FINAL DRAINAGE REPORT

for

BLACK FOREST OFFICE
The North Half of the NE Quarter of the SE Quarter of Section 7
Township 12 South, Range 65 West of the 6th P.M.
County of El Paso, State of Colorado
12740 Black Forest Road
Colorado Springs, Colorado 80908

2N Civil Job No. 19015
September 11, 2020
Revised November 20, 2020
Revised January 19, 2021

PREPARED FOR:
Black Forest, LLC
8655 Table Butte Road
Colorado Springs, Colorado 80908-1224
Contact: Rad Jackson, Project Manager

Engineer:
2N Civil, LLC
6 Inverness Court East, Suite 125
Englewood, Colorado 80112
Contact: Ryan Eichele, PE, Project Manager
Todd West, PE Project Engineer

Engineer's Statement
The attached drainage plan and report were prepared under my direct supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by El Paso County 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 in preparing this report.

SIGNATURE: _____
Todd Eric West, PE
Colorado Registration No. 37643
For and on behalf of 2N Civil, LLC

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

_____
Business Name

By: _____
Title: _____
Address: _____

El Paso County:
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.

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

Conditions:

Table of Contents

1) GENERAL LOCATION AND DESCRIPTION

(a) Location

The Black Hills Office property, addressed as 12740 Black Hills Road, is the north half of the Northeast Quarter of the Southeast Quarter of Section 7, Township 12 South, Range 65 West of the 6th Principal Meridian, County of El Paso, State of Colorado. Black Forest Road bounds the site on the east. Rural Residential development (Zoning RR-5) surrounds the site on the north, south, and west. An existing asphalt and gravel road provides access to the vacant parcel. There are no major drainageways on the site.

(b) Description of property and Proposed Improvements

The subject property contains approximately 4.83 acres. Sparse ground cover consists of native weeds with a few trees at the northeast corner of the site. A shallow ridgeline divides the site, directing the east portion of the site to the north, and the west portion of the site to the west. The National Resources Conservation Service Web Soil Survey classifies the in situ soils as Hydrologic Group B, which exhibit a moderate infiltration rate when thoroughly wet.

There are no major drainage ways or irrigation facilities on the site. Existing gas and electric facilities run along the property frontage adjacent to Black Forest Road, but do not affect the development of the site.

The development will consist of a single story 4,400 sf office building with a full, walk-out basement of equal size with a 3,250-sf studio/shop building on the 4.83 acres. The office building will house the Owner's corporate functions for Metal Roof Innovations, Ltd. company (strategic planning, accounting, sales/marketing management).

An existing barn (currently under construction) was permitted under the A-5 zoning. Construction began in the spring of 2020. The barn will be re-purposed in use as a studio/shop to supplement the corporate functions. No manufacturing, warehousing, shipping, wholesale or retail sales will take place at this facility.

2) DRAINAGE BASINS AND SUB-BASINS

(a) Major Basin Description

The site is tributary to the upper reach of Kettle Creek drainage basin (FOMO3000),

that flows from north to south approximately 1,500 feet west of the site. The report Drainage Basin Planning Study for Kettle Creek Basin was reviewed in the preparation of this report. The Study is a planning document and is not intended as a basis for final design, and thus has no direct influence on the design of this site. Developed flows will be attenuated as described in this report in order to follow the historic discharge rates as described in the Study.

Based on the FEMA Map No. 08041C0315G, Panel 315 of 1300, with an effective date of 12/07/18 the site is located within Zone X, areas of minimal flood hazard. No portion of the site is located within the 100 year floodplain. The FIRM Map is included in the Appendix on page 17. The upper reach of the Kettle Creek basin is sparsely developed and includes single family homes on large acreages.

(b) Sub-Basin Description

The site historically drains north and west. The site has been divided into three sub-basins, H-1, H-2, and H-3 and design points have been provided at each to identify the historic rate of discharge form the site (refer to Historic Basin Map included at the end of this report). A portion of Black Forest Road flows east onto the site, and is included in Basin H-2. These offsite flows will continue to follow their historic drainage path onto the site and will flow north and east to design point H2 (historic) and P2 (proposed) following development of the site.

The development of the site will occur on the upper portion of the lot, with the majority of the new impervious areas directed to a proposed detention facility that will intercept flow prior to discharge to the west.

3) DRAINAGE DESIGN CRITERIA

(a) Development Criteria Reference

The City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2 (DCMV1 & DCMV2) was utilized per El Paso County's stormwater quality design criteria as well as the applicable standards from the County's Engineering Criteria Manual (ECM).

(b) Hydrologic Criteria

The Rational Method was selected to calculate existing and proposed runoff rates from the site for the 5 year (minor storm) and 100 year (major storm) recurrence intervals. The design rainfall will be from DCMV1 Table 6-2 Rainfall Depths for Colorado Springs.

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100

The most current version of UDFCD's Peak Runoff Prediction by the Rational Method, Version 2.00 released May 2017 was used to determine flows. The Runoff Coefficients from DCMV1, Table 6-6 were input to determine peak runoff values.

The development will implement Full Spectrum Detention (FSD) utilizing an Extended Detention Basin (EDB) to capture and treat runoff prior to discharge downstream. Full Spectrum Detention (FSD) is a design concept that provides control of the full range of runoff rates that pass through detention facilities.

4) DRAINAGE FACILITY DESIGN

(a) General Concept

The area being developed has been divided into three subbasins. Basin PR-1 includes the paved parking area and portions of the buildings (office and warehouse) and perimeter landscaping. Basin PR-1 will flow within the asphalt parking lot to a new 5' Type R inlet, where it will be conveyed to the pond via an 18" RCP pipe. Due to the small size of the development, per the UD-BMP_v3.07 spreadsheet by MHFD, a forebay is not necessary for this size site.

Basin PR-2 will collect flow from a portion of the office roof, which will be conveyed to the detention basin via an earthen swale. Basin PR-3, located along the northern limit of the development, will flow north following the historic drainage path and is not tributary to the proposed pond.

Basins PR-4 and PR-5 include areas in which the historic and proposed impervious values will not be affected by the development of the site. These basins have been

delineated to compare historic discharge rates to those following development. As shown within the Summary Runoff Table included on the Historic Basin Map and Proposed Basin Map and included below, development of the site will result in a decrease in discharge rates at the design points that are located where flows exit the site.

The imperviousness value of 45.61%, which represents the composite value for the area tributary to the pond, was used to determine the required EDB. The UD-Detention spreadsheet can be found in the Appendix.

The drainage concept for the development does not alter historic drainage patterns. The detention pond will act to limit the stormwater release rate to pre-development conditions.

(b) Specific Details

The development will implement Full Spectrum Detention (FSD) utilizing an Extended Detention Basin (EDB) to capture and treat runoff prior to discharge downstream. The proposed detention pond is designed using the UDFCD spreadsheet, UD-Detention v.4.03. This design considers the water quality capture volume (WQCV), excess urban runoff volume (EURV), and 100-year detention volume. The EDB serves to limit the release rate to pre-development conditions. This is illustrated by the decrease in flow from historic to proposed conditions when comparing design point H1 to P1, H2 to P2, and H3 to P3 (historic and proposed, respectively) as shown in the tables below. Refer the accompanying drainage maps for locations of design points.

HISTORIC CONDITIONS

DESIGN POINT	CONTRIBUTING BASIN(S)	CONTRIBUTING AREA (AC)	Q_5 (cfs)	Q_{100} (cfs)	NOTES:
H1	H-1	1.72	0.63	5.86	Releases undetained (following historic flow path)
H2	H-2	2.96	1.97	9.75	Releases undetained (following historic flow path)
H3	H-3	0.23	0.11	0.83	Releases undetained (following historic flow path)

PROPOSED CONDITIONS

DESIGN POINT	CONTRIBUTING BASIN(S)	CONTRIBUTING AREA (AC)	Q_5 (cfs)	Q_{100} (cfs)	NOTES:
P1	PR-1, PR-2, PR-4	2.16	0.47	4.62	Releases offsite (developed basins PR-1 and PR-2 are detained prior to release)
P2	PR-3	2.60	1.53	8.33	Releases undetained (following historic flow path)
P3	PR-5	0.15	0.05	0.52	Releases undetained (following historic flow path)

The outlet of the EDB pond has been directed to the flowline of an existing drainageway, serving to minimize the potential for erosion. In addition, a low tailwater basin will be installed at the end of the EDB pond outfall pipe. This feature consists of a riprap-lined depression that will dissipate the energy of the pond discharge. This design, together with the net decrease in flow from historic conditions, will serve to protect downstream drainageways.

A ten-foot-wide gravel maintenance path provides access to the EDB. The path will provide vehicular access to the bottom of the pond for removing sediment and debris that will collect in the trickle channel and outlet works. The report titled *Stormwater Best Management Practices Inspection and Maintenance Plan (IM Plan) for Black Forest Office*, prepared by 2N Civil for the Owner and/or his assigns, shall be followed to ensure the ongoing performance of the drainage facilities associated with this project.

The cost estimate for the proposed drainage improvements is provided on page 34 in the Appendix of this report.

The Developer shall be responsible for all associated drainage impact fees including, but not limited to, the Drainage Basin Fees associated with the development of this project as outlined in the El Paso County Municipal Code.

5) OTHER GOVERNMENT AGENCY REQUIREMENTS

A permit issued by the *State of Colorado for Stormwater Discharges Associated with Construction Activity* detailing construction management BMPs will be obtained prior to construction activities.

No other government agency requirements are anticipated for this project.

6) DRAWING CONTENTS

(a) General Location Map

A Vicinity Map is included in the Appendix.

(b) Drainage Plan

Refer to the Proposed Drainage Plan in the Appendix for basin delineation, drainage routes and flows, and proposed stormwater facilities.

7) CONCLUSION

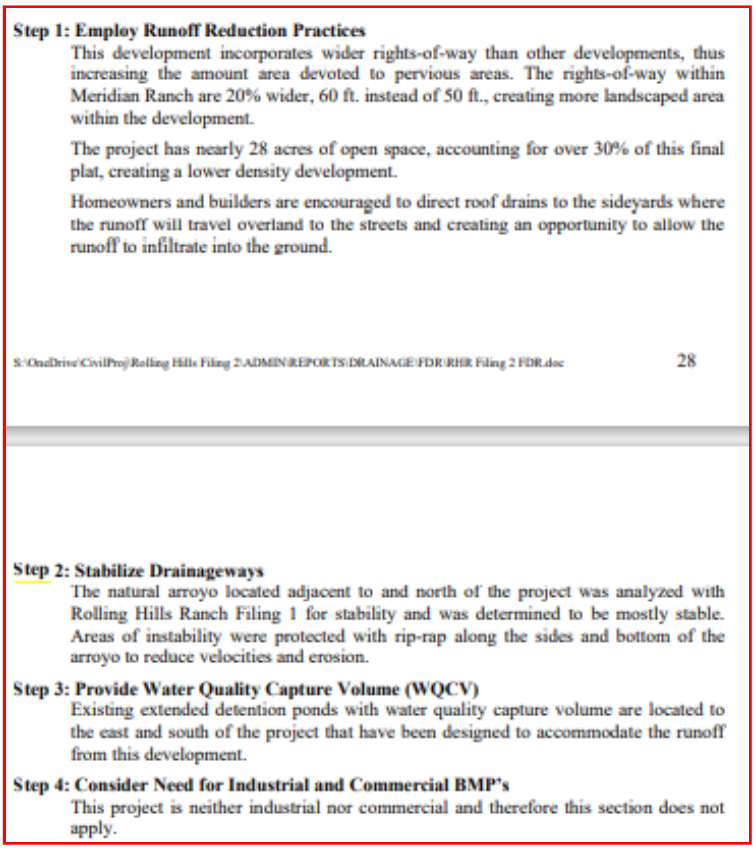
In our professional opinion, the proposed development will pose an insignificant change in the historic drainage patterns of the existing site. The development of the office and warehouse will include construction of an Extended Detention Basin, which will provide detention of the WQCV, EURV, and 100 year flow. This facility will slow the rate of discharge from the site to pre-development conditions and promote infiltration. These runoff reduction measures ensure that the capacity of the downstream drainageways will not be negatively affected by the construction of these improvements.

