clay, wet and very stiff.			25.9	86.6		>4.5
1842 — 22									
1840 — 24									
1838 — 26	3 4 9		...pinkish-brown, trace gravel, wet and stiff.			40.0	80.9		4.5
1836 — 28			END OF BORING AT 26.5 FEET						

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

BORING LOG
B-11

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.15640, W: -115.11560
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,848 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/5/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 15.0 Feet
FINAL DEPTH TO WATER: 14.7 Feet

DATE MEASURED: 7/5/2016
DATE MEASURED: 7/5/2016

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
1848 — 0			ASPHALT:						
		SM	Unit is approximately 7-inches thick						
1846 — 2			AGGREGATE BASE:						
		ML	Brown silty SAND with gravel, dry, and dense. Unit is approximately 16-inches thick.						
1844 — 4			NATIVE: Brown sandy SILT with gravel, dry and medium stiff.						
1842 — 6	43 50/4	CL	Light brown sandy lean CLAY with gravel, moist, very stiff and weakly cemented.			9.5	111.3		
1840 — 8									
1838 — 10	7 10 10					14.3	114.9		
1836 — 12									
1834 — 14									
1832 — 16	5 10 11		...greenish gray and wet.	16	33	27.4	99.6		4.5
1830 — 18									
1828 — 20	8 17 26		...reddish-light brown.			23.2	106.4		3.5
1826 — 22		GP	Reddish-light brown poorly graded GRAVEL with sand, wet and medium dense to dense.						
1824 — 24			**END OF BORING AT 21.5 FEET**						
1822 — 26									
1820 — 28									

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BORING LOG
B-12

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.1480, W: -115.1074
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,840 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/6/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 21.0 Feet
FINAL DEPTH TO WATER: 15.5 Feet

DATE MEASURED: 7/6/2016
DATE MEASURED: 7/6/2016

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
1840 — 0			ASPHALT:						
		GW-GM	Unit is approximately 9-inches thick.						
1838 — 2			AGGREGATE BASE:						
		SM	Well graded GRAVEL with sand and silt, dry. Unit is approximately 13-inches thick.						
1836 — 4			NATIVE: Light brown silty SAND, moist and dense.						
1834 — 6	18 21 40		...very dense.	NP	NV	8.4	112.3		
1832 — 8									
1830 — 10	2 3 7	CL	Light brown sandy lean CLAY, moist and stiff.			16.2	88.3		
1828 — 12									
1826 — 14									
1824 — 16	4 8 13		...moist to wet and very stiff.			18.9	89.5		4.0
1822 — 18									
1820 — 20	5 9 12		...with some gravel, wet.			18.0	109.7		4.5
1818 — 22									
1816 — 24									
1814 — 26	18 21 21					23.7	105.4		5.0
1812 — 28			END OF BORING AT 26.5 FEET						

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

BORING LOG
B-13

PROJECT: Boulder Highway Storm Drain
BORING LOCATION: N: 36.1478, W: -115.1100
EXPLORATION SIZE (dia.): 6-Inches
ELEVATION: 1,850 Feet (Approximate)

PROJECT NO.: 20153837E1
EXPLORATION DATE: 7/6/2016
EQUIPMENT: Diedrich D-120 with HSA
LOGGER/DRILLER: Wang/Luis-Sanchez

INITIAL DEPTH TO WATER: 20.0 Feet
FINAL DEPTH TO WATER: 15.0 Feet

DATE MEASURED: 7/6/2016
DATE MEASURED: 7/6/2016

ELEVATION/ DEPTH	SOIL & SAMPLE SYMBOLS	STRATA GROUP	DESCRIPTION	PI	LL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL (%)	POCKET PENETROMETER (tsf)
1850 — 0			ASPHALT: Unit is approximately 4-1/2 inches thick.						
		SM							
		SC	AGGREGATE BASE: Brown silty SAND with gravel, moist. Unit is approximately 7-1/2 inches thick.						
1848 — 2									
			NATIVE: Light brown clayey GRAVEL with sand, moist and medium dense to dense.						
1846 — 4									
	9 12 11	SM	Reddish brown silty SAND with trace gravel, moist and medium dense.			18.8	108.2		
1844 — 6									
1842 — 8									
1840 — 10	10 12 10		... no gravel.	NP	NV	14.9	115.9	1	
1838 — 12									
1836 — 14									
	5 5 4	CL	Reddish brown with white specks lean CLAY, moist and stiff.			17.8	97.8		4.5
1834 — 16									
1832 — 18									
1830 — 20	3 5 6		...reddish brown, moist to wet.			34.2	83.3		4.5
1828 — 22			END OF BORING AT 21.5 FEET						
1826 — 24									
1824 — 26									
1822 — 28									

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-16

APPENDIX B
LABORATORY TEST RESULTS

1. IN-PLACE MOISTURE CONTENT AND DENSITY

The in-place moisture content and density of relatively undisturbed soil samples obtained from the borings were measured in general accordance with ASTM D 2937. The in-place moisture content and density are a qualitative indication of soil consistency and compressibility. The results of these tests are presented on the boring logs (Figures A-4 through A-16) at the respective sampling depth.

2. GRAIN SIZE DISTRIBUTION

Thirteen grain size distribution tests were performed by sieve analysis in general accordance with AASHTO T27. Basically, a sample is oven dried to a constant weight and sieved through a number of different sized sieves. The amount of material retained on each sieve is measured and the percent of material passing each sieve is computed. The test results are presented as particle size distribution curves on Figures B-1 through B-13.

3. ATTERBERG LIMITS

Thirteen Atterberg limit tests were performed in general accordance with AASHTO T89 and T90. The results of these tests are shown on the boring logs at the respective sampling depths and on Figures B-14 through B-15.

4. 60 PSF SWELL POTENTIAL

Four swell tests were performed on relatively undisturbed samples of the native soils in general accordance with Section 1803.5.3.2 of the Southern Nevada Amendments to the 2012 International Building Code. A vertical confining pressure of approximately 60 pounds per square foot was applied to the oven-dried sample and then the sample was inundated with water. The deformation of the sample was recorded for 24 hours. The results of the swell test are presented on Figure B-16.

5. DIRECT SHEAR

Two direct shear strength tests was performed on a relatively undisturbed sample using a constant strain rate direct shear machine in general accordance with AASHTO T236. In the

shear machine, the samples were saturated, loaded to successive normal pressures, and then sheared beyond the peak shear strength until the residual shear strength was obtained. The results of the tests are presented graphically as Mohr-Coulomb failure surfaces and stress-strain diagrams on Figures B-17 through B-18.

6. CONSOLIDATION

Two one-dimensional consolidation tests were performed on relatively undisturbed samples in general accordance with ASTM D2435. The test was performed on 1-inch high sample having a diameter of 2.42 inches obtained from a ring-lined sampler. The sample was placed in the consolidometer, loaded incrementally, and then incrementally unloaded. The sample was saturated near the estimated overburden pressure during the loading process. The sample deformation was measured during each load increment. Results of the consolidation test are presented on Figures B-19 through B-20.

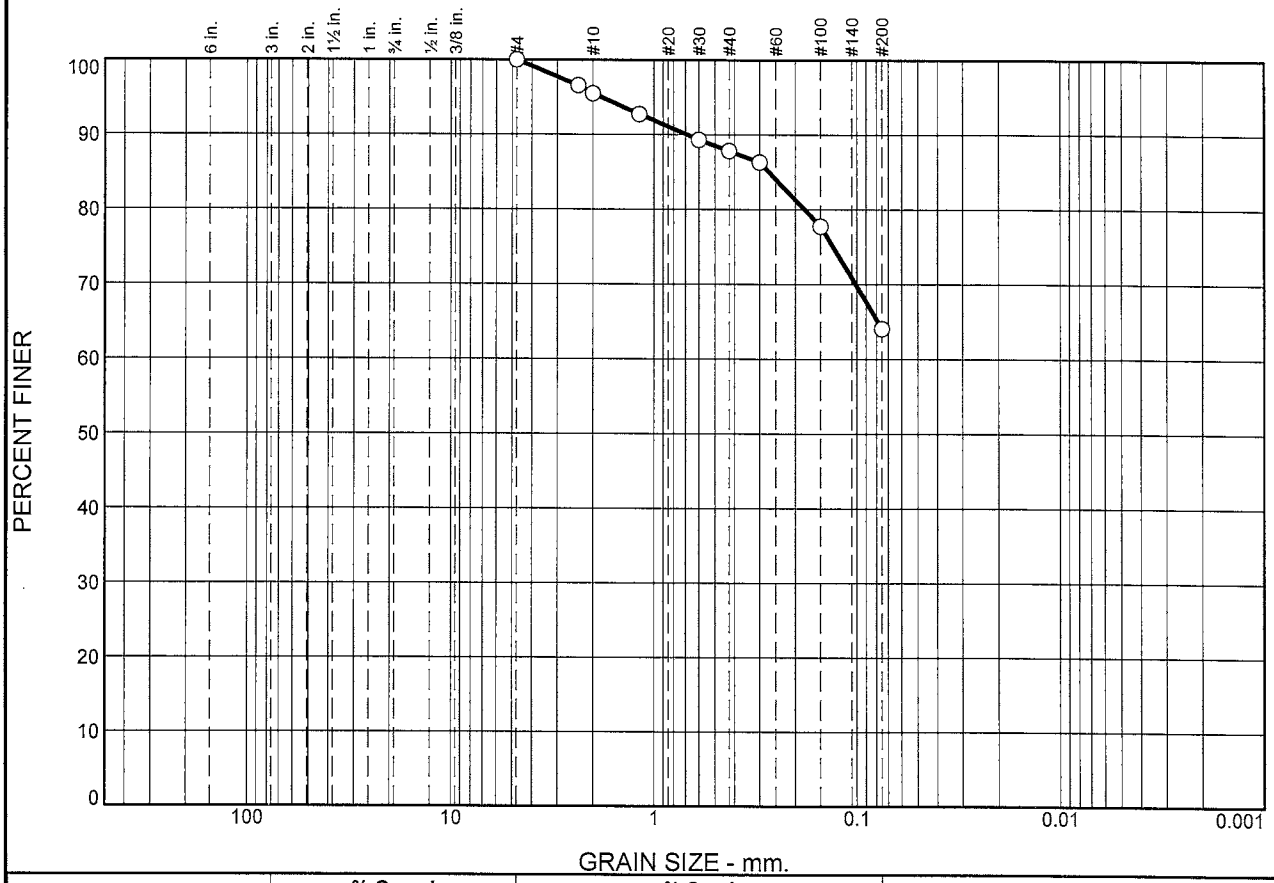
7. WATER SOLUBLE SALT AND SOLUBILITY

One test was performed on selected soil samples to determine the contents of soluble sodium, soluble sulfate, total available sodium sulfate, and total soluble solids (i.e. solubility). The test was performed by Silver State Analytical Laboratories. The results of the test are shown on Figure B-21.

8. CORROSIVITY TESTS

Thirteen suites of chemical corrosivity tests were performed on selected soil samples to aid in evaluating the corrosiveness of the on-site soils to buried metal. The suite of chemical corrosivity tests included the pH, reduction-oxidation (red-ox) potential, and the contents of sulfate, sulfide, total salts and chloride. The chemical tests were performed by Atlas Consultants, Inc. The test results are presented on Figures B-22 through B-35.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	4	8	24	64	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	97		
#10	96		
#16	93		
#30	89		
#40	88		
#50	86		
#100	78		
#200	64		

* (no specification provided)

Material Description

Sandy lean clay

Atterberg Limits

PL= 14 LL= 29 PI= 15

Classification

USCS= CL AASHTO= A-6(7)

Remarks

SAMPLED BY: E. WANG
AASHTO T 27

Location: BORING B-1 @ 10.0'-15.0'
Sample Number: B-1 **Depth:** 10.0'-15.0' **Date:** 8/8/16

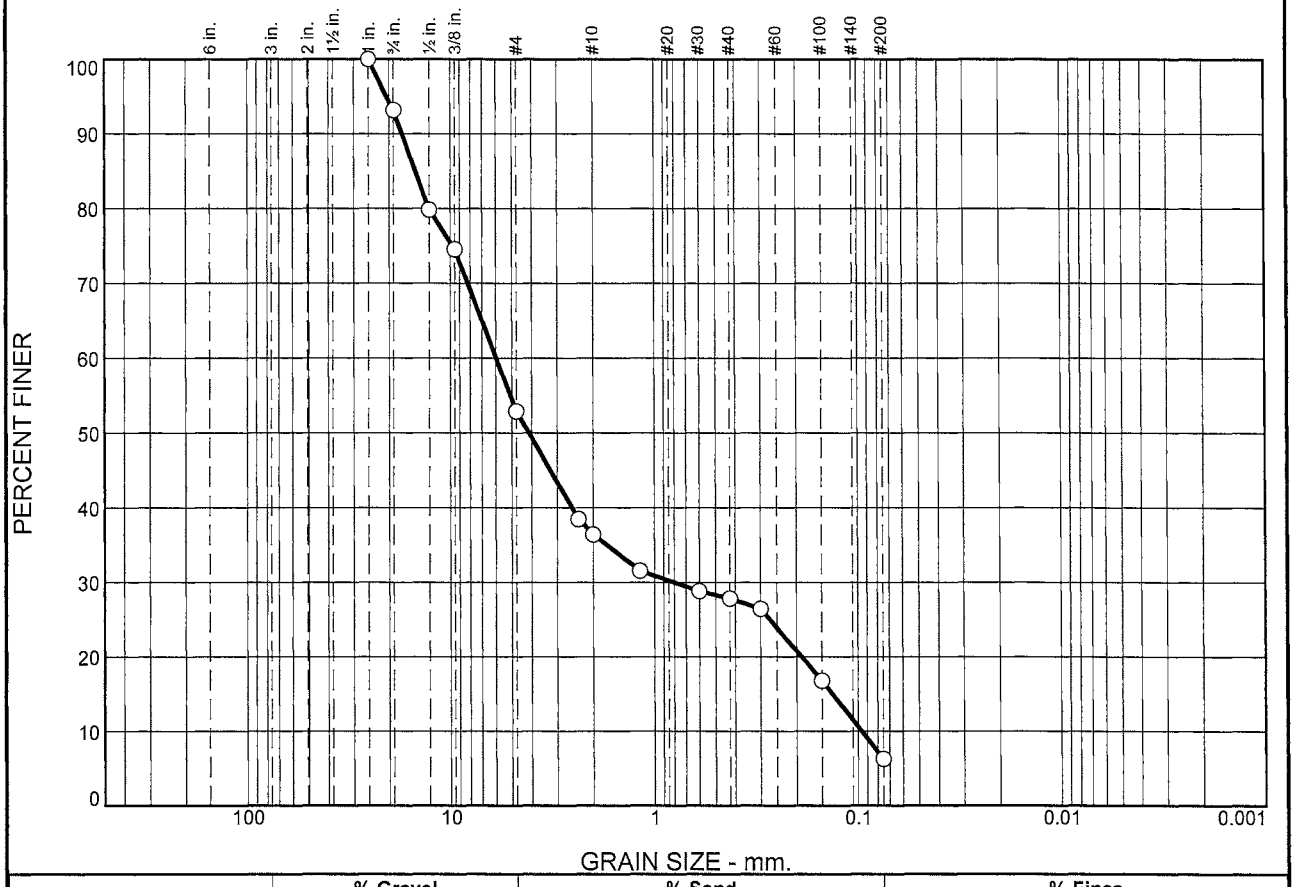
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-1

Tested By: T. FULLER

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	7	40	17	8	22	6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100		
.75	93		
.5	80		
.375	75		
#4	53		
#8	39		
#10	36		
#16	32		
#30	29		
#40	28		
#50	26		
#100	17		
#200	6.3		

* (no specification provided)

Material Description

Well-graded gravel with clay and sand

Atterberg Limits

PL= 17 LL= 25 PI= 8

Classification

USCS= GW-GC AASHTO= A-2-4(0)

Remarks

SAMPLED BY: E. WANG
AASHTO T 27

Location: BORING B-2 @ 10.0'-11.5'
Sample Number: B-2 **Depth:** 10.0'-11.5' **Date:** 8/2/16

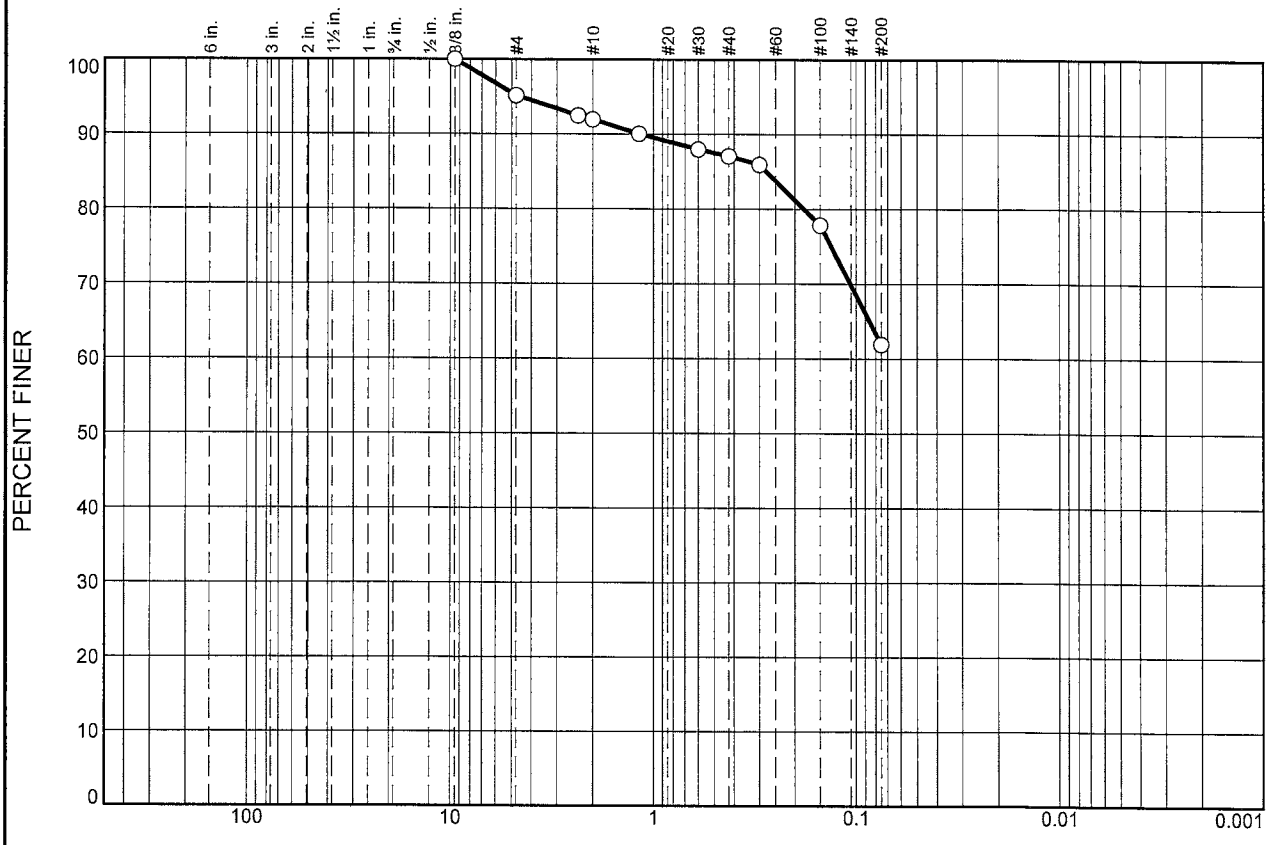
GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-2

Tested By: T. FULLER

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	5	3	5	25	62	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	95		
#8	92		
#10	92		
#16	90		
#30	88		
#40	87		
#50	86		
#100	78		
#200	62		

* (no specification provided)

Material Description

Sandy lean clay

Atterberg Limits

PL= 14 LL= 29 PI= 15

Classification

USCS= CL AASHTO= A-6(6)

Remarks

SAMPLED BY: E. WANG
AASHTO T 27

Location: BORING B-3 @ 10.0'-15.0'
Sample Number: B-3 **Depth:** 10.0'-15.0' **Date:** 8/2/16

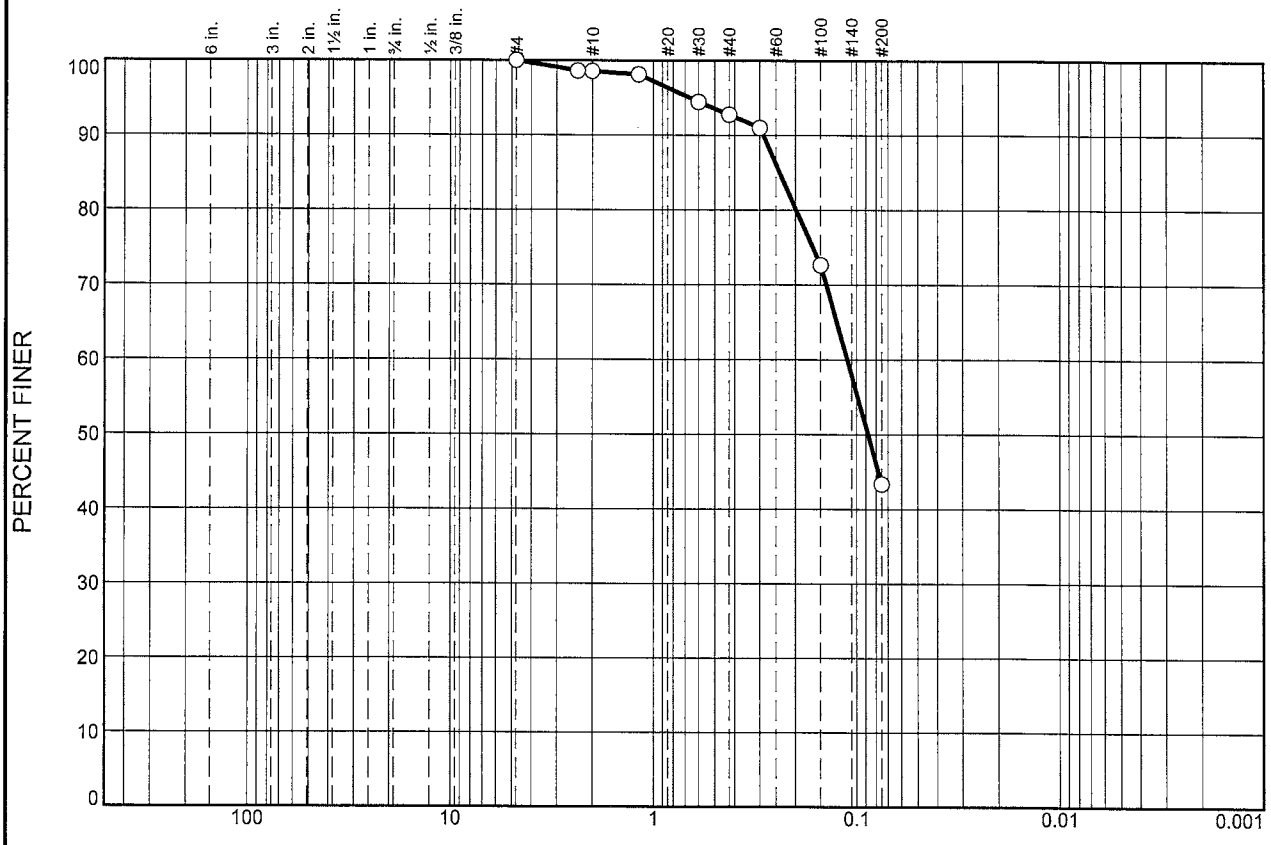
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-3

Tested By: S. COX

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	1	6	50	43	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	99		
#10	99		
#16	98		
#30	94		
#40	93		
#50	91		
#100	73		
#200	43		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Classification

USCS= SM AASHTO= A-4(0)

Remarks

SAMPLED BY: E. WANG
AASHTO T 27

Location: BORING B-4 @ 6.0'-7.5'
Sample Number: B-4 **Depth:** 6.0'-7.5' **Date:** 8/4/16

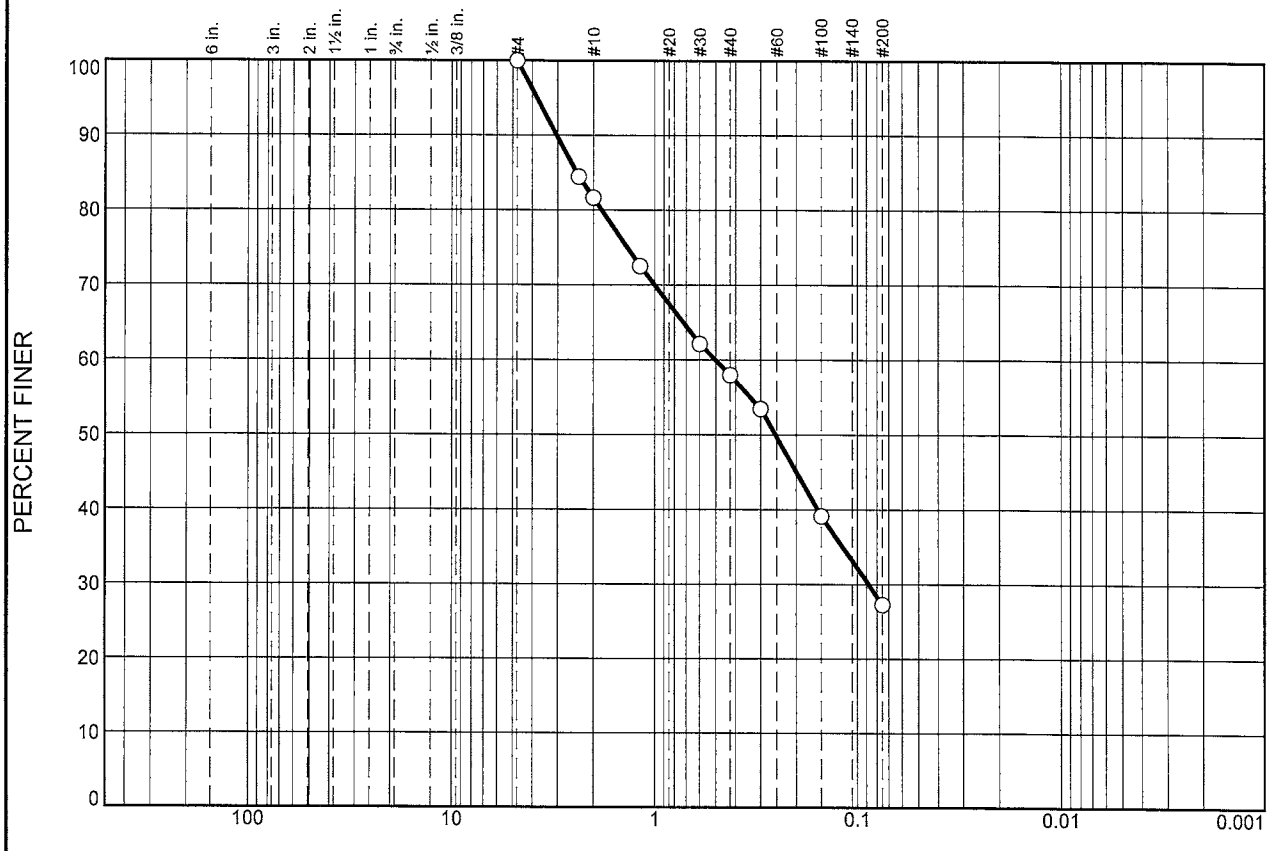
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-4

Tested By: S. COX

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	18	24	31	27	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	84		
#10	82		
#16	73		
#30	62		
#40	58		
#50	53		
#100	39		
#200	27		

* (no specification provided)

Material Description

Sandy lean clay

Atterberg Limits

PL= N/A LL= N/A PI= N/A

Classification

USCS= CL AASHTO= N/A

Remarks

SAMPLED BY: E. WANG
AASHTO T 27

Location: BORING B-5 @ 6.0'-7.5'
Sample Number: B-5 **Depth:** 6.0'-7.5' **Date:** 8/4/16

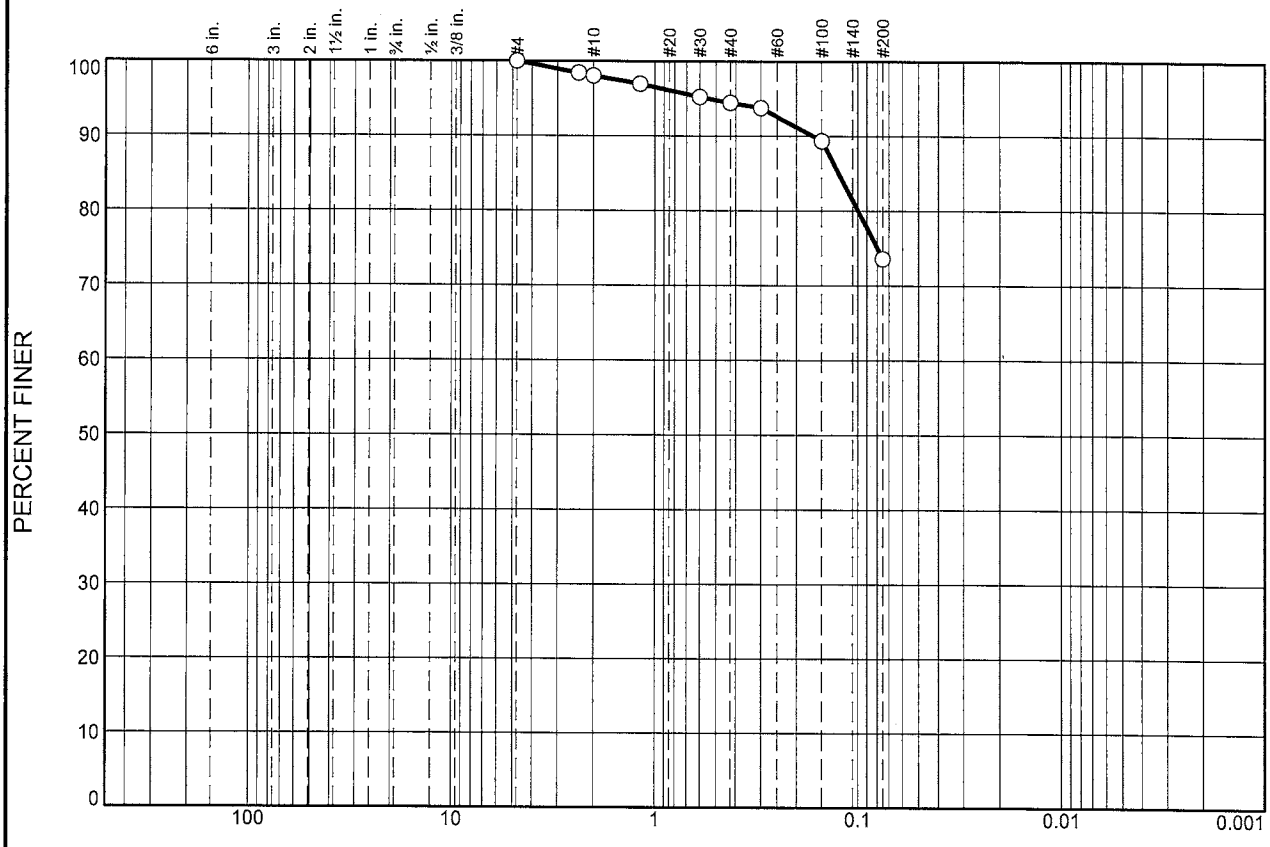
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-5

Tested By: S. COX

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	2	4	20	74	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	98		
#10	98		
#16	97		
#30	95		
#40	94		
#50	94		
#100	89		
#200	74		

* (no specification provided)

Material Description

Fat clay with sand

Atterberg Limits

PL= 30 LL= 103 PI= 73

Classification

USCS= CH AASHTO= A-7-5(57)

Remarks

SAMPLED BY: E. WANG
AASHTO T27

Location: BORING B-6 @ 7.0'-12.0'
Sample Number: B-6 **Depth:** 7.0'-12.0' **Date:** 8/8/16

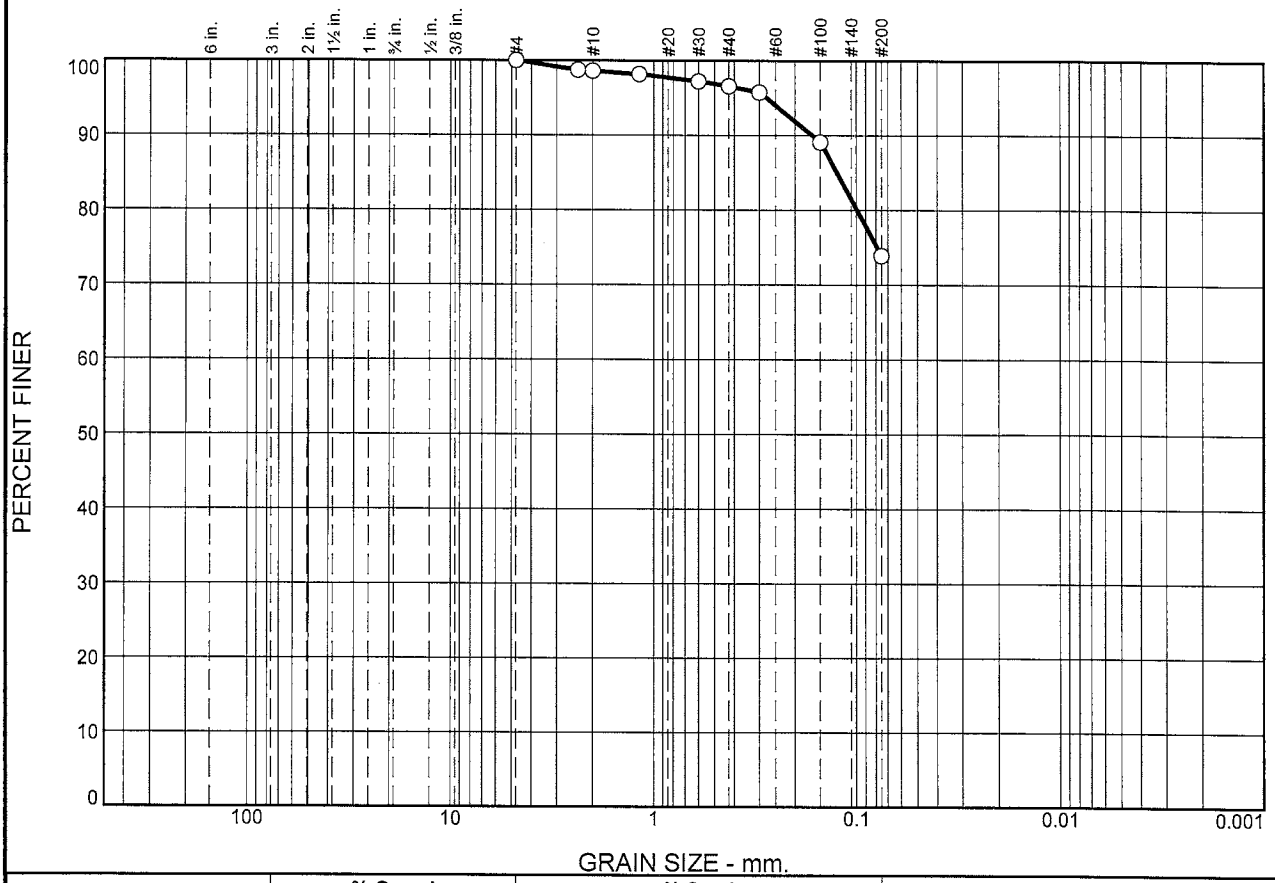
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-6

Tested By: T. FULLER

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	1	2	23	74	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	99		
#10	99		
#16	98		
#30	97		
#40	97		
#50	96		
#100	89		
#200	74		

* (no specification provided)

Material Description

Lean clay with sand

Atterberg Limits

PL= 18 LL= 35 PI= 17

Classification

USCS= CL AASHTO= A-6(11)

Remarks

SAMPLED BY: E. WANG
AASHTO T 27

Location: BORING B-7 @ 7.0'-12.0'
Sample Number: B-7 **Depth:** 7.0'-12.0' **Date:** 8/8/16

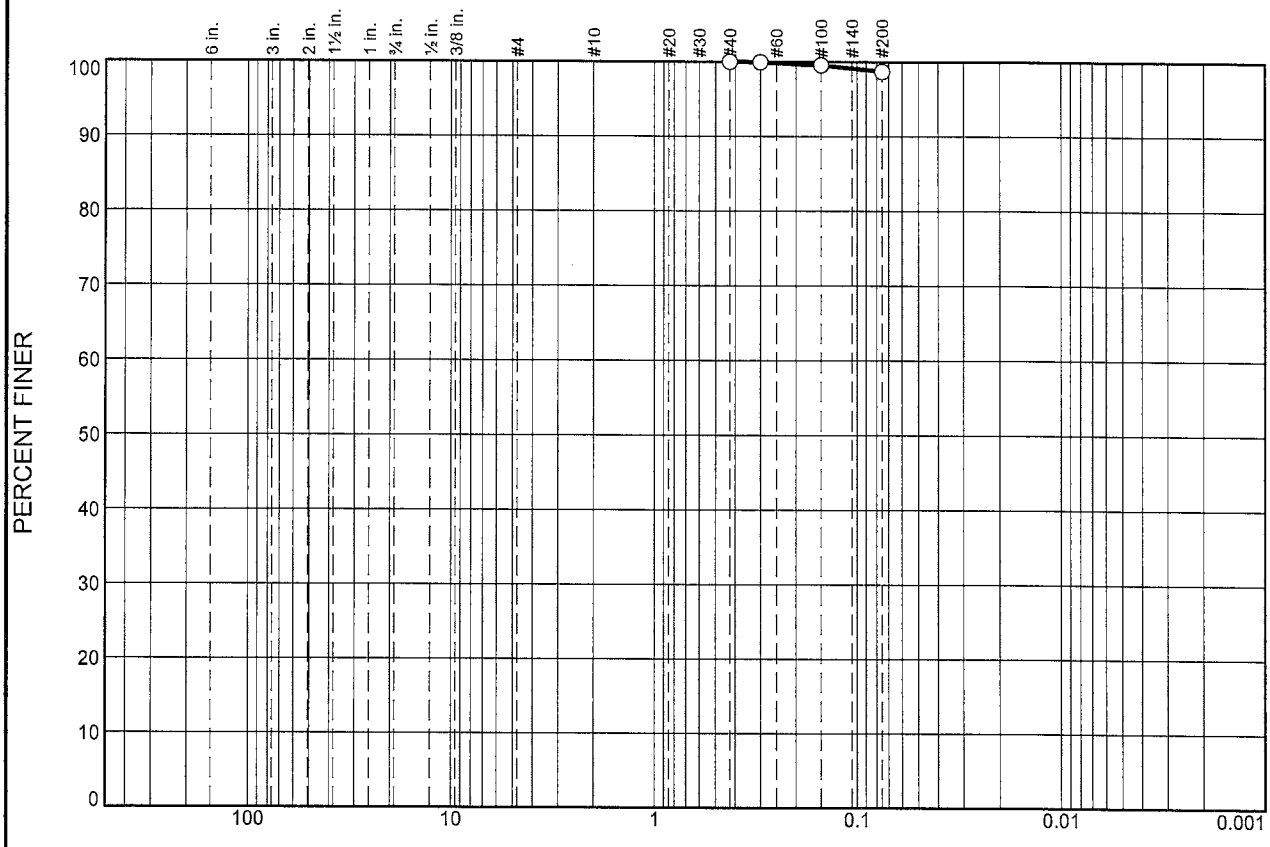
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-7

Tested By: T. FULLER

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	1	99	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#40	100		
#50	100		
#100	100		
#200	99		

* (no specification provided)

Material Description

Lean clay

Atterberg Limits

PL= 21 LL= 38 PI= 17

Classification

USCS= CL AASHTO= A-6(18)

Remarks

SAMPLED BY: E. WANG
AASHTO T 27

Location: BONRING B-8 @ 20.0-21.5'
Sample Number: B-8 **Depth:** 20.0'-21.5' **Date:** 8/17/16

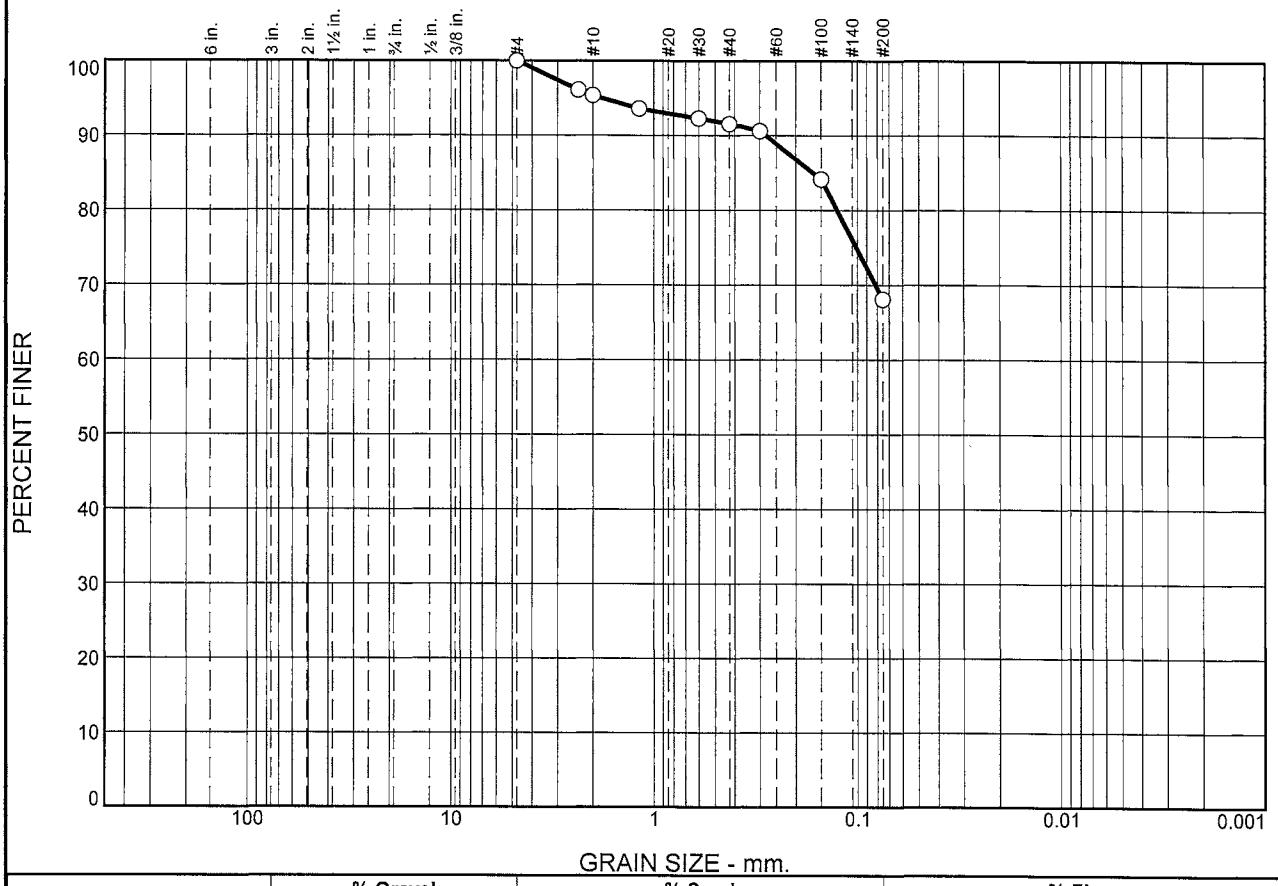
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-8

Tested By: A. SANDERS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	5	3	24	68	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	96		
#10	95		
#16	94		
#30	92		
#40	92		
#50	91		
#100	84		
#200	68		

* (no specification provided)

Material Description

Sandy lean clay

Atterberg Limits

PL= 19 LL= 47 PI= 28

Classification

USCS= CL AASHTO= A-7-6(17)

Remarks

SAMPLED BY:E. WANG
AASHTO T27

Location: BORING B-9 @ 5.0'-6.5'
Sample Number: B-9 **Depth:** 5.0'-6.5' **Date:** 07/14/16

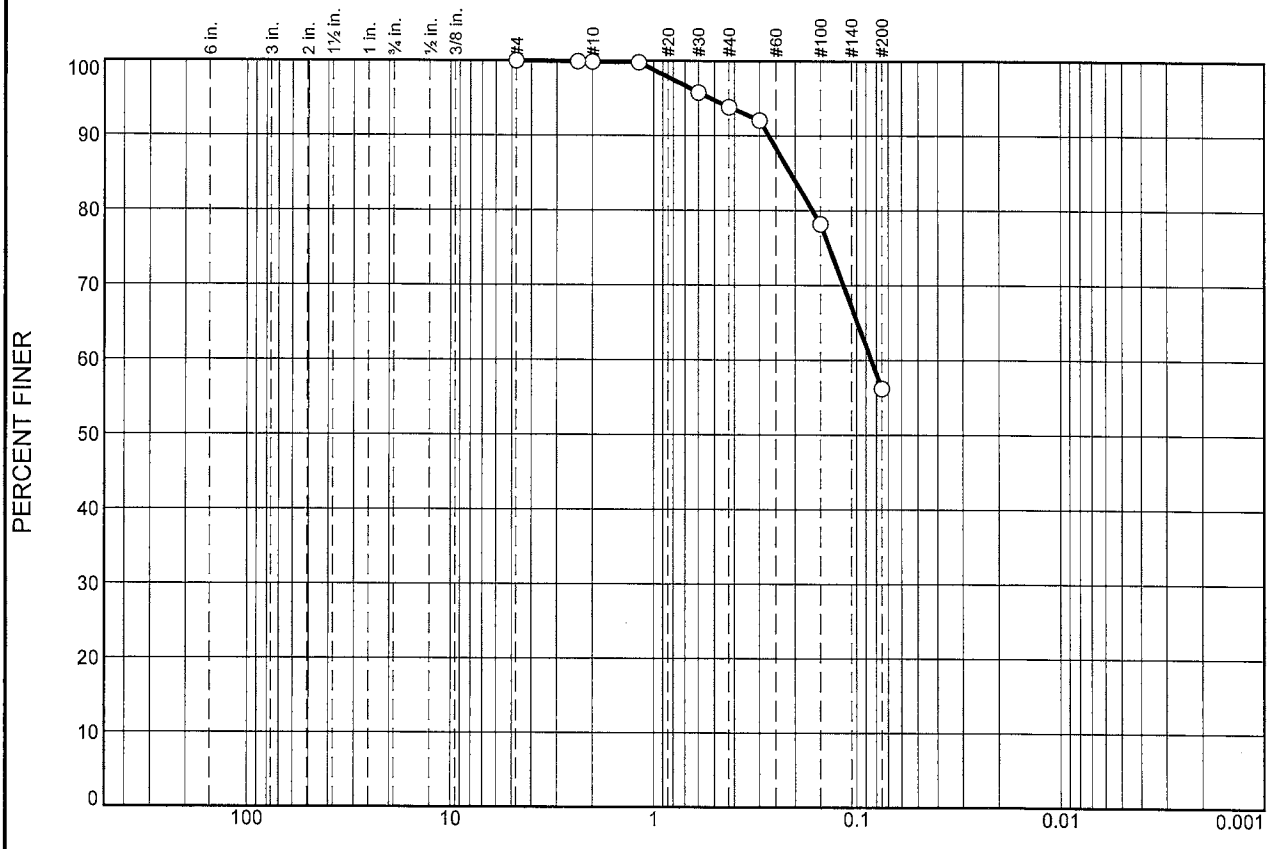
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-9

Tested By: K. KIMBLE

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	6	38	56	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#10	100		
#16	100		
#30	96		
#40	94		
#50	92		
#100	78		
#200	56		

* (no specification provided)

Material Description

Sandy lean clay

Atterberg Limits

PL= 16 LL= 27 PI= 11

Classification

USCS= CL AASHTO= A-6(3)

Remarks

SAMPLED BY:E. WANG
AASHTO T27

Location: BORING B-10 @ 10.0'-11.5'
Sample Number: B-10 **Depth:** 10.0'-11.5' **Date:** 07/14/16

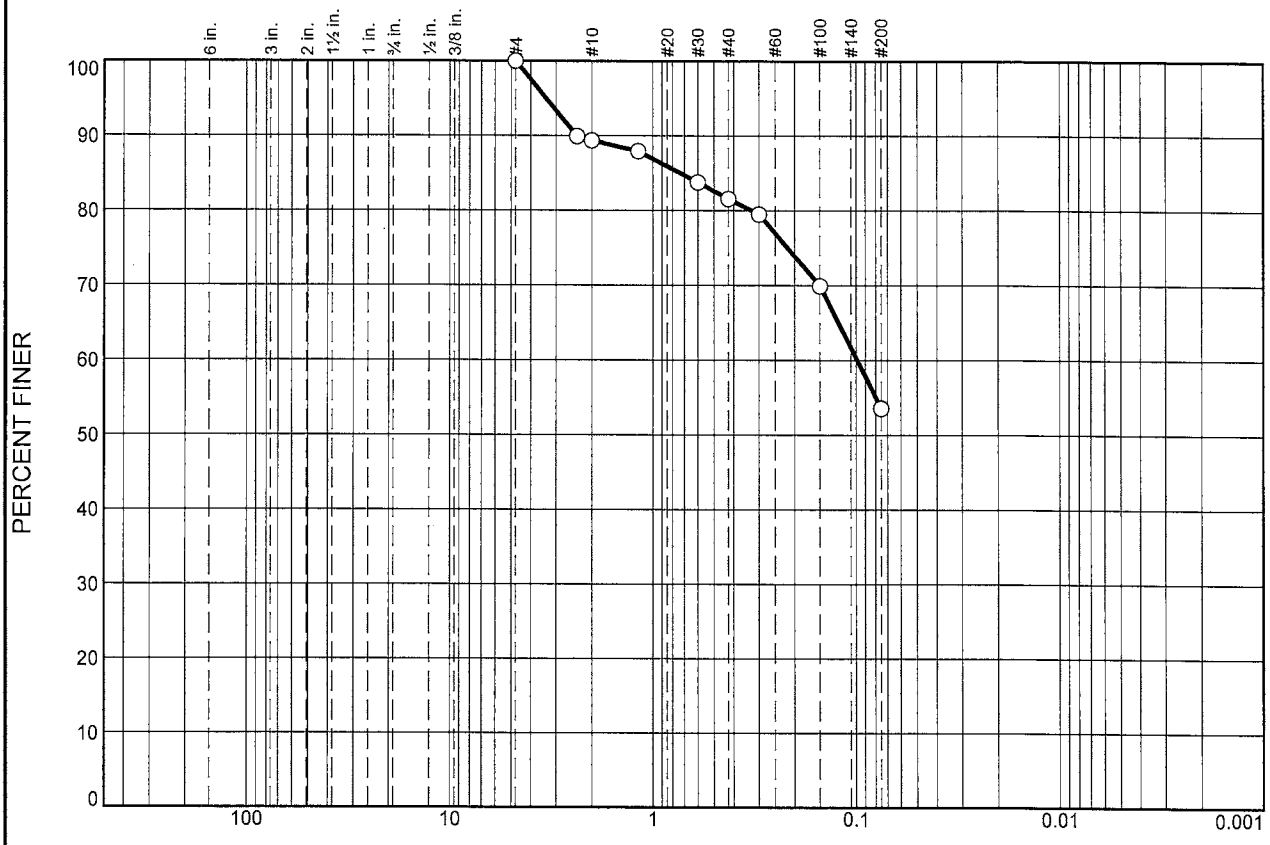
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-10

Tested By: K. KIMBLE

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	11	7	28	54	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	90		
#10	89		
#16	88		
#30	84		
#40	82		
#50	80		
#100	70		
#200	54		

* (no specification provided)

Material Description

Sandy lean clay

Atterberg Limits

PL= 17 LL= 33 PI= 16

Classification

USCS= CL AASHTO= A-6(5)

Remarks

SAMPLED BY:E. WANG
AASHTO T27

Location: BORING B-11 @ 15.0'-16.5'
Sample Number: B-11 **Depth:** 15.0'-16.5' **Date:** 07/14/16

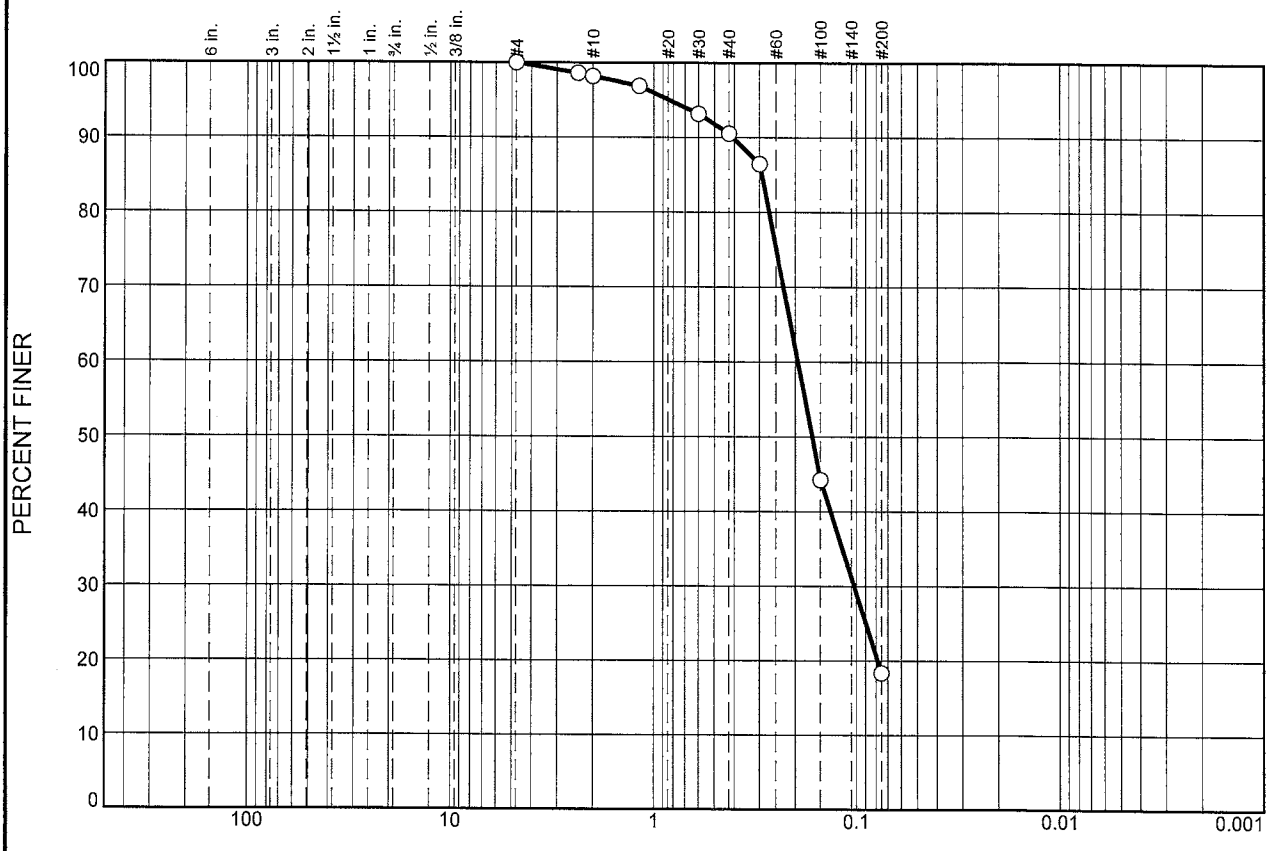
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-11

Tested By: K. KIMBLE

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	2	7	73	18	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	99		
#10	98		
#16	97		
#30	93		
#40	91		
#50	86		
#100	44		
#200	18		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

SAMPLED BY:E. WANG
AASHTO T27

Location: BORING B-12 @ 5.0'-6.5'
Sample Number: B-12 **Depth:** 5.0'-6.5' **Date:** 07/14/16

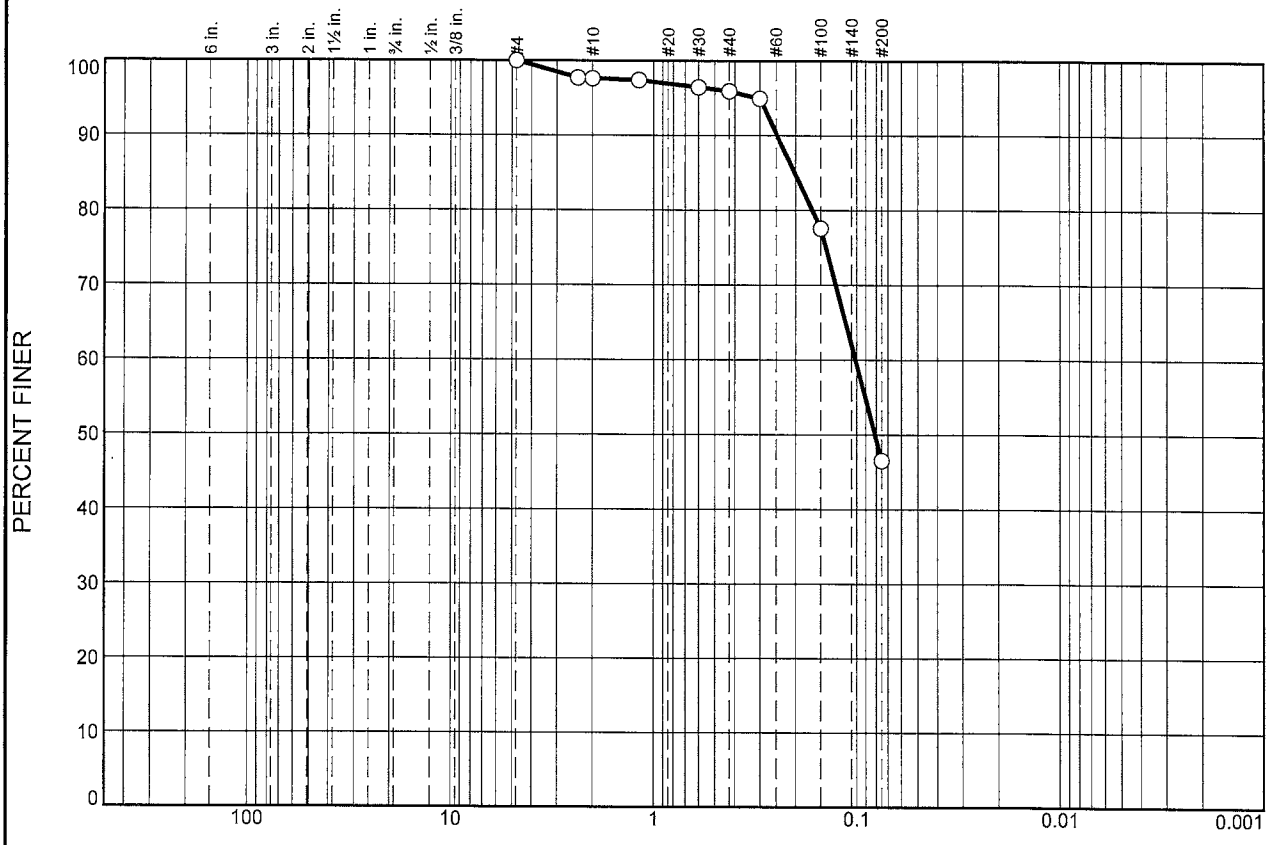
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-12

Tested By: K. KIMBLE

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	2	2	49	47	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	98		
#10	98		
#16	97		
#30	96		
#40	96		
#50	95		
#100	78		
#200	47		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Classification

USCS= SM AASHTO= A-4(0)

Remarks

SAMPLED BY:E. WANG
AASHTO T27

Location: BORING B-13 @ 10.0'-11.5'
Sample Number: B-13 **Depth:** 10.0'-11.5' **Date:** 7/11/16

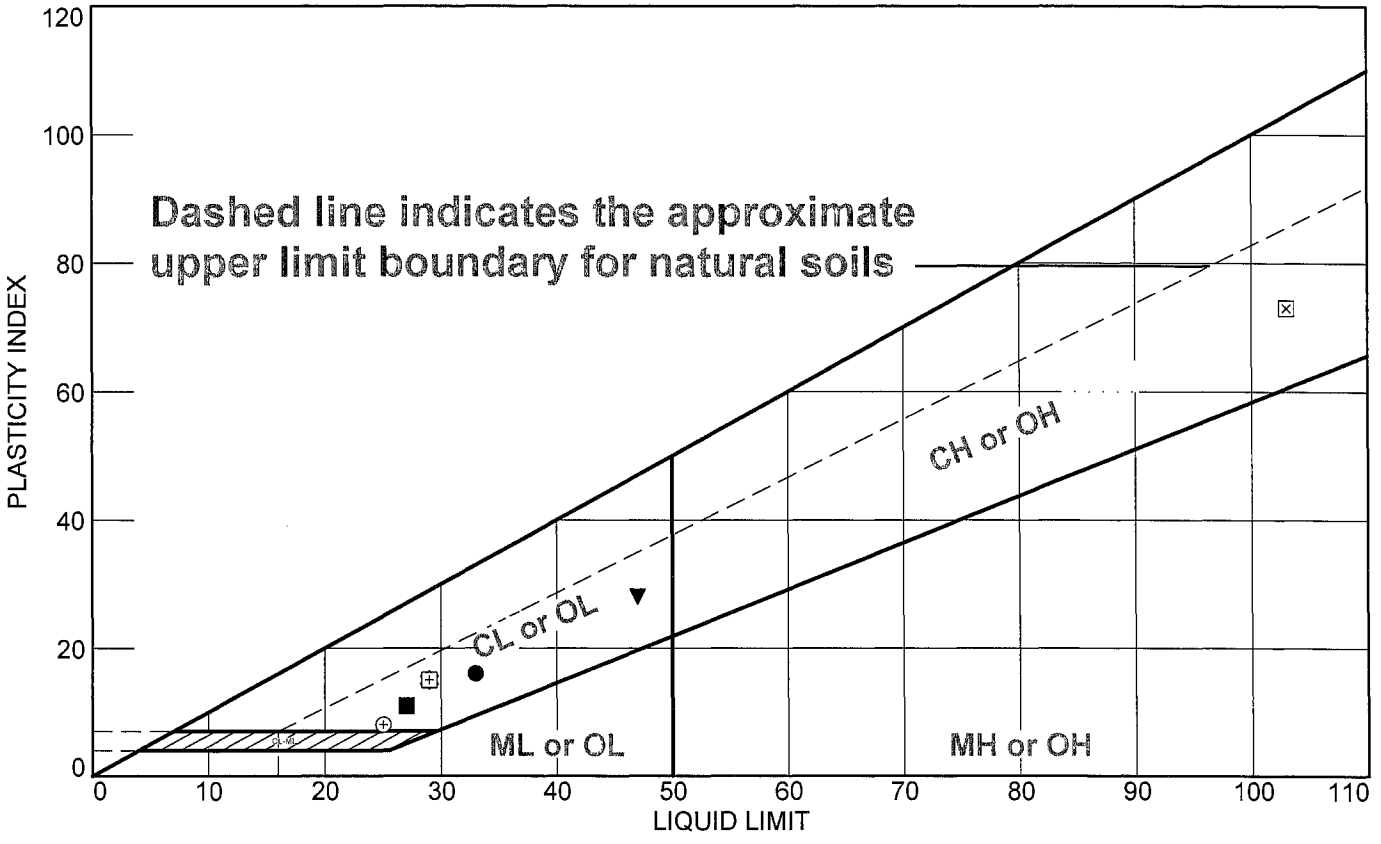
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-13

Tested By: T. FULLER

LIQUID AND PLASTIC LIMITS TEST REPORT



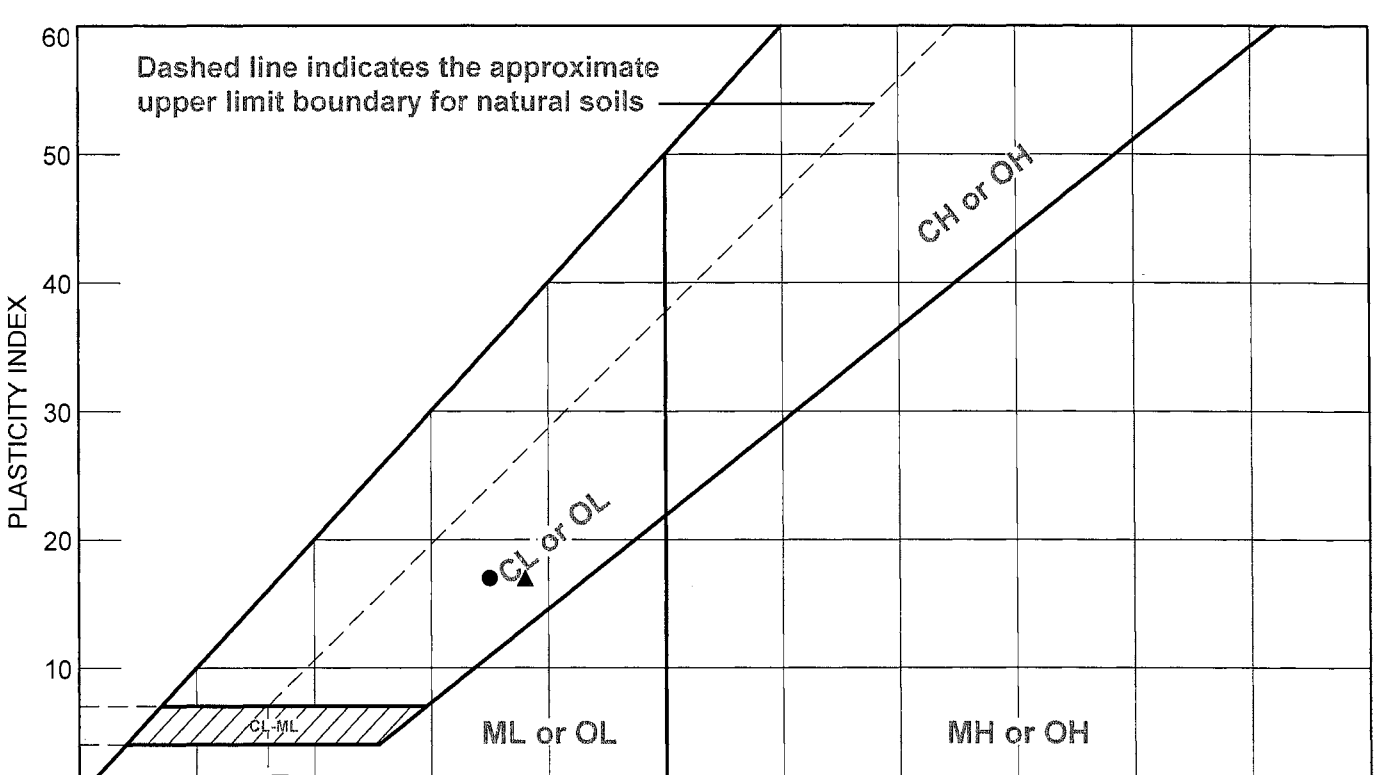
SOIL DATA								
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	LAB #16-274	B-11	15.0'-16.5'		17	33	16	CL
■	LAB #16-274	B-10	10.0'-11.5'		16	27	11	CL
▲	LAB #16-274	B-12	5.0'-6.5'		NP	NV	NP	SM
◆	LAB #16-274	B-13	10.0'-11.5'		NP	NV	NP	SM
▼	LAB #16-274	B-9	5.0'-6.5'		19	47	28	CL
✱	LAB #16-325	B-1	10.0'-15.0'		14	29	15	CL
⊕	LAB #16-325	B-2	10.0'-11.5'		17	25	8	GW-GC
⊞	LAB #16-325	B-3	10.0'-15.0'		14	29	15	CL
⊗	LAB #16-325	B-4	6.0'-7.5'		NP	NV	NP	SM
⊠	LAB #16-325	B-6	7.0'-12.0'		30	103	73	CH

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN
Project No.: 20153837E1 **Figure** B-14

Tested By: ○ C. RAMOS □ C. RAMOS △ C. RAMOS ◇ C. RAMOS ▽ C. RAMOS ✱ C. RAMOS ⊕ C. BYER ⊞ C

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	LAB #16-325	B-7	7.0'-12.0'		18	35	17	CL
■	LAB #16-353	B-5	10-11.5		16	17	1	
▲	LAB #16-355	B-8	20.0'-21.5'		21	38	17	CL

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN
Project No.: 20153837E1 **Figure** B-15

Tested By: ● C. RAMOS ■ C. BYER ▲ A. SANDERS

GEOTECHNICAL &
ENVIRONMENTAL
SERVICES, INC.

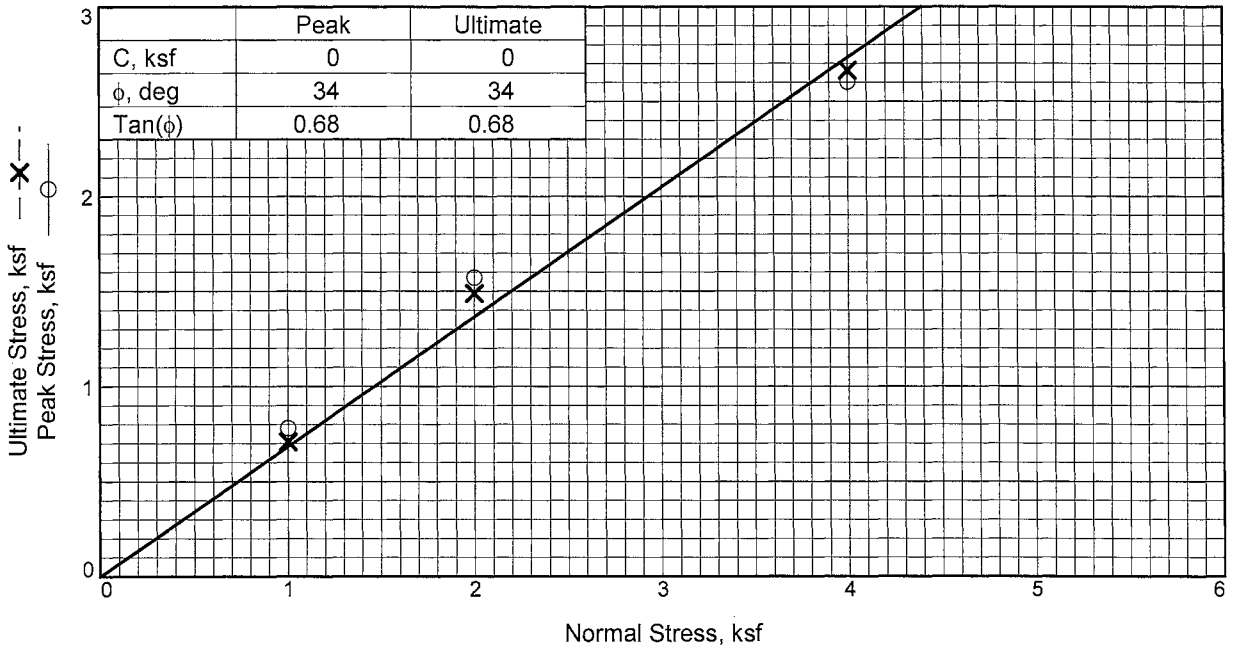
SWELL TEST SUMMARY

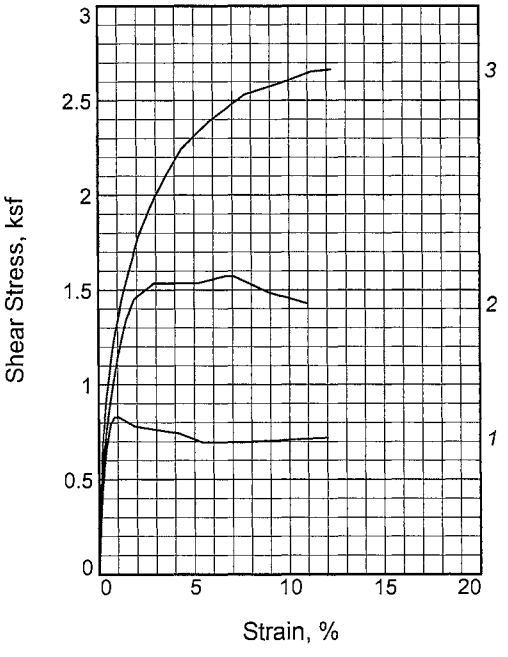
7150 PLACID STREET
LAS VEGAS NV, 89119
1-702-365-1001

Project Name: BOULDER HIGHWAY STORM DRAIN
Project No.: 20153837E1
Sample Dates: 7/5/2015
Client: ATKINS NORTH AMERICA, INC
Test Method: SNBC 1803.5.3.2
Report Date: 7/18/2016

LAB NUMBER	SAMPLE LOCATION	SAMPLE DEPTH (feet)	SOIL TYPE (USCS)	TEST CONDITION	SURCHARGE LOAD (psf)	INITIAL DRY DENSITY[1] (pcf)	INITIAL MOISTURE CONTENT[2] (%)	FINAL MOISTURE CONTENT (%)	EXPANSION[3] (%)
16-274-1	Boring B-10	10.0-11.5	CL	INSITU	60	82.1	47.2	53.2	0
16-274-2	Boring B-13	10.0-11.5	SM	INSITU	60	118.2	10.2	10.2	1
16-325	Boring B-1	10.0-15.0	CL	Remolded	60	114.0	8.3	14.5	3
16-325	Boring B-3	10.0-15.0	CL	Remolded	60	112.1	8.6	16.2	4
16-325	Boring B-5	6.0-7.5	CL	In Situ	60	109.0	13.9	16.1	-3
16-325	Boring B-7	6.0-7.5	CL	In Situ	60	86.0	15.1	22.6	-4
16-325	Boring B-7	7.0-12.0	CL	Remolded	60	114.1	7.6	14.9	3
16-355	Boring B-8	20-21.5	N/A	IN-SITU	60	100.8	25.0	25.9	6

1 Remolded samples were remolded to approximately 90% of the estimated soil maximum dry density (ASTM D 1557).
2 Moisture content prior to oven drying.
3 Positive values refer to swell. Negative values refer to collapse.





Sample No.		1	2	3
Initial	Water Content, %	12.8	12.8	14.1
	Dry Density, pcf	117.4	111.1	111.7
	Saturation, %	83.2	69.5	77.4
	Void Ratio	0.4087	0.4889	0.4811
	Diameter, in.	2.416	2.416	2.416
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	12.6	10.9	10.6
	Dry Density, pcf	117.4	111.1	111.7
	Saturation, %	81.4	59.3	58.6
	Void Ratio	0.4087	0.4889	0.4811
	Diameter, in.	2.416	2.416	2.416
	Height, in.	1.000	1.000	1.000
Normal Stress, ksf		1.000	2.000	4.000
Peak Stress, ksf		0.780	1.572	2.604
Strain, %		1.9	7.0	9.9
Ultimate Stress, ksf		0.708	1.488	2.664
Strain, %		9.8	8.9	12.2
Strain rate, in./min.		0.074	0.057	0.053

Sample Type:
Description:

Assumed Specific Gravity= 2.65
Remarks:

Figure B-17

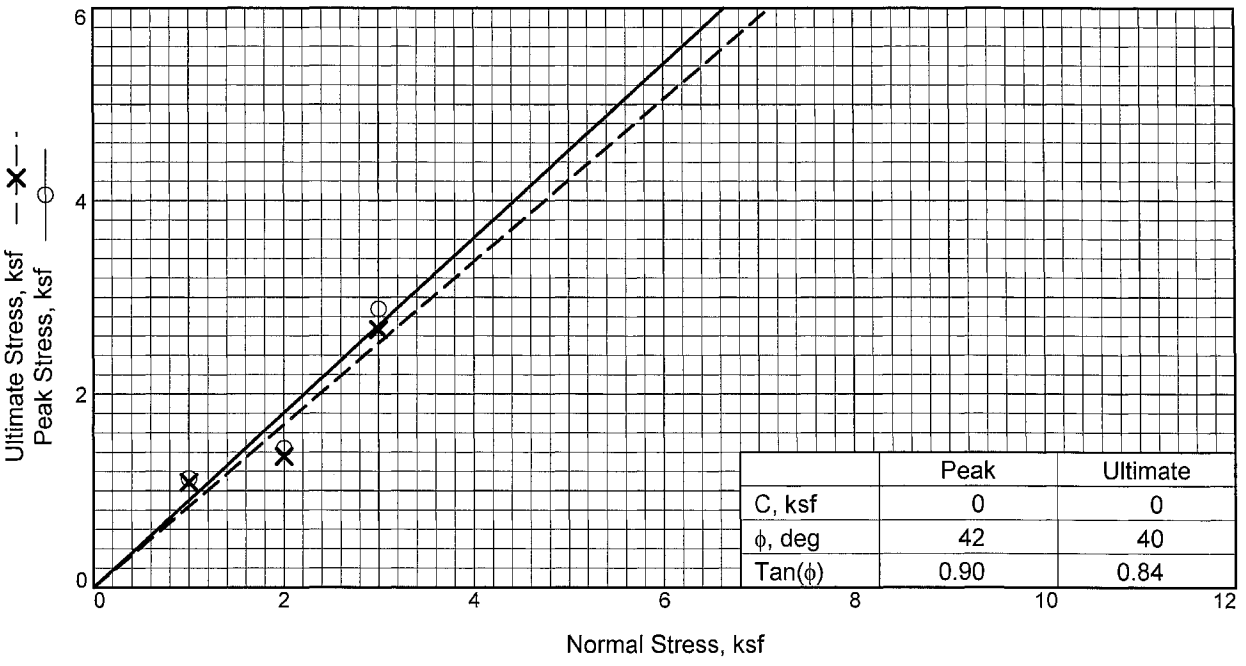
Client: ATKINS

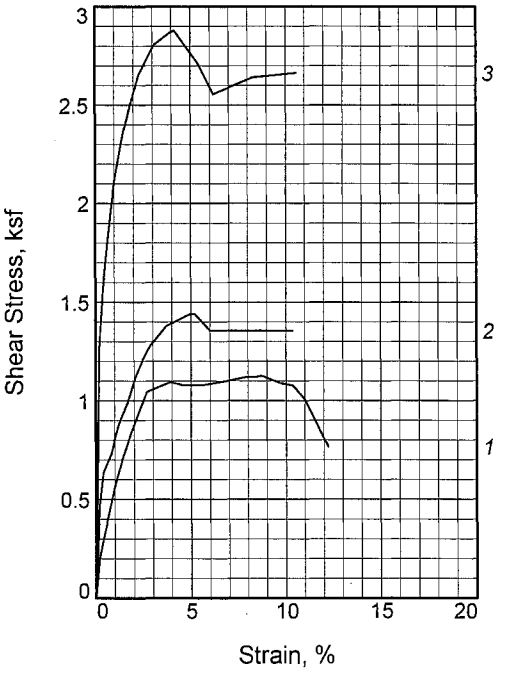
Project: BOULDER HIGHWAY STORM DRAIN

Location: BORING B-1 @ 15.0'-16.5'
Sample Number: B-1 **Depth:** 15.0'-16.5'
Proj. No.: 20153837E1 **Date Sampled:** 7/25/16

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Tested By: A. SANDERS





Sample No.		1	2	3
Initial	Water Content, %	16.0	16.0	16.0
	Dry Density, pcf	110.6	101.3	106.9
	Saturation, %	85.5	66.8	77.4
	Void Ratio	0.4955	0.6336	0.5470
	Diameter, in.	2.416	2.416	2.416
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	14.1	13.9	14.9
	Dry Density, pcf	110.6	101.3	106.9
	Saturation, %	75.6	58.0	72.0
	Void Ratio	0.4955	0.6336	0.5470
	Diameter, in.	2.416	2.416	2.416
	Height, in.	1.000	1.000	1.000
Normal Stress, ksf		1.000	2.000	3.000
Peak Stress, ksf		1.127	1.440	2.880
Strain, %		8.7	5.2	4.1
Ultimate Stress, ksf		1.088	1.356	2.664
Strain, %		9.7	10.3	10.6
Strain rate, in./min.		0.054	0.057	0.054

Sample Type:
Description:

Assumed Specific Gravity= 2.65
Remarks:

Client: ATKINS

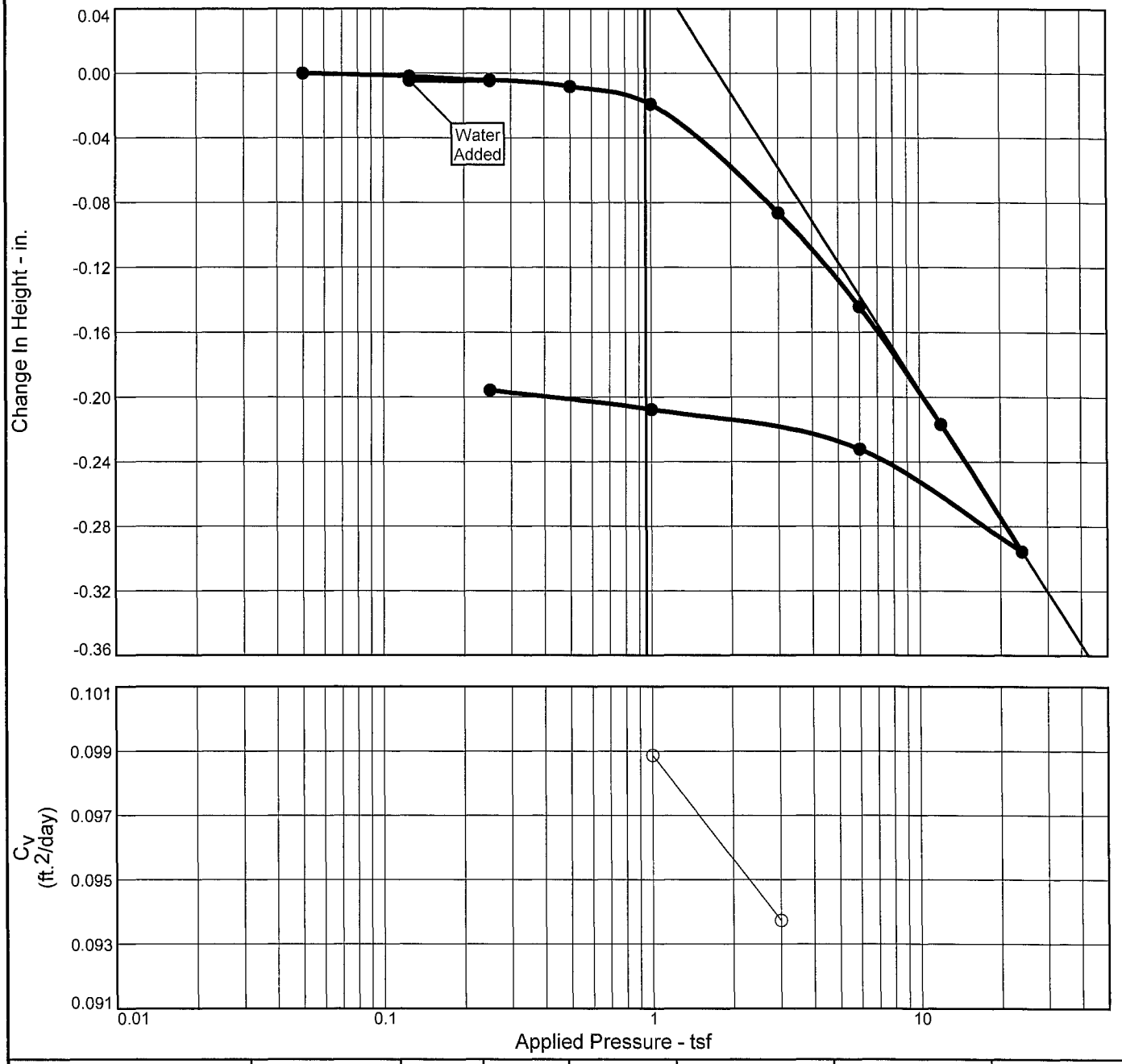
Project: BOULDER HIGHWAY STORM DRAIN

Location: BORING B-7 @ 15.0'-16.5'
Sample Number: B-7 **Depth:** 15.0'-16.5'
Proj. No.: 20153837E1 **Date Sampled:** 7/27/16

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure B-18

CONSOLIDATION



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
80.8 %	37.6 %	74.1	N/A	N/A	2.65	N/A	N/A	1.234

MATERIAL DESCRIPTION

CLAY

Project No. 20153837E1 **Client:** ATKINS

Project: BOULDER HIGHWAY STORM DRAIN

Loc.: BORING B-3 @ 20.0'-21.5' **Depth:** 20.0'-21.5' **Sample No.:** B-3

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Remarks:

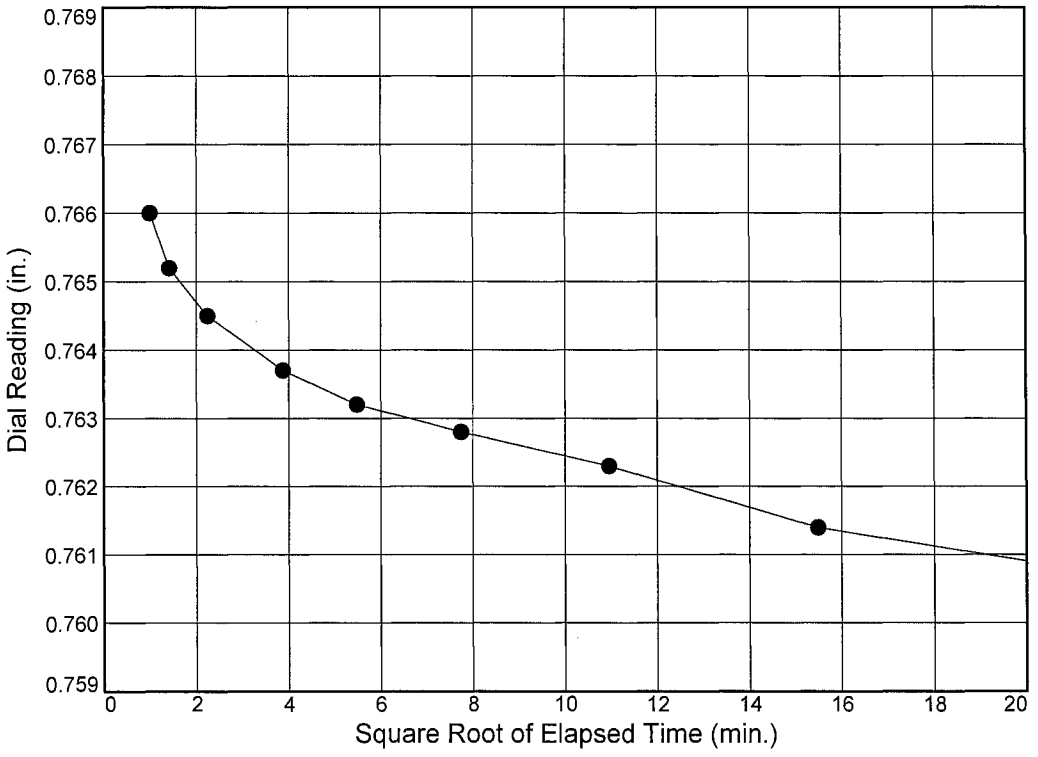
Figure B-19

Tested By: A. SANDERS

Dial Reading vs. Time

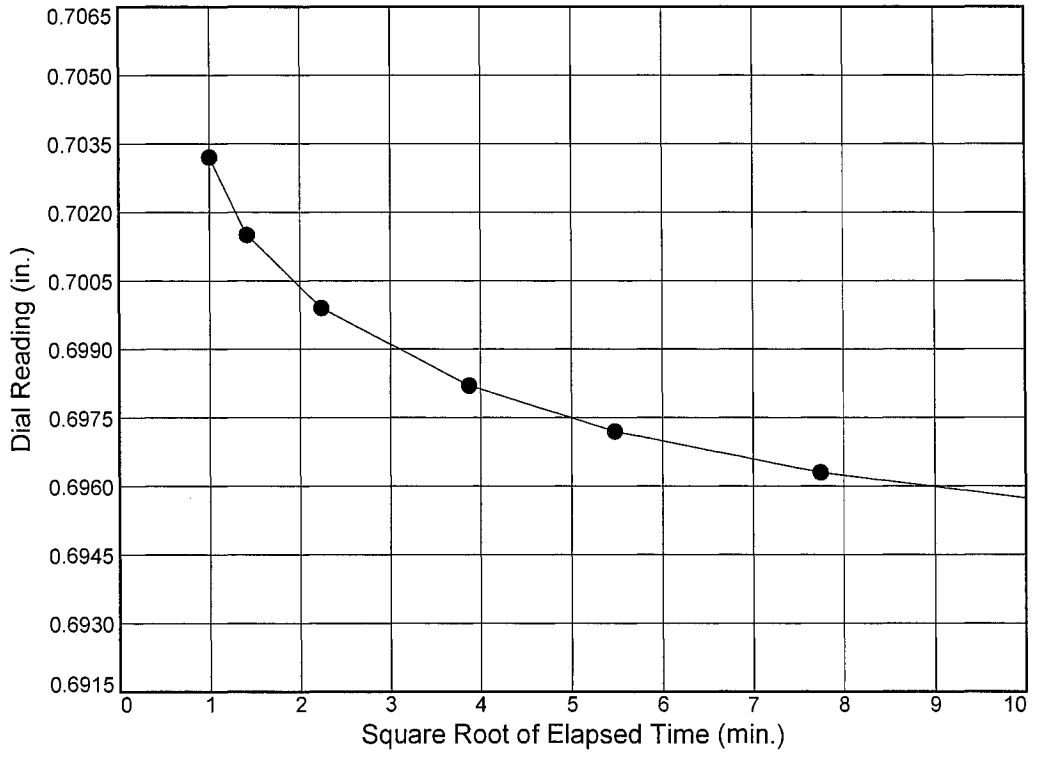
Project No.: 20153837E1
Project: BOULDER HIGHWAY STORM DRAIN

Location: BORING B-3 @ 20.0'-21.5' Depth: 20.0'-21.5' Sample Number: B-3



Load No.= 8
Load= 1.00 tsf
D_0 = 0.7664
D_{90} = 0.7635
D_{100} = 0.7632
T_{90} = 20.86 min.

C_v @ T_{90}
0.099 ft.^{2}/day

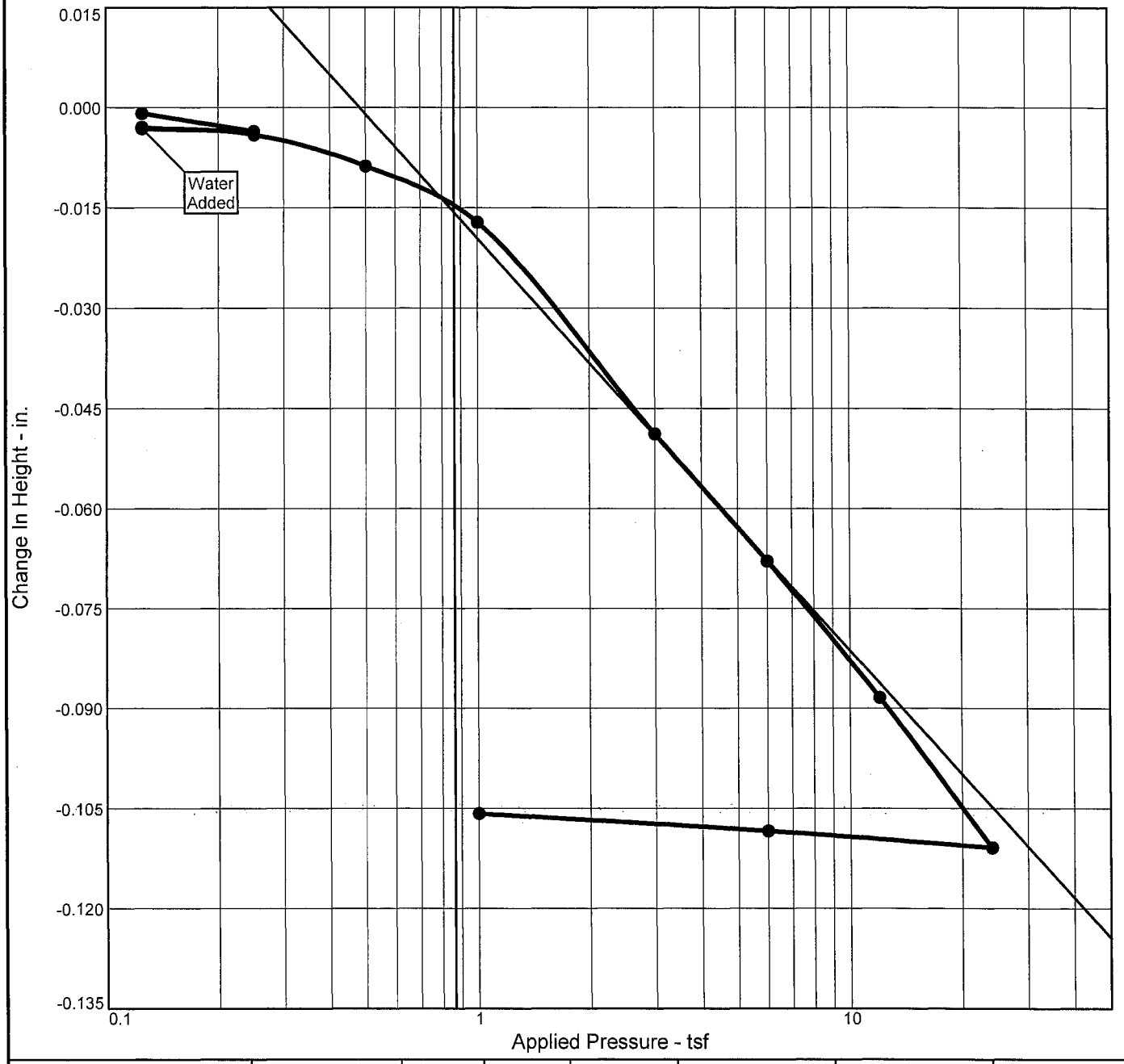


Load No.= 9
Load= 3.00 tsf
D_0 = 0.7042
D_{90} = 0.6978
D_{100} = 0.6971
T_{90} = 20.29 min.

C_v @ T_{90}
0.094 ft.^{2}/day

Figure B-19

CONSOLIDATION



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
96.0 %	21.8 %	103.3	N/A	N/A	2.65	N/A	N/A	0.602

MATERIAL DESCRIPTION

Project No. 20153837E1 **Client:** ATKINS

Project: BOULDER HIGHWAY STORM DRAIN

Loc.: BORING B-9 @ 20.0'-21.5' **Depth:** 20.0'-21.5' **Sample No.:** B-9

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Remarks:

Figure B-20

Tested By: A. SANDERS

SilverState Analytical Laboratories
Sierra Environmental Monitoring

Silver State Labs-Las Vegas
3626 E. Sunset Road, Suite 100
Las Vegas, NV 89120
(702) 873-4478 FAX: (702) 873-7967
www.ssalabs.com

Analytical Report

WO#: 16080036
Date Reported: 8/2/2016

CLIENT: GES
Collection Date:
Project: 20153837E1
Lab ID: 16080036-02
Matrix: SOIL
Client Sample ID: 16-325, B4 @ 6.0'-7.5'

Analyses	Result	Qual	Units	DF	Date Analyzed
SOIL 4. SULFATE, SOLUBILITY & CHLORIDE			**SM 4500 CL-B**		Analyst: **NM**
CHLORIDE - SOILS					
				5	8/2/2016 10:05:00 AM
SOIL 4. SULFATE, SOLUBILITY & CHLORIDE			**SM 2540 C**		Analyst: **NM**
TOTAL SALTS (SOLUBILITY)					
				1	8/2/2016 10:19:00 AM
SOIL 4. SULFATE, SOLUBILITY & CHLORIDE			**SM 4500 SO4 E**		Analyst: **NM**
WATER SOLUBLE SULFATE (SO4)					
				1	8/2/2016 10:04:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Revision v1

Figure B-21

SilverState Analytical Laboratories
Sierra Environmental Monitoring

Silver State Labs-Las Vegas
3626 E. Sunset Road, Suite 100
Las Vegas, NV 89120
(702) 873-4478 FAX: (702) 873-7967
www.ssalabs.com

Analytical Report

WO#: 16080253
Date Reported: 8/9/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16080253-01
Client Sample ID 16-325, B1@10-15

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	8/9/2016 12:10:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHLORIDE - SOILS				**SM 4500 CL- B**		Analyst: **NM**
Chloride	62	5.0	D	mg/Kg	5	8/8/2016 10:02:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0660	0		%	1	8/8/2016 1:55:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **NM**
pH	8.18	0		pH Units	1	8/8/2016 10:04:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	223	1.00		mV	1	8/8/2016 10:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0100	0.0100		%	1	8/8/2016 10:03:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **NM**
Solubility	0.160	0.0100		%	1	8/8/2016 9:59:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0400	0.0100		%	1	8/8/2016 10:01:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	MCL	Maximum Contaminant Level.
ND	Not Detected at the PQL.	PQL	Practical Quantitation Limit.
U	Sample was analyzed for, but not detected.		

Revision v1

Figure B-22

SilverState Analytical Laboratories
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Las Vegas, NV 89120
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Analytical Report

WO#: 16080253
Date Reported: 8/9/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16080253-02
Client Sample ID 16-325, B3@10-15

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	8/9/2016 12:10:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHLORIDE - SOILS				**SM 4500 CL- B**		Analyst: **NM**
Chloride	38	5.0	D	mg/Kg	5	8/8/2016 10:02:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0590	0		%	1	8/8/2016 1:55:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **NM**
pH	8.06	0		pH Units	1	8/8/2016 10:04:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	201	1.00		mV	1	8/8/2016 10:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	ND	0.0100		%	1	8/8/2016 10:03:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **NM**
Solubility	0.220	0.0100		%	1	8/8/2016 9:59:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.160	0.0100		%	1	8/8/2016 10:01:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	MCL	Maximum Contaminant Level.
ND	Not Detected at the PQL.	PQL	Practical Quantitation Limit.
U	Sample was analyzed for, but not detected.		

Revision v1

Figure B-23

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Analytical Report

WO#: 16080105
Date Reported: 8/9/2016

CLIENT: GES
Collection Date: 8/3/2016
Project: 20153837E1
Lab ID: 16080105-01
Matrix: SOIL
Client Sample ID 16-325, B-5@ 6.0'-7.5'

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	8/9/2016 12:10:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHLORIDE - SOILS				**SM 4500 CL- B**		Analyst: **NM**
Chloride	82	5.0	D	mg/Kg	5	8/9/2016 12:05:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0190	0		%	1	8/9/2016 4:42:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **NM**
pH	8.34	0	H	pH Units	1	8/9/2016 12:08:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	130	1.00		mV	1	8/9/2016 12:08:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0100	0.0100		%	1	8/9/2016 12:06:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **NM**
Solubility	0.130	0.0100		%	1	8/9/2016 12:03:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0300	0.0100		%	1	8/9/2016 12:04:00 PM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	MCL	Maximum Contaminant Level.
ND	Not Detected at the PQL.	PQL	Practical Quantitation Limit.
U	Sample was analyzed for, but not detected.		

Revision v1

Figure B-24

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Analytical Report

WO#: **16080253**
Date Reported: **8/9/2016**

CLIENT: GES
Project: 20153837E1
Lab ID: 16080253-03
Client Sample ID 16-325, B7@7-12

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	8/9/2016 12:10:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHLORIDE - SOILS				**SM 4500 CL- B**		Analyst: **NM**
Chloride	340	10	D	mg/Kg	10	8/8/2016 10:02:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.120	0		%	1	8/8/2016 1:55:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **NM**
pH	8.26	0		pH Units	1	8/8/2016 10:04:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	171	1.00		mV	1	8/8/2016 10:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0100	0.0100		%	1	8/8/2016 10:03:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **NM**
Solubility	1.45	0.0100		%	1	8/8/2016 9:59:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.480	0.0100		%	1	8/8/2016 10:01:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	MCL	Maximum Contaminant Level.
ND	Not Detected at the PQL.	PQL	Practical Quantitation Limit.
U	Sample was analyzed for, but not detected.		

Revision v1

Figure B-25

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Analytical Report

WO#: 16070194
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070194-01
Client Sample ID 16-274, B9 @ 20 - 21.5

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	163	5.00	D	mg/Kg	5	7/11/2016 2:09:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	ND	0		%	1	7/11/2016 11:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **SW**
pH	8.16	0		pH Units	1	7/11/2016 4:01:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	179	1.00		mV	1	7/11/2016 2:31:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	ND	0.0100		%	1	7/11/2016 10:56:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **CR**
Solubility	0.338	0.0100		%	1	7/11/2016 4:00:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0600	0.0100		%	1	7/11/2016 10:58:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	DF	Dilution Factor.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

Figure B-26

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Analytical Report

WO#: 16070194
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070194-02
Client Sample ID 16-274, B9 @ 25 - 26

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	128	5.00	D	mg/Kg	5	7/11/2016 2:09:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0300	0		%	1	7/11/2016 11:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **SW**
pH	8.33	0		pH Units	1	7/11/2016 4:01:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	175	1.00		mV	1	7/11/2016 2:31:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0100	0.0100		%	1	7/11/2016 10:56:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **CR**
Solubility	0.206	0.0100		%	1	7/11/2016 4:00:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0500	0.0100		%	1	7/11/2016 10:58:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	DF	Dilution Factor.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

Figure B-27

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Analytical Report

WO#: 16070194
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070194-03
Client Sample ID 16-274, B10 @ 15 - 16.5

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	180	5.00	D	mg/Kg	5	7/11/2016 2:09:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0600	0		%	1	7/11/2016 11:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **SW**
pH	8.33	0		pH Units	1	7/11/2016 4:01:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	196	1.00		mV	1	7/11/2016 2:31:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0200	0.0100		%	1	7/11/2016 10:56:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **CR**
Solubility	0.346	0.0100		%	1	7/11/2016 4:00:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0700	0.0100		%	1	7/11/2016 10:58:00 AM

Qualifiers: (Qual)
* Value exceeds Maximum Contaminant Level.
MCL Maximum Contaminant Level.
PQL Practical Quantitation Limit.
DF Dilution Factor.
ND Not Detected at the PQL.
U Sample was analyzed for, but not detected.

Original

Figure B-28

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Analytical Report

WO#: 16070194
Date Reported: 7/13/2016

CLIENT: GES **Collection Date:**
Project: 20153837E1
Lab ID: 16070194-04 **Matrix:** SOIL
Client Sample ID 16-274, B10 @ 20 - 21.5

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	124	5.00	D	mg/Kg	5	7/11/2016 2:09:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0300	0		%	1	7/11/2016 11:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **SW**
pH	8.40	0		pH Units	1	7/11/2016 4:01:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	180	1.00		mV	1	7/11/2016 2:31:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0200	0.0100		%	1	7/11/2016 10:56:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **CR**
Solubility	0.188	0.0100		%	1	7/11/2016 4:00:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0200	0.0100		%	1	7/11/2016 10:58:00 AM

Qualifiers: (Qual)

* Value exceeds Maximum Contaminant Level.
MCL Maximum Contaminant Level.
PQL Practical Quantitation Limit.
DF Dilution Factor.
ND Not Detected at the PQL.
U Sample was analyzed for, but not detected.

Original

Figure B-29

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Analytical Report

WO#: 16070194
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070194-05
Client Sample ID 16-274, B11 @ 10 - 11.5

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	121	5.00	D	mg/Kg	5	7/11/2016 2:09:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0300	0		%	1	7/11/2016 11:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **SW**
pH	8.29	0		pH Units	1	7/11/2016 4:01:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	163	1.00		mV	1	7/11/2016 2:31:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0100	0.0100		%	1	7/11/2016 10:56:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **CR**
Solubility	0.0520	0.0100		%	1	7/11/2016 4:00:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0200	0.0100		%	1	7/11/2016 10:58:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	DF	Dilution Factor.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

Figure B-30

SilverState Analytical Laboratories
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Analytical Report

WO#: 16070194
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070194-06
Client Sample ID 16-274, B11 @ 15 - 16.5

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	86.2	5.00	D	mg/Kg	5	7/11/2016 2:09:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0300	0		%	1	7/11/2016 11:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **SW**
pH	8.54	0		pH Units	1	7/11/2016 4:01:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	192	1.00		mV	1	7/11/2016 2:31:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0100	0.0100		%	1	7/11/2016 10:56:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **CR**
Solubility	0.0320	0.0100		%	1	7/11/2016 4:00:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0200	0.0100		%	1	7/11/2016 10:58:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	DF	Dilution Factor.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

Figure B-31

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Analytical Report

WO#: 16070194
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070194-07
Client Sample ID 16-274, B12 @ 20 - 21.5

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	97.2	5.00	D	mg/Kg	5	7/11/2016 2:09:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na_2SO_4	0.0300	0		%	1	7/11/2016 11:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **SW**
pH	8.50	0		pH Units	1	7/11/2016 4:01:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	198	1.00		mV	1	7/11/2016 2:31:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0100	0.0100		%	1	7/11/2016 10:56:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **CR**
Solubility	0.210	0.0100		%	1	7/11/2016 4:00:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0200	0.0100		%	1	7/11/2016 10:58:00 AM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	DF	Dilution Factor.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

Figure B-32

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Analytical Report

WO#: 16070194
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070194-08
Client Sample ID 16-274, B13 @ 10 - 11.5

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	134	5.00	D	mg/Kg	5	7/11/2016 2:09:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **NM**
Sodium Sulfate as Na2SO4	0.0100	0		%	1	7/11/2016 11:05:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **SW**
pH	8.49	0		pH Units	1	7/11/2016 4:01:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	191	1.00		mV	1	7/11/2016 2:31:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **NM**
Sodium	0.0100	0.0100		%	1	7/11/2016 10:56:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **CR**
Solubility	0.136	0.0100		%	1	7/11/2016 4:00:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **NM**
Sulfate	0.0100	0.0100		%	1	7/11/2016 10:58:00 AM

Qualifiers: (Qual)

* Value exceeds Maximum Contaminant Level.
MCL Maximum Contaminant Level.
PQL Practical Quantitation Limit.
DF Dilution Factor.
ND Not Detected at the PQL.
U Sample was analyzed for, but not detected.

