Proposed Retail/Drive-Thru
Address: TBD

Lot 2, Block 1, Horseshoe Ridge Subdivision, 1st Amendment
A Parcel of Land Located in the SE ¼ of Section 28, Township 6 South, Range 66 West of the 6th Principal Meridian
Town of Parker, County of Douglas, State of Colorado

Final Drainage Report

Prepared by: Brad Anderson
Reviewed by: Mike Beach, P.E.

Date: February 18, 2020

RIDGETOP
ENGINEERING & CONSULTING

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Project Location

Project Name: Retail/Drive-Thru

Location: Northwest corner of Pardee Street and Hess Road

Address: TBD

Parcels/Tax Lots: 2233-284-23-005

Zoning: PD Commercial (Horseshoe Ridge)

Site Area: Total = ±0.846 Acres

City, County, State: Town of Parker, Douglas County, Colorado

Governing Agency: Town of Parker

Design Criteria: "Storm Drainage and Environmental Criteria Manual", Town of Parker, Colorado, Revised and Adopted February 2014

Engineer's Certification

This report for the stormwater design of the Propsoed Retail/Drive-Thru was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

_____
Signature

_____
Colorado P.E. License No.

_____
Seal and Date

Section 1 – Project Overview

This report accompanies Civil Engineering Design plans to construct a new commercial Retail/Drive-Thru area within the Town of Parker.

The subject site (Lot 2, Block 1, as shown on the predeveloped basin drainage map, Appendix G) contains native grasses and is surrounded by public roads on the east and south, existing vacant lot to the north, and existing residential to the west. The property is +\-0.846-acres and has one allowed access point to the public right of way. The property is located in the northwest corner of corner of the intersection of Pardee Street and Hess Road.

The proposed onsite improvements include rough grading to provide a building pad, construction of a new commercial building. Other improvements include asphalt parking, concrete sidewalks, landscaping, water and sewer connections, storm drainage management facility, and temporary & permanent erosion control facilities. A newly proposed stormwater detention pond will be installed in the southwest corner of the site adjacent to the planned outlet.

Section 2 – Pre-Developed Conditions

The site is located on FEMA MAP 08035C0182G and does not contain any mapped floodplain areas. (See Appendix A – FIRM Flood Plain Panel).

The subject lot was included in the original *Final Drainage Report for Horseshoe Subdivision prepared by Tetra Tech, September 2005 and Revised date of January 17, 2006,* for calculation purposes only. No stormwater facilities were constructed outside of the existing conveyance pipe that is located for this site to tie into at time of development.

Majority of the site slopes towards the east at roughly 1% to 10%. Current stormwater runoff would flow over the curb into the right of way of Pardee Street. The existing conveyance pipe under Hess Road was sized for this contributing subbasin.

The NRCS classifies soils on all of Lot 2 as Hydrologic Group “B”, with a very small portion of Group “C”. Since the majority of the site is Group “B”, the calculations for this type of soil were used per UDFCD Manual. See Appendix C for more NRCS information.

Existing conditions for the site show an overall percent imperviousness of 2.4%, an existing Conditions Basin Map is included in the Appendix. See Appendix E for the calculations.

Section 3 – Post-Developed Conditions

Site improvements will include, but are not limited to, constructing a new commercial retail building, asphalt parking lot, concrete sidewalks, landscaping, water and sewer connections, storm drainage facility improvements, and temporary & permanent erosion control facilities.

The post-developed drainage area for this site is roughly 0.792 acres. This new pond will be constructed to hold runoff from the proposed development.

The proposed subbasins have been analyzed and modeled as one subbasin due to all of the runoff will sheet flow and/or be conveyed to the proposed pond via curb and gutter or concrete pans: (See Appendix G for the Existing and Proposed Basin Maps). The northewest portion of the site will be consisted of Basin OS1 which drains to the adjacent site to the north.

Subbasin 1 – This 0.792-acre subbasin currently contains the building, asphalt parking, concrete sidewalks, concrete pans, landscaping, and the proposed detention facility. Roof drain lines from the building will be hard lined directly to the proposed on-site conveyance system. Runoff from this basin will flow primary from the northeast to the southwest via sheet flow and shallow concentrated flows. Flows will then be emptied into the proposed pond via curb scuppers and rip rap. The proposed detention pond will outlet the detained water via and existing outlet pipe under Hess Road. The outlet pipe will have a metered flow leaving the facility. The percent imperviousness for this basin is 51.9%.

Subbasin OS1 – This 0.160-acre subbasin contributes due to the proposed grading on the site. Since the existing site if fairly steep across it, it is necessary to keep the shared driveway included into this conveyance system. This subbasin contains asphaltic concrete and sidewalk areas. Runoff from this subbasin will be directed towards the northeast into an area inlet. Flows will then travel into the conveyance piping and eventually to the existing regional detention pond. The percent imperviousness for this basin is 83.4%.

Flow Rates/Conveyance Table:

Subbasin	Area (acres)	5-year Coeff.	5-year Developed Flow	10-year Coeff.	10-year Developed Flow	100-year Coeff.	100-year Developed Flow
1	0.792	0.42	1.4	0.48	1.8	0.67	4.10
OS1	0.160	0.71	0.4	0.73	0.6	0.82	1.20

Precipitation data is obtained from the Storm Drainage and Environmental Criteria Manual from the Town of Parker.

TABLE 5.1
ONE-HOUR POINT RAINFALL

Frequency of Design Event (yr)	One-hour Point Rainfall, P_1 (in)
2	0.99
5	1.39
10	1.64
25	1.98
50	2.31
100	2.60

Peak discharge flow rates from this project are included in the Appendix. All conveyance for the project is provided via overland flow and curb and gutter.

Section 4 - Hydrologic Calculations

Water Quality & Detention Design:

Stormwater quality treatment will be provided within the detention pond. An outlet structure will be required to outlet the WQCV at 40 hours drain time and at the release rates as required by the Town of Parker Storm Drainage and Environmental Criteria Manual. The detention volume above the WQCV will spill over the structure and will have a controlled outlet flow. Water quality and detention facilities will need to be constructed prior to or at the same time as the proposed infrastructure improvements on the overall site. Please see Appendix D and E for calculations.

Detention Pond Design:

The proposed detention pond will accommodate the proposed developed contributing area. The total contributing developed subbasin area is 0.792 acres, with an imperviousness of 51.9%. The proposed construction of the stormwater detention pond will also include the construction of a new outlet structure. Water from the pond will flow through the new outlet structure into an existing 18” stub pipe.

The historic peak 100-year runoff release rate is 2.9 cfs. The detention pond will release the detained runoff at a 100-year release rate of 1.0 cfs, (as shown in the UDFCD Spreadsheet, UD-Detention_V3.07). The calculated detention volume (including WQ) is 0.081 acre-ft at the 100-yr water surface elevation. All calculations can be found in the Appendix section of this report.

Section 5 – Design and Placement of Construction BMP's

Temporary Erosion and Sediment Control:
All erosion and sediment control measures shall be governed by the requirements of the Town of Parker. A combination of silt fence, temporary conveyance swales, slope protection, rock socks, constructions fences, and temporary sediment pond will be implemented to prevent offsite discharge of sediment. An engineered temporary erosion and sedimentation control plan was prepared to direct the contractor in complying with these requirements.

Temporary swales will be installed along the property lines at certain locations to prevent sediment laden storm water from discharging offsite. Temporary slope protection will be installed along permanent slopes equal to 3:1 horizontal to vertical. Slope protection may include surface roughening, temporary erosion control blankets or other approved equivalent.

A construction entrance will be installed at the proposed entrance. This construction entrance will be relocated as necessary to accommodate the proposed site improvements.

Permanent Erosion and Sediment Control:
Permanent erosion and sediment control will be provided onsite to minimize long term erosion impacts and minimize the amount of sediment that discharges offsite. All areas of the natural ground surface which are not covered in impervious surfaces will be resurfaced with landscaping or native vegetation. The owner will maintain the grounds to ensure there are no areas of erosion.

