Final Drainage Report

A Storage Place

December 22, 2022
(Revised --------)

Prepared for:

A Storage Place Self Storage
1960 Highway 6 & 50
Fruita, CO 81521

Prepared by:

RIVERCITY CONSULTANTS

215 Pitkin Ave, Unit 201
Grand Junction, CO 81501
Phone: (970) 241-4722
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Job No. 2056-001

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Engineer's Certification

I hereby certify that the Drainage Report for the design of **A Storage Place** was prepared by me, or under my direct supervision, in accordance with the provisions of the Stormwater Management Manual (dated June 14, 2021) for the owners thereof. I understand that the **City of Fruita** does not and will not assume liability for drainage facilities designed by others.

Craig Rothluebber, P.E.
State of Colorado Reg. No. 51352

Developer's Certification

I, _____ hereby certify that the drainage facilities for the **A Storage Place** shall be constructed according to the design presented in this report. I understand that the **City of Fruita** reviews drainage plans but cannot, on behalf of the **A Storage Place Self Storage** guarantee that the preliminary drainage design review will absolve **A Storage Place Self Storage** and/or their successors and/or assigns of future liability for improper design.

_____ **(Name of Developer)**

_____ **(Authorized Signature)**

_____ **(Date)**

I. Introduction

A. Background

The purpose of this Drainage Report is to identify pre-development and post-development drainage conditions for the proposed A Storage Place development. This report identifies the following items with respect to the site:

- existing drainage patterns and issues
- developed drainage patterns
- potential drainage issues resulting from development
- solutions to the potential drainage issues
- design of the various elements of the storm drain system for the site
- stormwater water quality requirements
- post construction BMP's

B. Project Location

The proposed project site is located along the north side of Highway 6 & 50 between 19 ½ Road and 20 Road in Fruita, Colorado. The current project address is 1960 US-6&50, Fruita, CO (Parcel No. 2697-271-02-005). In more legal terms, the project site is located in Section 22, Township 1 North, Range 2 West of the Ute Meridian, Mesa County, Colorado. Refer to **Figure 1** for the General Location Map.

Access to the site will be from Highway 6 and 50 at the existing entrance to the property. The surrounding area contains a mix of commercial and industrial land uses. The proposed project site is zoned for Commercial uses, along with the parcels located directly to the west and east of the site.

C. Project Description

The current project parcel (Parcel No. 2697-271-02-005) is approximately 5.00 acres which consists of commercial uses for a self-storage facility. A portion of this self-storage facility currently existing on the adjacent property to the east as well (Parcel No. 2697-271-02-006) and is approximately 2.24 acres. This drainage report analyses the total parcel area for these two parcels as there is an existing detention pond located on the adjacent parcel that collects stormwater runoff for both parcels. The area routed to the existing detention pond totals approximately 7.66 acres. As part of this project this detention pond will be extended and modified in order to meet the requirements of the new development.

According to the NRCS web site, the soils present at the site consist entirely of Sagers Silty Clay Loam (0-2% slopes). Sagers is classified as Hydrologic Soil Group C. Group C soils have slower infiltration rates than Groups A and B Soils. NRCS Soil information is included in Appendix A.

The proposed development is located entirely within the Hunter Wash Major Drainage Basin. Hunter Wash drains to the Colorado River approximately 0.5 miles south of the site. A graphical representation of the project boundary in relation to the major drainage

basins is provided in **Figure 2**. There are no mapped FEMA Floodplains within or adjacent to the project site. A FEMA FIRM Map for the area is available in Appendix A.

D. Previous Investigations

No previous investigations involving the project parcel are known to exist.

II. Drainage System Description

A. Existing Drainage Conditions

Existing topography at the site consistently slopes from northwest to southeast with typical grades between 0.5% and 1.5%. The existing detention pond is located in the southeast corner of the adjacent parcel that collects runoff from the project site and conveys flows offsite to the south. Proposed grading from the site will follow the existing conditions and have runoff sheet flow through the site and be collected in the driveways to be routed to the existing pond.

Runoff generated from the site discharges at the southeast corner of the parcel into an existing detention pond and is routed to the storm drain system along Highway 6 & 50. This storm drain carries flow to the south and eventually discharges into the Colorado River. Refer to **Figure 3** for a layout and of the existing sub-basins covering the proposed project site. **Table 1** provides a summary of the existing sub-basins that were analyzed for this project. It should be noted that a historic basin (EX1 Historic) was also analyzed to ensure that release rates from the pond are within the Mesa County SWMM requirements.

Table 1: Existing Sub-Basins

Sub-Basin ID	Sub-Basin Area (acres)	Imperv. (%)	Existing Sub-Basin Peak Runoff Rates (cfs)		
			2-Year	10-Year	100-Year
EX1 (Historic)	7.660	2%	0.03	0.90	6.40
EX1	7.660	47%	1.59	3.98	11.95

B. Master Drainage Plan

No “Master Drainage Plan” is known to exist for the subject property.

C. Offsite Tributary Area

Existing topography at the site slopes generally from northwest to southeast. The Independent Ranchman’s Ditch is located directly to the north of the project parcel and there is a ridge along the western property boundaries. As such, there are no offsite flows that enter the site from the north or the west. Analysis of these flows is provided in the existing and proposed conditions for the project.

D. Proposed Drainage System Description

The proposed project will include lot grading, concrete drive aisles, storage buildings, fencing, landscaping, and modification of the existing detention pond. Runoff from the developed areas will sheet flow to the concrete drive aisles. Once runoff is collected in the driveway section, runoff will concentrate and be conveyed through the site to the stormwater pond at the southeast corner of the development. Proposed grading for this project follows the existing topography of the site and is made up of one contributing basin that is tributary to the proposed detention pond. Refer to **Figure 4** for the proposed sub-basin layout and more detailed basin information. **Table 2** provides a summary of the proposed sub-basin that was analyzed for this project.

Table 2: Proposed Sub-Basins

Sub-Basin ID	Sub-Basin Area (acres)	Imperv. (%)	Proposed Sub-Basin Peak Runoff Rates (cfs)		
			2-Year	10-Year	100-Year
PR1	7.66	56%	2.02	4.73	13.13

Water quality calculations and design stage storage information for the pond are provided in Appendix B. Refer to **Figure 4** for the proposed sub-basin layout and more detailed basin information.

The proposed detention pond is a permanent stormwater solution that requires the existing pond to be enlarged and the existing outlet structure to be modified in order to treat the WQCV. The pond has been designed to hold the water quality capture volume (WQCV) and 100-year storm event for the combined two parcels that make up the A Storage Place Self Storage. The detention pond design information for this filing is shown in **Table 3**.

Table 3: Water Surface Elevation and Volume Summary

Event	WSEL	Volume (cubic ft)	Peak Q (cfs)
Top of Pond	4520.90	19,166	-
100-Year Storm	4520.80	18,165	1.60
Top of Structure	4520.00	11,369	-
Minor Storm Weir	4519.50	7,623	-
10-Year Storm	4519.47	7,318	0.09
WQCV	4519.31	6,273	0.05
Bottom of Pond	4517.70	0	-
Bottom of Structure	4517.70	-	-
Top of Pond	4520.90	19,166	-

Table 3 demonstrates that the proposed detention pond has sufficient volume to hold the WQCV, the 10-year, and 100-year design storm runoff from the developed area. The SWMM requires that the detention pond collects and holds the 100-year storm volume and releases these storms at a rate less than the historical rates.

SWMM requirements dictate that the pond must drain within 48 hours of all storm events up to and including the 100-year storm event. Pond drain time calculations are provided in Appendix C. **Table 4** provides the existing and proposed discharge rates for the development. It should be noted that the release rates from the existing pond are unknown, as there is no information available from a pervious drainage report.

Table 4: Project Discharge Rates

Design Point ID*	Design Point Condition	Design Point Location	Peak Flow at Design Point		
			2-year Storm (cfs)	10-year Storm (cfs)	100-year Storm (cfs)
EX1 (Historic)	Existing	Historic Release Rates	0.03	0.90	6.40
EX1	Existing	Pond Discharge	-	-	-
PR1	Proposed	Pond Discharge	0.05	0.09	1.60

E. Drainage Facility Maintenance

Ownership and maintenance of the proposed drainage improvements within public ROW shall be by the City of Fruita. All storm drain, the detention pond, and other drainage facilities within Property Owner's Association tracts and easements and will be owned and maintained by the Property Owner's Association.

Inspection of the drainage facility and associated BMP's shall be as per the City's stormwater pollution prevention Ordinance No. 3824 and Sections 28.16.120 and 28.64.130 of the Stormwater Management Manual (SWMM).

The developed drainage for the site has been designed to minimize maintenance. Anticipated maintenance includes periodic (1-2 times per year and as needed after major storm events) clearing of debris from v-pans, drains, and trash racks. Periodic sediment removal from the pond may also be required. The removal frequency will vary depending on the sediment removal loading through the system to the detention pond, but it is unlikely sediment removal would be required more often than once every 5 to 10 years.

III. Drainage Analysis and Design Criteria

A. Regulations

The policy, design criteria, design constraints, methods of analysis, recommendations, and conclusions presented in this report are in conformance with standard engineering practice and the Stormwater Management Manual (dated June 14, 2021).

B. Development Criteria

No drainage constraints were noted for this project.

C. Hydrologic Criteria

The hydrologic design criteria presented in this report are in conformance with standard engineering practice and the Stormwater Management Manual (dated June 14, 2021), except as noted within the report.

D. Hydraulic Criteria

The hydraulic design criteria presented in this report are in conformance with standard engineering practice and the Stormwater Management Manual (dated June 14, 2021), except as noted within the report.

E. Variance from Criteria

No variances from the SWMM are requested for this project.

F. Calculation Methodology

The Rational was used to estimate the basin runoff while the MHFD Detention Pond Design Spreadsheet was used to calculate pond sizing and outlet structure configuration. As there are no proposed storm drain system within the project site no storm drain routing was performed.

G. Calculation and Modeling Results

Analysis of the developed site drainage conditions are included in the Appendix and highlighted below.