Original

Figure B-33

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Analytical Report

WO#: 16070220
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070220-01
Client Sample ID 20153837E1, 16-274, B-12@15-16.5

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	227	5.00	D	mg/Kg	5	7/12/2016 11:04:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **SW**
Sodium Sulfate as Na2SO4	0.0390	0		%	1	7/12/2016 2:16:27 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **NM**
pH	8.17	0		pH Units	1	7/12/2016 2:53:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	264	1.00		mV	1	7/12/2016 12:05:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **SW**
Sodium	0.0100	0.0100		%	1	7/12/2016 1:15:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **NM**
Solubility	0.110	0.0100		%	1	7/12/2016 2:26:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **SW**
Sulfate	0.0700	0.0100		%	1	7/12/2016 1:14:00 PM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	DF	Dilution Factor.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

Figure B-34

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Analytical Report

WO#: 16070220
Date Reported: 7/13/2016

CLIENT: GES
Project: 20153837E1
Lab ID: 16070220-02
Client Sample ID 20153837E1, 16-274, B13@15-16.5

Collection Date:
Matrix: SOIL

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **ET**
Sulfide	ND	5.00	D	mg/L	5	7/13/2016 11:53:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY CHORIDE - SOILS (MG/KG)				**SM 4500 CL- B**		Analyst: **NM**
Chloride	178	5.00	D	mg/Kg	5	7/12/2016 11:04:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION ONLY.				**CALCULATION**		Analyst: **SW**
Sodium Sulfate as Na2SO4	0.0170	0		%	1	7/12/2016 2:16:27 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SM 4500H+ B**		Analyst: **NM**
pH	6.99	0		pH Units	1	7/12/2016 2:53:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **NM**
Oxidation-Reduction Potential	238	1.00		mV	1	7/12/2016 12:05:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **SW**
Sodium	0.0100	0.0100		%	1	7/12/2016 1:15:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **NM**
Solubility	0.860	0.0100		%	1	7/12/2016 2:26:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500SO4 E**		Analyst: **SW**
Sulfate	0.0100	0.0100		%	1	7/12/2016 1:14:00 PM

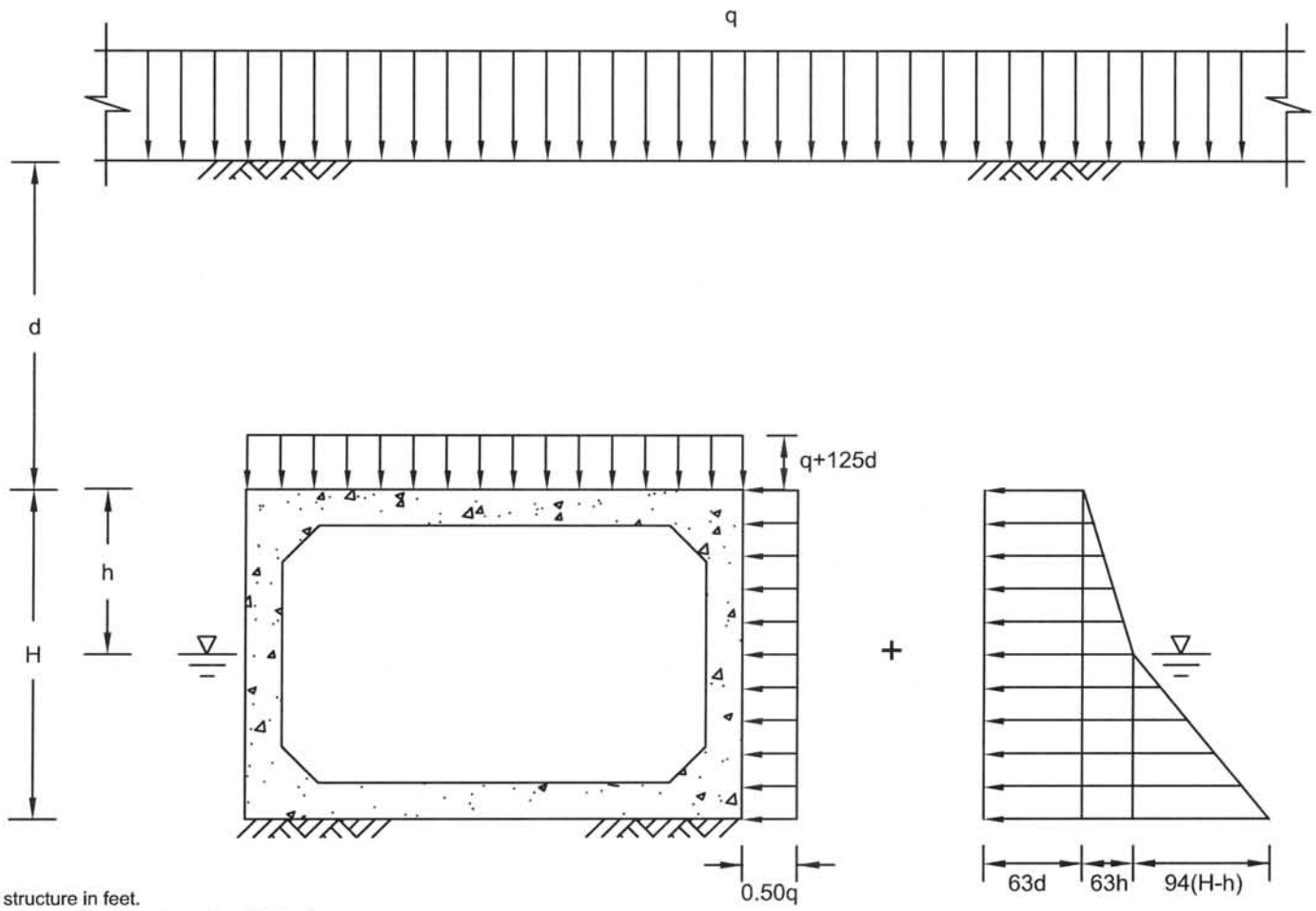
Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	DF	Dilution Factor.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

Figure B-35

APPENDIX C
DESIGN FIGURES



Notes:
H is height of vault structure in feet.
h is depth to groundwater in feet from top of vault structure.
d is depth to top of vault structure in feet.
q is magnitude of uniform surcharge load in pounds per square foot (psf).
Earth pressures are in psf.
Unit weight of backfill (125 pcf) is for native soil backfill, a value of 120 pcf may be used if the backfill is CLSM

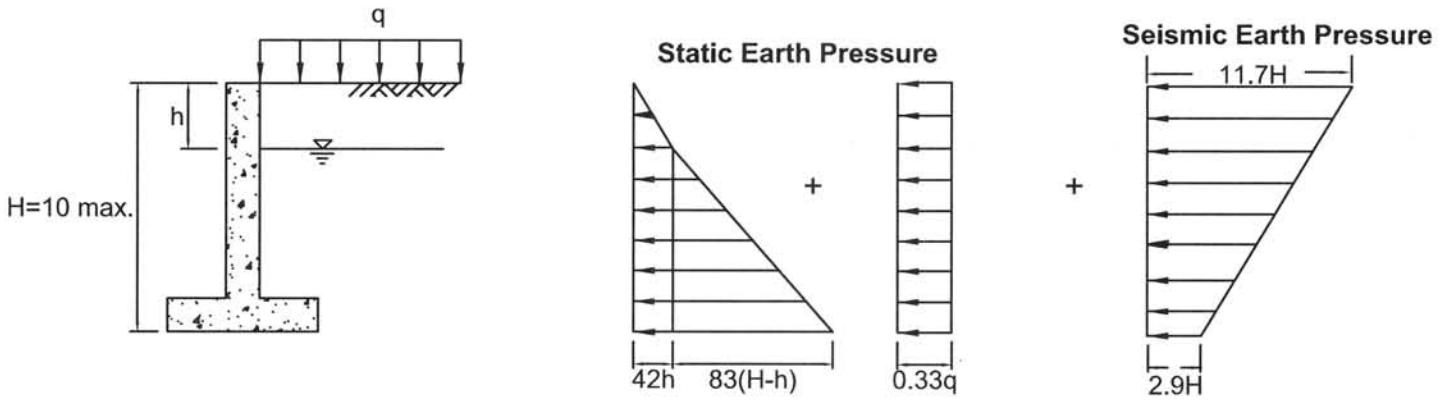
NOT TO SCALE

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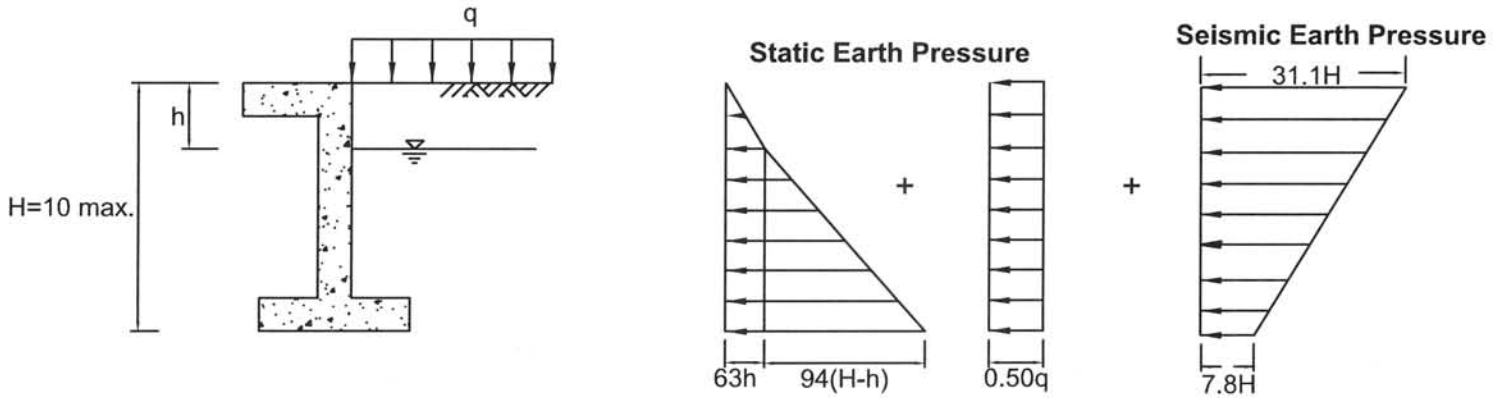
EARTH PRESSURE DIAGRAM FOR RCBS AND RIGID SUBSURFACE STRUCTURES
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

DRAWN BY:	REVIEWED BY:	DATE DRAWN:
PES	PES	8/24/2016
PROJECT NO. 20153837E1		FIGURE NO. C-1

j:\jobs\2015_jobs\20153837\e1\figure c-1.dwg



Active Condition



At-Rest Condition

Notes:
H is height of wall in feet.
h is depth to groundwater in feet.
q is magnitude of uniform surcharge load in pounds per square foot (psf).
Earth pressures are in psf.

NOT TO SCALE

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Las Vegas, NV 89119
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LATERAL EARTH PRESSURE DIAGRAM
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

DRAWN BY:	REVIEWED BY:	DATE DRAWN:
PES	PES	8/24/2015
PROJECT NO. 20153837E1		FIGURE NO. C-2

j:\jobs\2015_jobs\20153837\e1\figure no c-2 gw (081416).dwg

GROUNDWATER SAMPLING, SLUG TESTING AND GROUNDWATER MODELING REPORT
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

Project No. 20153837E1
September 9, 2016

DRAFT

Prepared for:

ATKINS

2270 Corporate Circle, Suite 200

Henderson, Nevada 89074

Prepared by:

GES

Geotechnical & Environmental Services, Inc.
7150 Placid Street
Las Vegas, Nevada 89119

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- IAS Accredited
- AASHTO Accredited Testing Laboratory

September 9, 2016
Project No. 20153837E1

Mr. Matt Baird, P.E.
Vice President
Integrated Water Resources
ATKINS North America
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

RE: Groundwater Sampling, Slug Testing and Groundwater Modeling Report Boulder Highway Storm Drain – Sahara Avenue to Charleston Boulevard Las Vegas, Nevada

Dear Mr. Baird:

Geotechnical & Environmental Services, Inc. (GES) is pleased to present the results of groundwater monitoring and sampling and modeling for the proposed Boulder Highway Storm Drain.

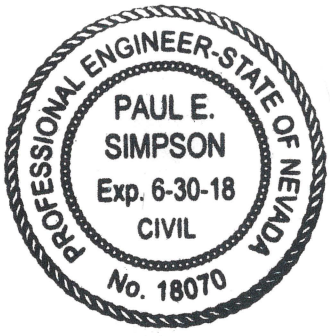
This report includes the results of the field exploration and laboratory testing programs, and recommendations for the design and construction of he proposed flood control facility.

We appreciate this opportunity to provide our professional services. If you have any questions or comments regarding this information, please feel free to contact our office.

Sincerely,

Geotechnical & Environmental Services, Inc.

DRAFT



David Decker
Staff Geologist

Paul E. Simpson, P.E.
Project Engineer

DD:PS:caw

Dist: # originals delivered/mailed to addressee
PDF e-mailed to addressee at Matt.Baird@Atkinsglobal.com
Copy to Project File

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APPENDIX B – ANALYTICAL LABORATORY REPORT

APPENDIX C – SLUG TESTING FIELD NOTES AND DATA GRPAHS

APPENDIX D – DEWATERING SUMMARY REPORT

DRAFT

GROUNDWATER SAMPLING, SLUG TESTING AND GROUNDWATER MODELING REPORT
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

1. INTRODUCTION

This report presents the results of an evaluation of the groundwater conditions and aquifer characteristics in the vicinity of the project alignment performed by Geotechnical & Environmental Services, Inc. (GES), for the Boulder Highway Storm Drain. Figure A-1 presents a vicinity map showing the approximate boundaries of the project alignment. The following sections present the purpose and scope of our evaluation, project and site descriptions, and the results of the field exploration, modeling and laboratory testing.

GES previously prepared the following documents for the project:

- Groundwater Impact Evaluation, Boulder Highway Storm Drain, Sahara & Charleston, Las Vegas Nevada, Project No. 20153837E1: dated June 3, 2016
- (Draft) Geotechnical Evaluation Report, Boulder Highway Storm Drain, Sahara & Charleston, Las Vegas Nevada, Project No. 20153837E1: dated August 25, 2016

1.1. PURPOSE AND SCOPE

The purpose of this evaluation was to provide the results of groundwater sampling along the Boulder Highway Storm Drain alignment in preparation for construction of a flood control facility consisting of reinforced concrete box (RCB) culvert and various reinforced concrete pipe (RCP) laterals. Additionally, to estimate the rate of discharge during temporary construction dewatering, GES performed slug testing of the shallow aquifer to evaluate the hydraulic conductivity of the formation and had performed computer modeling of the effects that dewatering will have on the local groundwater.

1.2. PROJECT DESCRIPTION

The project mainline alignment consists of approximately 1-1/2 miles of new storm drain along the Boulder Highway (Fremont Street) right-of-way from Sahara Avenue, north to Charleston Boulevard and extending along Charleston Boulevard to Eastern Avenue. In addition, lateral storm drain alignments will extend from the mainline in Fremont Street to the west on St. Louis Avenue and Oakey Boulevard.

DRAFT

2. FIELD EXPLORATION

GES evaluated the subsurface conditions along the proposed alignment by drilling 13 borings. The five borings (B-9 through B-13) located to the west of the Fremont Street for the portions of the lateral storm drain alignments were drilled on July 5 and 6, 2016 to depths of approximately 20 to 45 feet. The seven borings (B-1 through B-7) located in the mainline portions of the alignment at Fremont Street were performed upon the receipt of the permit from the NDOT and were drilled during the period between July 25 and 27, 2016. Among them, five borings (B-2, B-3 and B-5 through B-7) were drilled at the site to depths of approximately 25 to 30 feet. Borings B-1 and B-4 were drilled to a depth of approximately 45 and 40 feet, respectively. Boring B-8 was drilled at the night of August 11, 2016 to a depth of approximately 45 feet. The total footage drilled was approximately 400 lineal feet. Borings B-1, B-4 and B-8 were converted to temporary groundwater monitoring wells (MW-1, MW-2 and MW-3, respectively) for groundwater sampling. A discussion of the well installation activities can be found in Section 3 of this report.

2.1. REGIONAL GEOLOGY AND HYDROGEOLOGY

The Las Vegas Valley is a structural basin of late Mesozoic and Tertiary age block faulting origin (beginning about 100 million years ago). Deposits in the down-dropped Las Vegas Valley are mainly Tertiary age (from 67 to 1.6 million years old) and Quaternary Age (from 1.6 million years old to the present) unconsolidated sediments derived from the surrounding uplifted mountain ranges, which are composed of sedimentary and igneous rocks. The mountains to the north, east, and west are mostly sedimentary rocks, predominately carbonates (limestones and dolomites) of Paleozoic and Mesozoic age (between 586 and 67 million years old). The southern and southeastern ranges are for the most part volcanic rocks - primarily Tertiary age andesite lava flows.

There are several prominent fault escarpments in the Plio-Pleistocene basin fill in the central part of the Valley. These escarpments vary in relief from 5 to 100 feet or more and range from 1 to 10 miles in length. Faults in the Valley are the result of tectonic activity and/or the differential compaction of fine and coarse-grained basin fill. All faults are middle to late Pleistocene age in origin, with no major scarps forming since the late Pleistocene. No scarps occur in Holocene age (from 10,000 years old to the present) material.

DRAFT

The groundwater aquifer system within the Las Vegas Valley is complex, consisting of coarse-grained alluvial sands and gravels interbedded with finer-grained valley-fill deposits. In general, two separate aquifers exist in the Las Vegas Valley - a series of deep, confined (artesian) water-bearing zones and a shallow, relatively unconfined aquifer (non-artesian or water table). The majority of the groundwater withdrawn in the Valley is from the deeper aquifer zones, at depths estimated to be greater than 200 feet for most Valley locations. Extensive development of the groundwater resources in the Las Vegas Valley has resulted in the lowering of regional water levels.

Fault zones in the Las Vegas Valley have allowed for upward leakage between aquifer zones to the surface. This has resulted in springs and seeps where the faults intersect the surface at the escarpments. Historically, many of these surface water discharges have ceased due to the groundwater level declines in the Valley (from groundwater over-extraction of the deeper aquifer zones and therefore loss of artesian pressures). In contrast, the shallow groundwater table in portions of the Valley, especially the southeast, has risen steadily, due primarily to the over-watering of landscaped areas. Water tables have been found to be 10-feet or less from the ground surface in parts of this area. The near-surface groundwater has relatively poor water quality and is occasionally withdrawn in the Valley, principally for irrigation and industrial uses. The near surface groundwater flow gradient is not well defined in the vicinity of the subject site, but is presumed to be easterly or generally towards the Las Vegas Wash and the lower part of the Valley.

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2.2. SITE-SPECIFIC GEOLOGY AND HYDROGEOLOGY

The study area is located in the Las Vegas Valley groundwater basin (Hydrographic Basin 212) of the Basin and Range Geomorphic Province at an approximate elevation of 1,835 feet above mean sea level (msl). The area is underlain by Holocene and Pleistocene age alluvium and lake deposits. The lithologies observed in the boreholes along the project alignment in the vicinity of the Freemont Street ROW consist predominantly of medium dense coarse grained soils and firm to very stiff fine grained soils. The native soils encountered in the borings west to the Fremont Street generally consisted of medium dense to very dense coarse grained soils and firm to very stiff fine grained soils. Groundwater was encountered in each of the boring drilled at depth ranging from about 9.0 to 23.7 feet below the ground surface. The depth at which groundwater was encountered during drilling and the measured depth in the boreholes after drilling are shown on the boring logs. Groundwater levels should be anticipated to fluctuate due

to seasonal precipitation, groundwater withdrawal and recharge, irrigation practices, and dewatering efforts within and/or near the subject site.

3. MONOTORING WELL INSTALLATION

Upon completion of drilling and soil sampling activities, the boreholes B-1, B-4 and B-8 (MW-1, MW-2 and MW-3, respectively) were converted to 2-inch diameter groundwater monitoring wells. The wells were constructed with 2-inch diameter, flush-threaded Schedule 40 polyvinyl chloride (PVC) screened casing (0.020 inch slots) and blank casing. Flush-threaded end caps were placed at the bottom of the wells and locking, expandable watertight caps were placed at the top of the well risers. Up to 30 feet of screened casing was placed at the bottom of each borehole from up to approximately 45-feet below ground surface (bgs) to 15-feet bgs. Approximately 15-feet of blank casing was then placed from the top of the screen to the ground surface. The placement of the screened interval for the wells was determined based on the depth at which groundwater was observed during drilling activities, anticipation of seasonal water level fluctuations, and historically measured depth to water from within former groundwater monitoring wells located at the site.

The annular spaces between the well casings and boreholes were backfilled with No. 3 sand to approximately two feet above the top of the screened sections, then surged to equally displace the sand pack and reduce bridging or voids prior to installing the seal. Surging the well also improves the connection between the well and surrounding formation. Following surging, two feet of hydrated bentonite-chips were placed above the sand as a seal layer, followed by approximately 13 feet of bentonite grout above the bentonite chip seals and concrete was placed above the bentonite grout to the ground surface (approximately 1- to 2-feet thick). The wellheads were completed with 12-inch diameter, DOT traffic-rated, monitoring well boxes installed within concrete collars and completed flush with the surrounding surface.

3.1. WELL DEVELOPMENT

Well development activities were commenced after allowing a minimum of 72-hours to elapse after well installation. Approximately 35-gallons of development water was removed from each monitoring well following completion using a stainless steel bailer to remove fine sediment. The development and decontamination water were contained in DOT-approved 55-gallon drums, dated and labeled with respect to their contents, and disposed off-site.

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4. GROUNDWATER SAMPLING

On August 19, 2016, representative groundwater samples were collected from the newly installed wells. Prior to sampling, the static depth to groundwater was measured within MW-1 at 18.3-feet, MW-2 at 9.8-feet, MW-3 at 11.8-feet below the top of the casing (TOC), respectively. The groundwater level was measured with a Solinst™ Water Level Meter, Model 101. The wells were first purged of at least three well volumes of groundwater, during which time the purged groundwater was monitored for conductivity, temperature and pH to ensure the groundwater samples collected were representative of the surrounding formation. The groundwater samples were collected by lowering a disposable, Teflon bailer into the well, then transferring the water contained within the bailer to three 40-milliliter volatile organic analysis (VOA) vials preserved with 1:1 hydrochloric acid. The sample containers were then sealed, labeled and placed in a cooler with ice. Proper chain-of-custody (COC) procedures were maintained during sampling. Groundwater sampling field notes are provided in Appendix A.

4.1. GROUNDWATER SAMPLE ANALYSIS

The groundwater samples collected from monitoring wells MW-1 through MW-3 were submitted to Silver State Analytical Laboratories (SSAL), a Nevada-certified laboratory. The groundwater samples were analyzed for Total Petroleum Hydrocarbons (TPH) – gasoline range organics (GRO), TPH - diesel range organics (DRO) and TPH - oil range organics (ORO) using EPA Method 8015M, full list volatile organic compounds (VOCs) using EPA Method 8260B, total metals for RCRA 8 metals using EPA Method 200.7 and an NDEP Profile I analysis. A summary of the laboratory analytical results for the groundwater samples is provided in Tables 1 and 2. Laboratory reports and COC documentation for the groundwater samples collected during this investigation are provided in Appendix B.

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A summary of selected analytical data is presented below:

Table 1 – Summary of TPH, BTEX & MTBE Analytical Data

Sample ID	Sample Date	TPH-GRO (mg/L)	TPH-DRO (mg/L)	TPH-ORO (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	MTBE (µg/L)
MW-1	8/19/2016	<1	<5	<25	<5	<5	<5	<5	<5
MW-2	8/19/2016	<1	<5	<25	<5	<5	<5	7.6	<5
MW-3	8/19/2016	<1	<5	<25	<5	<5	<5	<5	<5
NDEP Reportable Concentrations		**NA**	**NA**	**NA**	**5**	**1,000**	**700**	**10,000**	**20 - 200***

Notes:

Bold Print - concentration equals or exceeds Regulatory Action Levels

mg/L - milligrams per Kilogram, equivalent to parts per million

µg/L - micrograms per Kilogram, equivalent to parts per billion

TPH-GRO - total petroleum hydrocarbons - gasoline range organics (Low Fraction)

Table 2 – Summary of VOC Analytical Data

Analyte	NDEP Standard	MW-2	MW-3
1,2,4-Trimethylbenzene	None	19.9 µg/L	*ND*
Xylenes	10.0	7.6 µg/L	*ND*
Isopropylbenzene	None	ND	12.7 µg/L
Sec-butylbenzene	None	ND	14.4 µg/L

ND – The given analyte was not detected in the sample above the RDL.

The NDEP groundwater clean-up standards are based on EPA Maximum Contaminant Levels which are applicable to public drinking water systems. The table below summarizes the NDEP groundwater clean-up standards:

Table 3 – NDEP Groundwater Clean-up Standards (State Action Levels)

Constituent of Concern	Groundwater Standard (µg/L)
Benzene	5
Toluene	1,000
Ethylbenzene	700
Total Xylenes	10,000
MTBE	20 – 200*

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4.2. SLUG TESTING

Slug testing was performed on monitoring wells MW-1 and MW-3 on August 16 and 17, 2016, respectively. Slug testing was conducted to evaluate the recharge rate and hydraulic conductivity of the aquifer that lies beneath the project alignment. Six slug test cycles were planned for each well, with each cycle consisting of a slug-in and slug-out test. Due to a battery failure of the levelogger meter in the sixth test, only five slug-out tests were able to be completed on MW-1. Each test lasted until the water level within the well returned to a level measured before each cycle of testing (i.e., the static water level). The slug used was a 3-foot long weighted PVC slug, 1.5 inches in diameter, resulting in a volume of 0.037 cubic feet being displaced during testing. A Solinst Levelogger transducer, capable of continuous data logging to a depth of 65 feet, was placed in the well below the level of the slug in both tests, and water level data was extracted at the end of the testing day at each well. The slug testing field sheets and data graphs can be found in Appendix C.

The data collected from the Levelogger was transferred to an Excel spreadsheet, plotted and supplied to Broadbent & Associates, Inc. (BAI), to be used in computer groundwater modeling of the aquifer. Broadbent created limited numerical models of the aquifer, first using AquiferTest Pro 2013.1 to calculate the hydraulic conductivity of the unit. Based on this analysis, the slug tests indicate the average hydraulic conductivity of the aquifer to be 0.21 ft/day, which is generally acceptable for the water bearing zone soils encountered within the Las Vegas Valley. BAI also utilized Visual MODFLOW 2011.1 Pro to perform additional groundwater modeling to determine well spacing and calculated drawdowns. Please refer to Appendix D for the complete summary of dewatering specifications provided in a report prepared by BAI.

5. CONCLUSIONS

The results of the groundwater analytical data shows there are no Reportable Concentrations for the constituents analyzed from samples collected from monitoring Wells MW-1 through MW-3. Slug Testing data and subsequent groundwater modeling activities demonstrate construction dewatering will likely be required as described in the Boulder Highway Storm Drain Summary of Dewatering Evaluation report prepared by BAI. Discharge rates for temporary construction dewatering is anticipated to be 180 gallons per minute (gpm) to 600 (gpm) with discharge rates for individual dewatering wells will be up to 25 (gpm) at steady state dewatering.

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6. LIMITATIONS

The recommendations contained in this report are based on field exploration, laboratory testing, research of pertinent maps and literature, and our understanding of the proposed construction. The soil data used in the preparation of this report were obtained from thirteen borings, and groundwater data was acquired from three monitoring wells. It is possible that variation in local conditions will exist between the locations explored. Therefore, if any soil or environmental conditions are encountered at the site that are different from those outlined in this report, Geotechnical & Environmental Services, Inc. should be immediately notified so that we may review the situation that exists and make supplementary recommendations as needed.

Our services were performed using that degree of care and skill ordinarily exercised under similar circumstances by reputable engineering firms in this or similar localities. No other warranties, either expressed or implied, are included or intended in this report.

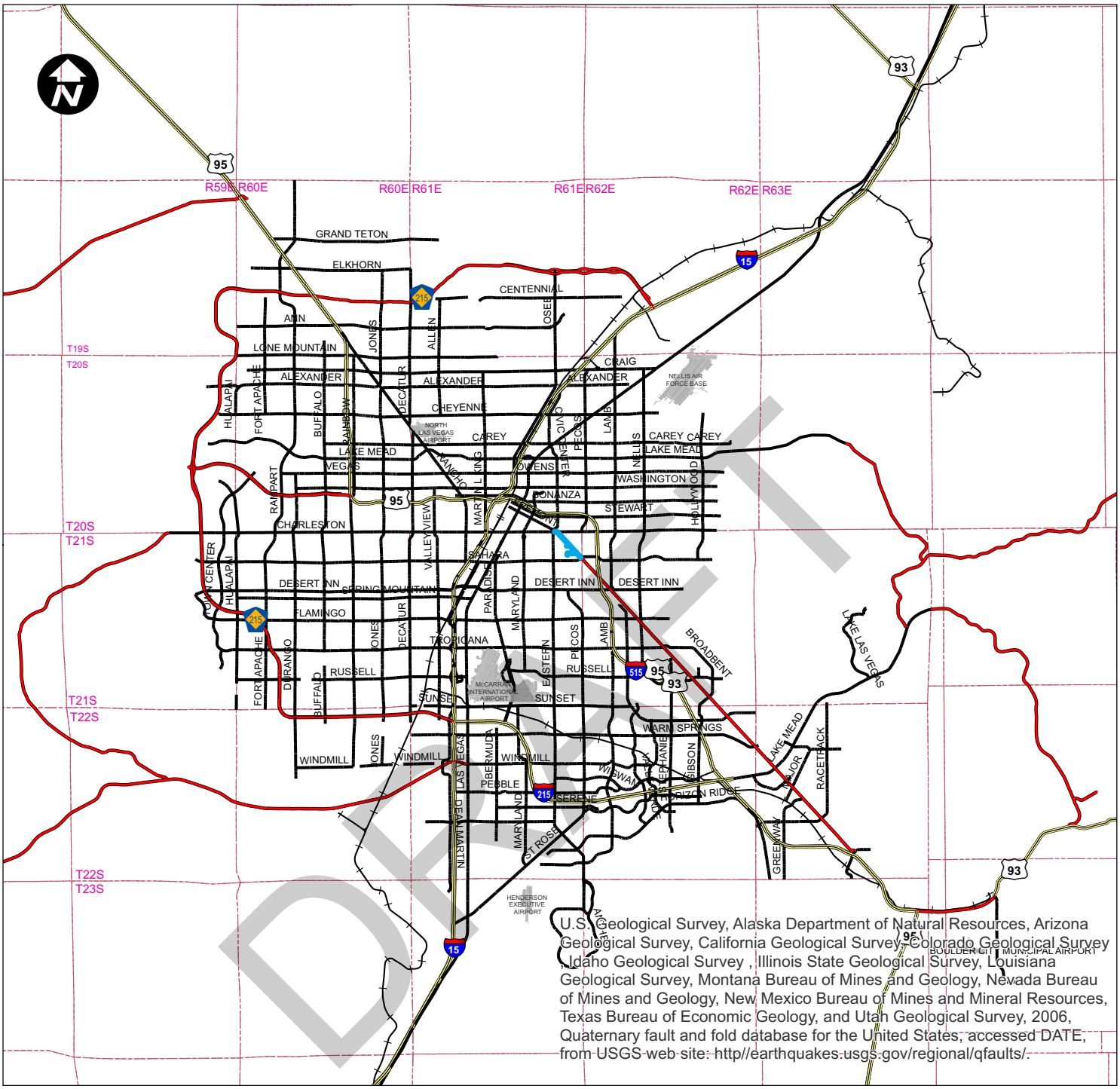
7. ENVIRONMENTAL CERTIFICATION JURAT

This Groundwater Sampling, Slug Testing and Dewatering Specifications Report for the Boulder Highway Storm Drain project (located between Sahara Avenue and Charleston Boulevard) in Las Vegas, Nevada, has been prepared in accordance with Nevada Administrative Code (NAC), Chapter 459, Section 9717. All information, conclusions, and recommendations provided by GES in this document regarding groundwater activities have been prepared under the supervision of and reviewed by the professional whose signature appears below.

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulations and ordinances.

Brian K. Loffman
Environmental Program Manager
Nevada Certified Environmental Manager EM-2265 (Expires 09/21/18)
Date Signed: _____

DRAFT



Legend

- Approximate Project Alignment
- Airports
- Township & Range
- Interstate
- Major Streets
- Railroad
- State Highway

0 2.5 5 10 15 20 Miles

Faults (USGS, 2010)

Linear Faults

Fault Age

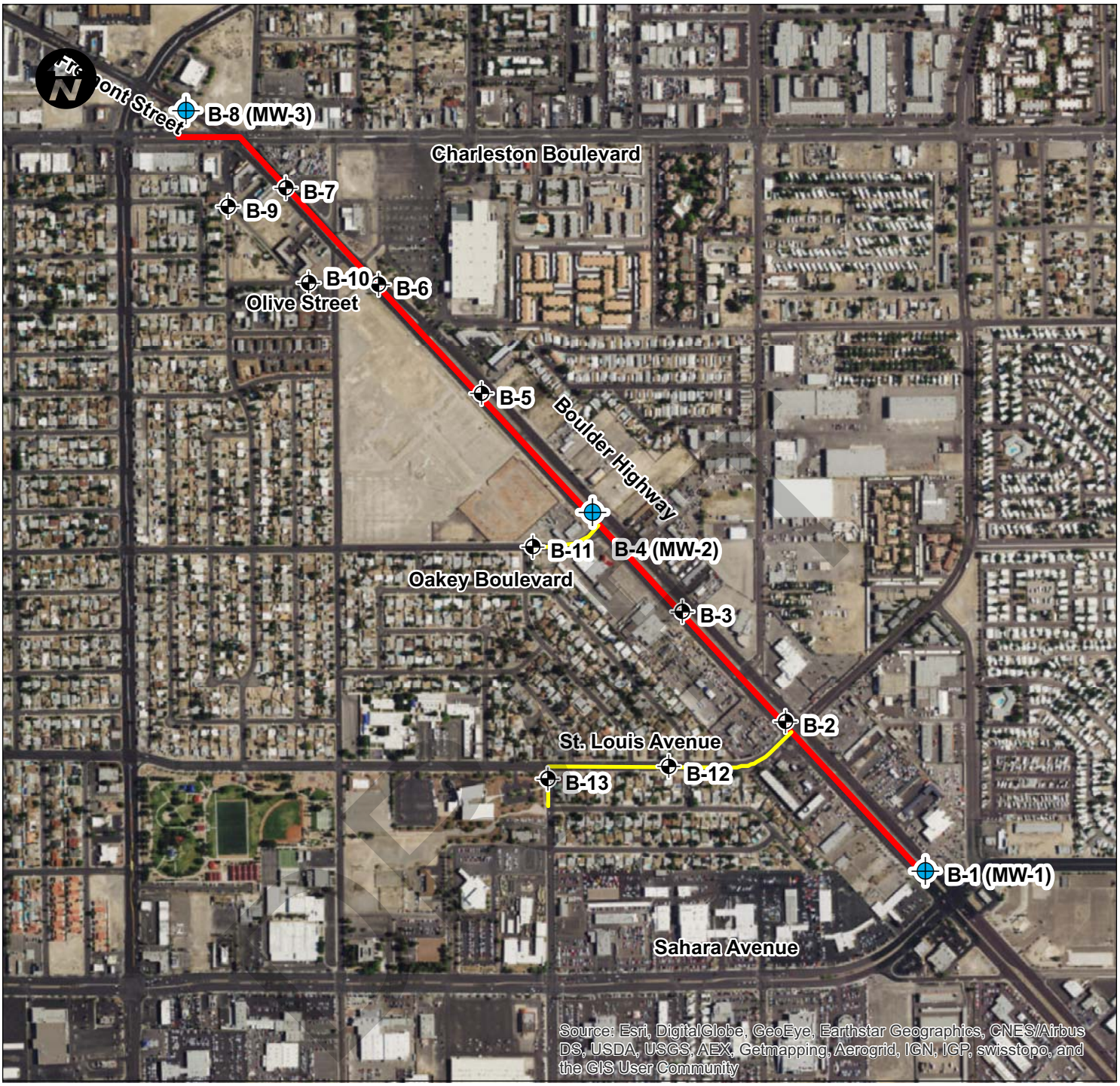
- Class B years
- Less than 1,600,000 years
- Less than 750,000 years
- Less than 130,000 years
- Less than 15,000 years
- Less than 150 years
- Unknown

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
7150 Placid St.
Las Vegas, NV 89119
702-365-1001
www.gesnevada.com

NOTE: Data presented on this map is a compilation of GIS Metadata extracted from a variety of sources. Major Streets, Airports, and Railroads is data obtained from the Southern Nevada GIS Management Office. This data is downloaded by GES for incorporation into drawings generated by GES. Data contained within this page is to be used for informational purposes only. GES has not modified the data contained herein and uses it as it is acquired from the respective agency.

VICINITY MAP
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

Drawn By:	Date Drawn:
PES	08/24/2016
Project No.	Figure No.
20153837E1	A-1



Legend

0 250 500 1,000 1,500 2,000 Feet

- B-13 — Approximate Boring Locations
- B-8 (MW-3) — Approximate Monitoring Well Locations
- Approximate Mainline Storm Drain Alignment
- Approximate Lateral Storm Drain Alignment

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NOTE: All locations are approximate. TD denotes total depth of exploration in feet. Data presented on this map is a compilation of GIS Metadata extracted from a variety of sources. Major Streets, Airports, and Railroads is data obtained from the Southern Nevada GIS Management Office. This data is downloaded by GES for incorporation into drawings generated by GES. Data contained within this page is to be used for informational purposes only. GES has not modified the data contained herein and uses it as it is acquired from the respective agency.

EXPLORATION LOCATION MAP
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

Drawn By:	Date Drawn:
PES	8/24/2016
Project No.	Figure No.
20153837E1	A-2

Note: A portion of this report omitted.

See Data CD for entire report content.

APPENDIX B

ANALYTICAL LABORATORY REPORT

DRAFT

SilverState Analytical Laboratories

Sierra Environmental Monitoring

EnviroTech

September 02, 2016

Brian Loffman
GES
7150 Placid Street
Las Vegas, NV 89119

Lab ID:
☒ Las Vegas, NV (NV930, CA2885)
☐ Reno, NV (NV015, CA2526)

Project: 20153837

Workorder No.: 16080631

Dear Brian Loffman:

Silver State Labs-Las Vegas received 3 sample(s) on 8/19/2016 for the analyses presented in the following report.

There were no problems with the analytical events associated with this report unless noted in the Case Narrative. Analytical results reported as non-detect (ND) in the result field are below the Practical Quantification Limit (PQL). Analytical results above the PQL are reported as the measured value in the results field.

Quality control data is within laboratory defined or method specified acceptance limits except if noted.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

John Sloan

John Sloan
Laboratory Director
3626 E. Sunset Road, Suite 100
Las Vegas, NV 89120

DRAFT

SilverState Analytical Laboratories
Sierra Environmental Monitoring

Silver State Labs-Las Vegas
3626 E. Sunset Road, Suite 100
Las Vegas, NV 89120
(702) 873-4478 FAX: (702) 873-7967
www.ssalabs.com

Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-01
Client Sample ID MW-1

Collection Date: 8/19/2016 6:55:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
PROFILE 1 LIST FROM NDEP ALKALINITY, FULL - CWA				**SM 2320 B**		Analyst: **RB**
Alkalinity, Bicarbonate (As CaCO3)	250	5.00		mg/L CaCO3	1	8/26/2016 9:45:00 AM
Alkalinity, Total (As CaCO3)	250	5.00		mg/L CaCO3	1	8/26/2016 9:45:00 AM
PROFILE 1 LIST FROM NDEP ANIONS - CWA (CL, F, NO2, NO3, SO4)				**EPA 300.0**		Analyst: **CL**
Chloride	449	10.0	D	mg/L	100	8/21/2016 9:41:00 AM
Fluoride	0.363	0.100		mg/L	1	8/20/2016 7:19:00 PM
Nitrogen, Nitrate-Nitrite	4.66	0		mg/L	1	8/20/2016 7:19:00 PM
Sulfate	2890	10.0	D	mg/L	100	8/21/2016 9:41:00 AM
CYANIDE, WAD - CWA				**SM 4500CN I-E**		Analyst: **JS**
Cyanide, WAD	ND	0.0500		mg/L	1	9/1/2016 3:45:44 PM
NITROGEN, TOTAL - CALCULATION				**CALCULATION**		Analyst: **CL**
Nitrogen, Total	5.97	0.100		mg/L	1	8/30/2016 11:08:59 AM
TDS - CWA				**SM 2540C**		Analyst: **RB**
TDS	3010	5.00		mg/L	1	8/23/2016 9:30:00 AM
TKN - CWA				**SM 4500NORG B**		Analyst: **CL**
Kjeldahl, Nitrogen	1.31	1.00		mg/L	1	8/30/2016 11:08:00 AM
PROFILE 1 LIST FROM NDEP MERCURY - CWA				**EPA 245.2**		Analyst: **ET**
Mercury	ND	0.160		µg/L	2	8/23/2016 2:28:59 PM
METALS, FULL LIST - CWA				**EPA 200.7**		Analyst: **ET**

DRAFT

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

SilverState Analytical Laboratories
Sierra Environmental Monitoring

Silver State Labs-Las Vegas
3626 E. Sunset Road, Suite 100
Las Vegas, NV 89120
(702) 873-4478 FAX: (702) 873-7967
www.ssalabs.com

Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-01
Client Sample ID MW-1

Collection Date: 8/19/2016 6:55:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
METALS, FULL LIST - CWA				**EPA 200.7**		Analyst: **ET**
Aluminum	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
Antimony	ND	0.00300		mg/L	1	8/23/2016 2:19:57 PM
Arsenic	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Barium	0.0250	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Beryllium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Cadmium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Calcium	828	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Chromium	ND	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Copper	ND	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Iron	0.0390	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Lead	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Magnesium	216	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Manganese	0.0190	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Potassium	63.2	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Selenium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Silver	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
Sodium	252	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Thallium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Zinc	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
TPH FULL **TPH - DIESEL RANGE ORGANICS**				**EPA 8015B**		Analyst: **JS**
Diesel Range Organics C10-C28	ND	5.00		mg/L	1	9/2/2016 2:54:35 PM
Oil Range Organics C28-C34	ND	25.0		mg/L	1	9/2/2016 2:54:35 PM
TPH FULL **TPH - GASOLINE RANGE ORGANICS**				**EPA 8015B**		Analyst: **CL**
Gasoline Range Organics C6-C10	ND	1.00		mg/L	1	8/24/2016 3:06:14 PM
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
1,1,1,2-Tetrachloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

DRAFT

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-01
Client Sample ID MW-1

Collection Date: 8/19/2016 6:55:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
1,1,1-Trichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1,2,2-Tetrachloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1,2-Trichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,3-Trichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,3-Trichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,4-Trichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,4-Trimethylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dibromo-3-chloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dibromoethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3,5-Trimethylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,4-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2,2-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Chloroethyl vinyl ether	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Chlorotoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Hexanone	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
4-Chlorotoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
4-Methyl-2-pentanone	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Acrylonitrile	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Benzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromochloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromodichloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromoform	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-01
Client Sample ID MW-1

Collection Date: 8/19/2016 6:55:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
Carbon disulfide	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Carbon tetrachloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chlorodibromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
cis-1,2-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
cis-1,3-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dibromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dichlorodifluoromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dimethyl disulfide	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Ethylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Hexachlorobutadiene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Isopropylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
m,p-Xylene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
MEK	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Methyl tert-butyl ether	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Methylene chloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Naphthalene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
n-Butylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
n-Propylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
o-Xylene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
p-Isopropyltoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
sec-Butylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Styrene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
tert-Butylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Tetrachloroethylene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Toluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
trans-1,2-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
trans-1,3-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Trichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Trichlorofluoromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

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Las Vegas, NV 89120
(702) 873-4478 FAX: (702) 873-7967
www.ssalabs.com

Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-01
Client Sample ID MW-1

Collection Date: 8/19/2016 6:55:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
Trichloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Vinyl chloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Xylenes, Total	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Surr: 4-Bromofluorobenzene	89.3	70 - 130		%Rec	1	8/24/2016 3:06:14 PM
Surr: Dibromofluoromethane	121	70 - 130		%Rec	1	8/24/2016 3:06:14 PM
Surr: Toluene-d8	98.0	70 - 130		%Rec	1	8/24/2016 3:06:14 PM

DRAFT

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-02
Client Sample ID MW-2

Collection Date: 8/19/2016 6:01:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
PROFILE 1 LIST FROM NDEP ALKALINITY, FULL - CWA				**SM 2320 B**		Analyst: **RB**
Alkalinity, Bicarbonate (As CaCO3)	255	5.00		mg/L CaCO3	1	8/26/2016 9:45:00 AM
Alkalinity, Total (As CaCO3)	255	5.00		mg/L CaCO3	1	8/26/2016 9:45:00 AM
PROFILE 1 LIST FROM NDEP ANIONS - CWA (CL, F, NO2, NO3, SO4)				**EPA 300.0**		Analyst: **CL**
Chloride	437	10.0	D	mg/L	100	8/21/2016 10:18:00 AM
Fluoride	0.201	0.100		mg/L	1	8/21/2016 9:59:00 AM
Nitrogen, Nitrate-Nitrite	7.58	0		mg/L	1	8/21/2016 9:59:00 AM
Sulfate	3030	10.0	D	mg/L	100	8/21/2016 10:18:00 AM
CYANIDE, WAD - CWA				**SM 4500CN I-E**		Analyst: **JS**
Cyanide, WAD	ND	0.0500		mg/L	1	9/1/2016 3:45:44 PM
NITROGEN, TOTAL - CALCULATION				**CALCULATION**		Analyst: **CL**
Nitrogen, Total	7.58	0.100		mg/L	1	8/30/2016 11:08:59 AM
TDS - CWA				**SM 2540C**		Analyst: **RB**
TDS	3620	5.00		mg/L	1	8/23/2016 9:30:00 AM
TKN - CWA				**SM 4500NORG B**		Analyst: **CL**
Kjeldahl, Nitrogen	ND	1.00		mg/L	1	8/30/2016 11:08:00 AM
PROFILE 1 LIST FROM NDEP MERCURY - CWA				**EPA 245.2**		Analyst: **ET**
Mercury	ND	0.160		µg/L	2	8/23/2016 2:28:59 PM
METALS, FULL LIST - CWA				**EPA 200.7**		Analyst: **ET**

DRAFT

Qualifiers: (Qual)

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DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-02
Client Sample ID MW-2

Collection Date: 8/19/2016 6:01:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
METALS, FULL LIST - CWA				**EPA 200.7**		Analyst: **ET**
Aluminum	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
Antimony	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Arsenic	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Barium	0.0200	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Beryllium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Cadmium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Calcium	347	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Chromium	ND	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Copper	ND	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Iron	0.0390	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Lead	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Magnesium	218	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Manganese	0.0190	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Potassium	63.2	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Selenium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Silver	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
Sodium	286	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Thallium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Zinc	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
TPH FULL **TPH - DIESEL RANGE ORGANICS**				**EPA 8015B**		Analyst: **JS**
Diesel Range Organics C10-C28	ND	5.00		mg/L	1	9/2/2016 2:54:35 PM
Oil Range Organics C28-C34	ND	25.0		mg/L	1	9/2/2016 2:54:35 PM
TPH FULL **TPH - GASOLINE RANGE ORGANICS**				**EPA 8015B**		Analyst: **CL**
Gasoline Range Organics C6-C10	ND	1.00		mg/L	1	8/24/2016 3:06:14 PM
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
1,1,1,2-Tetrachloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

Qualifiers: (Qual)

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DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-02
Client Sample ID MW-2

Collection Date: 8/19/2016 6:01:00 AM
Matrix: GROUNDWATER

VOLATILE ORGANIC COMPOUNDS, EPA 8260

EPA 8260B Analyst: **CL**

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
1,1,1-Trichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1,2,2-Tetrachloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1,2-Trichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,3-Trichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,3-Trichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,4-Trichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,4-Trimethylbenzene	19.9	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dibromo-3-chloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dibromoethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3,5-Trimethylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,4-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2,2-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Chloroethyl vinyl ether	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Chlorotoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Hexanone	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
4-Chlorotoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
4-Methyl-2-pentanone	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Acrylonitrile	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Benzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromochloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromodichloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromoform	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

Qualifiers: (Qual)

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DF	Dilution Factor.
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ND	Not Detected at the PQL.
U	Sample was analyzed for, but not detected.

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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-02
Client Sample ID MW-2

Collection Date: 8/19/2016 6:01:00 AM
Matrix: GROUNDWATER

DRAFT

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
Carbon disulfide	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Carbon tetrachloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chlorodibromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
cis-1,2-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
cis-1,3-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dibromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dichlorodifluoromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dimethyl disulfide	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Ethylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Hexachlorobutadiene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Isopropylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
m,p-Xylene	7.60	5.00		µg/L	1	8/24/2016 3:06:14 PM
MEK	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Methyl tert-butyl ether	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Methylene chloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Naphthalene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
n-Butylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
n-Propylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
o-Xylene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
p-Isopropyltoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
sec-Butylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Styrene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
tert-Butylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Tetrachloroethylene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Toluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
trans-1,2-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
trans-1,3-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Trichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Trichlorofluoromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

Qualifiers: (Qual)

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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-02
Client Sample ID MW-2

Collection Date: 8/19/2016 6:01:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
Trichloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Vinyl chloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Xylenes, Total	7.60	5.00		µg/L	1	8/24/2016 3:06:14 PM
Surr: 4-Bromofluorobenzene	114	70 - 130		%Rec	1	8/24/2016 3:06:14 PM
Surr: Dibromofluoromethane	122	70 - 130		%Rec	1	8/24/2016 3:06:14 PM
Surr: Toluene-d8	98.3	70 - 130		%Rec	1	8/24/2016 3:06:14 PM

DRAFT

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-03
Client Sample ID MW-3

Collection Date: 8/19/2016 5:12:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
PROFILE 1 LIST FROM NDEP ALKALINITY, FULL - CWA				**SM 2320 B**		Analyst: **RB**
Alkalinity, Bicarbonate (As CaCO3)	470	5.00		mg/L CaCO3	1	8/26/2016 9:45:00 AM
Alkalinity, Total (As CaCO3)	470	5.00		mg/L CaCO3	1	8/26/2016 9:45:00 AM
PROFILE 1 LIST FROM NDEP ANIONS - CWA (CL, F, NO2, NO3, SO4)				**EPA 300.0**		Analyst: **CL**
Chloride	239	10.0	D	mg/L	100	8/23/2016 2:20:00 PM
Fluoride	0.202	0.100		mg/L	1	8/23/2016 2:01:00 PM
Nitrogen, Nitrate-Nitrite	1.10	0		mg/L	1	8/23/2016 2:01:00 PM
Sulfate	2770	10.0	D	mg/L	100	8/23/2016 2:20:00 PM
CYANIDE, WAD - CWA				**SM 4500CN I-E**		Analyst: **JS**
Cyanide, WAD	ND	0.0500		mg/L	1	9/1/2016 3:45:44 PM
NITROGEN, TOTAL - CALCULATION				**CALCULATION**		Analyst: **CL**
Nitrogen, Total	1.10	0.100		mg/L	1	8/30/2016 11:08:59 AM
TDS - CWA				**SM 2540C**		Analyst: **RB**
TDS	3470	5.00		mg/L	1	8/23/2016 9:30:00 AM
TKN - CWA				**SM 4500NORG B**		Analyst: **CL**
Kjeldahl, Nitrogen	ND	1.00		mg/L	1	8/30/2016 11:08:00 AM
PROFILE 1 LIST FROM NDEP MERCURY - CWA				**EPA 245.2**		Analyst: **ET**
Mercury	ND	0.160		µg/L	2	8/23/2016 2:28:59 PM
METALS, FULL LIST - CWA				**EPA 200.7**		Analyst: **ET**

DRAFT

Qualifiers: (Qual)

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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-03
Client Sample ID MW-3

Collection Date: 8/19/2016 5:12:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
METALS, FULL LIST - CWA				**EPA 200.7**		Analyst: **ET**
Aluminum	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
Antimony	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Arsenic	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Barium	0.0180	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Beryllium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Cadmium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Calcium	2530	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Chromium	ND	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Copper	ND	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Iron	0.0580	0.0100		mg/L	1	8/23/2016 2:19:57 PM
Lead	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Magnesium	260	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Manganese	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Potassium	110	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Selenium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Silver	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
Sodium	188	10.0	D	mg/L	10	8/23/2016 2:19:57 PM
Thallium	ND	0.00100		mg/L	1	8/23/2016 2:19:57 PM
Zinc	ND	0.0500		mg/L	1	8/23/2016 2:19:57 PM
TPH FULL **TPH - DIESEL RANGE ORGANICS**				**EPA 8015B**		Analyst: **JS**
Diesel Range Organics C10-C28	ND	5.00		mg/L	1	9/2/2016 2:54:35 PM
Oil Range Organics C28-C34	ND	25.0		mg/L	1	9/2/2016 2:54:35 PM
TPH FULL **TPH - GASOLINE RANGE ORGANICS**				**EPA 8015B**		Analyst: **CL**
Gasoline Range Organics C6-C10	ND	1.00		mg/l	1	8/24/2016 3:06:14 PM
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
1,1,1,2-Tetrachloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
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Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-03
Client Sample ID MW-3

Collection Date: 8/19/2016 5:12:00 AM
Matrix: GROUNDWATER

DRAFT

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
1,1,1-Trichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1,2,2-Tetrachloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1,2-Trichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,1-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,3-Trichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,3-Trichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,4-Trichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2,4-Trimethylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dibromo-3-chloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dibromoethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,2-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3,5-Trimethylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,3-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
1,4-Dichlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2,2-Dichloropropane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Chloroethyl vinyl ether	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Chlorotoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
2-Hexanone	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
4-Chlorotoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
4-Methyl-2-pentanone	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Acrylonitrile	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Benzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromochloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromodichloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromoform	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Bromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

SilverState Analytical Laboratories
Sierra Environmental Monitoring

Silver State Labs-Las Vegas
3626 E. Sunset Road, Suite 100
Las Vegas, NV 89120
(702) 873-4478 FAX: (702) 873-7967
www.ssalabs.com

Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-03
Client Sample ID MW-3

Collection Date: 8/19/2016 5:12:00 AM
Matrix: GROUNDWATER

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Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
Carbon disulfide	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Carbon tetrachloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chlorobenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chlorodibromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chloroethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Chloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
cis-1,2-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
cis-1,3-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dibromomethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dichlorodifluoromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Dimethyl disulfide	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Ethylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Hexachlorobutadiene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Isopropylbenzene	12.7	5.00		µg/L	1	8/24/2016 3:06:14 PM
m,p-Xylene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
MEK	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Methyl tert-butyl ether	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Methylene chloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Naphthalene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
n-Butylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
n-Propylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
o-Xylene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
p-Isopropyltoluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
sec-Butylbenzene	14.4	5.00		µg/L	1	8/24/2016 3:06:14 PM
Styrene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
tert-Butylbenzene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Tetrachloroethylene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Toluene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
trans-1,2-Dichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
trans-1,3-Dichloropropene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Trichloroethene	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Trichlorofluoromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM

Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

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www.ssalabs.com

Analytical Report

WO#: **16080631**
Date Reported: **9/2/2016**

CLIENT: GES
Project: 20153837
Lab ID: 16080631-03
Client Sample ID MW-3

Collection Date: 8/19/2016 5:12:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS, EPA 8260				**EPA 8260B**		Analyst: **CL**
Trichloromethane	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Vinyl chloride	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Xylenes, Total	ND	5.00		µg/L	1	8/24/2016 3:06:14 PM
Surr: 4-Bromofluorobenzene	116	70 - 130		%Rec	1	8/24/2016 3:06:14 PM
Surr: Dibromofluoromethane	120	70 - 130		%Rec	1	8/24/2016 3:06:14 PM
Surr: Toluene-d8	90.7	70 - 130		%Rec	1	8/24/2016 3:06:14 PM

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Qualifiers: (Qual)

*	Value exceeds Maximum Contaminant Level.	C	Value is below Minimum Compound Limit.
DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

SilverState Analytical Laboratories
Sierra Environmental Monitoring
EnviroTech
ssalabs.com sem-analytical.com envirotechonline.com
3626 E. SUNSET RD., STE 100, LAS VEGAS, NV 89120
Phone (702) 873-4478 Fax: (702) 873-7967 (EPA#: NV00930, CA2885)
1135 FINANCIAL BOULEVARD, RENO, NV 89502
Phone (775) 857-2400 Fax: (888) 398-7002 (EPA#: NV00015, CA2526)

CHAIN-OF-CUSTODY-RECORD

Report Results To:
Report Attention: Brian Loffman Project Number: 20153837
Company: GES
Mailing Address: 7150 Placid street
City, State, Zip: Las Vegas, NV 89119
Phone: 702-365-1001 Email / Fax: brian.loffman@gesnevada.com

Send Invoice To:
Invoice Attention: Same PO# 8693 Quote #
Company:
Mailing Address:
City, State, Zip:
Phone: Email / Fax:

COMPLIANCE MONITORING? Yes ☐ No ☒
NEW ADDRESS? Results: ☐ Invoice: ☐

Applicable Program
SDWA ☐ CWA ☐ RCRA ☐ Mining ☐ Other _____

QC Level Report
I II III IV
NOTE: Surcharges apply to Level II, III and IV reports

Sampled by: Jeremy Shockley Signature:

I attest to the validity and authenticity of the sample. I am aware that tampering with or intentionally mislabeling the sample location, date or time is considered fraud and may be grounds for legal action.

Standard: ☒ Standard TAT 7-10 Business Days. Note that some tests vary.

Rush
Same Day: ☐ 3 Day: ☐ Other (specify): _____
1 Day: ☐ 4 Day: ☐ Rush results will be issued after 4:00 p.m.
2 Day: ☐ 5 Day: ☐

NOTE: A Rush Surcharge is applied for rush samples

Other Pertinent Information / Special Instructions

Send Results Via: Mail: ☐ Email: ☒ Fax: ☐

Send Invoice Via: Mail: ☐ Email: ☒ Fax: ☐

Field Measurements
On-Site pH: Chlorine:
Temperature: Other:

ANALYSES REQUESTED

Date Sampled	Time Sampled	Sample Identification	SSAL - SEM Lab No.	Comp. Grab	Matrix*	Preservative**	Number / Type of Containers ***	8260B Full List	TPH 8015 (GRO DRO only)	NDEP Profile I	(See Attached List)	Metals*
8/19/16	0655	MW-1	1608063I-1A		GW	Ice	9	X	X	X		
8/19/16	0601	MW-2			GW	Ice	9	X	X	X		
8/18/16	0512	MW-3			GW	Ice	9	X	X	X		

COMMENTS:

	Signature	Print Name	Company	Date	Time
Relinquished By:		Jeremy Shockley	GES	8/19/16	0945
Received By:		Kyle Anders	SSAL	8/19/16	945
Relinquished By:					
Received By:					
Relinquished By:					
Received By:					
Authorized By:			GES	8/19/16	945

Authorization is required to process samples. This obligates your organization for service fees. SSAL Standard T & C's or other written agreement applies. If collections or legal services are required to recover said fees, your organization will be responsible for all fees and costs in addition to service fees.

Samples are discarded 30 days after results are reported unless other arrangements are made and storage fees may apply.
The analytical results associated with this COC apply only to these samples as they are received by the laboratory.
The liability of the laboratory is limited to the amount paid for the report.

Matrix* DW-Drinking Water, WW-Waste Water, GW-Ground Water, SW-Surface Water, SS-Soil, S-Solid, OT-Other
Container*** P-Plastic, G-Glass, V-Voa Vial, OT-Other
Preservative** 1=H_2SO_4, 2=HNO_3, 3=HCl, 4=NaOH, 5=$Na_2S_2O_3$, 6=None, 7=Other

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Note: A portion of this report omitted.

See Data CD for entire report content.

APPENDIX D

DEWATERING SUMMARY REPORT

DRAFT

BROADBENT
8 West Pacific Ave., Henderson, NV 89015
[T] 702-563-0600 [F] 702-563-0610
broadbentinc.com

September 9, 2016

Project No. 16-01-189-101

Geotechnical & Environmental Services, Inc.
7150 Placid Street
Las Vegas, Nevada 89119

Attn: Paul Simpson, PE

Re: Boulder Highway Storm Drain Project
Summary of Dewatering Evaluation

Dear Mr. Simpson:

Broadbent & Associates, Inc. (Broadbent) has prepared this letter report to support the groundwater discharge permitting requirements for the proposed City of Las Vegas Boulder Highway Storm Drain Project (the Project). The purpose of the work detailed herein is to provide information regarding an estimate of the number of dewatering points required to provide sufficient groundwater drawdown during construction activities as well as to provide an estimate of the total volume of estimated groundwater discharge under various dewatering scenarios. Our work and results are summarized below.

- There are three proposed storm drain pipeline alignments associated with the Project requiring varying degrees of dewatering. These locations include: the Boulder Highway alignment extending from Charleston Boulevard east of Boulder Highway (Station 11+00) to Boulder Highway just northwest of Sahara Avenue (Station 83+00); the Oakey Boulevard lateral extending on East Oakey Boulevard (Station 11+00.00) to Boulder Highway (Station 15+39), and; the St. Louis Avenue Lateral extending from McLeod Street (Station 11+00) north to St. Louis Avenue and then east to Boulder Highway (Station 33.33+08).

- Geotechnical & Environmental Services, Inc. (GES) exploration logs B-1 through B-13 were used to identify approximate ground surface elevations and static groundwater elevations. Assuming a target dewatering elevation of three feet below the inverts to allow for construction excavations, it appears that the proposed construction work at the locations of exploration borings B-11 and B-13 will not require dewatering.

- A total of 11 slug tests were conducted in monitoring well MW-1 (six falling head tests and five rising head tests) and a total of 12 slug tests were performed in monitoring well MW-3 (six falling head tests and five rising head tests) in order to evaluate hydraulic conductivity of the aquifer. The slug tests were conducted by GES on August 17, 2016. Resulting slug test data was analyzed by Broadbent with AquiferTest Pro 2013.1 software utilizing the Hvorslev curve-matching method to obtain calculated values of hydraulic conductivity. The program's automatic curve fitting feature was used to automatically match the type curve to the test data. Since the automatic fits within the software program were successful with no failures, no attempt was made to manually

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match the type curve to the test data. Results of the analysis of selected slug tests indicated an average hydraulic conductivity value of 0.21 ft/day, a generally common value for the shallow aquifer alluvial soils in the Las Vegas Valley.

- Broadbent generated a limited numerical groundwater model using Visual MODFLOW 2011.1 Pro software. The input data was generated from information supplied to Broadbent by GES including borehole exploration logs, slug test data, and plans and profile sheets of the proposed project areas. The groundwater model was set up as a generalized 10,700 ft (X) by 9,040 ft (Y) by 100 ft (Z) grid with an average ground surface elevation of 1,868 feet. Grid cells were 20 ft by 20 ft within the proposed project area. Because of the significant change in static groundwater elevation across the project area, the measured groundwater elevations from GES's exploration logs were used as input data and the model allowed to interpolate initial heads across the model domain. The single boundary condition set within the model domain was a constant head boundary set as the static groundwater elevation near the perimeter of the model grid.

- Due to the significant change in static groundwater elevations across the project area, only some portions of the proposed pipeline alignments appear to require dewatering. Static groundwater elevations were estimated assuming a linear gradient between the measured groundwater elevations within the borehole exploration logs. Based on this assumption, the estimated dewatering requirements at each Station for the proposed alignments are summarized in the attached tables.

- The groundwater model was run under two different pumping scenarios, one with dewatering limited to 500-foot increments and the other at 1,000-foot increments, until satisfactory results were obtained in the model results, that is, until the model results demonstrated that the target dewatering elevations were achieved along the pipeline alignments. The model's Zone Budget feature was then reviewed to obtain an estimate of the volume of groundwater removed from the aquifer during the simulation.

- For the 500-foot incremental dewatering evaluation, the conceptual dewatering system design consisted of eight to nine dewatering wells per 500-foot section placed at approximate 60-foot intervals. Each dewatering well consisted of six-inch diameter casing, extended to a depth of 10 feet below the target dewatering elevations and was equipped with a submersible pump capable of producing up to 20 gpm for the areas requiring less than eight feet of dewatering drawdown and submersible pumps capable of producing up to 30 gpm for the areas requiring over eight feet of drawdown. The attached tables identify required dewatering drawdown at each Station. Anticipated dewatering discharge volume for the 500-foot incremental dewatering evaluation ranges from 180 gpm to 270 gpm for each 500-foot section. It is anticipated that after groundwater drawdown reaches a steady state (that is, drawdown stabilizes and the groundwater table ceases to decrease in elevation), individual pumps will operate at less than 25 gpm.

- For the 1,000-foot incremental dewatering evaluation, the conceptual dewatering system design consisted of 18 to 20 dewatering wells per 1,000-foot section placed at approximate 60-foot intervals. Each dewatering well consisted of six-inch diameter casing, extended to a depth of 10 feet below the target dewatering elevations and was equipped with a submersible pump capable of producing up to 18 gpm for the areas requiring less than eight feet of dewatering drawdown and submersible pumps capable of producing up to 30 gpm for the areas requiring over eight feet of drawdown. The attached tables identify required dewatering drawdown at each Station.

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Anticipated dewatering discharge volume for the 500-foot incremental dewatering evaluation ranges from 360 gpm to 600 gpm for each 1,000-foot section. It is anticipated that after groundwater drawdown reaches a steady state (that is, drawdown stabilizes and the groundwater table ceases to decrease in elevation), individual pumps will operate at less than 25 gpm.

- Although it does not appear that dewatering will be required at some portions of the proposed alignments, it is recommended that the selected contractor have at their disposal sufficient materials and pumps to be used as temporary sumps and/or drainage trenches in order to assist with the dewatering in the event that some amount of groundwater is encountered.

The recommendations made in this report are based on our field work, data interpretation, and our understanding of the project scope. The data used in the preparation of this report were obtained at the location(s) described herein. It is possible that variations in subsurface conditions exist between the location of the work and the remaining portions of the project area. In the event that unexpected conditions occur during dewatering activities that negatively impact construction progress, Broadbent should be notified so that we may evaluate the situation and amend our recommendations, if necessary. This investigation evaluated temporary dewatering only. Permanent dewatering requirements or designs were not evaluated.

Our services were performed in accordance with generally practices and procedures, as of the date of the report. This report represents professional opinion and judgment, which are dependent upon information obtained during the performance of consulting services. No warranties are implied or expressed.

If you have any questions or require additional information, please do not hesitate to contact this office at (702) 563-0600.

Sincerely,
BROADBENT & ASOCIATES, INC.

Mark E. Kazelskis, PG, CHG
Principal Geologist

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Boulder Highway Alignment

Station (Boring/Well ID)	Ground Surface Elevation (feet AMSL)	Static Groundwater Elevation (feet AMSL)	Pipeline Invert Elevation (feet AMSL)	Target Dewatering Elevation (feet AMSL)	Required Drawdown (feet)
11+00	1875	1856	1851	1848	8
12+00	1874	1854.5	1850	1847	7.5
13+00	1873	1853	1848.5	1845.5	7.5
14+00	1872	1851	1847	1844	7
15+00	1871	1850	1846	1843	7
16+00	1869	1848	1844.5	1841.5	6.5
17+00	1867	1847	1843.5	1840.5	6.5
18+00	1866	1845.5	1842.5	1839.5	6
19+00	1865.5	1843.5	1841	1838	5.5
20+00	1864.5	1842.5	1840.5	1837.5	5
21+00	1863.5	1841	1840	1837	4
22+00	1863.5	1839	1839	1836	3
23+00	1862.5	1838	1839	1836	2
24+00	1862	1836.5	1838.5	1835.5	1
24+50 (B-7)	1862	1835	1837.5	1834.5	0.5
25+00	1861.5	1836.5	1838.5	1835.5	1
26+00	1860.5	1838.5	1837.5	1834.5	4
27+00	1859.5	1840	1837	1834	6
28+00	1859	1842	1836.5	1833.5	8.5
29+00	1858	1844	1836	1833	11
30+00	1858	1846	1835.5	1832.5	13.5
31+00	1858	1847.5	1837	1834	13.5
32+00	1857	1850	1834.5	1831.5	18.5
33+00 (B-6)	1856.5	1851	1834	1831	20
34+00	1856.5	1846.5	1834	1831	15.5
35+00	1855.5	1848.8	1833.5	1830.5	18.3
36+00	1855	1847	1832.5	1829.5	17.5
37+00	1855	1846	1832	1829	17
38+00	1854.5	1844.5	1831.5	1828.5	16
39+00	1853.5	1843	1830.5	1827.5	15.5
40+00	1853	1841.5	1830.5	1827.5	14
41+00	1852	1840	1830	1827	13
42+00	1851	1838.5	1830	1827	11.5
42+50 (B-5)	1851	1838	1827	1824	14
43+00	1850.5	1837.5	1829.5	1826.5	11
44+00	1850.5	1837	1828.5	1825.5	11.5
45+00	1850	1837	1828	1825	12
46+00	1849.5	1836.5	1827.5	1824.5	12
47+00	1849	1836.5	1827	1824	12.5
48+00	1848.5	1836.5	1826.5	1823.5	13
49+00	1848	1836	1826.5	1823.5	12.5
50+00	1847.5	1836	1826	1823	13
51+00	1847	1835.5	1825	1822	13.5
52+00	1846.5	1835.5	1824.5	1821.5	14
52+50 (B-4/MW-1)	1846	1835	1824	1821	14

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Boulder Highway Alignment

Station (Boring/Well ID)	Ground Surface Elevation (feet AMSL)	Static Groundwater Elevation (feet AMSL)	Pipeline Invert Elevation (feet AMSL)	Target Dewatering Elevation (feet AMSL)	Required Drawdown (feet)
53+00	1846	1834	1824	1821	13
54+00	1845	1832	1823.5	1820.5	11.5
55+00	1844.5	1829.5	1823	1820	9.5
56+00	1844	1827.5	1822.5	1819.5	8
57+00	1843.5	1825	1822.5	1819.5	5.5
58+00	1842.5	1823	1821.5	1818.5	4.5
59+00	1842	1821	1821	1818	3
60+00	1841	1818.5	1820.5	1817.5	1
61+00 (B-3)	1840	1817	1820	1817	0
62+00	1839.5	1817	1819.5	1816.5	0.5
63+00	1839	1817	1819	1816	1
64+00	1838.5	1817.5	1818.5	1815.5	2
65+00	1837.5	1817.5	1818	1815	2.5
66+00	1837	1817.5	1818	1815	2.5
67+00	1836.5	1817.5	1817	1814	3.5
68+00	1835.5	1818	1816.5	1813.5	4.5
69+00	1834.5	1818	1816	1813	5
70+00 (B-2)	1834	1818	1815.5	1812.5	5.5
71+00	1833	1816.5	1815	1812	4.5
72+00	1832	1815.5	1807.5	1804.5	11
73+00	1831.5	1814.5	1805.5	1802.5	12
74+00	1831	1813	1806	1803	10
75+00	1830.5	1812	1805.5	1802.5	9.5
76+00	1829.5	1811	1805	1802	9
77+00	1829	1810.5	1805	1802	8.5
78+00	1828.5	1809	1804.5	1801.5	7.5
79+00	1828	1808	1804.5	1801.5	6.5
80+00	1828	1806.5	1804	1801	5.5
81+00	1827	1806	1804	1801	5
82+00	1827	1804	1803.5	1800.5	3.5
83+00 (B-1 / MW-1)	1826.5	1803	1803	1800	3

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St. Louis Avenue Lateral

Station (Boring/Well ID)	Ground Surface Elevation (feet AMSL)	Static Groundwater Elevation (feet AMSL)	Pipeline Invert Elevation (feet AMSL)	Target Dewatering Elevation (feet AMSL)	Required Drawdown (feet)
11+00 (B-13)	1848	1835	1843	1840	No Dewatering Anticipated
12+00	1848	1834	1842	1839	No Dewatering Anticipated
13+00	1849	1833	1841	1838	No Dewatering Anticipated
14+00	1850	1833	1840	1837	No Dewatering Anticipated
15+00	1850	1832	1839	1836	No Dewatering Anticipated
16+00	1849	1831	1838	1835	No Dewatering Anticipated
17+00	1848	1830	1838	1835	No Dewatering Anticipated
18+00	1846	1829	1834	1831	No Dewatering Anticipated
19+00	1845	1829	1833	1830	No Dewatering Anticipated
20+00	1844	1828	1832	1829	No Dewatering Anticipated
21+00	1842	1827	1830	1827	No Dewatering Anticipated
22+00	1841	1826	1829	1826	No Dewatering Anticipated
23+00	1839	1826	1828	1825	1
23+50 (B-12)	1839	1825	1827	1824	1
24+00	1838	1824	1826	1823	1
25+00	1837	1824	1824	1821	3
26+00	1835	1823	1823	1820	3
27+00	1835	1822	1821	1818	4
28+00	1834	1821	1818	1815	6
29+00	1833	1820	1815	1812	8
30+00	1832	1820	1812	1809	11
31+00	1832	1819	1808	1805	14
31+75	1832	1818	1807	1804	14

DRAFT

Oakey Boulevard Lateral

Station (Boring/Well ID)	Ground Surface Elevation (feet AMSL)	Static Groundwater Elevation (feet AMSL)	Pipeline Invert Elevation (feet AMSL)	Target Dewatering Elevation (feet AMSL)	Required Drawdown (feet)
11+00 (B-11)	1848	1833	1843	1840	No Dewatering Anticipated
12+00	1847	1833	1839	1836	No Dewatering Anticipated
13+00	1846	1834	1835	1832	2
14+00	1846	1834	1830	1827	7
15+00	1845	1835	1824	1821	14
15+50	1845	1835	1825	1822	13

DRAFT

Appendix D

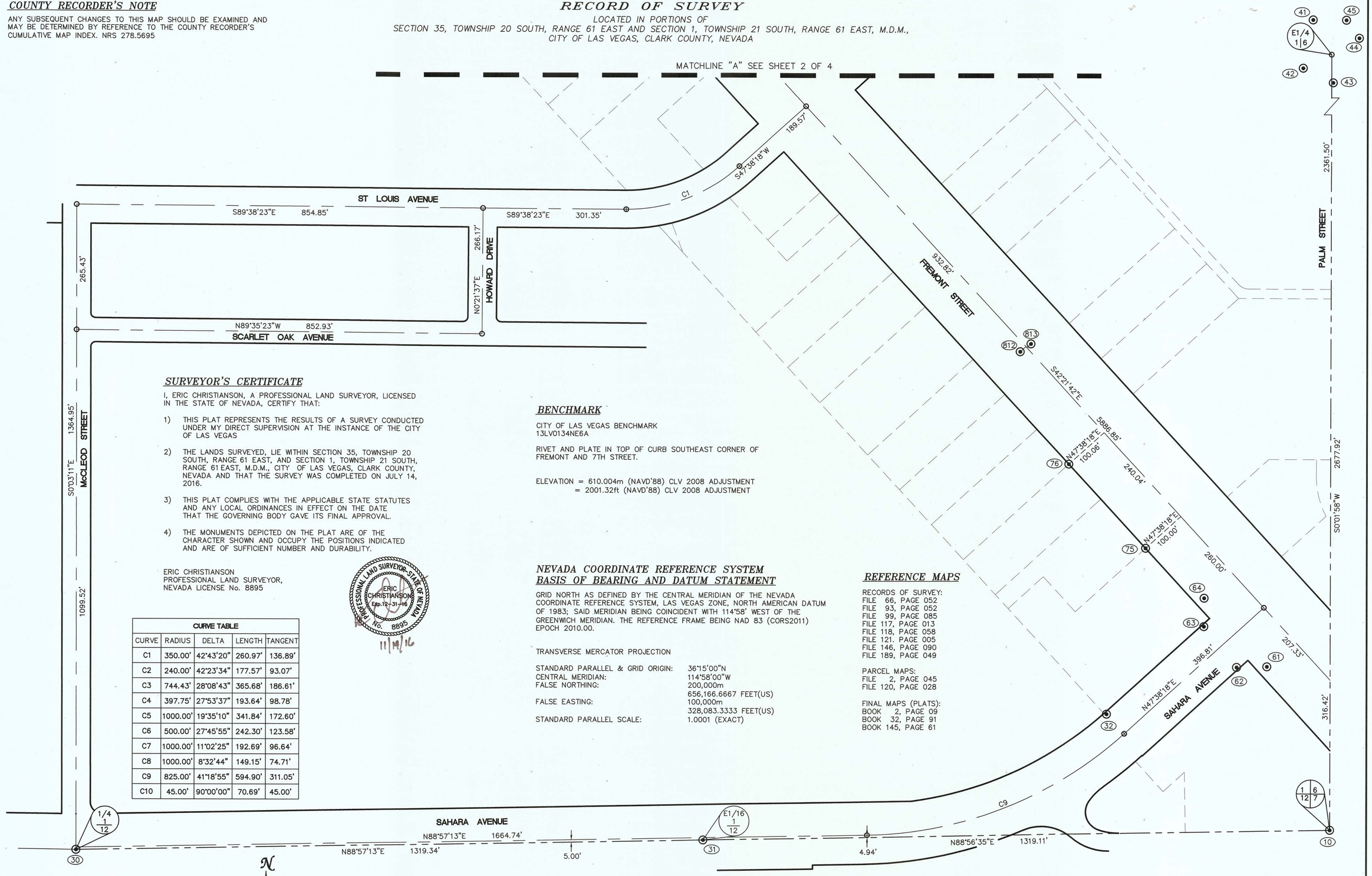
Record of Survey

COUNTY RECORDER'S NOTE

ANY SUBSEQUENT CHANGES TO THIS MAP SHOULD BE EXAMINED AND MAY BE DETERMINED BY REFERENCE TO THE COUNTY RECORDER'S CUMULATIVE MAP INDEX. NRS 278.5695

RECORD OF SURVEY

LOCATED IN PORTIONS OF
SECTION 35, TOWNSHIP 20 SOUTH, RANGE 61 EAST AND SECTION 1, TOWNSHIP 21 SOUTH, RANGE 61 EAST, M.D.M.,
CITY OF LAS VEGAS, CLARK COUNTY, NEVADA



SURVEYOR'S CERTIFICATE

I, ERIC CHRISTIANSON, A PROFESSIONAL LAND SURVEYOR, LICENSED IN THE STATE OF NEVADA, CERTIFY THAT:

1) THIS PLAT REPRESENTS THE RESULTS OF A SURVEY CONDUCTED UNDER MY DIRECT SUPERVISION AT THE INSTANCE OF THE CITY OF LAS VEGAS

2) THE LANDS SURVEYED, LIE WITHIN SECTION 35, TOWNSHIP 20 SOUTH, RANGE 61 EAST, AND SECTION 1, TOWNSHIP 21 SOUTH, RANGE 61 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AND THAT THE SURVEY WAS COMPLETED ON JULY 14, 2016.

3) THIS PLAT COMPLIES WITH THE APPLICABLE STATE STATUTES AND ANY LOCAL ORDINANCES IN EFFECT ON THE DATE THAT THE GOVERNING BODY GAVE ITS FINAL APPROVAL.

4) THE MONUMENTS DEPICTED ON THE PLAT ARE OF THE CHARACTER SHOWN AND OCCUPY THE POSITIONS INDICATED AND ARE OF SUFFICIENT NUMBER AND DURABILITY.

ERIC CHRISTIANSON
PROFESSIONAL LAND SURVEYOR,
NEVADA LICENSE No. 8895

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
ERIC CHRISTIANSON
Exp. 12-31-16
No. 8895

11/14/16

CURVE TABLE				
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C10	45.00'	90°00'00"	70.69'	45.00'

BENCHMARK

CITY OF LAS VEGAS BENCHMARK
13LV0134NE6A

RIVET AND PLATE IN TOP OF CURB SOUTHEAST CORNER OF FREMONT AND 7TH STREET.

ELEVATION = 610.004m (NAVD'88) CLV 2008 ADJUSTMENT
= 2001.32ft (NAVD'88) CLV 2008 ADJUSTMENT

NEVADA COORDINATE REFERENCE SYSTEM BASIS OF BEARING AND DATUM STATEMENT

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDIAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS2011) EPOCH 2010.00.

TRANSVERSE MERCATOR PROJECTION

STANDARD PARALLEL & GRID ORIGIN:	36°15'00"N
CENTRAL MERIDIAN:	114°58'00"W
FALSE NORTHING:	200,000m 656,166.6667 FEET(US)
FALSE EASTING:	100,000m 328,083.3333 FEET(US)
STANDARD PARALLEL SCALE:	1.0001 (EXACT)

REFERENCE MAPS

RECORDS OF SURVEY:
FILE 66, PAGE 052
FILE 93, PAGE 052
FILE 99, PAGE 085
FILE 117, PAGE 013
FILE 118, PAGE 058
FILE 121. PAGE 005
FILE 146, PAGE 090
FILE 189, PAGE 049

PARCEL MAPS:
FILE 2, PAGE 045
FILE 120, PAGE 028

FINAL MAPS (PLATS):
BOOK 2, PAGE 09
BOOK 32, PAGE 91
BOOK 145, PAGE 61

N

ATKINS

GRAPHIC SCALE

100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

LEGEND

- RIGHT-OF-WAY LINE
- SECTION LINE
- CENTERLINE
- PARCEL LINE
- FOUND MONUMENT AS INDICATED
- NO POINT FOUND OR SET-CALCULATED POINT

CLV GRID PROJECT NO. H62695

SHEET 1 OF 4

LOCATED IN PORTIONS OF SECTION 35, TOWNSHIP 20 SOUTH, RANGE 61 EAST AND SECTION 1, TOWNSHIP 21 SOUTH, RANGE 61 EAST, M.D.M. CITY OF LAS VEGAS, CLARK COUNTY, NEVADA

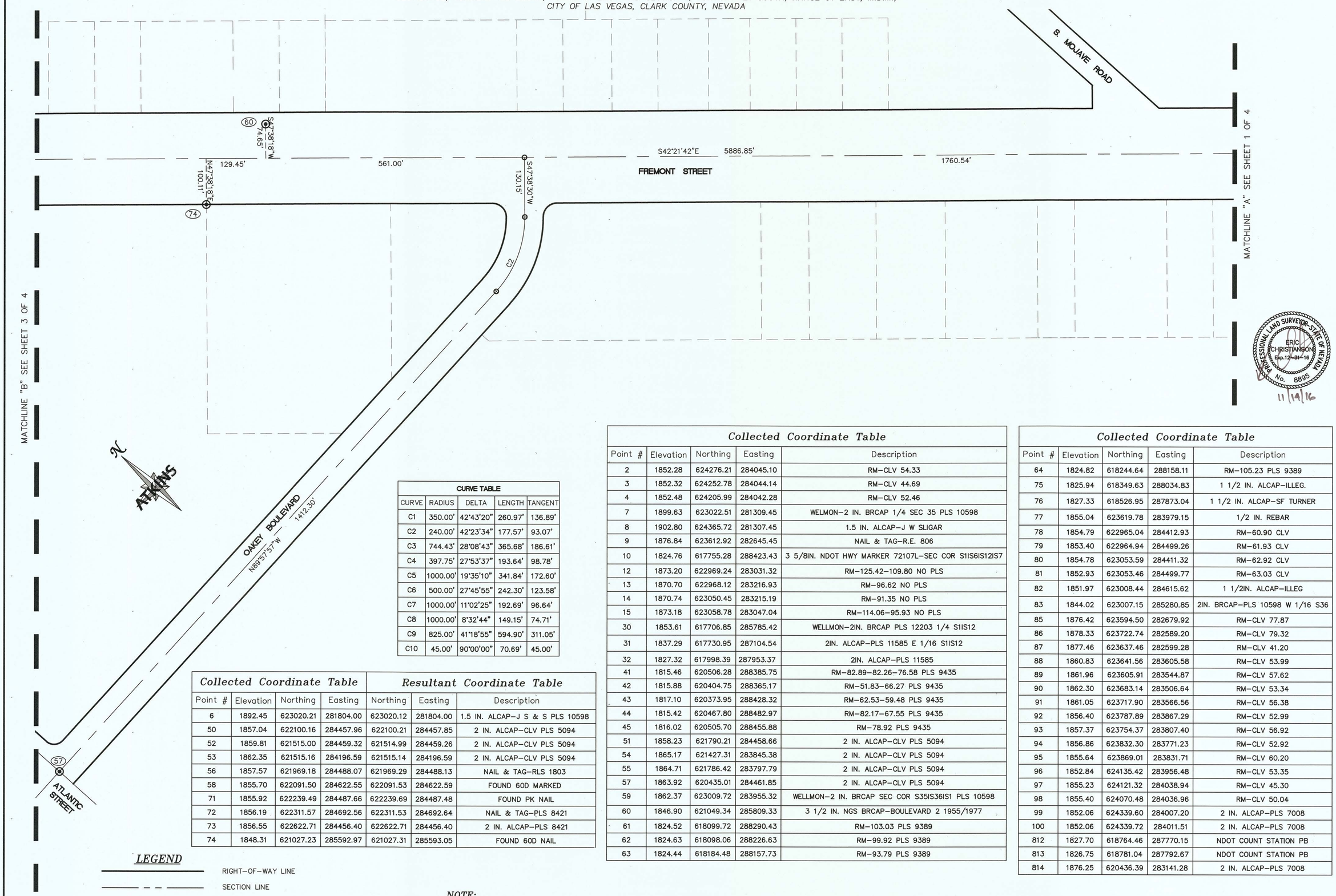
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No. 03618
Filed at the request of
Atkins North America, Inc.
Date 11/15/16 Time 16:34 PM
File 201 Page 0044
of SURVEYS
Official Records Book No.
20161115
Clark County, Nevada Records
DEBBIE CONWAY, Recorder
Fee $54.00 Deputy SAD

201/0044

RECORD OF SURVEY

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C9	825.00'	41°18'55"	594.90'	311.05'
C10	45.00'	90°00'00"	70.69'	45.00'

Collected Coordinate Table				Resultant Coordinate Table		
Point #	Elevation	Northing	Easting	Northing	Easting	Description
6	1892.45	623020.21	281804.00	623020.12	281804.00	1.5 IN. ALCAP–J S & S PLS 10598
50	1857.04	622100.16	284457.96	622100.21	284457.85	2 IN. ALCAP–CLV PLS 5094
52	1859.81	621515.00	284459.32	621514.99	284459.26	2 IN. ALCAP–CLV PLS 5094
53	1862.35	621515.16	284196.59	621515.14	284196.59	2 IN. ALCAP–CLV PLS 5094
56	1857.57	621969.18	284488.07	621969.29	284488.13	NAIL & TAG–RLS 1803
58	1855.70	622091.50	284622.55	622091.53	284622.59	FOUND 60D MARKED
71	1855.92	622239.49	284487.66	622239.69	284487.48	FOUND PK NAIL
72	1856.19	622311.57	284692.56	622311.53	284692.64	NAIL & TAG–PLS 8421
73	1856.55	622622.71	284456.40	622622.71	284456.40	2 IN. ALCAP–PLS 8421
74	1848.31	621027.23	285592.97	621027.31	285593.05	FOUND 60D NAIL

LEGEND

- RIGHT–OF–WAY LINE
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NOTE:

BEARINGS AND DISTANCES SHOWN HEREON ARE BASED ON THE "RESULTANT COORDINATES" TABLE. "RESULTANT COORDINATES" REPRESENT THE MATHEMATICAL LOCATION OF THE MONUMENTS BASED ON BEST FIT LINES OR ARCS AS DETERMINED BY A COMBINATION OF "COLLECTED COORDINATES" AND RECORD INFORMATION.

"COLLECTED COORDINATES" ARE POSITIONS OF MONUMENTS AS LOCATED DURING THE FIELD SURVEY FOR THE PROJECT AS DETERMINED BY GPS AND CONVENTIONAL SURVEY METHODS.

Collected Coordinate Table				
Point #	Elevation	Northing	Easting	Description
2	1852.28	624276.21	284045.10	RM–CLV 54.33
3	1852.32	624252.78	284044.14	RM–CLV 44.69
4	1852.48	624205.99	284042.28	RM–CLV 52.46
7	1899.63	623022.51	281309.45	WELMON–2 IN. BRCAP 1/4 SEC 35 PLS 10598
8	1902.80	624365.72	281307.45	1.5 IN. ALCAP–J W SLIGAR
9	1876.84	623612.92	282645.45	NAIL & TAG–R.E. 806
10	1824.76	617755.28	288423.43	3 5/8IN. NDOT HWY MARKER 72107L–SEC COR S1IS6IS12IS7
12	1873.20	622969.24	283031.32	RM–125.42–109.80 NO PLS
13	1870.70	622968.12	283216.93	RM–96.62 NO PLS
14	1870.74	623050.45	283215.19	RM–91.35 NO PLS
15	1873.18	623058.78	283047.04	RM–114.06–95.93 NO PLS
30	1853.61	617706.85	285785.42	WELLMON–2IN. BRCAP PLS 12203 1/4 S1IS12
31	1837.29	617730.95	287104.54	2IN. ALCAP–PLS 11585 E 1/16 S1IS12
32	1827.32	617998.39	287953.37	2IN. ALCAP–PLS 11585
41	1815.46	620506.28	288385.75	RM–82.89–82.26–76.58 PLS 9435
42	1815.88	620404.75	288365.17	RM–51.83–66.27 PLS 9435
43	1817.10	620373.95	288428.32	RM–62.53–59.48 PLS 9435
44	1815.42	620467.80	288482.97	RM–82.17–67.55 PLS 9435
45	1816.02	620505.70	288455.88	RM–78.92 PLS 9435
51	1858.23	621790.21	284458.66	2 IN. ALCAP–CLV PLS 5094
54	1865.17	621427.31	283845.38	2 IN. ALCAP–CLV PLS 5094
55	1864.71	621786.42	283797.79	2 IN. ALCAP–CLV PLS 5094
57	1863.92	620435.01	284461.85	2 IN. ALCAP–CLV PLS 5094
59	1862.37	623009.72	283955.32	WELLMON–2 IN. BRCAP SEC COR S35IS36IS1 PLS 10598
60	1846.90	621049.34	285809.33	3 1/2 IN. NGS BRCAP–BOULEVARD 2 1955/1977
61	1824.52	618099.72	288290.43	RM–103.03 PLS 9389
62	1824.63	618098.06	288226.63	RM–99.92 PLS 9389
63	1824.44	618184.48	288157.73	RM–93.79 PLS 9389

Collected Coordinate Table				
Point #	Elevation	Northing	Easting	Description
64	1824.82	618244.64	288158.11	RM–105.23 PLS 9389
75	1825.94	618349.63	288034.83	1 1/2 IN. ALCAP–ILLEG.
76	1827.33	618526.95	287873.04	1 1/2 IN. ALCAP–SF TURNER
77	1855.04	623619.78	283979.15	1/2 IN. REBAR
78	1854.79	622965.04	284412.93	RM–60.90 CLV
79	1853.40	622964.94	284499.26	RM–61.93 CLV
80	1854.78	623053.59	284411.32	RM–62.92 CLV
81	1852.93	623053.46	284499.77	RM–63.03 CLV
82	1851.97	623008.44	284615.62	1 1/2IN. ALCAP–ILLEG
83	1844.02	623007.15	285280.85	2IN. BRCAP–PLS 10598 W 1/16 S36
85	1876.42	623594.50	282679.92	RM–CLV 77.87
86	1878.33	623722.74	282589.20	RM–CLV 79.32
87	1877.46	623637.46	282599.28	RM–CLV 41.20
88	1860.83	623641.56	283605.58	RM–CLV 53.99
89	1861.96	623605.91	283544.87	RM–CLV 57.62
90	1862.30	623683.14	283506.64	RM–CLV 53.34
91	1861.05	623717.90	283566.56	RM–CLV 56.38
92	1856.40	623787.89	283867.29	RM–CLV 52.99
93	1857.37	623754.37	283807.40	RM–CLV 56.92
94	1856.86	623832.30	283771.23	RM–CLV 52.92
95	1855.64	623869.01	283831.71	RM–CLV 60.20
96	1852.84	624135.42	283956.48	RM–CLV 53.35
97	1855.23	624121.32	284038.94	RM–CLV 45.30
98	1855.40	624070.48	284036.96	RM–CLV 50.04
99	1852.06	624339.60	284007.20	2 IN. ALCAP–PLS 7008
100	1852.06	624339.72	284011.51	2 IN. ALCAP–PLS 7008
812	1827.70	618764.46	287770.15	NDOT COUNT STATION PB
813	1826.75	618781.04	287792.67	NDOT COUNT STATION PB
814	1876.25	620436.39	283141.28	2 IN. ALCAP–PLS 7008

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)

1 inch = 100 ft.