References

- *Town of Parker, "Storm Drainage and Environmental Criteria Manual", Revised February 2014.*
- *Urban Drainage & Flood Control District Drainage Criteria Manual*
- *FEMA Flood Insurance Rate Map, Community Panel #*08035C0182G*; March 16, 2016.*
- *USDA Natural Resources Conservation Service Web Soil Survey (WSS) aka NRCS Soils Map*
- *Survey prepared by PLS Group., dated 1/15/2019*
- *Final Drainage Report for Horseshoe Ridge Subdivision by Tetra Tech, Dated September 2005 and Revised date of January 17, 2006*

Appendix

Appendix A – FIRM Floodplain Panel

Appendix B – Vicinity Map

Appendix C – NRCS Soils Data

Appendix D – Criteria

Appendix E – Calculations

Appendix F – Detention Pond Volumes

Appendix G – Basin Map/Grading & Drainage Plan

Appendix A – FIRM Floodplain Panel

Site Location

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 shown on 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 Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

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 Floodway Data table shown on this FIRM.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM 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. 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, Maryland 20910-3282
(301) 713-3242

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 by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2010.

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 **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

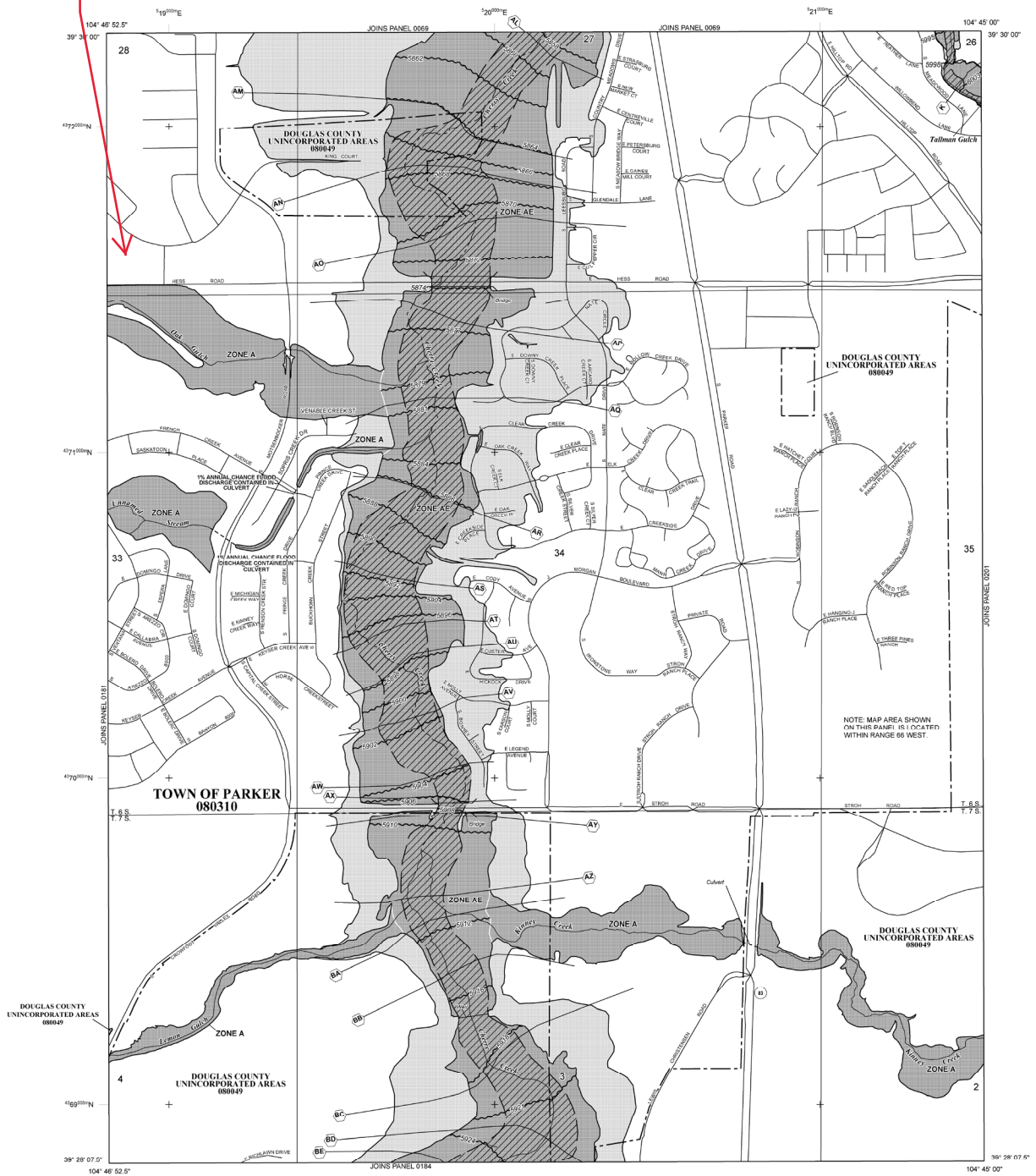
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

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.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

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



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 Areas 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.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and 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

A — A — Cross section line
23 — 23 — Transect line
45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4439000mN — 1000-meter Universal Transverse Mercator grid values, zone 13
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

SEPTEMBER 30, 2000

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

MARCH 16, 2016: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to update map format, to add roads and road names, to reflect updated topographic information, 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" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0182G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 182 OF 495

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

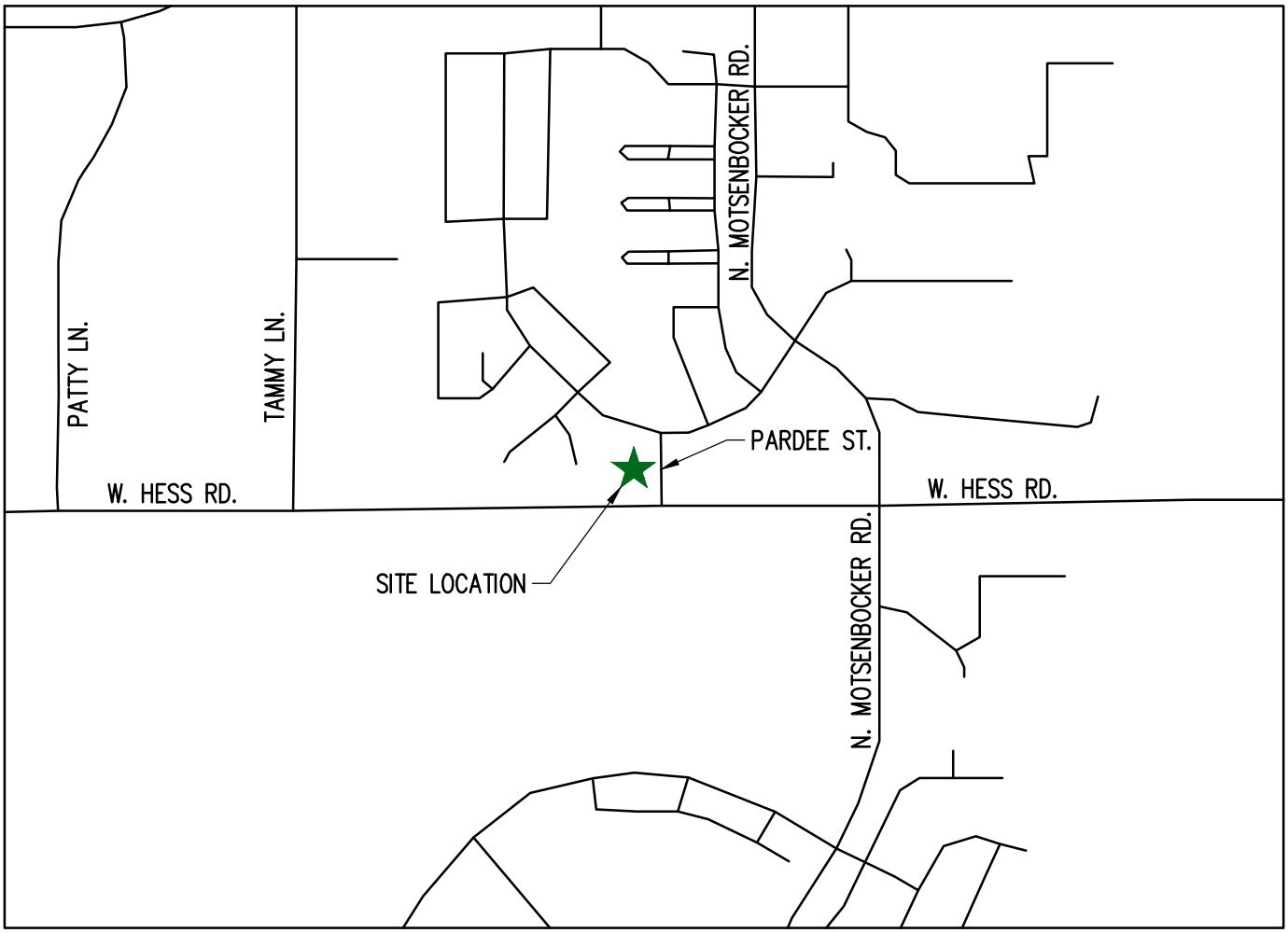
COMMUNITY	NUMBER	PANEL	SUFFIX
DOUGLAS COUNTY	080049	0182	G
PARKER, TOWN OF	080310	0182	G