- All design storms used for this project had a rainfall duration of 1-hour as required for Rational Method calculations. The 100-year 1-hour rainfall value used was 1.34 inches and the 10-year 1-hour rainfall value used was 0.34 inches. The 100-year and 10-year rainfall values used are the values provided in Table 28.24.040(a) of the SWMM.
- Two existing sub-basins, and one proposed sub-basin was analyzed for this project. Design storm peak flows for each of the project's sub-basins are shown on Figures 3 and 4.
- Street capacities were checked based on the 100-year 24-hour peak flow rates generated for each sub-basin and design points shown on Figure 4. There are no

issues with Street Conveyance Capacity for drive aisles, see attached driveway capacity worksheet included in Appendix G.

- Riprap protection for the slope of the pond at inflow points have been sized per the formulas in the SWMM. Calculations for the riprap sizing are included in Appendix G.

IV. Post Construction Stormwater Management

A. Stormwater Quality Control Measures

The detention pond for the project site has been designed to hold the 100-year storm event, including the WQCV, without overtopping. The detention pond will adequately drain the pond within SWMM requirements which iss below the historic release rates for all design storms.

B. Stormwater Quality Calculations

The WQCV was determined based on the percent imperviousness of the proposed development for this filing. WQCV was calculated using the MHFD Detention Pond Design Spreadsheet. WQCV calculations are provided in Appendix C of this report.

V. Conclusions

A. Compliance with Manual

The policy, design criteria, design constraints, methods of analysis, recommendations, and conclusions presented in this report are in conformance with standard engineering practice and the Stormwater Management Manual (dated Jun 14, 2021).

B. Design Effectiveness

This design will be very effective for controlling runoff from this site and will provide stormwater quality measures.

C. Areas in Flood Hazard Zone

There are no areas within the proposed project site that are classified as Flood Hazard Zones. There are no floodplains within the project area.

D. Variances from Manual

No variances from the manual are requested for this project.

VI. References

1. Stormwater Management Manual, WRC Engineering under the direction of Mesa County Colorado, June 14, 2021.

2. City of GJ GIS Website, City Map (gjcity.org)

3. Mesa County Colorado GIS Website, https://gis.mesacounty.us/ .

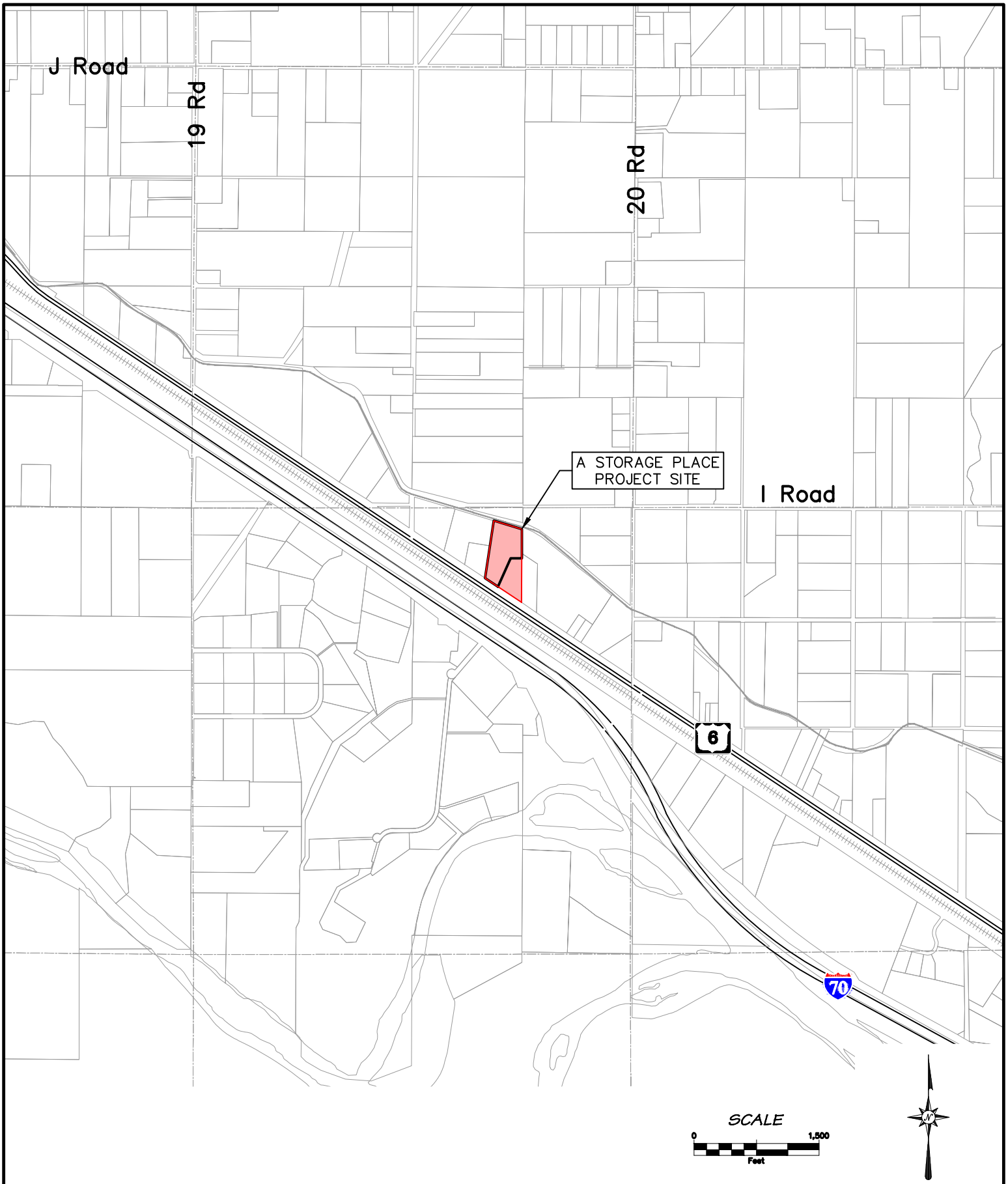
4. Natural Resources Conservation Service National Cooperative Soils Survey Website, http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx .

5. FEMA Flood Map Service Center website, https://msc.fema.gov/portal .

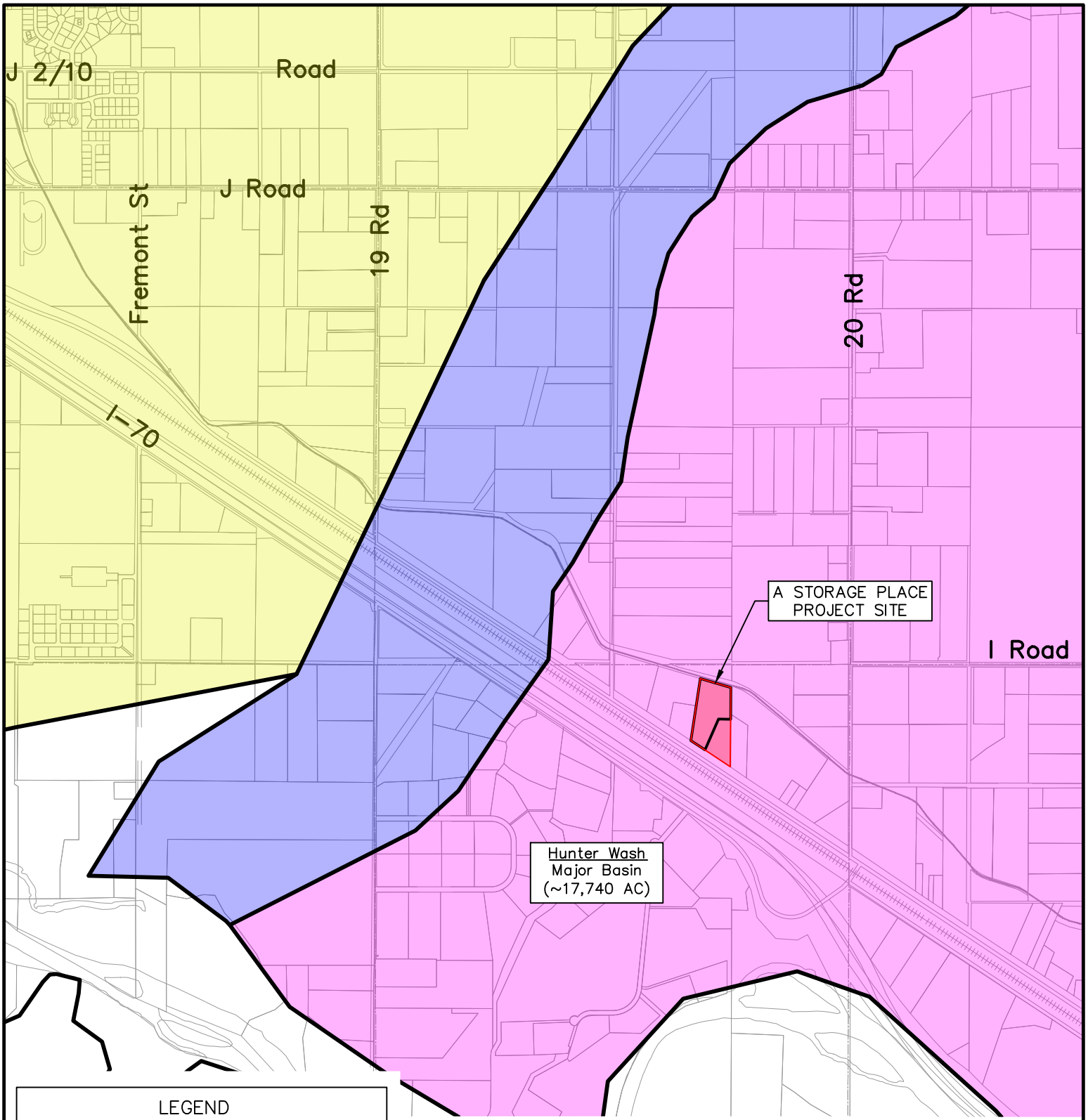
6. Drainage Criteria Manual, Urban Drainage and Flood Control District, Volumes 1, 2, & 3; Denver, Colorado 2001.

