ATKINS

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

(Boulder Highway Storm Drain)

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

September 26, 2016



9/26/16

Prepared for the City of Las Vegas



ATKINS

September 26, 2016

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

RE: Preliminary Design Report for Boulder Highway Storm Drain

Dear Ms. Marquez

Transmitted herewith are the Preliminary Design Report (Volume 1) and the 30% 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,



9/26/16

Matt Baird, PE, CFM
Project Manager

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Executive Summary

This Preliminary Design Report (PDR) has been prepared to describe the 30% 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 Eastwood Drive/Ballard Drive/Euclid Avenue 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 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 and have not been included in the 30% plans. Whether or not these laterals and the extension of the mainline storm drain to Eastern are included with this phase of the project or a future phase will be discussed after this report and the 30% plans are provided to the City and CCRFCD for review.

This report and the 30% 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 for the project and is included in this report for review by the City.
3. Collection of all available existing utility information has been completed and included on the 30% plans as well as the 30% SUE plans.
4. Major existing utilities have been potholed (Phase 1 test holes) at critical locations and incorporated into the 30% plans.
5. Existing ROW limits have been developed and included in the 30% plans as well as identification of potential ROW acquisition needs for the project (1, possibly 2 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.

8. Detailed hydraulic analysis (WSPG) has been completed for the mainline storm drain and the trunk line of the major lateral collection facilities. Drop inlet laterals have been sized using normal depth analysis. Drop inlets have also been sized using normal methods.
9. A utility conflict matrix has been developed and potential utility conflicts identified.
10. Horizontal Control and Alignment Control of the storm drain facilities has been develop and included in the 30% plans along with plan and profile of all the major storm drain facilities proposed with the project. Minor drop inlet laterals have been excluded from profiling, but are shown in plan view.
11. A summary of required permits has been developed and included in this report.
12. Estimated construction cost of the proposed facilities has been developed.

The total estimated construction cost of the project with 15% contingency (excluding the Eastern North and Eastern South laterals) is $19.9 million for the over option and $20.6 million for the under option (over and under the 51" sewer at St. Louis).

The major items to be addressed/discussed during the review of the 30% submittal along with Atkins recommendations are as follows:

1. Whether or not to construction the proposed mainline facility over or under the existing 51" sewer with 72" steel casing at Fremont Street and St. Louis Avenue. Both options are shown in the 30% plans. The sewer manholes on either end of the crossing have been dipped and the 72" steel casing has been potholed in two locations. Atkins recommends the over option.

2. Whether or not to move forward with the design of the St. Louis lateral as shown in the 30% plans. Another option is to pull the limits of the lateral back towards Fremont Street (similar to the Oakey lateral 400 – 500 feet/six drop inlets vs. 2,000 feet to Holly Hill) and construct a lateral north in McLeod Street from Sahara Avenue (1,100 feet) with the future construction of the regional facility in Sahara Avenue. The latter option is likely much less expensive due to the severe congestion of existing utilities in St. Louis, but would push the construction of the McLeod lateral out to 2024 as that is when the regional facility in Sahara is currently planned for construction funding. Atkins recommends the latter option as this is likely the least expensive option, but a case could be made to construct the entire St. Louis system as shown on the 30% plans to provide the benefit of reduced flood risk to the downstream residential community in the interim period between now and when the Sahara facility is constructed.

3. Construction phasing limits and where to end the Phase 1 construction, which is currently planned for half way between Eastern Avenue and Fremont Street on Charleston Boulevard. There are two factors that should be considered in determining if the current phasing is suitable or if an alternate phasing would be more appropriate.

    a. Charleston Boulevard is severely congested with large existing sewer, water and gas utilities, determining the most efficient/effective horizontal and vertical alignment of the proposed storm drain will be important. This is also influenced by the fact that future phases of the storm drain will extend the facility west in Charleston all the way to Main Street and the large existing utilities in Charleston also extend west in Charleston to Main Street. It would be beneficial to consider/evaluate the entire reach of the storm drain from Main Street to Fremont Street when selecting the horizontal and vertical alignment of the storm drain in Charleston.

    b. The intersections of Eastern and Fremont at Charleston carry heavy traffic loads, minimizing the construction impacts to these intersections would be advantageous.

In the current phasing limits these intersections would be impacted with both the current phase and the next phase of the storm drain construction.

Two alternate options for the construction phasing should be considered.

a. End the current phase of the storm drain just north of Atlantic Avenue on Fremont Street to minimize the traffic impact on Charleston at Fremont and Eastern with this phase of construction. This would also have the added benefit of allowing more time and effort to be spent evaluating the most efficient/effective horizontal and vertical alignment of the storm drain in Charleston as Phase 2 (Fremont to Maryland) of the storm drain design is to be initiated in the next couple months. Phase 2 could include an evaluation of this for the entire reach in Charleston (Fremont to Main St.). Ending Phase 1 just north of Atlantic may also allow the current phase to begin construction quicker (shorten the design schedule) as it is believed that the critical design issues/decisions have already been addressed or will be addressed following review of this submittal.

b. Extend the current phase west of Eastern Avenue to help reduce the traffic impacts to the intersections of Eastern and Fremont at Charleston with the next phase of construction (Eastern to Maryland). This would also allow construction of the Eastern North and Eastern South laterals with the first phase of construction. However, this may extend the design schedule for the first phase since it would take the first phase of construction far enough down Charleston that the entire reach of Charleston (Fremont to Main St.) should be considered in determining the most efficient/effective horizontal and vertical alignment of the facility.

Atkins recommends the construction phasing described in item “a.” above for the reasons stated.

Atkins has prepared this report and the 30% plans to compile all necessary information to summarize the progress to date and provide enough information and detail to allow the City (with input from Atkins and stakeholders) to make the decisions necessary to permit the design to advance in an efficient and timely manner. The level of completeness of the included plans is probably beyond what most would consider 30%, but Atkins felt that the level of detail provided was necessary to help resolve some of the project challenges, the most notable of which is the crossing of the 51” sanitary sewer at St. Louis and Fremont. It is our hope that the City, CCRFCD and NDOT will complete a thorough review of the information provided, followed by a comprehensive discussion with Atkins to gain the input necessary and decisions required to then turn the focus of the project towards production and permitting and advance the project to the bid phase as soon as possible. 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.

Table of Contents

Sections Page

1.	**Introduction**	**1**
1.1.	Purpose	1
1.2.	Project Description and Location	1
1.3.	Inventory of the Existing Condition	6
1.4.	Existing Facilities	6
1.5.	Report Organization	7
2.	**Hydrologic Analysis**	**9**
2.1.	General	9
2.2.	Previous and/or Related Drainage Studies	9
2.3.	Topography Data and Survey	9
2.4.	Hydrologic Design Scenarios	9
2.5.	Hydrologic Analysis and Parameterization	10
2.6.	Hydrologic Analysis Results	11
3.	**Proposed Facilities, Constraints and Hydraulic Analysis**	**15**
3.1.	Proposed Facilities	15
3.2.	Hydraulic Analysis Methodology and Results	27
3.3.	Drop Inlets	27
4.	**Other Design Considerations**	**30**
4.1.	Groundwater and Geotechnical	30
4.2.	Record of Survey	31
4.3.	Summary of Permits	31
4.4.	Right-of-Way Summary	33
5.	**Utility Issues and Conflicts Summary**	**36**
5.1.	Utility Data Collection and Conflicts	36
5.2.	Utility Potholing	39
6.	**Construction Cost, Key Issues and Conclusion**	**40**
6.1.	Construction Cost Estimate	40
6.2.	Summary of Key Issues	40
6.3.	Conclusion	41

List of Tables

Table 1. Summary of Design Flows at Key Locations 12
Table 2. Summary Matrix of Required Permits 32

List of Figures

Figure 1. Boulder Highway Storm Drain Vicinity Map 2
Figure 2. 2013 MPU Flood Control Facility Map (F-32) 3
Figure 3. Boulder Highway Storm Drain Alignment 5
Figure 4. Hydrology Summary Map - Mainline 13
Figure 5. Hydrology Summary Map - Collection 14
Figure 6. Proposed Mainline System Design 16
Figure 7. Proposed Major Lateral Storm Drains 17
Figure 8. Ballard and Euclid Drop Inlet Options 23
Figure 9. Future Laterals Recommended 24
Figure 10. Future Regional Facility in Charleston 26
Figure 11. Drop Inlet locations (1) 28
Figure 12. Drop Inlet locations (2) 29
Figure 13. City of Las Vegas Jurisdiction 34
Figure 14. Easement Exhibit 35

List of Appendices

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: CCRFD Design Manual Criteria
- Appendix A-5: Hydrologic Parameters
- Appendix A-6: Land Use Map and Soils Maps

Appendix B Hydraulic Analysis

- Appendix B-1: WSPG Models
- Appendix B-2: Drop Inlet summary

Appendix C Geotechnical Investigations

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

Appendix D Record of Survey

Appendix E Utility Conflicts

- Appendix E-1: Utility Conflict Matrix
- Appendix E-2: SUE plans
- Appendix E-3: Utility Pothole Reports

Appendix F Cost Estimate

Electronic Data CD

- Hydrologic/Hydraulic Models (Appendix A and B)
- Geotechnical Reports (Appendix C)
- Project topography
- PDF version of the Preliminary Design Report
- PDF version of the 30% Design Plans

1. Introduction

1.1. Purpose

The purpose of this Preliminary Design Report (PDR) is to describe the criteria, parameters, considerations, assumptions, and methodology used in the preliminary 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 PDR 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), as well as other stakeholders.

It is important to note that the proposed drainage system and the associated analysis presented in this PDR is still a work in progress and represents the latest information corresponding to the 30% milestone submittal. Thus, 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 detailed design phase. The content presented herein will later be updated as necessary and incorporated into the Draft Final Design Report at the 70% milestone.

1.2. Project Description and Location

This Preliminary Design Report (PDR) has been prepared to describe the 30% 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. The project also includes major lateral storm drain collection facilities in St. Louis Avenue, Oakey Boulevard and Atlantic Street west of Fremont Street as well as a small storm drain in the vicinity of Euclid Avenue/Eastwood Drive/Ballard Drive. 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. Whether or not these laterals and the extension of the mainline storm drain to Eastern Avenue are included with this phase of the project or a future phase will be discussed after this report and the 30% plans are provided to the City and CCRFCD for review.

Detailed sizes, locations, and alignments of the proposed storm drain facilities are shown on the 30% Design Plans that accompany this report and will be described later in this PDR.

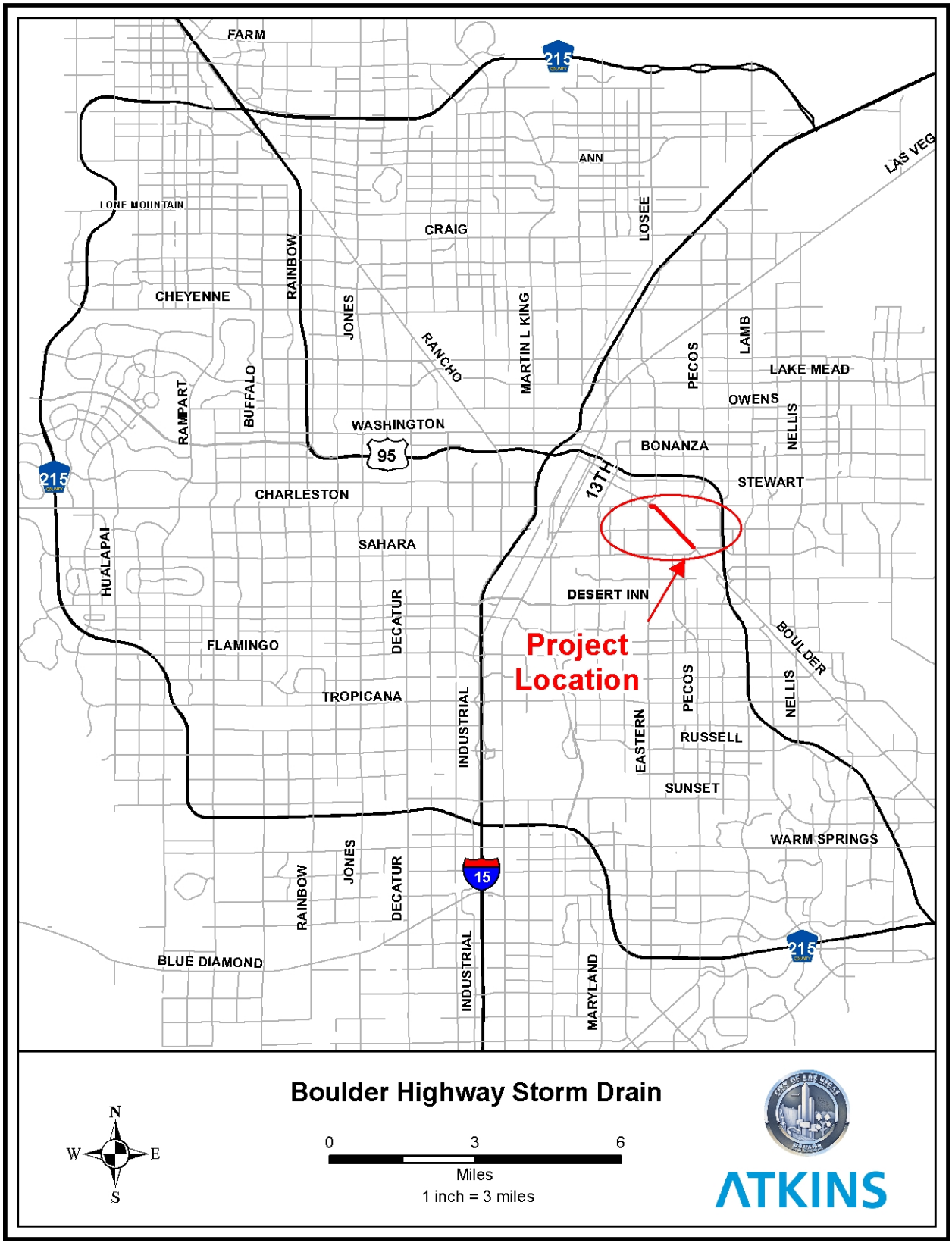


Figure 1. Boulder Highway Storm Drain Vicinity Map

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)

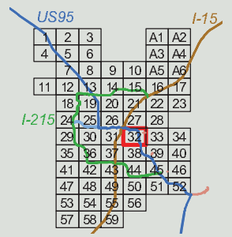


Figure 2

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 Lateral Storm Drain
- Proposed Mainline 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
Eastwood Dr
Euclid Ave
Eastern Ave
Atlantic St
Mojave Rd
Fremont St
Oakey Blvd
Wyoming Ave
St. Louis Ave
Mcleod St
Sahara Ave
Boulder Hwy
Sahara Ave

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 2706 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)

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 30% milestone submittal. The report has been organized into five 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, 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 as well as a summary of the key design issues 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 30% design plans in pdf format, and other electronic files related to this submittal. The 30% 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.

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 PDR 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.

- **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.

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	225	Collection	-
Fremont at St Louis	CFR03	2443	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.

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	Subbasin	0.29	254
CFR03	Combination Point	3.07	2443

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.

CH59-C
CH60A-C
CH68
CH52-C
CH56-C
CH63-C
CH64-C
CH67-C
FR04-C
FR03
CH51
CCH52
CCH60A-C
CCH56
CCH68-C
CCH67-C
CFR04C
CFR03
CFR03-1
LB Blvd

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

Aerial Source: Clark County Spring 2015

Boulder Highway Storm Drain
Figure 5: Hydrology Workmap - Collection

EC-1 Nod	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
CCH6AC4	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
CH68-4a	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
DCFR036	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	0.17	162
FR04-C13	Subbasin	0.03	26
CFR03B	Combination Point	0.2	188
CFR03C	Combination Point	0.22	208
FR03-4	Subbasin	0.02	20
CCH63-C	Combination Point	0.24	225
FR04-C16	Subbasin	0.03	40
FR04-C17	Subbasin	0.01	10
CBH4	Combination Point	3.05	2777
FR03-8	Subbasin	0	5
FR03-7	Subbasin	0.02	24
CBH5	Combination Point	3.07	2289

Legend

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

Collection Subbasins

- To Fremont
- To Olive/Atlantic
- To Oakey
- To St. Louis
- To Charleston
- To Fremont

0 600 1,200 Feet

1 inch = 600 feet

N

ATKINS

Aerial Source: Clark County Spring 2015

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 30% plans for the preliminary plan and profile.

The project also includes major lateral storm drain collection facilities in St Louis Avenue, Oakey Boulevard, Atlantic Street west of Boulder Highway and a small storm drain in the vicinity of Euclid Avenue/Eastwood Drive/Ballard Drive. 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. Whether or not these laterals and the extension of the mainline storm drain to Eastern Avenue are included with this phase of the project or a future phase will be discussed after this report and the 30% plans are provided to the City and CCRFCD for review.

The major laterals in St Louis, Oakey and Atlantic collect 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,** and the preliminary plan and profiles are shown on the 30% plans that accompany this report. The 30% plans display in plan view the mainline, major laterals and all anticipated drop inlets and associated laterals. The plans also display in profile the mainline, major laterals and some, but not all of the drop inlet laterals.

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.



Figure 6. Proposed Mainline System Design

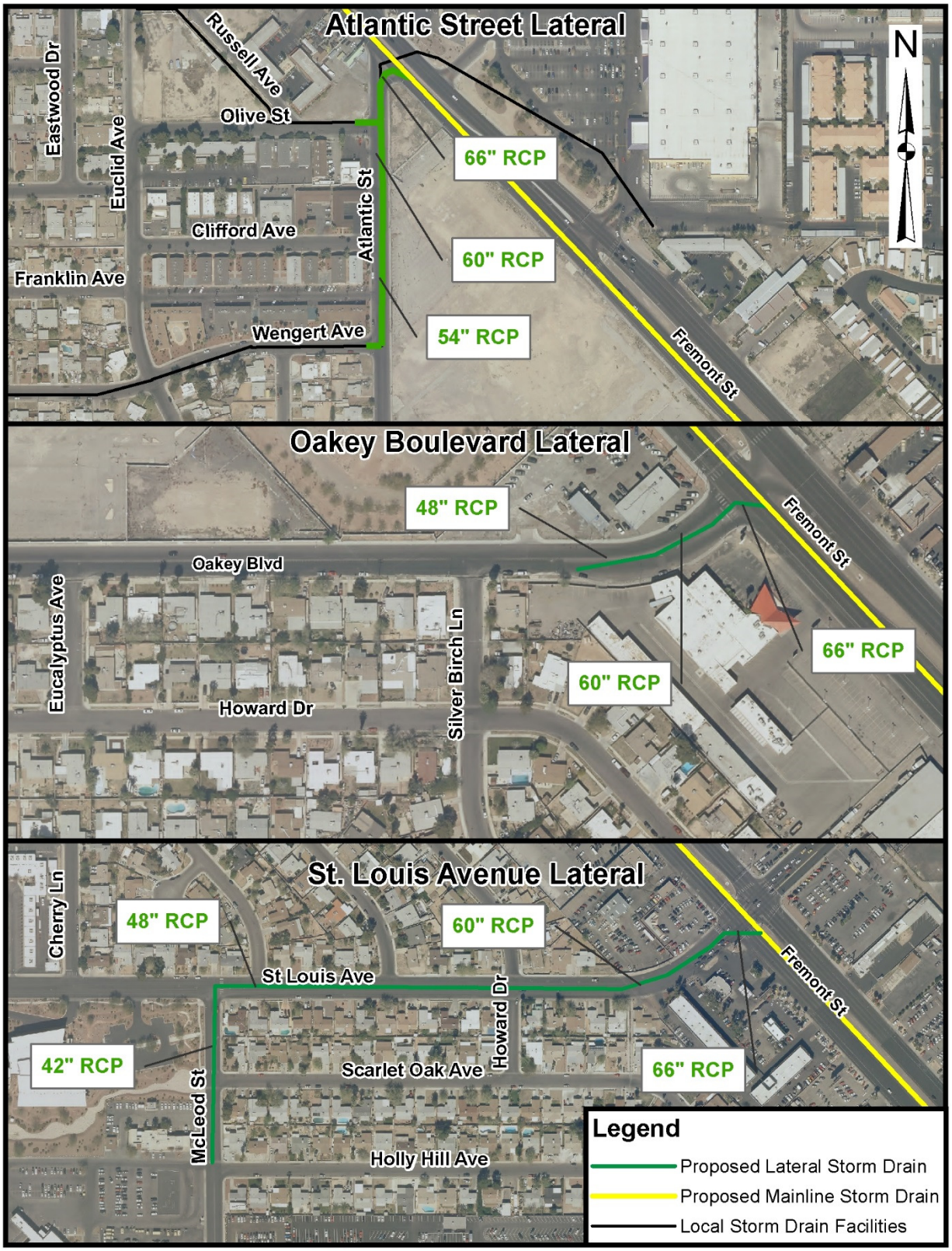


Figure 7. Proposed Major Lateral Storm Drains

North of St. Louis Avenue (after crossing the 51" sewer, which enters Fremont Street from the west in St. Louis) this same horizontal alignment was perpetuated. 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. North of St. Louis a median alignment could be considered if it is felt this alignment is more desirable despite the conflicts with the traffic signal/light poles. 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 should be considered. 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 is likely the most viable alignment in this reach.

At Charleston Boulevard the storm drain turns west and again 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 and moving the existing 18" sanitary sewer to the south side and possibly combining it with the existing 21" sewer appears to be the most viable option at this point.

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.

It is believed that the 30% plans included with this submittal avoid direct conflict with all of the above existing utilities 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 immediately under the sewer requiring relocation and is proposed to be consolidated with the existing 21" sewer and upsized to a 30" pipe.

Items 4, 5 and 6 above have been the most difficult to address (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 of the preliminary design phase. Both options are shown in the 30% plans – option 1 in black ink – the "over" option and option 2 in red ink – the "under" option. Based on the current design, associated hydraulic analysis and the potholes completed in this area it appears that both the over and under options avoid direct conflict with the existing large utilities (51" sewer, 30" water and CCWRD 10" sewer), including no direct conflict with the 72" steel casing encompassing the 51" sewer. The anticipated clear distance between the top of the RCB and the bottom of the 72" steel casing for the under option is estimated to be 8.5 inches at the centerline of the RCB, see 30% plans. The anticipated clear distance between the bottom of the RCB and the top of the 72" steel casing for the over option is estimated to be 4 inches at the centerline of the RCB, see 30% plans. In addition, based on preliminary coordination with NDOT it is believed that the estimated 1.3 feet clear distance between the top of the RCB and the roadway surface for the over option is acceptable for reconstruction of the roadway pavement. It may be possible to reduce this to as little as 1.0 foot providing additional clearance between the 72" steel casing and the bottom of the RCB if necessary.

Based on the above, the over option having a shallower profile and the under option requiring the sewer to span across a 30' wide open trench it is recommended that the over option be the selected alternative.

3.1.2. St. Louis Avenue Lateral

The St. Louis Avenue lateral begins with a drop inlet approximately 500 feet south of St. Louis Avenue on McLeod Street near the Holly Hill Avenue intersection. The storm drain proceeds north in McLeod Street to the Scarlet Oak Avenue intersection and a lateral is extended to the west side of McLeod Street where a headwall is proposed to be constructed behind the sidewalk at the downstream end of an existing rip rap ditch that conveys flows to McLeod Street from the west. These two inlets at Holly Hill and Scarlet Oak intercept flows from the west and in the existing condition it is believed that these flows continue east past McLeod Street down their respective streets and impact the adjacent residential homes. It should also be noted that based on the 1 foot topography and field investigation it appears that approximately half of the flow continuing down Holly Hill will drain to Sahara Avenue and the other half will drain to St. Louis Avenue due to a flow split at the Holly Hill and Scarlet Oak intersection.

The storm drain proceeds north on McLeod Street to St. Louis Avenue where it turns east and continues to the connection with the mainline at Fremont Street. Note that there are two options for the connection of the St. Louis lateral to the mainline facility in Fremont Street. Each option is associated with whether or not the mainline facility is constructed over or under the 51" sanitary sewer, see the 30% plans for the preliminary plan and profile of the two options, which vary downstream of St. Louis lateral station 30+72.

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 are shown in plan view on the 30% plans, but the sanitary sewer service laterals have not yet been added to the 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 would be relocated north towards the waterline. The relocated 8" sewer will discharge to the 45"/51" sewer just west of Fremont Street. This will allow the 10" sanitary sewer that crosses the mainline storm drain at station 69+43 to be abandoned if the "over" option of the mainline storm drain is selected 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.

The St. Louis lateral extends beyond the eligible ¼ mile lateral length that is funded by CCRFCD. The 30% design plans show the lateral extending to McLeod Street and Holly Hill Avenue, which is approximately 0.4 miles from the mainline facility. The City may elect to truncate this facility to be within the ¼ mile length, this will be discussed during the review of the 30% submittal. The construction cost estimate gives a separate cost for the portion of the lateral that is beyond the ¼ mile limit.

An alternative to the current design of the St. Louis lateral that should be considered for collecting the flows at Holly Hill and Scarlet Oak is to truncate the St. Louis lateral to ¼ mile (or less) from the BHSD and in the future when the regional facility in Sahara Avenue is constructed extend a lateral north in McLeod from Sahara to Holly Hill and Scarlet Oak to intercept the flows from the west. This would allow both laterals to be fully funded by CCRFCD as they would both be within the ¼ mile distance from a mainline regional facility. In addition, due to the severe utility congestion in St. Louis these two separate laterals may be less expensive to construct and would serve the same purpose.

See **Figure 7** for the schematic layout and the 30% plans for the preliminary 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. Based on desktop research this driveway is located within the City of Las Vegas boundary. 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 as well as avoiding conflict with the adjacent light pole and gas line.

There are two options for the connection of the Oakey lateral to the mainline facility in Fremont Street. Each option is associated with whether or not the mainline facility is constructed over or under the 51" sanitary sewer at St. Louis, see the 30% plans for the preliminary plan and profile of the two options, which vary downstream of Oakey lateral station 14+50. If the over option is selected for the mainline then the downstream end of

the Oakey lateral will require an elliptical instead of circular pipe cross-section to avoid conflict with the existing 30" water line along the west side of Fremont Street and still allow connection of the Oakey lateral to the mainline facility.

See **Figure 7** for the schematic layout and the 30% 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. This lateral also intercepts an existing 18" diameter storm drain in Olive Street from the west. It is important to note that the existing storm drain in Olive Street is the downstream outlet of the proposed storm drain for the Euclid/Eastwood/Ballard area. See **Figure 7** for the schematic layout and the 30% plans for the preliminary plan and profile.

The Atlantic lateral is necessary to collect flows from the west and south, without this lateral the 100-year flow would exceed the conveyance capacity of the street and flow will overtop the east curb of the street and enter the vacant property on the east side of Atlantic (where the old Showboat Casino was located).

3.1.5. 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 (**See Figure 8**). 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. 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. Based on available plans and field survey it is unclear exactly where the outlet of this third drop inlet drains to, but it is believed that it proceeds down Russell Avenue and eventually connects to the 18" storm drain in Olive Street that is proposed to be connected to the Atlantic lateral.

The dual 15" CMP pipes within the drainage easement between the homes are in need of extensive repair or replacement. The pipes are completely corroded through on either side at the pipe haunch, 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 have been 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**. The second option is to acquire a new easement on the south side of the same home that is adjacent to the existing easement. 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) and 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.

There were 3 primary options that were considered to address the drainage issues described above. These are shown schematically on **Figure 8**. These 3 options utilize existing streets and/or public easements in Olive Street, Russell Avenue, Eastern Avenue and the vacated Aledo Street.

All 3 options require a new storm drain in Euclid Avenue, a new easement between the existing homes between Eastwood Drive and Euclid Avenue (currently preferred over using the existing easement for reasons indicated above) and associated storm drain as well as storm drain improvements on Eastwood Drive to Ballard Drive and replacement of the existing drop inlets. See 30% plans for the preliminary plan and profile of this system.

Option 3 is recommended, which involves 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 Easter South lateral. This option also allows the proposed storm drain described above between Eastwood Drive and Euclid Avenue to be much smaller (18”) than it would need to be with Options 1 and 2. The smaller size and reduced flow rate will allow the storm drain to be connected to the existing storm drain that was recently installed by the City and terminates at Euclid Avenue just west of Russell Avenue.



Figure 8. Ballard and Euclid Drop Inlet Options

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 and have not been included in the 30% plans. Whether or not these laterals and the extension of the mainline storm drain to Eastern are included with this phase of the project or a future phase will be discussed after this report and the 30% plans are provided to the City and CCRFCD for review.

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 9**). 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 remaining 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 9**).

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.

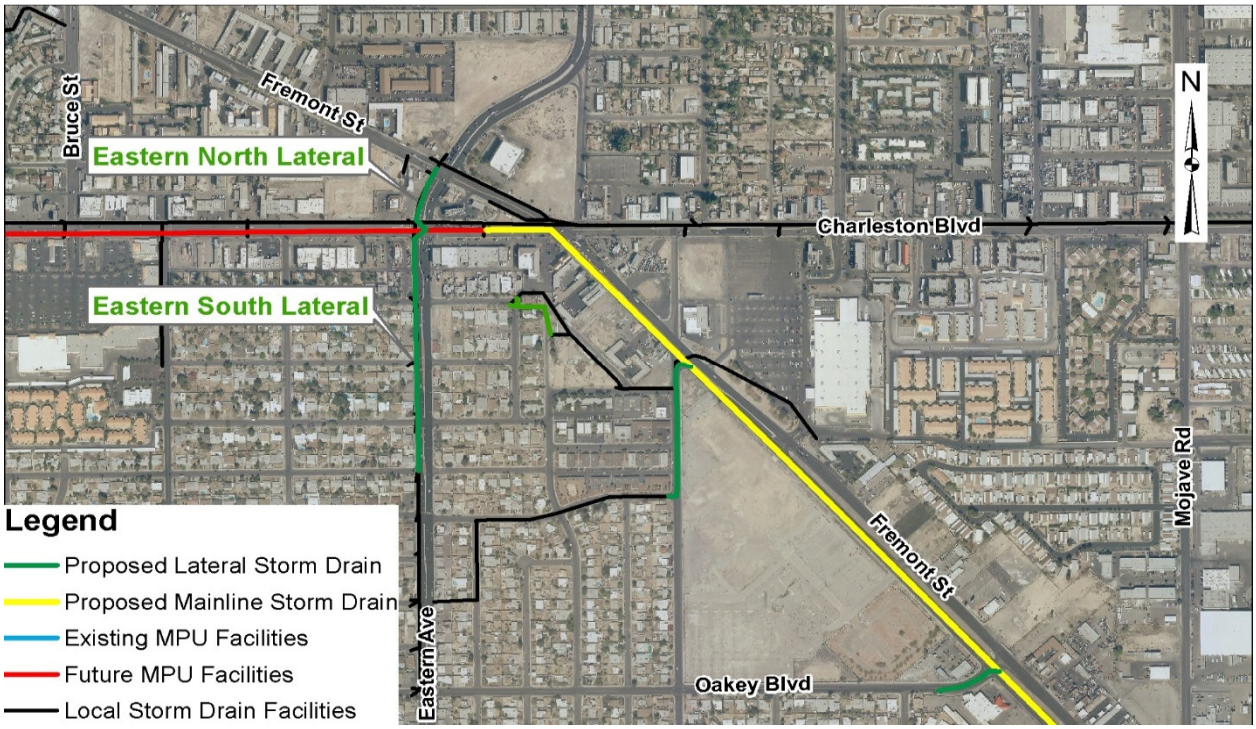


Figure 9. Future Laterals Recommended

3.1.7. Future Mainline Extension (Next Phase – Phase 2)

Upstream (west) of the termination of the mainline storm drain in Charleston Boulevard just west of Fremont Street for this phase of the BHSD there is approximately 1,800 cfs on Charleston Boulevard west of Eastern Avenue 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. The existing storm drain pipes and drop inlets in Charleston Boulevard are connected to the proposed 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. This is the current approach proposed for the short segment of the current phase that is to be constructed in Charleston Boulevard just west of Fremont Street as described in the Mainline Storm Drain Horizontal Alignment discussion at the beginning of this section of the report. The limits of the future extension of the proposed BHSD are shown on **Figure 10**.

The end point of the current phase is between Fremont Street and Eastern Avenue. With this end point, it will not be possible to construct the Eastern North and Eastern South laterals or connect them to the mainline facility. Extending the project end point west of Eastern Avenue would allow for construction and connection of these proposed laterals and may help alleviate a second traffic disruption at Charleston Boulevard and Fremont Street in the future.

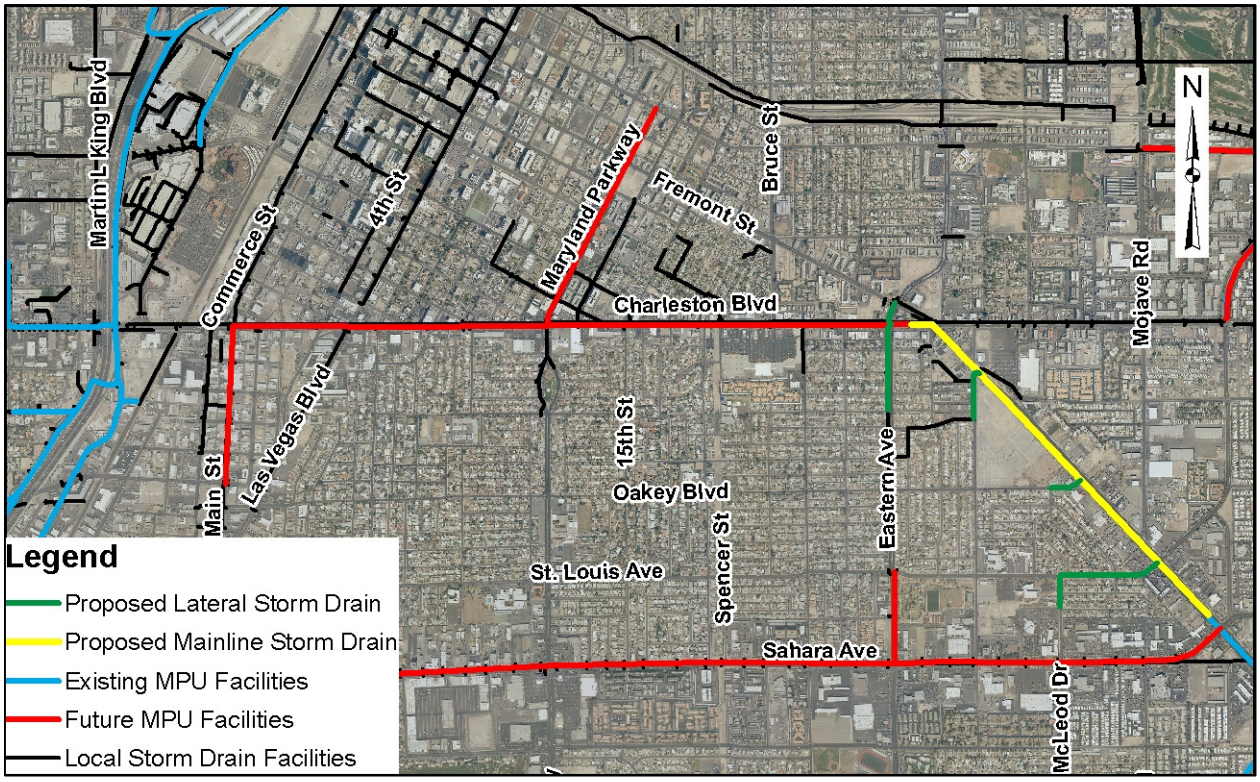


Figure 10.Future Regional Facility in Charleston

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.

There are two mainline models provided. They include options to go over and go under the 51" sewer at St. Louis Avenue. The mainline WSPG models are included in **Appendix B**.

The hydraulic grade lines for each option are shown on the plan and profile included in the 30% plans.

3.2.2. Lateral Design

At this phase of design, the major lateral storm drains and other minor facilities were sized using a mixture of WSPG and normal depth calculations. The mainline of the major laterals on St. Louis Avenue, Oakey Boulevard and Atlantic Street have been sized using WSPG and the HGLs are shown on the plan and profile included in the 30% plans. These WSPG models are included in **Appendix B**. The other major laterals, Eastern North and Eastern South, as well as all drop inlet laterals were preliminarily sized with normal depth analysis. All storm drain facilities and laterals will be analysed in WSPG prior to the 70% design submittal.

3.3. Drop Inlets

During the 30% design phase, cursory drop inlet analysis and assessment has been performed to get an overall understanding of the potential inlet locations and capacities. The preliminary drop inlet analysis was completed at this phase of the project to identify major obstacles/utility conflicts and to identify impacts on the overall design concept for the main line as well as aid in the development of the estimated construction costs for the project. Further refinement and more in depth analysis will be developed during the 70% design phase and submitted with the Draft Final Design Report.

The proposed drop inlet locations are shown on **Figure 11** and **Figure 12.** These figures also include tabular information regarding interception and bypass flows at each inlet. A drop inlet summary table is included in **Appendix B**.

DI #	General Location	Type C: curb length Gr: grate size	Slope / Sump	Qstr (cfs)	Qint (cfs)	Qbyp (cfs)
A-N-1	Fremont, N of charleston	C: 20' Gr: 1.5' x 17.5'	1.20%	77.0	49.0	28.0
A-N-2	Fremont, N of charleston	C: 20' Gr: 1.5' x 17.5'	1.20%	28.0	22.7	5.3
A-N-3	Fremont, N of charleston	C: 3' Gr: 2' x 3'	1.20%	5.3	3.5	1.8
A-N-4	Fremont, N of charleston	C: 3' Gr: 1.5' x 3'		Nuisance Flow		
A-S-1	Fremont, N of charleston	C: 20' Gr: 1.5' x 17.5'	1.20%	77.0	49.0	28.0
A-S-2	Fremont, N of charleston	C: 20' Gr: 1.5' x 17.5'	1.20%	28.0	22.7	5.3
A-S-3	Fremont, N of charleston	C: 3' Gr: 1.5' x 3'	0.83%	15.3	5.0	10.3
A-S-4	Fremont, N of charleston	C: 5' Gr: 1.5' x 5'	0.40%	10.3	5.4	4.9
A-S-5	Fremont, N of charleston	C: 0' Gr: 2' x 3'	0.50%	4.9	2.3	2.6
B-N-1	Charleston, W of Fremont	C: 5' Gr: 2' x 3'		Nuisance Flow		
B-S-1	Charleston, W of Fremont	C: 5' Gr: none		Nuisance Flow		
B-S-2	Charleston, W of Fremont	C: 10' Gr: 1.5' x 7.5'	0.70%	7.0	5.9	1.1
C-N-1	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	76.0	48.5	27.5
C-N-2	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	27.5	22.4	5.1
C-N-3	Atlantic Lateral	C: 2.5' Gr: 1.5' x 2.5'	0.89%	6.4	2.8	3.6
C-N-4	Atlantic Lateral	C: 2.5' Gr: 1.5' x 2.5'	0.53%	6.0	2.7	3.3
C-N-5	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	2.60%	13.5	11.8	1.7
C-S-1	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	76.0	48.5	27.5
C-S-2	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	27.5	22.4	5.1
C-E-1	Atlantic Lateral	C: 4' Gr: none	0.70%	2.5	1.5	1.0
C-E-2	Atlantic Lateral	C: 4' Gr: none	0.70%	1.0	0.9	0.1
C-W-1	Atlantic Lateral	C: 4' Gr: none	0.70%	17.7	3.9	13.8
C-W-2	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.90%	25.0	13.3	11.6
C-W-3	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.40%	22.8	14.3	8.5
C-W-4	Atlantic Lateral	C: 15' Gr: 1.5' x 12.5'	0.30%	23.7	20.2	3.5
C-W-5	Atlantic Lateral	C: 3' Gr: 1.5' x 3'	removed and replaced with CW4			
D-W-1	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	35.6	30.6	5.0
D-W-2	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'	removed and replaced with DW1			
D-W-3	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	35	30.2	4.8
D-W-4	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'	removed and replaced with DW3			
D-W-5	Boulder, Atlantic to Oakey	C: 15' Gr: 1.5' x 12.5'	0.42%	23.9	19.5	4.4
D-W-6	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'	removed and replaced with DW5			
D-W-7	Boulder, Atlantic to Oakey	C: 15' Gr: 1.5' x 12.5'	0.62%	18.3	15.1	3.2
D-C-1	Boulder, Atlantic to Oakey	C: none Gr: 2.5' x5'	sump	25	25.0	0.0
D-E-1	Boulder, Atlantic to Oakey	C: none Gr: 1.5' x 2.5'	0.50%	18.5	3.7	17.2
D-E-2	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'	0.50%	21	6.7	14.3
D-E-3	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'	0.50%	16	5.7	10.3
I-W-1	Eastern	C: 20' Gr: 1.5' x 17.5'	sump	59.3	59.3	
I-W-2	Eastern	C: 4' Gr: none	sump	12.0	12.0	
I-W-3	Eastern	C: 20' Gr: 1.5' x 17.5'	sump	59.4	59.4	0.0
I-W-4	Eastern		removed and replaced with IW3			
I-W-5	Eastern	C: 20' Gr: 1.5' x 17.5'	sump	30.0	30.0	0.0
I-W-6	Eastern	C: 4' Gr: 1.5' x 3'				
I-W-7	Eastern, on Ballard	C: 15' Gr: none	2.00%	6.0	2.5	3.5
J-N-1	Ballard and Eastwood	C: 3' Gr: 1.5' x 3'	sump	5.0	5.0	0.0
J-N-2	Ballard and Eastwood		removed and replaced with JN1			
J-S-1	Ballard and Eastwood	C: 3' Gr: 1.5' x 3'	sump	5.0	5.0	0.0
J-S-2	Ballard and Eastwood		removed and replaced with JS1			
J-W-1	Ballard and McLeod			Nuisance Flow		
J-W-2	Euclid and Russell			Nuisance Flow		
J-W-3	Euclid and Russell			Nuisance Flow		
J-W-4	Euclid and Olive			Nuisance Flow		

Boulder Highway Storm Drain

Figure 11: Drop Inlet Locations (1)

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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Aerial Source: Clark County Spring 2015

DI #	General Location	Type C: curb length Gr: grate size	Slope / Sump	Qstr (cfs)	Qint (cfs)	Qbyp (cfs)
E-S-1	Oakey Lateral	C: 15' Gr: 1.5' x 12.5'	0.77%	141.5	61.7	79.8
E-S-2	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	79.78	54.5	25.3
E-S-3	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	26.3	22.6	3.7
E-S-4	Oakey Lateral	C: 3' Gr: 2' x 3'		Nuisance Flow		
E-N-1	Oakey Lateral	C: 15' Gr: 1.5' x 12.5'	0.77%	141.5	61.7	79.8
E-N-2	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	79.78	54.5	25.3
E-N-3	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	26.3	22.6	3.7
E-N-4	Oakey Lateral	C: 7' Gr: None		Nuisance Flow		
F-E-1	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.50%	17.0	5.9	11.1
F-E-2	Boulder,Oakey to St Louis	C: 17.5' Gr: 1.5' x 15'	0.50%	11.1	10.1	0.9
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
F-W-1	Boulder,Oakey to St Louis	C: none Gr: 12' x 3'	0.67%	19.6	19.4	0.2
F-W-2	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.67%	11.4	7.2	4.2
F-W-3	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.67%	4.2	3.7	0.5
F-W-4	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.70%	8.5	6.0	2.5
G-E-1	St Louis Lateral	C: none Gr: 2' x 24'	sump	35.0	35.0	0.0
G-E-2	St Louis Lateral	Headwall		42.0	42.0	0.0
G-N-1	St Louis Lateral	C: 10' Gr: 1.5' x 7.5'	1.00%	16.0	9.9	6.1
G-N-2	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	39.6	30.6	9.0
G-N-3	St Louis Lateral	C: 20 Gr: 1.5' x 17.5'	sump	38.0	38.0	0.0
G-N-4	St Louis Lateral	C: none Gr: 2.5' x 5'	sump	9.7	9.7	0.0
G-S-1	St Louis Lateral	C: 10' Gr: 1.5' x 7.5'	1.00%	16.0	9.9	6.1
G-S-2	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	39.6	30.6	9.0
G-S-3	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	38.0	29.6	8.4
G-S-4	St Louis Lateral	C: none Gr: 1.5' x 5'	sump	4.4	4.2	0.0
G-S-5	St Louis Lateral	C: none Gr: 3' x 10'	sump	4.4	4.2	0.0
H-W-1	Boulder, St Louis to Sahara	C: 3' Gr: 2' x 3'	0.80%	4.0	3.0	1.0
H-W-2	Boulder, St Louis to Sahara	C: 15' Gr: 1.5' x 12.5'	0.80%	10.6	8.1	2.5
H-W-3	Boulder, St Louis to Sahara	C: 20' Gr: 1.5' x 17.5'	0.80%	12.9	10.5	2.5
H-W-4	Boulder, St Louis to Sahara	C: 3' Gr: 2' x 3'				
H-E-1	Boulder, St Louis to Sahara	C: 3' Gr: 2' x 3'	0.50%	1.3	1.1	0.2
H-E-2	Boulder, St Louis to Sahara	C: NONE Gr: 2' x 3'				
H-C-1	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'				
H-C-3	Boulder, St Louis to Sahara	C: NONE Gr: 2.5' x10'				

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

ATKINS

Aerial Source: ClarkCounty Spring 2015

4. Other Design Considerations

This section has been included in the PDR to summarize key considerations and factors that influenced the 30% design of the BHSD. This information has been provided for reference and also to aid with decision making during future design phases. This section also includes a summary of other activities that were performed during the 30% design phase. Pertinent aspects of the project explored to date are included below.

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. In addition, the "over" option for crossing the existing sewer at St. Louis Avenue and Fremont Street appears to have an advantage relative to dewatering when compared to the "under" option, since the "over" option has a more shallow profile and would likely require less dewatering. It is recommended that a groundwater discharge permit be obtained for the project from the Nevada Department of Environmental Protection prior to the advertisement for bid. During future design phases, additional coordination and planning for dewatering should occur to determine the best approach to dewatering and associated permitting with input and discussion from the City's Environmental Division.

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 is submitted with this report for formal review/comment/approval and is included in **Appendix D**. Once approval is received in writing, then the ROS will be submitted to the Clark County Recorder for recordation.

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 Section 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. There are also 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 30% 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 30% and 70% documents to NDOT for review and comment.

Based on the improvements proposed in the 30% 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. An existing storm drain is located within an existing drainage easement. Field observations revealed the edge of an existing house, two large trees and a block wall are likely located immediately adjacent or within portions of the existing 10' wide easement and would be impacted to remove and replace this existing storm drain. Therefore, a new 18" storm drain is proposed on the opposite side of the home where a new drainage easement would be required. 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 30% plans**.** The proposed storm drain is shown on the 30% plans.

The right-of-way at the intersection of Atlantic Street and Fremont Street (southwest corner) shows that a small portion of the proposed Atlantic lateral is located outside of the existing right-of-way. The proposed lateral is located within the limits of the existing roadway improvements. Atkins could not locate any existing documentation showing an easement under which the roadway improvements outside of the existing ROW may have been constructed. It is recommended that a title report for the adjacent property be acquired to determine if there is an existing easement that would allow the storm drain to be constructed as currently proposed. If no easement exists then either the storm drain can be realigned to be located within existing ROW or the City could acquire an easement from the land owner to construct the storm drain as currently proposed.

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. The need for an easement at Atlantic and Fremont will be further evaluated once a title report has been obtained.

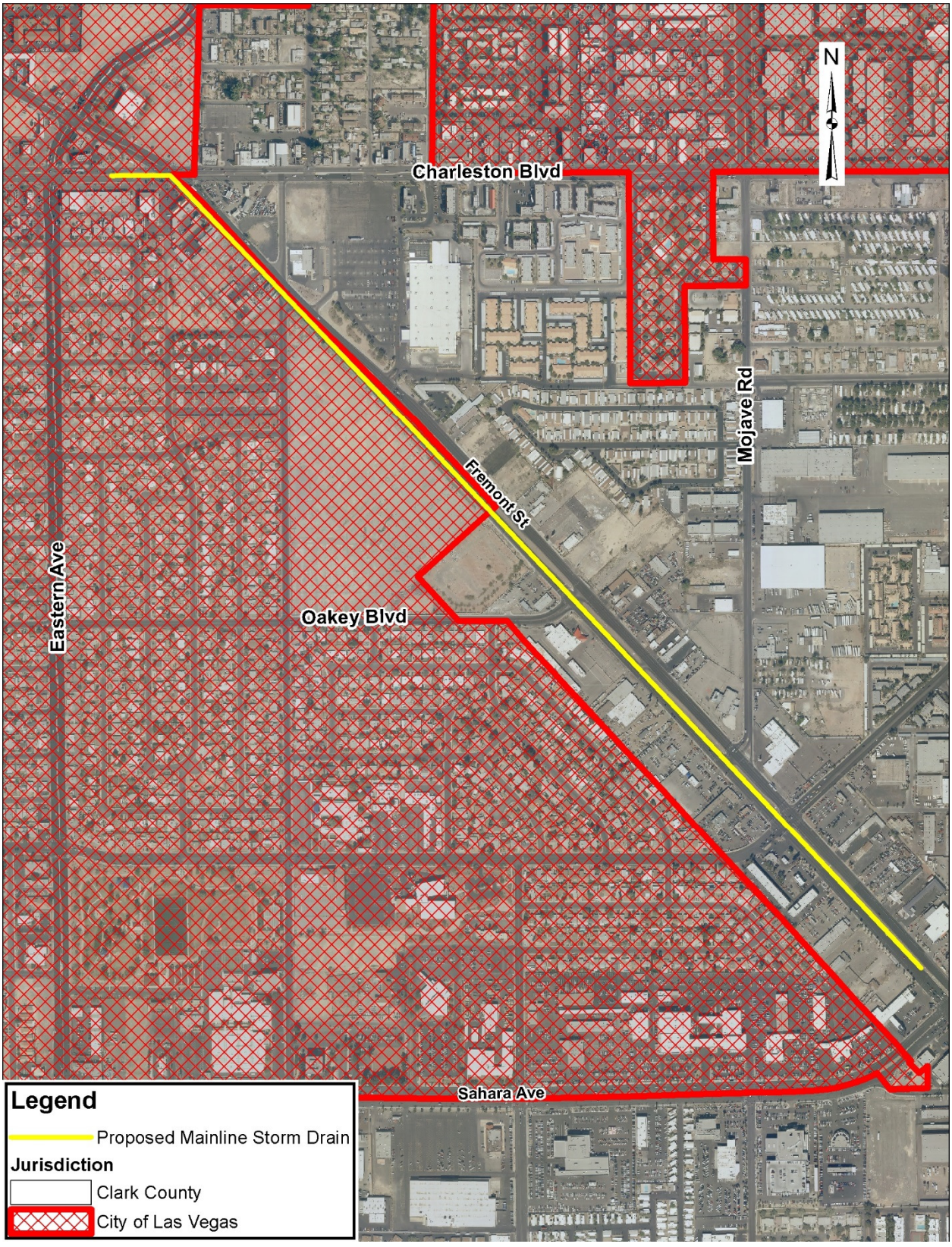


Figure 13. City of Las Vegas Jurisdiction



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, Phase 1 potholing was completed on large waterlines and the 72" casing of the 51" sanitary sewer at St. Louis Avenue and Fremont Street to supplement the existing utility database at critical potential conflict locations. Phase 2 potholing will be completed in the future to identify any potential conflicts with smaller utilities and any additional critical locations identified as the design progresses. 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 30% plans is based on this information.

Potential utility conflicts identified herein are preliminary and more detailed determination of the location and depth of the existing underground utilities will continue throughout final design by means of conventional potholing (test holes) and additional coordination with the impacted entities.

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)
- Southern Nevada Water Authority (SNWA)
- Southwest Gas Corporation
- Sprint LD
- Sprint Nextel Engineering
- 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 a description of the current status relative to potential conflict with the proposed facilities. 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 30% plans that accompany this report.

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 either over or under as shown in the 30% plans. Atkins is recommending the over option.
- Just north of St. Louis a 10" VCP sanitary sewer is in conflict with the mainline over option and is proposed to be abandoned (this has been confirmed to be possible with the sewer improvements proposed in St. Louis). The under option is not in conflict with this sewer.
- The mainline crosses under a 12" ACP water near Mojave in the under option. The over option is believed to be in conflict with this waterline.
- The mainline crosses under an 8" ACP water and 8" and 12" VCP sanitary sewers Atlantic Street.

Mainline – Charleston Boulevard

- The mainline crosses under a 30" MLCSP 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 30" 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 30% 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. All other existing utilities are currently anticipated to avoid direct conflict with the storm drain improvements.
- The lateral crosses under the 45" - 51" RCP sanitary sewer at McLeod and again at Fremont St.
- The lateral crosses under the 30" MLCSP waterline and 10" VCP sanitary sewer (CCWRD) at Fremont St.

- The drop inlet at Holly Hill and McLeod Street appears to be in conflict with the 8" VCP sanitary sewer there, but it is believed the sewer can be re-profiled to go under the drop inlet or the drop inlet designed to avoid the conflict.

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.
- The lateral crosses under a 30" MLCSP waterline and 10" VCP sanitary sewer (CCWRD) at Fremont Street.
- The storm drain drop inlets and laterals on the north side of Oakey are anticipated to be in conflict with the underground powerline.
- The 4"/2" PE gas line is shown on the 30% plans and utility conflict matrix as requiring relocation, but will be investigated further in the future design phases to determine if conflict avoidance is possible.

Lateral – Atlantic Street/Olive Street/Wengert Avenue

- The lateral crosses under a 10" VCP sanitary sewer and 8" CIP waterline on Wengert Avenue.
- The lateral crosses under a 12" VCP sanitary sewer and 6" ACP waterline on Atlantic near Wengert Avenue.
- The storm drain is placed between a 12" VCP sanitary sewer and the 16" ACP waterline along Atlantic Street between Olive Street and Fremont Street and crosses under the 16" ACP waterline at two locations. The lateral also crosses under the 30" MLCSP waterline at Fremont Street.

Lateral – Ballard/Eastwood/ Euclid

- The lateral may require relocation of a 6" CIP waterline, 8" PVC waterline and a 2" PE gas line at two locations.
- The lateral crosses over an 8" VCP sanitary sewer on Eastwood Drive.

The above summary and the utility conflict matrix in **Appendix E-1** represent the best available information at the time of this submittal. Conflict with major waterlines, sewer lines and gas lines is believed to be avoided with the current storm drain design. Additional potholing will be required in the future design phases to further confirm this as well as better identify potential conflicts with smaller existing utilities. The 30% Subsurface Utility Engineering (SUE) plans are included in **Appendix E-2**. Most utilities are currently shown as SUE Quality Level D. Sanitary Sewer and Storm Drain that have had the manholes surveyed and dipped are shown as Quality Level C, which constitutes nearly all of these utilities in the project area. Quality Level A is shown where potholes have been successfully performed, see Section 5.2 of this report.

5.2. Utility Potholing

A limited number of test holes (8 – Phase 1) have been performed on the project prior to the preparation of this report. Following the submittal of the 30% design plans and after addressing any comments received, a pothole plan will be submitted to the City for approval and the next round of potholes will be performed. A total of 50 potholes are anticipated to be performed for this project per the scope of services.

The Phase 1 potholes focused on the major utility crossing identified that were critical to the design. The location and facility is listed below

1. 72” sanitary sewer steel casing in Fremont at St. Louis [TH1]
2. 30” MLCSP water at St. Louis and Fremont [TH3A]
3. 72” sanitary sewer steel casing in St. Louis at Fremont [TH3B]
4. 30” MLCSP water at St. Louis and Fremont [TH4]
5. 30” MLCSP water at Oakey and Fremont [TH5]
6. 8” ACP water at Aledo and Fremont [TH6]
7. 30” MLCSP water at Aledo and Fremont [TH6A]
8. 30” MLCSP water at Charleston and Fremont [TH7]
9. 30” MLCSP water at Charleston and Fremont [TH8]

The pothole locations are shown on the 30% SUE plans in **Appendix E-2** and the test hole data sheets are included in **Appendix E-3**.

6. Construction Cost, Key Issues and Conclusion

6.1. Construction Cost Estimate

The construction cost estimate is broken down by the two mainline options. A cost is provided for the mainline over option and the mainline under option.

It is estimated that the project will have a total construction cost of **$19,897,000** for mainline over option. It is estimated that the project will have a total construction cost of **$20,572,000** for mainline under option. Both estimates include a 15% contingency.

All of the improvements are proposed to be funded by the Clark County Regional Flood Control District except for the portion of the St louis Avenue lateral that extends beyond the ¼ mile lateral limit. The additional cost will be paid by the City directly and has been broken out separately in the construction cost estimate.

The unit prices for the estimated construction cost are based on review of recent bid tabulations for other similar projects in Clark County. A 15-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. Summary of Key Issues

There are many key issues set forth in this report that require decision/input/agreement from the City and other stakeholders during review of this submittal. The following is a summary of these.

- The alignment of proposed mainline storm drain is be place under the left travel lane of Fremont Street adjacent to median from Sahara north to Atlantic where the road narrows and the storm drain transitions to the center of the roadway and continues there to the terminus in Charleston west of Fremont.
- The profile of the proposed mainline storm drain should avoid the 51” sanitary sewer near Fremont Street and St. Louis Avenue and it is recommended that the over option be the selected alternative.
- What approach to take with the St. Louis lateral – construct as shown in the 30% plans or split the lateral between the BHSD – St. Louis West and the future Sahara storm drain – McLeod North.
- What location should be the upstream terminus of this phase of the BHSD – as shown in the 30% plans, just north of Atlantic at Fremont or just west of Eastern at Charleston.
- The 18” and 21” sanitary sewers in Charleston are proposed to be consolidated into one 30” sewer on the south side of Charleston to create a corridor for the proposed storm drain.
- The 8” sanitary sewer in St. Louis is proposed to be relocated to the north side of the street to create a corridor for the proposed storm drain.
- The Atlantic lateral is proposed to be extended to Wengert Avenue.
- Eastern North and Eastern South laterals are to be constructed as part of this project either as an extension of this Phase or in the next Phase of the storm drain project.

- The Ballard Drive and Eastwood Drive drop inlets are to be connected to the existing storm drain in Euclid Avenue through a new drainage easement that is to be acquired
- An NDEP groundwater discharge permit will be required for construction, it is recommended that this permit be acquired prior to advertisement for bid.

6.3. Conclusion

Atkins has prepared this report and the 30% plans to compile all necessary information to summarize the progress to date and provide enough information and detail to allow the City (with input from Atkins and stakeholders) to make the decisions necessary to permit the design to advance in an efficient and timely manner. The level of completeness of the included plans is probably beyond what most would consider 30%, but Atkins felt that the level of detail provided was necessary to help resolve some of the project challenges, the most notable of which is the crossing of the 51" sanitary sewer at St. Louis and Fremont. It is our hope that the City, CCRFCD and NDOT will complete a thorough review of the information provided, followed by a comprehensive discussion with Atkins to gain the input necessary and decisions required to then turn the focus of the project towards production and permitting to advance the project to the bid phase as soon as possible. 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.