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
08035C0182G
MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

Appendix B – Vicinity Map

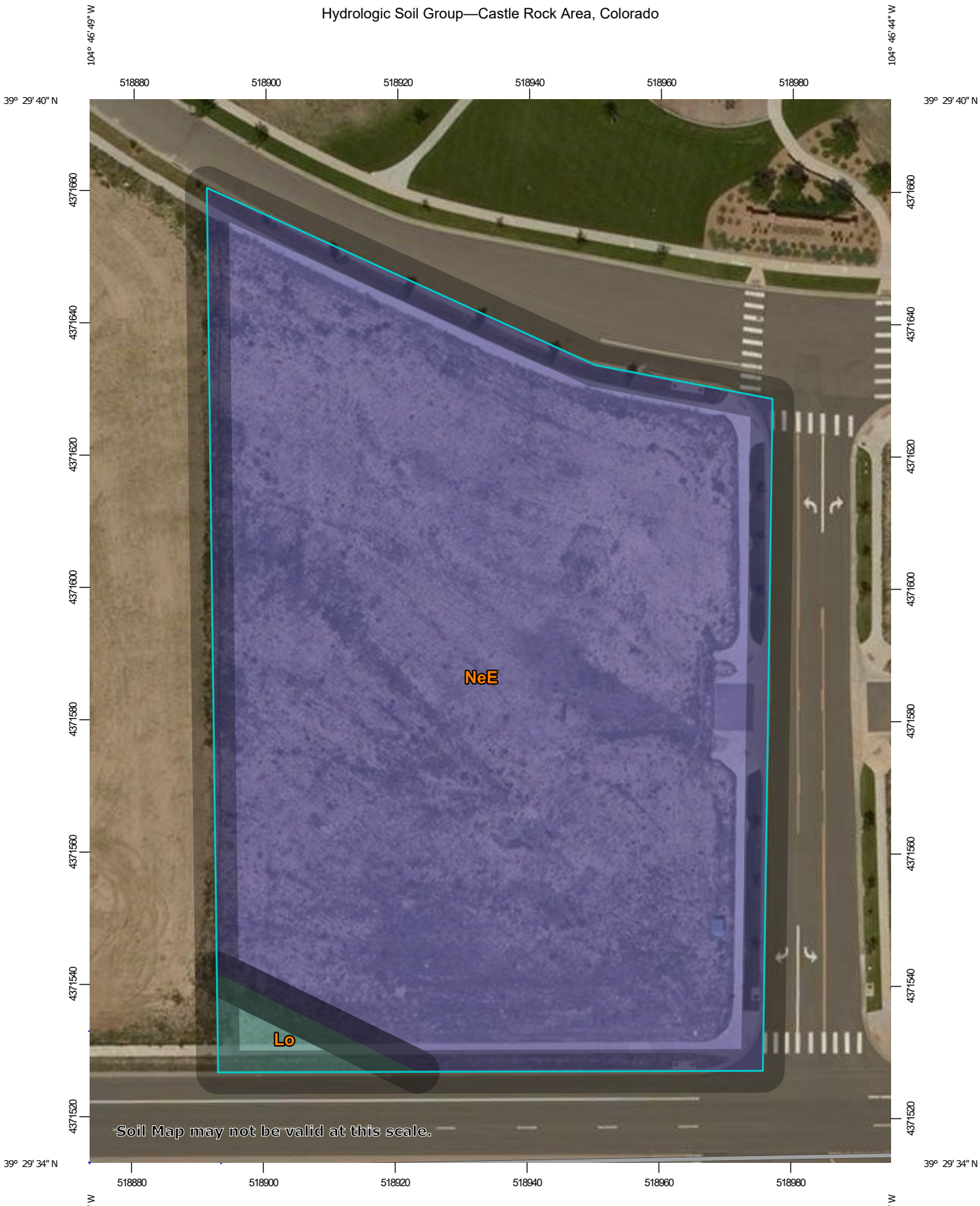


SCALE 1:1000

NORTH

VICINITY MAP

Appendix C – NRCS Soils Data



Map Scale: 1:783 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 35 70 140 210

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 1:20,000.

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: Castle Rock Area, Colorado
Survey Area Data: Version 11, Sep 10, 2018

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

Date(s) aerial images were photographed: Jun 10, 2014—Aug 21, 2014

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
Lo	Loamy alluvial land	C	0.1	2.3%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	B	2.3	97.7%
Totals for Area of Interest			**2.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix D – Criteria

UDFCD Intensity-Duration Calculations:

Equation 5-1

I = (28.5*P1) / ((10+Tc)^0.786)

Where: I = rainfall intensity (inches per hour)
P1 = 1-hour point rainfall depth (inches)
Tc= Time of Concentration (minutes)

Duration	P1	5	10	15	20	25	30	Tc	Rainfall
2-year	0.99	3.36	2.68	2.25	1.95	1.73	1.55		Enter Td
5-year	1.39	4.71	3.76	3.16	2.73	2.42	2.18		Enter Td
10-year	1.64	5.56	4.44	3.72	3.23	2.86	2.57		Enter Td
100-year	2.6	8.82	7.03	5.90	5.11	4.53	4.08		Enter Td

Notes:
Visit NOAA Atlas 14 to obtain 1-hour point rainfall depths (P1)
https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

5. HYDROLOGIC CRITERIA

5.1 INTRODUCTION

This section presents the criteria and methodology for determining storm runoff design peaks and volumes to be used in the Town of Parker for preparation of storm drainage plans and facility design. In general, hydrologic analysis of the initial and major storm events for both the historic and fully developed site conditions is required. In addition to the hydrologic analysis for a site, a hydrologic analysis should be performed for all off site basins that impact the proposed site. The Town of Parker adopts procedures prescribed by the Urban Drainage and Flood Control District (UDFCD) for performing hydrologic analysis. These procedures may be found in the Rainfall and Runoff sections of the MANUAL. Standards and technical criteria found in the MANUAL should be followed except where superseded by specific requirements of this manual.

5.2 DESIGN RAINFALL

For any storm runoff technique, design rainfall must first be established. The design rainfall data to be used for the Town of Parker were obtained from NOAA Atlas 2, Precipitation– Frequency Atlas of the Western United States, Volume III– Colorado. The design storm events developed and utilized are the same as those used by UDFCD.

The one-hour point rainfall depths for different frequency events are shown in Table 5.1 herein. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where, I = rainfall intensity (in/hr)
P_1 = one-hour point rainfall depth (in)
t_c = time of concentration (min)

Graphical presentation of the equation is shown as the Time-Intensity-Frequency curves in Figure 5.1 herein. Rainfall intensity for use in the Rational Method may be taken from Figure 5.1 or calculated using the equation.

TABLE 5.1
ONE-HOUR POINT RAINFALL

Frequency of Design Event (yr)	One-hour Point Rainfall, P_1 (in)
2	0.99
5	1.39
10	1.64
25	1.98
50	2.31
100	2.60

5.3 FLOOD HYDROLOGY OVERVIEW

Various methods exist to determine appropriate flood peaks or hydrographs for storm drainage planning and design. Methods for determining flood peaks or hydrographs are the Rational Method, the Colorado Urban Hydrograph Procedure (CUHP), and Urban Drainage Stormwater Management (UDSWM) model. The Town of Parker discourages the use of computer models other than CUHP and UDSWM since these programs are preferred, if not required, by UDFCD for studies involving major drainageways where UDFCD approval is sought or where maintenance eligibility is requested.