FIGURES

1. General Location Map
2. Major Basin & Floodplain Map
3. Existing Drainage Map
4. Developed Drainage Plan



A Storage Place	Figure 1	RIVER CITY CONSULTANTS
GENERAL LOCATION MAP		
DATE: 22.Dec.2022		



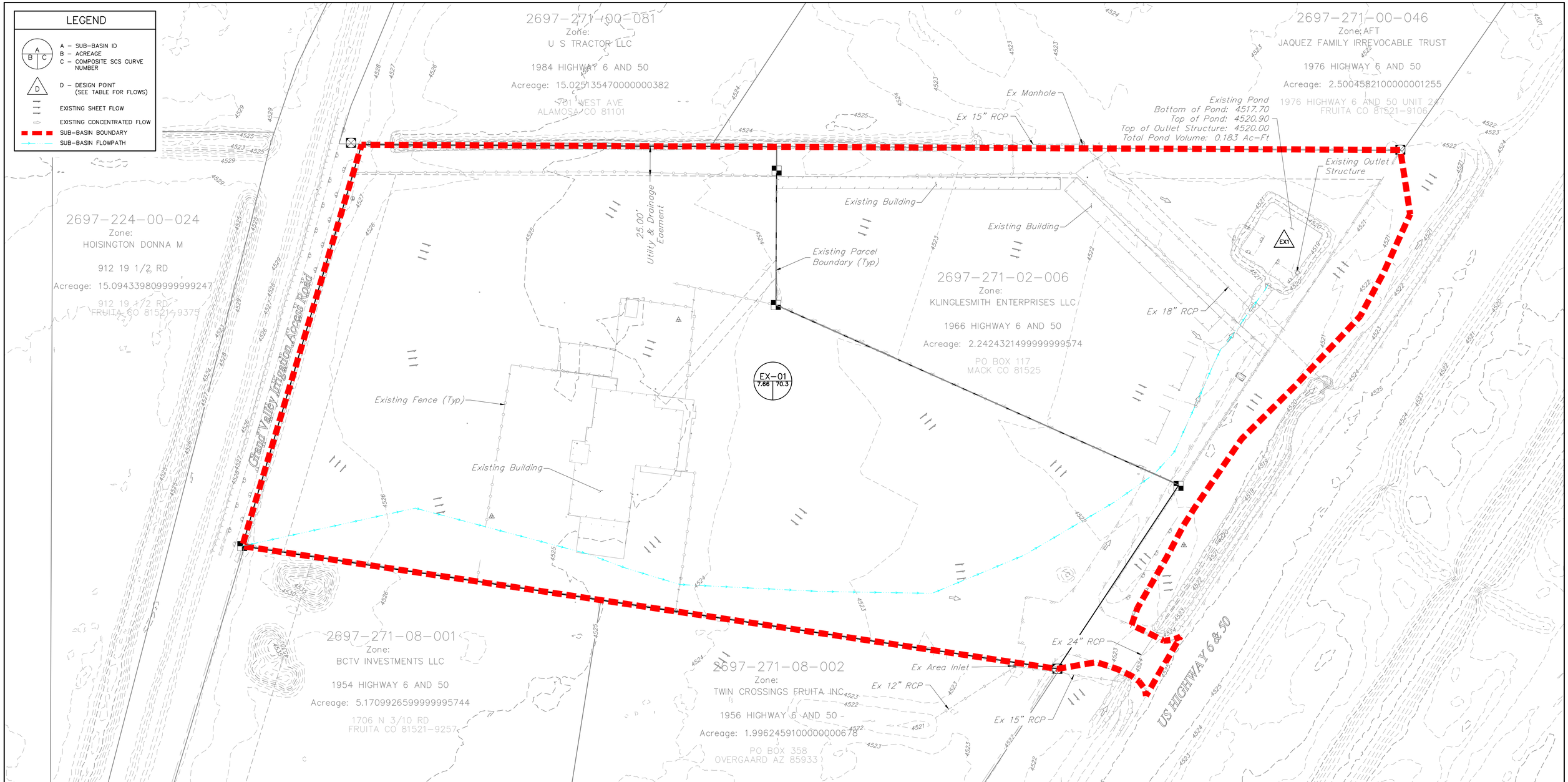
A Storage Place

MAJOR BASIN & FLOODPLAIN MAP

DATE: 22.Dec.2022

Figure 2

RIVER CITY CONSULTANTS



EXISTING DESIGN POINT TABLE

Design Point ID	Design Point Location	Peak Flow at Design Point		
		2-year Storm (cfs)	10-year Storm (cfs)	100-year Storm (cfs)
EX-1 (Historic)	Project Outall	0.03	0.90	6.40
EX-1	Project Outall	-	-	-

*Note: EX-1 Outfall Flows from the existing pond are unknown as there is no existing drainage report for the site.

EXISTING SUB-BASIN TABLE

Sub-Basin ID	Sub-Basin Area	Impervious Percent	Proposed Sub-Basin Peak Runoff Rates (cfs)		
			2-Year	10-Year	100-Year
EX1 (Historic)	7.660	2%	0.03	0.90	6.40
EX1	7.660	47%	1.59	3.98	11.95

NOTE:
1. EXISTING PARCELS, UTILITIES, AND SURFACE CONTOURS ARE TAKEN FROM MESA COUNTY GIS. THESE ITEMS ARE APPROXIMATE AND FOR INFORMATIONAL PURPOSES ONLY.
2. PERMISSION TO REPRODUCE THESE PLANS IS HEREBY GIVEN TO MESA COUNTY FOR COUNTY PURPOSES ASSOCIATED WITH NEW PLAN REVIEW, APPROVAL, PERMITTING, INSPECTION AND CONSTRUCTION OF WORK.

UNCC UTILITY NOTIFICATION CENTER OF COLORADO 800.922.1987 www.uncc.org Know what's below. Call before you dig. 811
CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

Project Benchmark
LS 16413 1.25" PLASTIC CAP
NE 1/4
SECTION 27
NORTHING: 59653.59
EASTING: 56154.54
ELEVATION: 4520.68
DATUM SOURCE: MCLCS Zone "GVA" (NAVD 88)

SCALE (FEET)
0 40 80
HORIZONTAL
VERTICAL: n/a
CONTOUR INTERVAL: 1 FT

PROJECT PHASE: Preliminary/Review
DATE ISSUED: 22.DEC.2022

NO.	DATE	REVISION	BY

S:\PROJECTS\2056 A Storage Place\001 1960 Hwy 6 & 50\Design\Drainage\01-DWG\2056-001 Fig 3 & 4.dwg [Figure 3] 12/22/2022 9:54:45 AM

COLORADO REGISTERED JAMES D. GESSLER 36518 PROFESSIONAL ENGINEER PRELIMINARY NOT FOR CONSTRUCTION

RIVER CITY CONSULTANTS
215 Pitkin Avenue, Unit 201
Grand Junction, CO 81501
Phone: 970.241.4722
www.rccwest.com
Fax: 970.241.8841

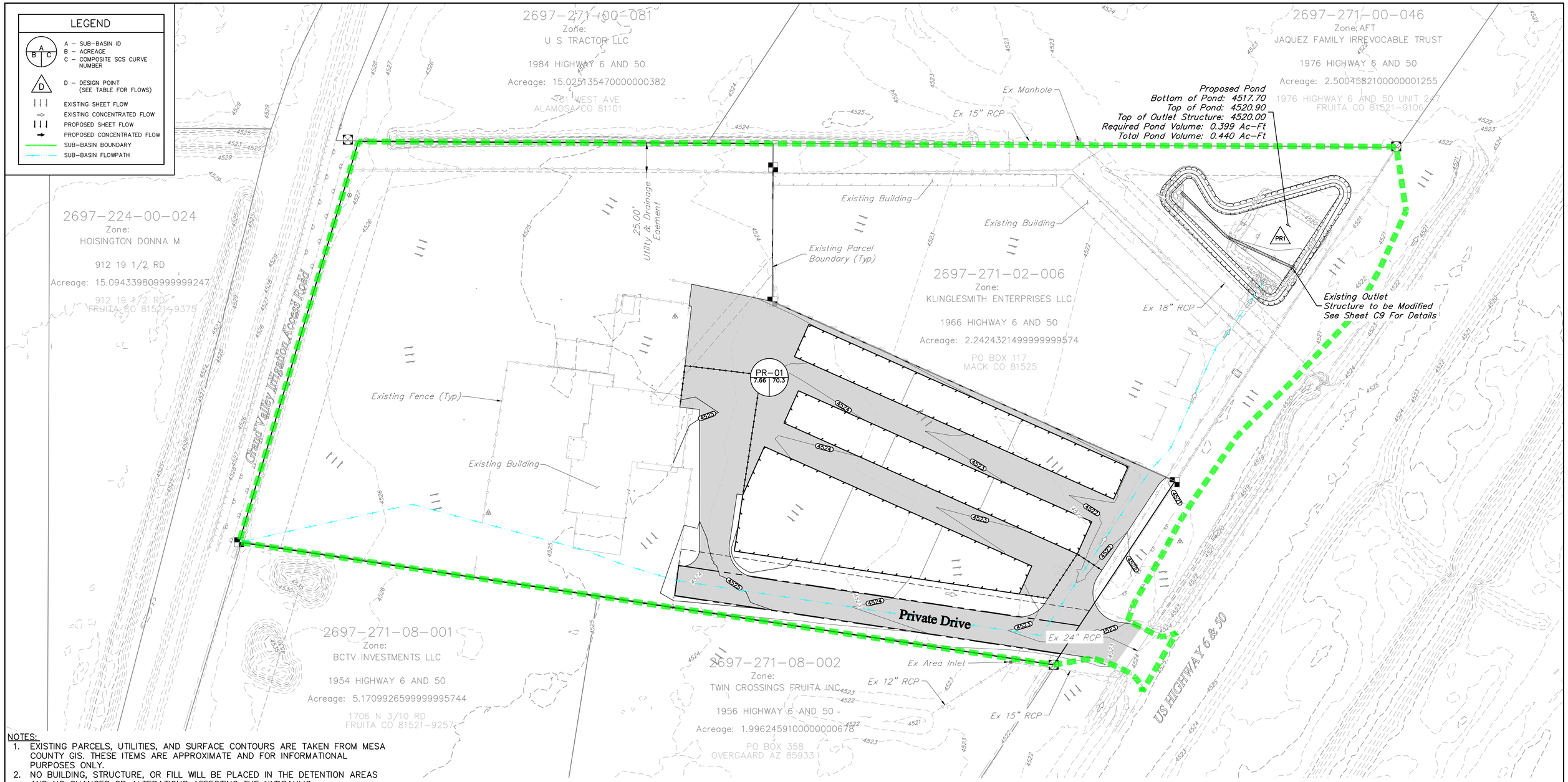
DRAWN BY: ctr | PROJECT: 2056-001
CHECKED BY: idg
ORIGINAL SHEET SIZE: 22 x 34

