FINAL DRAINAGE REPORT

Miller Downs at Wyoming Lane Addition No. 1

7020 Wyoming Lane
Colorado Springs, CO

Prepared for:

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c/o FGMC
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Prepared by:

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SWENT Master #: STM-MP25-0140
SWENT Project #:
Prepared: August 2026
Revised:

Kimley»Horn

QCERTIFICATION

ENGINEER'S STATEMENT

This report and plan for the drainage design of Miller Downs at Wyoming Lane 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 City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

SIGNATURE (Affix Seal): _____

Colorado P.E. No. 57234 Date

DEVELOPER'S STATEMENT

M&A, LLC. hereby certifies that the drainage facilities for the Miller Downs at Wyoming Lane shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.4.701 of the City Code; and cannot, on behalf of Miller Downs at Wyoming Lane, guarantee that final drainage design review will absolve M&A, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

_____

Name of Developer

_____

Authorized Signature Date

_____

Printed Name

_____

Title

_____

Address:

CITY OF COLORADO SPRINGS STATEMENT

Filed in accordance with Section 7.4.701 of the Code of the City of Colorado Springs, 2023, as amended.

_____ _____

For SWENT Manager Date

Conditions:

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INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report ("PDR") is to outline the drainage patterns for Miller Downs at Wyoming Lane Addition No. 1 single family homes development, located on the parcel addressed 7020 Wyoming Lane (the "Site"), City of Colorado Springs, Colorado (the "City"). The Site will ultimately be replatted into 2 blocks. Block 1 will contain 1 lot with the existing single family home, and Block 2 will contain 109 lots. This Drainage Study identifies on-site and off-site drainage patterns, areas tributary to the site and proposes to safely route developed storm water to adequate outfalls at less than historic flow rates. The Site is 21.37 acres in size, is mostly vacant and is located within the Sand Creek Basin. The Site is ultimately tributary to Sand Creek. The Sand Creek Basin is ultimately tributary to Fountain Creek.

Detailed hydraulic analysis for the proposed drainage infrastructure has been omitted from this PDR and will be provided within a final drainage report at such time that the proposed project design has been sufficiently advanced.

DBPS INVESTIGATIONS

The Site is located within the Sand Creek Drainage Basin per the "Sand Creek Drainage Basin Planning Study Final Report" by Stantec, HDR, and Dewberry, dated January 2021 (hereby the "DBPS"). This report serves as the current, approved DBPS for Sand Creek Drainage Basin. The proposed development will comply with the standards and required improvements set by the DBPS.

GENERAL PROJECT DESCRIPTION

The proposed improvements consist of the construction of 109 single-family detached homes (the "Project"). The platted Site is 21.37 acres and is located within Sand Creek Basin. The Sand Creek drainage basin total area is 36 square miles (23,040 acres), which includes the platted Site. The Site is ultimately tributary to Sand Creek which crosses the site along the southern property line. The southeast corner of the site is located within a streamside overlay zone.

The Project is located in a portion of the east half of Section 8, Township 13 South, Range 65 West of the 6th Principal Meridian, within the City of Colorado Springs, County of El Paso, State of Colorado. A vicinity map for the Project is included in the **Appendix**.

The Site is currently undeveloped and consists of natural vegetation with some existing mobile homes and a dirt road. The following provides plat and use information for the adjacent properties:

- South of the Site (vacant land): A portion of Sand Creek owned by the City with Reception #5308401031 and #5308310007 (no plat found)
- North of the Site: Existing residential homes with acre lots consisting of natural vegetation
- West of the Site: Residential homes which are a part of Quail Brush Creek HOA. Quail Brush Creek Filing No. 2 (Rec. No. 215713674), Quail Brush Creek Filing No. 3 (Rec. No. 217713977), Quail Brush Creek Filing No. 4 (Rec. No. 217713915).
- East of the Site: A portion of Sand Creek owned by the City with Reception #5308101008 and #5308401043, Wyoming Lane ROW, residential homes, a landscaping business, a mechanic shop, and a plant nursery

The Site consists of one parcel (Miller Downs at Wyoming Lane) and is planned to be platted into

a two blocks that includes Block 1 (1.91 AC) and Block 2 (19.46 AC). Additionally, there are eight (8) planned tracts for the Site that are used as open space.

PROJECT CHARACTERISTICS

The Project Site is 21.37 acres and involves the construction of 109 total single-family homes each with attached garages, along with internal roadways, landscaping, stormwater and utility improvements, and a proposed private full-spectrum extended detention basin ("FSD pond"). Additionally, off-site improvements include two vehicle access points which will connect to existing public roadways. There will be two vehicle access points on the west. The roadway that the internal drives will connect to are Cat Tail Creek Drive and Thorn Brush Way located in the residential subdivision to the west of the site.

The proposed Project will route stormwater for the development and to a proposed private FSD located to the south of the Site. The proposed private EDB will be privately owned and maintained by the Miller Downs Metropolitan District ("Metro District").

The proposed FSD pond is sized to detain flow to be released below the pre-development flow rate, as determined utilizing Mile High Flood District (MHFD) UD-Detention v4.04. The proposed FSD pond has been sized to treat the water quality control volume (WQCV) from only those sub-basins directly tributary to the proposed FSD pond. Flows from the proposed FSD pond will outfall from a proposed outlet structure in to Sand Creek.

There are no major irrigation facilities within the Site. The Site does not currently provide on-site water quality or detention for the Project area. There is no regional detention pond for the Project Site. The existing land use is vacant land. The proposed land use is residential.

STREAMSIDE OVERLAY CRITERIA

The proposed site design and drainage facilities are in compliance with The City of Colorado Springs Streamside Design Guidelines (the "SDG"), Revised 2009 and associated development plan review criteria. The proposed streamside land use is personal or business (small) which is most desirable based on the SDG land use hierarchy. The following site characteristics are to be considered when evaluating the proposed site for compliance with the eleven (11) streamside design criteria.

Grading and Landform

(1) Channel improvements along sand creek will be submitted under a separate application and submitted to SWENT. Improvements will include channel stabilization and revegetation. Areas of the site within the inner and outer stream side buffer have been designed as open space with detention, a trail overlook and small pocket park. Disturbed areas along the creek will be revegetated per the separate channel improvement plan. These disturbed areas along the streamside and emergency spillway will minimize disturbance and protect the existing slopes. Disturbed areas within the inner and outer stream side buffer will need to meet the requirements outlined in the Appendix A of the landscape policy manual.

Site Design

(2) A trail and pocket park are located within the inner and outer stream buffer and will provide an overlook of the stream. Trails within the development have been linked to provide an inclusive trail network supportive of active lifestyles. Streamside vegetation will be constructed along the creek to comply with inner and outer streamside planting requirements. A trail and pocket park are proposed to overlook the stream. Required streamside plantings for the inner and outer buffer will be made in compliance with appendix a of the landscape design manual. Improvements within the sand creek channel will be under a separate application. Sand Creek will provide a buffer between the proposed development and the existing development to the south. A separate channel improvement plan for Sand Creek will stabilize and restore the natural habitat of the creek, preserving many mature trees, and adding and enhancing the native vegetation and wildlife habitat(s) in the corridor.

Wildlife Habitat Preservation

(3) The project has been designed to minimize impacts on the existing riparian ecosystem. Vegetation that is undisturbed by construction activity and will be designated to remain. Disturbed areas in the outer buffer will be revegetated with appropriate species. A separate channel improvement plan will stabilize and restore the natural habitat of the creek, preserving many mature trees, and adding and enhancing the native vegetation and wildlife habitat(s) in the corridor.

Trails and Recreation

(4) A soft surface trail and pocket park are located along the stream and will provide an overlook of the stream. Trails within the development have been linked to provide an inclusive trail network supportive of active lifestyles. Trails within the development have been designed to promote connectivity and connect to open space tracts, pocket parks and the creek. Sidewalks from the adjacent neighborhood provide connectivity and access to the trail system.

Floodplain

(5) A separate channel improvement plan for Sand Creek will stabilize the creek, improve the riparian buffer and protect the area from potential flood damage. A full spectrum detention basin is located within the southern portion of the site. This basin will capture and treat stormwater to control sediment and runoff. No development is proposed within the 100-year flood plain.

Significant Natural Features

(6) Significant features include wetlands that are along Sand Creek have been identified and will be incorporated into the Sand Creek channel improvement plan. This plan will stabilize and restore the natural habitat of the creek, preserving many trees, and enhancing native vegetation and wildlife habitat(s) areas.

Complimentary Plans

(7) Not applicable. Plan conforms to the DBPS and the stream will be stabilized through

channel improvement plans to meet goals of the streamside stabilization.

Riparian Buffers and Impervious Surfaces

(8)

a. Implement a riparian buffer of specified width between the developed portions of the site and the adjacent waterway to assist in preventing point and non-point source pollutants and sediment from entering the waterway?

    i. Vegetation improvements between the site and sand creek will be made per the final landscape plan. Landscape improvements within inner or outer buffer of the sand creek channel will be in compliance with Appendix A of the landscape design manual. Best practices will be employed to preserve and protect existing vegetation. A separate Sand Creek channel improvement plan will stabilize and restore the Sand Creek channel.

b. Exclude impervious surfaces from the inner buffer zone and meet impervious restrictions across the entire overlay?

    i. A detention basin is located in the southwest corner of the site and within the inner and outer stream buffer. This detention basin will capture impervious runoff from the development and prevent sediment from going into the creek. Two residential lots and a small portion of the residential road are within the stream side outer buffer.

c. Incorporate all stormwater best management practices required by City engineering throughout the developed site and adjacent to the buffer to encourage on-site filtration of stormwater and protect water quality?

    i. Green infrastructure requirements will be met through the use of runoff reduction practices with planned infiltration areas. The site will provide a 10% reduction in water quality capture volume.

d. Incorporate visual buffer opportunities of the stream between identified existing and/or proposed projects on opposing sides of the stream?

    i. Streamside vegetation will be constructed along the creek to comply with inner and outer streamside planting requirements. A trail and pocket park are proposed to overlook the stream. Improvements within the sand creek channel will be under a separate application. Sand Creek will provide a buffer between the proposed development and the existing development to the south.

Landscape

(9) The streamside outer buffer and inner buffer criteria have been met. Disturbed areas will be revegetated with appropriate plant selections from appendix a that will promote stabilization of the stream bank. All landscape codes are met in the proposed plan.

Stream Bank Stabilization

(10) The disturbance to the inner buffer slopes along the stream is limited. Existing streamside trees not disturbed by construction activity are designated to remain. Slope stabilizing plants are specified for areas disturbed during construction.

Stream Reclamation

(11) A soft surface trail and pocket park are proposed to overlook the stream. A separate channel improvement plan for Sand Creek will stabilize and restore the natural habitat of the creek, preserving many mature trees, and adding and enhancing the native vegetation and wildlife habitat(s) in the corridor.

MAJOR DRAINAGEWAYS & STRUCTURES

There are two drainageways adjacent to the Site: Sand Creek and a perennial stream tributary to Sand Creek (reach 147-1 from Quail Brush Filing 1, 1A, 2, & 3 Final Drainage Report). The Sand Creek Drainageway traverses the Site flowing southwest along the southern property line. The small tributary to Sand Creek enters the Site at the north property line where it enters an existing wetland area and is released to the southwest and ultimately converges with Sand Creek at a point of confluence about 1000 feet southwest of the Site. The Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map (FIRM) No. 08041C0537G, effective date December 7, 2018, indicates that a majority of the Site is located in Zone X (Areas determined outside the 500-year floodplain), with a portion of Zone-X shaded (areas determined to be within the 500-year floodplain and outside the 100-year floodplain), and Flood Zone AE (base flood elevations determined), with a portion of Zone AE being a designated floodway. The limits of these zones are shown approximately on the Proposed Drainage Map in the **Appendix**. The FEMA FIRM panel is included in the **Appendix**.

DBPS COMPLIANCE

The proposed development will comply with the requirements, recommendations, and design intent set forth by the Sand Creek DBPS. Two areas of the Site will be improved per the DBPS recommendations as outlined below. Reference the **Appendix** for applicable excerpts from the DBPS.

1. The existing wetland located at the north end of the Site was identified as “Low Priority Spot – Improvement #9” due to the eroded nature of the low flow channel outfalling from the wetland. The flow path of the channel has been modified by cutting into the FSD pond embankment which resulted in bank sloughing and erosion from the new flow path of the channel. The proposed improvements include laying back and revegetating the banks to allow the low flow channel to be re-routed to its historic flow path, as recommended per the DBPS. Flows from the wetland will proceed south through a proposed box culvert crossing beneath the proposed access road at the northwest corner of the Site. The hydraulic design and sizing calculations for the proposed culvert will be within a future Channel Design Report.
2. The reach of Sand Creek traversing the Site on the south end of the property was identified as “Channel Type 3 – Unimproved – Existing or future problems” by the DBPS. The designated improvement theme for Type 3 channels is a “Natural Engineered Channel”. Proposed channel improvements include the implementation of grade control concrete check structures and reduction of bank slopes in order to minimize the erosive forces in the existing condition. A future channel design report and channel design plans for the proposed improvements will be submitted as separate construction documents.

SOILS CONDITIONS

NRCS soil data is available for this Site and it has been noted that soils on-site are generally USCS Type A. The NRSC Soils map is provided in the **Appendix**.

DRAINAGE DESIGN CRITERIA

DESIGN CRITERIA REFERENCE AND CONSTRAINTS

The Project follows the City of Colorado Springs Storm Drainage Criteria Manual Volume 1 (May 2014, revised January 2021), and Volume 2 (May 2014, revised December 2020) (the "DCM") , the MHFD Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3 (the "USDCM"), and the Green Infastructure Guidance Manual (March 2022) ("GIGM"). Project area drainage is not significantly impacted by such constraints as utilities or existing development. Further detail regarding onsite drainage patterns is provided in the Proposed Drainage Conditions section of this report.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per Tabel of the DCM. Table 6-2 of the DCM is the source for rainfall data for the 5-year and 100-year design storm events. Developed runoff was calculated using the Rational Method for existing and proposed conditions as established in the DCM and the USDCM. Runoff coefficients for the proposed development were determined using Table 6-6 of the DCM by calculating weighted impervious values for each specific site basin. The runoff reduction calculations were calculated per the GIGM.

HYDRAULIC CRITERIA

The proposed drainage facilities are designed in accordance with the DCM and the USDCM. Hydraulic calculations for inlet and street capacity were computed using MHFD spreadsheets for the 5-year and 100-year design storm events. The inlet size needed per basin to meet the basin's developed flow was determined the calculated capacities. The inlet capacity calculations are provided in the **Appendix**.

Final hydraulic calculations for detention volume, outlet structure, emergency spillway and street capacities have been computed using MHFD spreadsheets. Forebay sizing will be computed using the Water Quality Drain Time Equation EDB-1 provided in USDCM. Pipe flows, capacities, and hydraulic grade line calculations will be computed for the 5-year and 100-year design storm events using StormCAD implementing the standard method headloss coefficients from Table 9-4 in DCM Volume 1. Detailed computations will be provided with the Final Drainage Report for this development at a later date. Culvert calculations will be provided within a future Channel Design Report.

STREAMSIDE OVERLAY

The Site is located within a streamside overlay zone. The streamside overlay is classified as Type 3 which includes a 40' Inner Buffer and 80' outer buffer from the toe of the creek. Within the outer buffer zone, a 25% imperviousness is allowed because of the full spectrum detention pond that provides water quality on site. There is currently 10.5% imperviousness within the outer buffer area, which is less than the 25% allowed imperviousness.

VARIANCES FROM CRITERIA

There are no proposed variances related to hydrology, PCM's, or channels from the DCM, for the proposed development.

PREVIOUS DRAINAGE STUDIES

There are no known previous drainage studies completed for this site. Adjacent to the site, there were two drainage studies completed. These include "Quail Brush Creek Filing No. 1, 1A, 2 & 4 Final Drainage Report" prepared June 2014 by M&S Civil Consultants, Inc. and "Final Drainage Report for Quail Brush Creek Filing No. 4" prepared November 2016 by M&S Civil Consultants, Inc. Portions of these studies of referred to and referenced in the **Appendix**.

FEMA NO RISE CERTIFICATION

A "No Rise Certification" will be submitted with the Channel Improvement Plans to add improvements within the floodplain. This application is for the at-grade check structures located within the floodplain in Sand Creek.

EXISTING DRAINAGE CONDITIONS

EXISTING DRAINAGE BASIN

The Site is located in the Sand Creek watershed and generally slopes from northeast to southwest at approximately 1-4%. Currently, the site consists of vacant land with natural vegetation, gravel roads, and some existing buildings. There are no known major irrigation facilities within 100 feet of the property. There is no known existing storm infrastructure on or adjacent to the Site.

The Site has been divided into sixteen existing sub-basins, as described below, and shown in the existing conditions map in the **Appendix**. In existing conditions, runoff from the Site is split with outfalls into a Sand Creek Tributary to the west and Sand Creek to the south. Those sub-basins which outfall into the Sand Creek Tributary include EX1-EX6 and OF1-OF4, OF-6 – OF-8, OF-10. Those sub-basins which outfall into Sand Creek include EX-7, OF5, and OF-9. All hydrologic calculations can be found in the **Appendix**.

Table 1: Existing Stormwater Runoff Calculation and Sub-Basin Outfall Descriptions

DESIGN POINT	TRIBUTARY BASINS	AREA (AC)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	% IMPERV.	IMMEDIATE OUTFALL				ULTIMATE OUTFALL
						CONVEYANCE	CONVEYANCE DIRECTION	LOCATION	TYPE	
EX-1	EX-1	2.31	0.53	3.88	0%	OVERLAND	SOUTHWEST	WETLAND	WETLAND	SAND CREEK
EX-2	EX-2	0.96	0.24	1.78	0%	OVERLAND	NORTHWEST	OFFSITE	DRAINAGEWAY	SAND CREEK
EX-3	EX-3	0.15	0.05	0.33	0%	OVERLAND	SOUTH	OFFSITE	SAND CREEK TRIBUTARY	SAND CREEK
EX-4	EX-4	4.45	1.22	6.56	6%	OVERLAND	SOUTHWEST	OFFSITE	SAND CREEK TRIBUTARY	SAND CREEK
EX-5	EX-5	0.77	0.52	1.98	15%	OVERLAND	SOUTHWEST	SAND CREEK	SAND CREEK	SAND CREEK
EX-6	EX-6	8.19	1.90	10.98	4%	OVERLAND	SOUTHWEST	SAND CREEK	SAND CREEK	SAND CREEK
EX-7	EX-7	4.53	1.27	7.20	5%	OVERLAND	SOUTHWEST	SAND CREEK	SAND CREEK	SAND CREEK
OF-1	OF-1	0.23	0.46	1.07	54%	OVERLAND	EAST	EX-3 BASIN	N/A	SAND CREEK
OF-2	OF-2	0.19	0.59	1.18	80%	OVERLAND	WEST	EX-4 BASIN	N/A	SAND CREEK
OF-3	OF-3	0.40	0.27	1.08	13%	OVERLAND	WEST	EX-4 BASIN	N/A	SAND CREEK
OF-4	OF-4	0.96	0.27	2.00	0%	OVERLAND	SOUTHWEST	EX-6 BASIN	N/A	SAND CREEK
OF-5	OF-5	2.29	0.56	4.11	0%	OVERLAND	SOUTHWEST	EX-7 BASIN	N/A	SAND CREEK
OF-6	OF-6	0.14	0.43	0.86	80%	OVERLAND	SOUTHWEST	CAT TAIL CREEK DRIVE	N/A	SAND CREEK
OF-7	OF-7	0.03	0.01	0.08	0%	OVERLAND	SOUTHEAST	OFFSITE	N/A	SAND CREEK
OF-8	OF-8	0.36	0.08	0.60	0%	OVERLAND	SOUTHEAST	OS1	N/A	SAND CREEK
OF-9	OF-9	4.87	1.01	7.43	0%	OVERLAND	SOUTHWEST	OFFSITE	N/A	SAND CREEK
OF-10	OF-10	0.02	0.01	0.05	0%	OVERLAND	EAST	OF-1	N/A	SAND CREEK
Total		30.87								

PROPOSED DRAINAGE CONDITIONS

BASIN DESCRIPTIONS

The proposed development includes the construction of 109 single family detached residential homes with associated roadway, utility, and drainage improvements. Water quality treatment and detention will provided by one FSD Pond for the Site that includes a water quality outlet structure. The controlled 5-year and 100-year storm events will release from the outlet structure and discharge through proposed storm sewer which outfalls into Sand Creek.

The Site has been divided into thirty-seven (37) sub-basins. The sub-basins have been categorized as “P” Basins, “OS” Basins, and “OF” basins. The “P” basins, which include P1-P19, consist of drainage basins within the property boundary that are tributary to the proposed private FSD Pond. The “OS” basins, which include OS1-OS7, consist of drainage basins which are within the property boundary and flow off-site and are not routed to the FSD Pond. The “OF” basins, which include OF1-OF11, consist of drainage basins that are outside of the property boundary but are disturbed area and are either flowing onto the property boundary or outside of the property boundary.

All proposed storm infrastructure is public unless otherwise noted. All proposed storm pipes are RCP. Storm pipe sizing will be provided with the Final Drainage Report. A proposed conditions map and all hydrologic calculations can be found in the **Appendix**.

Table 2: Proposed Stormwater Runoff Calculation and Sub-Basin Outfall Descriptions

DESIGN POINT	TRIBUTARY BASINS	AREA (AC)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF	% IMPERV.	IMMEDIATE OUTFALL					EMERGENCY OVERFLOW PATH	LOCATION	ULTIMATE OUTFALL
						CONVEYANCE	CONVEYANCE DIRECTION	INLET TYPE	PROPOSED VS EXISTING	PUBLIC VS PRIVATE			
P1	P1	0.45	1.58	3.09	76%	C&G	SOUTH	4' COS TYPE 1 (D-	PROP.	PUBLIC	WETLAND	SUMP	SAND CREEK
P2	P2	0.70	1.32	2.90	65%	C&G	SOUTH	TYPE C AREA	PROP.	PUBLIC	OFFSITE	SUMP	SAND CREEK
P3	P3	0.86	2.32	4.72	70%	SWALE	SOUTH	4' COS TYPE 1 (D-	PROP.	PUBLIC	P11	SUMP	SAND CREEK
P4	P4	1.80	3.41	7.20	68%	C&G	SOUTH	8' COS TYPE 1 (D-	PROP.	PUBLIC	P12	ON-GRADE	SAND CREEK
P5	P5	2.05	4.43	9.09	72%	C&G	SOUTH	8' COS TYPE 1 (D-	PROP.	PUBLIC	P12	ON-GRADE	SAND CREEK
P6	P6	0.67	1.86	3.66	74%	C&G	SOUTH	8' COS TYPE 1 (D-	PROP.	PUBLIC	P15	ON-GRADE	SAND CREEK
P7	P7	2.67	4.12	9.54	53%	C&G	SOUTH	12' COS TYPE 1 (D-	PROP.	PUBLIC	P16	ON-GRADE	SAND CREEK
P8	P8	0.02	0.09	0.17	78%	C&G	SOUTH	4' COS TYPE 1 (D-	PROP.	PUBLIC	P11	SUMP	SAND CREEK
P9	P9	0.02	0.09	0.17	78%	C&G	WEST	4' COS TYPE 1 (D-	PROP.	PUBLIC	P10	ON-GRADE	SAND CREEK
P10	P10	0.66	1.18	2.64	63%	C&G	WEST	FSD POND	PROP.	PUBLIC	P19	ON-GRADE	SAND CREEK
P11	P11	0.52	1.53	3.06	73%	SWALE	SOUTH	4' COS TYPE 1 (D-	PROP.	PUBLIC	P18	ON-GRADE	SAND CREEK
P12	P12	0.78	1.63	3.40	69%	C&G	SOUTH	8' COS TYPE 1 (D-	PROP.	PUBLIC	P17	ON-GRADE	SAND CREEK
P13	P13	0.13	0.49	0.96	77%	C&G	SOUTH	4' COS TYPE 1 (D-	PROP.	PUBLIC	P12	ON-GRADE	SAND CREEK
P14	P14	0.57	1.44	2.94	74%	C&G	SOUTH	4' COS TYPE 1 (D-	PROP.	PUBLIC	P17	ON-GRADE	SAND CREEK
P15	P15	0.23	0.83	1.62	76%	C&G	SOUTH	4' COS TYPE 1 (D-	PROP.	PUBLIC	P17	SUMP	SAND CREEK
P16	P16	0.89	1.83	3.86	68%	C&G	SOUTH	4' COS TYPE 1 (D-	PROP.	PUBLIC	P18	ON-GRADE	SAND CREEK
P17	P17	0.49	0.87	2.03	49%	C&G	SOUTH	8' COS TYPE 1 (D-	PROP.	PUBLIC	P18	SUMP	SAND CREEK
P18	P18	0.35	1.31	2.52	78%	C&G	SOUTH	16' COS TYPE 1 (D-	PROP.	PUBLIC	P19	SUMP	SAND CREEK
P19	P19	0.85	0.28	2.07	0%	C&G	SOUTHWEST	OUTLET STRUCTUR	PROP.	PUBLIC	SAND CREEK	SUMP	SAND CREEK
OS1	OS1	1.46	1.00	3.52	19%	OVERLAND	SOUTHWEST	TRIPLE 5X5 CULVERT	EX.	N/A	OS2	N/A	REACH 147-1**
OS2	OS2	0.19	0.88	1.57	98%	OVERLAND/ C&G	NORTH	8' COS TYPE 1 (D-	EX.	N/A	OS3	N/A	REACH 147-1**
OS3	OS3	0.24	1.00	1.84	91%	OVERLAND/ C&G	SOUTHWEST	8' COS TYPE 1 (D-	EX.	N/A	OS4	N/A	REACH 147-1**
OS4	OS4	1.23	0.77	2.35	18%	OVERLAND	SOUTHWEST	WETLAND	EX.	N/A	SAND CREEK	N/A	REACH 147-1**
OS5	OS5	1.09	0.17	1.27	0%	OVERLAND	SOUTHWEST	SWALE	PROP.	PUBLIC	SAND CREEK	N/A	SAND CREEK
OS6	OS6	0.66	1.46	3.27	62%	OVERLAND	WEST	N/A	EX.	N/A	OFFSITE	N/A	REACH 147-1**
OS7	OS7	1.77	1.03	4.00	16%	OVERLAND	SOUTHWEST	SAND CREEK	EX.	N/A	SAND CREEK	N/A	SAND CREEK
OF1	OF1	0.11	0.42	0.79	81%	C/G	WEST	2-8' INLETS*	EX.	PUBLIC	THORN BRUSH WAY	N/A	SAND CREEK
OF2	OF2	0.05	0.24	0.43	96%	C/G	SOUTHEAST	P1	EX.	N/A	OS2	N/A	SAND CREEK
OF3	OF3	0.07	0.20	0.42	61%	C/G	SOUTHEAST	P2	EX.	N/A	OS3	N/A	SAND CREEK
OF4	OF4	0.08	0.26	0.52	80%	OVERLAND	WEST	OS2	EX.	N/A	P7	N/A	SAND CREEK
OF5	OF5	3.66	0.73	4.72	2%	OVERLAND	SOUTHWEST	SWALE	EX.	N/A	SAND CREEK	N/A	SAND CREEK
OF6	OF6	0.14	0.56	1.06	85%	C/G	WEST	16' INLET	EX.	N/A	OFFSITE	N/A	REACH 147-1**
OF7	OF7	0.03	0.01	0.07	0%	OVERLAND	EAST	SWALE	EX.	N/A	OFFSITE	N/A	SAND CREEK
OF8	OF8	0.36	0.08	0.56	1%	OVERLAND	SOUTHWEST	WETLAND	EX.	N/A	OS1	N/A	REACH 147-1**
OF9	OF9	4.87	1.04	7.46	0%	OVERLAND	SOUTHWEST	SAND CREEK	EX.	N/A	OS7	N/A	SAND CREEK
OF10	OF10	0.11	0.33	0.67	80%	OVERLAND	WEST	OS3	EX.	N/A	OS5	N/A	SAND CREEK
OF11	OF11	0.02	0.04	0.09	48%	C/G	EAST	OS1	EX.	N/A	OS1	N/A	REACH 147-1**
Total		###											

*Inlets are existing and located offsite. Reference Quail Brush Creek Final Drainage Reports for Filings 1, 1A, 2, 3, & 4.
**Reach 147-1 is tributary to Sand Creek.

Basin OF-1
Basin OF-1 is located in the Northwest corner of the Site. This basin is part of basin J in the Quail Brush Creek Filing No. 1, 1A, 2 &3 Final Drainage Report, prepared June 2014. Because this area is part of the "Residential – 1/8 acre or less area" and the current runoff coefficients to support this area are less than what the runoff coefficients were proposed in 2014, there will be no adverse effects to the existing storm infrastructure. Pages from this Drainage Report are in the **Appendix** for Reference.

Basin OF-6
Basin OF-6 is located in the Southwest corner of the Site. This basin is part of basin B in the "Final Drainage Report for Quail Brush Creek Filing No. 4", prepared November 2016. Because this area is part of the "Residential – 1/8 acre or less area" and the current runoff coefficients match what was used to determine the flows from this basin, there will be no adverse effects to the existing storm infrastructure. Pages from this Drainage Report are located in the **Appendix** for Reference.

FOUR-STEP PROCESS

The four-step process per the USDCM provides guidance and requirements for the selection and siting of permanent Control Measures (CMs) for new development and significant redevelopment. Compliance with this process is outlined below. The total area of disturbance associated with the development is 18.13 acres and 0.49 acres of excluded disturbance. Water quality treatment for the disturbed areas of the Site will be provided via 75% infiltration and a proposed private FSD Pond.

Step 1: Employ Runoff Reduction Practices
Currently the site is vacant land. Development of the site will increase current runoff conditions due to a portion of the proposed development area currently being vacant land. However, the proposed development is not anticipated to have negative impacts to downstream infrastructure. Implementation of landscaping throughout the Site will help slow runoff and encourage infiltration. Stormwater runoff reduction techniques will be used to promote stormwater infiltration and reduce the amount of developed runoff exiting the Site. As documented in the runoff reduction calculations and exhibit found in the Appendix, the site was divided into Upstream Impervious Areas (UIA), Receiving Pervious Area (RPA), Directly Connected Impervious Area (DCIA), and Separate Pervious Area (SPA) per the City of Colorado Springs Green Infrastructure Manual. Where feasible, developed stormwater runoff from the Site will be directed over the various RPA's. All PIA's shall be clearly depicted and labeled on the GEC plans. Reference the **Appendix** for the proposed Green Infrastructure Exhibit. Reference the **Appendix** for the UD-BMP spreadsheet by Mile High Flood District used to determine the runoff reduction. The total WQCV reduction for the total disturbed area is 18%, which exceeds the required minimum of 10%.

Step 2: Provide Water Quality Capture Volume (WQCV)
The water quality capture volume will be provided and slowly released from the outlet structure of the proposed FSD Pond for the Site in a minimum of 40 hours. Water quality treatment for the disturbed areas not tributary to the proposed private FSD pond will be provided via 75% infiltration. Drainage basins OF-1 and OF-6 are part of Quail Brush Creek Filing 3 and 4, respectively. These basins will receive water quaility through the exisitng master planned storm infastructure. Reference the table below for a breakdown of each sub-basin and the control measure providing water quality treatment.

Table 3: Proposed Disturbed Area Treatment Summary

DESIGN POINT	TOTAL AREA (AC)	ASSOCIATED DISTURBANCE AREA (AC)	EXCLUDED DISTURBANCE AREA (AC)	TREATMENT METHOD	OWNERSHIP/MAINTENANCE
P1	0.45	0.45		FSD POND	PRIVATE
P2	0.70	0.70		FSD POND	PRIVATE
P3	0.86	0.86		FSD POND	PRIVATE
P4	1.80	1.80		FSD POND	PRIVATE
P5	2.05	2.05		FSD POND	PRIVATE
P6	0.67	0.67		FSD POND	PRIVATE
P7	2.67	2.10		FSD POND	PRIVATE
P8	0.02	0.02		FSD POND	PRIVATE
P9	0.02	0.02		FSD POND	PRIVATE
P10	0.66	0.66		FSD POND	PRIVATE
P11	0.52	0.52		FSD POND	PRIVATE
P12	0.78	0.78		FSD POND	PRIVATE
P13	0.13	0.13		FSD POND	PRIVATE
P14	0.57	0.57		FSD POND	PRIVATE
P15	0.23	0.23		FSD POND	PRIVATE
P16	0.89	0.89		FSD POND	PRIVATE
P17	0.49	0.49		FSD POND	PRIVATE
P18	0.35	0.35		FSD POND	PRIVATE
P19	0.85	0.85		FSD POND	PRIVATE
OS1	1.46	0.47		75% INFILTRATION	N/A
Amount of OS1 Excluded - Channel			0.01	EXCLUDED - CHANNEL	N/A
Amount of OS1 Not Treated		0.19		NOT TREATED	N/A
OS2	0.19	-		-	N/A
Amount of OS2 Not Treated		0.19		NOT TREATED	N/A
OS3	0.24	0.06		75% INFILTRATION	N/A
Amount of OS3 Not Treated		0.19		NOT TREATED	N/A
OS4	1.23	0.69		75% INFILTRATION	N/A
Amount of OS1 Excluded - Channel			0.03	EXCLUDED - CHANNEL	N/A
Amount of OS4 Not Treated		0.06		NOT TREATED	N/A
OS5	1.09	0.39		75% INFILTRATION	N/A
OS6	0.66	0.66		75% INFILTRATION	N/A
OS7	1.77	0.68		75% INFILTRATION	N/A
Amount of OS1 Excluded - Channel			0.06	EXCLUDED - CHANNEL	N/A
OF1	0.11	0.02		75% INFILTRATION	N/A
Amount of OF1 Not Treated		0.09		NOT TREATED	PUBLIC
Amount of OF1 Excluded - Utility			0.002	EXCLUDED - UTILITY	N/A
OF2	0.05			N/A	N/A
Amount of OF2 Not Treated		0.05		NOT TREATED	PUBLIC
OF3	0.07	0.03		75% INFILTRATION	N/A
Amount of OF3 Not Treated		0.04		NOT TREATED	PUBLIC
OF4	0.08	0.00		FSD POND	N/A
OF5	3.66	0.00		N/A	N/A
OF6	0.14	0.13		QBC - FILING 4	N/A
Amount of OF6 Excluded - Utility			0.01	EXCLUDED - UTILITY	N/A
OF7	0.03	0.00		FSD POND	N/A
OF8	0.36	0.00		N/A	N/A
Amount of OS8 Excluded - Channel			0.09	EXCLUDED - CHANNEL	N/A
OF9	4.87	0.007		75% INFILTRATION	N/A
Amount of OF9 Excluded - Channel			0.30	EXCLUDED - CHANNEL	N/A
OF10	0.11	0.00		N/A	N/A
OF11	0.02			N/A	N/A
Amount of OF11 Not Treated		0.02		NOT TREATED	PUBLIC
Total Disturance (minus exlcusions)	**30.87**	**18.13**			
Total (FSD Pond)	**14.85**	**14.17**			
Total (75% Infiltration)	**11.54**	**3.00**			
Total (Excluded)			**0.49**		
Total (Not Treated)		**0.83**			
Total Treated Disturbed Area (AC):		**17.17**			
Total Untreated Disturbed Area (AC):		**0.83**			
Resulting Treatment Percentage:		**95.43%**			

Step 3: Stabilize Drainageways
Sand Creek is a major drainageway traversing the Site on the south end of the property. All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization within the drainage basin. There are no existing on-site storm outfalls into Sand Creek. The proposed outfall into Sand Creek will be protected from erosion with rip rap. The proposed riprap type will be specified further in the FDR. The proposed channel improvements to Sand Creek and to Reach 147-1 include the implementation of grade control check structures in order to minimize the erosive forces in the existing condition, per the Sand Creek DBPS. A future Channel Design Report and Channel Design Plans for the proposed improvements will be submitted as separate documents. Channel Design Plans must be approved prior to the approval of the development's final phase GEC Plan and issuance of the initial building permit.

Step 4: Implement Site Specific and Other Source Control CMs
The Site does not require specialized control measures (CM) in the final constructed condition. The Project consists of a residential development and does not require source CM such as Covering Outdoor Storage and Handling Areas, Spill Prevention Containment and Control, and Disposal of Household Waste.

Total Disturbed Area Exclusions
Utility connections to public utilities located in public Thorn Brush Way and Cat Tail Creek Drive right-of-way are anticipated. Per the SWENT Policy Clarification titled "4 Step Process Exclusions", the area of disturbance associated with the utility trenching and channel stabilization can be excluded from the 4 step process requirements. The total utility trenching area which is excluded as a part of this project is 0.013-acres. The total channel stabilization disturbance area which is excluded as part of the project is 0.48-acres.

WATER QUALITY AND DETENTION

Detention Storage Required

Existing drainage patterns include un-detained and un-controlled release from the Site. The proposed FSD Pond, with associated controlled release rates, represents an improvement over the existing conditions. Calculations included in the **Appendix** provide details regarding the private full spectrum extended detention basin sizing. The calculations include determination of the storage volume required for full spectrum detention for the Site. The total acreage contributing to the extended detention basin is 14.85 acres with a percent imperviousness of 62.57%. Overall, 1.749 acre-feet (76,186 cubic feet) of detention storage volume is required. The proposed private FSD Pond provides a minimum of 2.492 acre-feet of storage plus 1' of freeboard.

Outlet Requirements

The majority of Water quality treatment for the Site will be provided within the proposed private FSD pond. The detention and water quality outlet structure is designed per the specifications in section 13.5.10 of the DCM. The orifice plate of the structure will be designed based on section 13.4.2.2 of the DCM. The orifice plate will allow the Water Quality Capture Volume to be drained from the structure in a minimum of 40 hours and the EURV to be drained in 68-72 hours. The MHFD-Detention spreadsheet basin tab is provided in **Appendix**. Final outlet structure calculations are provided in **Appendix**, final calculations will be provided with the FDR for this development.

Emergency Overflow Path

The emergency overflow path for the FSD Pond consists of an emergency spillway located on the South side of the FSD Pond near the outlet structure and will be set at an elevation to allow a minimum of 1' of freeboard. The emergency spillway will be protected with riprap. Design of emergency overflow path will be specified in the Final Drainage Report.

Downstream Flows

The total flows developed from the Site in the proposed condition are less than the existing condition. The Site was further evaluated to ensure there are no increases in runoff which would overwhelm any specific downstream Design Point ("DP"). The site has one DP for this evaluation: Sand Creek. Since the overall proposed flows are less than historic flows, there will be no adverse effects on the system. Majority of the flows have been rerouted to the proposed private FSD Pond on the south end of the site. Because the full-spectrum detention provides extended release, the proposed 100-year flows are less than historic. Reference the table below for details on the existing and proposed flows at the wetland, west, and south design points.

ULTIMATE DESIGN POINT	TRIBUTARY BASINS (EXISTING)	AREA (AC)	EXISTING 5-YR FLOW (CFS)	EXISTING 100-YR FLOW (CFS)	TRIBUTARY BASINS (PROPOSED)	AREA (AC)	PROPOSED 5-YR FLOW (CFS)	PROPOSED 100-YR FLOW (CFS)
SAND CREEK	EX1-EX7, & OF1-OF-10	30.87	9.43	51.16	P1-P19, OS1-OS7, & OF1-OF11	30.87	4.06	17.38

EROSION CONTROL PLAN

An Erosion Control Plan will be submitted to the City of Colorado Sprigs Stormwater Enterprise (SWENT) for review/approval prior to construction.

DEVELOPMENT FEES

DRAINAGE AND BRIDGE FEES

The Project Site is located in the Sand Creek Basin. The Sand Creek requires fees which will be paid prior to Final Plat recordation of the entire 21.37-acre Site. The total 2026 drainage, bridge, and pond fee amount for this Site is $595,154.50, as summarized below.

Fee Type	Fee/Acre	Total
Drainage	$27,850	$595,154.50
Bridge	--	--
Pond Land	--	--
Pond Facility	--	--
Surcharge	--	--
Total		**$595,154.50**

Per the decision made by the SWENT Drainage Board, on July 14th, 2026, the drainage fees are to be waived, contingent that the proposed channel improvements are constructed.

GROUNDWATER CONSIDERATIONS

Per the Preliminary Subsurface Soil Investigation prepared by Entech Engineering, Inc. on June 16th, 2025 (revised February 20th, 2026) groundwater was encountered. Free groundwater was found within 10 feet of the existing ground surface in two test holes located in the southern portion of the site. The proposed FSD Pond has been designed with a bottom elevation at least 2.40' above the highest encountered groundwater, and therefore the FSD Pond is not expected to be negatively affected by groundwater. The depth to groundwater depth and proposed grades tended to increase to the north, therefore the proposed improvements are not anticipated to be negatively affected by the groundwater.

SUMMARY

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for the Miller Downs at Wyoming Lane Addition No. 1 conforms to the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2 and the Mile High Flood District Urban Storm Drainage Criteria Manual. Additionally, Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments, will not result in any increase in peak flows, nor will it result in any decrease in water quality downstream in Fountain Creek.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, Vol. 1 & 2, May 2014 (Vol. 1 revised January 2021, Vol. 2 revised December 2020).

2. Mile High Flood District Drainage Criteria Manual Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

3. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0537G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

4. "Final Drainage Report for Quail Brush Creek Filing No. 4" prepared by M&S Civil Consultants, Inc. and approved by the City of Colorado Springs on November 10, 2016.

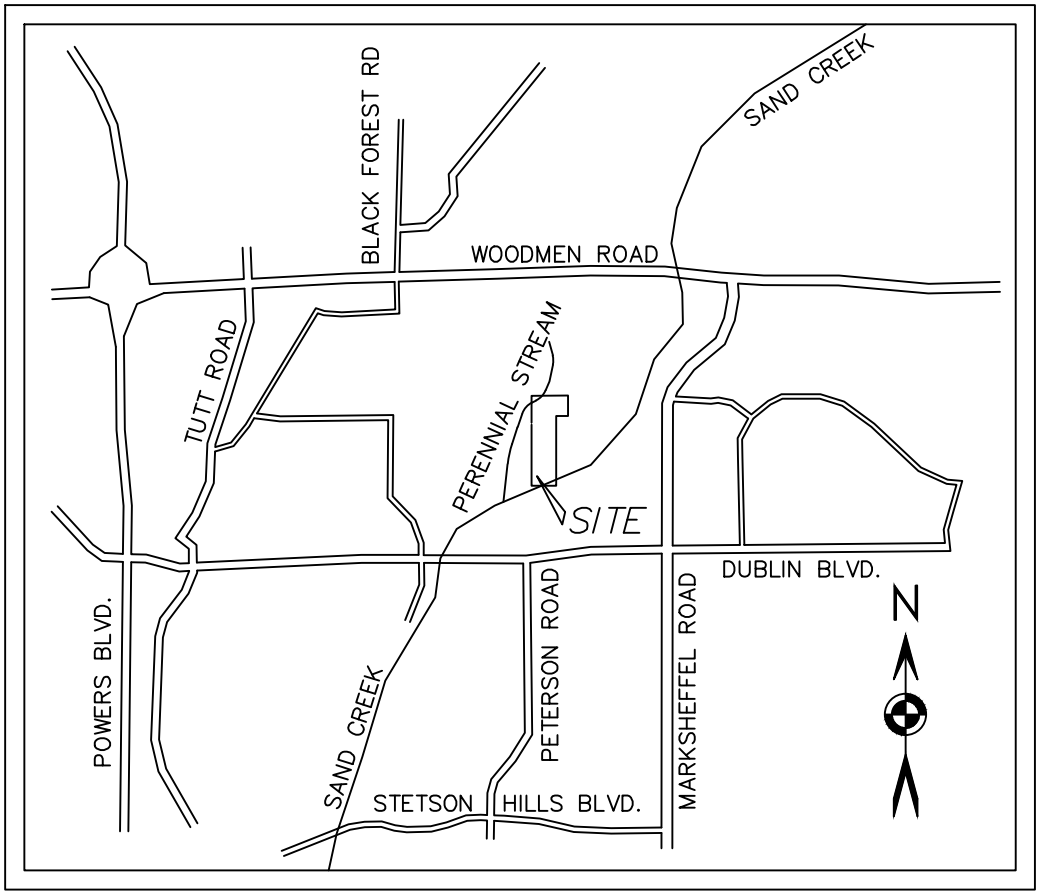
5. "Sand Creek Drainage Basin Planning Study Final Report" prepared by Stantec, HDR, and Dewberry, dated January 2021.

6. "Custom Soil Resource Report for El Paso County Area, Colorado" prepared by USGS National Cooperative Soil Survey, May 1st 2025.

7. "Master Development Drainage Plan and Preliminary Drainage Report" prepared by Kimley-Horn and Associates and approved by the City of Colorado Springs on October 28th, 2021

8. "Soil and Geology Study" prepared by Entech Engineering, Inc., dated February 20, 2026.

APPENDIX A – VICINITY MAP



VICINITY MAP

(NOT TO SCALE)

K:\COS_Civil\196142001_7020 Wyoming Lane\CADD\Exhibits\Vicinity Map 2021-0721\Vicinity Map.dwg

Kimley»Horn

© 2025 KIMLEY-HORN AND ASSOCIATES, INC.

2 N NEVADA AVE., SUITE 900, COLORADO SPRINGS, 80903
PHONE: 719-453-0180

APPENDIX B – FEMA MAP

NOTES TO USERS

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

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

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

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 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, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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.

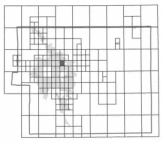
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

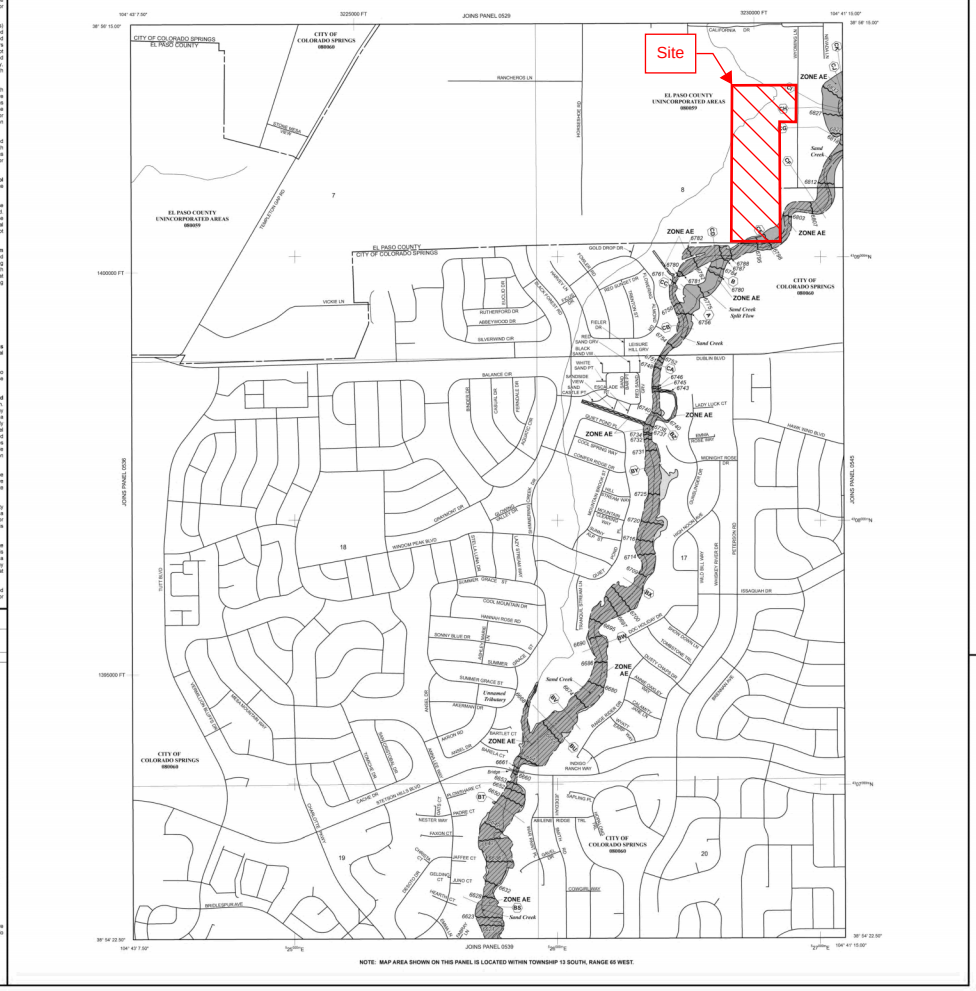
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

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.


Site
JOINS PANEL 0529
JOINS PANEL 0539
JOINS PANEL 0545
JOINS PANEL 0536
CITY OF COLORADO SPRINGS
080060
EL PASO COUNTY
UNINCORPORATED AREAS
080059
EL PASO COUNTY
CITY OF COLORADO SPRINGS
ZONE AE
ZONE AE
Sand Creek
Sand Creek Split Flow
Unnamed Tributary
CALIFORNIA DR
RANCHEROS LN
GOLD DROP DR
VICKIE LN
DUBLIN BLVD
MARK SAND BLVD
WIDGEON WAY
WINDROW VIEW
SAND DR
WHITE SAND PT
LEISURE HILL DRY
LAZY LUCK CT
MIDNIGHT ROSE DR
WINDROW RIDGE DR
PETERSON RD
ISSAQUAH DR
WINDROW HEAM BLVD
SUMMIN GRACE ST
HANNAH ROSE RD
SCARLET BLUE DR
RUNNER GRACE ST
ANDEAN DR
ARCH RD
MESSER WAY
PASSO CT
COFFEE CT
GOLDPAC CT
JUNO CT
HEATHCLIFF CT
WHISPERVINE
CONGRESS PARK DR
CONGRESSIONAL PKWY
CHAPEL ON
STETSON HILLS BLVD
ADELINE RIDGE TRL
CORNERBAR WAY
WHISPERVINE HILL
WHISPERVINE DR
WHISPERVINE CT
WHISPERVINE PARK
WHISPERVINE WAY
WHISPERVINE VIEW
WHISPERVINE CIR
WHISPERVINE HILL DR
WHISPERVINE HILL CT
WHISPERVINE HILL VIEW
WHISPERVINE HILL WAY
WHISPERVINE HILL PARK
WHISPERVINE HILL RIDGE
WHISPERVINE HILL CIR
WHISPERVINE HILL VIEW

APPENDIX C – SOILS REPORT AND GEOTECHNICAL REPORT

United States Department of Agriculture

NRCS

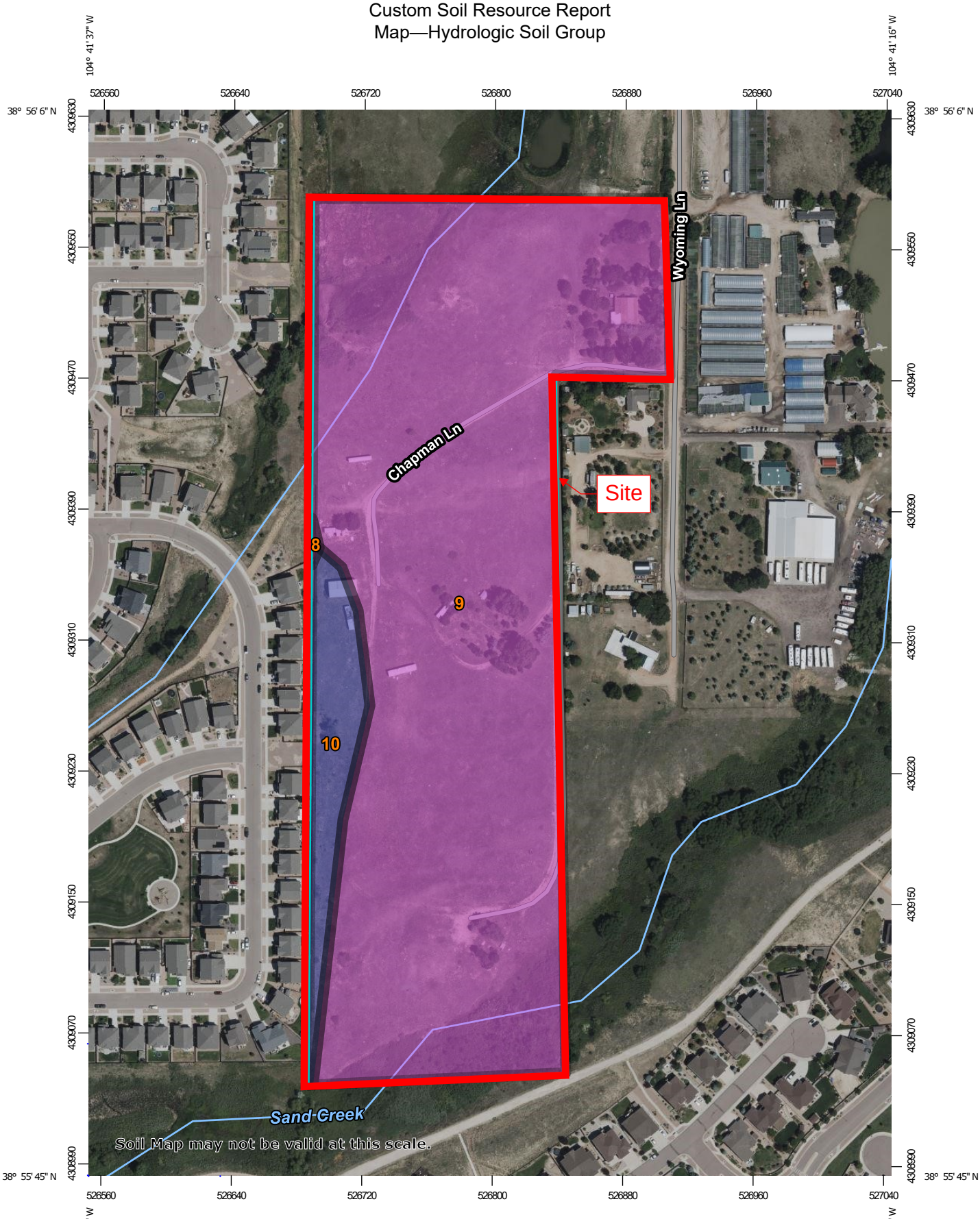
Natural Resources Conservation Service

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

Custom Soil Resource Report for El Paso County Area, Colorado

April 25, 2025

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:3,170 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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 22, Sep 3, 2024

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	0.0	0.1%
9	Blakeland-Fluvaquentic Haplaquolls	A	20.6	92.8%
10	Blendon sandy loam, 0 to 3 percent slopes	B	1.6	7.2%
Totals for Area of Interest			**22.2**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,170 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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 22, Sep 3, 2024

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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
8	Blakeland loamy sand, 1 to 9 percent slopes	0.0	0.1%
9	Blakeland-Fluvaquentic Haplaquolls	20.6	92.8%
10	Blendon sandy loam, 0 to 3 percent slopes	1.6	7.2%
Totals for Area of Interest		**22.2**	**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

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

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 supply, 0 to 60 inches: 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

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

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: Flats, hills
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 supply, 0 to 60 inches: 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
H2 - 12 to 60 inches: stratified very gravelly sand to loam

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)
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: R048AY241CO - Mountain Meadow
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

10—Blendon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3671
Elevation: 6,000 to 6,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blendon and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blendon

Setting

Landform: Alluvial fans, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 10 inches: sandy loam
Bw - 10 to 36 inches: sandy loam
C - 36 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

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

GEOLOGIC HAZARD STUDY APPLICATION

Applicant: M&A, LLC Telephone: _____

Address: 102 South Tejon Street, Suite 1100 Email: _____

City/State/Zip: Colorado Springs, CO 80903

Site Location: 7020 Wyoming Lane

The following documents have been included and considered as part of this study (checked off by individual(s) preparing the geologic study):

____ Rezoning

____ Development Plan

____ Land Use Plan

____ Public Improvement construction drawings

____ Final Plat

ENGINEER'S STATEMENT

I hereby attest that I am qualified to prepare a Geologic Hazard Study in accordance with the provisions of the City of Colorado Springs Unified Development Code Section, 7.4.5 Geological Hazards. I am qualified as:

___X___ Professional Geologist as defined by C.R.S. § 23-41-208; or,

_____ A Professional Geotechnical Engineer licensed by the Colorado State Board of Licensure for Architects, Professional Engineers and Professional Land Surveyors.

Submitted by: _____ Logan L. Langford, P.G. Date: 6/16/2025

This Geologic Hazard Study is filed in accordance with the City of Colorado Springs Unified Development Code Section 7.4.5 Geological Hazards.

City Engineering: _____ **Date:** 8-11-25

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599

SOILS AND GEOLOGY STUDY
7020 WYOMING LANE – MILLER DOWNS
EL PASO COUNTY, COLORADO

Prepared for:
M&A LLC
102 South Tejon Street, Suite 1100
Colorado Springs, Colorado 80903

June 16, 2025
Revised February 20, 2026

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
Sr. Geologist

Reviewed by:

COLORADO LICENSED
JOSEPH COLLIN GOODE
23725
PROFESSIONAL ENGINEER

Digitally signed by Joseph C Goode Jr.
Date: 02/20/26

Joseph C. Goode Jr., P.E.
President

LLL:JCG/ed

Entech Job No. 250953

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APPENDIX C: Colorado Geological Survey Review Letter, EP-22-0038
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1 SUMMARY

Project Location

The project lies in portions of the NE¼ and SE¼ of Section 8 of Township 13 South, Range 65 West of the 6th Principal Meridian. The site is located north and southwest of California Drive and Wyoming Lane, just east of Colorado Springs, Colorado in El Paso County. The site lies immediately east of the Colorado Springs city limits, and it is our understanding that the property is to be annexed into the city

Project Description

The Miller Downs development is approximately 22 acres. The proposed development is to consist of single-family residential development and other associated site improvements. The development will utilize central sewer and water.

Scope of Report

This report presents the results of our geologic evaluation and treatment of engineering geologic hazard study.

Land Use and Engineering Geology

This site was found to be suitable for the proposed development. Areas were encountered where the geologic conditions will impose some constraints on development and land use. These include areas of artificial fill, loose soils, potentially seasonal shallow groundwater areas, areas of ponded water, floodplains, and the potential for elevated radon levels. At the time of the completion of this report the development and grading plans were not available. These conditions will be discussed in greater detail in the report.

In general, it is our opinion that the development can be achieved if the observed geologic conditions on site are either avoided or properly mitigated. All recommendations are subject to the limitations discussed in the report.

2 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is located in portions of the NE¼ and SE¼ of Section 8 of Township 13 South, Range 65 West of the 6th Principal Meridian. The site is located approximately three miles northeast of Colorado Springs, Colorado, southwest of Poco Road and Vollmer Road. The location of the site is as shown on the Vicinity Map, Figure 1.

The topography of the site is generally gently sloping to the south with some moderate slopes along the drainage in the northern portion of the site. A tributary to Sand Creek is located along the northern side of the site, and Sand Creek is located along the southern side of the site. Drainages on-site flow in southwesterly directions. Water was observed flowing in the drainages at the time of this investigation, and areas of ponded water were observed in the northwestern portion of the site. The approximate boundaries of the site are indicated on the USGS Map, Figure 2. Previous site uses have included rural residential, grazing and pasture land. Vegetation on site consists primarily of field grasses and weeds, with some trees around some of the existing structures on the site. Site photographs are included in Appendix A. The approximate locations and directions of the photographs are indicated on Figure 3.

The proposed development is approximately 22-acres. The proposed development consists of single-family residential with associated site improvements. The area will be serviced by central water and sewer. Preliminary development and grading plans were not available at the time of the completion this report.

3 SCOPE OF THE REPORT

The scope of the report includes a general geologic analysis utilizing published geologic data. Detailed site-specific mapping will be conducted to obtain general information in respect to major geographic and geologic features, geologic descriptions and their effects on the development of the property.

4 FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of any bedrock features and significant surficial deposits. The Natural Resource Conservation Service (NRCS), previously the Soil Conservation Service (SCS) survey was also reviewed to evaluate the site. The position of mappable units within the subject property are shown on the Geologic Map. Our mapping procedures involved both field reconnaissance and measurements and air photo reconnaissance

and interpretation. The same mapping procedures have also been utilized to produce the Engineering Geology Map which identified pertinent geologic conditions affecting development. The initial field mapping of the property was performed by personnel of Entech Engineering, Inc. (Entech) on April 19, 2021. The site was revisited on May 28, 2025 to verify previous mapping and observe current site conditions.

Subsurface conditions within the proposed development were explored by eight test borings, designated TB-1 through TB-8 spaced across the site as part of a preliminary geotechnical investigation to determine the soils classification and engineering characteristics (Reference 1). Additionally, five (5) piezometers designated P1 through P5 were installed across the site to evaluate the seasonal fluctuation of the groundwater. The borings were drilled to depths of 20 feet using a truck-mounted, continuous flight auger drilling rig supplied and operated by Entech. Five (5) piezometers were installed across the site for The Test Borings Test Boring Logs and Summary of Laboratory Testing Results are presented in Appendix B.

The approximate location of the test borings and piezometers are presented on the Site and Exploration Plan (Figure 3), and the Geology/Engineering Geology Map (Figure 6). The Colorado Geological Survey (CSG) review letter for the previous investigation completed by Entech in 2021 is included in Appendix D (Reference 2).

5 SOIL, GEOLOGY, AND ENGINEERING GEOLOGY

5.1 General Geology

The site lies in the western portion of the Great Plains Physiographic Province. Approximately 10½ miles to the west is a major structural feature known as the Rampart Range Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southern edge of a large structural feature known as the Denver Basin. Bedrock in the area tends to be gently dipping in a northerly direction (Reference 3). Bedrock in the area of the site is sedimentary in nature, and typically Tertiary to Cretaceous in age. The bedrock underlying the site itself is the Dawson Formation. Overlying the Dawson are unconsolidated deposits of artificial, and alluvial soils. The site's stratigraphy will be discussed in more detail in Section 5.3.

5.2 Soil Conservation Survey

The Natural Resource Conservation Service (Reference 4), previously the Soil Conservation Service (Reference 5) has mapped two soil types on the site, Figure 5. In general, the soils classify as loamy sand and gravelly sandy loam. The soils are described as follows:

Exhibit 1: Soil Survey Description

Type	Description
9	Blakeland fluvaquentic haplaquolls, 1-9% slopes
10	Blendon sandy loam, 0-3% slopes

Complete descriptions of the soils are presented in Appendix D. The soils have generally been described to have rapid to very rapid permeabilities. The majority of the soils have been described by the Soil Conservation Service as good potential for urban development. Limitations include the hazard of flooding on some areas of Soil Types 9 and 10. Possible hazards with soil erosion are present on the site. The erosion potential can be controlled with vegetation. The majority of the soils have been described to have slight to moderate erosion hazards. The soil blowing hazard is severe if vegetation is removed.

5.3 Site Stratigraphy

The Falcon NW Quadrangle Geology Map showing the site is presented in Figure 5 (Reference 6). The Geology/Engineering Geology Map prepared for the site is presented in Figure 6. Four mappable units were identified on this site which are described as follows:

Qaf **Artificial Fill of Quaternary Age:** These are man-placed deposits associated with a portion of an existing earthen dam to located in the eastern portion of the site.

Qay **Young Alluvium, undivided of Quaternary Age:** These are recent stream deposits in the northern drainage that exist on-site. These materials consist of silty sands and may contain lenses of silt, clay or gravel. Areas of organic soils will also be encountered. This deposit correlates with the Piney Creek Alluvium.

Qam **Middle Alluvium of Quaternary Age:** These materials consist of lower stream terrace deposits. The alluvium typically consists of silty to clayey gravelly sands. This deposit correlates with the Broadway Alluvium.

Tkd **Dawson Formation of Tertiary to Cretaceous Age:** The Dawson formation typically consists of arkosic sandstone with interbedded fine-grained sandstone, siltstone and

claystone. Overlying this formation is a variable layer of residual and/or colluvial soils. The residual soils were derived from the in-situ weathering of the bedrock materials on-site. The colluvial soils have been transported by the action of sheetwash and gravity. These soils consisted of silty to clayey sands and sandy clays.

The soils listed above were mapped from the *Geologic Map of the Falcon NW Quadrangle* by Madole in 2003, Figure 5 (Reference 6); the *Geologic Map of the Colorado Springs-Castle Rock Area, Front Ranch Urban Corridor,* by the US Geological Survey in 1979 (Reference 7); and the *Geologic Map of the Pueblo 1°x2° Quadrangle, South-Central* distributed by the US Geological Survey in 1978 (Reference 8) and site-specific mapping of the site. The test borings from the preliminary subsurface investigation were also used in evaluating the site. The test boring logs are included in Appendix B.

5.4 Soil Conditions

Two primary soil type and one bedrock type were encountered in the test borings drilled for the subsurface investigation. Each soil and bedrock type was classified in accordance with the Unified Soil Classification System (USCS) using the laboratory testing results and the observations made during drilling.

Soil Type 1 classified as very loose to medium dense silty sand to sand with silt (SM, SW-SM). The sand was encountered in all test borings at the ground surface and extended to depths of 7 to 19 feet bgs, and to the termination of TB-2. The sand is anticipated to exhibit a low expansion potential.

Soil Type 2 classified as clay with varying amounts of sand (CH, CL) when classified as a soil. The bedrock was encountered in TB-2, TB-3, TB-4, and TB-8 at depths of 7 to 14 feet and extended to depths of 9 to 14 feet. FHA Swell testing resulted in expansion pressures of 670 to 1210 psf. One-dimensional swell/collapse testing resulted in a volume changes of 1.0 to 2.7%. These results indicate low to moderate expansion potentials

Soil Type 3 classified as siltstone bedrock or hard sandy silt or slightly sandy silt when classified as a soil (ML). The bedrock was encountered in TB-1, TB-4, TB-6, TB-7 and TB-8 was encountered at depth of 9 to 19 feet and extended to the termination of the borings. One-dimensional swell/collapse testing resulted in a volume change of 0.4% indicating a low expansion potential. Moderately to highly expansive claystone and siltstone are common in the area.

The Test Boring Logs and Laboratory Testing Summary are presented in Appendix B (Reference 1).

5.5 Groundwater

Depth to groundwater was measured in each of the borings at the conclusion of, and subsequent to drilling. Groundwater was encountered in all of the borings at depths ranging from 8 to 16 feet. Five piezometers were installed across the site to evaluate the seasonal fluctuation of the groundwater previous and recent measurements are shown on Exhibit 2 below. Depending on final grading elevations and development of the site the groundwater may affect foundation construction or utility placement on portions of this site. It should be noted that groundwater levels could change due to seasonal variations, changes in land runoff characteristics, and future development of nearby areas.

Areas of water, potential seasonally shallow groundwater has been mapped along the minor drainage swales within the project site. These areas are discussed in the following section. Drainages on the site generally flow in a southerly direction. Areas along and near the drainages on the site have been mapped as psw – potential seasonally shallow groundwater areas and are shown on the Geology/Engineering Geology Map is shown on Figure 6.

Exhibit 2: Piezometer Readings

Piezometer	Groundwater Level (ft.) 3/2/22	Groundwater Level (ft.) 3/30/22	Groundwater Level (ft.) 5/6/22	Groundwater Level (ft.) 5/24/22	Groundwater Level (ft.) 5/28/25
P1	9	8.5	9.5	8.4	6
P2	12.5	11.5	11.5	10.8	9.5
P3	>15	>15	>15	>15	12.7
P4	12	8.25	8	7.8	7
P5	11.5	11.5	10.7	10.5	10.5

It should be noted that in the sandy materials on-site, some groundwater conditions might be encountered due to the variability in the soil profile. Isolated sand and gravel layers within the soils, sometimes only a few feet in thickness and width, can carry water in the subsurface. Groundwater may also flow on top of the underlying bedrock. Builders and planners should be cognizant of the potential for the occurrence of such subsurface water features during construction on-site and deal with each individual issue as necessary at the time of construction.

6 ENGINEERING GEOLOGY – IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

Detailed mapping has been performed on this site to produce a Geology/Engineering Geology Map Figure 7. This map shows the location of various geologic conditions of which the developers should be cognizant during the planning, design and construction stages of the project. These hazards and the recommended mitigation techniques are as follows:

Artificial Fill – Constraint

Areas of artificial fill were observed on the site. The majority of the fill is associated with earthen dams and erosion berms. The earthen dams lie within areas designated as open space or easements and will be avoided by construction. The majority of the erosion berms are shallow and may be penetrated by foundations or will likely be removed during site grading.

Mitigation: Any uncontrolled fill encountered beneath foundations will require removal and recompaction to minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density.

Expansive Soils – Constraint

The site is classified in an area of low to moderate swell potential according to *the Map of Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado* by Hart, 1974 (Reference 9). While the majority of the soils encountered in the test borings drilled on-site have low expansion potential, expansive clays and claystone are common in the area and may be encountered in the subsurface on this site. The expansive soils on-site are highly sporadic, therefore, none have been indicated on the map. Expansive clays and claystone, if encountered beneath foundations, can cause differential movement in the structure foundation. These occurrences should be identified and dealt with on an individual basis.

Mitigation Should expansive soils be encountered beneath foundations; mitigation will be necessary. Mitigation of expansive soils will require special foundation design. Overexcavation and replacement with non-expansive soils to minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density is a suitable mitigation, which is common in the area. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. The use of structural floors should be considered for basement construction on highly expansive clays. Final recommendations should be determined after additional investigation of each building site.

Collapsible Soils – Constraint

Areas of loose or potentially collapsible soils were encountered in some of the test borings drilled on-site. Should loose or collapsible soils be encountered beneath foundations, removal and recompaction with thorough moisture conditioning at 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 will be necessary. Typically, the overexcavation extends to a depth of 2 to 3 feet. Specific recommendations should be made after additional investigation of each building site.

Subsidence Area

Based on a review of the *Mining Report for the Colorado Springs Coal Field* (Reference 10), a Subsidence Investigation Report for the Colorado Springs area by Dames and Moore, 1985 (Reference 11), and the *Evaluation of Mineral and Mineral Fuel Potential of El Paso County* (Reference 18), the site is not undermined. The closest underground mines in the area are 8 miles to the south and southwest and the site is not mapped within any potential subsidence zones.

Slope Stability and Landslide Susceptibility – Hazard

The slopes on-site are gently to moderately sloping and do not exhibit any past or potential unstable slopes or landslides. Grading plans were not available at the time of this investigation. All topsoil and organics should be removed prior to any regrading or fill placement. All new fill should be properly benched into native slopes and compacted to minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density. It is recommended that any future grading or fill slopes be 3:1 or flatter.

Shallow Bedrock – Constraint

Bedrock was encountered in TB-1, TB-4, TB-6, TB-7, and TB-8 at depths of 9 to 19 feet. A Summary of the Depth to Bedrock is included in Table A-1 in Appendix B. Where bedrock is encountered, excavation/grading may be difficult requiring track-mounted excavators. Bedrock may be encountered cuts for utility excavations.

Groundwater and Floodplain Areas – Constraint

Groundwater was encountered in five of the test borings at depths ranging from 6 to 16 feet. Areas within the drainages on-site have been identified as seasonal and potentially seasonal shallow groundwater. Only minor areas with water flowing in the drainages were noted at the time of this investigation, however, an area of ponded water was observed in the northwestern portion of the site. Sand Creek in the southern portion of the has been mapped within floodplain zones

according to the FEMA Map No. 08041CO537G, Figure 7 (Reference 12). Exact floodplain location and drainage studies are beyond the scope of this report. Groundwater areas are discussed as follows:

- Potentially Seasonal Shallow Groundwater Area – Constraint

  In these areas, we would anticipate the potential for periodically high subsurface moisture conditions, frost heave potential and highly organic soils. The majority of these areas lie within defined drainages which will be regraded with the overlot earthwork. The same mitigation recommendations for the seasonal shallow groundwater areas apply to the potentially seasonal shallow groundwater areas.