The three methods are briefly described in this section, and a discussion of their applicability to the Town of Parker is discussed. UDSWM is mostly used to combine and route the hydrographs generated using CUHP.

In general, the Rational Method is the most widely used and accepted technique for determining peak flows in urban areas for small basins. Within the constraints outlined in the MANUAL, use of the Rational Method provides a relatively simple but effective way to analyze storm runoff.

CUHP is somewhat more complicated than the Rational Method. It allows a manual computation of a runoff hydrograph which may be used for further hydraulic routing through channels and/or detention ponds. Historically, CUHP is best used in urban areas for which runoff coefficients have been derived. However, recent improvements by UDFCD include consideration for different soil types, thus CUHP is now more applicable to rural areas. The reader is referred to UDFCD for the latest version of CUHP.

UDSWM is a computer model that generates runoff hydrographs and routes and combines these hydrographs. UDSWM is a modified version of the Runoff Block of the Environmental Protection Agency's Storm Water Management Model (SWMM). It has been modified to be used in conjunction with CUHP. Table 5.2 herein provides guidance on selecting the appropriate method for a given project.

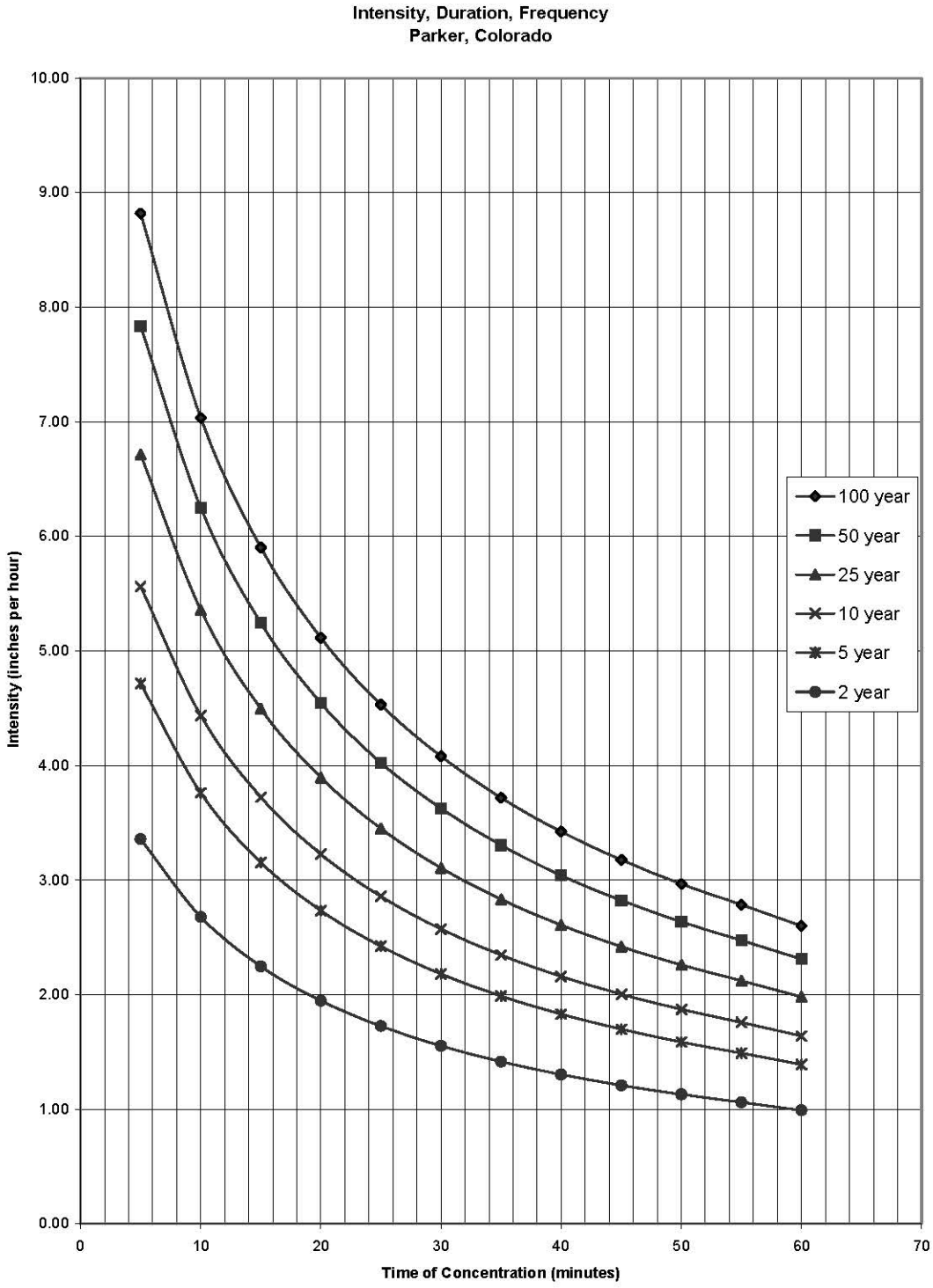


FIGURE 5.1
RAINFALL INTENSITY VERSUS DURATION CURVES FOR PARKER, COLORADO

Appendix E – Calculations

Weighted Runoff Coefficients - Existing Conditions

Project - Lot 2 Retail

Job Number: 18-075-001

Calculated By: BSA
Checked By: MRB
Date: 5/28/2019

Proposed/ Existing	IMP%
Roof	90
Concrete Drive/Walk	90
Landscaping	2
Multi-family (attached)	75
Gravel	40
Commercial	95
Undeveloped Historical	2

Soil Types: Loamy Alluvial Land
Newlin Gravelly Sandy loam, 8 to 30 percent slopes

Hydrologic Grouping: Type B and Type C

Runoff Coefficients: C = Kc
Kc(2year) = 0.84i^1.169
Kc(5year) =0.86i^1.088
Kc(10year) = 0.81i+.057
Kc(100year) = 0.47i+0.426

Existing Subbasins | **Land Use (Acres)** | **Weighted Runoff Coefficient**

Subbasin	Total Area	Roof	Concrete Drive/Walk	Landscape Native Grass	Undeveloped Historical	Gravel	Commercial	C2	C5	C10	C100	%Imp
1.00	0.846	0.000	0.007	0.000	0.946	0.000	0.000	0.01	0.02	0.08	0.44	3.0

TOTAL AREA: 0.846 ACRES
TOTAL IMPERVIOUS: 2.98 percent

STANDARD FORM SF-2
TIME OF CONCENTRATION - TOTAL BASIN
SUBDIVISION: LOT 1 - TLE
CALCULATED BY: BSA DATE: 5/28/2019

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)			FINAL t_c	REMARKS
DESIG:	C10	AREA Ac	LENGTH Ft	SLOPE %	t_i Min	LENGTH Ft	SLOPE %	VEL. FPS	t_t Min	COMP. t_c	TOT. LENGTH Ft	tc=(L/180)+10 Min	Min	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
1.00	0.08	0.85	25	5.6	5.2	240	5.3	1.5	2.7	7.8	265	11.5	7.8	

CALCULATED BY : BSA
DATE: 5/28/2019 **REV:**
CHECKED BY: MRB

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO: 18-066-001
PROJECT: LOT 1 - TLE
DESIGN STORM: 5-YEAR
TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ (C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1.00			0.85	0.02	7.8	0.02	4.12	0.1													

CALCULATED BY : BSA
DATE: 5/28/2019 **REV:**
CHECKED BY: MRB

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO: 18-066-001
PROJECT: LOT 1 - TLE
DESIGN STORM: 10-YEAR
TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ (C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1.00			0.85	0.08	7.8	0.07	4.86	0.3													

CALCULATED BY : BSA
DATE: 5/28/2019 **REV:**
CHECKED BY: MRB

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO: 18-066-001
PROJECT: LOT 1 - TLE
DESIGN STORM: 100-YEAR
TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ (C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1.00			0.85	0.44	7.8	0.37	7.71	2.9													

Weighted Runoff Coefficients - Developed Condition

Project - Lot 2 Retail

Job Number: 18-075-001

Calculated By: BSA
Checked By: MRB
Date: 10/29/2019

Proposed/ Existing	IMP%
Roof	90
Concrete Drive/Walk	90
Landscaping	2
Multi-family (attached)	75
Gravel	40
Commercial	95
Undeveloped Historical	2