A Storage Place Self Storage

A Storage Place

Drainage Plans
Existing Drainage Map

Fig 3



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2. NO BUILDING, STRUCTURE, OR FILL WILL BE PLACED IN THE DETENTION AREAS AND NO CHANGES OR ALTERATIONS AFFECTING THE HYDRAULIC CHARACTERISTICS OF THE DETENTION AREAS WILL BE MADE WITHOUT THE APPROVAL OF THE COUNTY.
3. MAINTENANCE AND OPERATION OF THE DETENTION AND WATER QUALITY AREAS ARE THE RESPONSIBILITY OF PROPERTY OWNER. IF OWNER FAILS IN THIS RESPONSIBILITY, THE COUNTY HAS THE RIGHT TO ENTER THE PROPERTY, MAINTAIN THE DETENTION AREAS, AND BE REIMBURSED FOR COSTS INCURRED.
4. DETENTION POND VOLUMES, ALL DRAINAGE APPURTENANCES, AND BASIN BOUNDARIES SHALL BE VERIFIED. AS-BUILT DRAWINGS SHALL BE PREPARED BY A REGISTERED PROFESSIONAL ENGINEER PRIOR TO ISSUANCE OF CERTIFICATE OF OCCUPANCY FOR ANY STRUCTURE WITHIN THE DEVELOPMENT.
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HORIZONTAL
VERTICAL: n/a
CONTOUR INTERVAL: 1 FT

PROJECT PHASE: Preliminary/Review DATE ISSUED: 22.DEC.2022

NO.	DATE	REVISION	BY

S:\PROJECTS\2056 A Storage Place\001 1960 Hwy 6 & 50\Design\Drainage\01-DWG\2056-001 Fig 3 & 4.dwg [Figure 4] 12/22/2022 9:53:08 AM

COLORADO REGISTERED PROFESSIONAL ENGINEER PATRICK T. NEWBY 38518 PRELIMINARY NOT FOR CONSTRUCTION

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DRAWN BY: ctr PROJECT: 2056-001
CHECKED BY: idq
ORIGINAL SHEET SIZE: 22 x 34

A Storage Place Self Storage

A Storage Place

Drainage Plans
Proposed Drainage Map

Fig 4

APPENDIX A

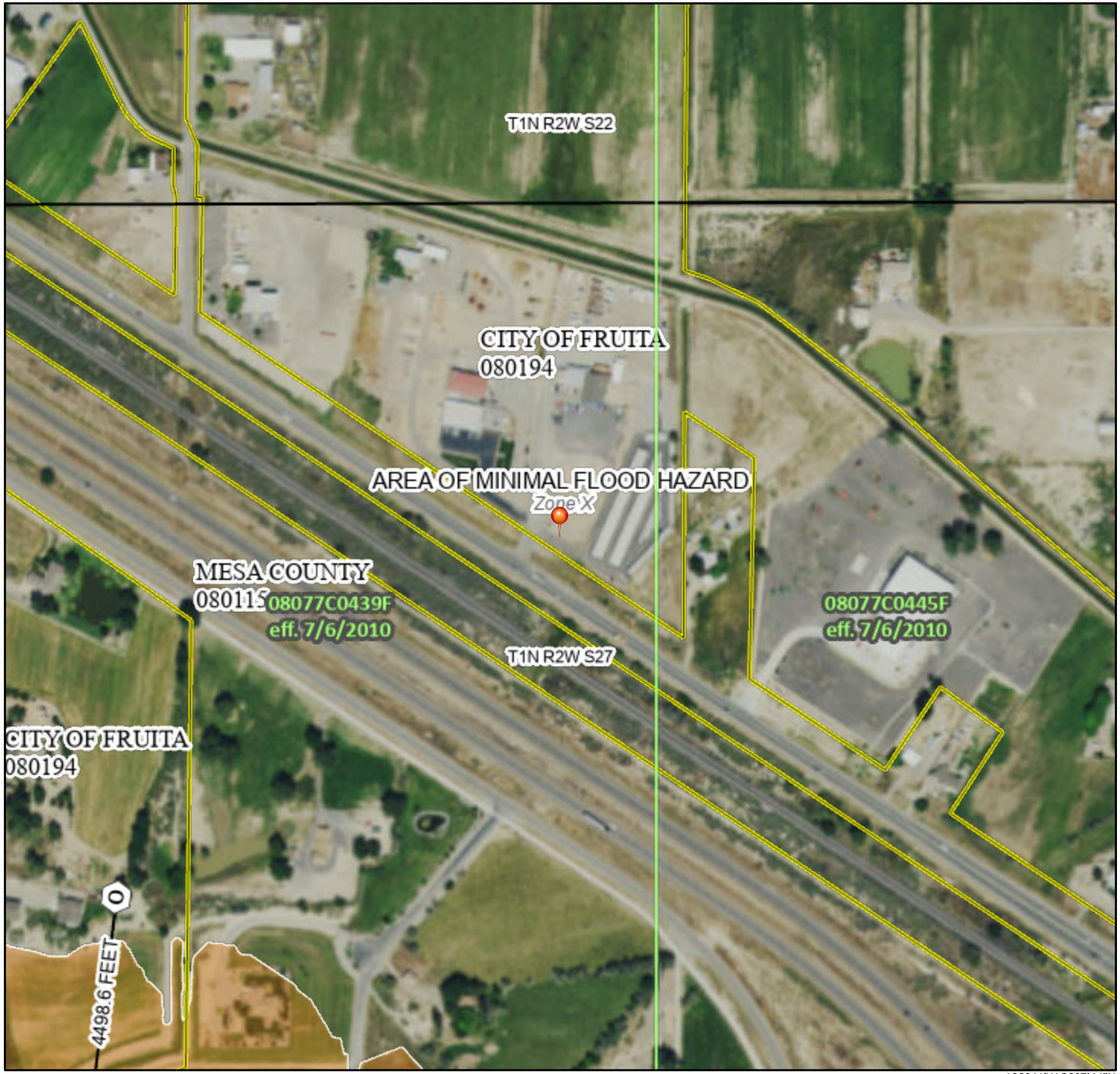
Project Site Information

1. **FEMA Firm Panel**
2. **NRCS Web Soil Survey & K Factor Whole Soil**

National Flood Hazard Layer FIRMette

FEMA

108°41'37"W 39°8'12"N



108°41'W 39°7'44"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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
- 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 12/21/2022 at 2:10 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Hydrologic Soil Group—Mesa County Area, Colorado
(A Storage Place)

Map Scale: 1:1,760 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N 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: Mesa County Area, Colorado
Survey Area Data: Version 13, Sep 6, 2022

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

Date(s) aerial images were photographed: Jun 24, 2020—Jul 8, 2020

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
BcS	Sagers silty clay loam, saline, 0 to 2 percent slopes	C	7.7	100.0%
Totals for Area of Interest			**7.7**	**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

K Factor, Whole Soil—Mesa County Area, Colorado
(A Storage Place)

Map Scale: 1:1,760 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

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

Soils

Soil Rating Polygons
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Lines
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Points
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- 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: Mesa County Area, Colorado
Survey Area Data: Version 13, Sep 6, 2022

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

Date(s) aerial images were photographed: Jun 24, 2020—Jul 8, 2020

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.

K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BcS	Sagers silty clay loam, saline, 0 to 2 percent slopes	.43	7.7	100.0%
Totals for Area of Interest			**7.7**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Factor K does not apply to organic horizons and is not reported for those layers.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

APPENDIX B

Hydrology Calculations

1. **Rainfall Duration Curve, Composite Impervious, Time of Concentration, Rational Method Runoff Calculations**

RIVERCITY CONSULTANTS

PROJECT: A Storage Place
JOB NO.: 2056-001
CALC. BY: CTR
DATE: 12/20/2022

= FORMULA CELLS
= USER INPUT CELLS

Project Location
Grand Valley Area

IDF Rainfall Data

T_d	P_1: 1-hour Rainfall Depths (inches)	
	Minor Storm	**Major Storm**
	2-Year	100-Year
Minutes	**0.34**	**1.34**
5	1.15	4.55
10	0.92	3.63
20	0.67	2.64
30	0.53	2.10
40	0.45	1.76
50	0.39	1.53
60	0.34	1.35
120	0.21	0.83

Equation 5-1 $I=(28.5*P_1)/(10+T_d)^{\wedge 0.786}$

I = rainfall intensity (inches per hour)

P_1 = 1-hour point rainfall depth (inches)

T_d = storm duration (minutes)

Reference:

1) Urban Drainage and Flood Control District - Urban Storm Drainage Criteria Manual Volume 1, 2017
2) NOAA Atlas 14, Volume 8, Version 2
http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=co

PROJECT: A Storage Place
JOB NO.: 2056-001
CALC. BY: CTR
DATE:

Impervious Percentages - from Urban Drainage Table 6-3

Asphalt	100%
Concrete	90%
Roofs	90%
Gravel	40%

Lawns	2%
Land Use 6	0%
Land Use 7	0%
Land Use 8	0%

SOIL TYPE: C or D (use equation from Table 6-4)

= FORMULA CELLS
= USER INPUT CELLS

COMPOSITE IMPERVIOUSNESS

		Weighted Impervious and C Values					Areas (ac)							
Basin	**Area (ac)**	**Imp.**	**C_2**	**C_5**	**C_{10}**	**C_{100}**	**Asphalt**	**Concrete**	**Roofs**	**Gravel**	**Lawns**	**Land Use 6**	**Land Use 7**	**Land Use 8**
EX1 (Historic)	7.66	2.0%	0.01	0.05	0.15	0.49	0.00	0.00	0.00	0.00	7.66			
EX1	7.66	46.8%	0.35	0.42	0.48	0.68	0.98	0.00	0.88	4.47	1.33			
PR1	7.66	56%	0.43	0.49	0.55	0.71	0.82	1.05	1.61	2.64	1.54			

