EPC STORMWATER REVIEW COMMENTS
IN ORANGE BOXES WITH BLACK TEXT

Final Drainage Report

Buc-ee's El Paso
El Paso County, Colorado

Prepared for:
Buc-ee's LTD
2500 North Hwy 228
Angleton, TX, 77515

Prepared by:
Kimley-Horn and Associates, Inc.
6200 South Syracuse Way, Suite 300
Greenwood Village, CO 80111
720-943-5665
Contact: Kyle Watson, P.E.

PCD Filing No.: PPR26-28

Prepared: September 11, 2026

Kimley»Horn

CERTIFICATION

DESIGN ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by El Paso County, Colorado for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

SIGNATURE (Affix Seal): _____

Kyle Watson Date
Colorado P.E. No. 55720

OWNER/DEVELOPER'S STATEMENT

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

Buc-ee's LTD
Developer Name

_____
Signature:

Developer/Owner
Title:

2500 North Hwy 228, Angleton, TX, 77515
Address:

EL PASO COUNTY STATEMENT

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code, as amended.

J.

_____
Joshua Palmer, P.E. Date
County Engineer/ECM Administrator

Conditions:

TABLE OF CONTENTS

CERTIFICATION 1

DESIGN ENGINEER'S STATEMENT 1

OWNER/DEVELOPER'S STATEMENT 1

EL PASO COUNTY STATEMENT 1

INTRODUCTION 4

PURPOSE AND SCOPE OF STUDY 4

LOCATION 4

DESCRIPTION OF THE PROPERTY 4

FLOODPLAIN STATEMENT 5

DRAINAGE BASINS 5

MAJOR BASINS 5

EXISTING SUB-BASIN DESCRIPTIONS 5

PROPOSED SUB-BASIN DESCRIPTIONS 7

DESIGN POINT COMPARISON ANALYSIS 12

DESIGN CRITERIA 13

REFERENCES 13

HYDROLOGIC CRITERIA 14

HYDRAULIC CRITERIA 14

DETENTION 15

CDOT RIGHT-OF-WAY ANALYSIS 17

FOUR-STEP PROCESS 18

STEP 1: EMPLOY RUNOFF REDUCTION PRACTICES 18

STEP 2: PROVIDE WATER QUALITY CAPTURE VOLUME 19

STEP 3: STABLIZE DRAINAGEWAYS 19

STEP 4: IMPLEMENT SITE SPECIFIC AND OTHER SOURCE CONTROL BMPS 19

DRAINAGE PLAN 19

GENERAL DRAINAGE CONCEPT 19

CONCLUSIONS 19

DRAINAGE FEES 19
SUMMARY 19
REFERENCES 20
APPENDIX A 21
APPENDIX B 22
APPENDIX C 23
APPENDIX D 24
APPENDIX E 25

Appendices:

Appendix A – Vicinity Map
Appendix B – FEMA Firm Panel and NRCS Soil Data
Appendix C – Hydrology
Appendix D – Hydraulics
Appendix E – El Paso County Drainage Basin Map
Appendix F – Drainage Maps

INTRODUCTION

This is the final drainage report and need to be included now.

AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to document the drainage design methodology in support of the proposed Buc-ee's El Paso ("the Project") for Buc-ee's LTD. The finalized hydraulic design and associated calculations will be provided with the Final Drainage Report. The Project is located within the jurisdictional limits of El Paso County ("the County"). Therefore, the hydrologic and hydraulic design is based on the County's criteria which is described in further detail within the report.

LOCATION

The proposed Project is located within the NW ¼ of Section 2, Township 11 South, Range 67W of the Sixth Principal Meridian, is in El Paso County, Colorado. The Site is bound by Interstate 25 to the east, E Palmer Divide Avenue to the north, Beacon Lite Road to the west, and undeveloped property to the south. The Project is within the Bald Mountain Drainage Basin. The Site is bordered by following platted developments: Beacon Heights Sub, Town of Monument Beacon Lite Water Tank Sub Exemption, Ehrich Sub, and Nance Sub. A vicinity map has been provided in the **Appendix** of this report.

The Site is currently owned by Buc-ee's LTD and will be developed by Buc-ee's LTD.

DESCRIPTION OF THE PROPERTY

Project area of disturbance totals approximately ±44.56 acres including Site development and Roadway improvements. Site development in the proposed conditions totals approximately 30.8 acres and will consist of the construction of a commercial convenience store with associated gas fueling. Water, sanitary, gas, and power utility infrastructure is proposed to serve the site. Offsite improvements will consist of the design and construction of a roundabout at the intersection of Palmer Divide Ave and Beacon Lite Road, Palmer Divide Ave improvements, and full paving of Beacon Lite Road from Palmer Divide Avenue to the southern limit of the project site. Minimal drainage infrastructure exists within the Project area. Proposed public storm infrastructure will include proposed inlets and storm pipes and will be routed to the proposed Site private full spectrum water quality and detention ponds or routed around the site to historic discharge locations.

The existing topography of the Project generally slopes east with a slope of 5% to 10%. The Existing Drainage Map provided in **Appendix B** illustrates the current flow patterns across the Project. Within the Project limits, the Roadway consists of existing asphalt pavement, dirt road, underground gas and communications lines, driveway storm culverts, and roadway ditches. Flows are conveyed east under Interstate 25 through a series of roadway ditches and open and closed conveyance systems, ultimately discharging into Greenland Ranch Creek, located approximately a half mile northeast. The site consists of undeveloped land, with approximately 40% of the site covered by trees and the remainder being grass fields with dirt drives.

A Natural Resources Conservation Service (NRCS) Web Soil Survey for the Project area was used to determine the soil characteristics of the Project. Soils were determined to consist of Peyton-Pring-Crowfoot Sandy loams, Peyton-Pring-Crowfoot complex, Peyton-Pring complex, and Tomah-Crowfoot loamy sands. The corresponding predominant Hydrologic Soil Groups used for the Project's hydrology calculations were classified as predominantly Hydrologic Soil Group (HSG) Type B. The NRCS soils map is included in **Appendix B** for reference.

FLOODPLAIN STATEMENT

The Project is outside of any mapped FEMA special flood hazard areas (i.e. flood-plains). The Site is located within Flood Zone X. The National Wetlands Inventory identified Riverine Intermittent Seasonally Flooded Streambed (R4SBC) on the Project site. The FEMA Flood Insurance Rate Map (FIRM) Panel (Map No. 08041C0065G and 08041C0276G) and National Wetlands Inventory Map are included in **Appendix A**.

DRAINAGE BASINS

MAJOR BASINS

The Project is within the Bald Mountain Drainage Basin. See **Appendix E** for a map of the Regional Basins. A topographic survey that was collected by Kimley-Horn & Associates in February of 2026, was utilized to delineate existing sub-basins for the Project drainage. El Paso County GIS topography was used to delineate off-site drainage sub-basins outside the limits of the Project.

EXISTING SUB-BASIN DESCRIPTIONS

The Project has been split into 14 existing sub-basins. Sub-basins are shown in the Existing Drainage Map in **Appendix B**.

Existing Sub-basin EX-1
Existing Sub-basin 1 is 5.44 acres and consists of landscape, vegetation, and portions of Palmer Divide Ave and Beacon Lite Road. Runoff from Sub-basin EX-1 sheet flows east across the landscape, crosses into the property to the east, and continues east into an existing roadside ditch along Interstate 25 and ultimately outfalling to a 24” culvert under the Interstate 25 on-ramp.

Existing Sub-Basin EX-2
Existing Sub-basin EX-2 is 1.62 acres and consists of landscape and vegetation. Runoff from Sub-basin EX-2 sheet flows east across the basin and collects in an existing road-side ditch for Interstate 25 before ultimately outfalling to an 18” culvert under the Interstate 25 on-ramp.

Existing Sub-basin EX-3
Existing Sub-basin EX-3 is 14.14 acres and consists of landscape, vegetation, and portions of Beacon Lite Road. Runoff from Sub-basin EX-3 sheet flows east across the basin and collects in existing swales and ultimately discharges into an existing roadside ditch for Interstate 25 and outfalls to a 42” culvert under Interstate 25.

Existing Sub-basin EX-4
Existing Sub-basin EX-4 is 11.54 acres and consists of landscape, vegetation, and portions of Beacon Lite Road. Runoff from Sub-basin EX-4 sheet flows northeast across the basin and collects in existing swales and ultimately discharges into an existing roadside ditch for Interstate 25 and outfalls to a 42” culvert under Interstate 25.

Existing Sub-basin EX-5
Existing Sub-basin EX-5 is 0.25 acres and consists of landscape and vegetation. Runoff from Sub-basin EX-5 sheet flows across the basin and ultimately discharges into an existing roadside ditch for Interstate 25 and outfalls to a 36” culvert under Interstate 25.

Existing Off-site Sub-basin OFF-1
Existing Off-site Sub-basin OFF-1 is 0.5 acres and consists of portions of Palmer Divide Ave and Beacon Lite Road as well as lawn. Runoff sheet flows to an existing roadside ditch along Beacon Lite Road and ultimately discharges to a culvert under Beacon Lite Road and onto the project site.

Existing Off-site Sub-basin OFF-2
Existing Off-site Sub-basin OFF-2 is 15.81 acres and consists of a portion of Beacon Lite Road, residential properties, landscape and vegetation. Runoff from Sub-basin OFF-2 sheet flows east to an existing roadside ditch along Beacon Lite Road and ultimately discharges to a culvert under Beacon Lite Road and onto the project site.

Existing Off-site Sub-basin OFF-3
Existing Off-site Sub-basin OFF-3 is 7.40 acres and consists of portions of Beacon Lite Road and Bricker Road, residential properties, landscape, and vegetation. Runoff from Sub-basin OFF-3 sheet flows east to an existing roadside ditch along Beacon Lite Road, discharges to a culvert under Beacon Lite Road and ultimately onto the project site.

Existing Off-site Sub-basin OFF-4
Existing Off-site Sub-basin OFF-4 is 2.79 acres and consists of portions of Beacon Lite Road and Bricker Road as well as residential property. Runoff from Sub-basin OFF-4 sheet flows east to an existing roadside ditch along Beacon Lite Road, discharges to a culvert under Beacon Lite Road, and ultimately onto the project site.

Existing Off-site Sub-basin OFF-5
Existing Off-site Sub-basin OFF-5 is 4.19 acres and consists of buildings, portions of Beacon Lite Road, landscape, and vegetation. Runoff sheet flows north onto the project site.

Existing Off-site Sub-basin OFF-6
Existing Off-site Sub-basin OFF-6 is 1.52 acres and consists of portions of buildings, landscape, and vegetation. Runoff sheet flows northeast and ultimately discharges into an existing roadside ditch for Interstate 25 and outfalls to a 36” culvert under Interstate 25.

Existing Off-site Sub-basin OS-1
Existing Off-site Sub-basin OS-1 is 3.54 acres and consists of portions of Palmer Divide Road and Interstate 25, landscape, and vegetation. Runoff sheet flows north to a 24” culvert under the Interstate on-ramp.

Existing Off-site Sub-basin OS-2
Existing Off-site Sub-basin OS-2 is 4.18 acres and consists of portions of Interstate 25, landscape, and vegetation. Runoff sheet flows north to an 18” culvert under the Interstate on-ramp.

Existing Off-site Sub-basin OS-3
Existing Off-site Sub-basin OS-3 is 3.22 acres and consists of portions of Interstate 25, landscape, and vegetation. Runoff sheet flows north to a 42” culvert under the Interstate on-ramp.

A summary of the existing sub-basins is provided in **Appendix C** and in Table 1 below**.**

Table 1: Existing Project Peak Runoff Based on Existing Drainage Locations

Tributary Basin Locations	Tributary Basins	Tributary Area (AC)	Peak Flows (CFS)*	
			10-Year	100-Year
On-Site Existing Basins	EX-1, EX-2, EX-3, EX-4, EX-5	33.21	12.31	66.98
Off-Site Existing Basins	OFF-1, OFF-2, OFF-3, OFF-4, OFF-5, OFF-6, OS-1, OS-2, OS-3	43.15	32.70	87.73
TOTAL		**76.36**	**45.01**	**154.71**

Table 2: Existing Project Peak Runoff Based on Existing Discharge Locations

Tributary Discharge Locations	Tributary Basins	Tributary Area (AC)	Peak Flows (CFS)*	
			10-Year	100-Year
24" Culvert	EX-1, OFF-1, OS-1	9.48	8.19	22.51
18" Culvert	EX-2, OS-2	6.02	4.48	12
42" Culvert	EX-3 THROUGH EX-5, OFF-2 THROUGH OFF-5, OS-3	59.34	31.38	117.2
36" Culvert	OFF-6	1.52	0.96	3
TOTAL		**76.36**	**45.01**	**154.71**

PROPOSED SUB-BASIN DESCRIPTIONS

The proposed Project tributary drainage areas were delineated on the grading associated with the Roadway improvements and the Buc-ee's Site development. Overall sub-basins were used on-site for this Drainage Report and are shown in the Drainage Area Maps in **Appendix B**. The proposed private full spectrum water quality and detention pond in the northwest corner of the Project site, Pond 1, serves the western side of the Buc-ee's Site development and approximately 3.8 acres of drainage from Palmer Divide Ave and Beacon Lite Road as well as approximately 10.4 acres of off-site flow coming on-site from adjacent properties. These overall basins that are conveyed to Pond 1 are denoted "ON-1," for onsite flows, and "OS-1," for offsite roadway flows, and "OF-1" for offsite flows that are conveyed to Pond 1 for treatment and detention.

The proposed private full spectrum water quality and detention pond on the eastern side of the Project Site, Pond 2, serves the northeastern half of the Buc-ee's Site development. These overall basins that are conveyed to Pond 2 are denoted "ON-2," for onsite flows.

The proposed private full spectrum water quality and detention pond on the southern side of the Project Site, Pond 3, serves the southeastern half of the Buc-ee's Site development. These overall basins that are conveyed to Pond 3 are denoted "ON-3," for onsite flows.

SUB-BASINS FLOWING TO POND 1

The following proposed storm infrastructure flowing to Pond 1 and located within the Site development are private, unless otherwise noted.

Proposed Sub-basin ON-1
Proposed Sub-basin ON-1 is 8.48 acres and will consist of landscape, asphalt with curb and gutter, the proposed fuel pumps and canopy, and the proposed Pond 1. Runoff will sheet flow directly into Pond 1 or utilize the proposed on-site drainage conveyance system by sheet flowing into proposed inlets, or will be captured by the canopy roof drains.

Proposed Sub-basin OS-1A
Proposed Sub-basin OS-1A is 3.64 acres and will consist of landscape, asphalt with curb and gutter, and the proposed roundabout. Runoff will sheet flow into proposed inlets along Beacon Lite Road and culvert under the road into the Proposed on-site closed conveyance system. This offsite area will be treated by Pond 1 to account for the improvements being made to Palmer Divide Road and Beacon Lite Road as part of the Project.

Pond 1

Proposed Sub-basin OS-1B
Proposed Sub-basin OS-1B is 0.16 acres and consists of a small portion of Beacon Lite Road that sheet flows onto the Project site and will be captured by the on-site storm infrastructure that directs flows to Pond A. This off-site area will be treated by Pond 1 to account for the improvements being made to Beacon Lite Road as part of the Project.

Proposed Sub-basin OF-1
Proposed Sub-basin OF-1 is 3.24 acres and consists of landscape, vegetation, and an existing private residence. Runoff from Sub-basin OF-1 sheet flows southeast across the private property and will be collected by an inlet within a ditch along Beacon Lite Road that will be constructed as part of the Beacon Lite Road improvements proposed as part of the Buc-ee's development. Runoff will be routed under Beacon Lite Road and will be routed via closed conveyance system north around the Site to the discharge point for Pond 1, where a ditch will convey the flows to a roadside collector ditch along Interstate 25, where flow from this sub-basin is ultimately conveyed in the pre-development condition.

Ensure these ditches and storm facilities are all shown and labeled on larger scale map (See basin map for additional info)

Proposed Sub-basin OF-2
Proposed Sub-basin OF-2 is 6.51 acres and consists of landscape, vegetation, and existing private residences. Runoff from Sub-basin OF-2 sheet flows east across the private properties and will be collected by an inlet within a ditch along Beacon Lite Road that will be constructed as part of the Beacon Lite Road improvements proposed as part of the Buc-ee's development. Runoff will be routed under Beacon Lite Road and will be routed via closed conveyance system north around the Site to the discharge point for Pond 1, where a ditch will convey the flows to a roadside collector ditch along Interstate 25, where flow from this sub-basin is ultimately conveyed in the pre-development condition.

Proposed Sub-basin OF-16
Proposed Sub-basin OF-16 is 0.39 acres and consists of portions of the vegetated area south of Palmer Divide Ave and west of Beacon Lite Road. Run-off from Sub-basin OF-16 flows will be collected by an inlet within a ditch along Beacon Lite Road that will be constructed as part of the Beacon Lite Road improvements proposed as part of the Buc-ee's development. Runoff will be routed under Beacon Lite Road and will be routed via closed conveyance system north around the Site to the discharge point for Pond 1, where a ditch will convey the flows to a roadside collector ditch along Interstate 25, where flow from this sub-basin is ultimately conveyed in the pre-development condition.

Ensure calculations are provided comparing existing vs proposed flows in the existing ditch. Compare such things as depth, velocity, shear, Fr, etc)

SUB-BASINS FLOWING TO POND 2

The following proposed storm infrastructure flowing to Pond 2 and located within the Site development are public, unless otherwise noted.

Proposed Sub-basin ON-2
Proposed Sub-basin ON-2 is 10.90 acres and will consist of landscape, asphalt with curb and gutter, the proposed building, and the proposed Pond 2. Runoff will sheet flow into proposed inlets, directly into Pond 2, or discharge into the proposed on-site closed conveyance system via roof drains.

SUB-BASINS FLOWING TO POND 3

The following proposed storm infrastructure flowing to Pond 3 and located within the Site development are public, unless otherwise noted.

Proposed Sub-basin ON-3
Proposed Sub-basin ON-3 is 8.67 acres and will consist of landscape, asphalt with curb and gutter, the proposed water treatment facilities and sanitary sewer lift station, and the proposed Pond 3. Runoff will sheet flow into proposed inlets or directly into Pond 3.

Proposed Sub-basins OS-3A
Proposed Sub-basin OS-3A is 0.14 acres and consists of landscape and asphalt with curb and gutter. Runoff will sheet flow onto the Site where it will be captured by swales or sheet flow into Pond 3. This offsite area will be treated by Pond 3 to account for the improvements being made to Beacon Lite Road as part of the Project.

SUB-BASINS FLOWING OFFSITE TO 24" CULVERT

The following basins are predominantly undisturbed private properties that flow onto Buc-ee's site or to the project's ultimate outfall in the pre-development condition and will bypass the Project site in the post-development condition. A portion of the following basins are onsite basins that are not able to be captured to be treated and detained.

Proposed Sub-basin ON-7
Proposed Sub-basin ON-7 is .25 acres and will consist of landscape. Runoff will sheet flow offsite over Sub-basin OF-11 (the adjacent northeastern parcel #7102200014) and into a channel along E Palmer Divide Ave, before ultimately leaving the channel via an existing 24" culvert to the east.

Proposed Sub-basin OF-11
Proposed Sub-basin OF-11 is 2.76 acres and consists of vegetated portions of the northeastern parcel #7102200014 and a portion of the proposed exit road to the north of the proposed development. Run-off from Sub-basin OF-11 sheet flows to the east and into a channel along E Palmer Divide Ave, before ultimately leaving the channel via an existing 24" culvert to the east.

Proposed Sub-basin OF-12
Proposed Sub-basin OF-12 is 0.74 acres and consists of portions of Palmer Divide Ave and the associated road-side channel. Run-off from Sub-basin OF-12 sheet flows off the roadways to inlets that convey the runoff to a channel, before ultimately leaving the channel via an existing 24" culvert to the east.

SUB-BASINS FLOWING OFFSITE TO 18" CULVERT

The following basins are predominantly undisturbed private properties that flow onto Buc-ee's site or to the project's ultimate outfall in the pre-development condition and will bypass the Project site in the post-development condition. A portion of the following basins are onsite basins that are not able to be captured to be treated and detained.

Proposed Sub-basin ON-6
Proposed Sub-basin ON-6 is 0.23 acres and will consist of landscape. Runoff will sheet flow offsite over Sub-basin OF-10 (the adjacent northeastern parcel #7102200014) and will sheet flow to the eastern side of the site and collects in the I-25 channel, before ultimately leaving the channel via an existing 18" culvert to the east.

Proposed Sub-basin OF-9
Proposed Sub-basin OF-9 is 1.56 acres and consists of portions of the Interstate 25 on-ramp and the associated road-side channel. Run-off from Sub-basin OF-9 sheet flows west and east and collects in the channel that runs parallel with the I-25 on-ramp, before ultimately leaving the channel via an existing 18" culvert to the east.

Proposed Sub-basin OF-10
Proposed Sub-basin OF-10 is 3.15 acres and consists of portions of the northeastern parcel #7102200014 which is composed of vegetation and landscaping. Run-off from Sub-basin OF-10 sheet flow to the eastern side of the site and collects in the I-25 channel, before ultimately leaving the channel via an existing 18" culvert to the east.

SUB-BASINS FLOWING OFFSITE TO 42" CULVERT

The following basins are predominantly undisturbed private properties that flow onto Buc-ee's site or to the project's ultimate outfall in the pre-development condition and will bypass the Project site in the post-development condition.

Proposed Sub-basin OF-3
Proposed Sub-basin OF-3 is 5.30 acres and consists of landscape and vegetation. Runoff from Sub-basin OF-3 sheet flows east across the private property and will be collected by an inlet within a ditch along Beacon Lite Road that will be constructed as part of the Beacon Lite Road improvements proposed as part of the Buc-ee's development. Runoff will be routed via closed conveyance system along the Site to the south where it will discharge into the roadside collector ditch along Interstate 25 at the 42" Culvert, where flow from this Sub-basin is ultimately conveyed in the pre-development condition.

Proposed Sub-basin OF-4
Proposed Sub-basin OF-4 is 7.19 acres and consists of landscape, vegetation, existing private residences, and portions of Bricker Road and Beacon Lite Road. Runoff from Sub-basin OF-4 sheet flows east across the private property and will be collected by roadside ditch and inlets that will be constructed as part of the Beacon Lite Road improvements proposed as part of the Buc-ee's development. This runoff is and will be conveyed under Beacon Lite Road and around the south side of the project where it is discharged into a roadside collector ditch along Interstate 25 at the 42" Culvert, where flow from this Sub-basin is ultimately conveyed in the pre-development condition.

Proposed Sub-basin OF-5
Proposed Sub-basin OF-5 is 2.79 acres and consists of landscape, vegetation, existing private residences, and portions of Bricker Road and Beacon Lite Road. Runoff from Sub-basin OF-5 sheet flows east across the private property and will be collected by roadside ditch and a culvert proposed to be constructed as part of the Beacon Lite Road Improvements (by others), which follows historic drainage patterns according to the Beacon Lite Road Improvements Drainage Report. This runoff is and will be conveyed under Beacon Lite Road onto OF-6 which ultimately flows north and will be collected by a proposed ditch along the southern edge of the project site and will be collected in an inlet that will convey flow into the closed conveyance bypass system around the Site to a roadside collector ditch along Interstate 25 at the 42" Culvert, where flow from this Sub-basin is ultimately conveyed in the pre-development condition.

Proposed Sub-basin OF-6
Proposed Sub-basin OF-6 is 4.19 acres and consists of landscape, a portion of Beacon Lite Road, and existing structures on the southern end of the Sub-basin. Run-off from Sub-basin OF-6 sheet flows north and will be collected by a proposed ditch along the southern edge of the project site and will be collected in an inlet that will convey flow into the closed conveyance bypass system around the Site to a roadside collector ditch along Interstate 25 at the 42" Culvert, where flow from this Sub-basin is ultimately conveyed in the pre-development condition.

Proposed Sub-basin OF-8
Proposed Sub-basin OF-8 is 3.25 acres and consists of portions of onsite landscape and the existing channel along Interstate 25. Run-off from Sub-basin OF-8 sheet flows east and collects in the channel that runs parallel with I-25 and the I-25 on-ramp, before ultimately leaving the channel via an existing 42" culvert to the east.

SUB-BASINS FLOWING OFFSITE TO 36" CULVERT

Proposed Sub-basin OF-7
Proposed Sub-basin OF-7 is 1.52 acres and consists of landscape, vegetation, and existing buildings on the southern end of the Sub-basin. Run-off from Sub-basin OF-7 sheet flows northeast and collects in existing ditches within the Sub-basin which convey runoff to the northeast corner of the Sub-basin and ultimately to a roadside collector ditch along Interstate 25 at the 36" Culvert, where flow from this Sub-basin is ultimately conveyed in the pre-development condition. Flows from this Sub-basin do not change from the existing condition (Sub-basin OFF-6) to the proposed condition and are provided as reference.

SUB-BASINS FLOWING OFFSITE TO NORTH AND WEST

The following basins are predominantly disturbed public roadways that the Buc-ee's project is improving in alignment with the El Paso County roadway improvements for Palmer Divide Road.

Proposed Sub-basin OF-13
Proposed Sub-basin OF-13 is 1.46 acres and consists of portions of the vegetated area north of Palmer Divide Ave and west of the Interstate 25 off-ramp. Run-off from Sub-basin OF-13 sheet flows to the north and west, as it does in the pre-development condition.

Proposed Sub-basin OF-14
Proposed Sub-basin OF-14 is 0.08 acres and consists of a portion of the driveway 9 access path. Run-off from Sub-basin OF-14 sheet flows to the north, as it does in the pre-development condition.

Proposed Sub-basin OF-15
Proposed Sub-basin OF-15 is 1.24 acres and consists of portions of Palmer Divide Ave and the road-side channel to the north. Run-off from Sub-basin OF-15 sheet flows off the roadways and northern side of the road and collects in the Palmer Divide channel flowing west before ultimately leaving the channel via a proposed 24" culvert to the west at the location where runoff from this Sub-basin is ultimately conveyed in the pre-development condition.

A summary of the flows going to each pond or outfall location in the proposed conditions are shown in the table below and a summary of peak flows for each sub-basin is in **Appendix C**.

Missing Basins ON-4, ON-5 and OF-17 in discussion. Please include

For all sub-basins flowing off-site that have any land disturbance (see highlighted basins on previous pages): Explain in the narrative how WQ is being addressed for these basins. Possible exclusions include I.6.1.B.7 (land disturbance to undeveloped land that will remain undeveloped) and/or I.6.3.A.1.a (which allows for 20% not to exceed 1 acre of the applicable development site area to not be captured).

For each sub-basin, notate which WQ PCM each basin is tributary to and/or which WQ exclusion applies.

Table 3: Proposed Project Peak Runoff Based on Proposed Project Development Discharge Locations

Tributary Discharge Locations	Tributary Basins	Tributary Area	Impervious	Peak Flows (CFS)*	
		(AC)	(%)	5-Year	100-Year
Pond 1	ON-1, OS-1A, OS-1B, OF-1, OF-2, OF-16, OF-17	22.69	38%	46.35	98.27
Pond 2	ON-2	10.9	85%	32.19	60.64
Pond 3	ON-3, OS-3A	8.81	42%	11.04	26.49
Offsite Bypass to 24" Culvert	ON-7, OF-11, OF-12	3.66	20%	4.23	12.24
Offsite Bypass to 18" Culvert	ON-6, OF-9, OF-10	4.94	0%	1.38	10.14
Offsite Bypass to 42" Culvert	ON-4, ON-5, OF-3 through OF-6, OF-8	22.72	6%	8.34	44.1
Offsite Bypass to 36" Culvert	OF-7	1.52	3%	0.41	3.02
Offsite Roadway flowing Offsite	OF-13 through OF-15	2.78	20%	3.06	9.8
TOTAL		**73.03**		**52.35**	**241.95**

DESIGN POINT COMPARISON ANALYSIS

This section will be reviewed with next submittal when full proposed hydrology calculations have been provided

24" Culvert

The 24" Culvert is located in the northeast corner of Sub-basin OF-12 and is at the outfall of proposed Full Spectrum Detention Pond 1 in the final condition. The flow entering the 24" culvert consists of the outfall from Pond 1 and runoff from the adjacent on-ramp and Palmer Divide Avenue. The outfall structure is designed to release flows from the EDB at less than or equal to historic rates. See **Appendix D** for outlet structure design. A localized low point is proposed at the culvert to match existing patterns. A downstream analysis of this culvert was completed and is discussed within the "CDOT Right-of-Way Analysis" section of this report. A table summarizing the existing historic flows and proposed flows for the 100-year event, at the 24" Culvert are presented here below.

Project Phase	Existing Rational Method Peak Inflow 100-YR (cfs)	Detained Outflow - 100 YR (cfs)	Undetained Outflow – 100 YR (cfs)	Total Outflow -100 YR (cfs)
Final Condition	22.51	12	12.24	24.24

In the final conditions, the EDB will limit the peak flow at the 24" Culvert to be less than the historic condition.

18" Culvert

The 18" Culvert is located on the eastern property edge, near the north portion of the Site, in the center of Subbasin OF-9 in the final condition. The basin flows going to the 18" Culvert are less than or equal to historic rates. A table summarizing the existing historic flows and proposed flows for the 100-year event, at the 18" Culvert are presented here.

Project Phase	Existing Rational Method Peak Inflow 100-YR (cfs)	Detained Outflow - 100 YR (cfs)	Undetained Outflow – 100 YR (cfs)	Total Outflow -100 YR (cfs)
Final Condition	12	0	10.14	10.14

In the final conditions, the peak flow at the 18" Culvert will be limited to be less than the historic condition.

42" Culvert
The 42" Culvert is located on the eastern property edge, near the center of the Site, in the center of Subbasin ON-5 and is at the outfall of proposed Full Spectrum Detention Pond 2 in the final condition. The outfall structure is designed to release flows from the EDB at less than or equal to historic rates. To prevent water from filling up in the channel and overflowing into the 18" Culvert, in the post-development condition, a pool was graded into the channel at the invert of the 42" culvert to hold more water so it can discharge more water through the 42" culvert. A table summarizing the existing historic flows and proposed flows for the 100-year event, at the 42" Culvert are presented here.

Project Phase	Existing Rational Method Peak Inflow 100-YR (cfs)	Detained Outflow - 100 YR (cfs)	Undetained Outflow – 100 YR (cfs)	Total Outflow -100 YR (cfs)
Final Condition	117.2	21.4	44.1	65.5

In the final conditions, the EDB's (Pond 2 and Pond 3) will limit the peak flow at the 42" Culvert to be less than the historic condition.

36" Culvert
The 36" Culvert is located on the eastern property edge, south of the Site. Flows to this culvert do not change from the existing condition to the proposed condition and are provided as reference.

A table summarizing the existing historic flows and proposed flows for the 100-year event, at the 36" Culvert are presented here.

Project Phase	Existing Rational Method Peak Inflow 100-YR (cfs)	Detained Outflow - 100 YR (cfs)	Undetained Outflow – 100 YR (cfs)	Total Outflow -100 YR (cfs)
Final Condition	2.55	0	2.55	2.55

DESIGN CRITERIA

REFERENCES

The El Paso County Drainage Criteria Manual (the "Criteria"), The El Paso Engineering Criteria Manual (the "ECM"), Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014 (the "Colorado Springs Manual") and the "Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual" Volumes 1, 2, and 3 (the "Manual"), from the Mile High Flood District (MHFD), with the latest revisions, were used in preparing the stormwater calculations. Weighted impervious values were calculated and used for the project area in accordance with the Criteria and the Manual.

