



Final Drainage Report for Life.Church at Bent Grass Meadows

May 2025

HR Green Project No: 2403591

Prepared For:

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Engineer’s Statement

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

Richie Lyon, PE Date

State of Colorado No. 53921

For and on behalf of HR Green Development, LLC

Developer’s Statement

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

Josh Brower Date

FAL Realty, LLC.

El Paso County:

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

Joshua Palmer, P.E.

Date

County Engineer/ECM Administrator

I. General Purpose, Location and Description

a. Purpose

This Final Drainage Report (FDR) aims to identify specific solutions to drainage concerns resulting from the development of the site. The report outlines the onsite and offsite drainage patterns, details the existing and proposed storm infrastructure, and proposes a solution for effectively routing developed stormwater to an adequate detention facility. A full-spectrum detention pond is proposed as the permanent control measure and is designed based on an analysis of changes in slopes, drainage patterns, and impervious areas which yield new peak stormwater runoff quantities compared to the existing conditions. Hydrologic and hydraulic calculations for both onsite and offsite areas, along with an assessment of the existing downstream stormwater infrastructure, are provided to demonstrate compliance with County stormwater criteria and ensure that existing infrastructure is not negatively impacted by this development.

b. Location

Life Church at Bent Grass Meadows totals 8.34 acres, referred to as 'the site' herein, is a portion of the east half of the northeast quarter of Section 1, Township 13 South, Range 65 West of the 6th P.M., El Paso County, Colorado. The site is a lot within the Bent Grass subdivision described in the Master Development Drainage Plan by Kiowa Engineering Corporation dated April 2006 entitled *Master Development Drainage Plan and Preliminary Drainage Plan Bent Grass Subdivision El Paso County, Colorado*, approved by El Paso County in August of 2007. The site is bound to the north by the Woodmen Hills Filing No. 4 residential subdivision. To the east of the site is the 120' wide public right-of-way of Meridian Road and across the roadway is Woodmen Hills Filing No. 5 and Filing No. 8. Directly adjacent to the site's eastern property boundary is a 75' wide right-of-way dedication, Reception No. 211037676. Immediately south of the site is the 80'-wide public right-of-way of Bent Grass Meadows Drive and south of the roadway are the commercial subdivisions of Bent Grass Plaza and Bent Grass East Commercial. There are no existing or proposed public roadways internal to the site. The assessor's parcel numbers for the two lots to be platted as a single lot for this development are 5301000026 and 5301000033. The property is not within a Streamside Zone or Hillside Zone. There are no no-build or preservation easements or areas within the platted parcel.

A vicinity map is presented in Appendix A.

c. Description of Existing Conditions

The undeveloped site (zoned Conceptual PUD RR-5) consists of no site improvements apart from a partially paved entry to the site off Bent Grass Meadows Drive which has a concrete cross pan and curb and gutter. The overall on-site imperviousness is approximately 1% and roughly 90% of the site is covered by native grasses and wildflowers. There are no trees or shrubs of significance existing on site. The site generally slopes from the northwest down to the southeast at grades ranging from 2% to 4%, with the average slope being 2.3%. The existing Bent Grass Meadows Drive roadway to the south of the site slopes from the west to the east at roughly a 1% slope.

The site consists of 100% Columbine gravelly sandy loam per the USDA, NRCS web soil survey. This soil is categorized as Hydrologic Soil Group A. The NRCS soil survey is presented in Appendix A.

The *Natural Features and Wetlands Report* prepared by Bristlecone Ecology, dated October 2024, identifies Black-tailed Prairie Dogs and Burrowing Owls as sensitive species of concern on site. Per the report, a colony

of approximately 34 Black-tailed Prairie Dogs or more were observed in a 6.8 acre area. Burrowing Owls typically utilize abandoned Prairie Dog burrows for nesting, which was the case for one observed owl onsite. Not mentioned in the report is the undeveloped land to the west, which may likely provide a suitable relocation for the aforementioned sensitive species. A specific construction schedule has been planned in which clearing, grubbing, and earthwork can only take place during the migratory season of the Burrowing Owl.

d. Description of Proposed Conditions

The developed site is to include a 39,338 square foot church building, paved parking lot areas, a private storm sewer network, and a private water quality and full spectrum detention pond. The proposed building is located in the northwest corner of the site and the proposed pond is located in the southeast corner of the site. The bulk of the on-site parking is within the northeast and southwest corners of the site. Private drive aisles go around the perimeter of the church building and throughout the parking areas on site. Landscape areas are dispersed throughout the parking area, around the detention pond, and at the perimeter of the site for landscape buffering to screen the commercial development from the adjacent residential land uses and provide landscaping along adjacent rights-of-way. The site is accessed by two entries on the adjacent public right-of-way of Bent Grass Meadows Drive roadway to the south. The primary access is the existing curb cut which is full movement and the secondary access is a right-in/right-out only ingress/egress for the site.

The on-site private storm includes a private Type D sump grate area inlet near the south of the site. This inlet drains to a forebay within the private pond through a concrete storm pipe. From the design point northeast of the pond, stormwater flows from the sump to the other forebay via a concrete rundown channel. From the northwest of the pond, a slotted curb allows stormwater to flow over sidewalk and landscape area into the pond as overland flow. The private water quality and detention pond includes an outlet structure with orifice plate and micropool that is designed to provide detention and release the stormwater at or below historic rates.

The entirety of the 8.34 acre site will be disturbed for development. Offsite disturbances included in the project will connect the site to existing public utilities owned and maintained by Woodmen Hills Metropolitan District within the Bent Grass Meadows right-of-way. Public improvements include the addition of a right-in lane on the north side of Bent Grass Meadows Drive for a taper and queue to enter the site, per the Traffic Impact Study. Other right-of-way improvements include the typical sections of a tree lawn and public concrete sidewalk with an ADA accessible route to the church building from the public right-of-way adjacent to the frontage of the site, on the north side of Bent Grass Meadows Drive.

e. Floodplain Statement

Based on FEMA Firm map 08041C0553G dated December 7, 2018, the site is Zone X, which are areas determined to be outside the 0.2% annual chance flood. No portion of the site is within a designated FEMA floodplain.

A map is provided in Appendix A.

II. Drainage Basins and Subbasins

a. Major Basin Description

The site is located within the Falcon Drainage Basin (CHWS1400). The site's drainage characteristics were previously studied in the following reports:

1. *Falcon Drainage Basin Planning Study* dated September 2015, prepared by Matrix Design Group (MP132)
2. *Bent Grass MDDP Amendment & DBPS Amendment* dated September 2021, prepared by Galloway & Company (MDP211)
3. *Final Drainage Report for Falcon Marketplace* dated November 2019 prepared by Drexel, Barrel & Co. (SF191)
4. *Request for Conditional Letter of Map Revision, Unnamed Tributary to Black Squirrel Creek, Falcon Owl Place* dated October 2022 (CLOMR)
5. *Final Drainage Report for Meridian Road & Bent Grass Meadows Drive* dated March 2020, prepared by Galloway & Company (CDR194)

The site is within the Middle Tributary area of the Falcon Drainage Basin, specifically within the MT060 sub-basin as designated by the 2015 DBPS and is referred to as Reach RMT064 in the 2021 DBPS Amendment by Galloway & Company. The site ultimately flows into the public roadside ditch on the west side of Meridian Road and on the north side of Bent Grass Meadows Drive where there are five existing public culvert pipes. This public ditch flows due south and into the storm system of the Owl Place development (VR2321, June 2024 by Drexel, Barrel & Co.) that conveys stormwater to the sub-regional detention pond at the King Soopers site referred to as Detention Facility SR4 (County File No. SF191). The Owl Place drainage study accounted for upstream stormwater basins with an assumption of on-site detention for development, which includes this site. The downstream Pond SR4 also assumed the same upstream drainage characteristics. Therefore, as long as on-site detention is provided so as to not exceed the historical stormwater runoff from this site, no downstream infrastructure or detention alterations are required.

b. Existing Subbasin Description

The existing subbasins were delineated based on existing drainage patterns. The on-site basins are comprised of undeveloped land except for the partially completed entry to the site. 2% imperviousness was assumed for each on site basin due classification of the site as greenbelts or agricultural land.

The following basins and sub-basins have been delineated.

Existing Basin A has a tributary area of **6.81 acres with a minor (5-year event) runoff of 1.87 cfs and major (100-year event) runoff of 13.74 cfs**. The basin is in the western 80 percent of the site. The basin contains undeveloped land (zoned PUD RR-5) with and a partially completed entryway to the site. The vegetation within the basin includes native grasses, wildflowers, and weeds. Runoff within the basin flows from northwest to southeast. The basin drains to **Design Point 1**, the curb and gutter within the right of way of Bent Grass Meadows Drive. The basin ultimately drains due east to the south flowing public ditch on the west side of North Meridian Road.

Existing Basin B has a total tributary area of **1.53 acres with a total minor (5-year event) runoff of 0.46 cfs and major (100-year event) runoff of 3.37 cfs**. The basin is in the eastern 20 percent of the site. The

basin contains entirely of undeveloped land (zoned PUD RR-5). The vegetation within the basin includes native grasses, wildflowers, and weeds. Runoff within the basin flows from northwest to southeast. The basin drains to **Design Point 2**, the south flowing channel west of Meridian Road.

Existing Basin OS has a total tributary area of **4.72 acres with a total minor (5-year event) runoff of 1.21 cfs and major (100-year event) runoff of 8.87 cfs**. The basin is located to the west of the site and is delineated such that all runoff that would enter the site is included. The basin contains of undeveloped land (zoned RR-5 PUD) as well as improvements such as a single family residence and accessory buildings such as sheds, barns, and stables. The vegetation within the basin includes native grasses, wildflowers, weeds, and pine and shade trees. Runoff within the basin flows from northwest to southeast. The basin drains to **Design Point 3**, the curb and gutter within the right of way of Bent Grass Meadows Drive.

Reference maps are included in Appendix G.

c. Proposed Subbasin Description

The Life.Church at Bent Grass Meadows developed area basins and subbasins vary from the historical basins due to changes in site layout and drainage conveyance.

The following basins were delineated per the revised site layout. The on site basins are to be zoned CS. Existing **Basin OS** remains unchanged.

Developed Basin A1 has a total tributary area of **2.96 acres with a total minor (5-year event) runoff of 9.65 cfs and major (100-year event) runoff of 17.98 cfs**. Basin A1 is within the western portion of the site and spans most of the property in the north/south direction. Within Basin A1 is part of the church building per its roof plan, drive aisles, parking stalls, and landscaped area. Runoff from the building rooftop is conveyed to daylight areas within the paved parking lot via roof drains and downspouts until being channelized within the gutter system and released into landscaped areas. Runoff within Basin A1 overland sheet flows across parking areas until it concentrates within the curb and gutter and drainage pans within the site. Basin A drains to **Design Point 1**, a private CDOT Type D grate sump inlet within a landscape area and is conveyed via a storm pipe a forebay in the private full spectrum detention pond.

Developed Basin A2 has a total tributary area of **2.99 acres with a total minor (5-year event) runoff of 12.37 cfs and major (100-year event) runoff of 22.94 cfs**. Basin A2 spans most of the northeastern portion of the site. Within Basin A2 is part of the church building per its roof plan, drive aisles, parking stalls, and landscaped area. Runoff from the building rooftop is routed via roof drains and downspouts to daylight areas in the parking lot until being channelized within the gutter system and released into landscaped areas. Runoff within Basin A2 overland sheet flows across parking areas until it concentrates within the curb and gutter and drainage pans within the site. Basin C drains to a low point in the southeastern corner of the basin, **Design Point 2**, which is an opening in the curb to a concrete rundown that flows south to the private full spectrum detention pond.

Developed Basin A3 has a total tributary area of **0.37 acres with a total minor (5-year event) runoff of 1.29 cfs and major (100-year event) runoff of 2.38 cfs**. Basin A3 is in the center of the site and consists of part of the church building per its roof plan, drive aisles, and landscaped area. Runoff from the building rooftop is routed via roof drains and downspouts to daylight areas in the parking lot until being channelized within the gutter system and released into landscaped areas. Runoff within Basin A3 overland sheet flows across landscaped and paved areas until it concentrates within the curb and gutter. The basin drains to

Design Point 3, a slotted curb in the southeast of the basin. The slotted curb directs flow over a sidewalk following a small drop that converts the blind swale within the curb and gutter into overland sheet flow to the full spectrum detention pond to the east. The slotted curb acts as a forebay for the small basin area and runoff.

Developed Basin A4 has a total tributary area of **0.74 acres with a total minor (5-year event) runoff of 0.42 cfs and major (100-year event) runoff of 1.94 cfs**. Basin A4 is located in the southeastern corner of the site. The basin contains the private full spectrum detention pond and surrounding landscape areas. Runoff within Basin D overland sheet flows into the detention pond except in the concrete rundowns and trickle channel where the flow is channelized. Basin A4 ultimately drains to **Design Point 4**, the outlet structure for the private detention pond. The private detention pond outflows to the public drainage ditch on the west side of Meridian Road which conveys stormwater due south via five public culvert pipes crossing Bent Grass Meadows Drive and continues via the public ditch due south within the public right-of-way.

Developed Basin N1 has a total tributary area of **0.20 acres with a total minor (5-year event) runoff of 0.06 cfs and major (100-year event) runoff of 0.47 cfs**. Basin N1 is a fully pervious thin landscape strip on the north of the site containing a berm and swale to direct any offsite flows to the drainage ditch to the east of the site. Runoff overland sheet flows across landscape area until it concentrates within the grass lined swale. The basin drains to **Design Point 5**, the drainage ditch east of the site.

Developed Basin E1 has a total tributary area of **0.27 acres with a total minor (5-year event) runoff of 0.11 cfs and major (100-year event) runoff of 0.81 cfs**. Basin E1 is a thin strip on the eastern edge of the property that spans most of the site north to south. The basin is fully pervious and contains landscape areas that daylight down to the existing ground to the east. Runoff overland sheet flows across the basin until reaching the drainage ditch to the east of the site, **Design Point 6**.

Developed Basin S1 has a total tributary area of **0.67 acres with a total minor (5-year event) runoff of 1.12 cfs and major (100-year event) runoff of 2.70 cfs**. Basin S1 is on the southern edge of the site and contains both the west and east site entrances. The basin is made up of landscape areas, paved sidewalks, and paved internal and public roadway surfaces. Runoff overland sheet flows across landscaped and paved areas until it concentrates within the curb and gutter. The basin drains to **Design Point 7**, which is the curb and gutter within the public right of way of Bent Grass Meadows Drive.

Developed Basin W1 has a total tributary area of **0.27 acres with a total minor (5-year event) runoff of 0.06 cfs and major (100-year event) runoff of 0.44 cfs**. Basin W1 is a thin strip on the western edge of the property that spans most of the site north to south. The basin contains landscape area and a grass lined swale that are fully pervious. Runoff overland sheet flows across the basin until concentrating within the swale and ultimately drains **Design Point 8**, which is a continuation of the grass lined swale and landscape area within Basin S1.

d. Downstream Drainage

This development includes a private full spectrum detention facility that provides detention of stormwater from the developed site. The private on-site pond includes an outlet pipe that drains to the roadside drainage ditch within the public right-of-way of Meridian Road. The public ditch conveys stormwater due south to the Owl Marketplace development that includes private storm system consisting of 10'x6' concrete box culverts that drain to the Falcon Marketplace Pond SR4, which is considered a sub-regional detention facility. This site was not accounted for in the detention volume of Pond SR4 in its developed condition, nor within the conveyance

of stormwater within the private storm system of the Owl Marketplace development. However, the downstream developments of Owl Marketplace and Falcon Marketplace analyzed upstream tributary areas and accounted for historical stormwater routing to their respective developments and infrastructure. The assumption made in the Owl Marketplace and Falcon Marketplace drainage studies was that upstream development would include full spectrum detention to not increase the stormwater to proposed design points. The Life.Church at Bent Grass Meadows development includes a private on-site water quality and detention pond that is designed to provide stormwater detention resulting in stormwater release from the site that is below historical rates, as shown in the hydraulic calculations in Appendix C. It is anticipated that there will be no negative impacts to downstream properties, developments, or infrastructure.

The tables below show the reduction in stormwater runoff releases from the site directed off site to Design Point X1, the design point at the northeast corner of Owl Marketplace, where the roadside ditch of Meridian Road is conveyed within the Owl Marketplace private storm infrastructure.

Peak Outflow - Existing Condition		
Basin	5-Yr Peak Outflow (cfs)	100-Yr Peak Outflow (cfs)
A	1.87	13.74
B	0.46	3.37
OS	1.21	8.87
Total To Ditch	3.54	25.98

Peak Outflow - Proposed Condition		
Basin	5-Yr Peak Outflow (cfs)	100-Yr Peak Outflow (cfs)
Pond A	0.30	5.60
N1	0.06	0.47
E1	0.11	0.81
S1	1.12	2.70
W1	0.06	0.44
OS	1.21	8.87
Total To Ditch	2.86	18.89

	5-Yr Peak Outflow (cfs)	100-Yr Peak Outflow (cfs)
Outflow	0.68	7.09
Reduction	19.21%	27.29%

Downstream Design Point	Existing 5-Yr Peak Outflow (cfs)	Proposed 5-Yr Peak Outflow (cfs)	Existing 100-Yr Peak Outflow (cfs)	Proposed 100-Yr Peak Outflow (cfs)
X1	288.5	287.82	920	912.91

III. Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis of existing and proposed storm sewer system follows the criteria from the *El Paso County Drainage Criteria Manual Volumes 1 and 2* (EPC DCM, latest revision October 2018).

b. Hydrologic Criteria

Hydrologic data was obtained from the *El Paso County, Colorado Drainage Criteria Manual – Chapter 5 Storm Runoff Methods of Analysis*. Runoff was calculated per *El Paso County, Colorado Drainage Criteria Manual – Section 5.2 - Rational Method*. Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using rainfall values from NOAA Atlas 14 below.

Rainfall Depths for Site Location		
Return Period (yr)	5	100
1-hr Rainfall Depth (in)	1.50	2.52

Private, full spectrum pond design was completed using the latest version of Mile High Flood District’s (MHFD) UD-Detention per EPCDCM guidelines. Detention pond allowable release rate will be limited to less than historic rates.

c. Hydraulic Criteria

Hydraulic criteria for inlet sizing was obtained from the *El Paso County, Colorado Drainage Criteria Manual – Chapter 7 Street Drainage and Storm Water Inlets* and the UD-Inlet calculator. Hydraulic criteria for storm sewer culverts were obtained from the *El Paso County, Colorado Drainage Criteria Manual – Chapter 9 Culvert Design*. Hydraulic criteria for swale sizing was obtained from the *El Paso County, Colorado Drainage Criteria Manual – Chapter 10 Open Channels and Structures*.

Existing roadway and proposed drive aisle capacities are analyzed utilizing hydraulic modeling (AutoCAD Civil 3D channel analysis tool) by designing the pavement sections as user-defined channels with the proper Manning’s coefficient, geometry of designed sections, and slopes. These user-defined capacity calculations are provided to determine the minor 5-year storm and major 100-year storm capacities in various areas of interest.

Storm sewer system modeling is provided in Appendix C. The hydraulic model was developed using Bentley StormCAD to assess and size private inlets and pipes, ensuring that both minor and major hydraulic grade lines comply with applicable stormwater design criteria. Table 9-4 StormCAD Standard Method Coefficients from *City of Colorado Springs, Drainage Criteria Manual, Volume 1* were used for the analysis. All proposed storm pipes are within 80% capacity for the minor storm event and do not surcharge the system to within 1’ of all storm manhole rim elevations for the major storm event. The hydraulic grade lines for the minor and major storm at the outfall point of pipes that drain to the proposed private pond are set at the appropriate detention water surface elevations for tailwater conditions.

IV. Drainage Facility Design

a. General Concept

Overland runoff areas include roof runoff from the church building as well as initial overland sheet flow within paved drive aisles and across landscaped areas. Onsite stormwater will be conveyed as channelized runoff

within the onsite curb and gutter and drainage pans that convey the runoff via a private storm sewer system and concrete rundowns to the private onsite full spectrum detention pond. The proposed private pond is assessed for the proposed site layout to meet stormwater criteria. The pond tributary area was assessed to include all basins that drain directly to it (Basin A1, Basin A2, Basin A3, Basin A4) for the WQCV and EURV. The WQCV and EURV exclude non-tributary areas (Basin N1, Basin E1, Basin S1, Basin W1), as allowable per criteria. For this FDR, the pond is assessed to provide over-detention of the development to alleviate downstream public infrastructure including the immediate outfall area of the public roadside drainage ditch and downstream public culvert pipes under Bent Grass Meadows Drive. Over-detention within the 100-year storm volume is provided by including the entire property as tributary area for the 100-year volume calculation, including basins that drain directly offsite. Over-detention in combination with the engineering design of the outlet structure yields a developed condition for the site that has a total peak outflow.

b. Basin Design Criteria

The MHFD-Detention spreadsheet was used to design the private basin and outlet structure. The 1-hour rainfall depths for the 2, 5, 10, 25, 50, and 100 year storm events used in the spreadsheet were obtained from Table 6-2 Rainfall Depths for Colorado Springs within the EPC DCM. These rainfall depths are 1.19, 1.50, 1.75, 2.00, 2.25, and 2.52 inches, respectively.

c. Water Quality & Detention

Water quality treatment is provided for all applicable areas of the site except for excluded areas which do not exceed 20 percent of the development site or 1 acre per the El Paso County base design standard requirements. The private full spectrum detention pond provides water quality treatment by facilitating the settling of suspended sediments and the capture of pollutants prior to controlled discharge from the site. This area is a designated receiving pervious area that is considered a Planned Infiltration Area (PIA).

Full spectrum detention is provided by the proposed private extended detention basin. The total area tributary to the detention basin is 7.07 acres and has 79.9% effective imperviousness. Included in Appendix C is the MHFD UD-Detention spreadsheet for the proposed private pond containing stage-storage tables and the outlet structure and orifice plate design. The total basin volume requirement including the WQCV, EURV, and 100-year volumes is calculated to be 1.167 ac-ft. The proposed pond has a total basin volume of 2.209 ac-ft of storage including the 1.0-foot of freeboard from the emergency spillway at a stage of 4.75-feet relative to bottom of pond. The design follows stormwater criteria for full spectrum detention and the release rate is 40 hours for WQCV, 72 hours for the EURV and 72 hours for the 100-year storm events. The peak outflow from the proposed pond outlet pipe in the 100-year event is 5.6 cfs. The total peak discharge from the site in the 100-year storm event including the outlet structure peak outflow and the developed basins that drain directly offsite totals 18.89 cfs. This represents a reduction of 7.09 cfs (27.29%) compared to the existing existing/historical peak outflow from the site of 25.98 cfs.

Over-detention is provided by the private full-spectrum detention pond by including Basins N1, E1, S1, and W1 within the tributary area for the 100-year basin design. The result is a 100-year zone that accommodates the volume of these basins that drain directly offsite and cannot be feasibly conveyed and captured within the pond basin. The WQCV and EURV detention volumes are calculated with the untreated true tributary areas that drain to the basin, Basins A1, A2, A3, and A4, so that the outlet structure and its components are designed to meet the required release rates. The result of including non-tributary areas within the 100-year zone is a developed

condition that has a 100-year peak runoff from the site that is far less than that of the existing, undeveloped site.

d. Major Drainageways

There are no formal major drainageways within the project boundary. The development lies within the Falcon Basin, which was last studied in the *Falcon Basin Planning Study* dated September 2015, prepared by Matrix Design Group. The proposed private pond outfalls into the channel east of the site and west of the roadway of Meridian Road. This channel flows south and stormwater is conveyed under the Bent Grass Meadows Drive roadway via five existing public culvert pipes. This channel continues south along Meridian Road until entering a concrete box culvert which crosses under the Owl Place roadway and directs stormwater to the sub-regional detention facility SR4 as described in the drainage plans for Owl Marketplace. There are no anticipated negative impacts to surrounding and downstream developments, stormwater infrastructure, or drainageways.

e. Inspection and Maintenance

An approved Inspection and Maintenance manual will be provided for the detention pond.

f. Grading and Erosion Control Plan

Due to the project disturbance area, a separate Grading and Erosion Control plan will be required. The Grading and Erosion Control Plan will be submitted for review and approval with subsequent submittals of this FDR.

g. Four Step Method to Minimize Adverse Impacts of Urbanization

Step 1 – Reducing Runoff Volumes: Roof drains and sidewalks will route across landscaped areas whenever possible to slow runoff and promote infiltration prior to entering the drive isles and storm sewer system. Landscape buffers are provided along the border of the property to provide runoff reduction to areas of the site that flow directly off-site.

Step 2 – Treat and slowly release the WQCV: The runoff from the site is treated through the capture and slow WQCV via the designated PIA within the bottom of the private on-site full spectrum detention pond.

A table summarizing the water quality treatment within the site is provided on the following page:

Water Quality Treatment Summary Table					
Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Trib to Pond A (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.7 (ac)
A1	2.96	2.96	2.96		
A2	2.99	2.99	2.99		
A3	0.37	0.37	0.37		
A4	0.74	0.74	0.74		
N1	0.20	0.20			0.20
E1	0.27	0.20			0.20
S1	0.67	0.67		0.67	
W1	0.20	0.20			0.20
Total	8.41	8.34	7.07	0.67	0.60

Min Required Area to Receive WQ (ac)	Total Proposed Disturbed Area (ac)	Total Proposed Treated Area (ac)	Total Proposed Disturbed Area Excluded from WQ (ac)	Net Treatment (ac)
7.07	8.34	7.07	1.27	0.00

Step 3 – Stabilize stream channels: Stormwater discharging from the curb and gutter along Bent Grass Meadows Drive and from the onsite detention pond will be stabilized with riprap at the point where the flow enters the public roadside ditch. Stormwater releases from the proposed site will not disturb the downstream ditch, as the flows released from the proposed onsite detention pond will be below historical rates. Decreased flows into the ditch east of the development help to stabilize the channelized flow. The historical combined stormwater outflow into the channel in a 100-year event is 25.98 cfs, while the proposed development combined outflow is 18.89 cfs. Landscape areas are stabilized with permanent seeding for lawn areas, shrubbery and trees, and ornamental landscaping.

All new and redevelopment projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid at the time of platting go towards channel stabilization within the drainage basin. There are no public drainageway improvements required or proposed as a part of this development.

Step 4 – Consider the need for source controls: No industrial uses are proposed within this development and therefore no industrial source controls are proposed. The developed area is not anticipated to have uses that would require commercial source controls such as a grease trap/interceptor at this time. Should the uses of that building change, the appropriate source controls will be implemented to meet code requirements.

h. Drainage and Bridge Fees

For the Falcon Drainage Basin, the 2025 Drainage Fees is \$43,094 per impervious acre, the 2025 Bridge Fee is \$5,920 per impervious acre. The fees will be required at final plat recording.

\$43,094 x 5.92 Impervious Acres = \$255,116.48 (2025 Drainage Fee)

\$5,920 x 5.92 Impervious Acres = \$35,046.40 (2025 Bridge Fee)

i. Hydraulic Grade Line Calculations

Hydraulic Grade Line analysis for the storm network is presented in Appendix C.

V. Summary

The Life.Church at Bent Grass development remains consistent with pre-development drainage patterns and conditions with the construction of the recommended drainage improvements. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments. This report meets the latest El Paso County Drainage criteria and is in accordance with previous reports. This Final Drainage Report presents the amended site layout and the resultant drainage changes with design solutions for these revisions.

VI. Variances

The variances requested for this development are as follows:

- Variance #1: Intersection spacing for the existing primary ingress/egress for the site.
- Variance #2: Length of taper for added right-turn in lane for the primary ingress to the site.
- Variance #3: Velocity of pond outfall pipe is below the minimum in the 5-year event.

A Variance Letter describing these variance requests and their justification with appendix items such as calculations and exhibits is to be approved by El Paso County as a part of the Site Development Plan and Final Plat applications.

