FINAL DRAINAGE REPORT: MARIAH TRAIL FILING NO. 1 MAJOR SUBDIVISION

A PORITION OF THE NORTHWEST QUARTER OF SECTION 17, TOWNSHIP 14 SOUTH, RANGE 66 WEST OF THE 6TH P.M.
COUNTY OF EL PASO, STATE OF COLORADO

LOTS 1-6 MARIAH TRAIL FILING NO. 1
EL PASO COUNTY, COLORADO

PCD FILE NO.: SF2315

PREPARED FOR: MR. THOMAS KIRK, JR.
19205 MARIAH TRAIL
COLORADO SPRINGS, CO

LATEST REVISION DATE: JUNE 21, 2024

PREPARED BY

CARLOS SERRANO, PE

ENGINEERING LOCAL XPERTS

PROJECT NO. 100678

PO BOX 6708 | COLORADO SPRINGS, CO 80934 | 719.308.9146

Engineer's Statement

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the ~~city~~/county for drainage reports and said report is in conformity with the master of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

SIGNATURE (Affix Seal): ______________________ 8/8/2024

Carlos David Serrano, Colorado P.E. No.: 52048 — Date

For and on Behalf of Engineering Local Xperts

SEAL:

COLORADO LICENSED
CARLOS D. SERRANO
52048
8/8/2024
PROFESSIONAL ENGINEER

sign across seal per DORA regulations

DEVELOPER'S STATEMENT

I, Mr. Thomas Kirk, Jr., the developer have read and will comply with all of the requirements specified in this drainage report and plan.

Thomas Kirk Jr

Name of Developer

8/12/2024

Authorized Signature — Date

Thomas Kirk Jr

Printed Name

Owner

Title

19205 Mariah tr. Colo. Spgs. 80908

Address

EL PASO COUNTY STATEMENT:

Filed in accordance with Section 51.1 of the El Paso Land Development Code as amended.

____

Director of Public Works

Conditions:

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

i apologize for not catching this before.

Table of Contents

Appendices

1) INTRODUCTION

The purpose of this report is to identify on-site and offsite drainage patterns, assess stormwater conditions per delineated project sub-basins, demonstrate adequate design standards for storm water conveyance and release into the existing storm water system (on-site or off-site), and provide a narrative for any other drainage considerations on the development. The purpose of the project is to subdivide an existing 35-acre RR-5 zoned parcel into six single-family residential lots as a Major Subdivision. A Drainage Letter is sufficient for the purposes of a final plat and "small subdivision" per County standards.

2) EXISTING CONDITIONS

LOCATION

The property of interest, henceforth referred to as the Site, addressed as 19205 Mariah Trail, is an unplatted 35-acre RR-5 zoned parcel within El Paso County with Schedule No. 5100000511. The Site within the northwest quarter of Section 7, Township 11 South, Range 65 West of the sixth P.M.. The Site is south of the County's 60-foot right-of-way of Mariah Trail, a rural local gravel roadway. The property is accessed via a private access drive within a 16-foot width common access easement (Reception No. 213070061). The adjacent properties or subdivisions are as follows:

North: El Creek Ranches Filing No. 1 (Lots 24-26)

East: 19275 Mariah Trail, Schedule No. 5100000512, Zoned RR-5, Unplatted 40.23 acre property

South: 18885 Brown Road, Schedule No. 5100000447, Zoned RR-5, Unplatted 61.55 acre property

West: Part of Section 12-11-66, Schedule No. 6100000224, Zoned RR-5, Unplatted 80 acre property

The Site is currently zoned RR-5 (Rural Residential), allowing 5-acre minimum lots with 25-foot front, rear, and side setbacks for principal structures, and a 200-foot minimum lot frontage width.

EXISTING SOILS

The soils indicative to the site are classified as Brussett loam and Peyton-Print complex by the USDA Soil Conservation Service and are listed as NRCS (National Resources Conservation Service) Hydrologic Soil Group B. A USDA Soil Map is provided in Appendix C.

There is little to no evidence of soil erosion and sediment runoff to the eastern downstream natural tertiary channel. The existing swales are assessed within the Final Drainage Report for this project and the existing conditions and developed conditions show no critical or supercritical flows. The data used to determine this include channel section calculations and hydrology calculations to determine peak runoff, velocities, and Froude numbers within swale sections within the property and downstream property.

EXISTING DRAINAGE CONDITIONS

The existing topography of the Site consists of slopes between 2.0 percent and 15 percent generally draining from the west to the east. There are several local topographic high points and grasslined swales across the property. The natural landscape comes to a swale located on the eastern property boundary, central to the Site. The majority of the Site drains to this point where it continues to flow due east. The stormwater runoff to this area is via overland sheet flow and remains generally as sheet flow until the swale reduces in width downstream to channelized flow. The ultimate outfall location is East Cherry Creek approximately 1.5 miles east of the Site.

There are no major drainageways or existing facilities on the Site. There are conservation easements that have been platted that coincide with tertiary drainage swales that convey stormwater during major storm events.

The Site lies within the East Cherry Creek Drainage Basin according to the El Paso County Drainage Basins map. There are no known non-stormwater discharges that contribute to the storm water systems on site and downstream, both private and public.

The project site does not lie within a designated floodplain according to information published in the Federal Emergency Management Agency Floodplain Map No. 08041C0305G, dated December 7, 2018. The FEMA FIRM panel is provided in Appendix B.

The existing percent imperviousness of the Site is less than 0.1% as evidence by aerial photography and site visits. The only non-vegetation land is a dirt path within a common access easement at the north of the Site. The existing vegetative cover of the Site is approximately 99.9% with sparse native grasses and weeds, also as evidence by aerial photography and site visits.

delete so that if it changes again with planning comments you dont have to keep changing it.

3) PROPOSED DEVELOPMENT

The existing site is to be platted as Mariah Trail Filing N[illegible]ct scope is for a subdivision for a total of six single-family RR-5 residential estate lots and two Tracts (A and B) with short extension of the Mariah Trail 60' right-of-way onto the property at the northern property boundary for a termination point of the roadway as a rural residential gravel cul-de-sac of 60' diameter right-of-way (50' diameter gravel roadway) for proper emergency vehicle maneuvering. The public right-of-way is situated such that its platted right-of-way extension and cul-de-sac area as well as a future knuckle does not overlap the existing conservation easement. The public right-of-way cul-de-sac is an access point to Lots 1, 2, 5, and 6. Lots 5 and 6 are flag lots along the public right-of-way. A private ~~20' width~~ access easement stems from the public right-of-way for access to future private driveway to two lots, Lots 3 and 4.

Tract A is a no-build area that contains an existing conservation easement and is the portion of the site that is north of the dedicated future Mariah Trail public 60' right-of-way. This tract ensures that no development is proposed that may disturb or hinder a future public right-of-way extension or existing accesses.

There is a dedicated 60’ public right-of-way for a Mariah Trail roadway extension due east as requested by the County. This dedication is shown on the Final Plat and is to accommodate a future rural local roadway. While the area east of the cul-de-sac that is to be constructed at this time may be able to be platted as a preservation easement, it was decided that a right-of-way dedication for the entire immediate and potential future extension of Mariah Trail is the best path forward for this entitlement to avoid several different types of interim easements and allow the County to extend Mariah Trail at their behest in the future.

A Final Plat and Major Development Plan show Lots 1 through 6 with minimum areas of 5 acres to meet RR-5 rural residential zoning standards. The only disturbance proposed at this time is the public gravel rural cul-de-sac extension of Mariah Trail. Future development to allow platting of the six rural estate lots includes platting of a 20’ common access easement that is to have a future dirt driveway to allow access for all properties within the subdivision. Private dirt roadways may stem from this common access easement to access respective private lots.

The small subdivision is to remain zoned as RR-5, allowing for single-family residences and accessory structures within the El Paso County zoning code’s allowed land uses. Covenants for the Mariah Trail Filing No. 1 subdivision shall meet El Paso County land use and development standards at a minimum with the following minimum criteria per the County and HOA covenants to be included on the Final Plat:

- Minimum 200’ width lot frontage
- Minimum 30’ lot frontage at public roadways
- No minimum lot frontage at private roadways
- 25’ front, side, and rear principal building setbacks
- 5% Imperviousness (per HOA covenants)

Proposed construction activity for the major subdivision is for the Mariah Trail right-of-way extension of the gravel roadway cul-de-sac. The limits of disturbance and construction is to establish the public cul-de-sac and private gravel roadway is approximately 12,000 square feet (0.27 acres) or 0.7% of the total 35-acre site area. This limit of disturbance/construction is the total disturbance and includes area for control measures during construction phases. The construction of the roadways is the only development proposed at this time. The ultimate future developed condition of the subdivision consists of a full build out of Lots 1 through 6 with single-family residences, driveways, hardscape, accessory structures, etc. to an assumed percent imperviousness of 5% per for the six lots on a 5-acre area basis. This closely resembles the assumed maximum imperviousness of 7% for 5 acre estate rural lots in the County DCM Appendix L and is to be established via HOA Covenants and the Final Plat. To qualify for the ECM App. I.7.B.5 exclusion for large lots, the total lot imperviousness must be less than 10%, including driveways.

The existing total imperviousness of the site is 2.0%. The imperviousness for the subdivision with the established public roadway (cul-de-sac) and future residences with an assumed 5.0%

maximum development yields an ultimate developed condition imperviousness of 6.5%. This is an increase of 4.5% from existing conditions, a minor/insignificant increase that requires no downstream improvements to the suitable outfall which is the downstream grasslined swale offsite within the eastern property, as will be proven in further sections.

The estate lots are over 2.5 acres in area and meet the large lot exclusion for Water Quality per the County ECM.

Disturbance for the construction of access roadways, both public and private as well as utilities and erosion and sediment control measures totals under one acre. The downstream grasslined swale located east of the site on the adjacent offsite property is a suitable outfall for the stormwater runoff from this development. Shown within the appendix calculations are cross sections within the natural tertiary drainageway with existing and developed stormwater conditions to determine the normal depth within the swale, velocities within the swale, and the Froude numbers for the drainage conditions during the 100-year storm event. The velocities are within the 3-4 fps range and the Froude numbers remain under 1.0 which are considered subcritical conditions. These conditions prove that energy dissipation is not required within this swale. There are no proposed temporary or permanent control measures.

There is no proposed drainage easement on the adjacent downstream property as it has been determined that the proposed subdivision does not result in negative impacts to the downstream tertiary channel that drains to and through the east neighboring parcel's stock pond. There are also no negative impacts to the stock pond as the increase in peak stormwater runoff is considered an insignificant amount.

Because there is less than one acre of disturbance, there is no water quality requirement with the large lot exclusion, and the downstream tertiary drainage swale does not experience critical or supercritical flow conditions due to development of this subdivision, no water quality or full spectrum detention permanent control measures such as an extended detention basin are proposed, nor are any improvements to the downstream offsite grasslined swale.

The construction timeline is anticipated to commence following the Subdivision Plat, Entitlements, and Construction Drawings processes with the County anticipated to be September of 2024. Construction of the roadway is anticipated to take one month with final stabilization occurring in November of 2024. Erosion and sediment control measures for the site are to be established prior to any disturbance or construction activity as required by the County and per the GEC Plan Set and Stormwater Management Report.

a) PROPOSED DRAINAGE CONDITIONS

The final drainage pattern of the ultimate buildout of the small subdivision generally follows the existing conditions by sheet flowing west to east and flowing to the concentrated swale within the central east area of the Site. The proposed public right-of-way extension of a gravel cul-de-sac matches the existing drainage patterns and stormwater overland sheet flows over the cul-de-sac. There are no proposed concentrated flows on the site.

The subdivision meets the large lot exclusion for water quality and therefore runoff reduction is not required. There are no water quality permanent control measures proposed for the site.

There are no stream crossings located within the construction site boundary. The lots are not within a streamside boundary. There are existing no-build conservation easements within and adjacent to the site (Rec. No. 212107364, Deed of Conservation Easement established January 12, 2010). There is no disturbance proposed within these no-build areas. There are no anticipated negative impacts to surrounding or downstream developments or infrastructure as a result of development of this small subdivision.

The downstream outfall location of the site is along the east property boundary where a natural grasslined swale is located per existing topography. The major storm event does not have excessive stormwater velocities that would scour the natural swale and therefore is deemed stabilized and meets the suitable outfall criteria of the El Paso County ECM.

