Final Drainage Report

La Foret
El Paso County, Colorado

PCD File No.: PPR2324

Prepared for:
La Foret
Conference & Retreat Center
6145 Shoup Rd
Colorado Springs, Colorado 80908

Prepared by:
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Project #: 096971007

Prepared: October 25, 2023

Kimley»Horn

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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 the City/County 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): _____ 10/26/2023

Colorado P.E. No. 57234 Date

DEVELOPER'S STATEMENT

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

La Foret Conference + Retreat Center, Inc.
Business Name

Brad Carroll
By:

Executive Director
Title:

6145 Shoup Rd. Colorado Springs, Co 80908
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.

Approved
By: Gilbert LaForce, P.E.
Engineering Manager
Date: 11/27/2023 12:49:51 PM
El Paso County Department of Public Works

Joshua
County

Date

Conditions:

Kimley»Horn

GENERAL LOCATION AND DESCRIPTION

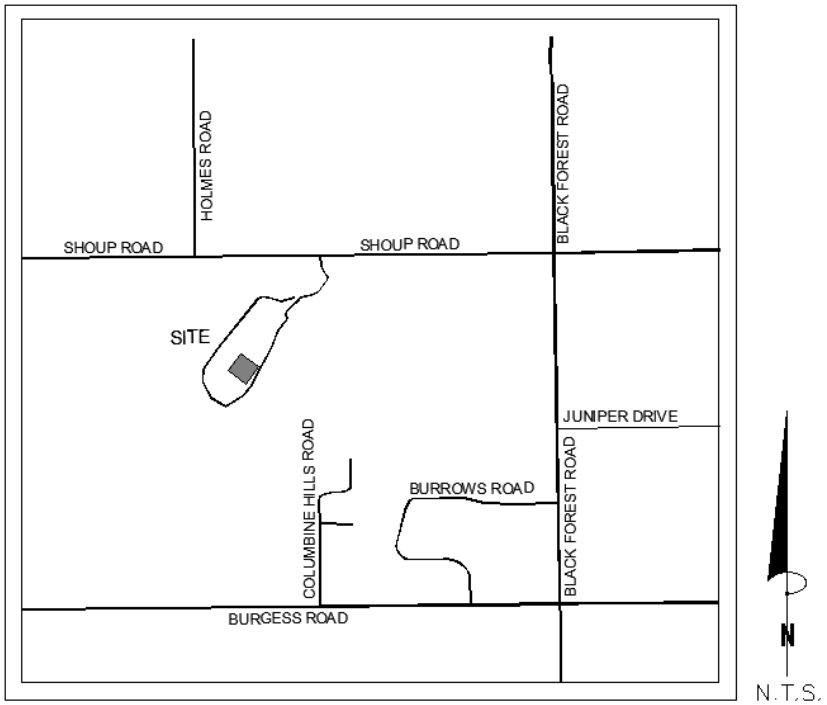
PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to provide the hydrologic and hydraulic calculations and to document and finalize the drainage design methodology in support of the proposed La Foret development ("the Project") for La Foret Conference & Retreat Center. 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 southwest of the Shoup Road and Black Forest Road intersection in El Paso County, Colorado. More specifically the Project lies within an unplatted property that is contained within section 18 of Township 12 South, Range 65 W and section 13 of township 12 south Range 66 W of the 6th Principal Meridian in El Paso County, Colorado. A vicinity map has been provided below.

VICINITY MAP



VICINITY MAP
N.T.S

DESCRIPTION OF PROPERTY

The Project is located on the 436.21 acres of La Foret Conference and Retreat Center (Parcel # 5218000112). The entire property consists of partially developed forested land with several existing buildings and other various structures and has private, dirt roadways; most of the property is undeveloped forest and meadow land. The proposed Project consists of an

approximately 9,870 SF guest lodge, parking lot, and associated landscaping. The site currently does not provide stormwater quality or detention. The site generally drains from the northeast to southwest with slopes ranging from 2% to 15% with the steeper slopes along the east side of the site. Runoff flows across the Site as sheet flow and is channelized in a grassy swale within the exiting meadow to the west of the Project site. The Project is ultimately tributary to Kettle Creek and approximately 1000 ft away. The Project it is not located in any flood plain buffers or flood plains.

SOILS DATA

NRCS soil data for the Site is provided in the **Appendix** and the onsite soils are USCS Hydrologic Soil Group B. Group B soils have moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

PROJECT CHARACTERISTICS

The Project limits of disturbance are 3.02 with a total drainage study area of 6.79 acres. The proposed commercial development will include an approximatley 9,870 SF confernece center building, gravel driveway, parking, sidewalks, landscaping, utility, and stormwater improvements. Water quality quality of the site will be provided by a proposed aboveground private rain garden located in the southwest corner of the project site that will accept flows from the majority of the site. Developed flows within the site will be collected by proposed draiange ditches, roof drains, and area inlets before being carried to the proposed water quality facility. Flows are planned to outfall into an existing shallow natural drainage ditch located in south west of the project site.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm 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 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. The water quality sand filter sizing was calculated using methods as specified in the CRITERIA and MANUAL. The water quality sand filter orifice structure was designed to release the Water Quality Capture Volume (WQCV) in 12 hours. Based upon this approach, the drainage design provided for the Site is in keeping with the historic drainage patterns for the Site.

HYDRAULIC CRITERIA

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA and information provided in the CRITERIA. Hydraulic calculations were computed using Flow master, and Storm CAD using the Standard Method. Results of the hydraulic calculations are summarized in the **Appendix**.

VARIANCES FROM CRITERIA

There are no proposed variances from the El Paso County Drainage Criteria.

DRAINAGE BASINS AND SUB-BASINS

MAJOR BASIN DESCRIPTIONS

The Property is located in the Kettle Creek drainage basin and is tributary to Black Squirrel Creek. The Drainage Basin Planning Study for the Kettle Creek drainage basin was prepared May 5th, 2015, by JR Engineering LLC. See Drainage Basin Planning Study in **Appendix**. There are no proposed creek improvements with this project. Due to the minor flows and distance from Kettle Creek the project is not anticipated to adversely affect downstream conditions. There are no identified nearby irrigation facilities or other obstructions which could influence the local drainage.

There are no currently approved drainage reports for the Property. All drainage design will be in compliance of the existing Drainage Basin Planning Study for the Kettle Creek drainage basin.

FLOODPLAIN STATEMENT

The Project Site (Proposed Building) is located outside the 100-year floodplain and within Zone X (an area of minimal flood hazard) as noted on the FEMA FIRM Map No. 08041C0315G revised on December 7, 2018 (See **Appendix**).

EXISTING DRAINAGE CONDITIONS

The existing Site has been divided into (5) five on-site sub-basins, E1-E5. A description of each sub-basin is listed below. Under existing conditions, the total studied drainage area of the site is 6.76 acres. Flows generally travel overland from northeast to southwest at slopes of 2-15%. Flows enter an existing meadow west of the site then is conveyed via a shallow natural channel that runs through the meadow southwest and into forest area that ultimately discharges at the confluence of the Burgess River and Kettle 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 is 7%. Total flows generated in existing conditions are 3.66 cfs for the 5-year event and 17.66 cfs for the 100-year event.

Sub-Basin E1

Sub-basin E1 is 1.77 acres and consists of northern portion of the Site. This sub-basin consists of native grasses and trees, a gravel parking area, and sidewalk. The runoff developed within

this basin sheet flows overland from east to west at slopes that range approximately 5-15%. Flows then enter the existing meadow at DP E1. The weighted imperviousness of sub-basin E1 is 18%. The developed direct runoff from sub-basin E1 is 1.54 cfs for the 5-year event and 5.23 cfs for the 100-year event.

Sub-Basin E2

Sub-basin E is 3.18 acres and consists of the central portion of the Site. This sub-basin consists of native grasses and trees, a gravel parking area, and an existing cabin. The runoff developed within this basin sheet flows overland from east to west at slopes that range approximately 5-15%. Flows then enter the existing meadow at DP E2. The weighted imperviousness of sub-basin E2 is 5%. The developed direct runoff from sub-basin E2 is 1.47 cfs for the 5-year event and 7.73 cfs for the 100-year event.

Sub-Basin E3

Sub-basin E3 is 0.74 acres and consists of southern portion of the Site. This sub-basin is undeveloped and consists of native grasses and trees. The runoff developed within this basin sheet flows overland from northeast to southwest at slopes of approximately 8%. Flows then enter an existing forest area at DP E3. The weighted imperviousness of sub-basin E3 is 0%. The developed direct runoff from sub-basin E3 is 0.25 cfs for the 5-year event and 1.80 cfs for the 100-year event.

Sub-Basin E4

Sub-basin E4 is 0.58 acres and consists of the southeast portion of the Site adjacent to the existing private drive. This sub-basin consists of native grasses and trees. The runoff developed within this basin sheet flows overland from northwest to southeast at slopes of approximately 7%. Flows are then captured by the existing roadside ditch and travel south at DP E4. Flows continue this path before being discharged into a forest area south of the project site. The weighted imperviousness of sub-basin E4 is 0%. The developed direct runoff from sub-basin E4 is 0.24 cfs for the 5-year event and 1.75 cfs for the 100-year event.

Sub-Basin E5

Sub-basin E5 is 0.49 acres and consists of the southwest portion of the Site. This sub-basin is undeveloped and consists of native grasses and trees. The runoff developed within this basin sheet flows overland from the northeast to southwest at slopes of approximately 7%. Flows then enter an existing forest area at DP E5. The weighted imperviousness of sub-basin E5 is 0%. The developed direct runoff from sub-basin E5 is 0.16 cfs for the 5-yeat even and 1.15 cfs for the 100-year event.

PROPOSED DRAINAGE CONDITIONS

The proposed Site has been divided into (19) nineteen on-site sub-basins, P1-P8, P1.U-P3.U, P5.U, A1-A3, and R1-R4. A description of each sub-basin is listed below. Under the proposed conditions, the total studied drainage area is 6.79 acres in size and involves the construction of an approximately 9,870 SF lodge, site access, parking, sidewalks, landscaping, wet and dry utilities, and stormwater infrastructure. The total disturbed area of the site is 3.02 acres. Flows generated from the majority of the drainage area's proposed conditions are to be captured and conveyed via proposed drainage ditches and roof drains to a proposed private above ground water quality rain garden. Flows are released from this proposed water quality feature via outlet pipe with orifice plate into the existing shallow natural channel that runs southwest through the forest area that ultimately discharges into a shallow valley that runs offsite into more forest area.

Flows generated from the proposed conditions will generally follow historic patterns. Under proposed conditions the studied drainage area associated with this project is 6.79 acres with a 20% weighted imperviousness and 5 and 100-yr flows of 7.40 cfs and 23.93 cfs respectively. The sub-basins tributary to the proposed water quality feature (P3, P3.U, P4, P6, R1-R4, A1-A3) is 2.89 acres with a 26% weighted imperviousness and 5 and 100-yr flows of 3.81 cfs and 11.04 cfs respectively. The rain garden sizing, drainage ditch sizing, and a proposed conditions drainage map can be found in the **Appendix.**

Sub-Basin P1

Sub-basin P1 is 0.07 acres and consists of northern portion of the Site. This sub-basin consists native grasses, tress and proposed sidewalk. The runoff developed within this basin sheet flows overland from east to west at slopes that range approximately 1-2%. Flows then enter Sub-basin P1 at DP P1.U. The weighted imperviousness of sub-basin P1 is 45%. The developed direct runoff from sub-basin P1 is 0.13 cfs for the 5-year event and 0.31 cfs for the 100-year event. Flows from sub-basin P1 will follow historic drainage patterns.

Sub-Basin P1.U

Sub-basin P1.U is 1.70 acres and consists of northern portion of the Site. This sub-basin consists of native grasses and trees and existing sidewalk. The runoff developed within this basin sheet flows overland from east to west at slopes that range approximately 5-15%. Flows then enter the existing meadow at DP P1. The weighted imperviousness of sub-basin P1.U is 22%. The developed direct runoff from sub-basin P1.U is 2.07 cfs for the 5-year event and 6.50 cfs for the 100-year event. Flows from sub-basin P1.U will follow historic drainage patterns.

Sub-Basin P2

Sub-basin P2 is 0.30 acres and is located north of the proposed development on the Site. This sub-basin consists of a gravel parking area, existing and proposed sidewalk, a portion of the proposed parking area, and the proposed drainage bypass channel. The runoff developed within this basin generally sheet flows overland from northeast to southwest at slopes that range approximately 5-12%. Flows are to be captured and bypass the site via the proposed drainage ditch and carried west to the existing meadow and shallow natural channel at DP P2. Flows within this sub-basin will generally follow historic drainage patterns. The weighted imperviousness of sub-basin P2 is 54%. The developed direct runoff from sub-basin P2 is 0.80 cfs for the 5-year event and 1.75 cfs for the 100-year event.

Sub-Basin P2.U

Sub-basin P2.U is 0.43 acres and is located north of the proposed development on the Site. This sub-basin consists of native grasses and trees. The runoff developed within this basin generally sheet flows overland from northeast to southwest at slopes that range approximately 5-12%. Flows then enter Sub-basin P2 at DP P2.U. Flows within this sub-basin will generally follow historic drainage patterns. The weighted imperviousness of sub-basin P2 is 0%. The developed direct runoff from sub-basin P2 is 0.14 cfs for the 5-year event and 1.02 cfs for the 100-year event.

Sub-Basin P3

Sub-basin P3 is 0.60 acres and is located on the eastern portion of the Site, between the proposed lodge parking area and the existing private gravel road. This sub-basin consists of a gravel parking area, a portion of the proposed access drive, and a proposed drainage ditch. The runoff developed within this basin sheet flows overland from east to west at slopes that range approximately 5-33.3%. Flows then enter Sub-basin P3 at DP P3.U. The weighted imperviousness of sub-basin P3 is 46%. The developed direct runoff from sub-basin P3 is 1.10 cfs for the 5-year event and 2.55 cfs for the 100-year event.

Sub-Basin P3.U

Sub-basin P3.U is 1.27 acres and is located on the eastern portion of the Site, between the proposed lodge parking area and the existing private gravel road. This sub-basin consists of native grasses and trees and an existing cabin structure. The runoff developed within this basin sheet flows overland from east to west at slopes that range approximately 5-33.3%%. Flows then enter the proposed Drainage Ditch A and are carried through a proposed culvert at DP P3 before ultimately being collected by the proposed private water quality rain garden. The weighted imperviousness of sub-basin P3 is 0%. The developed direct runoff from sub-basin P3 is 0.44 cfs for the 5-year event and 3.23 cfs for the 100-year event.

Sub-Basin P4

Sub-basin P4 is 0.38 acres and consists of the southeast portion of the Site adjacent to the existing private drive. This sub-basin consists of a portion of the proposed parking area, landscaping, a proposed drainage ditch, and a portion of the proposed access drive. The runoff developed within this basin sheet flows overland from east to west at slopes of approximately 7-33.3%. Flows are then captured by the proposed Drainage Ditch B and travel south where it enters the proposed water quality rain garden at DP P4. The weighted imperviousness of sub-basin P4 is 39%. The developed direct runoff from sub-basin P4 is 0.72 cfs for the 5-year event and 1.77 cfs for the 100-year event.