PROFESSIONAL LAND SURVEYOR–STATE OF NEVADA
ERIC CHRISTIANSON
Exp.12–31–16
No. 8895
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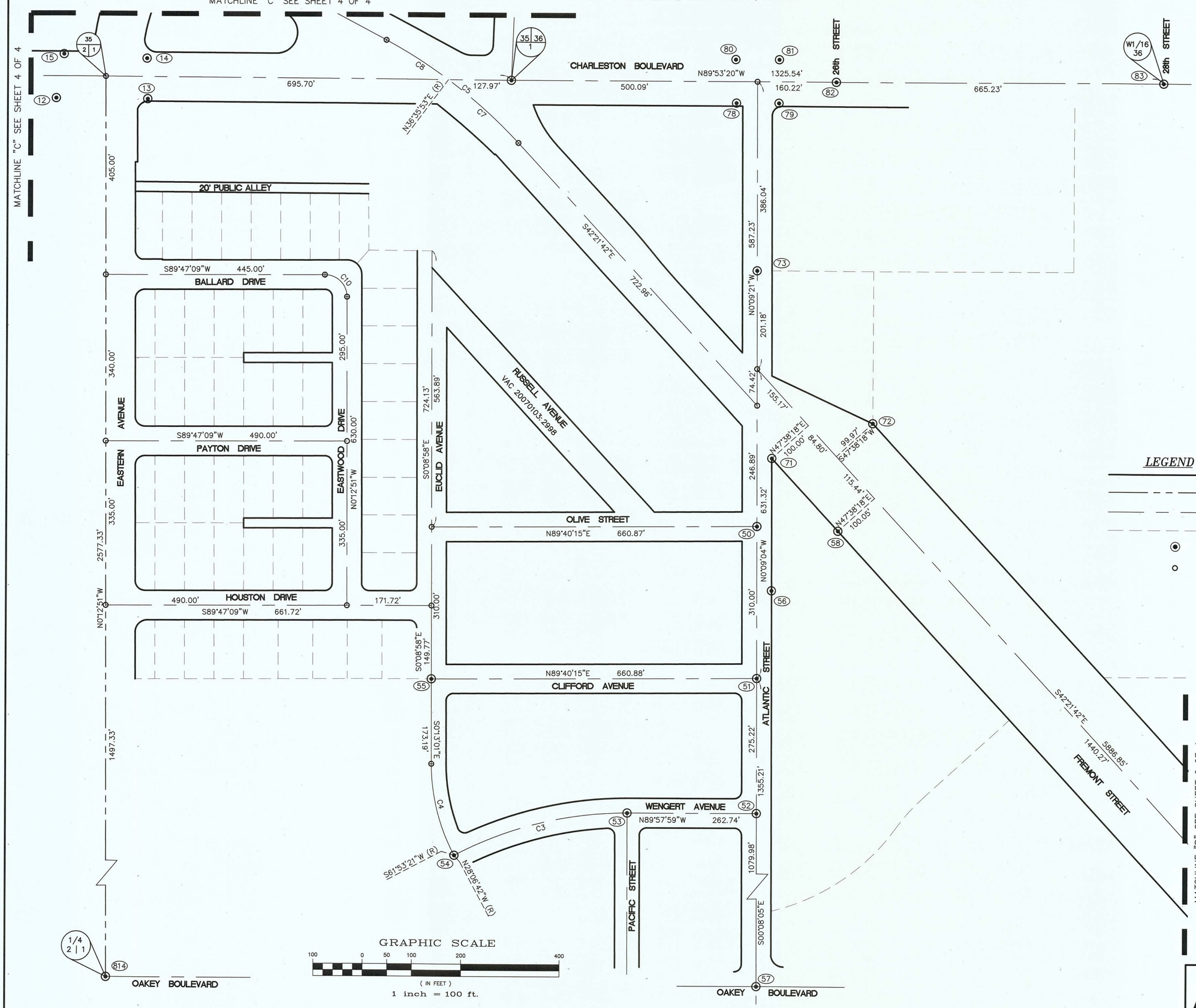
SHEET 2 of 4

ATKINS
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201/0044

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N

ATKINS

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PROFESSIONAL LAND SURVEYOR - STATE OF NEVADA
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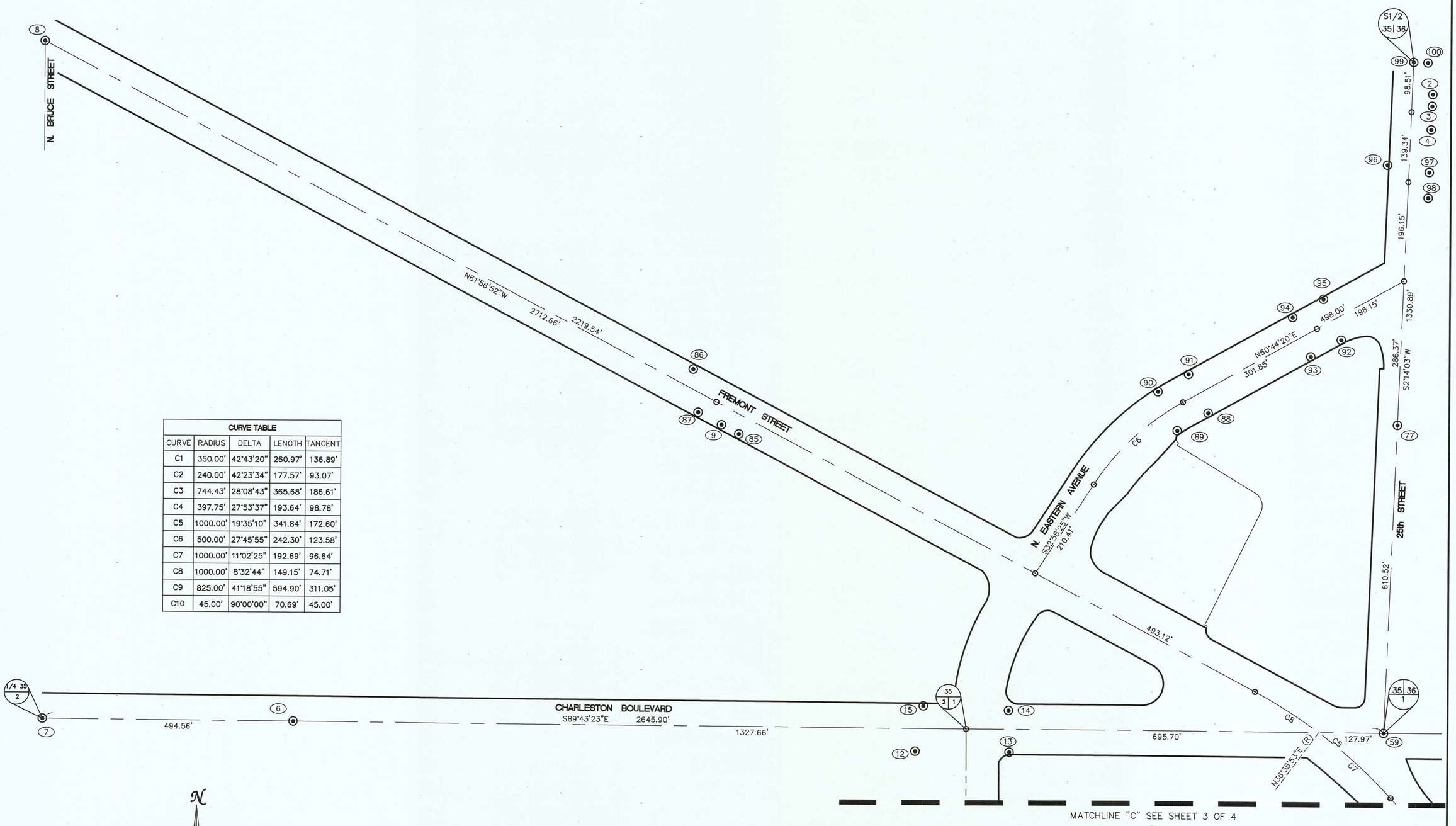
SHEET 3 of 4

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PROFESSIONAL LAND SURVEYOR - STATE OF NEVADA
ERIC CHRISTIANSON
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SHEET 4 of 4

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201/0044

Appendix E

Utility Conflicts

- Appendix E-1: Utility Conflict Matrix
- Appendix E-2: S U E plans
- Appendix E-3: Utility Pothole Reports

Appendix E-1

Utility Conflict Matrix

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - MAINLINE (SD-01)

BOULDER HIGHWAY STORM DRAIN — PREPARED BY: KRM — DATE: 5/17/2017

PROJECT NO.: 100050127 — CHECKED BY: VAS — DATE: 5/25/2017

SHEET	LOCATION					UTILITY	ROW	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	Owner	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
Mainline (SD-01)																				
SD01	89+40.23	10.00' LT	TO	89+61.13	10.00' RT	(2) 3-1/2" UG TELEPHONE	NDOT	1853.90	1853.61	X		18'X8' RCB	1847.14	1836.97	1.00'			6.47'	NO	PROTECT-IN-PLACE
SD01	89+46.84	10.00' LT	TO	89+68.15	10.00' RT	8" ACP WATER	NDOT	1852.50	1851.83	X		18'X8' RCB	1847.11	1836.94	1.50'			4.73'	NO	REMOVE AND REPLACE
SD01	89+72.19	10.00' LT	TO	89+94.80	10.00' RT	12" VCP SS	NDOT	1849.40	1848.40		MANHOLE DIP	18'X8' RCB	1847.01	1836.84	0.50'			1.39'	NO	REMOVE AND REPLACE
SD01	90+25.93	10.00' RT	TO	90+27.05	10.00' LT	8" VCP SS	NDOT	1848.50	1847.83		MANHOLE DIP	18'X8' RCB	1846.85	1836.68	0.50'			0.98'	NO	REMOVE AND REPLACE
SD01	90+53.62	10.00' RT	TO	90+56.38	10.00' LT	18" RCP SD	NDOT	1853.10	1851.18		MANHOLE DIP	18'X8' RCB	1846.74	1836.57				4.45'	NO	REMOVE
SD02	94+18.10	10.00' RT	TO	94+24.10	10.00' RT	LOOP DETECTORS	NDOT					18'X8' RCB							YES	REMOVE AND REPLACE
SD02	96+98.40	10.00' RT	TO	97+06.50	10.00' RT	LOOP DETECTOR AND CONDUIT	NDOT					18'X8' RCB							YES	REMOVE AND REPLACE
SD02	97+24.58	10.00' LT	TO	97+27.32	10.00' RT	24" RCP SD	NDOT	1851.60	1849.10		MANHOLE DIP	18'X8' RCB	1844.37	1834.20				4.73'	NO	REMOVE
SD02	98+62.55	10.00' RT	TO	98+62.65	10.00' LT	TRAFFIC SIGNAL CONDUIT	NDOT	1851.80	1851.63		STANDARD DEPTH	18'X8' RCB	1843.90	1833.73				7.74'	NO	PROTECT-IN-PLACE
SD03	105+17.72	10.00' RT	TO	105+20.23	10.00' LT	24" RCP SD	NDOT	1846.80	1844.30		MANHOLE DIP	18'X8' RCB	1841.62	1831.45				2.68'	NO	REMOVE
SD03	108+66.18	10.00' RT	TO	108+68.72	10.00' LT	24" RCP SD	NDOT	1845.60	1843.10		MANHOLE DIP	18'X8' RCB	1840.42	1830.25				2.68'	NO	REMOVE
SD04	113+50.88	10.00' LT	TO	113+51.56	10.00' RT	3-1000 MCM UG ELECTRIC	NDOT	1835.60	1833.93	X		18'X8' RCB	1841.42	1831.25					YES	RELOCATE BY OTHERS
SD05	119+44.64	11.00' RT	TO	119+48.53	11.00' LT	24" RCP SD	NDOT	1839.00	1836.50		MANHOLE DIP	20'X8' RCB	1835.20	1824.86				1.30'	NO	REMOVE
SD05	123+14.80	7.44' LT	TO	123+22.88	11.00' RT	LOOP DETECTORS AND CONDUIT	NDOT					20'X8' RCB							YES	REMOVE AND REPLACE
SD05	126+25.54	10.56' RT	TO	126+35.44	1.58' RT	LOOP DETECTORS AND CONDUIT	NDOT					20'X8' RCB							YES	REMOVE AND REPLACE
SD05	127+49.17	11.00' RT	TO	127+49.38	11.00' LT	12" ACP WATER (24" STL CASING)	NDOT	1828.30	1826.30	X		20'X8' RCB	1829.77	1819.43					YES	RELOCATE
SD06	128+30.94	7.44' LT	TO	128+40.02	11.00' RT	LOOP DETECTORS AND CONDUIT	NDOT					20'X8' RCB							YES	REMOVE AND REPLACE
SD06	129+26.54	11.00' LT	TO	129+61.07	11.00' RT	10" VCP SS	NDOT	1828.40	1827.57		MANHOLE DIP	24'X6' RCB	1825.11	1816.44				2.46'	NO	REMOVE
SD06	131+01.88	7.36' LT	TO	131+12.18	13.00' RT	LOOP DETECTORS AND CONDUIT	NDOT					24'X6' RCB							YES	REMOVE AND REPLACE
SD06	131+28.34	13.00' LT	TO	131+29.61	13.00' RT	4" ITS CONDUIT	NDOT	1829.70	1829.37		STANDARD DEPTH	24'X6' RCB	1814.12	1805.45				15.25'	NO	PROTECT-IN-PLACE
SD06	132+22.64	13.00' RT	TO	132+25.22	13.00' LT	51" RCP SS INSIDE 72" STEEL CASING	NDOT	1821.45	1815.28	X		24'X6' RCB	1813.93	1805.26				1.35'	NO	PROTECT-IN-PLACE
SD06	134+50.49	8.75' RT	TO	134+50.52	8.75' LT	24" RCP SD	NDOT	1827.50	1825.00		MANHOLE DIP	15'X10' RCB	1817.39	1804.89				7.61'	NO	REMOVE
SD07	138+73.17	8.75' RT	TO	138+76.61	8.75' LT	NDOT TRAFFIC COUNT CONDUIT	NDOT					15'X10' RCB							YES	PROTECT-IN-PLACE
SD07	139+11.64	8.75' LT	TO	139+11.64	8.75' RT	2" PE GAS	NDOT			X		15'X10' RCB		-12.50				0.00'	NO	PROTECT-IN-PLACE
SD07	142+33.49	7.44' LT	TO	142+41.90	8.75' RT	LOOP DETECTORS AND CONDUIT	NDOT					15'X10' RCB							YES	REMOVE AND REPLACE
Mainline Lateral 1 (DI#1)																				
SD08						STREETLIGHT CONDUIT	NDOT				STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD08						8" VCP SS	NDOT	1849.60	1848.93		MANHOLE DIP	24" RCP SD	1849.61	1847.11	0.50'				YES	RELOCATE
SD08						8" ACP WATER	NDOT	1852.70	1852.03	X		24" RCP SD	1849.10	1846.60	0.50'			2.93'	NO	REMOVE AND REPLACE
SD08						30" MLCP WATER	NDOT	1852.80	1850.30	X		24" RCP SD	1848.59	1846.09	0.50'			1.71'	NO	PROTECT IN PLACE
Mainline Lateral 2 (DI#2)																				
SD08						STREETLIGHT CONDUIT	NDOT				STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD08						30" MLCP WATER	NDOT	1850.50	1848.00	X		24" RCP SD	1846.44	1843.94	0.50'			1.56'	NO	PROTECT IN PLACE
Mainline Lateral 3 (DI#3)																				
SD09						30" MLCP WATER	NDOT	1848.40	1845.90	X		DROP INLET					2.67'		NO	PROTECT IN PLACE
SD09						STREETLIGHT CONDUIT	NDOT				STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD09						TRAFFIC SIGNAL CONDUIT	NDOT				STANDARD DEPTH	30" RCP SD					1.89'		YES	RELOCATE
Mainline Lateral 4 (DI#4)																				
SD09						STREETLIGHT CONDUIT	NDOT					DROP INLET							NO	PROTECT IN PLACE
SD09						4" ITS CONDUIT	NDOT				STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD09						TRAFFIC SIGNAL LOOPS	NDOT					18" RCP SD							NO	PROTECT IN PLACE
Mainline Lateral 5 (DI#5)																				
SD10						STREETLIGHT CONDUIT	NDOT				STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD10						30" MLCP WATER	NDOT	1850.50	1848.00	X		DROP INLET					5.29'		NO	PROTECT IN PLACE
Mainline Lateral 6 (DI#6)																				
SD10						8" ACP W	NDOT	1847.10	1846.43	X		24" RCP SD	1844.90	1842.40	0.50'			1.53'	NO	REMOVE AND REPLACE
SD10						4" ITS CONDUIT	NDOT	1847.10		X		DROP INLET					1.89'		YES	RELOCATE
SD10						CENTURYLINK CONDUIT	NDOT	1846.17		X		DROP INLET					3.34'		NO	PROTECT IN PLACE
Mainline Lateral 7 (DI#7, DI#8)																				
SD11						8" ACP W	NDOT	1842.80	1842.13	X		18" RCP SD	1846.26	1844.34	0.50'			1.54'	NO	REMOVE AND REPLACE
SD11						4" ITS CONDUIT	NDOT	1846.50	1846.17		STANDARD DEPTH	18" RCP SD	1846.51	1844.59					YES	RELOCATE
SD11						CENTURYLINK CONDUIT	NDOT	1842.90		X		DROP INLET					3.34'		NO	PROTECT IN PLACE
Mainline Lateral 8 (DI#9)																				

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - MAINLINE (SD-01)

BOULDER HIGHWAY STORM DRAIN — PREPARED BY: KRM — DATE: 5/17/2017

PROJECT NO.: 100050127 — CHECKED BY: VAS — DATE: 5/25/2017

SHEET	LOCATION					UTILITY	ROW	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	Owner	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
SD11						30" MLCP W	NDOT	1843.88	1841.38	X		DROP INLET					5.16'		NO	PROTECT IN PLACE
SD11						STREET LIGHT CONDUIT	NDOT	1847.60		X		DROP INLET					5.08'		NO	PROTECT IN PLACE
SD11						10" VCP SS	NDOT	1842.60	1841.93		MANHOLE DIP	30" RCP SD	1842.72	1839.64					YES	RELOCATE
Mainline Lateral 9 (DI#10)																				
SD12						30" MLCP W	NDOT	1842.24	1839.74	X		DROP INLET					6.13'		NO	PROTECT IN PLACE
SD12						STREET LIGHT CONDUIT	NDOT	1845.28		X		DROP INLET					6.08'		NO	PROTECT IN PLACE
SD12						10" VCP SS	NDOT	1840.60	1839.77		MANHOLE DIP	24" RCP SD	1839.05	1836.55	0.50'		0.70'	0.72'	YES	RELOCATE
Mainline Lateral 10 (DI#11)																				
SD12						30" MLCP W	NDOT	1840.65	1838.15	X		DROP INLET					5.84'		NO	PROTECT IN PLACE
SD12						10" VCP SS	NDOT	1838.40	1837.57		MANHOLE DIP	24" RCP SD	1835.81	1833.31	0.50'		0.50'	1.76'	YES	RELOCATE
Mainline Lateral 11 (DI#12, DI#13)																				
SD13						8" ACP W	NDOT	1839.60	1838.93	X		18" RCP SD	1837.39	1835.47	0.50'			1.54'	NO	REMOVE AND REPLACE
SD13						4" ITS CONDUIT	NDOT	1840.50	1840.17	X		DROP INLET					1.80'		YES	RELOCATE
SD13						CENTURYLINK CONDUIT	NDOT	1842.90		X		DROP INLET					1.90'		YES	RELOCATE
Mainline Lateral 12 (DI#14)																				
SD13						8" ACP W	NDOT	1835.70	1835.03	X		18" RCP SD	1833.47	1831.55	0.50'			1.56'	NO	REMOVE AND REPLACE
SD13						4" ITS CONDUIT	NDOT	1840.50	1840.17		STANDARD DEPTH	DROP INLET					1.80'		YES	RELOCATE
SD13						CENTURYLINK CONDUIT	NDOT	1835.50		X		DROP INLET					2.08'		YES	RELOCATE
Mainline Lateral 13 (DI#15)																				
SD14						8" ACP W	NDOT	1826.60	1825.93	X		18" PVC SD	1829.35	1827.81	0.50'			1.21'	NO	REMOVE AND REPLACE
SD14						4" ITS CONDUIT	NDOT	1828.54	1828.21	X		DROP INLET					1.82'		YES	RELOCATE
SD14						STREETLIGHT CONDUIT	NDOT	1830.10			STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD14						CENTURYLINK CONDUIT	NDOT	1826.37		X		DROP INLET							YES	RELOCATE
Mainline Lateral 14 (DI#16)																				
SD14						30" MLCP W	NDOT	1823.50	1821.00	X		DROP INLET					5.84'		NO	PROTECT IN PLACE
SD14						STREETLIGHT CONDUIT	NDOT	1828.50			STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD14						4" ITS CONDUIT	NDOT	1827.50	1827.17		STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD14						10" VCP SS	NDOT	1823.90	1823.07		MANHOLE DIP	24" RCP SD	1821.55	1819.05	0.50'		0.50'	1.52'	YES	RELOCATE
Mainline Lateral 15 (DI#17, DI#18)																				
SD15						8" ACP W	NDOT	1822.50	1821.83	X		18" RCP SD	1829.35	1827.81	0.50'			5.31'	NO	REMOVE AND REPLACE
SD15						4" ITS CONDUIT	NDOT	1826.50	1826.17		STANDARD DEPTH	DROP INLET	1829.42	1827.88	0.50'		1.82'		YES	RELOCATE
SD15						STREETLIGHT CONCUIT	NDOT	1826.90			STANDARD DEPTH	DROP INLET							YES	RELOCATE
SD15						CENTURYLINK CONDUIT	NDOT	1823.78		X		DROP INLET							YES	RELOCATE
Mainline Lateral 16 (DI#19)																				
SD15						30" MLCP W	NDOT	1820.00	1817.50	X		DROP INLET					5.11'		NO	PROTECT IN PLACE
SD15						STREET LIGHT CONDUIT	NDOT	1825.53		X		DROP INLET					5.04'		NO	PROTECT IN PLACE
SD15						10" VCP SS	NDOT	1840.60	1839.77		MANHOLE DIP	24" RCP SD	1838.72	1836.22	0.50'		0.70'	1.05'	YES	RELOCATE
Mainline Lateral 17 (DI#20)																				
SD16						30" MLCP W	NDOT	1818.30	1815.80	X		DROP INLET					4.93'		NO	PROTECT IN PLACE
SD16						STREET LIGHT CONDUIT	NDOT	1845.28			STANDARD DEPTH	DROP INLET					4.50'		NO	PROTECT IN PLACE
SD16						4" ITS CONDUIT	NDOT				STANDARD DEPTH	DROP INLET								RELOCATE
SD16						10" VCP SS	NDOT	1819.20	1818.37		MANHOLE DIP	24" RCP SD	1818.39	1815.89	0.50'		0.70'		YES	RELOCATE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - EUCLID LATERAL (SD-02)

PROJECT: BOULDER HIGHWAY STORM DRAIN | PREPARED BY: KRM | DATE: 5/15/2017

PROJECT NO.: 100050127 | CHECKED BY: VAS | DATE: 5/25/2017

SHEET	LOCATION					UTILITY	ROW	ELEVATION		SOURCE OF INFO		IMPROVEMENT	IMPROVEMENT ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	Owner	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
Euclid Mainline (SD-02)																				
SD17	10+52.42	1.17' LT	TO	10+52.77	0.79' LT	SS LATERAL	CLV	1861.90	1861.57		STANDARD DEPTH	18" RCP SD	1860.57	1858.65	0.50'			1.00'	YES	REMOVE AND REPLACE
SD17	12+10.96	1.25' LT	TO	12+10.96	1.25' RT	2" PE GAS IN 3" SLEEVE	CLV	1860.10	1859.85	X		24" RCP SD	1860.12	1845.12	0.50'				YES	RELOCATE BY OTHERS
SD17	12+15.96		TO	12+15.96		ABANDONED 2" STL GAS	CLV				STANDARD DEPTH	SDMH							YES	REMOVE
SD17	12+43.59	1.25' RT	TO	12+43.88	1.25' LT	2" PE GAS IN 3" SLEEVE	CLV	1859.60	1859.35	X		24" RCP SD	1859.75	1844.75	0.50'				YES	RELOCATE BY OTHERS
SD17	13+76.36	1.25' RT	TO	13+77.34	1.25' LT	3 - #4 ACSR OH ELECTRIC	CLV												NO	PROTECT IN PLACE
SD17	14+96.57	1.25' LT	TO	15+09.97	1.25' RT	3 - #4 ACSR OH ELECTRIC	CLV												NO	PROTECT IN PLACE
SD17	15+38.37	1.25' RT	TO	15+40.37	1.25' LT	3 - #4 ACSR OH ELECTRIC	CLV												NO	PROTECT IN PLACE
SD19	19+35.44	3.63' RT	TO	21+35.96	4.28' RT	2" PE GAS IN 3" SLEEVE	CLV	1857.60	1857.35	X		30' RCP SD	1853.48	1834.98	0.50'		2.50'	3.87'	YES	RELOCATE BY OTHERS
SD18	21+49.23	1.55' RT	TO	21+52.31	1.55' LT	8" ACP WATER	CLV	1853.50	1852.83	X		30' RCP SD	1848.12	1829.62	0.50'			4.71'	NO	REMOVE AND REPLACE
SD18	21+56.96	1.55' RT	TO	21+60.03	1.55' LT	2" PE GAS	CLV	1853.60	1853.43	X		30' RCP SD	1847.96	1829.46	0.50'			5.47'	NO	PROTECT IN PLACE
SD18	21+73.00	1.55' RT	TO	21+76.15	1.55' LT	12" VCP SEWER	CLV	1853.40	1852.36		MANHOLE DIP	30' RCP SD	1846.87	1828.37	0.50'			5.49'	NO	REMOVE AND REPLACE
Euclid Lateral 1							CLV													
SD19						8" PVC WATER	CLV	1860.50	1859.79	X		18" PVC SD	1863.48	1861.88		0.50'		1.38'	NO	PROTECT IN PLACE
SD19						ABANDONED 6" CIP WATER	CLV	1861.50	1860.98		STANDARD DEPTH	18" PVC SD	1863.46	1861.86		0.50'		0.36'	YES	REMOVE
SD19						8" VCP SS	CLV	1861.00	1860.29		MANHOLE DIP	18" PVC SD	1863.42	1861.82		0.50'		0.82'	NO	REMOVE AND REPLACE
Euclid Lateral 2							CLV													
SD19						2" PE GAS IN 3" SLEEVE	CLV	1860.60	1860.35	X		18" RCP SD	1859.99	1858.07		0.50'		0.36'	YES	RELOCATE BY OTHERS
SD19						ABANDONED 2" STL GAS	CLV	1861.00	1860.83		STANDARD DEPTH	18" RCP SD	1860.18	1858.26		0.50'		0.65'	NO	REMOVE
Euclid Lateral 3																				
SD20						OVERHEAD CABLE TV	CLV												NO	PROTECT IN PLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - ATLANTIC LATERAL (SD-03)

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: KRM DATE: 5/15/2017

PROJECT NO.: 100050127 CHECKED BY: VAS DATE: 5/25/2017

SHEET	LOCATION					UTILITY	ROW	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	Owner	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
Atlantic SD Mainline (SD-03)																				
SD21	11+05.19	2.71' LT	TO	11+05.19	2.71' RT	SANITARY SEWER LATERAL	CLV					54" RCP SD							NO	PROTECT-IN-PLACE
SD21	11+41.66	2.71' LT	TO	11+49.35	2.71' RT	2" PE GAS	CLV	1856.40	1856.21	X		54" RCP SD	1853.26	1847.84	0.50'		0.00'	2.95'	YES	RELOCATE BY OTHERS
SD21	11+52.88	2.71' RT	TO	11+56.66	2.71' LT	6" ACP WATER	CLV	1856.10	1855.58	X		54" RCP SD	1853.20	1847.78	0.50'			2.38'	NO	REMOVE AND REPLACE
SD21	11+66.36	2.71' RT	TO	11+70.20	2.71' LT	12" VCP SS	CLV	1855.40	1854.36		MANHOLE DIP	54" RCP SD	1853.06	1847.64	0.50'			1.30'	NO	REMOVE AND REPLACE
SD21	11+80.54	2.71' RT	TO	18+44.73	3.29' LT	24" TO 30" RCP SD AND MANHOLES	CLV					54" RCP SD							YES	REMOVE
SD21	12+70.46	2.71' RT	TO	12+70.53	2.71' LT	3-#6 CU OH ELECTRIC	CLV					54" RCP SD							NO	PROTECT-IN-PLACE
SD21	15+77.70	2.71' RT	TO	15+77.75	2.71' LT	3-#6 CU OH ELECTRIC	CLV					54" RCP SD							NO	PROTECT-IN-PLACE
SD21	17+14.84	3.00' LT	TO	17+14.84	3.00' RT	SANITARY SEWER LATERAL	CLV					54" RCP SD							NO	PROTECT-IN-PLACE
SD21	17+19.22	3.00' RT	TO	17+19.22	3.00' LT	16" ACP WATER	CLV	1848.64	1847.31	X		60" RCP SD	1846.34	1840.34	0.50'			0.97'	NO	REMOVE AND REPLACE
SD21	18+55.94	3.00' RT	TO	18+67.61	3.00' LT	STREET LIGHT CONDUIT	CLV	1854.40	1854.23		STANDARD DEPTH	60" RCP SD	1847.34	1841.34	1.50'			6.89'	NO	PROTECT-IN-PLACE
SD21	18+60.02	3.00' LT	TO	18+60.14	3.00' RT	8" ACP WATER	CLV	1853.40	1852.73		STANDARD DEPTH	60" RCP SD	1845.44	1839.44	0.50'			7.29'	NO	REMOVE AND REPLACE
SD21	19+02.22	3.29' LT	TO	19+06.23	3.29' RT	30" MLCP WATER	NDOT	1851.10	1848.60	X		60" RCP SD	1845.52	1839.52	0.50'			3.08'	NO	PROTECT-IN-PLACE
Atlantic Lateral 1																				
SD22						2" PE GAS	CLV	1857.10	1856.93	X		36" RCP SD	1855.91	1852.24	0.50'		0.50'	1.02'	YES	PROTECT-IN-PLACE
SD22						24" RCP SD	CLV				MANHOLE DIP	SDMH							YES	REMOVE
SD22						10" VCP SS	CLV	1856.00	1855.08		MANHOLE DIP	38"X60" HERCP SD	1853.85	1849.77				1.23'	NO	REMOVE AND REPLACE
SD22						AB 2" STL GAS	CLV	1857.50	1857.33		STANDARD DEPTH	38"X60" HERCP SD	1854.09	1850.01				3.24'	NO	REMOVE
SD22						8" CIP WATER	CLV	1857.10	1856.43	X		38"X60" HERCP SD	1854.59	1850.50			0.80'	1.85'	YES	RELOCATE
Atlantic Lateral 2																				
SD22						2" PE GAS	CLV	1854.50	1854.33	X		24" RCP SD	1853.49	1850.99	0.50'		0.35'	0.84'	YES	RELOCATE BY OTHERS
SD22						12" VCP SS	CLV	1854.80	1853.78		MANHOLE DIP	24" RCP SD	1851.78	1849.28	0.50'			2.00'	NO	REMOVE AND REPLACE
SD22						30" RCP SD	CLV	1852.50	1849.42		MANHOLE DIP	24" RCP SD	1850.57	1848.07					YES	REMOVE
Atlantic Lateral 3																				
SD23						6" ACP WATER	CLV	1852.80	1852.30	X		24" RCP SD	1850.98	1848.48	0.50'		0.35'	1.32'	YES	RELOCATE
SD23						12" VCP SS	CLV	1853.60	1852.60		MANHOLE DIP	24" RCP SD	1847.95	1845.45				4.65'	NO	REMOVE AND REPLACE
SD23						30" RCP SD	CLV					SDMH							YES	REMOVE
Atlantic Lateral 4																				
SD23						8" ACP WATER	CLV	1852.10	1851.43	X		24" RCP SD	1849.00	1846.50	0.50'		0.40'	2.43'	YES	RELOCATE
SD23						STREETLIGHT CONDUIT	CLV				STANDARD DEPTH	24" RCP SD	1849.00	1846.50	0.50'				NO	PROTECT IN PLACE
SD23						12" VCP SS	CLV	1851.40	1850.40		MANHOLE DIP	24" RCP SD	1846.94	1844.44	0.50'			3.46'	NO	REMOVE AND REPLACE
SD23						30" RCP SD	CLV					SDMH							YES	REMOVE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - OAKEY LATERAL (SD-04)

PROJECT: BOULDER HIGHWAY STORM DRAIN | PREPARED BY: KRM | DATE: 5/15/2017

PROJECT NO.: 100050127 | CHECKED BY: VAS | DATE: 5/25/2017

SHEET	LOCATION					UTILITY	ROW	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	Owner	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
Oakey Mainline (SD-04)																				
SD24	10+84.49	1.86' RT	TO	11+41.81	2.09' RT	STREET LIGHT CONDUIT	CLV / CC				STANDARD DEPTH	DROP INLETS							YES	RELOCATE
SD24	11+46.86	2.58' RT	TO	11+49.13	2.78' RT	STREET LIGHT POLE	CC					42" RCP SD					0.20'		YES	RELOCATE
SD24	12+38.42	2.58' LT	TO	12+26.71	2.23' RT	2" PE GAS	CC	1841.40	1841.23	X		48" RCP SD	1841.66	1836.83	0.50'				YES	RELOCATE BY OTHERS
SD24	12+82.22	3.00' LT	TO	13+05.83	3.00' RT	4" PE GAS	CC	1842.30	1841.97	X		60" RCP SD	1840.69	1834.69	0.50'			1.28'	NO	PROTECT-IN-PLACE
SD24	14+71.27	4.04' LT	TO	14+76.33	4.04' RT	30" MLCP WATER	NDOT	1838.00	1835.50	X		53"X83" HERCP SD	1834.98	1829.39	0.50'			0.52'	NO	PROTECT-IN-PLACE
SD24	14+71.86	4.04' LT	TO	14+78.10	4.04' RT	18" RCP SD	NDOT	1843.50	1841.58	X		53"X83" HERCP SD	1834.98	1829.39	0.50'			6.61'	NO	PROTECT-IN-PLACE
SD24	14+83.25	4.04' LT	TO	14+87.90	4.04' RT	10" VCP SS	NDOT	1837.50	1836.67		MANHOLE DIP	53"X83" HERCP SD	1834.96	1829.37	0.50'			1.71'	NO	REMOVE & REPLACE
Oakey Lateral 1																				
SD25						3-1000 MCM UG ELEC	CC	1843.92	1843.42	X		DROP INLET					0.00'		YES	RELOCATE BY OTHERS
SD25						4" PE GAS	CC	1841.80	1841.47	X		48" RCP SD	1841.66	1836.83	0.50'				YES	RELOCATE BY OTHERS
Oakey Lateral 2																				
SD25						3-1000 MCM UG ELEC	CC	1838.02	1837.52	X		24" RCP SD	1839.99	1837.49	0.50'				YES	RELOCATE BY OTHERS
SD25						2" PE GAS	CC	1842.10	1841.93	X		24" RCP SD	1837.27	1834.77				4.66'	NO	PROTECT-IN-PLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - ST. LOUIS LATERAL (SD-05)

PROJECT: BOULDER HIGHWAY STORM DRAIN | PREPARED BY: KRM | DATE: 5/16/2017

PROJECT NO.: 100050127 | CHECKED BY: VAS | DATE: 5/25/2017

SHEET	LOCATION					UTILITY	ROW	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	Owner	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
St louis Mainline (SD-05)																				
SD26	11+10.55	2.42' LT	TO	11+10.55	2.42' RT	SANITARY SEWER LATERAL	CLV					30" RCP SD							NO	RECONNECT TO NEW SEWER
SD26	11+11.03	2.42' LT	TO	1+11.03	2.42' RT	WATER SERVICE LATERAL	CLV					30" RCP SD							NO	PROTECT-IN-PLACE
SD26	11+56.60	2.42' LT	TO	11+56.60	2.42' RT	8" WATER	CLV	1833.50	1832.83	X		30" RCP SD	1826.18	1823.10	0.50'			6.65'	NO	PROTECT-IN-PLACE
SD26	11+66.04	2.42' LT	TO	11+69.53	2.42' LT	SANITARY SEWER MANHOLE	CLV				MANHOLE DIP	30" RCP SD							YES	RELOCATE
SD26	11+72.66	2.42' LT	TO	11+72.66	2.42' RT	2" PE GAS	CLV	1834.30	1834.13	X		30" RCP SD	1825.91	1822.83	0.50'			8.22'	NO	PROTECT-IN-PLACE
SD26	12+09.96	2.42' LT	TO	12+09.96	2.42' RT	WATER SERVICE LATERAL	CLV					30" RCP SD							NO	PROTECT-IN-PLACE
SD26	12+22.29	2.42' LT	TO	12+22.29	2.42' RT	SANITARY SEWER LATERAL	CLV					30" RCP SD							NO	RECONNECT TO NEW SEWER
SD26	13+17.39	2.42' LT	TO	13+17.39	2.42' RT	SANITARY SEWER LATERAL	CLV					30" RCP SD							NO	RECONNECT TO NEW SEWER
SD26	13+23.31	2.42' LT	TO	13+23.31	2.42' RT	WATER SERVICE LATERAL	CLV					30" RCP SD							NO	PROTECT-IN-PLACE
SD26	13+41.59	2.42' LT	TO	13+41.59	2.42' RT	SANITARY SEWER LATERAL	CLV					30" RCP SD							NO	RECONNECT TO NEW SEWER
SD26	13+68.89	2.42' LT	TO	13+68.89	2.42' RT	WATER SERVICE LATERAL	CLV					30" RCP SD							NO	PROTECT-IN-PLACE
SD26	13+80.15	2.42' LT	TO	13+82.95	2.42' LT	SANITARY SEWER MANHOLE	CLV				MANHOLE DIP	30" RCP SD							YES	RELOCATE
SD26	13+81.72	2.42' LT	TO	13+82.15	2.42' RT	8" VCP SS	CLV	1829.20	1828.53		MANHOLE DIP	30" RCP SD	1822.35	1819.27	0.50'			6.18'	NO	RELOCATE
SD26	14+34.48	2.42' LT	TO	14+34.48	2.42' RT	SANITARY SEWER LATERAL	CLV					30" RCP SD	DI						NO	RECONNECT TO NEW SEWER
SD26	14+39.19	2.42' LT	TO	14+39.19	2.42' RT	WATER SERVICE LATERAL	CLV					30" RCP SD							NO	PROTECT-IN-PLACE
SD26	14+54.28	2.42' LT	TO	14+54.28	2.42' RT	SANITARY SEWER LATERAL	CLV					30" RCP SD							NO	RECONNECT TO NEW SEWER
SD26	14+56.58	2.42' LT	TO	14+56.58	2.42' RT	WATER SERVICE LATERAL	CLV					30" RCP SD							NO	PROTECT-IN-PLACE
SD26	14+98.48	2.42' LT	TO	15+03.40	2.42' LT	SANITARY SEWER MANHOLE	CLV				MANHOLE DIP	30" RCP SD							YES	RELOCATE
SD26	15+01.00	2.42' LT	TO	15+00.54	2.42' RT	8" VCP SS	CLV	1830.20	1829.53		MANHOLE DIP	30" RCP SD	1820.12	1817.04	0.50'			9.41'	NO	REMOVE AND REPLACE
SD26	15+14.93	2.42' LT	TO	15+14.93	2.42' RT	WATER SERVICE LATERAL	CC					30" RCP SD							NO	PROTECT-IN-PLACE
SD26	15+21.29	2.42' LT	TO	15+21.26	2.42' RT	2" PE GAS	CC	1830.50	1830.33	X		30" RCP SD	1819.78	1816.70	0.50'			10.55'	NO	RELOCATE BY OTHERS
SD26	15+65.55	2.42' LT	TO	15+66.75	2.42' RT	SANITARY SEWER LATERAL	CC					30" RCP SD							NO	RELOCATE
SD26	16+58.72	2.42' LT	TO	16+58.72	2.42' RT	WATER SERVICE LATERAL	CC					54" RCP SD							NO	PROTECT-IN-PLACE
SD26	16+78.16	2.42' LT	TO	16+78.16	2.42' RT	WATER SERVICE LATERAL	CC					54" RCP SD							NO	PROTECT-IN-PLACE
SD26	16+93.92	2.42' LT	TO	16+93.92	2.42' RT	SANITARY SEWER LATERAL	CC					54" RCP SD							NO	REMOVE
SD26	17+04.08	2.42' LT	TO	17+04.08	2.42' RT	SANITARY SEWER LATERAL	CC					54" RCP SD							NO	REMOVE
SD26	18+35.29	3.00' LT	TO	18+35.29	3.00' RT	24" RCP SD	CC	1830.60	1828.10		ASBUILT DRAWING	60" RCP SD	1814.10	1808.10	0.50'			14.00'	NO	PROTECT-IN-PLACE
SD26	18+36.72	3.00' LT	TO	18+36.72	3.00' RT	30" MLCP W	CC	1825.30	1822.80	X		60" RCP SD	1814.03	1808.03	0.50'			8.77'	NO	PROTECT-IN-PLACE
SD26	18+38.48	3.00' LT	TO	18+38.48	3.00' RT	24" RCP SD	CC	1830.60	1828.10		ASBUILT DRAWING	60" RCP SD	1813.94	1807.94	0.50'			14.16'	NO	PROTECT-IN-PLACE
SD26	18+46.42	3.00' LT	TO	18+46.42	3.00' RT	4" ITS CONDUIT	CC	1829.60	1829.27		STANDARD DEPTH	60" RCP SD	1813.55	1807.55	0.50'			15.72'	NO	PROTECT-IN-PLACE
SD26	18+46.82	3.00' LT	TO	18+46.82	3.00' RT	10" VCP SS	CC	1825.60	1824.77		MANHOLE DIP	60" RCP SD	1813.53	1807.53	0.50'			11.24'	NO	REMOVE
SD26	18+52.23	3.00' LT	TO	18+52.23	3.00' RT	TRAFFIC SIGNAL CONDUIT	CC	1829.60	1829.43		STANDARD DEPTH	60" RCP SD	1813.26	1807.26	0.50'			16.18'	NO	PROTECT-IN-PLACE
St Louis Lateral 1																				
SD27						2" PE GAS	CLV	1835.60	1835.43	X		24" RCP SD	1835.22	1832.72	0.50'			0.21'	YES	RELOCATE BY OTHERS
SD27						WATER SERVICE LATERAL	CLV					24" RCP SD							NO	PROTECT-IN-PLACE
SD27						SANITARY SEWER LATERAL	CLV					24" RCP SD							NO	PROTECT-IN-PLACE
SD27						45" RCP SS	CLV	1829.50	1824.92		MANHOLE DIP	24" RCP SD	1833.13	1830.63	0.50'			1.13'	NO	PROTECT-IN-PLACE
SD27						8" VCP SS	CLV	1833.40	1832.73		MANHOLE DIP	24" RCP SD	1829.33	1826.83	0.50'			3.41'	NO	RELOCATE
SD27						8" ACP WATER	CLV	1834.40	1833.73	X		24" RCP SD	1832.00	1829.50	0.50'			1.73'	NO	REMOVE AND REPLACE
St Louis Lateral 2																				
SD27						45" RCP SS	CC	1823.70	1819.12		MANHOLE DIP	30" RCP SD	1828.05	1824.97	0.50'			1.27'	NO	PROTECT-IN-PLACE
SD27						SANITARY SEWER LATERAL	CC					30" RCP SD							NO	PROTECT-IN-PLACE
SD27						2" PE GAS	CC	1830.40	1830.23	X		30" RCP SD	1822.80	1819.72	0.50'			7.43'	YES	RELOCATE BY OTHERS
SD27						10" VCP SS	CC	1829.80	1828.97	X		30" RCP SD	1824.14	1821.06	0.50'			4.83'	YES	REMOVE
SD27						6" ACP WATER	CC	1828.70	1828.20	X		30" RCP SD	1824.16	1821.08	0.50'			4.04'	NO	REMOVE AND REPLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - ST. LOUIS LATERAL (SD-05)

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: KRM DATE: 5/16/2017

PROJECT NO.: 100050127 CHECKED BY: VAS DATE: 5/25/2017

SHEET	LOCATION					UTILITY	ROW	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	Owner	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
St Louis Lateral 3																				
SD28						45" RCP SS	CC	1821.30	1816.72		MANHOLE DIP	30" RCP SD	1825.36	1822.27	0.50'			0.97'	NO	PROTECT-IN-PLACE
SD28						10" VCP SS	CC	1828.90	1828.07		MANHOLE DIP	30" RCP SD	1820.58	1817.50	0.50'			7.48'	NO	REMOVE
SD28						2" PE GAS	CC	1829.20	1829.03	X		30" RCP SD	1820.95	1817.87	0.50'			8.08'	NO	PROTECT-IN-PLACE
SD28						6" WATER	CC	1828.00	1827.50	X		30" RCP SD	1822.47	1819.39	0.50'			5.03'	NO	REMOVE AND REPLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - PHASE 2

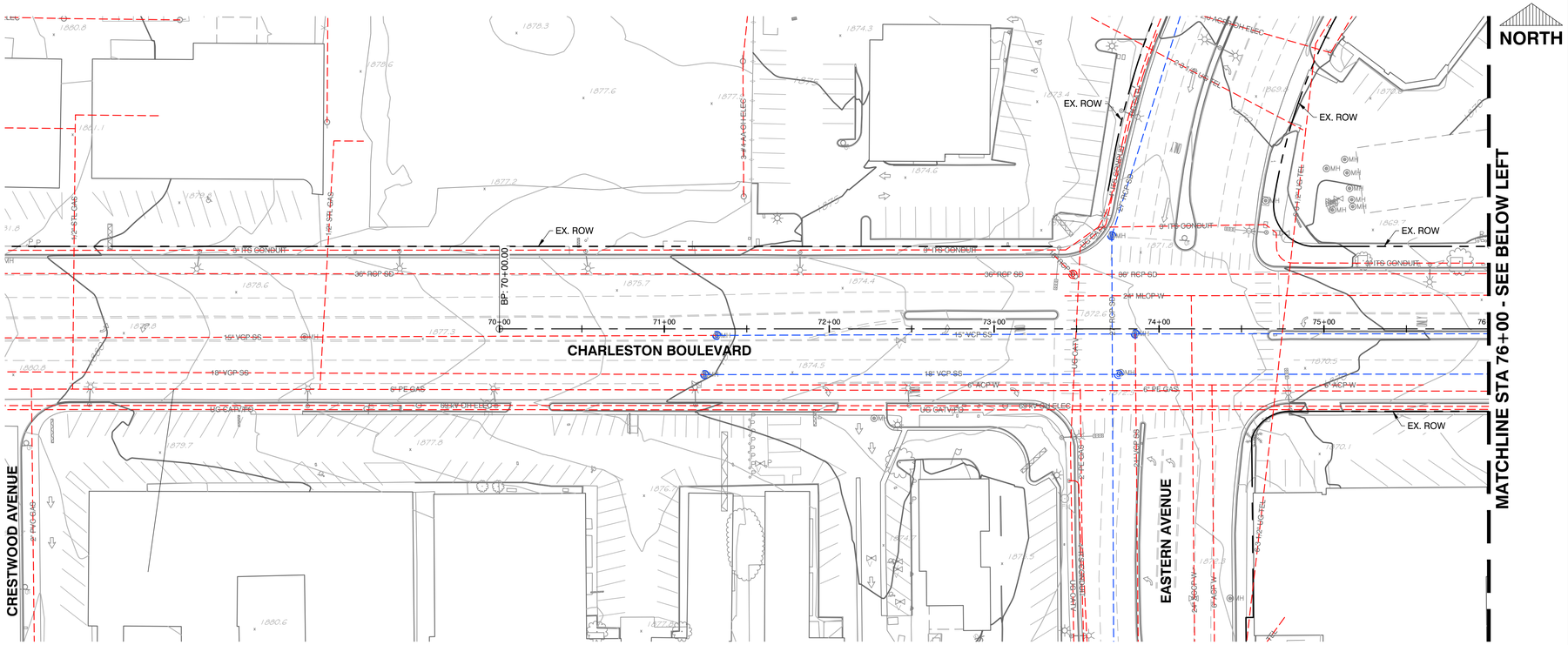
BOULDER HIGHWAY STORM DRAIN | PREPARED BY: KRM | DATE: 5/17/2017

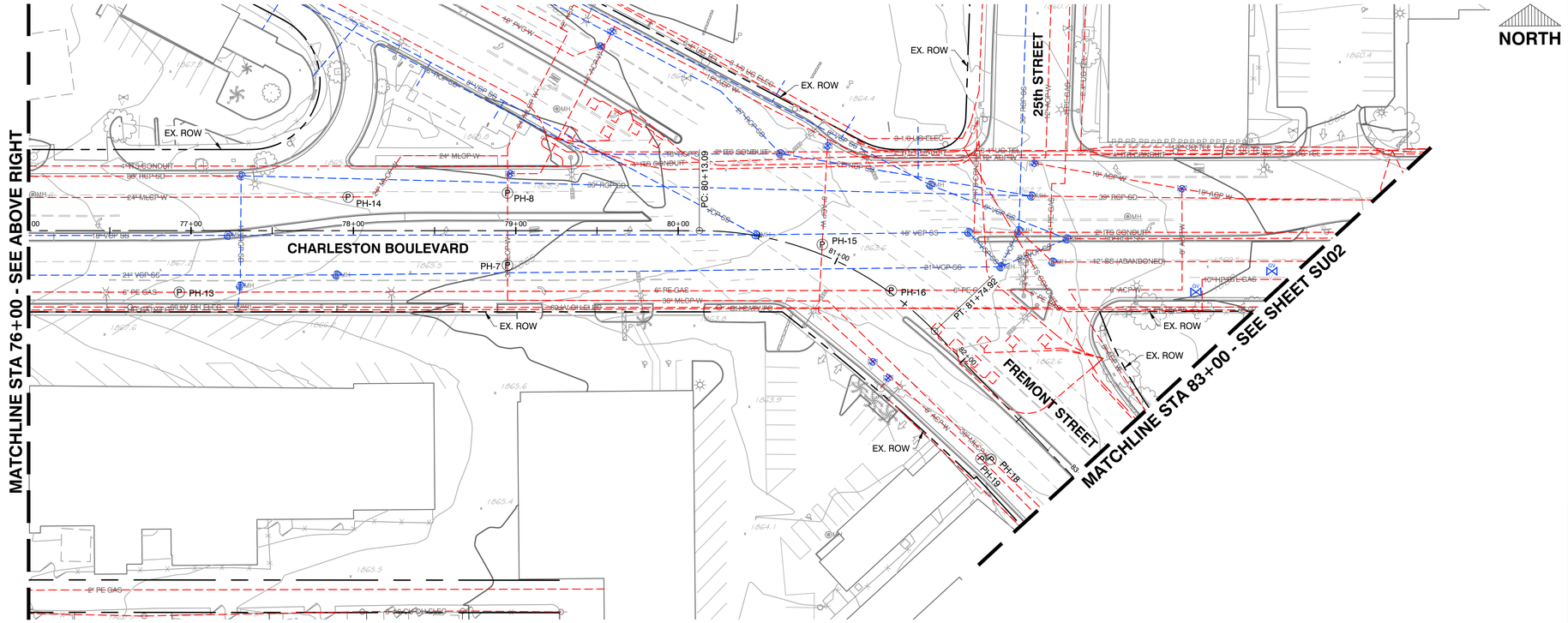
PROJECT NO.: 100050127 | CHECKED BY: VAS | DATE: 5/25/2017

SHEET	LOCATION					UTILITY	ROW	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	Owner	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
Mainline (SD-01)																				
SD01	77+00.00	2.29' RT	TO	80+88.59	12.15' LT	18" VCP SS	NDOT										0.00'		YES	REMOVE
SD01	77+30.57	8.00' RT	TO	77+30.76	8.00' LT	15" RCP SD	NDOT	1863.60	1862.10		MANHOLE DIP	14'X8' RCB SD	1853.50	1843.50					NO	PROTECT-IN-PLACE
SD01	78+95.00	8.00' RT	TO	78+95.00	8.00' LT	30" MLCP W	NDOT	1856.00	1853.50	X		14'X8' RCB SD	1851.00	1841.00	0.50'			2.50'	NO	PROTECT-IN-PLACE
SD01	80+24.22	10.00' LT	TO	80+47.88	0.49' LT	8" VCP SS	NDOT	1855.81	1855.14		MANHOLE DIP	18'X8' RCB SD					0.00'		YES	RELOCATE
SD01	80+89.34	10.00' RT	TO	81+26.34	10.00' LT	21" VCP SS	NDOT	1855.30	1853.47		MANHOLE DIP	18'X8' RCB SD	1850.37	1840.20					NO	UPSIZE TO 24" PVC SS
SD01	80+87.04	10.00' LT	TO	80+93.92	10.00' RT	8" ACP W	NDOT	1859.70	1859.03	X		18'X8' RCB SD	1850.29	1840.12					NO	REMOVE AND REPLACE
SD01	81+20.65	10.00' RT	TO	81+49.12	10.00' LT	6" PE GAS	NDOT	1860.71	1860.21	X		18'X8' RCB SD	1850.21	1840.04					NO	PROTECT-IN-PLACE
SD01	81+41.31	10.00' RT	TO	81+65.29	10.00' LT	69kV OK ELECTRIC	NDOT					18'X8' RCB SD							NO	PROTECT-IN-PLACE
SD01	81+41.31	10.00' RT	TO	81+65.29	10.00' LT	OH CATV/FO	NDOT					18'X8' RCB SD							NO	PROTECT-IN-PLACE
SD01	81+72.36	0.57' RT	TO	82+53.53	10.00' LT	LOOP DETECTORS AND CONDUIT	NDOT					18'X8' RCB SD							NO	REMOVE AND REPLACE
Mainline Lateral 1 (DI#1)																				
SD03																				
Mainline Lateral 2 (DI#2)																				
SD03						39" RCP SD	NDOT				ASBUILT PLANS	30" RCP SD							YES	REMOVE
SD03						18" VCP SS	NDOT	1850.50	1848.00	X	MANHOLE DIP	30" RCP SD	1846.44	1843.94	0.50'			1.56'	NO	REMOVE
SD03						8" ACP W	NDOT	1859.70	1859.03	X										REMOVE AND REPLACE
Mainline Lateral 3 (DI#3)																				
SD09						8" ACP W	NDOT	1848.40	1845.90	X		24" RCP SD	1846.44	1843.94	0.50'			-0.54'	NO	REMOVE AND REPLACE
SD09						30" MLCP W	NDOT	1848.40	1845.90	X		24" RCP SD	1846.44	1843.94	0.50'			-0.54'	NO	PROTECT IN PLACE

Appendix E-2

S U E plans





GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

HORIZ 1 inch = 40 ft.

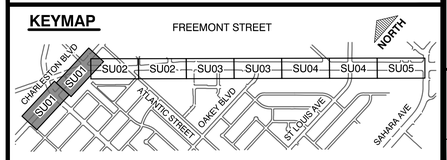
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7275
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H#	H62695
DATE:	MAY, 2017
SUBMITTAL STAGE:	70% SUBMITTAL
BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	WHJ
CHECKED BY:	MSB

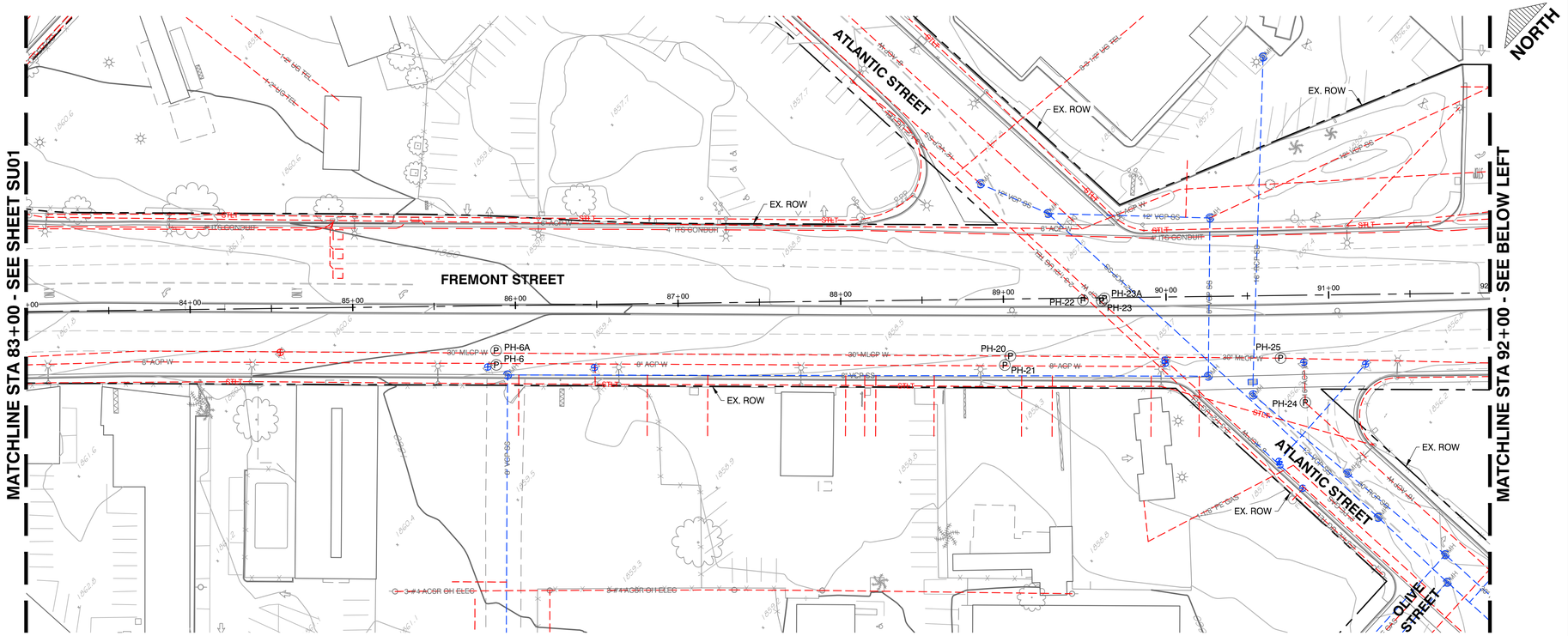
TITLE
BOULDER HIGHWAY
STORM DRAIN

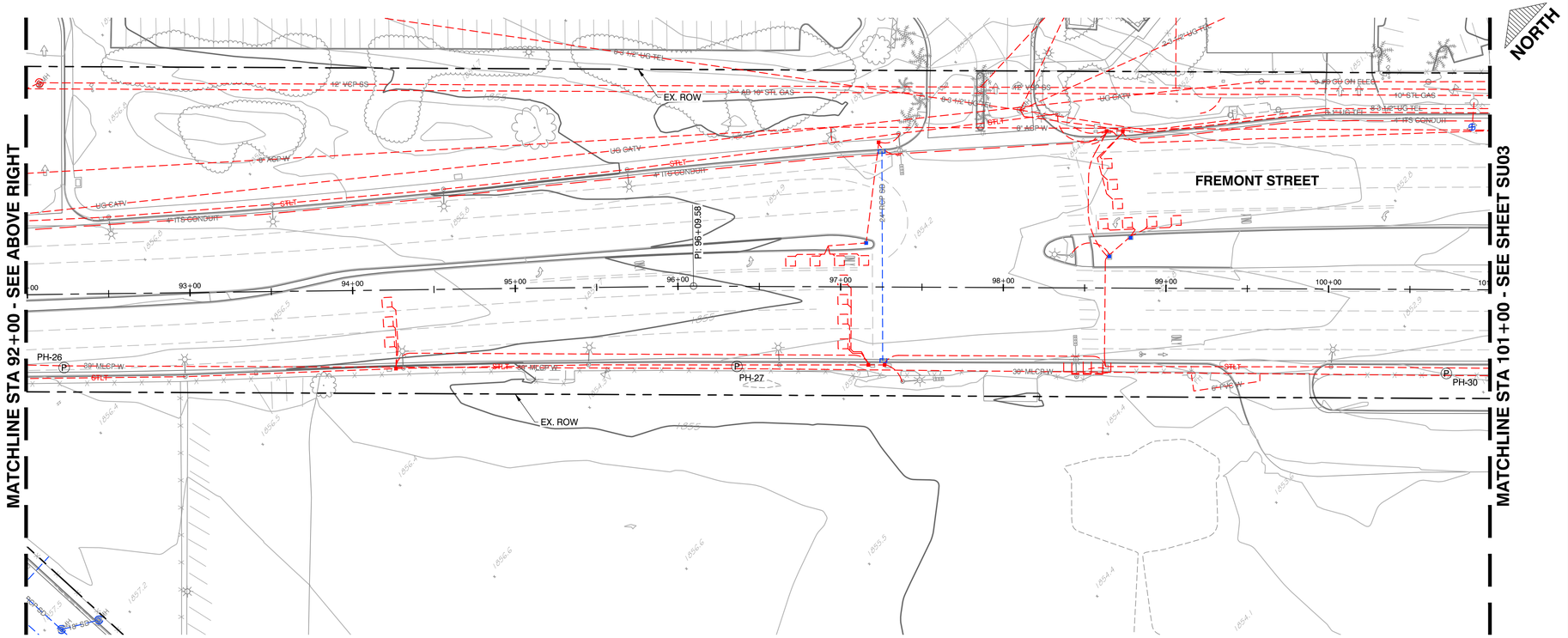
SHEET
EXISTING UTILITIES LOCATION PLAN
BEGIN TO STA 23+00

NOT FOR CONSTRUCTION

SHEET
SU01
1 OF 8
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

HORIZ 1 inch = 40 ft.

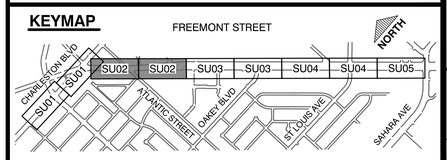
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7275
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H62695	BID# XX.XXXX	DESIGNED BY: KRM	CHECKED BY: MSB
DATE: MAY, 2017		DRAWN BY: WHJ	
SUBMITTAL STAGE: 70% SUBMITTAL			

TITLE
BOULDER HIGHWAY
STORM DRAIN

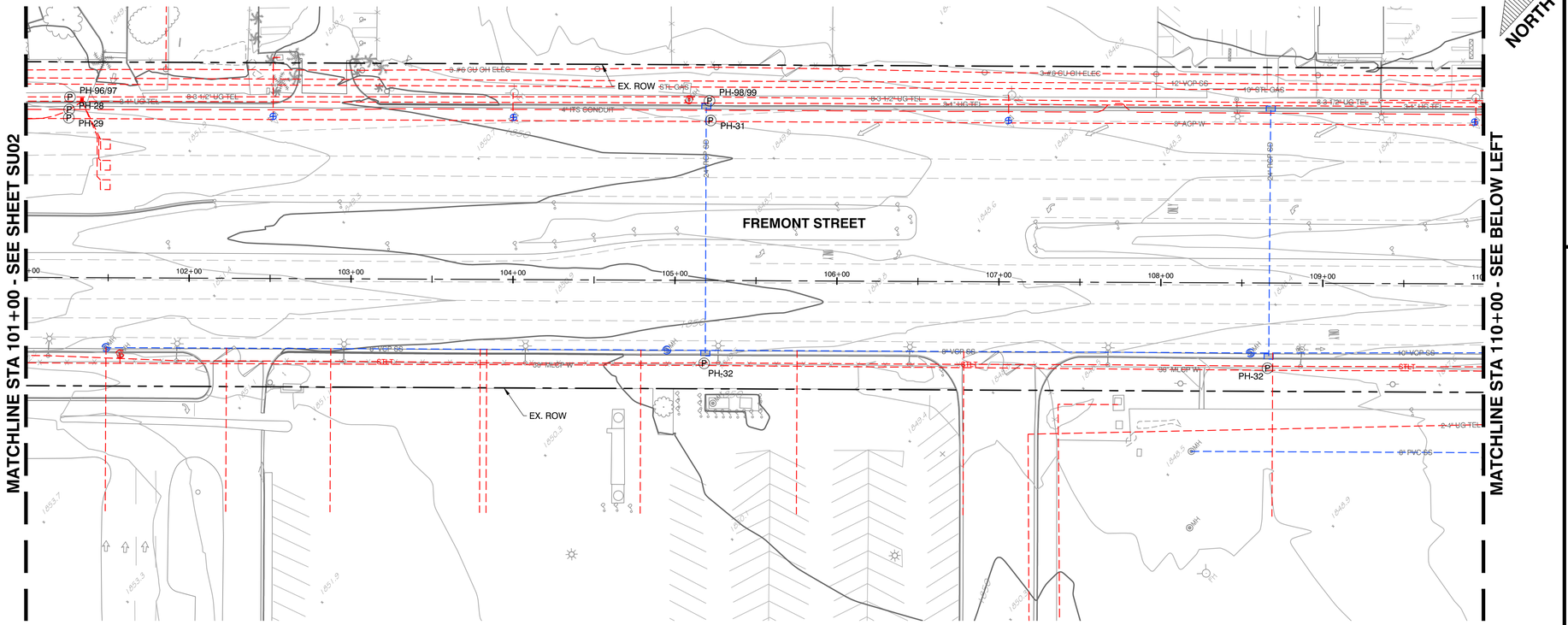
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EXISTING UTILITIES LOCATION PLAN
STA 23+00 TO STA 41+00

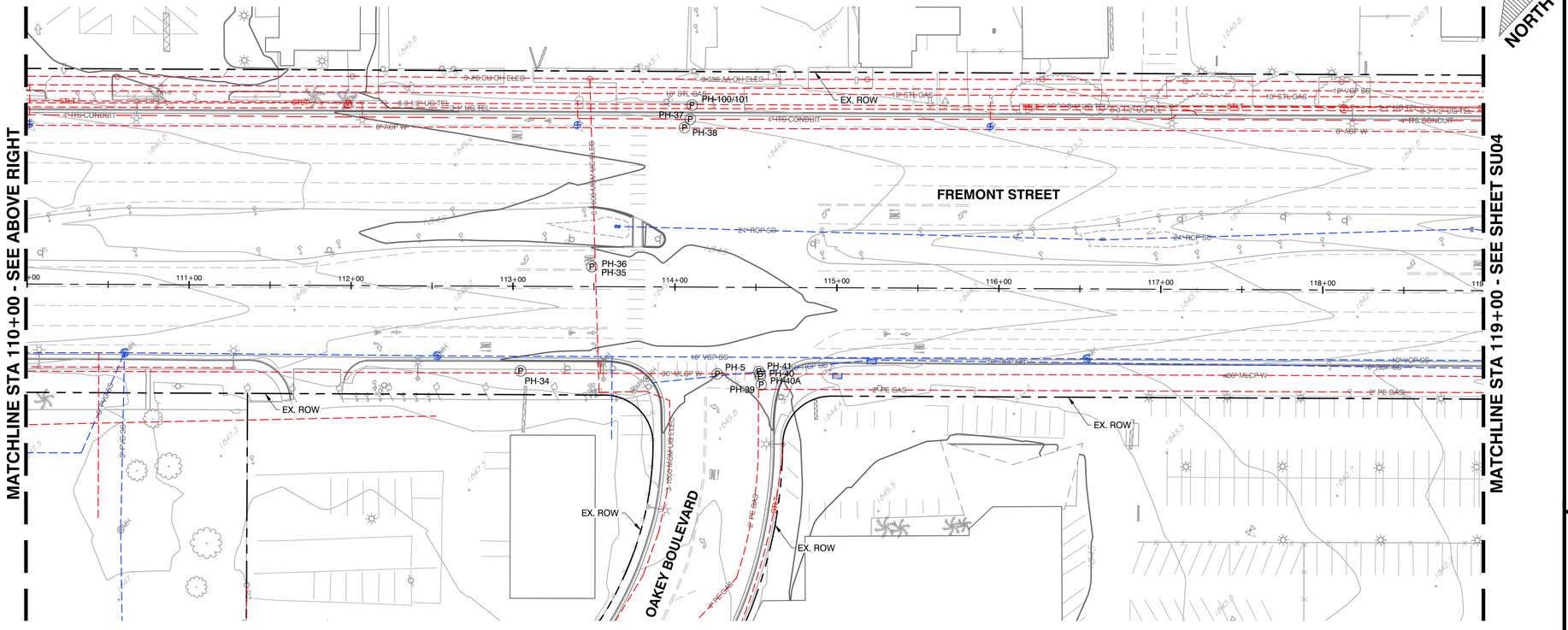
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SHEET
SU02
2 OF 8

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

HORIZ 1 inch = 40 ft.

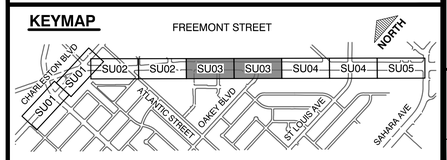
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



REVISIONS		
NO.	DATE	

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7275
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

		BID# XX.XXXX	
H# H62695		DESIGNED BY: KRM	
DATE: MAY, 2017		DRAWN BY: WHJ	
SUBMITTAL STAGE:	70% SUBMITTAL	CHECKED BY: MSB	

TITLE
BOULDER HIGHWAY
STORM DRAIN

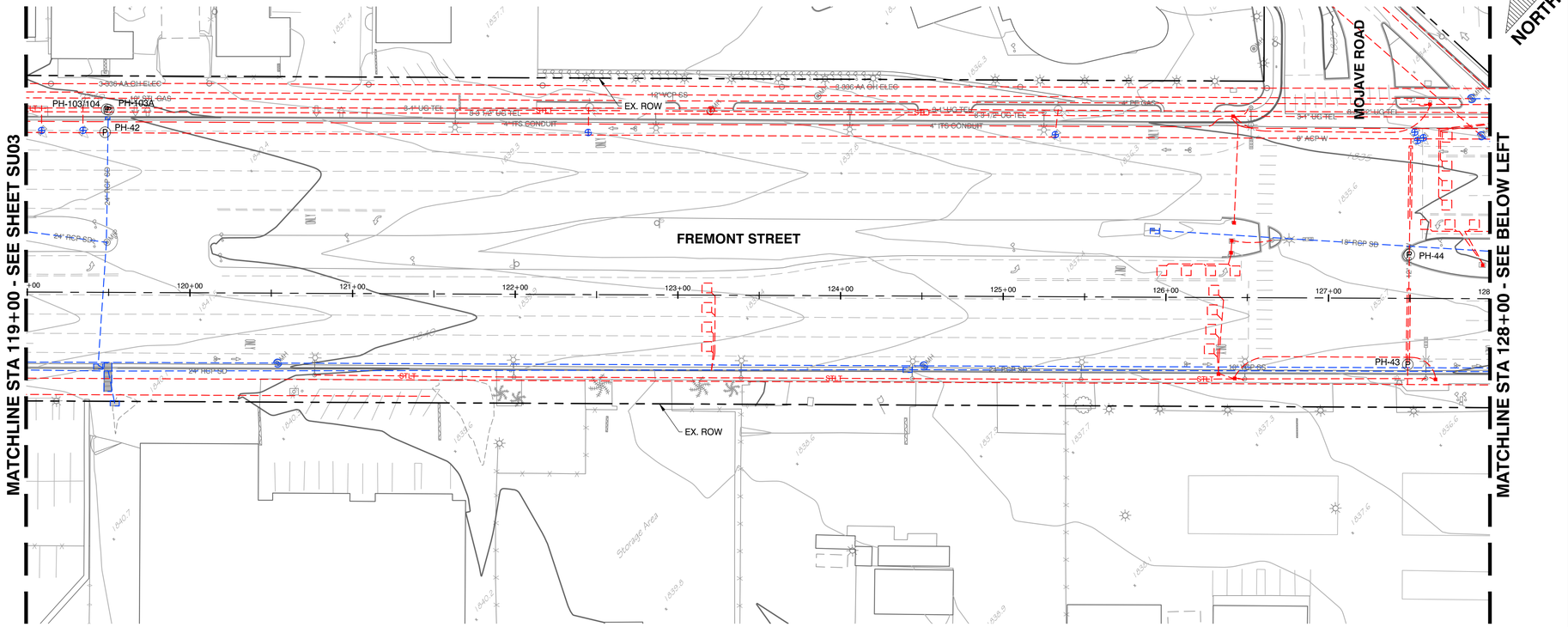
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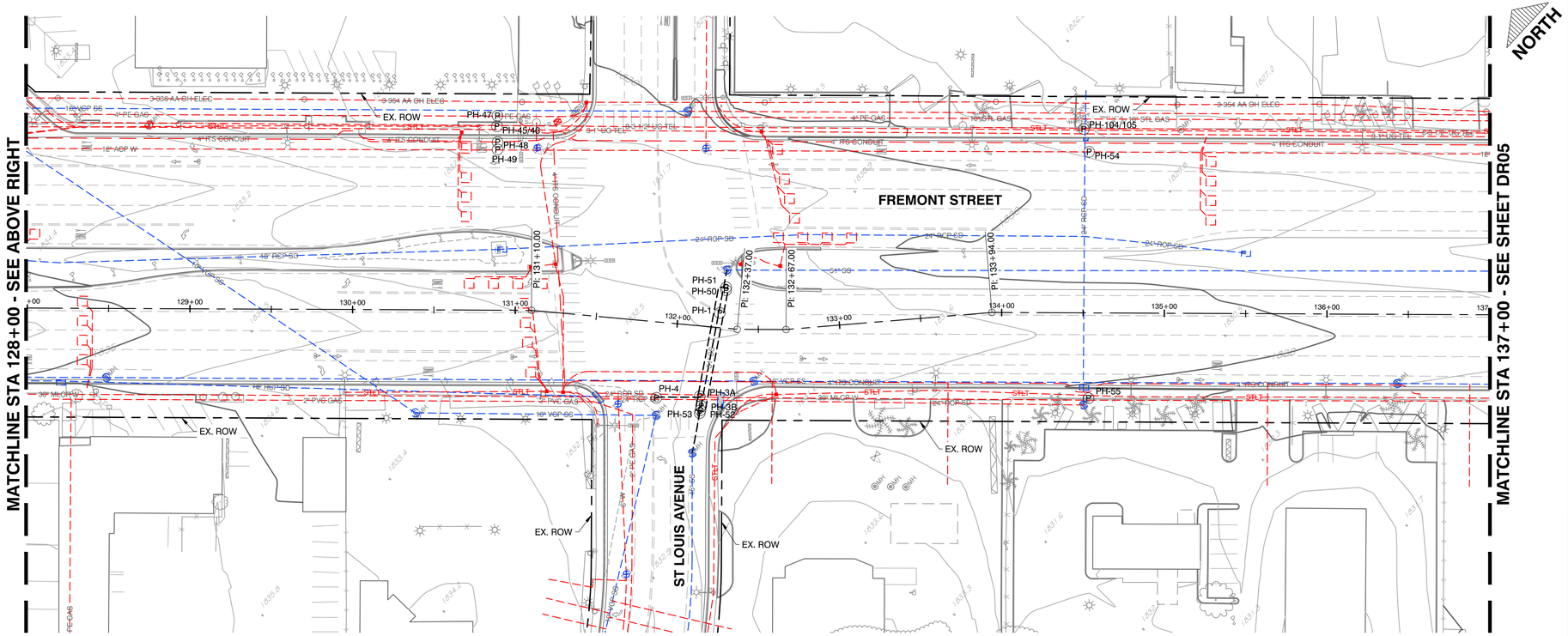
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GRAPHIC SCALE

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(IN FEET)

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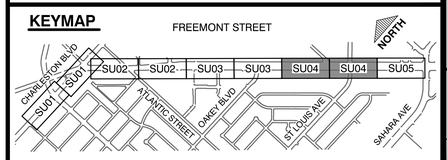
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BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7275
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

	BID# XX.XXXX	DESIGNED BY: KRM	
H# H62695		DRAWN BY: WHJ	
DATE: MAY, 2017		CHECKED BY: MSB	
SUBMITTAL STAGE: 70% SUBMITTAL			

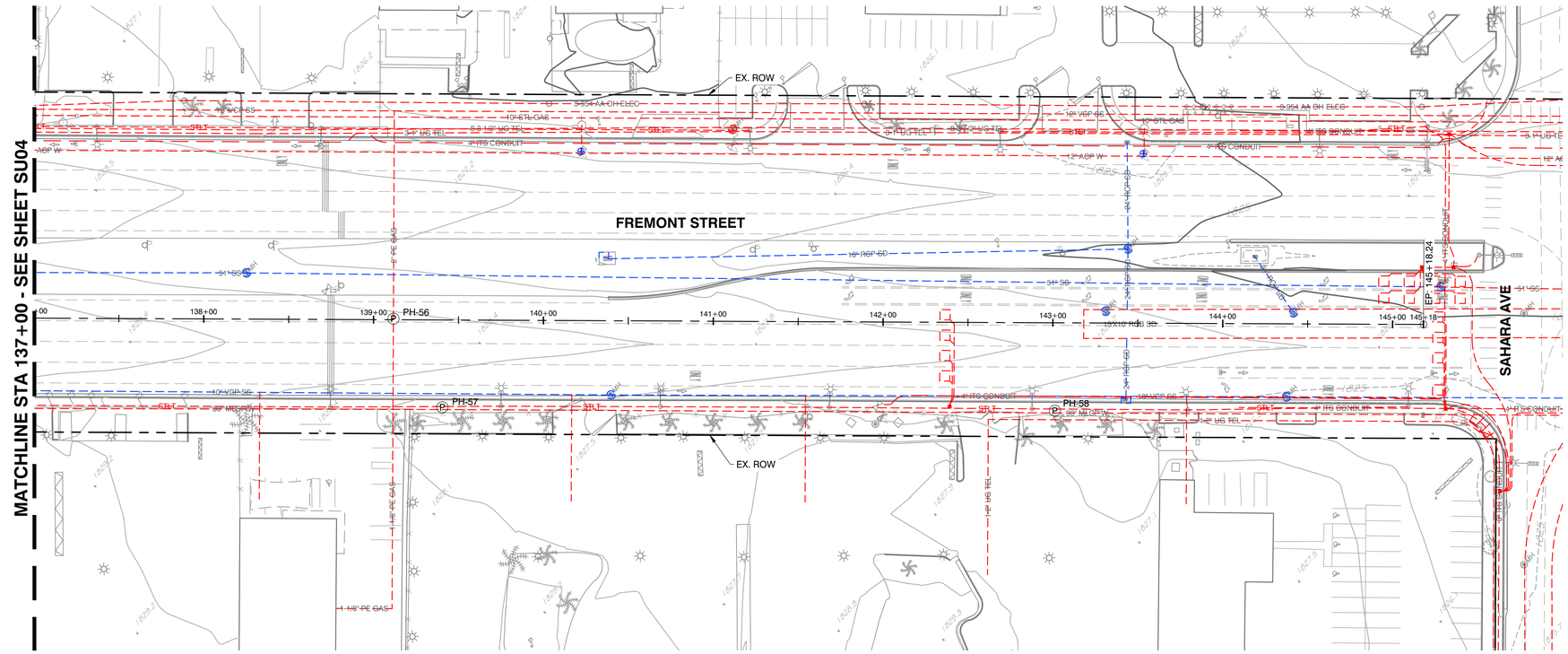
TITLE
BOULDER HIGHWAY
STORM DRAIN

SHEET
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STA 59+00 TO STA 77+00

NOT FOR CONSTRUCTION

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(IN FEET)

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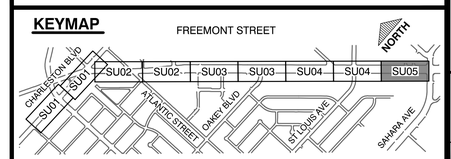
CALL BEFORE CONSTRUCTION

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

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7275
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H62695	BID# XX-XXXX	DESIGNED BY: KRM	
DATE: MAY, 2017	SUBMITTAL STAGE: 70% SUBMITTAL	DRAWN BY: WHJ	CHECKED BY: MSB

TITLE
BOULDER HIGHWAY
STORM DRAIN

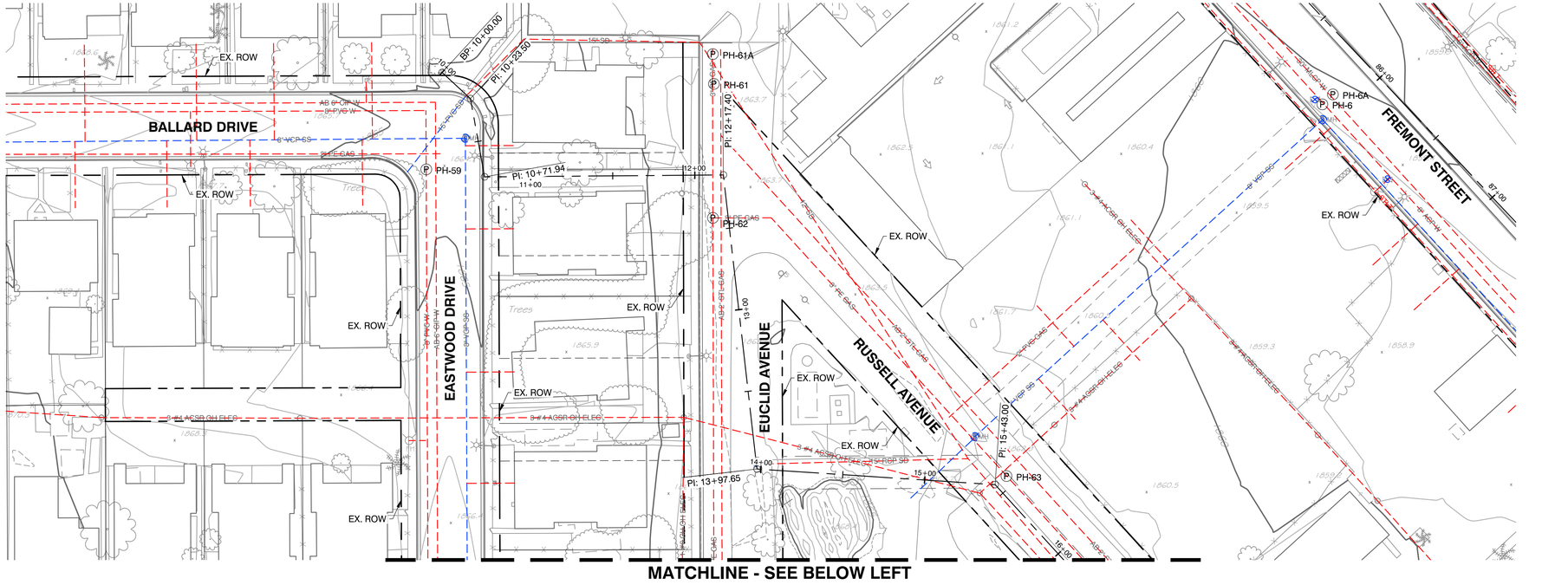
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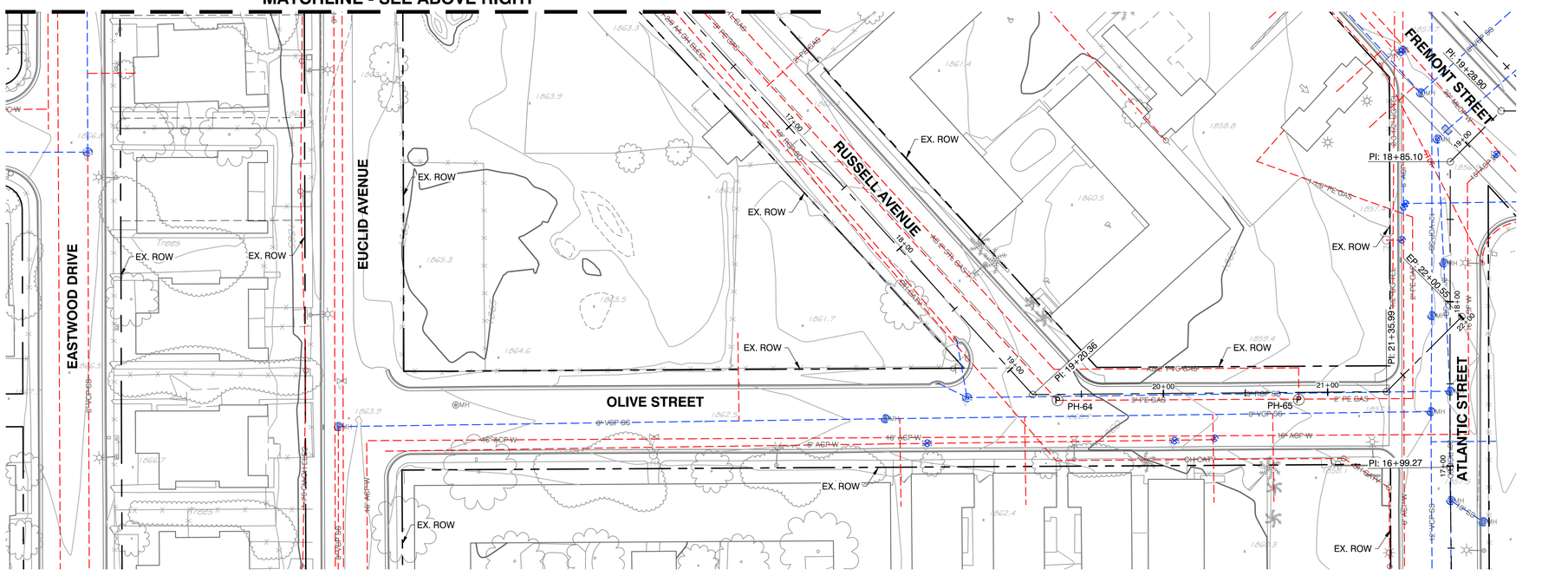
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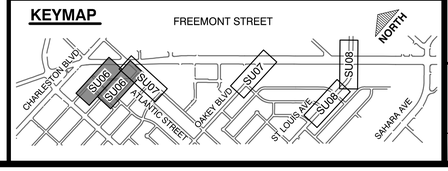
CALL BEFORE CONSTRUCTION

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

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



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PREPARED BY
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2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7275
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I-# H62695	BID# XX.XXXX	DESIGNED BY: KRM	
DATE: MAY, 2017		DRAWN BY: WHJ	
SUBMITTAL STAGE: 70% SUBMITTAL		CHECKED BY: MSB	

TITLE
BOULDER HIGHWAY
STORM DRAIN

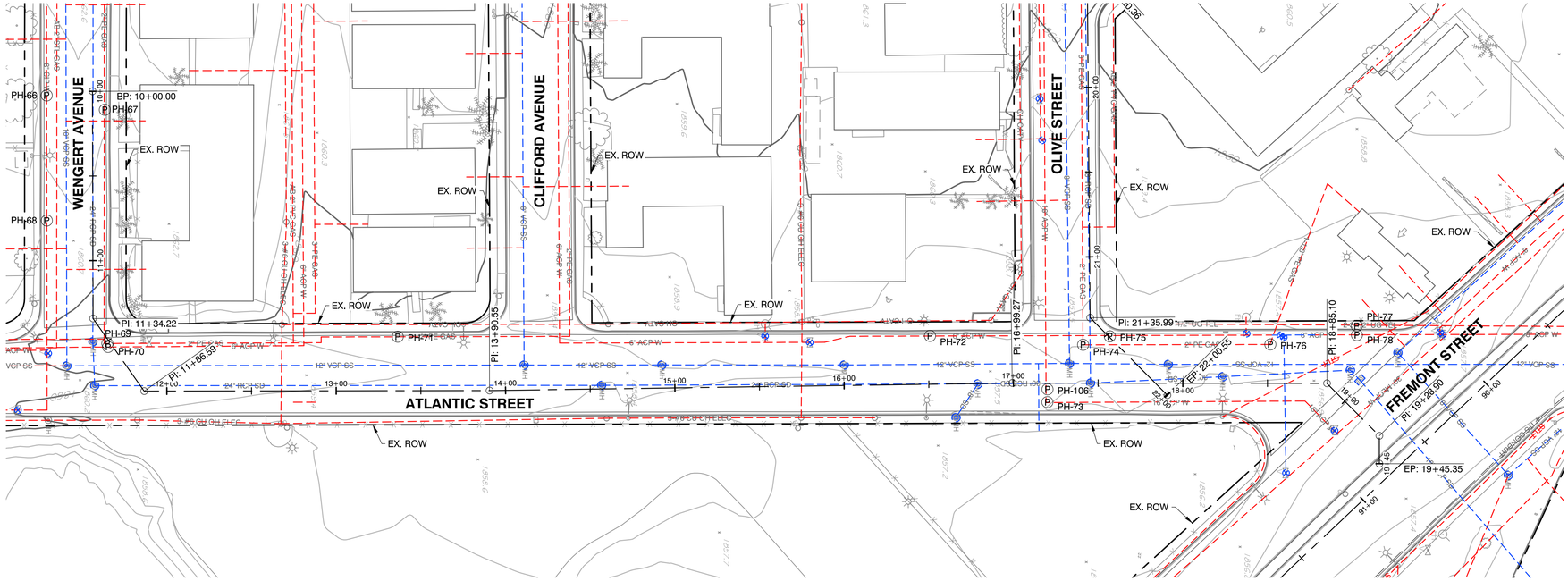
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NOT FOR CONSTRUCTION

SHEET
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6 OF 8

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(IN FEET)

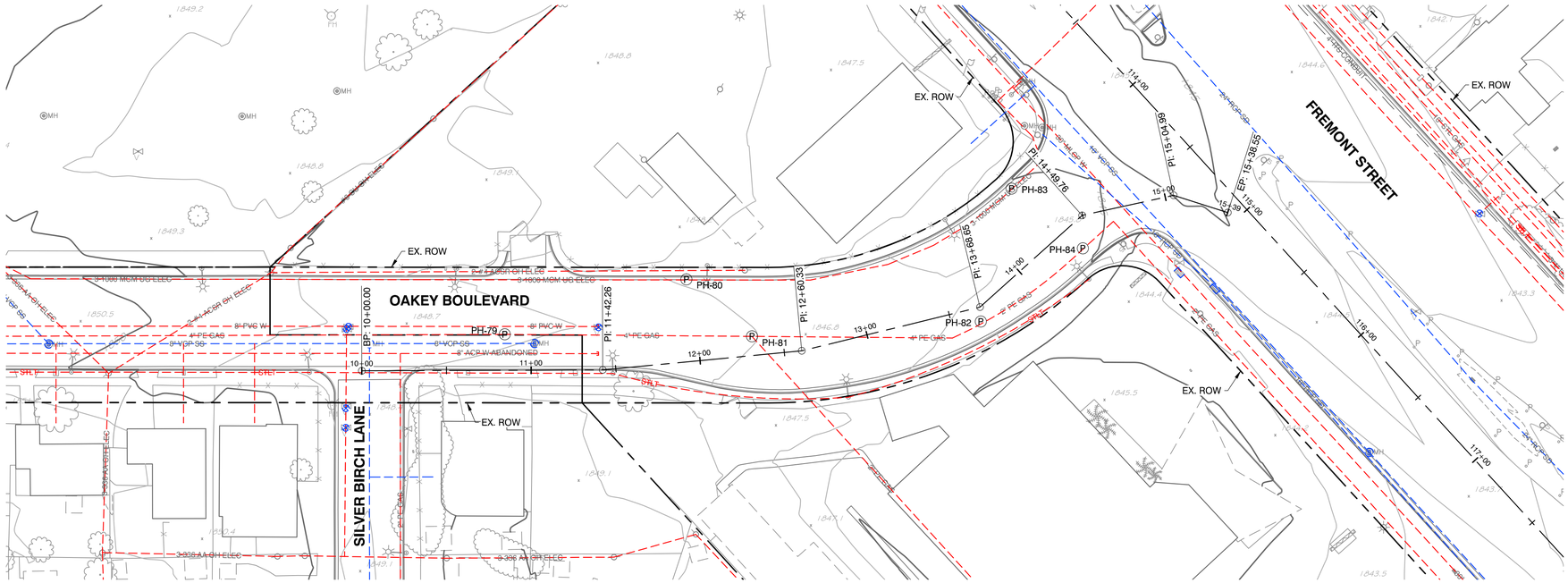
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CALL BEFORE CONSTRUCTION

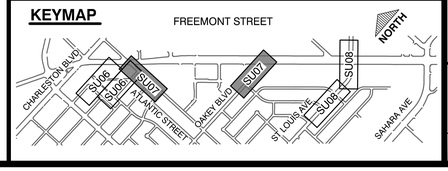
BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D



KEYMAP



PREPARED BY
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2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7275
Fax: +1 (702) 263 7200

NO.	DATE	REVISIONS

PREPARED FOR
CITY OF LAS VEGAS

I-# H62695	BID# XX-XXXX	DESIGNED BY: KRM	
DATE: MAY, 2017	SUBMITTAL STAGE: 70% SUBMITTAL	DRAWN BY: WHJ	CHECKED BY: MSB

TITLE
BOULDER HIGHWAY
STORM DRAIN

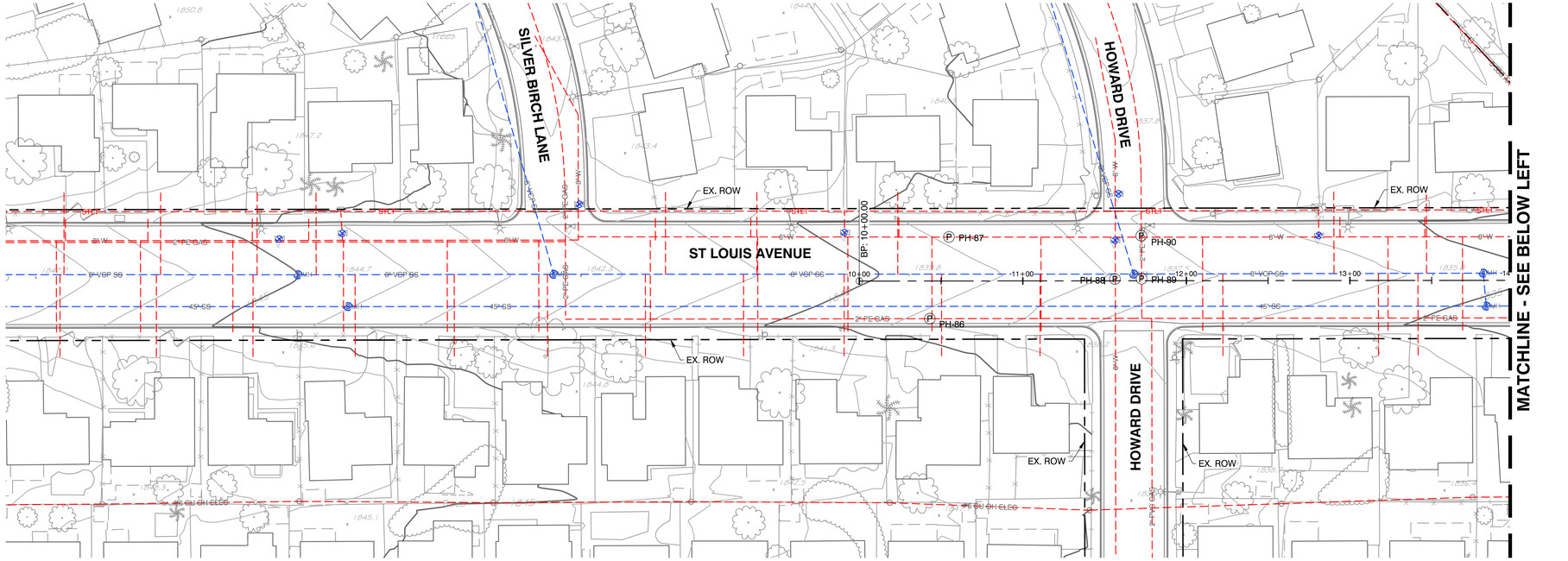
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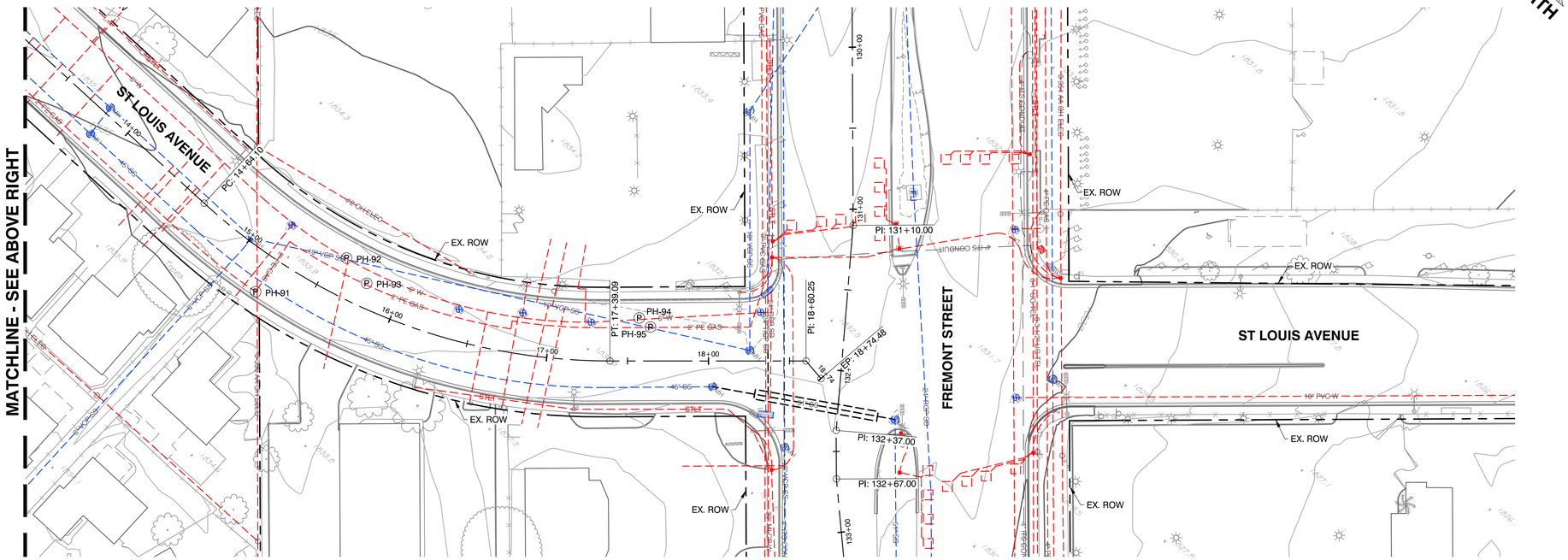
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SU07
7 OF 8

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XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

HORIZ 1 inch = 40 ft.

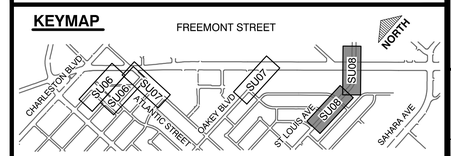
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7275
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I:# H62695	BID# XX.XXXX	DESIGNED BY: KRM	
DATE: MAY, 2017		DRAWN BY: WHJ	
SUBMITTAL STAGE: 70% SUBMITTAL		CHECKED BY: MSB	

TITLE
BOULDER HIGHWAY
STORM DRAIN

SHEET
EXISTING UTILITIES LOCATION PLAN
ST LOUIS AVE

NOT FOR CONSTRUCTION

SHEET
SU08
8 OF 8
DRAWING NO.
XXX-XXXX

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Appendix E-3

Utility Pothole Reports

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-1	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/16/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

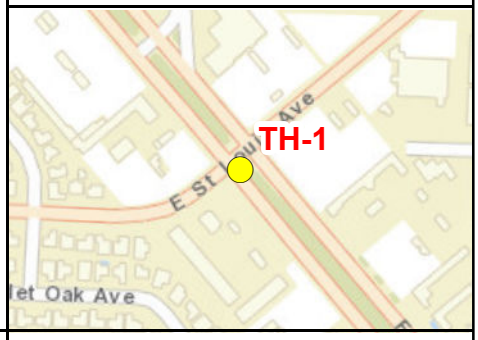
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

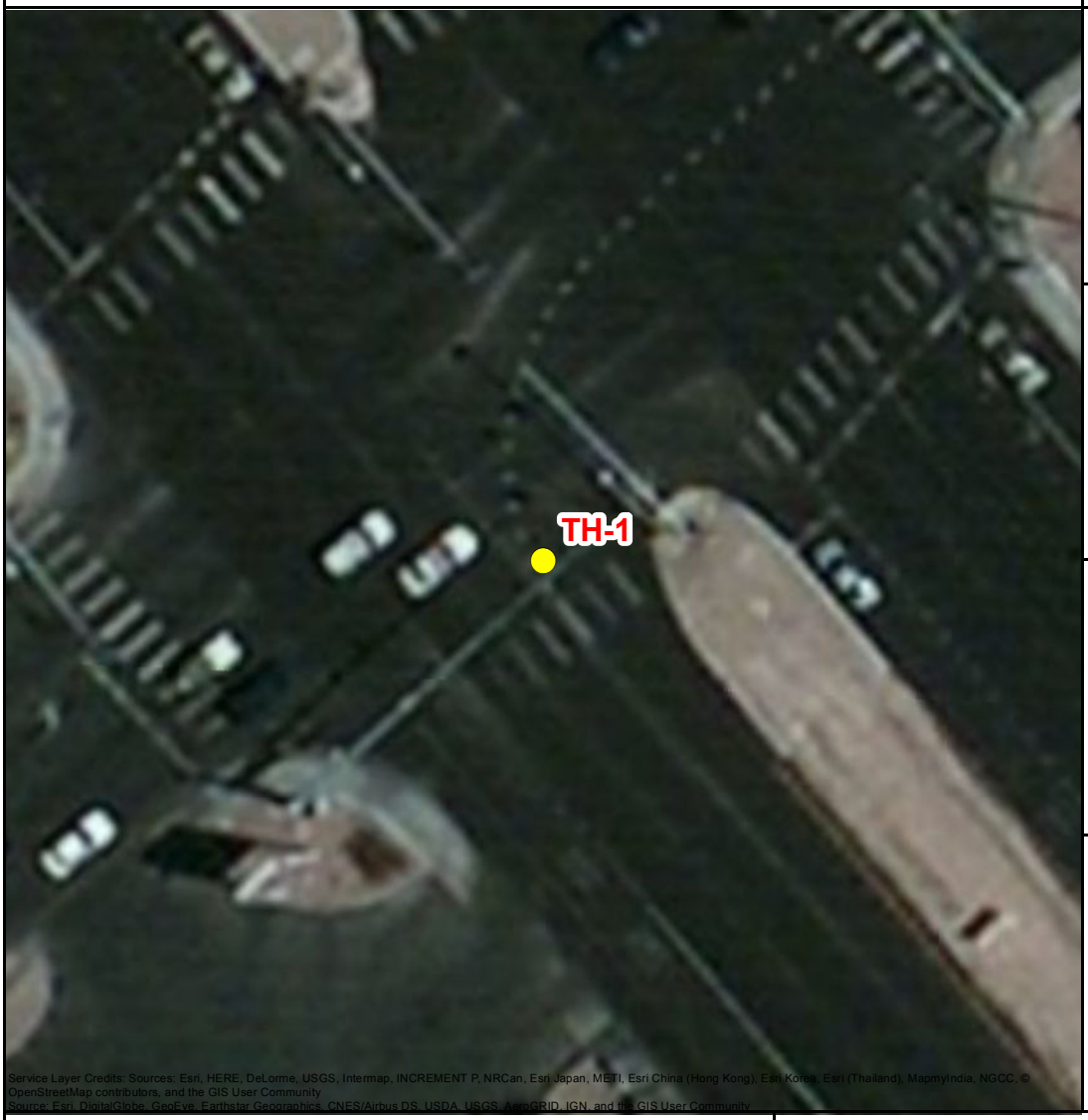
Utility Type:	Sewer	**Utility Size:**	72 Inches	**Utility Material:**	Metal
Utility Company:	City of Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nail
Depth to Top:	10.32	**Top Ref. Level:**	15.24	**Hand Meas. Top:**	10.36
Depth to Bottom:	16.32	**Bot. Ref. Level:**	21.24	**Hand Meas. Bot:**	N/A
Top Elevation:	1821.507	**Mkr. Ref. Level:**	4.92	**Ref. Elevation:**	1831.827
Bottom Elevation:	1815.507	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	48.8

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3



Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Sewer Manhole	89.00
B	Sewer Manhole	26.70
C	Traffic Signal	36.20

General Notes About This Test Hole

Dug 3 holes to expose "crown" and both edges for a 72" casing

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-3A	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/16/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

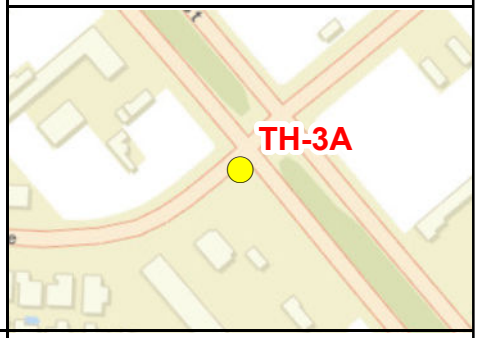
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

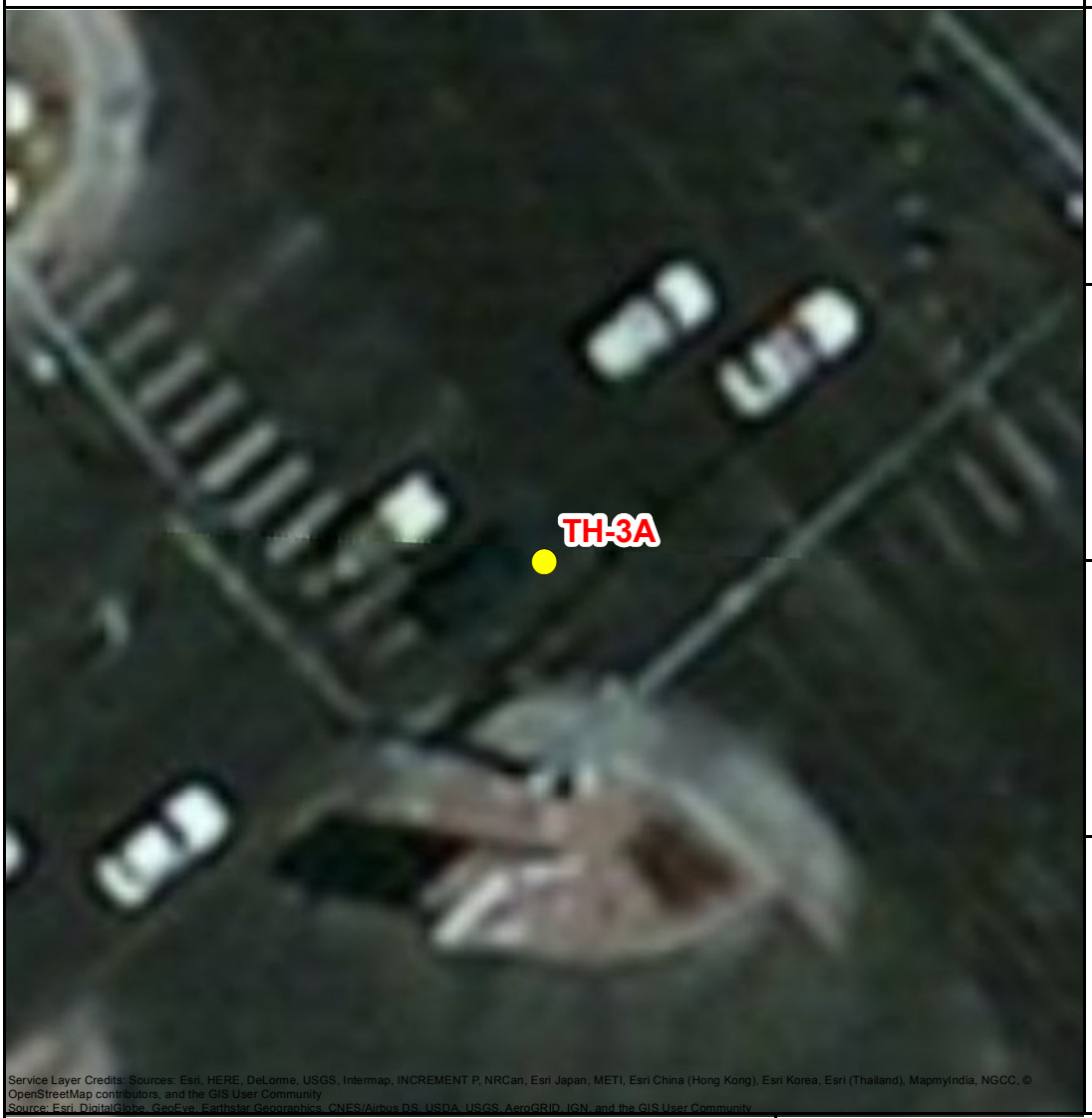
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	6.04	**Top Ref. Level:**	10.44	**Hand Meas. Top:**	6.06
Depth to Bottom:	8.54	**Bot. Ref. Level:**	12.94	**Hand Meas. Bot:**	N/A
Top Elevation:	1825.322	**Mkr. Ref. Level:**	4.40	**Ref. Elevation:**	1831.362
Bottom Elevation:	1822.822	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	16.3

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	51.20
B	Sewer Manhole	35.50
C	Traffic Signal	24.80

General Notes About This Test Hole

Dug down exposed 30" water first hole cored found drain directly under asphlt 26" West of pin. Also found another SD at 0.90' 11" East of pin

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-3B	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/16/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

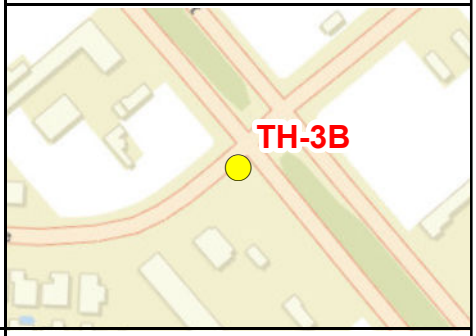
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

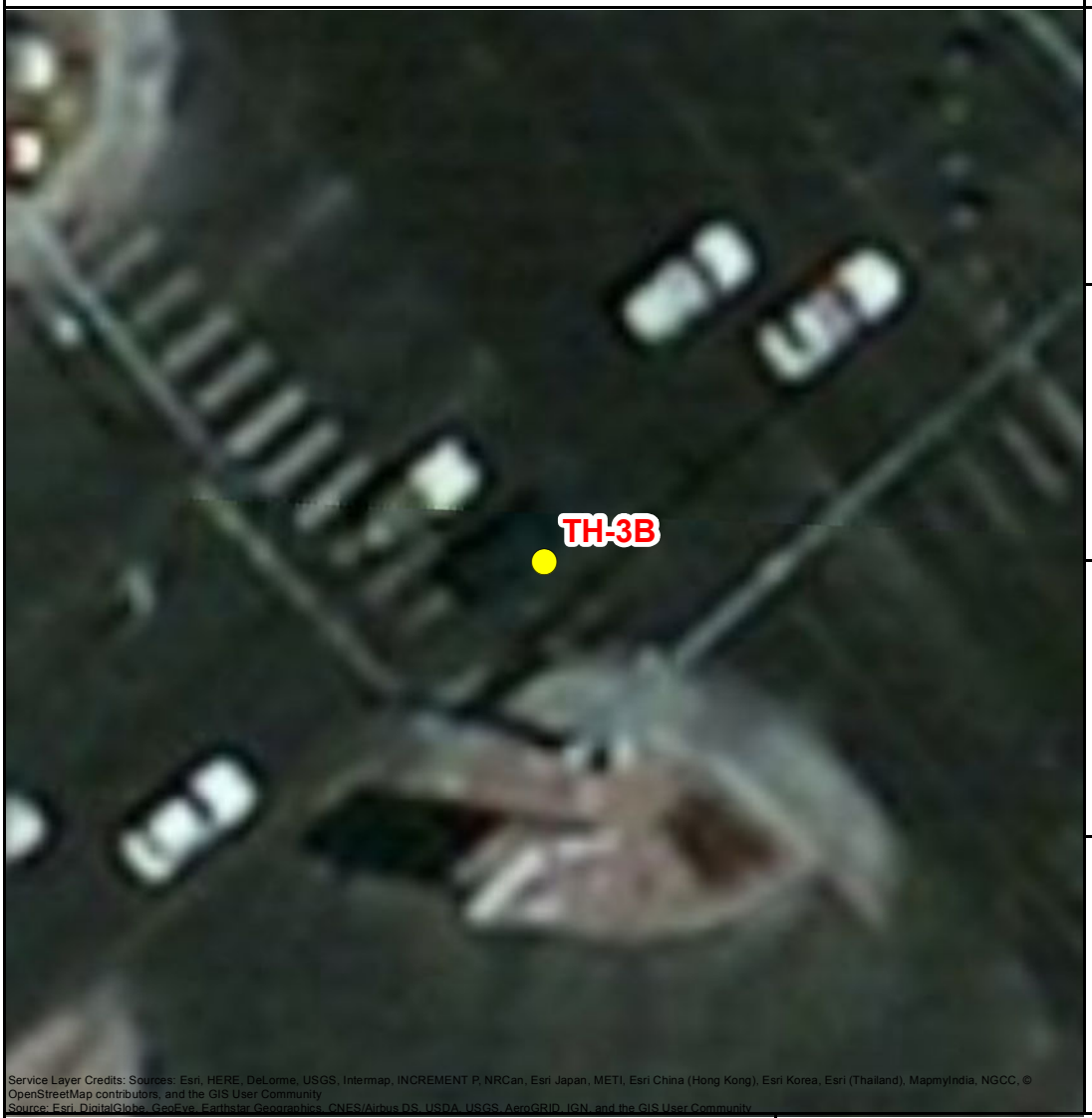
Utility Type:	Sewer	**Utility Size:**	72 Inches	**Utility Material:**	Metal
Utility Company:	City of Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	9.30	**Top Ref. Level:**	13.80	**Hand Meas. Top:**	9.30
Depth to Bottom:	15.30	**Bot. Ref. Level:**	19.80	**Hand Meas. Bot:**	N/A
Top Elevation:	1821.917	**Mkr. Ref. Level:**	4.50	**Ref. Elevation:**	1831.217
Bottom Elevation:	1815.917	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	11.8

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	
B	Sewer Manhole	
C	Traffic Signal	

General Notes About This Test Hole

Exposed "crown" for a 72" casing

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-4	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/17/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

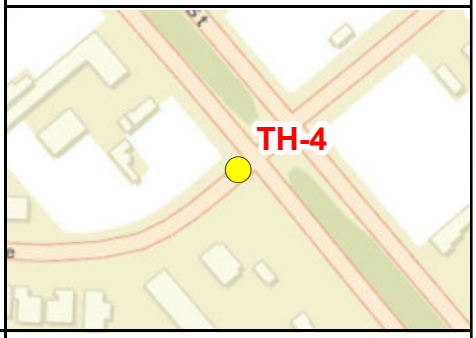
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

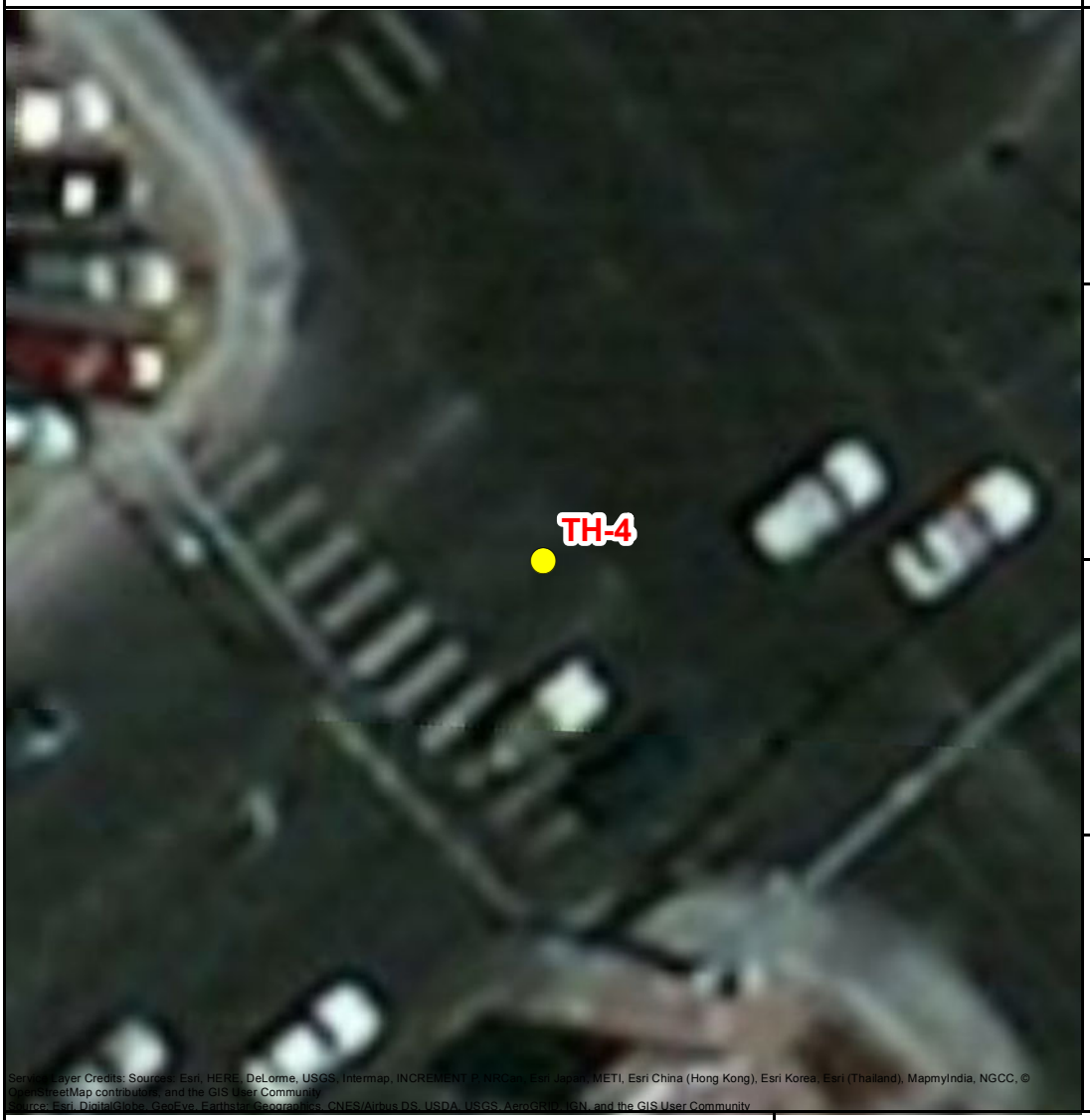
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	4 Inches	**Marker Type:**	PK Nail
Depth to Top:	6.40	**Top Ref. Level:**	11.20	**Hand Meas. Top:**	6.36
Depth to Bottom:	8.90	**Bot. Ref. Level:**	13.70	**Hand Meas. Bot:**	N/A
Top Elevation:	1825.573	**Mkr. Ref. Level:**	4.80	**Ref. Elevation:**	1831.973
Bottom Elevation:	1823.073	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	39.6

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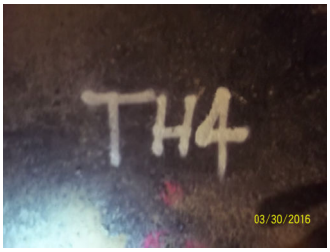
Overall Location of Test Hole



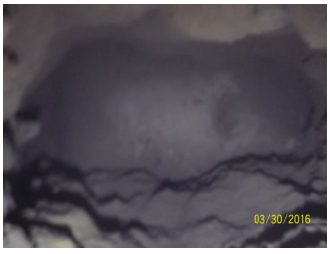
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	38.60
B	Water Valve	23.90
C	Traffic Signal	49.10

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-5	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/17/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

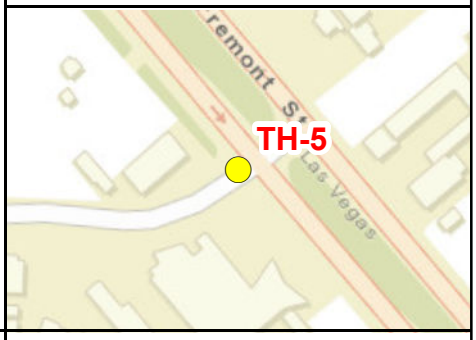
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

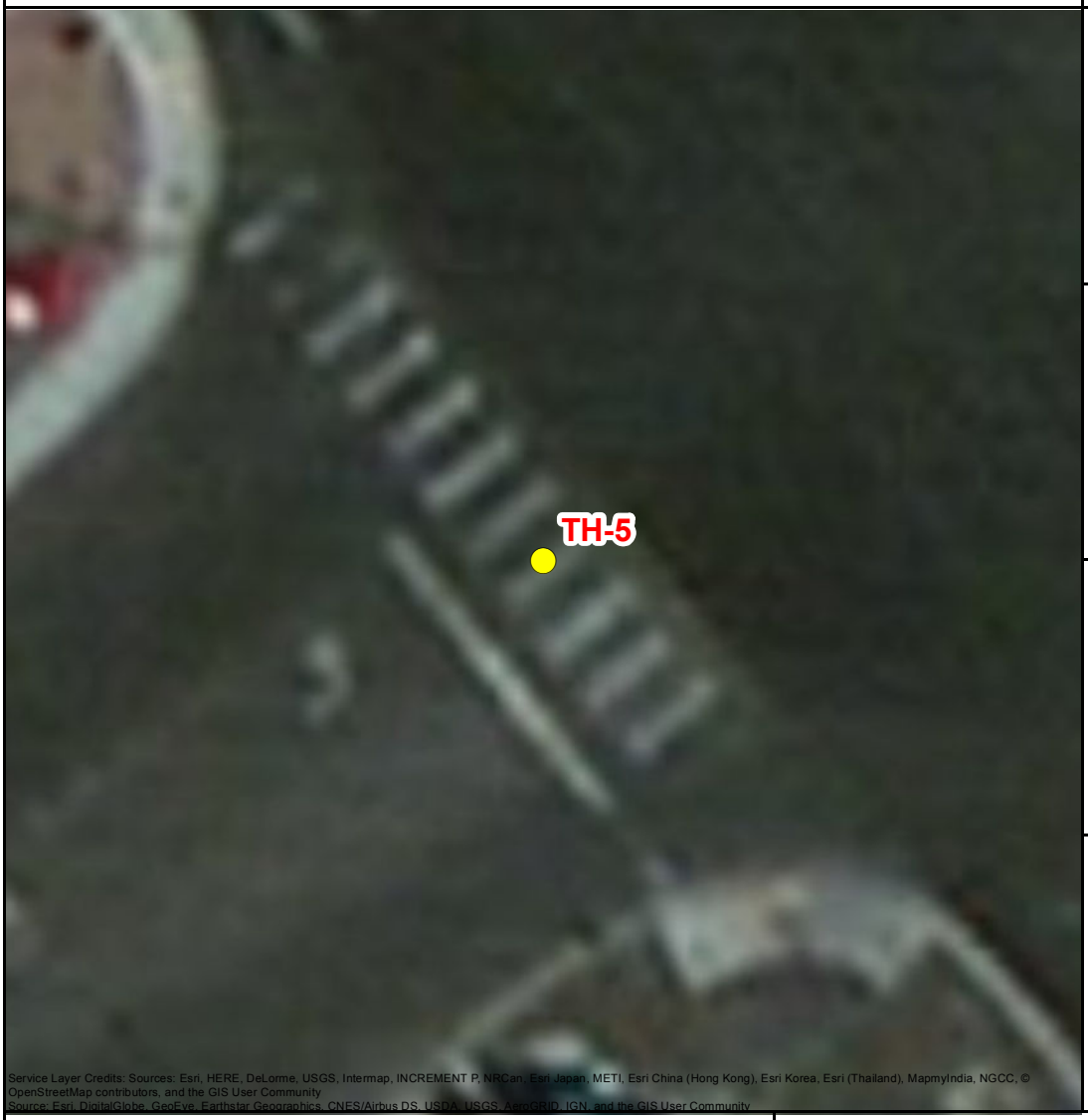
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Utility Company:	Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	4 Inches	**Marker Type:**	PK Nail
Depth to Top:	5.72	**Top Ref. Level:**	10.64	**Hand Meas. Top:**	5.72
Depth to Bottom:	8.22	**Bot. Ref. Level:**	13.14	**Hand Meas. Bot:**	N/A
Top Elevation:	1838.754	**Mkr. Ref. Level:**	4.92	**Ref. Elevation:**	1844.474
Bottom Elevation:	1836.254	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	39

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	43.20
B	Storm Drain inlet	41.20
C	Water Valve	18.00

General Notes About This Test Hole

Also found storm drain pipe at 1.56'

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-6	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/17/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

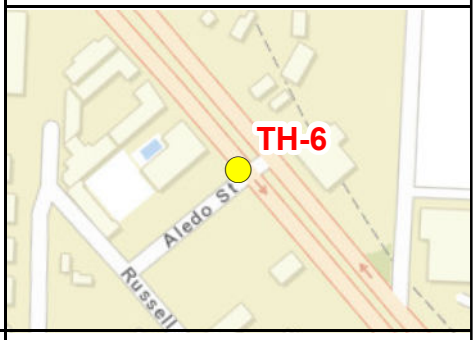
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

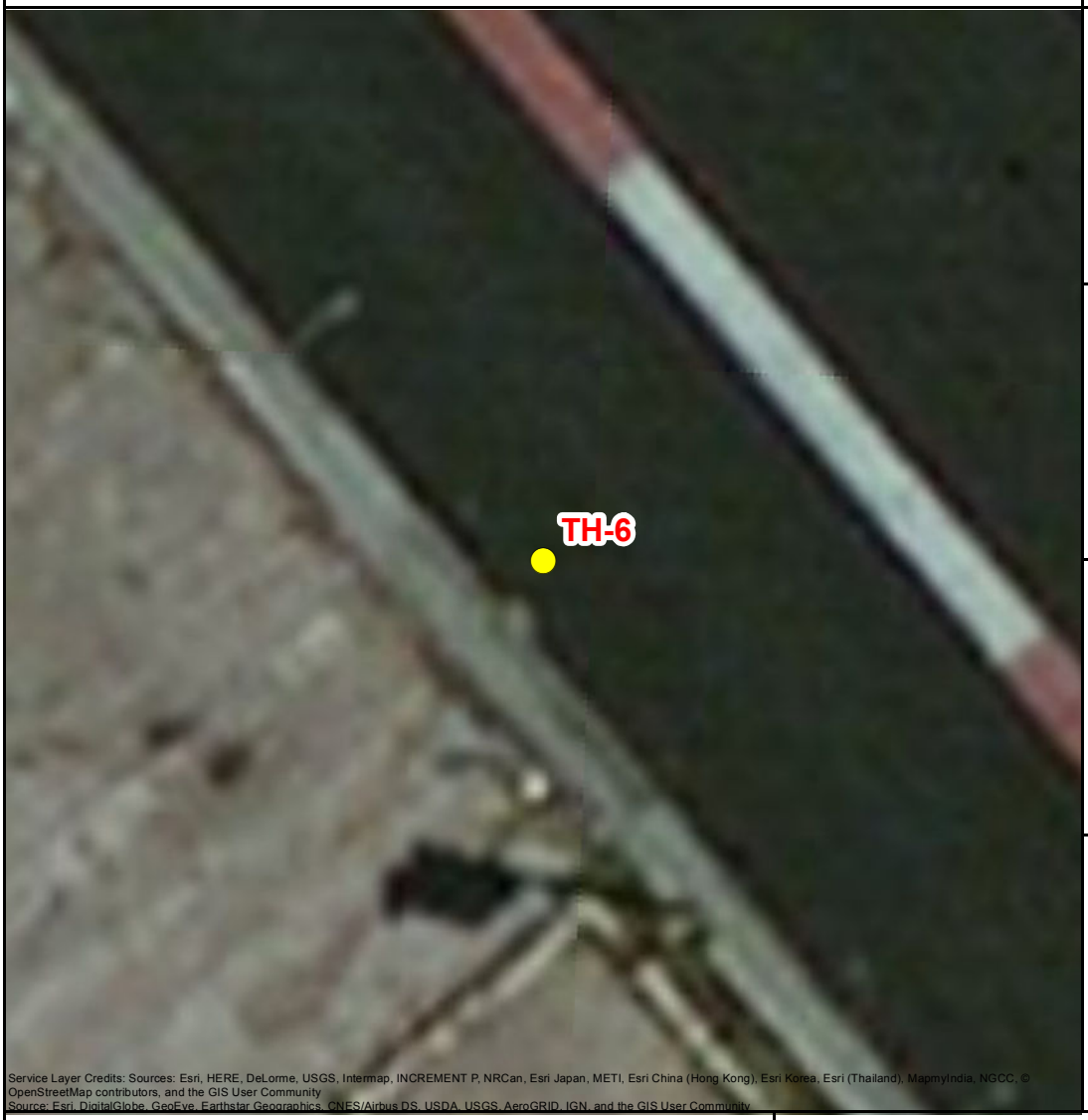
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	13 Inches	**Marker Type:**	PK Nail
Depth to Top:	4.84	**Top Ref. Level:**	10.20	**Hand Meas. Top:**	4.86
Depth to Bottom:	5.51	**Bot. Ref. Level:**	10.87	**Hand Meas. Bot:**	N/A
Top Elevation:	1854.278	**Mkr. Ref. Level:**	5.36	**Ref. Elevation:**	1859.118
Bottom Elevation:	1853.611	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	6.1

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	5.20
B	Face of median	31.30
C	Storm Drain Manhole	9.70

General Notes About This Test Hole

Found a 8" water. Dug down to 9 feet and side to side (4 feet wide) looking for 30" water.

