FINAL DRAINAGE REPORT

For

CIRCLE K at
HIGHWAY 24 & MERIDIAN ROAD

Prepared for:
EL PASO COUNTY
Engineering Development Review Team
2880 International Circle
Colorado Springs, CO 80910

Please consolidate the FDR from VR223 and this most current FDR report. Only one FDR is needed for both submittals. The Current and proposed drainage maps in VR223 are not shown in this FDR as LOT #2 area is cut off.

Prepared by:

Matrix Design Group
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
(719) 575-0100
fax (719) 572-0208

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Project No. 21.1207.037

PCD File No. PPR2230

Engineer's Statement:
This report and plan for the drainage design of Circle K at Highway 24 & Meridian was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the El Paso County Drainage Criteria Manual and is in conformity with the master plan of the drainage basin.

Jesse Sullivan Date
Registered Professional Engineer
State of Colorado
No. 55600

Developer's Statement:
I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

Circle K Stores Inc.
Business Name

By: _____ _____
Zoe Pericak Date

Title: _____

Address: 5500 S Quebec St., Ste 100
Greenwood Village, CO 80111

El Paso County:
Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

_____ _____
Jennifer Irvine, P.E. Date
County Engineer / ECM Administrator

Conditions:

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I. Introduction

The Circle K development at Highway 24 & Meridian Road is within El Paso County jurisdiction and is comprised of a total of 5.31 acres of commercial zoning. The site is located within 3 miles of the City of Colorado Springs and is subject to future annexation.

Figure 1 - Project Location

II. PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to identify and evaluate the offsite and onsite drainage patterns associated with the Circle K development (5.31 acres) and to provide hydrologic and hydraulic analyses of this area to ensure compliance with the El Paso County Drainage Criteria Manual (DCM), as well as provide effective, safe routing to downstream outfalls.

III. GENERAL LOCATION AND DESCRIPTION

The Circle K development is within Falcon in El Paso County, Colorado. An existing Circle K gas station is located at the northeast corner of the project site and will be demolished after construction

is complete. The property boundary encompasses 5.31 acres which includes a private access road for the site. A 25' Right of Way dedication borders the north part of the site adjacent to Highway 24. The north lot is 4.56 acres while the 60' wide tract with the private access road is 0.75 acres. The proposed Circle K site will be located in the north lot southwest of the existing Circle K gas station. The overall site is adjacent to the city of Colorado Springs on the southwest property line and is subject to future annexation efforts by Colorado Springs. The west portion of the site is bounded by the Meridian Road. The east portion of the site bounded by the Meridian Sol Drive (previously Old Meridian Road). To the south of the site is private developed land. The south lot will be returned to undeveloped conditions after the demolition of the existing structures present on the site by others. The general topography of the area is flat with drainage sloping from the northwest to the southeast. More specifically, the study area is located as follows:

A. General Location: A portion of the SE ¼ of section 12, township 13 south, range 6 west of the 6th P.M. County of El Paso County, State of Colorado.

B. Surrounding Streets and Developments:

a. North: Highway 24.

b. East: Big O Tires, several undeveloped properties, Falcon Vista Sub 2 neighborhood, Meridian Sol Drive

c. South: Farmland, undeveloped properties, Swingline Road

d. West: Meridian Road, undeveloped properties

C. Drainageways: This site is located within the Falcon Drainage Basin and ultimately discharges into Chico Creek.

a. West Swale: Proposed grading for the development of Meridian Road shows a drainage swale to the east of the roadway. The swale continues down to Swingline Road where existing storm infrastructure collects the drainage. Current drainage patterns show flows from Highway 24 converging onto the proposed Circle K site and draining northwest to southeast. Opposite of the west swale.

b. East Swale: An existing swale is located to the east of the Circle K property off of Meridian Sol Drive. Site imagery shows it is relatively flat with adjacent areas to the west of the swale consisting of farmland. An existing area inlet south of the project property collects flows.

D. Irrigation Facilities

No known functioning irrigation facilities are within the project area.

E. Utilities and Encumbrances

a) Storm Sewer: Existing inlets are present along Meridian Road to the south of the project site and along Meridian Sol Drive south of the project site. Two area inlets are present north of Swingline Road.

b) **Sanitary Sewer:** Sanitary sewer associated with the existing Circle K station at the northeast corner of the project is present and will remain in service during construction. Sanitary service for the residential housing located in the project site shall be removed prior to construction.

c) **Gas: E**xisting gas services associated with the existing Circle K station at the northeast corner of the project will remain in service during construction. Gas services for the residential housing located in the project site shall be removed prior to construction.

d) **Water: E**xisting water services associated with the existing Circle K station at the northeast corner of the project will remain in service during construction. Water services for the residential housing located in the project site shall be removed prior to construction.

e) **Electric: E**xisting electric services associated with the existing Circle K station at the northeast corner of the project will remain in service during construction. Electric services for the residential housing located in the project site shall be removed prior to construction. An existing overhead powerline is present in the middle of the site running north south and will be rerouted prior to construction.

F. Referenced Drainage Reports

This site is within the West Tributary area of the Falcon Drainage Basin Planning Study. This study looks at the future stormwater and infrastructure needs for the Falcon Watershed.

"Falcon Drainage Basin Planning Study", completed by Matrix Design Group, Dated September 2015 (FDBPS-2015)

G. Land Uses

Land uses for the proposed development will be commercial development and private roads.

IV. SOIL CONDITIONS

Soils can be classified in four different hydrologic groups, A, B, C, or D to help predict stormwater runoff rates. Hydrologic group "A" is characterized by deep, well-drained coarse-grained soils with a rapid infiltration rate when thoroughly wet and having a low runoff potential. Group "D" typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock and has a very slow infiltration rate and a high runoff potential. See Soils Map; Appendix C. Table 3.1 on the following page lists the soil types present in the development area:

Table 3.1 – NRCS Soil Survey for El Paso County

SOIL ID NUMBER	*SOIL*	*HYDROLOGIC CLASSIFICATION*	*PERMEABILITY*	*PERCENT ON SITE*
9	Blakeland-Fluvaquentic Haplaquolls	A	Well Drained	40.4%
19	Columbine Gravelly Sandy Loam, 0 to 3 percent slopes	A	Well Drained	59.6%

Predevelopment site conditions are undeveloped and ground cover consists of sparse natural vegetative land cover.

V. Project Characteristics

A. Major Basin Description

Chico Creek:

a. **Onsite Flows:**
8.03 Acres of commercial development/disturbance are within the Falcon Drainage Basin. Under predevelopment conditions flows in the project area generally flow south. After north lot development, flows will generally sheet flow to adjacent streets, where they will be conveyed via gutter flow towards sump or at-grade inlets which will capture the flows. Flows will then be conveyed to the proposed North Detention Pond via storm sewer.

b. **Offsite Flows:**
Runoff from the adjacent Highway 24 and the associated right of way will be bypassed around the site via existing swales. Undeveloped portions of the property will also be directed into these swales.

B. Regulatory Floodplain

Per the *Flood Insurance Rate Map (FIRM)* 08041C0561-G, effective date December 7, 2018, published by the Federal Emergency Management Agency (FEMA), no portion of Circle K at Highway 24 & Meridian Road lies within any designated 100-year floodplain. This map can be found in Appendix C.

VI. Drainage Design Criteria

A. Design References

As required by El Paso County, Colorado, this report has been prepared in accordance with the criteria set forth in the *El Paso County Drainage Criteria Manual Volume 1 & 2* (Drainage Criteria Manual or DCM), the El Paso County Engineering Criteria Manual (ECM), and El Paso County Resolutions 15-042 and 19-245.

In addition to the DCM, the *Urban Storm Drainage Criteria Manuals, Volumes 1-3* (UDFCD), published by the Urban Drainage and Flood Control District, latest update, have

been used to supplement the Drainage Criteria Manual for water quality capture volume (WQCV).

B. Design Frequency

Design frequency is based on the DCM. The 100-year storm event was used as the major storm for the project, and the 5-year storm event was used as the minor storm.

C. Design Discharge

a. Method of Analysis

The hydrology for this project uses the Rational Method as recommended by the Drainage Criteria Manual for the minor and major storms for drainage basins less than 100-acres in size. The Rational Method uses the following equation: $Q=C*i*A$

Where:

Q = Maximum runoff rate in cubic feet per second (cfs)
C = Runoff coefficient
i = Average rainfall intensity (inches per hour)
A = Area of drainage sub-basin (acres)

b. Runoff Coefficient

Rational Method coefficients from Table 6-6 of the Drainage Criteria Manual for developed land were utilized in the Rational Method calculations. See Appendix B for more information.

c. Time of Concentration

The time of concentration consists of the initial time of overland flow and the travel time in a channel to the inlet or point of interest. A minimum time of concentrations of 5 minutes is utilized for urban areas.

d. Rainfall Intensity

The hypothetical rainfall depths for the 1-hour storm duration were taken from Table 6-2 of the Drainage Criteria Manual. Table 5.1, below, lists the rainfall depth for the Major and Minor 1-hour storm events.

Table 5.1 – Project Area 1-Hour Rainfall Depth

Storm Recurrence Interval	Rainfall Depth (inches)
5-year	1.50
100-year	2.52

The rainfall intensity equation for the Rational Method was taken from Drainage Criteria Manual Volume 1 Figure 6-5.

e. StormCAD Analysis

1. **Routing**
   Storm CAD was utilized to analyze the routing of runoff through the proposed storm sewer system. The model was calibrated to match the values calculated in the Rational Method spreadsheet.

2. **HGL Profiles**
   StormCAD was also used to determine the Hydraulic Grade Profiles for the major and minor storms. The standard method was used to calculate head loss in the system with K coefficients taken from Table 9-4 of the Colorado Springs DCM.

Table 9-4. STORMCAD Standard Method Coefficients

Bend Loss		
Bend Angle	**K Coefficient**	
0°	0.05	
22.5°	0.10	
45°	0.40	
60°	0.64	
90°	1.32	
LATERAL LOSS		
One Lateral K Coefficient		
Bend Angle	Non-surcharged	Surcharged
45°	0.27	0.47
60°	0.52	0.90
90°	1.02	1.77
Two Laterals K Coefficient		
45°	0.96	
60°	1.16	
90°	1.52	

VII. Drainage Basins and Sub-basins

A. The ***predevelopment conditions*** for the site have been analyzed and are presented by design points (Table 6.2) and are described as follows:

a. Chico Creek:

The studied area is within the West Tributary to Chico Creek. Flows from the majority of the site sheet flow in an easterly direction where they are captured by a broad swale which drains to the into an existing area inlet. A portion of onsite flows drain to the west and are captured by a broad swale which drains into an existing area inlet. Both swales capture roadside drainage.

Total discharge to Chico Creek basin is approximately 6.12 cfs for the Q_5 event and 17.87 cfs for the Q_{100} event.

Circle K - HWY 24 & Meridian				
Existing Sub Basin Summary				
Design Point	**Sub-Basins**	**Total Area (ac.)**	**Q(5) (cfs)**	**Q(100) (cfs)**
EX 01	EX 01	1.68	1.52	4.09
EX 02	EX 02	3.95	1.27	6.39
EX 03	EX 03	0.09	0.10	0.29
EX 04	EX 04	1.88	3.95	8.70
EX 05	EX 05	0.43	1.34	2.69
EX SITE NORTH	EX SITE NORTH	8.03	6.12	17.87

B. The fully developed conditions for the site are as follows:

a. Chico Creek:

Under proposed conditions, developed flows for this basin will be directed to a proposed detention pond near the south boundary of the north lot. Sub-basins and Design Points for these major basins are summarized in hydrology tables below and on the following pages.

Circle K - HWY 24 & Meridian Proposed Conditions Sub-basin Summary			
Basin	**Area**	Q5	Q100
	acres	cfs	cfs
A	1.00	3.3	6.2
B	0.77	2.2	4.3
C	0.33	1.1	2.1
D	0.36	1.0	2.1
E	0.22	0.7	1.4
F	0.03	0.2	0.3
G	0.14	0.7	1.2
H	0.12	0.6	1.0
J	0.73	0.3	1.5
K	1.88	2.1	5.4
L	1.68	0.9	2.9
M	0.09	0.4	0.8
N	0.43	2.0	3.6
P	0.23	0.1	0.7

Circle K - HWY 24 & Meridian				
Proposed Design Point Summary				
Design Point	**Sub-Basins**	**Total Area (ac.)**	**Q(5) (cfs)**	**Q(100) (cfs)**
DP A	Inlet at lowpoint of access road	1.00	3.27	6.22
DP A Inlet Flow	Inlet at lowpoint of access road, combined flow from DP B	2.62	7.65	14.69
DP B	Inlet at NW Corner of Pond, Sub Basin B	0.77	2.16	4.27
DP B Inlet Flow	Inlet at NW corner of Pond, B, C, D & G	1.62	4.65	9.00
DP C	Area inlets in middle of front parking	0.33	1.09	2.08
DP C Inlet Flow	Area inlets in middle of front parking, combined flow from DP D	0.70	2.07	4.01
DP D	Area inlets in eastern part of front parking	0.36	1.05	2.06
DP E	Car wash entrance flume, E & F	0.25	0.71	1.39
DP F	Car Wash Roof Drain	0.03	0.16	0.28
DP G	Fuel Canopy Roof Drainage	0.14	0.67	1.20
DP H	C-Store Roof Drain	0.12	0.55	0.99
DP J1	Detention pond area	0.73	0.32	1.54
DP J2	Sub-basins A, B, E, G & H1	3.72	7.52	15.38
DP J3	Pond Outlet Structure	3.72	0.10	3.40
DP K	Undeveloped land to NE	1.88	2.12	5.43
DP L	Offsite drainage to west of site	1.68	0.91	2.87
DP M	Offsite street drainage for West entrance	0.09	0.43	0.77
DP N	Offsite street drainage for East entrance, west part of Meridian Sol	0.43	1.99	3.57
DP P	Offsite drainage to the south of the Access road, offsite culvert outlets	0.23	0.10	0.66
DP SITE NORTH	North Lot Overall Drainage	8.03	5.65	16.71

DESIGN POINT DESCRIPTIONS		
Design Point	**Description**	**Downstream Design Point**
DP A	- This design point is located at a private 5' Type R sump inlet on the north side of the private access road. It captures sheet flows from the access road, parts of the access entrances and sheet flows from paved portions of the commercial development. Flows from this inlet will be directed to the private detention pond via private 24" RCP storm drain.	J2
DP A Inlet Flow	-This design point is the same as DP A but includes potential bypass flows from design points DP B, DP C, and DP D.	J2
DP B	-This design point is located at a private 10' Type R sump inlet on the west side of the west entrance into the commercial development. It captures sheet flow from the northern area of the proposed site. Flows from this inlet will be directed to the private detention pond via private 18" RCP storm drain.	J2
DP B Inlet Flow	-This design point is the same as DP B but includes by-pass flows from design points DP C & DP D and flows from DP G.	J2
DP C	-This design point is located at a private triple valley inlet consisting of 3'x1.73' Denver No. 16 valley grates in the center of the front parking area. It captures sheet flows for the central area of the site. Flows from this inlet will be directed to the inlet at DP D via private 15" RCP storm drain.	B
DP C Inlet Flow	-This design point is the same as DP C but includes bypass flows from design point DP D.	B
DP D	This design point is located at a private triple valley inlet consisting of 3'x1.73' Denver No. 16 valley grates in the center of the east portion of the front parking area. It captures sheet flows for the northeast portion of the commercial site. Flows from this inlet will be directed to the inlet at DP B via private 15" and 18" RCP storm drain.	C
DP E	-This design point represents the private 5' wide concrete flume near the entrance to the onsite car wash. It captures sheet flows for the eastern paved portion of the site parking. It includes private roof drainage from the car wash building. Flows will be released into the private detention pond.	J2
DP F	-This design point represents the private roof drainage from the car wash building. Flows will be directed to the private detention pond via private 6" PVC pipe.	J2
DP G	-This design point represents the private roof drainage from the fuel canopy. Flows will be directed to the inlet at DP B via private 6" and 8" PVC pipe.	B
DP H	-This design point represents the private roof drainage from the convenience store building. Flows will be directed to the private detention pond via 6" PVC pipe.	J2
DP J1	-This design point represents the surface sheet flow from the detention pond area and the surrounding landscaping.	J2

DESIGN POINT DESCRIPTIONS		
Design Point	**Description**	**Downstream Design Point**
DP J2	-This design point includes the combined inflow into the detention pond from design points DP A, DP B, DP E, DP G, DP H and DP J1.	J3
DP K	-This design point includes the eastern sheet flows from the undeveloped area to the east of the proposed Circle K and road sheet flows draining to this area from Highway 24. A private 15" culvert and RCP storm drain will carry these flows across the proposed east entrance.	Existing East Swale
DP L	-This design point includes the western sheet flows draining to the proposed west culvert. These offsite flows include northern portions of offsite ROW green space, existing channel flows, flows from Highway 24 and flows from Meridian Road. A private 23"X14" culvert and RCP storm drain will carry these flows across the proposed west entrance.	Existing West Swale
Detention Pond Discharge (J3)	-This design point is at the private discharge structure from the proposed private detention and water quality pond. -Developed flows from the proposed improvements will be metered out by this private structure at predevelopment levels as determined by the UD-Detention modeling of the Full Spectrum Extended Detention Basin. -Flows will discharge onto the south lot. Flows shall disperse across the south lot via riprap outfall projection and a proposed spreader swale.	Existing East Swale
DP M	-This design point represents sheet flows from the proposed access road for the west entrance.	Existing Meridian Road Inlet
DP N	-This design point represents offsite sheet flows from Meridian Sol Drive and the east entrance. These flows will be collected via riprap rundown into the existing east swale.	Existing East Swale
DP P	-This design point represents sheet flows to the south of the proposed access road.	Existing East Swale
DP SITE NORTH	-This design point sums flows from the north and south lots (DP J3, DP K, DP L, DP M, DP N, and DP P) and gives a value to the overall site discharge. Both Q5 and Q100 flows are less than existing conditions.	Existing Swales & Inlets

- Generally, flows will sheet flow off the commercial development towards adjacent storm infrastructure. After capture by inlets, the flows will be conveyed onwards towards the downstream detention basin via storm sewer. Undeveloped flows will continue historic conditions.

VIII. Drainage Facility Design

A. Inlet Capacity

In accordance with the DCM, this project will use Type R inlets. On-grade inlet capacities were determined utilizing UD-Inlet. The following Table 6.2 lists inlets by design point and corresponding capacity. Table 6.3 describes overflow routing for each sump inlet.

Circle K at Highway 24 & Meridian Road
INLET SUMMARY

DESIGN POINT (#-Letter) or SUB-BASIN (Letter#)	SUB-BASINS	TOTAL AREA (AC)	INLET			Q(5) BYPASS FLOWS (cfs)	Q(5) TOTAL INFLOW	Q5 INLET CAPACITY	Q(100) BYPASS FLOWS (cfs)	Q(100) TOTAL INFLOW (cfs)	MAX INLET CAPACITY	NOTES:
			SIZE (Ft.)	TYPE	CONDITION							
DP A	A	1.00	5	R	**SUMP**	**0.0**	3.27	**5.4**	**0.0**	6.22	**9.2**	
DP B	B	0.77	10	R	**SUMP**	**0.0**	2.16	**2.5**	**0.0**	4.27	**6.1**	***Inlet B Captures 100% of Bypass Flows From Inlets C & D***
DP C	C	0.33	3	16	**AT GRADE**	**0.0**	1.09	**1.1**	**0.1**	2.08	**2.0**	***Bypass flows to Inlet B***
DP D	D	0.36	3	16	**AT GRADE**	**0.0**	1.05	**1.0**	**0.4**	2.06	**1.7**	***Bypass flows to Inlet C***

Table 6.3
Overflow Routing
Circle K at Highway 24 & Meridian Road

Inlet	*Overflow Routing Under Inlet Blockage Conditions*
A	In case of blockage of this inlet flows will surcharge the curb and gutter and flow directly into the North Detention Pond.

B. Storm Sewer Capacities

Storm sewer capacities and HGL's were analyzed in StormCAD. Summary tables and HGL profiles for the Q5 and Q100 events can be found in Appendix A.

C. Detention

Summary information for the North Detention Pond is listed below. Supporting UD-Detention spreadsheets for the Detention Pond can be found in Appendix A. The north Detention Pond will be privately owned and maintained.

Table 6.5											
North Pond Summary Table											
Major Basin	Pond ID	Analysis Method	Contributing Basins	Tributary Area	Imperviousness	Approximate Detention Volumes			EX	Proposed	EX	Proposed
						WQCV	EURV	Q100	5 Year	5 Year	100 Year	100 Year
				Ac.	%	Ac.-Ft.	Ac.-Ft.	Ac.-Ft.	(CFS)	(CFS)	(CFS)	(CFS)
Chico Creek	Detention Pond	UD-Detention	A, B, C, D, E, F, G, H, J1	3.72	65.5	0.08	0.306	0.367	0.1	**0.1**	3.2	**3.4**

Emergency Overflows

Table 6.6 Emergency Overflow Weirs		
Major Basin	**Pond ID**	**Description of Emergency Overflow Weir**
Chico Creek	North Detention Pond	The emergency overflow weir for this pond will release emergency overflows across the proposed access road and into the south parcel of land. Flows will then follow historic patterns.

