COTTAGES AT KETTLE CREEK

PRELIMINARY DRAINAGE REPORT

ALL TERRAIN ENGINEERING PROJECT NO: 24026

OCTOBER 2024

PREPARED FOR:

GOODWIN KNIGHT

CONTACT: DAVE MORRISON

8605 EXPLORER DRIVE, SUITE 250

COLORADO SPRINGS, CO 80920

PREPARED BY:

ALL TERRAIN ENGINEERING LLC

CONTACT: NICHOLAS Q. JOKERST

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ENGINEER'S STATEMENT

This report and plan for the drainage design of the development, COTTAGES AT KETTLE CREEK, was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the *City of Colorado Springs Drainage Criteria* Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____

Nicholas Q. Jokerst, PE Date

State of Colorado No. 59273

For and on behalf of All Terrain Engineering LLC

DEVELOPER'S STATEMENT

GOODWIN KNIGHT hereby certifies that the drainage facilities for COTTAGES AT KETTLE CREEK shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that City of Colorado Springs reviews drainage plans pursuant to Colorado Revised Statutes, Title 30, Article 28; but cannot, on behalf of COTTAGES AT KETTLE CREEK guarantee that final drainage design review will absolve GOODWIN KNIGHT and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

_____

Developer Name Authorized Signature Date

CITY OF COLORADO SPRINGS STATEMENT

Filed in accordance with 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

_____

For City Engineer Date

Conditions of Approval:

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Appendices

I. General Purpose, Location & Description

a. Purpose

The purpose of this Preliminary Drainage Report (PDR) for COTTAGES AT KETTLE CREEK is to describe the site's onsite and offsite drainage patterns, existing and proposed storm infrastructure, and to safely route developed stormwater to adequate outfalls.

b. Location

COTTAGES AT KETTLE CREEK, referred to as 'the site' herein, is in Section 28, Township 12 South and Range 66 West of the 6th P.M., Colorado Springs, El Paso County, Colorado. The site is bound by Old Ranch Road to the south and undeveloped parcels to the east, west and north. Surrounding platted developments include Kettle Creek Estates to the south, Fairlane Technology Park No. 4A and 4B to the west and Pendleton Subdivision to the north.

c. Description of Property

The site is approximately 11.11 acres with existing vegetation consisting of native grasses and trees. The approximate disturbed area is 8.97 acres. The site is currently unplatted. The development will plat a single lot with 85 duplex units. In general, the site slopes southeasterly towards Old Ranch Road and Kettle Creek. Onsite elevations range from 6,700' – 6,726' with slopes ranging 1 – 50%. Per a NRCS soil survey, the site is made up of Type A Columbine gravelly sandy loam and Type B Stapleton-Bernal sandy loams.

The existing site is partially developed with a single family residential buildings and associated structures. The site is zoned RR-2.5 (Rural Residential 2.5 acres). The Kettle Creek major drainageway traverses the eastern property line, however; the site is not a within a Streamside Overlay Zone. The site is partially encumbered by a Preble's Jumping Mouse habitat.

There are no irrigation facilities on the site. Onsite, existing utilities include water, sewer, fiberoptic, communications, gas and overhead electric.

d. Floodplain Statement

Based on FEMA Firm map 08041C0506G dated December 7, 2018, the site is Zone X, which are areas determined to be outside the 0.2% annual chance flood.

II. Drainage Basins

a. Major Basin Description

The site is located within the Kettle Creek Drainage Basin. The site's drainage characteristics were previously studied in the following reports:

1. "Drainage Basin Planning Study for Kettle Creek Basin" prepared by JR Engineering, May 2015.

Per the DBPS, the site is located within Basin B32 and flows from Basin B32 outfall to Kettle Creek at J24. Per the DBPS, improvements are needed to stabilize the creek adjacent to the site. Recommended channel

improvements were proposed with this DBPS; however, the City of Colorado Springs is currently studying Kettle Creek to provided updated recommendations for channel improvements.

b. Existing Subbasin Description

The existing site's drainage patterns are relatively uniform to the southeast. Existing stormwater drains towards Old Ranch Road and Kettle Creek. There is no existing storm sewer located on-site. See below for existing basin descriptions:

Basin EX1 is 15.11 acres of undeveloped land, existing residential buildings and Kettle Creek Road. Existing stormwater from this basin (Q_5 = 3.7 cfs Q_{100} = 19.6 cfs) flows to DP1. Stormwater at DP1 overtops Old Ranch Road and continues south.

Basin EX2 is 6.56 acres of undeveloped land and existing residential buildings. Existing stormwater from this basin (Q_5 = 1.8 cfs Q_{100} = 9.6 cfs) flows to an existing swale along the north side of Old Ranch Road at DP2. From here, stormwater drains east into Kettle Creek.

Basin EX3 is 10.41 acres of undeveloped land and Kettle Creek. Existing stormwater from this basin (Q_5 = 2.2 cfs Q_{100} = 14.9 cfs) drains directly into Kettle Creek at DP3. Stormwater at DP3 is conveyed under Old Ranch Road in an existing culvert. The size and material of the culvert are not known.

c. Proposed Subbasin Description

The proposed site has been divided into 10 subbasins for analysis. See below for proposed basin descriptions:

Basin A is 1.98 acres of roadway, duplex units and landscaping. Stormwater from this basin (Q_5 = 4.7 cfs, Q_{100} = 9.8 cfs) is conveyed in curb and gutter to DP1. Stormwater at DP1 is captured in a 15' Type R inlet (private, on-grade). Captured flows at DP1 are piped to DP4.1 and continue to Pond 1. A berm will be constructed along the northern property line of Basin A to direct offsite stormwater around the site to the west.

Basin B is 2.26 acres of roadway, duplex units and landscaping. Stormwater from this basin (Q_5 = 5.4 cfs, Q_{100} = 11.2 cfs) is conveyed in curb and gutter to DP2. Stormwater at DP2 is captured in a 15' Type R inlet (private, on-grade). Captured flows at DP2 are piped to DP3.1 and continue to Pond 1. A berm will be constructed along the northern property line of Basin B to direct offsite stormwater around the site to the east.

Basin C is 0.53 acres of roadway, duplex units and landscaping. Stormwater from this basin (Q_5 = 1.4 cfs, Q_{100} = 2.9 cfs) is conveyed in curb and gutter to DP4. Stormwater at DP4 is captured in a 10' Type R inlet (private, on-grade). Captured flows at DP4 are piped to DP4.1 and continue to Pond 1.

Basin D is 1.57 acres of roadway, duplex units and landscaping. Stormwater from this basin (Q_5 = 4.8 cfs, Q_{100} = 9.3 cfs) is conveyed in curb and gutter to DP3. Stormwater at DP3 is captured in a 15' Type R inlet (private, on-grade). Captured flows at DP3 are piped to DP3.1 and continue to Pond 1.

Basin E is 0.50 acres of landscaping area and Pond 1. Stormwater from this basin (Q_5 = 0.4 cfs, Q_{100} = 1.8 cfs) flows directly into Pond 1. See Water Quality and Detention section for Pond 1 details.

Basin F is 0.22 acres of roadway and landscaping. Stormwater from this basin (Q_5 = 0.5 cfs, Q_{100} = 1.2 cfs) is not captured on site. Basin F stormwater is conveyed in curb and gutter towards Old Ranch Road (DP6) and is captured in a roadside swale along the north side of Old Ranch Road. The roadside swale follows historic drainage patterns and discharges into Kettle Creek to the east of the site. The proposed flow to the roadside ditch is less than the existing condition. Pond 1 will overdetain the 5-year and 100-year storms by an amount equal to the undetained discharge from Basin F. See Water Quality and Detention section for Pond 1 details.

Basin G is 0.96 acres of offsite, undeveloped area and Old Ranch Road improvements. The City of Colorado Springs required the addition of turn lanes on Old Ranch Road. The addition of turn lanes expanded the existing pavement edge approximately 12' to the north. These improvements are downstream of the pond and can not be captured nor detained. Basin G stormwater (Q_5 = 0.7 cfs, Q_{100} = 2.5 cfs) follows historic drainage patterns along Old Ranch Road to the east in a roadside ditch. The existing roadside ditch has been shifted north per the expanded pavement, however; the total flow in the swale is reduced compared to the existing condition (Existing Q_{100} = 9.6 cfs, Proposed Q_{100} = 4.1 cfs). In the existing condition, the swale was over capacity. With the limited space between the Old Ranch Road pavement expansion and the existing right-of-way, the proposed swale has capacity for the 100-year flow but can only achieve 0.5' freeboard. A cross section is provided in Appendix C.

Basin OS1 is 1.97 acres of offsite, undeveloped area and Kettle Creek Road. Stormwater from this basin (Q_5 = 1.1 cfs, Q_{100} = 4.5 cfs) follows historic drainage patterns southerly along Kettle Creek Road to Old Ranch Road at DP8. Basin OS1 is not detained in Pond 1.

Basin OS2 is 12.06 acres of offsite, undeveloped area and Kettle Creek Road. Stormwater from this basin (Q_5 = 2.7 cfs, Q_{100} =15.3 cfs) follows the historic drainage patterns of Basin EX1 to DP9. A berm along the site's northern boundary will ensure offsite flows from Basin OS2 do not enter the site. Basin OS2 is not detained in Pond 1.

Basin OS3 is 10.37 acres of offsite, undeveloped area and Kettle Creek. Stormwater from this basin (Q_5 = 2.2 cfs, Q_{100} =14.8 cfs) follows the historic drainage patterns of Basin EX2 to DP10. A berm along the site's northern boundary will ensure offsite flows from Basin OS3 do not enter the site. Basin OS3 drains directly to Kettle Creek and is not detained in Pond 1.

III. Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis, proposed storm sewer system, and proposed private, full spectrum water quality and detention pond follow the criteria from the "City of Colorado Springs Drainage Criteria Manual" Volumes 1 and 2" (CCSDCM, latest revision).

b. Hydrologic Criteria

Hydrologic data was obtained from the "City of Colorado Springs Drainage Criteria Manual – Chapter 6 Hydrology". Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using 1-hr duration rainfall depths from NOAA Atlas 14. Runoff was calculated per CCSDCM Section 6.3.0 - Rational Method. Private, full spectrum pond design was completed using the latest version of Mile High Flood District's (MHFD) UD-Detention per CCSDCM Section 13.3.2.1 – Full Spectrum Detention. The detention pond allowable release rate will be limited to historic rates.

d. Hydraulic Criteria

Hydraulic criteria for inlet sizing were obtained from the "City of Colorado Springs Drainage Criteria Manual – Chapter 8 Inlets". Hydraulic criteria for storm sewer sizing were obtained from the "City of Colorado Springs Drainage Criteria Manual – Chapter 9 Storm Sewer". Hydraulic criteria for channel sizing were obtained from the "City of Colorado Springs Drainage Criteria Manual – Chapter 12 Open Channels".

Outfall tailwater conditions into detention facilities are based on the hydraulic grade line in the pond at the time of concentration of the tributary basin. The hydraulic grade line is adapted from the UD-Detention Drain Time v. Ponding Depth graph presented in Appendix D.

IV. Drainage Facility Design

a. General Concept

Onsite stormwater will be conveyed via curb and gutter to Type R inlets (on-grade, private). Captured stormwater will be piped to and detained in a private, full spectrum detention pond (Pond 1). Pond 1 will outfall at less than historic values to Kettle Creek. Kettle Creek is the historic outfall for the site.

b. Water Quality & Detention

Water quality and detention for Basins A – E is provided in a Pond 1, a private, full spectrum detention pond located along Old Ranch Road. Due to topography, Basin F can not be captured and routed to Pond 1. The total flow from Basin F is Q_5 = 0.5 cfs, Q_{100} = 1.2 cfs. As a result of this undetained flow leaving the site, the pond outlet structure has been designed to overdetain flow equal to the Basin F discharge. A total of 6.84 acres at 62.7% composite imperviousness will be detained in Pond 1. The WQCV is 0.140 ac-ft, the EURV is 0.387 ac-ft, and the 100-year volume is 0.265 ac-ft. The WQCV, EURV and 100-year storms are released in 40, 72 and 79 hours, respectively. A forebay is located at the outfall into the pond and a 2.0' trickle channel conveys flow towards the outlet structure. A 10' access and maintenance road is provided to the bottom of the pond to facilitate future maintenance of the pond facilities. A 6' emergency overflow spillway is provided that conveys the developed, peak 100-yr flow rate with 1.0' of freeboard towards Old Ranch Road. The spillway and downstream outfall will be lined with Type L. Pond design calculations are presented in Appendix D.

c. Operations & Maintenance

An Operations and Maintenance Manual will be submitted during the Final Drainage Report phase.

d. Grading & Erosion Control Plan

Due to the project disturbance area, a separate Grading and Erosion Control plan is required. The Grading and Erosion Control Plan will be submitted during the Final Drainage Report phase.

e. Four Step Method

Step 1 – Reducing Runoff Volumes: Cottages at Kettle Creek consists of duplex units with associated parking, sidewalks and landscape areas. The landscaped area disconnect impervious areas and reduce runoff volumes. Where possible, roof drains will route across landscape areas to promote infiltration. MHFD UD-BMP was used to calculate runoff reductions. The WQCV reduction for the site is 31%. The runoff reductions calculation and map are presented in Appendix B and F, respectively.

Step 2 – Treat and slowly release the WQCV: An onsite private, full spectrum detention pond (Pond 1) provides water quality treatment for the site. The WQCV is released over a period of 40 hours. The developed area of the site is contained within Basins A – F.

Step 3 – Stabilize stream channels: All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization within the drainage basin. The site lies adjacent to Kettle Creek. The City of Colorado Springs is currently completing a channel study of Kettle Creek. The channel study will determine the required improvements along the site's frontage to Kettle Creek. Once the study is completed, the necessary improvements or fees in lieu will be detailed here.