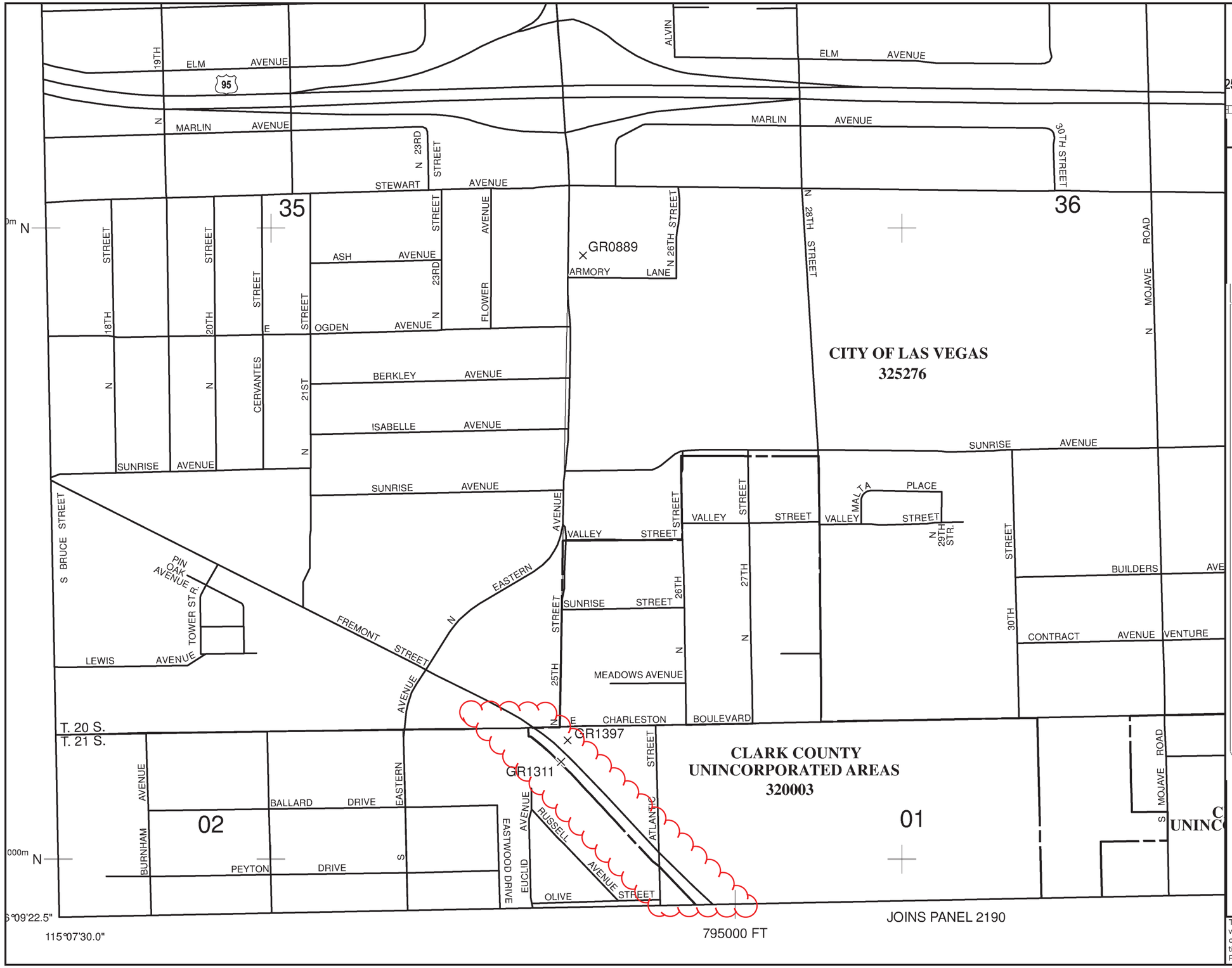
Appendix A

Hydrologic Analysis

- Appendix A-1: FEMA FIRMette
- Appendix A-2: Existing Condition Photo Library
- Appendix A-3: HEC-1 Model
- Appendix A-4: CCRFD Design Manual Tables
- 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

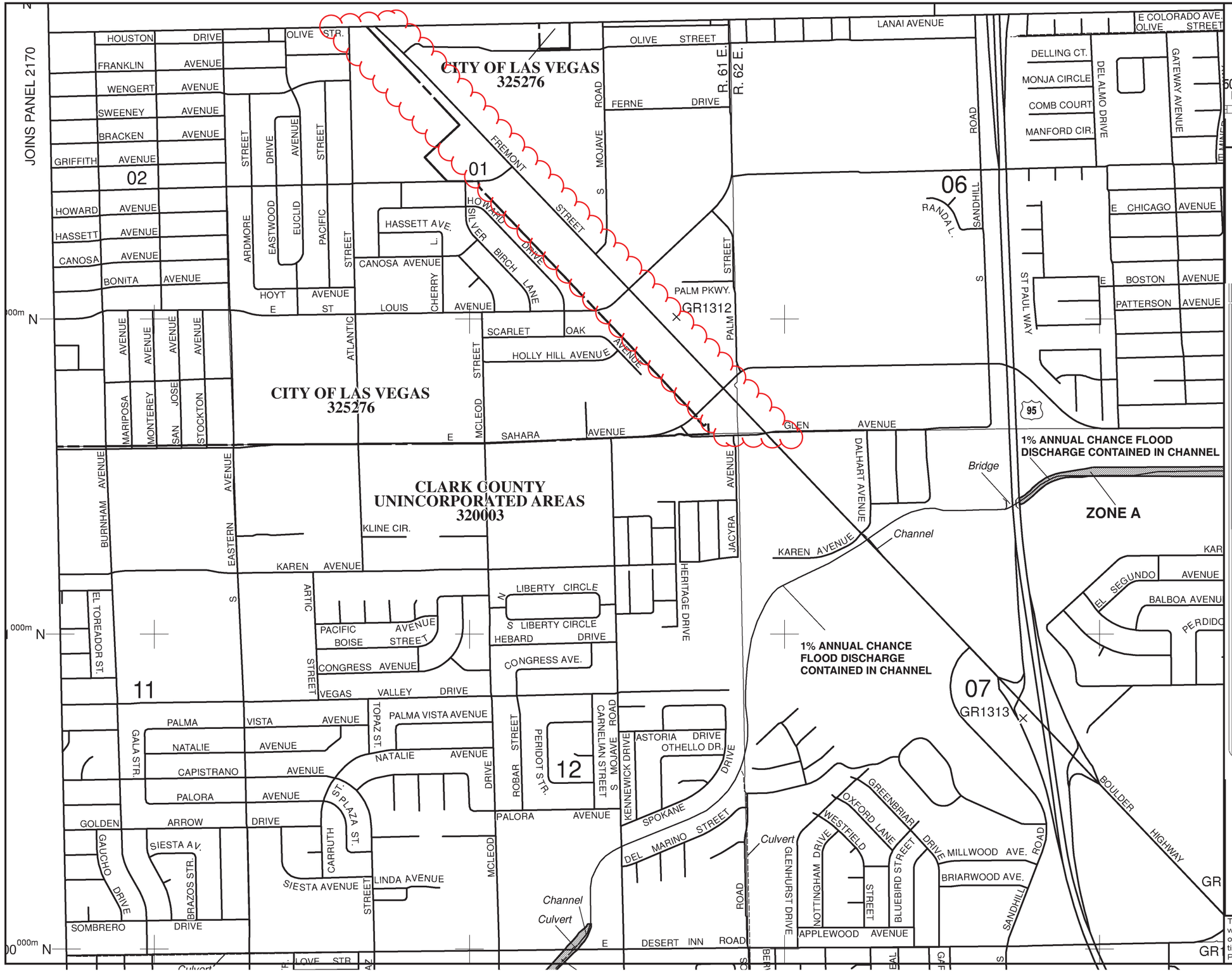


Figure A-2

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

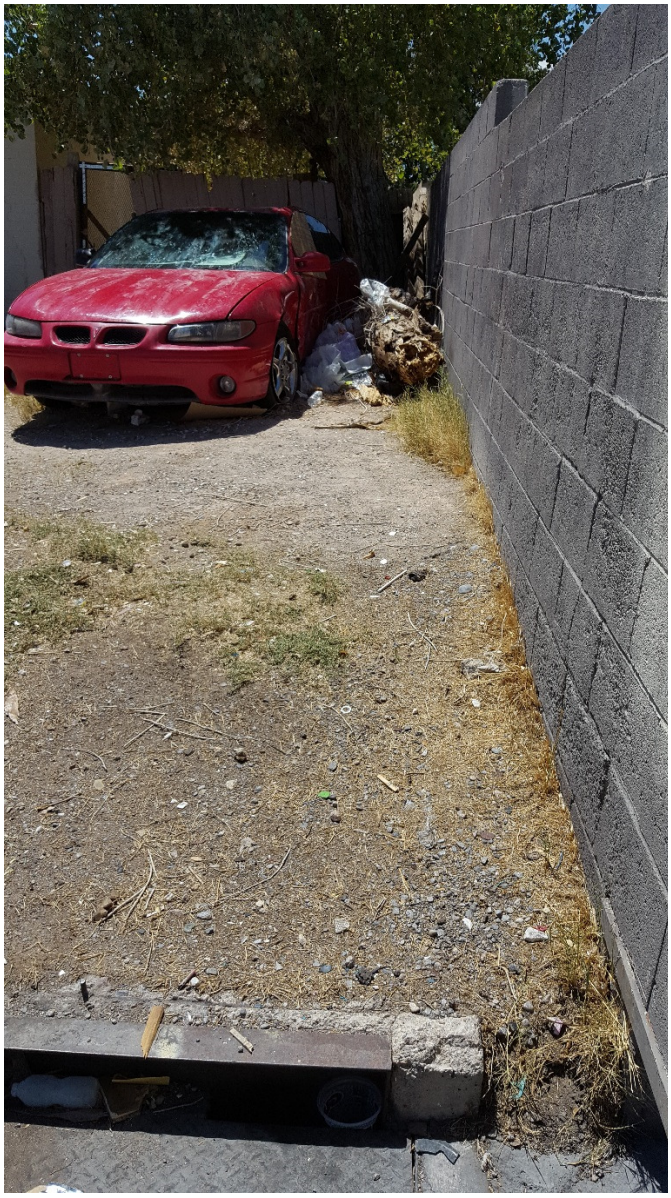


Photo 1: looking west, Euclid Ave Drop Inlet and 10’ Drainage Easement



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

```
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   14SEP16  TIME  09:51:06  *                                  *          (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    PRELIMINARY 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    SEPTEMBER 2016
              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
                         *
```



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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
             *

 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
             *
```



```
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
          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
                *
1                                        HEC-1 INPUT                                          PAGE  8

        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 FR04-C8
 312          BA   0.049
 313          PB    2.77
 314          LS       0    85.6
 315          UD   0.214
              *

 316          KK CFR04C8
 317          KM  COMBINE FR04-C8 AND CH67-C4
 318          HC       2
              *

 319          KK FR04-C6
 320          BA   0.009
 321          PB    2.77
 322          LS       0    85.6
 323          UD   0.116
              *

 324          KK FR04-C7
 325          BA   0.013
 326          PB    2.77
 327          LS       0    87.6
 328          UD   0.148
              *

 329          KK CFR04C7
 330          KM  COMBINE RFR04C12 AND FR04-C14
 331          HC       2
              *

 332          KKCCFR04C7
 333          KM  COMBINE CFR04C8 AND CFR04C7
 334          HC       2
              *

 335          KK FR04-C5
 336          BA   0.008
 337          PB    2.77
 338          LS       0    85.6
 339          UD   0.121
              *
1                                        HEC-1 INPUT                                                PAGE 10

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

 340          KK CCH04C5
 341          KM  COMBINE FR04-C5 AND CCH67C3
 342          HC       2
              *

 343          KK FR04-C2
 344          BA   0.013
 345          PB    2.77
 346          LS       0    87.9
 347          UD   0.107
              *

 348          KK FR04-C4
 349          BA   0.005
 350          PB    2.77
 351          LS       0    93.0
 352          UD   0.099
              *

 353          KK CFR04C4
 354          KM  COMBINE FR04-C4 AND CCFR04C2
 355          HC       2
              *

 356          KK  CFR04A
 357          KM  COMBINE CFR04-C4 AND CCFR04C5
 358          HC       2
              *

 359          KK FR04-C3
 360          BA   0.012
```

```
 361          PB    2.77
 362          LS       0    94.2
 363          UD   0.120
              *

 364          KK    CBH2
 365          KM  COMBINE CFR04 AND CBH1
 366          KM  WHERE OLIVE/ATLANTIC LATERAL COMES IN ON BOULDER HIGHWAY
 367          HC       3
              *

 368          KK   RCBH2
 369          KM  ROUTE CBH2 TO CBH3
 370          RD    1500  0.0036   0.015       0    TRAP      20       0
              *

 371          KK  CH64-C
 372          BA   0.286
 373          PB    2.77
 374          LS       0    90.0
 375          UD   0.470
              *
1                                        HEC-1 INPUT                                                PAGE 11

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

 376          KK RCH64-C
 377          KM  ROUTE CH64-C to CCH67C5
 378          RD    3925   0.001   0.016       0    TRAP       0      50
              *

 379          KK CH67-C5
 380          BA   0.150
 381          PB    2.77
 382          LS       0    85.3
 383          UD   0.324
              *

 384          KK CCH67C5
 385          KM  COMBINE RCH64-C and CCH67C5
 386          HC       2
              *

 387          KKRCCH67C5
 388          KM  ROUTE CCH67C5
 389          RD    2500   0.001   0.016       0    TRAP       0      50
              *

 390          KKFR04-C11
 391          BA   0.067
 392          PB    2.77
 393          LS       0    86.5
 394          UD   0.286
              *

 395          KKCFR04C11
 396          KM  COMBINE FR04-C11 AND RCCH67C5
 397          HC       2
              *

 398          KK FR04-C9
 399          BA   0.051
 400          PB    2.77
 401          LS       0    95.4
 402          UD   0.229
              *

 403          KKFR04-C10
 404          BA   0.009
 405          PB    2.77
 406          LS       0      91
 407          UD   0.228
              *

 408          KK    CBH3
 409          KM  COMBINE RCBH2, CFR04C11 AND FR04-C9
 410          HC       4
              *
1                                        HEC-1 INPUT                                                PAGE 12

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

 411          KK   RCBH3
 412          KM  ROUTE CBH3 TO CBH4
 413          RD    1800  0.0036   0.015       0    TRAP      20       0
              *

 414          KK  FR03-6
 415          BA   0.012
 416          PB    2.77
 417          LS       0    84.8
 418          UD   0.162
              *

 419          KK  DCFR03
```

```
 420          DT DCFR036
 421          DI       0      20      40      50
 422          DQ       0      10      20      25
              *

 423          KK  FR03-5
 424          BA   0.013
 425          PB    2.77
 426          LS       0    85.0
 427          UD   0.151
              *

 428          KK CFR03-5
 429          KM  COMBINE FR03-5 AND FR03-6
 430          HC       2
              *

 431          KKFR04-C12
 432          BA   0.011
 433          PB    2.77
 434          LS       0    85.8
 435          UD   0.142
              *

 436          KKRFR04C12
 437          KM  ROUTE FR04-C12
 438          RD    1140   0.012   0.016       0    TRAP       0      50
              *

 439          KKFR04-C14
 440          BA   0.029
 441          PB    2.77
 442          LS       0    85.7
 443          UD   0.145
              *
1                                     HEC-1 INPUT                                         PAGE 13

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

 444          KKCFR04C14
 445          KM  COMBINE RFR04C12 AND FR04-C14
 446          HC       2
              *

 447          KKRCFR4C14
 448          KM  ROUTE CFR04C14 TO CFR04C15
 449          RD     950   0.007   0.016       0    TRAP       0      50
              *

 450          KKFR04-C15
 451          BA   0.010
 452          PB    2.77
 453          LS       0    84.9
 454          UD   0.147
              *

 455          KKCFR04C15
 456          KM  COMBINE FR04-C15 AND RCFR4C14
 457          HC       2
              *

 458          KK  FR03-2
 459          BA   0.066
 460          PB    2.77
 461          LS       0    77.7
 462          UD   0.261
              *

 463          KK  FR03-3
 464          BA   0.027
 465          PB    2.77
 466          LS       0    88.0
 467          UD   0.161
              *

 468          KK  FR03-1
 469          BA   0.027
 470          PB    2.77
 471          LS       0    87.1
 472          UD   0.190
              *

 473          KK CFR03-2
 474          KM  COMBINE FR03-1 AND fr03-2
 475          HC       3
              *

 476          KK  CFR03A
 477          KM  COMBINE CFR03-2 AND CFR04C15
 478          HC       2
              *
1                                     HEC-1 INPUT                                         PAGE 14

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

```
            479           KKFR04-C13
            480           BA   0.025
            481           PB    2.77
            482           LS       0    85.1
            483           UD   0.219
                          *

            484           KK  CFR03B
            485           KM  COMBINE FR04-C13 AND CFR03A
            486           HC       2
                          *

            487           KK  CFR03C
            488           KM  COMBINE CFR03B AND CFR03-5
            489           HC       2
                          *

            490           KK  FR03-4
            491           BA   0.016
            492           PB    2.77
            493           LS       0    86.3
            494           UD   0.161
                          *

            495           KK CCH63-C
            496           KM  COMBINE FR03-4 AND CFR03C
            497           HC       2
                          *

            498           KKFR04-C16
            499           BA   0.025
            500           PB    2.77
            501           LS       0    94.2
            502           UD   0.173
                          *

            503           KKFR04-C17
            504           BA   0.007
            505           PB    2.77
            506           LS       0    91.7
            507           UD   0.180
                          *

            508           KK    CBH4
            509           KM  COMBINE CBH3 FR04-C17 FR04-C16 AND CCH63-C
            510           HC       4
                          *

            511           KK   RCBH4
            512           KM  ROUTE CBH3 TO CBH4
            513           RD    1100   0.016   0.015       0    TRAP      24       0
                          *
1                                                HEC-1 INPUT                                                    PAGE 15

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

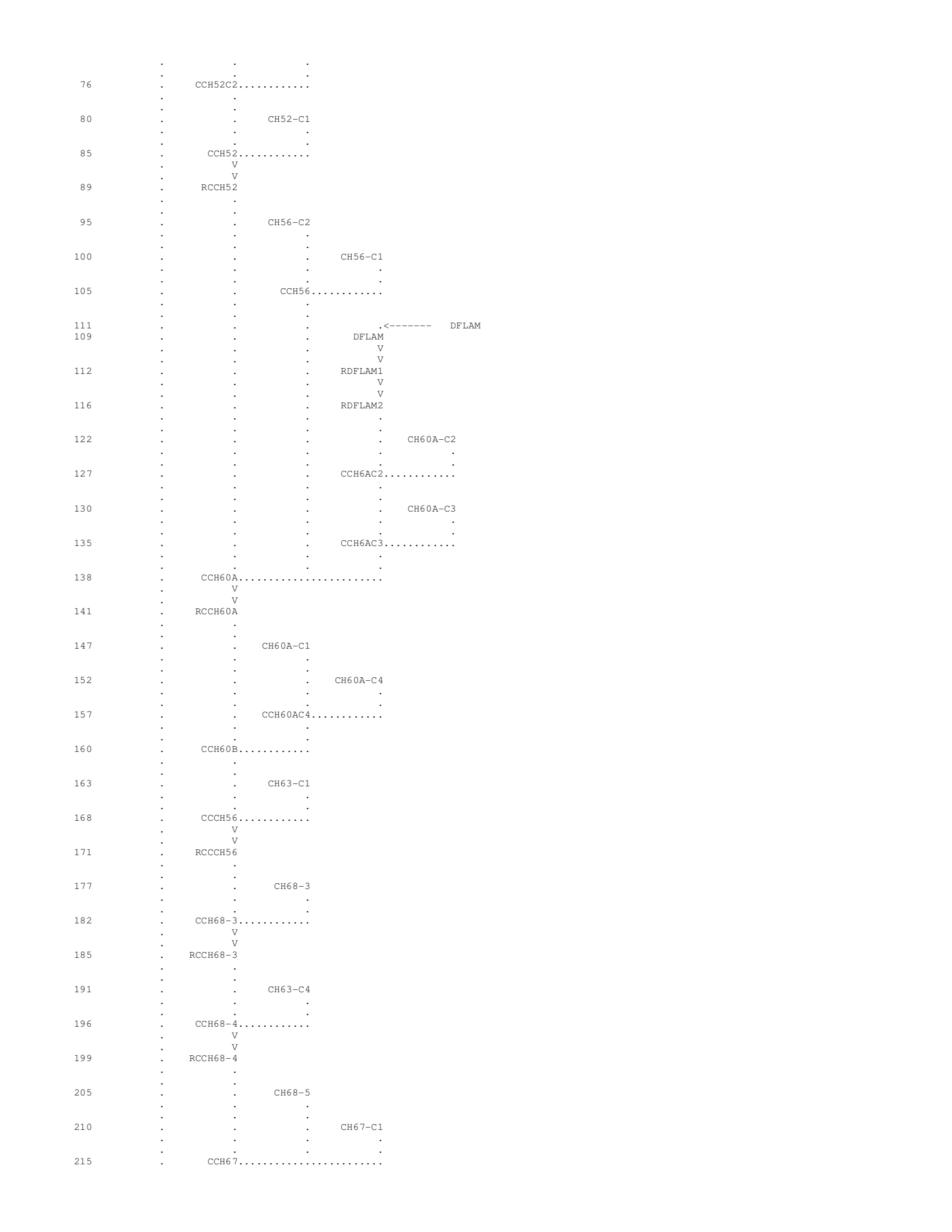
            514           KK  FR03-8
            515           BA   0.004
            516           PB    2.77
            517           LS       0      88
            518           UD   0.174
                          *

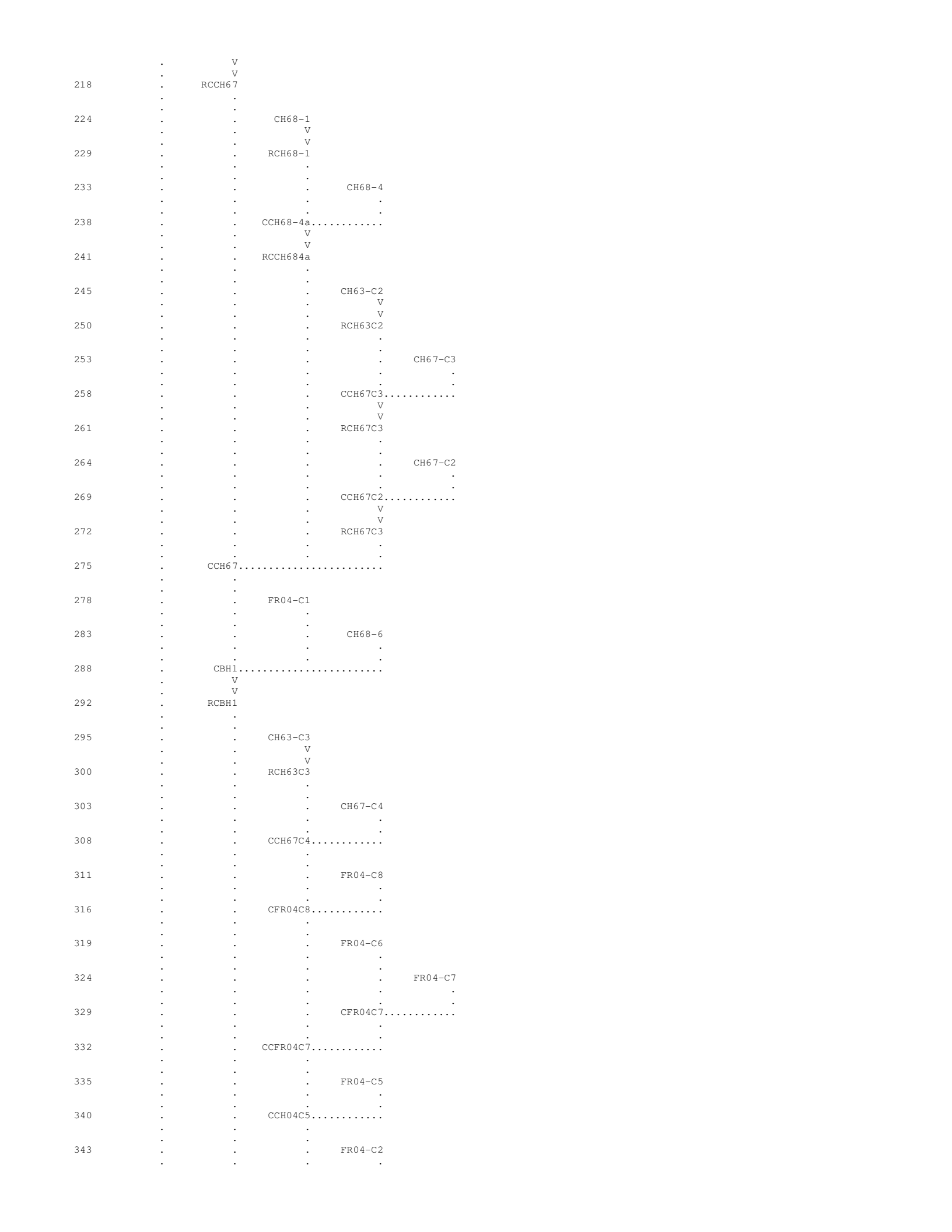
            519           KK  FR03-7
            520           BA   0.016
            521           PB    2.77
            522           LS       0    92.2
            523           UD   0.174
                          *

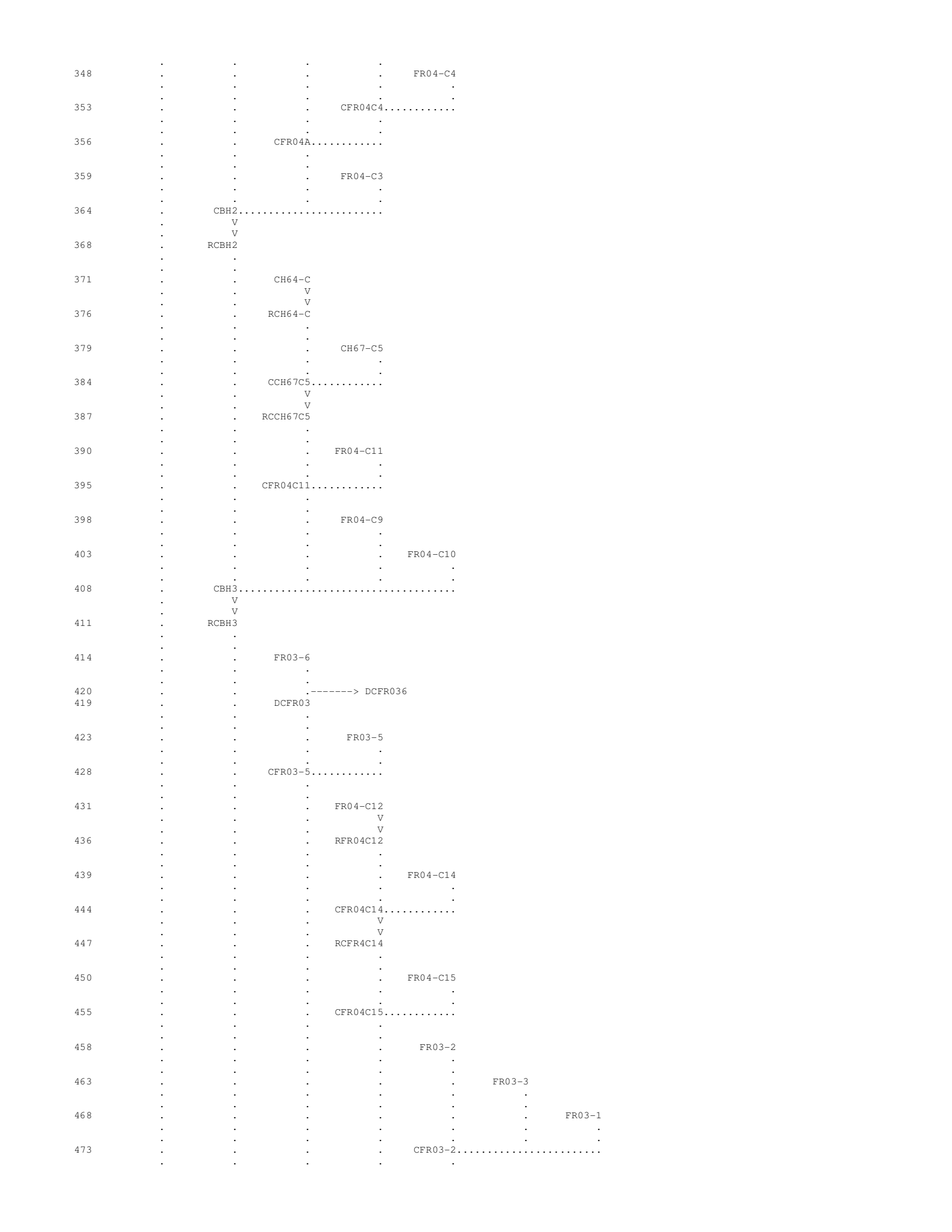
            524           KK    CBH5
            525           KM  COMBINE CBH4 FR03-8 FR03-7
            526           HC       3
                          *
            527           ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

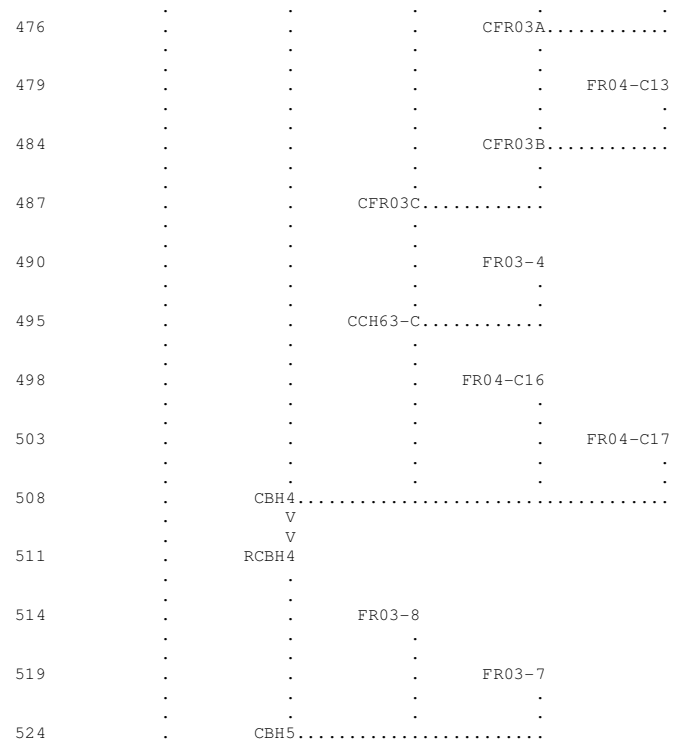
   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    39      CH59-C
                 .
                 .
    57           .------->   DFLAM
    52     DCH59-C
                 .
                 .
    60           .        CH51
                 .          V
                 .          V
    65           .       RCH51
                 .          .
                 .          .
    71           .          .     CH52-C2
```


CCH52C2
CH52-C1
CCH52
RCCH52
CH56-C2
CH56-C1
CCH56
DFLAM
DFLAM
RDFLAM1
RDFLAM2
CH60A-C2
CCH6AC2
CH60A-C3
CCH6AC3
CCH60A
RCCH60A
CH60A-C1
CH60A-C4
CCH60AC4
CCH60B
CH63-C1
CCCH56
RCCCH56
CH68-3
CCH68-3
RCCH68-3
CH63-C4
CCH68-4
RCCH68-4
CH68-5
CH67-C1
CCH67


RCCH67
CH68-1
RCH68-1
CH68-4
CCH68-4a
RCCH684a
CH63-C2
RCH63C2
CH67-C3
CCH67C3
RCH67C3
CH67-C2
CCH67C2
RCH67C3
CCH67
FR04-C1
CH68-6
CBH1
RCBH1
CH63-C3
RCH63C3
CH67-C4
CCH67C4
FR04-C8
CFR04C8
FR04-C6
FR04-C7
CFR04C7
CCFR04C7
FR04-C5
CCH04C5
FR04-C2


348 FR04-C4
353 CFR04C4
356 CFR04A
359 FR04-C3
364 CBH2
368 RCBH2
371 CH64-C
376 RCH64-C
379 CH67-C5
384 CCH67C5
387 RCCH67C5
390 FR04-C11
395 CFR04C11
398 FR04-C9
403 FR04-C10
408 CBH3
411 RCBH3
414 FR03-6
420 DCFR036
419 DCFR03
423 FR03-5
428 CFR03-5
431 FR04-C12
436 RFR04C12
439 FR04-C14
444 CFR04C14
447 RCFR4C14
450 FR04-C15
455 CFR04C15
458 FR03-2
463 FR03-3
468 FR03-1
473 CFR03-2



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN   1998               *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   14SEP16  TIME  09:51:06   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    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)
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

					RATIOS APPLIED TO PRECIPITATION				
OPERATION	STATION	AREA	PLAN		RATIO 1 1.00	RATIO 2 .98	RATIO 3 .95	RATIO 4 .93	RATIO 5 .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
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	164.	158.	152.	145.	143.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT									
+	FR04-C6	.01	1	FLOW	11.	11.	11.	10.	10.
				TIME	3.58	3.58	3.58	3.58	3.58

HYDROGRAPH AT									
+	FR04-C7	.01	1	FLOW	17.	17.	16.	16.	15.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CFR04C7	.02	1	FLOW	29.	28.	27.	26.	25.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CCFR04C7	.19	1	FLOW	189.	182.	174.	167.	164.
				TIME	3.58	3.58	3.58	3.58	3.58
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									
+	CCH04C5	.20	1	FLOW	200.	192.	184.	176.	173.
				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									
+	FR04-C4	.00	1	FLOW	9.	9.	8.	8.	8.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT									
+	CFR04C4	.02	1	FLOW	27.	26.	25.	24.	24.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT									
+	CFR04A	.22	1	FLOW	226.	217.	208.	200.	196.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	FR04-C3	.01	1	FLOW	21.	20.	19.	19.	19.
				TIME	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT									
+	CBH2	2.22	1	FLOW	2144.	2074.	2006.	1934.	1907.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCBH2	2.22	1	FLOW	2138.	2068.	1999.	1927.	1900.
				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	2363.	2283.	2204.	2123.	2092.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCBH3	2.78	1	FLOW	2346.	2267.	2187.	2106.	2074.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	FR03-6	.01	1	FLOW	14.	13.	13.	12.	12.
				TIME	3.58	3.58	3.58	3.58	3.58
DIVERSION TO									

+	DCFR036	.01	1	FLOW	7.	7.	6.	6.	6.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	DCFR03	.01	1	FLOW	7.	7.	6.	6.	6.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	FR03-5	.01	1	FLOW	16.	15.	14.	14.	13.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT									
+	CFR03-5	.03	1	FLOW	22.	22.	21.	20.	19.
				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									
+	FR03-2	.07	1	FLOW	43.	41.	39.	37.	36.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT									
+	FR03-3	.03	1	FLOW	36.	35.	33.	32.	32.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	FR03-1	.03	1	FLOW	32.	31.	30.	28.	28.
				TIME	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT									
+	CFR03-2	.12	1	FLOW	105.	101.	97.	92.	91.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CFR03A	.17	1	FLOW	162.	155.	149.	142.	140.
				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	.20	1	FLOW	188.	180.	173.	165.	163.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT									
+	CFR03C	.22	1	FLOW	208.	199.	191.	182.	180.
				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	.24	1	FLOW	225.	216.	207.	198.	195.
				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
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	3.05	1	FLOW	2579.	2491.	2403.	2312.	2277.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	RCBH4	3.05	1	FLOW	2572.	2484.	2396.	2306.	2270.

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                                        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      3.07     1   FLOW       2593.    2504.    2416.    2325.    2289.
                                        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


          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
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

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

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           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

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
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          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

          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
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          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
             RCBH2  MANE         1.05   2138.89    224.76      1.91      5.00   2138.38    225.00        1.91


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2258E+03 EXCESS= .0000E+00 OUTFLOW= .2258E+03 BASIN STORAGE= .2734E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.06   2067.81    225.63      1.84      5.00   2067.67    225.00        1.84


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2178E+03 EXCESS= .0000E+00 OUTFLOW= .2178E+03 BASIN STORAGE= .2655E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.07   1999.87    225.46      1.77      5.00   1998.92    225.00        1.77


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2096E+03 EXCESS= .0000E+00 OUTFLOW= .2096E+03 BASIN STORAGE= .2582E-02 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.09   1928.28    225.49      1.70      5.00   1927.21    225.00        1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2018E+03 EXCESS= .0000E+00 OUTFLOW= .2017E+03 BASIN STORAGE= .2582E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH2  MANE         1.10   1900.88    225.66      1.68      5.00   1899.92    225.00        1.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1987E+03 EXCESS= .0000E+00 OUTFLOW= .1987E+03 BASIN STORAGE= .2588E-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

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         1.21   2352.45    225.63      1.86      5.00   2345.72    225.00        1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2765E+03 EXCESS= .0000E+00 OUTFLOW= .2765E+03 BASIN STORAGE= .3271E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
             RCBH3  MANE         1.22   2274.23    226.33      1.80      5.00   2267.01    225.00        1.80
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2668E+03 EXCESS= .0000E+00 OUTFLOW= .2667E+03 BASIN STORAGE= .3037E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH3	MANE	1.24	2194.86	225.80	1.73	5.00	2187.19	225.00	1.73	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2567E+03 EXCESS= .0000E+00 OUTFLOW= .2567E+03 BASIN STORAGE= .3119E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH3	MANE	1.26	2111.39	226.70	1.66	5.00	2105.98	225.00	1.66	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2470E+03 EXCESS= .0000E+00 OUTFLOW= .2470E+03 BASIN STORAGE= .3077E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH3	MANE	1.27	2080.39	225.51	1.64	5.00	2074.14	225.00	1.64	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2432E+03 EXCESS= .0000E+00 OUTFLOW= .2432E+03 BASIN STORAGE= .3147E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

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	2574.34	225.21	1.82	5.00	2571.60	225.00	1.82	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2965E+03 EXCESS= .0000E+00 OUTFLOW= .2965E+03 BASIN STORAGE= .1268E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH4	MANE	.50	2487.61	225.39	1.76	5.00	2483.51	225.00	1.76	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2859E+03 EXCESS= .0000E+00 OUTFLOW= .2859E+03 BASIN STORAGE= .1314E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH4	MANE	.50	2399.44	225.62	1.69	5.00	2395.82	225.00	1.69	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2751E+03 EXCESS= .0000E+00 OUTFLOW= .2751E+03 BASIN STORAGE= .1262E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH4	MANE	.51	2310.33	225.53	1.63	5.00	2305.66	225.00	1.63	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2646E+03 EXCESS= .0000E+00 OUTFLOW= .2646E+03 BASIN STORAGE= .1267E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBH4	MANE	.51	2274.24	225.37	1.60	5.00	2269.86	225.00	1.60	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2605E+03 EXCESS= .0000E+00 OUTFLOW= .2605E+03 BASIN STORAGE= .1259E-02 PERCENT ERROR= .0

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

```
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   24AUG16  TIME  17:48:18  *                    *           (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    PRELIMINARY DESIGN REPORT (30% DESIGN)
             3      ID    MAINLINE MODEL
             4      ID    SEPTEMBER 2016
             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
                    *
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          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
             *
```