Soil Types: Loamy Alluvial Land
Newlin Gravelly Sandy loam, 8 to 30 percent slopes

Hydrologic Grouping: Type B

Runoff Coefficients: C = Kc
Kc(2year) = 0.84i^1.169
Kc(5year) =0.86i^1.088
Kc(10year) = 0.81i+.057
Kc(100year) = 0.47i+0.426

Proposed Basins (proposed conditions) **Land Use (Acres)** **Weighted Runoff Coefficient**

Subbasin	Total Area	Roof	Concrete Drive/Walk	Landscape Native Grass	Undeveloped Historical	Gravel	Commercial	C2	C5	C10	C100	%Imp
1.00	0.792	0.108	0.341	0.343	0.000	0.000	0.000	0.39	0.42	0.48	0.67	51.9
OS1	0.160	0.000	0.148	0.012	0.000	0.000	0.000	0.68	0.71	0.73	0.82	83.4

TOTAL AREA: 0.952 ACRES
TOTAL IMPERVIOUS: 57.18 percent

STANDARD FORM SF-2

TIME OF CONCENTRATION - TOTAL BASIN

SUBDIVISION: LOT 1 - TLE

CALCULATED BY: BSA DATE: 10/29/2019

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)			FINAL t_c	REMARKS
DESIG:	C10	AREA Ac	LENGTH Ft	SLOPE %	t_i Min	LENGTH Ft	SLOPE %	VEL. FPS	t_t Min	COMP. t_c	TOT. LENGTH Ft	tc=(L/180)+10 Min	Min	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
1.00	0.48	0.79	30	2.0	4.9	270	1.0	1.5	3.0	7.9	300	11.7	7.9	
OS1	0.73	0.16	30	2.0	2.9	90	1.5	1.5	1.0	3.9	120	10.7	5.0	

CALCULATED BY : BSA
DATE: 10/29/2019 **REV:**
CHECKED BY: MRB

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO: 18-066-001
PROJECT: LOT 1 - TLE
DESIGN STORM: 5-YEAR
TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ (C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1.00			0.79	0.42	7.9	0.33	4.1	1.4													
OS1			0.16	0.71	5.0	0.11	3.36	0.4													

CALCULATED BY : BSA
DATE: 10/29/2019 **REV:**
CHECKED BY: MRB

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO: 18-066-001
PROJECT: LOT 1 - TLE
DESIGN STORM: 10-YEAR
TOTAL BASIN

SUBBASIN	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ (C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1.00			0.79	0.48	7.9	0.38	4.84	1.8													
OS1			0.16	0.73	5.0	0.12	4.71	0.6													

CALCULATED BY : BSA
DATE: 10/29/2019 **REV:**
CHECKED BY: MRB

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO: 18-066-001
PROJECT: LOT 1 - TLE
DESIGN STORM: 100-YEAR

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			TOTAL BASIN
SUBBASIN	DESIGN POINT	AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ (C * A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	REMARKS
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1.00			0.79	0.67	7.9	0.53	7.67	4.1													
OS1			0.16	0.82	5.0	0.13	8.82	1.2													

100-YEAR

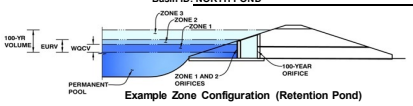
Appendix F – Detention Pond Volumes

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: TLE Parker

Basin ID: NORTH POND



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	0.79	acres	
Watershed Length =	300	ft	
Watershed Slope =	0.025	ft/ft	
Watershed Imperviousness =	51.90%	percent	
Percentage Hydrologic Soil Group A =	0.0%	percent	
Percentage Hydrologic Soil Group B =	97.7%	percent	
Percentage Hydrologic Soil Groups C/D =	2.3%	percent	
Desired WQCV Drain Time =	40.0	hours	
Location for 1-hr Rainfall Depths =	Parker - Town Hall		
Water Quality Capture Volume (WQCV) =	0.014	acre-feet	
Excess Urban Runoff Volume (EURV) =	0.044	acre-feet	
2-yr Runoff Volume (P1 = 0.99 in.) =	0.030	acre-feet	
5-yr Runoff Volume (P1 = 1.39 in.) =	0.045	acre-feet	
10-yr Runoff Volume (P1 = 1.64 in.) =	0.061	acre-feet	
25-yr Runoff Volume (P1 = 1.98 in.) =	0.089	acre-feet	
50-yr Runoff Volume (P1 = 2.31 in.) =	0.110	acre-feet	
100-yr Runoff Volume (P1 = 2.6 in.) =	0.134	acre-feet	
500-yr Runoff Volume (P1 = 3.08 in.) =	0.173	acre-feet	
Approximate 2-yr Detention Volume =	0.028	acre-feet	
Approximate 5-yr Detention Volume =	0.042	acre-feet	
Approximate 10-yr Detention Volume =	0.056	acre-feet	
Approximate 25-yr Detention Volume =	0.065	acre-feet	
Approximate 50-yr Detention Volume =	0.070	acre-feet	
Approximate 100-yr Detention Volume =	0.078	acre-feet	

Optional User Override 1-hr Precipitation

0.99	inches
1.39	inches
1.64	inches
1.98	inches
2.31	inches
2.60	inches
	inches

Stage-Storage Calculation

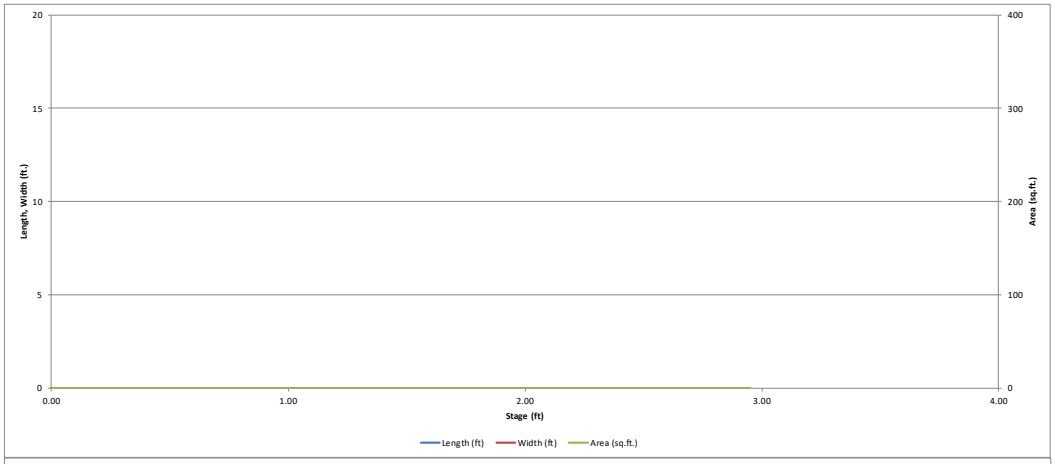
Zone 1 Volume (WQCV) =	0.014	acre-feet
Zone 2 Volume (10-year - Zone 1) =	0.042	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.022	acre-feet
Total Detention Basin Volume =	0.078	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

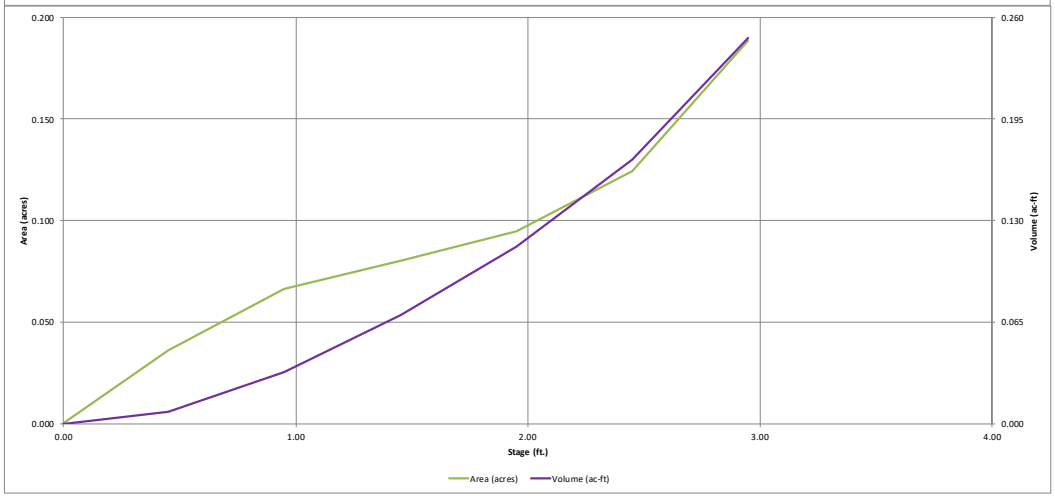
Depth Increment = 0.5 ft

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	--	--	--	16	0.000		
4988	--	0.45	--	--	--	1,568	0.036	341	0.008
4988.5	--	0.95	--	--	--	2,882	0.066	1,440	0.033
4989	--	1.45	--	--	--	3,495	0.080	3,028	0.070
4989.5	--	1.95	--	--	--	4,114	0.094	4,924	0.113
4990	--	2.45	--	--	--	5,414	0.124	7,347	0.169
4990.5	--	2.95	--	--	--	8,213	0.189	10,754	0.247