Step 4 – Consider the need for source controls: No industrial or commercial uses are proposed within this development. However, permanent erosion control measures will be provided in the form of asphalt drives, curb and gutter, storm inlets and storm sewer. Per MHFD guidance, the following permanent source controls may be necessary for residential development: S-3 Disposal of Household Waste, S-4 Illicit Discharge Controls, S-5 Good Housekeeping, S-8 Use of Pesticides, Herbicides and Fertilizers, S-9 Landscape Maintenance, and S-10 Snow and Ice Management.

f. Drainage Basin & Bridge Fees

Kettle Creek is a closed basin and therefore no fees are due. Building permits cannot be released for the site until the channel improvements are installed or channel improvement assurances have been paid.

g. Engineer's Opinion of Probable Cost

An engineer's opinion of probable cost will be included during the Final Drainage Report phase.

V. Summary

COTTAGES AT KETTLE CREEK remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments. This report meets the latest City of Colorado Springs Drainage criteria and is in accordance with the Kettle Creek DBPS.

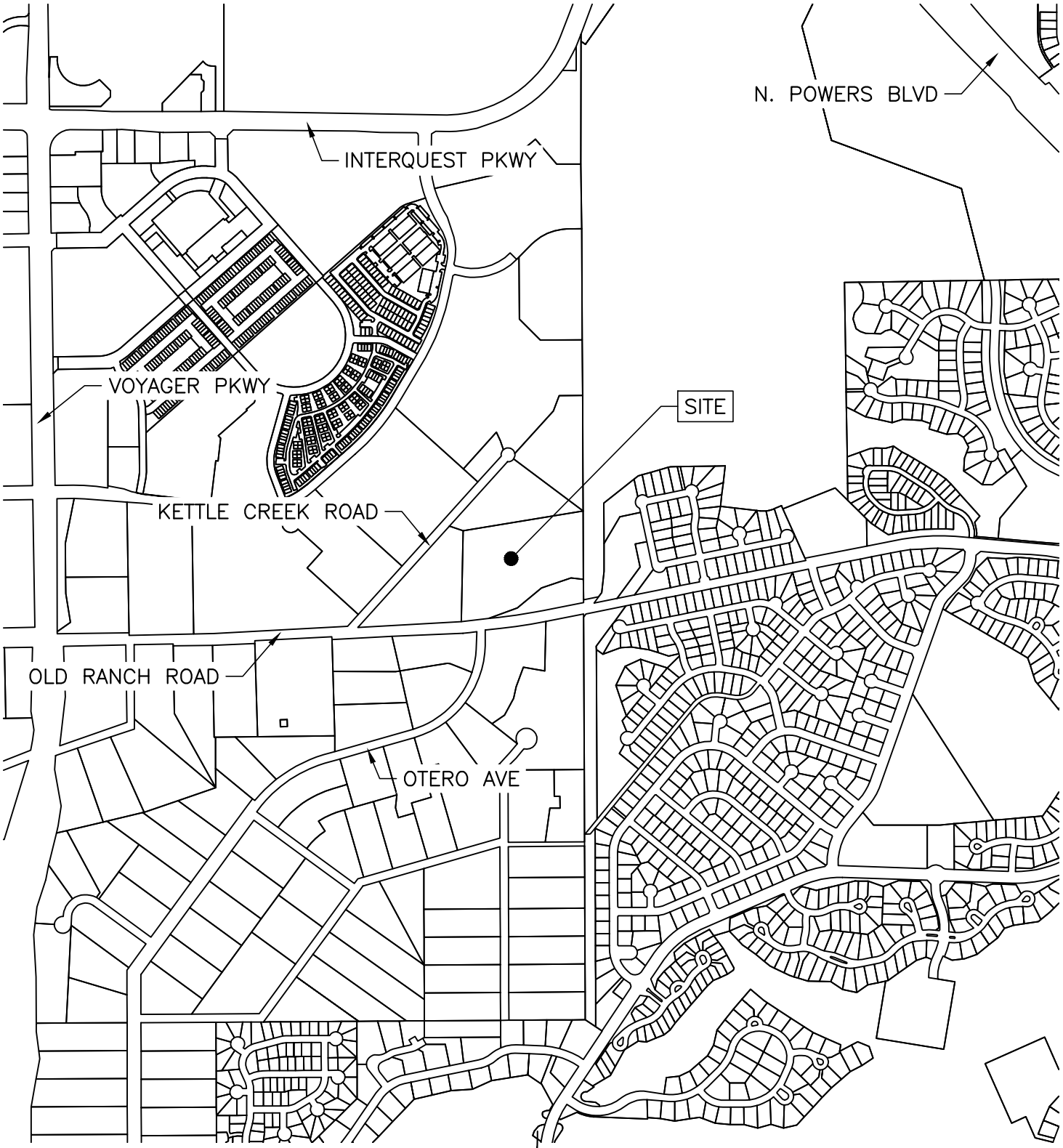
VI. References

1. City of Colorado Springs – Drainage Criteria Manual, May 2014, Revised January 2021.
2. Urban Storm Drainage Criteria Manual, Mile High Flood District, January 2018.

APPENDIX A – VICINITY MAP, FEMA MAP, NRCS WEB SOIL SURVEY & NOAA ATLAS 14

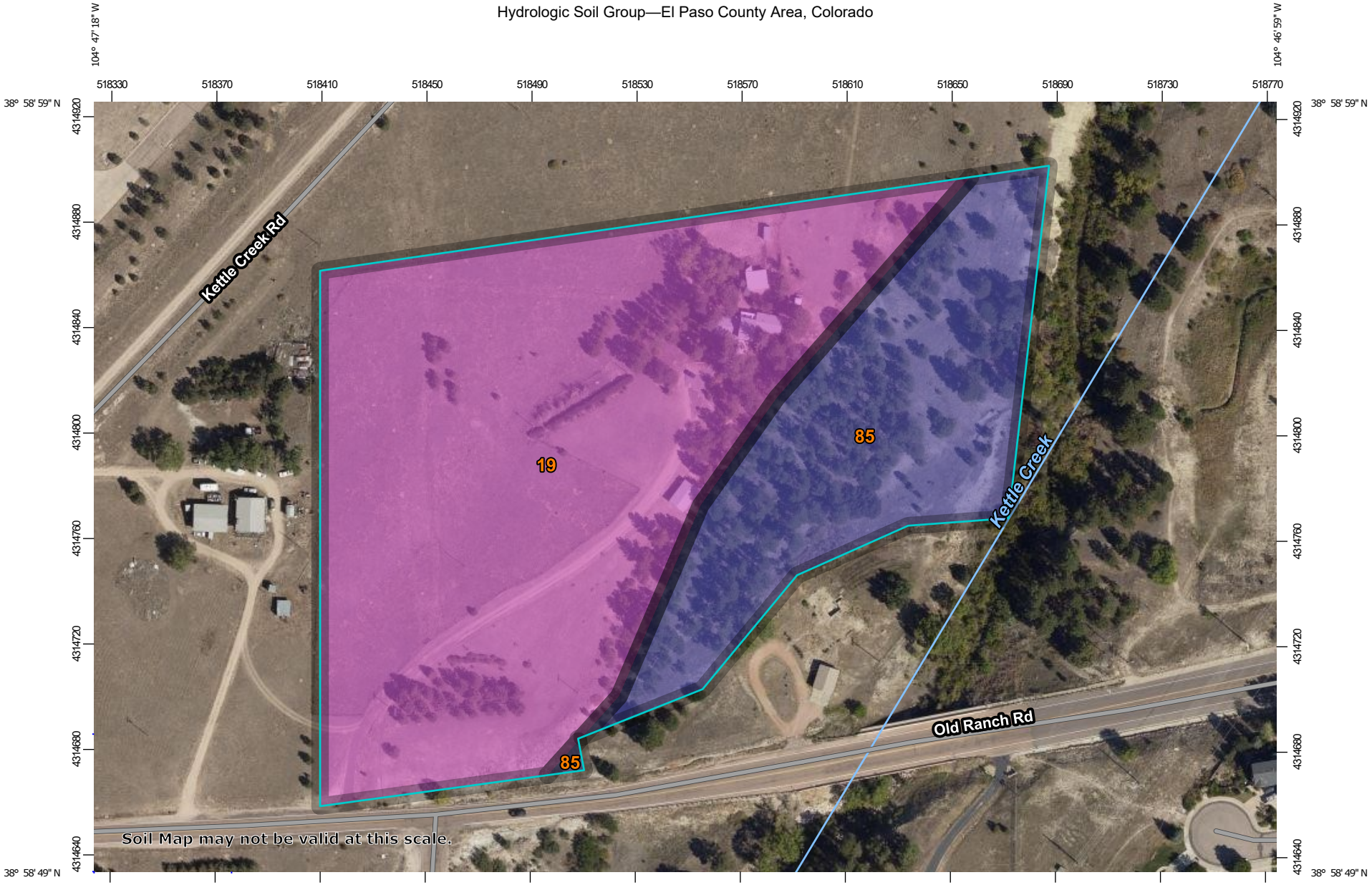
COTTAGES AT KETTLE CREEK

VICINITY MAP



VICINITY MAP	
COTTAGES AT KETTLE CREEK	
JOB NO. 24026	
LOCATION: CS	SHEET
10/03/2024	
SHEET: 1	

ALL TERRAIN ENGINEERING
1004 WEST VAN BUREN STREET
COLORADO SPRINGS, CO 80907



Map Scale: 1:2,060 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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 21, Aug 24, 2023

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	8.1	70.5%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	B	3.4	29.5%
Totals for Area of Interest			**11.5**	**100.0%**

Description

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

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

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

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

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

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

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

National Flood Hazard Layer FIRMette

FEMA

104°47'35"W 38°59'8"N

104°46'57"W 38°58'40"N

Feet

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

1:6,000

Basemap Imagery Source: USGS National Map 2023

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 9/12/2024 at 11:07 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.9824°, Longitude: -104.7856°
Elevation: 6728 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.231** (0.190-0.281)	**0.286** (0.235-0.349)	**0.381** (0.312-0.466)	**0.464** (0.378-0.570)	**0.584** (0.462-0.750)	**0.682** (0.525-0.886)	**0.785** (0.582-1.04)	**0.893** (0.633-1.22)	**1.04** (0.709-1.46)	**1.16** (0.767-1.65)
10-min	**0.338** (0.278-0.412)	**0.419** (0.345-0.511)	**0.558** (0.457-0.683)	**0.679** (0.554-0.835)	**0.856** (0.676-1.10)	**0.999** (0.768-1.30)	**1.15** (0.852-1.53)	**1.31** (0.927-1.78)	**1.53** (1.04-2.14)	**1.70** (1.12-2.41)
15-min	**0.412** (0.339-0.502)	**0.511** (0.420-0.623)	**0.680** (0.558-0.833)	**0.828** (0.675-1.02)	**1.04** (0.824-1.34)	**1.22** (0.937-1.58)	**1.40** (1.04-1.86)	**1.59** (1.13-2.18)	**1.86** (1.27-2.61)	**2.07** (1.37-2.94)
30-min	**0.583** (0.481-0.712)	**0.722** (0.594-0.882)	**0.960** (0.788-1.18)	**1.17** (0.953-1.44)	**1.47** (1.16-1.89)	**1.72** (1.32-2.23)	**1.98** (1.47-2.63)	**2.25** (1.60-3.07)	**2.63** (1.79-3.69)	**2.93** (1.93-4.16)
60-min	**0.755** (0.622-0.921)	**0.911** (0.750-1.11)	**1.19** (0.977-1.46)	**1.45** (1.18-1.78)	**1.84** (1.46-2.38)	**2.17** (1.67-2.83)	**2.52** (1.87-3.37)	**2.90** (2.06-3.98)	**3.45** (2.35-4.86)	**3.89** (2.57-5.52)
2-hr	**0.926** (0.768-1.12)	**1.10** (0.910-1.33)	**1.42** (1.17-1.73)	**1.73** (1.42-2.11)	**2.20** (1.77-2.84)	**2.61** (2.04-3.40)	**3.06** (2.30-4.08)	**3.56** (2.55-4.86)	**4.27** (2.94-5.99)	**4.86** (3.23-6.84)
3-hr	**1.03** (0.857-1.24)	**1.20** (0.997-1.45)	**1.53** (1.27-1.85)	**1.86** (1.53-2.26)	**2.38** (1.93-3.09)	**2.85** (2.23-3.71)	**3.36** (2.54-4.49)	**3.94** (2.85-5.39)	**4.79** (3.31-6.71)	**5.49** (3.67-7.71)
6-hr	**1.22** (1.02-1.46)	**1.40** (1.17-1.68)	**1.77** (1.47-2.12)	**2.14** (1.77-2.58)	**2.75** (2.25-3.56)	**3.30** (2.61-4.29)	**3.93** (2.99-5.21)	**4.63** (3.37-6.30)	**5.66** (3.95-7.90)	**6.53** (4.39-9.11)
12-hr	**1.43** (1.20-1.70)	**1.66** (1.39-1.97)	**2.10** (1.76-2.51)	**2.54** (2.11-3.04)	**3.24** (2.66-4.14)	**3.87** (3.07-4.97)	**4.56** (3.49-6.00)	**5.34** (3.91-7.21)	**6.48** (4.55-8.97)	**7.43** (5.03-10.3)
24-hr	**1.67** (1.41-1.97)	**1.96** (1.65-2.31)	**2.50** (2.10-2.96)	**3.00** (2.52-3.58)	**3.79** (3.11-4.77)	**4.47** (3.56-5.68)	**5.21** (4.00-6.78)	**6.03** (4.43-8.04)	**7.20** (5.07-9.86)	**8.16** (5.56-11.2)
2-day	**1.94** (1.65-2.27)	**2.29** (1.95-2.69)	**2.91** (2.47-3.43)	**3.48** (2.94-4.12)	**4.34** (3.57-5.39)	**5.06** (4.04-6.35)	**5.83** (4.50-7.50)	**6.67** (4.92-8.80)	**7.85** (5.56-10.6)	**8.81** (6.04-12.0)
3-day	**2.12** (1.82-2.48)	**2.50** (2.14-2.92)	**3.17** (2.70-3.72)	**3.77** (3.19-4.44)	**4.68** (3.85-5.77)	**5.43** (4.35-6.77)	**6.23** (4.82-7.97)	**7.09** (5.25-9.32)	**8.31** (5.91-11.2)	**9.30** (6.41-12.7)
4-day	**2.28** (1.95-2.66)	**2.67** (2.29-3.12)	**3.37** (2.87-3.94)	**3.99** (3.38-4.69)	**4.92** (4.07-6.06)	**5.70** (4.58-7.09)	**6.53** (5.06-8.32)	**7.42** (5.51-9.72)	**8.68** (6.19-11.7)	**9.69** (6.70-13.2)
7-day	**2.68** (2.31-3.11)	**3.10** (2.67-3.60)	**3.84** (3.30-4.47)	**4.51** (3.84-5.27)	**5.51** (4.57-6.73)	**6.34** (5.12-7.83)	**7.22** (5.63-9.14)	**8.17** (6.10-10.6)	**9.51** (6.82-12.7)	**10.6** (7.36-14.3)
10-day	**3.04** (2.63-3.51)	**3.49** (3.02-4.03)	**4.29** (3.69-4.96)	**5.00** (4.27-5.81)	**6.05** (5.03-7.35)	**6.92** (5.61-8.51)	**7.85** (6.14-9.89)	**8.84** (6.62-11.5)	**10.2** (7.36-13.6)	**11.3** (7.92-15.3)
20-day	**4.05** (3.52-4.64)	**4.64** (4.03-5.32)	**5.65** (4.89-6.49)	**6.51** (5.60-7.52)	**7.75** (6.46-9.29)	**8.75** (7.12-10.6)	**9.78** (7.68-12.2)	**10.9** (8.17-13.9)	**12.3** (8.92-16.3)	**13.5** (9.49-18.0)
30-day	**4.88** (4.26-5.57)	**5.60** (4.88-6.40)	**6.79** (5.90-7.77)	**7.79** (6.73-8.96)	**9.18** (7.66-10.9)	**10.3** (8.37-12.4)	**11.4** (8.94-14.1)	**12.5** (9.42-15.9)	**14.0** (10.2-18.3)	**15.2** (10.7-20.2)
45-day	**5.93** (5.19-6.73)	**6.81** (5.95-7.74)	**8.23** (7.17-9.38)	**9.39** (8.13-10.7)	**11.0** (9.14-12.9)	**12.1** (9.91-14.5)	**13.3** (10.5-16.3)	**14.5** (10.9-18.3)	**16.0** (11.6-20.8)	**17.1** (12.1-22.7)
60-day	**6.81** (5.98-7.71)	**7.82** (6.86-8.86)	**9.43** (8.24-10.7)	**10.7** (9.31-12.2)	**12.4** (10.4-14.5)	**13.7** (11.2-16.3)	**14.9** (11.8-18.2)	**16.1** (12.2-20.2)	**17.6** (12.8-22.7)	**18.6** (13.3-24.7)