4) Drainage Basins and Sub-Basins

a) Existing Major Drainage Basin and Sub-basins

Basin E1 (1.85 ac. ; Q_5 = 0.58 cfs, Q_{100} = 4.23 cfs) is a sub-basin within the northwest corner of the Site that consists of undeveloped area with native grasses and open meadow/pasture. The drainage pattern of the sub-basin consist of overland sheet flow due northwest directed offsite to **Design Point 1**. There are no significant natural features or storm infrastructure that capture or convey the runoff and the stormwater continues due north offsite.

Basin E2 (30.13 ac. ; Q_5 = 9.37 cfs, Q_{100} = 68.80 cfs) is the large sub-basin that consists of most of the undeveloped Site. The vast majority of the area consist of native grass and open meadow/pasture and the topography has natural grasslined swales that convey stormwater runoff due east toward the Site's outfall point at **Design Point 2**. There is existing fenceline and dirt trail within an existing access easement at the northeast area of the sub-basin. The stormwater runoff is overland sheet flow and is concentrated within the existing natural grass swales that flow along the east property boundary. The outfall point at **Design Point 2** is not a formal channel or drainage way and continues due east to a stock pond on the neighboring parcel.

Basin E3 (3.02 ac. ; Q_5 = 0.94 cfs, Q_{100} = 6.91 cfs) is a sub-basin within the northeast corner of the Site that consists of undeveloped area with native grasses, open meadow/pasture, and a dirt pathway within an existing access easement. The drainage pattern of the sub-basin consist of overland sheet flow due northeast directed offsite to **Design Point 3**. There are no significant natural features or storm infrastructure that capture or convey the runoff and the stormwater continues due east offsite toward East Cherry Creek.

Basin OS1 (27.08 ac. ; Q_5 = 8.42 cfs, Q_{100} = 61.85 cfs) is the upstream offsite basin location southwest of the site and drains to the property boundary at **Design Point 4**. The stormwater runoff from this sub-basin contributes to sub-basin **E2** and **Design Point 2** and ultimately **Design**

Point 5, the downstream tertiary drainage swale on the east adjacent parcel. The area consist of native grasses and open meadow/pasture.

Basin OS2 (22.77 ac. ; Q_5 = 7.17 cfs, Q_{100} = 52.11 cfs) is the downstream offsite basin located to the east and southeast of the site. The basin consists of undeveloped area with native grasses, open meadow/pasture that drains to a wide grasslined swale that conveys stormwater runoff northeast to **Design Point 5**, a tertiary grasslined swale that drains to the stock pond of the adjacent east parcel and ultimately overflows to East Cherry Creek.

Cross-sections A-A and B-B are analyzed along the east side of the property that consists of a tertiary grasslined drainageway within an existing conservation easement. The swale sections are assessed to determine flow conditions and the 100-year storm water surface elevation with a minimum 1.0 foot of freeboard to ensure that the existing conservation easement and proposed drainage easement contains the potentially pooling area.

The total stormwater runoff for the existing conditions of the Site is 10.88 cfs for the minor (5-year) storm event and 79.94 cfs for the major (100-year) storm event.

Offsite stormwater runoff contributions are 15.59 cfs for the minor storm event and 113.96 cfs for the major storm event.

The total stormwater runoff of the site plus offsite contributions to the offsite downstream swale totals 26.48 cfs for the minor storm event and 193.90 cfs for the major storm event.

b) DEVELOPED MAJOR DRAINAGE BASIN AND SUB-BASINS

Basin D1 (1.85 ac. ; Q_5 = 0.58 cfs, Q_{100} = 4.23 cfs) is assumed to have the same land use makeup, drainage patterns and values as the existing conditions. A single-family residence on Lot 1 is anticipated to contribute stormwater runoff to basin E2.

Basin D2 (30.13 ac. ; Q_5 = 13.80 cfs, Q_{100} = 74.06 cfs) is the large sub-basin that consists of the areas of the site to consist of single-family residential estate lots of minimum 5.0 acres each and the public gravel cul-de-sac extension of Mariah Trail. The vast majority of the area consist of native grass and open meadow/pasture and the topography has natural grasslined swales that convey stormwater runoff due east toward the Site's outfall point at **Design Point 2**. There is existing fenceline and dirt trail within an existing access easement at the northeast area of the sub-basin. The existing dirt pathway is to remain and the fenceline is to be removed. The stormwater runoff is overland sheet flow and is concentrated within the existing natural grass swales that flow along the east property boundary. The outfall point at **Design Point 2** is not a formal channel or drainage way and continues due east to a stock pond on the neighboring parcel.

Basin D3 (3.02 ac. ; Q_5 = 0.94 cfs, Q_{100} = 6.91 cfs) is assumed to have the same land use makeup, drainage patterns and values as the existing conditions. There is not to be any residential development or roadway construction within this basin.

Basin OS1 (27.08 ac. ; Q_5 = 8.42 cfs, Q_{100} = 61.85 cfs) is assumed to have the same land use makeup, drainage patterns and values as the existing conditions.

Basin OS2 (22.77 ac. ; Q_5 = 7.17 cfs, Q_{100} = 52.11 cfs) is assumed to have the same land use makeup, drainage patterns and values as the existing conditions.

The total stormwater runoff for the existing conditions from the Site is 10.88 cfs for the minor (5-year) storm event and 79.94 cfs for the major (100-year) storm event. The developed conditions for the Site result in a total of 15.55 cfs for the minor (5-year) storm event and 85.46 cfs for the major (100-year) storm event. This is an increase of 5.52 cfs (4.2% increase) for the 100-year storm event at the downstream exit point of the site, Design Point 2. This is a small/insignificant increase in runoff from existing conditions for such an event that does not result in negative impacts to downstream swales as proven with the channel analysis. Further downstream is Design Point 5, the stock pond inflow point on the adjacent property. The stormwater runoff increase to this design point is 3.0%, also a small/insignificant increase in runoff from existing conditions for this storm event that does not result in negative impacts to the downstream swales as proven with channel analysis, and no negative impact to the existing stock pond.

Offsite stormwater runoff contributions are 15.59 cfs for the minor storm event and 113.96 cfs for the major storm event. There is no change from the existing conditions.

The notable outfall point for the Site is the downstream offsite grasslined swale, assessed at **Design Point 2** and **Design Point 5**. The developed conditions of these cross sections yield no change from the existing subcritical flow conditions and therefore there are no proposed offsite swale improvements. The 100-year stormwater event pooling limits are shown on the Developed Conditions Drainage Map to show that there are no permanent structures or dwelling units nearby.

c) Downstream Storm Infrastructure Evaluation

There are no known drainage reports on file with El Paso County for this property or any nearby subdivisions that account for this property as an offsite basin. It is anticipated that there will be no negative impacts to surrounding and downstream developments and infrastructure. An assessment of the existing natural drainage way on the east side of the Site is included within this report to demonstrate that the outfall of the major subdivision is stable and is an appropriate outfall that does not require detention or structural control measures to attenuate the stormwater runoff or provide additional energy dissipation.

Cross-sections A-A and B-B are analyzed along the east side of the property that consists of a tertiary grasslined drainageway within an existing conservation easement. The swale sections are assessed to determine flow conditions and the 100-year storm water surface elevation with a minimum 1.0 foot of freeboard to ensure that the existing conservation easement and proposed drainage easement contains the potentially pooling area.

Cross-sections C-C and D-D are analyzed for a suitable outfall condition to determine if channel stabilization and/or energy dissipation are required for the developed conditions. Subcritical flow conditions remain and no improvements are proposed.

The stock pond located on the east neighboring parcel acts as stormwater attenuation. There are no proposed alterations or disturbance of the stock pond as it is owned and maintained by the neighboring owner. The pond has a total depth of 6.0' feet and is approximately 690 square feet in footprint. The total volume of the existing stock pond is approximately 1,270 cubic yards or 34,290 cubic feet, or 0.787 ac-ft. This volume includes some natural grasslined swale area that is at the pond rim elevation of 7390.00.

There is an increase in peak stormwater runoff for the 5-year minor storm event from 10.88 cfs to 15.55 cfs and an increase in the 100-year major storm event from 79.97 cfs to 85.46 cfs from existing conditions of the site to the developed conditions of Mariah Trail Filing No. 1. Existing conditions fill the stock pond within 53 minutes during a minor storm event and within approximately 7.2 minutes during a major storm event. The stock pond fill-up times are increased slightly due to the increase in peak stormwater runoff with fill times of 37 minutes during a minor storm event and 6.7 minutes during a major storm event. These attenuation times have no impact to downstream channels and developments and are considered insignificant. The velocity of the stormwater entering the stock pond from existing conditions to development conditions are not altered due to development, therefore it can be concluded that there is no negative impact to the stock pond or downstream areas from the stock pond.

The proposed project or developed land use does not cause downstream damage or adversely impact adjacent properties (ECM Chapter 3.2.8.B). Increases from the historical peak runoff values are allowable if the increase in stormwater runoff can be accommodated downstream, in this case, as a suitable outfall that remains in subcritical flow conditions (ECM Chapter 3.2.4).

V. Four-Step Process

In accordance with the Engineering Criteria Manual I.7.2.A and DCM V2, this stie has implemented the four-step process to minimize adverse impacts of urbanization. The four-step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume, and considering the need for Industrial Commercial BMP's.

Step 1 – Reducing Runoff Volumes – The site has minimal gravel roadway development and all other development in the future is to be of a land use that minimizes stormwater runoff, i.e. use of dirt driveways and limited development per lot as stated in the HOA Covenants. By limiting development on a per lot basis with covenants, the stormwater runoff increase from historic to developed conditions are limited.

Step 2 – Stabilize Drainageways: there are no drainageways for temporary or permanent control measures to be installed for stabilization. This FDR shows that the existing and developed conditions result in subcritical flows for the onsite and offsite downstream drainageways and are considered stable.

Step 3 – Provide WQCV: The subdivision consists of six rural estate lots of a minimum 5.0 acre in lot area. Therefore, the development qualifies for the large lot exemption and runoff reduction is not required.

Step 4 – Consider the need for industrial and commercial BMP's: as this is a rural estate lot subdivision, there are no industrial or commercial uses and such control measures are not required nor proposed.

VI. SUMMARY

The hydrology calculations presented in Appendix E and F quantify stormwater runoff and the existing and developed hydrology maps presented in Appendix G visually present stormwater runoff drainage patterns for the Site and offsite areas. The developed conditions show the subdivided lots and the hydrology calculations and map quantify the developed roadway and each lot's runoff contribution to their respective design points. There is no alteration to the general drainage pattern of the Site and the proposed construction to the Site yields a minor, insignificant increase to the total stormwater runoff from the onsite 35 acres to the downstream tertiary channel. The increase in stormwater runoff results in subcritical flow to the downstream grasslined swale concluding that it is a suitable outfall. It is anticipated that there will be no negative impacts to surrounding and downstream developments and infrastructure due to development.

A. COMPLIANCE WITH STANDARDS

The criteria used to design the storm water runoff volumes are formulas and figures within the El Paso County Engineering Criteria Manual, the El Paso County Drainage Criteria Manual, the City of Colorado Springs Drainage Manuals (DCM) Volumes 1 and 2. Tables 6-6 and Appendix L Table 3-1 of the EPC DCM was used for runoff coefficients for the Rational Method.

Appendix calculations show drainage way section calculations using Bentley's Flowmaster software. No water quality is required as the estate lots qualify for the large lot exclusion. No onsite stormwater detention is required as the major subdivision consists of relatively major imperviousness resulting in a relatively small increase to the stormwater runoff from the Site which is shown to have a stable outfall with capacity for the developed condition.

B. DRAINAGE BASIN AND BRIDGE FEES

The Site is located within the East Cherry Creek drainage basin which does not have a drainage basin fee listed within the 2024 El Paso County Drainage, Bridge, and Pond Fee Schedule. All outstanding County fees are to be paid at the time of platting.