Site drainage is not significantly impacted by such constraints as utilities or existing development.

The Approved Beacon Lite Road Improvements Drainage Report was prepared in February 2022 and outlines drainage improvements on Beacon Lite Road from Palmer Divide Ave to south of Wakonda Way. Additional information on this report is included below:

Drainage improvements from the Approved Beacon Lite Road Improvements Drainage Report within the limits of the proposed Project were included to relay off-site runoff from the west of Beacon Lite Road around the Project and to their ultimate outfall at Interstate 25. These improvements include swales along the west of Beacon Lite Road as well as driveway and under-road culverts. The culverts are generally shown per the sizing and at the locations provided in the Beacon Lite Road Improvements Drainage Report as the areas of off-site drainage they are conveying will remain undisturbed as part of the Project.

From the Beacon Lite Road Improvements Drainage Report:

The northern portion of the Project is a rural roadway section with no curb and gutter. Stormwater runoff from the roadway on the west will be collected in roadside ditches where it will combine with offsite flows coming towards the roadway from the west. The ditches will be conveyed under Beacon Lite Road to the east in cross culverts to conserve existing flow conditions to the extent possible. Roadway runoff on the east will sheet flow following existing drainage patterns.

This is the same general drainage approach proposed with this development. This development will utilize both inlets in roadside ditches and curb inlets to convey flows. The development of the Buc-ee's parcel necessitates conveyance of these flows east of Beacon Lite Road around the project site as there are no improvements proposed west of Beacon Lite Road with this project. A portion of these off-site flows are conveyed north to Pond 1 and will be treated and detained. A portion of these off-site flows are conveyed around the southern portion of the Buc-ee's development via closed pipe bypass system. All improvements on Beacon Lite Road from Palmer Divide Avenue to the southern property line of the Buc-ee's parcel are part of this development. Bypass pipe sizing calculations are provided in **Appendix C**.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and peak runoff for the proposed drainage system per chapter 6 of the Criteria. Table 6-2 of the Criteria is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the Criteria and Manual. Runoff coefficients for the proposed development were determined using Table 6-6 of the Criteria by calculating weighted impervious values for each specific site basin. Hydrologic calculations can be found in **Appendix C** of this report.

HYDRAULIC CRITERIA

The Project will construct public and private storm sewer to capture additional runoff generated in the proposed conditions and bypass existing off-site flows outside of the Project limits that are conveyed through the site in the existing condition. These inlets and pipes are shown and sized using StormCAD. A portion of the developed flows from the public roadway improvements will be conveyed to a portion of three proposed private water quality and detention ponds located within the Site. Applicable design methods were utilized to size the proposed ponds, and culverts, which includes the use of the UD-Detention spreadsheet, rational calculations spreadsheet, and FlowMaster, V8i software.

Proposed Drainage features on-site have been analyzed and sized for the following design storm events:

- Major Storm: 100-year Storm Event

Drainage features should be analyzed using the minor and major storm events.

To maintain historic flows, three private, full-spectrum detention ponds are proposed on this Project to provide water quality treatment and detention of the Site, a majority of the Roadway areas, and a portion of the off-site flows.

Three full spectrum extended detention basins are proposed in order to maintain historic flows and water quality. Mile High Flood District UD-Detention Spreadsheet was utilized to design the pond outlet structures. The three full spectrum extended detention basins are to be owned and maintained by Buc-ee's LTD. The UD-Detention spreadsheets used to calculate WQCV have been included in the **Appendix**. Detailed pond and outlet structure design can be found in the **Appendix**. A pond summary table can be found below

Roadside ditches are provided along the proposed roadways to route flows to the proposed culverts. The roadside ditches are sized to convey the major event flow. Culverts were sized to convey flows from the ditches and channels, underneath the off-site driveways. The proposed culverts range from 18" to 24" and have been designed to convey the 100-year storm event.

Inlets and storm drain pipes are designed to carry flows to the three Ponds onsite. The inlets capturing the largest amount of flow in each basin have been evaluated and calculations are provided in the **Appendix**. Storm drain pipes calculations will be provided as a part of subsequent submittals.

Emergency overflows will be routed through the overflow weirs located within the outlet structure of the Ponds. Flows will follow existing drainage conditions and flow to the ultimate culvert discharge locations to the east that eventually contribute to Greenland Ranch Creek to the northeast. The CDOT Drainage Ditch has sufficient capacity such that CDOT ROW is not overtopped, see **Appendix** for calculations.

DETENTION

The proposed Roadway improvements will consist of the construction of a roundabout, full-depth roadway improvements and expansion, and paving of Beacon Lite Road. The proposed Site development will consist of the construction of a new building, multiple fuel pumps, parking lot, sidewalk, landscaping, private storm sewer infrastructure, a private lift station, private sanitary infrastructure, and water wells with associated treatment and pumping infrastructure. Developed runoff will discharge to three proposed private full-spectrum water quality and detention ponds located on the Site, which will convey detained flows through a series of ditches and closed conveyance systems along and under Interstate 25 and ultimately discharge to Greenland Ranch Creek. The three proposed private full-spectrum water quality and detention ponds will be owned and maintained by the owner.

The Project area was divided into three portions – the Site, the Roadway, and Offsite. The Site area consists of the Buc-ee's development that will discharge into one of the three proposed private full spectrum water quality and detention ponds, Pond 1, Pond 2, or Pond 3. The Roadway area consists of Palmer Divide Ave and Beacon Lite Road improvements. Drainage from a portion of Palmer Divide Ave and Beacon Lite Road along the limits of the Project will discharge into Pond 1, and the remainder of Beacon Lite Road drainage will discharge to Pond 3. The Offsite area consists of surrounding land that will follow historic drainage patterns to proposed culverts under Beacon Lite Road which will convey flow one of two ways: 1) into Pond 1 to be treated and detained in order to slow down the water before discharging to the 24" Culvert ,or 2) around the Project site via closed conveyance systems to the south and ultimately to the discharge points at Interstate 25.

The outflows from the three proposed private full spectrum water quality and detention ponds will outfall into existing CDOT Drainage Ditches along the western side of Interstate 25 that are ultimately conveyed northeast of the Interstate 25/Palmer Divide Avenue interchange and ultimately discharge to Greenland Ranch Creek.

The first detention pond is on the north side of the Site and is referred to as "Pond 1" in this report, with a required volume of 1.742 ac-ft and a proposed volume of 2.388 ac-ft (at the 100-year water surface elevation) and designed for the 100-year storm event. Pond 1 has a total volume of 9.707 ac-ft and is large

enough to detain the 500-year storm event. The cut generated from Pond 1 will be used as fill on-site as appropriate. With a discharge rate of 12 cfs, water from the Pond 1 ultimately outfalls to the 24" Culvert located at the northeast corner of the site and ultimately out falling to Greenland Ranch Creek. The following proposed Sub-Basins are tributary to Pond 1: ON-1, OS-1A, OS-1B, OF-1, OF-2, OF-16, OF-17. Calculations detailing the contributing area and the Pond 1 design details can be found in **Appendix C and D**.

The second detention pond is on the east side of the Site and is referred to as "Pond 2" in this report, with a required volume of 1.552 ac-ft and a proposed volume of 1.467 ac-ft (at the 100-year water surface elevation) and designed for the 100-year storm event. Pond 2 has a total volume of 3.477 ac-ft. With a discharge rate of 11.7 cfs, water from the Pond 2 ultimately outfalls to the 42" Culvert located east of the site and ultimately out falling to Greenland Ranch Creek. The following proposed Sub-Basins are tributary to Pond 2: ON-2. Calculations detailing the contributing area and the Pond 2 design details can be found in **Appendix C and D**.

The third detention pond is on the east side of the Site and is referred to as "Pond 3" in this report, with a required volume of 0.771 ac-ft and a proposed volume of 0.730 ac-ft (at the 100-year water surface elevation) and designed for the 100-year storm event. Pond 3 has a total volume of 1.855 ac-ft. With a discharge rate of 0.7 cfs, water from the Pond 2 ultimately outfalls to the 42" Culvert located east of the site and ultimately out falling to Greenland Ranch Creek. The following proposed Sub-Basins are tributary to Pond 3: ON-3 and OS-3A. Calculations detailing the contributing area and the Pond 3 design details can be found in **Appendix C and D**.

Pond	Contributing Basins	Total Contributing Basin Area (Acre)	WQCV (Ac-ft)	Total Volume Required (Ac-ft)	Total Volume Provided (Ac-ft)	100-YR Pond Outfall (CFS)
P1	ON-1, OS-1A, OS-1B, OF-1, OF-2, OF-16, OF-17	22.69	0.330	1.742	9.707	12.0
P2	ON-2	10.9	0.329	1.552	3.477	11.7
P3	ON-3, OS-3A	8.81	0.144	0.771	1.855	9.7

WQCV

Some areas within the on-site improvements do not have water quality provided due to site grading constraints. In-order to provide adequate detention and treatment for the stormwater entering the site, additional offsite flows have been captured to be treated and detained, rather than by-passing the site. The comparison of undetained onsite flows and detained offsite flows is shown in the table below.

	Contributing Basins	Total Contributing Basin Area (Acre)	Peak Flow 5 YR (CFS)	Peak Flow 100 YR (CFS)
Undetained Onsite Flows	ON-4, ON-5, ON-6, ON-7	2.15	0.72	5.3
Detained Offsite Flows	OF-1, OF-2, OF-16, OF-17	10.4	5.25	21.2

Oil/Water Separation

These need to be shown and labeled on basin map

include details with CDs and O&M with the PCM O&M Manual

Three Downstream Defender Oil/Water Separation systems are proposed on-site. These Downstream Defenders are proposed directly upstream of each proposed pond. The Downstream Defenders are sized per MHFD for the 80th percentile storm event, or the 2-year storm event. The device upstream of Pond 1 will treat flows from Basin ON-1 which has a peak 2-year flow of 6.73 cfs. The device upstream from Pond 2 will treat flows from Basin ON-2 which has a peak 2-year flow of 24.92 cfs. The device upstream from Pond 3 will treat flows from Basin ON-3 which has a peak 2-year flow of 8.61 cfs. Per the Downstream Defender specification in Appendix C, each device has capacity to treat up to 25 cfs and the remaining flows will bypass the system in larger storm events. Details for these Downstream Defenders are included as a part of the Appendix.

CDOT RIGHT-OF-WAY ANALYSIS

In the pre-development condition, drainage from the site is conveyed west to east and collects in a roadside channel to the west of the Interstate 25 southbound on-ramp. There are 3 culverts under this on-ramp: a 24-inch culvert, an 18” culvert, and a 42” culvert that convey flow from the channel, under the interstate, and ultimately to an outfall northeast of the I-25/Palmer Divide Avenue interchange via a series of culverts and channels.

This network will remain in place in the post-development condition and has been analyzed for the 100-year storm to ensure that the proposed development will not negatively impact this existing infrastructure. An EPA SWMM model was used for this analysis.

Seven points of analysis were analyzed to compare the pre- and post-development conditions. These points are identified below:

Table 11 – CDOT Off-Site Analysis Element Identification

Description	Pre-Development Model ID	Post-Development Model ID
Inflow to 24” Culvert	OS-1	OF-11
Inflow to 18” Culvert	OS-2	OF-9
Inflow to 42” Culvert	OS-3	OF-8
Flow overtopping SB on-ramp	C35	C35
Flow Bypassing 42” Culvert towards 18” Culvert	C26	C26
Existing wetlands east of interchange	C11, C13	C11, C13
Outfall (NE of Interchange)	Outfall	Outfall

The existing channel as well as the adjacent I-25 southbound on-ramp has an ultimate low point at the location of the 18” culvert. The existing model indicated that this location is overtopping in the 100-year, pre-development event.

Localized low points exist at the location of the 24” and 42” culverts in the channel. The existing model indicates that as the channel fills up at the 42” culvert, water is conveyed to the low point at the 18” culvert reducing the effectiveness of the 42” culvert. To mitigate this in the post-development condition, a pool was graded into the channel at the invert of the 42” culvert to hold more water so it can discharge more water through the 42” culvert. Pond 2 and the site bypass pipe both discharge in this location. The HGL increases at this location in the post-development condition due to the additional storage. Without this storage, water would flow to the 18” culvert and overtop the southbound off-ramp.

There is an increase in flow to the 24” culvert, however the max flow is within the capacity of the 24” pipe. The flow entering the 24” culvert consists of the outfall from Pond 1 and runoff from the adjacent on-ramp and Palmer Divide Avenue, therefore no additional unmodeled flow would contribute to this pipe.

Indicate what the new flow is and how much it has increased. What are the impacts to the downstream facilities of the 24" culvert due to the increase

ultimately any increase in flows will need to be coordinated with CDOT

Calculations are provided in Appendix D showing the capacity of this culvert is sufficient for the increased flow. What about downstream of the culvert?

The downstream wetlands were also analyzed to ensure that they would not experience erosive velocities in the post-development condition, and also to ensure they will not be "starved" of water. These wetlands were modeled as two separate channels due to variations in channel geometry and are identified in both the pre- and post-development models as conduits C11 and C13. Though the velocity increases slightly in the post-development condition, the resulting velocities are below 5 ft/s and non-erosive.

At the ultimate outfall modeled, which is northeast of the interchange and just north of the existing service road, the maximum flow out is reduced in the post-development condition.

Generally, the post-development condition improves the pre-development condition. A summary of these results is provided in the table below, and a full report of the calculations is provided in **Appendix C.**

Table 12 – CDOT Off-Site Analysis Summary Table

OFFSITE DRAINAGE ANALYSIS SUMMARY								
NAME		ELEMENT	DESCRIPTION	PRE-DEVELOPMENT		POST-DEVELOPMENT		DELTA
PRE-DEV MODEL	POST-DEV MODEL							
OS-3	OF-8	Junction	Inflow to 42" culvert	168.9	CFS	66.7	CFS	-102.2
			HGL	7311.05	FT	7312.00	FT	0.95
OS-2	OF-9	Junction	Inflow to 18" culvert	141.0	CFS	56.6	CFS	-84.4
			HGL	7307.37	FT	7310.83	FT	3.46
OS-1	OF-11	Junction	Inflow to 24" culvert	22.5	CFS	24.0	CFS	1.5
			HGL	7312.05	FT	7311.5	FT	-0.55
C35	C35	Conduit	Flow (18" bypass)	118.1	CFS	34.2	CFS	-83.9
C26	C26	Conduit	Flow (from 42" to 18")	111.8	CFS	23.4	CFS	-88.4
C13	C13	Conduit	Velocity	2.11	FT/S	2.17	FT/S	0.06
C11	C11	Conduit	Velocity	2.31	FT/S	4.53	FT/S	2.22
Outfall	Outfall	Outfall	Max flow out	151.0	CFS	100.9	CFS	-50.1

Due to the expansion of the Interstate 25 southbound on-ramp, the existing channel has been regraded and generally expanded, and the existing c[illegible]ecessary to daylight at the proposed location of the channel.

label this on the drainage map.

The proposed channel was analyzed for the 100-year emergency overflow event in the case that the outlet control structure gets clogged. The channel was modeled in Flowmaster using the undetained 100-year event for each pond, plus the tributary area from offsite that sheetflows into the channel from the southbound on-ramp. In both cases, the proposed channel has the capacity to convey the emergency event. Channel capacity calculations have been provided in **Appendix C**. The channel has a minimum 1-foot freeboard from the top of the channel adjacent to the CDOT ROW in a hundred-year storm event. The channel has sufficient capacity to convey the 100-year storm without overtopping the CDOT ROW in a storm event.

FOUR-STEP PROCESS

The Project was designed in accordance with the four-step process to minimize adverse impacts of urbanization, as outlined in the El Paso County Engineering Manual for BMP selection as noted below:

STEP 1: EMPLOY RUNOFF REDUCTION PRACTICES

The Project is proposing a commercial development that will be designed to minimize impact to the current existing terrain. The Project's proposed paved driveways and roadways will increase the Site's impervious area; however, roadside and onsite ditches and swales will be constructed to slow down the runoff velocity

The criteria states:
"may exclude up to 20%, not to exceed 1 ac." 2.15 ac cannot be untreated under EPC's criteria and MS4 Permit. The 1.15 ac above the 1 ac threshold must be treated or otherwise covered with applicable exclusions.

and reduce runoff peaks. The three proposed detention ponds will be used to capture stormwater, provide water quality treatment, and maintain flows discharging off site at or below historic levels.

STEP 2: PROVIDE WATER QUALITY CAPTURE VOLUME

Permanent water quality measures and detention facilities will be necessary for the Project. Three (3) Full Spectrum Extended Detention Basins will treat developed areas and areas not excluded with either the Large Lot or 20% exclusion. Per ECM Appendix I Section 1.7.C.1.a., 20% of the development site or less than 1 acre can be excluded from providing water quality. As mentioned, 2.15 acres of the 30.8 acre parcel will not be able to be treated which is less than 20% of the overall site. In-order to offset the impacts of this and provide adequate detention and treatment for the stormwater entering the site, an additional 10.4 acres of offsite flows have been captured to be treated and detained, rather than by-passing the site.

The current criteria section is I.6.3.A.1.a

STEP 3: STABLIZE DRAINAGEWAYS

Stabilizing proposed roadside ditches and channels by designing them with slopes that control the flow rates. Placement of riprap upstream and downstream of culverts and pipe outfalls to help reduce erosion. Historic flows to existing outfall pipes crossing under I-25 are decreased in the proposed condition which will reduce overall flow and erosion.

STEP 4: IMPLEMENT SITE SPECIFIC AND OTHER SOURCE CONTROL BMPS

The erosion control construction BMPs of the Project were designed to reduce contamination. Source control BMPs include the use of vehicle tracking control, culvert protection, stockpile management, and stabilized staging areas.

DRAINAGE PLAN

GENERAL DRAINAGE CONCEPT

The proposed drainage patterns will match the historic patterns. To maintain historic flows, three full spectrum detention ponds are being proposed and will capture and control the flows from the proposed development at less than or equal to historic rates.

CONCLUSIONS

DRAINAGE FEES

The Project is within the Bald Mountain Drainage Basin (PLPL0200) which is part of the El Paso County Drainage Basin Fee Program. The 2026 Drainage Fee for this Basin is $13,554 per impervious acre. There are 20.3 impervious acres proposed on-site totaling $275,147 in Drainage Fees.

Include statement that drainage fees are not paid, as this is not a platting action.

SUMMARY

This report has been prepared in accordance with El Paso County stormwater criteria. It outlines the Site design for the 5-year and 100-year storm events drainage system. The drainage design presented within this report conforms to the criteria presented in the El Paso County Criteria. The Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments.

REFERENCES

Beacon Lite Road Improvements Drainage Report, El Paso County, February 3, 2022

El Paso County Drainage Criteria Manual, Vol. 1 and 2, October 1994

El Paso County Engineering Criteria Manual, December 2004, Revised 2016

Urban Storm Drainage Criteria Manual, Volume 1-3, Mile High Flood District, June 2001 with latest revisions.

National Wetlands Inventory, U.S. Department of the Interior, Fish and Wildlife Service, 1984.

Custom Soil Resource Report, Natural Resources Conservation Service, United State Department of Agriculture. Web Soil Survey. December 2024.

Flood Insurance Rate Map, Number 08041C0065G and Number 08041C0276G, Federal Emergency Management Agency, December 7, 2018.

Include a cost estimate for each PCM with line items for all components (ex: riprap, road base, forebay, trickle channel, outlet structure, outlet pipe, spillway, etc). Input the total value into the FAE form under “Permanent Pond/BMP (provide engineer’s estimate)” in Section 1. The total should not include grading, which is a separate line item in Section 1: “Earthwork.” The cost estimate should include labor costs (as a separate line item or added into the cost of each component).

APPENDIX A

Label appendices title sheets

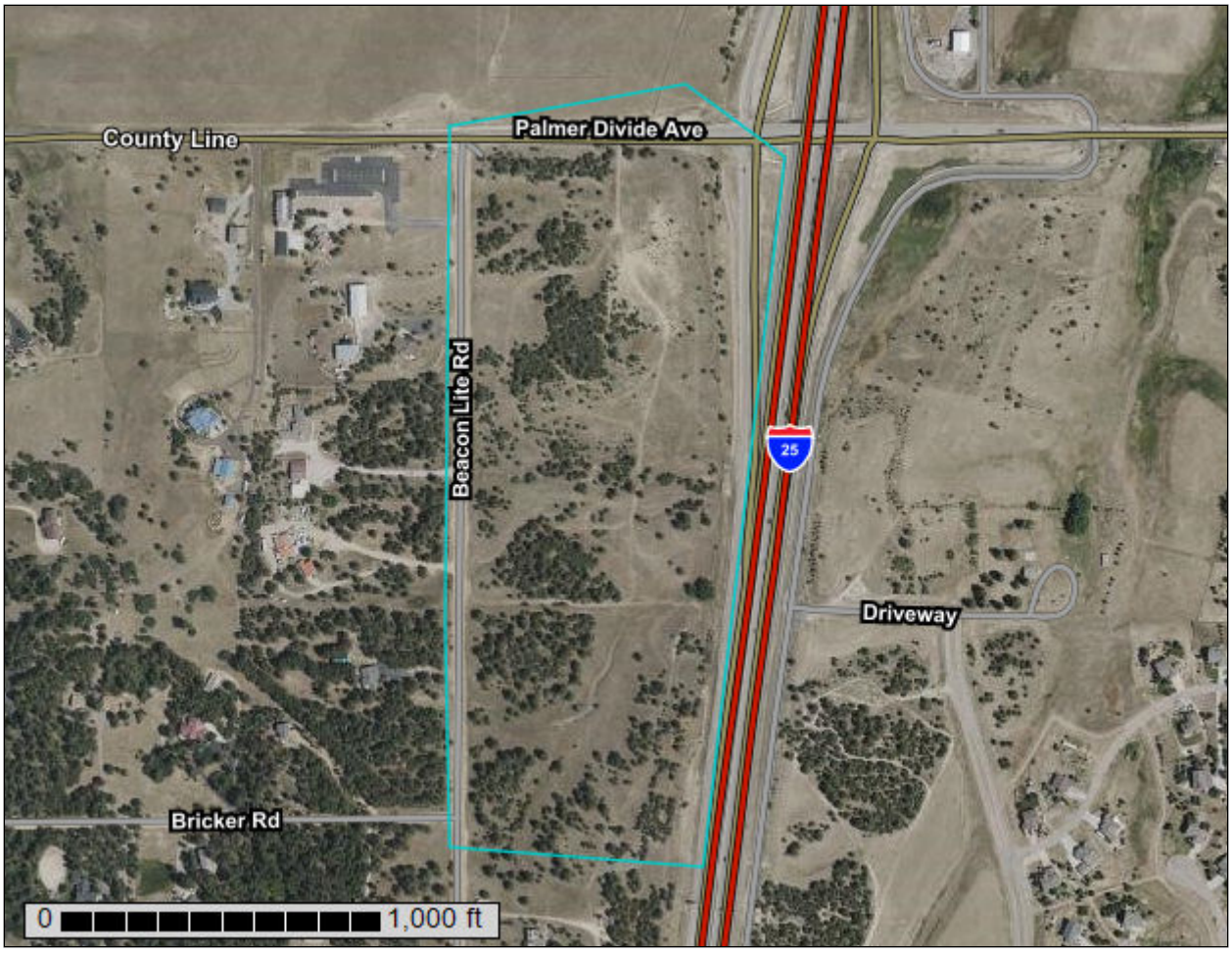
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Castle Rock Area, Colorado, and El Paso County Area, Colorado



March 27, 2026

Preface

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

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

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

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

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

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

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

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

Contents

Preface..... 2
How Soil Surveys Are Made.....5
Soil Map..... 8
Soil Map.....9
Legend.....10
Map Unit Legend..... 12
Map Unit Descriptions..... 12
Castle Rock Area, Colorado..... 14
PpE—Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes..... 14
PrE2—Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded... 16
El Paso County Area, Colorado.....19
69—Peyton-Pring complex, 8 to 15 percent slopes..... 19
92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes.....20
References.....23

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

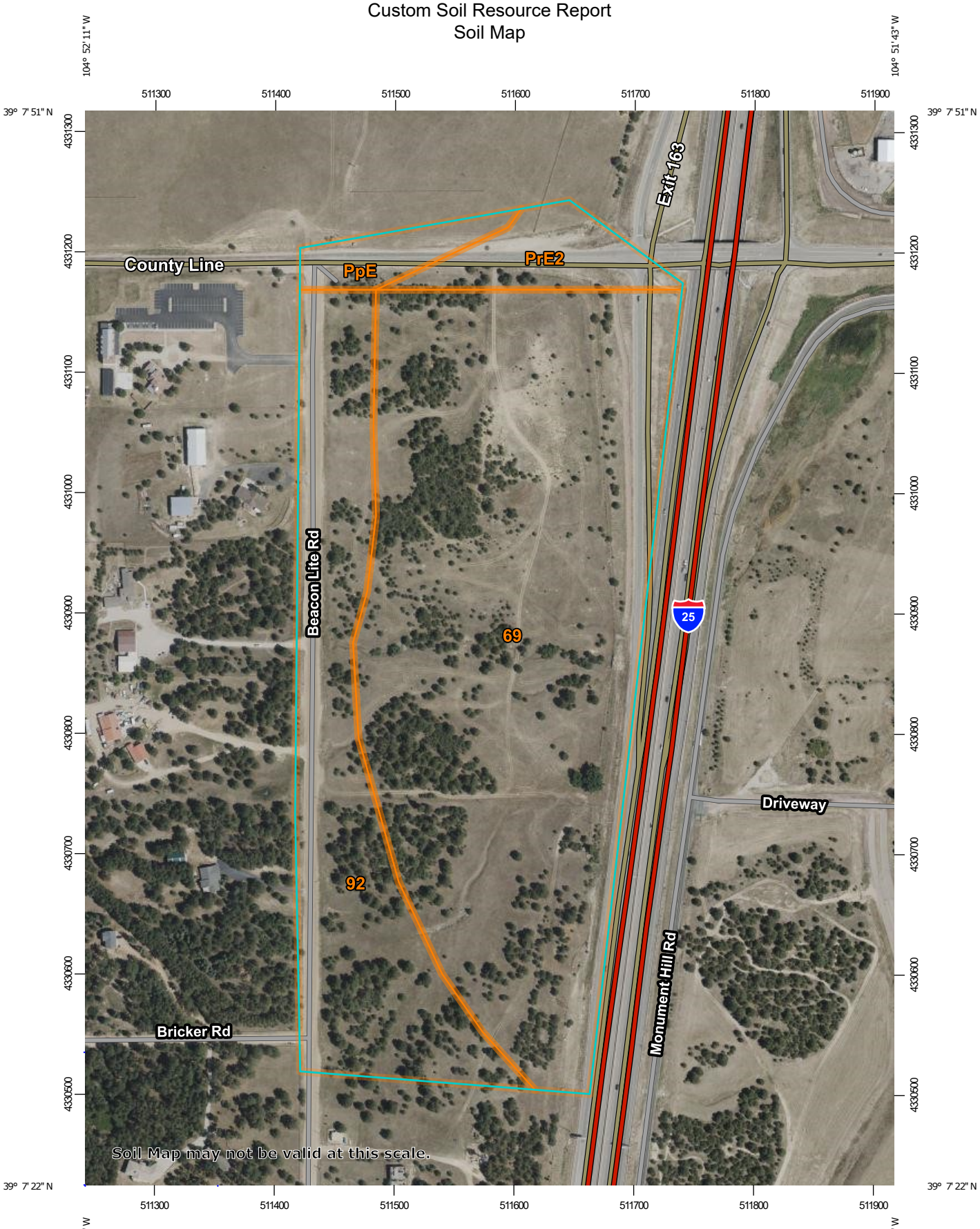
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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

Soil Map

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

Custom Soil Resource Report
Soil Map



Map Scale: 1:4,350 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 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: Castle Rock Area, Colorado
Survey Area Data: Version 18, Aug 29, 2025

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 23, Aug 29, 2025

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

MAP LEGEND

MAP INFORMATION

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
PpE	Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes	1.5	2.9%
PrE2	Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded	2.5	5.0%
Subtotals for Soil Survey Area		**4.0**	**7.9%**
Totals for Area of Interest		**50.2**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
69	Peyton-Pring complex, 8 to 15 percent slopes	33.4	66.6%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	12.8	25.5%
Subtotals for Soil Survey Area		**46.2**	**92.1%**
Totals for Area of Interest		**50.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a

given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Castle Rock Area, Colorado

PpE—Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes

Map Unit Setting

National map unit symbol: jqzn
Elevation: 6,500 to 8,000 feet
Mean annual precipitation: 15 to 18 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 115 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent
Crowfoot and similar soils: 25 percent
Pring and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting

Landform: Less sloping tops of ridges, Valley sides
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Weathered alluvium derived from arkose

Typical profile

H1 - 0 to 11 inches: sandy loam
H2 - 11 to 30 inches: sandy clay loam
H3 - 30 to 40 inches: sandy loam
H4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Less sloping tops of ridges, Valley sides

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from arkosic sedimentary rock

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 19 inches: loamy sand
H3 - 19 to 32 inches: gravelly sandy clay loam
H4 - 32 to 43 inches: gravelly sandy loam
H5 - 43 to 60 inches: coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Base slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkosic sedimentary rock

Typical profile

H1 - 0 to 12 inches: sandy loam
H2 - 12 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 5 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Minor Components

Brussett
Percent of map unit: 3 percent
Hydric soil rating: No

Jarre
Percent of map unit: 3 percent
Hydric soil rating: No

Tomah
Percent of map unit: 3 percent
Hydric soil rating: No

Aquic haploborolls
Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

PrE2—Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded

Map Unit Setting
National map unit symbol: jqzp
Elevation: 6,500 to 8,000 feet
Mean annual precipitation: 15 to 18 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 115 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition
Peyton, eroded, and similar soils: 40 percent
Pring, eroded, and similar soils: 25 percent
Crowfoot, eroded, and similar soils: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton, Eroded

Setting
Landform: Mesas, Plateaus
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Weathered alluvium derived from arkose

Typical profile

H1 - 0 to 11 inches: sandy loam
H2 - 11 to 30 inches: sandy clay loam
H3 - 30 to 40 inches: sandy loam
H4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Pring, Eroded

Setting

Landform: Mesas, Plateaus
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkosic sedimentary rock

Typical profile

H1 - 0 to 12 inches: gravelly sandy loam
H2 - 12 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Description of Crowfoot, Eroded

Setting

Landform: Mesas, Plateaus
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from arkosic sedimentary rock

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 19 inches: loamy sand
H3 - 19 to 32 inches: gravelly sandy clay loam
H4 - 32 to 43 inches: gravelly sandy loam
H5 - 43 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Kippen

Percent of map unit: 8 percent
Hydric soil rating: No

Truckton

Percent of map unit: 7 percent
Hydric soil rating: No

El Paso County Area, Colorado

69—Peyton-Pring complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 369g
Landscape: Uplands
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 45 percent
Pring and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting

Landscape: Uplands
Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 12 inches: sandy loam
Bt - 12 to 25 inches: sandy clay loam
BC - 25 to 35 inches: sandy clay loam
C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 8 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Pring