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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
             *
```

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 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

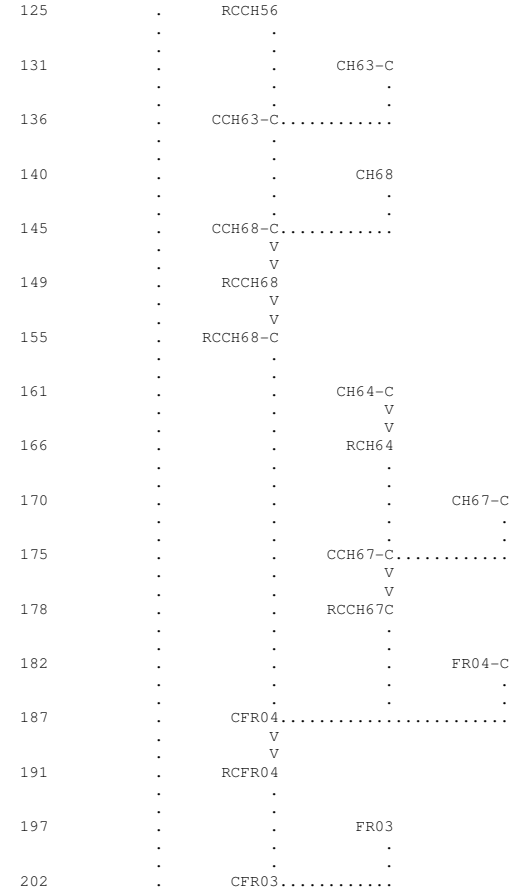
           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            197          KK    FR03
            198          BA   0.286
            199          PB    2.77
            200          LS       0    85.4
            201          UD   0.312
                         *

            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)   *                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *               JUN   1998              *                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1                *                    *          609 SECOND STREET           *
 *                                       *                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   24AUG16  TIME  17:48:18   *                    *           (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	.29	1	FLOW	254.	248.	238.	228.	224.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT										
+	CFR03	3.07	1	FLOW	2730.	2668.	2578.	2473.	2443.
				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								

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 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
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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:

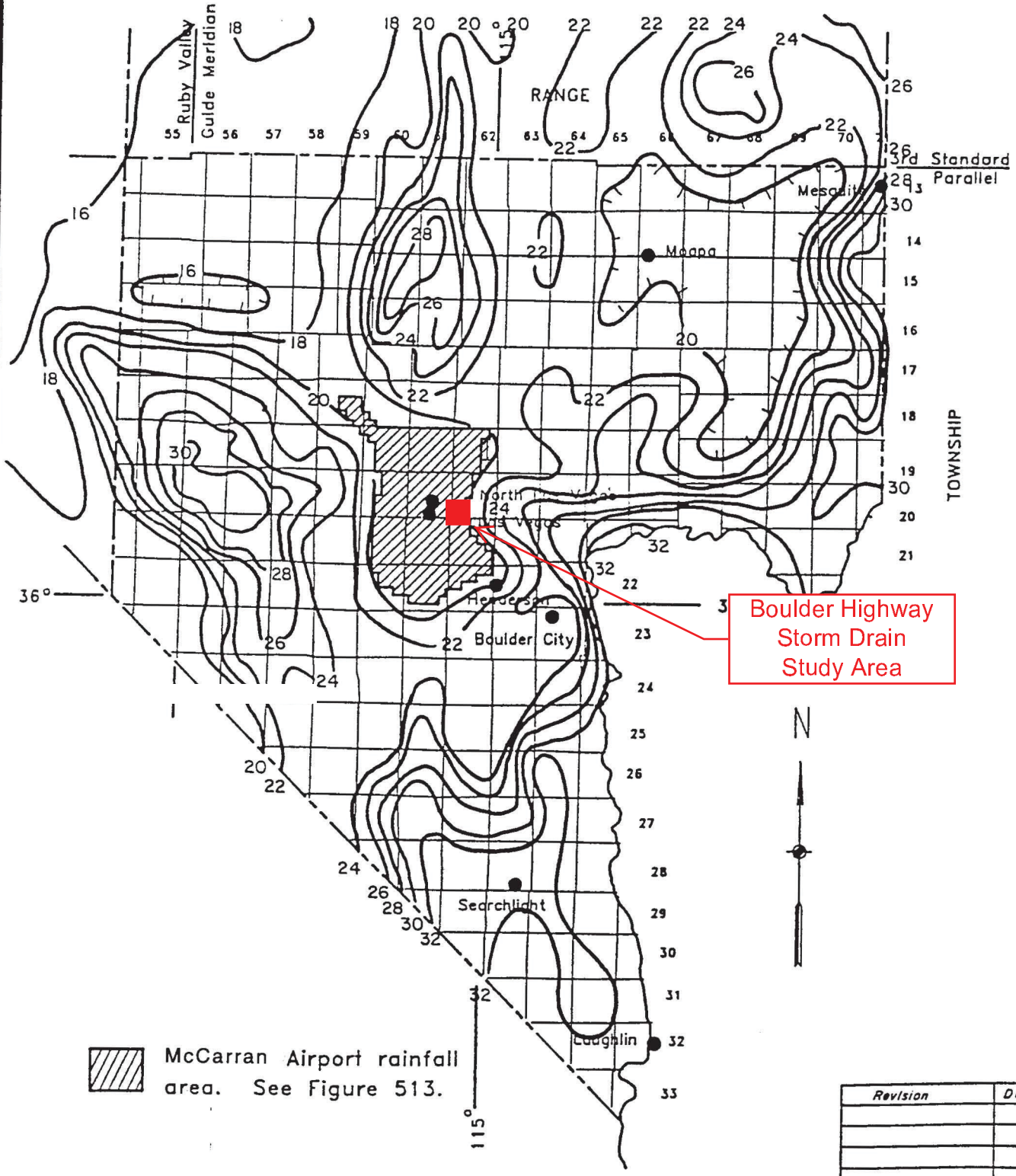
T_c	=	Time of concentration at the first design point in an urban watershed (minutes)
L	=	Watershed length (feet)

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.

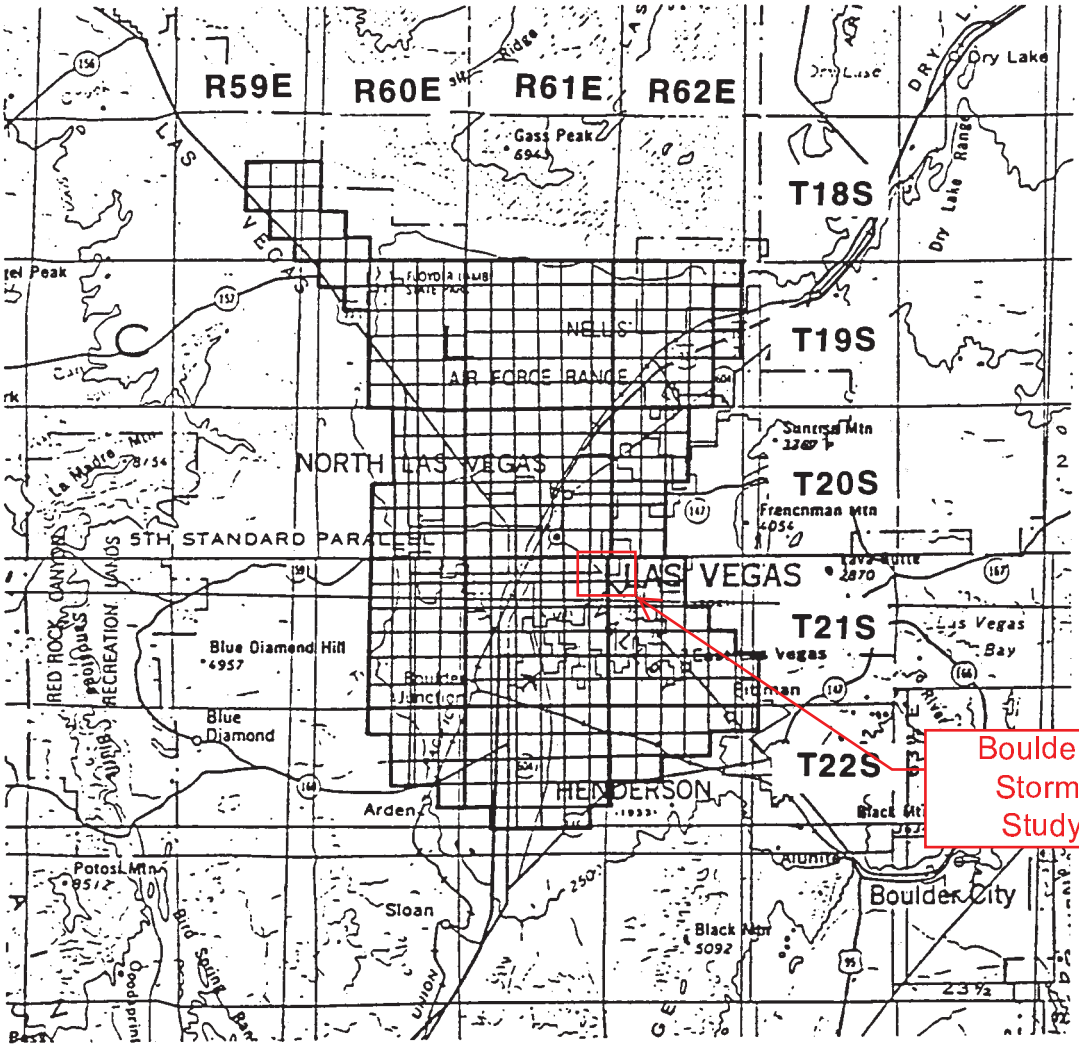
RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



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	D	85.4	0.7367	183.07	0.286	100	1.0	6.5	4700	1.2	2.2	3.4	24.6	31.2	36.7	**0.312**	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
FR03-2	D	77.7	0.6353	42.0	0.066	100	1.0	8.4	2800	1.3	2.3	2.1	21.9	30.2	26.1	**0.261**	2.77
FR03-3	D	88.0	0.7716	17.2	0.027	100	1.0	5.9	1610	1.0	2.0	3.1	10.2	16.1	19.5	**0.161**	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	85.0	0.7315	8.3	0.013	100	1.0	6.6	1220	0.9	1.9	2.9	8.5	15.1	17.3	**0.151**	2.77
FR03-6	D	84.8	0.7297	8.0	0.012	100	1.0	6.7	1210	0.7	1.7	2.6	9.6	16.2	17.3	**0.162**	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	93.0	0.8378	2.9	0.005	100	1.0	4.7	604	0.8	1.8	2.8	5.2	9.9	13.9	**0.099**	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	87.6	0.7664	8.3	0.013	100	1.0	6.0	1116	0.7	1.7	2.6	8.8	14.8	16.8	**0.148**	2.77
FR04-C8	D	85.6	0.7394	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	0.8208	4.3	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-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	136	2558558	0.0%	0.0%	0.01	0.01	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3224	2558558	0.1%	0.1%	0.12	0.13	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4927	2558558	0.2%	0.3%	0.18	0.31	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2513	2558558	0.1%	0.4%	0.09	0.41	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5027	2558558	0.2%	0.6%	0.19	0.59	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15738	2558558	0.6%	1.2%	0.59	1.18	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17815	2558558	0.7%	1.9%	0.67	1.85	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	388	2558558	0.0%	1.9%	0.01	1.87	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	3	2558558	0.0%	1.9%	0.00	1.87	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	1	2558558	0.0%	1.9%	0.00	1.87	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49701	2558558	1.9%	3.9%	1.86	3.73	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	29857	2558558	1.2%	5.1%	1.12	4.85	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49732	2558558	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	2558558	0.0%	7.0%	0.00	6.72	
CH52-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2152166	2558558	84.1%	91.1%	80.75	87.47	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	52	2558558	0.0%	91.1%	0.00	87.47	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	227113	2558558	8.9%	100.0%	8.08	95.55	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	135	2558558	0.0%	100.0%	0.00	95.55	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	29	2558558	0.0%	100.0%	0.00	95.55	
CH52-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	0	2558558	0.0%	100.0%	0.00	95.55	**95.6**
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	151977	6452417	2.4%	2.4%	2.26	2.26	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24493	6452417	0.4%	2.7%	0.36	2.63	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35640	6452417	0.6%	3.3%	0.53	3.16	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	37466	6452417	0.6%	3.9%	0.56	3.71	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	74	6452417	0.0%	3.9%	0.00	3.71	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	18	6452417	0.0%	3.9%	0.00	3.71	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	90	6452417	0.0%	3.9%	0.00	3.72	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	6452417	0.0%	3.9%	0.00	3.72	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452417	0.0%	3.9%	0.00	3.72	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	19419	6452417	0.3%	4.2%	0.29	4.00	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10557	6452417	0.2%	4.3%	0.16	4.16	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17043	6452417	0.3%	4.6%	0.25	4.42	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	14968	6452417	0.2%	4.8%	0.22	4.64	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9441	6452417	0.1%	5.0%	0.14	4.78	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5	6452417	0.0%	5.0%	0.00	4.78	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5166	6452417	0.1%	5.1%	0.08	4.86	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16837	6452417	0.3%	5.3%	0.25	5.11	
CH52-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1	6452417	0.0%	5.3%	0.00	5.11	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	19704	6452417	0.3%	5.6%	0.29	5.40	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	9279	6452417	0.1%	5.8%	0.14	5.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452417	0.0%	5.8%	0.00	5.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4	6452417	0.0%	5.8%	0.00	5.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42763	6452417	0.7%	6.4%	0.64	6.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55319	6452417	0.9%	7.3%	0.82	7.00	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55281	6452417	0.9%	8.1%	0.82	7.82	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8	6452417	0.0%	8.1%	0.00	7.82	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	53448	6452417	0.8%	9.0%	0.80	8.61	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56688	6452417	0.9%	9.9%	0.84	9.46	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	0	6452417	0.0%	9.9%	0.00	9.46	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	30	6452417	0.0%	9.9%	0.00	9.46	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	28807	6452417	0.4%	10.3%	0.43	9.89	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	25	6452417	0.0%	10.3%	0.00	9.89	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39832	6452417	0.6%	10.9%	0.59	10.48	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	36819	6452417	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	6452417	0.0%	11.5%	0.00	11.03	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	183944	6452417	2.9%	14.3%	2.74	13.77	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	75	6452417	0.0%	14.3%	0.00	13.77	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3838	6452417	0.1%	14.4%	0.06	13.82	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4798	6452417	0.1%	14.5%	0.07	13.90	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	6452417	0.0%	14.5%	0.00	13.90	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17701	6452417	0.3%	14.7%	0.26	14.16	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8931	6452417	0.1%	14.9%	0.13	14.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	6452417	0.0%	14.9%	0.00	14.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16959	6452417	0.3%	15.2%	0.25	14.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	6452417	0.0%	15.2%	0.00	14.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57162	6452417	0.9%	16.0%	0.85	15.39	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56720	6452417	0.9%	16.9%	0.84	16.24	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55612	6452417	0.9%	17.8%	0.83	17.07	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55204	6452417	0.9%	18.6%	0.82	17.89	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57292	6452417	0.9%	19.5%	0.85	18.74	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	5	6452417	0.0%	19.5%	0.00	18.74	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17544	6452417	0.3%	19.8%	0.26	19.00	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	43	6452417	0.0%	19.8%	0.00	19.00	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17575	6452417	0.3%	20.1%	0.26	19.26	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4736	6452417	0.1%	20.1%	0.07	19.33	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3897	6452417	0.1%	20.2%	0.06	19.39	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7688	6452417	0.1%	20.3%	0.11	19.51	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10	6452417	0.0%	20.3%	0.00	19.51	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10	6452417	0.0%	20.3%	0.00	19.51	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8322	6452417	0.1%	20.4%	0.12	19.63	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8247	6452417	0.1%	20.6%	0.12	19.75	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56005	6452417	0.9%	21.4%	0.83	20.59	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8219	6452417	0.1%	21.6%	0.12	20.71	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55699	6452417	0.9%	22.4%	0.83	21.54	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55862	6452417	0.9%	23.3%	0.83	22.37	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	6452417	0.0%	23.3%	0.00	22.37	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55510	6452417	0.9%	24.2%	0.83	23.19	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57253	6452417	0.9%	25.0%	0.85	24.05	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8332	6452417	0.1%	25.2%	0.12	24.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	78	6452417	0.0%	25.2%	0.00	24.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7956	6452417	0.1%	25.3%	0.12	24.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	6452417	0.0%	25.3%	0.00	24.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7767	6452417	0.1%	25.4%	0.12	24.40	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6	6452417	0.0%	25.4%	0.00	24.41	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	6452417	0.0%	25.4%	0.00	24.41	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16194	6452417	0.3%	25.7%	0.24	24.65	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7650	6452417	0.1%	25.8%	0.11	24.76	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7770	6452417	0.1%	25.9%	0.12	24.88	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3	6452417	0.0%	25.9%	0.00	24.88	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7582	6452417	0.1%	26.0%	0.11	24.99	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56682	6452417	0.9%	26.9%	0.84	25.83	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56517	6452417	0.9%	27.8%	0.84	26.67	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452417	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	6452417	0.9%	28.7%	0.84	27.51	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55693	6452417	0.9%	29.5%	0.83	28.34	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56163	6452417	0.9%	30.4%	0.84	29.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42	6452417	0.0%	30.4%	0.00	29.17	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8112	6452417	0.1%	30.5%	0.12	29.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	27	6452417	0.0%	30.5%	0.00	29.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452417	0.0%	30.5%	0.00	29.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	12131	6452417	0.2%	30.7%	0.18	29.47	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2	6452417	0.0%	30.7%	0.00	29.47	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1	6452417	0.0%	30.7%	0.00	29.47	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7247	6452417	0.1%	30.8%	0.11	29.58	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	10198	6452417	0.2%	31.0%	0.15	29.73	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34922	6452417	0.5%	31.5%	0.52	30.25	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	6452417	0.0%	31.5%	0.00	30.25	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34648	6452417	0.5%	32.1%	0.52	30.77	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35100	6452417	0.5%	32.6%	0.52	31.29	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	41067	6452417	0.6%	33.2%	0.61	31.90	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	33	6452417	0.0%	33.2%	0.00	31.90	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7352	6452417	0.1%	33.3%	0.11	32.01	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	40888	6452417	0.6%	34.0%	0.61	32.62	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	17177	6452417	0.3%	34.2%	0.26	32.88	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	20233	6452417	0.3%	34.6%	0.30	33.18	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	45182	6452417	0.7%	35.3%	0.67	33.85	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35936	6452417	0.6%	35.8%	0.53	34.38	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1478235	6452417	22.9%	58.7%	21.99	56.38	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	239771	6452417	3.7%	62.4%	3.57	59.94	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	427036	6452417	6.6%	69.1%	6.35	66.30	
CH52-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1992929	6452417	30.9%	99.9%	28.11	94.40	
CH52-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1938	6452417	0.0%	100.0%	0.03	94.43	
CH52-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	270	6452417	0.0%	100.0%	0.00	94.44	
CH52-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1214	6452417	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	188454	4437351	4.2%	4.2%	3.78	3.78	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	14292	4437351	0.3%	4.6%	0.31	4.09	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	18931	4437351	0.4%	5.0%	0.41	4.50	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	221403	4437351	5.0%	10.0%	4.44	8.94	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	140073	4437351	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	4437351	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	4437351	1.5%	14.6%	1.32	13.08	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	232125	4437351	5.2%	19.9%	5.02	18.10	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	16688	4437351	0.4%	20.2%	0.36	18.46	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13550	4437351	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	4437351	3.1%	23.7%	2.78	21.54	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	190849	4437351	4.3%	28.0%	3.83	25.37	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	184007	4437351	4.1%	32.1%	3.69	29.06	
CH56-C1	2	Parks, Golf Courses	390	76	76947	4437351	1.7%	33.9%	1.32	30.37	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	9237	4437351	0.2%	34.1%	0.20	30.57	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	320709	4437351	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	4437351	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	4437351	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	4437351	2.4%	50.1%	2.17	44.82	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	150104	4437351	3.4%	53.5%	3.01	47.83	
CH56-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	314800	4437351	7.1%	60.6%	6.31	54.15	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	202273	4437351	4.6%	65.1%	4.38	58.52	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	124594	4437351	2.8%	67.9%	2.70	61.22	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	202937	4437351	4.6%	72.5%	4.39	65.61	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	8258	4437351	0.2%	72.7%	0.18	65.79	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	6840	4437351	0.2%	72.8%	0.15	65.94	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	54714	4437351	1.2%	74.1%	1.18	67.12	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	62875	4437351	1.4%	75.5%	1.36	68.48	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	183624	4437351	4.1%	79.6%	3.97	72.45	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	146102	4437351	3.3%	82.9%	3.00	75.45	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	753173	4437351	17.0%	99.9%	15.45	90.89	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	10	4437351	0.0%	99.9%	0.00	90.89	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	2	4437351	0.0%	99.9%	0.00	90.89	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	4	4437351	0.0%	99.9%	0.00	90.89	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	11	4437351	0.0%	99.9%	0.00	90.89	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	10	4437351	0.0%	99.9%	0.00	90.89	
CH56-C1	2	Parks, Golf Courses	390	76	1456	4437351	0.0%	99.9%	0.02	90.92	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	1323	4437351	0.0%	99.9%	0.03	90.95	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	29	4437351	0.0%	100.0%	0.00	90.95	
CH56-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1938	4437351	0.0%	100.0%	0.04	90.99	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	270	4437351	0.0%	100.0%	0.01	91.00	
CH56-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	0	4437351	0.0%	100.0%	0.00	91.00	**91.0**
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6497	5072537	0.1%	0.1%	0.12	0.12	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	12009	5072537	0.2%	0.4%	0.21	0.33	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	13352	5072537	0.3%	0.6%	0.23	0.56	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	33193	5072537	0.7%	1.3%	0.58	1.14	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	15804	5072537	0.3%	1.6%	0.28	1.42	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7348	5072537	0.1%	1.7%	0.13	1.55	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	76243	5072537	1.5%	3.2%	1.34	2.89	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	9180	5072537	0.2%	3.4%	0.16	3.06	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6899	5072537	0.1%	3.6%	0.12	3.18	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	4612	5072537	0.1%	3.6%	0.08	3.26	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	0	5072537	0.0%	3.6%	0.00	3.26	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	9651	5072537	0.2%	3.8%	0.17	3.44	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7015	5072537	0.1%	4.0%	0.13	3.56	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	5346	5072537	0.1%	4.1%	0.10	3.66	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7056	5072537	0.1%	4.2%	0.13	3.78	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8225	5072537	0.2%	4.4%	0.15	3.93	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6979	5072537	0.1%	4.5%	0.13	4.06	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8305	5072537	0.2%	4.7%	0.15	4.21	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6647	5072537	0.1%	4.8%	0.12	4.32	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7911	5072537	0.2%	5.0%	0.14	4.47	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6421	5072537	0.1%	5.1%	0.12	4.58	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	85135	5072537	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	5072537	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	5072537	1.6%	9.7%	1.46	8.67	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6641	5072537	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	5072537	0.2%	10.0%	0.15	8.94	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	201257	5072537	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	5072537	2.1%	16.0%	1.83	14.30	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6588	5072537	0.1%	16.1%	0.12	14.42	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8210	5072537	0.2%	16.3%	0.15	14.56	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6721	5072537	0.1%	16.4%	0.12	14.69	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8669	5072537	0.2%	16.6%	0.16	14.84	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6567	5072537	0.1%	16.7%	0.12	14.96	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8585	5072537	0.2%	16.9%	0.15	15.11	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6688	5072537	0.1%	17.0%	0.12	15.23	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8749	5072537	0.2%	17.2%	0.16	15.39	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6484	5072537	0.1%	17.3%	0.12	15.51	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	102516	5072537	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	5072537	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	5072537	3.9%	25.6%	3.50	22.86	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8322	5072537	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	5072537	1.4%	27.1%	1.23	24.24	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6823	5072537	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	5072537	2.5%	29.8%	2.23	26.59	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7233	5072537	0.1%	29.9%	0.13	26.72	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6780	5072537	0.1%	30.1%	0.12	26.85	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	7043	5072537	0.1%	30.2%	0.13	26.97	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8628	5072537	0.2%	30.4%	0.15	27.13	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	8919	5072537	0.2%	30.6%	0.16	27.29	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	9759	5072537	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	5072537	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	5072537	2.4%	35.9%	2.12	32.03	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	99377	5072537	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	5072537	1.8%	39.7%	1.64	35.54	
CH56-C2	12	Schools	390	86	228297	5072537	4.5%	44.2%	3.87	39.41	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	138936	5072537	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	5072537	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	5072537	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	5072537	0.1%	53.0%	0.12	47.29	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	283	5072537	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	5072537	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	5072537	0.6%	55.9%	0.50	49.84	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	108044	5072537	2.1%	58.0%	1.90	51.74	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	405890	5072537	8.0%	66.0%	7.68	59.42	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	161424	5072537	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	5072537	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	5072537	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	5072537	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	5072537	0.0%	69.4%	0.02	62.67	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	162173	5072537	3.2%	72.6%	2.91	65.58	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1373377	5072537	27.1%	99.7%	24.64	90.22	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1	5072537	0.0%	99.7%	0.00	90.22	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	289	5072537	0.0%	99.7%	0.01	90.23	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1096	5072537	0.0%	99.7%	0.02	90.25	

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	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	839	5072537	0.0%	99.7%	0.01	90.26	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1437	5072537	0.0%	99.8%	0.03	90.29	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	626	5072537	0.0%	99.8%	0.01	90.30	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	2622	5072537	0.1%	99.8%	0.05	90.34	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	350	5072537	0.0%	99.8%	0.01	90.35	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	314	5072537	0.0%	99.8%	0.01	90.35	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	174	5072537	0.0%	99.9%	0.00	90.36	
CH56-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	693	5072537	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	5072537	0.0%	99.9%	0.01	90.38	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	245	5072537	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	5072537	0.0%	99.9%	0.00	90.39	
CH56-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	35	5072537	0.0%	99.9%	0.00	90.39	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1400	5072537	0.0%	99.9%	0.03	90.41	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1944	5072537	0.0%	100.0%	0.03	90.45	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1588	5072537	0.0%	100.0%	0.03	90.48	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	887	5072537	0.0%	100.0%	0.02	90.49	
CH56-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	6	5072537	0.0%	100.0%	0.00	90.49	**90.5**
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	
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	

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	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	
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	

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	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-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	1510844	0.0%	0.0%	0.00	0.00	
CH60A-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3	1510844	0.0%	0.0%	0.00	0.00	
CH60A-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1847	1510844	0.1%	0.1%	0.12	0.12	
CH60A-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1046	1510844	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	1510844	0.1%	0.3%	0.12	0.30	
CH60A-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	891717	1510844	59.0%	59.3%	52.53	52.83	
CH60A-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	542564	1510844	35.9%	95.3%	30.17	83.00	
CH60A-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	49964	1510844	3.3%	98.6%	3.01	86.01	
CH60A-C1	7	Public Facility and Residential, 8-12 units/acre	325	88	21708	1510844	1.4%	100.0%	1.26	87.27	**87.3**
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	125671	7189110	1.7%	1.7%	1.68	1.68	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	33643	7189110	0.5%	2.2%	0.45	2.13	
CH60A-C2	12	Schools	615	86	495640	7189110	6.9%	9.1%	5.93	8.06	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	50	7189110	0.0%	9.1%	0.00	8.06	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	19316	7189110	0.3%	9.4%	0.24	8.30	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	19	7189110	0.0%	9.4%	0.00	8.30	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	1493622	7189110	20.8%	30.2%	18.49	26.79	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	94332	7189110	1.3%	31.5%	1.17	27.96	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1764	7189110	0.0%	31.5%	0.02	27.98	
CH60A-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	725451	7189110	10.1%	41.6%	9.18	37.16	
CH60A-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1844	7189110	0.0%	41.6%	0.02	37.18	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	57053	7189110	0.8%	42.4%	0.71	37.89	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	55940	7189110	0.8%	43.2%	0.69	38.58	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	703	7189110	0.0%	43.2%	0.01	38.59	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2463	7189110	0.0%	43.2%	0.03	38.63	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	54982	7189110	0.8%	44.0%	0.68	39.31	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	34986	7189110	0.5%	44.5%	0.47	39.77	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	58959	7189110	0.8%	45.3%	0.73	40.50	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	76709	7189110	1.1%	46.4%	1.02	41.53	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	188219	7189110	2.6%	49.0%	2.51	44.04	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	117836	7189110	1.6%	50.6%	1.46	45.50	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57389	7189110	0.8%	51.4%	0.77	46.27	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7	7189110	0.0%	51.4%	0.00	46.27	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	57344	7189110	0.8%	52.2%	0.77	47.03	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	584949	7189110	8.1%	60.4%	7.81	54.84	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	60441	7189110	0.8%	61.2%	0.75	55.59	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	35539	7189110	0.5%	61.7%	0.44	56.03	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	55885	7189110	0.8%	62.5%	0.69	56.72	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55713	7189110	0.8%	63.2%	0.74	57.47	
CH60A-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	76973	7189110	1.1%	64.3%	0.95	58.42	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	55743	7189110	0.8%	65.1%	0.74	59.16	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15856	7189110	0.2%	65.3%	0.21	59.38	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	59439	7189110	0.8%	66.1%	0.79	60.17	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56186	7189110	0.8%	66.9%	0.75	60.92	

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CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	15640	7189110	0.2%	67.1%	0.21	61.13	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120611	7189110	1.7%	68.8%	1.61	62.74	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	25845	7189110	0.4%	69.2%	0.35	63.09	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56545	7189110	0.8%	70.0%	0.76	63.84	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	56179	7189110	0.8%	70.7%	0.75	64.59	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	35256	7189110	0.5%	71.2%	0.47	65.06	
CH60A-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1051236	7189110	14.6%	85.9%	14.04	79.10	
CH60A-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	1017133	7189110	14.1%	100.0%	12.87	91.97	**92.0**
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	1867	4407547	0.0%	0.0%	0.04	0.04	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	723	4407547	0.0%	0.1%	0.02	0.06	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	8788	4407547	0.2%	0.3%	0.19	0.25	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	6155	4407547	0.1%	0.4%	0.13	0.38	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	3403	4407547	0.1%	0.5%	0.07	0.46	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2732	4407547	0.1%	0.5%	0.06	0.52	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	15491	4407547	0.4%	0.9%	0.34	0.85	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	36121	4407547	0.8%	1.7%	0.79	1.64	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	42068	4407547	1.0%	2.7%	0.92	2.56	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	52182	4407547	1.2%	3.8%	1.14	3.69	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	55725	4407547	1.3%	5.1%	1.21	4.91	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	55715	4407547	1.3%	6.4%	1.21	6.12	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	523743	4407547	11.9%	18.3%	11.41	17.53	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	130332	4407547	3.0%	21.2%	2.84	20.37	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	27111	4407547	0.6%	21.8%	0.59	20.96	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	73	4407547	0.0%	21.8%	0.00	20.96	
CH60A-C3	12	Schools	615	86	33680	4407547	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	4407547	1.1%	23.6%	0.94	22.55	
CH60A-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	418503	4407547	9.5%	33.1%	8.45	31.00	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	331173	4407547	7.5%	40.7%	6.84	37.84	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	2219011	4407547	50.3%	91.0%	45.81	83.66	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	7117	4407547	0.2%	91.2%	0.16	83.81	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	28319	4407547	0.6%	91.8%	0.58	84.39	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	360933	4407547	8.2%	100.0%	7.45	91.85	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	10	4407547	0.0%	100.0%	0.00	91.85	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	2	4407547	0.0%	100.0%	0.00	91.85	
CH60A-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	4	4407547	0.0%	100.0%	0.00	91.85	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	11	4407547	0.0%	100.0%	0.00	91.85	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	10	4407547	0.0%	100.0%	0.00	91.85	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	135	4407547	0.0%	100.0%	0.00	91.85	
CH60A-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	0	4407547	0.0%	100.0%	0.00	91.85	**91.9**
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	1468	768283	0.2%	0.2%	0.18	0.18	
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	21	768283	0.0%	0.2%	0.00	0.19	
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	333	768283	0.0%	0.2%	0.04	0.23	
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	374066	768283	48.7%	48.9%	46.74	46.97	
CH60A-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	86329	768283	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	768283	4.8%	65.0%	4.31	61.84	
CH60A-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	171895	768283	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	768283	3.8%	91.2%	3.23	84.98	
CH60A-C4	7	Public Facility and Residential, 8-12 units/acre	390	91	58859	768283	7.7%	98.9%	6.97	91.96	
CH60A-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	8548	768283	1.1%	100.0%	0.98	92.94	**92.9**

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-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	13994	1628615	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	1628615	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	1628615	1.7%	12.8%	1.41	11.34	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	19913	1628615	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	1628615	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	1628615	3.7%	27.7%	3.08	24.49	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	15284	1628615	0.9%	28.6%	0.90	25.40	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	137115	1628615	8.4%	37.0%	7.49	32.89	
CH63-C1	2	Parks, Golf Courses	390	76	58485	1628615	3.6%	40.6%	2.73	35.62	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	9952	1628615	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	1628615	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	1628615	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	1628615	7.8%	56.7%	6.97	49.79	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	14857	1628615	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	1628615	1.7%	59.4%	1.46	52.01	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	189987	1628615	11.7%	71.0%	11.20	63.21	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	62251	1628615	3.8%	74.8%	3.67	66.88	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	10402	1628615	0.6%	75.5%	0.60	67.48	
CH63-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2310	1628615	0.1%	75.6%	0.13	67.62	
CH63-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	284480	1628615	17.5%	93.1%	15.90	83.51	
CH63-C1	7	Public Facility and Residential, 8-12 units/acre	325	88	109641	1628615	6.7%	99.8%	5.92	89.44	
CH63-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	43	1628615	0.0%	99.8%	0.00	89.44	
CH63-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	1	1628615	0.0%	99.8%	0.00	89.44	
CH63-C1	2	Parks, Golf Courses	390	76	1456	1628615	0.1%	99.9%	0.07	89.51	
CH63-C1	7	Public Facility and Residential, 8-12 units/acre	390	91	1323	1628615	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	100472	910432	11.0%	11.0%	9.82	9.82	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	45726	910432	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	910432	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	910432	3.7%	35.7%	3.09	31.32	
CH63-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	61857	910432	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	910432	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	910432	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	910432	2.5%	69.4%	2.08	61.71	
CH63-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	12915	910432	1.4%	70.9%	1.19	62.91	
CH63-C2	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	590	910432	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	910432	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	910432	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	910432	0.0%	71.9%	0.01	63.82	
CH63-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	184799	910432	20.3%	92.2%	18.47	82.29	
CH63-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	69610	910432	7.6%	99.8%	6.73	89.02	
CH63-C2	7	Public Facility and Residential, 8-12 units/acre	390	91	1588	910432	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	23241	513778	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	513778	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	513778	16.7%	30.0%	14.90	26.27	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	91193	513778	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	513778	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	513778	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	513778	2.2%	55.2%	1.85	47.63	
CH63-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	40440	513778	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	513778	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	513778	0.1%	71.2%	0.09	62.38	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	72336	513778	14.1%	85.2%	12.81	75.19	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	325	88	71721	513778	14.0%	99.2%	12.28	87.48	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	887	513778	0.2%	99.4%	0.16	87.64	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	784	513778	0.2%	99.5%	0.14	87.77	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1523	513778	0.3%	99.8%	0.25	88.02	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52	513778	0.0%	99.8%	0.01	88.03	
CH63-C3	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	250	513778	0.0%	99.9%	0.05	88.08	
CH63-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	260	513778	0.1%	99.9%	0.05	88.12	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	190	513778	0.0%	100.0%	0.03	88.15	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	325	88	156	513778	0.0%	100.0%	0.03	88.18	
CH63-C3	7	Public Facility and Residential, 8-12 units/acre	390	91	6	513778	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	3339913	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	3339913	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	3339913	0.2%	0.2%	0.13	0.17	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52662	3339913	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	3339913	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	3339913	0.3%	2.2%	0.24	1.85	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	167289	3339913	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	3339913	0.3%	7.5%	0.28	6.34	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	72077	3339913	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	3339913	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	3339913	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	3339913	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	3339913	0.5%	10.7%	0.38	9.04	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	82110	3339913	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	3339913	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	3339913	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	3339913	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	3339913	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	3339913	0.1%	21.6%	0.11	18.17	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	30490	3339913	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	3339913	0.9%	23.4%	0.73	19.66	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	6430	3339913	0.2%	23.5%	0.18	19.84	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	207799	3339913	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	3339913	0.5%	30.3%	0.44	25.51	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	15629	3339913	0.5%	30.8%	0.44	25.95	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	43589	3339913	1.3%	32.1%	1.23	27.17	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	9216	3339913	0.3%	32.3%	0.26	27.43	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	46372	3339913	1.4%	33.7%	1.31	28.74	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1416524	3339913	42.4%	76.1%	40.72	69.45	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	61559	3339913	1.8%	78.0%	1.73	71.19	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8394	3339913	0.3%	78.2%	0.24	71.43	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	24731	3339913	0.7%	79.0%	0.70	72.12	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	8486	3339913	0.3%	79.2%	0.24	72.37	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	615	91	196732	3339913	5.9%	85.1%	5.36	77.73	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	496714	3339913	14.9%	100.0%	13.09	90.81	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	615	91	127	3339913	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	27	3339913	0.0%	100.0%	0.00	90.82	
CH63-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	9	3339913	0.0%	100.0%	0.00	90.82	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	12	3339913	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	3339913	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	3339913	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	3339913	0.0%	100.0%	0.00	90.82	
CH63-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16	3339913	0.0%	100.0%	0.00	90.82	
CH63-C4	7	Public Facility and Residential, 8-12 units/acre	615	91	4	3339913	0.0%	100.0%	0.00	90.82	**90.8**
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	
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	

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	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	
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	

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	233721	7974105	2.9%	99.8%	2.58	89.81	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	0	7974105	0.0%	99.8%	0.00	89.81	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	289	7974105	0.0%	99.8%	0.00	89.81	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1096	7974105	0.0%	99.8%	0.01	89.82	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	839	7974105	0.0%	99.8%	0.01	89.83	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	1437	7974105	0.0%	99.8%	0.02	89.85	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	626	7974105	0.0%	99.8%	0.01	89.85	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	2622	7974105	0.0%	99.9%	0.03	89.88	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	350	7974105	0.0%	99.9%	0.00	89.89	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	314	7974105	0.0%	99.9%	0.00	89.89	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	174	7974105	0.0%	99.9%	0.00	89.89	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	693	7974105	0.0%	99.9%	0.01	89.90	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	526	7974105	0.0%	99.9%	0.01	89.91	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	245	7974105	0.0%	99.9%	0.00	89.91	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	268	7974105	0.0%	99.9%	0.00	89.91	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	35	7974105	0.0%	99.9%	0.00	89.91	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1400	7974105	0.0%	99.9%	0.02	89.93	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	1944	7974105	0.0%	99.9%	0.02	89.95	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7	7974105	0.0%	99.9%	0.00	89.95	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	325	88	178	7974105	0.0%	99.9%	0.00	89.95	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	615	91	1214	7974105	0.0%	100.0%	0.01	89.97	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	784	7974105	0.0%	100.0%	0.01	89.98	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1523	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	52	7974105	0.0%	100.0%	0.00	89.99	
CH64-C	9	Commercial, Retail, Casino, High Rise Condominiums	390	96	250	7974105	0.0%	100.0%	0.00	90.00	
CH64-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	390	89	260	7974105	0.0%	100.0%	0.00	90.00	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	390	91	190	7974105	0.0%	100.0%	0.00	90.00	
CH64-C	7	Public Facility and Residential, 8-12 units/acre	325	88	156	7974105	0.0%	100.0%	0.00	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-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	11418	403957	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	403957	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	403957	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	403957	6.9%	24.7%	5.81	21.19	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	3241	403957	0.8%	25.5%	0.77	21.96	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2482	403957	0.6%	26.1%	0.58	22.53	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	84196	403957	20.8%	47.0%	20.01	42.54	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	99907	403957	24.7%	71.7%	23.74	66.29	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	108660	403957	26.9%	98.6%	24.48	90.76	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	325	88	5548	403957	1.4%	100.0%	1.21	91.97	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	4	403957	0.0%	100.0%	0.00	91.97	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	325	88	22	403957	0.0%	100.0%	0.00	91.98	
CH67-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	2	403957	0.0%	100.0%	0.00	91.98	
CH67-C1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	18	403957	0.0%	100.0%	0.00	91.98	
CH67-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	16	403957	0.0%	100.0%	0.00	91.99	
CH67-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	4	403957	0.0%	100.0%	0.00	91.99	**92.0**
CH67-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	6	555656	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	555656	25.9%	25.9%	21.77	21.77	
CH67-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17848	555656	3.2%	29.1%	3.02	24.79	
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	157871	555656	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	555656	4.2%	61.7%	3.50	52.16	
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27717	555656	5.0%	66.7%	4.19	56.35	
CH67-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3214	555656	0.6%	67.3%	0.54	56.89	
CH67-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	181767	555656	32.7%	100.0%	28.79	85.68	
CH67-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	4	555656	0.0%	100.0%	0.00	85.68	
CH67-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	27	555656	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	555656	0.0%	100.0%	0.00	85.68	
CH67-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	12	555656	0.0%	100.0%	0.00	85.69	
CH67-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	16	555656	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	2723270	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	2723270	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	2723270	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	2723270	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	2723270	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	2723270	1.8%	7.2%	1.53	6.01	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5253	2723270	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	2723270	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	2723270	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	2723270	2.8%	19.7%	2.39	16.60	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	97600	2723270	3.6%	23.3%	3.01	19.61	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111402	2723270	4.1%	27.4%	3.44	23.04	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111084	2723270	4.1%	31.5%	3.43	26.47	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12175	2723270	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	2723270	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	2723270	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	2723270	4.5%	39.2%	3.79	32.98	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13134	2723270	0.5%	39.7%	0.45	33.44	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	124261	2723270	4.6%	44.2%	3.83	37.27	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	169312	2723270	6.2%	50.5%	5.22	42.49	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	142115	2723270	5.2%	55.7%	4.38	46.88	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	154358	2723270	5.7%	61.3%	4.76	51.64	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17216	2723270	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	2723270	2.1%	64.0%	1.74	53.97	
CH67-C3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	82725	2723270	3.0%	67.1%	2.55	56.52	
CH67-C3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5988	2723270	0.2%	67.3%	0.21	56.73	
CH67-C3	7	Public Facility and Residential, 8-12 units/acre	325	88	890589	2723270	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	2968523	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	2968523	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	2968523	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	2968523	1.7%	7.4%	1.42	6.23	
CH67-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5763	2968523	0.2%	7.6%	0.18	6.41	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	381522	2968523	12.9%	20.5%	10.80	17.21	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	42746	2968523	1.4%	21.9%	1.21	18.42	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	138752	2968523	4.7%	26.6%	3.93	22.35	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	101133	2968523	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	2968523	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	2968523	3.7%	37.4%	3.10	31.43	
CH67-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12229	2968523	0.4%	37.8%	0.39	31.82	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	139547	2968523	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	2968523	3.4%	45.9%	2.86	38.62	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	109913	2968523	3.7%	49.6%	3.11	41.73	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	109099	2968523	3.7%	53.3%	3.09	44.82	
CH67-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	11824	2968523	0.4%	53.7%	0.37	45.20	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	70412	2968523	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	2968523	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	2968523	1.1%	58.5%	0.94	49.22	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	45917	2968523	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	2968523	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	2968523	2.0%	64.0%	1.72	53.82	
CH67-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	5904	2968523	0.2%	64.2%	0.19	54.01	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	71258	2968523	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	2968523	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	2968523	0.6%	72.9%	0.46	61.37	
CH67-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	803745	2968523	27.1%	100.0%	23.83	85.20	
CH67-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	226	2968523	0.0%	100.0%	0.01	85.20	
CH67-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	0	2968523	0.0%	100.0%	0.00	85.20	**85.2**
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	71445	4183711	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	4183711	1.5%	3.2%	1.22	2.66	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	89365	4183711	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	4183711	2.3%	7.6%	1.93	6.38	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13263	4183711	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	4183711	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	4183711	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	4183711	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	4183711	2.6%	19.2%	2.22	16.14	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13903	4183711	0.3%	19.5%	0.31	16.45	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	141950	4183711	3.4%	22.9%	2.85	19.30	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	106527	4183711	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	4183711	2.7%	28.1%	2.26	23.70	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	113127	4183711	2.7%	30.8%	2.27	25.98	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13238	4183711	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	4183711	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	4183711	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	4183711	2.7%	39.7%	2.23	33.48	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	111728	4183711	2.7%	42.4%	2.24	35.72	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	13211	4183711	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	4183711	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	4183711	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	4183711	2.0%	45.8%	1.72	38.58	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	136819	4183711	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	4183711	1.4%	50.4%	1.15	42.48	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	142129	4183711	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	4183711	2.6%	56.4%	2.16	47.50	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	112380	4183711	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	4183711	2.7%	61.8%	2.25	52.01	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	12850	4183711	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	4183711	1.6%	63.7%	1.38	53.67	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52560	4183711	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	4183711	1.4%	66.4%	1.17	55.90	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	58048	4183711	1.4%	67.7%	1.17	57.07	
CH67-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	7362	4183711	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	4183711	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	4183711	0.3%	70.7%	0.24	59.60	
CH67-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	1223991	4183711	29.3%	100.0%	25.75	85.34	
CH67-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	26	4183711	0.0%	100.0%	0.00	85.34	
CH67-C5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7	4183711	0.0%	100.0%	0.00	85.34	
CH67-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	178	4183711	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	1790636	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	1790636	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	1790636	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	1790636	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	1790636	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	1790636	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	1790636	0.0%	0.0%	0.00	0.00	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17474	1790636	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	1790636	0.0%	1.0%	0.01	0.93	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4835	1790636	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	1790636	0.0%	1.3%	0.00	1.19	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	87595	1790636	4.9%	6.2%	4.70	5.89	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4101	1790636	0.2%	6.4%	0.22	6.11	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	38494	1790636	2.1%	8.5%	2.06	8.17	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	101365	1790636	5.7%	14.2%	5.43	13.60	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	38630	1790636	2.2%	16.4%	2.07	15.67	
CH68-1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	42510	1790636	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	1790636	1.9%	20.6%	1.70	19.65	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	73442	1790636	4.1%	24.7%	3.65	23.30	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	116816	1790636	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	1790636	0.4%	31.7%	0.38	29.49	
CH68-1	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	918690	1790636	51.3%	83.0%	43.10	72.59	
CH68-1	7	Public Facility and Residential, 8-12 units/acre	615	91	259162	1790636	14.5%	97.5%	13.17	85.76	
CH68-1	7	Public Facility and Residential, 8-12 units/acre	325	88	45314	1790636	2.5%	100.0%	2.23	87.98	**88.0**
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	793	1930768	0.0%	0.0%	0.04	0.04	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	694	1930768	0.0%	0.1%	0.03	0.07	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	1930768	0.0%	0.1%	0.00	0.07	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	1930768	0.0%	0.1%	0.00	0.07	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	165929	1930768	8.6%	8.7%	8.25	8.32	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	283064	1930768	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	1930768	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	1930768	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	1930768	0.0%	23.3%	0.00	22.11	
CH68-3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	24906	1930768	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	1930768	1.5%	26.1%	1.31	24.66	
CH68-3	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	1273471	1930768	66.0%	92.1%	55.40	80.06	
CH68-3	7	Public Facility and Residential, 8-12 units/acre	615	91	65465	1930768	3.4%	95.4%	3.09	83.15	
CH68-3	7	Public Facility and Residential, 8-12 units/acre	325	88	87868	1930768	4.6%	100.0%	4.00	87.15	**87.2**
CH68-4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	66421	1297412	5.1%	5.1%	4.91	4.91	
CH68-4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	49524	1297412	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	1132601	1297412	87.3%	96.2%	83.81	92.38	
CH68-4	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	2039	1297412	0.2%	96.4%	0.15	92.53	
CH68-4	7	Public Facility and Residential, 8-12 units/acre	615	91	46827	1297412	3.6%	100.0%	3.28	95.82	**95.8**
CH68-5	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	14193	528692	2.7%	2.7%	2.58	2.58	
CH68-5	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	138282	528692	26.2%	28.8%	25.11	27.69	
CH68-5	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	291274	528692	55.1%	83.9%	52.89	80.58	
CH68-5	7	Public Facility and Residential, 8-12 units/acre	615	91	84815	528692	16.0%	100.0%	14.60	95.17	
CH68-5	7	Public Facility and Residential, 8-12 units/acre	615	91	127	528692	0.0%	100.0%	0.02	95.20	**95.2**
CH68-6	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39497	155284	25.4%	25.4%	24.42	24.42	
CH68-6	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	4972	155284	3.2%	28.6%	3.07	27.49	
CH68-6	7	Public Facility and Residential, 8-12 units/acre	615	91	110815	155284	71.4%	100.0%	64.94	92.43	**92.4**
FR03-1	2	Parks, Golf Courses	325	64	5395	743568	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	743568	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	743568	7.0%	13.5%	5.87	11.17	
FR03-1	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2996	743568	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	743568	6.3%	20.2%	5.31	16.87	
FR03-1	7	Public Facility and Residential, 8-12 units/acre	325	88	593337	743568	79.8%	100.0%	70.22	87.09	**87.1**
FR03-2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	440	1828412	0.0%	0.0%	0.02	0.02	
FR03-2	2	Parks, Golf Courses	325	64	786617	1828412	43.0%	43.0%	27.53	27.56	
FR03-2	7	Public Facility and Residential, 8-12 units/acre	325	88	1041355	1828412	57.0%	100.0%	50.12	77.68	**77.7**
FR03-3	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	83	748196	0.0%	0.0%	0.01	0.01	
FR03-3	7	Public Facility and Residential, 8-12 units/acre	325	88	748113	748196	100.0%	100.0%	87.99	88.00	**88.0**
FR03-4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	28056	457821	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	457821	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	457821	1.6%	24.5%	1.35	20.58	
FR03-4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	35379	457821	7.7%	32.2%	7.26	27.84	
FR03-4	7	Public Facility and Residential, 8-12 units/acre	325	88	31	457821	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	457821	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	457821	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	457821	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	457821	3.5%	63.9%	2.95	54.44	
FR03-4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	236	457821	0.1%	63.9%	0.05	54.49	
FR03-4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4020	457821	0.9%	64.8%	0.83	55.32	
FR03-4	7	Public Facility and Residential, 8-12 units/acre	325	88	161062	457821	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	125395	361438	34.7%	34.7%	29.14	29.14	
FR03-5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	31153	361438	8.6%	43.3%	7.24	36.38	
FR03-5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	82932	361438	22.9%	66.3%	19.27	55.66	
FR03-5	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	34787	361438	9.6%	75.9%	8.08	63.74	
FR03-5	7	Public Facility and Residential, 8-12 units/acre	325	88	87171	361438	24.1%	100.0%	21.22	84.96	**85.0**
FR03-6	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	332	346580	0.1%	0.1%	0.09	0.09	
FR03-6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	140427	346580	40.5%	40.6%	34.03	34.13	
FR03-6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	135092	346580	39.0%	79.6%	32.74	66.87	
FR03-6	7	Public Facility and Residential, 8-12 units/acre	325	88	70729	346580	20.4%	100.0%	17.96	84.83	**84.8**
FR03-7	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	284262	454672	62.5%	62.5%	58.77	58.77	
FR03-7	9	Commercial, Retail, Casino, High Rise Condominiums	236	94	33480	454672	7.4%	69.9%	6.92	65.69	
FR03-7	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	2	454672	0.0%	69.9%	0.00	65.69	
FR03-7	7	Public Facility and Residential, 8-12 units/acre	325	88	100636	454672	22.1%	92.0%	19.48	85.17	
FR03-7	7	Public Facility and Residential, 8-12 units/acre	236	88	36291	454672	8.0%	100.0%	7.02	92.19	**92.2**
FR03-8	7	Public Facility and Residential, 8-12 units/acre	325	88	81681	116276	70.2%	70.2%	61.82	61.82	

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
FR03-8	7	Public Facility and Residential, 8-12 units/acre	236	88	34594	116276	29.8%	100.0%	26.18	88.00	**88.0**
FR04-C1	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	70813	114476	61.9%	61.9%	59.38	59.38	
FR04-C1	7	Public Facility and Residential, 8-12 units/acre	615	91	43663	114476	38.1%	100.0%	34.71	94.09	**94.1**
FR04-C10	7	Public Facility and Residential, 8-12 units/acre	615	91	249131	249131	100.0%	100.0%	91.00	91.00	**91.0**
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	84260	1867989	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	1867989	5.6%	10.1%	4.70	8.94	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	239154	1867989	12.8%	22.9%	10.75	19.69	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	157179	1867989	8.4%	31.3%	7.07	26.76	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	220531	1867989	11.8%	43.1%	9.92	36.68	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	179847	1867989	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	1867989	5.7%	58.4%	4.75	49.52	
FR04-C11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	58868	1867989	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	1867989	0.7%	62.2%	0.56	52.73	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1143	1867989	0.1%	62.3%	0.06	52.78	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3485	1867989	0.2%	62.5%	0.18	52.96	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1072	1867989	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	1867989	0.6%	63.2%	0.52	53.54	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4897	1867989	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	1867989	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	1867989	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	1867989	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	1867989	0.6%	65.7%	0.53	55.70	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	120266	1867989	6.4%	72.1%	6.18	61.88	
FR04-C11	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3824	1867989	0.2%	72.3%	0.19	62.07	
FR04-C11	7	Public Facility and Residential, 8-12 units/acre	615	91	53002	1867989	2.8%	75.2%	2.58	64.66	
FR04-C11	7	Public Facility and Residential, 8-12 units/acre	325	88	463561	1867989	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	301474	23.8%	23.8%	19.96	19.96	
FR04-C12	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	14751	301474	4.9%	28.7%	4.60	24.56	
FR04-C12	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	69615	301474	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	301474	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	301474	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	301474	10.8%	66.6%	9.08	56.40	
FR04-C12	7	Public Facility and Residential, 8-12 units/acre	325	88	100823	301474	33.4%	100.0%	29.43	85.83	**85.8**
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	50	705857	0.0%	0.0%	0.01	0.01	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	23	705857	0.0%	0.0%	0.00	0.01	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	86	705857	0.0%	0.0%	0.01	0.02	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	24	705857	0.0%	0.0%	0.00	0.02	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	7	705857	0.0%	0.0%	0.00	0.02	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	5	705857	0.0%	0.0%	0.00	0.02	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	39	705857	0.0%	0.0%	0.00	0.03	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	19	705857	0.0%	0.0%	0.00	0.03	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	7	705857	0.0%	0.0%	0.00	0.03	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	81	705857	0.0%	0.0%	0.01	0.04	
FR04-C13	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	88201	705857	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	705857	19.0%	31.5%	15.95	26.49	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	100	705857	0.0%	31.5%	0.01	26.50	
FR04-C13	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	60939	705857	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	705857	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	705857	23.8%	72.9%	19.97	61.25	

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-C13	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	4007	705857	0.6%	73.5%	0.53	61.79	
FR04-C13	7	Public Facility and Residential, 8-12 units/acre	325	88	187154	705857	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	795493	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	795493	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	795493	3.5%	24.4%	2.93	20.46	
FR04-C14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	121243	795493	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	795493	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	795493	3.1%	57.1%	2.61	47.95	
FR04-C14	7	Public Facility and Residential, 8-12 units/acre	325	88	341442	795493	42.9%	100.0%	37.77	85.72	**85.7**
FR04-C15	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	71561	279852	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	279852	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	279852	41.1%	76.3%	34.49	64.13	
FR04-C15	7	Public Facility and Residential, 8-12 units/acre	325	88	66205	279852	23.7%	100.0%	20.82	84.95	**84.9**
FR04-C16	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	384698	698783	55.1%	55.1%	52.85	52.85	
FR04-C16	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	114771	698783	16.4%	71.5%	15.44	68.29	
FR04-C16	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1129	698783	0.2%	71.6%	0.16	68.44	
FR04-C16	7	Public Facility and Residential, 8-12 units/acre	615	91	196840	698783	28.2%	99.8%	25.63	94.08	
FR04-C16	7	Public Facility and Residential, 8-12 units/acre	325	88	1344	698783	0.2%	100.0%	0.17	94.25	**94.2**
FR04-C17	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	373	187835	0.2%	0.2%	0.19	0.19	
FR04-C17	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	27626	187835	14.7%	14.9%	14.12	14.31	
FR04-C17	7	Public Facility and Residential, 8-12 units/acre	615	91	158908	187835	84.6%	99.5%	76.99	91.30	
FR04-C17	7	Public Facility and Residential, 8-12 units/acre	325	88	928	187835	0.5%	100.0%	0.43	91.73	**91.7**
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	29407	367106	8.0%	8.0%	7.53	7.53	
FR04-C2	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	32851	367106	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	367106	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	367106	34.7%	55.1%	29.14	47.25	
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	2560	367106	0.7%	55.8%	0.67	47.92	
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3663	367106	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	367106	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	367106	2.5%	61.2%	2.09	52.66	
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	39054	367106	10.6%	71.8%	10.21	62.87	
FR04-C2	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	6321	367106	1.7%	73.6%	1.62	64.49	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	23061	367106	6.3%	79.8%	5.72	70.21	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	73974	367106	20.2%	100.0%	17.73	87.94	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	4	367106	0.0%	100.0%	0.00	87.94	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	615	91	4	367106	0.0%	100.0%	0.00	87.94	
FR04-C2	7	Public Facility and Residential, 8-12 units/acre	325	88	22	367106	0.0%	100.0%	0.01	87.95	**87.9**
FR04-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	384	337785	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	337785	0.1%	0.2%	0.06	0.17	
FR04-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	212037	337785	62.8%	63.0%	60.26	60.43	
FR04-C3	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1936	337785	0.6%	63.5%	0.55	60.98	
FR04-C3	7	Public Facility and Residential, 8-12 units/acre	615	91	123196	337785	36.5%	100.0%	33.19	94.17	**94.2**
FR04-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	62961	128009	49.2%	49.2%	47.22	47.22	
FR04-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3012	128009	2.4%	51.5%	2.21	49.43	
FR04-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	357	128009	0.3%	51.8%	0.25	49.68	
FR04-C4	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	277	128009	0.2%	52.0%	0.18	49.86	
FR04-C4	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1444	128009	1.1%	53.2%	1.08	50.94	
FR04-C4	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	1168	128009	0.9%	54.1%	0.86	51.80	
FR04-C4	7	Public Facility and Residential, 8-12 units/acre	615	91	34117	128009	26.7%	80.7%	24.25	76.05	

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-C4	7	Public Facility and Residential, 8-12 units/acre	325	88	24673	128009	19.3%	100.0%	16.96	93.01	**93.0**
FR04-C5	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	10196	227687	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	227687	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	227687	46.1%	72.2%	38.77	61.09	
FR04-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	63309	227687	27.8%	100.0%	24.47	85.55	
FR04-C5	7	Public Facility and Residential, 8-12 units/acre	325	88	16	227687	0.0%	100.0%	0.01	85.56	**85.6**
FR04-C6	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3414	244164	1.4%	1.4%	1.31	1.31	
FR04-C6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	52469	244164	21.5%	22.9%	18.05	19.37	
FR04-C6	7	Public Facility and Residential, 8-12 units/acre	325	88	8	244164	0.0%	22.9%	0.00	19.37	
FR04-C6	7	Public Facility and Residential, 8-12 units/acre	325	88	3	244164	0.0%	22.9%	0.00	19.37	
FR04-C6	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	8726	244164	3.6%	26.5%	3.36	22.73	
FR04-C6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	72387	244164	29.6%	56.1%	24.90	47.63	
FR04-C6	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	40638	244164	16.6%	72.8%	13.98	61.61	
FR04-C6	7	Public Facility and Residential, 8-12 units/acre	325	88	66519	244164	27.2%	100.0%	23.97	85.59	**85.6**
FR04-C7	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	54	361940	0.0%	0.0%	0.01	0.01	
FR04-C7	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	243947	361940	67.4%	67.4%	59.99	60.00	
FR04-C7	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	104971	361940	29.0%	96.4%	24.36	84.36	
FR04-C7	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	159	361940	0.0%	96.5%	0.04	84.40	
FR04-C7	7	Public Facility and Residential, 8-12 units/acre	615	91	10218	361940	2.8%	99.3%	2.57	86.97	
FR04-C7	7	Public Facility and Residential, 8-12 units/acre	325	88	2590	361940	0.7%	100.0%	0.63	87.60	**87.6**
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	123530	1378720	9.0%	9.0%	7.53	7.53	
FR04-C8	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	65680	1378720	4.8%	13.7%	4.48	12.00	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	85386	1378720	6.2%	19.9%	5.20	17.21	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	217112	1378720	15.7%	35.7%	13.23	30.43	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	201197	1378720	14.6%	50.3%	12.26	42.69	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	195040	1378720	14.1%	64.4%	11.88	54.58	
FR04-C8	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	3978	1378720	0.3%	64.7%	0.27	54.85	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	61698	1378720	4.5%	69.2%	3.76	58.61	
FR04-C8	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	62384	1378720	4.5%	73.7%	3.80	62.41	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	615	91	39	1378720	0.0%	73.7%	0.00	62.41	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	362423	1378720	26.3%	100.0%	23.13	85.54	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	226	1378720	0.0%	100.0%	0.01	85.56	
FR04-C8	7	Public Facility and Residential, 8-12 units/acre	325	88	26	1378720	0.0%	100.0%	0.00	85.56	**85.6**
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	615	91	14	1431057	0.0%	0.0%	0.00	0.00	
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	615	91	870	1431057	0.1%	0.1%	0.06	0.06	
FR04-C9	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	245918	1431057	17.2%	17.2%	16.50	16.55	
FR04-C9	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1018481	1431057	71.2%	88.4%	68.32	84.88	
FR04-C9	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	8843	1431057	0.6%	89.0%	0.58	85.46	
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	615	91	153783	1431057	10.7%	99.8%	9.78	95.24	
FR04-C9	7	Public Facility and Residential, 8-12 units/acre	325	88	3148	1431057	0.2%	100.0%	0.19	95.43	**95.4**

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	7	Public Facility and Residential, 8-12 units/acre	325	88	50	7983403	0.0%	0.0%	0.00	0.00	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	23	7983403	0.0%	0.0%	0.00	0.00	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	190	7983403	0.0%	0.0%	0.00	0.00	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	630	7983403	0.0%	0.0%	0.01	0.01	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	140666	7983403	1.8%	1.8%	1.48	1.49	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	260487	7983403	3.3%	5.0%	2.74	4.23	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	59209	7983403	0.7%	5.8%	0.62	4.85	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	159667	7983403	2.0%	7.8%	1.68	6.53	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	42291	7983403	0.5%	8.3%	0.44	6.98	
FR03	2	Parks, Golf Courses	325	64	791985	7983403	9.9%	18.2%	6.35	13.33	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	319171	7983403	4.0%	22.2%	3.76	17.09	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	236	94	33334	7983403	0.4%	22.6%	0.39	17.48	

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	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	114510	7983403	1.4%	24.1%	1.20	18.68	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	117	7983403	0.0%	24.1%	0.00	18.69	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	24	7983403	0.0%	24.1%	0.00	18.69	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	85568	7983403	1.1%	25.2%	0.90	19.59	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	168624	7983403	2.1%	27.3%	1.77	21.36	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	7	7983403	0.0%	27.3%	0.00	21.36	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	5	7983403	0.0%	27.3%	0.00	21.36	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	173289	7983403	2.2%	29.4%	1.82	23.18	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	39	7983403	0.0%	29.4%	0.00	23.18	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	121243	7983403	1.5%	31.0%	1.28	24.46	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	19	7983403	0.0%	31.0%	0.00	24.46	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	7	7983403	0.0%	31.0%	0.00	24.46	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	373	7983403	0.0%	31.0%	0.00	24.46	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	81	7983403	0.0%	31.0%	0.00	24.47	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	229709	7983403	2.9%	33.8%	2.42	26.88	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	268057	7983403	3.4%	37.2%	2.82	29.70	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	100	7983403	0.0%	37.2%	0.00	29.70	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	17744	7983403	0.2%	37.4%	0.21	29.91	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	116647	7983403	1.5%	38.9%	1.23	31.14	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	7329	7983403	0.1%	39.0%	0.08	31.22	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	4734	7983403	0.1%	39.0%	0.05	31.27	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	32079	7983403	0.4%	39.4%	0.34	31.60	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	84609	7983403	1.1%	40.5%	0.89	32.49	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	63240	7983403	0.8%	41.3%	0.67	33.16	
FR03	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	325	84	183933	7983403	2.3%	43.6%	1.94	35.10	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	376499	7983403	4.7%	48.3%	4.53	39.62	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	123573	7983403	1.5%	49.9%	1.46	41.08	
FR03	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	27626	7983403	0.3%	50.2%	0.33	41.41	
FR03	7	Public Facility and Residential, 8-12 units/acre	615	91	324349	7983403	4.1%	54.3%	3.70	45.11	
FR03	7	Public Facility and Residential, 8-12 units/acre	325	88	3580395	7983403	44.8%	99.1%	39.47	84.57	
FR03	7	Public Facility and Residential, 8-12 units/acre	236	88	71171	7983403	0.9%	100.0%	0.78	85.36	**85.4**
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	

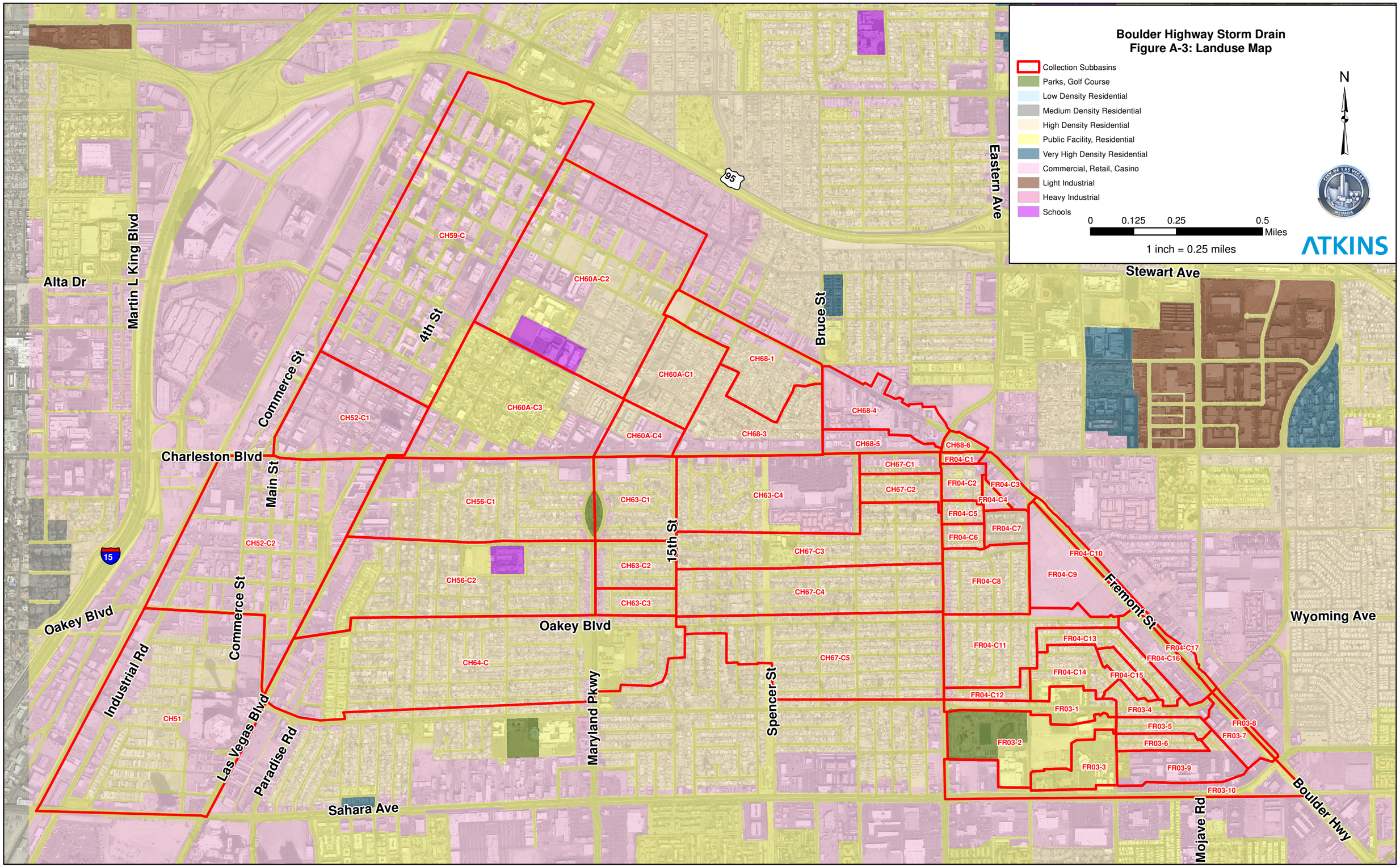
BOULDER HIGHWAY STORM DRAIN

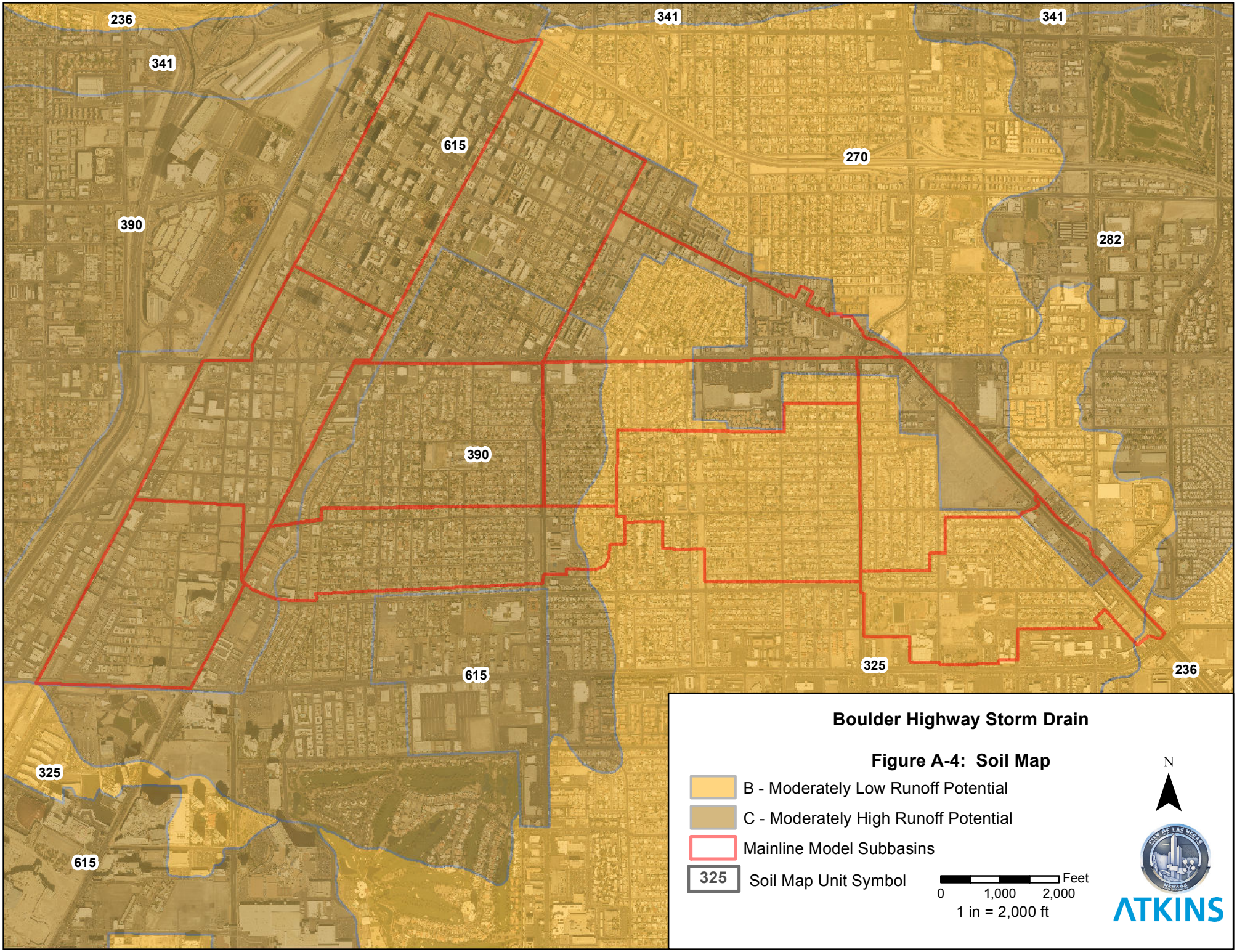
CN Calculation Summary

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	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	
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**

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
0 0.125 0.25 0.5 Miles
1 inch = 0.25 miles
N
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
CH52-C1
CH67-C1
FR04-C1
FR04-C2
FR04-C3
FR04-C4
CH67-C2
FR04-C5
FR04-C7
FR04-C6
CH56-C1
CH63-C1
CH63-C4
CH52-C2
CH67-C3
FR04-C10
FR04-C9
CH63-C2
CH56-C2
FR04-C8
CH67-C4
CH63-C3
FR04-C11
FR04-C13
FR04-C17
FR04-C16
CH64-C
CH67-C5
FR04-C14
FR04-C15
FR04-C12
FR03-1
FR03-4
FR03-8
FR03-5
FR03-7
CH51
FR03-2
FR03-6
FR03-3
FR03-9
FR03-10


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 Model
- Appendix B-2: Drop Inlet Summary

Appendix B-1

WSPG Model

```
************************************
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\Atlantic..wsx
Computed  09/21/16  11:06:44

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction Node14 has a different channel than its direct downstream element.
 WARNING 47: Junction Node15 has a different channel than its direct downstream element.
 WARNING 25: Link type element Link9 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link10 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link11 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link13 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link14 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction Node11 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
###																
"Node5"	Outlet	-1948.17	1837.92	1857.50	1850.400	12.480	231.90	9.76	1.48	1851.88	0.000	4.258	0.000	0.00000	0.000	Pipe
"Link4"	Reach	-1923.87	1838.57	1857.50	1850.516	11.946	231.90	9.76	1.48	1852.00	0.000	4.258	0.000	0.02675	2.494	Pipe
"Link3"	Reach	-1921.87	1838.64	1857.30	1850.599	11.959	231.90	9.76	1.48	1852.08	0.000	4.258	0.000	0.03500	2.313	Pipe
"Link2"	Reach	-1919.87	1838.70	1857.30	1850.755	12.055	231.90	9.76	1.48	1852.23	0.000	4.258	0.000	0.03000	2.415	Pipe
"Link1"	Reach	-1917.87	1838.77	1857.30	1850.838	12.068	231.90	9.76	1.48	1852.32	0.000	4.258	0.000	0.03500	2.313	Pipe
"Link5"	Reach	-1859.57	1840.29	1857.00	1851.189	10.899	231.90	9.76	1.48	1852.67	0.000	4.258	0.000	0.02607	2.512	Pipe
"Link8"	Reach	-1857.57	1840.36	1857.00	1851.272	10.912	231.90	9.76	1.48	1852.75	0.000	4.258	0.000	0.03500	2.313	Pipe
"Link7"	Reach	-1855.57	1840.42	1857.00	1851.429	11.009	231.90	9.76	1.48	1852.91	0.000	4.258	0.000	0.03000	2.415	Pipe
"Link6"	Reach	-1853.57	1840.49	1857.00	1851.512	11.022	231.90	9.76	1.48	1852.99	0.000	4.258	0.000	0.03500	2.313	Pipe
"Link9"	Reach	-1840.57	1840.68	1857.00	1851.574	10.894	231.90	9.76	1.48	1853.05	0.000	4.258	0.000	0.01462	2.979	Pipe
"Node10"	Junction	-1834.57	1840.88	1857.00	1851.931	11.051	216.50	9.11	1.29	1853.22	0.000	4.118	0.000	0.03333	0.000	Pipe
"Link10"	Reach	-1751.27	1841.77	1857.00	1852.277	10.507	216.50	9.11	1.29	1853.57	0.000	4.118	0.000	0.01068	3.146	Pipe
"Node11"	Junction	-1746.27	1841.97	1857.00	1853.077	11.107	180.70	7.61	0.90	1853.98	0.000	3.761	0.000	0.04000	0.000	Pipe
"Link11"	Reach	-1704.77	1842.43	1857.30	1853.197	10.767	180.70	7.61	0.90	1854.10	0.000	3.761	0.000	0.01108	2.786	Pipe
"Node12"	Junction	-1699.77	1842.63	1857.30	1853.432	10.802	165.50	6.97	0.75	1854.19	0.000	3.595	0.000	0.04000	0.000	Pipe
"Link13"	Reach	-1396.07	1845.72	1858.30	1854.170	8.450	165.50	6.97	0.75	1854.92	0.000	3.595	0.000	0.01017	2.713	Pipe
"Node14"	Junction	-1391.07	1845.92	1858.30	1854.089	8.169	152.20	7.75	0.93	1855.02	0.000	3.537	0.000	0.04000	0.000	Pipe
"Link14"	Reach	-1192.07	1847.96	1859.60	1854.769	6.809	152.20	7.75	0.93	1855.70	0.000	3.537	0.000	0.01025	2.725	Pipe
"Node15"	Junction	-1187.07	1848.16	1859.30	1854.567	6.407	141.80	8.92	1.23	1855.80	0.000	3.500	0.000	0.04000	0.000	Pipe
"Link18"	Reach	-1149.57	1848.46	1860.00	1854.762	6.302	141.80	8.92	1.23	1856.00	0.000	3.500	0.000	0.00800	3.062	Pipe
"Link17"	Reach	-1147.90	1848.53	1860.00	1854.832	6.302	141.80	8.92	1.23	1856.07	0.000	3.500	0.000	0.04192	1.844	Pipe
"Link16"	Reach	-1146.23	1848.59	1860.00	1854.963	6.373	141.80	8.92	1.23	1856.20	0.000	3.500	0.000	0.03593	1.924	Pipe
"Link15"	Reach	-1144.57	1848.66	1860.00	1854.972	6.312	141.80	8.92	1.23	1856.21	0.000	3.500	0.000	0.04217	1.841	Pipe
"Link19"	Reach	-1102.50	1848.99	1860.30	1855.191	6.201	141.80	8.92	1.23	1856.42	0.000	3.500	0.000	0.00784	3.084	Pipe
"Node20"	Headwrk	-1102.50	1848.99	1860.30	1855.191	6.201	141.80	8.92	1.23	1856.42	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]

[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE	NAME
Outlet	"Node5"
Reach	"Link4"
Reach	"Link3"
Reach	"Link2"
Reach	"Link1"
Reach	"Link5"
Reach	"Link8"
Reach	"Link7"
Reach	"Link6"
Reach	"Link9"
Junction	"Node10"
Reach	"Link10"
Junction	"Node11"
Reach	"Link11"
Junction	"Node12"
Reach	"Link13"
Junction	"Node14"
Reach	"Link14"
Junction	"Node15"
Reach	"Link18"
Reach	"Link17"
Reach	"Link16"
Reach	"Link15"
Reach	"Link19"
Headwork	"Node20"

**BRANCH DEFINITIONS

[OUTLET]
**NAME	STATION	INVERT ELEV	GROUND ELEV	CHANNEL ID	WATER SURFACE ELEV (opt.)
"Node5"	-1948.17	1837.92	1857.5	"66in"	1850.4

[HEADWORK]
**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	FLOW	WATER SURFACE ELEV (opt.)
"Node20"	1848.99	1860.3	"54in"	141.8	0

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

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

[BRIDGEENTRANCE]
**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	REDUCTION 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
"Node10"	1840.88	1857	"66in"	6	0.013	1		
"Node10_Lateral1"	1843.88		"24in"				60	15.4
"Node11"	1841.97	1857	"66in"	5	0.013	1		
"Node11_Lateral1"	1845.47		"24in"				90	35.8
"Node12"	1842.63	1857.3	"66in"	5	0.013	1		
"Node12_Lateral1"	1845.13		"24in"				45	15.2
"Node14"	1845.92	1858.3	"60in"	5	0.013	1		
"Node14_Lateral1"	1848.42		"24in"				45	13.3
"Node15"	1848.16	1859.3	"54in"	5	0.013	1		
"Node15_Lateral1"	1848.18		"18in"				45	10.4

[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)
"Link1"	1838.77	1857.3	"66in"	2	0.013	0	15	0
"Link2"	1838.7	1857.3	"66in"	2	0.013	0	15	1
"Link3"	1838.64	1857.3	"66in"	2	0.013	0	15	0
"Link4"	1838.57	1857.5	"66in"	24.3	0.013	0	0	0
"Link5"	1840.29	1857	"66in"	58.3	0.013	0	15	0
"Link6"	1840.49	1857	"66in"	2	0.013	0	15	0
"Link7"	1840.42	1857	"66in"	2	0.013	0	15	1
"Link8"	1840.36	1857	"66in"	2	0.013	0	15	0
"Link9"	1840.68	1857	"66in"	13	0.013	0	0	0
"Link10"	1841.77	1857	"66in"	83.3	0.013	0	0	0
"Link11"	1842.43	1857.3	"66in"	41.5	0.013	0	0	0
"Link13"	1845.72	1858.3	"66in"	303.7	0.013	0	0	0
"Link14"	1847.96	1859.6	"60in"	199	0.013	0	0	0
"Link15"	1848.66	1860	"54in"	1.66	0.013	0	0	0
"Link16"	1848.59	1860	"54in"	1.67	0.013	0	15	1
"Link17"	1848.53	1860	"54in"	1.67	0.013	0	15	0
"Link18"	1848.46	1860	"54in"	37.5	0.013	0	0	0
"Link19"	1848.99	1860.3	"54in"	42.07	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
"66in"	4	5.5	5.5					
"54in"	4	4.5	4.5					
"24in"	4	2	2					
"60in"	4	5	5					
"18in"	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\STLouis_under.wsx
Computed  09/21/16  09:49:14

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction Node1 has a different channel than its direct downstream element.
 WARNING 47: Junction Node8 has a different channel than its direct downstream element.
 WARNING 47: Junction Node12 has a different channel than its direct downstream element.
 WARNING 47: Junction Node19 has a different channel than its direct downstream element.
 WARNING 25: Link type element Link1 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link2 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link7 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link11 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction Node12 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node1 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node19 because critical momentum is greater than maximum momentum.