Please address the 4 step process indicated in ECM Appendix I.7.2. Please list each step and below each step please indicate how it is has been addressed. I have provided an example (see excerpt) as how other consultants address the four step process.

Also please address drainage basin fees. A statement indicating that drainage basin fees are not due with this site development plan application as you are not platting the lot would be sufficient.

Please feel free to give me a call if you have any questions.

Daniel Torres, 719-208-6783
danieltorres@elpasoco.com



Step 1: Employ Runoff Reduction Practices

This development incorporates wider rights-of-way than other developments, thus increasing the amount area devoted to pervious areas. The rights-of-way within Meridian Ranch are 20% wider, 60 ft. instead of 50 ft., creating more landscaped area within the development.

The project has nearly 28 acres of open space, accounting for over 30% of this final plat, creating a lower density development.

Homeowners and builders are encouraged to direct roof drains to the sideyards where the runoff will travel overland to the streets and creating an opportunity to allow the runoff to infiltrate into the ground.

S:\OneDrive\CivilProj\Rolling Hills Filing 2\ADMIN\REPORTS\DRAINAGE\FDR\RHR Filing 2 FDR.doc 28

Step 2: Stabilize Drainageways

The natural arroyo located adjacent to and north of the project was analyzed with Rolling Hills Ranch Filing 1 for stability and was determined to be mostly stable. Areas of instability were protected with rip-rap along the sides and bottom of the arroyo to reduce velocities and erosion.

Step 3: Provide Water Quality Capture Volume (WQCV)

Existing extended detention ponds with water quality capture volume are located to the east and south of the project that have been designed to accommodate the runoff from this development.

Step 4: Consider Need for Industrial and Commercial BMP's

This project is neither industrial nor commercial and therefore this section does not apply.

REFERENCES

1. El Paso County *Engineering Criteria Manual* (ECM), Revised 12/13/2016.

2. *Colorado Springs Drainage Criteria Manual Volumes 1 and 2* (DCMV1 & DCMV2), May 2014.

3. *Drainage Basin Planning Study for Kettle Creek Basin,* Prepared by JR Engineering, LLC, May 5, 2015.

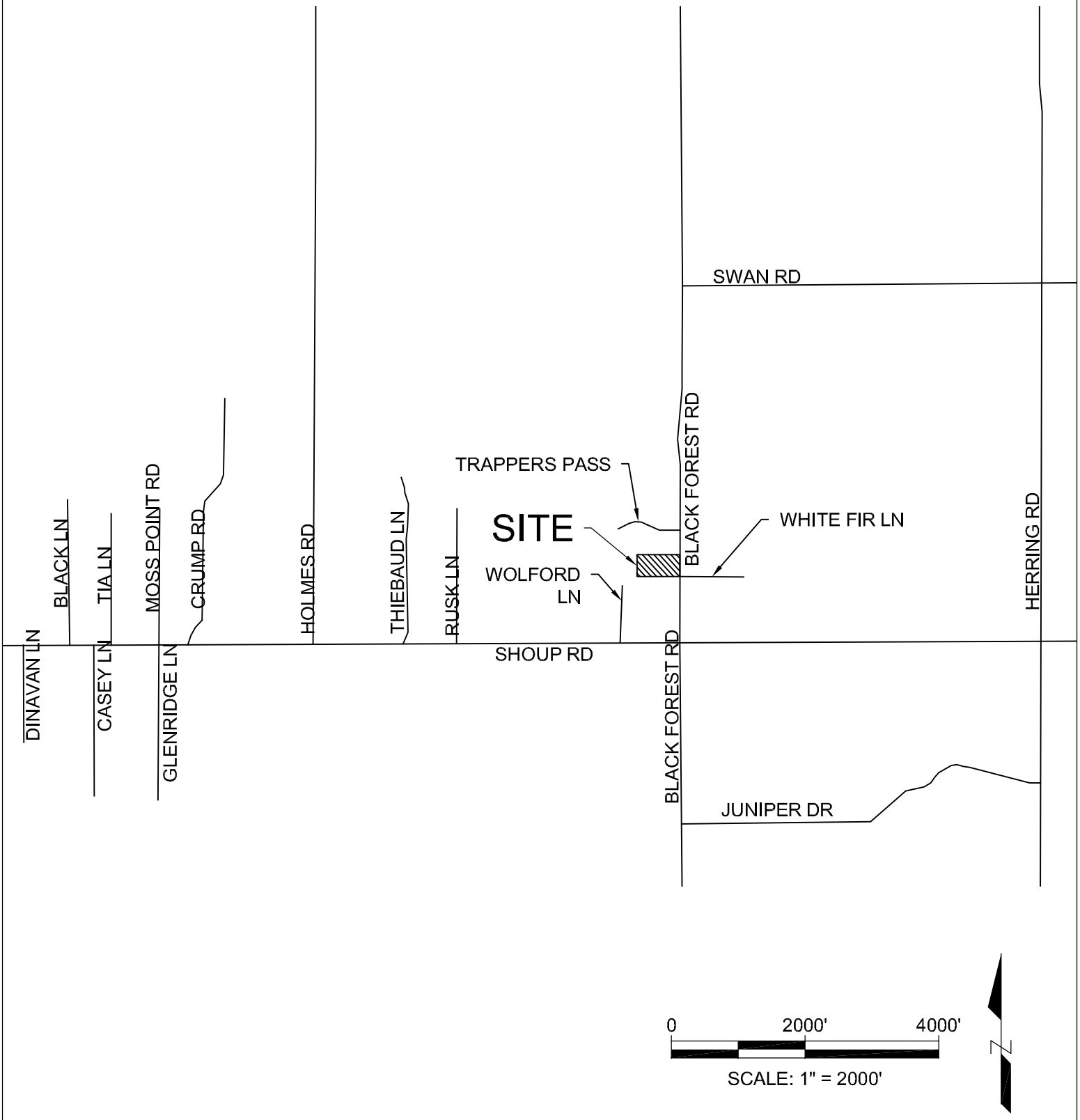
4. *Urban Storm Drainage Criteria Manual, Volumes 1, 2, & 3, Urban Drainage and Flood Control District*, Volumes 1 & 2 - Originally Published September 1969, Updated March 2017; Volume 3 - Originally Published September 1992, Updated November 2010.

5. *Stormwater Best Management Practices Inspection and Maintenance Plan (IM Plan) for Black Forest Office,* prepared by 2N Civil, LLC, Updated 2020.

APPENDIX A

Vicinity Map
Soils Map
FEMA Map

VICINITY MAP



Project Number: 19015

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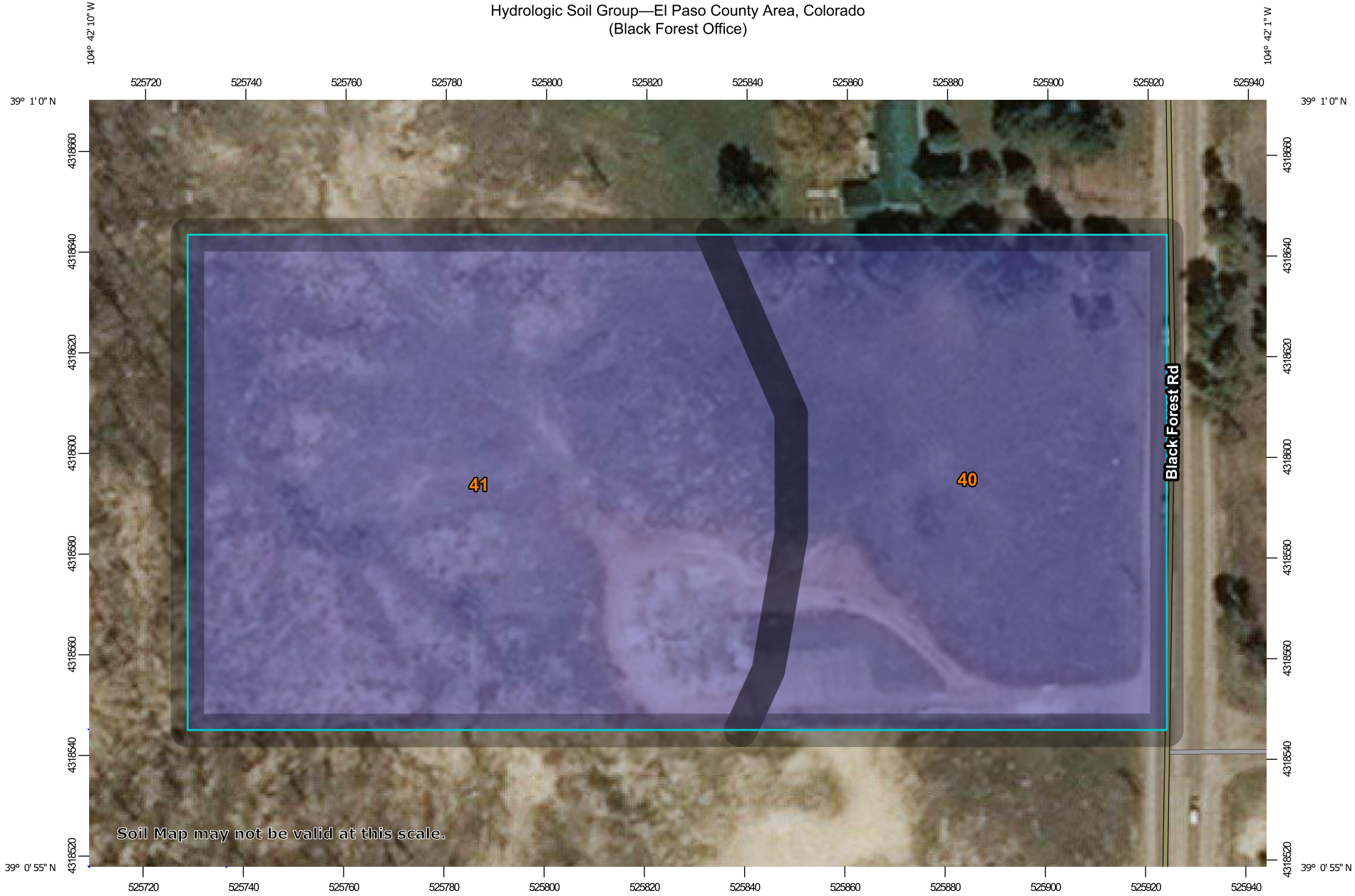
2N Civil, LLC
6 Inverness Ct. E., Suite 125
Englewood, CO 80112
Phone 303-925-0544 Fax 303-925-0547
www.2NCivil.com

VICINITY MAP
BLACK FOREST LLC

Drawn By: TEW
Checked By: EPT
Revisions: 7-2-20



Map Scale: 1:1,070 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

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 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	B	1.9	40.6%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	2.8	59.4%
Totals for Area of Interest			**4.8**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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/.