No 30" water located

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-6A	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/18/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

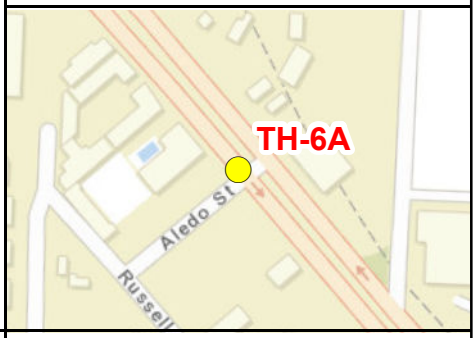
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

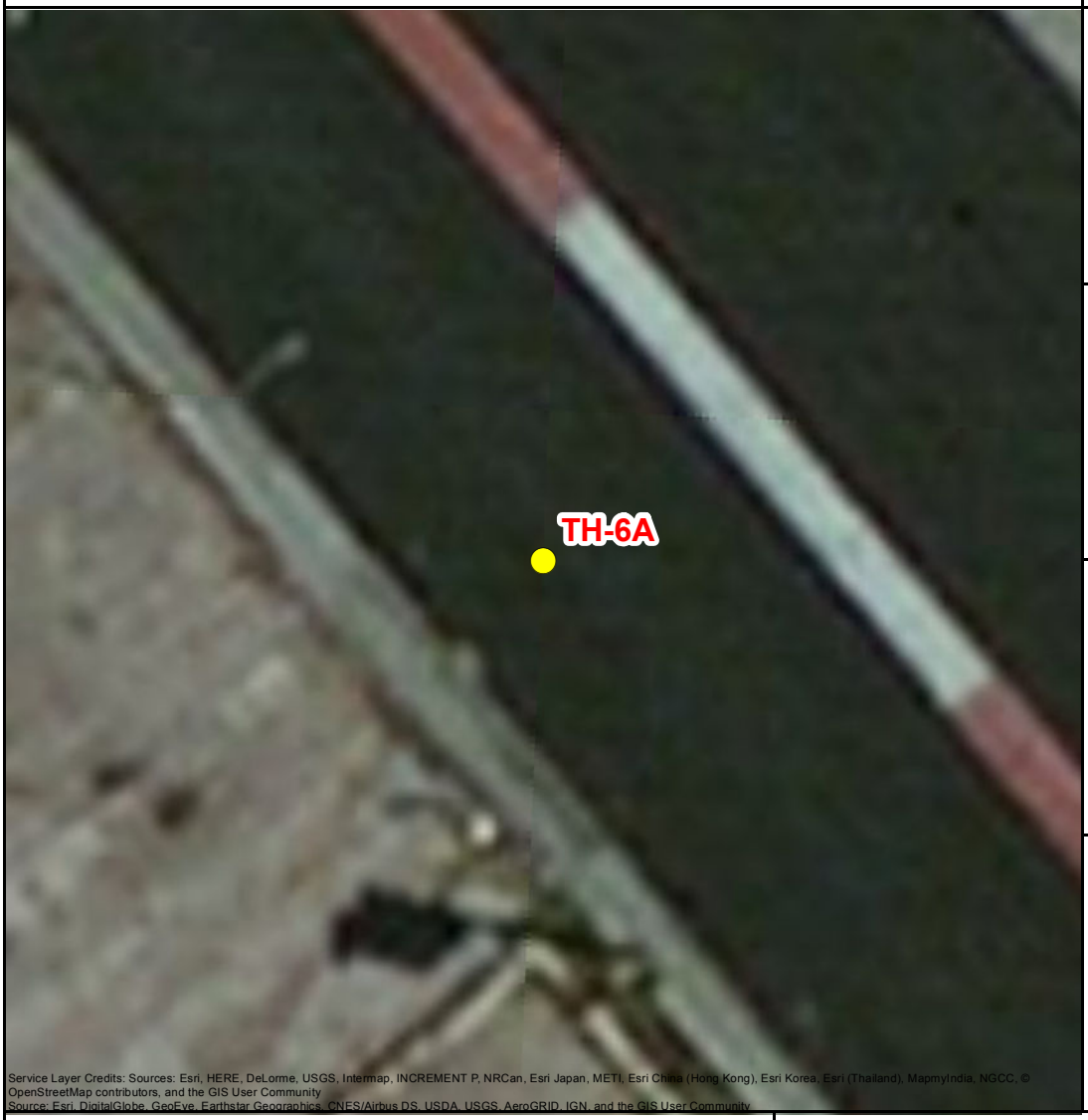
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	13 Inches	**Marker Type:**	PK Nail
Depth to Top:	5.76	**Top Ref. Level:**	10.82	**Hand Meas. Top:**	5.80
Depth to Bottom:	8.26	**Bot. Ref. Level:**	13.32	**Hand Meas. Bot:**	N/A
Top Elevation:	1853.789	**Mkr. Ref. Level:**	5.06	**Ref. Elevation:**	1859.549
Bottom Elevation:	1851.289	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	13.5

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	10.20
B	Storm Drain Manhole	15.60
C	Face of median	24.00

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-7	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/17/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

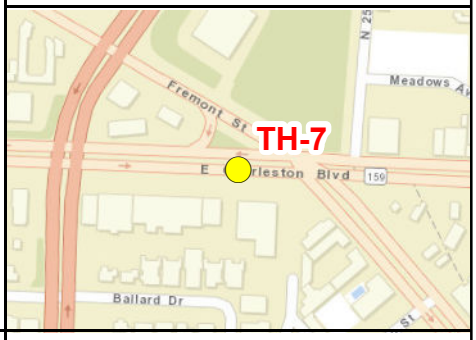
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

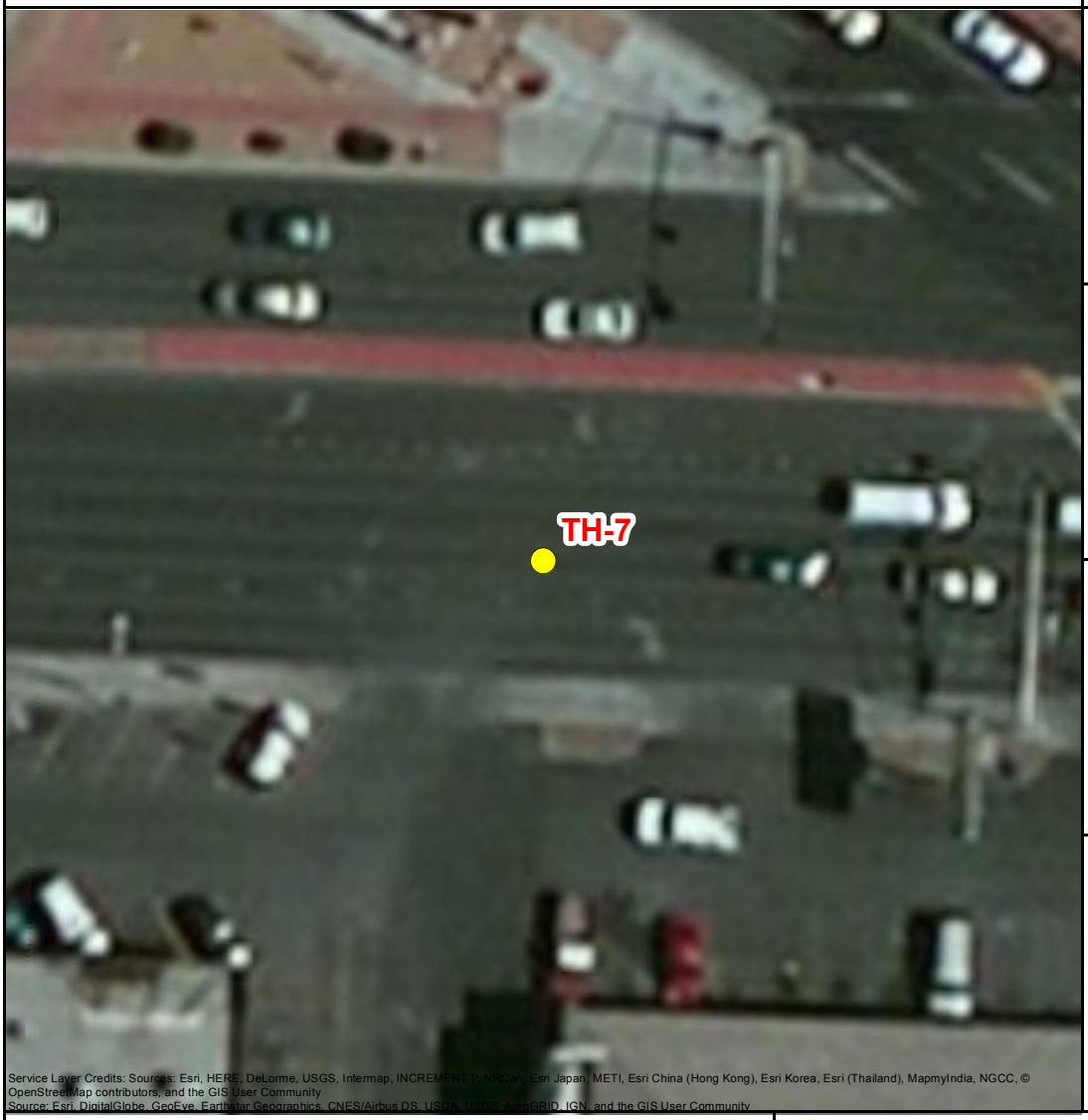
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	13 Inches	**Marker Type:**	PK Nail
Depth to Top:	9.34	**Top Ref. Level:**	14.30	**Hand Meas. Top:**	9.36
Depth to Bottom:	11.84	**Bot. Ref. Level:**	16.80	**Hand Meas. Bot:**	N/A
Top Elevation:	1855.730	**Mkr. Ref. Level:**	4.96	**Ref. Elevation:**	1865.070
Bottom Elevation:	1853.230	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	21.9

N

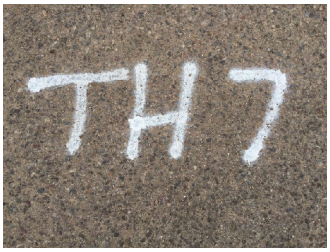
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of median	27.20
B	Face of Curb	23.40
C	Street Light	76.60

General Notes About This Test Hole

Found water was unable to manuver around water to locate sewer due to gravel caving in

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-8	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/17/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

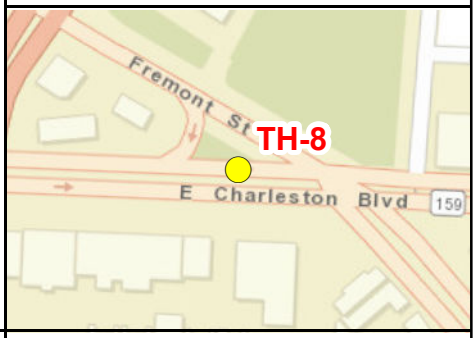
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

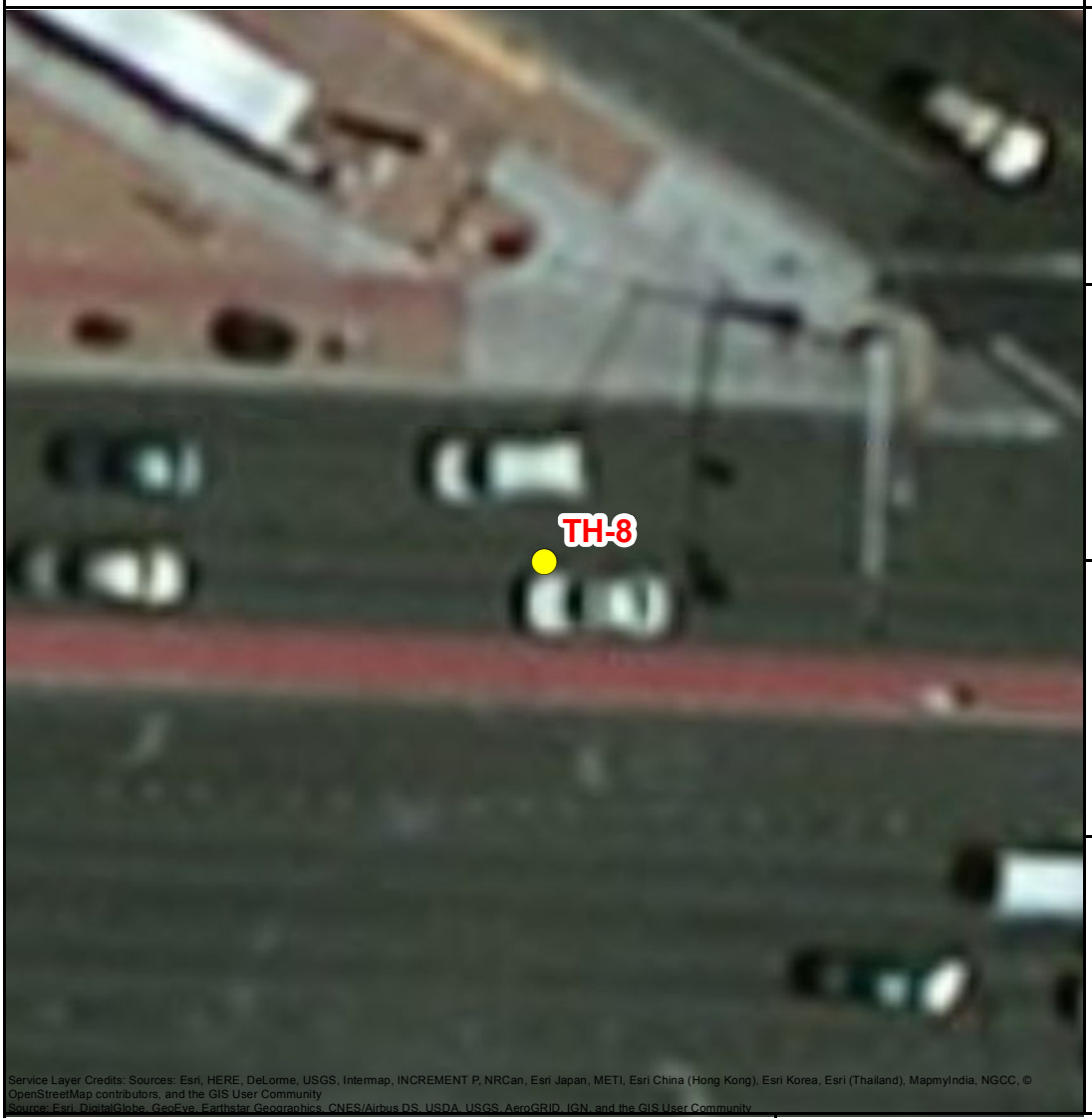
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	13 Inches	**Marker Type:**	PK Nail
Depth to Top:	8.66	**Top Ref. Level:**	13.72	**Hand Meas. Top:**	8.70
Depth to Bottom:	11.16	**Bot. Ref. Level:**	16.22	**Hand Meas. Bot:**	N/A
Top Elevation:	1856.652	**Mkr. Ref. Level:**	5.06	**Ref. Elevation:**	1865.312
Bottom Elevation:	1854.152	**Mkr. Offset From:**	RT	**Marker Offset (ft):**	14.4

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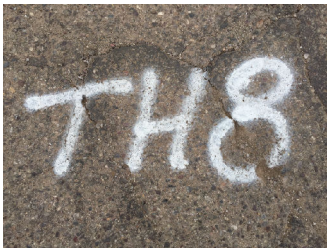
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	27.40
B	Water Valve	12.00
C	Face of median	11.70

General Notes About This Test Hole

Found 30" water unable to expose angle point due to 39" storm drain. Storm drain is at 4.76'

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-11	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Kenny Ward
Date:	8/17/2016	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

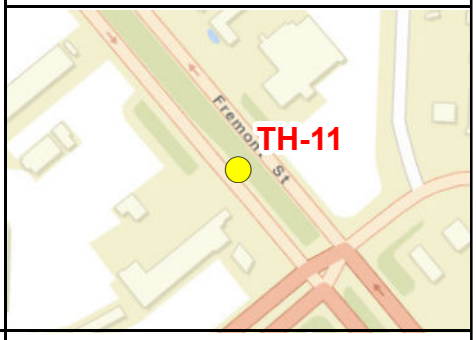
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

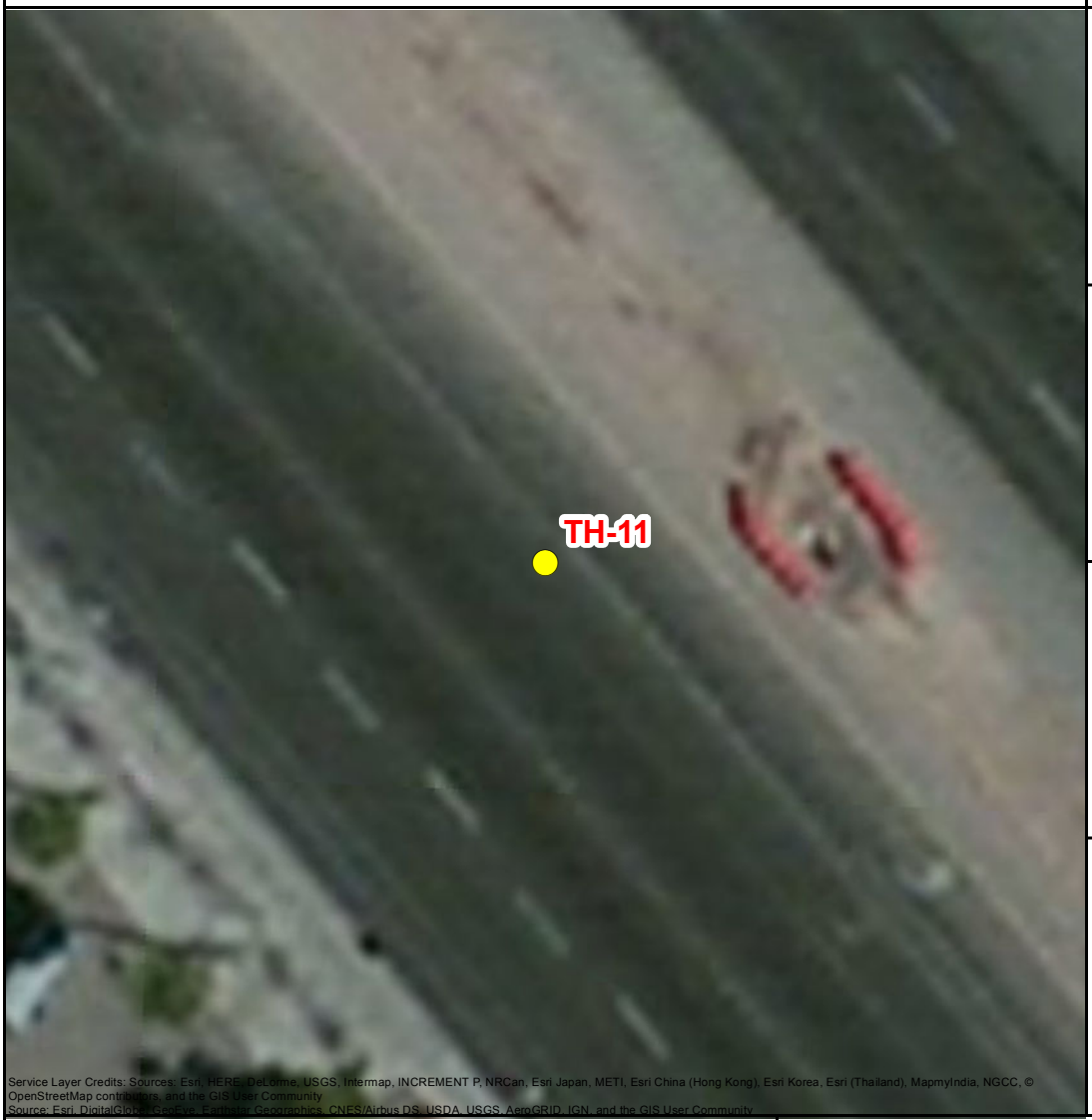
Utility Type:	Storm Drain	**Utility Size:**	N/A	**Utility Material:**	Slurry
Utility Company:	Clark County	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	12 Inches	**Marker Type:**	PK Nail
Depth to Top:	N/A	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	10.02
Depth to Bottom:	N/A	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	N/A	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1826.010
Bottom Elevation:	N/A	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	49

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



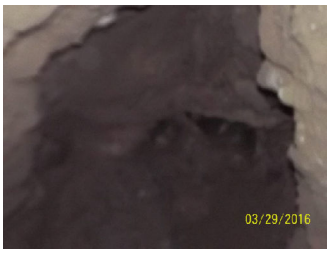
TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	62.10
B	Face of median	27.00
C	Storm Drain Manhole	15.50

General Notes About This Test Hole

Dug down to 10 feet hit slurry. Dug to North to find edge of slurry. Hit trench wall possible end of cap.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-13	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/23/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

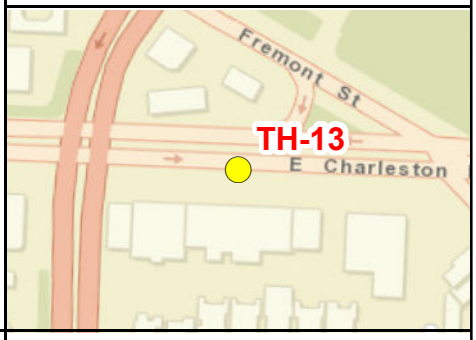
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

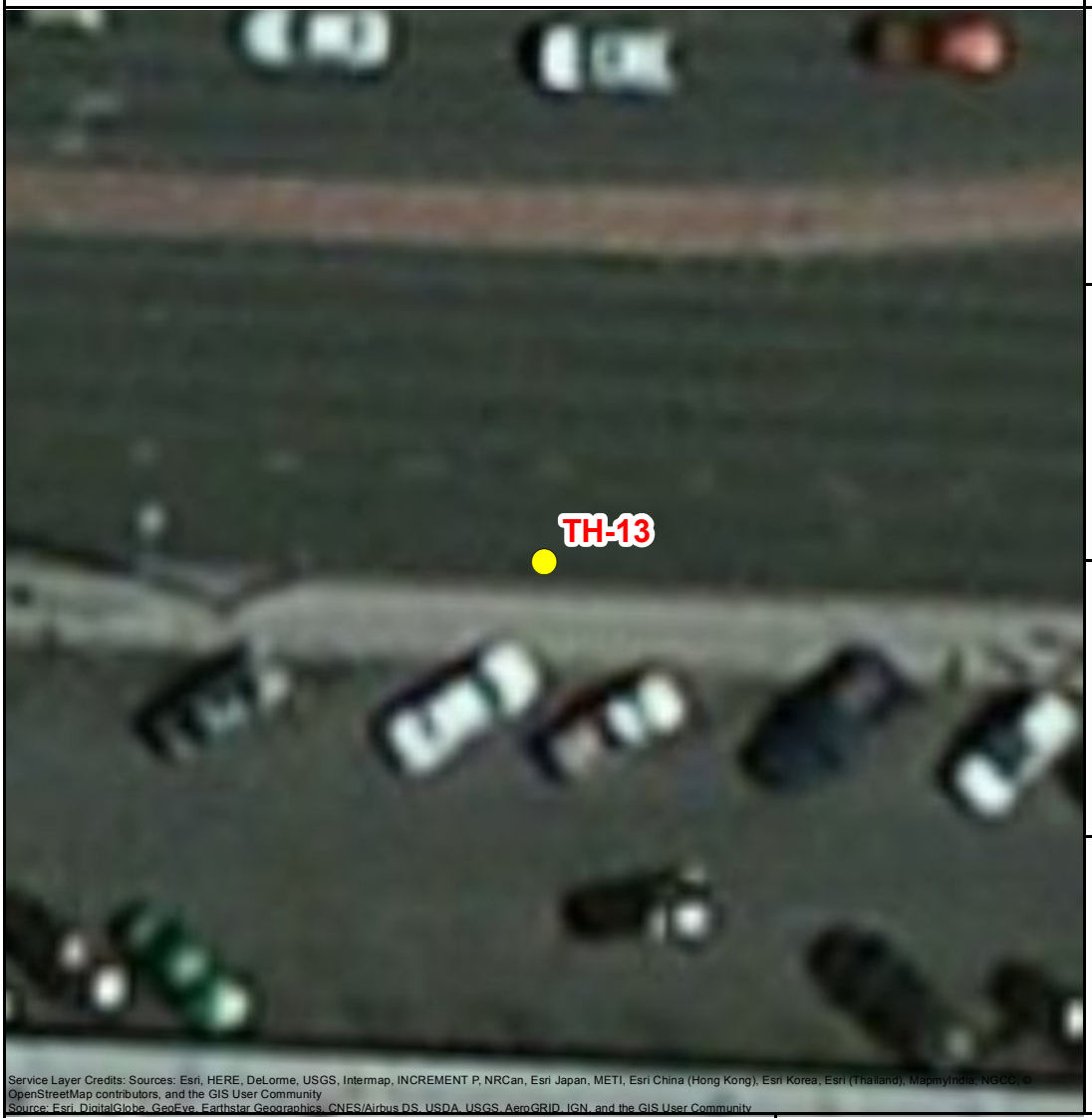
Utility Type:	Gas	**Utility Size:**	6 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	10 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.04	**Top Ref. Level:**	9.12	**Hand Meas. Top:**	3.05
Depth to Bottom:	3.54	**Bot. Ref. Level:**	9.62	**Hand Meas. Bot:**	N/A
Top Elevation:	1863.653	**Mkr. Ref. Level:**	6.08	**Ref. Elevation:**	1866.693
Bottom Elevation:	1863.153	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of median	31.30
B	Power Pole	31.20
C	Face of curb	6.40

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-14	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/23/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

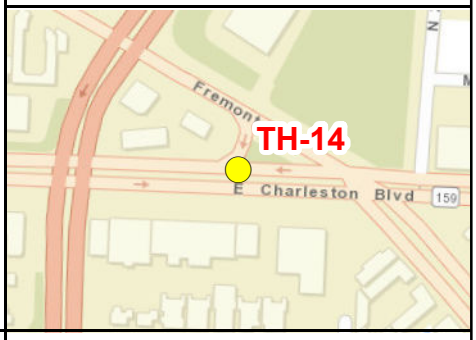
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

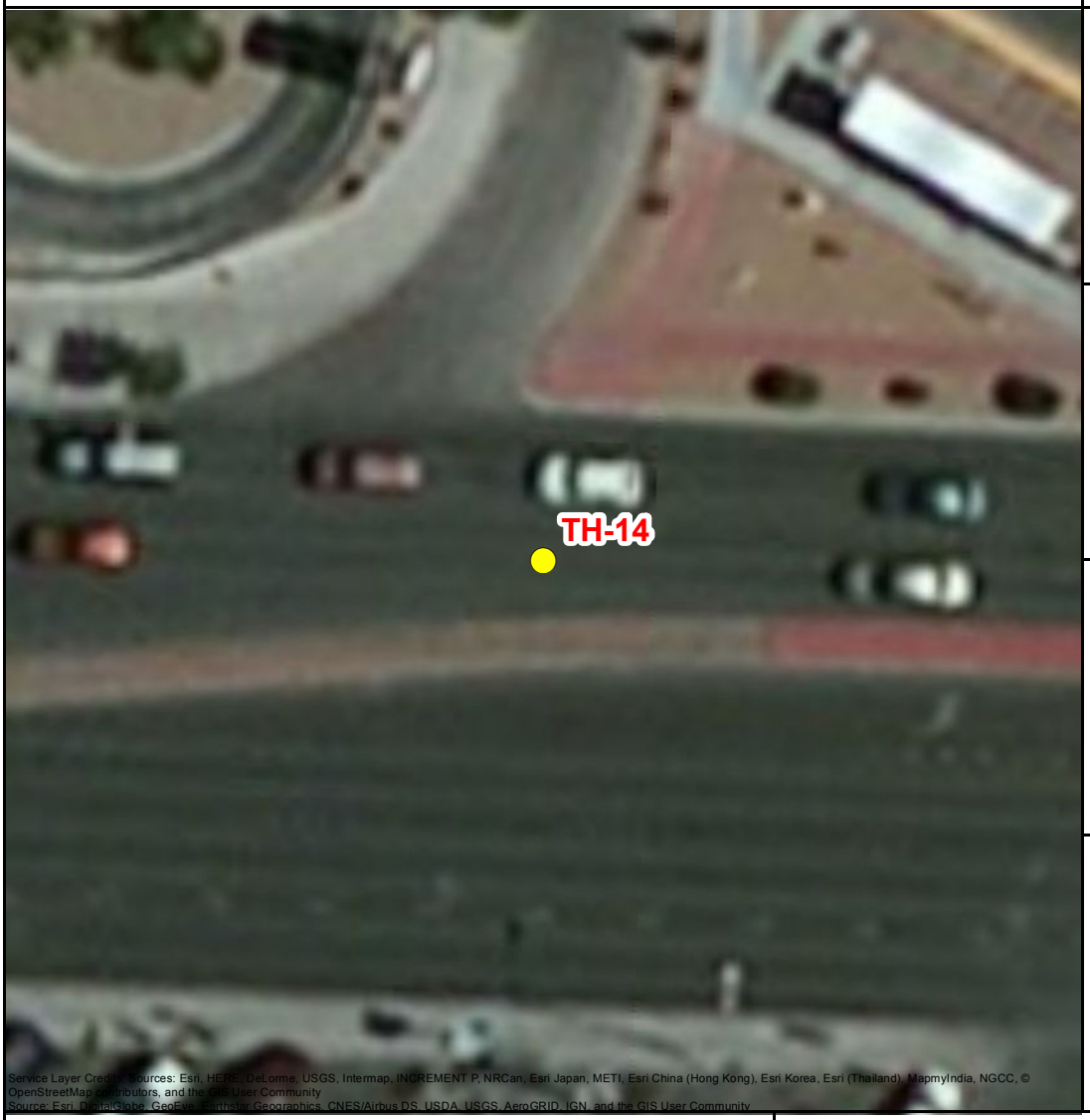
Utility Type:	Water	**Utility Size:**	24 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	9 Inches	**Marker Type:**	PK Nail
Depth to Top:	7.79	**Top Ref. Level:**	12.98	**Hand Meas. Top:**	7.80
Depth to Bottom:	9.79	**Bot. Ref. Level:**	14.98	**Hand Meas. Bot:**	N/A
Top Elevation:	1858.043	**Mkr. Ref. Level:**	5.19	**Ref. Elevation:**	1865.833
Bottom Elevation:	1856.043	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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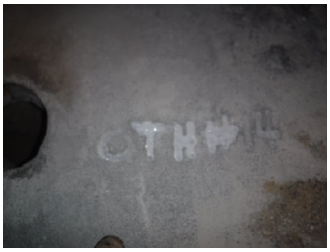
Overall Location of Test Hole



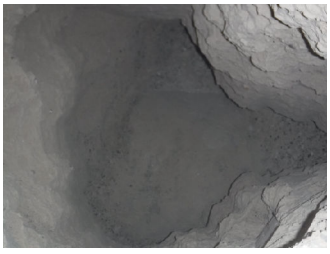
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of median	11.20
B	Street Light	63.10
C	Meter	61.30

General Notes About This Test Hole

Unable to pin angle point. Pinned center of 24 inches. Dug two holes for this location.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-15	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

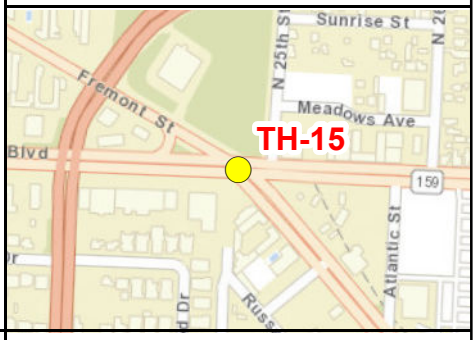
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

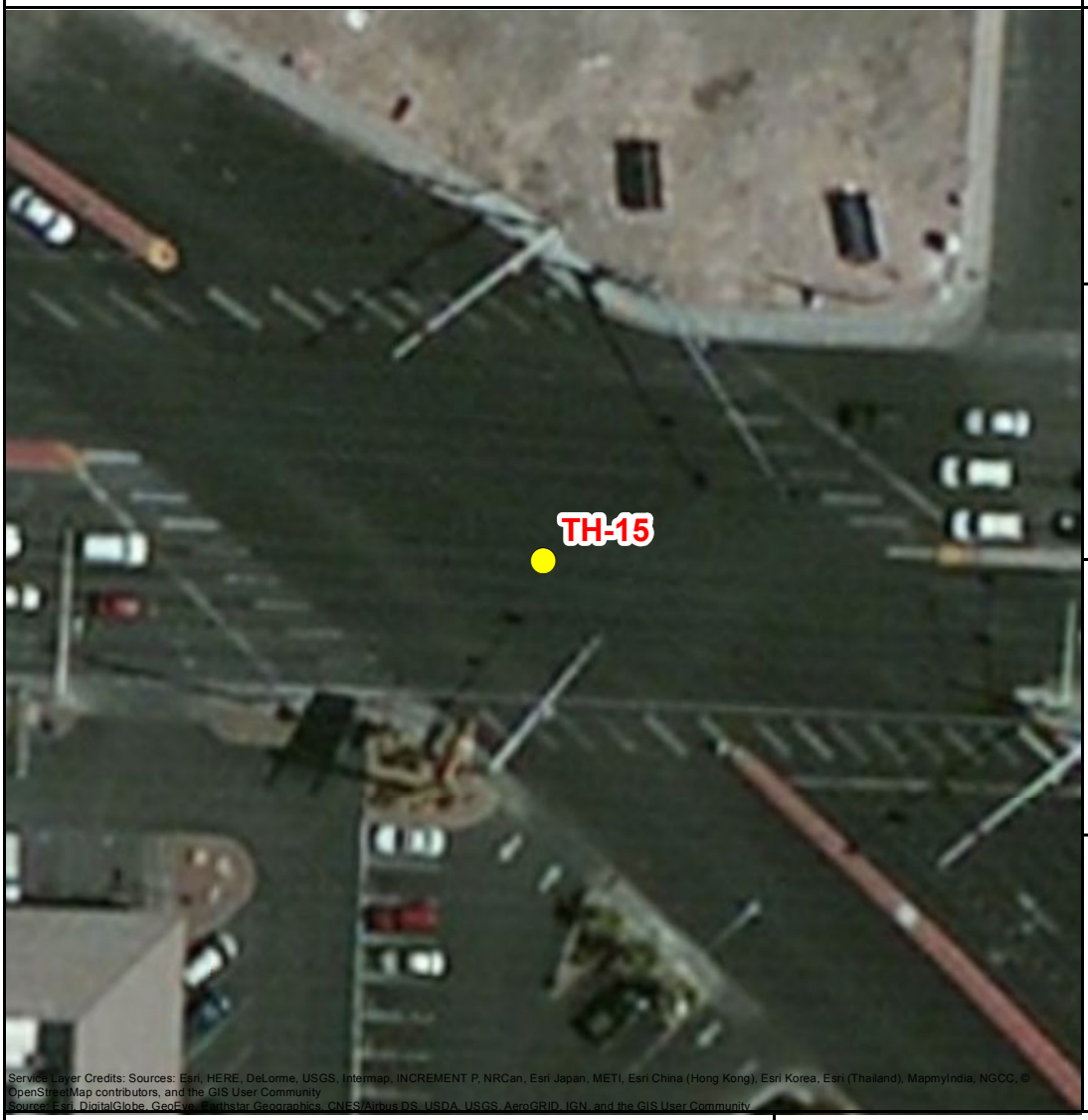
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	4.3	**Top Ref. Level:**	9.4	**Hand Meas. Top:**	4.29
Depth to Bottom:	4.97	**Bot. Ref. Level:**	10.07	**Hand Meas. Bot:**	N/A
Top Elevation:	1859.703	**Mkr. Ref. Level:**	5.1	**Ref. Elevation:**	1864.003
Bottom Elevation:	1859.033	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	54.50
B	Nose of Meridian	68.20
C	Nose of Meridian	108.40

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-16	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/23/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

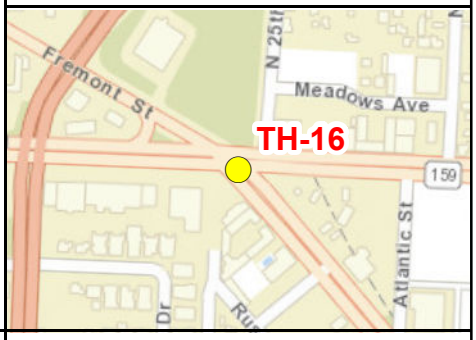
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

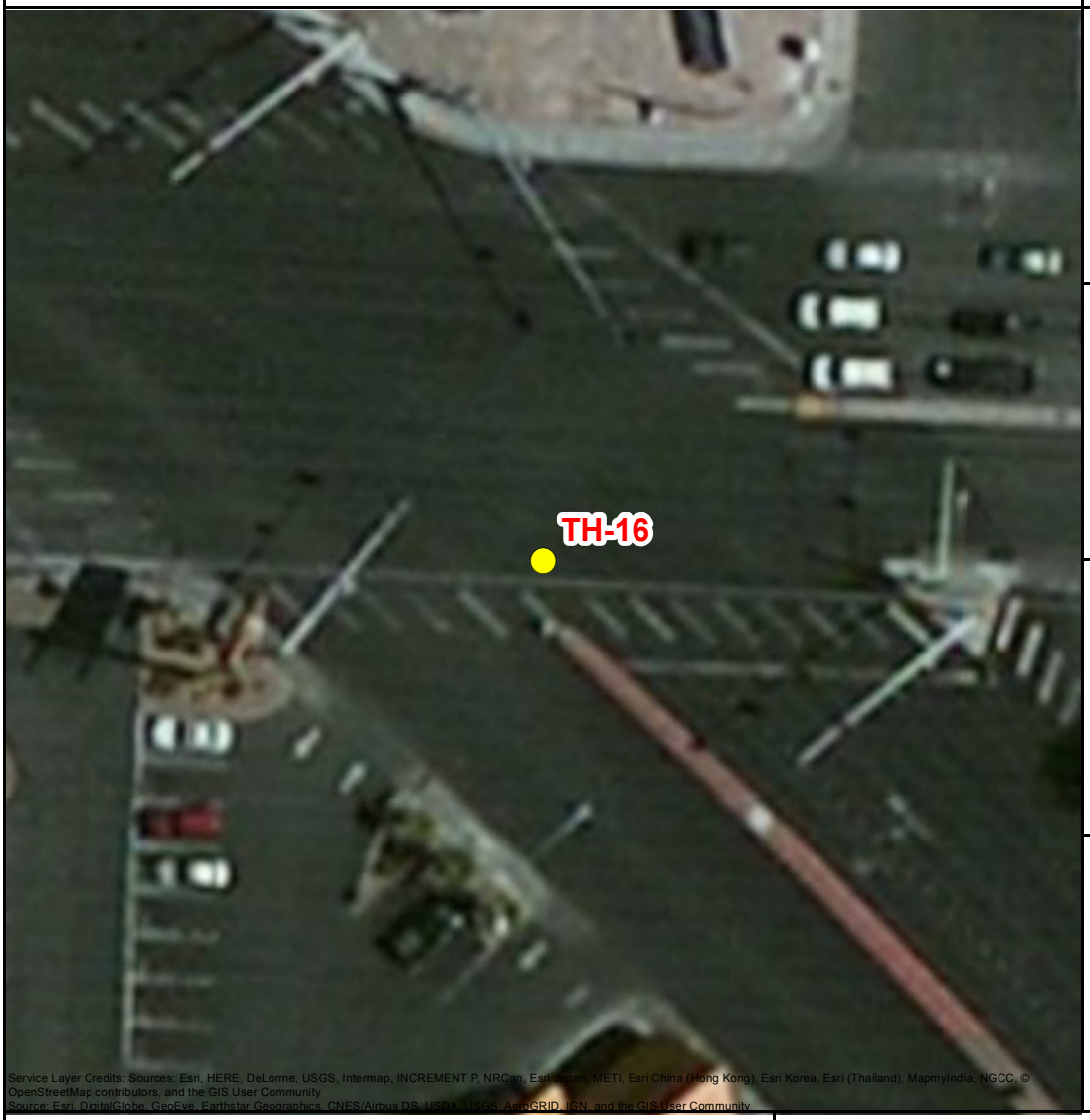
Utility Type:	Gas	**Utility Size:**	6 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	9 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.02	**Top Ref. Level:**	8.01	**Hand Meas. Top:**	3.02
Depth to Bottom:	3.52	**Bot. Ref. Level:**	8.51	**Hand Meas. Bot:**	N/A
Top Elevation:	1860.71	**Mkr. Ref. Level:**	4.99	**Ref. Elevation:**	1863.730
Bottom Elevation:	1860.21	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

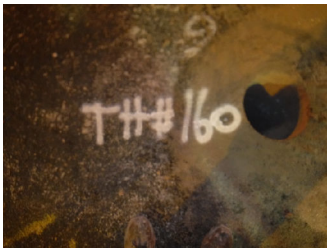
Overall Location of Test Hole



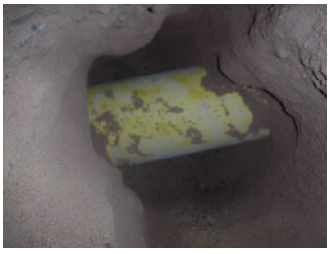
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	63.40
B	Traffic Signal	94.50
C	Traffic Signal	89.40

General Notes About This Test Hole

Orange tracer running with pipe.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-18	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/2/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

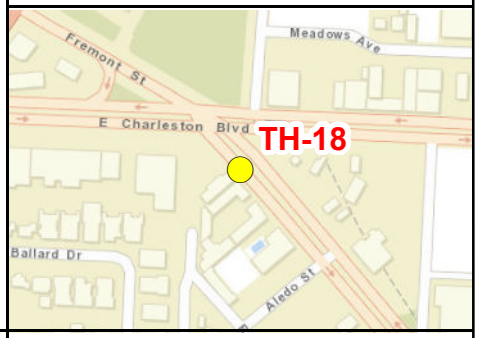
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

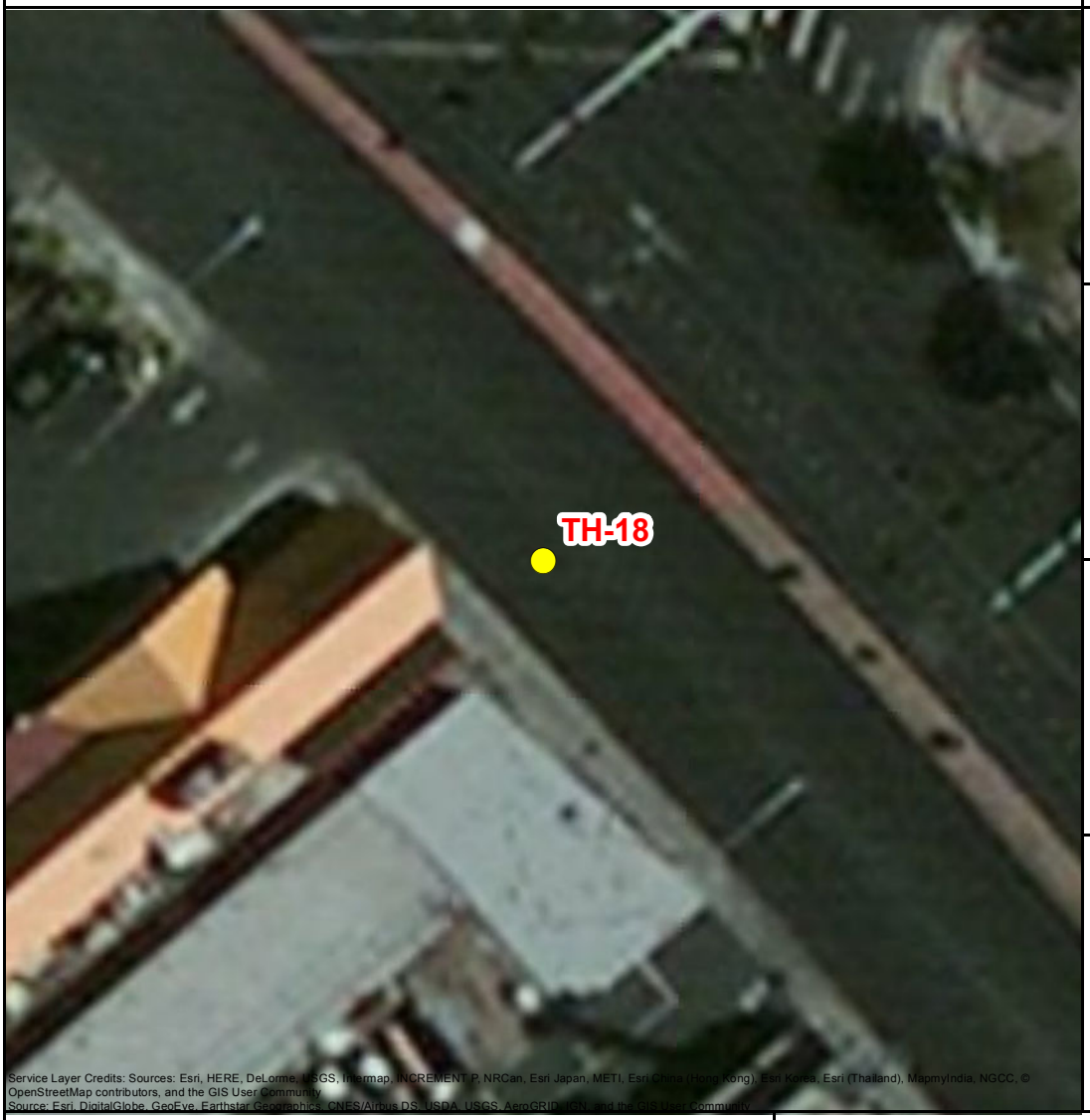
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	10 Inches	**Marker Type:**	Nail
Depth to Top:	7.82	**Top Ref. Level:**	12.91	**Hand Meas. Top:**	7.82
Depth to Bottom:	10.32	**Bot. Ref. Level:**	15.41	**Hand Meas. Bot:**	N/A
Top Elevation:	1854.219	**Mkr. Ref. Level:**	5.09	**Ref. Elevation:**	1862.039
Bottom Elevation:	1851.719	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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Overall Location of Test Hole



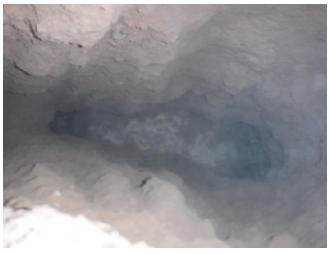
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	11.00
B	Face of median	27.10
C	Street Light	76.00

General Notes About This Test Hole

Dug 3 holes looking for utility.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-19	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/2/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

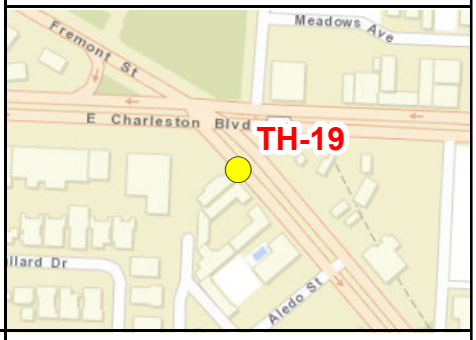
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

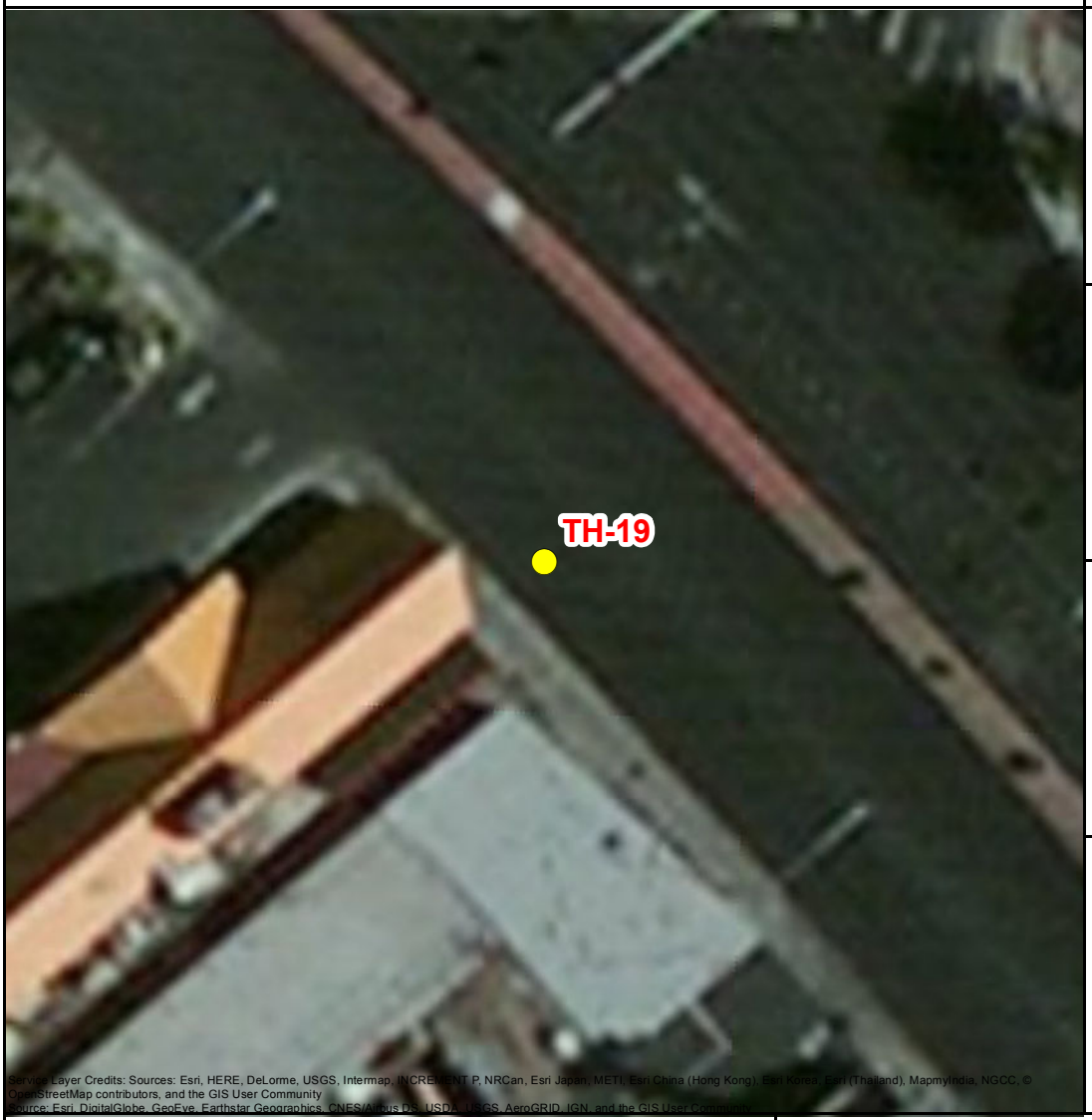
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	Nail
Depth to Top:	4.67	**Top Ref. Level:**	9.84	**Hand Meas. Top:**	4.69
Depth to Bottom:	5.34	**Bot. Ref. Level:**	10.51	**Hand Meas. Bot:**	N/A
Top Elevation:	1857.266	**Mkr. Ref. Level:**	5.17	**Ref. Elevation:**	1861.936
Bottom Elevation:	1856.596	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	7.30
B	Face of median	31.20
C	Street Light	69.60

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-20	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/2/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

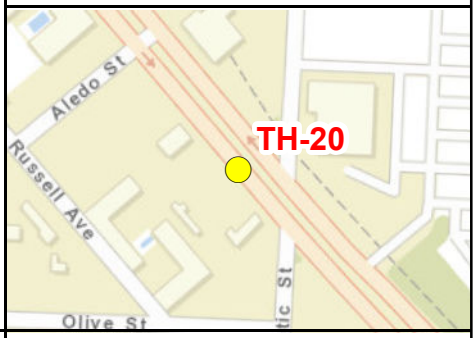
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

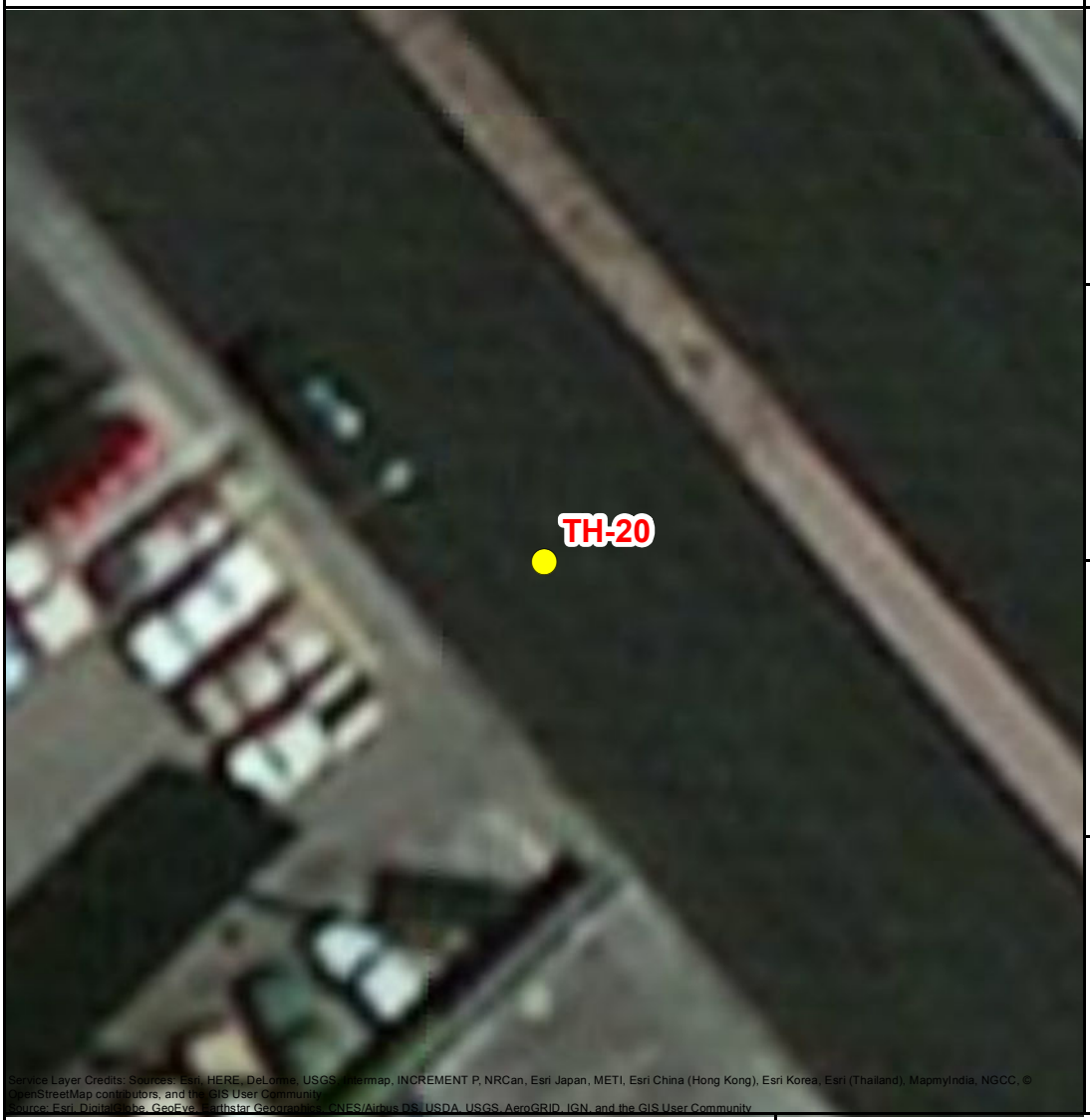
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	12 Inches	**Marker Type:**	Nail
Depth to Top:	4.73	**Top Ref. Level:**	9.72	**Hand Meas. Top:**	4.75
Depth to Bottom:	7.23	**Bot. Ref. Level:**	12.22	**Hand Meas. Bot:**	N/A
Top Elevation:	1852.836	**Mkr. Ref. Level:**	4.99	**Ref. Elevation:**	1857.566
Bottom Elevation:	1850.336	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



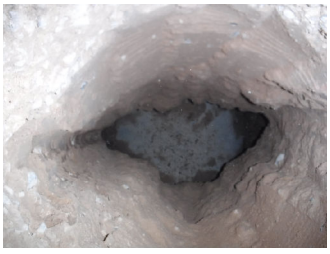
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of median	24.20
B	Face of curb	14.50
C	Street Light	24.30

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-21	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/2/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

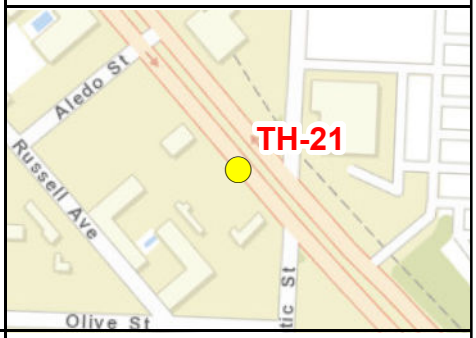
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

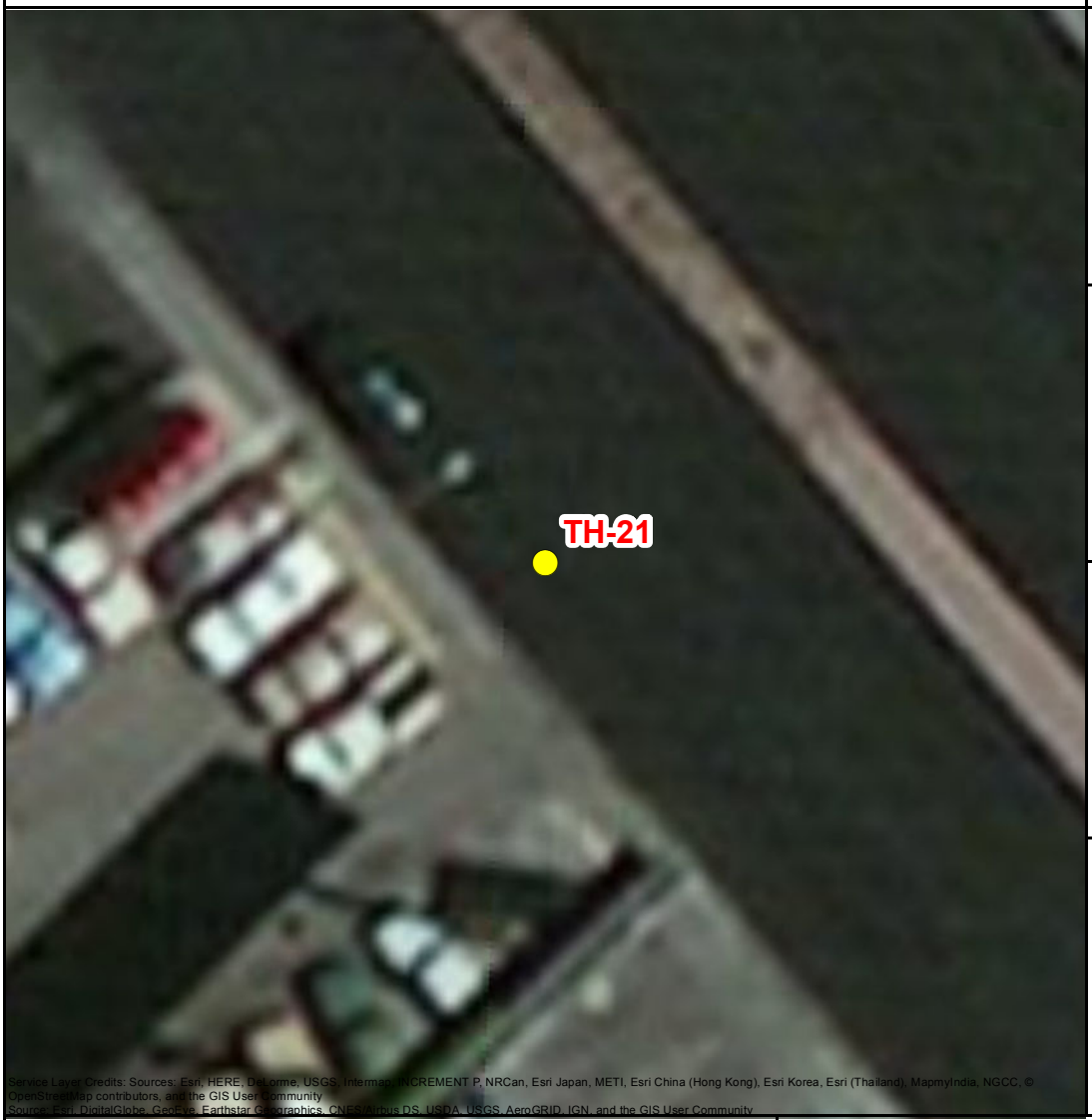
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	4.58	**Top Ref. Level:**	9.81	**Hand Meas. Top:**	4.59
Depth to Bottom:	5.25	**Bot. Ref. Level:**	10.48	**Hand Meas. Bot:**	N/A
Top Elevation:	1852.709	**Mkr. Ref. Level:**	5.23	**Ref. Elevation:**	1857.289
Bottom Elevation:	1852.039	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of median	30.30
B	Face of Curb	7.60
C	Street Light	19.20

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-22	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

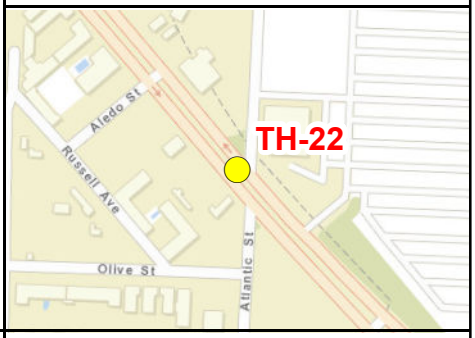
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

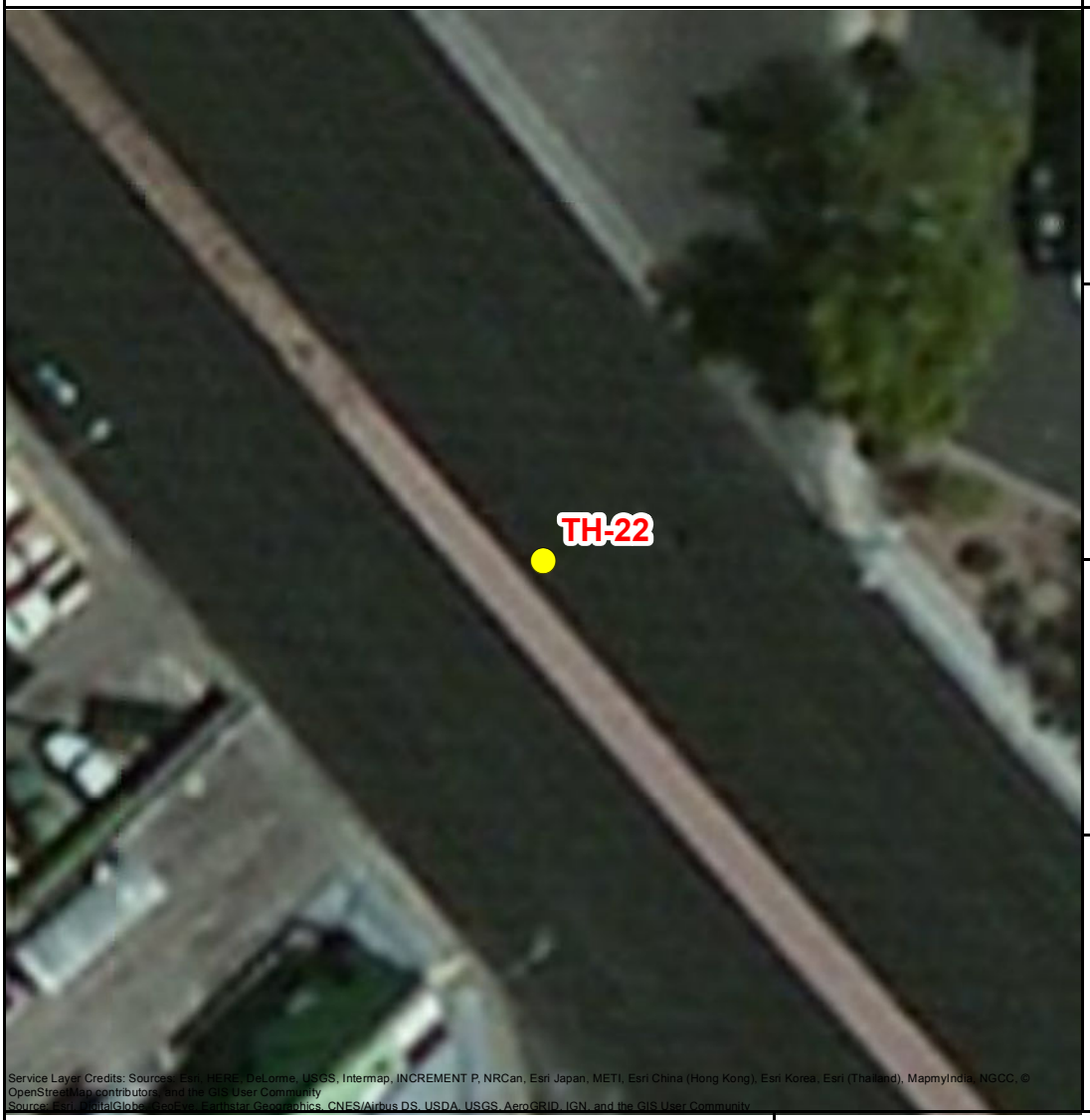
Utility Type:	Telephone	**Utility Size:**	12 Inches	**Utility Material:**	Metal Casing
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	3.43	**Top Ref. Level:**	8.72	**Hand Meas. Top:**	3.43
Depth to Bottom:	4.43	**Bot. Ref. Level:**	9.72	**Hand Meas. Bot:**	N/A
Top Elevation:	1853.925	**Mkr. Ref. Level:**	5.29	**Ref. Elevation:**	1857.355
Bottom Elevation:	1852.925	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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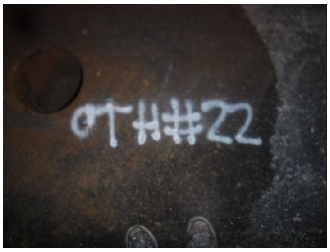
Overall Location of Test Hole



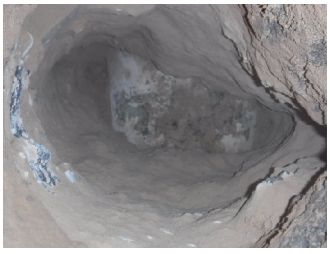
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Sewer Manhole	58.10
B	Face of Median	3.20
C	Street Light	73.80

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-23	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

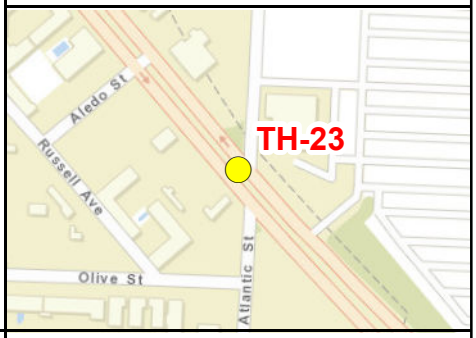
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

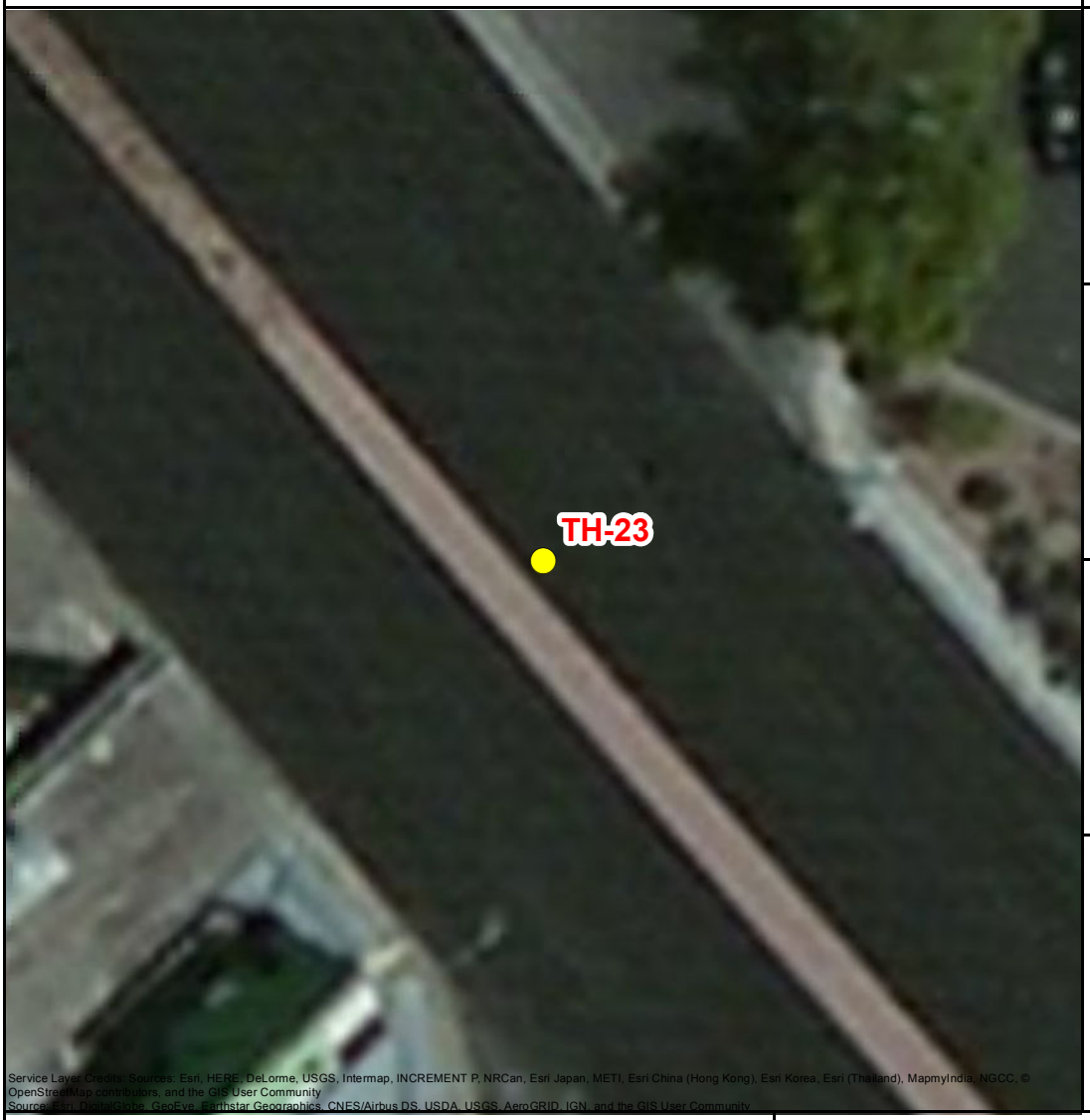
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Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	Nail
Depth to Top:	4.89	**Top Ref. Level:**	10.20	**Hand Meas. Top:**	4.89
Depth to Bottom:	5.56	**Bot. Ref. Level:**	10.87	**Hand Meas. Bot:**	N/A
Top Elevation:	1852.459	**Mkr. Ref. Level:**	5.31	**Ref. Elevation:**	1857.349
Bottom Elevation:	1851.789	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Sewer Manhole	65.60
B	Face of Median	4.50
C	Street Light	63.40

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-23A	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

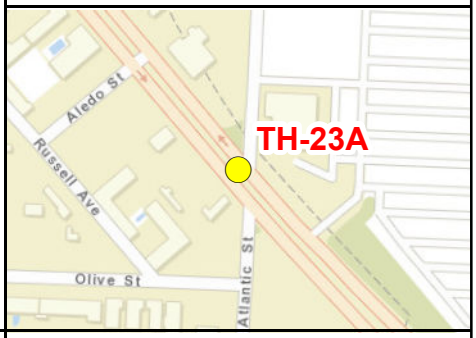
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

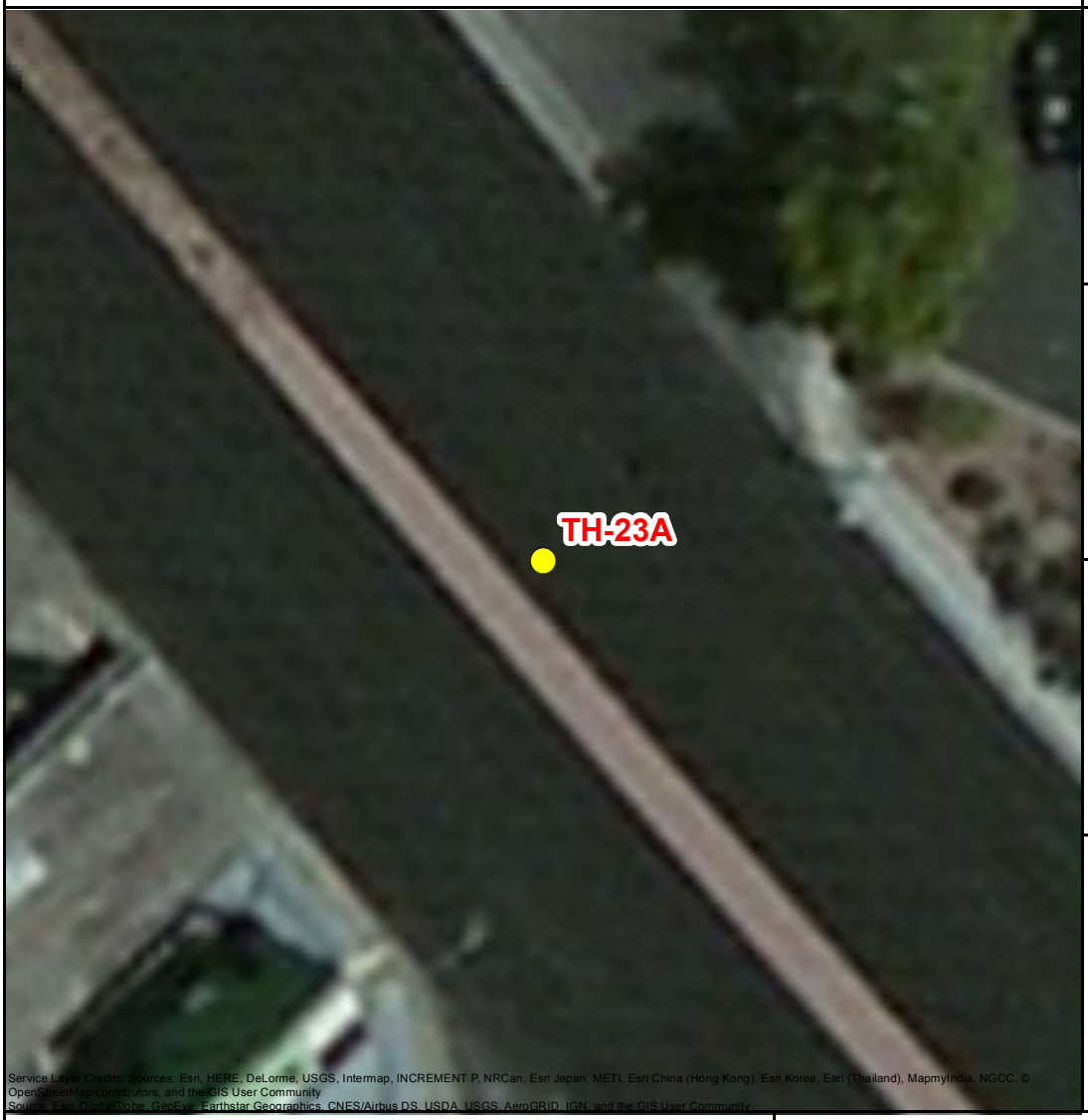
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Utility Company:	Unknown	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	1.68	**Top Ref. Level:**	6.99	**Hand Meas. Top:**	1.68
Depth to Bottom:	1.76	**Bot. Ref. Level:**	7.07	**Hand Meas. Bot:**	N/A
Top Elevation:	1855.640	**Mkr. Ref. Level:**	5.31	**Ref. Elevation:**	1857.320
Bottom Elevation:	1855.560	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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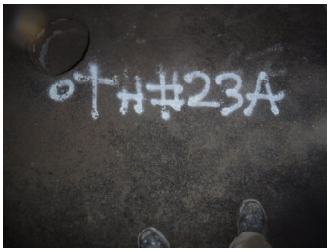
Overall Location of Test Hole



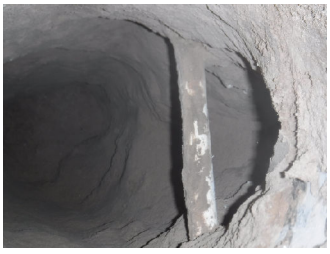
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Sewer Manhole	64.50
B	Face of Median	4.10
C	Street Light	64.00

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-24	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/2/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

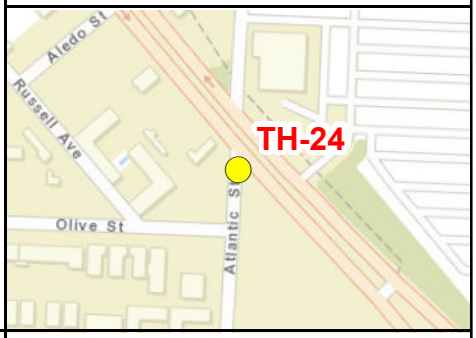
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

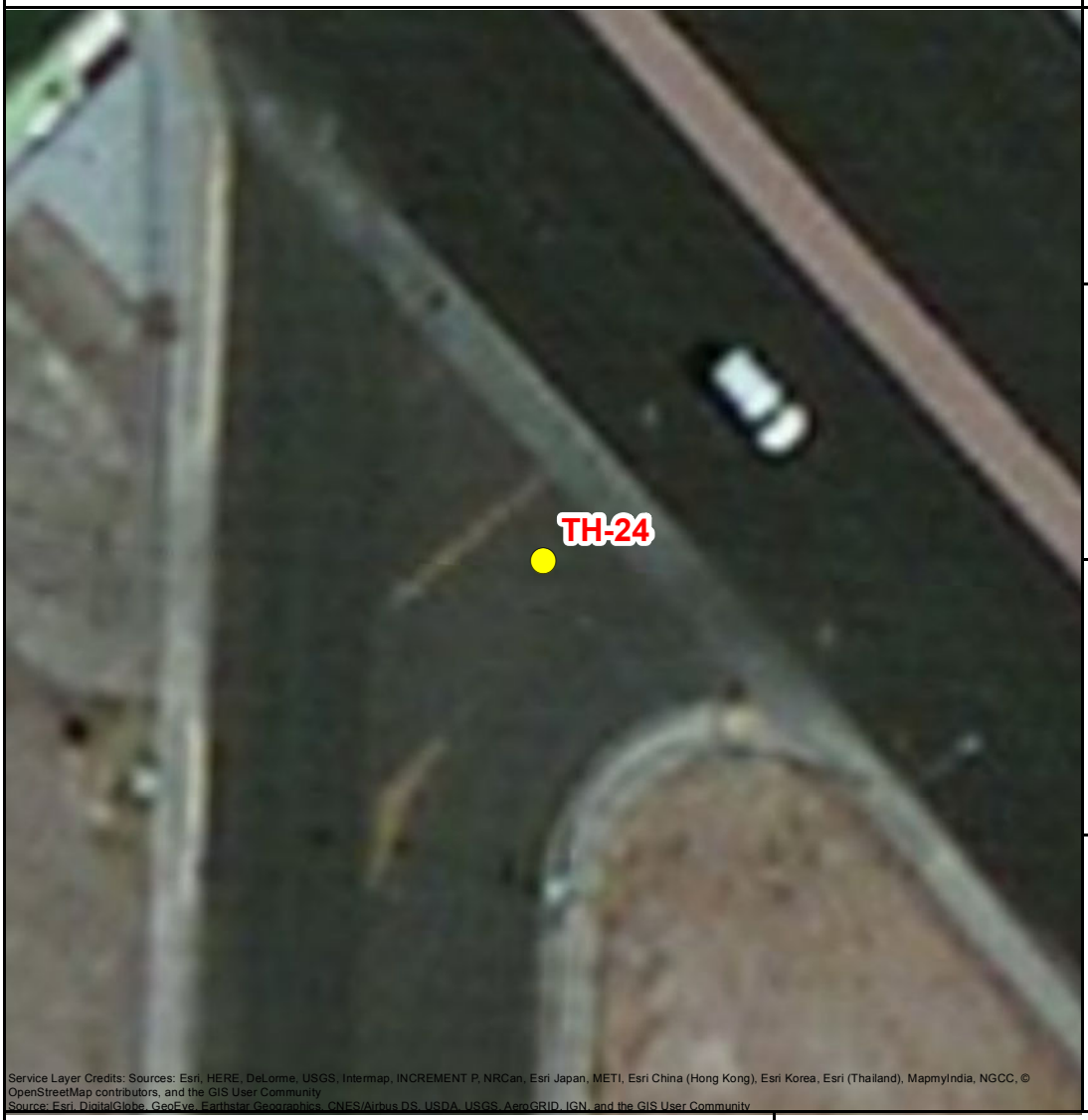
Utility Type:	Water	**Utility Size:**	16 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	10 Inches	**Marker Type:**	Disk
Depth to Top:	5.29	**Top Ref. Level:**	10.50	**Hand Meas. Top:**	5.29
Depth to Bottom:	6.62	**Bot. Ref. Level:**	11.83	**Hand Meas. Bot:**	N/A
Top Elevation:	1850.861	**Mkr. Ref. Level:**	5.21	**Ref. Elevation:**	1856.151
Bottom Elevation:	1849.531	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1


Picture #2


Picture #3


Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	25.50
B	Street Light	57.10
C	Fire Hydrant	62.40

General Notes About This Test Hole

Pinned pipe on south leg of 45 degree angle. 45 degree bend is encased in concrete.