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


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

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
"Node6"	Outlet	-3300.23	1807.27	1831.80	1828.300	21.030	224.50	9.45	1.39	1829.69	0.000	4.192	0.000	0.00000	0.000	Pipe
"Link5"	Reach	-3277.03	1807.36	1831.00	1828.404	21.044	224.50	9.45	1.39	1829.79	0.000	4.192	0.000	0.00388	5.062	Pipe
"Link20"	Reach	-3271.03	1807.56	1831.00	1828.431	20.871	224.50	9.45	1.39	1829.82	0.000	4.192	0.000	0.03333	2.303	Pipe
"Link19"	Reach	-3141.33	1808.11	1831.70	1829.010	20.900	224.50	9.45	1.39	1830.40	0.000	4.192	0.000	0.00424	4.652	Pipe
"Link13"	Reach	-3135.33	1808.15	1832.00	1829.145	20.995	224.50	9.45	1.39	1830.53	0.000	4.192	0.000	0.00667	3.786	Pipe
"Link7"	Reach	-3075.53	1808.81	1832.00	1829.550	20.740	224.50	9.45	1.39	1830.94	0.000	4.192	0.000	0.01104	3.186	Pipe
"Node8"	Junction	-3069.53	1809.01	1832.00	1830.633	21.623	161.50	8.23	1.05	1831.68	0.000	3.644	0.000	0.03333	0.000	Pipe
"Link4"	Reach	-3000.93	1812.10	1832.20	1830.897	18.797	161.50	8.23	1.05	1831.95	0.000	3.644	0.000	0.04504	1.851	Pipe
"Link14"	Reach	-2994.93	1812.30	1832.20	1830.973	18.673	161.50	8.23	1.05	1832.02	0.000	3.644	0.000	0.03333	2.009	Pipe
"Link3"	Reach	-2731.73	1821.17	1834.50	1832.128	10.958	161.50	8.23	1.05	1833.18	0.000	3.644	0.000	0.03370	2.003	Pipe
"Link15"	Reach	-2725.73	1821.37	1834.50	1832.204	10.834	161.50	8.23	1.05	1833.25	0.000	3.644	0.000	0.03333	2.009	Pipe
"Link6"	Reach	-2544.43	1824.18	1836.50	1832.901	8.721	161.50	8.23	1.05	1833.95	0.000	3.644	0.000	0.01550	2.494	Pipe
"Link21"	Reach	-2538.43	1824.38	1836.40	1832.924	8.544	161.50	8.23	1.05	1833.97	0.000	3.644	0.000	0.03333	2.009	Pipe

	"i.p."	-2227.28	1829.12	1841.14	1834.120	5.000	161.50	8.23	1.05	1835.17	0.000	3.644	0.069	0.01524	2.507	Pipe
	"i.p."	-2196.50	1829.59	1841.61	1834.126	4.537	161.50	8.63	1.16	1835.28	0.000	3.644	0.598	0.01524	2.507	Pipe
	"i.p."	-2183.43	1829.79	1841.81	1834.056	4.267	161.50	9.05	1.27	1835.33	0.000	3.644	0.710	0.01524	2.507	Pipe
	"i.p."	-2175.15	1829.91	1841.93	1833.960	4.045	161.50	9.49	1.40	1835.36	0.000	3.644	0.804	0.01524	2.507	Pipe
	"i.p."	-2170.22	1829.99	1842.01	1833.841	3.851	161.50	9.95	1.54	1835.38	0.000	3.644	0.893	0.01524	2.507	Pipe
"Link2"	Reach	-2168.23	1830.02	1842.50	1833.696	3.676	161.50	10.44	1.69	1835.39	0.000	3.644	0.982	0.01524	2.507	Pipe
"Node19"	Junction	-2162.23	1830.22	1841.30	1835.135	4.915	96.80	7.70	0.92	1836.06	0.000	2.982	0.000	0.03333	0.000	Pipe
HYDRAULIC JUMP at -2076.24 of length 0.09																
	"i.p."	-2076.24	1831.48	1842.56	1835.526	4.049	96.80	7.70	0.92	1836.45	0.000	2.982	0.000	0.01461	2.135	Pipe
	"i.p."	-2076.24	1831.48	1842.56	1833.609	2.133	96.80	14.21	3.13	1836.74	0.000	2.982	1.916	0.01461	2.135	Pipe
"Link8"	Reach	-1889.13	1834.21	1846.00	1836.336	2.126	96.80	14.26	3.16	1839.49	0.000	2.982	1.927	0.01461	2.135	Pipe
"Link16"	Reach	-1884.13	1834.41	1846.00	1836.587	2.177	96.80	13.85	2.98	1839.57	0.000	2.982	1.843	0.04000	1.600	Pipe
	"i.p."	-1773.53	1835.99	1847.58	1838.215	2.229	96.80	13.45	2.81	1841.03	0.000	2.982	1.762	0.01425	2.151	Pipe
	"i.p."	-1700.85	1837.02	1848.61	1839.340	2.317	96.80	12.83	2.55	1841.89	0.000	2.982	1.635	0.01425	2.151	Pipe
	"i.p."	-1663.22	1837.56	1849.15	1839.970	2.411	96.80	12.23	2.32	1842.29	0.000	2.982	1.516	0.01425	2.151	Pipe
	"i.p."	-1640.37	1837.88	1849.47	1840.395	2.510	96.80	11.66	2.11	1842.51	0.000	2.982	1.403	0.01425	2.151	Pipe
	"i.p."	-1625.87	1838.09	1849.68	1840.707	2.616	96.80	11.12	1.92	1842.63	0.000	2.982	1.295	0.01425	2.151	Pipe
	"i.p."	-1616.91	1838.22	1849.81	1840.948	2.728	96.80	10.60	1.75	1842.69	0.000	2.982	1.193	0.01425	2.151	Pipe
	"i.p."	-1612.05	1838.29	1849.88	1841.138	2.850	96.80	10.11	1.59	1842.72	0.000	2.982	1.095	0.01425	2.151	Pipe
"Link1"	Reach	-1610.53	1838.31	1849.00	1841.291	2.981	96.80	9.64	1.44	1842.73	0.000	2.982	1.000	0.01425	2.151	Pipe
"Node1"	Junction	-1605.53	1838.51	1848.50	1842.180	3.670	77.00	8.00	0.99	1843.17	0.000	2.745	0.000	0.04000	0.000	Pipe
"Link12"	Reach	-1551.93	1839.01	1849.00	1842.543	3.533	77.00	8.00	0.99	1843.54	0.000	2.745	0.000	0.00933	2.352	Pipe
	"i.p."	-1548.51	1839.15	1849.14	1842.647	3.500	77.00	8.00	0.99	1843.64	0.000	2.745	0.088	0.04000	1.502	Pipe
"Link17"	Reach	-1546.93	1839.21	1848.00	1842.647	3.437	77.00	8.04	1.00	1843.65	0.000	2.745	0.441	0.04000	1.502	Pipe
HYDRAULIC JUMP at -1486.42 of length 0.03																
	"i.p."	-1495.16	1839.66	1848.45	1842.817	3.158	77.00	8.43	1.10	1843.92	0.000	2.745	0.709	0.00868	2.415	Pipe
	"i.p."	-1486.42	1839.73	1848.52	1842.831	3.096	77.00	8.55	1.14	1843.97	0.000	2.745	0.751	0.00868	2.415	Pipe
	"i.p."	-1486.42	1839.73	1848.52	1842.158	2.423	77.00	10.83	1.82	1843.98	0.000	2.745	1.287	0.00868	2.415	Pipe
	"i.p."	-1370.70	1840.74	1849.53	1843.240	2.501	77.00	10.47	1.70	1844.94	0.000	2.745	1.209	0.00868	2.415	Pipe
	"i.p."	-1337.23	1841.03	1849.82	1843.646	2.617	77.00	9.98	1.55	1845.19	0.000	2.745	1.104	0.00868	2.415	Pipe
"Link11"	Reach	-1330.23	1841.09	1848.70	1843.834	2.744	77.00	9.52	1.41	1845.24	0.000	2.745	1.001	0.00868	2.415	Pipe
"Node12"	Junction	-1325.23	1841.29	1848.70	1845.425	4.135	35.00	4.95	0.38	1845.81	0.000	1.923	0.000	0.04000	0.000	Pipe
	"i.p."	-1124.95	1842.98	1850.39	1845.977	3.000	35.00	4.95	0.38	1846.36	0.000	1.923	0.061	0.00842	1.626	Pipe
"Link10"	Reach	-1100.83	1843.18	1848.20	1846.023	2.843	35.00	5.05	0.40	1846.42	0.000	1.923	0.391	0.00842	1.626	Pipe
"Node11"	Headwrk	-1100.83	1843.18	1848.20	1846.023	2.843	35.00	5.05	0.40	1846.42	0.000	1.923	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	"Node6"
Reach	"Link5"
Reach	"Link20"
Reach	"Link19"
Reach	"Link13"
Reach	"Link7"
Junction	"Node8"
Reach	"Link4"
Reach	"Link14"
Reach	"Link3"
Reach	"Link15"
Reach	"Link6"
Reach	"Link21"
Reach	"Link2"
Junction	"Node19"
Reach	"Link8"
Reach	"Link16"
Reach	"Link1"
Junction	"Node1"
Reach	"Link12"
Reach	"Link17"
Reach	"Link11"
Junction	"Node12"
Reach	"Link10"
Headwork	"Node11"

**BRANCH DEFINITIONS

[OUTLET]
**NAME	STATION	INVERT ELEV	GROUND ELEV	CHANNEL ID	WATER SURFACE ELEV (opt.)
"Node6"	-3300.23	1807.27	1831.8	"66 RCP"	1828.3

[HEADWORK]
**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	FLOW	WATER SURFACE ELEV (opt.)
"Node11"	1843.18	1848.2	"36 rcp"	35	0

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

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

[BRIDGEENTRANCE]
**NAME	INVERT ELEV	GROUND ELEV	CHANNEL ID	REDUCTION 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
"Node1"	1838.51	1848.5	"42 RCP"	5	0.013	2		

```
"Node1_Lateral1"    1839                "24rcp"                                     45          9.9
"Node1_Lateral2"    1839                "24rcp"                                     45          9.9

"Node8"             1809.01    1832     "60 RCP"    6          0.013      2
"Node8_Lateral1"    1810                "42 RCP"                                    75          35
"Node8_Lateral2"    1810                "42 RCP"                                    75          28

"Node12"            1841.29    1848.7   "36 rcp"    5          0.013      1
"Node12_Lateral1"   1841.5              "36 rcp"                                    45          42

"Node19"            1830.22    1841.3   "48 RCP"    6          0.013      2
"Node19_Lateral1"   1831.72             "30rcp"                                     45          34.7
"Node19_Lateral2"   1831.73             "30rcp"                                     45          30


[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)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Link1"             1838.31    1849       "48 RCP"    273.6      0.013      0          15         0
"Link2"             1830.02    1842.5     "60 RCP"    370.2      0.013      0          0          0
"Link3"             1821.17    1834.5     "60 RCP"    263.2      0.013      42         0          0
"Link4"             1812.1     1832.2     "60 RCP"    68.6       0.013      0          0          0
"Link5"             1807.36    1831       "66 RCP"    23.2       0.013      0          0          0
"Link6"             1824.18    1836.5     "60 RCP"    181.3      0.013      0          0          0
"Link7"             1808.81    1832       "66 RCP"    59.8       0.013      0          15         1
"Link8"             1834.21    1846       "48 RCP"    273.1      0.013      0          0          0
"Link10"            1843.18    1848.2     "36 rcp"    224.4      0.013      0          0          0
"Link11"            1841.09    1848.7     "42 RCP"    216.7      0.013      0          5          0
"Link12"            1839.01    1849       "42 RCP"    53.6       0.013      0          15         0
"Link13"            1808.15    1832       "66 RCP"    6          0.013      0          8.5        1
"Link14"            1812.3     1832.2     "60 RCP"    6          0.013      0          0          1
"Link15"            1821.37    1834.5     "60 RCP"    6          0.013      0          0          1
"Link16"            1834.41    1846       "48 RCP"    5          0.013      0          0          1
"Link17"            1839.21    1848       "42 RCP"    5          0.013      0          15         1
"Link19"            1808.11    1831.7     "66 RCP"    129.7      0.013      0          0          0
"Link20"            1807.56    1831       "66 RCP"    6          0.013      0          0          0
"Link21"            1824.38    1836.4     "60 RCP"    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
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"66 RCP"      4   5.5        5.5
"36 rcp"      4   3          3
"42 RCP"      4   3.5        3.5
"24rcp"       4   2          2
"60 RCP"      4   5          5
"48 RCP"      4   4          4
"30rcp"       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\oakeylat.wsx
Computed 09/21/16 10:30:04

TITLE INFORMATION
****

WARNING SUMMARY
****
WARNING 47: Junction DI#2 has a different channel than its direct downstream element.
WARNING 47: Junction MH#1 has a different channel than its direct downstream element.
WARNING 47: Junction MH#3 has a different channel than its direct downstream element.
WARNING 25: Link type element Link2 has different invert elevation than its upstream node.
WARNING 25: Link type element Link3 has different invert elevation than its upstream node.
WARNING 25: Link type element Link9 has different invert elevation than its upstream node.
WARNING 36: D/S processing stopped in junction DI#2 because critical momentum is greater than maximum momentum.
WARNING 36: D/S processing stopped in junction MH#1 because critical momentum is greater than maximum momentum.

RESULTS
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Main Line
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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
###																
"mainline"	Outlet	-1539.29	1829.67	1845.00	1837.450	7.780	268.60	11.31	1.98	1839.43	0.000	4.554	0.000	0.00000	0.000	Pipe
"Link7"	Reach	-1508.69	1829.75	1845.00	1837.744	7.994	268.60	11.31	1.98	1839.73	0.000	4.554	0.000	0.00261	5.500	Pipe
"Link8"	Reach	-1502.69	1829.95	1845.30	1837.980	8.030	268.60	11.31	1.98	1839.96	0.000	4.554	0.000	0.03333	2.547	Pipe
"Link6"	Reach	-1453.49	1830.09	1845.20	1838.393	8.303	268.60	11.31	1.98	1840.38	0.000	4.554	0.000	0.00285	5.500	Pipe
"Link9"	Reach	-1451.49	1830.14	1845.20	1838.504	8.364	268.60	11.31	1.98	1840.49	0.000	4.554	0.000	0.02500	2.769	Pipe
"MH#3"	Junction	-1447.49	1830.29	1845.20	1838.898	8.608	228.10	11.62	2.10	1840.99	0.000	4.272	0.000	0.03750	0.000	Pipe
HYDRAULIC JUMP at -1383.39 of length 0.19																
	"i.p."	-1383.39	1832.92	1847.83	1839.470	6.547	228.10	11.62	2.10	1841.57	0.000	4.272	0.000	0.04107	2.298	Pipe
	"i.p."	-1383.39	1832.92	1847.83	1835.624	2.702	228.10	21.07	6.89	1842.52	0.000	4.272	2.520	0.04107	2.298	Pipe
"Link5"	Reach	-1365.19	1833.67	1846.00	1836.434	2.764	228.10	20.48	6.51	1842.95	0.000	4.272	2.412	0.04107	2.298	Pipe
"Link4"	Reach	-1359.19	1833.87	1846.00	1836.649	2.779	228.10	20.35	6.43	1843.08	0.000	4.272	2.388	0.03333	2.440	Pipe
	"i.p."	-1340.55	1834.63	1846.76	1837.493	2.864	228.10	19.61	5.97	1843.46	0.000	4.272	2.254	0.04073	2.303	Pipe
	"i.p."	-1321.32	1835.41	1847.54	1838.392	2.979	228.10	18.70	5.43	1843.82	0.000	4.272	2.090	0.04073	2.303	Pipe
	"i.p."	-1306.08	1836.03	1848.16	1839.135	3.101	228.10	17.83	4.93	1844.07	0.000	4.272	1.935	0.04073	2.303	Pipe
	"i.p."	-1293.91	1836.53	1848.66	1839.760	3.231	228.10	17.00	4.49	1844.25	0.000	4.272	1.788	0.04073	2.303	Pipe
	"i.p."	-1284.24	1836.92	1849.05	1840.292	3.369	228.10	16.21	4.08	1844.37	0.000	4.272	1.648	0.04073	2.303	Pipe
	"i.p."	-1276.64	1837.23	1849.36	1840.750	3.518	228.10	15.45	3.71	1844.46	0.000	4.272	1.515	0.04073	2.303	Pipe
	"i.p."	-1270.85	1837.47	1849.60	1841.146	3.678	228.10	14.73	3.37	1844.52	0.000	4.272	1.386	0.04073	2.303	Pipe
	"i.p."	-1266.70	1837.64	1849.77	1841.491	3.853	228.10	14.05	3.06	1844.55	0.000	4.272	1.260	0.04073	2.303	Pipe
	"i.p."	-1264.12	1837.74	1849.87	1841.791	4.048	228.10	13.39	2.79	1844.58	0.000	4.272	1.133	0.04073	2.303	Pipe
"Link3"	Reach	-1263.19	1837.78	1846.50	1842.051	4.271	228.10	12.77	2.53	1844.58	0.000	4.272	1.000	0.04073	2.303	Pipe
"MH#1"	Junction	-1257.19	1837.98	1846.50	1844.337	6.357	117.90	9.38	1.37	1845.70	0.000	3.272	0.000	0.03333	0.000	Pipe
HYDRAULIC JUMP at -1177.10 of length 0.09																
	"i.p."	-1177.10	1840.65	1849.17	1844.897	4.250	117.90	9.38	1.37	1846.26	0.000	3.272	0.000	0.03331	1.880	Pipe
	"i.p."	-1177.10	1840.65	1849.17	1843.067	2.420	117.90	14.83	3.42	1846.48	0.000	3.272	1.833	0.03331	1.880	Pipe
	"i.p."	-1168.00	1840.95	1849.47	1843.451	2.501	117.90	14.26	3.16	1846.61	0.000	3.272	1.721	0.03331	1.880	Pipe
	"i.p."	-1159.27	1841.24	1849.76	1843.847	2.606	117.90	13.60	2.87	1846.72	0.000	3.272	1.589	0.03331	1.880	Pipe
	"i.p."	-1152.57	1841.46	1849.98	1844.182	2.718	117.90	12.97	2.61	1846.79	0.000	3.272	1.464	0.03331	1.880	Pipe
	"i.p."	-1147.59	1841.63	1850.15	1844.469	2.838	117.90	12.36	2.37	1846.84	0.000	3.272	1.345	0.03331	1.880	Pipe

	"i.p."	-1144.11	1841.75	1850.27	1844.715	2.969	117.90	11.79	2.16	1846.87	0.000	3.272	1.229	0.03331	1.880	Pipe
	"i.p."	-1142.02	1841.82	1850.34	1844.928	3.112	117.90	11.24	1.96	1846.89	0.000	3.272	1.115	0.03331	1.880	Pipe
"Link2"	Reach	-1141.30	1841.84	1848.00	1845.111	3.271	117.90	10.72	1.78	1846.89	0.000	3.272	1.001	0.03331	1.880	Pipe
"DI#2"	Junction	-1121.30	1842.04	1848.00	1845.651	3.611	68.90	9.75	1.48	1847.13	0.000	2.642	0.000	0.01000	0.000	Pipe
HYDRAULIC JUMP at -1115.09 of length 0.08																
	"i.p."	-1115.09	1842.38	1848.34	1845.718	3.339	68.90	9.75	1.48	1847.19	0.000	2.642	0.000	0.05446	1.398	Pipe
	"i.p."	-1115.09	1842.38	1848.34	1844.377	1.998	68.90	13.78	2.95	1847.32	0.000	2.642	1.826	0.05446	1.398	Pipe
	"i.p."	-1111.19	1842.59	1848.55	1844.657	2.067	68.90	13.27	2.73	1847.39	0.000	2.642	1.710	0.05446	1.398	Pipe
	"i.p."	-1107.24	1842.81	1848.77	1844.965	2.160	68.90	12.65	2.48	1847.45	0.000	2.642	1.568	0.05446	1.398	Pipe
	"i.p."	-1104.19	1842.97	1848.93	1845.232	2.260	68.90	12.06	2.26	1847.49	0.000	2.642	1.430	0.05446	1.398	Pipe
	"i.p."	-1101.96	1843.09	1849.05	1845.464	2.371	68.90	11.50	2.05	1847.52	0.000	2.642	1.294	0.05446	1.398	Pipe
	"i.p."	-1100.53	1843.17	1849.13	1845.666	2.496	68.90	10.96	1.87	1847.53	0.000	2.642	1.155	0.05446	1.398	Pipe
"Link1"	Reach	-1100.00	1843.20	1848.00	1845.841	2.641	68.90	10.45	1.70	1847.54	0.000	2.642	1.001	0.05446	1.398	Pipe
"DI#1"	Headwrk	-1100.00	1843.20	1848.00	1845.842	2.642	68.90	10.45	1.70	1847.54	0.000	2.642	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 "mainline"
Reach "Link7"
Reach "Link8"
Reach "Link6"
Reach "Link9"
Junction "MH#3"
Reach "Link5"
Reach "Link4"
Reach "Link3"
Junction "MH#1"
Reach "Link2"
Junction "DI#2"
Reach "Link1"
Headwork "DI#1"

**BRANCH DEFINITIONS

[OUTLET]
**NAME STATION INVERT GROUND CHANNEL WATER SURFACE
** ELEV ELEV ID ELEV (opt.)
**---------- --------- --------- --------- --------- ---------
"mainline" -1539.29 1829.67 1845 "66rcp" 1837.45

[HEADWORK]
**NAME INVERT GROUND CHANNEL FLOW WATER SURFACE
** ELEV ELEV ID ELEV (opt.)
**---------- --------- --------- --------- --------- ---------
"DI#1" 1843.2 1848 "36RCP" 68.9 1846.3

[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#2" 1842.04 1848 "36RCP" 20 0.015 1
"DI#2_Lateral1" 1845 "48rcp" 90 49

"MH#1" 1837.98 1846.5 "48rcp" 6 0.013 1
"MH#1_Lateral1" 1838 "48rcp" 43 110.2

"MH#3" 1830.29 1845.2 "60RCP" 4 0.013 2
"MH#3_Lateral1" 1833.29 "24rcp" 60 18.5
"MH#3_Lateral2" 1833.29 "24rcp" 60 22

[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)
**---------- --------- --------- --------- --------- --------- --------- --------- ---------
"Link1" 1843.2 1848 "36RCP" 21.3 0.013 0 0 0
"Link2" 1841.84 1848 "48rcp" 115.89 0.013 0 5 0
"Link3" 1837.78 1846.5 "60RCP" 96 0.013 0 8 0
"Link4" 1833.87 1846 "60RCP" 6 0.013 0 15 1
"Link5" 1833.67 1846 "60RCP" 82.3 0.013 0 15 0
"Link6" 1830.09 1845.2 "66rcp" 49.2 0.013 0 15 0

```
"Link7"             1829.75    1845       "66rcp"     30.6       0.013      0          15         0
"Link8"             1829.95    1845.3     "66rcp"     6          0.013      0          15         1
"Link9"             1830.14    1845.2     "66rcp"     2          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
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"66rcp"       4   5.5        5.5
"36RCP"       4   3          3
"48rcp"       4   4          4
"60RCP"       4   5          5
"24rcp"       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\mainline_over.wsx
Computed  09/20/16  13:55:05

TITLE INFORMATION
************************************
 Boulder Highway Strom Drain
 Mainline Model - Over 51" Sewer
 Preliminary Design Report

WARNING SUMMARY
************************************
 WARNING 45: One of the elevations of junction's Node4 laterals is less than the U/S elevation.
 WARNING 47: Junction Node4 has a different channel than its direct downstream element.
 WARNING 45: One of the elevations of junction's Node7 laterals is less than the U/S elevation.
 WARNING 25: Link type element Link4 has different invert elevation than its upstream node.
 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 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	-8936.54	1802.86	1824.00	1817.730	14.870	2443.00	16.31	4.13	1821.86	0.000	9.376	0.000	0.00000	0.000	Tr./Rect.closed
"Link14"	Reach	-8317.19	1804.41	1826.00	1821.620	17.210	2443.00	16.31	4.13	1825.75	0.000	9.376	0.910	0.00250	10.000	Tr./Rect.closed
"Link13"	Reach	-7790.01	1805.73	1827.00	1824.932	19.202	2443.00	16.31	4.13	1829.06	0.000	9.376	0.910	0.00250	10.000	Tr./Rect.closed
"Link4"	Reach	-7402.79	1806.67	1832.00	1827.364	20.694	2443.00	16.31	4.13	1831.50	0.000	9.376	0.910	0.00243	10.000	Tr./Rect.closed
"Node6"	Junction	-7392.79	1806.72	1832.00	1828.307	21.587	2275.00	15.19	3.58	1831.89	0.000	8.941	0.000	0.00500	0.000	Tr./Rect.closed
HYDRAULIC JUMP at -7270.01 of length 0.06																
	"i.p."	-7270.25	1818.97	1844.25	1828.975	10.000	2275.00	15.19	3.58	1832.56	0.000	8.941	0.847	0.10001	2.941	Tr./Rect.closed
	"i.p."	-7270.01	1819.00	1844.28	1828.914	9.915	2275.00	15.30	3.63	1832.55	0.000	8.941	0.856	0.10001	2.941	Tr./Rect.closed
	"i.p."	-7270.01	1819.00	1844.28	1827.029	8.030	2275.00	18.89	5.54	1832.57	0.000	8.941	1.175	0.10001	2.941	Tr./Rect.closed
"Link25"	Reach	-7270.00	1819.00	1831.90	1827.032	8.032	2275.00	18.88	5.54	1832.57	0.000	8.941	1.174	0.10001	2.941	Tr./Rect.closed
"Link19"	Transition	-7230.00	1823.00	1832.00	1828.864	5.864	2275.00	16.17	4.06	1832.92	0.000	6.000	1.176	0.10000	0.000	Tr./Rect.closed
	"i.p."	-7220.19	1823.03	1832.03	1828.878	5.844	2275.00	16.22	4.09	1832.96	0.000	6.000	1.182	0.00350	6.000	Tr./Rect.closed
	"i.p."	-7100.48	1823.45	1832.45	1829.026	5.572	2275.00	17.01	4.49	1833.52	0.000	6.000	1.270	0.00350	6.000	Tr./Rect.closed
	"i.p."	-6996.71	1823.82	1832.82	1829.130	5.313	2275.00	17.84	4.94	1834.07	0.000	6.000	1.364	0.00350	6.000	Tr./Rect.closed
	"i.p."	-6902.74	1824.15	1833.15	1829.212	5.065	2275.00	18.71	5.44	1834.65	0.000	6.000	1.465	0.00350	6.000	Tr./Rect.closed
"Link26"	Reach	-6816.00	1824.45	1835.80	1829.280	4.830	2275.00	19.63	5.98	1835.26	0.000	6.000	1.574	0.00350	6.000	Tr./Rect.closed
"Link20"	Transition	-6800.00	1824.51	1836.00	1831.890	7.380	2275.00	15.41	3.69	1835.58	0.000	7.381	1.000	0.00375	0.000	Tr./Rect.closed
"Link18"	Reach	-5502.00	1829.05	1844.84	1836.431	7.381	2275.00	15.41	3.69	1840.12	0.000	7.381	1.000	0.00350	7.397	Tr./Rect.closed
"Node4"	Junction	-5482.00	1829.12	1844.84	1837.455	8.335	2009.60	13.98	3.03	1840.49	0.000	7.290	0.000	0.00350	0.000	Tr./Rect.closed
"Link28"	Reach	-3198.00	1837.12	1856.00	1849.178	12.058	2009.60	13.98	3.03	1852.21	0.000	7.290	0.872	0.00350	7.459	Tr./Rect.closed
"Link11"	Reach	-3140.41	1837.34	1857.42	1849.474	12.134	2009.60	13.98	3.03	1852.51	0.000	7.290	0.872	0.00382	7.226	Tr./Rect.closed
"Node7"	Junction	-3124.41	1837.40	1858.00	1850.400	13.000	1801.00	12.53	2.44	1852.84	0.000	6.776	0.000	0.00375	0.000	Tr./Rect.closed
"Link9"	Reach	-2174.92	1840.96	1863.00	1854.314	13.354	1801.00	12.53	2.44	1856.75	0.000	6.776	0.781	0.00375	6.718	Tr./Rect.closed
"Link22"	Reach	-2013.09	1841.57	1864.50	1855.331	13.761	1801.00	12.53	2.44	1857.77	0.000	6.776	0.781	0.00377	6.705	Tr./Rect.closed
"Link23"	Reach	-1916.00	1841.94	1865.59	1855.731	13.791	1801.00	12.53	2.44	1858.17	0.000	6.776	0.781	0.00381	6.679	Tr./Rect.closed

"Link29"	Transition	-1900.00	1842.00	1866.00	1854.549	12.549	1801.00	16.12	4.03	1858.58	0.000	8.000	1.005	0.00375	0.000	Tr./Rect.closed
"Link12"	Reach	-1700.00	1844.50	1870.00	1856.076	11.576	1801.00	16.12	4.03	1860.11	0.000	8.000	1.005	0.01250	5.490	Tr./Rect.closed
"Node13"	Headwrk	-1700.00	1844.50	1870.00	1856.076	11.576	1801.00	16.12	4.03	1860.11	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]
 Boulder Highway Strom Drain
 Mainline Model - Over 51" Sewer
 Preliminary Design Report

[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Node15"
Reach            "Link14"
Reach            "Link13"
Reach            "Link4"
Junction         "Node6"
Reach            "Link25"
Transition       "Link19"
Reach            "Link26"
Transition       "Link20"
Reach            "Link18"
Junction         "Node4"
Reach            "Link28"
Reach            "Link11"
Junction         "Node7"
Reach            "Link9"
Reach            "Link22"
Reach            "Link23"
Transition       "Link29"
Reach            "Link12"
Headwork         "Node13"

**BRANCH DEFINITIONS

[OUTLET]
**NAME             STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                            ELEV       ELEV       ID          ELEV (opt.)
**-------------    ---------  ---------- ---------- ----------  ----------
"Node15"           -8936.54   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     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      ----------
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Node4"            1829.12    1844.84    "18 x 8"    20         0.015      1
"Node4_Lateral1"   1829.08               "66"                                       30         265.4

"Node6"            1806.72    1832       "15 x 10"   10         0.015      1
"Node6_Lateral1"   1807.7                "66"                                       30         168

"Node7"            1837.4     1858       "18 x 8"    16         0.015      1
"Node7_Lateral1"   1837.37               "66"                                       30         208.6


[TRANSITION]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                 ELEV       ELEV       ID
**-------------    ---------  ---------- ----------  ---------- ----------
"Link19"           1823       1832       "24 x 6"    40         0.015
"Link20"           1824.51    1836       "20 x 8"    16         0.015
"Link29"           1842       1866       "14 x 8"    16         0.015

[REACH]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
```

```
**                 ELEV       ELEV       ID                          (opt)      POINT(opt) MANHOLES(opt)
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Link4"            1806.67    1832       "15 x 10"   387.22     0.015      0          0          0
"Link9"            1840.96    1863       "18 x 8"    949.49     0.015      0          0          0
"Link11"           1837.34    1857.42    "18 x 8"    57.59      0.015      0          0          0
"Link12"           1844.5     1870       "14 x 8"    200        0.015      0          0          0
"Link13"           1805.73    1827       "15 x 10"   527.18     0.015      0          0          0
"Link14"           1804.41    1826       "15 x 10"   619.35     0.015      0          0          0
"Link18"           1829.05    1844.84    "20 x 8"    1298       0.015      0          0          0
"Link22"           1841.57    1864.5     "18 x 8"    161.83     0.015      46.36      0          0
"Link23"           1841.94    1865.59    "18 x 8"    97.09      0.015      0          0          0
"Link25"           1819       1831.9     "15 x 10"   122.79     0.015      0          0          0
"Link26"           1824.45    1835.8     "24 x 6"    414        0.015      0          0          0
"Link28"           1837.12    1856       "18 x 8"    2284       0.015      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      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        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\mainline_under.wsx
Computed  09/20/16  15:47:47

TITLE INFORMATION
************************************
 Boulder Highway Storm Drain
 Mainline WSPG - under 51" sewer
 Preliminary Design Report