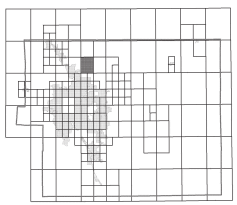
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

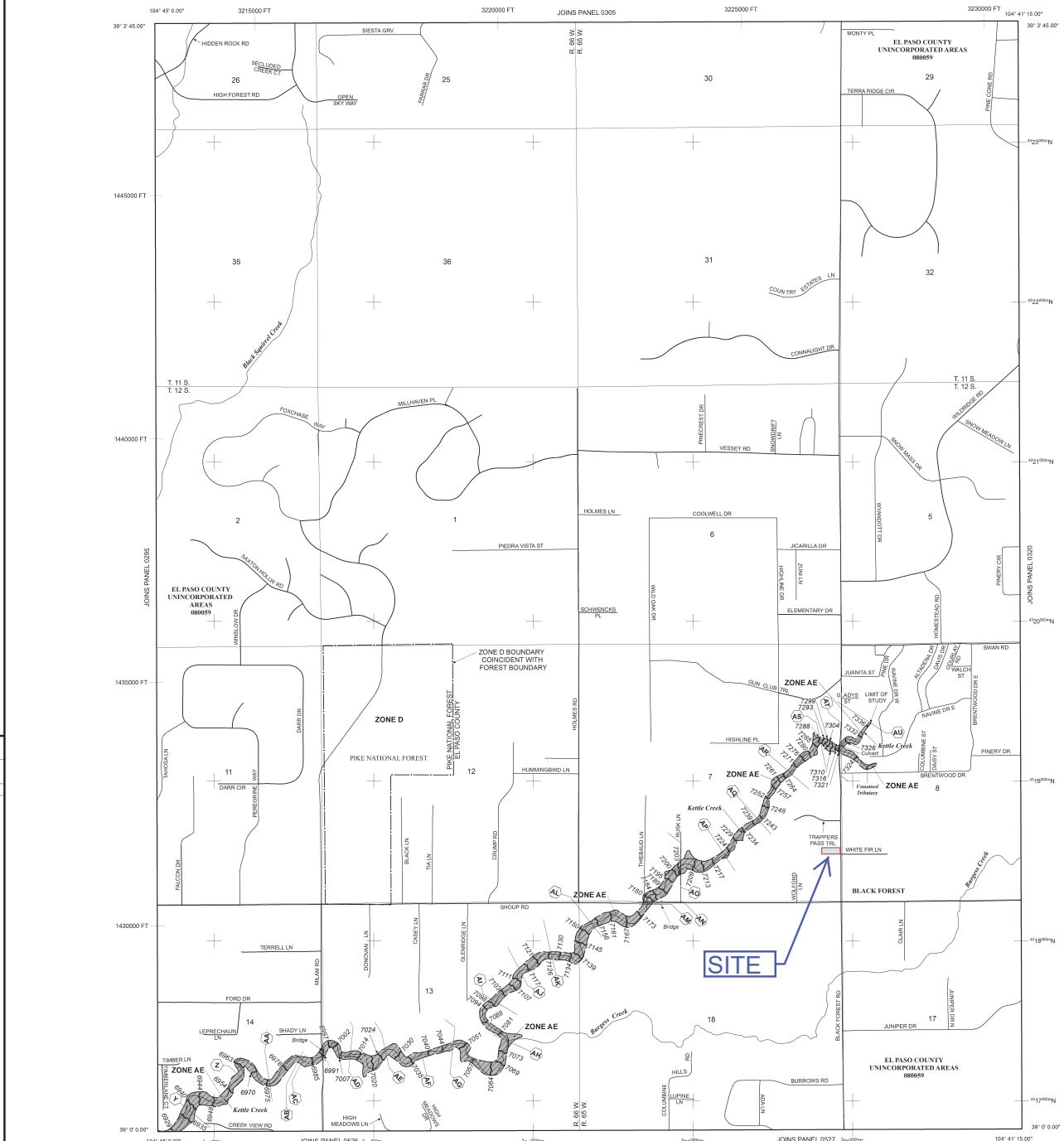
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

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)
4279000mN 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

National Flood Hazard Layer FIRMette

FEMA

104°42'25"W 39°1'11"N

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

1:6,000

18

104°41'47"W 39°0'43"N

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/16/2020 at 3:38 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX B

Hydrologic Calculations

Black Forest Office

Composite Impervious Calculations - Historic Conditions

Date: January 19, 2021

Historic Conditions

Information from UCFCD Volume 1 Table 6-6

Type B NRCS Hydrologic Soils Group

Land Use	% Impervious	C5	C100
Streets (Paved)	100%	0.90	0.96
Streets (Gravel)	80%	0.59	0.74
Drive and Walks	100%	0.90	0.96
Roofs	90%	0.73	0.83
Lawns	0%	0.08	0.50

I. Land Use Breakdown

Area (square feet)

Basin	Paved	Gravel	Drive/Walk	Roofs	Lawns	Σ Area
H-1	0	1,249	0	0	73,645	74,894
H-2	13,100	4,204	0	2,769	108,867	128,940
H-3	0	862	0	0	9,331	10,193
						214,027

Area (acres)

Basin	Paved	Gravel	Drive/Walk	Roofs	Lawns	Σ Area
H-1	0.00	0.03	0.00	0.00	1.69	1.719
H-2	0.30	0.10	0.00	0.06	2.50	2.960
H-3	0.00	0.02	0.00	0.00	0.21	0.234
Total						4.913

II. Composite Basin Imperviousness and Runoff Coefficients

Basin	Σ (% I * Area)	Σ Area (ac)	$I_{Weighted\ C5}$ = Σ (C5*Area) / Σ Area	$I_{Weighted\ C100}$ = Σ (C100*Area) / Σ Area	$I_{Weighted\ Basin}$ = Σ (%I*Area) / Σ Area
H-1	0.02	1.719	0.09	0.50	**1.3%**
H-2	0.44	2.960	0.19	0.56	**14.7%**
H-3	0.02	0.234	0.12	0.52	**6.8%**

Black Forest Office

Composite Impervious Calculations - Proposed Conditions

Date: January 19, 2021

Proposed Conditions

Information from UCFCD Volume 1 Table 6-6

Type B NRCS Hydrologic Soils Group

Land Use	% Impervious	C5	C100
Streets (Paved)	100%	0.90	0.96
Streets (Gravel)	80%	0.59	0.74
Drive and Walks	100%	0.90	0.96
Roofs	90%	0.73	0.83
Lawns	0%	0.08	0.50

I. Land Use Breakdown

Area (square feet)

Basin	Paved	Gravel	Drive/Walk	Roofs	Lawns	Σ Area
PR-1	14,245	0	2,969	1,640	4,374	23,228
PR-2	0	1,007	2,735	4,401	26,055	34,197
PR-3	10,364	0	375	1,609	100,980	113,328
PR-4	0	0	0	0	36,455	36,455
PR-5	0	0	0	0	6,640	6,640
						213,848

Area (acres)

Basin	Paved	Gravel	Drive/Walk	Roofs	Lawns	Σ Area
PR-1	0.33	0.00	0.07	0.04	0.10	0.533
PR-2	0.00	0.02	0.06	0.10	0.60	0.785
PR-3	0.24	0.00	0.01	0.04	2.32	2.602
PR-4	0.00	0.00	0.00	0.00	0.84	0.837
PR-5	0.00	0.00	0.00	0.00	0.15	0.152
Total						4.909

II. Composite Basin Imperviousness and Runoff Coefficients

Basin	Σ (% I * Area)	Σ Area (ac)	$I_{Weighted\ C5}$ = Σ (C5*Area) / Σ Area	$I_{Weighted\ C100}$ = Σ (C100*Area) / Σ Area	$I_{Weighted\ Basin}$ = Σ (%I*Area) / Σ Area
PR-1	0.43	0.533	0.73	0.86	**80.5%**
PR-2	0.17	0.785	0.24	0.59	**21.9%**
PR-3	0.28	2.602	0.17	0.55	**10.8%**
PR-4	0.00	0.837	0.08	0.50	**0.0%**
PR-5	0.00	0.152	0.08	0.50	**0.0%**

Composite Imperviousness Value for Watershed Tributary to Pond (used in MHFD-Detention Spreadsheet for EDB Pond)

Basins PR-1 & PR-2	Σ Area (ac)	**1.32**	% $I_{Watershed}$ =	**45.61%**

Calculation of Peak Runoff using Rational Method

Designer: TEW
Company: 2N Civil
Date: 1/12/2021
Project: Black Forest Office
Location: 12740 Black Forest Rd, Colo Springs, CO

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$\text{Computed } t_c = t_i + t_t$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum} = 5$ (urban)
$t_{minimum} = 10$ (non-urban)

$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

1-hour rainfall depth, P1 (in) =	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
	1.19	1.50	1.75	2.00	2.25	2.52	

Rainfall Intensity Equation Coefficients =	a	b	c
	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$Q(cfs) = CIA$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
PR-1	0.53	B	80.5	0.65	0.68	0.71	0.75	0.78	0.80	0.83	89.68	72.40	68.00	0.049	4.28	309.47	68.00	58.35	0.031	20	3.53	1.46	5.74	13.76	5.74	3.89	4.90	5.71	6.53	7.35	8.23		1.34	1.77	2.15	2.63	3.04	3.51	
					0.73				0.86						3.74								5.20										1.91					3.77	
PR-2	0.79	B	21.9	0.14	0.16	0.23	0.39	0.45	0.53	0.62	11.35	74.90	72.00	0.256	1.95	172.30	72.00	55.00	0.099	20	6.28	0.46	2.41	23.03	5.00	4.04	5.09	5.94	6.78	7.63	8.55		0.45	0.66	1.09	2.06	2.70	3.54	
					0.24				0.59						1.79								2.25										0.96					3.96	
PR-3	2.60	B	10.8	0.06	0.08	0.14	0.32	0.39	0.48	0.58	96.55	69.74	65.00	0.049	10.74	345.08	65.00	48.00	0.049	7	1.55	3.70	14.45	26.63	14.45	2.75	3.47	4.04	4.62	5.20	5.82		0.44	0.69	1.52	3.81	5.25	7.21	
					0.17				0.55						9.76								13.46										1.53					8.33	
PR-4	0.84	B	0.0	0.00	0.00	0.06	0.25	0.33	0.43	0.54	107.30	64.36	51.88	0.116	9.15	138.47	51.88	41.00	0.079	7	1.96	1.18	10.33	26.91	10.33	3.18	4.01	4.67	5.34	6.01	6.73		0.00	0.00	0.22	1.11	1.65	2.40	
					0.08				0.50						8.49								9.66										0.27					2.82	
PR-5	0.15	B	0.0	0.00	0.00	0.06	0.25	0.33	0.43	0.54	14.55	64.00	63.00	0.069	4.01	22.69	63.00	58.69	0.190	7	3.05	0.12	4.13	26.10	10.00	3.22	4.06	4.73	5.41	6.09	6.82		0.00	0.00	0.04	0.20	0.30	0.44	
					0.08				0.50						3.72								3.84										0.05					0.52	
H-1	1.72	B	1.3	0.01	0.01	0.07	0.26	0.34	0.43	0.54	42.88	74.05	66.00	0.188	4.91	304.44	66.00	41.00	0.082	7	2.01	2.53	7.44	27.70	10.00	3.22	4.06	4.73	5.41	6.09	6.82		0.03	0.05	0.55	2.39	3.51	5.07	
					0.09				0.50						4.54								7.07										0.63					5.86	
H-2	2.96	B	14.7	0.09	0.11	0.18	0.34	0.41	0.49	0.59	96.55	69.74	65.00	0.049	10.43	345.08	65.00	48.00	0.049	7	1.55	3.70	14.13	25.84	14.13	2.78	3.50	4.09	4.67	5.25	5.88		0.73	1.10	2.12	4.72	6.37	8.61	
					0.19				0.56						9.55								13.25										1.97					9.75	
H-3	0.02	B	6.8	0.04	0.05	0.11	0.29	0.37	0.46	0.56	14.55	64.00	63.00	0.069	3.84	22.69	63.00	58.69	0.190	7	3.05	0.12	3.97	24.94	10.00	3.22	4.06	4.73	5.41	6.09	6.82		0.00	0.00	0.01	0.03	0.04	0.06	
					0.12				0.52						3.57								3.70										0.01					0.07	

