Final Drainage Report

Knecht Minor Final Subdivision
El Paso County, Colorado

PCD File No.: SF2419

Prepared for:
David Knecht
12375 N. Meridian Rd.
El Paso County, Colorado 80106

Prepared by:
Kimley-Horn and Associates, Inc.
2 North Nevada Ave
Suite 900
Colorado Springs, CO 80903
(719) 435-0182
Contact: Kevin Kofford, P.E.

Project #: 196775000

Prepared: February 26, 2025

Kimley»Horn

CERTIFICATION

ENGINEERS 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 El Paso County, Colorado for drainage reports and said report is in conformity with the master plan 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): _____ 2/28/2025

Kevin R. Kofford — Date
Colorado P.E. No. 57234

DEVELOPER'S STATEMENT

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

David Knecht
Developer Name

DocuSigned by:
David Knecht
DF2B368D0BDD49A...
Signature:

Developer
Title:

12375 N. Meridian Rd. El Paso County, Colorado 80106
Address:

EL PASO COUNTY STATEMENT

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.

_____ _____

Joshua Palmer, P.E. — Date
County Engineer/ECM Administrator

Conditions:

GENERAL LOCATION AND DESCRIPTION

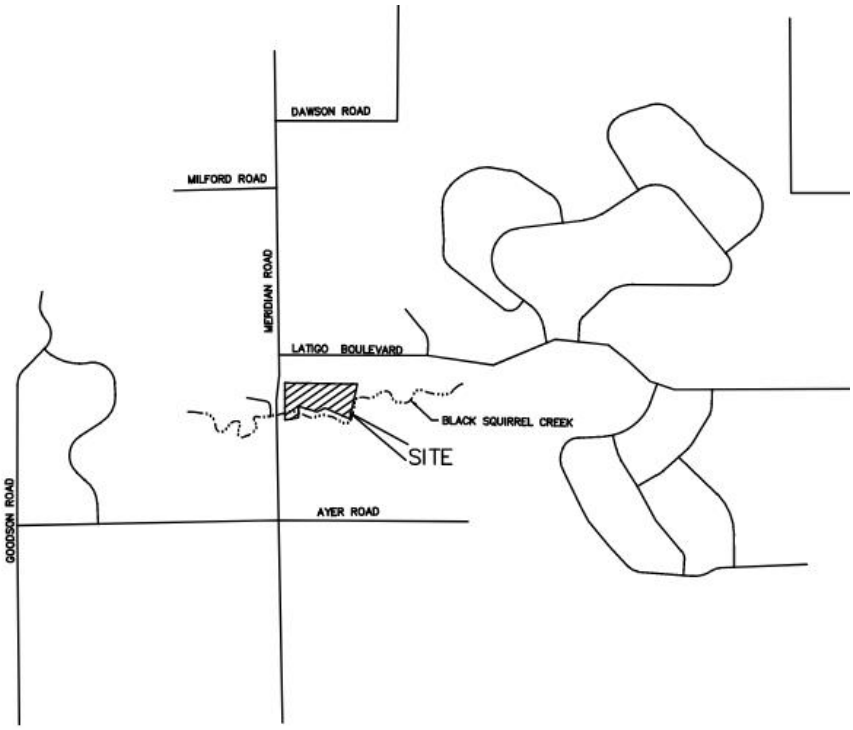
PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to provide the hydrologic and hydraulic calculations in addition to documenting and finalizing the drainage design methodology in support of the proposed Knecht Minor Final Plat Subdivision development ("the Project") for Jon Knecht ("the Owner"). The Project is located within the jurisdictional limits of El Paso County ("the County"). Thus, the guidelines for the hydrologic and hydraulic design components were based on the criteria outlined by the County.

LOCATION

The Project is located at 12375 and 12475 N. Meridian Rd. approximately southeast of the intersection of N. Meridian Rd. and Latigo Blvd. in El Paso County, Colorado. More specifically, the Project is within a portion of the northwest quarter of Section 18, Township 12 South, Range 64 West of the 6th Principal Meridian in El Paso County, Colorado. A vicinity map has been provided below.

VICINITY MAP



DESCRIPTION OF PROPERTY

The Project is located on approximately ±21.03 acres (Parcel ID's: 4218000002, 4218000023, 4218000004). In the existing condition, there are three existing residential homes with gravel driveways. Existing vegetation on the Site consists of natural vegetation with scattered patches or native shrubs and trees. Upper Black Squirrel Creek runs through the site and along the southern property line. The proposed Project consists of extending and paving the existing shared driveway from N. Meridian Drive and creating a private road with a gravel surface. The proposed lots will then tie-in to the private road with gravel driveways. Currently, the site does not provide stormwater quality or detention. The site generally drains from northwest to

southeast with slopes ranging from 1% to 20%, with the steeper slopes along the existing banks of Upper Black Squirrel Creek. Runoff generally flows throughout the Site as sheet flow and is then channelized via Upper Black Squirrel Creek. The Project is ultimately tributary to Upper Black Squirrel Creek which runs along the southern property line. The Project it is located within Flood Zone A along the banks of Upper Black Squirrel Creek where it meanders along the southern property line. A FEMA flood map is provided in the ***Appendix***.

The properties are currently owned by Jon Knecht. The survey was the basis for design of the drainage maps, report, and calculations. The survey was completed by Land Development Consultants, Inc. on November 12, 2018.

SOILS DATA

NRCS soil data for the Site is provided in the ***Appendix*** and most of the onsite soils are generally USCS Hydrologic Soil Group B. Group B soils generally have moderately low runoff potential when thoroughly wet. Generally, water transmission though the soil is unimpeded. Typically, soils in this group have between 10 and 20 percent clay and 50 to 90 percent sand and have loamy sand or sandy loam textures.

PROJECT CHARACTERISTICS

The proposed project has a total drainage study area of approximately ±34.50 acres. The proposed project consists of a minor subdivision where (3) existing lots are to be subdivided into five (5) proposed lots with a private gravel road, cul-de-sac, and separate driveways for each lot. Developed flows within the site will sheetflow across the site over exisitng natural vegetation and channelized through Upper Black Squirrel Creek where flows then generally run to the east and southeast.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed stormwater facilities follow the El Paso County Drainage Criteria Manual (the “CRITERIA”), El Paso Engineering Criteria Manual (the “ECM”), and the Mile High Flood District Urban Storm Drainage Criteria Manual (the “MANUAL”). Site drainage is not significantly impacted by such constraints as utilities or existing development. Further detail regarding proposed onsite drainage patterns is provided in the Proposed Drainage Conditions Section.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per chapter 6 of the CRITERIA. Table 6-2 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-6 of the CRITERIA by calculating weighted impervious values for each specific site basin.

HYDRAULIC CRITERIA

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Results of the hydraulic calculations are summarized in the ***Appendix***.

VARIANCES FROM CRITERIA

A request to waive the requirements of section 8.4.2.B.1.E of the Land Development Code proposed to allow for the use of the desktop BFEs in place of the officially approved FEMA BFEs. This waiver must be accepted by the Floodplain Administrator. See the Floodplain Statement for further information.

DRAINAGE BASINS AND SUB-BASINS

MAJOR BASIN DESCRIPTIONS

The Property is located in the Upper Black Squirrel Creek Drainage Basin and is adjacent to Upper Black Squirrel Creek. There are no creek improvements proposed with this project. Due to the minimal addition of impervious area and existing natural vegetation and soils readily available for infiltration, the project is not anticipated to adversely affect downstream conditions or cause excessive erosion within Upper Black Squirrel Creek embankments. There are no identified nearby irrigation facilities or other obstructions which could influence the local drainage. Currently, there is not an approved drainage report for the property.

EXISTING DRAINAGE CONDITIONS

The existing Site has been divided into four (4) on-site (E1-E4) and three (3) off-site (OE1-OE3) sub-basins. A description of each sub-basin is listed below. In existing conditions, the total studied drainage area of the site is ±34.50 acres. Flows from stormwater runoff generally travel overland to be channelized into Upper Black Squirrel Creek at slopes of 1% to 20%. Runoff flows then travel generally eastward to southeastward within Upper Black Squirrel Creek. Calculations of the existing sub-basins on the Project Site have been completed using current stormwater criteria. An Existing Conditions Drainage Map is provided in the ***Appendix*** of this report. The weighted imperviousness of the drainage area under existing conditions 3.0%. Total flows generated in existing conditions are 12.90 cfs for the 5-year event and 75.84 cfs for the 100-year event.

Sub-Basin E1

Sub-basin E1 is approximately 4.98 acres and consists of the northern portion of the Site. This sub-basin consists of existing native grasses and vegetation, gravel road, and residential houses. The runoff developed within this basin generally sheet flows overland from west to east at slopes that range approximately 0.5% to 6%. From design point E1, flows then converge into a tributary of Upper Black Squirrel Creek. The weighted imperviousness of sub-basin E1 is 4%. The existing direct runoff from sub-basin E1 is 1.83 cfs for the 5-year event and 10.81 cfs for the 100-year event.

Sub-Basin E2

Sub-basin E2 is approximately 7.55 acres and consists of the central and southern portion of the Site. This sub-basin consists of existing native grasses and vegetation, gravel driveway, and residential houses. The runoff developed within this basin sheet flows overland from northwest to southeast at slopes that range approximately 2% to 20%. From design point E2, flows then continue to travel south and east within Upper Black Squirrel Creek. The weighted imperviousness of sub-basin E2 is 3%. The existing direct runoff from sub-basin E2 is 2.70 cfs for the 5-year event and 16.70 cfs for the 100-year event.

Sub-Basin E3

Sub-basin E3 is approximately 5.94 acres and generally consists of the central-eastern portion of the Site. This sub-basin consists of existing native grasses and vegetation. The runoff developed within this basin sheet flows overland from west to east at slopes that range approximately 1% to 18%. From design point E3, flows then converge into Upper Black Squirrel Creek. The weighted imperviousness of sub-basin E3 is 0%. The existing direct runoff from sub-basin E3 is 1.61 cfs for the 5-year event and 11.84 cfs for the 100-year event.

Sub-Basin E4

Sub-basin E4 is approximately 2.54 acres and generally consists of the northeast portion of the Site. This sub-basin consists of existing native grasses and vegetation. The runoff developed within this basin sheet flows overland from west to east at slopes that range approximately 1% to 18%. From design point E4, flows then converge into Upper Black Squirrel Creek. The weighted imperviousness of sub-basin E4 is 0%. The existing direct runoff from sub-basin E4 is 0.75 cfs for the 5-year event and 5.49 cfs for the 100-year event.

Sub-Basin OE1

Sub-basin OE1 is approximately 5.16 acres and consists of the off-site portion north of the site. This sub-basin consists of existing native grasses and vegetation, gravel shoulder, and asphalt road. The runoff developed within this basin sheet flows overland to channelized within an existing drainage swale from northwest to southeast at slopes that range approximately 2% to 7%. The runoff flows all generally convene at the northern property line where the property owner to the north has built a small berm along the fence line. The berm flows directly east until it turns northeast into a larger tributary. In smaller events, it appears this berm would convey flow to the local tributary without ever coming on-site. In larger events, it may over top the berm and briefly come onto the site before making the turn to the northeast tributary. Please reference the drainage maps and the pictures in the appendix. From design point OE1, flows then turn to the northeast as they continue in the natural tributary of Upper Black Squirrel Creek and continue to travel southeastward discharging into Upper Black Squirrel Creek. The weighted imperviousness of sub-basin OE1 is 6%. The existing direct runoff from sub-basin OE1 is 2.38 cfs for the 5-year event and 11.94 cfs for the 100-year event.

Existing sub-basin OE2 is tributary to existing sub-basin OE1. Existing cumulative flows for design point OE1 are 2.96 cfs and 13.91 cfs for the 5-year and 100-year event respectively. Flows from sub-basin OE2 are channelized into the existing tributary as well and then flows off-site to the northeast. Please reference existing conditions drainage map and existing CIA calculations in the cumulative runoff column for cumulative flows tributary to design point OE1.

Sub-Basin OE2

Sub-basin OE2 is approximately 0.72 acres and consists of the off-site portion northwest of the site. This sub-basin consists of existing native grasses and vegetation, gravel shoulder, and asphalt road. The runoff developed within this basin sheet flows overland generally from northwest to southeast at slopes that range approximately 3% to 10%. From design point OE2, flows then continue to travel east and northeast to design point OE1 where they continue within the natural tributary of Upper Black Squirrel Creek that flows off-site. The weighted imperviousness of sub-basin OE2 is 18%. The existing direct runoff from sub-basin OE2 is 0.62 cfs for the 5-year event and 2.11 cfs for the 100-year event.