VII. Drawings

Please refer to the appendices for vicinity and drainage basin maps.

VIII. References

1. El Paso County – Drainage Criteria Manual Volume 1, Revised October 2018.
2. El Paso County – Drainage Criteria Manual Volume 2, Revised October 2018.
3. Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018.
4. Bent Grass Commercial Final Drainage Report, Classic Consulting Engineers & Surveyors, March 2013.
5. MDDP & DBPS Amendment Bent Grass Development, Galloway & Company, Inc., March 2021.
6. Owl Marketplace Filing No. 1 Final Drainage Report, Drexel, Barrell & Co., March 2024.
7. Meridian Road & Bent Grass Meadows Drive Final Drainage Report, Galloway & Company, Inc., March 2020.



APPENDIX A – VICINITY MAP, SOIL MAP, FEMA MAP

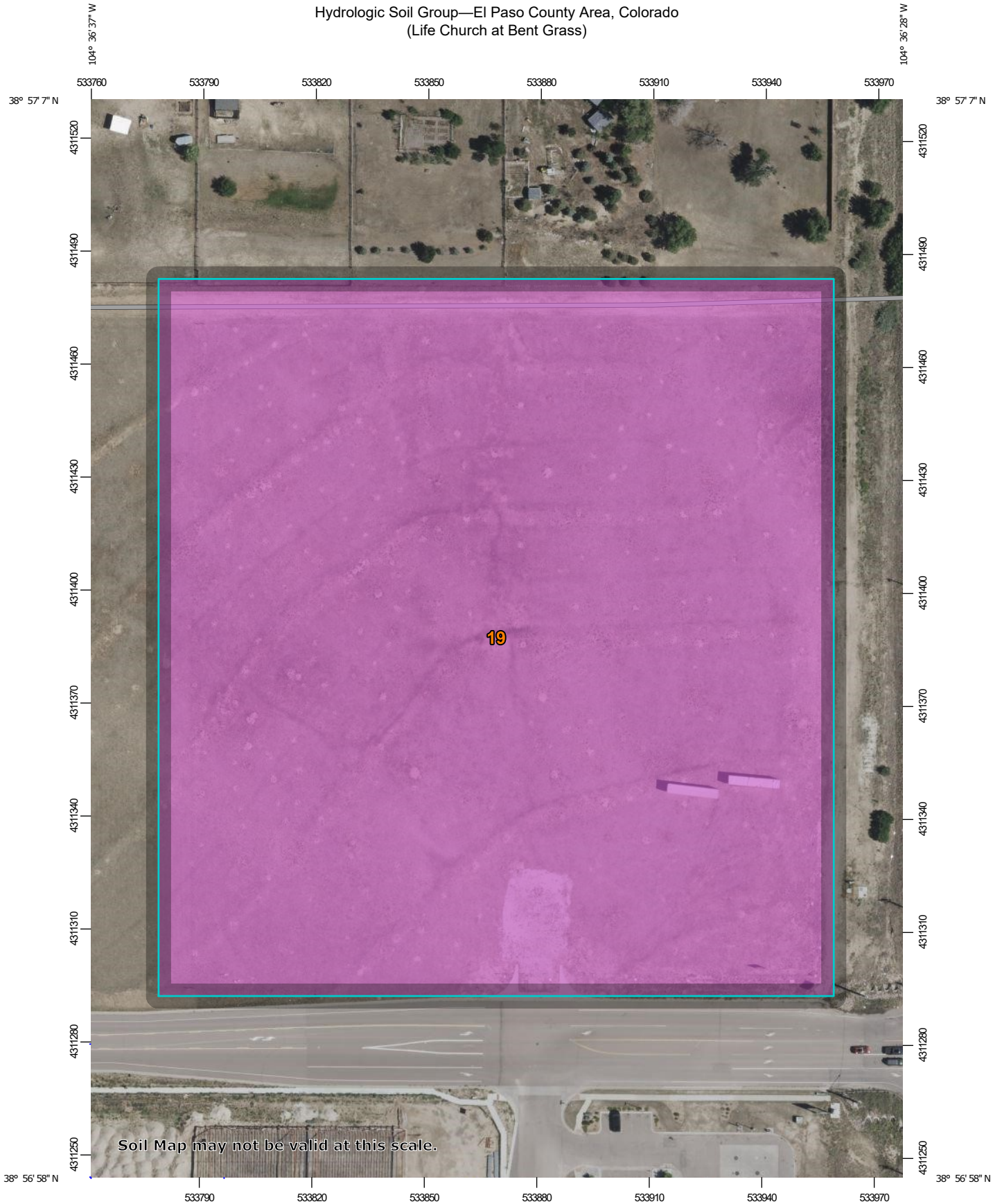
VICINITY MAP

LIFE CHURCH AT BENT GRASS

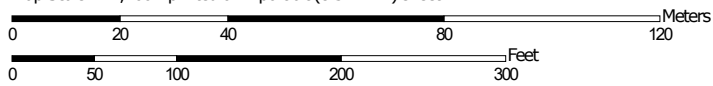


N.T.S.

Hydrologic Soil Group—El Paso County Area, Colorado
(Life Church at Bent Grass)



Map Scale: 1:1,400 if printed on A portrait (8.5" x 11") sheet.




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



Hydrologic Soil Group—El Paso County Area, Colorado
(Life Church at Bent Grass)

MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Rating Lines

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Rating Points





-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

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

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 22, Sep 3, 2024

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	8.5	100.0%
Totals for Area of Interest			8.5	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette



104°36'51"W 38°57'17"N



Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
		Area of Undetermined Flood Hazard <i>Zone D</i>
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation 17.5
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

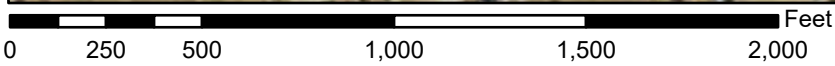


The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **3/20/2025 at 4:36 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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



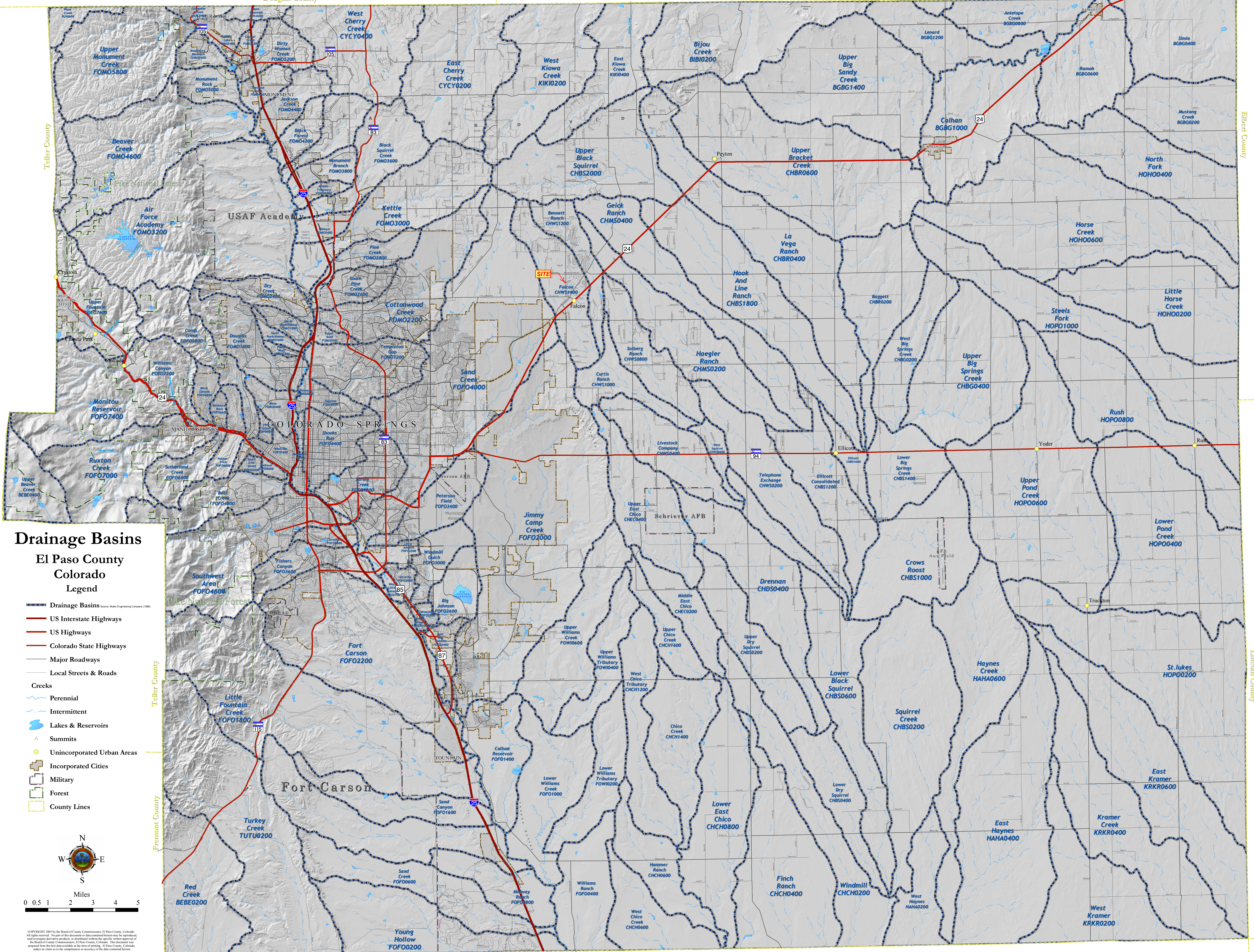
1:6,000

104°36'14"W 38°56'49"N

Basemap Imagery Source: USGS National Map 2023

Douglas County

Elbert County



Drainage Basins

El Paso County Colorado Legend

- Drainage Basins (Source: Mule 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



Miles
0 0.5 1 2 3 4 5

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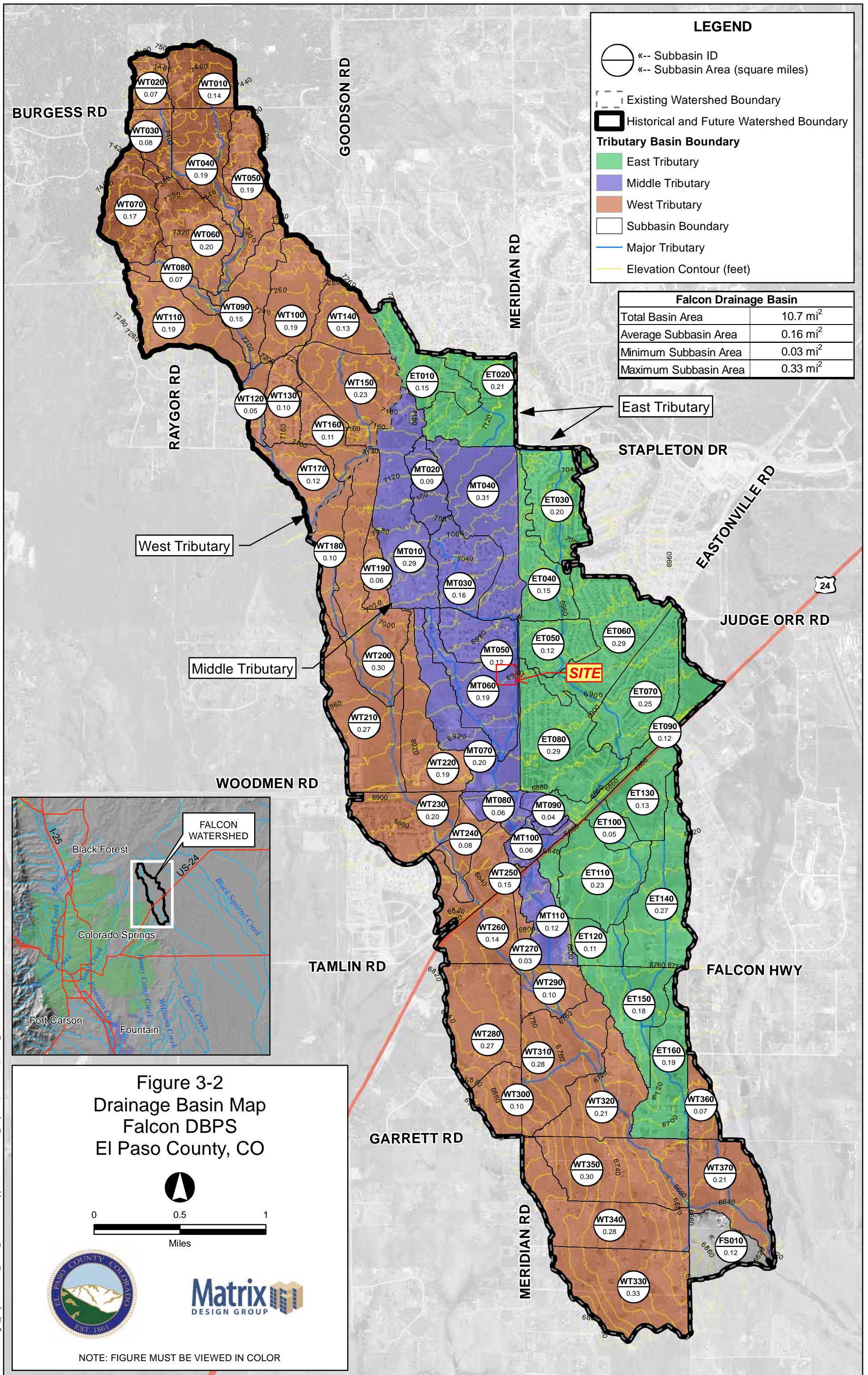
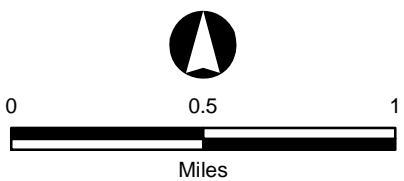


Figure 3-2
 Drainage Basin Map
 Falcon DBPS
 El Paso County, CO



NOTE: FIGURE MUST BE VIEWED IN COLOR



APPENDIX B – HYDROLOGIC CALCULATIONS



LIFE CHURCH AT BENT GRASS

EXISTING CONDITIONS

EL PASO COUNTY, CO

Calc'd by:

CMD

Checked by:

RDL

Date:

5/1/2025

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
A	6.81	2	2.10	14.13
B	1.53	2	0.52	3.47
OS	4.72	2	1.36	9.12

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ ₅ (cfs)	ΣQ ₁₀₀ (cfs)
1	A	2.10	14.13
2	B	0.52	3.47
3	OS	1.36	9.12



LIFE CHURCH AT BENT GRASS
EXISTING CONDITIONS
 EL PASO COUNTY, CO

Calc'd by: CMD
Checked by: RDL
Date: 5/1/2025

SOIL TYPE: HSG A&B

COMPOSITE 'C' FACTORS													
BASIN	LAND USE TYPE									TOTAL	COMPOSITE IMPERVIOUSNESS & C FACTOR		
	Roofs			Drive and Walks			Historic Flow Analysis-- Greenbelts,						
	%I	C₅	C₁₀₀	%I	C₅	C₁₀₀	%I	C₅	C₁₀₀				
	90	0.73	0.81	100	0.90	0.96	2	0.09	0.36				
	ACRES			ACRES			ACRES			ACRES	%I	C₅	C₁₀₀
A	0.00			0.00			6.81			6.81	2.00	0.09	0.36
B	0.00			0.00			1.53			1.53	2.00	0.09	0.36
OS	0.00			0.00			4.72			4.72	2.00	0.09	0.36
ON-SITE	0.00			0.00			8.34			8.34	2.00	0.06	0.36
OFF-SITE	0.00			0.00			4.72			4.72	2.00	0.09	0.36
TOTAL	0.00			0.00			13.06			13.06	2.00	0.09	0.36


	LIFE CHURCH AT BENT GRASS					Calc'd by:		CMD					
	EXISTING CONDITIONS					Checked by:		RDL					
	EL PASO COUNTY, CO					Date:		5/1/2025					
TIME OF CONCENTRATION													
BASIN DATA			OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					TOTAL	$tc=(L/180)+10$	Design tc
DESIGNATION	C_s	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_v	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)	tc_{max}	$tc_{design} (min)$
A	0.09	6.81	300	2.3	24.5	7	764	2.3	1.1	12.1	36.6	15.9	15.9
B	0.09	1.53	255	2.5	21.7	7	255	2.5	1.1	3.8	25.6	12.8	12.8
OS	0.09	4.72	621	2.8	32.8	7	924	2.6	1.1	13.7	46.5	18.6	18.6

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}}$$

$$V = C_v S_w^{0.5}$$



LIFE CHURCH AT BENT GRASS

Calc'd by:

CMD

EXISTING CONDITIONS

Checked by:

RDL

DESIGN STORM: 5-YEAR

Date:

5/1/2025

STRUCTURE	DESIGN POINT	BASIN ID	DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
			AREA (ac)	C ₅	f _c (min)	C ₅ *A (ac)	f (in./hr.)	Q (cfs)	f _c (min)	C ₅ *A (ac)	f (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₅ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₅ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min)	
	1	A	6.81	0.09	15.9	0.61	3.43	2.10															
	2	B	1.53	0.09	12.8	0.14	3.75	0.52															
	3	OS	4.72	0.09	18.6	0.42	3.20	1.36															



LIFE CHURCH AT BENT GRASS

Calc'd by:

CMD

EXISTING CONDITIONS

Checked by:

RDL

DESIGN STORM: 100-YEAR

Date:

5/1/2025

STRUCTURE	DESIGN POINT	BASIN ID	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS
			AREA (ac)	C ₁₀₀	f _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	f _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	Q _{pipe} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
	1	A	6.81	0.36	15.9	2.45	5.76	14.13															
	2	B	1.53	0.36	12.8	0.55	6.30	3.47															
	3	OS	4.72	0.36	18.6	1.70	5.37	9.12															



LIFE CHURCH AT BENT GRASS PROPOSED CONDITIONS EL PASO COUNTY, CO	Calc'd by:	CMD
	Checked by:	RDL
	Date:	5/1/2025

BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
A1	2.96	87.8	9.65	17.98
A2	2.99	88.8	12.37	22.94
A3	0.37	90.6	1.29	2.38
A4	0.74	7.8	0.42	1.94
N1	0.20	0.0	0.06	0.47
E1	0.27	0.0	0.11	0.81
S1	0.67	41.2	1.12	2.70
W1	0.20	0.0	0.06	0.44

DESIGN POINT	CONTRIBUTING BASINS	ΣQ ₅ (cfs)	ΣQ ₁₀₀ (cfs)
1	A1	9.65	17.98
2	A2	12.37	22.94
3	A3	1.29	2.38
4	A4	0.42	1.94
5	N1	0.06	0.47
6	E1	0.11	0.81
7	S1	1.12	2.70
8	W1	0.06	0.44



LIFE CHURCH AT BENT GRASS

PROPOSED CONDITIONS

EL PASO COUNTY, CO

Calc'd by: CMD

Checked by: RDL

Date: 5/1/2025

SOIL TYPE: HSG A&B

COMPOSITE 'C' FACTORS													
BASIN	LAND USE TYPE									TOTAL	COMPOSITE IMPERVIOUSNESS & C FACTOR		
	Roofs			Drive and Walks			Lawns						
	%I	C₅	C₁₀₀	%I	C₅	C₁₀₀	%I	C₅	C₁₀₀				
	90	0.73	0.81	100	0.90	0.96	0	0.08	0.35				
	ACRES		ACRES			ACRES			ACRES	%I	C₅	C₁₀₀	
A1	0.60		2.06			0.30			2.96	87.8	0.78	0.87	
A2	0.25		2.43			0.31			2.99	88.8	0.80	0.88	
A3	0.05		0.29			0.03			0.37	90.6	0.81	0.89	
A4	0.00		0.06			0.69			0.74	7.8	0.14	0.40	
N1	0.00		0.00			0.20			0.20	0.0	0.08	0.35	
E1	0.00		0.00			0.27			0.27	0.0	0.08	0.35	
S1	0.00		0.28			0.39			0.67	41.2	0.42	0.60	
W1	0.00		0.00			0.20			0.20	0.0	0.08	0.35	
ON-SITE	0.90		5.05			2.39			8.34	70.2	0.65	0.77	
OFF-SITE	0.00		0.06			0.00			0.06	100.0	0.90	0.96	
TOTAL	0.90		5.11			2.39			8.41	70.4	0.65	0.77	

POND SUMMARY							
POND A	0.90	4.83	1.33	7.07	79.9	0.72	0.83



LIFE CHURCH AT BENT GRASS

Calc'd by:

CMD

PROPOSED CONDITIONS

Checked by:

RDL

EL PASO COUNTY, CO

Date:

5/1/2025

TIME OF CONCENTRATION

BASIN DATA		OVERLAND TIME (T _o)				TRAVEL TIME (T _t)					TOTAL	tc=(L/180)+10	Design tc
DESIGNATION	C _s	AREA (ac)	LENGTH (ft)	SLOPE %	t _o (min)	C _v	LENGTH (ft)	SLOPE %	V (ft/s)	t _t (min)	t _c (min)	tc max	tc design (min)
A1	0.78	2.96	57	3.7	2.8	20	884	1.1	2.1	6.9	9.7	15.2	9.7
A2	0.80	2.99	90	6.0	2.9	20	237	4.3	4.2	0.9	5.0	11.8	5.0
A3	0.81	0.37	100	3.5	3.5	20	747	1.3	2.3	5.4	9.0	14.7	9.0
A4	0.14	0.74	86	3.4	10.8	7	207	4.0	1.4	2.5	13.3	11.6	11.6
N1	0.08	0.20	13	33.0	2.1	7	582	2.3	1.1	9.1	11.2	13.3	11.2
E1	0.08	0.27	20	25.0	2.9	7	20	25.0	3.5	0.1	5.0	10.2	5.0
S1	0.42	0.67	119	4.6	8.2	15	352	2.0	2.1	2.7	10.9	12.6	10.9
W1	0.08	0.20	13	25.0	2.3	7	618	1.5	0.9	12.0	14.3	13.5	13.5

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}}$$

$$V = C_v S_w^{0.5}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C _v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried) ¹	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

¹For buried riprap, select C_v value based on type of vegetative cover.



LIFE CHURCH AT BENT GRASS
PROPOSED CONDITIONS
DESIGN STORM: 5-YEAR

Calc'd by: **CMD**
 Checked by: **RDL**
 Date: **5/1/2025**

STRUCTURE	DESIGN POINT	BASIN ID	DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS
			AREA (ac)	C _s	t _c (min)	C _s *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C _s *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C _s *A (ac)	SLOPE %	Q _{pipe} (cfs)	C _s *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	
	1	A1	2.96	0.78	9.7	2.31	4.17	9.65														CDOT TYPE D INLET IN SUMP
	2	A2	2.99	0.80	5.0	2.39	5.17	12.37														CURB CUT TO CONCRETE RUNDOWN
	3	A3	0.37	0.81	9.0	0.30	4.29	1.29														CURB CUT TO CONCRETE RUNDOWN
	4	A4	0.74	0.14	11.6	0.11	3.90	0.42														FULL SPECTRUM DETENTION POND
	5	N1	0.20	0.08	11.2	0.02	3.95	0.06														SWALE ON NORTHERN BORDER OF SITE, DIRECTS OFF-SITE FLOW TO THE EAST
	6	E1	0.27	0.08	5.0	0.02	5.17	0.11														
	7	S1	0.67	0.42	10.9	0.28	3.99	1.12														
	8	W1	0.20	0.08	13.5	0.02	3.68	0.06														SWALE ON WESTERN BORDER OF SITE, DIRECTS OFF-SITE FLOW TO THE SOUTH



LIFE CHURCH AT BENT GRASS
PROPOSED CONDITIONS
DESIGN STORM: 100-YEAR

Calc'd by:

Checked by:

Date:

5/1/2025

STRUCTURE	DESIGN POINT	BASIN ID	DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME		REMARKS	
			AREA (ac)	C ₁₀₀	f _c (min)	C ₁₀₀ *A (ac)	f (in./hr.)	Q (cfs)	f _c (min)	C ₁₀₀ *A (ac)	f (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	Q _{pipe} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)		VEL. (ft/s)
	1	A1	2.96	0.87	9.7	2.57	7.00	17.98														CDOT TYPE D INLET IN SUMP
	2	A2	2.99	0.88	5.0	2.64	8.68	22.94														CURB CUT TO CONCRETE RUNDOWN
	3	A3	0.37	0.89	9.0	0.33	7.21	2.38														CURB CUT TO CONCRETE RUNDOWN
	4	A4	0.74	0.40	11.6	0.30	6.55	1.94														FULL SPECTRUM DETENTION POND
	5	N1	0.20	0.35	11.2	0.07	6.64	0.47														SWALE ON NORTHERN BORDER OF SITE, DIRECTS OFF-SITE FLOW TO THE EAST
	6	E1	0.27	0.35	5.0	0.09	8.68	0.81														
	7	S1	0.67	0.60	10.9	0.40	6.71	2.70														
	8	W1	0.20	0.35	13.5	0.07	6.18	0.44														SWALE ON WESTERN BORDER OF SITE, DIRECTS OFF-SITE FLOW TO THE SOUTH



APPENDIX C – HYDRAULIC CALCULATIONS

Weir Report

Curb Cut Basin A1 - 100-Yr WSEL

Rectangular Weir

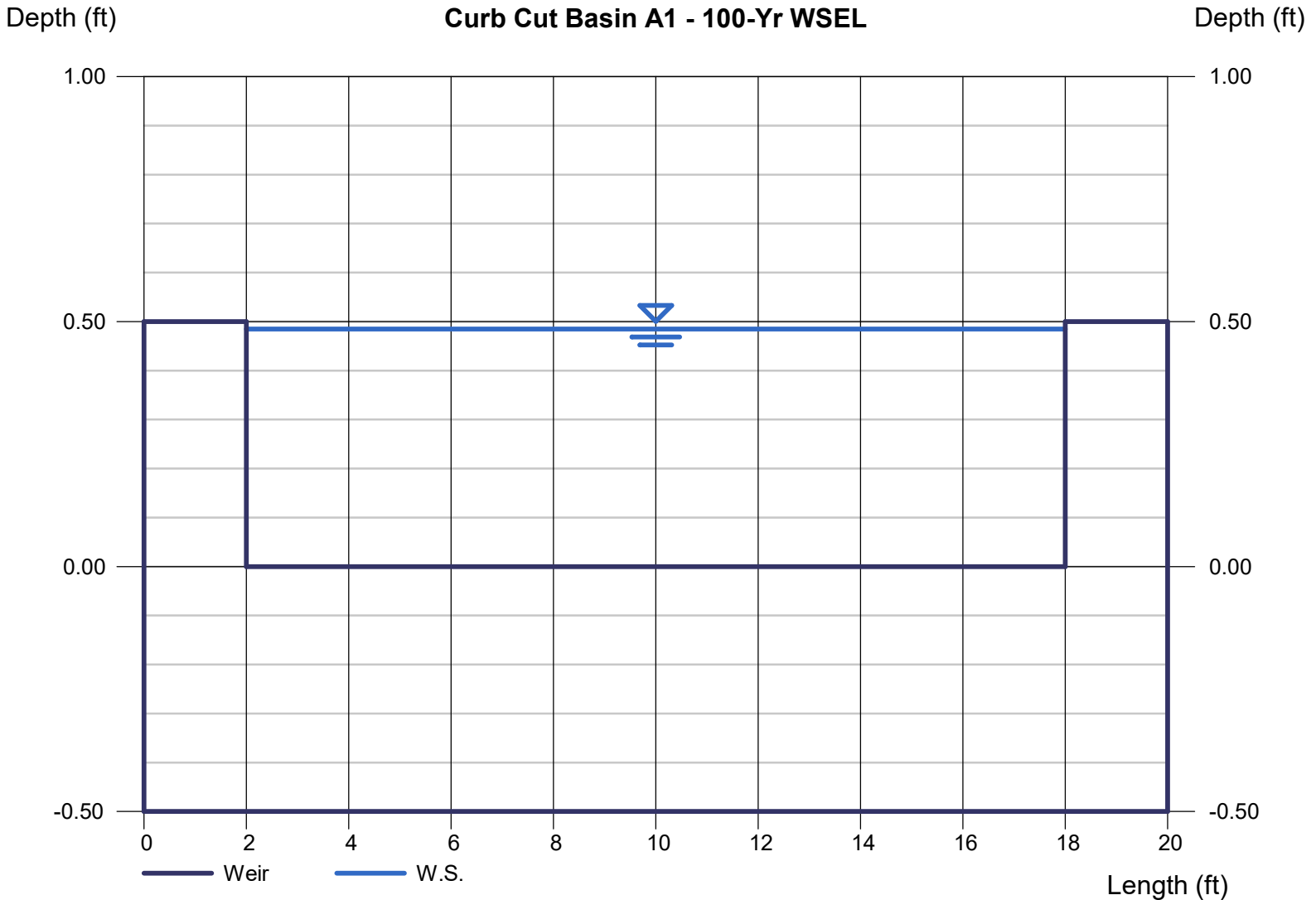
Crest = Sharp
Bottom Length (ft) = 16.00
Total Depth (ft) = 0.50