RIVERCITY CONSULTANTS

Calculated By: CTR
Date: 1/0/1900

STANDARD FORM SF-2

TIME OF CONCENTRATION SUMMARY

Project: A Storage Place
Job No.: 2056-001
Checked By: xxxxxxxxx

SUB-BASIN DATA				INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)					t_c CHECK (URBANIZED BASINS)				FINAL t_c	REMARKS
Basin	i	C_5	AREA	LENGTH	SLOPE	t_i	LENGTH	Cv	SLOPE	VEL.	t_t	COMP.	TOT. LENGTH	S_o	tc (Equation 6-5)		
			Ac	Ft	%	Min	Ft		%	FPS	Min	t_c	Ft	%	Min	Min	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	
EX1 (Historic)	0.02	0.05	7.66	300	1.5	28.69	716	10	0.8	0.9	13.8	42.5	1,016	0.97	44.2	42.5	
EX1	0.47	0.42	7.66	300	1.5	18.63	716	20	0.8	1.7	6.9	25.5	1,016	0.97	29.1	25.5	
PR1	0.56	0.49	7.66	300	1.5	16.55	754	20	0.8	1.7	7.3	23.8	1,054	0.96	27.1	23.8	

Equation 6-3 $t_i=((0.395(1.1-C_5)SQRT(L))/(S_o\text{^}0.33))$
Equation 6-5 $t_c=(26-17i)+(L_t/(60(14i+9)SQRT(S_o)))$

= FORMULA CELLS
= USER INPUT CELLS

NRCS Conveyance Factor K Table - Cv Value	
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

Calculated By: CTR
Date: 1/0/1900
Checked By: xxxxxxxxx
2-Year 1-hour rainfall= 0.34

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Project: A Storage Place
Job No.: 2056-001
Design Storm: 2-Year

= FORMULA CELLS
= USER INPUT CELLS

BASIN	DIRECT RUNOFF								TOTAL RUNOFF				STREET		PIPE						REMARKS
	DESIGN POINT	AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I (IN/HR)	Q (CFS)	t_c (MIN)	S (C * A) (CA)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW	DESIGN FLOW (CFS)	SLOPE (%)	PIPE DIAM. (IN.)	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)
EX1 (Historic)			7.66	0.01	42.5	0.08	0.43	**0.03**													Pre-Development Flow
EX1	EX-1		7.66	0.35	25.5	2.71	0.59	**1.59**													Existing Development Flow
PR1	PR-1		7.66	0.43	23.8	3.32	0.61	**2.02**													Post Development Flow

Calculated By: CTR
Date: 1/0/1900
Checked By: xxxxxxxxxx
10-Year 1-hour rainfall= 0.63

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Project: A Storage Place
Job No.: 2056-001
Design Storm: 10-Year

= FORMULA CELLS
= USER INPUT CELLS

BASIN	DIRECT RUNOFF								TOTAL RUNOFF				STREET		PIPE						REMARKS
	DESIGN POINT	AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I (IN/HR)	Q (CFS)	t_c (MIN)	S (C * A) (CA)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW	DESIGN FLOW (CFS)	SLOPE (%)	PIPE DIAM. (IN.)	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)
EX1 (Historic)			7.66	0.15	42.5	1.12	0.80	**0.90**													Pre-Development Flow
EX1	EX-1		7.66	0.48	25.5	3.67	1.09	**3.98**													Existing Development Flow
PR1	PR-1		7.66	0.55	23.8	4.19	1.13	**4.73**													Post Development Flow

Calculated By: CTR
Date: 1/0/1900
Checked By: xxxxxxxxxx
100-Year 1-hour rainfall= 1.34

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Project: A Storage Place
Job No.: 2056-001
Design Storm: 100-Year

= FORMULA CELLS
= USER INPUT CELLS

BASIN	DIRECT RUNOFF								TOTAL RUNOFF				STREET		PIPE						REMARKS
	DESIGN POINT	AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A (AC)	I (IN/HR)	Q (CFS)	t_c (MIN)	S (C * A) (CA)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW	DESIGN FLOW (CFS)	SLOPE (%)	PIPE DIAM. (IN.)	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)
EX1 (Historic)			7.66	0.49	42.5	3.77	1.70	**6.40**													Pre-Development Flow
EX1	EX-1		7.66	0.68	25.5	5.18	2.31	**11.95**													Existing Development Flow
PR1	PR-1		7.66	0.71	23.8	5.47	2.40	**13.13**													Post Development Flow

APPENDIX C

Detention Pond Calculations

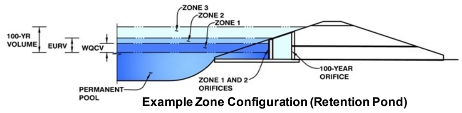
1. **Mile High Flood District (MHFD) Detention Basin Design Spreadsheet**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: 2056-001 - A Storage Place

Basin ID: A Storage Place Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	7.66	acres		
Watershed Length =	750	ft		
Watershed Length to Centroid =	350	ft		
Watershed Slope =	0.008	ft/ft		
Watershed Imperviousness =	56.10%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	100.0%	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) =	0.143	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.410	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.34 in.) =	0.085	acre-feet	0.34	inches
5-yr Runoff Volume (P1 = 0.49 in.) =	0.136	acre-feet	0.49	inches
10-yr Runoff Volume (P1 = 0.63 in.) =	0.183	acre-feet	0.63	inches
25-yr Runoff Volume (P1 = 0.85 in.) =	0.279	acre-feet	0.85	inches
50-yr Runoff Volume (P1 = 1.07 in.) =	0.398	acre-feet	1.07	inches
100-yr Runoff Volume (P1 = 1.34 in.) =	0.577	acre-feet	1.34	inches
500-yr Runoff Volume (P1 = 1.59 in.) =	0.733	acre-feet	1.59	inches
Approximate 2-yr Detention Volume =	0.104	acre-feet		
Approximate 5-yr Detention Volume =	0.173	acre-feet		
Approximate 10-yr Detention Volume =	0.218	acre-feet		
Approximate 25-yr Detention Volume =	0.276	acre-feet		
Approximate 50-yr Detention Volume =	0.319	acre-feet		
Approximate 100-yr Detention Volume =	0.399	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.143	acre-feet
Zone 2 Volume (10-year - Zone 1) =	0.075	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.181	acre-feet
Total Detention Basin Volume =	0.399	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)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.10	--	--	--	89	0.002	4	0.000
	--	0.20	--	--	--	354	0.008	27	0.001
	--	0.30	--	--	--	797	0.018	84	0.002
	--	0.40	--	--	--	1,382	0.032	193	0.004
	--	0.50	--	--	--	2,080	0.048	366	0.008
	--	0.60	--	--	--	2,886	0.066	614	0.014
	--	0.70	--	--	--	3,737	0.086	946	0.022
	--	0.80	--	--	--	4,468	0.103	1,311	0.030
	--	0.90	--	--	--	5,042	0.116	1,781	0.041
	--	1.00	--	--	--	5,539	0.127	2,305	0.053
	--	1.10	--	--	--	5,962	0.137	2,876	0.066
	--	1.20	--	--	--	6,284	0.144	3,548	0.081
	--	1.30	--	--	--	6,527	0.150	4,188	0.096
	--	1.40	--	--	--	6,659	0.153	4,848	0.111
	--	1.50	--	--	--	6,793	0.156	5,520	0.127
	--	1.60	--	--	--	6,926	0.159	6,206	0.142
	--	1.70	--	--	--	7,060	0.162	6,905	0.159
	--	1.80	--	--	--	7,194	0.165	7,618	0.175
	--	1.90	--	--	--	7,329	0.168	8,344	0.192
	--	2.00	--	--	--	7,464	0.171	9,084	0.209
	--	2.10	--	--	--	7,600	0.174	9,837	0.226
	--	2.20	--	--	--	7,736	0.178	10,604	0.243
	--	2.30	--	--	--	7,872	0.181	11,384	0.261
	--	2.40	--	--	--	8,009	0.184	12,178	0.280
	--	2.50	--	--	--	8,146	0.187	12,986	0.298
	--	2.60	--	--	--	8,284	0.190	13,808	0.317
	--	2.70	--	--	--	8,458	0.194	14,645	0.336
	--	2.80	--	--	--	8,630	0.198	15,499	0.356
	--	2.90	--	--	--	8,823	0.203	16,372	0.376
	--	3.00	--	--	--	9,007	0.207	17,263	0.396
	--	3.10	--	--	--	9,352	0.215	18,181	0.417
	--	3.20	--	--	--	9,993	0.229	19,149	0.440
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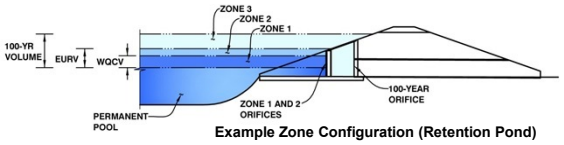
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: 2056-001 - A Storage Place

Basin ID: A Storage Place Pond



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.61	0.143	Orifice Plate
Zone 2 (10-year)	2.06	0.075	Circular Orifice
Zone 3 (100-year)	3.02	0.181	Weir&Pipe (Restrict)
Total (all zones)		0.399	

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	ft²
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 =	5.208E-03	ft²
Depth at top of Zone using Orifice Plate =	1.61	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	6.40	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.75	sq. inches (diameter = 15/16 inch)	Elliptical Slot Area =	N/A	ft²

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	0.54	1.07					
Orifice Area (sq. inches)	0.75	0.75	0.75					

	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 =	1.61	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A	ft²
Depth at top of Zone using Vertical Orifice =	2.06	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.04	N/A	feet
Vertical Orifice Diameter =	0.94	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 =	1.80	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.80	N/A	feet
Overflow Weir Front Edge Length =	2.50	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 =	20.14	N/A	
Horiz. Length of Weir Sides =	2.00	N/A	feet	Overflow Grate Open Area w/o Debris =	3.96	N/A	ft²
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	3.96	N/A	ft²
Debris Clogging % =	0%	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 =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.20	N/A	ft²
Outlet Pipe Diameter =	6.00	N/A	inches	Outlet Orifice Centroid =	0.25	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