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

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

Please refer to NOAA Atlas 14 document for more information.

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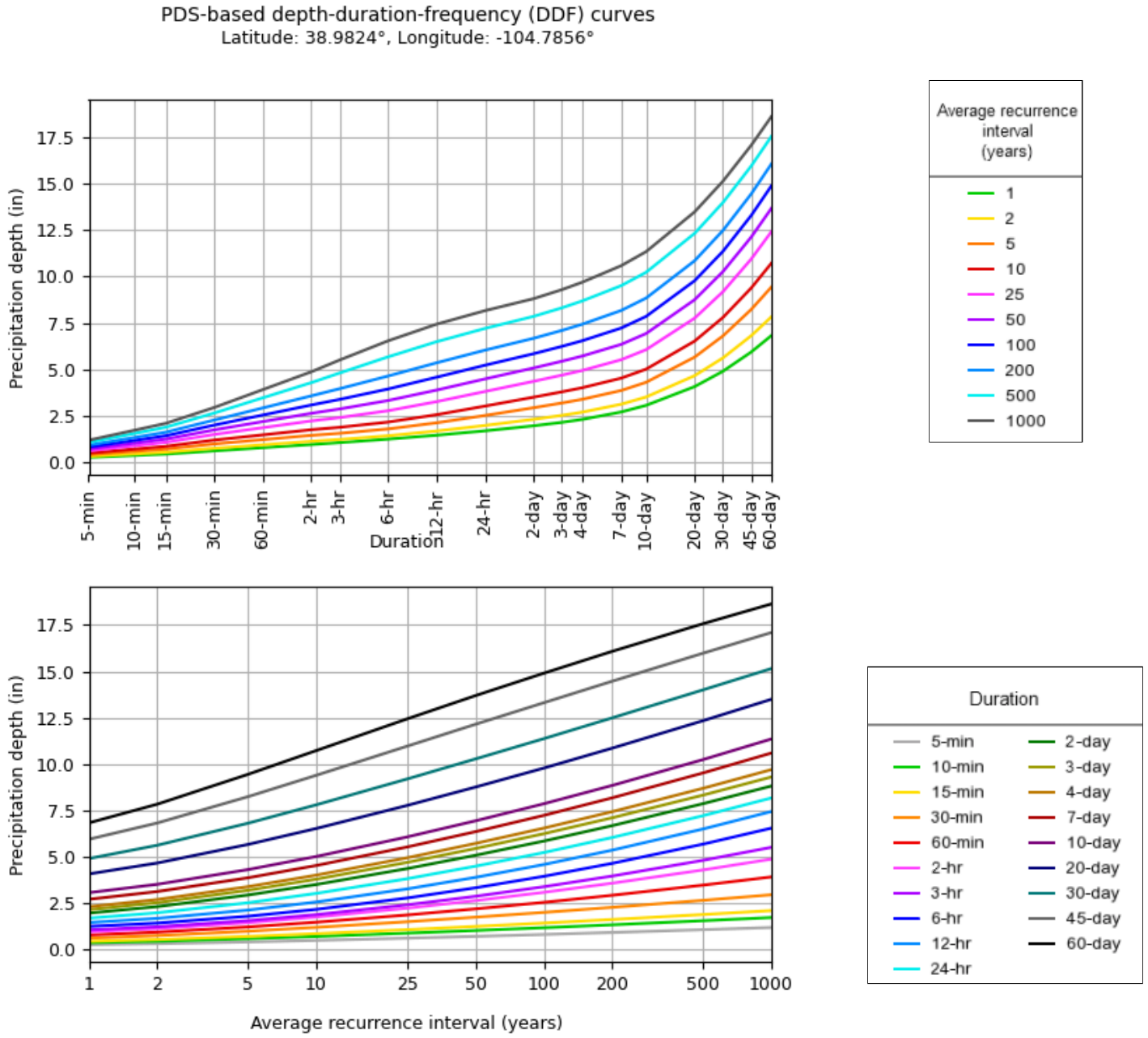
PF graphical



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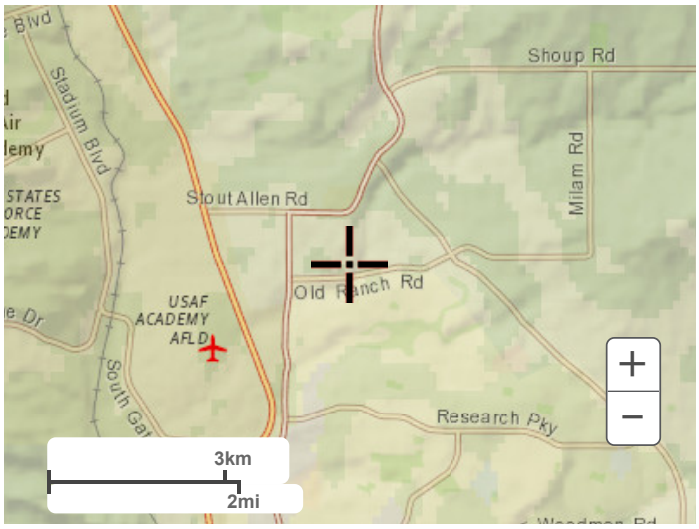
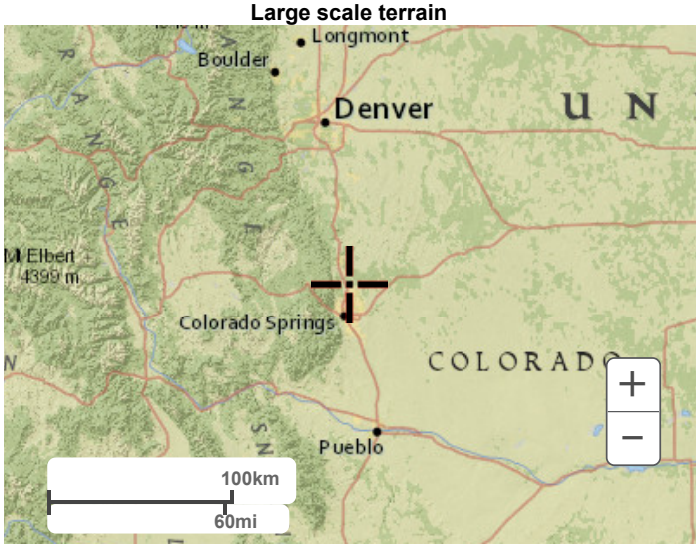
Maps & aerials

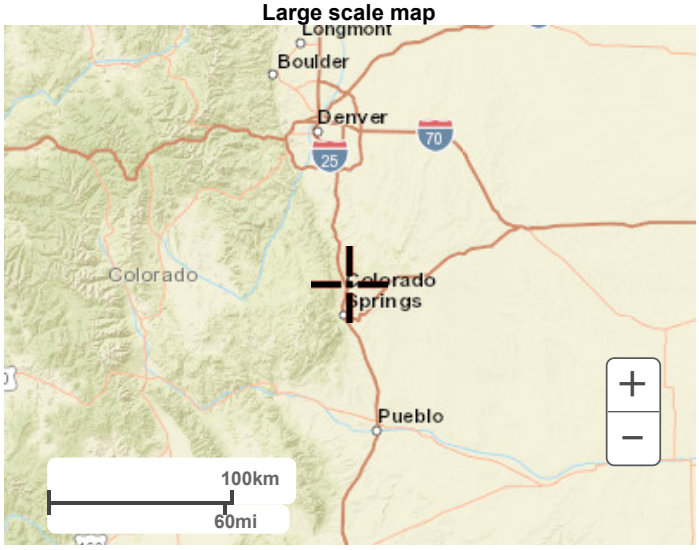
Small scale terrain



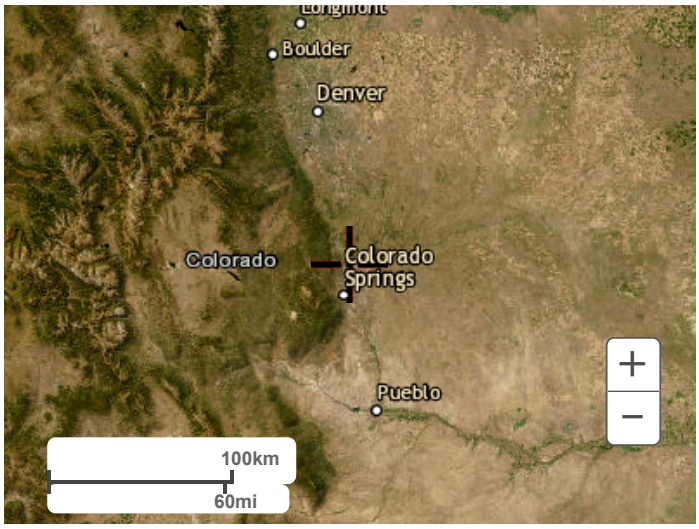
Large scale terrain



Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
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Disclaimer

APPENDIX B – HYDROLOGIC CALCULATIONS

Subdivision:	Cottages at Kettle Creek
Location:	Colorado Springs
Project Name:	Cottages at Kettle Creek
Project Number:	24026
Calculated By:	NQJ
Checked By:	
Date:	9/30/2024

EX DRAINAGE CALCS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX1	15.11	7%	0.09	0.36	40.5	3.7	19.6
EX2	6.56	6%	0.09	0.36	34.3	1.8	9.6
EX3	10.41	2%	0.09	0.36	32.3	2.2	14.9

DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	3.7	19.6
2	1.8	9.6
3	3.9	23.9

COMPOSITE % IMPERVIOUS CALCULATIONS - EXISTING CONDITIONS

Subdivision: Cottages at Kettle Creek
Location: Colorado Springs

Project Name: Cottages at Kettle Creek
Project No.: 24026.00
Calculated By: NQJ
Checked By:
Date: 9/30/24

		Gravel Drives				Paved				Roofs				Historic/Agriculture				Weighted C_5 & C_{100}		Basins Total Weighted % Imp.
Basin ID	Total Area (ac)	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	
EX1	15.11	0.59	0.70	0.83	80.0%	0.90	0.96	0.00	100.0%	0.73	0.81	0.06	90.0%	0.09	0.36	14.22	2.0%	0.12	0.38	6.6%
EX2	6.56	0.59	0.70	0.22	80.0%	0.90	0.96	0.05	100.0%	0.73	0.81	0.08	90.0%	0.09	0.36	6.21	2.0%	0.12	0.38	6.4%
EX3	10.41	0.59	0.70	0.00	80.0%	0.90	0.96	0.00	100.0%	0.73	0.81	0.00	90.0%	0.09	0.36	10.41	2.0%	0.09	0.36	2.0%
Total	**32.08**																			**3.8%**

STANDARD FORM SF-2 - EXISTING CONDITIONS
TIME OF CONCENTRATION

Subdivision: Cottages at Kettle Creek
Location: El Paso County

Project Name: Cottages at Kettle Creek
Project No.: 24019.00
Calculated By: NQJ
Checked By:
Date: 9/30/24