Setting

Landform: Hills

Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 15 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b9
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Alluvial fans, Hills
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
Bt - 22 to 48 inches: stratified coarse sand to sandy clay loam
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Hills, Alluvial fans
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 15 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

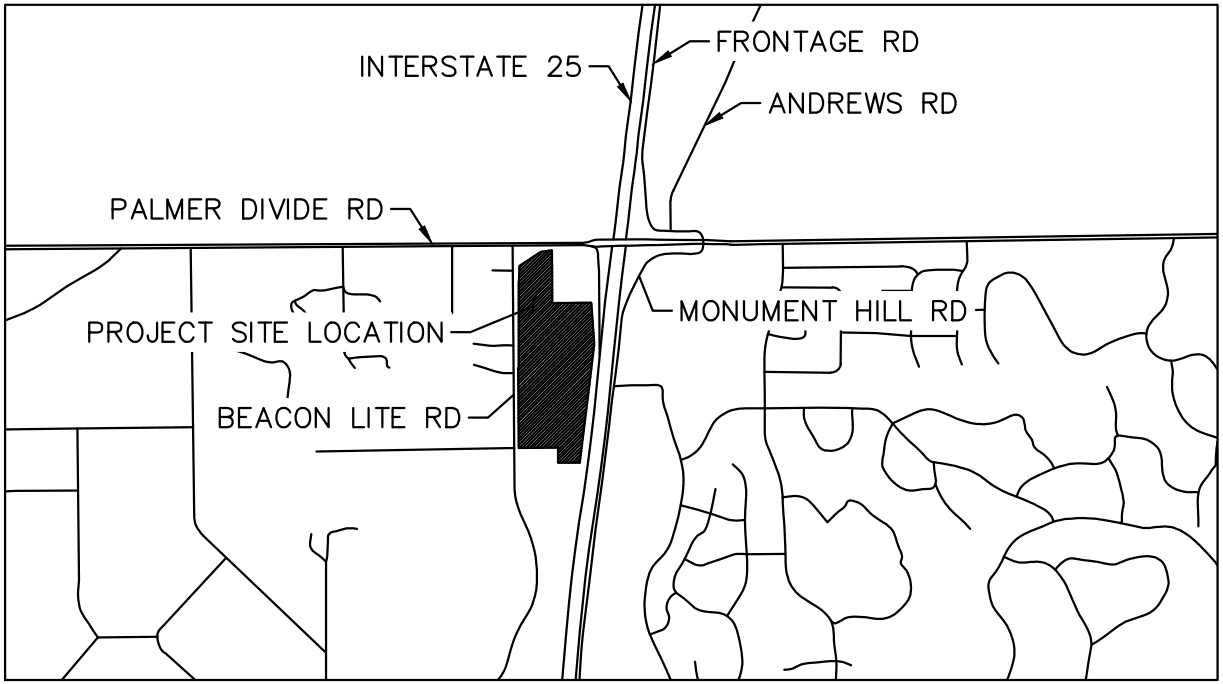
United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

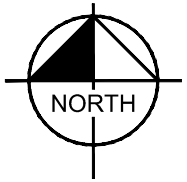
United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf



VICINITY MAP

1" = 1000'



APPENDIX B

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

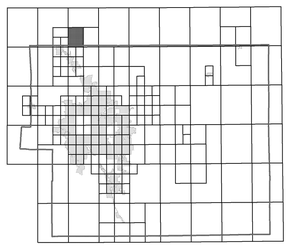
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

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

El Paso County Vertical Datum Offset Table

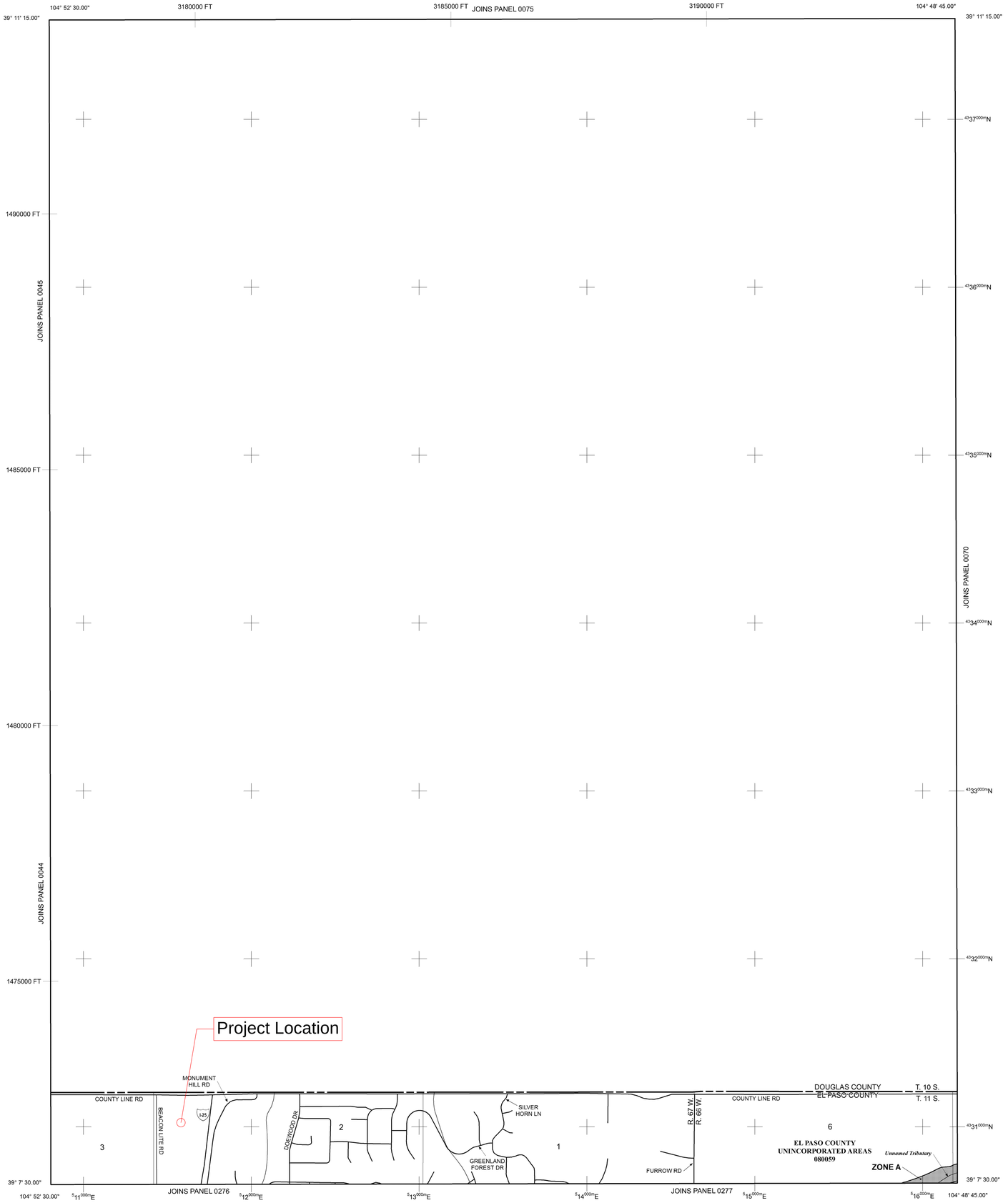
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 66 WEST, AND TOWNSHIP 11 SOUTH, RANGE 67 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A — Cross section line
23 — 23 — Transect line
97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

PANEL 0065G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 65 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0065	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
08041C0065G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

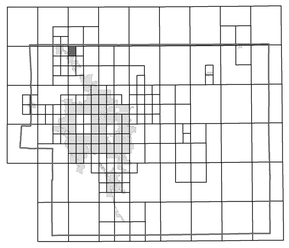
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

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

El Paso County Vertical Datum Offset Table

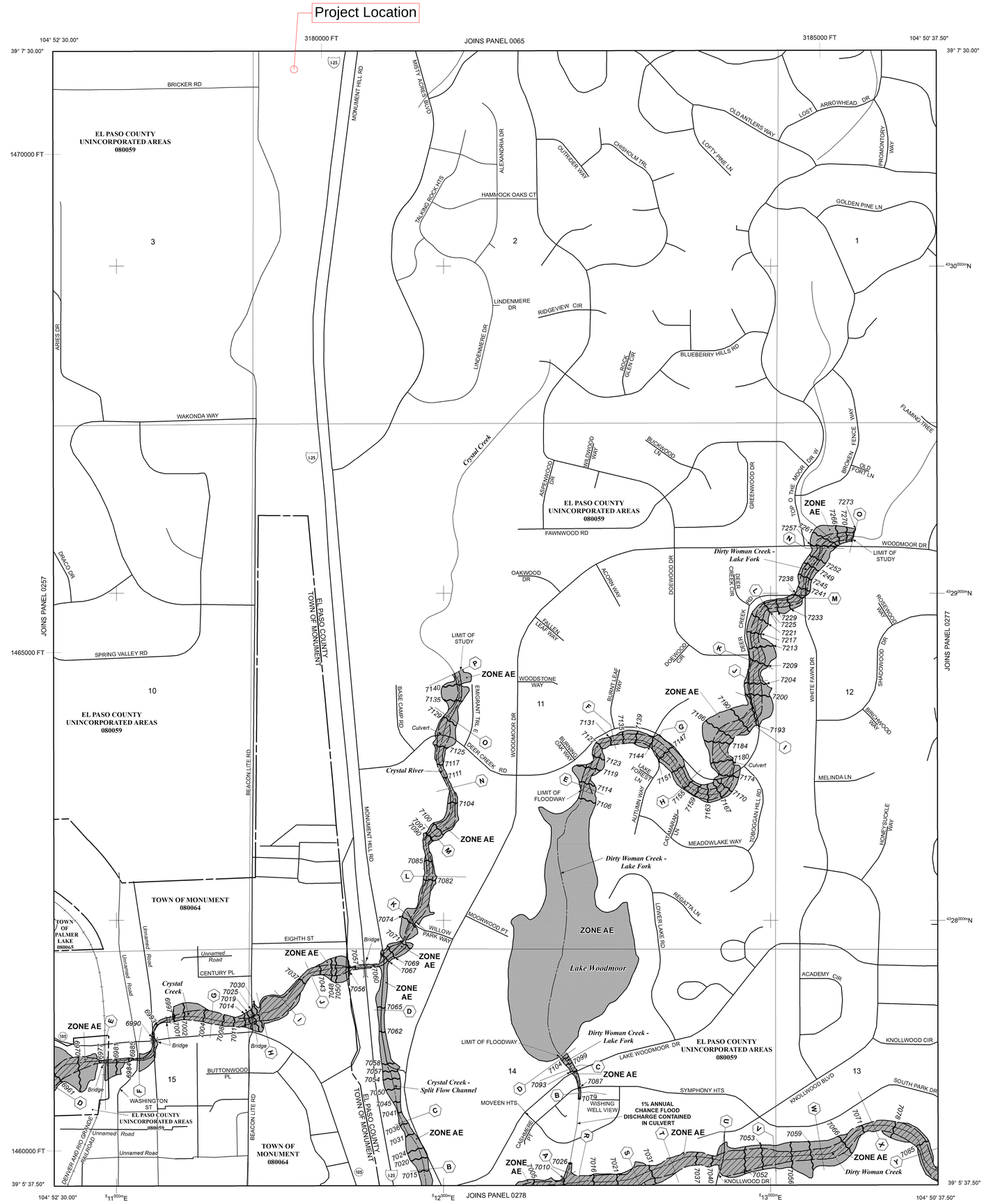
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 67 WEST.

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 equalled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A–A — Cross section line
- 23–23 — Transect line
- 97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0276G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 276 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0276	G
MONUMENT, TOWN OF	080064	0276	G
PALMER LAKE, TOWN OF	080065	0276	G

Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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.

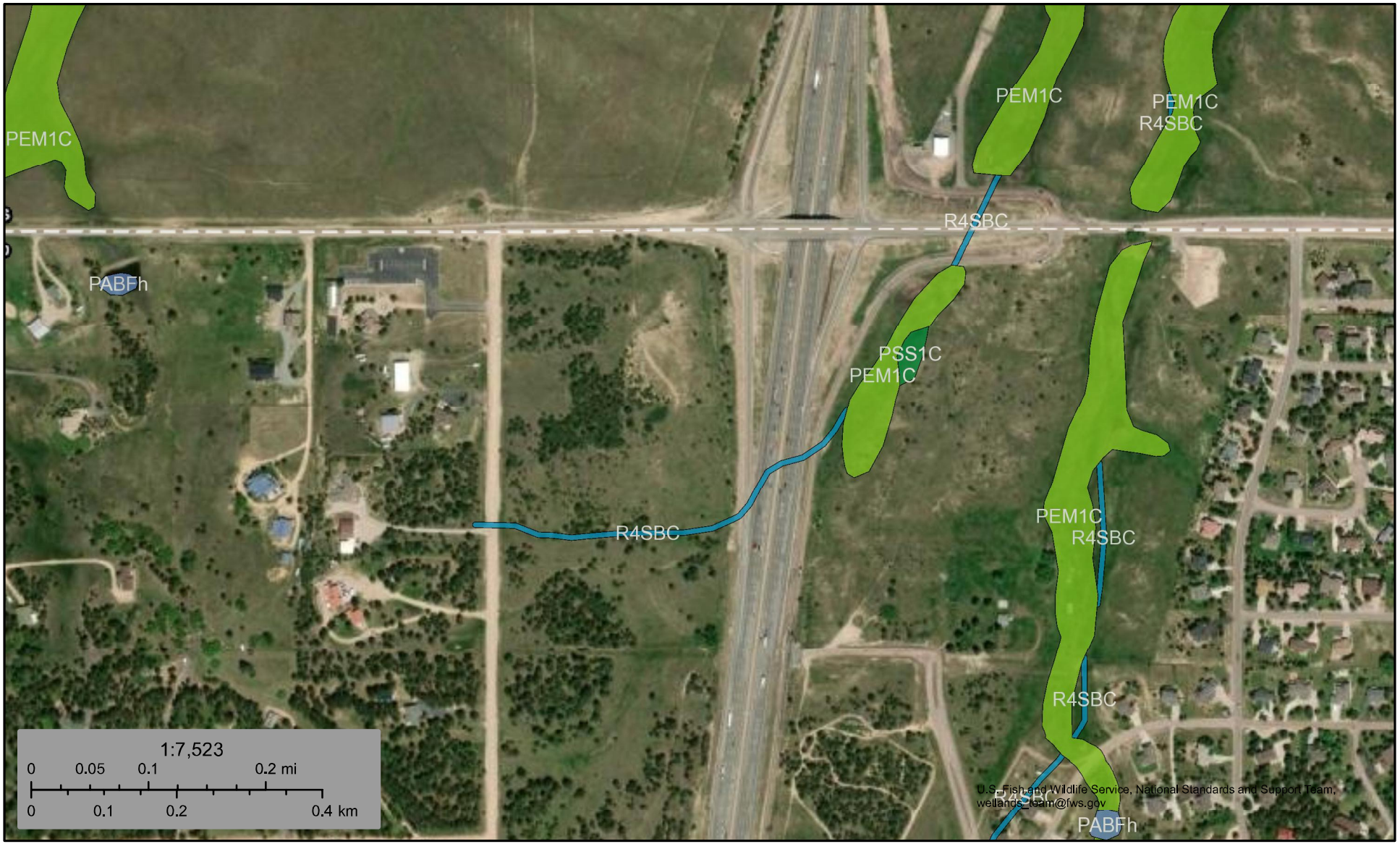
MAP NUMBER
08041C0276G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

U.S. Fish and Wildlife Service

National Wetlands Inventory



February 18, 2025

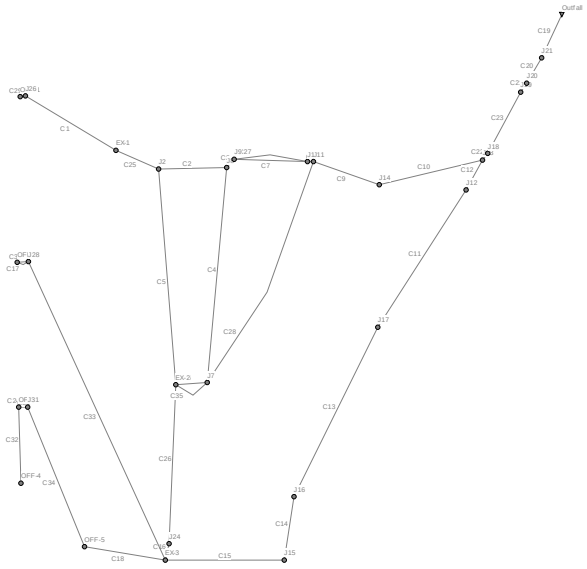
Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

APPENDIX C

06/26/2025 00:01:00



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

****
Element Count
****

Provide summary tables rather than raw SWMM output

Number of rain gages 0
Number of subcatchments ... 0
Number of nodes 29
Number of links 35
Number of pollutants 0
Number of land uses 0

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J10	JUNCTION	7290.35	10.00	0.0	
J11	JUNCTION	7290.30	15.00	0.0	
J12	JUNCTION	7274.12	10.00	0.0	
J13	JUNCTION	7272.98	21.00	0.0	
J14	JUNCTION	7282.59	21.00	0.0	
J15	JUNCTION	7305.64	10.00	0.0	
J16	JUNCTION	7294.00	10.00	0.0	
J17	JUNCTION	7284.00	10.00	0.0	
J18	JUNCTION	7272.95	10.00	0.0	
J19	JUNCTION	7266.85	15.00	0.0	
J2	JUNCTION	7311.00	9.50	0.0	
J20	JUNCTION	7266.00	15.00	0.0	
J21	JUNCTION	7264.75	25.00	0.0	
EX-1	JUNCTION	7311.09	9.50	0.0	Yes
J24	JUNCTION	7309.65	10.00	0.0	
OFF-1	JUNCTION	7369.51	1.50	0.0	Yes
J26	JUNCTION	7367.12	5.50	0.0	
OFF-2	JUNCTION	7350.58	8.00	0.0	Yes
J28	JUNCTION	7349.98	9.00	0.0	
EX-2	JUNCTION	7305.75	8.00	0.0	Yes
OFF-3	JUNCTION	7356.10	8.00	0.0	Yes
J31	JUNCTION	7354.16	9.00	0.0	
OFF-4	JUNCTION	7369.50	5.00	0.0	Yes
EX-3	JUNCTION	7308.84	10.00	0.0	Yes
OFF-5	JUNCTION	7325.06	6.00	0.0	Yes
J7	JUNCTION	7302.24	10.00	0.0	
J8	JUNCTION	7297.73	5.00	0.0	
J9	JUNCTION	7297.70	7.00	0.0	
Outfall	OUTFALL	7264.00	25.00	0.0	

  ****
  Link Summary
  ****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J26	EX-1	CONDUIT	109.8	59.3215	0.0350
C10	J14	J13	CONDUIT	253.7	3.7907	0.0350
C11	J17	J12	CONDUIT	263.7	3.7493	0.0400
C12	J12	J13	CONDUIT	74.6	1.5283	0.0130
C13	J16	J17	CONDUIT	549.2	1.8211	0.0400
C14	J15	J16	CONDUIT	252.0	4.6240	0.0400
C15	EX-3	J15	CONDUIT	284.5	1.1250	0.0100
C16	EX-3	J24	CONDUIT	39.0	-2.0789	0.0100
C17	OFF-2	J28	CONDUIT	31.1	-1.2875	0.0100
C18	OFF-5	EX-3	CONDUIT	423.0	3.8373	0.0350
C19	J21	Outfall	CONDUIT	113.3	0.6622	0.4500
C2	J2	J8	CONDUIT	163.5	8.1422	0.0100
C20	J20	J21	CONDUIT	68.4	1.8278	0.0130
C21	J19	J20	CONDUIT	147.0	0.5782	0.0350
C22	J13	J18	CONDUIT	26.0	0.1154	0.0400
C23	J18	J19	CONDUIT	166.6	3.6642	0.0130
C24	OFF-3	J31	CONDUIT	25.2	3.7317	0.0100
C25	EX-1	J2	CONDUIT	110.5	0.0815	0.0550
C26	J24	EX-2	CONDUIT	382.1	1.0208	0.0100
C27	J9	J10	CONDUIT	177.8	4.1383	0.0100
C28	J7	J11	CONDUIT	592.8		

1.9302	0.0300				
C29		OFF-1	J26	CONDUIT	52.0
4.6010	0.0130				
C3		J8	J9	CONDUIT	169.0
0.0178	0.0100				
C30		OFF-2	J28	CONDUIT	52.8
1.1364	0.0130				
C31		OFF-3	J31	CONDUIT	53.4
3.6354	0.0130				
C32		OFF-4	OFF-3	CONDUIT	500.0
2.6810	0.0450				
C33		J28	EX-3	CONDUIT	767.0
5.3715	0.0350				
C34		J31	OFF-5	CONDUIT	877.0
3.3200	0.0350				
C35		EX-2	J7	CONDUIT	71.7
4.2018	0.0130				
C4		J7	J8	CONDUIT	558.0
0.8083	0.0400				
C5		J2	EX-2	CONDUIT	520.6
1.0086	0.0550				
C6		EX-2	J7	CONDUIT	71.7
4.9013	0.0130				
C7		J9	J10	CONDUIT	154.2
4.7729	0.0100				
C8		J10	J11	CONDUIT	13.8
0.3634	0.0350				
C9		J11	J14	CONDUIT	154.2
5.0072	0.0100				

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	TRIANGULAR	5.50	440.00	2.74	160.00	1	28197.81
C10	TRAPEZOIDAL	21.00	987.00	9.98	89.00	1	37814.85
C11	TRAPEZOIDAL	2.00	18.00	1.15	15.00	1	142.14
C12	CIRCULAR	4.00	12.57	1.00	4.00	1	177.58
C13	PARABOLIC	7.20	1243.20	4.79	259.00	1	17710.73

C14	TRAPEZOIDAL	10.00	760.00	5.28	141.00	1
18419.94						
C15	CIRCULAR	3.50	9.62	0.88	3.50	1
138.73						
C16	TRAPEZOIDAL	5.00	162.50	2.89	55.00	1
7064.26						
C17	TRAPEZOIDAL	3.00	390.00	2.43	160.00	1
11895.31						
C18	TRIANGULAR	6.00	402.00	2.99	134.00	1
6936.12						
C19	TRAPEZOIDAL	25.00	4000.00	13.80	285.00	1
6182.66						
C2	CIRCULAR	2.00	3.14	0.50	2.00	1
83.92						
C20	CIRCULAR	4.00	12.57	1.00	4.00	1
194.20						
C21	TRAPEZOIDAL	15.00	1012.50	8.10	120.00	1
13182.44						
C22	TRAPEZOIDAL	10.00	250.00	5.03	45.00	1
925.91						
C23	CIRCULAR	4.00	12.57	1.00	4.00	1
274.96						
C24	TRAPEZOIDAL	3.00	390.00	2.43	160.00	1
20251.63						
C25	TRIANGULAR	9.50	380.00	4.62	80.00	1
812.98						
C26	TRIANGULAR	2.00	45.00	1.00	45.00	1
673.86						
C27	TRAPEZOIDAL	3.00	390.00	2.43	160.00	1
21326.42						
C28	TRAPEZOIDAL	5.00	200.00	3.53	55.00	1
3192.16						
C29	CIRCULAR	1.50	1.77	0.38	1.50	1
22.53						
C3	TRAPEZOIDAL	2.00	72.00	1.19	60.00	1
160.45						
C30	CIRCULAR	1.50	1.77	0.38	1.50	1
11.20						
C31	CIRCULAR	1.50	1.77	0.38	1.50	1
20.03						
C32	TRIANGULAR	1.00	5.00	0.49	10.00	1
16.81						
C33	TRAPEZOIDAL	4.20	82.32	2.45	32.20	1
1473.21						
C34	TRAPEZOIDAL	2.10	35.49	1.49	23.20	1
357.53						
C35	TRAPEZOIDAL	3.00	390.00	2.43	160.00	1
16530.17						
C4	TRIANGULAR	1.50	11.25	0.74	15.00	1
30.61						
C5	TRIANGULAR	2.00	45.00	1.00	45.00	1

```
121.78
  C6               CIRCULAR            1.50     1.77     0.38     1.50        1
23.26
  C7               CIRCULAR            2.50     4.91     0.62     2.50        1
116.49
  C8               TRIANGULAR          9.20   230.00     4.32    50.00        1
1560.77
  C9               CIRCULAR            3.00     7.07     0.75     3.00        1
194.03


  ****************
  Analysis Options
  ****************
  Flow Units ..............  CFS
  Process Models:
    Rainfall/Runoff ........  NO
    RDII ...................  NO
    Snowmelt ...............  NO
    Groundwater ............  NO
    Flow Routing ...........  YES
    Ponding Allowed ........  NO
    Water Quality ..........  NO
  Flow Routing Method ......  DYNWAVE
  Surcharge Method .........  EXTRAN
  Starting Date ............  06/26/2025 00:00:00
  Ending Date ..............  06/26/2025 12:00:00
  Antecedent Dry Days ......  0.0
  Report Time Step .........  00:01:00
  Routing Time Step ........  5.00 sec
  Variable Time Step .......  YES
  Maximum Trials ...........  8
  Number of Threads ........  4
  Head Tolerance ...........  0.005000 ft


  *************************         Volume         Volume
  Flow Routing Continuity        acre-feet       10^6 gal
  *************************     ---------      ---------
  Dry Weather Inflow .......         0.000          0.000
  Wet Weather Inflow .......         0.000          0.000
  Groundwater Inflow .......         0.000          0.000
  RDII Inflow ..............         0.000          0.000
  External Inflow ..........       136.467         44.470
  External Outflow .........       127.152         41.434
  Flooding Loss ............         0.000          0.000
  Evaporation Loss .........         0.000          0.000
  Exfiltration Loss ........         0.000          0.000
  Initial Stored Volume ....         0.000          0.000
  Final Stored Volume ......         6.299          2.053
  Continuity Error (%) .....         2.210
```

```
*************************
Highest Continuity Errors
*************************
Node J10 (5.13%)
Node EX-2 (1.63%)
Node J11 (1.61%)
Node J17 (1.39%)
Node OFF-3 (1.14%)


**************************
Time-Step Critical Elements
**************************
Link C8 (96.09%)


*******************************
Highest Flow Instability Indexes
*******************************
Link C23 (63)
Link C22 (24)
Link C21 (12)
Link C7 (4)
Link C20 (3)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Outfall (4.92%)
Node J18 (4.52%)
Node J12 (0.37%)
Node J8 (0.02%)
Node OFF-2 (0.01%)


************************
Routing Time Step Summary
************************
Minimum Time Step           :     0.25 sec
Average Time Step           :     0.87 sec
Maximum Time Step           :     5.00 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.69
% of Steps Not Converging   :     4.92
Time Step Frequencies       :
    5.000 -  3.155 sec      :     0.00 %
    3.155 -  1.991 sec      :     0.03 %
    1.991 -  1.256 sec      :     2.97 %
```

```
    1.256 -  0.792 sec      :    95.36 %
    0.792 -  0.500 sec      :     1.64 %


  ******************
  Node Depth Summary
  ******************

  ------------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
  Node                  Type       Feet     Feet     Feet  days hr:min        Feet
  ------------------------------------------------------------------------------
  J10                   JUNCTION    9.28     9.85  7300.20     0  07:01        9.85
  J11                   JUNCTION    9.33     9.90  7300.20     0  07:01        9.90
  J12                   JUNCTION    3.48    10.00  7284.12     0  04:28        5.25
  J13                   JUNCTION    4.61     6.37  7279.35     0  07:16        6.37
  J14                   JUNCTION    1.53     1.58  7284.17     0  07:02        1.58
  J15                   JUNCTION    0.47     0.49  7306.13     0  00:22        0.48
  J16                   JUNCTION    0.35     0.35  7294.35     0  00:27        0.35
  J17                   JUNCTION    0.89     0.90  7284.90     0  11:39        0.90
  J18                   JUNCTION    4.55     6.38  7279.33     0  07:16        6.38
  J19                   JUNCTION    3.89     5.22  7272.07     0  07:18        5.21
  J2                    JUNCTION    0.96     0.96  7311.96     0  00:14        0.96
  J20                   JUNCTION    4.71     6.07  7272.07     0  07:18        5.96
  J21                   JUNCTION    4.43     4.93  7269.68     0  07:19        4.93
  EX-1                  JUNCTION    2.16     2.22  7313.31     0  00:06        2.22
  J24                   JUNCTION    1.19     1.26  7310.91     0  00:23        1.25
  OFF-1                 JUNCTION    0.35     0.52  7370.03     0  00:00        0.35
  J26                   JUNCTION    0.15     0.15  7367.27     0  01:17        0.15
  OFF-2                 JUNCTION    5.44     5.46  7356.04     0  00:00        5.46
  J28                   JUNCTION    0.54     0.54  7350.52     0  00:27        0.54
  EX-2                  JUNCTION    5.10     5.14  7310.89     0  00:26        5.14
  OFF-3                 JUNCTION    4.86     4.91  7361.01     0  10:59        4.91
  J31                   JUNCTION    0.43     0.43  7354.59     0  09:44        0.43
  OFF-4                 JUNCTION    0.69     0.69  7370.19     0  01:10        0.69
  EX-3                  JUNCTION    2.19     2.21  7311.05     0  00:24        2.21
  OFF-5                 JUNCTION    0.92     0.92  7325.98     0  09:13        0.92
  J7                    JUNCTION    3.07     3.10  7305.34     0  04:29        3.10
  J8                    JUNCTION    2.88     3.01  7300.74     0  04:30        3.01
  J9                    JUNCTION    2.91     3.03  7300.73     0  04:29        3.03
  Outfall               OUTFALL     0.73     0.85  7264.85     0  07:19        0.84


  ********************
  Node Inflow Summary
  ********************


--------------------------------------------------------------------------------
-------------
```

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
J10	JUNCTION	0.00	68.91	0 01:34	0	11.3	5.407
J11	JUNCTION	0.00	166.24	0 01:34	0	34.3	1.638
J12	JUNCTION	0.00	56.01	0 00:32	0	8.24	0.390
J13	JUNCTION	0.00	200.59	0 04:46	0	41.9	0.136
J14	JUNCTION	0.00	111.62	0 07:01	0	33.7	0.052
J15	JUNCTION	0.00	29.84	0 00:22	0	8.32	0.087
J16	JUNCTION	0.00	26.97	0 00:22	0	8.31	0.368
J17	JUNCTION	0.00	26.01	0 00:27	0	8.28	1.415
J18	JUNCTION	0.00	287.40	0 04:45	0	41.8	-0.072
J19	JUNCTION	0.00	295.62	0 04:45	0	41.8	0.326
J2	JUNCTION	0.00	23.28	0 00:09	0	7.26	0.394
J20	JUNCTION	0.00	277.57	0 11:56	0	41.7	0.262
J21	JUNCTION	0.00	171.33	0 07:18	0	41.5	0.274
EX-1	JUNCTION	20.70	22.55	0 00:28	6.69	7.29	0.389
J24	JUNCTION	0.00	78.60	0 00:26	0	24.9	0.131
OFF-1	JUNCTION	1.85	1.85	0 00:00	0.598	0.598	0.012
J26	JUNCTION	0.00	2.32	0 00:00	0	0.598	0.072
OFF-2	JUNCTION	26.37	26.37	0 00:00	8.52	8.52	0.050
J28	JUNCTION	0.00	28.77	0 00:01	0	8.52	0.145
EX-2	JUNCTION	11.23	109.08	0 00:25	3.63	34	1.653