  Mitigation: Foundations must have a minimum 30-inch depth for frost protection. Subsurface perimeter drains are recommended for any below grade usable areas to help prevent the intrusion of water into areas below grade. Foundations should maintain a minimum separation of 3 feet between the lowest foundation grade and the maximum anticipated groundwater level. Shallow groundwater areas can be mitigated with the installation of drains. Typical drain options/details are presented in Figures 9 through 11. Structures should not block drainages. All organic material should be completely removed prior to any fill placement. The groundwater levels should be considered when the grading plans are being developed.

- Areas of Ponded/Flowing Water – Constraint

  These are areas where there is standing water observed in drainages or ponded water behind earthen dams. The majority of these areas lie within the drainages designated as open space and will be avoided by construction. Where construction is proposed, the following mitigation is recommended:

  Mitigation: The pond is located behind an earthen dam in the northwestern portion of the site and can be avoided by the proposed development. All soft and organic soils should be removed prior to fill placement. Any drainage into these areas should be rerouted in a non-erosive manner where it does not create areas of ponded water around proposed structures. The same mitigation techniques for the seasonal shallow groundwater areas are recommended for these areas as well.

Debris Fans/Debris Flow Susceptibility – Hazard

The site is not mapped within any area susceptible to debris flows according to the *Debris Flow Susceptibility Map of El Paso County, Colorado,* by McCoy, Morgan, and Berry (Reference 14).

Faults – Hazard

The closest fault is the Rampart Range Fault, located 10½ miles to the west. No faults are mapped on the site itself. Previously Colorado was mapped entirely within Seismic Zone 1, a very low seismic risk. Additionally, the International Residential Code (IRC), 2003, currently places this area in Seismic Design Category B, also a low seismic risk. According to a report by the Colorado Geological Survey by Kirkman and Rogers, 1981, (Reference 15) this area should be designed for Zone 2 due to more recent data on the potential for movement in this area, and any resultant earthquakes.

Radon – Hazard

Radon is a colorless, tasteless radioactive gas with a United States Environmental Protection Agency (EPA) specified action level of 4.0 picocuries per liter (pCi/L) of air. Radon gas has a very short half-life of 3.8 days. Radon levels for the area have been reported by the Colorado Geologic Survey in the open file, Report No. 91-4 (Reference 16). Only two readings have been taken in the area. The minimal information from this report is not sufficient to determine if radon levels are higher for this site. An occurrence of radioactive minerals has been identified approximately 7 miles northwest of the site (Reference 17). This occurrence is associated with a limonite deposit in the Dawson Formation. No known occurrences exist on the site, however, radon gas originating in the bedrock underlying the site could migrate up into the upper soil profile. Exhibit 3 presents the radon levels in this area:

Exhibit 3: Radon Levels

Average Radon Levels for the nearby area	
0 < 4 pCi/L	50.00%
4 < 10 pCi/L	50.00%
10 < 20 pCi/L	0.00%
> 20 pCi/L	0.00%

Mitigation:

The potential for high radon levels is present for the site. Build-up of radon gas can usually be mitigated by providing increased ventilation of basement and crawlspace and sealing joints. Specific requirements for mitigation should be based on site specific testing.

6.1 Relevance of Geologic Conditions to Land Use Planning

We understand that the development will be residential. It is our opinion that the existing geologic and engineering geologic conditions will impose some constraints on the proposed development and construction. The most significant hazards associated with the site are those associated with the drainage areas and potential seasonal shallow groundwater conditions, and potential for elevated radon levels, these constraints/hazards can be satisfactorily mitigated through proper engineering design and construction practices.

The upper materials are typically at medium dense to dense states. The medium dense to dense granular soils encountered in the upper soil profiles of the test borings should provide good support for foundations. Loose soils, where encountered, will require removal and recompaction. Expansive soils, although sporadic, were encountered. Expansive clayey sandstone, claystone, and siltstone are common in the Dawson Formation, and may require mitigation. Foundations anticipated for the site are standard spread footings possibly in conjunction with overexcavation in areas of expansive soils or loose soils. Areas of artificial fill, if encountered beneath foundations will require penetration or recompaction. Expansive layers may also be encountered in the soil and bedrock on this site. Expansive soils, if encountered, will require special foundation design and/or overexcavation. These soils will not prohibit development.

Areas of perched groundwater may be encountered on this site in areas other than those mapped. Permeable sands exist on the site that may carry water in the subsurface perched on less permeable bedrock. Groundwater was encountered at depths ranging from 6 to 16 feet in five of the test borings drilled on the site. Site grading in areas of shallow water should be kept to a minimum. The groundwater levels should be considered when preparing the grading plans. Fluctuation in groundwater conditions may occur due to variations in rainfall, soil conditions and development of surrounding areas. Builders should also be cognizant of the potential for the occurrence of subsurface water features during construction and deal with each individual problem as necessary at the time of construction. Subsurface drains and dewatering systems may be necessary in some areas where seepage and perched water occurs. Unstable conditions should be expected where excavations approach the groundwater level. Stabilization using geofabric or shot rock may be necessary.

Foundations should maintain a minimum separation of 3 feet between the lowest foundation grade and the maximum anticipated groundwater level. Building in areas of shallow water will require the installation of drains which is a common construction practice in the area. Typical drain details

are presented in Figures 9 through 11. Specific drain recommendations will be made for each site after additional investigation. After site grading the structures will not block drainages. The souther portion of the site does lie within any floodplain zones according to the FEMA Map No. 08041CO537G, dated December 7, 2108, Figure 7 (Reference 12). Exact locations of floodplain and specific drainage studies are beyond the scope of this report. Additional investigation is recommended after site grading to evaluate groundwater conditions.

In summary, development of the site can be achieved if the items mentioned above are mitigated. These items can be mitigated through proper design and construction or through avoidance. Investigation on each lot is recommended prior to construction.

7 ECONOMIC MINERAL RESOURCES

Some of the sandy materials on-site could be considered a low grade sand resource. According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 18), the area is mapped as upland deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 19), areas of the site are mapped as A3 – Alluvial fan: sand resource. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 20), the area of the site has been mapped as "Good" for industrial minerals. The sands associated with the alluvial deposits are considered a sand resource. Considering the abundance of similar materials through the region and close proximity to developed land, they would be considered to have little significance as an economic resource.

According to *the Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands* (Reference 18), the site is mapped within the Denver Basin Coal Region. However, the area of the site has been mapped as "Poor" for coal resources. No active or inactive mines have been mapped in the area of the site. The *El Paso County Aggregate Resource Map* (Reference 18) has mapped coal resources in the Falcon area approximately ½ mile south of the site; however, the coal resources are estimated at 1,500 feet below the surface (Reference 20). At this depth, mining the coal would not be economical at this time. No metallic mineral resources have been mapped on the site (Reference 20).

The site has been mapped as "Fair" for oil and gas resources (Reference 20). No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area may lack the geologic structure for trapping oil or gas; therefore, it would not be considered a significant

resource. Hydraulic fracturing is a new method that is being used to extract oil and gas from rocks that would not normally be productive. The area of the site has not been explored to determine If the rocks underlying the site would be commercially viable utilizing hydraulic fracturing. The practice of hydraulic fracturing has come under review due to concerns about environmental impacts, health and safety.

8 EROSION CONTROL

The soil types observed on the site are mildly to highly susceptible to wind erosion, and moderately to highly susceptible to water erosion. A minor wind erosion and dust problem may be created for a short time during and immediately after construction. Should the problem be considered severe enough during this time, watering of the cut areas or the use of chemical palliative may be required to control dust. However, once construction has been completed and vegetation re-established, the potential for wind erosion should be considerably reduced.

With regard to water erosion, loosely compacted soils will be the most susceptible to water erosion, residually weathered soils become increasingly less susceptible to water erosion. For the typical soils observed on-site, allowable velocities or unvegetated and unlined earth channels would be on the order of 3 to 4 feet/second, depending upon the sediment load carried by the water. Permissible velocities may be increased through the use of vegetation to something on the order of 4 to 7 feet/second, depending upon the type of vegetation established. Should the anticipated velocities exceed these values, some form of channel lining material may be required to reduce erosion potential. These might consist of some of the synthetic channel lining materials on the market or conventional riprap. In cases where ditch-lining materials are still insufficient to control erosion, small check dams or sediment traps may be required. The check dams will serve to reduce flow velocities, as well as provide small traps for containing sediment. The determination of the amount, location and placement of ditch linings, check dams and of the special erosion control features should be performed by or in conjunction with the drainage engineer who is more familiar with the flow quantities and velocities.

Cut and fill slope areas will be subjected primarily to sheetwash and rill erosion. Unchecked rill erosion can eventually lead to concentrated flows of water and gully erosion. The best means to combat this type of erosion is, where possible, the adequate re-vegetation of cut and fill slopes. Cut and fill slopes having gradients more than three (3) horizontal to one (1) vertical become increasingly more difficult to revegetate successfully. Therefore, recommendations pertaining to

the vegetation of the cut and fill slopes may require input from a qualified landscape architect and/or the Soil Conservation Service.

9 ROADWAY, EMBANKMENT, AND STORMWATER FACILITY CONSTRUCTION RECOMMENDATIONS

In general, the site soils are suitable for the anticipated roadways and embankments. Groundwater should be expected to be encountered in the areas of deeper cuts and along drainages and low-lying areas. Temporary dewatering may be needed where groundwater is encountered in cut areas during construction. If excavations encroach on the groundwater level unstable soil conditions may be encountered. Excavation of saturated soils will be difficult with rubber-tired equipment. Stabilization using shot rock or geogrids may be necessary.

Any areas to receive fill should have all topsoil, organic material or debris removed. Prior to fill placement Entech should observe the subgrade. Fill must be properly benched and compacted to minimize potentially unstable conditions in slope areas. Fill slopes should be 3:1. The subgrade should be scarified and moisture conditioned to within 2% of optimum moisture content and compacted to minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density, prior to placing new fill. Areas receiving fill may require stabilization with rock or fabric if shallow groundwater conditions are encountered.

New fill should be placed in thin lifts not to exceed 6 inches after compaction while maintaining to minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density. These materials should be placed at a moisture content conducive to compaction, usually 0 to ±2% of Proctor optimum moisture content. Sandstone/claystone will require processing to break it down for use in fills. The placement and compaction of fill should be observed and tested by Entech during construction. Entech should approve any import materials prior to placing or hauling them to the site. Additional investigation will be required for pavement designs once roadway grading is completed and utilities are installed.

10 CLOSURE

It is our opinion that the existing geologic engineering and geologic conditions will impose some constraints on development and construction of the site. The majority of these conditions can be mitigated through proper engineering design and construction practices. The proposed development and use are consistent with anticipated geologic and engineering geologic conditions.

It should be pointed out that because of the nature of data obtained by random sampling of such variable and non-homogeneous materials as soil and rock, it is important that we be informed of any differences observed between surface and subsurface conditions encountered in construction and those assumed in the body of this report. Individual investigations for building sites will be required prior to construction. Construction and design personnel should be made familiar with the contents of this report. Reporting such discrepancies to Entech Engineering, Inc. soon after they are discovered would be greatly appreciated and could possibly help avoid construction and development problems.

This report has been prepared for M&A, LLC for application to the proposed project in accordance with generally accepted geologic soil and engineering practices. No other warranty expressed or implied is made.

We trust that this report has provided you with all the information that you required. Should you require additional information, please do not hesitate to contact Entech Engineering, Inc.

11 REFERENCES

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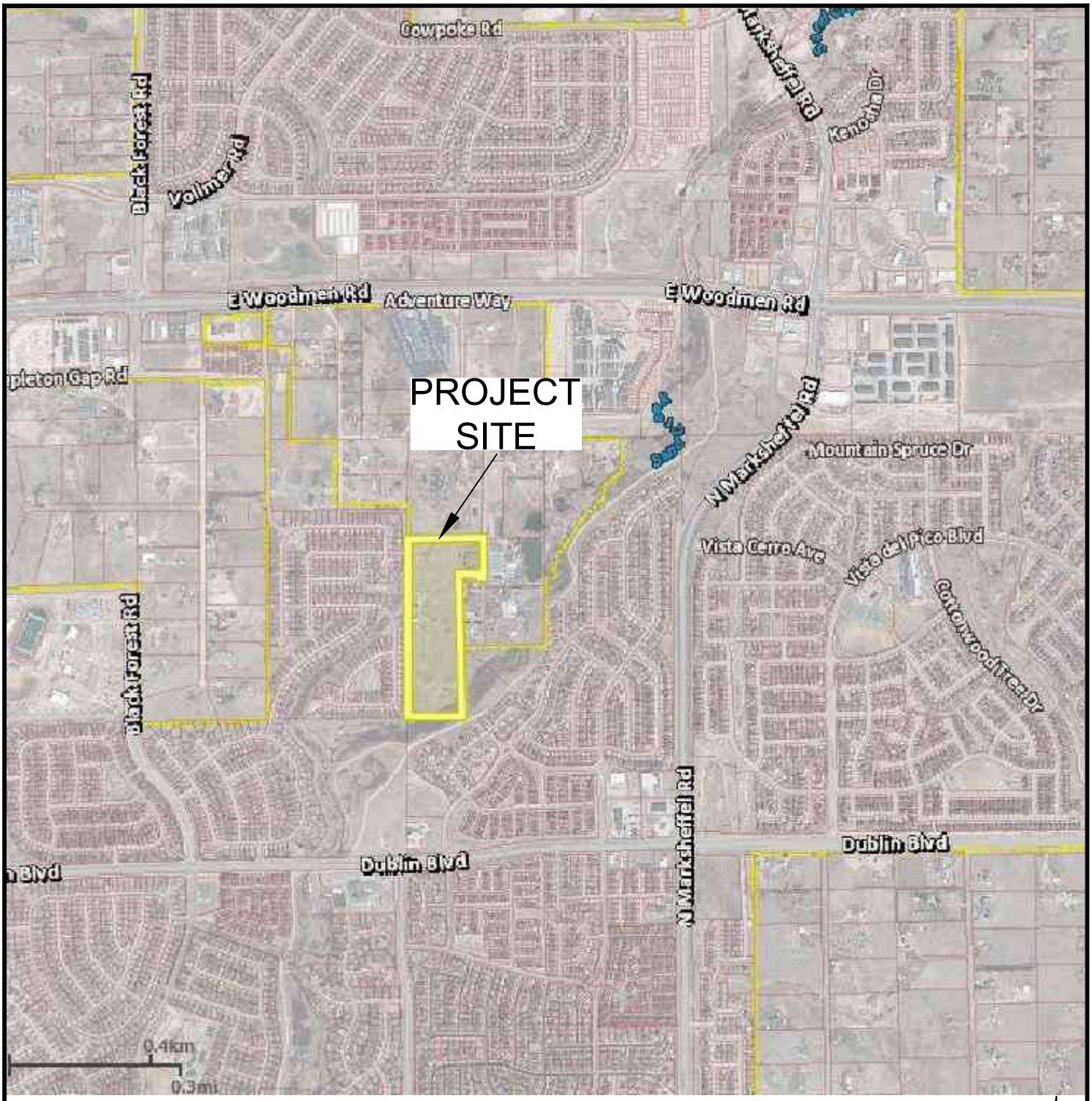
FIGURES



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VICINITY MAP

7020 WYOMING LANE - MILLER DOWNS
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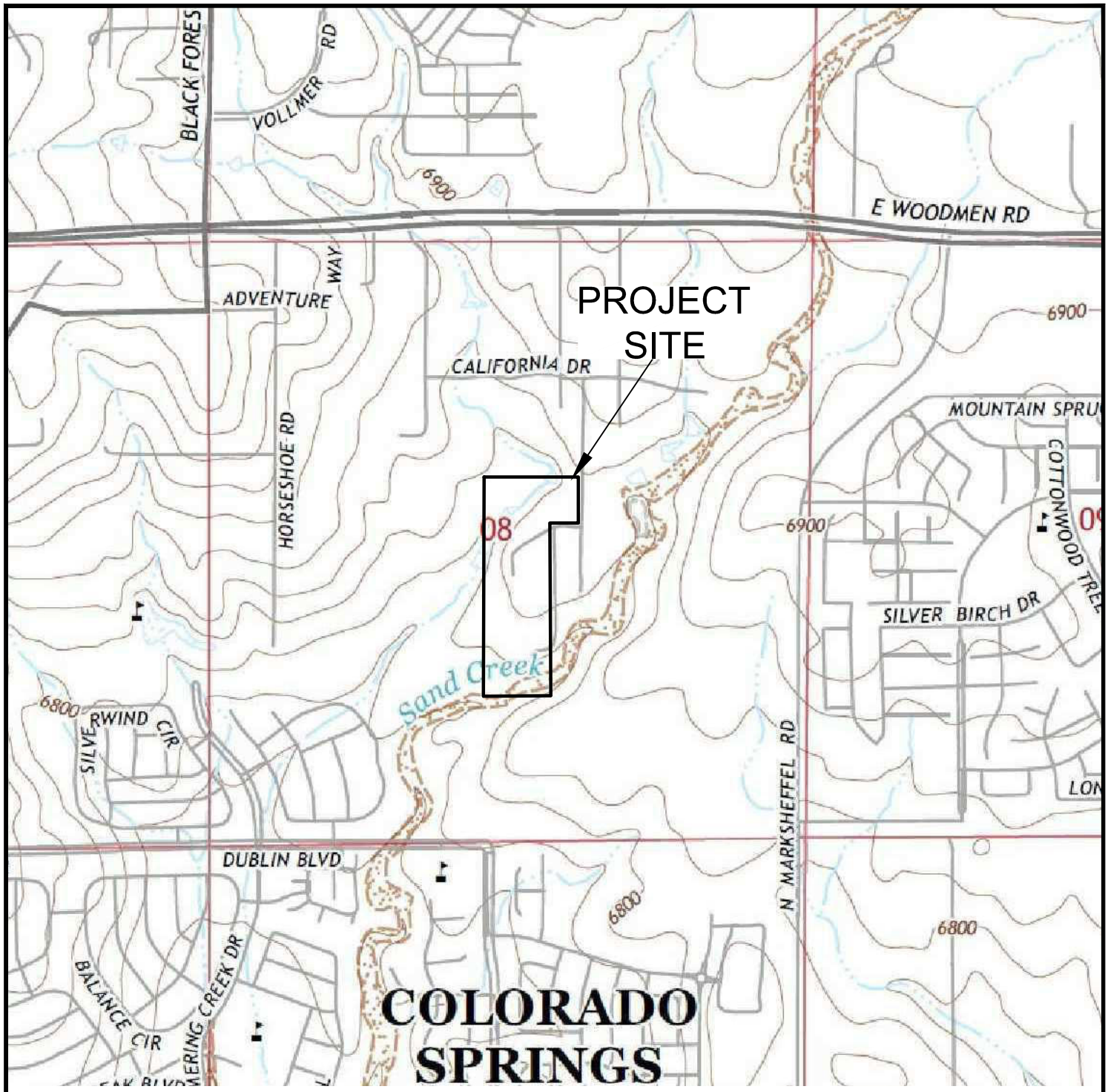
250953

FIG. 1



USGS TOPOGRAPHY MAP

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FIG. 2

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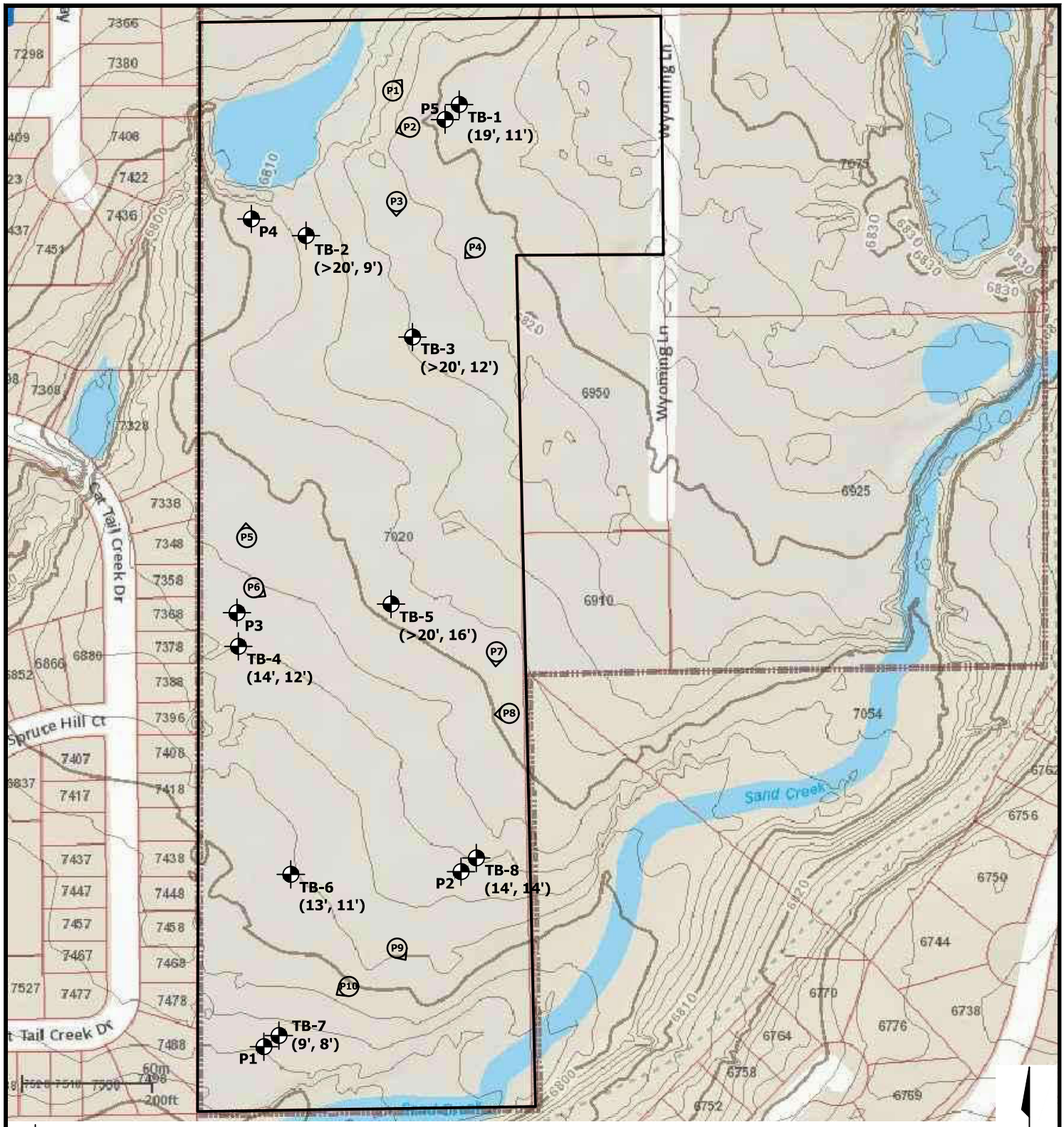

TB- APPROXIMATE TEST BORING LOCATION AND NUMBER (BEDROCK DEPTH, GROUNDWATER DEPTH)

P - APPROXIMATE PIEZOMETER LOCATION AND NUMBER

(P2) APPROXIMATE PHOTOGRAPH LOCATION AND DIRECTION

N

ENTECH ENGINEERING, INC.

SITE AND EXPLORATION PLAN

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FIG. 3

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SOIL SURVEY MAP

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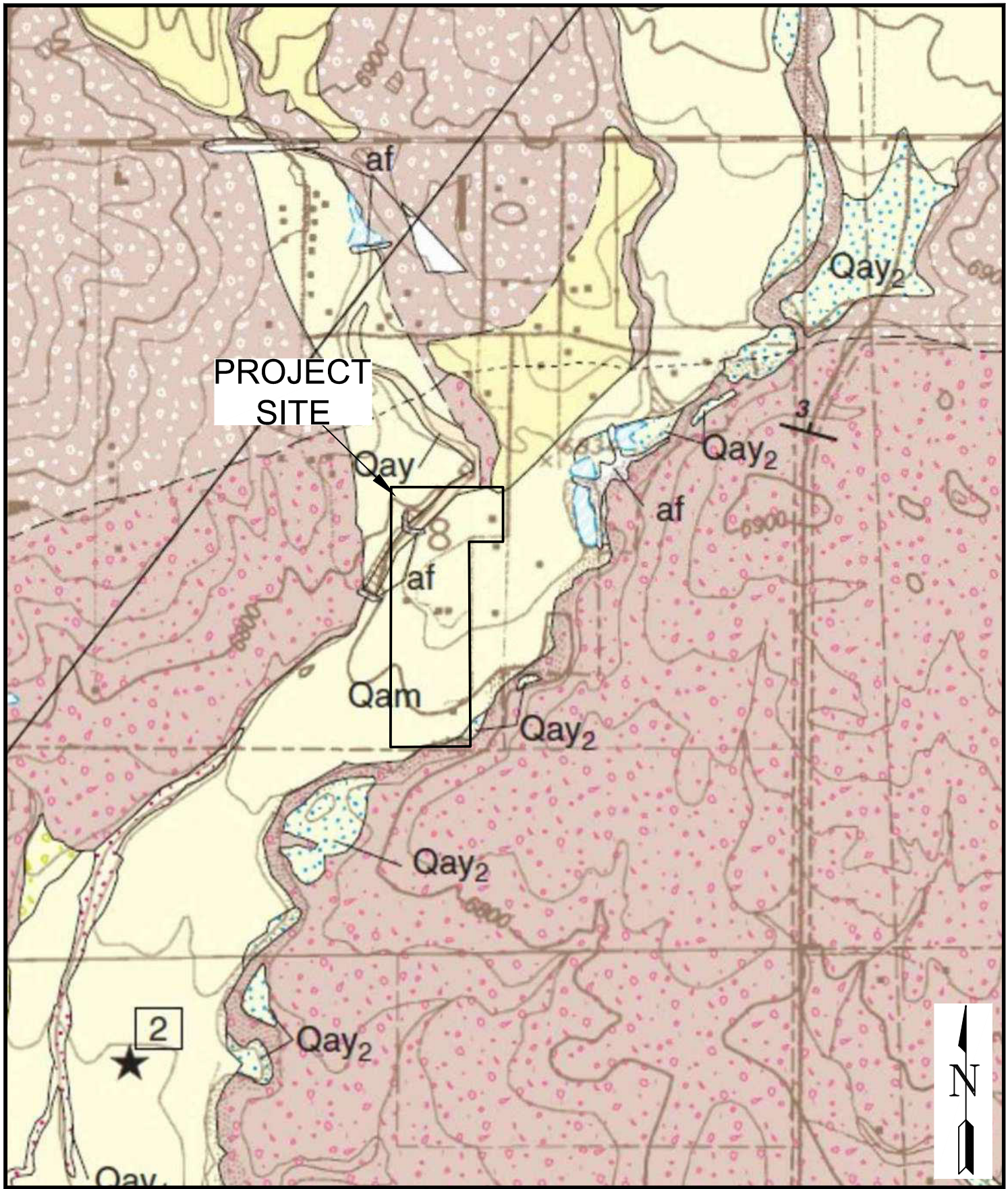
FIG. 4



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GEOLOGIC MAP OF THE FALCON NW QUADRANGLE

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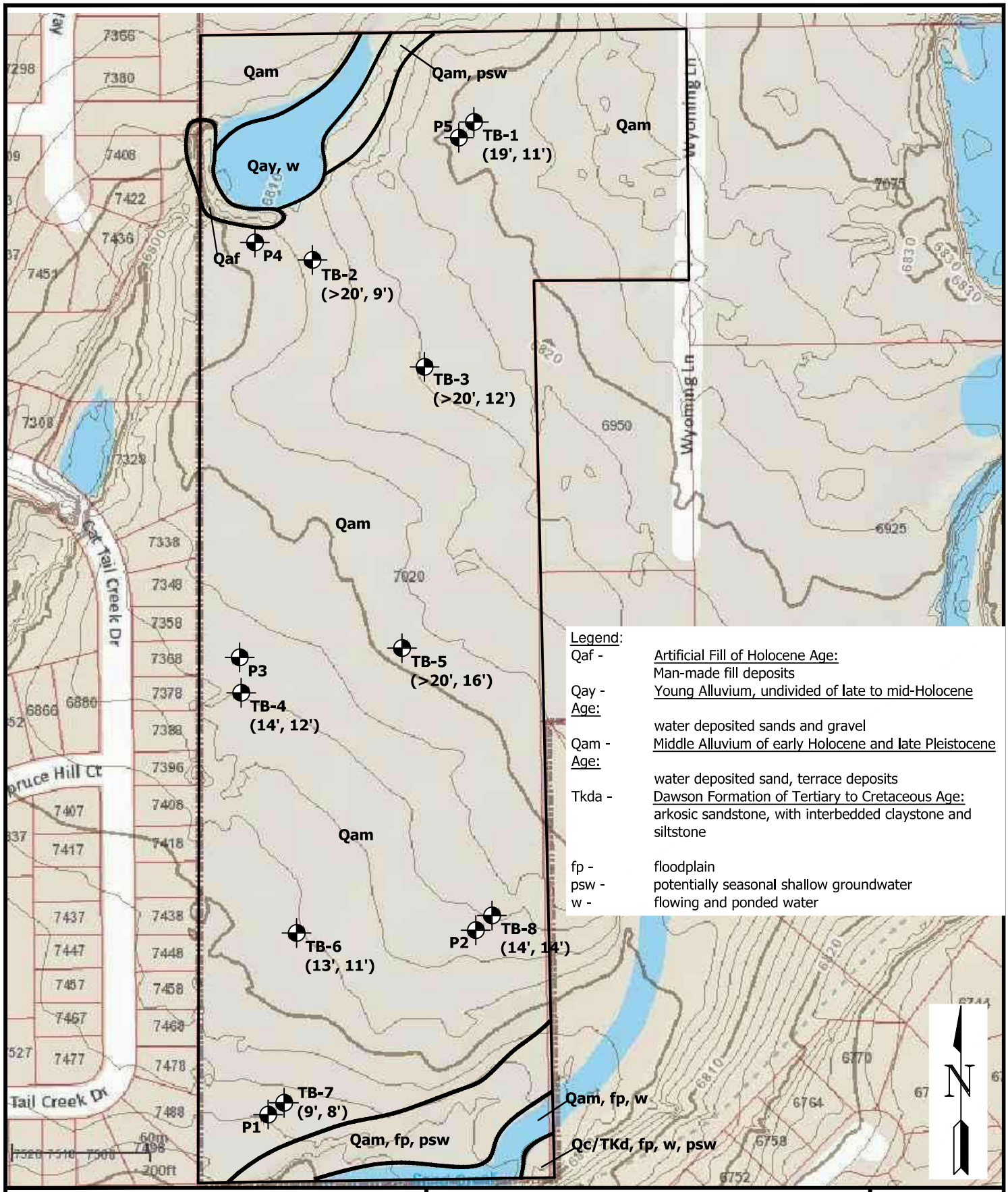
FIG. 5



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GEOLOGY/ENGINEERING GEOLOGY MAP

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FIG. 6

N

ENTECH ENGINEERING, INC.

FEMA FLOODPLAIN MAP

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FIG. 7

N

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USFWS WETLANDS MAP

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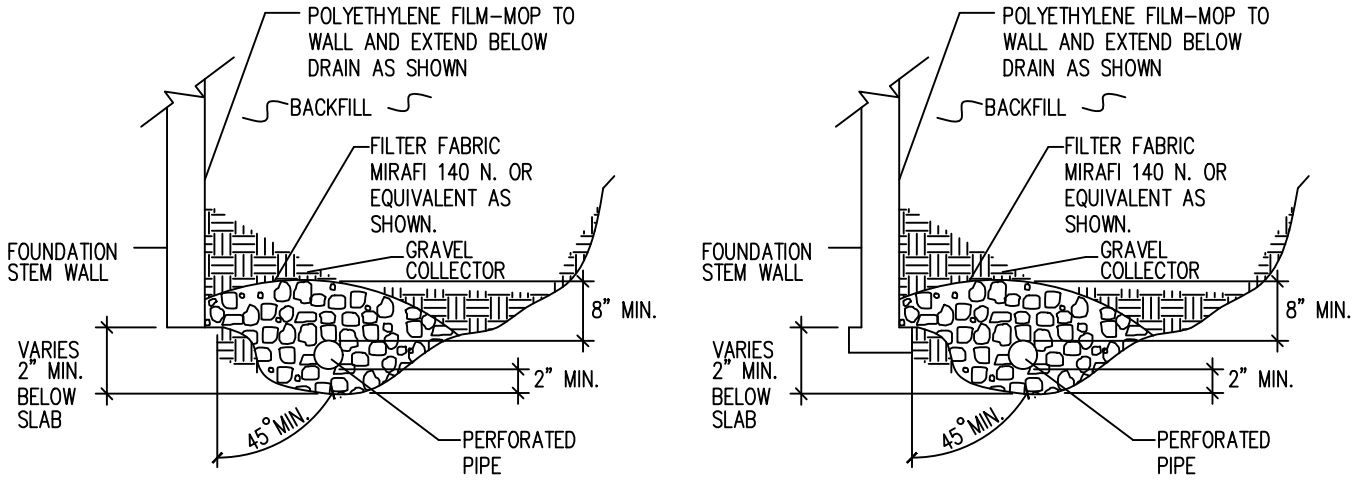
FIG. 8



NOTES:

–GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS–85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

–PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4–INCH DIAMETER IS MOST OFTEN USED.

–ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON–PERFORATED PIPE.

–FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

–MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

–DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

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PERIMETER DRAIN DETAIL

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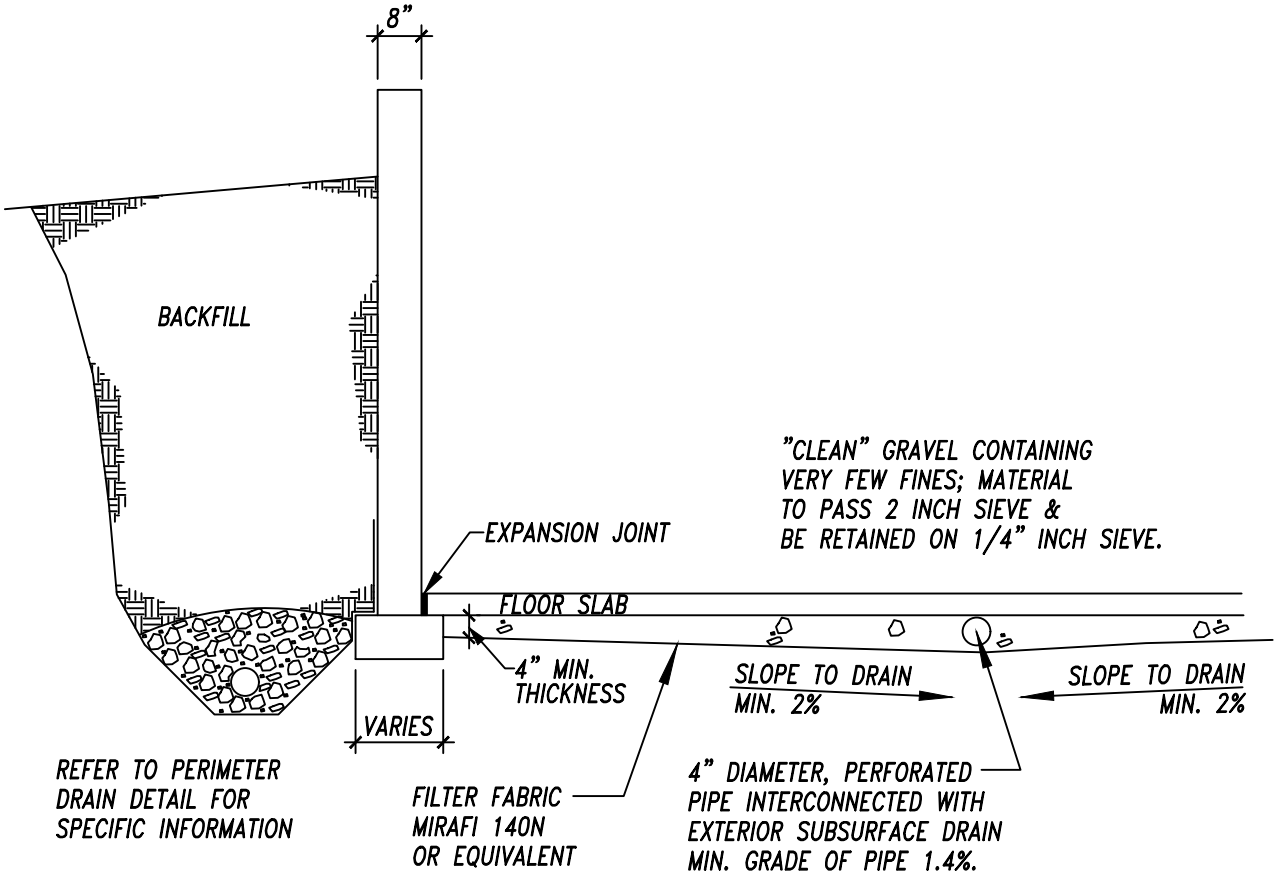
FIG. 9



ENTECH ENGINEERING, INC.

TYP. UNDERSLAB DRAINAGE LAYER (CAPILLARY BREAK)

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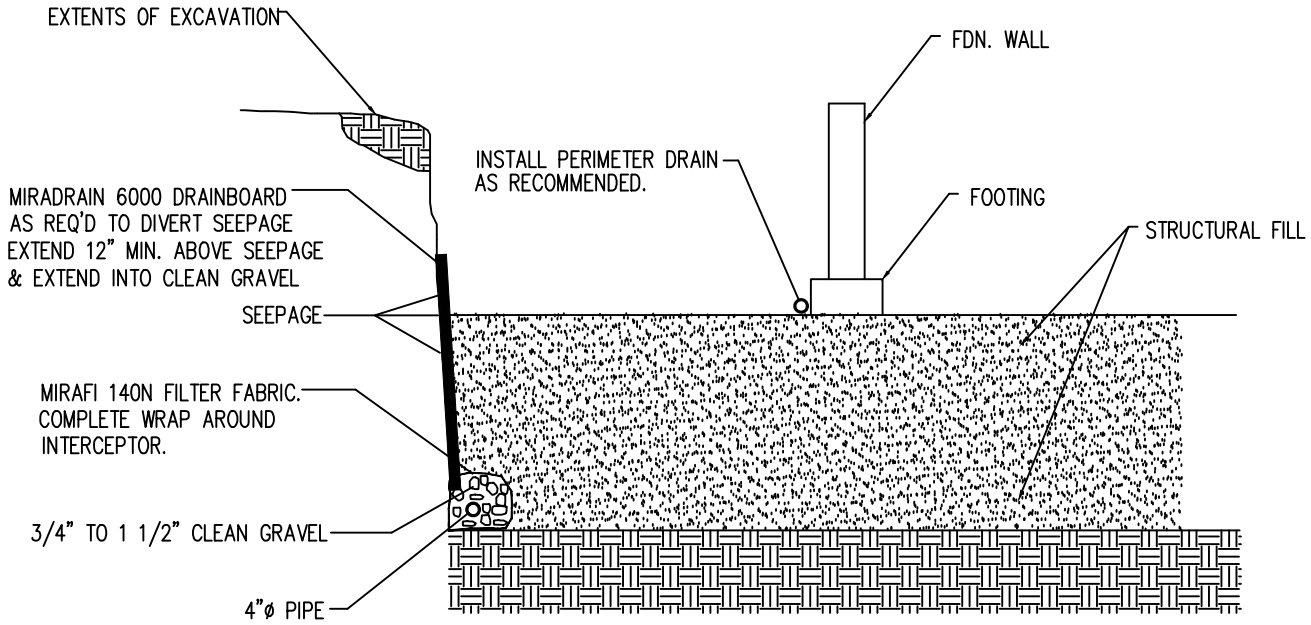
250953

FIG. 10



NOTE:
EXTEND INTERCEPTOR DRAIN TO UNDERDRAIN OR TO SUMP.
BENCH DRAIN INTO NATIVE SOILS 12 INCHES MINIMUM.

INTERCEPTOR DRAIN DETAIL

N.T.S.

ENTECH ENGINEERING, INC.

INTERCEPTOR DRAIN DETAIL

7020 WYOMING LANE - MILLER DOWNS
M&A, LLC

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250953

FIG. 11

APPENDIX A: Site Photographs

1

Looking northeast along drainage in the northern portion of the site.

May 28, 2025

2

Looking west-southwest from the northern portion of the site.

May 28, 2025

Job No. 250953

3

Looking south from the northern portion of the site.

May 28, 2025

4

Looking southwest from the northeastern portion of the site.

May 28, 2025

Job No. 250953

5

Looking north from the western portion of the site.

May 28, 2025

6

Looking southeast from the western portion of the site.

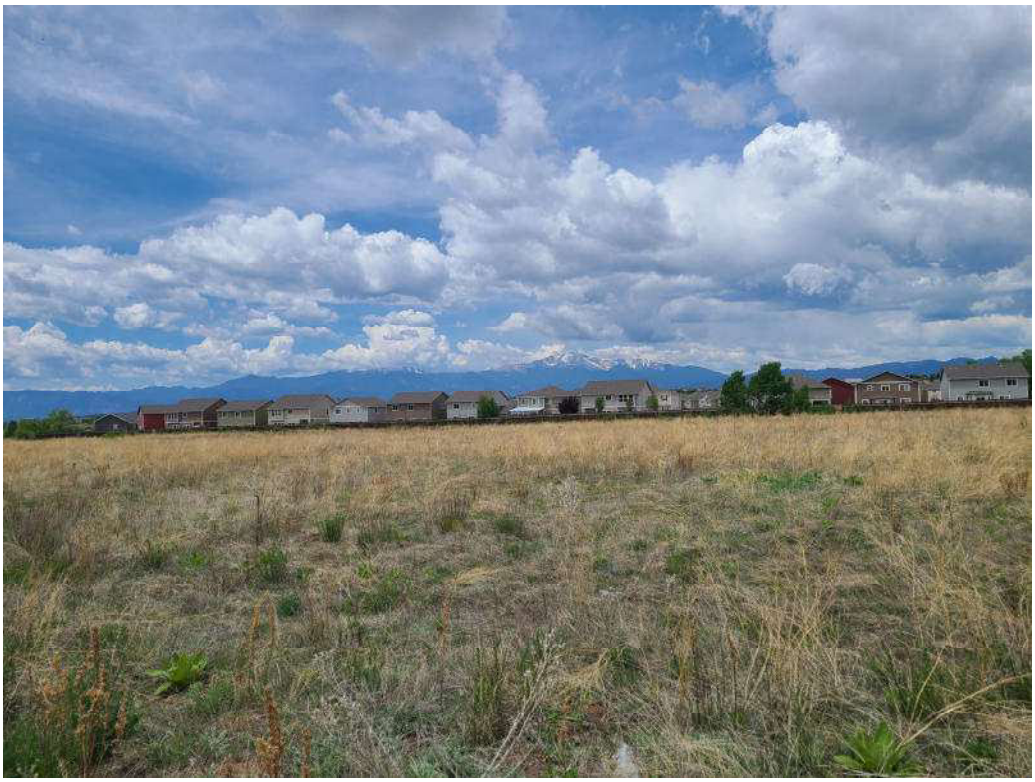
May 28, 2025

Job No. 250953

7

Looking south from the southeastern portion of the site.

May 28, 2025



8

Looking west from the southeastern portion of the site.

May 28, 2025

Job No. 250953

9

Looking southeast towards Sand Creek from the southern portion of the site.

May 28, 2025

10

Looking southwest towards Sand Creek from the southern portion of the site.

May 28, 2025

Job No. 250953

APPENDIX B: Test Boring Logs and Laboratory Testing Results, EEI Job No. 250953

TEST BORING 1
DATE DRILLED 4/23/2021

REMARKS

WATER @ 11', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			15	0.7	1	SAND, WITH SILT, BROWN, MEDIUM DENSE to LOOSE, DRY to WET
5			14	0.7	1	
					1	
10			17	3.8		
15			4	11.2	1	
20			20	25.3	3	SILTSTONE, VERY WEAK, BLUE-GRAY, HIGHLY WEATHERED (SILT, SLIGHTLY SANDY, VERY STIFF, MOIST)

TEST BORING 2
DATE DRILLED 4/23/2021

REMARKS

WATER @ 9', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			4	5.6	1	SAND, SILTY, BROWN, VERY LOOSE, MOIST
5			2	11.9	1	
						CLAY, SLIGHTLY SANDY, GRAY, STIFF, WET
10			8	38.6	2	
						SAND, SILTY, TAN, LOOSE, WET
15			9		1	
20			5	10.2	1	

ENTECH ENGINEERING, INC.

TEST BORING LOGS

7020 WYOMING LANE - MILLER DOWNS
M&A, LLC

JOB NO. 250953

FIG. A-1

TEST BORING 3
DATE DRILLED 4/23/2021

REMARKS

WATER @ 12', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			12	0.6	1
5			15	5.4	1
10			12	4.2	1
15			25	21.6	2
20					

SAND, WITH SILT, TAN, MEDIUM DENSE, DRY to MOIST

CLAY, SANDY, GRAY, VERY STIFF, WET

TEST BORING 4
DATE DRILLED 4/23/2021

REMARKS

WATER @ 12', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			9	2.1	1
5			8	3.3	1
10			5	31.6	2
15			50/6"	23.0	3
20			50/8"	25.2	3

SAND, SILTY, TAN, LOOSE, DRY to MOIST

CLAY, SANDY, TAN, MEDIUM STIFF, WET

SILTSTONE, VERY WEAK, GRAY, HIGHLY WEATHERED (SILT, WITH SAND, HARD, MOIST)

ENTECH ENGINEERING, INC.

TEST BORING LOGS

7020 WYOMING LANE - MILLER DOWNS
M&A, LLC

JOB NO. 250953

FIG. A-2

TEST BORING 5
DATE DRILLED 4/25/2021

REMARKS

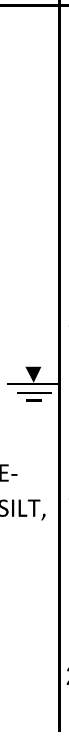
WATER @ 16', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, TAN, MEDIUM DENSE to VERY LOOSE, DRY to WET		15	4.0	1
5			17	2.1	1
10			24	2.2	1
15			27	4.8	1
20			3	12.8	1

TEST BORING 6
DATE DRILLED 4/25/2021

REMARKS

WATER @ 11', 4/29/21



Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, TAN, MEDIUM DENSE, DRY to MOIST		20	2.5	1
5			22	2.4	1
10			28	5.6	1
15	SILTSTONE, VERY WEAK, BLUE-GRAY, HIGHLY WEATHERED (SILT, SANDY, HARD, MOIST)		50/8"	23.1	3
20			50/6"	26.1	3

ENTECH ENGINEERING, INC.

TEST BORING LOGS

7020 WYOMING LANE - MILLER DOWNS
M&A, LLC

JOB NO. 250953

FIG. A-3

TEST BORING 7
DATE DRILLED 4/25/2021

REMARKS

WATER @ 8', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, BROWN, MEDIUM DENSE, MOIST		18	3.8	1
5			14	6.0	1
10	SILTSTONE, VERY WEAK, TAN, HIGHLY WEATHERED (SILT, SANDY, HARD, VERY MOIST)		50	24.9	3
15			50/7"	20.5	3
20			50/8"	26.0	3

TEST BORING 8
DATE DRILLED 4/25/2021

REMARKS

WATER @ 14', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, BROWN, MEDIUM DENSE, DRY to MOIST		26	2.3	1
5			28	3.5	1
10	CLAY, SLIGHTLY SANDY, TAN, HARD, MOIST		41	27.5	2
15	SILTSTONE, VERY WEAK, TAN, HIGHLY WEATHERED (SILT, SANDY, HARD, MOIST)		45	20.9	3
20			50/7"	18.0	3

ENTECH ENGINEERING, INC.

TEST BORING LOGS

7020 WYOMING LANE - MILLER DOWNS
M&A, LLC

JOB NO.
250953

FIG. A-4

PIEZOMETER P1
DATE DRILLED 3/1/2022

REMARKS

DRY TO 15', 3/1/22,
WATER @ 9', 3/2/22

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, BROWN, DRY to WET				
5			*	2.9	1
10			*	14.6	1
	CLAY, SANDY, GRAY, MOIST		*	20.8	2
15					
20					

* - BULK SAMPLE TAKEN

PIEZOMETER P2
DATE DRILLED 3/1/2022

REMARKS

DRY TO 15', 3/1/22
WATER @ 12.5', 3/2/22

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, BROWN, DRY to MOIST				
5			*	2.9	1
10			*	12.9	1
	CLAY, SANDY, GRAY, MOIST		*	20.7	2
15					
20					

* - BULK SAMPLE TAKEN

ENTECH ENGINEERING, INC.

TEST BORING LOGS

7020 WYOMING LANE - MILLER DOWNS
M&A, LLC

JOB NO.
250953

FIG. A-5

PIEZOMETER P4
DATE DRILLED 3/1/2022

REMARKS

DRY TO 15', 3/1/22,
DRY TO 15', 3/2/22

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, WITH SILT, TAN, DRY to MOIST				
5			*	1.6	1
10			*	2.1	1
15			*	4.7	1
20					

* - BULK SAMPLE TAKEN

PIEZOMETER P5
DATE DRILLED 3/1/2022

REMARKS

DRY TO 15', 3/1/22
WATER @ 12', 3/2/22

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, BROWN, DRY to MOIST				
5			*	1.0	1
10			*	11.1	1
	CLAY, SANDY, GRAY, WET ▼				
15			*	17.7	2
20					

* - BULK SAMPLE TAKEN

ENTECH ENGINEERING, INC.

TEST BORING LOGS

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M&A, LLC

JOB NO.
250953

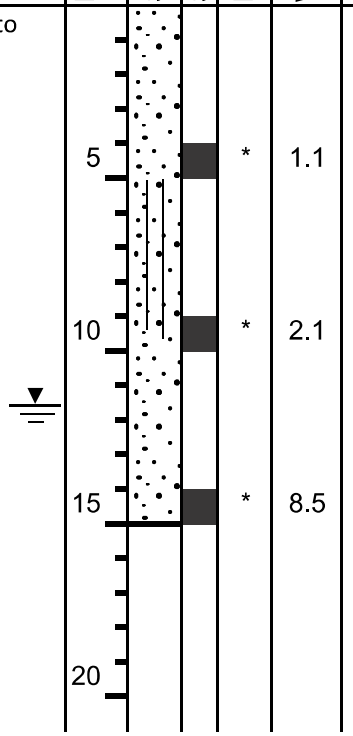
FIG. A-6

PIEZOMETER P5
DATE DRILLED 3/1/2022

REMARKS

WATER @ 14', 3/1/22
WATER @ 11.5', 3/2/22

SAND, WITH SILT, TAN, DRY to MOIST



* - BULK SAMPLE TAKEN

ENTECH ENGINEERING, INC.

TEST BORING LOGS

7020 WYOMING LANE - MILLER DOWNS
M&A, LLC

JOB NO.
250953

FIG. A-7

TABLE A-1

DEPTH TO GROUNDWATER & BEDROCK

TEST BORING	DEPTH TO GROUNDWATER (ft.)	DEPTH TO BEDROCK (ft.)
1	11	19
2	9	>20
3	12	>20
4	12	14
5	16	>20
6	11	13
7	8	9
8	14	14
P1	9	>14
P2	12.5	>15
P3	>15	>15
P4	12	>15
P5	11.5	>15

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

SOIL TYPE	TEST BORING/ PIEZOMETER NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/ CONSOL (%)	USCS	SOIL DESCRIPTION
1	1	2-3			5.9	NV	NP	NP	<0.01			SW-SM	SAND, WITH SILT
1	3	5			8.7							SW-SM	SAND, WITH SILT
1	5	5			21.6							SM	SAND, SILTY
1	7	2-3			28.3							SM	SAND, SILTY
1	P3	5			7.9							SW-SM	SAND, WITH SILT
1	P4	10			27.4							SM	SAND, SILTY
1	P5	5			9.7							SW-SM	SAND, WITH SILT
2	2	10	39.2	81.6	94.5	57	29	28	0.02		1.0	CH	CLAY, SLIGHTLY SANDY
2	4	10			82.9					670		CL	CLAY, WITH SAND
2	8	10	25.5	95.8	93.2						2.7	CL	CLAY, SLGIHTLY SANDY
2	9	15			58.3					780		CL	CLAY, SANDY
2	P2	15			77.7					1210		CL	CLAY, SANDY
3	1	20			89.5	45	29	16	0.02			ML	SILTSTONE (SILT, SLIGHTLY SANDY)
3	4	15	22.5	105.9	78.5	42	27	15	<0.01		0.4	ML	SILTSTONE (SILT, WITH SAND)
3	6	1			57.3							ML	SILTSTONE (SILT, SANDY)

APPENDIX C: Colorado Geological Survey Review Letter, EP-22-0038

COLORADO GEOLOGICAL SURVEY

1801 Moly Road
Golden, Colorado 80401

Karen Berry
State Geologist

December 2, 2021

Daniel Sexton
Planning and Community Development
City of Colorado Springs
30 S. Nevada Ave, Suite 701
Colorado Springs, CO 80901

Location:
W NW SE Section 8,
T13S, R65W of the 6th PM
38.9324°, -104.6911°

Subject: Wyoming Lane Annexation; Master Plan Amendment, Zone Change, PUD Concept Plan; City of Colorado Springs, El Paso County, CO; City File Nos. CPC A 21-00156: CGS Unique No. EP-22-0038

Dear Daniel:

As requested, the Colorado Geological Survey (CGS) has reviewed the referral. Pertinent documents reviewed included: City request for review (11.15.21), Application (11.10.21), Drainage Report (Kimley Horn, 10.28.21), Plat (Barron Land, 7.9.21), Preliminary Subsurface Soil Investigation (Entech, 5.13.21), and Soil, Geology and Geologic Hazard Study (Entech, 6.25.21). We understand that 21.17 acres are proposed for annexation into the City of Colorado Springs. Multi-family residential is being proposed for the annexation along with a proposed zone change. We offer the following observations and recommendations.

CGS has no objection to the proposed annexation or planned residential uses provided the following observations and recommendations are addressed in future development and grading plans, site investigations and reports.

Geologic Hazards. CGS concurs in general with Entech's geologic interpretation and identification of hazards and constraints associated with the site geology. Shallow groundwater is a significant geologic condition at this site. The shallow groundwater is associated with an unconfined aquifer impacted both by precipitation and proximity to Sand Creek and one of its tributaries. The depth to the aquifer will vary both seasonally and year to year. Entech p.13 *"The water table may be of sufficient depth to minimize the effects on buildings. Additional investigation is recommended after development and grading plans are finalized."* CGS agrees that additional investigation should be conducted but that this may include a groundwater monitoring program prior to finalization of plans that can be used to inform and guide the development and grading plans.

Basement feasibility. Entech states that shallow foundations are expected for this location. It would be prudent for the city to not allow basement construction unless a groundwater monitoring program or other engineering alternative such as raising site grades, garden level basement construction, or an underdrain system are proposed.

Mitigation for shallow groundwater often becomes guesswork due to the inexact method of determining its impact on inhabitable below grade areas (basements and crawlspaces). Groundwater measurements in test borings are limited to the time of year measured and are inherently inaccurate in predicting depth to groundwater during the engineering life of the planned residence. They are snapshots only. The extent of the yearly variation in depth to groundwater must be known, or estimated from groundwater and precipitation data, to determine basement feasibility.

Areas of ponded water in tributary drainages to Sand Creek. Entech p. 13 *"The pond is located behind an earthen dam in the northwestern portion of the site and can be avoided by the proposed development. All soft and organic soils should be removed prior to fill placement. Any drainage into these areas should be rerouted in a nonerosive manner where it does not create areas of ponded water around proposed structures. The same mitigation techniques for the seasonal shallow groundwater areas are recommended for these areas as well."*

The pond area described by Entech is within the tributary drainage to Sand Creek. Soils within drainages tend to remain conduits for subsurface flow even after drainage channels have been filled or otherwise truncated or relocated. CGS recommends that the flow from this drainage be collected and piped into the required detention pond. and that this mitigation be depicted on the development plans once they are produced and prior to their approval by the city.

Perimeter drains. Entech states (p. 9) *"Fluctuation in groundwater conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Isolated sand layers within the variable soil profile, sometimes only a few feet in thickness and width, can carry water in the subsurface. Water may also flow on top of the sandstone."* Due to the uncertainties of where perched groundwater may occur and the difficulties in predicting this CGS recommends that perimeter drains be required for all planned structures.

Drainage report and groundwater considerations. The drainage report states (p. 19) *"Free groundwater was found within 10 feet of the existing ground surface in two test holes located in the southern portion of the site. The proposed private EDB has been designed with a bottom elevation at least 3.75' above the highest encountered groundwater, and therefore the pond is not expected to be negatively affected by groundwater."* There is no data on the extent of groundwater fluctuations to support the statement that the pond will not be negatively affected by groundwater. The extent of groundwater fluctuations is unknown as Entech has stated.

Additional investigations. Entech (p. 13) *"Additional investigation is recommended after development and grading plans are finalized."* Site-specific geotechnical investigations consisting of drilling, sampling, laboratory testing and analysis are required prior to building permit applications to (1) determine soil and bedrock engineering properties such as expansion/consolidation potential, density, strength, allowable bearing pressures, etc., especially of the loose soils, and the expansive soil and bedrock identified within the site, (2) design individual foundations and floor systems, retaining walls, surface and subsurface drainage, and other development parameters.

Geologic Hazard Disclosure Statement. It is planned for this property to be annexed into the City of Colorado Springs. The submittal documents must follow the City of Colorado Springs Geologic Hazard Ordinance requiring the listing of the geologic hazard of record and the identified geologic hazards. Entech has listed the geologic hazards they have identified in several places in their report. These lists found in various parts of the report differ as do the lists of geologic hazards described in the report for the site. We recommend that Entech provide the applicant with a complete list of the hazards and constraints imposed by the geology that they can use in the required disclosure statement on the plans. This list should include perched groundwater and erosion along with the other conditions noted by Entech.

Development Plan. CGS understands from the application that approval of the Development Plan and Subdivision Plat will be administrative after the process of annexation, concept plan and zone change. It would be prudent for the city to require several notes on these documents prior to their approval. We recommend that these notes include:

- The requirement for additional, lot specific soils and foundation investigations,
- Mitigation with drains of the ponded and flowing tributary,
- That basements are not allowed unless specific mitigation or a groundwater monitoring program is conducted,
- Perimeter drains are installed at all homes,
- The required geologic hazard disclosure statement is added to the plans.

Thank you for the opportunity to comment on this project. If you have questions or require further review, please e-mail me at jlovekin@mines.edu.

Sincerely,

Jonathan R. Lovekin, P.G.
Senior Engineering Geologist

APPENDIX D: Soil Survey Descriptions

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: Flats, hills
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 supply, 0 to 60 inches: 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
H2 - 12 to 60 inches: stratified very gravelly sand to loam

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)
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: R048AY241CO - Mountain Meadow
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

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 22, Sep 3, 2024

El Paso County Area, Colorado

10—Blendon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3671
Elevation: 6,000 to 6,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blendon and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blendon

Setting

Landform: Alluvial fans, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 10 inches: sandy loam
Bw - 10 to 36 inches: sandy loam
C - 36 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

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

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 22, Sep 3, 2024

ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

SOIL, GEOLOGY AND GEOLOGIC HAZARD STUDY
7020 WYOMING LANE
TAX SCHEDULE NO. 53080-00-105
EL PASO COUNTY, COLORADO

Prepared for

Phoenix Holdings
4900 O'Hear Avenue, Suite 100
North Charleston, SC 29405

Attn: Sarah Chitsaz

June 25, 2021

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
Geologist

Reviewed by

COLORADO LICENSED
JOSEPH COLLIN GOODE
23725
PROFESSIONAL ENGINEER

6.25.21

Joseph C. Goode, Jr, P.E.
President

LLL

Encl.

Entech Job No. 210932
AAProjects/2021/210932 soil geo

CITY OF COLORADO SPRINGS

APPLICATION FORM FOR GEOLOGIC HAZARD REPORT

Applicant: Phoenix Holdings Telephone 719-330-0259 Fax

Address: 4900 O'Hear Ave, Suite 100 Zip Code 29405 e-mail sarah@phoenixholdings.co

Premises Involved: Development Plan/Subdivision Plat Name: 7020 Wyoming Lane

Tax Schedule No(s). 53080-00-105
(This can be obtained from the El Paso County Tax Assessor located at 27 E. Vermijo Avenue on the 2nd Floor; phone: 520-6600 or at their web site http://www.land.elpasoco.com)

GEOLOGIC HAZARD REPORT REQUIRED: (FIVE (5) PRELIMINARY COPIES)

An application review fee will be required to accompany these applications (make checks payable to City of Colorado Springs). The fee schedule is as follows:

Review of Geologic Hazard Reports	City Planning Fee: $300 plus any Colorado Geological Survey Review Cost Over $300
	City Engineering Fee: $284

The following documents have been included and considered as part of this report (checked off by individual(s) preparing the geologic report):

Development Plan: _____

Landscape Plan (if applicable): _____

Grading Plan: _____

Drainage Report (necessary if debris and/or mud flow hazard is present): _____

ENGINEERS STATEMENT

I hereby attest that I am qualified to prepare a Geologic Hazard Study in accordance with the provisions of Section 504 of the Geologic Hazards Ordinance of Colorado Springs. I am qualified as:

_____X_____ Professional Geologist as defined by CRS 34-1-201(3); or,

_____ Professional Engineer as defined by Board Policy Statement 50.2 - "Engineering in Natural Hazard Areas" of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors. Board authority as defined by CRS 12-25-107(1).

Submitted by: _____ Date: 6/25/2021
Logan L. Langford, P.G., Entech Engineering, Inc.

This Geologic Hazard Study is filed in accordance with the Zoning Code of the Code of the City of Colorado Springs, 2001, as amended.

City Engineer Date

City Planning Director Date

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APPENDICES
APPENDIX A: Site Photographs
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APPENDIX C: Soil Survey Descriptions

1.0 SUMMARY

Project Location:

The project lies in portions of the NE¼ and SE¼ of Section 8 of Township 13 South, Range 65 West of the 6th Principal Meridian. The site is located north and southwest of California Drive and Wyoming Lane, just east of Colorado Springs, Colorado in El Paso County. The site lies immediately east of the Colorado Springs city limits, and it is our understanding that the property is to be annexed into the city.

Project Description:

Total acreage involved in the project is approximately 22 acres. The proposed development is single-family residential with associated site improvements.

Scope of Report:

The report presents the results of our geologic investigation and treatment of engineering geologic hazard study for the sketch plan submitted. This report presents the results of our geologic reconnaissance, a review of available maps, aerial photographs and our conclusions with respect to the impacts of the geologic conditions on development.

Land Use and Engineering Geology:

This site was found to be suitable for the proposed development. Geologic conditions will impose some constraints on development. These include areas of artificial fill, loose soils, potentially seasonal shallow groundwater areas, areas of ponded water, and floodplains. Site conditions will be discussed in greater detail in this report. All recommendations are subject to the limitations discussed in the report.

2.0 GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION

The site is located in portions of the NE¼ and SE¼ of Section 8 of Township 13 South, Range 65 West of the 6th Principal Meridian, El Paso County, Colorado. The site is located north and south of Woodmen Road, east of Brule Road, and west of Golden Sage Road, immediately north of the Colorado Springs city limits, and approximately one mile west of Falcon, in El Paso County, Colorado. It is our understanding the site is to be annexed into the city of Colorado Springs. The location of the site is shown on the Vicinity Map, Figure 1.

The topography of the site is generally gently sloping to the south with some moderate slopes along the drainage in the northern portion of the site. A tributary to Sand Creek is located along the northern side of the site, and Sand Creek is located along the southern side of the site. Drainages on-site flow in southwesterly directions. Water was observed flowing in of the drainages at the time of this investigation, and areas of ponded water were observed in the northwestern portion of the site. The approximate boundaries of the site are indicated on the USGS Map, Figure 2. Previous site uses have included rural residential, grazing and pasture land. Vegetation on site consists primarily of field grasses and weeds, with some trees around some of the existing structures on the site. Site photographs are included in Appendix A. The approximate locations and directions of the photographs are indicated on Figure 3.

Total acreage involved in the proposed development is approximately 22 acres. The proposed development consists of single-family residential with associated site improvements. The area will be serviced by central water and sewer. Preliminary development and grading plans were not available at the time of this report.

3.0 SCOPE OF THE REPORT

The scope of this report will include the following:

- A general geologic analysis utilizing published geologic data. Detailed site-specific mapping will be conducted to obtain general information in respect to major geographic and geologic features, geologic descriptions and their effects on the development of the property.

4.0 FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of bedrock features and significant surficial deposits. The Natural Resource Conservation Service (NRCS), previously the Soil Conservation Service (SCS) survey was also reviewed to evaluate the site.

The position of mappable units within the subject property are shown on the Geologic Map. Our mapping procedures involved field reconnaissance, measurements and interpretation. The same mapping procedures have also been utilized to produce the Engineering Geology Map which identifies pertinent geologic conditions affecting development.

Eight (8) test borings were drilled as a part of the preliminary subsurface soil investigation for the site to determine general soil conditions. The borings were drilled with a power driven continuous flight auger drill rig to depths of 20 feet. Samples were obtained during drilling using the Standard Penetration Test, ASTM D-1586, utilizing a 2-inch O.D. Split Barrel Sampler and a California Sampler. Results of the penetration tests are shown on the drilling logs to the right of the sampling point. The location of the test borings is shown on the Site Map/Test Boring Location Map, Figure 3. The drilling logs are included in Appendix B.

Laboratory testing was performed to classify and determine the soils engineering characteristic. Laboratory tests included moisture content, ASTM D-2216, grain size analysis, ASTM D-422, and Atterberg Limits, ASTM D-4318. Swell/Consolidation Testing, ASTM D-4546, was conducted on select samples to evaluate the expansive/compressive characteristics of the soils. Results of the laboratory testing are included in Appendix B. A Summary of Laboratory Test Results is presented in Table 1.

5.0 SOIL, GEOLOGY AND ENGINEERING GEOLOGY

5.1 General Geology

Physiographically, the site lies in the western portion of the Great Plains Physiographic Province. Approximately 10½ miles to the west is a major structural feature known as the Rampart Range Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the southern edge of a large structural feature known as the Denver Basin. Bedrock in the area tends to be gently dipping in a northerly direction (Reference 1). Bedrock in the area of the site is sedimentary in nature, and typically Tertiary to Cretaceous in age. The bedrock underlying the site itself is the Dawson Formation. Overlying the Dawson are unconsolidated deposits of artificial, and alluvial soils. The site's stratigraphy will be discussed in more detail in Section 5.3.

5.2 Soil Conservation Service

The Natural Resource Conservation Service (Reference 2), previously the Soil Conservation Service (Reference 3) has mapped two soil types on the site (Figure 4). In general, the soils consist of loamy sand and gravelly sandy loam. Soils are described as follows:

Type	Description
9	Blakeland Fluvaquentic Haplaquolls, 1-9% slopes
10	Blendon sandy loam, 0-3% slopes

Complete descriptions of the soils are presented in Appendix C. The soils have generally been described to have rapid to very rapid permeabilities. The majority of the soils have been described by the Soil Conservation Service as good potential for urban development. Limitations include the hazard of flooding on some areas of Soil Types 9 and 10. Possible hazards with soil erosion are present on the site. The erosion potential can be controlled with vegetation. The majority of the soils have been described to have slight to moderate erosion hazards. The soil blowing hazard is severe if vegetation is removed.

5.3 Site Stratigraphy

The Falcon NW Quadrangle Geology Map showing the site is presented in Figure 5 (Reference 4). The Geology Map prepared for the site is presented in Figure 6. Four mappable units were identified on this site, which are identified as follows:

- **Qaf** **Artificial Fill of Quaternary Age:** These are man-made fill deposits associated with earthen dams and erosion berms on-site.

- **Qay** **Young Alluvium, undivided of Quaternary Age:** These are recent stream deposits in the northern drainage that exist on-site. These materials consist of silty sands and may contain lenses of silt, clay or gravel. Areas of organic soils will also be encountered. This deposit correlates with the Piney Creek Alluvium.

- **Qam** **Middle Alluvium of Quaternary Age:** These materials consist of lower stream terrace deposits. The alluvium typically consists of silty to clayey gravelly sands. This deposit correlates with the Broadway Alluvium.

- **TKda** **Dawson Arkose Formation of Tertiary to Cretaceous Age:** The bedrock underlying the site is the Dawson Formation. This formation consists of arkosic sandstone with interbedded lenses on fine grained sandstone, claystone or siltstone. Typically, it is buff to light brown and light gray in color. Overlying the Dawson is a variable layer of residual soil derived from the in-situ weathering of the bedrock materials.

The soils listed above were mapped from the *Geologic Map of the Falcon NW Quadrangle* by Madole in 2003 (Figure 5, Reference 4), the *Geologic Map of the Pueblo 1°x2° Quadrangle, South-Central* distributed by the US Geological Survey in 1978 (Reference 5) and site-specific mapping of the site. The test borings from the preliminary subsurface investigation were also used in evaluating the site. The test boring logs are included in Appendix B.

5.4 Soil Conditions

The soils encountered in the test borings can be grouped into three general soil types. The soils were classified using the Unified Soil Classification System (USCS).

Soil Type 1 classified as a slightly silty to silty sand (SM). The sand was encountered in all of the test borings at the existing ground surface and extending to depths ranging from 9 to 19 feet bgs, and the termination of Test Boring No. 2 (20 feet). Standard Penetration testing on the sand resulted in N-values of 2 to 28 bpf, indicating very loose to medium dense states. The majority of the sands were encountered at medium dense states. Water content and grain testing resulted in water contents of 1 to 13 percent, with approximately 6 to 28 percent of the soil size particles passing the No. 200 sieve. Atterberg limits testing on the sand resulted non-plastic results. Sulfate testing resulted in less than 0.01 percent soluble sulfate by weight, indicating a negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 2 classified as a sandy clay (CH, CL). The clay was encountered in four of the test borings at depths ranging from 7 to 14 feet bgs and extending to depths ranging from 9 to 14 feet bgs. Standard Penetration Testing conducted on the clay resulted in N-values of 5 to 41 bpf, which indicates soft to very stiff consistencies. Water content and grain size testing resulted in water contents of 28 to 29 percent with approximately 83 to 95 percent of the soil size particles passing the No. 200 Sieve. Atterberg limits testing on the clay resulted a liquid limit of 70 and plastic index of 51. FHA Swell Testing resulted in an expansion pressure of 670 psf. Swell/Consolidation Testing resulted in a volume changes of 1 to 2.7 percent. These results indicate a low to moderate expansion potential. Sulfate testing resulted in 0.02 percent soluble sulfate by weight, indicating the clay exhibits negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 3 classified as very sandy to sandy siltstone (ML). The siltstone was encountered in five of the test borings at depths ranging from 9 to 19 feet bgs and extending to the termination of the borings (20 feet). Standard Penetration Testing conducted on the siltstone resulted in N-values of 20 to greater than bpf, which indicates stiff to hard consistencies. Water content and grain size testing resulted in water content of 18 to 26 percent with approximately 57 to 90 percent of the soil size particles passing the No. 200 Sieve. Atterberg limits testing resulted in liquid limits

of 42 and 45 and a plastic indexes of 15 and 16. Swell/Consolidation Testing resulted in volume change of 0.4 percent, indicating low expansion potential. Highly expansive claystone is commonly interbedded with the bedrock in the area. Sulfate testing resulted in less than 0.01 to 0.02 percent soluble sulfate by weight, indicating the siltstone exhibits negligible potential for below grade concrete degradation due to sulfate attack.

A Summary of Laboratory Results is presented in Table 1. Laboratory results are included in Appendix C. A summary of the depth to bedrock is included in Table 2.