Sub-Basin OE3

Sub-basin OE3 is approximately 7.60 acres and consists of the off-site portion south of the site. This sub-basin consists of existing native grasses and vegetation, gravel road, and residential houses. The runoff developed within this basin sheet flows overland generally from southwest to northeast at slopes that range approximately 3% to 15%. From design point OE3, flows then continue to travel within Upper Black Squirrel Creek generally eastward along the southern property line of lots 2-5. The weighted imperviousness of sub-basin OE3 is 5%. The existing direct runoff from sub-basin OE3 is 3.01 cfs for the 5-year event and 16.95 cfs for the 100-year event.

PROPOSED DRAINAGE CONDITIONS

The proposed Site has been divided into four (4) on-site (P1-P4), and three (3) off-site (OP1-OP3) sub-basins. A description of each sub-basin is listed below. Under the proposed conditions, the total studied drainage area is ±34.50 acres in size. The project involves the construction of a proposed gravel road with cul-de-sac and asphalt entrance from Meridian Rd., internal gravel driveways to serve each proposed home, and proposed estimated residential homes. Generally, flows from stormwater runoff travel overland to be channelized into Upper Black Squirrel Creek at slopes of 1% to 20%. Some of the stormwater runoff will be conveyed via a proposed drainage ditch along the proposed private gravel roadway and cul-de-sac. Ultimately, these flows conveyed from the drainage ditch will be channelized into a tributary of Upper Black Squirrel Creek. Runoff flows then travel generally east to southeast within Upper Black Squirrel Creek. Flows generated from the proposed conditions will generally follow historic patterns. Under proposed conditions the studied drainage area associated with this project is ±34.50 acres with an 8% weighted imperviousness and flows of 16.59 cfs and 80.14 cfs for the 5-year and 100-year events, respectively.

Reference **Appendix** for the Proposed Drainage Map and delineation of proposed sub-basins. Reference the proposed rational calculations in **Appendix** for each sub-basin area, minor storm runoff, and major storm runoff.

Sub-Basin P1

Sub-basin P1 is 4.98 acres and consists of the northern portion of the Site. This sub-basin consists of proposed gravel private roadway with cul-de-sac, gravel driveways, existing residential houses, and native grasses. The runoff developed within this basin is conveyed via a proposed drainage ditch along the north side of the proposed gravel road into the existing tributary of Upper Black Squirrel Creek. The rest of the runoff overland flows from west to east at slopes that range approximately 0.5% to 6% into proposed sub-basin P4 and P3 and ultimately discharge into Upper Black Squirrel Creek. The weighted imperviousness of sub-basin P1 is 19%. The developed direct runoff from sub-basin P1 is 3.53 cfs for the 5-year event and 12.79 cfs for the 100-year event.

Sub-Basin P2

Sub-basin P2 is 7.55 acres and consists of the central and southern portion of the Site. This sub-basin consists of proposed and existing gravel driveway, existing residential homes, and native grasses. The runoff developed within this basin sheet flows overland from northwest to southeast at slopes that range approximately 2% to 20%. From design point P2, flows then continue to travel south and east within Upper Black Squirrel Creek. The weighted imperviousness of sub-basin P2 is 4%. The developed direct runoff from sub-basin P2 is 2.85 cfs for the 5-year event and 16.87 cfs for the 100-year event.

Sub-Basin P3

Sub-basin P3 is 5.94 acres and consists of the central-eastern portion of the Site. This sub-basin consists of proposed gravel driveways, proposed residential homes, and native grasses. The runoff developed within this basin sheet flows overland from west to east at slopes that range approximately 1% to 18%. From design point P3, flows then converge into Upper Black Squirrel Creek. The weighted imperviousness of sub-basin P3 is 9%. The developed direct runoff from sub-basin P3 is 2.93 cfs for the 5-year event and 13.39 cfs for the 100-year event.

Sub-Basin P4

Sub-basin P4 is approximately 2.54 acres and generally consists of the northeast portion of the Site. This sub-basin consists of existing native grasses and vegetation, and gravel driveway. The runoff developed within this basin sheet flows overland from west to east at slopes that range approximately 1% to 18%. From design point P4, flows then converge into Upper Black Squirrel Creek. The weighted imperviousness of sub-basin P4 is 9%. The developed direct runoff from sub-basin P4 is 1.27 cfs for the 5-year event and 6.09 cfs for the 100-year event.

Sub-Basin OP1

Sub-basin OP1 is approximately 5.16 acres and consists of the off-site portion north of the site. This sub-basin consists of existing native grasses and vegetation, gravel shoulder, and asphalt road. The runoff developed within this basin sheet flows overland to channelized within an existing drainage swale from northwest to southeast at slopes that range approximately 2% to 7%. The runoff flows all generally convene at the northern property line where the property owner to the north has built a small berm along the fence line. The berm flows directly east until it turns northeast into a larger tributary. In smaller events, it appears this berm would convey flow to the local tributary without ever coming on-site. In larger events, it may over top the berm and briefly come onto the site before making the turn to the northeast tributary. Please reference the drainage maps and the pictures in the appendix. From design point OP1, flows then turn to the northeast as they continue in the natural tributary of Upper Black Squirrel Creek and continue to travel southeastward discharging into Upper Black Squirrel Creek. The weighted imperviousness of sub-basin OP1 is 6%. The developed direct runoff from sub-basin OP1 is 2.38 cfs for the 5-year event and 11.94 cfs for the 100-year event.

Proposed sub-basin OP2 is tributary to proposed sub-basin OP1. Proposed cumulative flows for design point OP1 are 2.96 cfs and 13.91 cfs for the 5-year and 100-year event respectively. Flows from sub-basin OP2 are channelized into the existing tributary as well and then flows off-site to the northeast. Please reference proposed conditions drainage map and proposed CIA calculations in the cumulative runoff column for cumulative flows tributary to design point OP1.

Sub-Basin OP2

Sub-basin OP2 is approximately 0.72 acres and consists of the off-site portion northwest of the site. This sub-basin consists of existing native grasses and vegetation, gravel shoulder, and asphalt road. The runoff developed within this basin sheet flows into sub-basin P1 and overland generally from northwest to southeast at slopes that range approximately 3% to 10%. Flows will be captured in the proposed roadside ditch on the north side of the proposed private road and conveyed eastward to match historic drainage patterns consistent with existing conditions. From design point OE2, flows then continue to travel east and northeast to design point OP1 where they continue within the natural tributary of Upper Black Squirrel Creek that flows off-site. The weighted imperviousness of sub-basin OP2 is 18%. The developed direct runoff from sub-basin OP2 is 0.62 cfs for the 5-year event and 2.11 cfs for the 100-year event.

Sub-Basin OP3

Sub-basin OP3 is approximately 7.60 acres and consists of the off-site portion south of the site. This sub-basin consists of existing native grasses and vegetation, gravel road, and residential houses. The runoff developed within this basin sheet flows overland generally from southwest to northeast at slopes that range approximately 3% to 15%. From design point OP3, flows then continue to travel within Upper Black Squirrel Creek generally eastward along the southern property line of lots 2-5. The weighted imperviousness of sub-basin OP3 is 8%. The developed direct runoff from sub-basin OE3 is 3.01 cfs for the 5-year event and 16.95 cfs for the 100-year event.

FOUR-STEP PROCCESS

The Site was designed in accordance with the four-step process to minimize adverse impacts of urbanization, as outlined in Section I.7.2 BMP Selection of the MANUAL. The four-step process per the MANUAL provides guidance and requirements for the selection of siting of structural Best Management Practices (BMPs) for new development and significant redevelopment.

Step 1: Employ Runoff Reduction Practices

The purpose of this project is to subdivide the existing two (2) lots north of Black Squirrel Creek into four (4) proposed residential lots. Per Section I.7.1B of Appendix I of the ECM, the single-family residences fall under the large lot exemption as the total impervious area is planned to be less than 10%. A BESQCP permit will be required by the County to prevent erosion and mitigate any runoff due to those activities.

Step 2: Stabilize Drainageways

Black Squirrel Creek flows throughout the southern portion of the Site. During a Site visit, a qualitative assessment found that the area (basins) tributary to the drainage way is currently well-stabilized and well-vegetated. As the drainageway is currently stable the existing drainageway can be left as-is in its stable condition. As noted in Chapter 1, Section 1.4 of the MANUAL, “Natural channel systems, primarily the designated Major Drainageways and Primary outfalls, serve to store flood waters, enhance water quality, provide for ground water recharge and preserve riparian corridors. The use of historical channels to convey storm water runoff from developed and developing areas is acceptable. However, if historical storm water flows are increased, or if historical channels are unstable in their natural conditions, these channels must be adequately stabilized to prevent excessive erosion.” Additionally, Chapter 2, Section 2.2 of the MANUAL states, “A stable natural channel reaches ‘equilibrium’ over many years. Therefore, channel modifications should be minimal.”

In addition to the qualitative assessment completed, a limited study of the channel stability was conducted. FlowMaster was used to assess four (4) cross-sections along the Upper Black Squirrel Creek, using publicly available LIDAR data. These cross sections can be referenced on the proposed drainage map in the **Appendix**. The roughness coefficient (Manning’s N) was taken to be 0.1 for the channel banks and 0.05 for the channel bottom. Site photos can be referenced in the **Appendix.** The existing conditions of the channel are well vegetated with scattered trees on the embankments. Type B soils are predominantly present on-site. For the FlowMaster model, the tributary flows used for the existing conditions was the flows provided in the StreamStats model for the 100-year storm event (605 cfs) and the flows generated in existing conditions (75.84 cfs) for a total of 680.84 cfs. The tributary flows used for the proposed conditions was the flows provided in the StreamStats model for the 100-year storm event (605 cfs) and the flows generated in

proposed conditions (80.14 cfs) for a total of 685.14 cfs. The overall longitudinal slope of the existing channel varies from 0.6%- 1.0%.

The following parameters were taken from MHFD, Ch. 8, Open Channels, Table 8-1 as a criteria for determining the current stability of the channel:

- Non-Cohesive Soils (Type B)
    - Maximum Flow Velocity
        - 5 ft/s
    - Maximum Froude Number
        - 0.6

The following results were calculated in FlowMaster for both the proposed and existing 100-year condition and available in detail in the **Appendix**:

	Velocity (ft/s)	**Normal Depth (ft)**	**Froude Number**
Ex. XS-1	3.02	5.9	0.27
Ex. XS-2	3.43	4.5	0.41
Ex. XS-3	4.38	5.4	0.48
Ex. XS-4	3.55	4.7	0.42
Pr. XS-1	3.03	5.9	0.27
Pr. XS-2	3.44	4.5	0.41
Pr. XS-3	4.39	5.4	0.48
Pr. XS-4	3.54	4.7	0.42

Given the available data for the channel analysis, it appears that the channel is a stable condition as assessed at the four cross sections shown.

Finally, to help mitigate potential for erosion for the downstream drainageway on the property to the north, there is proposed riprap at design point OP1. This will mitigate proposed flows running along the proposed ditch adjacent to the proposed gravel private road and cul-de-sac. The type VL riprap is proposed per the calculation in the USDCM Volume 1, Ch. 8. The equation can be referenced in the **Appendix**.

Step 3: Provide Water Quality Capture Volume (WQCV)
Per Section I.7.1B of Appendix I of the ECM, detention and water-quality facilities are not required for the Project. No infrastructure improvements are included with the Minor Final Plat.

Full Exclusions per I.7.1.B.5

Large Lot - Single Family Sites

A single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling and having a total lot impervious area of less than 10 percent. A total lot imperviousness greater than 10 percent is allowed when a study specific to the watershed and/or MS4 shows that expected soil and vegetation conditions are suitable for infiltration/filtration of the WQCV for a typical site, and the permittee accepts such study as applicable within its MS4 boundaries. The maximum total lot impervious covered under this exclusion shall be 20 percent.

The 10 percent imperviousness includes the proposed private road within the calculations for the total impervious area for the lot. The builder will need to comply with assumed proposed roof and driveway areas within the areas listed on the drainage map.

Step 4: Consider need for Industrial and Commercial BMPs
The proposed Project consists of residential lots with a Minor Final Plat. There are no industrial and commercial uses or developments are anticipated as part of the proposed development.

WATER QUALITY DESIGN

As discussed in Section I.7.1B of Appendix I of the ECM, detention and water-quality facilities are not required for the Project.