Outfall Analysis

North Detention Pond

In order to assure a suitable outfall, we have completed Manning's channel flow analysis on the discharge from the proposed north detention pond. This outfall will discharge to the property to the south which will be rezoned for future commercial development. Using the FHWA Hydraulic Toolbox we have determined that the natural untouched vegetation is suitable for handling the outflow from the proposed north detention pond. The velocity of the anticipated Q100 discharge in the swale downstream off the 24" outfall was calculated to be 0.44 ft/s which is well below the maximum low-flow velocity and maximum 100-year velocity. Table 12-3 (below) of the DCM regarding Hydraulic Design Criteria for natural unlined channels.

Table 12-3. Hydraulic Design Criteria for Natural Unlined Channels

Design Parameter	Erosive Soils or Poor Vegetation	Erosion Resistant Soils and Vegetation
Maximum Low-flow Velocity (ft/sec)	3.5 ft/sec	5.0 ft/sec
Maximum 100-year Velocity (ft/sec)	5.0 ft/sec	7.0 ft/sec
Froude No., Low-flow	0.5	0.7
Froude No., 100-year	0.6	0.8
Maximum Tractive Force, 100-year	0.60 lb/sf	1.0 lb/sf

[1] Velocities, Froude numbers and tractive force values listed are average values for the cross section.
[2] "Erosion resistant" soils are those with 30% or greater clay content. Soils with less than 30% clay content shall be considered "erosive soils."

The Web Soil Survey for the site indicates that the Soils for the receiving swale are are class A sandy soils and likely resistant to erosive conditions.

IX. Environmental Evaluations

A. WETLAND IMPACTS

There are no designated wetland or riparian areas on site, and no anticipated impacts.

B. STORMWATER QUALITY

All on-site detention facilities shall be designed to accommodate water quality requirements. As the development of each parcel progresses, the detention guidelines outlined in this report are to be upheld. Per Chapter 4, Section 4.1, of the El Paso County DCM, Volume 2, the DCM requires a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

Step 1: Employ Runoff Reduction Practices

- Site specific landscaping will be done on each lot to decrease the connectivity of impervious areas. Grass lined swales will be used where possible to allow infiltration.

Step 2: Provide Water Quality Capture Volume

- The Detention Pond meets the DCM standards for the release rates of Full Spectrum Detention Ponds for Water Quality Capture Volumes.

Step 3: Stabilize Drainageways.

- Existing roadside swales are present along the east and western property boundaries for the entire site. The west swale collects flows from Meridian Road and portions of greenspace while the east swale collects flows from Meridian Sol Drive and portions of onsite undeveloped land. Both swales shall be maintained in current conditions where no development occurs. Proposed culverts shall be installed where the proposed private access road crosses each existing swale. Riprap protection and erosion control shall be installed at all culvert entrances and exits. Proposed sidewalk along the north portion of Meridian Sol Drive shall drain into the street while slopes facing west shall be installed with erosion control. Existing area inlets to the south of the property shall have erosion control measures installed during construction.

Step 4: Consider Need for Industrial and Commercial BMPs

- There are commercial components of this development, therefore special BMPs of this nature are required. Covering of fuel storage areas and spill containment & control will be required for this project. Please see the applicable underground fuel tank construction drawings for details and design information. The stormwater management plan developed for this site also includes potential sources of commercial pollution and a spill prevention and response plan. The Full Spectrum Detention BMP is provided for the proposed development by the detention pond.

C. PERMITTING REQUIREMENTS

No additional permitting requirements are expected at this time.

D. TREATMENT EXCLUSIONS

a. Land Disturbance to Undeveloped

Per Appendix I, Section 7.1.B.7, of the El Paso County DCM, Volume 2, the DCM allows the exclusion of sites with land disturbance resulting in undeveloped land that will remain undeveloped to remain untreated. DP L and DP K shall both be constructed back to undeveloped land and are not treated via the north detention pond. Both design points will flow downstream to existing swales via proposed culverts.

b. Impractical Capture

Per Appendix I, Section 7.1.C.1, of the El Paso County DCM, Volume 2, the DCM allows for areas less than 20%, and not to exceed 1 acre, of the applicable development site area to remain untreated if it is determined impractical to capture their flows. Both access driveways on the west and east sides into the proposed site are impractical to treat as they have been proposed to grade entrance flows away from the site so as to not take on offsite flows from Meridian Sol Drive and Meridian Road. The combined impervious area of both drive entrances does not exceed 20% of the site's applicable development area and does not exceed 1 acre.

X. Erosion Control Plan

A grading and erosion control plan (GEC) for Circle K at Highway 24 & Meridian has been completed. The GEC incorporates check dams, silt fence, vehicle tracking control, inlet & outlet control, sedimentation basins and other best management practices (BMPs) identified in the DCM Volume 2. Please refer to the GEC for phasing and procedural information.

XI. Drainage Fees

Impervious Area Calculations

Land Use Type	% Impervious	Area (Acres)	Impervious Acres
Falcon Drainage Basin			
Commercial	95%	8.54*	5.97**
Untouched/Green Space	0%	0	0
	Total	8.54	5.97

* Total area includes entire replat area (Lot 1, Lot 2, & Tract A)

** Lot 1 contains 2.57 AC of pervious area. The existing Circle K developed area of 0.98 AC is not subject to fees and is included in this calculation ✔

Circle K at Highway 24 & Meridian 2022 Drainage and Bridge Fees for Falcon Drainage Basin						
	Impervious Area (ac.)	Fee/ Imp. Acre	Fee Due	Reimbursable Const. Costs	Fee Due at Platting	Drainage Fee Credit
Chico Creek						
Drainage Fee	5.97	$34,117.00	$203,678.49	$0.00	$203,678.49	$0.00
Bridge Fee	5.97	$4,687	$27,981.39	$0.00	$27,981.39	$0.00
Overall Total					***$231,659.88***	

XII. Construction Cost Opinion

Engineer's Estimate of Probable Construction Costs				
Circle K at Highway 24 & Meridian				
Public Non-Reimbursable				
Item	**Unit**	**Quantity**	**Unit Cost**	**Extension**
15" RCP	LF	302	$58.00	$17,516.00
18" RCP	LF	218	$70.00	$15,260.00
24" RCP	LF	85	$83.00	$7,055.00
23"X14" HERCP	LF	97	$85.00	$8,245.00
15" FES	EA	2	$400.00	$800.00
18" FES	EA	1	$420.00	$420.00
24" FES	EA	2	$498.00	$498.00
23"X14" FES	EA	2	$510.00	$1,020.00
TYPE II MANHOLE	EA	1	$7,082.00	$7,082.00
5' TYPE R INLET	EA	1	$7,981.00	$7,981.00
10' TYPE R INLET	EA	1	$10,898.00	$10,898.00
DENVER NO. 16 VALLEY GRATE	EA	6	$4,000.00	$24,000.00
DETENTION/WQ POND	EA	1	$86,000.00	$86,000.00
		Sub Total	$186,775.00	
		10% Contingency	$18,677.50	
		TOTAL:		$205,452.50

Since the engineer has no control over the cost of labor, materials, equipment, or services furnished by others, or over the contractor's method of determining prices, or over the competitive bidding or market conditions, the opinion of probable construction costs provided herein are made on the basis of the engineer's experience and qualifications and represents the best judgment as an experienced and qualified professional familiar with the construction industry. The engineer cannot, and does not guarantee that proposals, bid or actual construction costs will not vary from the opinions of probable cost.

XIII. Summary

The above report has demonstrated that the proposed Circle K at Highway 24 & Meridian development will comply with the governing DCM, ECM, and the El Paso County MS4 permit. There are no DBPS requirements affecting the site and no adverse effects on downstream infrastructure is anticipated. Therefore, we recommend approval of the proposed development.

XIV. References

1. ***El Paso County Drainage Criteria Manual, Volume 1 & 2***, El Paso County, May 2014
2. ***El Paso County Engineering Criteria Manual,*** El Paso County, Rev. December 2016
3. ***Web Soil Survey of El Paso County Area, Colorado. Unites States Department of Agriculture Soil Conservation Service***.
4. ***Flood Insurance Rate Maps for El Paso County, Colorado and Incorporated Areas, Panel 561 of 1300, Federal Emergency Management Agency***, Effective Date December 7, 2018.
5. ***Urban Storm Drainage Criteria Manual, Vol. 1-3*** by Urban Drainage and Flood Control District (UDFCD), January 2016
6. ***Falcon Drainage Basin Planning Study,*** Matrix Design Group, September 2015
7. ***Stormwater Management Plan, Circle K at Highway 24 & Meridian Road,*** Matrix Design Group, Under review.
8. ***El Paso County Department of Public Services U.S. 24 and Meridian Road Improvement Plans*** **by HDR, August 2019.**

XV. Appendices

APPENDIX A

HYDROLOGIC AND HYDRAULIC CALCULATIONS

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches	
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches	
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches	
Optional User Defined Storm	CUHP			
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52		
Max Intensity for Optional User Defined Storm	2.51496			

Designer: Luke Bonner
Company: Matrix Design Group
Date: December 1, 2022
Project: Circle K at Highway 24 & Meridian Road - SDP FDR
Location: El Paso County, CO

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**J3**													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	8.034													
Directly Connected Impervious Area (DCIA, acres)	4.025													
Unconnected Impervious Area (UIA, acres)	0.000													
Receiving Pervious Area (RPA, acres)	0.000													
Separate Pervious Area (SPA, acres)	4.009													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	V	C	C	C	C	C	C	C	C	C	C	C	C	
		MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	8.034													
Directly Connected Impervious Area (DCIA, %)	50.1%													
Unconnected Impervious Area (UIA, %)	0.0%													
Receiving Pervious Area (RPA, %)	0.0%													
Separate Pervious Area (SPA, %)	49.9%													
A_B (RPA / UIA)	0.000													
I_a Check	1.000													
f / I for WQCV Event:	3.2													
f / I for 5-Year Event:	0.5													
f / I for 100-Year Event:	0.4													
f / I for Optional User Defined Storm CUHP:	0.39													
IRF for WQCV Event:	0.00													
IRF for 5-Year Event:	1.00													
IRF for 100-Year Event:	1.00													
IRF for Optional User Defined Storm CUHP:	1.00													
Total Site Imperviousness: I_{total}	50.1%													
Effective Imperviousness for WQCV Event:	50.1%													
Effective Imperviousness for 5-Year Event:	50.1%													
Effective Imperviousness for 100-Year Event:	50.1%													
Effective Imperviousness for Optional User Defined Storm CUHP:	50.1%													

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	N/A													N/A
This line only for 10-Year Event	N/A													N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%													N/A
User Defined CUHP CREDIT: Reduce Detention By:	0.0%													

Total Site Imperviousness:	**50.1%**
Total Site Effective Imperviousness for WQCV Event:	**50.1%**
Total Site Effective Imperviousness for 5-Year Event:	**50.1%**
Total Site Effective Imperviousness for 100-Year Event:	**50.1%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**50.1%**

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Rational Method - Existing Conditions

Project Name:	Circle K - HWY 24 & Meridian
Project Location:	Falcon, Colorado
Designer	LCB/JTS
Notes:	Existing Conditions

Average Channel Velocity	5	ft/s
Average Slope for Initial Flow	0.04	ft/ft

Channel Flow Type Key

Heavy Meadow	2
Tillage/Field	3
Short Pasture and Lawns	4
Nearly Bare Ground	5
Grassed Waterway	6
Paved Areas	7

		Area		Rational 'C' Values								Flow Lengths				Initial Flow		Channel Flow				Tc	Rainfall Intensity & Rational Flow Rate			
				Surface Type 1 (Impervious)			Surface Type 2 (Undeveloped)			Composite																
Major Basin / Sub-basin	**Comments**	sf	acres	C5	C100	Area (SF)	C5	C100	Area	C5	C100	Initial ft	True Initial Length ft	Channel ft	True Channel Length ft	Average Slope	Initial Tc (min)	Average (%) Slope	Channel Flow Type (See Key above) Ground Type	Velocity (ft/s)	Channel Tc (min)	Total (min)	i5 in/hr	Q5 cfs	i100 in/hr	Q100 cfs
EX 01	***West offsite drainage, south part of HWY 24, pervious area north of PR SITE***	72,996.4	1.68	0.90	0.96	22557.26	0.09	0.36	50439.15	0.34	0.55	350.00	300.00	500.00	300.00	0.020	20.30	2.000	4	1.0	5.1	25.4	2.7	**1.5**	4.5	**4.1**
EX 02	***Proposed site treated by WQ Pond, proposed comercial area, portion of access road***	172,214.5	3.95	0.90	0.96	8543.30	0.09	0.36	163671.18	0.13	0.39	300.00	300.00	300.00	300.00	0.020	24.00	2.000	4	1.0	5.1	29.0	2.5	**1.3**	4.1	**6.4**
EX 03	***West Entrance***	3,997.5	0.09	0.90	0.96	965.17	0.09	0.36	3032.36	0.29	0.50	40.00	40.00	75.00	300.00	0.020	7.36	2.000	4	1.0	5.1	12.4	3.8	**0.1**	6.3	**0.3**
EX 04	***Northeast area, south part of HWY 24, existing comercial building***	81,916.8	1.88	0.90	0.96	42958.11	0.09	0.36	38958.73	0.51	0.67	100.00	380.00	300.00	300.00	0.020	8.36	2.000	7	2.8	1.8	10.1	4.1	**4.0**	6.9	**8.7**
EX 05	***East Entrance, west part of Meridian Sol, proposed sidewalk***	18,712.0	0.43	0.90	0.96	12980.34	0.09	0.36	5731.65	0.65	0.78	50.00	50.00	450.00	300.00	0.020	4.53	2.000	7	2.8	1.8	6.3	4.8	**1.3**	8.1	**2.7**
EX SITE NORTH	***EX 01-05***	349,837.3	8.03	0.90	0.96	88004.19	0.09	0.36	261833.07	0.29	0.51	350.00	300.00	500.00	300.00	0.020	21.55	2.000	4	1.0	5.1	26.6	2.6	**6.1**	4.4	**17.9**

Rational Method - Proposed Conditions

Project Name:	Circle K - HWY 24 & Meridian
Project Location:	Falcon, Colorado
Designer	LCB/JTS
Notes:	Circle K Proposed Conditions

Average Channel Velocity 4.00 ft/s (If specific channel vel is used, this will be ignored)
Average Slope for Initial Flow 0.04 ft/ft (If Elevations are used, this will be ignored)

Channel Flow Type Key

Heavy Meadow	2
Tillage/Field	3
Short Pasture and Lawns	4
Nearly Bare Ground	5
Grassed Waterway	6
Paved Areas	7

		Area		Rational 'C' Values									Flow Lengths										Tc	Rainfall Intensity & Rational Flow Rate				
Sub-basin	**Comments**			Surface Type 1 Streets - Paved (100% Impervious)			Surface Type 2 Undeveloped-Historic Flow Analysis (2% Impervious)			Composite		Percent Impervious	Initial	True Initial	Channel	True Channel	Average (decimal)	Initial	Average (%)	Channel Flow Type (See Key above)	Velocity	Channel	Total	i5	Q5	i100	Q100
		sf	acres	C5	C100	Area (SF)	C5	C100	Area	C5	C100		ft	Length ft	ft	Length ft	Slope	Tc (min)	Slope	Ground Type	(ft/s)	Tc (min)	(min)	in/hr	cfs	in/hr	cfs
A	***South Access road, internal west entrance, internal east entrance north adjacent to carwash***	43748	1.00	0.90	0.96	35838.80	0.09	0.36	7909.38	0.75	0.85	82.28	100	100	500	500	0.02	5.45	1.50	7	2.45	3.40	8.84	4.29	**3.3**	7.21	**6.2**
B	***West side of parcel, bypass from C and D***	33696	0.77	0.90	0.96	24390.84	0.09	0.36	9304.86	0.68	0.79	72.94	120	100	180	200	0.01	8.35	1.00	7	2.00	1.67	10.02	4.10	**2.2**	6.89	**4.3**
C	***Middle of fuel canopy and parking, central area inlet***	14589	0.33	0.90	0.96	11878.55	0.09	0.36	2710.02	0.75	0.85	81.80	140	100	110	150	0.01	7.46	1.00	7	2.00	1.25	8.71	4.32	**1.1**	7.25	**2.1**
D	***NE corner draining towards SW, NW area inlet at parking gutter***	15880	0.36	0.90	0.96	11551.84	0.09	0.36	4328.52	0.68	0.80	73.29	100	100	225	225	0.01	7.57	1.00	7	2.00	1.88	9.44	4.19	**1.0**	7.04	**2.1**
E	***Car Wash entrance and landscaping, east parking***	9463	0.22	0.90	0.96	6574.49	0.09	0.36	2888.07	0.65	0.78	70.09	30	30	130	130	0.01	4.41	1.00	7	2.00	1.08	5.49	4.98	**0.7**	8.37	**1.4**
F	***Car Wash Roof drainage***	1458	0.03	0.90	0.96	1458.00	0.09	0.36	0.00	0.90	0.96	100.00	20	20	65	65	0.01	1.61	1.00	7	2.00	0.54	5.00	5.10	**0.2**	8.58	**0.3**
G	***Fuel Canopy Roof Drainage***	6312	0.14	0.90	0.96	6312.00	0.09	0.36	0.00	0.90	0.96	100.00	15	15	220	220	0.01	1.39	1.00	7	2.00	1.83	5.00	5.10	**0.7**	8.58	**1.2**
H	***C-Store Roof Drainage***	5200	0.12	0.90	0.96	5200.00	0.09	0.36	0.00	0.90	0.96	100.00	40	40	100	100	0.01	2.28	1.00	7	2.00	0.83	5.00	5.10	**0.6**	8.58	**1.0**
J	***Detention pond***	31797	0.73	0.90	0.96	1915.79	0.09	0.36	29881.69	0.14	0.40	7.90	60	60	210	210	0.01	13.40	1.00	4	0.70	5.00	18.40	3.14	**0.3**	5.28	**1.5**
K	***Northeast area, south part of HWY 24***	81917	1.88	0.90	0.96	28612.90	0.09	0.36	53303.94	0.37	0.57	36.23	75	75	375	375	0.01	11.33	1.00	4	0.70	8.93	20.26	2.99	**2.1**	5.03	**5.4**
L	***Offsite drainage to north and west of site, roadway flows***	72996	1.68	0.90	0.96	15235.61	0.09	0.36	57760.80	0.26	0.49	22.45	300	300	525	525	0.01	26.22	1.00	4	0.70	12.50	38.71	2.09	**0.9**	3.50	**2.9**
M	***Offsite street drainage for West entrance***	4050	0.09	0.90	0.96	4049.98	0.09	0.36	0.00	0.90	0.96	100.00	20	20	75	75	0.01	1.61	1.00	7	2.00	0.63	5.00	5.10	**0.4**	8.58	**0.8**
N	***Offsite street drainage for East entrance, west part of Meridian Sol***	18722	0.43	0.90	0.96	18721.61	0.09	0.36	0.00	0.90	0.96	100.00	20	20	50	50	0.01	1.61	1.00	7	2.00	0.42	5.00	5.10	**2.0**	8.58	**3.6**
P	***Offsite drainage to the south of the Access road, offsite culvert outlets***	10123	0.23	0.90	0.96	0.00	0.09	0.36	10123.38	0.09	0.36	2.00	20	20	20	20	0.02	6.45	2.00	4	0.99	0.34	6.78	4.69	**0.1**	7.88	**0.7**
DESIGN POINTS																												
DP A	***Inlet at lowpoint of access road***	43748	1.00	0.90	0.96	35839	0.09	0.36	7909	0.75	0.85	82.28	100	100	500	500	0.02	5.45	1.5	7	2.45	3.40	8.84	4.29	**3.3**	7.21	**6.2**
DP A Inlet Flow	***Inlet at lowpoint of access road, combined flow from DP B***	114225	2.62	0.90	0.96	89972	0.09	0.36	24253	0.73	0.83	79.19	100	100	500	500	0.01	6.70	1.0	7	2.00	4.17	10.86	3.97	**7.6**	6.67	**14.7**
DP B	***Inlet at NW Corner of Pond, Sub Basin B***	33696	0.77	0.90	0.96	24391	0.09	0.36	9305	0.68	0.79	72.94	120	100	180	200	0.01	8.35	1.0	7	2.00	1.67	10.02	4.10	**2.2**	6.89	**4.3**
DP B Inlet Flow	***Inlet at NW corner of Pond, B, C, D & G***	70477	1.62	0.90	0.96	54133	0.09	0.36	16343	0.71	0.82	77.27	140	100	250	290	0.01	8.26	1.0	7	2.00	2.42	10.67	4.00	**4.6**	6.72	**9.0**
DP C	***Area inlets in middle of front parking***	14589	0.33	0.90	0.96	11879	0.09	0.36	2710	0.75	0.85	81.80	140	100	110	150	0.01	7.46	1.0	7	2.00	1.25	8.71	4.32	**1.1**	7.25	**2.1**
DP C Inlet Flow	***Area inlets in middle of front parking, combined flow from DP D***	30469	0.70	0.90	0.96	23430	0.09	0.36	7039	0.71	0.82	77.36	100	100	350	350	0.01	6.97	1.0	7	2.00	2.92	9.88	4.12	**2.1**	6.92	**4.0**
DP D	***Area inlets in eastern part of front parking***	15880	0.36	0.90	0.96	11552	0.09	0.36	4329	0.68	0.80	73.29	100	100	225	225	0.01	7.57	1.0	7	2.00	1.88	9.44	4.19	**1.0**	7.04	**2.1**
DP E	***Car wash entrance flume, E & F***	10921	0.25	0.90	0.96	8032	0.09	0.36	2888	0.69	0.80	74.08	140	100	110	150	0.01	8.82	1.0	7	2.00	1.25	10.07	4.09	**0.7**	6.87	**1.4**
DP F	***Car Wash Roof Drain***	1458	0.03	0.90	0.96	1458	0.09	0.36	0	0.90	0.96	100.00	20	20	65	65	0.01	1.61	1.0	7	2.00	0.54	5.00	5.10	**0.2**	8.58	**0.3**
DP G	***Fuel Canopy Roof Drainage***	6312	0.14	0.90	0.96	6312	0.09	0.36	0	0.90	0.96	100.00	15	15	220	220	0.01	1.39	1.0	7	2.00	1.83	5.00	5.10	**0.7**	8.58	**1.2**
DP H	***C-Store Roof Drain***	5200	0.12	0.90	0.96	5200	0.09	0.36	0	0.90	0.96	100.00	40	40	100	100	0.01	2.28	1.0	7	2.00	0.83	5.00	5.10	**0.6**	8.58	**1.0**
DP J1	***Detention pond area***	31797	0.73	0.90	0.96	1916	0.09	0.36	29882	0.14	0.40	7.90	60	60	210	210	0.01	13.40	1.0	4	0.70	5.00	18.40	3.14	**0.3**	5.28	**1.5**
DP J2	***Sub-basins A, B, E, G & H1***	162143	3.72	0.90	0.96	105120	0.09	0.36	57023	0.62	0.75	65.54	140	100	771	811	0.01	10.33	1.0	7	2.00	6.76	17.08	3.26	**7.5**	5.47	**15.4**
DP J3	***Pond Outlet Structure***	162143	3.72	0.90	0.96	105120	0.09	0.36	57023	0.62	0.75	65.54	140	100	771	811	0.01	10.33	1.0	7	2.00	6.76	17.08	3.26	**0.1**	5.47	**3.4**
DP K	***Undeveloped land to NE***	81917	1.88	0.90	0.96	28613	0.09	0.36	53304	0.37	0.57	36.23	75	75	375	375	0.01	11.33	1.0	4	0.70	8.93	20.26	2.99	**2.1**	5.03	**5.4**
DP L	***Offsite drainage to west of site***	72996	1.68	0.90	0.96	15236	0.09	0.36	57761	0.26	0.49	22.45	300	300	525	525	0.01	26.22	1.0	4	0.70	12.50	38.71	2.09	**0.9**	3.50	**2.9**
DP M	***Offsite street drainage for West entrance***	4050	0.09	0.90	0.96	4050	0.09	0.36	0	0.90	0.96	100.00	20	20	75	75	0.01	1.61	1.0	7	2.00	0.63	5.00	5.10	**0.4**	8.58	**0.8**
DP N	***Offsite street drainage for East entrance, west part of Meridian Sol***	18722	0.43	0.90	0.96	18722	0.09	0.36	0	0.90	0.96	100.00	20	20	50	50	0.01	1.61	1.0	7	2.00	0.42	5.00	5.10	**2.0**	8.58	**3.6**
DP P	***Offsite drainage to the south of the Access road, offsite culvert outlets***	10123	0.23	0.90	0.96	0	0.09	0.36	10123	0.09	0.36	2.00	20	20	20	20	0.02	6.45	2.0	4	0.99	0.34	6.78	4.69	**0.1**	7.88	**0.7**
DP SITE NORTH	***North Lot Overall Drainage***	349951	8.03	0.90	0.96	171740	0.09	0.36	178211	0.49	0.65	50.09	300	300	525	525	0.01	19.10	1.0	4	0.70	12.50	31.59	2.35	**5.6**	3.95	**16.7**