Black Forest Office

SUMMARY RUNOFF TABLE

Date: January 19, 2021

HISTORIC CONDITIONS

DESIGN POINT	CONTRIBUTING BASIN(S)	CONTRIBUTING AREA (AC)	Q_5 (cfs)	Q_{100} (cfs)	NOTES:
H1	H-1	1.72	0.63	5.86	Releases undetained (following historic flow path)
H2	H-2	2.96	1.97	9.75	Releases undetained (following historic flow path)
H3	H-3	0.23	0.11	0.83	Releases undetained (following historic flow path)

PROPOSED CONDITIONS

DESIGN POINT	CONTRIBUTING BASIN(S)	CONTRIBUTING AREA (AC)	Q_5 (cfs)	Q_{100} (cfs)	NOTES:
P1	PR-1, PR-2, PR-4	2.16	0.47	4.62	Releases offsite (developed basins PR-1 and PR-2 are detained prior to release)
P2	PR-3	2.60	1.53	8.33	Releases undetained (following historic flow path)
P3	PR-5	0.15	0.05	0.52	Releases undetained (following historic flow path)
1	PR-1	0.53	1.91	3.77	Releases to EDB Pond
2	PR-2	0.79	0.96	3.96	Releases to EDB Pond

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

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

3.2 Time of Concentration

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

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

APPENDIX C

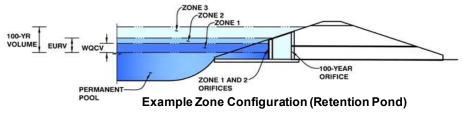
EDB Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **Black Forest Office**

Basin ID: **EDB Basin (PR-1 and PR-2)**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	1.32	acres		
Watershed Length =	390	ft		
Watershed Length to Centroid =	160	ft		
Watershed Slope =	0.040	ft/ft		
Watershed Imperviousness =	45.61%	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 =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.021	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.064	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.058	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.085	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.108	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.140	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.166	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.199	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.266	acre-feet	3.14	inches
Approximate 2-yr Detention Volume =	0.048	acre-feet		
Approximate 5-yr Detention Volume =	0.066	acre-feet		
Approximate 10-yr Detention Volume =	0.089	acre-feet		
Approximate 25-yr Detention Volume =	0.098	acre-feet		
Approximate 50-yr Detention Volume =	0.102	acre-feet		
Approximate 100-yr Detention Volume =	0.116	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.021	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.042	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.052	acre-feet
Total Detention Basin Volume =	0.116	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increement = 0.20 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	13	0.000		
	--	0.20	--	--	--	121	0.003	13	0.000
	--	0.40	--	--	--	247	0.006	50	0.001
	--	0.60	--	--	--	465	0.011	121	0.003
	--	0.80	--	--	--	917	0.021	260	0.006
	--	1.00	--	--	--	2,126	0.049	564	0.013
	--	1.20	--	--	--	3,590	0.082	1,135	0.026
	--	1.40	--	--	--	3,848	0.088	1,879	0.043
	--	1.60	--	--	--	4,044	0.093	2,668	0.061
	--	1.80	--	--	--	4,242	0.097	3,497	0.080
	--	2.00	--	--	--	4,442	0.102	4,365	0.100
	--	2.20	--	--	--	4,646	0.107	5,274	0.121
	--	2.40	--	--	--	4,855	0.111	6,224	0.143
	--	2.60	--	--	--	5,066	0.116	7,216	0.166
	--	2.80	--	--	--	5,279	0.121	8,251	0.189
	--	3.00	--	--	--	5,495	0.126	9,328	0.214
	--	3.20	--	--	--	5,726	0.131	10,450	0.240
	--	3.40	--	--	--	5,978	0.137	11,621	0.267
	--	3.60	--	--	--	6,248	0.143	12,843	0.295
	--	3.80	--	--	--	6,538	0.150	14,122	0.324
	--	4.00	--	--	--	6,847	0.157	15,461	0.355
	--	4.10	--	--	--	7,008	0.161	16,153	0.371
	--	4.20	--	--	--	7,008	0.161	16,854	0.387
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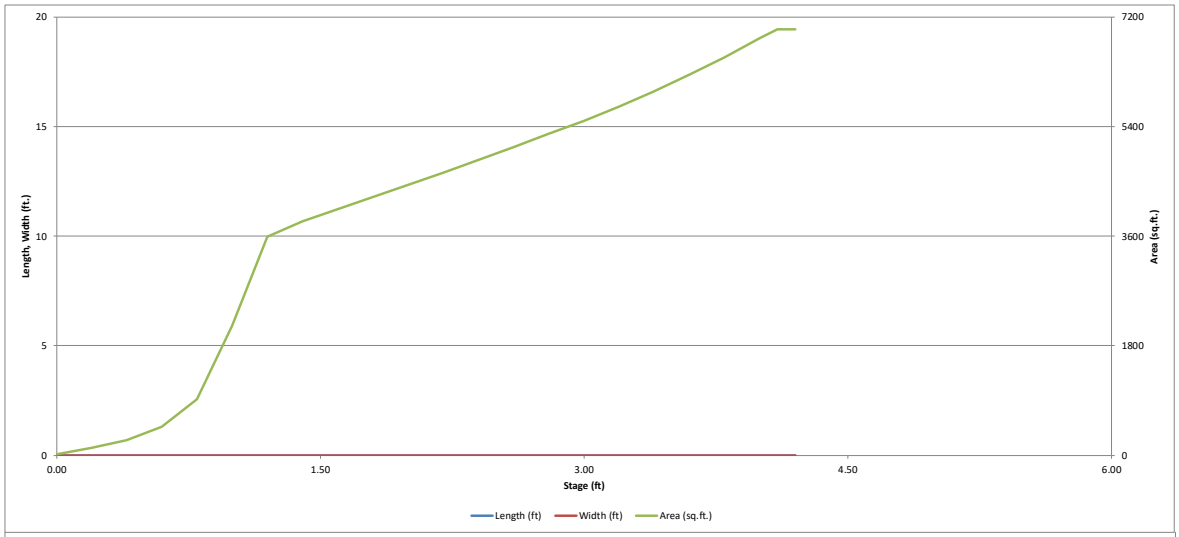
20
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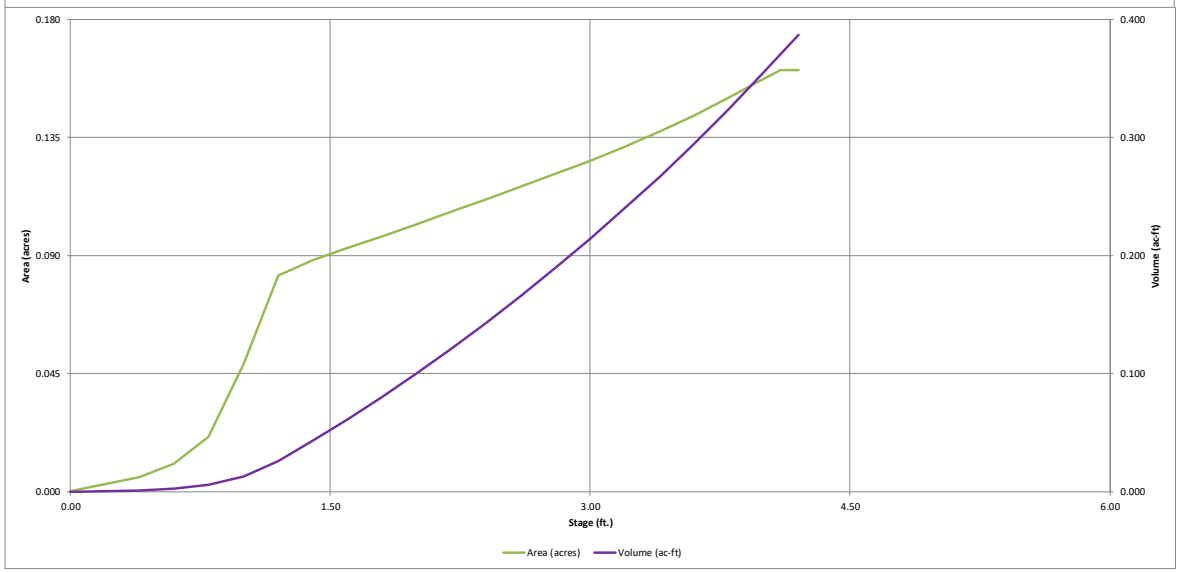
7200
5400
3600
1800
0
Length, Width (ft.)
Area (sq.ft.)
0.00
1.50
3.00
4.50
6.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

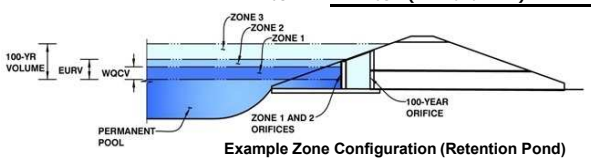

0.180
0.135
0.090
0.045
0.000
0.400
0.300
0.200
0.100
0.000
Area (acres)
Volume (ac-ft)
0.00
1.50
3.00
4.50
6.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Black Forest Office

Basin ID: EDB Basin (PR-1 and PR-2)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.14	0.021	Orifice Plate
Zone 2 (EURV)	1.63	0.042	Orifice Plate
Zone 3 (100-year)	2.15	0.052	Weir&Pipe (Restrict)
Total (all zones)		0.116	

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

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

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		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.63	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	6.50	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	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 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.54	1.09					
Orifice Area (sq. inches)	0.14	0.14	0.50					

	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 =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.63	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.63	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.12	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	69.46	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.54	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	5.77	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	3.40	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.17	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.13	N/A	feet
Restrictor Plate Height Above Pipe Invert =	2.70		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.80	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

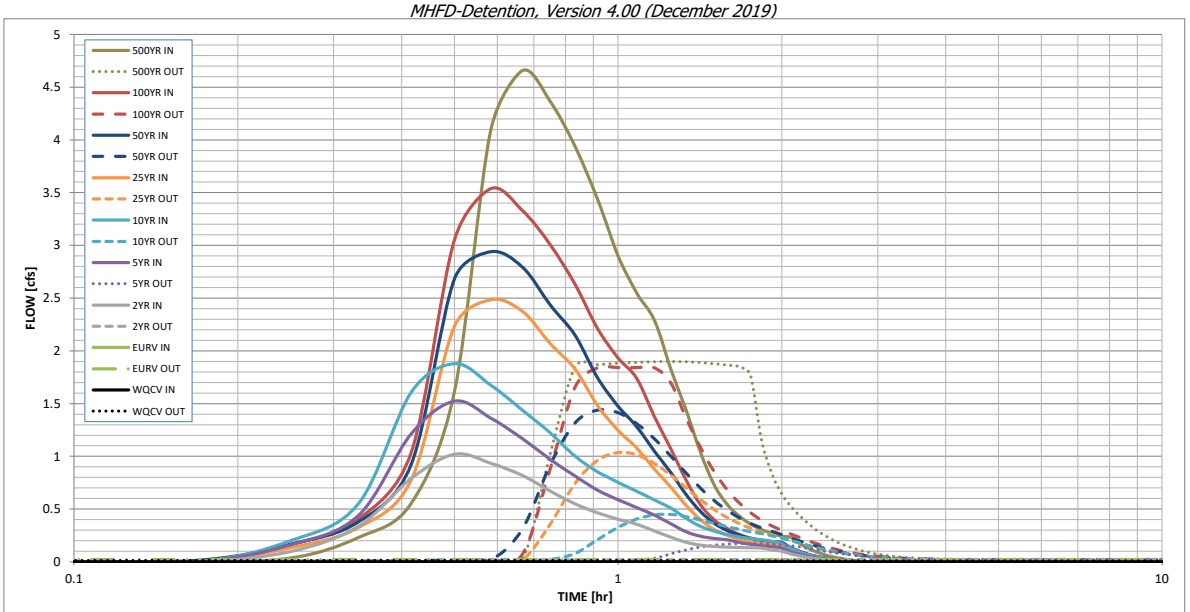
			Calculated Parameters for Spillway		
Spillway Invert Stage=	2.62	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.33	feet
Spillway Crest Length =	5.00	feet	Stage at Top of Freeboard =	3.95	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.16	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.35	acre-ft