FLOODPLAIN STATEMENT

According to the National Flood Insurance Program, Flood Insurance Rate Map Panel 08041C030G with an effective date of December 7, 2018, the subject property is located in Zone A 100-year floodplain. Draft model backed BFEs and floodplain extents for this area have been developed as part of Phase 1 for the ongoing El Paso County, CO, Risk MAP Project. The data has been reviewed and approved through FEMA's QA/QC process (May 11, 2022) and is currently in MIP (Case No. 19-08-0037s). The Phase 1/Base Level Engineering outputs and Zone A ready deliverables are, under the following folder: K:/FY2019/19-08-0037S/Discovery - BLE - El Paso and Teller Counties, CO - FY18 - 04/Discovery Data Capture - Discovery Data Capture - El Paso and Teller Counties, CO - 01/El Paso_Discovery_1. Floodplain extents and Base Flood Elevations (BFEs) shown on the plat include the outer limits of both current and effective and CWCB Phase 1 data. The Minor Final Plat shows desktop developed BFEs based on the Phase 1 Risk MAP Project information provided by FEMA but does not show any FEMA approved BFEs. A request to waive the requirements of section 8.4.2.B.1.E of the Land Development Code proposed to allow for the use of the desktop BFEs in place of the officially approved FEMA BFEs. This waiver must be accepted by the Floodplain Administrator. A drainage easement will be included on the plat to limit any construction within the floodplain.

FEES DEVELOPMENT

Applicable Fees

The project is within the Upper Black Squirrel Creek Drainage Basin, and per El Paso County Drainage Basin Fees there are no Drainage Basin Fees associated with this Drainage Basin. There are also no bridge fees for Upper Black Squirrel Creek Drainage Basin.

Construction Cost Opinion

There are no public drainage ponds or permanent control measures proposed as part of the Project.

MAINTENANCE AND OPERATIONS

There are no public drainage ponds or permanent control measures proposed as part of the Project.

GRADING AND EROSION CONTROL

Erosion Control Plans with the Minor Final Plat are not required, as the proposed disturbances is less than one acre. A BESQCP permit will be required by the County to prevent erosion and mitigate any runoff due to those activities for each lot.

OTHER GOVERNMENT AGENCY REQUIREMENTS

Approval from other agencies such as the FEMA, the Army Corps of Engineers, Colorado State Engineer, Colorado Water Conservation Board, and others are not needed with this Project.

SUMMARY

Overall, the existing flows for the site are 12.90 cfs and 75.84 cfs for the 5-year and 100-year storm events respectively with a 3% existing imperviousness. The proposed flows are 16.59 cfs and 80.14 cfs for the 5-year and 100-year storm events respectively with an 8% proposed imperviousness. The proposed conditions consist of single-family lots at less than 10% imperviousness. Additionally, the proposed private drive improvements are under an acre of disturbance and therefore water quality treatment is not required per Section I.7.1B of Appendix I of the ECM.

Furthermore, the net increase in flows under proposed conditions for the 100-year storm event is 4.70 cfs. The total increase in overall flows is less than a 1% increase when compared to the offsite flows of 605 cfs from Upper Black Squirrel Creek. Additionally, the proposed conditions also only have a net increase of 5% imperviousness for the site. Stormwater runoff will continue to follow historic drainage patterns within the site. Flows will travel overland, and a large majority of the runoff will infiltrate into the soil prior to reaching Upper Black Squirrel Creek.

COMPLIANCE WITH STANDARDS

The drainage design presented within this report conforms to the El Paso County Drainage Criteria Manual, El Paso Engineering Criteria Manual, and the Mile High Flood District Urban Storm Drainage Criteria Manual. Additionally, the Minor Final Plat will not adversely affect the downstream and surrounding developments or waterways.

REFERENCES

1. El Paso County Drainage Criteria Manual, Vol. 1 and 2, October 1994.

2. City of Colorado Springs Drainage Criteria Manual, May 2014, Revised 2021.

3. El Paso County Engineering Criteria Manual, December 2004, Revised 2016

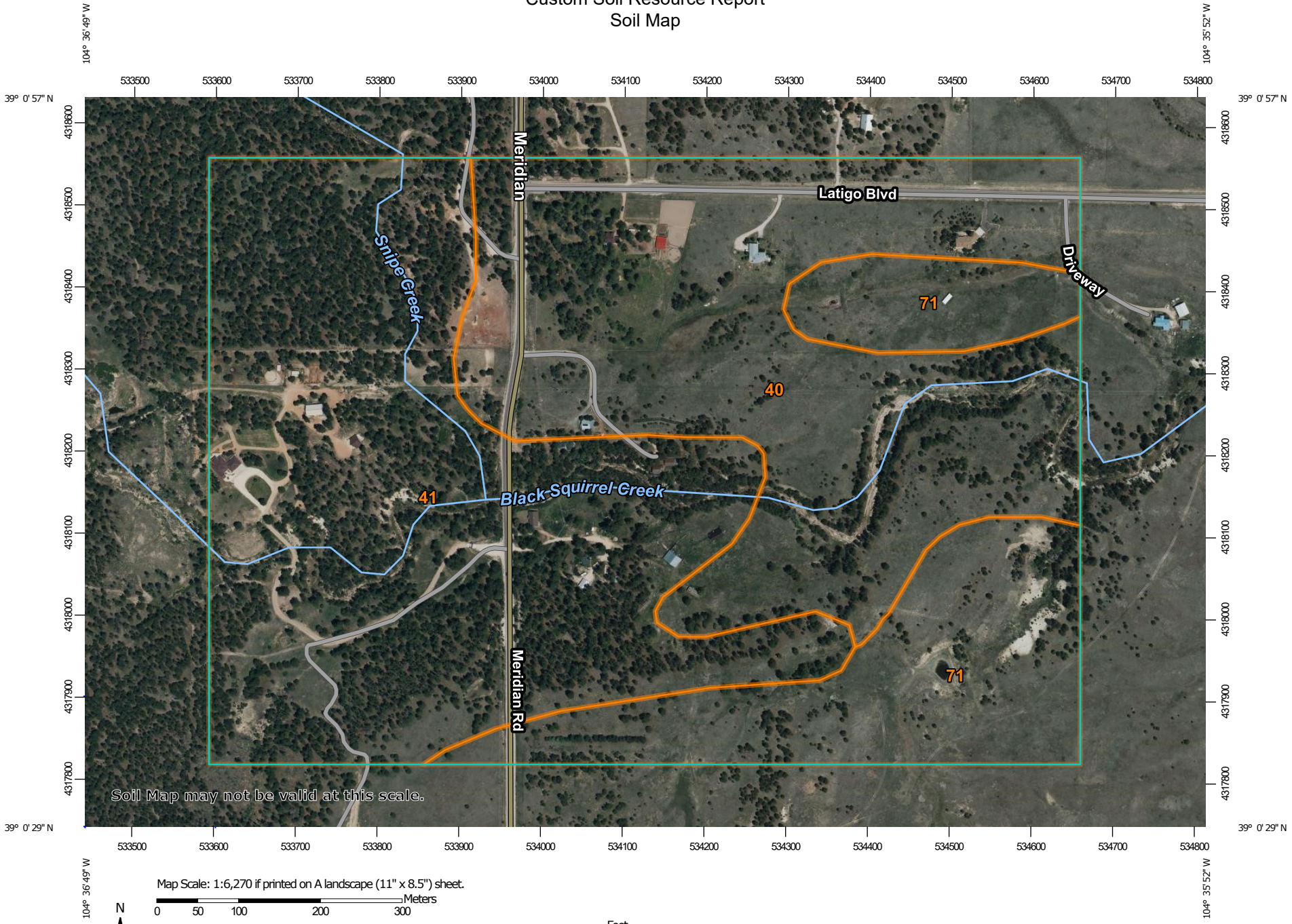
4. Mile High Flood District Drainage Criteria Manual (MHFDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

5. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0780G Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

APPENDIX

SOILS MAP AND FEMA FIRM PANEL

Custom Soil Resource Report
Soil Map



Map Scale: 1:6,270 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 21, Aug 24, 2023

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	72.9	37.3%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	86.2	44.1%
71	Pring coarse sandy loam, 3 to 8 percent slopes	36.5	18.6%
Totals for Area of Interest		**195.6**	**100.0%**

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

40—Kettle gravelly loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 368g
Elevation: 7,000 to 7,700 feet
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kettle

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

41—Kettle gravelly loamy sand, 8 to 40 percent slopes

Map Unit Setting

National map unit symbol: 368h
Elevation: 7,000 to 7,700 feet
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kettle

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Minor Components

Pleasant

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

Other soils

Percent of map unit:
Hydric soil rating: No

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NOTES TO USERS

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

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

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

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

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

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

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

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

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

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

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

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

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

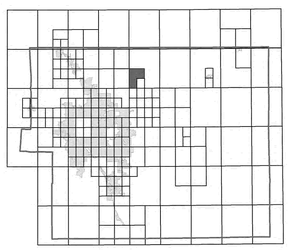
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

El Paso County Vertical Datum Offset Table

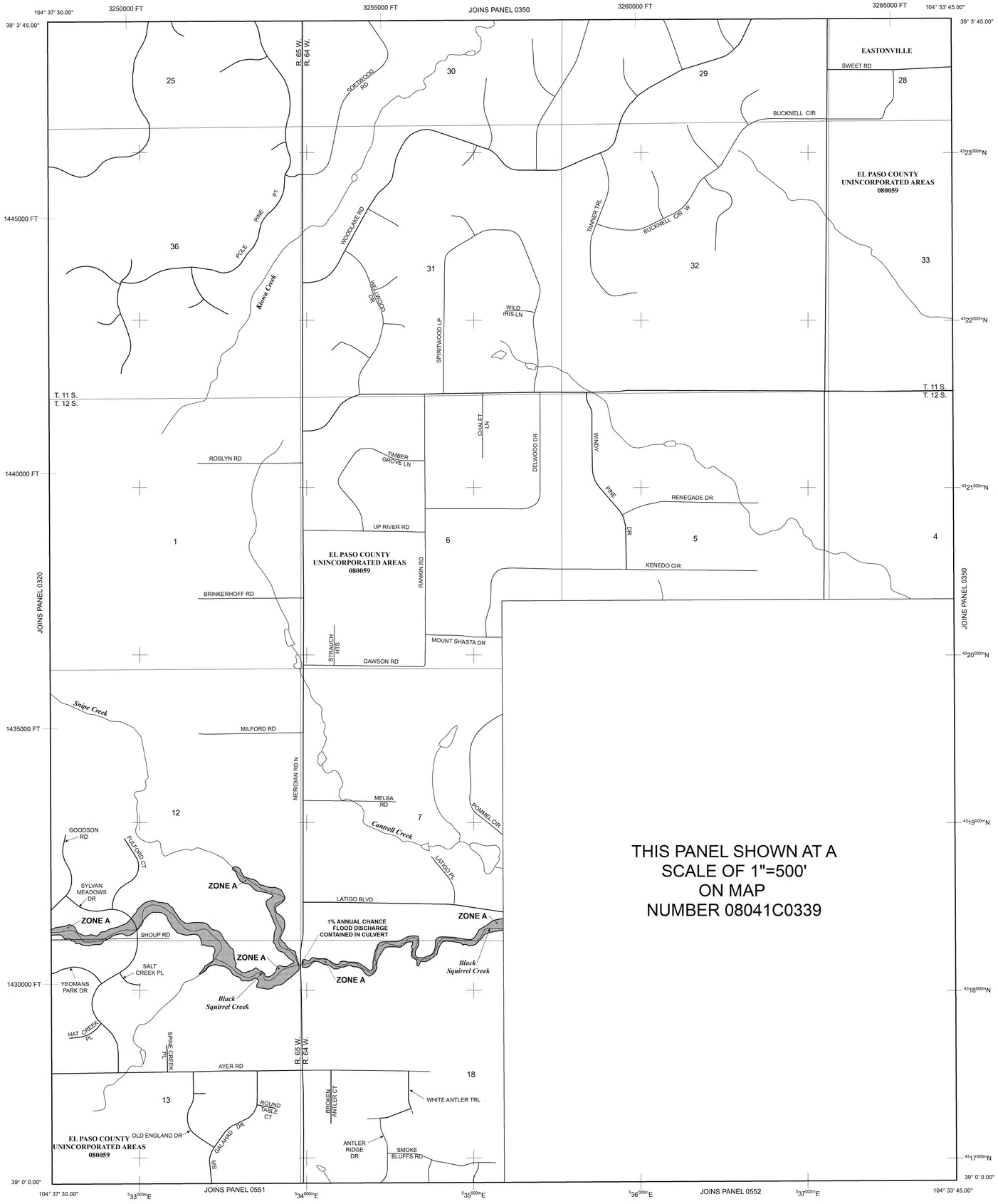
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