Highlighted

Depth (ft) = 0.48
Q (cfs) = 17.98
Area (sqft) = 7.75
Velocity (ft/s) = 2.32
Top Width (ft) = 16.00

Calculations

Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 17.98



Weir Report

Curb Cut Basin A2 - 100-Yr WSEL

Rectangular Weir

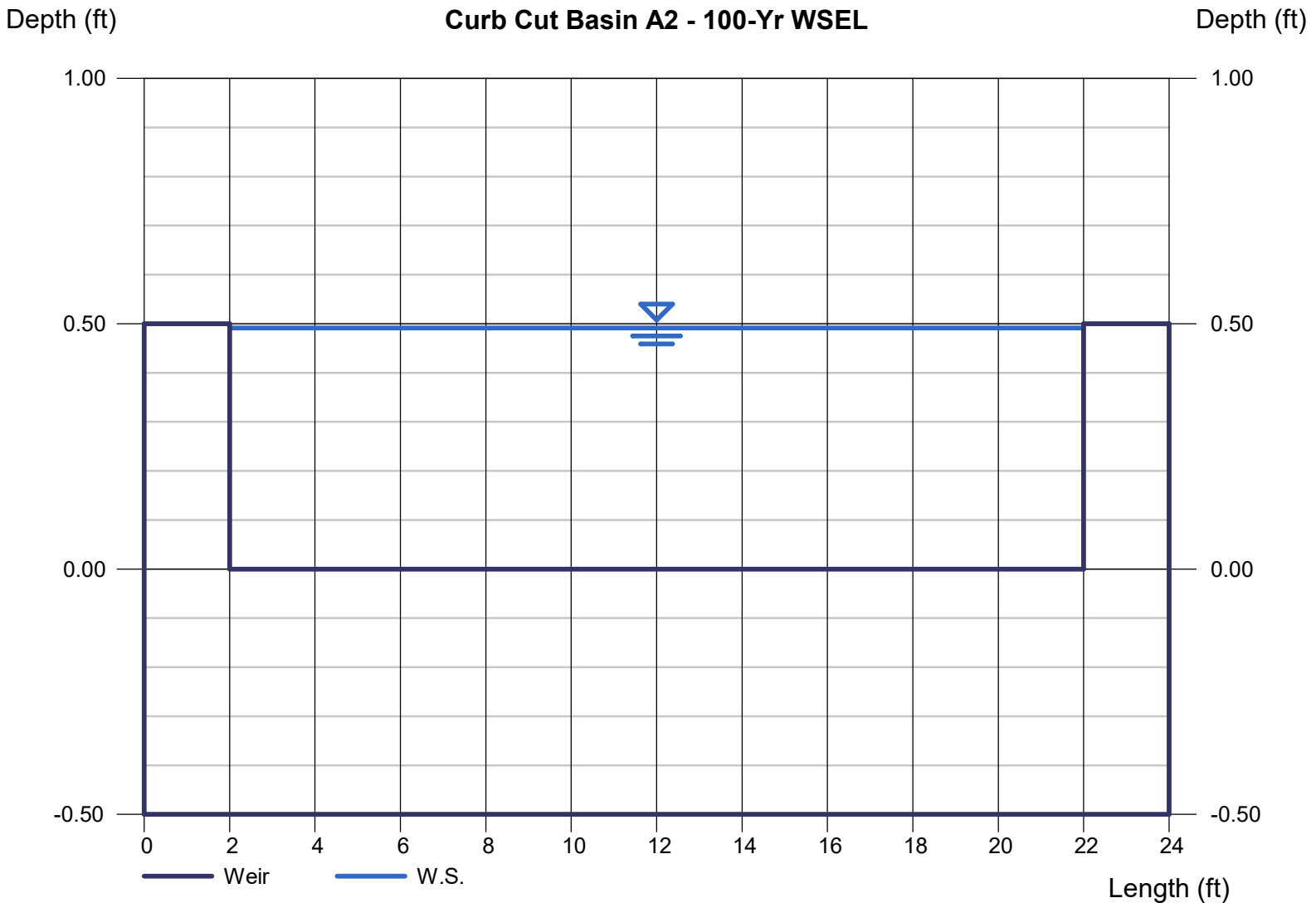
Crest = Sharp
Bottom Length (ft) = 20.00
Total Depth (ft) = 0.50

Highlighted

Depth (ft) = 0.49
Q (cfs) = 22.94
Area (sqft) = 9.82
Velocity (ft/s) = 2.34
Top Width (ft) = 20.00

Calculations

Weir Coeff. C_w = 3.33
Compute by: Known Q
Known Q (cfs) = 22.94



Weir Report

Curb Cut Basin A3 - 100-Yr WSEL

Rectangular Weir

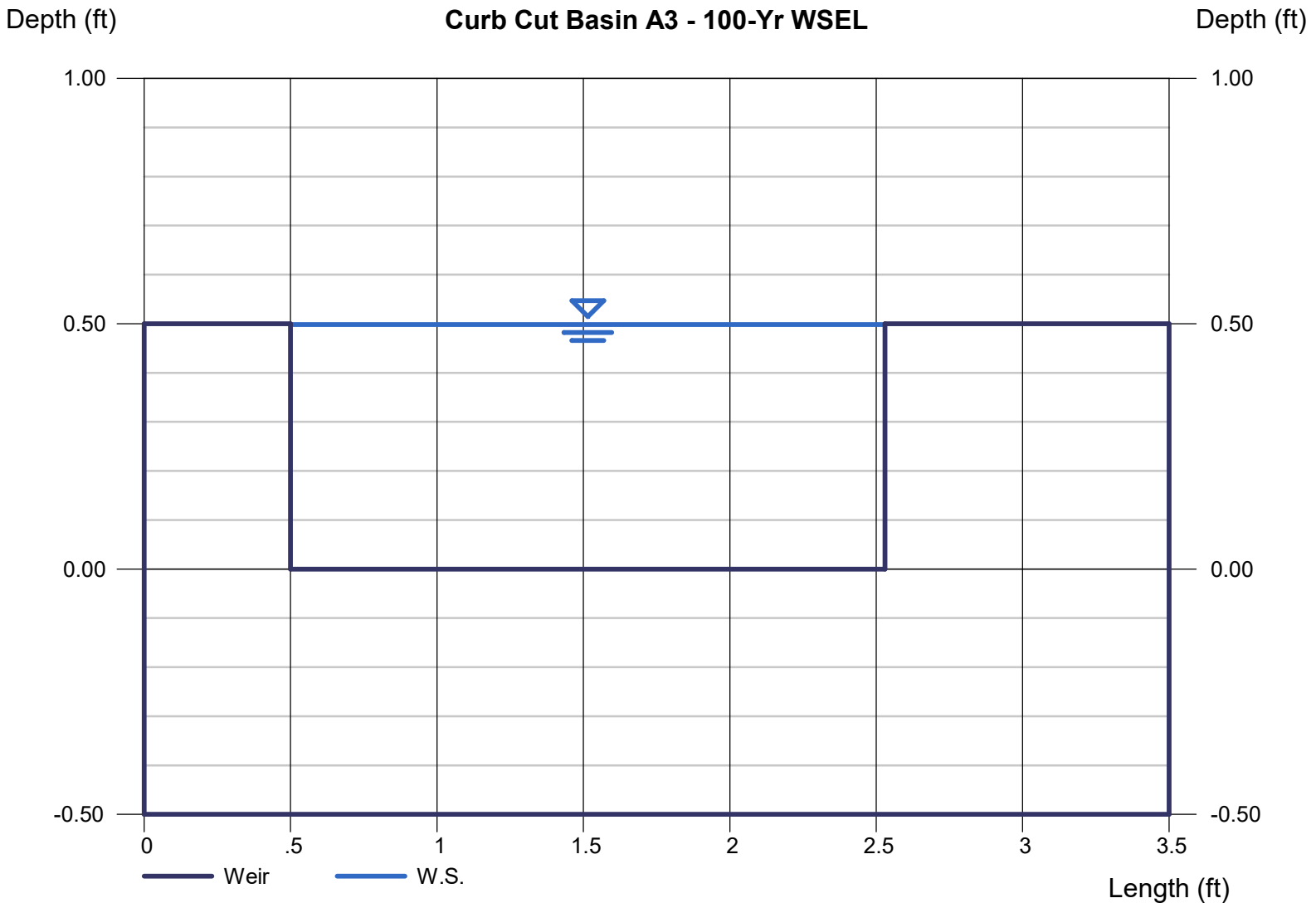
Crest = Sharp
Bottom Length (ft) = 2.03
Total Depth (ft) = 0.50

Highlighted

Depth (ft) = 0.50
Q (cfs) = 2.380
Area (sqft) = 1.01
Velocity (ft/s) = 2.35
Top Width (ft) = 2.03

Calculations

Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 2.38



Weir Report

Slotted Curb Basin A3 - 100-Yr WSEL

Rectangular Weir

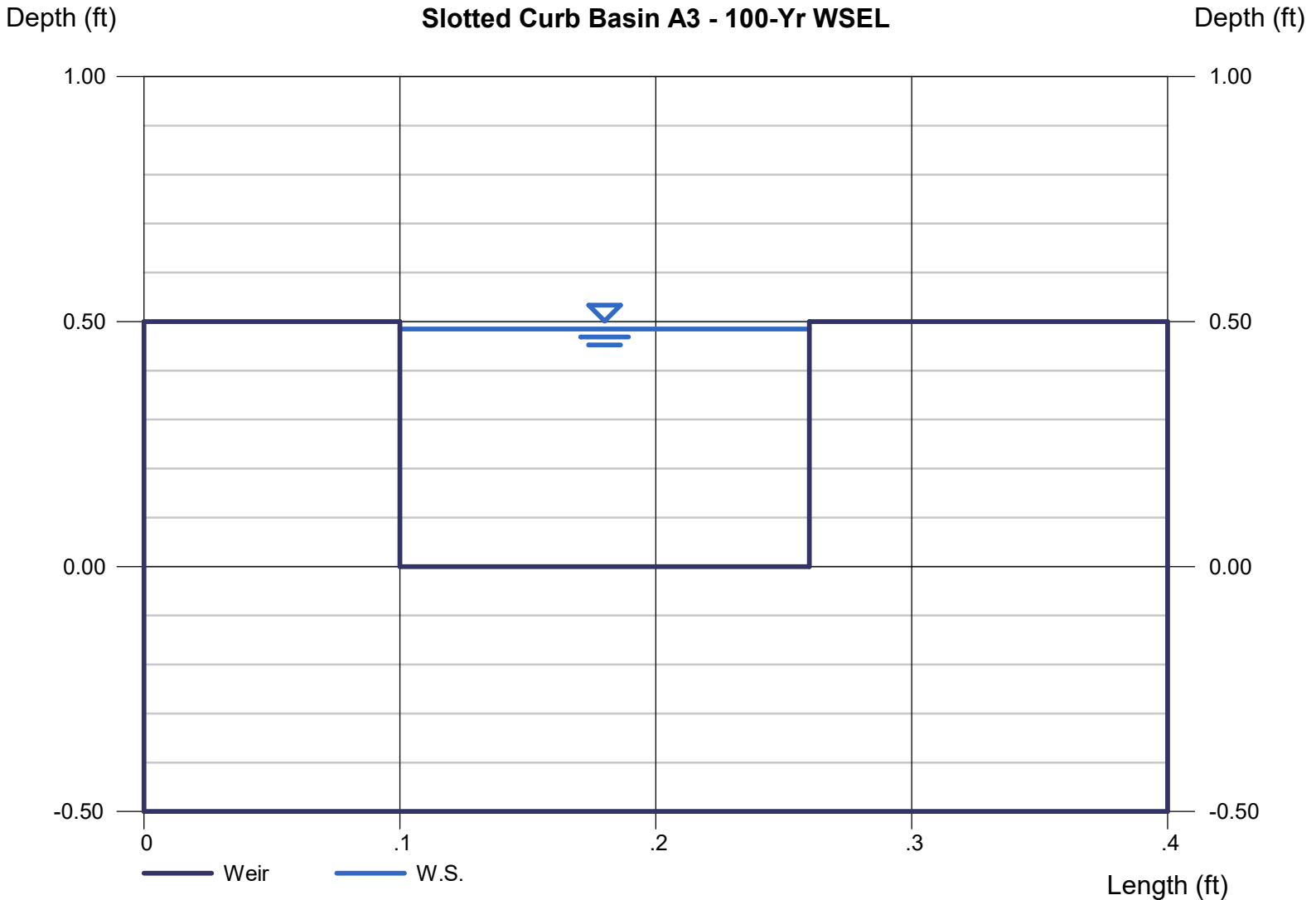
Crest = Sharp
Bottom Length (ft) = 0.16
Total Depth (ft) = 0.50

Highlighted

Depth (ft) = 0.48
Q (cfs) = 0.180
Area (sqft) = 0.08
Velocity (ft/s) = 2.32
Top Width (ft) = 0.16

Calculations

Weir Coeff. C_w = 3.33
Compute by: Known Q
Known Q (cfs) = 0.18



Channel Report

Rundown Basin A2 - 100-Yr WSEL

Rectangular

Bottom Width (ft) = 2.00
Total Depth (ft) = 0.66

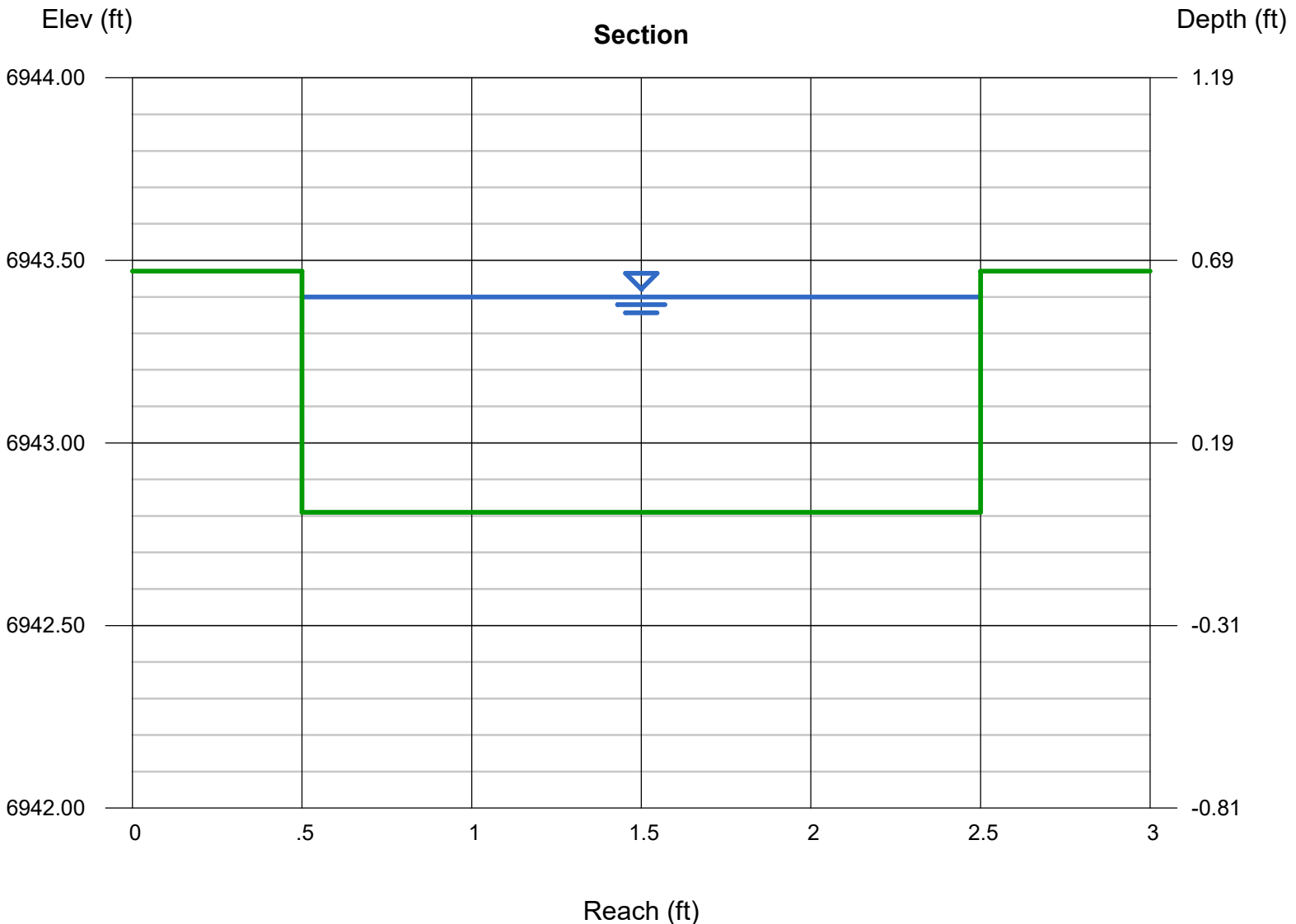
Invert Elev (ft) = 6942.81
Slope (%) = 8.00
N-Value = 0.011

Calculations

Compute by: Known Q
Known Q (cfs) = 22.94

Highlighted

Depth (ft) = 0.59
Q (cfs) = 22.94
Area (sqft) = 1.18
Velocity (ft/s) = 19.44
Wetted Perim (ft) = 3.18
Crit Depth, Yc (ft) = 0.66
Top Width (ft) = 2.00
EGL (ft) = 6.47



Channel Report

Rundown Basin A3 - 100-Yr WSEL

Rectangular

Bottom Width (ft) = 1.00
Total Depth (ft) = 0.50

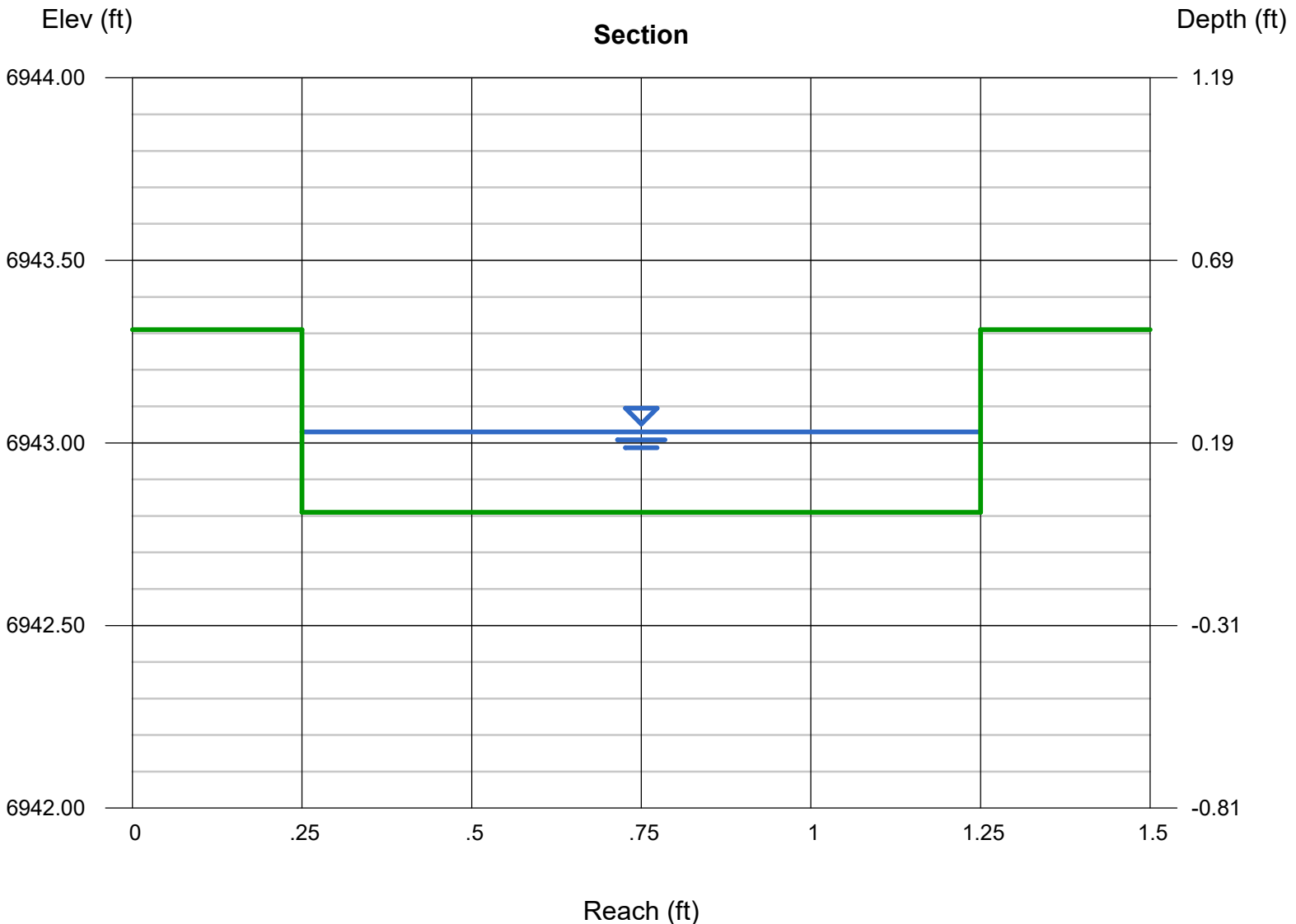
Invert Elev (ft) = 6942.81
Slope (%) = 8.00
N-Value = 0.011

Calculations

Compute by: Known Q
Known Q (cfs) = 2.38

Highlighted

Depth (ft) = 0.22
Q (cfs) = 2.380
Area (sqft) = 0.22
Velocity (ft/s) = 10.82
Wetted Perim (ft) = 1.44
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 1.00
EGL (ft) = 2.04



Channel Report

Permanent Swale - 100-yr WSEL

Triangular

Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 2.00

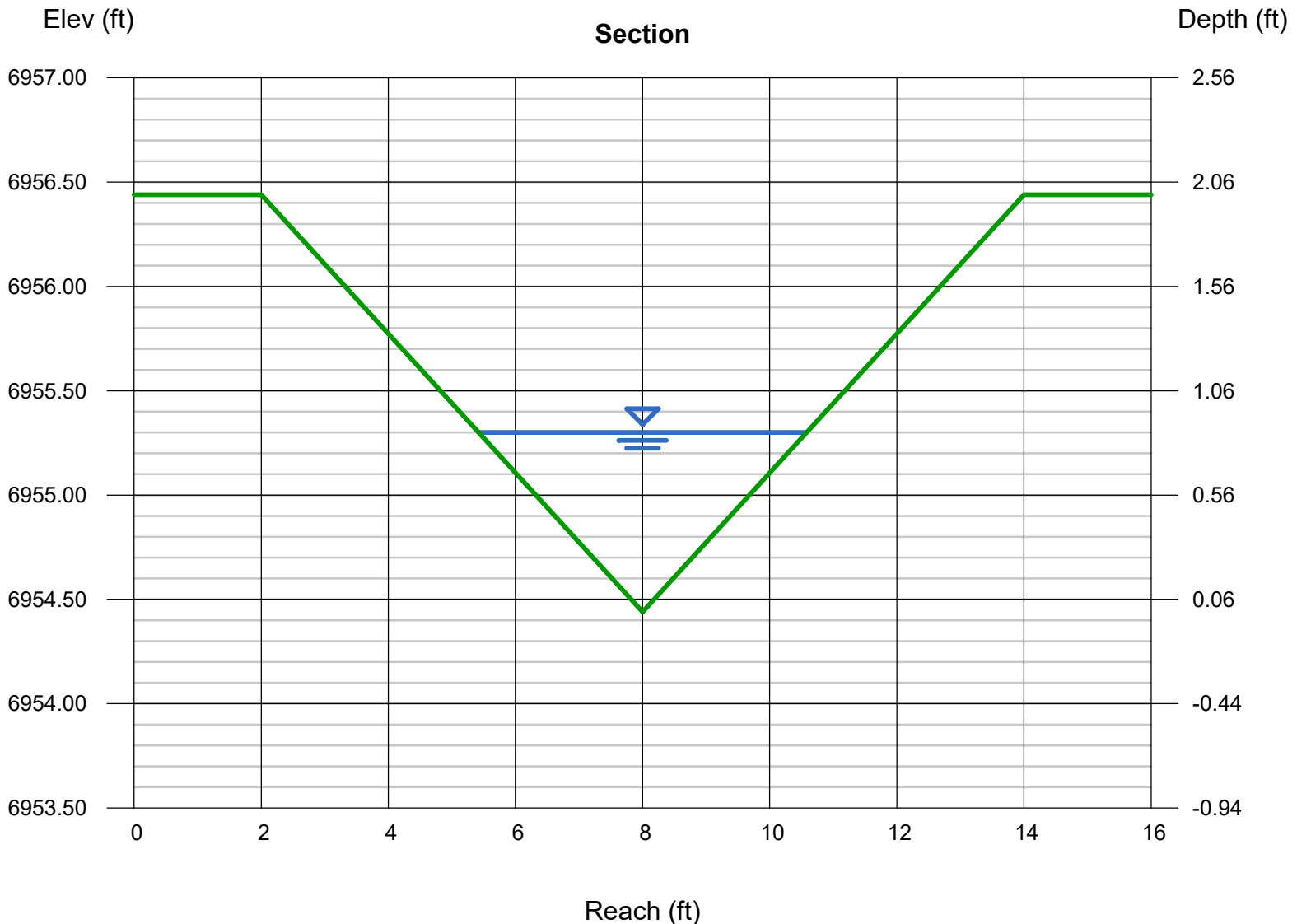
Invert Elev (ft) = 6954.44
Slope (%) = 1.86
N-Value = 0.027

Calculations

Compute by: Known Q
Known Q (cfs) = 9.12

Highlighted

Depth (ft) = 0.86
Q (cfs) = 9.120
Area (sqft) = 2.22
Velocity (ft/s) = 4.11
Wetted Perim (ft) = 5.44
Crit Depth, Yc (ft) = 0.90
Top Width (ft) = 5.16
EGL (ft) = 1.12