SUB-BASIN DATA					INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C_5	Impervious (%)	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EX1	15.11	B	0.12	6.6%	300	2.7%	22.1	1280	1.9%	7.0	1.0	22.1	44.2	1580.0	40.5	40.5
EX2	6.56	B	0.12	6.4%	300	1.8%	25.2	920	2.7%	7.0	1.2	13.3	38.6	1220.0	34.3	34.3
EX3	10.41	B	0.09	2.0%	300	1.6%	27.0	1006	7.3%	7.0	1.9	8.9	35.9	1306.0	32.3	32.3

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

Eq
$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$
Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

Equation 6-4 $26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$
Equation 6-5

:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cottages at Kettle Creek
Location: Colorado Springs
Design Storm: 5-Year

Project Name: Cottages at Kettle Creek
Project No.: 24026.00
Calculated By: NQJ
Checked By:
Date: 9/30/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	EX1	15.11	0.12	40.5	1.81	2.03	3.7															BASIN EX1 HISTORIC FLOW @ DP1, DRAINS WEST ALONG OLD RANCH ROAD
	2	EX2	6.56	0.12	34.3	0.79	2.28	1.8															BASIN EX2 HISTORIC FLOW @ DP2, DRAINS EAST ALONG OLD RANCH ROAD TO DP3
	3	EX3	10.41	0.09	32.3	0.94	2.37	2.2	34.3	1.73	2.28	3.9											BASIN EX3 HISTROIC FLOW & DP2 FLOW @ DP3, FLOWS SOUTH UNDER OLD RANCH ROAD IN EX CULVERT

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cottages at Kettle Creek
Location: Colorado Springs
Design Storm: 100-Year

Project Name: Cottages at Kettle Creek
Project No.: 24026.00
Calculated By: NQJ
Checked By:
Date: 9/30/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	EX1	15.11	0.38	40.5	5.75	3.41	19.6															BASIN EX1 HISTORIC FLOW @ DP1, DRAINS WEST ALONG OLD RANCH ROAD
	2	EX2	6.56	0.38	34.3	2.50	3.82	9.6															BASIN EX2 HISTORIC FLOW @ DP2, DRAINS EAST ALONG OLD RANCH ROAD TO DP3
	3	EX3	10.41	0.36	32.3	3.75	3.97	14.9	34.3	6.25	3.82	23.9											BASIN EX3 HISTROIC FLOW & DP2 FLOW @ DP3, FLOWS SOUTH UNDER OLD RANCH ROAD IN EX CULVERT

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

Subdivision:	Cottages at Kettle Creek
Location:	Colorado Springs
Project Name:	Cottages at Kettle Creek
Project Number:	24026
Calculated By:	NQJ
Checked By:	
Date:	9/24/2024

PROPOSED CALCS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	1.98	62%	0.57	0.71	17.9	4.7	9.8
B	2.26	64%	0.58	0.72	18.1	5.4	11.2
C	0.53	65%	0.60	0.73	15.9	1.4	2.9
D	1.57	76%	0.69	0.80	15.4	4.8	9.3
E	0.50	12%	0.17	0.42	25.9	0.4	1.8
F	0.22	47%	0.46	0.63	19.7	0.5	1.2
G	0.96	17%	0.22	0.45	27.8	0.7	2.5
OS1	1.97	14%	0.17	0.41	35.4	1.1	4.5
OS2	12.06	5%	0.11	0.38	40.9	2.7	15.3
OS3	10.37	2%	0.09	0.36	17.9	2.2	14.8

DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	4.7	9.8
2	5.4	11.2
3	4.8	9.4
3.1	9.6	18.4
4	1.4	3.5
4.1	10.8	20.7
5	11.1	22.0
6	0.5	1.7
7	1.1	4.1
8	1.1	4.5
9	2.7	15.3
10	2.2	14.8

COMPOSITE % IMPERVIOUS CALCULATIONS - PROPOSED CONDITIONS

Subdivision: Cottages at Kettle Creek
Location: Colorado Springs

Project Name: Cottages at Kettle Creek
Project No.: 24026.00
Calculated By: NQJ
Checked By:
Date: 9/24/24

		Paved				Gravel				Roofs				Landscaping/Undeveloped				Weighted C_5 & C_{100}		Basins Total Weighted % Imp.
Basin ID	Total Area (ac)	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	
A	1.98	0.90	0.96	0.82	100.0%	0.59	0.70	0.06	80.0%	0.73	0.81	0.39	90.0%	0.09	0.36	0.71	2.0%	0.57	0.71	62.3%
B	2.26	0.90	0.96	0.97	100.0%	0.59	0.70	0.00	80.0%	0.73	0.81	0.52	90.0%	0.09	0.36	0.77	2.0%	0.58	0.72	64.3%
C	0.53	0.90	0.96	0.27	100.0%	0.59	0.70	0.00	80.0%	0.73	0.81	0.08	90.0%	0.09	0.36	0.18	2.0%	0.60	0.73	65.2%
D	1.57	0.90	0.96	0.93	100.0%	0.59	0.70	0.00	80.0%	0.73	0.81	0.29	90.0%	0.09	0.36	0.35	2.0%	0.69	0.80	76.3%
E	0.50	0.90	0.96	0.05	100.0%	0.59	0.70	0.00	80.0%	0.73	0.81	0.00	90.0%	0.09	0.36	0.45	2.0%	0.17	0.42	11.8%
F	0.22	0.90	0.96	0.10	100.0%	0.59	0.70	0.00	80.0%	0.73	0.81	0.00	90.0%	0.09	0.36	0.12	2.0%	0.46	0.63	46.5%
G	0.96	0.90	0.96	0.15	100.0%	0.59	0.70	0.00	80.0%	0.73	0.81	0.00	90.0%	0.09	0.36	0.81	2.0%	0.22	0.45	17.3%
OS1	1.97	0.90	0.96	0.00	100.0%	0.59	0.70	0.30	80.0%	0.73	0.81	0.00	90.0%	0.09	0.36	1.67	2.0%	0.17	0.41	13.9%
OS2	12.06	0.90	0.96	0.00	100.0%	0.59	0.70	0.46	80.0%	0.73	0.81	0.06	90.0%	0.09	0.36	11.54	2.0%	0.11	0.38	5.4%
OS3	10.37	0.90	0.96	0.00	100.0%	0.59	0.70	0.00	80.0%	0.73	0.81	0.00	90.0%	0.09	0.36	10.37	2.0%	0.09	0.36	2.0%
Total	**32.42**																			**17.6%**
Pond (A-E)	**6.84**																			**62.7%**

STANDARD FORM SF-2 - PROPOSED CONDITIONS
TIME OF CONCENTRATION

Subdivision: Cottages at Kettle Creek
Location: El Paso County

Project Name: Cottages at Kettle Creek
Project No.: 24019.00
Calculated By: NQJ
Checked By:
Date: 9/24/24

SUB-BASIN DATA					INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C_5	Impervious (%)	*L* (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	*K*	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A	1.98	A	0.57	62.3%	100	2.0%	7.7	340	1.7%	20.0	2.6	2.2	9.8	440.0	17.9	9.8
B	2.26	A	0.58	64.3%	100	2.0%	7.4	420	1.6%	20.0	2.5	2.8	10.2	520.0	18.1	10.2
C	0.53	A	0.60	65.2%	100	2.0%	7.2	270	6.0%	20.0	4.9	0.9	8.1	370.0	15.9	8.1
D	1.57	A	0.69	76.3%	100	2.0%	5.9	400	2.0%	20.0	2.8	2.4	8.3	500.0	15.4	8.3
E	0.50	A	0.17	11.8%	65	33.0%	4.3	123	1.0%	20.0	2.0	1.0	5.3	188.0	25.9	5.3
F	0.22	A	0.46	46.5%	24	2.0%	4.5	310	4.4%	20.0	4.2	1.2	5.7	334.0	19.7	5.7
G	0.96	A	0.22	17.3%	140	2.8%	13.4	630	3.8%	20.0	3.9	2.7	16.1	770.0	27.8	16.1
OS1	1.97	A	0.17	13.9%	10	2.0%	4.2	980	1.6%	10.0	1.3	12.9	17.2	990.0	35.4	17.2
OS2	12.06	A	0.11	5.4%	300	2.7%	22.3	1280	1.9%	7.0	1.0	22.1	44.4	1580.0	40.9	40.9
OS3	10.37	A	0.09	2.0%	300	1.6%	27.0	1006	7.3%	7.0	1.9	8.9	35.9	1306.0	32.3	32.3

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

Eq $$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

Equation 6-4 $26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$ Equation 6-5

:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3 - PROPOSED CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cottages at Kettle Creek
Location: Colorado Springs
Design Storm: 5-Year

Project Name: Cottages at Kettle Creek
Project No.: 24026.00
Calculated By: NQJ
Checked By:
Date: 9/24/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	A	1.98	0.57	9.8	1.12	4.15	4.7								4.7	1.12	2.0	18	196	7.4	0.4	BASIN A FLOW @ DP1, CAPTURED IN 15' TYPE R, PIPE TO DP4.1
	2	B	2.26	0.58	10.2	1.32	4.10	5.4								5.4	1.32	2.0	18	360	7.7	0.8	BASIN B FLOW @ DP2, CAPTURED IN 15' TYPE R, PIPE TO DP4.1
		C	0.53	0.60	8.1	0.32	4.44	1.4															BASIN C FLOW @ DP4
	3	D	1.57	0.69	8.3	1.08	4.41	4.8								4.8	1.08	2.0	18	360	7.4	0.8	BASIN D FLOW @ DP3, CAPTURED IN 15' TYPE R INLET, PIPE TO DP4.1
	3.1								10.9	2.40	3.99	9.6				9.6	2.40	2.0	18	45	8.9	0.1	COMBINED DP2 & DP3 FLOW @ DP3.1, PIPE TO DP4.1
	4								8.1	0.32	4.44	1.4				1.4	0.32	2.0	18	360	5.1	1.2	BASIN C FLOW @ DP4, CAPTURED IN 10' TYPE R, PIPE TO DP4.1
	4.1								11.0	2.72	3.98	10.8				10.8	2.72	2.0	24	50	9.1	0.1	COMBINED DP1-DP4 FLOW, PIPE TO DP5
	5	E	0.50	0.17	5.3	0.09	5.08	0.4	11.1	2.81	3.97	11.1											COMBINED DP4.1 & BASIN E FLOW, **TOTAL FLOW ENTERING WQ POND**
	6	F	0.22	0.46	5.7	0.10	4.96	0.5	5.7	0.10	4.96	0.5											COMBINED DP3 FLOWBY & BASIN F FLOW, **TOTAL FLOW LEAVING SITE UNDETAINED**
	7	G	0.96	0.22	16.1	0.21	3.41	0.7	16.1	0.31	3.41	1.1											COMBINED DP6 & BASIN G FLOW @ DP7
	8	OS1	1.97	0.17	17.2	0.33	3.32	1.1															BASIN OS1 FLOW @ DP7, FOLLOW HISTORIC DRAINAGE PATTERNS WEST ALONG OLD RANCH ROAD
	9	OS2	12.06	0.11	40.9	1.35	2.01	2.7															BASIN OS2 FLOW @ DP8, FOLLOWS HISTORIC DRAINAGE PATTERNS SOUTH ACROSS OLD RANCH ROAD
	10	OS3	10.37	0.09	32.3	0.93	2.37	2.2															BASIN OS3 FLOW @ DP9, FOLLOWS HISTORIC DRAINAGE PATTERNS UNDER OLD RANCH ROAD

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

STANDARD FORM SF-3 - PROPOSED CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cottages at Kettle Creek
Location: Colorado Springs
Design Storm: 100-Year

Project Name: Cottages at Kettle Creek
Project No.: 24026.00
Calculated By: NQJ
Checked By:
Date: 9/24/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_C (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	A	1.98	0.71	9.8	1.40	6.97	9.8					1.1	0.15	4.80	8.7	1.25	2.0	18	280 196	2.2 8.7	2.1 0.4	DP1 BYPASS, C&G FLOW TO DP4 BASIN A FLOW @ DP1, CAPTURED IN 15' TYPE R, PIPE TO DP4.1
	2	B	2.26	0.72	10.2	1.63	6.89	11.2					1.7	0.25	4.00	9.5	1.38	2.0	18	360 360	2.0 8.8	3.0 0.7	DP2 BYPASS, C&G FLOW TO DP3 BASIN B FLOW @ DP2, CAPTURED IN 15' TYPE R, PIPE TO DP4.1
		C	0.53	0.73	8.1	0.39	7.46	2.9															BASIN C FLOW @ DP4
	3	D	1.57	0.80	8.3	1.25	7.41	9.3	13.2	1.50	6.24	9.4	0.9	0.14	4.00	8.5	1.36	2.0	18	60 360	2.0 8.6	0.5 0.7	DP3 BYPASS FLOW, C&G FLOW TO DP6
	3.1								10.8	2.74	6.73	18.4				18.4	2.74	2.0	18	45	10.4	0.1	COMBINED DP2 & DP3 FLOW @ DP3.1, PIPE TO DP4.1
	4								12.0	0.54	6.48	3.5				3.5	0.54	2.0	18	360	6.8	0.9	BASIN C & DP1 BYPASS FLOW @ DP4, CAPTURED IN 10' TYPE R INLET, PIPE TO DP4.1
	4.1								12.8	3.28	6.30	20.7				20.7	3.28	2.0	24	50	10.8	0.1	COMBINED DP1-DP4 FLOW, PIPE TO DP5
	5	E	0.50	0.42	5.3	0.21	8.54	1.8	12.9	3.49	6.29	22.0											COMBINED DP4.1 & BASIN E FLOW, **TOTAL FLOW ENTERING WQ POND**
	6	F	0.22	0.63	5.7	0.14	8.33	1.2	13.7	0.28	6.15	1.7											COMBINED DP3 FLOWBY & BASIN F FLOW, **TOTAL FLOW LEAVING SITE UNDETAINED**
	7	G	0.96	0.45	16.1	0.44	5.73	2.5	16.1	0.72	5.73	4.1											COMBINED DP6 & BASIN G FLOW @ DP7
	8	OS1	1.97	0.41	17.2	0.81	5.57	4.5															BASIN OS1 FLOW @ DP7, FOLLOW HISTORIC DRAINAGE PATTERNS WEST ALONG OLD RANCH ROAD
	9	OS2	12.06	0.38	40.9	4.53	3.38	15.3															BASIN OS2 FLOW @ DP8, FOLLOWS HISTORIC DRAINAGE PATTERNS SOUTH ACROSS OLD RANCH ROAD
	10	OS3	10.37	0.36	32.3	3.73	3.97	14.8															BASIN OS3 FLOW @ DP9, FOLLOWS HISTORIC DRAINAGE PATTERNS UNDER OLD RANCH ROAD