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

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



THIS PANEL SHOWN AT A SCALE OF 1"=500' ON MAP NUMBER 08041C0339

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

PANEL 0340G

MAP REVISED TO REFLECT LOMR(S) EFFECTIVE DECEMBER 7, 2018

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 340 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0340	G

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

MAP NUMBER 08041C0340G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

HYDROLOGIC CALCULATIONS

Kimley»Horn

STANDARD FORM SF-1
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION
EXISTING CONDITIONS

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK
DATE: 2/19/2025

SOIL: B

LAND USE:	PAVEMENT AREA	ROOF AREA	GRAVEL AREA	LANSCAPE AREA
2-YEAR COEFF.	0.89	0.71	0.57	0.02
5-YEAR COEFF.	0.90	0.73	0.59	0.08
10-YEAR COEFF.	0.92	0.75	0.63	0.15
100-YEAR COEFF.	0.96	0.81	0.70	0.35
IMPERVIOUS %	100%	90%	80%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (AC)	ROOF AREA (AC)	GRAVEL AREA (AC)	LANSCAPE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
FDR Basins											
E1	E1	0.00	0.03	0.20	4.76	**4.98**	0.05	0.10	0.17	0.37	4%
E2	E2	0.00	0.13	0.11	7.31	**7.55**	0.04	0.10	0.17	0.36	3%
E3	E3	0.00	0.00	0.00	5.94	**5.94**	0.02	0.08	0.15	0.35	0%
E4	E4	0.00	0.00	0.00	2.54	**2.54**	0.02	0.08	0.15	0.35	0%
OE1	OE1	0.24	0.00	0.11	4.81	**5.16**	0.07	0.13	0.20	0.39	6%
OE2	OE2	0.11	0.00	0.03	0.58	**0.72**	0.17	0.22	0.29	0.46	18%
OE3	OE3	0.00	0.11	0.32	7.17	**7.60**	0.05	0.11	0.18	0.37	5%
TOTAL - OVERALL		**0.35**	**0.26**	**0.77**	**33.11**	**34.50**	**0.05**	**0.10**	**0.17**	**0.37**	**3%**
		1%	**1%**	**2%**	**96%**	**100%**					

Note: Land use coefficients sourced from City of Colorado Springs Drainage Criteria Manual, Volume 1, Table 6-6.

Kimley»Horn

STANDARD FORM SF-2
Time of Concentration

PROJECT NAME: **KNECHT MINOR SUBDIVISION**
PROJECT NUMBER: **196775000**
CALCULATED BY: **DPM**
CHECKED BY: **KRK**

EXISTING CONDITIONS

DATE: 2/19/2025

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
FDR Basins																
E1	4.98	0.10	300	2.8%	22.4	588	1.9%	2.5	0.3	28.4	50.9	888	2.2%	4%	14.9	14.9
E2	7.55	0.10	300	15.0%	12.9	409	0.6%	2.5	0.2	35.2	48.1	709	6.7%	3%	13.9	13.9
E3	5.94	0.08	300	1.6%	27.7	844	5.2%	2.5	0.6	24.7	52.4	1144	4.3%		16.4	16.4
E4	2.54	0.08	300	3.3%	21.8	337	1.0%	2.5	0.3	22.5	44.2	637	2.1%		13.5	13.5
OE1	5.16	0.13	300	1.0%	30.8	515	2.5%	2.5	0.4	21.7	52.5	815	1.9%	6%	14.5	14.5
OE2	0.72	0.22	300	2.9%	19.5	103	3.1%	2.5	0.4	3.9	23.4	403	3.0%	18%	12.2	12.2
OE3	7.60	0.11	300	3.1%	21.5	500	5.8%	2.5	0.6	13.8	35.4	800	4.8%	5%	14.4	14.4

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_0^{0.33}} \qquad t_c = \frac{L}{180} + 10 \qquad V = C_v S_w^{0.5}$$

Note: Conveyance coefficient from Table 6-7 of DCM

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK

EXISTING CONDITIONS

DATE: 2/19/2025

STORM LINE		DESIGN POINT	DIRECT RUNOFF							CUMULATIVE RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	sum (C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		E1	E1	4.98	0.10	14.93	0.52	3.53	1.83													
		E2	E2	7.55	0.10	13.94	0.74	3.63	2.70													
		E3	E3	5.94	0.08	16.36	0.48	3.39	1.61													
		E4	E4	2.54	0.08	13.54	0.20	3.67	0.75													
		OE1	OE1	5.16	0.13	14.53	0.67	3.57	2.38	14.53	0.83	3.57	2.96									OE2 is tributary to OE1
		OE2	OE2	0.72	0.22	12.24	0.16	3.83	0.62													OE2 is tributary to OE1
		OE3	OE3	7.60	0.11	14.44	0.84	3.58	3.01													

$$I_5 = -1.5\ln(t_{c,min}) + 7.583$$

Note: Rainfall intensity from Figure 6-5 IDF Equations

CUMULATIVE FLOWS

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK

EXISTING CONDITIONS

DATE: 2/19/2025

STORM LINE		DESIGN POINT	DIRECT RUNOFF							CUMULATIVE RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	sum (C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		E1	E1	4.98	0.37	14.93	1.83	5.92	10.81													
		E2	E2	7.55	0.36	13.94	2.74	6.10	16.70													
		E3	E3	5.94	0.35	16.36	2.08	5.69	11.84													
		E4	E4	2.54	0.35	13.54	0.89	6.17	5.49													
		OE1	OE1	5.16	0.39	14.53	1.99	5.99	11.94	14.53	2.32	5.99	13.91									OE2 is tributary to OE1
		OE2	OE2	0.72	0.46	12.24	0.33	6.42	2.11													OE2 is tributary to OE1
		OE3	OE3	7.60	0.37	14.44	2.82	6.01	16.95													

$$I_{100} = -2.52 \ln(t_{c,min}) + 12.735$$

Note: Rainfall intensity from Figure 6-5 IDF Equations

CUMULATIVE FLOWS

Kimley»Horn

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK

EXISTING CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)			% IMPERVIOUS
			Q5	Q100	
E1	E1	4.98	1.83	10.81	4%
E2	E2	7.55	2.70	16.70	3%
E3	E3	5.94	1.61	11.84	0%
E4	E4	2.54	0.75	5.49	0%
OE1	OE1	5.16	2.38	11.94	6%
OE2	OE2	0.72	0.62	2.11	18%
OE3	OE3	7.60	3.01	16.95	5%
Cumulative Sub-Basins					
OE1	OE1+OE2	5.88	2.96	13.91	
TOTAL		**34.50**	**12.90**	**75.84**	**3%**

Kimley»Horn

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

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK
DATE: 2/19/2025

SOIL: B

LAND USE:	PAVEMENT AREA	ROOF AREA	GRAVEL AREA	LANSCAPE AREA
2-YEAR COEFF.	0.89	0.71	0.57	0.02
5-YEAR COEFF.	0.90	0.73	0.59	0.08
10-YEAR COEFF.	0.92	0.75	0.63	0.15
100-YEAR COEFF.	0.96	0.81	0.70	0.35
IMPERVIOUS %	100%	90%	80%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (AC)	ROOF AREA (AC)	GRAVEL AREA (AC)	LANSCAPE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
FDR Basins											
P1	P1	0.05	0.03	1.06	3.84	**4.98**	0.15	0.20	0.26	0.43	19%
P2	P2	0.00	0.13	0.19	7.23	**7.55**	0.05	0.10	0.17	0.37	4%
P3	P3	0.00	0.46	0.18	5.31	**5.94**	0.09	0.15	0.21	0.40	9%
P4	P4	0.00	0.00	0.28	2.26	**2.54**	0.08	0.14	0.20	0.39	9%
OP1	OP1	0.24	0.00	0.11	4.81	**5.16**	0.07	0.13	0.20	0.39	6%
OP2	OP2	0.11	0.00	0.03	0.58	**0.72**	0.17	0.22	0.29	0.46	18%
OP3	OP3	0.00	0.11	0.32	7.17	**7.60**	0.05	0.11	0.18	0.37	5%
TOTAL - OVERALL		**0.40**	**0.72**	**2.17**	**31.21**	**34.50**	**0.08**	**0.14**	**0.20**	**0.39**	**8%**
		1%	**2%**	**6%**	**90%**	**100%**					

Note: Land use coefficients sourced from City of Colorado Springs Drainage Criteria Manual, Volume 1, Table 6-6.

Kimley»Horn

STANDARD FORM SF-2
Time of Concentration

PROJECT NAME: **KNECHT MINOR SUBDIVISION**
PROJECT NUMBER: **196775000**
CALCULATED BY: **DPM**
CHECKED BY: **KRK**

PROPOSED CONDITIONS

DATE: 2/19/2025

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
FDR Basins																
P1	4.98	0.20	300	2.8%	20.3	588	1.9%	7.0	1.0	10.2	30.4	888	2.2%	19%	14.9	14.9
P2	7.55	0.10	300	15.0%	12.8	409	0.6%	2.5	0.2	35.2	48.0	709	6.7%	4%	13.9	13.9
P3	5.94	0.15	300	1.6%	25.9	844	5.2%	7.0	1.6	8.8	34.7	1144	4.3%	9%	16.4	16.4
P4	2.54	0.14	300	3.3%	20.6	337	1.0%	2.5	0.3	22.5	43.0	637	2.1%	9%	13.5	13.5
OP1	5.16	0.13	300	1.0%	30.8	515	2.5%	2.5	0.4	21.7	52.5	815	1.9%	6%	14.5	14.5
OP2	0.72	0.22	300	2.9%	19.5	103	3.1%	2.5	0.4	3.9	23.4	403	3.0%	18%	12.2	12.2
OP3	7.60	0.11	300	3.1%	21.5	500	5.8%	2.5	0.6	13.8	35.4	800	4.8%	5%	14.4	14.4

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_0^{0.33}} \qquad t_c = \frac{L}{180} + 10 \qquad V = C_v S_w^{0.5}$$

Note: Conveyance coefficient from Table 6-7 of DCM

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK

PROPOSED CONDITIONS

DATE: 2/19/2025

STORM LINE		DESIGN POINT	DIRECT RUNOFF							CUMULATIVE RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	sum (C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		P1	P1	4.98	0.20	14.93	1.00	3.53	3.53													
		P2	P2	7.55	0.10	13.94	0.78	3.63	2.85													
		P3	P3	5.94	0.15	16.36	0.86	3.39	2.93													
		P4	P4	2.54	0.14	13.54	0.35	3.67	1.27													
		OP1	OP1	5.16	0.13	14.53	0.67	3.57	2.38	14.53	0.83	3.57	2.96									OP2 is tributary to OP1
		OP2	OP2	0.72	0.22	12.24	0.16	3.83	0.62													OP2 is tributary to OP1
		OP3	OP3	7.60	0.11	14.44	0.84	3.58	3.01													

$$I_5 = -1.5\ln(t_{c,min}) + 7.583$$

Note: Rainfall intensity from Figure 6-5 IDF Equations

CUMULATIVE FLOWS

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK

PROPOSED CONDITIONS

DATE: 2/19/2025

STORM LINE		DESIGN POINT	DIRECT RUNOFF							CUMULATIVE RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	sum (C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		P1	P1	4.98	0.43	14.93	2.16	5.92	12.79													
		P2	P2	7.55	0.37	13.94	2.77	6.10	16.87													
		P3	P3	5.94	0.40	16.36	2.35	5.69	13.39													
		P4	P4	2.54	0.39	13.54	0.99	6.17	6.09													
		OP1	OP1	5.16	0.39	14.53	1.99	5.99	11.94	14.53	2.32	5.99	13.91									OP2 is tributary to OP1
		OP2	OP2	0.72	0.46	12.24	0.33	6.42	2.11													OP2 is tributary to OP1
		OP3	OP3	7.60	0.37	14.44	2.82	6.01	16.95													