Circle K at Highway 24 & Meridian Road
INLET SUMMARY

DESIGN POINT (#-Letter) or SUB-BASIN (Letter#)	SUB-BASINS	TOTAL AREA (AC)	INLET			Q(5) BYPASS FLOWS (cfs)	Q(5) TOTAL INFLOW	Q5 INLET CAPACITY	Q(100) BYPASS FLOWS (cfs)	Q(100) TOTAL INFLOW (cfs)	MAX INLET CAPACITY	NOTES:
			SIZE (Ft.)	TYPE	CONDITION							
DP A	A	1.00	5	R	**SUMP**	**0.0**	3.27	**5.4**	**0.0**	6.22	**9.2**	
DP B	B	0.77	10	R	**SUMP**	**0.0**	2.16	**2.5**	**0.0**	4.27	**6.1**	***Inlet B Captures 100% of Bypass Flows From Inlets C & D***
DP C	C	0.33	3	16	**AT GRADE**	**0.0**	1.09	**1.1**	**0.1**	2.08	**2.0**	***Bypass flows to Inlet B***
DP D	D	0.36	3	16	**AT GRADE**	**0.0**	1.05	**1.0**	**0.4**	2.06	**1.7**	***Bypass flows to Inlet C***

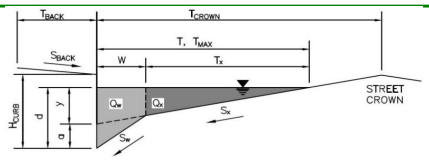
MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: **Inlet A**



Gutter Geometry:

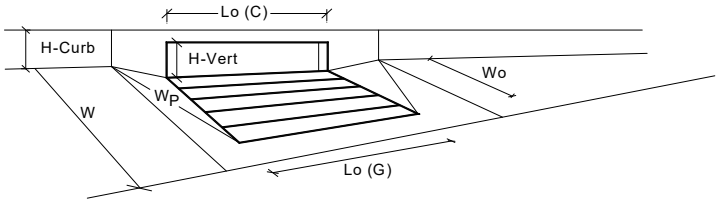
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	35.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.015	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	35.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	10.5	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	7.9	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.50	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**9.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.3	6.2	cfs

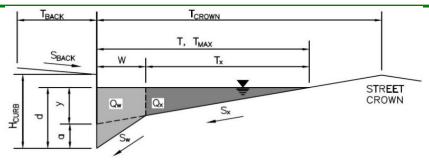
MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: **Inlet B**



Gutter Geometry:

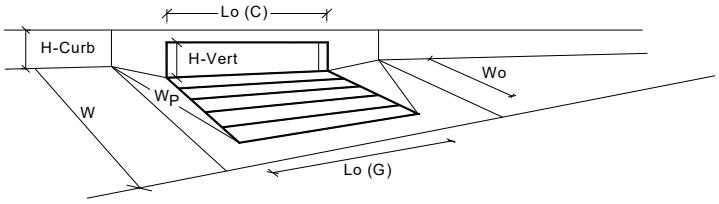
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	40.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.0	5.4	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.17	0.28	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.38	0.50	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.89	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.5**	**6.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.4	4.9	cfs

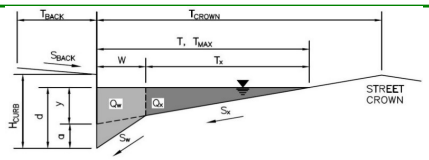
MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: **Inlet C**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.004	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.1	3.9	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

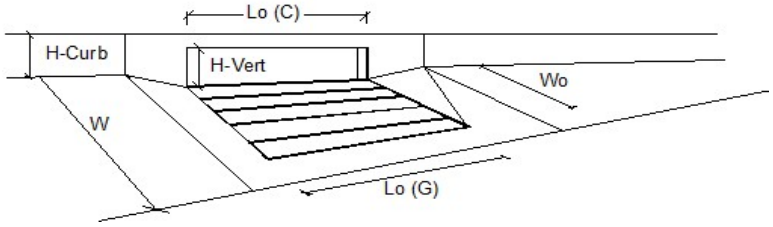
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**1.3**	**3.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.1**	**2.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**0.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**87**	**78**	**%**

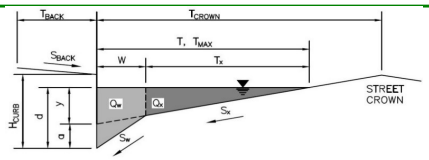
MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Inlet ID: **Inlet D**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.015	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.004	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.0	3.9	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

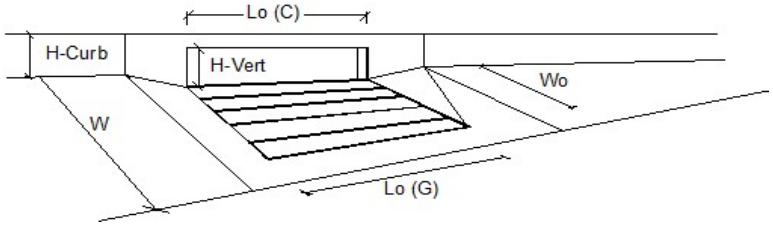
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**1.1**	**3.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

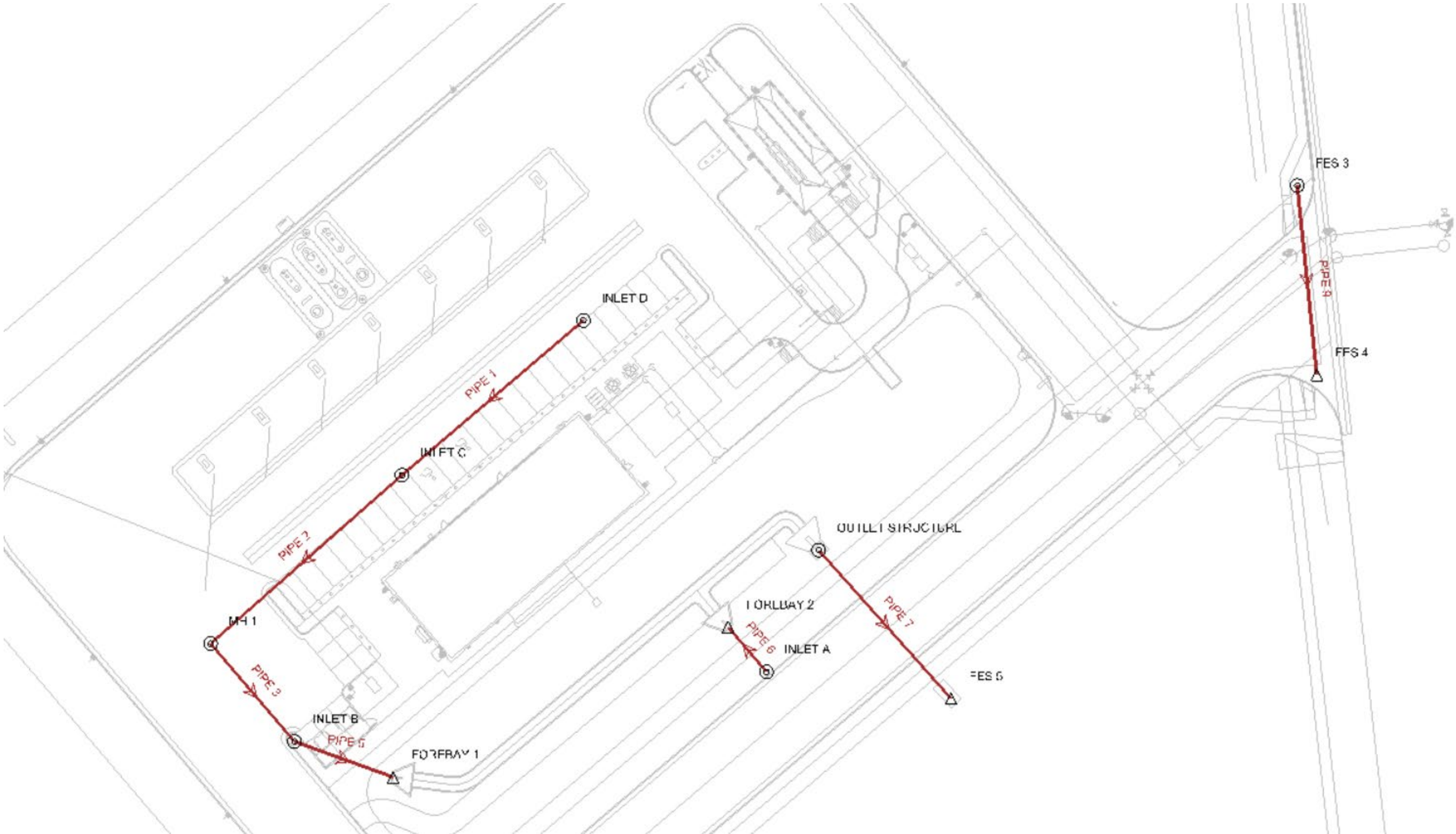
INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

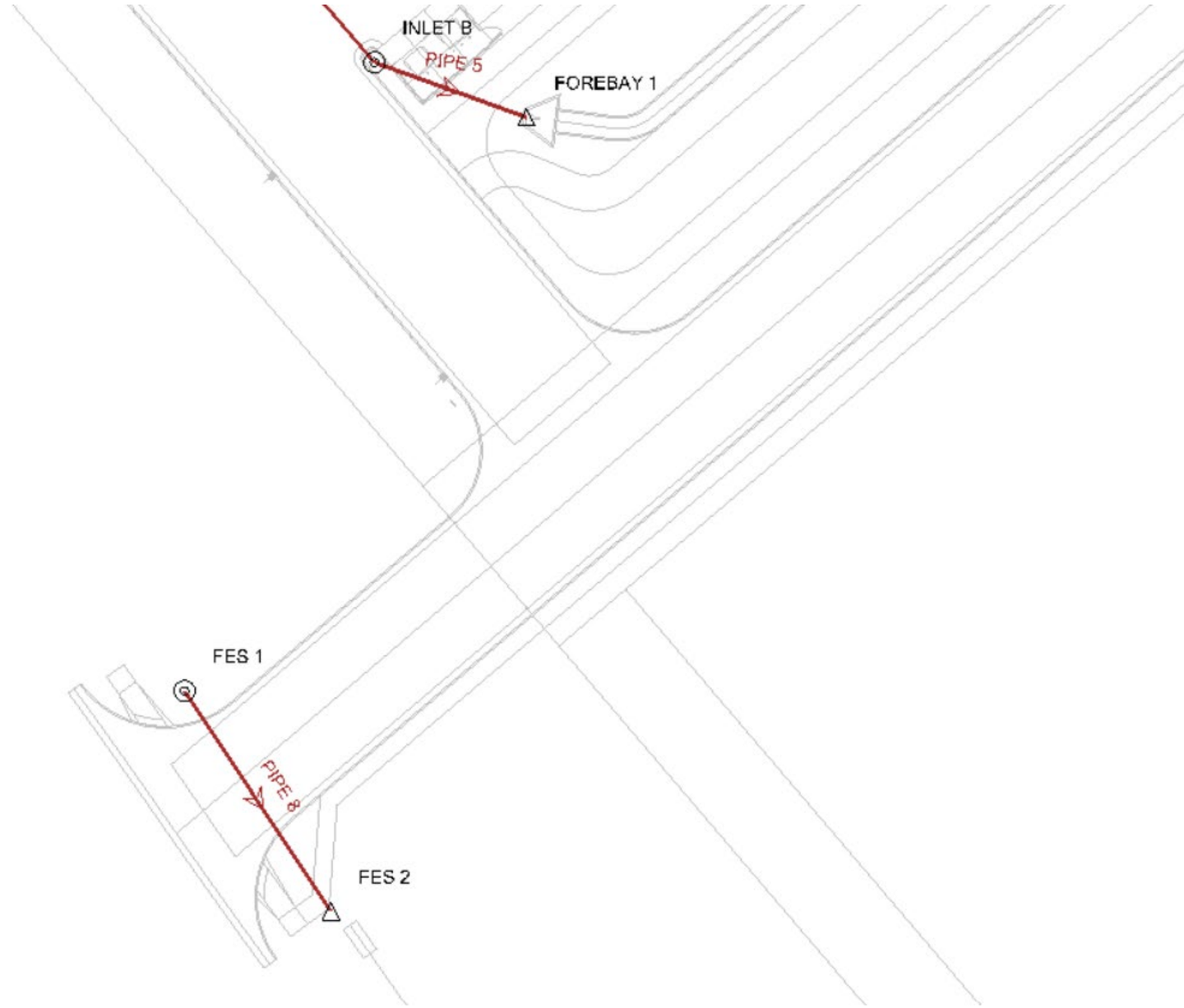


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	

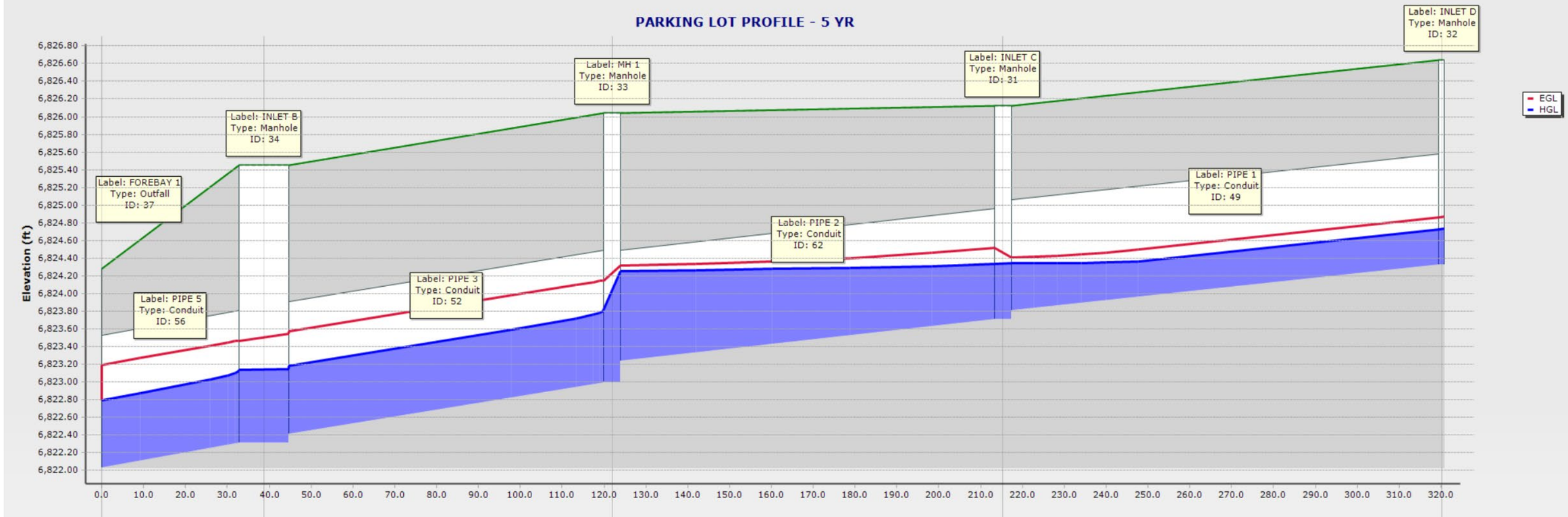
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.9**	**1.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**89**	**80**	**%**