Sub-Basin P5

Sub-basin P5 is 0.03 acres and consists of southern portion of the Site. This sub-basin consists of a portion of the proposed gravel driveway. The runoff developed within this basin sheet flows overland from northeast to southwest at slopes of approximately 8%. Flows then enter an existing forest area at DP P5. The weighted imperviousness of sub-basin P5 is 0%. The developed direct runoff from sub-basin P5 is 0.01 cfs for the 5-year event and 0.08 cfs for the 100-year event. Flows from sub-basin P5 will follow historic drainage patterns.

Sub-Basin P5.U

Sub-basin P5.U is 0.47 acres and consists of southern portion of the Site. This sub-basin is undeveloped and consists of native grasses and trees. The runoff developed within this basin sheet flows overland from northeast to southwest at slopes of approximately 7%. Flows then enter an existing forest area at DP P5.U. The weighted imperviousness of sub-basin P5 is 0%. The developed direct runoff from sub-basin P5 is 0.16 cfs for the 5-year event and 1.18 cfs for the 100-year event. Flows from sub-basin P5 will follow historic drainage patterns.

Sub-Basin P6

Sub-basin P6 is 0.28 acres and is located of southwest portion of the Site. This sub-basin consists of a portion of the proposed parking area, landscaping, and the proposed water quality rain garden. The runoff developed within this basin sheet flows overland from north to south at slopes of approximately 4-10%. Flows then enter the proposed private above ground water quality rain garden at DP P6. The weighted imperviousness of sub-basin P6 is 18%. The developed direct runoff from sub-basin P6 is 0.33 cfs for the 5-year event and 1.11 cfs for the 100-year event.

Sub-Basin P7

Sub-basin P7 is 0.38 acres and is located in the western portion of the Site. This sub-basin consists of a portion of the meadow area behind the proposed lodge. The runoff developed within this basin sheet flows overland from east to west at slopes of approximately 5-10%. Flows enter the existing meadow at DP P7. The weighted imperviousness of sub-basin P7 is 0%. The developed direct runoff from sub-basin P7 is 0.15 cfs for the 5-year event and 1.07 cfs for the 100-year event. There are no proposed improvements or changes to imperviousness to sub-basin P7 and all flows in sub-basin P7 will follow historic drainage patterns.

Sub-Basin P8

Sub-basin P8 is 0.52 acres and is located in the southern portion of the Site. This sub-basin will be the location of the proposed underground septic system, and sanitary leach field. The runoff developed within this basin will follow historic drainage patterns and travel southwest and into the existing shallow natural drainage channel that runs southwest through the meadow at DP P8 and into the forest area southwest of the Site. The weighted imperviousness of sub-basin P8 is 0%. The developed direct runoff from sub-basin P8 is 0.13 cfs for the 5-year event and 0.98 cfs for the 100-year event. There are no proposed above ground improvements or changes to imperviousness to sub-basin P8 and all flows in sub-basin P8 will follow historic drainage patterns.

Sub-Basin R1

Sub-basin R1 is 0.06 acres and is located in the central portion of the site. This sub-basin consists of the southeast quarter of the proposed lodge roof. The runoff developed within this basin will be collected via proposed roof drains at DP R1 and carried through proposed private 8” HDPE storm line before being ultimately released into the proposed private aboveground water quality rain garden. The weighted imperviousness of sub-basin R1 is 84%. The developed direct runoff from sub-basin R1 is 0.23 cfs for the 5-year event and 0.44 cfs for the 100-year event.

Sub-Basin R2

Sub-basin R2 is 0.07 acres and is located in the central portion of the site. This sub-basin consists of the southwest quarter of the proposed lodge roof. The runoff developed within this basin will be collected via proposed roof drains at DP R2 and carried through proposed private 8” HDPE storm line before being ultimately released into the proposed private aboveground water quality rain garden. The weighted imperviousness of sub-basin R2 is 88%. The developed direct runoff from sub-basin R2 is 0.26 cfs for the 5-year event and 0.50 cfs for the 100-year event.

Sub-Basin R3

Sub-basin R3 is 0.10 acres and is located in the central portion of the site. This sub-basin consists of the northeast quarter of the proposed lodge roof. The runoff developed within this

basin will be collected via proposed roof drains at DP R3 and carried through proposed private 8" HDPE storm line before being ultimately released into the proposed private aboveground water quality rain garden. The weighted imperviousness of sub-basin R3 is 89%. The developed direct runoff from sub-basin R3 is 0.38 cfs for the 5-year event and 0.71 cfs for the 100-year event.

Sub-Basin R4

Sub-basin R4 is 0.09 acres and is located in the central portion of the site. This sub-basin consists of the northwest quarter of the proposed lodge roof. The runoff developed within this basin will be collected via proposed roof drains at DP R4 and carried through proposed private 8" HDPE storm line before being ultimately released into the proposed private aboveground water quality rain garden. The weighted imperviousness of sub-basin R4 is 92%. The developed direct runoff from sub-basin R4 is 0.34 cfs for the 5-year event and 0.63 cfs for the 100-year event.

Sub-Basin A1

Sub-basin A1 is 0.02 acres and is located in the western portion of the site. This sub-basin consists of a small portion of proposed lawn located on the rear of the proposed lodge. The runoff developed within this basin will be collected via proposed 6" Nyoplast area inlet at DP A1 and carried through proposed private 8" HDPE storm line before being ultimately released into the proposed private aboveground water quality rain garden. The weighted imperviousness of sub-basin A1 is 0%. The developed direct runoff from sub-basin A1 is 0.01 cfs for the 5-year event and 0.05 cfs for the 100-year event.

Sub-Basin A2

Sub-basin A2 is 0.01 acres and is located in the western portion of the site. This sub-basin consists of a small portion of proposed lawn located on the rear of the proposed lodge. The runoff developed within this basin will be collected via proposed 6" Nyoplast area inlet at DP A2 and carried through proposed private 8" HDPE storm line before being ultimately released into the proposed private aboveground water quality rain garden. The weighted imperviousness of sub-basin A2 is 0%. The developed direct runoff from sub-basin A2 is 0.01 cfs for the 5-year event and 0.04 cfs for the 100-year event.

Sub-Basin A3

Sub-basin A3 is 0.01 acres and is located in the western portion of the site. This sub-basin consists of a small portion of proposed lawn located on the rear of the proposed lodge. The runoff developed within this basin will be collected via proposed 6" Nyoplast area inlet at DP A3 and carried through proposed private 8" HDPE storm line before being ultimately released into the proposed private aboveground water quality rain garden. The weighted imperviousness of sub-basin A3 is 0%. The developed direct runoff from sub-basin A3 is less than 0.01 cfs for the 5-year event and 0.03 cfs for the 100-year event.

DRAINAGE FACILITY DESIGN

DETENTION AND WATER QUALITY

The WQCV is required for this Project. This is accomplished through the proposed private above ground rain garden located in the southwest corner of the Site. Per Chapter 3.2.8.B of the

Criteria, “The proposed project or developed land use shall not change historical runoff values, cause downstream damage or adversely impact adjacent properties”. A justification of the above criteria can be found below.

1. Shall not change historic runoff values.

   Generally, there are two points of ultimate outflow from this site. The first occurs at the western side of the proposed Site where flows will be conveyed through existing shallow natural channel that runs southwest through the meadow and into forest area. Total flows entering this area in existing conditions (sub-basins E1, and E2) are 3.01 cfs during the 5-year storm event and 12.96 cfs in the 100-yr storm event. Under proposed conditions, these flows entering this area (sub-basins P1, P1.U, P2, P2.U, P7, and the combined flow from the proposed rain garden) are 7.10 cfs during the 5-year storm event and 21.69 cfs in the 100-yr storm event. The second area of outflow from the site is the forested area along the southern portion of the proposed Site. Total flows entering this area in existing conditions (sub-basins E3, E4 and E5) are 0.65 cfs during the 5-year storm event and 4.70 cfs in the 100-yr storm event. Under proposed conditions, these flows entering this area (sub-basins P5, P5.U, and P8) are 0.30 cfs during the 5-year storm event and 2.24 cfs in the 100-yr storm event. Overall, site imperviousness increases slightly from 7% to 20% with flows increasing from 17.66 to 23.93 cfs in the 100-year storm event. In the proposed conditions there is a slight increase to total flows generated from the project site. The slight increase in flows generated for the western portion of the Site are entering a densely wooded and naturally vegetated area. These areas are extremely stable and the minimal increase in flows will have a negligible impact, and as such the proposed project poses no risk to downstream waterways or infrastructure.

2. Shall not cause downstream damage.

   The downstream meadow is stable and gradual with longitudinal and side slopes of approximately 1-2% and 5-7% respectively. Photos of meadow and natural receiving areas have been added to the **Appendix**. As the receiving area is vegetated and extremely stable. In addition, as Black Squirrel Creek is approximately 1000 ft downstream from the proposed site, the slight increase to flows exiting the site pose no risk downstream.

3. Shall not adversely impact adjacent properties.

   The proposed Site is approximately 1200 ft from the nearest adjacent property. In the proposed conditions all flows from Site will reach its ultimate outfall on the property. No adjacent properties will be impacted with the proposed improvements.

Any increases from the historical flow rates will be minor in nature and are accommodated downstream. The proposed flows will travel approximately 1000 ft through natural channels and woodland before arriving to the ultimate outfall. The water quality calculations are provided in the **Appendix** of this report. The proposed Rain Garden will be maintained by the La Foret Resort Centers.

The total disturbed area for this site without exclusions is 3.02 acres. The exclusions applicable to this Site include utility work which will not alter terrain ground cover or drainage patterns, and Land Disturbance to Undeveloped Land that will Remain Undeveloped. An exclusion exhibit has been provided in the **Appendix**.

Exclusions

1. Utility Work (Exclusion I.7.1.B.4): A proposed sanitary septic system and leach field is proposed on the south side of the Site which is included within the sub-basin P8. In addition, proposed utility tie-in areas are within sub-basin P1 and P1.U. The associated area with this exemption is 0.61 acres.

2. Land to Remain Undeveloped (Exclusion I.7.1.B.7): The proposed portion on the west side of the site which is included within the sub-basin P7. In addition, a small section within sub-basin P5.U located on the south side of the site. In existing conditions this area is undeveloped meadow, and in the proposed conditions this area is to remain as meadow. The associated area with this exemption is 0.39 acres.

The following table summarizes the exclusions from the total disturbed area considered for the Four Step Process.

Area Description	Area(ac)
Total Disturbed Area	3.02
Utility Exemption	0.61
Land to Remain Undeveloped	0.39
Disturbed Treatment Area	3.02 - 0.61 – 0.39 = 2.02

Four-Step Process

The four-step process per the MANUAL provides guidance and requirements for the selection of siting of structural Construction Control Measures (CCMs) for new development and significant redevelopment.

Step 1: Employ Runoff Reduction Practices
Currently the site is mostly vacant land with some minor development. Additional development of the site will increase current runoff conditions due to increased imperviousness values. However, implementation of landscaping throughout the site, the proposed storm sewer infrastructure, and the proposed rain garden will help slow runoff and encourage infiltration.

Step 2: Provide Water Quality Capture Volume (WQCV)
The water quality capture volume will be detained using a rain garden on the southeast corner of the Site. Sub-basin P8 and the utility tie-ins from sub-basin P1 and P1.U will be excluded from the four-step process based on **Appendix** I.7.1.B.4 as the underground leach field utility work will not permanently alter terrain, ground cover or drainage patterns. Sub-basin P7 and a small section of sub-basin P5.U will be excluded from the four-step process based on **Appendix** I.7.1.B.7 as the land disturbance to undeveloped land (land with no human-made structures such as buildings or pavement) will remain undeveloped after the site. The outfall from the water quality outlet structure will control the release of the WQCV stormwater to less than historic rates. Due to grading constraints, a portion of the disturbed area cannot be captured and treated in the proposed rain garden. 80% of the total disturbed, non-exempt area must receive water quality. The total non-exempt, disturbed area as a part of this development is 2.02 acres. Water quality treatment is being provided for 1.63 acres which is 80.7% of the total.

The following table outlines the non-exempt areas receiving water quality treatment, the disturbed areas flowing offsite that do not receive water quality treatment, and the areas of the site exempt from water quality treatment.

Condition	Total Area (AC)	Percentage of Total Non-Exempt Disturbed Area (%)	Sub-Basins
Areas Captured and Treated with Proposed Private Rain Garden	1.63	80.7%	P3, P4, P6, R1-R4, A1-A3
Disturbed Areas That Flow Offsite (No Treatment)	0.39	19.3%	P1, P2, P5
Areas Exempt from WQ Treatment			
Exclusion I.7.1.B.4 (Utility Work)	0.61	N/A	P8, P1, P1.U
Exclusion I.7.1.B.7 (Land to Remain Undeveloped)	0.39	N/A	P7, P5.U

Step 3: Stabilize Drainageways
There are no current drainageways conveyed adjacent to the Site. The proposed Site is approximately 1200 ft from the nearest adjacent property. In the proposed conditions all flows from Site will reach its ultimate outfall on the property. No adjacent properties will be impacted with the proposed improvements. No improvements to stabilize drainageways are proposed as part of this Project.

Step 4: Consider need for Industrial and Commercial BMPs
Erosion control features for the final stages of the Project will be designed to reduce contamination. Source control BMPs will include the use of, inlet protection, silt fences, concrete washout areas, stockpile management, and stabilized staging areas. The Grading and Erosion Control Plans will be submitted as a separate construction document set.

Water Quality Design

The proposed private rain garden is designed with an outlet structure that is fitted with a restrictor plate to release the WQCV in a 12-hour time period per the MANUAL. Calculations included in the **Appendix** provide details regarding the private water quality design.

Overall, based on 12-hour drain time 1,161 cu ft of WQCV is required. The total area contributing to the rain garden is 2.89 acres (26% imperviousness). The outlet structure and orifice releases approximately 0.03 cfs in the WQCV event.

Outlet Requirements

The water quality standards established by the CRITERIA are met by the proposed rain garden. The water quality outlet structure was designed per the specifications in the CRITERIA. The orifice plate will allow the WQCV to be drained in 12 hours.

MHFD UD-Detention v4.06 was utilized for the sole purposed of demonstrating volume provided and to determine WQCV WSE for the design of the outlet structure. All other information provided on UD-Detention spreadsheet can be disregarded as it is not applicable to the outlet structure design. Please refer to rain garden construction details and UD-BMP spreadsheet provided in **Appendix** for rain garden outlet structure design and details.

Emergency Spillway Path

The emergency overflow from the rain garden is designed to spill over the top of the rain garden and flow west into the existing natural shallow channel located in the meadow west of the site. Emergency overflow spillway path can be found on the Proposed Drainage report.

COST OF PROPOSED DRAINAGE FACILITIES

An Opinion of Probable Construction Cost (OPCC) is provided in the **Appendix** of the report. There are no public drainage facilities. All improvements with this Project will be private.

DRAINAGE AND BRIDGE FEES

The Site is located in the Kettle Creek Drainage Basin. The site is not planned to be platted and as such there are no required drainage and bridge fees.

GRADING AND EROSION CONTROL

The GEC will be submitted in conjunction with this report to El Paso County Planning and Community Development Department for review and approval prior to construction. The GEC plans are consistent with this drainage report.

MAINTENANCE AND OPERATIONS

Twice per year inspections (spring and fall) of the water quality structure is recommended. The owner/operator will be responsible for maintenance. A copy of this report will be provided to the owner/operator. This satisfies the Operation and Maintenance (O&M) Manual.