5.5 Groundwater

Groundwater was encountered in all of the test borings at depths of 8 to 16 feet. The shallower water was encountered near the drainages (Test Boring Nos. 1 and 7). Depending on site grading groundwater should not affect shallow foundations on the majority of the site. Groundwater may be encountered in deeper utility excavations. Unstable conditions should be expected where excavations approach the groundwater levels. Stabilization using geo grids or shot rock may be necessary. It should be noted that groundwater levels could change due to seasonal variations, changes in land runoff characteristics and future development of nearby areas. Areas of seasonal and potentially seasonal groundwater, springs, and ponded water have been mapped on the site and are discussed in the following section.

Fluctuation in groundwater conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Isolated sand layers within the variable soil profile, sometimes only a few feet in thickness and width, can carry water in the subsurface. Water may also flow on top of the sandstone. Contractors should be cognizant of the potential for the occurrence of such subsurface water features during construction on-site. Grading in areas of shallow water should be minimized.

6.0 ENGINEERING GEOLOGY - IDENTIFICATION AND MITIGATION OF GEOLOGIC HAZARDS

As mentioned previously, detailed mapping has been performed on this site to produce an Engineering Geology Map (Figure 6). This map shows the location of various geologic conditions of which the developers and planners should be cognizant during the planning, design and construction stages of the project. The hazards identified on this site include artificial fill, loose soils, potentially seasonal shallow groundwater areas, and areas of flowing and ponded water. The following hazards have been addressed as a part of this investigation:

Artificial Fill

Areas of artificial fill were observed on the site. The majority of the fill is associated with earthen dams and erosion berms. The earthen dams lie within areas designated as open space or easements and will be avoided by construction. The majority of the erosion berms are shallow and may be penetrated by foundations or will likely be removed during site grading. Should any uncontrolled fill be encountered beneath foundations, removal and recompaction at 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 will be required.

Expansive Soils

While the majority of the soils encountered in the test borings drilled on-site have low expansion potential, expansive clays and claystone are common in the area and may be encountered in the subsurface on this site. The expansive soils on-site are highly sporadic, therefore, none have been indicated on the map. Expansive clays and claystone, if encountered beneath foundations, can cause differential movement in the structure foundation. These occurrences should be identified and dealt with on an individual basis.

Mitigation: Should expansive soils be encountered beneath foundations; mitigation will be necessary. Mitigation of expansive soils will require special foundation design. Overexcavation and replacement with non-expansive soils at 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation which is common in the area. Drilled piers are another option that is used in areas where highly expansive soils are encountered. Typical minimum pier depths are on the order of 25 feet or more and require penetration into the bedrock

material a minimum of 4 to 6 feet, depending on building loads. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. The use of structural floors should be considered for basement construction on highly expansive clays. Final recommendations should be determined after additional investigation of each building site.

Subsidence Area

Based on a review of the *Mining Report for the Colorado Springs Coal Field* (Reference 6), a Subsidence Investigation Report for the Colorado Springs area by Dames and Moore, 1985 (Reference 7), and the *Evaluation of Mineral and Mineral Fuel Potential of El Paso County* (Reference 8), the site is not undermined. The closest underground mines in the area are 8 miles to the south and southwest and the site is not mapped within any potential subsidence zones.

Slope Stability and Landslide Hazard

The slopes on-site are gently to moderately sloping and do not exhibit any past or potential unstable slopes or landslides. Grading plans were not available at the time of this investigation. Slopes should be no steeper than 3:1, if regraded unless specifically evaluated. All topsoil and organics should be removed prior to any regrading or fill placement. All new fill should be properly benched into native slopes and compacted at a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557.

Rockfall Hazards

Based on our site observation, no rock outcrops or areas of rockfall hazard were observed on this site.

Areas of Erosion

No significant areas of erosion were observed during our site investigation.

Mitigation: Due to the nature of the soils on this site, virtually all the soils are subject to erosion by wind and water. Other minor areas of erosion were observed on site other than those mapped, particularly where some rill erosion has occurred. Areas of erosion can occur across the entire site, particularly if the soils are disturbed during construction. Vegetation reduces the potential for erosion. The areas identified where erosion is actually taking place may require check dams,

regrading and revegetation using channel lining mats to anchor vegetation. Further recommendations for erosion control are discussed under Section 9.0 "Erosion Control" of this report. Recommendations pertaining to revegetation may require input from a qualified landscape architect and/or the Natural Resource Conservation Service (previously Soil Conservation Service).

Debris Fans

Based on site observations, debris fans were not observed in this area. Areas of recent sediment deposits were observed in some of the drainages on the site. The drainage areas are discussed below.

Groundwater and Drainage Areas

Groundwater was encountered in five of the test borings at depths ranging from 8 to 16 feet. Areas within the drainages on-site have been identified as seasonal and potentially seasonal shallow groundwater. Only minor areas with water flowing in the drainages were noted at the time of this investigation, however, an area of ponded water was observed in the northwestern portion of the site. Sand Creek in the southern portion of the has been mapped within floodplain zones according to the FEMA Map No. 08041CO535G, Figure 7 (Reference 9). Exact floodplain location and drainage studies are beyond the scope of this report. Groundwater areas are discussed as follows:

- *Potentially Seasonal Shallow Groundwater*

  In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and possible frost heave potential, depending on the soil conditions. The majority of the areas mapped with this designation lie within drainages designated as open space and will be avoided by development. Where structures encroach on, or lie within these areas, the following mitigation is recommended:

  Mitigation: In these locations, foundations in areas subject to severe frost heave potential should penetrate sufficient depth so as to discourage the formation of ice lenses beneath foundations. At this location and elevation, a foundation depth for frost protection of 30 inches is recommended. In areas where high subsurface moisture conditions are anticipated periodically, a subsurface perimeter drain will be necessary to help prevent the intrusion of

water into areas located below grade. A typical perimeter drain detail is presented in Figure 8. Where shallow groundwater is encountered, additional drains, such as capillary breaks and/or interceptor drains may be necessary. Unstable conditions should be expected where excavations approach the groundwater level. The used of shot rock or geo-grids may be necessary to stabilize excavations. Additionally, swales should be created to intercept surface runoff and carry it safely around and away from structures. It is anticipated that the drainages can be avoided or site grading will mitigate the drainages and raise foundations further above the groundwater level. The water table may be of sufficient depth to minimize the effects on buildings. Additional investigation is recommended after development and grading plans are finalized.

- *Areas of Ponded Water*

These are areas where there is standing water observed in drainages or ponded water behind earthen dams. The majority of these areas lie within the drainages designated as open space and will be avoided by construction. Where construction is proposed, the following mitigation is recommended:

Mitigation: The pond is located behind an earthen dam in the northwestern portion of the site and can be avoided by the proposed development. All soft and organic soils should be removed prior to fill placement. Any drainage into these areas should be rerouted in a non-erosive manner where it does not create areas of ponded water around proposed structures. The same mitigation techniques for the seasonal shallow groundwater areas are recommended for these areas as well.

Collapsible Soils

Areas of loose or potentially collapsible soils were encountered in some of the test borings drilled on-site. Should loose or collapsible soils be encountered beneath foundations, removal and recompaction with thorough moisture conditioning at 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 will be necessary. Typically, the overexcavation extends to a depth of 2 to 3 feet. Specific recommendations should be made after additional investigation of each building site.

Faults

The closest fault is the Rampart Range Fault, located 10½ miles to the west. No faults are mapped on the site itself. Previously Colorado was mapped entirely within Seismic Zone 1, a very low seismic risk. Additionally, the International Residential Code (IRC), 2003, currently places this area in Seismic Design Category B, also a low seismic risk. According to a report by the Colorado Geological Survey by Kirkman and Rogers, 1981, (Reference 10) this area should be designed for Zone 2 due to more recent data on the potential for movement in this area, and any resultant earthquakes.

Dipping Bedrock

The bedrock underlying the site is the Dawson Formation of Tertiary to Cretaceous Age. The Dawson in this area is gently dipping a northerly direction according to the *Geologic Structure Map of the Pueblo 1x2 Quadrangle, South-Central Colorado* (1978) (Reference 1). The bedrock encountered in the test borings and observed on-site did not exhibit steeply dipping characteristics; therefore, mitigation is not necessary.

Radioactivity

Radon levels for the area have been reported by the Colorado Geologic Survey in the Open-File, Report No. 91-4 (Reference 11). Radon levels ranging from 0 to 20 pci/l have been measured in the area. The following is a table of radon levels in this area.

0<4 pci/l	50.00%
4<10 pci/l	50.00%
10<20 pci/l	0.00%
>20 pci/l	0.00%

Only two readings have been taken in the area. The minimal information from this report is not sufficient to determine if radon levels are higher for this site. An occurrence of radioactive minerals has been identified approximately 7 miles northwest of the site (Reference 12). This occurrence is associated with a limonite deposit in the Dawson Formation. No known occurrences exist on the site, however, radon gas originating in the bedrock underlying the site could migrate up into the upper soil profile.

Mitigation: The potential exists for radon gas to build up in areas of the site. Build-ups of radon gas can be mitigated by providing increased ventilation of basements and crawlspaces and sealing of joints. Specific requirements for mitigation should be based on-site specific testing after the site is constructed.

7.0 EROSION CONTROL

The soil types observed on the site are mildly to moderately susceptible to wind erosion, and moderately to highly susceptible to water erosion. A minor wind erosion and dust problem may be created for a short time during and immediately after construction. Should the problem be considered severe enough during this time, watering of the cut areas or the use of chemical palliative may be required to control dust. However, once construction has been completed, and vegetation reestablished, the potential for wind erosion should be considerably reduced.

With regard to water erosion, loosely compacted soils will be the most susceptible to water erosion, residually weathered soils and weathered bedrock materials become increasingly less susceptible to water erosion. For the typical soils observed on-site, allowable velocities or unvegetated and unlined earth channels would be on the order of 3 to 4 feet/second, depending upon the sediment load carried by the water. Permissible velocities may be increased through the use of vegetation to something on the order of 4 to 7 feet/second, depending upon the type of vegetation established. Should the anticipated velocities exceed these values, some form of channel lining material may be required to reduce erosion potential. These might consist of some of the synthetic channel lining materials on the market or conventional riprap.

In cases where ditch-lining materials are still insufficient to control erosion, small check dams or sediment traps may be required. The check dams will serve to reduce flow velocities, as well as provide small traps for containing sediment. The determination of the amount, location and placement of ditch linings, check dams and of the special erosion control features should be performed by or in conjunction with the drainage engineer who is more familiar with the flow quantities and velocities.

Cut and fill slope areas will be subjected primarily to sheetwash and rill erosion. Unchecked rill erosion can eventually lead to concentrated flows of water and gully erosion. The best means to combat this type of erosion is, where possible, the adequate re-vegetation of cut and fill slopes. Cut and fill slopes having gradients more than three (3) horizontal to one (1) vertical become increasingly more difficult to re-vegetate successfully. Therefore, recommendations pertaining to the vegetation of the cut and fill slopes may require input from a qualified landscape architect and/or the Soil Conservation Service.

8.0 ECONOMIC MINERAL RESOURCES

Some of the sandy materials on-site could be considered a low grade sand resource. According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 13), the area is mapped as upland deposits. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 14), areas of the site are mapped as A3 – Alluvial fan: sand resource. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 8), the area of the site has been mapped as "Good" for industrial minerals. The sands associated with the alluvial deposits are considered a sand resource. Considering the abundance of similar materials through the region and close proximity to developed land, they would be considered to have little significance as an economic resource.

According to *the Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands* (Reference 8), the site is mapped within the Denver Basin Coal Region. However, the area of the site has been mapped as "Poor" for coal resources. No active or inactive mines have been mapped in the area of the site. The *El Paso County Aggregate Resource Map* (Reference 13) has mapped coal resources in the Falcon area approximately ½ mile south of the site; however, the coal resources are estimated at 1,500 feet below the surface (Reference 8). At this depth, mining the coal would not be economical at this time. No metallic mineral resources have been mapped on the site (Reference 8).

The site has been mapped as "Fair" for oil and gas resources (Reference 8). No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area may lack the

geologic structure for trapping oil or gas; therefore, it would not be considered a significant resource. Hydraulic fracturing is a new method that is being used to extract oil and gas from rocks that would not normally be productive. The area of the site has not been explored to determine If the rocks underlying the site would be commercially viable utilizing hydraulic fracturing. The practice of hydraulic fracturing has come under review due to concerns about environmental impacts, health and safety.

9.0 RELEVANCE OF GEOLOGIC AND SITE CONDITIONS TO LAND USE PLANNING

We understand that the development will be residential. It is our opinion that the existing geologic and engineering geologic conditions will impose some constraints on the proposed development and construction. The most significant hazards associated with the site are those associated with the drainage areas and potential seasonal shallow groundwater conditions. These can be satisfactorily mitigated by either avoidance, regrading, or through proper engineering design, construction and drainage systems. Constraints identified on the site such as artificial fill, collapsible soils, shallow water, and expansive soils can also be mitigated through proper engineering design and construction.

The upper materials are typically at medium dense to dense states. The medium dense to dense granular soils encountered in the upper soil profiles of the test borings should provide good support for foundations. Loose soils, where encountered, will require removal and recompaction. Expansive soils, although sporadic, were encountered. Expansive clayey sandstone, claystone, and silstone are common in the Dawson Formation, and may require mitigation. Foundations anticipated for the site are standard spread footings possibly in conjunction with overexcavation in areas of expansive soils or loose soils. Areas of artificial fill, if encountered beneath foundations will require penetration or recompaction. Expansive layers may also be encountered in the soil and bedrock on this site. Expansive soils, if encountered, will require special foundation design and/or overexcavation. These soils will not prohibit development.

Areas of potentially seasonal shallow groundwater, flowing/ponded water, and floodplains exist on this site. The floodplains, and areas of ponded water can to be avoided by development and preserved as open space in drainage easements. Finished floor levels must be a minimum of one foot above the floodplain level. Where structures encroach on areas of potential shallow groundwater or construction and regrading is proposed, drains may be necessary. Typical drain details are included in Figures 8 through 10. Exact floodplain locations and drainage studies are beyond the scope of this report.

Areas of perched groundwater may be encountered on this site in areas other than those mapped. Permeable sands exist on the site that may carry water in the subsurface perched on less permeable bedrock. Groundwater was encountered at depths ranging from 6 to 18 feet in five of the test borings drilled on the site. Site grading in areas of shallow water should be kept to a minium. Fluctuation in groundwater conditions may occur due to variations in rainfall, soil conditions and development of surrounding areas. Builders should be cognizant of the potential for the occurrence of subsurface water features during construction and deal with each individual problem as necessary at the time of construction. Subsurface drains and dewatering systems may be necessary in some areas where seepage and perched water occurs. Unstable conditions should be expected where excavations approach the groundwater level. Stabilization using geofabric or shot rock may be necessary.

In summary, development of the site can be achieved if the items discussed above are mitigated. These items can be mitigated through proper design and construction or by avoidance. Additional investigation is recommended as grading and development plans are prepared, prior to construction.

10.0 CLOSURE

It is our opinion that the existing geologic engineering and geologic conditions will impose some constraints on development and construction of the site. The geologic hazards identified on the site can either be avoided by development or satisfactorily mitigated through proper engineering design and construction practices. The report was prepared for the proposed master plan. Additional soils investigation is recommended as the development and grading plans are prepared to provide more detailed information on soil, groundwater and bedrock.

It should be pointed out that because of the nature of data obtained by random sampling of such variable and non-homogeneous materials as soil and rock, it is important that we be informed of any differences observed between surface and subsurface conditions encountered in construction and those assumed in the body of this report. Discrepancies should be reported to Entech Engineering, Inc. soon after they are discovered so that the evaluation and recommendations presented can be reviewed and revised if necessary. Planning and design personnel should be made familiar with the contents of this report.

This report has been prepared for Phoenix Holdings for application to the proposed project in accordance with generally accepted geologic soil and engineering practices. No other warranty expressed or implied is made.

We trust this report has provided you with all the information you required. Should you require additional information, please do not hesitate to contact Entech Engineering, Inc.

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TABLES

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT PHOENIX HOLDINGS
PROJECT 7020 WYOMING LANE
JOB NO. 210932

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	1	2-3			5.9	NV	NP	<0.01			SM-SW	SAND, SLIGHTLY SILTY
1	3	5			8.7						SM-SW	SAND, SLIGHTLY SILTY
1	5	5			21.6						SM	SAND, SILTY
1	7	2-3			28.3						SM	SAND, SILTY
2	2	10	39.2	81.6	94.5	57	28	0.02		1.0	CH	CLAY, SANDY
2	4	10			82.9				670		CL	CLAY, SANDY
2	8	10	25.5	95.8	93.2					2.7	CL	CLAY, SANDY
3	1	20			89.5	45	16	0.02			ML	SILTSTONE, SANDY
3	4	15	22.5	105.9	78.5	42	15	<0.01		0.4	ML	SILTSTONE, SANDY
3	6	15			57.3						ML	SILTSTONE, VERY SANDY

Table 2: Summary of Depth to Bedrock and Groundwater

Test Boring No.	Depth to Bedrock (ft.)	Depth to Groundwater (ft.)
1	19*	11
2	>20	9
3	>20	12
4	14	12
5	>20	16
6	13	11
7	9	8
8	14	14

* Highly Weathered Bedrock

FIGURES

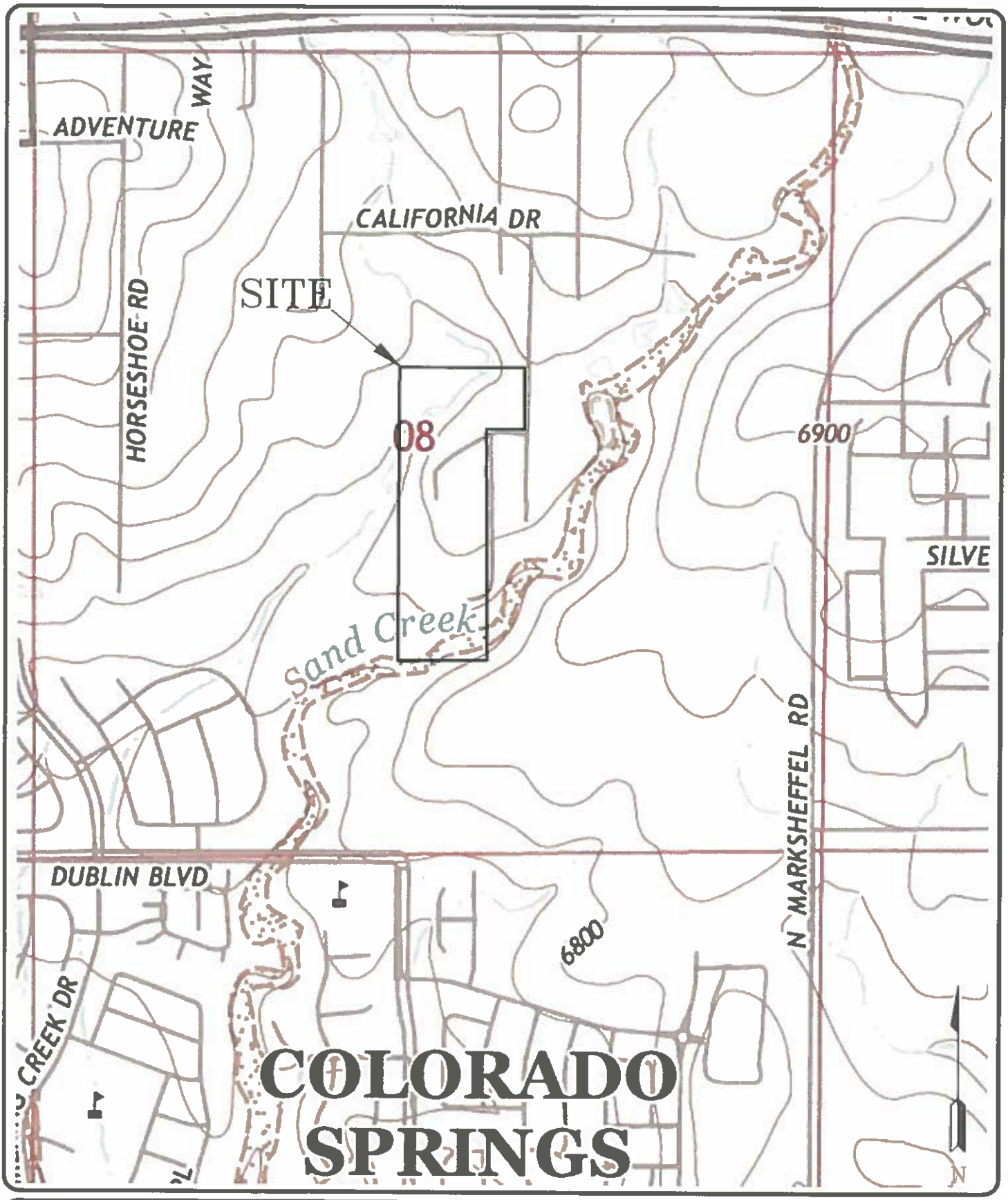
ENTECH ENGINEERING, INC.
393 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

VICINITY MAP
7020 WYOMING LANE
PARCEL NO. 53080-00-105
EL PASO COUNTY, CO
FOR: PHOENIX HOLDINGS

DRAWN:	DATE:	CHECKED:	DATE:
LLL	5/13/21		

JOB NO.: 210932

FIG NO.: 1



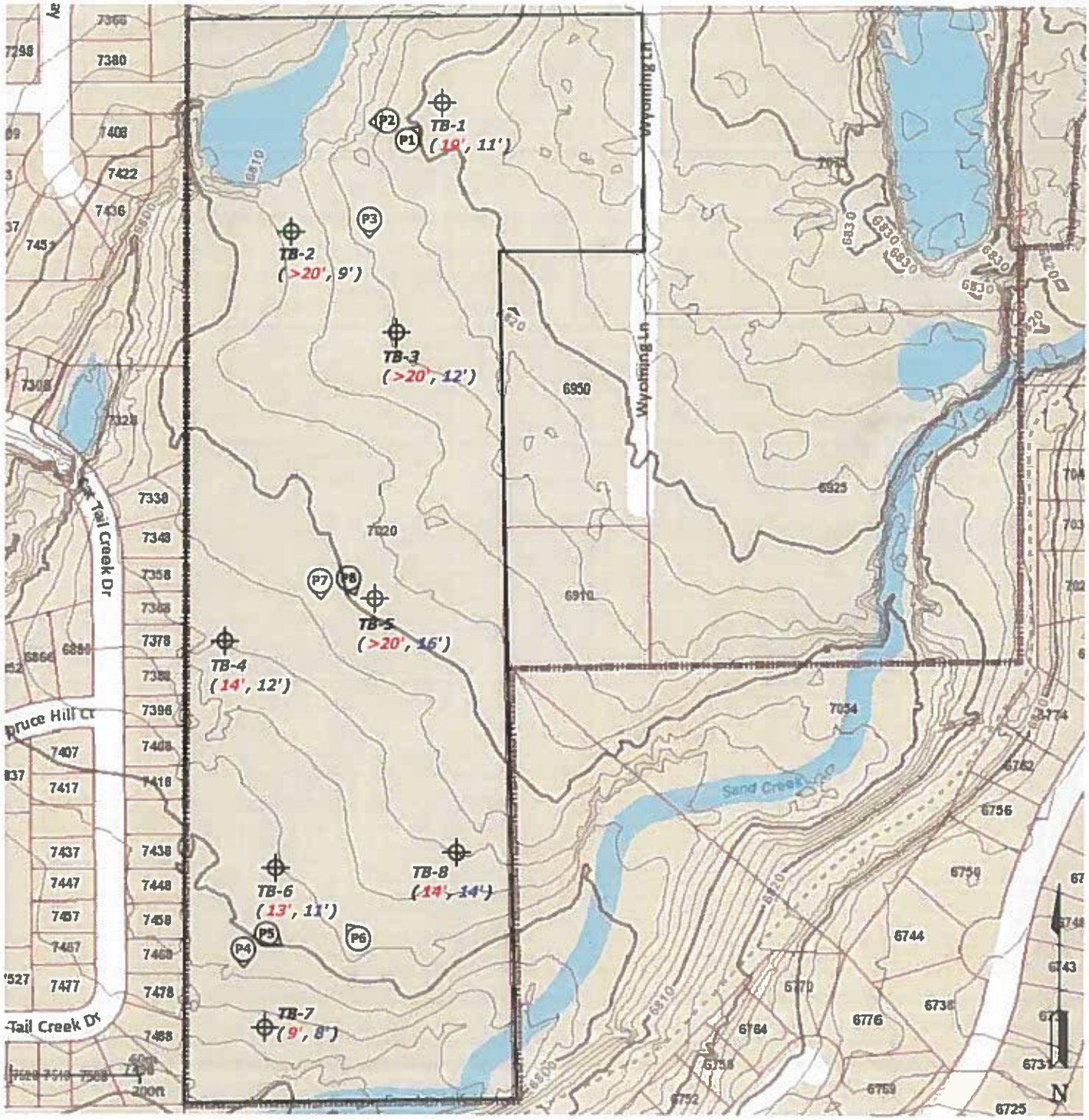
ENTECH
ENGINEERING, INC.
385 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

USGS MAP
7020 WYOMING LANE
PARCEL NO. 53080-00-105
EL PASO COUNTY, CO
FOR: PHOENIX HOLDINGS

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/2/21		

JOB NO.: 210932

FIG NO.: 2



TB- APPROXIMATE TEST BORING LOCATION AND NUMBER
(bedrock depth, ground wwater depth)

(P2) - APPROXIMATE TEST PIT LOCATION AND NUMBER

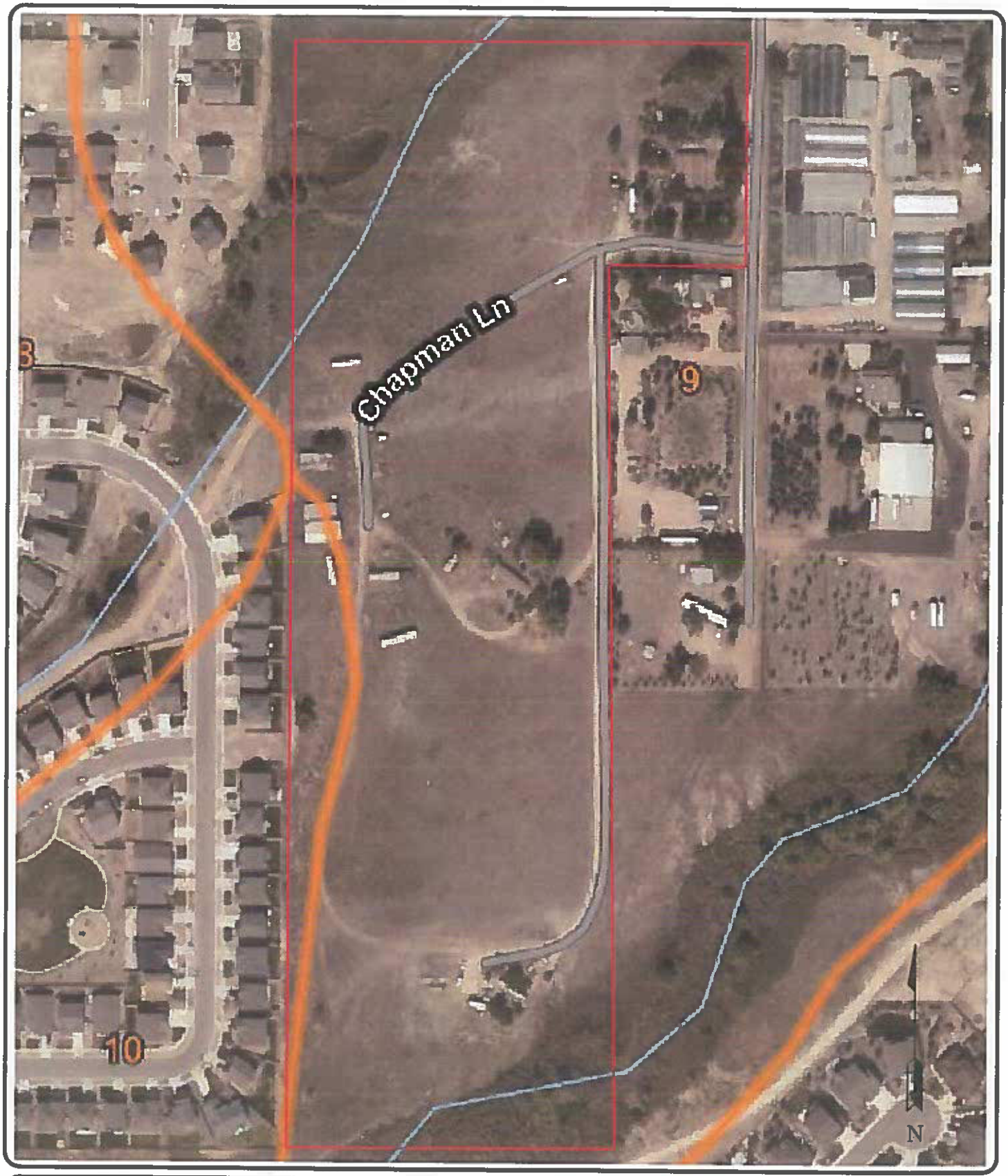
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

SITE MAP/TEST BORING LOCATION MAP
7020 WYOMING LANE
PARCEL NO. 53080-00-105
EL PASO COUNTY, CO
FOR: PHOENIX HOLDINGS

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/2/21		

JOB NO.: 210932

FIG NO.: 3



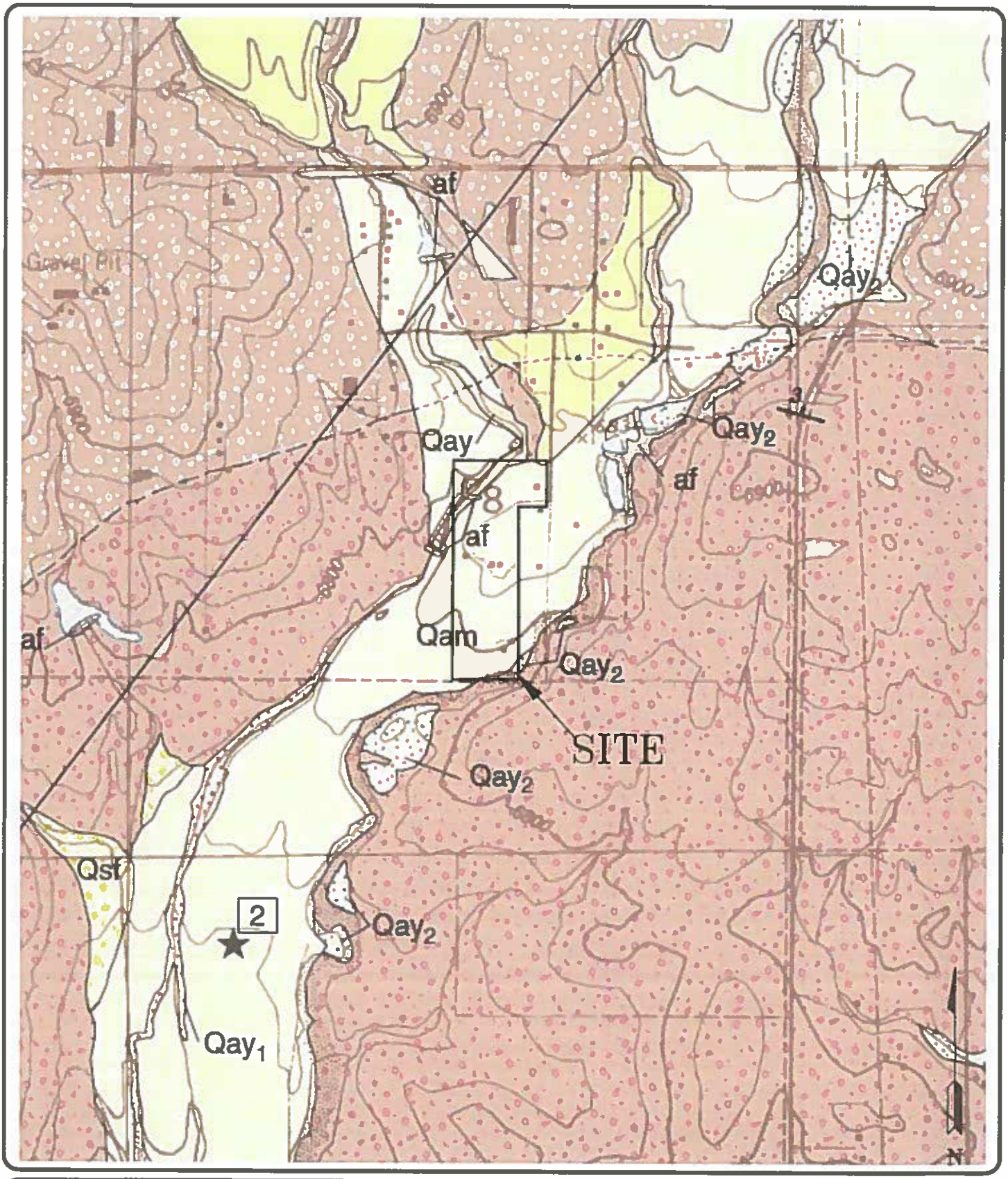
ENTECH
ENGINEERING, INC.
595 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

SOIL SURVEY MAP
7020 WYOMING LANE
PARCEL NO. 53080-00-105
EL PASO COUNTY, CO
FOR: PHOENIX HOLDINGS

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/2/21		

JOB NO.: 210932

FIG NO.: 4



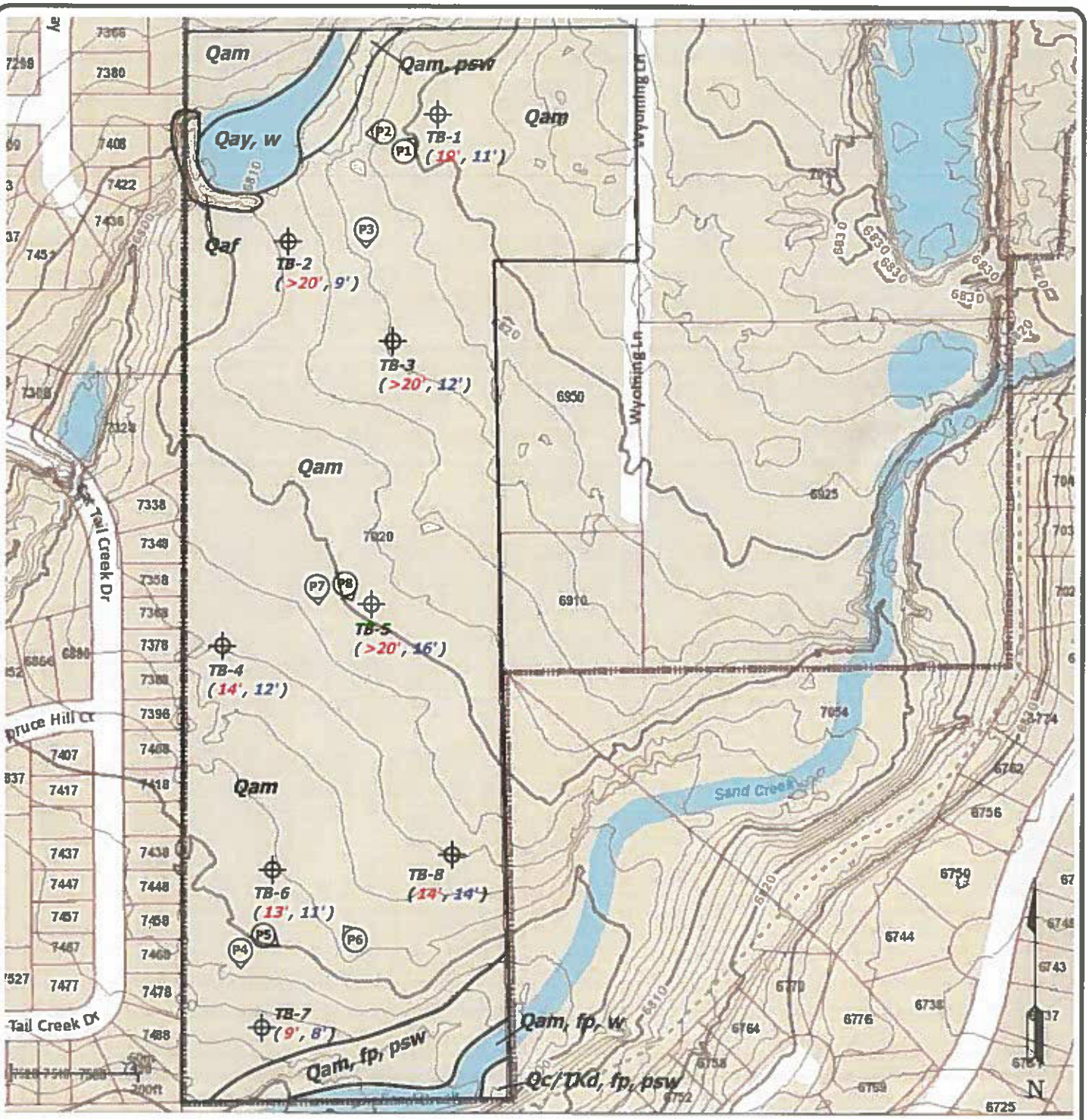
ENTECH ENGINEERING, INC.
305 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

FALCON NW QUADRANGLE GEOLOGY MAP
7020 WYOMING LANE
PARCEL NO. 53080-00-105
EL PASO COUNTY, CO
FOR: PHOENIX HOLDINGS

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/2/21		

JOB NO.: 210932

FIG NO.: 5



Legend:

Qaf -	*Artificial Fill of Holocene Age:* *Man-made fill deposits*	*fp -*	*floodplain*
Qay -	*Young Alluvium, undivided of late to mid Holocene Age:* *water deposited sands and gravel*	*psw -*	*potentially seasonal shallow groundwater*
Qam -	*Middle Alluvium of early Holocen and late Pleistocene Age:* *water deposited sand, terrace deposits*	*w -*	*flowing and ponded water*
Tkda -	*Dawson Formation of Tertiary to Cretaceous Age:* *arkosic sandstone, with interbedded claystone and siltstone*		

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

GEOLOGY/ENGINEERING GEOLOGY MAP
7020 WYOMING LANE
PARCEL NO. 53080-00-105
EL PASO COUNTY, CO
FOR: PHOENIX HOLDINGS

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/2/21		

JOB NO.: 210932

FIG NO.: 6

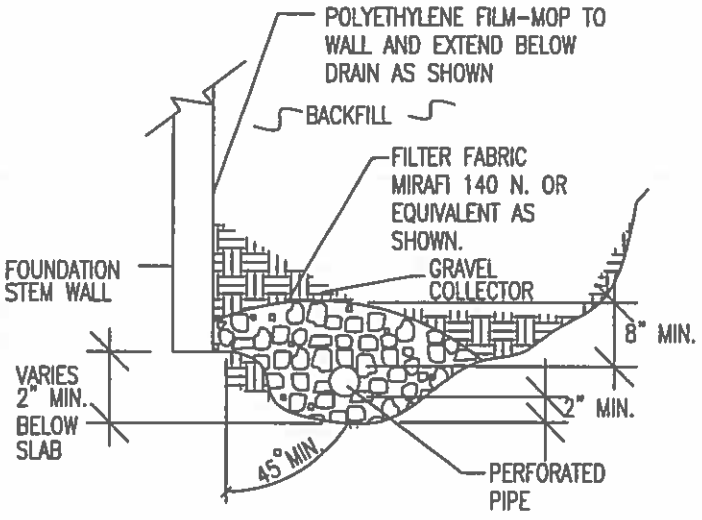
ENTECH ENGINEERING, INC.
595 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

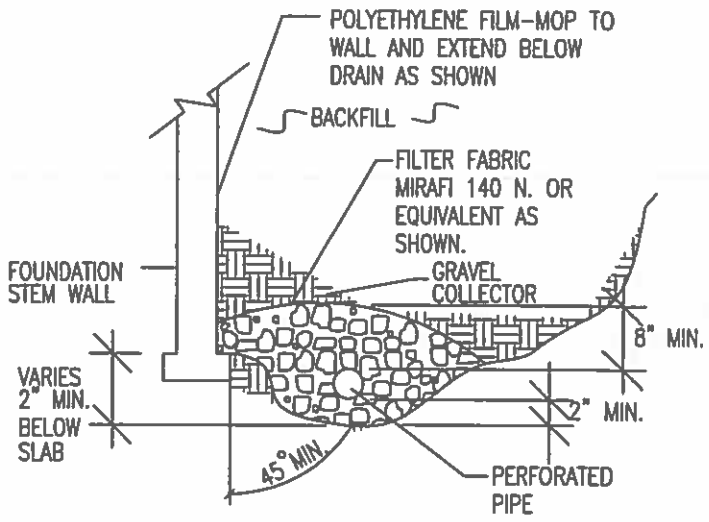
FEMA FLOODPLAIN MAP
7020 WYOMING LANE
PARCEL NO. 53080-00-105
EL PASO COUNTY, CO
FOR: PHOENIX HOLDINGS

DRAWN:	DATE:	CHECKED:	DATE:
LLL	6/2/21		

JOB NO.: 210932

FIG NO.: 7





NOTES:

-GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS-85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

-PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4-INCH DIAMETER IS MOST OFTEN USED.

-ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON-PERFORATED PIPE.

-FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

-MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

-DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

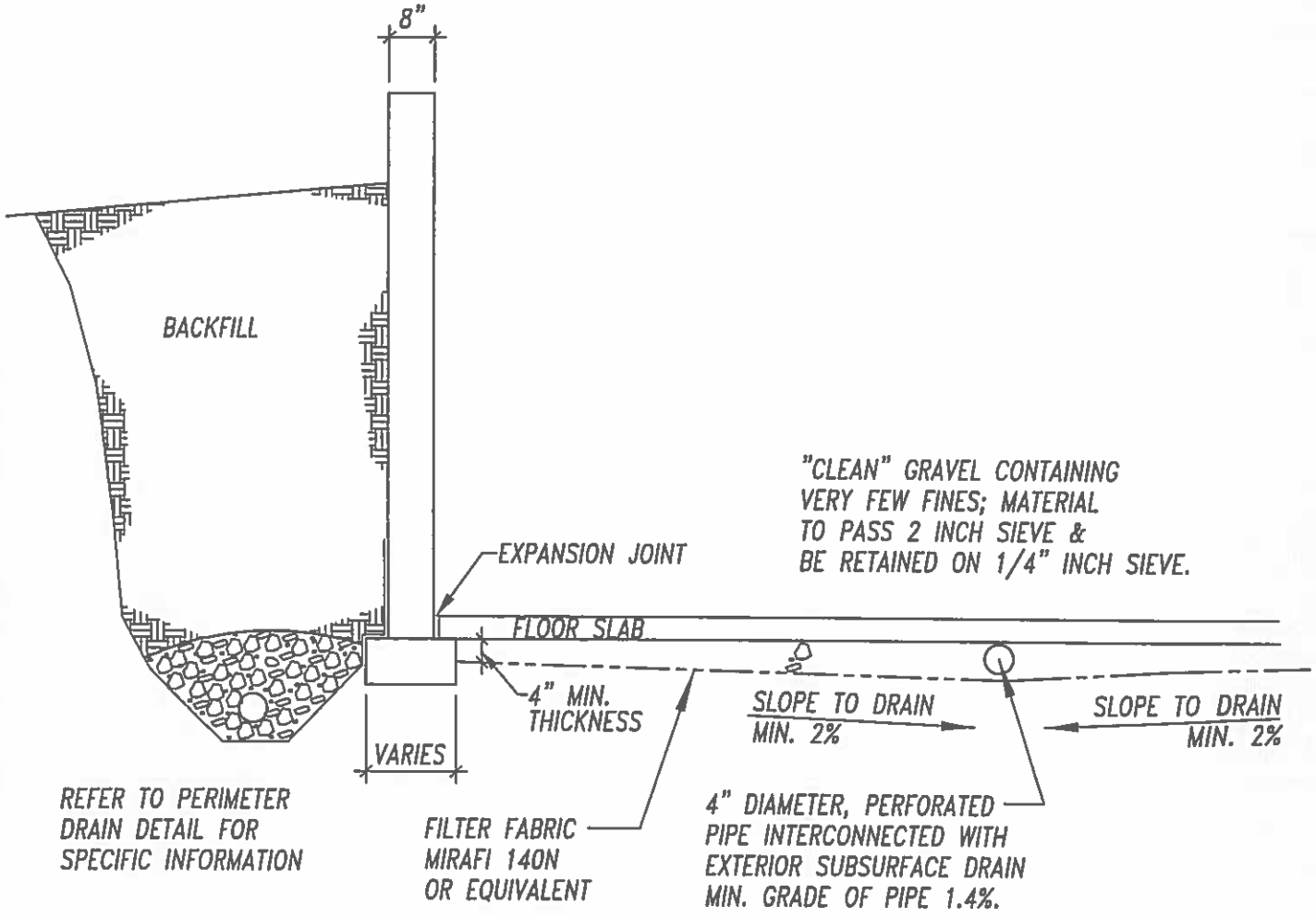
ENTECH
ENGINEERING, INC.
565 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:
		DS	LLL

JOB NO.: 210932

FIG NO.: 8



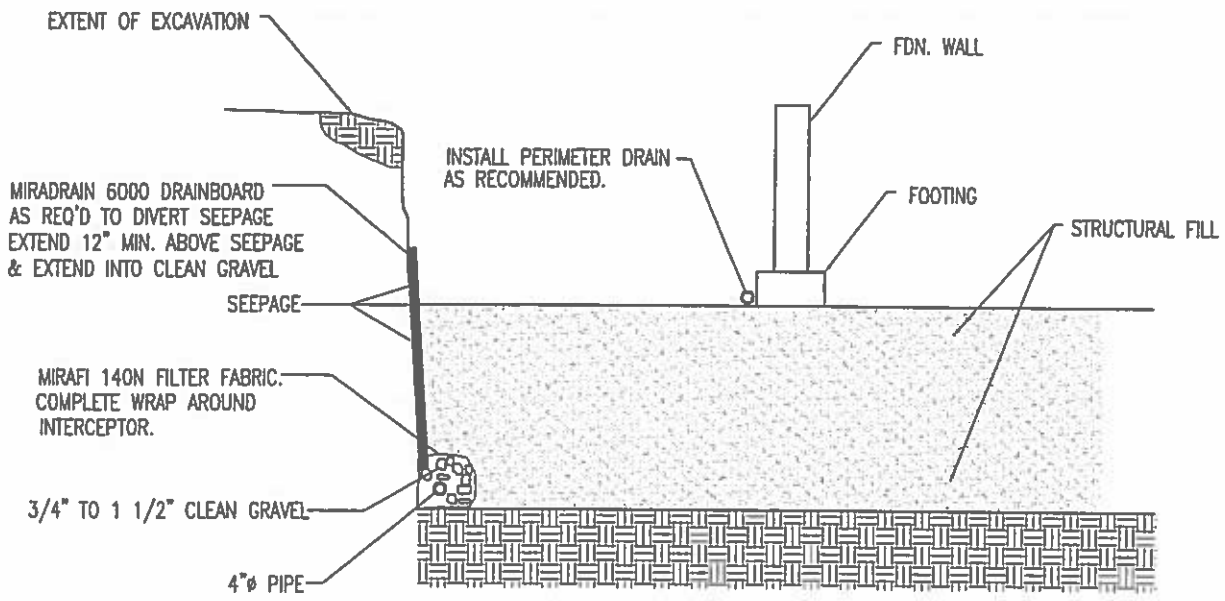
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

TYP. UNDERSLAB DRAINAGE
LAYER (CAPILLARY BREAK)

DRAWN:	DATE:	DESIGNED:	CHECKED:
		DS	LLL

JOB NO.: 210932
FIG NO.: 9

410_Detail Book\Details\UNDERSLAB CAPILLARY BREAK DRAIN.dwg, 1-Detail, 6/12/2007 12:11:55 PM, 1:48



NOTE:
EXTEND INTERCEPTOR DRAIN TO DAYLIGHT

INTERCEPTOR DRAIN DETAIL

N.T.S.

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

INTERCEPTOR DRAIN DETAIL			
DRAWN BY:	DATE DRAWN:		CHECKED: LLC

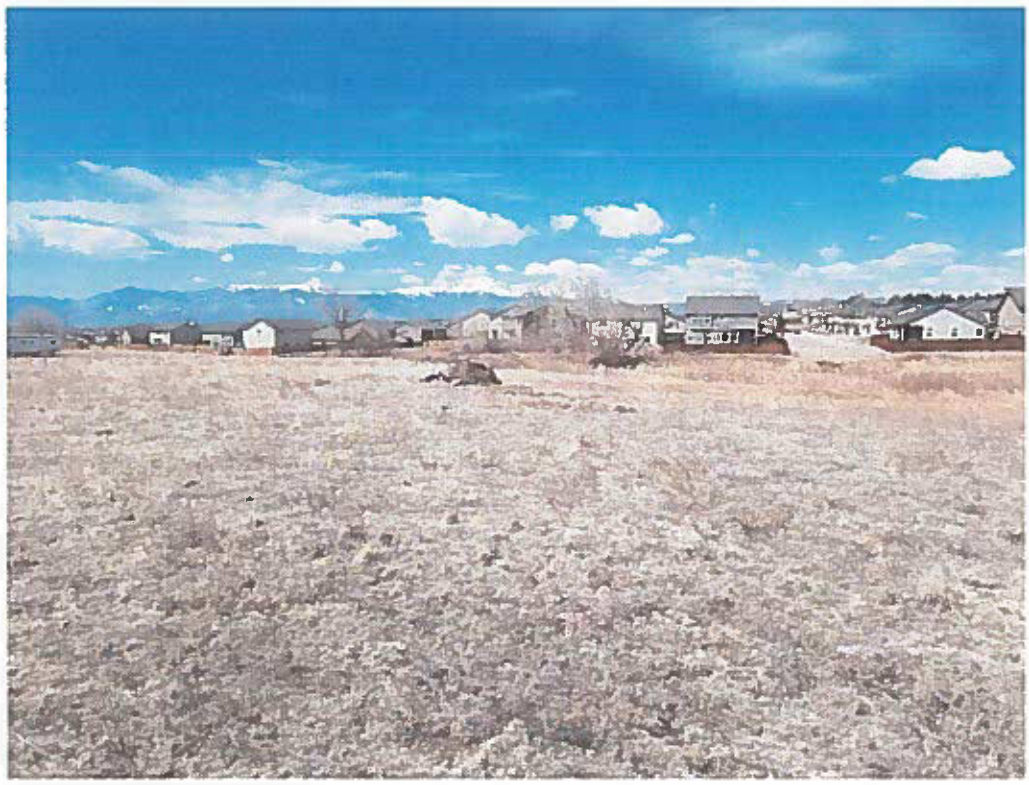
JOB NO.: 210932
FIG. NO.: 10

APPENDIX A: Site Photographs

1

Looking northeast from northern portion of the site.

April 19, 2021



2

Looking west from the northern portion of the site.

April 19, 2021

Job No. 210932

3

Looking south from northern portion of the site.

April 19, 2021

4

Looking south from the southwestern portion of the site.

April 19, 2021

Job No. 210932

5

Looking southeast from the southwestern portion of the site.

April 19, 2021

6

Looking northwest from the southern portion of the site.

April 19, 2021

Job No. 210932

7

Looking south from the central portion of the site.

April 19, 2021

8

Looking southeast from the central portion of the site.

April 19, 2021

Job No. 210932

APPENDIX B: Test Boring Logs & Laboratory Test Results, Preliminary Subsurface Soil Investigation, Entech Job No. 210932

TEST BORING NO. 1
DATE DRILLED 4/23/2021
Job # 210932

REMARKS

WATER @ 11', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			15	0.7	1
5			14	0.7	1
10			17	3.8	1
15			4	11.2	1
20			20	25.3	3

SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO LOOSE, DRY TO WET

HIGHLY WEATHERED SILTSTONE, SANDY, BLUE GRAY, STIFF, WET

TEST BORING NO. 2
DATE DRILLED 4/23/2021
CLIENT PHOENIX HOLDINGS
LOCATION 7020 WYOMING LANE

REMARKS

WATER @ 9', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			4	5.6	1
5			2	11.9	1
10			8	38.6	2
15			9		1
20			5	10.2	1

SAND, SILTY, FINE TO COARSE GRAINED, BROWN, LOOSE, MOIST

CLAY, SANDY, GRAY BROWN, FIRM, WET

SAND, SILTY, FINE TO COARSE GRAINED, TAN, LOOSE, WET

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO 210932
FIG NO A- 1

TEST BORING NO. 3
DATE DRILLED 4/23/2021
Job # 210932

REMARKS

WATER @ 12', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS
			12	0.6	1	SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, DRY TO MOIST
5			15	5.4	1	
10			12	4.2	1	
15			25	21.6	2	CLAY, SANDY, GRAY BROWN STIFF, WET
20						

TEST BORING NO. 4
DATE DRILLED 4/23/2021
CLIENT PHOENIX HOLDINGS
LOCATION 7020 WYOMING LANE

REMARKS

WATER @ 12', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS
			9	2.1	1	SAND, SILTY, FINE TO COARSE GRAINED, TAN, LOOSE, DRY TO MOIST
5			8	3.3	1	
10			5	31.6	2	CLAY, SANDY, TAN, SOFT, WET
15			50 | 6"	23.0	3	SILTSTONE, SANDY, GRAY BROWN, HARD, MOIST
20			50 | 8"	25.2	3	

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ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO. 210932
FIG NO. A- 2

TEST BORING NO. 5
DATE DRILLED 4/25/2021
Job # 210932

REMARKS

WATER @ 16', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE TO LOOSE, DRY TO WET		15	4.0	1
5			17	2.1	1
10			24	2.2	1
15			27	4.8	1
20			3	12.8	1

TEST BORING NO. 6
DATE DRILLED 4/25/2021
CLIENT PHOENIX HOLDINGS
LOCATION 7020 WYOMING LANE

REMARKS

WATER @ 11', 4/29/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, DRY TO MOIST		20	2.5	1
5			22	2.4	1
10			28	5.6	1
15	SILTSTONE, VERY SANDY, BLUE GRAY, HARD, MOIST		50/8"	23.1	3
20			50/6"	26.1	3

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO. 210932
FIG NO. A-3

TEST BORING NO. 7
DATE DRILLED 4/25/2021
Job # 210932

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 8', 4/29/21						
SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST				18	3.8	1
	5			14	6.0	1
SILTSTONE, SANDY, TAN, HARD, MOIST	10			50	24.9	3
	15			50/7"	20.5	3
	20			50/8"	26.0	3

TEST BORING NO. 8
DATE DRILLED 4/25/2021
CLIENT PHOENIX HOLDINGS
LOCATION 7020 WYOMING LANE

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 14', 4/29/21						
SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, DRY TO MOIST				26	2.3	1
	5			28	3.5	1
CLAY, SANDY, TAN, VERY STIFF, MOIST	10			41	27.5	2
WEATHERED TO FORMATIONAL SILTSTONE, SANDY, TAN, HARD, MOIST	15			45	20.9	3
	20			50/7"	18.0	3

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

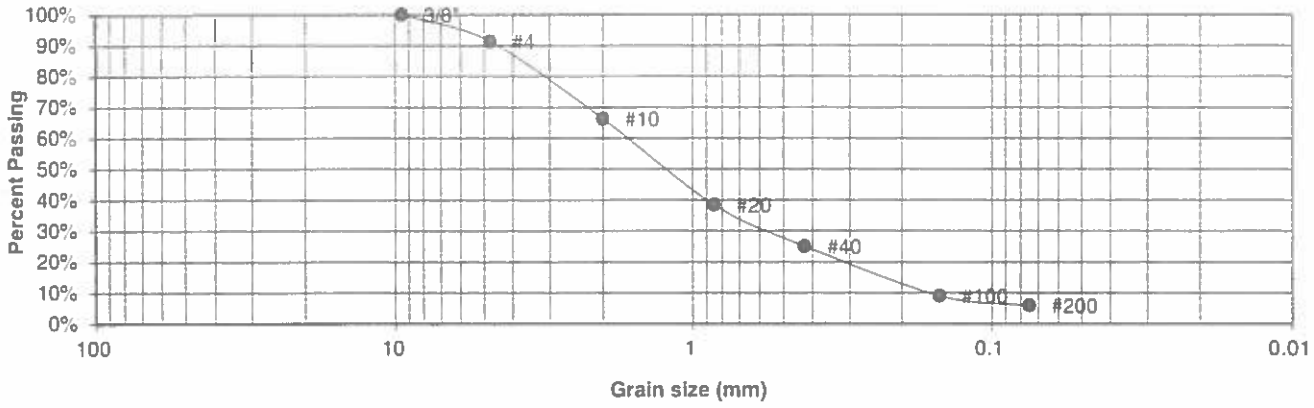
TEST BORING LOG

DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO 210932
FIG NO A- 4

UNIFIED CLASSIFICATION	SM-SW	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	1	PROJECT	7020 WYOMING LANE
TEST BORING #	1	JOB NO.	210932
DEPTH (FT)	2-3	TEST BY	BL

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	91.3%
10	66.3%
20	38.4%
40	25.0%
100	9.0%
200	5.9%

Atterberg Limits

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell

Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

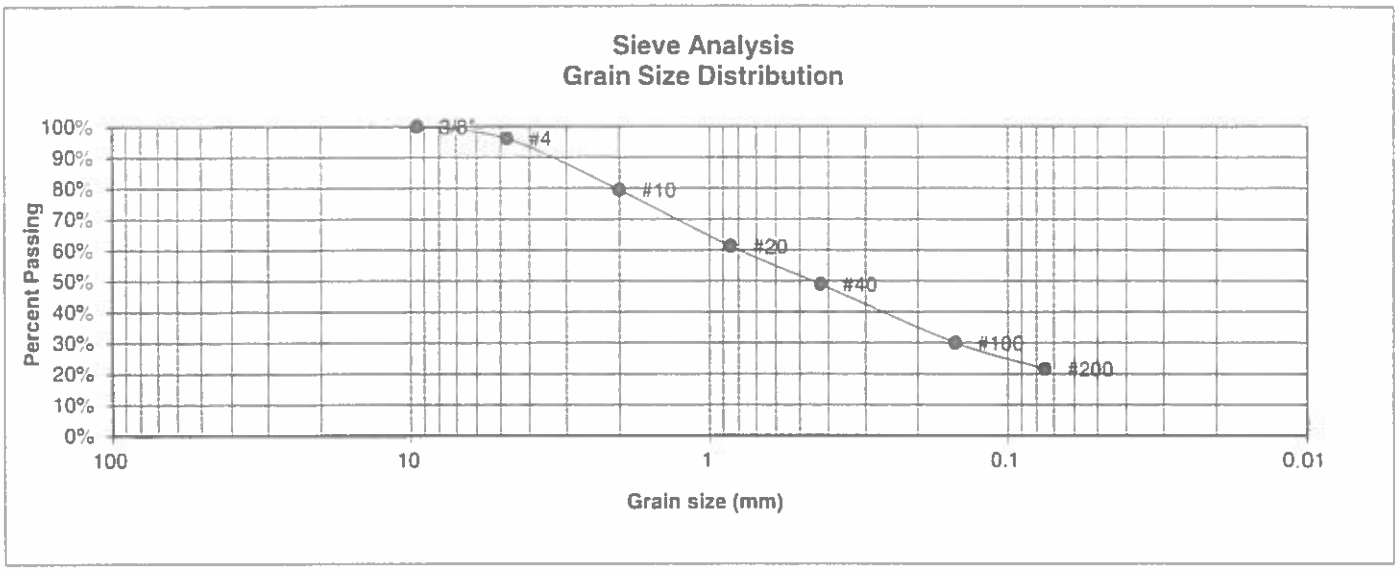
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO 210932

FIG NO B-1

UNIFIED CLASSIFICATION	SM	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	1	PROJECT	7020 WYOMING LANE
TEST BORING #	5	JOB NO.	210932
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.1%
10	79.5%
20	61.2%
40	48.9%
100	30.0%
200	21.6%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

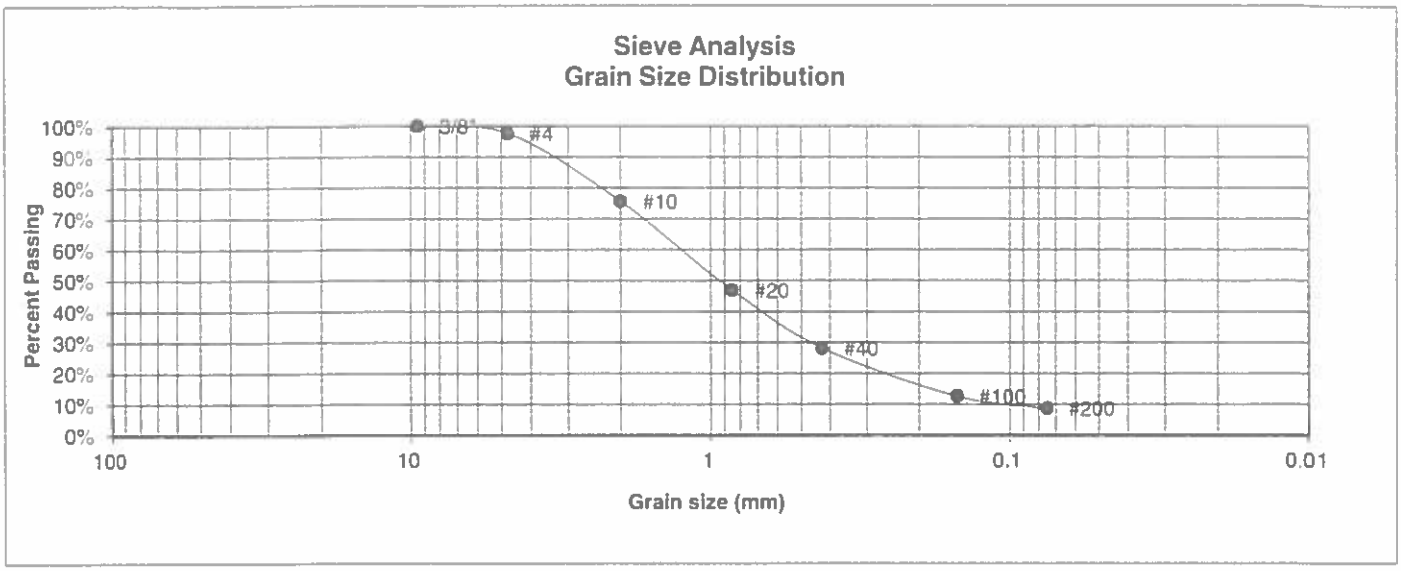
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO 210932

FIG NO B-2

UNIFIED CLASSIFICATION	SM-SW	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	1	PROJECT	7020 WYOMING LANE
TEST BORING #	3	JOB NO.	210932
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.7%
10	75.7%
20	46.9%
40	28.1%
100	12.6%
200	8.7%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

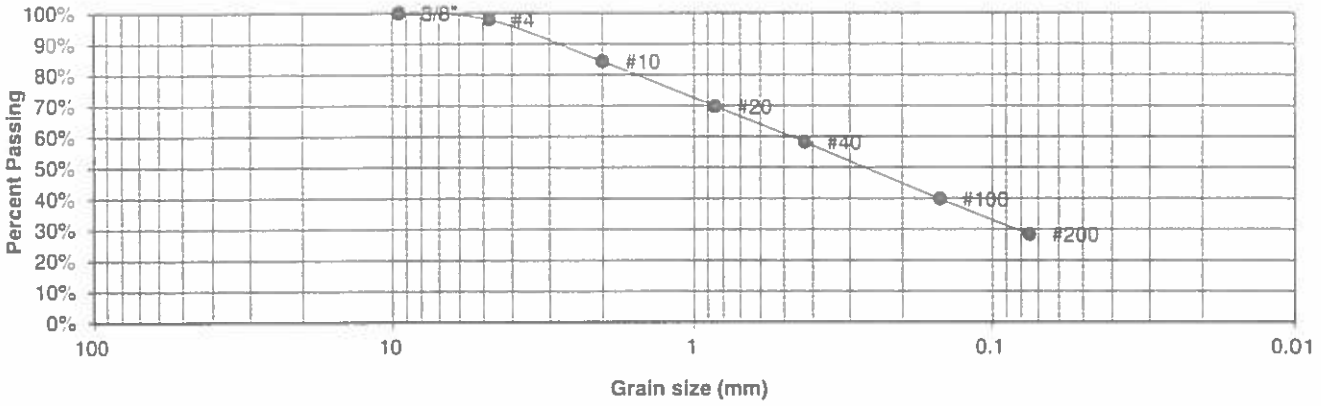
DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO 210932

FIG NO B-3

UNIFIED CLASSIFICATION	SM	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	1	PROJECT	7020 WYOMING LANE
TEST BORING #	7	JOB NO.	210932
DEPTH (FT)	2-3	TEST BY	BL

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.9%
10	84.3%
20	69.7%
40	58.2%
100	39.8%
200	28.3%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

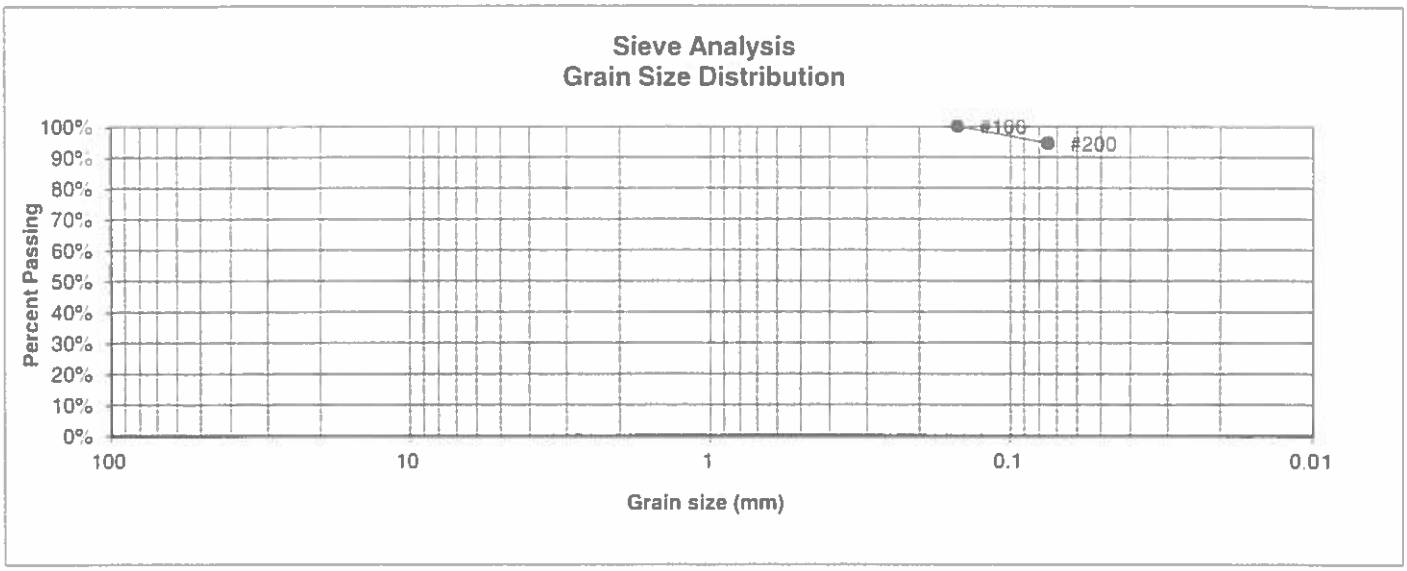
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED:	DATE
		LLL	5/12/21

JOB NO. 210932

FIG NO. B-4

UNIFIED CLASSIFICATION	CH	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	2	PROJECT	7020 WYOMING LANE
TEST BORING #	2	JOB NO.	210932
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	
40	
100	100.0%
200	94.5%

Atterberg Limits	
Plastic Limit	29
Liquid Limit	57
Plastic Index	28

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

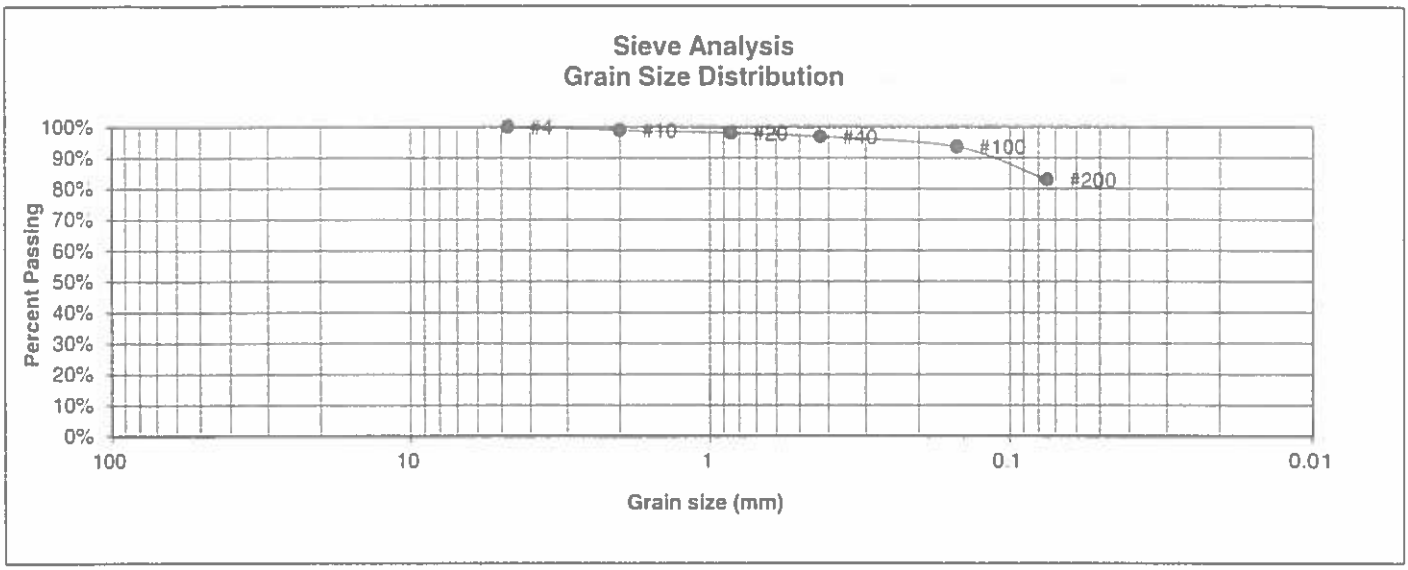
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED:	DATE
		LLL	5/2/21

JOB NO 210932

FIG NO B-5

UNIFIED CLASSIFICATION	CL	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	2	PROJECT	7020 WYOMING LANE
TEST BORING #	4	JOB NO.	210932
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.0%
20	98.1%
40	96.9%
100	93.6%
200	82.9%

Atterberg Limits	
Plastic Limit	
Liquid Limit	
Plastic Index	
Swell	
Moisture at start	16.6%
Moisture at finish	24.9%
Moisture increase	8.3%
Initial dry density (pcf)	95
Swell (psf)	670