VII. References

El Paso County Engineering Criteria Manual, latest revision October 14, 2020

El Paso County Drainage Criteria Manual, latest revision October 31, 2018

City of Colorado Springs Drainage Manual Volumes I & II (May 2014, Revised January 2021)

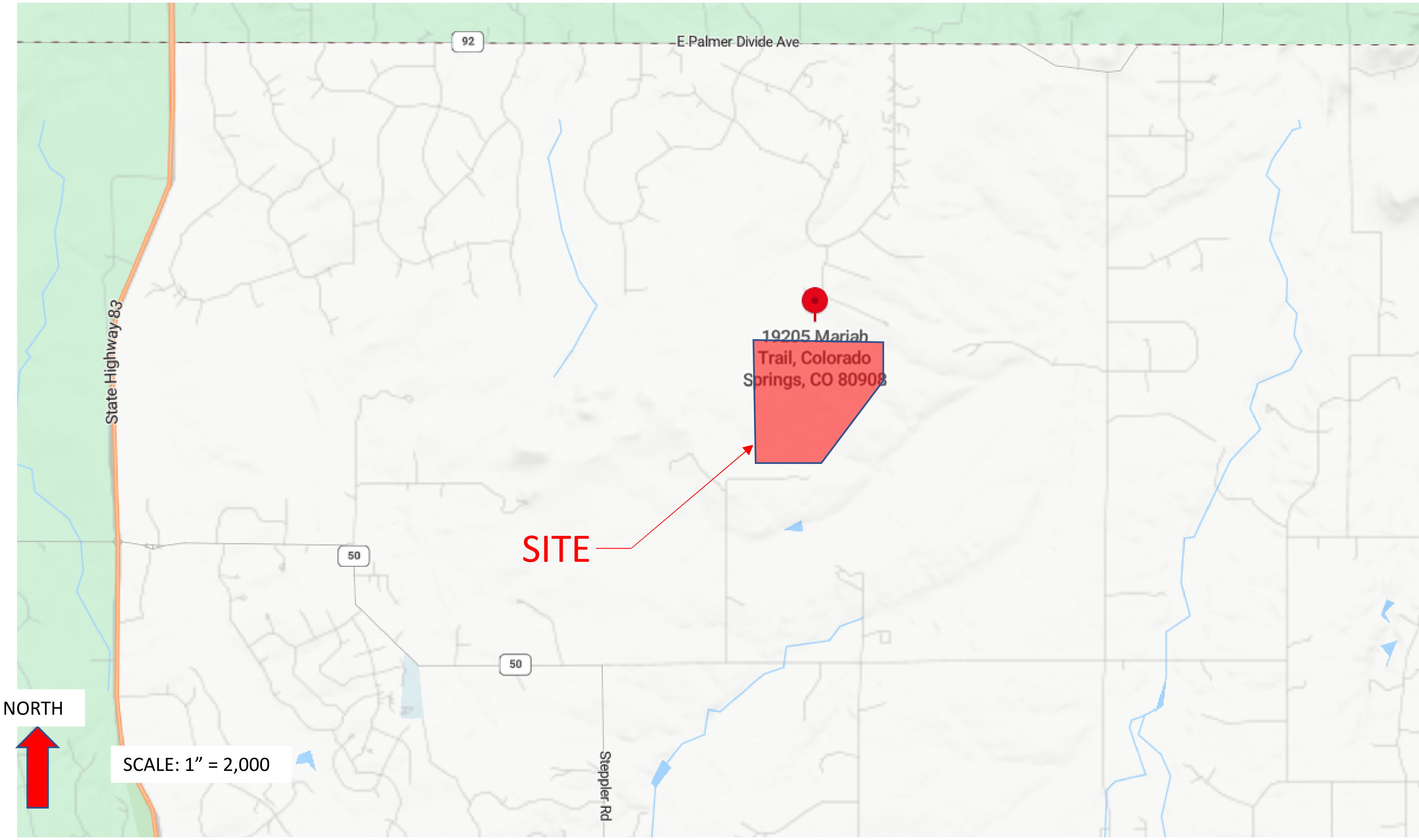
Mile High Flood District Drainage Criteria Manual, Volume I (January 2016)

FEMA Flood Map Service Center

United States Department of Agriculture National Resources Conservation Service

Appendix A: Vicinity Map

VICINITY MAP
MARIAH TRAIL FILING NO. 1
A PORTION OF THE NORTHWEST QUARTER OF SECTION 7, TOWNSHIP 11 SOUTH, RANGE 65 WEST, OF THE SIXTH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO



Appendix B: FEMA Floodplain Map

National Flood Hazard Layer FIRMette

FEMA

104°43'24"W 39°7'8"N

104°42'46"W 39°6'40"N

Feet
0 250 500 1,000 1,500 2,000

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

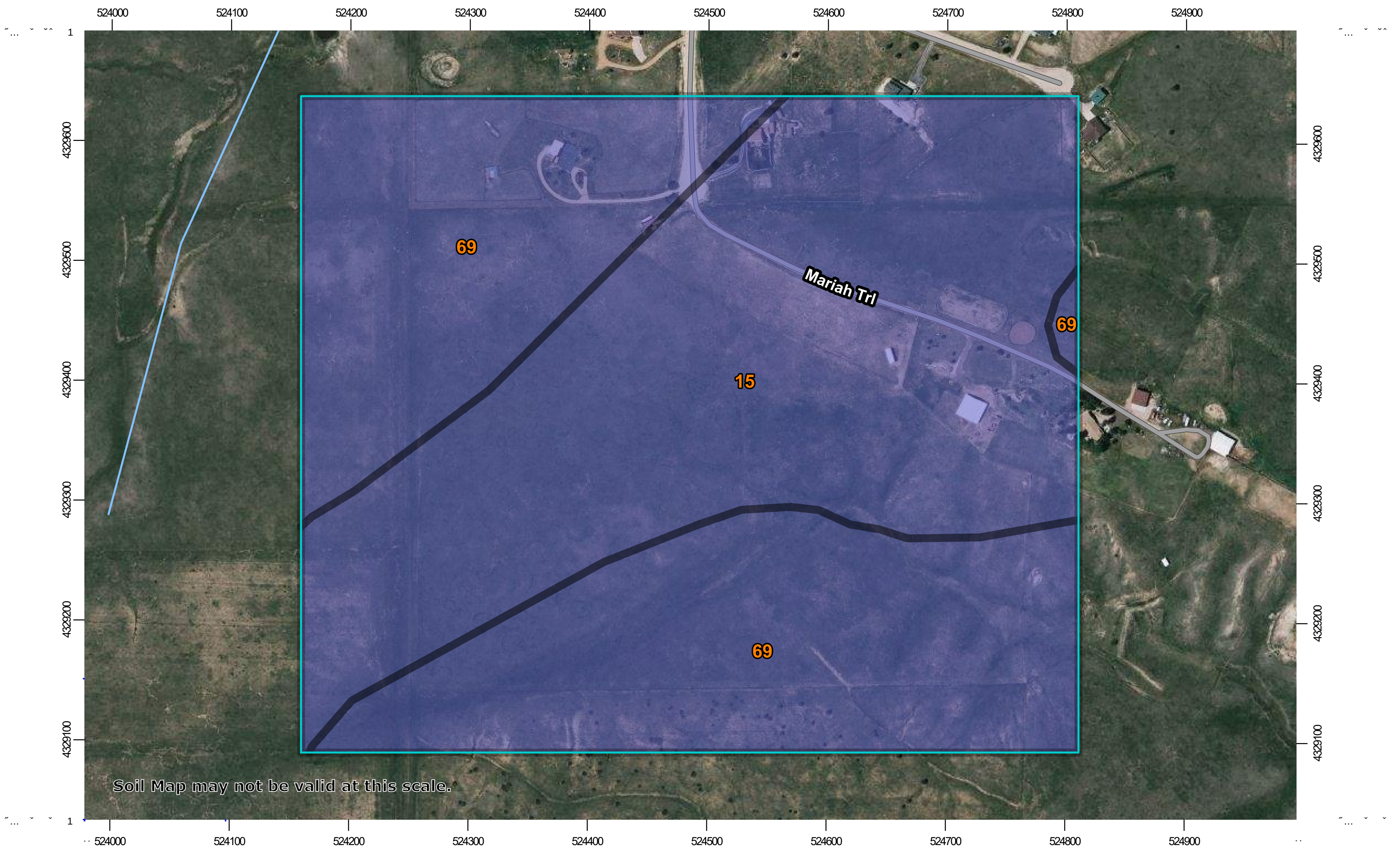
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/5/2023 at 10:49 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix C: NRCS Soils Map



0DS 6FDOH˛ ˛ ˘ LI SULQWHG RQ $ ODQGVFDSH [˙ ˘ VKHHW

1

0 50 100 200 300 0HWHUV

0 200 400 800 1200)HHW

0DS SURMHFWLRQ˛ :HE 0HUFDWRU &RUQHU FRRUGLQDWHV˛ :*6˙ (GJH WLFV˛ 870 =RQH 1 :*6˙

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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
15	Brussett loam, 3 to 5 percent slopes	B	44.8	50.6%
69	Peyton-Pring complex, 8 to 15 percent slopes	B	43.7	49.4%
Totals for Area of Interest			**88.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix D: Hydrology Calculations

Project:	**MARIAH TRAIL FILING NO. 1**
Engineer:	**Carlos Serrano**
Date:	**4/21/2024**
Address:	**19205 Mariah Trail El Paso County, Colorado**

CONDITION: **EXISTING**

Sub-Basin:	**E1**	**(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)**			
t_t Duration:	**11.75**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
3.102718495	3.886846842	4.5348213	5.1827958	5.8307703	6.5254627

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: $C_i * A_i$	5 Yr: $C_i * A_i$	10 Yr: $C_i * A_i$	25 Yr: $C_i * A_i$	50 Yr: $C_i * A_i$	100 Yr: $C_i * A_i$	2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
Roof + Hardscape	-	0.000	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	**0.020**	**0.080**	**0.150**	**0.250**	**0.300**	**0.350**
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70	0.000	0.000	0.000	0.000	0.000	0.000						
Pasture/Meadow	80,586	1.850	0.02	0.08	0.15	0.25	0.30	0.35	0.037	0.148	0.278	0.463	0.555	0.648						
A_t :	80,586	1.850																		

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.11	**0.58**	**1.26**	**2.40**	**3.24**	**4.23**

Sub-Basin:	**E2**	**(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)**			
t_t Duration:	**25.82**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
2.165945954	2.706041118	3.1572146	3.6083882	4.0595617	4.5417091

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: $C_i * A_i$	5 Yr: $C_i * A_i$	10 Yr: $C_i * A_i$	25 Yr: $C_i * A_i$	50 Yr: $C_i * A_i$	100 Yr: $C_i * A_i$	2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
Roof + Hardscape	-	0.000	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	**0.020**	**0.080**	**0.150**	**0.250**	**0.300**	**0.350**
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70	0.000	0.000	0.000	0.000	0.000	0.000						
Pasture/Meadow	1,312,276	30.126	0.02	0.08	0.15	0.25	0.30	0.35	0.603	2.410	4.519	7.531	9.038	10.544						
A_t :	1,312,276	30.126																		

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
1.87	**9.37**	**20.49**	**39.03**	**52.70**	**68.80**

Sub-Basin:	**E3**	**(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)**			
t_t Duration:	**10.97**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
3.184258474	3.989628328	4.654733	5.3198378	5.9849425	6.6981356

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: $C_i * A_i$	5 Yr: $C_i * A_i$	10 Yr: $C_i * A_i$	25 Yr: $C_i * A_i$	50 Yr: $C_i * A_i$	100 Yr: $C_i * A_i$	2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
Roof + Hardscape	-	0.000	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	**0.020**	**0.080**	**0.150**	**0.250**	**0.300**	**0.350**
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70	0.000	0.000	0.000	0.000	0.000	0.000						
Pasture/Meadow	131,738	3.024	0.02	0.08	0.15	0.25	0.30	0.35	0.060	0.242	0.454	0.756	0.907	1.059						
A_t :	131,738	3.024																		

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.19	**0.94**	**2.06**	**3.92**	**5.29**	**6.91**

Sub-Basin:	**OS1**	**(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)**			
t_t Duration:	**53.67**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
1.29546713	1.608798903	1.8770987	2.1453985	2.4136984	2.6983422

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: $C_i * A_i$	5 Yr: $C_i * A_i$	10 Yr: $C_i * A_i$	25 Yr: $C_i * A_i$	50 Yr: $C_i * A_i$	100 Yr: $C_i * A_i$	2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
Roof + Hardscape	-	0.000	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	**0.020**	**0.080**	**0.150**	**0.250**	**0.300**	**0.350**
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70	0.000	0.000	0.000	0.000	0.000	0.000						
Pasture/Meadow	1,179,605	27.080	0.02	0.08	0.15	0.25	0.30	0.35	0.542	2.166	4.062	6.770	8.124	9.478						
A_t :	1,179,605	27.080																		

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
1.68	**8.42**	**18.42**	**35.09**	**47.37**	**61.85**

Sub-Basin:	OS2	(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)			
t_t Duration:	40.05				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
1.643888265	2.047985208	2.3894827	2.7309803	3.0724778	3.4361751