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

Generally speaking, there are two points of ultimate outflow from this site. The first occurs at the western side of the proposed Site where flows will be conveyed through existing shallow natural channel that runs southwest through the meadow and into forest area. Total flows entering this area in existing conditions (sub-basins E1, and E2) are 3.01 cfs during the 5-year storm event and 12.96 cfs in the 100-yr storm event. Under proposed conditions, these flows entering this area (sub-basins P1, P1.U, P2, P2.U, P7, and the combined flow from the proposed rain

garden) are 7.10 cfs during the 5-year storm event and 21.69 cfs in the 100-yr storm event. The second area of outflow from the site is the forested area along the southern portion of the proposed Site. Total flows entering this area in existing conditions (sub-basins E3, E4, and E5) are 0.65 cfs during the 5-year storm event and 4.70 cfs in the 100-yr storm event. Overall, site imperviousness increases slightly from 7% to 20% with flows slightly decreasing from 17.66 to 23.93 cfs in the 100-year storm event. The slight decrease in flows can be accounted for by the decrease in the Time of Concentration for the proposed basins. Any changes in flows are minimal in nature and effects of these changes would be negligible.

Compliance With Standards

The drainage design presented within this report for La Foret, conforms to the El Paso County Drainage Criteria Manual and the Mile High Flood District Urban Storm Drainage Criteria Manual. Additionally, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments.

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 08041C0315G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

APPENDIX

SOILS MAP AND FEMA FIRM PANEL

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/.

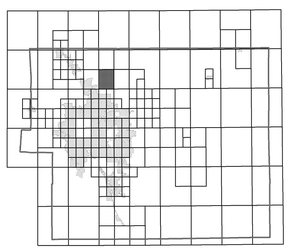
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

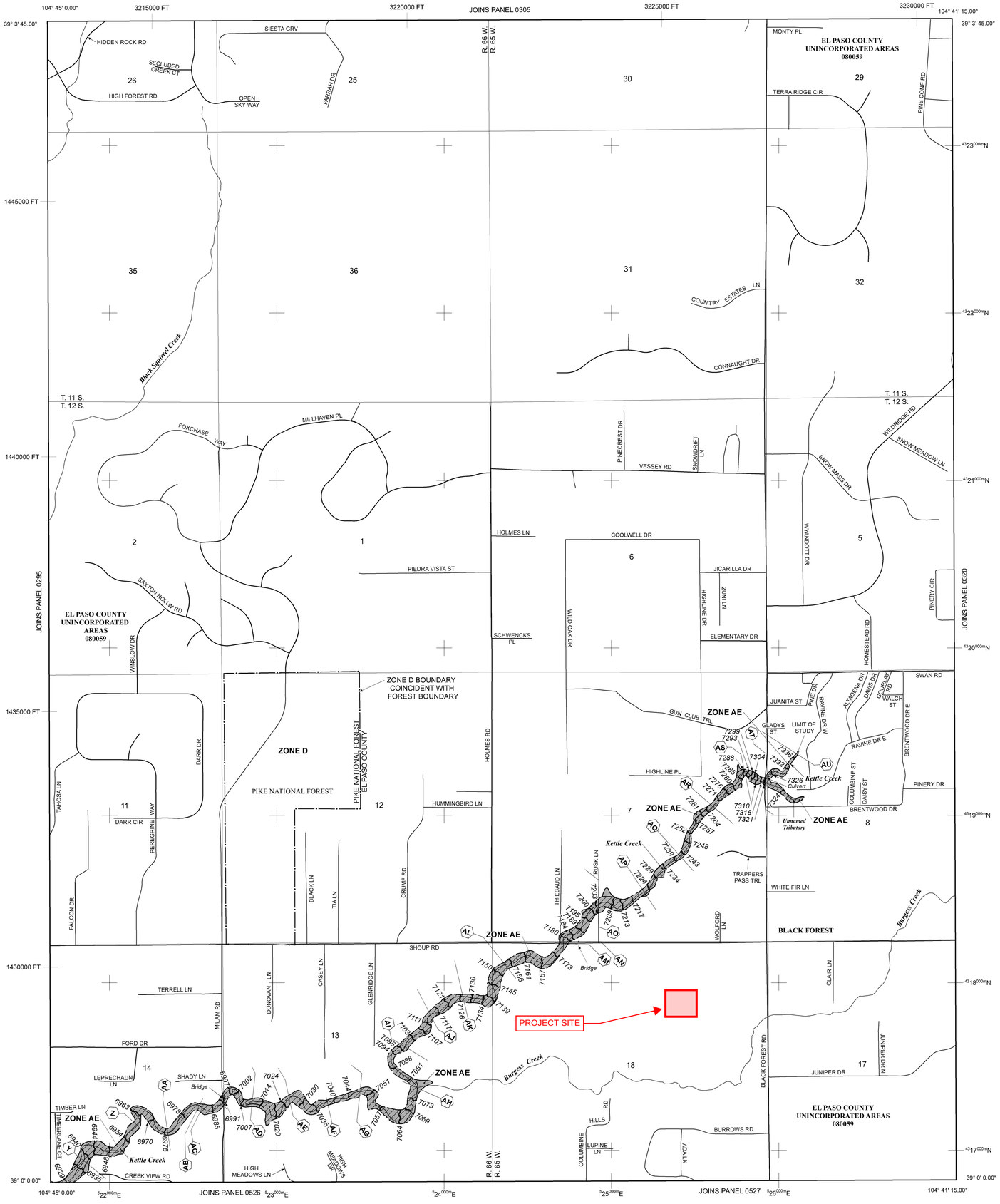
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

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.



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 0315G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 315 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0315	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 08041C0315G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for El Paso County Area, Colorado

May 11, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,800 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

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 20, Sep 2, 2022

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

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

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

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	6.1	100.0%
Totals for Area of Interest		**6.1**	**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

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Qualities and Features

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

Hydrologic Soil Group

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

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

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

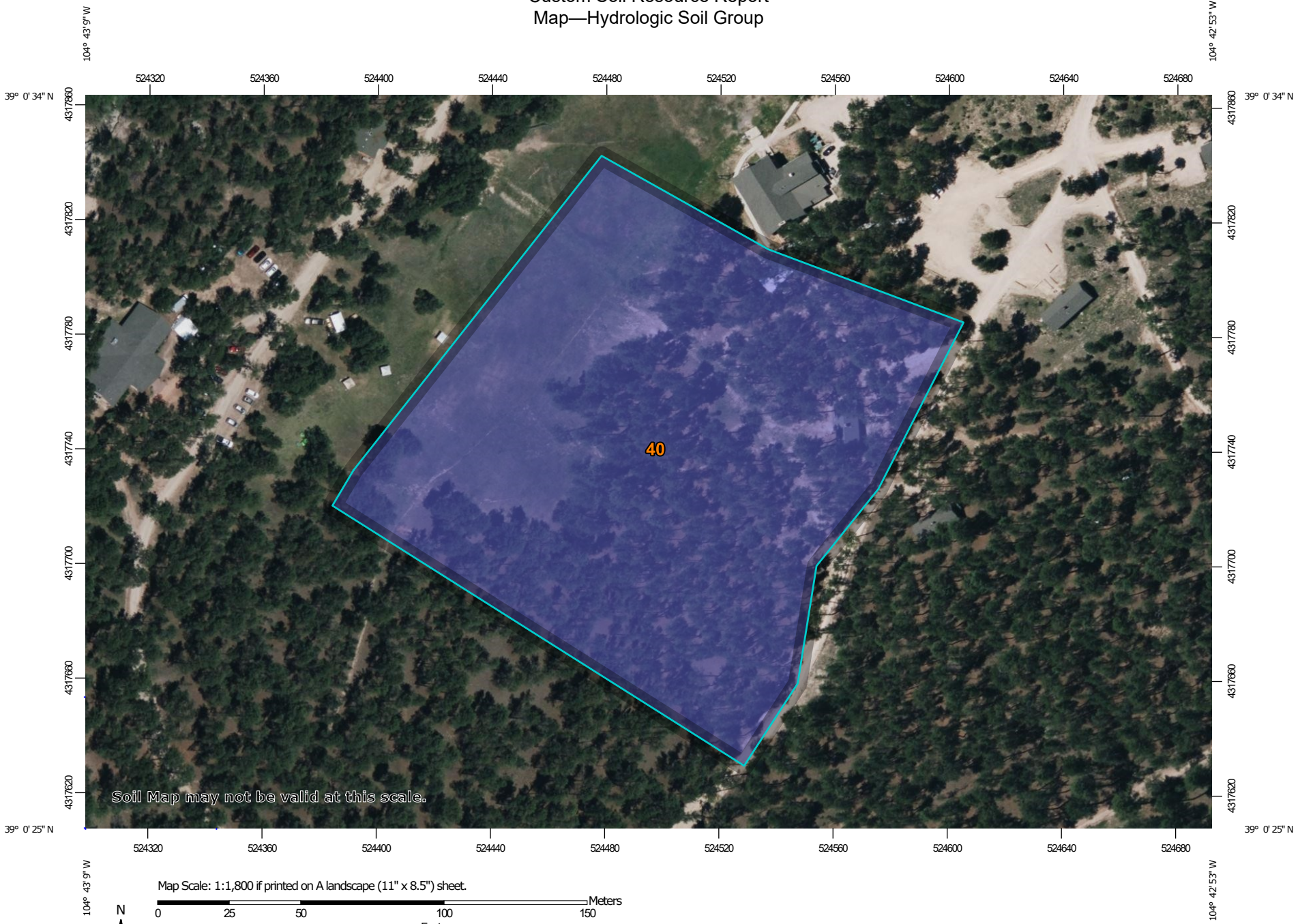
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:1,800 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

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

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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

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

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	B	6.1	100.0%
Totals for Area of Interest			**6.1**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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HYDROLOGIC CALCULATIONS

STANDARD FORM SF-1

RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

EXISTING CONDITIONS

PROJECT NAME: LA FORET DATE: ######
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

SOIL: B

LAND USE:	PAVEMENT AREA	ROOF AREA	LANDSCAPE AREA
2-YEAR COEFF.	0.89	0.71	0.02
5-YEAR COEFF.	0.90	0.73	0.08
10-YEAR COEFF.	0.92	0.75	0.15
100-YEAR COEFF.	0.96	0.81	0.35
IMPERVIOUS %	100%	90%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (AC)	ROOF AREA (AC)	LANDSCAPE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
FDR Basins										
E1	E1	0.32	0.00	1.45	**1.77**	0.18	0.23	0.29	0.46	18%
E2	E2	0.14	0.03	3.01	**3.18**	0.06	0.12	0.19	0.38	5%
E3	E3	0.00	0.00	0.74	**0.74**	0.02	0.08	0.15	0.35	0%
E4	E4	0.00	0.00	0.58	**0.58**	0.02	0.08	0.15	0.35	0%
E5	E5	0.00	0.00	0.49	**0.49**	0.02	0.08	0.15	0.35	0%
TOTAL - OVERALL		**0.46**	**0.03**	**6.27**	**6.76**	**0.08**	**0.14**	**0.20**	**0.39**	**7%**
		7%	**0%**	**93%**	**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: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

EXISTING CONDITIONS

DATE: 10/18/2023

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	1.77	0.23	100	9.5%	7.6	300	9.5%	2.5	0.8	6.5	14.0	400	9.5%	18%	12.2	12.2
E2	3.18	0.12	100	12.0%	7.8	350	6.0%	2.5	0.6	9.5	17.4	450	7.3%	5%	12.5	12.5
E3	0.74	0.08	100	8.0%	9.4	20	8.0%	2.5	0.7	0.5	9.8	120	8.0%		10.7	9.8
E4	0.58	0.08	100	6.0%		25	6.0%	2.5	0.6	0.7	0.7	125	6.0%		10.7	5.0
E5	0.49	0.08	70	3.5%	10.3	100	7.0%	2.5	0.7	2.5	12.8	170	5.6%		10.9	10.9

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

Note: Conveyance coefficient from Table 6-7 of DCM

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 2 YEAR EVENT

EXISTING CONDITIONS

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

DATE: 10/18/2023

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	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	1.77	0.23	12.22	0.40	3.06	1.23													
		E2	E2	3.18	0.12	12.50	0.39	3.03	1.18													
		E3	E3	0.74	0.08	9.82	0.06	3.32	0.20													
		E4	E4	0.58	0.08	5.00	0.05	4.12	0.19													
		E5	E5	0.49	0.08	10.94	0.04	3.19	0.13													

$$I_2 = -1.19 \ln(t_{c,min}) + 6.035$$

Note: Rainfall intensity from Figure 6-5 IDF Equations

Kimley»Horn

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

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

EXISTING CONDITIONS

DATE: 10/18/2023

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	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	1.77	0.23	12.22	0.40	3.83	1.54													
		E2	E2	3.18	0.12	12.50	0.39	3.79	1.47													
		E3	E3	0.74	0.08	9.82	0.06	4.16	0.25													
		E4	E4	0.58	0.08	5.00	0.05	5.17	0.24													
		E5	E5	0.49	0.08	10.94	0.04	3.99	0.16													

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

Note: Rainfall intensity from Figure 6-5 IDF Equations

Kimley»Horn

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

EXISTING CONDITIONS

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

DATE: 10/18/2023

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	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	1.77	0.46	12.22	0.81	6.43	5.23													
		E2	E2	3.18	0.38	12.50	1.21	6.37	7.73													
		E3	E3	0.74	0.35	9.82	0.26	6.98	1.80													
		E4	E4	0.58	0.35	5.00	0.20	8.68	1.75													
		E5	E5	0.49	0.35	10.94	0.17	6.71	1.15													

12.735

Note: Rainfall intensity from Figure 6-5 IDF Equations

Kimley»Horn

PROJECT NAME: LA FORET 10/18/2023
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

EXISTING CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	CFS			% IMPERVIOUS
			Q2	Q5	Q100	
FDR Basins						
E1	E1	1.77	1.23	1.54	5.23	18%
E2	E2	3.18	1.18	1.47	7.73	5%
E3	E3	0.74	0.20	0.25	1.80	0%
E4	E4	0.58	0.19	0.24	1.75	0%
E5	E5	0.49	0.13	0.16	1.15	0%
TOTAL		**6.76**	**2.92**	**3.66**	**17.66**	**7%**

Kimley»Horn

STANDARD FORM SF-1
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROPOSED CONDITIONS