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

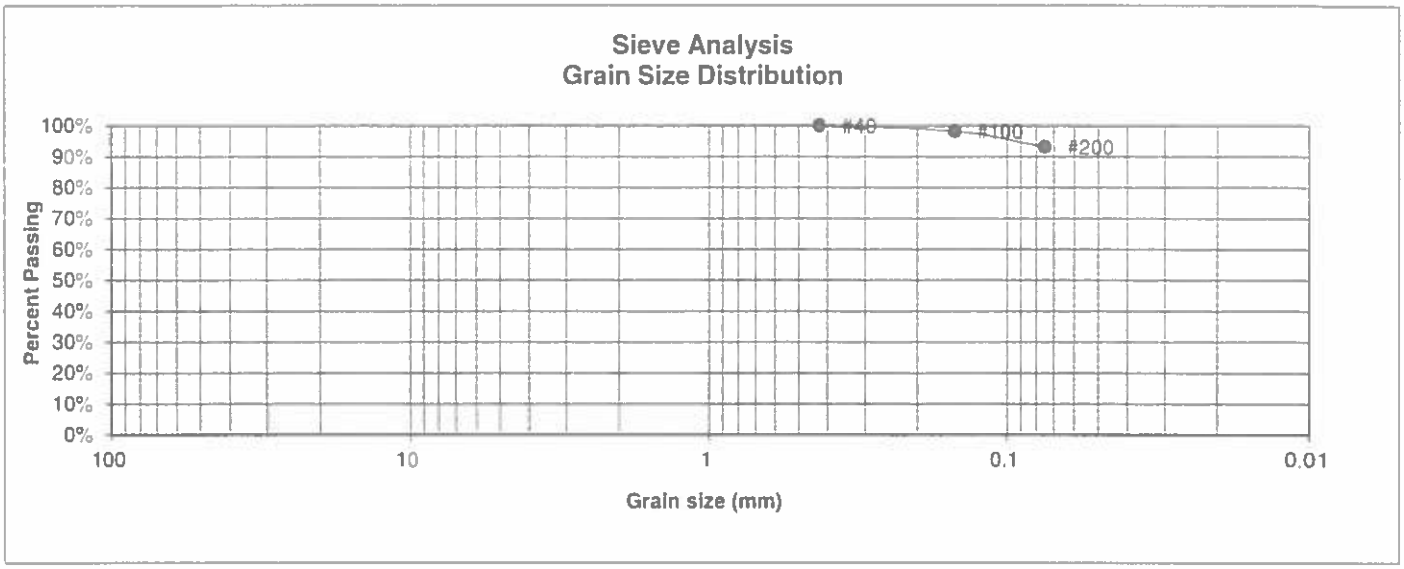
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		LLL	5/12/21

JOB NO 210932

FIG NO B-6

UNIFIED CLASSIFICATION	CL	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	2	PROJECT	7020 WYOMING LANE
TEST BORING #	8	JOB NO.	210932
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	
40	100.0%
100	98.3%
200	93.2%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

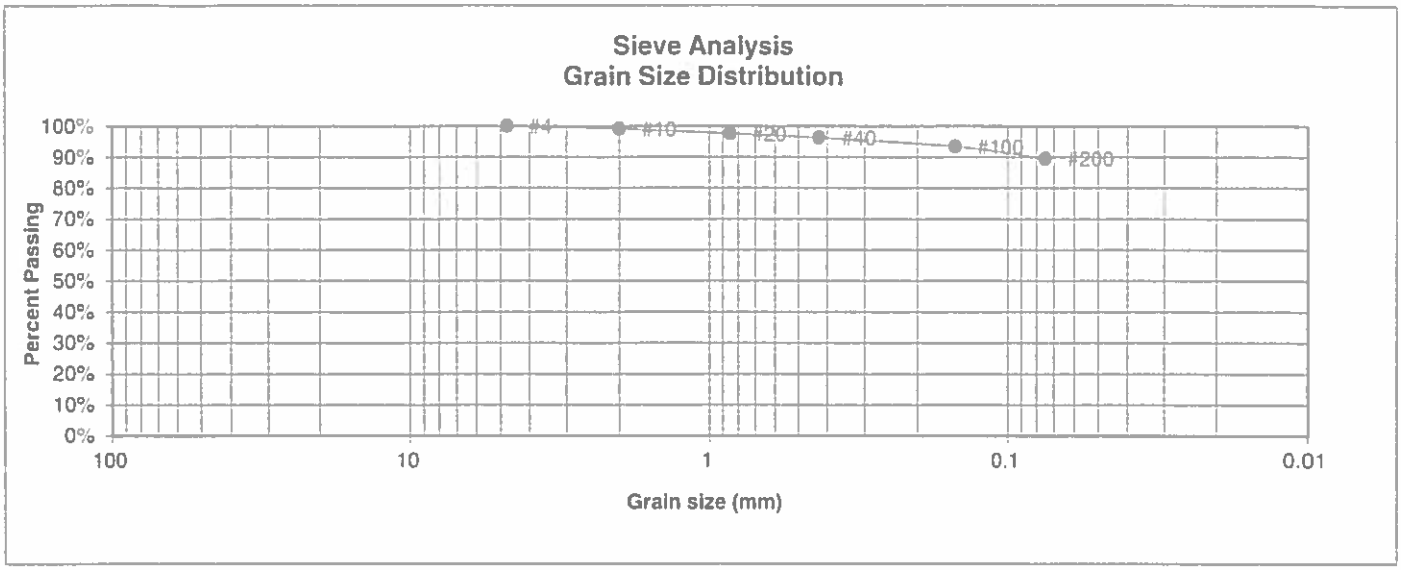
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED:	DATE
		LLL	5/12/21

JOB NO 210932

FIG NO B-7

UNIFIED CLASSIFICATION	ML	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	3	PROJECT	7020 WYOMING LANE
TEST BORING #	1	JOB NO.	210932
DEPTH (FT)	20	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.1%
20	97.5%
40	96.2%
100	93.4%
200	89.5%

Atterberg Limits	
Plastic Limit	29
Liquid Limit	45
Plastic Index	16

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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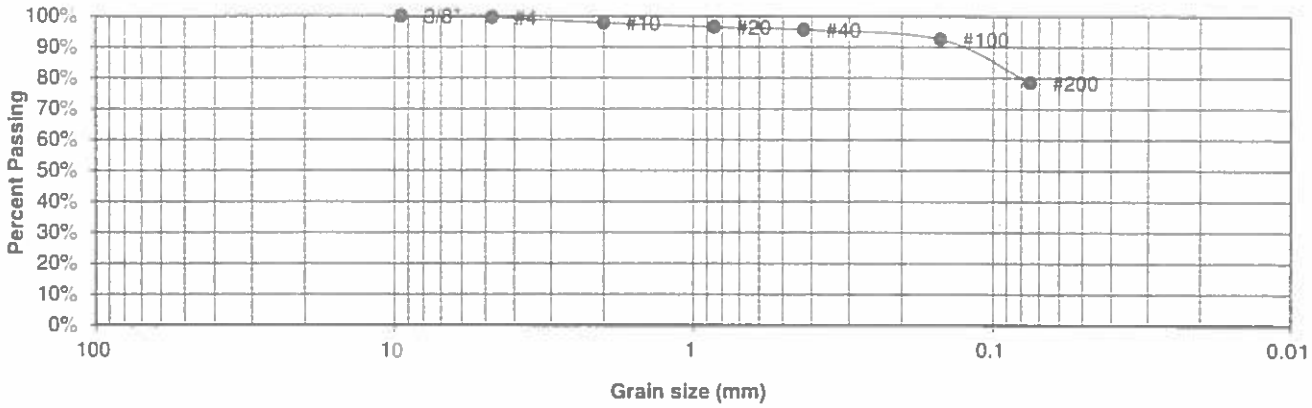
DRAWN	DATE	CHECKED:	DATE:
		LLC	5/12/21

JOB NO 210932

FIG NO B-8

UNIFIED CLASSIFICATION	ML	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	3	PROJECT	7020 WYOMING LANE
TEST BORING #	4	JOB NO.	210932
DEPTH (FT)	15	TEST BY	BL

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.5%
10	97.8%
20	96.5%
40	95.6%
100	92.5%
200	78.5%

Atterberg Limits	
Plastic Limit	27
Liquid Limit	42
Plastic Index	15

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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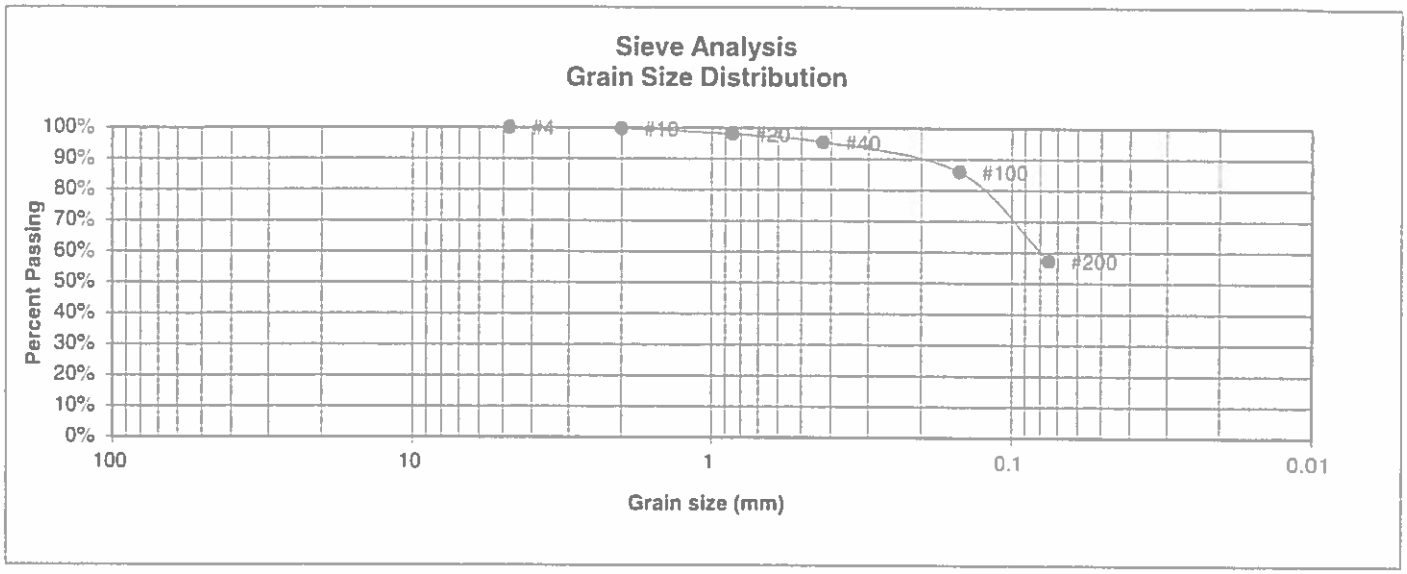
DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO 210932

FIG NO B-9

UNIFIED CLASSIFICATION	ML	CLIENT	PHOENIX HOLDINGS
SOIL TYPE #	3	PROJECT	7020 WYOMING LANE
TEST BORING #	6	JOB NO.	210932
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.7%
20	98.0%
40	95.4%
100	86.0%
200	57.3%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

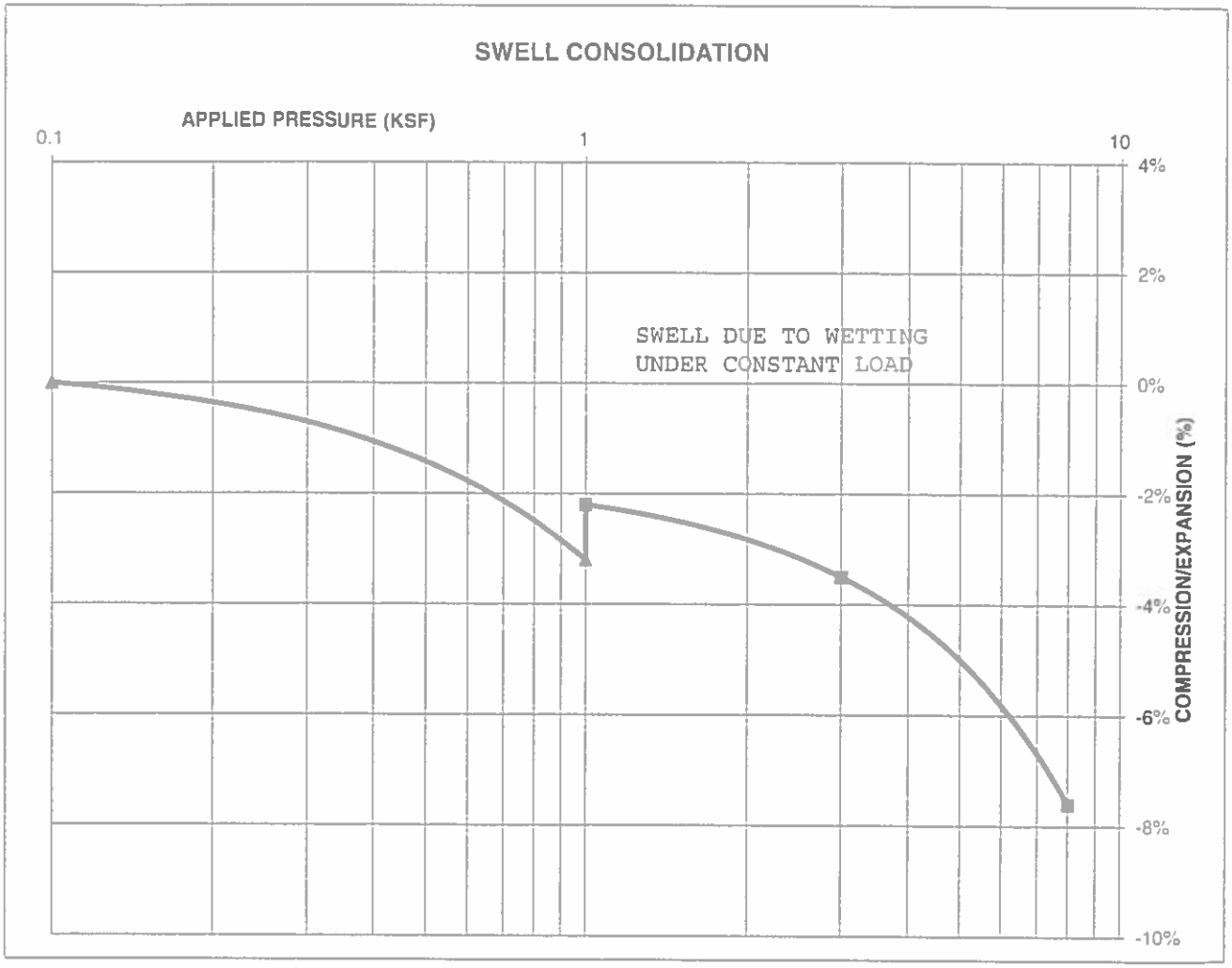
JOB NO 210932

FIG NO B-10

CONSOLIDATION TEST RESULTS

TEST BORING #	2	DEPTH(ft)	10
DESCRIPTION	CH	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			82
NATURAL MOISTURE CONTENT			39.2%
SWELL/CONSOLIDATION (%)			1.0%

JOB NO. 210932
CLIENT PHOENIX HOLDINGS
PROJECT 7020 WYOMING LANE



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SWELL CONSOLIDATION
TEST RESULTS

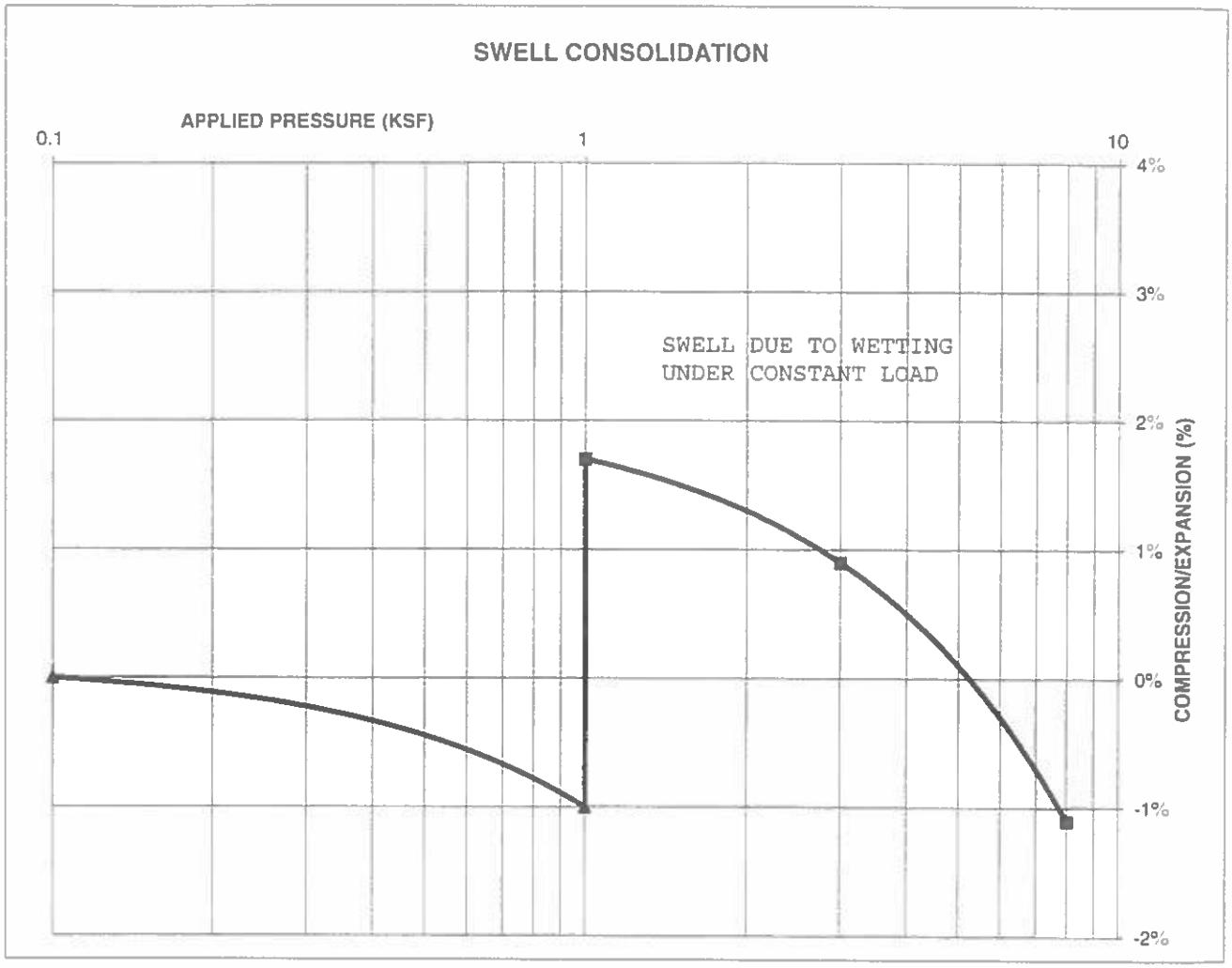
DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO 210932
FIG NO B-11

CONSOLIDATION TEST RESULTS

TEST BORING #	8	DEPTH(ft)	10
DESCRIPTION	CL	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			96
NATURAL MOISTURE CONTENT			25.5%
SWELL/CONSOLIDATION (%)			2.7%

JOB NO. 210932
CLIENT PHOENIX HOLDINGS
PROJECT 7020 WYOMING LANE



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SWELL CONSOLIDATION
TEST RESULTS

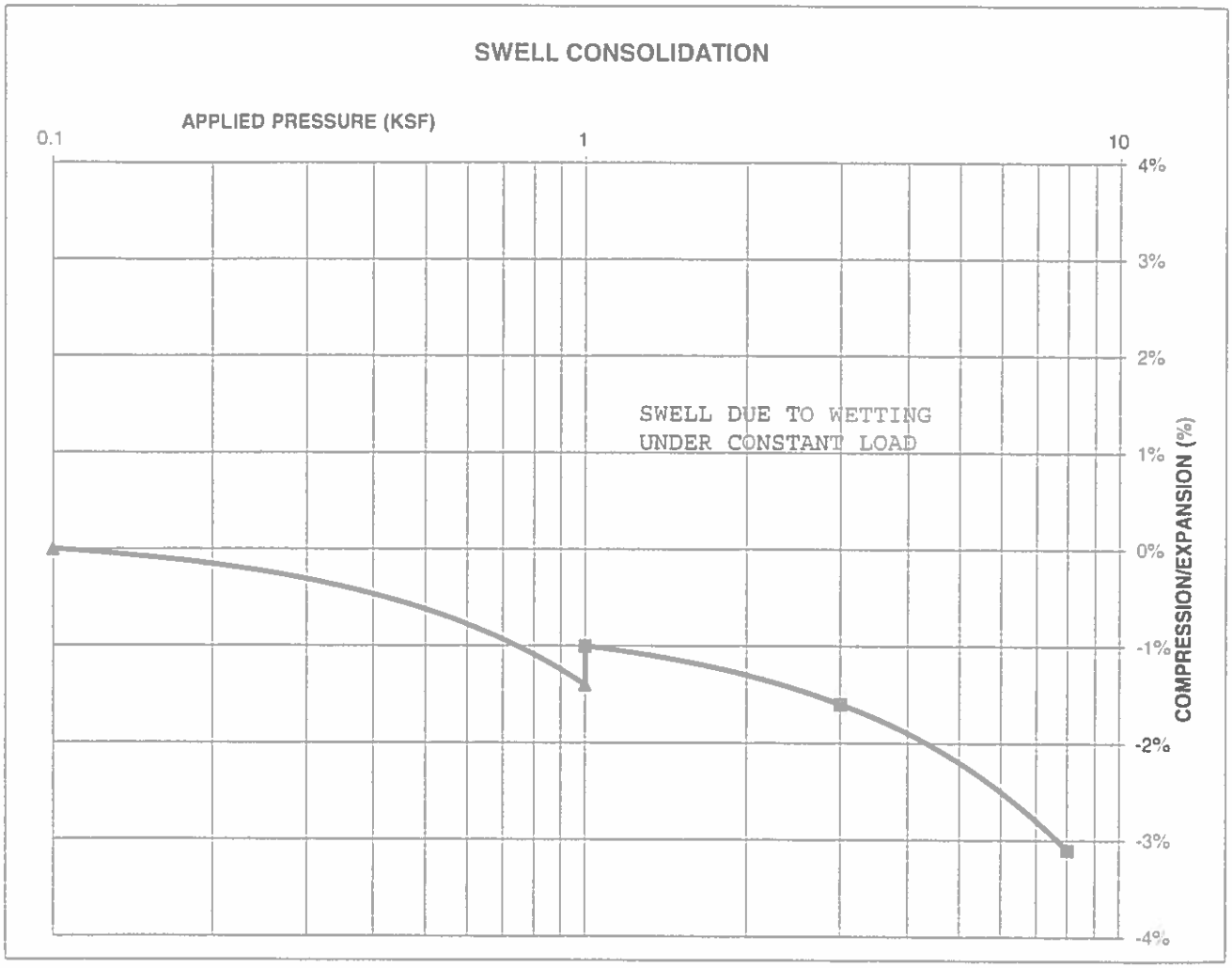
DRAWN	DATE	CHECKED:	DATE
		LLL	5/12/21

JOB NO. 210932
FIG NO. B-12

CONSOLIDATION TEST RESULTS

TEST BORING #	4	DEPTH(ft)	15
DESCRIPTION	ML	SOIL TYPE	3
NATURAL UNIT DRY WEIGHT (PCF)			106
NATURAL MOISTURE CONTENT			22.5%
SWELL/CONSOLIDATION (%)			0.4%

JOB NO. 210932
CLIENT PHOENIX HOLDINGS
PROJECT 7020 WYOMING LANE



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COLORADO SPRINGS COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

DRAWN	DATE	CHECKED	DATE
		LLL	5/12/21

JOB NO. 210932
FIG NO. B-13

CLIENT	PHOENIX HOLDINGS	JOB NO.	210932
PROJECT	7020 WYOMING LANE	DATE	5/4/2021
LOCATION	7020 WYOMING LANE	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	2-3	1	SM-SW	<0.01
TB-1	20	3	ML	0.02
TB-2	10	2	CH	0.02
TB-4	15	3	ML	<0.01

QC BLANK PASS

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LABORATORY TEST
SULFATE RESULTS

DRAWN	DATE	CHECKED:	DATE
		LLL	5/12/21

JOB NO.: 210932

FIG NO.: B-14

APPENDIX C: Soil Survey Discerptions

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

Data Source Information

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

El Paso County Area, Colorado

10—Blendon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3671
Elevation: 6,000 to 6,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blendon and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blendon

Setting

Landform: Terraces, alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 10 inches: sandy loam
Bw - 10 to 36 inches: sandy loam
C - 36 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Available water capacity: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy 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

Data Source Information

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

COLORADO GEOLOGICAL SURVEY

1801 Moly Road
Golden, Colorado 80401

Matthew L. Morgan
State Geologist

August 7, 2025

Joel Dagnillo
Engineering Development Review
2880 International Circle, 200-7
Colorado Springs, CO 80910

Location:
NW ¼ of SE ¼ of Sec 8
T13S, R65W of the 6th PM
38.9331°, -104.6910°

Subject: **0514 Miller Downs**
Colorado Springs, El Paso County, CO
City No. STM-REV25-0514; CGS Unique No. EP-25-0004

Dear Joel,

The Colorado Geological Survey (CGS) has reviewed the referral, per your request (email dated April 1, 2025). The Miller Downs application proposes the rezoning of approximately 21.4 acres for the construction of approximately 140 residential units, including detached single-family and paired townhome units. The site is located along Sand Creek and includes areas mapped within FEMA Zone AE floodplain and the City's Streamside Overlay.

CGS generally agrees with Entech's geologic interpretation and the identification of hazards and constraints related to the geology, as well as the proposed mitigation measures. CGS has no objection to approval provided all of Entech's recommendations are strictly adhered to. We agree with Entech and recommend site-specific investigations for individual structures, including testing and analysis, to design foundations, floor systems, subsurface drainage, pavements, and more. Given the relatively shallow groundwater encountered in the exploratory borings, Entech stated on p.9 that "groundwater should not affect shallow foundations on the majority of the site." CGS recommends that basements be restricted at this site unless a groundwater monitoring program is carried out through a complete annual cycle, measuring groundwater elevations at this location. We also suggest that this restriction be noted on the site plans along with the required geologic hazard disclosure statement.

Thank you for the opportunity to provide this review. If you need additional clarification, please contact me at jlovekin@mines.edu.

Sincerely,

Jonathan R. Lovekin, P.G.
Senior Engineering Geologist

APPENDIX D – HYDROLOGIC CALCULATIONS

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.9329°, Longitude: -104.6898°
Elevation: 6821 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.236** (0.195-0.289)	**0.288** (0.237-0.352)	**0.378** (0.310-0.464)	**0.458** (0.373-0.564)	**0.575** (0.455-0.741)	**0.671** (0.516-0.875)	**0.772** (0.572-1.03)	**0.879** (0.623-1.21)	**1.03** (0.699-1.45)	**1.15** (0.757-1.64)
10-min	**0.346** (0.285-0.423)	**0.422** (0.347-0.516)	**0.554** (0.454-0.679)	**0.670** (0.547-0.826)	**0.842** (0.666-1.08)	**0.982** (0.756-1.28)	**1.13** (0.837-1.51)	**1.29** (0.912-1.77)	**1.51** (1.02-2.13)	**1.68** (1.11-2.40)
15-min	**0.422** (0.348-0.516)	**0.514** (0.423-0.629)	**0.675** (0.554-0.829)	**0.817** (0.666-1.01)	**1.03** (0.812-1.32)	**1.20** (0.921-1.56)	**1.38** (1.02-1.84)	**1.57** (1.11-2.16)	**1.84** (1.25-2.59)	**2.05** (1.35-2.92)
30-min	**0.613** (0.505-0.750)	**0.747** (0.615-0.914)	**0.979** (0.803-1.20)	**1.18** (0.966-1.46)	**1.49** (1.18-1.92)	**1.73** (1.33-2.26)	**1.99** (1.48-2.66)	**2.27** (1.61-3.12)	**2.66** (1.81-3.75)	**2.97** (1.96-4.23)
60-min	**0.797** (0.657-0.975)	**0.949** (0.782-1.16)	**1.23** (1.01-1.50)	**1.48** (1.21-1.83)	**1.88** (1.49-2.44)	**2.21** (1.71-2.90)	**2.57** (1.91-3.45)	**2.96** (2.11-4.09)	**3.53** (2.40-4.99)	**3.98** (2.62-5.68)
2-hr	**0.981** (0.815-1.19)	**1.15** (0.955-1.40)	**1.47** (1.22-1.80)	**1.78** (1.46-2.18)	**2.26** (1.82-2.94)	**2.68** (2.09-3.51)	**3.14** (2.36-4.21)	**3.65** (2.62-5.02)	**4.39** (3.02-6.20)	**5.00** (3.32-7.08)
3-hr	**1.08** (0.903-1.31)	**1.25** (1.04-1.51)	**1.58** (1.31-1.92)	**1.91** (1.58-2.33)	**2.45** (1.99-3.18)	**2.92** (2.30-3.82)	**3.45** (2.61-4.62)	**4.05** (2.92-5.56)	**4.92** (3.40-6.93)	**5.65** (3.77-7.97)
6-hr	**1.26** (1.06-1.51)	**1.44** (1.21-1.73)	**1.81** (1.51-2.18)	**2.18** (1.81-2.64)	**2.80** (2.30-3.63)	**3.37** (2.67-4.39)	**4.00** (3.05-5.33)	**4.72** (3.44-6.45)	**5.78** (4.03-8.10)	**6.67** (4.48-9.35)
12-hr	**1.45** (1.23-1.73)	**1.67** (1.41-1.99)	**2.11** (1.78-2.52)	**2.55** (2.13-3.06)	**3.26** (2.68-4.17)	**3.89** (3.10-5.02)	**4.59** (3.52-6.06)	**5.38** (3.94-7.29)	**6.54** (4.59-9.09)	**7.51** (5.08-10.5)
24-hr	**1.66** (1.42-1.97)	**1.95** (1.66-2.31)	**2.49** (2.11-2.95)	**2.99** (2.52-3.57)	**3.78** (3.12-4.77)	**4.46** (3.57-5.68)	**5.20** (4.01-6.79)	**6.02** (4.44-8.07)	**7.20** (5.08-9.91)	**8.17** (5.58-11.3)
2-day	**1.93** (1.66-2.27)	**2.28** (1.96-2.68)	**2.91** (2.49-3.43)	**3.48** (2.96-4.12)	**4.34** (3.59-5.39)	**5.06** (4.06-6.36)	**5.82** (4.51-7.51)	**6.66** (4.93-8.82)	**7.83** (5.56-10.7)	**8.78** (6.04-12.1)
3-day	**2.12** (1.83-2.48)	**2.51** (2.16-2.93)	**3.18** (2.73-3.73)	**3.78** (3.23-4.46)	**4.68** (3.88-5.78)	**5.43** (4.38-6.79)	**6.23** (4.84-7.98)	**7.08** (5.26-9.34)	**8.29** (5.91-11.2)	**9.26** (6.40-12.7)
4-day	**2.29** (1.98-2.67)	**2.69** (2.32-3.13)	**3.38** (2.91-3.96)	**4.01** (3.43-4.71)	**4.94** (4.11-6.08)	**5.71** (4.62-7.11)	**6.53** (5.09-8.35)	**7.41** (5.53-9.74)	**8.65** (6.19-11.7)	**9.65** (6.69-13.2)
7-day	**2.71** (2.36-3.13)	**3.13** (2.72-3.63)	**3.88** (3.36-4.51)	**4.55** (3.92-5.31)	**5.54** (4.64-6.77)	**6.37** (5.18-7.88)	**7.24** (5.68-9.19)	**8.18** (6.14-10.7)	**9.49** (6.83-12.8)	**10.6** (7.36-14.3)
10-day	**3.08** (2.69-3.55)	**3.54** (3.09-4.08)	**4.34** (3.78-5.03)	**5.06** (4.37-5.88)	**6.11** (5.13-7.42)	**6.98** (5.70-8.59)	**7.89** (6.22-9.97)	**8.87** (6.68-11.5)	**10.2** (7.40-13.7)	**11.3** (7.94-15.3)
20-day	**4.12** (3.63-4.72)	**4.73** (4.16-5.42)	**5.76** (5.05-6.62)	**6.64** (5.78-7.66)	**7.89** (6.65-9.45)	**8.89** (7.30-10.8)	**9.92** (7.86-12.4)	**11.0** (8.33-14.1)	**12.5** (9.06-16.5)	**13.6** (9.61-18.3)
30-day	**4.98** (4.41-5.68)	**5.73** (5.06-6.53)	**6.95** (6.12-7.95)	**7.97** (6.98-9.16)	**9.38** (7.92-11.1)	**10.5** (8.64-12.6)	**11.6** (9.21-14.4)	**12.7** (9.67-16.2)	**14.2** (10.4-18.7)	**15.4** (10.9-20.6)
45-day	**6.06** (5.39-6.87)	**6.97** (6.19-7.91)	**8.43** (7.46-9.60)	**9.62** (8.46-11.0)	**11.2** (9.50-13.2)	**12.4** (10.3-14.9)	**13.6** (10.9-16.8)	**14.8** (11.3-18.8)	**16.4** (12.0-21.4)	**17.5** (12.5-23.3)
60-day	**6.96** (6.21-7.87)	**8.01** (7.14-9.06)	**9.67** (8.59-11.0)	**11.0** (9.71-12.5)	**12.8** (10.8-14.9)	**14.1** (11.6-16.7)	**15.3** (12.2-18.7)	**16.5** (12.6-20.8)	**18.1** (13.2-23.5)	**19.2** (13.7-25.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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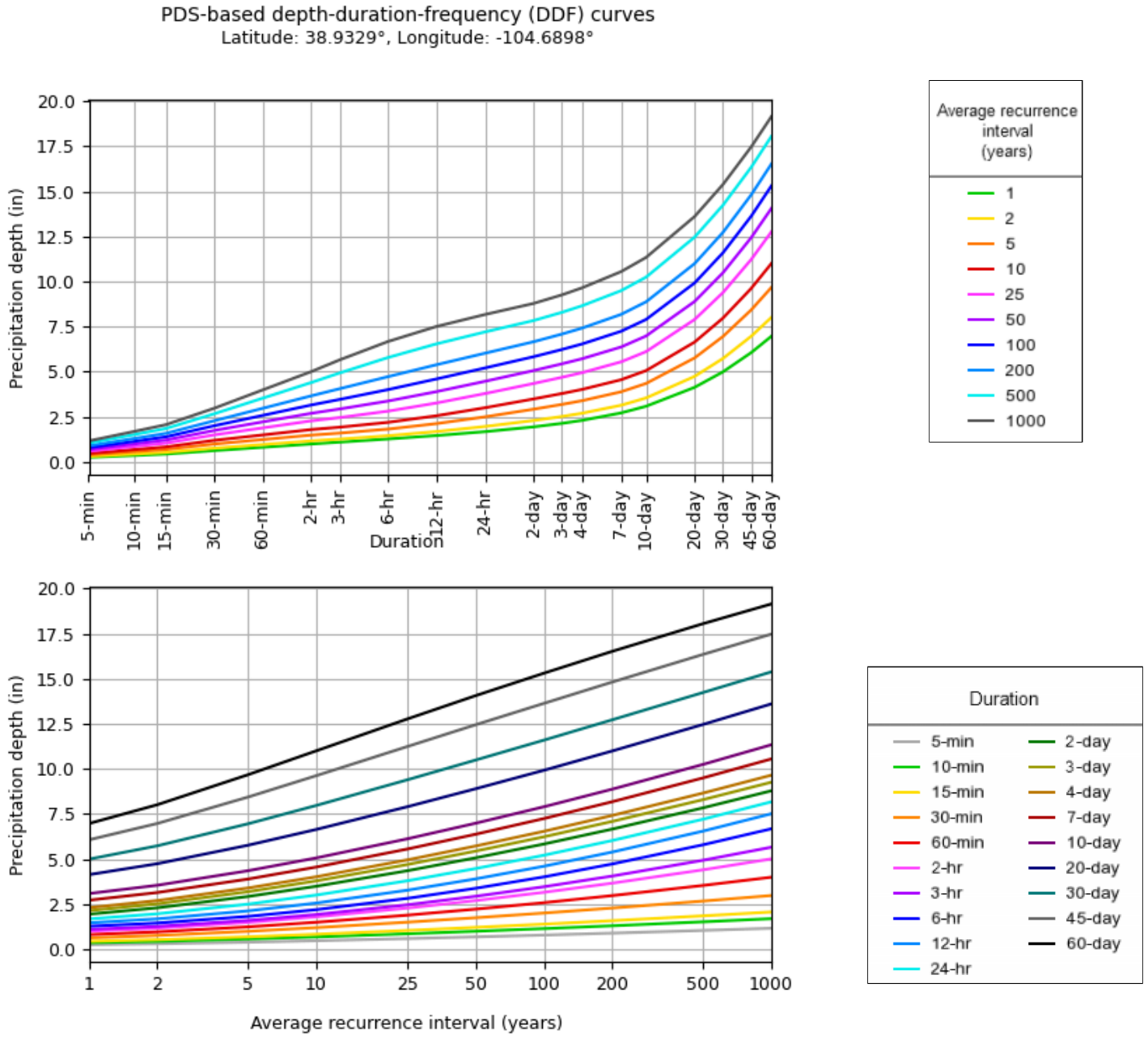
PF graphical



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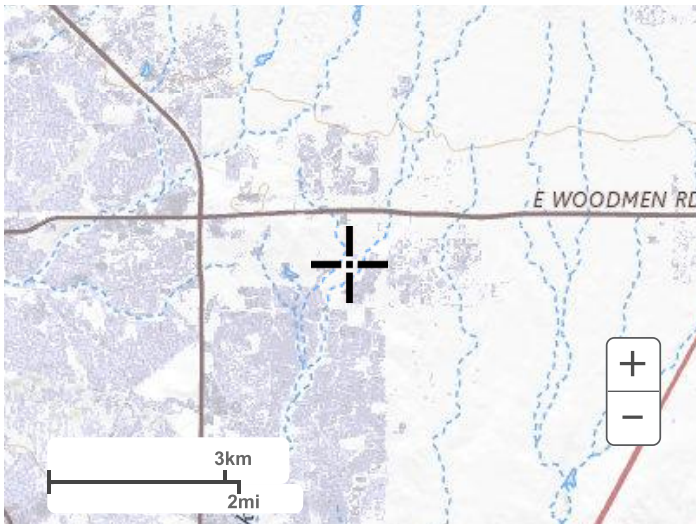
Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
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APPENDIX D – HYDROLOGIC CALCULATIONS

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.9329°, Longitude: -104.6898°
Elevation: 6821 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.236** (0.195-0.289)	**0.288** (0.237-0.352)	**0.378** (0.310-0.464)	**0.458** (0.373-0.564)	**0.575** (0.455-0.741)	**0.671** (0.516-0.875)	**0.772** (0.572-1.03)	**0.879** (0.623-1.21)	**1.03** (0.699-1.45)	**1.15** (0.757-1.64)
10-min	**0.346** (0.285-0.423)	**0.422** (0.347-0.516)	**0.554** (0.454-0.679)	**0.670** (0.547-0.826)	**0.842** (0.666-1.08)	**0.982** (0.756-1.28)	**1.13** (0.837-1.51)	**1.29** (0.912-1.77)	**1.51** (1.02-2.13)	**1.68** (1.11-2.40)
15-min	**0.422** (0.348-0.516)	**0.514** (0.423-0.629)	**0.675** (0.554-0.829)	**0.817** (0.666-1.01)	**1.03** (0.812-1.32)	**1.20** (0.921-1.56)	**1.38** (1.02-1.84)	**1.57** (1.11-2.16)	**1.84** (1.25-2.59)	**2.05** (1.35-2.92)
30-min	**0.613** (0.505-0.750)	**0.747** (0.615-0.914)	**0.979** (0.803-1.20)	**1.18** (0.966-1.46)	**1.49** (1.18-1.92)	**1.73** (1.33-2.26)	**1.99** (1.48-2.66)	**2.27** (1.61-3.12)	**2.66** (1.81-3.75)	**2.97** (1.96-4.23)
60-min	**0.797** (0.657-0.975)	**0.949** (0.782-1.16)	**1.23** (1.01-1.50)	**1.48** (1.21-1.83)	**1.88** (1.49-2.44)	**2.21** (1.71-2.90)	**2.57** (1.91-3.45)	**2.96** (2.11-4.09)	**3.53** (2.40-4.99)	**3.98** (2.62-5.68)
2-hr	**0.981** (0.815-1.19)	**1.15** (0.955-1.40)	**1.47** (1.22-1.80)	**1.78** (1.46-2.18)	**2.26** (1.82-2.94)	**2.68** (2.09-3.51)	**3.14** (2.36-4.21)	**3.65** (2.62-5.02)	**4.39** (3.02-6.20)	**5.00** (3.32-7.08)
3-hr	**1.08** (0.903-1.31)	**1.25** (1.04-1.51)	**1.58** (1.31-1.92)	**1.91** (1.58-2.33)	**2.45** (1.99-3.18)	**2.92** (2.30-3.82)	**3.45** (2.61-4.62)	**4.05** (2.92-5.56)	**4.92** (3.40-6.93)	**5.65** (3.77-7.97)
6-hr	**1.26** (1.06-1.51)	**1.44** (1.21-1.73)	**1.81** (1.51-2.18)	**2.18** (1.81-2.64)	**2.80** (2.30-3.63)	**3.37** (2.67-4.39)	**4.00** (3.05-5.33)	**4.72** (3.44-6.45)	**5.78** (4.03-8.10)	**6.67** (4.48-9.35)
12-hr	**1.45** (1.23-1.73)	**1.67** (1.41-1.99)	**2.11** (1.78-2.52)	**2.55** (2.13-3.06)	**3.26** (2.68-4.17)	**3.89** (3.10-5.02)	**4.59** (3.52-6.06)	**5.38** (3.94-7.29)	**6.54** (4.59-9.09)	**7.51** (5.08-10.5)
24-hr	**1.66** (1.42-1.97)	**1.95** (1.66-2.31)	**2.49** (2.11-2.95)	**2.99** (2.52-3.57)	**3.78** (3.12-4.77)	**4.46** (3.57-5.68)	**5.20** (4.01-6.79)	**6.02** (4.44-8.07)	**7.20** (5.08-9.91)	**8.17** (5.58-11.3)
2-day	**1.93** (1.66-2.27)	**2.28** (1.96-2.68)	**2.91** (2.49-3.43)	**3.48** (2.96-4.12)	**4.34** (3.59-5.39)	**5.06** (4.06-6.36)	**5.82** (4.51-7.51)	**6.66** (4.93-8.82)	**7.83** (5.56-10.7)	**8.78** (6.04-12.1)
3-day	**2.12** (1.83-2.48)	**2.51** (2.16-2.93)	**3.18** (2.73-3.73)	**3.78** (3.23-4.46)	**4.68** (3.88-5.78)	**5.43** (4.38-6.79)	**6.23** (4.84-7.98)	**7.08** (5.26-9.34)	**8.29** (5.91-11.2)	**9.26** (6.40-12.7)
4-day	**2.29** (1.98-2.67)	**2.69** (2.32-3.13)	**3.38** (2.91-3.96)	**4.01** (3.43-4.71)	**4.94** (4.11-6.08)	**5.71** (4.62-7.11)	**6.53** (5.09-8.35)	**7.41** (5.53-9.74)	**8.65** (6.19-11.7)	**9.65** (6.69-13.2)
7-day	**2.71** (2.36-3.13)	**3.13** (2.72-3.63)	**3.88** (3.36-4.51)	**4.55** (3.92-5.31)	**5.54** (4.64-6.77)	**6.37** (5.18-7.88)	**7.24** (5.68-9.19)	**8.18** (6.14-10.7)	**9.49** (6.83-12.8)	**10.6** (7.36-14.3)
10-day	**3.08** (2.69-3.55)	**3.54** (3.09-4.08)	**4.34** (3.78-5.03)	**5.06** (4.37-5.88)	**6.11** (5.13-7.42)	**6.98** (5.70-8.59)	**7.89** (6.22-9.97)	**8.87** (6.68-11.5)	**10.2** (7.40-13.7)	**11.3** (7.94-15.3)
20-day	**4.12** (3.63-4.72)	**4.73** (4.16-5.42)	**5.76** (5.05-6.62)	**6.64** (5.78-7.66)	**7.89** (6.65-9.45)	**8.89** (7.30-10.8)	**9.92** (7.86-12.4)	**11.0** (8.33-14.1)	**12.5** (9.06-16.5)	**13.6** (9.61-18.3)
30-day	**4.98** (4.41-5.68)	**5.73** (5.06-6.53)	**6.95** (6.12-7.95)	**7.97** (6.98-9.16)	**9.38** (7.92-11.1)	**10.5** (8.64-12.6)	**11.6** (9.21-14.4)	**12.7** (9.67-16.2)	**14.2** (10.4-18.7)	**15.4** (10.9-20.6)
45-day	**6.06** (5.39-6.87)	**6.97** (6.19-7.91)	**8.43** (7.46-9.60)	**9.62** (8.46-11.0)	**11.2** (9.50-13.2)	**12.4** (10.3-14.9)	**13.6** (10.9-16.8)	**14.8** (11.3-18.8)	**16.4** (12.0-21.4)	**17.5** (12.5-23.3)
60-day	**6.96** (6.21-7.87)	**8.01** (7.14-9.06)	**9.67** (8.59-11.0)	**11.0** (9.71-12.5)	**12.8** (10.8-14.9)	**14.1** (11.6-16.7)	**15.3** (12.2-18.7)	**16.5** (12.6-20.8)	**18.1** (13.2-23.5)	**19.2** (13.7-25.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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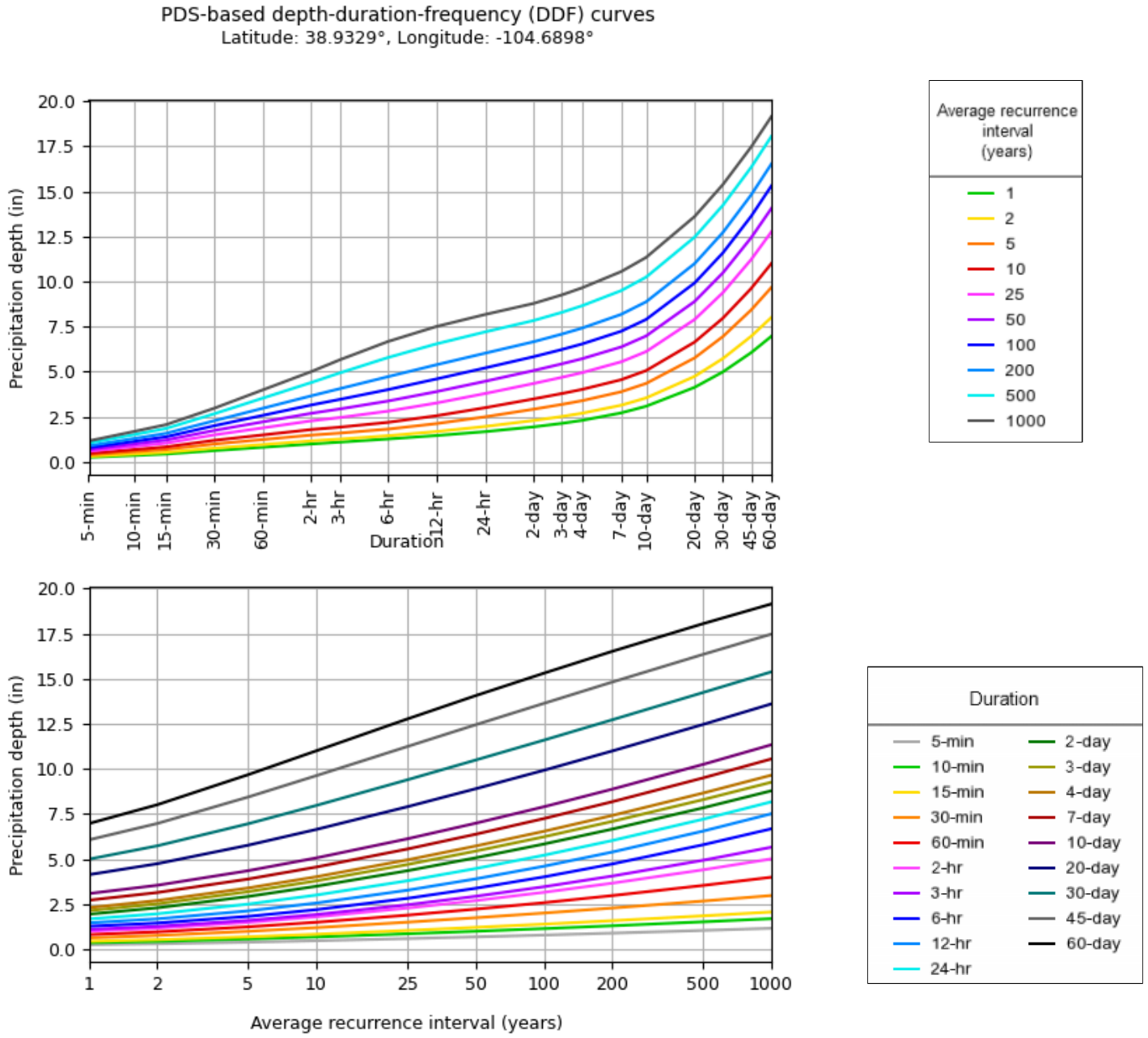
PF graphical



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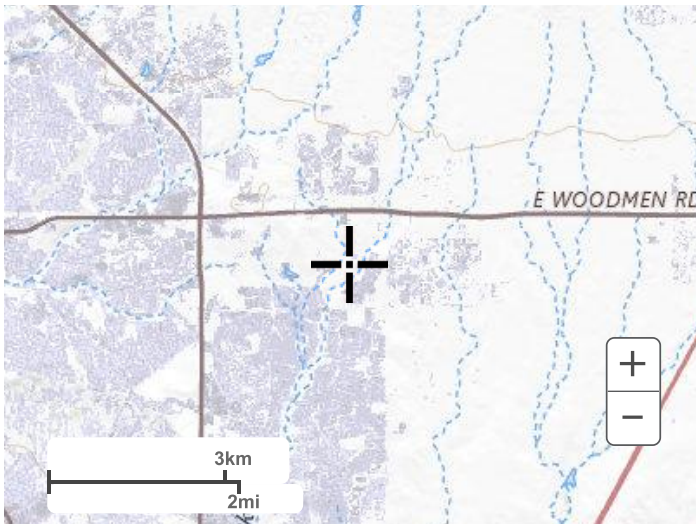

Large scale terrain

Large scale map

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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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Kimley»Horn

STANDARD FORM SF-1 (EXISITNG CONDITIONS)
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: **Miller Downs**
PROJECT NUMBER: 296082000
CALCULATED BY: MEO
CHECKED BY: KRK

HYDROLOGIC SOIL GROUP: A

Impervious values and runoff coefficients are taken from the Colorado Springs Drainage Criteria Manual (Vol. 1) - Table 6-6

LAND USE (HSG A/B):	PAVEMENT	ROOF	GRAVEL	LANDSCAPE
2-YEAR COEFF.	0.89	0.71	0.57	0.02
5-YEAR COEFF.	0.90	0.73	0.59	0.08
10-YEAR COEFF.	0.92	0.75	0.63	0.15
100-YEAR COEFF.	0.96	0.81	0.70	0.35
IMPERVIOUS %	100%	90%	80%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (SF)	ROOF AREA (SF)	GRAVEL AREA (SF)	LANDSCAPE AREA (SF)	TOTAL AREA (SF)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %	HSG
Basins													
EX-1	EX-1				100,818	**100,818**	**2.31**	0.02	0.08	0.15	0.35	0%	A
EX-2	EX-2				41,975	**41,975**	**0.96**	0.02	0.08	0.15	0.35	0%	A
EX-3	EX-3				6,617	**6,617**	**0.15**	0.02	0.08	0.15	0.35	0%	A
EX-4	EX-4		2,605	11,010	180,306	**193,920**	**4.45**	0.03	0.12	0.19	0.38	6%	A
EX-5	EX-5		4,803	944	27,902	**33,649**	**0.77**	0.12	0.19	0.25	0.43	15%	A
EX-6	EX-6		927	17,512	338,434	**356,873**	**8.19**	0.02	0.11	0.18	0.37	4%	A
EX-7	EX-7		552	10,965	185,689	**197,206**	**4.53**	0.02	0.11	0.18	0.37	5%	A
OF-1	OF-1			6,727	3,235	**9,962**	**0.23**	0.02	0.42	0.47	0.59	54%	A
OF-2	OF-2			8,471		**8,471**	**0.19**	0.02	0.59	0.63	0.70	80%	A
OF-3	OF-3	1,168	1,185		15,156	**17,509**	**0.40**	0.12	0.18	0.24	0.42	13%	A
OF-4	OF-4				41,950	**41,950**	**0.96**	0.02	0.08	0.15	0.35	0%	A
OF-5	OF-5				99,885	**99,885**	**2.29**	0.02	0.08	0.15	0.35	0%	A
OF-6	OF-6			6,131		**6,131**	**0.14**	0.02	0.59	0.63	0.70	80%	A
OF-7	OF-7				1,135	**1,135**	**0.03**	0.02	0.08	0.15	0.35	0%	A
OF-8	OF-8				15,825	**15,825**	**0.36**	0.02	0.08	0.15	0.35	0%	A
OF-9	OF-9				212,005	**212,005**	**4.87**	0.02	0.08	0.15	0.35	0%	A
OF-10	OF-10				741	**741**	**0.02**	0.02	0.08	0.15	0.35	0%	A
BASIN SUBTOTAL		**1,168**	**10,072**	**61,761**	**1,271,673**	**1,344,674**	**30.87**	**0.05**	**0.11**	**0.18**	**0.37**	**4.44%**	A
		0%	**1%**	**5%**	**95%**	**100%**	**100%**						

Kimley»Horn

STANDARD FORM SF-2 (EXISTING CONDITIONS)
Time of Concentration

PROJECT NAME: **Miller Downs**
PROJECT NUMBER: 296008000
CALCULATED BY: **MEO**
CHECKED BY: **KRK**

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA SF (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
All Basins																
EX-1	100,818	0.08	250	2.5%	21.9	160	6.5%	7.0	1.8	1.5	23.4	410	4.0%	0%	29.8	23.4
EX-2	41,975	0.08	272	5.3%	17.7	135	4.5%	7.0	1.5	1.5	19.2	407	5.0%	0%	29.4	19.2
EX-3	6,617	0.08	71	2.2%	12.1	65	3.8%	7.0	1.4	0.8	12.9	136	2.9%	0%	27.5	12.9
EX-4	193,920	0.12	300	2.0%	24.8	550	2.5%	7.0	1.1	8.3	33.0	850	2.3%	6%	34.5	33.0
EX-5	33,649	0.19	111	2.6%	12.8	80	1.5%	7.0	0.9	1.6	14.4	191	2.1%	15%	25.4	14.4
EX-6	356,873	0.11	260	2.6%	21.4	855	1.7%	7.0	0.9	15.6	37.0	1115	1.9%	4%	39.3	37.0
EX-7	197,206	0.11	210	2.0%	20.9	530	2.7%	7.0	1.2	7.7	28.6	740	2.5%	5%	33.3	28.6
OF-1	9,962	0.42	63	3.8%	6.3	64	9.9%	10.0	3.2	0.3	6.6	127	6.9%	54%	17.3	6.6
OF-2	8,471	0.59	23	2.6%	3.3	110	1.4%	20.0	2.4	0.8	4.1	133	1.6%	80%	13.3	5.0
OF-3	17,509	0.18	93	2.7%	11.7	112	1.7%	20.0	2.6	0.7	12.4	205	2.2%	13%	26.0	12.4
OF-4	41,950	0.08	85	2.3%	13.1	96	1.5%	7.0	0.9	1.9	14.9	181	1.9%	0%	28.4	14.9
OF-5	99,885	0.08	121	1.6%	17.6	148	1.4%	7.0	0.8	3.0	20.6	269	1.5%	0%	30.1	20.6
OF-6	6,131	0.59	36	4.4%	3.4	71	3.9%	7.0	1.4	0.9	4.3	107	4.1%	80%	12.8	5.0
OF-7	1,135	0.08	20	3.0%	5.8	10	2.0%	7.0	1.0	0.2	6.0	30	2.7%	0%	26.3	6.0
OF-8	15,825	0.08	200	1.7%	22.2	150	4.0%	7.0	1.4	1.8	23.9	350	2.7%	0%	30.0	23.9
OF-9	212,005	0.08	230	8.3%	14.0	772	1.8%	7.0	0.9	13.7	27.7	1002	3.3%	0%	36.2	27.7
OF-10	741	0.08	20	2.5%	6.2	25	2.0%	7.0	1.0	0.4	6.6	45	2.2%	0%	26.6	6.6

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Kimley»Horn

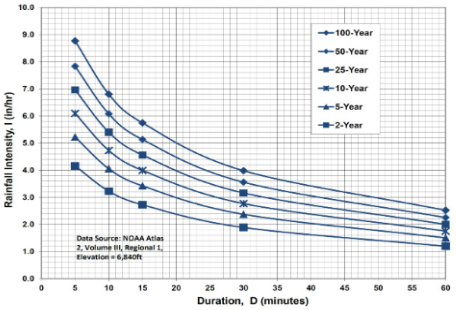
STANDARD FORM SF-3 (EXISTING CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: **Miller Downs**
PROJECT NUMBER: 296008000
CALCULATED BY: MEO
CHECKED BY: KRK

P_1 (1-Hour Rainfall) = **1.23**

STORM LINE	DESIGN POINT	DIRECT RUNOFF: DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	TOTAL RUNOFF: tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	REMARKS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(22)
All Basins													
		EX-1	EX-1	2.31	0.08	23.4	0.19	2.85	0.53					
		EX-2	EX-2	0.96	0.08	19.2	0.08	3.15	0.24					
		EX-3	EX-3	0.15	0.08	12.9	0.01	3.75	0.05					
		EX-4	EX-4	4.45	0.12	33.0	0.52	2.34	1.22					
		EX-5	EX-5	0.77	0.19	14.4	0.14	3.58	0.52					
		EX-6	EX-6	8.19	0.11	37.0	0.87	2.17	1.90					
		EX-7	EX-7	4.53	0.11	28.6	0.50	2.56	1.27					
		OF-1	OF-1	0.23	0.42	6.6	0.10	4.74	0.46					
		OF-2	OF-2	0.19	0.59	5.0	0.11	5.17	0.59					
		OF-3	OF-3	0.40	0.18	12.4	0.07	3.80	0.27					
		OF-4	OF-4	0.96	0.08	14.9	0.08	3.53	0.27					
		OF-5	OF-5	2.29	0.08	20.6	0.18	3.05	0.56					
		OF-6	OF-6	0.14	0.59	5.0	0.08	5.17	0.43					
		OF-7	OF-7	0.03	0.08	6.0	0.00	4.90	0.01					
		OF-8	OF-8	0.36	0.08	23.9	0.03	2.82	0.08					
		OF-9	OF-9	4.87	0.08	27.7	0.39	2.60	1.01					
		OF-10	OF-10	0.02	0.08	6.6	0.00	4.76	0.01					

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Kimley»Horn

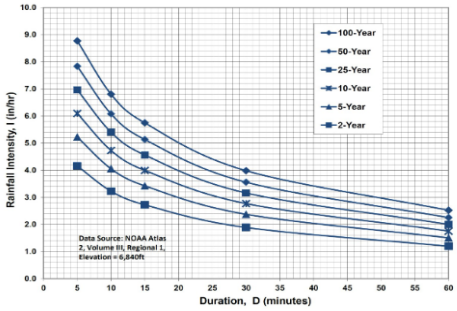
STANDARD FORM SF-3 (EXISTING CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: **Miller Downs**
PROJECT NUMBER: 296008000
CALCULATED BY: MEO
CHECKED BY: KRK

P_1 (1-Hour Rainfall) = **2.57**

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(22)
All Basins														
		EX-1	EX-1	2.31	0.35	23.4	0.81	4.79	3.88					
		EX-2	EX-2	0.96	0.35	19.2	0.34	5.29	1.78					
		EX-3	EX-3	0.15	0.35	12.9	0.05	6.29	0.33					
		EX-4	EX-4	4.45	0.38	33.0	1.67	3.92	6.56					
		EX-5	EX-5	0.77	0.43	14.4	0.33	6.02	1.98					
		EX-6	EX-6	8.19	0.37	37.0	3.02	3.64	10.98					
		EX-7	EX-7	4.53	0.37	28.6	1.68	4.29	7.20					
		OF-1	OF-1	0.23	0.59	6.6	0.13	7.96	1.07					
		OF-2	OF-2	0.19	0.70	5.0	0.14	8.68	1.18					
		OF-3	OF-3	0.40	0.42	12.4	0.17	6.39	1.08					
		OF-4	OF-4	0.96	0.35	14.9	0.34	5.92	2.00					
		OF-5	OF-5	2.29	0.35	20.6	0.80	5.12	4.11					0
		OF-6	OF-6	0.14	0.70	5.0	0.10	8.68	0.86					0
		OF-7	OF-7	0.03	0.35	6.0	0.01	8.23	0.08					0
		OF-8	OF-8	0.36	0.35	23.9	0.13	4.73	0.60					0
		OF-9	OF-9	4.87	0.35	27.7	1.70	4.36	7.43					0
		OF-10	OF-10	0.02	0.35	6.6	0.01	7.99	0.05					0

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Kimley»Horn

EXISTING CONDITIONS

Miller Downs

DATE: 2/25/2026

PROJECT NUMBER: 296008000

CALCULATED BY: MEO

CHECKED BY: KRK

EXISTING RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
EX-1	EX-1	2.31	0.53	3.88
EX-2	EX-2	0.96	0.24	1.78
EX-3	EX-3	0.15	0.05	0.33
EX-4	EX-4	4.45	1.22	6.56
EX-5	EX-5	0.77	0.52	1.98
EX-6	EX-6	8.19	1.90	10.98
EX-7	EX-7	4.53	1.27	7.20
OF-1	OF-1	0.23	0.46	1.07
OF-2	OF-2	0.19	0.59	1.18
OF-3	OF-3	0.40	0.27	1.08
OF-4	OF-4	0.96	0.27	2.00
OF-5	OF-5	2.29	0.56	4.11
OF-6	OF-6	0.14	0.43	0.86
OF-7	OF-7	0.03	0.01	0.08
OF-8	OF-8	0.36	0.08	0.60
OF-9	OF-9	4.87	1.01	7.43
OF-10	OF-10	0.02	0.01	0.05

Kimley»Horn

STANDARD FORM SF-1 (PROPOSED CONDITIONS)
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: **Miller Downs**
PROJECT NUMBER: 296082000
CALCULATED BY: MEO
CHECKED BY: KRK

HYDROLOGIC SOIL GROUP: A

Impervious values and runoff coefficients are taken from the Colorado Springs Drainage Criteria Manual (Vol. 1) - Table 6-6

LAND USE (HSG A/B):	RESIDENTIAL - 1/8 ACRE OR LESS	PAVED STREET & WALKS	GRAVEL	LAWN
2-YEAR COEFF.	0.41	0.89	0.57	0.02
5-YEAR COEFF.	0.45	0.90	0.59	0.08
10-YEAR COEFF.	0.49	0.92	0.63	0.15
100-YEAR COEFF.	0.59	0.96	0.70	0.35
IMPERVIOUS %	65%	100%	80%	0%

DESIGN BASIN	DESIGN POINT	RESIDENTIAL - 1/8 ACRE OR LESS AREA (SF)	PAVED STREET & WALKS AREA (SF)	GRAVEL AREA (SF)	LAWN AREA (SF)	TOTAL AREA (SF)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %	HSG
Basins													
P1	P1	1,861	13,525		4,114	**19,501**	**0.45**	0.58	0.68	0.72	0.80	76%	A
P2	P2	30,430				**30,430**	**0.70**	0.89	0.45	0.49	0.59	65%	A
P3	P3	16,824	15,455		5,155	**37,434**	**0.86**	0.70	0.58	0.62	0.71	70%	A
P4	P4	57,917	15,451		5,155	**78,523**	**1.80**	0.80	0.51	0.55	0.65	68%	A
P5	P5	66,726	21,425		1,353	**89,505**	**2.05**	0.83	0.55	0.59	0.67	72%	A
P6	P6	2,956	19,799		6,411	**29,166**	**0.67**	0.58	0.67	0.71	0.79	74%	A
P7	P7	65,383	19,633		31,408	**116,424**	**2.67**	0.62	0.43	0.47	0.59	53%	A
P8	P8		788		221	**1,010**	**0.02**	0.56	0.72	0.75	0.83	78%	A
P9	P9		789		222	**1,011**	**0.02**	0.56	0.72	0.75	0.83	78%	A
P10	P10	27,888			836	**28,724**	**0.66**	0.86	0.44	0.48	0.58	63%	A
P11	P11	7,663	11,441		3,480	**22,584**	**0.52**	0.66	0.62	0.66	0.74	73%	A
P12	P12	23,235	8,405		2,530	**34,170**	**0.78**	0.78	0.53	0.57	0.66	69%	A
P13	P13		4,506		1,351	**5,856**	**0.13**	0.55	0.71	0.74	0.82	77%	A
P14	P14	18,514	6,354			**24,868**	**0.57**	0.84	0.56	0.60	0.68	74%	A
P15	P15		7,604		2,355	**9,959**	**0.23**	0.55	0.71	0.74	0.82	76%	A
P16	P16	28,396	7,900		2,608	**38,903**	**0.89**	0.80	0.52	0.55	0.65	68%	A
P17	P17	5,581	6,973		8,944	**21,498**	**0.49**	0.47	0.44	0.49	0.61	49%	A
P18	P18		11,926		3,444	**15,370**	**0.35**	0.56	0.72	0.75	0.82	78%	A
P19	P19				36,960	**36,960**	**0.85**	0.02	0.08	0.15	0.35	0%	A
OS1	OS1	9,701	4,434	1,934	47,352	**63,420**	**1.46**	0.20	0.21	0.27	0.44	19%	A
OS2	OS2		8,203			**8,345**	**0.19**	0.70	0.88	0.90	0.94	98%	A
OS3	OS3	1,529	8,556		408	**10,493**	**0.24**	0.71	0.80	0.83	0.88	91%	A
OS4	OS4	12,339		1,760	39,365	**53,464**	**1.23**	0.22	0.18	0.24	0.42	18%	A
OS5	OS5				47,485	**47,485**	**1.09**	0.02	0.08	0.15	0.35	0%	A
OS6	OS6	27,666			1,205	**28,871**	**0.66**	0.85	0.43	0.48	0.58	62%	A
OS7	OS7	7,582	127	9,562	59,783	**77,054**	**1.77**	0.11	0.18	0.24	0.42	16%	A
OF1	OF1		3,810		870	**4,680**	**0.11**	0.58	0.75	0.78	0.85	81%	A
OF2	OF2		2,212		85	**2,297**	**0.05**	0.68	0.87	0.89	0.94	96%	A
OF3	OF3		1,887		1,187	**3,074**	**0.07**	0.44	0.58	0.62	0.72	61%	A
OF4	OF4			3,697		**3,697**	**0.08**	0.02	0.59	0.63	0.70	80%	A
OF5	OF5		2,123	867	156,354	**159,344**	**3.66**	0.03	0.09	0.16	0.36	2%	A
OF6	OF6		5,180		948	**6,128**	**0.14**	0.60	0.77	0.80	0.87	85%	A
OF7	OF7				1,129	**1,129**	**0.03**	0.02	0.08	0.15	0.35	0%	A
OF8	OF8		155		15,670	**15,825**	**0.36**	0.03	0.09	0.16	0.36	1%	A
OF9	OF9		485		211,521	**212,006**	**4.87**	0.02	0.08	0.15	0.35	0%	A
OF10	OF10			4,774		**4,774**	**0.11**	0.02	0.59	0.63	0.70	80%	A
OF11	OF11		352		389	**741**	**0.02**	0.35	0.47	0.52	0.64	48%	A
OVERALL		**412,191**	**209,500**	**22,594**	**700,298**	**1,344,583**	**30.87**	**0.28**	**0.33**	**0.38**	**0.52**	**36.85%**	A
SUBTOTAL		**31%**	**16%**	**2%**	**52%**	**100%**	**100%**						
ONSITE BASINS SUBTOTAL (P1-P19, OS1-OS5)		**412,191**	**193,295**	**13,256**	**312,146**	**930,888**	**21.37**	**0.38**	**0.42**	**0.47**	**0.59**	**50.69%**	A
		44%	**21%**	**1%**	**34%**	**100%**	**100%**						
POND SUBTOTAL (P1-P19, OF4, OF7)		**353,375**	**171,975**	**3,697**	**117,677**	**646,724**	**14.85**	**0.47**	**0.50**	**0.54**	**0.65**	**62.57%**	A
		55%	**27%**	**1%**	**18%**	**100%**	**100%**						

Kimley»Horn

STANDARD FORM SF-2 (PROPOSED CONDITIONS)
Time of Concentration

PROJECT NAME: **Miller Downs**
PROJECT NUMBER: 296008000
CALCULATED BY: **MEO**
CHECKED BY: **KRK**

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA SF (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
All Basins																
P1	19,501	0.68	30	2.0%	3.3	200	1.0%	20.0	2.0	1.7	5.0	230	1.1%	76%	15.0	5.0
P2	30,430	0.45	80	3.0%	7.4	200	1.0%	15.0	1.5	2.2	9.6	280	1.6%	65%	17.0	9.6
P3	37,434	0.58	20	1.7%	3.5	500	1.3%	20.0	2.2	3.7	7.3	520	1.3%	70%	18.1	7.3
P4	78,523	0.51	100	1.7%	9.0	620	1.3%	20.0	2.3	4.5	13.5	720	1.4%	68%	20.1	13.5
P5	89,505	0.55	100	3.4%	6.7	700	1.4%	20.0	2.4	4.9	11.6	800	1.6%	72%	19.1	11.6
P6	29,166	0.67	50	1.6%	4.7	700	1.2%	20.0	2.2	5.3	10.0	750	1.2%	74%	19.1	10.0
P7	116,424	0.43	100	3.0%	8.6	730	1.2%	20.0	2.2	5.5	14.1	830	1.4%	53%	23.9	14.1
P8	1,010	0.72	34	2.3%	3.1	45	2.3%	20.0	3.0	0.2	3.3	79	2.3%	78%	13.2	5.0
P9	1,011	0.72	34	2.3%	3.1	45	2.3%	20.0	3.0	0.2	3.3	79	2.3%	78%	13.2	5.0
P10	28,724	0.44	85	4.5%	6.8	330	1.1%	15.0	1.6	3.5	10.3	415	1.8%	63%	18.2	10.3
P11	22,584	0.62	40	1.8%	4.6	276	1.3%	20.0	2.3	2.0	6.6	316	1.3%	73%	16.0	6.6
P12	34,170	0.53	115	1.3%	10.2	210	1.3%	20.0	2.3	1.6	11.7	325	1.3%	69%	16.9	11.7
P13	5,856	0.71	20	2.6%	2.3	150	2.3%	20.0	3.0	0.8	3.1	170	2.4%	77%	13.9	5.0
P14	24,868	0.56	93	3.8%	6.1	226	1.0%	20.0	2.0	1.9	7.9	319	1.8%	74%	15.5	7.9
P15	9,959	0.71	21	4.0%	2.1	218	1.8%	20.0	2.7	1.3	3.4	239	2.0%	76%	14.4	5.0
P16	38,903	0.52	132	2.3%	9.3	287	1.7%	20.0	2.6	1.8	11.1	419	1.9%	68%	17.2	11.1
P17	21,498	0.44	154	3.0%	10.4	75	1.9%	20.0	2.8	0.5	10.8	229	2.6%	49%	19.1	10.8
P18	15,370	0.72	30	2.0%	3.1	150	1.4%	20.0	2.4	1.1	4.1	180	1.5%	78%	14.0	5.0
P19	36,960	0.08	50	5.0%	7.7	150	3.0%	7.0	1.2	2.1	9.8	200	3.5%	0%	28.0	9.8
OS1	63,420	0.21	300	4.4%	17.2	50	6.3%	7.0	1.8	0.5	17.7	350	4.7%	19%	25.0	17.7
OS2	8,345	0.88	10	1.5%	1.1	100	1.0%	20.0	2.0	0.8	1.9	110	1.0%	98%	10.1	5.0
OS3	10,493	0.80	10	2.0%	1.4	100	1.0%	20.0	2.0	0.8	2.2	110	1.1%	91%	11.3	5.0
OS4	53,464	0.18	100	1.5%	14.7	100	4.0%	7.0	1.4	1.2	15.9	200	2.8%	18%	24.8	15.9
OS5	47,485	0.08	250	2.6%	21.5	1149	1.8%	7.0	0.9	20.4	41.9	1399	1.9%	0%	44.6	41.9
OS6	28,871	0.43	50	5.0%	5.0	20	2.0%	7.0	1.0	0.3	5.4	70	4.1%	62%	15.7	5.4
OS7	77,054	0.18	140	4.0%	12.6	300	1.6%	7.0	0.9	5.7	18.3	440	2.3%	16%	27.4	18.3
OF1	4,680	0.75	20	2.2%	2.2	41	1.8%	20.0	2.6	0.3	2.5	61	1.9%	81%	12.5	5.0
OF2	2,297	0.87	70	0.9%	3.7	31	1.0%	20.0	2.0	0.3	3.9	101	0.9%	96%	10.4	5.0
OF3	3,074	0.58	30	0.8%	5.7	45	1.5%	20.0	2.4	0.3	6.0	75	1.2%	61%	16.2	6.0
OF4	3,697	0.59	23	5.7%	2.5	115	1.2%	20.0	2.1	0.9	3.4	138	1.9%	80%	13.2	5.0
OF5	159,344	0.09	191	2.0%	20.2	900	1.5%	7.0	0.9	17.5	37.7	1091	1.6%	2%	41.3	37.7
OF6	6,128	0.77	35	2.8%	2.5	55	3.4%	20.0	3.7	0.2	2.8	90	3.2%	85%	12.0	5.0
OF7	1,129	0.08	20	3.0%	5.8	10	2.0%	7.0	1.0	0.2	6.0	30	2.7%	0%	26.3	6.0
OF8	15,825	0.09	295	1.7%	26.5	150	4.0%	7.0	1.4	1.8	28.3	445	2.5%	1%	31.0	28.3
OF9	212,006	0.08	230	8.3%	14.0	772	1.8%	7.0	0.9	13.7	27.7	1002	3.3%	0%	36.2	27.7
OF10	4,774	0.59	23	5.7%	2.5	115	1.2%	20.0	2.2	0.9	3.4	138	2.0%	80%	13.2	5.0
OF11	741	0.47	20	2.5%	3.8	25	2.0%	20.0	2.8	0.1	4.0	45	2.2%	48%	18.2	5.0