Hydrologic Soil Type:	B

Coefficient (Table 6-6)																					
Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: $C_i * A_i$	5 Yr: $C_i * A_i$	10 Yr: $C_i * A_i$	25 Yr: $C_i * A_i$	50 Yr: $C_i * A_i$	100 Yr: $C_i * A_i$	2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
Roof + Hardscape	1,600	0.037	0.71	0.73	0.75	0.78	0.80	0.81	0.026	0.027	0.028	0.029	0.029	0.030	**0.021**	**0.081**	**0.151**	**0.251**	**0.301**	**0.351**
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70	0.000	0.000	0.000	0.000	0.000	0.000						
Pasture/Meadow	990,261	22.733	0.02	0.08	0.15	0.25	0.30	0.35	0.455	1.819	3.410	5.683	6.820	7.957						
A_t:	991,861	22.770																		

Q Peak Flow (cfs)					
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
1.49	**7.17**	**15.59**	**29.60**	**39.94**	**52.11**

Basin Summary				
Basin Summary	Design Point	Area (ac.)	Q_5	Q_{100}
E1	1	1.85	0.58	4.23
E2	2	30.13	9.37	68.80
E3	3	3.02	0.94	6.91
OS1	4	27.08	8.42	61.85
OS2	5	22.77	7.17	52.11
TOTAL ONSITE		35.00	10.88	79.94
TOTAL OFFSITE		49.85	15.59	113.96
TOTALS		84.85	26.48	193.90

Cumulative Design Point Summary				
Design Point	Basins	Area (ac.)	Q_5	Q_{100}
1	E1	1.85	17.12	125.14
2	E2, DP4	57.21	17.79	130.65
3	E3	3.02	0.94	6.91
4	OS1	27.08	8.42	61.85
5	DP2, OS5	79.98	24.96	182.77
TOTAL ONSITE	E1-E3	35.00	10.88	79.94
TOTAL OFFSITE	OS1, OS2	49.85	15.59	113.96

	Q_5	Q_{100}
SECTION A-A	10.76	79.05
SECTION B-B	13.10	96.25
SECTION C-C	17.79	130.65
SECTION D-D	24.96	182.77

Time of Concentration $\quad t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	E1	
C_5:	**0.08**	[Table 6-6. Runoff Coefficients for Rational Method]
L:	**100**	ft
S:	**0.039**	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \ldots C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	-	0.00	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	80,586	1.85	0.08
At :	80,586	1.85	

$C_c = (0.08*1.85) / 1.85 =$ **0.08**

$t_i = (0.395*(1.1\text{-}C_5)*sqrt(L))/(S\text{^}0.33)$

$t_i = (0.395*(1.1\text{-}0.08)*sqrt(100))/(0.039\text{^}0.33) =$ **11.75** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$

$V = (7)(0.039)^{0.5} =$ **0.01** ft/s

Flow Distance: **0.00** ft

$t_t = L/V =$ 0.00 sec.

0.00 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t =$ **11.75** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **11.75** min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	E2	
C_5:	0.08	[Table 6-6. Runoff Coefficients for Rational Method]
L:	300	ft
S:	0.06	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	-	0.00	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	1,312,276	30.13	0.08
At :	1,312,276	30.13	

*C_c = (0.08*30.13) / 28.42 =* **0.08**

t_i = (0.395(1.1-C_5)*sqrt(L))/(S^0.33)*
t_i = (0.395(1.1-0.08)*sqrt(300))/(0.06^0.33) =* **17.66** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$
$V = (7)(0.06)^{0.5}$ = **1.71** ft/s

Flow Distance: **840.00** ft

t_t = L/V = 489.90 sec.
8.16 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t$ = **25.82** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **25.82** min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	E3	
C_5:	**0.08**	[Table 6-6. Runoff Coefficients for Rational Method]
L:	**100**	ft
S:	**0.048**	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1 A_1 + C_2 A_2 + C_3 A_3 + ...C_i A_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	-	0.00	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	131,738	3.02	0.08
At :	131,738	3.02	

C_c = (0.08*3.02) / 0.83 = **0.08**

t_i = (0.395*(1.1-C_5)*sqrt(L))/(S^0.33)

t_i = (0.395*(1.1-0.08)*sqrt(100))/(0.048^0.33) = **10.97** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$

$V = (7)(0.048)^{0.5}$ = **1.53** ft/s

Flow Distance: **0.00** ft

t_t = L/V = 0.00 sec.

0.00 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t$ = **10.97** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **10.97** min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	OS1	
C_5:	**0.08**	[Table 6-6. Runoff Coefficients for Rational Method]
L:	**300**	ft
S:	**0.016**	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	-	0.00	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	1,179,605	27.08	0.08
At :	1,179,605	27.08	

$C_c = (0.08 * 27.08) / 27.08 =$ **0.08**

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S\text{^}0.33)$

$t_i = (0.395*(1.1-0.08)*sqrt(70))/(0.016\text{^}0.33) =$ **27.31** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$

$V = (7)(0.016)^{0.5} =$ **0.89** ft/s

Flow Distance: **1400.00** ft

$t_t = L/V =$ 1581.14 sec.
26.35 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t$ = **53.67** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **53.67** min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	OS2	
C_5:	0.08	[Table 6-6. Runoff Coefficients for Rational Method]
L:	300	ft
S:	0.03	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	1,600	0.04	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	990,261	22.73	0.08
At :	991,861	22.77	

C_c = [(0.73 * 0.04) + (0.08 * 22.73)] / 22.77 = **0.08**

t_i = (0.395*(1.1-C_5)*sqrt(L))/(S^0.33)
t_i = (0.395*(1.1-0.08)*sqrt(300))/(0.03^0.33) = **22.17** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$
$V = (7)(0.03)^{0.5}$ = **1.21** ft/s

Flow Distance: **1300.00** ft

t_t = L/V = 1072.22 sec.
17.87 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t$ = **40.05** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **40.05** min.

Project: MARIAH TRAIL FILING NO. 1
Engineer: Carlos Serrano
Date: 6/21/2024
Address: 19205 Mariah Trail El Paso County, Colorado

CONDITION: **DEVELOPED**

Sub-Basin:	**D1**	(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)			
t_t Duration:	**11.75**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
3.102718495	3.886846842	4.5348213	5.1827958	5.8307703	6.5254627

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: C_i * A_i	5 Yr: C_i * A_i	10 Yr: C_i * A_i	25 Yr: C_i * A_i	50 Yr: C_i * A_i	100 Yr: C_i * A_i
Roof + Hardscape	-	0.000	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70	0.000	0.000	0.000	0.000	0.000	0.000
Pasture/Meadow	80,586	1.850	0.02	0.08	0.15	0.25	0.30	0.35	0.037	0.148	0.278	0.463	0.555	0.648
A_t :	80,586	1.850												

2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
0.020	**0.080**	**0.150**	**0.250**	**0.300**	**0.350**

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.11	**0.58**	**1.26**	**2.40**	**3.24**	**4.23**

Sub-Basin:	**D2**	(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)			
t_t Duration:	**19.91**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
2.475703181	3.096491404	3.61274	4.1289885	4.6452371	5.1976656

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: C_i * A_i	5 Yr: C_i * A_i	10 Yr: C_i * A_i	25 Yr: C_i * A_i	50 Yr: C_i * A_i	100 Yr: C_i * A_i
Roof + Hardscape	69,565	1.597	0.71	0.73	0.75	0.78	0.80	0.81	1.134	1.166	1.198	1.246	1.278	1.294
Gravel Roadway	13,995	0.321	0.57	0.59	0.63	0.66	0.68	0.70	0.183	0.190	0.202	0.212	0.218	0.225
Pasture/Meadow	1,228,716	28.207	0.02	0.08	0.15	0.25	0.30	0.35	0.564	2.257	4.231	7.052	8.462	9.873
A_t :	1,312,276	30.126												

2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
0.062	**0.120**	**0.187**	**0.282**	**0.331**	**0.378**

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
5.84	**14.04**	**25.54**	**44.10**	**58.06**	**74.33**

Sub-Basin:	**D3**	(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)			
t_t Duration:	**10.97**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
3.184258474	3.989628328	4.654733	5.3198378	5.9849425	6.6981356

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: C_i * A_i	5 Yr: C_i * A_i	10 Yr: C_i * A_i	25 Yr: C_i * A_i	50 Yr: C_i * A_i	100 Yr: C_i * A_i
Roof + Hardscape	-	0.000	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70	0.000	0.000	0.000	0.000	0.000	0.000
Pasture/Meadow	131,738	3.024	0.02	0.08	0.15	0.25	0.30	0.35	0.060	0.242	0.454	0.756	0.907	1.059
A_t :	131,738	3.024												

2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
0.020	**0.080**	**0.150**	**0.250**	**0.300**	**0.350**

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.19	**0.94**	**2.06**	**3.92**	**5.29**	**6.91**

Sub-Basin:	**OS1**	(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)			
t_t Duration:	**53.67**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
1.29546713	1.608798903	1.8770987	2.1453985	2.4136984	2.6983422

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$	2 Yr: C_i * A_i	5 Yr: C_i * A_i	10 Yr: C_i * A_i	25 Yr: C_i * A_i	50 Yr: C_i * A_i	100 Yr: C_i * A_i
Roof + Hardscape	-	0.000	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70	0.000	0.000	0.000	0.000	0.000	0.000
Pasture/Meadow	1,179,605	27.080	0.02	0.08	0.15	0.25	0.30	0.35	0.542	2.166	4.062	6.770	8.124	9.478
A_t :	1,179,605	27.080												

2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
0.020	**0.080**	**0.150**	**0.250**	**0.300**	**0.350**

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
1.68	**8.42**	**18.42**	**35.09**	**47.37**	**61.85**

Sub-Basin:	**OS2**	**(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)**			
t_t Duration:	**40.05**				
I_2	I_5	I_{10}	I_{25}	I_{50}	I_{100}
1.643888265	2.047985208	2.3894827	2.7309803	3.0724778	3.4361751

Hydrologic Soil Type:	**B**

Coefficient (Table 6-6)

Land Use or Surface Characteristic	Square Feet	Acreage	Coefficient $_2$	Coefficient $_5$	Coefficient $_{10}$	Coefficient $_{25}$	Coefficient $_{50}$	Coefficient $_{100}$
Roof + Hardscape	1,600	0.037	0.71	0.73	0.75	0.78	0.80	0.81
Gravel Roadway	-	0.000	0.57	0.59	0.63	0.66	0.68	0.70
Pasture/Meadow	990,261	22.733	0.02	0.08	0.15	0.25	0.30	0.35
A_t :	991,861	22.770						

Land Use or Surface Characteristic	2 Yr: $C_i * A_i$	5 Yr: $C_i * A_i$	10 Yr: $C_i * A_i$	25 Yr: $C_i * A_i$	50 Yr: $C_i * A_i$	100 Yr: $C_i * A_i$	2 Yr C_c	5 Yr C_c	10 Yr C_c	25 Yr C_c	50 Yr C_c	100 Yr C_c
Roof + Hardscape	0.026	0.027	0.028	0.029	0.029	0.030	**0.021**	**0.081**	**0.151**	**0.251**	**0.301**	**0.351**
Gravel Roadway	0.000	0.000	0.000	0.000	0.000	0.000						
Pasture/Meadow	0.455	1.819	3.410	5.683	6.820	7.957						

Q Peak Flow (cfs)

2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
1.49	**7.17**	**15.59**	**29.60**	**39.94**	**52.11**

Basin Summary

Basin Summary	Design Point	Area (ac.)	Q_5	Q_{100}
D1	1	1.85	0.58	4.23
D2	2	30.13	14.04	74.33
D3	3	3.02	0.94	6.91
OS1	4	27.08	8.42	61.85
OS2	5	22.77	7.17	52.11
TOTAL ONSITE		35.00	15.55	85.46
TOTAL OFFSITE		49.85	15.59	113.96
TOTALS		84.85	31.15	199.43

Cumulative Design Point Summary

Design Point	Basins	Area (ac.)	Q_5	Q_{100}		
1	D1	1.85	0.58	4.23		
2	D2, DP4	57.21	22.46	136.18	% INCREASE FROM EX. @ DP2:	4.2%
3	D3	3.02	0.94	6.91		
4	OS1	27.08	8.42	61.85		
5	DP2, OS5	79.98	29.63	188.30	% INCREASE FROM EX. @ DP5:	3.0%
TOTAL ONSITE	D1-D3	35.00	15.55	85.46		
TOTAL OFFSITE	OS1, OS2	49.85	15.59	113.96		

	Q_5	Q_{100}
SECTION A-A	11.93	80.43
SECTION B-B	15.44	99.01
SECTION C-C	22.46	136.18
SECTION D-D	29.63	188.30

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft <u>maximum</u> for non-urban land uses, 100 ft <u>maximum</u> for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	D1	
C_5:	**0.08**	[Table 6-6. Runoff Coefficients for Rational Method]
L:	**100**	ft
S:	**0.039**	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	-	0.00	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	80,586	1.85	0.08
At :	80,586	1.85	

$C_c = (0.08*1.85) / 1.85 =$ **0.08**

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S\text{^}0.33)$
$t_i = (0.395*(1.1-0.08)*sqrt(100))/(0.039\text{^}0.33) =$ **11.75** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$
$V = (7)(0.039)^{0.5} =$ **0.01** ft/s

Flow Distance: **0.00** ft

$t_t = L/V =$ 0.00 sec.
0.00 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t$ = **11.75** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **11.75** min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	D2	
C_5:	0.12	[Table 6-6. Runoff Coefficients for Rational Method]
L:	100	ft
S:	0.06	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	69,565	1.60	0.73
Gravel Roadway	13,995	0.32	0.59
Pasture/Meadow	1,228,716	28.21	0.08
At :	1,312,276	30.13	

C_c = [(0.73*1.60) + (0.59*0.32) + (0.08*28.21) / 30.13 = **0.12**

t_i = (0.395*(1.1-C_5)*sqrt(L))/(S^0.33)

t_i = (0.395*(1.1-0.12)*sqrt(100))/(0.06^0.33) = **9.80** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$

$V = (7)(0.06)^{0.5}$ = **1.71** ft/s

Flow Distance: **1040.00** ft

t_t = L/V = 606.54 sec.