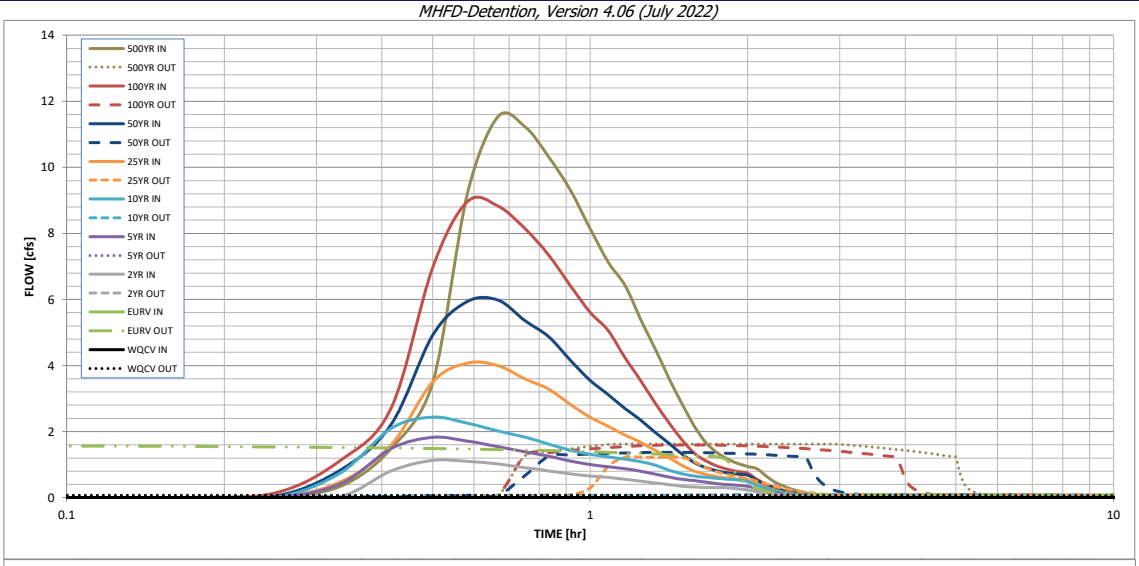
Routed Hydrograph Results

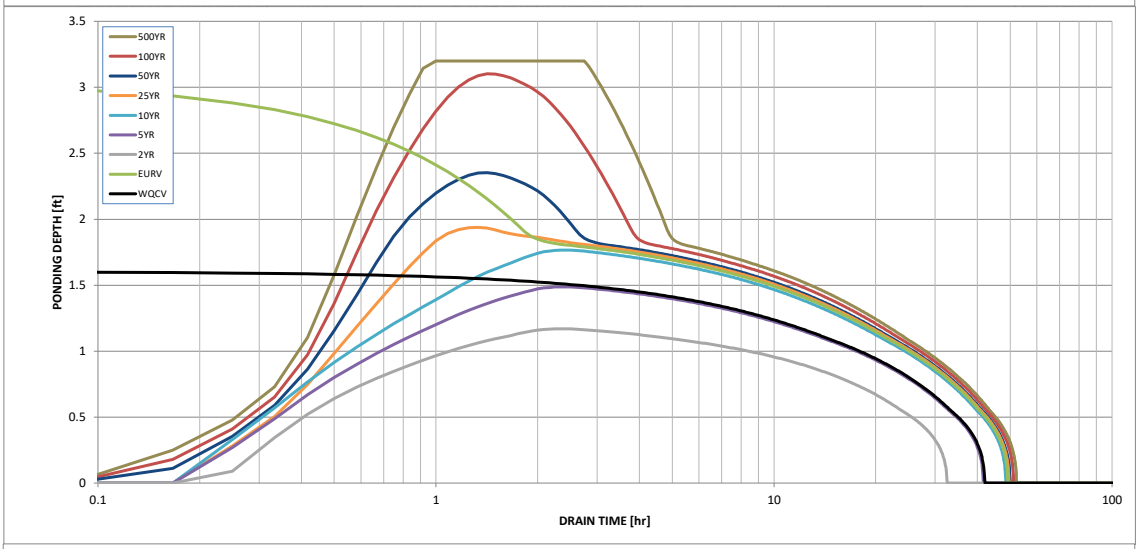
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

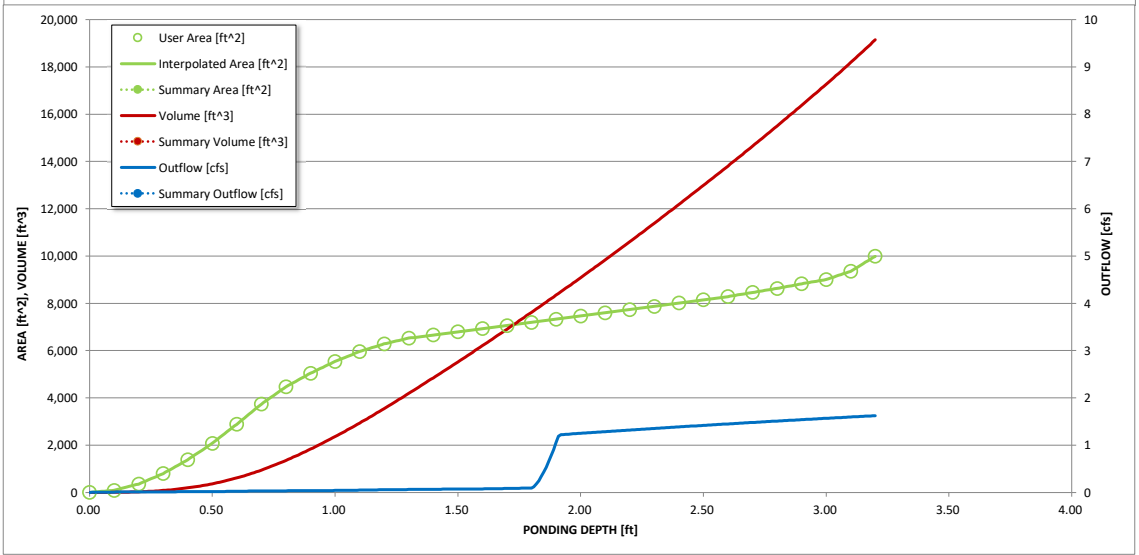
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.34	0.49	0.63	0.85	1.07	1.34	1.59
CUHP Runoff Volume (acre-ft) =	0.143	0.410	0.085	0.136	0.183	0.279	0.398	0.577	0.733
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.085	0.136	0.183	0.279	0.398	0.577	0.733
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.00	0.00	0.02	0.09	1.05	2.89	4.40
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.0	0.0	0.0	0.0	0.1	0.4	0.6
Peak Inflow Q (cfs) =	N/A	N/A	1.1	1.8	2.4	4.1	6.0	9.0	11.5
Peak Outflow Q (cfs) =	0.1	1.6	0.05	0.07	0.09	1.23	1.37	1.60	1.62
Structure Controlling Flow =	Plate	Outlet Plate 1	Plate	Plate	Vertical Orifice 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	0.36	N/A	N/A	N/A	0.3	0.3	0.4	0.4
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	40	30	38	44	43	41	40	39
Time to Drain 99% of Inflow Volume (hours) =	**40**	45	32	40	47	47	46	46	46
Maximum Ponding Depth (ft) =	1.61	3.07	1.17	1.49	1.77	1.94	2.35	3.10	3.20
Area at Maximum Ponding Depth (acres) =	0.16	0.21	0.14	0.16	0.16	0.17	0.18	0.21	0.23
Maximum Volume Stored (acre-ft) =	0.144	0.411	0.076	0.124	0.168	0.197	0.270	0.417	0.440

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.14	0.34
	0:20:00	0.00	0.00	0.03	0.42	0.75	0.48	0.84	1.12	1.49
	0:25:00	0.00	0.00	0.80	1.48	2.10	1.59	2.21	2.71	3.47
	0:30:00	0.00	0.00	1.13	1.83	2.44	3.50	4.91	6.96	9.22
	0:35:00	0.00	0.00	1.10	1.71	2.25	4.07	5.94	8.97	11.53
	0:40:00	0.00	0.00	1.02	1.54	2.02	4.00	5.98	8.83	11.24
	0:45:00	0.00	0.00	0.91	1.39	1.83	3.60	5.36	8.15	10.32
	0:50:00	0.00	0.00	0.81	1.26	1.62	3.28	4.87	7.35	9.31
	0:55:00	0.00	0.00	0.72	1.11	1.43	2.82	4.16	6.42	8.14
	1:00:00	0.00	0.00	0.65	1.00	1.31	2.43	3.55	5.61	7.12
	1:05:00	0.00	0.00	0.61	0.93	1.23	2.16	3.12	5.05	6.43
	1:10:00	0.00	0.00	0.55	0.88	1.16	1.90	2.70	4.24	5.39
	1:15:00	0.00	0.00	0.50	0.80	1.09	1.67	2.34	3.54	4.49
	1:20:00	0.00	0.00	0.44	0.71	0.98	1.43	1.97	2.85	3.60
	1:25:00	0.00	0.00	0.39	0.62	0.83	1.20	1.64	2.26	2.83
	1:30:00	0.00	0.00	0.35	0.55	0.72	0.98	1.31	1.74	2.16
	1:35:00	0.00	0.00	0.32	0.52	0.65	0.80	1.06	1.34	1.65
	1:40:00	0.00	0.00	0.31	0.46	0.61	0.70	0.90	1.11	1.36
	1:45:00	0.00	0.00	0.30	0.42	0.58	0.63	0.81	0.96	1.17
	1:50:00	0.00	0.00	0.30	0.40	0.56	0.59	0.75	0.85	1.04
	1:55:00	0.00	0.00	0.26	0.37	0.53	0.56	0.71	0.78	0.94
	2:00:00	0.00	0.00	0.23	0.35	0.49	0.54	0.68	0.74	0.88
	2:05:00	0.00	0.00	0.18	0.27	0.38	0.42	0.52	0.55	0.66
	2:10:00	0.00	0.00	0.14	0.20	0.28	0.31	0.39	0.41	0.48
	2:15:00	0.00	0.00	0.10	0.15	0.21	0.23	0.29	0.30	0.36
	2:20:00	0.00	0.00	0.08	0.11	0.16	0.17	0.22	0.23	0.27
	2:25:00	0.00	0.00	0.06	0.08	0.11	0.13	0.16	0.17	0.20
	2:30:00	0.00	0.00	0.04	0.06	0.08	0.09	0.11	0.12	0.14
	2:35:00	0.00	0.00	0.03	0.04	0.06	0.07	0.08	0.09	0.10
	2:40:00	0.00	0.00	0.02	0.03	0.04	0.05	0.06	0.06	0.07
	2:45:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.04	0.05
	2:50:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	2:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	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
	5:15:00	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