Channel Report

Internal Street Section - 100-yr WSEL

User-defined

Invert Elev (ft) = 6942.76
Slope (%) = 1.00
N-Value = 0.013

Highlighted

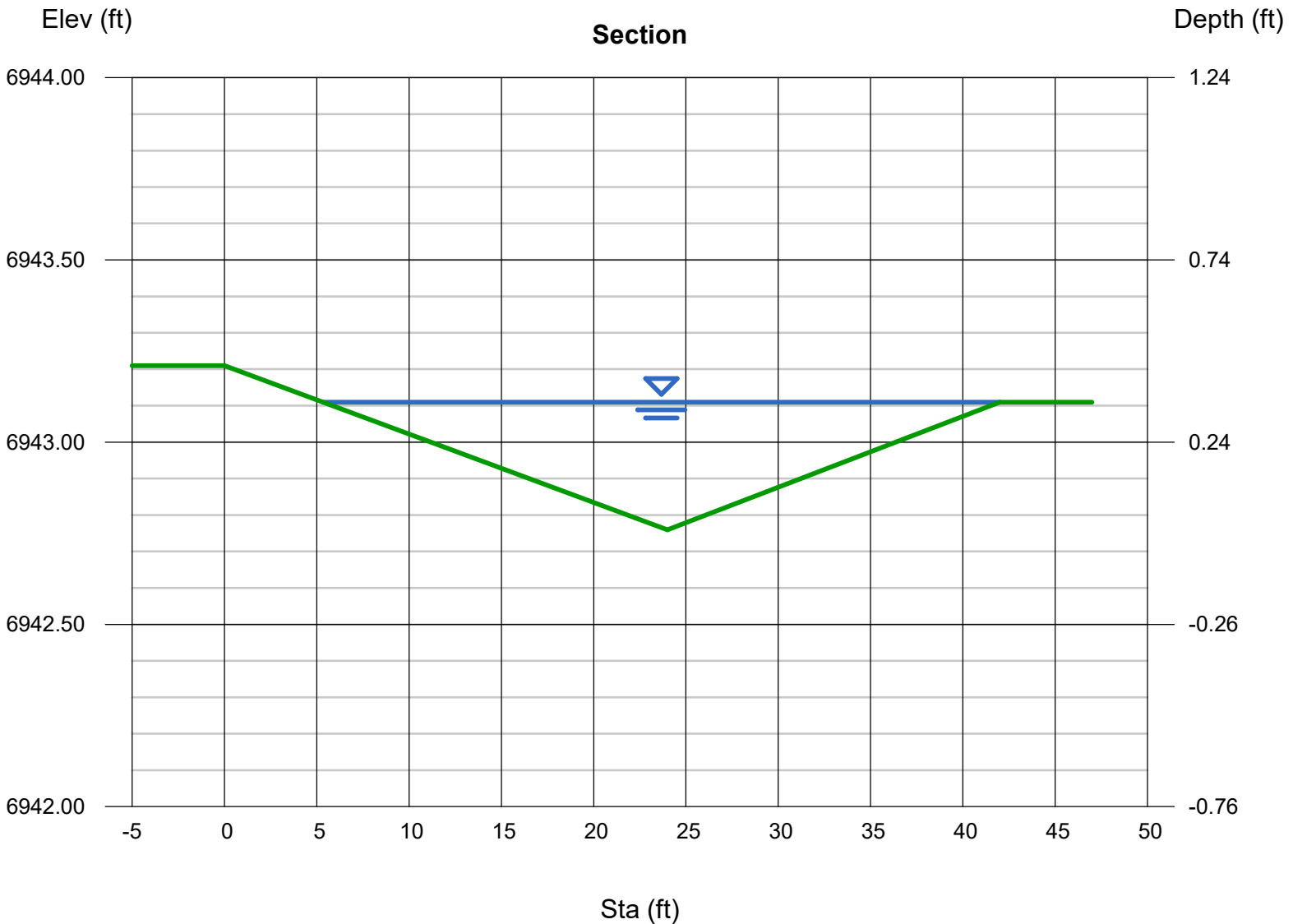
Depth (ft) = 0.35
Q (cfs) = 22.94
Area (sqft) = 6.42
Velocity (ft/s) = 3.57
Wetted Perim (ft) = 36.67
Crit Depth, Yc (ft) = 0.41
Top Width (ft) = 36.66
EGL (ft) = 0.55

Calculations

Compute by: Known Q
Known Q (cfs) = 22.94

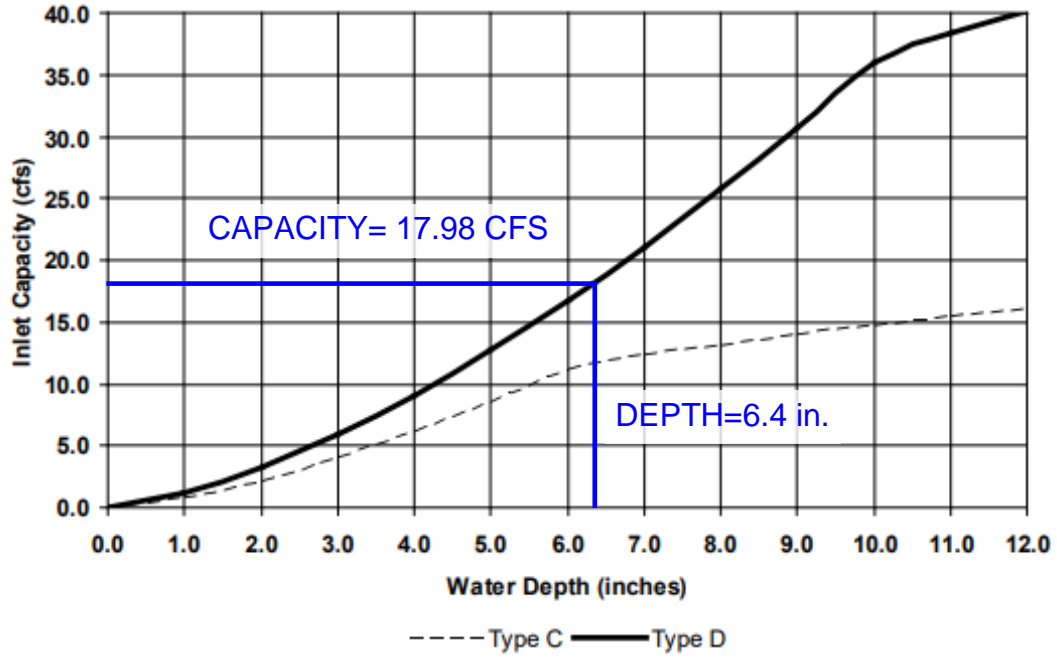
(Sta, El, n)-(Sta, El, n)...

(0.00, 6943.21)-(24.00, 6942.76, 0.013)-(42.00, 6943.11, 0.013)



DP1 INLET CAPACITY

Allowable Inlet Capacity for Type C and D Inlets for Sump Conditions





LIFE CHURCH AT BENT GRASS	<u>Calc'd by:</u>	CMD
2403591	<u>Checked by:</u>	RDL
POND OUTFALL RIPRAP	<u>Date:</u>	4/24/2025

Input Parameters	
Flow (Q)	5.6 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	5.8
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	2.03
D ₅₀ =	2.53 in
UDFCD Riprap Type =	Type VL
Design D ₅₀ =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.50 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_t}{Y_t} - W \right)$$

Equation 9-11

$$A_t = \frac{Q}{V}$$

Equation 9-12

Where:

- L_p = length of protection (ft)
- W = width of the conduit (ft, use diameter for circular conduits)
- Y_t = tailwater depth (ft)
- θ = the expansion angle of the culvert flow

Where:

- Q = design discharge (cfs)
- V = the allowable non-eroding velocity in the downstream channel (ft/sec)
- A_t = required area of flow at allowable velocity (ft²)

Note:

- ¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9
- ² Calculations assume a circular culvert
- ³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.
- ⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



LIFE CHURCH AT BENT GRASS	<u>Calc'd by:</u>	CMD
2403591	<u>Checked by:</u>	RDL
POND SPILLWAY RIPRAP	<u>Date:</u>	4/29/2025

Input Parameters	
Q (cfs)	27.50
Spillway Width (ft)	9.00
q (cfs/ft)	3.06
S (ft/ft)	0.33
C_f	2
η	0

Calculated Parameters	
$D_{50} =$	10.58 in
UDFCD Riprap Type =	Type M
Design $D_{50} =$	12 in
Minimum Mantle Thickness =	24 in

Calculated D_{50} for riprap was calculated using Equation 13-9 in the CCS DCM Vol 1.

$$D_{50} = 5.23 S^{0.43} (1.35 C_f q)^{0.56} \qquad \text{Equation 13-9}$$

Where:

- D_{50} = median rock size (in)
- S = longitudinal slope (ft/ft)
- C_f = concentration factor (1.0 to 3.0)
- q = unit discharge (cfs/ft)

When:

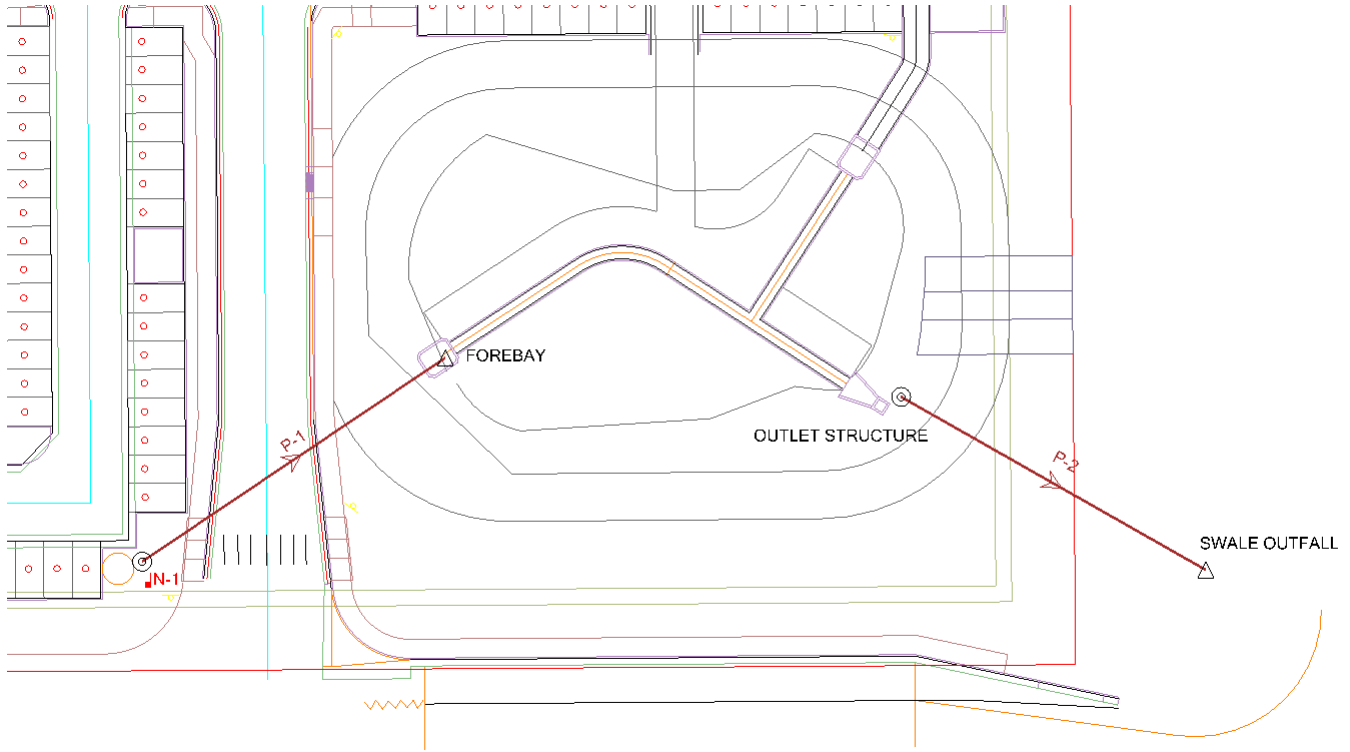
η (porosity) = 0.0 (i.e., for buried soil riprap)

Note:

¹ Calculations follow criteria in the CCS DCM Vol. 1 Chapter 13

² Calculations assume buried soil riprap

STORMCAD NETWORK LAYOUT

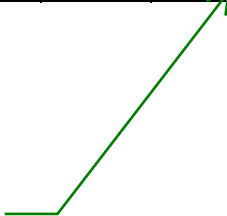


5 YEAR TABLE

FlexTable: Conduit Table

Label	Start Node	Diameter (in)	Length (Unified) (ft)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-1	IN-1	24.0	115.5	9.65	7.22	6,938.00	6,936.70	0.011	6,939.11	6,937.59
P-2	OUTLET STRUCTURE	18.0	110.7	0.30	2.73	6,934.26	6,933.01	0.011	6,934.47	6,933.18

SEE PIPE VELOCITY
DEVIATION PACKET
ASSOCIATED WITH
THIS PROJECT



5 YEAR TABLE

FlexTable: Manhole Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Flow (Total Out) (cfs)	Depth (Out) (ft)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Notes	Headloss (ft)
IN-1	6,943.03	6,943.03	9.65	1.11	6,939.11	6,939.79	TYPE D SUMP INLET(PVT)	0.68
OUTLET STRUCTURE	6,938.66	6,938.66	0.30	0.20	6,934.47	6,934.47	TYPE-C	0.00

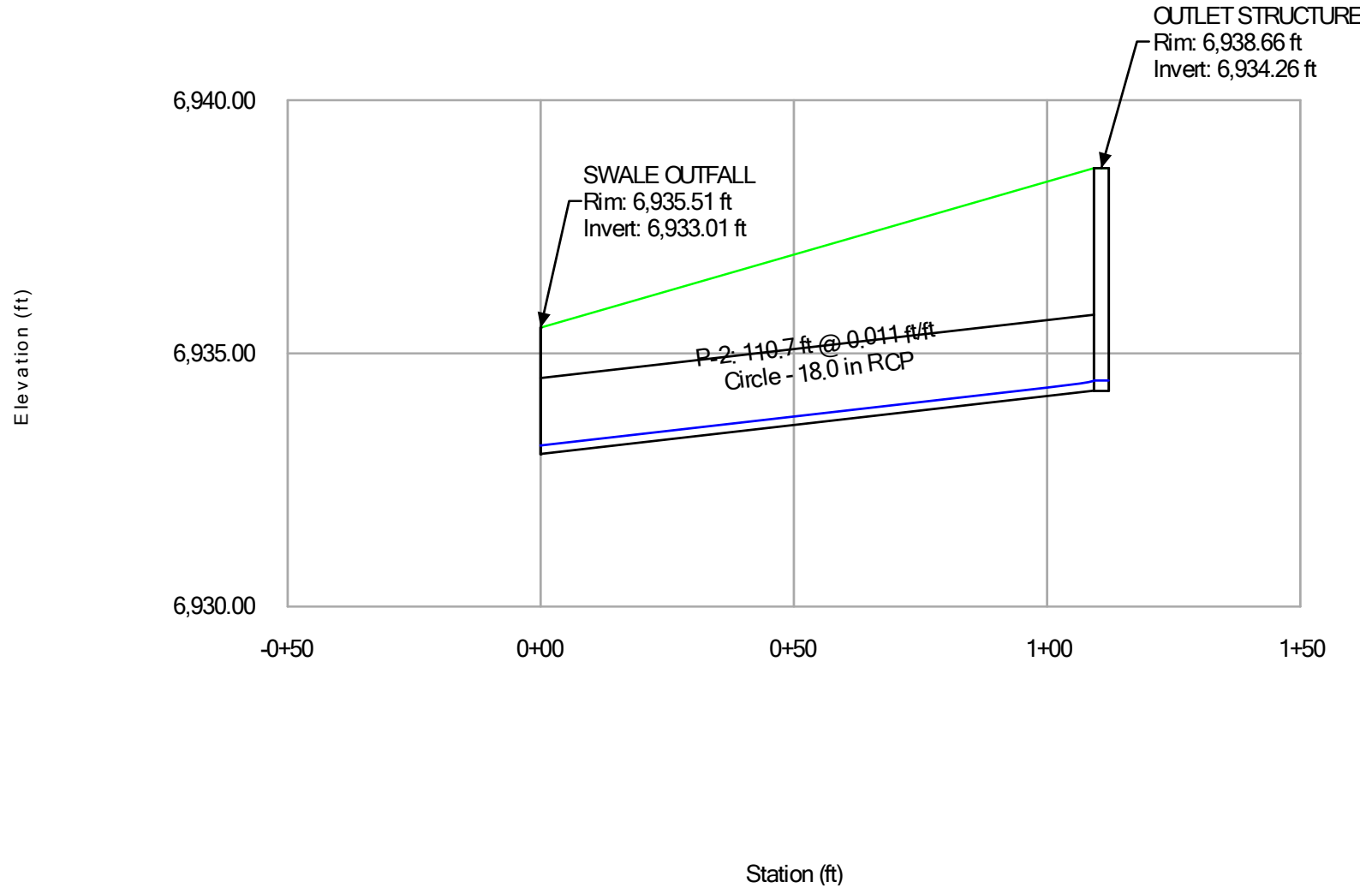
5 YEAR TABLE

FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
SWALE OUTFALL	6,935.51	6,933.01		6,933.18	0.30	18" FES Dummy Null Structure for LandXML purposes
FOREBAY	6,937.50	6,936.70		6,937.59	9.65	

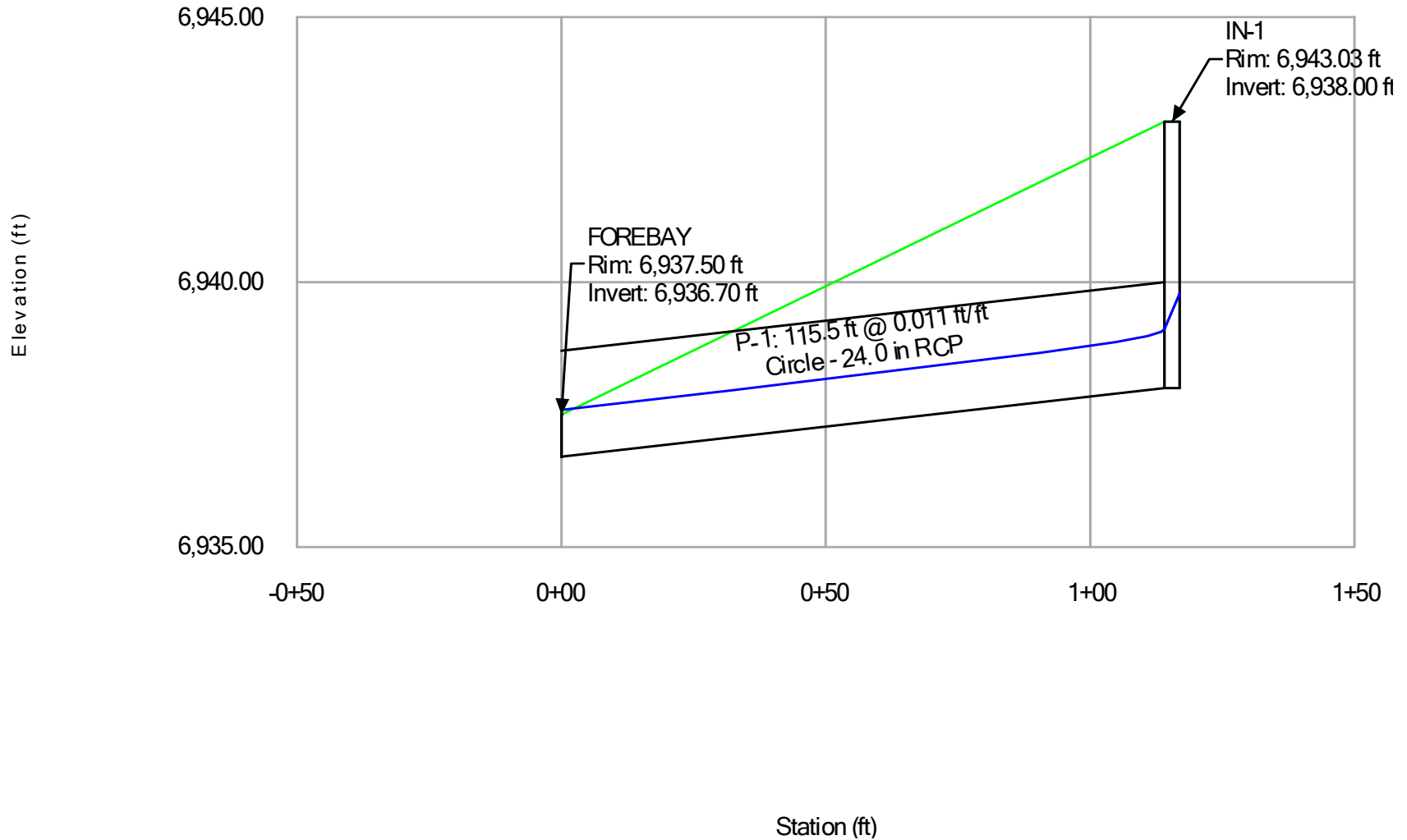
5 YEAR

Profile Report
Engineering Profile - POND OUTFALL (Untitled1.stsw)



5 YEAR

Profile Report
Engineering Profile - STORM 1 (Untitled1.stsw)



100 YEAR TABLE

FlexTable: Conduit Table

Label	Start Node	Diameter (in)	Length (Unified) (ft)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-1	IN-1	24.0	115.5	17.98	8.37	6,938.00	6,936.70	0.011	6,939.53	6,938.00
P-2	OUTLET STRUCTURE	18.0	110.7	5.60	3.17	6,934.26	6,933.01	0.011	6,937.87	6,937.56

100 YEAR TABLE

FlexTable: Manhole Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Flow (Total Out) (cfs)	Depth (Out) (ft)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Notes	Headloss (ft)
IN-1	6,943.03	6,943.03	17.98	1.53	6,939.53	6,940.29	TYPE D SUMP INLET(PVT)	0.76
OUTLET STRUCTURE	6,938.66	6,938.66	5.60	2.71	6,936.97	6,936.97	TYPE-C	0.00

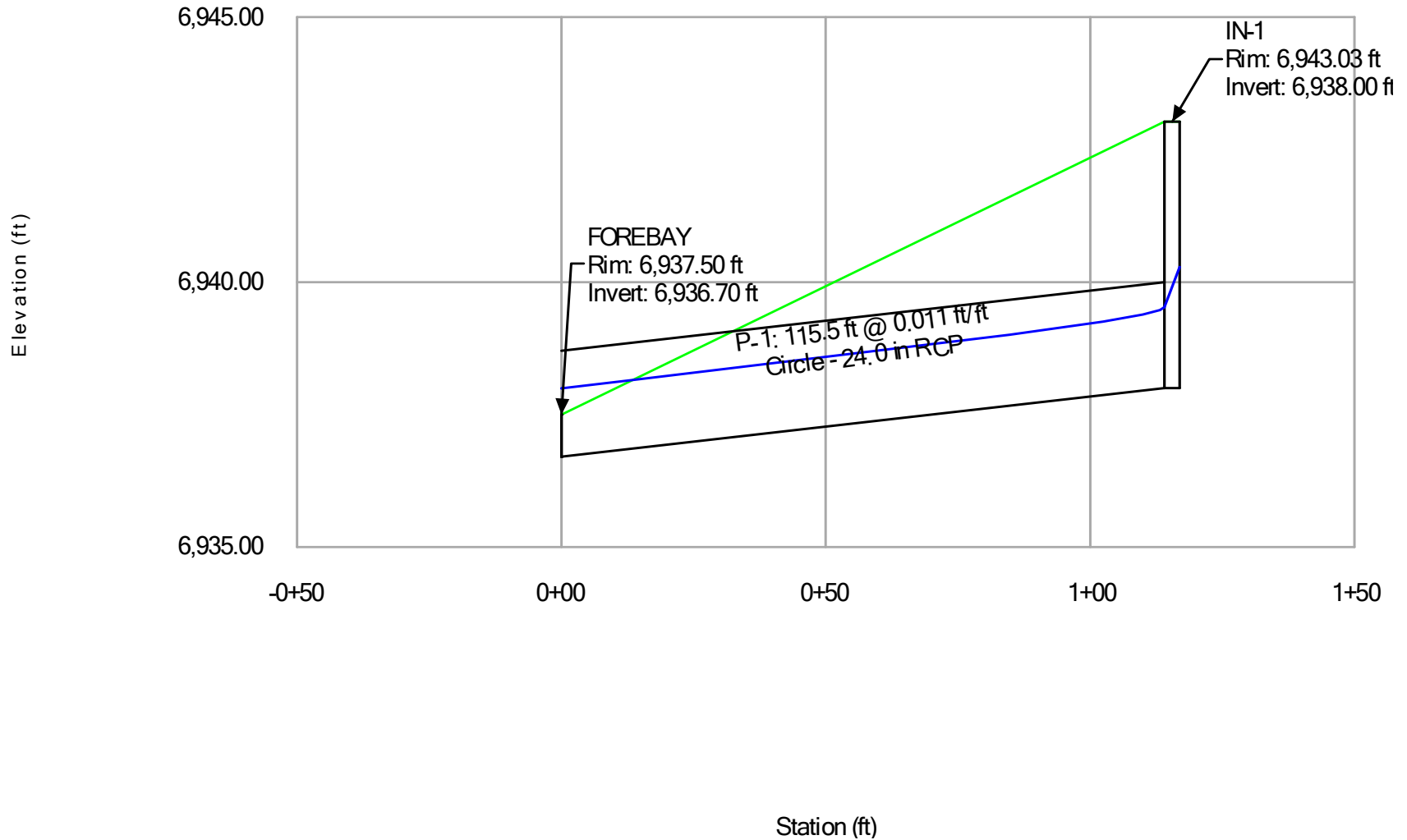
100 YEAR TABLE

FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
SWALE OUTFALL	6,935.51	6,933.01	6,937.56	6,937.56	5.60	18" FES Dummy Null Structure for LandXML purposes
FOREBAY	6,937.50	6,936.70		6,938.00	17.98	

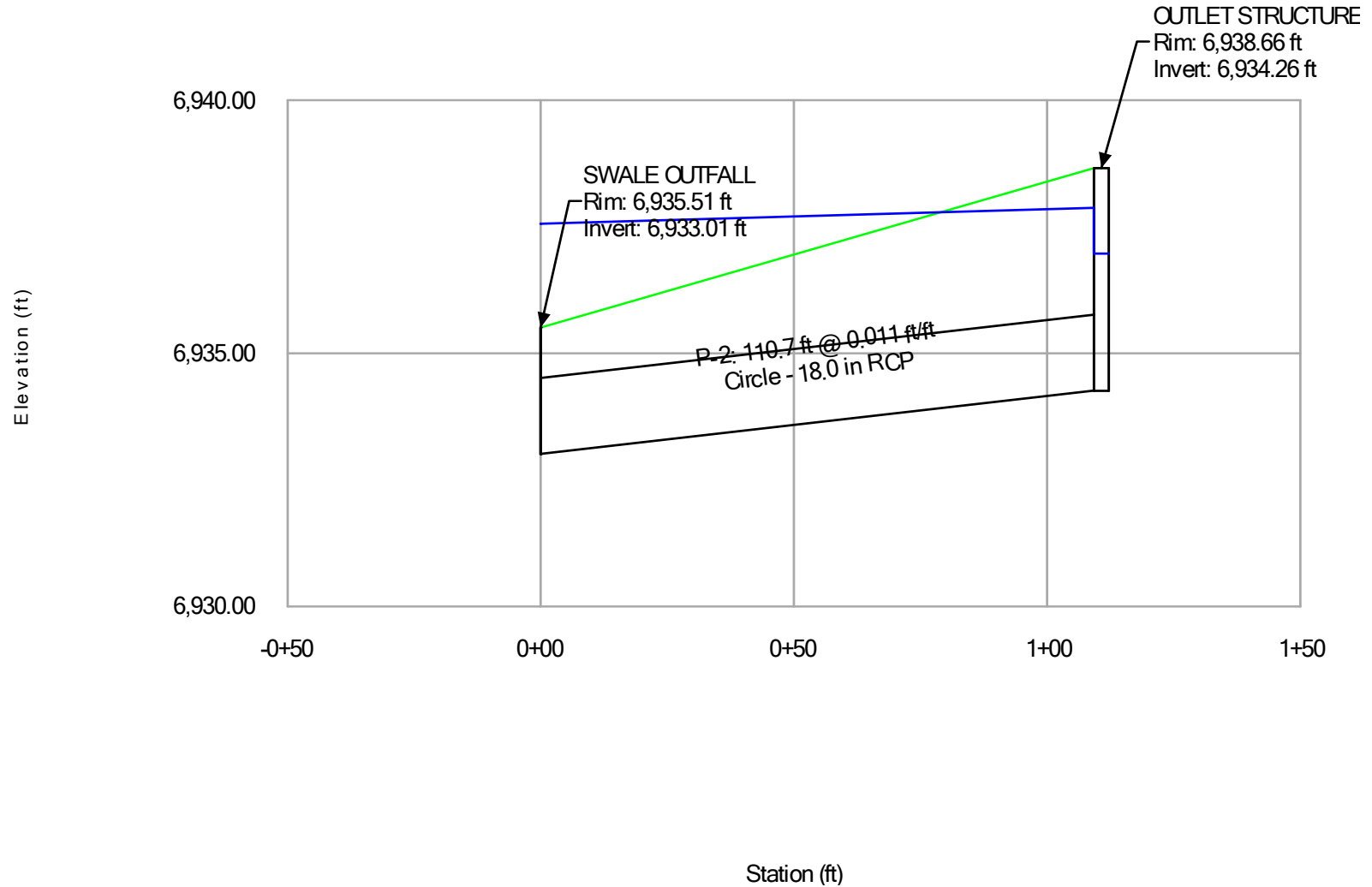
100 YEAR

Profile Report
Engineering Profile - STORM 1 (Untitled1.stsw)