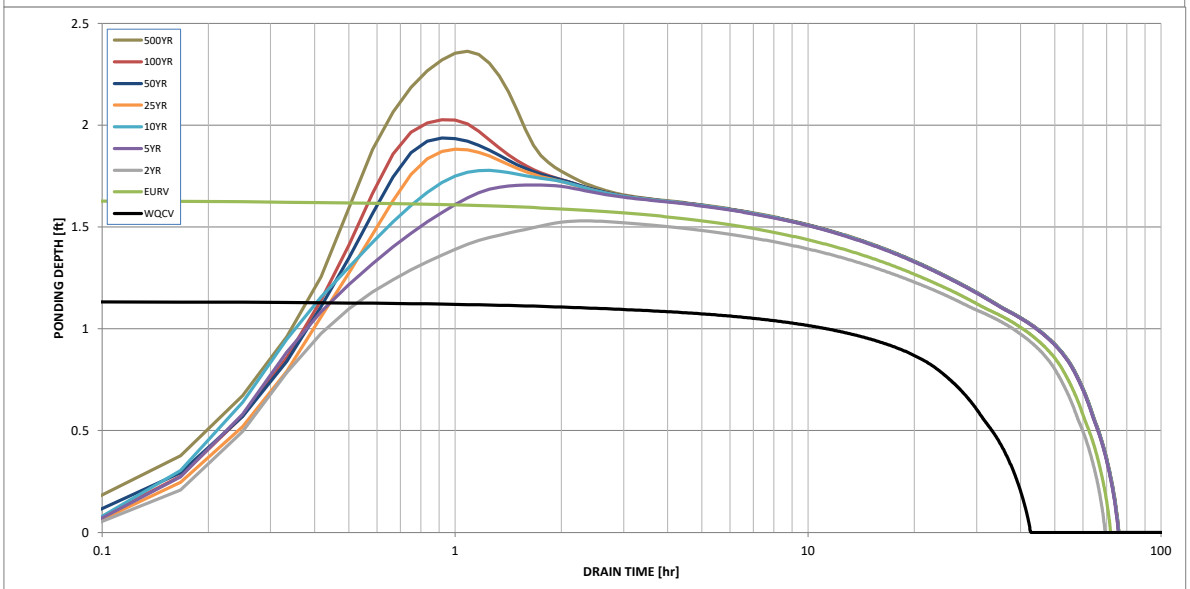
Routed Hydrograph Results — *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

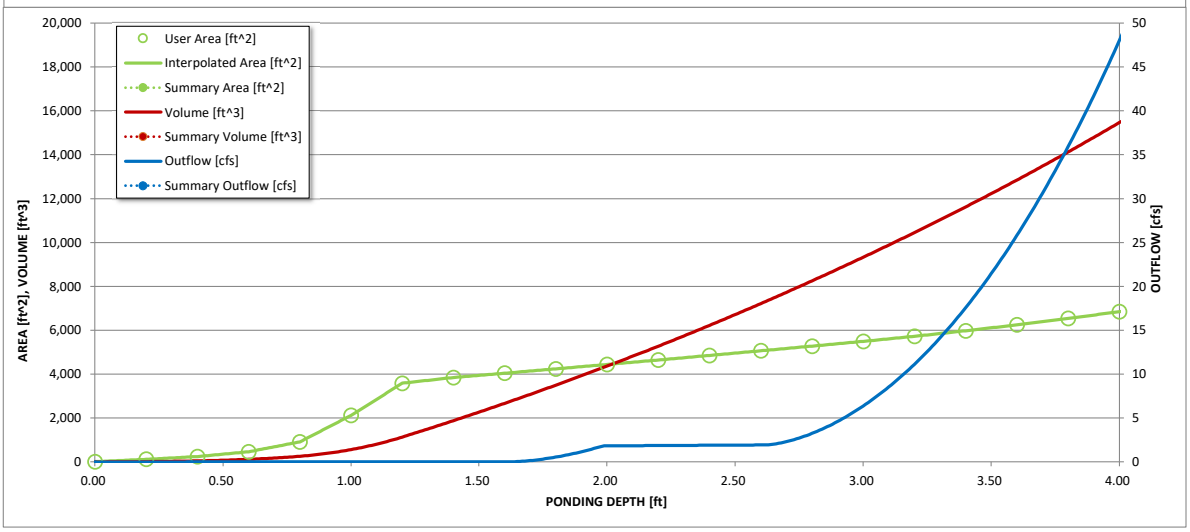
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.021	0.064	0.058	0.085	0.108	0.140	0.166	0.199	0.266
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.058	0.085	0.108	0.140	0.166	0.199	0.266
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.5	0.7	1.2	1.5	1.9	2.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.35	0.53	0.93	1.17	1.46	2.04
Peak Inflow Q (cfs) =	N/A	N/A	1.0	1.5	1.9	2.5	2.9	3.5	4.7
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.2	0.4	1.0	1.4	1.8	1.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.8	0.9	1.0	0.7
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.0	0.1	0.1	0.2	0.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	62	60	64	62	60	58	56	53
Time to Drain 99% of Inflow Volume (hours) =	**41**	68	65	70	69	68	67	66	64
Maximum Ponding Depth (ft) =	1.14	1.63	1.53	1.71	1.78	1.88	1.94	2.03	2.36
Area at Maximum Ponding Depth (acres) =	0.07	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.11
Maximum Volume Stored (acre-ft) =	0.021	0.064	0.055	0.071	0.077	0.088	0.093	0.102	0.138

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04
	0:15:00	0.00	0.00	0.10	0.16	0.20	0.13	0.17	0.16	0.23
	0:20:00	0.00	0.00	0.34	0.44	0.55	0.33	0.38	0.41	0.55
	0:25:00	0.00	0.00	0.79	1.22	1.61	0.78	0.92	1.04	1.61
	0:30:00	0.00	0.00	1.02	1.52	1.88	2.23	2.68	3.05	4.09
	0:35:00	0.00	0.00	0.94	1.36	1.68	2.48	2.94	3.54	4.66
	0:40:00	0.00	0.00	0.82	1.17	1.44	2.37	2.80	3.33	4.37
	0:45:00	0.00	0.00	0.67	0.97	1.22	2.07	2.44	3.01	3.94
	0:50:00	0.00	0.00	0.55	0.81	1.00	1.83	2.15	2.63	3.44
	0:55:00	0.00	0.00	0.46	0.68	0.85	1.48	1.74	2.21	2.90
	1:00:00	0.00	0.00	0.40	0.59	0.75	1.25	1.48	1.93	2.54
	1:05:00	0.00	0.00	0.36	0.51	0.67	1.08	1.28	1.74	2.29
	1:10:00	0.00	0.00	0.29	0.44	0.59	0.88	1.05	1.37	1.83
	1:15:00	0.00	0.00	0.23	0.36	0.51	0.71	0.85	1.07	1.44
	1:20:00	0.00	0.00	0.19	0.28	0.41	0.53	0.64	0.77	1.04
	1:25:00	0.00	0.00	0.16	0.24	0.34	0.40	0.48	0.54	0.73
	1:30:00	0.00	0.00	0.15	0.22	0.29	0.31	0.37	0.40	0.55
	1:35:00	0.00	0.00	0.14	0.21	0.26	0.25	0.30	0.32	0.44
	1:40:00	0.00	0.00	0.14	0.18	0.24	0.22	0.25	0.26	0.36
	1:45:00	0.00	0.00	0.13	0.17	0.22	0.19	0.22	0.22	0.31
	1:50:00	0.00	0.00	0.13	0.15	0.21	0.18	0.20	0.20	0.27
	1:55:00	0.00	0.00	0.11	0.14	0.19	0.17	0.19	0.18	0.24
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	2:05:00	0.00	0.00	0.07	0.10	0.12	0.12	0.13	0.12	0.17
	2:10:00	0.00	0.00	0.05	0.07	0.09	0.08	0.09	0.09	0.12
	2:15:00	0.00	0.00	0.04	0.05	0.06	0.06	0.07	0.06	0.09
	2:20:00	0.00	0.00	0.03	0.03	0.05	0.04	0.05	0.04	0.06
	2:25:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	2:30:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	2:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02
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	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Summary Stage-Area-Volume-Discharge Relationships

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

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

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

BLACK FOREST OFFICE

POND OUTLET PIPE

***D* =**	18 inches
***D* =**	1.5 ft
***A* =**	1.77 sq ft
$V_{Allowed}$	6.05 ft/s

***Q* =** 2.00 cfs

Use Type M Riprap Minimum

Required Riprap Rock Size

P_d	6.31
***V* =**	6.05 ft/s
***g* =**	32.20 ft/sq sec
***d* =**	0.1 (assumed value)

→ Req'd Riprap Type Based off P_d: L

Riprap Type	D_{50}-Median Rock Size (in.)
L	9
M	12
H	18
B18	18 (Grouted)

By Figure HS-20 in Drainage Criteria Manual Vol. 2, Type L Riprap is Mandated
Using Type L

Length of Riprap Required - Basin Length Minimum

L = 4D

***D* =**	1.5 ft
***L* =**	6.00 ft

L* = $D^{1/2}$ *x (V/2)

***D* =**	1.5 ft
***V* =**	6.05 ft/s
***L* =**	3.70 ft

Using the Greater of the Two Lengths, L = 6

Basin Minimum Width

W = 4D

D =	1.5 ft - Diameter of Circular Conduit
W =	6.00 ft

Minimum Thickness of Riprap, T

$T = 1.75 \times D_{50}$

D_{50} =	9 inches
T =	1.31 ft

APPENDIX D

EDB Construction Plans
Historic Drainage Map
Proposed Drainage Map

ITEMIZED COST ESTIMATE

Proposed Drainage Facilities

Black Forest Office

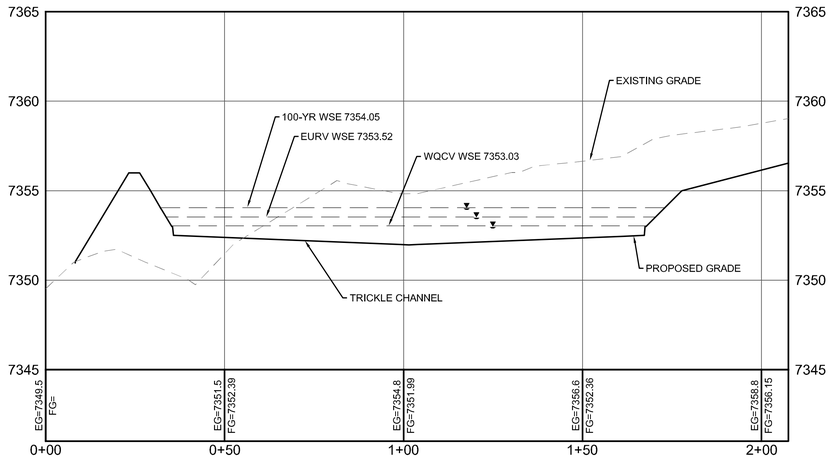
Date: January 19, 2021

Storm Sewer Utility	Unit	Quantity	Unit Cost	Amount
Permanent Pond/BMP Construction	CY	187	$20.00	$3,740
Permanent Pond/BMP Construction (Spillway)	EA	1	$850.00	$850
Permanent Pond/BMP Construction (Outlet Structure)	EA	1	$20,000.00	$20,000
5' Type R Curb Inlet	EA	1	$5,542.00	$5,542
18" RCP	LF	71	$65.00	$4,615
18" RCP Flared End Section	EA	2	$390.00	$780
			Subtotal	$35,527

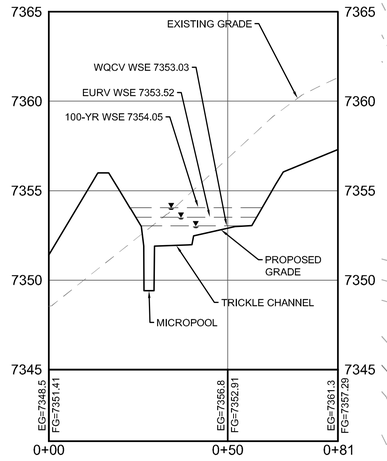
In providing opinions of probable construction cost, the client understands that the Engineer has no control over cost or price of labor, equipment or materials, or over the contractor's method of pricing, and that the opinions of probable construction costs provided herein are made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, to the accuracy of such opinions as compared to bid or actual costs.