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



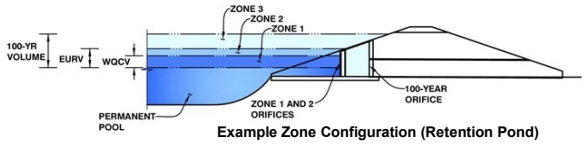


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.60	0.014	Orifice Plate
Zone 2 (10-year)	1.27	0.042	Rectangular Orifice
Zone 3 (100-year)	1.55	0.022	Weir&Pipe (Circular)
		0.078	Total

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	0.60	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.22	sq. inches (diameter = 1/2 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.528E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
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							
Orifice Area (sq. inches)	0.22							

	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 Rectangular	Not Selected	
Invert of Vertical Orifice =	0.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	1.30	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	0.50	N/A	inches
Vertical Orifice Width =	0.50		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.00	N/A	ft^2
Vertical Orifice Centroid =	0.02	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.30	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.30	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	69.97	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	11.54	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.77	N/A	ft^2

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

	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	5.50	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected	
Outlet Orifice Area =	0.16	N/A	ft^2
Outlet Orifice Centroid =	0.23	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =		feet
Spillway End Slopes =		H:V
Freeboard above Max Water Surface =		feet

Calculated Parameters for Spillway

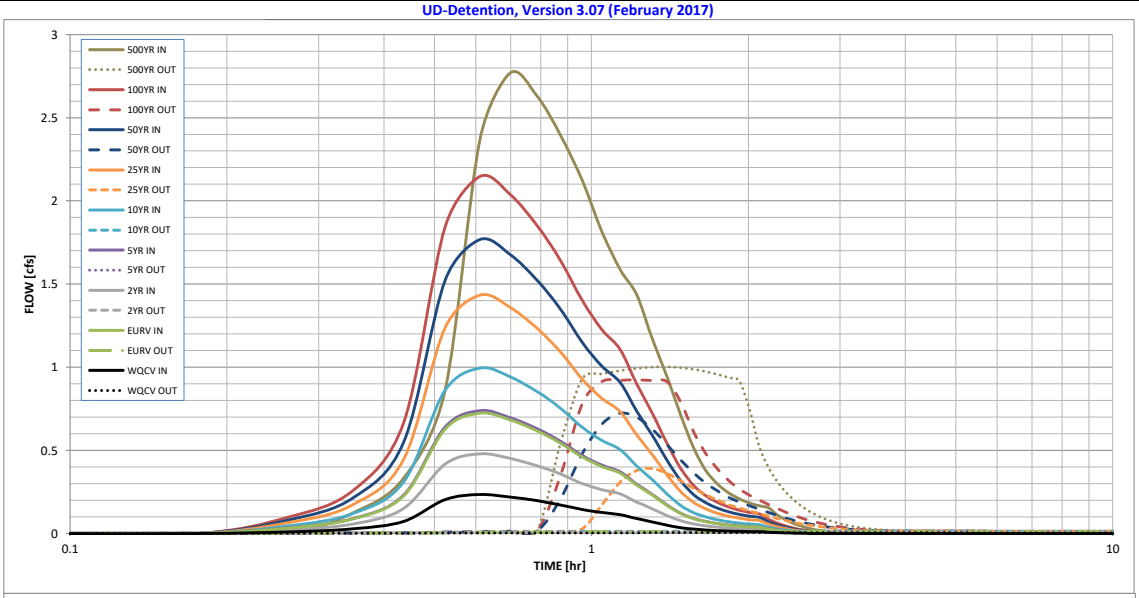
Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres

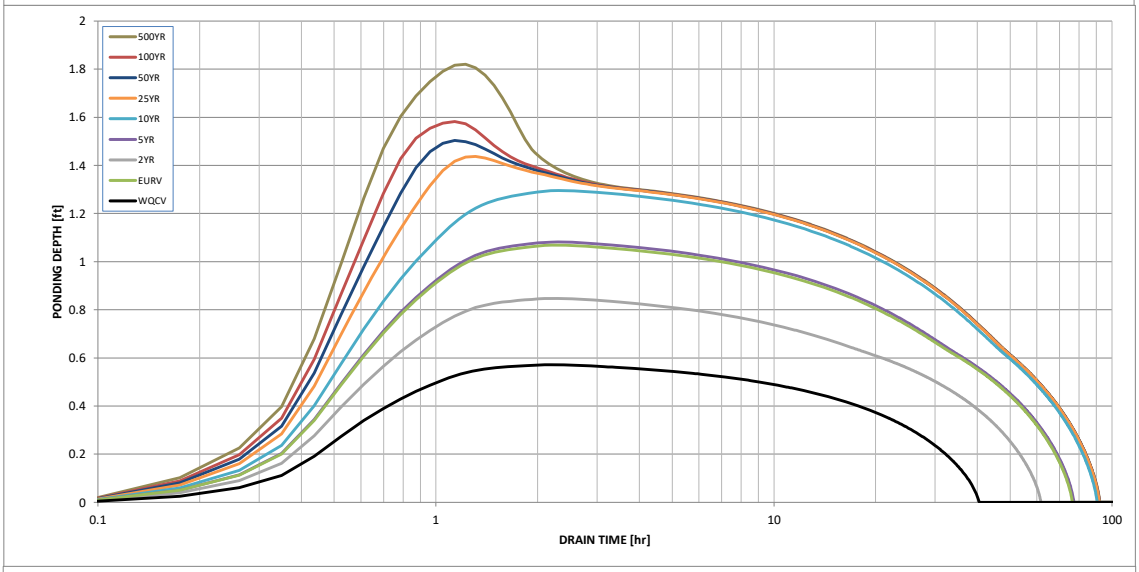
Routed Hydrograph Results

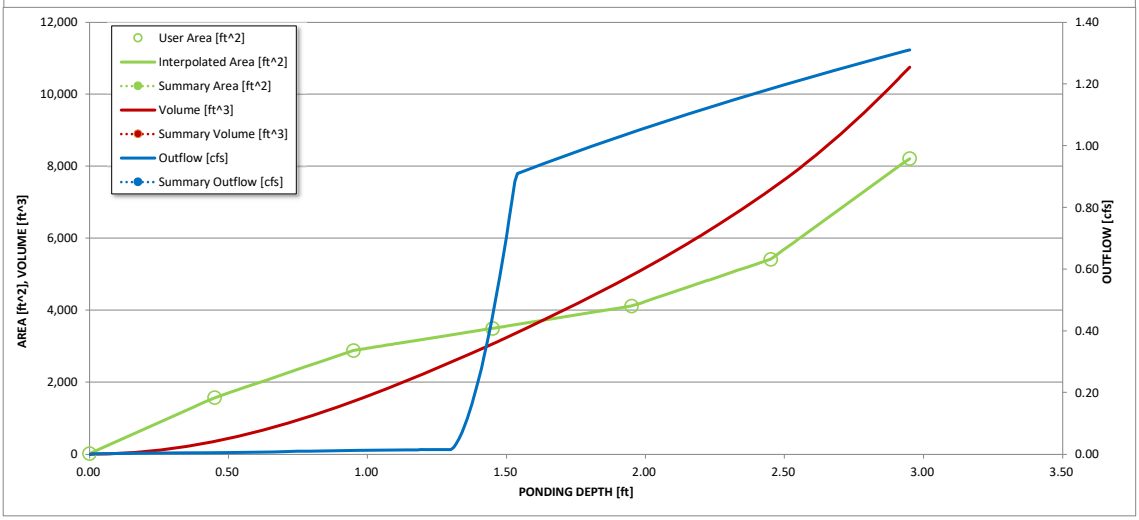
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.99	1.39	1.64	1.98	2.31	2.60	3.08
Calculated Runoff Volume (acre-ft) =	0.014	0.044	0.030	0.045	0.061	0.089	0.110	0.134	0.173
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.014	0.044	0.029	0.045	0.061	0.088	0.109	0.133	0.172
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.18	0.62	0.89	1.21	1.70
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.5	0.7	1.0	1.3
Peak Inflow Q (cfs) =	0.2	0.7	0.5	0.7	1.0	1.4	1.8	2.1	2.8
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.4	0.7	0.9	1.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.11	0.8	1.0	1.0	0.7
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1	0.1
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	69	57	70	82	80	78	76	73
Time to Drain 99% of Inflow Volume (hours) =	39	73	59	74	87	87	86	85	84
Maximum Ponding Depth (ft) =	0.57	1.07	0.85	1.08	1.30	1.44	1.50	1.58	1.82
Area at Maximum Ponding Depth (acres) =	0.04	0.07	0.06	0.07	0.08	0.08	0.08	0.08	0.09
Maximum Volume Stored (acre-ft) =	0.013	0.041	0.027	0.043	0.058	0.069	0.074	0.081	0.101