Exposed 16" & end of concrete encase. Edge of encase Is 6' N of pin.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-25	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/2/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

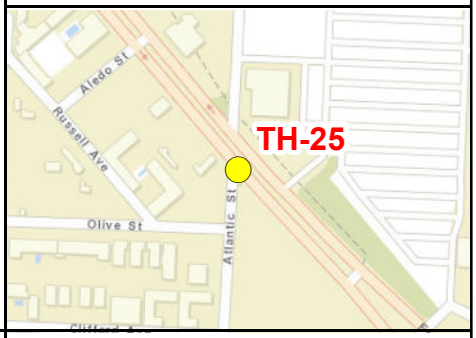
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Phone: 702-966-4063

Test Hole Data

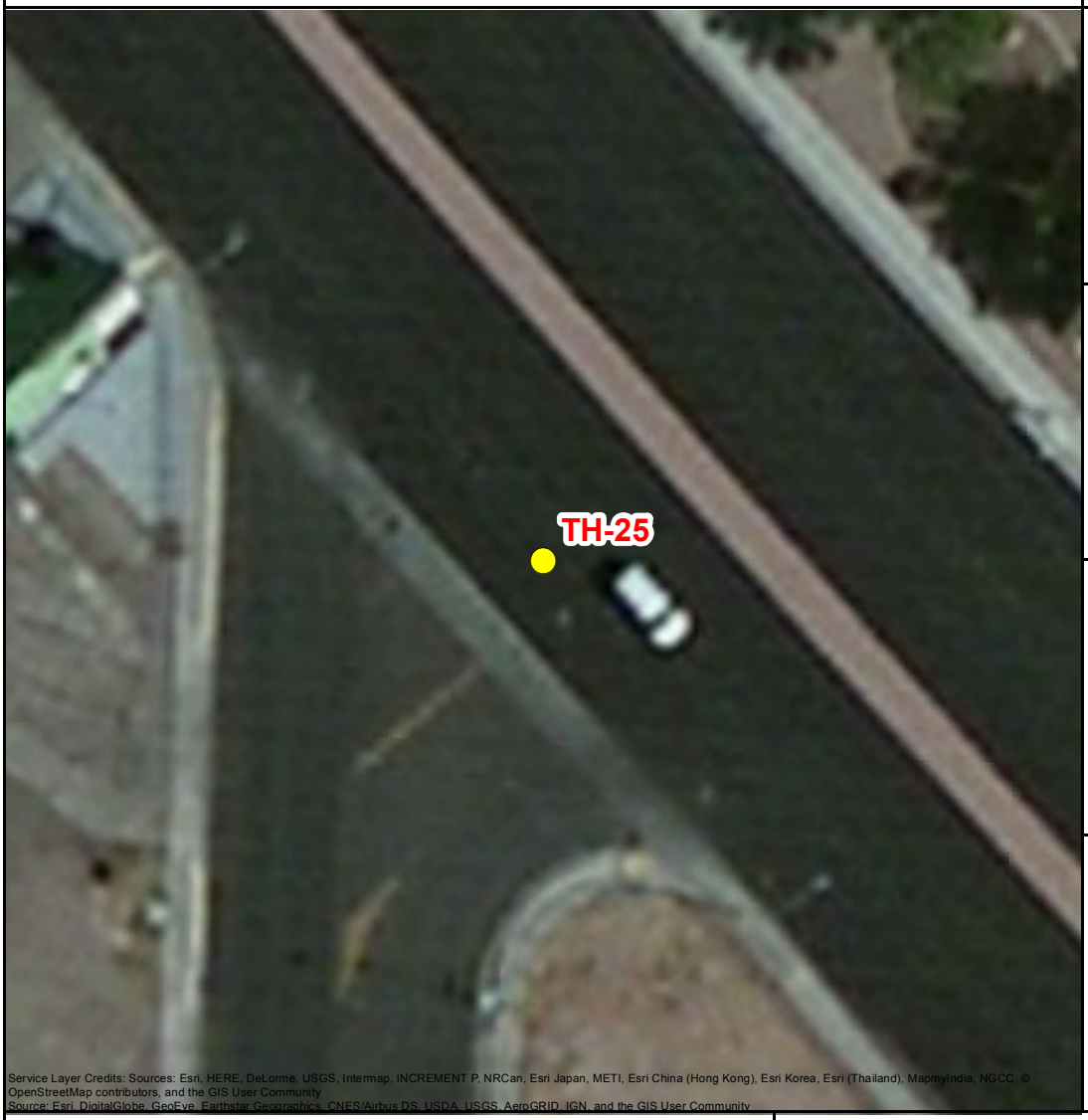
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	Nail
Depth to Top:	5.57	**Top Ref. Level:**	10.30	**Hand Meas. Top:**	5.58
Depth to Bottom:	8.07	**Bot. Ref. Level:**	12.80	**Hand Meas. Bot:**	N/A
Top Elevation:	1851.062	**Mkr. Ref. Level:**	4.73	**Ref. Elevation:**	1856.632
Bottom Elevation:	1848.562	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN

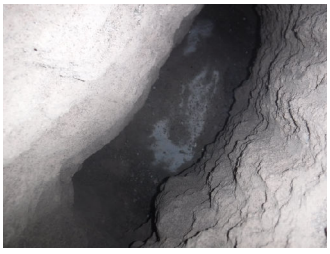


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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	77.30
B	Face of median	25.20
C	Water Valve	15.30

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-26	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/2/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

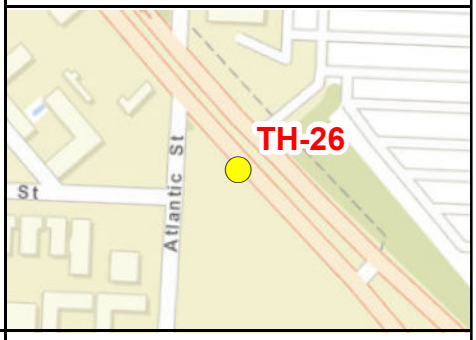
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

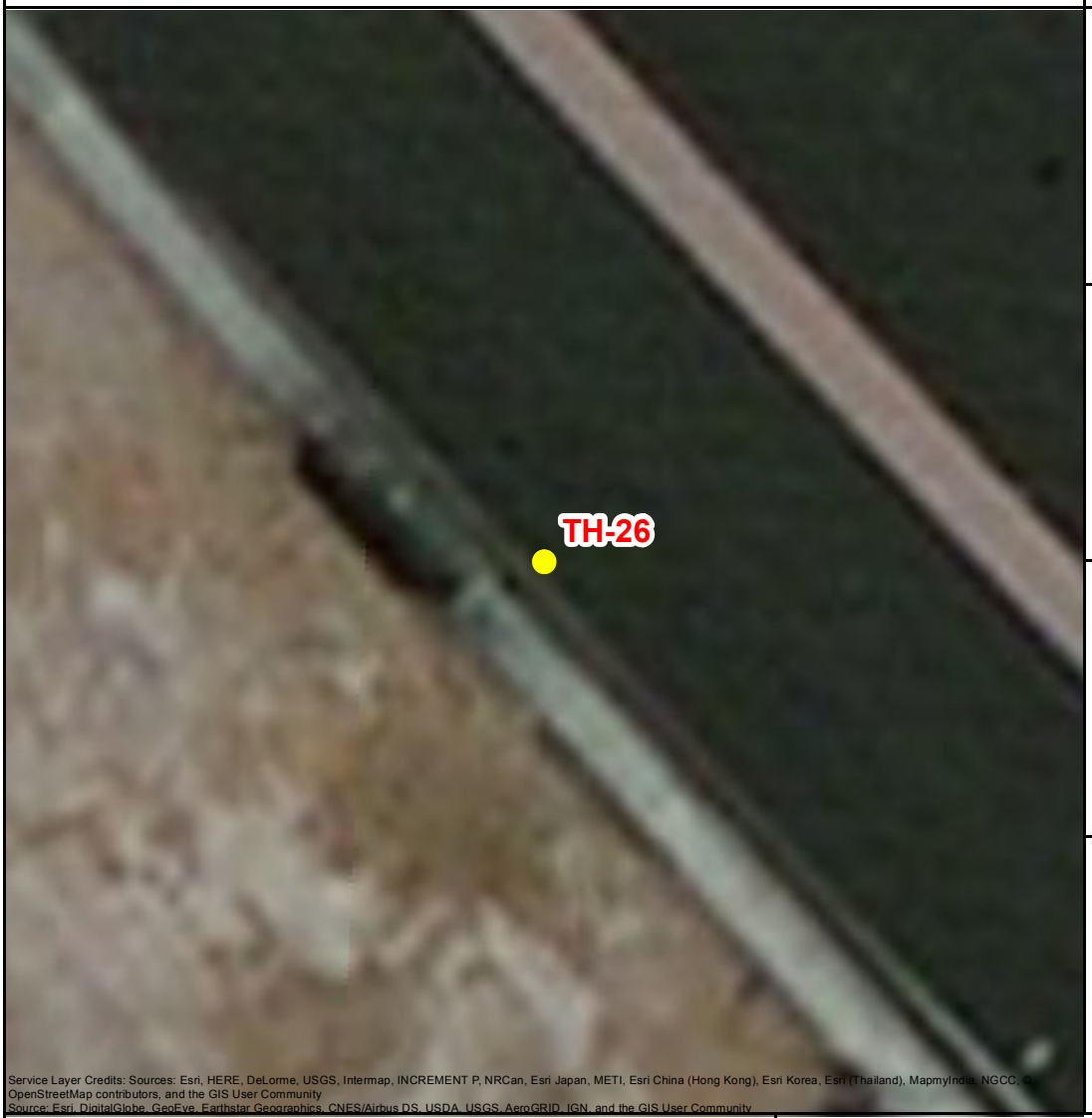
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	Nail
Depth to Top:	4.97	**Top Ref. Level:**	10.22	**Hand Meas. Top:**	4.98
Depth to Bottom:	7.47	**Bot. Ref. Level:**	12.72	**Hand Meas. Bot:**	N/A
Top Elevation:	1850.509	**Mkr. Ref. Level:**	5.25	**Ref. Elevation:**	1855.479
Bottom Elevation:	1848.009	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	4.10
B	Face of median	35.10
C	Street Light Pull Box	12.10

General Notes About This Test Hole

Pinned west edge of 30" pipe from west edge of pipe f.o.c. Is 56.5" west of pin.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-27	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

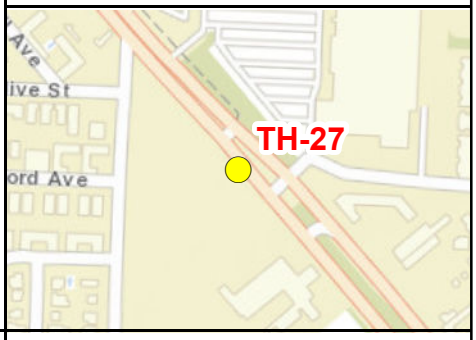
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	5 Inches	**Marker Type:**	X
Depth to Top:	5.55	**Top Ref. Level:**	10.41	**Hand Meas. Top:**	5.56
Depth to Bottom:	8.05	**Bot. Ref. Level:**	12.91	**Hand Meas. Bot:**	N/A
Top Elevation:	1848.391	**Mkr. Ref. Level:**	4.86	**Ref. Elevation:**	1853.941
Bottom Elevation:	1845.891	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	25.40
B	Face of median	67.20
C	Street Light	92.10

General Notes About This Test Hole

Pinned east edge of 30" pipe. Face of curb is 38" east of east edge.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-28	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

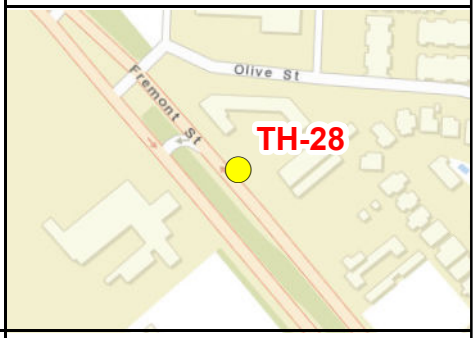
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

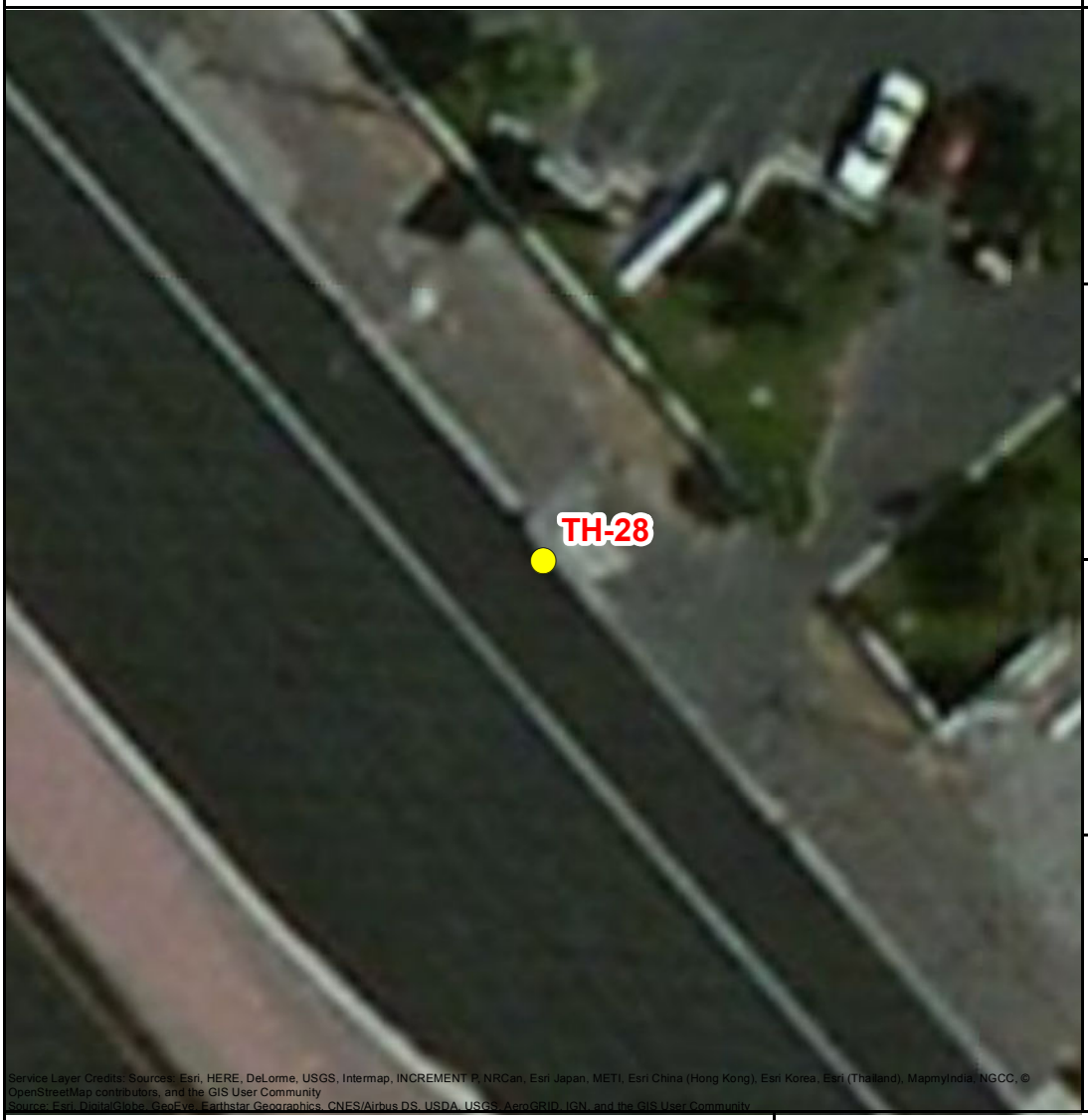
Utility Type:	ITS	**Utility Size:**	4 Inches	**Utility Material:**	Plastic
Utility Company:	City of Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	1.91	**Top Ref. Level:**	6.82	**Hand Meas. Top:**	3.91
Depth to Bottom:	2.24	**Bot. Ref. Level:**	7.15	**Hand Meas. Bot:**	N/A
Top Elevation:	1849.435	**Mkr. Ref. Level:**	4.91	**Ref. Elevation:**	1851.345
Bottom Elevation:	1849.102	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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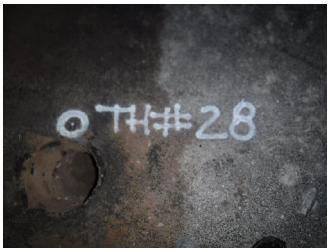
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	TS Pull Box	7.40
B	Face of Median	68.20
C	Fire Hydrant	38.10

General Notes About This Test Hole

Also found 2" plastic running w/ 4" ITS. Found 2" @ 2.18'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-29	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

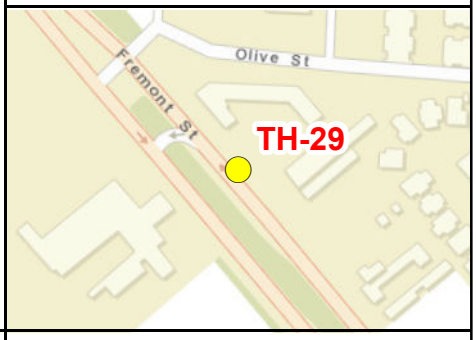
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

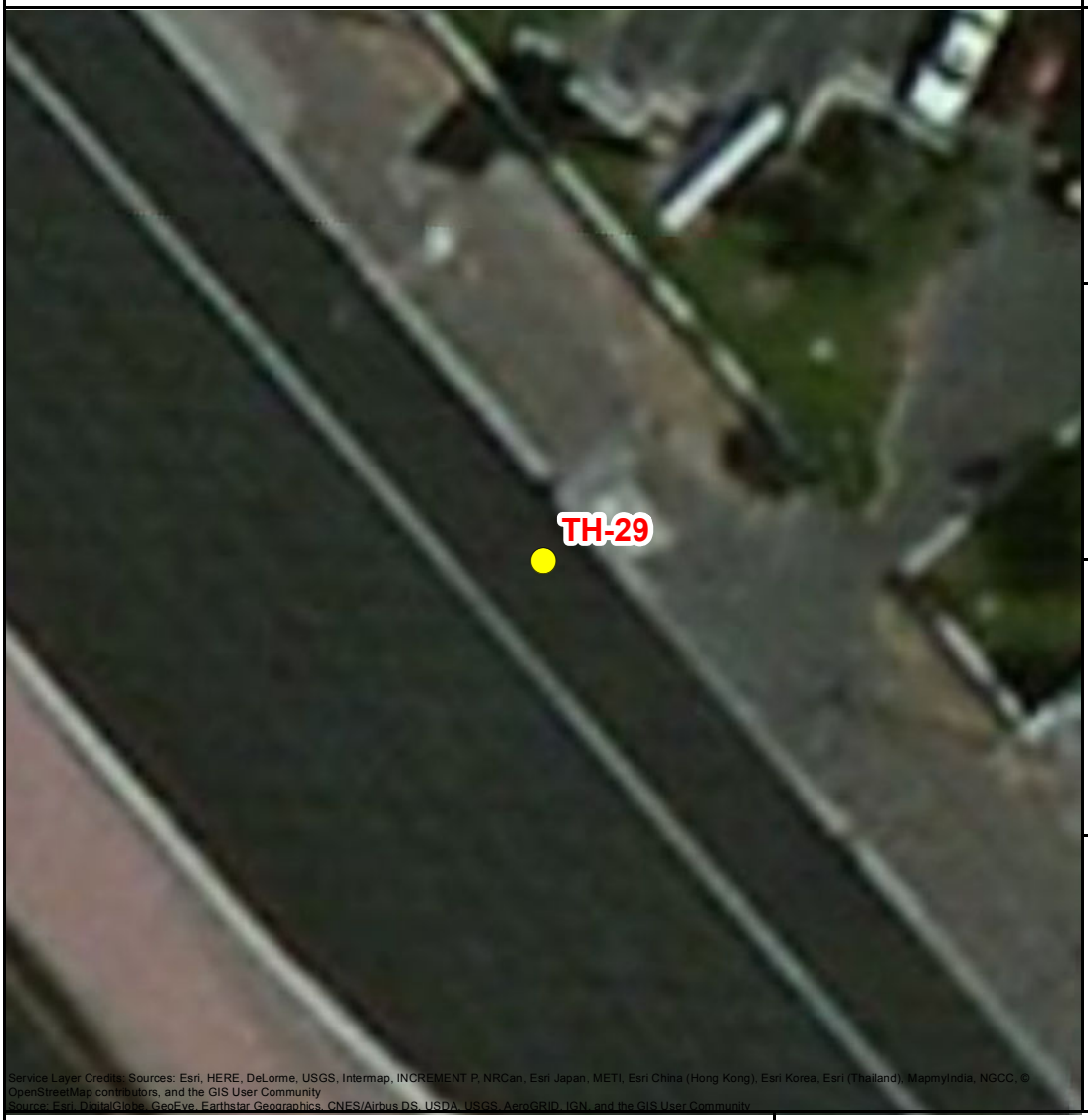
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	4.62	**Top Ref. Level:**	9.20	**Hand Meas. Top:**	4.62
Depth to Bottom:	5.29	**Bot. Ref. Level:**	9.87	**Hand Meas. Bot:**	N/A
Top Elevation:	1847.043	**Mkr. Ref. Level:**	4.58	**Ref. Elevation:**	1851.663
Bottom Elevation:	1846.373	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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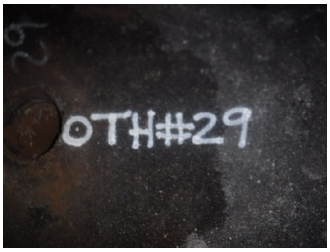
Overall Location of Test Hole



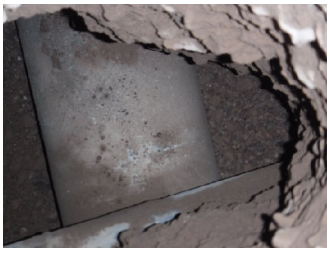
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	TS Pull Box	15.80
B	Face of median	60.00
C	Fire Hydrant	40.00

General Notes About This Test Hole

Also found 4" running East and West. Found 4" @ 3.82'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-30	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

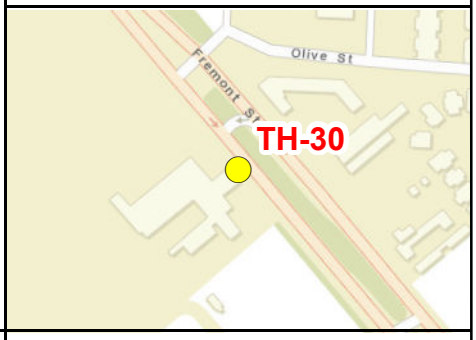
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	6 Inches	**Marker Type:**	X
Depth to Top:	5.62	**Top Ref. Level:**	10.60	**Hand Meas. Top:**	5.63
Depth to Bottom:	8.12	**Bot. Ref. Level:**	13.1	**Hand Meas. Bot:**	N/A
Top Elevation:	1846.079	**Mkr. Ref. Level:**	4.98	**Ref. Elevation:**	1851.699
Bottom Elevation:	1843.579	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN

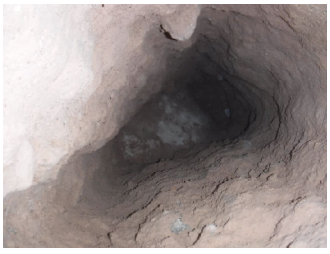


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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	72.20
B	Street Light	40.80
C	Edge of Asphalt	67.20

General Notes About This Test Hole

Exposed and pinned east edge of 30" pipe. F.o.c. is 68" east of east edge of 30" pipe.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-31	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

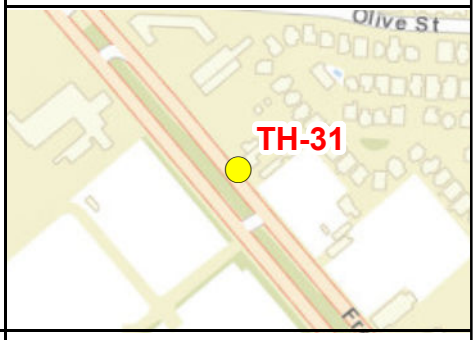
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

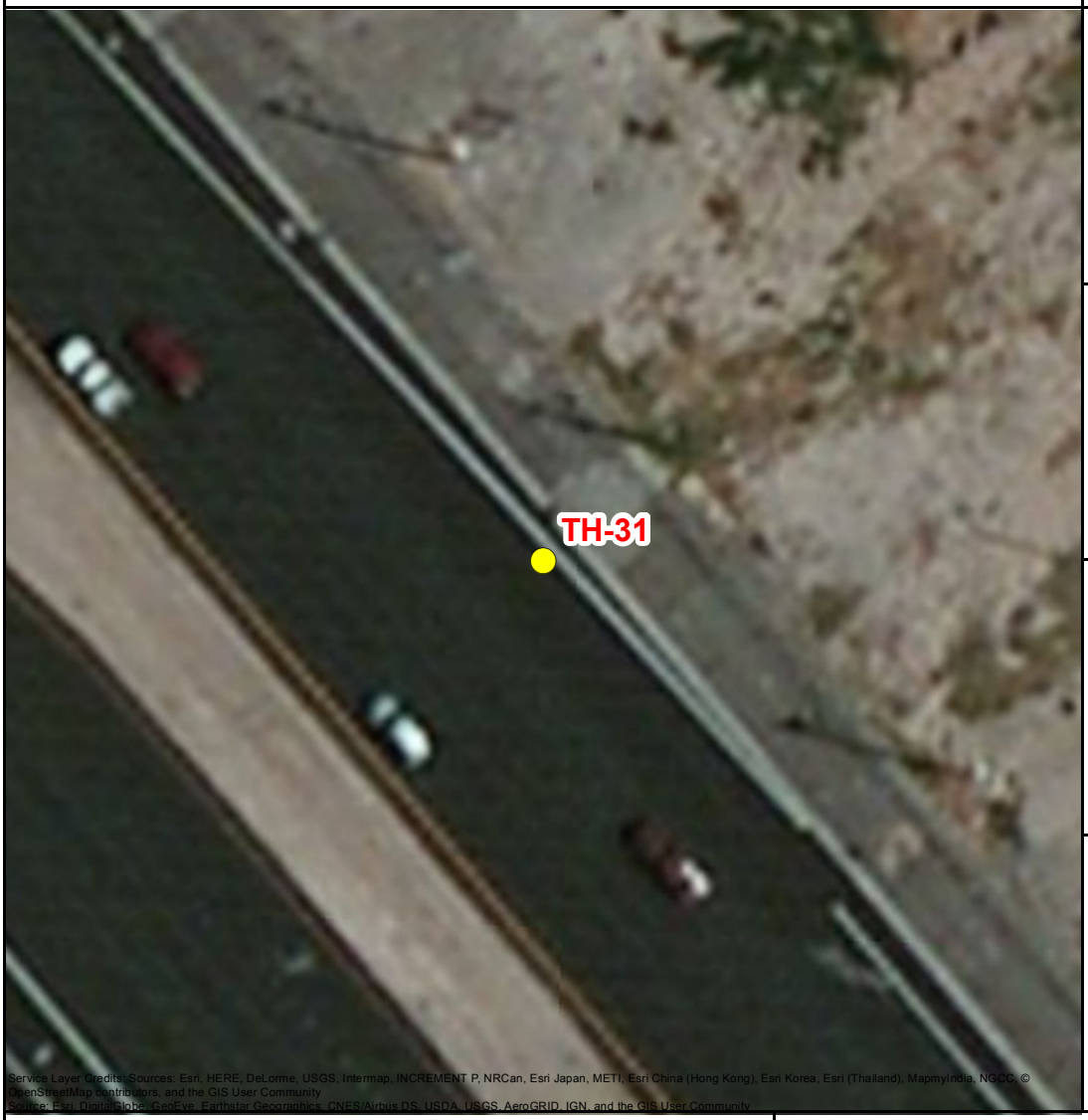
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	Nail
Depth to Top:	6.26	**Top Ref. Level:**	10.57	**Hand Meas. Top:**	6.25
Depth to Bottom:	6.93	**Bot. Ref. Level:**	11.24	**Hand Meas. Bot:**	N/A
Top Elevation:	1842.801	**Mkr. Ref. Level:**	4.31	**Ref. Elevation:**	1849.061
Bottom Elevation:	1842.131	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



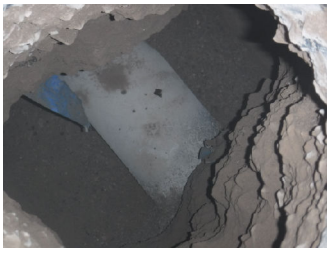
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of Curb	8.60
B	Power Pole	76.10
C	Power Pole	86.10

General Notes About This Test Hole

Hit tear tape 32"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-32	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

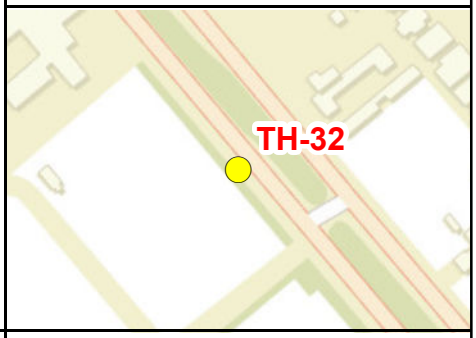
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	7 Inches	**Marker Type:**	X
Depth to Top:	5.73	**Top Ref. Level:**	11.03	**Hand Meas. Top:**	5.74
Depth to Bottom:	8.23	**Bot. Ref. Level:**	13.53	**Hand Meas. Bot:**	N/A
Top Elevation:	1843.873	**Mkr. Ref. Level:**	5.30	**Ref. Elevation:**	1849.603
Bottom Elevation:	1841.373	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



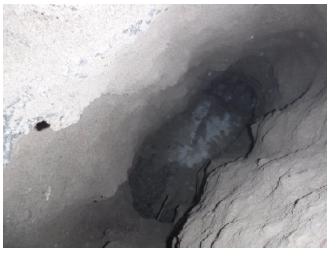
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Manhole	24.10
B	Storm Drain Inlet	5.80
C	Street Light	9.10

General Notes About This Test Hole

Exposed and pinned east edge of 30" pipe. F.o.c. is 68" east of east edge of 30" pipe.

Also found 1.5" pvc W 2.08'

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-33	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

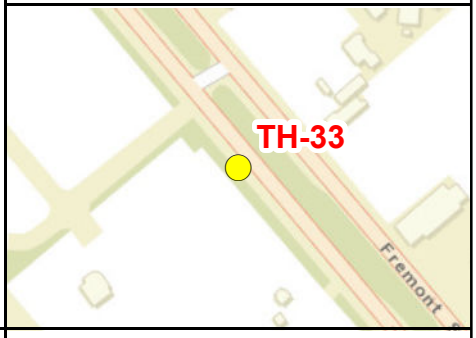
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Natural Ground	**Thickness:**	N/A	**Marker Type:**	Rebar and Cap
Depth to Top:	5.30	**Top Ref. Level:**	10.60	**Hand Meas. Top:**	5.3
Depth to Bottom:	7.80	**Bot. Ref. Level:**	13.10	**Hand Meas. Bot:**	N/A
Top Elevation:	1842.239	**Mkr. Ref. Level:**	5.30	**Ref. Elevation:**	1847.539
Bottom Elevation:	1839.739	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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

TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3



Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	55.20
B	Storm Drain Inlet	8.20
C	Street Light	20.40

General Notes About This Test Hole

Exposed crown & east edge of 30" pinned east edge. F.o.c is 81" east of east edge of 30" pipe. 5" running E&W . Found 5" od clay pipe in this hole W 6.64'. Found 1.5" pvc pipe in this hole @ 2.26'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-34	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

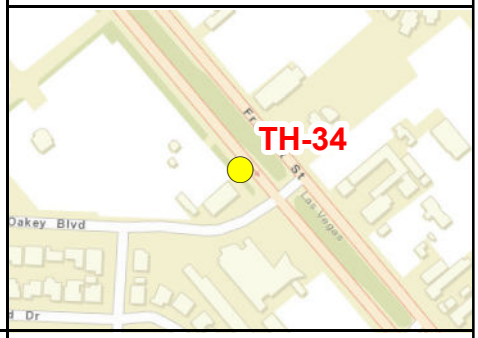
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

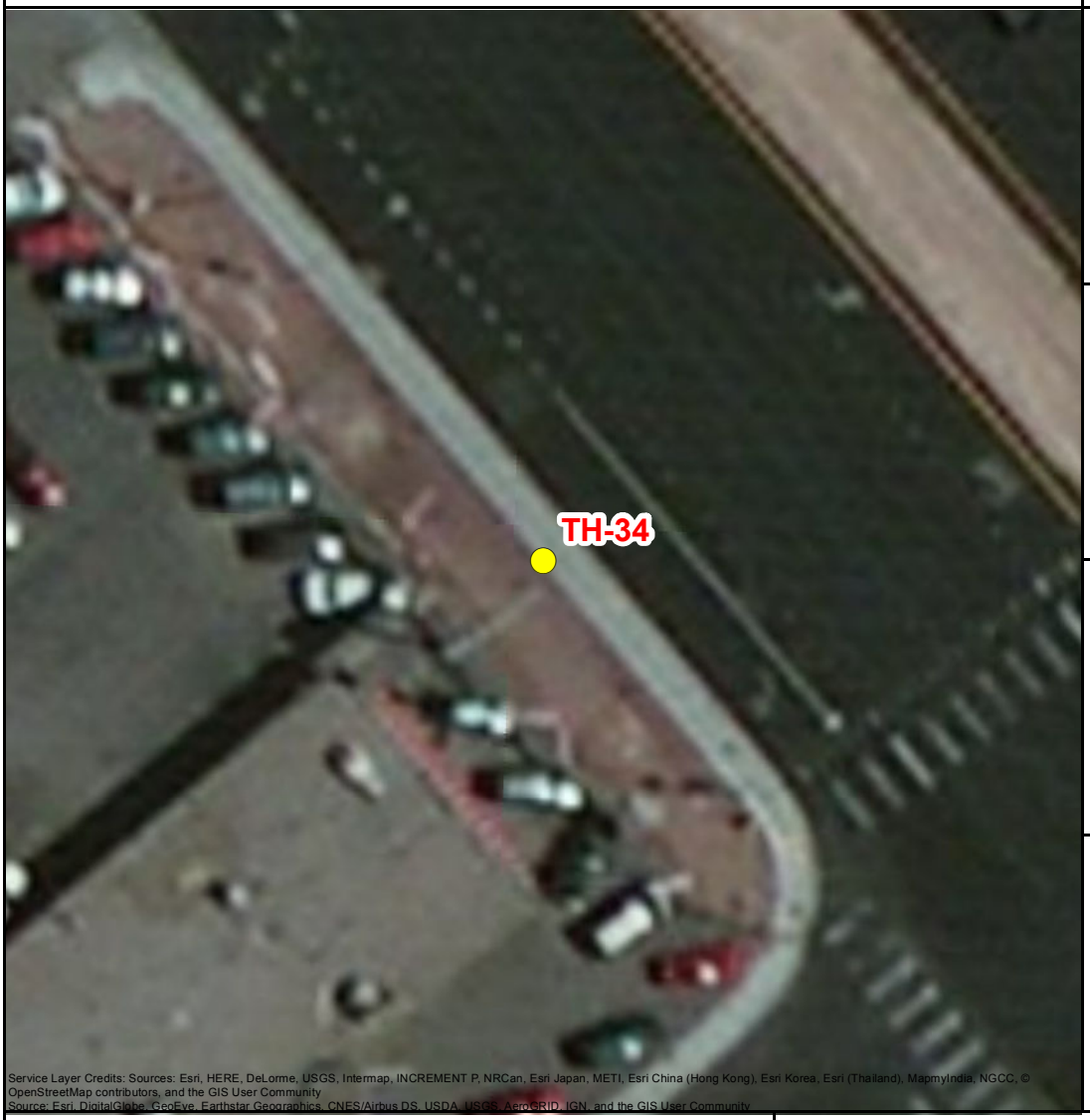
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Natural Ground	**Thickness:**	N/A	**Marker Type:**	Rebar
Depth to Top:	4.60	**Top Ref. Level:**	9.97	**Hand Meas. Top:**	4.6
Depth to Bottom:	7.10	**Bot. Ref. Level:**	12.47	**Hand Meas. Bot:**	N/A
Top Elevation:	1840.654	**Mkr. Ref. Level:**	5.37	**Ref. Elevation:**	1845.254
Bottom Elevation:	1838.154	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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Overall Location of Test Hole



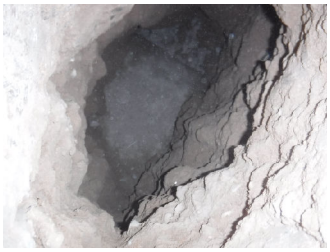
TEST HOLE LOCATION PLAN



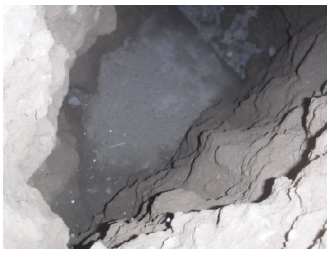
TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3



Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	62.90
B	Edge of Asphalt	78.10
C	Street Light	49.80

General Notes About This Test Hole

Exposed crown & east edge of 30" pinned east edge. F.o.c is 76" east of east edge of 30" pipe.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-35	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/4/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

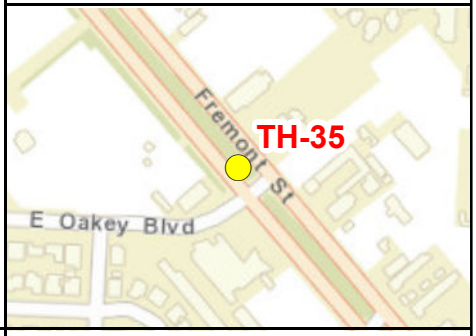
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

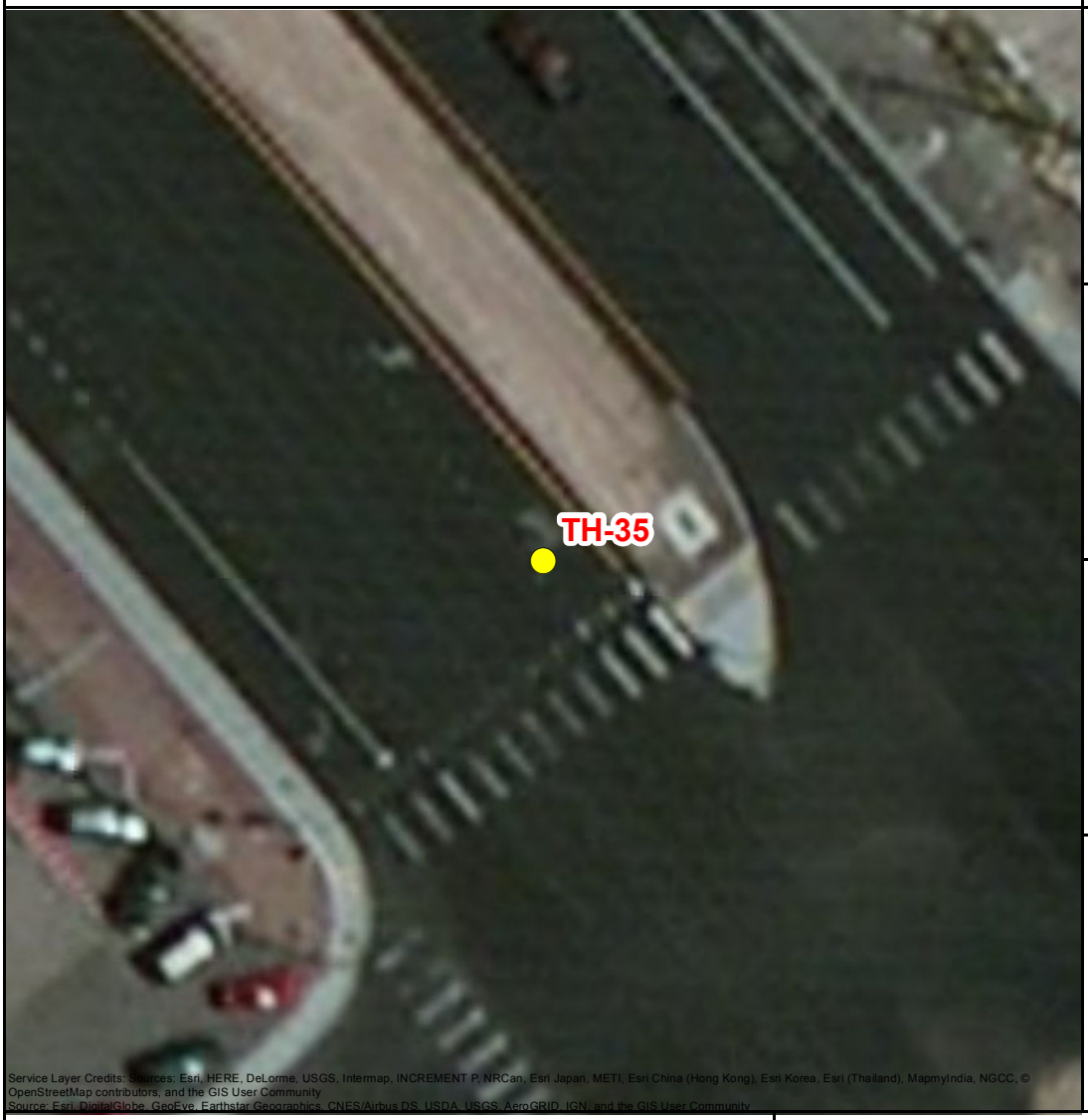
Utility Type:	Electric	**Utility Size:**	N/A	**Utility Material:**	N/A
Utility Company:	NVE	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	N/A	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	11.90
Depth to Bottom:	N/A	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	N/A	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1845.159
Bottom Elevation:	N/A	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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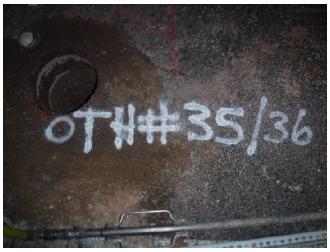
Overall Location of Test Hole



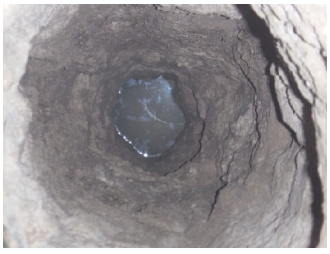
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Telephone Pole	82.30
B	Edge of Asphalt	13.10
C	Face of curb	58.30

General Notes About This Test Hole

Unable to expose pipe due to water filling hole, probed down and felt what seem to be a concrete encasement. See pictures

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-36	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/4/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

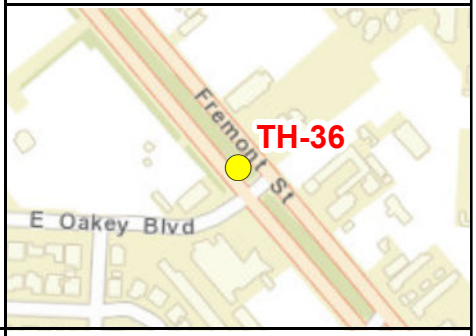
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

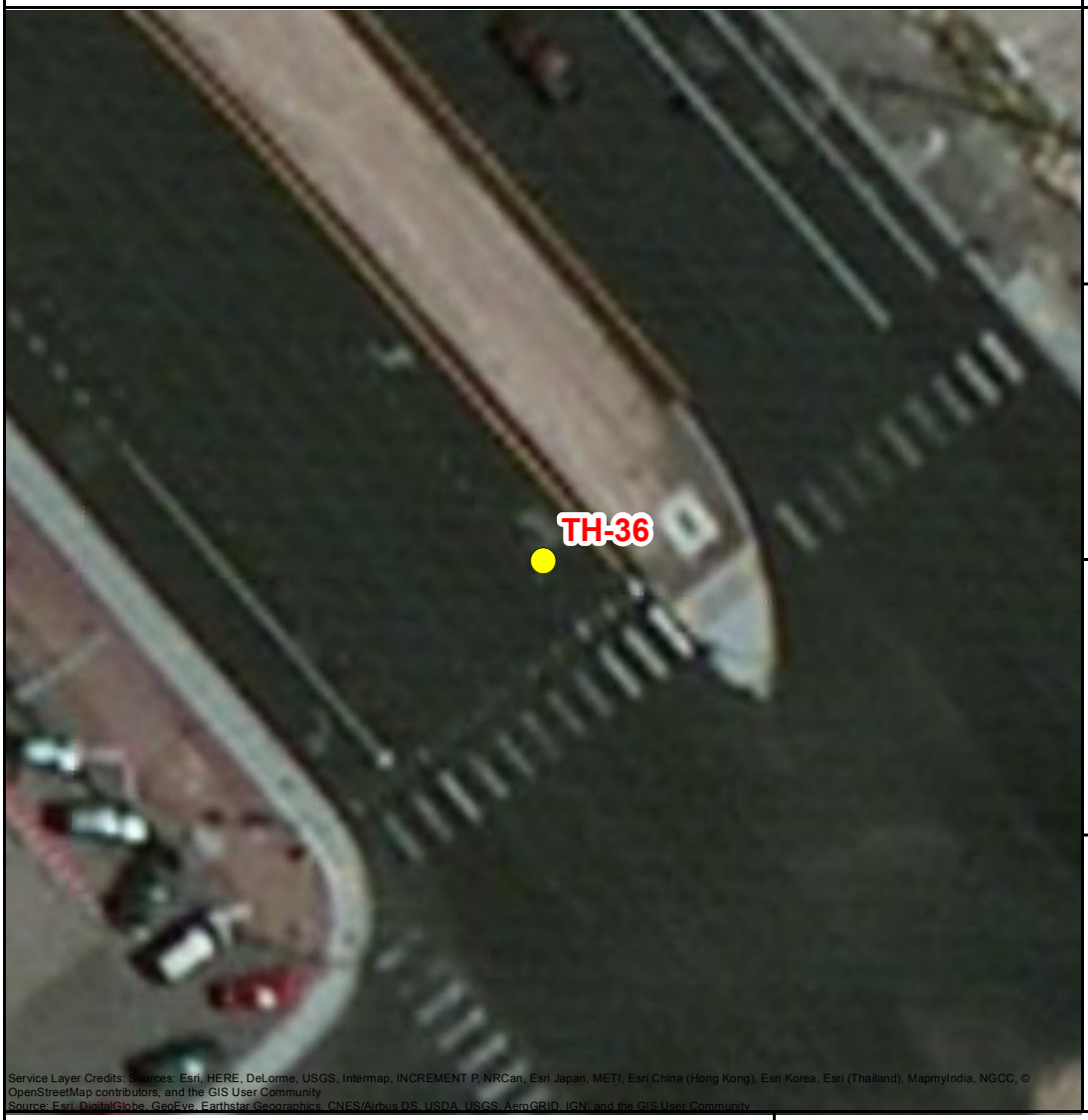
Utility Type:	Electric	**Utility Size:**	N/A	**Utility Material:**	N/A
Utility Company:	NVE	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	N/A	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	11.90
Depth to Bottom:	N/A	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	N/A	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1845.159
Bottom Elevation:	N/A	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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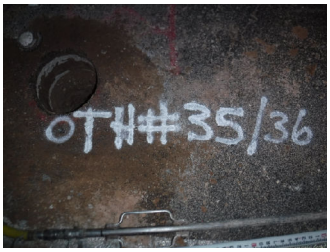
Overall Location of Test Hole



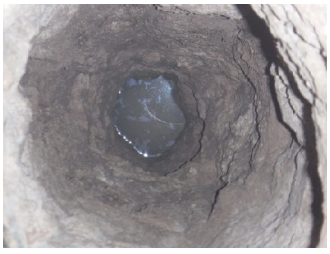
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Telephone Pole	82.30
B	Edge of Asphalt	13.10
C	Face of curb	58.30

General Notes About This Test Hole

Unable to expose pipe due to water filling hole, probed down and felt what seem to be a concrete encasement. See pictures

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-37	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

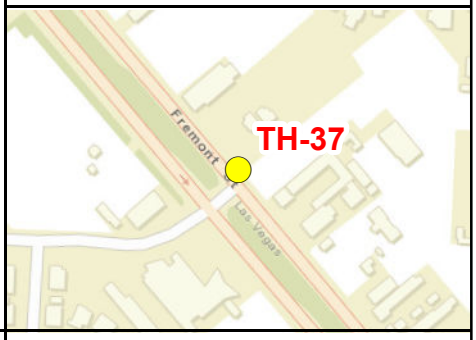
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

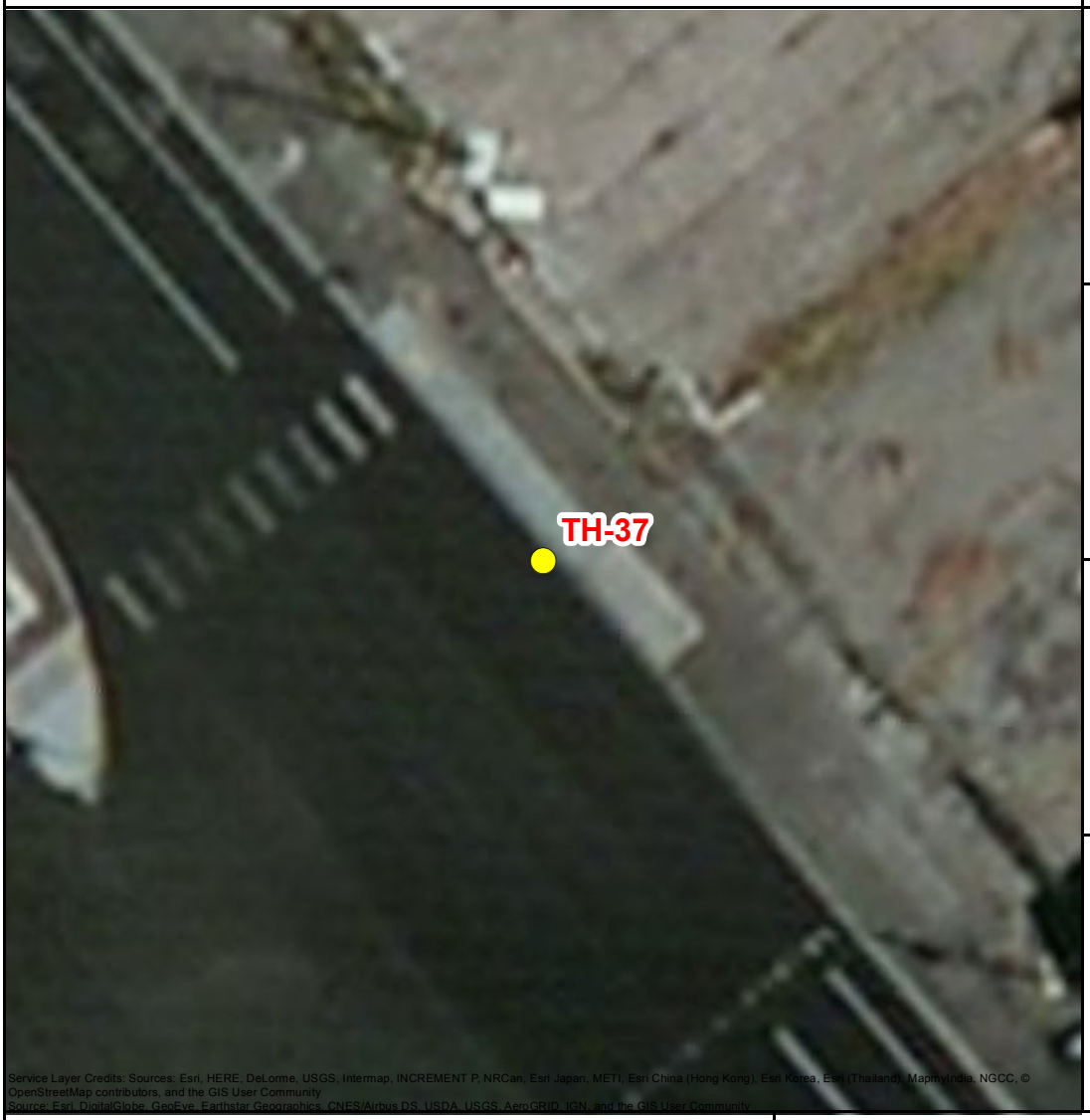
Utility Type:	ITS	**Utility Size:**	4 Inches	**Utility Material:**	Concrete
Utility Company:	City of Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	Nail
Depth to Top:	3.01	**Top Ref. Level:**	7.19	**Hand Meas. Top:**	3.01
Depth to Bottom:	3.34	**Bot. Ref. Level:**	7.52	**Hand Meas. Bot:**	N/A
Top Elevation:	1840.563	**Mkr. Ref. Level:**	4.18	**Ref. Elevation:**	1843.573
Bottom Elevation:	1840.233	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

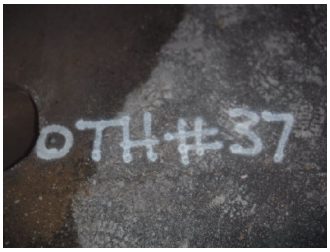
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Nose of Median	66.10
B	Face of Curb	3.10
C	Fire Hydrant	70.50

General Notes About This Test Hole

Hit tear tape 23"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-38	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

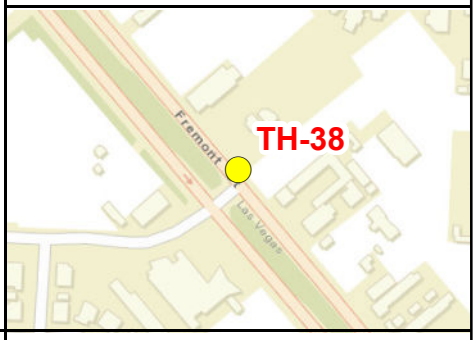
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

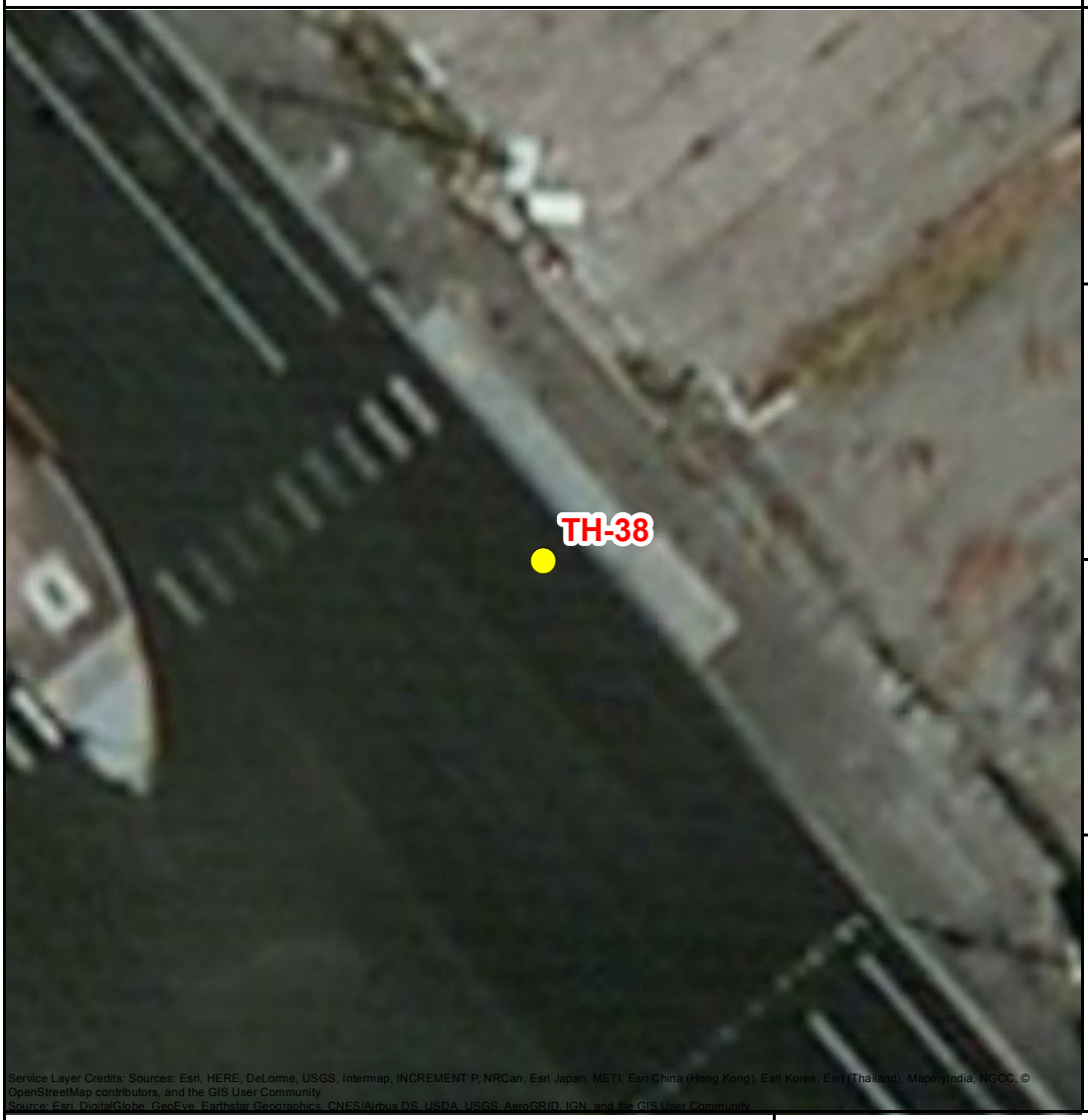
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	Nail
Depth to Top:	4.25	**Top Ref. Level:**	8.14	**Hand Meas. Top:**	4.26
Depth to Bottom:	4.92	**Bot. Ref. Level:**	8.81	**Hand Meas. Bot:**	N/A
Top Elevation:	1839.607	**Mkr. Ref. Level:**	3.89	**Ref. Elevation:**	1843.857
Bottom Elevation:	1838.937	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



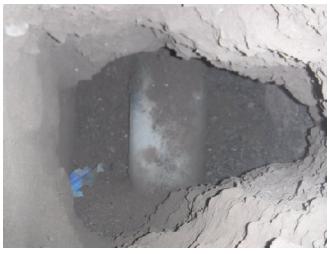
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Nose of Median	72.40
B	Face of Curb	8.00
C	Fire Hydrant	65.40

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-39	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

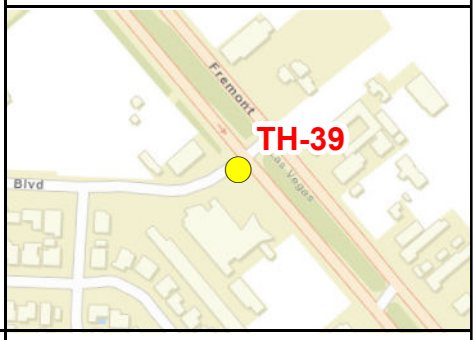
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

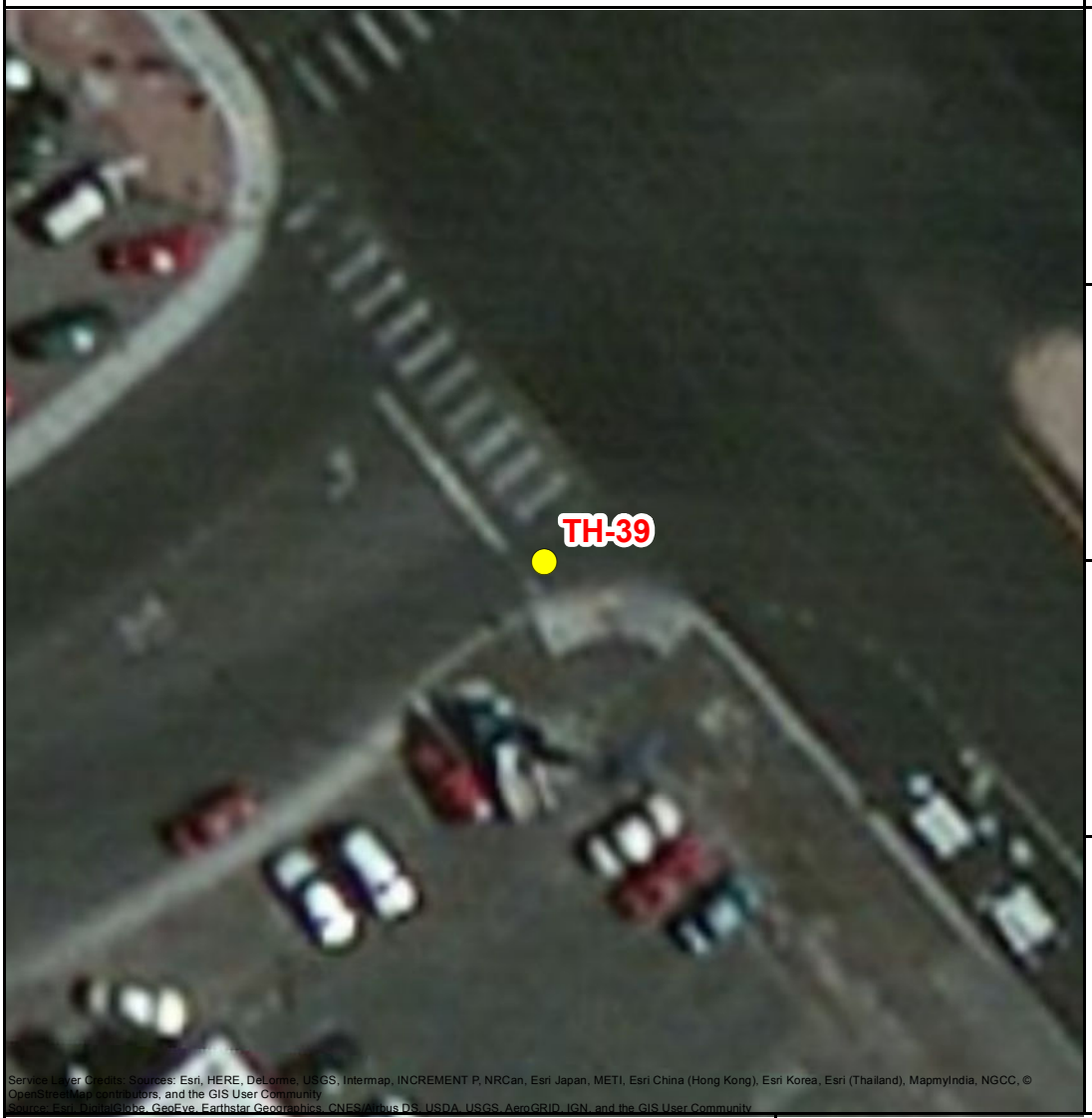
Utility Type:	Gas	**Utility Size:**	1.25 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Slurry
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	Nail
Depth to Top:	2.53	**Top Ref. Level:**	7.82	**Hand Meas. Top:**	2.54
Depth to Bottom:	2.634	**Bot. Ref. Level:**	7.924	**Hand Meas. Bot:**	N/A
Top Elevation:	1841.836	**Mkr. Ref. Level:**	5.29	**Ref. Elevation:**	1844.366
Bottom Elevation:	1841.732	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

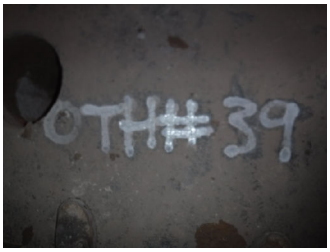
Overall Location of Test Hole



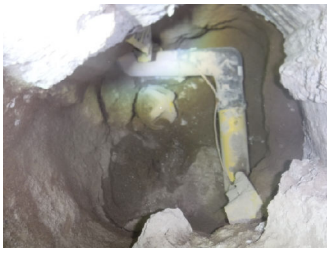
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	70.50
B	Street Light	39.60
C	Power Pole	74.60

General Notes About This Test Hole

Pinned center of angle point 10" slurry

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-40	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

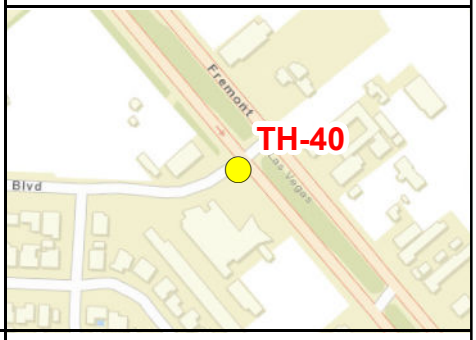
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

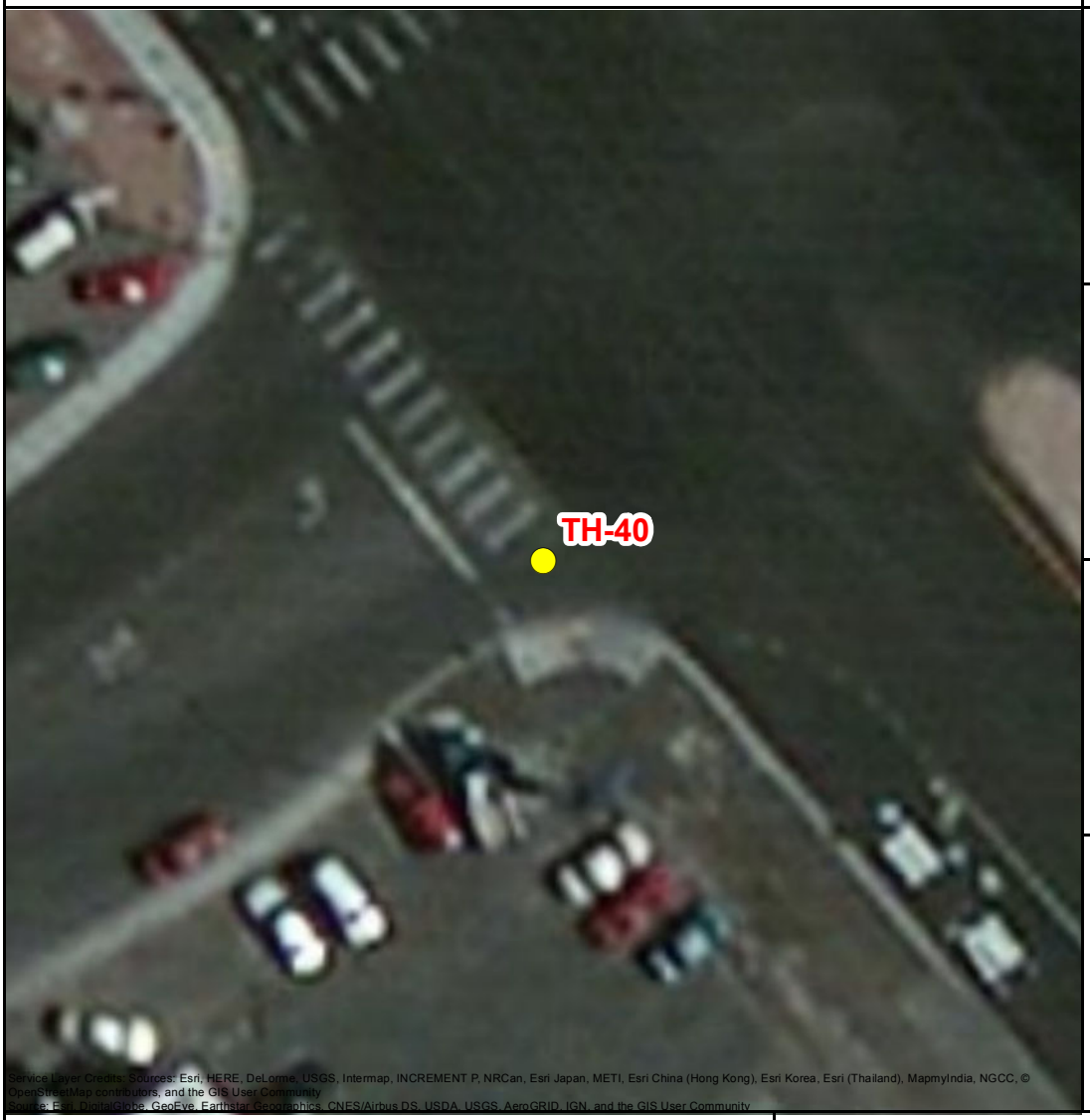
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Clay
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	Nail
Depth to Top:	6.36	**Top Ref. Level:**	11.74	**Hand Meas. Top:**	6.36
Depth to Bottom:	8.86	**Bot. Ref. Level:**	14.24	**Hand Meas. Bot:**	N/A
Top Elevation:	1837.917	**Mkr. Ref. Level:**	5.38	**Ref. Elevation:**	1844.277
Bottom Elevation:	1835.417	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	70.50
B	Street Light	46.50
C	Power Pole	74.60

General Notes About This Test Hole

Top of 30"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-40A	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

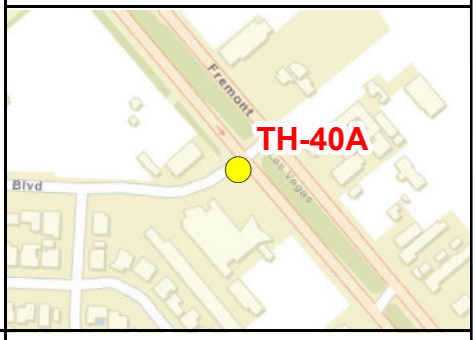
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

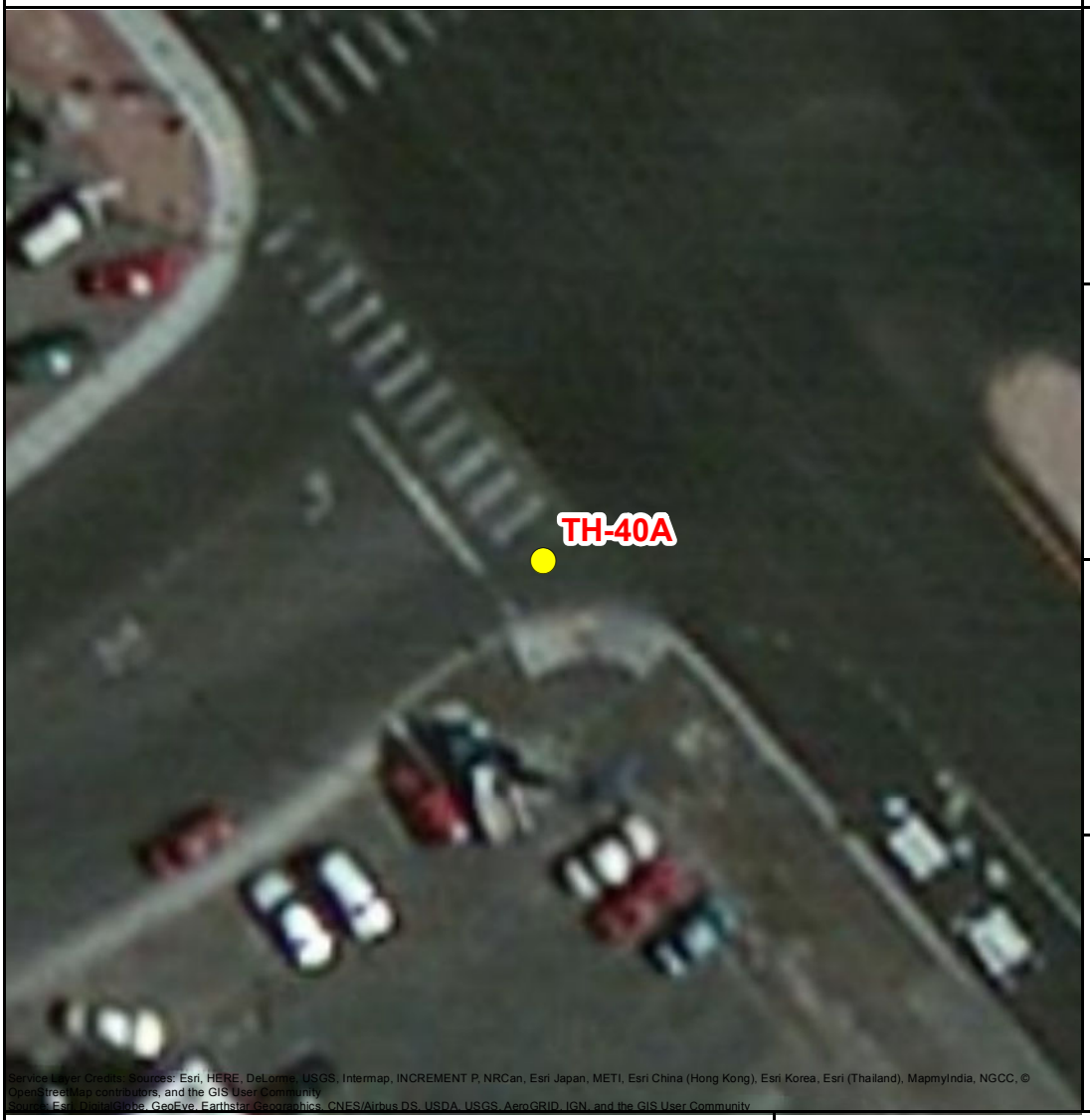
Utility Type:	SD	**Utility Size:**	24 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Sewer	**English/Metric:**	English	**Soil Conditions:**	Clay
Surface Type:	Asphalt	**Thickness:**	N/A	**Marker Type:**	Nail
Depth to Top:	1.37	**Top Ref. Level:**	6.72	**Hand Meas. Top:**	1.37
Depth to Bottom:	3.37	**Bot. Ref. Level:**	8.72	**Hand Meas. Bot:**	N/A
Top Elevation:	1842.943	**Mkr. Ref. Level:**	5.35	**Ref. Elevation:**	1844.313
Bottom Elevation:	1840.943	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	70.50
B	Street Light	44.70
C	Power Pole	74.60

General Notes About This Test Hole

SD measured out to 24". Dug on one call marks for 30" water. Found Storm drain.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-41	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/3/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

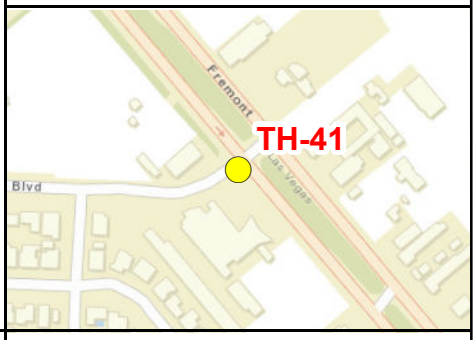
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

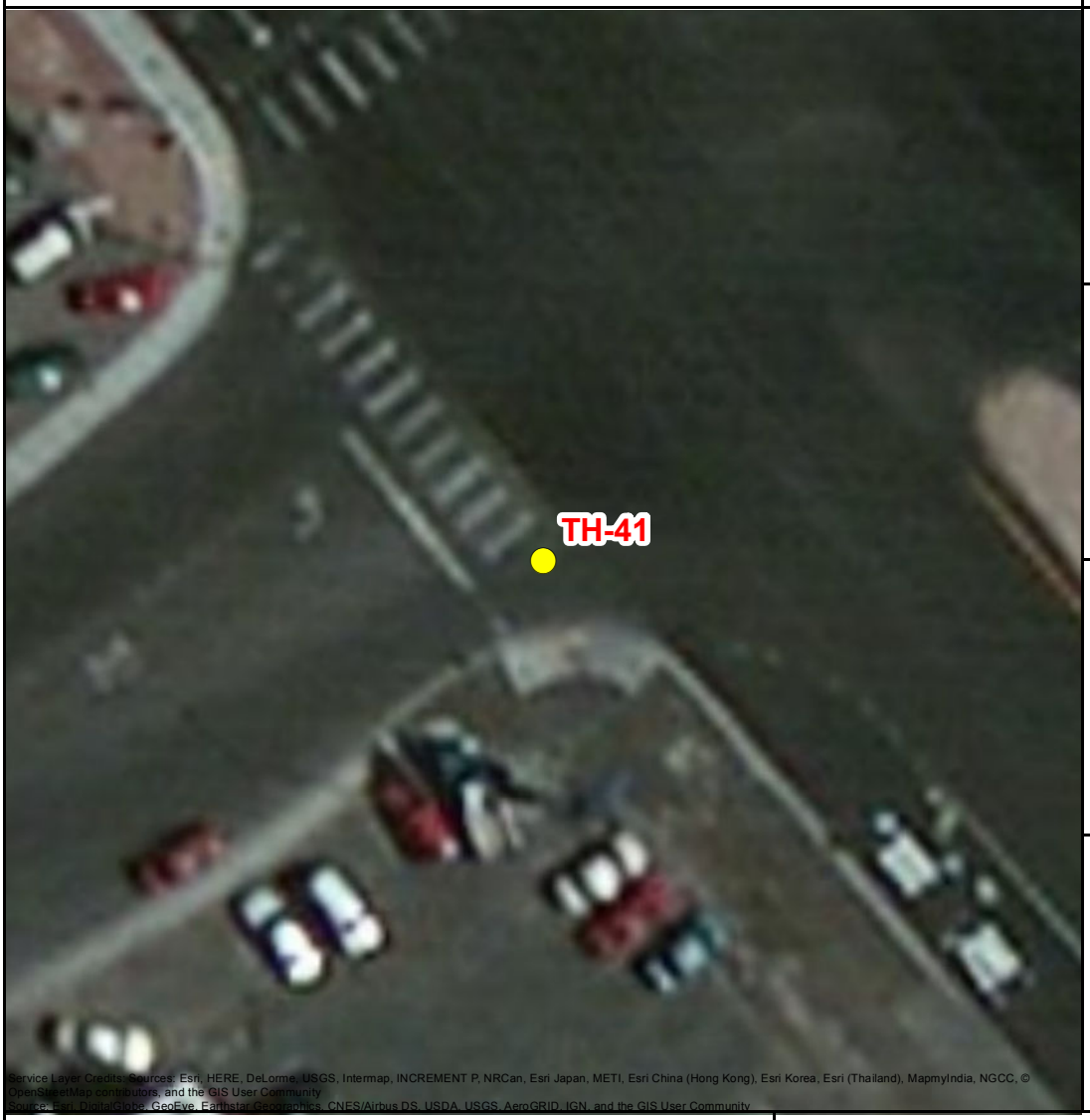
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Clay
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	8.54	**Top Ref. Level:**	13.92	**Hand Meas. Top:**	8.55
Depth to Bottom:	11.04	**Bot. Ref. Level:**	16.42	**Hand Meas. Bot:**	N/A
Top Elevation:	1835.694	**Mkr. Ref. Level:**	5.38	**Ref. Elevation:**	1844.234
Bottom Elevation:	1833.194	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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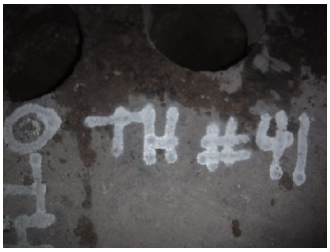
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



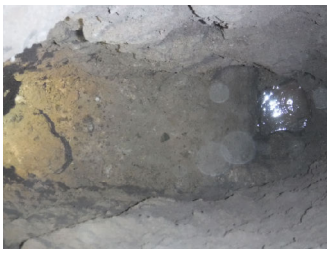
TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	70.50
B	Street Light	47.20
C	Power Pole	74.60

General Notes About This Test Hole

Bottom of 30" pipe

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-42	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

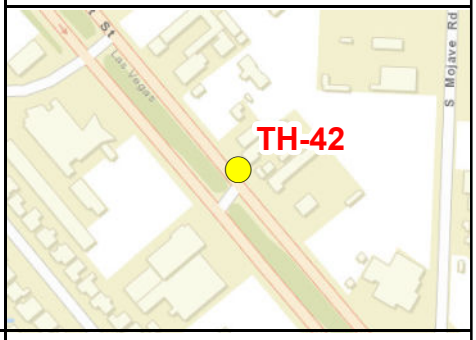
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

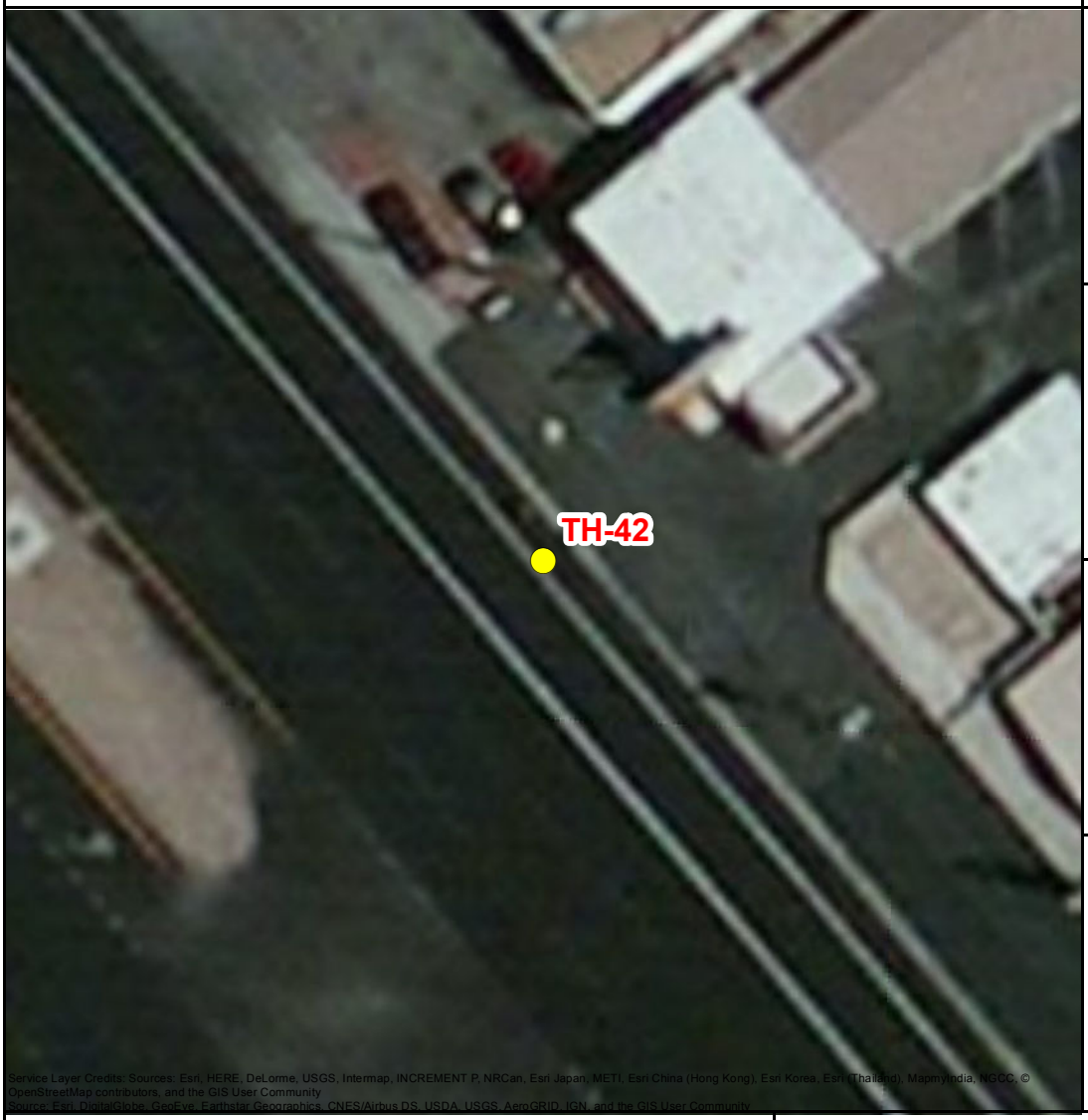
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	4.59	**Top Ref. Level:**	8.53	**Hand Meas. Top:**	4.59
Depth to Bottom:	5.26	**Bot. Ref. Level:**	9.20	**Hand Meas. Bot:**	N/A
Top Elevation:	1835.695	**Mkr. Ref. Level:**	3.94	**Ref. Elevation:**	1840.285
Bottom Elevation:	1835.025	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



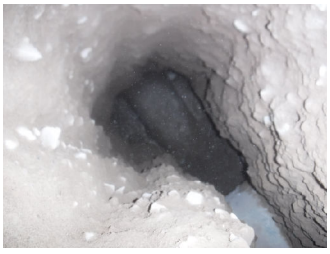
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1


Picture #2


Picture #3


Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	35.20
B	Power Pole	74.20
C	Edge of Asphalt	57.30

General Notes About This Test Hole

SD is 8" South of pin, SD is running east west

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-43	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/4/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

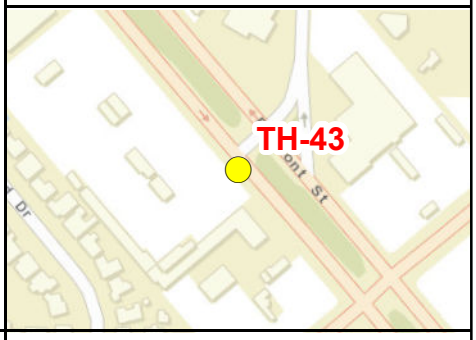
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

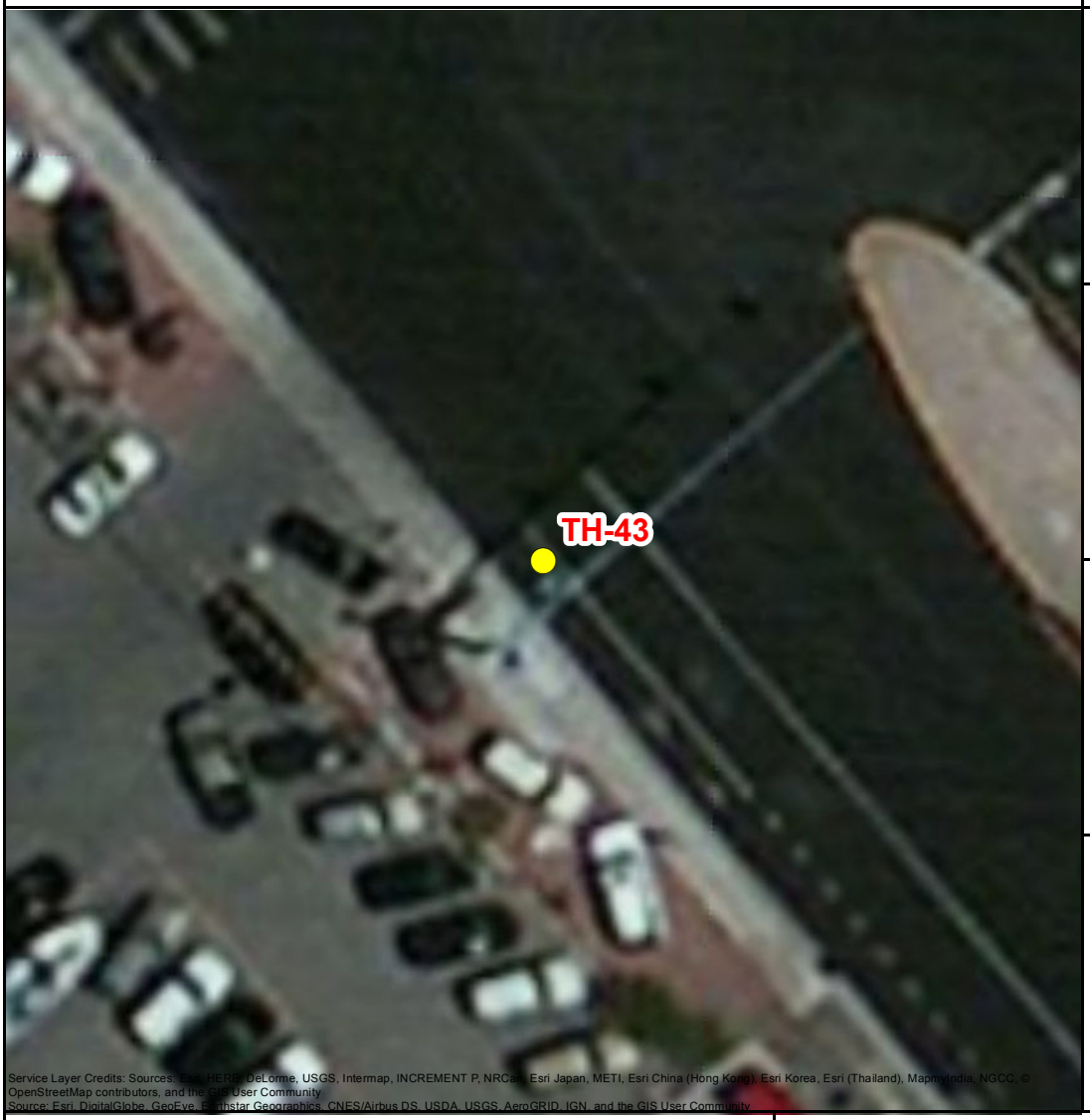
Utility Type:	Water	**Utility Size:**	12 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	12 Inches	**Marker Type:**	Nail
Depth to Top:	7.95	**Top Ref. Level:**	13.75	**Hand Meas. Top:**	7.96
Depth to Bottom:	8.95	**Bot. Ref. Level:**	14.75	**Hand Meas. Bot:**	N/A
Top Elevation:	1827.514	**Mkr. Ref. Level:**	5.80	**Ref. Elevation:**	1835.464
Bottom Elevation:	1826.514	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



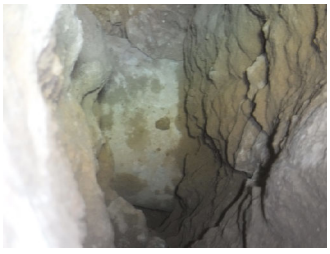
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	9.30
B	Traffic Signal	13.70
C	Face of Median	64.90

General Notes About This Test Hole

Measured out to 12"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-44	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

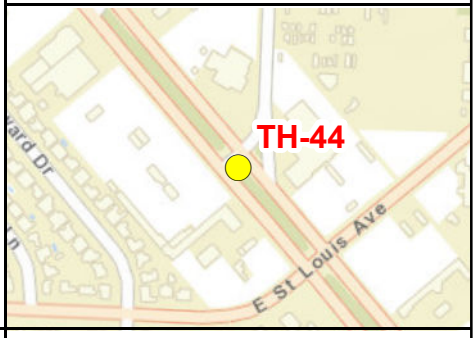
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

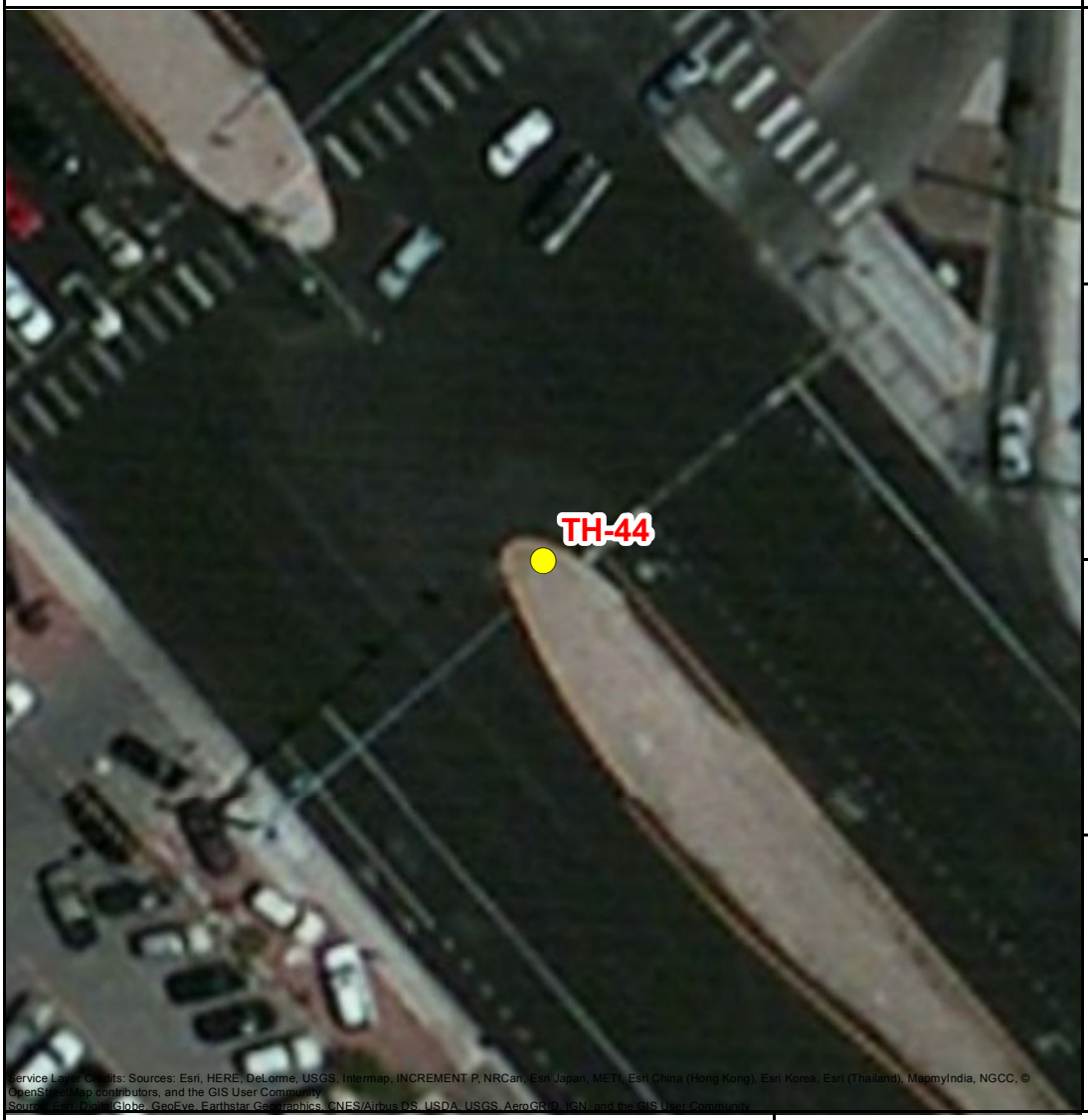
Utility Type:	Water	**Utility Size:**	12 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Natural Ground	**Thickness:**	N/A	**Marker Type:**	Rebar and Cap
Depth to Top:	8.03	**Top Ref. Level:**	12.51	**Hand Meas. Top:**	8.04
Depth to Bottom:	9.03	**Bot. Ref. Level:**	13.51	**Hand Meas. Bot:**	N/A
Top Elevation:	1827.617	**Mkr. Ref. Level:**	4.48	**Ref. Elevation:**	1835.647
Bottom Elevation:	1826.617	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



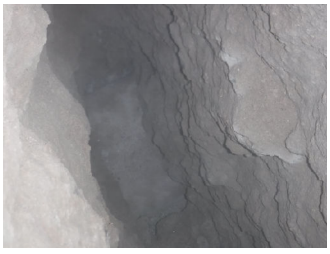
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	73.20
B	Traffic Signal	96.10
C	Nose of Meridian	4.90

General Notes About This Test Hole

12" Concrete (Water)

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-45	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/7/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

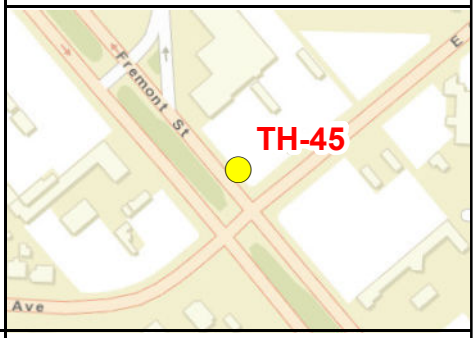
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

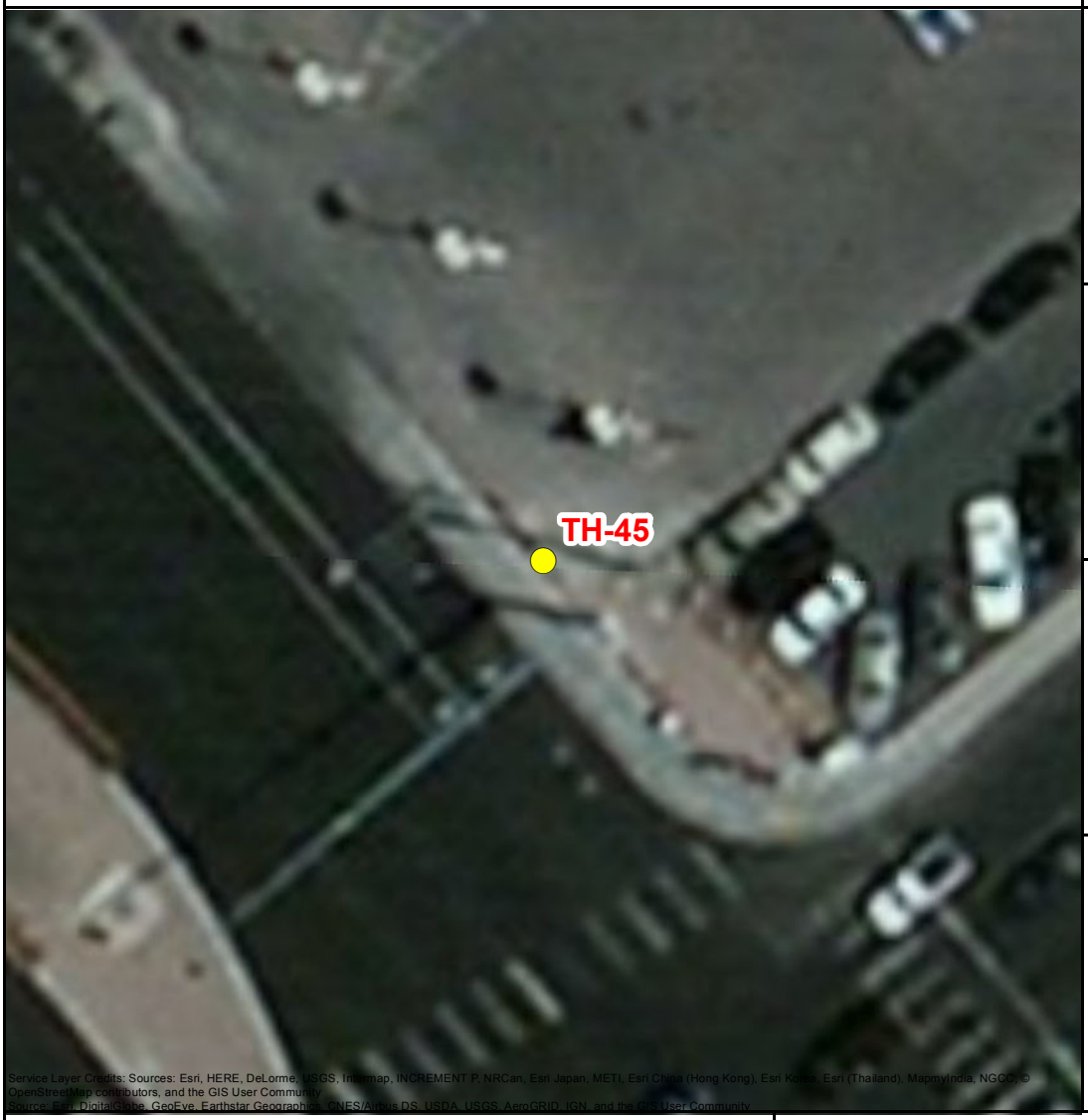
Utility Type:	Telephone	**Utility Size:**	21 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	X
Depth to Top:	5.34	**Top Ref. Level:**	10.60	**Hand Meas. Top:**	5.34
Depth to Bottom:	7.09	**Bot. Ref. Level:**	12.35	**Hand Meas. Bot:**	6.52
Top Elevation:	1826.364	**Mkr. Ref. Level:**	5.26	**Ref. Elevation:**	1831.704
Bottom Elevation:	1824.614	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



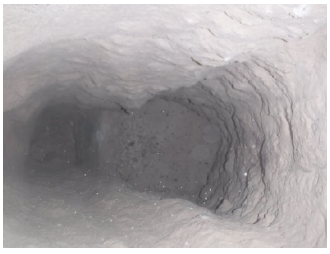
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	8.50
B	Traffic Signal	11.20
C	Face of Median	65.10

General Notes About This Test Hole

45 and 46 are in same encasement exposed west edge of encasement and bottom unable to expose full width due to large rocks, caving in hole. Also found 2 (1") conduits @ 2.02'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-46	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/7/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

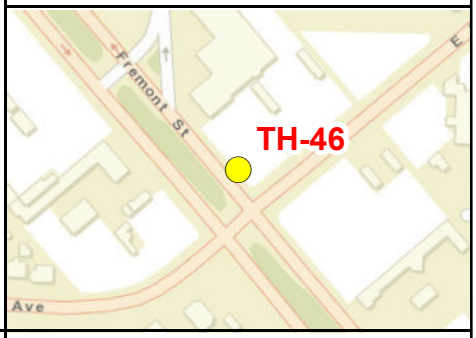
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

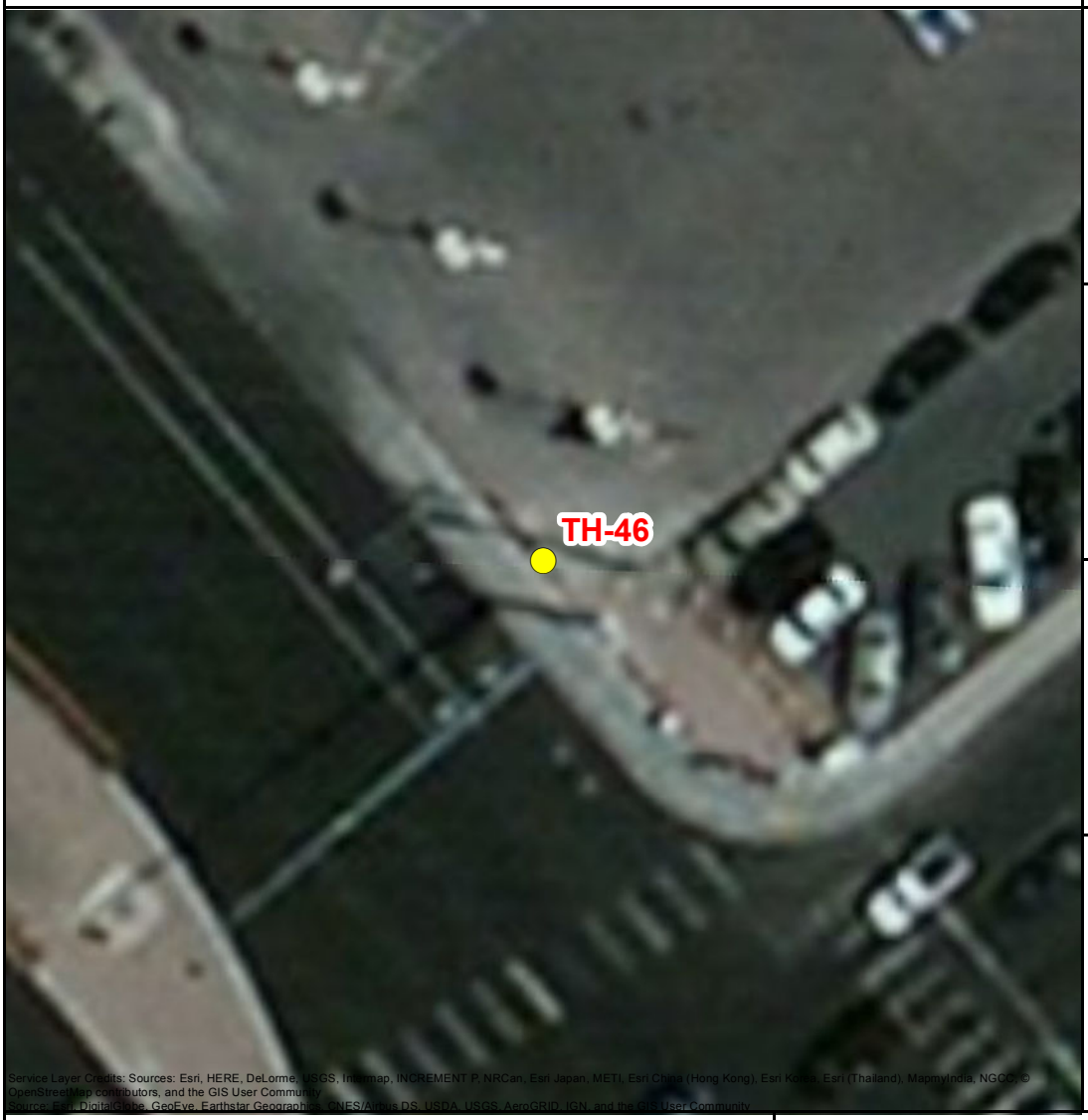
Utility Type:	Telephone	**Utility Size:**	21 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	X
Depth to Top:	5.34	**Top Ref. Level:**	10.60	**Hand Meas. Top:**	5.34
Depth to Bottom:	7.09	**Bot. Ref. Level:**	12.35	**Hand Meas. Bot:**	6.52
Top Elevation:	1826.364	**Mkr. Ref. Level:**	5.26	**Ref. Elevation:**	1831.704
Bottom Elevation:	1824.614	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



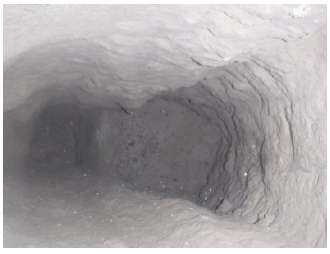
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	8.50
B	Traffic Signal	11.20
C	Face of Median	65.10

General Notes About This Test Hole

45 and 46 are in same encasement exposed west edge of encasement and bottom unable to expose full width due to large rocks, caving in hole. Also found 2 (1") conduits @ 2.02'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-47A	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/7/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

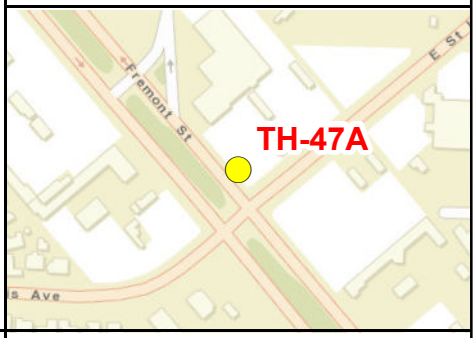
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

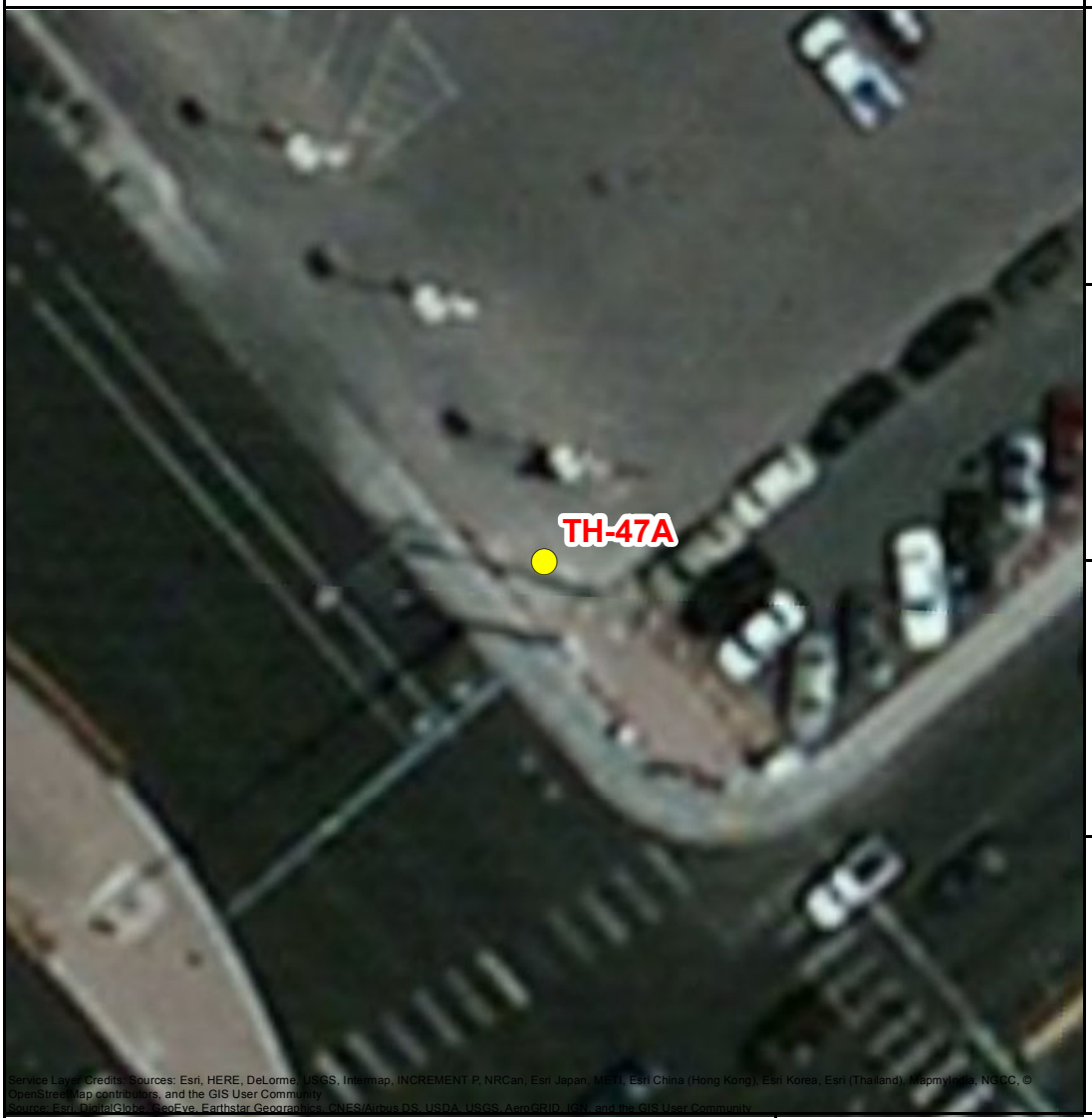
Utility Type:	Sewer	**Utility Size:**	12 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Sewer	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	Nail
Depth to Top:	5.70	**Top Ref. Level:**	11.05	**Hand Meas. Top:**	5.71
Depth to Bottom:	6.70	**Bot. Ref. Level:**	12.05	**Hand Meas. Bot:**	N/A
Top Elevation:	1825.741	**Mkr. Ref. Level:**	5.35	**Ref. Elevation:**	1831.441
Bottom Elevation:	1824.741	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES

Picture #1

Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	12.30
B	Traffic Signal	13.70
C	Face of Median	71.80

General Notes About This Test Hole

Pinned 12" sewer looking for gas in this. Found dug 2' west and 2' south no gas found.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-48	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/7/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

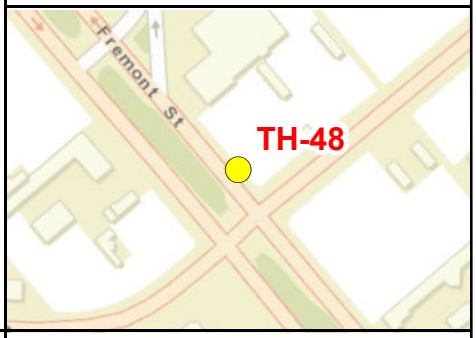
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

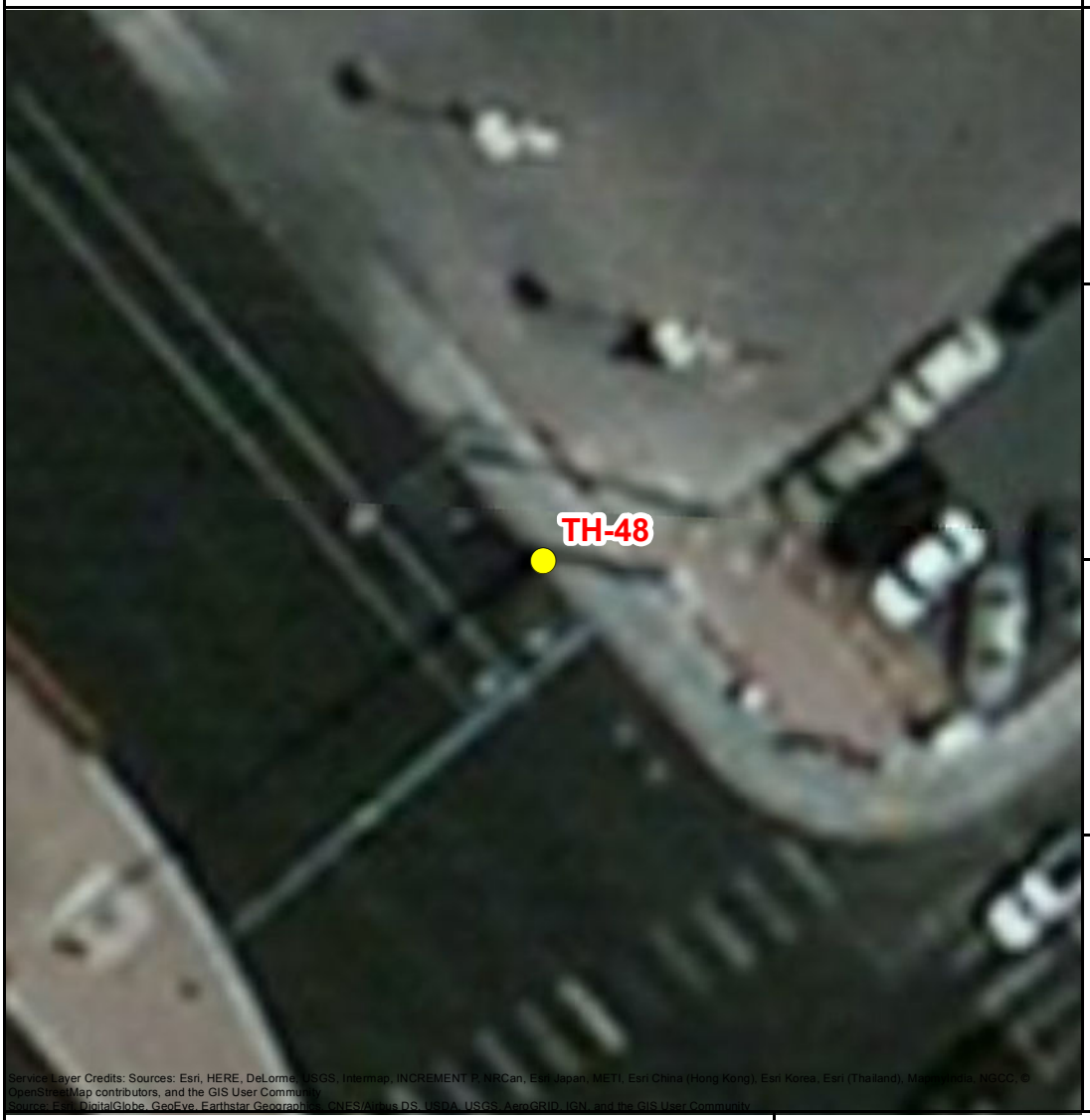
Utility Type:	ITS	**Utility Size:**	4 Inches	**Utility Material:**	Plastic
Utility Company:		**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	Nail
Depth to Top:	2.78	**Top Ref. Level:**	8.42	**Hand Meas. Top:**	2.78
Depth to Bottom:	3.11	**Bot. Ref. Level:**	8.75	**Hand Meas. Bot:**	N/A
Top Elevation:	1828.542	**Mkr. Ref. Level:**	5.64	**Ref. Elevation:**	1831.322
Bottom Elevation:	1828.212	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	13.50
B	Traffic Signal	17.50
C	Face of median	55.00

General Notes About This Test Hole

Found unk 2" conduit over 4" ITS @ 1.75'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-49	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/7/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

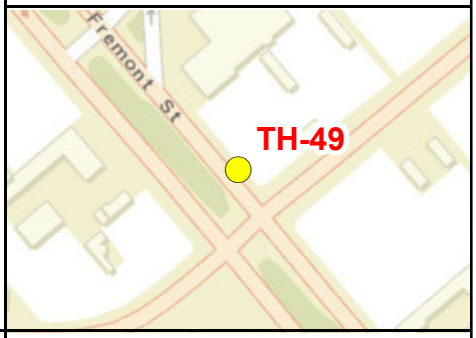
1349 Galleria Drive, Suite 110
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Phone: 702-966-4063