10.11 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t$ = **19.91** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **19.91** min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	D3	
C_5:	0.08	[Table 6-6. Runoff Coefficients for Rational Method]
L:	100	ft
S:	0.048	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	-	0.00	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	131,738	3.02	0.08
At :	131,738	3.02	

$C_c = (0.08*3.02) / 0.83 =$ **0.08**

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S\text{^}0.33)$

$t_i = (0.395*(1.1-0.08)*sqrt(100))/(0.048\text{^}0.33) =$ **10.97** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$

$V = (7)(0.048)^{0.5} =$ **1.53** ft/s

Flow Distance: **0.00** ft

$t_t = L/V =$ 0.00 sec.
0.00 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t =$ **10.97** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **10.97** min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	OS1	
C_5:	0.08	[Table 6-6. Runoff Coefficients for Rational Method]
L:	300	ft
S:	0.016	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1 A_1 + C_2 A_2 + C_3 A_3 + ...C_i A_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	-	0.00	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	1,179,605	27.08	0.08
At :	1,179,605	27.08	

C_c = (0.08 * 27.08) / 27.08 = **0.08**

t_i = (0.395*(1.1-C_5)*sqrt(L))/(S^0.33)
t_i = (0.395*(1.1-0.08)*sqrt(70))/(0.016^0.33) = **27.31** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$
$V = (7)(0.016)^{0.5}$ = **0.89** ft/s

Flow Distance: **1400.00** ft

t_t = L/V = 1581.14 sec.
26.35 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t$ = **53.67** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **53.67** min.

Time of Concentration $t_c = t_i + t_t$

3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin or DP:	OS2	
C_5:	**0.08**	[Table 6-6. Runoff Coefficients for Rational Method]
L:	**300**	ft
S:	**0.03**	ft/ft

Composite Runoff Coefficient Calculation:

$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + ...C_iA_i) / A_t$

Land Use or Surface Characteristic	Square Feet	Acreage	C_5
Roof + Hardscape	1,600	0.04	0.73
Gravel Roadway	-	0.00	0.59
Pasture/Meadow	990,261	22.73	0.08
At :	991,861	22.77	

$C_c = [(0.73 * 0.04) + (0.08 * 22.73)] / 22.77 =$ **0.08**

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S\text{^}0.33)$

$t_i = (0.395*(1.1-0.08)*sqrt(300))/(0.03\text{^}0.33) =$ **22.17** mins

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$

$V = (7)(0.03)^{0.5} =$ **1.21** ft/s

Flow Distance: **1300.00** ft

$t_t = L/V =$ 1072.22 sec.
17.87 min.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$t_c = t_i + t_t$ = **40.05** min.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Final t_c: **40.05** min.

Appendix E: Hydraulic Calculations

Worksheet for EX Section A-A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.039 ft/ft
Discharge	80.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,452.44
1+09	7,442.27
1+51	7,435.49
1+81	7,435.01
2+05	7,435.66
2+77	7,443.63

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,452.44)	(2+77, 7,443.63)	0.045

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	8.3 in
Roughness Coefficient	0.045
Elevation	7,435.70 ft
Elevation Range	7,435.0 to 7,452.4 ft
Flow Area	22.5 ft²
Wetted Perimeter	55.8 ft
Hydraulic Radius	4.8 in
Top Width	55.73 ft
Normal Depth	8.3 in
Critical Depth	8.2 in
Critical Slope	0.040 ft/ft
Velocity	3.56 ft/s
Velocity Head	0.20 ft
Specific Energy	0.89 ft
Froude Number	0.988

Worksheet for EX Section A-A

Results	
Flow Type	Subcritical

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	8.3 in
Critical Depth	8.2 in
Channel Slope	0.039 ft/ft
Critical Slope	0.040 ft/ft

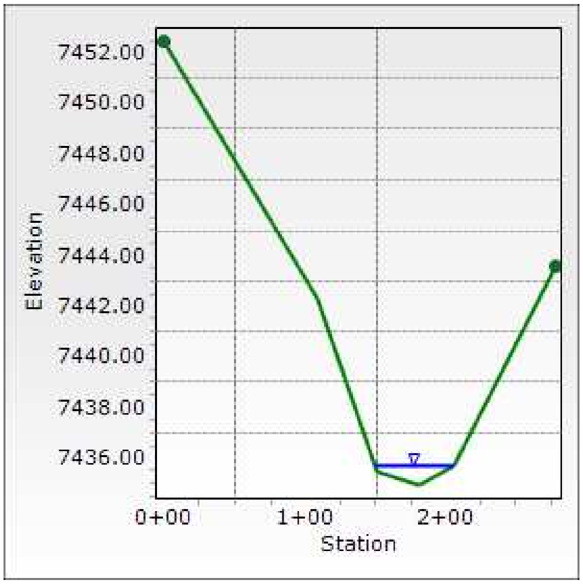
Cross Section for EX Section A-A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.039 ft/ft
Normal Depth	8.3 in
Discharge	80.00 cfs



Worksheet for EX Section B-B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.019 ft/ft
Discharge	97.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,431.70
0+25	7,429.83
1+10	7,419.31
1+17	7,419.06
1+38	7,417.10
1+60	7,418.05
2+18	7,424.45
2+77	7,430.27

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,431.70)	(2+77, 7,430.27)	0.045

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	15.3 in
Roughness Coefficient	0.045
Elevation	7,418.38 ft
Elevation Range	7,417.1 to 7,431.7 ft
Flow Area	27.2 ft²
Wetted Perimeter	39.1 ft
Hydraulic Radius	8.3 in
Top Width	38.99 ft
Normal Depth	15.3 in
Critical Depth	13.7 in
Critical Slope	0.035 ft/ft
Velocity	3.57 ft/s
Velocity Head	0.20 ft

Worksheet for EX Section B-B

Results

Specific Energy	1.48 ft
Froude Number	0.755
Flow Type	Subcritical

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	15.3 in
Critical Depth	13.7 in
Channel Slope	0.019 ft/ft
Critical Slope	0.035 ft/ft

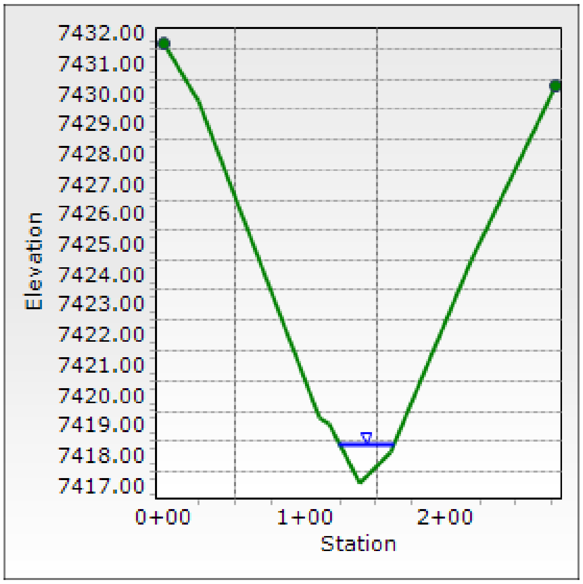
Cross Section for EX Section B-B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.019 ft/ft
Normal Depth	15.3 in
Discharge	97.00 cfs



Worksheet for EX Section C-C

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.020 ft/ft
Discharge	131.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,420.33
0+31	7,417.70
1+20	7,406.80
1+54	7,405.07
1+70	7,403.98
2+00	7,404.74
2+77	7,414.44

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,420.33)	(2+77, 7,414.44)	0.045

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	14.3 in
Roughness Coefficient	0.045
Elevation	7,405.18 ft
Elevation Range	7,404.0 to 7,420.3 ft
Flow Area	35.8 ft²
Wetted Perimeter	51.8 ft
Hydraulic Radius	8.3 in
Top Width	51.71 ft
Normal Depth	14.3 in
Critical Depth	12.8 in
Critical Slope	0.035 ft/ft
Velocity	3.65 ft/s
Velocity Head	0.21 ft
Specific Energy	1.40 ft

Worksheet for EX Section C-C

Results	
Froude Number	0.774
Flow Type	Subcritical

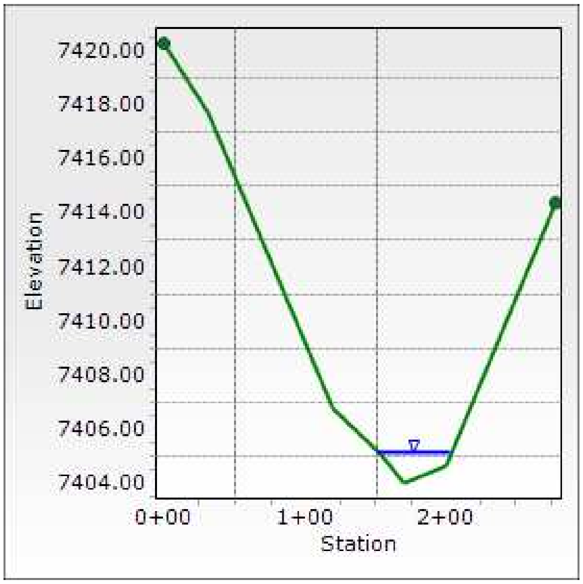
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

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	14.3 in
Critical Depth	12.8 in
Channel Slope	0.020 ft/ft
Critical Slope	0.035 ft/ft

Cross Section for EX Section C-C

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	14.3 in
Discharge	131.00 cfs



Worksheet for EX Section D-D

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.020 ft/ft
Discharge	183.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,404.00
0+22	7,401.76
0+46	7,398.00
0+72	7,394.00
1+24	7,393.85
1+79	7,394.00
2+06	7,398.33
2+24	7,400.00
2+43	7,404.00
2+77	7,404.14

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,404.00)	(2+77, 7,404.14)	0.045

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	7.5 in
Roughness Coefficient	0.045
Elevation	7,394.47 ft
Elevation Range	7,393.9 to 7,404.1 ft
Flow Area	59.9 ft²
Wetted Perimeter	113.1 ft
Hydraulic Radius	6.4 in
Top Width	113.00 ft
Normal Depth	7.5 in
Critical Depth	6.3 in
Critical Slope	0.039 ft/ft

Worksheet for EX Section D-D

Results

Velocity	3.06 ft/s
Velocity Head	0.15 ft
Specific Energy	0.77 ft
Froude Number	0.740
Flow Type	Subcritical

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	7.5 in
Critical Depth	6.3 in
Channel Slope	0.020 ft/ft
Critical Slope	0.039 ft/ft