100 YEAR

Profile Report
Engineering Profile - POND OUTFALL (Untitled1.stsw)

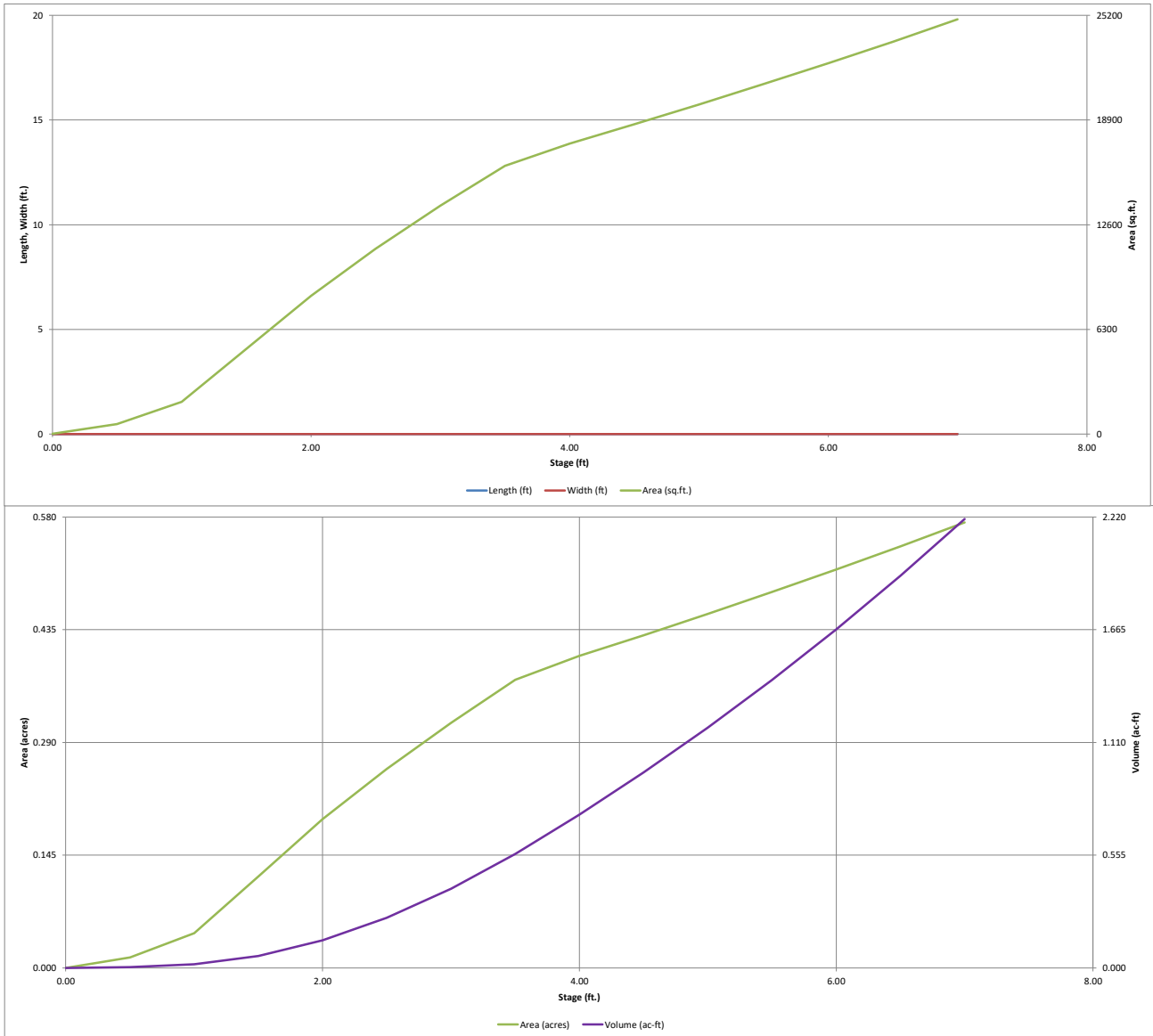




APPENDIX D – WATER QUALITY AND DETENTION CALCULATIONS

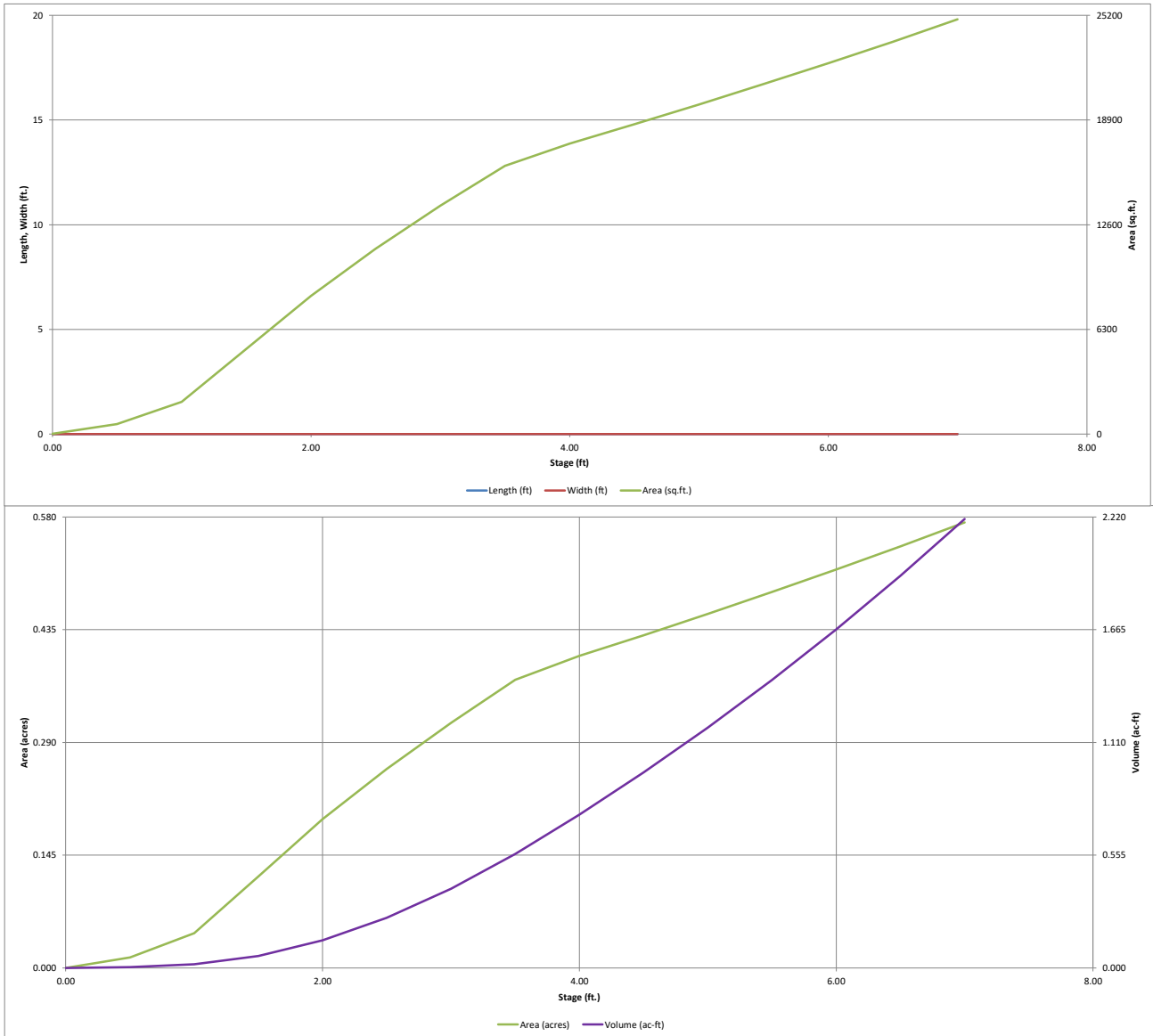
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

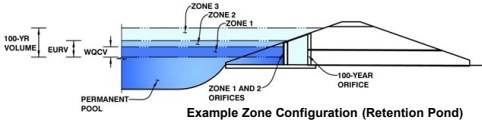


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD- Detention, Version 4.06 (July 2022)

Project: Life Church - FULL SPECTRUM DETENTION

Basin ID: Pond A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.28	0.193	Orifice Plate
Zone 2 (EURV)	3.97	0.549	Rectangular Orifice
Zone 3 (100-year)	4.97	0.425	Weir&Pipe (Restrict)
Total (all zones)		1.167	

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

Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)
Underdrain Orifice Diameter =		inches

Calculated Parameters for Underdrain	
Underdrain Orifice Area =	ft ²
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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.15	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	18.00	inches
Orifice Plate: Orifice Area per Row =	1.11	sq. inches (diameter = 1-3/16 inches)

Calculated Parameters for Plate	
WQ Orifice Area per Row =	7.708E-03 ft ²
Elliptical Half-Width =	N/A feet
Elliptical Slot Centroid =	N/A feet
Elliptical Slot Area =	N/A ft ²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.50	3.00					
Orifice Area (sq. inches)	1.11	1.11	1.11					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.28	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.97	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	N/A	inches
Vertical Orifice Width =	1.76	N/A	inches

Calculated Parameters for Vertical Orifice	
Zone 2 Rectangular	Not Selected
Vertical Orifice Area =	0.02 ft ²
Vertical Orifice Centroid =	0.08 ft

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	
Overflow Weir Front Edge Height, Ho =	4.16	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir	
Zone 3 Weir	Not Selected
Height of Grate Upper Edge, H ₁ =	4.16 feet
Overflow Weir Slope Length =	3.00 feet
Grate Open Area / 100-yr Orifice Area =	11.49 N/A
Overflow Grate Open Area w/o Debris =	6.26 ft ²
Overflow Grate Open Area w/ Debris =	6.26 ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	6.25	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	
Zone 3 Restrictor	Not Selected
Outlet Orifice Area =	0.55 ft ²
Outlet Orifice Centroid =	0.30 ft
Half-Central Angle of Restrictor Plate on Pipe =	1.26 radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	4.75	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	9.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway	
Spillway Design Flow Depth =	0.84 feet
Stage at Top of Freeboard =	6.59 feet
Basin Area at Top of Freeboard =	0.55 acres
Basin Volume at Top of Freeboard =	1.98 acre-ft

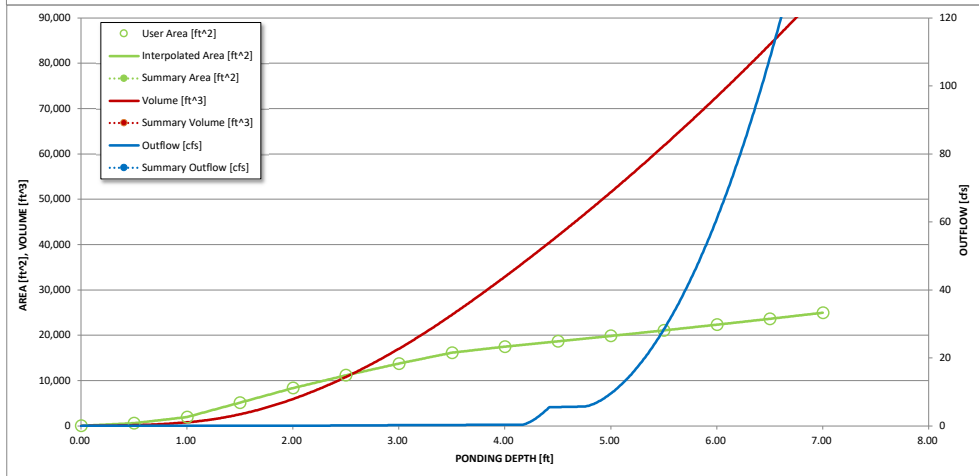
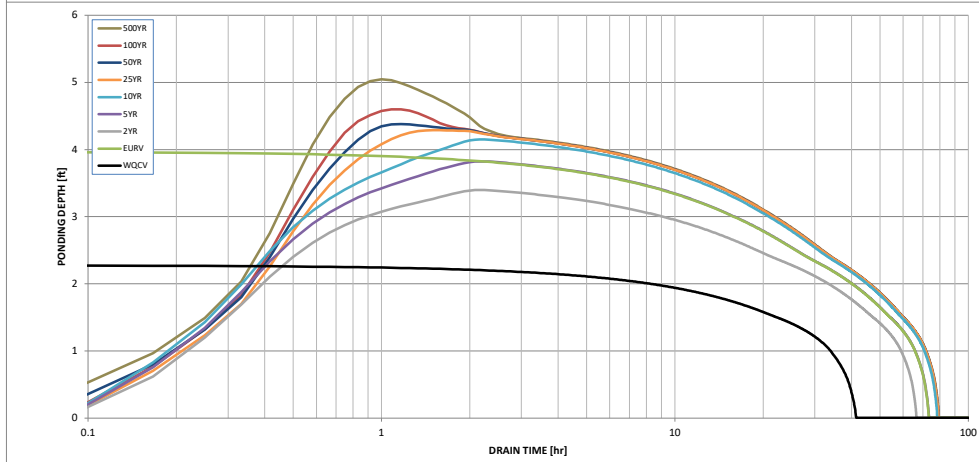
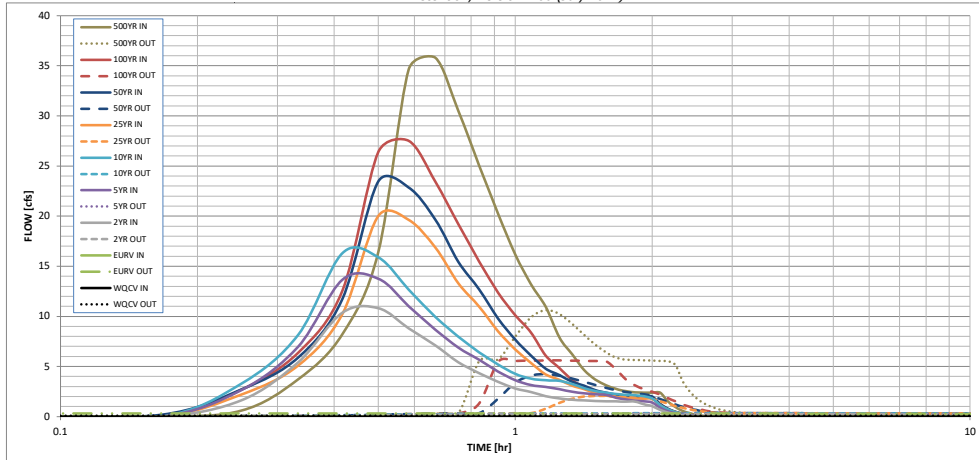
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	0.193	0.742	0.559	0.728	0.863	1.026	1.186	1.374	1.788
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.559	0.728	0.863	1.026	1.186	1.374	1.788
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.1	0.1	0.2	1.8	3.6	5.9	10.5
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.0	2.5	2.9	3.3	4.1		
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.24	0.30	0.35	0.40	0.50	0.71	1.26
Peak Inflow Q (cfs) =	N/A	N/A	10.8	13.8	16.3	20.0	23.5	27.5	35.8
Peak Outflow Q (cfs) =	0.1	0.3	0.3	0.30	0.3	2.1	4.2	5.60	10.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.6	1.0	0.9	1.0
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	0.6	0.8	0.9
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	65	60	65	69	68	67	65	62
Time to Drain 99% of Inflow Volume (hours) =	40	70	64	70	74	74	74	73	72
Maximum Ponding Depth (ft) =	2.28	3.97	3.39	3.82	4.15	4.29	4.38	4.60	5.04
Area at Maximum Ponding Depth (acres) =	0.23	0.40	0.36	0.39	0.41	0.42	0.42	0.43	0.46
Maximum Volume Stored (acre-ft) =	0.194	0.743	0.522	0.684	0.812	0.870	0.907	1.001	1.202

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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	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	0.18	0.02	0.59
	0:15:00	0.00	0.00	1.63	2.66	3.29	2.21	2.71	2.68	3.72
	0:20:00	0.00	0.00	5.42	6.99	8.16	5.11	5.90	6.39	8.21
	0:25:00	0.00	0.00	10.37	13.66	16.30	10.24	11.73	12.57	16.39
	0:30:00	0.00	0.00	10.81	13.76	15.90	20.02	23.47	26.38	34.64
	0:35:00	0.00	0.00	8.80	11.01	12.66	19.61	22.86	27.52	35.82
	0:40:00	0.00	0.00	7.10	8.69	9.97	16.88	19.67	23.44	30.51
	0:45:00	0.00	0.00	5.43	6.88	7.99	13.31	15.45	19.22	25.06
	0:50:00	0.00	0.00	4.33	5.67	6.42	10.97	12.69	15.48	20.26
	0:55:00	0.00	0.00	3.47	4.51	5.20	8.51	9.79	12.39	16.17
	1:00:00	0.00	0.00	2.81	3.63	4.27	6.70	7.68	10.13	13.21
	1:05:00	0.00	0.00	2.45	3.14	3.78	5.34	6.10	8.39	10.96
	1:10:00	0.00	0.00	2.04	2.96	3.62	4.22	4.79	6.10	7.91
	1:15:00	0.00	0.00	1.82	2.72	3.56	3.66	4.14	4.84	6.23
	1:20:00	0.00	0.00	1.69	2.47	3.26	3.08	3.48	3.65	4.66
	1:25:00	0.00	0.00	1.61	2.32	2.83	2.74	3.08	2.93	3.71
	1:30:00	0.00	0.00	1.56	2.22	2.55	2.35	2.65	2.49	3.13
	1:35:00	0.00	0.00	1.53	2.16	2.37	2.11	2.37	2.20	2.76
	1:40:00	0.00	0.00	1.51	1.88	2.25	1.96	2.20	2.03	2.53
	1:45:00	0.00	0.00	1.50	1.70	2.18	1.86	2.10	1.95	2.43
	1:50:00	0.00	0.00	1.50	1.58	2.13	1.81	2.04	1.92	2.39
	1:55:00	0.00	0.00	1.23	1.52	2.02	1.78	2.01	1.91	2.38
	2:00:00	0.00	0.00	1.05	1.40	1.81	1.77	1.99	1.91	2.38
	2:05:00	0.00	0.00	0.66	0.88	1.15	1.12	1.26	1.21	1.51
	2:10:00	0.00	0.00	0.41	0.55	0.71	0.71	0.79	0.76	0.94
	2:15:00	0.00	0.00	0.24	0.33	0.43	0.43	0.48	0.46	0.57
	2:20:00	0.00	0.00	0.13	0.19	0.25	0.25	0.28	0.27	0.33
	2:25:00	0.00	0.00	0.06	0.10	0.13	0.14	0.15	0.15	0.18
	2:30:00	0.00	0.00	0.03	0.04	0.05	0.06	0.06	0.06	0.07
	2:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	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



LIFE CHURCH AT BENT GRASS	<u>Calc'd by:</u>	CMD
2403591	<u>Checked by:</u>	RDL
FOREBAY WQCV CALCULATION	<u>Date:</u>	4/29/2025

Input Parameters			
Basin	<i>a</i>	<i>I</i> (%)	<i>A</i> (acres)
A1	1.0	87.8%	2.96
A2	1.0	88.8%	2.99

Calculated Parameters		
Basin	WQCV (watershed-inches)	<i>V</i> (acre-feet)
A1	0.383	0.095
A2	0.391	0.097

WQCV was calculated using Equation 3-1 and Equation 3-2 in the MHFD USDCM V3.

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I) \tag{Equation 3-1}$$

Where:

- WQCV = Water Quality Capture Volume (watershed-inches)
- a* = Coefficient corresponding to BMP type and based on WQCV design drain time (Table 3-2)
- I* = Imperviousness (percent expressed as a decimal) Note: At a planning level, the watershed imperviousness can be estimated based on the zoned density. When finalizing design, calculate imperviousness based on the site plan.

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hours)	Coefficient, <i>a</i>
12 hours (filtration BMPs and retention ponds)	0.8
24 hours (constructed wetland ponds)	0.9
40 hours (extended detention)	1.0
No attenuation (e.g., grass buffer or swale)	1.0

$$V = \frac{WQCV}{12} A \tag{Equation 3-2}$$

Where:

- V* = required storage volume (acre-feet)
- A* = watershed tributary area upstream (acres)
- WQCV = Water Quality Capture Volume (watershed-inches)

HR GREEN FOREBAY SIZING

PROJECT: LIFE CHURCH AT BENT GRASS

DATE: 10/14/2025

DESIGNED BY: CMD

CHECKED BY: RDL

POND OR DP: BASIN A1

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

Equation 4-1

Where:

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)

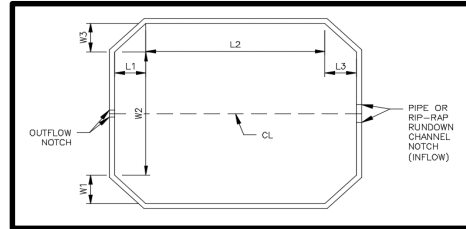
	INNER DIMENSIONS	OUTER DIMENSIONS
LENGTH		
L1	1 FT	1.83 FT
L2	7.167 FT	8.000 FT
L3	1 FT	1.83 FT
INNER L	9.167 FT	OUTER TOTAL L 10.833 FT
WIDTH		
W1	1 FT	1.83 FT
W2	5.375 FT (75% of L2)	6.21 FT
W3	1 FT	1.83 FT
INNER W	7.375 FT	OUTER TOTAL W 9.041 FT
BAFFLE	(W2'x0.83' + 2.5'x0.83')	
AREA	6.56 SF	

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,	Size to drain in 4 to 5 minutes using Equation 4-1			
Minimum Forebay Volume ¹	concrete pad with slotted metal edge,	1% of WQCV			
Forebay Depth ¹	or similar design	12 to 15 inches	15 to 18 inches	18 to 24 inches	24 to 30 inches

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

TRIANGLES	2
RECTANGLE	38.5
BAFFLE	6.6
TOTAL SURFACE AREA	34.0 SQ FT



FOREBAY HT. **1.25 FT**

FOREBAY VOLUME	42.5	CF
	1.6	CY
	0.0	AC-FT

SUFFICIENT VOLUME?	YES
--------------------	-----

REQ'D VOL (1% WQCV)	0.00095	AC-FT
	41.382	CF
Notch Width per Eq. 4-1	1.0	in

HR GREEN FOREBAY SIZING

PROJECT: LIFE CHURCH AT BENT GRASS

DATE: 10/14/2025

DESIGNED BY: CMD

CHECKED BY: RDL

POND OR DP: BASIN A2

	INNER DIMENSIONS	OUTER DIMENSIONS
LENGTH		
L1	1 FT	1.83 FT
L2	7.167 FT	8.000 FT
L3	1 FT	1.83 FT
INNER L	9.167 FT	OUTER TOTAL L 10.833 FT
WIDTH		
W1	1 FT	1.83 FT
W2	5.38 FT (75% of L2)	6.21 FT
W3	1 FT	1.83 FT
INNER W	7.375 FT	OUTER TOTAL W 9.041 FT
BAFFLE AREA	(W2'x0.83' + 2.5'x0.83')	
	6.56 SF	

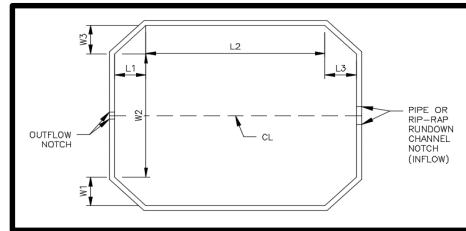
TRIANGLES	2
RECTANGLE	38.5
BAFFLE	6.6
TOTAL SURFACE AREA	34.0 SQ FT

FOREBAY HT. 1.25 FT

FOREBAY VOLUME	42.5	CF
	1.6	CY
	0.0	AC-FT

REQ'D VOL (1% WQCV)	0.00097	AC-FT
	42.25	CF
Notch Width per Eq. 4-1	1.0	in

SUFFICIENT VOLUME?	YES
--------------------	-----



$$w = 9.23 (A_{FB} / t) (1 / \sqrt{h_{max}}) \quad \text{Equation 4-1}$$

Where:

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)

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				
Minimum Forebay Volume ¹	Size to drain in 4 to 5 minutes using Equation 4-1				
Forebay Depth ¹	1% of WQCV				
	12 to 15 inches	15 to 18 inches	18 to 24 inches	24 to 30 inches	24 to 30 inches

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



APPENDIX E – APPROVED VARIANCE REQUESTS



APPENDIX F – REFERENCE MATERIAL

FINAL DRAINAGE REPORT
for
OWL MARKETPLACE FILNG NO. 1

Falcon, Colorado

June 2024

Prepared for:

Meridian & Owl X, LLC
450 N McClintock Drive
Chandler, AZ 85226
Contact: Brian Zurek
(480)-313-2724

Prepared by:

Drexel, Barrell & Co.
3 South 7th Street
Colorado Springs, CO 80905
Contact: Tim McConnell, P.E.
(719) 260-0887

El Paso County File No. VR2321

6.0 EXISTING ONSITE CONDITION

Rational Method Existing Runoff Summary

EXISTING				
BASIN	DP	Area (Ac.)	Q ₅ (CFS)	Q ₁₀₀ (CFS)
RMT064	X1		288.5	920.0
OSE1	E1	1.26	0.9	3.1
E2		1.95	0.5	3.7
	E2	3.21	1.4	6.9
E3	E3	2.34	0.6	4.4
E4	E4	0.33	0.1	0.7
MT060	X2		60.1	196.8

Offsite flows reaching Owl Place from the roadside ditch along Meridian Road to the north are represented by **Design Point X1**. These flows are established by the DBPS (Matrix) and subsequent DBPS Amendment (Galloway) studies as DBPS Reach RMT064. The most recent CLOMR study determined rates of **Q₅=288.5 cfs** and **Q₁₀₀=920 cfs** for this section. See further description below.

An offsite basin for adjacent Lot 14 Falcon Ranchettes has not been delineated on the existing conditions map, but excerpts from the Falcon DBPS (Matrix) and DBPS Amendment (Galloway) have been included in the appendix to establish the existing flows entering Pond SR4 at the south of the lot, at **Design Point X2**. These flows are represented by DBPS Reach MT060 and consist of rates of Q₅=60.1 cfs and Q₁₀₀=196.8 cfs.

Basin OSE1 represents an offsite 1.26-acre basins to the north of Owl Place. Runoff rates of Q₅=0.9 cfs and Q₁₀₀=3.1 cfs are generated by this basin, and generally travel to the south towards the low point in Owl Place (**Design Point E1**) before discharging on to the Owl Marketplace property.

Basin E2 represents a 1.95 acre basin on the north side of the Owl Marketplace property to the south of Owl Place. This basin contains the Upper Black Squirrel Creek Tributary and as such flow generated by this basin (Q₅=0.5 cfs and Q₁₀₀=3.7 cfs) combine with those from offsite basin OSE1 and travel towards the center of the basin before following the tributary and discharging out the southwest property line at **Design Point E2**.