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

DATE: 10/18/2023

SOIL: B

LAND USE:	PAVEMENT AREA	ROOF AREA	LANDSCAPE AREA
2-YEAR COEFF.	0.89	0.71	0.02
5-YEAR COEFF.	0.90	0.73	0.08
10-YEAR COEFF.	0.92	0.75	0.15
100-YEAR COEFF.	0.96	0.81	0.35
IMPERVIOUS %	100%	90%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (AC)	ROOF AREA (AC)	LANDSCAPE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
On-Site Basins										
P1	P1	0.03	0.00	0.04	**0.07**	0.41	0.45	0.49	0.62	45%
P1.U	P1.U	0.37	0.00	1.33	**1.70**	0.21	0.26	0.32	0.48	22%
P2	P2	0.16	0.00	0.14	**0.30**	0.49	0.52	0.56	0.68	54%
P2.U	P2.U	0.00	0.00	0.43	**0.43**	0.02	0.08	0.15	0.35	0%
P3	P3	0.25	0.03	0.32	**0.60**	0.42	0.45	0.50	0.63	46%
P3.U	P3.U	0.00	0.00	1.27	**1.27**	0.02	0.08	0.15	0.35	0%
P4	P4	0.15	0.00	0.23	**0.38**	0.36	0.40	0.45	0.59	39%
P5	P5	0.00	0.00	0.03	**0.03**	0.02	0.08	0.15	0.35	0%
P5.U	P5.U	0.00	0.00	0.47	**0.47**	0.02	0.08	0.15	0.35	0%
P6	P6	0.05	0.00	0.23	**0.28**	0.18	0.23	0.29	0.46	18%
P7	P7	0.00	0.00	0.38	**0.38**	0.02	0.08	0.15	0.35	0%
P8	P8	0.00	0.00	0.52	**0.52**	0.02	0.08	0.15	0.35	0%
R1	R1	0.00	0.06	0.00	**0.06**	0.66	0.68	0.71	0.78	84%
R2	R2	0.00	0.07	0.00	**0.07**	0.70	0.72	0.74	0.80	88%
R3	R3	0.00	0.10	0.00	**0.10**	0.70	0.72	0.74	0.81	89%
R4	R4	0.00	0.09	0.00	**0.09**	0.72	0.74	0.76	0.82	92%
A1	A1	0.00	0.00	0.02	**0.02**	0.02	0.08	0.15	0.35	0%
A2	A2	0.00	0.00	0.01	**0.01**	0.02	0.08	0.15	0.35	0%
A3	A3	0.00	0.00	0.01	**0.01**	0.02	0.08	0.15	0.35	0%
TOTAL OVERALL		**1.01**	**0.35**	**5.43**	**6.79**	**0.18**	**0.24**	**0.30**	**0.46**	**20%**
		15%	**5%**	**80%**	**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

PROPOSED CONDITIONS

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

DATE: 10/18/2023

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.
On-Site Basins																
P1	0.07	0.45	50	1.0%	8.5						8.5	50	1.0%	45%	19.0	8.5
P1.U	1.70	0.26	100	12.0%	6.7						6.7	100	12.0%	22%	22.7	6.7
P2	0.30	0.52	40	33.0%	2.1	100	2.0%	7.0	1.0	1.7	3.8	140	10.9%	54%	17.3	5.0
P2.U	0.43	0.08	100	6.0%	10.3						10.3	100	6.0%		26.8	10.3
P3	0.60	0.45	50	4.0%	5.3	100	1.5%	2.5	0.3	5.4	10.7	150	2.3%	46%	19.2	10.7
P3.U	1.27	0.08	100	10.0%	8.7						8.7	100	10.0%		26.6	8.7
P4	0.38	0.40	80	5.0%	6.7	50	2.0%	20.0	2.8	0.3	7.0	130	3.8%	39%	20.1	7.0
P5	0.03	0.08	45	8.0%	6.3						6.3	45	8.0%		26.3	6.3
P5.U	0.47	0.08	90	7.0%	9.3			2.5			9.3	90	7.0%		26.6	9.3
P6	0.28	0.23	50	15.0%	4.6	20	4.0%	7.0	1.4	0.2	4.8	70	11.9%	18%	23.2	5.0
P7	0.38	0.08	50	8.0%	6.6			2.5			6.6	50	8.0%		26.3	6.6
P8	0.52	0.08	100	1.0%	18.7			2.5			18.7	100	1.0%		27.9	18.7
R1	0.06	0.68	30	25.0%	1.4			20.0			1.4	30	25.0%	84%	11.8	5.0
R2	0.07	0.72	30	25.0%	1.3			20.0			1.3	30	25.0%	88%	11.1	5.0
R3	0.10	0.72	30	25.0%	1.3			20.0			1.3	30	25.0%	89%	10.9	5.0
R4	0.09	0.74	30	25.0%	1.2			20.0			1.2	30	25.0%	92%	10.5	5.0
A1	0.02	0.08	10	10.0%	2.7			7.0			2.7	10	10.0%		26.1	5.0
A2	0.01	0.08	10	10.0%	2.7			7.0			2.7	10	10.0%		26.1	5.0
A3	0.01	0.08	10	10.0%	2.7			7.0			2.7	10	10.0%		26.1	5.0

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

Note: Conveyance coefficient from Table 6-7 of DCM

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 2 YEAR EVENT

PROPOSED CONDITIONS

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

DATE: 10/18/2023

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	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	0.07	0.41	8.48	0.03	3.49	0.10													
		P1.U	P1.U	1.70	0.21	6.74	0.36	3.76	1.34													
		P2	P2	0.30	0.49	5.00	0.15	4.12	0.60													
		P2.U	P2.U	0.43	0.02	10.29	0.01	3.26	0.03													
		P3	P3	0.60	0.42	10.72	0.25	3.21	0.80													
		P3.U	P3.U	1.27	0.02	8.68	0.03	3.46	0.09													
		P4	P4	0.38	0.36	6.99	0.14	3.72	0.51													
		P5	P5	0.03	0.02	6.27	0.00	3.85	0.00													
		P5.U	P5.U	0.47	0.02	9.27	0.01	3.38	0.03													
		P6	P6	0.28	0.18	5.00	0.05	4.12	0.20													
		P7	P7	0.38	0.02	6.61	0.01	3.79	0.03													
		P8	P8	0.52	0.02	18.70	0.01	2.55	0.03													
		R1	R1	0.06	0.66	5.00	0.04	4.12	0.18													
		R2	R2	0.07	0.70	5.00	0.05	4.12	0.20													
		R3	R3	0.10	0.70	5.00	0.07	4.12	0.29													
		R4	R4	0.09	0.72	5.00	0.06	4.12	0.26													
		A1	A1	0.02	0.02	5.00	0.00	4.12	0.00													
		A2	A2	0.01	0.02	5.00	0.00	4.12	0.00													
		A3	A3	0.01	0.02	5.00	0.00	4.12	0.00													

$$I_2 = -1.19 \ln(t_{c,min}) + 6.035$$

Note: Rainfall intensity from Figure 6-5 IDF Equations

Kimley»Horn

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

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

PROPOSED CONDITIONS

$$I_5 = -1.50\ln(T_{i,min}) + 7.583$$

DATE: 10/18/2023

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (ft/s)	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																					
		P1	P1	0.07	0.45	8.48	0.03	4.38	0.13												
		P1.U	P1.U	1.70	0.26	6.74	0.44	4.72	2.07												
		P2	P2	0.30	0.52	5.00	0.15	5.17	0.80												
		P2.U	P2.U	0.43	0.08	10.29	0.03	4.09	0.14												
		P3	P3	0.60	0.45	10.72	0.27	4.02	1.10												
		P3.U	P3.U	1.27	0.08	8.68	0.10	4.34	0.44												
		P4	P4	0.38	0.40	6.99	0.15	4.67	0.72												
		P5	P5	0.03	0.08	6.27	0.00	4.83	0.01												
		P5.U	P5.U	0.47	0.08	9.27	0.04	4.24	0.16												
		P6	P6	0.28	0.23	5.00	0.06	5.17	0.33												
		P7	P7	0.38	0.08	6.61	0.03	4.75	0.15												
		P8	P8	0.52	0.08	18.70	0.04	3.19	0.13												
		R1	R1	0.06	0.68	5.00	0.04	5.17	0.23												
		R2	R2	0.07	0.72	5.00	0.05	5.17	0.26												
		R3	R3	0.10	0.72	5.00	0.07	5.17	0.38												
		R4	R4	0.09	0.74	5.00	0.07	5.17	0.34												
		A1	A1	0.02	0.08	5.00	0.00	5.17	0.01												
		A2	A2	0.01	0.08	5.00	0.00	5.17	0.01												
		A3	A3	0.01	0.08	5.00	0.00	5.17	0.00												

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

Note: Rainfall intensity from Figure 6-5 IDF Equations

Kimley»Horn

STANDARD FORM SF-3

STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROPOSED CONDITIONS

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

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

DATE: 10/18/2023

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs)	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY (fps)	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																						
		P1	P1	0.07	0.62	8.48	0.04	7.35	0.31													
		P1.U	P1.U	1.70	0.48	6.74	0.82	7.93	6.50													
		P2	P2	0.30	0.68	5.00	0.20	8.68	1.75													
		P2.U	P2.U	0.43	0.35	10.29	0.15	6.86	1.02													
		P3	P3	0.60	0.63	10.72	0.38	6.76	2.55													
		P3.U	P3.U	1.27	0.35	8.68	0.44	7.29	3.23													
		P4	P4	0.38	0.59	6.99	0.23	7.83	1.77													
		P5	P5	0.03	0.35	6.27	0.01	8.11	0.08													
		P5.U	P5.U	0.47	0.35	9.27	0.17	7.12	1.18													
		P6	P6	0.28	0.46	5.00	0.13	8.68	1.11													
		P7	P7	0.38	0.35	6.61	0.13	7.98	1.07													
		P8	P8	0.52	0.35	18.70	0.18	5.35	0.98													
		R1	R1	0.06	0.78	5.00	0.05	8.68	0.44													
		R2	R2	0.07	0.80	5.00	0.06	8.68	0.50													
		R3	R3	0.10	0.81	5.00	0.08	8.68	0.71													
		R4	R4	0.09	0.82	5.00	0.07	8.68	0.63													
		A1	A1	0.02	0.35	5.00	0.01	8.68	0.05													
		A2	A2	0.01	0.35	5.00	0.00	8.68	0.04													
		A3	A3	0.01	0.35	5.00	0.00	8.68	0.03													

12.735

Note: Rainfall intensity from Figure 6-5 IDF Equations

Kimley»Horn

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

DATE: 10/18/2023

PROPOSED CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	IMPERVIOUSNESS %	PEAK FLOWS (CFS)		
				Q2	Q5	Q100
On-Site Basins						
P1	P1	0.07	45%	0.10	0.13	0.31
P1.U	P1.U	1.70	22%	1.34	2.07	6.50
P2	P2	0.30	54%	0.60	0.80	1.75
P2.U	P2.U	0.43	0%	0.03	0.14	1.02
P3	P3	0.60	46%	0.80	1.10	2.55
P3.U	P3.U	1.27	0%	0.09	0.44	3.23
P4	P4	0.38	39%	0.51	0.72	1.77
P5	P5	0.03	0%	0.00	0.01	0.08
P5.U	P5.U	0.47	0%	0.03	0.16	1.18
P6	P6	0.28	18%	0.20	0.33	1.11
P7	P7	0.38	0%	0.03	0.15	1.07
P8	P8	0.52	0%	0.03	0.13	0.98
R1	R1	0.06	84%	0.18	0.23	0.44
R2	R2	0.07	88%	0.20	0.26	0.50
R3	R3	0.10	89%	0.29	0.38	0.71
R4	R4	0.09	92%	0.26	0.34	0.63
A1	A1	0.02	0%	0.00	0.01	0.05
A2	A2	0.01	0%	0.00	0.01	0.04
A3	A3	0.01	0%	0.00	0.00	0.03
TOTAL		**6.79**	**20%**	**4.70**	**7.40**	**23.93**

Kimley»Horn

STANDARD FORM SF-1
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROPOSED CONDITIONS

PROJECT NAME: LA FORET
PROJECT NUMBER: 96971007
CALCULATED BY: AJL
CHECKED BY: KRK

DATE: 10/18/2023

SOIL: B

LAND USE:	PAVEMENT AREA	ROOF AREA	LANDSCAPE AREA
2-YEAR COEFF.	0.89	0.71	0.02
5-YEAR COEFF.	0.90	0.73	0.08
10-YEAR COEFF.	0.92	0.75	0.15
100-YEAR COEFF.	0.96	0.81	0.35
IMPERVIOUS %	100%	90%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (AC)	ROOF AREA (AC)	LANDSCAPE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
On-Site Basins										
P3	P3	0.25	0.03	0.32	**0.60**	0.42	0.45	0.50	0.63	46%
P3.U	P3.U	0.00	0.00	1.27	**1.27**	0.02	0.08	0.15	0.35	0%
P4	P4	0.15	0.00	0.23	**0.38**	0.36	0.40	0.45	0.59	39%
P6	P6	0.05	0.00	0.23	**0.28**	0.18	0.23	0.29	0.46	18%
R1	R1	0.00	0.06	0.00	**0.06**	0.66	0.68	0.71	0.78	84%
R2	R2	0.00	0.07	0.00	**0.07**	0.70	0.72	0.74	0.80	88%
R3	R3	0.00	0.10	0.00	**0.10**	0.70	0.72	0.74	0.81	89%
R4	R4	0.00	0.09	0.00	**0.09**	0.72	0.74	0.76	0.82	92%
A1	A1	0.00	0.00	0.02	**0.02**	0.02	0.08	0.15	0.35	0%
A2	A2	0.00	0.00	0.01	**0.01**	0.02	0.08	0.15	0.35	0%
A3	A3	0.00	0.00	0.01	**0.01**	0.02	0.08	0.15	0.35	0%
BASIN SUBTOTAL		**0.45**	**0.35**	**2.09**	**2.89**	**0.24**	**0.29**	**0.34**	**0.50**	**26%**
		16%	**12%**	**72%**	**100%**					

IMPERVIOUS CALCULATIONS ARE FOR BASINS THAT ARE TRIBUTARY TO WQ RAIN GARDEN ONLY

HYDRAULIC CALCULATIONS

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018) **Sheet 1 of 2**

Designer: AJL
Company: Kimley-Horn
Date: October 18, 2023
Project:
Location:

1. Basin Storage Volume		
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 26.0	%
B) Tributary Area's Imperviousness Ratio (i = I_a/100)	i = 0.260	
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.11	watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 125,888	sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area	V_{WQCV} = 1,161	cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 =	in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ =	cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ =	cu ft
2. Basin Geometry		
A) WQCV Depth (12-inch maximum)	D_{WQCV} = 12	in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 4.00	ft / ft
C) Mimimum Flat Surface Area	A_{Min} = 655	sq ft
D) Actual Flat Surface Area	A_{Actual} = 779	sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 3557	sq ft
F) Rain Garden Total Volume (V_T= ((A_{Top} + A_{Actual}) / 2) * Depth)	V_T= 2,168	cu ft
3. Growing Media	Choose One: (•) 18" Rain Garden Growing Media ( ) Other (Explain):	
4. Underdrain System		
A) Are underdrains provided?	Choose One: (•) YES ( ) NO	
B) Underdrain system orifice diameter for 12 hour drain time		
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 0.3	ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 1,161	cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 1 3/16	in

Design Procedure Form: Rain Garden (RG)

Designer: AJL
Company: Kimley-Horn
Date: October 18, 2023
Project:
Location:

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ○ YES ○ NO
6. Inlet / Outlet Control A) Inlet Control	Choose One ○ Sheet Flow- No Energy Dissipation Required ◉ Concentrated Flow- Energy Dissipation Provided
7. Vegetation	Choose One ◉ Seed (Plan for frequent weed control) ○ Plantings ○ Sand Grown or Other High Infiltration Sod
8. Irrigation A) Will the rain garden be irrigated?	Choose One ○ YES ◉ NO