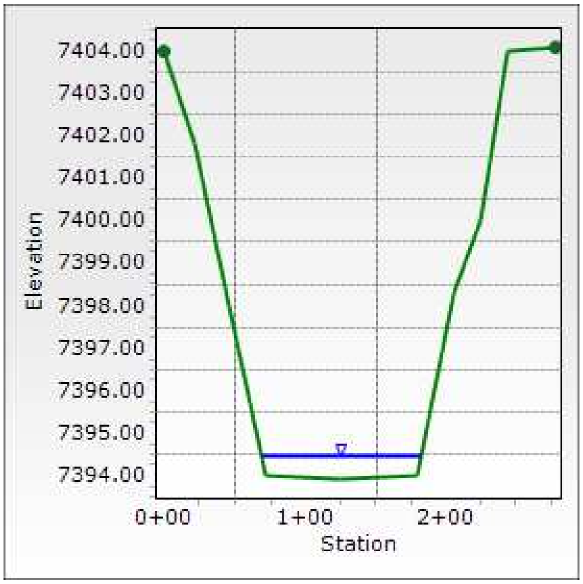
Cross Section for EX Section D-D

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.020 ft/ft
Normal Depth	7.5 in
Discharge	183.00 cfs



Worksheet for PR Section A-A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.039 ft/ft
Discharge	81.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,452.44
1+09	7,442.27
1+51	7,435.49
1+81	7,435.01
2+05	7,435.66
2+77	7,443.63

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,452.44)	(2+77, 7,443.63)	0.045

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	8.3 in
Roughness Coefficient	0.045
Elevation	7,435.70 ft
Elevation Range	7,435.0 to 7,452.4 ft
Flow Area	22.7 ft²
Wetted Perimeter	55.8 ft
Hydraulic Radius	4.9 in
Top Width	55.78 ft
Normal Depth	8.3 in
Critical Depth	8.3 in
Critical Slope	0.040 ft/ft
Velocity	3.57 ft/s
Velocity Head	0.20 ft
Specific Energy	0.89 ft
Froude Number	0.989

Worksheet for PR Section A-A

Results	
Flow Type	Subcritical

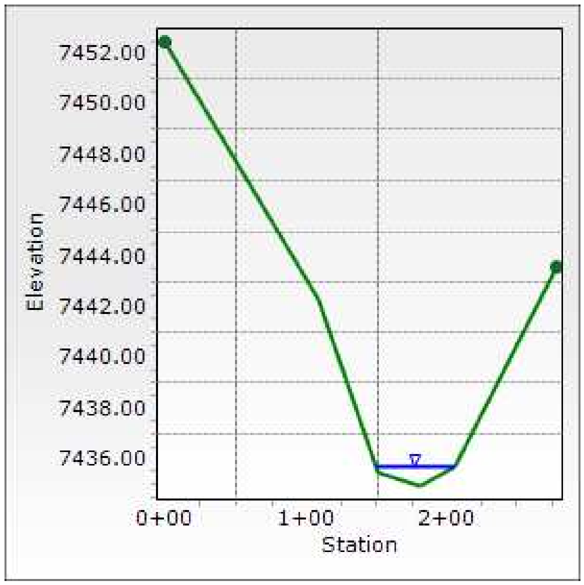
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

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	8.3 in
Critical Depth	8.3 in
Channel Slope	0.039 ft/ft
Critical Slope	0.040 ft/ft

Cross Section for PR Section A-A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.039 ft/ft
Normal Depth	8.3 in
Discharge	81.00 cfs



Worksheet for PR Section B-B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.019 ft/ft
Discharge	100.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,431.70
0+25	7,429.83
1+10	7,419.31
1+17	7,419.06
1+38	7,417.10
1+60	7,418.05
2+18	7,424.45
2+77	7,430.27

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,431.70)	(2+77, 7,430.27)	0.045

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	15.5 in
Roughness Coefficient	0.045
Elevation	7,418.39 ft
Elevation Range	7,417.1 to 7,431.7 ft
Flow Area	27.7 ft²
Wetted Perimeter	39.4 ft
Hydraulic Radius	8.5 in
Top Width	39.28 ft
Normal Depth	15.5 in
Critical Depth	13.9 in
Critical Slope	0.035 ft/ft
Velocity	3.60 ft/s
Velocity Head	0.20 ft

Worksheet for PR Section B-B

Results	
Specific Energy	1.50 ft
Froude Number	0.756
Flow Type	Subcritical

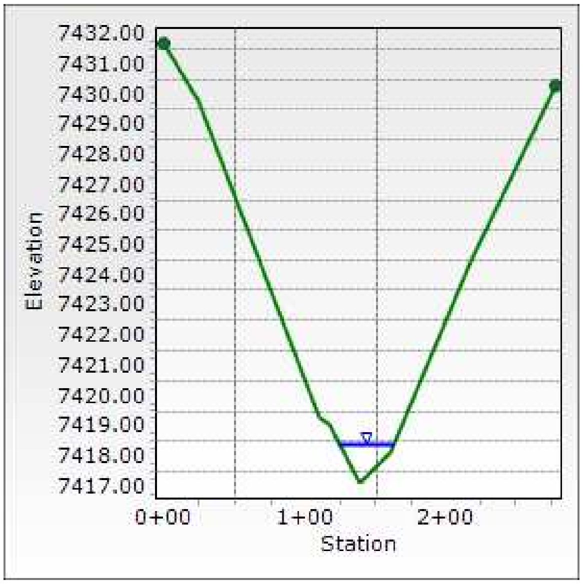
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

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	15.5 in
Critical Depth	13.9 in
Channel Slope	0.019 ft/ft
Critical Slope	0.035 ft/ft

Cross Section for PR Section B-B

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.019 ft/ft
Normal Depth	15.5 in
Discharge	100.00 cfs



Worksheet for PR Section C-C

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.020 ft/ft
Discharge	136.20 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,420.33
0+31	7,417.70
1+20	7,406.80
1+54	7,405.07
1+70	7,403.98
2+00	7,404.74
2+77	7,414.44

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,420.33)	(2+77, 7,414.44)	0.045

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	14.6 in
Roughness Coefficient	0.045
Elevation	7,405.19 ft
Elevation Range	7,404.0 to 7,420.3 ft
Flow Area	36.8 ft²
Wetted Perimeter	52.3 ft
Hydraulic Radius	8.5 in
Top Width	52.24 ft
Normal Depth	14.6 in
Critical Depth	13.1 in
Critical Slope	0.035 ft/ft
Velocity	3.70 ft/s
Velocity Head	0.21 ft
Specific Energy	1.43 ft

Worksheet for PR Section C-C

Results	
Froude Number	0.776
Flow Type	Subcritical

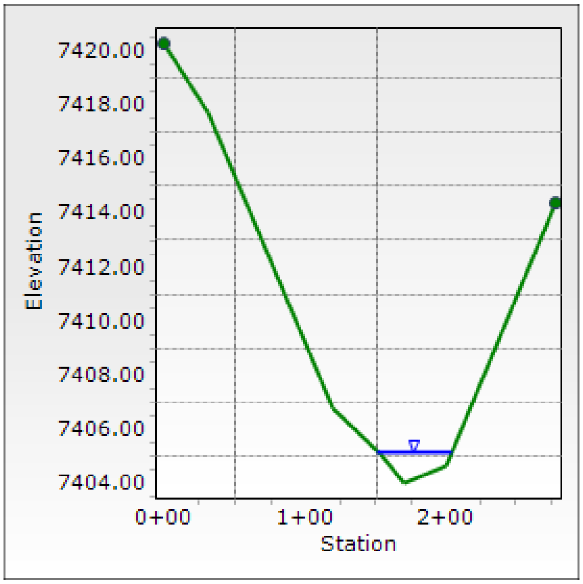
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

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	14.6 in
Critical Depth	13.1 in
Channel Slope	0.020 ft/ft
Critical Slope	0.035 ft/ft

Cross Section for PR Section C-C

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	14.6 in
Discharge	136.20 cfs



Worksheet for PR Section D-D

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.020 ft/ft
Discharge	190.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,404.00
0+22	7,401.76
0+46	7,398.00
0+72	7,394.00
1+24	7,393.85
1+79	7,394.00
2+06	7,398.33
2+24	7,400.00
2+43	7,404.00
2+77	7,404.14

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,404.00)	(2+77, 7,404.14)	0.045

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	7.6 in
Roughness Coefficient	0.045
Elevation	7,394.48 ft
Elevation Range	7,393.9 to 7,404.1 ft
Flow Area	61.3 ft²
Wetted Perimeter	113.2 ft
Hydraulic Radius	6.5 in
Top Width	113.15 ft
Normal Depth	7.6 in
Critical Depth	6.4 in
Critical Slope	0.039 ft/ft

Worksheet for PR Section D-D

Results	
Velocity	3.10 ft/s
Velocity Head	0.15 ft
Specific Energy	0.78 ft
Froude Number	0.743
Flow Type	Subcritical

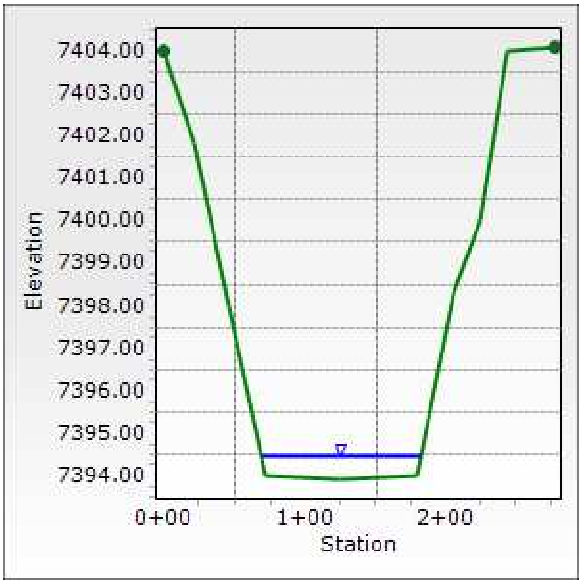
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

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	7.6 in
Critical Depth	6.4 in
Channel Slope	0.020 ft/ft
Critical Slope	0.039 ft/ft

Cross Section for PR Section D-D

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	7.6 in
Discharge	190.00 cfs



Appendix F : Drainage Maps

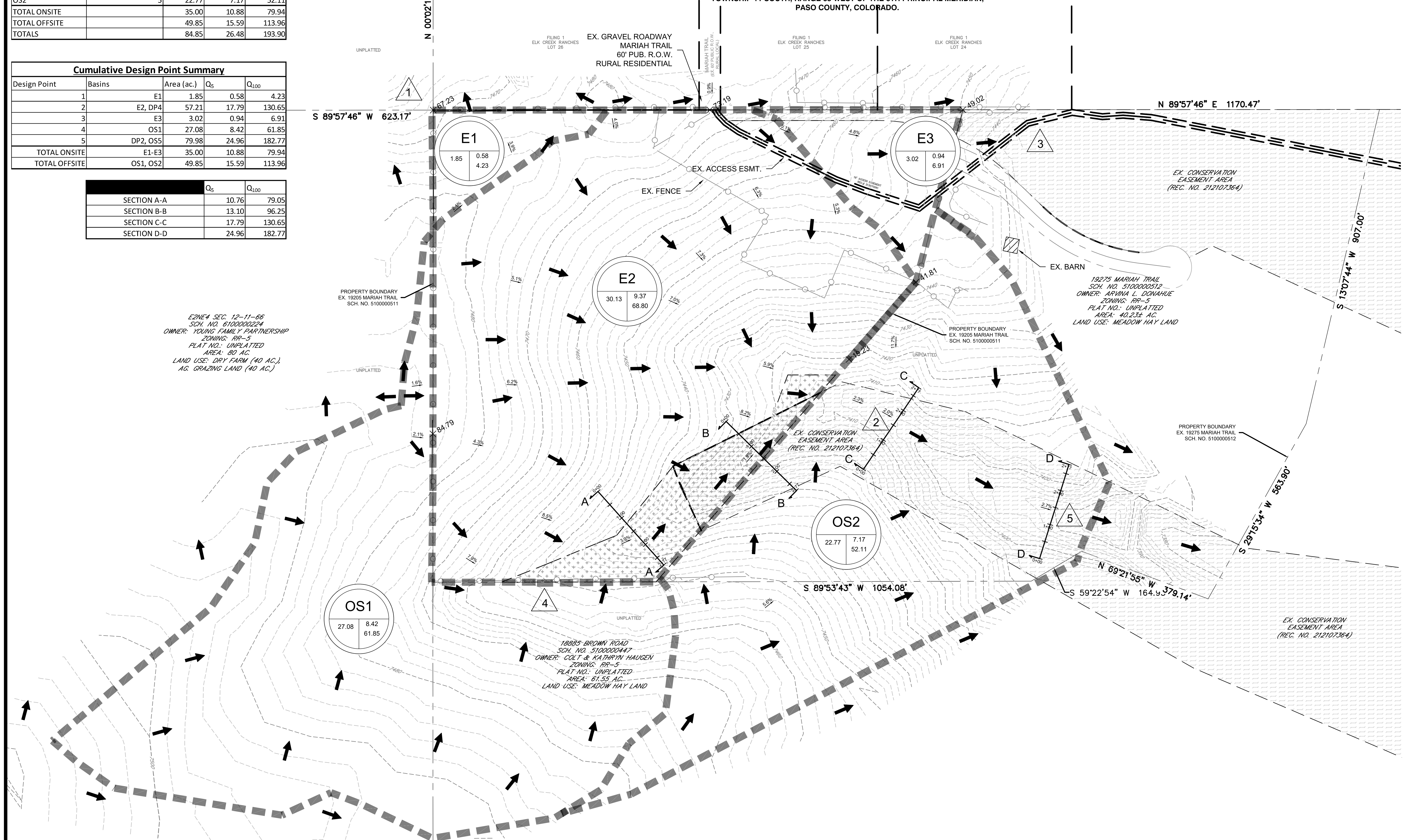
MAJOR SUBDIVISION FINAL DRAINAGE REPORT
EXISTING CONDITIONS HYDROLOGY MAP
MARIAH TRAIL FILING NO. 1

A PORTION OF THE NORTHWEST QUARTER OF SECTION 7,
TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH PRINCIPAL MERIDIAN,
PASO COUNTY, COLORADO.