BLACK FOREST OFFICE

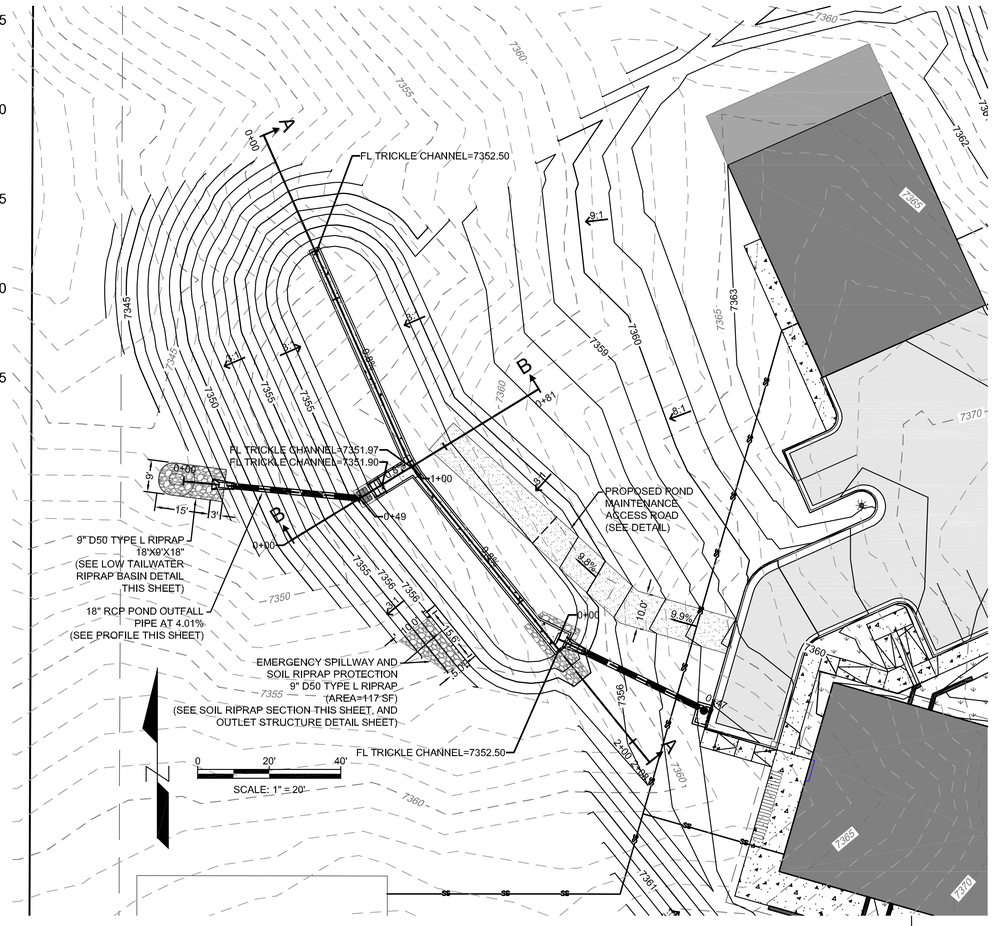
N1/2 NE1/4 SE1/4 SE1/4 OF SECTION 07, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M., EL PASO COUNTY, COLORADO



SECTION A-A PROFILE
SCALE: (H) 1" = 20' (V) 1" = 4'
START STA: 0+00.00, END STA: 2+07.51



SECTION B-B PROFILE
SCALE: (H) 1" = 20' (V) 1" = 4'
START STA: 0+00.00, END STA: 0+80.77

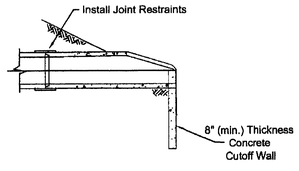


Pay Item		Percent of Material Smaller Than Typical Stone[2]	Typical Stone Dimensions[3] (Inches)	Typical Stone Weight[4] (Pounds)
	Stone Size d50[1] (Inches)			
Riprap	9	70-100	15	160
		50-70	12	85
		35-50	9	35
		2-10	3	1.3

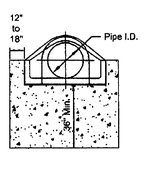
[1]d50 = nominal stone size
[2]based on typical rock mass
[3]equivalent spherical diameter
[4]based on a specific gravity = 2.5

CLASSIFICATION FOR AGGREGATE BASE COURSE

Sieve Size	Mass Percent Passing Square Mesh Sieves						
	LL not greater than 35			LL not greater than 30			
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
150 mm (6")			100				
100 mm (4")		100					
75 mm (3")		95-100					
60 mm (2 ½")	100						
50 mm (2")	95-100			100			
37.5 mm (1 ½")				90-100	100		
25 mm (1")					95-100	100	100
19 mm (3/4")				50-90		95-100	
4.75 mm (#4)	30-65			30-50	30-70	30-65	
2.36 mm (#8)						25-55	20-85
75 µm (#200)	3-15	3-15	20 max	3-12	3-15	3-12	5-15
NOTE: Class 3 material shall consist of bank or pit run material.							



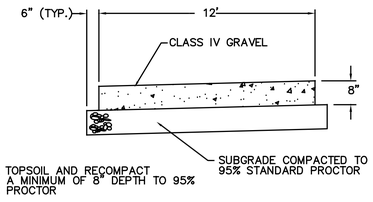
Section at Centerline



End View

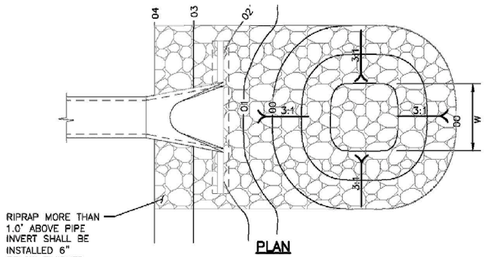
PIPE DIA.	W	L	D
18"	2.50'	5.0'	18"
24"	3.00'	6.0'	18"
30"	4.00'	8.0'	18"

Concrete Flared End Section With Cutoff Wall

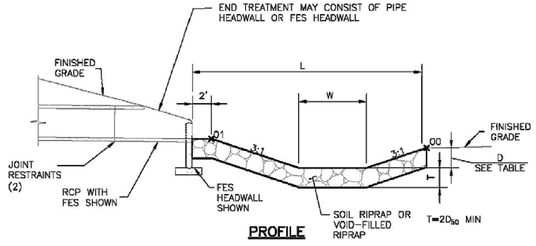


STRIP ALL TOPSOIL AND RECOMPACT SUBGRADE A MINIMUM OF 8" DEPTH TO 95% STANDARD PROCTOR

POND MAINTENANCE ROAD DETAIL
N.T.S.



PLAN

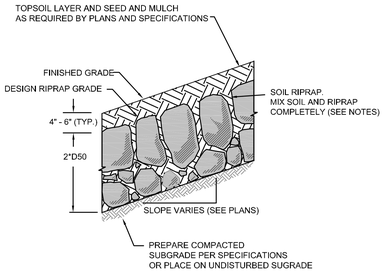


PROFILE

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

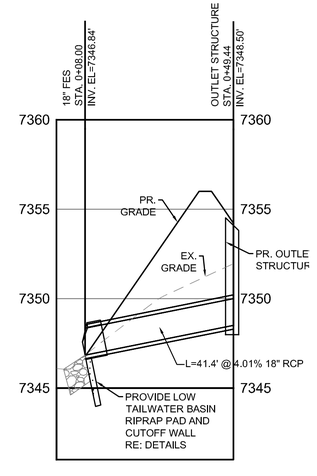
* IF OUTLET PIPE IS A BOX CULVERT WITH A WIDTH GREATER THAN W, THEN W = CULVERT WIDTH

LOW TAILWATER RIPRAP BASIN
N.T.S.

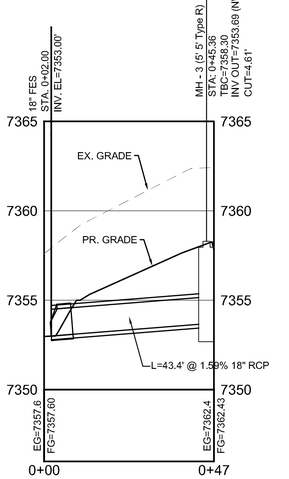


NOTES:
1. SOIL RIPRAP DETAILS ARE APPLICABLE TO SLOPED AREAS. REFER TO THE SITE PLAN FOR ACTUAL LOCATION AND LIMITS.
2. MIX UNIFORM ALLY 65% RIPRAP BY VOLUME WITH 35% OF APPROVED SOIL BY VOLUME PRIOR TO PLACEMENT.
3. PLACE STONE-SOIL MIX TO RESULT IN SECURELY INTERLOCKED ROCK AT THE DESIGN THICKNESS AND GRADE. COMPACT AND LEVEL TO ELIMINATE ALL VOIDS AND ROCKS PROJECTING ABOVE DESIGN RIPRAP TOP GRADE.
4. CRIMP OR TACKIFY MULCH OR USE APPROVED HYDROMULCH AS CALLED FOR IN THE PLANS AND SPECIFICATIONS.

TYPICAL SECTION - SOIL RIPRAP WITH MULCH



STORM - POND OUTFALL PROFILE
SCALE: (H) 1" = 20' (V) 1" = 4'
START STA: 0+00.00, END STA: 0+49.44



STORM PROFILE
SCALE: (H) 1" = 20' (V) 1" = 4'
START STA: 0+00.00, END STA: 0+47.44

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PREPARED FOR:
BLACK FOREST, LLC
12740 BLACK FOREST ROAD
COLORADO SPRINGS, CO 80908

Pond Details
CONSTRUCTION DOCUMENTS
BLACK FOREST OFFICE
COLORADO SPRINGS, COLORADO

BY: TEW DATE: 1-18-21

REVISIONS:
1. EL PASO CNTY COMMENTS 1-7-21
2.
3.
4.