STORMCAD LAYOUT – HIGHWAY 24 & MERIDIAN ROAD

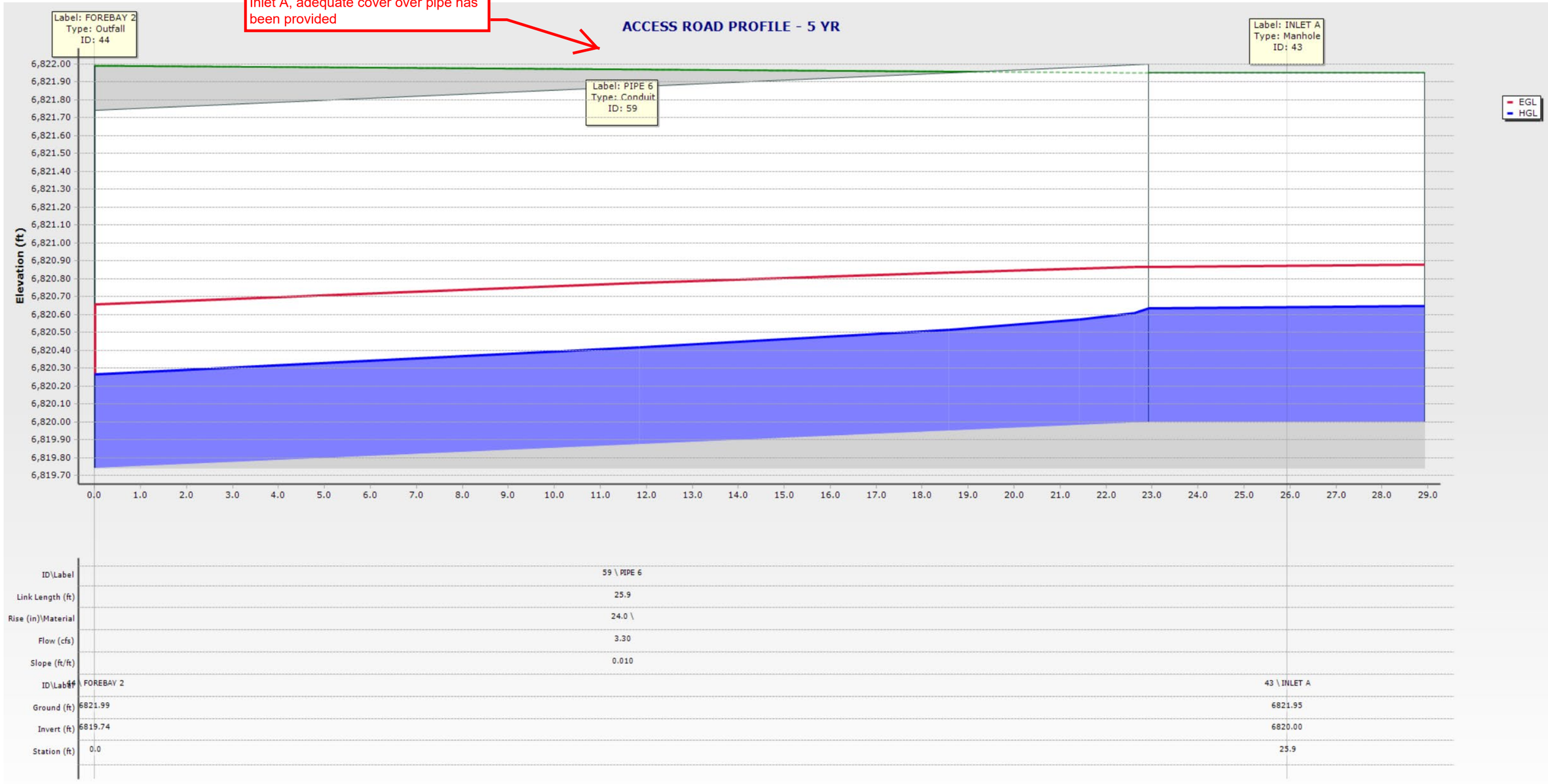


STORMCAD LAYOUT – HIGHWAY 24 & MERIDIAN ROAD

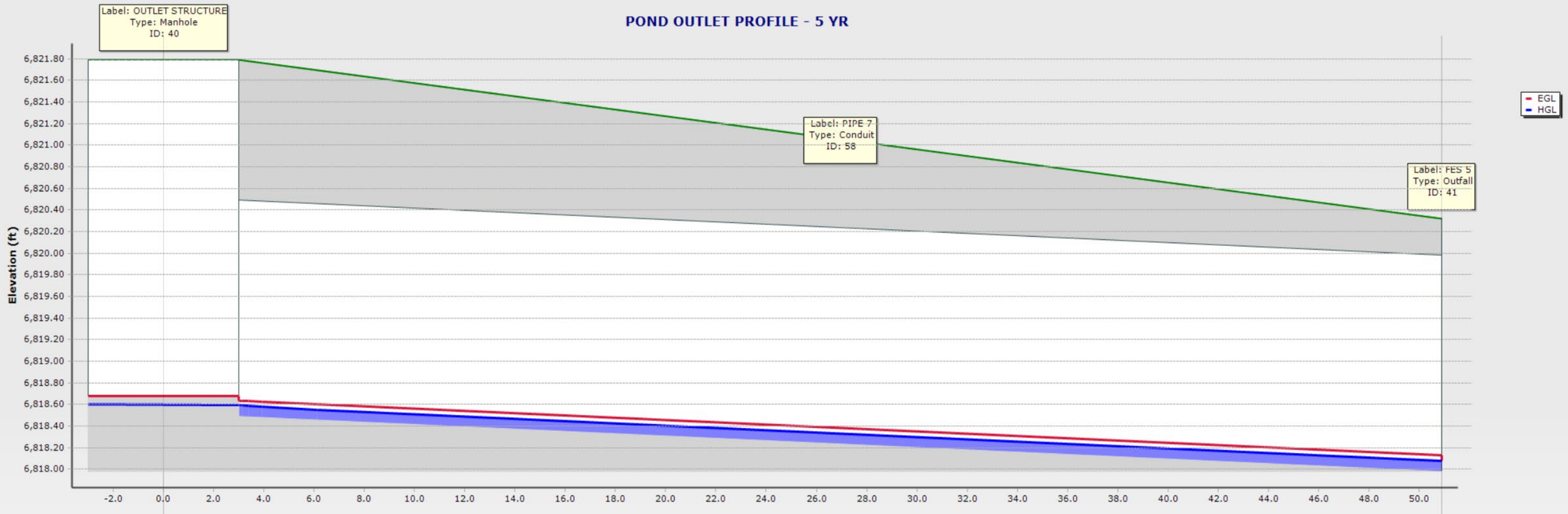


ID\Label	56 \ PIPE 5	52 \ PIPE 3	62 \ PIPE 2	49 \ PIPE 1	
Link Length (ft)	38.8	83.2	93.4	104.8	
Rise (in)\Material	18.0 \	18.0 \	15.0 \	15.0 \	
Flow (cfs)	4.60	4.60	2.10	1.00	
Slope (ft/ft)	0.007	0.007	0.005	0.005	
ID\Label	37 \ FOREBAY 1	34 \ INLET B	33 \ MH 1	31 \ INLET C	32 \ INLET D
Ground (ft)	6824.28	6825.45	6826.04	6826.12	6826.64
Invert (ft)	6822.03	6822.31	6822.99	6823.71	6824.33
Station (ft)	0.0	38.8	122.0	215.3	320.1

Berm present between Forebay 2 and Inlet A, adequate cover over pipe has been provided

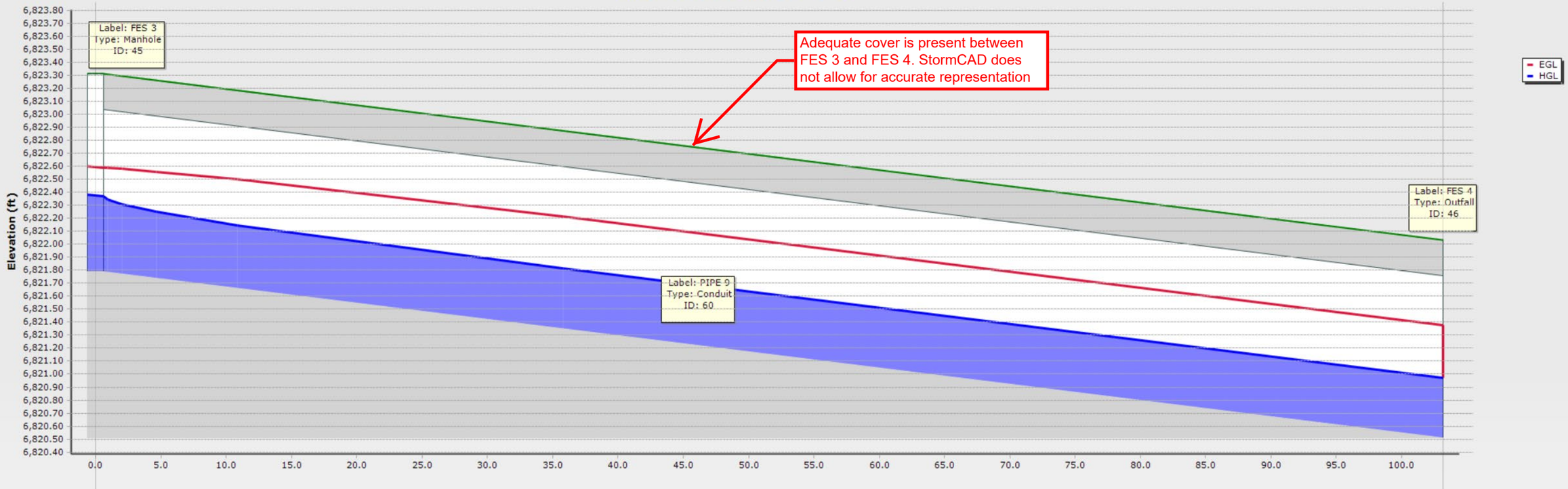


POND OUTLET PROFILE - 5 YR

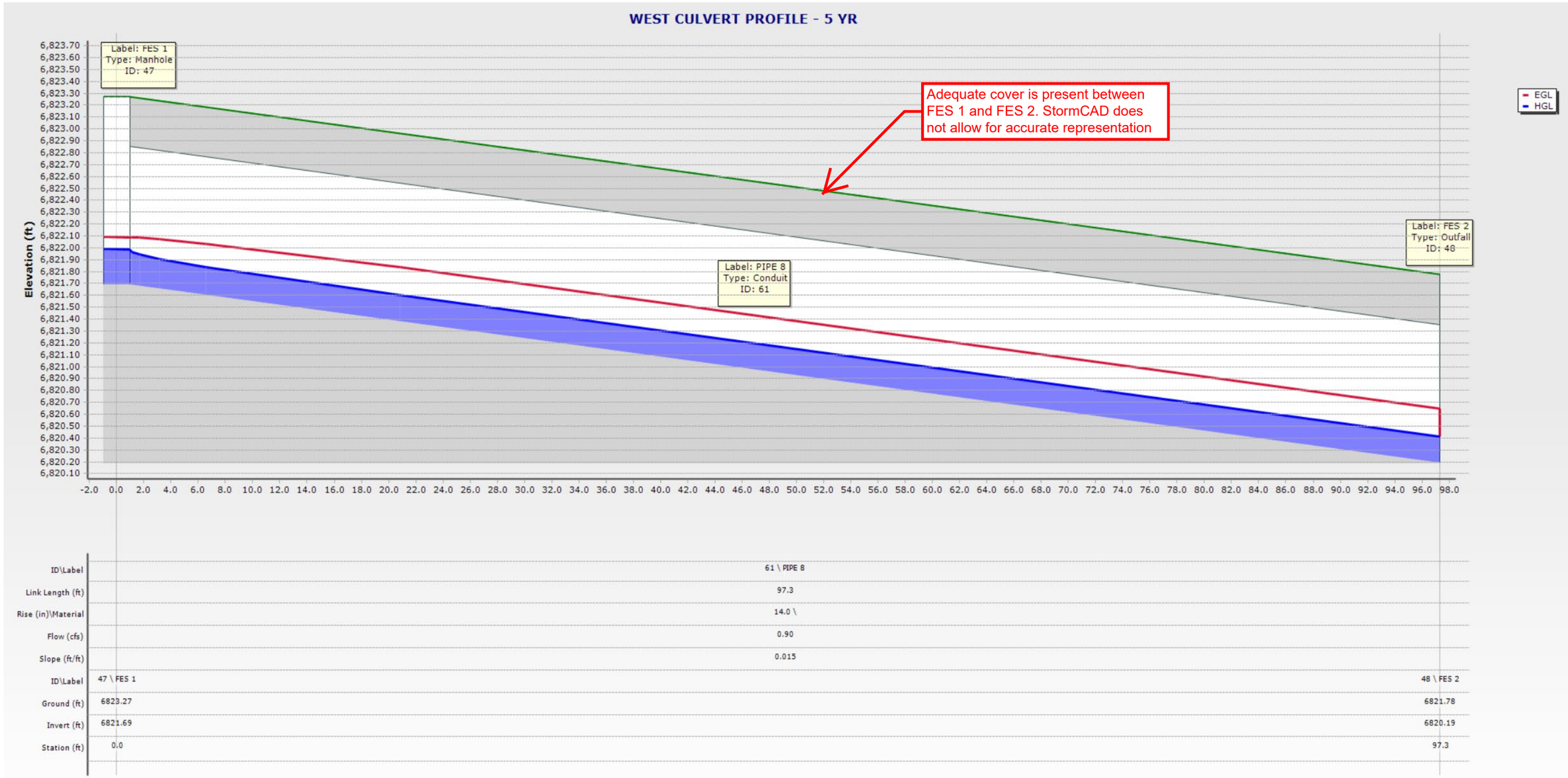


ID\Label		58 \ PIPE 7	
Link Length (ft)		50.9	
Rise (in)\Material		24.0 \	
Flow (cfs)		0.10	
Slope (ft/ft)		0.010	
ID\Label	40 \ OUTLET STRUCTURE		41 \ FES 5
Ground (ft)	6821.79		6820.32
Invert (ft)	6818.68		6817.98
Station (ft)	0.0		50.9

EAST CULVERT PROFILE - 5 YR



ID\Label		60 \ PIPE 9	
Link Length (ft)		103.2	
Rise (in)\Material		15.0 \	
Flow (cfs)		2.10	
Slope (ft/ft)		0.012	
ID\Label	45 \ FES 3		46 \ FES 4
Ground (ft)	6823.31		6822.03
Invert (ft)	6821.79		6820.51
Station (ft)	0.0		103.2

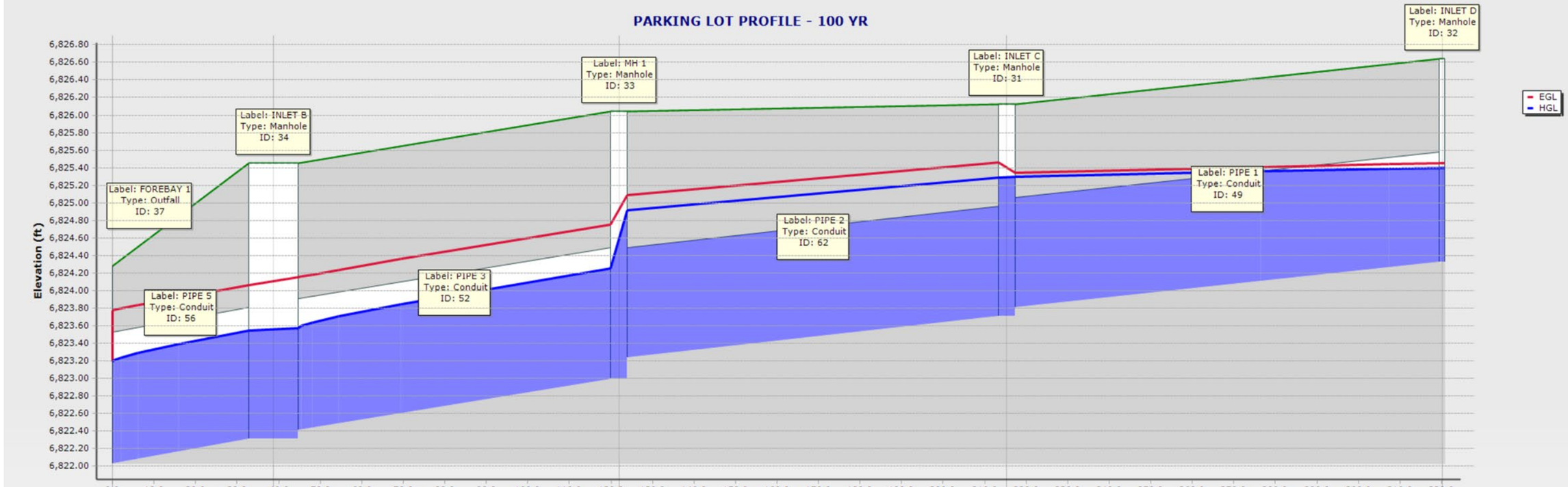

WEST CULVERT PROFILE - 5 YR
Label: FES 1
Type: Manhole
ID: 47
Adequate cover is present between FES 1 and FES 2. StormCAD does not allow for accurate representation
Label: PIPE 8
Type: Conduit
ID: 61
Label: FES 2
Type: Outfall
ID: 48
EGL
HGL
Elevation (ft)
6,823.70
6,823.60
6,823.50
6,823.40
6,823.30
6,823.20
6,823.10
6,823.00
6,822.90
6,822.80
6,822.70
6,822.60
6,822.50
6,822.40
6,822.30
6,822.20
6,822.10
6,822.00
6,821.90
6,821.80
6,821.70
6,821.60
6,821.50
6,821.40
6,821.30
6,821.20
6,821.10
6,821.00
6,820.90
6,820.80
6,820.70
6,820.60
6,820.50
6,820.40
6,820.30
6,820.20
6,820.10
-2.0 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0 82.0 84.0 86.0 88.0 90.0 92.0 94.0 96.0 98.0
ID\Label
61 \ PIPE 8
Link Length (ft)
97.3
Rise (in)\Material
14.0 \
Flow (cfs)
0.90
Slope (ft/ft)
0.015
ID\Label
47 \ FES 1
48 \ FES 2
Ground (ft)
6823.27
6821.78
Invert (ft)
6821.69
6820.19
Station (ft)
0.0
97.3

PIPE REPORT (5 YR)

	ID	Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
49: PIPE 1	49	PIPE 1	INLET D	6,824.33	INLET C	6,823.81	0.005	15.0	0.013	1.00	2.97	6,824.73	6,824.34
62: PIPE 2	62	PIPE 2	INLET C	6,823.71	MH 1	6,823.24	0.005	15.0	0.013	2.10	3.65	6,824.33	6,824.25
52: PIPE 3	52	PIPE 3	MH 1	6,822.99	INLET B	6,822.41	0.007	18.0	0.013	4.60	5.02	6,823.81	6,823.18
56: PIPE 5	56	PIPE 5	INLET B	6,822.31	FOREBAY 1	6,822.03	0.007	18.0	0.013	4.60	5.09	6,823.13	6,822.79
59: PIPE 6	59	PIPE 6	INLET A	6,820.00	FOREBAY 2	6,819.74	0.010	24.0	0.013	3.30	5.14	6,820.63	6,820.26
58: PIPE 7	58	PIPE 7	OUTLET STRUCTURE	6,818.49	FES 5	6,817.98	0.010	24.0	0.013	0.10	1.80	6,818.60	6,818.08
61: PIPE 8	61	PIPE 8	FES 1	6,821.69	FES 2	6,820.19	0.015		0.013	0.90	3.92	6,821.98	6,820.41
60: PIPE 9	60	PIPE 9	FES 3	6,821.79	FES 4	6,820.51	0.012	15.0	0.013	2.10	5.08	6,822.37	6,820.97

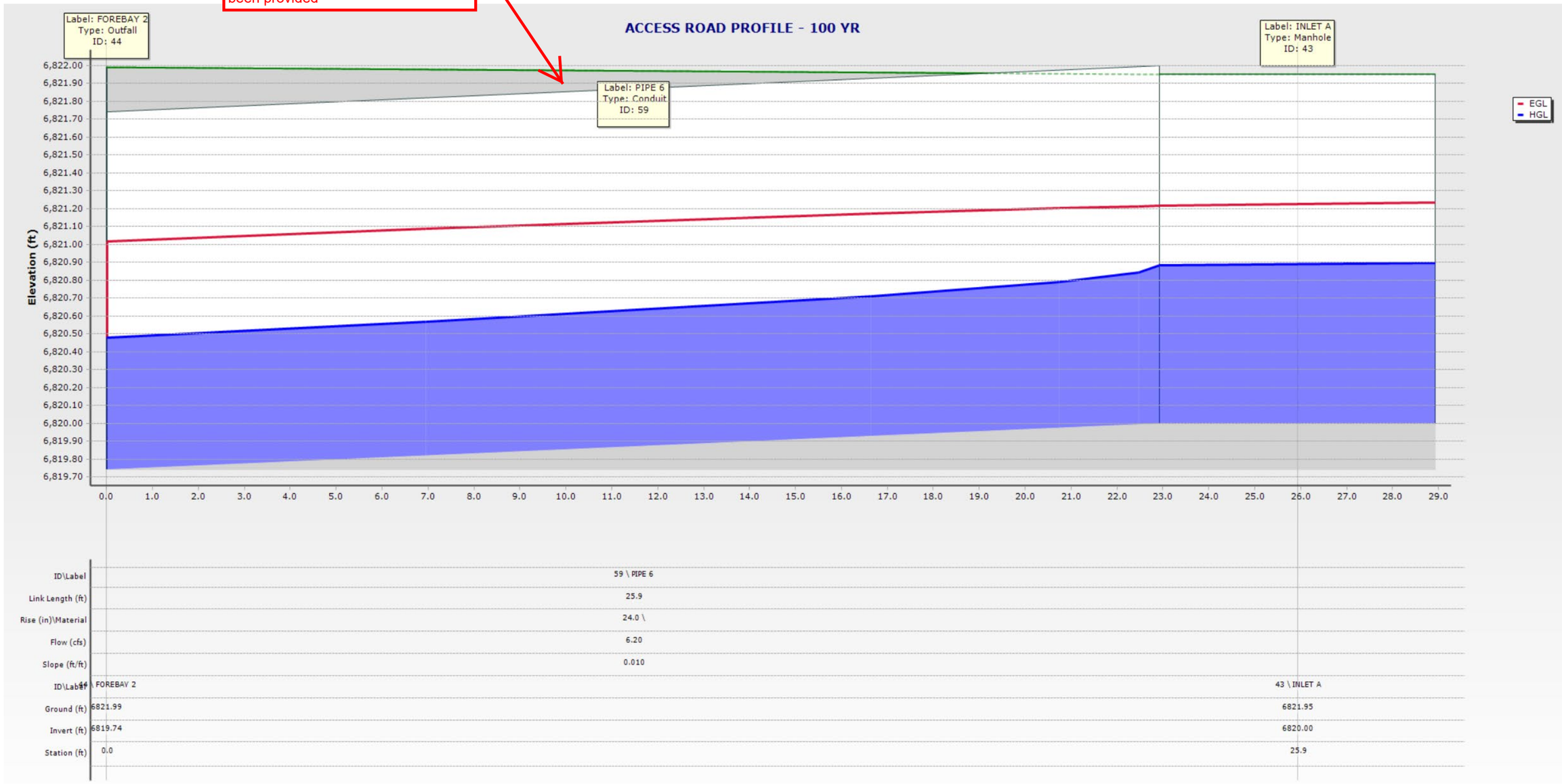
STRUCTURE REPORT (5 YR)

	ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
47: FES 1	47	FES 1	6,823.27	6,823.27	0.29	6,821.99	6,821.98	0.050	0.90
45: FES 3	45	FES 3	6,823.31	6,823.31	0.58	6,822.38	6,822.37	0.050	2.10
43: INLET A	43	INLET A	6,821.95	6,821.95	0.64	6,820.65	6,820.63	0.050	3.30
34: INLET B	34	INLET B	6,825.45	6,825.45	0.82	6,823.15	6,823.13	0.050	4.60
31: INLET C	31	INLET C	6,826.12	6,826.12	0.62	6,824.34	6,824.33	0.050	2.10
32: INLET D	32	INLET D	6,826.64	6,826.64	0.40	6,824.73	6,824.73	0.050	1.00
33: MH 1	33	MH 1	6,826.04	6,826.04	0.82	6,824.25	6,823.81	1.320	4.60
40: OUTLET ST	40	OUTLET STRUCTURE	6,821.79	6,821.79	-0.08	6,818.60	6,818.60	0.050	0.10

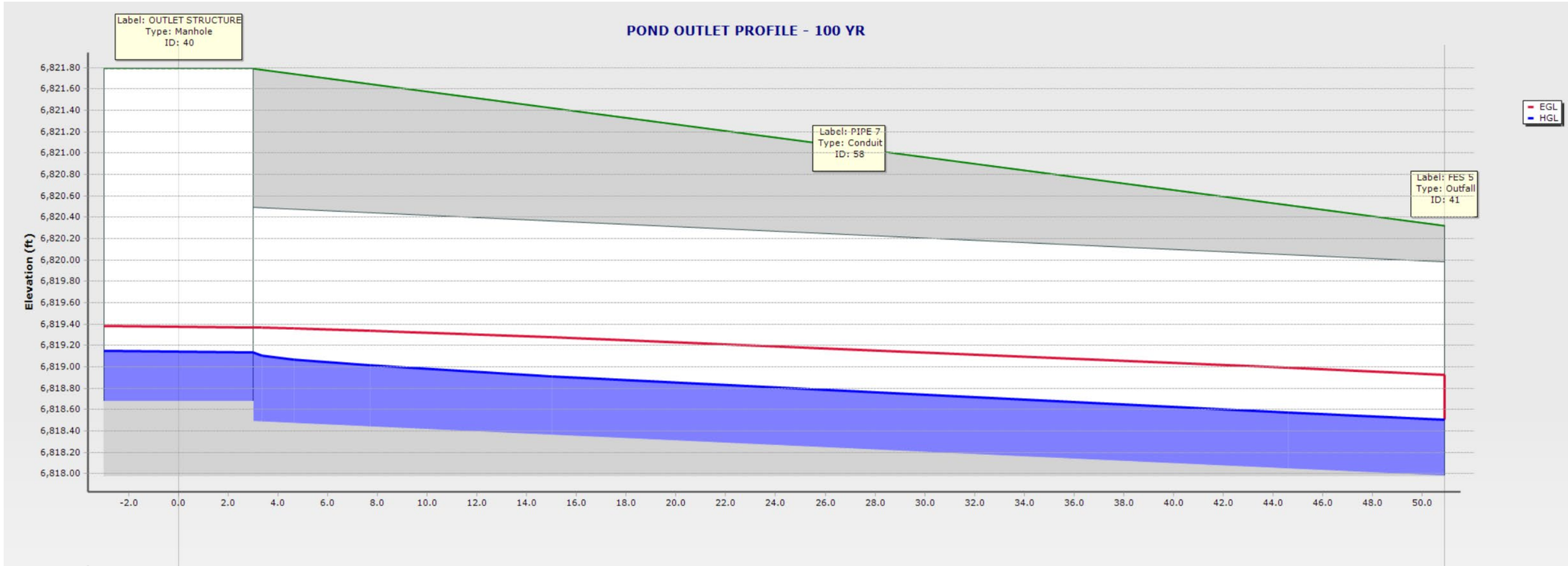


ID\Label	56 \ PIPE 5	52 \ PIPE 3	62 \ PIPE 2	49 \ PIPE 1	
Link Length (ft)	38.8	83.2	93.4	104.8	
Rise (in)\Material	18.0 \	18.0 \	15.0 \	15.0 \	
Flow (cfs)	9.00	9.00	4.10	2.10	
Slope (ft/ft)	0.007	0.007	0.005	0.005	
ID\Label	37 \ FOREBAY 1	34 \ INLET B	33 \ MH 1	31 \ INLET C	32 \ INLET D
Ground (ft)	6824.28	6825.45	6826.04	6826.12	6826.64
Invert (ft)	6822.03	6822.31	6822.99	6823.71	6824.33
Station (ft)	0.0	38.8	122.0	215.3	320.1

Berm present between Forebay 2 and Inlet A, adequate cover over pipe has been provided

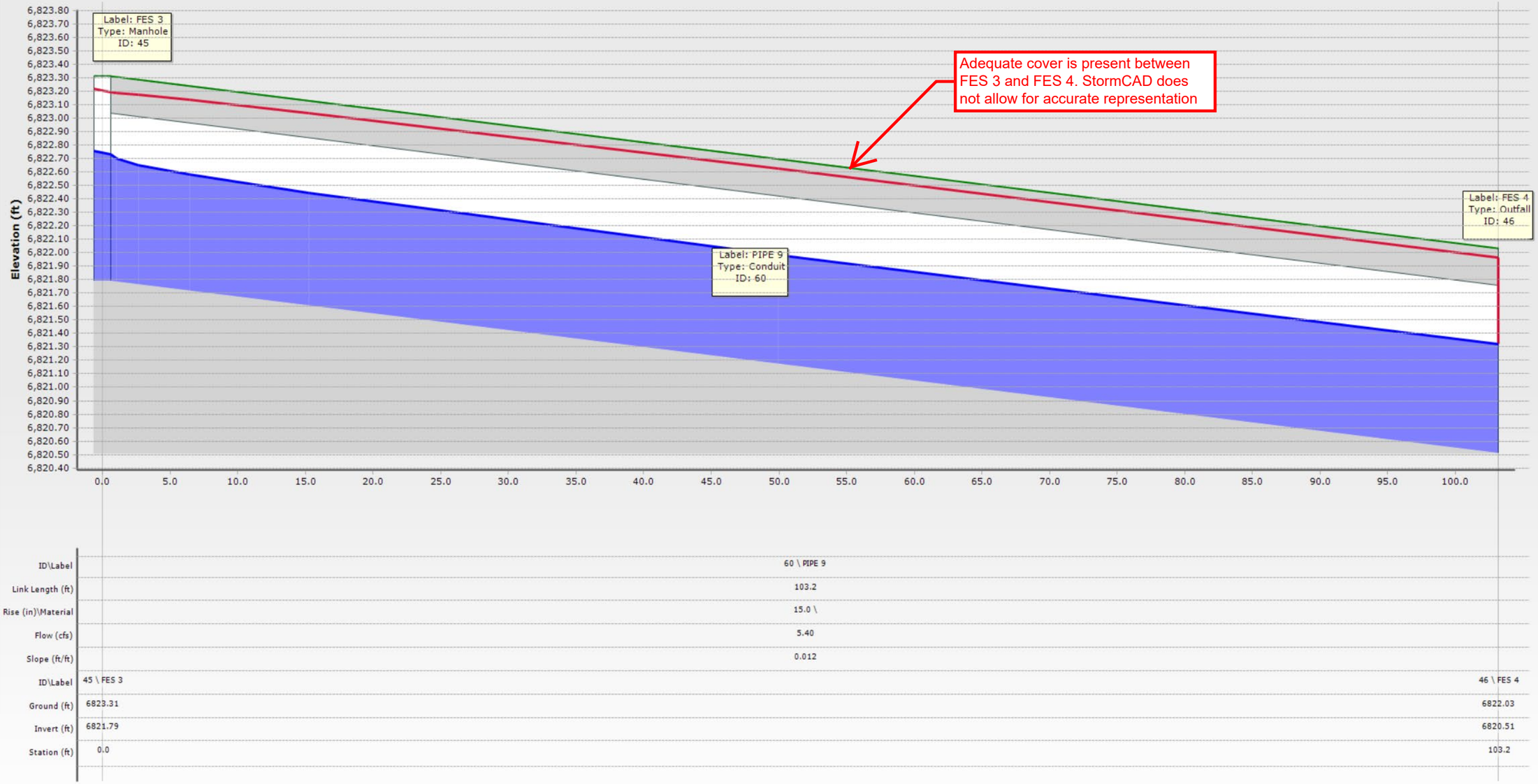


ID\Label		59 \ PIPE 6
Link Length (ft)		25.9
Rise (in)\Material		24.0 \
Flow (cfs)		6.20
Slope (ft/ft)		0.010
ID\Label	44 \ FOREBAY 2	43 \ INLET A
Ground (ft)	6821.99	6821.95
Invert (ft)	6819.74	6820.00
Station (ft)	0.0	25.9



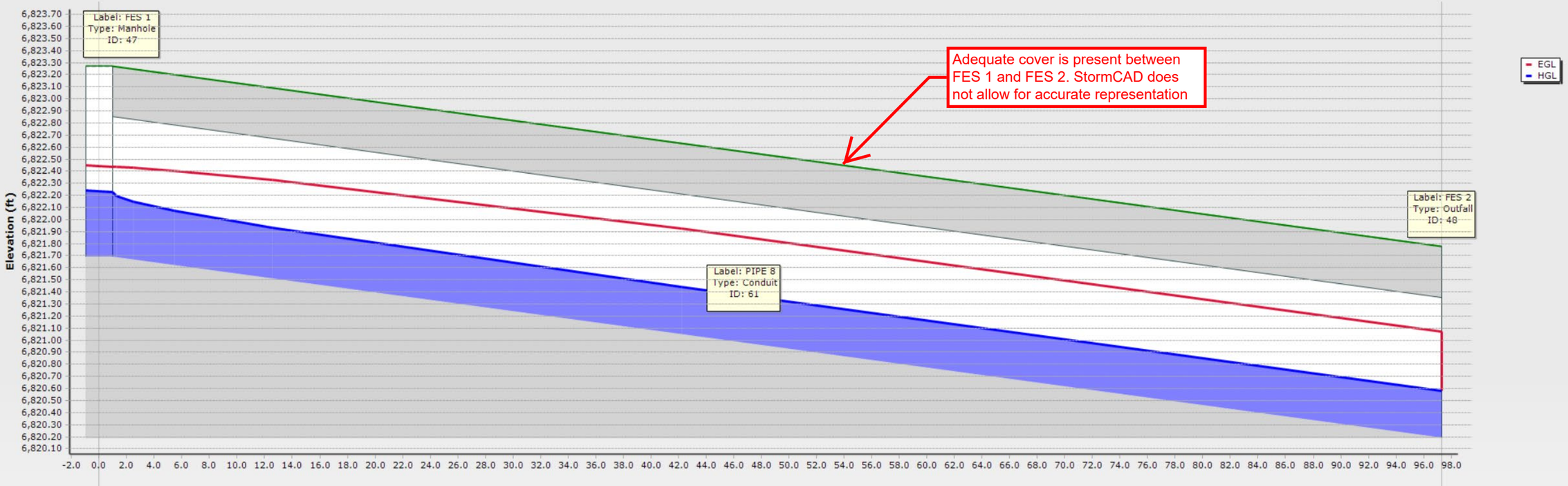
ID\Label		58 \ PIPE 7	
Link Length (ft)		50.9	
Rise (in)\Material		24.0 \	
Flow (cfs)		3.40	
Slope (ft/ft)		0.010	
ID\Label	40 \ OUTLET STRUCTURE		41 \ FES 5
Ground (ft)	6821.79		6820.32
Invert (ft)	6818.68		6817.98
Station (ft)	0.0		50.9

EAST CULVERT PROFILE - 100 YR



ID\Label		60 \ PIPE 9	
Link Length (ft)		103.2	
Rise (in)\Material		15.0 \	
Flow (cfs)		5.40	
Slope (ft/ft)		0.012	
ID\Label	45 \ FES 3		46 \ FES 4
Ground (ft)	6823.31		6822.03
Invert (ft)	6821.79		6820.51
Station (ft)	0.0		103.2

WEST CULVERT PROFILE - 100 YR



ID\Label		61 \ PIPE 8	
Link Length (ft)		97.3	
Rise (in)\Material		14.0 \	
Flow (cfs)		2.90	
Slope (ft/ft)		0.015	
ID\Label	47 \ FES 1		48 \ FES 2
Ground (ft)	6823.27		6821.78
Invert (ft)	6821.69		6820.19
Station (ft)	0.0		97.3

PIPE REPORT (100 YR)

	ID	Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
49: PIPE 1	49	PIPE 1	INLET D	6,824.33	INLET C	6,823.81	0.005	15.0	0.013	2.10	3.63	6,825.40	6,825.30
62: PIPE 2	62	PIPE 2	INLET C	6,823.71	MH 1	6,823.24	0.005	15.0	0.013	4.10	3.34	6,825.29	6,824.91
52: PIPE 3	52	PIPE 3	MH 1	6,822.99	INLET B	6,822.41	0.007	18.0	0.013	9.00	5.65	6,824.26	6,823.57
56: PIPE 5	56	PIPE 5	INLET B	6,822.31	FOREBAY 1	6,822.03	0.007	18.0	0.013	9.00	5.76	6,823.55	6,823.19
59: PIPE 6	59	PIPE 6	INLET A	6,820.00	FOREBAY 2	6,819.74	0.010	24.0	0.013	6.20	6.15	6,820.88	6,820.48
58: PIPE 7	58	PIPE 7	OUTLET STRUCTURE	6,818.49	FES 5	6,817.98	0.010	24.0	0.013	3.40	5.19	6,819.13	6,818.50
61: PIPE 8	61	PIPE 8	FES 1	6,821.69	FES 2	6,820.19	0.015		0.013	2.90	5.60	6,822.23	6,820.58
60: PIPE 9	60	PIPE 9	FES 3	6,821.79	FES 4	6,820.51	0.012	15.0	0.013	5.40	6.43	6,822.73	6,821.32

STRUCTURE REPORT (100 YR)

	ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
47: FES 1	47	FES 1	6,823.27	6,823.27	0.54	6,822.24	6,822.23	0.050	2.90
45: FES 3	45	FES 3	6,823.31	6,823.31	0.94	6,822.75	6,822.73	0.050	5.40
43: INLET A	43	INLET A	6,821.95	6,821.95	0.88	6,820.90	6,820.88	0.050	6.20
34: INLET B	34	INLET B	6,825.45	6,825.45	1.24	6,823.57	6,823.55	0.050	9.00
31: INLET C	31	INLET C	6,826.12	6,826.12	1.58	6,825.30	6,825.29	0.050	4.10
32: INLET D	32	INLET D	6,826.64	6,826.64	1.07	6,825.40	6,825.40	0.050	2.10
33: MH 1	33	MH 1	6,826.04	6,826.04	1.27	6,824.91	6,824.26	1.320	9.00
40: OUTLET ST	40	OUTLET STRUCTURE	6,821.79	6,821.79	0.45	6,819.15	6,819.13	0.050	3.40

Design Point	Total Water Quality Control Volume (Cu. Ft.)	Pond Name	Pond Drainage Area (Acres)	Pond Drainage Area Less Pond Footprint (Acres)	Forebay Location	Drainage area tributary to Forebay	Proportion of Total Drainage Area	Proportional WQCV Volume (Cu. Ft.)	Forebay Volume 2% of WQCV (Cu. Ft.)	Q100 to Forebay (cfs)	Forebay Outlet Sizing 2% of Q100 (cfs)	Forebay Slot Sizing (inches)
DP A	3463.591143	Detention Pond	3.73	3.263	South	1	0.31	1061.47	21	14.8	0.3	3.8

	WQCV		Pond Footprint	
Single Family EDB Pond	0.080	Acre-Ft	0.47	Acres

Percent of WQCV for Forebay	2%	Between 2 and 5 impervious acres	
Impervious Percentage	65.43%		
	Impervious Acres	2.4	Acres

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre[1]	EDBs with Watersheds between 1 and 2 Impervious Acres[1]	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration	EDBs should not be used for watersheds with less than 1 impervious acre.	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe[2] configuration
Minimum Forebay Volume		1% of the WQCV	2% of the WQCV	3% of the WQCV	3% of the WQCV
Maximum Forebay Depth		12 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity		≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity
Micropool		Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2
Initial Surcharge Volume		Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

[1] EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

[2] Round up to the first standard pipe size (minimum 8 inches).