Basin E3 represents 3.21-acres at the south of the Owl Marketplace property. Runoff rates of Q₅=0.6 cfs and Q₁₀₀=4.4 cfs are generated by this basin, and generally travel to the southwest towards the property corner at **Design Point E3** before discharging into the adjacent subregional pond SR4 on the Falcon Marketplace property.

Basin E4 covers 0.33-acres along Meridian Road at the eastern boundary of the Owl Marketplace property. Runoff rates of Q₅=0.1 cfs and Q₁₀₀=0.7 cfs are generated by this basin, and generally travel to the east and south towards Meridian Road and **Design Point E4**.

7.0 PROPOSED CONDITION CLOMR ANALYSIS

The Middle Branch of the UTBSC flows southwest across the property and is proposed to be contained within a 10'x6' box culvert that will discharge into the Subregional Pond SR4 recently constructed on the Falcon Marketplace property.

Pond SR4 was designed for a 100-year discharge of 1,016 cfs, which includes both West and Middle branches of the UTBSC. The 100-year water surface elevation upstream of the pond as shown in the LOMR is 6902.5 (NAVD88), or 6898.7 (NGVD29). The starting HGL for the box culvert analysis was conservatively placed at the top of pipe elevation of 6895.84 feet (NGVD29) for analyzing flows to the East branch only. However, an additional analysis was performed with a starting HGL of 6898.7, to evaluate the backwater effects from the pond.

The proposed box culvert will convey the entire 100-year event (920 cfs), as established by the Falcon DBPS with an HGL of 6911.31 at the proposed headwall upstream of Owl Place, which is more than one foot below Owl Place and contained within the existing and proposed channel upstream. Channel grading will be required for approximately 30 feet to tie into the existing creek profile upstream. The channel side slopes will be reduced from approximately 5.5H:1V to 1.8H:1V and protected with Type M grouted riprap. A proposed Type VI stilling basin and additional riprap slope protection is proposed at the outfall into Pond SR4. An extension of the existing trickle channel will provide connection to the existing low flow path through the facility.

8.0 PROPOSED ONSITE CONDITION

As noted in Section 6.0 of this report, offsite flows reaching Owl Place from the roadside ditch along Meridian Road to the north are represented by **Design Point X1**. These flows are established by the DBPS (Matrix) and subsequent DBPS Amendment (Galloway) studies as DBPS Reach RMT064 and consist of rates of $Q_5=288.5$ cfs and $Q_{100}=920$ cfs. As noted above in Section 7.0 a proposed public 10'x6' box culvert will convey the full 100-year event without overtopping Owl Place from this point to Pond SR4 to the south.

An offsite basin for adjacent Lot 14 Falcon Ranchettes has not been delineated on the developed conditions map, as no changes - beyond those already incorporated into the following developed condition analysis - are proposed for Lot 14. The lot will remain in its current residential condition and any further development of Lot 14 (or Lot 5 as replatted with Owl Marketplace) will require additional drainage analysis and possible CLOMR to remove portions of the lot from the remaining floodplain. Flows reaching Pond SR4 to the south will remain as described in the existing condition as **Design Point X2** ($Q_5=60.1$ cfs and $Q_{100}=196.8$ cfs).

Basins A through D represent each of the 4 commercial pad sites within the Owl Marketplace property. For this initial stage of overlot development, each lot/pad site will be graded to direct flows towards its southwest corner, where runoff will be intercepted by a temporary sediment basins, before discharging into the proposed private 18" RCP storm sewer stubs provided to each lot. The storm sewer stubs will remain in place for use by the individual lot users.

Future Land Use Condition - Peak Discharge				
Model Location	Physical Location	Branch	Proximity to Owl Place	Future Flow Q100 (cfs)
JMT050	Bent Grass Meadows Drive & Meridian Road	East Branch	Upstream of site	850
JMT060	Eastonville Road & Meridian Road	East and West Convergence	Downstream of site	1000

Bent Grass DPBS Amendment (Galloway)

The Bent Grass DBPS Amendment addresses a drainage diversion took place as part of the Bent Grass Residential Filing No. 1 development, specifically the rerouting of the UTBSC West Tributary to the east towards the intersection of Meridian Road and Bent Grass Meadows Drive. As a result of this diversion, a new junction was created in the Middle Tributary – JMT060a. This junction is located just south of JMT050 from the Falcon DPBS (Matrix) and is summarized below.

Future Land Use Condition - Peak Discharge				
Model Location	Physical Location	Branch	Proximity to Owl Place	Future Flow Q100 (cfs)
JMT060a	Bent Grass Meadows Drive & Meridian Road	East Branch	Upstream of site	909.3

The Bent Grass DBPS Amendment recommends a 15' wide bottom channel with 4:1 side slopes at 6.5' deep with a longitudinal slope of 0.30% for reach RMT064.

Falcon Ranchettes Filing No. 1a – Meridian Storage (Galloway)

The Falcon Ranchettes Filing No. 1a development located directly north of Owl Place, includes regrading a portion of the UTBSC East Branch along Meridian Road with small drop structures with toe protection. The channel has been designed for a 925-cfs design flow as specified in the Bent Grass DBPS Amendment.

The improvements are intended to be intercepted by the 10'x6' box culvert proposed with this development. Per discussions with the adjacent developer, construction is expected to run concurrently with the Owl Marketplace project and design has been coordinated accordingly.

Owl Place CLOMR Analysis

This Owl Marketplace development includes regrading and rerouting a portion of the UTBSC East Branch. The improvements intercept the existing creek immediately north of Owl Place and convey is via 10'x6' box culvert to the subregional detention facility SR4 directly to the south. The box culvert is designed to convey the full 100-year discharge.

The Falcon DBPS did not include a junction on the East Branch immediately upstream of the convergence at pond SR4. Therefore, the Owl Place CLOMR modified the HMS model to create a new junction located at the southern boundary of this development. This junction is summarized below.

Future Land Use Condition - Peak Discharge				
Model Location	Physical Location	Branch	Proximity to Owl Place	Future Flow Q100 (cfs)
JMT051	Immediately upstream of Pond SR4	East Branch	Downstream of site	920

As mentioned above, a Conditional Letter of Map Revision (CLOMR) was approved by FEMA (Case No. 22-08-0669R) on December 21, 2022.

Referenced portions of the CLOMR are included in the appendix.

DBPS Analysis conclusions

Per the Falcon DBPS, channel improvements are required to stabilize RMT064 of the UTBSC East Branch. The table below compares the proposed design flow against previous reports.

Future Land Use Condition - Peak Discharge				
Model Location	Physical Location	Branch	Proximity to Owl Place	Future Flow Q100 (cfs)
RMT064	North of Owl Place, South of Bent Grass Meadows Drive	East Branch	-	925
JMT050 (Falcon DBPS)	Bent Grass Meadows Drive & Meridian Road	East Branch	Upstream of site	850
JMT060a (Bent Grass Amendment)	Bent Grass Meadows Drive & Meridian Road	East Branch	Upstream of site	909.3
JMT051 (Owl Place CLOMR)	Immediately upstream of Pond SR4	East Branch	Downstream of site	920

Due to the added junctions (JMT060a and JMT051), no revisions to the existing HMS models are needed for identifying the proposed design flow for RMT064.

There are no proposed changes to the West Tributary proposed as part of this project. The property encumbered by this tributary and associated floodplain (Lot 14 Falcon Ranchettes – Lot 5, Owl Marketplace as replatted), will be required to undergo additional drainage analysis in the future at time of development.

17.0 REFERENCES

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs/El Paso County Drainage Criteria Manual, May 2014.
2. Urban Storm Drainage Criteria Manuals, Urban Drainage and Flood Control District. June 2001, Revised April 2008.
3. Request for Conditional Letter of Map Revision, Unnamed Tributary to Black Squirrel Creek, Prepared by Drexel, Barrell & Co., October 25, 2022.
5. Natural Resources Conservation Service (NRCS) Web Soil Survey
7. EL Paso County Board Resolution No 15-042: El Paso County adoption of Chapter 6 and Section 3.2.1, Chapter 13 of the City of Colorado Springs Drainage Criteria Manual, May 2014.
8. Falcon Drainage Basin Planning Study. Prepared by Matrix Design Group, September 2015.
9. Final Drainage Report for Falcon Marketplace. Prepared by Drexel, Barrell & Co. November 2019.
10. El Paso County Engineering Criteria Manual , July 18, 2023.
11. MDDP & DBPS Amendment Bent Grass Development. Prepared by Galloway & Co. February 2021.

APPENDIX
REPORT EXCERPTS
FALCON DBPS

FALCON DRAINAGE BASIN PLANNING STUDY
SELECTED PLAN REPORT
FINAL - SEPTEMBER 2015

Prepared for:



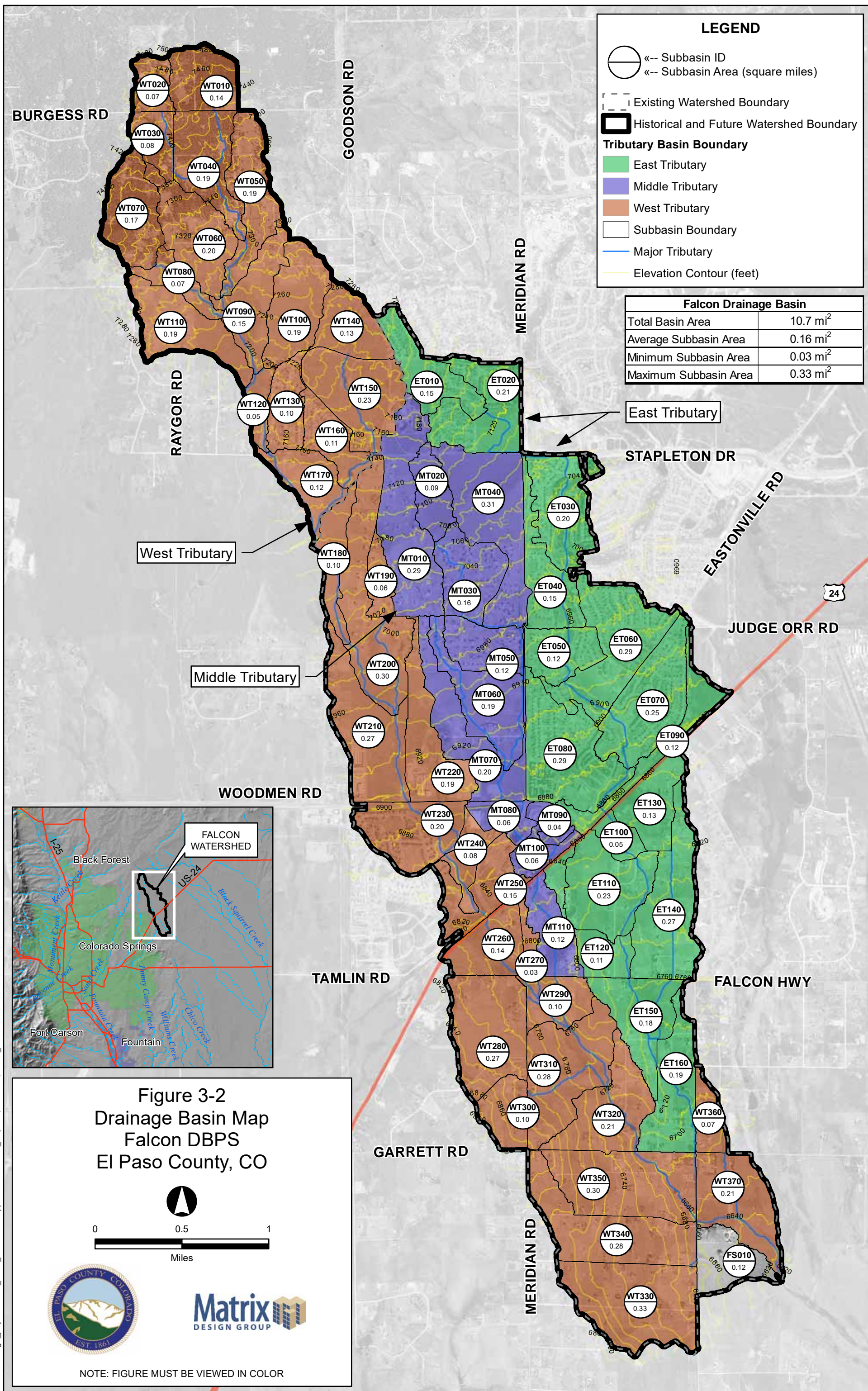
El Paso County Public Services Department
3275 Akers Drive
Colorado Springs, CO 80922

Prepared By:



Matrix Design Group
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920

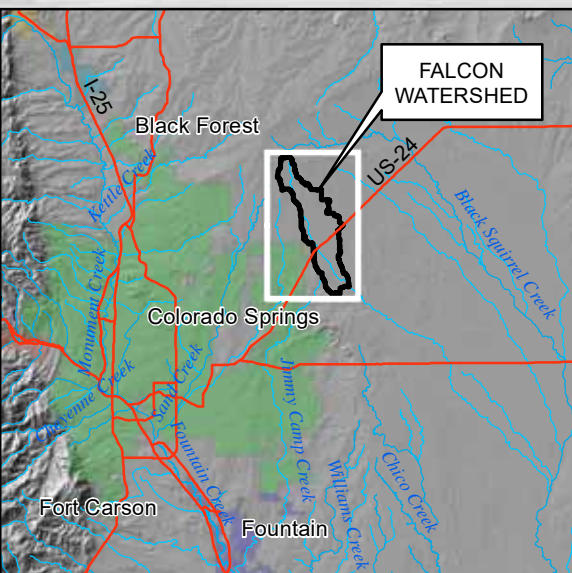
Matrix Project No. 10.122.003



LEGEND

- Subbasin ID
- Subbasin Area (square miles)
- Existing Watershed Boundary
- Historical and Future Watershed Boundary
- Tributary Basin Boundary**
- East Tributary
- Middle Tributary
- West Tributary
- Subbasin Boundary
- Major Tributary
- Elevation Contour (feet)

Falcon Drainage Basin	
Total Basin Area	10.7 mi ²
Average Subbasin Area	0.16 mi ²
Minimum Subbasin Area	0.03 mi ²
Maximum Subbasin Area	0.33 mi ²

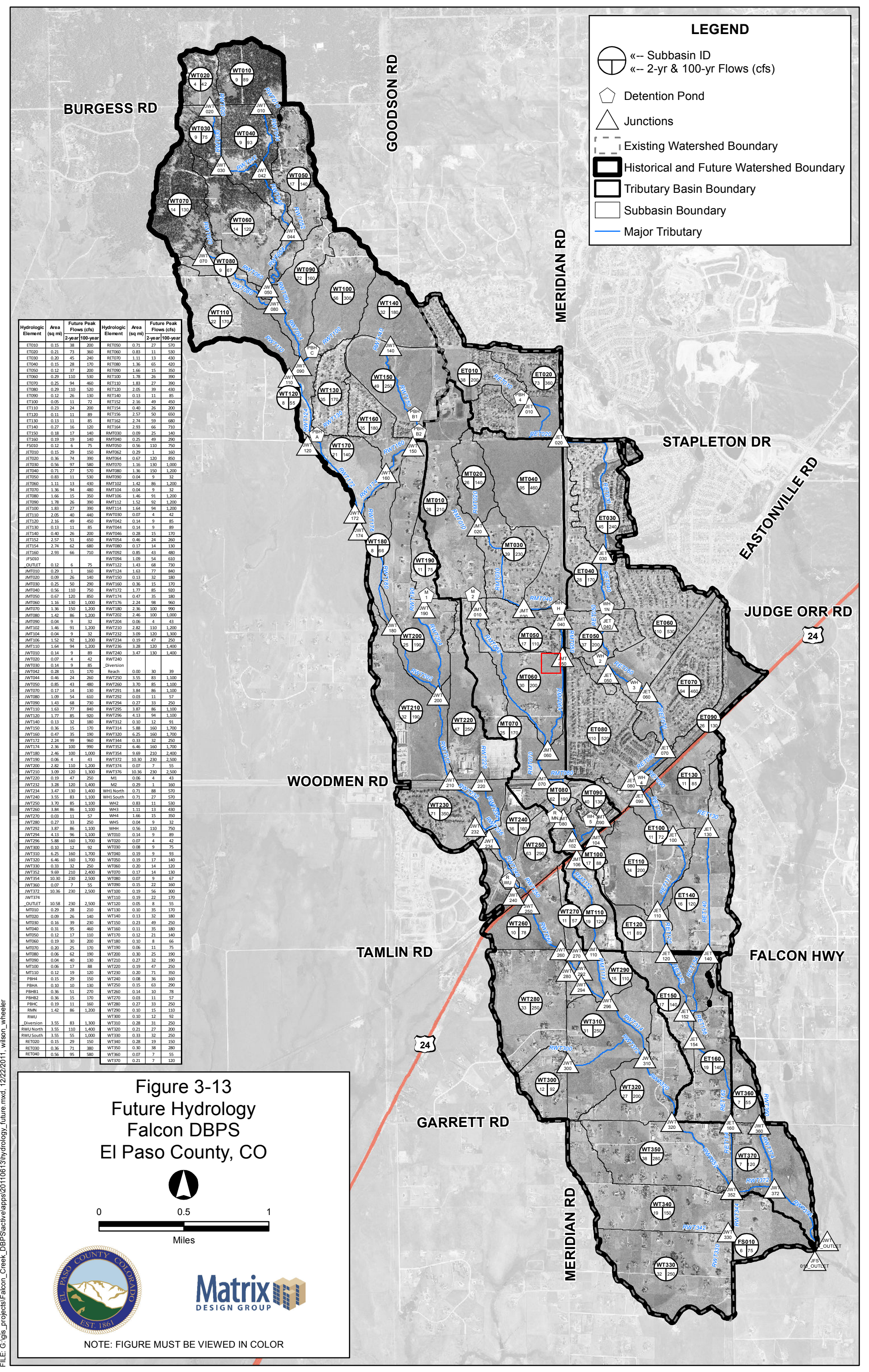


**Figure 3-2
Drainage Basin Map
Falcon DBPS
El Paso County, CO**

0 0.5 1
Miles

NOTE: FIGURE MUST BE VIEWED IN COLOR

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20110613\basin_map.mxd, 8/29/2011, wilson_wheeler

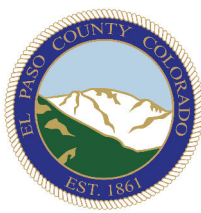
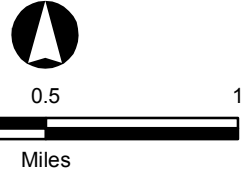


LEGEND

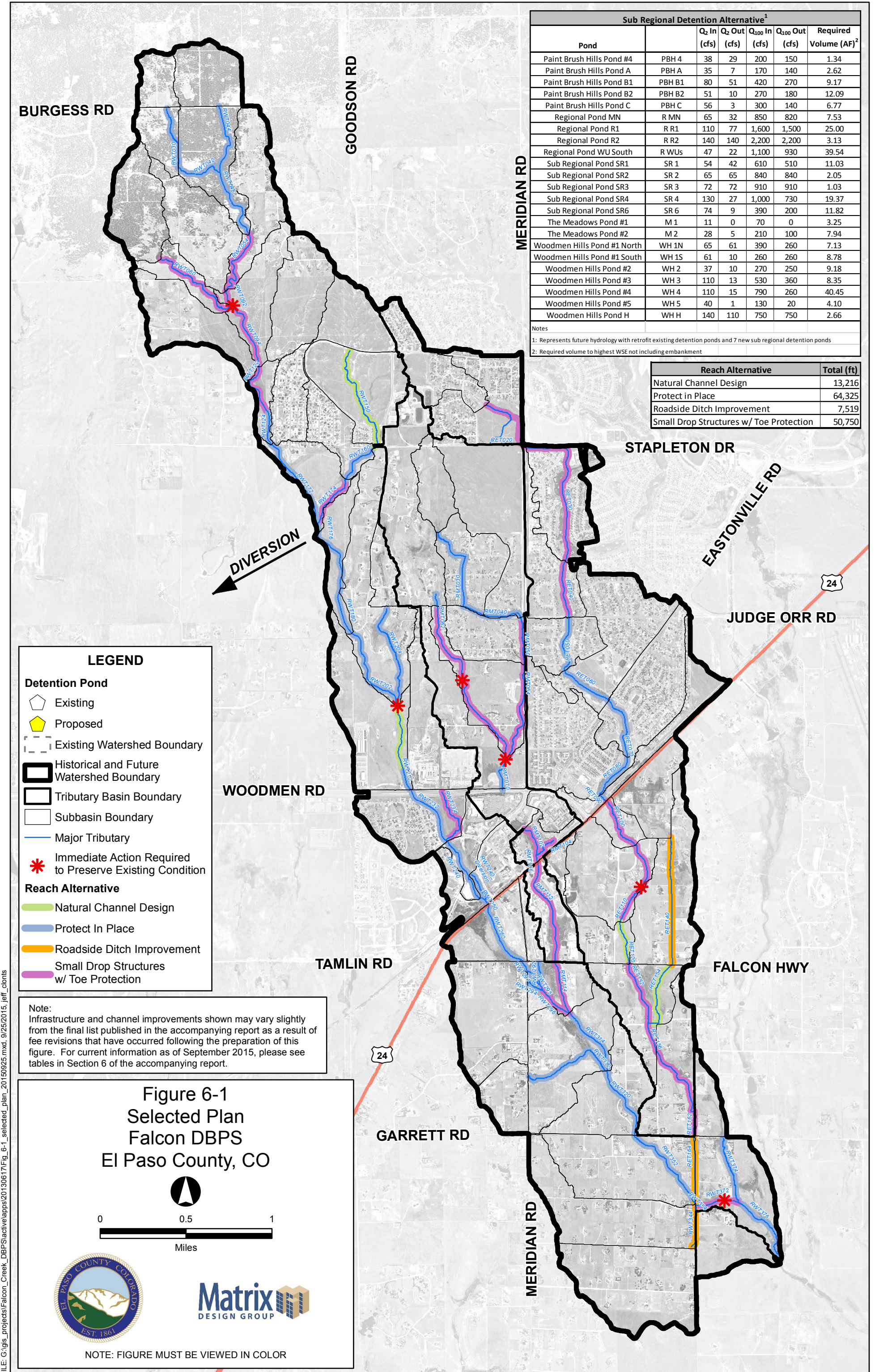
- Subbasin ID
- 2-yr & 100-yr Flows (cfs)
- Detention Pond
- Junctions
- Existing Watershed Boundary
- Historical and Future Watershed Boundary
- Tributary Basin Boundary
- Subbasin Boundary
- Major Tributary

Hydrologic Element	Area (sq mi)	Future Peak Flows (cfs)		Hydrologic Element	Area (sq mi)	Future Peak Flows (cfs)	
		2-year	100-year			2-year	100-year
ET010	0.15	38	200	RET050	0.71	27	570
ET020	0.21	73	360	RET060	0.83	11	530
ET030	0.20	45	240	RET070	1.11	13	430
ET040	0.15	28	170	RET080	1.36	65	420
ET050	0.12	37	200	RET090	1.66	15	350
ET060	0.29	110	530	RET100	1.78	26	390
ET070	0.25	94	460	RET110	1.83	27	390
ET080	0.29	110	520	RET120	2.05	39	490
ET090	0.12	26	130	RET130	0.13	11	85
ET100	0.05	11	72	RET152	2.16	49	450
ET110	0.23	24	200	RET154	0.40	26	200
ET120	0.11	11	89	RET156	2.57	50	650
ET130	0.13	11	85	RET162	2.74	59	680
ET140	0.27	16	120	RET164	2.93	66	710
ET150	0.18	17	140	RMT030	0.09	25	140
ET160	0.19	19	140	RMT040	0.25	49	290
FS010	0.12	6	75	RMT050	0.56	110	750
JET010	0.15	29	150	RMT062	0.29	1	160
JET020	0.36	74	390	RMT064	0.67	120	850
JET030	0.56	97	580	RMT070	1.16	130	1,000
JET040	0.71	27	570	RMT080	1.36	150	1,200
JET050	0.83	11	520	RMT090	0.04	9	32
JET060	1.11	13	430	RMT102	1.42	86	1,200
JET070	1.36	94	480	RMT104	0.04	9	32
JET080	1.66	15	350	RMT106	1.46	91	1,200
JET090	1.78	26	390	RMT112	1.52	92	1,200
JET100	1.83	27	390	RMT114	1.64	94	1,200
JET110	2.05	40	460	RMT030	0.07	4	42
JET120	2.16	49	450	RMT042	0.14	9	85
JET130	0.13	11	85	RMT044	0.14	9	89
JET140	0.40	26	200	RMT046	0.28	15	170
JET152	2.57	51	650	RMT054	0.46	24	260
JET154	2.74	62	680	RMT080	0.17	14	130
JET160	2.93	66	710	RMT092	0.85	43	480
FS010	0.12	6	75	RMT094	1.09	54	610
JMT010	0.29	1	160	RMT122	1.43	68	730
JMT020	0.09	26	140	RMT124	1.63	77	840
JMT030	0.25	50	290	RMT150	0.13	32	180
JMT040	0.56	110	750	RMT160	0.36	15	170
JMT050	0.67	120	850	RMT170	1.77	85	920
JMT060	1.16	130	1,000	RMT176	2.24	98	960
JMT070	1.36	150	1,200	RMT180	2.36	100	990
JMT080	1.42	86	1,200	RMT202	2.46	100	1,000
JMT090	0.04	9	32	RMT204	0.06	4	43
JMT102	1.46	91	1,200	RMT210	2.82	110	1,200
JMT104	0.04	9	32	RMT232	3.09	120	1,300
JMT106	1.52	92	1,200	RMT234	0.19	47	250
JMT110	1.64	94	1,200	RMT236	3.28	120	1,400
JMT110	0.14	9	89	RMT240	3.47	130	1,400
JMT120	0.07	4	42	RMT240			
JMT130	0.14	9	85	Diversion			
JMT142	0.28	15	170	RMT252	0.00	30	39
JMT144	0.46	24	260	RMT250	3.55	83	1,100
JMT150	0.85	43	480	RMT260	3.70	85	1,100
JMT170	0.17	14	130	RMT291	3.84	86	1,100
JMT180	1.09	54	610	RMT292	0.03	11	57
JMT190	1.43	68	730	RMT294	0.27	33	250
JMT210	1.63	77	840	RMT295	3.87	86	1,100
JMT220	1.77	85	920	RMT296	4.13	94	1,100
JMT230	0.13	32	180	RMT312	0.10	12	91
JMT240	0.36	15	170	RMT314	5.88	160	1,700
JMT250	0.47	35	190	RMT320	6.25	160	1,700
JMT272	2.24	99	960	RMT344	0.33	32	250
JMT274	2.36	100	990	RMT352	6.46	160	1,700
JMT280	2.46	100	1,000	RMT354	9.69	210	2,400
JMT290	0.06	4	43	RMT372	10.30	230	2,500
JMT200	2.82	110	1,200	RMT374	0.07	7	55
JMT210	3.09	120	1,300	RMT376	10.36	230	2,500
JMT220	0.19	47	250	M1	0.06	4	43
JMT232	3.28	120	1,400	M2	0.29	1	160
JMT234	3.47	130	1,400	WH1 North	0.71	28	570
JMT240	3.55	83	1,100	WH1 South	0.71	27	520
JMT250	3.70	85	1,100	WH2	0.83	11	530
JMT260	3.84	86	1,100	WH3	1.11	13	430
JMT270	0.03	11	57	WH4	1.66	15	350
JMT280	0.27	33	250	WH5	0.04	9	32
JMT292	3.87	86	1,100	WHH	0.56	110	750
JMT294	4.13	96	1,100	WT010	0.14	9	89
JMT296	5.88	160	1,700	WT020	0.07	4	42
JMT300	0.10	12	92	WT030	0.08	9	75
JMT310	6.25	160	1,700	WT040	0.19	9	93
JMT320	6.46	160	1,700	WT050	0.19	17	140
JMT330	0.33	32	250	WT060	0.20	14	120
JMT352	9.69	210	2,400	WT070	0.17	14	130
JMT354	10.30	230	2,500	WT080	0.07	9	67
JMT360	0.07	7	55	WT090	0.15	22	160
JMT372	10.36	230	2,500	WT100	0.19	56	300
JMT374				WT110	0.19	22	170
OUTLET	10.58	230	2,500	WT120	0.05	8	55
WT010	0.29	28	210	WT130	0.10	35	180
WT020	0.09	26	140	WT140	0.13	32	180
WT030	0.16	39	230	WT150	0.23	49	250
WT040	0.31	95	460	WT160	0.11	35	180
WT050	0.12	17	110	WT170	0.12	21	140
WT060	0.19	30	200	WT180	0.10	8	66
WT070	0.20	25	170	WT190	0.06	11	75
WT080	0.06	62	190	WT200	0.30	25	190
WT090	0.04	40	130	WT210	0.27	32	190
WT100	0.06	17	88	WT220	0.19	47	250
WT110	0.12	19	120	WT230	0.20	71	350
PBH4	0.15	29	150	WT240	0.08	36	160
PBH1	0.10	10	130	WT250	0.15	63	290
PBH2	0.36	51	270	WT260	0.14	10	78
PBH3	0.36	51	270	WT270	0.03	11	57
PBHC	0.19	11	160	WT280	0.27	33	250
RMN	1.42	86	1,200	WT290	0.10	15	110
RWU				WT300	0.10	12	92
Diversion	3.55	83	1,100	WT310	0.28	31	250
RWU North	3.55	110	1,400	WT320	0.21	27	200
RWU South	3.55	55	1,000	WT330	0.33	32	250
RET020	0.15	29	150	WT340	0.28	19	150
RET030	0.36	71	380	WT350	0.30	38	280
RET040	0.56	95	580	WT360	0.07	7	55
				WT370	0.21	7	120