$$I_{100} = -2.52 \ln(t_{c,min}) + 12.735$$

Note: Rainfall intensity from Figure 6-5 IDF Equations

CUMULATIVE FLOWS

Kimley»Horn

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK

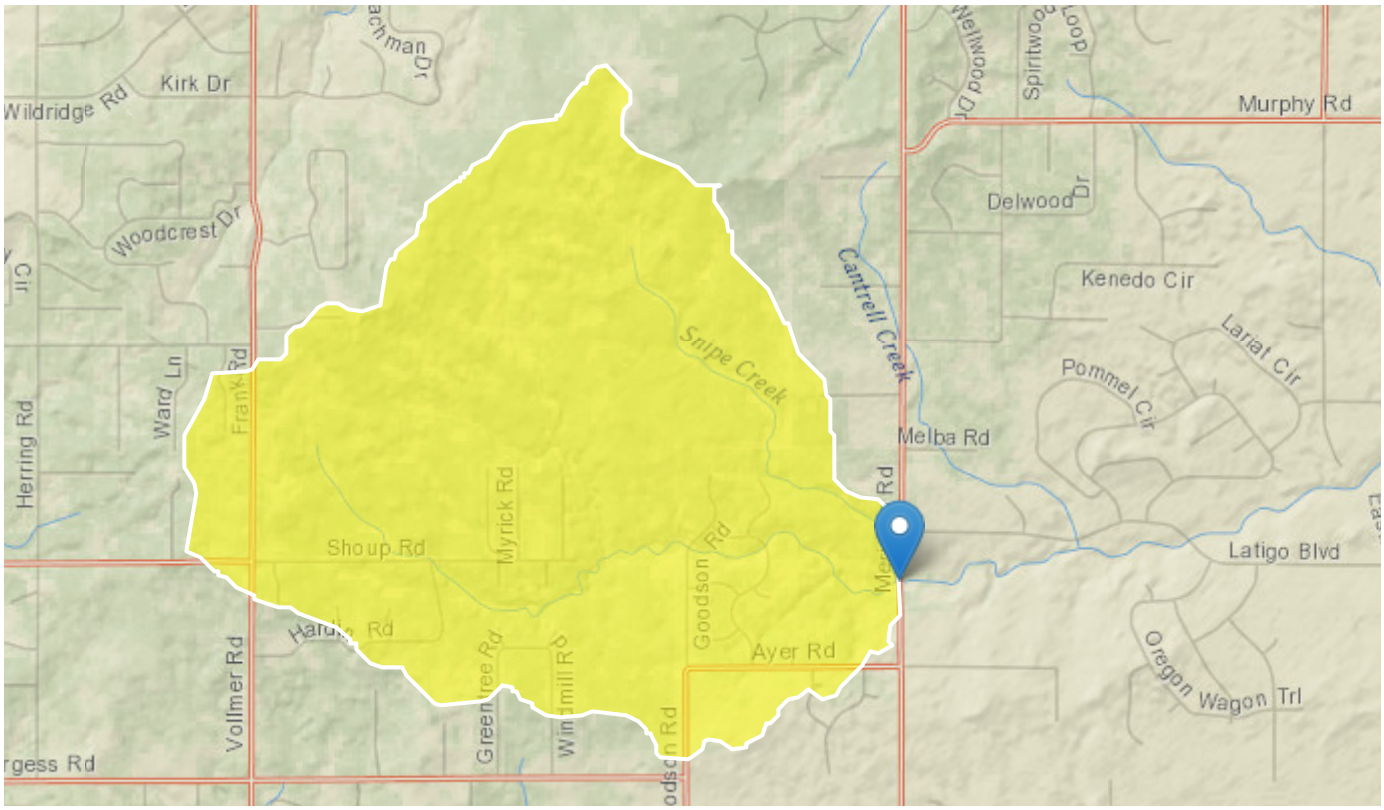
PROPOSED CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)			% IMPERVIOUS
			Q5	Q100	
P1	P1	4.98	3.53	12.79	19%
P2	P2	7.55	2.85	16.87	4%
P3	P3	5.94	2.93	13.39	9%
P4	P4	2.54	1.27	6.09	9%
OP1	OP1	5.16	2.38	11.94	6%
OP2	OP2	0.72	0.62	2.11	18%
OP3	OP3	7.60	3.01	16.95	5%
Cumulative Sub-Basins					
OP1	OP1+OP2	5.88	2.96	13.91	
TOTAL		**34.50**	**16.59**	**80.14**	**8%**

MERIDIAN CULVERT

12420 N. Meridian Rd - Upper Black Squirrel Drainage Basin Report

Region ID: CO
Workspace ID: CO20220630134843865000
Clicked Point (Latitude, Longitude): 39.01167, -104.60776
Time: 2022-06-30 07:49:04 -0600



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Uni
BSLDEM10M	Mean basin slope computed from 10 m DEM	5	per
CSL1085LFP	Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid	90.6	feet
DRNAREA	Area that drains to a point on a stream	6.29	squ
EL7500	Percent of area above 7500 ft	36	per
ELEV	Mean Basin Elevation	7463	feet

5-year storm event

Statistic	Value	Unit	ASEp
20-percent AEP flood	105	ft^3/s	87
10-percent AEP flood	177	ft^3/s	80
4-percent AEP flood	307	ft^3/s	80
2-percent AEP flood	436	ft^3/s	83
1-percent AEP flood	605	ft^3/s	88
0.5-percent AEP flood	803	ft^3/s	94
0.2-percent AEP flood	1120	ft^3/s	104

100-year storm event

Peak-Flow Statistics Citations

Kohn, M.S., Stevens, M.R., Harden, T.M., Godaire, J.E., Klinger, R.E., and Mommandi, A.,2016, Paleoflood investigations to improve peak-streamflow regional-regression equations for natural streamflow in eastern Colorado, 2015: U.S. Geological Survey Scientific Investigations Report 2016–5099, 58 p. (http://dx.doi.org/10.3133/sir20165099)

Bankfull Statistics

Bankfull Statistics Parameters [Interior Plains D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	6.29	square miles	0.19305	59927.7393

Bankfull Statistics Parameters [Great Plains P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	6.29	square miles	0.598455	30899.82624

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	6.29	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Interior Plains D Bieger 2015]

Statistic	Value	Unit

SITE PHOTOS

EXISTING ACCESS TO 12475 N. MERIDIAN DRIVE

UPPER BLACK SQUIRREL CREEK (WALKING EAST TO WEST ALONG SOUTHERN PROPERTY LINE)

INTERSECTION OF TWO EXISTING OVERHEAD ELECTRIC LINES

EXISTING STRUCTURE

EXISTING STRUCTURE

EXISTING STRUCTURE

EXISTING DRIVEWAY

Existing gravel road at northern property line, looking west

Existing ridge on adjacent property at the northern property line (Sub-Basin OE2), looking north from existing gravel road

Existing tributary flow from design pointe OE1&OE2, travels along northern property line (existing berm) and then off-site

Existing drainage swale on property adjacent to northern property line (Sub-Basin OE2)

Looking towards existing tributary from design points OE1&OE2

Existing berm on adjacent property along northern property line that directs flows east to north east

HYDRAULIC CALCULATIONS

Knecht Pr. Roadside Drainage Ditch

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.025 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	3.000 H:V
Discharge	2.11 cfs

Results	
Normal Depth	5.5 in
Flow Area	0.7 ft²
Wetted Perimeter	3.3 ft
Hydraulic Radius	2.6 in
Top Width	3.21 ft
Critical Depth	5.6 in
Critical Slope	0.022 ft/ft
Velocity	2.86 ft/s
Velocity Head	0.13 ft
Specific Energy	0.59 ft
Froude Number	1.052
Flow Type	Supercritical

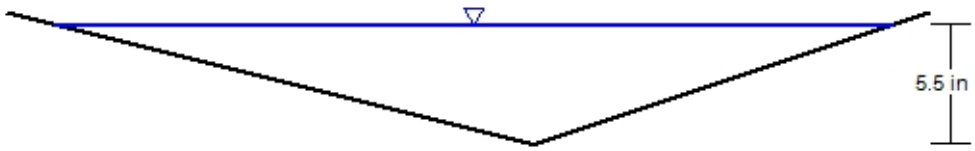
GVF Input Data	
Downstream Depth	30.0 in
Length	400.0 ft
Number Of Steps	0

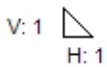
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	10.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.5 in
Critical Depth	5.6 in
Channel Slope	0.025 ft/ft
Critical Slope	0.022 ft/ft

Pr. Drainage Ditch Cross-Section

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.025 ft/ft
Normal Depth	5.5 in
Left Side Slope	4.000 H:V
Right Side Slope	3.000 H:V
Discharge	2.11 cfs





Bentley Systems, Inc. Haestad Methods
Solution Center
27 Siemon Company Drive Suite 200 W
Watertown, CT 06795 USA +1-203-755-1666

Kimley»Horn

Knecht Minor Subdivision			
Rip-Rap Sizing Calculaiton			
V	2.86 fps	**0.067479 ft**	0.809743 in
S	0.025 ft/ft		
Gs	2.5		

$$d_{50} \geq \left[\frac{VS^{0.17}}{4.5(G_s - 1)^{0.66}} \right]^2$$ Equation 8-11

Where:

V = mean channel velocity (ft/sec)

S = longitudinal channel slope (ft/ft)

d_{50} = mean rock size (ft)

Gs = specific gravity of stone (minimum = 2.50, typically 2.5 to 2.7), Note: In this equation (Gs -1) considers the buoyancy of the water, in that the specific gravity of water is subtracted from the specific gravity of the rock.

TABLE MT-1
Gradation Requirements for Riprap

	Pay Item Type	Stone Size d50 (inches)	Percent of Material Smaller Than Typical Stone	Typical Stone Dimensions (inches)	Typical Stone Weight (Pounds)
			70-100	12	85
Riprap	VL	6	50-70	9	35
			35-50	6	10
			2-10	2	0.4
Riprap			70-100	15	160
	L	9	50-70	12	85
			35-50	9	35
			2-10	3	1.3
Riprap			70-100	21	440
	M	12	50-70	18	275
			35-50	12	85
			2-10	4	3
Riprap			100	30	1,280
	H	18	50-70	24	650
			35-50	18	275
			2-10	6	10
Riprap			100	42	3,500
	VH	24	50-70	33	1,700
			35-50	24	650
			2-10	9	35

Table taken from CDOT's Standard Specifications for Road and Bridge Construction, 1999 and City of Colorado Springs/El Paso County Drainage Criteria Manual.

8.1.1 Mild Slope Conditions

When subcritical flow conditions occur and/or slopes are mild (less than 2 percent), UDFCD recommends the following equation (Hughes, et al, 1983):

$$d_{50} \geq \left[\frac{VS^{0.17}}{4.5(G_s - 1)^{0.66}} \right]^2 \qquad \text{Equation 8-11}$$

Where:

V = mean channel velocity (ft/sec)

S = longitudinal channel slope (ft/ft)

d_{50} = mean rock size (ft)

Gs = specific gravity of stone (minimum = 2.50, typically 2.5 to 2.7), Note: In this equation (Gs -1) considers the buoyancy of the water, in that the specific gravity of water is subtracted from the specific gravity of the rock.