OFF-3		JUNCTION	14.42	20.77	0	01:00	4.66	
6.71	1.157							
J31		JUNCTION	0.00	20.77	0	10:39	0	
6.63	0.270							
OFF-4		JUNCTION	6.35	6.35	0	00:00	2.05	
2.05	0.267							
EX-3		JUNCTION	30.89	103.83	0	09:05	9.98	
33.4	0.496							
OFF-5		JUNCTION	25.80	46.57	0	09:05	8.34	
14.9	0.386							
J7		JUNCTION	0.00	108.86	0	00:26	0	
33.5	0.421							
J8		JUNCTION	0.00	38.58	0	00:24	0	
11.5	0.820							
J9		JUNCTION	0.00	44.28	0	00:26	0	
11.4	0.878							
Outfall		OUTFALL	0.00	164.45	0	07:19	0	
41.4	0.000							

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
J10	JUNCTION	9.29	0.650	0.150
J11	JUNCTION	9.36	0.700	5.100
J12	JUNCTION	3.42	6.000	0.000
J8	JUNCTION	11.59	1.014	1.986

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
J12	0.01	12.05	0 04:28	0.000	0.000

****

Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Outfall	98.95	132.45	164.45	41.431
System	98.95	132.45	164.45	41.431

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	1.85	0	00:28	0.29	0.00	0.22
C10	CONDUIT	111.62	0	07:02	3.78	0.00	0.19
C11	CONDUIT	25.99	0	11:39	4.20	0.18	0.73
C12	CONDUIT	89.40	0	03:19	7.53	0.50	1.00
C13	CONDUIT	26.01	0	00:27	1.99	0.00	0.09
C14	CONDUIT	26.97	0	00:22	4.77	0.00	0.04
C15	CONDUIT	29.84	0	00:22	9.15	0.22	0.38
C16	CONDUIT	78.60	0	00:26	3.22	0.01	0.35
C17	CONDUIT	13.58	0	00:00	0.43	0.00	0.12
C18	CONDUIT	46.57	0	09:05	33.95	0.01	0.26
C19	CONDUIT	164.45	0	07:19	1.15	0.03	0.12
C2	CONDUIT	5.25	0	00:14	6.86	0.06	0.74
C20	CONDUIT	171.33	0	07:18	13.63	0.88	1.00
C21	CONDUIT	277.57	0	11:56	1.77	0.02	0.37
C22	CONDUIT	287.40	0	04:45	4.35	0.31	0.64
C23	CONDUIT	295.62	0	04:45	23.52	1.08	1.00
C24	CONDUIT	0.00	0	00:00	0.00	0.00	0.00
C25	CONDUIT	23.28	0	00:09	2.30	0.03	0.17
C26	CONDUIT	80.52	0	00:25	3.38	0.12	0.81
C27	CONDUIT	11.02	0	04:29	0.06	0.00	0.51
C28	CONDUIT	75.74	0	04:29	4.44	0.02	0.56
C29	CONDUIT	2.32	0	00:00	11.22	0.10	0.19
C3	CONDUIT	44.28	0	00:26	1.19	0.28	1.00
C30	CONDUIT	20.58	0	05:27	16.19	1.84	0.68
C31	CONDUIT	20.77	0	10:39	17.30	1.04	0.64
C32	CONDUIT	6.35	0	01:00	1.77	0.38	0.85
C33	CONDUIT	26.37	0	00:23	3.69	0.02	0.33
C34	CONDUIT	20.77	0	09:05	2.44	0.06	0.32
C35	CONDUIT	86.74	0	00:26	6.20	0.01	0.05

C4	CONDUIT	33.35	0	00:24	2.96	1.09	1.00
C5	CONDUIT	17.43	0	00:14	0.81	0.14	0.74
C6	CONDUIT	24.68	0	00:19	13.96	1.06	1.00
C7	CONDUIT	46.75	0	00:37	9.52	0.40	1.00
C8	CONDUIT	92.24	0	01:34	2.88	0.06	1.00
C9	CONDUIT	111.62	0	07:01	19.27	0.58	0.76

****
Flow Classification Summary
****

	Adjusted	---------- Fraction of Time in Flow Class							
	/Actual		Up	Down	Sub	Sup	Up	Down	Norm Inlet
Conduit	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd Ctrl
C1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00 0.00
C10	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.99 0.00
C11	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.99 0.00
C12	1.00	0.01	0.00	0.00	0.98	0.01	0.00	0.00	0.01 0.00
C13	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.99 0.00
C14	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00 0.00
C15	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00 1.00
C16	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00 0.00
C17	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00 0.00
C18	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00 0.00
C19	1.00	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.00 0.00
C2	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.00 1.00
C20	1.00	0.01	0.00	0.00	0.97	0.01	0.00	0.00	0.00 0.05
C21	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.00

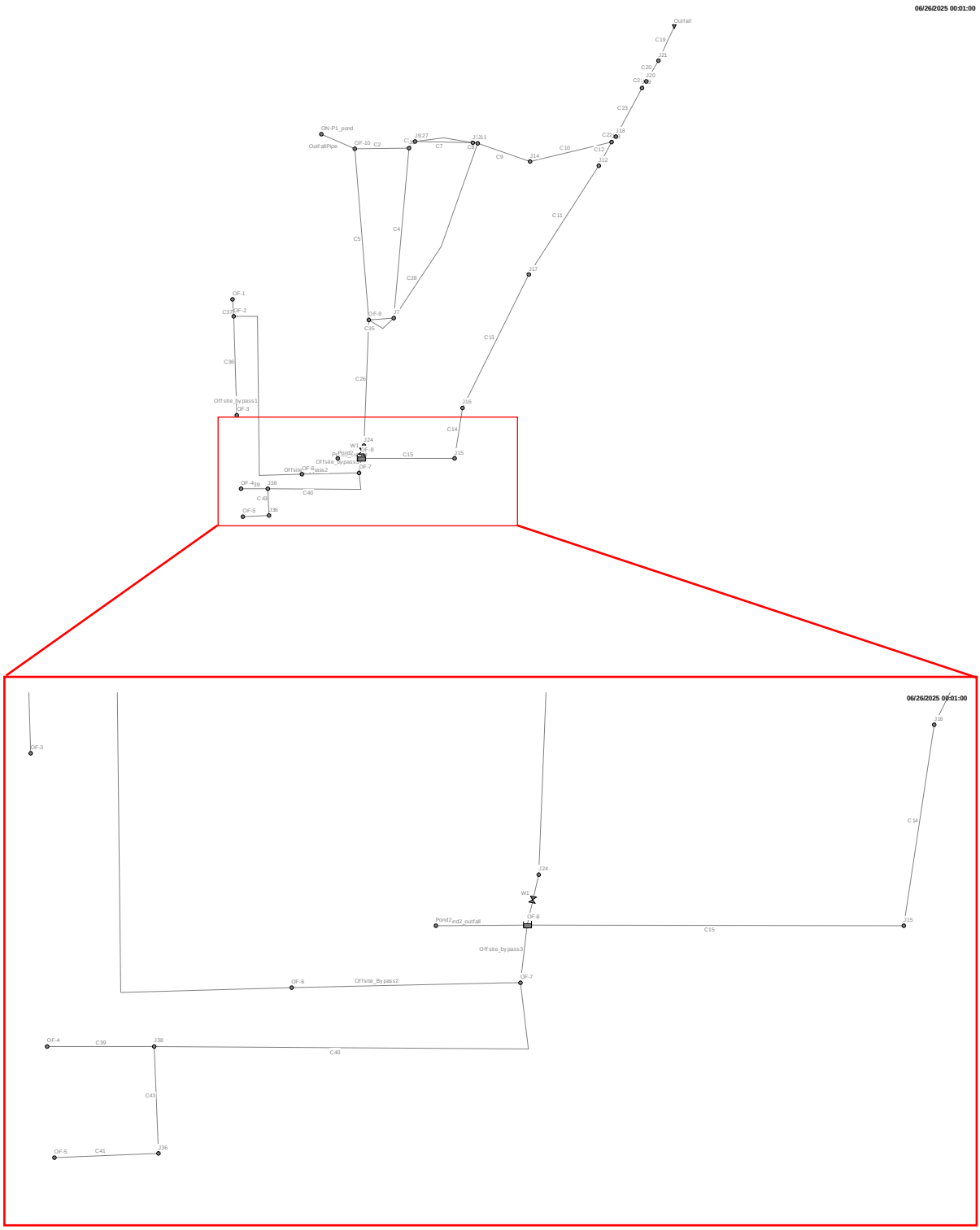
0.00									
C22	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.00
0.00									
C23	1.00	0.01	0.00	0.00	0.97	0.02	0.00	0.00	0.00
0.39									
C24	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00									
C25	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
0.00									
C26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02
0.00									
C27	1.00	0.03	0.20	0.00	0.77	0.00	0.00	0.00	0.77
0.00									
C28	1.00	0.03	0.00	0.00	0.96	0.00	0.00	0.01	0.96
0.00									
C29	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
0.00									
C3	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
0.00									
C30	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
0.00									
C31	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
0.00									
C32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
0.00									
C33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
0.00									
C34	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
0.00									
C35	1.00	0.03	0.00	0.00	0.00	0.00	0.00	0.97	0.00
0.00									
C4	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
0.00									
C5	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
0.00									
C6	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.00
0.03									
C7	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.00
0.05									
C8	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00
0.00									
C9	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	0.00
0.99									

****
Conduit Surcharge Summary
****

	Hours	Hours

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Above Full Normal Flow	Capacity Limited
C11	0.01	0.01	11.53	0.01	0.01
C12	3.42	3.42	11.40	0.01	0.01
C2	0.01	0.01	11.59	0.01	0.01
C20	11.11	11.37	11.11	0.01	10.13
C23	7.19	11.14	7.47	0.05	0.70
C26	0.01	0.01	11.86	0.01	0.01
C27	0.01	0.01	9.19	0.01	0.01
C28	0.01	0.01	10.51	0.01	0.01
C3	11.59	11.59	11.59	0.01	0.01
C30	0.01	12.00	0.01	11.99	0.01
C31	0.01	11.96	0.01	11.33	0.01
C32	0.01	0.01	11.98	0.01	0.01
C4	11.67	11.67	11.67	11.67	11.67
C5	0.01	0.01	11.86	0.01	0.01
C6	11.67	11.89	11.67	0.02	11.67
C7	11.35	11.35	11.61	0.01	0.01
C8	9.29	9.29	9.36	0.01	0.01
C9	0.01	11.60	0.01	0.01	0.01

Analysis begun on: Wed Jul 2 17:17:15 2025
Analysis ended on: Wed Jul 2 17:17:16 2025
Total elapsed time: 00:00:01


06/26/2025 00:01:00
Outfall
C19
J21
C20
J20
C21
C23
J18
C24
C12
J14
C10
C9
J11
C7
J19
C2
J27
C1
OF-10
ON-P1_pond
OutfallPipe
J12
C11
C4
C5
C28
J17
OF-1
C37
OF-2
OF-9
J7
C35
C13
C36
C26
Off site_by pass1
OF-3
J16
C14
J24
W1
OF-8
Pond2_nd2_outfall
Off site_By pass3
C15
J15
OF-7
Off site_By pass2
OF-6
OF-4
J38
C39
C40
C43
OF-5
C41
J36

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

WARNING 10: crest elevation raised to downstream invert for regulator Link W1

****
Element Count
****
Number of rain gages 0
Number of subcatchments ... 0
Number of nodes 31
Number of links 35
Number of pollutants 0
Number of land uses 0

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J10	JUNCTION	7290.35	10.00	0.0	
J11	JUNCTION	7290.30	15.00	0.0	
J12	JUNCTION	7274.12	10.00	0.0	
J13	JUNCTION	7272.98	21.00	0.0	
J14	JUNCTION	7282.59	21.00	0.0	
J15	JUNCTION	7305.64	10.00	0.0	
J16	JUNCTION	7294.00	10.00	0.0	
J17	JUNCTION	7284.00	10.00	0.0	
J18	JUNCTION	7272.95	10.00	0.0	
J19	JUNCTION	7266.85	15.00	0.0	
OF-10	JUNCTION	7311.00	10.00	0.0	Yes
J20	JUNCTION	7266.00	15.00	0.0	
J21	JUNCTION	7264.75	25.00	0.0	
ON-P1_pond	JUNCTION	7322.00	10.00	0.0	Yes
J24	JUNCTION	7311.50	10.00	0.0	
OF-9	JUNCTION	7305.75	8.00	0.0	Yes
Pond2	JUNCTION	7314.00	10.00	0.0	Yes
J7	JUNCTION	7302.24	10.00	0.0	
J8	JUNCTION	7297.73	5.00	0.0	
J9	JUNCTION	7297.70	7.00	0.0	
OF-1	JUNCTION	7360.37	10.00	0.0	Yes
OF-2	JUNCTION	7359.15	8.00	0.0	Yes
OF-3	JUNCTION	7367.18	10.00	0.0	Yes
OF-6	JUNCTION	7345.38	10.00	0.0	Yes
OF-5	JUNCTION	7371.10	10.00	0.0	Yes
J36	JUNCTION	7369.84	10.00	0.0	
OF-4	JUNCTION	7354.15	10.00	0.0	Yes
J38	JUNCTION	7351.08	10.00	0.0	

```
  OF-7                JUNCTION          7326.20     10.00       0.0    Yes
  Outfall             OUTFALL           7264.00     25.00       0.0
  OF-8                STORAGE           7309.00     10.00       0.0    Yes


  ************
  Link Summary
  ************
  Name             From Node        To Node          Type            Length
%Slope Roughness

-------------------------------------------------------------------------------
---------
  C10              J14              J13              CONDUIT          253.7
3.7907    0.0350
  C11              J17              J12              CONDUIT          263.7
3.7493    0.0400
  C12              J12              J13              CONDUIT           74.6
1.5283    0.0130
  C13              J16              J17              CONDUIT          549.2
1.8211    0.0400
  C14              J15              J16              CONDUIT          252.0
4.6240    0.0400
  C15              OF-8             J15              CONDUIT          284.5
1.1813    0.0100
  Pond2_outfall    Pond2            OF-8             CONDUIT           66.0
7.5976    0.0130
  C19              J21              Outfall          CONDUIT          113.3
0.6622    0.4500
  C2               OF-10            J8               CONDUIT          198.0
6.7171    0.0130
  C20              J20              J21              CONDUIT           68.4
1.8278    0.0130
  C21              J19              J20              CONDUIT          147.0
0.5782    0.0350
  C22              J13              J18              CONDUIT           26.0
0.1154    0.0400
  C23              J18              J19              CONDUIT          166.6
3.6642    0.0130
  OutfallPipe      ON-P1_pond       OF-10            CONDUIT          110.5
10.0052    0.0550
  C26              J24              OF-9             CONDUIT          330.0
1.7427    0.0400
  C27              J9               J10              CONDUIT          177.8
4.1383    0.0100
  C28              J7               J11              CONDUIT          592.8
1.9302    0.0300
  C3               J8               J9               CONDUIT          169.0
0.0178    0.0100
  C35              OF-9             J7               CONDUIT           71.7
4.2018    0.0130
```

C4	J7	J8	CONDUIT	558.0	
0.8083	0.0400				
C5	OF-10	OF-9	CONDUIT	512.0	
1.0254	0.0400				
C6	OF-9	J7	CONDUIT	71.7	
4.9013	0.0130				
C7	J9	J10	CONDUIT	154.2	
4.7729	0.0100				
C8	J10	J11	CONDUIT	13.8	
0.3634	0.0350				
C9	J11	J14	CONDUIT	154.2	
5.0072	0.0100				
C36	OF-3	OF-2	CONDUIT	200.0	
4.0182	0.0400				
C37	OF-1	OF-2	CONDUIT	100.0	
1.2201	0.0400				
Offsite_bypass1	OF-2	OF-6	CONDUIT	754.0	
1.8266	0.0130				
Offsite_Bypass2	OF-6	OF-7	CONDUIT	437.0	
4.3932	0.0130				
C39	OF-4	J38	CONDUIT	82.0	
3.7465	0.0130				
C40	J38	OF-7	CONDUIT	944.0	
2.6365	0.0350				
C41	OF-5	J36	CONDUIT	66.0	
1.9094	0.0130				
Offsite_bypass3	OF-7	OF-8	CONDUIT	439.0	
3.9210	0.0130				
C43	J36	J38	CONDUIT	507.0	
3.7027	0.0350				
W1	OF-8	J24	WEIR		

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C10	TRAPEZOIDAL	21.00	987.00	9.98	89.00	1	37814.85
C11	TRAPEZOIDAL	2.00	18.00	1.15	15.00	1	142.14
C12	CIRCULAR	4.00	12.57	1.00	4.00	1	177.58
C13	PARABOLIC	7.20	1243.20	4.79	259.00	1	17710.73

C14	TRAPEZOIDAL	10.00	760.00	5.28	141.00	1
18419.94						
C15	CIRCULAR	3.50	9.62	0.88	3.50	1
142.15						
Pond2_outfall	CIRCULAR	2.00	3.14	0.50	2.00	1
62.36						
C19	TRAPEZOIDAL	25.00	4000.00	13.80	285.00	1
6182.66						
C2	CIRCULAR	2.00	3.14	0.50	2.00	1
58.63						
C20	CIRCULAR	4.00	12.57	1.00	4.00	1
194.20						
C21	TRAPEZOIDAL	15.00	1012.50	8.10	120.00	1
13182.44						
C22	TRAPEZOIDAL	10.00	250.00	5.03	45.00	1
925.91						
C23	CIRCULAR	4.00	12.57	1.00	4.00	1
274.96						
OutfallPipe	TRIANGULAR	9.50	380.00	4.62	80.00	1
9010.26						
C26	TRAPEZOIDAL	3.50	119.00	2.44	48.00	1
1056.41						
C27	TRAPEZOIDAL	3.00	390.00	2.43	160.00	1
21326.42						
C28	TRAPEZOIDAL	5.00	200.00	3.53	55.00	1
3192.16						
C3	TRAPEZOIDAL	2.00	72.00	1.19	60.00	1
160.45						
C35	TRAPEZOIDAL	3.00	390.00	2.43	160.00	1
16530.17						
C4	TRIANGULAR	1.50	11.25	0.74	15.00	1
30.61						
C5	TRAPEZOIDAL	3.50	119.00	2.44	48.00	1
810.36						
C6	CIRCULAR	1.50	1.77	0.38	1.50	1
23.26						
C7	CIRCULAR	2.50	4.91	0.62	2.50	1
116.49						
C8	TRIANGULAR	9.20	230.00	4.32	50.00	1
1560.77						
C9	CIRCULAR	3.00	7.07	0.75	3.00	1
194.03						
C36	TRIANGULAR	0.75	3.00	0.37	8.00	1
11.48						
C37	TRIANGULAR	3.00	7.50	0.96	5.00	1
29.96						
Offsite_bypass1	CIRCULAR	3.00	7.07	0.75	3.00	1
90.14						
Offsite_Bypass2	CIRCULAR	3.50	9.62	0.88	3.50	1
210.88						
C39	CIRCULAR	1.50	1.77	0.38	1.50	1

```
20.33
  C40              TRAPEZOIDAL          4.00    96.00     2.57    36.00        1
1242.96
  C41              CIRCULAR             1.50     1.77     0.38     1.50        1
14.52
  Offsite_bypass3  CIRCULAR             4.00    12.57     1.00     4.00        1
284.44
  C43              TRAPEZOIDAL          3.50   185.50     2.10    88.00        1
2484.95


  ****************
  Analysis Options
  ****************
  Flow Units ............... CFS
  Process Models:
    Rainfall/Runoff ........ NO
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ NO
    Water Quality .......... NO
  Flow Routing Method ...... DYNWAVE
  Surcharge Method ......... EXTRAN
  Starting Date ............ 06/26/2025 00:00:00
  Ending Date .............. 06/26/2025 12:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:01:00
  Routing Time Step ........ 5.00 sec
  Variable Time Step ....... YES
  Maximum Trials ........... 8
  Number of Threads ........ 4
  Head Tolerance ........... 0.005000 ft


  *************************        Volume        Volume
  Flow Routing Continuity        acre-feet      10^6 gal
  *************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......         0.000         0.000
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........       114.471        37.302
  External Outflow .........       108.402        35.324
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         5.288         1.723
  Continuity Error (%) .....         0.682
```

```
*************************
Highest Continuity Errors
*************************
Node OF-9 (2.67%)
Node J9 (1.79%)
Node J17 (1.17%)


***************************
Time-Step Critical Elements
***************************
Link C8 (75.86%)
Link C7 (22.53%)


*******************************
Highest Flow Instability Indexes
*******************************
Link C7 (88)
Link C3 (38)
Link C8 (31)


*********************************
Most Frequent Nonconverging Nodes
*********************************
Node Outfall (0.06%)
Node J18 (0.04%)
Node OF-4 (0.01%)
Node J8 (0.01%)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.06 sec
Maximum Time Step           :     2.86 sec
% of Time in Steady State   :     0.00
Average Iterations per Step :     2.01
% of Steps Not Converging   :     0.06
Time Step Frequencies       :
    5.000 -  3.155 sec      :     0.00 %
    3.155 -  1.991 sec      :     0.95 %
    1.991 -  1.256 sec      :     2.65 %
    1.256 -  0.792 sec      :    85.98 %
    0.792 -  0.500 sec      :    10.42 %
```

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
J10	JUNCTION	4.57	4.74	7295.09	0 09:15	4.74
J11	JUNCTION	4.62	4.79	7295.09	0 09:15	4.79
J12	JUNCTION	4.16	4.30	7278.42	0 09:15	4.30
J13	JUNCTION	5.21	5.35	7278.33	0 09:15	5.35
J14	JUNCTION	1.17	1.20	7283.79	0 09:15	1.20
J15	JUNCTION	0.68	0.69	7306.33	0 00:13	0.68
J16	JUNCTION	0.47	0.48	7294.48	0 00:14	0.48
J17	JUNCTION	1.22	1.23	7285.23	0 04:23	1.23
J18	JUNCTION	5.21	5.35	7278.30	0 09:15	5.35
J19	JUNCTION	3.22	4.50	7271.35	0 00:59	4.46
OF-10	JUNCTION	0.38	0.43	7311.43	0 00:04	0.43
J20	JUNCTION	4.03	5.32	7271.32	0 00:59	5.06
J21	JUNCTION	4.15	4.63	7269.38	0 01:00	4.61
ON-P1_pond	JUNCTION	0.92	1.00	7323.00	0 00:00	1.00
J24	JUNCTION	0.62	0.62	7312.12	0 07:21	0.62
OF-9	JUNCTION	5.04	5.09	7310.84	0 00:56	5.09
Pond2	JUNCTION	0.57	0.82	7314.82	0 00:00	0.57
J7	JUNCTION	2.83	2.88	7305.12	0 00:55	2.88
J8	JUNCTION	2.43	2.49	7300.22	0 00:40	2.48
J9	JUNCTION	2.46	2.50	7300.20	0 01:17	2.50
OF-1	JUNCTION	1.73	1.73	7362.10	0 00:02	1.73
OF-2	JUNCTION	1.17	1.17	7360.32	0 00:03	1.17
OF-3	JUNCTION	0.66	0.66	7367.84	0 00:09	0.66
OF-6	JUNCTION	0.85	0.86	7346.24	0 00:03	0.85
OF-5	JUNCTION	0.74	0.94	7372.04	0 00:00	0.76
J36	JUNCTION	0.15	0.15	7369.99	0 00:38	0.15
OF-4	JUNCTION	1.02	2.64	7356.79	0 00:00	1.12
J38	JUNCTION	0.42	0.43	7351.51	0 06:38	0.43
OF-7	JUNCTION	1.43	1.43	7327.63	0 02:25	1.43
Outfall	OUTFALL	0.66	0.77	7264.77	0 01:00	0.76
OF-8	STORAGE	3.25	3.26	7312.26	0 05:30	3.26

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
J10	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J11	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J12	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J13	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J14	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J15	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J16	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J17	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J18	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J19	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-10	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J20	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J21	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
ON-P1_pond	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J24	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-9	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
Pond2	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J7	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J8	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J9	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-1	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-2	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-3	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-6	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-5	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J36	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-4	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
J38	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-7	JUNCTION	0.00	0.00	0 00:00	0.000	0.000	0.000
Outfall	OUTFALL	0.00	0.00	0 00:00	0.000	0.000	0.000
OF-8	STORAGE	0.00	0.00	0 00:00	0.000	0.000	0.000

Node	Type	Lateral Inflow CFS	Total Inflow CFS	Time of Max Occurrence days	hr:min	Inflow Volume 10^6 gal	Inflow Volume 10^6 gal	Balance Error Percent
J10	JUNCTION	0.00	42.02	0	00:42	0	9.85	0.263
J11	JUNCTION	0.00	67.19	0	05:10	0	20.3	0.524
J12	JUNCTION	0.00	49.04	0	02:46	0	15.5	0.317
J13	JUNCTION	0.00	166.06	0	00:59	0	35.6	0.227
J14	JUNCTION	0.00	66.39	0	09:15	0	20.2	0.065
J15	JUNCTION	0.00	49.83	0	00:13	0	15.8	0.072
J16	JUNCTION	0.00	49.79	0	00:13	0	15.7	0.294
J17	JUNCTION	0.00	49.27	0	00:14	0	15.7	1.184
J18	JUNCTION	0.00	220.94	0	00:59	0	35.6	0.049
J19	JUNCTION	0.00	250.78	0	00:59	0	35.5	0.160
OF-10	JUNCTION	3.38	16.47	0	00:01	1.09	5.23	0.312
J20	JUNCTION	0.00	240.63	0	00:59	0	35.5	0.195
J21	JUNCTION	0.00	165.33	0	00:59	0	35.4	0.265
ON-P1_pond	JUNCTION	12.80	12.80	0	00:00	4.14	4.14	0.029
J24	JUNCTION	0.00	46.08	0	06:59	0	14.7	0.122
OF-9	JUNCTION	4.13	65.79	0	01:26	1.33	21.1	2.739
Pond2	JUNCTION	11.00	11.00	0	00:00	3.55	3.55	0.005
J7	JUNCTION	0.00	65.79	0	00:59	0	20.5	0.523
J8	JUNCTION	0.00	33.55	0	00:35	0	10.1	0.943
J9	JUNCTION	0.00	34.62	0	00:39	0	10	1.818
OF-1	JUNCTION	5.49	5.49	0	00:00	1.77	1.77	0.047

OF-2	JUNCTION	12.96	26.47	0	00:05	4.19	8.55	0.141
OF-3	JUNCTION	8.02	8.02	0	00:00	2.59	2.59	0.066
OF-6	JUNCTION	0.93	27.48	0	00:03	0.301	8.84	0.092
OF-5	JUNCTION	6.10	6.10	0	00:00	1.97	1.97	0.011
J36	JUNCTION	0.00	7.40	0	00:00	0	1.97	0.277
OF-4	JUNCTION	14.52	14.52	0	00:00	4.69	4.69	0.007
J38	JUNCTION	0.00	20.62	0	00:14	0	6.66	0.587
OF-7	JUNCTION	29.67	77.69	0	01:32	9.59	25	0.365
Outfall	OUTFALL	0.00	141.39	0	01:00	0	35.3	0.000
OF-8	STORAGE	6.43	95.12	0	01:28	2.08	30.6	0.095

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
J12	JUNCTION	10.79	0.297	5.703
J8	JUNCTION	11.39	0.485	2.515
OF-4	JUNCTION	0.01	1.142	7.358

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

	Average	Avg	Evap	Exfil	Maximum	Max	Time of Max	Maximum
	Volume	Pcnt	Pcnt	Pcnt	Volume	Pcnt	Occurrence	Outflow
Storage Unit	1000 ft	Full	Loss	Loss	1000 ft	Full	days hr:min	CFS
OF-8	7.951	11.5	0.0	0.0	7.972	11.6	0 05:30	95.12

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
Outfall	99.31	112.40	141.39	35.322
System	99.31	112.40	141.39	35.322

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
C10	CONDUIT	66.39	0	09:15	2.32	0.00	0.16
C11	CONDUIT	49.04	0	02:46	4.55	0.35	0.81
C12	CONDUIT	108.42	0	00:59	9.08	0.61	1.00
C13	CONDUIT	49.27	0	00:14	2.46	0.00	0.12
C14	CONDUIT	49.79	0	00:13	5.80	0.00	0.06
C15	CONDUIT	49.83	0	00:13	8.99	0.35	0.56
Pond2_outfall	CONDUIT	12.81	0	00:00	25.07	0.21	0.64
C19	CONDUIT	141.39	0	01:00	1.08	0.02	0.11
C2	CONDUIT	0.73	0	00:04	5.23	0.01	0.60
C20	CONDUIT	165.33	0	00:59	13.16	0.85	1.00
C21	CONDUIT	240.63	0	00:59	1.78	0.02	0.32
C22	CONDUIT	220.94	0	00:59	3.98	0.24	0.54
C23	CONDUIT	250.78	0	00:59	19.96	0.91	1.00
OutfallPipe	CONDUIT	13.09	0	00:01	10.19	0.00	0.07
C26	CONDUIT	46.08	0	01:23	1.82	0.04	0.59

C27	CONDUIT	0.00	0	00:00	0.00	0.00	0.29
C28	CONDUIT	34.14	0	00:55	3.41	0.01	0.22
C3	CONDUIT	34.62	0	00:39	0.91	0.22	1.00
C35	CONDUIT	43.45	0	00:56	4.72	0.00	0.03
C4	CONDUIT	32.95	0	00:35	3.82	1.08	1.00
C5	CONDUIT	18.12	0	00:05	1.99	0.02	0.55
C6	CONDUIT	24.71	0	00:30	13.98	1.06	1.00
C7	CONDUIT	42.02	0	00:42	8.56	0.36	1.00
C8	CONDUIT	33.05	0	05:10	2.87	0.02	0.52
C9	CONDUIT	66.39	0	09:15	12.56	0.34	0.70
C36	CONDUIT	8.02	0	00:40	3.11	0.70	0.94
C37	CONDUIT	5.57	0	00:00	5.12	0.19	0.48
Offsite_bypass1	CONDUIT	26.55	0	00:03	12.67	0.29	0.34
Offsite_Bypass2	CONDUIT	27.64	0	00:03	15.15	0.13	0.33
C39	CONDUIT	17.55	0	00:00	25.32	0.86	0.50
C40	CONDUIT	20.62	0	01:32	1.50	0.02	0.23
C41	CONDUIT	7.40	0	00:00	18.62	0.51	0.31
Offsite_bypass3	CONDUIT	77.69	0	01:27	10.16	0.27	0.59
C43	CONDUIT	6.10	0	00:36	1.42	0.00	0.08
W1	WEIR	46.08	0	06:59			0.19

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C10	1.00	0.01	0.01	0.00	0.99	0.00	0.00	0.00	0.99	0.00
C11	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.99	0.00
C12	1.00	0.01	0.00	0.00	0.98	0.02	0.00	0.00	0.00	0.00
C13	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.99	0.00
C14	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
C15	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00
Pond2_outfall	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	