WARNING SUMMARY
************************************
 WARNING 47: Junction Node4 has a different channel than its direct downstream element.
 WARNING 47: Junction Node6 has a different channel than its direct downstream element.
 WARNING 25: Link type element Link4 has different invert elevation than its upstream node.
 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 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	-8936.54	1802.86	1824.00	1817.730	14.870	2443.00	16.31	4.13	1821.86	0.000	9.376	0.000	0.00000	0.000	Tr./Rect.closed
"Link14"	Reach	-8317.19	1804.41	1826.00	1821.620	17.210	2443.00	16.31	4.13	1825.75	0.000	9.376	0.910	0.00250	10.000	Tr./Rect.closed
"Link13"	Reach	-7790.00	1805.73	1827.00	1824.932	19.202	2443.00	16.31	4.13	1829.06	0.000	9.376	0.910	0.00250	10.000	Tr./Rect.closed
"Link4"	Reach	-7281.49	1806.99	1832.00	1828.126	21.136	2443.00	16.31	4.13	1832.26	0.000	9.376	0.910	0.00248	10.000	Tr./Rect.closed
"Node6"	Junction	-7251.49	1807.07	1832.00	1828.937	21.867	2275.00	15.83	3.89	1832.83	0.000	6.000	0.000	0.00267	0.000	Tr./Rect.closed
"Link19"	Reach	-7213.31	1807.17	1831.90	1829.241	22.071	2275.00	15.83	3.89	1833.13	0.000	6.000	1.140	0.00262	6.000	Tr./Rect.closed
"Link5"	Reach	-7183.31	1810.17	1832.00	1829.480	19.310	2275.00	15.83	3.89	1833.37	0.000	6.000	1.140	0.10000	2.071	Tr./Rect.closed
"Link21"	Transition	-7167.31	1811.77	1832.00	1830.398	18.628	2275.00	14.24	3.15	1833.55	0.000	7.381	0.888	0.10000	0.000	Tr./Rect.closed
"Link20"	Reach	-7126.31	1815.87	1832.50	1830.608	14.738	2275.00	14.24	3.15	1833.76	0.000	7.381	0.888	0.10000	2.359	Tr./Rect.closed
"Link18"	Reach	-5502.00	1823.99	1844.84	1838.904	14.914	2275.00	14.24	3.15	1842.05	0.000	7.381	0.888	0.00500	6.508	Tr./Rect.closed
"Node4"	Junction	-5482.00	1824.09	1844.84	1839.362	15.272	2009.60	13.98	3.03	1842.40	0.000	7.290	0.000	0.00500	0.000	Tr./Rect.closed
"Link11"	Reach	-3140.41	1835.79	1857.42	1851.381	15.591	2009.60	13.98	3.03	1854.42	0.000	7.290	0.872	0.00500	6.555	Tr./Rect.closed
"Node7"	Junction	-3124.41	1835.87	1858.00	1852.307	16.437	1801.00	12.53	2.44	1854.74	0.000	6.776	0.000	0.00500	0.000	Tr./Rect.closed
"Link9"	Reach	-2172.92	1840.63	1863.00	1856.229	15.599	1801.00	12.53	2.44	1858.67	0.000	6.776	0.781	0.00500	6.056	Tr./Rect.closed
"Link22"	Reach	-2011.09	1841.43	1864.50	1857.246	15.816	1801.00	12.53	2.44	1859.68	0.000	6.776	0.781	0.00494	6.082	Tr./Rect.closed
"Link23"	Reach	-1916.00	1841.94	1865.59	1857.638	15.698	1801.00	12.53	2.44	1860.08	0.000	6.776	0.781	0.00536	5.908	Tr./Rect.closed
"Link24"	Transition	-1900.00	1842.00	1866.00	1856.455	14.455	1801.00	16.12	4.03	1860.49	0.000	8.000	1.005	0.00375	0.000	Tr./Rect.closed
"Link12"	Reach	-1700.00	1844.50	1870.00	1857.983	13.483	1801.00	16.12	4.03	1862.02	0.000	8.000	1.005	0.01250	5.490	Tr./Rect.closed
"Node13"	Headwrk	-1700.00	1844.50	1870.00	1857.983	13.483	1801.00	16.12	4.03	1862.02	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
```

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[TITLE]
 Boulder Highway Storm Drain
 Mainline WSPG - under 51" sewer
 Preliminary Design Report

[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Node15"
Reach            "Link14"
Reach            "Link13"
Reach            "Link4"
Junction         "Node6"
Reach            "Link19"
Reach            "Link5"
Transition       "Link21"
Reach            "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"           -8936.54   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     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
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Node4"            1824.09    1844.84    "18 x 8"    20         0.015      1
"Node4_Lateral1"   1826.95               "66"                                       30         265.4

"Node6"            1807.07    1832       "24 x 6"    30         0.015      1
"Node6_Lateral1"   1807.31               "66"                                       30         168

"Node7"            1835.87    1858       "18 x 8"    16         0.015      1
"Node7_Lateral1"   1838.25               "66"                                       30         208.6


[TRANSITION]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                 ELEV       ELEV       ID
**-------------    ---------  ---------- ----------  ---------- ----------
"Link21"           1811.77    1832       "20 x 8"    16         0.015
"Link24"           1842       1866       "14 x 8"    16         0.015

[REACH]
**NAME             INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                 ELEV       ELEV       ID                               (opt)      POINT(opt) MANHOLES(opt)
**-------------    ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
```

```
"Link4"             1806.99    1832       "15 x 10"   508.51     0.015      0          0          0
"Link5"             1810.17    1832       "24 x 6"    30         0.015      0          0          0
"Link9"             1840.63    1863       "18 x 8"    951.49     0.015      0          0          0
"Link11"            1835.79    1857.42    "18 x 8"    2341.59    0.015      0          0          0
"Link12"            1844.5     1870       "14 x 8"    200        0.015      0          0          0
"Link13"            1805.73    1827       "15 x 10"   527.19     0.015      0          0          0
"Link14"            1804.41    1826       "15 x 10"   619.35     0.015      0          0          0
"Link18"            1823.99    1844.84    "20 x 8"    1624.31    0.015      0          0          0
"Link19"            1807.17    1831.9     "24 x 6"    38.18      0.015      0          0          0
"Link20"            1815.87    1832.5     "20 x 8"    41         0.015      0          0          0
"Link22"            1841.43    1864.5     "18 x 8"    161.83     0.015      46.36      0          0
"Link23"            1841.94    1865.59    "18 x 8"    95.09      0.015      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      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        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
**----------- ---------- ----------
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Appendix B-2

Drop Inlet Summary

BOULDER HIGHWAY STORM DRAIN SYSTEM DROP INLET SUMMARY

DI #	General Location	Type C: curb length Gr: grate size	Slope / Sump	Qstr	Q Source	Qint	Qbyp
A-N-1	Fremont, N of charleston	C: 20' Gr: 1.5' x 17.5'	1.20%	77.0	(1/2) CCH68-4a	49.0	28.0
A-N-2	Fremont, N of charleston	C: 20' Gr: 1.5' x 17.5'	1.20%	28.0	Bypass of A-N-1	22.7	5.3
A-N-3	Fremont, N of charleston	C: 3' Gr: 2' x 3'	1.20%	5.3	Bypass of A-N-2	3.5	1.8
A-N-4	Fremont, N of charleston	C: 3' Gr: 1.5' x 3'	0.45%		nuisance flow		0.0
A-S-1	Fremont, N of charleston	C: 20' Gr: 1.5' x 17.5'	1.20%	77.0	(1/2) CCH68-4a	49.0	28.0
A-S-2	Fremont, N of charleston	C: 20' Gr: 1.5' x 17.5'	1.20%	28.0	Bypass	22.7	5.3
A-S-3	Fremont, N of charleston	C: 3' Gr: 1.5' x 3'	0.83%	15.3	CH68-6 plus bypass of A-S-2	5.0	10.3
A-S-4	Fremont, N of charleston	C: 5' Gr: 1.5' x 5'	0.40%	10.3	Bypass of A-S-3	5.4	4.9
A-S-5	Fremont, N of charleston	C: 0' Gr: 2' x 3'	0.50%	4.9	bypass of A-S-4	2.3	2.6
B-N-1	Charleston, W of Fremont	C: 5' Gr: 2' x 3'			nuisance flow		
B-S-1	Charleston, W of Fremont	C: 5' Gr: none	1.20%		nuisance flow		
B-S-2	Charleston, W of Fremont	C: 10' Gr: 1.5' x 7.5'	0.70%	7.0	FR04-C1	5.9	1.1
C-N-1	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	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	27.5	Bypass of C-N-1	22.4	5.1
C-N-3	Atlantic Lateral	C: 2.5' Gr: 1.5' x 2.5'	0.89%	6.4	(1/2)[FR04-C5 plus (1/6)FR04-C7]	2.8	3.6
C-N-4	Atlantic Lateral	C: 2.5' Gr: 1.5' x 2.5'	0.53%	6.0	(2/3) of FR04-C4 Anything that goes to the ditch on the west	2.7	3.3
C-N-5	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	2.60%	13.5	1/2[(1/3) FR04-c4 and8 (anything that doesn't go to C-N-4) plus bypass of CN-3 and C-N-4 and half of (FR04-C5 + (1/6)FR04-C7) pluS (1/6)FR04-c7]	11.8	1.7
C-S-1	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	Atlantic Lateral	C: 20' Gr: 1.5' x 17.5'	1.20%	27.5	Bypass of C-S-1	22.4	5.1
C-E-1	Atlantic Lateral	C: 4' Gr: none	0.70%	2.5	(1/5) of FR04-C8 stays on Atlantic. (1/4) of that is on the west side of the street	1.5	1.0
C-E-2	Atlantic Lateral	C: 4' Gr: none	0.70%	1.0	bypass of C-E-1	0.9	0.1
C-W-1	Atlantic Lateral	C: 4' Gr: none	0.70%	17.7	(1/5) of FR04-C8 stays on Atlantic. (3/4) of that is on the west side of the street(7.5 cfs). Plus C-S-2 and C-N-2	3.9	13.8
C-W-2	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.90%	25.0	(1/2) of FR04-C6 and (1/3) of FR04-C7 and bypass of C-W-1	13.3	11.6
C-W-3	Atlantic Lateral	C: 10' Gr: 1.5' x 7.5'	0.40%	22.8	(1/2) of FR04-C6 and (1/3) of FR04-C7 and bypass of C-W-2	14.3	8.5
C-W-4	Atlantic Lateral	C: 15' Gr: 1.5' x 12.5'	0.30%	23.7	Bypass of C-W-3, C-N-5 and the flow that stays on the south side of Olive (13.5 cfs - same asCN5)	20.2	3.5
C-W-5	Atlantic Lateral	C: 3' Gr: 1.5' x 3'			Remove		
D-W-1	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	35.6	(1/6) of FR04-C9 and (4/5) of FR04-C3 plus bypass of A-S-5 plus bypass of CW4	30.6	5.0
D-W-2	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'			removed and replaced with DW1		
D-W-3	Boulder, Atlantic to Oakey	C: 20' Gr: 1.5' x 17.5'	0.50%	35	(1/2.5) of FR04-C9 and bypass of D-W-1	30.2	4.8
D-W-4	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'			removed and replaced with DW3		
D-W-5	Boulder, Atlantic to Oakey	C: 15' Gr: 1.5' x 12.5'	0.42%	23.9	(1/4) of FR04-C9 and bypass of D-W-3	19.5	4.4
D-W-6	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'			removed and replaced with DW5		
D-W-7	Boulder, Atlantic to Oakey	C: 15' Gr: 1.5' x 12.5'	0.62%	18.3	Remaining of FR04-Cr (13.9 cfs) and bypass of D-W-5	15.1	3.2
D-C-1	Boulder, Atlantic to Oakey	C: none Gr: 2.5' x5'	sump	25		25.0	0.0
D-E-1	Boulder, Atlantic to Oakey	C: none Gr: 1.5' x 2.5'	0.50%	18.5		3.7	17.2
D-E-2	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'	0.50%	21		6.7	14.3
D-E-3	Boulder, Atlantic to Oakey	C: 3' Gr: 2' x 3'	0.50%	16		5.7	10.3
E-S-1	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	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	79.78	Bypass	54.5	25.3
E-S-3	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-S-4	Oakey Lateral	C: 3' Gr: 2' x 3'			nuisance flow		
E-N-1	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	Oakey Lateral	C: 20' Gr: 1.5' x 17.5'	0.80%	79.78	Bypass	54.5	25.3
E-N-3	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-4	Oakey Lateral	C: 7' Gr: None					

DI #	General Location	Type C: curb length Gr: grate size	Slope / Sump	Qstr	Q Source	Qint	Qbyp
F-E-1	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.50%	17.0		5.9	11.1
F-E-2	Boulder,Oakey to St Louis	C: 17.5' Gr: 1.5' x 15'	0.50%	11.1		10.1	0.9
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
F-W-1	Boulder,Oakey to St Louis	C: none Gr: 12' x 3'	0.67%	19.6	(1/3.5) of FR04-C16 plus bypass of D-W-7, E-S-3 and E-N-3	19.4	0.2
F-W-2	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.67%	11.6	(1/3.5) of FR04-C16	7.2	4.2
F-W-3	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.67%	4.2	Bypass	3.7	0.5
F-W-4	Boulder,Oakey to St Louis	C: 3' Gr: 2' x 3'	0.70%	8.5	(1/5) of FR04-C16 plus bypass of F-W-3	6.0	2.5
G-E-1	St Louis Lateral	C: none Gr: 2' x 24'	sump	35.0	FR03-3	35.0	0.0
G-E-2	St Louis Lateral	Headwall		42.0	FR03-2	42.0	0.0
G-N-1	St Louis Lateral	C: 10' Gr: 1.5' x 7.5'	1.00%	16.0	Half of CFR03-1	9.9	6.1
G-N-2	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	39.6	half of [(1/2) of FR03-4 plus GN1 bypass plus GS1 bypass plus CFR04C15]	30.6	9.0
G-N-3	St Louis Lateral	C: 20 Gr: 1.5' x 17.5'	sump	38.0	half of [(1/2) of FR03-4 plus GN2 bypass plus GS2 bypass plus CFR03-5 plus FR04-C13]	38.0	0.0
G-N-4	St Louis Lateral	C: none Gr: 2.5' x 5'	sump	9.7	Remaining of FR04-C16 (7.2 cfs) and bypass of FW4	9.7	0.0
G-S-1	St Louis Lateral	C: 10' Gr: 1.5' x 7.5'	1.00%	16.0	Half of CFr03-1	9.9	6.1
G-S-2	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	39.6	half of [(1/2) of FR03-4 plus GN1 bypass plus GS1 bypass plus CFR04C15]	30.6	9.0
G-S-3	St Louis Lateral	C: 20' Gr: 1.5' x 17.5'	1.00%	38.0	half of [(1/2) of FR03-4 plus GN2 bypass plus GS2 bypass plus CFR03-5 plus FR04-C13]	29.6	8.4
G-S-4	St Louis Lateral	C: none Gr: 1.5' x 5'	sump	4.4	Bypass of GS3	4.2	0.0
G-S-5	St Louis Lateral	C: none Gr: 3' x 10'	sump	4.4	Bypass pof GS3	4.2	0.0
H-W-1	Boulder, St Louis to Sahara	C: 3' Gr: 2' x 3'	0.80%	4.0	(1/6) of FR03-7	3.0	1.0
H-W-2	Boulder, St Louis to Sahara	C: 15' Gr: 1.5' x 12.5'	0.80%	10.6	(1/2.5) of FR03-7 and bypass of H-W-1	8.1	2.5
H-W-3	Boulder, St Louis to Sahara	C: 20' Gr: 1.5' x 17.5'	0.80%	12.9	remaining of FR03-7 (10.4 cfs) plus bypass of H-w-3	10.5	2.5
H-W-4	Boulder, St Louis to Sahara	C: 3' Gr: 2' x 3'			Removed. Replace by HW4		
H-E-1	Boulder, St Louis to Sahara	C: 3' Gr: 2' x 3'	0.50%	1.3		1.1	0.2
H-E-2	Boulder, St Louis to Sahara	C: NONE Gr: 2' x 3'					
H-C-1	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'					
H-C-3	Boulder, St Louis to Sahara	C: NONE Gr: 2.5' x10'					
I-W-1	Eastern	C: 20' Gr: 1.5' x 17.5'	SUMP	59.3	(1/2) [CH63-C2 plus (3/4) of CH67-C3]	59.3	
I-W-2	Eastern	C: 4' Gr: none	sump	12.0	collect enough for reaa than 1 feet depth	12.0	
I-W-3	Eastern	C: 20' Gr: 1.5' x 17.5'	sump	59.4	(1/2) [CH63-C2 plus (3/4) of CH67-C3] plus Q on Houston Dr (which is 1/8th of CH67-C-3) minus 12 cfs from I	59.4	0.0
I-W-4	Eastern				Removed. Replace by IW3		
I-W-5	Eastern	C: 20' Gr: 1.5' x 17.5'	sump	30.0	(1/2) of CH67-C2 plus (1/8) CH67-C3 plus (1/4) of CH67-C2 that's on the south side of Ballard.	30.0	0.0
I-W-6	Eastern	C: 4' Gr: 1.5' x 3'			Removed. Replace by IW5		
I-W-7	Eastern, on Ballard	C: 15' Gr: none	2.00%	6.0	(1/4) of CH67-C2 that's on the north side of Ballard.	2.5	3.5
J-N-1	Ballard and Eastwood	C: 3' Gr: 1.5' x 3'	sump	5.0		3.5	0.0
J-N-2	Ballard and Eastwood				Removed. Replace by JN1	3.5	0
J-S-1	Ballard and Eastwood	C: 3' Gr: 1.5' x 3'	sump	5.0		3.5	0.0
J-S-2	Ballard and Eastwood				Removed. Replace by JS1		
J-W-1	Ballard and McLeod				Nuisance Flow		
J-W-2	Euclid and Russell				Nuisance Flow		
J-W-3	Euclid and Russell				Nuisance Flow		
J-W-4	Euclid and Olive				Nuisance Flow		

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."

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TABLE OF CONTENTS

1. INTRODUCTION 2
1.1. PURPOSE AND SCOPE 2
1.2. PROJECT DESCRIPTION 2
2. GROUNDWATER IMPACT EVALUATION 3
2.1. INFORMATION REVIEWED 3
2.2. SITE RECONNAISSANCE 3
2.3. FINDINGS 4
3. RECOMMENDATIONS 8
3.1. WELL INSTALLATION AND GROUNDWATER SAMPLING 9
4. LIMITATIONS 10
5. REFERENCES 10

TABLES
Table 2.3.1 – Federal Database Results Search 4
Table 2.3.2 – State/County Database Result Search 5
Table 2.3.3 – EDR Proprietary Database Results Search 5
Table 2.3.4 – Tribal Records Database Results Search 6

APPENDIX A
Figure 1
Figure 2
Figure 3

APPENDIX B
Photographic Log

APPENDIX C
NDRW Well Log Database Report

APPENDIX D
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

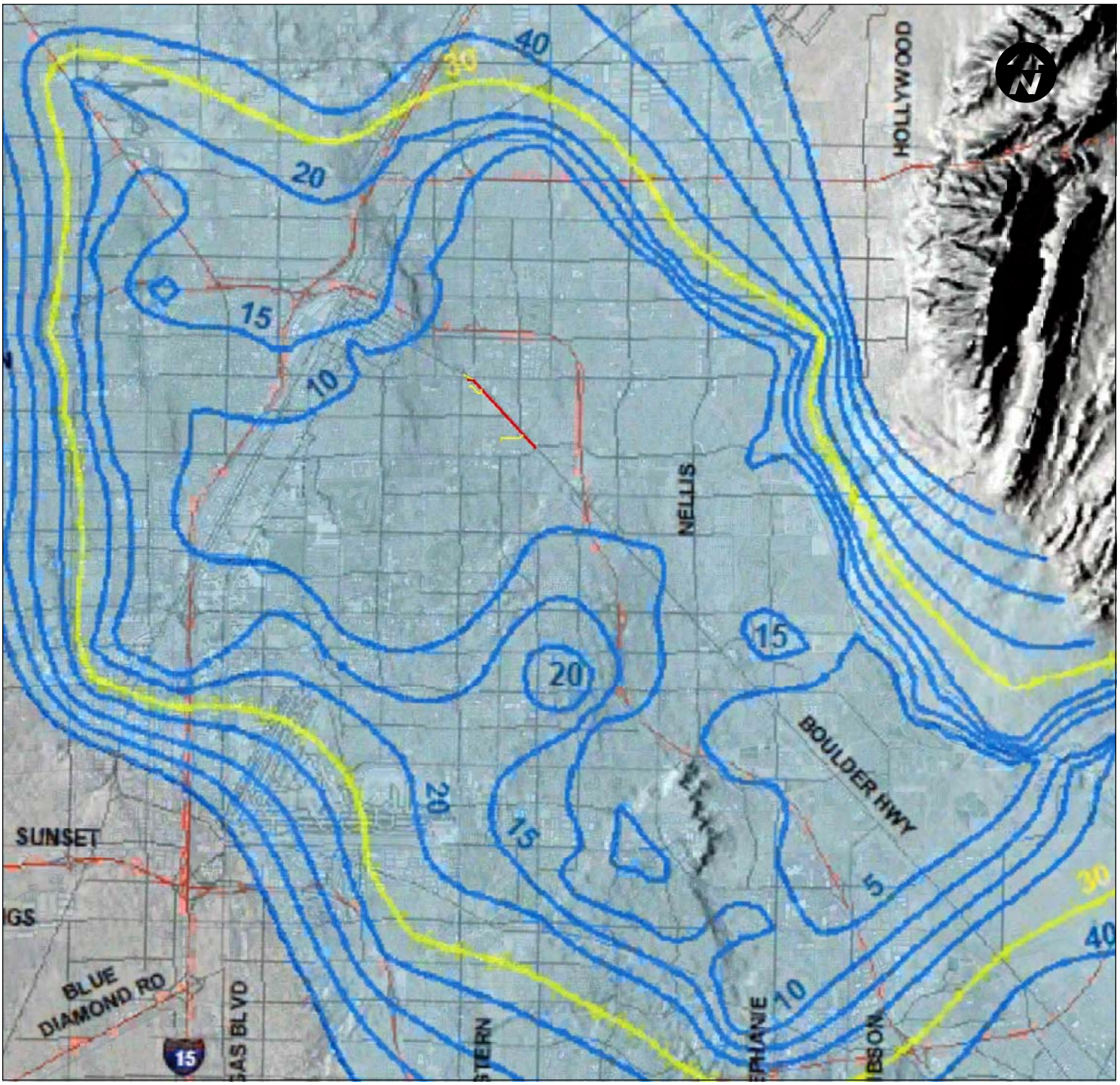
0 225 450 900 1,350 1,800 Feet

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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.

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:

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Henderson, Nevada 89074

Prepared by:

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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.

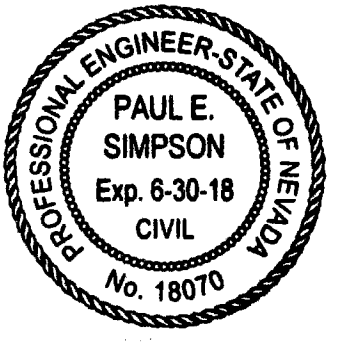
The Geotechnical Evaluation Report includes the findings of the geologic review, the results of the field exploration and laboratory testing programs, presents recommendations for design and construction for the proposed project.

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

Dist: 5 originals delivered to addressee
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cc to Project File

TABLE OF CONTENTS

1. INTRODUCTION 1
   1.1. PURPOSE AND SCOPE 1
   1.2. PROJECT DESCRIPTION 1
   1.3. ALIGNMENT DESCRIPTION 2
   1.4. FIELD EXPLORATION 2
   1.5. LIMITED GROUNDWATER SCREENING 4
   1.6. LIMITED HYDRO-GEOLOGICAL STUDY 4
   1.7. SOIL LABORATORY TESTING 5
2. DISCUSSION 7
   2.1. GEOLOGY AND SEISMICITY 7
   2.2. EXISTING ASPHALT CONCRETE PAVEMENT 8
   2.3. SUBSURFACE MATERIALS AND CONDITIONS 9
      2.3.1. FILL 9
      2.3.2. NATIVE SOILS 9
   2.4. GROUNDWATER 10
   2.5. TRENCH BACKFILL SUITABILITY 12
3. CONCLUSIONS 13
4. RECOMMENDATIONS 14
   4.1. EXCAVATION CONSIDERATIONS 15
   4.2. STRUCTURAL FILL 16
   4.3. BEDDING 18
   4.4. INITIAL BACKFILL 18
   4.5. FINAL BACKFILL 18
   4.6. SUBTERANEAN STRUCTURES 19
   4.7. VERTICAL LOADS 21
   4.8. SETTLEMENT 21
   4.9. MATERIAL VOLUME CHANGES 21
   4.10. LATERAL EARTH PRESSURES 22
   4.11. SEISMIC SITE CLASS 22
   4.12. ASPHALT CONCRETE PAVEMENT SECTIONS 23
   4.13. AGGREGATE BASE FOR PAVEMENT SECTIONS 23
   4.14. SOIL CORROSIVITY 24
5. LIMITATIONS 25
6. REFERENCES 26

TABLES

Table 1.7.-1 – Laboratory Test Summary – Mainline at Fremont Street 5
Table 1.7.-2 – Laboratory Test Summary- Lateral Drains west of Fremont Street 6
Table 2.2. – Approximate Asphalt Concrete Pavement Thicknesses 9
Table 2.4. – Groundwater Depths 11
Table 2.5.-1 – Trench Backfill Suitability 12
Table 2.5.-2 – Maximum PI for Selected and Granular Backfill 13
Table 4.11. Spectral Response Accelerations and Site Coefficients 23

APPENDIX A – SUBSURFACE STUDY
APPENDIX B – LABORATORY TEST RESULTS
APPENDIX C – DESIGN FIGURES

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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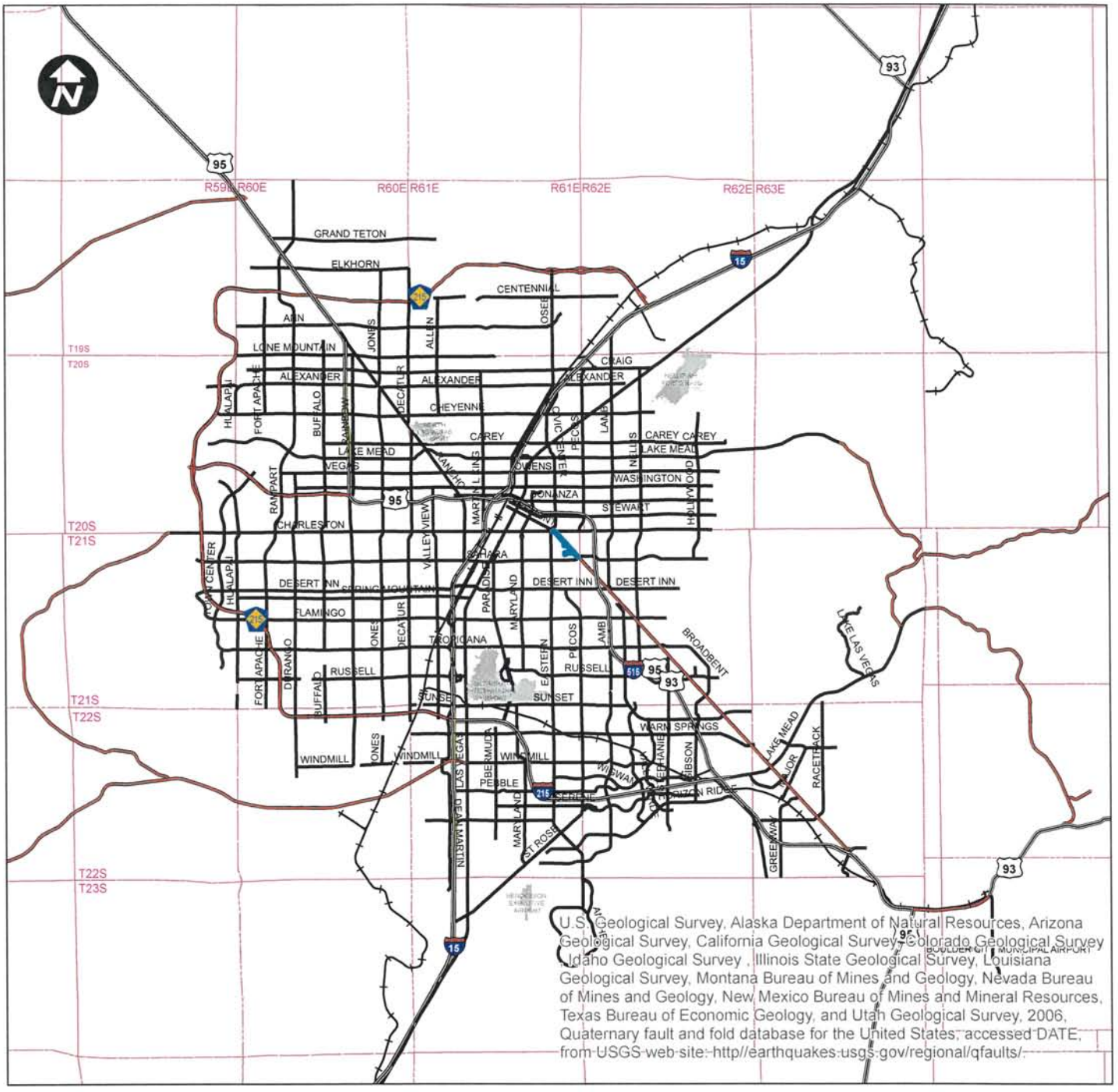
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APPENDIX A
SUBSURFACE STUDY



U.S. Geological Survey, Alaska Department of Natural Resources, Arizona Geological Survey, California Geological Survey, Colorado Geological Survey, Idaho Geological Survey , Illinois State Geological Survey, Louisiana Geological Survey, Montana Bureau of Mines and Geology, Nevada Bureau of Mines and Geology, New Mexico Bureau of Mines and Mineral Resources, Texas Bureau of Economic Geology, and Utah Geological Survey, 2006, Quaternary fault and fold database for the United States, accessed DATE, from USGS web site: http://earthquakes.usgs.gov/regional/qfaults/.

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

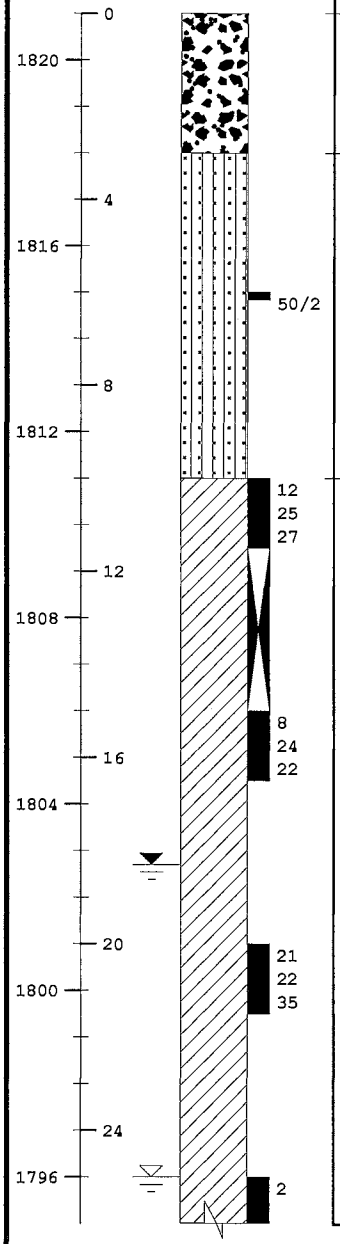
BORING/MONITORING WELL LOG
B-1

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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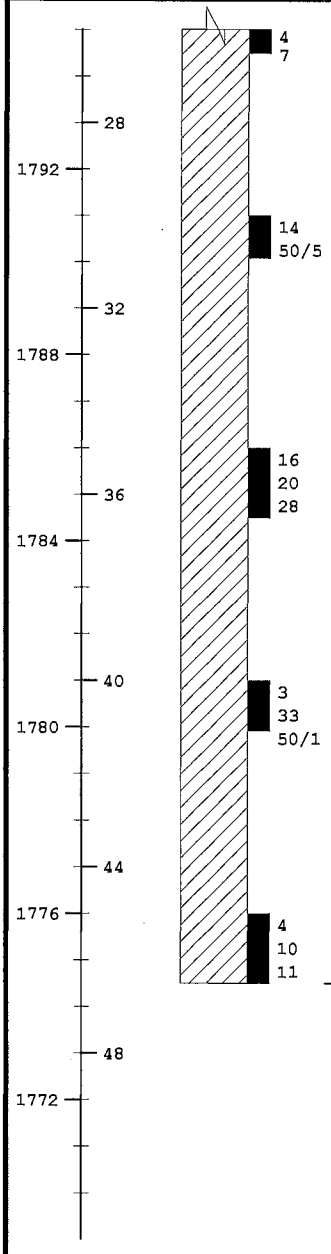
Figure No. A-4

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								

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

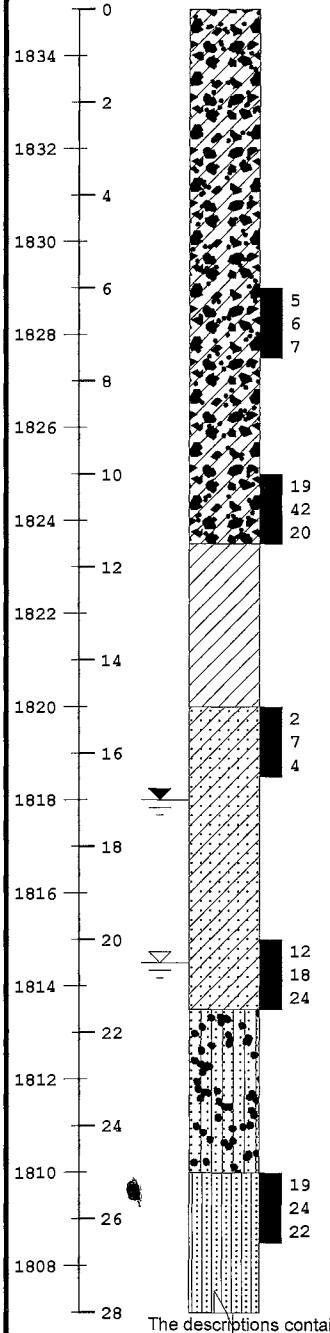
BORING LOG
B-2

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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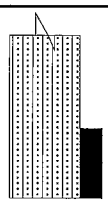
BORING LOG
B-2

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									

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Figure No. A-5

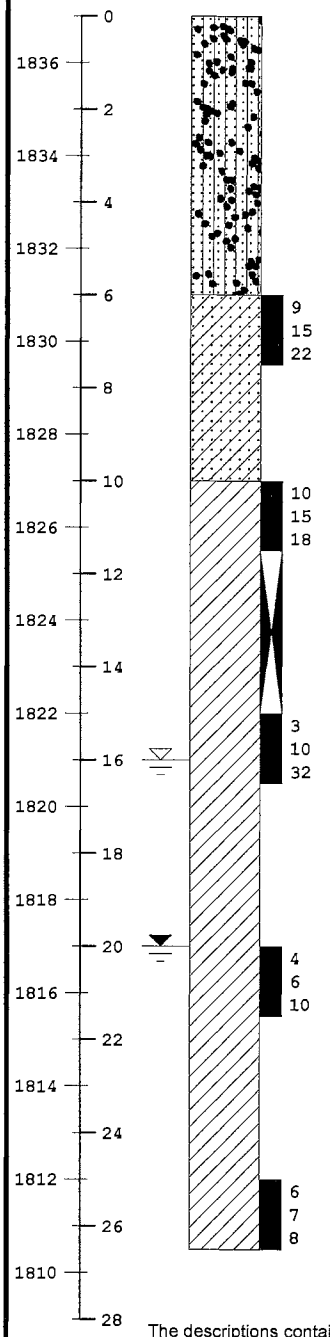
BORING LOG
B-3

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.

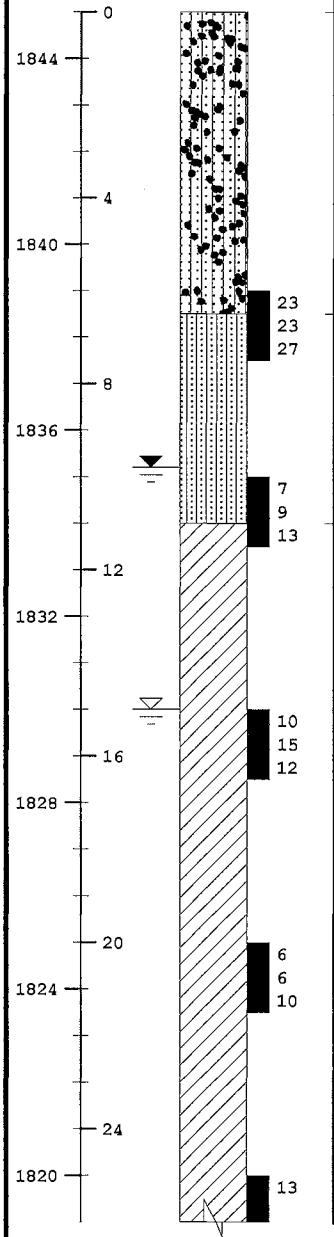
Figure No. A-6

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											

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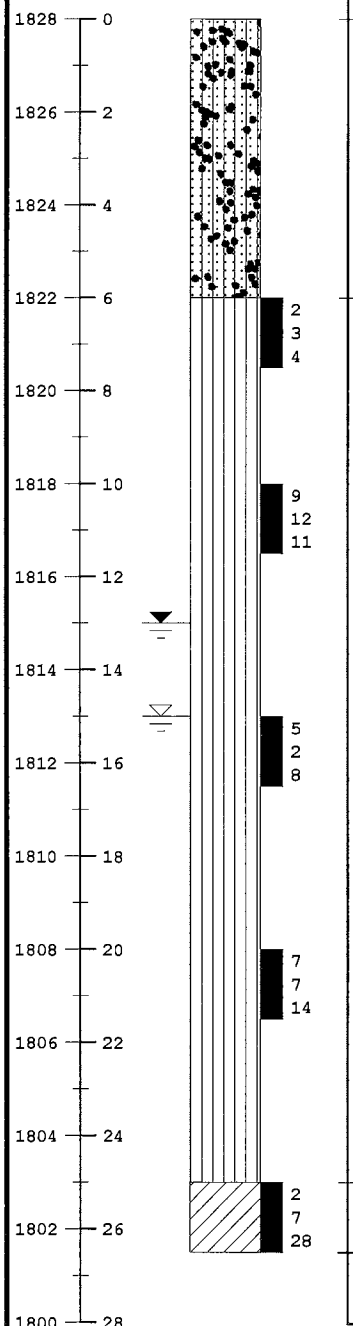
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

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											

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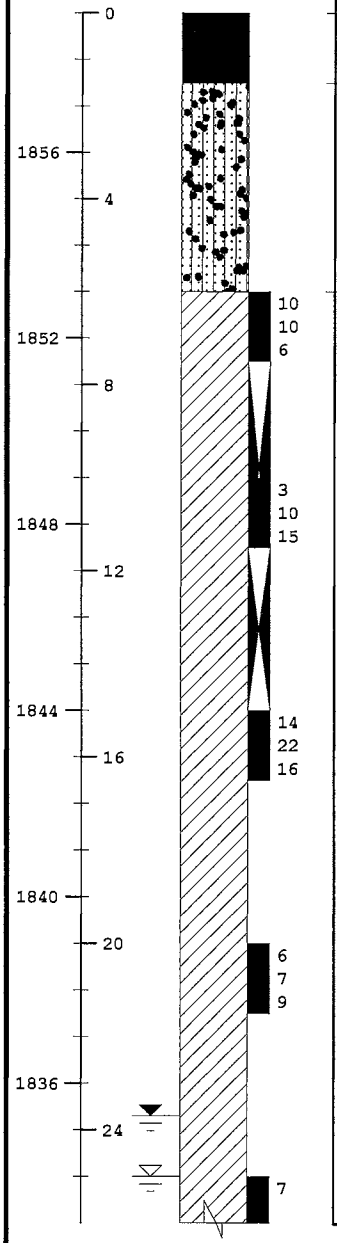
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

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											

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.

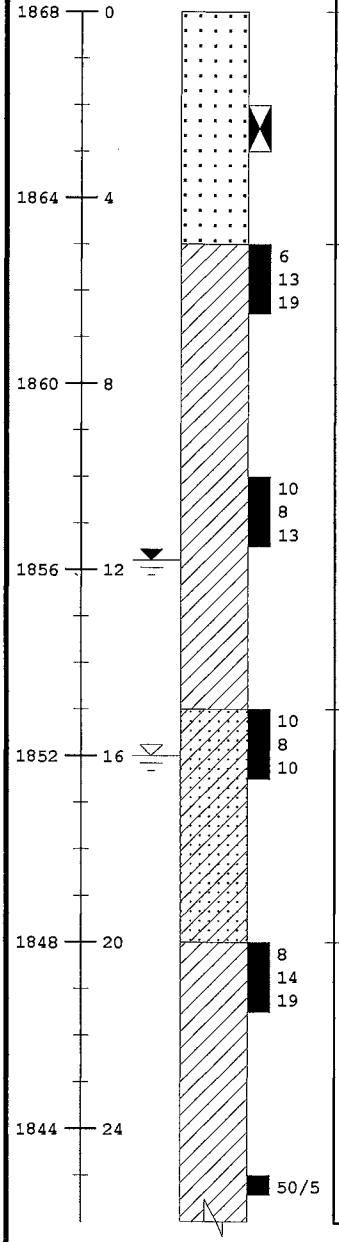
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure No. A-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			

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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									

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-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.

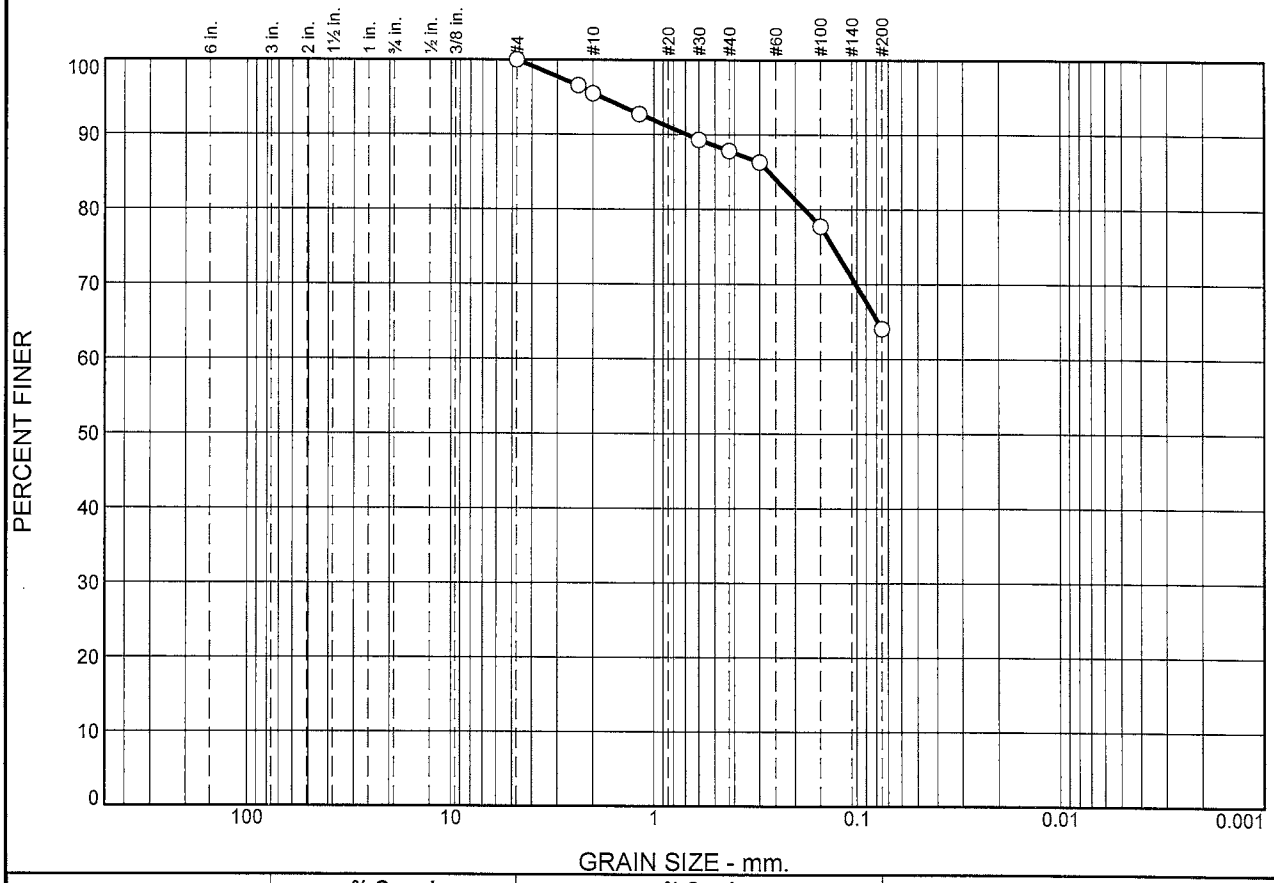
7. WATER SOLUBLE SALT AND SOLUBILITY

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

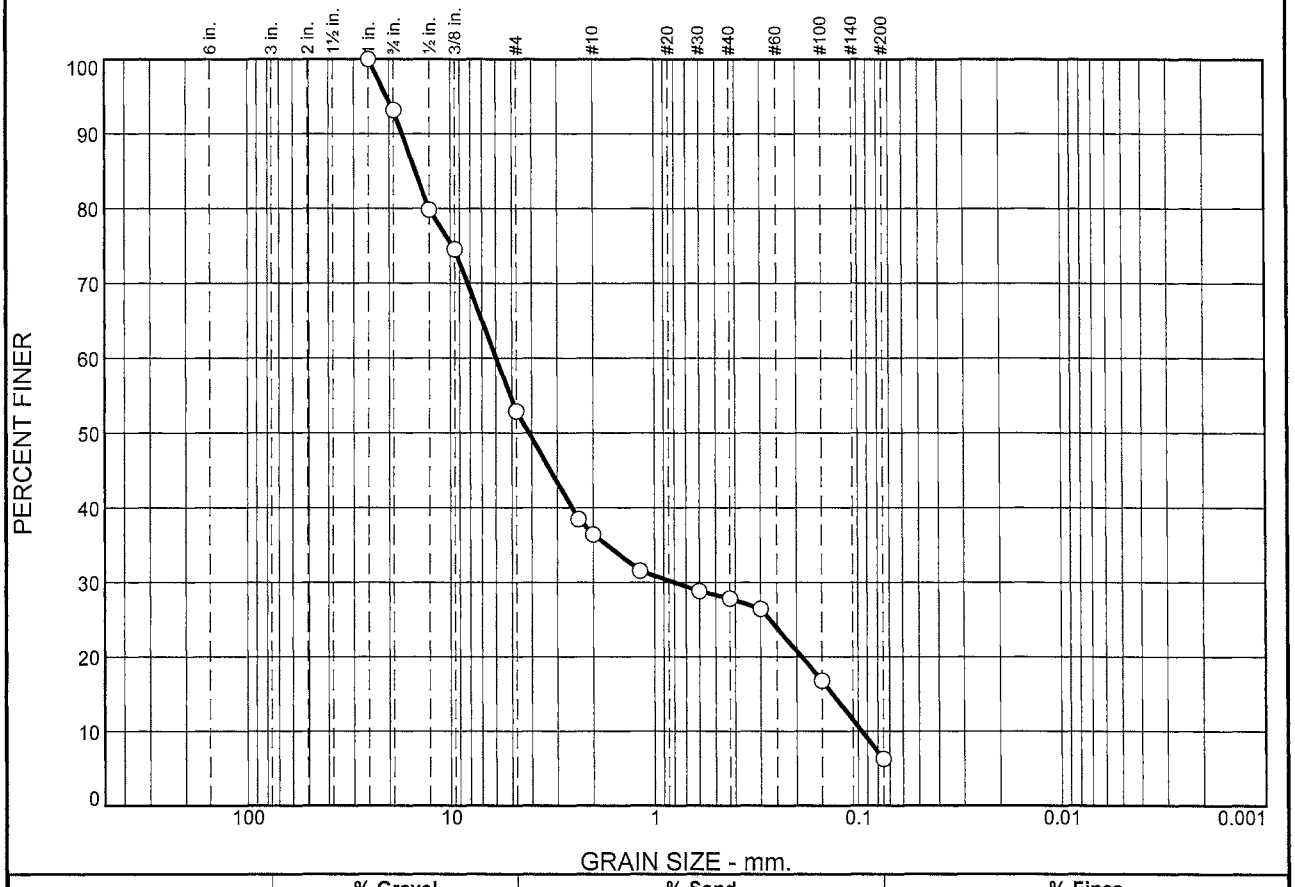
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

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

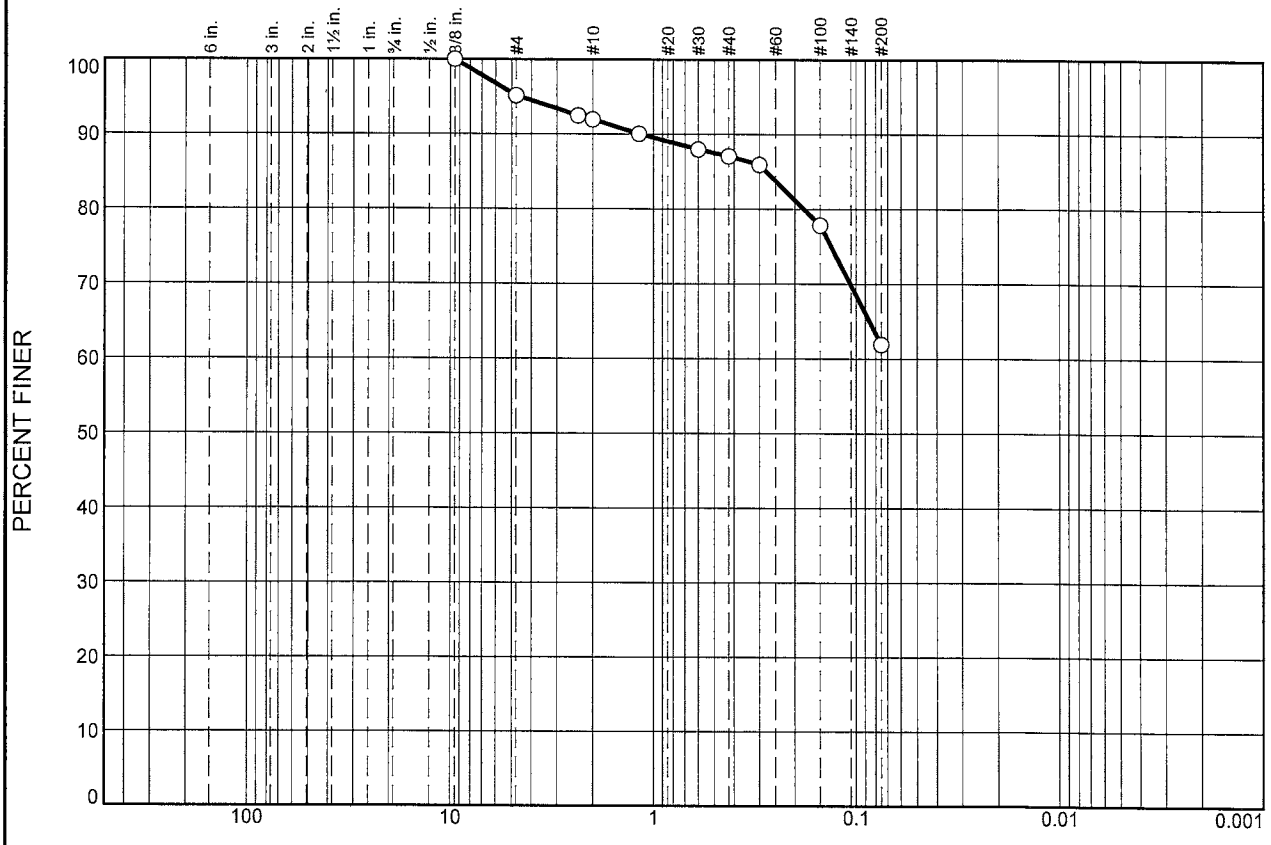
GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

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

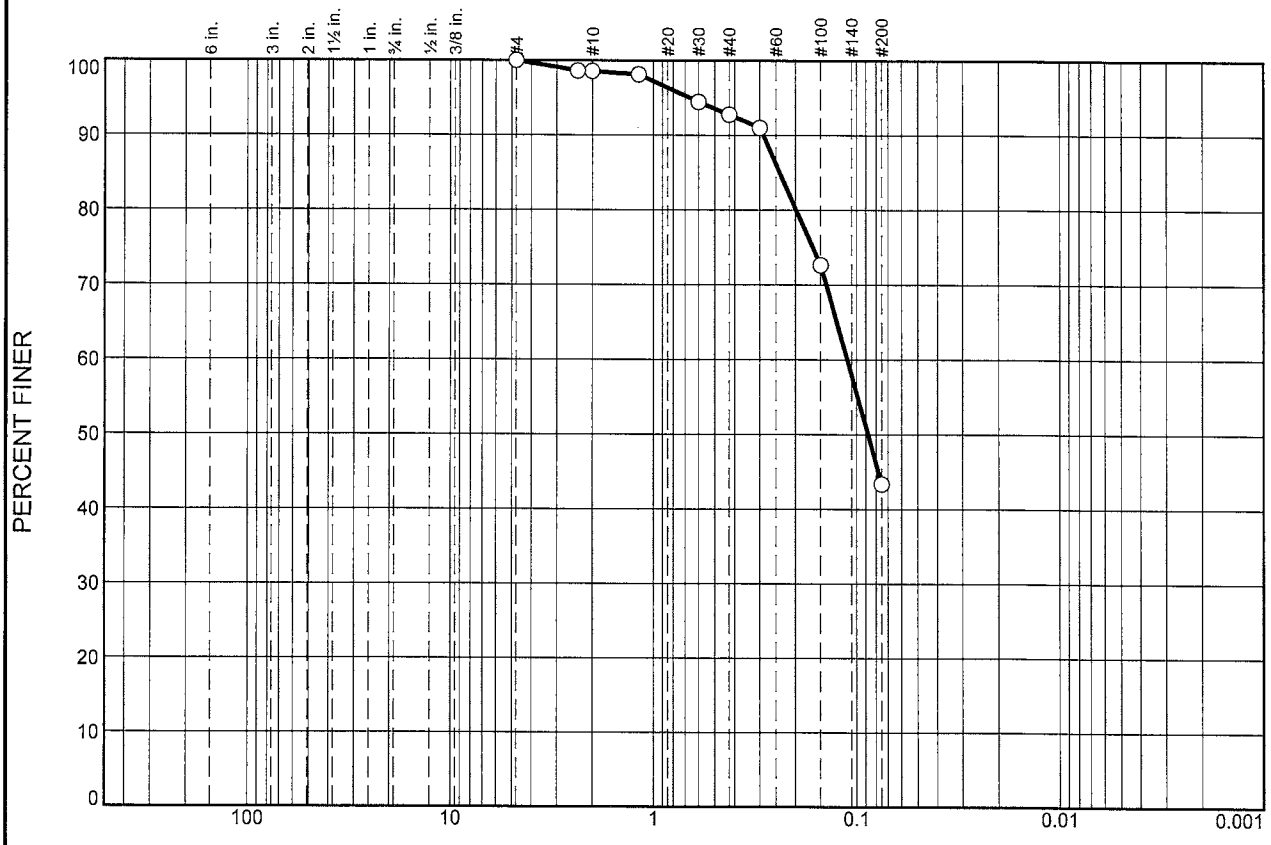
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GES

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

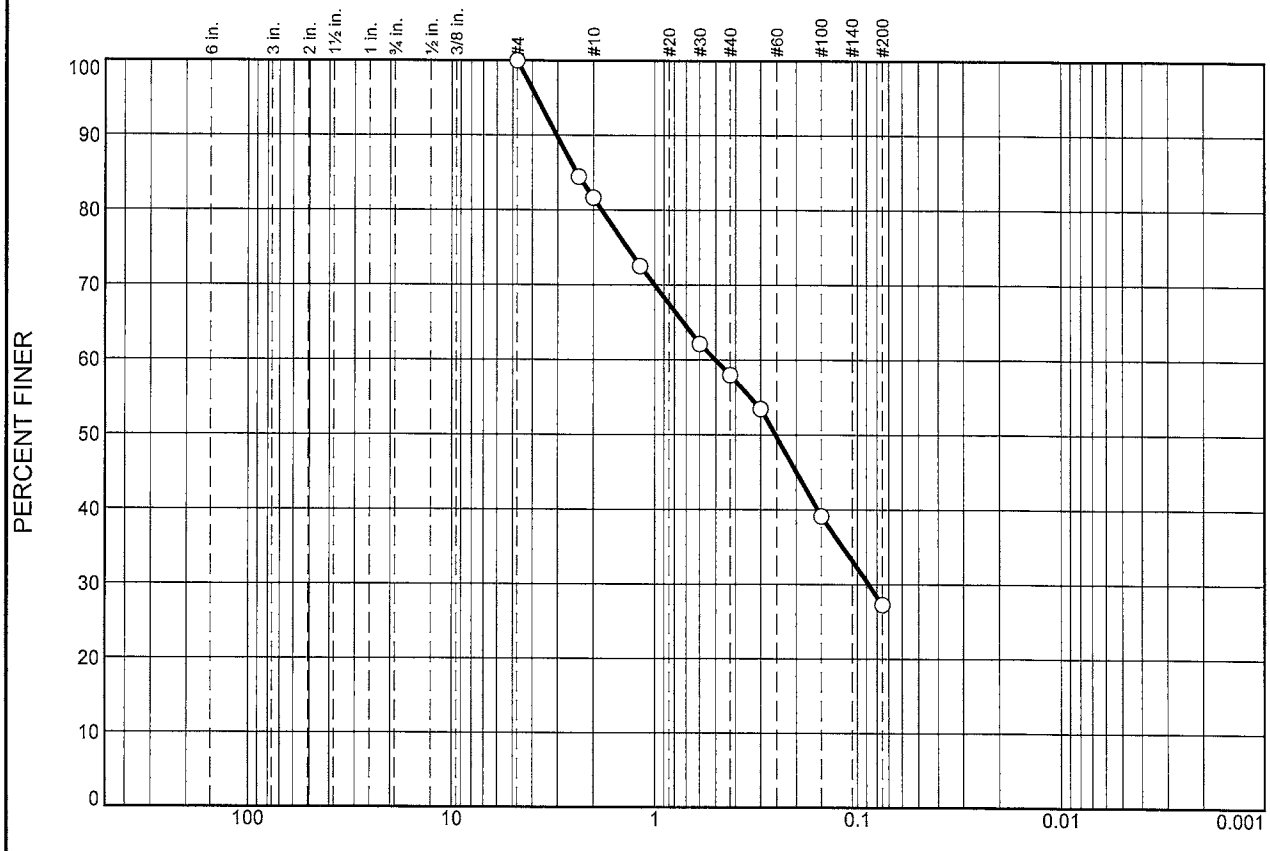
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GES

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

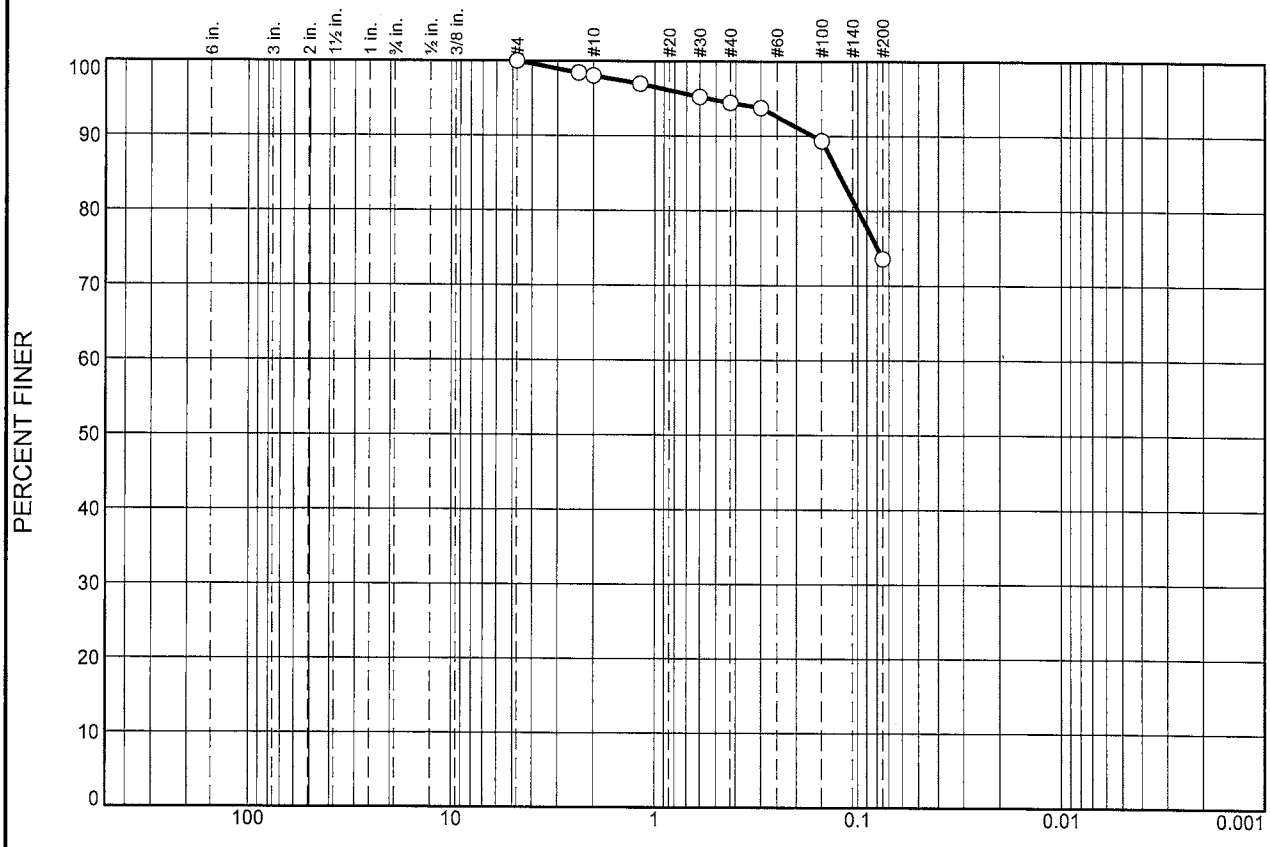
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

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

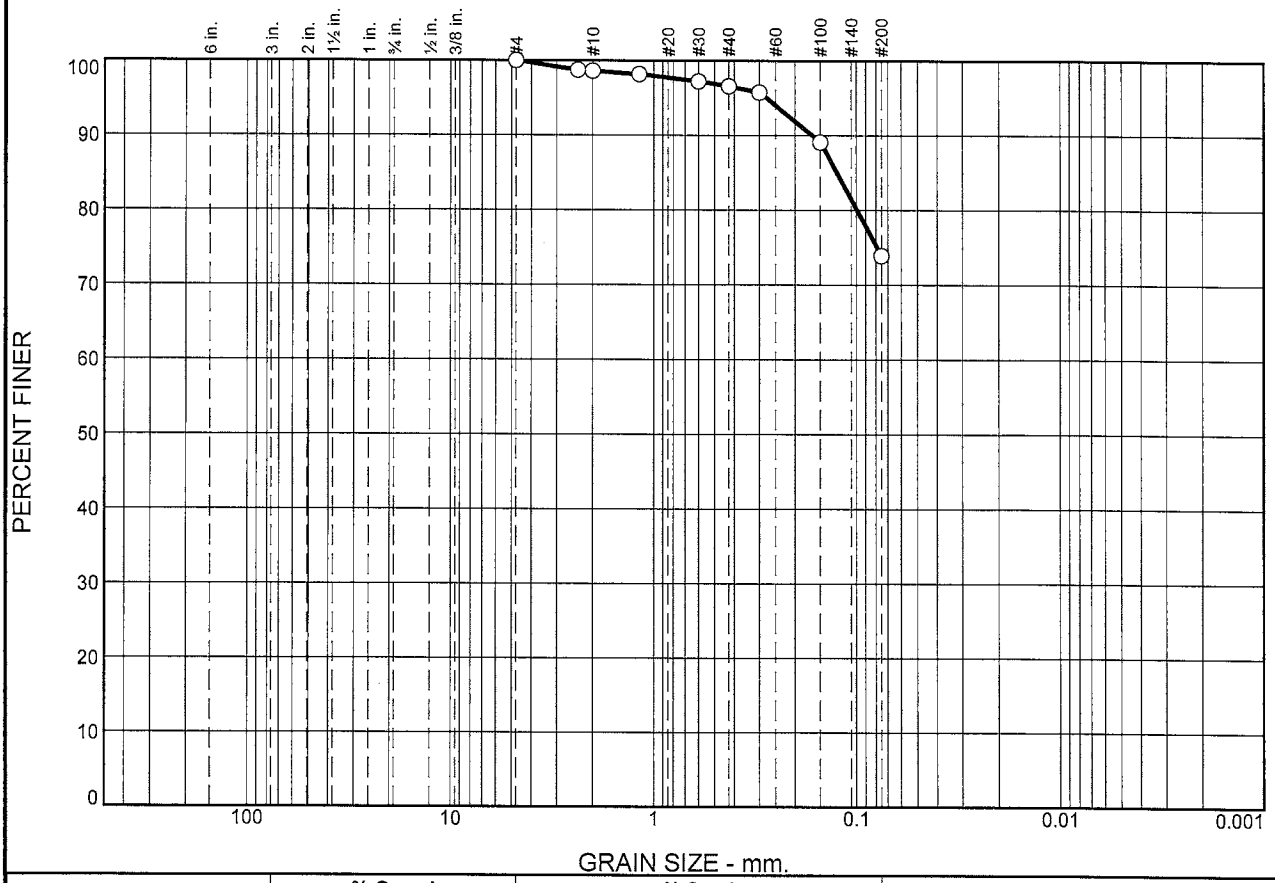