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Kimley»Horn

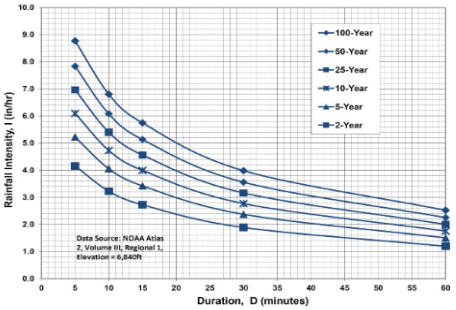
STANDARD FORM SF-3 (PROPOSED CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: **Miller Downs**
PROJECT NUMBER: 296008000
CALCULATED BY: MEO
CHECKED BY: KRK

P_1 (1-Hour Rainfall) = **1.23**

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(22)
All Basins													
		P1	P1	0.45	0.68	5.0	0.31	5.17	1.58					
		P2	P2	0.70	0.45	9.6	0.31	4.19	1.32					
		P3	P3	0.86	0.58	7.3	0.50	4.61	2.32					
		P4	P4	1.80	0.51	13.5	0.93	3.68	3.41					
		P5	P5	2.05	0.55	11.6	1.13	3.90	4.43					
		P6	P6	0.67	0.67	10.0	0.45	4.13	1.86					
		P7	P7	2.67	0.43	14.1	1.14	3.62	4.12					
		P8	P8	0.02	0.72	5.0	0.02	5.17	0.09					
		P9	P9	0.02	0.72	5.0	0.02	5.17	0.09					
		P10	P10	0.66	0.44	10.3	0.29	4.09	1.18					
		P11	P11	0.52	0.62	6.6	0.32	4.74	1.53					
		P12	P12	0.78	0.53	11.7	0.42	3.89	1.63					
		P13	P13	0.13	0.71	5.0	0.10	5.17	0.49					
		P14	P14	0.57	0.56	7.9	0.32	4.48	1.44					
		P15	P15	0.23	0.71	5.0	0.16	5.17	0.83					
		P16	P16	0.89	0.52	11.1	0.46	3.97	1.83					
		P17	P17	0.49	0.44	10.8	0.22	4.01	0.87					
		P18	P18	0.35	0.72	5.0	0.25	5.17	1.31					
		P19	P19	0.85	0.08	9.8	0.07	4.16	0.28					
		OS1	OS1	1.46	0.21	17.7	0.30	3.27	1.00					
		OS2	OS2	0.19	0.88	5.0	0.17	5.17	0.88					
		OS3	OS3	0.24	0.80	5.0	0.19	5.17	1.00					
		OS4	OS4	1.23	0.18	15.9	0.22	3.43	0.77					
		OS5	OS5	1.09	0.08	41.9	0.09	1.98	0.17					
		OS6	OS6	0.66	0.43	5.4	0.29	5.06	1.46					
		OS7	OS7	1.77	0.18	18.3	0.32	3.22	1.03					
		OF1	OF1	0.11	0.75	5.0	0.08	5.17	0.42					
		OF2	OF2	0.05	0.87	5.0	0.05	5.17	0.24					
		OF3	OF3	0.07	0.58	6.0	0.04	4.89	0.20					
		OF4	OF4	0.08	0.59	5.0	0.05	5.17	0.26					
		OF5	OF5	3.66	0.09	37.7	0.34	2.14	0.73					
		OF6	OF6	0.14	0.77	5.0	0.11	5.17	0.56					
		OF7	OF7	0.03	0.08	6.0	0.00	4.90	0.01					
		OF8	OF8	0.36	0.09	28.3	0.03	2.57	0.08					
		OF9	OF9	4.87	0.08	27.7	0.40	2.60	1.04					
		OF10	OF10	0.11	0.59	5.0	0.06	5.17	0.33					
		OF11	OF11	0.02	0.47	5.0	0.01	5.17	0.04					

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Kimley»Horn

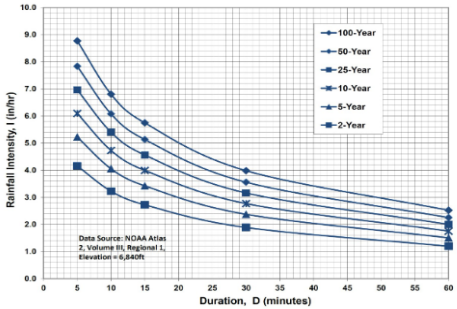
STANDARD FORM SF-3 (PROPOSED CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: **Miller Downs**
PROJECT NUMBER: 296008000
CALCULATED BY: MEO
CHECKED BY: KRK

P_1 (1-Hour Rainfall) = **2.57**

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(22)
All Basins													
		P1	P1	0.45	0.80	5.0	0.36	8.68	3.09					
		P2	P2	0.70	0.59	9.6	0.41	7.03	2.90					
		P3	P3	0.86	0.71	7.3	0.61	7.74	4.72					
		P4	P4	1.80	0.65	13.5	1.17	6.17	7.20					
		P5	P5	2.05	0.67	11.6	1.39	6.55	9.09					
		P6	P6	0.67	0.79	10.0	0.53	6.93	3.66					
		P7	P7	2.67	0.59	14.1	1.57	6.08	9.54					
		P8	P8	0.02	0.83	5.0	0.02	8.68	0.17					
		P9	P9	0.02	0.83	5.0	0.02	8.68	0.17					
		P10	P10	0.66	0.58	10.3	0.38	6.86	2.64					
		P11	P11	0.52	0.74	6.6	0.38	7.96	3.06					
		P12	P12	0.78	0.66	11.7	0.52	6.53	3.40					
		P13	P13	0.13	0.82	5.0	0.11	8.68	0.96					
		P14	P14	0.57	0.68	7.9	0.39	7.51	2.94					
		P15	P15	0.23	0.82	5.0	0.19	8.68	1.62					
		P16	P16	0.89	0.65	11.1	0.58	6.66	3.86					
		P17	P17	0.49	0.61	10.8	0.30	6.73	2.03					
		P18	P18	0.35	0.82	5.0	0.29	8.68	2.52					
		P19	P19	0.85	0.35	9.8	0.30	6.98	2.07					
		OS1	OS1	1.46	0.44	17.7	0.64	5.49	3.52					
		OS2	OS2	0.19	0.94	5.0	0.18	8.68	1.57					
		OS3	OS3	0.24	0.88	5.0	0.21	8.68	1.84					
		OS4	OS4	1.23	0.42	15.9	0.51	5.77	2.95					
		OS5	OS5	1.09	0.35	41.9	0.38	3.32	1.27					
		OS6	OS6	0.66	0.58	5.4	0.38	8.49	3.27					
		OS7	OS7	1.77	0.42	18.3	0.74	5.41	4.00					
		OF1	OF1	0.11	0.85	5.0	0.09	8.68	0.79					
		OF2	OF2	0.05	0.94	5.0	0.05	8.68	0.43					
		OF3	OF3	0.07	0.72	6.0	0.05	8.21	0.42					
		OF4	OF4	0.08	0.70	5.0	0.06	8.68	0.52					
		OF5	OF5	3.66	0.36	37.7	1.32	3.59	4.72					
		OF6	OF6	0.14	0.87	5.0	0.12	8.68	1.06					
		OF7	OF7	0.03	0.35	6.0	0.01	8.23	0.07					
		OF8	OF8	0.36	0.36	28.3	0.13	4.31	0.56					
		OF9	OF9	4.87	0.35	27.7	1.71	4.36	7.46					
		OF10	OF10	0.11	0.70	5.0	0.08	8.68	0.67					
		OF11	OF11	0.02	0.64	5.0	0.01	8.68	0.09					

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Kimley»Horn

PROPOSED CONDITIONS

Miller Downs

DATE: 2/25/2026

PROJECT NUMBER: 296008000

CALCULATED BY: MEO

CHECKED BY: KRK

PROPOSED RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
P1	P1	0.45	1.58	3.09
P2	P2	0.70	1.32	2.90
P3	P3	0.86	2.32	4.72
P4	P4	1.80	3.41	7.20
P5	P5	2.05	4.43	9.09
P6	P6	0.67	1.86	3.66
P7	P7	2.67	4.12	9.54
P8	P8	0.02	0.09	0.17
P9	P9	0.02	0.09	0.17
P10	P10	0.66	1.18	2.64
P11	P11	0.52	1.53	3.06
P12	P12	0.78	1.63	3.40
P13	P13	0.13	0.49	0.96
P14	P14	0.57	1.44	2.94
P15	P15	0.23	0.83	1.62
P16	P16	0.89	1.83	3.86
P17	P17	0.49	0.87	2.03
P18	P18	0.35	1.31	2.52
P19	P19	0.85	0.28	2.07
OS1	OS1	1.46	1.00	3.52
OS2	OS2	0.19	0.88	1.57
OS3	OS3	0.24	1.00	1.84
OS4	OS4	1.23	0.77	2.95
OS5	OS5	1.09	0.17	1.27
OS6	OS6	0.66	1.46	3.27
OS7	OS7	1.77	1.03	4.00
OF1	OF1	0.11	0.42	0.79
OF2	OF2	0.05	0.24	0.43
OF3	OF3	0.07	0.20	0.42
OF4	OF4	0.08	0.26	0.52
OF5	OF5	3.66	0.73	4.72
OF6	OF6	0.14	0.56	1.06
OF7	OF7	0.03	0.01	0.07
OF8	OF8	0.36	0.08	0.56
OF9	OF9	4.87	1.04	7.46
OF10	OF10	0.11	0.33	0.67
OF11	OF11	0.02	0.04	0.09

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018) — Sheet 1 of 1

Designer: MEO
Company: KIMLEY-HORN
Date: May 12, 2026
Project: Miller Downs (TOTAL DISTURBED AREA CALCULATION TO MEET STEP 1) (10% RUNOFF REDUCTION)
Location: Colorado Springs, CO

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	DCIA	SPA	DCIA	SPA	UIA:RPA	UIA:RPA						
Area ID	SITE IMPERVIOUS	SITE PERVIOUS	OFFSITE IMPERVIOUS	OFFSITE PERVIOUS	ROAD (1/2)	ROAD (2/2)						
Downstream Design Point ID	FSD POND	FSD POND	OFFSITE	OFFSITE	FSD POND	FSD POND						
Downstream BMP Type	EDB	EDB	None	None	EDB	EDB						
DCIA (ft^2)	248,320	--	59,106	--	--	--						
UIA (ft^2)	--	--	--	--	70,061	70,061						
RPA (ft^2)	--	--	--	--	5,820	5,820						
SPA (ft^2)	--	217,031	--	113,411	--	--						
HSG A (%)	--	100%	--	100%	100%	100%						
HSG B (%)	--	0%	--	0%	0%	0%						
HSG C/D (%)	--	0%	--	0%	0%	0%						
Average Slope of RPA (ft/ft)	--	--	--	--	0.020	0.020						
UIA:RPA Interface Width (ft)	--	--	--	--	2.00	2.00						

CALCULATED RUNOFF RESULTS

Area ID	SITE IMPERVIOUS	SITE PERVIOUS	OFFSITE IMPERVIOUS	OFFSITE PERVIOUS	ROAD (1/2)	ROAD (2/2)						
UIA:RPA Area (ft^2)	--	--	--	--	75,881	75,881						
L / W Ratio	--	--	--	--	16.00	16.00						
UIA / Area	--	--	--	--	0.9233	0.9233						
Runoff (in)	0.50	0.00	0.50	0.00	0.20	0.20						
Runoff (ft^3)	10347	0	2463	0	1263	1263						
Runoff Reduction (ft^3)	0	10852	0	5671	1657	1657						

CALCULATED WQCV RESULTS

Area ID	SITE IMPERVIOUS	SITE PERVIOUS	OFFSITE IMPERVIOUS	OFFSITE PERVIOUS	ROAD (1/2)	ROAD (2/2)						
WQCV (ft^3)	10347	0	2463	0	2919	2919						
WQCV Reduction (ft^3)	0	0	0	0	1657	1657						
WQCV Reduction (%)	0%	0%	0%	0%	57%	57%						
Untreated WQCV (ft^3)	10347	0	2463	0	1263	1263						

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	FSD POND	OFFSITE										
DCIA (ft^2)	248,320	59,106										
UIA (ft^2)	140,122	0										
RPA (ft^2)	11,640	0										
SPA (ft^2)	217,031	113,411										
Total Area (ft^2)	617,113	172,516										
Total Impervious Area (ft^2)	388,441	59,106										
WQCV (ft^3)	16,185	2,463										
WQCV Reduction (ft^3)	3,313	0										
WQCV Reduction (%)	20%	0%										
Untreated WQCV (ft^3)	12,872	2,463										

=14.17 AC total disturbed area flowing to pond

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	789,629
Total Impervious Area (ft^2)	447,547
WQCV (ft^3)	18,648
WQCV Reduction (ft^3)	3,313
WQCV Reduction (%)	18%
Untreated WQCV (ft^3)	15,334

=18.13 AC = Total disturbed area

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer: MEO
Company: KIMLEY-HORN
Date: May 15, 2026
Project: Miller Downs (PROVIDED TO SHOW COMPLIANCE WITH STEP 2) (95% TREATMENT)
Location: COLORADO SPRINGS, CO (OS1,OS3-OS7, OF1-OF-3, OF9)

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	DCIA	SPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA					
Area ID	FLOWING OFFSITE IMPERVIOUS	FLOWING OFFSITE PERVIOUS	OS1	OS3	OS4	OS6	OS7					
Downstream Design Point ID	OFFSITE	OFFSITE	OFFSITE	OFFSITE	OFFSITE	OFFSITE	OFFSITE					
Downstream BMP Type	None	None	None	None	None	None	None					
DCIA (ft^2)	5,420	--	--	--	--	--	--					
UIA (ft^2)	--	--	5,525	318	1,754	17,983	4,794					
RPA (ft^2)	--	--	1,184	482	2,572	3,782	4,427					
SPA (ft^2)	--	82,536	--	--	--	--	--					
HSG A (%)	--	100%	100%	100%	100%	100%	100%					
HSG B (%)	--	0%	0%	0%	0%	0%	0%					
HSG C/D (%)	--	0%	0%	0%	0%	0%	0%					
Average Slope of RPA (ft/ft)	--	--	0.050	0.020	0.050	0.050	0.030					
UIA:RPA Interface Width (ft)	--	--	75.00	75.00	150.00	300.00	75.00					

CALCULATED RUNOFF RESULTS

Area ID	FLOWING OFFSITE IMPERVIOUS	FLOWING OFFSITE PERVIOUS	OS1	OS3	OS4	OS6	OS7					
UIA:RPA Area (ft^2)	--	--	6,709	800	4,326	21,765	9,221					
L / W Ratio	--	--	1.19	0.14	0.19	0.24	1.64					
UIA / Area	--	--	0.8235	0.3979	0.4055	0.8262	0.5199					
Runoff (in)	0.50	0.00	0.04	0.00	0.00	0.04	0.00					
Runoff (ft^3)	226	0	24	0	0	81	0					
Runoff Reduction (ft^3)	0	4127	206	13	73	668	200					

CALCULATED WQCV RESULTS

Area ID	FLOWING OFFSITE IMPERVIOUS	FLOWING OFFSITE PERVIOUS	OS1	OS3	OS4	OS6	OS7					
WQCV (ft^3)	226	0	230	13	73	749	200					
WQCV Reduction (ft^3)	0	0	206	13	73	668	200					
WQCV Reduction (%)	0%	0%	90%	100%	100%	89%	100%					
Untreated WQCV (ft^3)	226	0	24	0	0	81	0					

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	OFFSITE											
DCIA (ft^2)	5,420											
UIA (ft^2)	30,374											
RPA (ft^2)	12,446											
SPA (ft^2)	82,536											
Total Area (ft^2)	130,777											
Total Impervious Area (ft^2)	35,794											
WQCV (ft^3)	1,491											
WQCV Reduction (ft^3)	1,161											
WQCV Reduction (%)	78%											
Untreated WQCV (ft^3)	330											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	130,777
Total Impervious Area (ft^2)	35,794
WQCV (ft^3)	1,491
WQCV Reduction (ft^3)	1,161
WQCV Reduction (%)	78%
Untreated WQCV (ft^3)	330

= 3.00 AC total disturbed area being treated by 75% Infiltration

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018) **Sheet 1 of 1**

Designer: MEL
Company: KIMLEY-HORN
Date: May 13, 2025
Project: Miller Downs (UD-DETENTION OVERRIDE)
Location: Colorado Springs, CO (P1-P16, OF-2 & OF-3)

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth = 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	DCIA	SPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA						
Area ID	SITE IMPERVIOUS	SITE PERVIOUS	P2	P4	P6	P7/P14						
Downstream Design Point ID	FSD POND	FSD POND	FSD POND	FSD POND	FSD POND	FSD POND						
Downstream BMP Type	EDB	EDB	EDB	EDB	EDB	EDB						
DCIA (ft^2)	339,925	--	--	--	--	--						
UIA (ft^2)	--	--	2,045	19,503	22,240	46,447						
RPA (ft^2)	--	--	2,705	15,064	16,883	25,960						
SPA (ft^2)	--	127,228	--	--	--	--						
HSG A (%)	--	100%	100%	100%	100%	100%						
HSG B (%)	--	0%	0%	0%	0%	0%						
HSG C/D (%)	--	0%	0%	0%	0%	0%						
Average Slope of RPA (ft/ft)	--	--	0.020	0.050	0.050	0.020						
UIA:RPA Interface Width (ft)	--	--	83.30	610.00	695.00	792.00						

CALCULATED RUNOFF RESULTS

Area ID	SITE IMPERVIOUS	SITE PERVIOUS	P2	P4	P6	P7/P14						
UIA:RPA Area (ft^2)	--	--	4,750	34,567	39,123	72,406						
L / W Ratio	--	--	0.68	0.09	0.08	0.12						
UIA / Area	--	--	0.4305	0.5642	0.5685	0.6415						
Runoff (in)	0.50	0.00	0.00	0.00	0.00	0.00						
Runoff (ft^3)	14164	0	0	0	0	0						
Runoff Reduction (ft^3)	0	6361	85	813	927	1935						

CALCULATED WQCV RESULTS

Area ID	SITE IMPERVIOUS	SITE PERVIOUS	P2	P4	P6	P7/P14						
WQCV (ft^3)	14164	0	85	813	927	1935						
WQCV Reduction (ft^3)	0	0	85	813	927	1935						
WQCV Reduction (%)	0%	0%	100%	100%	100%	100%						
Untreated WQCV (ft^3)	14164	0	0	0	0	0						

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	FSD POND											
DCIA (ft^2)	339,925											
UIA (ft^2)	90,234											
RPA (ft^2)	60,612											
SPA (ft^2)	127,228											
Total Area (ft^2)	617,999											
Total Impervious Area (ft^2)	430,159											
WQCV (ft^3)	17,923											
WQCV Reduction (ft^3)	3,760											
WQCV Reduction (%)	21%											
Untreated WQCV (ft^3)	14,164											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

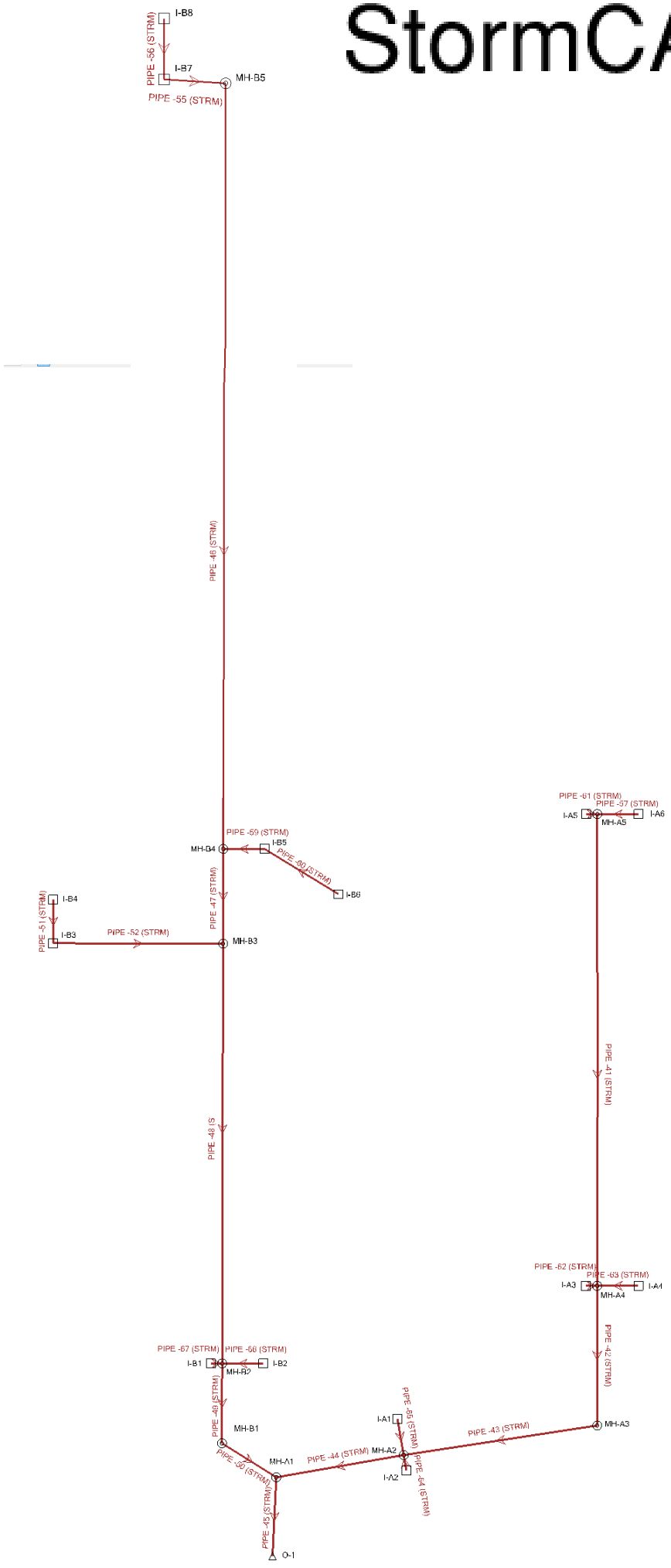
Total Area (ft^2)	617,999
Total Impervious Area (ft^2)	430,159
WQCV (ft^3)	17,923
WQCV Reduction (ft^3)	3,760
WQCV Reduction (%)	21%
Untreated WQCV (ft^3)	14,164

= 14.19 ACRES

= 0.325 AC-FT USED FOR UD-DETENTION OVERRIDE

APPENDIX E – HYDRAULIC CALCULATIONS

StormCAD Map



5-YEAR FREE OUTFALL

Conduit Table - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
PIPE -56 (STRM)	I-B7	6,807.40	I-B8	6,807.66	34.0	-0.007	0.013	1.05	3.43	9.10	6,808.04	6,808.03
PIPE -55 (STRM)	MH-B5	6,806.85	I-B7	6,807.10	34.3	-0.007	0.013	2.69	4.48	9.10	6,807.73	6,807.48
PIPE -46 (STRM)	MH-B5	6,806.55	MH-B4	6,801.11	724.8	0.007	0.013	2.69	4.48	9.10	6,807.17	6,801.67
PIPE -57 (STRM)	MH-A5	6,801.99	I-A6	6,802.82	27.5	-0.030	0.013	4.45	8.29	39.29	6,803.56	6,802.47
PIPE -61 (STRM)	MH-A5	6,801.99	I-A5	6,802.22	7.5	-0.031	0.013	2.93	7.38	39.61	6,802.82	6,802.43
PIPE -41 (STRM)	MH-A5	6,801.49	MH-A4	6,796.30	346.3	0.015	0.013	7.38	7.32	50.22	6,802.40	6,797.29
PIPE -59 (STRM)	MH-B4	6,801.61	I-B5	6,802.16	27.5	-0.020	0.013	5.79	7.88	14.85	6,803.09	6,802.30
PIPE -60 (STRM)	I-B5	6,802.36	I-B6	6,803.60	57.7	-0.022	0.013	3.57	7.10	15.40	6,804.32	6,803.34
PIPE -47 (STRM)	MH-B4	6,800.11	MH-B3	6,799.32	63.0	0.012	0.013	8.48	7.13	45.85	6,801.08	6,800.61
PIPE -48 (STRM)	MH-B3	6,799.22	MH-B2	6,795.32	311.7	0.012	0.013	9.13	7.28	45.85	6,800.23	6,797.13
PIPE -52 (STRM)	I-B3	6,800.89	MH-B3	6,800.32	112.9	0.005	0.013	0.65	2.58	7.43	6,801.19	6,800.62
PIPE -51 (STRM)	I-B4	6,801.23	I-B3	6,801.07	30.0	0.005	0.013	0.35	2.20	7.67	6,801.45	6,801.32
PIPE -62 (STRM)	I-A3	6,797.34	MH-A4	6,797.30	7.5	0.005	0.013	1.30	3.23	7.67	6,797.77	6,797.72
PIPE -63 (STRM)	MH-A4	6,796.91	I-A4	6,797.19	27.5	-0.010	0.013	1.92	4.52	10.50	6,797.71	6,797.35
PIPE -42 (STRM)	MH-A4	6,796.20	MH-A3	6,794.81	92.8	0.015	0.013	10.60	8.11	50.18	6,797.29	6,795.59

5-YEAR FREE OUTFALL

Conduit Table - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
PIPE -67 (STRM)	MH-B2	6,796.32	I-B1	6,796.36	7.5	-0.005	0.013	1.42	3.24	7.43	6,797.13	6,797.13
PIPE -66 (STRM)	MH-B2	6,796.31	I-B2	6,796.45	27.5	-0.005	0.013	2.21	3.69	7.49	6,797.14	6,797.13
PIPE -49 (STRM)	MH-B2	6,795.22	MH-B1	6,794.68	53.1	0.010	0.013	12.76	7.44	41.54	6,796.42	6,795.65
PIPE -43 (STRM)	MH-A3	6,794.61	MH-A2	6,793.30	130.2	0.010	0.013	10.60	7.02	41.08	6,795.70	6,794.71
PIPE -50 (STRM)	MH-B1	6,794.48	MH-A1	6,792.77	42.6	0.040	0.013	12.86	12.18	82.13	6,795.69	6,794.68
PIPE -44 (STRM)	MH-A2	6,793.20	MH-A1	6,792.77	86.0	0.005	0.013	14.83	5.94	29.00	6,794.71	6,794.68
PIPE -45 (STRM)	MH-A1	6,792.27	O-1	6,791.51	52.6	0.014	0.013	27.69	10.30	80.19	6,793.97	6,792.81
PIPE -65 (STRM)	MH-A2	6,794.30	I-A1	6,794.43	24.4	-0.005	0.013	2.61	3.88	7.54	6,795.04	6,794.91
PIPE -64 (STRM)	MH-A2	6,794.30	I-A2	6,794.36	10.6	-0.005	0.013	1.62	3.43	7.64	6,794.84	6,794.77

5-YEAR FREE OUTFALL

Catch Basin Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Additional Subsurface) (cfs)	Hydraulic Grade Line (In) (ft)	Headloss Coefficient (Standard)
I-B1	6,801.00	6,801.00	6,796.35	1.42	6,797.13	0.000
I-B2	6,801.00	6,801.00	6,796.45	2.21	6,797.14	0.000
I-A1	6,798.57	6,798.57	6,794.43	2.61	6,795.04	0.000
I-A2	6,798.57	6,798.57	6,794.36	1.62	6,794.84	0.000
I-A3	6,802.69	6,802.69	6,797.34	1.30	6,797.77	0.000
I-A4	6,802.69	6,802.69	6,797.44	1.92	6,797.71	0.000
I-A5	6,809.58	6,809.58	6,802.22	2.93	6,802.82	0.000
I-A6	6,809.58	6,809.58	6,802.82	4.45	6,803.56	0.000
I-B4	6,804.85	6,804.85	6,801.23	0.35	6,801.45	0.000
I-B3	6,804.81	6,804.81	6,800.87	0.30	6,801.32	1.320
I-B5	6,808.07	6,808.07	6,802.15	2.22	6,803.34	0.640
I-B6	6,807.64	6,807.64	6,803.59	3.57	6,804.32	0.000
I-B7	6,813.85	6,813.85	6,807.09	1.64	6,808.03	1.320
I-B8	6,813.94	6,813.94	6,807.64	1.05	6,808.04	0.000

5-YEAR FREE OUTFALL

Manhole Table - Time: 0.00 hours

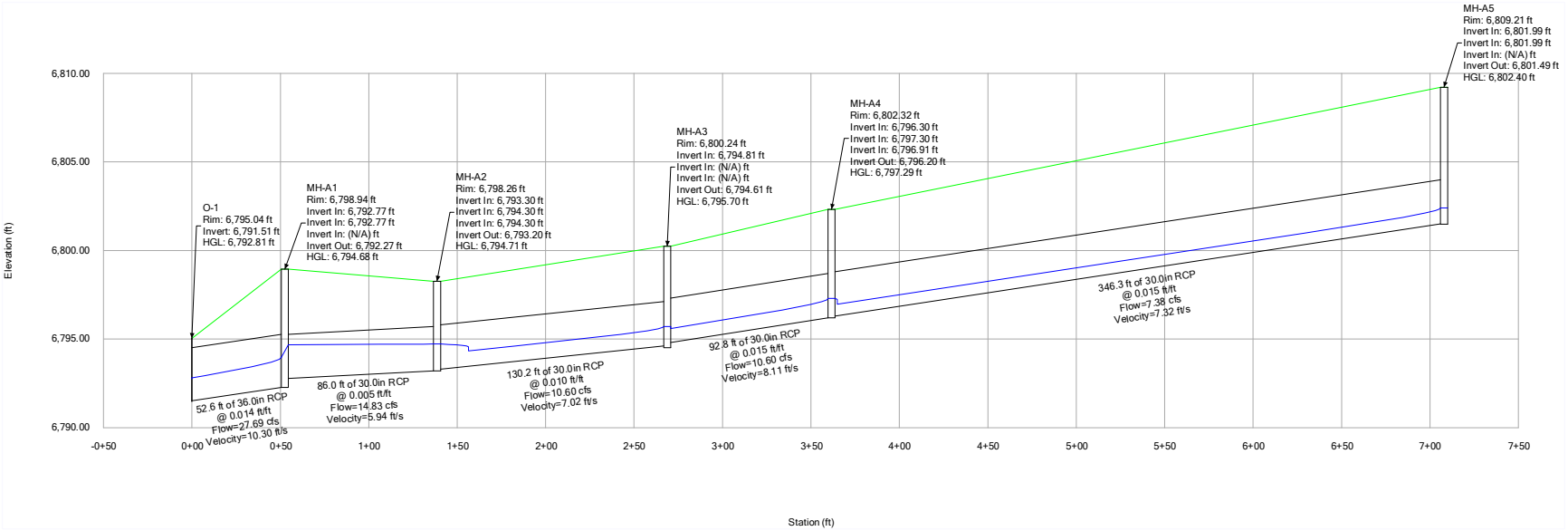
Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert Out) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Hydraulic Grade Line (In) (ft)	Headloss Coefficient (Standard)
MH-B5	6,813.67	6,813.67	6,806.55	2.69	6,807.17	Standard	6,807.48	1.320
MH-A5	6,809.21	6,809.21	6,801.49	7.38	6,802.40	Standard	6,802.40	0.000
MH-B4	6,807.70	6,807.70	6,800.11	8.48	6,801.08	Standard	6,801.45	1.020
MH-B3	6,806.81	6,806.81	6,799.22	9.13	6,800.23	Standard	6,800.61	1.020
MH-A4	6,802.32	6,802.32	6,796.20	10.60	6,797.29	Standard	6,797.29	0.000
MH-B2	6,800.63	6,800.63	6,795.22	12.76	6,796.42	Standard	6,797.13	1.520
MH-A3	6,800.24	6,800.24	6,794.61	10.60	6,795.70	Standard	6,795.70	0.000
MH-B1	6,799.48	6,799.48	6,794.48	12.86	6,795.69	Standard	6,795.69	0.000
MH-A1	6,798.94	6,798.94	6,792.27	27.69	6,793.97	Standard	6,794.68	1.020
MH-A2	6,798.26	6,798.26	6,793.20	14.83	6,794.71	Standard	6,794.71	0.000

5-YEAR FREE OUTFALL

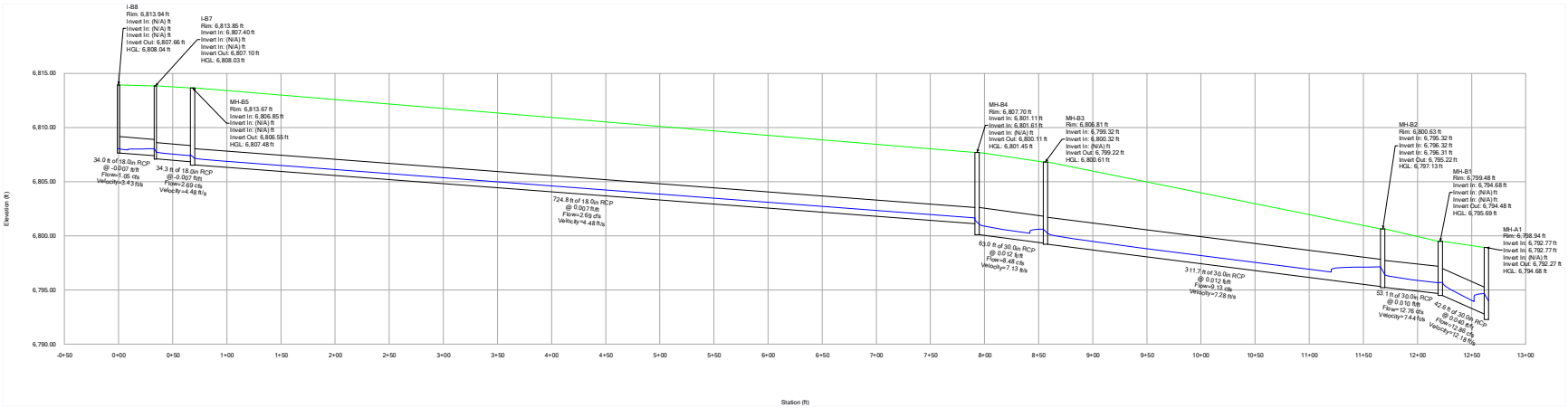
Outfall Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
O-1	6,795.04	True	6,791.51	Free Outfall	6,792.81	27.69

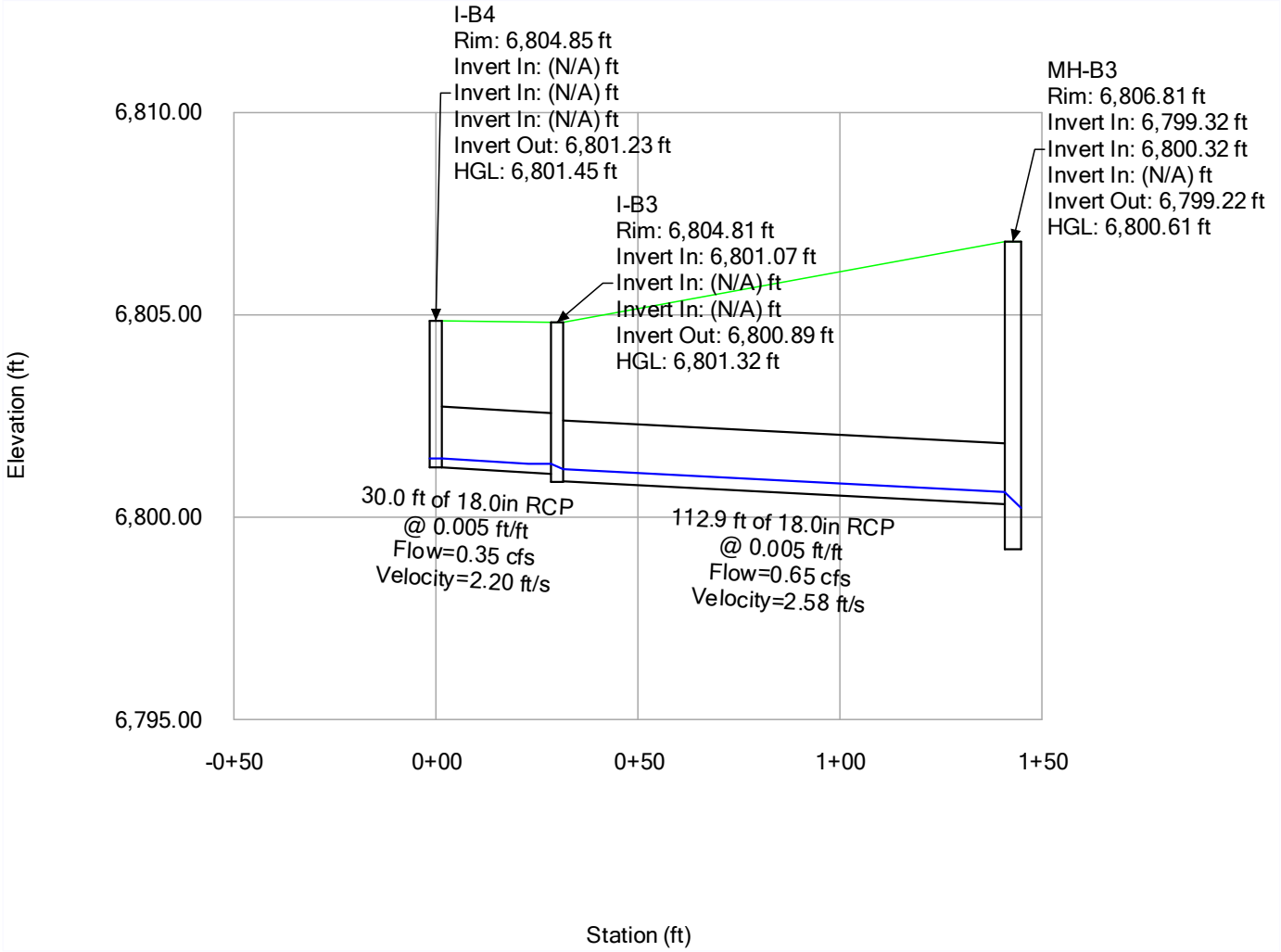
5-YEAR - FREE OUTFALL - STORM A



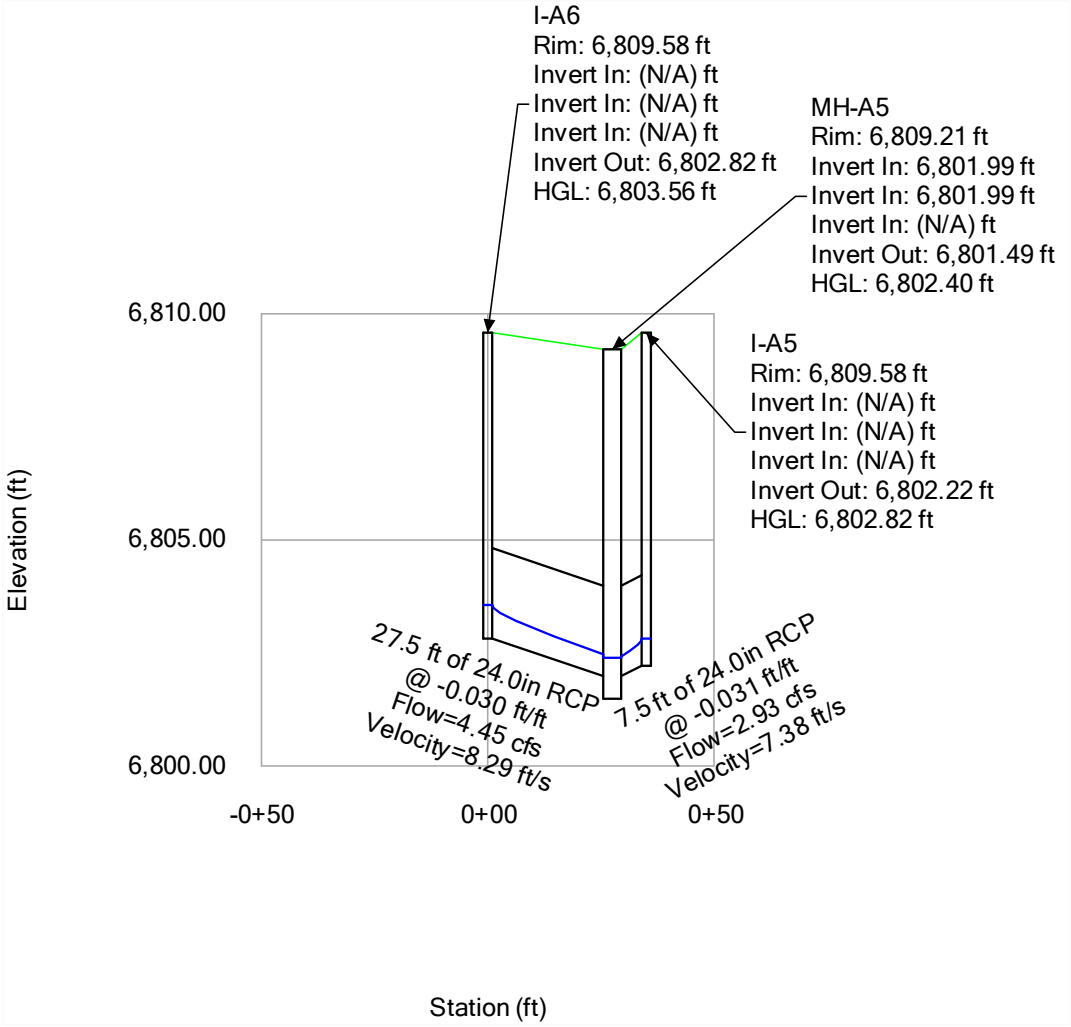
5-YEAR - FREE OUTFALL - STORM B



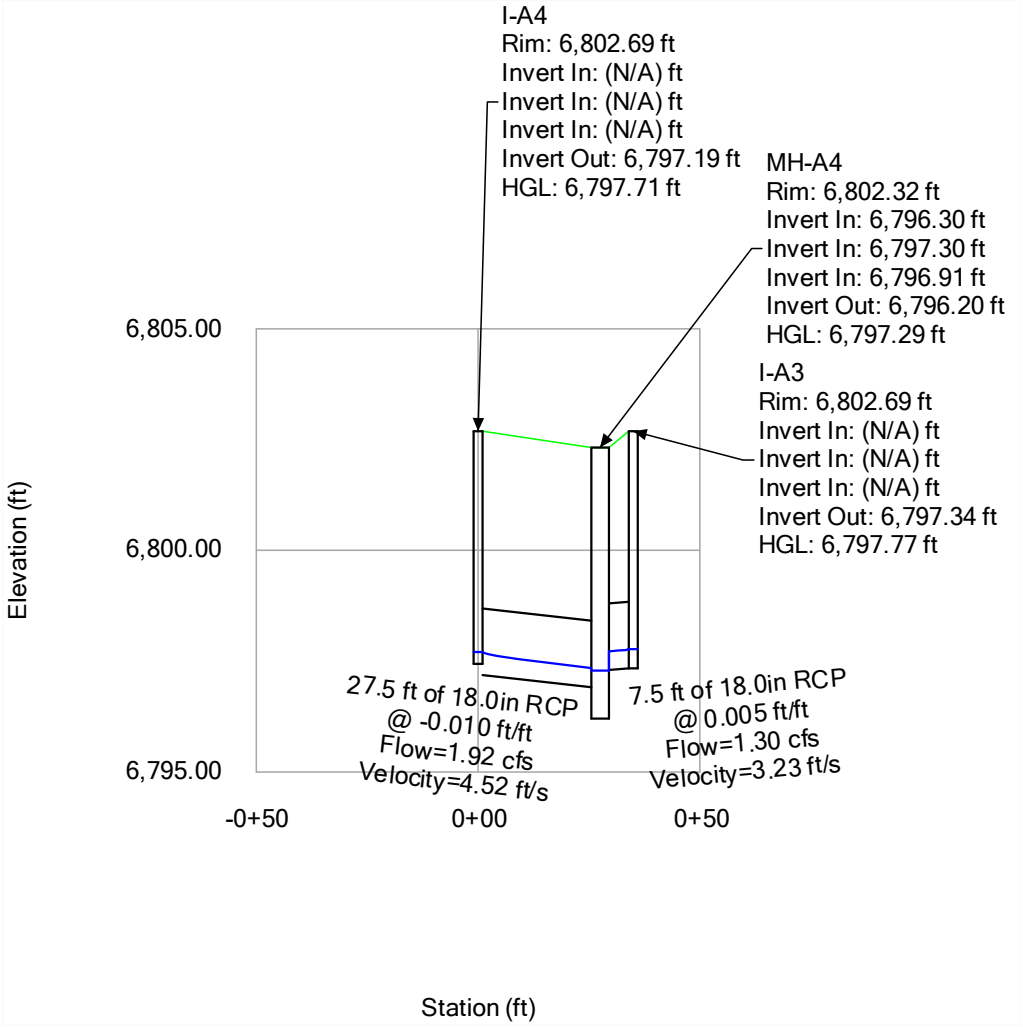
5-YEAR - FREE OUTFALL - STRM C



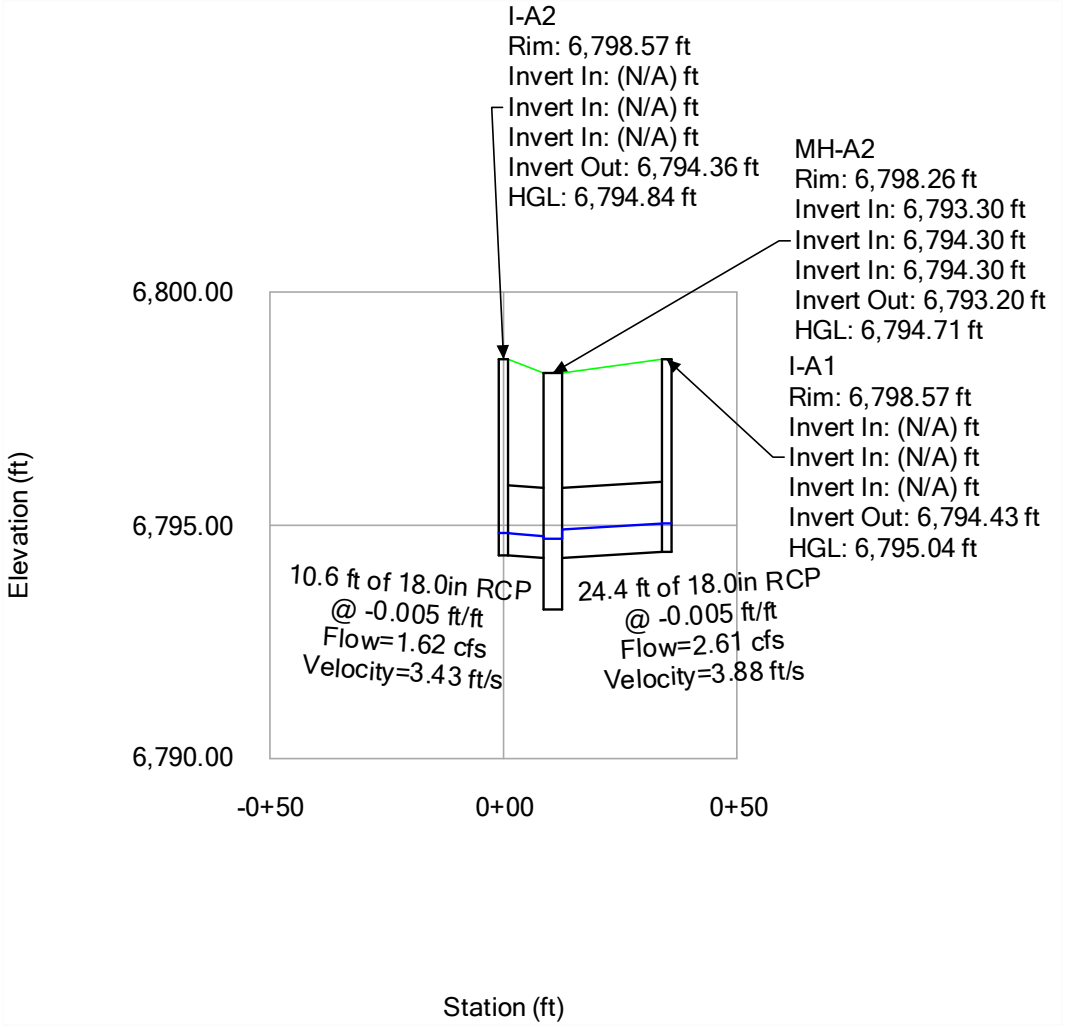
5-YEAR - FREE OUTFALL - STRM A.1



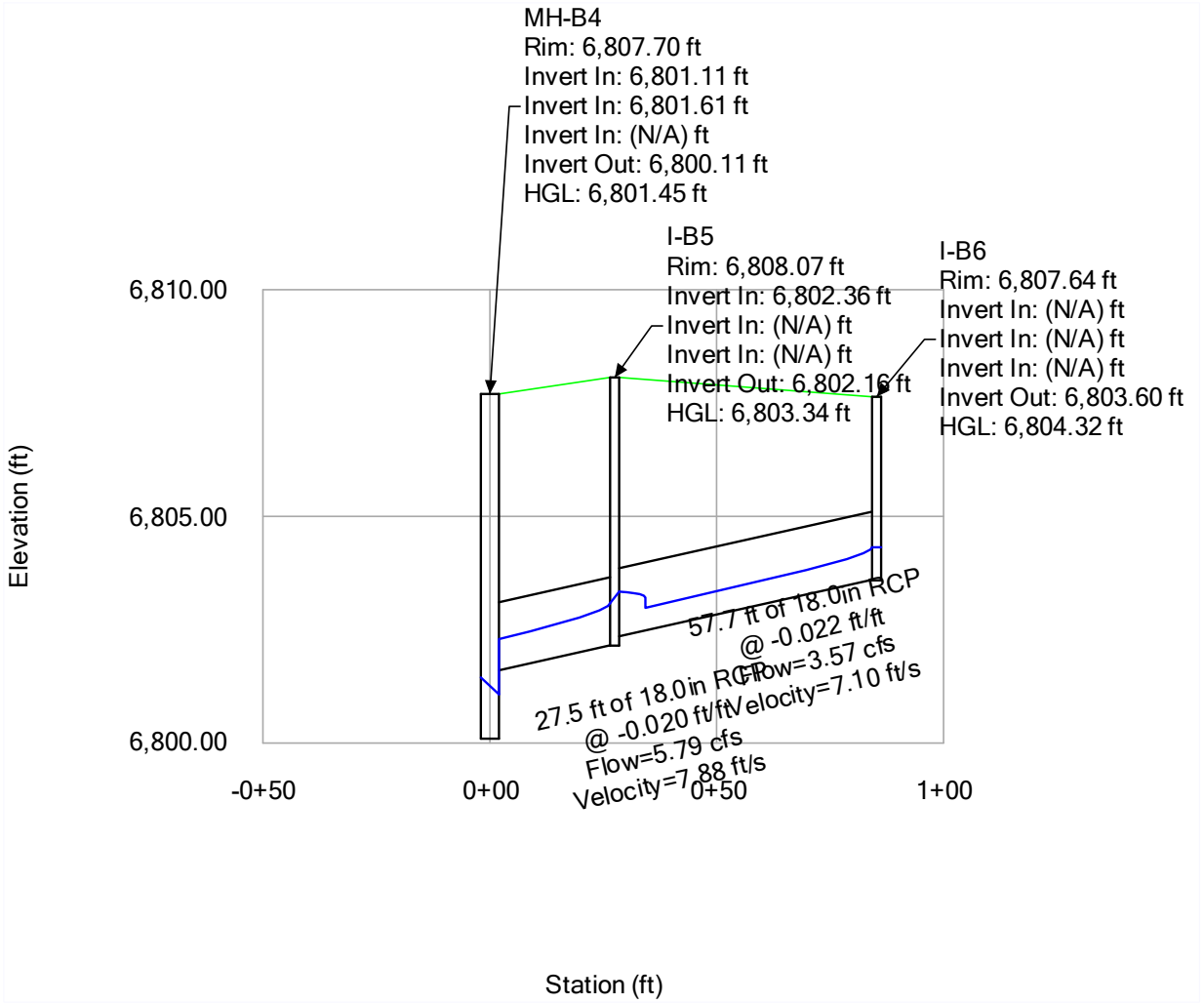
5-YEAR - FREE OUTFALL - STRM A.2



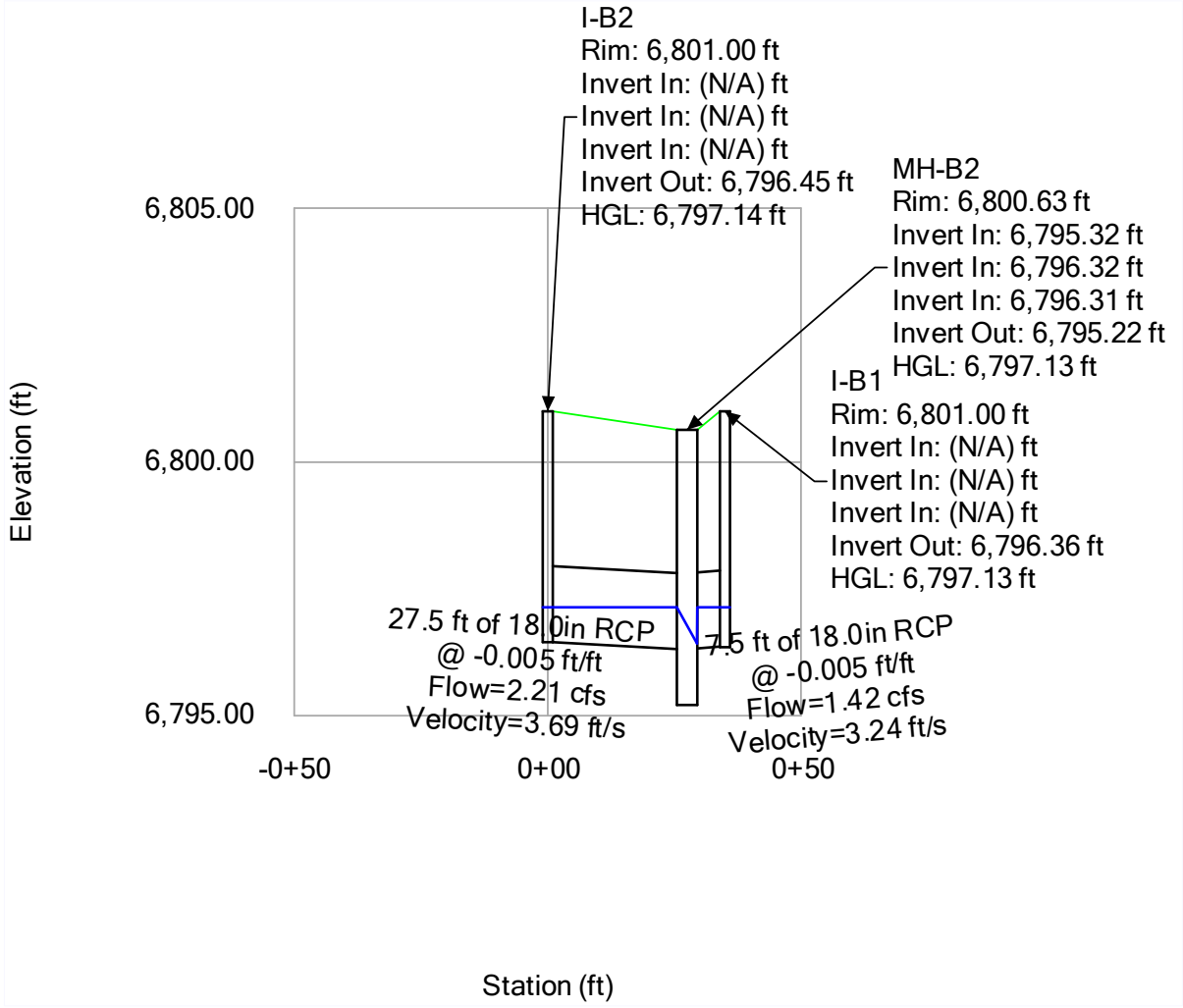
5-YEAR - FREE OUTFALL - STRM A.3



5-YEAR - FREE OUTFALL - STRM B.1



5-YEAR - FREE OUTFALL - STRM B.2



100-YEAR FREE OUTFALL

Conduit Table - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
PIPE -56 (STRM)	I-B7	6,807.40	I-B8	6,807.66	34.0	-0.007	0.013	2.08	4.17	9.10	6,808.47	6,808.48
PIPE -55 (STRM)	MH-B5	6,806.85	I-B7	6,807.10	34.3	-0.007	0.013	5.32	5.35	9.10	6,807.99	6,807.92
PIPE -46 (STRM)	MH-B5	6,806.55	MH-B4	6,801.11	724.8	0.007	0.013	5.32	5.35	9.10	6,807.43	6,802.09
PIPE -57 (STRM)	MH-A5	6,801.99	I-A6	6,802.82	27.5	-0.030	0.013	9.33	10.24	39.29	6,803.91	6,802.73
PIPE -61 (STRM)	MH-A5	6,801.99	I-A5	6,802.22	7.5	-0.031	0.013	5.95	9.07	39.61	6,803.08	6,802.64
PIPE -41 (STRM)	MH-A5	6,801.49	MH-A4	6,796.30	346.3	0.015	0.013	15.28	8.98	50.22	6,802.81	6,797.79
PIPE -59 (STRM)	MH-B4	6,801.61	I-B5	6,802.16	27.5	-0.020	0.013	11.84	9.33	14.85	6,803.47	6,802.69
PIPE -60 (STRM)	I-B5	6,802.36	I-B6	6,803.60	57.7	-0.022	0.013	7.32	8.61	15.40	6,804.65	6,803.99
PIPE -47 (STRM)	MH-B4	6,800.11	MH-B3	6,799.32	63.0	0.012	0.013	17.16	8.67	45.85	6,801.51	6,801.29
PIPE -48 (STRM)	MH-B3	6,799.22	MH-B2	6,795.32	311.7	0.012	0.013	18.44	8.83	45.85	6,800.68	6,798.14
PIPE -52 (STRM)	I-B3	6,800.89	MH-B3	6,800.32	112.9	0.005	0.013	1.28	3.15	7.43	6,801.31	6,801.29
PIPE -51 (STRM)	I-B4	6,801.23	I-B3	6,801.07	30.0	0.005	0.013	0.70	2.70	7.67	6,801.54	6,801.51
PIPE -62 (STRM)	I-A3	6,797.34	MH-A4	6,797.30	7.5	0.005	0.013	2.61	3.93	7.67	6,797.95	6,797.90
PIPE -63 (STRM)	MH-A4	6,796.91	I-A4	6,797.19	27.5	-0.010	0.013	4.02	5.55	10.50	6,797.95	6,797.79
PIPE -42 (STRM)	MH-A4	6,796.20	MH-A3	6,794.81	92.8	0.015	0.013	21.91	9.87	50.18	6,797.79	6,796.83

100-YEAR FREE OUTFALL

Conduit Table - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
PIPE -67 (STRM)	MH-B2	6,796.32	I-B1	6,796.36	7.5	-0.005	0.013	2.88	1.63	7.43	6,798.15	6,798.14
PIPE -66 (STRM)	MH-B2	6,796.31	I-B2	6,796.45	27.5	-0.005	0.013	4.40	2.49	7.49	6,798.19	6,798.14
PIPE -49 (STRM)	MH-B2	6,795.22	MH-B1	6,794.68	53.1	0.010	0.013	25.72	8.91	41.54	6,796.95	6,796.15
PIPE -43 (STRM)	MH-A3	6,794.61	MH-A2	6,793.30	130.2	0.010	0.013	21.91	8.50	41.08	6,796.83	6,796.51
PIPE -50 (STRM)	MH-B1	6,794.48	MH-A1	6,792.77	42.6	0.040	0.013	25.82	14.81	82.13	6,796.21	6,796.03
PIPE -44 (STRM)	MH-A2	6,793.20	MH-A1	6,792.77	86.0	0.005	0.013	30.43	6.20	29.00	6,796.51	6,796.03
PIPE -45 (STRM)	MH-A1	6,792.27	O-1	6,791.51	52.6	0.014	0.013	56.25	12.28	80.19	6,794.70	6,793.51
PIPE -65 (STRM)	MH-A2	6,794.30	I-A1	6,794.43	24.4	-0.005	0.013	5.31	3.00	7.54	6,796.57	6,796.51
PIPE -64 (STRM)	MH-A2	6,794.30	I-A2	6,794.36	10.6	-0.005	0.013	3.21	1.82	7.64	6,796.52	6,796.51

100-YEAR FREE OUTFALL

Catch Basin Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Additional Subsurface) (cfs)	Hydraulic Grade Line (In) (ft)	Headloss Coefficient (Standard)
I-B1	6,801.00	6,801.00	6,796.35	2.88	6,798.15	0.000
I-B2	6,801.00	6,801.00	6,796.45	4.40	6,798.19	0.000
I-A1	6,798.57	6,798.57	6,794.43	5.31	6,796.57	0.000
I-A2	6,798.57	6,798.57	6,794.36	3.21	6,796.52	0.000
I-A3	6,802.69	6,802.69	6,797.34	2.61	6,797.95	0.000
I-A4	6,802.69	6,802.69	6,797.44	4.02	6,797.95	0.000
I-A5	6,809.58	6,809.58	6,802.22	5.95	6,803.08	0.000
I-A6	6,809.58	6,809.58	6,802.82	9.33	6,803.91	0.000
I-B4	6,804.85	6,804.85	6,801.23	0.70	6,801.54	0.000
I-B3	6,804.81	6,804.81	6,800.87	0.58	6,801.51	1.320
I-B5	6,808.07	6,808.07	6,802.15	4.52	6,803.99	0.640
I-B6	6,807.64	6,807.64	6,803.59	7.32	6,804.65	0.000
I-B7	6,813.85	6,813.85	6,807.09	3.24	6,808.48	1.320
I-B8	6,813.94	6,813.94	6,807.64	2.08	6,808.47	0.000

100-YEAR FREE OUTFALL

Manhole Table - Time: 0.00 hours

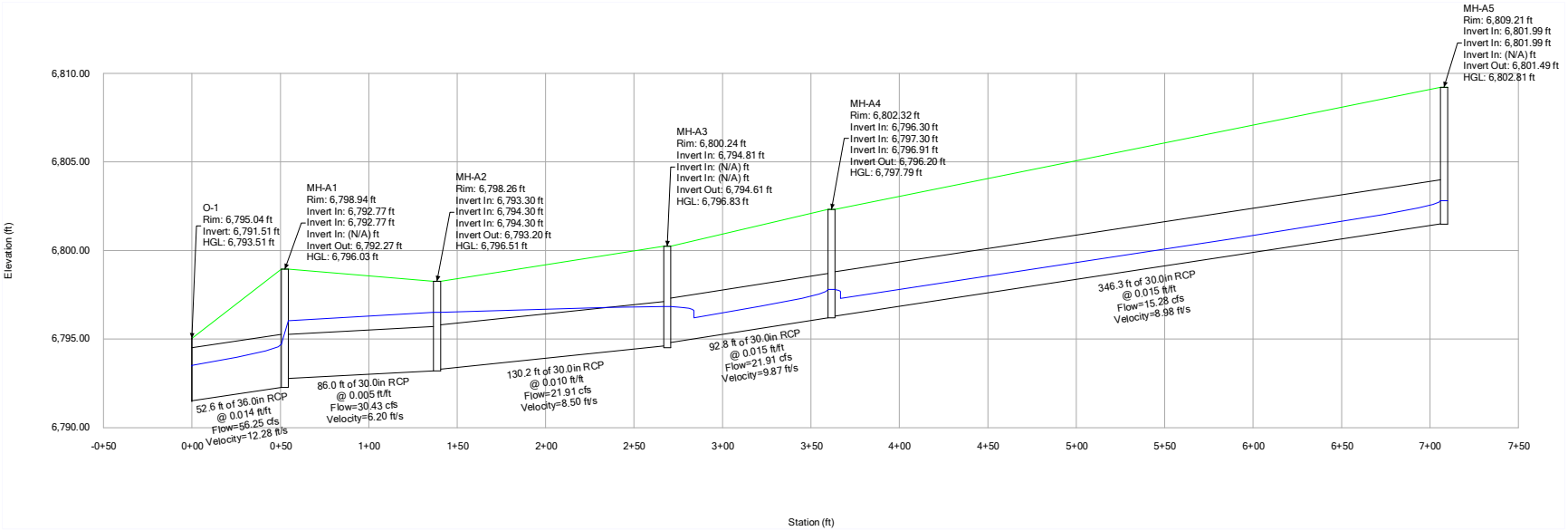
Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert Out) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Hydraulic Grade Line (In) (ft)	Headloss Coefficient (Standard)
MH-B5	6,813.67	6,813.67	6,806.55	5.32	6,807.43	Standard	6,807.92	1.320
MH-A5	6,809.21	6,809.21	6,801.49	15.28	6,802.81	Standard	6,802.81	0.000
MH-B4	6,807.70	6,807.70	6,800.11	17.16	6,801.51	Standard	6,802.09	1.020
MH-B3	6,806.81	6,806.81	6,799.22	18.44	6,800.68	Standard	6,801.29	1.020
MH-A4	6,802.32	6,802.32	6,796.20	21.91	6,797.79	Standard	6,797.79	0.000
MH-B2	6,800.63	6,800.63	6,795.22	25.72	6,796.95	Standard	6,798.14	1.520
MH-A3	6,800.24	6,800.24	6,794.61	21.91	6,796.83	Standard	6,796.83	0.000
MH-B1	6,799.48	6,799.48	6,794.48	25.82	6,796.21	Standard	6,796.21	0.000
MH-A1	6,798.94	6,798.94	6,792.27	56.25	6,794.70	Standard	6,796.03	1.020
MH-A2	6,798.26	6,798.26	6,793.20	30.43	6,796.51	Standard	6,796.51	0.000

100-YEAR FREE OUTFALL

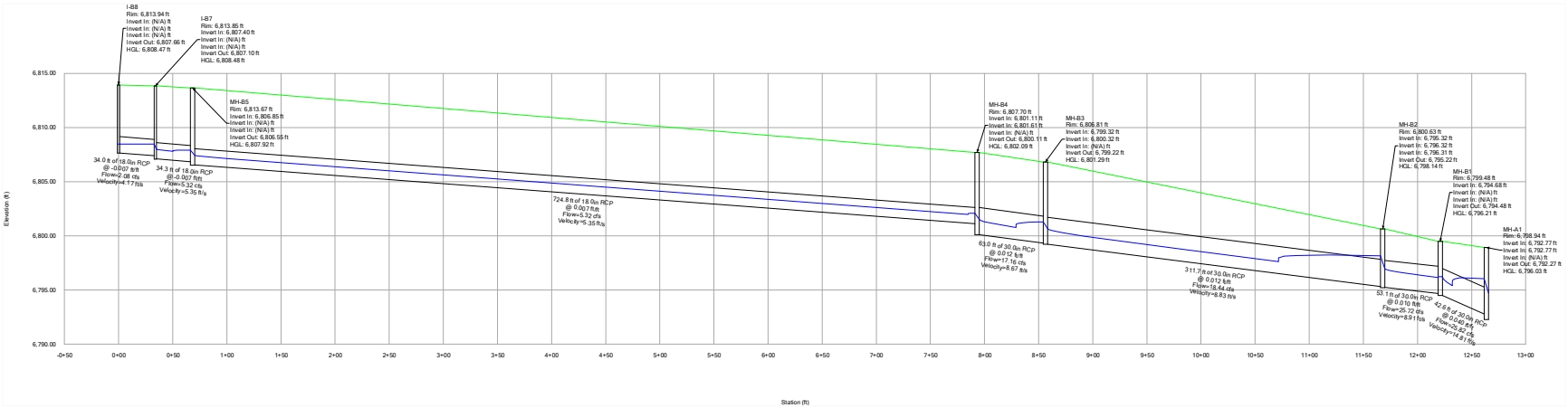
Outfall Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
O-1	6,795.04	True	6,791.51	Free Outfall	6,793.51	56.25