Test Hole Data

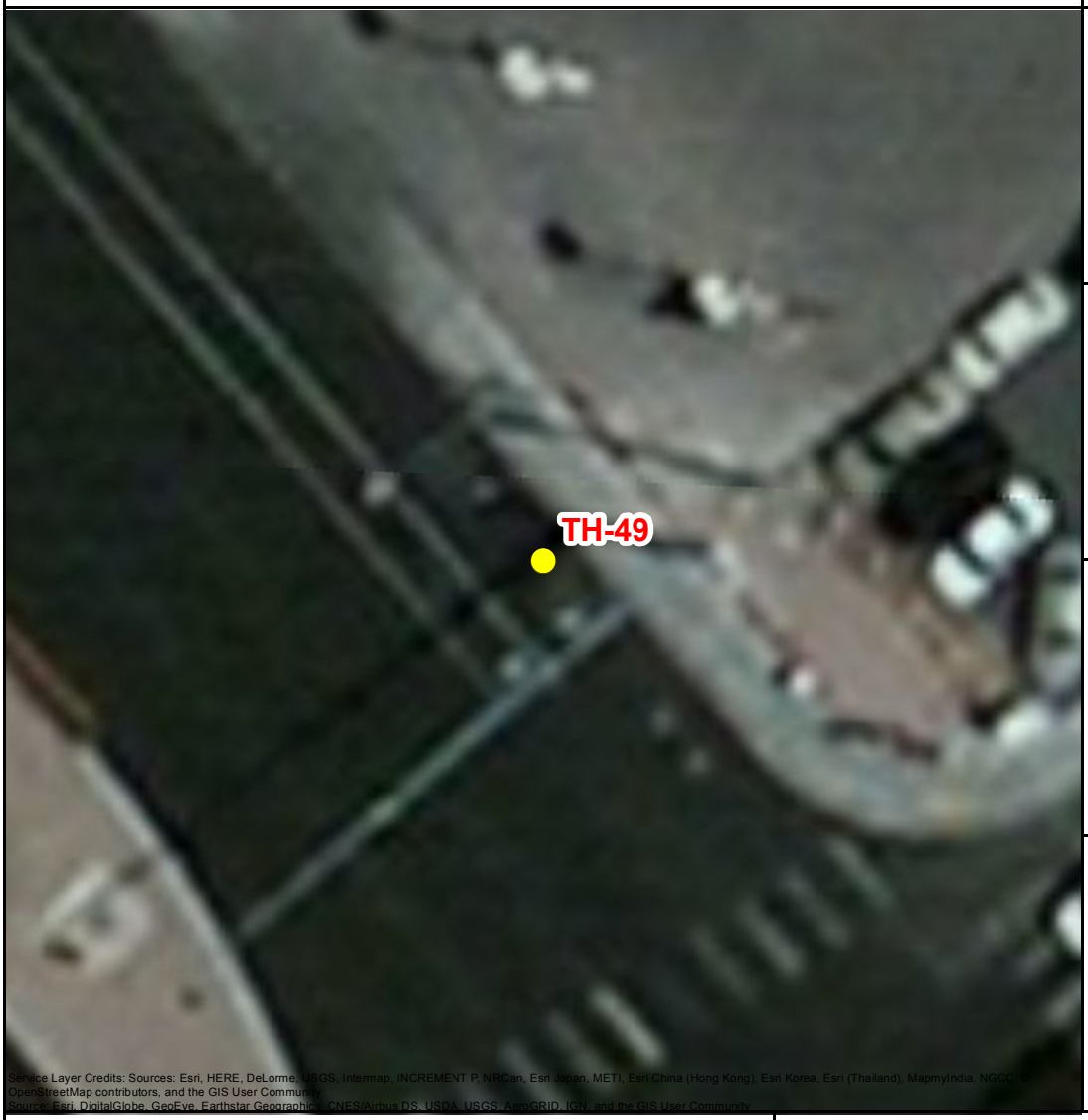
Utility Type:	Water	**Utility Size:**	12 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Disk
Depth to Top:	3.92	**Top Ref. Level:**	9.29	**Hand Meas. Top:**	3.92
Depth to Bottom:	4.92	**Bot. Ref. Level:**	10.29	**Hand Meas. Bot:**	N/A
Top Elevation:	1827.653	**Mkr. Ref. Level:**	5.37	**Ref. Elevation:**	1831.573
Bottom Elevation:	1826.653	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



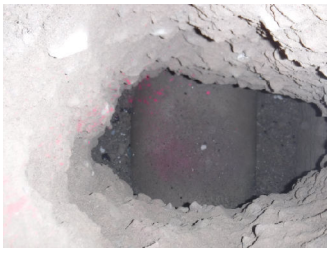
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	17.00
B	Traffic Signal	21.10
C	Face of median	50.70

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-50	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/24/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

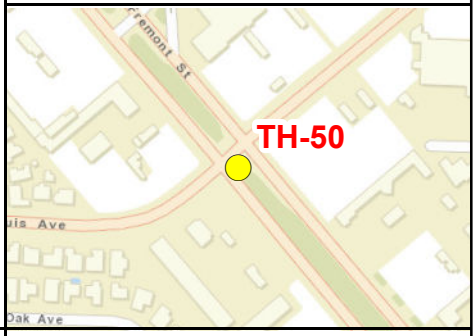
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

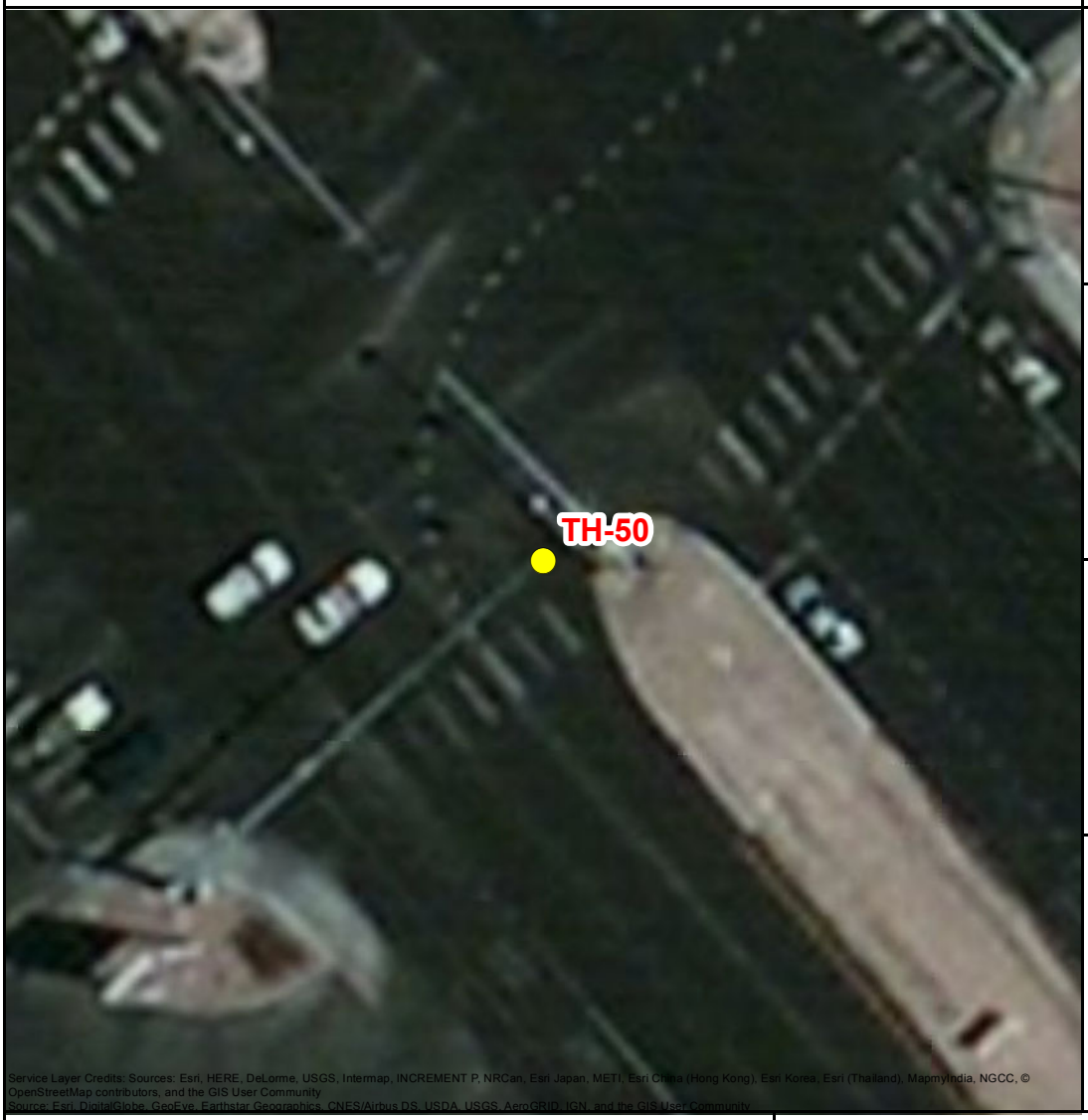
Utility Type:	Sewer	**Utility Size:**	72 Inches	**Utility Material:**	Steel Casing
Utility Company:	Las Vegas Sewer	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	9.91	**Top Ref. Level:**	14.48	**Hand Meas. Top:**	9.92
Depth to Bottom:	15.91	**Bot. Ref. Level:**	20.48	**Hand Meas. Bot:**	N/A
Top Elevation:	1821.496	**Mkr. Ref. Level:**	4.57	**Ref. Elevation:**	1831.406
Bottom Elevation:	1815.496	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3



Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	43.40
B	Traffic Signal	75.50
C	Sewer Manhole	12.40

General Notes About This Test Hole

Took shot off the top of the steel casing. Edge of casing is 14" E of pin. Casing seems to be in fair condition.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-51	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/24/2017	**HE Project #:**	LV-839-1607
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

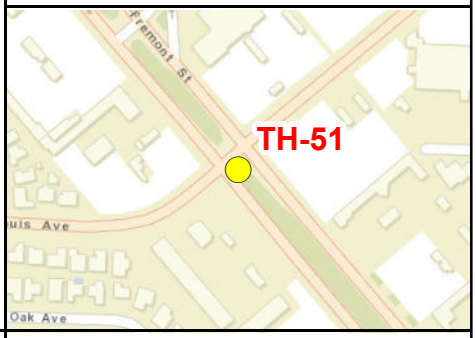
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

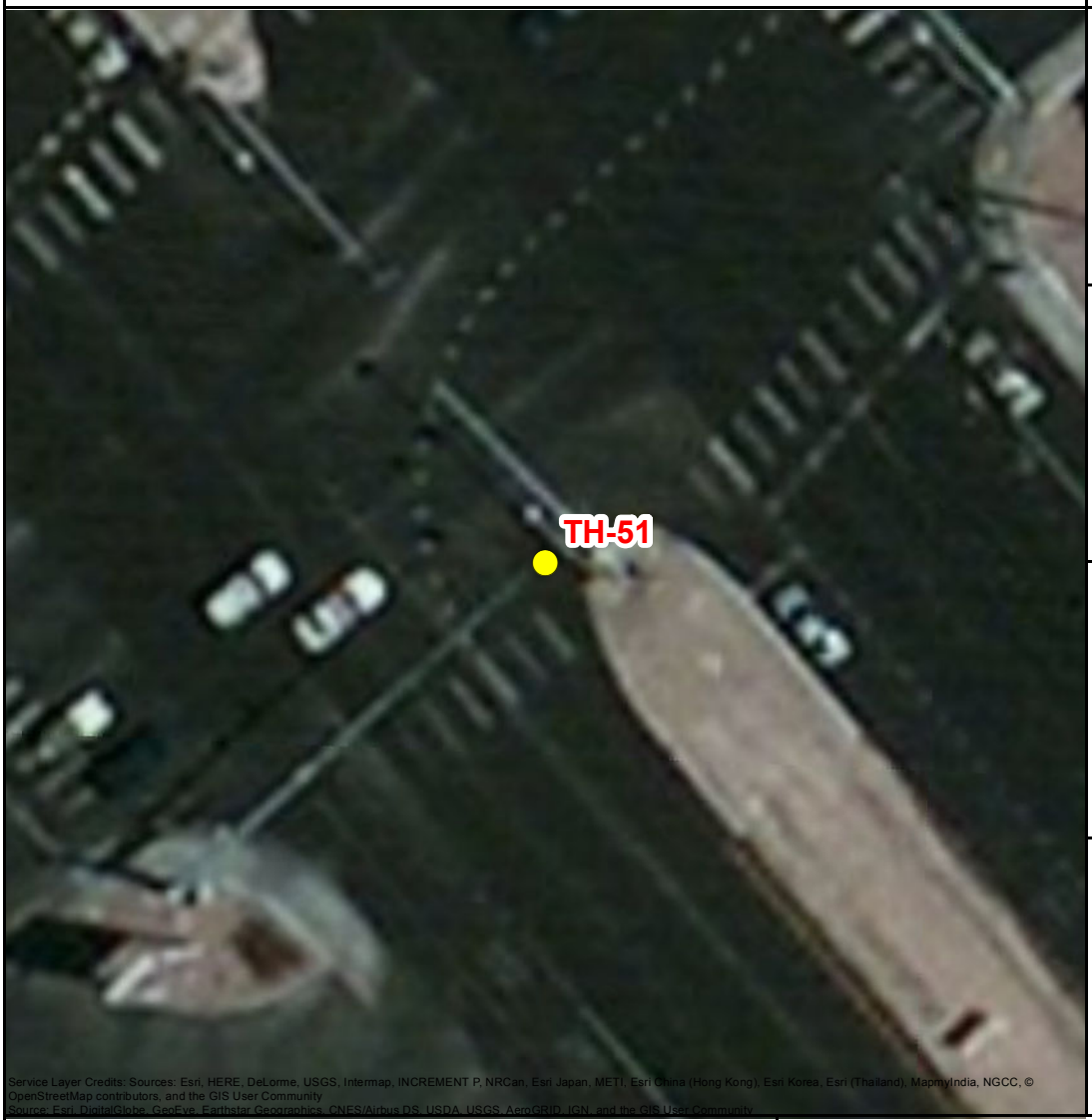
Utility Type:	Sewer	**Utility Size:**	51 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Sewer	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	PK Nail
Depth to Top:	10.95	**Top Ref. Level:**	15.52	**Hand Meas. Top:**	10.96
Depth to Bottom:	15.2	**Bot. Ref. Level:**	19.77	**Hand Meas. Bot:**	N/A
Top Elevation:	1820.397	**Mkr. Ref. Level:**	4.57	**Ref. Elevation:**	1831.347
Bottom Elevation:	1816.147	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



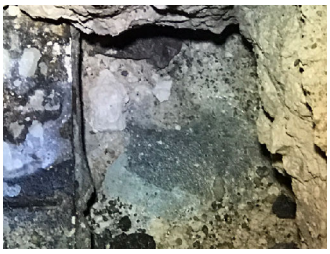
TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3



Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	21.60
B	Traffic Signal	77.30
C	Sewer Manhole	10.60

General Notes About This Test Hole

Took shot off 51", unable to shoot bottom of casing because it is filled with concrete.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-52	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/24/2017	**HE Project #:**	LV-839-1608
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

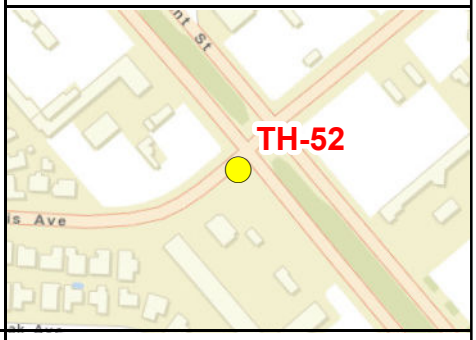
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

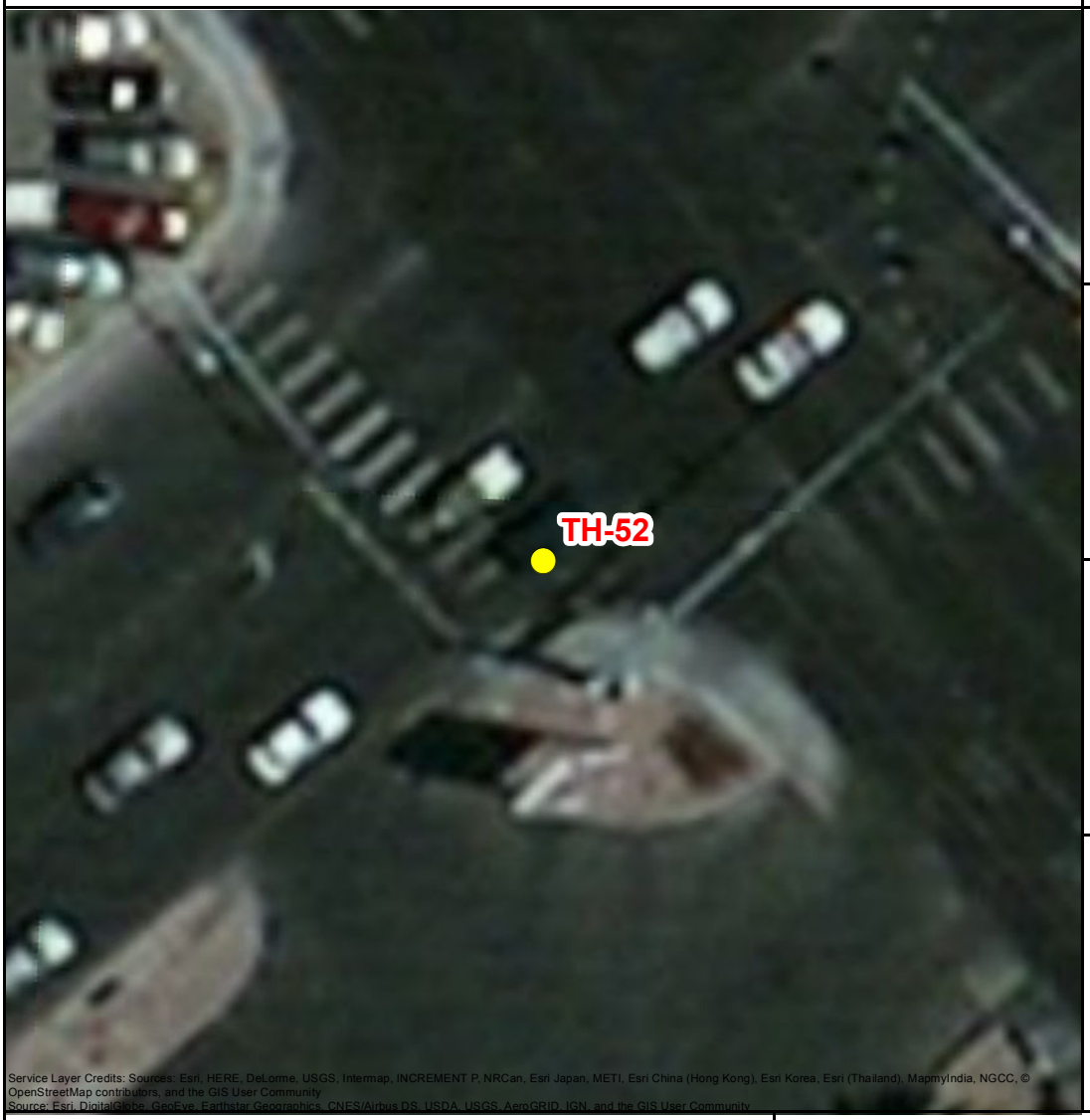
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Utility Company:	Las Vegas Sewer	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	10.20	**Top Ref. Level:**	14.91	**Hand Meas. Top:**	10.21
Depth to Bottom:	14.45	**Bot. Ref. Level:**	19.16	**Hand Meas. Bot:**	N/A
Top Elevation:	1821.043	**Mkr. Ref. Level:**	4.71	**Ref. Elevation:**	1831.243
Bottom Elevation:	1816.793	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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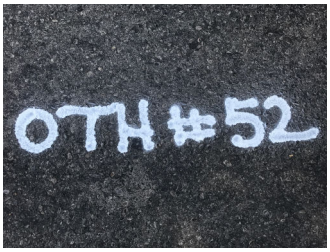
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Storm Drain Inlet	13.20
B	Traffic Signal	65.20
C	Sewer Manhole	26.40

General Notes About This Test Hole

Took shot off top of 51", unable to take shot of bottom of casing due to concrete.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-53	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/24/2017	**HE Project #:**	LV-839-1609
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

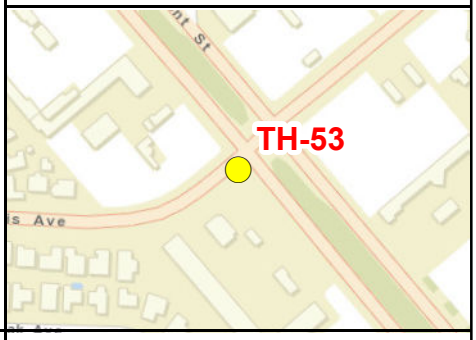
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

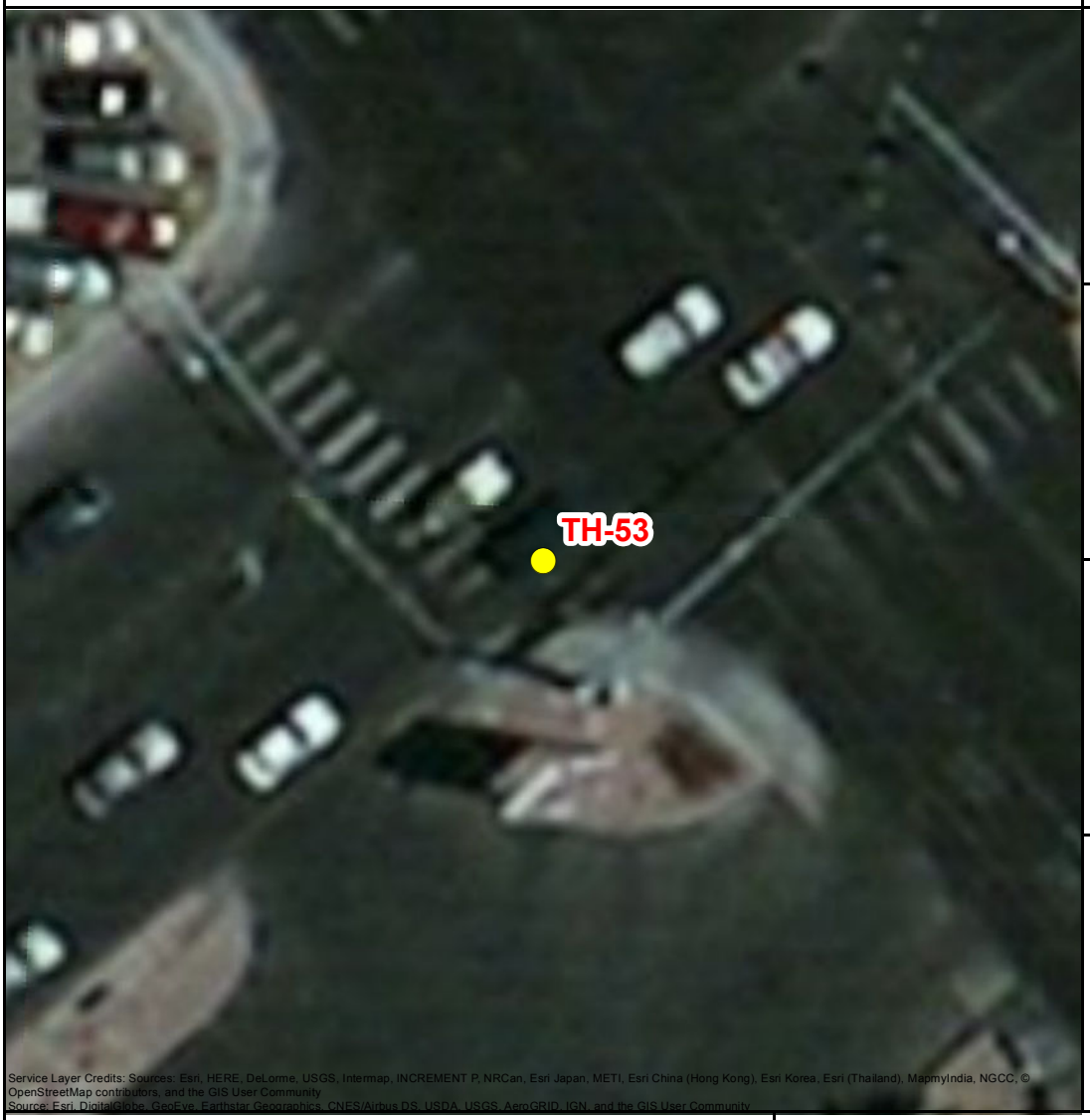
Utility Type:	Sewer	**Utility Size:**	72 Inches	**Utility Material:**	Steel
Utility Company:	Las Vegas Sewer	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	PK Nail
Depth to Top:	9.17	**Top Ref. Level:**	13.89	**Hand Meas. Top:**	9.17
Depth to Bottom:	15.17	**Bot. Ref. Level:**	19.89	**Hand Meas. Bot:**	N/A
Top Elevation:	1822.068	**Mkr. Ref. Level:**	4.72	**Ref. Elevation:**	1831.238
Bottom Elevation:	1816.068	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Storm Drain Inlet	13.10
B	Traffic Signal	65.20
C	Sewer Manhole	28.50

General Notes About This Test Hole

Casing seems to be in fair condition. Casing is full with concrete. Too shot off top of 70" edge casing is 8" W of pin.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-54	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/4/2017	**HE Project #:**	LV-839-1609
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

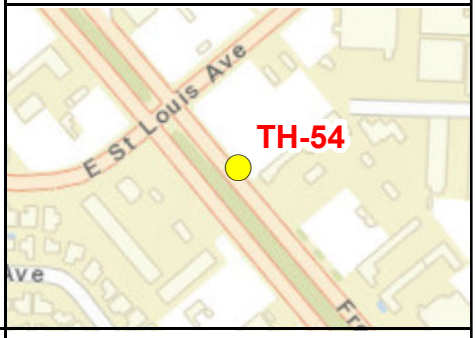
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

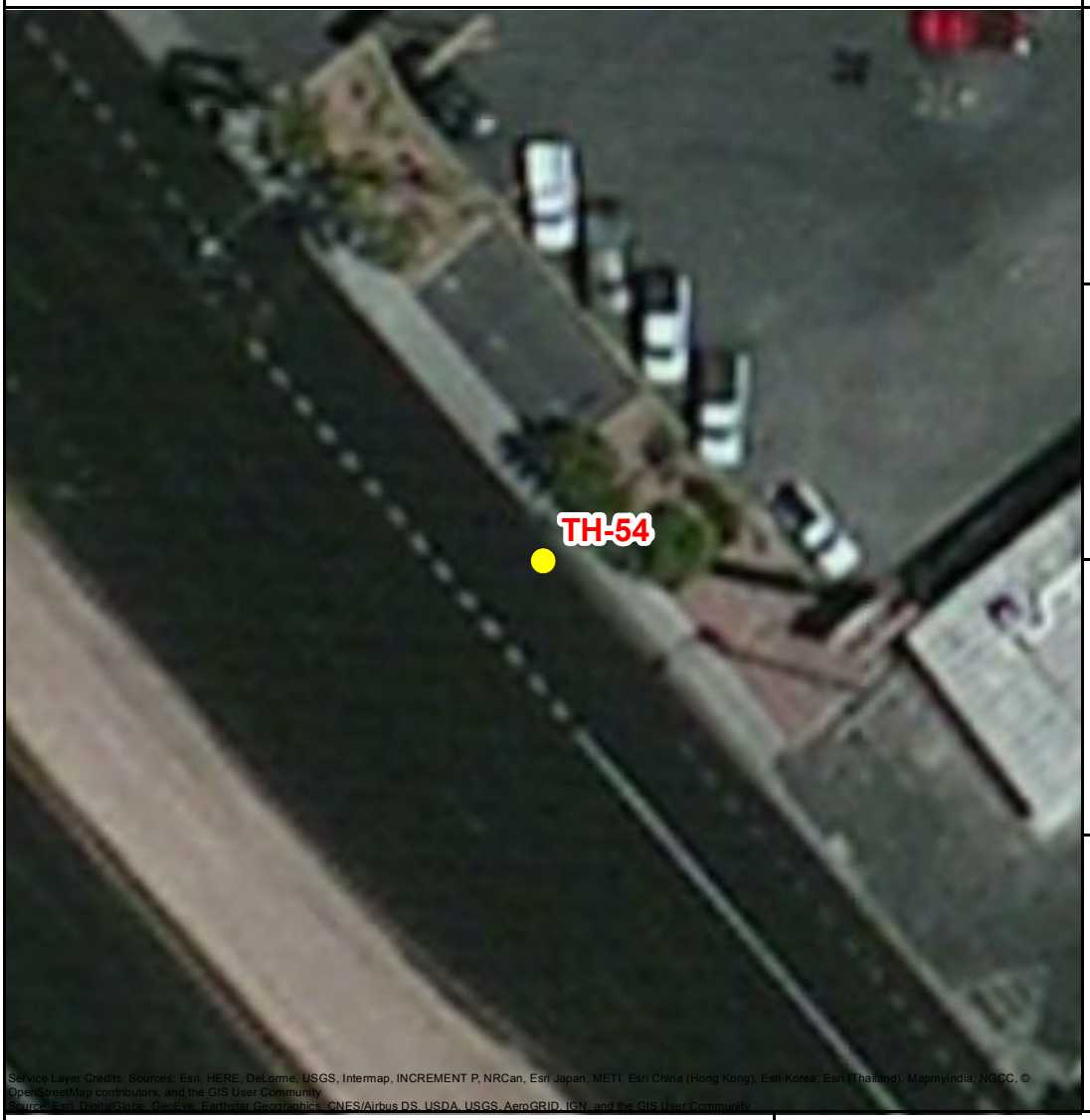
Utility Type:	Water	**Utility Size:**	12 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	10 Inches	**Marker Type:**	Nail
Depth to Top:	5.89	**Top Ref. Level:**	10.78	**Hand Meas. Top:**	5.90
Depth to Bottom:	6.89	**Bot. Ref. Level:**	11.78	**Hand Meas. Bot:**	N/A
Top Elevation:	1822.898	**Mkr. Ref. Level:**	4.89	**Ref. Elevation:**	1828.788
Bottom Elevation:	1821.898	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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Overall Location of Test Hole



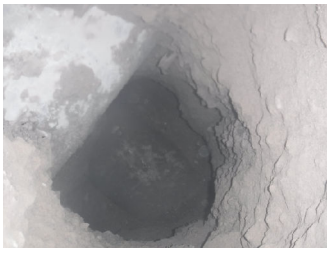
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	78.90
B	Drain Inlet	8.40
C	Power Pole	61.10

General Notes About This Test Hole

Found 24" SD in this hole dpeth to top 2.17'

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-55	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/4/2017	**HE Project #:**	LV-839-1609
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

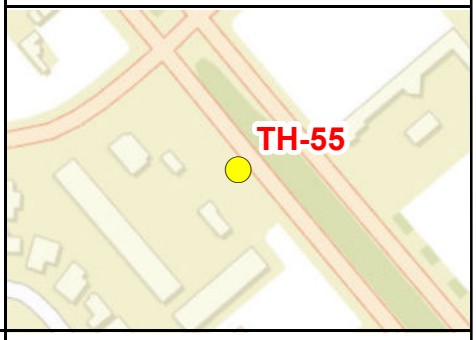
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Phone: 702-966-4063

Test Hole Data

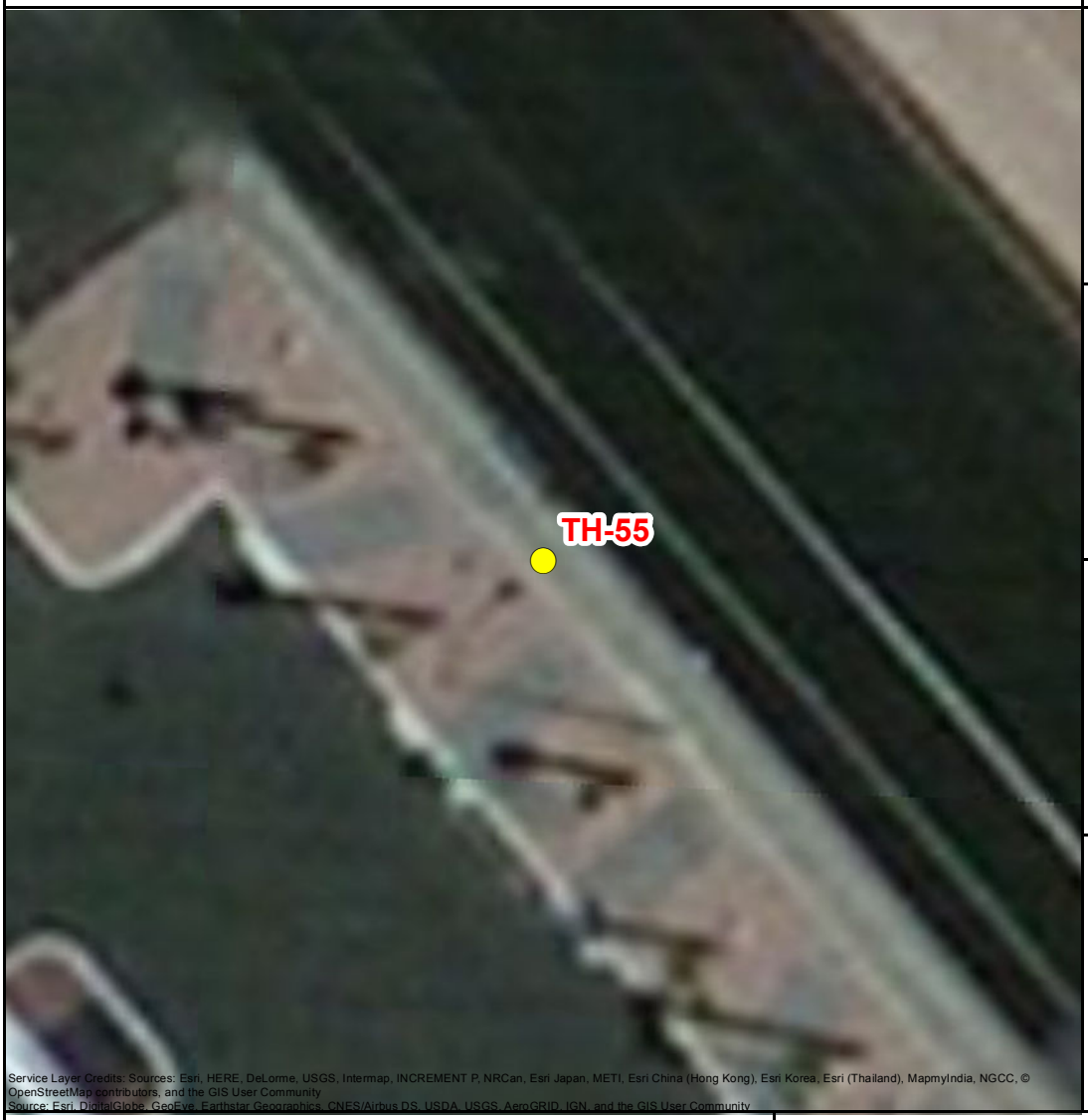
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Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Natutal Ground	**Thickness:**	N/A	**Marker Type:**	Nail
Depth to Top:	6.57	**Top Ref. Level:**	11.52	**Hand Meas. Top:**	6.58
Depth to Bottom:	9.07	**Bot. Ref. Level:**	14.02	**Hand Meas. Bot:**	N/A
Top Elevation:	1823.53	**Mkr. Ref. Level:**	4.95	**Ref. Elevation:**	1830.100
Bottom Elevation:	1821.03	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



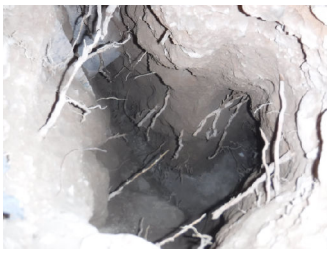
TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Drainage Inlet	8.20
B	Storm Drain Manhole	5.70
C	Street Light	28.20

General Notes About This Test Hole

24" Sd crossing 30" water exposed crown and east edge of 30". Pinned east edge of 30" water Face of Curb is 78" east of east ege of 30" pipe. Depth to bottom of 24" is 4.82'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-56	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/4/2017	**HE Project #:**	LV-839-1609
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

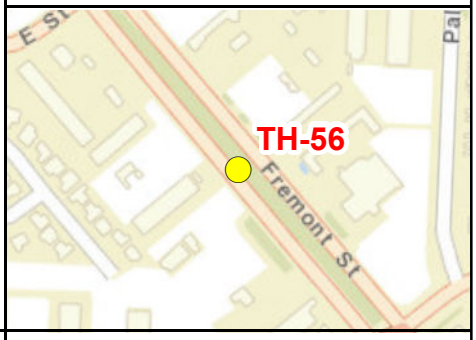
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

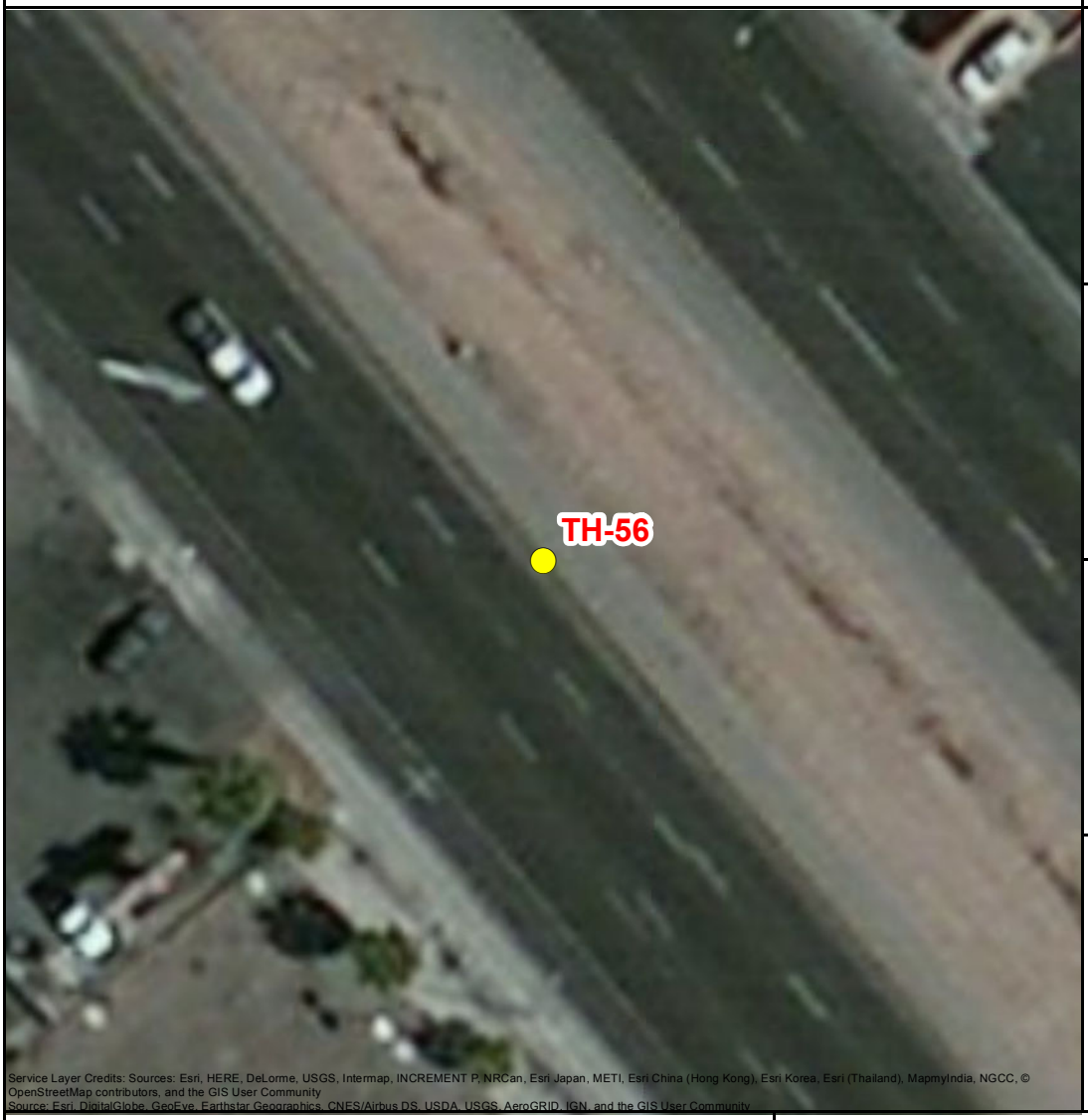
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	Nail
Depth to Top:	4.27	**Top Ref. Level:**	9.12	**Hand Meas. Top:**	4.28
Depth to Bottom:	4.44	**Bot. Ref. Level:**	9.29	**Hand Meas. Bot:**	N/A
Top Elevation:	1823.654	**Mkr. Ref. Level:**	4.85	**Ref. Elevation:**	1827.924
Bottom Elevation:	1823.484	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Edge of Asphalt	13.70
B	Face of Curb	47.10
C	Street Light	82.80

General Notes About This Test Hole

Orange tracer running w/ 2".

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-57	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/4/2017	**HE Project #:**	LV-839-1609
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

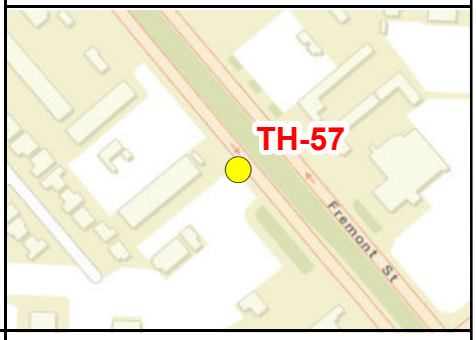
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

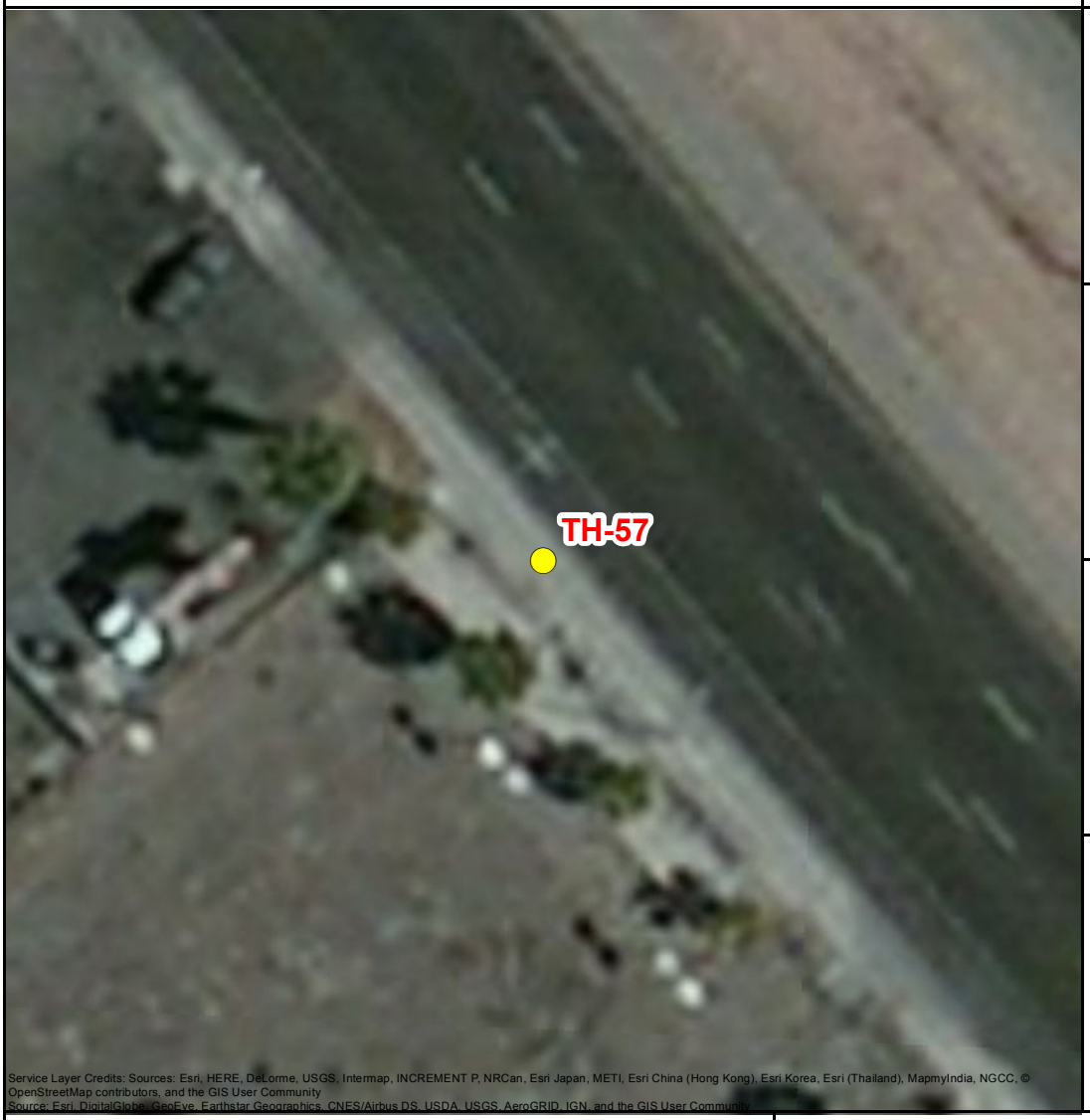
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Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	6 Inches	**Marker Type:**	X
Depth to Top:	7.54	**Top Ref. Level:**	12.45	**Hand Meas. Top:**	7.55
Depth to Bottom:	10.04	**Bot. Ref. Level:**	14.95	**Hand Meas. Bot:**	N/A
Top Elevation:	1819.989	**Mkr. Ref. Level:**	4.91	**Ref. Elevation:**	1827.529
Bottom Elevation:	1817.489	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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Overall Location of Test Hole



TEST HOLE LOCATION PLAN

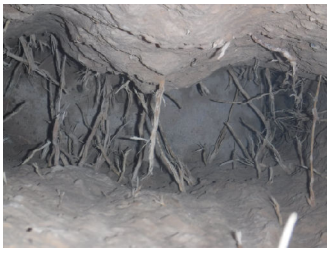


Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

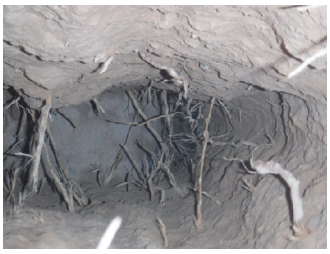
TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	35.20
B	Street Light	66.50
C	Edge of Asphalt	67.90

General Notes About This Test Hole

Exposed crown and east edge of 30" pipe. Pinned east edfe of 30" Face of Curb is 63" east of east edge of 30". Also found 1" pvc in hole @ 2.05'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-58	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/4/2017	**HE Project #:**	LV-839-1609
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

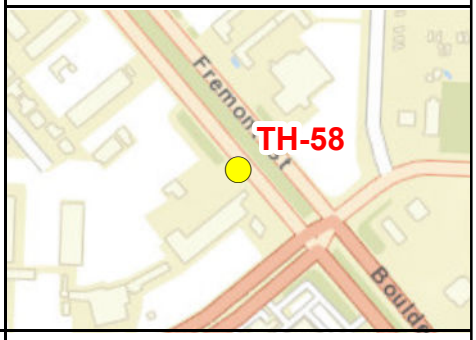
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

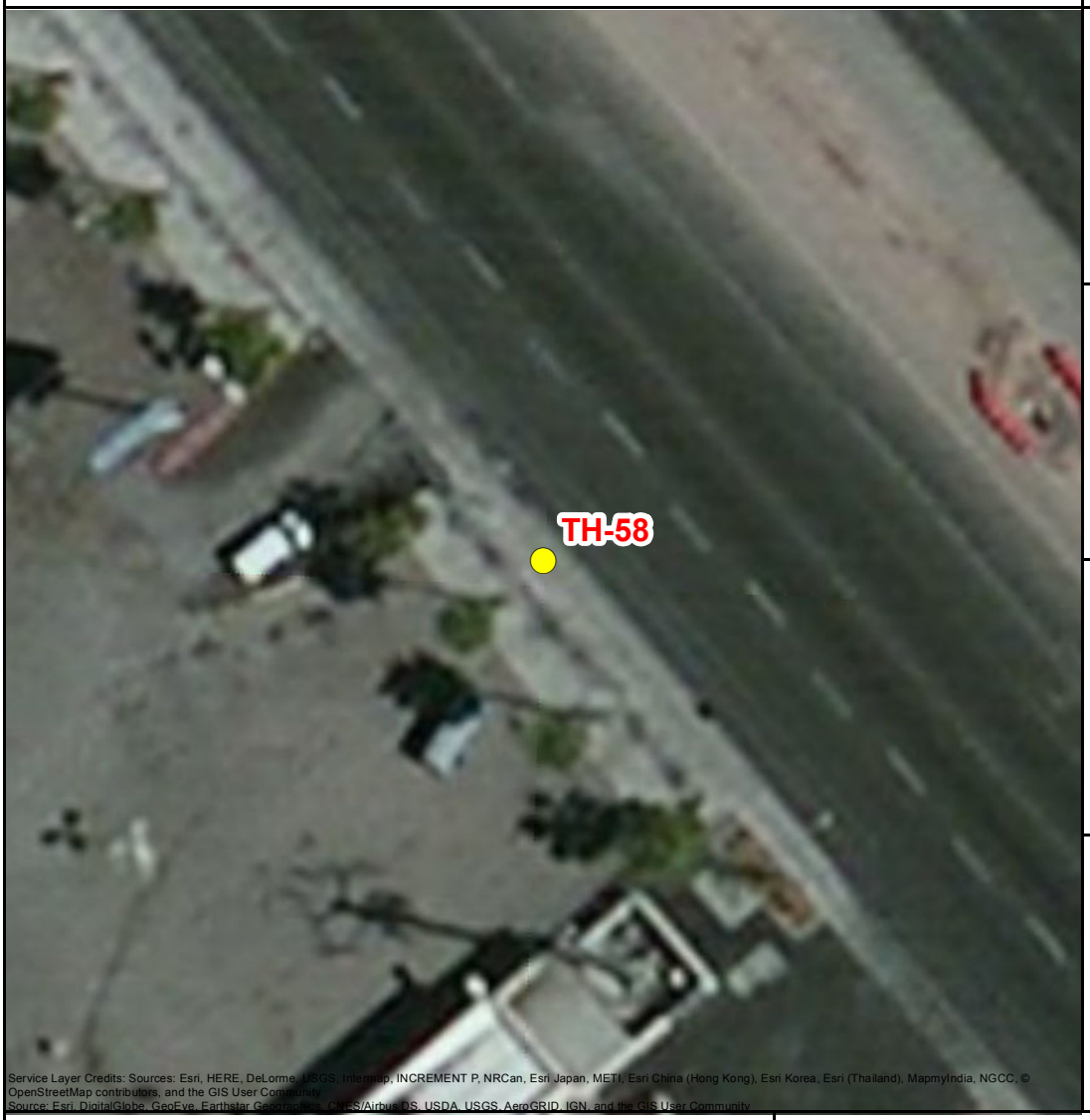
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	7 Inches	**Marker Type:**	Nail
Depth to Top:	7.78	**Top Ref. Level:**	13.06	**Hand Meas. Top:**	7.79
Depth to Bottom:	10.28	**Bot. Ref. Level:**	15.56	**Hand Meas. Bot:**	N/A
Top Elevation:	1818.31	**Mkr. Ref. Level:**	5.28	**Ref. Elevation:**	1826.090
Bottom Elevation:	1815.81	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	13.70
B	Face of Median	83.80
C	Street Light	77.90

General Notes About This Test Hole

Exposed crown of the 30" and the east edge. Pinned east edge of 30". Face of Curb is 65" east of east edge of 30" water

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-59	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/11/2017	**HE Project #:**	LV-839-1610
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

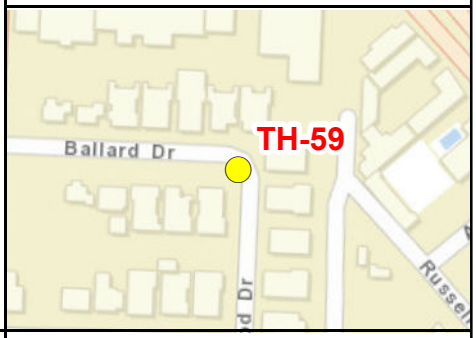
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Phone: 702-966-4063

Test Hole Data

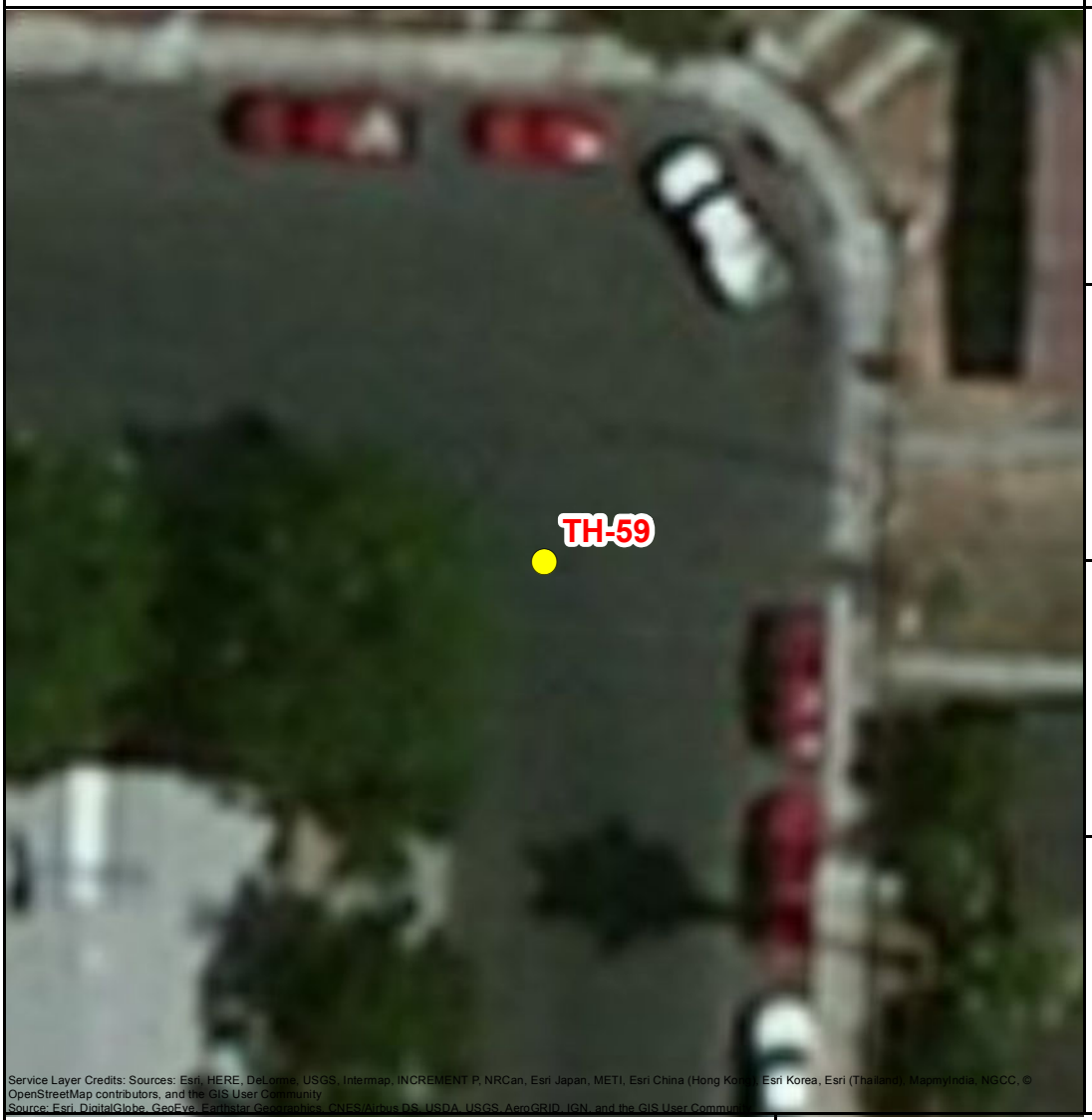
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Plastic
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	4.36	**Top Ref. Level:**	9.47	**Hand Meas. Top:**	4.34
Depth to Bottom:	5.03	**Bot. Ref. Level:**	10.14	**Hand Meas. Bot:**	N/A
Top Elevation:	1860.523	**Mkr. Ref. Level:**	5.11	**Ref. Elevation:**	1864.883
Bottom Elevation:	1859.853	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



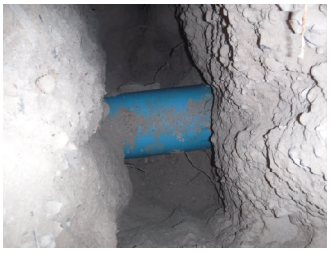
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Storm Drain Inlet	12.00
B	Street Light	40.90
C	Storm Drain Inlet	48.60

General Notes About This Test Hole

Dug east hit trench wall. Dug wast 3' no other utility found did not see 6" in testhole.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-61	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/11/2017	**HE Project #:**	LV-839-1611
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

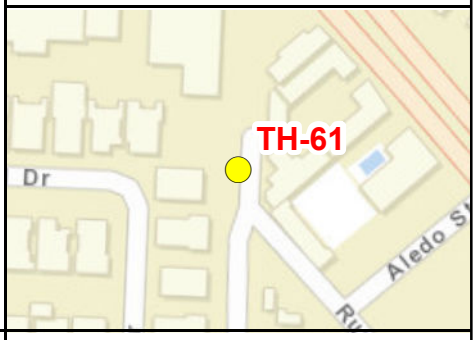
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

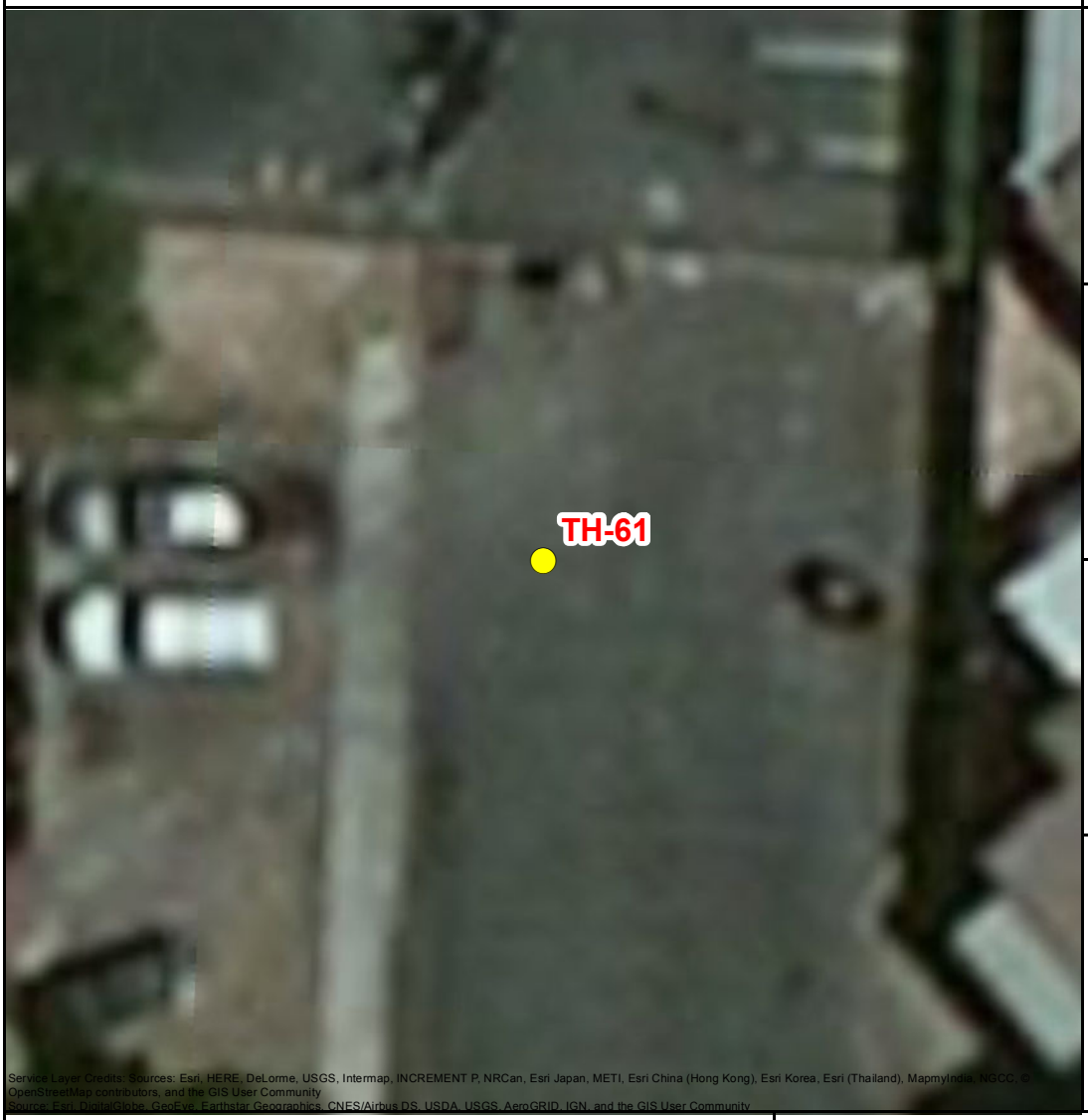
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	2.51	**Top Ref. Level:**	7.62	**Hand Meas. Top:**	2.53
Depth to Bottom:	2.68	**Bot. Ref. Level:**	7.79	**Hand Meas. Bot:**	N/A
Top Elevation:	1861.190	**Mkr. Ref. Level:**	5.11	**Ref. Elevation:**	1863.700
Bottom Elevation:	1861.020	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Edge of Asphalt	6.70
B	Face of Wall	25.50
C	Edge of Asphalt	41.60

General Notes About This Test Hole

Pipe did not end pipe continued north east. Pinned center of "T" hit yellow tear tape @ 28" moved hole. Pipe continued ar this pothole.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-61A	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/11/2017	**HE Project #:**	LV-839-1612
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

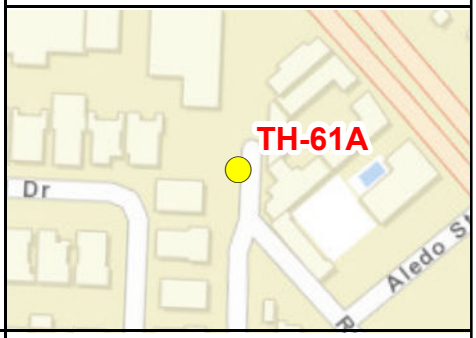
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Phone: 702-966-4063

Test Hole Data

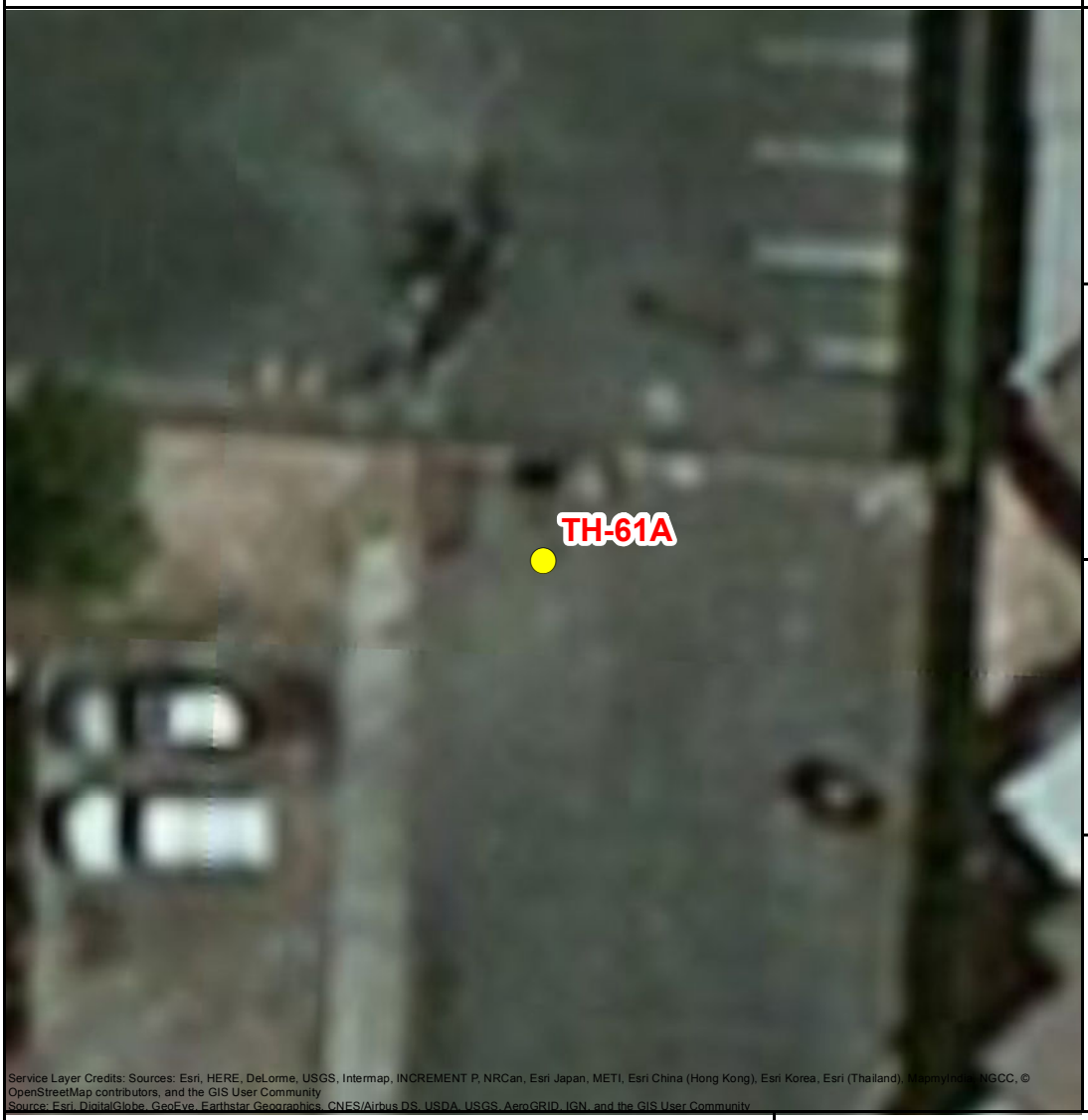
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Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	2.26	**Top Ref. Level:**	7.15	**Hand Meas. Top:**	2.30
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Top Elevation:	1861.414	**Mkr. Ref. Level:**	4.89	**Ref. Elevation:**	1863.674
Bottom Elevation:	1861.244	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Wall	6.50
B	Edge of Asphalt	41.50
C	Storm Drain Inlet	7.60

General Notes About This Test Hole

Pipe did not end pipe continued north east. (Did not see end in hole dug 3.5' north east)

Pinned center of "T"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-62	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/11/2017	**HE Project #:**	LV-839-1613
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

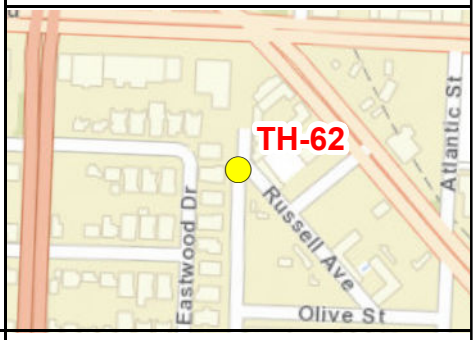
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

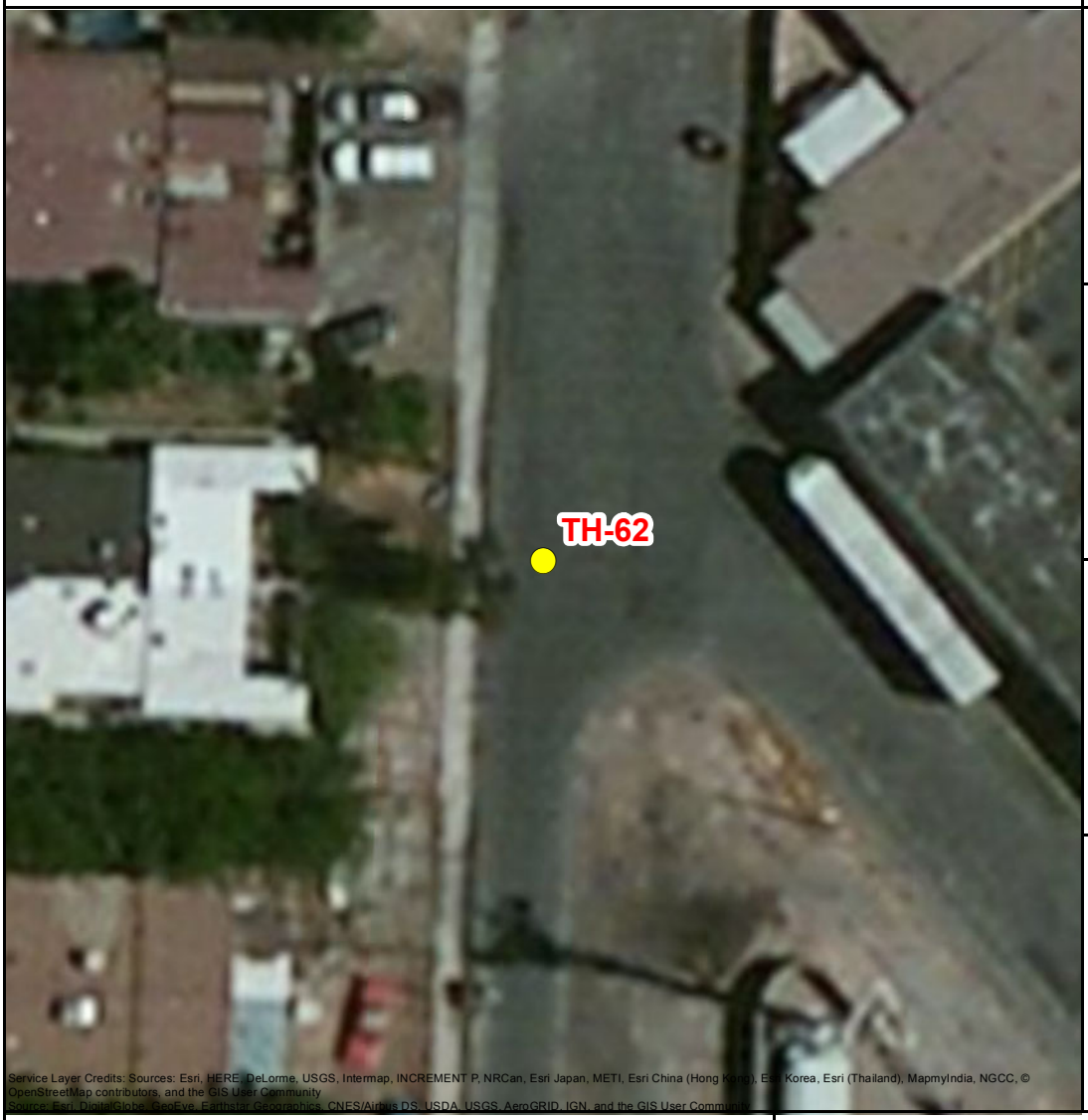
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Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	Nail
Depth to Top:	3.81	**Top Ref. Level:**	8.96	**Hand Meas. Top:**	3.82
Depth to Bottom:	3.98	**Bot. Ref. Level:**	9.13	**Hand Meas. Bot:**	N/A
Top Elevation:	1859.628	**Mkr. Ref. Level:**	5.15	**Ref. Elevation:**	1863.438
Bottom Elevation:	1859.458	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



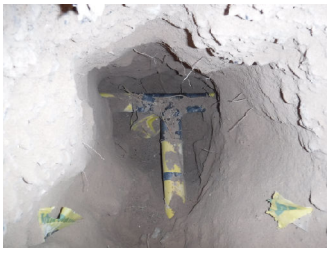
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	86.40
B	Face of Curb	7.40
C	Telephone Pole	75.50

General Notes About This Test Hole

Pinned center of "T" hit yellow tear tape @ 30"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-63	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/11/2017	**HE Project #:**	LV-839-1614
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

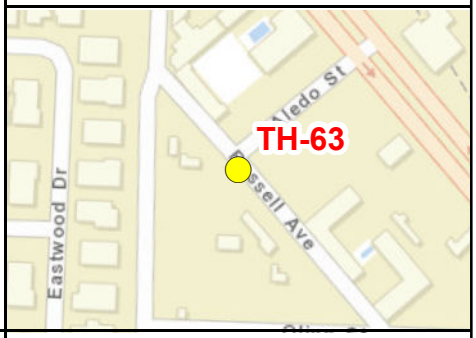
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	2.63	**Top Ref. Level:**	7.79	**Hand Meas. Top:**	2.64
Depth to Bottom:	2.80	**Bot. Ref. Level:**	7.96	**Hand Meas. Bot:**	N/A
Top Elevation:	1860.343	**Mkr. Ref. Level:**	5.16	**Ref. Elevation:**	1862.973
Bottom Elevation:	1860.173	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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Overall Location of Test Hole



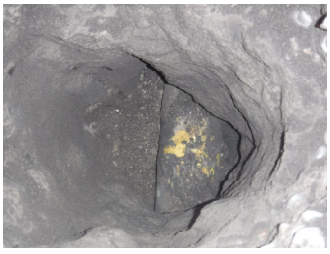
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	20.20
B	Edge of Asphalt	19.30
C	Storm Drain Manhole	30.70

General Notes About This Test Hole

No tear tape

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-64	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/10/2017	**HE Project #:**	LV-839-1615
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

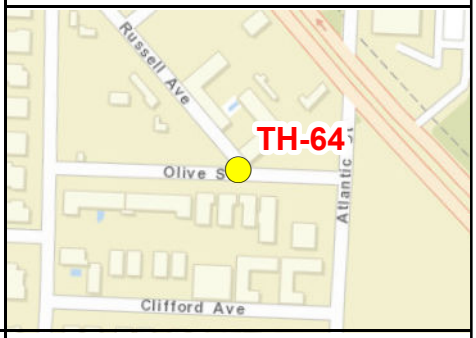
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

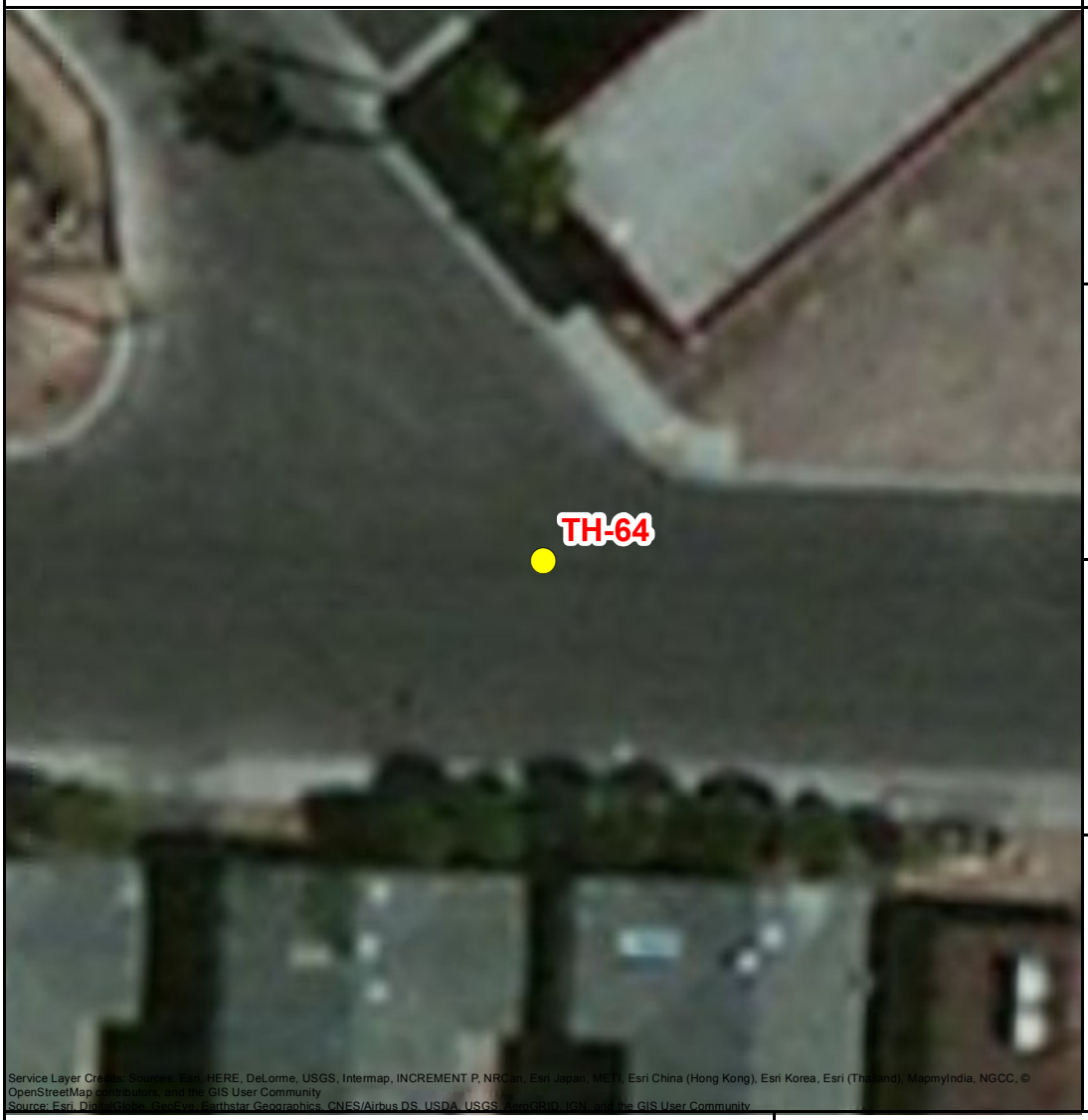
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Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	2.69	**Top Ref. Level:**	7.03	**Hand Meas. Top:**	2.70
Depth to Bottom:	2.86	**Bot. Ref. Level:**	7.20	**Hand Meas. Bot:**	N/A
Top Elevation:	1857.642	**Mkr. Ref. Level:**	4.34	**Ref. Elevation:**	1860.332
Bottom Elevation:	1857.472	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	60.60
B	Street Light	40.60
C	Corner of building	34.90

General Notes About This Test Hole

Put pin directly over angle point. Hit yellow tear @ 36"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-65	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/10/2017	**HE Project #:**	LV-839-1616
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

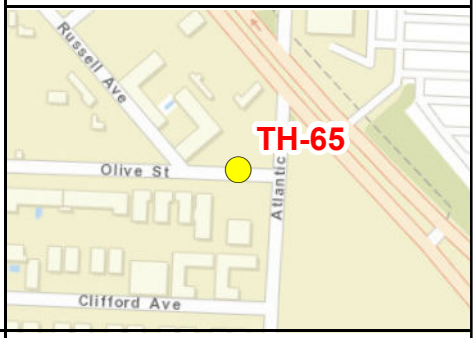
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

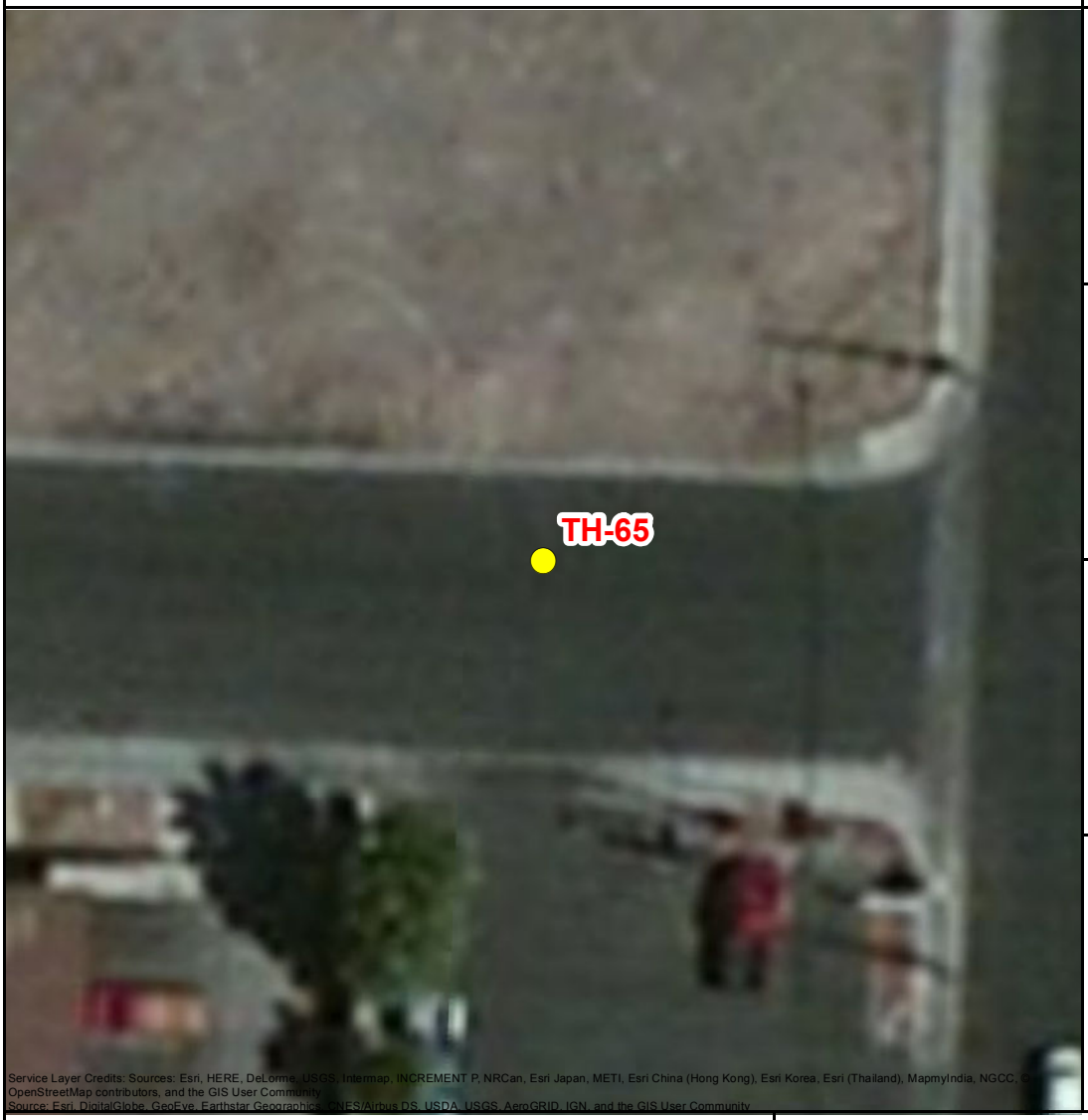
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.11	**Top Ref. Level:**	8.20	**Hand Meas. Top:**	3.12
Depth to Bottom:	3.28	**Bot. Ref. Level:**	8.37	**Hand Meas. Bot:**	N/A
Top Elevation:	1854.732	**Mkr. Ref. Level:**	5.09	**Ref. Elevation:**	1857.842
Bottom Elevation:	1854.562	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



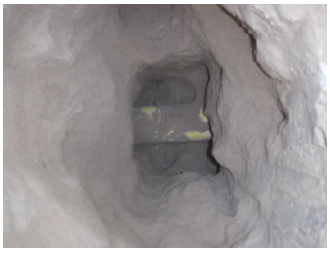
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	50.30
B	Face of Curb	10.00
C	Power Pole	61.50

General Notes About This Test Hole

Pipe runs E/W on Olive

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-66	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/12/2017	**HE Project #:**	LV-839-1617
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

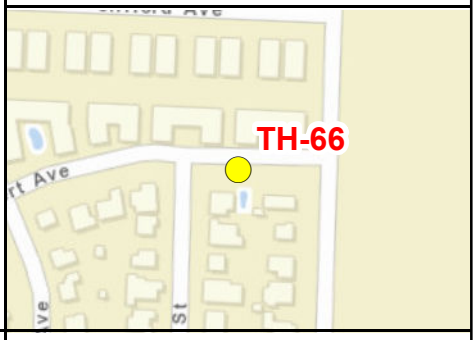
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

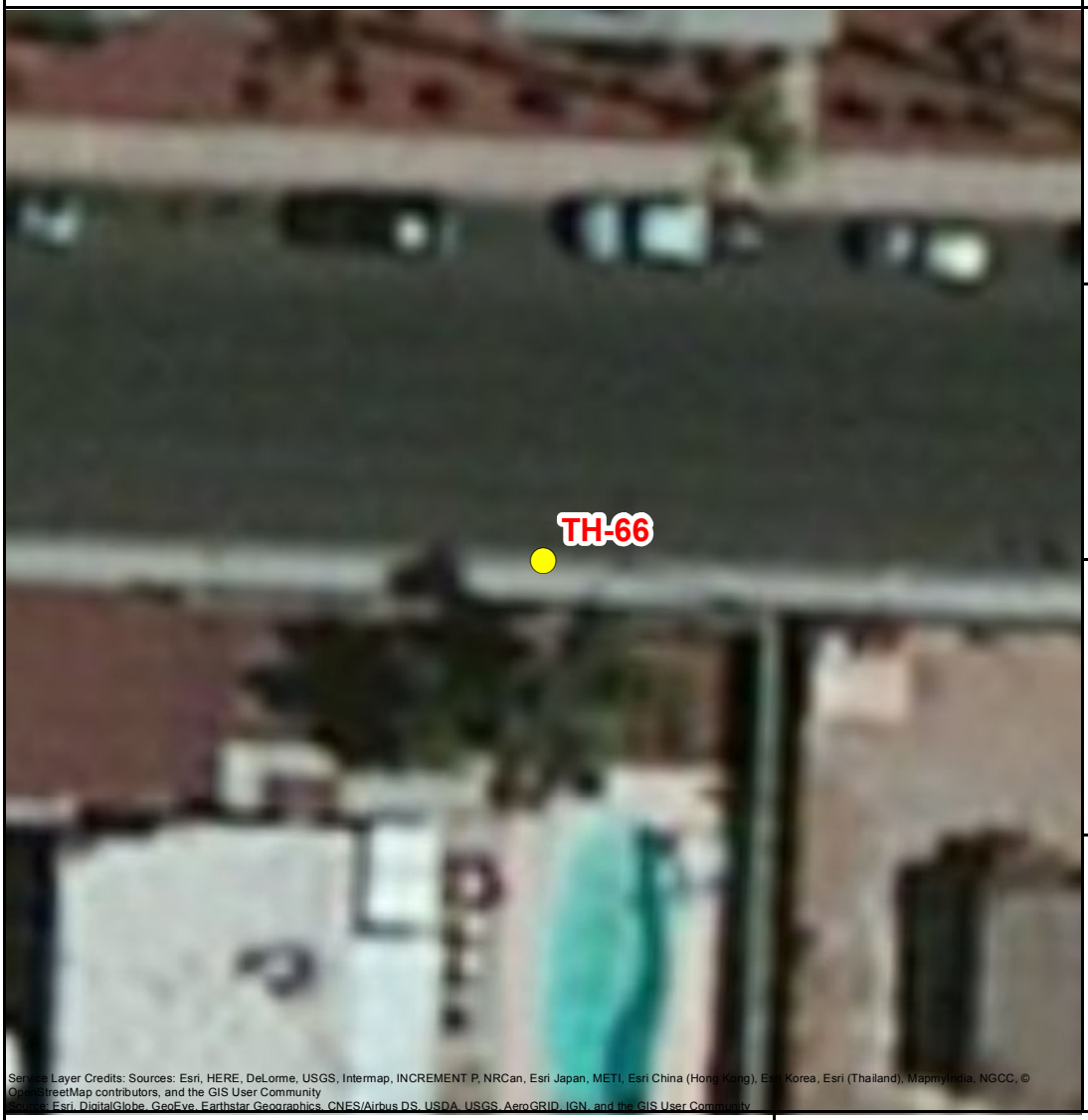
Utility Type:	Water	**Utility Size:**	6 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.25	**Top Ref. Level:**	7.58	**Hand Meas. Top:**	3.24
Depth to Bottom:	3.75	**Bot. Ref. Level:**	8.08	**Hand Meas. Bot:**	N/A
Top Elevation:	1857.976	**Mkr. Ref. Level:**	4.33	**Ref. Elevation:**	1861.226
Bottom Elevation:	1857.476	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



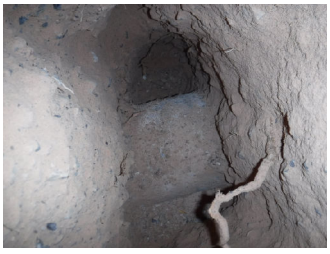
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of Curb	2.60
B	Face of Curb	37.30
C	Water pull box	31.90

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-67	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/12/2017	**HE Project #:**	LV-839-1618
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

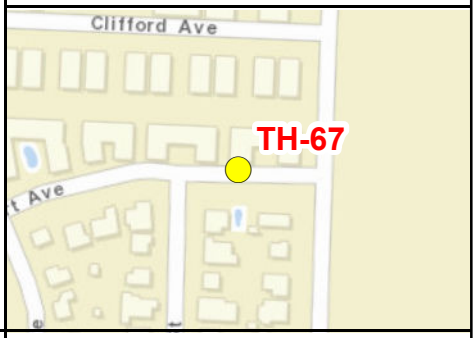
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

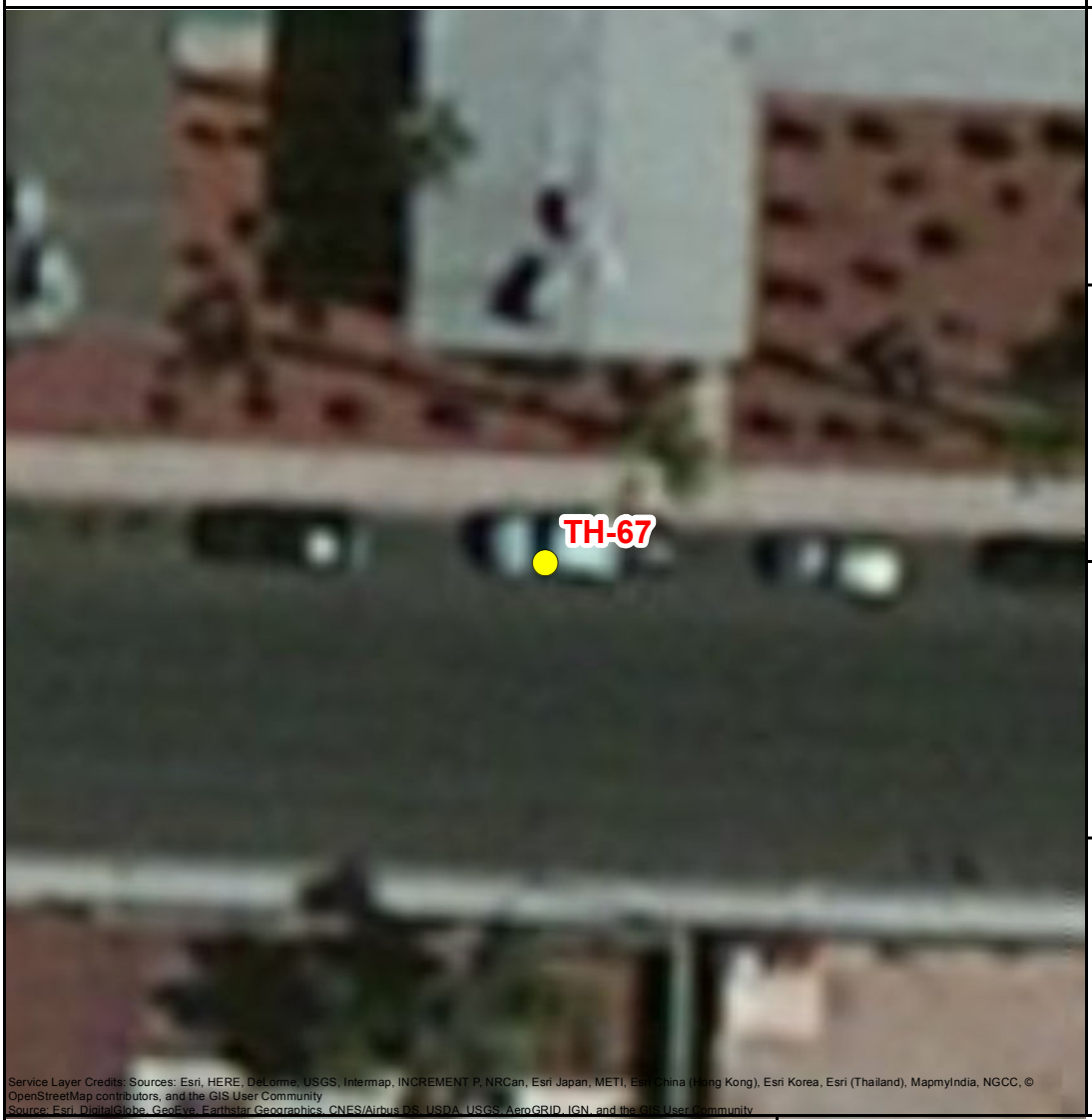
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	2.85	**Top Ref. Level:**	7.80	**Hand Meas. Top:**	4.95
Depth to Bottom:	3.02	**Bot. Ref. Level:**	7.97	**Hand Meas. Bot:**	N/A
Top Elevation:	1858.021	**Mkr. Ref. Level:**	4.95	**Ref. Elevation:**	1860.871
Bottom Elevation:	1857.851	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	2.40
B	Face of Curb	37.50
C	Corner of building	26.60

General Notes About This Test Hole

Orange tracer wire running with gas.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-68	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/12/2017	**HE Project #:**	LV-839-1619
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

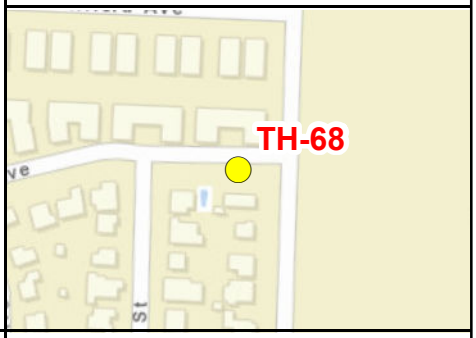
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	6 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.35	**Top Ref. Level:**	7.90	**Hand Meas. Top:**	3.36
Depth to Bottom:	3.85	**Bot. Ref. Level:**	8.40	**Hand Meas. Bot:**	N/A
Top Elevation:	1857.073	**Mkr. Ref. Level:**	4.55	**Ref. Elevation:**	1860.423
Bottom Elevation:	1856.573	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	2.80
B	Face of Curb	36.50
C	Street Light	38.50

General Notes About This Test Hole

No tear tape

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-69	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/12/2017	**HE Project #:**	LV-839-1620
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

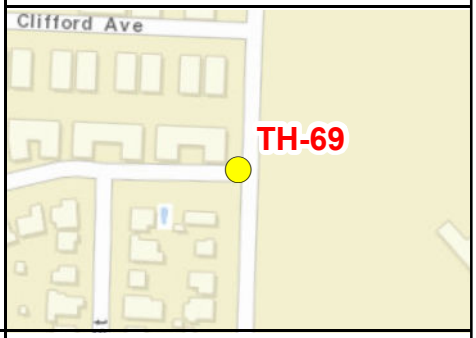
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

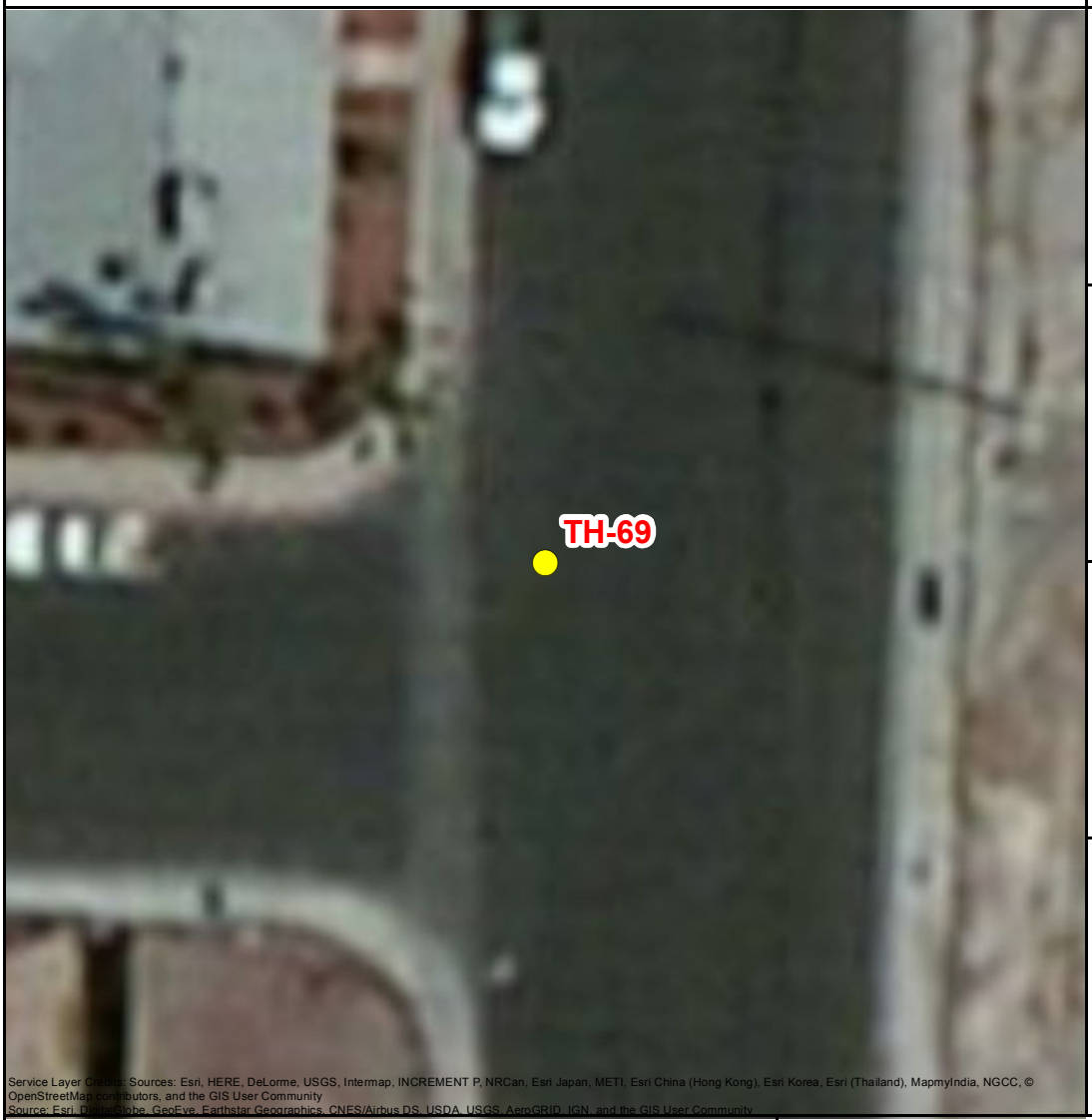
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	Nail
Depth to Top:	2.84	**Top Ref. Level:**	8.05	**Hand Meas. Top:**	2.85
Depth to Bottom:	3.01	**Bot. Ref. Level:**	8.22	**Hand Meas. Bot:**	N/A
Top Elevation:	1856.458	**Mkr. Ref. Level:**	5.21	**Ref. Elevation:**	1859.298
Bottom Elevation:	1856.288	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Storm Drain Manhole	8.80
B	Storm Drain Manhole	26.40
C	Fire Hydrant	29.00

General Notes About This Test Hole

Pinned center of "T"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-70	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/12/2017	**HE Project #:**	LV-839-1621
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

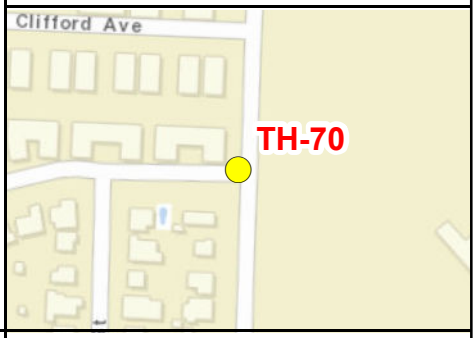
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	6 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.33	**Top Ref. Level:**	8.54	**Hand Meas. Top:**	3.34
Depth to Bottom:	3.83	**Bot. Ref. Level:**	9.04	**Hand Meas. Bot:**	N/A
Top Elevation:	1856.096	**Mkr. Ref. Level:**	5.21	**Ref. Elevation:**	1859.426
Bottom Elevation:	1855.596	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Storm Drain Manhole	8.80
B	Storm Drain Manhole	24.80
C	Fire Hydrant	29.00

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-71	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/12/2017	**HE Project #:**	LV-839-1622
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

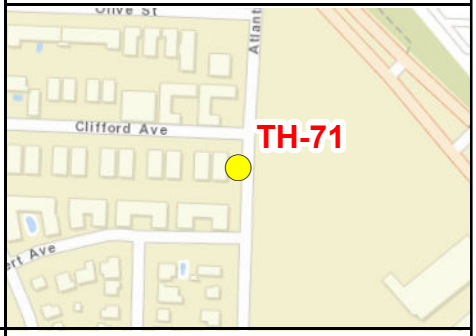
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

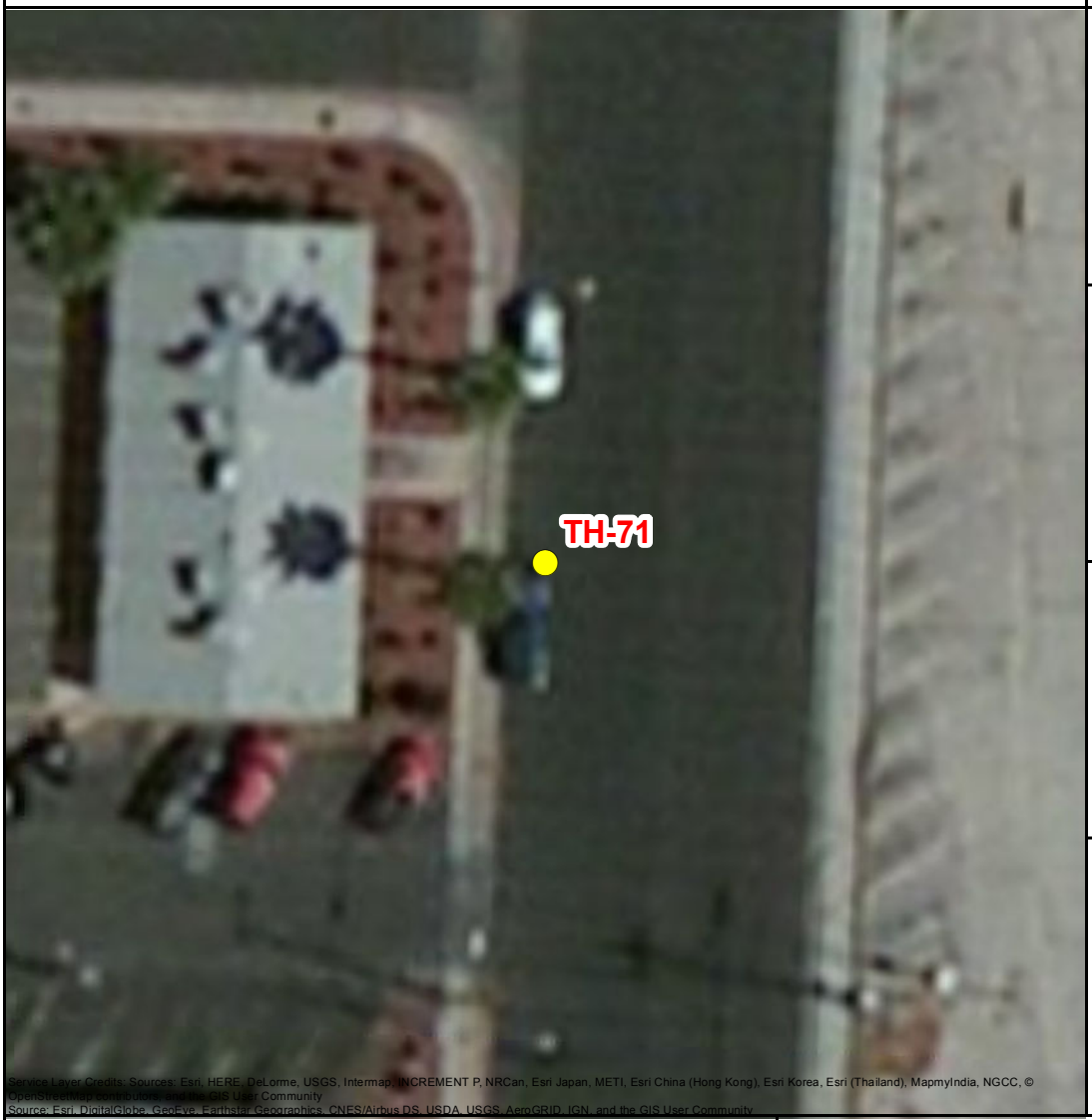
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.66	**Top Ref. Level:**	7.91	**Hand Meas. Top:**	3.75
Depth to Bottom:	3.83	**Bot. Ref. Level:**	8.08	**Hand Meas. Bot:**	N/A
Top Elevation:	1854.621	**Mkr. Ref. Level:**	4.25	**Ref. Elevation:**	1858.281
Bottom Elevation:	1854.451	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	2.1