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D_{50}* (INCHES)
TYPE VL	70 – 100 50 – 70 35 – 50 2 – 10	12 9 6 2	6
TYPE L	70 – 100 50 – 70 35 – 50 2 – 10	15 12 9 3	9
TYPE M	70 – 100 50 – 70 35 – 50 2 – 10	21 18 12 4	12
TYPE H	70 – 100 50 – 70 35 – 50 2 – 10	30 24 18 6	18
*D_{50} = MEAN ROCK SIZE			

Figure 8-34. Riprap and soil riprap placement and gradation (part 1 of 3)

Ex. XS-1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Discharge	681.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+11	7,230.00
0+25	7,226.00
0+42	7,214.00
0+50	7,213.99
0+56	7,214.00
0+85	7,218.00
0+93	7,220.00
1+04	7,228.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+11, 7,230.00)	(0+25, 7,226.00)	0.100
(0+25, 7,226.00)	(0+42, 7,214.00)	0.100
(0+42, 7,214.00)	(0+50, 7,213.99)	0.050
(0+50, 7,213.99)	(0+56, 7,214.00)	0.050
(0+56, 7,214.00)	(0+85, 7,218.00)	0.100
(0+85, 7,218.00)	(0+93, 7,220.00)	0.100
(0+93, 7,220.00)	(1+04, 7,228.00)	0.100

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	70.4 in
Roughness Coefficient	0.091
Elevation	7,219.85 ft
Elevation Range	7,214.0 to 7,230.0 ft
Flow Area	225.4 ft²
Wetted Perimeter	61.2 ft
Hydraulic Radius	44.2 in

Ex. XS-1

Results	
Top Width	58.79 ft
Normal Depth	70.4 in
Critical Depth	36.8 in
Critical Slope	0.098 ft/ft
Velocity	3.02 ft/s
Velocity Head	0.14 ft
Specific Energy	6.01 ft
Froude Number	0.272
Flow Type	Subcritical

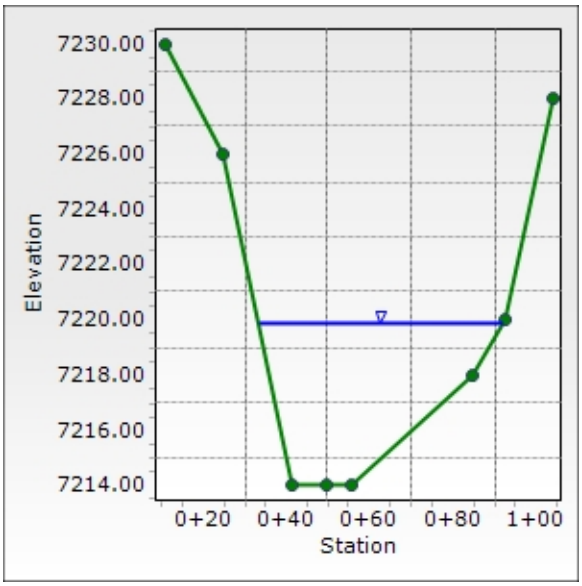
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	70.4 in
Critical Depth	36.8 in
Channel Slope	0.006 ft/ft
Critical Slope	0.098 ft/ft

Ex. XS-1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Normal Depth	70.4 in
Discharge	681.00 cfs



Ex. XS-2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Discharge	681.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+08	7,230.58
0+34	7,218.00
0+41	7,214.00
0+49	7,213.17
0+66	7,214.00
0+78	7,215.99
1+05	7,216.37
1+32	7,218.00
1+47	7,228.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+08, 7,230.58)	(0+34, 7,218.00)	0.100
(0+34, 7,218.00)	(0+41, 7,214.00)	0.100
(0+41, 7,214.00)	(0+49, 7,213.17)	0.050
(0+49, 7,213.17)	(0+66, 7,214.00)	0.050
(0+66, 7,214.00)	(0+78, 7,215.99)	0.050
(0+78, 7,215.99)	(1+05, 7,216.37)	0.050
(1+05, 7,216.37)	(1+32, 7,218.00)	0.050
(1+32, 7,218.00)	(1+47, 7,228.00)	0.100

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	53.9 in
Roughness Coefficient	0.056
Elevation	7,217.66 ft
Elevation Range	7,213.2 to 7,230.6 ft
Flow Area	198.3 ft²

Ex. XS-2

Results	
Wetted Perimeter	92.9 ft
Hydraulic Radius	25.6 in
Top Width	91.67 ft
Normal Depth	53.9 in
Critical Depth	39.1 in
Critical Slope	0.040 ft/ft
Velocity	3.43 ft/s
Velocity Head	0.18 ft
Specific Energy	4.67 ft
Froude Number	0.412
Flow Type	Subcritical

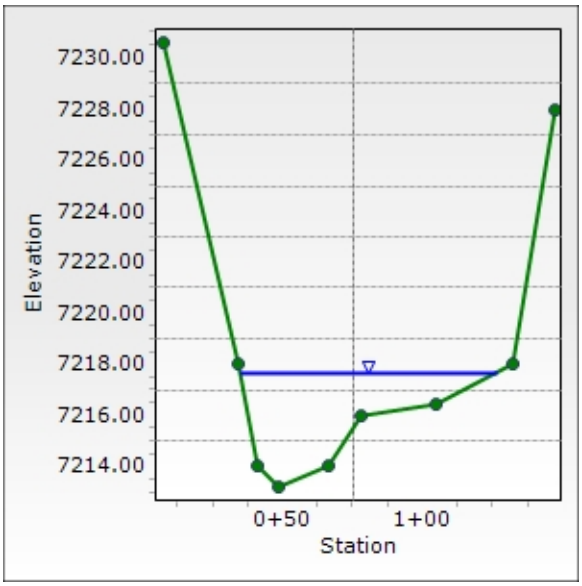
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	53.9 in
Critical Depth	39.1 in
Channel Slope	0.006 ft/ft
Critical Slope	0.040 ft/ft

Ex. XS-2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Normal Depth	53.9 in
Discharge	681.00 cfs



Ex. XS-3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Discharge	681.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+18	7,222.00
0+39	7,212.00
0+49	7,206.00
0+56	7,206.00
0+64	7,208.00
0+81	7,210.00
0+84	7,210.00
1+07	7,212.00
1+17	7,216.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+18, 7,222.00)	(0+39, 7,212.00)	0.100
(0+39, 7,212.00)	(0+49, 7,206.00)	0.100
(0+49, 7,206.00)	(0+56, 7,206.00)	0.050
(0+56, 7,206.00)	(0+64, 7,208.00)	0.050
(0+64, 7,208.00)	(0+81, 7,210.00)	0.050
(0+81, 7,210.00)	(0+84, 7,210.00)	0.050
(0+84, 7,210.00)	(1+07, 7,212.00)	0.050
(1+07, 7,212.00)	(1+17, 7,216.00)	0.100

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	65.2 in
Roughness Coefficient	0.062
Elevation	7,211.43 ft
Elevation Range	7,206.0 to 7,222.0 ft
Flow Area	155.5 ft²

Ex. XS-3

Results	
Wetted Perimeter	63.0 ft
Hydraulic Radius	29.6 in
Top Width	61.16 ft
Normal Depth	65.2 in
Critical Depth	49.0 in
Critical Slope	0.047 ft/ft
Velocity	4.38 ft/s
Velocity Head	0.30 ft
Specific Energy	5.73 ft
Froude Number	0.484
Flow Type	Subcritical

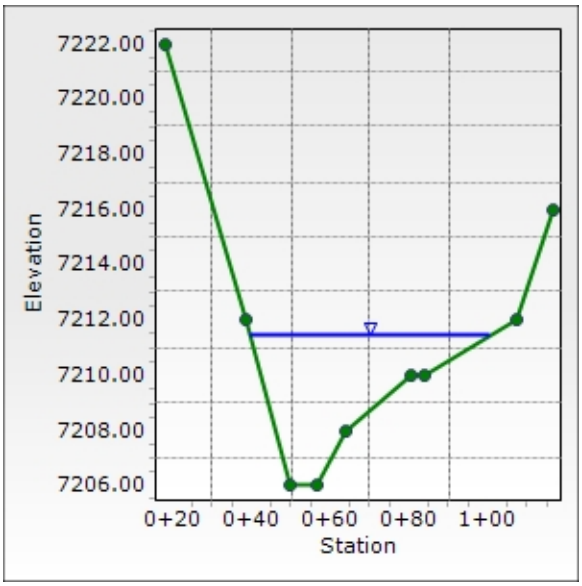
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	65.2 in
Critical Depth	49.0 in
Channel Slope	0.010 ft/ft
Critical Slope	0.047 ft/ft

Ex. XS-3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Normal Depth	65.2 in
Discharge	681.00 cfs



Ex. XS-4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Discharge	681.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+35	7,219.16
0+63	7,212.26
0+88	7,208.00
0+95	7,207.96
1+08	7,206.00
1+15	7,204.00
1+37	7,204.00
1+39	7,206.00
1+47	7,207.30
1+54	7,208.00
1+89	7,209.32
2+21	7,210.00
2+35	7,214.16

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+35, 7,219.16)	(0+63, 7,212.26)	0.100
(0+63, 7,212.26)	(0+88, 7,208.00)	0.100
(0+88, 7,208.00)	(0+95, 7,207.96)	0.100
(0+95, 7,207.96)	(1+08, 7,206.00)	0.050
(1+08, 7,206.00)	(1+15, 7,204.00)	0.050
(1+15, 7,204.00)	(1+37, 7,204.00)	0.050
(1+37, 7,204.00)	(1+39, 7,206.00)	0.050
(1+39, 7,206.00)	(1+47, 7,207.30)	0.050
(1+47, 7,207.30)	(1+54, 7,208.00)	0.050
(1+54, 7,208.00)	(1+89, 7,209.32)	0.100
(1+89, 7,209.32)	(2+21, 7,210.00)	0.100
(2+21, 7,210.00)	(2+35, 7,214.16)	0.100

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

Ex. XS-4

Results	
Normal Depth	56.1 in
Roughness Coefficient	0.070
Elevation	7,208.67 ft
Elevation Range	7,204.0 to 7,219.2 ft
Flow Area	192.1 ft²
Wetted Perimeter	88.8 ft
Hydraulic Radius	25.9 in
Top Width	87.47 ft
Normal Depth	56.1 in
Critical Depth	34.7 in
Critical Slope	0.059 ft/ft
Velocity	3.55 ft/s
Velocity Head	0.20 ft
Specific Energy	4.87 ft
Froude Number	0.422
Flow Type	Subcritical

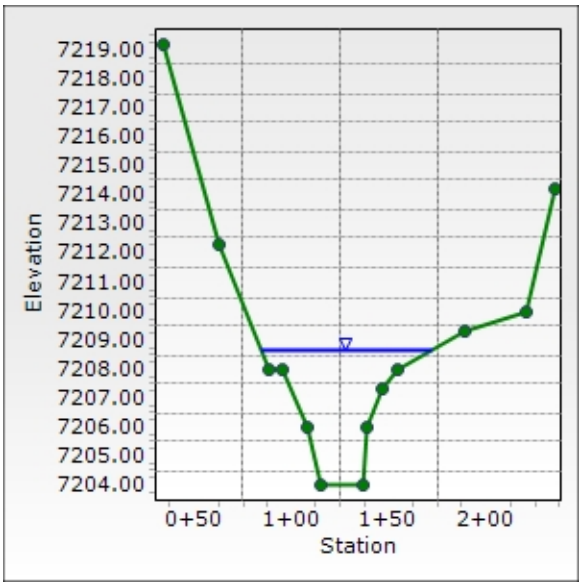
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	56.1 in
Critical Depth	34.7 in
Channel Slope	0.010 ft/ft
Critical Slope	0.059 ft/ft

Ex. XS-4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Normal Depth	56.1 in
Discharge	681.00 cfs



Pr. XS-1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Discharge	685.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+11	7,230.00
0+25	7,226.00
0+42	7,214.00
0+50	7,213.99
0+56	7,214.00
0+85	7,218.00
0+93	7,220.00
1+04	7,228.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+11, 7,230.00)	(0+25, 7,226.00)	0.100
(0+25, 7,226.00)	(0+42, 7,214.00)	0.100
(0+42, 7,214.00)	(0+50, 7,213.99)	0.050
(0+50, 7,213.99)	(0+56, 7,214.00)	0.050
(0+56, 7,214.00)	(0+85, 7,218.00)	0.100
(0+85, 7,218.00)	(0+93, 7,220.00)	0.100
(0+93, 7,220.00)	(1+04, 7,228.00)	0.100

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	70.6 in
Roughness Coefficient	0.091
Elevation	7,219.87 ft
Elevation Range	7,214.0 to 7,230.0 ft
Flow Area	226.4 ft²
Wetted Perimeter	61.3 ft
Hydraulic Radius	44.3 in

Pr. XS-1

Results	
Top Width	58.88 ft
Normal Depth	70.6 in
Critical Depth	36.9 in
Critical Slope	0.098 ft/ft
Velocity	3.03 ft/s
Velocity Head	0.14 ft
Specific Energy	6.02 ft
Froude Number	0.272
Flow Type	Subcritical

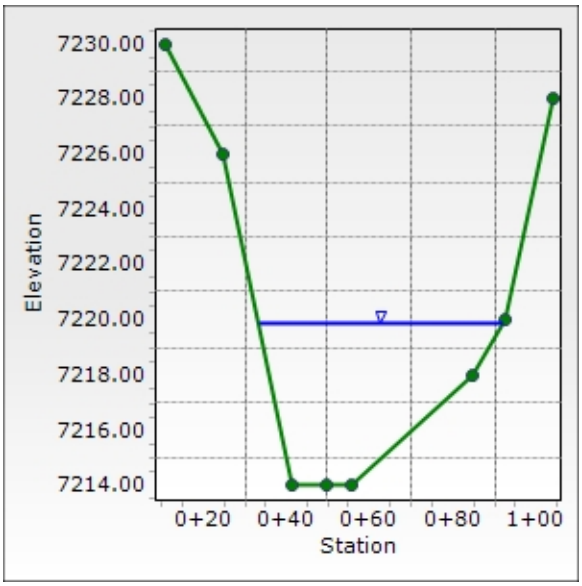
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	70.6 in
Critical Depth	36.9 in
Channel Slope	0.006 ft/ft
Critical Slope	0.098 ft/ft