APPENDIX D

Street and Riprap Sizing

1. **Street Flow Capacity**
2. **Riprap Sizing**

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Dec 21 2022

Driveway Capacity

User-defined

Invert Elev (ft)	= 4521.36
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

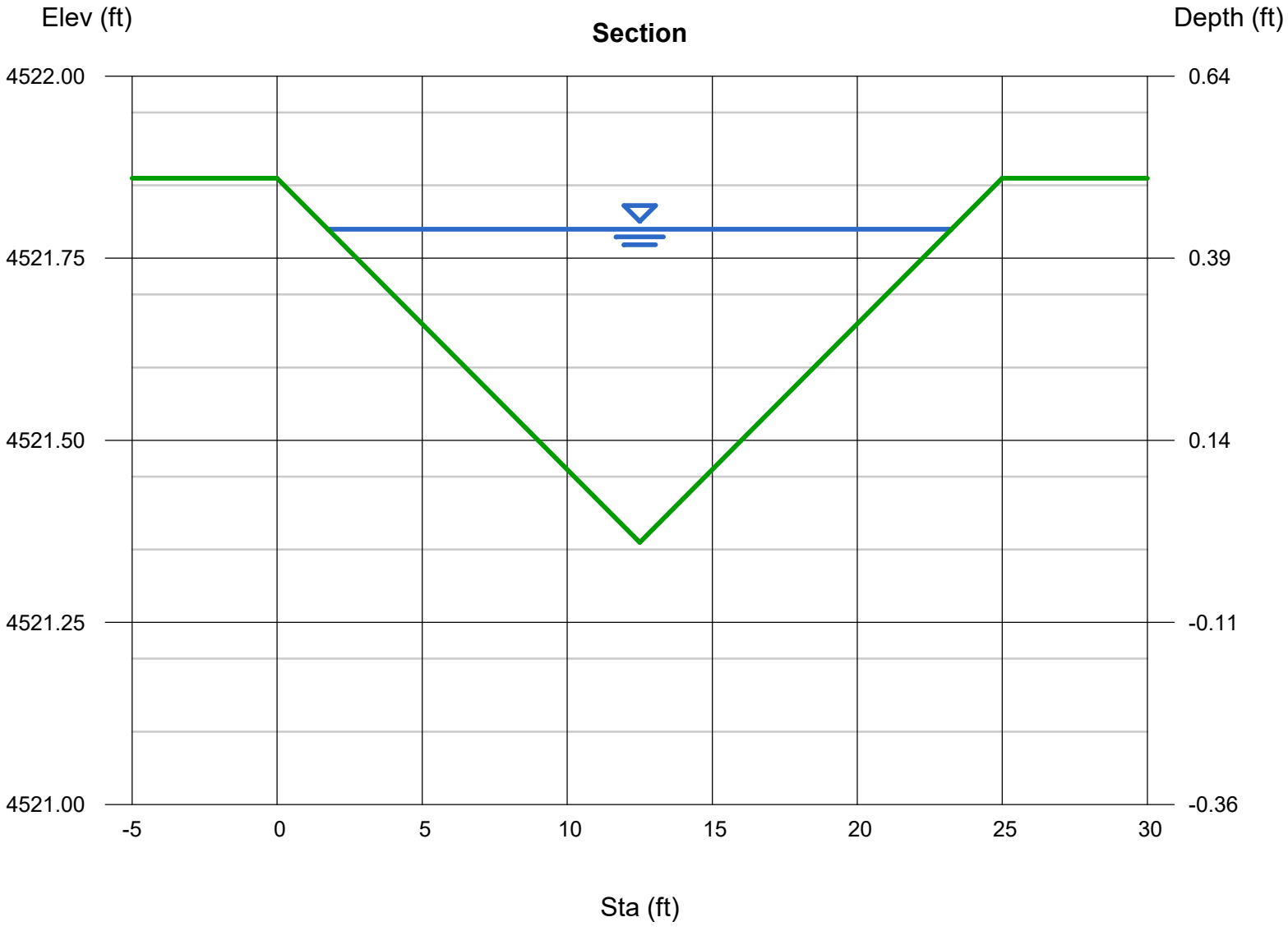
Compute by:	Known Q
Known Q (cfs)	= 13.10

Highlighted

Depth (ft)	= 0.43
Q (cfs)	= 13.10
Area (sqft)	= 4.63
Velocity (ft/s)	= 2.83
Wetted Perim (ft)	= 21.53
Crit Depth, Yc (ft)	= 0.45
Top Width (ft)	= 21.51
EGL (ft)	= 0.55

(Sta, El, n)-(Sta, El, n)...

(0.00, 4521.86)-(12.50, 4521.36, 0.013)-(25.00, 4521.86, 0.013)



RIVERCITY CONSULTANTS

A Storage Place

RIP-RAP CHANNEL LINING SIZING

REQUIRED INFORMATION:

V =	1.7	ft/sec	Mean Channel Velocity
S =	0.33	ft/ft	Longitudinal Channel Slope
S_S =	2.7		Specific Gravity of Rock (Unitless)

$$D_{50}=0.05v^{2}"S^{0.34"}$$

Eq. 824 SWMM

D_{50}= 0.05 Feet

0.59 Inches

3 Inch

Check on Rock Size for Riprap

D50		Riprap
6	Inch	VL
9	Inch	L
12	Inch	M
18	Inch	H
24	Inch	VH

← Use 6": Minimum Riprap Sizing

APPENDIX E

SWMM Checklists

1. **Drainage Report Checklist**
2. **Drainage Plan Checklist**

A STORAGE PLACE

Table 302
Stormwater Management Manual
Drainage Report Checklist

Instructions:
1. Applicant to identify with a "check-mark" if information is provided with report. If applicant believes information is not required, indicate with "n/a" and attach separate sheet with explanation
2. The reviewer will determine if information labeled "n/a" is required and whether information must be submitted.
3. Those items noted with an "asterisk" are not typically required for conceptual/ preliminary report. Applicant shall confirm this with local jurisdiction.
4. Submit three (3) copies of report and include copy of check list bound with report.

TITLE PAGE

A. Type of report (Conceptual/Preliminary or Final Drainage Report).
B. Project Name.
C. Preparer name, firm, address, number, and date.
D. Professional Engineer's seal of preparer.
E. Certifications (see SWMM Section 303.1)

I. INTRODUCTION

A. Background
- ✓ 1. Identify report preparer and purpose.
- ✓ 2. Identify date of letter with previous County comments.

B. Project Location
- ✓ 1. Identify Township, Range, and Section.
- ✓ 2. Identify adjacent street and subdivision names.
- ✓ 3. Reference to General Location Map.

C. Property Description
- ✓ 1. Identify area in acres of entire contiguous ownership.
- ✓ 2. Describe existing ground cover, vegetation, soils, topography and slopes.
- ✓ 3. Describe existing drainage facilities, such as channels, detention areas, or structures.
- ✓ 4. Describe existing irrigation facilities, such as ditches, head-gates, or diversions.
- ✓ 5. Identify proposed types of land use and encumbrances.

D. Previous Investigations
- ✓ 1. Identify drainage master plans that include the project area, including floodplain studies.
- N/A 2. Identify drainage reports for adjacent development.

II. DRAINAGE SYSTEM DESCRIPTION

A. Existing Drainage Conditions
- ✓ 1. Describe existing topography and provide map with contours extending a minimum of 100 feet beyond property limits.
- ✓ 2. Identify major drainageway or outfall drainageway and describe map showing location of proposed development within the drainageways.
- ✓ 3. Identify pre-developed drainage patterns and describe map showing pre-developed sub-basins and concentrated discharge locations. Provide calculations of pre-developed peak flows entering and leaving the site.

B. Master Drainage Plan
- N/A 1. Describe location of the project relative to a previously prepared master drainage plan, including drainage plans prepared for adjacent development.

C. Offsite Tributary Area

✓ 1. Identify all offsite drainage basins that are tributary to the project.
✓ 2. Identify assumptions regarding existing and future land use and effects of offsite detention on peak flows.

D. Proposed Drainage System Description
✓ 1. Identify how offisite stormwater is collected and conveyed through the site and ultimately to the receiving water(s).
✓ 2. Identify sub-basins and describe, in general terms, how onsite stormwater is collected and conveyed through the site for each location where stormwater is discharged from the site.
✓ * 3. Describe detention volumes, release rates and pool elevations.
✓ * 4. Identify the difference in elevation between pond invert and the groundwater table.
✓ 5. Describe how stormwater is discharged from the site, including both concentrated and dispersed discharges and rates.
✓ 6. Describe stormwater quality facilities.
✓ * 7. Describe maintenance access aspects of design.
✓ * 8. Describe easements and tracts for drainage purposes, including limitation on use.

E. Drainage Facility Maintenance
✓ * 1. Identify responsible parties for maintenance of each drainage and water quality facility.
✓ * 2. Identify general maintenance activities and schedules.

III. DRAINAGE ANALYSIS AND DESIGN CRITERIA

A. Regulations
✓ 1. Identify that analysis and design was prepared in accordance with the provisions of the Manual.
✓ 2. Identify other regulations or criteria which have been used to prepare analysis and design.

B. Development Criteria
✓ 1. Identify drainage constraints placed on the project, such as by a major drainage study, floodplain study or other drainage reports relevant to the project.
N/A 2. Identify drainage constraints placed on the project, such as from major street alignments, utilities, existing structures, and other developments.