Design Point	Total Water Quality Control Volume (Cu. Ft.)	Pond Name	Pond Drainage Area (Acres)	Pond Drainage Area Less Pond Footprint (Acres)	Forebay Location	Drainage area tributary to Forebay	Proportion of Total Drainage Area	Proportional WQCV Volume (Cu. Ft.)	Forebay Volume 2% of WQCV (Cu. Ft.)	Q100 to Forebay (cfs)	Forebay Outlet Sizing 2% of Q100 (cfs)	Forebay Slot Sizing (inches)
DP B	3463.591143	Detention Pond	3.73	3.263	West	1.63	0.50	1730.20	35	9.1	0.2	4.0

	WQCV		Pond Footprint	
Single Family EDB Pond	0.080	Acre-Ft	0.47	Acres

Percent of WQCV for Forebay	2%	Between 2 and 5 impervious acres	
Impervious Percentage	65.43%		
	Impervious Acres	2.4	Acres

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre[1]	EDBs with Watersheds between 1 and 2 Impervious Acres[1]	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration	EDBs should not be used for watersheds with less than 1 impervious acre.	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe[2] configuration
Minimum Forebay Volume		1% of the WQCV	2% of the WQCV	3% of the WQCV	3% of the WQCV
Maximum Forebay Depth		12 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity		≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity
Micropool		Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2
Initial Surcharge Volume		Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

[1] EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

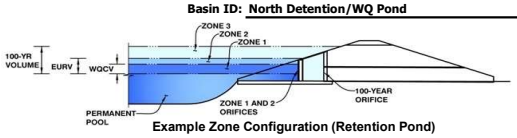
[2] Round up to the first standard pipe size (minimum 8 inches).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Circle K at Highway 24 & Meridian

Basin ID: North Detention/WQ Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	3.73	acres
Watershed Length =	450	ft
Watershed Length to Centroid =	150	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	65.43%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.080	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.303	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.205	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.269	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.320	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.387	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.452	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.531	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.55 in.) =	0.824	acre-feet	3.55 inches
Approximate 2-yr Detention Volume =	0.197	acre-feet	
Approximate 5-yr Detention Volume =	0.258	acre-feet	
Approximate 10-yr Detention Volume =	0.311	acre-feet	
Approximate 25-yr Detention Volume =	0.374	acre-feet	
Approximate 50-yr Detention Volume =	0.412	acre-feet	
Approximate 100-yr Detention Volume =	0.451	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.080	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.224	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.148	acre-feet
Total Detention Basin Volume =	0.451	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

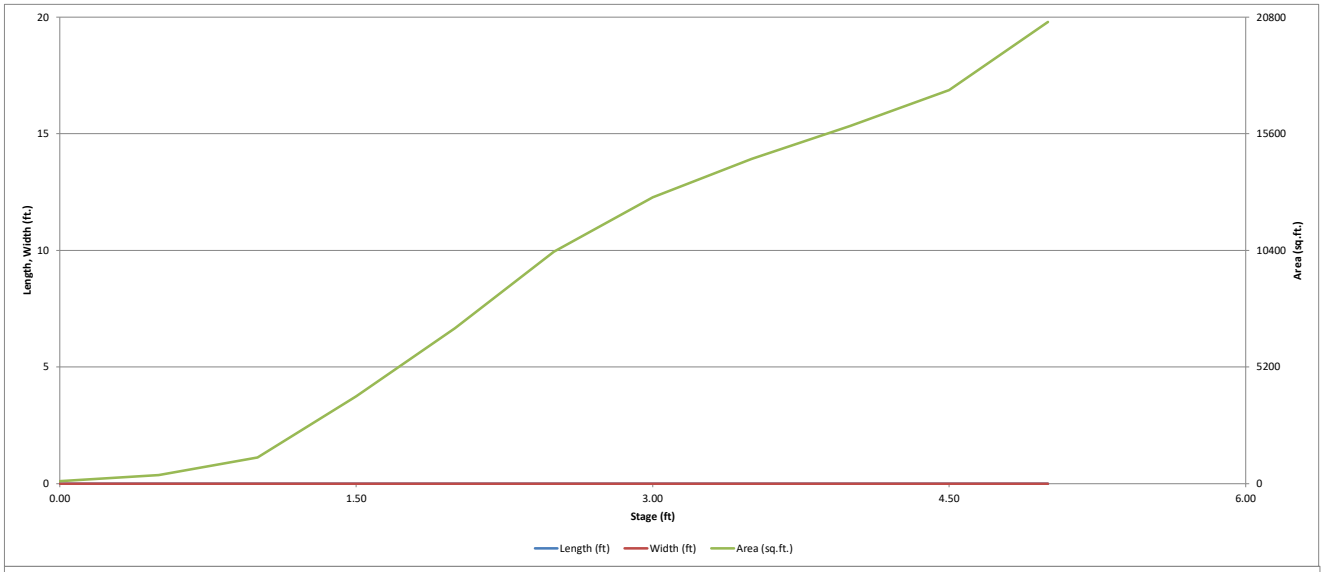
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

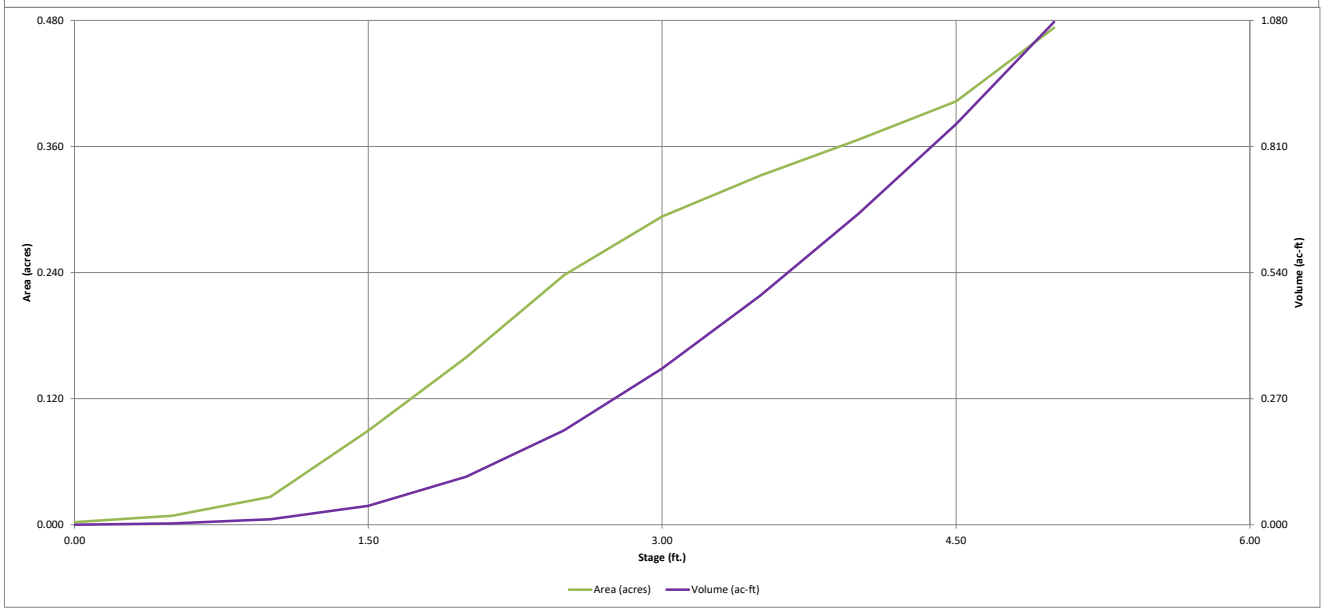
Depth Increment = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	104	0.002		
6819.5	--	0.50	--	--	--	376	0.009	120	0.003
	--	1.00	--	--	--	1,157	0.027	503	0.012
	--	1.50	--	--	--	3,897	0.089	1,767	0.041
	--	2.00	--	--	--	6,935	0.159	4,475	0.103
	--	2.50	--	--	--	10,344	0.237	8,795	0.202
	--	3.00	--	--	--	12,769	0.293	14,573	0.335
	--	3.50	--	--	--	14,478	0.332	21,385	0.491
	--	4.00	--	--	--	15,956	0.366	28,993	0.666
	--	4.50	--	--	--	17,548	0.403	37,369	0.858
	--	5.00	--	--	--	20,596	0.473	46,905	1.077

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



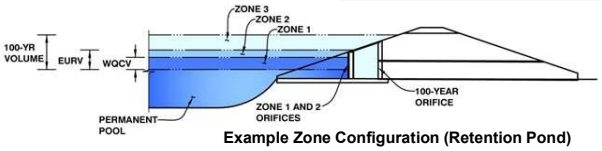


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Circle K at Highway 24 & Meridian**

Basin ID: **North Detention/WQ Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.85	0.080	Orifice Plate
Zone 2 (EURV)	2.90	0.224	Circular Orifice
Zone 3 (100-year)	3.38	0.148	Weir&Pipe (Restrict)
Total (all zones)		0.451	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.188E-03	ft^2
Depth at top of Zone using Orifice Plate =	1.85	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	6.70	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.32	sq. inches (diameter = 5/8 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.62	1.23					
Orifice Area (sq. inches)	0.32	0.32	0.32					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.72	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.01	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	2.78	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.05	N/A	feet
Vertical Orifice Diameter =	1.25	N/A	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe))

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.90	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.90	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	37.34	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	16.70	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	8.35	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.45	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.24	N/A	feet
Restrictor Plate Height Above Pipe Invert =	4.80		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.93	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.38	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.28	feet
Spillway Crest Length =	25.00	feet	Stage at Top of Freeboard =	4.66	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.43	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.92	acre-ft

Calculated Parameters for Spillway

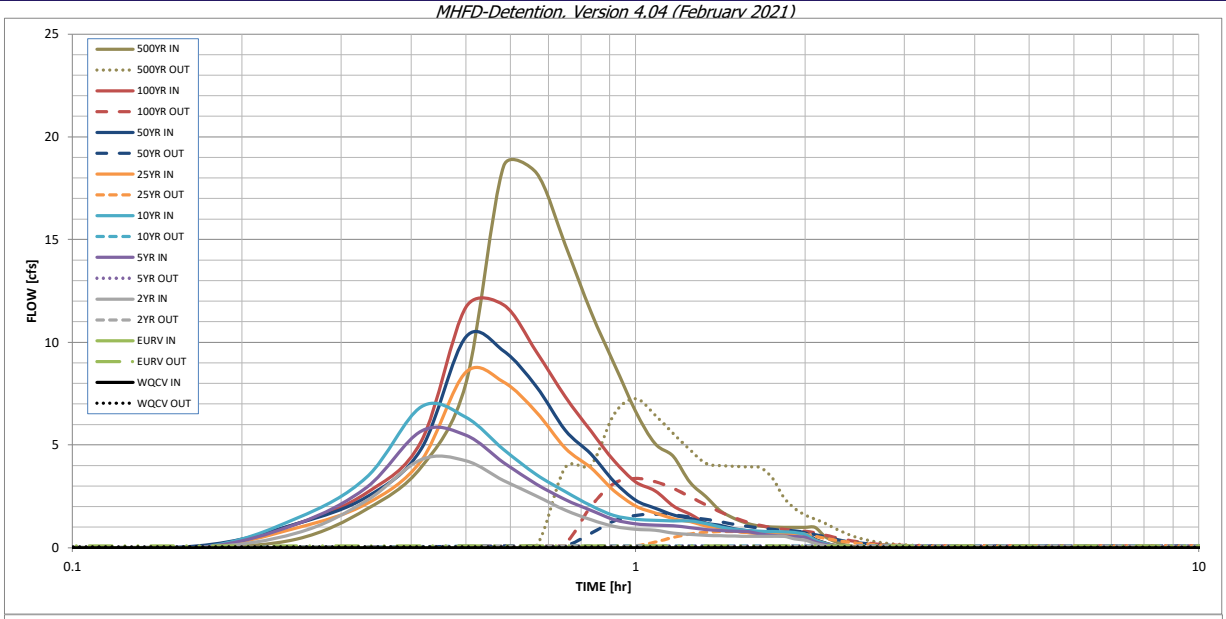
Routed Hydrograph Results

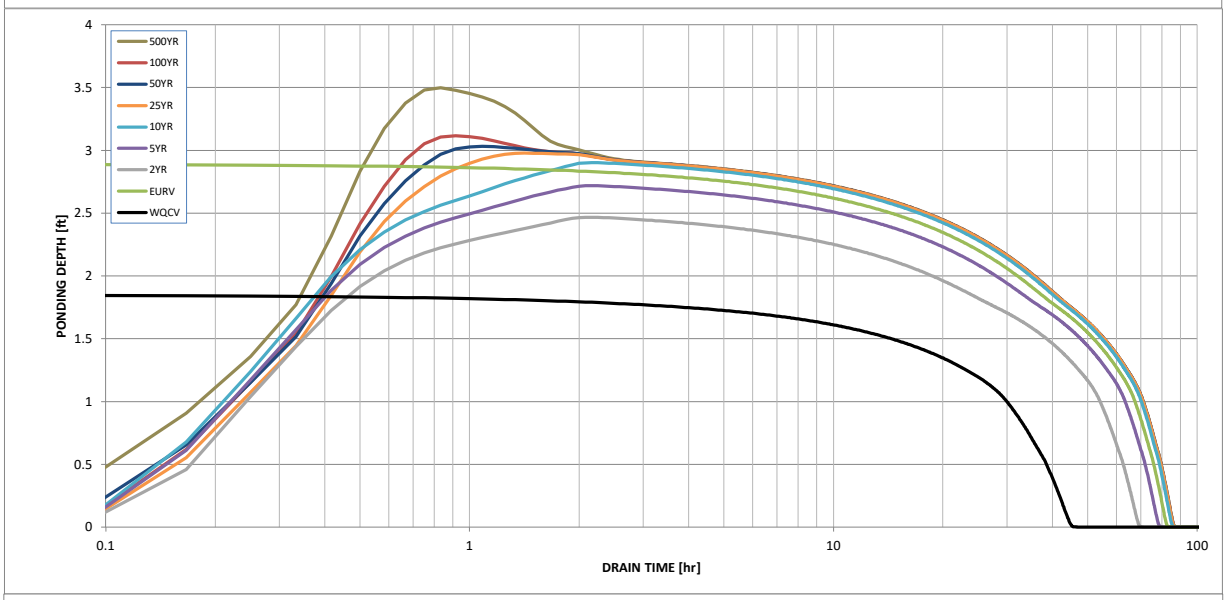
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

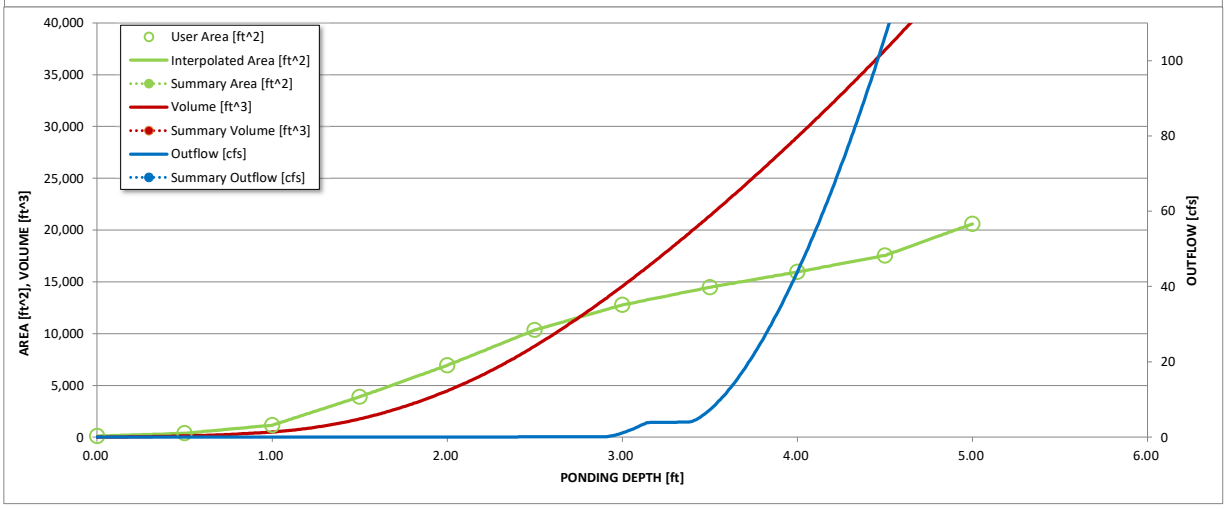
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.080	0.303	0.205	0.269	0.320	0.387	0.452	0.531	0.824
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.205	0.269	0.320	0.387	0.452	0.531	0.824
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.1	1.0	2.0	3.2	7.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.27	0.52	0.85	1.98
Peak Inflow Q (cfs) =	N/A	N/A	4.3	5.7	6.9	8.5	10.3	11.8	18.6
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.1	0.8	1.6	3.4	7.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.9	0.8	0.8	1.1	1.0
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.0	0.1	0.2	0.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	69	58	66	72	71	70	68	63
Time to Drain 99% of Inflow Volume (hours) =	**42**	76	64	72	78	78	77	76	74
Maximum Ponding Depth (ft) =	1.85	2.90	2.47	2.72	2.90	2.98	3.03	3.12	3.50
Area at Maximum Ponding Depth (acres) =	0.14	0.28	0.23	0.26	0.28	0.29	0.30	0.30	0.33
Maximum Volume Stored (acre-ft) =	0.080	0.306	0.193	0.254	0.306	0.326	0.343	0.367	0.491

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Figure 13-12b. Emergency Spillway Profile at Embankment

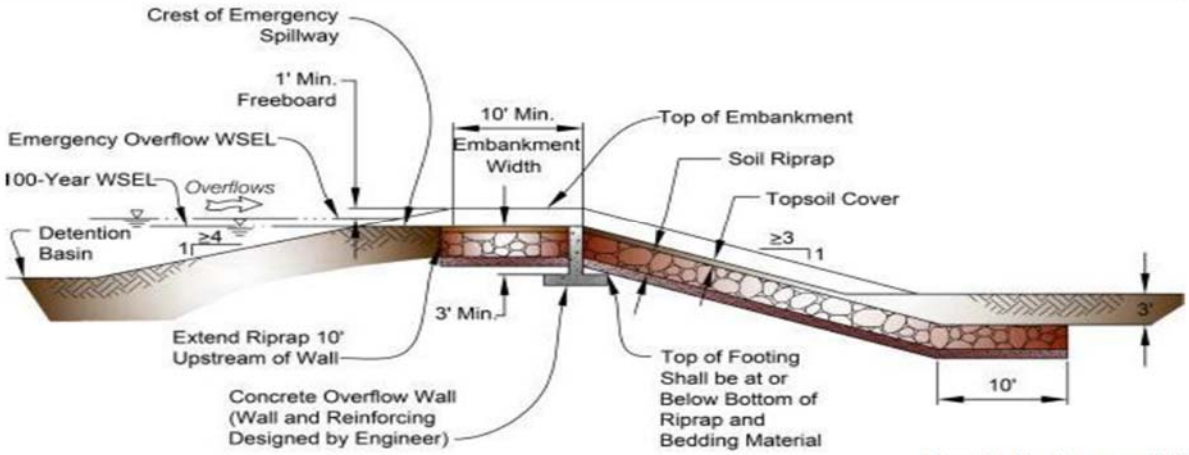
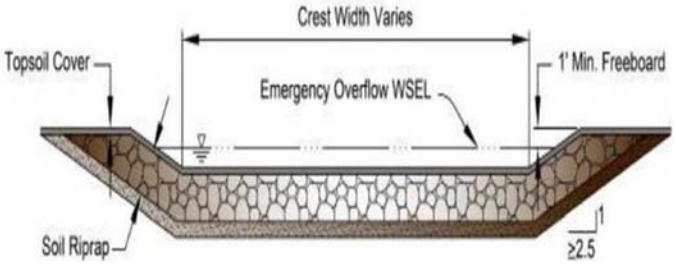


Figure 13-12c. Emergency Spillway Protection

North Pond: Side slopes: 4:1
Unit Discharge: 11.8 cfs / 30 ft
= 0.39 cfs/ft



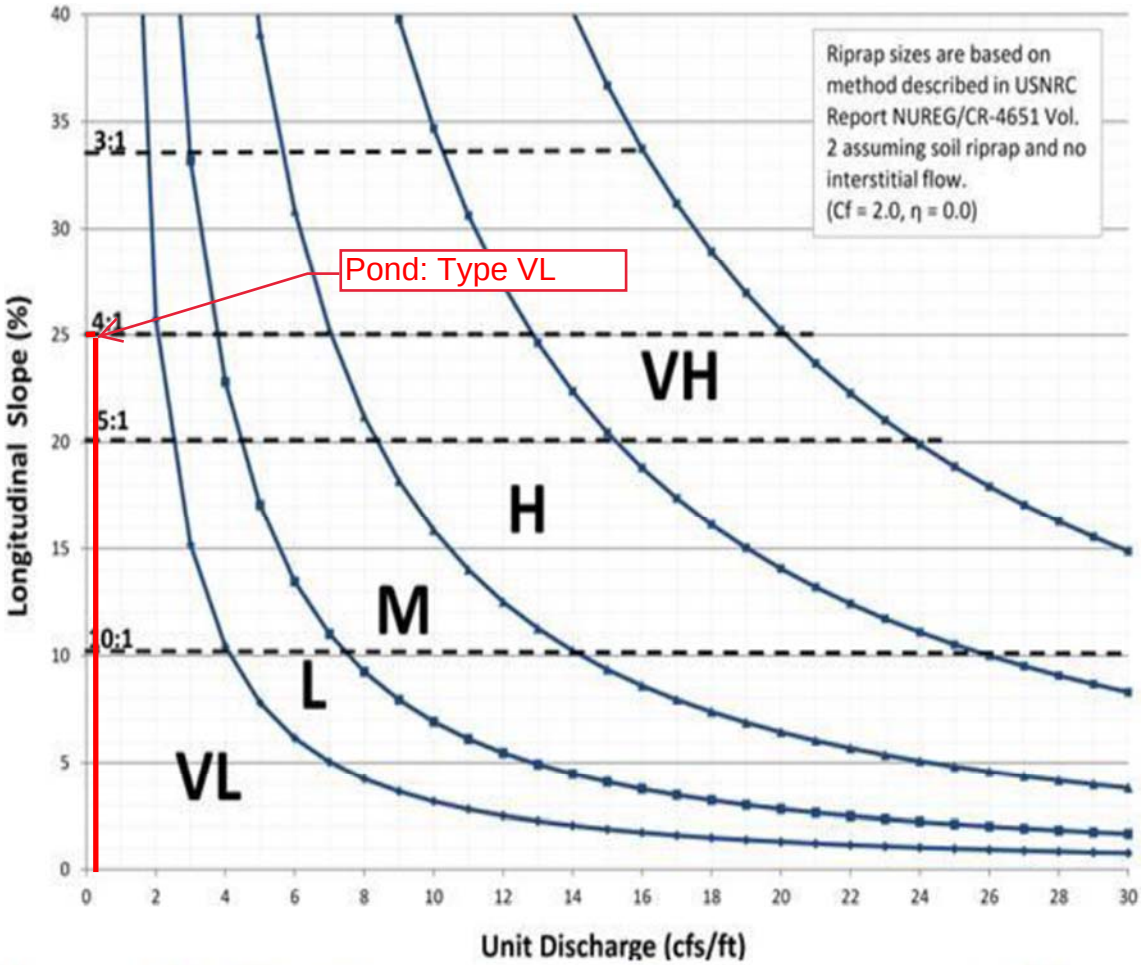
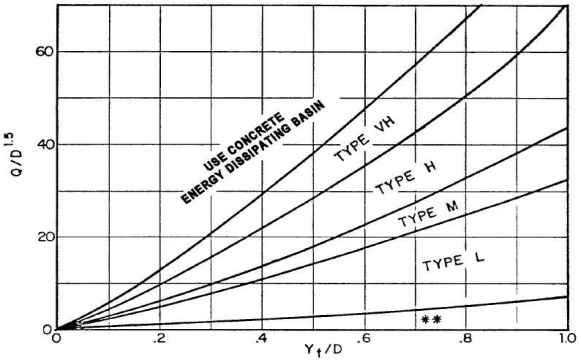