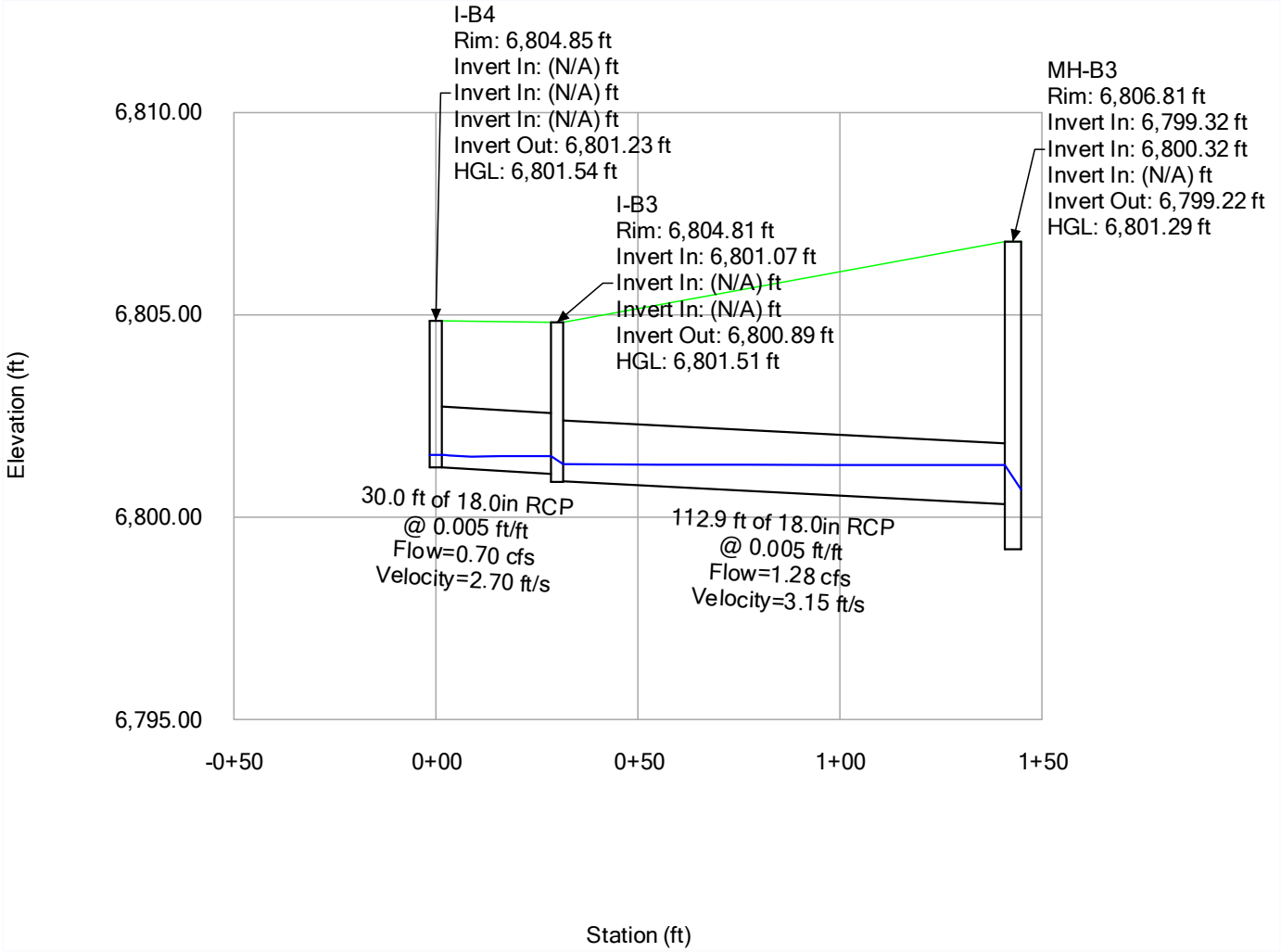
100-YEAR - FREE OUTFALL - STORM A



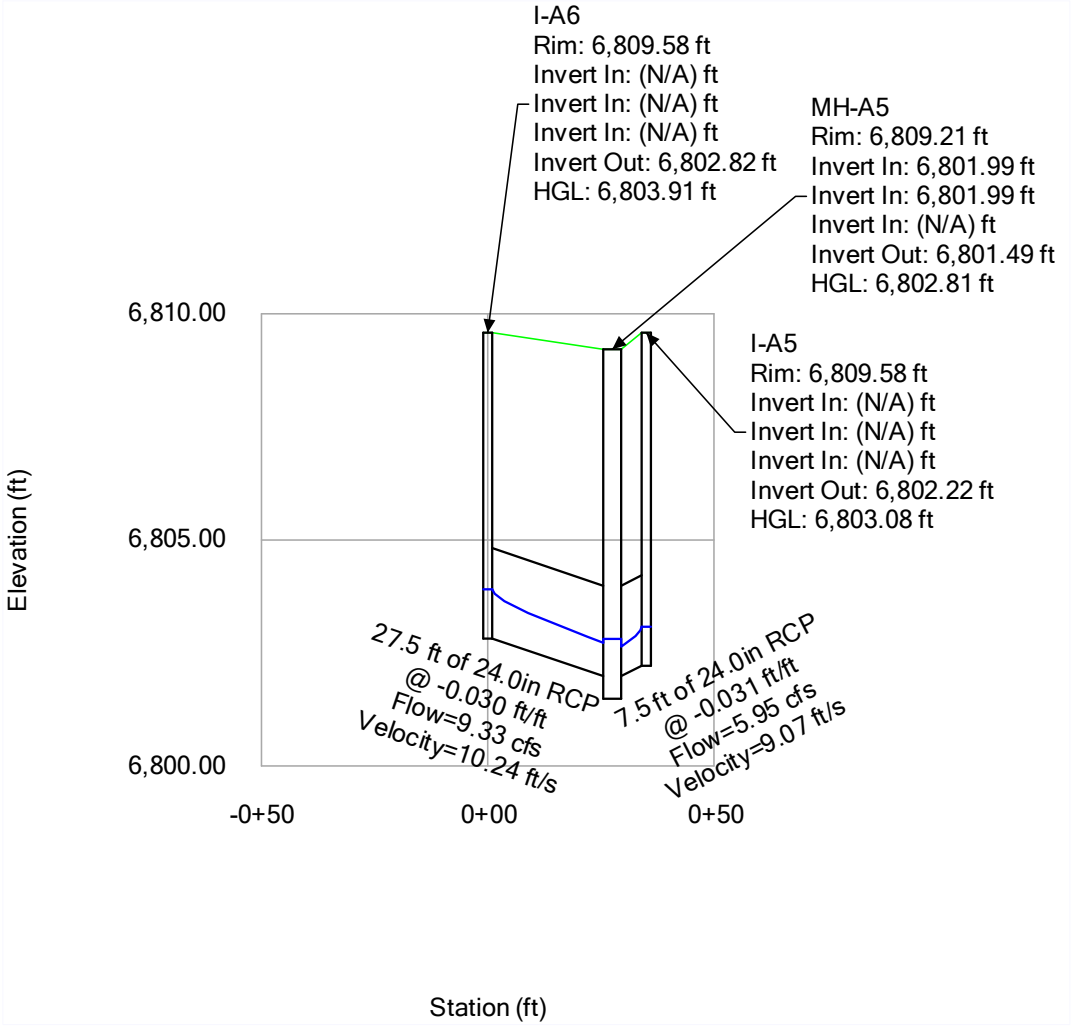
100-YEAR - FREE OUTFALL - STORM B



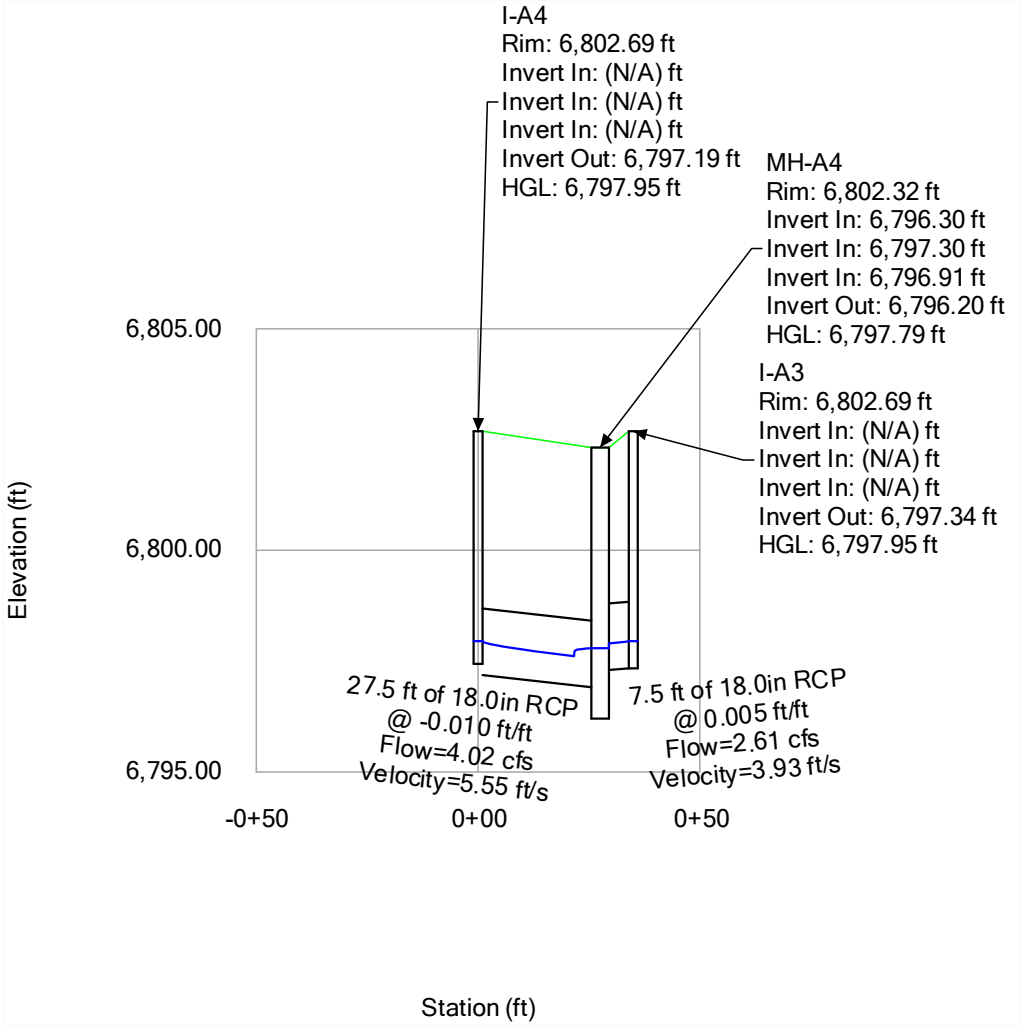
100-YEAR - FREE OUTFALL - STRM C



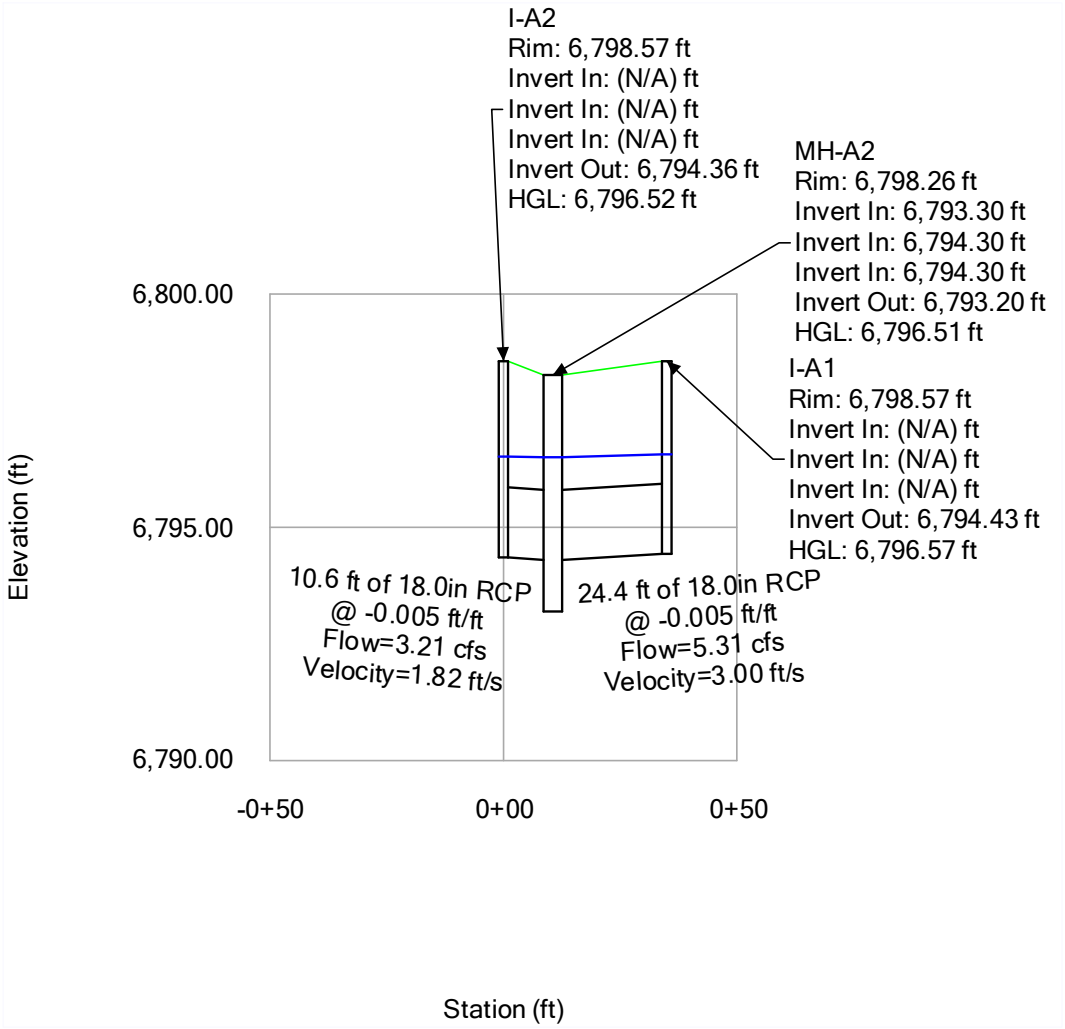
100-YEAR - FREE OUTFALL - STRM A.1



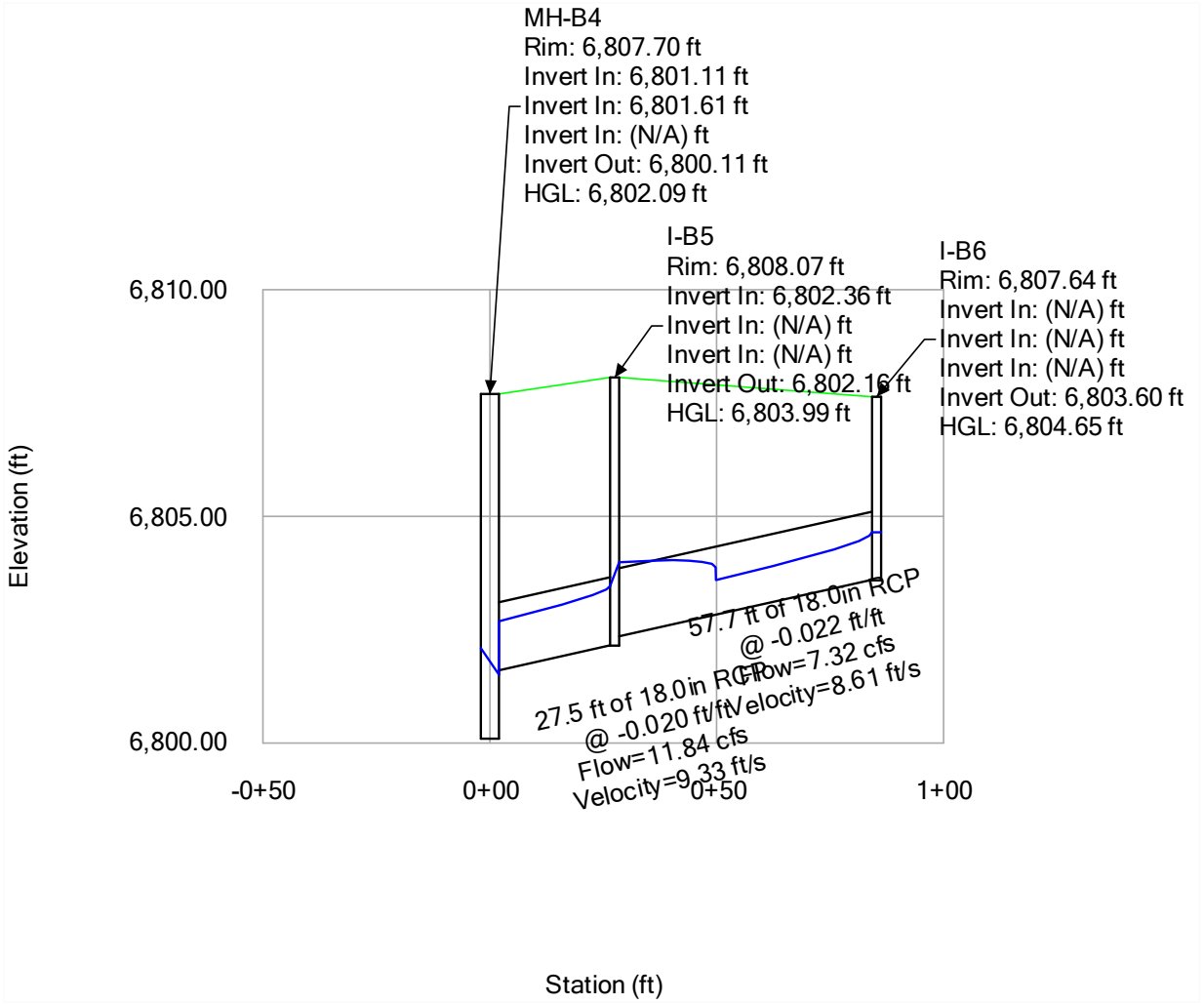
100-YEAR - FREE OUTFALL - STRM A.2



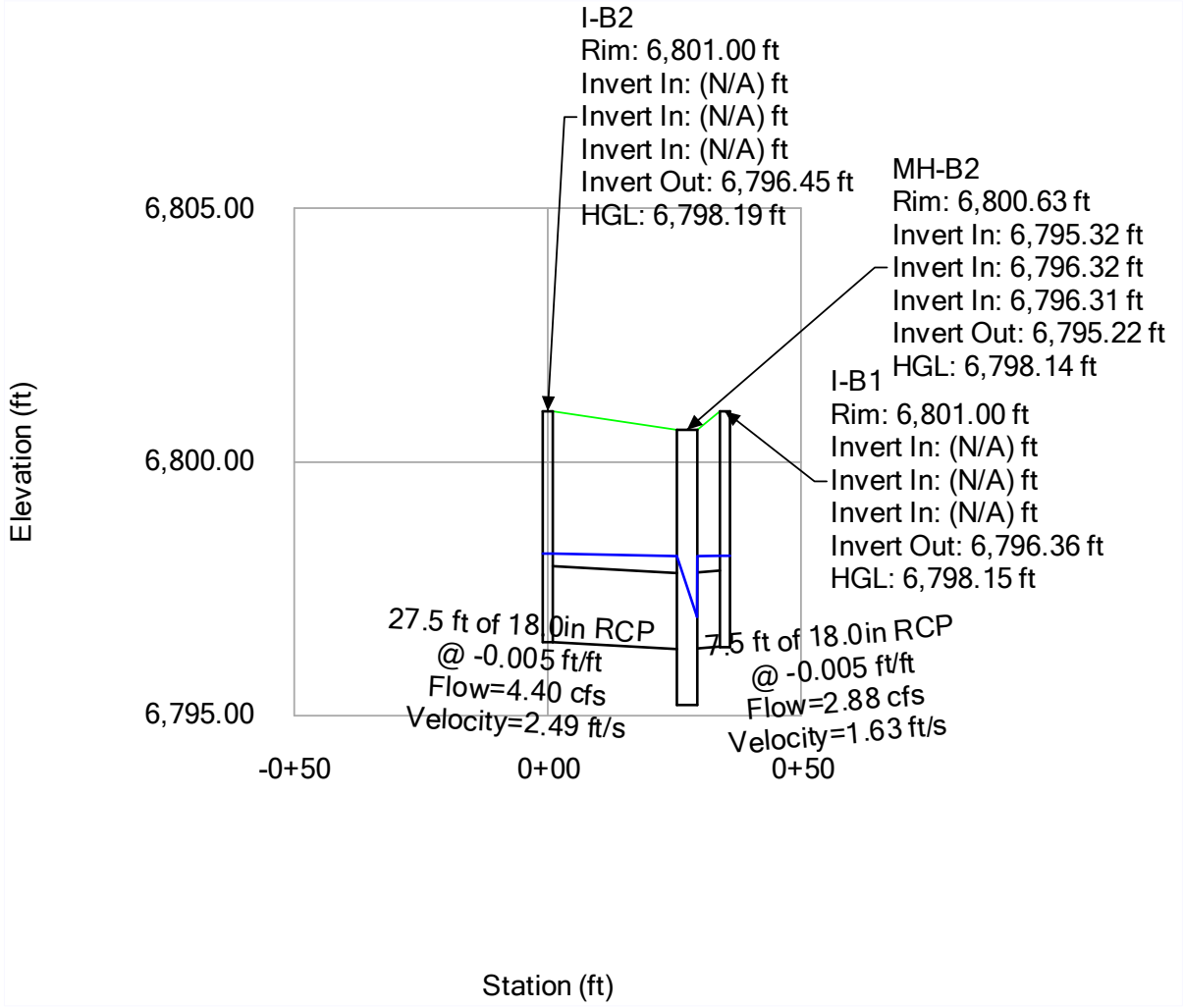
100-YEAR - FREE OUTFALL - STRM A.3



100-YEAR - FREE OUTFALL - STRM B.1



100-YEAR - FREE OUTFALL - STRM B.2



MHFD-Inlet, Version 6.00 (August 2025)

INLET MANAGEMENT

Project: Miller Downs
Minor: 5-year
Major: 100-year

Worksheet Protected

INLET NAME	P1A	P1B	P3	P4	P5	P6	P7	P8	P9	P11	P12	P13	P14	P15	P16	P17	P18
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade	In Sump	On Grade	On Grade	On Grade	In Sump
Inlet Type	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R	Colorado Springs D-10-R
Number of Inlet Units	1	1	1	2	2	2	3	1	1	1	2	1	1	1	1	2	4

USER-DEFINED INPUT

User-Defined Peak Flows

Minor Peak Flow, Q (cfs)	1.58	1.58	2.32	3.41	4.43	1.86	4.12	0.09	0.09	1.53	1.63	0.49	1.44	0.83	1.83	0.87	1.31
Major Peak Flow, Q (cfs)	3.09	3.09	4.72	7.20	9.09	3.66	9.54	0.17	0.17	3.06	3.40	0.96	2.94	1.62	3.86	2.03	2.52

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	User-Defined	User-Defined	No Bypass Flow Received	No Bypass Flow Received	P6	P7	User-Defined	User-Defined
Bypass Flow Description (Optional):																	
Minor Bypass Flow Received, Q_b (cfs)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.01	0.66
Major Bypass Flow Received, Q_b (cfs)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.59	0.00	0.00	0.26	1.70	3.58	5.54

CALCULATED OUTPUT

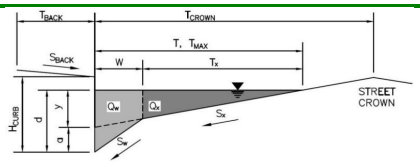
Minor Total Design Peak Flow, Q (cfs)	1.58	1.58	2.32	3.41	4.43	1.86	4.12	0.09	0.09	1.53	2.39	0.49	1.44	0.83	1.83	0.88	1.97
Major Total Design Peak Flow, Q (cfs)	3.09	3.09	4.72	7.20	9.09	3.66	9.54	0.17	0.17	3.06	8.99	0.96	2.94	1.88	5.56	5.61	8.06
Minor Inlet Interception Capacity, Q_i (cfs)	3.93	3.93	6.35	3.23	3.85	1.86	4.12	0.09	0.09	1.28	2.39	0.49	3.93	0.82	1.42	0.88	8.46
Major Inlet Interception Capacity, Q_i (cfs)	3.93	3.93	6.35	5.06	5.67	3.40	7.84	0.17	0.17	1.85	5.84	0.93	3.93	1.44	2.42	4.43	8.46
Minor Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	N/A	0.18	0.58	0.00	0.00	0.00	0.00	0.25	0.00	0.00	N/A	0.01	0.41	0.00	N/A
Major Flow Bypassed Downstream, Qb (cfs)	N/A	N/A	N/A	2.14	3.42	0.26	1.70	0.00	0.00	1.21	3.15	0.03	N/A	0.44	3.14	1.19	N/A
Minor Flow Capture Percentage, C%	100%	100%	100%	95%	87%	100%	100%	100%	100%	84%	100%	100%	100%	99%	78%	100%	100%
Major Flow Capture Percentage, C%	100%	100%	100%	70%	62%	93%	82%	100%	100%	61%	65%	97%	100%	77%	43%	79%	100%

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

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

Project: Miller Downs

Inlet ID: P1A



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

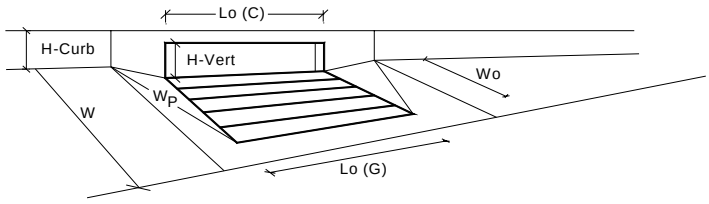
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)



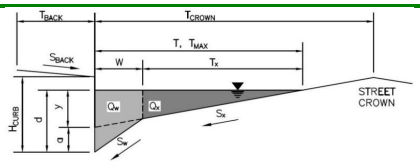
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	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
Open Area 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) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat	Theta =	81.00	81.00	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} =	0.30	0.30	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	3.9	3.9	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.6	3.1	cfs

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

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

Project: Miller Downs

Inlet ID: P1B



Gutter Geometry:

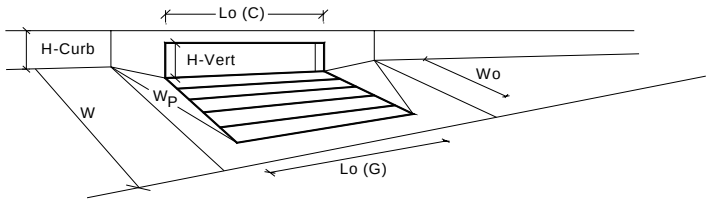
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)



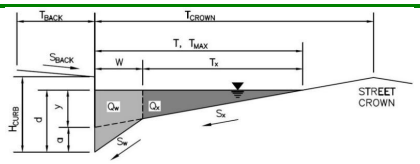
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	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
Open Area 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) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat	Theta =	81.00	81.00	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} =	0.30	0.30	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	3.9	3.9	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.6	3.1	cfs

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

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

Project: Miller Downs

Inlet ID: P3



Gutter Geometry:

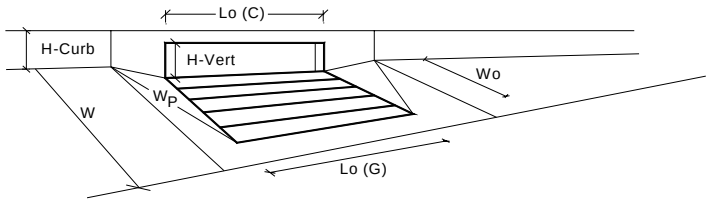
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)



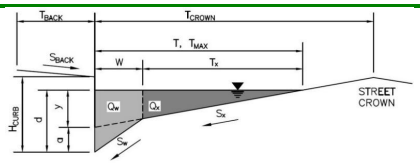
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	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
Open Area 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) =	8.00	8.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat	Theta =	81.00	81.00	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} =	0.30	0.30	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.99	0.99	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	6.3	6.3	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.3	4.7	cfs

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

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

Project: Miller Downs

Inlet ID: P4



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

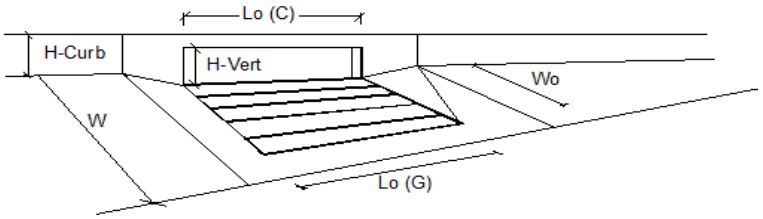
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 3.41 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.20 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



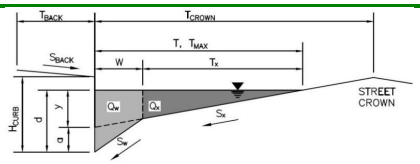
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	3.2	5.1	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.2	2.1	cfs
Capture Percentage = Q_a/Q_o		C% =	95	70	%

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

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

Project: Miller Downs

Inlet ID: P5



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

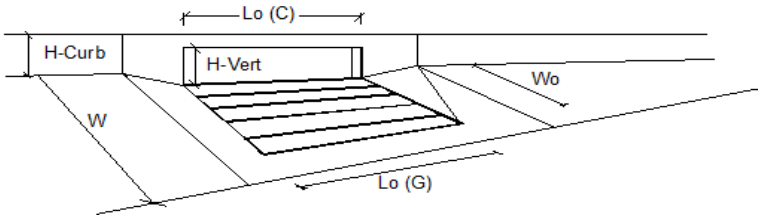
		Minor Storm	Major Storm	
	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.43 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 9.09 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



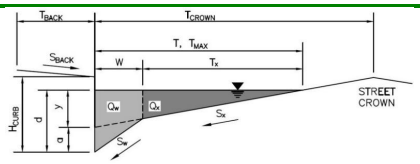
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	3.9	5.7	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.6	3.4	cfs
Capture Percentage = Q_a/Q_o		C% =	87	62	%

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

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

Project: Miller Downs

Inlet ID: P6



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

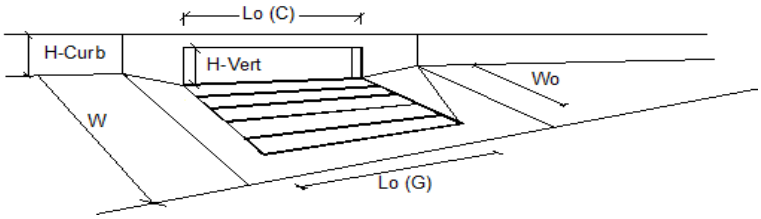
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.86 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.66 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



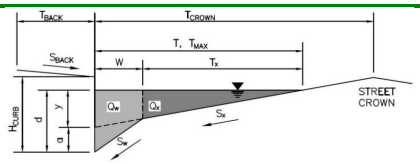
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	1.9	3.4	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.0	0.3	cfs
Capture Percentage = Q_a/Q_o		C% =	100	93	%

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

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

Project: Miller Downs

Inlet ID: P7



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

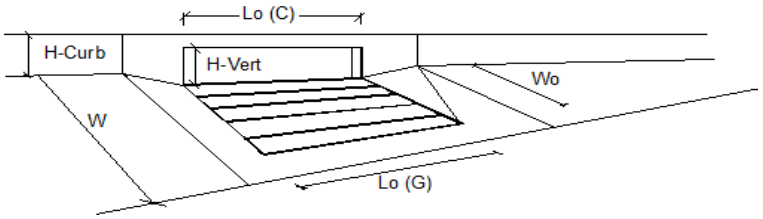
		Minor Storm	Major Storm	
	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.12 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 9.54 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



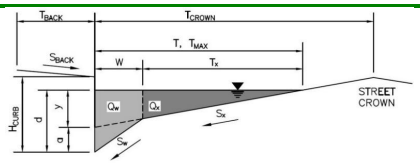
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	4.1	7.8	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.0	1.7	cfs
Capture Percentage = Q_a/Q_o		C% =	100	82	%

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

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

Project: Miller Downs

Inlet ID: P8



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

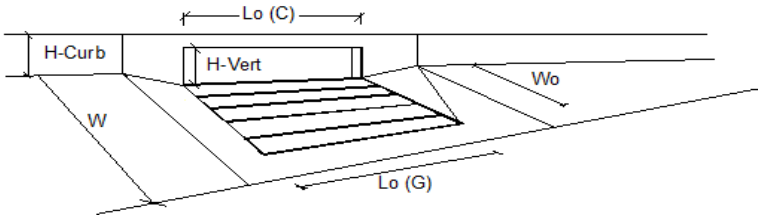
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.09 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.17 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



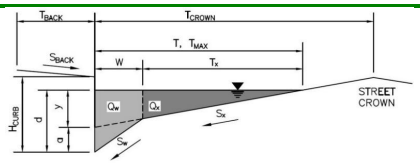
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	8.00	8.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	0.1	0.2	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.0	0.0	cfs
Capture Percentage = Q_a/Q_o		C% =	100	100	%

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

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

Project: Miller Downs

Inlet ID: P9



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.025	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Spread Criterion

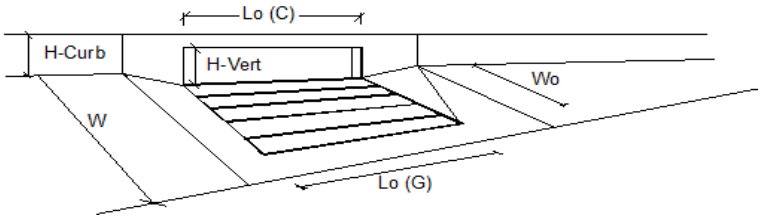
		Minor Storm	Major Storm	
	Q_{allow} =	21.1	21.1	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.09 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.17 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



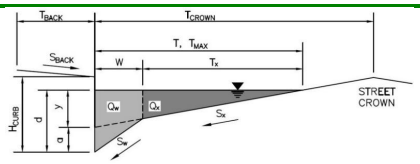
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	0.1	0.2	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.0	0.0	cfs
Capture Percentage = Q_a/Q_o		C% =	100	100	%

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

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

Project: Miller Downs

Inlet ID: P11



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

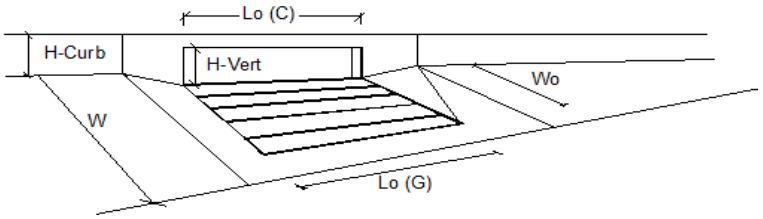
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.53 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.06 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



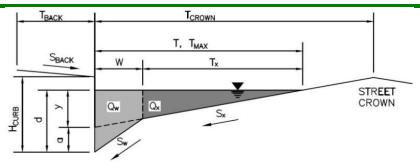
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	1.3	1.9	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.3	1.2	cfs
Capture Percentage = Q_a/Q_o		C% =	84	61	%

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

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

Project: Miller Downs

Inlet ID: P12



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.125	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

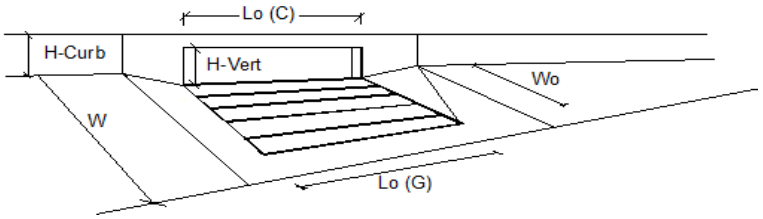
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	14.2	14.2	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.39 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.99 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



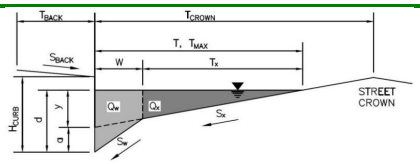
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	2.4	5.8	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.0	3.1	cfs
Capture Percentage = Q_a/Q_o		C% =	100	65	%

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

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

Project: Miller Downs

Inlet ID: P13



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

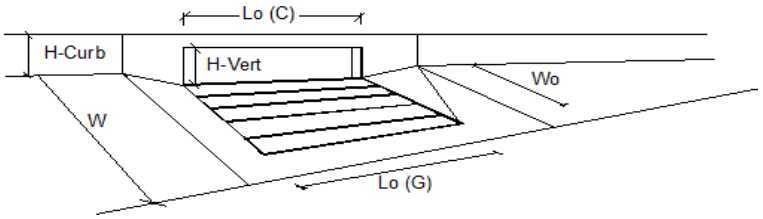
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.49 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.96 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



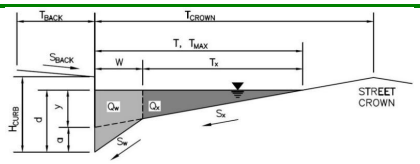
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	0.5	0.9	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.0	0.0	cfs
Capture Percentage = Q_a/Q_o		C% =	100	97	%

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

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

Project: Miller Downs

Inlet ID: P14



Gutter Geometry:

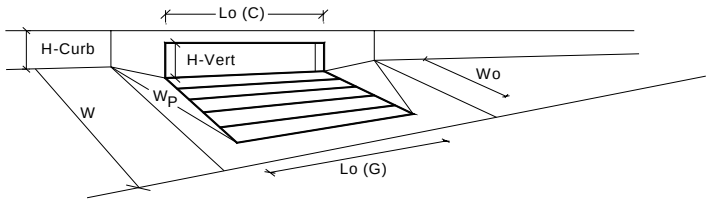
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)



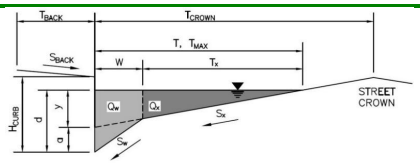
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	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
Open Area 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) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat	Theta =	81.00	81.00	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} =	0.30	0.30	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	3.9	3.9	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.4	2.9	cfs

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

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

Project: Miller Downs

Inlet ID: P15



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

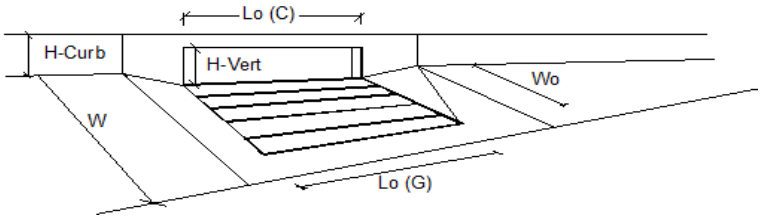
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.83 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.88 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



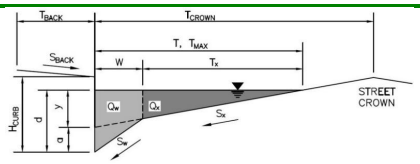
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	0.8	1.4	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.0	0.4	cfs
Capture Percentage = Q_a/Q_o		C% =	99	77	%

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

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

Project: Miller Downs

Inlet ID: P16



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

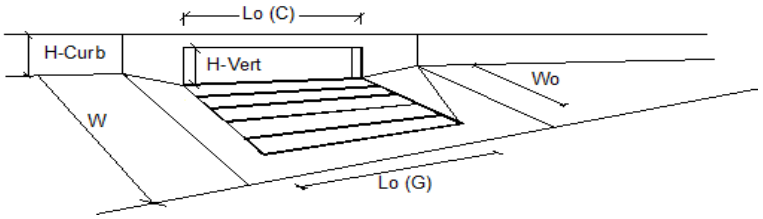
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.83 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.56 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



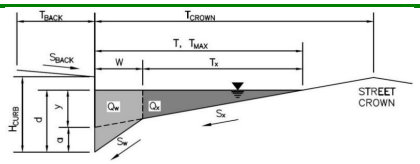
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	1.4	2.4	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.4	3.1	cfs
Capture Percentage = Q_a/Q_o		C% =	78	43	%

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

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

Project: Miller Downs

Inlet ID: P17



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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 =	0.013	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

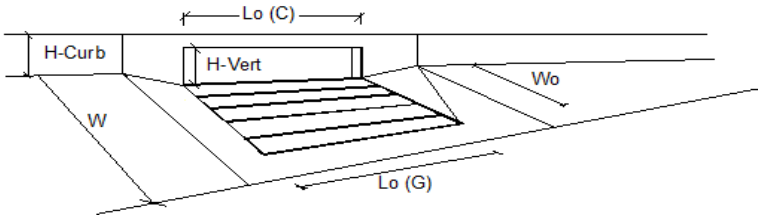
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	14.9	14.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.88 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.61 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 6.00 (August 2025)



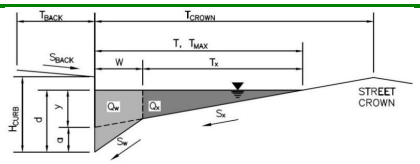
Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	4.00	4.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		Q_a =	0.9	4.4	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	0.0	1.2	cfs
Capture Percentage = Q_a/Q_o		C% =	100	79	%

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

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

Project: Miller Downs

Inlet ID: P18



Gutter Geometry:

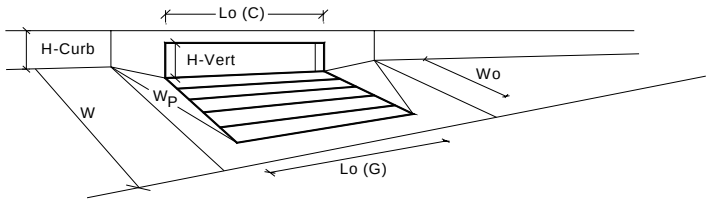
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 6.00 (August 2025)



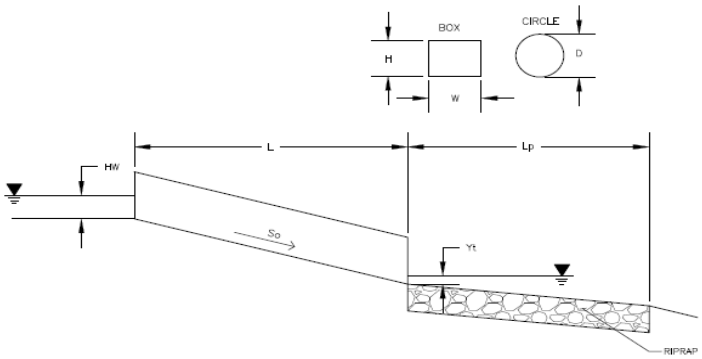
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	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
Open Area 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) =	4.00	4.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	8.00	8.00	inches
Angle of Throat	Theta =	81.00	81.00	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} =	0.30	0.30	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.76	0.76	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	8.5	8.5	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.0	8.1	cfs

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.01 (April 2025)

Project: **Miller Downs**

ID: **New Meadow Drive Outfall**



Soil Type:
Choose One:
○ Sandy
◉ Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:				
	Design Discharge	Q =	4.35	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =	24	inches
	Inlet Edge Type (Choose from pull-down list)		Grooved Edge Projecting	
OR:				
Box Culvert:			**OR**	
	Barrel Height (Rise) in Feet	H (Rise) =		ft
	Barrel Width (Span) in Feet	W (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	# Barrels =	1	
	Inlet Elevation	Elev IN =	6810	ft
	Outlet Elevation **OR** Slope	Elev OUT =	6809.8	ft
	Culvert Length	L =	10	ft
	Manning's Roughness	n =	0.012	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
	Max Allowable Channel Velocity	V =	7	ft/s

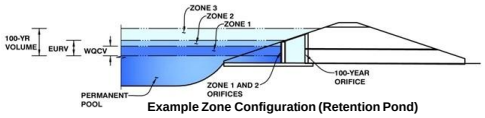
Calculated Results:				
	Culvert Cross Sectional Area Available	A =	3.14	ft^2
	Culvert Normal Depth	Y_n =	0.48	ft
	Culvert Critical Depth	Y_c =	0.73	ft
	Froude Number	Fr =	2.29	**Supercritical!**
	Entrance Loss Coefficient	k_e =	0.20	
	Friction Loss Coefficient	k_f =	0.11	
	Sum of All Loss Coefficients	k_s =	1.31	ft
Headwater:				
	Inlet Control Headwater	HW_I =	0.99	ft
	Outlet Control Headwater	HW_O =	N/A	ft
	Design Headwater Elevation	**HW =**	**N/A**	**ft**
	Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**N/A**	
	Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required			
Outlet Protection:				
	Flow/(Diameter^2.5)	Q/D^2.5 =	0.77	$ft^{0.5}/s$
	Tailwater Surface Height	Y_t =	0.80	ft
	Tailwater/Diameter	Yt/D =	0.40	
	Expansion Factor	1/(2*tan(Θ)) =	6.70	
	Flow Area at Max Channel Velocity	A_t =	0.62	ft^2
	Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
	Length of Riprap Protection	**L_p =**	**6**	**ft**
	Width of Riprap Protection at Downstream End	**T =**	**3**	**ft**
	Adjusted Diameter for Supercritical Flow	Da =	1.24	ft
	Minimum Theoretical Riprap Size	d_{50} min=	1	in
	Nominal Riprap Size	d_{50} nominal=	6	in
	MHFD Riprap Type	**Type =**	**VL**	

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	14.85	acres
Watershed Length =	1,500	ft
Watershed Length to Centroid =	750	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	62.57%	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) =	0.325	acre-feet	0.325	acre-feet
Excess Urban Runoff Volume (EURV) =	1.141	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.95 in.) =	0.656	acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.23 in.) =	0.872	acre-feet	1.23	inches
10-yr Runoff Volume (P1 = 1.48 in.) =	1.084	acre-feet	1.48	inches
25-yr Runoff Volume (P1 = 1.88 in.) =	1.468	acre-feet	1.88	inches
50-yr Runoff Volume (P1 = 2.21 in.) =	1.832	acre-feet	2.21	inches
100-yr Runoff Volume (P1 = 2.57 in.) =	2.274	acre-feet	2.57	inches
500-yr Runoff Volume (P1 = 3.53 in.) =	3.446	acre-feet	3.53	inches
Approximate 2-yr Detention Volume =	0.591	acre-feet		
Approximate 5-yr Detention Volume =	0.795	acre-feet		
Approximate 10-yr Detention Volume =	0.990	acre-feet		
Approximate 25-yr Detention Volume =	1.328	acre-feet		
Approximate 50-yr Detention Volume =	1.531	acre-feet		
Approximate 100-yr Detention Volume =	1.749	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.325	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.816	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.608	acre-feet
Total Detention Basin Volume =	1.749	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	

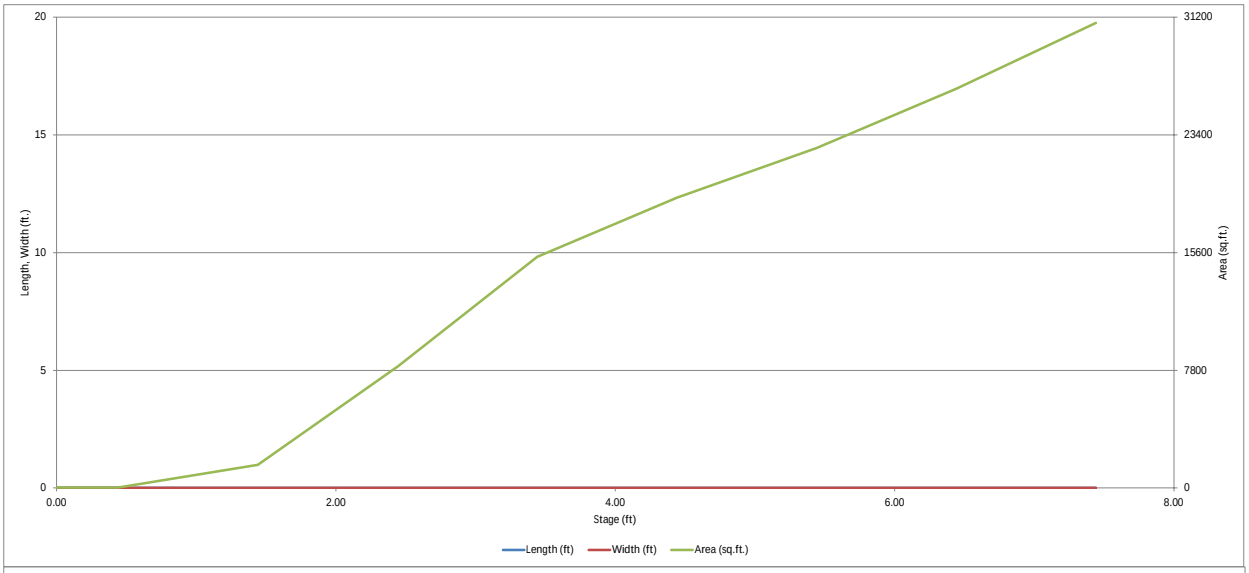
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

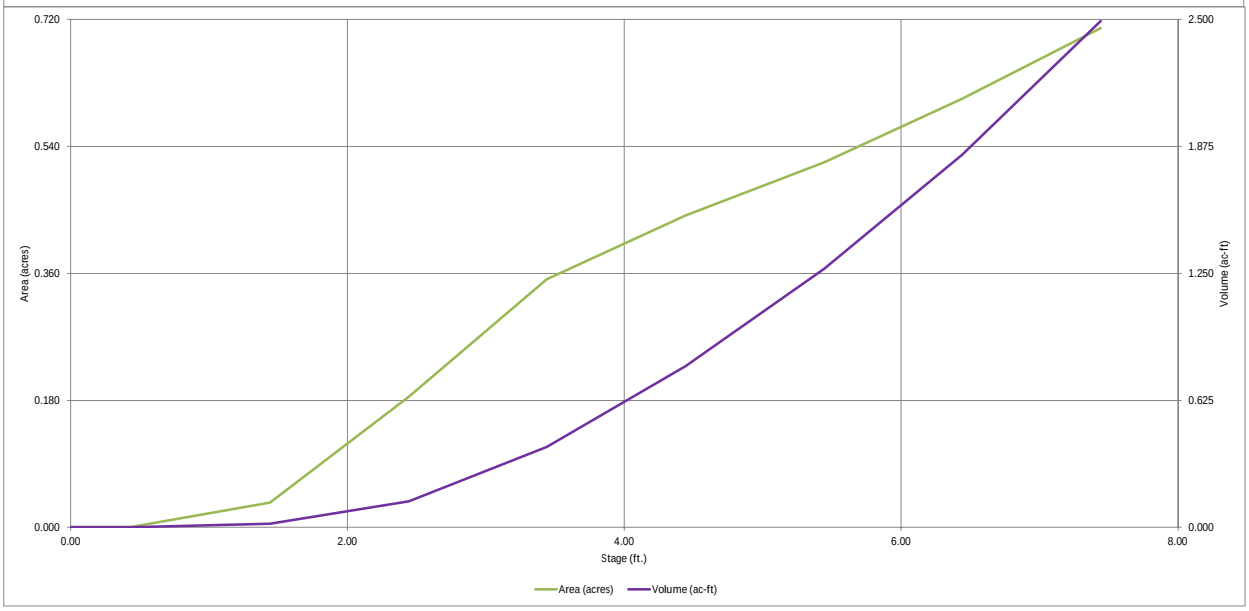
Depth Increment = _____ ft

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)
6792.56 Top of Micropool	--	0.00	--	--	--	16	0.000		
	--	0.44	--	--	--	22	0.001	8	0.000
	--	1.44	--	--	--	1,526	0.035	782	0.018
	--	2.44	--	--	--	8,074	0.185	5,569	0.128
	--	3.44	--	--	--	15,316	0.352	17,250	0.396
	--	4.44	--	--	--	19,254	0.442	34,532	0.793
	--	5.44	--	--	--	22,528	0.517	55,419	1.272
	--	6.44	--	--	--	26,455	0.607	79,906	1.834
	--	7.44	--	--	--	30,824	0.708	108,539	2.492

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



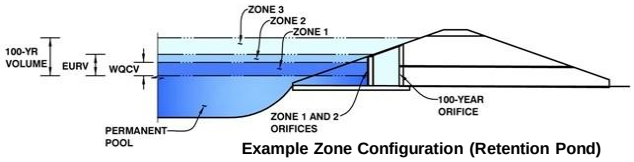


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.23	0.325	Orifice Plate
Zone 2 (EURV)	5.19	0.816	Orifice Plate
Zone 3 (100-year)	6.30	0.608	Weir&Pipe (Restrict)
Total (all zones)		1.749	

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	5.19	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	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	1.00	2.00	3.25				
Orifice Area (sq. inches)	0.69	0.79	2.07	3.14				

	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)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	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 =	5.19	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.19	N/A	feet
Overflow Weir Front Edge Length =	3.92	N/A	feet	Overflow Weir Slope Length =	2.92	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	12.97	N/A	
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	7.97	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.98	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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.61	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.29	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.05	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.15	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.28	feet
Spillway Crest Length =	75.00	feet	Stage at Top of Freeboard =	7.43	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.71	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	2.48	acre-ft

Calculated Parameters for Spillway

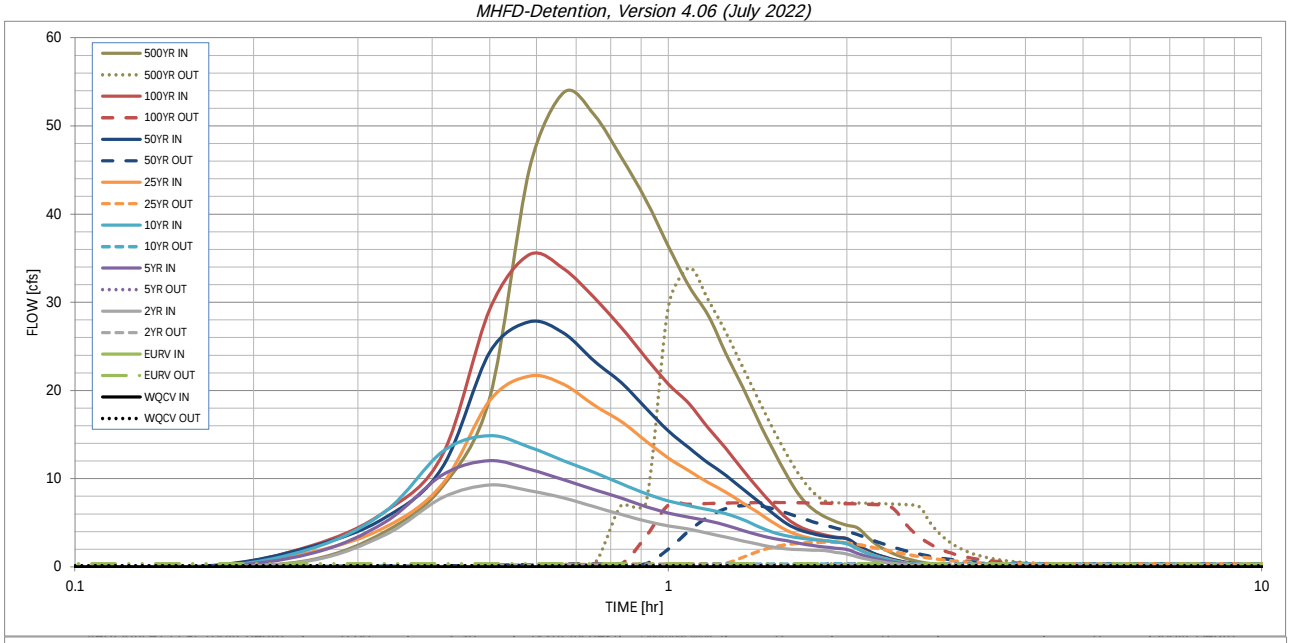
Routed Hydrograph Results

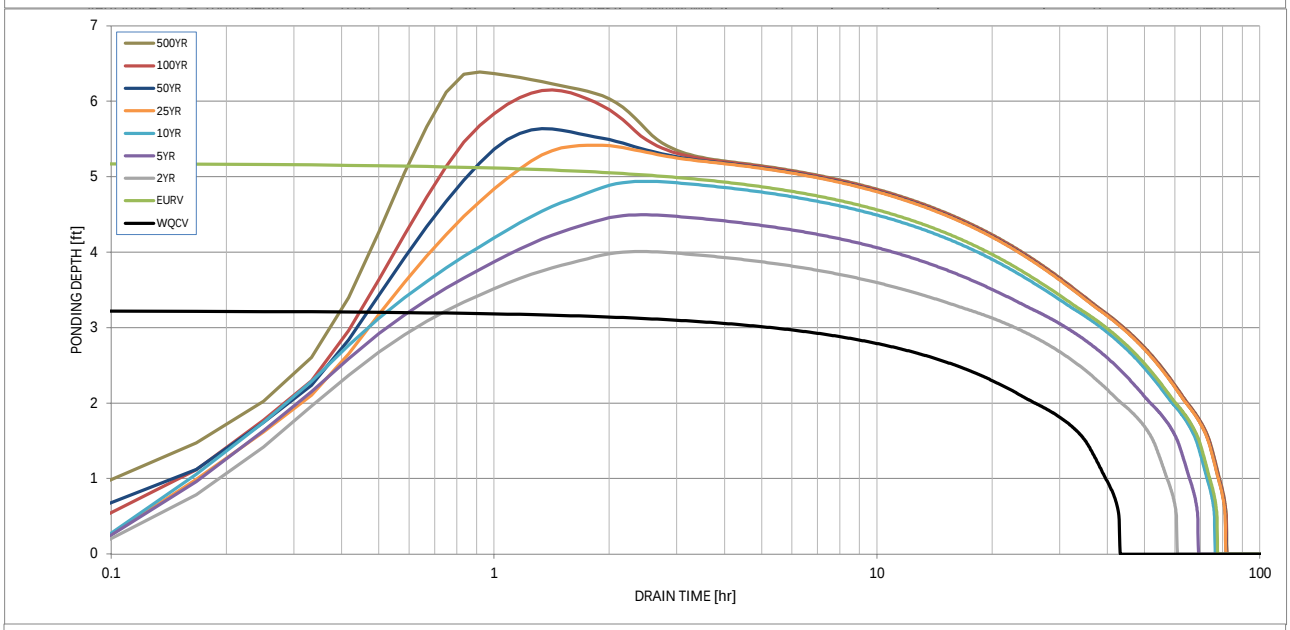
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

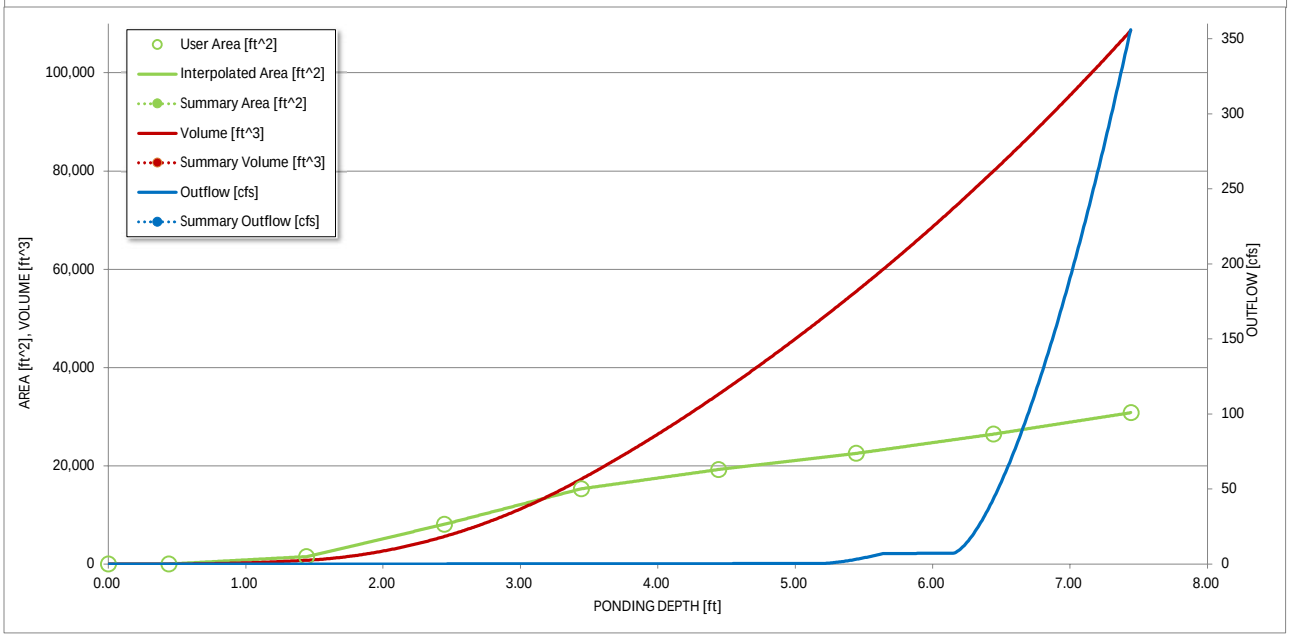
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.95	1.23	1.48	1.88	2.21	2.57	3.53
CUHP Runoff Volume (acre-ft) =	0.325	1.141	0.656	0.872	1.084	1.468	1.832	2.274	3.446
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.656	0.872	1.084	1.468	1.832	2.274	3.446
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.2	1.2	4.2	7.9	17.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.08	0.28	0.53	1.20
Peak Inflow Q (cfs) =	N/A	N/A	9.3	12.0	14.9	21.7	27.8	35.4	53.8
Peak Outflow Q (cfs) =	0.2	0.4	0.3	0.3	0.4	2.8	7.0	7.3	33.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.6	2.3	2.3	1.7	0.9	1.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Plate	Overflow Weir 1	Outlet Plate 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	0.8	0.9	0.9
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) =	38	66	53	60	65	68	66	63	59
Time to Drain 99% of Inflow Volume (hours) =	41	72	57	64	71	75	74	73	71
Maximum Ponding Depth (ft) =	3.23	5.19	4.01	4.50	4.94	5.42	5.64	6.15	6.39
Area at Maximum Ponding Depth (acres) =	0.32	0.50	0.40	0.45	0.48	0.51	0.53	0.58	0.60
Maximum Volume Stored (acre-ft) =	0.326	1.145	0.611	0.815	1.023	1.257	1.372	1.662	1.798

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.06	0.83
	0:15:00	0.00	0.00	0.73	1.53	2.09	1.68	2.32	2.42	4.01
	0:20:00	0.00	0.00	3.66	5.10	6.28	4.50	5.60	6.28	9.17
	0:25:00	0.00	0.00	7.89	10.48	13.11	9.44	11.35	12.78	19.19
	0:30:00	0.00	0.00	9.29	12.05	14.90	18.89	24.38	29.23	45.16
	0:35:00	0.00	0.00	8.66	11.09	13.59	21.66	27.81	35.41	53.84
	0:40:00	0.00	0.00	7.82	9.88	12.04	20.68	26.49	33.78	51.24
	0:45:00	0.00	0.00	6.82	8.77	10.73	18.32	23.34	30.52	46.47
	0:50:00	0.00	0.00	5.95	7.81	9.43	16.50	20.91	27.15	41.62
	0:55:00	0.00	0.00	5.21	6.85	8.31	14.29	18.00	23.71	36.36
	1:00:00	0.00	0.00	4.67	6.12	7.48	12.35	15.42	20.73	31.82
	1:05:00	0.00	0.00	4.30	5.64	6.94	10.90	13.50	18.52	28.57
	1:10:00	0.00	0.00	3.82	5.24	6.50	9.59	11.81	15.78	24.20
	1:15:00	0.00	0.00	3.37	4.74	6.05	8.48	10.39	13.44	20.43
	1:20:00	0.00	0.00	2.96	4.17	5.39	7.27	8.85	11.03	16.63
	1:25:00	0.00	0.00	2.57	3.64	4.60	6.17	7.46	8.91	13.32
	1:30:00	0.00	0.00	2.26	3.23	3.94	5.06	6.07	7.06	10.42
	1:35:00	0.00	0.00	2.06	2.97	3.52	4.14	4.91	5.52	8.02
	1:40:00	0.00	0.00	1.96	2.67	3.28	3.56	4.20	4.56	6.58
	1:45:00	0.00	0.00	1.91	2.43	3.11	3.21	3.77	4.00	5.72
	1:50:00	0.00	0.00	1.88	2.26	2.99	2.99	3.51	3.64	5.13
	1:55:00	0.00	0.00	1.66	2.13	2.85	2.83	3.32	3.38	4.73
	2:00:00	0.00	0.00	1.48	1.98	2.61	2.72	3.20	3.20	4.44
	2:05:00	0.00	0.00	1.15	1.54	2.03	2.12	2.49	2.45	3.38
	2:10:00	0.00	0.00	0.87	1.17	1.54	1.59	1.87	1.82	2.49
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	2:30:00	0.00	0.00	0.27	0.35	0.47	0.49	0.57	0.56	0.76
	2:35:00	0.00	0.00	0.19	0.25	0.34	0.36	0.41	0.41	0.56
	2:40:00	0.00	0.00	0.14	0.18	0.25	0.26	0.30	0.30	0.40
	2:45:00	0.00	0.00	0.09	0.12	0.16	0.18	0.20	0.20	0.27
	2:50:00	0.00	0.00	0.05	0.07	0.10	0.11	0.13	0.12	0.16
	2:55:00	0.00	0.00	0.02	0.04	0.05	0.06	0.07	0.06	0.08
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	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

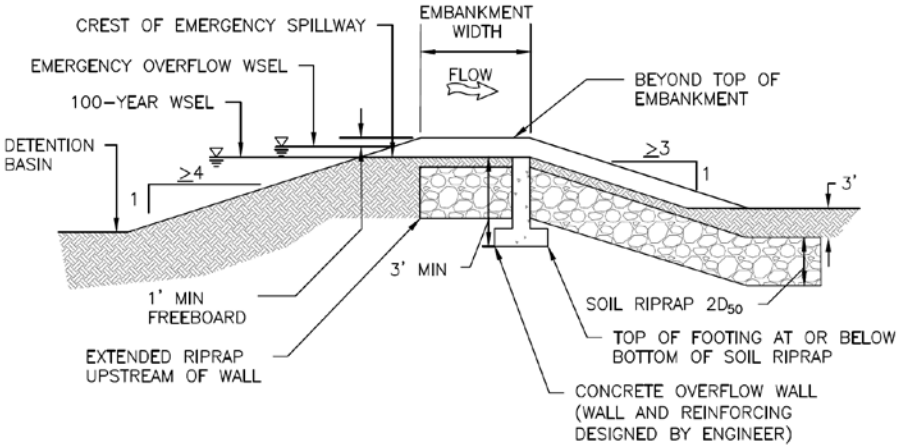
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

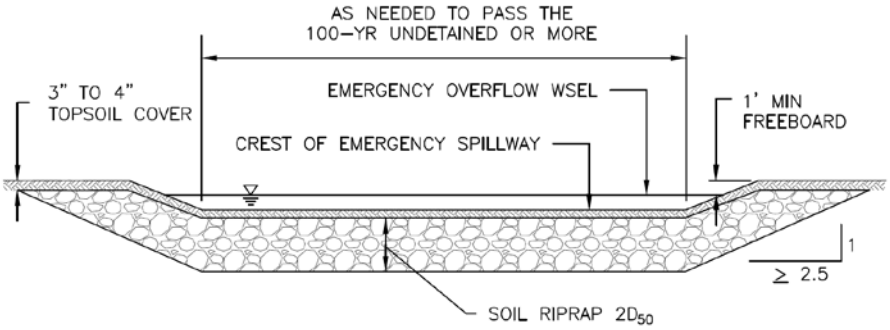
Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

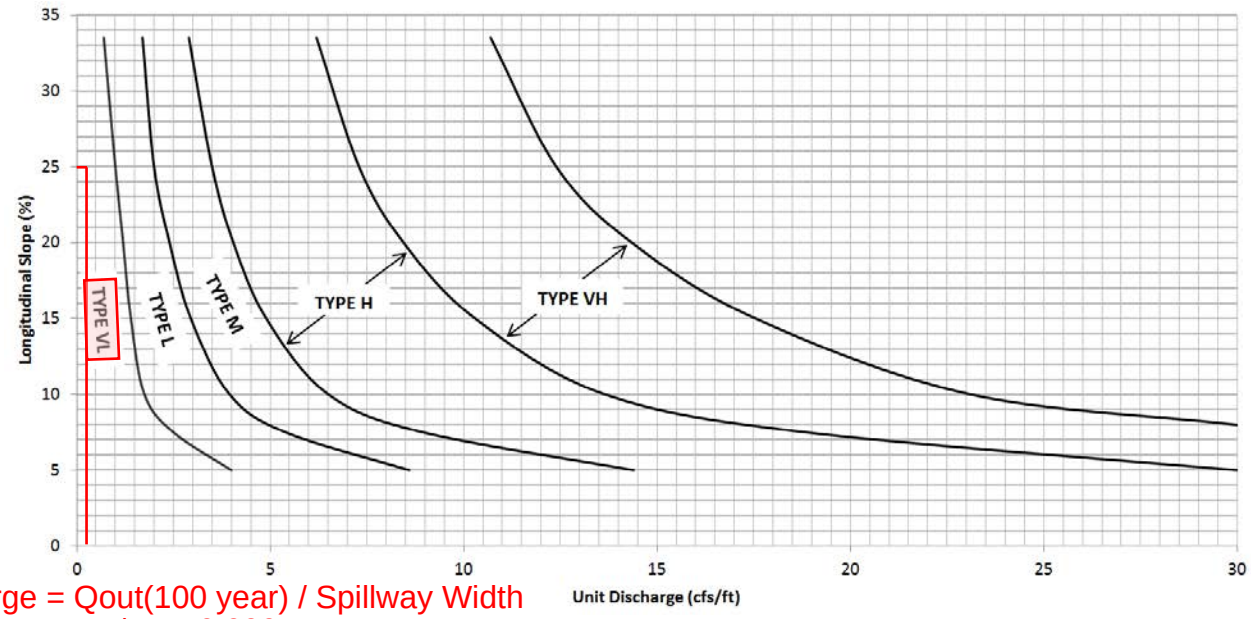
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]



EMERGENCY SPILLWAY PROFILE



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL



Unit discharge = Qout(100 year) / Spillway Width
Unit discharge = 7.4/75 = 0.099

Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

Kimley»Horn

STAGE-STORAGE ISV ANALYSIS

PROJECT NAME: Miller Downs
CALCULATED BY: MEL
CHECKED BY: NMB

ISV

ELEV. (FT)	AREA (SQ FT)	ACCUM. VOL. (CU FT)	ACCUM. VOL. (AC-FT)	
2.5	20.0	50.0	0.0011	MICROPOOL HAS SUFFICIENT VOLUME
	WQCV	14,287	0.1410	
	ISV (0.3% OF WQCV)	42.9	0.0004	

Trickle Channel

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Discharge	1.30 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.50
0+01	0.50
0+01	0.00
0+04	0.00
0+04	0.50
0+04	0.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.50)	(0+01, 0.50)	0.013
(0+01, 0.50)	(0+01, 0.00)	0.013
(0+01, 0.00)	(0+04, 0.00)	0.013
(0+04, 0.00)	(0+04, 0.50)	0.013
(0+04, 0.50)	(0+04, 0.50)	0.013

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

Results	
Normal Depth	1.7 in
Roughness Coefficient	0.013
Elevation	0.15 ft
Elevation Range	0.0 to 0.5 ft
Flow Area	0.4 ft²
Wetted Perimeter	3.3 ft
Hydraulic Radius	1.6 in
Top Width	3.00 ft
Normal Depth	1.7 in
Critical Depth	2.2 in
Critical Slope	0.005 ft/ft
Velocity	2.98 ft/s

Trickle Channel

Results	
Velocity Head	0.14 ft
Specific Energy	0.28 ft
Froude Number	1.375
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.7 in
Critical Depth	2.2 in
Channel Slope	0.010 ft/ft
Critical Slope	0.005 ft/ft

Streamside Design Guidelines

Revised 2009

TABLE 2 - Vegetation Requirements and Uses within the Overlay Zone. Requirements are in addition to the Landscape Code requirements.

Streamside Overlay Zone	Vegetation	Uses
Stream Channel	Little to no vegetation; riparian where present	Stabilization, restoration and flood control only.
Inner Buffer Zone	Riparian vegetation corresponding to Appendix B; 1 tree per 20 feet of stream frontage	Riparian area; flood control, stormwater BMPs, landscaping, and recreational uses; no impervious surfaces.
Outer Buffer Zone	Riparian or upland vegetation; 1 tree per 30' of stream frontage	Upland area; all uses permitted within the underlying zoning and complying with 7.3.508.E.2.d(1)

- Soil type relative to the susceptibility to erosion;
- Vegetation compatibility;
- Site hydrology/drainage;
- Existing vegetation;
- Existing land use;
- Impact of proposed land use;
- Floodplain location; and
- Impact of vegetation on flows.

Stream Types and Buffers

Within the city, three steam types are identified and represented on the Streamside Overlay zone on the City Zoning Map (Appendix C). Each streamside type establishes a buffer zone, made up of the stream channel, the inner buffer zone and the outer buffer zone.