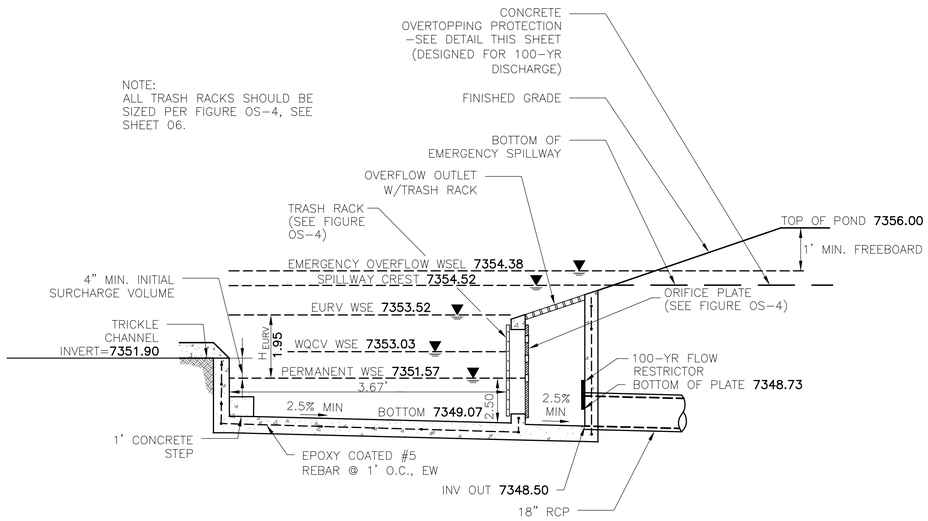
PROJECT NUMBER: 19015
ISSUED DATE: 12-03-2020
DESIGNED BY: TEW
REVIEWED BY: RCE

Pond Details

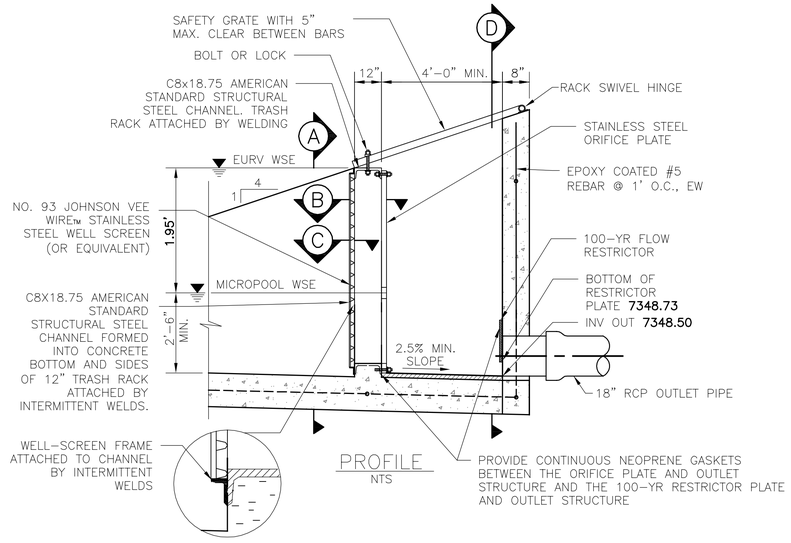
J:\Projects\19\19015\dwg\Drainage\Outlet Structure Details.dwg 1/18/2021

BLACK FOREST OFFICE

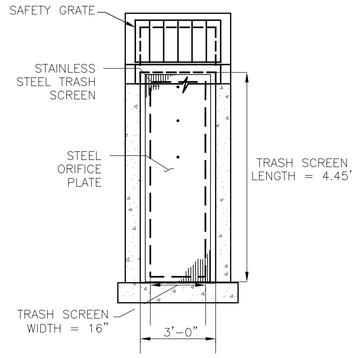
N1/2 NE1/4 SE1/4 SE1/4 OF SECTION 07, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M., EL PASO COUNTY, COLORADO



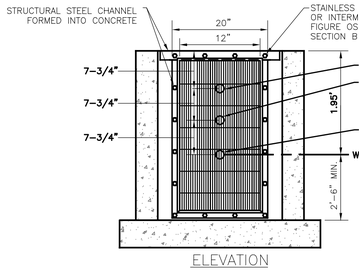
OUTLET STRUCTURE SECTION VIEW
NTS



PROFILE
NTS



SECTION A
NTS



ELEVATION

ORIFICE PLATE NOTES:

1. PROVIDE CONTINUOUS NEOPRENE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE.
2. BOLT PLATE TO CONCRETE 12" MAX. ON CENTER. SEE TABLE OS–2 FOR PLATE THICKNESS.

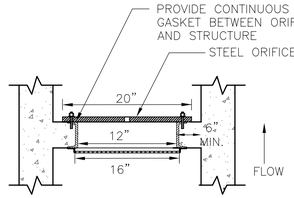
EURV AND WQCV TRASH RACKS:

1. WELL–SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.
2. BAR GATE TRASH RACKS SHALL BE ALUMINUM AND SHALL BE BOLTED USING STAINLESS STEEL HARDWARE.
3. TRASH RACK OPEN AREAS ARE FOR SPECIFIED TRASH RACK MATERIALS. TOTAL TRASH RACK SIZE MAY NEED TO BE ADJUSTED FOR MATERIALS HAVING DIFFERENT OPEN AREA/GROSS AREA RATIO (R VALUE).
4. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

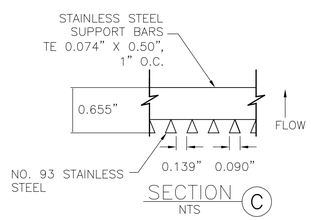
OVERFLOW SAFETY GRATES:

1. ALL SAFETY GRATES SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
2. SAFETY GRATES SHALL BE STAINLESS STEEL, ALUMINUM, OR STEEL. STEEL GRATES SHALL BE HOT DIP GALVANIZED AND MAY BE HOT POWDER COATED AFTER GALVANIZING.
3. SAFETY GRATES SHALL BE DESIGNED SUCH THAT THE DIAGONAL DIMENSION OF EACH OPENING IS SMALLER THAN THE DIAMETER OF THE OUTLET PIPE.
4. STRUCTURAL DESIGN OF SAFETY GRATES SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

FIGURE OS–4 ORIFICE PLATE AND TRASH RACK DETAILS AND NOTES
NTS

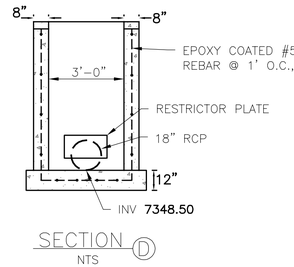


SECTION B
NTS



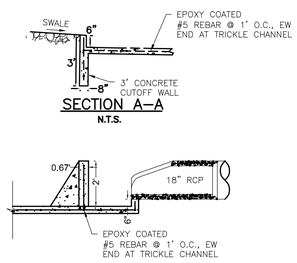
SECTION C
NTS

R VALUE = (NET OPEN AREA)/(GROSS RACK AREA)
= 0.60



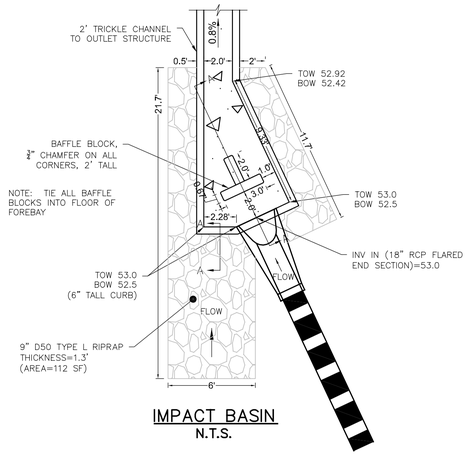
SECTION D
NTS

FIGURE OS–5 TYPICAL OUTLET STRUCTURE WITH WELL SCREEN TRASH RACK



SECTION A–A
N.T.S.

SECTION B–B
N.T.S.



IMPACT BASIN
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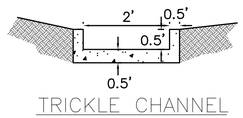
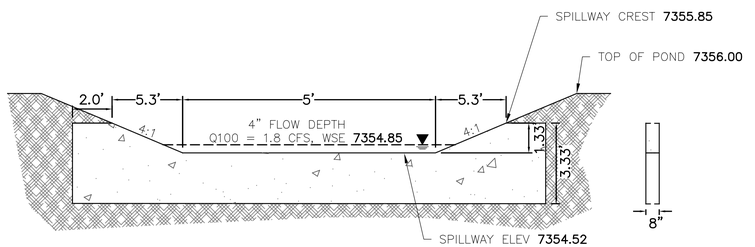


TRICKLE CHANNEL

POND SIGNAGE
N.T.S.

(TO BE ATTACHED TO THE OUTLET BOX OR POSTED NEARBY)



EMERGENCY SPILLWAY
NTS

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PREPARED FOR:
BLACK FOREST, LLC
12740 BLACK FOREST ROAD
COLORADO SPRINGS, CO 80908

Outlet Structure Details
CONSTRUCTION DOCUMENTS
BLACK FOREST OFFICE
COLORADO SPRINGS, COLORADO

BY: TEW DATE: 1-19-21

REVISIONS:
1. EL PASO CNTY COMMENTS 1-7-21
2.
3.
4.