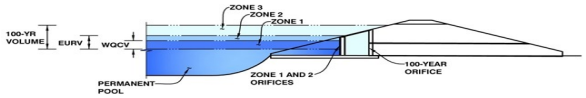
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**RG**	
Watershed Area =	2.89	acres
Watershed Length =	500	ft
Watershed Length to Centroid =	250	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	26.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	12.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.027	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.076	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.077	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.130	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.179	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.255	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.312	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.389	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.535	acre-feet		inches
Approximate 2-yr Detention Volume =	0.054	acre-feet		
Approximate 5-yr Detention Volume =	0.078	acre-feet		
Approximate 10-yr Detention Volume =	0.117	acre-feet		
Approximate 25-yr Detention Volume =	0.139	acre-feet		
Approximate 50-yr Detention Volume =	0.147	acre-feet		
Approximate 100-yr Detention Volume =	0.176	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.027	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.027	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

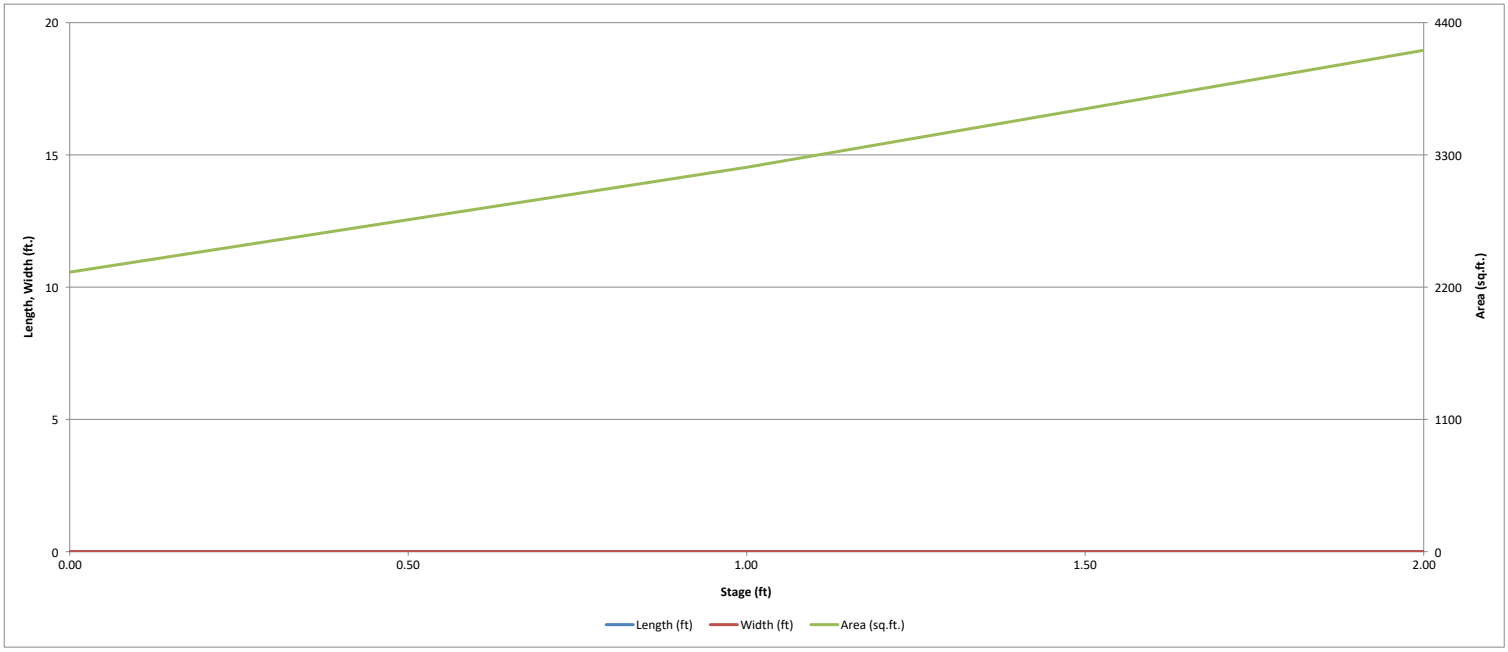
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

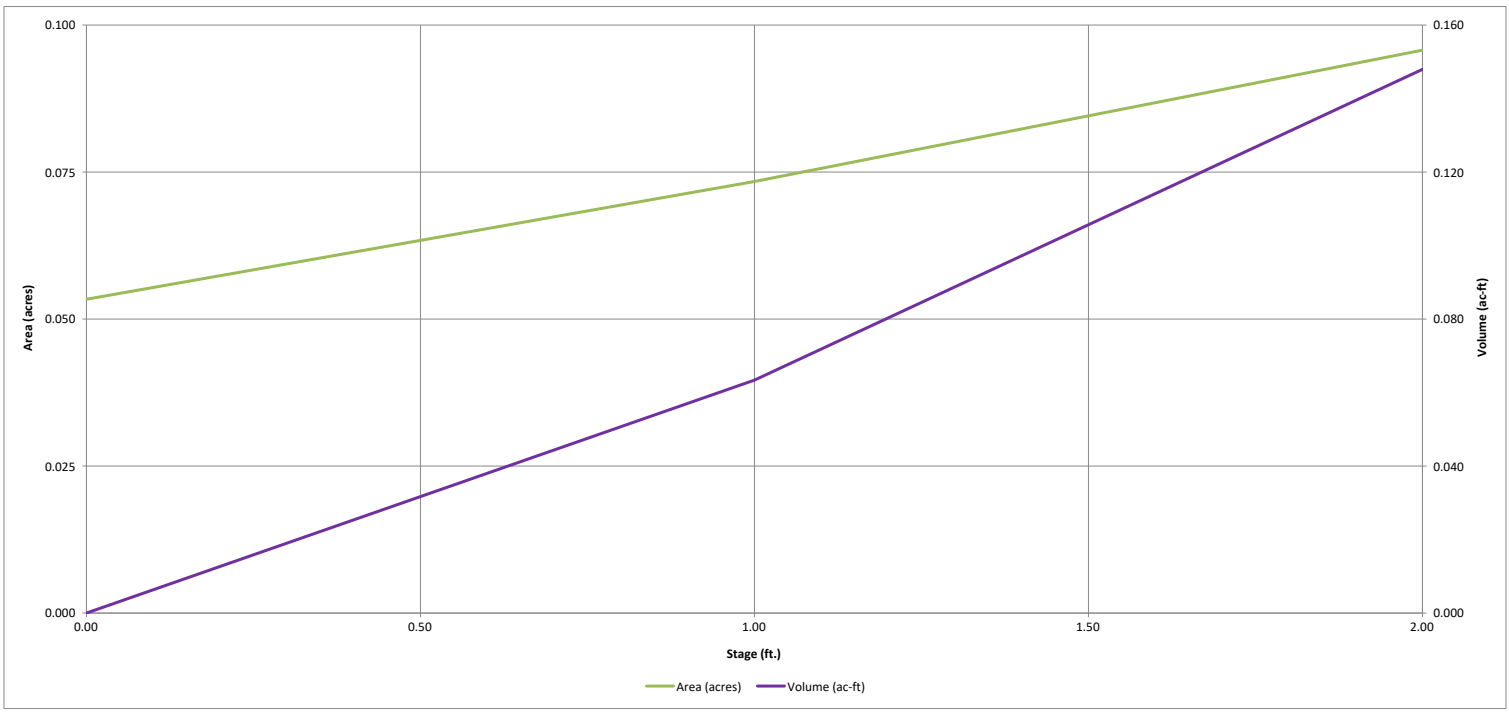
Depth Increment = _____ ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Media Surface	--	0.00	--	--	--	2,325	0.053		
7188.75	--	1.00	--	--	--	3,197	0.073	2,761	0.063
7189.75	--	2.00	--	--	--	4,170	0.096	6,444	0.148

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



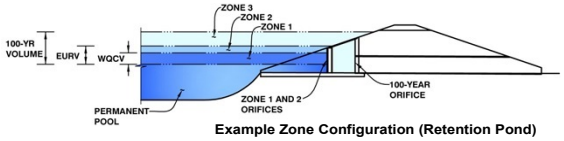


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.46	0.027	Filtration Media
Zone 2			
Zone 3			
Total (all zones)		0.027	

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	1.75	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.86	inches	Underdrain Orifice Centroid =	0.04	feet

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

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =		ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =		ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =		inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =		sq. inches	Elliptical Slot Area =	N/A	ft^2

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

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

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected		Calculated Parameters for Vertical Orifice	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			inches				

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

	Not Selected	Not Selected		Calculated Parameters for Overflow Weir	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	0.46		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	0.46		feet
Overflow Weir Front Edge Length =	2.60		feet	Overflow Weir Slope Length =	2.60		feet
Overflow Weir Grate Slope =	0.00		H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =	2.60		feet	Overflow Grate Open Area w/o Debris =	4.70		ft^2
Overflow Grate Type =	Type C Grate			Overflow Grate Open Area w/ Debris =	2.35		ft^2
Debris Clogging % =	50%		%				

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

	Not Selected	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft^2
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet	Basin Volume at Top of Freeboard =		acre-ft

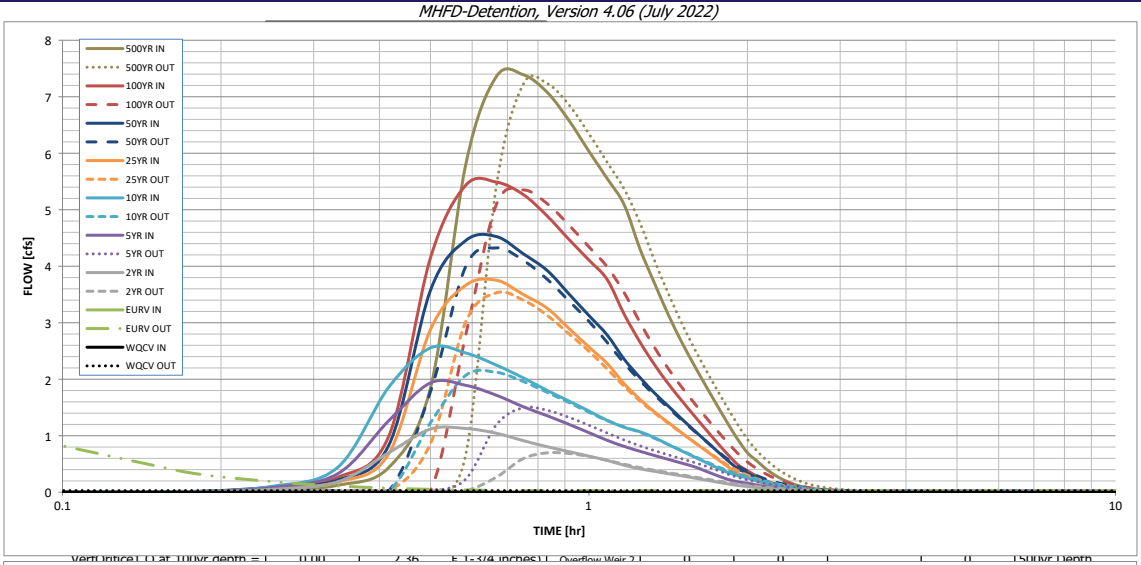
Routed Hydrograph Results

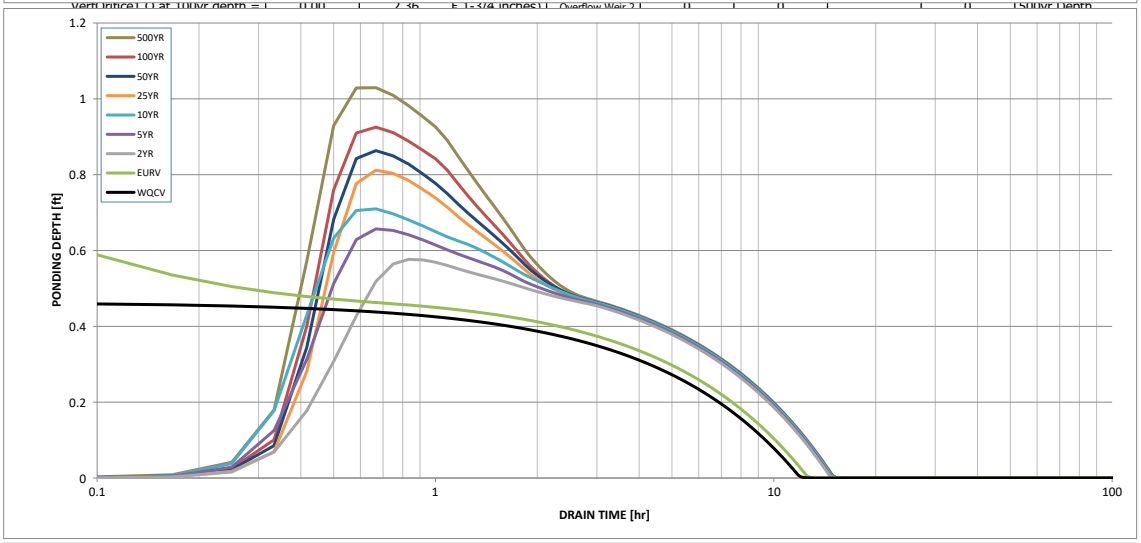
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

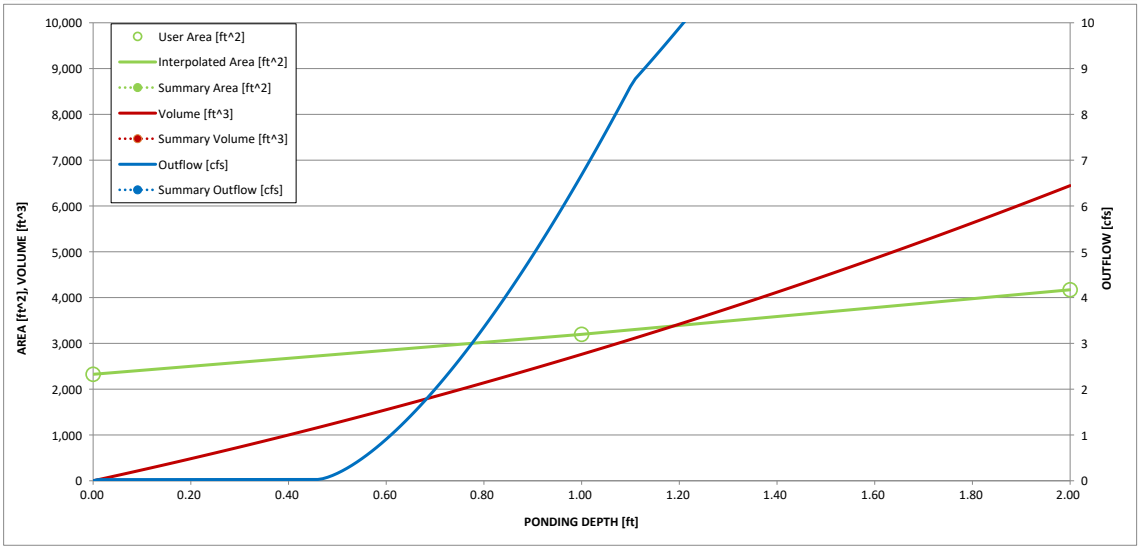
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.027	0.076	0.077	0.130	0.179	0.255	0.312	0.389	0.535
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.077	0.130	0.179	0.255	0.312	0.389	0.535
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	1.1	1.6	2.9	3.6	4.5	6.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.38	0.56	0.99	1.24	1.55	2.16
Peak Inflow Q (cfs) =	N/A	N/A	1.1	1.9	2.6	3.8	4.5	5.5	7.4
Peak Outflow Q (cfs) =	0.03	5.3	0.7	1.5	2.1	3.5	4.3	5.4	7.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.4	1.3	1.2	1.2	1.2	1.2
Structure Controlling Flow =	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	-0.01	-0.01	-0.01	0.0	0.0	0.0	0.0	0.0	0.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	12	14	13	13	11	11	10	8
Time to Drain 99% of Inflow Volume (hours) =	**12**	12	14	14	14	14	14	13	13
Maximum Ponding Depth (ft) =	0.47	1.17	0.58	0.66	0.71	0.81	0.86	0.93	1.03
Area at Maximum Ponding Depth (acres) =	0.06	0.08	0.06	0.07	0.07	0.07	0.07	0.07	0.07
Maximum Volume Stored (acre-ft) =	0.027	0.076	0.034	0.039	0.042	0.050	0.053	0.058	0.065

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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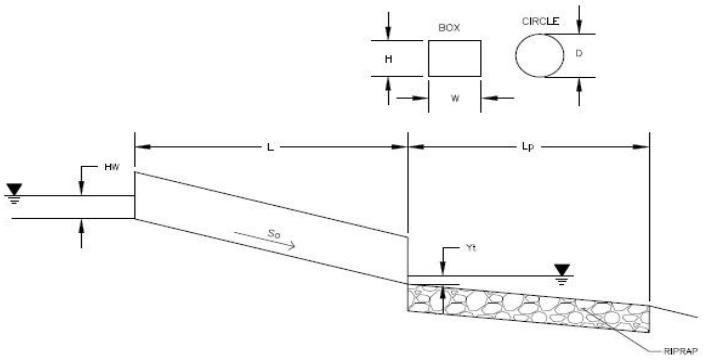
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: La Foret

ID:



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Adjusted Diameter to calculate protection type.