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	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]
5.24 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:15:43	0.01	0.03	0.02	0.03	0.05	0.07	0.08	0.10	0.13
0.954	0:20:58	0.03	0.09	0.06	0.09	0.12	0.17	0.22	0.26	0.34
	0:26:12	0.07	0.23	0.15	0.23	0.31	0.45	0.55	0.67	0.86
	0:31:26	0.21	0.63	0.42	0.64	0.86	1.24	1.52	1.84	2.37
	0:36:41	0.23	0.72	0.48	0.74	1.00	1.43	1.77	2.15	2.77
	0:41:55	0.22	0.68	0.45	0.70	0.94	1.36	1.68	2.04	2.63
	0:47:10	0.20	0.62	0.41	0.63	0.85	1.23	1.52	1.85	2.39
	0:52:24	0.17	0.54	0.36	0.55	0.75	1.09	1.35	1.64	2.12
	0:57:38	0.14	0.46	0.30	0.47	0.64	0.93	1.15	1.40	1.81
	1:02:53	0.13	0.40	0.26	0.41	0.56	0.81	1.01	1.23	1.59
	1:08:07	0.11	0.36	0.24	0.37	0.50	0.73	0.91	1.11	1.43
	1:13:22	0.09	0.29	0.19	0.30	0.41	0.59	0.74	0.90	1.17
	1:18:36	0.07	0.23	0.15	0.24	0.32	0.47	0.59	0.72	0.94
	1:23:50	0.05	0.17	0.11	0.17	0.24	0.35	0.44	0.54	0.71
	1:29:05	0.04	0.12	0.08	0.12	0.17	0.25	0.32	0.39	0.51
	1:34:19	0.03	0.09	0.06	0.09	0.13	0.19	0.23	0.29	0.38
	1:39:34	0.02	0.07	0.05	0.07	0.10	0.15	0.19	0.23	0.30
	1:44:48	0.02	0.06	0.04	0.06	0.08	0.12	0.15	0.19	0.25
	1:50:02	0.02	0.05	0.03	0.05	0.07	0.11	0.13	0.16	0.21
	1:55:17	0.01	0.05	0.03	0.05	0.06	0.09	0.12	0.14	0.18
	2:00:31	0.01	0.04	0.03	0.04	0.06	0.08	0.10	0.13	0.17
	2:05:46	0.01	0.04	0.03	0.04	0.05	0.08	0.10	0.12	0.16
	2:11:00	0.01	0.03	0.02	0.03	0.04	0.06	0.07	0.09	0.11
	2:16:14	0.01	0.02	0.01	0.02	0.03	0.04	0.05	0.06	0.08
	2:21:29	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06
	2:26:43	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.04
	2:31:58	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.02	0.03
	2:37:12	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.02
	2:42:26	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02
	2:47:41	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	2:52:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:58:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:03:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:08:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:13:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:24:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:34:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:16:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:48:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:09:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:14:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:19:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:24:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:51:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:56:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:01:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:06:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:12:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:17:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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'.

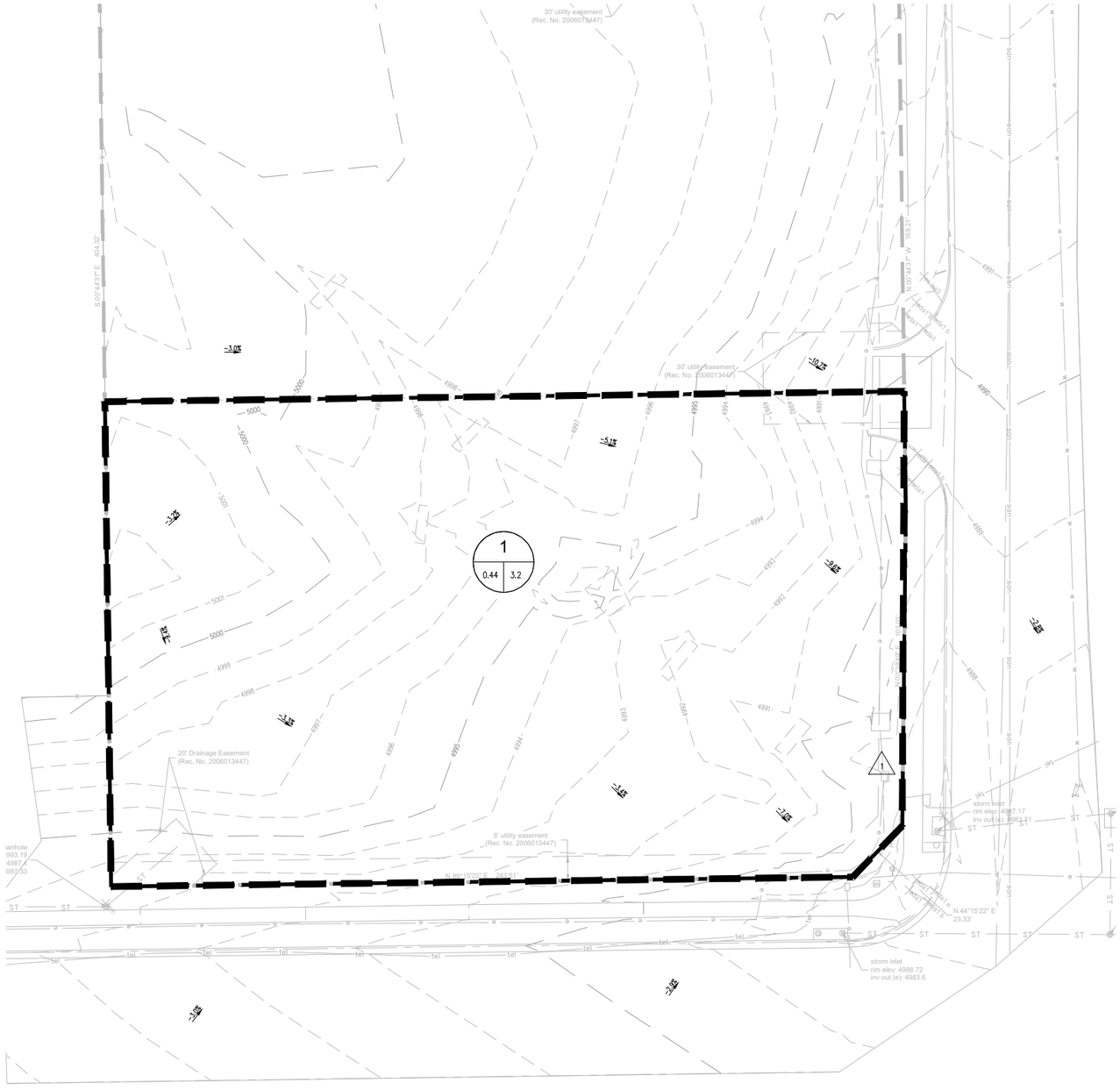
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Appendix G – Basin Map/Grading and Drainage Plan

HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT

LOT 2, BLOCK 1, HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT
A PARCEL OF LAND LOCATED IN THE SE 1/4 OF SECTION 28, TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE 6TH PRINCIPAL MERIDIAN

CONSTRUCTION DOCUMENTS



LEGEND

- 3156 — EXISTING CONTOUR
- PROPERTY LINE
- BASIN LIMITS
- # — BASIN
- X.XX — 100-YR COEF
- X.XX — 100-YR CFS
- 1 — DESIGN POINT

SUMMARY RUNOFF TABLE

SUBBASIN # / DESIGN POINT	CONTRIBUTING AREA (ACRES)	RUNOFF 10YR (CFS)	PEAK 100YR (CFS)
1	0.953	0.4	3.2

NORTH
0 10 20 40
1 inch = 20 ft.