N

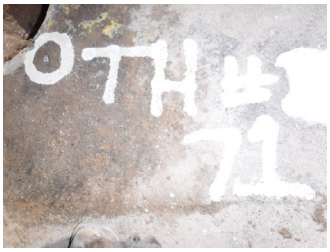
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	46.40
B	Street Light	39.20
C	Power Pole	68.30

General Notes About This Test Hole

Hit red tear tape @ 27"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-72	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/11/2017	**HE Project #:**	LV-839-1623
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

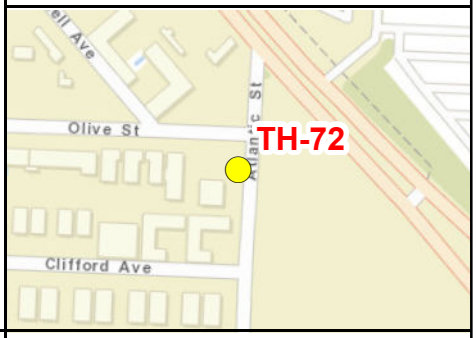
1349 Galleria Drive, Suite 110
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Phone: 702-966-4063

Test Hole Data

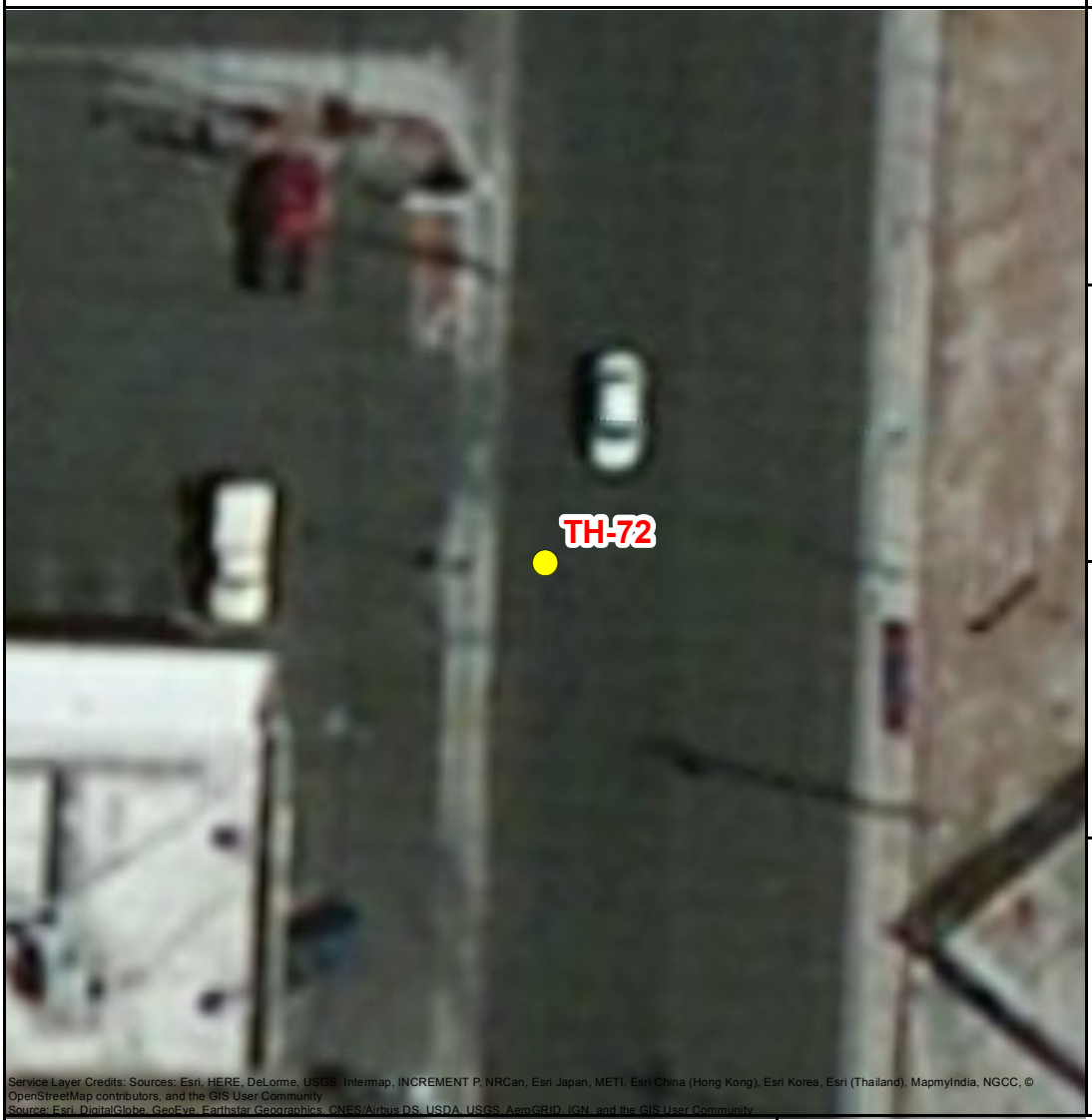
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	4.23	**Top Ref. Level:**	9.79	**Hand Meas. Top:**	4.24
Depth to Bottom:	4.90	**Bot. Ref. Level:**	10.46	**Hand Meas. Bot:**	N/A
Top Elevation:	1852.850	**Mkr. Ref. Level:**	5.56	**Ref. Elevation:**	1857.080
Bottom Elevation:	1852.180	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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Overall Location of Test Hole



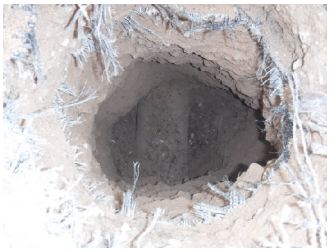
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Storm Drain Manhole	40.70
B	Power Pole	59.30
C	Face of curb	2.50

General Notes About This Test Hole

(Dug 2 holes) Dug on one-call marks, moved second hole 3' west off one call marks

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-73	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/12/2017	**HE Project #:**	LV-839-1624
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

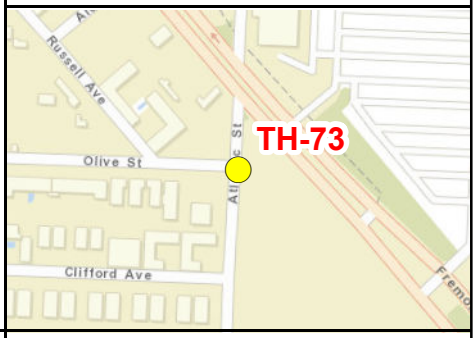
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Phone: 702-966-4063

Test Hole Data

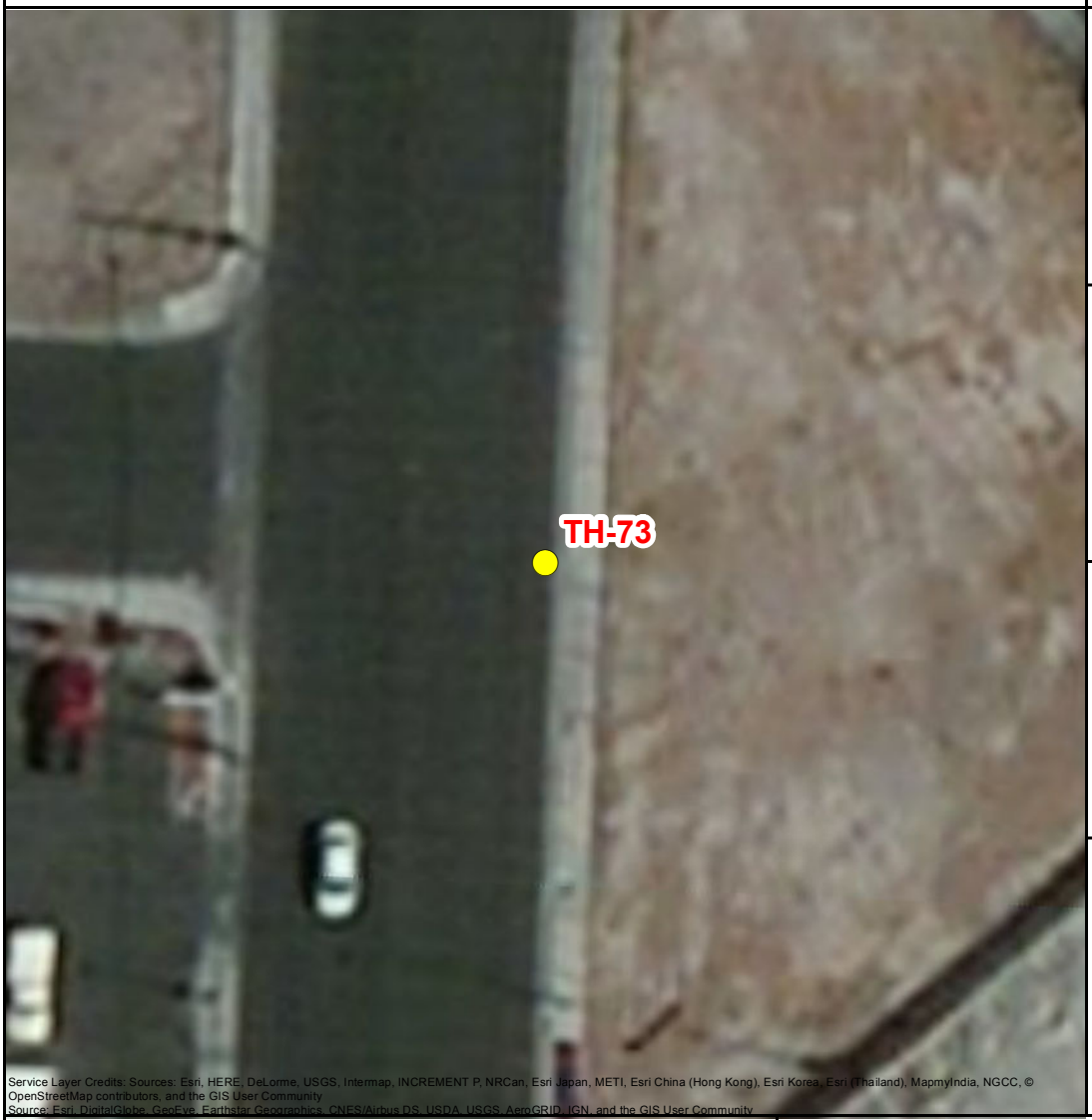
Utility Type:	Water	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	7.55	**Top Ref. Level:**	12.31	**Hand Meas. Top:**	7.56
Depth to Bottom:	7.72	**Bot. Ref. Level:**	12.48	**Hand Meas. Bot:**	N/A
Top Elevation:	1849.389	**Mkr. Ref. Level:**	4.76	**Ref. Elevation:**	1856.939
Bottom Elevation:	1849.219	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	10.5

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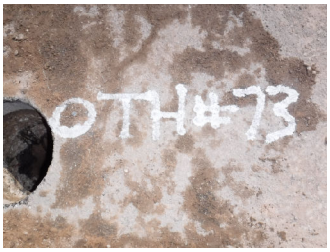
Overall Location of Test Hole



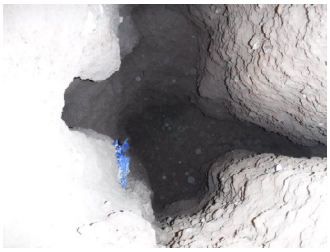
TEST HOLE LOCATION PLAN



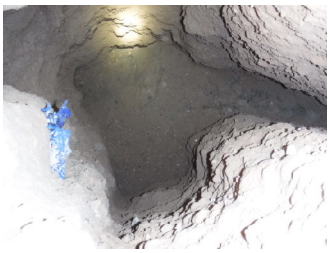
TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3



Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	72.50
B	Sewer Manhole	24.20
C	Storm Drain Manhole	25.20

General Notes About This Test Hole

Dug 2 holes. Pipe is encased in concrete, pinned center of concrete for 90 degree bend. Hit blue tear tabe @ 45". Encasement is 24" wide

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-74	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/10/2017	**HE Project #:**	LV-839-1625
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

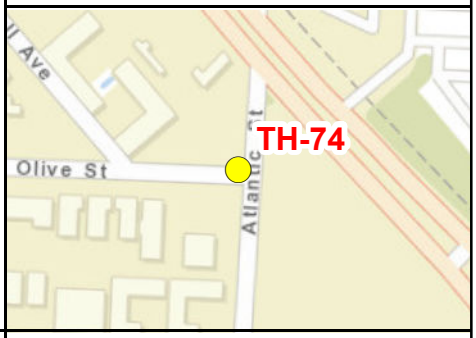
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Phone: 702-966-4063

Test Hole Data

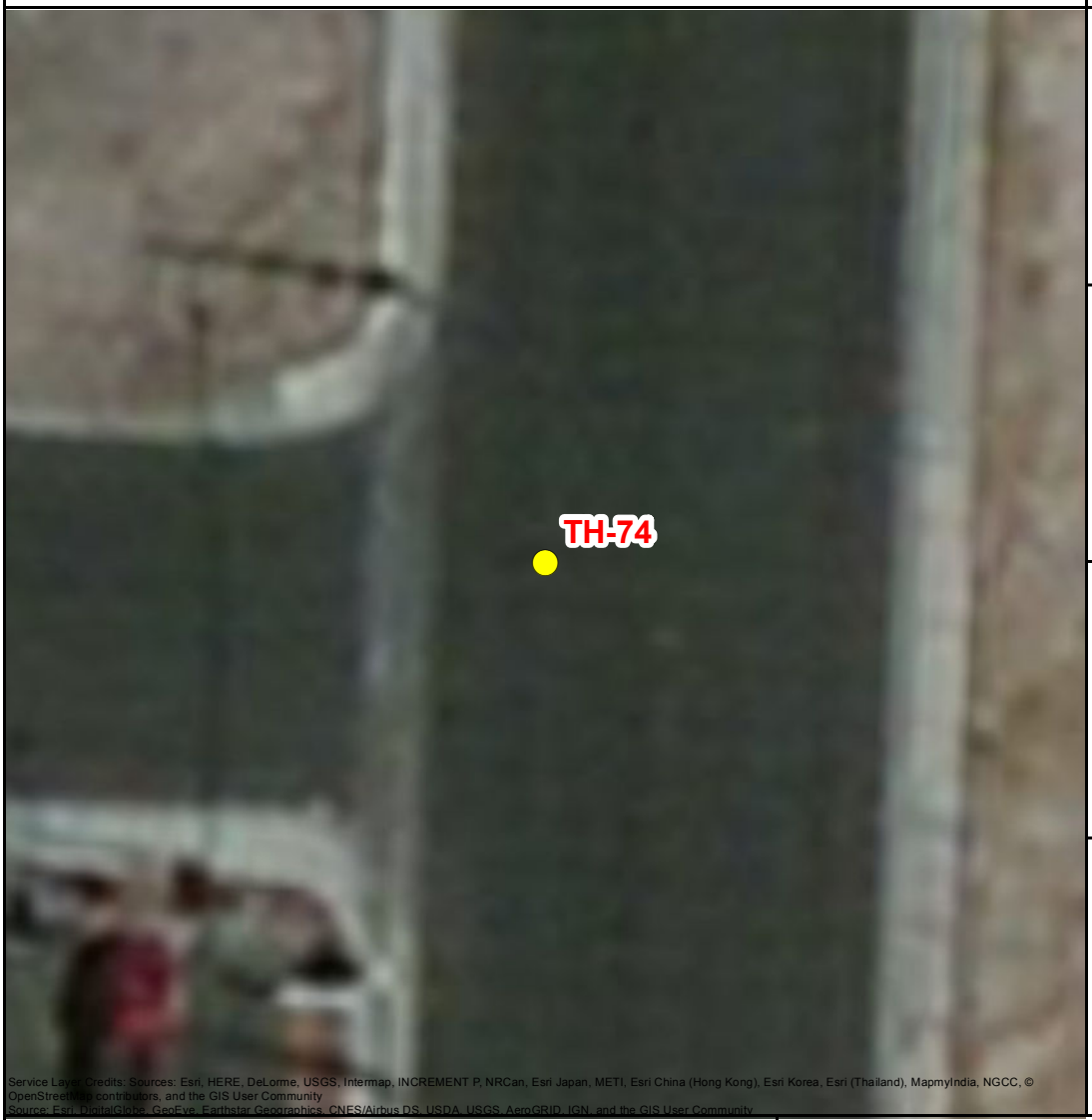
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.05	**Top Ref. Level:**	8.09	**Hand Meas. Top:**	3.07
Depth to Bottom:	3.22	**Bot. Ref. Level:**	8.26	**Hand Meas. Bot:**	N/A
Top Elevation:	1853.823	**Mkr. Ref. Level:**	5.04	**Ref. Elevation:**	1856.873
Bottom Elevation:	1853.653	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	28.30
B	Street Light	46.50
C	Sewer Manhole	13.40

General Notes About This Test Hole

Pinned center of angle point

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-75	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/10/2017	**HE Project #:**	LV-839-1626
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

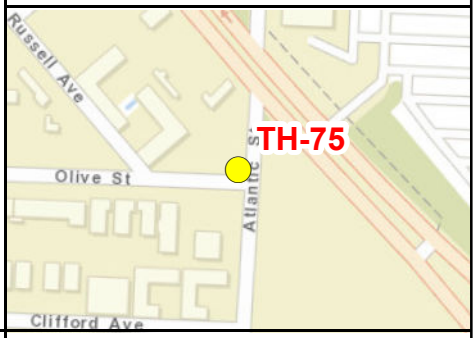
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

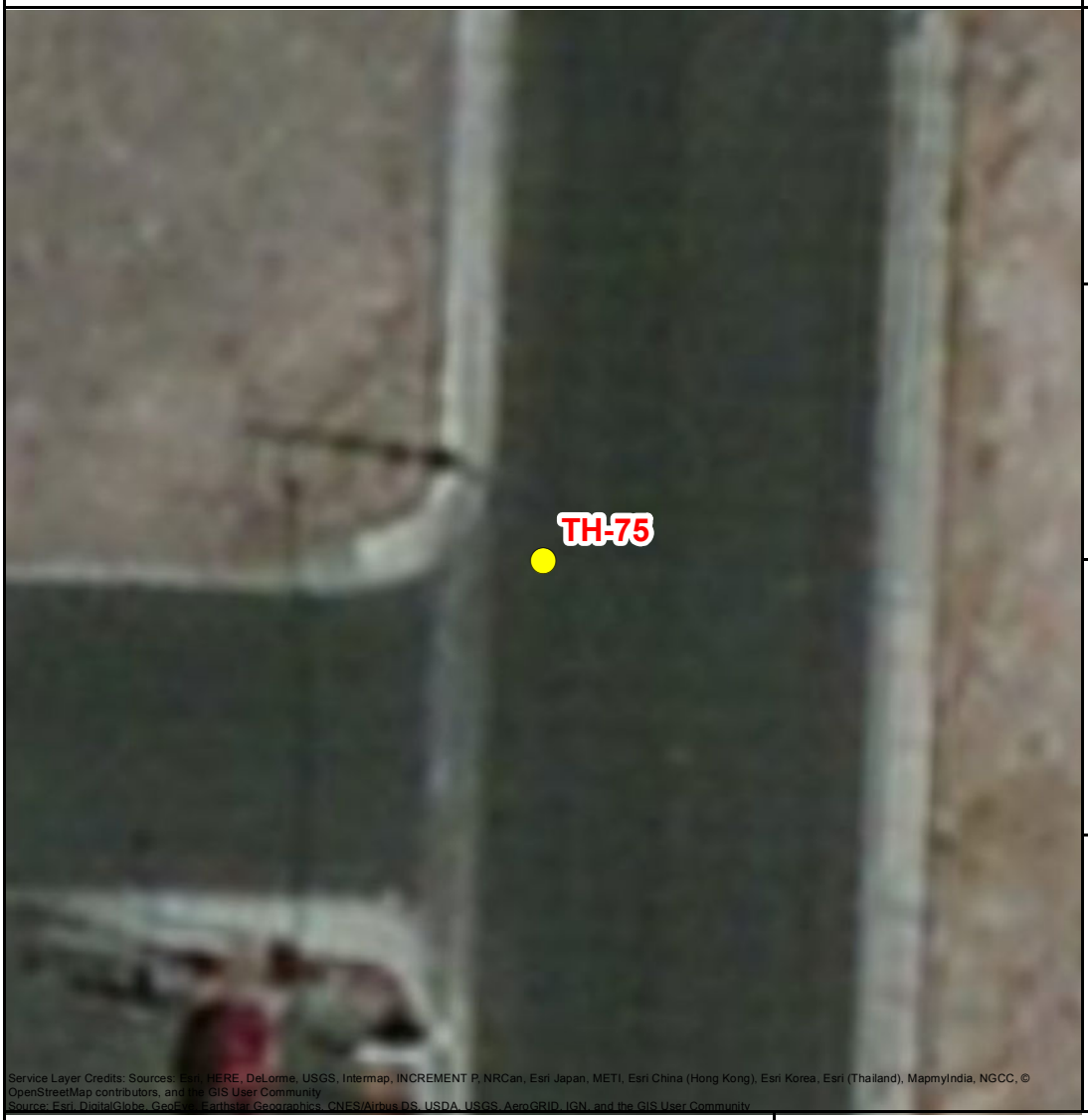
Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Clay
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	4.39	**Top Ref. Level:**	9.90	**Hand Meas. Top:**	4.40
Depth to Bottom:	5.06	**Bot. Ref. Level:**	10.57	**Hand Meas. Bot:**	N/A
Top Elevation:	1852.207	**Mkr. Ref. Level:**	5.51	**Ref. Elevation:**	1856.597
Bottom Elevation:	1851.537	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



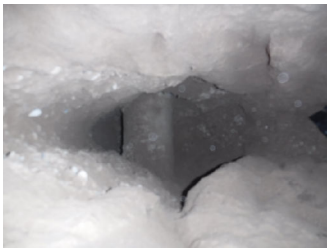
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	55.80
B	Power Pole	11.60
C	Sewer Manhole	29.00

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-76	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/10/2017	**HE Project #:**	LV-839-1627
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

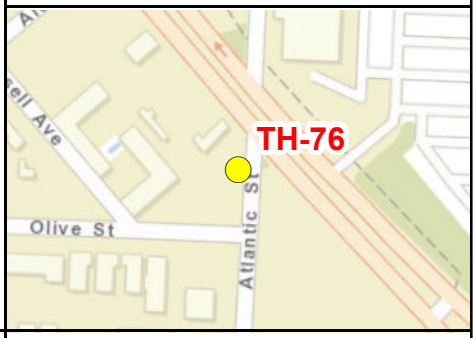
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

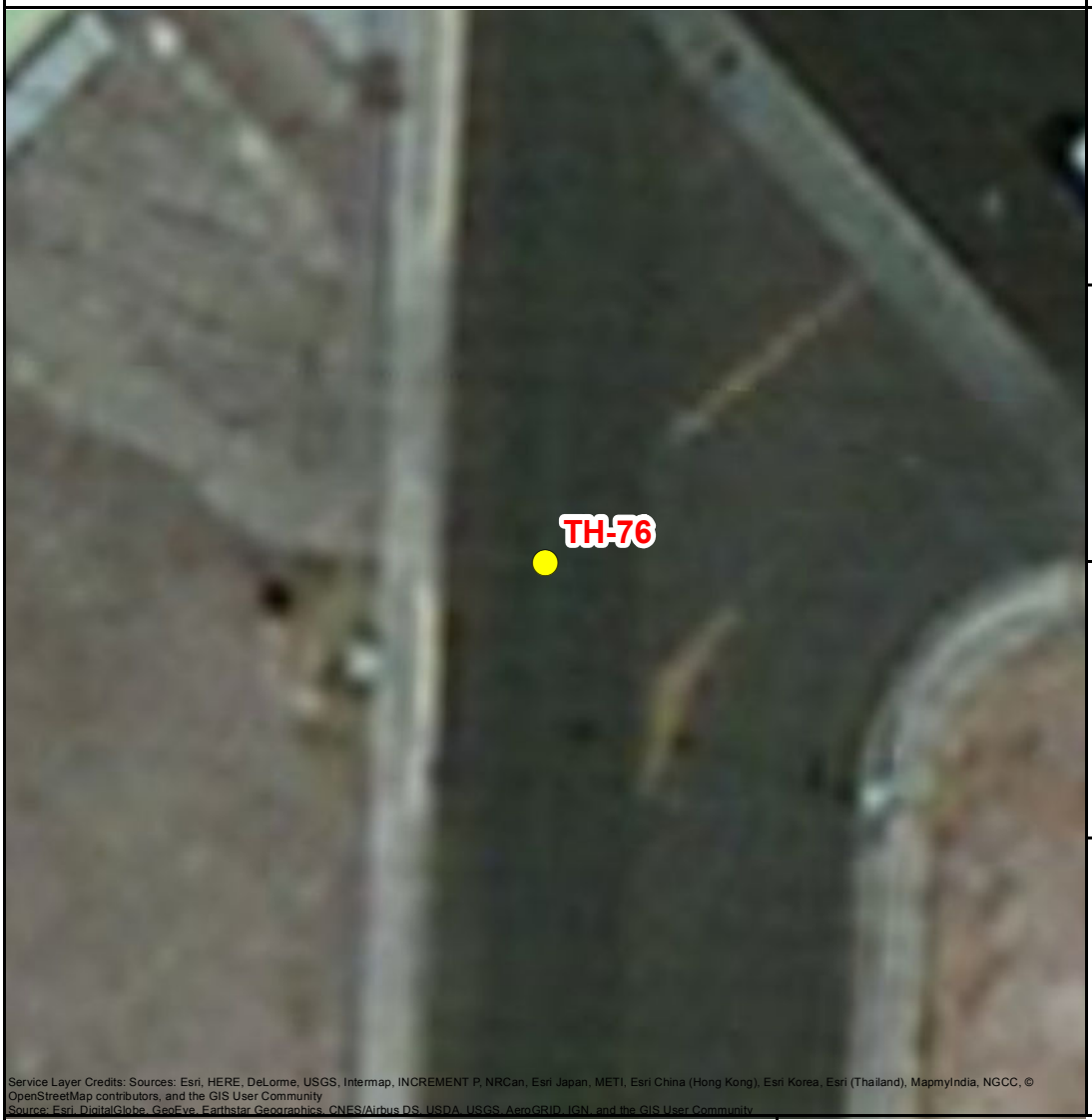
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.82	**Top Ref. Level:**	9.15	**Hand Meas. Top:**	3.83
Depth to Bottom:	3.99	**Bot. Ref. Level:**	9.32	**Hand Meas. Bot:**	N/A
Top Elevation:	1852.719	**Mkr. Ref. Level:**	5.33	**Ref. Elevation:**	1856.539
Bottom Elevation:	1852.549	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Fire Hydrant	21.11
B	Storm Drain Manhole	50.20
C	Street Light	50.10

General Notes About This Test Hole

Pinned center of "T"

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-77	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/10/2017	**HE Project #:**	LV-839-1628
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

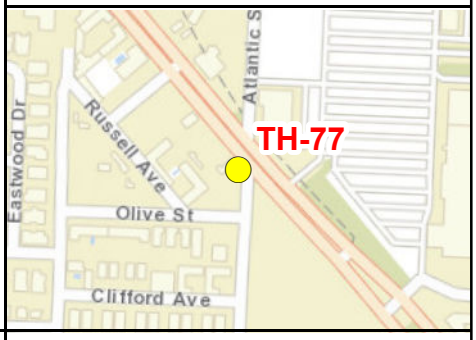
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Telephone	**Utility Size:**	16 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	2.87	**Top Ref. Level:**	7.88	**Hand Meas. Top:**	2.89
Depth to Bottom:	4.20	**Bot. Ref. Level:**	9.21	**Hand Meas. Bot:**	N/A
Top Elevation:	1854.029	**Mkr. Ref. Level:**	5.01	**Ref. Elevation:**	1856.899
Bottom Elevation:	1852.699	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	53.40
B	Storm Drain Manhole	27.00
C	Street Light	97.00

General Notes About This Test Hole

At this pothole location, pinned center of concrete encasement. Measurement from east edge of encasement 8" form center of pin (16" encasement)

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-78	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/10/2017	**HE Project #:**	LV-839-1629
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

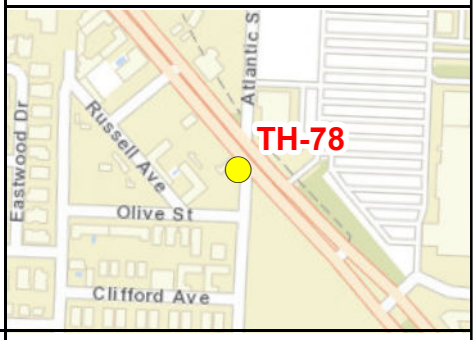
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Test Hole Data

Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	4.50	**Top Ref. Level:**	9.82	**Hand Meas. Top:**	4.50
Depth to Bottom:	5.17	**Bot. Ref. Level:**	10.49	**Hand Meas. Bot:**	N/A
Top Elevation:	1852.066	**Mkr. Ref. Level:**	5.32	**Ref. Elevation:**	1856.566
Bottom Elevation:	1851.396	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	53.40
B	Storm Drain Manhole	21.20
C	Street Light	98.80

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-79	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/14/2017	**HE Project #:**	LV-839-1630
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

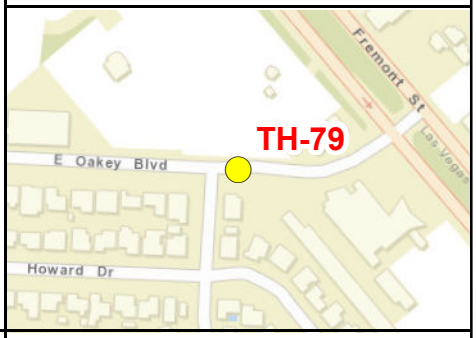
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Test Hole Data

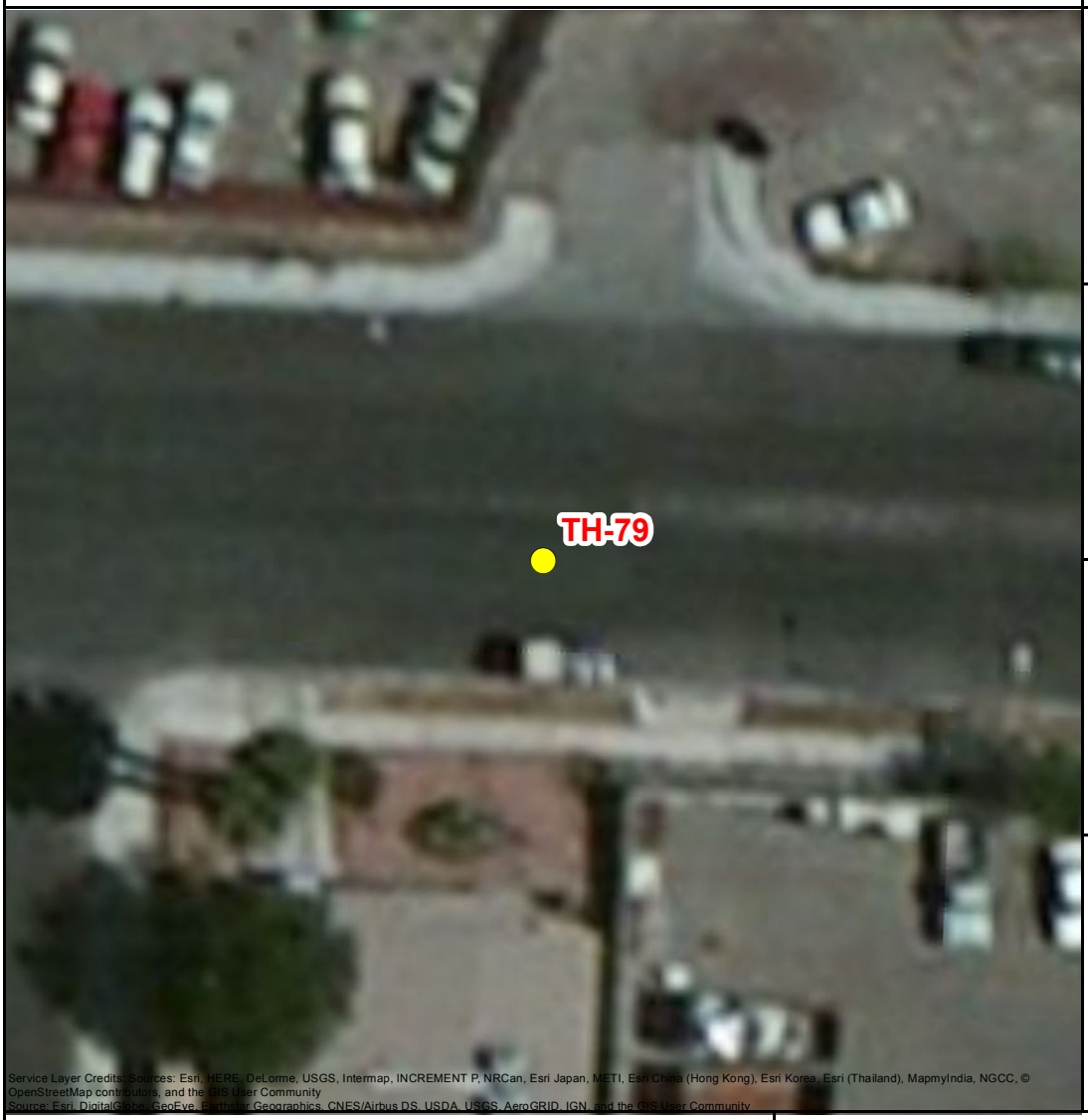
Utility Type:	Gas	**Utility Size:**	4 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	Nail
Depth to Top:	4.20	**Top Ref. Level:**	9.29	**Hand Meas. Top:**	4.21
Depth to Bottom:	4.53	**Bot. Ref. Level:**	9.62	**Hand Meas. Bot:**	N/A
Top Elevation:	1843.636	**Mkr. Ref. Level:**	5.09	**Ref. Elevation:**	1847.836
Bottom Elevation:	1843.306	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



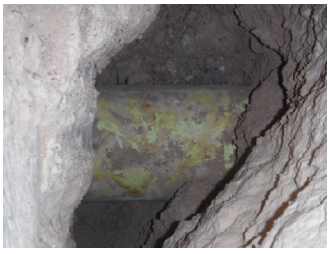
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	20.40
B	Street Light	66.50
C	Street Light	47.70

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-80	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/20/2017	**HE Project #:**	LV-839-1631
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

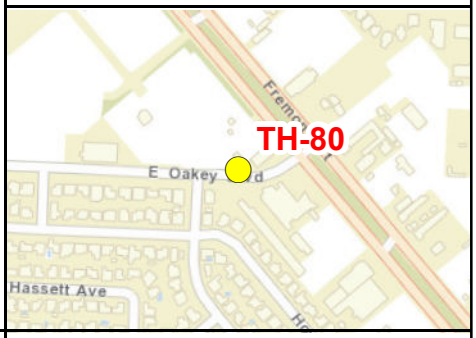
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Electric	**Utility Size:**	6 Inches	**Utility Material:**	Plastic
Utility Company:	NVE	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	2.79	**Top Ref. Level:**	8.00	**Hand Meas. Top:**	2.79
Depth to Bottom:	3.29	**Bot. Ref. Level:**	8.50	**Hand Meas. Bot:**	N/A
Top Elevation:	1843.916	**Mkr. Ref. Level:**	5.21	**Ref. Elevation:**	1846.706
Bottom Elevation:	1843.416	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	13.70
B	Street Light	118.40
C	Face of curb	57.30

General Notes About This Test Hole

2 (6") conduits 15" wide. The north edge of the conduit closest to the curb is 1.1' S of curb.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-81	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/20/2017	**HE Project #:**	LV-839-1632
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

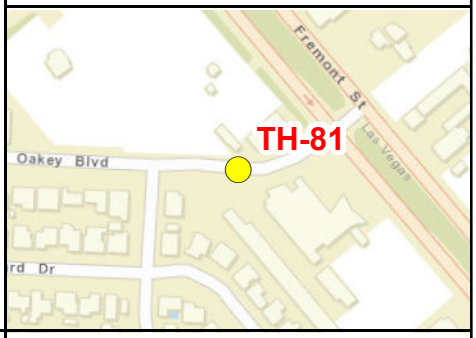
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Phone: 702-966-4063

Test Hole Data

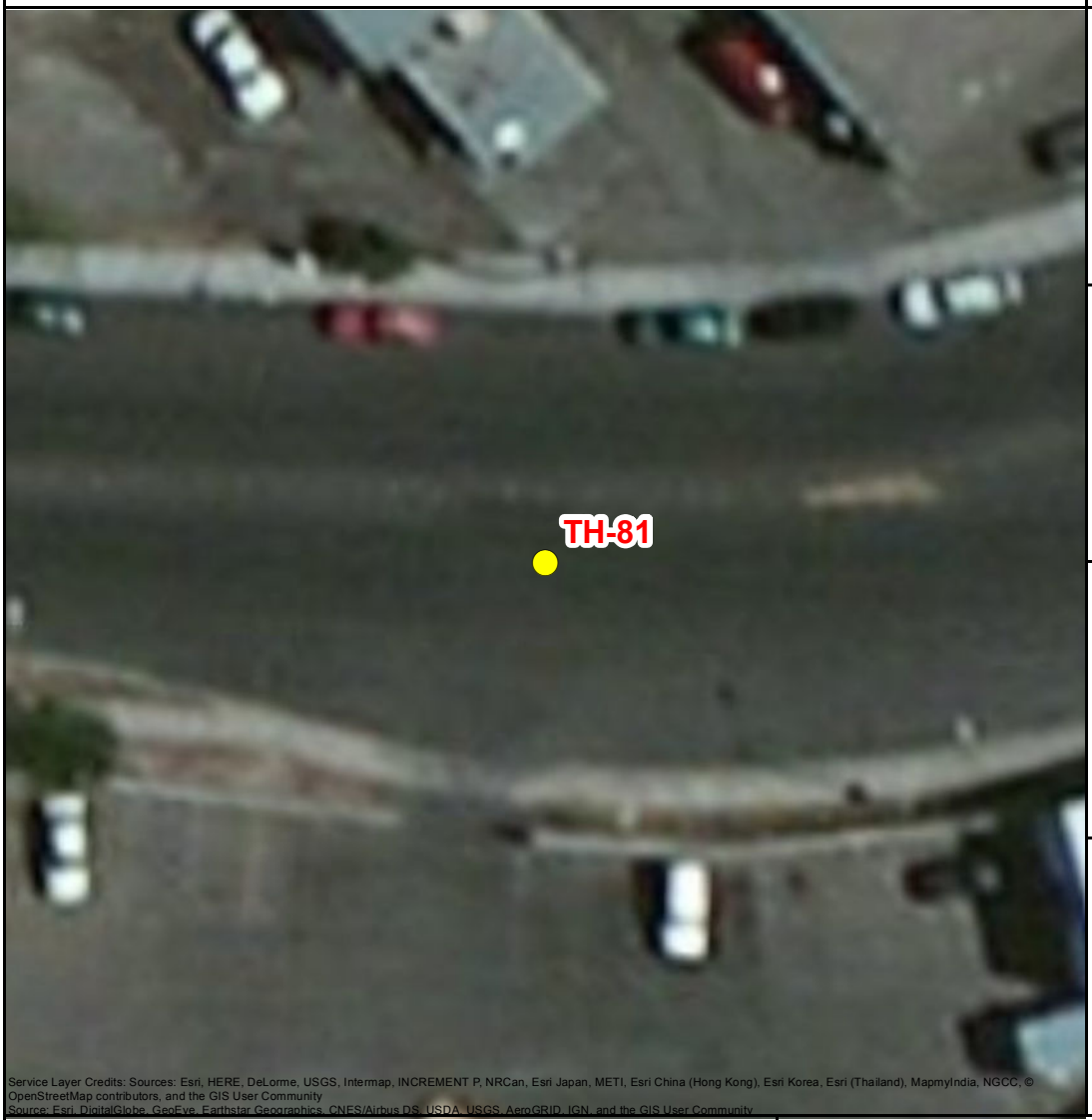
Utility Type:	Gas	**Utility Size:**	4 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Slurry/Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	5.01	**Top Ref. Level:**	9.88	**Hand Meas. Top:**	5.00
Depth to Bottom:	5.34	**Bot. Ref. Level:**	10.21	**Hand Meas. Bot:**	N/A
Top Elevation:	1841.663	**Mkr. Ref. Level:**	4.87	**Ref. Elevation:**	1846.673
Bottom Elevation:	1841.333	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	66.50
B	Power Pole	37.40
C	Street Light	47.70

General Notes About This Test Hole

Slurry is 27" thick. Pinned center of "T". Hit yellow tear tape @ 27" from bottom of asphalt.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-82	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/20/2017	**HE Project #:**	LV-839-1633
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

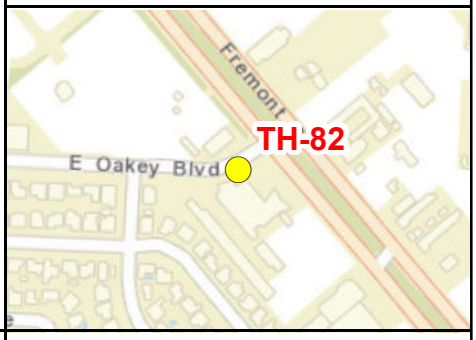
1349 Galleria Drive, Suite 110
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Phone: 702-966-4063

Test Hole Data

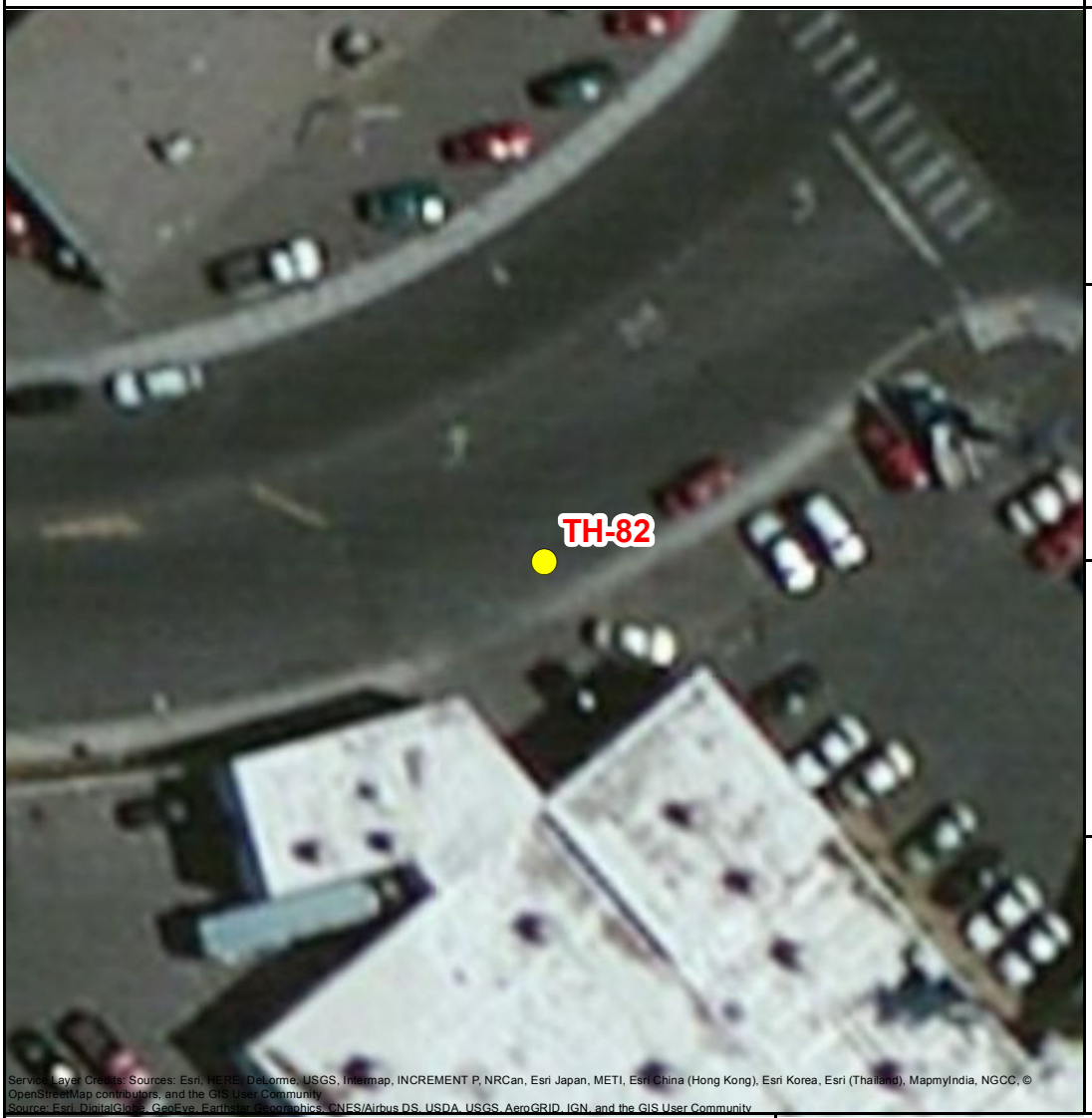
Utility Type:	Gas	**Utility Size:**	4 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Slurry/Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nail
Depth to Top:	2.61	**Top Ref. Level:**	7.43	**Hand Meas. Top:**	2.62
Depth to Bottom:	2.94	**Bot. Ref. Level:**	7.76	**Hand Meas. Bot:**	N/A
Top Elevation:	1842.989	**Mkr. Ref. Level:**	4.82	**Ref. Elevation:**	1845.599
Bottom Elevation:	1842.659	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	90.10
B	Street Light	63.80
C	Street Light	68.30

General Notes About This Test Hole

Slurry is 28" thick from top of asphalt. Yellow tear tape directly above pipe.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-83	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/20/2017	**HE Project #:**	LV-839-1634
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

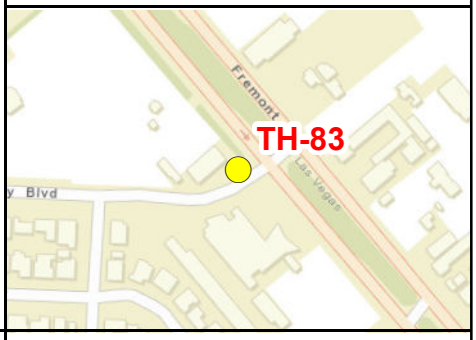
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

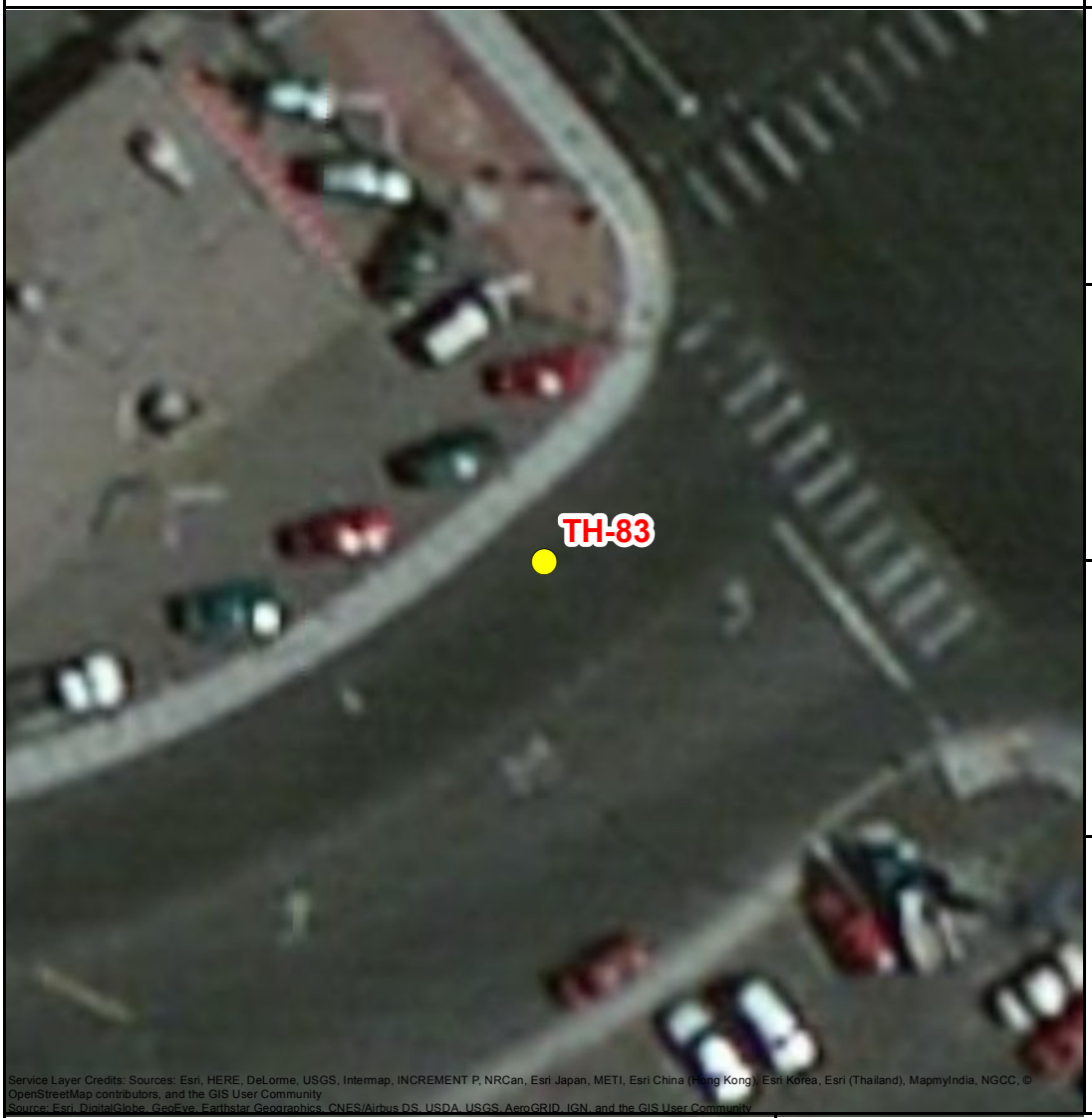
Utility Type:	Electric	**Utility Size:**	(2) 6 Inch	**Utility Material:**	Plastic
Utility Company:	NVE	**English/Metric:**	English	**Soil Conditions:**	Clay
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	6.80	**Top Ref. Level:**	11.77	**Hand Meas. Top:**	6.81
Depth to Bottom:	7.80	**Bot. Ref. Level:**	12.77	**Hand Meas. Bot:**	N/A
Top Elevation:	1838.018	**Mkr. Ref. Level:**	4.97	**Ref. Elevation:**	1844.818
Bottom Elevation:	1837.018	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	71.00
B	Telephone Pole	35.00
C	Face of Curb	35.10

General Notes About This Test Hole

2 (6") conduits / the north edge of the conduit closet to the curb is 4.1' south of curb/

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-84	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/20/2017	**HE Project #:**	LV-839-1635
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

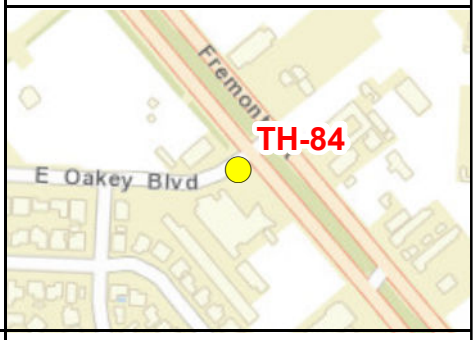
1349 Galleria Drive, Suite 110
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Phone: 702-966-4063

Test Hole Data

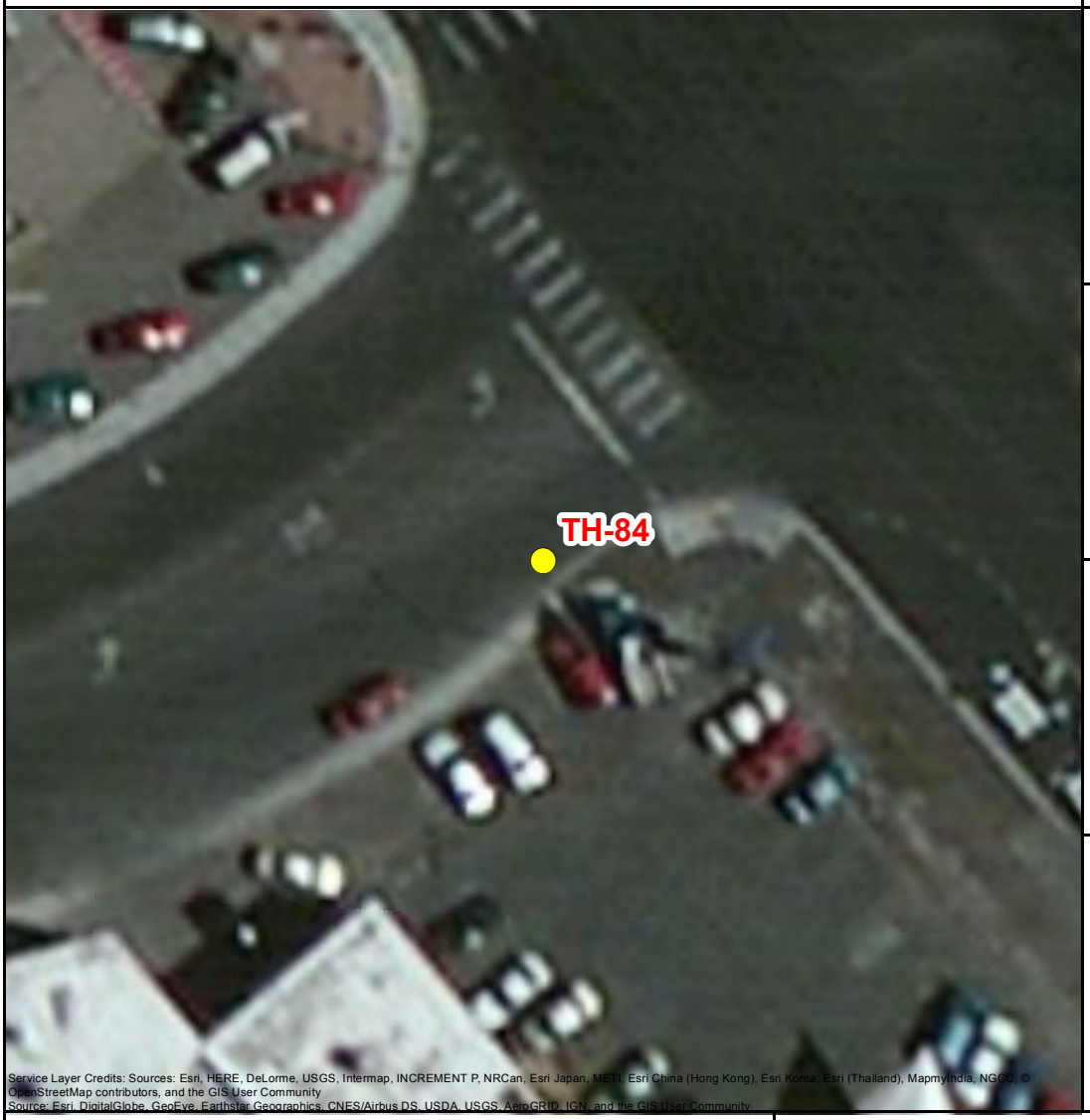
Utility Type:	Gas	**Utility Size:**	4 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Slurry/Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nail
Depth to Top:	2.67	**Top Ref. Level:**	7.64	**Hand Meas. Top:**	2.68
Depth to Bottom:	3.00	**Bot. Ref. Level:**	7.97	**Hand Meas. Bot:**	N/A
Top Elevation:	1842.235	**Mkr. Ref. Level:**	4.97	**Ref. Elevation:**	1844.905
Bottom Elevation:	1841.905	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	18.10
B	Street Light	83.20
C	Telephone Pole	74.50

General Notes About This Test Hole

Hit slurry in this hole, slurry is 24" from the top of ashpalt. Yellow tear tape directly above pipe. Orange tracer wire running w/ gas.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-86	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/14/2017	**HE Project #:**	LV-839-1636
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

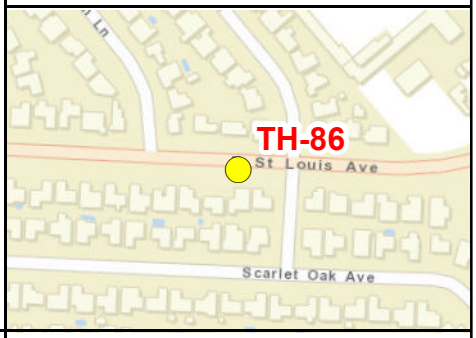
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Phone: 702-966-4063

Test Hole Data

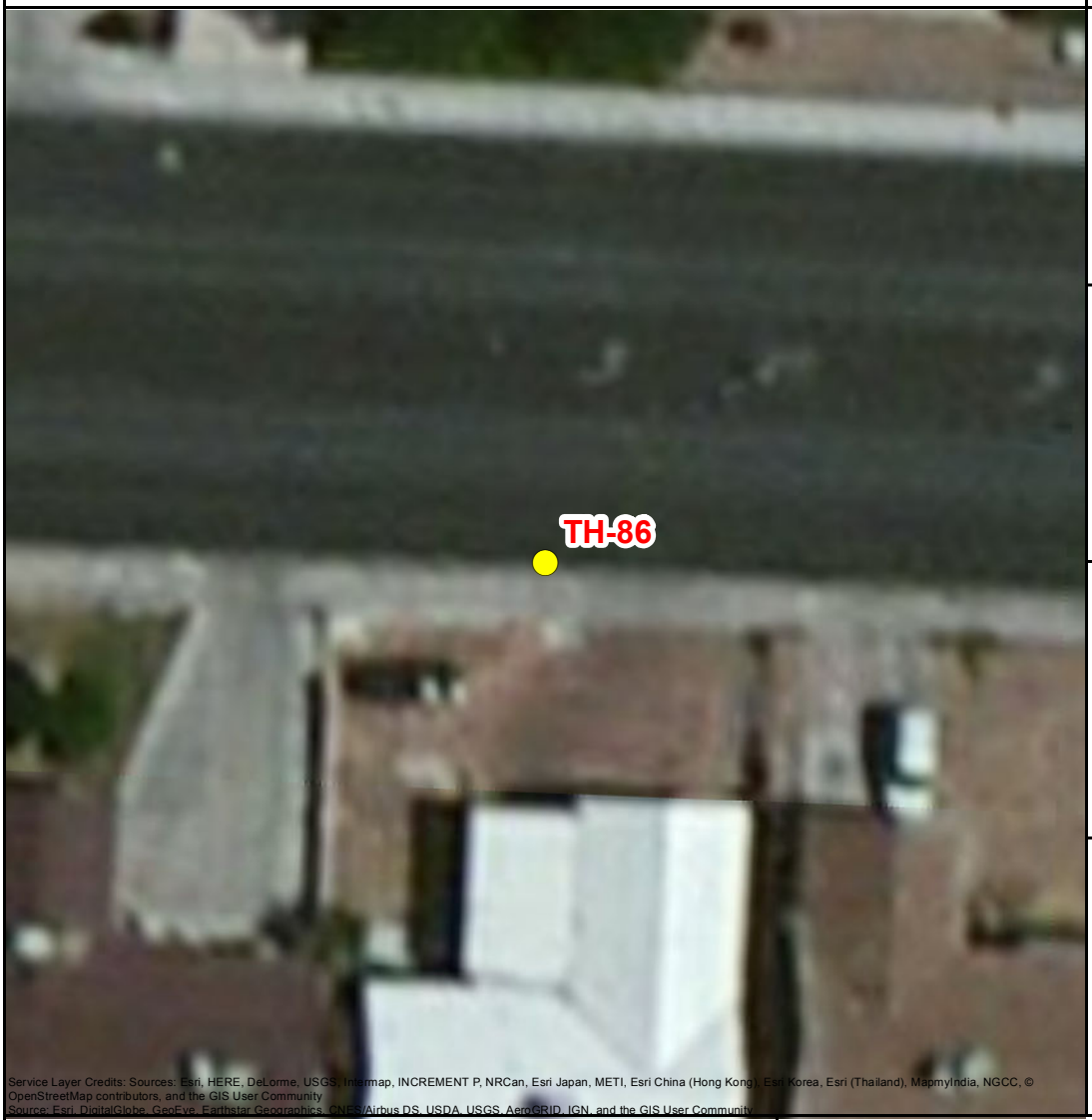
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Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Slurry/Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.04	**Top Ref. Level:**	7.87	**Hand Meas. Top:**	3.04
Depth to Bottom:	3.21	**Bot. Ref. Level:**	8.04	**Hand Meas. Bot:**	N/A
Top Elevation:	1835.691	**Mkr. Ref. Level:**	4.83	**Ref. Elevation:**	1838.731
Bottom Elevation:	1835.521	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Meter	65.10
B	Face of Curb	58.90
C	Water Meter	13.30

General Notes About This Test Hole

22" of slurry over utility

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-87	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/14/2017	**HE Project #:**	LV-839-1637
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

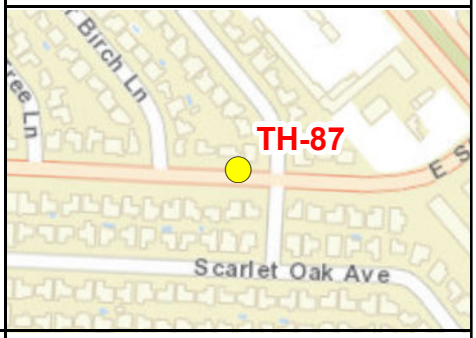
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	6 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	PK Nail
Depth to Top:	4.45	**Top Ref. Level:**	9.25	**Hand Meas. Top:**	4.46
Depth to Bottom:	4.95	**Bot. Ref. Level:**	9.75	**Hand Meas. Bot:**	N/A
Top Elevation:	1834.431	**Mkr. Ref. Level:**	4.80	**Ref. Elevation:**	1838.881
Bottom Elevation:	1833.931	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	79.40
B	Fire Hydrant	63.80
C	Water Meter Pull Box	65.40

General Notes About This Test Hole

No tear tape in testhole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-88	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/13/2017	**HE Project #:**	LV-839-1638
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

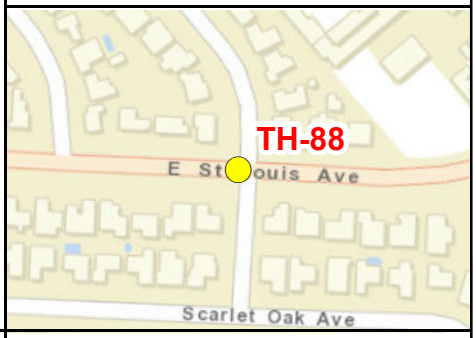
1349 Galleria Drive, Suite 110
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Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	8 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	9 Inches	**Marker Type:**	PK Nail
Depth to Top:	4.42	**Top Ref. Level:**	8.84	**Hand Meas. Top:**	4.40
Depth to Bottom:	5.09	**Bot. Ref. Level:**	9.51	**Hand Meas. Bot:**	N/A
Top Elevation:	1833.339	**Mkr. Ref. Level:**	4.42	**Ref. Elevation:**	1837.759
Bottom Elevation:	1832.669	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	24.00
B	Sewer Manhole	11.90
C	Edge of Asphalt	26.30

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-89	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/13/2017	**HE Project #:**	LV-839-1639
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

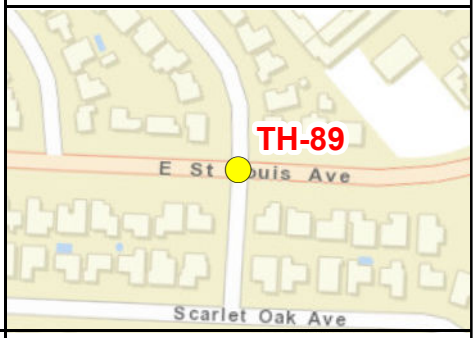
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

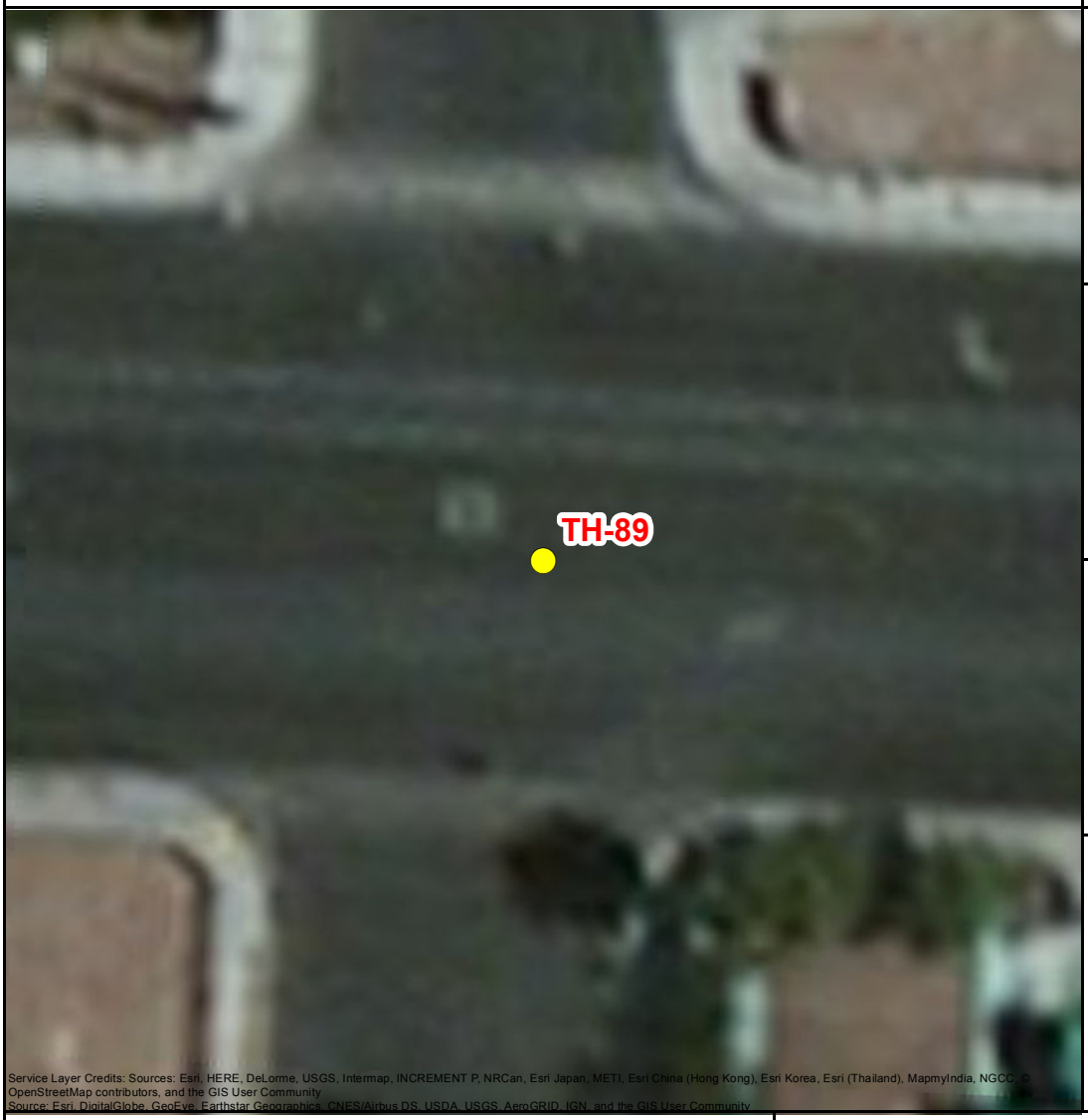
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Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Slurry/Sand
Surface Type:	Asphalt	**Thickness:**	9 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.17	**Top Ref. Level:**	7.94	**Hand Meas. Top:**	3.20
Depth to Bottom:	3.34	**Bot. Ref. Level:**	8.11	**Hand Meas. Bot:**	N/A
Top Elevation:	1834.447	**Mkr. Ref. Level:**	4.77	**Ref. Elevation:**	1837.617
Bottom Elevation:	1834.277	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Gas (test point)	33.70
B	Sewer Manhole	5.70
C	Edge of Asphalt	26.70

General Notes About This Test Hole

21" of slurry. Also found yellow tear tape at 40".

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-90	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/14/2017	**HE Project #:**	LV-839-1640
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

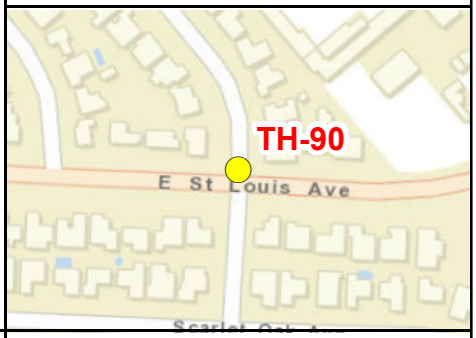
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Phone: 702-966-4063

Test Hole Data

Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	Nail
Depth to Top:	3.12	**Top Ref. Level:**	7.36	**Hand Meas. Top:**	3.12
Depth to Bottom:	3.29	**Bot. Ref. Level:**	7.53	**Hand Meas. Bot:**	N/A
Top Elevation:	1834.072	**Mkr. Ref. Level:**	4.24	**Ref. Elevation:**	1837.192
Bottom Elevation:	1833.902	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	16.60
B	Sewer Manhole	24.10
C	Test point	8.30

General Notes About This Test Hole

pin is 5" N of where gas crosses the water. Slurry is 14" thick.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-91	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/13/2014	**HE Project #:**	LV-839-1641
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

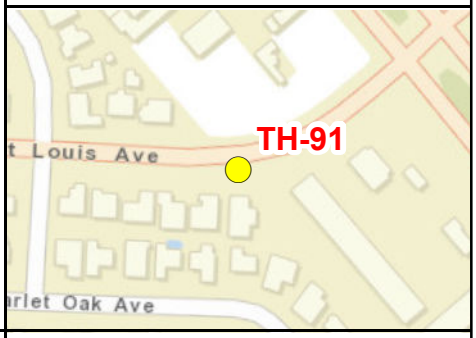
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Phone: 702-966-4063

Test Hole Data

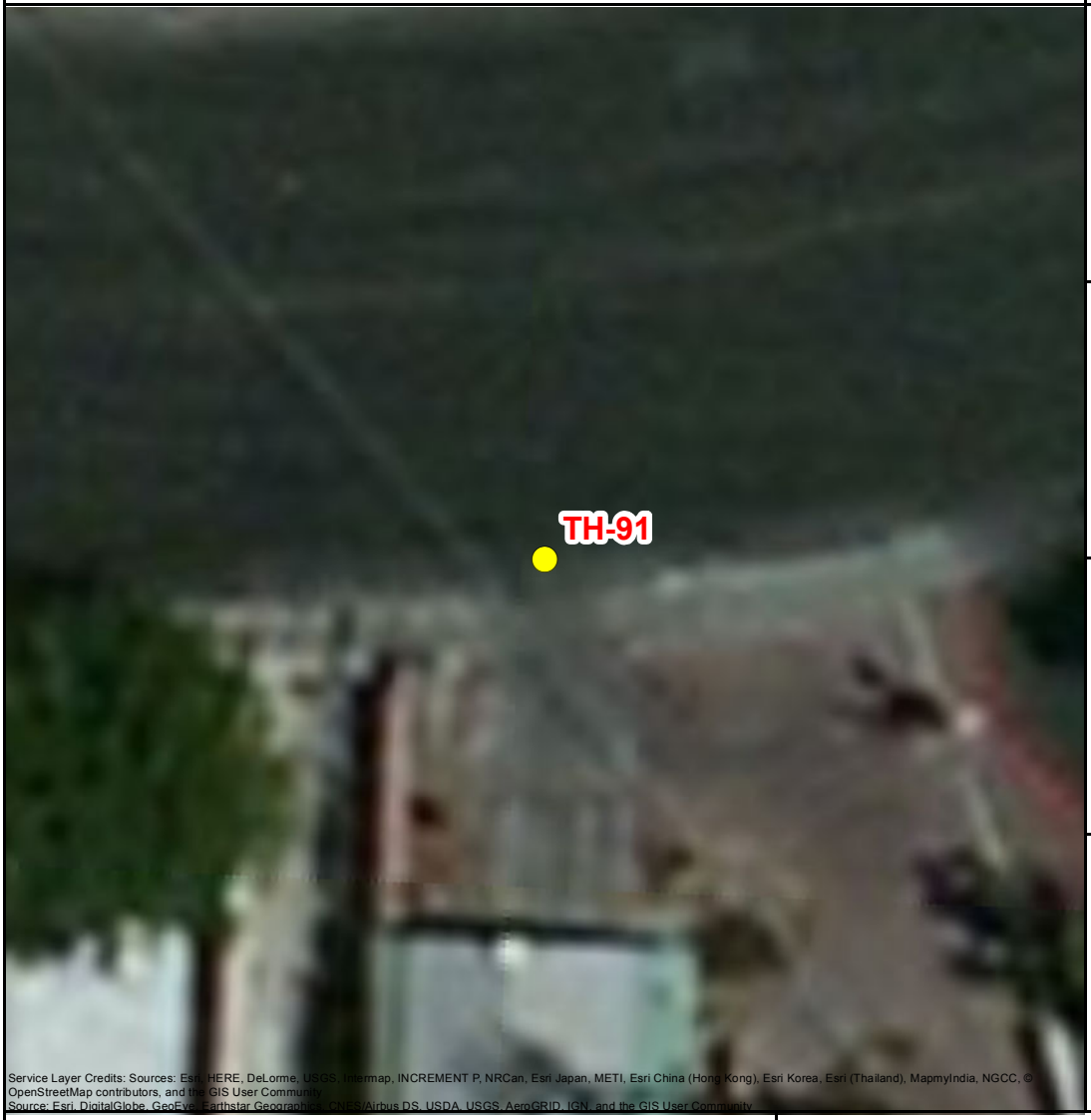
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Slurry/Sand
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	2.60	**Top Ref. Level:**	7.82	**Hand Meas. Top:**	2.60
Depth to Bottom:	2.77	**Bot. Ref. Level:**	7.99	**Hand Meas. Bot:**	N/A
Top Elevation:	1830.583	**Mkr. Ref. Level:**	5.22	**Ref. Elevation:**	1833.183
Bottom Elevation:	1830.413	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Water Valve	47.80
B	Sewer Manhole	32.60
C	Face of curb	4.60

General Notes About This Test Hole

18" of slurry over utility. Pin is directly over 90 degree angle point.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-92	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/14/2017	**HE Project #:**	LV-839-1642
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

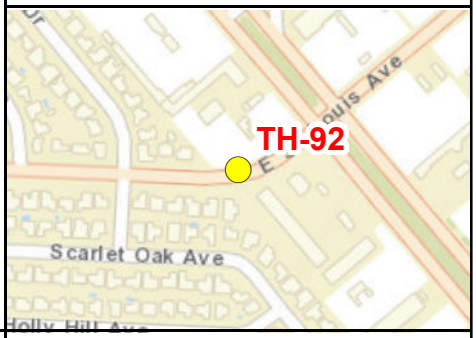
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Phone: 702-966-4063

Test Hole Data

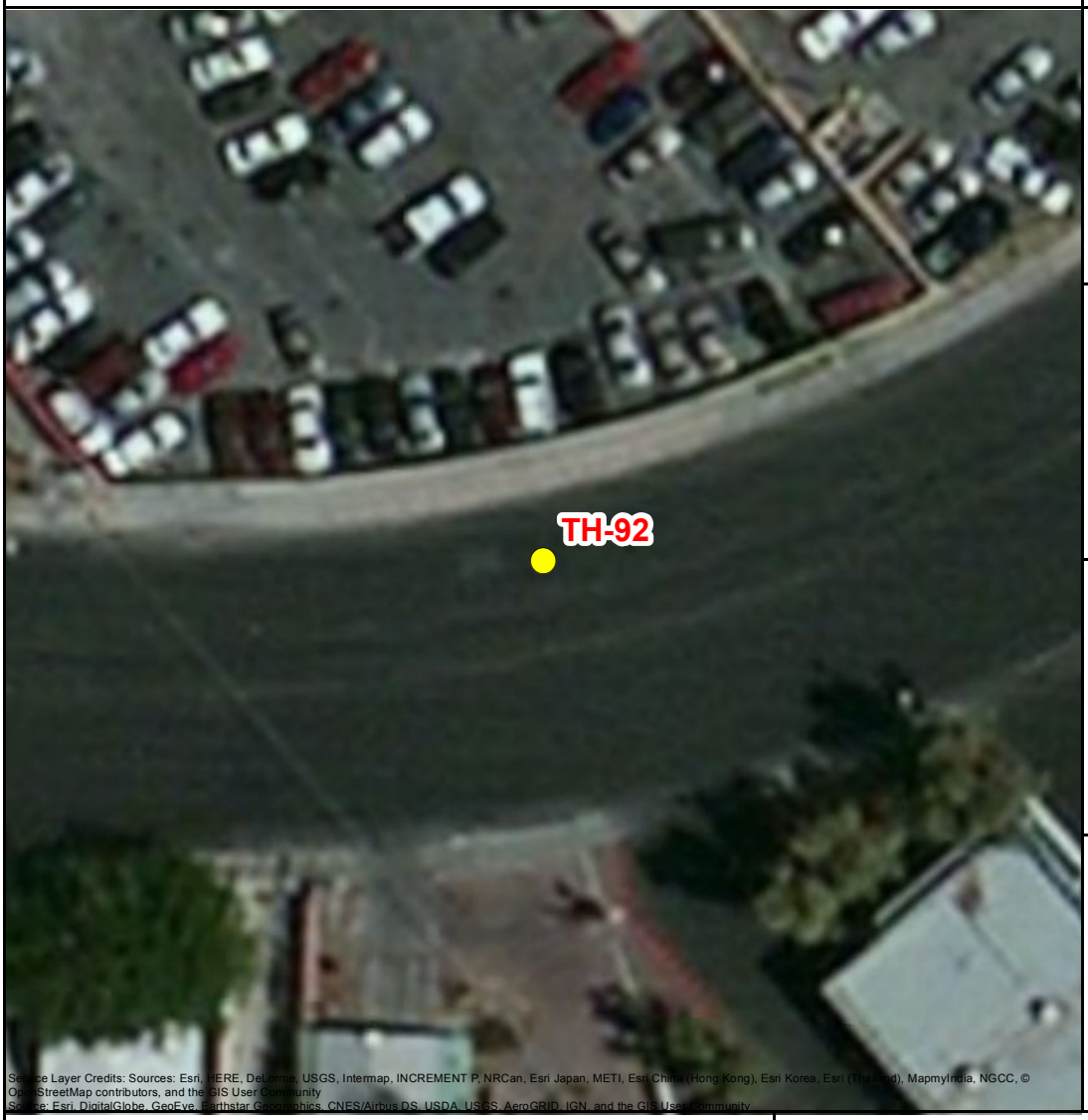
Utility Type:	Water	**Utility Size:**	6 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	4.50	**Top Ref. Level:**	9.35	**Hand Meas. Top:**	4.51
Depth to Bottom:	5.00	**Bot. Ref. Level:**	9.85	**Hand Meas. Bot:**	N/A
Top Elevation:	1828.742	**Mkr. Ref. Level:**	4.85	**Ref. Elevation:**	1833.242
Bottom Elevation:	1828.242	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	70.30
B	Power Pole	85.20
C	Street Light	89.50

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-92A	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/14/2017	**HE Project #:**	LV-839-1643
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

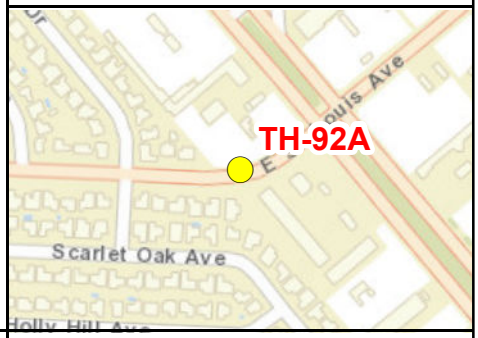
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Phone: 702-966-4063

Test Hole Data

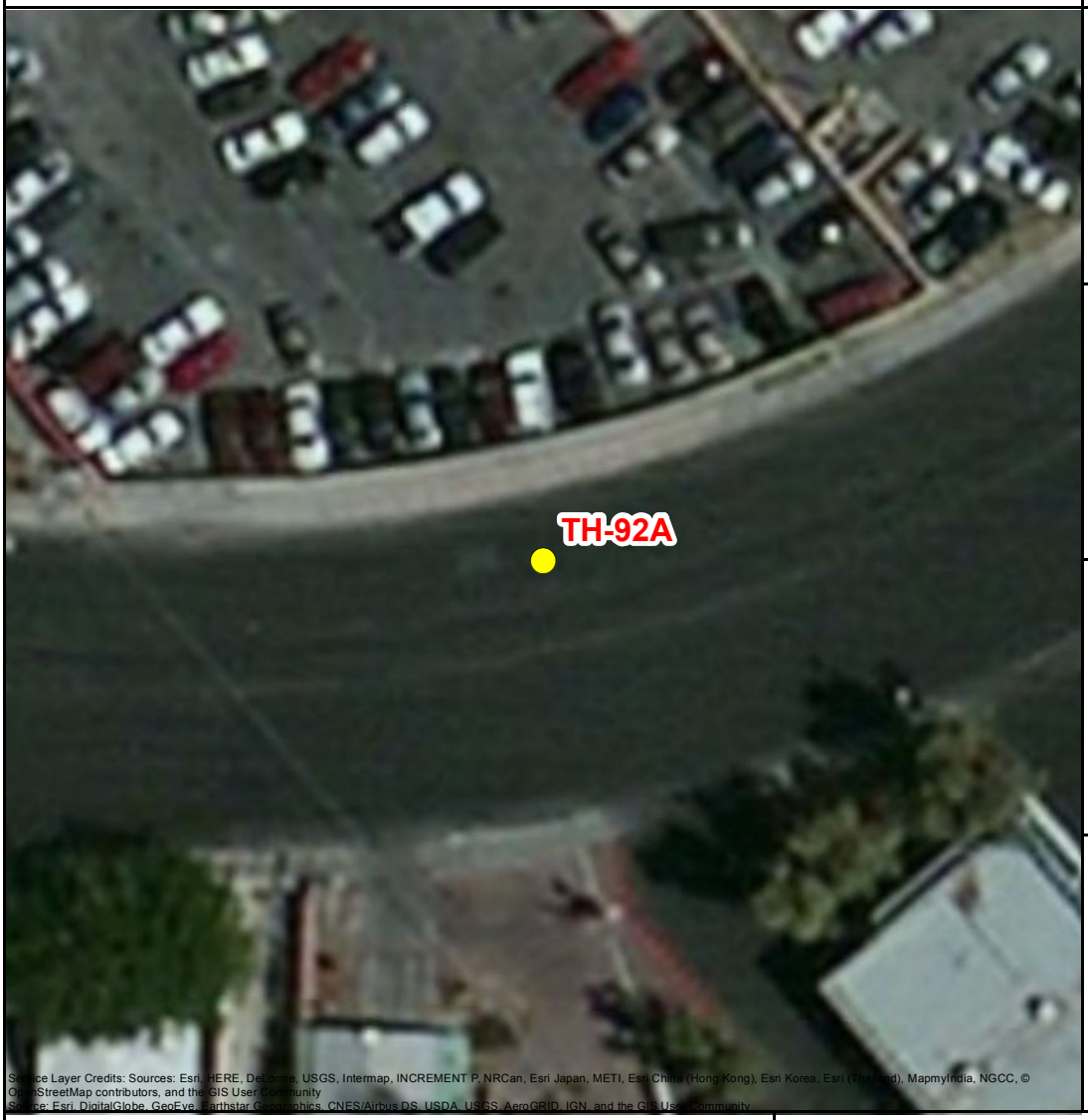
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Utility Company:	Las Vegas Sewer	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
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Depth to Bottom:	4.13	**Bot. Ref. Level:**	8.97	**Hand Meas. Bot:**	N/A
Top Elevation:	1830.133	**Mkr. Ref. Level:**	4.84	**Ref. Elevation:**	1833.263
Bottom Elevation:	1829.133	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



Source Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	78.30
B	Power Pole	85.20
C	Street Light	89.50

General Notes About This Test Hole

12" 0.0

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-93	**Completed By:**	Levi Herrera
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/13/2017	**HE Project #:**	LV-839-1644
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

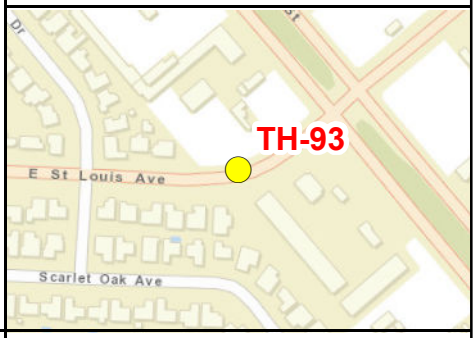
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

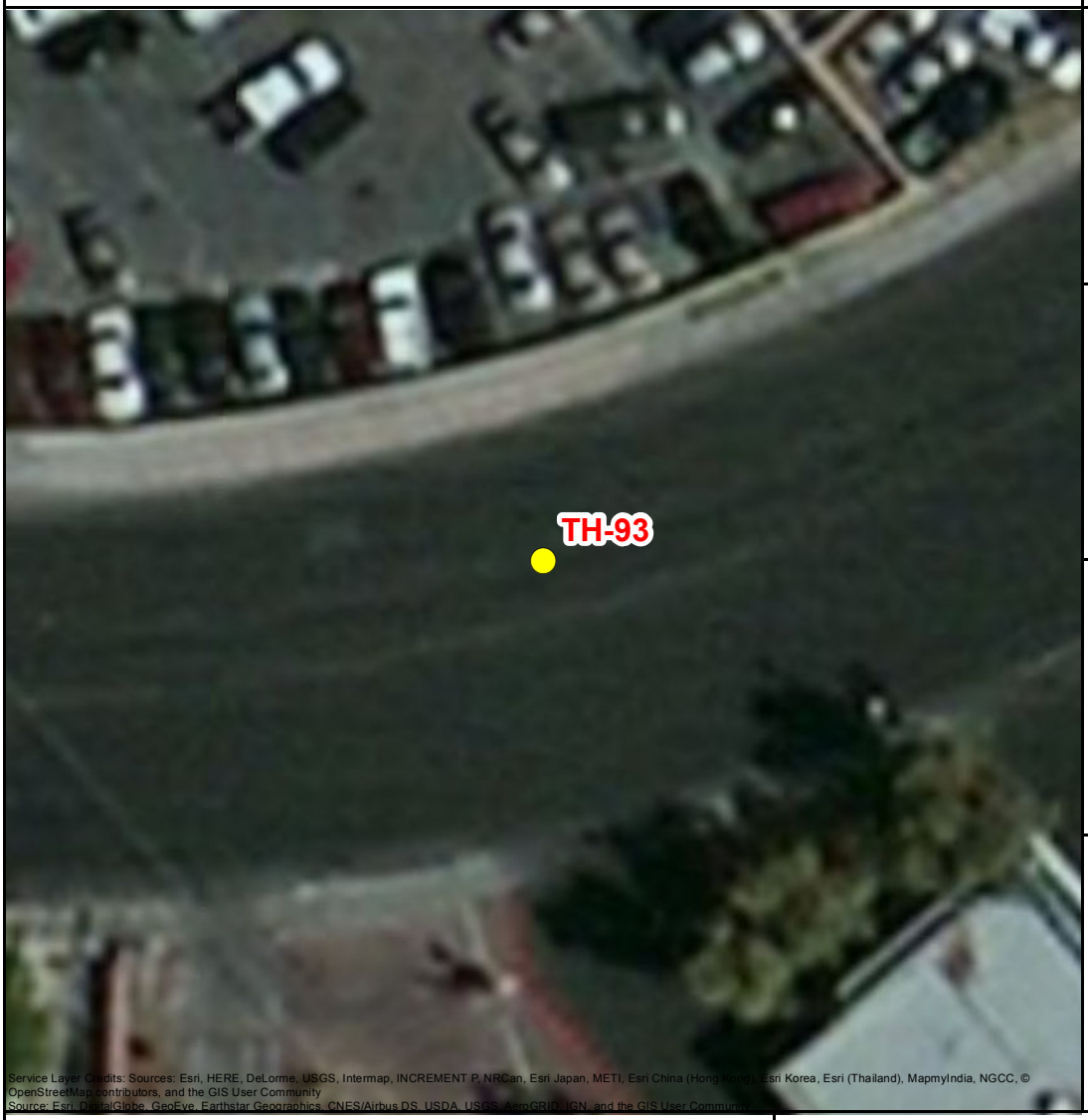
Utility Type:	Gas	**Utility Size:**	2 Inches	**Utility Material:**	Plastic
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Slurry/Type 2
Surface Type:	Asphalt	**Thickness:**	4 Inches	**Marker Type:**	PK Nail
Depth to Top:	3.06	**Top Ref. Level:**	7.90	**Hand Meas. Top:**	3.10
Depth to Bottom:	3.23	**Bot. Ref. Level:**	8.07	**Hand Meas. Bot:**	N/A
Top Elevation:	1830.387	**Mkr. Ref. Level:**	4.84	**Ref. Elevation:**	1833.447
Bottom Elevation:	1830.217	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	20.40
B	Power Pole	64.00
C	Street Light	70.20

General Notes About This Test Hole

Orange tracer wire runnin with pipe. Dug 2 holes

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-94	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/14/2017	**HE Project #:**	LV-839-1645
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

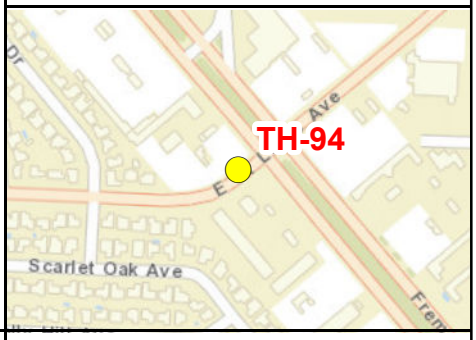
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

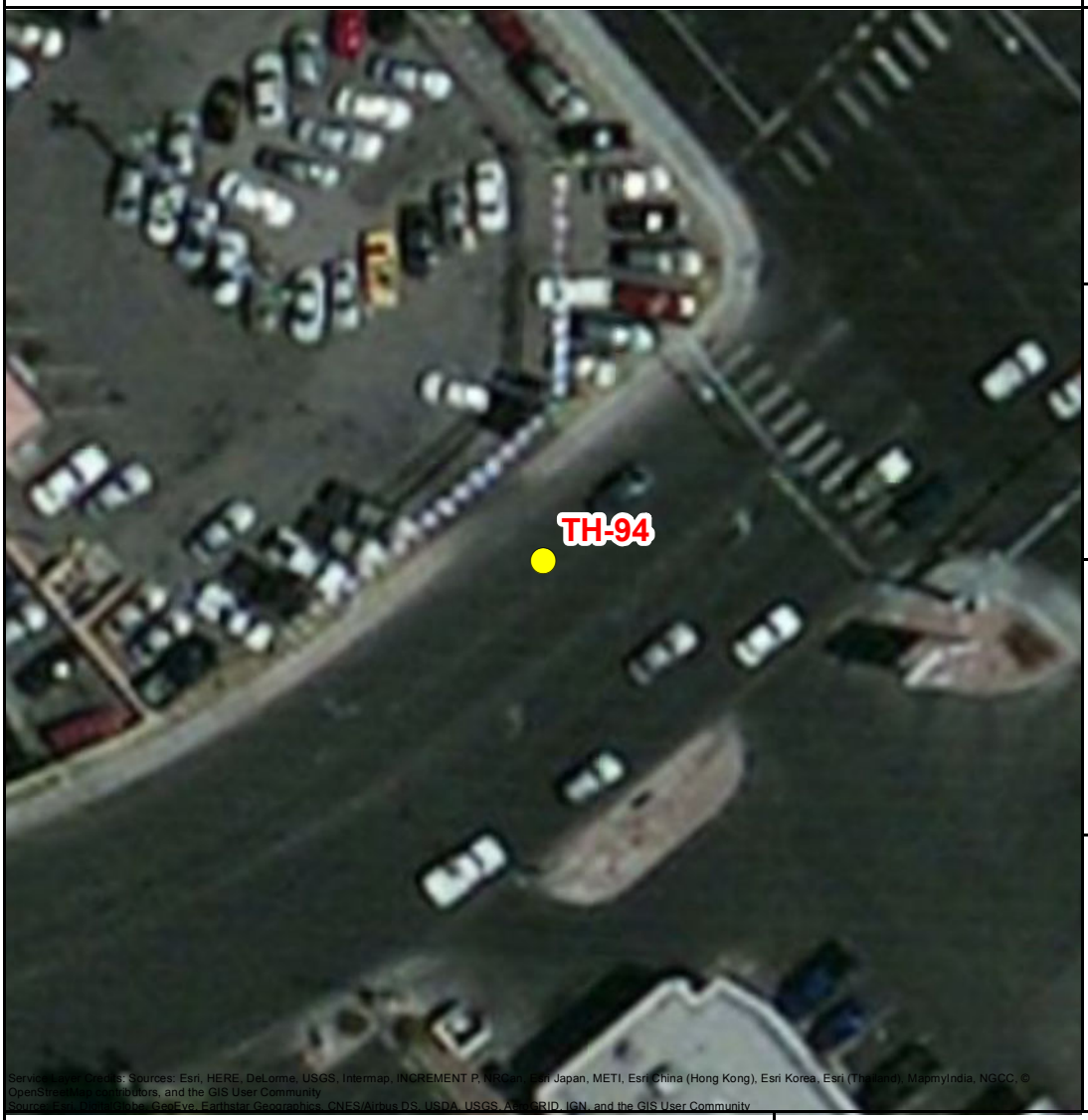
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Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	Nail
Depth to Top:	3.97	**Top Ref. Level:**	8.75	**Hand Meas. Top:**	3.95
Depth to Bottom:	4.47	**Bot. Ref. Level:**	9.25	**Hand Meas. Bot:**	N/A
Top Elevation:	1827.978	**Mkr. Ref. Level:**	4.78	**Ref. Elevation:**	1831.948
Bottom Elevation:	1827.478	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



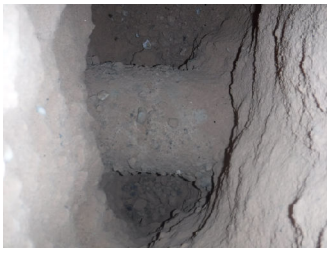
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	64.10
B	Street Light	71.70
C	Traffic Signal	101.20

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-95	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	4/14/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

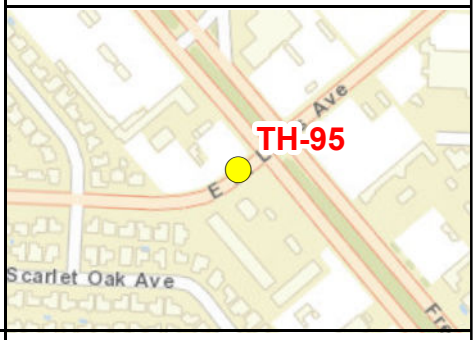
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

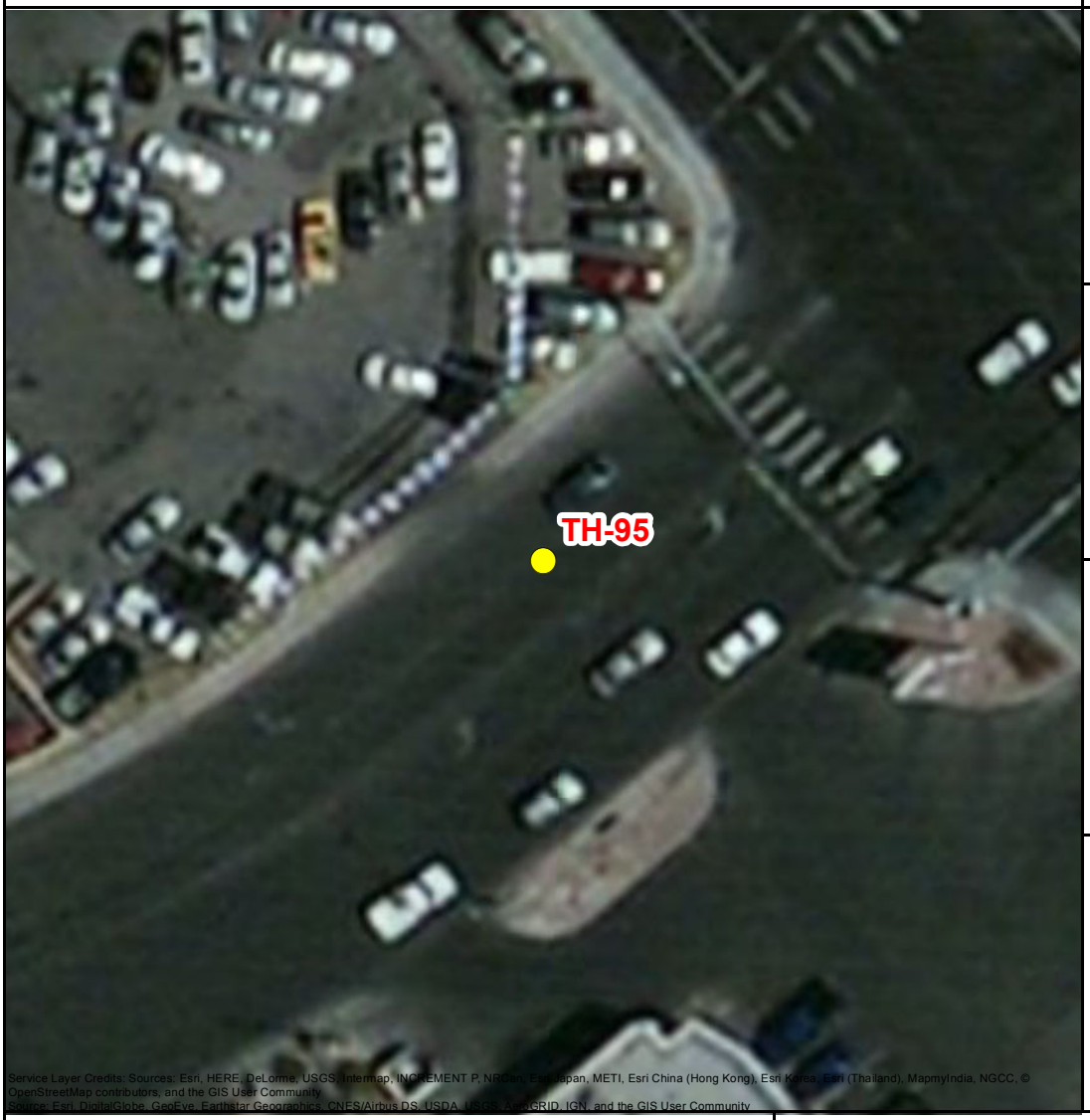
Utility Type:	Gas	**Utility Size:**	24 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	SWG	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	2.23	**Top Ref. Level:**	6.88	**Hand Meas. Top:**	2.24
Depth to Bottom:	4.23	**Bot. Ref. Level:**	8.88	**Hand Meas. Bot:**	4.25
Top Elevation:	1829.845	**Mkr. Ref. Level:**	4.65	**Ref. Elevation:**	1832.075
Bottom Elevation:	1827.845	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1


Picture #2


Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	56.60
B	Street Light	64.50
C	Traffic Signal	92.20

General Notes About This Test Hole

Dug on one call came down on concrete encase exposed both edges of concrete encase.