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

Design Procedure Form: Runoff Reduction

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

Designer:	NQJ
Company:	ALL TERRAIN ENGINEERING
Date:	October 4, 2024
Project:	COTTAGES AT KETTLE CREEK
Location:	COLORADO SPRINGS

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches

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

Area Type	UIA:RPA	DCIA	SPA	UIA:RPA	DCIA							
Area ID	A:UIA-RPA	A:DCIA	A:SPA	B:UIA-RPA	B:DCIA							
Downstream Design Point ID	1	1	1	1	1							
Downstream BMP Type	EDB	EDB	EDB	EDB	EDB							
DCIA (ft^2)	--	37,836	--	--	56,702							
UIA (ft^2)	9,025	--	--	4,535	--							
RPA (ft^2)	9,300	--	--	6,783	--							
SPA (ft^2)	--	--	25,942	--	--							
HSG A (%)	100%	--	100%	100%	--							
HSG B (%)	0%	--	0%	0%	--							
HSG C/D (%)	0%	--	0%	0%	--							
Average Slope of RPA (ft/ft)	0.020	--	--	0.020	--							
UIA:RPA Interface Width (ft)	35.00	--	--	35.00	--							

CALCULATED RUNOFF RESULTS

Area ID	A:UIA-RPA	A:DCIA	A:SPA	B:UIA-RPA	B:DCIA							
UIA:RPA Area (ft^2)	18,325	--	--	11,318	--							
L / W Ratio	14.96	--	--	9.24	--							
UIA / Area	0.4925	--	--	0.4007	--							
Runoff (in)	0.00	0.50	0.00	0.00	0.50							
Runoff (ft^3)	0	1577	0	0	2363							
Runoff Reduction (ft^3)	376	0	1297	189	0							

CALCULATED WQCV RESULTS

Area ID	A:UIA-RPA	A:DCIA	A:SPA	B:UIA-RPA	B:DCIA							
WQCV (ft^3)	376	1577	0	189	2363							
WQCV Reduction (ft^3)	376	0	0	189	0							
WQCV Reduction (%)	100%	0%	0%	100%	0%							
Untreated WQCV (ft^3)	0	1577	0	0	2363							

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

Downstream Design Point ID	1	1	1	1	1							
DCIA (ft^2)	94,538	94,538	94,538	94,538	94,538							
UIA (ft^2)	13,560	13,560	13,560	13,560	13,560							
RPA (ft^2)	16,083	16,083	16,083	16,083	16,083							
SPA (ft^2)	25,942	25,942	25,942	25,942	25,942							
Total Area (ft^2)	150,123	150,123	150,123	150,123	150,123							
Total Impervious Area (ft^2)	108,098	108,098	108,098	108,098	108,098							
WQCV (ft^3)	4,504	4,504	4,504	4,504	4,504							
WQCV Reduction (ft^3)	565	565	565	565	565							
WQCV Reduction (%)	13%	13%	13%	13%	13%							
Untreated WQCV (ft^3)	3,939	3,939	3,939	3,939	3,939							

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

Total Area (ft^2)	750,615
Total Impervious Area (ft^2)	540,490
WQCV (ft^3)	4,504
WQCV Reduction (ft^3)	565
WQCV Reduction (%)	13%
Untreated WQCV (ft^3)	3,939

APPENDIX C – HYDRAULIC CALCULATIONS

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP1	DP2	DP3	DP4
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	4.7	5.4	4.8	1.4
Major Q_{Known} (cfs)	9.8	11.2	9.4	3.5

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

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type				

Watershed Profile

Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				

CALCULATED OUTPUT

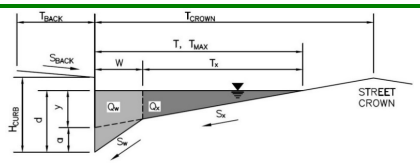
Minor Total Design Peak Flow, Q (cfs)	**4.7**	**5.4**	**4.8**	**1.4**
Major Total Design Peak Flow, Q (cfs)	**9.8**	**11.2**	**9.4**	**3.5**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	1.1	1.7	0.9	0.0

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

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

Project: **COTTAGES AT KETTLE CREEK**

Inlet ID: **DP1**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.048	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

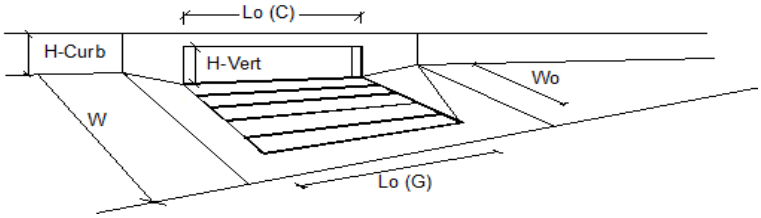
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**21.9**	**21.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.70 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 9.80 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

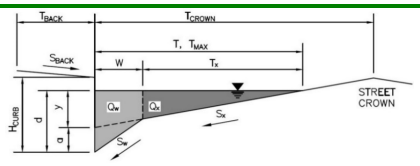
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.7**	**8.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**89**	**%**

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

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

Project: **COTTAGES AT KETTLE CREEK**

Inlet ID: **DP2**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.041	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

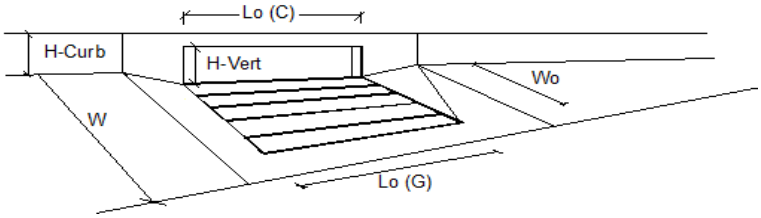
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**22.9**	**22.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 5.40 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 11.20 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

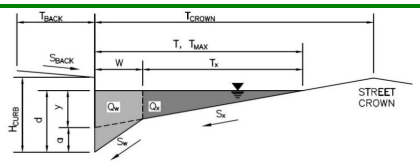
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.4**	**9.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.7**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**84**	**%**

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

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

Project: **COTTAGES AT KETTLE CREEK**

Inlet ID: **DP3**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

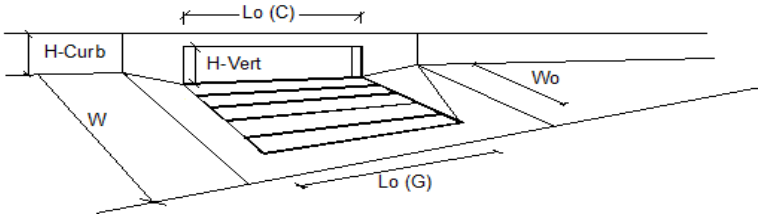
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**23.1**	**23.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.80 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 9.40 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

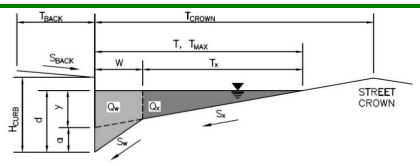
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.8**	**8.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**90**	**%**

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

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

Project: **COTTAGES AT KETTLE CREEK**

Inlet ID: **DP4**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	1.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

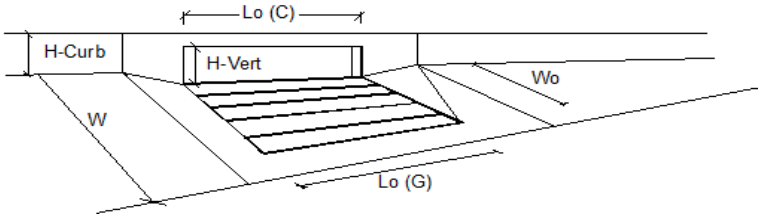
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**23.1**	**23.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.40 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.50 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**3.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**99**	**%**

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Oct 2 2024

Old Ranch Road - Roadside Ditch (Q = DP7 = 4.1 cfs)

Triangular

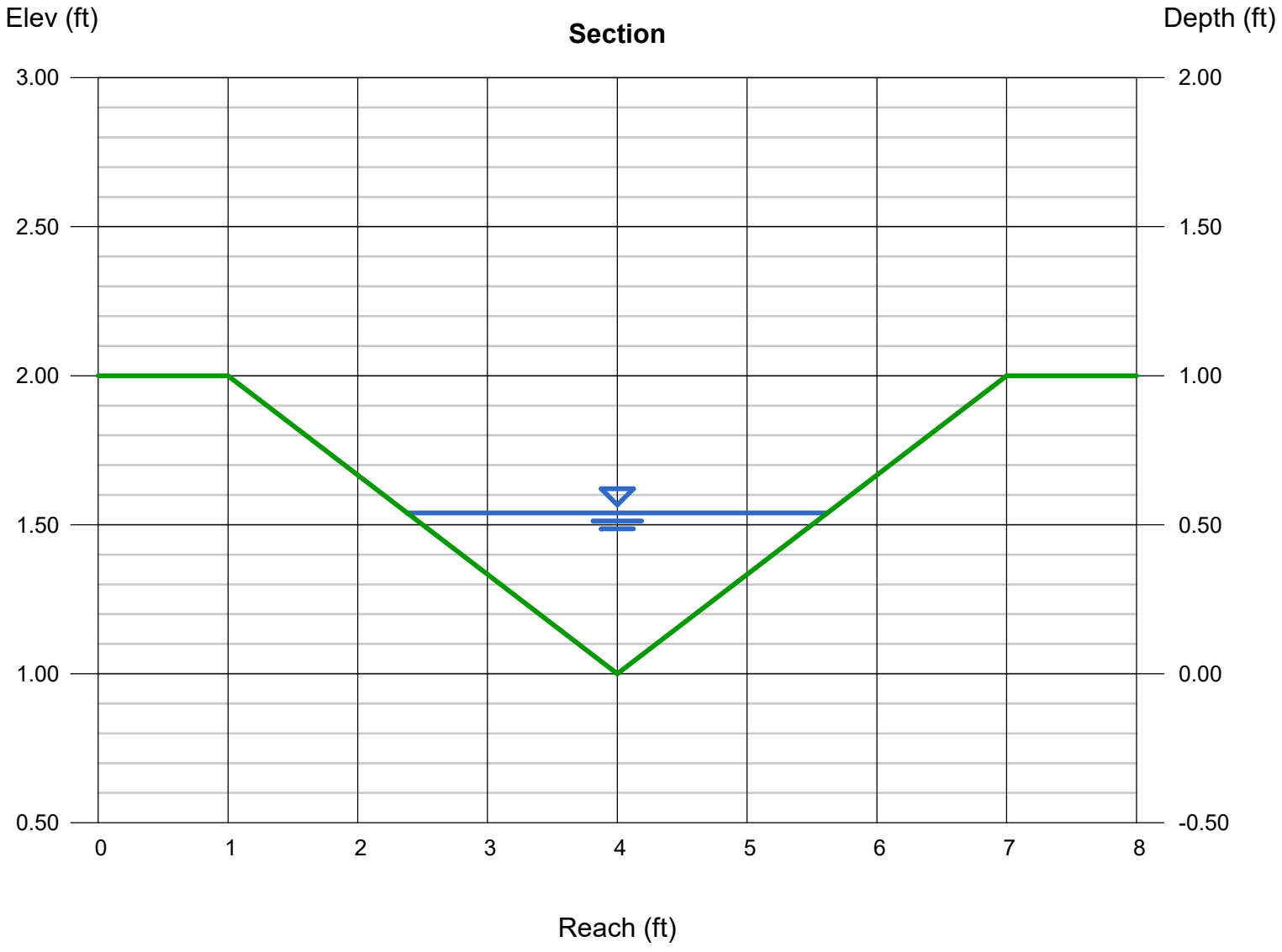
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 1.00
Slope (%)	= 4.00
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.10

Highlighted

Depth (ft)	= 0.54
Q (cfs)	= 4.100
Area (sqft)	= 0.87
Velocity (ft/s)	= 4.69
Wetted Perim (ft)	= 3.42
Crit Depth, Yc (ft)	= 0.66
Top Width (ft)	= 3.24
EGL (ft)	= 0.88



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Oct 2 2024

TRICKLE CHANNEL SIZING (1% OF 100-YR = 2.2 cfs)