Design Information:

Design Discharge	Q =	5.01	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Grooved Edge Projecting	
OR:			
Box Culvert:		OR	
Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	# Barrels =	1	
Inlet Elevation	Elev IN =	7192.722	ft
Outlet Elevation OR Slope	Elev OUT =	7192.015	ft
Culvert Length	L =	66	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =	7192.72	ft
Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:

Culvert Cross Sectional Area Available	A =	1.77	ft^2
Culvert Normal Depth	Y_n =	0.68	ft
Culvert Critical Depth	Y_c =	0.86	ft
Froude Number	Fr =	1.56	Supercritical!
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.02	
Sum of All Loss Coefficients	k_s =	2.22	ft
Headwater:			
Inlet Control Headwater	HW_I =	1.24	ft
Outlet Control Headwater	HW_O =	N/A	ft
Design Headwater Elevation	HW =	7193.96	ft
Headwater/Diameter OR Headwater/Rise Ratio	HW/D =	0.83	

Outlet Control Headwater Approximation Method Inaccurate for Low Flow - Backwater Calculations Required

Outlet Protection:			
Flow/(Diameter^2.5)	Q/D^2.5 =	1.82	$ft^{0.5}/s$
Tailwater Surface Height	Y_t =	0.70	ft
Tailwater/Diameter	Yt/D =	0.47	
Expansion Factor	1/(2*tan(Θ)) =	6.46	
Flow Area at Max Channel Velocity	A_t =	1.00	ft^2
Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	-	ft
Length of Riprap Protection	L_p =	5	ft
Width of Riprap Protection at Downstream End	T =	3	ft
Adjusted Diameter for Supercritical Flow	Da =	1.09	ft
Minimum Theoretical Riprap Size	d_{50} min=	2	in
Nominal Riprap Size	d_{50} nominal=	6	in
MHFD Riprap Type	Type =	VL	

Ditches

Description	Drainage Area (DA)	Drainage Area (DA)	Runoff Coefficient (C)	Intensity (100-Year)	Flow (Q)	Velocity (V)	Liner	Ditch Shape	Bottom Width	Side Slope (H:V)	Total Depth	Running Slope	Depth of Flow	Manning's Number (n)	Freeboard	Channel Top Width	Ridge Width	Ridge Height
ID	sf	ac		in/hr	cfs	ft/s			ft	x:1	ft	%	ft		ft	ft	ft	ft
1)By-Pass Ditch (P2)	31,781	0.73	0.48	6.60	2.32	1.25	Ch-1	Trapizoidal	3	3:1	1.16	1.50	0.43	0.030	0.73	10.0	4	1.16
2) Drainage Ditch A (P3)	73,049	1.68	0.45	6.65	5.01	1.53	Ch-1	Trapizoidal	3	3:1	1.16	1.50	0.66	0.030	0.50	10.0	4	1.16
3) Draiange Ditch B (P3 & P4)	89,557	2.06	0.59	7.84	6.77	1.87	Ch-1	Trapizoidal	3	3:1	1.16	2.00	0.71	0.030	0.45	10.0	4	1.16

SITE DATA	
Location:	Colorado Springs
Frequency:	100-Year
Cover Desc.:	Graded Soil (Sandy 5-10%)
Channel Material:	Rock Riprap (6-inch)

Blue = User Entered (Verify they reflect the current design)

Green = Calculated

Channel Lining	
Description	BMP
Bare Soil	N/A
Synthetic Mat	Ch-1
Gravel Riprap	Ch-2
Rock Riprap	Ch-2
Concrete	Ch-3
Asphalt	Ch-3

Worksheet for Bypass Channel

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.069	
Channel Slope	0.015	ft/ft
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V
Bottom Width	3.00	ft
Discharge	2.32	cfs

Results		
Normal Depth	5.2	in
Flow Area	1.9	ft²
Wetted Perimeter	5.7	ft
Hydraulic Radius	3.9	in
Top Width	5.60	ft
Critical Depth	2.9	in
Critical Slope	0.121	ft/ft
Velocity	1.25	ft/s
Velocity Head	0.02	ft
Specific Energy	0.46	ft
Froude Number	0.381	
Flow Type	Subcritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.2	in
Critical Depth	2.9	in
Channel Slope	0.015	ft/ft
Critical Slope	0.121	ft/ft

Worksheet for Bypass CMP Culvert

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.024	
Channel Slope	0.010	ft/ft
Diameter	18.0	in
Discharge	2.32	cfs

Results		
Normal Depth	8.0	in
Flow Area	0.8	ft²
Wetted Perimeter	2.2	ft
Hydraulic Radius	4.2	in
Top Width	1.49	ft
Critical Depth	6.9	in
Percent Full	44.5	%
Critical Slope	0.017	ft/ft
Velocity	3.06	ft/s
Velocity Head	0.15	ft
Specific Energy	0.81	ft
Froude Number	0.755	
Maximum Discharge	6.12	cfs
Discharge Full	5.69	cfs
Slope Full	0.002	ft/ft
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
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	0.0	%
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	8.0	in
Critical Depth	6.9	in
Channel Slope	0.010	ft/ft
Critical Slope	0.017	ft/ft

Worksheet for Drainage Ditch A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.069	
Channel Slope	0.015	ft/ft
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V
Bottom Width	3.00	ft
Discharge	5.10	cfs

Results		
Normal Depth	7.9	in
Flow Area	3.3	ft²
Wetted Perimeter	7.2	ft
Hydraulic Radius	5.5	in
Top Width	6.94	ft
Critical Depth	4.7	in
Critical Slope	0.106	ft/ft
Velocity	1.56	ft/s
Velocity Head	0.04	ft
Specific Energy	0.69	ft
Froude Number	0.402	
Flow Type	Subcritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.9	in
Critical Depth	4.7	in
Channel Slope	0.015	ft/ft
Critical Slope	0.106	ft/ft

Worksheet for Drainage Ditch B

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.069
Channel Slope	0.020 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	3.00 ft
Discharge	6.77 cfs

Results	
Normal Depth	8.5 in
Flow Area	3.6 ft²
Wetted Perimeter	7.5 ft
Hydraulic Radius	5.8 in
Top Width	7.23 ft
Critical Depth	5.5 in
Critical Slope	0.102 ft/ft
Velocity	1.88 ft/s
Velocity Head	0.05 ft
Specific Energy	0.76 ft
Froude Number	0.469
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	8.5 in
Critical Depth	5.5 in
Channel Slope	0.020 ft/ft
Critical Slope	0.102 ft/ft

Worksheet for Driveway CMP Culvert

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.024	
Channel Slope	0.010	ft/ft
Diameter	18.0	in
Discharge	5.01	cfs

Results		
Normal Depth	13.1	in
Flow Area	1.4	ft²
Wetted Perimeter	3.1	ft
Hydraulic Radius	5.4	in
Top Width	1.33	ft
Critical Depth	10.3	in
Percent Full	72.8	%
Critical Slope	0.020	ft/ft
Velocity	3.63	ft/s
Velocity Head	0.21	ft
Specific Energy	1.30	ft
Froude Number	0.630	
Maximum Discharge	6.12	cfs
Discharge Full	5.69	cfs
Slope Full	0.008	ft/ft
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
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	0.0	%
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	13.1	in
Critical Depth	10.3	in
Channel Slope	0.010	ft/ft
Critical Slope	0.020	ft/ft

Worksheet for Roof Drain Pipe (R1,R3)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.010	
Channel Slope	0.015	ft/ft
Diameter	8.0	in
Discharge	1.16	cfs

Results		
Normal Depth	4.5	in
Flow Area	0.2	ft²
Wetted Perimeter	1.1	ft
Hydraulic Radius	2.1	in
Top Width	0.66	ft
Critical Depth	6.1	in
Percent Full	56.0	%
Critical Slope	0.006	ft/ft
Velocity	5.77	ft/s
Velocity Head	0.52	ft
Specific Energy	0.89	ft
Froude Number	1.845	
Maximum Discharge	2.07	cfs
Discharge Full	1.92	cfs
Slope Full	0.005	ft/ft
Flow Type	Supercritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	56.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.5	in
Critical Depth	6.1	in
Channel Slope	0.015	ft/ft
Critical Slope	0.006	ft/ft

Worksheet for Roof Drain Pipe (R2,R4,A1-A3)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.015	ft/ft
Diameter	8.0	in
Discharge	1.25	cfs

Results

Normal Depth	4.7	in
Flow Area	0.2	ft²
Wetted Perimeter	1.2	ft
Hydraulic Radius	2.2	in
Top Width	0.66	ft
Critical Depth	6.3	in
Percent Full	58.7	%
Critical Slope	0.007	ft/ft
Velocity	5.87	ft/s
Velocity Head	0.53	ft
Specific Energy	0.93	ft
Froude Number	1.815	
Maximum Discharge	2.07	cfs
Discharge Full	1.92	cfs
Slope Full	0.006	ft/ft
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	58.7	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	4.7	in
Critical Depth	6.3	in
Channel Slope	0.015	ft/ft
Critical Slope	0.007	ft/ft

OPINION OF PROBABLE CONSTRUCTION COST

Kimley»Horn
2 North Nevada, Suite 900
Colorado Springs, Colorado 80903

Project:	Proposed Stormwater Infrastructure La Foret	Prepared By:	AJL
Project Number:	96971007	Checked By:	KRK
Date:	June 9 2023		

ALL INFRASTRUCTURE IS PRIVATE

	Bid Item #	Item Description	Unit	Unit Cost	Quantity	Extended Cost
	1	18" CMP PIPE	LF	$98.00	10	$980
	2	18" FES	EA	$588.00	2	$1,176
	3	12" HDPE	LF	$70.00	55	$3,850
	4	8" HDPE	LF	$40.00	590	$23,600
	5	4" HDPE	LF	$30.00	250	$7,500
	6	6" NYOPLAST AREA DRAIN	EA	$500.00	3	$1,500
	7	DRAINAGE CHANNEL LINING, RIP RAP	CY	$135.00	65	$8,775
	8	RAIN GARDEN & OUTLET STRUCTURE	EA	$15,000.00	1	$15,000
		PROJECT CONSTRUCTION BID ITEMS COST			**B**	**$62,381**
		Contingencies (Construction Items)	(0 - 25%) of **B**		10.0%	$6,238
		Total Project Cost (Non-Reimbursable)				**$68,619**

Conceptual Opinion of Probable Construction Cost

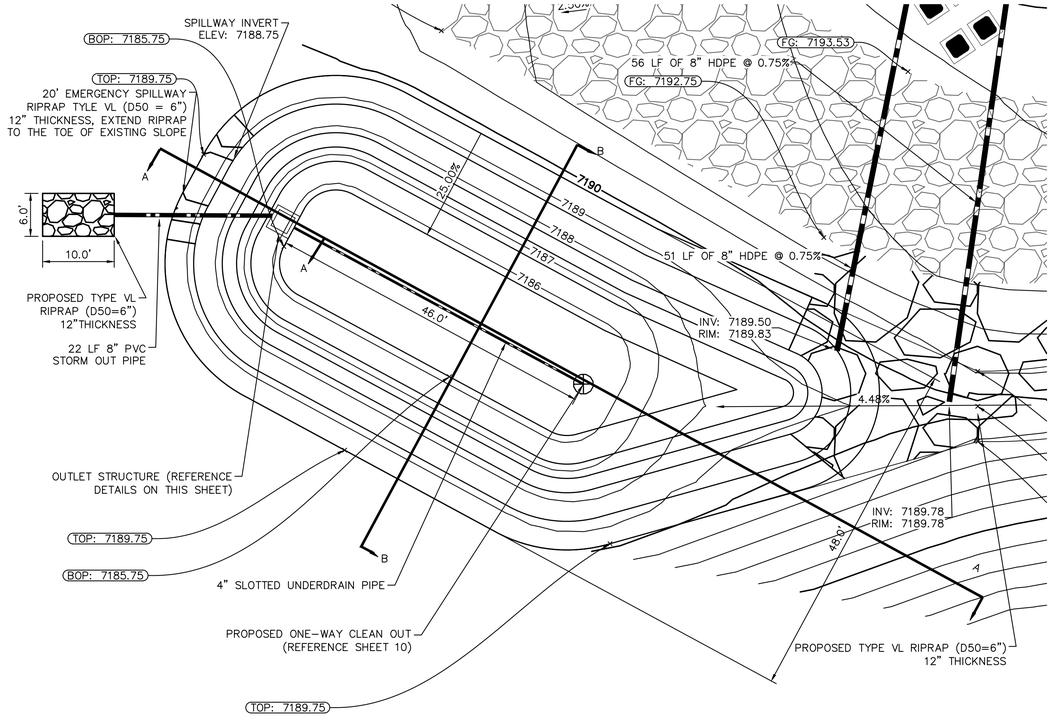
The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