Figure 13-12d. Riprap Types for Emergency Spillway Protection

	DP J3		DP K		DP L	
Pipe Size (D)	24	Inches	15	Inches	18	Inches
Q	3.3	cfs	5.6	cfs	2.9	cfs
L	6	Feet	3.75	Feet	4.5	Feet
W	6	Feet	3.75	Feet	4.5	Feet
D	0	Feet	0	Feet	0	Feet
d_{50}	0.13	Feet	0.20	Feet	0.17	Feet
	1.52	Inches	2.42	Inches	2.07	Inches
Depth of Flow	0.55	Feet	0.65	Feet	0.4	Feet
Q/D^1.5	1.17		4.01		1.58	
Yt/D	0.275		0.520		0.273	
Rip Rap	Type L for 3 x Pipe Dia Downstream		Type L for 3 x Pipe Dia Downstream		Type L for 3 x Pipe Dia Downstream	
Length of Rock	6	Feet	3.75	Feet	4.5	Feet
Width of Rock	6.0	Feet	3.8	Feet	4.5	Feet

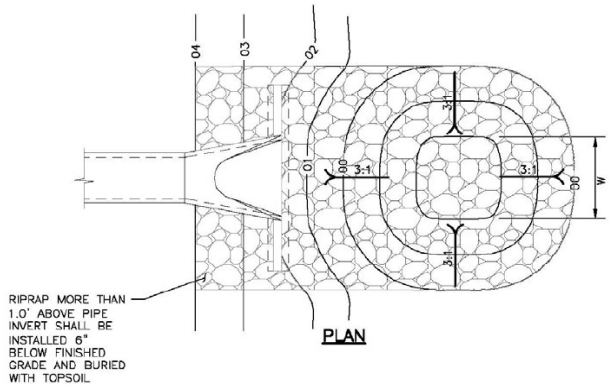


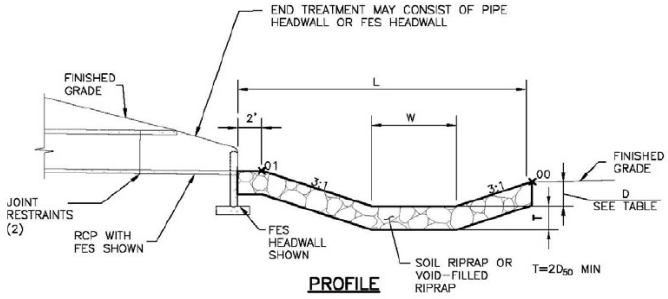
Use D_o instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

CLASSIFICATION AND GRADATION OF ORDINARY RIP RAP

Rip Rap Designation by Weight	% Smaller Than Given Size (inches)	Intermediate Rock Dimension	d50* (inches)
Type VL	70 – 100	12	6**
	50 – 70	9	
	35 – 50	6	
	2 - 10	2	
Type L	70 – 100	15	9**
	50 – 70	12	
	35 – 50	9	
	2 - 10	3	
Type M	70 – 100	21	12
	50 – 70	18	
	35 – 50	12	
	2 - 10	4	
Type H	70 – 100	30	18
	50 – 70	24	
	35 – 50	18	
	2 - 10	6	
Type VH	70 – 100	42	24
	50 – 70	33	
	35 – 50	24	
	2 - 10	9	

* d50 = Mean particle size
** Bury types VL and L with native top soil and revegetate to protect from vandalism.





PIPE SIZE OR BOX HEIGHT	D	W*	L
18" – 24"	1'-0"	4'	15'
30" – 36"	1'-6"	6'	20'
42" – 48"	2'-0"	7'	24'
54" – 60"	2'-6"	8'	28'
66" – 72"	3'-0"	9'	32'

* IF OUTLET PIPE IS A BOX CULVERT WITH A WIDTH GREATER THAN W, THEN W = CULVERT WIDTH

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

Channel Report

BASIN E FLUME

Rectangular

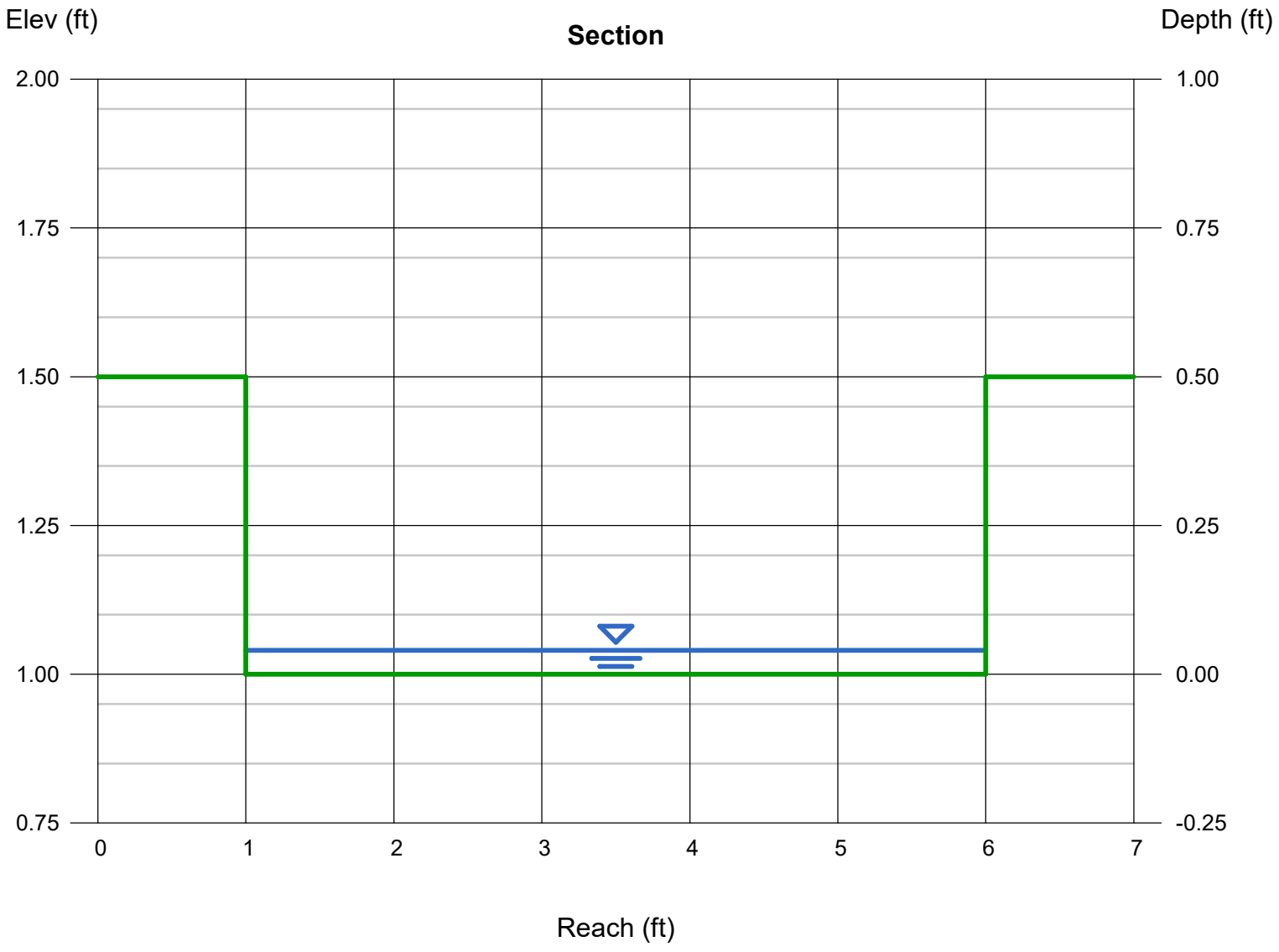
Bottom Width (ft)	= 5.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 1.00
Slope (%)	= 33.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.40

Highlighted

Depth (ft)	= 0.04
Q (cfs)	= 1.400
Area (sqft)	= 0.20
Velocity (ft/s)	= 7.00
Wetted Perim (ft)	= 5.08
Crit Depth, Yc (ft)	= 0.14
Top Width (ft)	= 5.00
EGL (ft)	= 0.80



APPENDIX B

STANDARD DESIGN CHARTS AND TABLES

El Paso County Drainage Basin Fees

Resolution No. 21-468

Basin Number	Receiving Waters	Year Studied	Drainage Basin Name	2022 Drainage Fee (per Impervious Acre)	2022 Bridge Fee (per Impervious Acre)
Drainage Basins with DBPS's:					
CHMS0200	Chico Creek	2013	Haegler Ranch	$11,891	$1,755
CHWS1200	Chico Creek	2001	Bennett Ranch	$13,312	$5,106
CHWS1400	Chico Creek	2013	Falcon	$34,117	$4,687
FOFO2000	Fountain Creek	2001	West Fork Jimmy Camp Creek	$14,470	$4,281
FOFO2600	Fountain Creek	1991*	Big Johnson / Crews Gulch	$21,134	$2,729
FOFO2800	Fountain Creek	1988*	Widefield	$21,134	$0
FOFO2900	Fountain Creek	1988*	Security	$21,134	$0
FOFO3000	Fountain Creek	1991*	Windmill Gulch	$21,134	$317
FOFO3100 / FOFO3200	Fountain Creek	1988*	Carson Street / Little Johnson	$12,891	$0
FOFO3400	Fountain Creek	1984*	Peterson Field	$15,243	$1,156
FOFO3600	Fountain Creek	1991*	Fisher's Canyon	$21,134	$0
FOFO4000	Fountain Creek	1996	Sand Creek	$21,814	$8,923
FOFO4200	Fountain Creek	1977	Spring Creek	$10,961	$0
FOFO4600	Fountain Creek	1984*	Southwest Area	$21,134	$0
FOFO4800	Fountain Creek	1991	Bear Creek	$21,134	$1,156
FOFO5800	Fountain Creek	1964	Camp Creek	$2,342	$0
FOMO1000	Monument Creek	1981	Douglas Creek	$13,291	$294
FOMO1200	Monument Creek	1977	Templeton Gap	$13,644	$317
FOMO2000	Monument Creek	1971	Pulpit Rock	$7,008	$0
FOMO2200	Monument Creek	1994	Cottonwood Creek / S. Pine	$21,134	$1,156
FOMO2400	Monument Creek	1966	Dry Creek	$16,684	$604
FOMO3600	Monument Creek	1989*	Black Squirrel Creek	$9,595	$604
FOMO3700	Monument Creek	1987*	Middle Tributary	$17,636	$0
FOMO3800	Monument Creek	1987*	Monument Branch	$21,134	$0
FOMO4000	Monument Creek	1996	Smith Creek	$8,616	$1,156
FOMO4200	Monument Creek	1989*	Black Forest	$21,134	$575
FOMO5200	Monument Creek	1993*	Dirty Woman Creek	$21,134	$1,156
FOMO5300	Fountain Creek	1993*	Crystal Creek	$21,134	$1,156
Miscellaneous Drainage Basins: [1]					
CHBS0800	Chico Creek		Book Ranch	$19,830	$2,871
CHEC0400	Chico Creek		Upper East Chico	$10,803	$313
CHWS0200	Chico Creek		Telephone Exchange	$11,870	$278
CHWS0400	Chico Creek		Livestock Company	$19,552	$233
CHWS0600	Chico Creek		West Squirrel	$10,192	$4,229
CHWS0800	Chico Creek		Solberg Ranch	$21,134	$0
FOFO1200	Fountain Creek		Crooked Canyon	$6,381	$0
FOFO1400	Fountain Creek		Calhan Reservoir	$5,327	$310
FOFO1600	Fountain Creek		Sand Canyon	$3,849	$0
FOFO2000	Fountain Creek		Jimmy Camp Creek[3]	$21,134	$989
FOFO2200	Fountain Creek		Fort Carson	$16,684	$604
FOFO2700	Fountain Creek		West Little Johnson	$1,392	$0
FOFO3800	Fountain Creek		Stratton	$10,137	$453
FOFO5000	Fountain Creek		Midland	$16,684	$604
FOFO6000	Fountain Creek		Palmer Trail	$16,684	$604
FOFO6800	Fountain Creek		Black Canyon	$16,684	$604
FOMO4600	Monument Creek		Beaver Creek	$12,635	$0
FOMO3000	Monument Creek		Kettle Creek	$11,413	$0
FOMO3400	Monument Creek		Elkhorn	$1,917	$0
FOMO5000	Monument Creek		Monument Rock	$9,160	$0
FOMO5400	Monument Creek		Palmer Lake	$14,647	$0
FOMO5600	Monument Creek		Raspberry Mountain	$4,927	$0
PLPL0200	Monument Creek		Bald Mountain	$10,500	$0
Interim Drainage Basins: [2]					
FOFO1800	Fountain Creek		Little Fountain Creek	$2,702	$0
FOMO4400	Monument Creek		Jackson Creek	$8,365	$0
FOMO4800	Monument Creek		Teachout Creek	$5,809	$873

1. The miscellaneous drainage fee previous to September 1999 resolution was the average of all drainage fees for basins with Basin Planning Studies performed within the last 14 years.

2. Interim Drainage Fees are based upon draft Drainage Basin Planning Studies or the Drainage Basin Identification and Fee Estimation Report. (Best available information suitable for setting a fee.)

3. This is an interim fee and will be adjusted when a DBPS is completed. In addition to the Drainage Fee a surety in the amount of $7,285 per impervious acre shall be provided to secure payment of additional fees in the event that the DBPS results in a fee greater than the current fee. Fees paid in excess of the future revised fee will be reimbursed. See Resolution 06-326 (9/14/06) and Resolution 16-320 (9/07/16).

EPC Stormwater Management *Jennifer Irvine, P.E.*

depths over the duration of the storm as a fraction of the 1-hour depth and is also shown in Figure 6-19. By applying the 1-hour depths shown in Table 6-2 to the values shown in Table 6-3, a short-duration project design storm can be developed for any return period storm from a 2-year up to 100-year frequency. By applying the appropriate 1-hour depth for other project locations, a project design storm can be created for any location.

Table 6-3. 2-Hour Design Storm Distribution, ≤ 1 mi^2

Time (minutes)	Fraction of 1-Hour Rainfall Depth	Time (minutes)	Fraction of 1-Hour Rainfall Depth
5	0.014	65	1.004
10	0.046	70	1.018
15	0.079	75	1.030
20	0.120	80	1.041
25	0.179	85	1.052
30	0.258	90	1.063
35	0.421	95	1.072
40	0.712	100	1.082
45	0.824	105	1.091
50	0.892	110	1.100
55	0.935	115	1.109
60	0.972	120	1.119

- **Frontal Storms**: The characteristics of longer-duration "frontal storms" (general) is less well understood than the shorter duration thunderstorms and should be studied further. However, some events of this nature have been observed, such as the April 1999 storm which produced flooding on Fountain Creek, showing that these types of events do occur and tend to produce hazardous flood flows. In addition, modeling of the Jimmy Camp Creek drainage basin using the 24-hour, Type II distribution shows that it produces results reasonably comparably to recorded flow data. Therefore, the NRCS 24-hour Type II distribution has replaced the Type IIa distribution as the standard, long-duration design storm. This distribution can be applied to drainage basins up to 10 square miles without a DARF correction and is shown in Table 6-4. This distribution is included as a standard storm option in the HEC-HMS program.

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

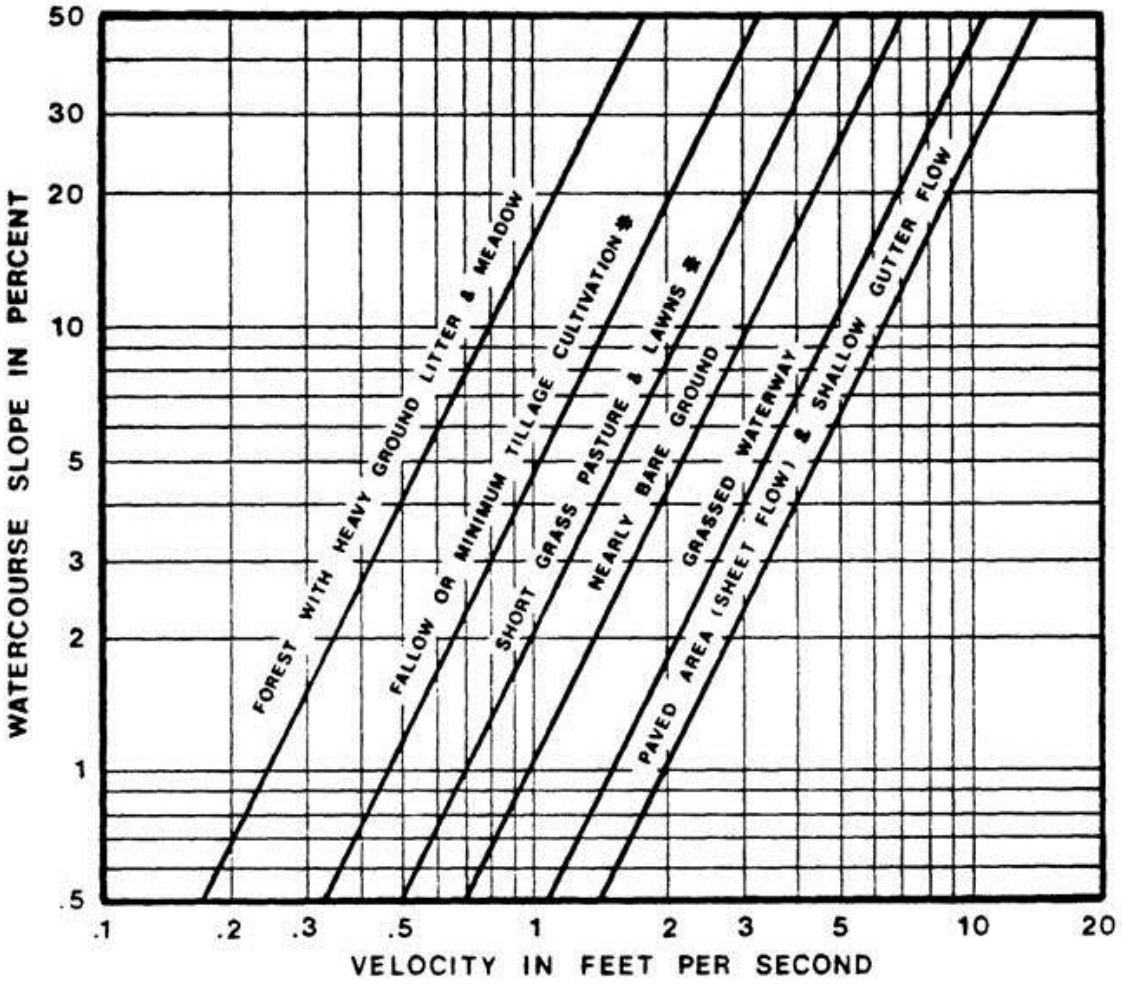
Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Figure 6-25. Estimate of Average Concentrated Shallow Flow



APPENDIX C

REPORT REFERENCES

FIRMETTE

NOTES TO USERS

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

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

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

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

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

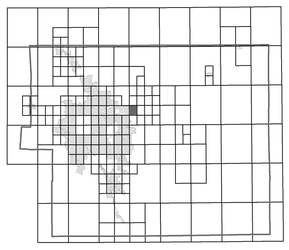
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

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

El Paso County Vertical Datum Offset Table

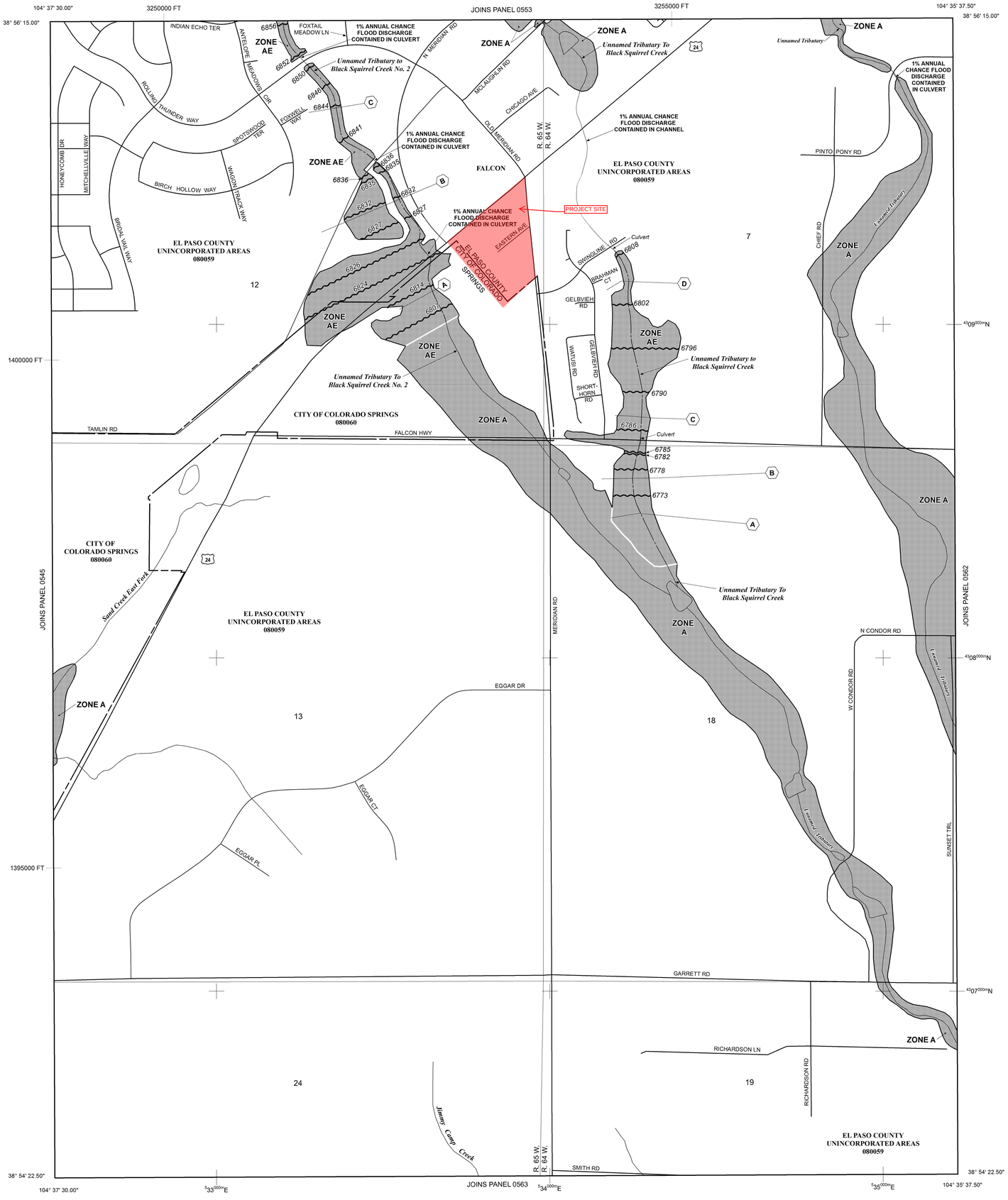
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 13 SOUTH, RANGE 64 WEST, AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

A A	Cross section line
23 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0561G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 561 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0561	G
EL PASO COUNTY	080059	0561	G

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.