Basin Summary				
Basin Summary	Design Point	Area (ac.)	Q_5	Q_{100}
E1	1	1.85	0.58	4.23
E2	2	30.13	9.37	68.80
E3	3	3.02	0.94	6.91
OS1	4	27.08	8.42	61.85
OS2	5	22.77	7.17	52.11
TOTAL ONSITE		35.00	10.88	79.94
TOTAL OFFSITE		49.85	15.59	113.96
TOTALS		84.85	26.48	193.90

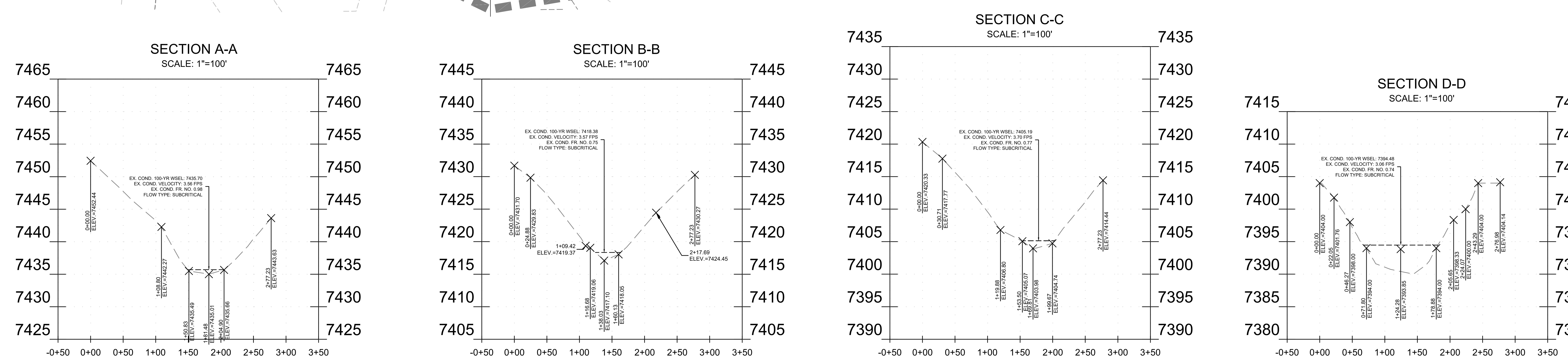
Cumulative Design Point Summary				
Design Point	Basins	Area (ac.)	Q_5	Q_{100}
1	E1	1.85	0.58	4.23
2	E2, DP4	57.21	17.79	130.65
3	E3	3.02	0.94	6.91
4	OS1	27.08	8.42	61.85
5	DP2, OS5	79.98	24.96	182.77
TOTAL ONSITE	E1-E3	35.00	10.88	79.94
TOTAL OFFSITE	OS1, OS2	49.85	15.59	113.96

	Q_5	Q_{100}
SECTION A-A	10.76	79.05
SECTION B-B	13.10	96.25
SECTION C-C	17.79	130.65
SECTION D-D	24.96	182.77



LEGEND

PROPERTY BOUNDARY	
EXITING LOT LINE	
PROPOSED LOT LINE	
RIGHT-OF-WAY LINE	
EXISTING CONTOURS	
BASIN ID	BASIN AREA 5_YR 100_YR
DESIGN POINT ID	
BASIN BOUNDARY	
DRAINAGE FLOW ARROW	
EXISTING BUILDING	
PROPOSED BUILDING	
EXISTING GRAVEL	
PROPOSED GRAVEL	



EXISTING LEGAL DESCRIPTION:
UNPLATTED

A TR OF LAND BEING IN A PORTION OF LOT 1 SEC 7-11-65...

REPLATTED LEGAL DESCRIPTION:
LOTS 1-6 KIRK RANCH FILING NO. 1

PARCEL SCHEDULE NO.:
5100000511

PROJECT DESCRIPTION:
SMALL SUBDIVISION OF 6 LOTS FROM EX. 35-ACRE RR-5 ZONED PARCEL WITH DRAINAGE TRACTS A AND B, 60' R.O.W. DEDICATION

FLOODPLAIN STATEMENT:
THE SUBJECT PROPERTY IS NOT LOCATED IN A DESIGNATED FLOODPLAIN AS SHOWN ON THE FEMA FLOOD INSURANCE RATE MAP 08041C0305G, EFFECTIVE DATE DECEMBER 7, 2018.

CONSTRUCTION ACTIVITIES:

THE SCOPE OF WORK INVOLVES DISTURBANCE AND CONSTRUCTION ACTIVITY FOR THE MINOR EXTENSION OF COUNTY RIGHT-OF-WAY OF MARIAH TRAIL WITH A ROADWAY TERMINATION POINT AT A CUL-DE-SAC.

ULTIMATE BUILDOUT OF THE SMALL SUBDIVISION IS FOR SIX (LOTS 1-6) SINGLE-FAMILY RESIDENTS AT A DESIGNATED MAXIMUM ALLOWABLE COVERAGE BY RESPECTIVE LOT DEVELOPMENTS AT 5%.

AREA TO BE CLEARED, EXCAVATED, OR GRADED:
FOR ROADWAY: 0.27 ACRES
TOTAL DISTURBED AREA INCLUDING EROSION AND SEDIMENT CONTROL MEASURES YIELDS: 0.70 ACRES

-THIS MAP SHOWS EXISTING CONDITIONS, NO DISTURBANCE HAS TAKEN PLACE-

RECEIVING WATERS: EAST CHERRY CREEK, LOCATED APPROXIMATELY 1.5 MILES EAST OF THE PROPERTY OF INTEREST

SOIL TYPE: BRUSSETT LOAM AND PEYTON-PRINT COMPLEX - HYDROLOGIC SOIL GROUP B

NOTE:

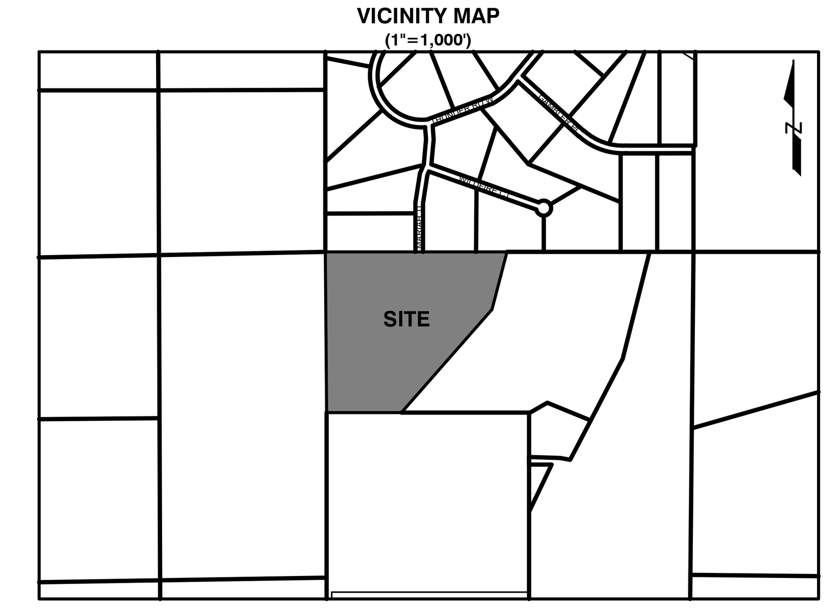
THE PROPERTY INFORMATION AND LINEWORK SHOWN IS CONSIDERED APPROXIMATE AND BASED ON THE PRELIMINARY AND FINAL PLAT DOCUMENTS PREPARED BY MARR LAND SURVEYING DATED OCTOBER OF 2022.

THERE IS NO PUBLIC OR PRIVATE STORMWATER INFRASTRUCTURE WITHIN THE VICINITY OF THE PROPERTY OF INTEREST TO DISPLAY ON THIS HYDROLOGY MAP.

THE PROPERTY OF INTEREST IS NOT WITHIN A STREAMSIDE ZONE, PRESERVATION AREA, OR NO-BUILD AREA.

THE PROPERTY OF INTEREST IS NOT WITHIN A FEMA FLOODPLAIN.

VICINITY MAP
(1"=1,000')



PCD FIL. NO.: SF-2315

ELX
Phone: 719.308.9146
www.elxsoco.com
Hablamos Español

COPYRIGHT
© 2024 ENGINEERING LOCAL XPERTS, LLC:
ALL RIGHTS RESERVED. THE INFORMATION DEPICTED ON THIS SHEET IS THE SOLE PROPERTY OF ENGINEERING LOCAL XPERTS, LLC AND NO PART OF THIS INFORMATION MAY BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN PERMISSION OF ENGINEERING LOCAL XPERTS, LLC

PROJECT NAME:
MARIAH TRAIL SUBDIVISION FILING NO. 1

PROJECT LOCATION:
19205 MARIAH TRAIL
EL PASO COUNTY, COLORADO

CLIENT:
MR. THOMAS KIRK

CONTACT INFO:
THOMAS KIRK
19205 MARIAH TRAIL
COLORADO SPRINGS, CO
80908-1123

PROFESSIONAL SEAL:

DATE:	DESCRIPTION:
05/01/23	SUBMITTAL 1
08/04/23	SUBMITTAL 2
03/20/24	SUBMITTAL 3
04/21/24	SUBMITTAL 4
06/16/24	SUBMITTAL 5