0.00
  C19 1.00 0.01 0.00 0.00 0.99 0.00 0.00 0.00 0.00
0.00
  C2 1.00 0.00 0.00 0.00 0.99 0.01 0.00 0.00 0.00
1.00
  C20 1.00 0.01 0.00 0.00 0.98 0.01 0.00 0.00 0.00
0.07
  C21 1.00 0.01 0.00 0.00 0.99 0.00 0.00 0.00 0.00
0.00
  C22 1.00 0.01 0.00 0.00 0.99 0.00 0.00 0.00 0.00
0.00
  C23 1.00 0.01 0.00 0.00 0.97 0.02 0.00 0.00 0.00
0.99
  OutfallPipe 1.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00
0.00
  C26 1.00 0.00 0.01 0.00 0.99 0.00 0.00 0.00 0.99
0.00
  C27 1.00 0.05 0.95 0.00 0.00 0.00 0.00 0.00 0.00
0.00
  C28 1.00 0.05 0.00 0.00 0.94 0.00 0.00 0.01 0.94
0.00
  C3 1.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00 0.00
0.00
  C35 1.00 0.04 0.00 0.00 0.00 0.00 0.00 0.96 0.00
0.00
  C4 1.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00 0.01
0.00
  C5 1.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00 0.99
0.00
  C6 1.00 0.00 0.00 0.00 0.98 0.02 0.00 0.00 0.00
0.04
  C7 1.00 0.00 0.00 0.00 0.99 0.01 0.00 0.00 0.00
0.44
  C8 1.00 0.00 0.00 0.00 0.99 0.00 0.00 0.00 0.00
0.00
  C9 1.00 0.01 0.00 0.00 0.00 0.99 0.00 0.00 0.00
0.99
  C36 1.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00 1.00
0.00
  C37 1.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00 0.00
0.00
  Offsite_bypass1 1.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00
0.00
  Offsite_Bypass2 1.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00 1.00
0.00
  C39 1.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00
0.00
  C40 1.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00 1.00
0.00
  C41 1.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00
0.00

```
  Offsite_bypass3         1.00   0.00  0.00  0.00  0.00  1.00  0.00  0.00  1.00
0.00
  C43                     1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  1.00
0.00


  *************************
  Conduit Surcharge Summary
  *************************

  ---------------------------------------------------------------------------
                                                      Hours        Hours
                        --------- Hours Full --------   Above Full   Capacity
  Conduit               Both Ends  Upstream  Dnstream   Normal Flow   Limited
  ---------------------------------------------------------------------------
  C11                        0.01      0.01     11.41      0.01         0.01
  C12                       10.79     10.79     11.31      0.01         0.01
  Pond2_outfall              0.01      0.01     11.93      0.01         0.01
  C2                         0.01      0.01     11.39      0.01         0.01
  C20                       10.99     11.26     11.02      0.01         0.05
  C23                        0.03     11.31      0.03      0.01         0.01
  C26                        0.01      0.01     11.66      0.01         0.01
  C3                        11.39     11.39     11.40      0.01         0.01
  C4                        11.49     11.49     11.50     11.48        11.49
  C5                         0.01      0.01     11.66      0.01         0.01
  C6                        11.49     11.83     11.49      0.03        11.49
  C7                         6.63      6.63     11.40      0.01         0.01
  C9                         0.01     11.38      0.01      0.01         0.01
  C36                        0.01      0.01     11.99      0.01         0.01
  C39                        0.01      0.01      0.01      0.01         0.01


  Analysis begun on:  Thu Jul  3 13:28:58 2025
  Analysis ended on:  Thu Jul  3 13:28:58 2025
  Total elapsed time: < 1 sec
```

Kimley»Horn

STANDARD FORM SF-1
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: Buc-ee's El Paso
PROJECT NUMBER: 196094002
CALCULATED BY: LES
CHECKED BY: KEW
DATE: 5/4/2026

SOIL: GROUP B

LAND USE:	TYPE LAWNS	TYPE GRAVEL	TYPE ROOF	TYPE PAVEMENT
2-YEAR COEFF.	0.02	0.57	0.71	0.89
5-YEAR COEFF.	0.08	0.59	0.73	0.90
10-YEAR COEFF.	0.15	0.63	0.75	0.90
100-YEAR COEFF.	0.35	0.70	0.81	0.96
IMPERVIOUS %	0%	80%	90%	100%

DESIGN BASIN	DESIGN POINT	TYPE AREA (AC)			TYPE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
On-Site Basins											
EX-1	1	5.18			0.27	**5.44**	0.06	0.12	0.19	0.38	5%
EX-2	2	1.60			0.24	**1.84**	0.14	0.19	0.25	0.43	13%
EX-3	3	13.45			0.69	**14.14**	0.06	0.12	0.19	0.38	5%
EX-4	4	10.78			0.76	**11.54**	0.08	0.13	0.20	0.39	7%
EX-5	5	0.25				**0.25**	0.02	0.08	0.15	0.35	0%
		31.25	**0.00**	**0.00**	**1.96**	**33.21**	**0.07**	**0.13**	**0.19**	**0.39**	**6%**
BASIN SUBTOTAL		**94%**	**0%**	**0%**	**6%**	**100%**					
Off-Site Basins											
OFF-1	OFF-1	0.29	0.18		0.03	**0.50**	0.26	0.31	0.36	0.51	34%
OFF-2	OFF-2	13.12	1.95	0.62	0.12	**15.81**	0.12	0.17	0.24	0.42	14%
OFF-3	OFF-3	6.98	0.24	0.08	0.10	**7.40**	0.06	0.11	0.18	0.37	5%
OFF-4	OFF-4	2.62	0.17			**2.79**	0.05	0.11	0.18	0.37	5%
OFF-5	OFF-5	3.75	0.37	0.07		**4.19**	0.08	0.14	0.20	0.39	9%
OFF-6	OFF-6	1.47	0.03	0.02		**1.52**	0.04	0.10	0.17	0.36	3%
OS-1	OS-1	3.25			0.29	**3.54**	0.09	0.15	0.21	0.40	8%
OS-2	OS-2	3.92			0.26	**4.18**	0.07	0.13	0.20	0.39	6%
OS-3	OS-3	1.77			1.45	**3.22**	0.41	0.45	0.49	0.62	45%
		28.24	**2.94**	**0.79**	**0.25**	**32.21**	**0.09**	**0.15**	**0.21**	**0.40**	**10%**
BASIN SUBTOTAL		**88%**	**9%**	**2%**	**1%**	**100%**					

Kimley»Horn

STANDARD FORM SF-2
Time of Concentration

PROJECT NAME: **Buc-ee's El Paso**
PROJECT NUMBER: **196094002**
CALCULATED BY: **LES**
CHECKED BY: **KEW**

DATE: 5/4/2026

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
On-Site Basins																
EX-1	5.440	0.120	100	6.0%	9.8	453	5.9%	7.0	1.7	4.4	14.3	553	5.9%	5%	28.4	14.3
EX-2	1.840	0.189	100	7.9%	8.3	427	8.3%	7.0	2.0	3.5	11.8	527	8.2%	13%	26.0	11.8
EX-3	14.140	0.120	100	4.6%	10.7	835	6.6%	7.0	1.8	7.7	18.4	935	6.4%	5%	30.8	18.4
EX-4	11.540	0.134	100	6.6%	9.4	1,079	4.5%	7.0	1.5	12.2	21.5	1179	4.6%	7%	33.5	21.5
EX-5	0.250	0.080	100	8.8%	9.0	73	8.3%	7.0	2.0	0.6	9.6	173	8.6%		26.5	9.6
Off-Site Basins																
OFF-1	0.50	0.31	47	4.5%	6.0	169	1.3%	15.0	1.7	1.6	7.6	216	2.0%	34%	22.0	7.6
OFF-2	15.81	0.17	84	2.4%	11.5	1,364	3.4%	7.0	1.3	17.6	29.1	1448	3.3%	14%	34.8	29.1
OFF-3	7.40	0.11	164	5.6%	12.9	741	4.3%	7.0	1.5	8.5	21.4	905	4.5%	5%	31.3	21.4
OFF-4	2.79	0.11	296	8.1%	15.4	230	2.2%	15.0	2.2	1.7	17.1	526	5.5%	5%	27.8	17.1
OFF-5	4.19	0.14	100	3.8%	11.2	393	7.8%	7.0	2.0	3.4	14.6	493	7.0%	9%	26.8	14.6
OFF-6	1.52	0.10	100	3.3%	12.2	500	7.3%	7.0	1.9	4.4	16.6	600	6.6%	3%	28.9	16.6
OS-1	3.54	0.15	100	6.1%	9.5	430	6.3%	7.0	1.8	4.1	13.6	530	6.3%	8%	27.4	13.6
OS-2	4.18	0.13	300	7.2%	15.8	430	1.0%	7.0	0.7	10.2	26.0	730	3.6%	6%	32.2	26.0
OS-3	3.22	0.45	100	1.7%	9.9	1,102	3.6%	7.0	1.3	13.8	23.7	1202	3.5%	45%	24.7	23.7

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Kimley»Horn

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

PROJECT NAME: Buc-ee's El Paso
PROJECT NUMBER: 1.96E+08
CALCULATED BY: LES
CHECKED BY: KEW

DATE: 5/4/2026

P_1 (1-Hour Rainfall) = 1.19

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																					
		1	EX-1	5.44	0.06	14.25	0.34	2.77	0.94												
		2	EX-2	1.84	0.14	11.84	0.25	3.00	0.75												
		3	EX-3	14.14	0.06	18.44	0.88	2.44	2.16												
		4	EX-4	11.54	0.08	21.53	0.89	2.25	2.01												
		5	EX-5	0.25	0.02	9.59	0.01	3.27	0.02												
Off-Site Basins																					
		OFF-1	OFF-1	0.50	0.26	7.62	0.13	3.56	0.47												
		OFF-2	OFF-2	15.81	0.12	29.08	1.92	1.90	3.65												
		OFF-3	OFF-3	7.40	0.06	21.41	0.42	2.26	0.95												
		OFF-4	OFF-4	2.79	0.05	17.13	0.15	2.53	0.38												
		OFF-5	OFF-5	4.19	0.08	14.55	0.34	2.74	0.92												
		OFF-6	OFF-6	1.52	0.04	16.59	0.06	2.57	0.15												
		OS-1	OS-1	3.54	0.09	13.55	0.32	2.83	0.91												
		OS-2	OS-2	4.18	0.07	26.03	0.31	2.03	0.63												
		OS-3	OS-3	3.22	0.41	23.69	1.33	2.14	2.83												

Kimley»Horn

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

PROJECT NAME: Buc-ee's El Paso
PROJECT NUMBER: 1.96E+08
CALCULATED BY: LES
CHECKED BY: KEW

DATE: 5/4/2026

P_1 (1-Hour Rainfall) = 1.5

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																					
		1	EX-1	5.44	0.12	14.25	0.65	3.49	2.28												
		2	EX-2	1.84	0.19	11.84	0.35	3.79	1.31												
		3	EX-3	14.14	0.06	18.44	0.88	3.08	2.72												
		4	EX-4	11.54	0.08	21.53	0.89	2.84	2.53												
		5	EX-5	0.25	0.02	9.59	0.01	4.12	0.02												
Off-Site Basins																					
		OFF-1	OFF-1	0.50	0.31	7.62	0.15	4.48	0.69												
		OFF-2	OFF-2	15.81	0.17	29.08	2.76	2.40	6.62												
		OFF-3	OFF-3	7.40	0.11	21.41	0.85	2.85	2.41												
		OFF-4	OFF-4	2.79	0.11	17.13	0.31	3.19	0.99												
		OFF-5	OFF-5	4.19	0.14	14.55	0.57	3.45	1.97												
		OFF-6	OFF-6	1.52	0.10	16.59	0.15	3.24	0.48												
		OS-1	OS-1	3.54	0.15	13.55	0.52	3.57	1.86												
		OS-2	OS-2	4.18	0.13	26.03	0.55	2.56	1.40												
		OS-3	OS-3	3.22	0.45	23.69	1.45	2.69	3.90												

Kimley»Horn

STANDARD FORM SF-3
STORM DRAINAGE DESIGN - RATIONAL METHOD 10 YEAR EVENT

PROJECT NAME: Buc-ee's El Paso
PROJECT NUMBER: 1.96E+08
CALCULATED BY: LES
CHECKED BY: KEW

DATE: 5/4/2026

P_1 (1-Hour Rainfall) = 1.75

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																					
		1	EX-1	5.44	0.19	14.25	1.01	4.07	4.13												
		2	EX-2	1.84	0.25	11.84	0.46	4.42	2.03												
		3	EX-3	14.14	0.06	18.44	0.88	3.59	3.17												
		4	EX-4	11.54	0.08	21.53	0.89	3.31	2.96												
		5	EX-5	0.25	0.02	9.59	0.01	4.81	0.02												
Off-Site Basins																					
		OFF-1	OFF-1	0.50	0.36	7.62	0.18	5.23	0.95												
		OFF-2	OFF-2	15.81	0.24	29.08	3.77	2.80	10.54												
		OFF-3	OFF-3	7.40	0.18	21.41	1.35	3.32	4.47												
		OFF-4	OFF-4	2.79	0.18	17.13	0.50	3.73	1.86												
		OFF-5	OFF-5	4.19	0.20	14.55	0.85	4.03	3.42												
		OFF-6	OFF-6	1.52	0.17	16.59	0.25	3.79	0.96												
		OS-1	OS-1	3.54	0.21	13.55	0.75	4.16	3.12												
		OS-2	OS-2	4.18	0.20	26.03	0.82	2.98	2.45												
		OS-3	OS-3	3.22	0.49	23.69	1.57	3.14	4.94												

Kimley»Horn

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

PROJECT NAME: Buc-ee's El Paso
PROJECT NUMBER: 1.96E+08
CALCULATED BY: LES
CHECKED BY: KEW

DATE: 5/4/2026

P_1 (1-Hour Rainfall) = 2.52

STORM LINE	DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																					
		1	EX-1	5.44	0.38	14.25	2.07	5.86	12.10												
		2	EX-2	1.84	0.43	11.84	0.79	6.36	5.04												
		3	EX-3	14.14	0.38	18.44	5.37	5.17	27.76												
		4	EX-4	11.54	0.39	21.53	4.50	4.77	21.46												
		5	EX-5	0.25	0.35	9.59	0.09	6.93	0.61												
Off-Site Basins																					
		OFF-1	OFF-1	0.50	0.51	7.62	0.25	7.53	1.92												
		OFF-2	OFF-2	15.81	0.42	29.08	6.57	4.03	26.47												
		OFF-3	OFF-3	7.40	0.37	21.41	2.77	4.78	13.25												
		OFF-4	OFF-4	2.79	0.37	17.13	1.04	5.37	5.56												
		OFF-5	OFF-5	4.19	0.39	14.55	1.63	5.80	9.45												
		OFF-6	OFF-6	1.52	0.36	16.59	0.55	5.45	3.00												
		OS-1	OS-1	3.54	0.40	13.55	1.42	6.00	8.49												
		OS-2	OS-2	4.18	0.39	26.03	1.62	4.29	6.96												
		OS-3	OS-3	3.22	0.62	23.69	2.01	4.53	9.10												

Flows don't match with summary spreadsheet

Kimley»Horn

PROJECT NAME: Buc-ee's El Paso
PROJECT NUMBER: 196094002
CALCULATED BY: LES
CHECKED BY: KEW
DATE: 5/4/2026

EXISTING RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	IMPERVIOUSNESS %	PEAK FLOWS (CFS)			
				Q2	Q5	Q10	Q100
On-Site Basins							
1	EX-1	5.44	5%	0.94	2.28	4.13	12.10
2	EX-2	1.84	13%	0.75	1.31	2.03	5.04
3	EX-3	14.14	5%	2.16	2.72	3.17	27.76
4	EX-4	11.54	7%	2.01	2.53	2.96	21.46
5	EX-5	0.25	0%	0.02	0.02	0.02	0.61
TOTAL		**33.21**	**6%**	**5.87**	**8.86**	**12.31**	**66.98**
Off-Site Basins							
OFF-1	OFF-1	0.50	34%	0.47	0.69	0.95	1.92
OFF-2	OFF-2	15.81	14%	3.65	6.62	10.54	26.47
OFF-3	OFF-3	7.40	5%	0.95	2.41	4.47	13.25
OFF-4	OFF-4	2.79	5%	0.38	0.99	1.86	9.45
OFF-5	OFF-5	4.19	9%	0.92	1.97	3.42	9.10
OFF-6	OFF-6	1.52	3%	0.15	0.48	0.96	3.00
OS-1	OS-1	3.54	8%	0.91	1.86	3.12	8.49
OS-2	OS-2	4.18	6%	0.63	1.40	2.45	6.96
OS-3	OS-3	3.22	45%	2.83	3.90	4.94	9.10
TOTAL		**43.15**	**10%**	**10.90**	**20.30**	**32.70**	**87.73**

Flows don't match with Q100 spreadsheet

Kimley»Horn

PROJECT NAME: Buc-ee's Palmer Lake
PROJECT NUMBER: 196094002
CALCULATED BY: JM
CHECKED BY: KEW

DATE: 7/2/2025

Where are rational calculations?

RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	IMPERVIOUSNESS %	PEAK FLOWS (CFS)			
				Q2	Q5	Q10	Q100
On-Site Basins							
P1	ON-P1	11.42	67%	15.78	20.97	25.73	56.18
P2	ON-P2	12.65	72%	19.55	25.99	31.88	67.17
P1	OS-P1	4.11	69%	6.10	8.11	9.95	21.29
P2	OS-P2	0.82	98%	1.96	2.60	3.19	5.95
POND 1		**15.53**	**67%**	**21.88**	**29.09**	**35.69**	**77.47**
POND 2		**13.47**	**74%**	**21.50**	**28.59**	**35.08**	**73.12**
TOTAL		**29.00**	**70%**	**43.38**	**57.68**	**70.76**	**150.59**
Off-Site Basins							
OFF-1	OFF-1	3.19	7%	0.39	0.51	0.63	5.49
OFF-2	OFF-2	6.48	17%	1.56	2.07	2.54	12.96
OFF-3	OFF-3	5.39	5%	0.45	0.60	0.73	8.02
OFF-4	OFF-4	7.40	9%	1.11	1.47	1.81	14.52
OFF-5	OFF-5	2.79	12%	0.55	0.73	0.89	6.10
OFF-6	OFF-6	0.48	6%	0.06	0.07	0.09	0.93
OFF-7	OFF-7	17.22	7%	2.12	2.82	3.46	29.67
OFF-8	OFF-8	1.67	41%	1.43	1.91	2.34	6.43
OFF-9	OFF-9	1.48	23%	0.66	0.88	1.08	4.13
OFF-10	OFF-10	0.94	33%	0.59	0.79	0.96	2.98
TOTAL		**47.03**	**11%**	**8.91**	**11.85**	**14.54**	**91.23**

Missing basins (on and off-site) and design points in summary. Please provide all basins and DP's as shown on drainage map

APPENDIX D

All hydraulic calculations will be reviewed once proposed hydrology has been provided with next review. Any comments provided with this review are cursory.

Provide calculations for trickle channel in ponds

Provide excerpts from Beacon Lite Road Improvements Drainage Report.

Be sure to include all calculations for storm sewer, ditches, inlets, swales, outlet protection, etc

Worksheet for 24" Culvert

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.064	ft/ft
Diameter	24.0	in
Discharge	24.00	cfs

Results		
Normal Depth	10.9	in
Flow Area	1.4	ft²
Wetted Perimeter	3.0	ft
Hydraulic Radius	5.6	in
Top Width	1.99	ft
Critical Depth	20.8	in
Percent Full	45.3	%
Critical Slope	0.010	ft/ft
Velocity	17.37	ft/s
Velocity Head	4.69	ft
Specific Energy	5.59	ft
Froude Number	3.675	
Maximum Discharge	61.32	cfs
Discharge Full	57.00	cfs
Slope Full	0.011	ft/ft
Flow Type	Supercritical	

This velocity is very large - what was the tailwater depth assumed for the outlet condition?

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	45.3	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	10.9	in
Critical Depth	20.8	in
Channel Slope	0.064	ft/ft
Critical Slope	0.010	ft/ft

This document was created by an application that isn't licensed to use novaPDF.
Purchase a license to generate PDF files without this notice.

Worksheet for Trapezoidal Channel going to 18"

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.016 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	5.000 H:V
Bottom Width	20.00 ft
Discharge	10.14 cfs

Results	
Normal Depth	2.6 in
Flow Area	4.6 ft²
Wetted Perimeter	22.2 ft
Hydraulic Radius	2.5 in
Top Width	22.18 ft
Critical Depth	2.4 in
Critical Slope	0.023 ft/ft
Velocity	2.21 ft/s
Velocity Head	0.08 ft
Specific Energy	0.29 ft
Froude Number	0.856
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.6 in
Critical Depth	2.4 in
Channel Slope	0.016 ft/ft
Critical Slope	0.023 ft/ft

Worksheet for Trapezoidal Channel going to 24"

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	20.00 ft
Discharge	24.24 cfs

Results	
Normal Depth	4.6 in
Flow Area	8.2 ft²
Wetted Perimeter	23.2 ft
Hydraulic Radius	4.3 in
Top Width	23.06 ft
Critical Depth	4.2 in
Critical Slope	0.019 ft/ft
Velocity	2.94 ft/s
Velocity Head	0.13 ft
Specific Energy	0.52 ft
Froude Number	0.868
Flow Type	Subcritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	4.6 in
Critical Depth	4.2 in
Channel Slope	0.014 ft/ft
Critical Slope	0.019 ft/ft

Worksheet for Trapezoidal Channel going to 42"

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

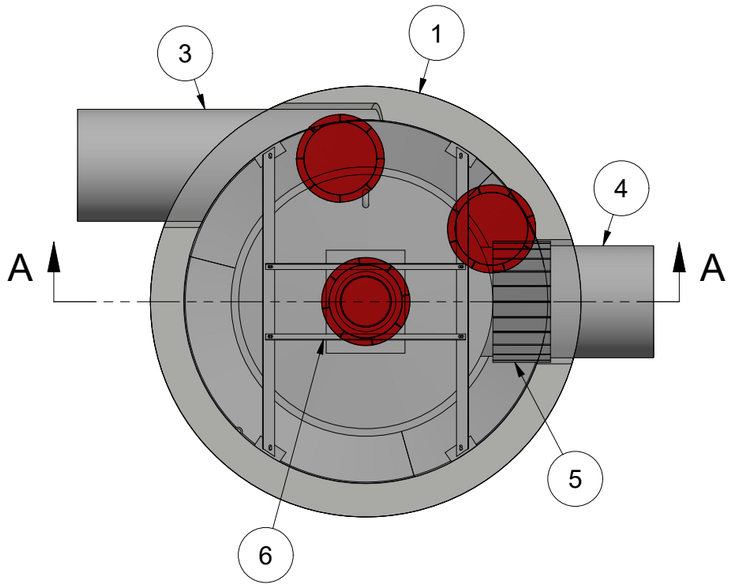
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.034 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	8.00 ft
Discharge	65.30 cfs

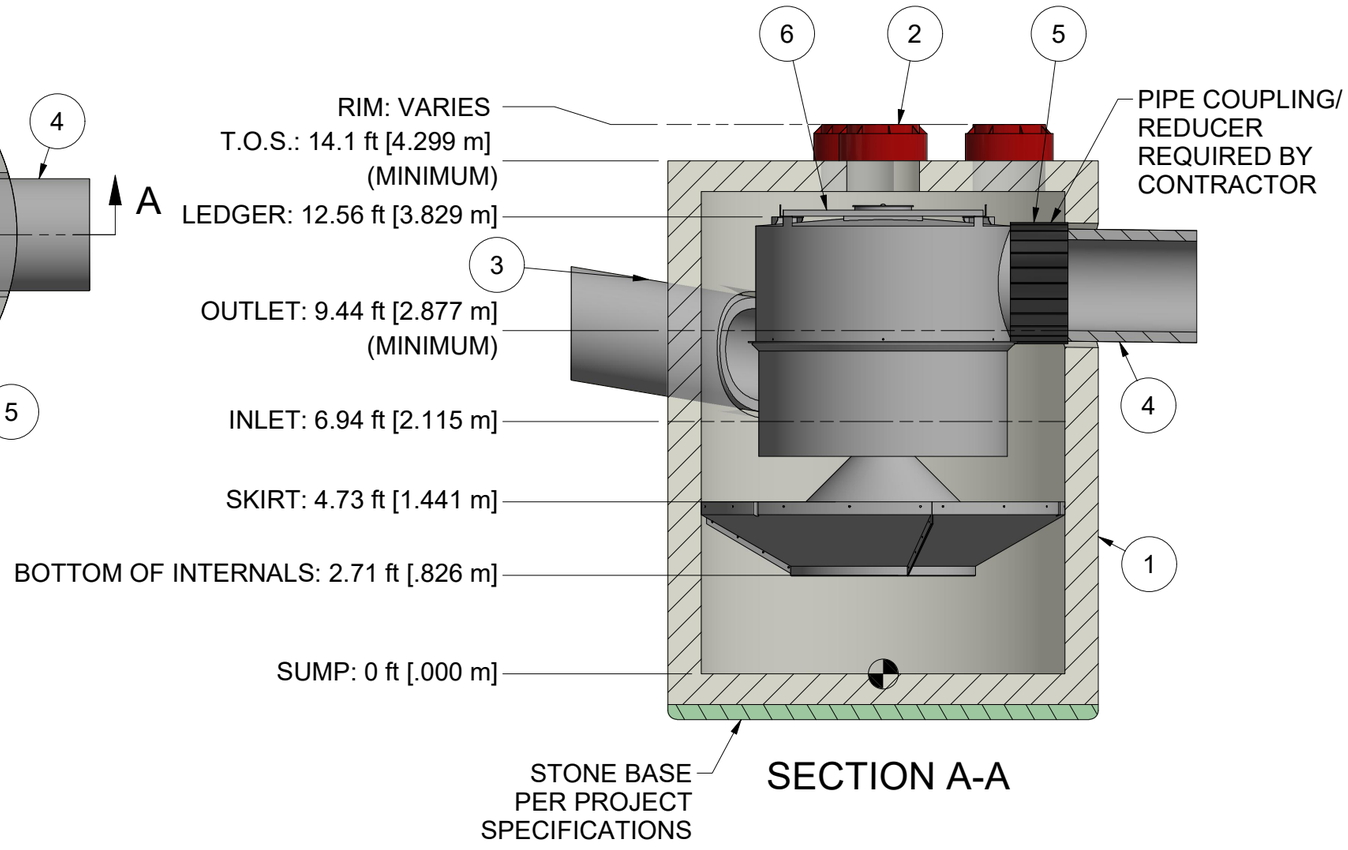
Results	
Normal Depth	10.1 in
Flow Area	9.6 ft²
Wetted Perimeter	15.0 ft
Hydraulic Radius	7.7 in
Top Width	14.74 ft
Critical Depth	12.7 in
Critical Slope	0.015 ft/ft
Velocity	6.81 ft/s
Velocity Head	0.72 ft
Specific Energy	1.56 ft
Froude Number	1.490
Flow Type	Supercritical

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

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	10.1 in
Critical Depth	12.7 in
Channel Slope	0.034 ft/ft
Critical Slope	0.015 ft/ft

OUTLET STUB ID: 30" (750 mm)
OUTLET STUB OD: 36" (900 mm)





SECTION A-A

1. MANHOLE WALL AND SLAB THICKNESSES ARE NOT TO SCALE.
2. CONTACT HYDRO INTERNATIONAL FOR A BOTTOM OF STRUCTURE ELEVATION PRIOR TO SETTING DOWNSTREAM DEFENDER MANHOLE.

HYDRO FRAME AND COVER (INLCUDED)

GRADE RINGS BY OTHERS AS REQUIRED

NOTE: NOT FOR CONSTRUCTION. CONTACT HYDRO FOR SITE SPECIFIC DETAIL

EQUIPMENT PERFORMANCE

The stormwater treatment unit shall adhere to the hydraulic parameters given in the chart below and provide the removal efficiencies and storage capacities as follows:

1. The treatment system shall use an induced vortex to separate pollutants from stormwater runoff.
2. Peak Hydraulic Capacity: 25.0 cfs (708 l/s)
3. Sediment Storage Capacity: 8.70 cu. yd. (6.65 cu. m)
4. Continuous Oil Storage Capacity: 1050 gal. (3975 liters)
5. Sediment shall be stored in a zone that is isolated from the main flow path and protected from reintrainment by a benching skirt.
6. For more product information including regulatory acceptances, please visit https://hydro-int.com/en/products/downstream-defender

PARTS LIST

ITEM	QTY	SIZE (in)	SIZE (mm)	DESCRIPTION
1	1	120	3000	PRECAST MANHOLE (BY HYDRO VIA PRECASTER)
2	3	24	600	FRAME AND COVER (QTY 3)
3	1	30 (MAX)	750 (MAX)	INLET PIPE (BY OTHERS)
4	1	30 (MAX)	750 (MAX)	OUTLET PIPE (BY OTHERS)
5	1			PIPE COUPLING (BY OTHERS)
6	1			INTERNAL COMPONENTS (PRE-INTALLED)

PROJECTION

IF IN DOUBT ASK

DATE:	SCALE:
12/7/2020	1 / 50

DRAWN BY:	CHECKED BY:	APPROVED BY
ER	MRJ	

Title
10ft-DIAMETER
DOWNSTREAM DEFENDER

GENERAL ARRANGEMENT

Hydro International
A CRH COMPANY
hydro-int.com
HYDRO INTERNATIONAL

WEIGHT:	MATERIAL:
N/A	

STOCK NUMBER:
NEXT ASSY

DRAWING NO.:
DD GA-10

SHEET SIZE:	SHEET:	Rev:
B	1 OF 1	A

Kimley»Horn

Project: Pond 1
Date: 6/1/2026

Label what component this is for. Is this the spillway calculation? If so do the MHFD calcs not apply?

Emergency Overflow Weir Calculation

Q (cfs) =	49.7	(100-yr peak inflow)
C_{BCW} =	3	
Z =	4	
H =	0.5	(.5' assumption, as spillway is above the 500-yr WSE)
L (ft) =	45.26	

$$Q = C_{BCW} L H^{1.5} + 2\left[\left(2/5\right) C_{BCW} Z H^{2.5}\right]$$

rearrange to solve for length:

$$L = \frac{Q - \left(4/5\right) C_{BCW} Z H^{2.5}}{C_{BCW} H^{1.5}}$$

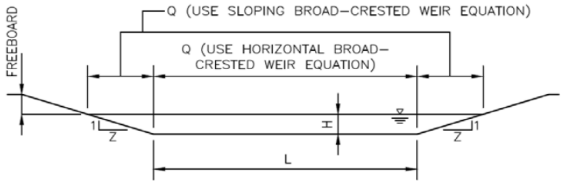


Figure 12-20. Sloping broad-crest weir

Horizontal Broad Crested Weir Equation (from USDCM Eqn. 12-8)

$$Q = C_{BCW} L H^{1.5}$$ Equation 12-8

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

L = broad-crested weir length (ft)

H = head above weir crest (ft)

Sloping Broad Crested Weir Equation (from USDCM Eqn. 12-9)

$$Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$$ Equation 12-9

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

Z = side slope (horizontal: vertical)

H = head above weir crest (ft)

Note that in order to calculate the total flow over the weir depicted in Figure 12-20, the results from Equation 12-8 must be added to two times the results from Equation 12-9.