Figure 3-13
 Future Hydrology
 Falcon DBPS
 El Paso County, CO



NOTE: FIGURE MUST BE VIEWED IN COLOR



Sub Regional Detention Alternative ¹						
Pond		Q ₂ In (cfs)	Q ₂ Out (cfs)	Q ₁₀₀ In (cfs)	Q ₁₀₀ Out (cfs)	Required Volume (AF) ²
Paint Brush Hills Pond #4	PBH 4	38	29	200	150	1.34
Paint Brush Hills Pond A	PBH A	35	7	170	140	2.62
Paint Brush Hills Pond B1	PBH B1	80	51	420	270	9.17
Paint Brush Hills Pond B2	PBH B2	51	10	270	180	12.09
Paint Brush Hills Pond C	PBH C	56	3	300	140	6.77
Regional Pond MN	R MN	65	32	850	820	7.53
Regional Pond R1	R R1	110	77	1,600	1,500	25.00
Regional Pond R2	R R2	140	140	2,200	2,200	3.13
Regional Pond WU South	R WUs	47	22	1,100	930	39.54
Sub Regional Pond SR1	SR 1	54	42	610	510	11.03
Sub Regional Pond SR2	SR 2	65	65	840	840	2.05
Sub Regional Pond SR3	SR 3	72	72	910	910	1.03
Sub Regional Pond SR4	SR 4	130	27	1,000	730	19.37
Sub Regional Pond SR6	SR 6	74	9	390	200	11.82
The Meadows Pond #1	M 1	11	0	70	0	3.25
The Meadows Pond #2	M 2	28	5	210	100	7.94
Woodmen Hills Pond #1 North	WH 1N	65	61	390	260	7.13
Woodmen Hills Pond #1 South	WH 1S	61	10	260	260	8.78
Woodmen Hills Pond #2	WH 2	37	10	270	250	9.18
Woodmen Hills Pond #3	WH 3	110	13	530	360	8.35
Woodmen Hills Pond #4	WH 4	110	15	790	260	40.45
Woodmen Hills Pond #5	WH 5	40	1	130	20	4.10
Woodmen Hills Pond H	WH H	140	110	750	750	2.66

Notes

1: Represents future hydrology with retrofit existing detention ponds and 7 new sub regional detention ponds

2: Required volume to highest WSE not including embankment

Reach Alternative	Total (ft)
Natural Channel Design	13,216
Protect in Place	64,325
Roadside Ditch Improvement	7,519
Small Drop Structures w/ Toe Protection	50,750

LEGEND

Detention Pond

- Existing
- Proposed

Watershed Boundary

- Existing Watershed Boundary
- Historical and Future Watershed Boundary
- Tributary Basin Boundary
- Subbasin Boundary

Major Tributary

- Major Tributary

Immediate Action Required to Preserve Existing Condition

- Immediate Action Required to Preserve Existing Condition

Reach Alternative

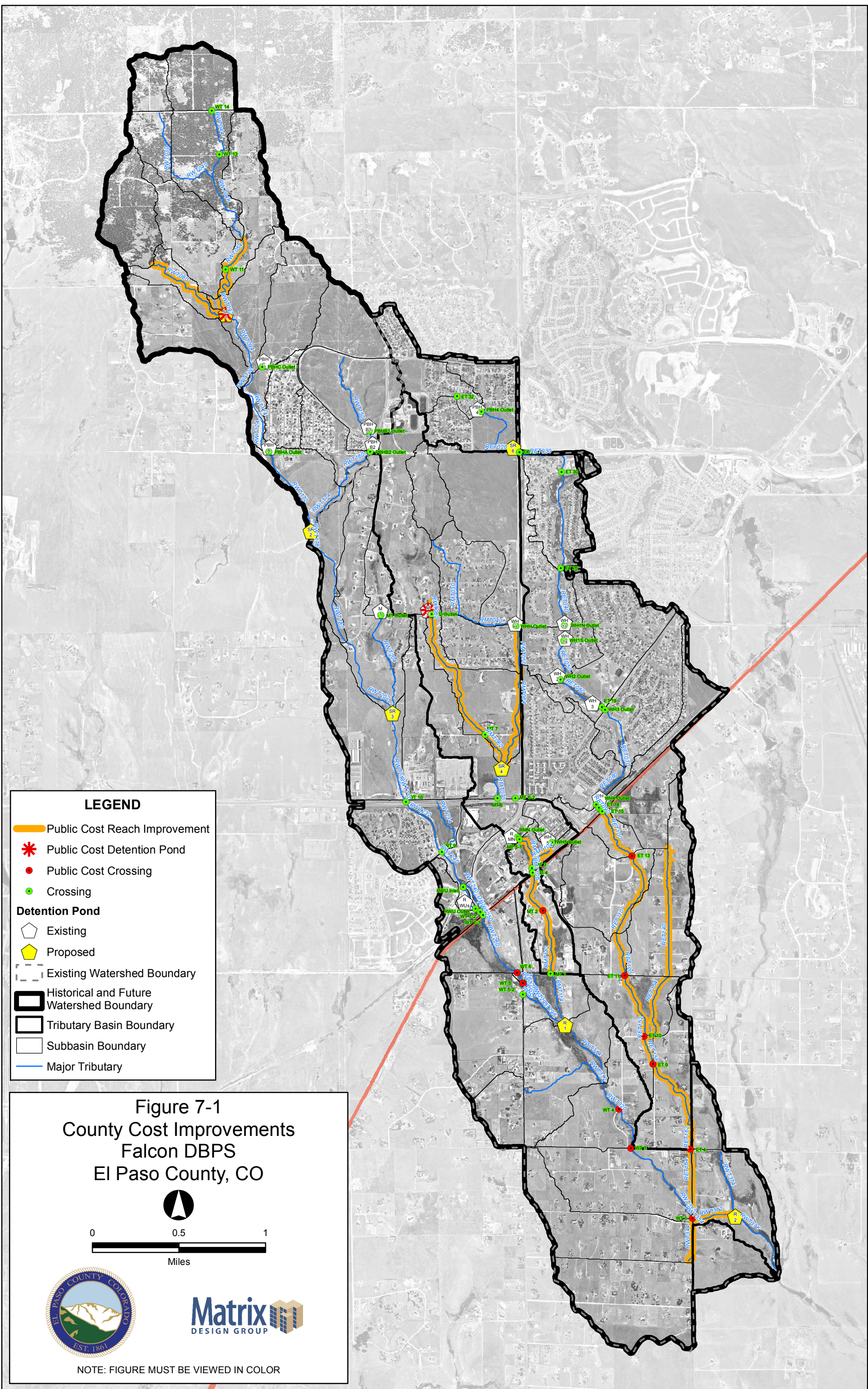
- Natural Channel Design
- Protect In Place
- Roadside Ditch Improvement
- Small Drop Structures w/ Toe Protection

Note:
Infrastructure and channel improvements shown may vary slightly from the final list published in the accompanying report as a result of fee revisions that have occurred following the preparation of this figure. For current information as of September 2015, please see tables in Section 6 of the accompanying report.

Figure 6-1
Selected Plan
Falcon DBPS
El Paso County, CO

NOTE: FIGURE MUST BE VIEWED IN COLOR

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**Falcon DBPS
County Costs**

Drainage Fees			
Reach/Pond	Reach Length (ft)	Improvement	Cost
RWT344	1,379	Roadside Ditch Improvement	\$ 167,006
RET140	4,052	Roadside Ditch Improvement	\$ 295,914
RET164	2,072	Roadside Ditch Improvement	\$ 132,703
RET100	1,791	Small Drop Structures w/Toe Protection	\$ 1,342,120
RET110	2,751	Small Drop Structures w/Toe Protection	\$ 1,055,516
RET152	2,030	Small Drop Structures w/Toe Protection	\$ 1,081,390
RET120	1,379	Natural Channel Design	\$ 72,798
RET162	3,256	Small Drop Structures w/Toe Protection	\$ 656,460
RMT050	1,568	Small Drop Structures w/Toe Protection	\$ 814,189
RMT062	5,688	Small Drop Structures w/Toe Protection	\$ 2,381,127
RMT064	3,358	Small Drop Structures w/Toe Protection	\$ 1,231,110
RMT112	3,372	Small Drop Structures w/Toe Protection	\$ 1,276,142
RWT054	2,497	Small Drop Structures w/Toe Protection	\$ 1,414,531
RWT080	3,494	Small Drop Structures w/Toe Protection	\$ 2,345,153
RWT092	626	Small Drop Structures w/Toe Protection	\$ 414,434
RWT372	1,377	Small Drop Structures w/Toe Protection	\$ 947,221
RMT102	1,021	Small Drop Structures w/Toe Protection	\$ 636,082
RMT104	874	Small Drop Structures w/Toe Protection	\$ 186,349
RET154	2,357	Natural Channel Design	\$ 468,927
RET156	942	Natural Channel Design	\$ 73,722
WT 5	43	Crossing - Culvert	\$ 8,651
ET 13	50	Crossing - Culvert	\$ 113,991
ET 11	40	Crossing - Culvert	\$ 84,348
ET 9	40	Crossing - Culvert	\$ 84,102
ET 4	61	Crossing - Culvert	\$ 106,060
Sub Regional Pond SR1		Detention Pond	\$ 405,769
The Meadows Pond #2		Detention Pond	\$ 20,000
		Subtotal	\$ 17,815,814
		Engineering/Construction Admin (15%)	\$ 2,672,372
		Contingency (20%)	\$ 3,563,163
		Total	\$ 24,051,349

Bridge Fees			
Reach/Pond	Reach Length (ft)	Improvement	Cost
WT 6	43	Crossing - Bridge	\$ 249,775
WT 4	48	Crossing - Bridge	\$ 528,324
WT 3	46	Crossing - Bridge	\$ 218,292
WT 1	40	Crossing - Bridge	\$ 636,648
MT 2	83	Crossing - Bridge	\$ 343,147
ET 10	44	Crossing - Bridge	\$ 162,656
		Subtotal	\$ 2,138,842
		Engineering/Construction Admin (15%)	\$ 320,826
		Contingency (20%)	\$ 427,768
		Total	\$ 2,887,437



MDDP & DBPS AMENDMENT

BENT GRASS DEVELOPMENT

El Paso County, Colorado

PREPARED FOR:
Challenger Communities, LLC
8605 Explorer Dr., Suite 250
Colorado Springs, CO 80920

PREPARED BY:
Galloway & Company, Inc.
1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920

DATE:
January 2021
Revised: March 2021
Revised: April 2021
Revised: June 2021
Revised: August 2021
Revised: September 2021

PUDSP-20-005



recommendations from the Falcon DBPS, when additional land is obtained to expand the ROW along the southbound portion of Meridian Road.

In the interim condition, it has been proposed to add a temporary lining to the existing channel to handle the excess velocities and depth associated with the DBPS flows and Bent Grass development re-routed flows. This analysis has been included in the Appendix.

The West Tributary Channel will be natural, vegetated facility, helping to ensure that the overall velocities will be reduced, flow depth will not exceed 5' and minimize any potential for scour. If needed, grade control structures may be designed as proposed in the DBPS to ensure these criteria are met.

3. Implement BMPs That Provide a Water Quality Capture Volume with Slow Release

This step utilizes formalized water quality capture volume to slow the release of runoff from the site. The WQCV will release in no less than 40 hours. On-site water quality control volume detention ponds will provide water quality treatment prior to the runoff being released into the channel. WQCV facilities will be designed as Extended Detention Basins.

The Falcon Meadows at Bent Grass development, west of Bent Grass Residential, Filing No. 1 and No. 2, will include several water quality ponds throughout the site to ensure flows will be treated prior to being released into the West Tributary Channel, running through the site. Only a small area, less than 1.0 acres will not be treated prior to releasing into the channel.

Currently, the existing Meridian Road roadside ditch, ultimately conveys runoff to the existing detention and water quality pond MN, as shown and discussed in the Falcon DBPS. The Falcon DBPS also shows a future detention and water quality pond SR-4 that is to receive flows from basin MT060 and discharge into basin MT070, ultimately routing to existing Pond MN. Flows from Bent Grass Meadows Drive are listed in basin MT060 but are being routed to the existing roadside ditch along Meridian Road, which is in basin MT070. The flows from the "School Site" and upstream basins will release into the east side of Pond SR-4 (west of Falcon Market Place). Pond SR-4 is currently under construction. The proposed improvements impact on the existing drainage basin and both Pond MN and Pond SR-4 are discussed later in the report.

4. Consider Need for Industrial and Commercial BMPs

Source control BMPs for homeowners include the use of garages as the primary area where pollutants can be stored. The single-family detached homes provide garages which can act as storage areas. The proposed development does not include outdoor storage or the potential for introduction of contaminants to the Counties' MS4, thus no targeted source control BMPs are necessary. The biggest source control BMP is public education and discuss topics such as: pet waste, car washing, lawn care, fall leaves, and snow melt and deicer.

Bent Grass East Commercial Filing No. 1 contains commercial development. This area will need to consider the need for Industrial & Commercial BMPs. No industrial uses or outside storage is proposed for this area. Drainage will be routed through water quality ponds prior to leaving the site to minimize contaminants into the public system.

VII. Future Drainage Conditions

MIDDLE TRIBUTARY

Design Point 30 and Basins OS-25 and OS-26 are as described under Existing Drainage Conditions. However, Basins OS-25 and OS-26 now route through proposed “future” detention pond, on what’s been previously referred to as the “School Site”, north of Bent Grass Meadows Drive and just west of Bent Grass Filing No. 2. This “future” pond will replace the current sedimentation pond on the “School Site”. Upon any additional development within the Middle Tributary area of the Bent Grass Development and north of Bent Grass Meadows Drive, this pond will need to be constructed to accommodate the re-routed flows from the Meadows Pond #2 at DP 30.

This future facility will need to provide 2.76 ac-ft of water quality, 6.26 ac-ft for EURV and 11.98 ac-ft for 100-year storage volume. Preliminary release rates for the 5 and 100-year storms are 3.8 cfs and 32.2 cfs. These flows were then routed to Bent Grass Meadows to the south. With the decrease in flows, flows will not overtop Bent Grass Meadows Drive and continue east to the future box culvert under Bent Grass Meadows Drive at DP BG20 (5-year flow=292.5 cfs, 100-year flow=909.3 cfs). Flows were still checked against street capacity on the north and south side of Bent Grass Meadows Drive, as it continues to the east. With the construction of the future pond, Bent Grass Meadows Drive will be able to adequately handle the flows and no additional storm infrastructure would need to be built to carry these future developed flows. Any area north of Bent Grass Meadows Drive that will develop in the future will need to provide its own on-site detention. Should future development not be able to release flows into Bent Grass Meadows Drive, a 42” RCP would be able to convey the flows of DP BG 15n (Q100=40.9 cfs, Q5=8.8 cfs) to the northwest corner of the Bent Grass Meadows Drive and Meridian Road intersection. Analysis for this culvert sizing has been included in the appendix.

At the Bent Grass Meadows Drive/Meridian Road intersection, the elliptical rcp’s will need to be replaced with a double 16’ x 4’ rcbc. The future roadside ditch will have a 15’ wide bottom channel with 4:1 side slope, 6.5’ deep and a longitudinal slope of 0.30%. This will result in a flow depth of 5.15’ and velocity of 5.04 fps. This channel will direct flows to Owl Place where the existing twin cmp’s will be replaced with a 20’ x 4’ rcbc or equivalent. This structure will need to be built when any development west of Meridian Road at the intersection of Owl Place happens. With future development, it is anticipated that the existing channel conveying flows to the south will be removed to accommodate the new development. The new channel will need to be a 35’ wide bottom channel with 4:1 sides, 5’ deep and a longitudinal slope of 0.30%. This will produce a flow depth of 3.7’ and a velocity of 4.6 fps. If the channel option is not viable, twin 78” rcp’s at a minimum 0.50% slope would be able to handle this future flow. Analysis for this design option has been included in the appendix.

Calculations are provided in Appendix C for the future culverts and roadside channel.

WEST TRIBUTARY

Offsite flows entering the west tributary location of Bent Grass have not changed from what was discussed under Current Conditions. Reach RWT202 at the northwest corner of the development has a 100-year flow of 1000 cfs and Reach RWT204 has a flow of 43 cfs. These were obtained from the DBPS by Matrix. The Flood Insurance Study (FIS) by FEMA does not have flows evaluated this far north. The have a flow of 1482 cfs beginning at RWT210. The 8 undeveloped on-site basins for Bent Grass West have been replaced with 17 developed basins. These basins are found in the Falcon Meadows for Bent Grass PDR. A summary of these basins is provided below and are part of the hydrology analysis provided in Appendix B.

Sub Regional Detention Alternative ¹						
Pond		Q ₂ In (cfs)	Q ₂ Out (cfs)	Q ₁₀₀ In (cfs)	Q ₁₀₀ Out (cfs)	Required Volume (AF) ²
Paint Brush Hills Pond #4	PBH 4	38	29	200	150	1.34
Paint Brush Hills Pond A	PBH A	35	7	170	140	2.62
Paint Brush Hills Pond B1	PBH B1	80	51	420	270	9.17
Paint Brush Hills Pond B2	PBH B2	51	10	270	180	12.09
Paint Brush Hills Pond C	PBH C	56	3	300	140	6.77
Regional Pond MN	R MN	65	32	850	820	7.53
Regional Pond R1	R R1	110	77	1,600	1,500	25.00
Regional Pond R2	R R2	140	140	2,100	2,100	7.90
Regional Pond WU South	R WU	47	22	1,070	930	39.54
Sub Regional Pond SR1	SR 1	54	42	610	510	11.03
Sub Regional Pond SR2	SR 2	65	65	840	840	2.05
Sub Regional Pond SR3	SR 3	72	72	910	910	1.03
Sub Regional Pond SR4	SR 4	130	27	1,000	730	19.37
Sub Regional Pond SR6	SR 6	74	9	390	200	11.82
The Meadows Pond #1	M 1	11	0	75	2	3.25
The Meadows Pond #2	M 2	28	5	210	99	7.94
Woodmen Hills Pond #1 North	WH 1N	65	61	390	260	7.13
Woodmen Hills Pond #1 South	WH 1S	61	10	260	260	8.78
Woodmen Hills Pond #2	WH 2	37	10	270	250	9.18
Woodmen Hills Pond #3	WH 3	105	13	530	360	8.35
Woodmen Hills Pond #4	WH 4	110	15	790	260	40.45
Woodmen Hills Pond #5	WH 5	40	1	130	19	4.10
Woodmen Hills Pond H	WH H	140	110	750	750	2.66

Notes
1: Represents future hydrology with retrofit existing detention ponds and 5 new subregional detention ponds
2: Required volume to highest WSE

Reach Alternative	Total (ft)
Protect In Place	30,066
Natural Channel Design	32,359
Small Drop Structures w/ Toe Protection	76,812
Large Drop Structures w/ Toe Protection	0

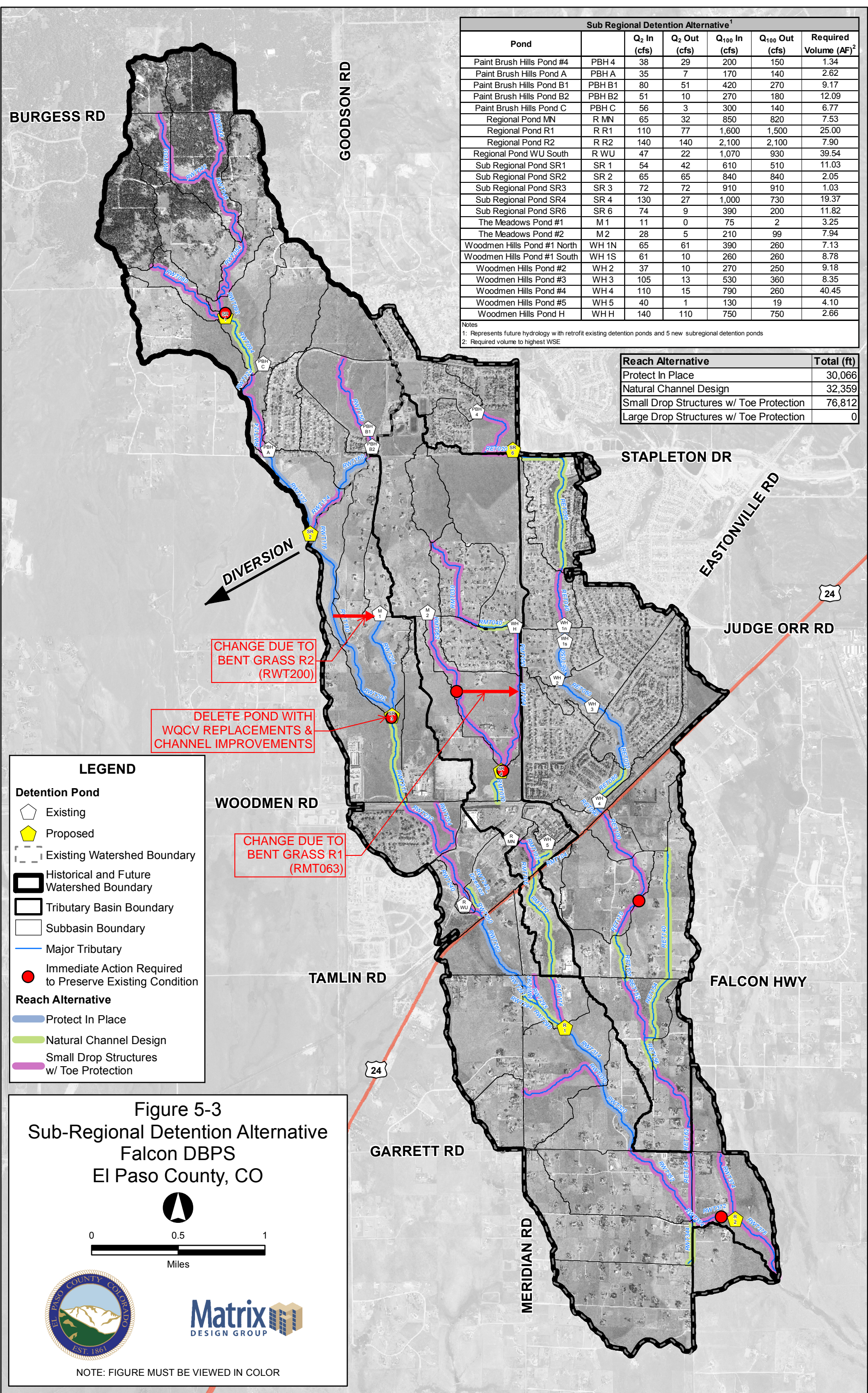
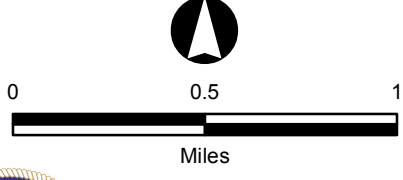


Figure 5-3
Sub-Regional Detention Alternative
Falcon DBPS
El Paso County, CO



NOTE: FIGURE MUST BE VIEWED IN COLOR

MERIDIAN ROAD

Worksheet for Fut Channel - Pr 100 Yr Flow-MR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	0.30 %
Left Side Slope	4.00 ft/ft (H:V)
Right Side Slope	4.00 ft/ft (H:V)
Bottom Width	15.00 ft
Discharge	925.00 ft ³ /s

Results

Normal Depth	5.15 ft
Flow Area	183.50 ft ²
Wetted Perimeter	57.49 ft
Hydraulic Radius	3.19 ft
Top Width	56.22 ft
Critical Depth	3.58 ft
Critical Slope	0.01368 ft/ft
Velocity	5.04 ft/s
Velocity Head	0.39 ft
Specific Energy	5.55 ft
Froude Number	0.49
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.15 ft
Critical Depth	3.58 ft
Channel Slope	0.30 %

LEGEND

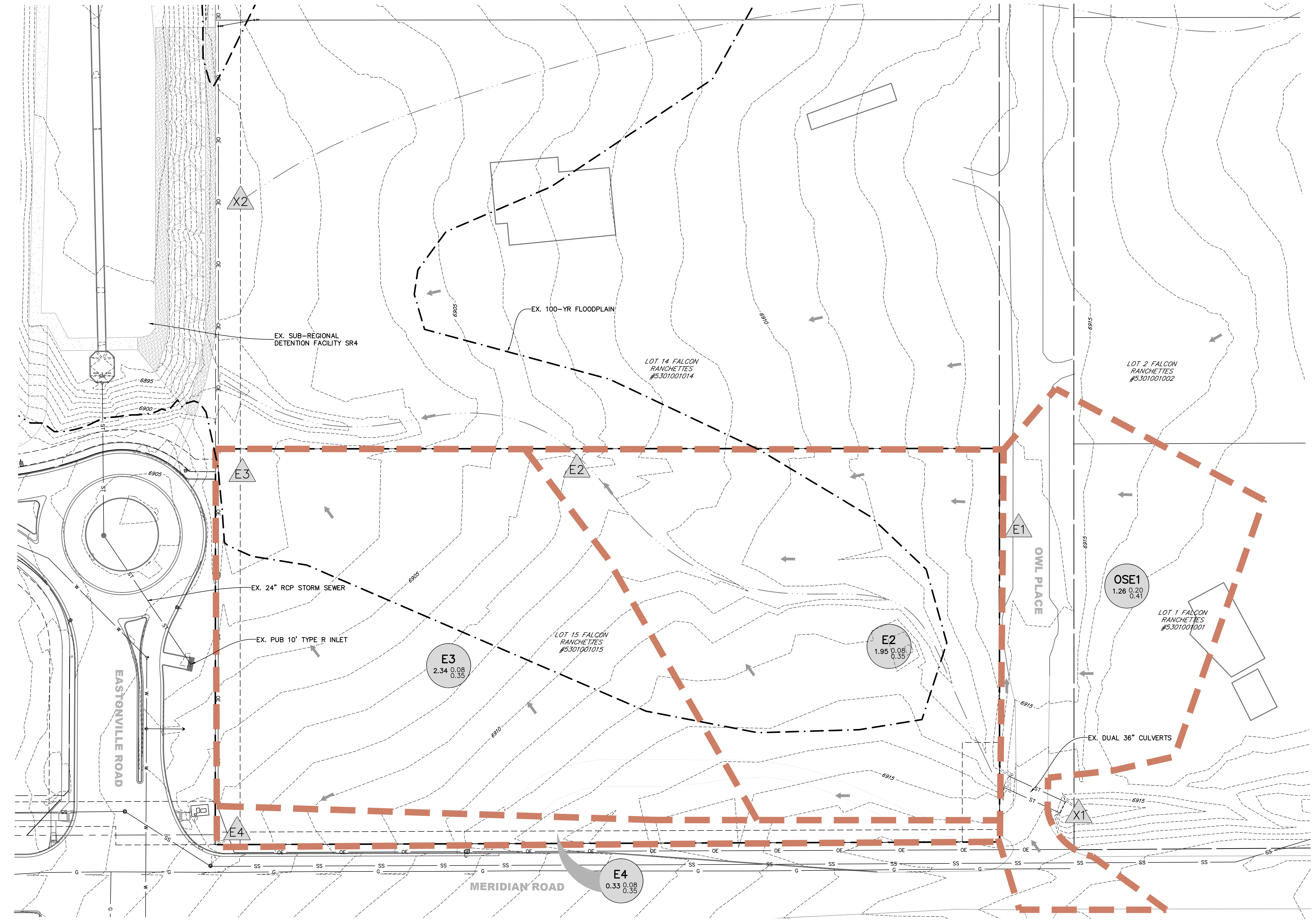
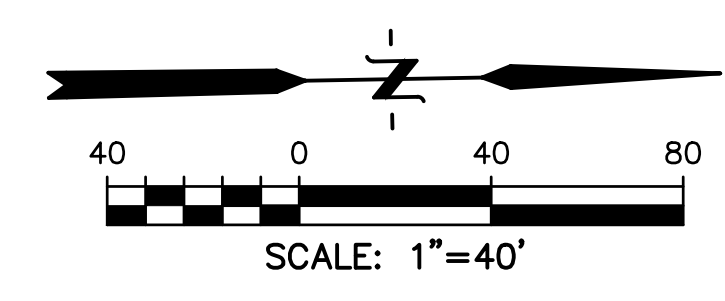
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- - - EX. MAJOR CONTOUR
- PR. MINOR CONTOUR
- 6800 — PR. MAJOR CONTOUR
- ST — EX. STORM DRAIN
- - - FLOODPLAIN BOUNDARY
- - - BASIN BOUNDARY
- ← FLOW DIRECTION
- △ DESIGN POINT

BASIN

AREA (ACRE)

OS-1
C5
C100

EXISTING				
BASIN	DP	Area (Ac.)	Q ₂ (CFS)	Q ₁₀₀ (CFS)
RMT064	X1		288.5	920.0
OSE1	E1	1.26	0.9	3.1
E2		1.95	0.5	3.7
E2	E2	3.21	1.4	6.9
E3	E3	2.34	0.6	4.4
E4	E4	0.33	0.1	0.7
MT060	X2		60.1	196.8



PREPARED BY:

DREXEL, BARRELL & CO.
 Engineers • Surveyors
 101 SAWATCH ST., STE #100
 COLORADO SPGS, COLORADO 80903
 CONTACT: TIM D. MCCONNELL, P.E.
 (719)260-0887
 COLORADO SPRINGS • LAFAYETTE

CLIENT:

BH RE INVESTMENTS, LLC
 450 N MCCLINTOCK DRIVE
 CHANDLER, AZ 85226
 (480) 313-2724

DRAINAGE PLANS FOR:
OWL MARKETPLACE
 FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	9-29-2023
RESUBMITTAL	3-11-2024

DESIGNED BY:	KGV
DRAWN BY:	CGH
CHECKED BY:	TDM
FILE NAME:	21611-DRN-EX

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.
 DRAWING SCALE:
 HORIZONTAL: 1" = 40"
 VERTICAL: N/A

EXISTING DRAINAGE MAP

PROJECT NO. 21611-01CSCV
 DRAWING NO.