Concrete encase is 24" wide. No tear tape in testhole. Dug 2 holes for this location

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-96	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

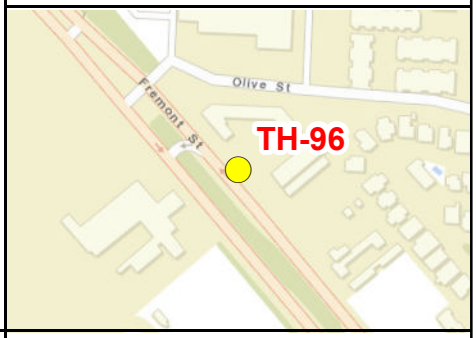
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

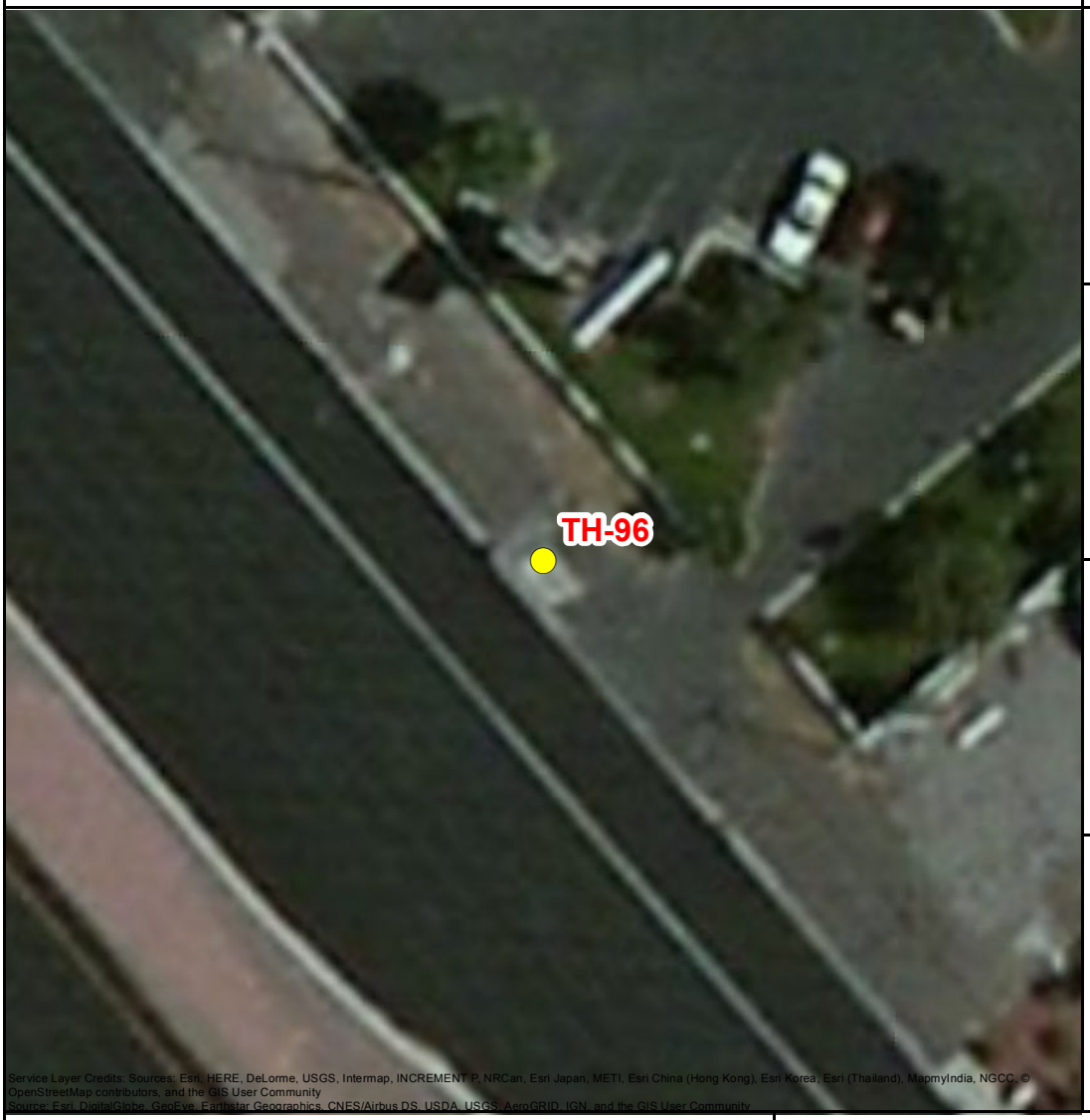
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Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	N/A	**Marker Type:**	Nail
Depth to Top:	5.18	**Top Ref. Level:**	9.89	**Hand Meas. Top:**	5.19
Depth to Bottom:	7.10	**Bot. Ref. Level:**	11.81	**Hand Meas. Bot:**	6.22
Top Elevation:	1846.367	**Mkr. Ref. Level:**	4.71	**Ref. Elevation:**	1851.547
Bottom Elevation:	1844.450	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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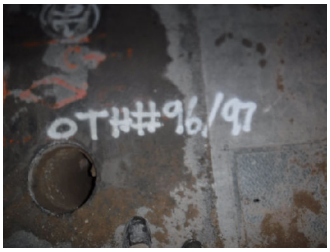
Overall Location of Test Hole



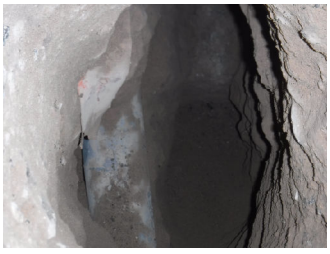
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal Pull	3.20
B	Face of Median	76.30
C	Fire Hydrant	43.60

General Notes About This Test Hole

Exposed both edges and bottom pinned west edge of encasement west edge of encasement is 46" east of face of curb. Found 4" plastic pipe @ 3.28'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-97	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

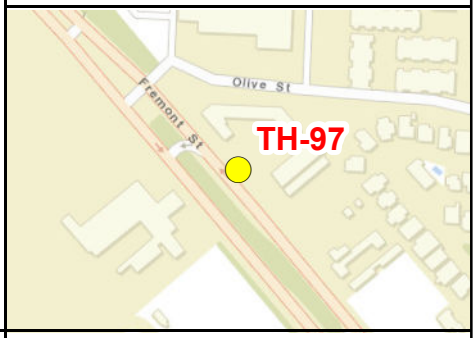
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

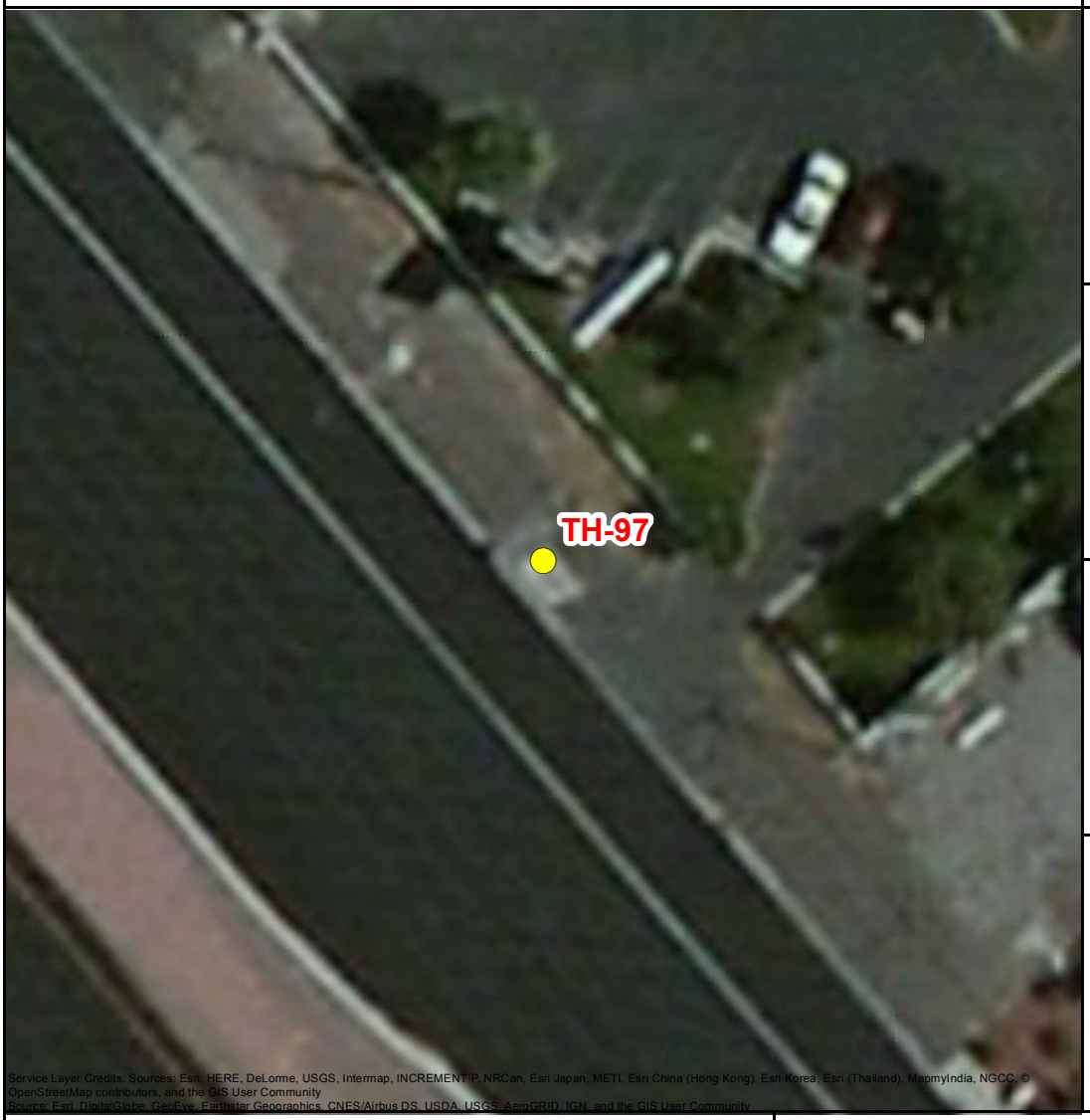
Utility Type:	Telephone	**Utility Size:**	23 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	N/A	**Marker Type:**	Nail
Depth to Top:	5.18	**Top Ref. Level:**	9.89	**Hand Meas. Top:**	5.19
Depth to Bottom:	7.10	**Bot. Ref. Level:**	11.81	**Hand Meas. Bot:**	6.22
Top Elevation:	1846.367	**Mkr. Ref. Level:**	4.71	**Ref. Elevation:**	1851.547
Bottom Elevation:	1844.450	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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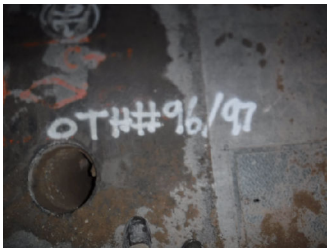
Overall Location of Test Hole



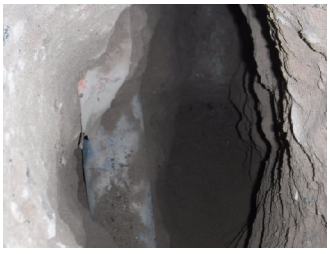
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal Pull	3.20
B	Face of Median	76.30
C	Fire Hydrant	43.60

General Notes About This Test Hole

Exposed both edges and bottom pinned west edge of encasement west edge of encasement is 46" east of face of curb. Found 4" plastic pipe @ 3.28'.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-98	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

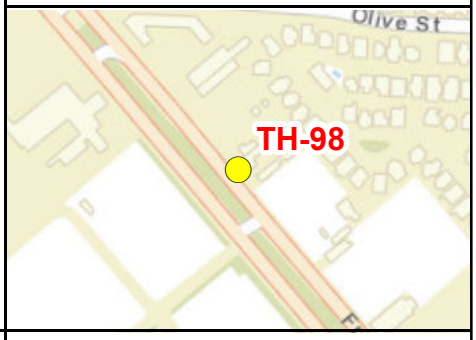
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

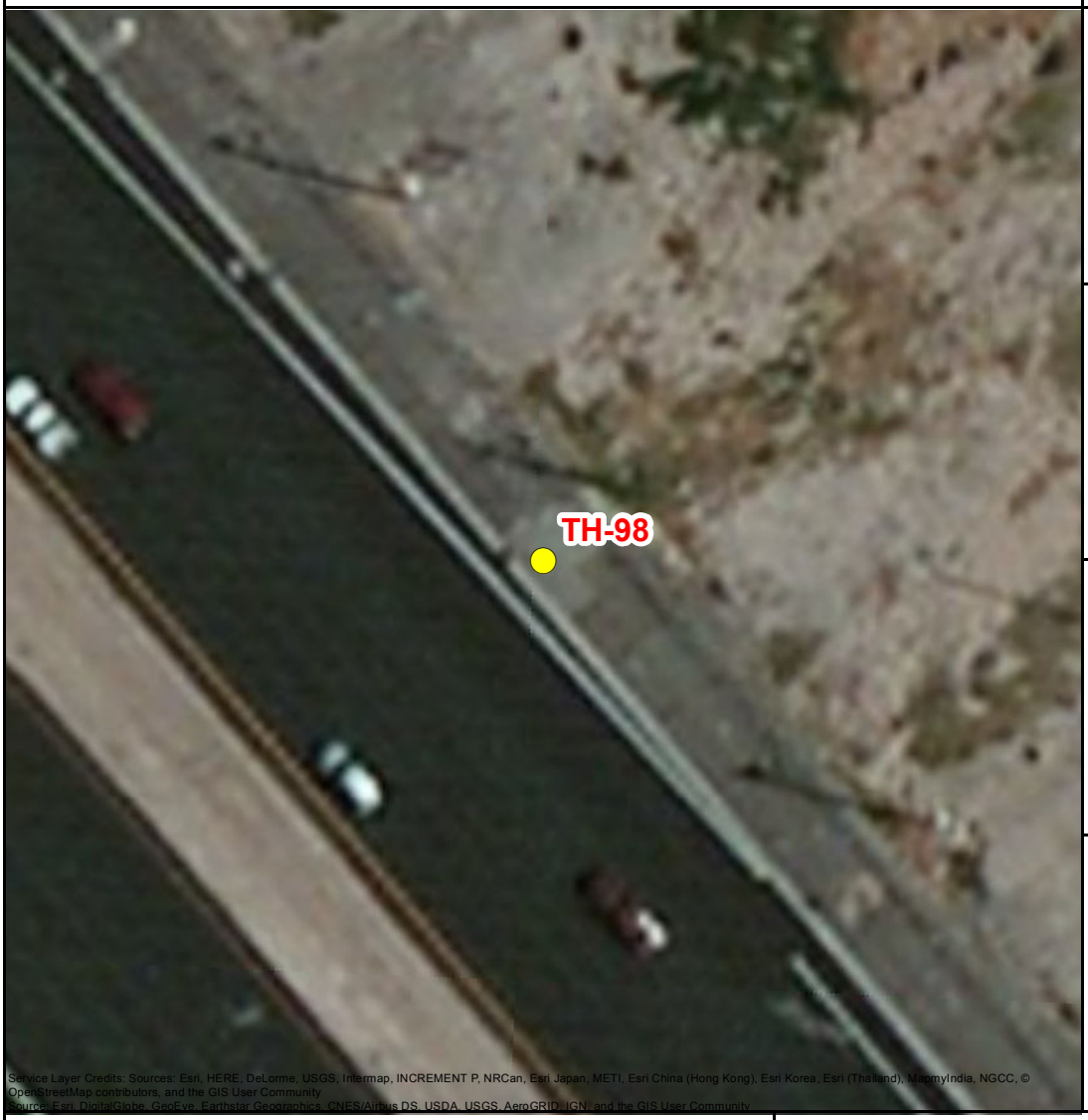
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Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	5 Inches	**Marker Type:**	X
Depth to Top:	6.15	**Top Ref. Level:**	11.06	**Hand Meas. Top:**	6.15
Depth to Bottom:	7.98	**Bot. Ref. Level:**	12.89	**Hand Meas. Bot:**	7.9
Top Elevation:	1842.939	**Mkr. Ref. Level:**	4.91	**Ref. Elevation:**	1849.089
Bottom Elevation:	1841.106	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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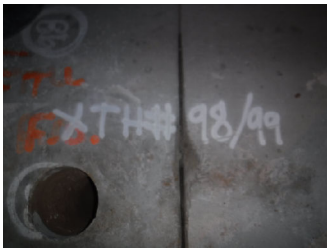
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of Curb	3.70
B	Telephone Manhole	13.30
C	Power Pole	84.50

General Notes About This Test Hole

Exposed both edges and bottom of encasement. Pinned center of encase west edge of encasement is 31" east from face of curb.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-99	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/9/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

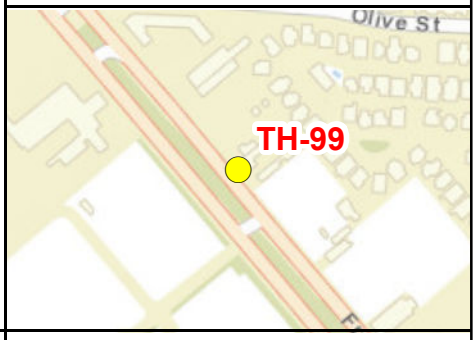
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

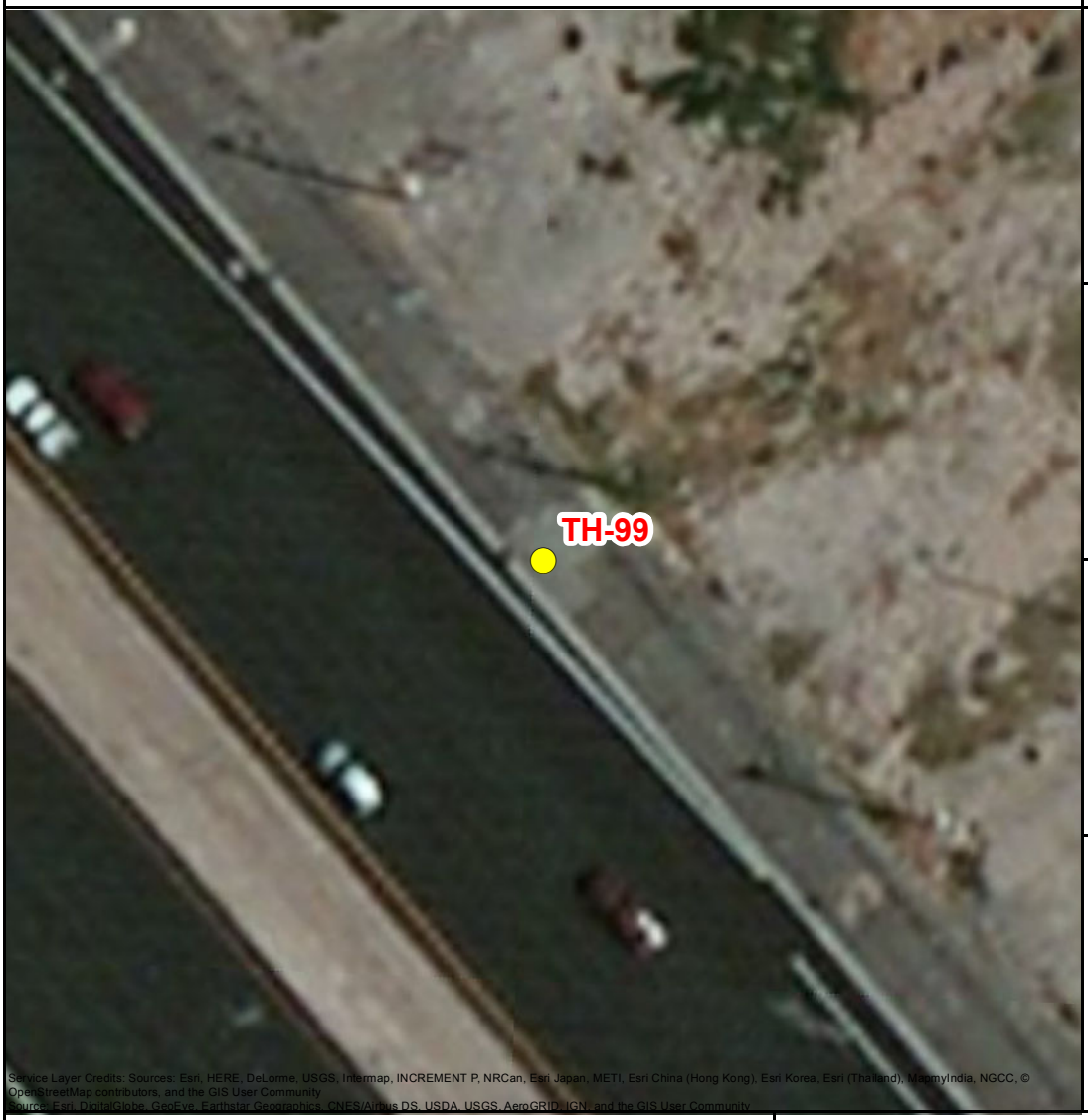
Utility Type:	Telephone	**Utility Size:**	22 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	5 Inches	**Marker Type:**	X
Depth to Top:	6.15	**Top Ref. Level:**	11.06	**Hand Meas. Top:**	6.15
Depth to Bottom:	7.98	**Bot. Ref. Level:**	12.89	**Hand Meas. Bot:**	7.9
Top Elevation:	1842.939	**Mkr. Ref. Level:**	4.91	**Ref. Elevation:**	1849.089
Bottom Elevation:	1841.106	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

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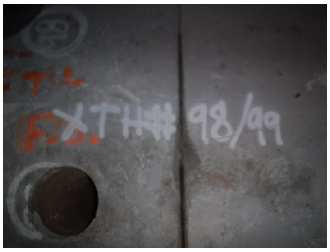
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of Curb	3.70
B	Telephone Manhole	13.30
C	Power Pole	84.50

General Notes About This Test Hole

Exposed both edges and bottom of encasement. Pinned center of encase west edge of encasement is 31" east from face of curb.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-100	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

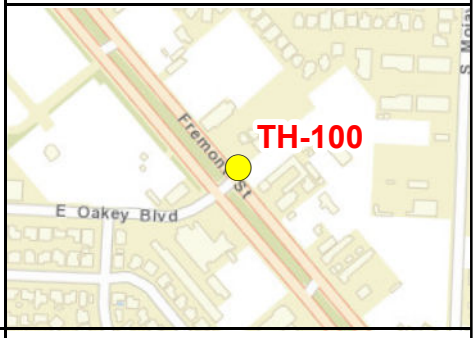
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

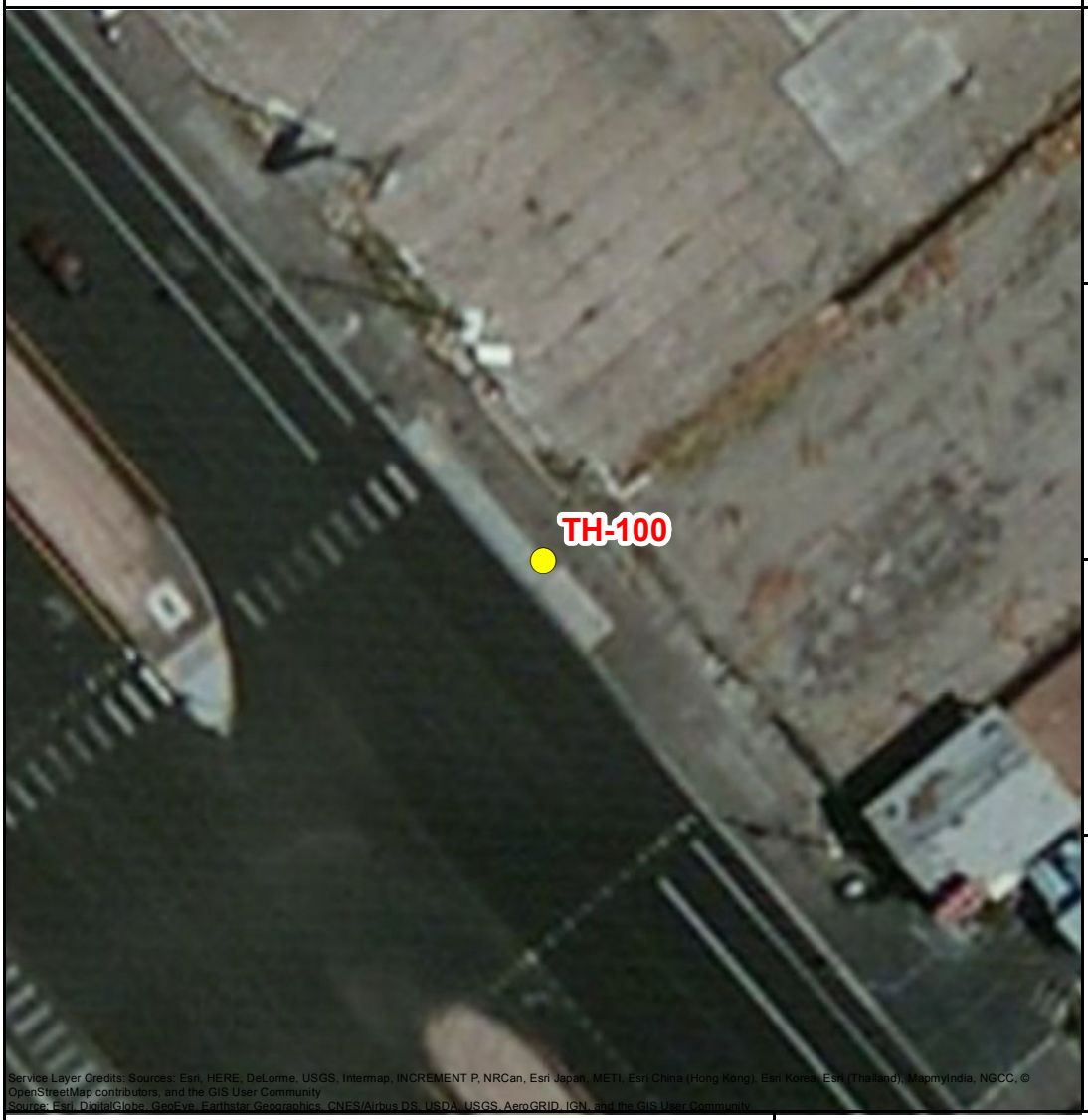
Utility Type:	Telephone	**Utility Size:**	23 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	8 Inches	**Marker Type:**	Nail
Depth to Top:	3.78	**Top Ref. Level:**	7.64	**Hand Meas. Top:**	3.79
Depth to Bottom:	5.7	**Bot. Ref. Level:**	9.56	**Hand Meas. Bot:**	5.1
Top Elevation:	1840.062	**Mkr. Ref. Level:**	3.86	**Ref. Elevation:**	1843.842
Bottom Elevation:	1838.142	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Nose of Median	84.80
B	Fire Hydrant	70.60
C	Power Pole	111.10

General Notes About This Test Hole

TH 100 and 101 are in the same encasement. The encasement is 23" wide. The west edge of the encasement is 50" east of face of the curb.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-101	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

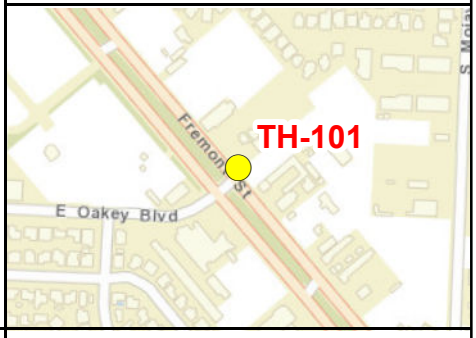
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

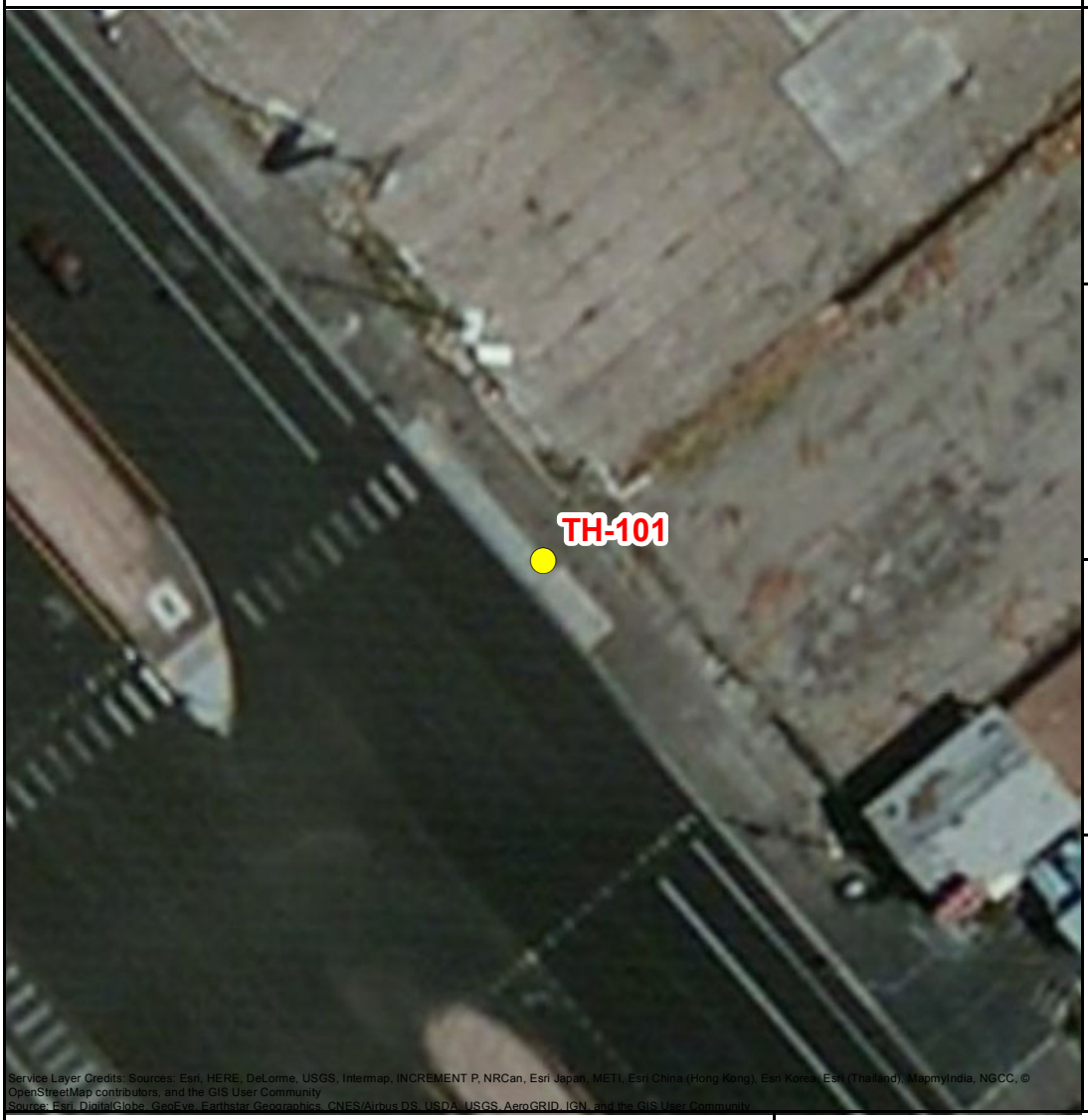
Utility Type:	Telephone	**Utility Size:**	23 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	8 Inches	**Marker Type:**	Nail
Depth to Top:	3.78	**Top Ref. Level:**	7.64	**Hand Meas. Top:**	3.79
Depth to Bottom:	5.7	**Bot. Ref. Level:**	9.56	**Hand Meas. Bot:**	5.1
Top Elevation:	1840.062	**Mkr. Ref. Level:**	3.86	**Ref. Elevation:**	1843.842
Bottom Elevation:	1838.142	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Nose of Median	84.80
B	Fire Hydrant	70.60
C	Power Pole	111.10

General Notes About This Test Hole

TH 100 and 101 are in the same encasement. The encasement is 23" wide. The west edge of the encasement is 50" east of face of the curb.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-102	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

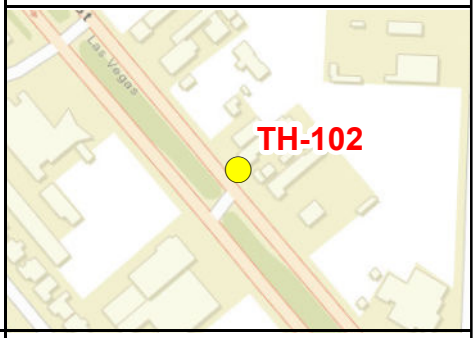
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

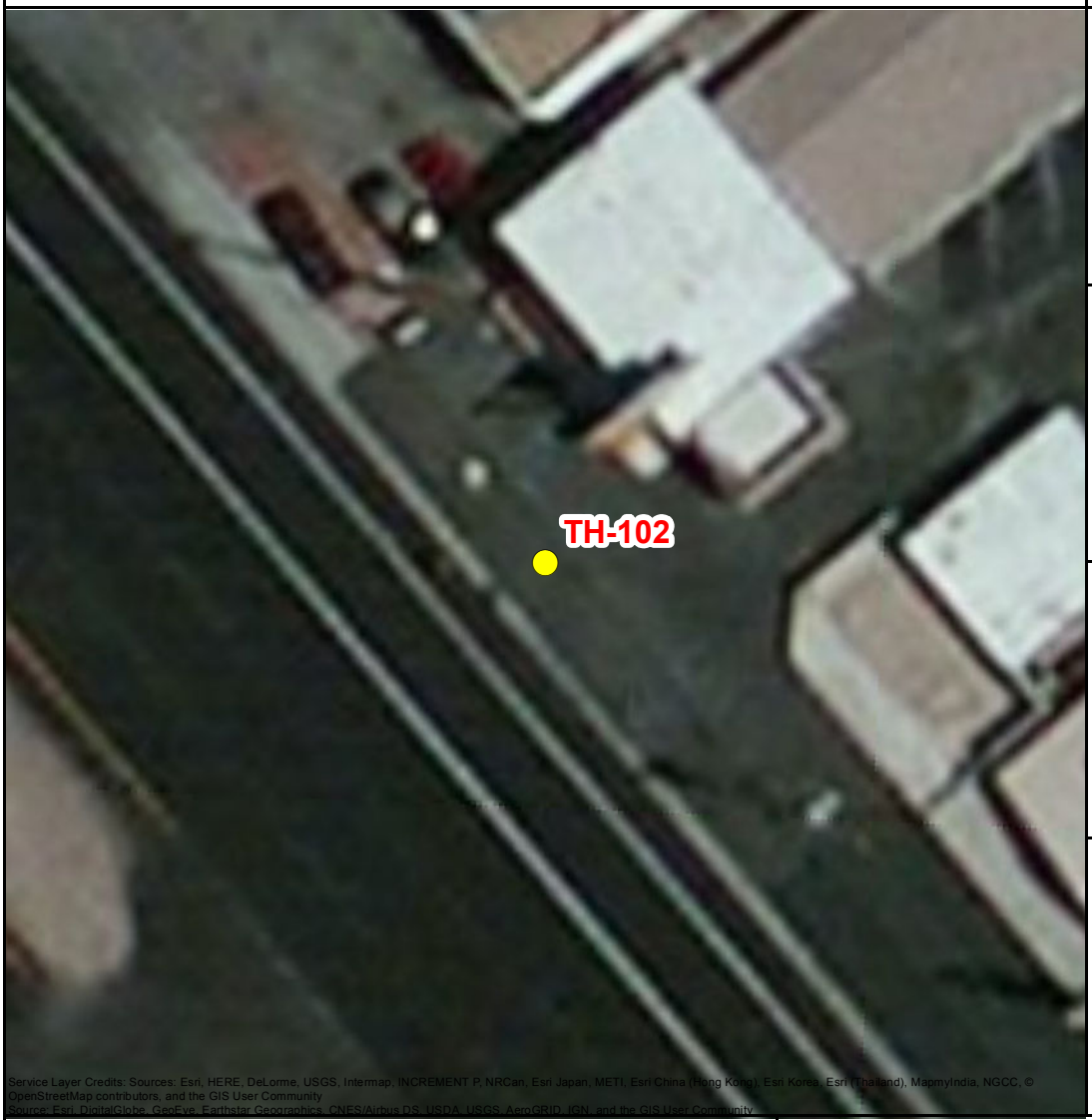
Utility Type:	Telephone	**Utility Size:**	22 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	Nail
Depth to Top:	4.36	**Top Ref. Level:**	8.76	**Hand Meas. Top:**	4.35
Depth to Bottom:	6.19	**Bot. Ref. Level:**	10.59	**Hand Meas. Bot:**	5.22
Top Elevation:	1835.471	**Mkr. Ref. Level:**	4.40	**Ref. Elevation:**	1839.831
Bottom Elevation:	1833.641	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES

Picture #1

Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	33.90
B	Power Pole	64.50
C	Fire Hydrant	13.70

General Notes About This Test Hole

Pinned center of encasement exposed both edges and bottom west edge is 60" east to face of cur

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-103	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

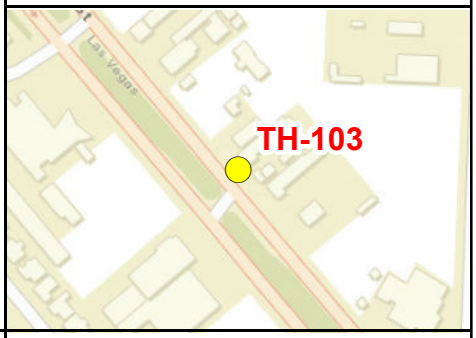
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

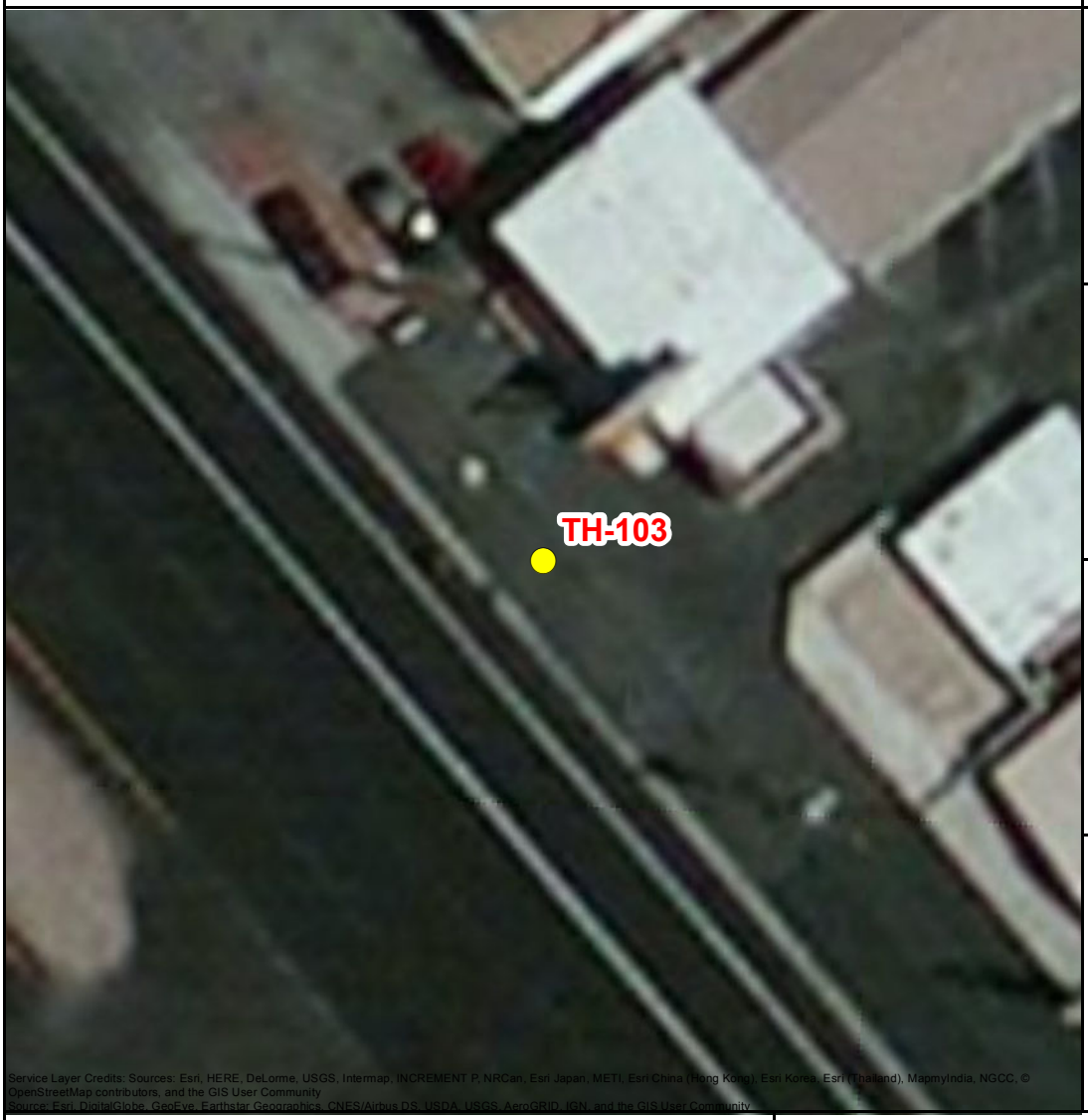
Utility Type:	Telephone	**Utility Size:**	22 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	Nail
Depth to Top:	4.36	**Top Ref. Level:**	8.76	**Hand Meas. Top:**	4.35
Depth to Bottom:	6.19	**Bot. Ref. Level:**	10.59	**Hand Meas. Bot:**	5.22
Top Elevation:	1835.471	**Mkr. Ref. Level:**	4.40	**Ref. Elevation:**	1839.831
Bottom Elevation:	1833.641	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	33.90
B	Power Pole	64.50
C	Fire Hydrant	13.70

General Notes About This Test Hole

Pinned center of encasement exposed both edges and bottom west edge is 60" east to face of cur

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-103A	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

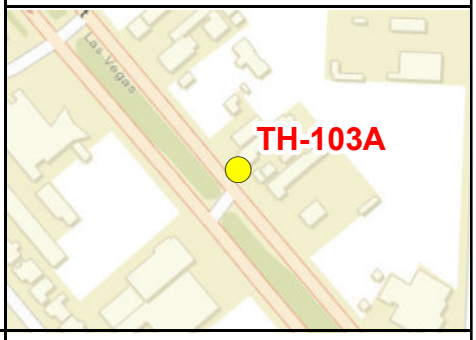
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

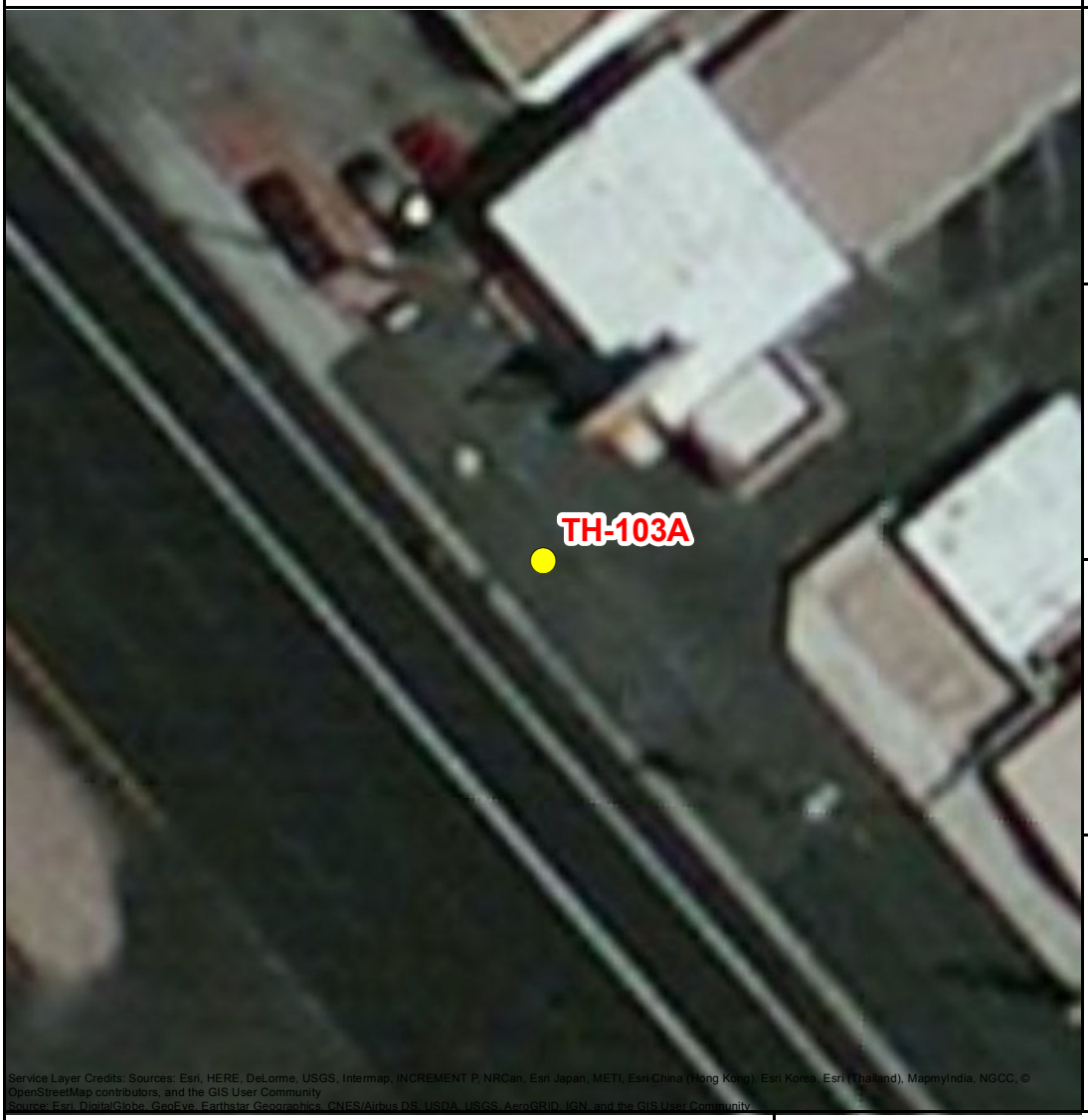
Utility Type:	SD	**Utility Size:**	24 Inches	**Utility Material:**	Plastic
Utility Company:	City of Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	6 Inches	**Marker Type:**	Nail
Depth to Top:	1.85	**Top Ref. Level:**	6.25	**Hand Meas. Top:**	1.85
Depth to Bottom:	3.85	**Bot. Ref. Level:**	8.25	**Hand Meas. Bot:**	N/A
Top Elevation:	1837.979	**Mkr. Ref. Level:**	4.40	**Ref. Elevation:**	1839.829
Bottom Elevation:	1835.979	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	35.10
B	Power Pole	63.40
C	Hydrant	15.10

General Notes About This Test Hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-104	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/7/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

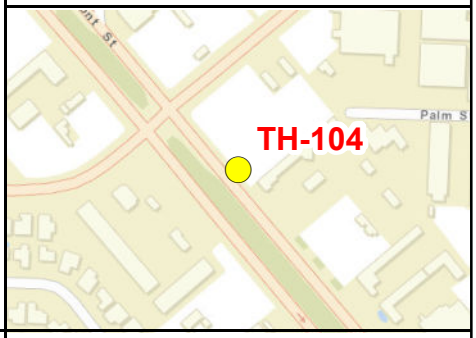
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

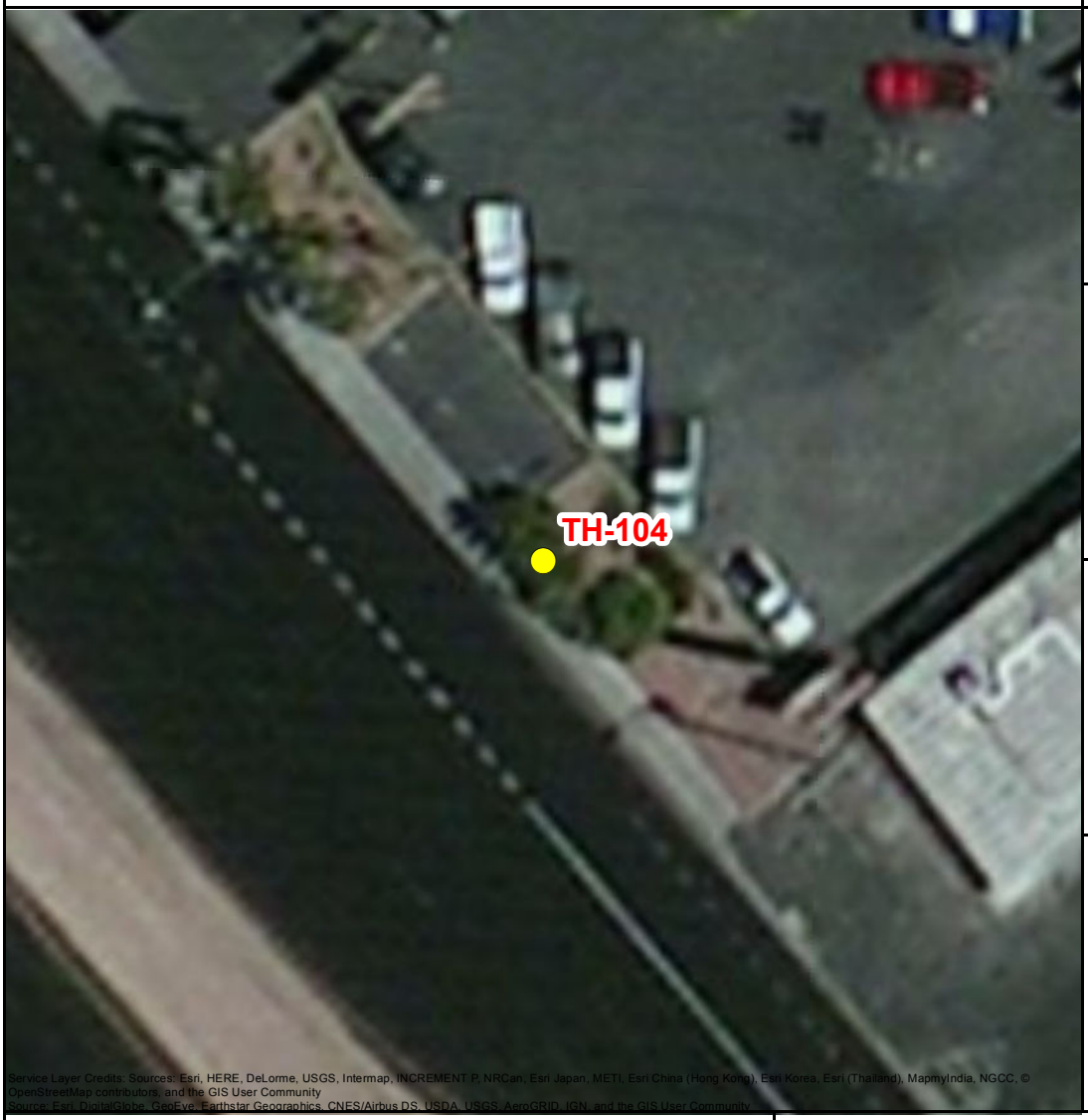
Utility Type:	Telephone	**Utility Size:**	21 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	5 Inches	**Marker Type:**	X
Depth to Top:	5.08	**Top Ref. Level:**	10.40	**Hand Meas. Top:**	5.08
Depth to Bottom:	6.83	**Bot. Ref. Level:**	12.15	**Hand Meas. Bot:**	6.68
Top Elevation:	1823.784	**Mkr. Ref. Level:**	5.32	**Ref. Elevation:**	1828.864
Bottom Elevation:	1822.034	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3



Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	69.50
B	Telephone Manhole	60.30
C	Edge of Asphalt	77.50

General Notes About This Test Hole

TH 104 and 105 are in the same concrete encasement. Encasement is 21" wide. Also found 1(2") @ 1.40' and 1(.5") 2.34'. 24" SD running east and west in hole found sd @ 2.64'. Dug 3 holes looking for utility.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-105	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/7/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

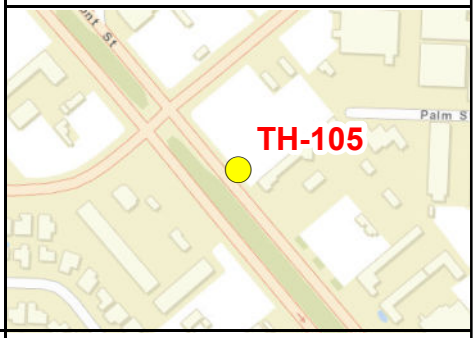
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

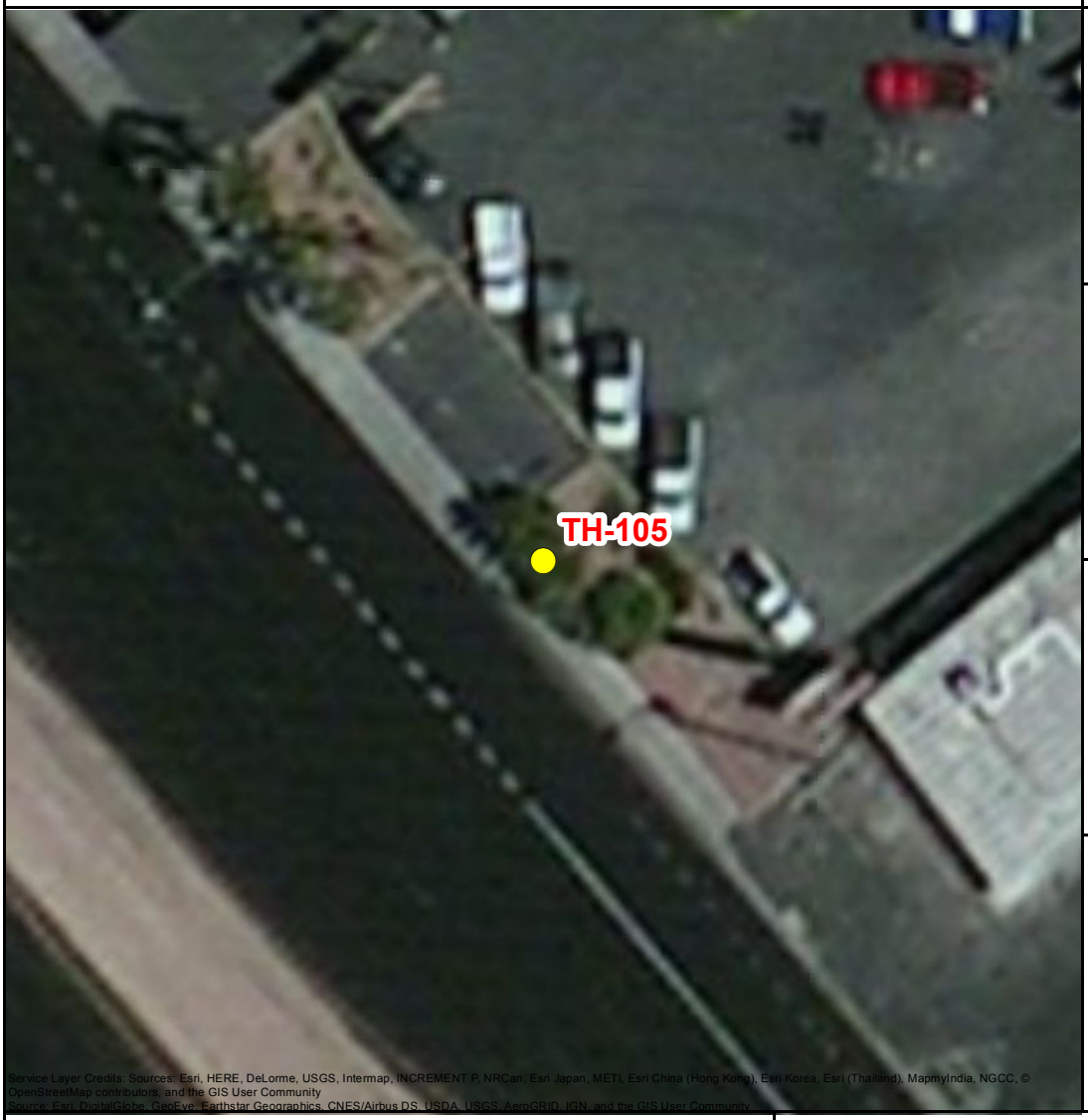
Utility Type:	Telephone	**Utility Size:**	21 Inches	**Utility Material:**	Concrete Encasement
Utility Company:	CTL	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Concrete	**Thickness:**	5 Inches	**Marker Type:**	X
Depth to Top:	5.08	**Top Ref. Level:**	10.40	**Hand Meas. Top:**	5.08
Depth to Bottom:	6.83	**Bot. Ref. Level:**	12.15	**Hand Meas. Bot:**	6.68
Top Elevation:	1823.784	**Mkr. Ref. Level:**	5.32	**Ref. Elevation:**	1828.864
Bottom Elevation:	1822.034	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

Overall Location of Test Hole



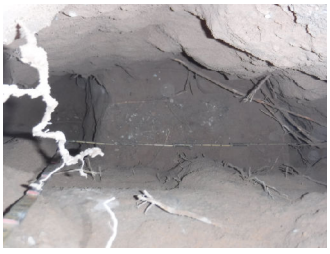
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3



Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	69.50
B	Telephone Manhole	60.30
C	Edge of Asphalt	77.50

General Notes About This Test Hole

TH 104 and 105 are in the same concrete encasement. Encasement is 21" wide. Also found 1(2") @ 1.40' and 1(.5") 2.34'. 24" SD running east and west in hole found sd @ 2.64'. Dug 3 holes looking for utility.

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-106	**Completed By:**	Chauncey Pu'ulei
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	5/8/2017	**HE Project #:**	LV-839-1646
Project City:	Las Vegas	**Client Project #:**	
Project County:	Clark	**Sheet:**	

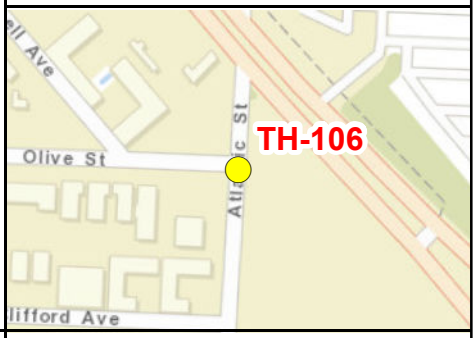
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	16 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	7 Inches	**Marker Type:**	Nail
Depth to Top:	8.2	**Top Ref. Level:**	12.98	**Hand Meas. Top:**	8.21
Depth to Bottom:	9.53	**Bot. Ref. Level:**	14.31	**Hand Meas. Bot:**	N/A
Top Elevation:	1848.855	**Mkr. Ref. Level:**	4.78	**Ref. Elevation:**	1857.055
Bottom Elevation:	1847.525	**Mkr. Offset From:**	N/A	**Marker Offset (ft):**	

N

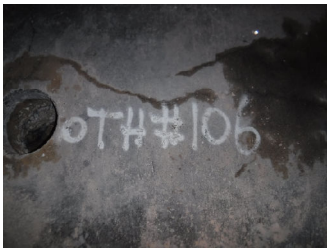
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2



Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Face of curb	15.30
B	Street Light	51.20
C	Sewer Manhole	9.70

General Notes About This Test Hole

Found 38" SD (per plan). Found SD pipe @ 5.30'.

Appendix F

Cost Estimate

BOULDER HIGHWAY STORM DRAIN
PRELIMINARY COST ESTIMATE
70% SUBMITTAL

				CCRFCD		CLV		TOTAL	
ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
202.01	REMOVE EXISTING SIDEWALK	SF	$4.00	3,954	$15,816.00		$0.00	3,954	$15,816.00
202.02	REMOVE EXISTING CURB AND GUTTER	LF	$8.00	871	$6,968.00		$0.00	871	$6,968.00
202.03	REMOVE ASPHALT PAVEMENT	SY	$15.00	24,658	$369,870.00		$0.00	24,658	$369,870.00
202.04	COLD MILL EXISTING PAVEMENT (3/4 INCH)	SY	$15.00	22,520	$337,800.00		$0.00	22,520	$337,800.00
202.05	REMOVE EXISTING RCP STORM DRAIN	LF	$20.00	2,388	$47,760.00		$0.00	2,388	$47,760.00
202.06	REMOVE EXISTING MANHOLE	EA	$1,500.00	9	$13,500.00		$0.00	9	$13,500.00
202.07	REMOVE EXISTING DROP INLET	EA	$3,000.00	18	$54,000.00		$0.00	18	$54,000.00
202.08	REMOVE EXISTING MEDIAN ISLAND	SF	$7.00	3,777	$26,439.00		$0.00	3,777	$26,439.00
202.09	ABANDON EXISTING STORM DRAIN	LF	$25.00	616	$15,400.00		$0.00	616	$15,400.00
202.10	REMOVE EXISTING CROSS GUTTER	SY	$20.00	841	$16,820.00		$0.00	841	$16,820.00
202.11	COLD MILL EXISTING PAVEMENT (2 INCH)	SY	$10.00	5,077	$50,770.00		$0.00	5,077	$50,770.00
202.12	REMOVE EXISTING DRIVEWAY	SY	$15.00	68	$1,020.00		$0.00	68	$1,020.00
203.01	BORROW EMBANKMENT	CY	$12.00	46,315	$555,780.00		$0.00	46,315	$555,780.00
206.01	STRUCTURAL EXCAVATION	CY	$10.00	100,025	$1,000,250.00		$0.00	100,025	$1,000,250.00
270.01	DEWATERING	LS	$1,000,000.00	1	$1,000,000.00		$0.00	1	$1,000,000.00
302.01	TYPE I CLASS B AGGREGATE BASE	CY	$45.00	9,548	$429,660.00		$0.00	9,548	$429,660.00
302.02	TYPE II AGGREGATE BASE	CY	$35.00	927	$32,445.00		$0.00	927	$32,445.00
402.01	PLANTMIX BITUMINOUS SURFACE 2-INCH	SY	$35.00	5,077	$177,695.00		$0.00	5,077	$177,695.00
402.02	PLANTMIX BITUMINOUS SURFACE 3-INCH	SY	$38.00	1,042	$39,596.00		$0.00	1,042	$39,596.00
402.03	PLANTMIX BITUMINOUS SURFACE 4-INCH	SY	$40.00	4,520	$180,800.00		$0.00	4,520	$180,800.00
402.04	PLANTMIX BITUMINOUS SURFACE 7-INCH	SY	$50.00	19,096	$954,800.00		$0.00	19,096	$954,800.00
403.01	3/4-INCH PLANTMIX BITUMINOUS OPEN-GRADED SURFACE	SY	$12.00	41,616	$499,392.00		$0.00	41,616	$499,392.00
502.01	18'X8' REINFORCED CONCRETE BOX	LF	$1,000.00	2,621	$2,621,000.00		$0.00	2,621	$2,621,000.00
502.02	20'X8' REINFORCED CONCRETE BOX	LF	$1,025.00	1,393	$1,427,825.00		$0.00	1,393	$1,427,825.00
502.03	24'X6' REINFORCED CONCRETE BOX	LF	$2,000.00	391	$782,000.00		$0.00	391	$782,000.00
502.04	15'X10' REINFORCED CONCRETE BOX	LF	$900.00	987	$888,300.00		$0.00	987	$888,300.00
502.05	TRANSITION STRUCTURE #2 (18'X8' TO 20'X8')	LF	$1,250.00	20	$25,000.00		$0.00	20	$25,000.00
502.06	TRANSITION STRUCTURE #3 (20'X8' TO 24'X6')	LF	$1,500.00	15	$22,500.00		$0.00	15	$22,500.00
502.07	TRANSITION STRUCTURE #4 (24'X6' TO 15'X10')	LF	$2,000.00	30	$60,000.00		$0.00	30	$60,000.00
502.08	MAINTENANCE STRUCTURE	EA	$25,000.00	2	$50,000.00		$0.00	2	$50,000.00
603.01	18-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$175.00	496	$86,800.00		$0.00	496	$86,800.00
603.02	24-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$200.00	1,526	$305,200.00		$0.00	1,526	$305,200.00
603.03	30-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$215.00	1,234	$265,310.00		$0.00	1,234	$265,310.00
603.04	36-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$250.00	98	$24,500.00		$0.00	98	$24,500.00
603.05	42-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$275.00	79	$21,725.00		$0.00	79	$21,725.00
603.06	48-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$325.00	532	$172,900.00		$0.00	532	$172,900.00
603.07	54-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$350.00	599	$209,650.00		$0.00	599	$209,650.00
603.08	60-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$500.00	529	$264,500.00		$0.00	529	$264,500.00
603.09	66-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$550.00	60	$33,000.00		$0.00	60	$33,000.00
603.10	38" X 60" HE REINFORCED CONCRETE PIPE CLASS III	LF	$600.00	46	$27,600.00		$0.00	46	$27,600.00
603.11	53" X 83" HE REINFORCED CONCRETE PIPE CLASS III	LF	$750.00	89	$66,750.00		$0.00	89	$66,750.00
603.12	18-INCH C900 PVC PIPE	LF	$300.00	118	$35,400.00		$0.00	118	$35,400.00
609.01	TYPE I (60") STORM DRAIN MANHOLE	EA	$7,500.00	1	$7,500.00		$0.00	1	$7,500.00
609.02	TYPE III STORM DRAIN MANHOLE	EA	$10,000.00	18	$180,000.00		$0.00	18	$180,000.00
609.03	NDOT TYPE 4 MANHOLE	EA	$12,000.00	4	$48,000.00		$0.00	4	$48,000.00
609.04	TYPE B DROP INLET	EA	$3,000.00	3	$9,000.00		$0.00	3	$9,000.00
609.05	5-FOOT "CM2" DROP INLET	EA	$5,000.00	7	$35,000.00		$0.00	7	$35,000.00
609.06	7.5-FOOT "CM2" DROP INLET	EA	$7,500.00	1	$7,500.00		$0.00	1	$7,500.00
609.07	10-FOOT "CM2" DROP INLET	EA	$10,000.00	5	$50,000.00		$0.00	5	$50,000.00

BOULDER HIGHWAY STORM DRAIN
PRELIMINARY COST ESTIMATE
70% SUBMITTAL

				CCRFCD		CLV		TOTAL	
ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
609.08	15-FOOT "CM2" DROP INLET	EA	$15,000.00	2	$30,000.00		$0.00	2	$30,000.00
609.09	20-FOOT "CM2" DROP INLET	EA	$20,000.00	14	$280,000.00		$0.00	14	$280,000.00
609.10	20-FOOT "CM2" DROP INLET SPECIAL	EA	$26,000.00	1	$26,000.00		$0.00	1	$26,000.00
609.11	5-FOOT "CM" DROP INLET	EA	$5,000.00	1	$5,000.00		$0.00	1	$5,000.00
609.12	15-FOOT "CM" DROP INLET	EA	$15,000.00	2	$30,000.00		$0.00	2	$30,000.00
609.13	15-FOOT "CM" DROP INLET SPECIAL	EA	$20,000.00	1	$20,000.00		$0.00	1	$20,000.00
609.14	20-FOOT "CM" DROP INLET	EA	$20,000.00	5	$100,000.00		$0.00	5	$100,000.00
609.15	NDOT TYPE 2B DROP INLET WITH CONCRETE APRON	EA	$12,000.00	4	$48,000.00		$0.00	4	$48,000.00
609.16	48-INCH ACCESS MANHOLE WITH STEPS	EA	$4,000.00	13	$52,000.00		$0.00	13	$52,000.00
613.01	CONSTRUCT "L" TYPE CURB AND GUTTER	LF	$25.00	1,367	$34,175.00		$0.00	1,367	$34,175.00
613.02	CONSTRUCT CONCRETE SIDEWALK	SF	$5.00	3,954	$19,770.00		$0.00	3,954	$19,770.00
613.03	CONSTRUCT TACK-ON MEDIAN	SF	$8.00	3,777	$30,216.00		$0.00	3,777	$30,216.00
623.01	INSTALL 6'X6' TRAFFIC LOOP DETECTOR	EA	$1,000.00	25	$25,000.00		$0.00	25	$25,000.00
629.01	ADJUST EXISTING WATER VALVE BOX COVER TO FINISH GRADE	EA	$650.00	17	$11,050.00		$0.00	17	$11,050.00
629.02	REMOVE EXISTING 6-INCH ACP WATERLINE	LF	$100.00	106	$10,600.00		$0.00	106	$10,600.00
629.03	REMOVE EXISTING 8-INCH ACP WATERLINE	LF	$125.00	289	$36,125.00		$0.00	289	$36,125.00
629.04	REMOVE EXISTING 8-INCH CIP WATERLINE	LF	$100.00	139	$13,900.00		$0.00	139	$13,900.00
629.05	REMOVE EXISTING 12-INCH ACP WATERLINE	LF	$175.00	66	$11,550.00		$0.00	66	$11,550.00
629.06	6-INCH PC900 PVC WATERLINE	LF	$100.00	123	$12,300.00		$0.00	123	$12,300.00
629.07	8-INCH PC900 PVC WATERLINE	LF	$120.00	440	$52,800.00		$0.00	440	$52,800.00
629.08	12-INCH DUCTILE IRON WATERLINE	LF	$300.00	66	$19,800.00		$0.00	66	$19,800.00
630.01	ADJUST SANITARY SEWER MANHOLE TO GRADE	EA	$2,500.00	3	$7,500.00		$0.00	3	$7,500.00
630.02	REMOVE 8-INCH VCP SANITARY SEWER LINE	LF	$40.00	785	$31,400.00		$0.00	785	$31,400.00
630.03	REMOVE 10-INCH VCP SANITARY SEWER LINE	LF	$50.00	285	$14,250.00		$0.00	285	$14,250.00
630.04	REMOVE 12-INCH VCP SANITARY SEWER LINE	LF	$60.00	190	$11,400.00		$0.00	190	$11,400.00
630.05	REMOVE SANITARY SEWER MANHOLE	EA	$1,750.00	8	$14,000.00		$0.00	8	$14,000.00
630.06	ABANDON 8-INCH SANITARY SEWER LINE	LF	$25.00	267	$6,675.00		$0.00	267	$6,675.00
630.07	ABANDON 10-INCH SANITARY SEWER LINE	LF	$30.00	2,251	$67,530.00		$0.00	2,251	$67,530.00
630.08	ABANDON SANITARY SEWER MANHOLE	EA	$1,500.00	5	$7,500.00		$0.00	5	$7,500.00
630.09	4-INCH PVC SDR 35 SANITARY SEWER LATERAL	LF	$150.00	525	$78,750.00		$0.00	525	$78,750.00
630.10	8-INCH PVC SDR 35 SANITARY SEWER PIPE	LF	$150.00	1,211	$181,650.00		$0.00	1,211	$181,650.00
630.11	10-INCH PVC SDR 35 SANITARY SEWER PIPE	LF	$225.00	1,925	$433,125.00		$0.00	1,925	$433,125.00
630.12	12-INCH PVC SDR 35 SANITARY SEWER PIPE	LF	$300.00	190	$57,000.00		$0.00	190	$57,000.00
630.13	48-INCH SANITARY SEWER MANHOLE	EA	$9,000.00	11	$99,000.00		$0.00	11	$99,000.00
630.14	60-INCH SANITARY SEWER MANHOLE	EA	$15,000.00	10	$150,000.00		$0.00	10	$150,000.00
630.21	SEWER BY PASS (8" SS RELOCATION AT ATLANTIC)	LS	$200,000.00	1	$200,000.00		$0.00	1	$200,000.00
630.22	SEWER BY PASS (10" SS RELOCATION AT OAKEY AND ST LOUIS)	LS	$400,000.00	1	$400,000.00		$0.00	1	$400,000.00
630.23	SEWER BY PASS (12" VCP REMOVE AND REPLACE AT ATLANTIC)	LS	$75,000.00	1	$75,000.00		$0.00	1	$75,000.00
630.24	SEWER BY PASS (8" VCP REMOVE AND REPLACE AT ATLANTIC)	LS	$50,000.00	1	$50,000.00		$0.00	1	$50,000.00
630.25	SEWER BY PASS (10" VCP REMOVE AND REPLACE WENGERT)	LS	$50,000.00	1	$50,000.00		$0.00	1	$50,000.00
630.26	SEWER BY PASS (12" VCP REMOVE AND REPLACE ATLANTIC)	LS	$150,000.00	1	$150,000.00		$0.00	1	$150,000.00
630.27	SEWER BYPASS (8" SS RELOCATION ST LOUIS)	LS	$250,000.00	1	$250,000.00		$0.00	1	$250,000.00
	TOTAL				**$16,756,607.00**		**$0.00**		**$16,756,607.00**
	Contingencies (10%)				$1,675,660.70		$0.00		$1,675,660.70
	GRAND TOTAL				**$18,432,267.70**		**$0.00**		**$18,432,267.70**

BOULDER HIGHWAY STORM DRAIN
PRELIMINARY COST ESTIMATE
70% SUBMITTAL

				CCRFCD		CLV		TOTAL	
ITEM	**DESCRIPTION**	**UNIT**	**UNIT COST**	**QUANTITY**	**COST**	**QUANTITY**	**COST**	**QUANTITY**	**TOTAL COST**
202.01	REMOVE EXISTING SIDEWALK	SF	$4.00	100	$400.00		$0.00	100	$400.00
202.02	REMOVE EXISTING CURB AND GUTTER	LF	$8.00	18	$144.00		$0.00	18	$144.00
202.03	REMOVAL OF ASPHALT PAVEMENT	SY	$15.00	3425	$51,375.00		$0.00	3,425	$51,375.00
202.04	COLD MILL EXISTING PAVEMENT (3/4-INCH)	SY	$15.00	4636	$69,540.00		$0.00	4,636	$69,540.00
202.06	REMOVE EXISTING MANHOLE	EA	$1,500.00	1	$1,500.00		$0.00	1	$1,500.00
202.08	REMOVE EXISTING MEDIAN ISLAND	SF	$7.00	5561	$38,927.00		$0.00	5,561	$38,927.00
202.09	ABANDON EXISTING STORM DRAIN	LF	$25.00	527	$13,175.00		$0.00	527	$13,175.00
203.01	BORROW EMBANKMENT	CY	$12.00	12985	$155,820.00		$0.00	12,985	$155,820.00
206.01	STRUCTURAL EXCAVATION	CY	$10.00	23379	$233,790.00		$0.00	23,379	$233,790.00
270.01	DEWATERING	LS	$240,000.00	1	$240,000.00		$0.00	1	$240,000.00
302.01	TYPE I CLASS B AGGREGATE BASE	CY	$45.00	1712	$77,040.00		$0.00	1,712	$77,040.00
402.04	PLANTMIX BITUMINOUS SURFACE7-INCH	SY	$50.00	3425	$171,250.00		$0.00	3,425	$171,250.00
403.01	3/4-INCH PLANTMIX BITUMINOUS OPEN-GRADED SURFACE	SY	$12.00	8061	$96,732.00		$0.00	8,061	$96,732.00
502.01	18'X8' REINFORCED CONCRETE BOX	LF	$1,000.00	934	$934,000.00		$0.00	934	$934,000.00
502.09	14'X8' REINFORCED CONCRETE BOX	LF	$900.00	200	$180,000.00		$0.00	200	$180,000.00
502.10	TRANSITION STRUCTURE #2 (14'X8' TO 18'X8')	LF	$1,200.00	16	$19,200.00		$0.00	16	$19,200.00
603.02	24-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$200.00	47	$9,400.00		$0.00	47	$9,400.00
603.03	30-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$215.00	61	$13,115.00		$0.00	61	$13,115.00
603.05	42-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$275.00	48	$13,200.00		$0.00	48	$13,200.00
609.02	TYPE III (60") STORM DRAIN MANHOLE	EA	$10,000.00	2	$20,000.00		$0.00	2	$20,000.00
609.16	48-INCH ACCESS MANHOLE WITH STEPS	EA	$4,000.00	3	$12,000.00		$0.00	3	$12,000.00
609.17	10-FOOT "CM2" DROP INLET SPECIAL	EA	$4,000.00	1	$4,000.00		$0.00	1	$4,000.00
613.01	CONSTRUCT "L" TYPE CURB AND GUTTER	LF	$25.00	18	$450.00		$0.00	18	$450.00
613.02	CONSTRUCT CONCRETE SIDEWALK	SF	$5.00	100	$500.00		$0.00	100	$500.00
613.03	CONSTRUCT TACK-ON MEDIAN	SF	$8.00	5561	$44,488.00		$0.00	5,561	$44,488.00
623.01	INSTALL 6'X6' TRAFFIC LOOP DETECTOR	EA	$1,000.00	5	$5,000.00		$0.00	5	$5,000.00
629.01	ADJUST EXISTING WATER VALVE BOX COVER TO FINISH GRADE	EA	$650.00	4	$2,600.00		$0.00	4	$2,600.00
629.03	REMOVE EXISTING 8-INCH ACP WATERLINE	LF	$125.00	40	$5,000.00		$0.00	40	$5,000.00
629.07	8-INCH C900 PVC WATERLINE	LF	$120.00	40	$4,800.00		$0.00	40	$4,800.00
630.02	REMOVE 8-INCH VCP SANITARY SEWER LINE	LF	$40.00	49	$1,960.00		$0.00	49	$1,960.00
630.05	REMOVE SANITARY SEWER MANHOLE	EA	$1,750.00	4	$7,000.00		$0.00	4	$7,000.00
630.08	ABANDON SANITARY SEWER MANHOLE	EA	$1,500.00	1	$1,500.00		$0.00	1	$1,500.00
630.10	8-INCH PVC SDR 35 SANITARY SEWER PIPE	LF	$150.00	50	$7,500.00		$0.00	50	$7,500.00
630.13	48-INCH SANITARY SEWER MANHOLE	EA	$9,000.00	1	$9,000.00		$0.00	1	$9,000.00
630.15	REMOVE 18-INCH SANITARY SEWER MAIN	LF	$70.00	405	$28,350.00		$0.00	405	$28,350.00
630.16	REMOVE 21-INCH SANITARY SEWER MAIN	LF	$75.00	404	$30,300.00		$0.00	404	$30,300.00
630.17	ABANDON 18-INCH SANITARY SWER MAIN	LF	$45.00	105	$4,725.00		$0.00	105	$4,725.00
630.18	18-INCH C905 PVC SEWER PIPE	LF	$200.00	29	$5,800.00		$0.00	29	$5,800.00
630.19	24-INCH C905 PVC SEWER PIPE	LF	$250.00	537	$134,250.00		$0.00	537	$134,250.00
630.20	72-INCH SANITARY SEWER MANHOLE	EA	$18,000.00	3	$54,000.00		$0.00	3	$54,000.00
630.28	SEWER BY PASS (8" SS RELOCATION)	LS	$50,000.00	1	$50,000.00		$0.00	1	$50,000.00
630.29	SEWER BY PASS (21' SS RELOCATION AND 18" SS REMOVAL)	LS	$1,000,000.00	1	$1,000,000.00		$0.00	1	$1,000,000.00
	TOTAL				**$3,751,831.00**		**$0.00**		**$3,751,831.00**
	Contingencies (10%)				$375,183.10		$0.00		$375,183.10
	GRAND TOTAL				**$4,127,014.10**		**$0.00**		**$4,127,014.10**

Appendix G

Comment Matrix

BOULDER HIGHWAY STORM DRAIN
30% REVIEW COMMENT MATRIX

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	REVIEWER NAME & DATE	RESPONSDED BY & DATE	RESPONSE & ACTION
		CLV, Peter Jackson, Flood Control			
1	General	Flood Control has reviews the supplemental hydrology as it relates to the current Soils Data abad both the City and CCRFCD concur with using the 2008/2013 data, which shows a slightly higher flow rate within this older urban environment.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	No action required
2	General	The provided HEC-1 analysis will require further refinement as the design process moves forward to reflect the identified collection facilities, flow splits and system design changes to allow Boulder Hwy to function as the 100-year-cut-off. A detailed review of the revised HEC-1 analysis will be performed with with the next submittal. Two key areas include: • Updating the local impacts to the Ballard/Eastwood intersection, Euclid, Russell and Olive area as Flood Control desires to collect the local flow. Additional storm drain may be needed to convey this flow. This neighborhood has experienced flood in the past, from even minor events and this has a Severe Repetitive Loss Property, which under the CRS Program should be mitigated. • Updating the St. Louis draingage lateral to reduce the extension to approximately west of the Howard intersection (1/4 mile) and eliminating the McLeod lateral. It should be noted that the McLeod lateral shall be extended with the future Sahara MPU facility. Provide interim and future splits impacting the system as CFRO3-5 and CFRO3-6.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	HEC-1 updated
3	General	Evaluate the proposed connection of the Euclid, Russell, Olive system to verify that the system will convey the local 100-year flow. Upsize the system if necessary to show local 100-year conveyance and provide additional inlets to collect the flow.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	System updated
4	General	Flood Control recommends additional along both sides of Boulder Hwy at maximum 660-foot spacing to reduce or eliminate the flow on both sides of the street. Currently flows mitigate properties to the east side of Boulder Hwy as they are lower than the street. This problem is a concern of both NDOT and the County and we should try to reduce the impact with this MPU facility.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	Drop inlets added per agreement with CLV and CCRFCD
5	General	Floow Control concurs with Phasing the MPU facility improvements to stop short of impacting the Charleston intersection. The exact limits need to logically end to minimize construction work zone impacts to Charleston. The Phase 1 limit needs to include inlet collection.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Phase 1 termination point is determined to be just north of Atlantic Street, see 70% design plans
6	General	The existing and proposed inlets along the west side of Boulder Hwy are located over the existing County (CCWRD) sewer main that is located at the curb line. Coordinate with CCWRD for the necessary relocations and/or if there is a planned replacement of the sewer in the future whereby the sewer would be moved from under the curb line.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	CCWRD sewer relocated as needed. (No proposed drop inlets between Oakey and St Louis)
7	General	Provide street flow calculations that verify Dry Lane and DV product are in compliance with the Manual Criteria.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	Addressed in DDR.
8	General	Flood Control recommends that the Over Option RCB Transition of the existing 51" City Sewer be reduced to a 7% maximum from the current 10%.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Per multiple meetings, the under option was preferred and the 70% design plans show updated profile
9	General	Provide a Maintenance Access Structure to the proposed MPU facility from the median island toward the northern end of the project. A possible location would be near the Station 39-25. This grated structurew will also need to provide man access. Complted design needs to be incorporated by the 90% submittal.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Two maintenance access locations identified in 70% design plans
10	General	Review the existing inlet size and flow capacity and upsize the maximize flow collection thereby reducing the flow impacts to the east. The inlets shown as Note 38; connect to existing drop inlet need to be replaced.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	Collection was accounted for and the existing drop inlets are being replaced
11	General	Clarify the removal and/or replacement of existing inlets and storm drain within the Right-of-Way along the westerly side of Boulder Hwy as shown on SD05-SD07.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Existing drop inlets between Oakey Blvd and St Louis Ave are to remain.
12	General	Provide an Updated Figure that quantifies the flow being collected at the various intersections & inlets and identifies any flows that bypass the proposed facility.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	See figures 11 and 12 from the report
13	General	Provide Flood Control with CCRFCD's acceptance of the Environmental Screening for this project by the 70% submittal.	Peter Jackson, CLV Flood Control 11-16-16	Matt Baird	
14	General	Incorporate the NDOT 30% comments and coordinate the necessary design issues for compliance with NDOT requirements.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri / Vance Skidmore	NDOT comments addressed
15	General	Provide the status of the necessary Right-of-Way with the 70% submittal. Right-of-Way shall be provided at the 90% level to secure construction funding from CCRFCD.	Peter Jackson, CLV Flood Control 11-16-16	Matt Baird	Noted
16	General	Provide an updated WSPG analysis of the recommended system with the 70% submittal that reflects storm drain design modifications and system parameters. Flood Control recommends that the plans and WSPG Stationing match. Provide a WSPG Exhibit showing the system.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	Updated WSPG
17	General	Flow Split Calculations need to be provided for the indentified flow split locations per the HCDDM criteria. Provide additional Flow Split Calculations based upon HEC-1 routing and physical roadway conditions to verify inlet and system parameters.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	No flow splits identified
18	General	Provide details for the proposed inlet types. Limit the length of the curb inlets to a maximum of 20-foot increments. Provide a minimum spacing of twenty feet between inlets.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted
19	General	Flod Control recommends that many of the median area inlets be replaced to improve inlet collection. Consider using NDOT Type 2B inlets. Provide detailed grading around the area drop inlets with the 70% submittal that includes; concrete collars, roadway safety markers and grading swales.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	Median inlets replaced as needed
20	General	Provide the HGL and Q100 on all Profiles and Lateral facilities with the next submittal.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	Noted, See 70% design plans
21	General	Show the RCB angle points and/or curved segments by the station location and angle/degree change. Include the radius information and dicuss how the curved section are to be completed using curved forms or multiple angled segments. This needs to be explained within the Specifications. This information is needed to allow for the use of precrast RCB's as well as cast in place construction.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted. See 70% design plans
22	General	Provide details for RCB construction. System design needs to determine the construction options of pre-cast or cast-in-place improvements. Verify that the Specifications and schedule accommodate the construction methods proposed.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Structural details will be provided at 90% design
23	General	Provide Access Manholes along the RCB at 400-foot spacing. Adjust spacing to include Manholes near the junction structures for maintenance consideration. Show that the manhole profiles begin at the top of the RCB using manhole openings that are cast with the RCB's to reduce costs.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted. See 70% design plans
24	General	Provide updated inlet calculations as necessary to support the system design.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	Noted. See 70% design plans
25	General	Provide the lateral and inlet design information to includewater and/or sewer relocations with the 70% submittal. Provide the clearance between storm drain and the water & sewer lines. Provide recommendation for water quality pipe on needed laterals, encasement requirements and details. Coordinate the seperation and material requirement approvals with the LVVWD.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted. See 70% design plans
26	General	The existing and proposed utility crossing of the storm drain must be shwon on the storm drain plan and profiles sheets and on the lateral profiles by the 70% submittal. Indicate the type of pipe material for water and sewer lines. ACP water lines will require special consideration and handling and must be addressed in the specifications.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted. See 70% design plans

BOULDER HIGHWAY STORM DRAIN
30% REVIEW COMMENT MATRIX

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	REVIEWER NAME & DATE	RESPONSDED BY & DATE	RESPONSE & ACTION
27	General	Clearly identify the required utlity relocations and which relocations are incidental to and part of the storm drain work. Identify any required Over Head Power protection needed for the RCB installation due to power pole proximity.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted. See 70% design plans
28	General	Provide separate plans and profiles for any relocated sewer and/or water lines.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted. See 70% design plans
29	General	Provide details sheets showing typical details needed for the construction, connection and any special transition structure details. Required structural details must be submitted by the 90% submittal.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted
30	General	Add a note for all storm drain drop inlets that reference the newly adopted USDCCA Drawing NO. 421 (Storwater Quality Magement Stamp and Sign Detail). Include the USDDCA Drawing No. 421 (Stormwater Quality Management Stamp and Sign Detail) note to the concrete collar detail for the NDOT Type 2B inlets.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted. See 70% design plans
31	General	Provide pothole data with the 70% submittal sufficient to determine major utility impacts like the large diamter water line and sewer main. The pothole information should identify the bottom limits of cunduit bank crossing and show the limits of concrete encasement where applicable.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Pothole information incorporated in to the design
32	General	Clearly identify that this Regional Facility is within the jurisdictional boundaries of Clark County for the project limits. Flood Control understands that the main line RCB system will be maintained by the City and the inlets and laterals within the County will be the maintenance responsibility of the County. Coordinate the permit, inspection and maintenance requirements with Clark County.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted, City and County boundary shown on plans
33	General	Complete the Construction Notes and include the corresponding details with the next submittal.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted, See 70% design plans
34	General	Provide an updated detailed cost estimate with each submittal for review. Rediuce the contingency to 10% by the 70% submittal. The cost estimate must be refinced prior to the 90% submittal and request for construction funding to assure that the requested and allocated storm drain funds are sufficient for construction.	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	See updated cost estimate
35	General	The Final Design Report shall include an electronic copy of the entire report with the input and output files for the hydraulics and hydrology.	Peter Jackson, CLV Flood Control 11-16-16	Vance Skidmore	Noted
36	GN01	Markups: a. Add Location Maps/ Survey as-built of facility	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Vicinity map shown on GN03
37	TY02	Section needed for Fremont/Boullder Hwy with next Phase	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Will be added to Charleston SD project
38	SD01	Markups: a. Show Existing Inlets b. Inlet Spacing 660' max (typical) c. Whenever we end phase 1, Need inlets to get flow into RCB	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Proposed inlet layout shown in the 70% design plans
39	SD02	Markups: a. Phase 1 limits? Include collection inlets 20' each side b. Label City sewer c. Show existing inlets d. Verify possible inlet	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Phase I termination point and the existing and proposed inlet layout shown in the 70% design plans
40	SD03	Markups: a. Add access structure grate with man access b. Show next access over 1 mile downstream c. Enlarge inlet d. Show existing inlet size with small grate	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Proposed inlet layout shown in the 70% design plans
41	SD04	Markups: a. How do we install inlet on top of existing county sewer? b. Show existing inlet size. Show (typical) replacemet	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	County sewer being relocated as needed
42	SD05	Markups: a.Show existing inlets	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Existing inlets shown
43	SD06	Markups: a. Show existing inlet and size. b. Use NDOT Type 2B inlet instead of Type 2 (Keynote 13)	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Existing inlets will be noted. Type 2B inlet being used instead of Type 2 inlet
44	SD07	Markups: a. Show existing inlets and size. b. Relocate 10" sewer or cut line to north? c. Verify Manhole d. Is this the most efficent transistion, does a flatter slope work?	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Existing inlets will be noted. Existing 10" VCP SS to be removed/abandoned. Transition is flattened to 7%
45	SD08	Markups: a. Add inlet to the east side of Fremont St and connect to proposed RCB	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Proposed inlet layout shown in the 70% design plans
46	SD09	Markups: a. Collect flow from Existing inlet at the north end of Euclid Ave b. is 15' easement doable? c. Upsize storm drain for local 100-yr d. Connects to 15" Pipe? e. In profile view, is the pipe Q100?	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Eculid/Russell/Olive system updated in the 70% design plans
47	SD10	Extend and upsize system for local 100-yr Q	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Eculid/Russell/Olive system updated in the 70% design plans
48	SD14	Will relocate to Sahara System	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Agreed and removed from the 70% design
49	SD15	Markups: a. 80' Right-of-Way ? b. Limit lateral to Howard Drive c. To the East of Howard Drive, meet dry lane criteria and collect 100 Yr before Boulder Hwy	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	ROW labeled and St Louis Lateral revised in the 70% design plans
50	SD16	Support plan required by (LVVWD) cover in specs? For contractor to provide IE similar to Oakey Meadows Phase 3	Peter Jackson, CLV Flood Control 11-16-16	Kondala Rao Mantri	Noted
CLV, Tim Parks, Sewer					

BOULDER HIGHWAY STORM DRAIN
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NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	REVIEWER NAME & DATE	RESPONSDED BY & DATE	RESPONSE & ACTION
51	TY01	Relocating Existing 12" VCP SS or anticipating requiring shoring to Protect in Place	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Existing 12" VCP SS will be protected in place
52	SD01	Cut and replace 21" VCP SS crossing the proposed RCB per SD-20 of DCSWCS	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	21" VCP SS upsized to 24" SS per CLV direction
53	SD02	Plan view calls out SD01, fix	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Call out is for alignment "SD01"
54	SD02	Live laterals on the 8" VCP SS on the west side of Fremont Street	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Noted, Sewer being relcoated
55	SD02	No Sewer line (12" VCP SS, southeast of the intersection of Atlantic and Fremont)	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	CCWRD Sewer Line??
56	SD02	Cut and Replace 12"SS and 8" SS crossing the proposed RCB per SD-20 of DCSWCS	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Agreed and shown as replacement in the 70% Plans
57	SD03	Label CCWRD Sewer as such (Typ.)	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Updated in the 70% Plans
58	SD04	Showboat formerly served by CLV Sewer	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Noted
59	SD07	10" VCP SS crossing Fremont Street to be abandoned	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Agreed and shown as abandoned in the 70% Plans
60	SD07	Rerouting Ex 10" VCP SS to 45" SS after the last lateral	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Design updated, see 70% plans
61	SD07	Can the proposed St Louis Lateral SD be rerouted to cross the 30" W and 51"SS at different locations? Concept shown on plan	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Design updated, see 70% plans
62	SD07	Can the proposed 24'X6' RCB be reduced to 5' tall RCB to provide more clearance over the 51" SS?	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Design updated, see 70% plans
63	SD09	SS Lateral inc conflict with the SD pipe between DI#20 and DI#21	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Noted, and accommodated for lateral
64	SD09	Provide 6" Min vertical clearance between proposed 18" RCP SD and existing 8" VCP SS per SD-20 of DCSWCS	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Noted and clearance shown on 70% plans
65	SD10	Provide profiles for the laterals in the next submittal	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	SD Lateral profiles shown in the 70% Plans
66	SD10	Provide 6" Min vertical clearance between proposed 54" RCP SD and existing 12" VCP SS per SD-20 of DCSWCS	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Noted and clearance shown on 70% plans
67	SD11	Avoid the active Laterals along 10" VCP SS with the proposed SD improvements	Tim Parks, CLV Sewer, 10/25/16	Kondala Rao Mantri	Noted and design updated, see 70% Plans
68	SD11	Provide 6" Min vertical clearance between proposed 38"X60" RCP SD and existing 10" VCP SS per SD-20 of DCSWCS	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Noted and clearance shown on 70% plans
69	SD12	Provide 6" Min vertical clearance between proposed 53"X83" RCP SD and existing 10" VCP SS per SD-20 of DCSWCS	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Noted and clearance shown on 70% plans
70	SD14	Existing SSMH in conflct with the proposed drop inlet at the intersection of McLeod Street and Holly Hill Avenue	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	The proposed SD improvement are no longer extended to McLeod Street
71	SD15	Existing SS to be relocated. Must serve both sides of the street.	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Design updated, see 70% plans
72	SD16	May be able to intercept flow from the new 8" SS in to the 45" SS at Station SD-05 27+50	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Design updated, see 70% plans
73	SD16	Might be a potential conlift with the 45" SS for the lateral from the DI at STA SD-05 30+00	Tim Parks, CLV Sewer, 10/25/16	KRM, 12-1-16	Design updated, see 70% plans
CLV Land Development (No Active Land Development Projects found)					
Nevada Department of Transportation Drainage (Jim Moore)					
74	General	As discussed in a meeting held in Las Vegas on July 12, 2016, there will need to be an agreement between the City of Las Vegas, Clark County, and NDOT regarding maintenance of the proposed drop inlets and box culvert.	Jim Moore, NDOT Hydrology, 10/18/16	Matt Baird	Noted.
75	General	We concur with using the "Over" options for the conflict between the proposed box culvert and the 51" Clark County Water Reclamation District (CCWRD) sanitary sewer at the intersection of Boulder Highway and St. Louis Avenue. Please ensure that the CCWRD would accept the proposed shallow clearance. In addition, we would need acceptance from our Materials Lab regarding the "Over" option, and we will work with them and keep you informed.	Jim Moore, NDOT Hydrology, 10/18/16	KRM, 12-1-16	The project is moving forward with the under option
76	General	We concur with ending the project north of Alantic Avenue to allow more investigation and design of the proposed extension under Charleston Boulevard. The proposed extenstion under Charleston will also reqiure an NDOT encroachment permit, and we would like to be involved with that phase early as well.	Jim Moore, NDOT Hydrology, 10/18/16	KRM, 12-1-16	Phase 1 termination point is determined to be just north of Atlantic Street, see 70% design plans
77	General	There is an empty lot on the west side of Boulder highway between Oakey Boulevard and Atlantic Avenue. We are asssuming that the design of the proposed drop inlest and box culvert on Boulder Highway takes into account full buildout of this lot. Please clarify and adjust any calculations if necessary.	Jim Moore, NDOT Hydrology, 10/18/16	Vance Skidmore	Hydrology assumes full build out
78	General	Please provide spread calculations for the drop inlets along Boulder highway. The bus lane can be considered as a shoulder, and with the Functional Classification of Boulder Highway in this area being "Minor Arterial," the minimum design returen frequency to use for surface drainage (onsite) facilities in the 10-year storm, with allowable spread of 1/2 the adjacent travel lane. It appears that the spread will be well within the 1/2 lane criteria but for backup puposes, please provide spread calculations.	Jim Moore, NDOT Hydrology, 10/18/16	Vance Skidmore	Spread Calculations provided with the report
79	General	In figures 11 and 12 in the Preliminary design Report, it is assumed that the proposed Dis are spaced closely enough, with no offsite flow, that the only flows are Bypass Flows from adjacent upstream Dis (per the table in the Figures). Please ensure that the flows are accurate and any offsite flow to the DIs is included in the analysis.	Jim Moore, NDOT Hydrology, 10/18/16	Vance Skidmore	Noted, Please see updated drainage report
80	General	Structure G-N-5 was inadvertently omitted from the table in FIGURE 11. Please ensure this structure is added.	Jim Moore, NDOT Hydrology, 10/18/16	Vance Skidmore	Noted, Please see updated drainage report

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NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	REVIEWER NAME & DATE	RESPONSDED BY & DATE	RESPONSE & ACTION
81	General	In relation to Comment #4, we assume that the design of Structure FR04-C9 and FR04-C10 accounts for full buildout of the empty lot on the west side of Boulder highway between Oakey Boulevard and Atlantic Avenue. Please clarify and adjust calculations if necessary.	Jim Moore, NDOT Hydrology, 10/18/16	Vance Skidmore	Hydrology assumes full build out
82	General	It is assumed that the final profile of Boulder Highway will correspond to ground elevations shown in the WSPG runs. If this is the case, then the calculated Hydraulic Grade Lines should be adequate as they are all as least one foot below profile grade. Please clarify and adjust if necessary.	Jim Moore, NDOT Hydrology, 10/18/16	Vance Skidmore	Noted
		CLV CPM (D Davies)			
83	General, all sheets	Markups: a. Add street names (typ.) b. Add SDDI info (typ.) c. Add Storm Drain Details (typ.)	D Davies, CLV CPM, 10-25-16	KRM, 12-1-16	Updated, see 70% plans
84	Cover Sheet	Markups: a. City Council switch names of Stavros S. Anthony and Steven D. Ross. Steven is current Mayor Pro-Tem b. Update LVVWD Signature block with the LVVWD project # c. Update drawingt# in border to 107V6679	D Davies, CLV CPM, 10-25-16	KRM, 12-1-16	Updated, see 70% plans
85	GN01	Update City of Las Vegas Street light Notes	D Davies, CLV CPM, 10-25-16	KRM, 12-1-16	Updated, see 70% plans
86	GN03	Sheet List Table 29 AVE MAIN LINE and 30 AVE UNDER OPTION does not match title block names See SD16 & 17	D Davies, CLV CPM, 10-25-16	KRM, 12-1-16	Updated, see 70% plans
87	SD01	Markups: a. Add "per detail" to keynote 22	D Davies, CLV CPM, 10-25-16	KRM, 12-1-16	Updated, see 70% plans
88	SD10	Add legend	D Davies, CLV CPM, 10-25-16	KRM, 12-1-16	Legend is no longer valid, as there is only one option for the RCB along Fremont St moving forward
89	SD12	Markups: a. Add legend b. Change SD04 to SD05	D Davies, CLV CPM, 10-25-16	KRM, 12-1-16	Legend is no longer valid, as there is only one option for the RCB along Fremont St moving forward
90	SD16	Sheet should be 29 of 30	D Davies, CLV CPM, 10-25-16	KRM, 12-1-17	Updated, see 70% plans
91	SD17	Markups: a. Add Legend b. Sheet should be 30 of 30	D Davies, CLV CPM, 10-25-16	KRM, 12-1-18	Legend is no longer valid, as there is only one option for the RCB along Fremont St moving forward
		CLV Transportation Engineering Division (Connie L. Diso)			
92		A stripping restoration plan is needed to replace the existing pavement striping / markings that will be removed as part of the storm drain work. Tha plan will need to provide demensions of lanes and show limits of replacement.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Striping plans added, see 70% design plans
93		The storm drain project will impact existing traffic signal infrastructures and underground conduit within the project limits. The signals impacted will be Fremont/Charleston/25th, Fremont/Lowe's, Fremont/Mojave, and Fremont/St. Louis. NDOT plans of the Boulder BRT project are attached for reference (they do not include the Charleston/Eastern instersection).	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Traffic Signal Conduit that are impacted is called out as remove and replace
94		If Possible, pavement cuts should be along lane lines. Show pavement patch restoration limits.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Pavement restoration limits will be shown in the 70% plans. If the restoration limits are not along the lane line then the rest of the lane will be cold milled and overlayed to create a consistent lane surface
95		Center storm drain manholes in center of travel lanes where possible.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Will accommodate wherever possible
96		Existing in-road vehicle loop detectors that are damaged or removed due to construction work shall be replaced and need to be shown on the plans.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Loop detectors that are impacted is called out as remove and replace. See utility conflict matrix
97		Please address impacts to existing improvements (median, etc.) perhaps as incedentals.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Updated, see 70% plans
98		Include the following language in section 107.07 of the Special Provisions to address the following traffic and access issues: a. For work requiring lane closures on Charleston Boulevard, the contractor shall maintain a minimum of two lanes in each direction and equivalent left-turn pocket storage lengths to what currently exists at all times. Note: The maintenance of two lanes each direction in Charleston will reqiure coordination with City traffic barricade staff and NDOT. b. For work requiring lane closure on Fremont Street, Atlantic Street, Oakey Boulevard and St. Louis Avenue, the contractor shall maintain a minimum of one lane each direction and equivalent left-turn pocket storage legths to what exists at all times. c. As the project limits are within a resedential area, no work between the hours of 6 pm and 7 am shall be allowed. d. Traffic access must be maintained for business along project alignment.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Noted. Language will be added to the Specifications at 90%. Note (a) is not applicable anymore as the project limits are cut short of Charleston Boulevard
99		A Maintenance of traffic (MOT) exhibit should be provided depicting proposed traffic access during construction. The exhibit would idealy have cross sections showing maintained access lanes and the work zone; which includes the trench and area needed for equipment.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	See 70% Design plans
100		"Weekend marathon" work should be considered to help minimize traffic disruptions.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Will be addressed in the specifications at 90%
101		Note that approximately 0.25 miles west of the Charleston/Eastern/Fremont intersection of Charleston is the Suggested Routes to School (SRTS) route for Hollingsworth Elementary located at Bruce and Fremont. Although the project boundry is outside of the route, TED recommends contacting the school to determine whether the Charleston/Eastern/Fremont instersection is also used by students. The Contractor shall be required to maintain a safe pedestrian route at all times.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	The project limits are cut short and does not affect this Suggested Route to School anymore
102		If the proposed drop inlets in St. louis Avenue impact the existing bike lanes' minimum requirement width of four feet; use bicycle safe grates.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Will evaluate the impact to the bike lanes and use the appropriate grates
103		Coordinate improvements as necessary with the upstream CIP Flamingo-Boulder Highway storm drain project (H# 66740) currently in the scoping phase.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Will coordinate
104		NDOT coordination and permitting is required for Charleston Boulevard and Fremont Avenue.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Noted and will coordinate with NDOT
105		Clark County coorination is recommened for protions of project abutting or within County jursidiction.	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Noted and will coordinate with CCPW

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NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	REVIEWER NAME & DATE	RESPONSDED BY & DATE	RESPONSE & ACTION
106		Fast coordination is required for interconnect as-built information. (I have contacted Jesus Marmolejo at FAST for the information; which will be forwarded to the Project manager.)	Connie Diso, CLV Traffic, 11-08-16	KRM, 12-1-16	Noted and will coordinate with FAST
		CCPW (Layne Weber)			
107	General	Comment regarding flooding at specific APN's: "Wherever there is a DI on the east/north side of Boulder Hwy in this area there is an CMP that bubbles out into parking lots or other areas and creates problems for the owners." Properties effected include Lowes (162-01-102-008), Lamplighter Motel (162-00-202-001), Silver State Glass (162-01-202-002), into the Motel site (162-01-202-012), as well as 162-01-704-003, 162-01-704-002, 162-01-704-005, 162-01-802-001, 162-01-802-002, 162-01-802-003	Layne Weber, CCPW, 11-23-16	Kondala Rao Mantri	Design updated, See 70% plans
		CCRFCD (Todd Myers)			
108	General	Complete a facility-specific environmental analysis (Section 8) in accordance with Chapter 8 of District's Supplemental Programmatic Environmental Impact Statement, Clark County Regional Flood Control District. 2002 Master Plan Update, September 2001.	Todd Myers, CCRFCD, 11-23-16	Matt Baird	Submitted with DDR
109	General	Identify all right-of-way (ROW) and easement acquisition requirements for this project. All ROW/easements must be acquired prior to City's request for construction funding.	Todd Myers, CCRFCD, 11-23-16	Matt Baird	Noted
110	Report	District concurs with Atkins recommendation to construct mainline facility over the existing 51" sanitary sewer at Fremont Street and St. Louis Avenue.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	The preferred alternative is going under the 51" SS at St Louis Avenue
111	Report	St. Louis Avenue lateral: District concurs with Atkins recommendation not to construct lateral facility in St. Louis extending east to McLeod St, then south to Holly Hill. Alternatively, construct drop inlet tree at Fremont / St. Louis intersection and construct lateral facility in McLeod St. with future District facility BHSA 0026, in Sahara Avenue.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Noted. Design updated, see 70% plans
112	Report	Phasing Limits: District concurs with Atkins recommendation to end current phase of the project just north of Atlantic Avenue on Fremont St. in order to minimize traffic impacts on Charleston at Fremont St. and Eastern Ave.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Noted. Design updated, see 70% plans
113	Report	Euclid/Eastwood/Ballard System: The report presents alternatives to mitigate this problem area. District concurs with constructing Eastern South Lateral with future facility in Charleston to cut off the majority of runoff impacting this area.	Todd Myers, CCRFCD, 11-23-16	Vance Skidmore	Noted, Eastern lateral is deferred in to Phase 2
114	Report	What condition is the existing storm drain in Russell Ave and Olive St., and what specifications were they constructed to? Are there as-built plans or GPS data on the facility? It may be necessary to replace the entire system from Fremont to the Eastwood/Ballard area depending on the findings. This should be discussed at the next progress meeting.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Noted, Design updated, see 70% Plans
115	Report	Update cost estimate as project continues.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Updated cost estimate provided
116	Hydrology	District reviewed new soils data provided in 11/2/2016 email. It appears that there is a relatively insignificant (<10%) change in resulting flows using the new data. Therefore, District takes no exception to utilizing the 2008/2013 MPU soils data to provide a slightly more conservative design approach.	Todd Myers, CCRFCD, 11-23-16	Vance Skidmore	No action required
117	Hydrology	Figures 4 & 5: Provide street labeling.	Todd Myers, CCRFCD, 11-23-16	Vance Skidmore	Updated
118	Hydrology	District takes no exception to Hydrologic analyses presented in PDR.	Todd Myers, CCRFCD, 11-23-16	Vance Skidmore	No action required
119	Hydraulics	Only cursory review of hydraulic (WSPG) analyses were conducted at this time. A more thorough review will be conducted at 70% level of design once vertical and horizontal alignments have been refined.	Todd Myers, CCRFCD, 11-23-16	Vance Skidmore	Noted, see updated PDR
120	Geotech Report	Section 2.3.2 of the report indicates moderately and strongly cemented hard soil was encountered at several boring locations; and heavy duty excavator or trencher will likely be needed. This should be noted and discussed in the mandatory Pre-Bid meeting.	Todd Myers, CCRFCD, 11-23-16	Matt Baird	Noted.
121	Groundwater Impact Evaluation	Provide status updates from ground water monitoring wells at soil borings B-1. B-4 and B-8. with next submittal.	Todd Myers, CCRFCD, 11-23-16	Matt Baird	Not completed at time 70% submittal
122	Groundwater Impact Evaluation	The Special Provisions must thoroughly address dewatering requirements for facility construction..	Todd Myers, CCRFCD, 11-23-16	Matt Baird	Noted.
123	Groundwater Impact Evaluation	Coordinate with NDEP for permit requirements. Does City intend on obtaining Discharge Permit, or will that be Contractors responsibility? In either case, District recommends that the City start the process to determine requirements and projected time frame.	Todd Myers, CCRFCD, 11-23-16	Matt Baird	Atkins will prepare permit on behalf of CLV. Process to begin after 70% design.
124	Plans	Deliniate Clark County / City of Las Vegas boundaries on plans. Typical all sheets.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Updated, see 70% plans
125	Plans	Provide pothole information for all major utility crossings with next submittal.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Updated, see 70% plans
126	AC02	Obtain ROW at southeast corner of Fremont / Atlantic Street intersection prior to construction funding request.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Design updated, ROW no longer needed
127	SD02	As noted above, proceed with "over" profile. Show revised limits of facility. Are existing dry utilities covered under franchise agreement through City, Clark County and/or NDOT?	Todd Myers, CCRFCD, 11-23-16	Matt Baird	The Intent is excersise franchise where possible
128	SD03	Show proposed lateral penetrations on mainline profile, typical all sheets. Evaluate existing drop inlets on east side of Fremont Street to determine if they need replaced or upsized. Also determine if there adequate drop inlets based on ultimate conditions hydrology.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Updated, see 70% plans
129	SD04	Verify location of existing 8" Sanitary Sewer and provide recommendation to resolve conflict with proposed drop inlets and laterals on west side of Fremont Street. Verify location of existing 30" MLCP waterline shown back of sidewalk.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Verified existing utilities, Design updated, see 70% Plans
130	SD05	Address and provide instruction (abandon, remove, tie in...) for existing storm drain system in Freemont Street.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Updated, see 70% plans
131	SD06	Revise sheet layout to show transition structure at matchline (STA 68+00) to be entirely within Sheet SD06 or SD07.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Transition updated, see 70% Plans
132	SD07	Provide draft construction details for major structures with next submittal.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Structural details to be provided at 90%
133	SD09	See Comment No. 114. Show hydraulic grade line on profiles.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Updated, see 70% plans
134	SD10	Obtain right-of-way, or adjust alignments of Atlantic Street lateral near "SD03 18+75." See additional redlines	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Design updated, ROW no longer needed
135	SD12	Address dry utility conflicts at drop inlet locations.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Updated, see 70% plans

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NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	REVIEWER NAME & DATE	RESPONSDED BY & DATE	RESPONSE & ACTION
136	SD14, SD15, SD16	See Comment No.113 above. Delete sheets SDI4 and 5D15 and add additional drop inlets as necessary on Sheet SDI6. See additional red-lines.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Updated, see 70% plans
137	Plans	See additional redline comments on attached check prints.	Todd Myers, CCRFCD, 11-23-16	Kondala Rao Mantri	Noted.

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