*orange cells require input

EDB - Forebay Calculations

Date	06/03/2026
Prepared by	LES
Checked by	KEW
Project	Buc-ee's #87 El Paso County - Pond 1

Forebay Sizing

WQCV Volume	0.33	ac-ft	
Watershed Impervious Area	8.62	ac	
Forebay Depth	18	in	*Per MHFD Chapter 4 Section 5.2.2
Forebay Volume	0.0033	ac-ft	1% of WQCV
	143.7	cf	
Forebay Area	95.8	sf	

Notch Sizing

Sized to drain forebay in 4 to 5 minutes

A_{FB}	95.8	sf
t	270	s
h_{max}	1.5	ft
Notch Width	2.67	in

Manual input cells

TABLE 4-12. FOREBAY SIZING CRITERIA

FOREBAY SIZING CRITERIA	WATERSHED IMPERVIOUS AREA (IA)				
	IA UP TO 2 ACRES	IA 2 UP TO 5 ACRES	IA 5 UP TO 10 ACRES	IA 10 UP TO 20 ACRES	IA GREATER THAN 20 ACRES
Forebay Release Rate and Configuration	Concrete sediment pad with dense grasses surrounding, concrete pad with slotted metal edge, or similar design	Size to drain in 4 to 5 minutes using Equation 4-1			
Minimum Forebay Volume [1]		1% of WQCV			
Forebay Depth [1]		12 to 15 inches	15 to 18 inches	18 to 24 inches	24 to 30 inches

[1] Appropriate volume and depth should consider maintenance and access needs. The values provided are approximate and provide a starting point for design.

$$w = 9.23\ (A_{FB} / t)\ (1 / \sqrt{h_{max}})$$

w = width of the rectangular vertical notch (inches)

A_{FB} = surface area of the forebay (square feet)

t = emptying time of the brim-full forebay (seconds)

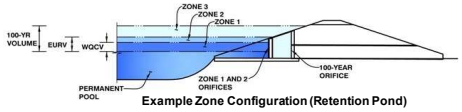
h_{max} = maximum depth of the forebay (feet)

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Buc-ee's El Paso County

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	22.69	acres
Watershed Length =	1,500	ft
Watershed Length to Centroid =	750	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	38.00%	percent
Percentage Hydrologic Soil Group A =	5.0%	percent
Percentage Hydrologic Soil Group B =	87.0%	percent
Percentage Hydrologic Soil Groups C/D =	8.0%	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) =	0.330	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.894	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.870	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.324	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.729	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.331	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.793	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.401	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	4.598	acre-feet		inches
Approximate 2-yr Detention Volume =	0.660	acre-feet		
Approximate 5-yr Detention Volume =	0.933	acre-feet		
Approximate 10-yr Detention Volume =	1.270	acre-feet		
Approximate 25-yr Detention Volume =	1.431	acre-feet		
Approximate 50-yr Detention Volume =	1.507	acre-feet		
Approximate 100-yr Detention Volume =	1.742	acre-feet		

Define Zones and Basin Geometry

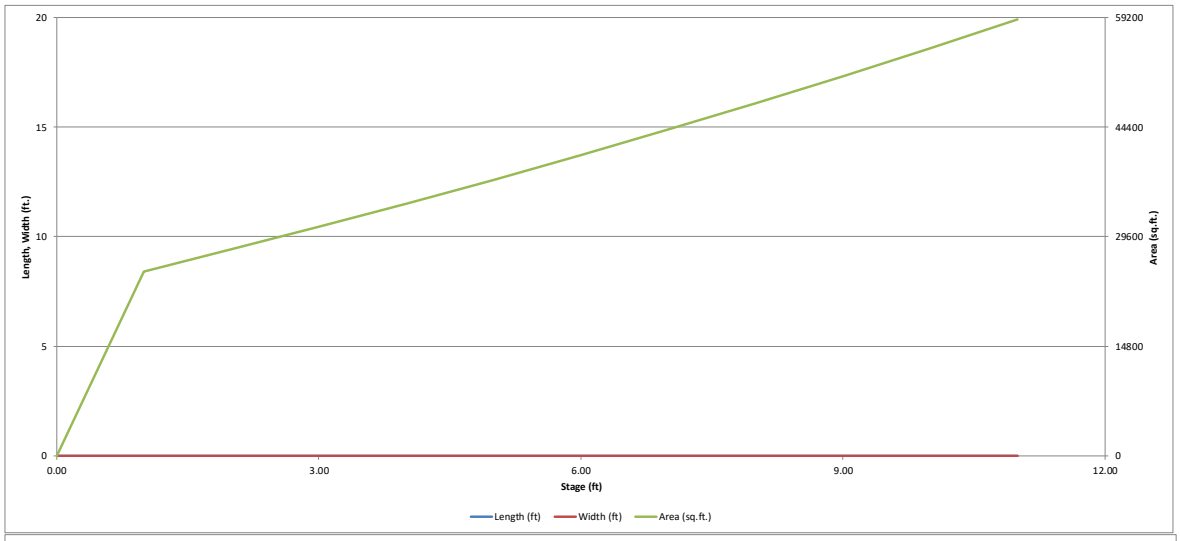
Zone 1 Volume (WQCV) =	0.330	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.564	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.848	acre-feet
Total Detention Basin Volume =	1.742	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

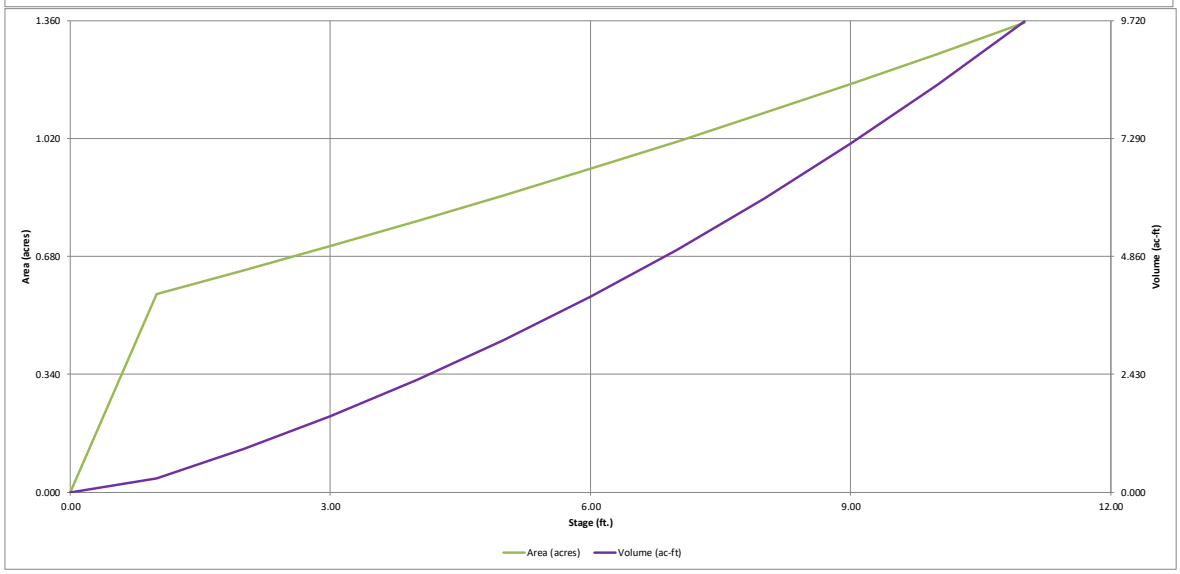
Depth Increment = 0.50 ft

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		
7338	--	1.00	--	--	--	24,838	0.570	12,418	0.285
7339	--	2.00	--	--	--	27,875	0.640	38,775	0.890
7340	--	3.00	--	--	--	30,895	0.709	68,160	1.565
7341	--	4.00	--	--	--	34,020	0.781	100,617	2.310
7342	--	5.00	--	--	--	37,250	0.855	136,252	3.128
7343	--	6.00	--	--	--	40,585	0.932	175,170	4.021
7344	--	7.00	--	--	--	44,030	1.011	217,477	4.993
7345	--	8.00	--	--	--	47,580	1.092	263,282	6.044
7346	--	9.00	--	--	--	51,250	1.177	312,697	7.179
7347	--	10.00	--	--	--	55,020	1.263	365,832	8.398
7348	--	11.00	--	--	--	58,993	1.354	422,839	9.707

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



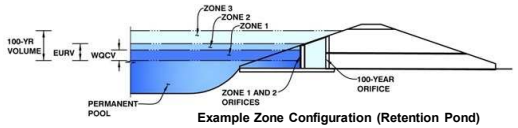


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Buc-ee's El Paso County

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.08	0.330	Orifice Plate
Zone 2 (EURV)	2.01	0.564	Orifice Plate
Zone 3 (100-year)	3.25	0.848	Weir&Pipe (Restrict)
Total (all zones)		1.742	

✓ = calcs match details in plans

X = calcs do not match details in plans

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

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

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

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.99	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft^2

See comments on CDs regarding stage = 0

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	0.66	1.33					
Orifice Area (sq. inches)	3.00	3.50	4.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.99	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.83	N/A	feet
Overflow Weir Front Edge Length =	2.92	N/A	feet	Overflow Weir Slope Length =	7.59	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	15.29	N/A	
Horiz. Length of Weir Sides =	7.36	N/A	feet	Overflow Grate Open Area w/o Debris =	15.42	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	7.71	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

could not verify

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.01	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.48	N/A	feet
Restrictor Plate Height Above Pipe Invert =	10.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.68	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway	
Spillway Invert Stage=	8.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.46 feet
Spillway Crest Length =	50.00	feet	Stage at Top of Freeboard =	9.96 feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.26 acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	8.35 acre-ft

qe

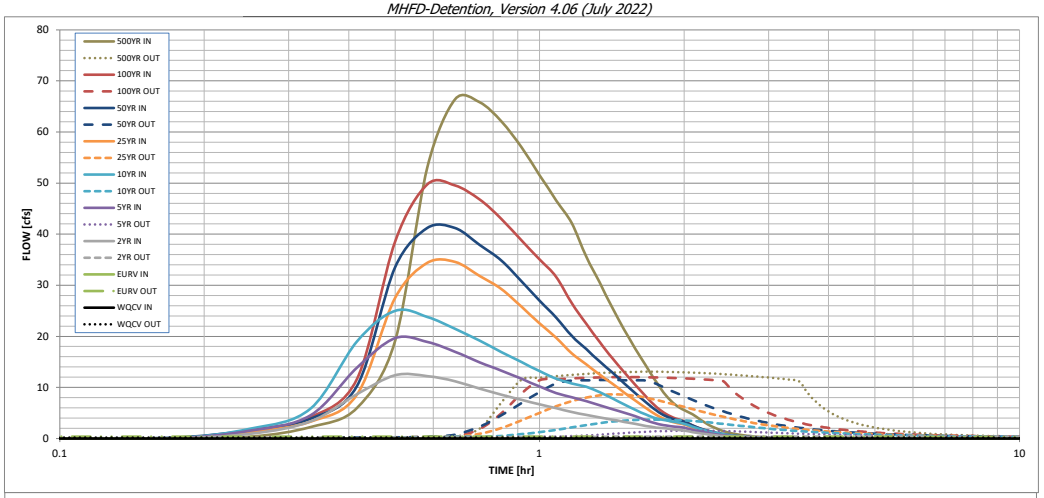
Routed Hydrograph Results

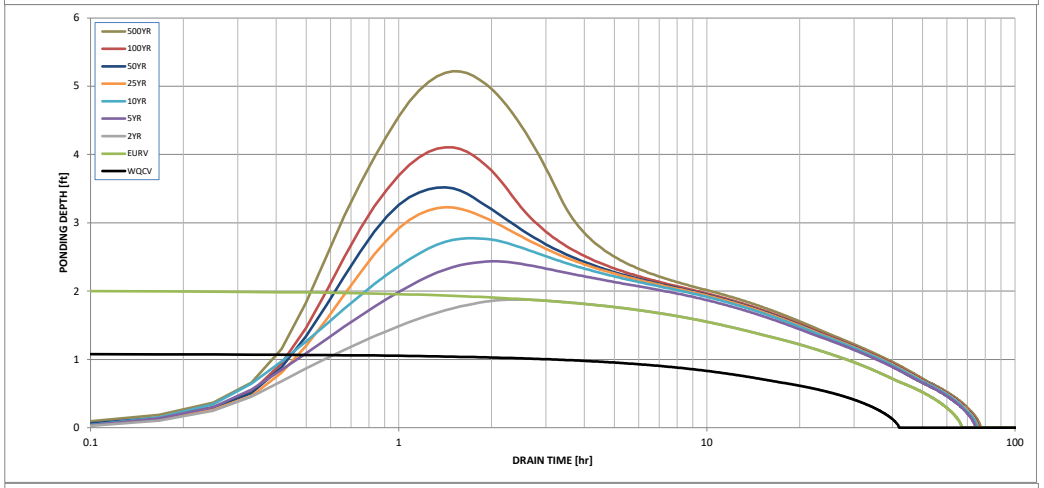
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

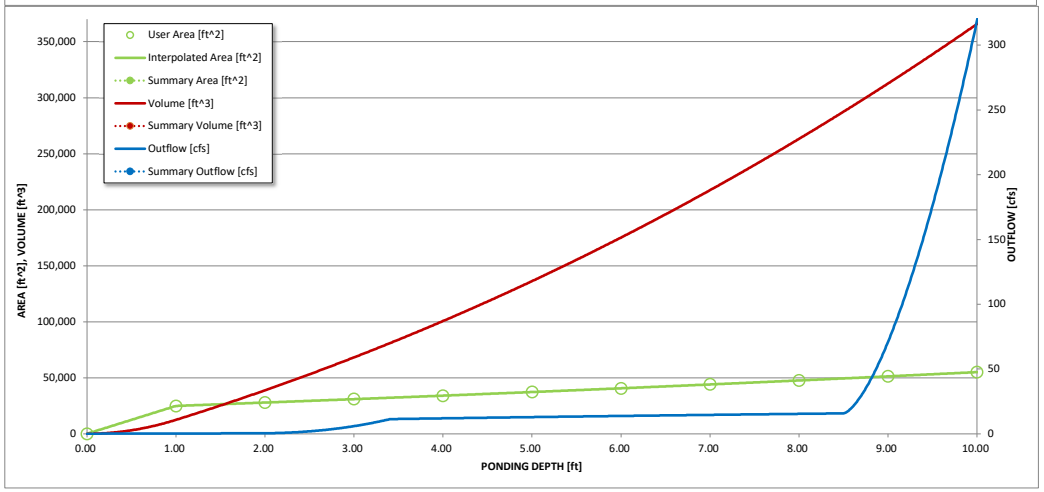
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.330	0.894	0.870	1.324	1.729	2.331	2.793	3.401	4.598
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.870	1.324	1.729	2.331	2.793	3.401	4.598
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.2	6.8	10.4	18.6	23.4	30.0	41.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.30	0.46	0.82	1.03	1.32	1.85
Peak Inflow Q (cfs) =	N/A	N/A	12.4	19.6	25.0	34.6	41.2	49.7	66.4
Peak Outflow Q (cfs) =	0.2	0.4	0.4	1.6	3.7	8.6	11.4	12.0	13.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.4	0.5	0.5	0.4	0.3
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	0.00	N/A	0.1	0.2	0.5	0.7	0.7	0.8
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	59	60	64	63	60	58	55	51
Time to Drain 99% of Inflow Volume (hours) =	**40**	64	64	70	70	69	68	67	66
Maximum Ponding Depth (ft) =	1.08	2.01	1.88	2.43	2.77	3.23	3.52	4.10	5.22
Area at Maximum Ponding Depth (acres) =	0.58	0.64	0.63	0.67	0.69	0.73	0.75	0.79	0.87
Maximum Volume Stored (acre-ft) =	0.331	0.897	0.808	1.172	1.403	1.723	1.936	2.388	3.309

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.01	0.35
	0:15:00	0.00	0.00	0.93	1.53	1.90	1.28	1.60	1.57	2.27
	0:20:00	0.00	0.00	3.36	4.56	5.88	3.33	3.90	4.17	5.99
	0:25:00	0.00	0.00	8.71	13.92	19.03	8.61	10.34	11.70	19.17
	0:30:00	0.00	0.00	12.37	19.64	25.01	27.57	33.59	38.57	52.96
	0:35:00	0.00	0.00	12.23	18.92	23.80	34.35	41.22	49.70	66.41
	0:40:00	0.00	0.00	11.20	16.99	21.46	34.56	41.18	49.51	65.81
	0:45:00	0.00	0.00	9.76	14.91	19.14	31.82	37.89	46.78	62.05
	0:50:00	0.00	0.00	8.57	13.27	16.91	29.26	34.82	42.93	57.02
	0:55:00	0.00	0.00	7.59	11.68	14.95	25.77	30.77	38.77	51.56
	1:00:00	0.00	0.00	6.68	10.19	13.18	22.55	26.99	35.05	46.62
	1:05:00	0.00	0.00	5.91	8.91	11.70	19.71	23.66	31.63	42.15
	1:10:00	0.00	0.00	5.17	8.07	10.78	16.68	20.08	26.48	35.65
	1:15:00	0.00	0.00	4.61	7.31	10.12	14.50	17.51	22.48	30.56
	1:20:00	0.00	0.00	4.13	6.51	9.09	12.50	15.08	18.88	25.67
	1:25:00	0.00	0.00	3.69	5.77	7.85	10.76	12.95	15.75	21.36
	1:30:00	0.00	0.00	3.27	5.05	6.69	9.02	10.83	13.02	17.62
	1:35:00	0.00	0.00	2.85	4.37	5.61	7.42	8.87	10.51	14.19
	1:40:00	0.00	0.00	2.46	3.58	4.66	5.94	7.08	8.22	11.08
	1:45:00	0.00	0.00	2.14	2.92	3.94	4.62	5.48	6.22	8.42
	1:50:00	0.00	0.00	1.97	2.54	3.53	3.66	4.36	4.82	6.64
	1:55:00	0.00	0.00	1.73	2.32	3.22	3.10	3.70	3.96	5.53
	2:00:00	0.00	0.00	1.55	2.12	2.89	2.75	3.28	3.39	4.78
	2:05:00	0.00	0.00	1.25	1.70	2.32	2.15	2.55	2.57	3.64
	2:10:00	0.00	0.00	0.99	1.34	1.82	1.64	1.95	1.90	2.69
	2:15:00	0.00	0.00	0.78	1.05	1.42	1.26	1.49	1.39	1.98
	2:20:00	0.00	0.00	0.61	0.82	1.09	0.96	1.13	1.02	1.44
	2:25:00	0.00	0.00	0.48	0.63	0.83	0.73	0.86	0.76	1.08
	2:30:00	0.00	0.00	0.37	0.48	0.62	0.55	0.64	0.58	0.81
	2:35:00	0.00	0.00	0.28	0.36	0.47	0.41	0.48	0.44	0.62
	2:40:00	0.00	0.00	0.22	0.27	0.35	0.31	0.36	0.33	0.47
	2:45:00	0.00	0.00	0.16	0.20	0.27	0.24	0.28	0.25	0.36
	2:50:00	0.00	0.00	0.12	0.14	0.19	0.17	0.20	0.19	0.26
	2:55:00	0.00	0.00	0.08	0.10	0.13	0.12	0.14	0.13	0.18
	3:00:00	0.00	0.00	0.05	0.06	0.08	0.08	0.09	0.08	0.11
	3:05:00	0.00	0.00	0.03	0.04	0.04	0.04	0.05	0.05	0.06
	3:10:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

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

Kimley»Horn

Project: Pond 2
Date: 6/1/2026

Emergency Overflow Weir Calculation

Q (cfs) =	72.2	(100-yr peak inflow, from rational calcs)
C_{BCW} =	3	
Z =	4	
H =	1	
L (ft) =	20.87	21' used

$$Q = C_{BCW} L H^{1.5} + 2\left[\left(2/5\right) C_{BCW} Z H^{2.5}\right]$$

rearrange to solve for length:

$$L = \frac{Q - \left(4/5\right) C_{BCW} Z H^{2.5}}{C_{BCW} H^{1.5}}$$

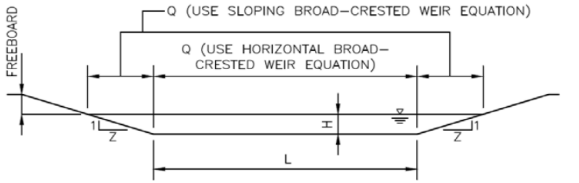


Figure 12-20. Sloping broad-crest weir

Horizontal Broad Crested Weir Equation (from USDCM Eqn. 12-8)

$$Q = C_{BCW} L H^{1.5}$$ Equation 12-8

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

L = broad-crested weir length (ft)

H = head above weir crest (ft)

Sloping Broad Crested Weir Equation (from USDCM Eqn. 12-9)

$$Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$$ Equation 12-9

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

Z = side slope (horizontal: vertical)

H = head above weir crest (ft)

Note that in order to calculate the total flow over the weir depicted in Figure 12-20, the results from Equation 12-8 must be added to two times the results from Equation 12-9.

*orange cells require input

Kimley»Horn

EDB - Forebay Calculations

Date	06/01/2026
Prepared by	LES
Checked by	KEW
Project	Buc-ee's #87 El Paso County - Pond 2

Forebay Sizing

WQCV Volume	0.329	ac-ft	
Watershed Impervious Area	9.42	ac	
Forebay Depth	18	in	*Per MHFD Chapter 4 Section 5.2.2
Forebay Volume	0.00329	ac-ft	1% of WQCV
	143.3	cf	
Forebay Area	95.5	sf	

Notch Sizing

Sized to drain forebay in 4 to 5 minutes

A_{FB}	95.5	sf
t	270	s
h_{max}	1.5	ft
Notch Width	✓ 2.67	in

Manual input cells

TABLE 4-12. FOREBAY SIZING CRITERIA

FOREBAY SIZING CRITERIA	WATERSHED IMPERVIOUS AREA (IA)				
	IA UP TO 2 ACRES	IA 2 UP TO 5 ACRES	IA 5 UP TO 10 ACRES	IA 10 UP TO 20 ACRES	IA GREATER THAN 20 ACRES
Forebay Release Rate and Configuration	Concrete sediment pad with dense grasses surrounding, concrete pad with slotted metal edge, or similar design	Size to drain in 4 to 5 minutes using Equation 4-1			
Minimum Forebay Volume [1]		1% of WQCV			
Forebay Depth [1]		12 to 15 inches	15 to 18 inches	18 to 24 inches	24 to 30 inches

[1] Appropriate volume and depth should consider maintenance and access needs. The values provided are approximate and provide a starting point for design.

$$w = 9.23\ (A_{FB} / t)\ (1 / \sqrt{h_{max}})$$

w = width of the rectangular vertical notch (inches)

A_{FB} = surface area of the forebay (square feet)

t = emptying time of the brim-full forebay (seconds)

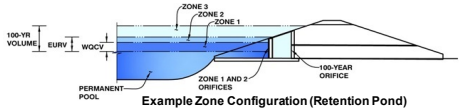
h_{max} = maximum depth of the forebay (feet)

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Buc-ee's El Paso County

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	10.90	acres
Watershed Length =	850	ft
Watershed Length to Centroid =	400	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	85.00%	percent
Percentage Hydrologic Soil Group A =	5.0%	percent
Percentage Hydrologic Soil Group B =	87.0%	percent
Percentage Hydrologic Soil Groups C/D =	8.0%	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) =	0.329 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.034 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.880 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.155 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.379 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.622 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.853 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.113 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.690 acre-feet		inches
Approximate 2-yr Detention Volume =	0.824 acre-feet		
Approximate 5-yr Detention Volume =	1.082 acre-feet		
Approximate 10-yr Detention Volume =	1.325 acre-feet		
Approximate 25-yr Detention Volume =	1.425 acre-feet		
Approximate 50-yr Detention Volume =	1.482 acre-feet		
Approximate 100-yr Detention Volume =	1.552 acre-feet		

Define Zones and Basin Geometry

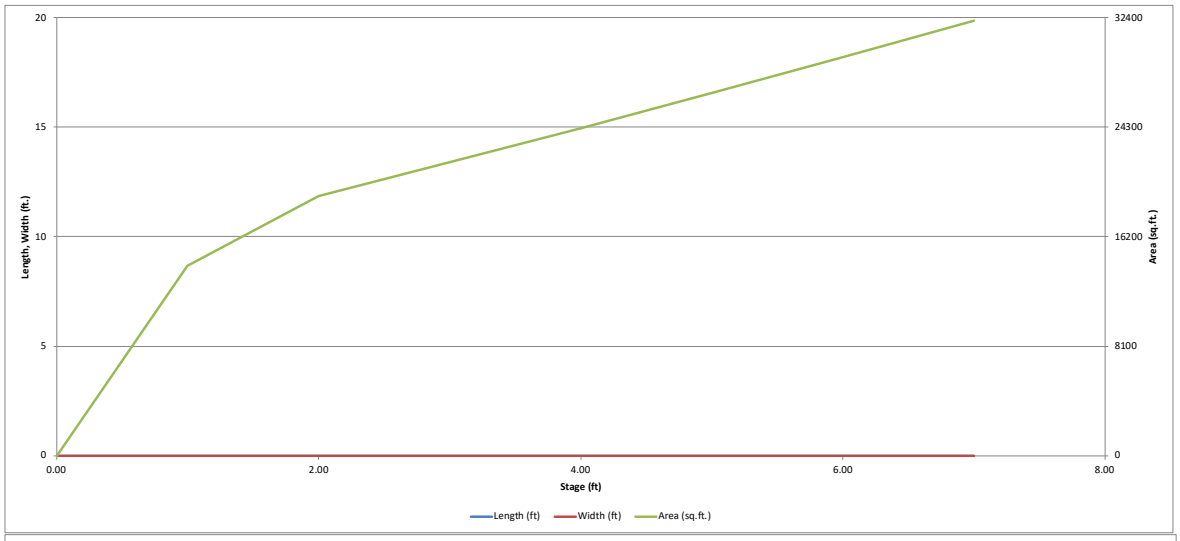
Zone 1 Volume (WQCV) =	0.329	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.705	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.518	acre-feet
Total Detention Basin Volume =	1.552	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

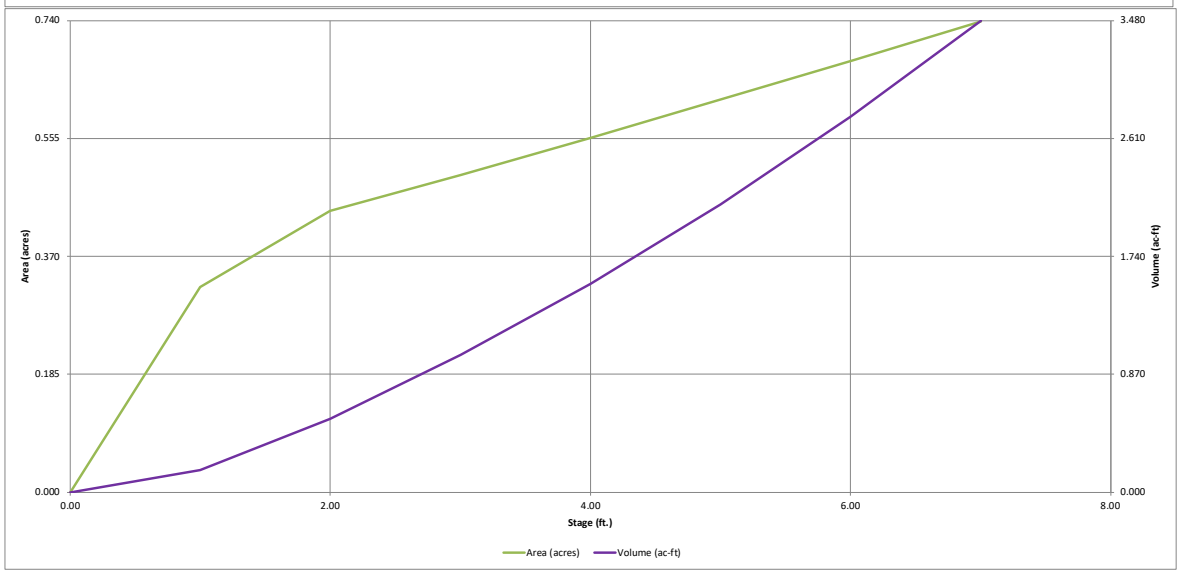
Depth Increment = 0.50 ft

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		
7314	--	1.00	--	--	--	14,020	0.322	7,009	0.161
7315	--	2.00	--	--	--	19,208	0.441	23,623	0.542
7316	--	3.00	--	--	--	21,685	0.498	44,070	1.012
7317	--	4.00	--	--	--	24,216	0.556	67,020	1.539
7318	--	5.00	--	--	--	26,805	0.615	92,531	2.124
7319	--	6.00	--	--	--	29,453	0.676	120,660	2.770
7320	--	7.00	--	--	--	32,175	0.739	151,474	3.477

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



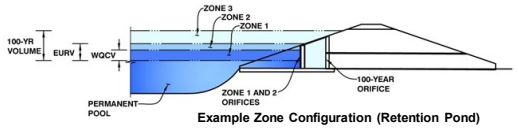


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Cottonwood Highlands Lot 3

Basin ID: Flood Control Pond 2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.48	0.329	Orifice Plate
Zone 2 (EURV)	3.05	0.705	Orifice Plate
Zone 3 (100-year)	4.03	0.518	Weir&Pipe (Restrict)
Total (all zones)		1.552	

✓ = calcs match details in plans

X = calcs do not match details in plans

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

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

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

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.05	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (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	1.00	2.00					
Orifice Area (sq. inches)	2.50	3.50	3.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.05	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.78	N/A	feet
Overflow Weir Front Edge Length =	15.00	N/A	feet	Overflow Weir Slope Length =	3.01	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	17.78	N/A	
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	31.42	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	15.71	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.75	N/A	feet
Restrictor Plate Height Above Pipe Invert =	18.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.71	feet
Spillway Crest Length =	21.00	feet	Stage at Top of Freeboard =	5.71	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.66	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	2.58	acre-ft