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GES

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

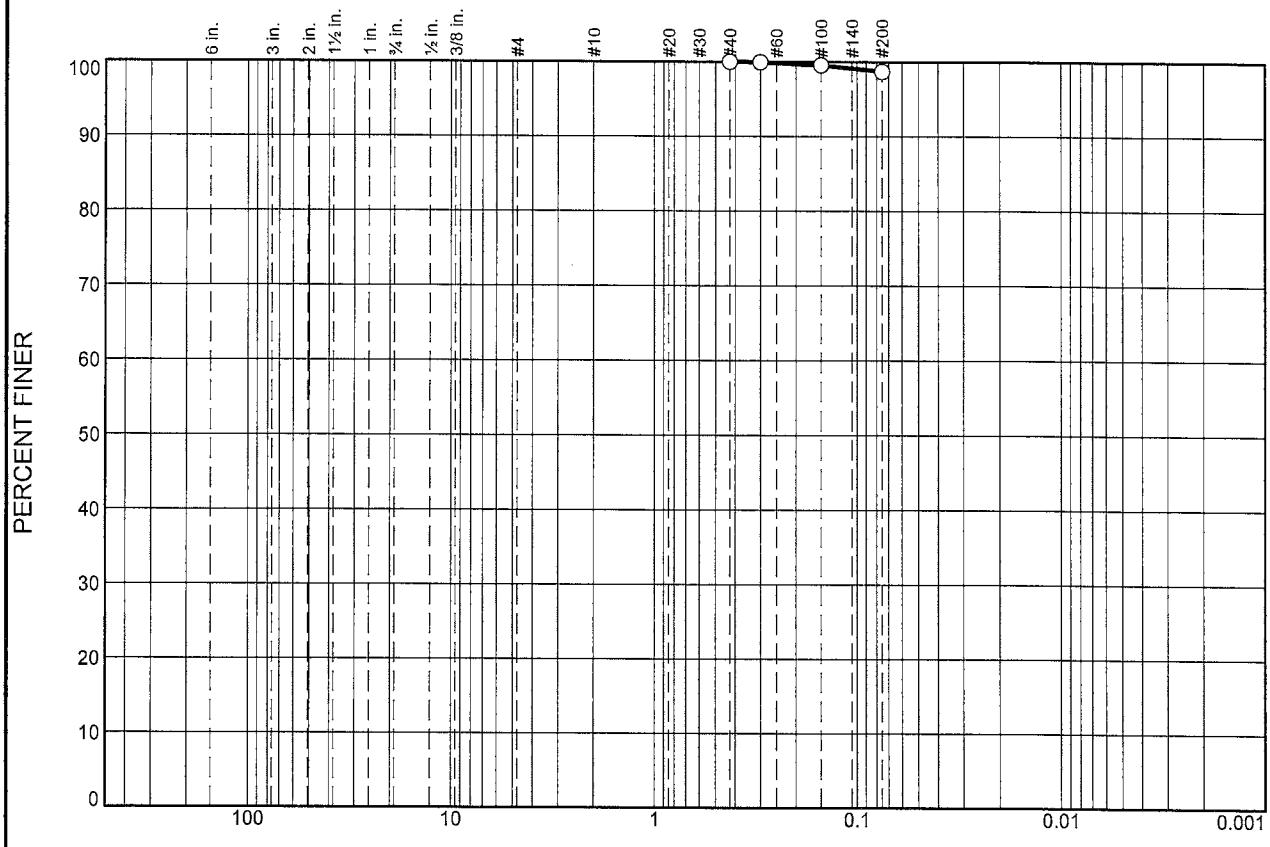
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GES

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

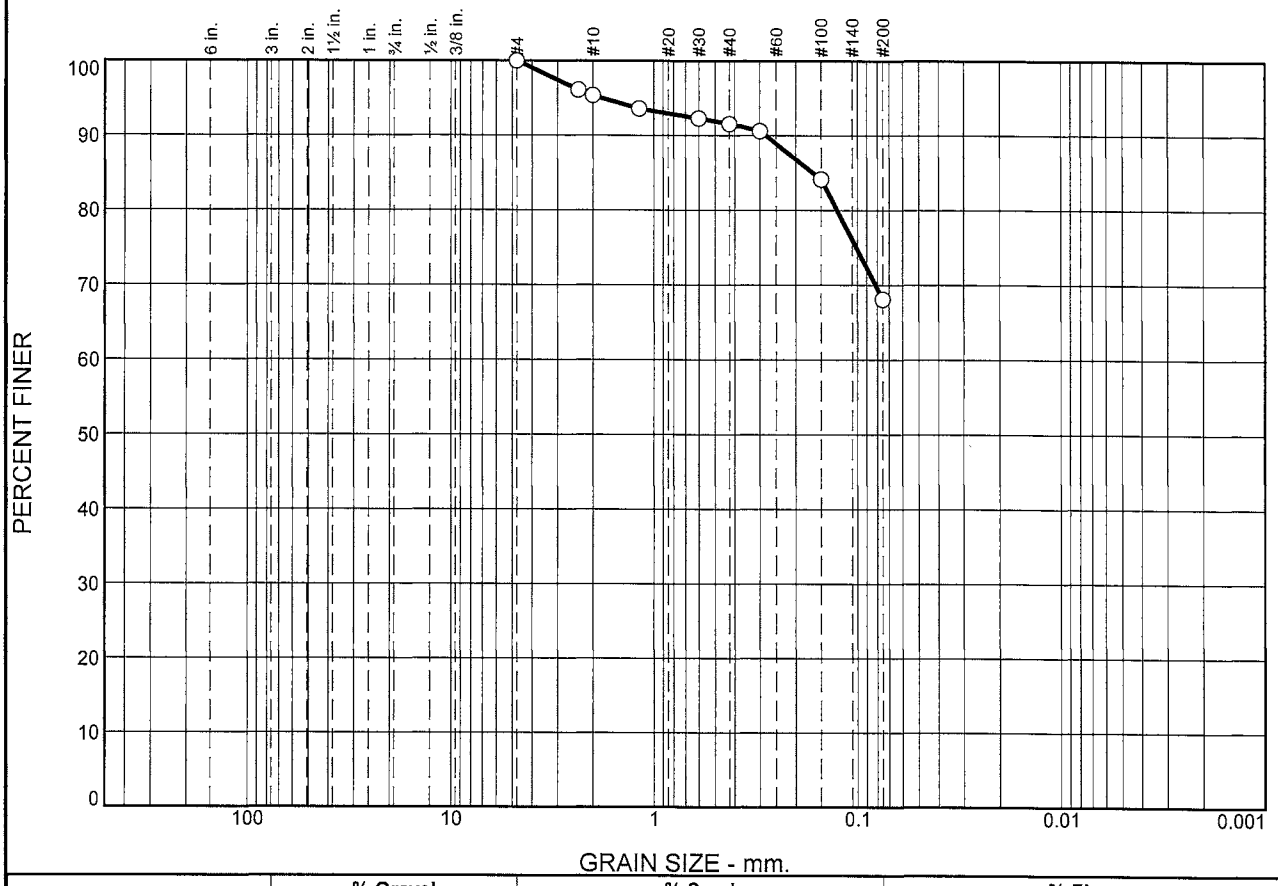
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

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

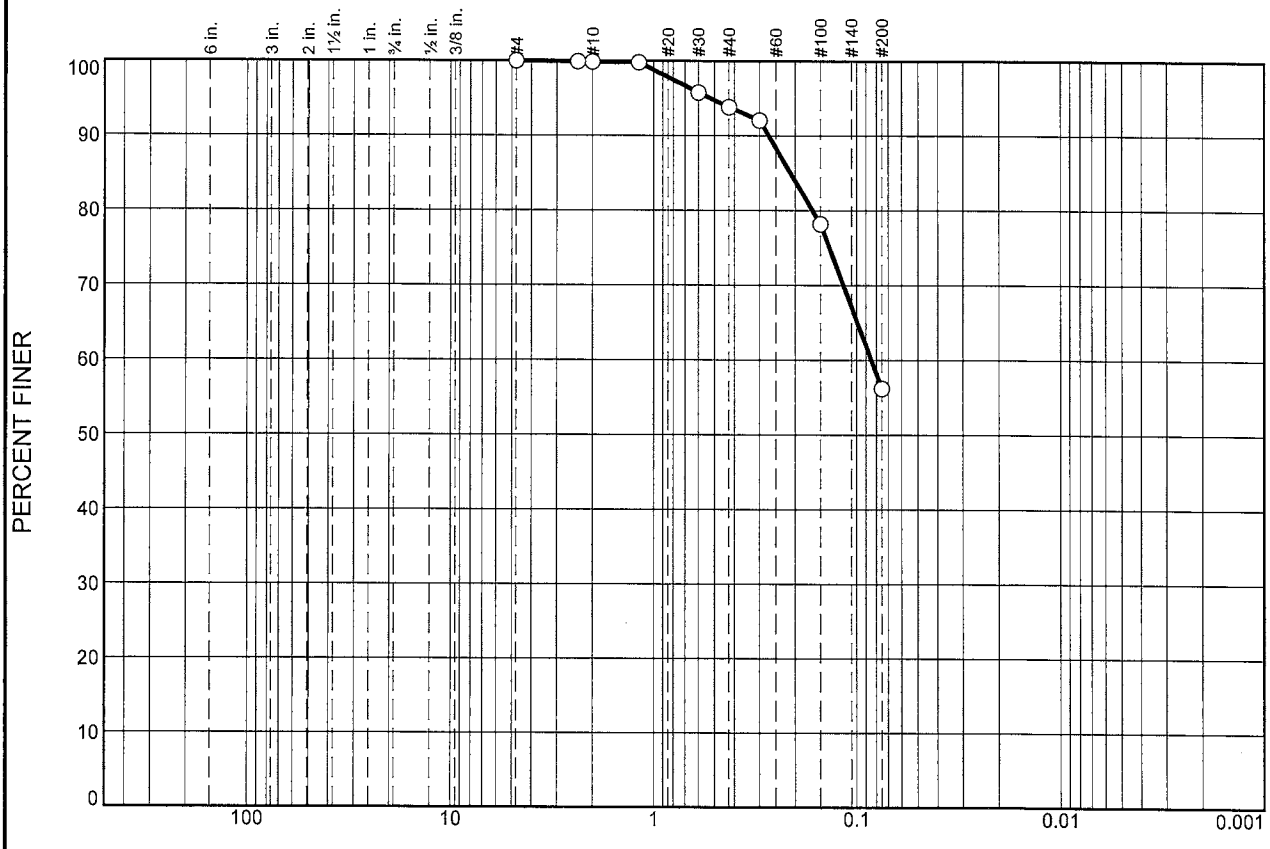
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

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

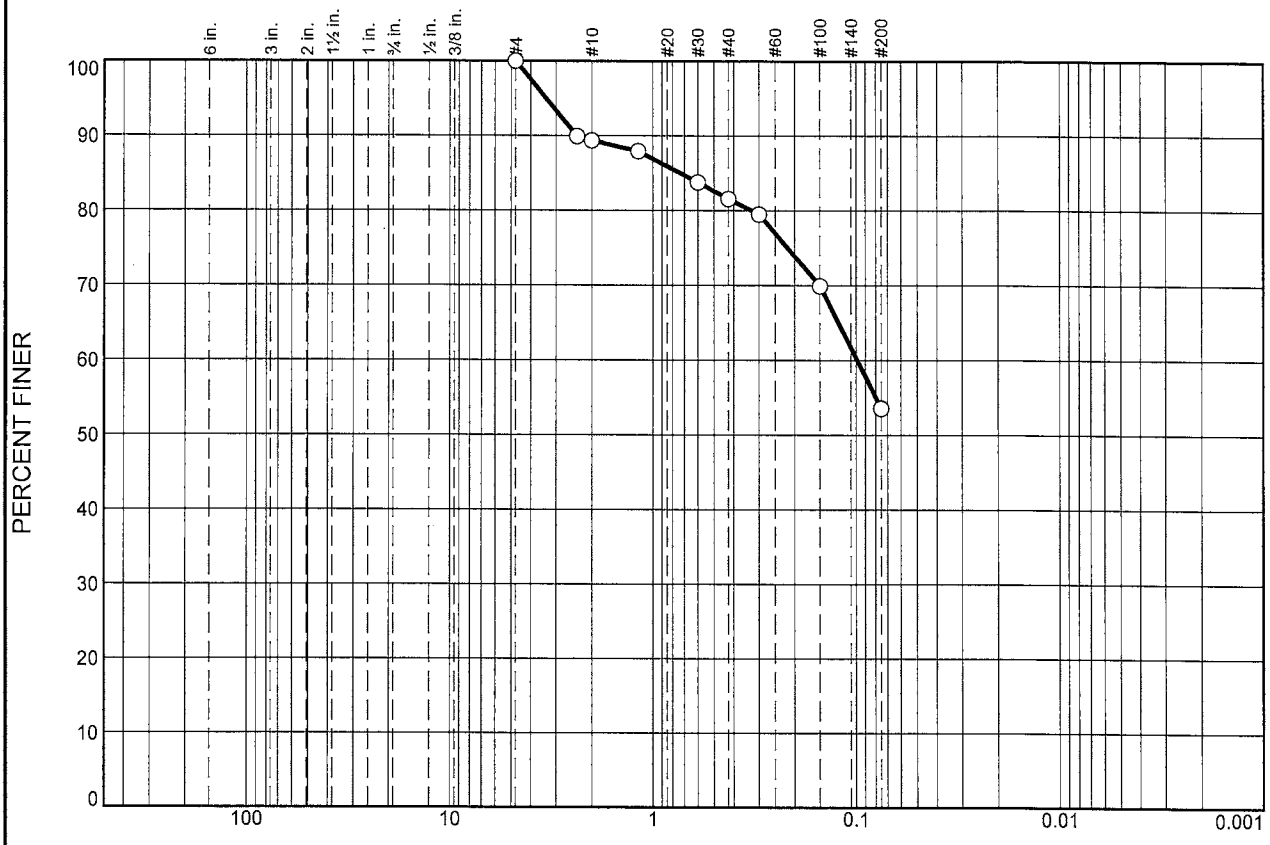
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

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

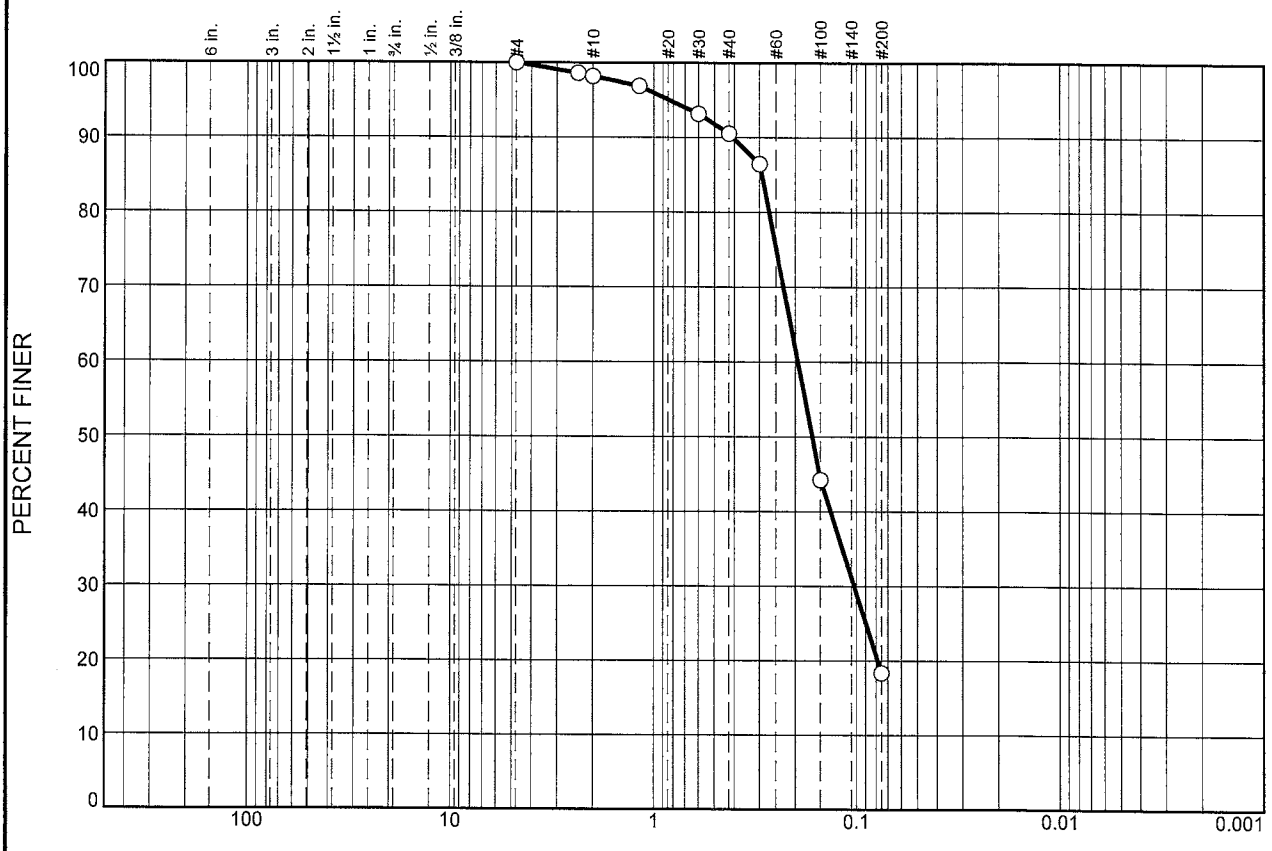
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

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

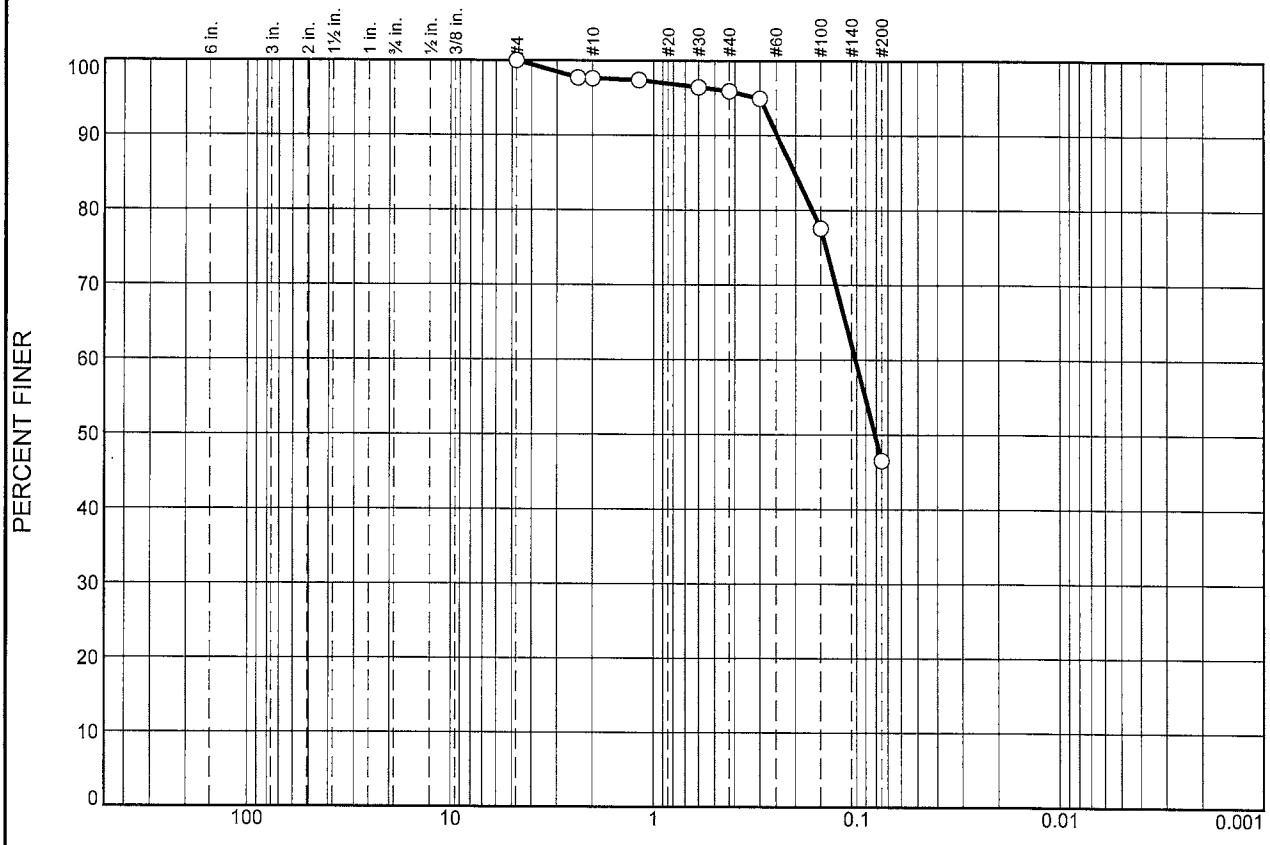
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

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

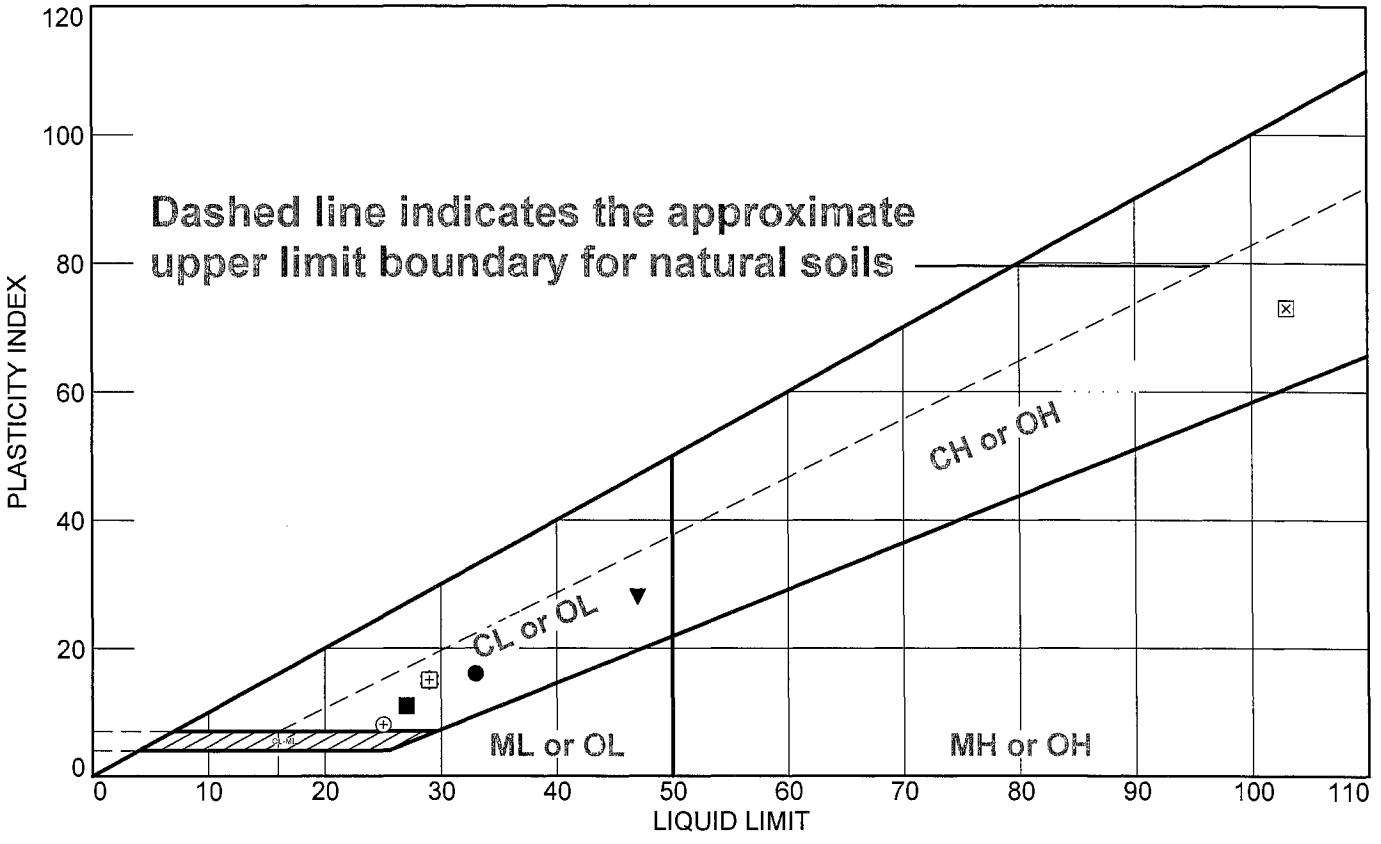
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: ATKINS
Project: BOULDER HIGHWAY STORM DRAIN

Project No: 20153837E1 **Figure** B-13

Tested By: T. FULLER

LIQUID AND PLASTIC LIMITS TEST REPORT



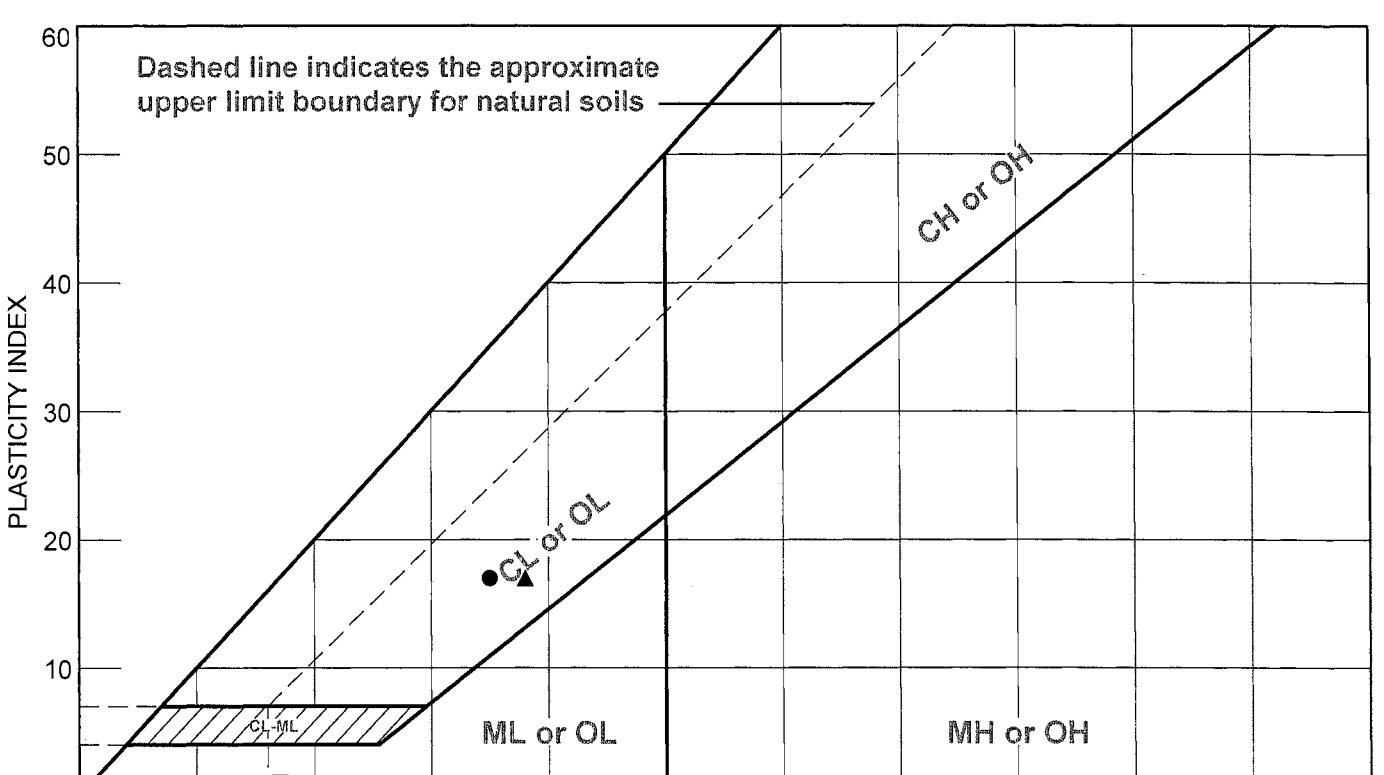
SOIL DATA								
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	LAB #16-274	B-11	15.0'-16.5'		17	33	16	CL
■	LAB #16-274	B-10	10.0'-11.5'		16	27	11	CL
▲	LAB #16-274	B-12	5.0'-6.5'		NP	NV	NP	SM
◆	LAB #16-274	B-13	10.0'-11.5'		NP	NV	NP	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.

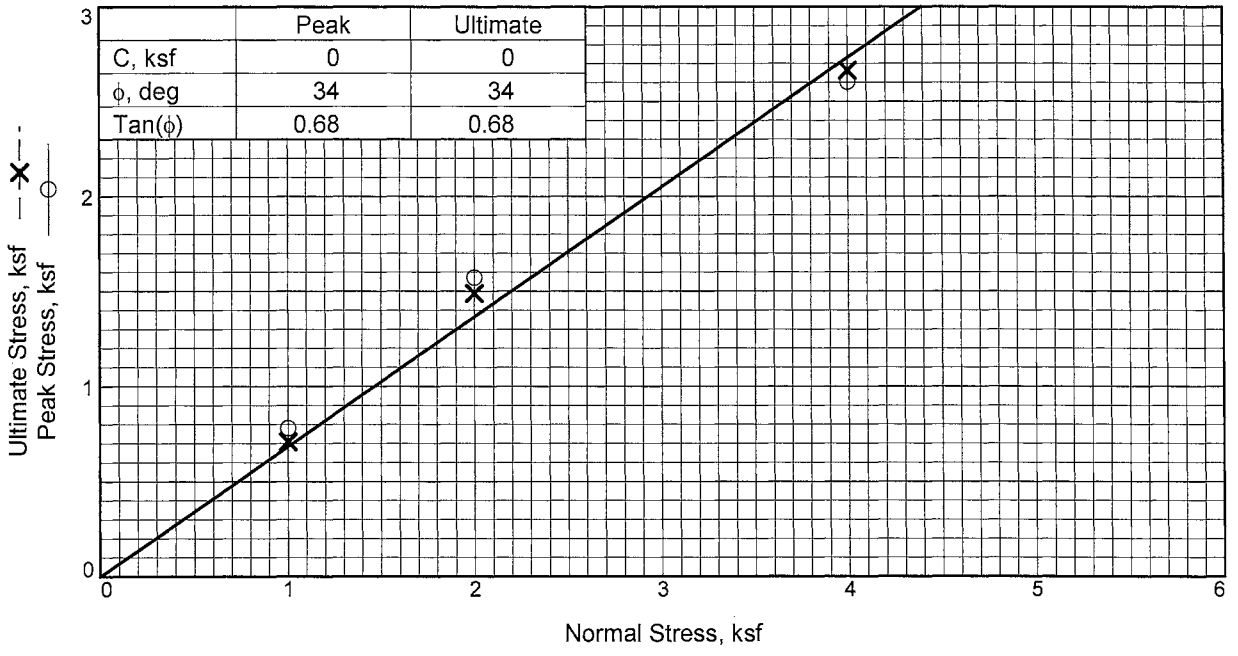
SWELL TEST SUMMARY

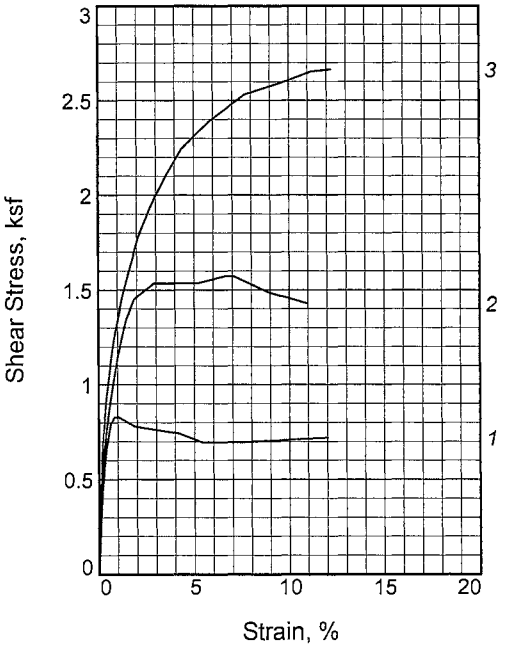
7150 PLACID STREET
LAS VEGAS NV, 89119
1-702-365-1001

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

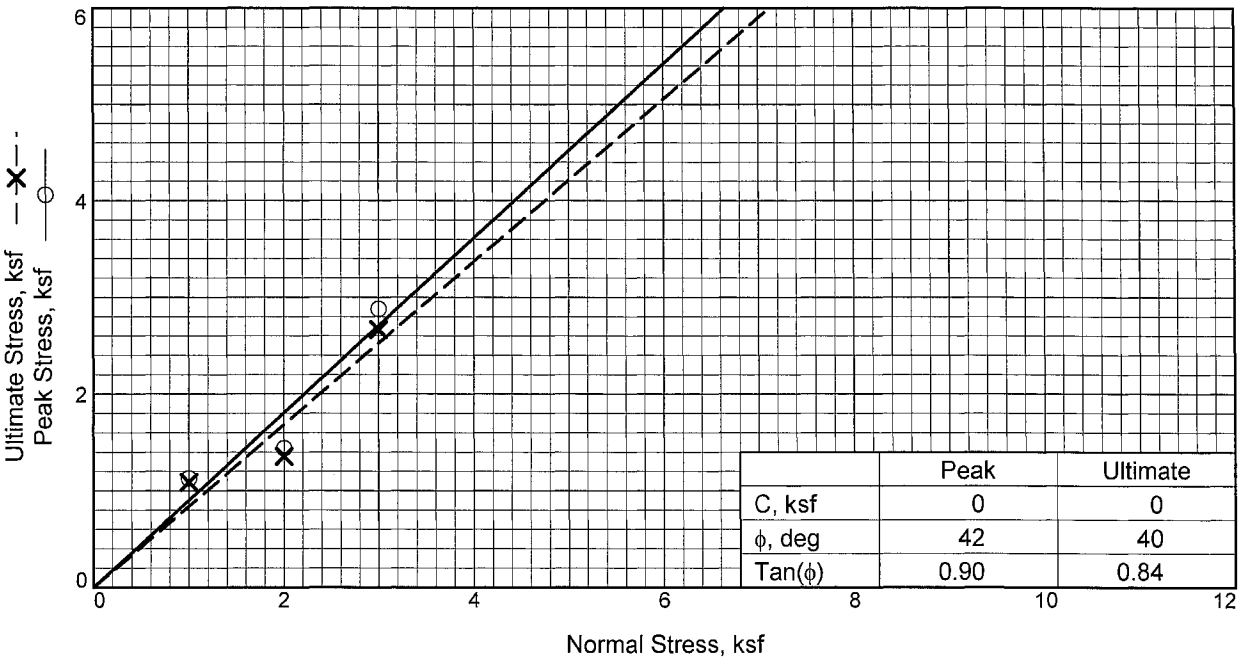
Client: ATKINS

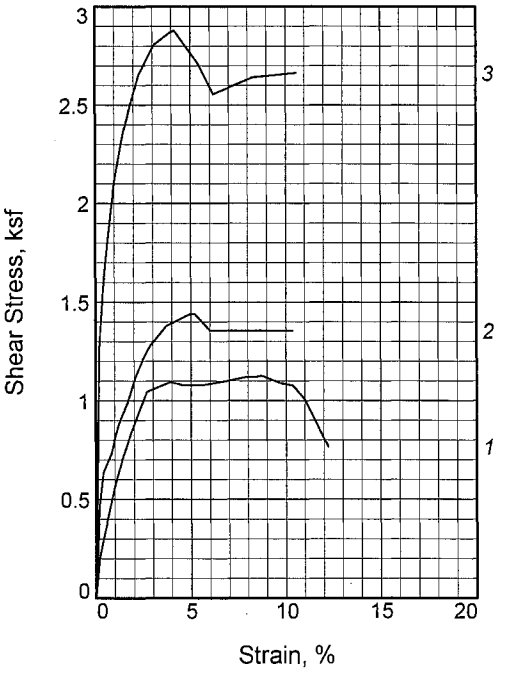
Project: BOULDER HIGHWAY STORM DRAIN

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

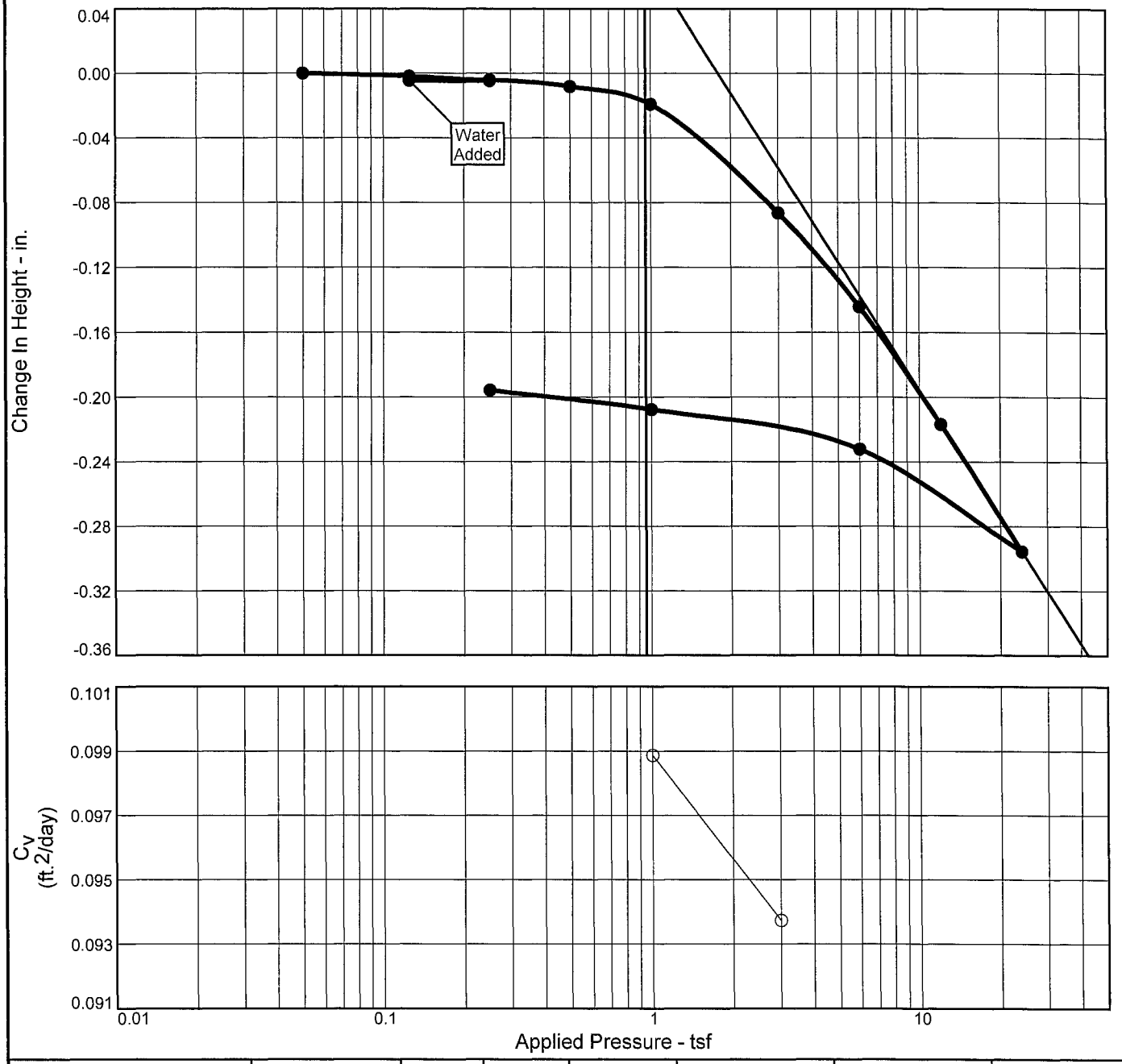
Project: BOULDER HIGHWAY STORM DRAIN

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:

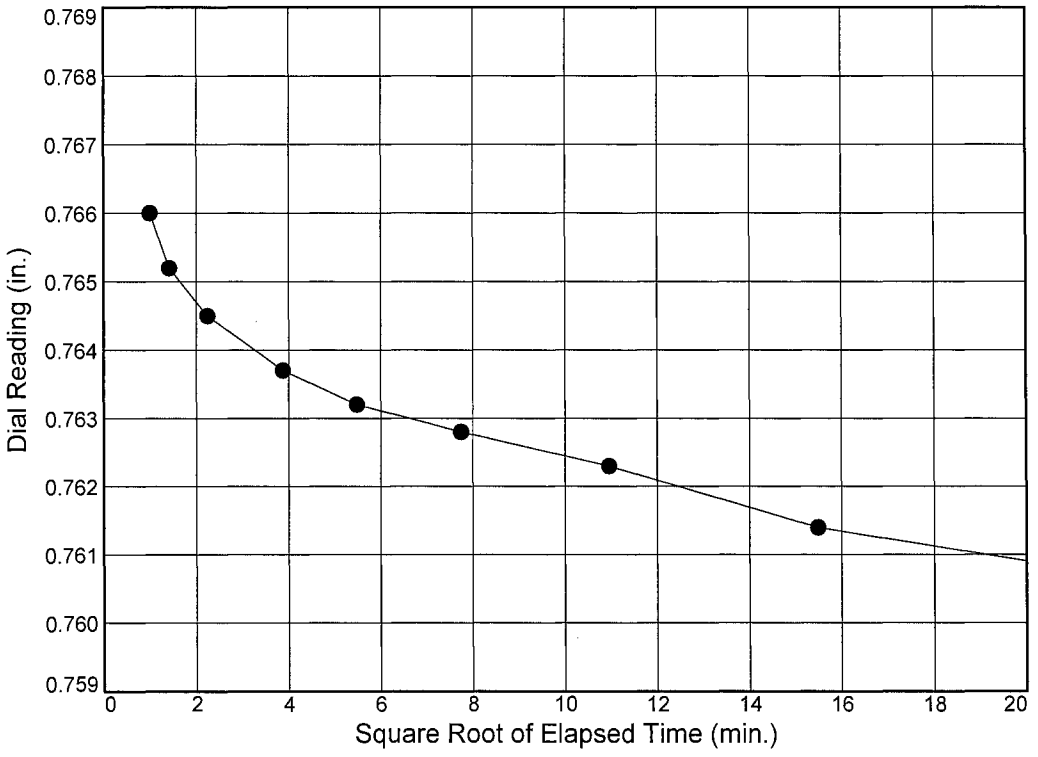
Figure B-19

Tested By: A. SANDERS

Dial Reading vs. Time

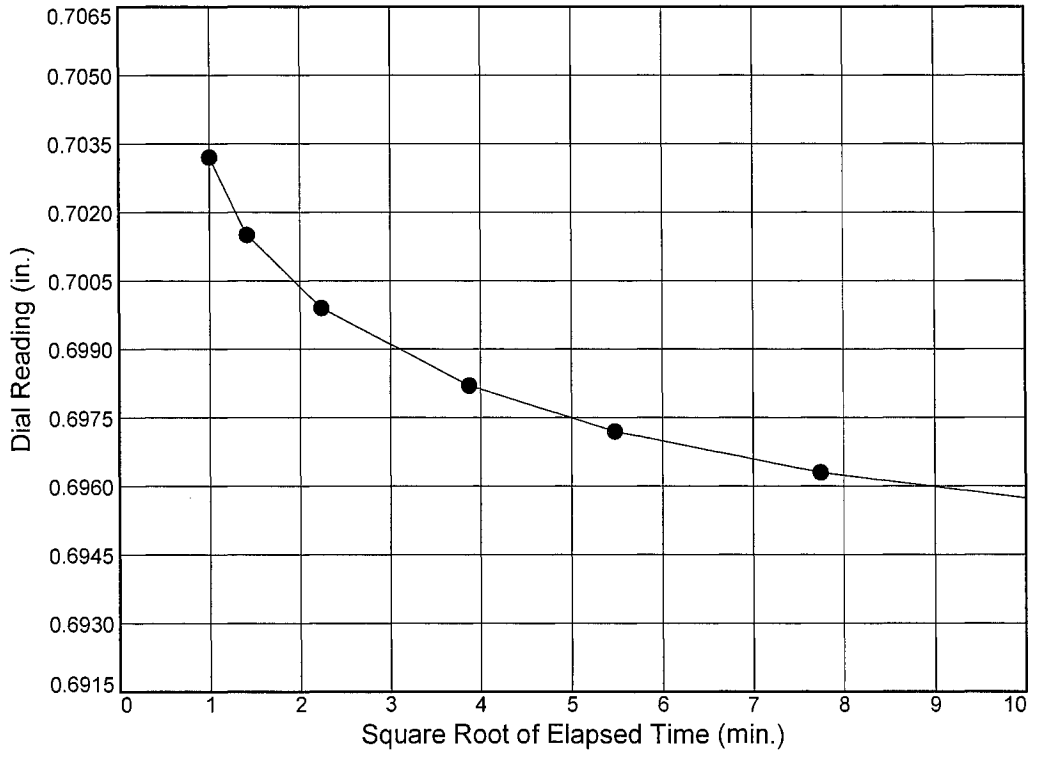
Project No.: 20153837E1
Project: BOULDER HIGHWAY STORM DRAIN

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

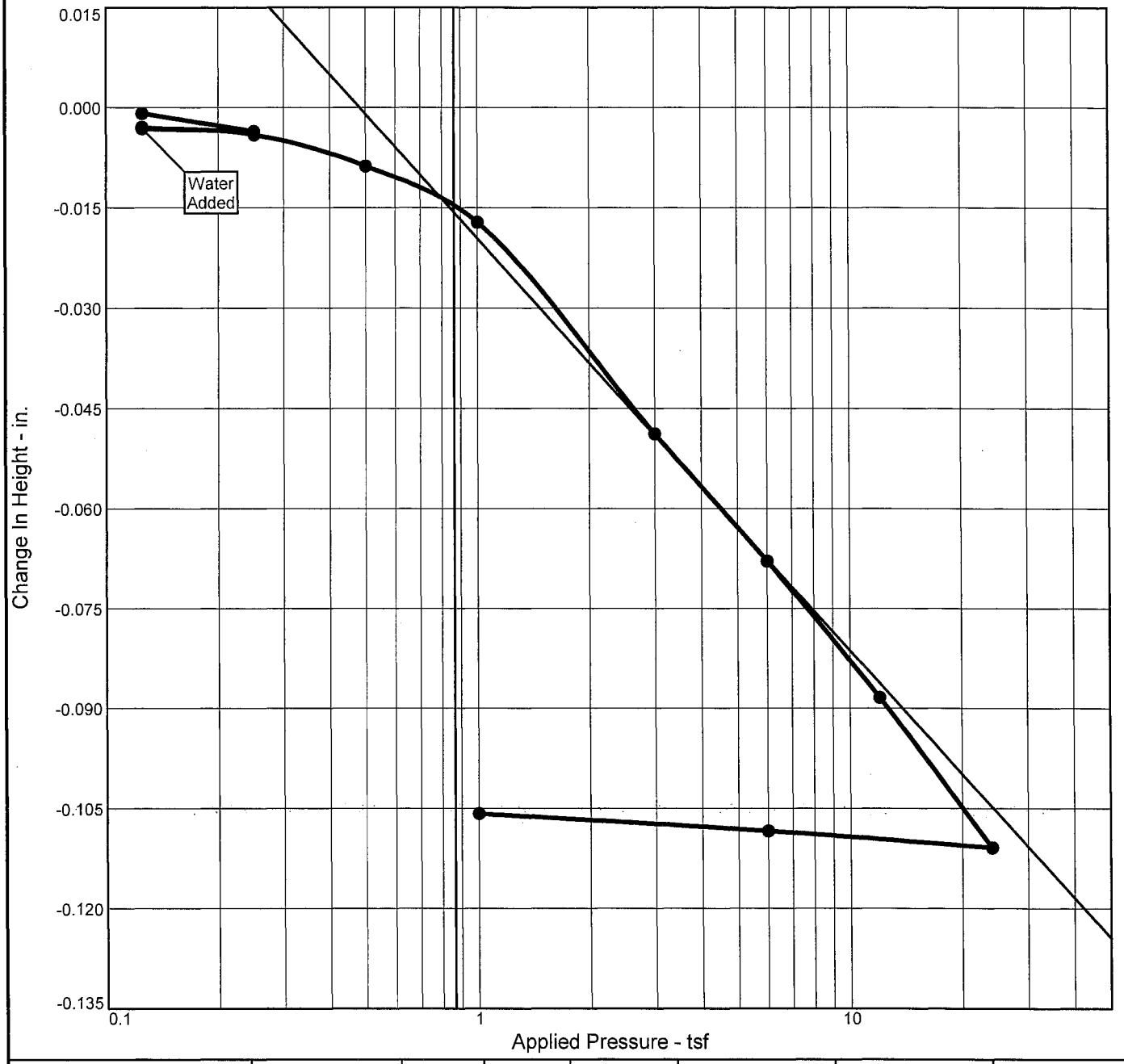


Load No.= 9
Load= 3.00 tsf
D_0 = 0.7042
D_{90} = 0.6978
D_{100} = 0.6971
T_{90} = 20.29 min.

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
Sierra Environmental Monitoring

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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

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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

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#: 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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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#: 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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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#: 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

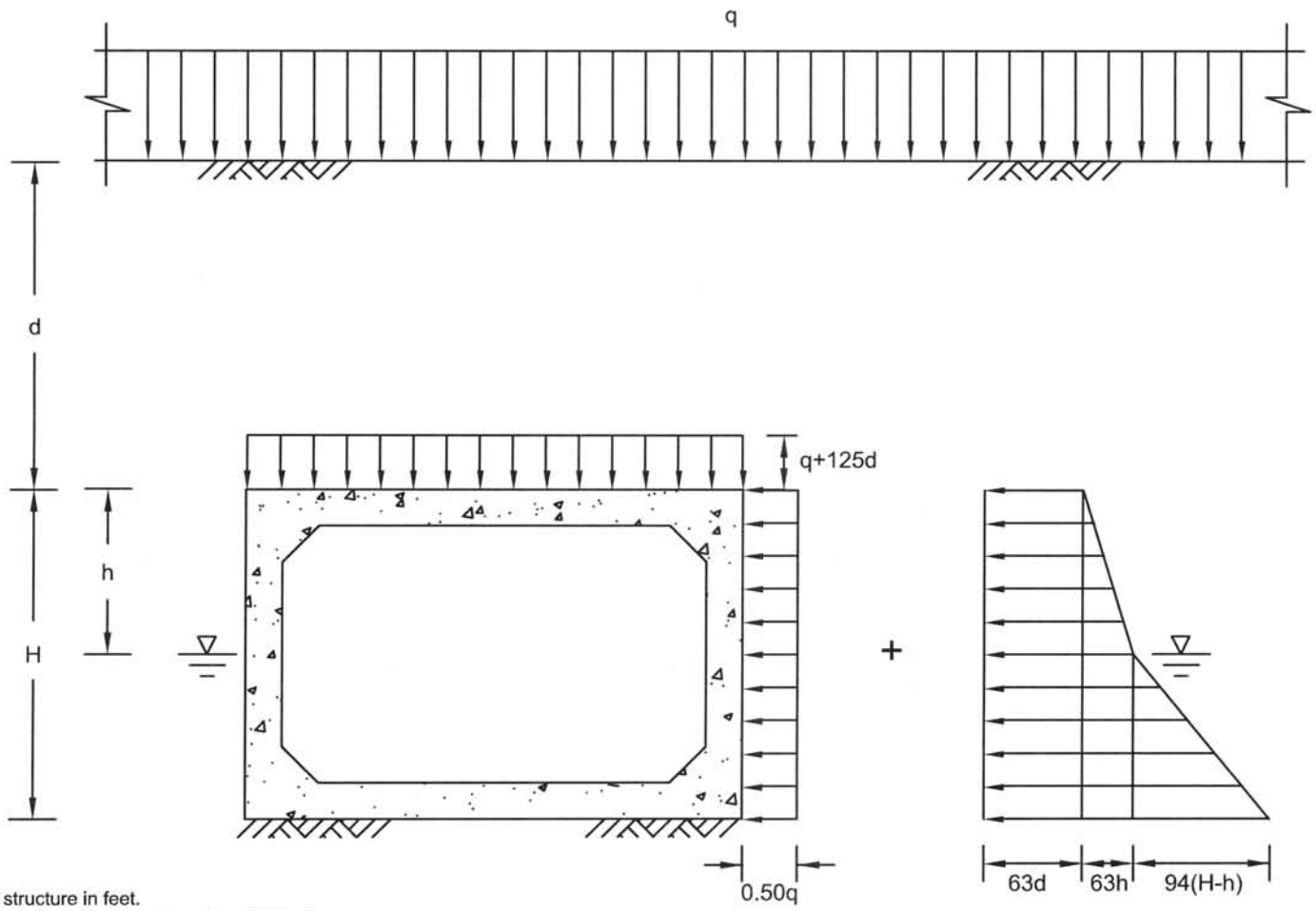
Qualifiers: (Qual)

*	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

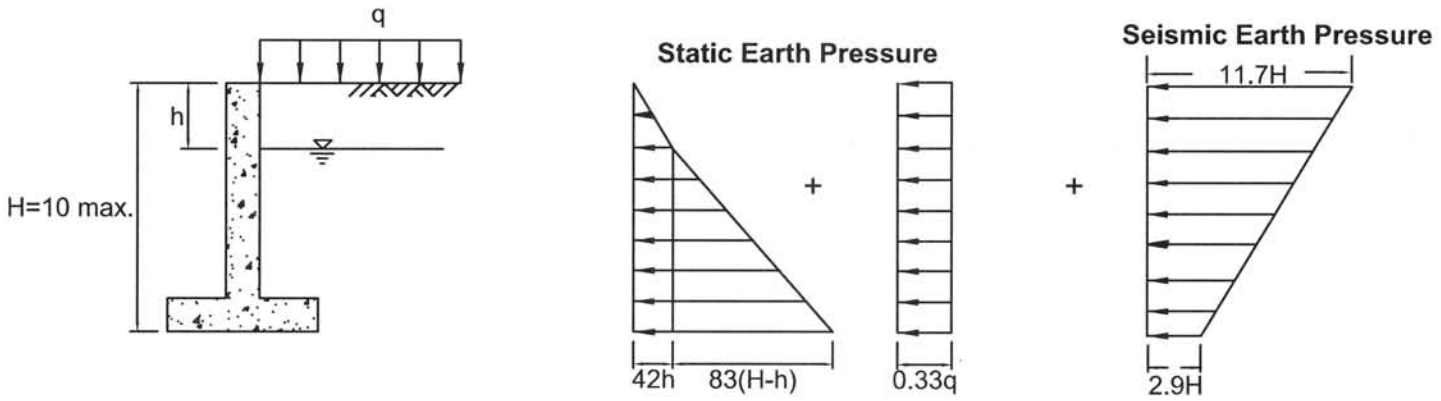
NOT TO SCALE

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
(702) 365-1001
7150 Placid Street
Las Vegas, NV 89119
www.gesnevada.com

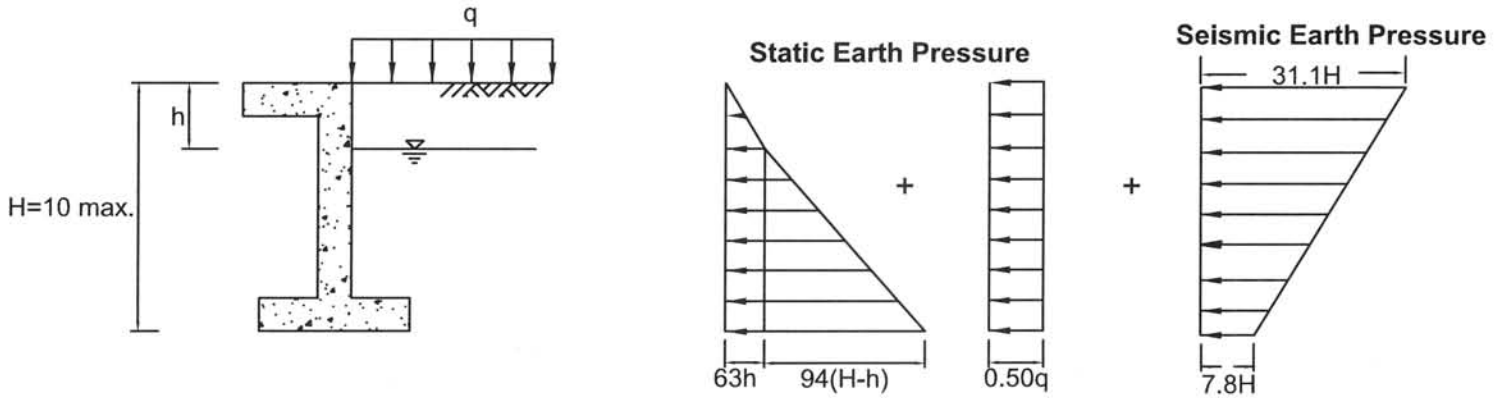
EARTH PRESSURE DIAGRAM FOR RCBS AND RIGID SUBSURFACE STRUCTURES
BOULDER HIGHWAY STORM DRAIN
SAHARA AVENUE TO CHARLESTON BOULEVARD
LAS VEGAS, NEVADA

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

GES
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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.

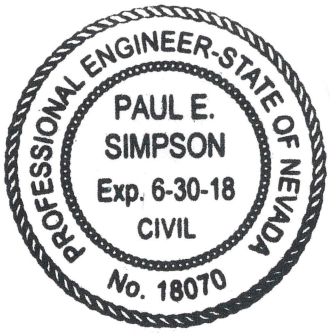
This report includes the results of the field exploration and laboratory testing programs, and recommendations for the design and construction of he proposed flood control facility.

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

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1. PURPOSE AND SCOPE 1
1.2. PROJECT DESCRIPTION 1
2. FIELD EXPLORATION 2
2.1. REGIONAL GEOLOGY AND HYDROGEOLOGY 2
2.2. SITE-SPECIFIC GEOLOGY AND HYDROGEOLOGY 3
3. MONOTORING WELL INSTALLATION 4
3.1. WELL DEVELOPMENT 4
4. GROUNDWATER SAMPLING 5
4.1. GROUNDWATER SAMPLE ANALYSIS 5
4.2. SLUG TESTING 7
5. CONCLUSIONS 7
6. LIMITATIONS 8
7. ENVIRONMENTAL CERTIFICATION JURAT 8

FIGURES

Figure A-1 – Vicinity Map
Figure A-2 – Exploration Location Map

TABLES

Table 1 – Summary of TPH, BTEX & MTBE Analytical Data
Table 2 - Summary of VOC Analytical Data
Table 3 - NDEP Groundwater Clean-up Standards (State Action Levels)

APPENDIX A – GROUNDWATER SAMPLING FIELD NOTES

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.

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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.

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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.

DRAFT

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*

DRAFT

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.

DRAFT

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.

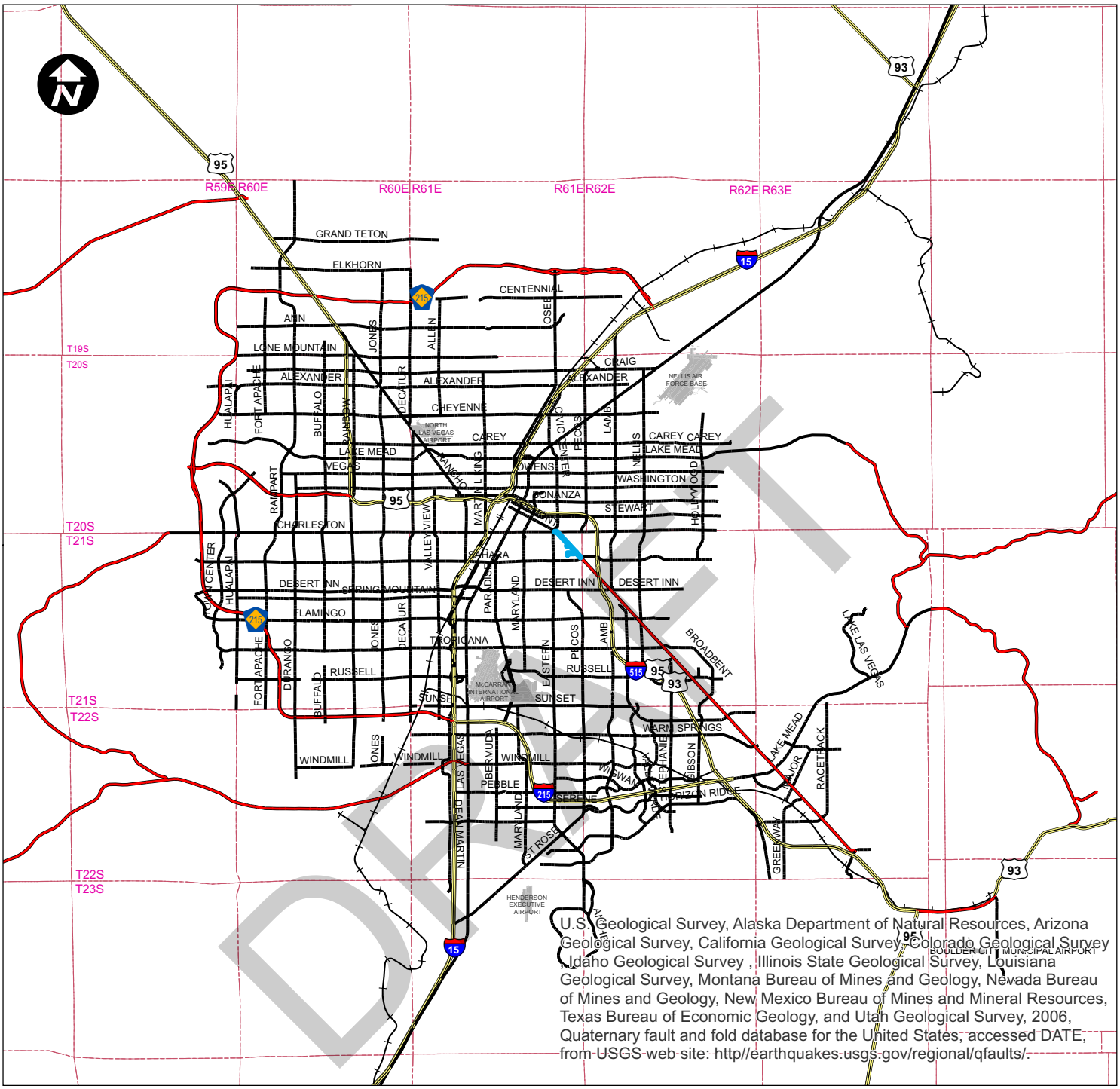
7. ENVIRONMENTAL CERTIFICATION JURAT

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

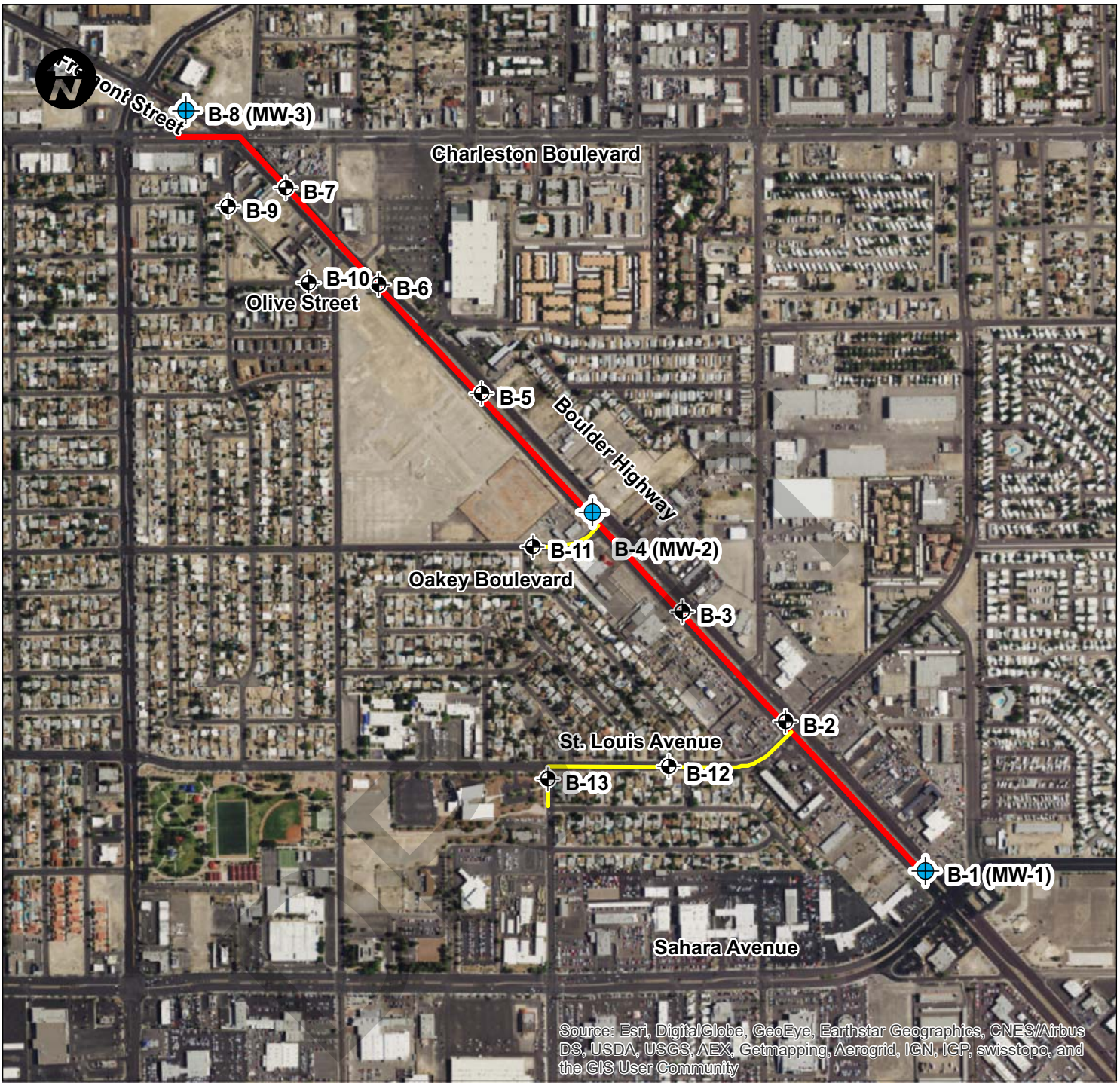
- Class B years
- Less than 1,600,000 years
- Less than 750,000 years
- Less than 130,000 years
- Less than 15,000 years
- Less than 150 years
- Unknown

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

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
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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

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Las Vegas, NV 89120
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Analytical Report

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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.
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Analytical Report

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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.
PQL	Practical Quantitation Limit.	U	Sample was analyzed for, but not detected.

Original

DRAFT

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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**
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

DRAFT

Qualifiers: (Qual)

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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**
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.
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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)

*	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: 16080631-02
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.
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: 16080631-02
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)

*	Value exceeds Maximum Contaminant Level.
DF	Dilution Factor.
MCL	Maximum Contaminant Level.
PQL	Practical Quantitation Limit.
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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: 16080631-02
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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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: 16080631-02
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)

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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: 16080631-03
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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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
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.
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: 16080631-03
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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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

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

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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

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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

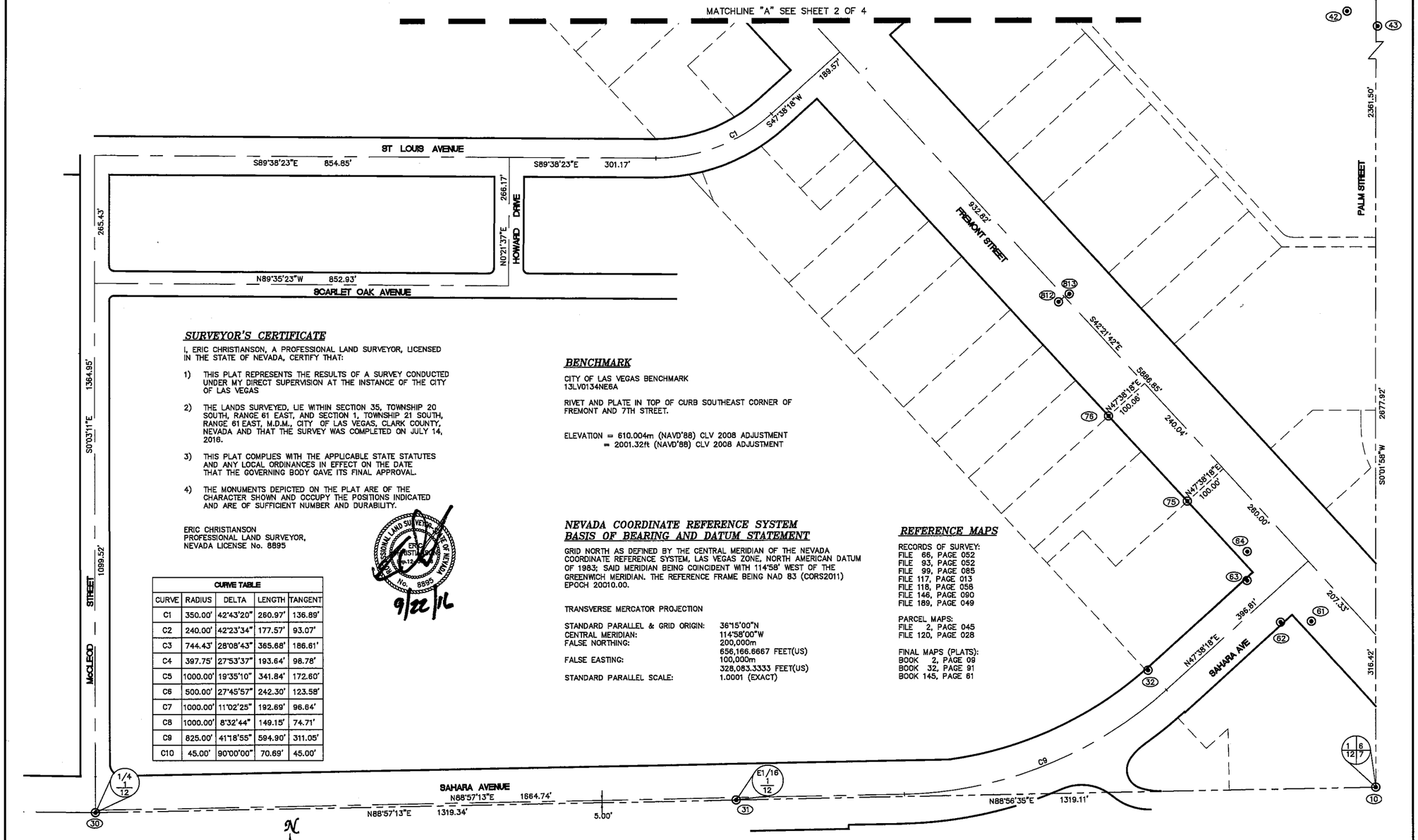
Record of Survey

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 · No. 8895

9/22/16

CURVE TABLE				
CURVE	RADIUS	DELTA	LENGTH	TANGENT
C1	350.00'	42°43'20"	260.97'	136.89'
C2	240.00'	42°23'34"	177.57'	93.07'
C3	744.43'	28°08'43"	365.68'	186.61'
C4	397.75'	27°53'37"	193.64'	98.78'
C5	1000.00'	19°35'10"	341.84'	172.60'
C6	500.00'	27°45'57"	242.30'	123.58'
C7	1000.00'	11°02'25"	192.69'	96.64'
C8	1000.00'	8°32'44"	149.15'	74.71'
C9	825.00'	41°18'55"	594.90'	311.05'
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 20010.00.

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 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

SHEET 1 OF 4

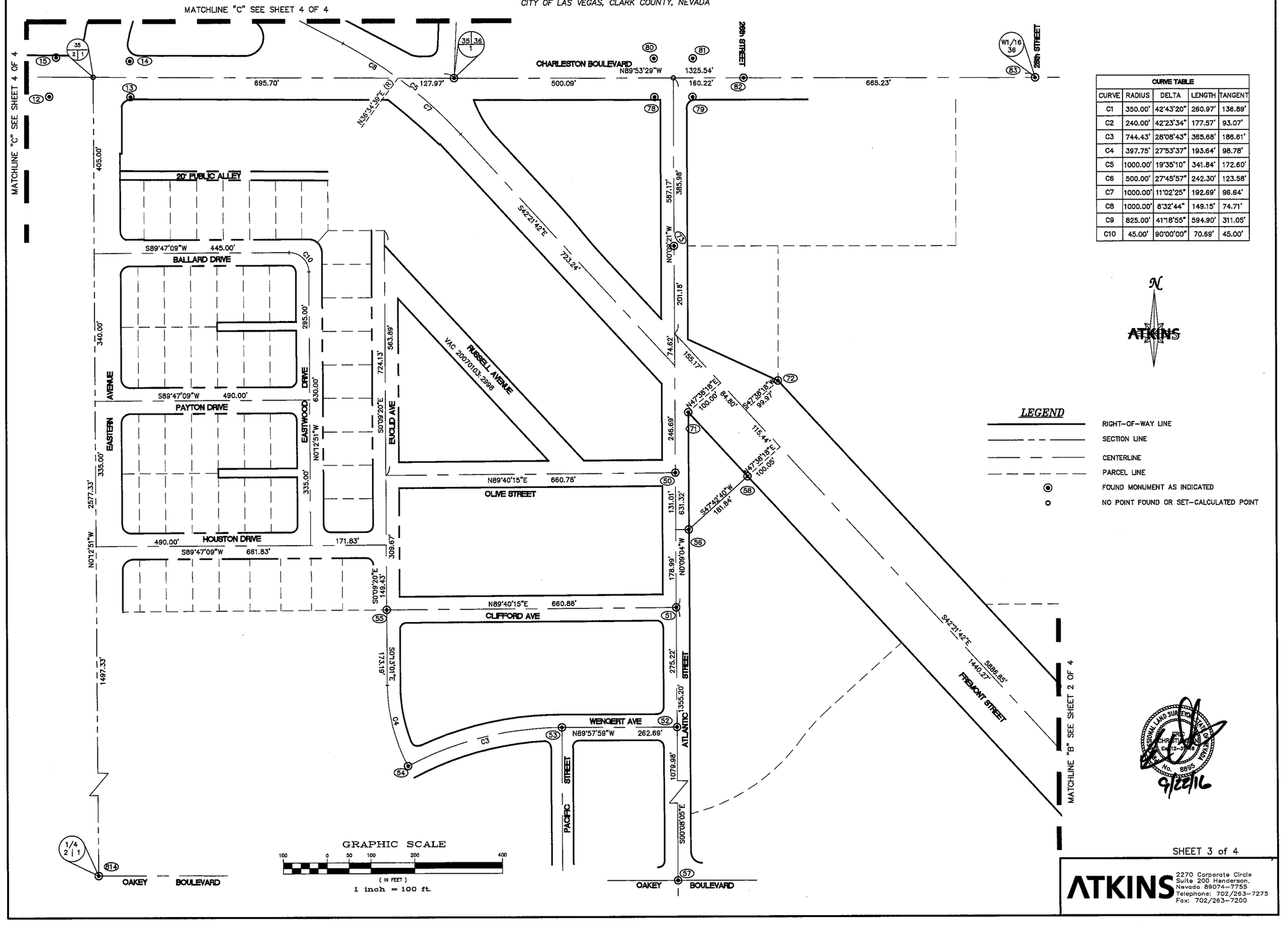
LOCATED IN PORTIONS OF SECTION 35, TOWNSHIP 20 SOUTH, RANGE 61 EAST AND SECTION 1, TOWNSHIP 21 SOUTH, RANGE 61 EAST, M.D.M. CITY OF LAS VEGAS, CLARK COUNTY, NEVADA

ATKINS
2270 Corporate Circle
Suite 200 Henderson,
Nevada 89074-7755
Telephone: 702/263-7275
Fax: 702/263-7200

No. _____
Filed at the request of
Atkins North America, Inc.
Date _____ Time _____
File _____ Page _____
of SURVEYS
Official Records Book No.
_____
Clark County, Nevada Records
DEBBIE CONWAY, Recorder
Fee _____ Deputy _____

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



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N

ATKINS

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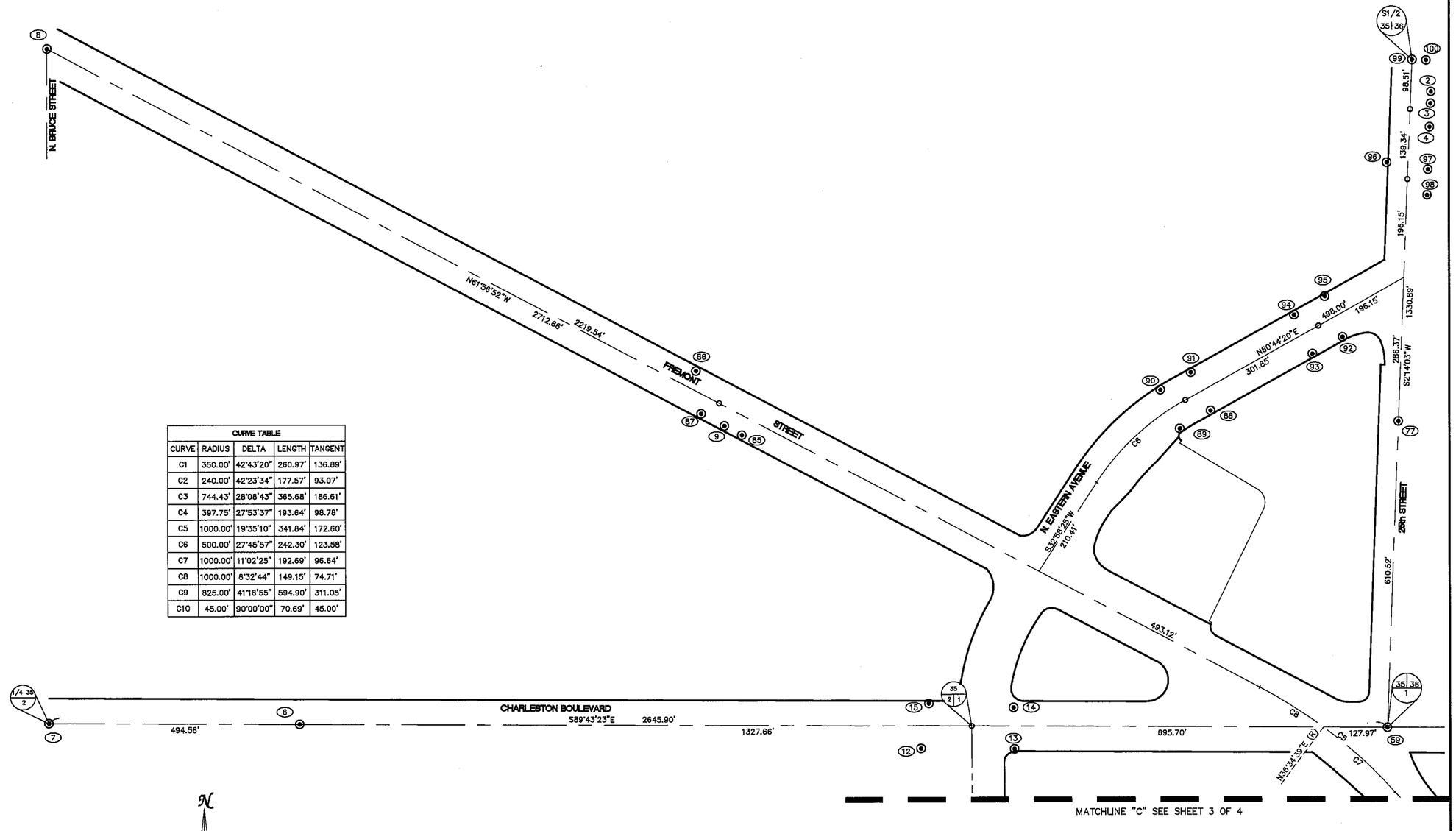
NEVADA
CHRISTOPHER H. ATKINS
No. 8895
PROFESSIONAL LAND SURVEYOR
9/22/16

SHEET 3 of 4

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Suite 200 Henderson,
Nevada 89074-7755
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Fax: 702/263-7200

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.,
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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

MATCHLINE "C" SEE SHEET 3 OF 4

PROFESSIONAL LAND SURVEYOR
CHRISTOPHER M. KEMP
STATE OF NEVADA
No. 8895

SHEET 4 of 4

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Appendix E

Utility Conflicts

Appendix E-1

Utility Conflict Matrix

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - MAINLINE

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: MK DATE:

PROJECT NO.: 100050127 CHECKED BY: KM DATE: 9/20/2016

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
SD01	17+00.00	2.29' RT	TO	20+88.59	12.15' LT	18" VCP SS												YES	COMBINE WITH 21" VCP SS
SD01	17+29.76	8.00' RT	TO	17+31.50	8.00' LT	15" RCP SD												NO	CONNECT TO RCB
SD01	18+93.69	8.00' RT	TO	18+96.19	8.00' LT	30" MLCSP WATER												NO	PROTECT-IN-PLACE
SD01	20+23.47	10.00' LT	TO	20+47.88	0.49' LT	8" VCP SS												YES	CONNECT TO 21" VCP SS
SD01	20+87.27	10.00' RT	TO	21+28.24	10.00' LT	21" VCP SS												NO	UPSIZE TO 30"
SD01	21+03.32	10.00' LT	TO	21+20.23	10.00' RT	8" ACP WATER												NO	REMOVE AND REPLACE
SD01	21+16.21	10.00' RT	TO	21+46.94	10.00' LT	6" PE GAS												NO	PROTECT-IN-PLACE
SD01	21+41.31	10.00' RT	TO	21+65.29	10.00' LT	69kV OK ELECTRIC												NO	PROTECT-IN-PLACE
SD01	21+41.40	10.00' RT	TO	21+64.86	10.00' LT	UG CATV/FO												NO	PROTECT-IN-PLACE
SD01	21+72.36	0.57' RT	TO	22+53.53	10.00' LT	LOOP DETECTORS AND CONDUIT												NO	REMOVE AND REPLACE
LATERAL	22+51.17	37.63' RT	TO	22+55.91	36.42' RT	8" ACP WATER												NO	PROTECT-IN-PLACE
LATERAL	22+56.72	32.08' RT	TO	22+63.08	29.26' RT	30" MLCSP WATER												NO	PROTECT-IN-PLACE
SD02	29+40.23	10.00' LT	TO	29+61.13	10.00' RT	(2) 3-1/2" UG TELEPHONE												NO	PROTECT-IN-PLACE
SD02	29+51.23	10.00' LT	TO	29+73.99	10.00' RT	8" ACP WATER												NO	REMOVE AND REPLACE
SD02	29+72.19	10.00' LT	TO	29+94.80	10.00' RT	12" VCP SS												NO	REMOVE AND REPLACE
SD02	30+25.93	10.00' RT	TO	30+27.05	10.00' LT	8" VCP SS												NO	REMOVE AND REPLACE
SD02	30+53.62	10.00' RT	TO	30+56.38	10.00' LT	18" RCP SD												NO	REMOVE
SD03	34+18.10	10.00' RT	TO	34+24.10	10.00' RT	LOOP DETECTORS												NO	REMOVE AND REPLACE
SD03	36+47.58	42.00' RT	TO	36+51.94	42.00' RT	LOOP DETECTOR CONDUIT												NO	REMOVE AND REPLACE
SD03	36+98.40	10.00' RT	TO	37+06.50	10.00' RT	LOOP DETECTOR AND CONDUIT												NO	REMOVE AND REPLACE
SD03	37+24.58	10.00' LT	TO	37+27.32	10.00' RT	24" RCP SD												NO	CONNECT TO RCB
SD03	38+62.55	10.00' RT	TO	38+62.65	10.00' LT	TRAFFIC SIGNAL CONDUIT												NO	REMOVE AND REPLACE
INLET	45+08.45	43.45' RT	TO	45+29.45	43.53' RT	8" VCP SS												NO	REMOVE AND REPLACE
SD04	45+17.72	10.00' RT	TO	45+20.23	10.00' LT	24" RCP SD												NO	CONNECT TO RCB
SD04	48+66.18	10.00' RT	TO	48+68.72	10.00' LT	24" RCP SD												NO	CONNECT TO RCB
INLET	48+77.58	43.50' RT	TO	48+81.97	42.65' RT	10" VCP SS												NO	REMOVE AND REPLACE
INLET	52+98.43	43.73' RT	TO	53+14.43	43.73' RT	10" VCP SS												NO	REMOVE AND REPLACE
SD05	53+50.88	10.00' LT	TO	53+51.56	10.00' RT	3-1000 MCM UG ELECTRIC												NO	PROTECT-IN-PLACE
SD06	59+44.64	11.00' RT	TO	59+48.53	11.00' LT	24" RCP SD												NO	CONNECT TO RCB
SD06	63+14.80	7.44' LT	TO	63+22.88	11.00' RT	LOOP DETECTORS AND CONDUIT												NO	REMOVE AND REPLACE
INLET	65+03.42	46.39' RT	TO	65+15.74	43.88' RT	24" RCP SD												NO	CONNECT TO RCB
INLET	65+11.88	43.22' RT	TO	65+18.33	42.38' RT	10" VCP SS												NO	REMOVE AND REPLACE
INLET	65+77.41	98.55' LT	TO	65+80.19	97.55' LT	8" ACP WATER												NO	REMOVE AND REPLACE
SD06	66+25.54	10.56' RT	TO	66+35.44	1.58' RT	LOOP DETECTORS AND CONDUIT												NO	REMOVE AND REPLACE
SD06	67+53.43	11.00' RT	TO	67+54.76	11.00' LT	12" ACP WATER												YES/NO	"OVER" - RELOCATE; "UNDER" - REMOVE & REPLACE
SD07	68+30.94	7.44' LT	TO	68+40.02	11.00' RT	LOOP DETECTORS AND CONDUIT												NO	REMOVE AND REPLACE
SD07	69+26.54	11.00' LT	TO	69+61.07	11.00' RT	10" VCP SS												YES/NO	"OVER" - ABANDON; "UNDER" - ABANDON
SD07	71+01.88	7.36' LT	TO	71+12.18	13.00' RT	LOOP DETECTORS AND CONDUIT												NO	REMOVE AND REPLACE
SD07	71+28.34	13.00' LT	TO	71+29.61	13.00' RT	LOOP DETECTOR CONDUIT												NO	REMOVE AND REPLACE
SD07	72+20.63	13.00' RT	TO	72+30.00	13.00' LT	51" RCP SS INSIDE 72" STEEL CASING												NO	PROTECT-IN-PLACE
SD07	74+48.27	8.75' RT	TO	74+50.81	8.75' LT	24" RCP SD												NO	CONNECT TO RCB
LATERAL	74+79.53	28.31' LT	TO	74+92.25	23.85' LT	51" RCP SS												NO	PROTECT-IN-PLACE
SD08	78+72.24	8.75' RT	TO	78+75.66	8.75' LT	NDOT TRAFFIC COUNT CONDUIT												NO	REMOVE AND REPLACE
SD08	79+05.76	8.75' LT	TO	79+05.96	8.75' RT	2" PE GAS												NO	PROTECT-IN-PLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - MAINLINE

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: MK DATE:

PROJECT NO.: 100050127 CHECKED BY: KM DATE: 9/20/2016

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
INLET	79+41.46	43.79' RT	TO	79+45.82	42.97' RT	10" VCP SS												NO	REMOVE AND REPLACE
SD08	82+32.52	7.44' LT	TO	82+40.93	8.75' RT	LOOP DETECTORS AND CONDUIT												NO	REMOVE AND REPLACE
INLET	83+08.41	43.57' RT	TO	83+10.91	42.73' RT	10" VCP SS												NO	REMOVE AND REPLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - OAKEY

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: MK DATE:

PROJECT NO.: 100050127 CHECKED BY: KM DATE: 9/20/2016

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
	Oakey Lateral Alignment 1																		
SD13	10+84.33	1.19' RT	TO	10+91.21	4.00' LT	3-1000 MCM UG ELEC												YES	RELOCATE
	Oakey Mainline																		
SD12	11+95.93	2.88' LT	TO	12+66.72	3.00' RT	4" PE GAS												YES	RELOCATE
SD12	14+73.09	3.29' LT	TO	14+76.90	3.29' RT	30" MLCSP WATER												NO	PROTECT-IN-PLACE
SD12	14+73.25	3.29' LT	TO	14+78.06	3.29' RT	18" RCP SD												NO	PROTECT-IN-PLACE
SD12	14+84.35	3.29' LT	TO	14+88.15	3.29' RT	10" VCP SS												NO	REMOVE & REPLACE
	Oakey lateral alignment 2																		
SD13	10+51.06	1.25' RT	TO	10+52.46	1.25' LT	3-1000 MCM UG ELEC												YES	RELOCATE
SD13	11+16.35	1.25' LT	TO	11+17.82	1.25' RT	1-1/4" PE GAS												NO	PROTECT-IN-PLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - ST. LOUIS

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: MK DATE:

PROJECT NO.: 100050127 CHECKED BY: KM DATE: 9/20/2016

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
St louis Mainline																			
SD14	10+75.50	2.50' RT	TO	10+81.56	2.50' LT	8" VCP SS, AND SS MANHOLE												YES	RELOCATE
SD14	11+97.51	1.83' LT	TO	11+97.65	1.83' RT	#6 CU OH ELEC												NO	PROTECT-IN-PLACE
SD14	15+69.06	2.13' RT	TO	15+73.21	2.13' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD14	15+75.33	2.13' LT	TO	15+86.08	2.13' RT	45" RCP SS												NO	PROTECT-IN-PLACE
SD14	15+75.61	2.13' RT	TO	15+79.79	2.13' LT	8" WATER												NO	PROTECT-IN-PLACE
SD14-16	16+02.17	6.06' LT	TO	30+76.81	12.74' LT	8" TO 10" VCP SS (AND MANHOLES)												YES	RELOCATE
SD14	16+42.78	2.42' LT	TO	16+42.79	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD14	17+05.65	2.42' LT	TO	17+05.66	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	17+67.96	2.42' LT	TO	17+67.97	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	18+19.40	2.42' LT	TO	18+19.41	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	18+75.86	2.42' LT	TO	18+76.87	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	19+43.49	2.42' LT	TO	19+43.49	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	20+06.89	2.42' LT	TO	20+06.96	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	20+62.90	2.42' LT	TO	20+62.90	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	20+79.24	2.42' LT	TO	20+79.24	2.42' RT	2" PE GAS												NO	PROTECT-IN-PLACE
SD15	21+31.10	2.42' LT	TO	21+31.10	2.42' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	21+96.78	3.00' LT	TO	21+96.78	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	22+51.90	3.00' LT	TO	22+51.91	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	23+03.28	3.00' LT	TO	23+03.28	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	23+69.98	3.00' LT	TO	23+69.98	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	24+15.43	3.00' LT	TO	23+15.43	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	24+31.99	3.00' LT	TO	24+32.01	3.00' RT	2" PE GAS												NO	PROTECT-IN-PLACE
SD15	24+68.80	3.00' RT	TO	24+68.80	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	24+78.85	3.00' LT	TO	24+78.85	3.00' RT	SS SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	25+82.14	3.00' LT	TO	25+82.14	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	25+99.49	3.00' LT	TO	25+99.50	3.00' RT	SS SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	26+27.22	3.00' LT	TO	26+27.72	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD15	26+40.51	3.00' LT	TO	26+41.05	3.00' RT	8" VCP SS												YES	RELOCATE AND CONNECT TO 45" RCP SS AT 30+90
SD16	26+98.02	3.00' LT	TO	26+98.02	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD16	27+15.42	3.00' LT	TO	27+15.42	3.00' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD16	27+59.88	3.03' LT	TO	27+59.31	2.97' RT	8" VCP SS												NO	REMOVE AND REPLACE
SD16	27+62.87	3.03' LT	TO	27+67.27	3.00' RT	3-336 AA OH ELEC												NO	PROTECT-IN-PLACE
SD16	27+75.63	2.98' RT	TO	27+76.49	3.01' LT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD16	27+96.29	2.98' RT	TO	27+96.55	3.02' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD16	28+30.67	3.01' LT	TO	28+32.05	3.00' RT	SS SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD16	29+17.50	3.02' LT	TO	29+17.61	2.98' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD16	29+27.28	3.03' LT	TO	29+27.30	2.97' RT	SS SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD16	29+36.95	2.97' RT	TO	29+37.03	3.03' RT	WATER SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD16	29+46.88	2.97' RT	TO	29+47.12	3.03' LT	SS SERVICE LATERAL												NO	PROTECT-IN-PLACE
SD16	30+96.01	3.29' LT	TO	31+06.01	3.29' RT	24" RCP SD												NO	PROTECT-IN-PLACE
SD16	30+96.09	3.29' RT	TO	31+14.85	3.29' LT	51" RCP SS INSIDE 72" STEEL CASING												NO	PROTECT-IN-PLACE
SD16	30+98.99	3.52' LT	TO	31+08.71	3.29' RT	30" MLCSP WATER												NO	PROTECT-IN-PLACE
SD16	31+14.07	3.29' LT	TO	31+21.30	3.29' RT	10" VCP SS												NO	REMOVE AND REPLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - ST. LOUIS

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: MK DATE:

PROJECT NO.: 100050127 CHECKED BY: KM DATE: 9/20/2016

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
St Louis SD lateral at intersection of McLeod Street and Scarlet Oak Avenue: no utility conflicts																			
St Louis SD lateral west of McLeod Street																			