PROJECT NUMBER: 19015
ISSUED DATE: 12-03-2020
DESIGNED BY: TEW
REVIEWED BY: RCE

Outlet Structure Details

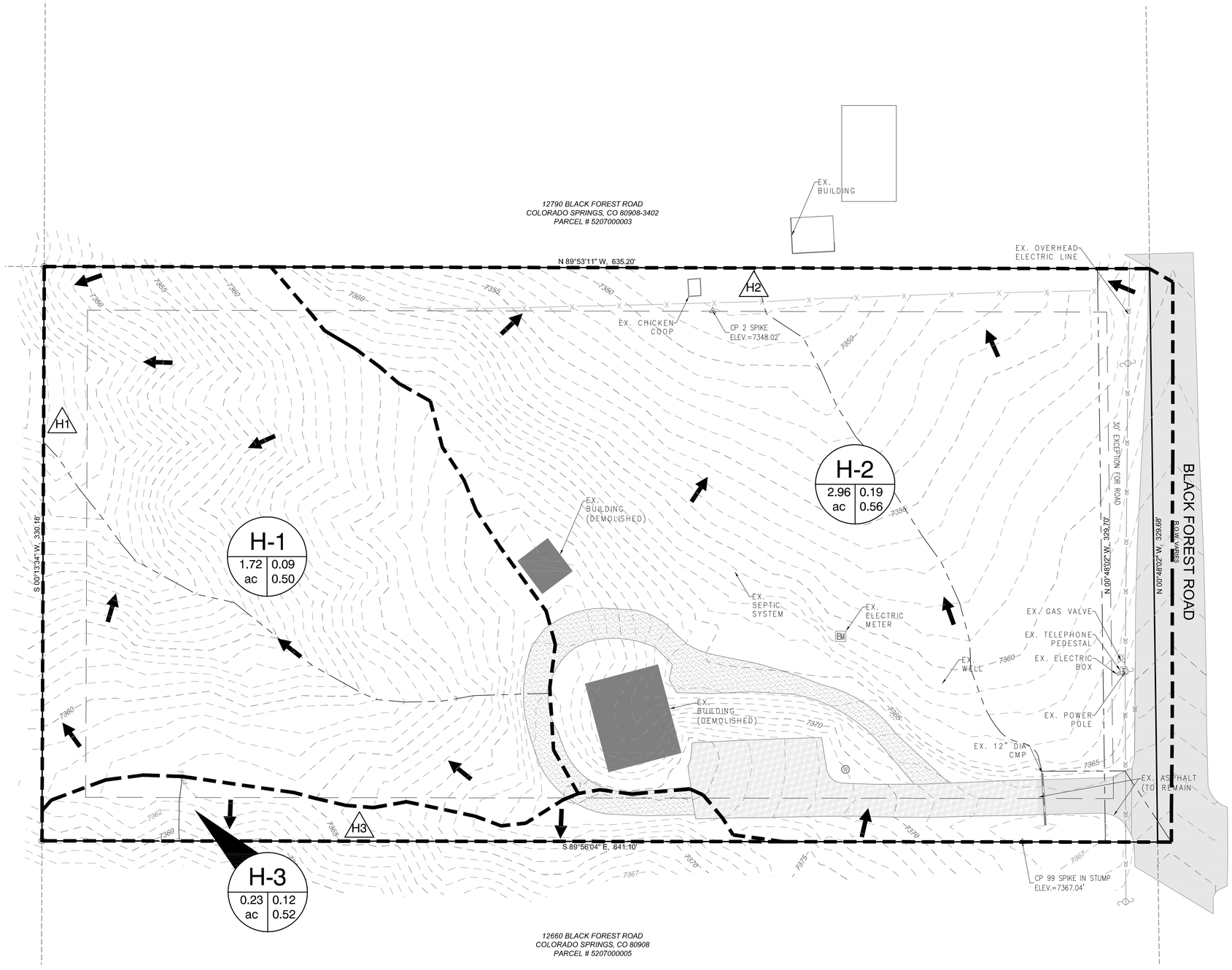
12

J:\Projects\19150\15dwg\Drainage\Outlet Structure Details.dwg 1/18/2021

BLACK FOREST OFFICE

N1/2 NE1/4 SE1/4 SE1/4 OF SECTION 07, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M., EL PASO COUNTY, COLORADO

SCALE: 1" = 30'



LEGEND

EXISTING	PROPOSED
ZONE LOT LINE	BUILDING LINE
RIGHT OF WAY	CONCRETE
RANGE LINE	LANDSCAPING
LOT LINE	STORM SEWER MAIN
SANITARY SEWER MAIN	STORM SEWER CLEANOUT
SANITARY SEWER MANHOLE	STORM SEWER MANHOLE
SANITARY SERVICE LINE	
STORM SEWER MAIN	
STORM SEWER INLET	
STORM SEWER MANHOLE	
12" WATER LINE	
8" WATER LINE	
4" WATER LINE	
FIRE HYDRANT	
VALVE	
WATER SERVICE & METER	
OVERHEAD UTILITY LINE	
ELECTRIC MANHOLE	
LIGHT POLE	
POWER POLE	
ELECTRIC BOX	
RAIL POLE	
TRAFFIC BOX	
BURIED COMM. LINE	
GAS LINE	
BURIED ELECTRIC LINE	
MAJOR CONTOUR	
MINOR CONTOUR	

BASIN NAME
H-1
0.0 ac
.00
.00
RUNOFF COEFFICIENT VALUE
BASIN AREA
1
BASIN DESIGN POINT
RUNOFF FLOW ARROW
HISTORIC BASIN LIMITS
FLOW PATH

HISTORIC CONDITIONS

DESIGN POINT	CONTRIBUTING BASIN(S)	CONTRIBUTING AREA (AC)	Q_5 (cfs)	Q_{100} (cfs)	NOTES:
H1	H-1	1.72	0.63	5.86	Releases undetained (following historic flow path)
H2	H-2	2.96	1.97	9.75	Releases undetained (following historic flow path)
H3	H-3	0.23	0.11	0.83	Releases undetained (following historic flow path)

CAUTION: NOTICE TO CONTRACTOR

THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES AND, WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUST CALL THE LOCAL UTILITY LOCATION CENTER AT LEAST 48 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATIONS OF THE UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS.

811 Know what's below. Call before you dig.

BENCHMARK

SURVEY CONTROL POINTS AS SHOWN HEREON. ALL ELEVATIONS ARE BASED UPON NAVD88 VERTICAL DATUM.

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PREPARED FOR:
BLACK FOREST, LLC
12740 BLACK FOREST RD
COLORADO SPRINGS, CO 80908

HISTORIC BASIN MAP

BLACK FOREST OFFICE
COLORADO SPRINGS, COLORADO

REVISIONS: BY: DATE:
1.
2.
3.
4.

PROJECT NUMBER: 19015
ISSUED DATE: 11-20-20
DESIGNED BY: TEW
REVIEWED BY: RCE

HISTORIC BASIN MAP

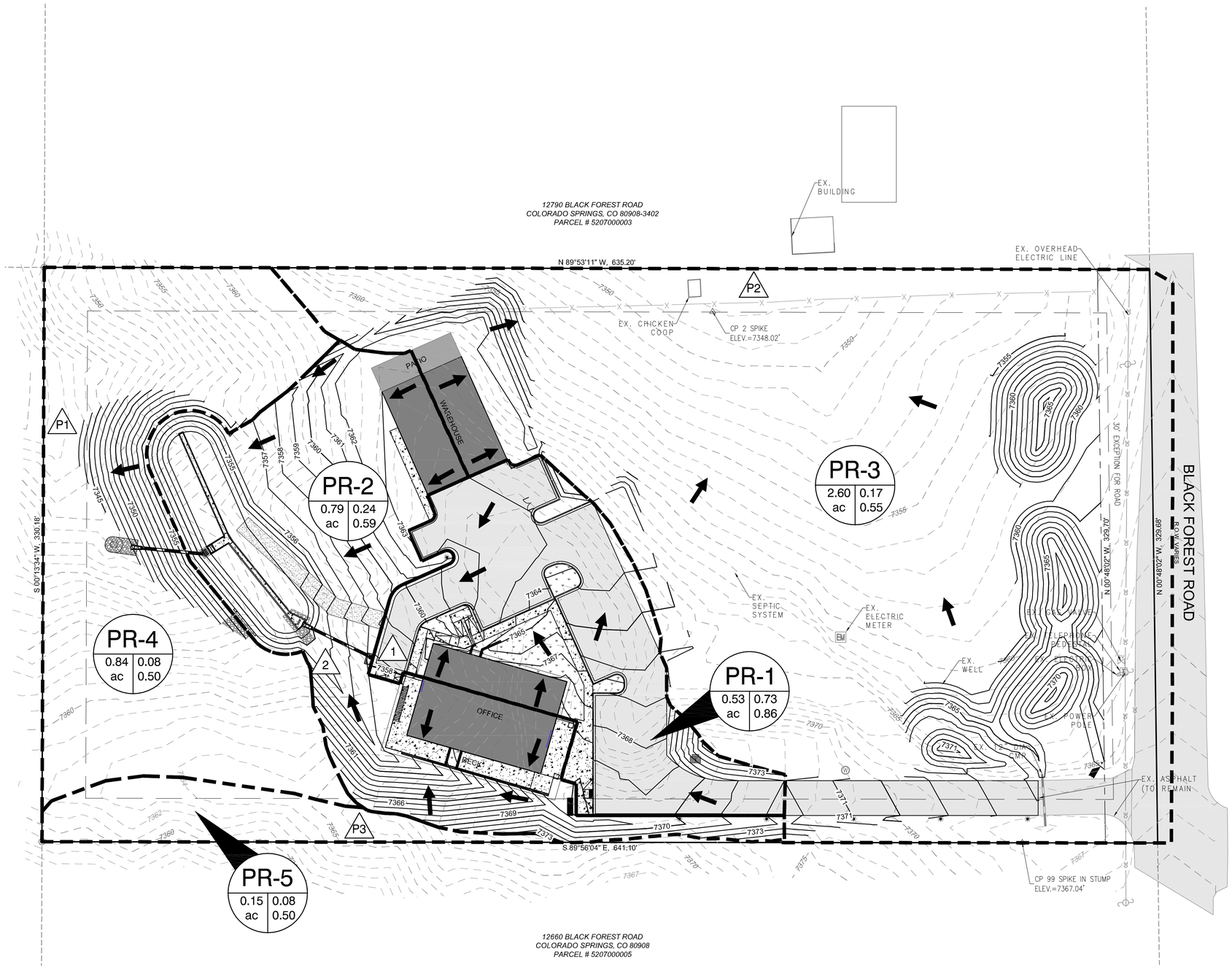
HIST-BASIN

J:\Projects\19\15\Dwg\Drainage\Historic Basin Map.dwg 11/12/2021

BLACK FOREST OFFICE

N1/2 NE1/4 SE1/4 SE1/4 OF SECTION 07, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M., EL PASO COUNTY, COLORADO

0 30' 60'
SCALE: 1" = 30'
N



LEGEND

EXISTING
- ZONE LOT LINE
- RIGHT OF WAY
- RANGE LINE
- LOT LINE
- SANITARY SEWER MAIN
- SANITARY SEWER MANHOLE
- SANITARY SERVICE LINE
- STORM SEWER MAIN
- STORM SEWER INLET
- STORM SEWER MANHOLE
- 12" WATER LINE
- 8" WATER LINE
- 4" WATER LINE
- FIRE HYDRANT
- VALVE
- WATER SERVICE & METER
- OVERHEAD UTILITY LINE
- ELECTRIC MANHOLE
- LIGHT POLE
- POWER POLE
- ELECTRIC BOX
- RAIL POLE
- TRAFFIC BOX
- BURIED COMM. LINE
- GAS LINE
- BURIED ELECTRIC LINE
- 5225 MAJOR CONTOUR
- 5227 MINOR CONTOUR

PROPOSED
- BUILDING LINE
- CONCRETE
- LANDSCAPING
- STORM SEWER MAIN
- STORM SEWER CLEANOUT
- STORM SEWER MANHOLE
- BASIN NAME
- PR-1 (0.0 ac | .00 | .00) RUNOFF COEFFICIENT VALUE
- BASIN AREA
- 1 BASIN DESIGN POINT
- RUNOFF FLOW ARROW
- PROPOSED BASIN LIMITS
- FLOW PATH

PROPOSED CONDITIONS

DESIGN POINT	CONTRIBUTING BASIN(S)	CONTRIBUTING AREA (AC)	Q_5 (cfs)	Q_{100} (cfs)	NOTES:
P1	PR-1, PR-2, PR-4	2.16	0.47	4.62	Releases offsite (developed basins PR-1 and PR-2 are detained prior to release)
P2	PR-3	2.60	1.53	8.33	Releases undetained (following historic flow path)
P3	PR-5	0.15	0.05	0.52	Releases undetained (following historic flow path)
1	PR-1	0.53	1.91	3.77	Releases to EDB Pond
2	PR-2	0.79	0.96	3.96	Releases to EDB Pond

CAUTION: NOTICE TO CONTRACTOR

THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES AND, WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUST CALL THE LOCAL UTILITY LOCATION CENTER AT LEAST 48 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATIONS OF THE UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS.

811 Know what's below. Call before you dig.

BENCHMARK

SURVEY CONTROL POINTS AS SHOWN HEREON. ALL ELEVATIONS ARE BASED UPON NAVD88 VERTICAL DATUM.

2N CIVIL
303.925.0544
www.2ncivil.com

PREPARED FOR:
BLACK FOREST, LLC
12740 BLACK FOREST RD
COLORADO SPRINGS, CO 80908

PROPOSED BASIN MAP
BLACK FOREST OFFICE
COLORADO SPRINGS, COLORADO

REVISIONS: BY: DATE:
1.
2.
3.
4.

PROJECT NUMBER: 19015
ISSUED DATE: 11-20-20
DESIGNED BY: TEW
REVIEWED BY: RCE

PROPOSED BASIN MAP

PR-BASIN

J:\Projects\19\15\dwg\Drainage\Proposed Basin Map.dwg 11/13/2021