SITE PHOTOS

VIEW OF MEADOWN FACING NORTH

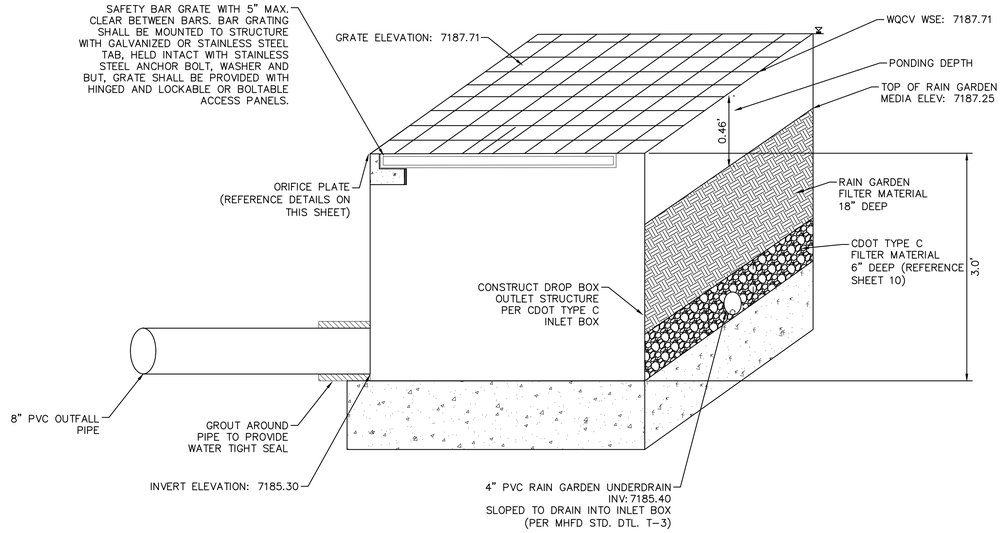
VIEW OF NATURAL CHANNEL IN SOUTHWEST PORTION OF PROJECT SITE, FACING SOUTH

RAIN GARDEN DETAIL SHEETS



RAIN GARDEN PLAN VIEW

1" = 10'



RAIN GARDEN OUTLET STRUCTURE SECTION A-A DETAIL

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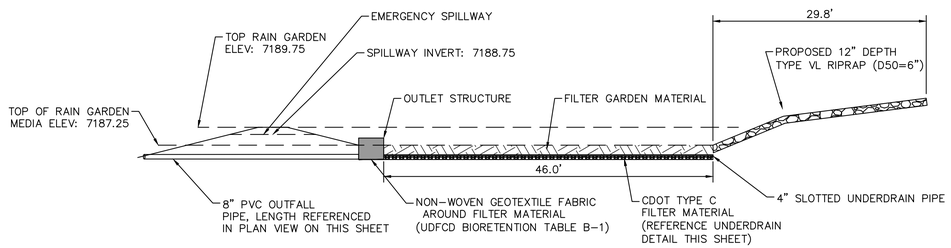
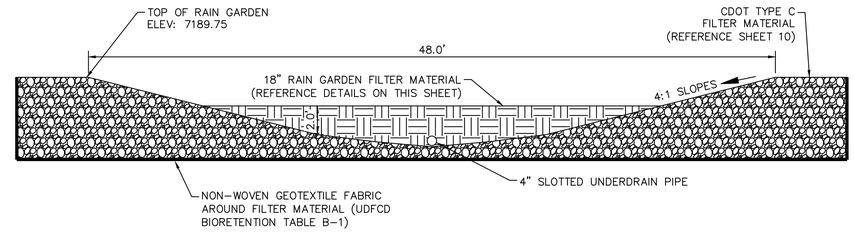


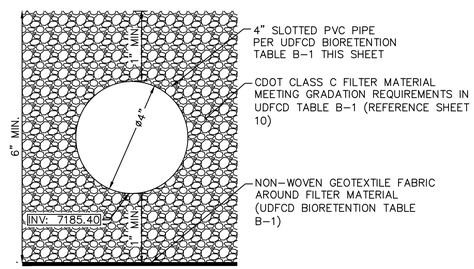
RAIN GARDEN SECTION A-A DETAIL

1" = 10'



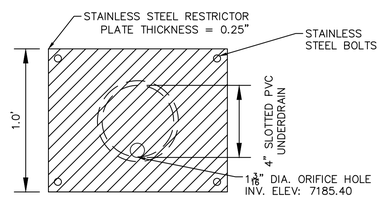
RAIN GARDEN SECTION B-B DETAIL

1" = 5'



RAIN GARDEN UNDERDRAIN

N.T.S.



FLOW RESTRICTOR DETAIL

N.T.S.

NO.	REVISION	BY	DATE	APPR.

Kimley»Horn
2023 KIMLEY-HORN AND ASSOCIATES, INC.
2 North Nevada Avenue Suite 300
Colorado Springs, Colorado 80903 (719) 453-0180

DESIGNED BY: KFK
DRAWN BY: XXX
CHECKED BY: KFK
DATE: XX/XX/2023

LA FORET
EL PASO COUNTY, COLORADO
CONSTRUCTION DOCUMENTS
RAIN GARDEN DETAILS

PROJECT NO.
096971007

SHEET
9

NOTES

1. WHERE POSSIBLE, IRRIGATION SYSTEMS SHALL BE INSTALLED IN CONJUNCTION WITH FINISH GRADING. IF IRRIGATION INSTALLATION WILL LAG, BUFFER AND SWALE SHALL BE RESTORED TO ORIGINAL CONDITION FOLLOWING INSTALLATION. DISTURBED MEDIA LAYERS SHALL BE RESTORED, GEOTEXTILES AND EROSION CONTROL BLANKETS SHALL BE REPLACED OR PATCHED, AND FINISH GRADES SHALL BE RESTORED TO THE DESIGNED SLOPES.
2. FERTILIZERS SHALL NOT BE APPLIED WHEN HEAVY PRECIPITATION IS ANTICIPATED. APPLICATION SHALL BE IN ACCORDANCE WITH THE SITE'S STANDARD OPERATION PROCEDURES AND THE MANUFACTURER'S RECOMMENDATIONS.
3. SEE BMP MATERIAL SPECIFICATIONS, THIS SHEET, FOR ADDITIONAL DETAILS.

BMP MATERIAL SPECIFICATIONS:

SANDY LOAM (GROWING MEDIA)

SANDY LOAM SHALL CONSIST OF NATIVE TOPSOIL (SURFACE O – AND A–HORIZONS HAVING MAXIMUM ROOT MASS, ORGANIC MATTER, AND BIOLOGICAL ACTIVITY) STRIPPED FROM GRASSY AREAS OF THE SITE OR A NEARBY SITE AND SHALL MEET THE FOLLOWING PROPERTIES:

ORGANIC MATTER: 2.0% OR GREATER

SOIL TEXTURE: SANDY LOAM OR SANDY CLAY LOAM MEETING THE FOLLOWING COMPONENT RANGES:

SAND OR COARSER	50 – 80 %
SILT	5 – 40 %
CLAY	5 – 25 %
COARSE PARTICLES > 2MM	0 – 20 %

SALTS, SALINITY (ELECTRICAL CONDUCTIVITY, EC) : 0 TO 2 MILL–MHOS PER CENTIMETER (MMHOS/CM) OR DECI–SIEMENS PER METER (DS/M) (MMHOS/CM ARE EQUIVALENT TO DS/M)

SODIUM (SODIUM ADSORPTION RATIO, SAR): 0 TO 4

ACIDITY, ALKALINITY (PH) : 6.5 TO 7.5

TO DETERMINE ADEQUACY OF SANDY LOAM, AT LEAST THREE REPRESENTATIVE SAMPLES OF THE NATIVE TOPSOIL SHALL RECEIVE A TEXTURAL ANALYSIS AND STANDARD AGRONOMIC TEST BY A QUALIFIED SOIL LAB. IF ORGANIC MATTER OR PH IS OUTSIDE OF THE SPECIFIED RANGE, AMENDMENTS MAY BE RECOMMENDED FOR REVIEW AND APPROVAL OF SEMSWA. ANY RECOMMENDATION FOR AMENDMENTS SHALL INCLUDE DOCUMENTATION OF AMENDMENT PROPERTIES, RATER OF APPLICATION, AND METHOD OF INCORPORATION. THE USE OF CHEMICAL FERTILIZERS OTHER THAN AN ORGANIC SLOW–RELEASE TYPE SUCH AS BIOSOL BY ROCKY MOUNTAIN BIO PRODUCTS IS NOT PERMITTED. THE USE OF ORGANIC MATTER THAT WOULD SIGNIFICANTLY INCREASE SOIL SALINITY IS NOT PERMITTED.

FILTER MATERIAL

FILTER MATERIAL SHALL BE CDOT CLASS C OR APPROVED EQUAL.

Table B-2. Gradation Specifications for CDOT Class C Filter Material
(Source: CDOT Table 703-7)

Sieve Size	Mass Percent Passing Square Mesh Sieves
19.0 mm (3/4")	100
4.75 mm (No. 4)	60 – 100
300 µm (No. 50)	10 – 30
150 µm (No. 100)	0 – 10
75 µm (No. 200)	0 - 3

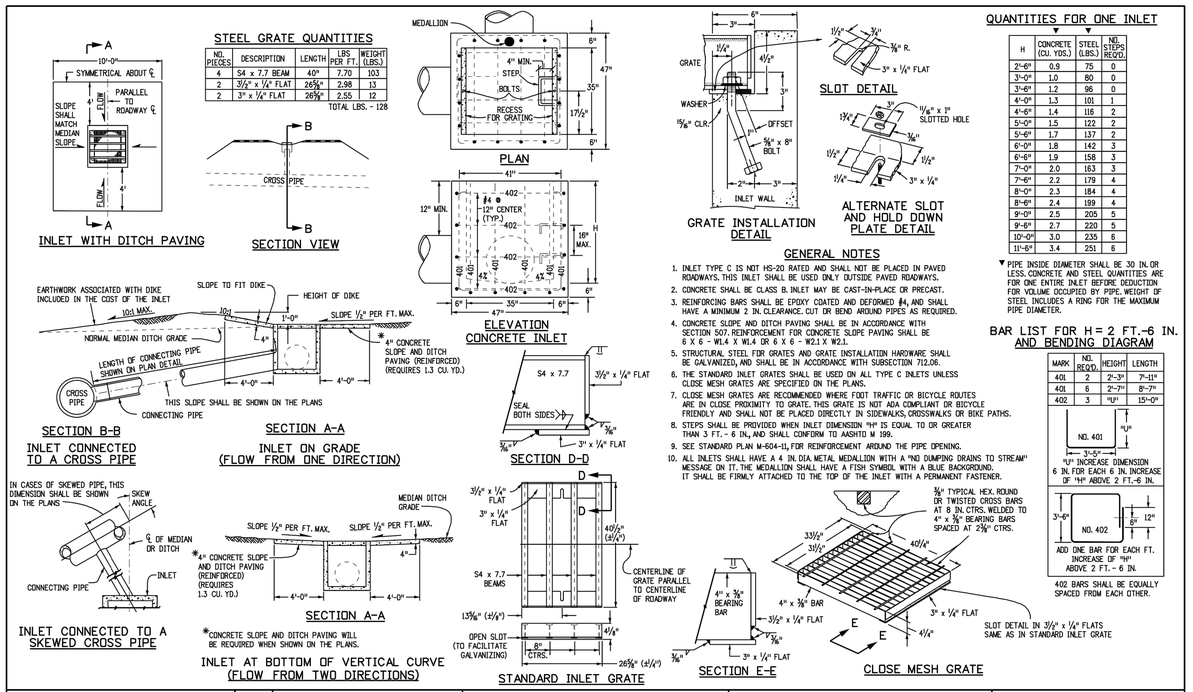
NONWOVEN GEOTEXTILE

PROPERTY	CRITERION ELONGATION<50%	ELONGATION>50%	TEST METHOD
GRAB STRENGTH	800N (180 LBS)	510N (115 LBS)	ASTM D4632
PUNCTURE RESISTANCE	310N (70 LBS)	180N (40 LBS)	ASTM D6241
TRAPEZOIDAL TEAR STRENGTH	310N (70 LBS)	180N (40 LBS)	ASTM D6241
APPARENT OPENING SIZE	0.3MM(NO. 50)		ASTM D4751
PERMITTIVITY	0.02 SEC–1 DEFAULT VALUE		ASTM D4491
PERMEABILITY	K FABRIC > K SOIL CM/SEC		ASTM D4491
UV DEGRADATION AT 500 HOURS	50% STRENGTH		ASTM D4355

Table B-6. Native Seed Mix for Rain Gardens [2]

Common Name	Scientific Name	Variety	PLS[2] lbs per Acre	Ounces per Acre
Sand bluestem	Andropogon hallii	Garden	3.5	
Sideoats grama	Bouteloua curtipendula	Butte	3	
Prairie sandreed	Calamovilfa longifolia	Goshen	3	
Indian ricegrass	Oryzopsis hymenoides	Paloma	3	
Switchgrass	Panicum virgatum	Blackwell	4	
Western wheatgrass	Pascopyrum smithii	Ariba	3	
Little bluestem	Schizachyrium scoparium	Patura	3	
Alkali sacaton	Sporobolus airoides		3	
Sand dropseed	Sporobolus cryptandrus		3	
Pasture sage[1]	Artemisia frigida			2
Blue aster[1]	Aster laevis			4
Blanket flower[1]	Gaillardia aristata			8
Prairie coneflower[1]	Ratibida columnifera			4
Purple prairieclover[1]	Dalea (Petalostemum) purpurea			4
Sub-Totals:			27.5	22
Total lbs per acre:			**28.9**	

[1] Wildflower seed (optional) for a more diverse and natural look.
[2] PLS = Pure Live Seed.



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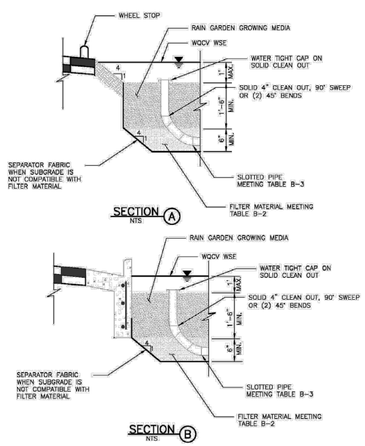
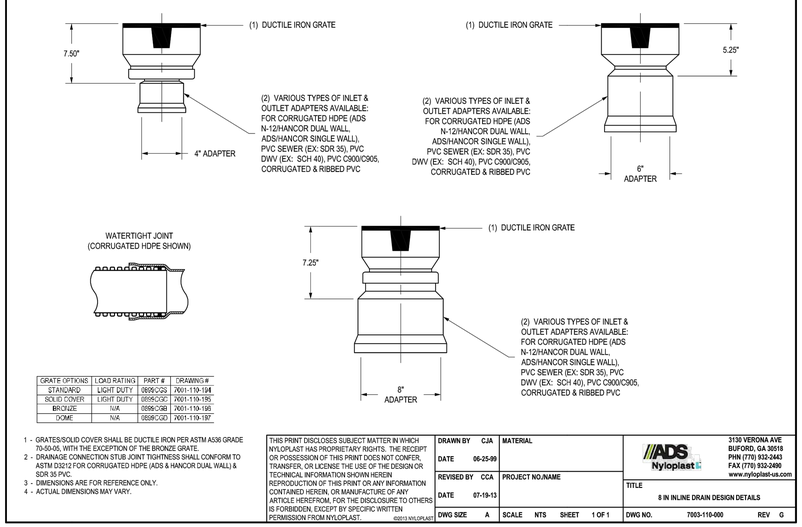
Creation Date: 07/04/12 Initials: DD		Date:	Comments	4201 East Arkansas Avenue, Denver, Colorado 80222, Phone: (303) 757-9083, Fax: (303) 757-9820	INLET, TYPE C	M-604-10
Last Modification Date: 07/04/12 Initials: LTA	(R-X)			Project Development Branch DD/LTA	Issued By: Project Development Branch July 4, 2012	Sheet No. 1 of 1
Full Path: www.coloradodot.info/business/designsupport	(R-X)					
Drawing File Name: 6040100101.dgn	(R-X)					
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)					





NO.	REVISION	BY	DATE	APPR.