Rectangular

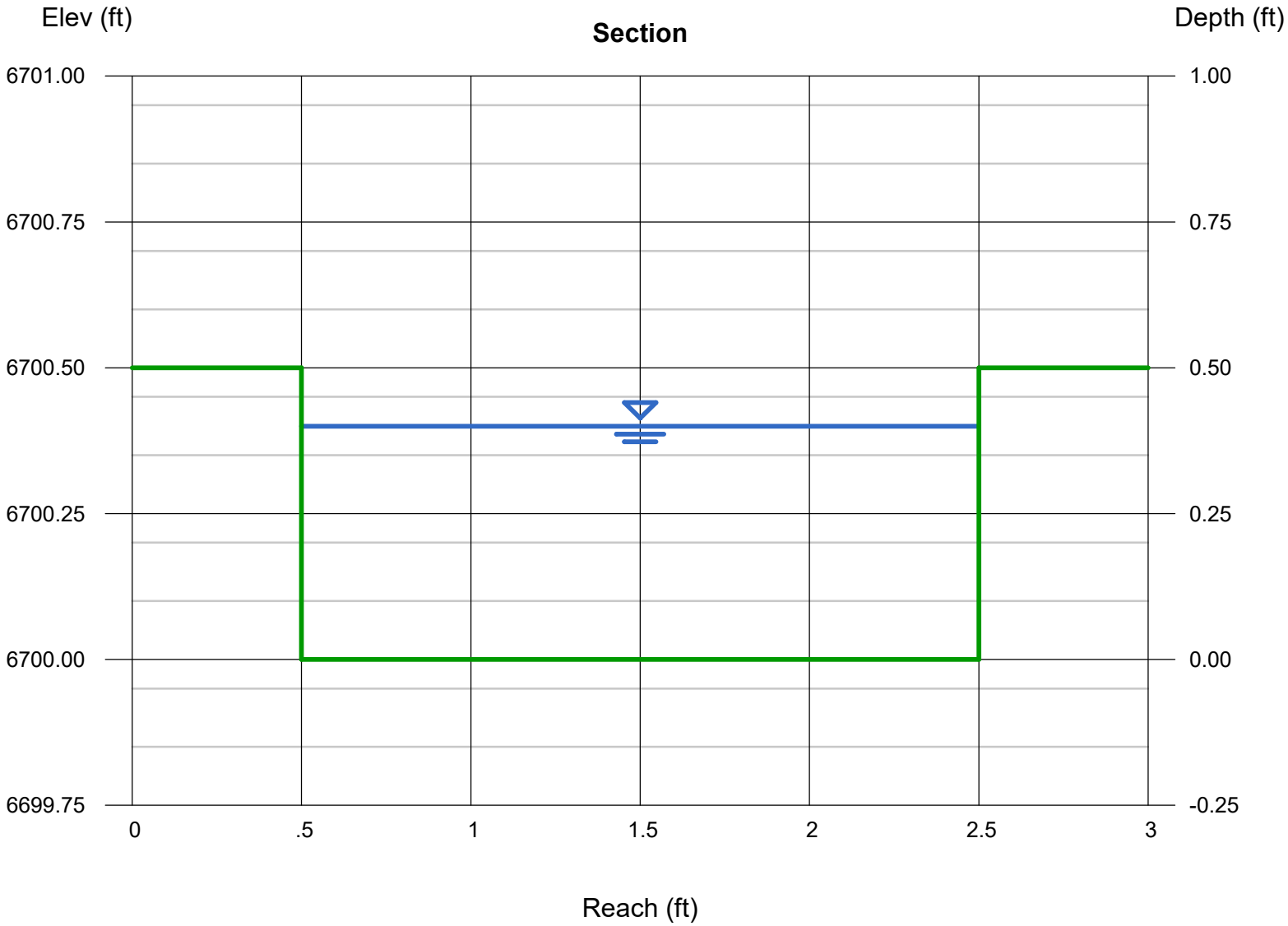
Bottom Width (ft)	= 2.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 6700.00
Slope (%)	= 0.50
N-Value	= 0.016

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.20

Highlighted

Depth (ft)	= 0.40
Q (cfs)	= 2.200
Area (sqft)	= 0.80
Velocity (ft/s)	= 2.75
Wetted Perim (ft)	= 2.80
Crit Depth, Yc (ft)	= 0.34
Top Width (ft)	= 2.00
EGL (ft)	= 0.52



Project: Cottages at Kettle Creek
Project No: 24026
10/2/2024

Forebay Sizing (Per USDCM Volume 3, Table 4-12)				
WQCV (ac-ft)	1% WQCV (ft^3)	Forebay Area (ft^2)	Forebay Depth (ft)	Forebay Volume (ft^3)
0.142	62	46	1.5	69

Forebay Notch Sizing (Per USDCM Volume 3 Equation 4-1)			
$w=9.23(A_{FB}/t)(1/sqrt(h_{max}))$			
A_{FB} (ft^2)	t (s)	h_{max} (ft)	w (in)
46	240	1.5	1.44

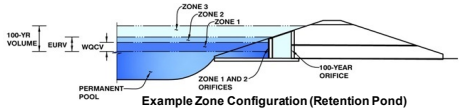
APPENDIX D – WATER QUALITY & DETENTION

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: COTTAGES AT KETTLE CREEK

Basin ID: PRELIM POND SIZING



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	6.84	acres
Watershed Length =	935	ft
Watershed Length to Centroid =	387	ft
Watershed Slope =	0.023	ft/ft
Watershed Imperviousness =	62.70%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.140 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.527 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.91 in.) =	0.282 acre-feet	0.91	inches
5-yr Runoff Volume (P1 = 1.19 in.) =	0.377 acre-feet	1.19	inches
10-yr Runoff Volume (P1 = 1.45 in.) =	0.475 acre-feet	1.45	inches
25-yr Runoff Volume (P1 = 1.84 in.) =	0.640 acre-feet	1.84	inches
50-yr Runoff Volume (P1 = 2.17 in.) =	0.803 acre-feet	2.17	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.995 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.45 in.) =	1.501 acre-feet	3.45	inches
Approximate 2-yr Detention Volume =	0.262 acre-feet		
Approximate 5-yr Detention Volume =	0.355 acre-feet		
Approximate 10-yr Detention Volume =	0.448 acre-feet		
Approximate 25-yr Detention Volume =	0.600 acre-feet		
Approximate 50-yr Detention Volume =	0.694 acre-feet		
Approximate 100-yr Detention Volume =	0.792 acre-feet		

Define Zones and Basin Geometry

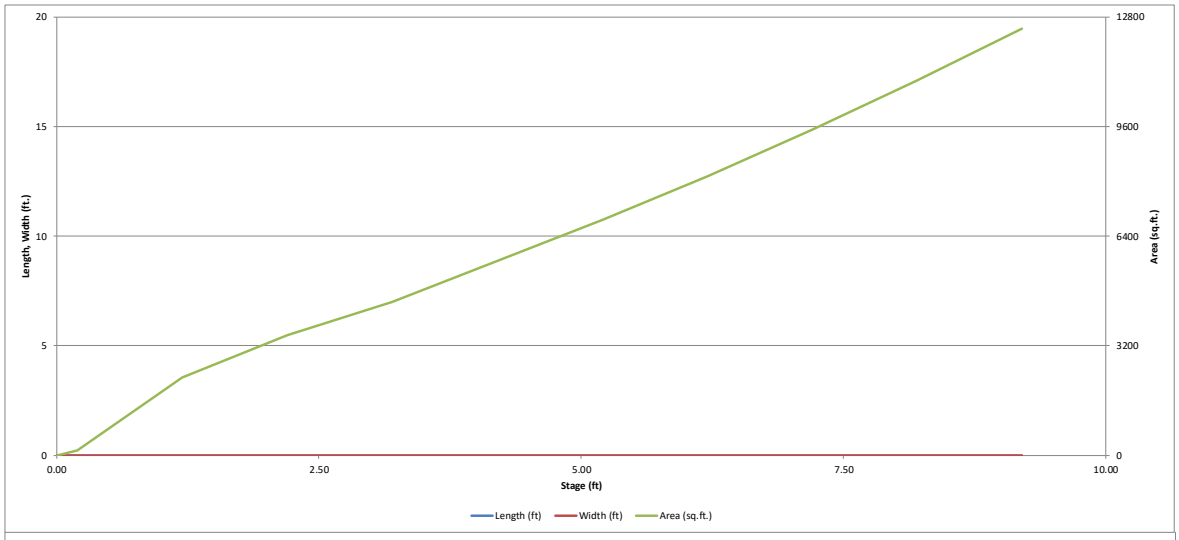
Zone 1 Volume (WQCV) =	0.140	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.387	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.265	acre-feet
Total Detention Basin Volume =	0.792	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

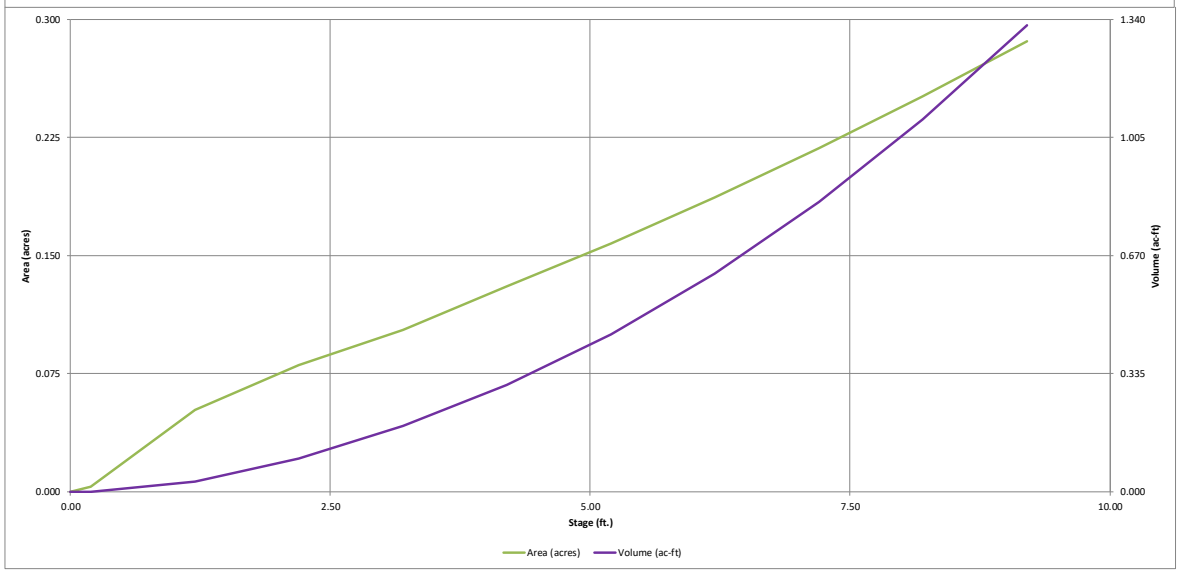
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6696.8 **Top of Micropool**	--	0.00	--	--	--	0	0.000		
6697	--	0.20	--	--	--	142	0.003	14	0.000
6698	--	1.20	--	--	--	2,269	0.052	1,220	0.028
6699	--	2.20	--	--	--	3,511	0.081	4,110	0.094
6700	--	3.20	--	--	--	4,483	0.103	8,107	0.186
6701	--	4.20	--	--	--	5,678	0.130	13,187	0.303
6702	--	5.20	--	--	--	6,865	0.158	19,459	0.447
6703	--	6.20	--	--	--	8,138	0.187	26,960	0.619
6704	--	7.20	--	--	--	9,497	0.218	35,778	0.821
6705	--	8.20	--	--	--	10,943	0.251	45,998	1.056
6706	--	9.20	--	--	--	12,478	0.286	57,708	1.325

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



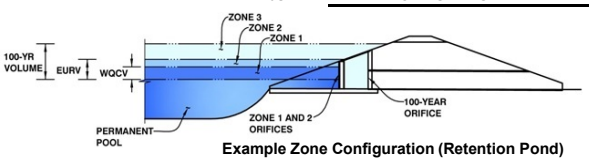


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **COTTAGES AT KETTLE CREEK**

Basin ID: **PRELIM POND SIZING**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.73	0.140	Orifice Plate
Zone 2 (EURV)	5.69	0.387	Circular Orifice
Zone 3 (100-year)	7.07	0.265	Weir&Pipe (Restrict)
Total (all zones)		0.792	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.236E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.73	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.90	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.61	sq. inches (diameter = 7/8 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.91	1.82					
Orifice Area (sq. inches)	0.61	0.61	0.61					

	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)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.75	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	5.69	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.04	N/A	feet
Vertical Orifice Diameter =	0.90	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.25	N/A	feet
Overflow Weir Front Edge Length =	2.00	N/A	feet	Overflow Weir Slope Length =	2.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	16.31	N/A	
Horiz. Length of Weir Sides =	2.00	N/A	feet	Overflow Grate Open Area w/o Debris =	2.78	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	1.39	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	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 =	0.14	N/A	feet
Restrictor Plate Height Above Pipe Invert =	2.75		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.80	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.15	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.77	feet
Spillway Crest Length =	6.00	feet	Stage at Top of Freeboard =	8.92	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.28	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.25	acre-ft