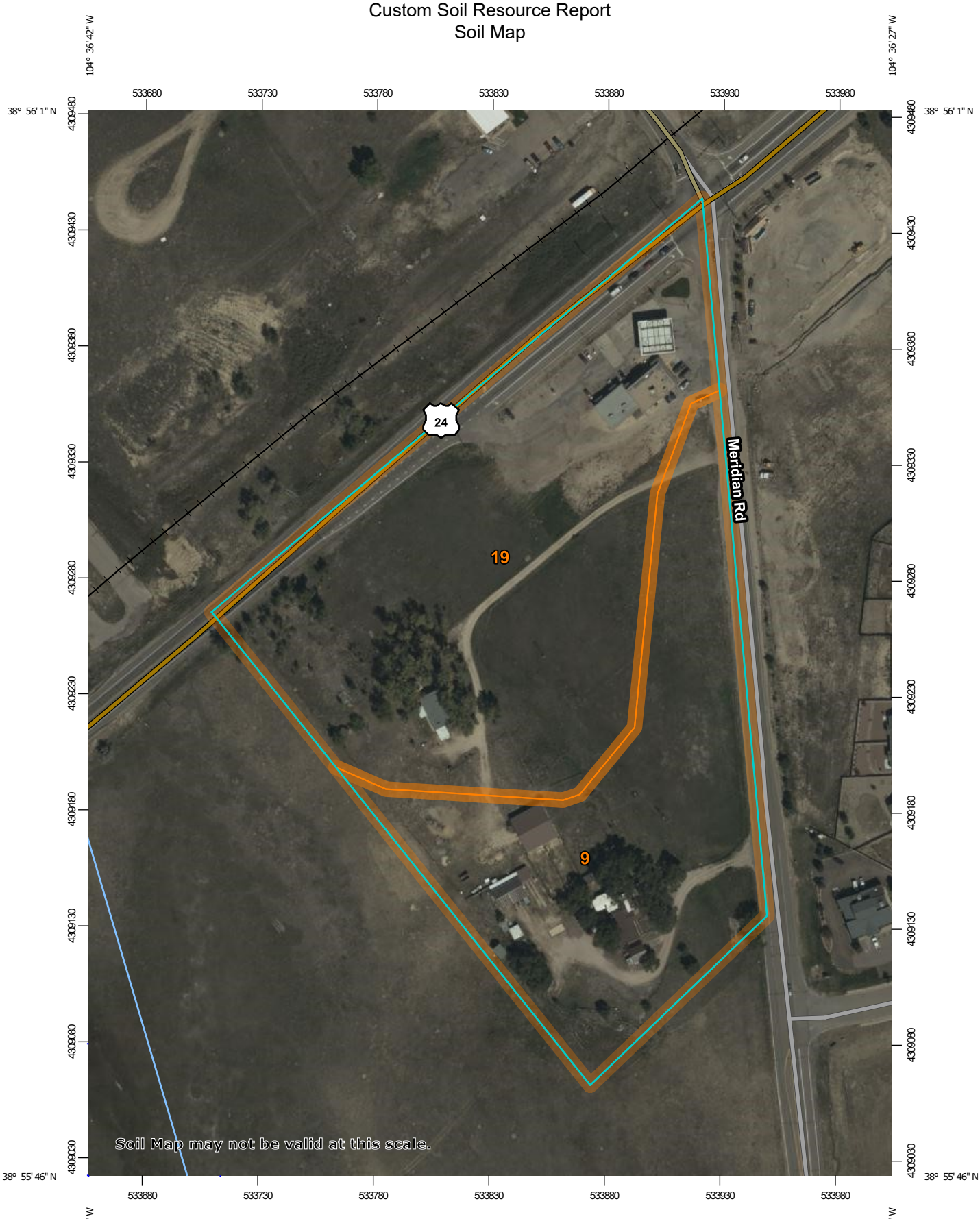
MAP NUMBER 08041C0561G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

USDA NRCS WEB SOIL SURVEY REPORT

Custom Soil Resource Report
Soil Map



Map Scale: 1:2,240 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9	Blakeland-Fluvaquentic Haplaquolls	4.9	40.4%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	7.3	59.6%
Totals for Area of Interest		**12.2**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

9—Blakeland-Fluvaquentic Haplaquolls

Map Unit Setting

National map unit symbol: 36b6
Elevation: 3,500 to 5,800 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 60 percent
Fluvaquentic haplaquolls and similar soils: 38 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose and/or eolian deposits derived from arkose

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Description of Fluvaquentic Haplaquolls

Setting

Landform: Swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: variable

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Fans, flood plains, fan terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB215CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Fluvaquentic haplaquolls

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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

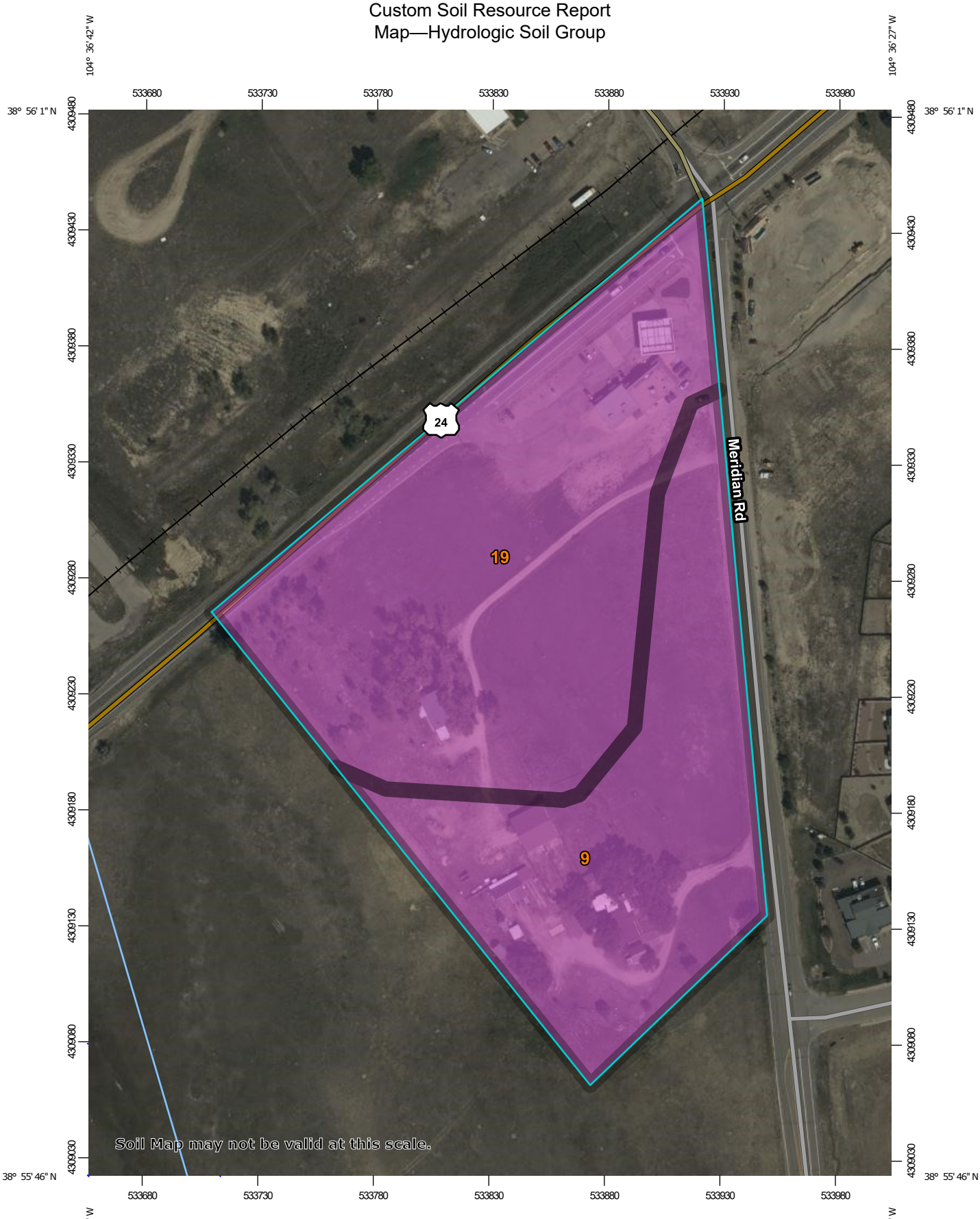
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:2,240 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9	Blakeland-Fluvaquentic Haplaquolls	A	4.9	40.4%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	7.3	59.6%
Totals for Area of Interest			**12.2**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX D

MAPS

Circle K - HWY 24 & Meridian				
Existing Sub Basin Summary				
Design Point	**Sub-Basins**	**Total Area (ac.)**	**Q(5) (cfs)**	**Q(100) (cfs)**
EX 01	EX 01	1.68	1.52	4.09
EX 02	EX 02	3.95	1.27	6.39
EX 03	EX 03	0.09	0.10	0.29
EX 04	EX 04	1.88	3.95	8.70
EX 05	EX 05	0.43	1.34	2.69
EX SITE NORTH	EX SITE NORTH	8.03	6.12	17.87

OWNER: FARMERS STATE BANK OF CALHAN
1500 8TH ST. CALHAN CO, 80808
PUD

OWNER: BRIAN M MOODY - BETTER LAND LLC
8605 EXPLORER DR, SUITE 250
COLORADO SPRINGS, CO 8092
R/CR SS

HIGHWAY 24
MERIDIAN ROAD
MERIDIAN SOL DRIVE
PROPERTY LINE
EASEMENT TE-7 REC. #219142201
EASEMENT PE-7 REC. #219142201
EXISTING EPC TYPE A C&G
EXISTING ROADSIDE DRAINAGE SWALE
EXISTING DRAINAGE CULVERT TO BE REMOVED
12.2%
6830
6825
6820
6815
5239

EX 01 (1.68 | 4.1)
EX 02 (3.95 | 6.4)
EX 03 (0.09 | 0.3)
EX 04 (1.88 | 8.7)
EX 05 (0.43 | 2.7)

LEGEND

- PROPERTY LINE
- DRAINAGE BASIN BOUNDARY
- FLOW DIRECTION
- PROPOSED SITE
- PERVIOUS AREAS
- BASIN ID
- BASIN AREA [AC]
- 100-YR RUNOFF [CFS]

GRAPHIC SCALE
40' 0' 40' 80'
(IN FEET)
1 inch = 40 ft.

PCD FILING NO.: PPR2230

Know what's below. Call before you dig.

CONSULTANTS:

Matrix
Excellence by Design
2435 RESEARCH PARKWAY, SUITE
300 COLORADO SPRINGS, CO 80920
PHONE: (719) 575-0100

LAND DEVELOPMENT CONSULTANTS, LLC
950 S. CHERRY ST., SUITE 512
DENVER, CO 80246

OWNER/DEVELOPER:

CIRCLE K
ROCKY MOUNTAINS DIVISION
5500 S QUEBEC STREET, SUITE 100
GREENWOOD VILLAGE, CO 80111
PHONE: (720) 758-6223

SEAL

COLORADO LICENSED
NICOLE M. SCHWEIZER
52434
PROFESSIONAL ENGINEER

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC

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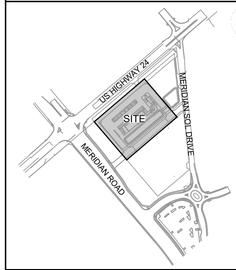
VICINITY MAP:



PROJECT:

CIRCLE K STORES INC.

SITE DEVELOPMENT PLAN

HIGHWAY 24 & MERIDIAN ROAD
FALCON, CO

REVISION HISTORY:

NO.	DATE	DESCRIPTION	BY

DRAWING INFORMATION:

PROJECT NO: 21.1207.037
DRAWN BY: LCB
CHECKED BY: NMS
DESIGNED BY: NMS

SHEET TITLE:

EXISTING DRAINAGE MAP

SHEET 1 OF 2
DR01

ISSUE DATE: DECEMBER 2022

FILE LOCATION: S:\CIRCLE K\HWY 24 & MERIDIAN\DRAINAGE\DR01 SDP.DWG

Circle K - HWY 24 & Meridian
Proposed Design Point Summary

Design Point	Sub-Basins	Total Area (ac.)	Q(5) (cfs)	Q(100) (cfs)
DP A	Inlet at lowpoint of access road	1.00	3.27	6.22
DP A Inlet Flow	Inlet at lowpoint of access road, combined flow from DP B	2.62	7.65	14.69
DP B	Inlet at NW Corner of Pond, Sub Basin B	0.77	2.16	4.27
DP B Inlet Flow	Inlet at NW corner of Pond, B, C, D & G	1.62	4.65	9.00
DP C	Area inlets in middle of front parking	0.33	1.09	2.08
DP C Inlet Flow	Area inlets in middle of front parking, combined flow from DP D	0.70	2.07	4.01
DP D	Area inlets in eastern part of front parking	0.36	1.05	2.06
DP E	Car wash entrance flume, E & F	0.25	0.71	1.39
DP F	Car Wash Roof Drain	0.03	0.16	0.28
DP G	Fuel Canopy Roof Drainage	0.14	0.67	1.20
DP H	C-Store Roof Drain	0.12	0.55	0.99
DP J1	Detention pond area	0.73	0.32	1.54
DP J2	Sub-basins A, B, E, G & H1	3.72	7.52	15.38
DP J3	Pond Outlet Structure	3.72	0.10	3.40
DP K	Undeveloped land to NE	1.88	2.12	5.43
DP L	Offsite drainage to west of site	1.68	0.91	2.87
DP M	Offsite street drainage for West entrance	0.09	0.43	0.77
DP N	Offsite street drainage for East entrance, west part of Meridian Sol	0.43	1.99	3.57
DP P	Offsite drainage to the south of the Access road, offsite culvert outlets	0.23	0.10	0.66
DP SITE NORTH	North Lot Overall Drainage	8.03	5.65	16.71

Circle K - HWY 24 & Meridian
Proposed Conditions
Sub-basin Summary

Basin	Area	Q5	Q100
	acres	cfs	cfs
A	1.00	3.3	6.2
B	0.77	2.2	4.3
C	0.33	1.1	2.1
D	0.36	1.0	2.1
E	0.22	0.7	1.4
F	0.03	0.2	0.3
G	0.14	0.7	1.2
H	0.12	0.6	1.0
J	0.73	0.3	1.5
K	1.88	2.1	5.4
L	1.68	0.9	2.9
M	0.09	0.4	0.8
N	0.43	2.0	3.6
P	0.23	0.1	0.7

OWNER: FARMERS STATE BANK OF CALHAN
1500 8TH ST. CALHAN CO, 80808
PUD

OWNER: BRIAN M MOODY - BETTER LAND LLC
8605 EXPLORER DR, SUITE 250
COLORADO SPRINGS, CO 8092
R/CR SS

HIGHWAY 24
MERIDIAN ROAD
MERIDIAN SOL DRIVE
ACCESS ROAD
PROPERTY LINE
EASEMENT TE-7 REC. #219142200
EASEMENT PE-7 REC. #219142201
PROPOSED PRIVATE DENVER NO. 16 VALLEY GRATES (3) (PRIVATE)
PROPOSED PRIVATE 15" RCP STORM
PROPOSED PRIVATE DENVER NO. 16 VALLEY GRATES (3) (PRIVATE)
PROPOSED PRIVATE 6" PVC FUEL CANOPY ROOF DRAINS
PROPOSED PRIVATE 18" RCP STORM
PROPOSED OFFSITE DRAINAGE
PROPOSED 10' TYPE R INLET (PRIVATE)
C-STORE 5,200 SF
CAR WASH 1,488 SF
PROPOSED PRIVATE 6" PVC CAR WASH ROOF DRAIN
PROPOSED BASIN E FLUME 5' CONCRETE FLUME & STILLING BASIN
PROPOSED 6" PVC PRIVATE CAR WASH ROOF DRAIN DAYLIGHT POINT
PROPOSED POND OUTLET (SEE OFFSITE PLANS - PCD FILE# VR-22-03) OUTLET TO INCLUDE RIPRAP PROTECTION AND 30'x2'x1' SPREADER SWALE TO DISPERSE OUTLET FLOWS
PROPOSED OFFSITE DRAINAGE
PROPOSED PRIVATE 5' TYPE R INLET (SEE OFFSITE PLANS - PCD FILE# VR-22-03)
PROPOSED PRIVATE 6" PVC C-STORE ROOF DRAIN DAYLIGHT POINT
PROPOSED PRIVATE 23"x14" CULVERT (SEE OFFSITE PLANS - PCD FILE# VR-22-03)
PROPOSED PRIVATE 15' CULVERT (SEE OFFSITE PLANS - PCD FILE# VR-22-03)
PROPOSED TYPE VL RIPRAP RUNDOWN (SEE OFFSITE PLANS - PCD FILE# VR-22-03)
EXISTING ROADSIDE DRAINAGE SWALE

Label size/type of riprap.

And then copy this text callout for the spreader swale over to the GEC Plans.

LEGEND

- PROPERTY LINE
- PERVIOUS AREAS
- DRAINAGE BASIN BOUNDARY
- PROPOSED SITE TREATED BY DETENTION POND
- FLOW DIRECTION
- DESIGN POINT
- BASIN ID
- BASIN AREA [AC]
- 100-YR RUNOFF [CFS]

DRAINAGE NOTES

1. ALL STORM SEWER, STORM STRUCTURES, AND DRAINAGE INFRASTRUCTURE INCLUDED CURB CUTS, RIP RAP PADS, SWALES AND FLUMES TO BE PRIVATE UNLESS OTHERWISE NOTED.

GRAPHIC SCALE
(IN FEET)
1 inch = 40 ft.

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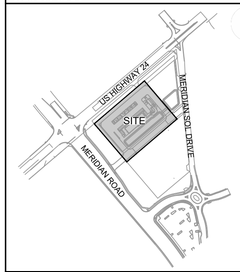

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DESIGNED BY: NMS

SHEET TITLE:

PROPOSED DRAINAGE MAP

SHEET 2 OF 2
DR02

ISSUE DATE: DECEMBER 2022