JOB #: 100678

DRAWN BY: CDS
REVIEWED BY: CDS
PROJ. MNGR.: CDS

PLAN SET:
MAJOR SUBDIVISION CONSTRUCTION DRAWINGS

SHEET TITLE:
EXISTING CONDITIONS HYDROLOGY MAP

SHEET NO.:
C.01

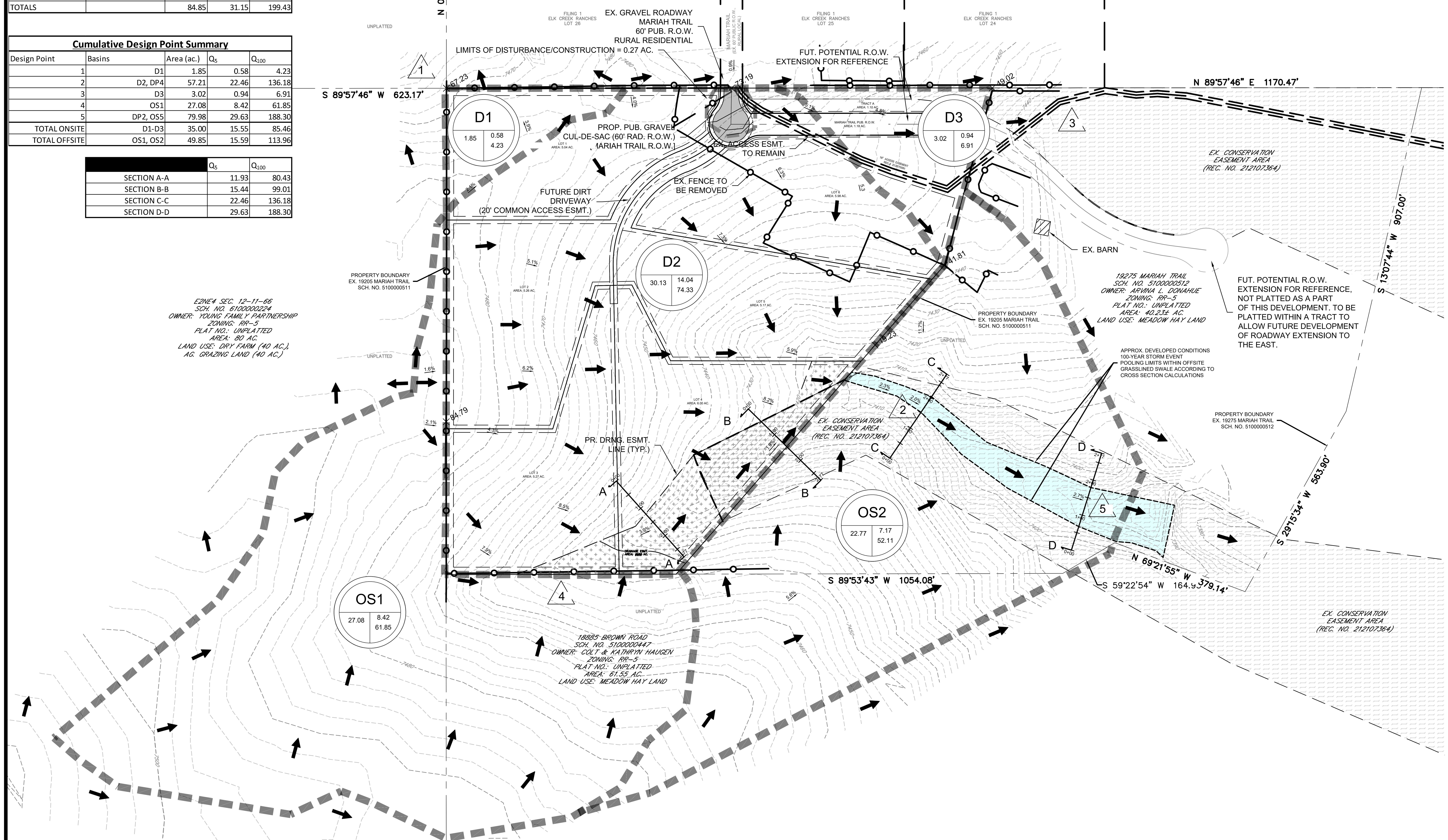
MAJOR SUBDIVISION FINAL DRAINAGE REPORT
PROPOSED CONDITIONS HYDROLOGY MAP
MARIAH TRAIL FILING NO. 1

A PORTION OF THE NORTHWEST QUARTER OF SECTION 7,
TOWNSHIP 11 SOUTH, RANGE 65 WEST OF THE 6TH PRINCIPAL MERIDIAN,
PASO COUNTY, COLORADO.

Basin Summary				
Basin Summary	Design Point	Area (ac.)	Q_5	Q_{100}
D1	1	1.85	0.58	4.23
D2	2	30.13	14.04	74.33
D3	3	3.02	0.94	6.91
OS1	4	27.08	8.42	61.85
OS2	5	22.77	7.17	52.11
TOTAL ONSITE		35.00	15.55	85.46
TOTAL OFFSITE		49.85	15.59	113.96
TOTALS		84.85	31.15	199.43

Cumulative Design Point Summary				
Design Point	Basins	Area (ac.)	Q_5	Q_{100}
1	D1	1.85	0.58	4.23
2	D2, DP4	57.21	22.46	136.18
3	D3	3.02	0.94	6.91
4	OS1	27.08	8.42	61.85
5	DP2, OS5	79.98	29.63	188.30
TOTAL ONSITE	D1-D3	35.00	15.55	85.46
TOTAL OFFSITE	OS1, OS2	49.85	15.59	113.96

	Q_5	Q_{100}
SECTION A-A	11.93	80.43
SECTION B-B	15.44	99.01
SECTION C-C	22.46	136.18
SECTION D-D	29.63	188.30



150 0 150 300
(IN FEET)
1 inch = 150 ft.

EXISTING LEGAL DESCRIPTION:
UNPLATTED

A TR OF LAND BEING IN A PORTION OF LOT 1 SEC 7-11-65...

REPLATTED LEGAL DESCRIPTION:
LOTS 1-6 MARIAH TRAIL FILING NO. 1

PARCEL SCHEDULE NO.:
5100000511

PROJECT DESCRIPTION:
SMALL SUBDIVISION OF 6 LOTS FROM EX. 35-ACRE RR-5 ZONED PARCEL WITH DRAINAGE TRACTS A AND B, 60' WIDTH R.O.W. DEDICATION

FLOODPLAIN STATEMENT:
THE SUBJECT PROPERTY IS NOT LOCATED IN A DESIGNATED FLOODPLAIN AS SHOWN ON THE FEMA FLOOD INSURANCE RATE MAP 08041C0305G, EFFECTIVE DATE DECEMBER 7, 2018.

CONSTRUCTION ACTIVITIES:

THE SCOPE OF WORK INVOLVES DISTURBANCE AND CONSTRUCTION ACTIVITY FOR THE MINOR EXTENSION OF COUNTY RIGHT-OF-WAY OF MARIAH TRAIL WITH A ROADWAY TERMINATION POINT AT A CUL-DE-SAC.

ULTIMATE BUILDOUT OF THE SMALL SUBDIVISION IS FOR SIX (LOTS 1-6) SINGLE-FAMILY RESIDENTS AT A DESIGNATED MAXIMUM ALLOWABLE COVERAGE BY RESPECTIVE LOT DEVELOPMENTS AT 5%.

AREA TO BE CLEARED, EXCAVATED, OR GRADED:
FOR ROADWAY: 0.27 ACRES
TOTAL DISTURBED AREA INCLUDING EROSION AND SEDIMENT CONTROL MEASURES YIELDS: 0.70 ACRES

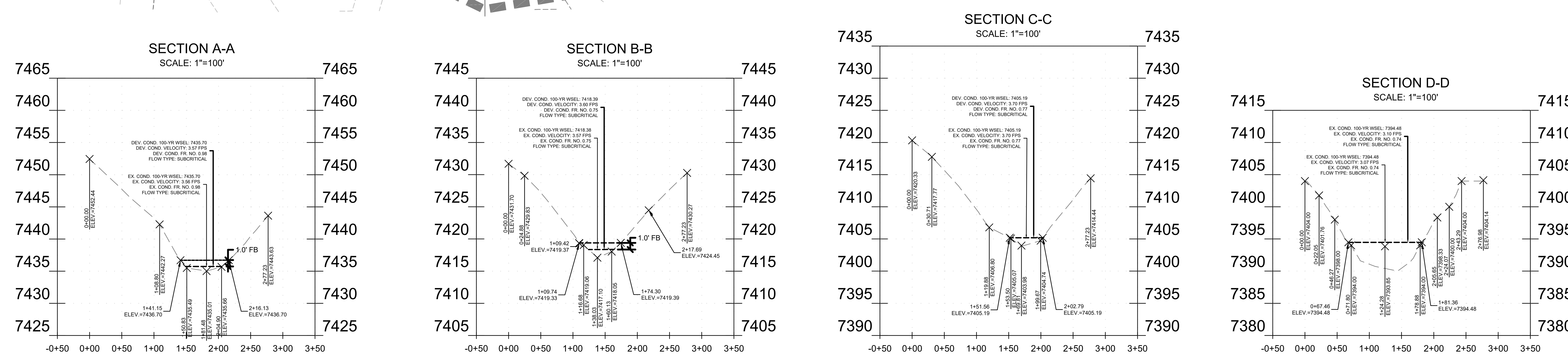
-THIS MAP SHOWS EXISTING CONDITIONS, NO DISTURBANCE HAS TAKEN PLACE-

RECEIVING WATERS: EAST CHERRY CREEK, LOCATED APPROXIMATELY 1.5 MILES EAST OF THE PROPERTY OF INTEREST

SOIL TYPE: BRUSSETT LOAM AND PEYTON-PRINT COMPLEX - HYDROLOGIC SOIL GROUP B

LEGEND

- PROPERTY BOUNDARY
- EXITING LOT LINE
- PROPOSED LOT LINE
- RIGHT-OF-WAY LINE
- PROPOSED CONTOURS
- EXISTING CONTOURS
- BASIN ID (BASIN / AREA / 5_YR / 100_YR)
- DESIGN POINT ID
- BASIN BOUNDARY
- DRAINAGE FLOW ARROW
- EXISTING BUILDING
- PROPOSED BUILDING
- EXISTING GRAVEL
- PROPOSED GRAVEL



NOTE:

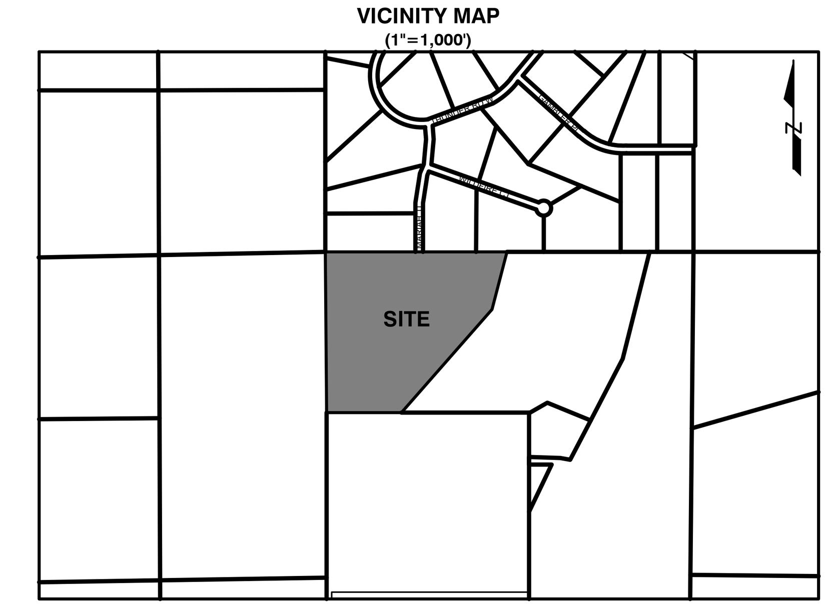
THE PROPERTY INFORMATION AND LINEWORK SHOWN IS CONSIDERED APPROXIMATE AND BASED ON THE PRELIMINARY AND FINAL PLAT DOCUMENTS PREPARED BY MARR LAND SURVEYING DATED OCTOBER OF 2022.

THERE IS NO PUBLIC OR PRIVATE STORMWATER INFRASTRUCTURE WITHIN THE VICINITY OF THE PROPERTY OF INTEREST TO DISPLAY ON THIS HYDROLOGY MAP.

THE PROPERTY OF INTEREST IS NOT WITHIN A STREAMSIDE ZONE, PRESERVATION AREA, OR NO-BUILD AREA.

THE PROPERTY OF INTEREST IS NOT WITHIN A FEMA FLOODPLAIN.

VICINITY MAP
(1"=1,000')



PCD FIL. NO.: SF-2315

ELX
Phone: 719.308.9146
www.elxsoco.com
Hablamos Español

COPYRIGHT
© 2024 ENGINEERING LOCAL XPERTS, LLC:
ALL RIGHTS RESERVED. THE INFORMATION DEPICTED ON THIS SHEET IS THE SOLE PROPERTY OF ENGINEERING LOCAL XPERTS, LLC AND NO PART OF THIS INFORMATION MAY BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN PERMISSION OF ENGINEERING LOCAL XPERTS, LLC

PROJECT NAME:
MARIAH TRAIL SUBDIVISION FILING NO. 1

PROJECT LOCATION:
19205 MARIAH TRAIL
EL PASO COUNTY, COLORADO

CLIENT:
MR. THOMAS KIRK

CONTACT INFO:
THOMAS KIRK
19205 MARIAH TRAIL
COLORADO SPRINGS, CO
80908-1123

PROFESSIONAL SEAL:

DATE:	DESCRIPTION:
05/01/23	SUBMITTAL 1
08/04/23	SUBMITTAL 2
03/20/24	SUBMITTAL 3
04/21/24	SUBMITTAL 4
06/16/24	SUBMITTAL 5

JOB #: 100678

DRAWN BY: CDS
REVIEWED BY: CDS
PROJ. MNGR.: CDS

PLAN SET:
MAJOR SUBDIVISION CONSTRUCTION DRAWINGS

SHEET TITLE:
PROPOSED CONDITIONS HYDROLOGY MAP

SHEET NO.:
C.02