SD14	10+89.69	1.25' LT	TO	11+21.16	1.25' RT	45" RCP SS												NO	PROTECT-IN-PLACE
SD14	11+56.64	1.25' RT	TO	11+57.13	1.25' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD14	11+61.48	1.25' RT	TO	11+61.98	1.25' LT	8" WATER												NO	PROTECT-IN-PLACE
SD14	11+90.45	1.25' RT	TO	11+96.84	1.25' LT	8" VCP SS												YES	RELOCATE
SD14	11+98.73	1.25' LT	TO	12+00.09	1.25' RT	8" WATER												NO	PROTECT-IN-PLACE
SD14	12+04.21	1.25' LT	TO	12+05.58	1.25' RT	2" PE GAS												NO	PROTECT-IN-PLACE
SD14	12+27.66	1.25' RT	TO	12+32.33	1.25' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD14	12+29.78	1.25' RT	TO	12+34.45	1.25' LT	8" WATER												NO	PROTECT-IN-PLACE
St Louis SD lateral east of Silver Birch Lane																			
SD15	10+55.16	1.54' LT	TO	10+60.50	1.54' RT	2" PE GAS												NO	PROTECT-IN-PLACE
SD15	10+61.81	1.54' LT	TO	10+75.13	1.54' RT	45" RCP SS												NO	PROTECT-IN-PLACE
SD15	10+65.59	1.54' RT	TO	10+67.37	1.54' LT	WATER SERVICE LATERAL												YES	RELOCATE
SD15	11+03.28	1.54' RT	TO	11+07.31	1.54' LT	8" VCP SS												YES	RELOCATE
SD15	11+33.30	1.54' RT	TO	11+36.40	1.54' LT	8" WATER												NO	PROTECT-IN-PLACE
SD15	11+34.49	0.06' RT	TO	11+43.01	8.27' RT	WATER SERVICE LATERAL												YES	RELOCATE
St Louis SD lateral west of Fremont Street																			
SD16	10+21.50	57.15' LT	TO	10+21.69	62.48' LT	WATER SERVICE LATERAL												YES	RELOCATE
SD16	10+61.58	1.83' LT	TO	10+82.90	1.83' RT	45" RCP SS												NO	PROTECT-IN-PLACE
SD16	11+50.70	1.83' RT	TO	11+72.45	1.83' LT	10" VCP SS												NO	REMOVE AND REPLACE
SD16	11+63.79	1.83' RT	TO	11+71.76	1.83' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD16	11+76.16	1.83' RT	TO	11+83.16	1.83' LT	6" WATER												NO	PROTECT-IN-PLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - ATLANTIC

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: MK DATE:

PROJECT NO.: 100050127 CHECKED BY: KM DATE: 9/20/2016

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
Atlantic SD Mainline																			
SD10	11+51.79	2.71' RT	TO	11+57.73	2.71' LT	4" PE GAS												NO	PROTECT-IN-PLACE
SD10	11+53.37	2.71' LT	TO	11+55.51	0.84' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD10	11+58.28	2.71' RT	TO	11+64.59	2.71' LT	6" ACP WATER												NO	REMOVE AND REPLACE
SD10	11+64.90	2.71' RT	TO	11+71.75	2.71' LT	12" VCP SS												NO	REMOVE AND REPLACE
SD10	11+80.54	2.71' RT	TO	18+44.73	3.29' LT	24" TO 30" RCP SD AND MANHOLES												YES	REMOVE
SD10	12+70.46	2.71' RT	TO	12+70.53	2.71' LT	3-#6 CU OH ELECTRIC												NO	PROTECT-IN-PLACE
SD10	15+77.70	2.71' RT	TO	15+77.75	2.71' LT	3-#6 CU OH ELECTRIC												NO	PROTECT-IN-PLACE
SD10	17+21.05	3.00' RT	TO	17+23.40	3.00' LT	16" ACP WATER												NO	REMOVE AND REPLACE
SD10	17+48.09	3.00' LT	TO	17+49.70	3.00' LT	18" RCP SD												YES	REMOVE
SD10	18+62.93	3.29' RT	TO	18+68.38	3.29' RT	16" ACP WATER												NO	REMOVE AND REPLACE
SD10	19+02.22	3.29' LT	TO	19+06.23	3.29' RT	30" MLCSP WATER												NO	PROTECT-IN-PLACE
Atlantic SD lateral on Wengert Avenue																			
SD11	11+43.66	2.42' RT	TO	11+52.52	2.42' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD11	11+54.69	2.42' RT	TO	11+66.12	2.96' RT	24" RCP SD												YES	REMOVE
SD11	11+79.73	2.96' LT	TO	11+87.08	2.96' RT	10" VCP SS												NO	REMOVE AND REPLACE
SD11	11+90.65	2.96' LT	TO	11+97.61	2.96' RT	8" CIP WATER												NO	PROTECT-IN-PLACE
Atlantic SD lateral at intersection of Wengert Avenue																			
SD10	10+34.84	0.96' RT	TO	10+35.09	0.96' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD10	10+39.38	0.96' LT	TO	10+40.00	0.96' RT	6" ACP WATER												NO	REMOVE AND REPLACE
SD10	10+44.18	0.96' LT	TO	10+45.13	0.96' RT	12" VCP SS												NO	REMOVE AND REPLACE
Atlantic SD lateral just south of Clifford Avenue																			
SD10	10+44.10	3.96' RT	TO	10+53.80	1.65' LT	2" PE GAS												YES	RELOCATE
SD10	10+81.66	1.25' RT	TO	10+87.99	1.25' LT	12" VCP SS												NO	REMOVE AND REPLACE
Atlantic SD lateral south of Olive Street																			
SD10	10+55.77	1.25' RT	TO	10+61.42	1.25' LT	6" ACP WATER												NO	REMOVE AND REPLACE
SD10	10+83.70	1.25' RT	TO	10+87.97	1.25' LT	12" VCP SS												NO	REMOVE AND REPLACE
Atlantic SD lateral north of Olive Street																			
SD10	10+51.37	1.25' RT	TO	10+52.56	1.25' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD10	10+54.76	1.25' RT	TO	10+56.81	1.25' LT	8" ACP WATER												NO	REMOVE AND REPLACE
SD10	10+69.54	1.25' RT	TO	10+71.60	1.25' LT	12" VCP SS												NO	REMOVE AND REPLACE
Atlantic SD lateral on Olive Street																			
SD10	10+56.81	0.96' RT	TO	10+60.84	0.96' RT	18" RCP SD												YES	CONNECT TO NEW SD MANHOLE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - ATLANTIC

PROJECT: BOULDER HIGHWAY STORM DRAIN PREPARED BY: MK DATE:

PROJECT NO.: 100050127 CHECKED BY: KM DATE: 9/20/2016

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
SD10	10+90.41	1.25' RT	TO	10+90.65	1.25' LT	2" PE GAS												NO	PROTECT-IN-PLACE
SD10	10+93.66	1.25' RT	TO	10+94.52	1.25' LT	8" ACP WATER												NO	REMOVE AND REPLACE
SD10	11+06.51	1.25' RT	TO	11+07.78	1.25' LT	12" VCP SS												NO	REMOVE AND REPLACE

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - EUCLID

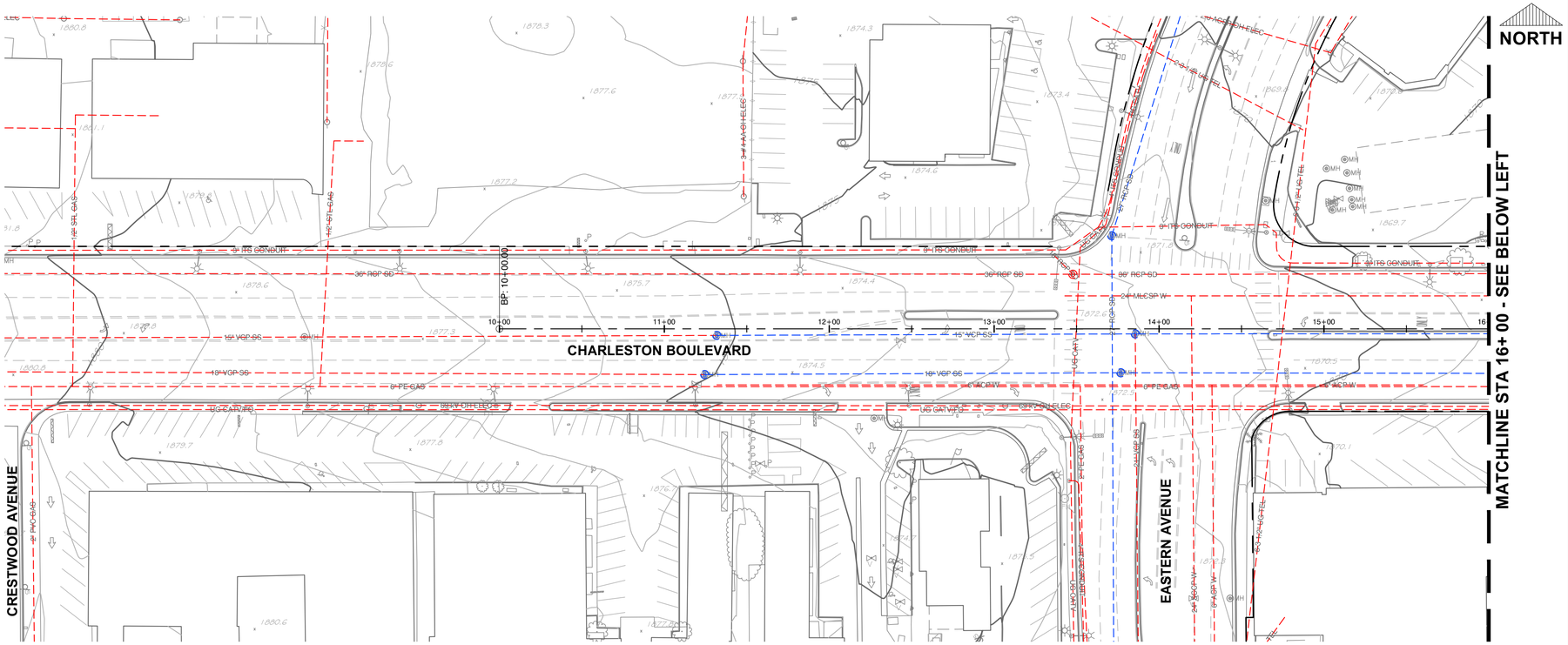
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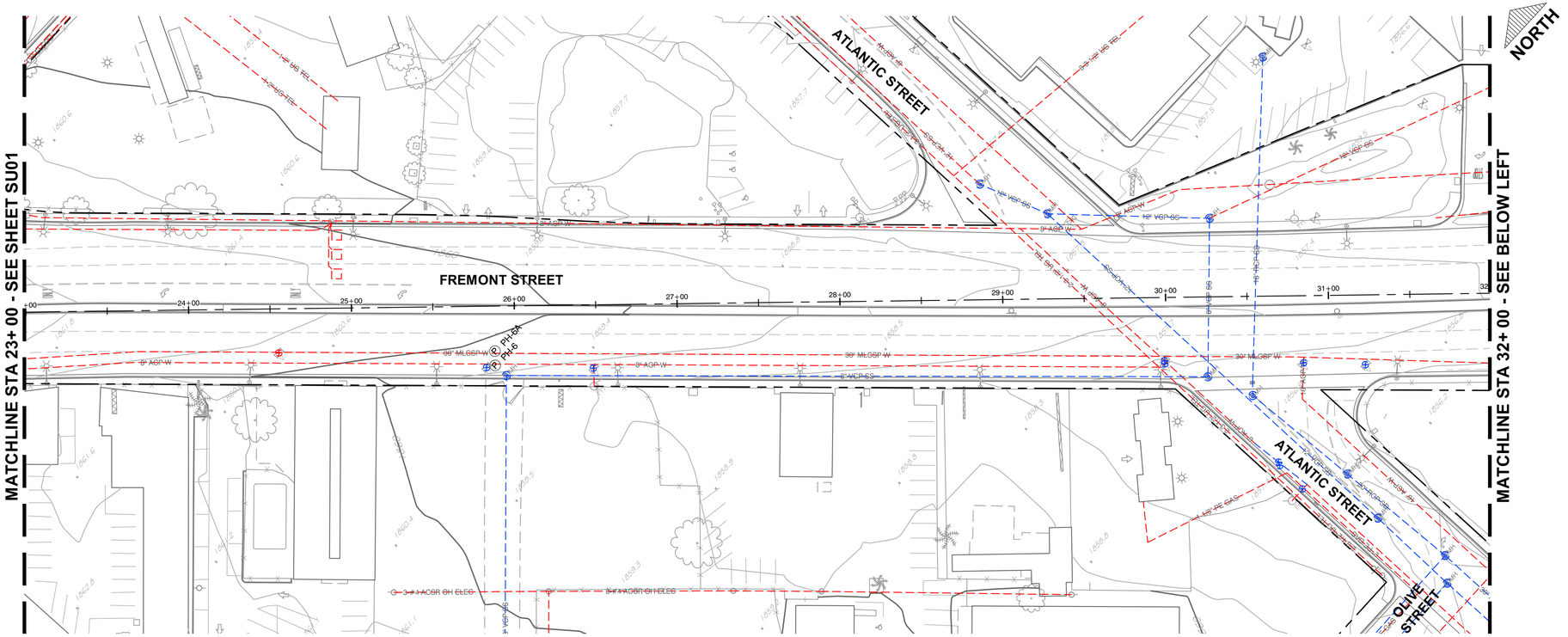
PROJECT NO.: 100050127 CHECKED BY: KM DATE: 9/20/2016

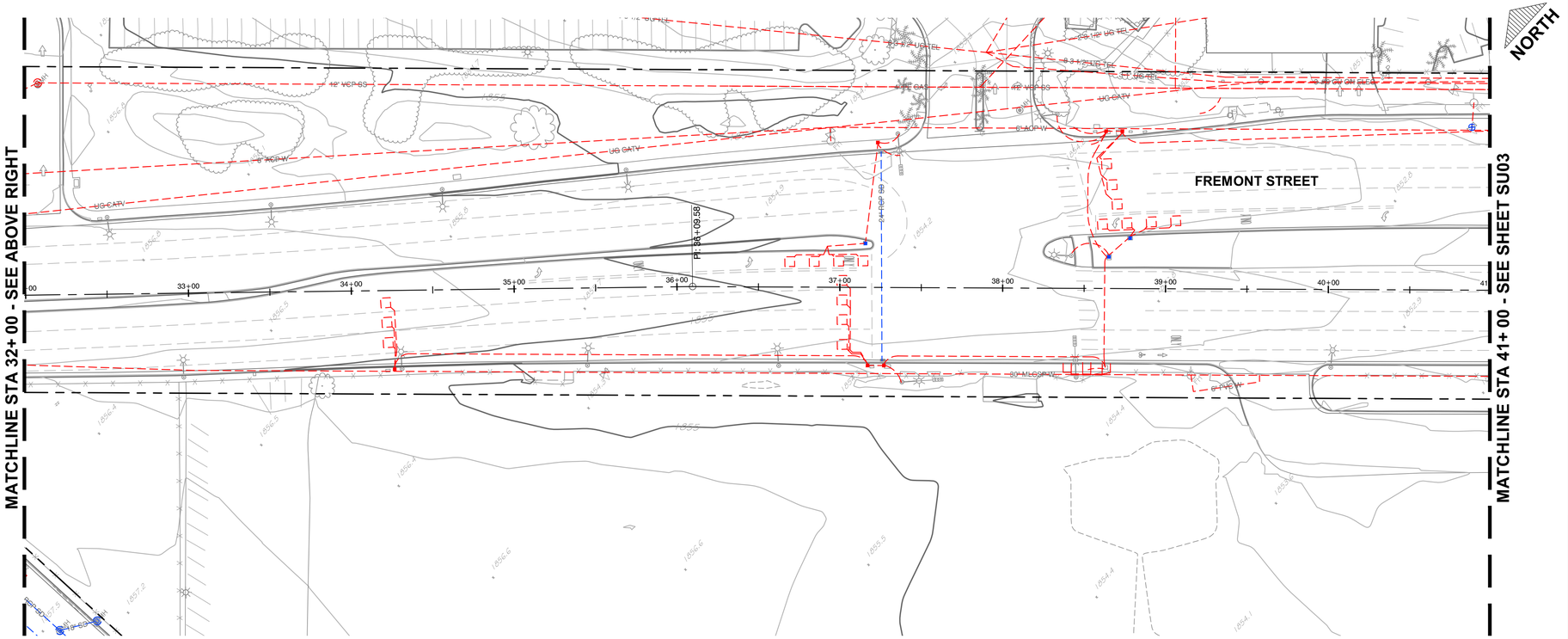
SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA	OFFSET	SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
	Euclid Lateral Alignment 1																		
SD09	10+32.48	0.28' RT	TO	10+33.34	2.17' RT	8" PVC WATER												YES	RELOCATE
SD09	10+39.56	0.05' RT	TO	10+40.25	1.94' RT	6" CIP WATER												YES	RELOCATE
SD09	10+57.54	0.55' LT	TO	10+58.48	1.34' RT	8" VCP SS												NO	PROTECT-IN-PLACE
	Euclid Mainline																		
SD09	12+06.37	0.96' RT	TO	12+06.59	0.96' LT	2" PE GAS												YES	RELOCATE
SD09	12+29.60	0.96' RT	TO	12+30.02	0.96' LT	2" PE GAS												YES	RELOCATE

Appendix E-2

S U E plans


NORTH
CHARLESTON BOULEVARD
CRESTWOOD AVENUE
EASTERN AVENUE
MATCHLINE STA 16+ 00 - SEE BELOW LEFT
BP: 10+00.00
10+00
11+00
12+00
13+00
14+00
15+00
16
36" RCP SD
15" VCP SS
18" VCP SS
24" MLCSP W
8" PE GAS
6" PE GAS
8" TS CONDUIT
6" TS CONDUIT
4" TS CONDUIT
8" TR CONDUIT
4" TR CONDUIT
4" TS CONDUIT
8





GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

HORIZ 1 inch = 40 ft.

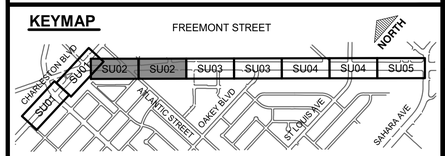
CALL BEFORE CONSTRUCTION

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 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

BID# XX-XXXX	DESIGNED BY: KRM		
H# H62695	DRAWN BY: WHJ		
DATE: SEPTEMBER, 2016	CHECKED BY: MSB		
SUBMITTAL STAGE: 30% SUBMITTAL			

TITLE
BOULDER HIGHWAY
STORM DRAIN

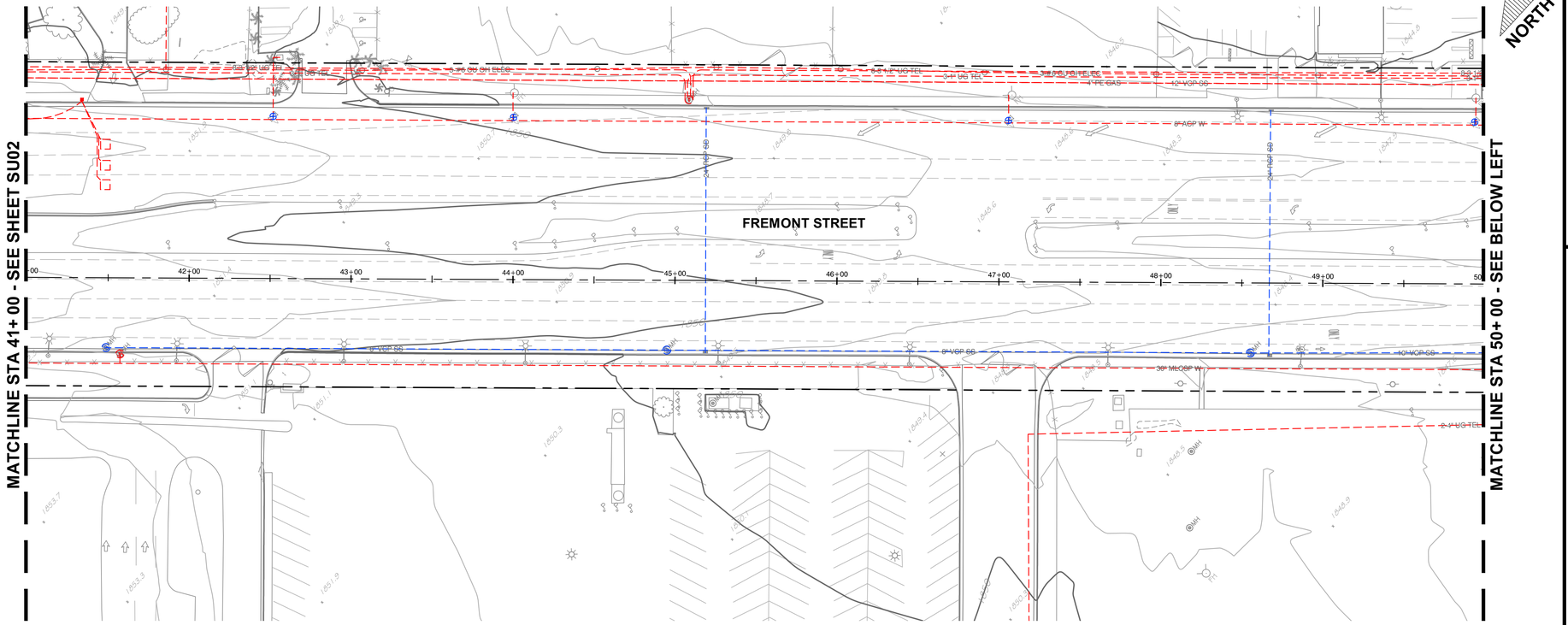
SHEET
EXISTING UTILITIES LOCATION PLAN
STA 23+ 00 TO STA 41+ 00

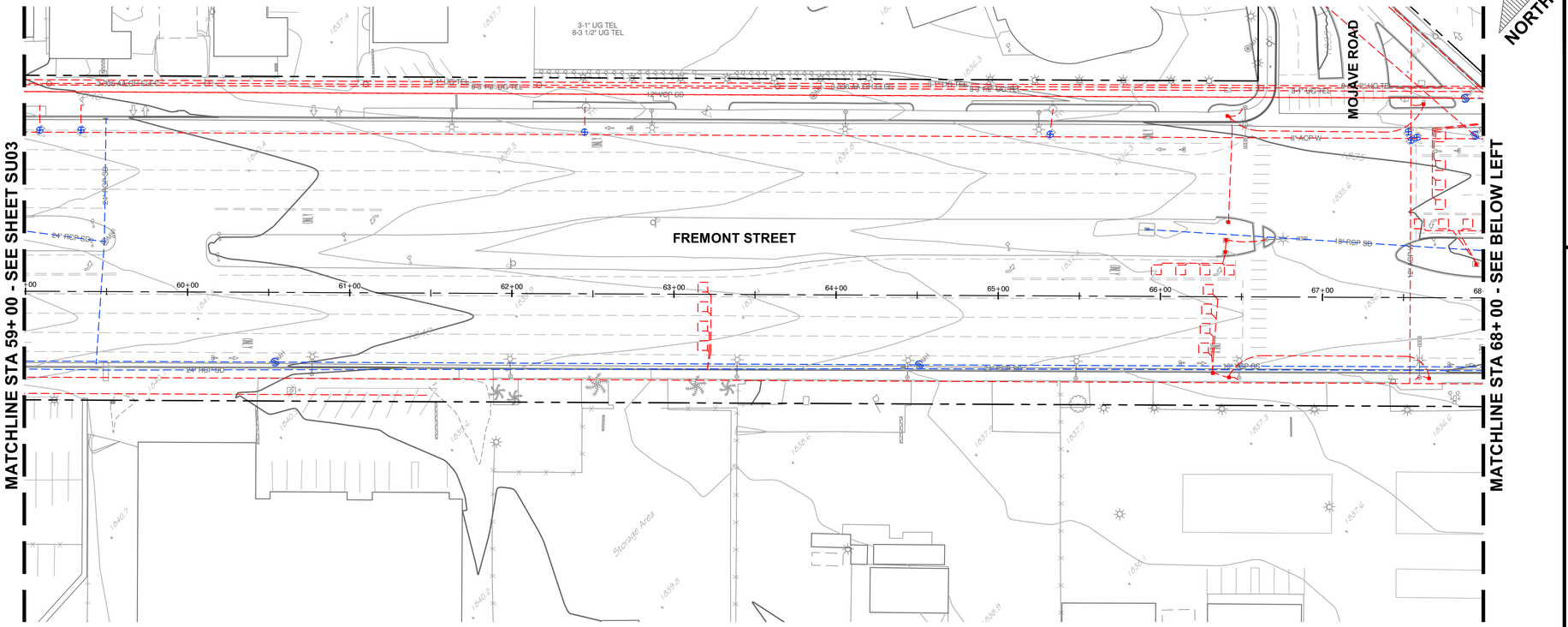
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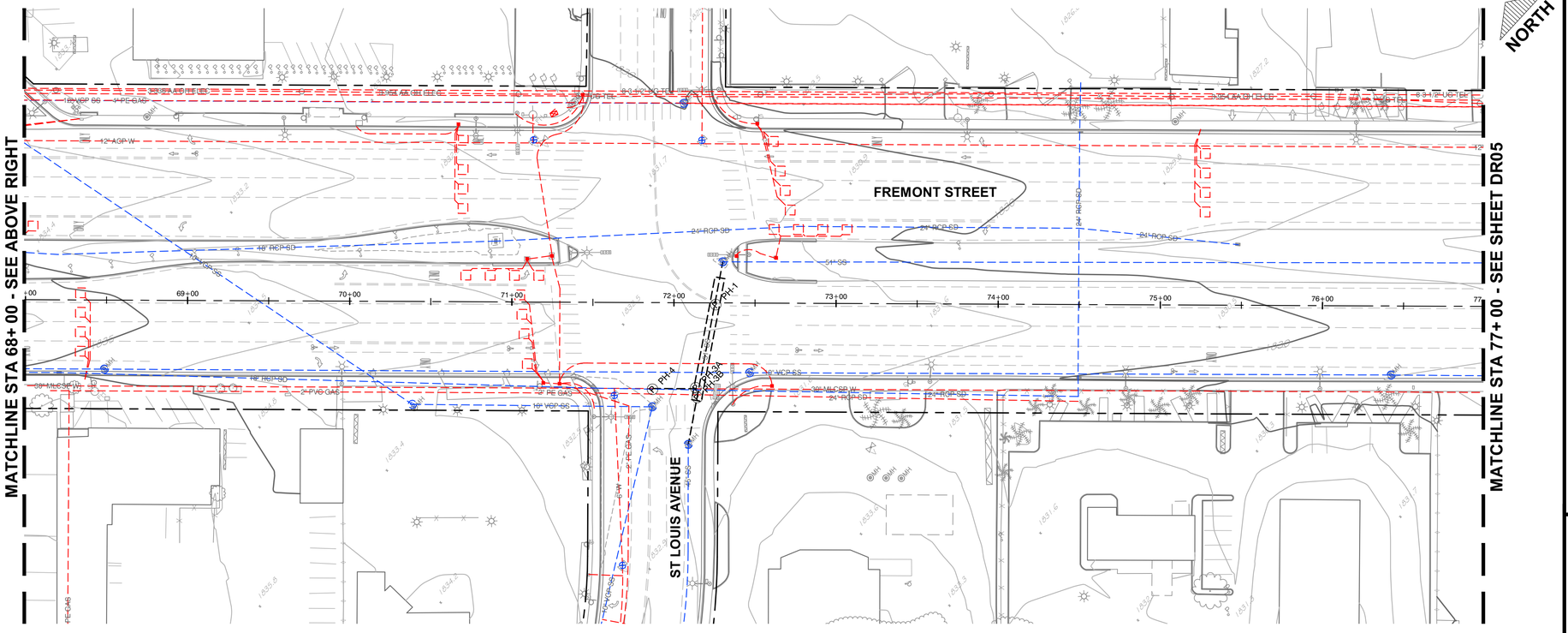
SHEET
SU02
2 OF 8

DRAWING NO.
XXX-XXXX

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NORTH
MATCHLINE STA 41+ 00 - SEE SHEET SU02
MATCHLINE STA 50+ 00 - SEE BELOW LEFT
FREMONT STREET
42+00
43+00
44+00
45+00
46+00
47+00
48+00
49+00
24" VCP SD
8" VCP SD
8" MLOSP W
8" AGT W
4" UG TEL
4" FE GAS
12" VCP SD
24" RCP SD
2" UG TEL
2" STL GAS
6" UG TEL
6" UG ELEC
6" UG TEL
6" UG ELEC
6" UG TEL
6" UG ELEC





GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

HORIZ 1 inch = 40 ft.

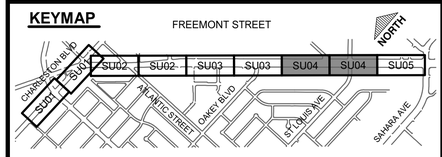
CALL BEFORE CONSTRUCTION

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

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I#	H62695
DATE:	SEPTEMBER, 2016
BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	WHJ
CHECKED BY:	MSB
SUBMITTAL STAGE:	30% SUBMITTAL

TITLE
BOULDER HIGHWAY STORM DRAIN

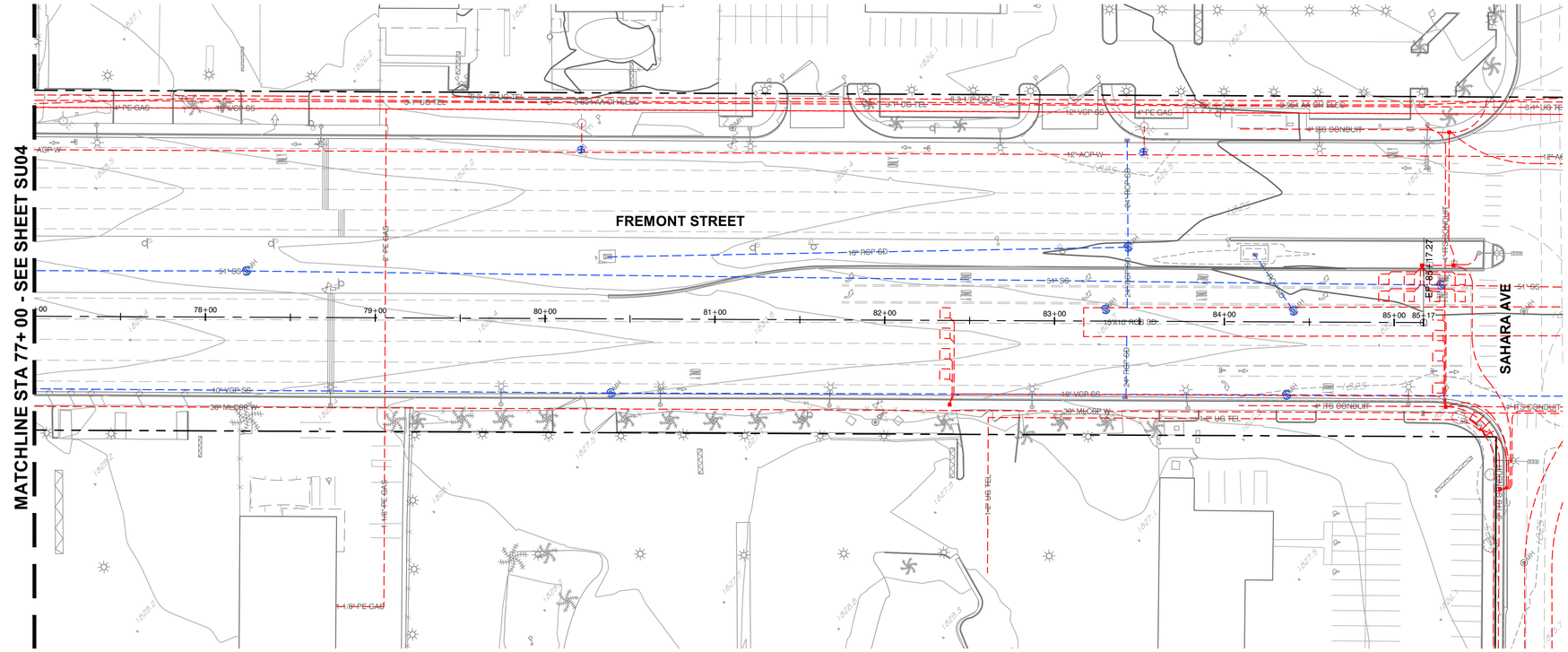
SHEET
EXISTING UTILITIES LOCATION PLAN STA 59+ 00 TO STA 77+ 00

NOT FOR CONSTRUCTION

SHEET
SU04
4 OF 8

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

HORIZ 1 inch = 40 ft.

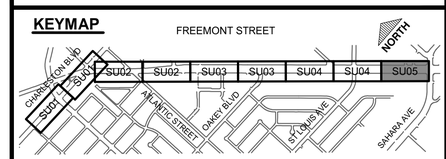
CALL BEFORE CONSTRUCTION

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



REVISIONS

NO.	DATE

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H#	H62695
DATE:	SEPTEMBER, 2016
SUBMITTAL STAGE:	30% SUBMITTAL
BID#	XX-XXXX
DESIGNED BY:	KRM
DRAWN BY:	WHJ
CHECKED BY:	MSB

TITLE
BOULDER HIGHWAY STORM DRAIN

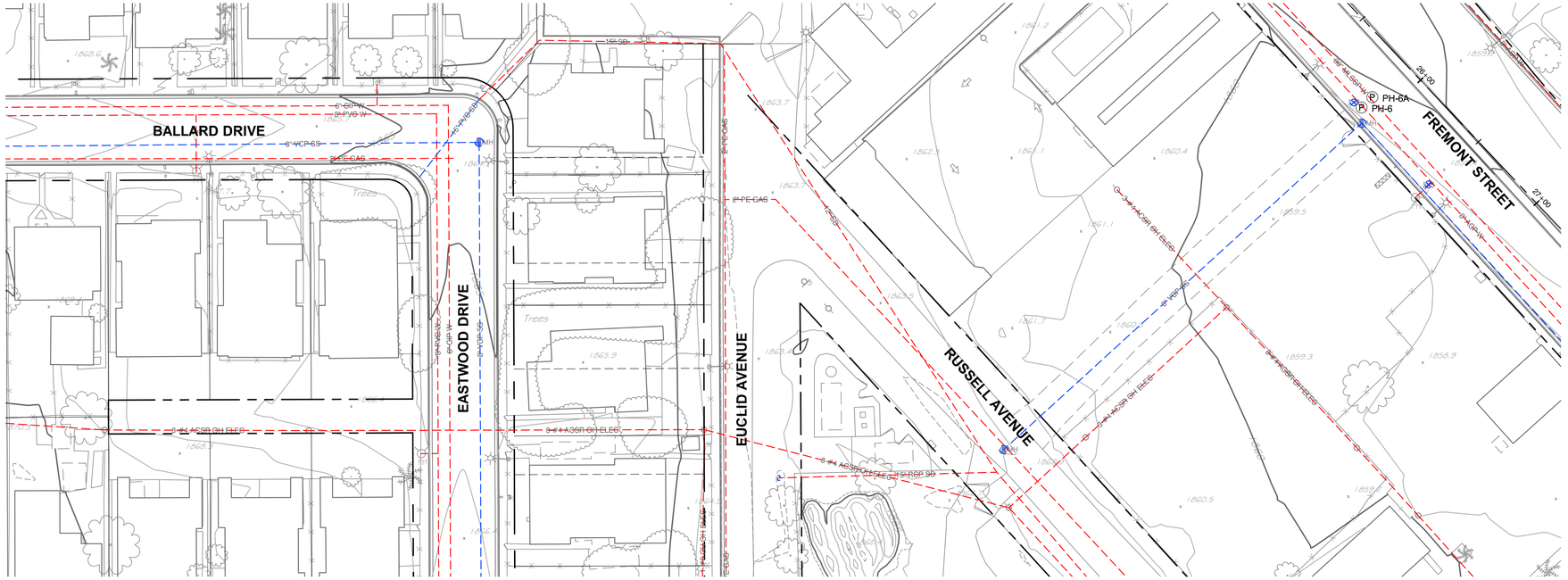
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EXISTING UTILITIES LOCATION PLAN STA 77+ 00 TO END

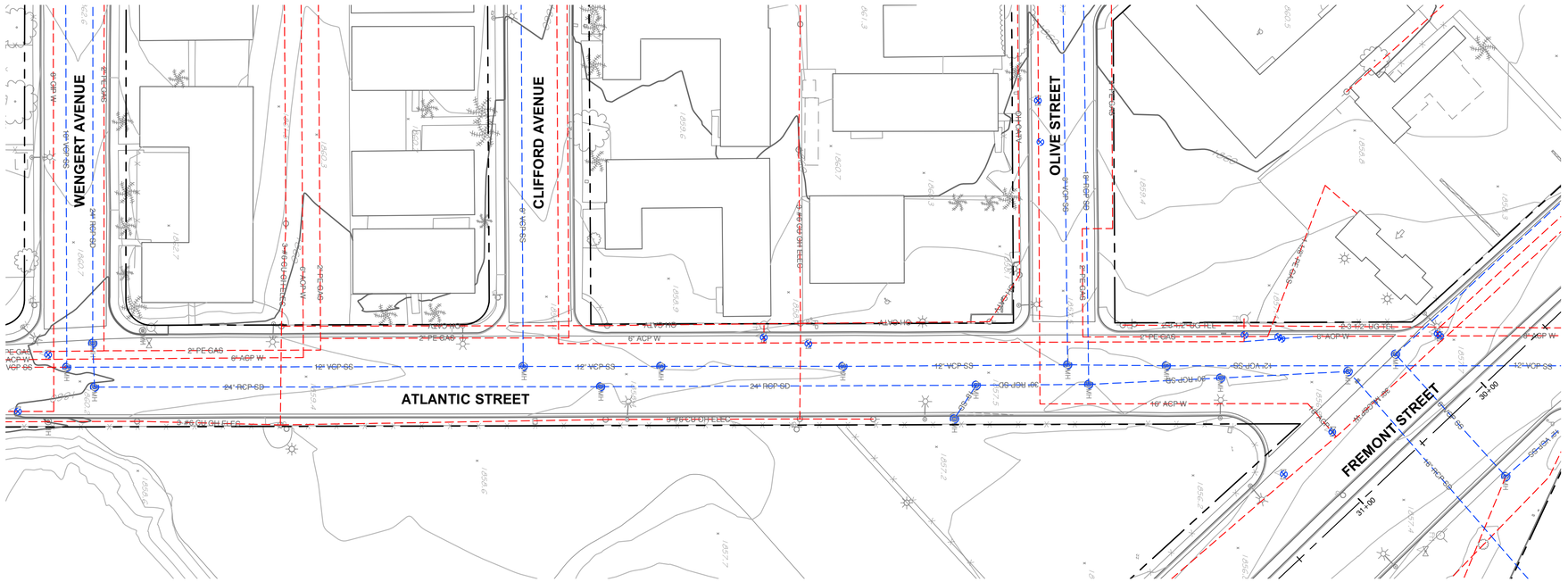
NOT FOR CONSTRUCTION

SHEET
SU05
5 OF 8

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

HORIZ 1 inch = 40 ft.
VERTICAL 1 inch = 4 ft.

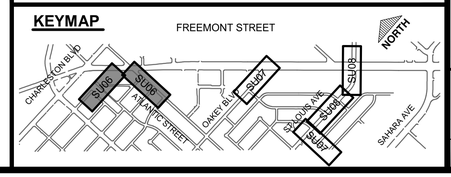
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



REVISIONS

NO.	DATE

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I#	H626/95
DATE:	SEPTEMBER, 2016
SUBMITTAL STAGE:	30% SUBMITTAL
BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	WHJ
CHECKED BY:	MSB

TITLE
BOULDER HIGHWAY STORM DRAIN

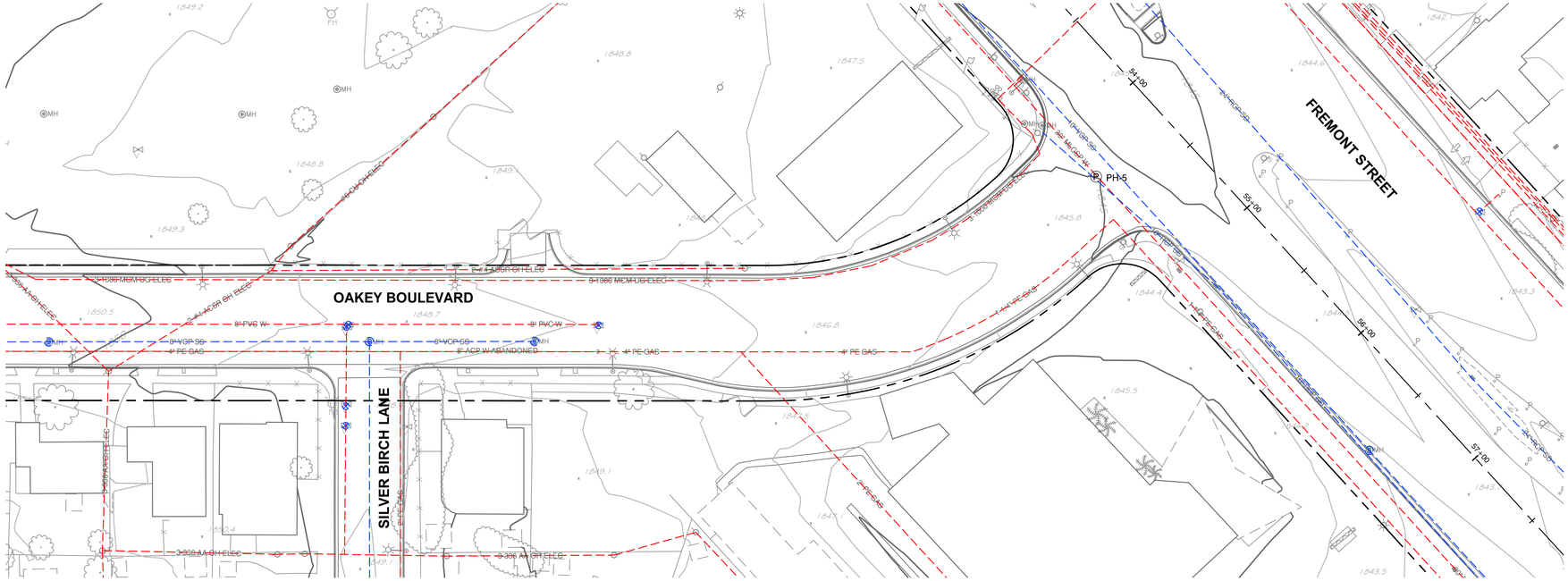
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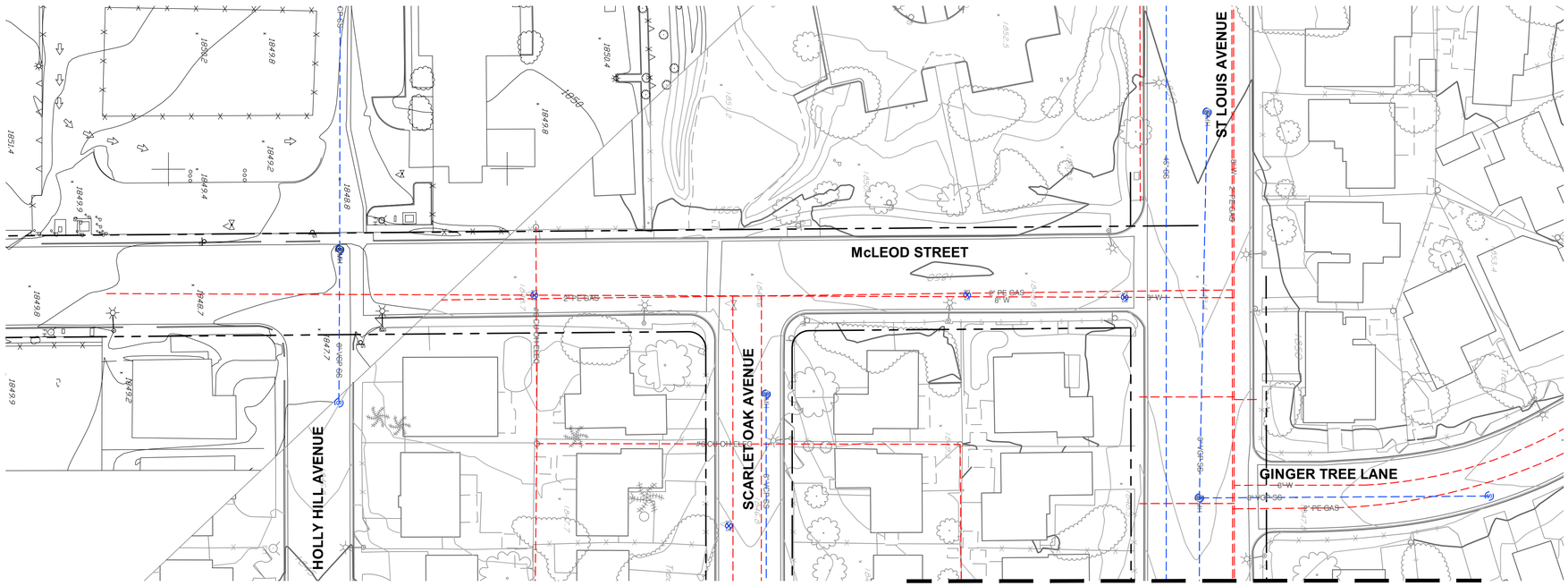
NOT FOR CONSTRUCTION

SHEET
SU06
6 OF 8

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

HORIZ 1 inch = 40 ft.
VERTICAL 1 inch = 4 ft.

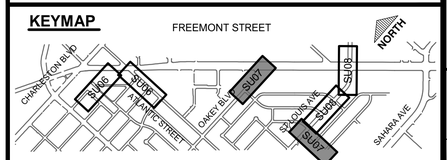
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ PH-XX — SUE QUALITY A POTHOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



REVISIONS	DATE	NO.

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H626595 | BID# XX.XXXX | DESIGNED BY: KRM
DATE: SEPTEMBER, 2016 | DRAWN BY: WHJ
SUBMITTAL STAGE: **30% SUBMITTAL** | CHECKED BY: MSB

TITLE
BOULDER HIGHWAY STORM DRAIN

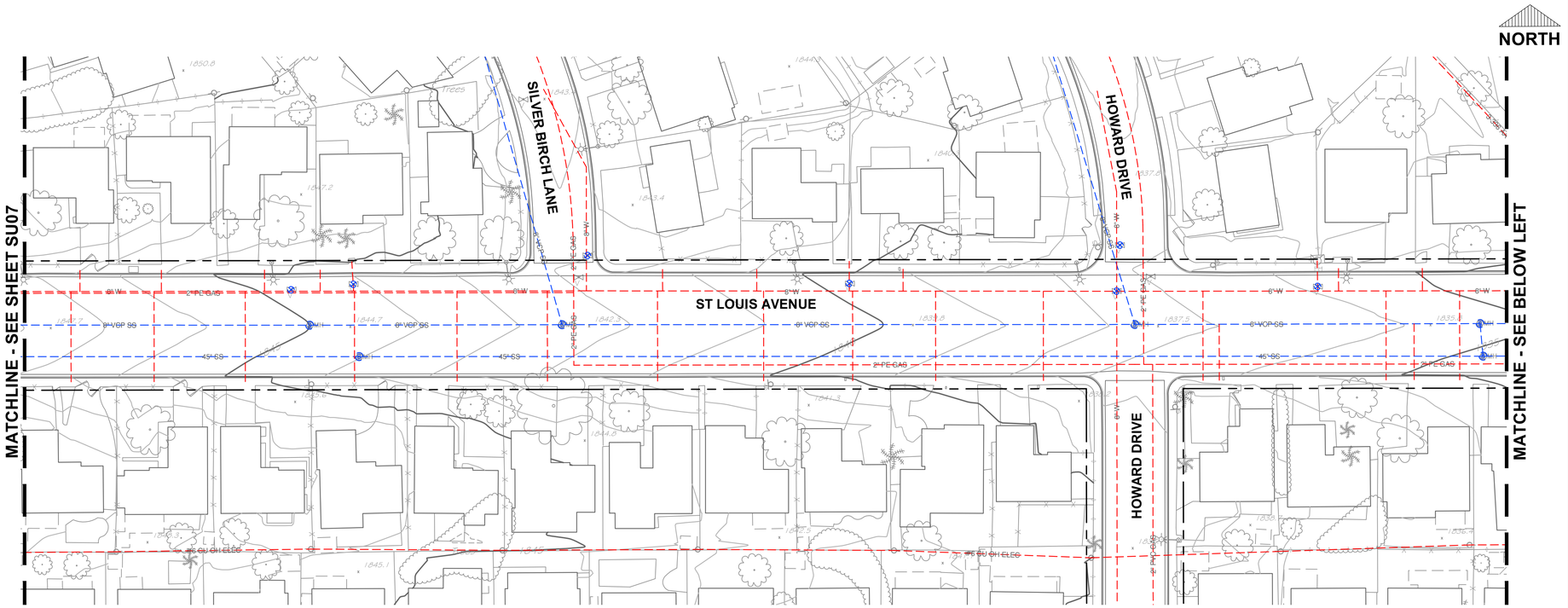
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NOT FOR CONSTRUCTION

SHEET
SU07
7 OF 8

DRAWING NO.
XXX-XXXX

X:\Projects\160050127_Boulder Hwy SD\H626595\Sheet Set\DWG\H626595-SU10 *9-22-16 04:57pm


NORTH
MATCHLINE - SEE SHEET SU07
SILVER BIRCH LANE
HOWARD DRIVE
ST LOUIS AVENUE
HOWARD DRIVE
MATCHLINE - SEE BELOW LEFT
6"W
2" PE GAS
8" PVC SS
45° SS
8" VCP SS
8" W
8" VCP SS
2" PE GAS
45° SS
6" W
8" VCP SS
2" PE GAS
45° SS
6" W
8" VCP SS
2" PE GAS
45° SS
6

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:**	

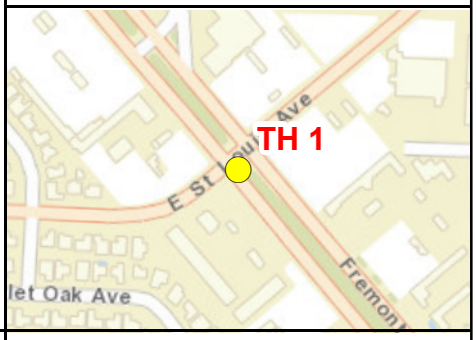
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

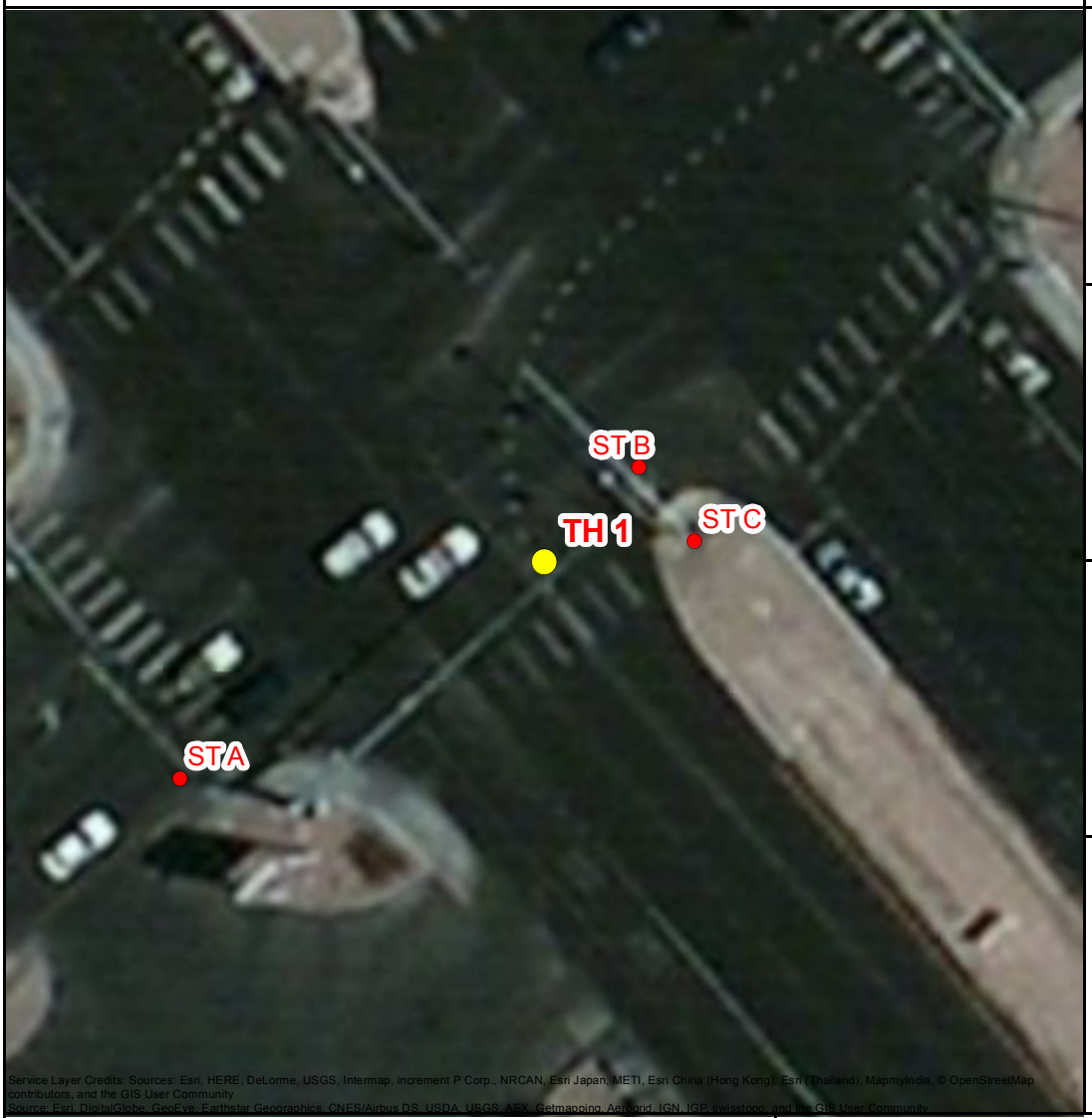
Utility Type:	Sewer	**Utility Size:**	72 Inches	**Utility Material:**	Metal
Utility Company:	City of Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nail
Depth to Top:	10.32	**Top Ref. Level:**	15.24	**Hand Meas. Top:**	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:**	

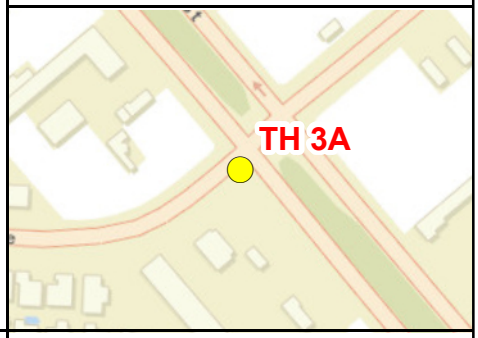
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

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



Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, 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	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:**	

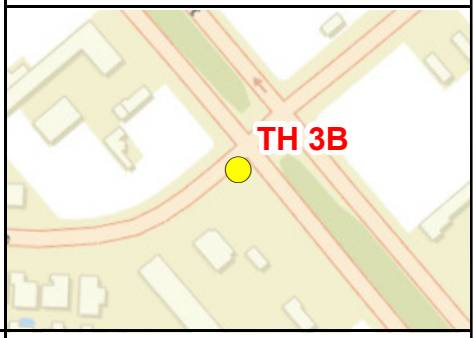
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

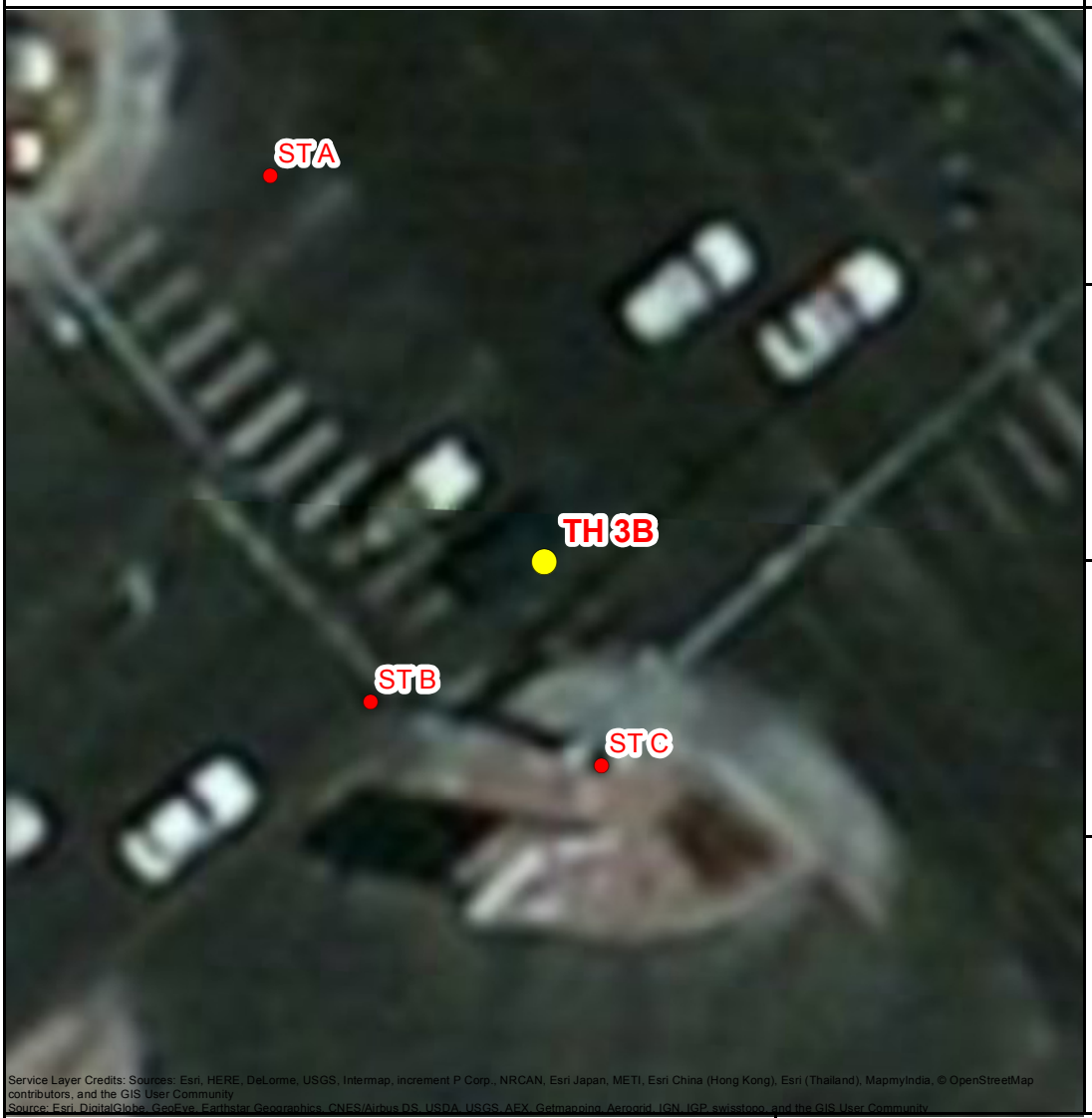
Utility Type:	Sewer	**Utility Size:**	72 Inches	**Utility Material:**	Metal
Utility Company:	City of Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nail
Depth to Top:	9.30	**Top Ref. Level:**	13.80	**Hand Meas. Top:**	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



Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, 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	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:**	

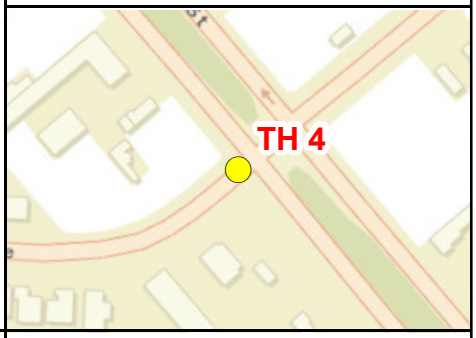
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

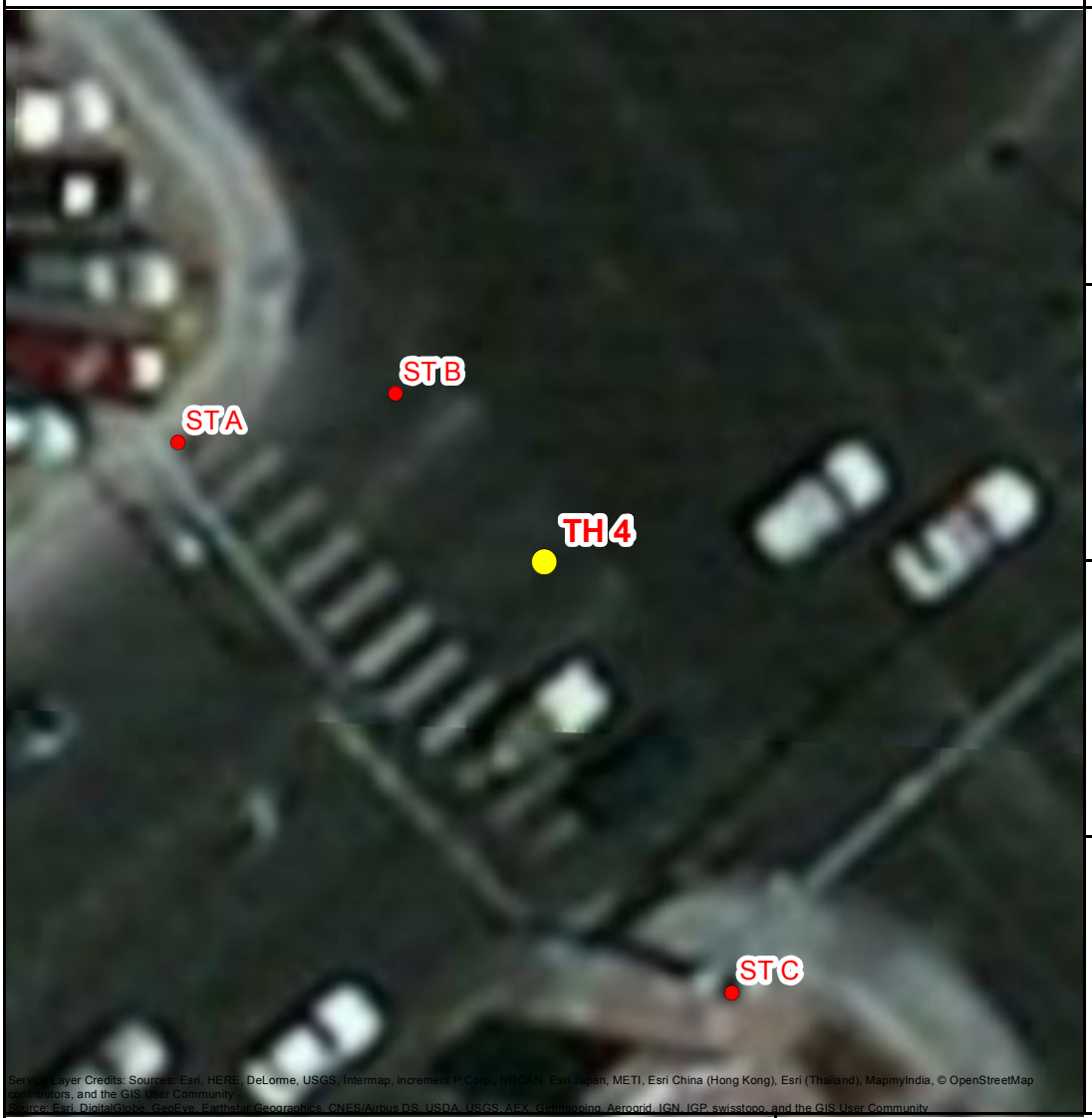
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	4 Inches	**Marker Type:**	PK Nail
Depth to Top:	6.40	**Top Ref. Level:**	11.20	**Hand Meas. Top:**	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

N

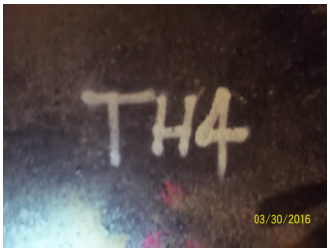
Overall Location of Test Hole



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	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:**	

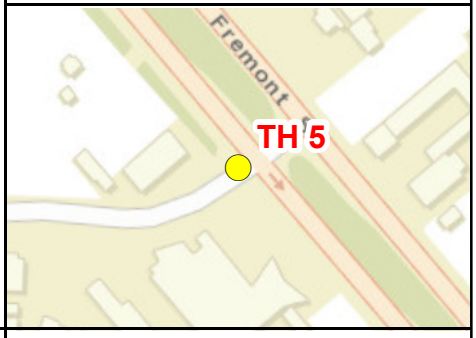
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

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:	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



Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, 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	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:**	

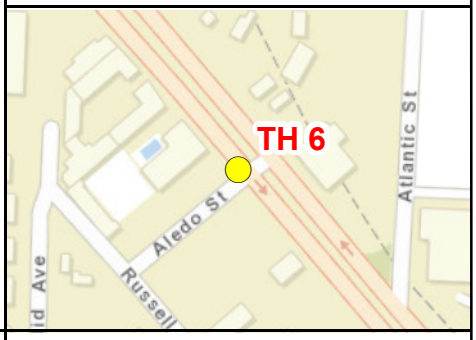
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

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:**	

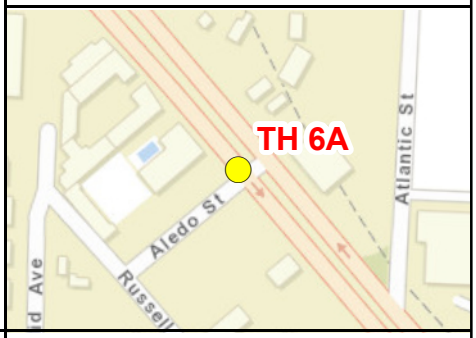
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

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:**	

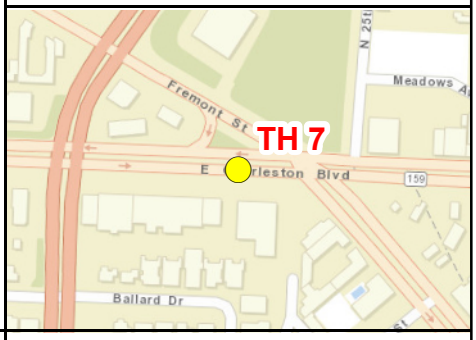
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

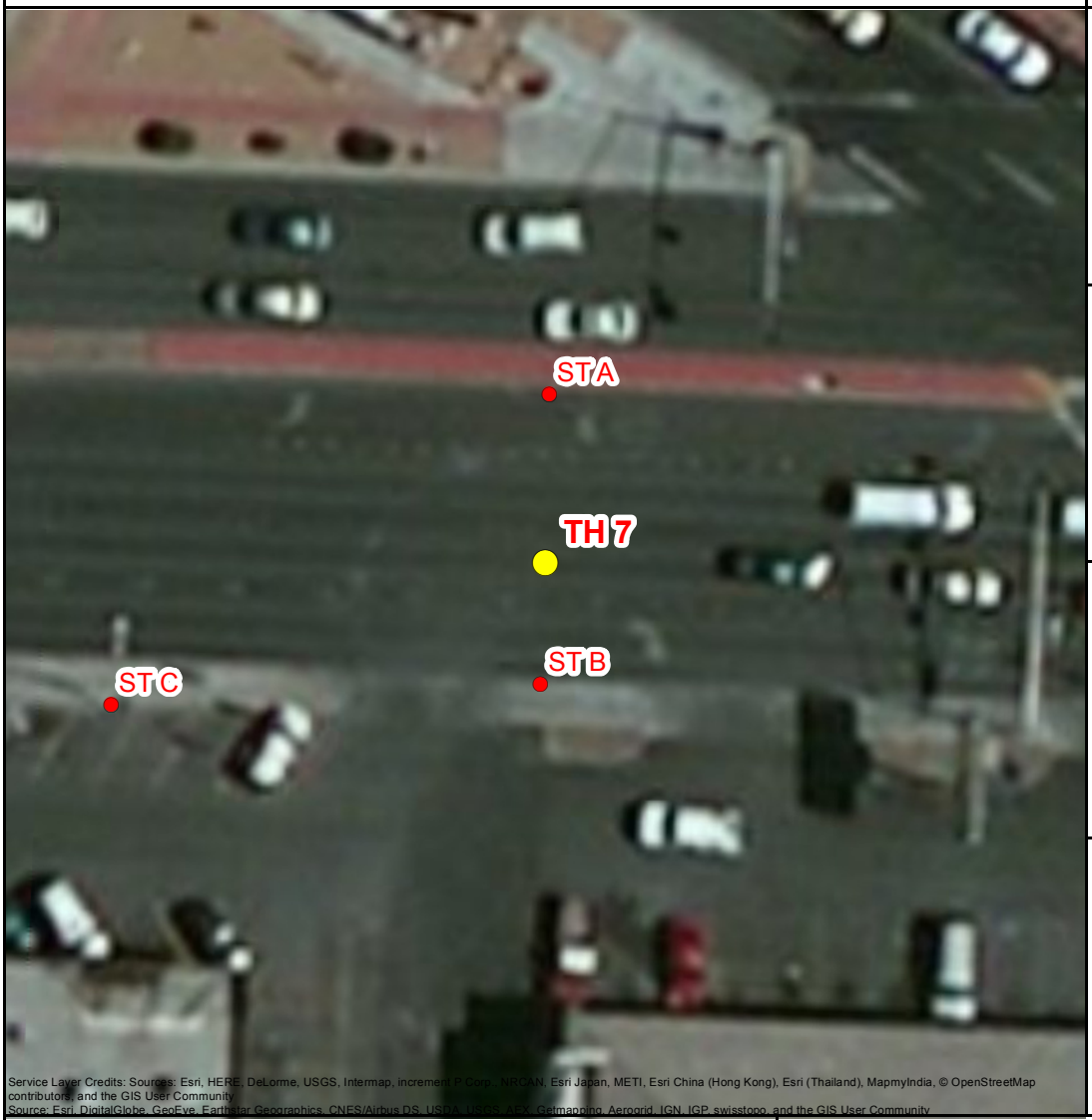
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	13 Inches	**Marker Type:**	PK Nail
Depth to Top:	9.34	**Top Ref. Level:**	14.30	**Hand 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:**	1865.07
Bottom Elevation:	1853.230	**Mkr. Offset From:**	LT	**Marker Offset (ft):**	21.9

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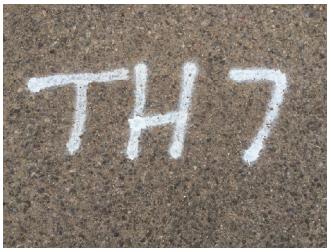
Overall Location of Test Hole



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	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:**	

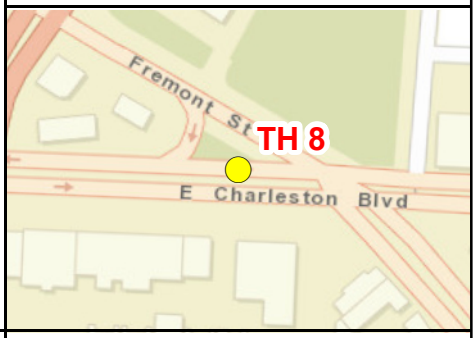
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

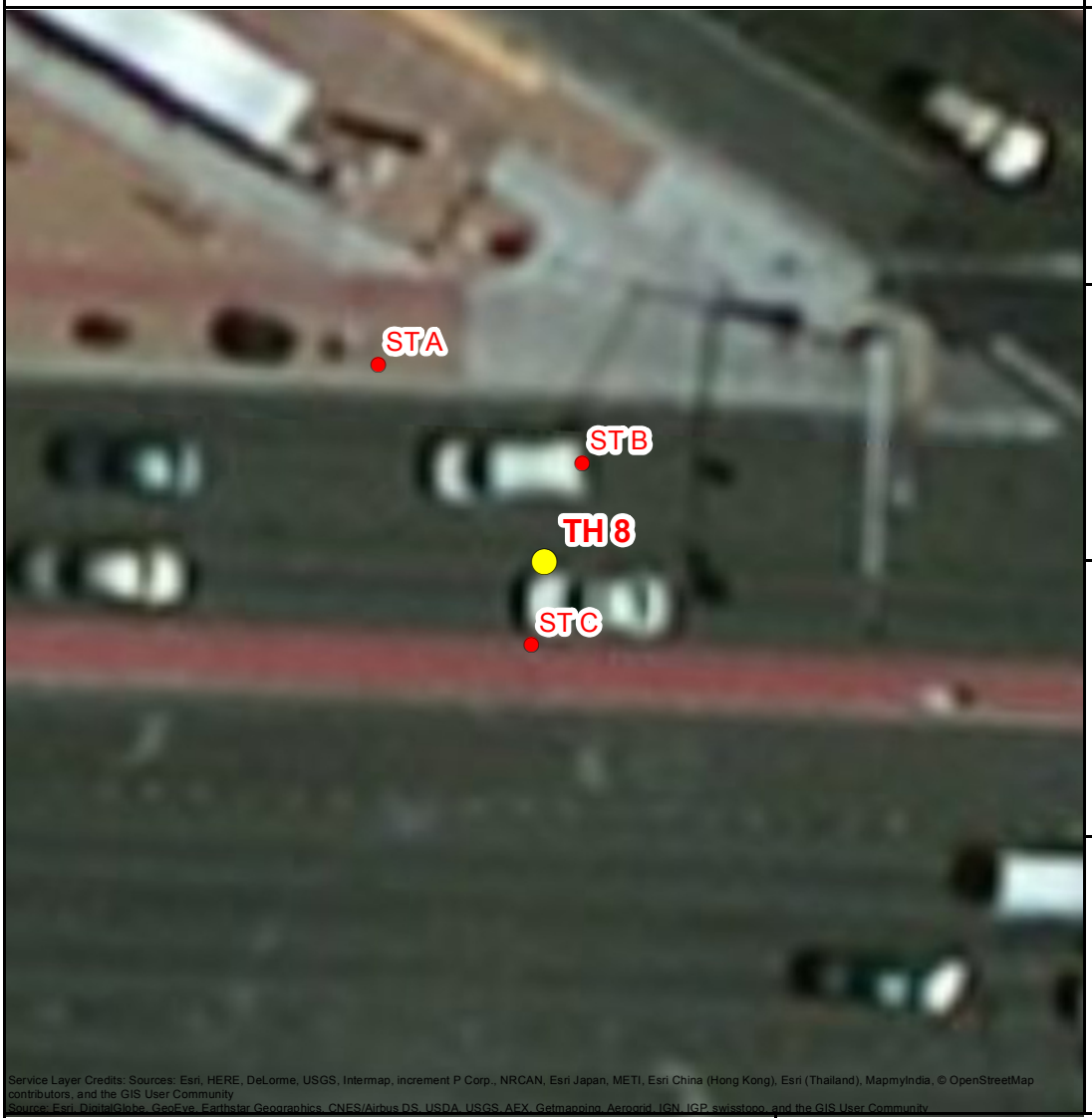
Utility Type:	Water	**Utility Size:**	30 Inches	**Utility Material:**	Concrete
Utility Company:	Las Vegas Water District	**English/Metric:**	English	**Soil Conditions:**	Type 2
Surface Type:	Asphalt	**Thickness:**	13 Inches	**Marker Type:**	PK Nail
Depth to Top:	8.66	**Top Ref. Level:**	13.72	**Hand 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

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, 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	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'

Appendix F

Cost Estimate

BOULDER HIGHWAY STORM DRAIN
PRELIMINARY COST ESTIMATE (OVER OPTION)
30% SUBMITTAL

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
	202.01	REMOVE EXISTING SIDEWALK	SF	$3.00	390	$1,170.00	-	$0.00	390	$1,170.00
	202.02	REMOVE EXISTING CURB AND GUTTER	LF	$7.00	75	$525.00	-	$0.00	75	$525.00
	202.03	REMOVE EXISTING RCP STORM DRAIN	LF	$20.00	3,536	$70,720.00	-	$0.00	3,536	$70,720.00
	202.04	REMOVE EXISTING MANHOLE	EA	$1,500.00	20	$30,000.00	1	$1,500.00	21	$31,500.00
	202.05	REMOVE EXISTING DROP INLET	EA	$3,000.00	8	$24,000.00	-	$0.00	8	$24,000.00
	202.06	REMOVE EXISTING MEDIAN ISLAND	SF	$7.00	7,545	$52,815.00	-	$0.00	7,545	$52,815.00
	202.07	REMOVE EXISTING SANITARY SEWER LINE	LF	$30.00	2,980	$89,400.00	410	$12,300.00	3,390	$101,700.00
	202.08	ABANDON EXISTING STORM DRAIN	LF	$15.00	767	$11,505.00	-	$0.00	767	$11,505.00
	203.01	ROADWAY EXCAVATION	CY	$8.00	-	$0.00	244	$1,952.00	244	$1,952.00
	203.02	BORROW EMBANKMENT	CY	$12.00	47,640	$571,680.00	-	$0.00	47,640	$571,680.00
	206.01	STRUCTURAL EXCAVATION	CY	$10.00	111,719	$1,117,190.00	-	$0.00	111,719	$1,117,190.00
	270.01	DEWATERING	LS	$1,240,000.00	1	$1,240,000.00		$0.00	1	$1,240,000.00
	302.01	TYPE II AGGREGATE BASE	CY	$35.00	-	$0.00	174	$6,090.00	174	$6,090.00
	302.02	TYPE I CLASS B AGGREGATE BASE	CY	$65.00	8,922	$579,930.00	-	$0.00	8,922	$579,930.00
	402.01	5-INCH PLANTMIX BITUMINOUS SURFACE	SY	$35.00	-	$0.00	630	$22,050.00	630	$22,050.00
	402.02	7-INCH PLANTMIX BITUMINOUS SURFACE	SY	$60.00	17,844	$1,070,640.00	-	$0.00	17,844	$1,070,640.00
	403.01	3/4-INCH PLANTMIX BITUMINOUS OPEN-GRADED SURFACE	SY	$5.00	17,844	$89,220.00	-	$0.00	17,844	$89,220.00
	502.01	14'X8' REINFORCED CONCRETE BOX	LF	$900.00	200	$180,000.00	-	$0.00	200	$180,000.00
	502.02	18'X8' REINFORCED CONCRETE BOX	LF	$1,000.00	3,566	$3,566,000.00	-	$0.00	3,566	$3,566,000.00
	502.03	20'X8' REINFORCED CONCRETE BOX	LF	$1,025.00	1,298	$1,330,450.00	-	$0.00	1,298	$1,330,450.00
	502.04	24'X6' REINFORCED CONCRETE BOX	LF	$1,350.00	414	$558,900.00	-	$0.00	414	$558,900.00
	502.05	15'X10' REINFORCED CONCRETE BOX	LF	$900.00	1,048	$943,200.00	-	$0.00	1,048	$943,200.00
	502.06	TRANSITION STRUCTURE #1 (14'X8' TO 18'X8')	LF	$1,200.00	16	$19,200.00	-	$0.00	16	$19,200.00
	502.07	TRANSITION STRUCTURE #2 (18'X8' TO 20'X8')	LF	$1,250.00	20	$25,000.00	-	$0.00	20	$25,000.00
	502.08	TRANSITION STRUCTURE #3 (20'X8' TO 24'X6')	LF	$1,400.00	16	$22,400.00	-	$0.00	16	$22,400.00
	502.10	TRANSITION STRUCTURE #4 (24'X6' TO 15'X10')	LF	$1,450.00	40	$58,000.00	-	$0.00	40	$58,000.00
	502.11	NDOT TYPE 1 HEADWALL	EA	$20,000.00	-	$0.00	1	$20,000.00	1	$20,000.00
	603.01	18-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$175.00	556	$97,300.00	-	$0.00	556	$97,300.00
	603.02	24-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$200.00	1,208	$241,600.00	200	$40,000.00	1,408	$281,600.00
	603.03	30-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$215.00	161	$34,615.00	-	$0.00	161	$34,615.00
	603.04	36-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$250.00	257	$64,250.00	250	$62,500.00	507	$126,750.00
	603.05	42-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$275.00	70	$19,250.00	280	$77,000.00	350	$96,250.00
	603.06	48-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$325.00	609	$197,925.00	178	$57,850.00	787	$255,775.00
	603.07	54-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$350.00	602	$210,700.00	-	$0.00	602	$210,700.00
	603.08	60-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$500.00	1,239	$619,500.00	-	$0.00	1,239	$619,500.00
	603.09	66-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$550.00	343	$188,650.00	-	$0.00	343	$188,650.00
	603.10	38" X 60" HE REINFORCED CONCRETE PIPE CLASS III	LF	$600.00	43	$25,800.00	-	$0.00	43	$25,800.00
	603.11	53" X 83" HE REINFORCED CONCRETE PIPE CLASS III	LF	$750.00	89	$66,750.00	-	$0.00	89	$66,750.00
	609.01	TYPE I (48") STORM DRAIN MANHOLE	EA	$6,000.00	2	$12,000.00	-	$0.00	2	$12,000.00
	609.02	TYPE III (60") STORM DRAIN MANHOLE	EA	$10,000.00	16	$160,000.00	3	$30,000.00	19	$190,000.00
	609.03	NDOT TYPE 4 MANHOLE	EA	$12,000.00	9	$108,000.00	-	$0.00	9	$108,000.00
	609.04	3-FOOT TYPE D-MODIFIED DROP INLET	EA	$5,000.00	1	$5,000.00	-	$0.00	1	$5,000.00
	609.05	15-FOOT TYPE D-MODIFIED DROP INLET	EA	$20,000.00	1	$20,000.00	-	$0.00	1	$20,000.00
	609.06	17.5-FOOT TYPE D-MODIFIED DROP INLET	EA	$20,000.00	1	$20,000.00	-	$0.00	1	$20,000.00
	609.07	20-FOOT TYPE D-MODIFIED DROP INLET	EA	$25,000.00	1	$25,000.00	-	$0.00	1	$25,000.00
	609.08	10-FOOT TYPE C-MODIFIED DROP INLET	EA	$15,000.00	3	$45,000.00	-	$0.00	3	$45,000.00
	609.09	15-FOOT TYPE C-MODIFIED DROP INLET	EA	$20,000.00	4	$80,000.00	-	$0.00	4	$80,000.00
	609.10	20-FOOT TYPE C-MODIFIED DROP INLET	EA	$25,000.00	1	$25,000.00	-	$0.00	1	$25,000.00
	609.11	10-FOOT TYPE CM DROP INLET	EA	$15,000.00	-	$0.00	2	$30,000.00	2	$30,000.00

BOULDER HIGHWAY STORM DRAIN
PRELIMINARY COST ESTIMATE (OVER OPTION)
30% SUBMITTAL

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
	609.12	15-FOOT TYPE CM DROP INLET	EA	$20,000.00	2	$40,000.00	-	$0.00	2	$40,000.00
	609.13	20-FOOT TYPE CM DROP INLET	EA	$25,000.00	6	$150,000.00	-	$0.00	6	$150,000.00
	609.14	5-FOOT TYPE B DROP INLET	EA	$7,500.00	3	$22,500.00	-	$0.00	3	$22,500.00
	609.15	NDOT TYPE 2 DROP INLET	EA	$7,500.00	1	$7,500.00	4	$30,000.00	5	$37,500.00
	610.01	RIP RAP d50 = 12"	CY	$100.00	-	$0.00	180	$18,000.00	180	$18,000.00
	613.01	CONSTRUCT "L" TYPE CURB AND GUTTER	LF	$25.00	390	$9,750.00	-	$0.00	390	$9,750.00
	613.02	CONSTRUCT CONCRETE SIDEWALK	SF	$5.00	75	$375.00	-	$0.00	75	$375.00
	613.03	CONSTRUCT TACK-ON MEDIAN	SF	$8.00	7,545	$60,360.00	-	$0.00	7,545	$60,360.00
	623.01	INSTALL 6'X6' TRAFFIC LOOP DETECTOR	EA	$1,000.00	29	$29,000.00	-	$0.00	29	$29,000.00
	629.01	6-INCH DUCTILE IRON WATERLINE	LF	$450.00	25	$11,250.00	-	$0.00	25	$11,250.00
	629.02	8-INCH DUCTILE IRON WATERLINE	LF	$500.00	25	$12,500.00	-	$0.00	25	$12,500.00
	629.03	12-INCH DUCTILE IRON WATERLINE	LF	$600.00	50	$30,000.00	-	$0.00	50	$30,000.00
	630.01	4-INCH PVC SDR35 SANITARY SEWER LATERAL	LF	$150.00	600	$90,000.00	270	$40,500.00	870	$130,500.00
	630.02	8-INCH PVC SDR35 SANITARY SEWER PIPE	LF	$175.00	2,074	$362,950.00	570	$99,750.00	2,644	$462,700.00
	630.03	30-INCH PVC SDR35 SANITARY SEWER PIPE	LF	$350.00	822	$287,700.00	-	$0.00	822	$287,700.00
	630.04	48-INCH SANITARY SEWER MANHOLE	EA	$12,000.00	9	$108,000.00	1	$12,000.00	10	$120,000.00
		SEWER BYPASS (ST LOUIS AVENUE)	LS	$400,000.00	0.77	$308,000.00	0.23	$92,000.00	1	$400,000.00
		SEWER BYPASS (CHARLESTON BOULEVARD)	LS	$1,200,000.00	1	$1,200,000.00	-	$0.00	1	$1,200,000.00
		TOTAL				**$16,648,170.00**		**$653,492.00**		**$17,301,662.00**
		Contingencies (15%)				$2,497,225.50		$98,023.80		$2,595,249.30
		GRAND TOTAL				**$19,145,395.50**		**$751,515.80**		**$19,896,911.30**