C. Hydrologic Criteria
(If Manual was followed without deviation, then a statement to that effect is all that is required. Otherwise provide the following information where the criteria used deviates from the Manual.)
✓ 1. Identify developed storm runoff peak flows and volumes and how they were determined, including rainfall intensity or design storm.
✓ 2. Identify which storm events were used for minor and major flood analysis and design.
✓ 3. Identify how and why any other deviations from the Manual occurred.

D. Hydraulic Criteria
(If Manual was followed without deviation, then a statement to that effect is all that is required. Otherwise provide the following information where the criteria used deviates from the Manual.)
N/A * 1. Identify type(s) of streets within and adjacent to development and source for allowable street capacity.
N/A * 2. Identify which type(s) of storm inlets were analyzed or designed and source for allowable capacity.
3. Identify which type of storm sewers which were analyzed or designed and

✓ * Manning's n-values used.

4. Identify which method was used to determine detention volume requirements and how allowable release rates were determined. ✓ *

5. Identify how the capacity of open channels and culverts were determined. N/A *

6. Identify any special analysis or design requirements not contained with the Manual. N/A *

7. Identify how and why any other deviations from the Manual occurred. ✓

E. Variance from Criteria

1. Identify any provisions of the Manual for which a variance is requested. ✓

2. Identify pre-existing conditions which cause the variance request. ✓

***IV. POST CONSTRUCTION STORMWATER MANAGEMENT. See Manual Section 1600 for requirements.**

Note: This section of the Final Drainage Report identifies additional information required by Mesa County's, City of Grand Junction's, and Town of Palisade's, Permit for Stormwater Discharges Associated with Municipal Separate Storm Sewer Systems (MS4s), permit No. COR-090000. The Final Drainage Plan and the Construction SWMP (see SWMM Section 1500) meets the requirements of the MS4s Permit. In general, this section identifies permanent BMP practices to control the discharge of pollutants after construction is complete.

*A. Stormwater Quality Control Measures

1. Describe the post-construction BMPs to control discharge of pollutants from the project site. N/A *

2. If compensating detention is provided, discuss practices to address water quality from area not tributary to detention area. N/A *

3. If underground detention is proposed, discuss how water quality facilities will be provided on the surface. N/A *

4. If proprietary BMPs are proposed, provide the justification and sizing requirements (see SWMM Section 1603.3). N/A

*B. Calculations

1. Provide methods and calculations for WQCV, sediment storage, and water quality outlet structure. ✓

V. CONCLUSIONS

A. Compliance with Manual

Compliance with Manual and other approved documents, such as drainage plans and floodplain studies. ✓

B. Design Effectiveness

Effectiveness of drainage design to control impacts of storm runoff. ✓

C. Areas in Flood Hazard Zone

Meet requirements of Floodplain Regulations: Mesa County Land Development Code, Section 7.13; City of Grand Junction Zoning and Development Code, Section 7.1. ✓

D. Variances from Manual

Applicant shall identify any requested variances and provide basis for approving variance. If no variances are requested, applicant shall state that none are requested. ✓

VII. REFERENCES

Provide a reference list of all criteria, master plans, drainage reports, and technical information used. ✓

TABLES

Include copy of all tables prepared for report. ✓

FIGURES

A. General Location Map (See Section 303.2a) ✓

✓ B. Flood Plain Information
✓ C. Drainage Plan (See Section 303.2b)
✓ D. Other pertinent figures.

APPENDICIES

A. DESIGN CHARTS

✓ 1. Provide copy of all design charts (i.e.: tables, figures, charts from other criteria) used for the report.

B. HYDROLOGIC CALCULATIONS (see Manual Sections 600 and 700)

✓ 1. Land use assumptions for off-site runoff calculations.
✓ 2. Time of concentration and runoff coefficients for pre-existing and post development conditions.
✓ 3. Pre-developed hydrologic computations.
✓ 4. Developed conditions hydrologic computations.

C. HYDRAULIC CALCULATIONS

N/A 1. Capacity of existing channels, streets, storm sewers, inlets, culverts and other facilities.
N/A 2. Calculations for existing storm sewer and open channel.
N/A 3. Irrigation ditch flows and ditch system capacity.
✓* 4. Detention pond design (see Manual, Section 1400 for requirements).
✓* a. Storage volume, release rates, and pool elevations for 10-year and 100-year storm.
✓* b. Outlet structure dimensions, orifice diameter, weir lengths, pipe headwater and other data.
✓* c. Outlet velocity and energy dissipation requirements.
✓* d. Routing of outlet flows and emergency spillway flows.
✓* 5. Street capacity calculations, if data in Manual not used (see Section 1100).
N/A* 6. Storm inlet capacity calculations, if data in Manual not used (see Section 1100).
N/A* 7. Storm sewer capacity calculations, if data in Manual not used (see Section 1000).
N/A* 8. Channel capacity calculations, if data in Manual not used (see Section 800).
N/A* 9. Culvert capacity calculations (see Manual, Section 1200).
N/A* 10. Other hydraulic structure calculations (see Manual, Section 900).

D. STORMWATER QUALITY CALCULATIONS

✓ 1. Water Quality Capture Volume (WQCV).
✓* 2. Storage volume for sediment volume and pool elevations for WQCV.
✓* 3. Outlet calculations for required area per row, diameter of individual holes, number of holes per row, and number of holes per column.

✓ **CERTIFICATION – PROFESSIONAL ENGINEER'S SEAL AND SIGNATURE**

ACKNOWLEDGEMENTS

Drainage Report checklist was prepared by: *Craig Rothluebber, PE*

A STORAGE PLACE

Table 303
Stormwater Management Manual
Drainage Plan Checklist

Instructions:
1. Applicant to identify with a "check-mark" if information is provided. If applicant believes information is not required, indicate with "n/a".
2. County will determine if information labeled "n/a" is required and whether information must be submitted.

I. EXISTING FACILITIES

- ✓ A. Contours at two foot intervals, based on USGS datum. Contours to extend at least 50 feet past property line.
- ✓(see plans) B. Location and elevation of USGS benchmarks or benchmarks referenced to USGS.
- ✓ C. Property lines.
- ✓ D. Drainage easements.
- ✓ E. Street names.
- ✓ F. Major and minor channels and floodplains.
- ✓ G. A historic drainage plan including historic basin boundaries and flow paths.

II. PROPOSED FACILITIES

- ✓ A. Contours at two-foot intervals, based on USGS datum.
- ✓ B. Property lines.
- ✓ C. Drainage easements.
- ✓ D. Street names and grades.
- ✓ E. Right of way and easement.
- ✓(see plans) F. Finished floor elevations for protection from major storm run-off.
- ✓ G. Detention pond information:
  - ✓(see plans) 1. Location of each detention pond with site at 1"=50' scale or larger with 2-foot contour intervals.
  - ✓(see plans) 2. Inlet and outlet structure, and trickle channel design details.
  - ✓(see plans) 3. Details of emergency spillway and channel.
  - ✓(see plans) 4. Landscape information, including side slopes, vegetation and planting requirements.
  - ✓(see plans) 5. Details of water quality outlet structure.
- N/A H. Channel Information:
  - N/A 1. Profiles with existing and proposed grades.
  - ✓(see plans) 2. Cross sections on 100-foot stations showing existing and proposed topography and required rights of way.
  - N/A 3. Locations and size of all existing and proposed structures.
  - N/A 4. Locations and profiles of adjacent utilities.
  - 5. Typical channel section and lining details.
- I. Storm sewer information:
  - ✓(see plans) 1. Alignment and location of manholes, inlets, and outlet structures.
  - ✓(see plans) 2. Profile of invert and pipe crown.
  - ✓(see plans) 3. Invert elevations at manholes and inlets.
  - ✓(see plans) 4. Lengths and grades between manholes and inlets.
  - ✓(see plans) 5. Locations and elevations of utilities adjacent to and crossing storm sewer.
  - ✓(see plans) 6. Easement and other O&M access geometry.
  - ✓(see plans) 7. Outlet details, such as end sections, headwall and wingwalls, erosion control, and vegetation.
- ✓(see plans) J. Street cross sections with design 100-year flood depth.
- N/A K. Other drainage related structures and facilities, including underdrains and sump pump discharge lines.
- N/A L. Other permanent BMP measures to control pollutant discharges to the County's MS4 system.

III. HYDRAULIC AND HYDROLOGIC INFORMATION

✓ A. Routing and accumulative runoff peaks at upstream and downstream ends of the site and at various critical points onsite for initial and major storms. Inflow and outflow from each subbasin shall be shown for both initial and major storms.

✓(see plans) B. Street cross sections showing 100-year flood levels.

✓ C. Major and minor channels and floodplains.

✓ D. Detention pond data:

✓ 1. Release rates for 10- and 100-year storm events.

✓ 2. Required and provided volumes for 10- and 100-year storm events.

✓ 3. Design depths for 10- and 100-year storm events.

✓ 4. Water quality capture volume and pool elevation.

E. Channel data:

N/A 1. Water surface profiles.

N/A 2. Representative 100-year flow velocity and Froude number.

F. Storm sewer data:

✓ 1. Profile of water surface for design flow rate.

✓ 2. Peak flows for design flow, 2-year and 100-year storm events.

IV. STANDARD NOTES

✓ A. No building, structure, or fill will be placed in the detention areas and no changes or alterations affecting the hydraulic characteristics of the detention areas will be made without the approval of the County.

✓ B. Maintenance and operation of the detention and water quality areas is the responsibility of property owner. If owner fails in this responsibility, the County has the right to enter the property, maintain the detention areas, and be reimbursed for costs incurred.

✓ C. Detention pond volumes, all drainage appurtenances, and basin boundaries shall be verified. As-built drawings shall be prepared by a registered professional engineer prior to issuance of certificate of occupancy for any structure within the development.

D. Permission to reproduce these plans is hereby given to Mesa County for County purposes associated with plan review, approval, permitting, inspection and construction of work.

V. PROFESSIONAL ENGINEER'S SEAL AND SIGNATURE

✓

VI. OTHER

✓(see plans) A. Horizontal and vertical control information and ties to existing and proposed features.

ACKNOWLEDGEMENTS

Drainage Plan checklist was prepared by: *Craig Rothluebber, PE*