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

The Town of Parker review constitutes general compliance with the Town's Standards and approved variances, subject to these plans being stamped, signed, and dated by the professional engineer of record. Review by the Town does not constitute approval of the plan design or accuracy and correctness of engineering calculations. Errors in the design or calculations remain the responsibility of the registered professional engineer whose stamp and signature are affixed to this document.

This review does not constitute approval of any private on-site improvements which may be shown. Construction cannot commence until all required drainage/traffic report(s), final development plan(s), special review(s), grading permit, and/or other permits are complete, approved and on file with the Town of Parker.

Town of Parker, Director of Engineering — Date

LOGO
RIDGETOP ENGINEERING & SURVEYING
541 E. Garden Drive, Unit N
Windsor, CO 80550
T (970) 663-4632
W ridgetopeng.com

SEAL

PROJECT TITLE
RETAIL

LOT 2, BLOCK 1
HORSESHOE RIDGE
PARKER, CO 80134

PREPARED FOR
BRYTAR COMPANIES

8117 PRESTON RD. #300
DALLAS, TX 75225

SUBMITTAL
CONSTRUCTION DOCS.

DRAWN BY:	BSA
CHECKED BY:	MRB
PROJECT NO.:	18-075-001

REVISIONS

DATE
5/28/2019

SHEET TITLE
EXISTING CONDITIONS BASIN MAP

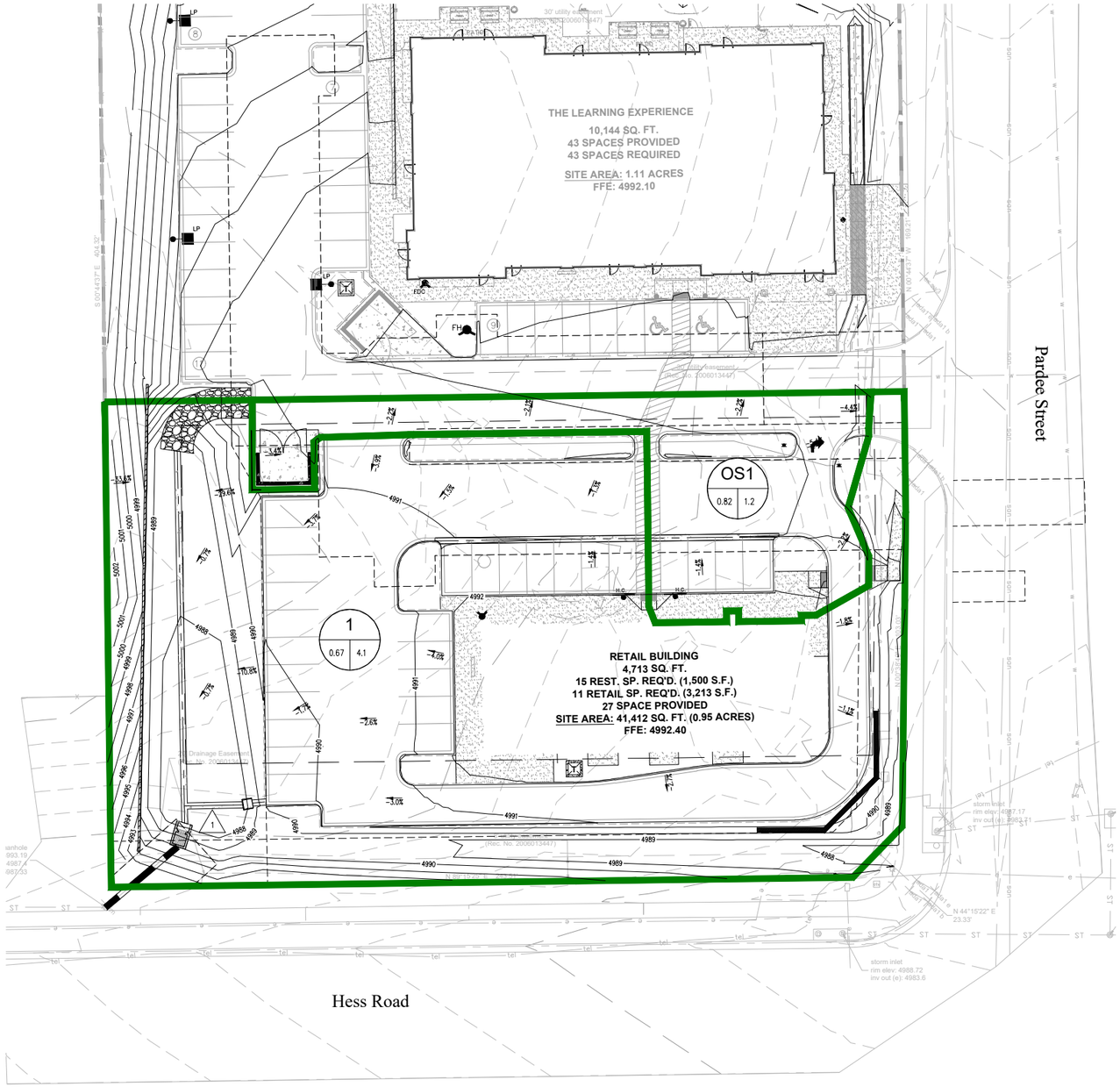
SHEET INFORMATION
BM-2.0

File: RE - BASIN MAP EX.dwg Path: P:\Colorado\Parker\Brytar\PARKER TLE - 18-075-001\2 Drawings\ Plotted by: banderson Date: 28-May-19 6:50:01am

HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT

LOT 2, BLOCK 1, HORSESHOE RIDGE SUBDIVISION 1ST AMENDMENT
A PARCEL OF LAND LOCATED IN THE SE 1/4 OF SECTION 28, TOWNSHIP 6 SOUTH, RANGE 66 WEST OF THE 6TH PRINCIPAL MERIDIAN

CONSTRUCTION DOCUMENTS



LEGEND

- 3155 — PROPOSED MAJOR CONTOUR
- 3156 — PROPOSED MINOR CONTOUR
- 3156 — EXISTING CONTOUR
- PROPERTY LINE
- BASIN LIMITS
- # — BASIN; X.XX (100-YR COEF) X.XX (100-YR CFS)
- 1 — DESIGN POINT

SUMMARY RUNOFF TABLE

SUBBASIN # / DESIGN POINT	CONTRIBUTING AREA (ACRES)	RUNOFF 10YR (CFS)	PEAK 100YR (CFS)
1	0.792	1.8	4.1
OS1	0.160	0.6	1.2

NORTH
0 10 20 40
1 inch = 20 ft.

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

The Town of Parker review constitutes general compliance with the Town's Standards and approved variances, subject to these plans being stamped, signed, and dated by the professional engineer of record. Review by the Town does not constitute approval of the plan design or accuracy and correctness of engineering calculations. Errors in the design or calculations remain the responsibility of the registered professional engineer whose stamp and signature are affixed to this document.

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DRAWN BY: BSA
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PROJECT NO.: 18-075-001

REVISIONS

2ND SUBMITTAL	10/30/2019
3RD SUBMITTAL	02/18/2020

DATE
5/28/2019

SHEET TITLE
PROPOSED BASIN MAP

SHEET INFORMATION
BM-1.0

File: RE - BASIN MAP PRO.dwg Path: P:\Colorado\Parker\Brytar\PARKER TLE - 18-075-001\2 Drawings\ Plotted by: Brad Date: 18-Feb-20 11:17:22am