BOULDER HIGHWAY STORM DRAIN
PRELIMINARY COST ESTIMATE (UNDER OPTION)
30% SUBMITTAL

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
	202.01	REMOVE EXISTING SIDEWALK	SF	$3.00	390	$1,170.00	-	$0.00	390	$1,170.00
	202.02	REMOVE EXISTING CURB AND GUTTER	LF	$7.00	75	$525.00	-	$0.00	75	$525.00
	202.03	REMOVE EXISTING RCP STORM DRAIN	LF	$20.00	3,536	$70,720.00	-	$0.00	3,536	$70,720.00
	202.04	REMOVE EXISTING MANHOLE	EA	$1,500.00	20	$30,000.00	1	$1,500.00	21	$31,500.00
	202.05	REMOVE EXISTING DROP INLET	EA	$3,000.00	8	$24,000.00	-	$0.00	8	$24,000.00
	202.06	REMOVE EXISTING MEDIAN ISLAND	SF	$7.00	7,545	$52,815.00	-	$0.00	7,545	$52,815.00
	202.07	REMOVE EXISTING SANITARY SEWER LINE	LF	$30.00	2,980	$89,400.00	410	$12,300.00	3,390	$101,700.00
	202.08	ABANDON EXISTING STORM DRAIN	LF	$15.00	767	$11,505.00	-	$0.00	767	$11,505.00
	203.01	ROADWAY EXCAVATION	CY	$8.00	-	$0.00	244	$1,952.00	244	$1,952.00
	203.02	BORROW EMBANKMENT	CY	$12.00	67,001	$804,012.00	-	$0.00	67,001	$804,012.00
	206.01	STRUCTURAL EXCAVATION	CY	$10.00	130,959	$1,309,590.00	-	$0.00	130,959	$1,309,590.00
	270.01	DEWATERING	LS	$1,650,000.00	1	$1,650,000.00		$0.00	1	$1,650,000.00
	302.01	TYPE II AGGREGATE BASE	CY	$35.00	-	$0.00	174	$6,090.00	174	$6,090.00
	302.02	TYPE I CLASS B AGGREGATE BASE	CY	$65.00	8,848	$575,120.00	-	$0.00	8,848	$575,120.00
	402.01	5-INCH PLANTMIX BITUMINOUS SURFACE	SY	$35.00	-	$0.00	630	$22,050.00	630	$22,050.00
	402.02	7-INCH PLANTMIX BITUMINOUS SURFACE	SY	$60.00	17,696	$1,061,760.00	-	$0.00	17,696	$1,061,760.00
	403.01	3/4-INCH PLANTMIX BITUMINOUS OPEN-GRADED SURFACE	SY	$5.00	17,844	$89,220.00	-	$0.00	17,844	$89,220.00
	502.01	14'X8' REINFORCED CONCRETE BOX	LF	$900.00	200	$180,000.00	-	$0.00	200	$180,000.00
	502.02	18'X8' REINFORCED CONCRETE BOX	LF	$1,000.00	3,566	$3,566,000.00	-	$0.00	3,566	$3,566,000.00
	502.03	20'X8' REINFORCED CONCRETE BOX	LF	$1,025.00	1,665	$1,706,625.00	-	$0.00	1,665	$1,706,625.00
	502.04	24'X6' REINFORCED CONCRETE BOX	LF	$2,000.00	68	$136,000.00	-	$0.00	68	$136,000.00
	502.05	15'X10' REINFORCED CONCRETE BOX	LF	$900.00	1,066	$959,400.00	-	$0.00	1,066	$959,400.00
	502.06	TRANSITION STRUCTURE #1 (14'X8' TO 18'X8')	LF	$1,200.00	16	$19,200.00	-	$0.00	16	$19,200.00
	502.07	TRANSITION STRUCTURE #2 (18'X8' TO 20'X8')	LF	$1,250.00	20	$25,000.00	-	$0.00	20	$25,000.00
	502.08	TRANSITION STRUCTURE #3 (20'X8' TO 24'X6')	LF	$2,000.00	16	$32,000.00	-	$0.00	16	$32,000.00
	502.10	TRANSITION STRUCTURE #4 (24'X6' TO 15'X10')	LF	$2,000.00	30	$60,000.00	-	$0.00	30	$60,000.00
	502.11	NDOT TYPE 1 HEADWALL	EA	$20,000.00	-	$0.00	1	$20,000.00	1	$20,000.00
	603.01	18-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$175.00	556	$97,300.00	-	$0.00	556	$97,300.00
	603.02	24-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$200.00	1,208	$241,600.00	200	$40,000.00	1,408	$281,600.00
	603.03	30-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$215.00	161	$34,615.00	-	$0.00	161	$34,615.00
	603.04	36-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$250.00	257	$64,250.00	250	$62,500.00	507	$126,750.00
	603.05	42-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$275.00	70	$19,250.00	280	$77,000.00	350	$96,250.00
	603.06	48-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$325.00	609	$197,925.00	178	$57,850.00	787	$255,775.00
	603.07	54-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$350.00	602	$210,700.00	-	$0.00	602	$210,700.00
	603.08	60-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$500.00	1,239	$619,500.00	-	$0.00	1,239	$619,500.00
	603.09	66-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$550.00	193	$106,150.00	-	$0.00	193	$106,150.00
	603.10	38" X 60" HE REINFORCED CONCRETE PIPE CLASS III	LF	$600.00	43	$25,800.00	-	$0.00	43	$25,800.00
	609.01	TYPE I (48") STORM DRAIN MANHOLE	EA	$6,000.00	2	$12,000.00	-	$0.00	2	$12,000.00
	609.02	TYPE III (60") STORM DRAIN MANHOLE	EA	$10,000.00	16	$160,000.00	3	$30,000.00	19	$190,000.00
	609.03	NDOT TYPE 4 MANHOLE	EA	$12,000.00	8	$96,000.00	-	$0.00	8	$96,000.00
	609.04	3-FOOT TYPE D-MODIFIED DROP INLET	EA	$5,000.00	1	$5,000.00		$0.00	1	$5,000.00
	609.05	15-FOOT TYPE D-MODIFIED DROP INLET	EA	$20,000.00	1	$20,000.00	-	$0.00	1	$20,000.00
	609.06	17.5-FOOT TYPE D-MODIFIED DROP INLET	EA	$20,000.00	1	$20,000.00	-	$0.00	1	$20,000.00
	609.07	20-FOOT TYPE D-MODIFIED DROP INLET	EA	$25,000.00	1	$25,000.00	-	$0.00	1	$25,000.00
	609.08	10-FOOT TYPE C-MODIFIED DROP INLET	EA	$15,000.00	3	$45,000.00	-	$0.00	3	$45,000.00
	609.09	15-FOOT TYPE C-MODIFIED DROP INLET	EA	$20,000.00	4	$80,000.00	-	$0.00	4	$80,000.00
	609.10	20-FOOT TYPE C-MODIFIED DROP INLET	EA	$25,000.00	1	$25,000.00	-	$0.00	1	$25,000.00
	609.11	10-FOOT TYPE CM DROP INLET	EA	$15,000.00	-	$0.00	2	$30,000.00	2	$30,000.00
	609.12	15-FOOT TYPE CM DROP INLET	EA	$20,000.00	2	$40,000.00	-	$0.00	2	$40,000.00
	609.13	20-FOOT TYPE CM DROP INLET	EA	$25,000.00	6	$150,000.00	-	$0.00	6	$150,000.00
	609.14	5-FOOT TYPE B DROP INLET	EA	$7,500.00	3	$22,500.00	-	$0.00	3	$22,500.00

BOULDER HIGHWAY STORM DRAIN
PRELIMINARY COST ESTIMATE (UNDER OPTION)
30% SUBMITTAL

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
	609.15	NDOT TYPE 2 DROP INLET	EA	$7,500.00	1	$7,500.00	4	$30,000.00	5	$37,500.00
	610.01	RIP RAP d50 = 12"	CY	$100.00	-	$0.00	180	$18,000.00	180	$18,000.00
	613.01	CONSTRUCT "L" TYPE CURB AND GUTTER	LF	$25.00	390	$9,750.00	-	$0.00	390	$9,750.00
	613.02	CONSTRUCT CONCRETE SIDEWALK	SF	$5.00	75	$375.00	-	$0.00	75	$375.00
	613.03	CONSTRUCT TACK-ON MEDIAN	SF	$8.00	7,545	$60,360.00	-	$0.00	7,545	$60,360.00
	623.01	INSTALL 6'X6' TRAFFIC LOOP DETECTOR	EA	$1,000.00	29	$29,000.00	-	$0.00	29	$29,000.00
	629.01	6-INCH DUCTILE IRON WATERLINE	LF	$450.00	25	$11,250.00	-	$0.00	25	$11,250.00
	629.02	8-INCH DUCTILE IRON WATERLINE	LF	$500.00	25	$12,500.00	-	$0.00	25	$12,500.00
	630.01	4-INCH PVC SDR35 SANITARY SEWER LATERAL	LF	$150.00	600	$90,000.00	270	$40,500.00	870	$130,500.00
	630.02	8-INCH PVC SDR35 SANITARY SEWER PIPE	LF	$175.00	2,074	$362,950.00	570	$99,750.00	2,644	$462,700.00
	630.03	30-INCH PVC SDR35 SANITARY SEWER PIPE	LF	$350.00	822	$287,700.00	-	$0.00	822	$287,700.00
	630.04	48-INCH SANITARY SEWER MANHOLE	EA	$12,000.00	7	$84,000.00	1	$12,000.00	8	$96,000.00
		SEWER BYPASS (ST LOUIS AVENUE)	LS	$400,000.00	0.77	$308,000.00	0.23	$92,000.00	1	$400,000.00
		SEWER BYPASS (CHARLESTON BOULEVARD)	LS	$1,200,000.00	1	$1,200,000.00	-	$0.00	1	$1,200,000.00
		TOTAL				**$17,235,037.00**		**$653,492.00**		**$17,888,529.00**
		Contingencies (15%)				$2,585,255.55		$98,023.80		$2,683,279.35
		GRAND TOTAL				**$19,820,292.55**		**$751,515.80**		**$20,571,808.35**

OVER OPTION

STA FROM	STA TO	DEPTH	WIDTH	EXCAVATION (CUYD)	RCB WIDTH	RCB DEPTH	RCB VOL (CUYD)	7" PLANTMIX (SY)	7" PLANTMIX (CUYD)	18" AGG BASE	FILL (CUYD)
17+00.00	19+00.00	24.00	20.00	3555.56	16.00	10.00	1185.19	444.44	86.42	222.22	2061.73
19+00.00	19+16.00	24.00	22.00	312.89	18.00	10.00	106.67	39.11	7.60	19.56	179.06
19+16.00	23+00.00	23.58	24.00	8048.64	20.00	10.17	2892.80	1024.00	199.11	512.00	4444.73
23+00.00	32+00.00	22.00	24.00	17600.00	20.00	10.17	6780.00	2400.00	466.67	1200.00	9153.33
32+00.00	41+00.00	20.00	24.00	16000.00	20.00	10.17	6780.00	2400.00	466.67	1200.00	7553.33
41+00.00	50+00.00	18.38	24.00	14704.00	20.00	10.17	6780.00	2400.00	466.67	1200.00	6257.33
50+00.00	54+82.00	17.38	24.00	7446.36	20.00	10.17	3631.07	1285.33	249.93	642.67	2922.69
54+82.00	55+02.00	16.75	25.00	310.19	21.00	10.34	160.84	55.56	10.80	27.78	110.77
55+02.00	59+00.00	16.00	26.00	6132.15	22.00	10.34	3353.22	1149.78	223.57	574.89	1980.47
59+00.00	68+00.00	14.00	26.00	12133.33	22.00	10.34	7582.67	2600.00	505.56	1300.00	2745.10
68+00.00	68+16.00	12.50	28.00	207.41	24.00	9.67	137.53	49.78	9.68	24.89	35.31
68+16.00	72+30.00	11.50	30.00	5290.00	26.00	8.67	3456.44	1380.00	268.33	690.00	875.23
72+30.00	72+70.00	12.25	25.75	467.31	21.50	11.17	355.79	114.44	22.25	57.22	32.05
72+70.00	73+92.79	19.50	21.50	1906.66	17.50	12.50	994.83	293.33	57.04	146.67	708.12
73+92.79	77+00.00	24.75	21.50	6054.60	17.50	12.50	2488.97	733.89	142.70	366.95	3055.98
77+00.00	83+17.19	23.50	21.50	11549.45	17.50	12.50	5000.38	1474.40	286.69	737.20	5525.18
				111718.55				**17844.06**	**3469.69**	**8922.05**	**47640.41**

UNDER OPTION

STA FROM	STA TO	DEPTH	WIDTH	EXCAVATION (CUYD)	RCB WIDTH	RCB DEPTH	RCB VOL (CUYD)	7" PLANTMIX (SY)	7" PLANTMIX (CUYD)	18" AGG BASE	FILL (CUYD)
17+00.00	19+00.00	24.00	20.00	3555.56	16.00	10.00	1185.19	444.44	86.42	222.22	2061.73
19+00.00	19+16.00	24.00	22.00	312.89	18.00	10.00	106.67	39.11	7.60	19.56	179.06
19+16.00	23+00.00	24.00	24.00	8192.00	20.00	10.17	2892.80	1024.00	199.11	512.00	4588.09
23+00.00	32+00.00	23.00	24.00	18400.00	20.00	10.17	6780.00	2400.00	466.67	1200.00	9953.33
32+00.00	41+00.00	22.25	24.00	17800.00	20.00	10.17	6780.00	2400.00	466.67	1200.00	9353.33
41+00.00	50+00.00	22.00	24.00	17600.00	20.00	10.17	6780.00	2400.00	466.67	1200.00	9153.33
50+00.00	54+82.00	22.00	24.00	9425.78	20.00	10.17	3631.07	1285.33	249.93	642.67	4902.11
54+82.00	55+02.00	22.00	25.00	407.41	21.00	10.34	160.84	55.56	10.80	27.78	207.99
55+02.00	59+00.00	21.50	26.00	8240.07	22.00	10.34	3353.22	1149.78	223.57	574.89	4088.39
59+00.00	68+00.00	20.25	26.00	17550.00	22.00	10.34	7582.67	2600.00	505.56	1300.00	8161.77
68+00.00	71+26.32	18.88	26.00	5932.74	22.00	10.34	2749.31	942.70	183.30	471.35	2528.78
71+26.32	71+67.31	19.75	26.00	779.57	22.00	10.34	345.35	118.42	23.03	59.21	351.98
71+67.31	71+83.31	22.13	28.00	367.19	24.00	9.34	132.84	49.78	9.68	24.89	199.78
71+83.31	72+13.31	24.00	30.00	800.00	26.00	8.34	240.93	100.00	19.44	50.00	489.63
72+13.31	72+51.50	25.00	30.00	1060.83	26.00	8.34	306.71	127.30	24.75	63.65	665.72
72+51.50	72+81.50	25.00	25.75	715.28	21.75	10.34	249.88	85.83	16.69	42.92	405.79
72+81.50	73+92.79	25.00	21.50	2215.50	17.50	12.50	901.66	265.86	51.69	132.93	1129.22
73+92.79	77+00.00	24.75	21.50	6054.60	17.50	12.50	2488.97	733.89	142.70	366.95	3055.98
77+00.00	83+17.19	23.50	21.50	11549.45	17.50	12.50	5000.38	1474.40	286.69	737.20	5525.18
				130958.87				**17696.40**	**3440.97**	**8848.22**	**67001.19**

EUCLID LATERAL QUANTITIES

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
		REMOVE EXISTING SIDEWALK	SF	$3.00	390	$1,170.00		$0.00	390	$1,170.00
		REMOVE EXISTING CURB AND GUTTER	LF	$7.00	75	$525.00		$0.00	75	$525.00
		REMOVE EXISTING RCP STORM DRAIN	LF	$20.00	60	$1,200.00		$0.00	60	$1,200.00
		REMOVE EXISTING DROP INLET	EA	$3,000.00	2	$6,000.00		$0.00	2	$6,000.00
		18-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$175.00	419	$73,325.00		$0.00	419	$73,325.00
		TYPE I (48") STORM DRAIN MANHOLE	EA	$6,000.00	1	$6,000.00		$0.00	1	$6,000.00
		5-FOOT TYPE B DROP INLET	EA	$7,500.00	3	$22,500.00		$0.00	3	$22,500.00
		CONSTRUCT "L" TYPE CURB AND GUTTER	LF	$25.00	390	$9,750.00		$0.00	390	$9,750.00
		CONSTRUCT CONCRETE SIDEWALK	SF	$5.00	75	$375.00		$0.00	75	$375.00
		6-INCH DUCTILE IRON WATERLINE	LF	$450.00	25	$11,250.00		$0.00	25	$11,250.00
		8-INCH DUCTILE IRON WATERLINE	LF	$500.00	25	$12,500.00		$0.00	25	$12,500.00
						$144,595.00		**$0.00**		**$144,595.00**

ATLANTIC LATERAL QUANTITIES

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
		REMOVE EXISTING RCP STORM DRAIN	LF	$20.00	2742	$54,840.00		$0.00	2,742	$54,840.00
		REMOVE EXISTING MANHOLE	EA	$1,500.00	7	$10,500.00		$0.00	7	$10,500.00
		REMOVE EXISTING DROP INLET	EA	$3,000.00	1	$3,000.00		$0.00	1	$3,000.00
		18-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$175.00	137	$23,975.00		$0.00	137	$23,975.00
		24-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$200.00	219	$43,800.00		$0.00	219	$43,800.00
		36-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$250.00	85	$21,250.00		$0.00	85	$21,250.00
		48-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$325.00	20	$6,500.00		$0.00	20	$6,500.00
		54-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$350.00	602	$210,700.00		$0.00	602	$210,700.00
		60-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$500.00	135	$67,500.00		$0.00	135	$67,500.00
		66-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$550.00	111	$61,050.00		$0.00	111	$61,050.00
		38" X 60" HE REINFORCED CONCRETE PIPE CLASS III	LF	$600.00	43	$25,800.00		$0.00	43	$25,800.00
		TYPE I (48") STORM DRAIN MANHOLE	EA	$6,000.00	1	$6,000.00		$0.00	1	$6,000.00
		TYPE III (60") STORM DRAIN MANHOLE	EA	$10,000.00	6	$60,000.00		$0.00	6	$60,000.00
		NDOT TYPE 4 MANHOLE	EA	$12,000.00	3	$36,000.00		$0.00	3	$36,000.00
		17.5-FOOT TYPE D-MODIFIED DROP INLET	EA	$20,000.00	1	$20,000.00		$0.00	1	$20,000.00
		10-FOOT TYPE C-MODIFIED DROP INLET	EA	$15,000.00	3	$45,000.00		$0.00	3	$45,000.00
						$695,915.00		**$0.00**		**$695,915.00**

OAKEY LATERAL QUANTITIES

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
		24-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$200.00	68	$13,600.00		$0.00	68	$13,600.00
		36-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$250.00	22	$5,500.00		$0.00	22	$5,500.00
		42-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$275.00	22	$6,050.00		$0.00	22	$6,050.00
		48-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$325.00	209	$67,925.00		$0.00	209	$67,925.00
		60-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$500.00	190	$95,000.00		$0.00	190	$95,000.00
		66-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$550.00	89	$48,950.00		$0.00	89	$48,950.00
		53" X 83" HE REINFORCED CONCRETE PIPE CLASS III	LF	$750.00	89	$66,750.00		$0.00	89	$66,750.00
		TYPE III (60") STORM DRAIN MANHOLE	EA	$10,000.00	2	$20,000.00		$0.00	2	$20,000.00
		NDOT TYPE 4 MANHOLE	EA	$12,000.00	2	$24,000.00		$0.00	2	$24,000.00
		15-FOOT TYPE C-MODIFIED DROP INLET	EA	$20,000.00	2	$40,000.00		$0.00	2	$40,000.00
		15-FOOT TYPE CM DROP INLET	EA	$20,000.00	2	$40,000.00		$0.00	2	$40,000.00
		20-FOOT TYPE CM DROP INLET	EA	$25,000.00	2	$50,000.00		$0.00	2	$50,000.00
	Under item				**OVER**	**$428,825.00**	**OVER**	**$0.00**	**OVER**	**$428,825.00**
	Over item				**UNDER**	**$411,025.00**	**UNDER**	**$0.00**	**UNDER**	**$411,025.00**
	both									

ST LOUIS LATERAL QUANTITIES

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
		REMOVE EXISTING MANHOLE	EA	$1,500.00	6	$9,000.00	1	$1,500.00	7	$10,500.00
		REMOVE EXISTING SANITARY SEWER LINE	LF	$30.00	1250	$37,500.00	410	$12,300.00	1,660	$49,800.00
		ROADWAY EXCAVATION	CY	$8.00		$0.00	244	$1,952.00	244	$1,952.00
		TYPE II AGGREGATE BASE	CY	$35.00		$0.00	174	$6,090.00	174	$6,090.00
		5-INCH PLANTMIX BITUMINOUS SURFACE	SY	$35.00		$0.00	630	$22,050.00	630	$22,050.00
		NDOT TYPE 1 HEADWALL	EA	$20,000.00		$0.00	1	$20,000.00	1	$20,000.00
		24-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$200.00		$0.00	200	$40,000.00	200	$40,000.00
		30-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$215.00	100	$21,500.00		$0.00	100	$21,500.00
		36-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$250.00	150	$37,500.00	250	$62,500.00	400	$100,000.00
		42-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$275.00		$0.00	280	$77,000.00	280	$77,000.00
		48-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$325.00	380	$123,500.00	178	$57,850.00	558	$181,350.00
		60-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$500.00	914	$457,000.00		$0.00	914	$457,000.00
		66-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$550.00	104	$57,200.00		$0.00	104	$57,200.00
		66-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$550.00	232	$127,600.00		$0.00	232	$127,600.00
		38" X 60" HE REINFORCED CONCRETE PIPE CLASS III	LF	$600.00	43	$25,800.00		$0.00	43	$25,800.00
		TYPE III (60") STORM DRAIN MANHOLE	EA	$10,000.00	4	$40,000.00	3	$30,000.00	7	$70,000.00
		NDOT TYPE 4 MANHOLE	EA	$12,000.00	3	$36,000.00		$0.00	3	$36,000.00
		NDOT TYPE 4 MANHOLE	EA	$12,000.00	4	$48,000.00		$0.00	4	$48,000.00
		10-FOOT TYPE CM DROP INLET	EA	$15,000.00		$0.00	2	$30,000.00	2	$30,000.00
		20-FOOT TYPE CM DROP INLET	EA	$25,000.00	4	$100,000.00		$0.00	4	$100,000.00
		NDOT TYPE 2 DROP INLET	EA	$7,500.00		$0.00	4	$30,000.00	4	$30,000.00
		RIP RAP d50 = 12"	CY	$100.00		$0.00	180	$18,000.00	180	$18,000.00
		4-INCH PVC SDR35 SANITARY SEWER LATERAL	LF	$150.00	600	$90,000.00	270	$40,500.00	870	$130,500.00
		8-INCH PVC SDR35 SANITARY SEWER PIPE	LF	$175.00	1890	$330,750.00	570	$99,750.00	2,460	$430,500.00
		48-INCH SANITARY SEWER MANHOLE	EA	$12,000.00	6	$72,000.00	1	$12,000.00	7	$84,000.00
		SEWER BYPASS	LS	$400,000.00	0.77	$308,000.00	0.23	$92,000.00	1	$400,000.00
	Under item				**OVER**	**$1,828,150.00**	**OVER**	**$653,492.00**	**OVER**	**$2,481,642.00**
	Over item				**UNDER**	**$1,745,750.00**	**UNDER**	**$653,492.00**	**UNDER**	**$2,399,242.00**
	both									

MAINLINE QUANTITIES

					CCRFCD		CLV		TOTAL	
#	ITEM	DESCRIPTION	UNIT	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	TOTAL COST
		REMOVE EXISTING RCP STORM DRAIN	LF	$20.00	734	$14,680.00		$0.00	734	$14,680.00
		REMOVE EXISTING MANHOLE	EA	$1,500.00	7	$10,500.00		$0.00	7	$10,500.00
		REMOVE EXISTING DROP INLET	EA	$3,000.00	5	$15,000.00		$0.00	5	$15,000.00
		REMOVE EXISTING MEDIAN ISLAND	SF	$7.00	7545	$52,815.00		$0.00	7,545	$52,815.00
		REMOVE EXISTING SANITARY SEWER LINE	LF	$30.00	1730	$51,900.00		$0.00	1,730	$51,900.00
		ABANDON EXISTING STORM DRAIN	LF	$15.00	767	$11,505.00		$0.00	767	$11,505.00
		BORROW EMBANKMENT	CY	$12.00	47640	$571,680.00		$0.00	47,640	$571,680.00
		BORROW EMBANKMENT	CY	$12.00	67001	$804,012.00		$0.00	67,001	$804,012.00
		STRUCTURAL EXCAVATION	CY	$10.00	111719	$1,117,190.00		$0.00	111,719	$1,117,190.00
		STRUCTURAL EXCAVATION	CY	$10.00	130959	$1,309,590.00		$0.00	130,959	$1,309,590.00
		DEWATERING	LS	$1,240,000.00	1	$1,240,000.00		$0.00	1	$1,240,000.00
		DEWATERING	LS	$1,650,000.00	1	$1,650,000.00		$0.00	1	$1,650,000.00
		TYPE I CLASS B AGGREGATE BASE	CY	$65.00	8922	$579,930.00		$0.00	8,922	$579,930.00
		TYPE I CLASS B AGGREGATE BASE	CY	$65.00	8848	$575,120.00		$0.00	8,848	$575,120.00
		7-INCH PLANTMIX BITUMINOUS SURFACE	SY	$60.00	17844	$1,070,640.00		$0.00	17,844	$1,070,640.00
		7-INCH PLANTMIX BITUMINOUS SURFACE	SY	$60.00	17696	$1,061,760.00		$0.00	17,696	$1,061,760.00
		3/4-INCH PLANTMIX BITUMINOUS OPEN-GRADED SURFACE	SY	$5.00	17,844	$89,220.00	-	$0.00	17,844	$89,220.00
		3/4-INCH PLANTMIX BITUMINOUS OPEN-GRADED SURFACE	SY	$5.00	17,696	$88,480.00	-	$0.00	17,696	$88,480.00
		14'X8' REINFORCED CONCRETE BOX	LF	$900.00	200	$180,000.00	-	$0.00	200	$180,000.00
		18'X8' REINFORCED CONCRETE BOX	LF	$1,000.00	3,566	$3,566,000.00	-	$0.00	3,566	$3,566,000.00
		20'X8' REINFORCED CONCRETE BOX	LF	$1,025.00	1,298	$1,330,450.00	-	$0.00	1,298	$1,330,450.00
		20'X8' REINFORCED CONCRETE BOX	LF	$1,025.00	1,665	$1,706,625.00	-	$0.00	1,665	$1,706,625.00

		24'X6' REINFORCED CONCRETE BOX	LF	$1,350.00	414	$558,900.00	-	$0.00	414	$558,900.00
		24'X6' REINFORCED CONCRETE BOX	LF	$1,600.00	68	$108,800.00	-	$0.00	68	$108,800.00
		15'X10' REINFORCED CONCRETE BOX	LF	$900.00	1,048	$943,200.00	-	$0.00	1,048	$943,200.00
		15'X10' REINFORCED CONCRETE BOX	LF	$900.00	1,066	$959,400.00	-	$0.00	1,066	$959,400.00
		TRANSITION STRUCTURE #1 (14'X8' TO 18'X8')	LF	$1,200.00	16	$19,200.00	-	$0.00	16	$19,200.00
		TRANSITION STRUCTURE #2 (18'X8' TO 20'X8')	LF	$1,250.00	20	$25,000.00	-	$0.00	20	$25,000.00
		TRANSITION STRUCTURE #3 (20'X8' TO 24'X6')	LF	$1,400.00	16	$22,400.00	-	$0.00	16	$22,400.00
		TRANSITION STRUCTURE #4 (24'X6' TO 15'X10')	LF	$1,450.00	40	$58,000.00	-	$0.00	40	$58,000.00
		TRANSITION STRUCTURE #4 (24'X6' TO 15'X10')	LF	$1,450.00	30	$43,500.00	-	$0.00	30	$43,500.00
		24-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$200.00	921	$184,200.00		$0.00	921	$184,200.00
		30-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$215.00	61	$13,115.00		$0.00	61	$13,115.00
		42-INCH REINFORCED CONCRETE PIPE CLASS III	LF	$275.00	48	$13,200.00		$0.00	48	$13,200.00
		TYPE III (60") STORM DRAIN MANHOLE	EA	$10,000.00	4	$40,000.00		$0.00	4	$40,000.00
		3-FOOT TYPE D-MODIFIED DROP INLET	EA	$5,000.00	1	$5,000.00		$0.00	1	$5,000.00
		15-FOOT TYPE D-MODIFIED DROP INLET	EA	$20,000.00	1	$20,000.00		$0.00	1	$20,000.00
		20-FOOT TYPE D-MODIFIED DROP INLET	EA	$25,000.00	1	$25,000.00		$0.00	1	$25,000.00
		15-FOOT TYPE C-MODIFIED DROP INLET	EA	$20,000.00	2	$40,000.00		$0.00	2	$40,000.00
		20-FOOT TYPE C-MODIFIED DROP INLET	EA	$25,000.00	1	$25,000.00		$0.00	1	$25,000.00
		NDOT TYPE 2 DROP INLET	EA	$7,500.00	1	$7,500.00		$0.00	1	$7,500.00
		CONSTRUCT TACK-ON MEDIAN	SF	$8.00	7545	$60,360.00		$0.00	7,545	$60,360.00
		INSTALL 6'X6' TRAFFIC LOOP DETECTOR	EA	$1,000.00	29	$29,000.00		$0.00	29	$29,000.00
		12-INCH DUCTILE IRON WATERLINE	LF	$600.00	50	$30,000.00		$0.00	50	$30,000.00
		8-INCH PVC SDR35 SANITARY SEWER PIPE	LF	$175.00	184	$32,200.00		$0.00	184	$32,200.00
		30-INCH PVC SDR35 SANITARY SEWER PIPE	LF	$350.00	822	$287,700.00		$0.00	822	$287,700.00
		48-INCH SANITARY SEWER MANHOLE	EA	$12,000.00	3	$36,000.00		$0.00	3	$36,000.00
		SEWER BYPASS (CHARLESTON BOULEVARD)	LS	$1,200,000.00	1	$1,200,000.00	-	$0.00	1	$1,200,000.00
	Under item				**OVER**	**$13,576,485.00**	**OVER**	**$0.00**	**OVER**	**$13,576,485.00**
	Over item				**UNDER**	**$14,294,562.00**	**UNDER**	**$0.00**	**UNDER**	**$14,294,562.00**
	both									

Electronic Data CD

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