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LA FORET
EL PASO COUNTY, COLORADO
CONSTRUCTION DOCUMENTS
RAIN GARDEN DETAILS CONT.

PROJECT NO. 096971007
SHEET 10

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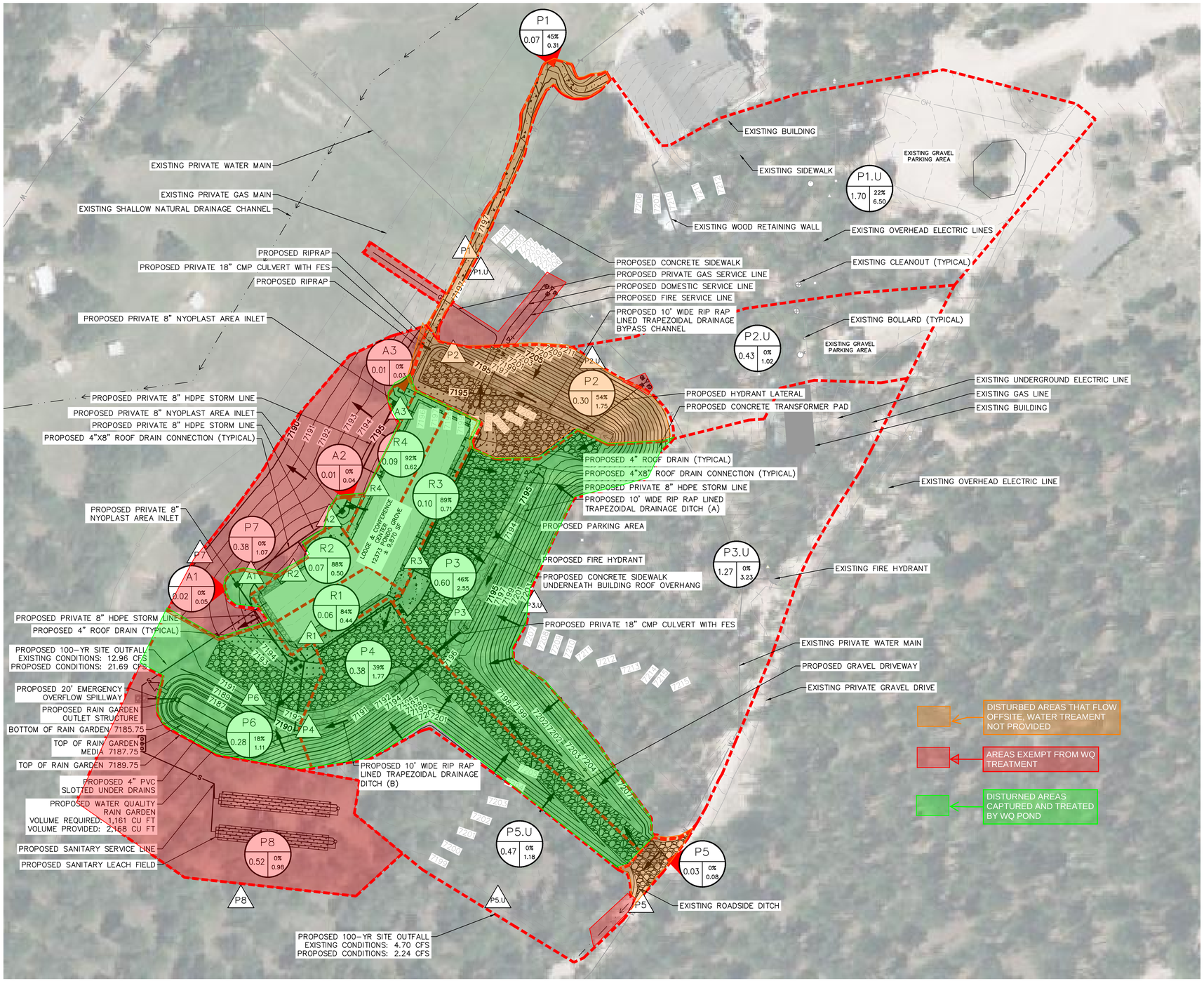
EXEMPTIONS EXHIBIT



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

- EXISTING GAS LINE
- EXISTING WATER LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING DRAINAGE ROUTE
- DRAINAGE BASIN BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED DRAINAGE DITCH
- PROPOSED GRAVEL DRIVEWAY
- PROPOSED CONCRETE
- PROPOSED LODGE
- PROPOSED UNDERGROUND LEACH FIELD
- PROPOSED RIP RAP

PROPOSED CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	IMPERVIOUSNESS %	PEAK FLOWS (CFS) Q2	Q5	Q100
On-Site Basins						
P1	P1	0.07	45%	0.10	0.13	0.31
P1.U	P1.U	1.70	22%	1.34	2.07	6.50
P2	P2	0.30	54%	0.60	0.80	1.75
P2.U	P2.U	0.43	0%	0.03	0.14	1.02
P3	P3	0.60	46%	0.80	1.10	2.55
P3.U	P3.U	1.27	0%	0.09	0.44	3.23
P4	P4	0.38	39%	0.51	0.72	1.77
P5	P5	0.03	0%	0.00	0.01	0.08
P5.U	P5.U	0.47	0%	0.03	0.16	1.18
P6	P6	0.28	18%	0.20	0.33	1.11
P7	P7	0.38	0%	0.03	0.15	1.07
P8	P8	0.52	0%	0.03	0.13	0.98
R1	R1	0.06	84%	0.18	0.23	0.44
R2	R2	0.07	88%	0.20	0.26	0.50
R3	R3	0.10	89%	0.29	0.38	0.71
R4	R4	0.09	92%	0.26	0.34	0.63
A1	A1	0.02	0%	0.00	0.01	0.05
A2	A2	0.01	0%	0.00	0.01	0.04
A3	A3	0.01	0%	0.00	0.00	0.03
TOTAL		**6.79**	**20%**	**4.70**	**7.40**	**23.93**

The following table outlines the non-exempt areas receiving water quality treatment, the disturbed areas flowing offsite that do not receive water quality treatment, and the areas of the site exempt from water quality treatment.

Condition	Total Area (AC)	Percentage of Total Non-Exempt Disturbed Area (%)	Sub-Basins
Areas Captured and Treated with Proposed Private Rain Garden	1.63	80.7%	P3, P4, P6, R1-R4, A1-A3
Disturbed Areas That Flow Offsite (No Treatment)	0.39	19.3%	P1, P2, P5
Areas Exempt from WQ Treatment			
Exclusion I.7.1.B.4 (Utility Work)	0.61	N/A	P8, P3, P1.U
Exclusion I.7.1.B.7 (Land to Remain Undeveloped)	0.39	N/A	P7, P5.U

NORTH

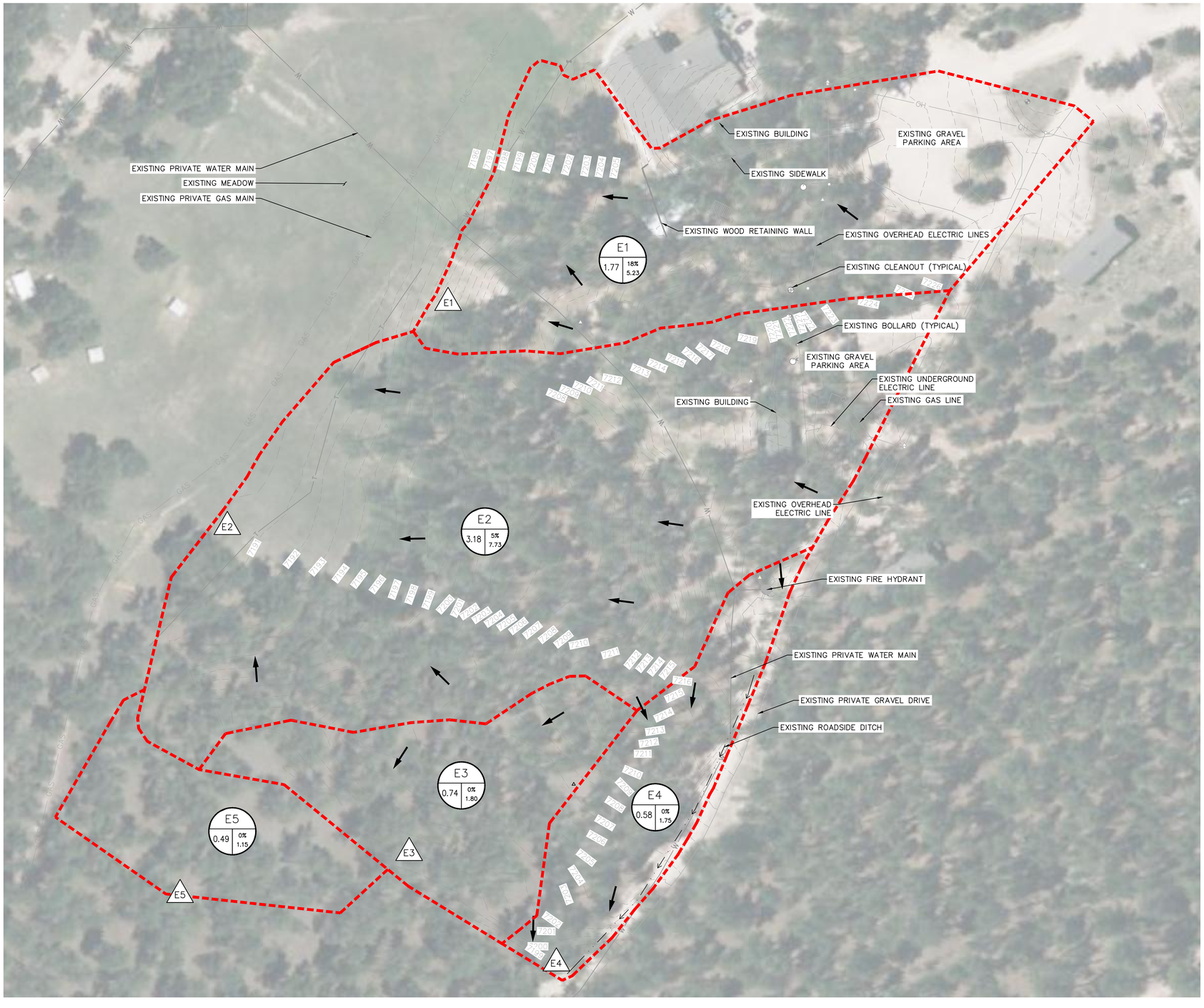
GRAPHIC SCALE IN FEET
0 20 40 80

PROPOSED CONDITIONS DRAINAGE MAP
10/25/2023

Kimley»Horn

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

EXISTING AND PROPOSED DRAINAGE MAP



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EXISTING OVERHEAD ELECTRIC LINE
EXISTING ROADSIDE DITCH
DRAINAGE BASIN BOUNDARY
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR

EXISTING CONDITIONS RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	CFS Q2	CFS Q5	CFS Q100	% IMPERVIOUS
FDR Basins						
E1	E1	1.77	1.23	1.54	5.23	18%
E2	E2	3.18	1.18	1.47	7.73	5%
E3	E3	0.74	0.20	0.25	1.80	0%
E4	E4	0.58	0.19	0.24	1.75	0%
E5	E5	0.49	0.13	0.16	1.15	0%
TOTAL		**6.76**	**2.92**	**3.66**	**17.66**	**7%**

NORTH

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0 20 40 80

EXISTING CONDITIONS DRAINAGE MAP
10/25/2023

Kimley»Horn

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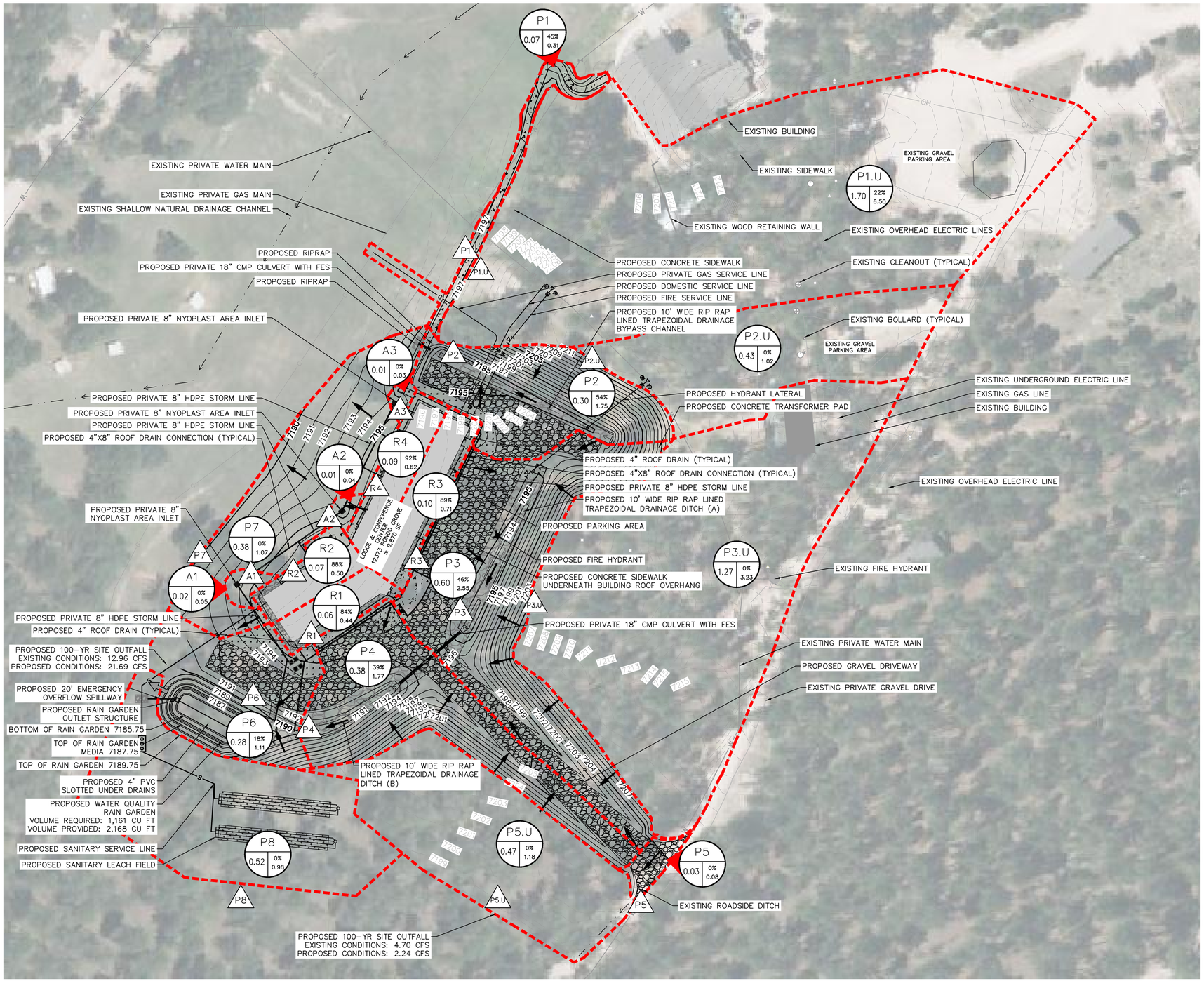

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0 20 40 80

PROPOSED CONDITIONS DRAINAGE MAP
10/25/2023

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