Pr. XS-1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Normal Depth	70.6 in
Discharge	685.00 cfs



Pr. XS-2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Discharge	685.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+08	7,230.58
0+34	7,218.00
0+41	7,214.00
0+49	7,213.17
0+66	7,214.00
0+78	7,215.99
1+05	7,216.37
1+32	7,218.00
1+47	7,228.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+08, 7,230.58)	(0+34, 7,218.00)	0.100
(0+34, 7,218.00)	(0+41, 7,214.00)	0.100
(0+41, 7,214.00)	(0+49, 7,213.17)	0.050
(0+49, 7,213.17)	(0+66, 7,214.00)	0.050
(0+66, 7,214.00)	(0+78, 7,215.99)	0.050
(0+78, 7,215.99)	(1+05, 7,216.37)	0.050
(1+05, 7,216.37)	(1+32, 7,218.00)	0.050
(1+32, 7,218.00)	(1+47, 7,228.00)	0.100

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	54.0 in
Roughness Coefficient	0.056
Elevation	7,217.67 ft
Elevation Range	7,213.2 to 7,230.6 ft
Flow Area	199.1 ft²

Pr. XS-2

Results	
Wetted Perimeter	93.1 ft
Hydraulic Radius	25.7 in
Top Width	91.84 ft
Normal Depth	54.0 in
Critical Depth	39.2 in
Critical Slope	0.040 ft/ft
Velocity	3.44 ft/s
Velocity Head	0.18 ft
Specific Energy	4.68 ft
Froude Number	0.412
Flow Type	Subcritical

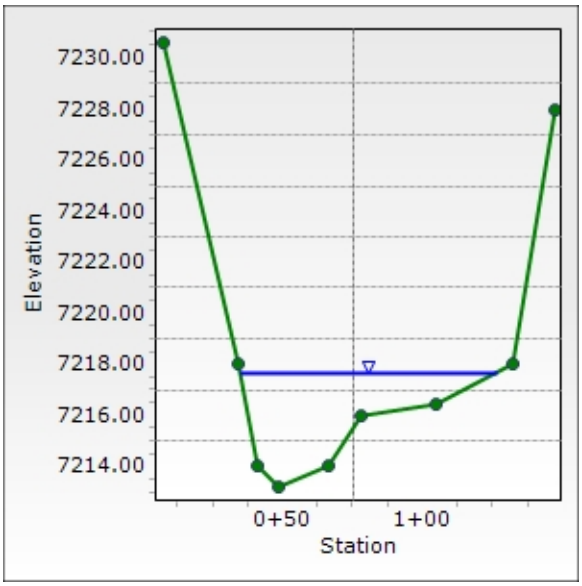
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	54.0 in
Critical Depth	39.2 in
Channel Slope	0.006 ft/ft
Critical Slope	0.040 ft/ft

Pr. XS-2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.006 ft/ft
Normal Depth	54.0 in
Discharge	685.00 cfs



Pr.. XS-3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Discharge	685.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+18	7,222.00
0+39	7,212.00
0+49	7,206.00
0+56	7,206.00
0+64	7,208.00
0+81	7,210.00
0+84	7,210.00
1+07	7,212.00
1+17	7,216.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+18, 7,222.00)	(0+39, 7,212.00)	0.100
(0+39, 7,212.00)	(0+49, 7,206.00)	0.100
(0+49, 7,206.00)	(0+56, 7,206.00)	0.050
(0+56, 7,206.00)	(0+64, 7,208.00)	0.050
(0+64, 7,208.00)	(0+81, 7,210.00)	0.050
(0+81, 7,210.00)	(0+84, 7,210.00)	0.050
(0+84, 7,210.00)	(1+07, 7,212.00)	0.050
(1+07, 7,212.00)	(1+17, 7,216.00)	0.100

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	65.3 in
Roughness Coefficient	0.062
Elevation	7,211.44 ft
Elevation Range	7,206.0 to 7,222.0 ft
Flow Area	156.2 ft²

Pr.. XS-3

Results	
Wetted Perimeter	63.2 ft
Hydraulic Radius	29.7 in
Top Width	61.31 ft
Normal Depth	65.3 in
Critical Depth	49.1 in
Critical Slope	0.047 ft/ft
Velocity	4.39 ft/s
Velocity Head	0.30 ft
Specific Energy	5.74 ft
Froude Number	0.484
Flow Type	Subcritical

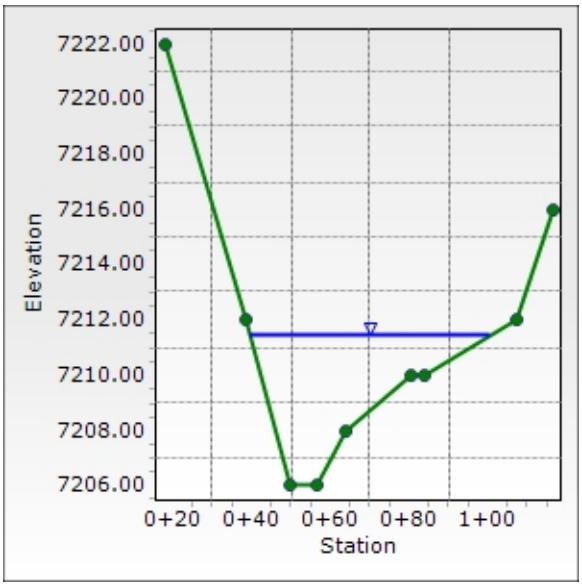
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	65.3 in
Critical Depth	49.1 in
Channel Slope	0.010 ft/ft
Critical Slope	0.047 ft/ft

Pr. XS-3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Normal Depth	65.3 in
Discharge	685.00 cfs



Pr. XS-4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Discharge	685.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+35	7,219.16
0+63	7,212.26
0+88	7,208.00
0+95	7,207.96
1+08	7,206.00
1+15	7,204.00
1+37	7,204.00
1+39	7,206.00
1+47	7,207.30
1+54	7,208.00
1+89	7,209.32
2+21	7,210.00
2+35	7,214.16

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+35, 7,219.16)	(0+63, 7,212.26)	0.100
(0+63, 7,212.26)	(0+88, 7,208.00)	0.100
(0+88, 7,208.00)	(0+95, 7,207.96)	0.100
(0+95, 7,207.96)	(1+08, 7,206.00)	0.050
(1+08, 7,206.00)	(1+15, 7,204.00)	0.050
(1+15, 7,204.00)	(1+37, 7,204.00)	0.050
(1+37, 7,204.00)	(1+39, 7,206.00)	0.050
(1+39, 7,206.00)	(1+47, 7,207.30)	0.050
(1+47, 7,207.30)	(1+54, 7,208.00)	0.050
(1+54, 7,208.00)	(1+89, 7,209.32)	0.100
(1+89, 7,209.32)	(2+21, 7,210.00)	0.100
(2+21, 7,210.00)	(2+35, 7,214.16)	0.100

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

Pr. XS-4

Results	
Normal Depth	56.3 in
Roughness Coefficient	0.070
Elevation	7,208.69 ft
Elevation Range	7,204.0 to 7,219.2 ft
Flow Area	193.6 ft²
Wetted Perimeter	89.4 ft
Hydraulic Radius	26.0 in
Top Width	88.04 ft
Normal Depth	56.3 in
Critical Depth	34.8 in
Critical Slope	0.059 ft/ft
Velocity	3.54 ft/s
Velocity Head	0.19 ft
Specific Energy	4.89 ft
Froude Number	0.421
Flow Type	Subcritical

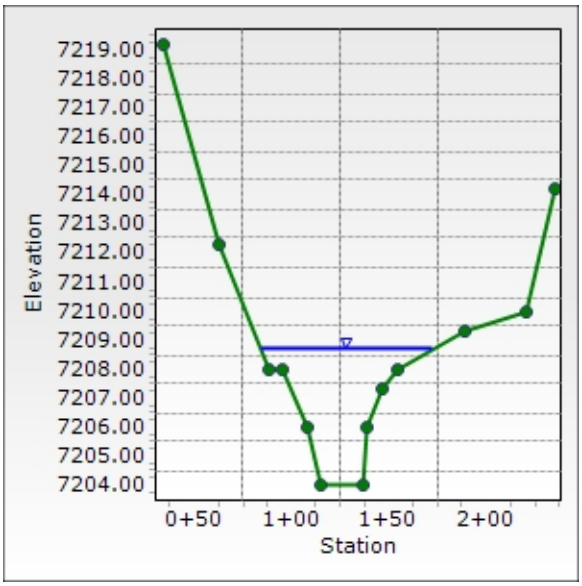
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	56.3 in
Critical Depth	34.8 in
Channel Slope	0.010 ft/ft
Critical Slope	0.059 ft/ft

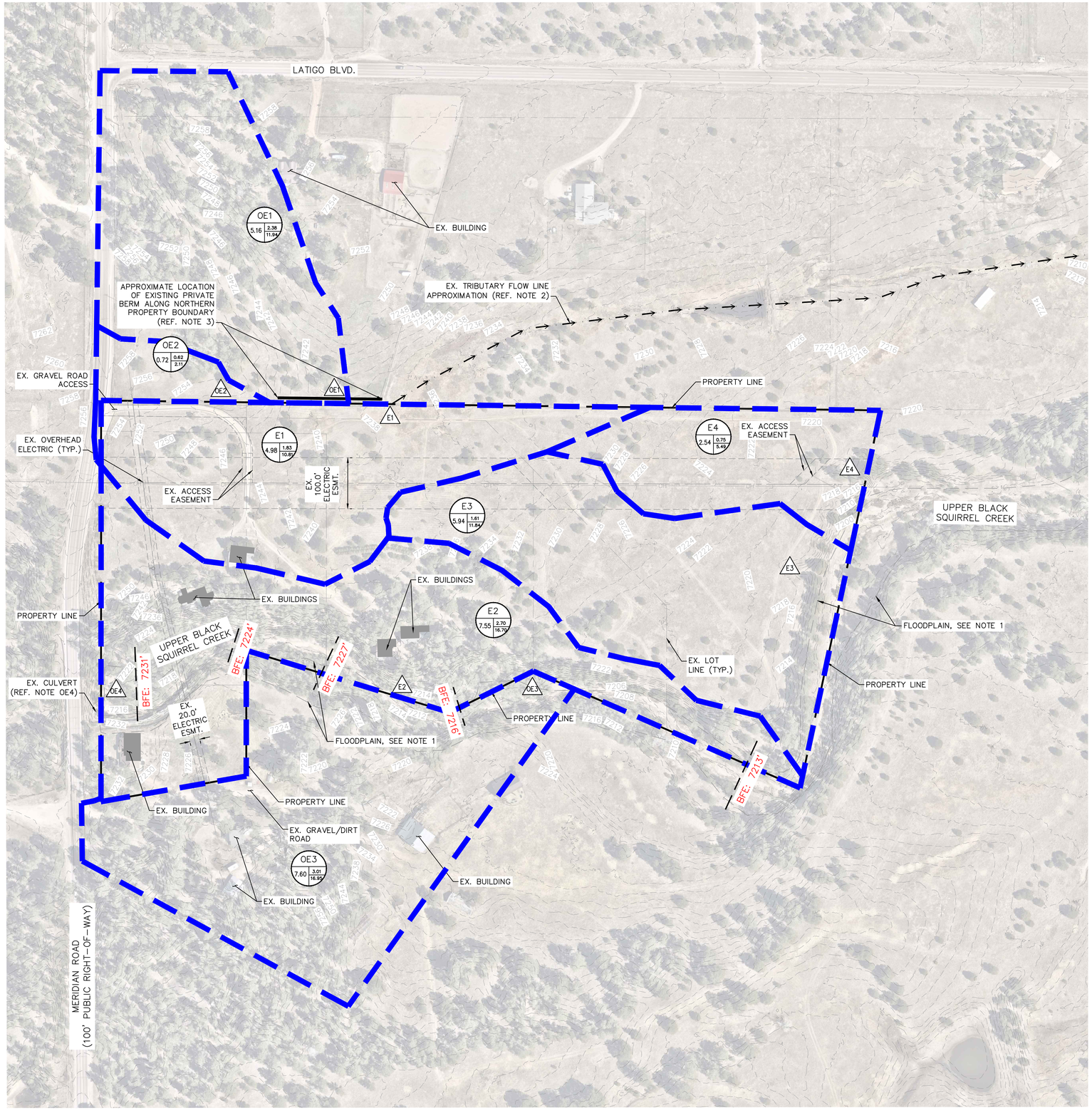
Pr. XS-4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.010 ft/ft
Normal Depth	56.3 in
Discharge	685.00 cfs