Stream Channel

The protection of the stream channel is critical for flood mitigation, water quality and wildlife habitat. It is identified as the area between the toe of both channel banks. All proposed uses for the stream channel are subject to the review and approval of the Community Development Department. Wetland areas, which are between defined channel banks and are contiguous to the stream itself, are to be considered a part of the stream channel regulation category. Stream bank stabilization, restoration activities, trail cross-

ESSENTIAL POINTS

- **Define Stream Channel, Inner Buffer Zone and Outer Buffer Zone.**
- **10% site impervious surface is allowed. If additional Water Quality Capture Volume (WQCV) or stream bank improvements in excess of the DBPS are provided, up to 25% site impervious surface maybe allowed.**
- **Example Stormwater BMPs include Grass Buffers, Grass Swales, Porous Landscape Detention, and Constructed Wetlands Channels.**

	Type 1	Type 2	Type 3
Typical Stream Channel Width	Less than 25'	25'-75'	Greater than 75'
Buffer Total	70'	90'	120'
Inner Buffer	20'	30'	40'
Outer Buffer	50'	60'	80'

TABLE 3 - Buffer Widths.

ings, road crossings and flood control activities are typically the only permitted activities within the stream channel.

Inner Buffer Zone

The Inner Buffer Zone is measured outward from the toe of the channel bank. It is considered a preservation area where uses are restricted to flood control stormwater BMPs, landscaping, utility corridors and recreational trails. Impervious surfaces are not permitted within the Inner Buffer Zone. Specific permitted, prohibited and/or conditional uses (listed in Section 7.3.508.E.2.d(1) of the Zoning Code), impervious surface limitations, grading limitations and landscaping standards apply within the Inner Buffer Zone.

Outer Buffer Zone

The Outer Buffer Zone extends from the outward edge of the Inner Buffer Zone to the outer extent of the overlay area. The Outer Buffer Zone may often be an area of increased activity to improve the human relationship with adjacent stream area. The full range of uses that are permitted in the base zone (unless listed in Section 7.3.508.E.2.d (1) of the Zoning Code) are permitted in the Outer Buffer Zone. However, specific impervious surface limitations, grading limitations and landscaping standards will apply within the Outer Buffer Zone.

Impervious Surfaces

An impervious surface is defined as a surface on or in real property where the infiltration of stormwater into the earth has been reduced by manmade improvements such as, but not limited to buildings or other structures; streets, parking lots, storage areas and driveways (including gravel, dirt or stone driveways – although those constructed with pavers specifically designed to permit groundwater infiltration are considered pervious); brick, stone or paved patio areas; concrete or asphalt sidewalks; paving and compacted surfaces; and other bricked, oiled, macadam or hard-surfaced areas which impede passage of storm waters into the earth's surface. The conversion of pervious areas to rooftops, roads, and parking lots creates a layer of impervious surface in the urban landscape. In natural settings, very little annual rainfall is converted to runoff and about half is infiltrated into the underlying soils and the water table. Conversely, in situations with increased impervious surfaces, surface runoff increases the impact of flood events, increasing erosion and decreasing water quality.

Site Imperviousness Standards

Those portions of the subject parcel or project that fall within the inner and outer buffer zone of the Streamside Overlay area shall be used to calculate the required limit on impervious surfaces. Wooden decks constructed with spaces between boards with pervious materials such as sand or gravel beneath are considered pervious. When ponds, wetlands, or water quality BMPs are located on the subject property, they are to be considered as pervious surfaces.

Directions for Calculating Impervious Surface

1. Determine the square footage of the inner and outer buffer zone of the Streamside Overlay zone on each individual parcel. Any area included within the buffer, but not

	Stream Channel	Inner Buffer Zone	Outer Buffer Zone	Outside SS Overlay
% Impervious Allowed	0%	0%	10%	Restricted by base zoning
% Allowed with WQCV or Other Improvements	0%	0%	25%	Restricted by base zoning

TABLE 4 - Impervious Surface.

APPENDIX F – SAND CREEK DBPS

Compliance with this report will be outlined in the future Final Drainage Report and Channel Design Report.

SAND CREEK DRAINAGE BASIN PLANNING STUDY

FINAL REPORT

JANUARY 2021

Prepared for:

COLORADO SPRINGS
OLYMPIC CITY USA

STORMWATER ENTERPRISE

Prepared by:

Stantec

HDR Dewberry

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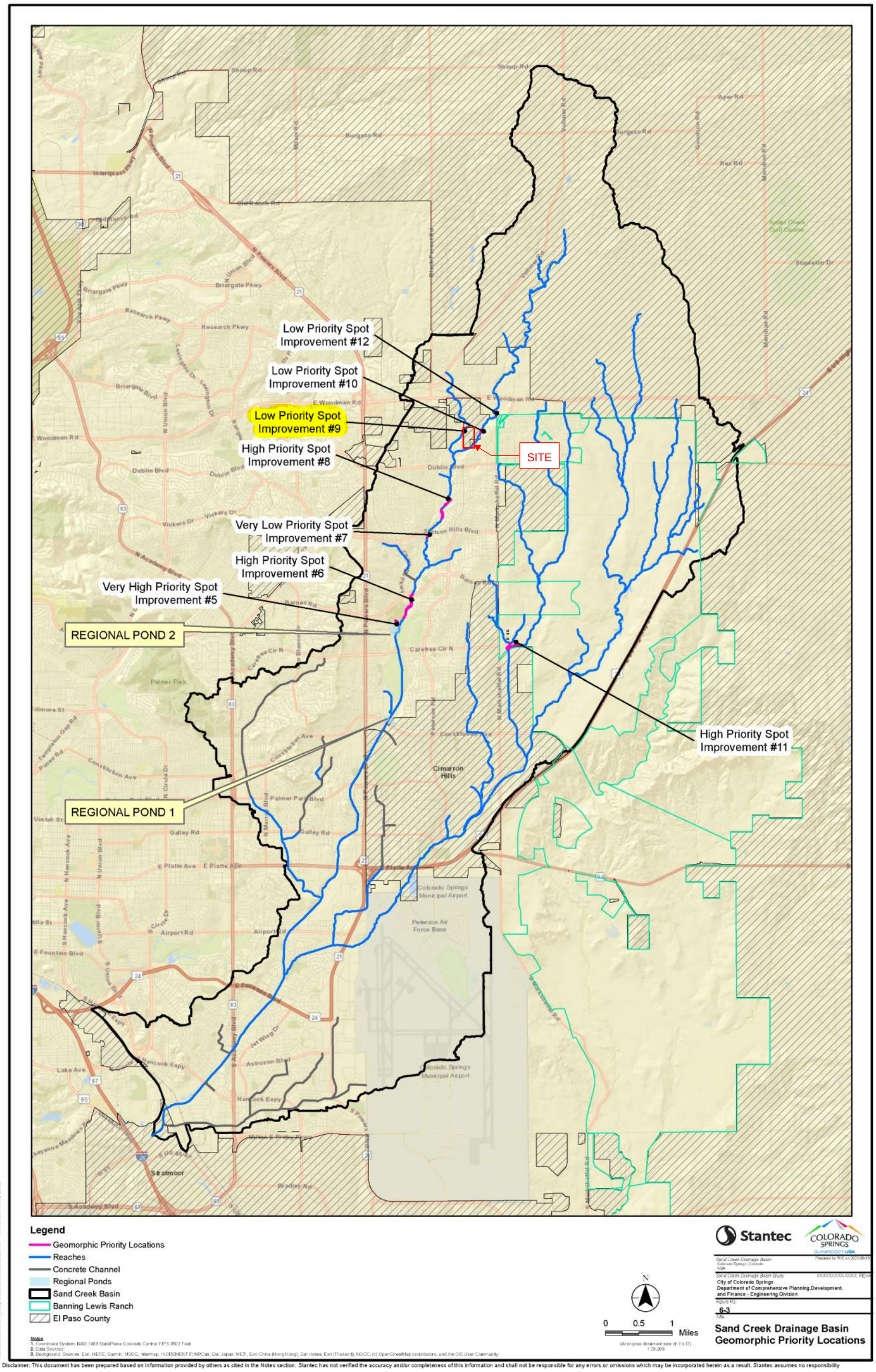

Figure 6-3. Sand Creek Drainage Basin Geomorphic Priority Locations

6.2.4.3 Low Priority

Priority Area 9 Description

A manmade embankment previously inundated the existing valley upstream. At some point during 2006-2011 a cut was made in this embankment, lowering the extent of ponded water up valley. Priority Area 9 begins at the outlet of the ponded area. As a result of the cut embankment, the existing channel is incised within the approximately 5-foot-tall walls of the abandoned embankment. Bank sloughing from the incised terrace walls have formed an inset bankfull bench and low flow channel. The lower banks are relatively well vegetated and stable while the upper banks are exposed as a result of sloughing. The reach ends at the edge of a forested floodplain after a single left-hand bend.

Photo 9. Inset bankfull bench with low flow channel due to sloughing of material from terraces

Priority Area 9 Recommendations

The results of the BANCS model estimate a low erosion volume rate compared to the other priority areas. A reduced Near Bank Stress (NBS) score due to sloughing and the formation of a low flow channel with an inset bankfull bench indicates that the amount of sediment recruitment from this reach is limited. Reach 9 is designated as Low Priority because of its short length, lower BANCS estimated erosion, and the existence of a suitably large wetland area downstream that acts as a sediment sink. The channel could be stabilized by laying back and revegetating terrace banks while allowing the current low flow channel to continue to build a bankfull bench within the terrace.

Priority Area 10 Description

Reach 10 begins as a small low flow channel within a manmade trapezoidal ditch with a willow covered 6-foot-tall terrace along river right and well vegetated floodplain on river left. This section was likely constructed in sequence with the impoundment located on river right. After a short stretch of this constructed channel, the channel takes an abrupt 4-foot drop over a head cut into a plunge pool. Vegetation with a strong root mass and lack of exposed bed provides evidence of a stable drop. Multiple smaller head cuts are active throughout the reach and separate sections of actively eroding trapezoidal channel spanning the entirety of the terrace cut from sections of defined channel with a small bankfull bench within the incised terrace. The reach is vegetated with willows along with groups of mature trees providing protection from advancing head cuts. Erosive and depositional features seem to be well balanced despite the existence of head cuts.

Photo 10. Constructed trapezoidal ditch with willow plantings (Priority Area 10)

Environmental Goals	• ***Approximate naturally functioning system:*** Produce channels with active floodplains, efficient low flow channels, stable slopes, and natural channel and floodplain vegetation • ***Improve environmental resources:*** Improve health of channel and floodplain vegetation, wetlands, and aquatic and terrestrial habitat; improve water quality • ***Improve Fountain Creek water quality:*** Reduce discharge of potential pollutants from Sand Creek to Fountain Creek, primarily in the form of excess sediment
Multiple Benefit Goals	• ***Reduce peak flows to pre-development conditions:*** Use detention, retention or land management to reduce 10-yr and 100-yr peak flows to as close to pre-development conditions as possible as required of new development under the City's DCM • ***Provide open space and trail opportunities:*** Allow stream corridors to be used for multiple public recreation benefits such as parks, trails and open space
Cost Goals	• ***Minimize construction cost:*** Minimize cost for property acquisition and construction • ***Minimize maintenance cost:*** Minimize cost for ongoing maintenance, repair and replacement • ***Provide access for maintenance:*** Provide space for maintenance access roads

6.4 ALTERNATIVE DEVELOPMENT

This section describes the process and basic information used to develop Sand Creek DBPS alternatives and describes the two alternatives developed for the DBPS.

6.4.1 Assumptions for Alternative Development

At the beginning of the alternative development process, a number of assumptions were adopted to focus the effort and avoid exploring alternatives that would ultimately not meet the City's objectives for the DBPS. The key assumptions framing the alternative development process are listed below.

- **No new regional ponds.** The two existing on-channel regional ponds on the mainstem of Sand Creek – Regional Pond 1 upstream of Constitution Avenue and Regional Pond 2 upstream of N Carefree Circle – have been a source of concern for the City. They have limited benefit in reducing downstream flood flows and represent significant maintenance challenges due to accumulation of sediment. There are a number of additional reasons that new regional ponds are not included with this DBPS. New development within the City requires full spectrum detention to be included with any improvements and developments greater than 10 acres are required to consolidate their facilities through creation of a development level master plan. In addition, the DCM precludes the use of in-line regional detention which would result in additional property impacts to provide detention facilities. Therefore, alternatives will not include new regional detention ponds.
- **Ignore effect of onsite detention or water quality permanent control measures.** The City DCM requires new developments to install extended detention basins or other permanent control measures to maintain post-development runoff rates at pre-development conditions and to mitigate impacts of land development on receiving water quality. To be conservative, any effects of these measures in areas of new development were not considered in the future conditions hydrology described in the hydrology section, and thus are not considered in the hydrology used to develop DPBS alternatives.
- **Adopt stable channel slope for planning.** The stable channel slope used for planning is 0.3% (0.003 ft/ft) in lower parts of the watershed and 0.2% (0.002 ft/ft) in upper parts of the watershed. The stable slope is intended to approximate the slope at which sediment transport should be roughly balanced to avoid excessive channel erosion. Values of stable slope for the Sand Creek watershed were based on input from the City based on experience in other City watersheds and the geomorphic reconnaissance performed for this project.
- **Account for potential channel instability throughout the watershed.** Upper reaches of Sand Creek tributaries have undeveloped watershed areas, mild slopes and mostly natural channel conditions. Hydraulic modeling does not predict post-development velocities over 5 ft/sec so these reaches are not shown as having deficiencies. However, City staff have noted that based on their experience channels with these characteristics elsewhere in the City have had problems with erosion after development occurs. In addition to the potential for increased velocities, development also increases the volume of runoff a section of natural channel creates. As a result, DBPS alternatives must include channel stability measures in these tributaries despite the fact they are not shown as being deficient under future conditions.
- **Incorporate existing improvements to the maximum extent practical.** Many stream reaches in the Sand Creek Drainage Basin have been improved through installation of grade control structures, bank stabilization measures, and in some cases concrete lining. These improvements are incorporated into any alternatives, except in the case where the improvements exhibit signs of failure and would have to be replaced. If current infrastructure problems could be addressed through enhanced maintenance as opposed to replacement, the structures are included in the alternatives as-is.

In addition to the above assumptions, a comprehensive list of potential types of drainage options was prepared, and City staff narrowed the list to those they considered appropriate for application in the Sand Creek DBPS. This process is summarized in Table 6-3. The options marked with a YES in the "Viable Option" column were considered for use in the DBPS alternatives. In practice, some of the options were viable but were not used because of the unique conditions in the Sand Creek Drainage Basin.

- The option for acquiring impacted structures in the 100-year floodplain was viable but was not used because the DBPS hydraulic analysis did not show any impacted structures.
- The option for hard-lined channel removal was viable but was not used because there were no specific locations where this would be practical given the narrow available rights-of-way, potential impacts on upstream and downstream reaches, and the probable cost in comparison to the need to address existing and future drainage problems in the Sand Creek Drainage Basin and throughout the City.

Table 6-3. Screening of Drainage Options for Use in Sand Creek DBPS Alternatives

Potential Options to Include in Alternatives	Viable Option	Comments
Watershed Scale		
Structural		
Existing Regional Ponds	**YES**	Existing structures will not be removed
Modify Existing Regional Ponds	**YES**	City has already considered modifications to Regional Pond 1 and Regional Pond 2
Additional On-line Regional Ponds	**NO**	Maintenance, sediment issues
Regional Off-line Detention Basins	**NO**	Create future problems with fees
Water Quality Attenuation	**NO**	Not in scope of DBPS; assumption was to ignore effects of onsite permanent control measures in basin-scale planning
Nonstructural		
LID Requirements for New Development to Minimize Runoff	**NO**	Considered by City but not in DBPS
Redevelopment Incentives to Minimize Runoff	**NO**	No incentive programs available
Acquire Impacted Structures	**YES**	Purchase structures in 100-yr floodplain; but no structures are in the new 100-yr floodplain
Individual Reach Scale		
Structural		
Modified Channel Restoration	**YES**	Create naturally functioning system, but not preserve entirely natural channel
Localized Grade Control	**YES**	At critical structures
Reduce Overall Channel Slope - High drops (6 ft)	**YES**	Maximum height allowed in DCM for constructed channels
Reduce Overall Channel Slope – Medium drops (4 ft)	**YES**	Maximum height allowed in DCM for constructed natural channels
Reduce Overall Channel Slope - Low drops (3 ft)	**YES**	Half of maximum height listed in DCM for constructed channels
Reduce Overall Channel Slope - Riffle drops (1 ft)	**YES**	Not preferred; past maintenance issues
Bank Protection	**YES**	Various methods of controlling lateral channel migration
Hard-lined Channels (e.g., concrete)	**NO**	Only use if absolutely necessary
Hard-lined Channel Removal	**YES**	Use only in unique situations
Nonstructural		
Floodplain Preservation	**YES**	In undeveloped reaches; over-ridden by assumption that all natural channels will have high risk of instability after land development occurs
Maintenance Only	**YES**	In existing developed reaches

6.4.2 Channel Types

Based on the consideration of the evaluation criteria, existing channel segments were categorized into four types depending on if the channel is improved and if the channel would experience capacity or stability problems based on the existing or future flows. Table 6.4 shows the definition of the four channel categories, channel types designated for each channel segment in the Sand Creek Drainage Basin are shown on Figure 6-4.

Table 6-4. Sand Creek Channel Types

Channel Types	Description
Type 1	Improved, and no existing or future problems expected during peak flows • No additional improvements needed (except for possible isolated drop/check structures to manage slope) • Focus on maintaining existing improvements
Type 2	Improved, but existing or future problems expected during peak flows • Unless existing improvements are failing or undersized, existing improvements will be maintained to minimize cost • Additional improvements needed to stabilize existing channels and protect existing infrastructure
Type 3	Unimproved, with existing or future problems expected during peak flows • Extensive improvements will be needed
Type 4	Unimproved, and no existing or future problems modeled during peak flows • No additional improvements needed (except for possible drop/check structures to manage slope)

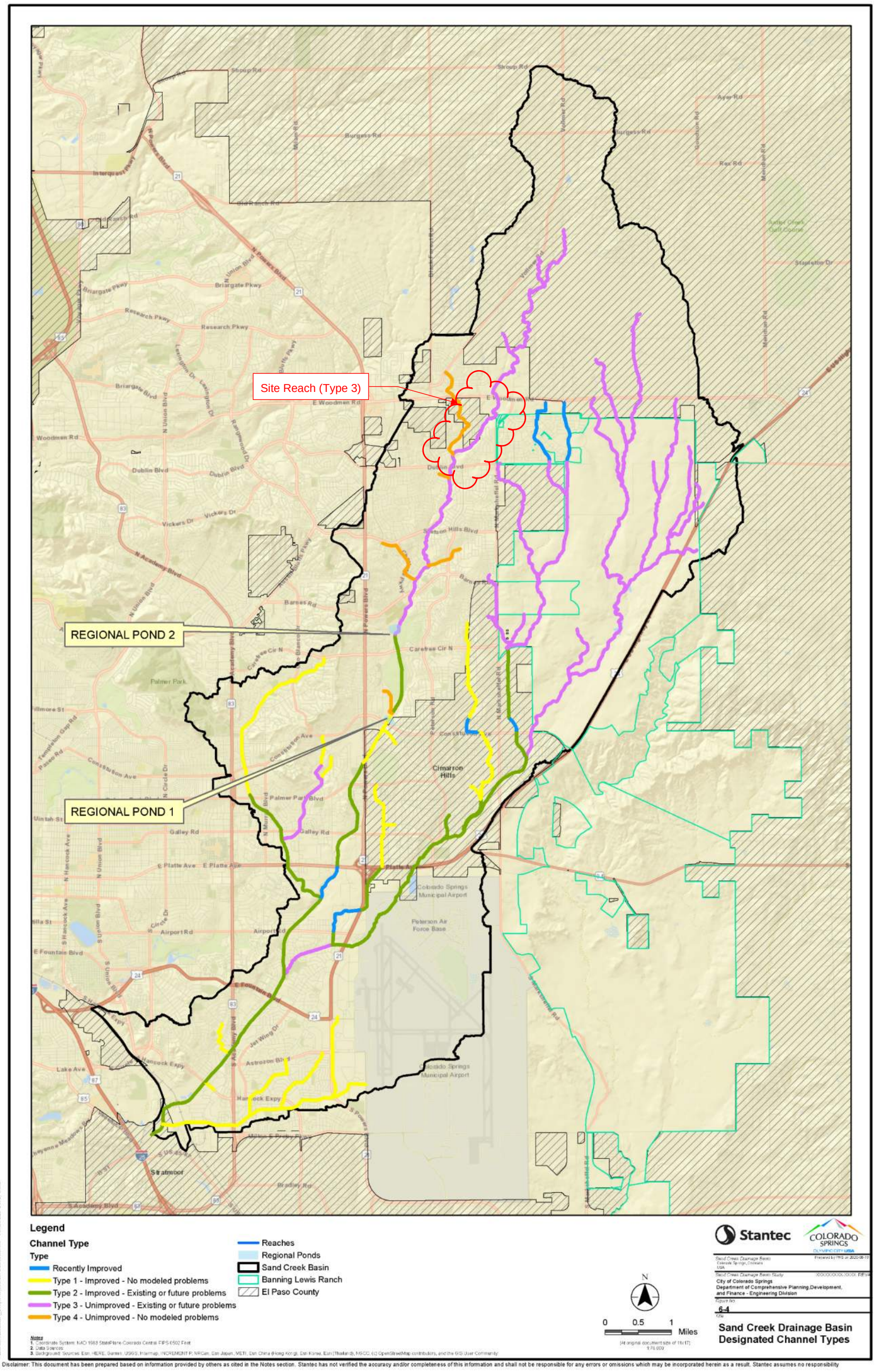

Figure 6-4. Sand Creek Drainage Basin Designated Channel Types

6.4.3 Channel Improvement Themes

6.4.3.1 Description of Channel Improvement Themes

Based on the channel improvement options that were acceptable to the City and the existing channel types, channel improvement themes were created to organize and standardize improvement decisions. Because Sand Creek Drainage Basin has approximately 86 stream miles, standard channel improvement themes were needed to simplify the development of conveyance options. These themes helped marry the options available for the basin and the improvements necessary due to increased flow in an optimal way. Table 6.5 shows the definition of the three themes adopted for the Sand Creek Drainage Basin. Figure 6-5 shows the themes assigned to each of the channel segments in the basin.

Table 6-5. Channel Improvement Themes

Channel Theme	Description
Maintenance Only	For most of the lower basin, major improvements have been made over time. There is limited right-of-way to expand any improvements, so the chances of adding ecological value is very limited and would require a total removal and restoration of the channel. Most of these channel segments fall into either Type 1 or Type 2. Proper maintenance and minor localized improvements are needed, with the exception of possible drop/check structures to manage slope.
Engineered Channel	For most of the middle part of the basin, there is some available right-of-way and some existing improvements. The opportunity for channel restoration is not available due to both areaconstraints and the increase of peak flow due to development. Most of these channel segments fall into either Type 1 or Type 2. A balanced engineered solution with a terraced floodplain will be used in conjunction with grade control, allowing for some restoration of ecological value within the existing limitations of the right-of-way.
Natural Engineered Channel	For most of the upper part of the basin, the channels are unimproved as development has not occurred on a large scale. Most of these channel segments fall into either Type 3 or Type 4. As peak flows increase, these channels will experience stress to handle the new hydrologic flow regime. The opportunity to handle this change in a natural engineered channel with wider corridors that provide natural functions is available.

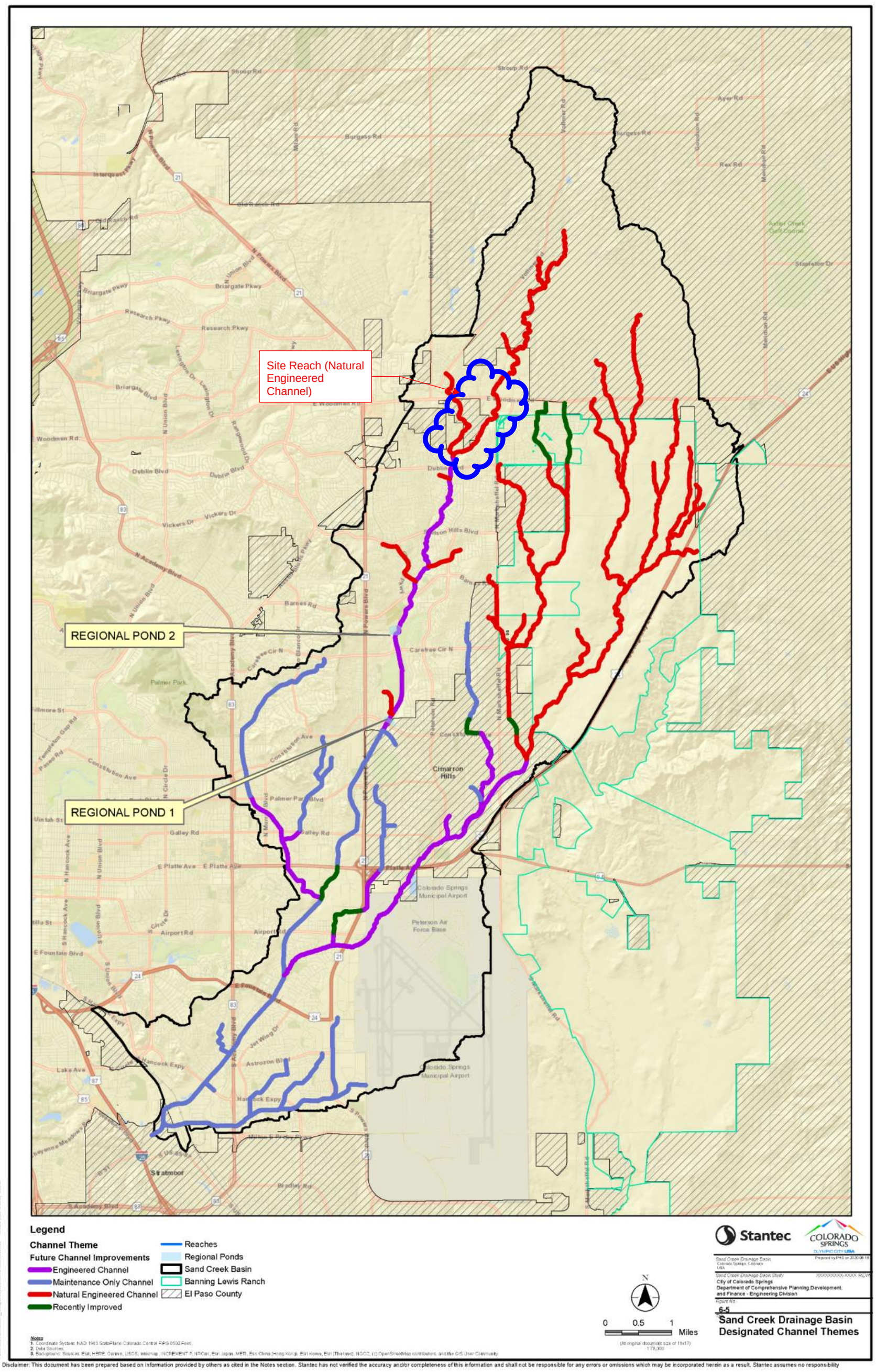

Figure 6-5. Sand Creek Drainage Basin Designated Channel Themes

6.4.3.2 Typical Cross Sections

For the three Channel Improvement Themes, typical cross sections were designed as guidelines for both the Engineered Channels and the Natural Engineered Channels to help with cost estimating and projection of right-of-way requirements. However, these typical cross sections are based on assumptions of the estimated stable slope and geomorphic parameters of the two themes. Additional geomorphic and sediment transport data will be needed to properly size any specific channel improvement project within these segments.

Both sets of typical cross sections were based on the following assumptions:

- The typical channel cross sections were sized based on three peak flow events: the estimated bankfull, 10-year and the 100-year future flows.
- The bankfull event was estimated by comparing 70% of the 2-year event and 10% of the 100-year event. Though MHFD suggests using the maximum of these two flows as the bankfull flow, it was decided to use the minimum of these two events based on a review of the results of the geomorphic site visits and the professional judgement of the consulting team.
- The stable slope for Engineered Channels and Natural Engineered Channels was 0.30% and 0.20%, respectively, based on the geomorphic reconnaissance performed for this project and input from the City.
- The width/depth ratios for the Engineered Channels and Natural Engineered Channels were 24 and 40, respectively, for each of the three peak flow events (bankfull, 10-yr, and 100-yr). These were based on geomorphic estimates of a natural channel design in the natural engineered channel and engineered channel sections..
- Four typical sections were developed for each theme based on the range of peak discharges estimated from the hydrologic analysis. This allowed wider and deeper cross section templates to be applied in reaches with higher peak flows. Typical cross sections were assigned to each channel segment based on where the segment's bankfull flow fit within the range of peak discharges used to select the cross section dimensions.

Figure 6-6 and Figure 6-7 show the four typical Engineered Channel cross sections and four typical Natural Engineered Channel cross sections with the dimensions for each.

Figure 6-7. Natural Engineered Chanel Sections

6.4.4 Channel Stabilization Options

6.4.4.1 Grade Control Options

Stable channel slopes for the Sand Creek Drainage Basin are 0.30% for Engineered Channel Sections and 0.20% for Natural Engineered Channel Sections as described above. These stable slopes are generally significantly flatter than existing channel slopes. To achieve the desired stable condition, grade control structures are proposed to mitigate steeper channel sections and stabilize the stream reach. For quantification and estimation purposes, grade control structures in the DBPS consist of grouted boulder drop structures with a total drop height of 6 ft for the Engineered Channel Section and 4 ft for the Natural Engineered Channel Section. These are the maximum drop structure heights allowed by the DCM in constructed channels (incised and often including bank and bottom lining) and constructed natural channel conditions (unlined and approximating a natural width/depth ratio), respectively. Spacing of the drops was checked to confirm that a minimum of 200 ft was sufficient between structures. This was checked to prevent an excessive number of drops in short channel reaches. In final design, drop structures must consist of sculpted concrete or grouted boulders in a natural configuration and may have different heights based on the local features.

6.4.4.2 Bank Stabilization Options

Channel improvements proposed in the DBPS will alter the existing grade of degraded channels in the areas identified for imporvements and reshape the channel and active floodplain to provide additional stability within the system. In some locations, however, additional bank stabilization will be required to protect critical infrastructure or may be required where additional channel improvements are not proposed. In general, these improvements will be needed on outside bends where shear stresses induce bank erosion and lateral channel migration. Some of the existing problem areas described previously may be candidates for these bank stabilization treatments.

Bank stabilization will consist of one or more of the following techniques specified in the DCM.

1. Reduction of Bank Slopes: Reducing banks slopes to 6H:1V or flatter in locations with sufficient right-of-way (ROW) and channel width will assist with vegetation establishment and overall stability. Steeper slopes may be required where site constraints do not allow for shallower slopes, with a maximum of 3H:1V being allowed with appropriate slope protection. This option would also involve revegetation to stabilize regraded banks.

2. Riprap/Boulder Protection: Large riprap or boulder bank protection can be used at locations where ROW conditions limit shallower bank slopes. Riprap or boulder protection should be designed using the tractive force method and as defined in the DCM. Riprap bank protection may also be designed to be buried and revegetated to improve channel aesthetics.

3. Bioengineered Bank: In limited places where establishment of vegetation is feasible, bioengineered channel banks can provide stability with a more natural look and feel than other armoring techniques. This option would involve use of surface stabilization measures (straw mats, geotextile fabrics, etc.) in combination with strategic revegetation selected for the specific application.

6.4.5 Improvements to Existing Hydraulic Structures

Existing culverts and bridges with inadequate capacity are listed in Table 2-1. Necessary improvements to these structures were determined by sizing a new structure to carry the 100-year future condition peak flow without causing pressure flow in the new structure. This is a conservative approach, and would provide an allowance for a certain amount of debris obstruction without forcing flow over the top of the roadway. New hydraulic structures included in the DBPS are listed in Sections 4.10 and 4.11.

6.4.6 Regional Pond Modification Options

This section describes the evaluation of the performance of Sand Creek Regional Ponds 1 and 2 and the options for alternatives to modify the existing ponds to operate more efficiently. The existing Sand Creek regional ponds were constructed fairly recently: Pond 1 was constructed in 2002 and Pond 2 was constructed in 2006. Both are on-channel flood storage basins located on the mainstem of Sand Creek.

The two regional ponds were designed to capture sediment to reduce downstream sediment loads. Unfortunately, the facilities upset the downstream sediment balance and maintenance of accumulated sediment in the facilities has become a challenge for the City. In addition, they were each designed based on a 24-hour storm distribution previously utilized within the limits of the City of Colorado Springs. As part of the Sand Creek DBPS a new 6-hour rainfall distribution recently developed by the City was utilized to analyze the runoff from the watershed. As a result of the DBPS hydrologic analysis, it was determined that the regional pond facilities have a minimal impact on reducing the peak flow in the watershed. The City requested that the consultant evaluate potential modifications to the facilities to increase the effectiveness of the system.

The analysis of the ponds was completed in three phases. The first phase looked at the effectiveness of the ponds as constructed as a means to provide detention for the developed watershed. The second phase assessed modifications to the ponds to fully utilize the available detention storage for peak flow reduction. The final phase assessed additional modifications to the pond grading and outlet structures to allow more frequent minor storm events to be conveyed through the pond without dropping sediment loads.

6.4.6.1 Description of Current Conditions and Flood Operations

The existing Sand Creek Regional Ponds are both designed and constructed with similar characteristics. Both are situated on the mainstem of Sand Creek immediately upstream of a roadway (Constitution Avenue for Pond 1, Carefree Circle for Pond 2). In both basins, the upstream channel drains into the basin where flow is allowed to spread out, slow down, and drop sediment as runoff is conveyed through the pond. Each pond has a similar outlet structure configuration (see Figure 6-8).

Similar to Pond 1, the final phase of the analysis assessed grading improvements within the pond along with modifications to the low-flow outlet structure to maximize the efficiency of the system. Grading improvements consist of constructing a small guide dike on both sides of a low flow channel from the entrance of the pond to the proposed berm to prevent stormwater from spreading out and dropping sediment as it enters the pond. These banks were sized for 10% of the 100-year storm event peak flow (245 cfs) but final design will determine the optimal configuration. The guide banks direct flow to the Low Flow Outlet Structure designed for the same capacity. A 24-inch RCP is proposed to be placed within each side of the dike near the location of the dike and the proposed berm tie-in. These two 24-inch RCPs evenly distribute flow within the pond on each side of the dike during smaller storm events. The proposed Low Flow Outlet Structure consists of replacing the five 12-inch RCPs with a 6'x6' RCBC and a weir raised to 7 ft. Similar to Pond 1, an emergency overflow structure will be provided to utilize the full capacity of the existing structure under N. Carefree Circle during events greater than the 100-yr storm.

6.4.7 Storm Drain Improvements

Two categories of potential storm drain improvements were included in the DBPS: upgrades to existing closed conduits and assumed major storm drains in areas of new development. Each of these categories is discussed below. Storm drain improvements were calculated after reviewing the total flow generated within each subbasin in the existing and future condition.

6.4.7.1 Upgrades to Existing Closed Conduits

The SWMM modeling performed for the hydrologic analysis incorporated existing closed conduits with diameters of 48 inches and larger. Model results were reviewed to determine whether 100-yr peak flows could be conveyed within the existing facilities without surcharging. This is a conservative approach since Colorado Springs drainage policy allows surcharging of storm drains for the 100-yr discharge.

After reviewing the SWMM models for the existing watersheds, there were no locations identified that exceeded the capacity of the existing storm drain trunkline system. There are several locations where capacity of circular culverts crossing roadways are exceeded in the existing condition. However, these are not located within actual storm sewer trunk lines.

6.4.7.2 Storm Drains in Areas of New Development

Closed conduit drainage facilities could be required in areas of new development to connect to the open channel systems. Although developers would determine whether minor drainage facilities are open channels or storm drains, for the DBPS it was assumed that any minor conveyance facilities needed within a DBPS hydrologic subbasin (within the maximum 160 acre watershed size) would be a storm drain. If a storm drain diameter of 60 inches or larger is required to convey the 100-yr peak flow according to DCM requirements, that facility would qualify for inclusion in the DBPS and the drainage fee computation and therefore be considered as reimbursable.

All hydrologic subbasins in the SWMM model are routed within the existing channel system. All existing open channels shall remain open channels after land development occurs (although some may be consolidated, as described below). Therefore, any future storm drains would be constructed within hydrologic subbasins only. Because the DBPS hydrologic analysis does not provide flows within subbasins, the following approach was used to determine requirements for storm drains at subbasin outlets.

1. The future condition 100-yr peak discharge for subbasins with undeveloped land at the subbasin outlet point was determined from the SWMM model.
2. The slope of a proposed storm drain at the subbasin outlet was based on the land slope along either a north-south or east-west alignment based on the main orientation of the subbasin. This assumes a future north-south/east-west street grid pattern.
3. The required storm drain size at the subbasin outlet was calculated to convey the fully developed 100-yr peak flow with no surcharge (conservative assumption). If the facility diameter was 48 inches or larger it will be included in the DBPS inventory of drainage improvements.
4. For DBPS storm drains, the assumed length of the subbasin outlet storm drain was estimated based on the travel length of the basin. If the subbasin outlet storm drain was 48-in diameter or larger, the portion of the subbasin area generating a 100-yr flow requiring a 48-in diameter pipe was determined. At the approximate concentration point for that portion of the subbasin, a 48-in storm drain was assumed to begin, and the intervening length between that point and the subbasin outlet point was divided between storm drain pipe sizes at 12-inch intervals (i.e., 48-in, 60-in, 72-in, 84-in, etc.).

The capacity of a 48-in storm drain at a conservative slope of 0.3% is 73 cfs. Each undeveloped basin that generates greater than 73 cfs was then assessed based on the steps identified above to determine the total pipe length estimated for each basin. The proposed storm drain improvements based on the modeling results are displayed in Table 6-7. Only the storm drain improvements listed below are considered to be reimbursable under the DBPS fee calculation.

Table 6-7. Proposed Storm Drain Improvements per Sand Creek Subbasin

Subbasin ID	Location	Proposed Storm Drain Pipe Length			
		Diameter = 48"	Diameter = 60"	Diameter = 72"	Diameter = >72"
SACR1_46	City Undeveloped	683	1229	0	0
SACR1_43W3_W	City Undeveloped	924	589	0	0
SACR1_46E	City Undeveloped	1261	55	0	0
SACR1_39_E	City Developed	446	1211	664	0
SACR1_32_N	City Developed	641	1023	0	0
SACR1_32_E	City Developed	557	1500	0	0
SACR1_29	City Developed	486	665	0	0

Table 6-8. No Action and Alternative 1 Future Condition Peak Discharges

Location	No Action Future Conditions 10-yr Peak Flow (cfs)	Alternative 1 Future Conditions 10-yr Peak Flow (cfs)	No Action Future Conditions 100-yr Peak Flow (cfs)	Alternative 1 Future Conditions 100-yr Peak Flow (cfs)
SC1R1	6493	5622	13601	11629
SC1R4	5738	4914	11305	9434
SC1R4	3096	2032	6105	4046
SC1R4	1864	977	3572	1636
SC1R5	1626	1322	3084	2114
SC1R10	196	196	789	789
SC2R1	801	803	1705	1713
EF1R1	3480	3480	6860	6860
EF1R4	2980	2980	6108	6108
EF1R5	2293	2293	4615	4615
EF1R6	943	943	1630	1630
EF3R2	389	389	702	702
WF1R1	1241	1241	2319	2319
WF2R1	175	175	325	325

6.4.10.2 Alternative 1 Channel Improvements

The channel improvements associated with Alternative 1 were based on the channel themes described in a previous section. Maintenance Only, Engineered Channel, and Natural Engineered Channel themes were applied to each existing stream reach based on current conditions and future opportunities.

Typical channel cross sections were applied to each existing stream reach from the menu of options described in a previous section. Cross section dimensions for the typical sections were based on the 100-year discharge.

Alternative 1 includes grade control structures in every channel reach in which the current slope exceeds the adopted stable slope. The default grade control structure height was 3 feet. Higher drops were used when the spacing between 3 ft high structures would be less than 200 feet. It was assumed that grouted boulder drop structures would be used as grade control features, although other designs could be applied based on localized conditions and preferences.

Alternative 1 includes channel stabilization measures for Priority Areas identified during the geomorphic assessment and at channel bends experiencing high shear stress. As described previously, bank stabilization measures could include: reducing bank slopes to 6H:1V or flatter in locations with sufficient channel width, large riprap or boulder bank protection at locations where ROW conditions limit bank slopes, and bioengineered channel banks in locations where establishment of vegetation is feasible.

The conveyance improvements associated with Alternative 1 are shown in Figure 6-13 and Table 6-9. Figure 6-13 shows proposed channel cross section improvement locations. Table 6-9 lists the channel and grade control structure dimensions assumed for each reach.

The improvements to the geomorphic priority areas described in the previous section would be integrated with the channel improvement themes discussed previously. In some cases the proposed improvements to the geomorphic priority areas would be addressed through implementation of the proposed general channel improvements; in other more severe cases special treatment of the priority areas may be needed to address the more significant instability problems.

7.0 CONCEPTUAL DESIGN OF SELECTED PLAN

This section describes the conceptual design analysis of the selected plan for the Sand Creek Drainage Basin. After review of the alternatives presented to the City and Project stakeholders, the selected plan was developed to incorporate the recommended improvements within the basin. The conceptual plans for the selected alternative are included in Appendix C of this report. Based on the results in the Alternative Evaluation chapter, the selected plan is Alternative 2 which includes the proposed channel improvements as well as the improvements to Regional Ponds 1 and 2. Comprehensive tables outlining stream reach costs for all stream reaches identified within the Sand Creek watershed are located in Tables 8-6 and 8-7.

7.1 CHANNEL IMPROVEMENTS

As described in Chapter 6, Alternative Evaluation, improvements were developed for all channel reaches where overbank flooding, erosive velocities, geomorphic issues, or other issues have been identified. Additional channel improvements were proposed for undeveloped stream reaches where there are not modeled or identified issues to account for future degradation of the system. In undeveloped areas, stream reaches were categorized into four channel types to define the top widths to be maintained utilizing a natural engineered channel configuration. In the downstream, more confined reaches, engineered channel sections were specified. These reach improvements were also broken down into four distinct channel types based on overall top width. As described in Chapter 6, the eight channel improvement themes were developed based on the physical properties and flow rates that stream reaches exhibit. The eight channel themes and their associated properties are outlined in Table 7-1 below. An additional 11 locations were identified as requiring spot improvements to alleviate excessive channel bank erosion or to protect critical infrastructure.

Table 7-1. Properties of Channel Improvement Theme ID

	Engineered Channel Section				Natural Engineered Channel Section			
Channel ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
BW	16	22	32	44	20	32	42	64
Bankfull depth	0.90	1.29	1.87	2.62	0.6	1.05	1.35	1.95
Bankfull width	23.24	32.34	46.99	64.96	24.84	40.37	52.78	79.6
Bankfull w/d	26	25	25	25	41	38	39	41
10yr depth	2.09	3.03	4.37	5.72	1.44	2.38	2.99	4.78
10yr width	51.59	76.24	106.97	137.2	59.52	87.01	119.91	186.25
10yr w/d	25	25	24	24	41	37	40	39
100yr depth	3.22	4.44	6.3	7.97	1.89	3.61	4.2	6.99
100yr width	77.78	107.51	154.41	193.71	75.16	136.9	170.75	275.93
100yr w/d	24	24	25	24	40	38	41	39
TW	92	120	168	200	84	144	188	284
Total depth	5	6	8	9	3	5	6	8
Slope	0.30%	0.30%	0.30%	0.30%	0.20%	0.20%	0.20%	0.20%

Throughout the basin, the slope of the existing channel was reviewed to determine if grade control structures were required. Grade control structures were included in all locations where the channel slope is currently greater than 0.3% in the lower channel reaches and 0.2% in the upper watershed. While exact locations of new grade control structures were not determined, the number of grade control structures for each reach was developed based on an anticipated drop height of 3 ft. Actual location and height of grade control structures will be determined in final design.

7.2 REGIONAL POND MODIFICATION

Proposed concepts for modification to Sand Creek Regional Ponds 1 and 2 are described in Chapter 6. The selected alternative incorporates proposed improvements to both ponds to improve the balance of sediment transport within and downstream of the ponds while maintaining their flood control benefits. Improvements consist of constructing low flow channels through the existing basins and modifying the outlet structures. Proposed designs have been presented as conceptual only. Final configuration will be determined during final design.

8.0 FEE DEVELOPMENT

This section describes the basis of estimating capital costs and the drainage fee per acre for the recommended DBPS stormwater improvements.

Stormwater improvements identified for Sand Creek consist of spot channel improvements (e.g., eroding streambanks), reach channel improvements (including channel grading and grade control structures), new storm drain systems, and improvements to Sand Creek Regional Ponds 1 and 2. These improvements are broken down by reach to identify the improvements required in each subbasin. Engineering design costs have been estimated to be 10% of the overall construction cost. No allowances have been provided for utility relocations, habitat mitigation, or ROW acquisition.

During implementation, the recommended stormwater improvements may have to be modified to fit specific site conditions. The number of drop structures within a particular reach has been estimated based on allowable slope within the channel reach. The assumed size and locations may be moved to minimize disturbance and to fit site conditions.

The drainage fee for Sand Creek has been established to determine an equitable cost of drainage improvements that will be shared across all remaining developable land within the basin. Currently, platted land is not required to pay for additional stormwater improvements within the basin. The drainage fee is the cost of reimbursable stormwater improvements within the City's future developable area that have been identified in this DBPS divided by the remaining unplatted land within the basin.

8.1 UNIT COSTS

Improvements to Regional Ponds 1 and 2 consist of constructing new outlet structures and low flow channels through the storage areas. Costs of these improvements were calculated based on the specific proposed improvements at each location, using typical unit costs for concrete work, earthwork, and other requirements.

The costs of new storm drain systems were based on a unit cost per linear foot for the required pipe diameter. The unit cost includes the pipe, excavation, transitions, and all appurtenances.

The costs of roadway crossing improvements were also based on a unit cost per linear foot for the required culvert size. The unit cost includes excavation and embankment as well as required headwalls and wingwalls and other appurtenances necessary for construction.

The costs of reach channel improvements were estimated as a linear foot cost based on recent channel projects completed in Sand Creek and surrounding basins. Reach channel Improvements include channel grading, bank stabilization, drop structures, revegetation, and all other construction elements needed along each channel segment. Only road crossings are included in separate cost items.

The costs of spot channel improvements such as localized erosion control and stabilization measures were estimated as a lump sum based on recent projects in the basin. Each spot improvement assumes a project length of 250 LF. In order to account for variations in stream width, three types of spot improvements are identified. Small improvements correspond to upstream locations with top widths less than 90'. Medium improvements correspond to locations with top widths between 90' and 150' while large improvements correspond to locations where spot improvements are required on channels greater than 150' in top width.

A summary of the unit costs is provided in Table 8-1 and Table 8-2.

Table 8-1. Unit Costs for Sand Creek DBPS Cost Estimates

Facility	Unit	Unit Cost	Notes
Engineered Channel ID 1 (TW = 92')	LF	$600	Based on CCS CIP Channel Costs
Engineered Channel ID 2 (TW = 120')	LF	$800	Based on CCS CIP Channel Costs
Engineered Channel ID 3 (TW = 168')	LF	$1,200	Based on CCS CIP Channel Costs
Engineered Channel ID 4 (TW = 200')	LF	$2,400	Based on CCS CIP Channel Costs
Natural Channel ID 5 (TW = 84')	LF	$400	Based on CCS CIP Channel Costs
Natural Channel ID 6 (TW = 144')	LF	$700	Based on CCS CIP Channel Costs
Natural Channel ID 7 (TW = 188')	LF	$1,000	Based on CCS CIP Channel Costs
Natural Channel ID 8 (TW = 284')	LF	$2,000	Based on CCS CIP Channel Costs
Small Spot Channel Improvement	EA	$250,000	Estimated Improvement Length of 250'
Medium Spot Channel Improvement	EA	$350,000	Estimated Improvement Length of 250'
Large Spot Channel Improvement	EA	$550,000	Estimated Improvement Length of 250'
Concrete Channel Improvement	LF	$1,000	Based on CDOT Cost Data Book 2019
48" RCP	LF	$350	Based on CDOT Cost Data Book 2019
60" RCP	LF	$450	Based on CDOT Cost Data Book 2019
72" RCP	LF	$550	Based on CDOT Cost Data Book 2019
84" RCP	LF	$650	Based on CDOT Cost Data Book 2019
Box Culvert < 50 SF	LF	$1,000	Based on MHFD Bid Item Pricing v8.0.
Box Culvert 50 < 74 SF	LF	$1,400	Based on MHFD Bid Item Pricing v8.0.
Box Culvert 75 < 99 SF	LF	$1,700	Based on MHFD Bid Item Pricing v8.0.
Box Culvert 100 < 150 SF	LF	$2,000	Based on MHFD Bid Item Pricing v8.0.
Box Culvert > 150 SF	LF	$2,500	Based on MHFD Bid Item Pricing v8.0.
Sand Creek DBPS Report	EA	$500,000	City Cost

Table 8-3. Sand Creek DBPS Reimbursable Facility Cost Estimates in Colorado Springs

Facility (excluding BLR)	Estimate	Unit Cost (dollars)	Cost (dollars)
Engineered Channel ID 1 (TW = 92')	0	$600	$ -
Engineered Channel ID 2 (TW = 120')	0	$800	$ -
Engineered Channel ID 3 (TW = 168')	6,057	$1,200	$ 7,268,060
Engineered Channel ID 4 (TW = 200')	1,628	$2,400	$ 3,907,703
Natural Channel ID 5 (TW = 84')	2,292	$400	$ 916,635
Natural Channel ID 6 (TW = 144')	10,647	$700	$ 7,452,648
Natural Channel ID 7 (TW = 188')	0	$1,000	$ -
Natural Channel ID 8 (TW = 284')	0	$2,000	$ -
Concrete Reach	1,321	$1,000	$ 1,321,306
Small Spot Channel Improvement	0	$250,000	$ -
Medium Spot Channel Improvement	13	$350,000	$ 4,550,000
Box Culvert 100 < 150 SF	55	$2,000	$ 110,000
Box Culvert > 150 SF	160	$2,500	$ 420,000
Facility (BLR only)	**Estimate**	**Unit Cost**	**Cost**
Engineered Channel ID 1 (TW = 92')	0	$600	$ -
Engineered Channel ID 2 (TW = 120')	0	$800	$ -
Engineered Channel ID 3 (TW = 168')	0	$1,200	$ -
Engineered Channel ID 4 (TW = 200')	0	$2,400	$ -
Natural Channel ID 5 (TW = 84')	44,144	$400	$ 17,657,600
Natural Channel ID 6 (TW = 144')	37,619	$700	$ 26,333,308
Natural Channel ID 7 (TW = 188')	9,352	$1,000	$ 9,352,457
Natural Channel ID 8 (TW = 284')	16,060	$2,000	$ 32,120,000
Small Spot Channel Improvement	0	$250,000	$ -
Medium Spot Channel Improvement	0	$350,000	$ -
Large Spot Channel Improvement	0	$550,000	$ -
48" RCP	5,763	$350	$ 2,017,062
60" RCP	9,354	$450	$ 4,209,455
72" RCP	5,587	$550	$ 3,072,958
84" RCP	1,409	$650	$ 915,904
Box Culvert < 50 SF	0	$1,000	$ -
Box Culvert 50 < 74 SF	104	$1,400	$ 145,600
Box Culvert 75 < 99 SF	0	$1,700	$ -
Box Culvert 100 < 150 SF	0	$2,000	$ -
Box Culvert > 150 SF	0	$2,500	$ -
Excluding BLR Subtotal		**$25,946,352**	
BLR Subtotal		**$95,824,344**	
Sand Creek DBPS Study Cost		**$500,000**	
Total		**$122,270,696**	

The bridge fee, pond land fee, pond facility fee, and surcharge fee are removed. Bridge, pond land, and pond facilities are not reimbursable within the Sand Creek basin. A summary of 2021 fees for the Sand Creek basin is as follows:

Table 8-4. Summary of Fees

Fee	Dollars/Acre
Drainage Fee	$18,841
Bridge Fee	$0
Pond Land Fee	$0
Pond Facility Fee	$0
Surcharge Fee	$0

Only improvements specifically included in this fee calculation are considered to be reimbursable. All other improvements in new development areas are the sole responsibility of the developer. Table 8-5 summarizes the total cost associated with the drainage basin fee.

Table 8-5. Sand Creek DBPS Total Undeveloped Cost Estimates for the City of Colorado Springs and Banning Lewis Ranch

Cost Type	Costs
Total Cost	$122,270,696
Total Cost (Including Deferred Areas)	$131,837,737
Deferred Fees	$20,716,825
Fund Balance	$1,551,076
Total Unfunded Cost	$109,569,836
Undeveloped Cost per Acre	$18,841

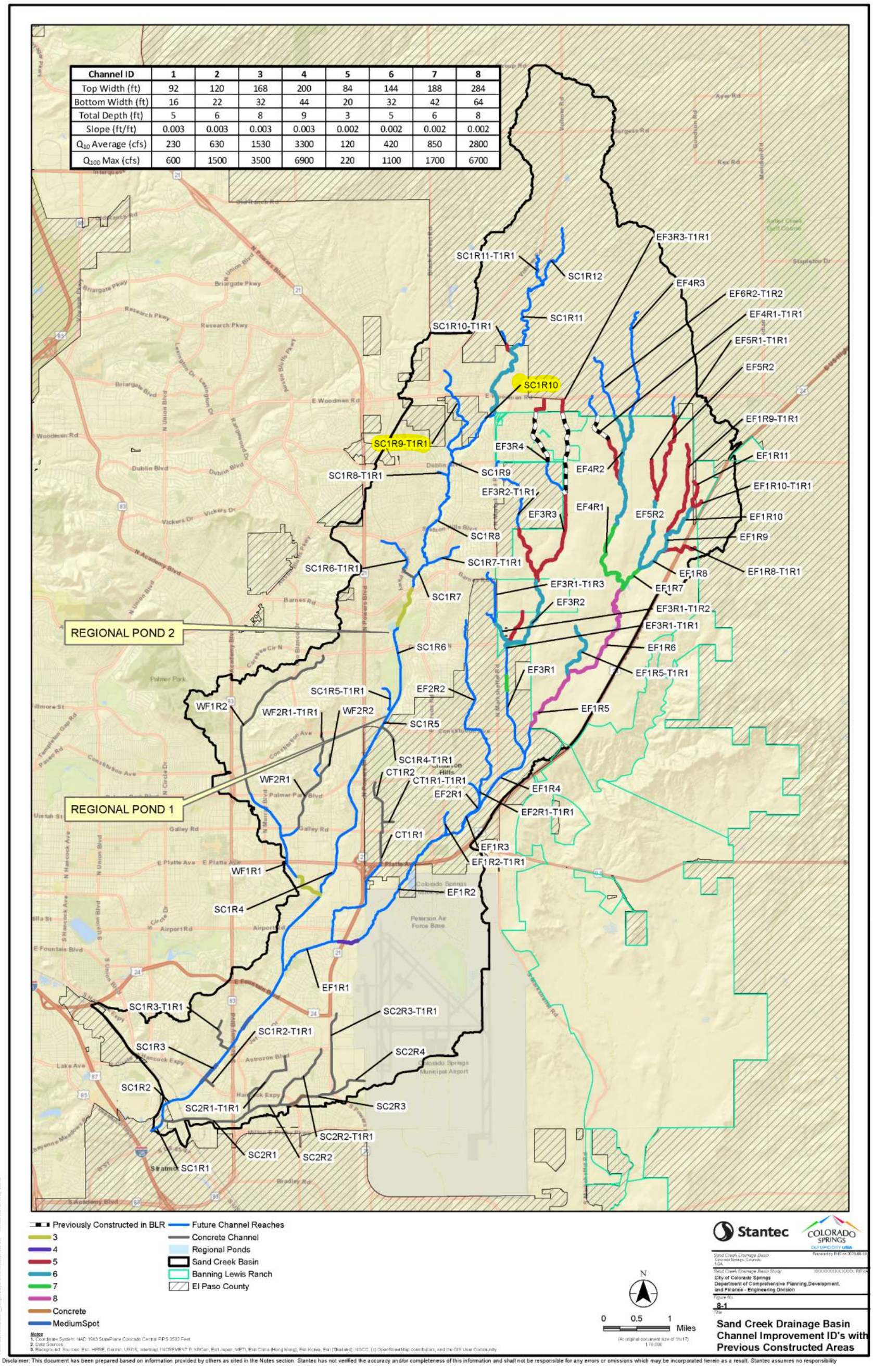

Figure 8-1. Sand Creek Drainage Basin Chanel Improvement IDs with Previous Constructed Areas

APPENDIX G – PREVIOUS DRAINAGE STUDIES

QUAIL BRUSH CREEK
FILING NO. 1, 1A, 2 & 3
FINAL DRAINAGE REPORT

June 2014

Prepared for:

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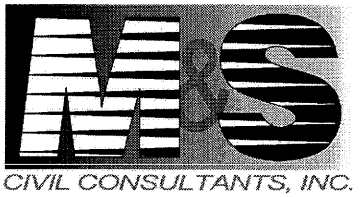
Brian Bahr

Prepared by:



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Projects #08-019 & #08-021

Basin H, 3.20 acres, consists of proposed single family residential lots and a portion of New Meadow Drive. Runoff (Q5=6.6 cfs and Q100=13.7 cfs) will be directed towards the street via side lot swales and unconcentrated sheet flow. Flows are conveyed via the street curb and gutter (type 5) easterly to DP14, the intersection of Thorn Brush Trail and New Meadow Drive.

Basin I, 6.63 acres, consists of proposed single family residential lots and a portion of Thorn Brush Trail. Runoff (Q5=13.4 cfs and Q100=27.8 cfs) will be directed towards the street via side lot swales and unconcentrated sheet flow. Offsite flows (Q5=8.0 cfs, Q100=19.9 cfs) from MDDP H-E shall be diverted to Design Point 17, via a temporary diversion swale and captured in a CDOT type D grated inlet and conveyed in a 24" RCP pipe (pipe 12). Flows are conveyed to design point 14A. Approximately 65% of the unconcentrated sheet flow (Q5=1.8 cfs, Q100=3.9 cfs) from MDDP OS5 shall enter Basin I and be conveyed via side lot swales. Flows are conveyed via the street curb and gutter (type 5) easterly to DP14A, a 12' D-10-R at-grade inlet. At DP14A, flows (Q5=13.7 cfs, Q100=29.2 cfs) from basins I and MDDP OS5combined. The combined flows from pipe 12 and DP 14A (Q5=13.1 cfs, Q100=30.2 cfs) are conveyed in a 30" RCP (pipe 14) to DP 16.

Basin J, 1.78 acres, consists of proposed single family residential lots and a portion of Thorn Brush Trail. Runoff (Q5=4.3 cfs and Q100=8.8 cfs) will be directed towards the eastern edge of the development via side lot swales and unconcentrated sheet flow to the Reach 147 tributary. Approximately 35% of the unconcentrated sheet flow (Q5=1.0 cfs, Q100=2.1cfs) from MDDP OS5 shall enter Basin J and be conveyed via back and side lot swales offsite and onto historic drainage patterns to the Reach 147 tributary.

Basin K, 2.05 acres, consists of single family residential lots. Runoff (Q5=4.5 cfs and Q100=9.4 cfs) will be directed towards the street via side lot swales and unconcentrated sheet flow. Flows are conveyed via the street curb and gutter (type 5) easterly to DP16. At DP16, a 1-16' sump inlet shall be installed to capture 100% of basin K,H and flowby from DP14A runoff (Q5=14.4 cfs and Q100=30.3 cfs). Pipe 15 (42" RCP) flow (Q5=48.7 cfs and Q100=102.4 cfs) will be routed to outfall into the Reach 147 tributary. A riprap pad will be constructed to dissipate energy and prevent local scour at the outlet. A temporary sediment basin (TSB) (see map for location) will be installed until basins H, I, and K are fully developed. The TSB will be required to hold 0.49 ac-ft.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual the pertinent data sheets are included in the appendix of this report.

CLIMATE

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation ranges from 12 to 14 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

FLOODPLAIN STATEMENT

From *Composite Runoff Coefficient Summary*				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL** *(Acres)*	C_5	C_{100}	C_5	**Length** *(ft)*	**Height** *(ft)*	T_C *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	T_t *(min)*	**TOTAL** *(min)*	I_5 *(in/hr)*	I_{100} *(in/hr)*	Q_5 *(c.f.s.)*	Q_{100} *(c.f.s.)*
		From DCM Table 5-1														
B	4.33	0.60	0.70	0.25	75	2	10.0	1100	2.5%	5.5	3.3	13.3	3.7	6.5	***9.5***	***19.7***
C	5.15	0.60	0.70	0.25	120	2	14.7	750	2.5%	5.5	2.3	17.0	3.3	5.8	***10.1***	***21.0***
D	5.19	0.60	0.70	0.25	100	2	12.6	500	1.0%	3.5	2.4	15.0	3.5	6.2	***10.8***	***22.4***
E	3.75	0.60	0.70	0.25	100	2	12.6	600	1.7%	4.6	2.2	14.8	3.5	6.2	***7.8***	***16.3***
F	8.13	0.60	0.70	0.25	50	6	5.0	1350	2.0%	4.9	4.5	9.5	4.2	7.4	***20.4***	***42.4***
G	3.94	0.60	0.70	0.25	100	2	12.6	400	2.0%	4.9	1.3	14.0	3.6	6.4	***8.4***	***17.5***
H	3.20	0.60	0.70	0.25	100	2	12.6	665	1.5%	4.3	2.6	15.2	3.4	6.1	***6.6***	***13.7***
I	6.63	0.60	0.70	0.25	100	2	12.6	1100	2.5%	5.5	3.3	16.0	3.4	6.0	***13.4***	***27.8***
J	1.78	0.60	0.70	0.25	75	2	10.0	240	2.0%	4.9	0.8	10.8	4.0	7.1	***4.3***	***8.8***
K	2.05	0.60	0.70	0.25	100	2	12.6	100	1.0%	3.5	0.5	13.1	3.7	6.5	***4.5***	***9.4***

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: ET
Date: 5/14/2014
Checked by: VAS

CA_5	Basin	CA_{100}
2.60	B	3.03
3.09	C	3.61
3.11	D	3.63
2.25	E	2.63
4.88	F	5.69
2.36	G	2.76
1.92	H	2.24
3.98	I	4.64
1.07	J	1.25
1.23	K	1.44

QUAIL BRUSH CREEK FILING NO. 1, 1A, 2 & 3
FINAL DRAINAGE REPORT
(Surface Routing Summary)

Design Point(s)	Contributing Basins/Design Points	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity		Flow		Comments
					I_5	I_{100}	Q_5	Q_{100}	
1	MDDP BASINS 2, 2A,2B,3A,3B	10.57	13.68	29.0	2.5	4.4	26.1	60.1	2-16' Sump Inlets
2	MDDP BASINS 4A, A1	2.55	3.40	18.8	3.1	5.5	7.9	18.8	Swale
3	DP2, MDDP BASINS 4B, A2	5.22	6.98	20.6	3.0	5.3	15.5	36.9	Swale
4	DP3	5.22	6.98	21.5	2.9	5.2	15.1	36.1	CDOT Inlet
5	A (70%)	1.32	1.54	15.2	3.4	6.1	4.6	9.5	1-16' At-grade Inlet
6	A (30%)	0.57	0.66	15.2	3.4	6.1	2.0	4.1	1-6' At-grade Inlet
7	-	-	-	-	-	-	-	-	(Not used)
8	B	2.60	3.03	13.3	3.7	6.5	9.5	19.7	8' Sump Inlet
9	C	3.09	3.61	17.0	3.3	5.8	10.1	21.0	10' Sump Inlet
10	D	3.11	3.63	15.0	3.5	6.2	10.8	22.4	2-4' Sump Inlets
11	-	-	-	-	-	-	-	-	(Not used)
12	E	2.25	2.63	14.8	3.5	6.2	7.8	16.3	4' Sump Inlet
13	G	2.36	2.76	14.0	3.6	6.4	8.4	17.5	4' Sump Inlet
14A	I, MDDP OS5	4.93	5.91	23.4	2.8	4.9	13.7	29.2	1-12' At-grade Inlet
14	H,FLOWBY I & MDDP OS5	4.52	5.47	23.4	2.8	4.9	12.5	27.0	Street Flow
15	J	1.07	1.25	10.8	4.0	7.1	4.3	8.8	Unconcentrated Sheet Flow
16	K (50%),DP 14	5.14	6.19	23.4	2.8	4.9	14.4	30.3	16' Sump Inlet
17	MDDP H-E	2.49	3.49	16.1	3.4	6.0	8.3	20.8	CDOT Inlet

Calculated by: ET
Date: 5/14/2014
Checked by: VAS

DESIGN POINT SUMMARY

DESIGN POINT	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
1	26.1	60.1
2	7.9	18.8
3	15.5	36.9
4	15.1	36.1
5	4.6	9.5
6	2.0	4.1
7	–	–
8	9.5	19.7
9	10.1	21.0
10	10.8	22.4
11	–	–
12	7.8	16.3
13	8.4	17.5
14A	13.7	29.2
14	12.5	27.0
15	4.3	8.8
16	14.4	30.3
17	8.3	20.8

PIPE SUMMARY

PIPE	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	SIZE/TYPE
1	13.0	30.0	30" RCP
2	13.0	30.0	30" RCP
3	26.1	60.1	42" RCP
4	45.9	106.8	43"X68" HERCP
5	4.6	9.5	18" RCP
6	6.5	13.5	24" RCP
7	51.3	118.2	43"X68" HERCP
8	9.5	19.7	24" RCP
9	10.1	21.0	24" RCP
10	23.7	49.2	42" RCP
11	32.2	66.8	42" RCP
12	8.3	20.8	24" RCP
14	13.0	30.5	30" RCP
15	30.8	65.2	42" RCP
16	4.2	8.8	18" RCP
17	8.4	17.5	24" RCP

BASIN SUMMARY

BASIN	AREA (Acres)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
MDDP OS2	22.76	17.0	38.0
MDDP 2A	0.69	3.0	5.0
MDDP 2B	0.84	3.0	6.0
MDDP 3A	7.46	7.0	15.0
MDDP 3B	0.17	1.0	1.0
MDDP 4A	8.06	8.0	17.0
MDDP 4B	8.21	8.0	18.0
MDDP A1	0.51	1.0	1.0
MDDP A2	0.83	1.0	2.0
MDDP OS5	3.18	2.7	6.0
MDDP H–E	9.97	8.0	19.9
A	3.15	6.5	13.5
B	4.33	9.5	19.7
C	5.15	10.1	21.0
D	5.19	10.8	22.4
E	3.75	7.8	16.3
F	8.13	20.4	42.4
G	3.94	8.4	17.5
H	3.20	6.6	13.7
I	6.63	13.4	27.8
J	1.78	4.3	8.8
K	2.05	4.5	9.4

1" = 100'

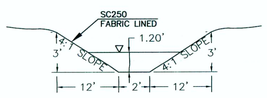
0 25 50 100 200

Scale in Feet

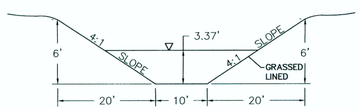
LEGEND

- A / 0.10 — BASIN DESCRIPTION / BASIN AREA, ACRES
- 1 — DESIGN POINT
- BASIN BOUNDARY
- EX MAJ CONT
- EX MIN CONT
- PROP MAJ CONT
- PROP MIN CONT
- FLOW ARROW
- PERIMETER SWALE
- TSB — TEMPORARY SEDIMENT BASIN

pipe run



SWALE A–A
X–SECT A–A
NOT TO SCALE



MAIN CHANNEL
X–SECT B–B
NOT TO SCALE

MATCHLINE SEE DRAINAGE PLAN SHEET 2

SITE

PHILIP B CZOROWSKI REV TRUST

OVEL J MILLER III

LOT 25

LOT 24

LOT 23

LOT 22

LOT 21

LOT 20

* HORSESHOE RANCHEROS *

HORSESHOE ROAD

MDDP BASIN 4A

MDDP BASIN A1

MDDP BASIN 4B

MDDP BASIN A2

HIGH POINT STREET FLOW DIVERTED NORTH AND SOUTH

EXISTING SWALE

COORDINATE WITH PROPERTY OWNER PRIOR TO CONSTRUCTION OF TEMPORARY DIVERSION SWALE

CDOT TYPE D GRATED INLET

PIPE 12

MANE LANE

THORN BRUSH TRAIL

30' SANITARY EASEMENT

I 6.63

J 1.78

H 3.20

FILING NO. 2

FILING NO. 3

NEW MEADOW DRIVE

1–12' AT–GRADE INLET

PIPE 14

G 3.94

C 5.15

FILING NO. 2

FILING NO. 3

1–16' SUMP INLET

2–4' SUMP INLET

PIPE 16

PIPE 15

K 2.05

SILVER MOON DRIVE

TSB

PIPE 17

E 3.75

FILING NO. 3

FILING NO. 1A

PROPOSED RIP RAP PAD (TYPICAL)

EXISTING POND

CAT TAIL CREEK DRIVE

2–PROPOSED RIP RAP PAD (TYPICAL)

FUTURE BOX CULVERTS

B 4.33

D 5.19

FILING NO. 2

FILING NO. 1A

FILING NO. 1

GOLD DROP DRIVE

1–10' SUMP INLET

PROPERTY LINE (TYP)

1–8' SUMP INLET

2–4' SUMP INLETS

A 3.15

PIPE 9

PIPE 10

PIPE 11

LP

HP

PROPOSED RIP RAP PAD (TYPICAL)

PROPERTY LINE (TYP)

REACH 1&7 TRIBUTARY

F 8.13

FUTURE LOTS *NOT PART OF THIS FDR*

PROPOSED CHANNEL IMPROVEMENTS COMPLETED WITH QBC FILING 1A

EXISTING JURISDICTIONAL WETLANDS (TO REMAIN)

PROPOSED RIP RAP PAD (TYPICAL)

CDOT TYPE D GRATED INLET

PIPE 4

PIPE 5

1–16' & 1–6' AT–GRADE INLET

PIPE 6

PIPE 7

RIDGEVIEW AT STETSON HILLS FIL NO 27

CITY OF COLORADO SPRINGS

TRACT B RIDGE VIEW AT STETSON HILLS FIL NO.27 REC. NO. 204205719

Pub. drainage easement & tracts

pipe 13 exit west swale w/in qbc filing.

QUAIL BRUSH CREEK FILING NO. 1, 1A, 2 & 3

DRAINAGE PLAN

102 E PIKES PEAK AVENUE, SUITE 306
COLORADO SPRINGS,
COLORADO 80903

v 719.955.5485
f 719.444.8427

CIVIL CONSULTANTS, INC.

DATE: 12/17/2012
REV 1 DATE: 3/17/2013
REV 2 DATE: 9/2/2013
REV 3 DATE: 5/14/2014
REV 4 DATE: 5/29/2014

FINAL DRAINAGE REPORT FOR QUAIL BRUSH CREEK FILING No. 4

November 2016

Prepared for:

Rivers Quail Brush, LLC
13530 Northgate Estates Drive
Colorado Springs, CO 80921
Brian Bahr

Prepared by:

CIVIL CONSULTANTS, INC.
20 Boulder Crescent, STE 110
Colorado Springs, CO 80903
(719) 955-5485

Project #08-033

21842-34

historic drainage patterns. Runoff (Q5=3.1 cfs and Q100=22.4 cfs) will follow historic drainage patterns to Design Point 5 (DP5) which will outfall into Sand Creek. Per Section A-A, open channel flow calculator (see appendix), the spread of this flow is approximately 34', the nearest building to the property boundary is approximately 51'. The buildings are located at the north end of Basin OS-6 where the flow is initially collected, hence the spread of flow is less. The previous delineation of Basin OS-6 (MDDP Woodmen Heights Additions 7,8 & 9-Development Drainage Map)is included in the back pocket of this report for comparison. This map will also act as an existing drainage map. This flow will outfall into Sand Creek as historic patterns have dictated. The berm along the east boundary will be installed as a precautionary measure to protect homes as requested by the City of Colorado Springs.