Calculated Parameters for Spillway

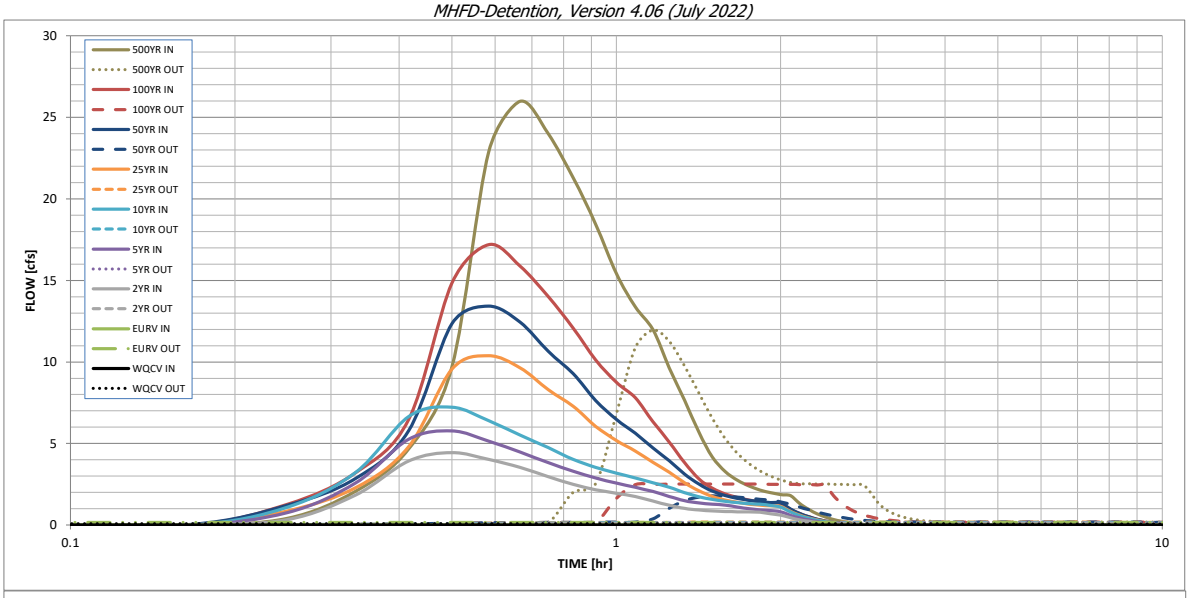
Routed Hydrograph Results

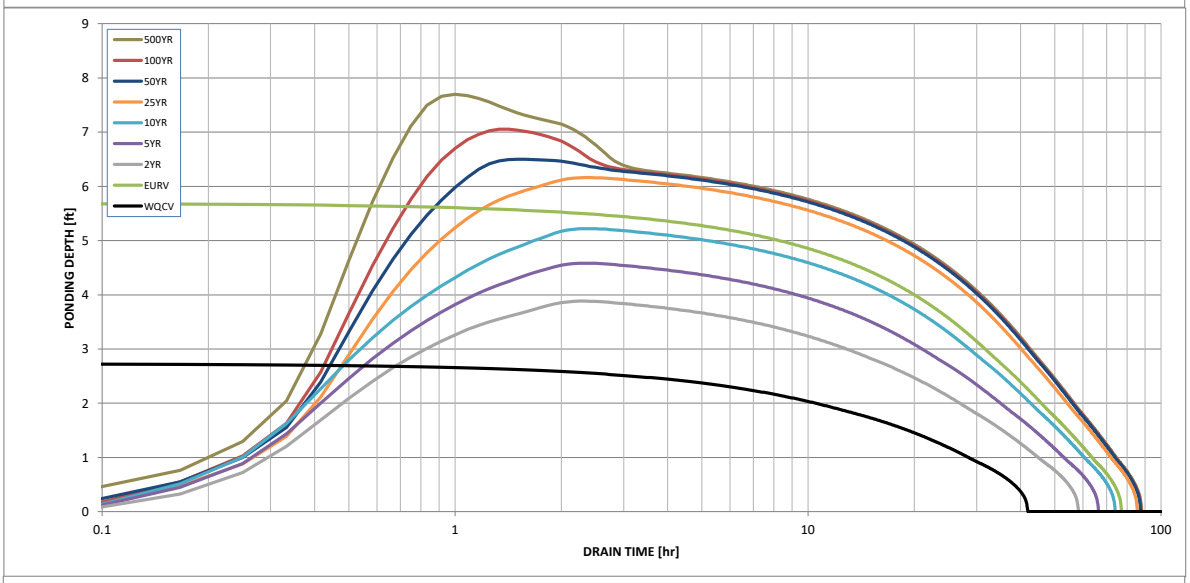
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

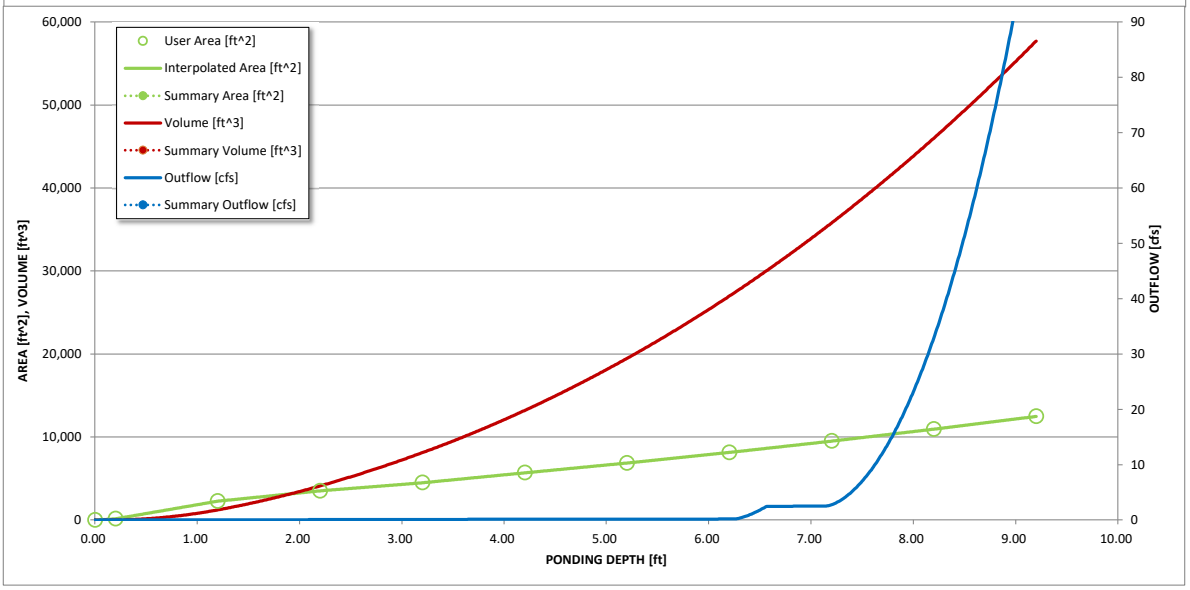
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.91	1.19	1.45	1.84	2.17	2.52	3.45
CUHP Runoff Volume (acre-ft) =	0.140	0.527	0.282	0.377	0.475	0.640	0.803	0.995	1.501
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.282	0.377	0.475	0.640	0.803	0.995	1.501
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.1	0.5	2.0	4.0	8.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.07	0.30	0.58	1.30
Peak Inflow Q (cfs) =	N/A	N/A	4.4	5.8	7.2	10.4	13.4	17.2	26.0
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.1	0.2	0.2	1.8	2.5	12.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.4	2.0	0.4	0.9	0.6	1.3
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.6	0.8	0.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	65	51	57	63	72	72	70	65
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	55	63	70	80	81	79	77
Maximum Ponding Depth (ft) =	2.73	5.69	3.88	4.58	5.22	6.16	6.50	7.05	7.69
Area at Maximum Ponding Depth (acres) =	0.09	0.17	0.12	0.14	0.16	0.19	0.20	0.21	0.23
Maximum Volume Stored (acre-ft) =	0.140	0.527	0.261	0.353	0.448	0.610	0.674	0.787	0.932

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.42
	0:15:00	0.00	0.00	0.34	0.78	1.10	0.88	1.22	1.28	2.08
	0:20:00	0.00	0.00	1.85	2.59	3.24	2.30	2.87	3.22	4.67
	0:25:00	0.00	0.00	3.93	5.26	6.65	4.80	5.79	6.48	9.70
	0:30:00	0.00	0.00	4.44	5.77	7.23	9.55	12.35	14.85	22.88
	0:35:00	0.00	0.00	4.02	5.15	6.40	10.38	13.42	17.19	25.98
	0:40:00	0.00	0.00	3.54	4.47	5.51	9.65	12.43	15.88	24.00
	0:45:00	0.00	0.00	2.96	3.83	4.75	8.31	10.65	14.02	21.29
	0:50:00	0.00	0.00	2.49	3.31	4.03	7.28	9.28	12.08	18.45
	0:55:00	0.00	0.00	2.17	2.88	3.53	6.06	7.63	10.12	15.42
	1:00:00	0.00	0.00	1.95	2.58	3.19	5.18	6.47	8.75	13.38
	1:05:00	0.00	0.00	1.76	2.31	2.89	4.54	5.63	7.80	11.98
	1:10:00	0.00	0.00	1.47	2.06	2.59	3.85	4.73	6.34	9.64
	1:15:00	0.00	0.00	1.21	1.76	2.31	3.23	3.94	5.09	7.66
	1:20:00	0.00	0.00	1.02	1.49	2.00	2.59	3.13	3.83	5.69
	1:25:00	0.00	0.00	0.92	1.35	1.73	2.10	2.51	2.84	4.17
	1:30:00	0.00	0.00	0.86	1.28	1.57	1.75	2.07	2.25	3.27
	1:35:00	0.00	0.00	0.83	1.22	1.46	1.53	1.81	1.91	2.75
	1:40:00	0.00	0.00	0.82	1.10	1.37	1.39	1.64	1.69	2.39
	1:45:00	0.00	0.00	0.80	1.00	1.31	1.29	1.52	1.54	2.15
	1:50:00	0.00	0.00	0.79	0.93	1.27	1.22	1.44	1.44	1.99
	1:55:00	0.00	0.00	0.69	0.88	1.21	1.18	1.39	1.36	1.87
	2:00:00	0.00	0.00	0.60	0.82	1.09	1.14	1.35	1.32	1.80
	2:05:00	0.00	0.00	0.45	0.60	0.80	0.84	0.99	0.97	1.33
	2:10:00	0.00	0.00	0.32	0.43	0.58	0.61	0.72	0.70	0.96
	2:15:00	0.00	0.00	0.23	0.31	0.41	0.44	0.51	0.51	0.69
	2:20:00	0.00	0.00	0.16	0.22	0.29	0.31	0.36	0.36	0.49
	2:25:00	0.00	0.00	0.11	0.15	0.20	0.21	0.25	0.25	0.34
	2:30:00	0.00	0.00	0.07	0.10	0.14	0.15	0.17	0.17	0.23
	2:35:00	0.00	0.00	0.05	0.07	0.09	0.10	0.11	0.11	0.15
	2:40:00	0.00	0.00	0.02	0.04	0.05	0.06	0.07	0.07	0.09
	2:45:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.04
	2:50:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

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).

APPENDIX E – REFERENCE MATERIAL

APPENDIX F – DRAINAGE MAPS

COTTAGES AT KETTLE CREEK

EXISTING DRAINAGE MAP

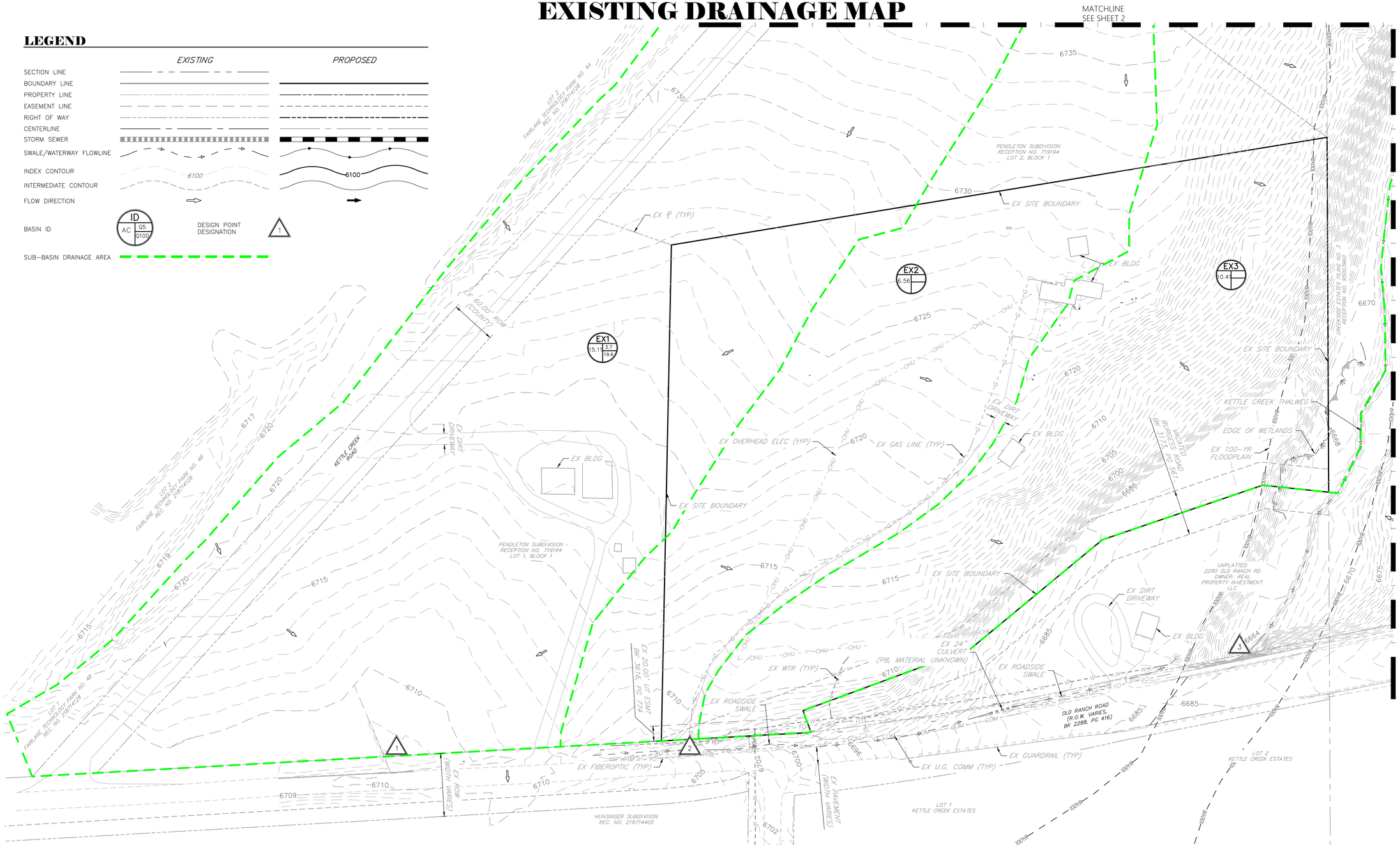
LEGEND

	EXISTING	PROPOSED
SECTION LINE		
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		

BASIN ID — ID / AC / Q5 / Q100

DESIGN POINT DESIGNATION — 1

SUB-BASIN DRAINAGE AREA



EX DRAINAGE CALCS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX1	15.11	7%	0.09	0.36	40.5	3.7	19.6
EX2	6.56	6%	0.09	0.36	34.3	1.8	9.6
EX3	10.41	2%	0.09	0.36	32.3	2.2	14.9

DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	3.7	19.6
2	1.8	9.6
3	3.9	23.9

60 30 0 60 120

ORIGINAL SCALE: 1" = 60'

EX DRAINAGE MAP

COTTAGES AT KETTLE CREEK

JOB NO. 24026 | SHEET 1

LOCATION: CS

09/30/2024

ALL TERRAIN ENGINEERING

COTTAGES AT KETTLE CREEK

EXISTING DRAINAGE MAP

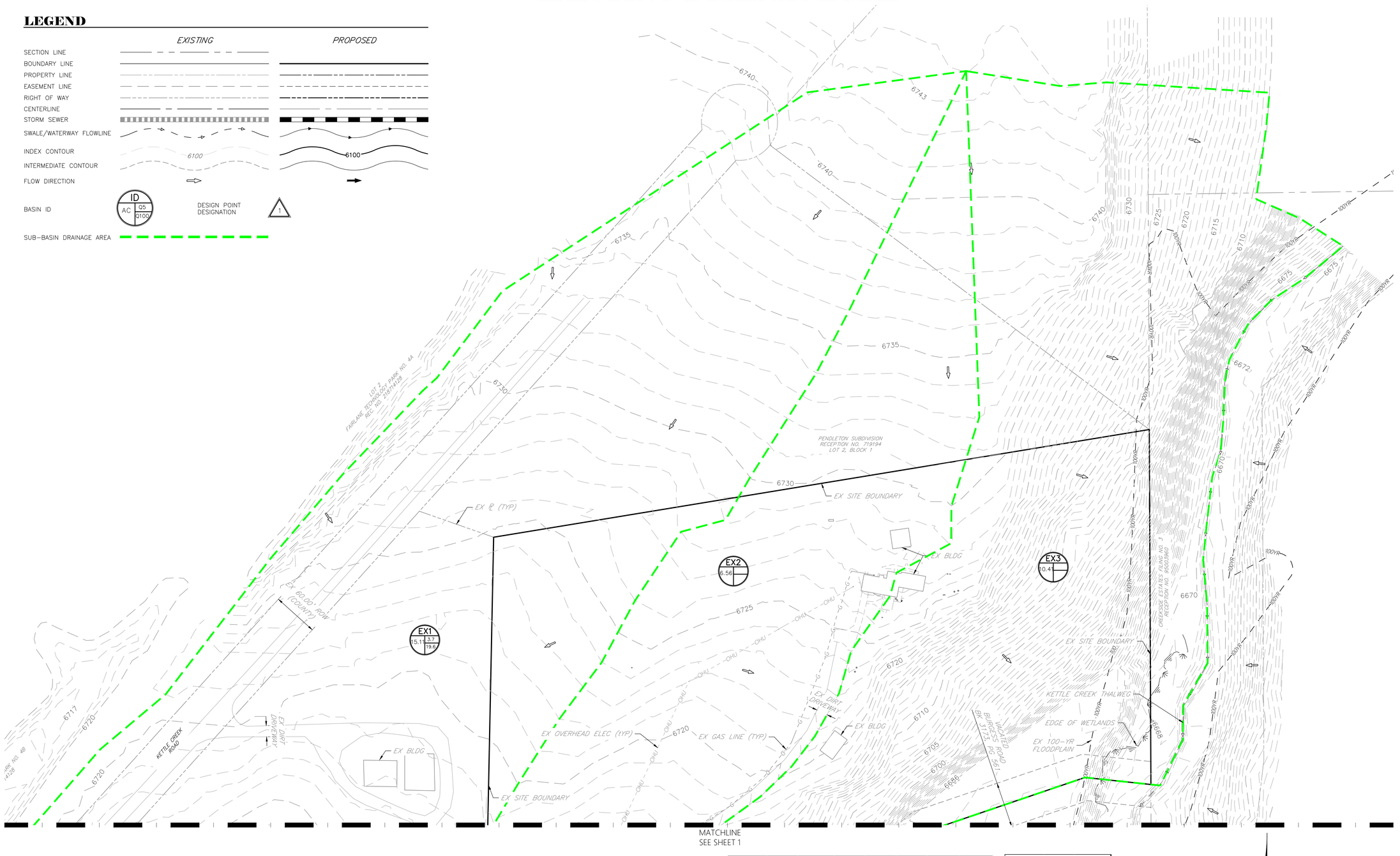
LEGEND

	EXISTING	PROPOSED
SECTION LINE		
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		

BASIN ID — ID / AC / Q5 / Q100

DESIGN POINT DESIGNATION — 1

SUB-BASIN DRAINAGE AREA



MATCHLINE
SEE SHEET 1

EX DRAINAGE CALCS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX1	15.11	7%	0.09	0.36	40.5	3.7	19.6
EX2	6.56	6%	0.09	0.36	34.3	1.8	9.6
EX3	10.41	2%	0.09	0.36	32.3	2.2	14.9

DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	3.7	19.6
2	1.8	9.6
3	3.9	23.9

60 30 0 60 120

ORIGINAL SCALE: 1" = 60'

EX DRAINAGE MAP

COTTAGES AT KETTLE CREEK

JOB NO. 24026 | SHEET 2

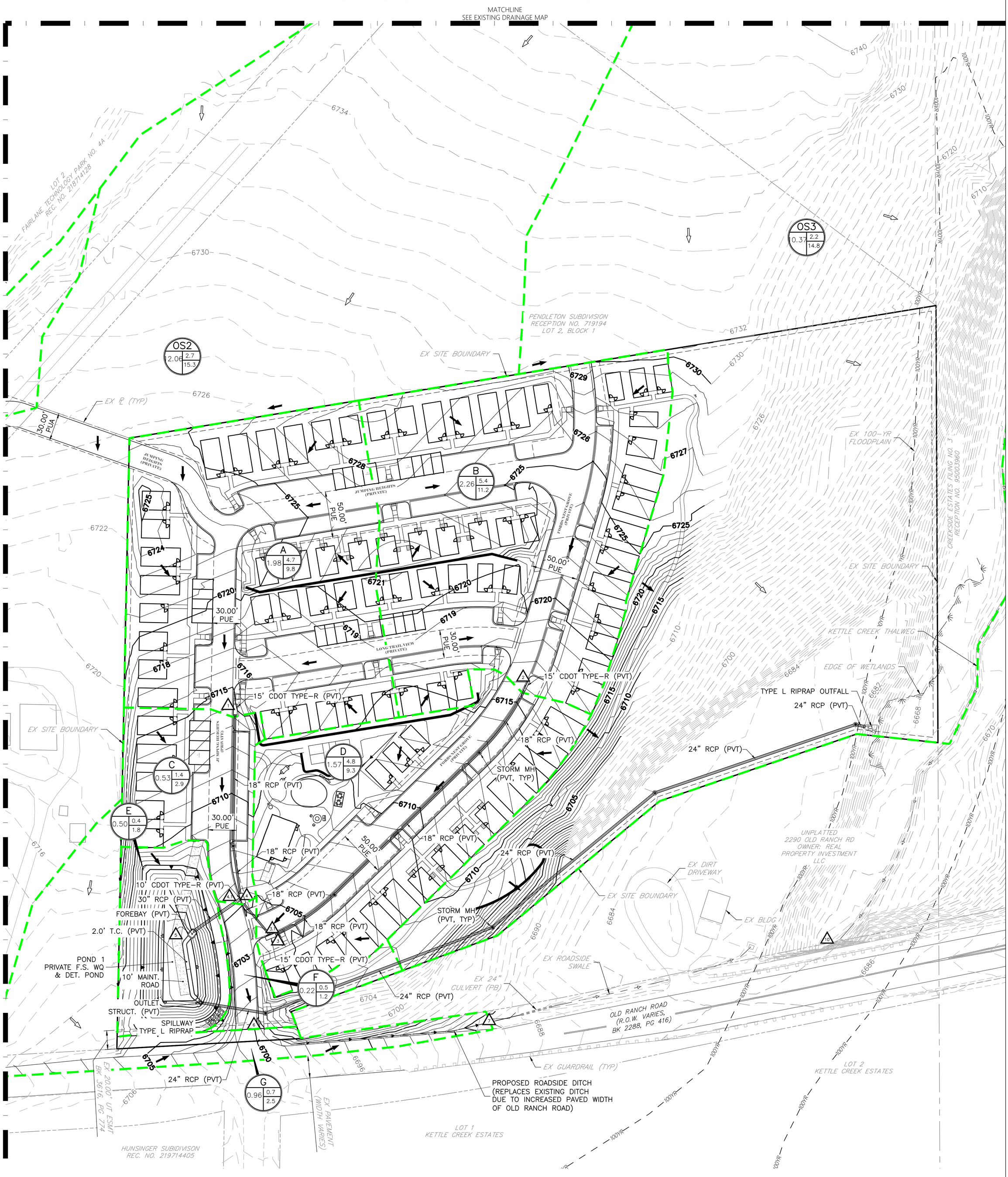
LOCATION: CS

09/30/2024

ALL TERRAIN ENGINEERING

COTTAGES AT KETTLE CREEK

PROPOSED DRAINAGE MAP



LEGEND

	EXISTING	PROPOSED
SECTION LINE		
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		

BASIN ID — ID / AC / Q5 / Q100

DESIGN POINT DESIGNATION — 1

SUB-BASIN DRAINAGE AREA

PROPOSED CALCS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	1.98	62%	0.57	0.71	17.9	4.7	9.8
B	2.26	64%	0.58	0.72	18.1	5.4	11.2
C	0.53	65%	0.60	0.73	15.9	1.4	2.9
D	1.57	76%	0.69	0.80	15.4	4.8	9.3
E	0.50	12%	0.17	0.42	25.9	0.4	1.8
F	0.22	47%	0.46	0.63	19.7	0.5	1.2
G	0.96	17%	0.22	0.45	27.8	0.7	2.5
OS1	1.97	14%	0.17	0.41	35.4	1.1	4.5
OS2	12.06	5%	0.11	0.38	40.9	2.7	15.3
OS3	10.37	2%	0.09	0.36	17.9	2.2	14.8

DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	4.7	9.8
2	5.4	11.2
3	4.8	9.4
3.1	9.6	18.4
4	1.4	3.5
4.1	10.8	20.7
5	11.1	22.0
6	0.5	1.7
7	1.1	4.1
8	1.1	4.5
9	2.7	15.3
10	2.2	14.8

NOTES

1. ALL PROPOSED STORM SEWER IS PRIVATE.
2. THE FULL SPECTRUM (F.S.) WATER QUALITY AND DETENTION POND AND ITS APPURTENANCES ARE ALL PRIVATE.
3. NON-STORMWATER, EXISTING UTILITIES ARE NOT SHOWN, SEE EXISTING DRAINAGE MAP FOR REFERENCE.
4. SEE EXISTING DRAINAGE MAP FOR NORTHERN LIMITS OF BASIN OS1 AND OS2. THERE ARE NO IMPROVEMENTS OR CHANGES TO DRAINAGE BEYOND THE LIMITS OF THIS DRAINAGE MAP.

50 25 0 50 100

ORIGINAL SCALE: 1" = 50'

PROPOSED DRAINAGE MAP

COTTAGES AT KETTLE CREEK

JOB NO. 24026 | SHEET 1

LOCATION: CS

09/30/2024

ALL TERRAIN ENGINEERING

COTTAGES AT KETTLE CREEK

PROPOSED DRAINAGE MAP

LEGEND

	EXISTING	PROPOSED
SECTION LINE		
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		

BASIN ID — ID / AC / Q5 / Q100

DESIGN POINT DESIGNATION — 1

SUB-BASIN DRAINAGE AREA

PROPOSED CALCS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	1.98	62%	0.57	0.71	17.9	4.7	9.8
B	2.26	64%	0.58	0.72	18.1	5.4	11.2
C	0.53	65%	0.60	0.73	15.9	1.4	2.9
D	1.57	76%	0.69	0.80	15.4	4.8	9.3
E	0.50	12%	0.17	0.42	25.9	0.4	1.8
F	0.22	47%	0.46	0.63	19.7	0.5	1.2
G	0.96	17%	0.22	0.45	27.8	0.7	2.5
OS1	1.97	14%	0.17	0.41	35.4	1.1	4.5
OS2	12.06	5%	0.11	0.38	40.9	2.7	15.3
OS3	10.37	2%	0.09	0.36	17.9	2.2	14.8

DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	4.7	9.8
2	5.4	11.2
3	4.8	9.4
3.1	9.6	18.4
4	1.4	3.5
4.1	10.8	20.7
5	11.1	22.0
6	0.5	1.7
7	1.1	4.1
8	1.1	4.5
9	2.7	15.3
10	2.2	14.8

NOTES

1. ALL PROPOSED STORM SEWER IS PRIVATE.
2. THE FULL SPECTRUM (F.S.) WATER QUALITY AND DETENTION POND AND ITS APPURTENANCES ARE ALL PRIVATE.
3. NON-STORMWATER, EXISTING UTILITIES ARE NOT SHOWN, SEE EXISTING DRAINAGE MAP FOR REFERENCE.
4. SEE EXISTING DRAINAGE MAP FOR NORTHERN LIMITS OF BASIN OS1 AND OS2. THERE ARE NO IMPROVEMENTS OR CHANGES TO DRAINAGE BEYOND THE LIMITS OF THIS DRAINAGE MAP.

N

50 25 0 50 100

ORIGINAL SCALE: 1" = 50'

PROPOSED DRAINAGE MAP

COTTAGES AT KETTLE CREEK

JOB NO. 24026 | SHEET 2

LOCATION: CS

09/30/2024

ALL TERRAIN ENGINEERING

COTTAGES AT KETTLE CREEK

RUNOFF REDUCTION MAP

LEGEND:

DCIA	
UIA	
RPA	
SPA	

30 15 0 30 60

ORIGINAL SCALE: 1" = 30'

RUNOFF REDUCTION MAP	
COTTAGES AT KETTLE CREE	
JOB NO. 24026	SHEET
LOCATION: CS	1
10/01/2024	

ALL TERRAIN ENGINEERING