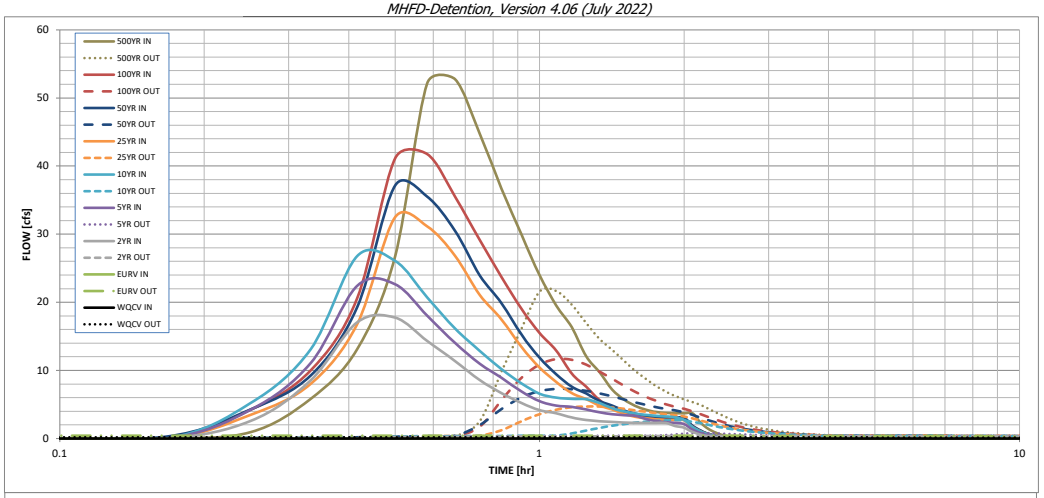
Routed Hydrograph Results

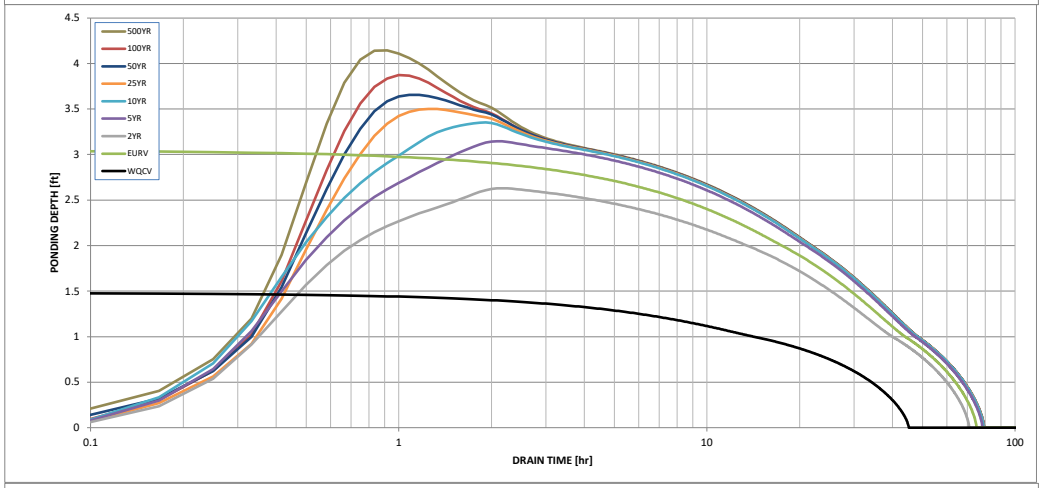
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

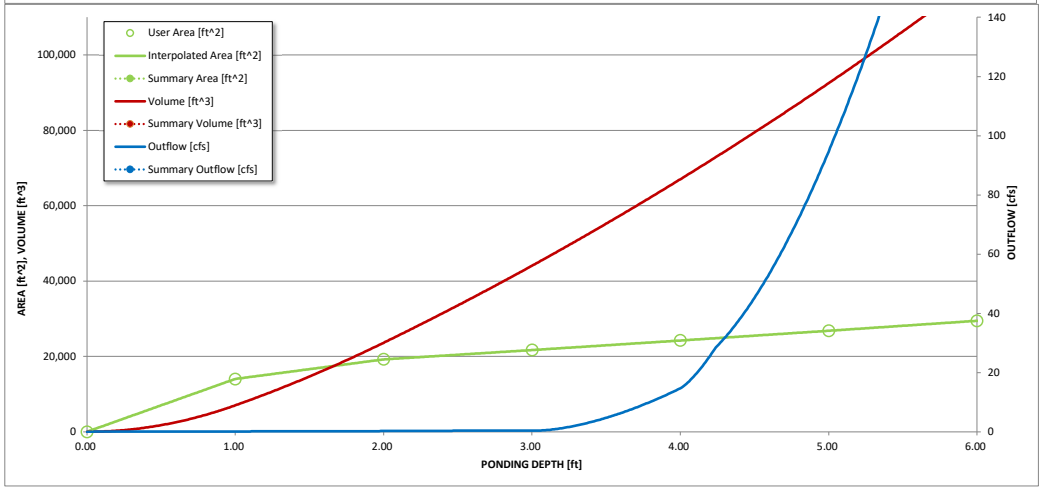
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.329	1.034	0.880	1.155	1.379	1.622	1.853	2.113	2.690
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.880	1.155	1.379	1.622	1.853	2.113	2.690
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.2	3.7	5.6	10.1	12.7	15.9	22.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.34	0.52	0.92	1.16	1.46	2.03
Peak Inflow Q (cfs) =	N/A	N/A	17.7	22.6	26.7	32.5	37.1	41.8	52.7
Peak Outflow Q (cfs) =	0.2	0.4	0.4	0.8	2.7	4.7	7.3	11.7	21.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.5	0.5	0.6	0.7	1.0
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.1	0.1	0.2	0.4	0.6
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) =	41	66	63	69	68	67	65	64	61
Time to Drain 99% of Inflow Volume (hours) =	**44**	71	68	74	74	74	73	73	71
Maximum Ponding Depth (ft) =	1.48	3.05	2.63	3.15	3.35	3.50	3.65	3.87	4.14
Area at Maximum Ponding Depth (acres) =	0.38	0.50	0.48	0.51	0.52	0.53	0.54	0.55	0.56
Maximum Volume Stored (acre-ft) =	0.329	1.037	0.827	1.082	1.190	1.268	1.348	1.467	1.617

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.03	0.93
	0:15:00	0.00	0.00	2.58	4.20	5.19	3.48	4.26	4.22	5.83
	0:20:00	0.00	0.00	8.53	11.06	13.12	8.01	9.24	9.99	13.10
	0:25:00	0.00	0.00	17.07	22.42	26.75	16.78	19.25	20.56	26.79
	0:30:00	0.00	0.00	17.73	22.64	26.07	32.48	37.15	41.13	52.14
	0:35:00	0.00	0.00	14.31	18.01	20.71	31.16	35.50	41.77	52.74
	0:40:00	0.00	0.00	11.39	14.02	16.14	26.82	30.51	35.51	44.75
	0:45:00	0.00	0.00	8.57	10.98	12.89	21.09	23.97	29.15	36.71
	0:50:00	0.00	0.00	6.68	8.90	10.17	17.48	19.86	23.74	29.91
	0:55:00	0.00	0.00	5.21	6.91	8.09	13.41	15.25	19.03	23.99
	1:00:00	0.00	0.00	4.17	5.48	6.58	10.43	11.87	15.50	19.55
	1:05:00	0.00	0.00	3.70	4.85	6.00	8.29	9.45	12.92	16.33
	1:10:00	0.00	0.00	3.09	4.64	5.82	6.67	7.60	9.52	12.08
	1:15:00	0.00	0.00	2.74	4.25	5.75	5.79	6.61	7.62	9.71
	1:20:00	0.00	0.00	2.55	3.83	5.21	4.83	5.51	5.65	7.20
	1:25:00	0.00	0.00	2.43	3.57	4.45	4.25	4.84	4.49	5.72
	1:30:00	0.00	0.00	2.36	3.41	3.96	3.61	4.11	3.77	4.81
	1:35:00	0.00	0.00	2.30	3.32	3.66	3.20	3.64	3.31	4.22
	1:40:00	0.00	0.00	2.28	2.86	3.46	2.95	3.35	3.05	3.89
	1:45:00	0.00	0.00	2.28	2.56	3.33	2.81	3.20	2.95	3.77
	1:50:00	0.00	0.00	2.28	2.39	3.26	2.73	3.11	2.91	3.71
	1:55:00	0.00	0.00	1.85	2.29	3.09	2.70	3.06	2.91	3.71
	2:00:00	0.00	0.00	1.57	2.11	2.74	2.68	3.04	2.91	3.71
	2:05:00	0.00	0.00	0.96	1.29	1.69	1.66	1.89	1.81	2.30
	2:10:00	0.00	0.00	0.58	0.78	1.03	1.02	1.16	1.10	1.41
	2:15:00	0.00	0.00	0.33	0.45	0.59	0.60	0.68	0.65	0.82
	2:20:00	0.00	0.00	0.17	0.26	0.33	0.34	0.38	0.37	0.47
	2:25:00	0.00	0.00	0.07	0.13	0.15	0.17	0.19	0.18	0.23
	2:30:00	0.00	0.00	0.03	0.04	0.05	0.06	0.07	0.06	0.08
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

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

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

Kimley»Horn

Project: Pond 3
Date: 9/11/2026

Emergency Overflow Weir Calculation

Q (cfs) =	26.5	(100-yr peak inflow, from rational calcs)
C_{BCW} =	3	
Z =	4	
H =	0.3	
L (ft) =	52.80	60' used

$$Q = C_{BCW} L H^{1.5} + 2\left[\left(2/5\right) C_{BCW} Z H^{2.5}\right]$$

rearrange to solve for length:

$$L = \frac{Q - \left(4/5\right) C_{BCW} Z H^{2.5}}{C_{BCW} H^{1.5}}$$

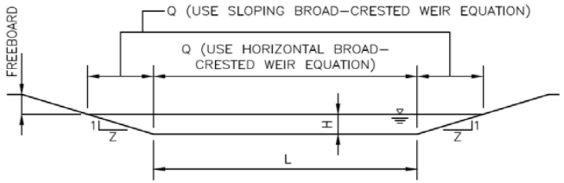


Figure 12-20. Sloping broad-crest weir

Horizontal Broad Crested Weir Equation (from USDCM Eqn. 12-8)

$$Q = C_{BCW} L H^{1.5}$$ Equation 12-8

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

L = broad-crested weir length (ft)

H = head above weir crest (ft)

Sloping Broad Crested Weir Equation (from USDCM Eqn. 12-9)

$$Q = \left(\frac{2}{5}\right) C_{BCW} Z H^{2.5}$$ Equation 12-9

Where:

Q = discharge (cfs)

C_{BCW} = broad-crested weir coefficient (This ranges from 2.6 to 3.0. A value of 3.0 is often used in practice.) See Hydraulic Engineering Circular No. 22 for additional information.

Z = side slope (horizontal: vertical)

H = head above weir crest (ft)

Note that in order to calculate the total flow over the weir depicted in Figure 12-20, the results from Equation 12-8 must be added to two times the results from Equation 12-9.

*orange cells require input

Kimley»Horn

EDB - Forebay Calculations

Date	06/01/2026
Prepared by	LES
Checked by	KEW
Project	Buc-ee's #87 El Paso County - Pond 3

Forebay Sizing

WQCV Volume	0.144	ac-ft	
Watershed Impervious Area	4.09	ac	
Forebay Depth	15	inches	*Per MHFD Chapter 4 Section 5.2.2
Forebay Volume	0.00144	ac-ft	1% of WQCV
	62.7	cf	
Forebay Area	50.2	sf	

Notch Sizing *Per MHFD Vol. 3 Chapter 4 Eq. 4-1

Sized to drain forebay in 4 to 5 minutes

A_{FB}	50.2	sf
t	270	s
h_{max}	1.25	ft
Notch Width	1.53	in

Manual input cells

TABLE 4-12. FOREBAY SIZING CRITERIA

FOREBAY SIZING CRITERIA	WATERSHED IMPERVIOUS AREA (IA)				
	IA UP TO 2 ACRES	IA 2 UP TO 5 ACRES	IA 5 UP TO 10 ACRES	IA 10 UP TO 20 ACRES	IA GREATER THAN 20 ACRES
Forebay Release Rate and Configuration	Concrete sediment pad with dense grasses surrounding, concrete pad with slotted metal edge, or similar design	Size to drain in 4 to 5 minutes using Equation 4-1			
Minimum Forebay Volume [1]		1% of WQCV			
Forebay Depth [1]		12 to 15 inches	15 to 18 inches	18 to 24 inches	24 to 30 inches

[1] Appropriate volume and depth should consider maintenance and access needs. The values provided are approximate and provide a starting point for design.

MHFD Equation 4-1

$$w = 9.23\ (A_{FB} / t)\ (1 / \sqrt{h_{max}})$$

w = width of the rectangular vertical notch (inches)

A_{FB} = surface area of the forebay (square feet)

t = emptying time of the brim-full forebay (seconds)

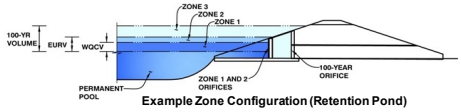
h_{max} = maximum depth of the forebay (feet)

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Buc-ee's El Paso County

Basin ID: Pond 3



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	9.07	acres
Watershed Length =	700	ft
Watershed Length to Centroid =	300	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	44.00%	percent
Percentage Hydrologic Soil Group A =	5.0%	percent
Percentage Hydrologic Soil Group B =	87.0%	percent
Percentage Hydrologic Soil Groups C/D =	8.0%	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) =	0.144	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.419	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.385	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.566	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.725	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.953	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.131	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.363	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.825	acre-feet	inches
Approximate 2-yr Detention Volume =	0.314	acre-feet	
Approximate 5-yr Detention Volume =	0.438	acre-feet	
Approximate 10-yr Detention Volume =	0.582	acre-feet	
Approximate 25-yr Detention Volume =	0.646	acre-feet	
Approximate 50-yr Detention Volume =	0.679	acre-feet	
Approximate 100-yr Detention Volume =	0.771	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.144	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.276	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.351	acre-feet
Total Detention Basin Volume =	0.771	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	

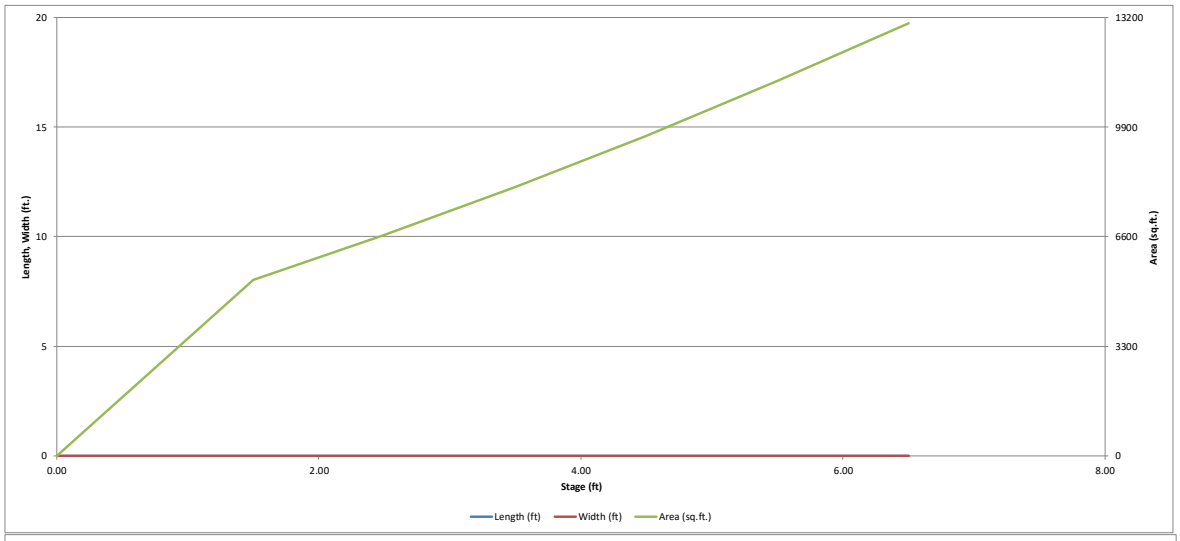
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

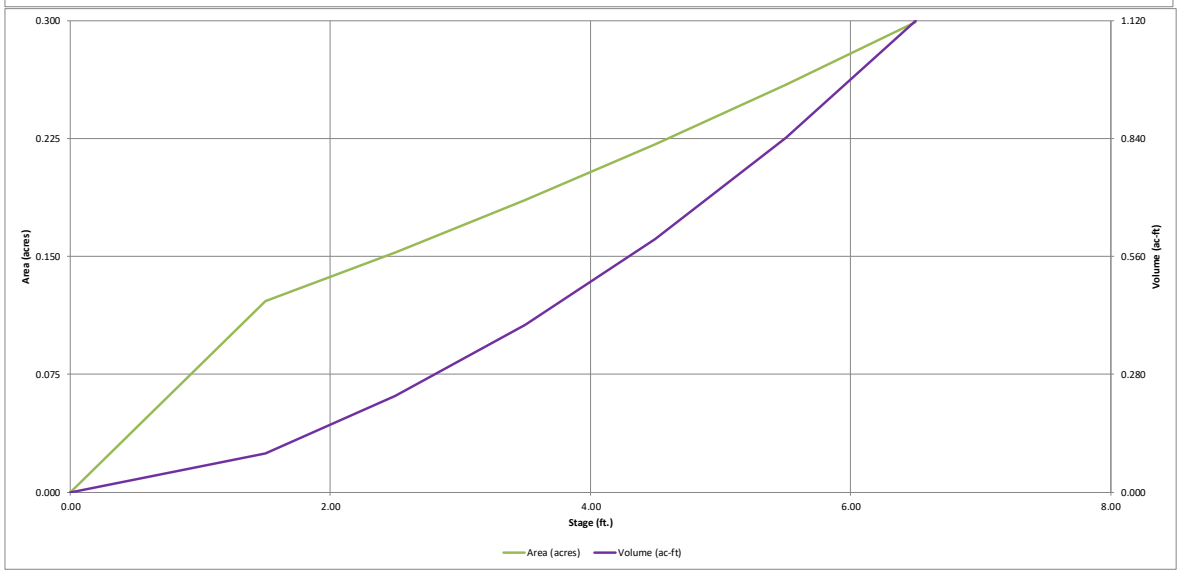
Depth Increment = 0.50 ft

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		
7340	--	1.50	--	--	--	5,297	0.122	3,973	0.091
7341	--	2.50	--	--	--	6,639	0.152	9,941	0.228
7342	--	3.50	--	--	--	8,087	0.186	17,304	0.397
7343	--	4.50	--	--	--	9,636	0.221	26,165	0.601
7344	--	5.50	--	--	--	11,286	0.259	36,626	0.841
7345	--	6.50	--	--	--	13,036	0.299	48,787	1.120

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



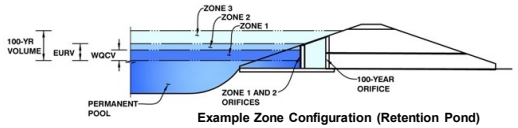


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Buc-ee's El Paso County**

Basin ID: **Pond 3**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.92	0.144	Orifice Plate
Zone 2 (EURV)	3.62	0.276	Orifice Plate
Zone 3 (100-year)	5.23	0.351	Weir&Pipe (Restrict)
Total (all zones)		0.771	

✓ = calcs match details in plans

X = calcs do not match details in plans

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

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

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

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.62	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (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	1.00	2.00					
Orifice Area (sq. inches)	0.85	1.25	1.25					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

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

	Zone 3 Weir	Not Selected		**Calculated Parameters for Overflow Weir**	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.68	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.43	N/A	feet
Overflow Weir Front Edge Length =	2.92	N/A	feet	Overflow Weir Slope Length =	15.46	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	41.67	N/A	
Horiz. Length of Weir Sides =	15.00	N/A	feet	Overflow Grate Open Area w/o Debris =	31.42	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	15.71	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.75	N/A	ft^2
Outlet Pipe Diameter =	12.00	N/A	inches	Outlet Orifice Centroid =	0.48	N/A	feet
Restrictor Plate Height Above Pipe Invert =	11.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.56	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

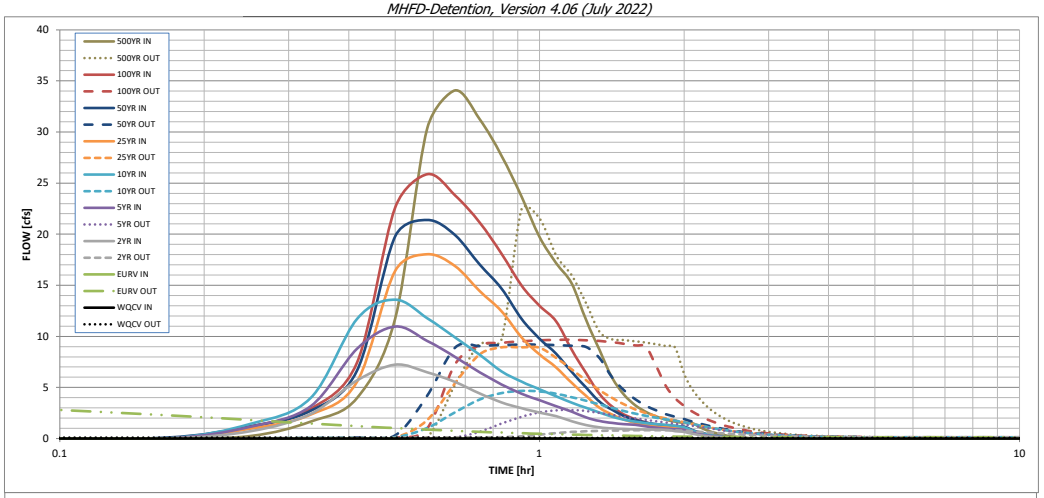
			Calculated Parameters for Spillway		
Spillway Invert Stage=	5.20	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.27	feet
Spillway Crest Length =	60.00	feet	Stage at Top of Freeboard =	6.47	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.30	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.11	acre-ft

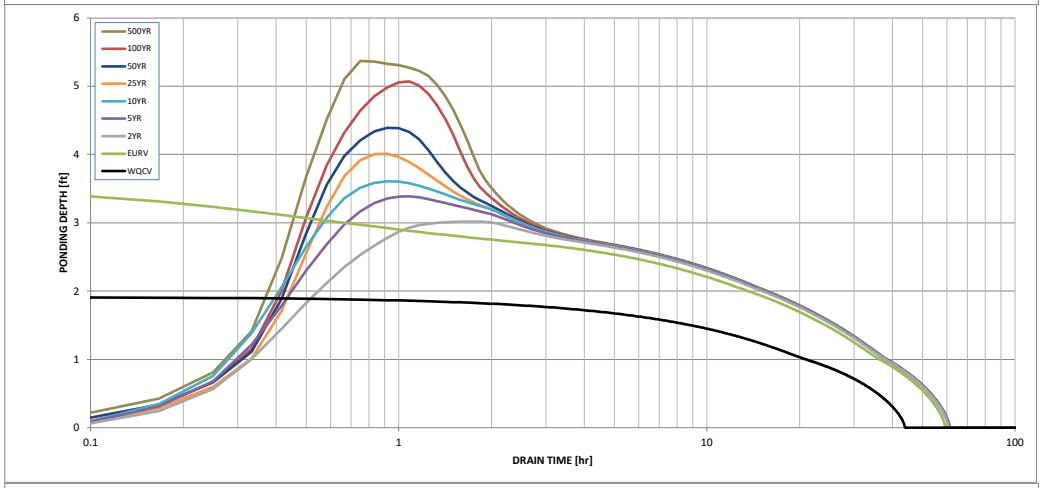
Routed Hydrograph Results *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

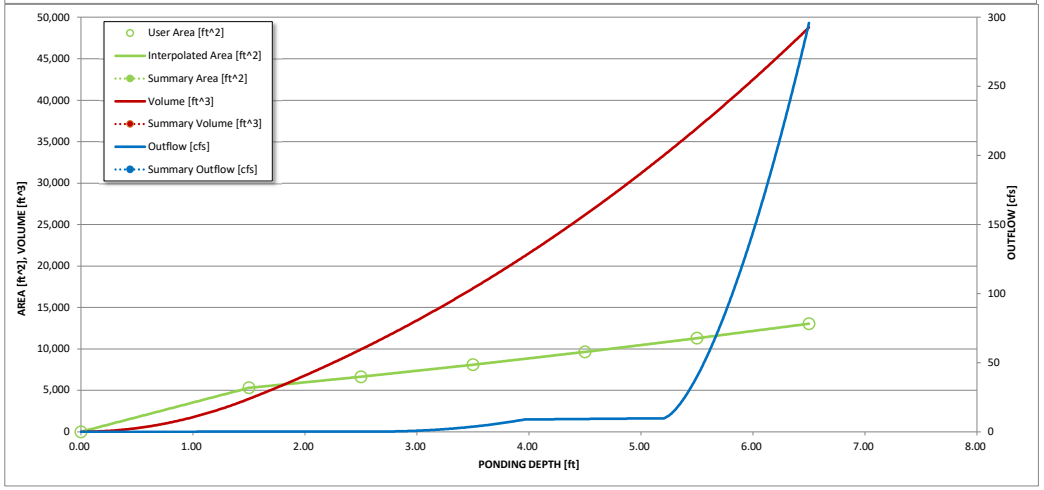
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.144	0.419	0.385	0.566	0.725	0.953	1.131	1.363	1.825
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.385	0.566	0.725	0.953	1.131	1.363	1.825
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.2	3.5	5.2	9.3	11.6	14.6	20.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.38	0.57	1.02	1.28	1.61	2.24
Peak Inflow Q (cfs) =	N/A	N/A	7.2	11.0	13.6	18.0	21.4	25.9	34.1
Peak Outflow Q (cfs) =	0.1	4.1	0.8	2.8	4.7	8.9	9.2	9.7	22.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.9	1.0	0.8	0.7	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.15	0.02	0.1	0.1	0.3	0.3	0.3	0.3
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) =	40	50	52	49	47	44	41	38	34
Time to Drain 99% of Inflow Volume (hours) =	**42**	55	57	56	55	53	52	51	49
Maximum Ponding Depth (ft) =	1.92	3.62	3.02	3.39	3.61	4.01	4.39	5.07	5.37
Area at Maximum Ponding Depth (acres) =	0.13	0.19	0.17	0.18	0.19	0.20	0.22	0.24	0.25
Maximum Volume Stored (acre-ft) =	0.145	0.420	0.310	0.375	0.416	0.495	0.574	0.730	0.805

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.01	0.26
	0:15:00	0.00	0.00	0.71	1.16	1.44	0.97	1.20	1.18	1.67
	0:20:00	0.00	0.00	2.42	3.17	3.96	2.34	2.71	2.92	3.98
	0:25:00	0.00	0.00	5.68	8.79	11.73	5.58	6.66	7.46	11.76
	0:30:00	0.00	0.00	7.22	10.97	13.59	16.42	19.80	22.61	30.34
	0:35:00	0.00	0.00	6.48	9.57	11.79	18.04	21.40	25.87	34.08
	0:40:00	0.00	0.00	5.53	7.99	9.90	16.88	19.91	23.81	31.26
	0:45:00	0.00	0.00	4.41	6.49	8.20	14.43	17.02	21.15	27.69
	0:50:00	0.00	0.00	3.54	5.31	6.58	12.46	14.68	18.09	23.68
	0:55:00	0.00	0.00	2.96	4.40	5.57	9.90	11.71	14.98	19.73
	1:00:00	0.00	0.00	2.55	3.75	4.82	8.22	9.78	12.99	17.16
	1:05:00	0.00	0.00	2.18	3.16	4.13	6.94	8.29	11.47	15.17
	1:10:00	0.00	0.00	1.70	2.63	3.50	5.44	6.50	8.68	11.57
	1:15:00	0.00	0.00	1.31	2.07	3.00	4.16	4.98	6.39	8.64
	1:20:00	0.00	0.00	1.09	1.71	2.55	2.99	3.59	4.35	5.95
	1:25:00	0.00	0.00	0.99	1.53	2.13	2.34	2.81	3.12	4.29
	1:30:00	0.00	0.00	0.93	1.42	1.85	1.85	2.20	2.36	3.26
	1:35:00	0.00	0.00	0.90	1.35	1.65	1.54	1.82	1.89	2.61
	1:40:00	0.00	0.00	0.88	1.18	1.51	1.33	1.56	1.56	2.15
	1:45:00	0.00	0.00	0.87	1.07	1.42	1.20	1.39	1.34	1.85
	1:50:00	0.00	0.00	0.86	0.98	1.35	1.12	1.28	1.19	1.64
	1:55:00	0.00	0.00	0.73	0.91	1.25	1.06	1.21	1.11	1.53
	2:00:00	0.00	0.00	0.64	0.84	1.10	1.03	1.17	1.09	1.49
	2:05:00	0.00	0.00	0.46	0.60	0.77	0.73	0.82	0.77	1.05
	2:10:00	0.00	0.00	0.32	0.42	0.54	0.51	0.58	0.55	0.74
	2:15:00	0.00	0.00	0.22	0.29	0.38	0.35	0.40	0.38	0.52
	2:20:00	0.00	0.00	0.15	0.19	0.25	0.24	0.27	0.26	0.35
	2:25:00	0.00	0.00	0.10	0.12	0.17	0.16	0.18	0.17	0.23
	2:30:00	0.00	0.00	0.06	0.08	0.11	0.10	0.12	0.11	0.15
	2:35:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.09
	2:40:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.04
	2:45:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

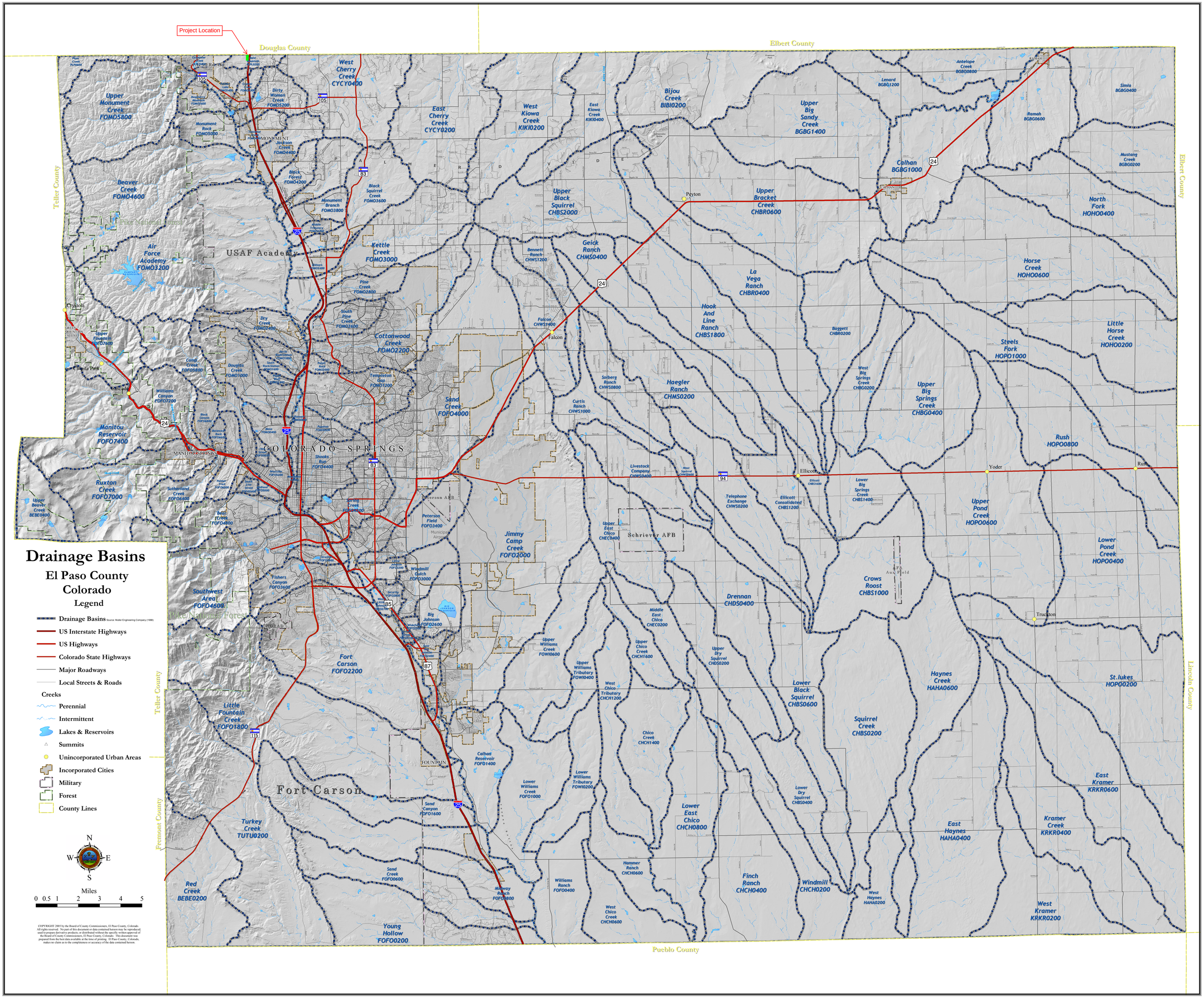
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