Basin EX-E, 3.75 acres, consists of existing single family residential lots and a portion of Cat Tail Creek Drive. This basin has been studied in the "Update to Quail Brush Creek Filing No. 1, 1A, 2 & 3 Final Drainage Report", prepared by M&S Civil Consultants, approved June 2014. The runoff from the site outfalls into Reach 147, via a riprap pad at the end of Cat Tail Drive. The continuation of Cat Tail Drive will cross Reach 147 and connect with Filing No. 4. Runoff from Basin EX-E (Q5=6.4 cfs and Ql00=14.0 cfs) will be routed via street curb and gutter southerly to a low point east of the proposed 8"x6" Box culvert (as determined by the Catamount Engineering report) where developed flows will outfall into 2-4' sump inlets, DP 1. The cumulative flows at DP 1 (Q5=7.8 cfs and Ql00=17.2 cfs) will be routed via a 24" polypropylene pipe (PP) , Pipe Run-1 (PR-1) pipe and outfall through one of the culvert wing walls into Reach 147. Coordination between the Catamount Engineering construction drawings (Quail Brush Creek Filing No. 4 Channel Realignment Plan and Profile) and the construction drawings for this project (Quail Brush Creek Filing No. 4 Street Improvement Plans included Storm Sewer) will account for this outfall.

Basin A, 0.84 acres, consists of proposed single family residential lots, a portion of Reach 147 tributary and a portion of Cat Tail Creek Drive. Runoff(Q5=1.5 cfs and Q100=3.4 cfs) will be directed towards the street via side lot swales and unconcentrated sheet flow. Roof drains shall be routed through pervious areas (grass buffers) and will incorporate vegetation in these areas that generate filtration and slow runoff. Flows are conveyed via the street curb and gutter northerly to a low point east of the proposed 8'x6' Box culvert (determined by the Catamount Engineering report) where developed flows will outfall into 2-4' sump inlets, DP 1. The cumulative flows at DP1 (Q5=7.8 cfs and Ql00=17.2 cfs) will be routed via a 24" PP, Pipe Run-1 (PR-1) pipe and outfall through one of the box culvert wing walls into Reach 147. Coordination between the Catamount Engineering construction drawings (Quail Brush Creek Filing No. 4 Channel Realignment Plan and Profile) and the construction drawings for this project (Quail Brush Creek Filing No. 4 Street Improvement Plans incl Storm Sewer) will account for this outfall.

Basin B, 3.94 acres, consists of single family residential lots and streets. Runoff (Q5=6.3 cfs and Q100=13.8 cfs) will be directed towards the street via side lot swales. Flows are conveyed via the street curb and gutter to DP2 (Q5=6.3 cfs and Ql00=13.8 cfs). At DP2, 2-8' at-grade inlets shall be installed to capture Basin B runoff. A 24" PP (PR-2) will route the capture flow (Q5=6.2 cfs and Q100=12.8 cfs) to DP 3. Surface flow-by from the inlet will be routed via curb and gutter to DP3.

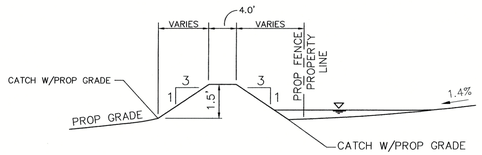
Basin C, 1.95 acres, consists of park area and a small portion of single family residential backyards. Runoff from Basin C (Q5=0.5 cfs and Q100=3.9 cfs) will sheet flow across the park. A berm and swale will be constructed along the south boundary of the park and lots to route flows to the west. Flows will outfall into the street via a 2' curb cut and sidewalk chase. Runoff will be conveyed via the street curb and gutter to

QUAIL BRUSH CREEK FILING NO. 4
PRELIMINARY DRAINAGE REPORT
(Area Drainage Summary)

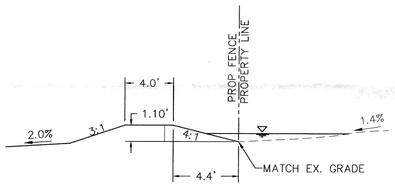
From Area Runoff Coefficient Summary				OVERLAND				STREET / CHANNEL FLOW				of Travel	INTENSITY *		TOTAL FLOWS		#REF!		#REF!
BASIN	AREA TOTAL (Acres)	C_5	C_{100}	C_5	Length (ft)	Height (ft)	T_C (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	TOTAL (min)	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	CA_5	Basin	CA_{100}
		From DCM Table 5-1																	
Existing Area Drainage Summary																			
OS6 Historic	18.75	0.08	0.35	0.08	300	6	25.4	2043	1.9%	2.3	15.0	40.3	2.0	3.4	3.1	22.4	1.50	OS6 Historic	6.56
EX-E	3.75	0.45	0.59	0.45	100	2	9.3	600	1.7%	3.0	3.3	12.6	3.8	6.3	6.4	14.0	1.69	EX-E	2.21
U																			
U	0.84	0.45	0.59	0.45	100	2	9.3	232	2.0%	3.0	1.3	10.6	4.0	6.8	1.5	3.4	0.38	U	0.50
B	3.94	0.45	0.59	0.45	100	2	9.3	993	1.4%	3.0	5.5	14.8	3.5	5.9	6.3	13.8	1.77	B	2.32
C	1.95	0.08	0.33	0.08	71	2	11.1	427	1.6%	2.3	3.1	14.2	3.6	6.0	0.5	3.9	0.15	C	0.64
D	5.2	0.45	0.59	0.45	100	2	9.3	427	1.5%	3.0	2.3	11.7	3.9	6.5	9.1	20.1	2.34	D	3.07
E	0.13	0.08	0.35	0.08	12	4	2.0	1036	1.8%	2.3	7.4	9.4	4.2	7.1	0.04	0.3	0.01	E	0.05
F	0.84	0.08	0.35	0.08	70	1.4	12.3	0	2.0%	2.3	0.0	12.3	3.8	6.4	0.3	1.9	0.07	F	0.29
G	0.28	0.08	0.35	0.08	100	2	14.7	0	2.0%	2.3	0.0	14.7	3.6	6.0	0.1	0.6	0.02	G	0.10
H	0.34	0.08	0.35	0.08	64	3.5	8.4	100	0.5%	3.0	0.5	9.0	4.3	7.2	0.1	0.9	0.03	H	0.12
I	0.71	0.08	0.35	0.08	100	13	7.9	100	1.0%	2.3	0.7	8.6	4.3	7.3	0.2	1.8	0.06	I	0.25
J	4.98	0.08	0.35	0.08	100	10	8.6	1247	1.4%	2.3	9.1	17.7	3.3	5.5	1.3	9.6	0.40	J	1.74

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: ET
Date: 4/4/2016
Checked by: VAS



SECTION "B–B" BERM
NOT TO SCALE



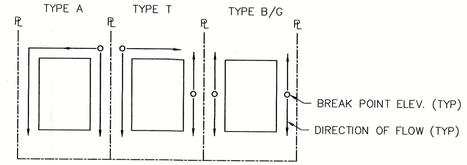
SECTION A–A
NOT TO SCALE

LEGEND

- SB — SEDIMENT BASIN
- 4 — PIPE RUN REFERENCE LABEL
- 3 — SURFACE DESIGN POINT
- BASIN BOUNDARY
- (6920) EXISTING CONTOUR
- 6920 PROPOSED CONTOUR
- STORM SEWER PIPE
- CROSSPAN
- INLET
- BASIN DESIGNATION: Z / 25 / .25 / .35 / C5 / C100 / ACRES
- EXISTING FLOW DIRECTION ARROW
- EMERGENCY OVERFLOW DIRECTION
- FLOW DIRECTION
- FLARED END SECTION
- PERIMETER SWALE
- FILING LINE
- 11 — LOT NUMBER
- 2.5% — STREET GRADE W/DIRECTION
- H.P. — HIGH POINT
- L.P. — LOW POINT
- PP — POLYPROPYLENE PIPE

1" = 100'

0 25 50 100 200
Scale in Feet

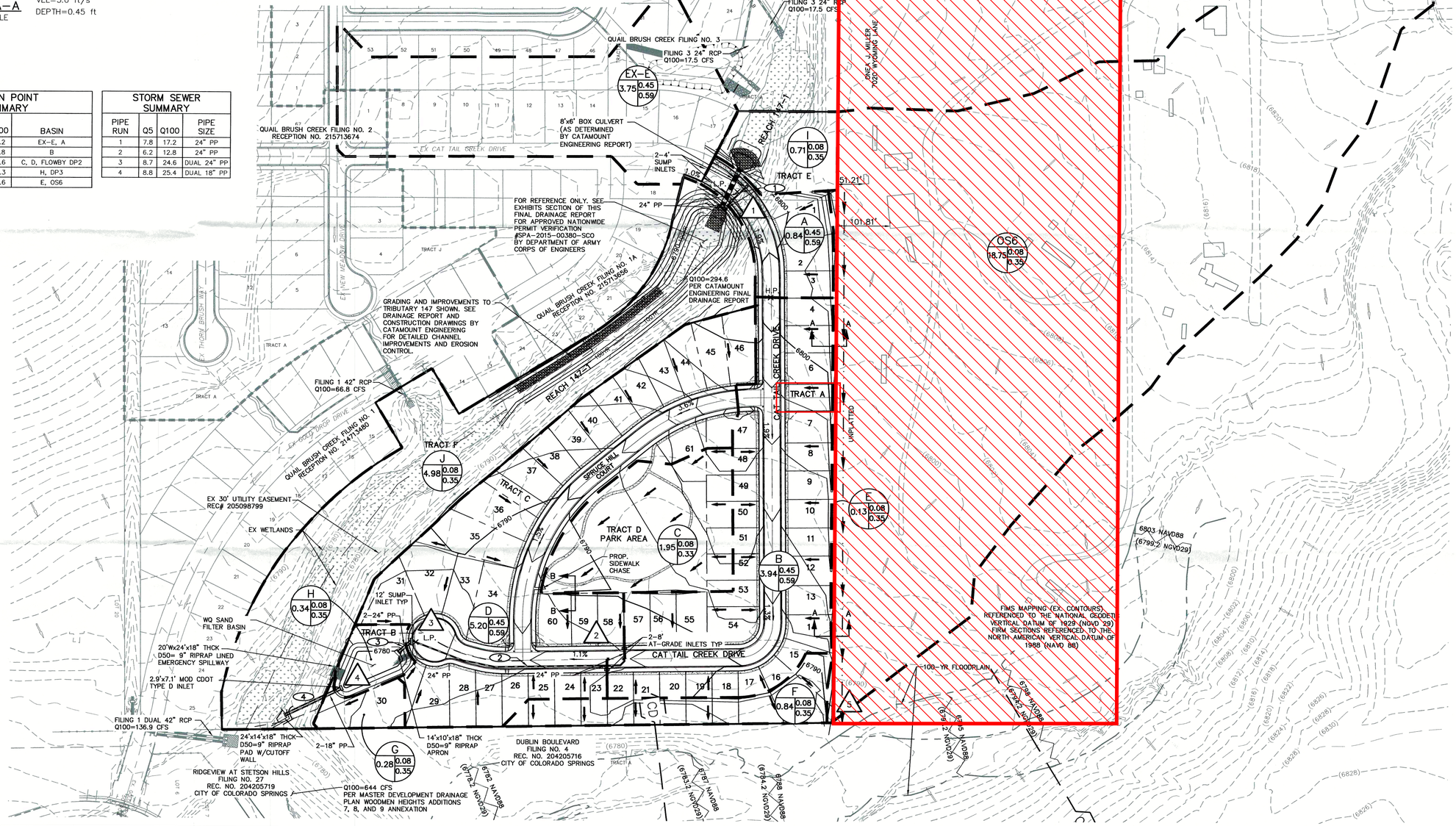


LOT DRAINAGE TYPES AND SWALE DIRECTION
NOT TO SCALE

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q5	Q100
OS6	18.75	3.1	22.4
EX–E	3.75	6.4	14.0
A	0.84	1.5	3.4
B	3.94	6.3	13.8
C	1.95	0.5	3.9
D	5.2	9.1	20.1
E	0.13	0.04	0.3
F	0.84	0.3	1.9
G	0.28	0.1	0.6
H	0.34	0.1	0.9
I	0.71	0.2	1.8
J	4.98	1.3	9.6

DESIGN POINT SUMMARY			
DESIGN POINT	Q5	Q100	BASIN
1	7.8	17.2	EX–E, A
2	6.2	13.8	B
3	8.7	23.6	C, D, FLOWBY DP2
4	8.8	24.3	H, DP3
5	3.1	22.6	E, OS6

STORM SEWER SUMMARY			
PIPE RUN	Q5	Q100	PIPE SIZE
1	7.8	17.2	24" PP
2	6.2	12.8	24" PP
3	8.7	24.6	DUAL 24" PP
4	8.8	25.4	DUAL 18" PP



QUAIL BRUSH CREEK FILING NO. 4
DRAINAGE MAP

PROJECT NO. 08–033 | FILE: V:\dwg\08033\ENG EXHIBITS\08X4 DM.dwg | SCALE HORIZ: 1"=100' VERT: NA | DATE: 09/7/2016 | SHEET 1 OF 1 | DM–1

DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:

APP'D. BY: DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

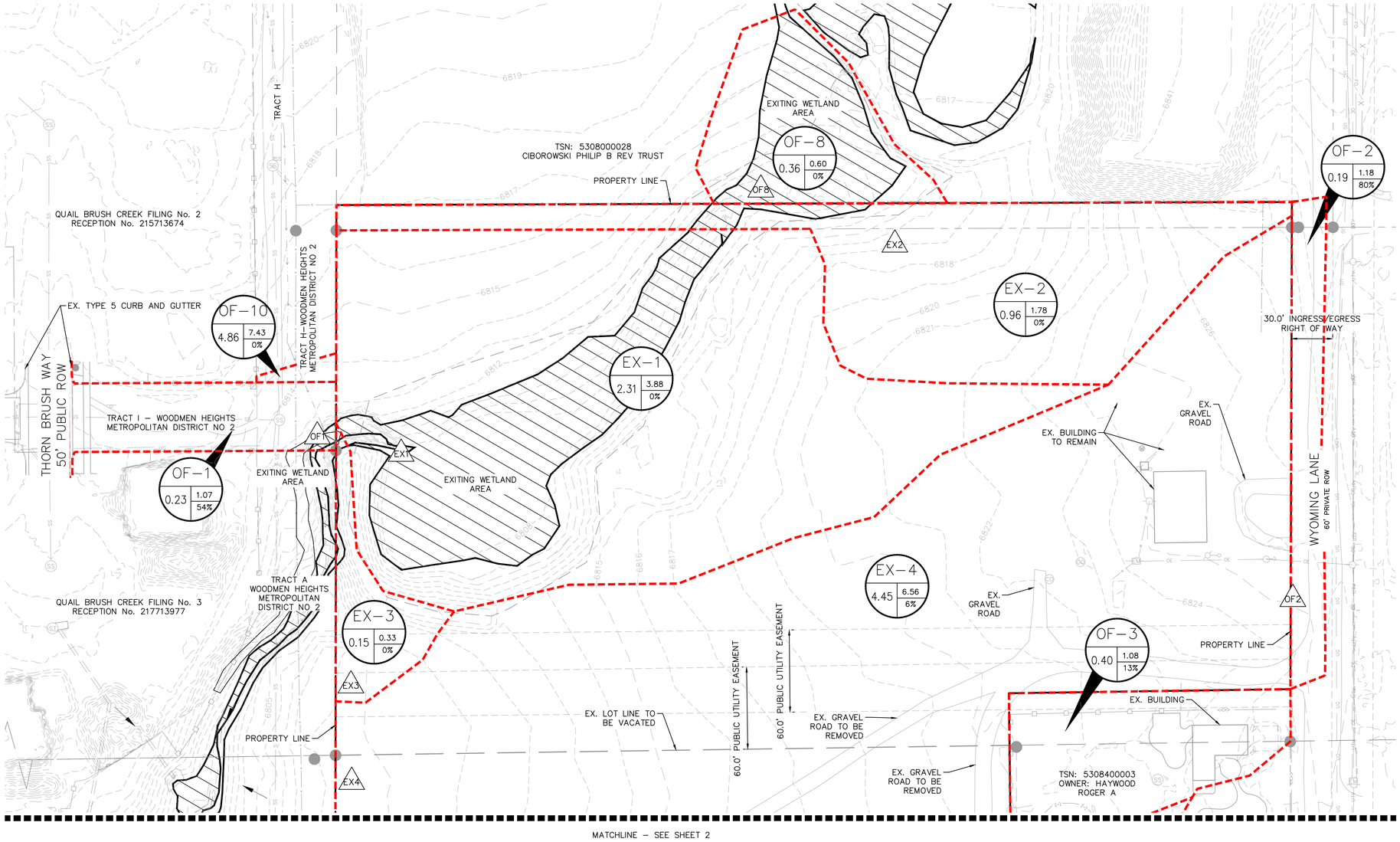
CAUTION

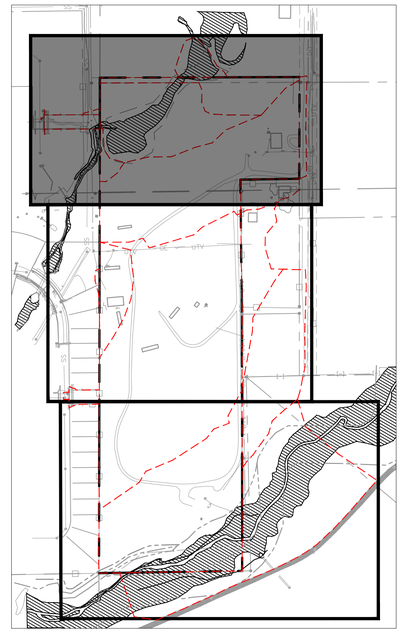
APPENDIX H – DRAINAGE & GREEN INFRASTRUCTURE MAPS

MILLER DOWNS

EXISTING DRAINAGE EXHIBIT - SHEET 1

SITUATED IN A PORTION OF THE EAST 1/2 OF SECTION 8, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.
CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO





KEY MAP
1" = 250'

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR DESIGN STORM RUNOFF (CFS)
D = IMPERVIOUSNESS

1 = # = DESIGN POINT

- EXISTING FLOW DIRECTION
- DRAINAGE BASIN BOUNDARY
- XXXX EXISTING MAJOR CONTOUR
- XXXX EXISTING MINOR CONTOUR
- PROPERTY LINE
- PARCEL LINE
- EASEMENT LINE
- UG EXISTING UNDERGROUND GAS LINE
- FO EXISTING UNDERGROUND FIBER OPTICS LINE
- UE EXISTING UNDERGROUND ELECTRIC LINE
- SS EXISTING SANITARY SEWER LINE & MH
- WL EXISTING WATER LINE
- ST EXISTING STORM LINE & MH

EXISTING RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
EX-1	EX-1	2.31	0.53	3.88
EX-2	EX-2	0.96	0.24	1.78
EX-3	EX-3	0.15	0.05	0.33
EX-4	EX-4	4.45	1.22	6.56
EX-5	EX-5	0.77	0.52	1.98
EX-6	EX-6	8.19	1.90	10.98
EX-7	EX-7	4.53	1.27	7.20
OF-1	OF-1	0.23	0.46	1.07
OF-2	OF-2	0.19	0.59	1.18
OF-3	OF-3	0.40	0.27	1.08
OF-4	OF-4	0.96	0.27	2.00
OF-5	OF-5	2.29	0.56	4.11
OF-6	OF-6	0.14	0.43	0.86
OF-7	OF-7	0.03	0.01	0.08
OF-8	OF-8	0.36	0.08	0.60
OF-9	OF-9	4.87	1.01	7.43
OF-10	OF-10	0.02	0.01	0.05

COLORADO SPRINGS GENERAL NOTES

1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR OMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

Kimley»Horn

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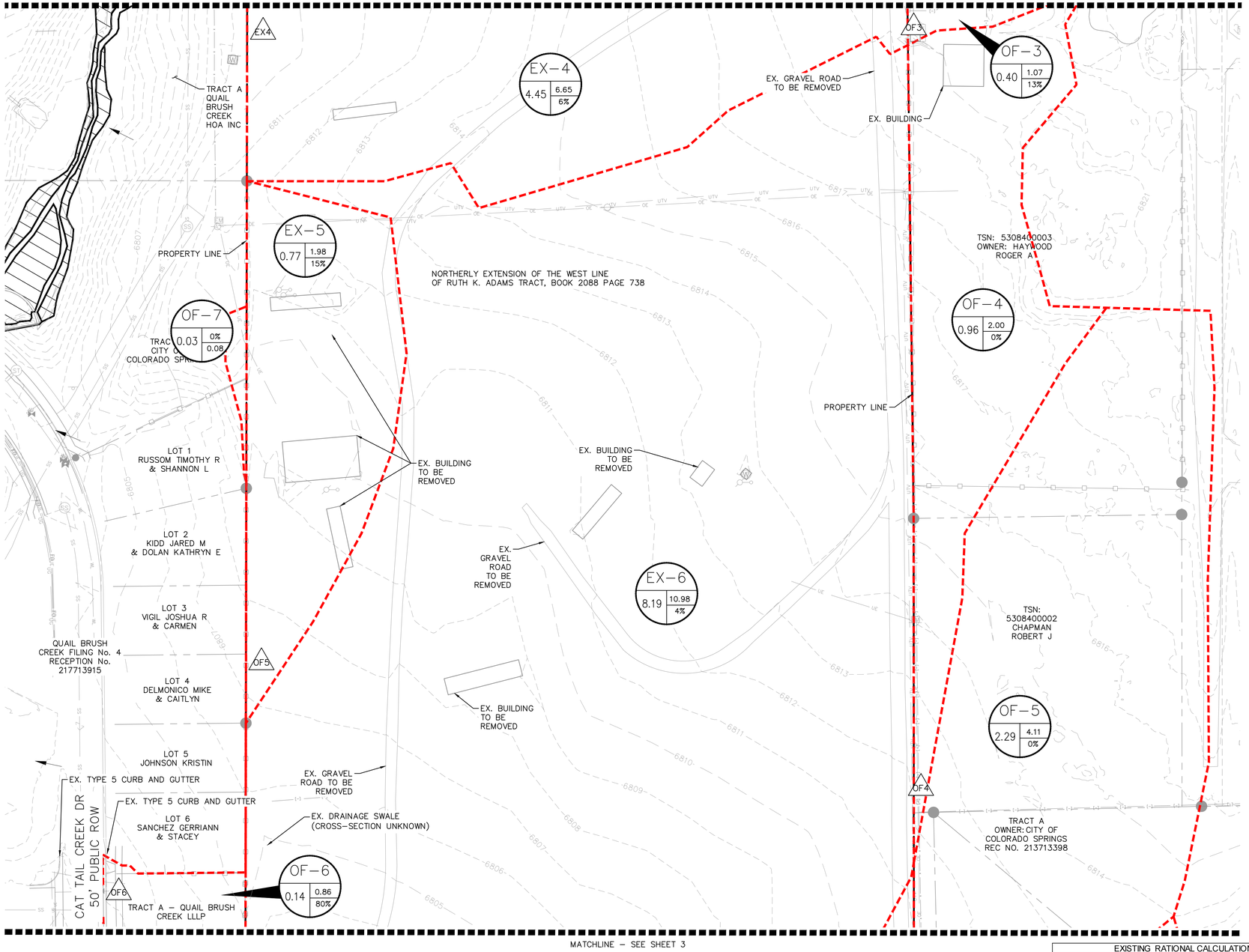
2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

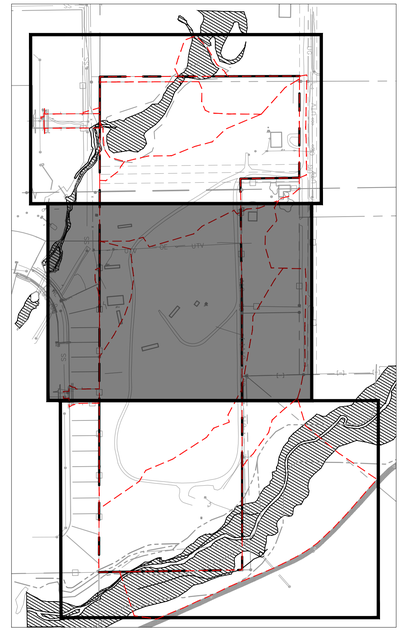
K:\COS_Civil\296083000_Miller Downs (Wyoming Lane)\CADD\Exhibits\Drainage & GI Maps\EX-DRN_296083000.dwg [1 EXISTING DRAINAGE MAP (1 OF 3)] 8/18/2026 11:12:36 AM Maria Olesen

MILLER DOWNS

EXISTING DRAINAGE EXHIBIT - SHEET 2

SITUATED IN A PORTION OF THE EAST 1/2 OF SECTION 8, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.
CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO





KEY MAP
1" = 250'

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR DESIGN STORM RUNOFF (CFS)
D = IMPERVIOUSNESS

1 = # = DESIGN POINT

EXISTING FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPERTY LINE
PARCEL LINE
EASEMENT LINE
EXISTING UNDERGROUND GAS LINE
EXISTING UNDERGROUND FIBER OPTICS LINE
EXISTING UNDERGROUND ELECTRIC LINE
EXISTING SANITARY SEWER LINE & MH
EXISTING WATER LINE
EXISTING STORM LINE & MH

EXISTING RATIONAL CALCULATIONS SUMMARY				
DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS) Q5	Q100
EX-1	EX-1	2.31	0.53	3.88
EX-2	EX-2	0.96	0.24	1.78
EX-3	EX-3	0.15	0.05	0.33
EX-4	EX-4	4.45	1.22	6.56
EX-5	EX-5	0.77	0.52	1.98
EX-6	EX-6	8.19	1.90	10.98
EX-7	EX-7	4.53	1.27	7.20
OF-1	OF-1	0.23	0.46	1.07
OF-2	OF-2	0.19	0.59	1.18
OF-3	OF-3	0.40	0.27	1.08
OF-4	OF-4	0.96	0.27	2.00
OF-5	OF-5	2.29	0.56	4.11
OF-6	OF-6	0.14	0.43	0.86
OF-7	OF-7	0.03	0.01	0.08
OF-8	OF-8	0.36	0.08	0.60
OF-9	OF-9	4.87	1.01	7.43
OF-10	OF-10	0.02	0.01	0.05

COLORADO SPRINGS GENERAL NOTES

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NORTH

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0 20 40 80

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2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453–0180

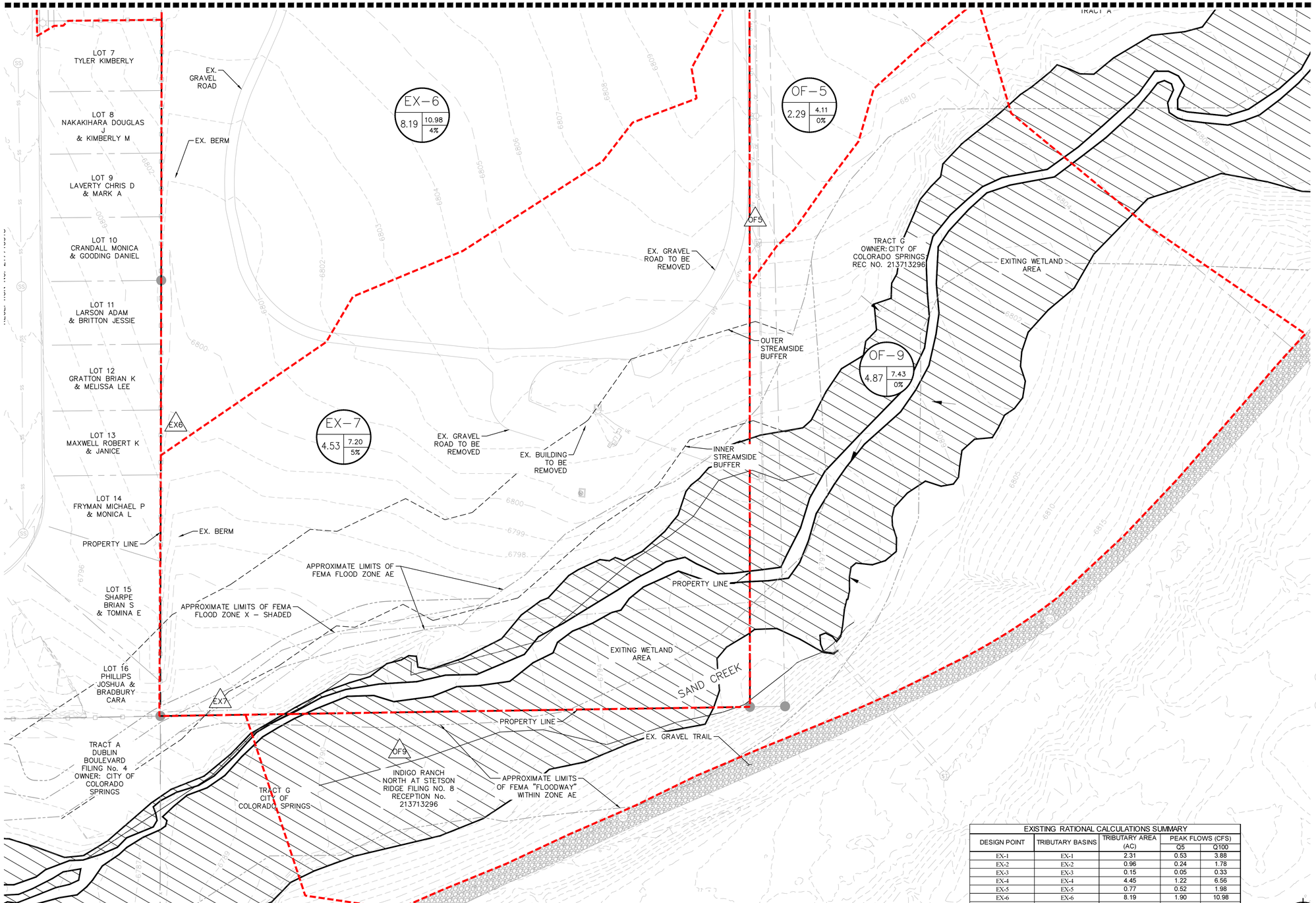
K:\COS_Civil\236082000_Miller Downs (Wyoming Lease)\CADD\Exhibits\Drainage & GI Maps\EX-DRN_236082000.dwg [2 EXISTING DRAINAGE MAP (2 OF 3)] 8/18/2026 11:12:38 AM Maria Olesen

MILLER DOWNS

EXISTING DRAINAGE EXHIBIT - SHEET 3

SITUATED IN A PORTION OF THE EAST 1/2 OF SECTION 8, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.
CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

MATCHLINE – SEE SHEET 2



KEY MAP
1" = 250'

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = 100-YR DESIGN STORM RUNOFF (CFS)
D = IMPERVIOUSNESS

= DESIGN POINT

EXISTING FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPERTY LINE
PARCEL LINE
EASEMENT LINE
EXISTING UNDERGROUND GAS LINE
EXISTING UNDERGROUND FIBER OPTICS LINE
EXISTING UNDERGROUND ELECTRIC LINE
EXISTING SANITARY SEWER LINE & MH
EXISTING WATER LINE
EXISTING STORM LINE & MH

EXISTING RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS) Q5	Q100
EX-1	EX-1	2.31	0.53	3.88
EX-2	EX-2	0.96	0.24	1.78
EX-3	EX-3	0.15	0.05	0.33
EX-4	EX-4	4.45	1.22	6.56
EX-5	EX-5	0.77	0.52	1.98
EX-6	EX-6	8.19	1.90	10.98
EX-7	EX-7	4.53	1.27	7.20
OF-1	OF-1	0.23	0.46	1.07
OF-2	OF-2	0.19	0.59	1.18
OF-3	OF-3	0.40	0.27	1.08
OF-4	OF-4	0.96	0.27	2.00
OF-5	OF-5	2.29	0.56	4.11
OF-6	OF-6	0.14	0.43	0.86
OF-7	OF-7	0.03	0.01	0.08
OF-8	OF-8	0.36	0.08	0.60
OF-9	OF-9	4.87	1.01	7.43
OF-10	OF-10	0.02	0.01	0.05

COLORADO SPRINGS GENERAL NOTES

1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR OMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

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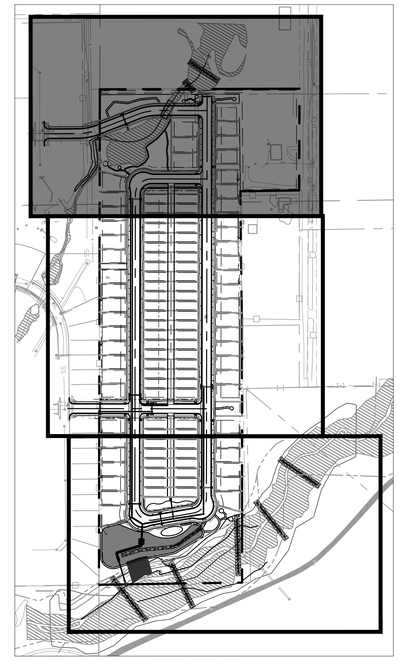
K:\COS_Civil\296082000_Miller Downs (Wyoming Lane)\CADD\Exhibits\Drainage & GI Maps\EX-DRN_296082000.dwg L3 EXISTING DRAINAGE MAP (3 OF 3)) 8/18/2026 11:12:39 AM Maria.Olesen

MILLER DOWNS

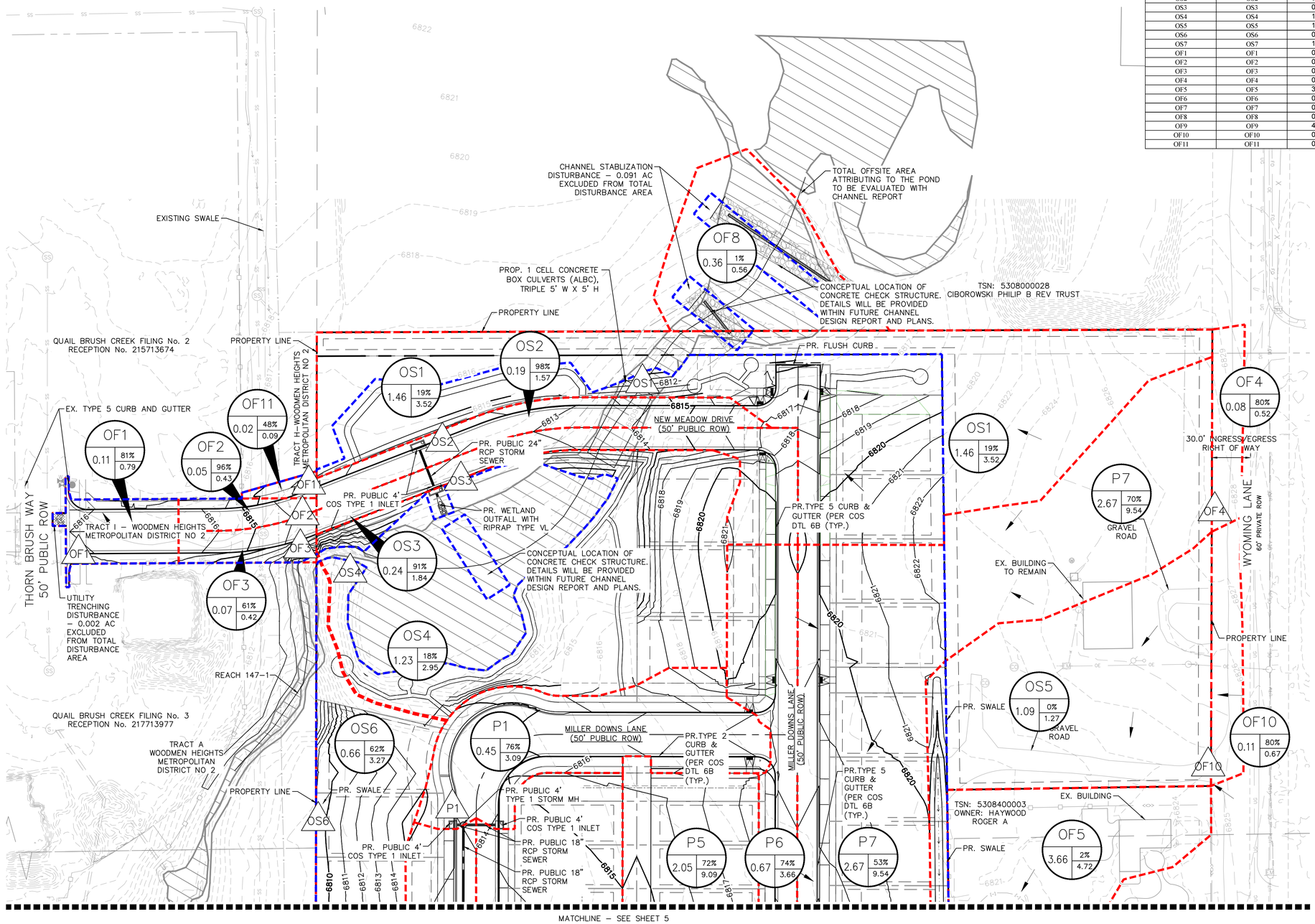
PROPOSED DRAINAGE EXHIBIT - SHEET 4

SITUATED IN A PORTION OF THE EAST 1/2 OF SECTION 8, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.
CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED RATIONAL CALCULATIONS SUMMARY				
DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS) Q5	Q100
P1	P1	0.45	1.58	3.09
P2	P2	0.70	1.32	2.90
P3	P3	0.86	2.32	4.72
P4	P4	1.80	3.41	7.20
P5	P5	2.05	4.43	9.09
P6	P6	0.67	1.86	3.66
P7	P7	2.67	4.12	9.54
P8	P8	0.02	0.09	0.17
P9	P9	0.02	0.09	0.17
P10	P10	0.66	1.18	2.64
P11	P11	0.52	1.53	3.06
P12	P12	0.78	1.63	3.40
P13	P13	0.13	0.49	0.96
P14	P14	0.57	1.44	2.94
P15	P15	0.23	0.83	1.62
P16	P16	0.89	1.83	3.86
P17	P17	0.49	0.87	2.03
P18	P18	0.35	1.31	2.52
P19	P19	0.85	0.28	2.07
OS1	OS1	1.46	1.00	3.52
OS2	OS2	0.19	0.88	1.57
OS3	OS3	0.24	1.00	1.84
OS4	OS4	1.23	0.77	2.95
OS5	OS5	1.09	0.17	1.27
OS6	OS6	0.66	1.46	3.27
OS7	OS7	1.77	1.03	4.00
OF1	OF1	0.11	0.42	0.79
OF2	OF2	0.05	0.24	0.43
OF3	OF3	0.07	0.20	0.42
OF4	OF4	0.08	0.26	0.52
OF5	OF5	3.66	0.73	4.72
OF6	OF6	0.14	0.56	1.06
OF7	OF7	0.03	0.01	0.07
OF8	OF8	0.36	0.08	0.56
OF9	OF9	4.87	1.04	7.46
OF10	OF10	0.11	0.33	0.67
OF11	OF11	0.02	0.04	0.09



KEY MAP
1" = 250'



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = IMPERVIOUSNESS
D = 100-YR DESIGN STORM RUNOFF (CFS)

1 = # = DESIGN POINT

- PROPOSED FLOW DIRECTION
- DRAINAGE BASIN BOUNDARY
- PROPOSED LIMITS OF DISTURBANCE
- XXXX EXISTING MAJOR CONTOUR
- XXXX EXISTING MINOR CONTOUR
- 6540 PROPOSED MAJOR CONTOUR
- 6540 PROPOSED MINOR CONTOUR
- PROPERTY LINE
- PARCEL LINE
- EASEMENT LINE
- UG EXISTING UNDERGROUND GAS LINE
- FO EXISTING UNDERGROUND FIBER OPTICS LINE
- UE EXISTING UNDERGROUND ELECTRIC LINE
- SS EXISTING SANITARY SEWER LINE & MH
- WL EXISTING WATER LINE
- ST EXISTING STORM LINE & MH
- UTILITY TRENCHING AREA

COLORADO SPRINGS GENERAL NOTES

1. PLAN REVIEW BY CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

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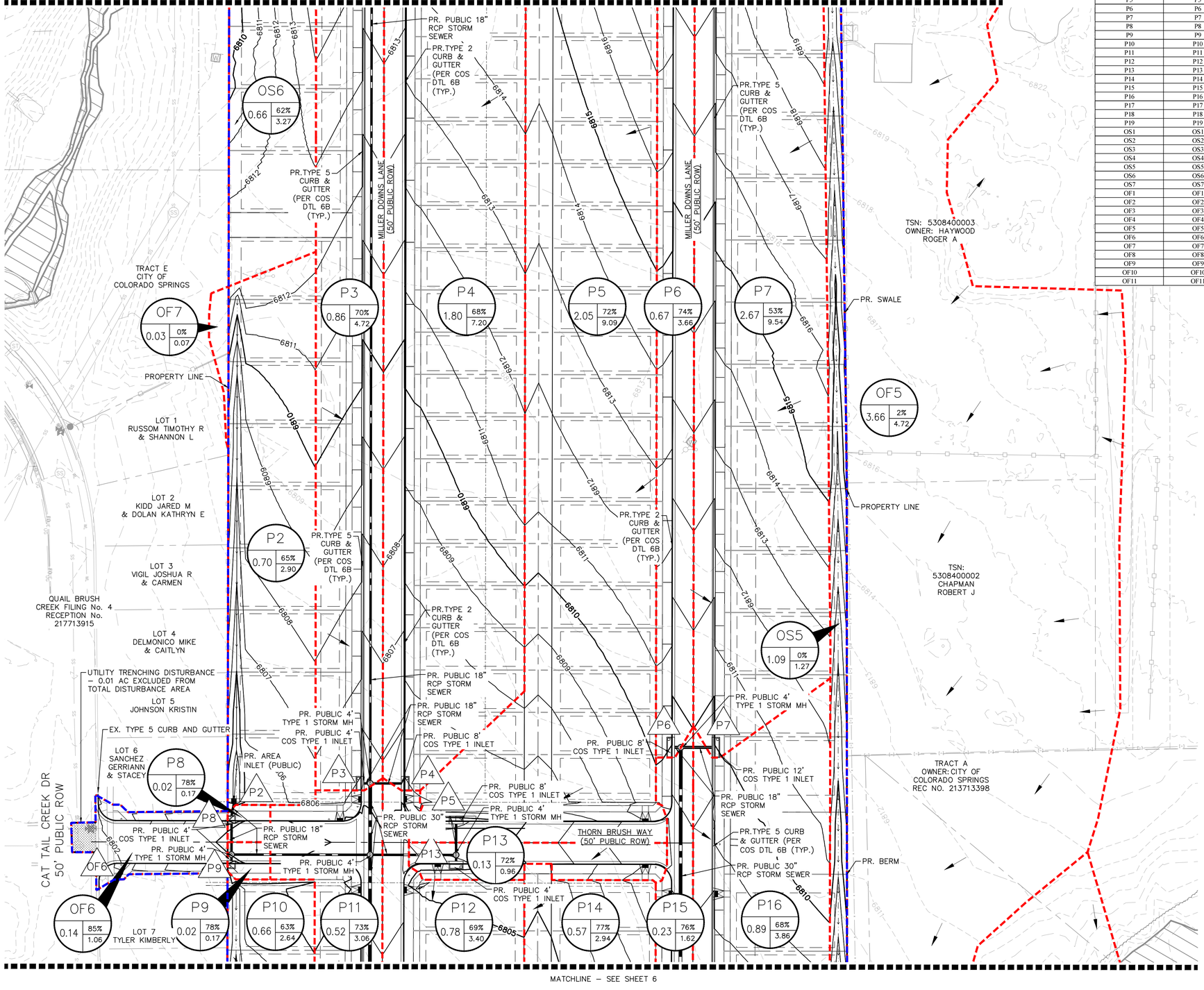
K:\COS_Civil\296082000_Miller Downs (Wyoming Lane)\CAD\Exhibits\Drainage & GI Maps\DR-DRN_296082000.dwg 14 PROPOSED DRAINAGE MAP (1 OF 3)) 8/18/2026 11:12:43 AM DJ Schwenke

MILLER DOWNS

PROPOSED DRAINAGE EXHIBIT - SHEET 5

SITUATED IN A PORTION OF THE EAST 1/2 OF SECTION 8, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.
CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

MATCHLINE – SEE SHEET 4



MATCHLINE – SEE SHEET 6

PROPOSED RATIONAL CALCULATIONS SUMMARY				
DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS) Q5	Q100
P1	P1	0.45	1.58	3.09
P2	P2	0.70	1.32	2.90
P3	P3	0.86	2.32	4.72
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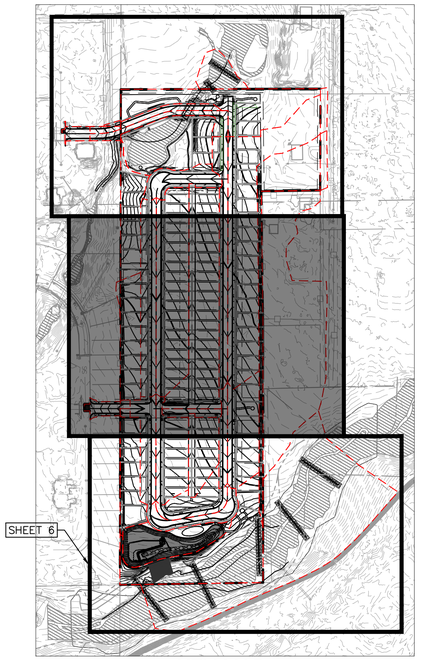
P6	P6	0.67	1.86	3.66
P7	P7	2.67	4.12	9.54
P8	P8	0.02	0.09	0.17
P9	P9	0.02	0.09	0.17
P10	P10	0.66	1.18	2.64
P11	P11	0.52	1.53	3.06
P12	P12	0.78	1.63	3.40
P13	P13	0.13	0.49	0.96
P14	P14	0.57	1.44	2.94
P15	P15	0.23	0.83	1.62
P16	P16	0.89	1.83	3.86
P17	P17	0.49	0.87	2.03
P18	P18	0.35	1.31	2.52
P19	P19	0.85	0.28	2.07
OS1	OS1	1.46	1.00	3.52
OS2	OS2	0.19	0.88	1.57
OS3	OS3	0.24	1.00	1.84
OS4	OS4	1.23	0.77	2.95
OS5	OS5	1.09	0.17	1.27
OS6	OS6	0.66	1.46	3.27
OS7	OS7	1.77	1.03	4.00
OF1	OF1	0.11	0.42	0.79
OF2	OF2	0.05	0.24	0.43
OF3	OF3	0.07	0.20	0.42
OF4	OF4	0.08	0.26	0.52
OF5	OF5	3.66	0.73	4.72
OF6	OF6	0.14	0.56	1.06
OF7	OF7	0.03	0.01	0.07
OF8	OF8	0.36	0.08	0.56
OF9	OF9	4.87	1.04	7.46
OF10	OF10	0.11	0.33	0.67
OF11	OF11	0.02	0.04	0.09



KEY MAP
1" = 250'

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = IMPERVIOUSNESS
D = 100-YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

PROPOSED FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
PROPOSED LIMITS OF DISTURBANCE
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
PROPERTY LINE
PARCEL LINE
EASEMENT LINE
EXISTING UNDERGROUND GAS LINE
EXISTING UNDERGROUND FIBER OPTICS LINE
EXISTING UNDERGROUND ELECTRIC LINE
EXISTING SANITARY SEWER LINE & MH
EXISTING WATER LINE
EXISTING STORM LINE & MH
UTILITY TRENCHING AREA

COLORADO SPRINGS GENERAL NOTES

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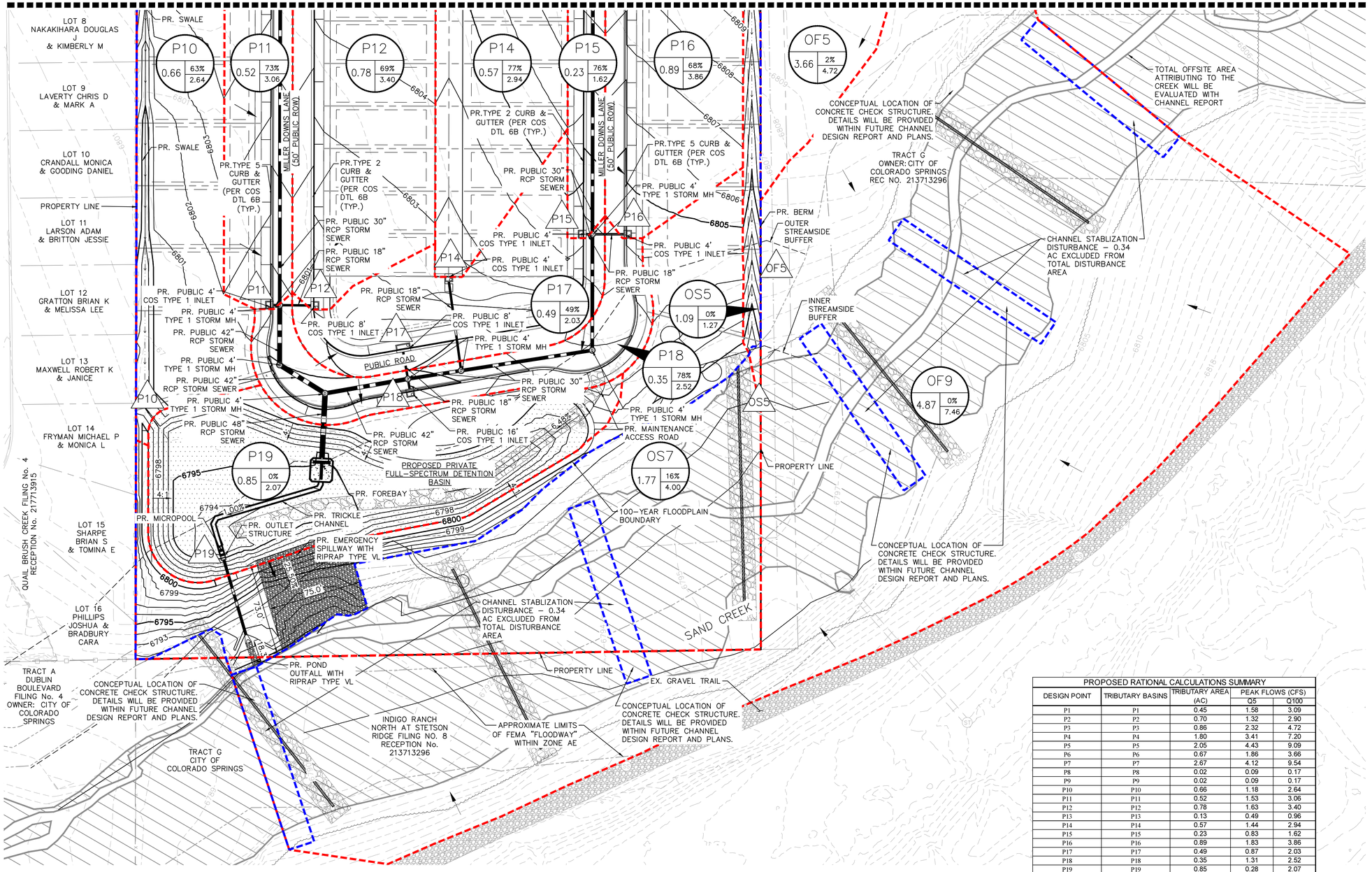
K:\COS_Civil\296083000_Miller Downs (Wynnmon Lane)\CADD\Exhibits\Drainage & GI Maps\DR-DRN_296083000.dwg (5 PROPOSED DRAINAGE MAP (2 OF 3)) 8/18/2026 11:17:45 AM OJ Schwenke

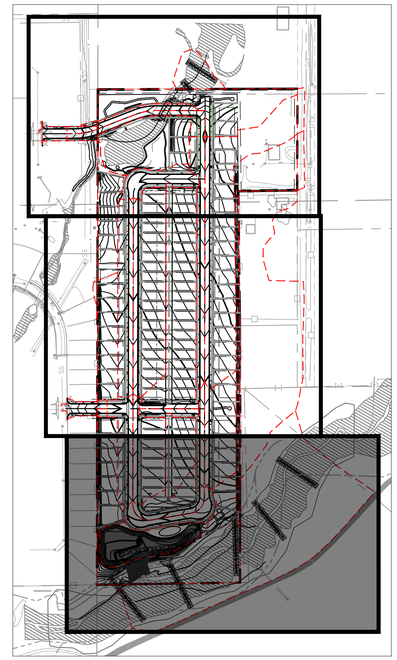
MILLER DOWNS

PROPOSED DRAINAGE EXHIBIT - SHEET 6

SITUATED IN A PORTION OF THE EAST 1/2 OF SECTION 8, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.
CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

MATCHLINE – SEE SHEET 5





KEY MAP
1" = 250'

KEY MAP
1" = 200'

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = IMPERVIOUSNESS
D = 100-YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

PROPOSED FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
PROPOSED LIMITS OF DISTURBANCE
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
PROPERTY LINE
PARCEL LINE
EASEMENT LINE
EXISTING UNDERGROUND GAS LINE
EXISTING UNDERGROUND FIBER OPTICS LINE
EXISTING UNDERGROUND ELECTRIC LINE
EXISTING SANITARY SEWER LINE & MH
EXISTING WATER LINE
EXISTING STORM LINE & MH
UTILITY TRENCHING AREA

PROPOSED RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS) Q5	Q100
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P5	P5	2.05	4.43	9.09
P6	P6	0.67	1.86	3.66
P7	P7	2.67	4.12	9.54
P8	P8	0.02	0.09	0.17
P9	P9	0.02	0.09	0.17
P10	P10	0.66	1.18	2.64
P11	P11	0.52	1.53	3.06
P12	P12	0.78	1.63	3.40
P13	P13	0.13	0.49	0.96
P14	P14	0.57	1.44	2.94
P15	P15	0.23	0.83	1.62
P16	P16	0.89	1.83	3.86
P17	P17	0.49	0.87	2.03
P18	P18	0.35	1.31	2.52
P19	P19	0.85	0.28	2.07
OS1	OS1	1.46	1.00	3.52
OS2	OS2	0.19	0.88	1.57
OS3	OS3	0.24	1.00	1.84
OS4	OS4	1.23	0.77	2.95
OS5	OS5	1.09	0.17	1.27
OS6	OS6	0.66	1.46	3.27
OS7	OS7	1.77	1.03	4.00
OF1	OF1	0.11	0.42	0.79
OF2	OF2	0.05	0.24	0.43
OF3	OF3	0.07	0.20	0.42
OF4	OF4	0.08	0.26	0.52
OF5	OF5	3.66	0.73	4.72
OF6	OF6	0.14	0.56	1.06
OF7	OF7	0.03	0.01	0.07
OF8	OF8	0.36	0.08	0.56
OF9	OF9	4.87	1.04	7.46
OF10	OF10	0.11	0.33	0.67
OF11	OF11	0.02	0.04	0.09

COLORADO SPRINGS GENERAL NOTES

1. PLAN REVIEW BY CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

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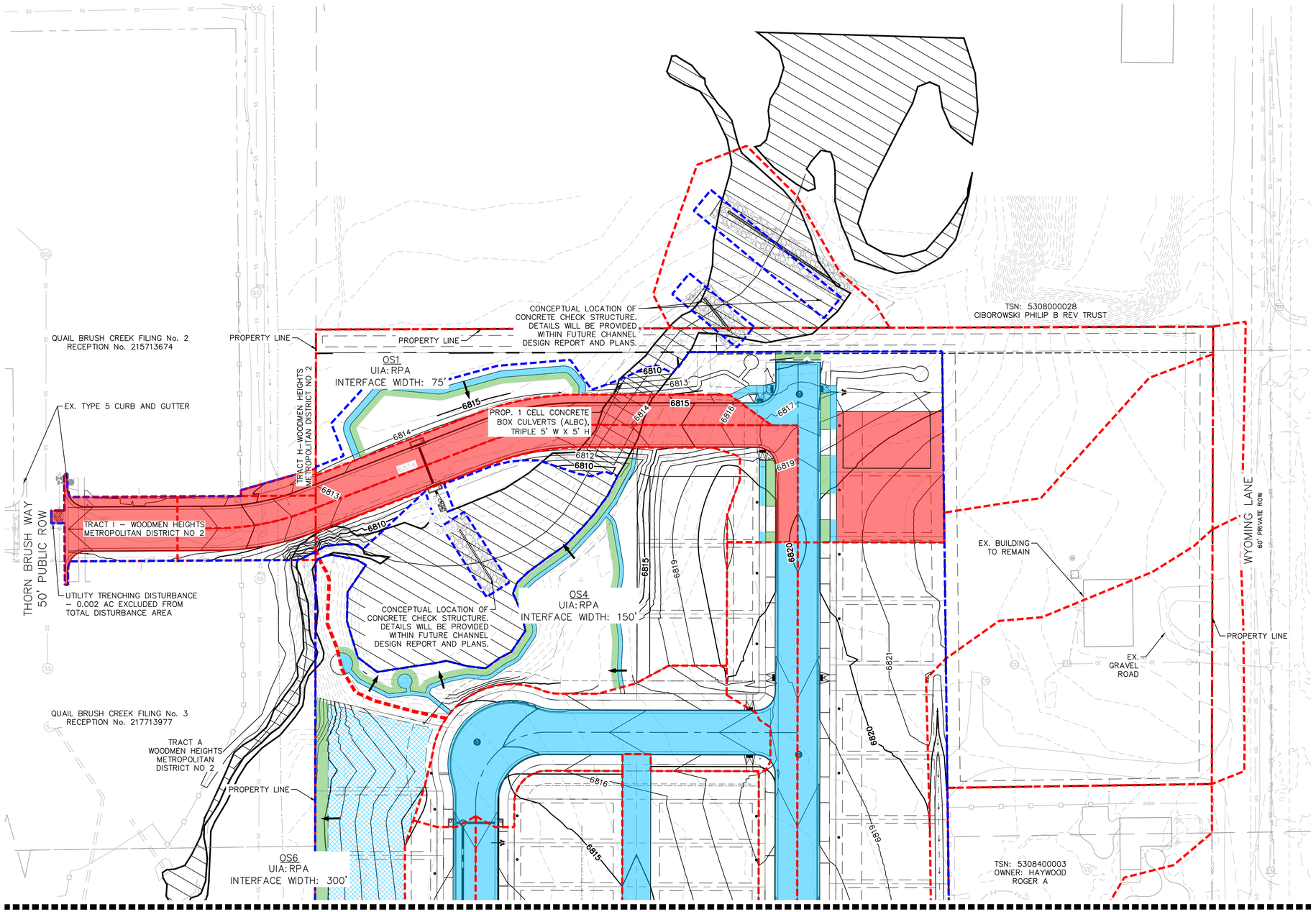
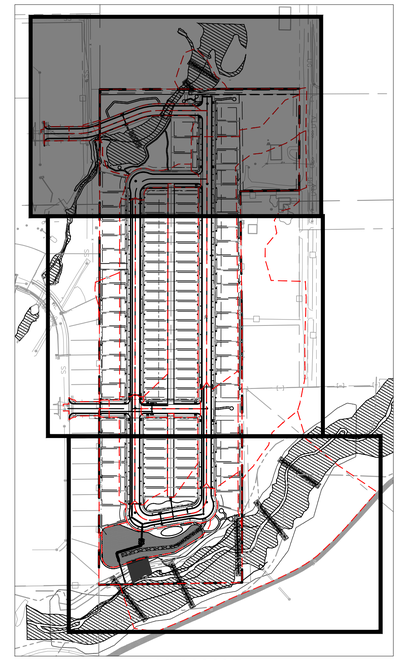
K:\COS_Civil\296082000_Miller Downs \Wynnins Lee\VCAD\Exhibits\Drainage & GI Maps\PR-DRN_296082000.dwg [6.PROPOSED DRAINAGE MAP (3 OF 3)] 8/18/2026 11:12:47 AM, DJ Schmeike

MILLER DOWNS

GREEN INFRASTRUCTURE EXHIBIT - SHEET 7



MATCHLINE – SEE SHEET 8



KEY MAP

1" = 250'

LEGEND

- DRAINAGE BASIN BOUNDARY
- PROPOSED LIMITS OF DISTURBANCE
- XXXX EXISTING MAJOR CONTOUR
- XXXX EXISTING MINOR CONTOUR
- 6540 PROPOSED MAJOR CONTOUR
- 6540 PROPOSED MINOR CONTOUR
- PROPERTY LINE
- PARCEL LINE
- EASEMENT LINE
- UG EXISTING UNDERGROUND GAS LINE
- FO EXISTING UNDERGROUND FIBER OPTICS LINE
- UE EXISTING UNDERGROUND ELECTRIC LINE
- SS EXISTING SANITARY SEWER LINE & MH
- WL EXISTING WATER LINE
- ST EXISTING STORM LINE & MH
- UNCONNECTED IMPERVIOUS AREA
- UNCONNECTED IMPERVIOUS AREA (65% IMPERVIOUS)
- RECEIVING PERVIOUS AREA
- UTILITY TRENCHING AREA
- UNTREATED AREA

SPA NOTES

1. SEPARATE PERVIOUS AREA (SPA) HATCHING IS NOT SHOWN ON THIS PLAN BUT ARE PROVIDED TO ILLUSTRATE PROPOSED DISTURBED BASINS THAT ARE ALLOWED TO FLOW OFFSITE WITHOUT WATER QUALITY TREATMENT VIA THE PROPOSED POND.
2. SPA BASINS ARE TREATED VIA 75% INFILTRATION, SEE RUNOFF REDUCTION SHEET 2 PROVIDED IN APPENDIX D.
3. SPA AREAS LOCATED IN DISTURBED BASINS THAT ARE ROUTED TO THE PROPOSED WATER QUALITY POND ARE NOT HATCHED ON THIS PLAN.

Total Area (ft²)	789,629	= 18.13 ACRES
Total Impervious Area (ft²)	447,547	
WQCV (ft³)	18,648	
WQCV Reduction (ft³)	3,313	
WQCV Reduction (%)	18%	
Untreated WQCV (ft³)	15,334	

COLORADO SPRINGS GENERAL NOTES

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K:\COS_Civil\296082000_Miller Downs (Wynnmoor Lane)\CAD\EXHIBITS\Drainage & GI Maps\GR_INF_296082000.dwg [7 PROPOSED GREEN INFRASTRUCTURE MAP] 1:OF 31) 8/18/2026 11:13:06 AM Mirela Olsson

MILLER DOWNS

GREEN INFRASTRUCTURE EXHIBIT - SHEET 8

MATCHLINE – SEE SHEET 7

OS6
UIA: RPA
INTERFACE WIDTH: 300'

TRACT E
CITY OF
COLORADO SPRINGS

PROPERTY LINE

LOT 1
RUSSOM TIMOTHY R
& SHANNON L

LOT 2
KIDD JARED M
& DOLAN KATHRYN E

LOT 3
VIGIL JOSHUA R
& CARMEN

QUAIL BRUSH
CREEK FILING No. 4
RECEPTION No.
217713915

LOT 4
DELMONICO MIKE
& CAITLYN

LOT 5
JOHNSON KRISTIN

EX. TYPE 5 CURB AND GUTTER

LOT 6
SANCHEZ GERRIANN
& STACEY

CAT TAIL CREEK DR
50' PUBLIC ROW

LOT 7
TYLER KIMBERLY

UTILITY TRENCHING DISTURBANCE
– 0.01 AC EXCLUDED FROM
TOTAL DISTURBANCE AREA

TSN: 5308400003
OWNER: HAYWOOD
ROGER A

PROPERTY LINE

TSN:
5308400002
CHAPMAN
ROBERT J

TRACT A
OWNER: CITY OF
COLORADO SPRINGS
REC NO. 213713398

MATCHLINE – SEE SHEET 9

KEY MAP
1" = 250'

LEGEND

- DRAINAGE BASIN BOUNDARY
- PROPOSED LIMITS OF DISTURBANCE
- XXXX EXISTING MAJOR CONTOUR
- XXXX EXISTING MINOR CONTOUR
- 6540 PROPOSED MAJOR CONTOUR
- 6540 PROPOSED MINOR CONTOUR
- PROPERTY LINE
- PARCEL LINE
- EASEMENT LINE
- UG EXISTING UNDERGROUND GAS LINE
- FO EXISTING UNDERGROUND FIBER OPTICS LINE
- UE EXISTING UNDERGROUND ELECTRIC LINE
- SS EXISTING SANITARY SEWER LINE & MH
- WL EXISTING WATER LINE
- ST EXISTING STORM LINE & MH
- UNCONNECTED IMPERVIOUS AREA
- UNCONNECTED IMPERVIOUS AREA (65% IMPERVIOUS)
- RECEIVING PERVIOUS AREA
- UTILITY TRENCHING AREA
- UNTREATED AREA

SPA NOTES

1. SEPARATE PERVIOUS AREA (SPA) HATCHING IS NOT SHOWN ON THIS PLAN BUT ARE PROVIDED TO ILLUSTRATE PROPOSED DISTURBED BASINS THAT ARE ALLOWED TO FLOW OFFSITE WITHOUT WATER QUALITY TREATMENT VIA THE PROPOSED POND.
2. SPA BASINS ARE TREATED VIA 75% INFILTRATION, SEE RUNOFF REDUCTION SHEET 2 PROVIDED IN APPENDIX D.
3. SPA AREAS LOCATED IN DISTURBED BASINS THAT ARE ROUTED TO THE PROPOSED WATER QUALITY POND ARE NOT HATCHED ON THIS PLAN.

Total Area (ft²)	789,629	= 18.13 ACRES
Total Impervious Area (ft²)	447,547	
WQCV (ft³)	18,648	
WQCV Reduction (ft³)	3,313	
WQCV Reduction (%)	18%	
Untreated WQCV (ft³)	15,334	

COLORADO SPRINGS GENERAL NOTES

1. PLAN REVIEW BY CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

Kimley»Horn

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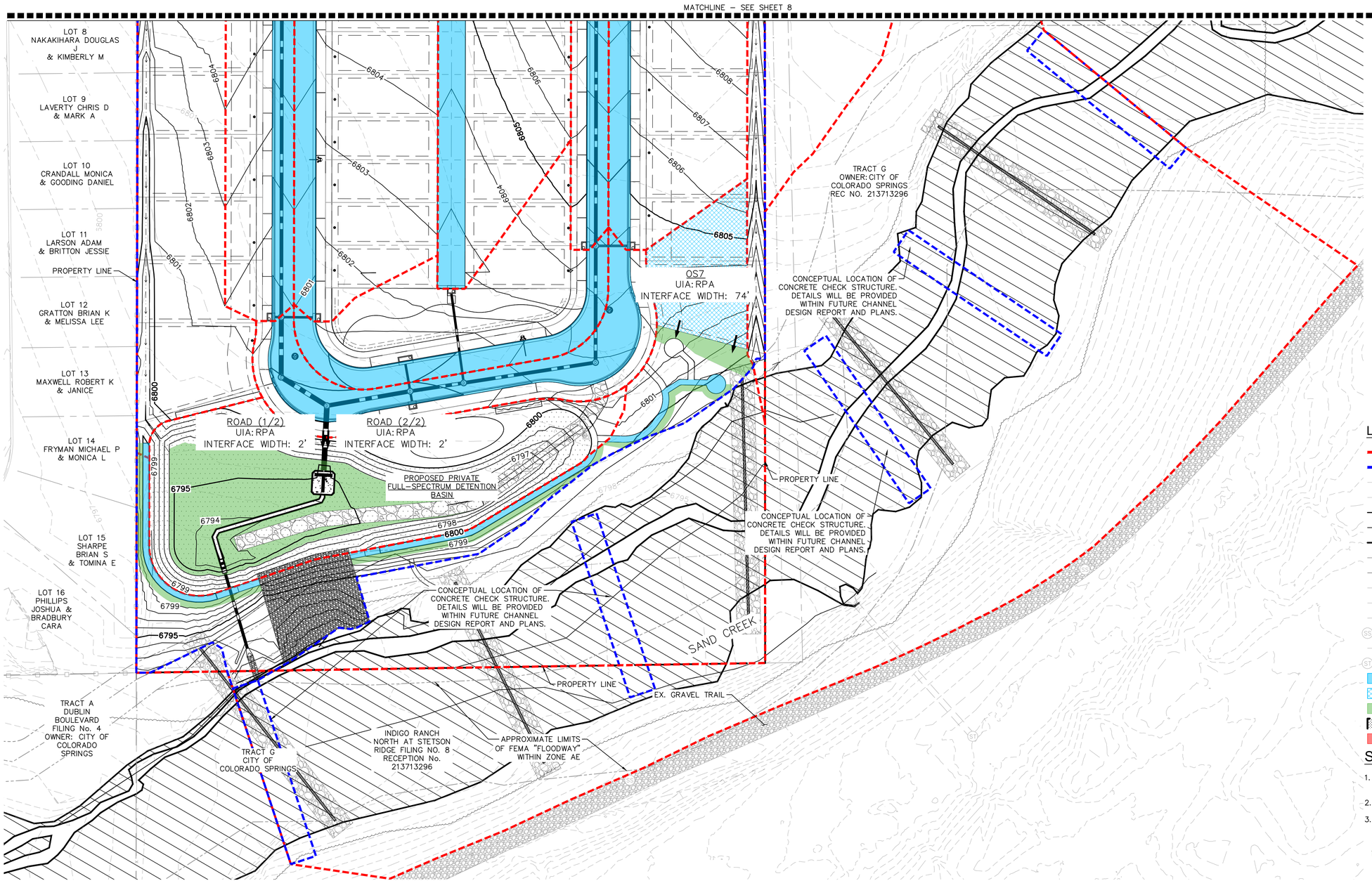
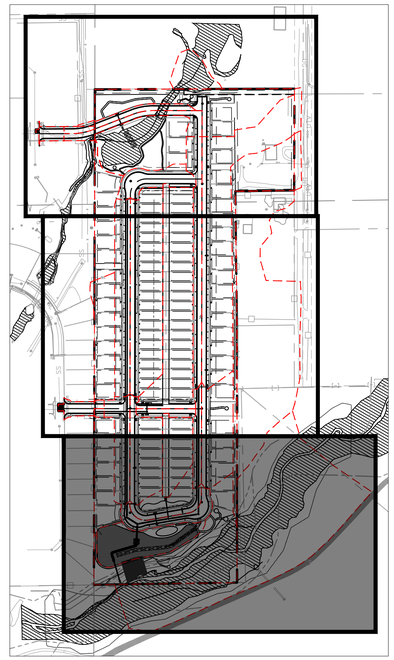
2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453–0180

K:\COS_Civil\296082000_Miller Downs (Wynnmoor Lane)\CAD\Exhibits\Drainage & GI Maps\GR-INF_296082000.dwg (8 PROPOSED GREEN INFRASTRUCTURE MAP (1 OF 3)) 8/18/2026 11:13:08 AM Mirela Ohlsen

MILLER DOWNS

GREEN INFRASTRUCTURE EXHIBIT - SHEET 9





KEY MAP

1" = 250'

LEGEND

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K:\COS_Civil\296082000_Miller Downs (Wynetka Lane)\CAD\Exhibits\Drainage & GI Maps\GI-LINE_296082000.dwg 19 PROPOSED GREEN INFRASTRUCTURE MAP (3 of 3)1 8/18/2026 11:13:11 AM Maria.Olsson