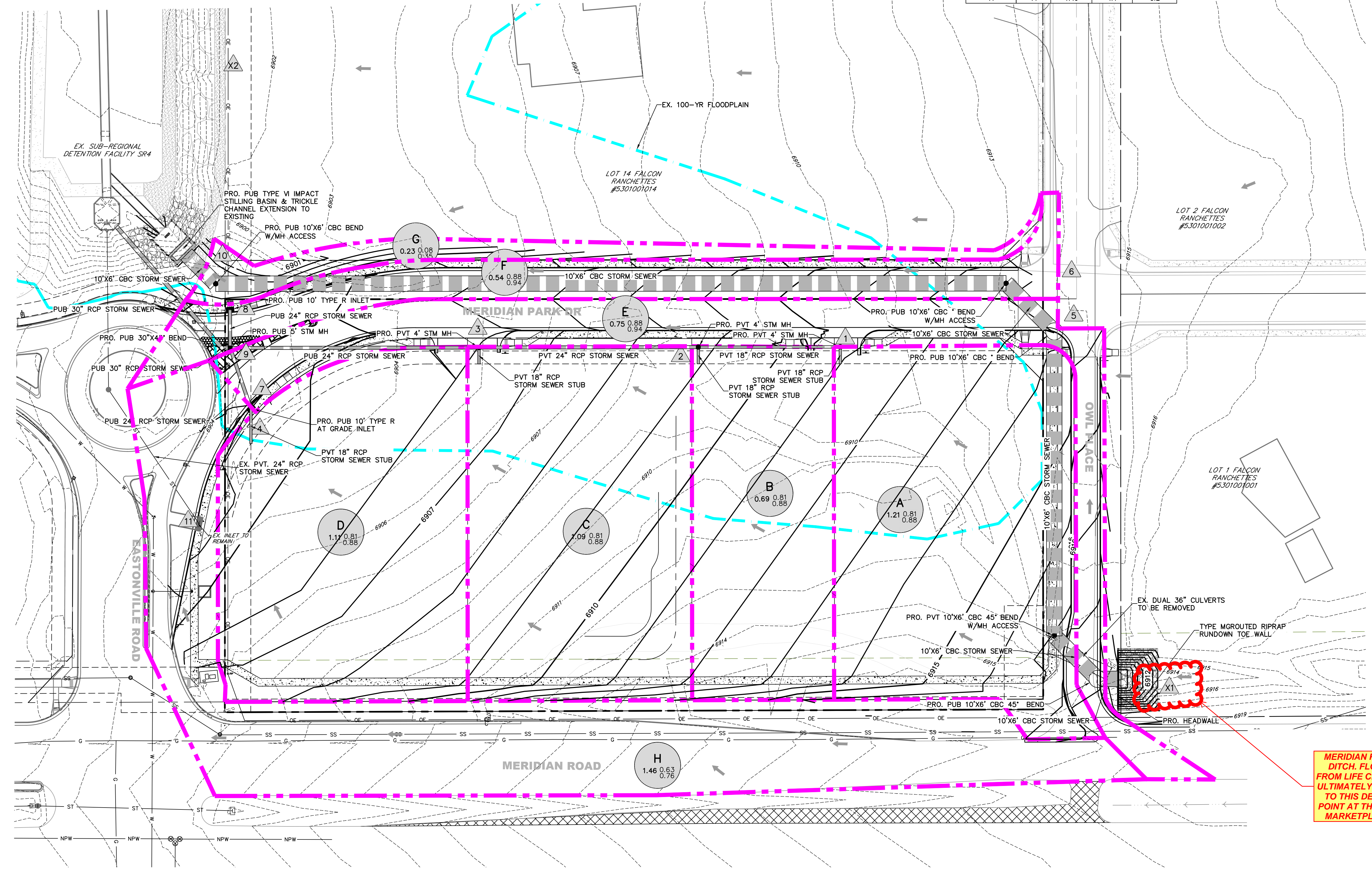
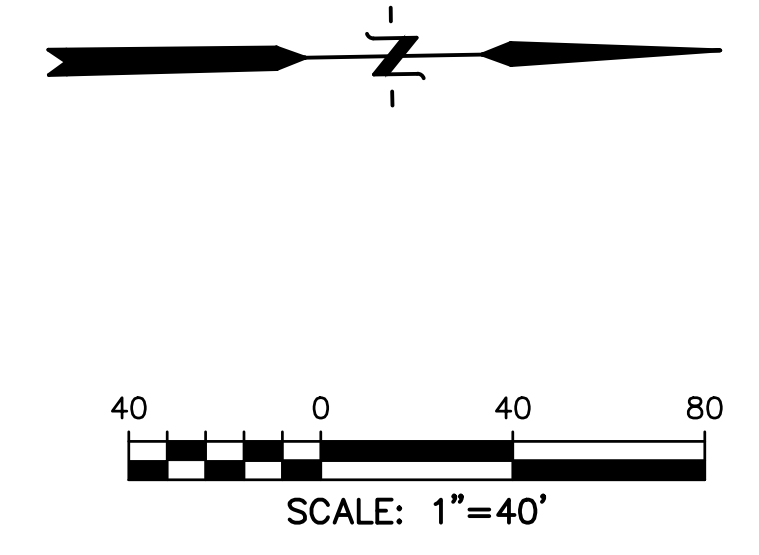
DRN

SHEET: 1 OF 2

LEGEND

- - - - - EX. MINOR CONTOUR
- - - - - EX. MAJOR CONTOUR
- - - - - PR. MINOR CONTOUR
- - - - - PR. MAJOR CONTOUR
- ST — EX. STORM DRAIN
- FLOODPLAIN BOUNDARY
- BASIN BOUNDARY
- ← FLOW DIRECTION
- △ DESIGN POINT
- BASIN
- AREA (ACRE)
- C5
- C100

DEVELOPED				
BASIN	DP	Area (Ac.)	Q ₅ (CFS)	Q ₁₀₀ (CFS)
A	1	1.21	5.0	9.1
B	2	0.69	2.8	5.2
C	3	1.09	4.5	8.2
D	4	1.11	4.6	8.4
E	5	0.00	0.6	1.5
F	6	0.50	1.0	2.1
G	7	0.75	3.0	5.5
H	8	1.86	7.8	14.6
	9	0.54	2.4	4.3
	10	0.54	3.4	6.4
	11	5.38	22.1	40.9
	12	0.23	0.1	0.6
	13	1.46	4.1	8.2



MERIDIAN ROAD DITCH FLOWS FROM LIFE CHURCH ULTIMATELY DRAIN TO THIS DESIGN POINT AT THE OWL MARKETPLACE.

PREPARED BY:



DREXEL, BARRELL & CO.
 Engineers-Surveyors
 101 SAWATCH ST., STE #100
 COLORADO SPGS, COLORADO 80903
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DRAINAGE PLANS FOR:
OWL MARKETPLACE
 FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	9-29-2023
RESUBMITTAL	3-11-2024

DESIGNED BY: KGV
 DRAWN BY: CGH
 CHECKED BY: TDM
 FILE NAME: 21611-DRN-PP

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.
 DRAWING SCALE:
 HORIZONTAL: 1" = 40"
 VERTICAL: N/A

PROPOSED DRAINAGE MAP
 PROJECT NO. 21611-01CSCV
 DRAWING NO.

DRN



FINAL DRAINAGE REPORT

MERIDIAN ROAD & BENT GRASS MEADOWS DRIVE

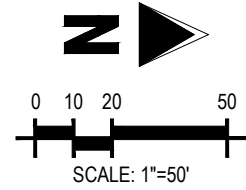
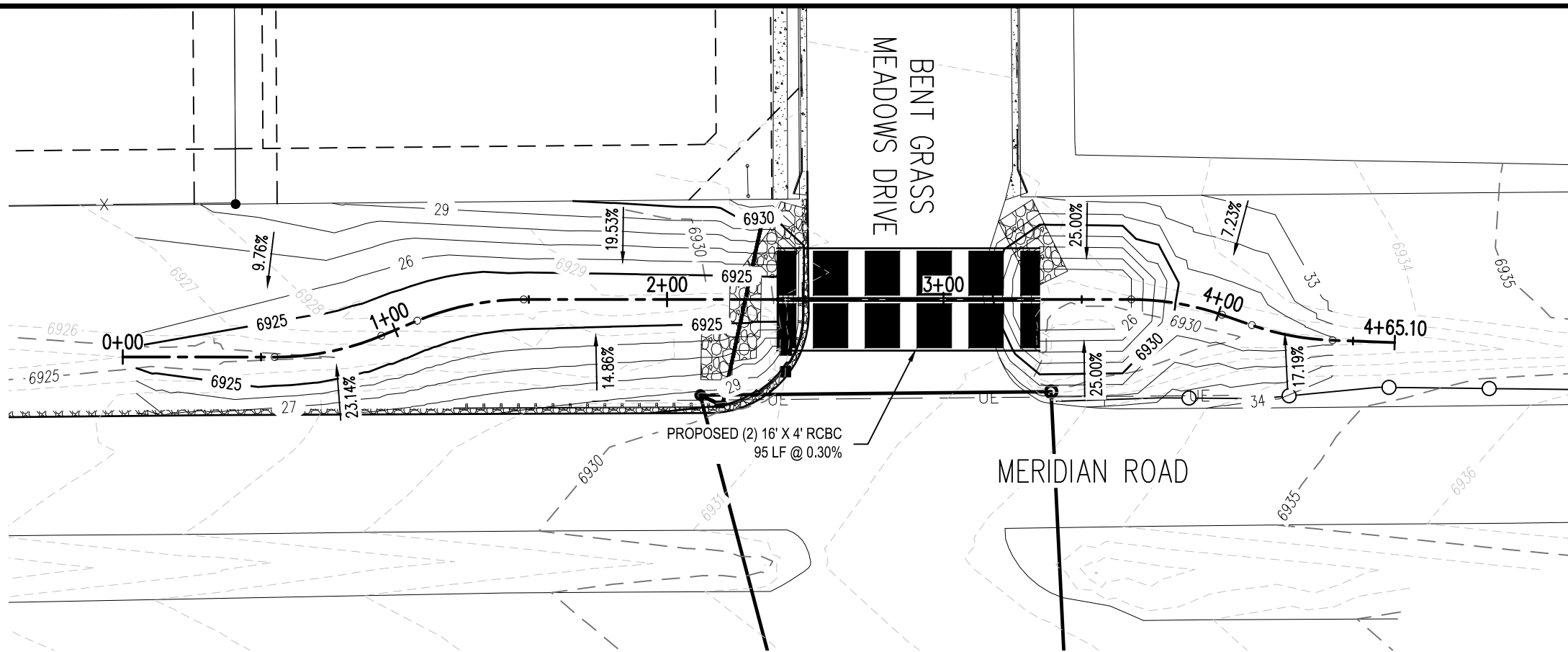
El Paso County, Colorado

PREPARED FOR:
Challenger Communities, LLC
8605 Explorer Dr., Suite 250
Colorado Springs, CO 80920

PREPARED BY:
Galloway & Company, Inc.
1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920

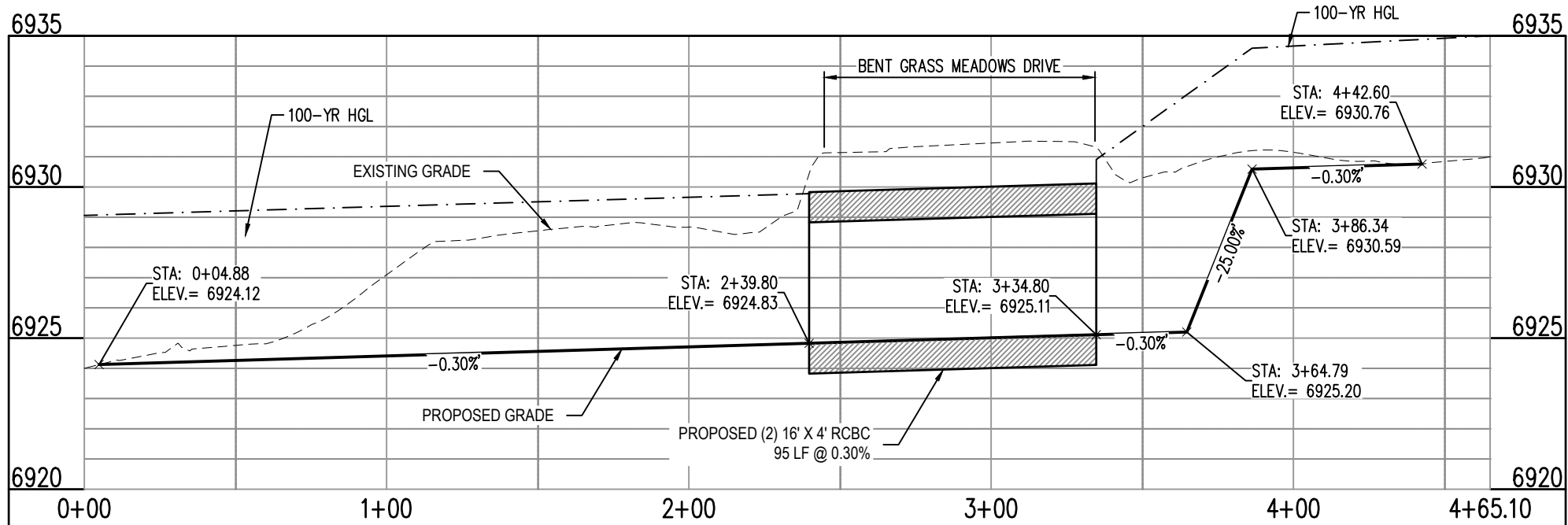
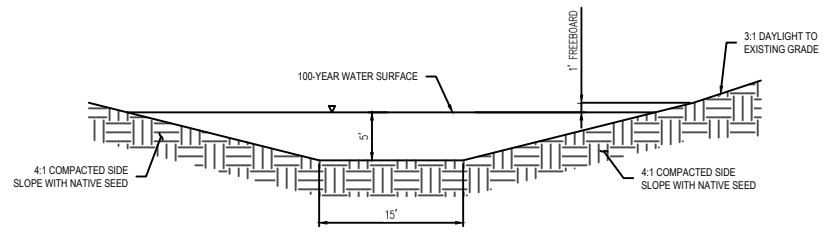
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March 2020
Revised: July 2020
Revised: September 2020
Revised: September 23, 2020





LEGEND

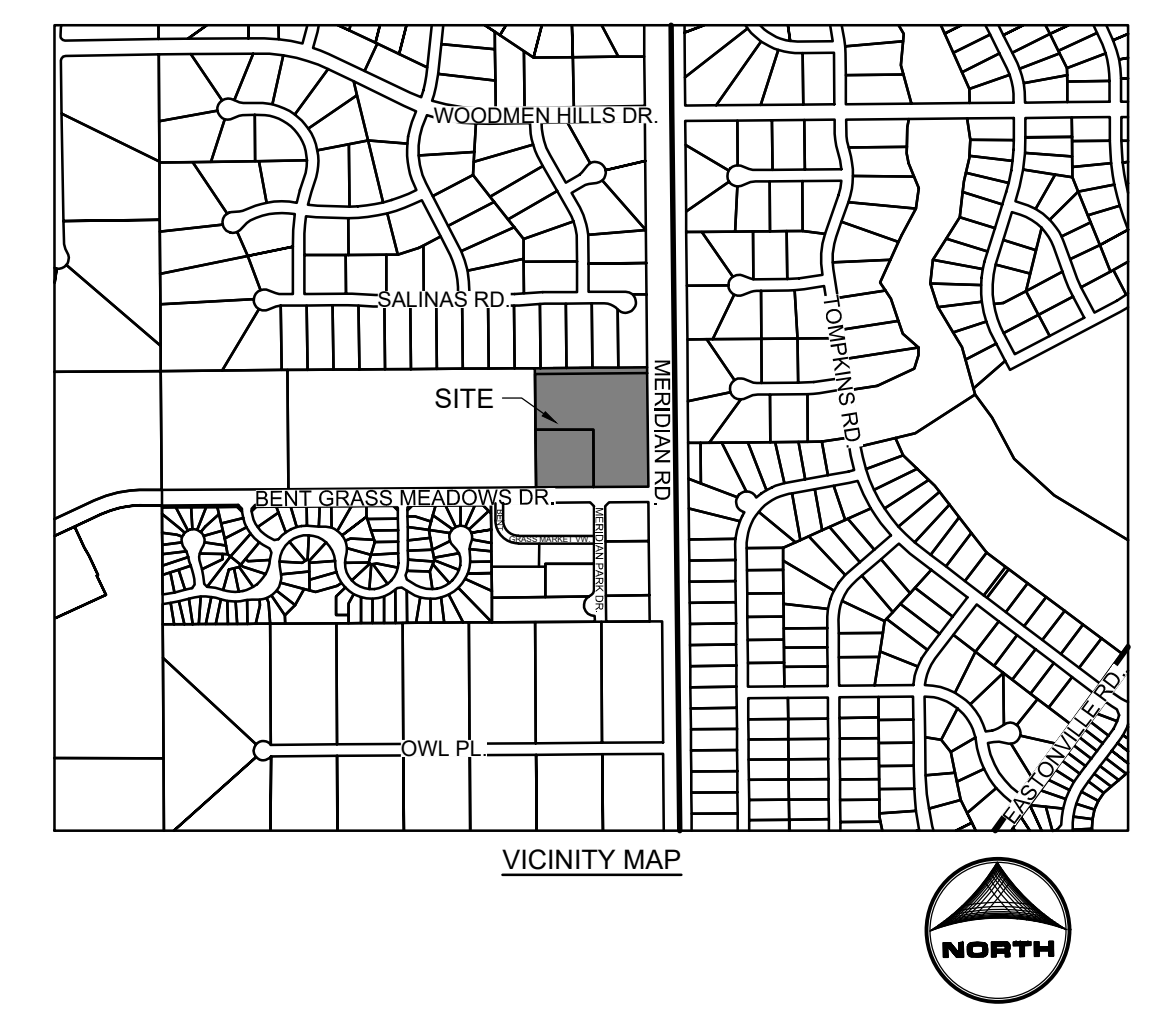
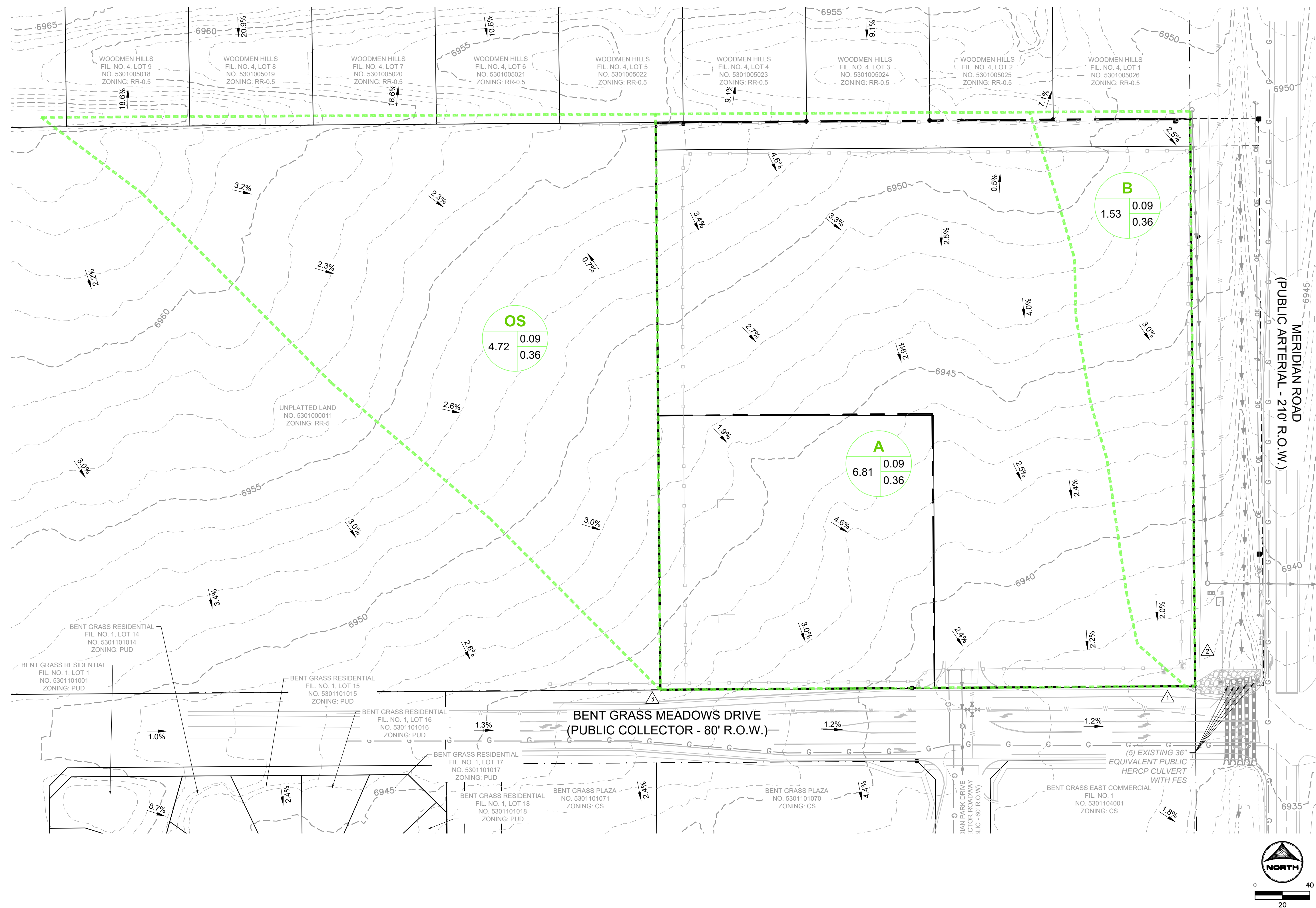
---	6485	EXISTING MAJOR CONTOUR
---	6483	EXISTING MINOR CONTOUR
---	6485	PROPOSED MAJOR CONTOUR
---	6483	PROPOSED MINOR CONTOUR



Project No:	CLH15.20
Drawn By:	BHB
Checked By:	SMB
Date:	11/15/19



APPENDIX G – DRAINAGE MAPS



LEGEND

	EXISTING	PROPOSED
PROPERTY BOUNDARY	---	---
PROPERTY LINE	---	---
EASEMENT LINE	---	---
RIGHT OF WAY	---	---
CENTERLINE	---	---
CURB & GUTTER	---	---
DRAINAGE BASIN	---	---
MAJOR CONTOUR	---	---
MINOR CONTOUR	---	---
STORM SEWER	---	---
ADA ROUTE	---	---
RETAINING WALL	---	---
FLOW DIRECTION	---	---
DESIGN POINT	---	---

BASIN LABEL

BASIN DESIGNATION	AREA (ac)	MINOR 5-YR RUNOFF COEF.	MAJOR 100-YR RUNOFF COEF.
A1	1.00	0.40	0.60

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
A	6.81	2	2.10	14.13
B	1.53	2	0.52	3.47
OS	4.72	2	1.36	9.12

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ ₅ (cfs)	ΣQ ₁₀₀ (cfs)
1	A	2.10	14.13
2	B	0.52	3.47
3	OS	1.36	9.12

DRAWN BY: CMD JOB DATE: 5/1/2025
 APPROVED: RDL JOB NUMBER: 2403591
 CAD DATE: 3/12/2025
 CAD FILE: J:\2024\2403591\CAD\DWG\CIDrainage\Existing_Condition

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
 IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
 HR GREEN - COLORADO SPRINGS
 1975 RESEARCH PARKWAY SUITE 160
 COLORADO SPRINGS, CO 80920
 PHONE: 719.300.4140
 FAX: 713.965.0044

LIFE CHURCH AT BENT GRASS
 LIFE CHURCH
 FALCON, COLORADO

FINAL DRAINAGE REPORT
 EXISTING CONDITIONS DRAINAGE MAP

STM-REV25-XXXX
 SHEET
DR
 1