EXISTING AND PROPOSED DRAINAGE MAP



LEGEND

- PROPERTY LINE
- XXXX — EX. MAJOR CONTOUR
- XXXX — EX. MINOR CONTOUR
- EX. SUB-BASIN BOUNDARY
- A = BASIN DESIGNATION
  B = AREA IN ACRES
  C = 5-YR RUNOFF
  D = 100-YR RUNOFF
- # = DESIGN POINT DESIGNATION
- X.XX% EXISTING SLOPE ARROW
- FLOW DIRECTIONAL ARROW

Kimley»Horn

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK

EXISTING CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	Q5	Q100	% IMPERVIOUS
E1	E1	4.98	1.83	10.81	4%
E2	E2	7.55	2.70	16.70	3%
E3	E3	5.94	1.61	11.84	0%
E4	E4	2.54	0.75	5.49	0%
OE1	OE1	5.16	2.38	11.94	6%
OE2	OE2	0.72	0.62	2.11	18%
OE3	OE3	7.60	3.01	16.95	5%
Cumulative Sub-Basins					
OE1	OE1+OE2	5.88	2.96	13.91	
TOTAL		34.50	12.90	75.84	3%

NOTES

1. DRAFT MODEL BACKED BFES AND FLOODPLAIN EXTENTS FOR THIS AREA HAVE BEEN DEVELOPED AS PART OF PHASE 1 FOR THE ONGOING EL PASO COUNTY, CO, RISK MAP PROJECT". THE DATA HAS BEEN REVIEWED AND APPROVED THROUGH FEMA'S QA/QC PROCESS (MAY 11, 2022) AND IS CURRENTLY IN THE MIP (CASE NO. 19-08-0037S). THE PHASE 1/BASE LEVEL ENGINEERING OUTPUTS AND ZONE A READY DELIVERABLES ARE, UNDER THE FOLLOWING FOLDER: K:/FY2019/19-08-0037S/DISCOVERY - BLE - EL PASO AND TELLER COUNTIES, CO - FY18 - 04/DISCOVERY DATA CAPTURE - DISCOVERY DATA CAPTURE - EL PASO AND TELLER COUNTIES, CO - 01/EL PASO_DISCOVERY_1. FLOODPLAIN EXTENTS AND BASE FLOOD ELEVATIONS (BFES) SHOWN HEREON INCLUDE BOTH CURRENT EFFECTIVE AND CWCB PHASE 1 DATA.
2. SUB-BASINS OE1 AND OE2 FOLLOW DRAINAGE PATTERS CONSISTENT WITH THE EXISTING TRIBUTARY OF UPPER BLACK SQUIRREL CREEK. FLOWS ENTER THE SITE ALONG THE NORTHERN PROPERTY BOUNDARY AND IMMEDIATELY FLOW OFFSITE INTO THE EXISTING TRIBUTARY THAT EVENTUALLY DRAINS TO UPPER BLACK SQUIRREL CREEK. (REF. SITE VISIT PHOTOS IN FDR APPENDIX)
3. THERE IS AN EXISTING BERM ALONG THE NORTHERN PROPERTY LINE THAT FOLLOWS THE EXISTING FENCE LINE OF THE ADJACENT PROPERTY. THIS ACTS TO MITIGATE ANY EXCESSIVE STORMWATER RUNOFF FROM THE NORTH AND DIRECTS FLOWS INTO THE TRIBUTARY OF UPPER BLACK SQUIRREL CREEK. (REF. SITE VISIT PHOTOS IN FDR APPENDIX)

OE4

DESIGN POINT OE4 REPRESENTS TOTAL FLOWS ENTERING SITE FROM BLACK SQUIRREL CREEK & SNIPE CREEK

TRIBUTARY AREA: 6.29 SQ MI
5-YR EVENT: 105 CFS
100-YR EVENT: 605 CFS

PLEASE REFERENCE FINAL DRAINAGE REPORT NARRATIVE AND ASSOCIATED APPENDIX FOR 'STREAMSTATS' MODEL AND CALCULATIONS

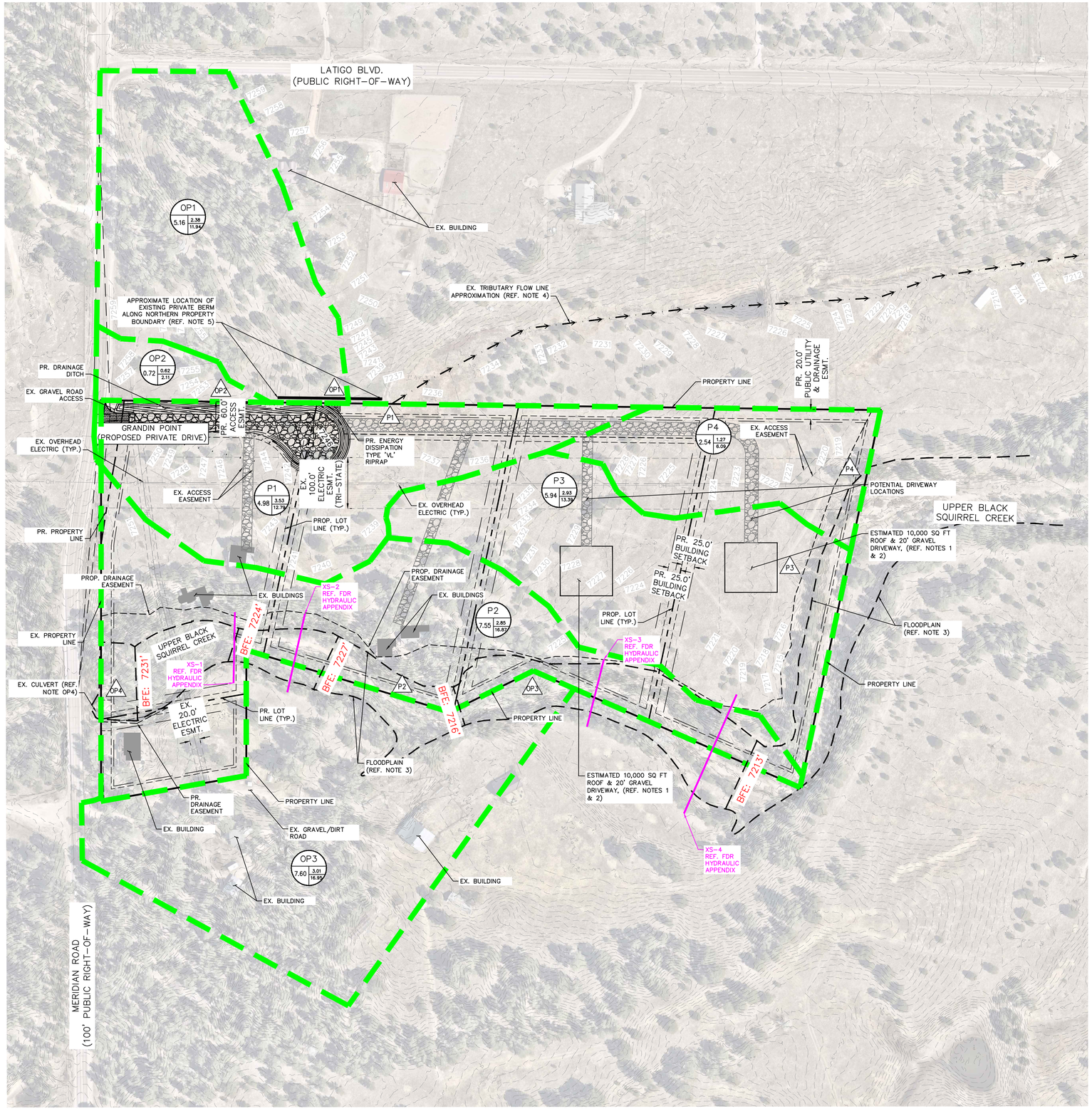
NORTH

GRAPHIC SCALE IN FEET
0 50 100 200

KNECHT MINOR SUBDIVISION
EXISTING CONDITIONS
DRAINAGE MAP

Kimley»Horn

Date: February 19, 2025 — 3:38pm / User: drewmcclain
Path: K:\COS_Civil\196775000_Knecht Minor Subdivision\CADD\Exhibits\Drainage\Ex Conditions Drainage Map.dwg



LEGEND

- PROPERTY LINE
- FLOODPLAIN BOUNDARY
- XXXX — EX. MAJOR CONTOUR
- XXXX — EX. MINOR CONTOUR
- XXXX — PROP. MAJOR CONTOUR
- XXXX — PROP. MINOR CONTOUR
- PROPOSED SUB-BASIN BOUNDARY

A = BASIN DESIGNATION
B = AREA IN ACRES
C = 5-YR RUNOFF
D = 100-YR RUNOFF

\# = DESIGN POINT DESIGNATION

X.XX% — EXISTING SLOPE ARROW

X.XX% — PROPOSED SLOPE ARROW

FLOW DIRECTIONAL ARROW

Kimley»Horn

PROJECT NAME: KNECHT MINOR SUBDIVISION
PROJECT NUMBER: 196775000
CALCULATED BY: DPM
CHECKED BY: KRK

PROPOSED CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	PROPOSED AREA (AC)	Q5	Q100	% IMPERVIOUS
P1	P1	4.98	3.53	12.79	19%
P2	P2	7.55	2.85	16.87	4%
P3	P3	5.94	2.93	13.39	9%
P4	P4	2.54	1.27	6.09	9%
OP1	OP1	5.16	2.38	11.94	6%
OP2	OP2	0.72	0.62	2.11	18%
OP3	OP3	7.60	3.01	16.95	5%
Cumulative Sub-Basins					
OP1	OP1+OP2	5.88	2.96	13.91	
TOTAL		**34.50**	**16.59**	**80.14**	**8%**

NOTES

1. ALL SINGLE-FAMILY LOTS SHOWN ARE GREATER THAN OR EQUAL TO 2.5 ACRES IN SIZE PER DWELLING UNIT AND HAVE A TOTAL LOT IMPERVIOUS AREA OF LESS THAN 10 PERCENT.
2. ALL POTENTIAL BUILDING FOOTPRINTS AND DRIVEWAY ALIGNMENTS ARE CONCEPTUAL IN NATURE AND ARE INTENDED ONLY TO PROVIDE A CONSERVATIVE ESTIMATE OF THE AREAS AND LOCATIONS. ADDITIONALLY, THIS FURTHER DEMONSTRATES THE OVERALL COMPLIANCE AND ADHERENCE TO EL PASO COUNTY LOT STANDARDS THAT EACH LOT CAN ACHIEVE AN IMPERVIOUS AREA OF LESS THAN 10%.
3. DRAFT MODEL BACKED BFES AND FLOODPLAIN EXTENTS FOR THIS AREA HAVE BEEN DEVELOPED AS PART OF PHASE 1 FOR THE ONGOING EL PASO COUNTY, CO, RISK MAP PROJECT". THE DATA HAS BEEN REVIEWED AND APPROVED THROUGH FEMA'S QA/QC PROCESS (MAY 11, 2022) AND IS CURRENTLY IN THE MIP (CASE NO. 19-08-0037S). THE PHASE 1/BASE LEVEL ENGINEERING OUTPUTS AND ZONE A READY DELIVERABLES ARE, UNDER THE FOLLOWING FOLDER: K:/FY2019/19-08-0037S/DISCOVERY - BLE - EL PASO AND TELLER COUNTIES, CO - FY18 - 04/DISCOVERY DATA CAPTURE - DISCOVERY DATA CAPTURE - EL PASO AND TELLER COUNTIES, CO - 01/EL PASO_DISCOVERY_1. FLOODPLAIN EXTENTS AND BASE FLOOD ELEVATIONS (BFES) SHOWN HEREON INCLUDE BOTH CURRENT EFFECTIVE AND CWCB PHASE 1 DATA.
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OP4

DESIGN POINT OE4 REPRESENTS TOTAL FLOWS ENTERING SITE FROM BLACK SQUIRREL CREEK & SNIPE CREEK

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NORTH

GRAPHIC SCALE IN FEET
0 50 100 200

KNECHT MINOR SUBDIVISION
PROPOSED CONDITIONS
DRAINAGE MAP

Kimley»Horn

Date: February 27, 2025 - 5:39pm / User: drewmcclain
Path: K:\COS_Civil\196775000_Knecht Minor Subdivision\CADD\Exhibits\Drainage\Pr. Conditions Drainage Map.dwg