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

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

APPENDIX E



Drainage Basins

El Paso County
Colorado

Legend

- Drainage Basins Source: Muller Engineering Company (1988)
- US Interstate Highways
- US Highways
- Colorado State Highways
- Major Roadways
- Local Streets & Roads

Creeks

- Perennial
- Intermittent

- Lakes & Reservoirs
- Summits
- Unincorporated Urban Areas
- Incorporated Cities
- Military
- Forest
- County Lines

N W E S

Miles

0 0.5 1 2 3 4 5

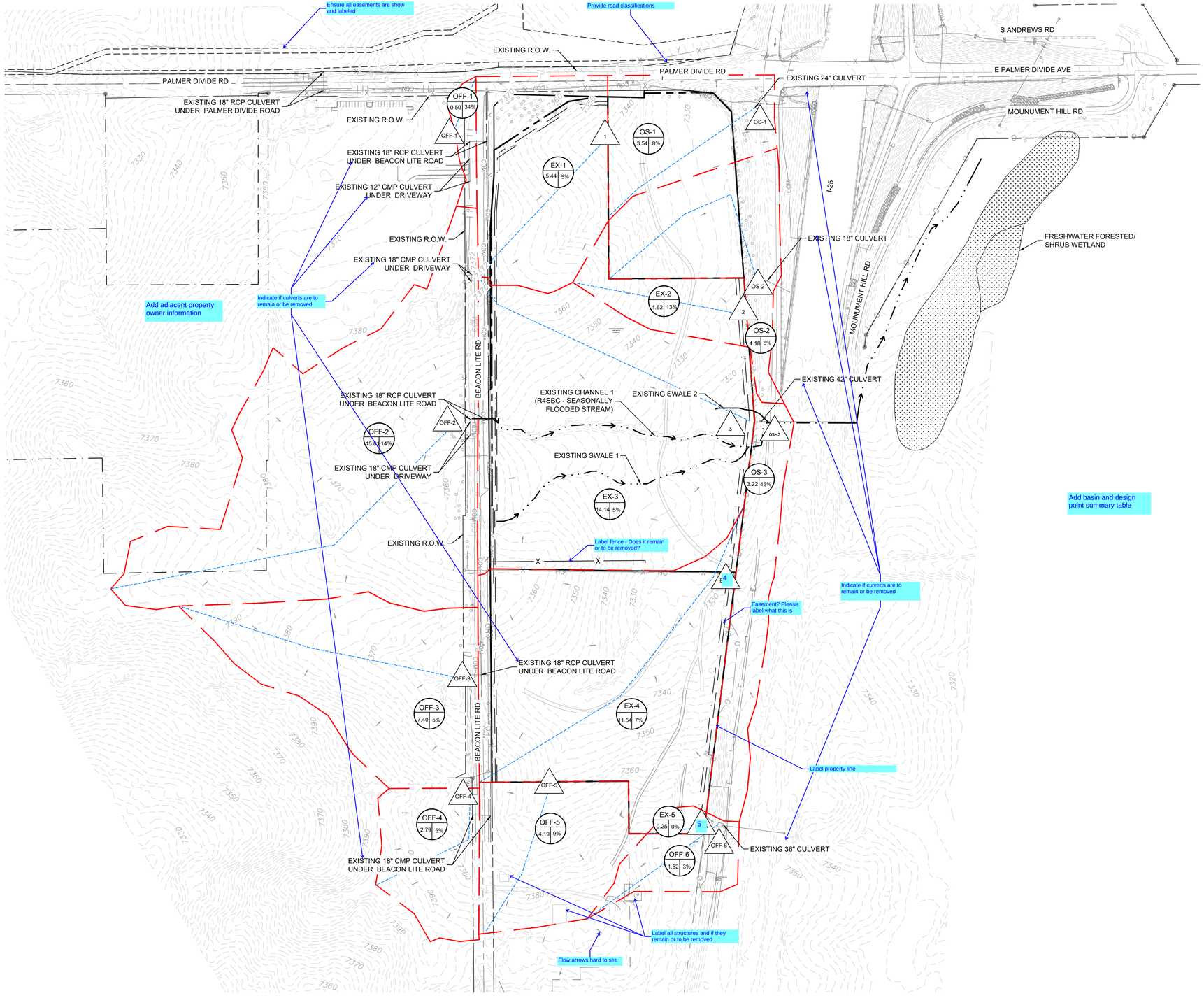
COPYRIGHT 2005 by the Board of County Commissioners, El Paso County, Colorado. All rights reserved. No part of this document or data contained hereon may be reproduced; used to prepare derivative products; or distributed without the specific written approval of the Board of County Commissioners, El Paso County, Colorado. This document was prepared from the best data available at the time of printing. El Paso County, Colorado, makes no claim as to the completeness or accuracy of the data contained hereon.

APPENDIX F

We need to know how much of the proposed area of disturbance (not just the impervious surfaces) is treated vs untreated and if there are any exclusions that apply to the untreated areas. So please create a basic overview map (or modify an existing drainage map) with color shading/hatching that shows areas tributary to each PCM (pond, runoff reduction, etc.) and those disturbed areas that are not treated by a PCM, with the applicable exclusion labeled (ex: 20% up to 1ac of development can be excluded per ECM App I.6.1.C.1 (only if using the WQCV Design Base Standard) and exclusions listed in ECM App I.6.1.B.#). An accompanying summary table on this map would also be very helpful. Example provided:

Water Quality Treatment Summary Table

Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Trib to Pond A (ac)	Disturbed Area Treated via Runoff Reduction (ac)	Disturbed Area Excluded from WQ per ECM App I.7.1.C.1 (ac)	Disturbed Area Excluded from WQ per ECM App I.7.1.B.# (ac)	Applicable WQ Exclusions (App I.7.1.B.#)
A	4.50	4.50	4.50				
B	1.25	1.25		1.25			
C	6.00	4.00				4.00	ECM App I.7.1.B.5
D	2.50	2.50	1.00		0.50	1.00	ECM App I.7.1.B.7
E	3.00		3.00				
F	8.25						
Total	25.50	12.25	8.50	1.25	0.50	5.00	



LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- DRAINAGE BASIN BOUNDARY
- EXISTING FENCE
- EXISTING GAS LINE
- EXISTING FIBER LINE
- EXISTING OVERHEAD ELECTRIC
- TIME OF CONCENTRATION PATH
- A = BASIN DESIGNATION; B = AREA IN ACRES; C = IMPERVIOUSNESS
- DESIGN POINT DESIGNATION
- EXISTING FLOW ARROW
- EXISTING SWALE

NORTH

GRAPHIC SCALE IN FEET
0 75 150 300

Know what's below. Call before you dig.

No.	REVISIONS	DATE	BY

Kimley»Horn
© 2026 KIMLEY-HORN AND ASSOCIATES, INC.
6200 SOUTH SYRACUSE WAY, SUITE 300
GREENWOOD VILLAGE, COLORADO 80111
PHONE: (303) 228-2300

KHA PROJECT 196094001
DATE 9/11/2026
SCALE AS SHOWN
DESIGNED BY MMR
DRAWN BY ECM
CHECKED BY KEW

EXISTING DRAINAGE MAP

BUC-EE'S #87 - CONSTRUCTION DOCUMENTS
EL PASO COUNTY

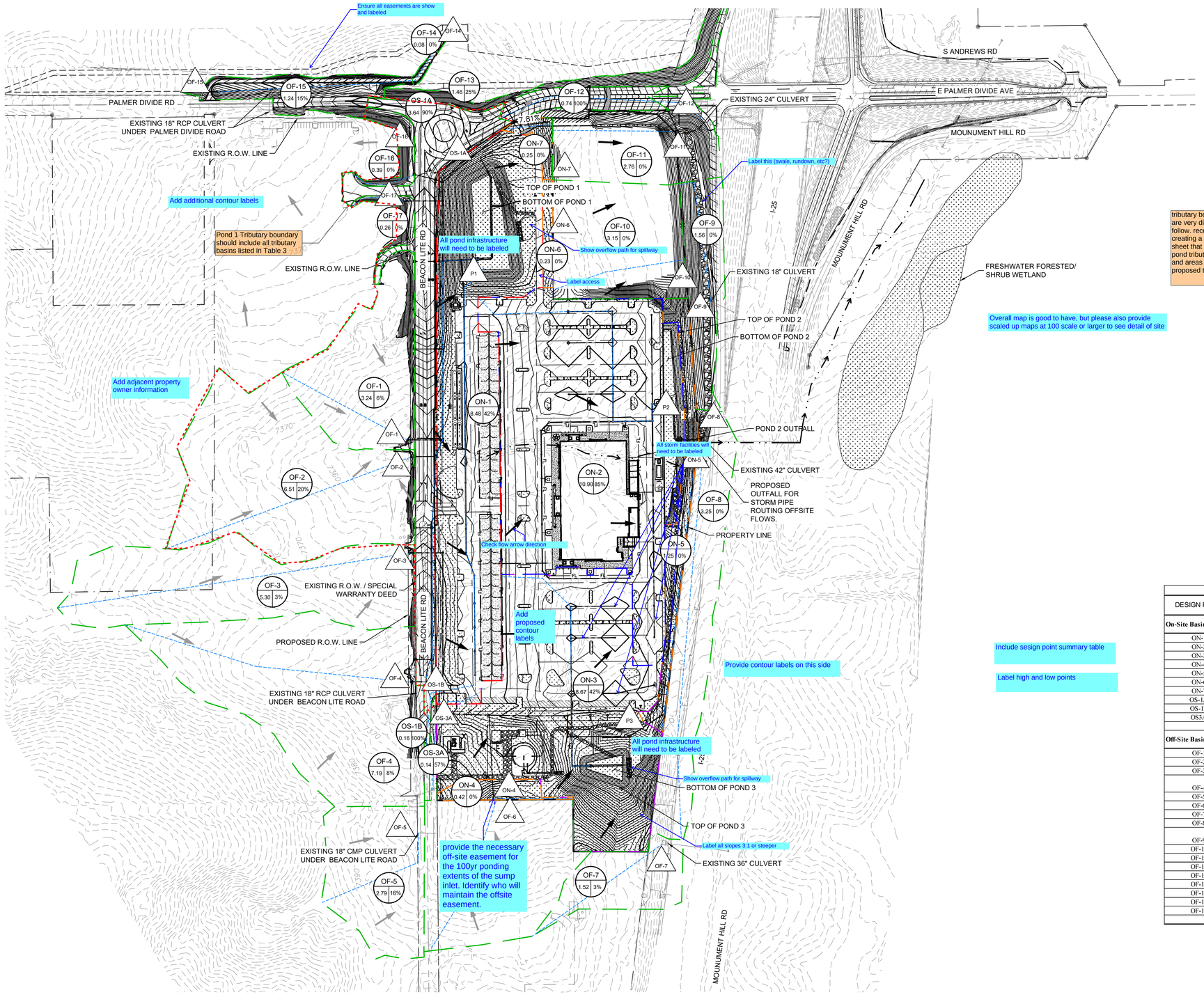
PREPARED FOR
BUC-EE'S, LTD.

COUNTY OF EL PASO
COLORADO

SHEET NUMBER
C-12A

C-12A EXISTING DRAINAGE MAP

This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.



LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- DRAINAGE BASIN BOUNDARY - ONSITE POND 1
- DRAINAGE BASIN BOUNDARY - ONSITE POND 2
- DRAINAGE BASIN BOUNDARY - ONSITE POND 3
- DRAINAGE BASIN BOUNDARY - UNTREATED ONSITE
- DRAINAGE BASIN BOUNDARY - OFFSITE
- EXISTING FENCE
- EXISTING GAS LINE
- EXISTING FIBER LINE
- EXISTING OVERHEAD ELECTRIC
- PROPOSED WATER LINE
- PROPOSED ELECTRIC LINE
- PROPOSED FIRE LINE
- TIME OF CONCENTRATION PATH
- A = BASIN DESIGNATION; B = AREA IN ACRES; C = IMPERVIOUSNESS
- DESIGN POINT DESIGNATION
- EXISTING FLOW ARROW
- PROPOSED FLOW ARROW
- TYPE C INLET
- FLARED END SECTION

RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	IMPERVIOUSNESS %	PEAK FLOWS (CFS) Q2	Q5	Q100
On-Site Basins						
ON-1	ON-1	8.48	42%	6.73	9.39	22.69
ON-2	ON-2	10.90	85%	24.92	32.19	60.64
ON-3	ON-3	8.67	42%	7.69	10.69	25.74
ON-4	ON-4	0.42	0%	0.03	0.13	0.95
ON-5	ON-5	1.25	0%	0.08	0.41	3.00
ON-6	ON-6	0.23	0%	0.02	0.09	0.69
ON-7	ON-7	0.25	0%	0.02	0.09	0.66
OS-1A	OS-1A	3.64	90%	6.61	8.49	15.68
OS-1B	OS-1B	0.16	100%	0.33	0.42	0.75
OS3A	OS-3A	0.14	57%	0.26	0.35	0.75
TOTAL		**33.84**	**58%**	**46.09**	**61.48**	**130.06**
Off-Site Basins						
OF-1	OF-1	3.24	6%	0.52	1.24	6.51
OF-2	OF-2	6.51	20%	2.32	3.82	13.34
OF-3	OF-3	5.30	3%	0.38	1.23	7.76
OF-4	OF-4	7.19	8%	1.10	2.45	12.20
OF-5	OF-5	2.79	16%	1.02	1.80	6.95
OF-6	OF-6	4.19	7%	0.22	1.76	9.09
OF-7	OF-7	1.52	3%	0.22	0.41	2.55
OF-8	OF-8	3.25	0%	0.08	0.56	4.15
OF-9	OF-9	1.56	0%	0.17	0.41	3.02
OF-10	OF-10	3.15	0%	0.15	0.88	6.43
OF-11	OF-11	2.67	0%	0.06	0.75	5.51
OF-12	OF-12	0.74	100%	5.24	3.39	6.07
OF-13	OF-13	1.46	25%	0.11	2.14	6.30
OF-14	OF-14	0.08	0%	0.07	0.04	0.33
OF-15	OF-15	1.24	15%	0.16	0.88	3.17
OF-16	OF-16	0.39	0%	0.02	0.10	0.77
OF-17	OF-17	0.26	0%	0.00	0.08	0.58
TOTAL		**45.54**	**9%**	**11.84**	**21.95**	**94.73**

NORTH

GRAPHIC SCALE IN FEET
0 75 150 300

Know what's below. Call before you dig.

No.	REVISIONS	DATE	BY

Kimley»Horn
© 2026 KIMLEY-HORN AND ASSOCIATES, INC.
6200 SOUTH SYRACUSE WAY, SUITE 300
GREENWOOD VILLAGE, COLORADO 80111
PHONE: (303) 228-2300

KHA PROJECT 196094001
DATE 9/17/2026
SCALE AS SHOWN
DESIGNED BY MMR
DRAWN BY ECM
CHECKED BY KEW

PROPOSED DRAINAGE MAP

BUC-EE'S #87 - CONSTRUCTION DOCUMENTS

EL PASO COUNTY COLORADO

PREPARED FOR
BUC-EE'S, LTD.

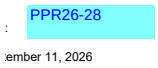
COUNTY OF EL PASO

SHEET NUMBER
C-12B

This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.

V1_Drainage Report - Final.pdf Markup Summary

1 (2)



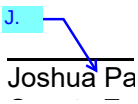
Subject: Text Box
Page Label: 1
Status:
Color:
Layer:
Space:

PPR26-28



Subject: Stamp - Stormwater Comment Legend
Page Label: 1
Status:
Color:
Layer:
Space:

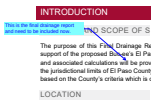
2 (1)



Subject: Callout
Page Label: 2
Status:
Color:
Layer:
Space:

J.

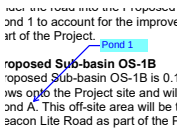
5 (1)



Subject: Callout
Page Label: 5
Status:
Color:
Layer:
Space:

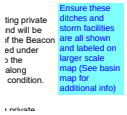
This is the final drainage report and need to be included now.

9 (3)



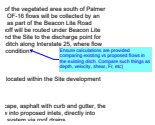
Subject: Callout
Page Label: 9
Status:
Color:
Layer:
Space:

Pond 1



Subject: Text Box
Page Label: 9
Status:
Color:
Layer:
Space:

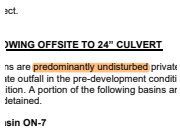
Ensure these ditches and storm facilities are all shown and labeled on larger scale map (See basin map for additional info)



Subject: Callout
Page Label: 9
Status:
Color:
Layer:
Space:

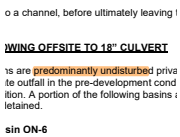
Ensure calculations are provided comparing existing vs proposed flows in the existing ditch. Compare such things as depth, velocity, shear, Fr, etc)

10 (2)



Subject: SW - Highlight
Page Label: 10
Status:
Color:
Layer:
Space:

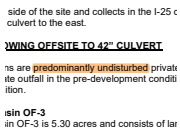
predominantly undisturbed



Subject: SW - Highlight
Page Label: 10
Status:
Color:
Layer:
Space:

predominantly undisturbe

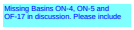
11 (1)



Subject: SW - Highlight
Page Label: 11
Status:
Color:
Layer:
Space:

predominantly undisturbed

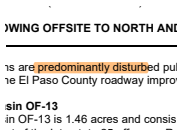
12 (3)



Subject: Text Box
Page Label: 12
Status:
Color:
Layer:
Space:

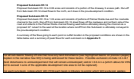
Missing Basins ON-4, ON-5 and OF-17 in discussion. Please include

---



Subject: SW - Highlight
Page Label: 12
Status:
Color:
Layer:
Space:

predominantly disturb

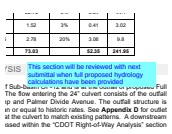


Subject: SW - Textbox
Page Label: 12
Status:
Color:
Layer:
Space:

For all sub-basins flowing off-site that have any land disturbance (see highlighted basins on previous pages):
Explain in the narrative how WQ is being addressed for these basins. Possible exclusions include I.6.1.B.7 (land disturbance to undeveloped land that will remain undeveloped) and/or I.6.3.A.1.a (which allows for 20% not to exceed 1 acre of the applicable development site area to not be captured).

For each sub-basin, notate which WQ PCM each basin is tributary to and/or which WQ exclusion applies.

13 (1)



Subject: Text Box
Page Label: 13
Status:
Color:
Layer:
Space:

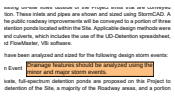
This section will be reviewed with next submittal when full proposed hydrology calculations have been provided

15 (2)



Subject: SW - Highlight
Page Label: 15
Status:
Color:
Layer:
Space:

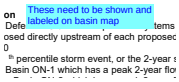
Proposed Drainage features on-site have been analyzed and sized for the following design storm events:



Subject: SW - Textbox
Page Label: 15
Status:
Color:
Layer:
Space:

Drainage features should be analyzed using the minor and major storm events.

18 (4)



Subject: Text Box
Page Label: 18
Status:
Color:
Layer:
Space:

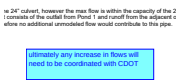
These need to be shown and labeled on basin map



Subject: Callout
Page Label: 18
Status:
Color:
Layer:
Space:

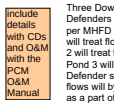
Indicate what the new flow is and how much it has increased. What are the impacts to the downstream facilities of the 24" culvert due to the increase

---



Subject: Text Box
Page Label: 18
Status:
Color:
Layer:
Space:

ultimately any increase in flows will need to be coordinated with CDOT



Subject: Text Box
Page Label: 18
Status:
Color:
Layer:
Space:

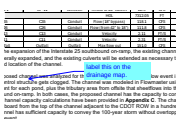
include details with CDs and O&M with the PCM O&M Manual

19 (2)



Subject: Text Box
Page Label: 19
Status:
Color:
Layer:
Space:

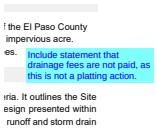
What about downstream of the culvert?



Subject: Callout
Page Label: 19
Status:
Color:
Layer:
Space:

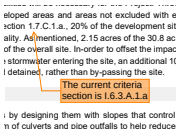
label this on the drainage map.

20 (5)



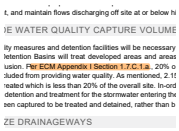
Subject: Text Box
Page Label: 20
Status:
Color:
Layer:
Space:

Include statement that drainage fees are not paid, as this is not a platting action.



Subject: SW - Textbox with Arrow
Page Label: 20
Status:
Color:
Layer:
Space:

The current criteria section is I.6.3.A.1.a



Subject: SW - Highlight
Page Label: 20
Status:
Color:
Layer:
Space:

er ECM Appendix I Section 1.7.C.1.a



Subject: SW - Highlight
Page Label: 20
Status:
Color:
Layer:
Space:

or less
than 1 acre can be excluded from providing water quality. As mentioned, 2.15 acres of the 30.8 acre parcel
will not be able to be treated which is less than 20% of the overall site

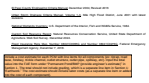
---



Subject: SW - Textbox with Arrow
Page Label: 20
Status:
Color:
Layer:
Space:

The criteria states:
"may exclude up to 20%, not to exceed 1 ac." 2.15 ac cannot be untreated under EPC's criteria and MS4 Permit. The 1.15 ac above the 1 ac threshold must be treated or otherwise covered with applicable exclusions.

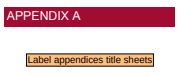
21 (1)



Subject: SW - Textbox
Page Label: 21
Status:
Color:
Layer:
Space:

Include a cost estimate for each PCM with line items for all components (ex: riprap, road base, forebay, trickle channel, outlet structure, outlet pipe, spillway, etc). Input the total value into the FAE form under “Permanent Pond/BMP (provide engineer’s estimate)” in Section 1. The total should not include grading, which is a separate line item in Section 1: “Earthwork.” The cost estimate should include labor costs (as a separate line item or added into the cost of each component).

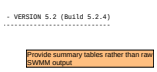
22 (1)



Subject: SW - Textbox
Page Label: 22
Status:
Color:
Layer:
Space:

Label appendices title sheets

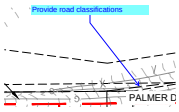
31 (1)



Subject: SW - Textbox
Page Label: 31
Status:
Color:
Layer:
Space:

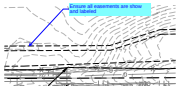
Provide summary tables rather than raw SWMM output

60 (13)



Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Provide road classifications



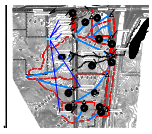
Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Ensure all easements are show and labeled



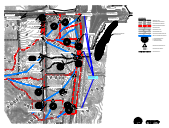
Subject: Text Box
Page Label: 60
Status:
Color:
Layer:
Space:

Add adjacent property owner information



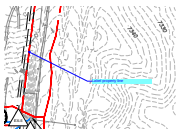
Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Indicate if culverts are to remain or be removed



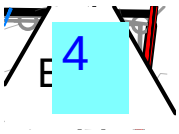
Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Indicate if culverts are to remain or be removed



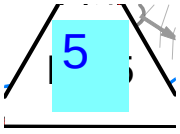
Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Label property line



Subject: Text Box
Page Label: 60
Status:
Color:
Layer:
Space:

4



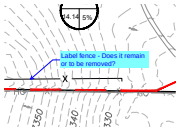
Subject: Text Box
Page Label: 60
Status:
Color:
Layer:
Space:

5



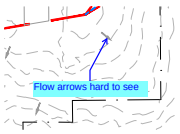
Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Easement? Please label what this is



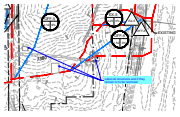
Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Label fence - Does it remain or to be removed?



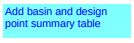
Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Flow arrows hard to see



Subject: Callout
Page Label: 60
Status:
Color:
Layer:
Space:

Label all structures and if they remain or to be removed

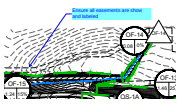


Subject: Text Box
Page Label: 60
Status:
Color:
Layer:
Space:

Add basin and design point summary table

---

61 (22)



Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

Ensure all easements are show and labeled



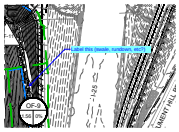
Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

Add adjacent property owner information



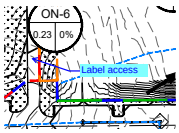
Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

Provide contour labels on this side



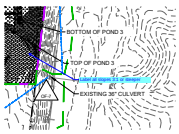
Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

Label this (swale, rundown, etc?)



Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

Label access



Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

Label all slopes 3:1 or steeper

Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

Include sesign point summary table

Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

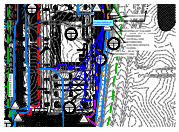
Label high and low points



Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

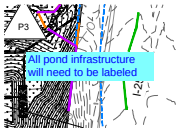
Overall map is good to have, but please also provide scaled up maps at 100 scale or larger to see detail of site

---



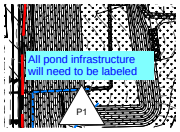
Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

All storm facilities will need to be labeled



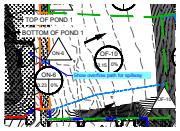
Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

All pond infrastructure will need to be labeled



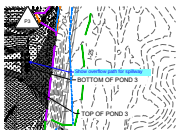
Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

All pond infrastructure will need to be labeled



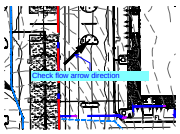
Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

Show overflow path for spillway



Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

Show overflow path for spillway



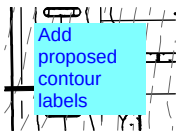
Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

Check flow arrow direction



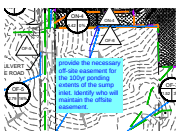
Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

Add additional contour labels



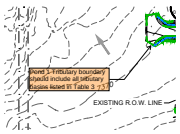
Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

Add proposed contour labels



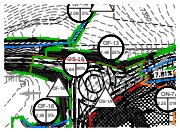
Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

provide the necessary off-site easement for the 100yr ponding extents of the sump inlet. Identify who will maintain the offsite easement.

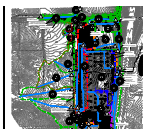


Subject: Callout
Page Label: 61
Status:
Color:
Layer:
Space:

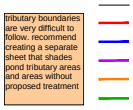
Pond 1 Tributary boundary should include all tributary basins listed in Table 3



Subject: PolyLine
Page Label: 61
Status:
Color:
Layer:
Space:



Subject: PolyLine
Page Label: 61
Status:
Color:
Layer:
Space:



Subject: Text Box
Page Label: 61
Status:
Color:
Layer:
Space:

tributary boundaries are very difficult to follow. recommend creating a separate sheet that shades pond tributary areas and areas without proposed treatment

---

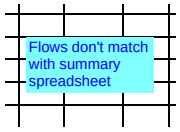
63 (3)

Subject: Highlight
Page Label: 63
Status:
Color:
Layer:
Space:

5.56

Subject: Highlight
Page Label: 63
Status:
Color:
Layer:
Space:

9.45

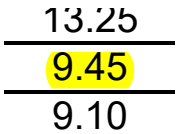


Subject: Text Box
Page Label: 63
Status:
Color:
Layer:
Space:

Flows don't match with summary spreadsheet

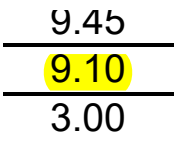
---

64 (3)



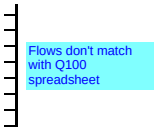
Subject: Highlight
Page Label: 64
Status:
Color:
Layer:
Space:

9.45



Subject: Highlight
Page Label: 64
Status:
Color:
Layer:
Space:

9.10

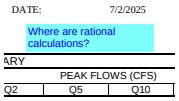


Subject: Text Box
Page Label: 64
Status:
Color:
Layer:
Space:

Flows don't match with Q100 spreadsheet

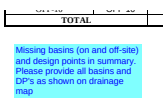
---

65 (2)



Subject: Text Box
Page Label: 65
Status:
Color:
Layer:
Space:

Where are rational calculations?

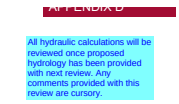


Subject: Text Box
Page Label: 65
Status:
Color:
Layer:
Space:

Missing basins (on and off-site) and design points in summary. Please provide all basins and DP's as shown on drainage map

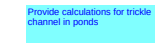
---

66 (4)



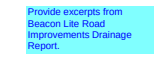
Subject: Text Box
Page Label: 66
Status:
Color:
Layer:
Space:

All hydraulic calculations will be reviewed once proposed hydrology has been provided with next review. Any comments provided with this review are cursory.



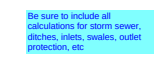
Subject: Text Box
Page Label: 66
Status:
Color:
Layer:
Space:

Provide calculations for trickle channel in ponds



Subject: Text Box
Page Label: 66
Status:
Color:
Layer:
Space:

Provide excerpts from Beacon Lite Road Improvements Drainage Report.



Subject: Text Box
Page Label: 66
Status:
Color:
Layer:
Space:

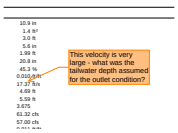
Be sure to include all calculations for storm sewer, ditches, inlets, swales, outlet protection, etc

67 (2)

0.010 ft/f
17.37 ft/s
4.69 ft

Subject: SW - Highlight
Page Label: 67
Status:
Color:
Layer:
Space:

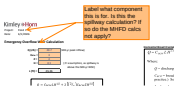
17.37



Subject: SW - Textbox with Arrow
Page Label: 67
Status:
Color:
Layer:
Space:

This velocity is very large - what was the tailwater depth assumed for the outlet condition?

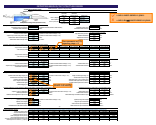
72 (1)



Subject: SW - Textbox with Arrow
Page Label: 72
Status:
Color:
Layer:
Space:

Label what component this is for. Is this the spillway calculation? If so do the MHFD calcs not apply?

77 (1)



Subject: Group
Page Label: 77
Status:
Color:
Layer:
Space:

X

82 (1)

✓ 2.67

Subject: Checkmark
Page Label: 82
Status:
Color:
Layer:
Space:

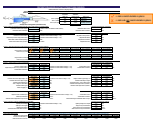
86 (1)



Subject: Group
Page Label: 86
Status:
Color:
Layer:
Space:

X

95 (1)



Subject: Group
Page Label: 95
Status:
Color:
Layer:
Space:

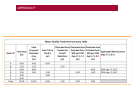
X

101 (2)



Subject: SW - Textbox
Page Label: 101
Status:
Color:
Layer:
Space:

We need to know how much of the proposed area of disturbance (not just the impervious surfaces) is treated vs untreated and if there are any exclusions that apply to the untreated areas. So please create a basic overview map (or modify an existing drainage map) with color shading/hatching that shows areas tributary to each PCM (pond, runoff reduction, etc.) and those disturbed areas that are not treated by a PCM, with the applicable exclusion labeled (ex: 20% up to 1ac of development can be excluded per ECM App I.6.1.C.1 (only if using the WQCV Design Base Standard) and exclusions listed in ECM App I.6.1.B.#). An accompanying summary table on this map would also be very helpful. Example provided:



Subject: Image
Page Label: 101
Status:
Color:
Layer:
Space: