



Falcon Highlands South Filing No. 1

Final Drainage Report

Owner/Developer

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Atwell Project Number

24004308

PCD File Number

SF2418

Submitted by: Atwell, LLC

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Engineer's Statement:

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

Daniel Madruga, PE 36834

Date

Seal:

**Developer's Statement:**

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

Business Name: Challenger Homes

By:

Title:

Address:

El Paso County Approval:

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

Date

Joshua Palmer, PE
County Engineer/ECM Administrator
Conditions:

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INTRODUCTION

This Final Drainage Report (FDR) has been completed for Challenger Homes in order to present an effective storm water management plan for the Falcon Highlands South Filing 1 development, hereinafter referred to as the Site. This report is intended to guide the development of the Site and recommend general drainage concepts that can be implemented as development progresses. Included within this report is a proposed drainage plan for the Site along with reference information for drainage basins and storm water conveyance facilities.

The Site was most recently studied in the Preliminary Drainage Report (PDR) level in the *Falcon Highlands South PUDSP Preliminary Drainage Report* by Atwell, LLC, approved May 17, 2024.

The Site for Falcon Highlands South Filing 1 is approximately 20.88 acres and will include a total of approximately 24 single-family residential units.

Proposed herein is a network of storm infrastructure, permanent water quality and detention facilities, and swales that will meet relevant drainage criteria.

GENERAL LOCATION AND DESCRIPTION

The Site is located within Section 12, Township 13 South, Range 65 West of the Sixth Principal Meridian, County of El Paso, State of Colorado. The Site is bounded by Antelope Meadows to the south, Bridal Vail Way to the west. Falcon Highlands Filing No. 2 is located to the north of the Site.

The overall area consists of approximately 20.87 acres that is proposed to be developed into 24 single-family residential units, roadways, and open space. In addition to the Site development, two off-site water quality and detention will be constructed to detain runoff from the Site and other areas of the overall Falcon Highlands development.

The Site is within the Sand Creek Drainage Basin.

A vicinity map showing the location of the Site is included in appendix A.

The Site is within the Falcon Highlands MDDP by Atwell, LLC, dated March 2022.

SOILS AND EXISTING CONDITIONS

Much of the Site is currently undeveloped. Of the development within the Site, there are existing dirt roadways and sanitary sewer infrastructure installed per the Construction Drawings for Falcon Highlands Filing No. 2 prepared by Terra Nova Engineering, most recent revised date of September 7, 2010. The ALTA survey conducted by Atwell, LLC., shows the existing conditions of Falcon Highlands and adjacent development of Filing No. 2. The Site is comprised of existing natural grass vegetation typical of the eastern plains with sparse vegetative cover at its outer limits to the south and southeast. There is an existing detention pond south of the Site, from Falcon Highlands Filing No.2 and the future development of Falcon Highlands Filing No. 3. The on-Site slopes range from 0 percent to 10 percent and generally sheet flows from west to east. An Existing Conditions Drainage Map is included in Appendix G showing the delineated drainage basins.

The Site is comprised of Blakeland-Fluvaquentic Haplaquolls soil, a loamy sand, and hydraulic soils group A. The Natural Resources Conservation Service of the United State Department of Agriculture Web Soil Survey has been included in Appendix B for reference.

Based on a Geotechnical Report done by Rocky Mountain Group, dated October 8, 2021, three bore holes were drilled within the Site, TB-1, TB-2, TB-3. From these bore holes it was noted that ground water was hit at 16.0', 14.6', and 11.4' respectively. In a more recent piezometer reading ground water was found as shallow as 4.5' in the nearest reading to proposed pond 2, Atwell sees no reason for concern as there is an existing pond in the same location as the proposed pond and there seem to be no adverse effects. A copy of these two reports can be found in Appendix F.

DRAINAGE DESIGN CRITERIA

The El Paso County Drainage Manual (EPC DCM) and El Paso County Engineering Criteria Manual (EPC ECM) were used in conjunction with the Colorado Springs Drainage Criteria Manual (DCM) Mile High Flood District (MHFD) Criteria Manual. The rational method was used for a drainage basin less than 100-acres. The 5-year design frequency was used for the minor storm and a 100-year design frequency was used for the major storm in calculation on-Site storm hydraulics. The City of Colorado Springs IDF Curve has used for calculating the rainfall intensity of 1.50 inches for the 5-year and 2.52 inches for the 100-year.

EXISTING ONSITE AND OFFSITE DRAINAGE BASINS

Off-Site drainage basin runoff data and calculations have been updated per current codes and standards. The developments of Falcon Highlands Filings No. 1 and 2 remain consistent with the Master Drainage Development Plan, MDDP (EDARP project number SF05033) and therefore off-site basin descriptions are delineations provided are based on previous County approved reports.

The Site has been broken down into several major existing drainage basins. An Existing Conditions Drainage Map is in Appendix G.

Off-Site Basins (Existing):

Falcon Highlands Filing No. 2:

OS-1 (6.38 ac, $Q_5 = 5.58$ cfs, $Q_{100} = 16.11$ cfs) is an off-Site sub-basin within the developed area of Filing No. 1 for quarter-acre lots and is an off-Site basin that was included in the MDDP for Filing No. 2. The basin's runoff sheet flows due south in Filing No. 2 and is captured by the roadways and storm system in Filing No. 2 that runs through Falcon Highlands South, and ultimately outfalls into the existing Pond 1.

OS-2 (3.12 ac, $Q_5 = 2.29$ cfs, $Q_{100} = 6.06$ cfs) is an off-Site sub-basin within the developed area of Filing No. 1 for quarter-acre lots and is an off-Site basin that was included in the MDDP for Filing No. 2. The basin's runoff sheet flows due south in Filing No. 2 and is captured by the roadways and storm system in Filing No. 2 that runs through Falcon Highlands South, and ultimately outfalls into the existing Pond 1.

OS-3 (1.14 ac, $Q_5 = 4.06$ cfs, $Q_{100} = 7.04$ cfs) is an off-Site basin within Filing No. 1 that includes the developed right-of-way of Rolling Thunder Way. This sub-basin was included in the previous MDDP as an off-Site basin and represents a portion of the landscaped right-of-way on the south side of Rolling Thunder Way that sheet flows due south into the developed areas of Filing No. 2 and ultimately into the public storm system shared with Falcon Highlands South, out falling to existing Detention Pond 2.

OS-4 (13.09 ac, $Q_5 = 4.44$ cfs, $Q_{100} = 15.98$ cfs) is an off-Site basin located on the southwestern part of Falcon Highlands Filing No. 2 and consists of mostly Tract A and portions of PUD residential zoned lots rear yard areas. The historic drainage pattern sheet flows south where it is runs offsite into Sand Creek and per existing drainage patterns is not tributary to on-Site detention ponds and drains directly off Site via overland sheet flow.

OS-5 (59.62 ac, $Q_5 = 51.26$ cfs, $Q_{100} = 135.79$ cfs) is an off-Site basin that stretches from the eastern border of basin OS-4 to the eastern edge of Bridal Vail Way within Filing No. 2. The basin is zoned as PUD residential lots of about quarter-acre size. Runoff is carried in the public rights-of-way where the flow travels south through a series of public curb and gutters, sump inlets and storm infrastructure within Filing No. 2. The flow outfalls into the existing Pond 1 through the public

60" RCP storm pipe that runs through Falcon Highlands South. No surface flow from this basin enters the Site.

OS-6 (35.75 ac, $Q_5 = 14.22$ cfs, $Q_{100} = 49.60$ cfs) is off-Site basin located between Bridal Vail Way and Antelope Meadows Circle within Filing 2. This basin includes PUD residential zoned lots of half-acre size and contains drainage tracts. The basin is captured by a series of public curb and gutter systems in the rights-of-way where public storm infrastructure conveys storm water to the end of the cul-de-sac of Wagon Track Drive where the public storm system of Filing No. 2 connects and daylights to Falcon Highlands South within future Antelope Meadows Circle right-of-way. Flows continue through Falcon Highlands South via an existing diversion ditch to Pond 2.

OS-7 (6.47 ac, $Q_5 = 2.29$ cfs, $Q_{100} = 7.97$ cfs) is the off-Site basin located within Filing 2. The basin includes PUD residential zoned lots of half-acre size with right of way. The basin runoff is captured in the public right-of-way curb and gutter where it travels south and is released at the road end, where it continues south through Antelope Meadows Circle and then due east through OS-13 where it outfalls to Pond WU.

OS-8 (3.74 ac, $Q_5 = 0.15$ cfs, $Q_{100} = 2.03$ cfs) is the basin located southwest of Antelope Meadow Circle, just below basin OS-4, and west of basin OS-11. The storm water runoff from this basin sheet flows south and off-Site at with the combined flow of OS-4, and per existing drainage patterns is not tributary to on-Site detention ponds.

OS-9 (3.14 ac, $Q_5 = .20$ cfs, $Q_{100} = 2.62$ cfs) is the undeveloped, natural landscaped area between Tamlin Road and the existing Pond 1. Runoff from basin OS-9 is directed by a ditch section to a low point between the future Dublin Road and Highway 24. This drainage concept and its associated storm infrastructure is presented in the previous master plan and is to remain as the intended plan. The 2005 PDR suggested that an inline grate inlet be installed but there is no evidence that this was installed. The existing drainage pattern consists of pooling within the local low point of the ditch that surcharges and is directed south through the grassland swale.

OS-10 (3.67 ac, $Q_5 = 0.18$ cfs, $Q_{100} = 2.42$ cfs) is the undeveloped area between Tamlin Road and the existing Detention Pond 2. The runoff from Basin OS-10 is directed to the low point in the downstream grasslined swale between the Site and Tamlin Road. This drainage concept and its associated storm infrastructure is presented in the previous master plan and is to remain as the intended plan. The 2005 PDR suggested that a 4'x4' area inlet be constructed but there is no evidence that this was installed. The existing drainage pattern consists of pooling within the local low point of the ditch that surcharges and is directed south through the grassland swale.

OS-11 (35.55 ac, $Q_5 = 1.32$ cfs, $Q_{100} = 17.58$ cfs) is located south of Antelope Meadow Circle, adjacent to basin OS-12. The Site is covered in native grasses with limited grading work from a previous development. Runoff from the Site sheet flows southwesterly overland to existing Pond 1.

OS-12 (39.29 ac, $Q_5 = 1.57$ cfs, $Q_{100} = 20.90$ cfs) is located adjacent to Basin OS-11 and covered in native grasses and weeds. The Site has limited grading due to work from a previous

development that did not finish. Runoff from the basin sheet flows southwesterly overland to an existing diversion ditch that runs into Existing Pond 2.

OS-13 (10.54 ac, $Q_5=0.44$ cfs, $Q_{100}=5.86$ cfs) is located to the northeast of the Filing and consists of undeveloped area with native grasses. The basin's runoff drains directly to existing Pond WU.

OS-14 (8.84 ac, $Q_5=0.39$ cfs, $Q_{100}=5.14$ cfs) is the area east of Basin OS-12 that is not to be disturbed and remain as open, natural landscape. The Basin consists of existing regional pond WU.

On-Site Basins (Existing):

This Site has been broken down into three major existing drainage basins. An existing drainage map can be found in Appendix G.

EX-1 (3.38 ac, $Q_5=0.12$ cfs, $Q_{100}=1.60$ cfs) is located in the west portion of the Site, and consists of undeveloped land. Stormwater flows south and west into the existing Bridal Vail Way then continues south via curb and gutter to a cross pan at the intersection of Bridal Vail Way and Antelope Meadows Circle and flows west to an existing inlet (Design point 1), flow from this inlet is then conveyed west and then south through existing storm infrastructure where it is then released into the existing detention pond 1 built with Falcon Highlands Filing No. 2 & No. 3 File No. SF05033 .

EX-2 (9.38 ac, $Q_5=0.36$ cfs, $Q_{100}=4.85$ cfs) is located in the northern part of the Site, and consists of undeveloped land. Stormwater flows southwest to a natural swale and continues off-Site and into an existing detention pond 2, built with Falcon Highlands Filing No. 2 & No. 3 File No. SF05033.

EX-3 (9.14 ac, $Q_5=0.42$ cfs, $Q_{100}=5.53$ cfs) is located in the south portion of the Site and consists of undeveloped land. Stormwater flows south to a low point in the basin then continues south to existing detention pond 2, built with Falcon Highlands Filing No. 2 & No. 3 File No. SF05033.

PROPOSED DRAINAGE BASINS

Preliminary grading design on the Site has been completed to include right-of-way design and assignment of lot type A, B, and Transition (T). The assigned lots drain per a typical lot template, into roadways where on-grade sump inlets are located to capture and convey stormwater through public storm system and outfall to a permanent water quality and detention facility.

The overarching premise of the drainage design is to route overland flow from residential lots to adjacent right-of-ways where public storm infrastructure will be installed and ultimately convey the stormwater to the downstream permanent water quality and detention facility to provide water quality treatment as well as flow attenuation and detention. Previous drainage reports designed ponds 1 and 2 in order to provide detention for existing Filings 2 and 3. The analysis in this report provides a detailed and defined design of these ponds to account for drainage requirement changes as well as a design to account for full spectrum detention. This report will redesign these existing ponds to meet current standards and provide full-spectrum detention.

There is a proposed grass-lined swale to capture flows in the open space behind the northern lots, The design of this swale is included in the report in Appendix E, to accurately access the width and depth of the drainage way for the minor and major storm events.

HLG calculations for both the 5-year and 100-year storms are provided in Appendix E.

On-Site Basins (Proposed):

A-1 (4.49 ac, $Q_5=0.12$ cfs, $Q_{100}=1.64$ cfs) is located in the north portion of the Site along the back of the existing lots and the proposed lots, and consists of open space. Stormwater flows to a proposed swale in the open space and flows to an existing outlet (Design point A1). The existing Design point discharges to a natural swale that flows southwest to proposed pond 2.

A-2 (4.83 ac, $Q_5=2.89$ cfs, $Q_{100}=8.24$ cfs) is located in the north portion of the Site south of Basin A-1 and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows from the lots toward the public right-of-way, and is conveyed south via curb and gutter to an on-grade design point in Sahalee Trail where it is partially captured by a proposed 10' Type R inlet (Design point A2) and enters the proposed public storm infrastructure and is released into Proposed Pond 2 (Design point P2). Bypass flow from the inlet will continue to flow south and will be picked up by design point A5 and will be released into proposed pond 2.

A-3 (2.46 ac, $Q_5=1.48$ cfs, $Q_{100}=4.22$ cfs) is located on the west side on the Site south of Basin A-2 and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows from the lots toward the public right-of-way, and is conveyed south via curb and gutter to an on-grade design point in Sahalee Trail where it is then captured by a proposed 10' Type R inlet (Design point A3) and enters the proposed public storm infrastructure and is released into a Proposed Pond 2 (Design point P2). Bypass flow from the

inlet will continue to flow south and will be picked up by design point A4 and will be released into proposed pond 2.

A-4 (1.98 ac, $Q_5= 1.54$ cfs, $Q_{100}= 4.38$ cfs) is located on the southwest side on the Site south of Basin A-3 and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows from the lots toward the public right-of-way, and is conveyed east via curb and gutter to a local low point in Sahalee Trail where it is then captured by a proposed 10' Type R sump inlet (Design point A4) and enters the proposed public storm infrastructure and is released into proposed pond 2.

A-5 (3.52 ac, $Q_5= 2.35$ cfs, $Q_{100}= 6.7$ cfs) is located on the southeast side on the Site south of Basin A-2 and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows from the lots toward the public right-of-way, and is conveyed west via curb and gutter to a local low point in Sahalee Trail where it is then captured by a proposed 10' Type R sump inlet (Design point A-5) and enters the proposed public storm infrastructure and is released into proposed pond 2.

A-6 (1.63 ac, $Q_5= 1.61$ cfs, $Q_{100}= 4.59$ cfs) is located on the western boundary of the Site and consists of large lots (greater than 19,000 sf) public right-of-way, curb and gutter, and attached sidewalk. Stormwater sheet flows west toward the public right-of-way, and is conveyed south via existing curb and gutter in Bridal Vail Way, it then flows west via an existing crossspan to a local low point in the existing Antelope Meadows where it is captured by an existing 20' inlet at the northwest corner of the intersection of the existing Bridal Vail Way and the existing Antelope Meadows Circle (Design point 1), where it will enter existing storm infrastructure and be released into the proposed pond 1. An analysis has been done on the existing 20' inlet and it is able to accommodate the 100 year flow. Analysis is included in appendix E.

Major Basin B (40.12 ac, $Q_5= 18.65$ cfs, $Q_{100}= 53.18$ cfs) is located south-west of the proposed Site. In current undeveloped conditions, the basin will follow existing flow patterns, sheet flowing to south into proposed pond 1. In the future it is modeled as a future Falcon Highlands development and will consist of lots, public right-of-way, curb and gutter, and attached sidewalk. Future Stormwater will be conveyed via storm infrastructure into proposed pond 1.

Major Basin C (41.08 ac, $Q_5= 25.69$ cfs, $Q_{100}= 73.24$ cfs) is located south of the proposed Site, the basin will follow existing flow patterns, sheet flowing to an existing drainage swale and south into proposed pond 2. It is modeled as a future Falcon Highlands development and will consist of lots, public right-of-way, curb and gutter, and attached sidewalk. Stormwater will be conveyed via storm infrastructure into proposed pond 2. In the interim condition a berm will cause Basin C to be split into 2 interim basins. To address this, a temporary swale/diversion ditch is being added along the western/southwestern edge of the berm to collect this temporary runoff and divert a temporary storm pipe and discharge into proposed pond 2. The temporary berm will isolate an estimated drainage area of approximately 13.5 acres. The associated diversion ditch has been hydraulically designed to convey a peak flow rate of 7.55 cfs generated from this delineated catchment. The analysis is included in appendix E.

Major Basin D (8.26 ac, $Q_5 = 12.79$ cfs, $Q_{100} = 26.67$ cfs) is located east of the proposed Site. It is modeled as a future Falcon Highlands development and will consist of lots, public right-of-way, curb and gutter, and attached sidewalk. Stormwater will be conveyed via storm infrastructure into proposed pond 2.

Major Basin E (1.41 ac, $Q_5 = 0.08$ cfs, $Q_{100} = 1.03$ cfs) is located south of pond 1. It is undisturbed area and is planned to remain undisturbed. Stormwater sheets flows off the basin south into Sand Creek.

Major Basin F (5.91 ac, $Q_5 = 0.26$ cfs, $Q_{100} = 1.41$ cfs) is located east of pond 1 and west of pond 2. It is undisturbed area and is planned to remain undisturbed. Stormwater sheets flows off the basin south into Sand Creek.

Major Basin G (8.38 ac, $Q_5 = 0.37$ cfs, $Q_{100} = 4.93$ cfs) is located north east of pond 2. It is undisturbed area and is planned to remain undisturbed. Stormwater sheets flows off the basin south into Sand Creek.

Basins B-G were also modeled as undeveloped land using an imperviousness of 5% to design the outlet structure of both pond 1 and 2.

STORMWATER CONVEYANCE AND STORAGE FACILITIES

The proposed on-Site conveyance facilities will consist of a combination of storm pipe, swales/channels, curb and gutter, and inlets, and has been designed using runoff data from the calculations shown in Appendix D. Proposed drainage patterns will generally follow historic drainage patterns outlined in the previous section of this report. At sump conditions, inlets will be sized to collect 100-year flows. Runoff entering the inlets will be conveyed within the public storm sewer system to proposed pond 2.

The Site will send storm water runoff to both proposed ponds 1 and 2. These proposed ponds have been redesigned to meet current standards and provide full spectrum detention.

The outlet structures of both ponds have been designed for an interim condition, while the volume of the ponds have been designed to incorporate a full build out final condition. The interim condition includes the disturbance and adjusted imperviousness of the 20.87 acres while the remaining site is to remain undisturbed and in an existing condition. The full build out final condition uses an increased imperviousness value to account for future developments and to size the ponds fully.

In the interim condition it is worth noting that both proposed ponds providing more volume than necessary. The restrictor plate in the interim has been designed to meet release rates by utilizing a larger orifice as the top hole. This larger orifice is intended to release flow at an earlier stage than the top of the outlet structure. The top of the outlet structure in the interim being used for anything above a 100-year event. The emergency spillway, in both ponds, are not intended to be used in the interim but are designed for the final condition build out, in the interim the overflow weir will act more as an emergency spillway. The height of the outlet structures was designed based on final conditions and the restrictor plate was designed based on interim conditions to reduce the amount of pond design with future filings being built.

The existing 60" RCP storm pipe coming into Pond 1 has been analyzed in previous reports by Terra Nova Engineering, Inc. Revised Nov. 2005, SF-05-033. The plan and profile sheet has been included in Appendix F of this report. Since no additional flow is proposed into this system further analysis is not provided.

Under interim conditions, two temporary pipes have been installed at Pond 2. Both pipes were analyzed and sized using Bentley FlowMaster, with the analysis results provided in Appendix E.

- **Temporary Pipe 1** conveys runoff from the temporary Basin C berm.
- **Temporary Pipe 2** conveys runoff from the existing drainage channel.

As no additional flow has been introduced to the existing drainage channel, no further analysis is provided.

Due to the interim configuration of the outlet structures, outflows are hydraulically constrained by the restrictor plate, as reflected in the results of the MHFD detention spreadsheet. Consequently, the water surface elevations for both the 5-year and 100-year storm events are not expected to exceed the elevation of the overflow weir. As such, a detailed headwater analysis was not conducted.

Release rates of both ponds in both conditions are designed to meet current drain time requirements by the State of Colorado. The requirements for WQCV, EURV, and 100 year events are 40 hours, 72 hours, and 120 hours respectively. Below is a table describing proposed drain times.

	WQCV	EURV	100-YR
State requirement	40	72	120
Pond 1 Interim	40	70	84
Pond 1 Final	40	64	72
Pond 2 Interim	40	68	98
Pond 2 Final	40	72	78

In the interim and final conditions for both ponds, the 5-year and 10-year release rates remain below the current outflow rates of the existing pond outlet structures. Therefore, it is concluded that, since the proposed design results in lower release rates than the existing conditions, no adverse downstream impacts are anticipated. For the final conditions detention design using the MHFD spreadsheets, the existing outflow rates from the existing ponds were used to override the Predevelopment Peak Q to reflect the actual, existing rates.

Below is a summary of the interim and full build out final conditions.

Proposed Flows to Ponds for Interim Condition				
	WQCV	EURV-WQCV	100-year - EURV-WQCV	Total Volume Required
Interim Pond 1	1.568 ac-ft	2.679 ac-ft	3.166 ac-ft	7.413 ac-ft
Interim Pond 2	1.280 ac-ft	1.955 ac-ft	2.605 ac-ft	5.840 ac-ft

Proposed Flows to Ponds for Future (Ultimate) Build Out Condition

	WQCV	EURV-WQCV	100-year - EURV-WQCV	Total Volume Required
Ultimate Pond 1	2.342 ac-ft	6.579 ac-ft	4.372 ac-ft	13.293 ac-ft
Ultimate Pond 2	2.030 ac-ft	5.703 ac-ft	3.790 ac-ft	11.523 ac-ft

Both ponds were designed using Mile High Flood District Detention spreadsheets for volume and outlet structures. There are two sets of pond design scenarios in Appendix E, for both interim and final conditions. The ponds and outlet structures will function within MHFD design guidelines. The pond designs within this report only provide a preliminary volume capacity and outlet structure design for the final, full build out condition. Any future development shall engineer and redesign the outlet structure(s) to accommodate the additional runoff from the associated development. The design shall also confirm there is adequate volume capacity, and make any adjustments as needed. Additionally, the Construction Documents associated with this report only provide a detailed design for the interim condition. Future development shall provide Construction Documents that engineer and redesign the outlet structure(s) to accommodate the additional runoff from the associated development.

Both ponds are designed to release into Sand Creek at or below the peak existing flows.

MHFD-Inlet_v5.03 software was used to analyze and design the street and inlet capacities throughout the Site. The result of the software is included in the appendices for reference. Chapter 7 of the City of Colorado Springs Drainage Criteria Manual, Volume 1 was used for street flow design criteria.

A proposed grass lined swale with a 2.0' wide, 0.75' deep concrete pan is designed in basin A-1 (swale A-1) to convey stormwater to an outfall point for tributary areas within the northern open space portion of the Site. This swale is to be designed to El Paso County and Colorado Springs Drainage standards with one foot of freeboard. Design calculations and cross sections are included within the appendix.

FOUR STEP PROCESS

The Four Step Process focuses on reducing runoff volumes, treating the WQCV, stabilizing drainageways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring events, as opposed to larger storms for which drainage and flood control infrastructure are sized. The Four Step Process is summarized below, and elements of the designed development are presented as a means to address and follow this process.

1. Step 1: Employ Runoff Reduction Practices

The Site is developed to capture runoff from impervious areas at sump locations and local low points within the public storm system. Impervious area is avoided where functional hardscape is not needed and open space is provided within the subdivision and remains undisturbed where developed lots are not laid out. Pervious landscaped areas are proposed where feasible in order to reduce runoff. Typical lot layouts will include pervious landscape areas surrounding the residences including front yards, rear yards, and side yard swales for drainage. The exact future ratio of pervious to impervious area per lot may vary depending on future homebuilding activity. In order to calculate estimated runoff reduction for each lot for this project, lots were assumed to have 35% imperviousness as specified by the DCM Volume 1, Table 6-6 for residential lots sized as 0-3 dwelling per acre.

Runoff calculations were completed for three two separate areas, the basins tributary to the permanent water quality and detention facilities 1 and 2, and the basins that flow off Site. The 2 permanent water quality and detention facilities are responsible for all water quality treatment for the Site.

Runoff reduction calculations and results are included in Appendix D. Runoff reduction areas are shown and can be found in the Green Infrastructure Maps, included in Appendix G.

2. Step 2: Implement Control Measures That Provide a Water Quality Capture Volume with Slow Release.

Runoff from this development is treated through the capture and timed release of the WQCV via the 2 proposed detention ponds on Site. Proposed ponds 1 and 2 provide the required and necessary WQCV for their respective tributary basins. A drainage map can be found in appendix F.

Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Tributary to Pond 1 (ac)	Area Tributary to Pond 2 (ac)	Disturbed Area Treated (ac)	Un-Disturbed Area un-Treated (ac)
A-1	4.49	4.49	0	4.49	4.49	0
A-2	4.83	4.83	0	4.83	4.83	0
A-3	2.46	2.46	0	2.46	2.46	0
A-4	2.55	2.55	0	2.55	2.55	0
A-5	3.52	3.52	0	3.52	3.52	0
A-6	2.75	2.75	2.75	0	2.75	0
B	38.75	0	38.75	0	0	0
C	41.08	0	0	41.08	0	0
D	8.26	0	0	0	0	8.26
E	1.41	0	0	0	0	1.41
F	5.91	0	0	0	0	5.91
G	8.38	0	0	0	0	8.38
OS-1	6.38	0	6.38	0	0	0
OS-2	3.12	0	3.12	0	0	0.00
OS-3	1.14	0	0	1.14	0	0
OS-4	13.1	0	0	0	0	13.1
OS-5	59.6	0	59.6	0	0	0
OS-6	35.8	0	0	35.8	0	0
OS-7	6.47	0	0	0	0	6.47
TOTAL	250	20.60	110.6	95.87	20.60	43.53

3. Step 3: Stabilized Drainageways

The Site utilizes concrete curb and gutter to channel stormwater from impervious runoff, mostly paved roadways, and residential lots. Landscaped areas are to be permanently stabilized with native seeding and mulching as well as trees and shrubbery according to the landscaping plans. Sloped landscaped areas will not exceed 3H:1V grades. The proposed grass lined swale with a 2.0' wide, 0.75' deep concrete pan in basin A-1 (swale A-1) follows El Paso County and City of Colorado Springs drainage criteria. The Site will outfall into the Existing Detention Pond 2.

4. Step 4: Implement Site Specific and Other Control Measures

Site construction is to follow a Stormwater Management Report and Grading and Erosion Control Plan that includes non-structural control measures during the initial, interim, and final phases of construction. As the development is multifamily residential land use, there are no anticipated Site-specific permanent source control measures required for the Site.

WATER QUALITY ENHANCEMENT CONTROL MEASURES

The proposed ponds 1 and 2 discussed in previous sections shall have infrastructure in place that meets El Paso County and MHFD Urban Storm Drainage Criteria Manuals. The proposed permanent water quality and detention facility is designed to treat the WQCV and detain the EURV and the 100-year detention volumes as well as meet release rate criteria. Runoff from the upstream tributary areas will be conveyed to the permanent water quality and detention facility via storm sewer. A developed drainage plan showing developed areas and their drainage patterns to the permanent water quality and detention facility is included in Appendix G.

Non-structural Best Management Practices that will be incorporated into the project are anticipated to include grass swales. Water quality is provided via side yard grass swales between lots in developed areas throughout the subdivision. It is provided for basins that drain directly off-site and are not tributary to the ponds by way of grass-lined swales, and by having minimal grading with no developed imperviousness in these areas as either open space or permanently seeded and landscaped rear yard areas.

Structural Best Management Practices that are incorporated in the Site design include storm infrastructure within the extended detention basins such as outlet structures and spillways.

MAINTENANCE

The proposed permanent water quality and detention facility will be maintained by the Challenger Homes, as well as all storm systems and swales not in the public right of way or within an easement. The proposed storm sewer system in the internal streets will be owned and maintained by El Paso County.

FLOODPLAIN MODIFICATION

There are no floodplain modifications required or proposed for the Site, see Appendix C for the FEMA Flood Zone Map.

DRAINAGE/BRIDGE FEES AND COST ESTIMATES

The Site lies within the Sand Creek Drainage Basin. The El Paso County Drainage Basin Fees were last updated in 2024 and were used.

The project Site has a total area of 20.87 acres. The following calculations for the imperviousness of the development is shown below.

Average Housing Footprint: =3,400 sf

Total Housing Footprint Area: $3,400 \times 24$ =21,600 sf

Total ROW Area: =212,421 sf

Total Tract Area: =257,918 sf

ROW and Housing Footprint areas are 100% impervious.

Total Impervious Area: $(21,600 + 212,421) / 43,560 = 5.37$ ac

Drainage Fees:

$\$25,632 \times 5.37$ Imp. Acres = \$137,643.84

Bridge Fees:

$\$10,484 \times 5.37$ Imp. Acres = \$56,299.08

The table below summarizes these costs.

Drainage Basin	Area Impervious (acres)	2024 Drainage Fee (per impervious acre \$)	2024 Bridge Fee (per impervious acre)	Drainage fees (\$)	Bridge Fees (\$)	Total (\$)
Sand Creek	5.37	\$ 25,632.00	\$ 10,484.00	\$ 137,643.84	\$ 56,299.08	\$ 193,942.92

Verify pipe quantities as there are discrepancies in pipe lengths between StormCAD and CD's. Ensure FDR and FAE quantities match

ate for the proposed storm infrastructure proposed within the filing.

Item	Quantity	Unit	Unit Cost	Cost
Storm Infrastructure				
5' CDOT Type R Inlet	1	EA	\$ 7,753.00	\$ 7,753.00
10' CDOT Type R Inlet	3	EA	\$ 10,669.00	\$ 32,007.00
CDOT Type C Inlet	1	EA	\$ 6,490.00	\$ 6,490.00
Riprap (Outlet Protection)	147.5	TON	\$ 112.00	\$ 16,520.00
18" RCP	181.5	LF	\$ 88.00	\$ 15,972.00
24" RCP	241	LF	\$ 105.00	\$ 25,305.00
30" RCP	207.9	LF	\$ 132.00	\$ 27,442.80
36" RCP	457	LF	\$ 162.00	\$ 74,034.00
48" RCP	420.9	LF	\$ 263.00	\$ 110,696.70
54" RCP	178.5	LF	\$ 344.00	\$ 61,404.00
Storm Sewer Manhole	8	EA	\$ 16,265.00	\$ 130,120.00
PBMPs				
Pond 1				
Forebay	3	EA	\$ 15,000.00	\$ 45,000.00
Trickle Channel	1008	LF	\$ 15.00	\$ 15,120.00
Outlet Structure	1	EA	\$ 15,000.00	\$ 15,000.00
Outlet Pipe (30")	122.8	LF	\$ 132.00	\$ 16,209.60
Riprap (Spillway)	54	TON	\$ 112.00	\$ 6,048.00
			Total	\$ 97,377.60
Pond 2				
Forebay	2	EA	\$ 15,000.00	\$ 30,000.00
Trickle Channel	385	LF	\$ 15.00	\$ 5,775.00
Outlet Structure	1	EA	\$ 15,000.00	\$ 15,000.00
Outlet Pipe (36")	125.4	LF	\$ 162.00	\$ 20,314.80
18" RCP CULVERT	93	LF	\$ 88.00	\$ 8,184.00
30" RCP CULVERT	91	LF	\$ 132.00	\$ 12,012.00
Riprap (Spillway)	32	TON	\$ 112.00	\$ 3,584.00
			Total	\$ 94,869.80
			Subtotal	\$ 699,991.90
			Contingency (15%)	\$ 104,998.79
			Total	\$ 804,990.69

Pipe size and length for Pond 2 do not match with CD's

CONCLUSION

This Final Drainage Plan report describes the proposed storm water management plan for the Falcon Highlands South Filing 1 development. This Plan will improve the existing ponds 1 and 2 on Site to current El Paso County standards and will provide water quality treatment and detention of storm water. This document will provide guidance so that the drainage infrastructure constructed throughout the Falcon Highlands South Filing 1 development will function efficiently and effectively. This report follows all standard criteria set forth by the El Paso County Drainage Criteria Manual, El Paso County Engineering Criteria Manual, the City of Colorado Springs Drainage Criteria Manuals Volumes 1, 2, and 3, and the Mile High Flood District Urban Storm Drainage Criteria Manual, with no requested variances. Downstream drainage facilities will not be negatively affected, as existing drainage patterns and allowable release rates shall be maintained. It has been concluded that the proposed Falcon Highlands South Filing 1 development will have no negative impact to infrastructure and development.

Ponds 1 and 2 both outfall into the existing Sand Creek, where the current outfalls already exist. The updated and redesigned ponds will release below the existing release rate of the existing ponds and will be at or less than the CUHP predevelopment peak flow in the interim condition, therefore no negative downstream effects are anticipated for the existing channels. Pond 1 outfall will follow existing drainage patterns where the flow is conveyed south via an existing channel until it meets with the existing Sand Creek. Pond 2 outfall will follow existing drainage patterns where flow is conveyed southwest via an existing channel until it reaches the existing Sand Creek. An analysis of both existing channels has been completed to ensure that the existing channels are hydraulically adequate, calculations for these existing channels can be found in appendix E.

REFERENCES

- 1) Urban Storm Drainage Criteria Manuals; Mile High Flood District; latest edition
- 2) El Paso County Engineering Criteria Manual (ECM), latest revision October 14, 2020
- 3) El Paso County Drainage Criteria Manual (DCM), October 1991; latest revision October 31, 2018
- 4) City of Colorado Springs Drainage Criteria Manuals, Volumes 1, 2, and 3, latest revision May 2014 (Not Adopted by El Paso County)
- 5) Flood Insurance Rate Map of El Paso County Colorado, Federal Emergency Management Agency, Flood Insurance Rate Map No. 08041C0561G and 08041C0545G dated December 7, 2018.
- 6) Hydrologic Soil Group – El Paso County, Colorado, Web Soil Survey, National Cooperative Soils Survey, May 21, 2021
- 7) *Falcon Highlands Filing No. 2 & 3 Final Drainage Report* by Terra Nova Engineering, Inc., latest revision August 2010.
- 8) *Falcon Highlands Phase 2, Filing No. 2 & 3 Master Development Drainage Plan and Preliminary Drainage Report* by Terra Nova Engineering, Inc. latest revision September 2005
- 9) *Bent Grass Residential Subdivision Filing No. 2 (SF-19-014) Final Drainage Report*, latest revision March 2020.
- 10) URS Section for Regional Detention Pond WU, developed by Galloway & Company
- 11) Sand Creek DBPS, developed by Stantec, HDR, and Dewberry dated January 2021 (Not Adopted by El Paso County)
- 12) Falcon DBS, developed by Matrix Design Group dated September 2015

Appendix A

Vicinity map

Falcon Highlands South - Filing No. 1

A PART OF SECTION 12, TOWNSHIP 13 SOUTH, RANGE 65 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
COUNTY OF EL PASO,
STATE OF COLORADO



PROJECT NO.: 24004308
DATE: 05/27/2025



ATWELL

866.850.4200 www.atwell-group.com

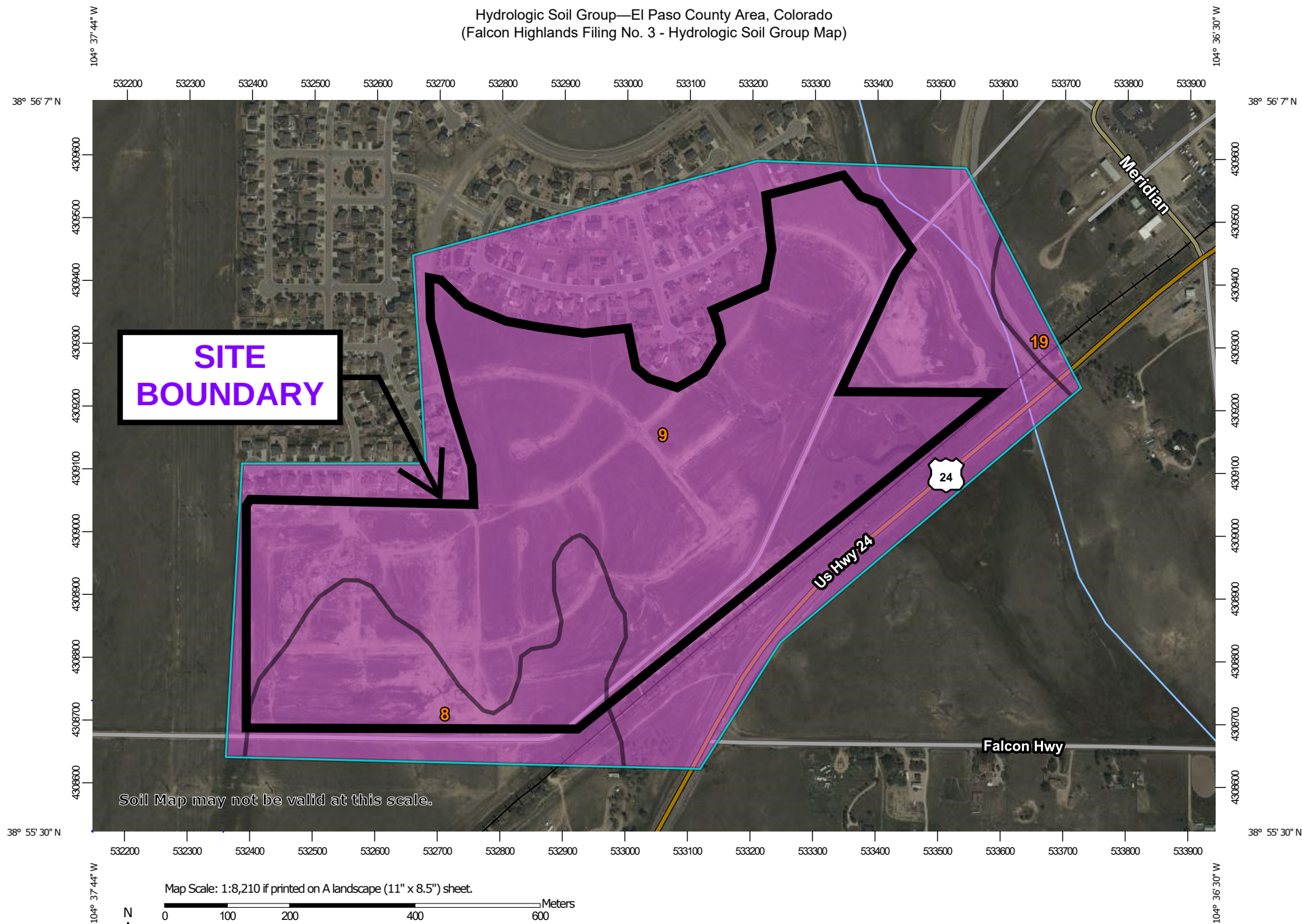
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Appendix B

Soils Report

Hydrologic Soil Group—El Paso County Area, Colorado
(Falcon Highlands Filing No. 3 - Hydrologic Soil Group Map)



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 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	31.0	14.2%
9	Blakeland-Fluvaquentic Haplaquolls	A	184.2	84.5%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	2.8	1.3%
Totals for Area of Interest			218.0	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

Job No. 197925

November 1, 2024

Revised March 27, 2025

Challenger Communities
8605 Explorer Drive, Suite 250
Colorado Springs, CO 80920

Re: Addendum to Soils and Geology Study
Falcon Highlands South, Filing No. 1, Phase 1
El Paso County, Colorado

Dear Challenger Communities:

RMG – Rocky Mountain Group (RMG) prepared the original *Soils and Geology Study, Phases 1-4, Falcon Highlands* (RMG Job No. 184041, last dated September 7, 2022) for the proposed development comprising 380 single-family residential lots on approximately 109.05 acres located east of the intersection of Highway 24 and Meridian Road in El Paso County, Colorado. That report was reviewed by personnel of the El Paso County Planning and Community Development and the Colorado Geological Survey (CGS). The location of the site is presented in the Site Vicinity Map, Figure 1.

Since the approval of that report, which contained all four phases, it has been requested an updated report be completed for Filing No. 1. The filings are now defined and this letter is to update and confirm that our findings and recommendations previously presented are still valid and/or to provide additional information since the issuance of the original *Soils and Geology Study*. The Filing No. 1, Phase I, Lot Layout is presented in Figure 2.

Existing Land Use

The site currently consists of a portion of one parcel. The parcel included in this amended study is:

- **Schedule No. 5300000817** – consists of approximately 109.05 acres and encompasses the entire site. The parcel is not developed.

Filing No. 1, Phase I was originally Phase 4 of the previous report. The lot and roadway layouts have remained the same.

Project Description

Filing No. 1, Phase I is to consist of approximately 23.592 acres. Of that, single-family residences are to comprise approximately 12.8 acres (55%), open spaces and parks are to comprise approximately 6.1 acres (25%), and the remaining 4.7 acres (20%) are designated for public right-of-way usage. The main access into the filing, Sahalee Trail is to extend east and south from the existing Bridal Vail Way. One interior roadway, Fox Kestrel Court, is to extend northeast and southwest from Sahalee Trail and terminate on each end with a cul-de-sac. Both the roadways are to be constructed with a 50-foot ROW that will meet the requirements of an El Paso County Local Residential – Urban roadway. The roadways are to be paved and contain curb and gutter per El Paso County specifications.

Qualifications of Preparers

This *Addendum to Soils and Geology Study* was prepared by a professional geologist as defined by Colorado Revised Statutes section 34-1-201(3) and by a qualified geotechnical engineer as defined by policy statement 15, "Engineering in Designated Natural Hazards Areas" of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors. (Ord. 96-74; Ord. 01-42)

The principle investigators for this study are Kelli Zigler P.G., and Tony Munger, P.E. Ms. Zigler is a Professional Geologist as defined by State Statute (C.R.S 34-1-201) with over 24 years of experience in the geological and geotechnical engineering field. Ms. Kelli Zigler holds a B.S. in Geology from the University of Tulsa. Ms. Zigler has supervised and performed numerous geological and geotechnical field investigations throughout Colorado.

Tony Munger is a licensed professional engineer with over 24 years of experience in the construction engineering (residential) field. Mr. Munger and holds a B.S. in Architectural Engineering from the University of Wyoming.

Previous Studies and Investigations

Previous geotechnical engineering/geologic investigation for the site and nearby sites were available for our review and are listed below:

1. *Soils and Geology Study, Phases 1-4, Falcon Highlands, El Paso County, Colorado*, prepared by RMG – Rocky Mountain Group, Job No. 184041, last dated September 7, 2022.
2. *Engineering Geology Study, Falcon Highlands Subdivision, El Paso County, Colorado*, prepared by John Himmelrieck & Associates, Project No. 00-139, dated June 28, 2000.
3. *Soil and Geology Study, Falcon Highlands, Woodmen Road and Tamlin Road, El Paso County, Colorado*, prepared by Entech Engineering, Inc., Entech Job No. 39431, last dated January 24, 2002.
4. *Subsurface Soil Investigation, Lots 4, 30-44, 83-86, 101, 135-137, 142-146, 149-151, 1456, 157, 160, Falcon Highlands, Filing No. 2, El Paso County, Colorado*, prepared by RMG Engineers Group, Job No. 133001, dated August 24, 2012.

Since the issuance of our original report, the site conditions, topography and vegetation have not changed substantially.

RMG previously completed 11 exploratory test borings on June 8, 2021 for the original Soils and Geology Study. The borings extended to approximately 20 feet below the existing ground surface. Three of these previous test borings (TB-1, TB-2, and TB-3) were located within the area included in this current study. RMG did not perform additional borings for this study. Since the site has not undergone significant changes since the issuance of the original report, additional test borings (beyond those already performed) would not be anticipated to provide new information that would substantially change the recommendations presented herein. The Explanation of Test Boring Logs, Test Boring Logs, Summary of Laboratory Results, and Soil Classification Data for the pertinent three borings are presented in Appendix A.

As noted in the review comments from the County and CGS, in regards to our original study, “groundwater measurements at the time of drilling, or even several weeks later, do not provide the necessary data to determine groundwater fluctuations.” At Challenger’s request, RMG installed 5 piezometers on May 15, 2024, within the Falcon Highlands Subdivision. The piezometer locations were selected by Challenger, within tracts around the subdivision. Groundwater depths are being measured within these piezometers on a montly basis, for a period of at least 12 months.

Though we did not perform new test borings for this study, we are utilizing our current piezometer readings to provide additional groundwater information. The groundwater depths measured in each of the piezometers to date are presented in the **Groundwater** section of this report. The groundwater monitoring is ongoing, and future measurements can be made available (upon request) once completed.

Geologic Conditions

Based upon review of the *Falcon Quadrangle Geologic Map, El Paso County, Colorado*, the site is within an area of the Colorado Piedmont, a region that is distinguished primarily by the fact that it has been stripped of the Miocene fluvial rocks that cap the adjoining High Plains Section of the Great Plains physiographic province. Sand is abundant in the Falcon Highlands area due to the sandstone bedrock of the Squirrel Formation and/or Dawson Formation. Sandy alluvial and pluvial deposits blanket the majority of the area, and are generally 5 feet thick or more. The deposits are considered residuum, unconsolidated material derived from the weathering of the underlying bedrock, and are wide-spread. The sandstone is generally weakly-cemented, easily excavated, shows little or no lamination, and can be irregularly stratified with evidence of cross sorting.

General Geology

Our field investigation included a site reconnaissance, with consideration given to geologic features and significant surficial deposits. The general geology of the area is typically a combination of alluvial and pluvial deposits overlying the Black Squirrel Formation. The general geology units were mapped in our previous *Soils and Geology Study*, and the units that occur within the currently-proposed Filing No. 1, Phase I, are noted below:

- *Qa2: Alluvium two* (lower Holocene) – Dark gray to brown, poorly to well sorted, moderately consolidated, silt, sand, gravel, and minor clay and occasional boulders in stream terrace deposits approximately 6 to 12 feet above the modern flood plain or as non-terrace forming alluvium in valley headwaters. Clasts are subrounded to well-rounded and the dominant sediment is sandy gravel with a silty sand matrix. Clay seams are poorly to moderately stratified.
- *Tbs: Black Squirrel Formation (Paleocene)* – Gray-green to tan to brownish gray, moderately-well sorted cross-bedded sandy arkoses interbedded with micaceous sand claystone that contain abundant plant fragments and occasional, fine-to medium-grained massive arkosic beds. The exposed upper part of the Black Squirrel Formation is gradational with the overlying Dawson Arkose making the contact problematic. Thickness within the Falcon quadrangle is approximately 130 feet. The claystone within this unit may be prone to swelling when wet.
- *Af: – Artificial Fill* – man-placed fill in the form of stockpiles that were placed between prior to 2005 to 2015, as indicated by historical aerial photos. The stockpiles generally consisted of unsorted silt, sand, clay, and rock fragments. The unsorted soil was mixed with uncontrolled dumping of household debris. The average thickness of the unit is less than 15 feet, above and below the ground surface.

Engineering Geology

The Engineering Geology is presented below. Charles Robinson and Associates have mapped one environmental engineering unit on the site as:

- 2D: Eolian deposits generally on flat to gentle slopes of upland areas.

The Engineering and Geology Map specific to Filing No. 1, Phase I is included in Figure 3.

Potential Geologic Conditions

The following geologic constraints were considered in the preparation of the previous report and this addendum, and are not expected to pose a significant risk to the proposed development in Filing No. 1, Phase I:

- Avalanches
- Debris Flows, Debris Fans, Mudslides
- Floodplains
- Ground Subsidence
- Landslides
- Rockfall
- Steeply Dipping Bedrock
- Unstable or Potentially Unstable Slopes
- Scour, Erosion, Accelerated Erosion along creek banks and drainageways

The geologic conditions that are anticipated to impact Filing No. 1, Phase I are as follows:

Groundwater

Groundwater readings were performed at the time of the original drilling in June, 2021, with additional groundwater readings in September and October of 2021. The final water readings revealed that all eleven test borings (performed across the development as a whole) had water at depths ranging from 9 to 17.4 feet in October of 2021. However, with respect to just the three test borings located in Filing No. 1, Phase I (TB-1, TB-2, and TB-3), the final groundwater readings in October of 2021 ranged from 11.4 to 16 feet.

Test Boring (TB) Number	Depth of Groundwater (ft) June 2021	Depth of Groundwater (ft) September 2021	Depth of Groundwater (ft) October 2021
TB-1	19	3.5	16
TB-2	15	3.5	14.6
TB-3	10	3.5	11.4

We do understand groundwater information obtained at the time of the preliminary investigations performed prior to the land development phase may or may not be representative of the conditions present at the time of construction. Furthermore, the development processes (reshaping of the ground surface, installation of buried utilities, installation of an underdrain below the roadways, etc.) can significantly alter the depth and flow paths of the subsurface water. The construction of surrounding lots can also alter the amount and depth of subsurface groundwater below a given lot.

Our recommendations, as noted in our original study, were that basement construction should be restricted except where the following conditions apply:

- Underdrains are installed at the bottom of sanitary sewer trenches within drive lanes;
- A year-long groundwater monitoring study has been undertaken, and the results indicate that groundwater is sufficiently deep to allow basement construction;
- The proposed site grading will result in at least 14 feet of separation between the proposed ground surface and the groundwater elevation.

Based on the Grading Plan provided by Challenger Homes, prepared by Atwell and dated July 12, 2024, the majority of the grading is to either level the site and maintain or raise the existing grades. Minor cuts are proposed in localized areas, but they appear to be limited to approximately 3 feet or less.

Additionally, two retention basins are to be located outside the boundaries of Filing No.1, Phase I, in designated tracts. The potential impacts of shallow groundwater should be evaluated by the civil engineer of record when preparing the designs for those retention basins.

Mitigation

As noted above, it is our understanding that stiffened-slab foundations are to be used for the proposed lots. Neither basement nor crawlspace construction are currently proposed.

Additionally, at Challenger's request, RMG installed 5 piezometers on May 15, 2024, within the Falcon Highlands Subdivision. The piezometer locations were selected by Challenger, within tracts around the subdivision. The location of the piezometers is shown in Figure 4. Piezometer 1 (P1) is located in a tract within Filing No. 1, Phase I. However, for completeness, all 5 piezometer readings to date are presented in the table below.

Piezometer Number	Date of reading (2024)	Total Depth (ft) of Piezometer	Depth (ft) to Groundwater
P1			
	May 15	20	6.5
	June 17	20	3.8
	July 15	20	4.0
	August 21	20	5.0
	September 24	20	5.5
	October 22	20	7.3
P2			
	May 15	20	14.0
	June 17	20	13.8
	July 15	20	13.8
	August 21	20	13.5
	September 24	20	14.5
	October 22	20	11.9
P3			
	May 15	19.4	8.5
	June 17	19.4	4.5
	July 15	19.4	4.5
	August 21	19.4	5.0
	September 24	19.4	7.5
	October 22	19.4	8.0
P4			
	May 15	24	*N/A
	June 17	24	7.0
	July 15	24	7.0
	August 21	24	5.0
	September 24	24	8.5
	October 22	24	9.0
P5			
	May 15	24.2	*N/A
	June 17	24.2	15.5
	July 15	24.2	15.0
	August 21	24.2	14.5
	September 24	24.2	15.0
	October 22	24.2	15.0

**N/A is not believed that groundwater was not present but some other technical issues may have been encountered.*

Based on these monthly groundwater measurements, it is our opinion that the proposed stiffened slab foundations are suitable for the included lots. However, underslab drains may be recommended at the time of either the lot-specific subsurface soil investigations and/or open excavation observations.

Furthermore, overlot grading may encounter elevated groundwater conditions necessitating localized stabilization, especially in areas where groundwater measurements were at depths of 7 feet or less from the proposed finished ground surface.

Compressible and/or Potentially Expansive Soils

The subsurface materials at the site generally consist of silty to clayey sand and sandy clay overlying sandstone and claystone. Based on the test borings performed for the original *Soils and Geology Study* referenced above, the soils and bedrock encountered at the site generally possess low to moderate swell potential and low compressibility potential. If these materials are encountered in the excavations for the proposed residences, they can readily be mitigated with typical construction practices common to this region of El Paso County, Colorado.

Mitigation

Shallow foundations are anticipated for the lots included in this study. Foundation design and construction are typically adjusted for expansive or compressible soils. Several mitigation alternatives were presented in our previous study. Based on discussions with personnel of Challenger Communities, it is our understanding that stiffened slab foundations are preferred for these lots. Based on the boring logs and laboratory test data from our previous study, it is our opinion that stiffened slab foundations atop either undisturbed native soil or atop structural fill after limited overexcavation and replacement will be suitable for the proposed lots.

Undocumented Fill

Fill soils were encountered in five of the eleven test borings previously performed by RMG. The majority of fill was located in the southern half of the parcel and near the western boundary. Fill was not encountered in test borings TB-1, TB-2, or TB-3 which were located within the area of this study. However, some surficial fill may be encountered within this site.

Mitigation

The fill soils must be considered undocumented fill, and as such are not suitable for development. It is our opinion that they can be mitigated with typical construction practices common to the El Paso County region. If undocumented or otherwise unsuitable fill soils are encountered during the overlot grading process, they will require removal (overexcavation) and replacement with compacted structural fill. The zone of overexcavation shall extend to the bottom of the unsuitable fill zone and shall extend at least that same distance beyond the building perimeter (or to the lateral extent of the fill, if encountered first).

Additional Geologic Conditions

The following listed constraints were discussed and included in the original *Soils and Geology Study*, included in Appendix C. It is our opinion that our findings, conclusions, and recommendations regarding these conditions are still valid for the lots within the currently-proposed Filing No. 1, Phase 1:

- faults, seismicity, radon, flooding, surface drainage, erosion, corrosion, surface grading and drainage

Conclusions

Based upon our evaluation of the geologic conditions, it is our opinion that the proposed development is feasible. The potential for expansive/compressible soils and shallow groundwater are not considered unusual for the Front Range region of Colorado. Mitigation of geologic hazards is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic hazards should be mitigated by implementing appropriate planning, engineering, and local construction practices.

Stiffened slab foundations are currently proposed with in Filing No. 1, Phase. The foundation and floor slabs of the structure should be designed using the recommendations provided in the site-specific subsurface soil investigation performed for each lot. In addition, appropriate surface drainage should be established during construction and maintained by the homeowner.

The findings, conclusions and recommendations presented in this report were provided to evaluate the suitability of the site for future development. Unless indicated otherwise, the test borings, laboratory test results, conclusions and recommendations presented in this report are not intended for use for design and construction. ***A site-specific subsurface soil investigation will be required for all proposed residences.***

To develop recommendations for construction of the proposed roadways, a pavement design investigation should be performed. This investigation should consist of additional test borings, soil laboratory testing and specific recommendations for the design and construction of roadway pavement sections.

The recommendations in this and the referenced reports are intended to address normal surface drainage conditions, assuming the presence of groundcover (established vegetation, paved surfaces, and/or structures) throughout the regions upslope from this structure. However, groundcover may not be present due to a variety of factors (ongoing construction/development, wildfires, etc.). During periods when groundcover is not present in the "upslope" regions, higher than normal surface drainage conditions may occur, resulting in perched water tables, excess runoff, flash floods, etc. In these cases, the surface drainage recommendations presented herein (even if properly maintained) may not mitigate all groundwater problems or moisture intrusion into the structure.

Revisions and modifications to the conclusions and recommendations presented in this report may be issued subsequently by RMG based upon additional observations made during grading and construction which may indicate conditions that require re-evaluation of some of the criteria presented in this report.

Closing

This report is for the exclusive purpose of providing geologic hazards information and preliminary geotechnical engineering recommendations. The scope of services did not include, either specifically or by implication, evaluation of wild fire hazards, environmental assessment of the site, or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to, biological or toxicological issues, are beyond the scope of this report. If the owner is concerned about the potential for such contamination or conditions, other studies should be undertaken.

This report has been prepared for **Challenger Communities** in accordance with generally accepted geotechnical engineering and engineering geology practices. The conclusions and recommendations in this report are based in part upon data obtained from review of available topographic and geologic maps, review of available reports of previous studies conducted in the site vicinity, a site reconnaissance, and research of available published information, soil test borings, soil laboratory testing, and engineering analyses. The nature and extent of variations may not become evident until construction activities begin. If variations then become evident, RMG should be retained to re-evaluate the recommendations of this report, if necessary.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers and engineering geologists practicing in this or similar localities. RMG does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied, is made by the preparation of this report. Third parties reviewing this report should draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

I hope this provides the information you have requested. Should you have questions, please feel free to contact our office.

Cordially,

Reviewed by,

RMG – Rocky Mountain Group

RMG – Rocky Mountain Group



Kelli Zigler
Project Geologist

Tony Munger, P.E.
Sr. Geotechnical Project Manager



Additional Referenced Documents

1. *Falcon Highlands South, Filing No. 1, Phase 1, Construction Plans*, prepared by Atwell, Job No. 24004308, dated July 12, 2024.
2. *Falcon Highlands South, Filing No. 1, Landscape Construction Documents*, prepared by Matrix, Project No. 24.1208.013, date issued, August 16, 2024.
3. *Falcon Highland, Concept Plan 03, Phasing Exhibit*, prepared by Matrix, dated May 18, 2021.
4. *Appendix C, Soils Investigation Reports and Mitigation, Engineering Criteria Manual*, El Paso County, revised July 9, 2019.
5. *Master Plan for Mineral Extraction, Map 2*. El Paso County, February 8, 1996,
6. *Earthquake Potential in Colorado, A Preliminary Evaluation*, Colorado Geological Survey, Bulletin 4, Kirkham, R.M. and Rogers, W.P., 1981,
7. *Results of the 1987-88 EPA Supported Radon Study in Colorado, with a discussion on Geology*, Open file Report 91-4, Colorado Geological Survey, 1991,
8. *Colorado Springs Landslide Susceptibility, Colorado Geological Survey*: <https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=5e7484a637c4432e84f4f16d0af306d3>
9. *Colorado Landslide Inventory, Colorado Geological Survey*: <https://cologeosurvey.maps.arcgis.com/apps/webappviewer/index.html?id=9dd73db7fbc34139abe51599396e2648>.
10. *Pikes Peak Regional Building Department*: <https://www.pprbd.org/>.
11. *City of Colorado Springs, Subdivision Document Viewer*: <http://www.springsgov.com/SubDivView/default.asp?cmdGoBack=New+Search...>
12. *El Paso County Assessor, El Paso County, Colorado*: <https://property.spatalest.com/co/elpaso/#/property/7109000098> and <https://property.spatalest.com/co/elpaso/#/property/7109000024>
13. *Colorado Geological Survey, USGS Geologic Map Viewer*: <http://coloradogeologicalsurvey.org/geologic-mapping/6347-2/>.
14. *Historical Aerials*: <https://www.historicaerials.com/viewer>, Images dated 1952, 1953, 1955, 1960, 1969, 1984, 1999, 2004, 2005, 2009, 2011, 2013, 2015, 2017, and 2019.
15. *USGS Historical Topographic Map Explorer*: <http://historicalmaps.arcgis.com/usgs/> Images dated 1950, 1951, 1956, 1957, 1963, 1966, 1970, 1974, 1977, 1994, 2001, 2013 and 2013.
16. *Google Earth Pro*, Imagery dated 1999, 2004, 2005, 2006, 2008, 2010, 2011, 2015, 2017, 2018, 2019, 2020, 2022, and 2024.



NOT TO SCALE



ROCKY MOUNTAIN GROUP

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Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071

SITE VICINITY MAP

FALCON HIGHLANDS SOUTH
FILING NO. 1 PHASE I
EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

JOB No. 197925

FIG No. 1

DATE 10-31-2024



BASE MAP PROVIDED BY ATWELL

JOB No. 197925



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(970) 330-1071
Woodland Park Office:
(719) 687-6077
Monument Office:
(719) 488-2145
Pueblo / Canon City:
(719) 544-7750

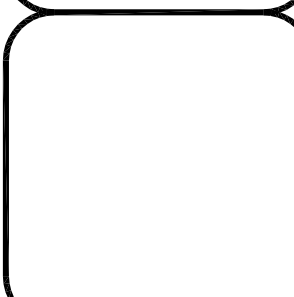
FALCON HIGHLANDS SOUTH
FILING NO. 1, PHASE 1
EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

ENGINEER: TM
DRAWN BY: KZ
CHECKED BY: TM
ISSUED: 10/31/2024
REVISED: 3/21/2025

LOT LAYOUT

SHEET No.

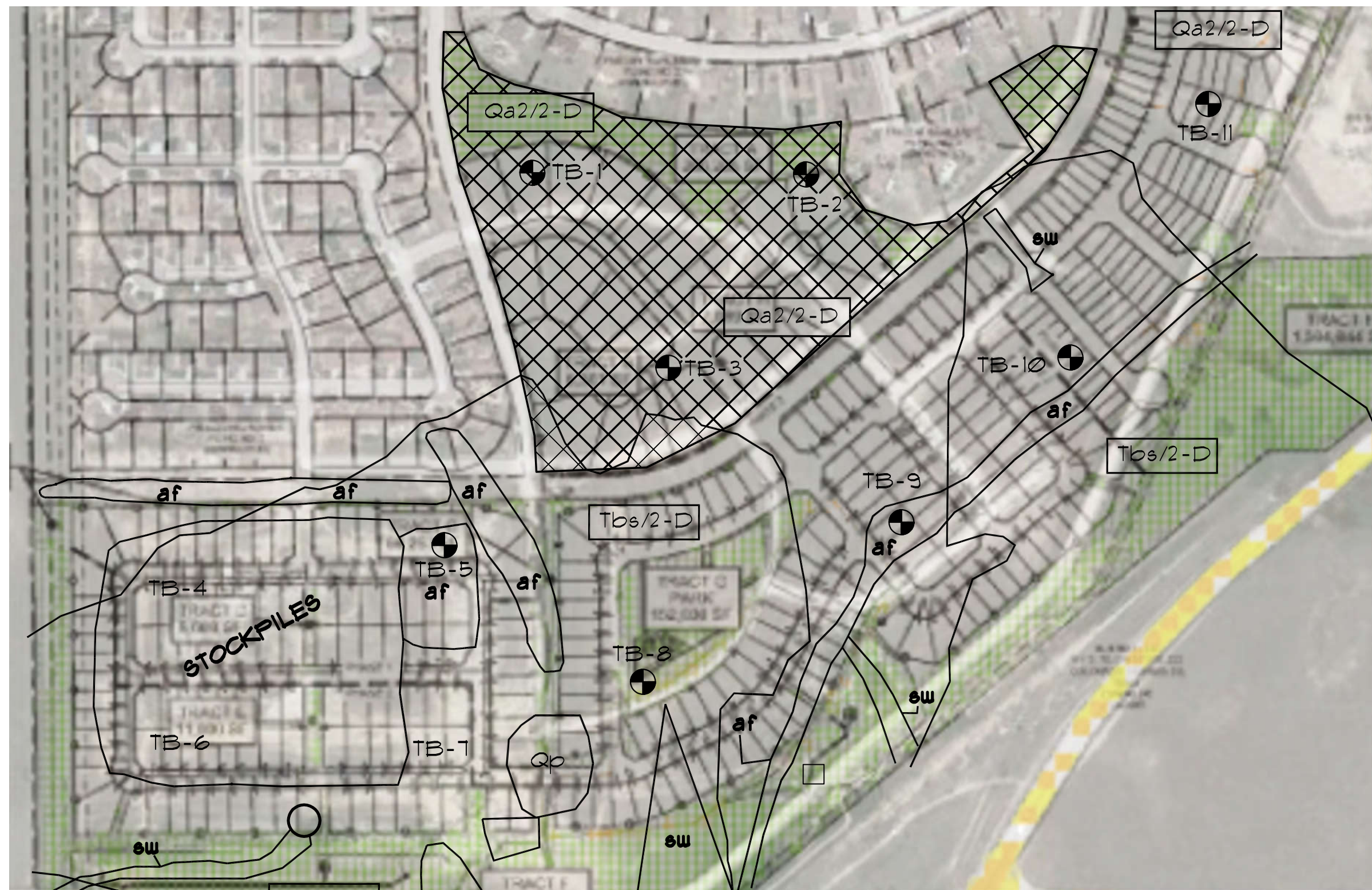
FIG-2



FALCON HIGHLANDS SOUTH
FILING NO. 1, PHASE 1
EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

ENGINEER:	TM
DRAWN BY:	KZ
CHECKED BY:	TM
ISSUED:	10/31/2024

ENGINEERING
AND GEOLOGY
MAP

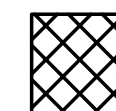


NOT TO SCALE

⊕ DENOTES APPROXIMATE LOCATION
OF TEST BORINGS AS PERFORMED
FOR OUR ORIGINAL SOILS AND
GEOLOGY STUDY, JOB NO. 184041,
LAST DATED SEPTEMBER 7, 2022

- *Qa2*: Alluvium two (lower Holocene) - Dark gray to brown, poorly to well sorted, moderately consolidated, silt, sand, gravel, and minor clay and occasional boulders.
- *Tbs*: Black Squirrel Formation (Paleocene) - The exposed upped part of the Black Squirrel Formation is gradational with the overlying Dawson Arkose making the contact problematic. Thickness within the Falcon quadrangle is approximately 130 feet. The claystone within this unit may be prone to swelling when wet.

- *af*: - Artificial Fill - man-placed fill in the form of stockpiles that were placed between prior to 2005 to 2015, as indicated by historical aerial photos. The stockpiles generally consisted of unsorted silt, sand, clay, and rock fragments. The unsorted soil was mixed with uncontrolled dumping of household debris. The average thickness of the unit is less than 15 feet, above and below the ground surface.
- 2D: - Eolian deposits generally on flat to gentle slopes of upland areas.



DENOTES AREA INCLUDED IN THIS
STUDY



ROCKY MOUNTAIN GROUP

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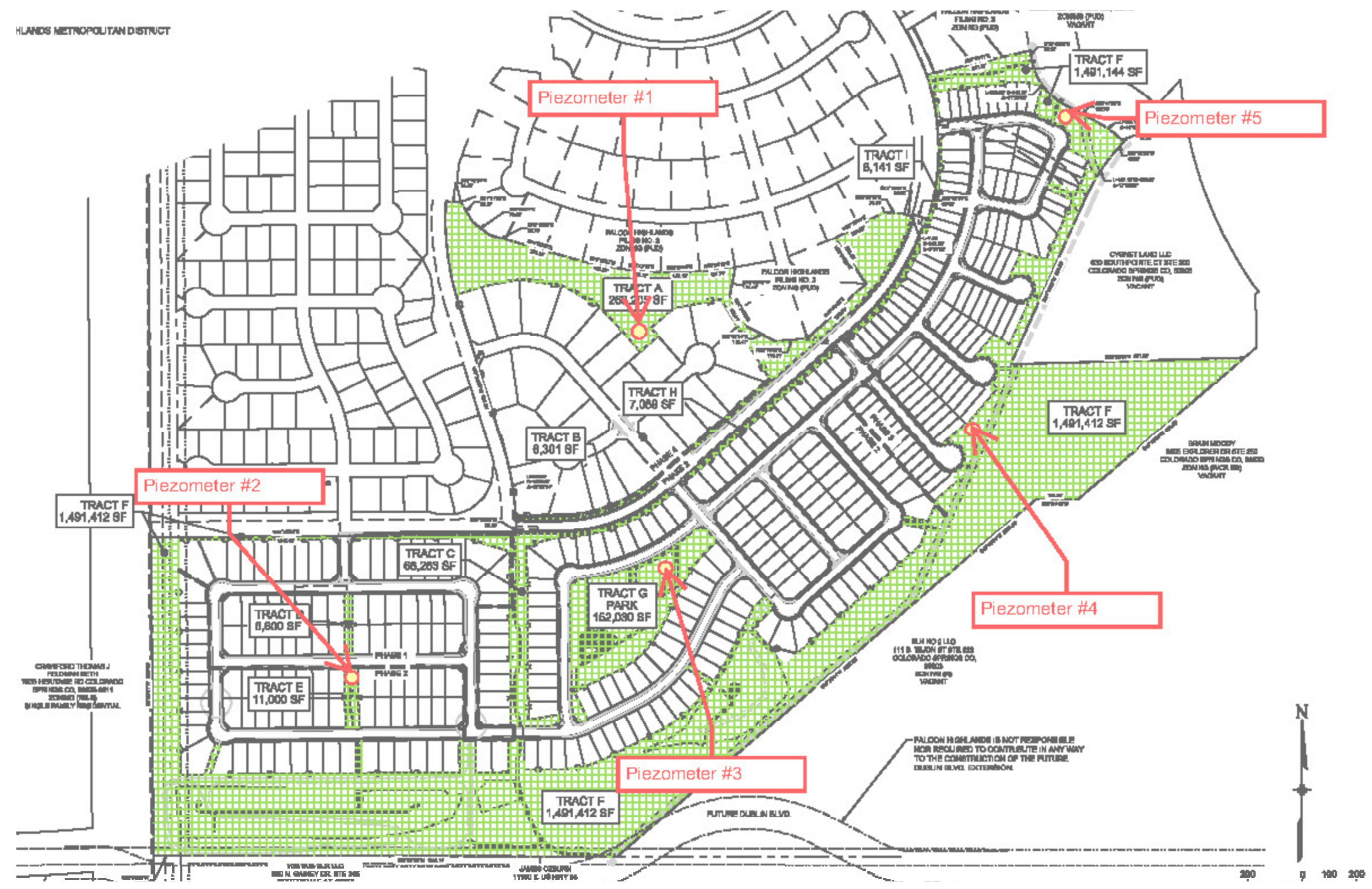
FALCON HIGHLANDS SOUTH
FILING NO. 1, PHASE 1
EL PASO COUNTY, COLORADO
CHALLENGER COLORADO, LLC

ENGINEER:	TPM
DRAWN BY:	KZ
CHECKED BY:	TPM
ISSUED:	10-31-2024

PIEZOMETER
LOCATIONS

SHEET No.
FIG-4

HIGHLANDS METROPOLITAN DISTRICT



NOT TO SCALE

APPENDIX A

Explanation of Test Boring Logs, Test Boring Logs, Summary of Laboratory Results,
And Soil Classification Data by RMG, Job No. 184041

SOILS DESCRIPTION



CLAYSTONE



SANDSTONE



SANDY CLAY



SILTY SAND



SILTY TO CLAYEY SAND

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
RMG - ROCKY MOUNTAIN GROUP
5085 LIST DRIVE, SUITE 200
COLORADO SPRINGS, COLORADO

SYMBOLS AND NOTES



XX

STANDARD PENETRATION TEST - MADE BY DRIVING A SPLIT-BARREL SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-1586. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).



XX

UNDISTURBED CALIFORNIA SAMPLE - MADE BY DRIVING A RING-LINED SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-3550. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).



FREE WATER TABLE



DEPTH AT WHICH BORING CAVED



BULK DISTURBED BULK SAMPLE



AUG AUGER "CUTTINGS"

4.5

WATER CONTENT (%)

ROCKY MOUNTAIN GROUP

Structural
Forensics



Geotechnical
Materials Testing

Colorado Springs: (Corporate Office)
5085 List Drive, Suite 200
Colorado Springs, CO 80918
(719) 548-0600

SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

EXPLANATION OF TEST BORING LOGS

JOB No. 184041

FIGURE No. 1

DATE Oct/25/2024

TEST BORING: 1	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	TEST BORING: 2	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
DATE DRILLED: 6/8/21 GROUNDWATER @ 16.0 ' 10/6/21						DATE DRILLED: 6/8/21 GROUNDWATER @ 14.6 ' 10/6/21					
SAND, SILTY, with gravel, light brown to brown, medium dense to dense, moist	5			15	3.7	SAND, SILTY TO CLAYEY, with gravel, light brown, with rust staining, medium dense to dense, moist	5			30	7.0
	10			35	7.0		10			19	38.9
SANDSTONE, SILTY TO CLAYEY, light brown to gray, with rust staining, hard, moist to wet	15			50/9"	16.3	SANDSTONE, SILTY TO CLAYEY, gray, very hard, moist to wet	15			10/0"	11.8
	20			50/9"	18.6	CLAYSTONE, SANDY, gray to dark gray, hard, moist to wet	20			50	21.7

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5085 List Drive, Suite 200
Colorado Springs, CO 80918
(719) 548-0800

SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

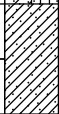
Geotechnical
Materials Testing

TEST BORING LOG

JOB No. 184041

FIGURE No. 2

DATE Oct/25/2024

TEST BORING: 3 DATE DRILLED: 6/8/21 GROUNDWATER @ 11.4 ' 10/6/21	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	
SAND, SILTY TO CLAYEY, with gravel, light brown, with rust staining, medium dense, moist	5			15	10.1	
CLAY, SANDY, light gray, very stiff, moist to wet	10			30	20.4	
CLAYSTONE, SANDY, gray, medium hard, moist to wet	15			50/11"	25.1	
	20			40	24.3	

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Materials Testing

TEST BORING LOG

JOB No. 184041

FIGURE No. 3

DATE Oct/25/2024

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	Load at Saturation (psf)	% Swell/ Collapse	USCS Classification
1	4.0	3.7								
1	9.0	7.0		NP	NP	0.2	11.1			SW-SM
1	14.0	16.3								
1	19.0	18.6								
2	4.0	7.0		NP	NP	4.8	18.4			SM
2	9.0	38.9								
2	14.0	11.8								
2	19.0	21.7								
3	4.0	10.1								
3	9.0	20.4		30	11	11.2	14.3			SC
3	14.0	25.1								
3	19.0	24.3								

ROCKY MOUNTAIN GROUP

Structural
Forensics



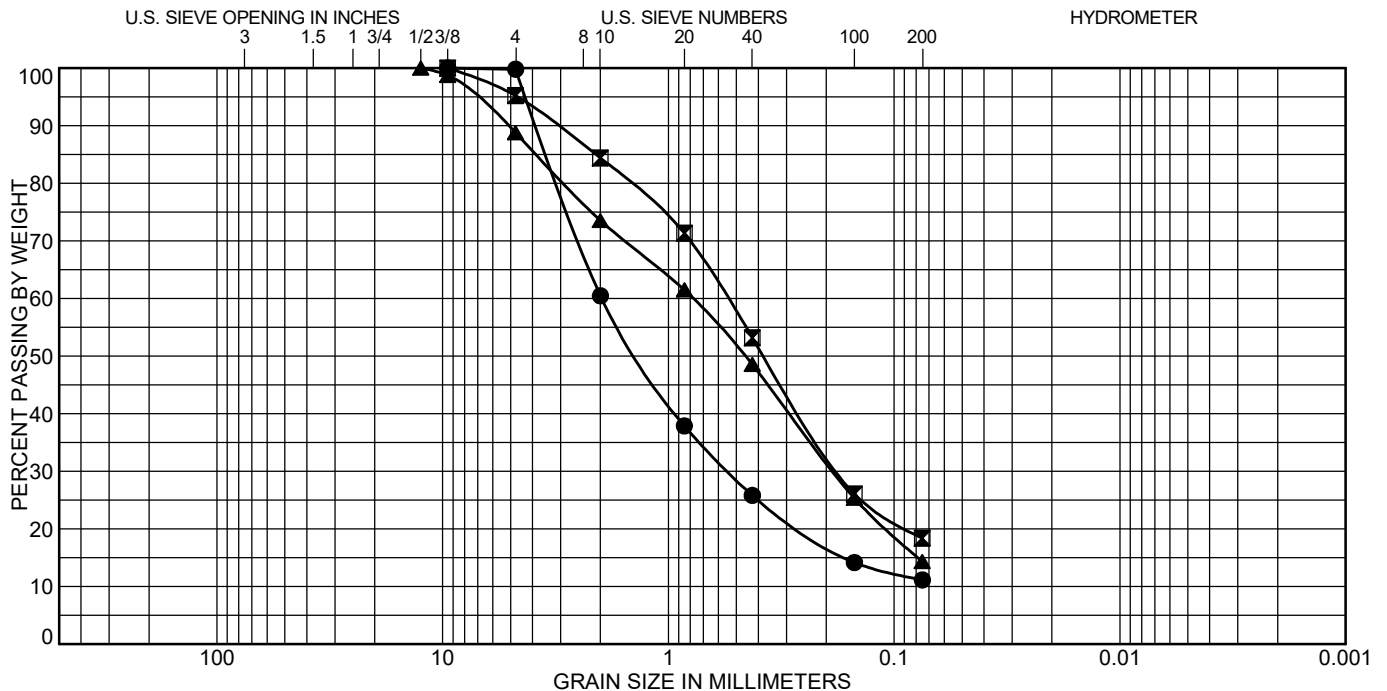
Colorado Springs, (Corporate Office)
5085 List Drive, Suite 200
Colorado Springs, CO 80918
(719) 548-0600

SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

Geotechnical
Materials Testing

SUMMARY OF LABORATORY TEST RESULTS

JOB No. 184041
FIGURE No. 4
PAGE 1 OF 1
DATE Oct/25/2024



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring	Depth (ft)	Classification	LL	PL	PI
● 1	9.0	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP
⊠ 2	4.0	SILTY SAND(SM)	NP	NP	NP
▲ 3	9.0	CLAYEY SAND(SC)	30	19	11

Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
● 1	9.0	0.2	88.7	11.1	
⊠ 2	4.0	4.8	76.8	18.4	
▲ 3	9.0	11.2	74.5	14.3	

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(719) 548-0600

SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

SOIL CLASSIFICATION DATA

JOB No. 184041

FIGURE No. 5

DATE Oct/25/2024

Job No. 197925

September 29, 2025

Challenger Communities
8605 Explorer Drive, Suite 250
Colorado Springs, CO 80920

Re: Response to Review Comments
Antelope Meadows Cr
Falcon Highlands South, Filing No. 1
El Paso County, Colorado

Dear Challenger Communities:

RMG Engineers prepared the *Addendum to Soils and Geology Study* (RMG Job No. 197925, last dated March 27, 2025) for the proposed Filing No. 1 development to consist of 24 single-family residential lots located east of the intersection of Highway 24 and Meridian Road in El Paso County, Colorado. The report was reviewed El Paso County, and several review comments were provided to RMG to address.

The purpose of this letter is to provide RMG's response to the comments. For clarity and ease of review we have included the comments (clouded in red) below or that were included in an email from Joe Sandstrom with the Department of Public Works (dated 9.22.25), each followed by our response to that comment.

CGS Comments:

The submitted documents for the Soils Report says it is an Addendum to the original soils report, and it is specifically for Filing 1. Since the addendum was created specifically for Filing 1, it should contain information specific to this filing and not future filings.

RMG Response:

The original *Soils and Geology Study* was prepared for the entire development. Since the submittal of the original study, Challenger decided to break out the development in phases. The information presented in the referenced addendum includes the totality of our groundwater observations to provide the full context of the groundwater for the development as a whole. However, the conclusions presented are specific to Filing No. 1. We understand that an additional Soils and Geology Study will likely be required for each future filing.

CGS Comments:

revealed that all eleven test borings (performed across the development as a whole) had water at depths ranging from 9 to 17.4 feet in October of 2021. However, with respect to just the three test borings located in Filing No. 1, Phase I (TB-1, TB-2, and TB-3), the final groundwater readings in October of 2021 ranged from 11.4 to 16 feet.

Test Boring (TB) Number	Depth of Groundwater (ft) June 2021	Depth of Groundwater (ft) September 2021	Depth of Groundwater (ft) October 2021
TB-1	19	3.5	16
TB-2	15	3.5	14.6
TB-3	10	3.5	11.4

Comment below states there is at least 14 ft between ground and water elevation. Based on table, that is not the case, and this TB is right in the middle of the proposed site. Piezometer shows water levels way less than 14 ft as well.

We do understand groundwater information obtained at the time of the preliminary investigations performed prior to the land development phase may or may not be representative of the conditions present at the time of construction. Furthermore, the development processes (reshaping of the ground surface, installation of buried utilities, installation of an underdrain below the roadways, etc.) can significantly alter the depth and flow paths of the subsurface water. The construction of surrounding lots can also alter the amount and depth of subsurface groundwater below a given lot.

Based on mitigation measures below, basements and crawlspace are not recommended/proposed. If this is the case, why are we providing conditions where a basement could be constructed?

ations, as noted in our original study, were that basement construction should be t where the following conditions apply:

rains are installed at the bottom of sanitary sewer trenches within drive lanes;

long groundwater monitoring study has been undertaken, and the results indicate groundwater is sufficiently deep to allow basement construction;

the proposed site grading will result in at least 14 feet of separation between the proposed ground surface and the groundwater elevation.

RMG Response:

Incorrect. The statement that the clouded comment is referring to is a reiteration (in our *Addendum* report) of a statement that was made in our original *Soils and Geology Study*. Our original report indicated that basement construction should be restricted except where one of three conditions were met, and listed what those conditions are. That restriction and its associated conditions were duplicated in the *Addendum* letter to provide context for the groundwater discussion. They were not included as an evaluation of (nor were they intended to indicate) whether or not any of those three conditions were met.

CGS Comments:

ground surface, installation of buried utilities, installation of an underdrain below the roadways, etc.) can significantly alter the depth and flow paths of the subsurface water. The construction of surrounding lots can also alter the amount and depth of subsurface groundwater below a given lot.

Based on mitigation measures below, basements and crawlspace are not recommended/proposed. If this is the case, why are we providing conditions where a basement could be constructed?

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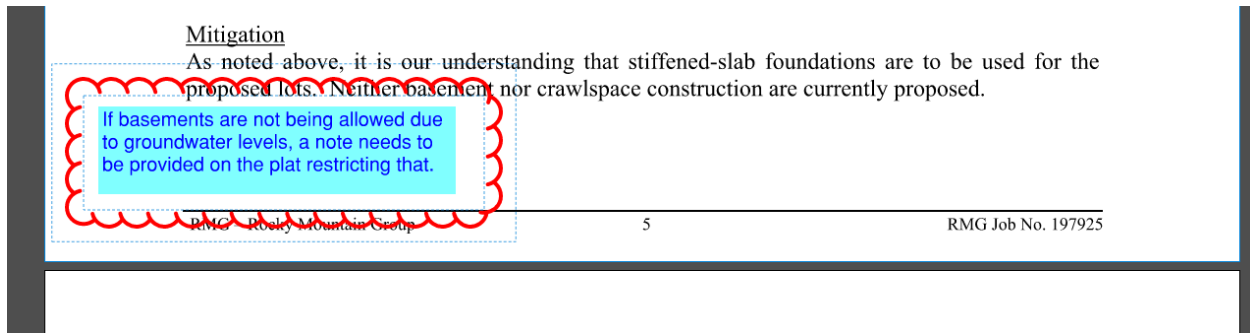
long groundwater monitoring study has been undertaken, and the results indicate groundwater is sufficiently deep to allow basement construction;

the proposed site grading will result in at least 14 feet of separation between the proposed ground surface and the groundwater elevation.

RMG Response:

Again, that restriction and its associated conditions were included for context, only. We were not providing conditions where a basement could be constructed. Rather, we were reiterating the restrictions that had previously been placed upon basement construction in our original report.

CGS Comments:



RMG Response:

Review of the plat document is outside the scope of both our original investigation and the addendum letter which included the comments. However, as noted in our *Addendum*, stiffened slabs are to be used for the proposed lots, and no basements or crawlspaces are currently proposed. Therefore, RMG has no objection to such a note being added to the plat.

I hope this provides the information you have requested. Should you have questions, please feel free to contact our office.

Cordially,

RMG Engineers

Kelli Zigler
Geotechnical Group Director

Reviewed by,

RMG Engineers



Tony Munger, P.E.
Sr. Geotechnical Proj Mgr | COO

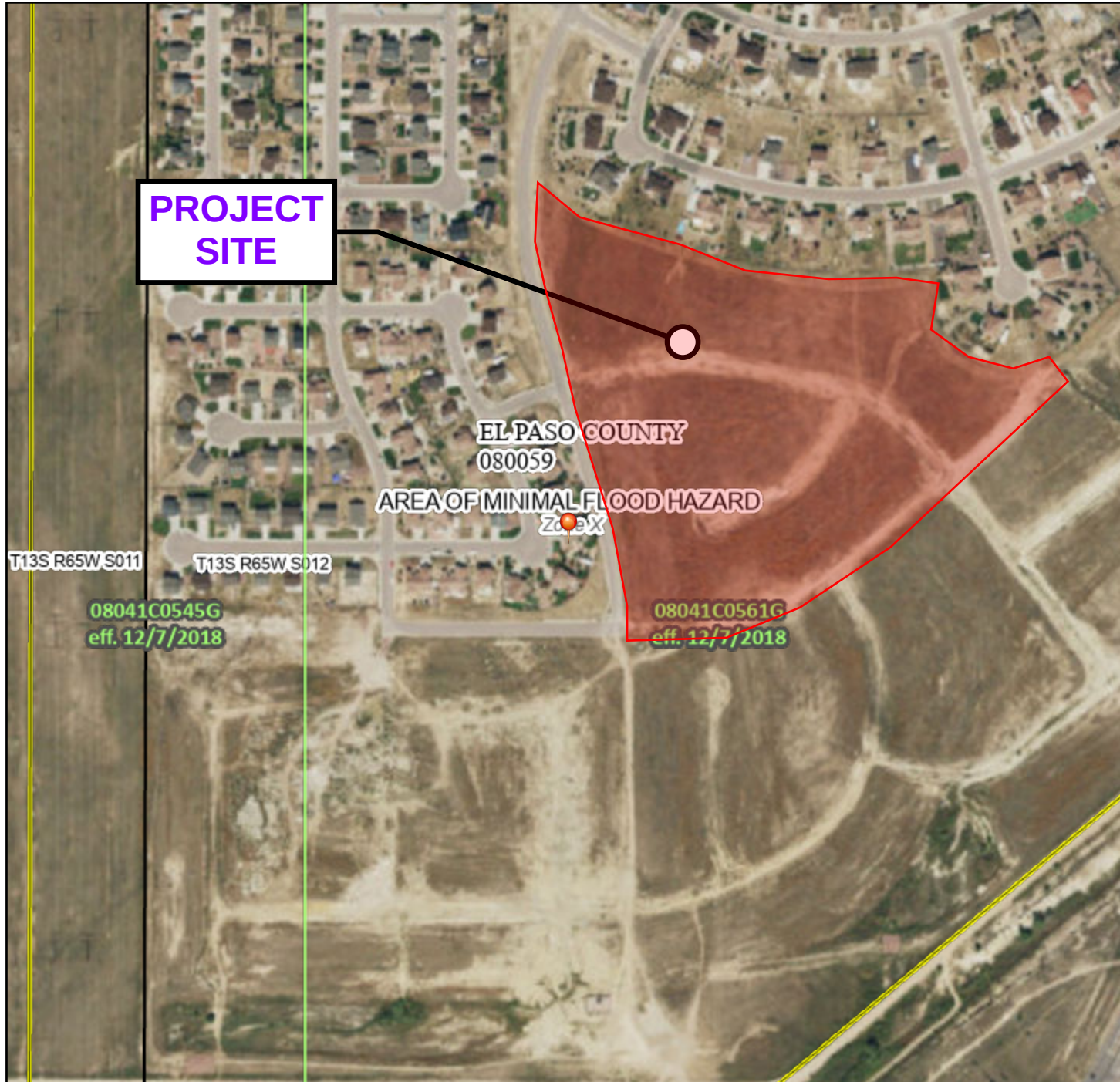
Appendix C

FEMA Map

National Flood Hazard Layer FIRMMette



104°37'40"W 38°56'3"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

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

Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
MAP PANELS		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 **5/21/2021 at 11:21 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.

Appendix D

Hydrologic Calculations

Calculation of Peak Runoff using Rational Method	
--	--

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website ([click this link](#))

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
our rainfall depth, P1 (in) =	1.16	1.44	1.68	1.92	2.16	2.42
ity Equation Coefficients =	a 28.50	b 10.00	c 0.786	$l(in/hr) = \frac{a * P_1}{(b + t_c)^c}$		
				$Q(cfs) = CIA$		

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time			Channelized (Travel) Flow Time					Time of Concentration			Rainfall Intensity, I (in/hr)						Peak Flow, Q (cfs)					
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L _i (ft)	Overland Flow Slope S _i (ft/ft)	Overland Flow Time t _i (min)	Channelized Flow Length L _i (ft)	Channelized Flow Slope S _i (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V _i (ft/sec)	Channelized Flow Time t _i (min)	Computed t _c (min)	Regional t _c (min)	Selected t _c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
EX-1	3.38	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00	0.050	19.88	1250.00	0.020	5	0.71	29.46	49.34	40.34	40.34	1.52	1.89	2.20	2.51	2.83	3.17	0.09	0.12	0.16	0.26	0.65	1.60
EX-2	9.38	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00	0.090	16.37	975.00	0.030	5	0.87	18.76	35.14	34.82	34.82	1.66	2.07	2.41	2.75	3.10	3.47	0.27	0.36	0.49	0.79	1.97	4.85
EX-3	9.14	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00	0.090	16.37	440.00	0.020	5	0.71	10.37	26.74	30.50	26.74	1.95	2.42	2.82	3.22	3.62	4.06	0.30	0.42	0.56	0.90	2.24	5.53
OS-1	6.38	A	34.3	0.21	0.22	0.23	0.27	0.32	0.38	0.48	25.00	0.020	6.32	650.00	0.030	20	3.46	3.13	9.45	24.70	9.45	3.21	3.98	4.65	5.31	5.97	6.69	4.27	5.58	6.92	9.00	12.12	16.11
OS-2	3.12	A	40.0	0.25	0.27	0.28	0.32	0.37	0.42	0.51	50.00	0.020	8.46	2180.00	0.020	20	2.83	12.85	21.30	36.80	21.30	2.21	2.74	3.20	3.65	4.11	4.60	1.75	2.29	2.82	3.60	4.70	6.06
OS-3	1.14	A	100.0	0.84	0.86	0.87	0.88	0.88	0.89	0.90	20.00	0.020	1.54	1190.00	0.020	20	2.83	7.01	8.55	15.10	8.55	3.33	4.13	4.82	5.51	6.20	6.95	3.19	4.06	4.80	5.55	6.21	7.04
OS-4	13.09	A	23.8	0.13	0.14	0.15	0.18	0.23	0.30	0.41	80.00	0.020	12.36	2300.00	0.020	20	2.83	13.55	25.91	43.93	25.91	1.98	2.46	2.87	3.28	3.69	4.13	3.36	4.44	5.59	7.56	11.02	15.98
OS-5	59.62	A	40.0	0.25	0.27	0.28	0.32	0.37	0.42	0.51	100.00	0.020	11.96	608.00	0.020	20	2.83	3.58	15.54	24.11	15.54	2.59	3.21	3.75	4.29	4.82	5.40	39.33	51.26	63.13	80.65	105.39	135.79
OS-6	35.75	A	25.0	0.14	0.15	0.16	0.19	0.24	0.30	0.42	300.00	0.020	23.71	0.00	0.006	20	1.55	0.00	23.71	21.75	21.75	2.18	2.71	3.16	3.61	4.06	4.55	10.78	14.22	17.88	24.03	34.65	49.60
OS-7	6.47	A	25.0	0.14	0.15	0.16	0.19	0.24	0.30	0.42	300.00	0.020	23.71	300.00	0.006	20	1.55	3.23	26.94	26.91	26.91	1.94	2.41	2.81	3.21	3.61	4.04	1.73	2.29	2.87	3.86	5.57	7.97
OS-8	3.74	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	202.00	0.020	22.07	910.00	0.010	15	1.50	10.11	32.18	40.79	32.18	1.75	2.17	2.53	2.89	3.25	3.64	0.11	0.15	0.21	0.33	0.82	2.03
OS-9	3.14	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	75.00	0.020	13.45	150.00	0.030	15	2.60	0.96	14.41	26.64	14.41	2.68	3.33	3.89	4.44	5.00	5.60	0.14	0.20	0.27	0.43	1.06	2.62
OS-10	3.67	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	125.00	0.020	17.36	630.00	0.016	15	1.90	5.53	22.90	33.71	22.90	2.12	2.63	3.07	3.51	3.95	4.43	0.13	0.18	0.25	0.39	0.98	2.42
OS-11	35.55	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00	0.020	26.90	950.00	0.010	15	1.50	10.56	37.45	41.47	37.45	1.59	1.98	2.30	2.63	2.96	3.32	0.96	1.32	1.78	2.85	7.13	17.58
OS-12	39.29	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00	0.020	26.90	570.00	0.010	15	1.50	6.33	33.23	34.94	33.23	1.71	2.13	2.48	2.83	3.19	3.57	1.14	1.57	2.12	3.39	8.48	20.90
OS-13	10.54	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00	0.020	26.90	360.00	0.010	15	1.50	4.00	30.90	31.34	30.90	1.79	2.22	2.59	2.96	3.33	3.73	0.32	0.44	0.59	0.95	2.38	5.86
OS-14	8.84	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	200.00	0.020	21.96	630.00	0.011	15	1.57	6.67	28.64	35.47	28.64	1.87	2.32	2.71	3.10	3.48	3.90	0.28	0.39	0.52	0.83	2.08	5.14

Calculation of Peak Runoff using Rational Method	
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Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website ([click this link](#))

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
our rainfall depth, P1 (in) =	1.16	1.44	1.68	1.92	2.16	2.42
ity Equation Coefficients =	a 28.50	b 10.00	c 0.786	$l(in/hr) = \frac{a * P_1}{(b + t_c)^c}$		
				$Q(cfs) = CIA$		

Falcon Highlands South Fil. No. 1 Consolidated A basins for Overall

Project Name: Falcon Highlands South Fil. No. 1
Project Number: 24004308

Prep. By: Scott Z
Date: 05/29/2025

'A' Basins					
Basin	(AC)	Assigned "I"	A x I%	Q₅	Q₁₀₀
A-1	4.49	5%	0.225	0.12	1.64
A-2	4.83	35%	1.691	2.89	8.24
A-3	2.46	35%	0.861	1.48	4.22
A-4	2.55	35%	0.893	1.54	4.38
A-5	3.52	35%	1.232	2.35	6.70
A-6	2.75	35%	0.963	1.61	4.59
A (consolidated)	20.60		5.863		
Total Wtd i%	28.5%				
C₅ @ I=28.5%	0.17				
C₁₀₀ @ I=28.5%	0.33				
		Q₅ Total (additive & conservative)		9.99	
		Q₁₀₀ Total (additive & conservative)			29.77

Appendix E

Hydraulic Calculations

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A-1	A-2	A-3	A-4	A-5
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	STREET	STREET	STREET	STREET
Hydraulic Condition	Swale	On Grade	On Grade	In Sump	In Sump
Inlet Type	CDOT Type C	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.1	2.9	1.5	1.5	2.4
Major Q_{Known} (cfs)	1.6	8.2	4.2	4.4	6.7

Bypass (Carry-Over) Flow from Upstream

Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	A-3	A-2
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.2	2.1

Watershed Characteristics

Subcatchment Area (acres)					
Percent Impervious					
NRCS Soil Type					

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	0.1	2.9	1.5	1.5	2.4
Major Total Design Peak Flow, Q (cfs)	1.6	8.2	4.2	4.6	8.8
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	2.1	0.2	N/A	N/A

BYPASS to A-5

BYPASS to A-4

BYPASS from A-3

BYPASS from A-2

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A-1	A-2	A-3	A-4	A-5
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	STREET	STREET	STREET	STREET
Hydraulic Condition	Swale	On Grade	On Grade	In Sump	In Sump
Inlet Type	CDOT Type C	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.1	2.9	1.5	1.5	2.4
Major Q_{Known} (cfs)	1.6	8.2	4.2	4.4	6.7

Bypass (Carry-Over) Flow from Upstream

Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	A-3	A-2
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.2	2.1

Watershed Characteristics

Subcatchment Area (acres)					
Percent Impervious					
NRCS Soil Type					

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	0.1	2.9	1.5	1.5	2.4
Major Total Design Peak Flow, Q (cfs)	1.6	8.2	4.2	4.6	8.8
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	2.1	0.2	N/A	N/A

BYPASS to A-5

BYPASS to A-4

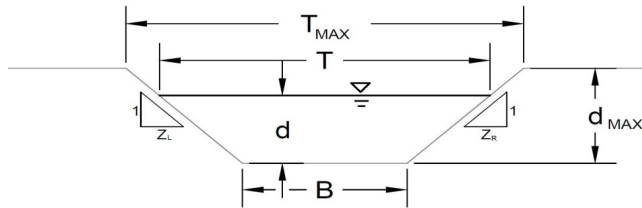
BYPASS from A-3

BYPASS from A-2

AREA INLET IN A SWALE

Falcon Highlands South

A-1



This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

NRCS Vegetal Retardance (A, B, C, D, or E)

Manning's n (Leave cell D16 blank to manually enter an n value)

Channel Invert Slope

Bottom Width

Left Side Slope

Right Side Slope

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

A, B, C, D, or E =

E
n = see details below
S_o = 0.0050 ft/ft
B = 2.00 ft
Z_L = 4.00 ft/ft
Z_R = 4.00 ft/ft

Choose One:

- ☐ Non-Cohesive
☒ Cohesive
☐ Paved

Maximum Allowable Top Width of Channel for Minor & Major Storm

Maximum Allowable Water Depth in Channel for Minor & Major Storm

	Minor Storm	Major Storm
T_{MAX} =	8.00	8.00
d_{MAX} =	2.00	2.00

Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Top Width Criterion

MAJOR STORM Allowable Capacity is based on Top Width Criterion

	Minor Storm	Major Storm
Q_{allow} =	5.9	5.9
d_{allow} =	0.75	0.75

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow

Water Depth

	Minor Storm	Major Storm
Q_o =	0.1	1.6
d =	0.13	0.48

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Inlet Design Information (Input)

Type of Inlet

CDOT Type C

Inlet Type =

CDOT Type C

Angle of Inclined Grate (must be ≤ 30 degrees)

Width of Grate

Length of Grate

Open Area Ratio

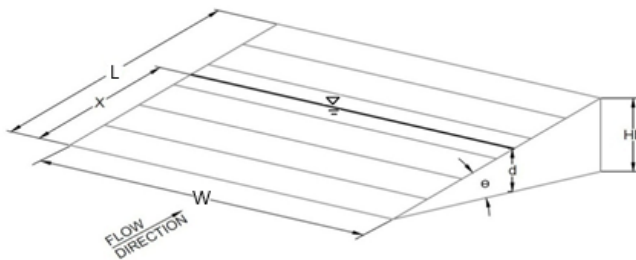
Height of Inclined Grate

Clogging Factor

Grate Discharge Coefficient

Orifice Coefficient

Weir Coefficient



θ =	0.00	degrees
W =	3.00	ft
L =	3.00	ft
A_{RATIO} =	0.70	
H_B =	0.00	ft
C_f =	0.50	
C_d =	0.96	
C_o =	0.64	
C_w =	2.05	

Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)

Total Inlet Interception Capacity (assumes clogged condition)

Bypassed Flow

Capture Percentage = Q_a/Q_o

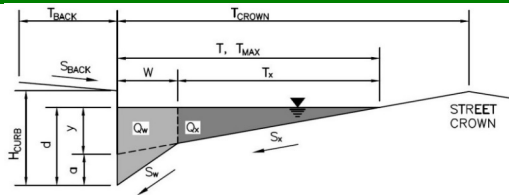
	MINOR	MAJOR
d =	0.13	0.48
Q_a =	0.9	6.1
Q_b =	0.0	0.0
C% =	100	100

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

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

Project: Falcon Highlands South

Inlet ID: A-2

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.013	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	17.7	ft
W	=	2.00	ft
S_x	=	0.020	ft/ft
S_w	=	0.083	ft/ft
S_o	=	0.020	ft/ft
n_{STREET}	=	0.013	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	17.0	17.0	ft
d_{MAX}	6.0	7.2	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

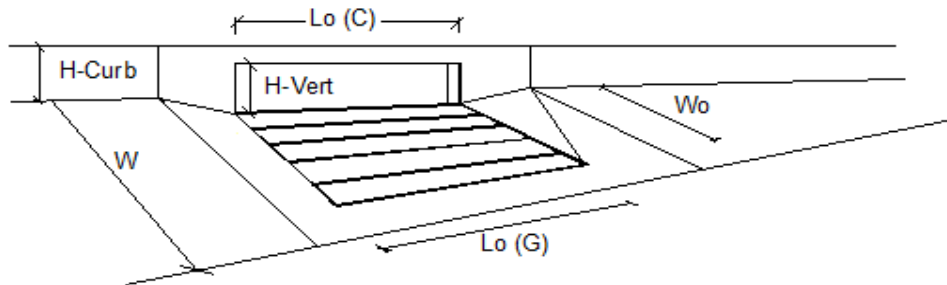
MAJOR STORM Allowable Capacity is based on Spread Criterion

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.90 cfs on sheet 'Inlet Management'**Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.20 cfs on sheet 'Inlet Management'**

	Minor Storm	Major Storm	
Q_{allow}	18.9	18.9	cfs

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

**Design Information (Input)**

Type of Inlet

CDOT Type R Curb Opening

Local Depression (additional to continuous gutter depression 'a')

Total Number of Units in the Inlet (Grate or Curb Opening)

Length of a Single Unit Inlet (Grate or Curb Opening)

Width of a Unit Grate (cannot be greater than W, Gutter Width)

Clogging Factor for a Single Unit Grate (typical min. value = 0.5)

Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

Street Hydraulics: OK - $Q < Q_a$ Allowable Street Capacity'

Total Inlet Interception Capacity

Total Inlet Carry-Over Flow (flow bypassing inlet)

Capture Percentage = Q_a/Q_o

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a_{LOCAL}	3.0	3.0	inches
N_o	1	1	
L_o	10.00	10.00	ft
W_o	N/A	N/A	ft
$C_f(G)$	N/A	N/A	
$C_f(C)$	0.10	0.10	

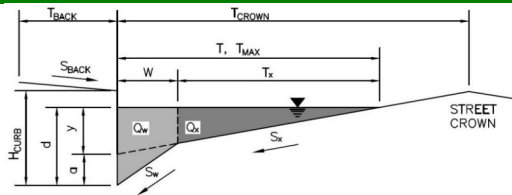
	MINOR	MAJOR	
Q	2.9	6.1	cfs
Q_b	0.0	2.1	cfs
$C\%$	100	74	%

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

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

Project: Falcon Highlands South

Inlet ID: A-3

**Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.013	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	17.7	ft
W	=	2.00	ft
S_x	=	0.020	ft/ft
S_w	=	0.083	ft/ft
S_o	=	0.020	ft/ft
n_{STREET}	=	0.013	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	=	17.0	ft
d_{MAX}	=	6.0	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

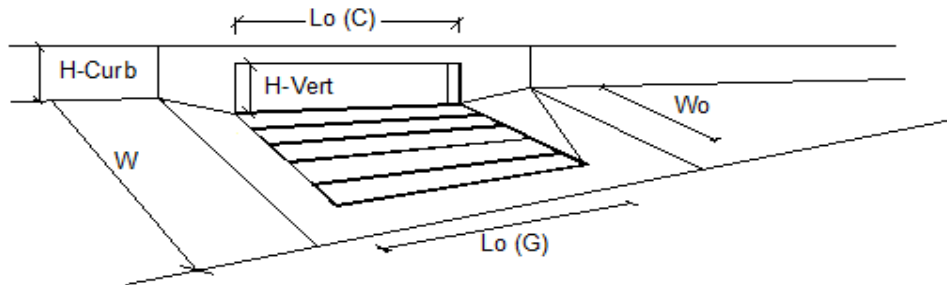
MAJOR STORM Allowable Capacity is based on Spread Criterion

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.50 cfs on sheet 'Inlet Management'**Major storm max. allowable capacity GOOD - greater than the design peak flow of 4.20 cfs on sheet 'Inlet Management'**

	Minor Storm	Major Storm	
Q_{allow}	=	18.9	cfs

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

**Design Information (Input)**

Type of Inlet

CDOT Type R Curb Opening

Local Depression (additional to continuous gutter depression 'a')

Total Number of Units in the Inlet (Grate or Curb Opening)

Length of a Single Unit Inlet (Grate or Curb Opening)

Width of a Unit Grate (cannot be greater than W, Gutter Width)

Clogging Factor for a Single Unit Grate (typical min. value = 0.5)

Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

Street Hydraulics: OK - $Q < Q_a$ Allowable Street Capacity'

Total Inlet Interception Capacity

Total Inlet Carry-Over Flow (flow bypassing inlet)

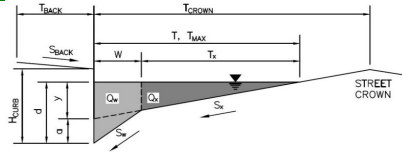
Capture Percentage = Q_a/Q_o

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a_{LOCAL}	=	3.0	inches
N_o	=	1	
L_o	=	10.00	ft
W_o	=	N/A	ft
$C_f(G)$	=	N/A	
$C_f(C)$	=	0.10	

	MINOR	MAJOR	
Q	=	1.5	cfs
Q_b	=	0.0	cfs
$C\%$	=	100	%

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

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

Project: **Falcon Highlands South**Inlet ID: **A-4****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.013	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	17.7	ft
W	=	2.00	ft
S_x	=	0.020	ft/ft
S_w	=	0.083	ft/ft
S_o	=	0.000	ft/ft
n_{STREET}	=	0.013	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
T_{MAX}	17.0	17.0	ft
d_{MAX}	6.0	7.2	inches

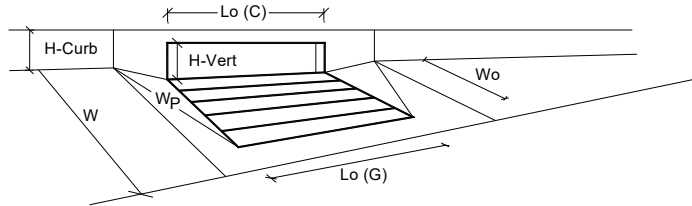
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow}	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

**Design Information (Input)**

Type of Inlet

CDOT Type R Curb Opening

Local Depression (additional to continuous gutter depression 'a' from above)

Number of Unit Inlets (Grate or Curb Opening)

Water Depth at Flowline (outside of local depression)

Grate Information

Length of a Unit Grate

Width of a Unit Grate

Open Area Ratio for a Grate (typical values 0.15-0.90)

Clogging Factor for a Single Grate (typical value 0.50 - 0.70)

Grate Weir Coefficient (typical value 2.15 - 3.60)

Grate Orifice Coefficient (typical value 0.60 - 0.80)

Curb Opening Information

Length of a Unit Curb Opening

Height of Vertical Curb Opening in Inches

Height of Curb Orifice Throat in Inches

Angle of Throat

Side Width for Depression Pan (typically the gutter width of 2 feet)

Clogging Factor for a Single Curb Opening (typical value 0.10)

Curb Opening Weir Coefficient (typical value 2.3-3.7)

Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth

Depth for Curb Opening Weir Equation

Grated Inlet Performance Reduction Factor for Long Inlets

Curb Opening Performance Reduction Factor for Long Inlets

Combination Inlet Performance Reduction Factor for Long Inlets

	MINOR	MAJOR	
Type	CDOT Type R Curb Opening		
a_{local}	3.00	3.00	inches
No	1	1	
Ponding Depth	5.6	7.2	inches
	MINOR	MAJOR	☒ Override Depths
$L_o (G)$	N/A	N/A	feet
W_o	N/A	N/A	feet
A_{ratio}	N/A	N/A	
$C_r (G)$	N/A	N/A	
$C_w (G)$	N/A	N/A	
$C_o (G)$	N/A	N/A	
	MINOR	MAJOR	
$L_o (C)$	5.00	5.00	feet
H_{vert}	6.00	6.00	inches
H_{throat}	6.00	6.00	inches
Theta	63.40	63.40	degrees
W_p	2.00	2.00	feet
$C_r (C)$	0.10	0.10	
$C_w (C)$	3.60	3.60	
$C_o (C)$	0.67	0.67	
	MINOR	MAJOR	
d_{Grate}	N/A	N/A	ft
d_{Curb}	0.30	0.43	ft
RF_{Grate}	N/A	N/A	
RF_{Curb}	1.00	1.00	
$RF_{Combination}$	N/A	N/A	

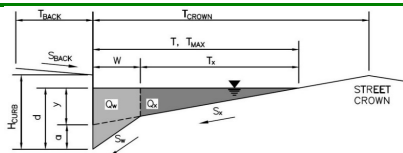
Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)

	MINOR	MAJOR	
Q_a	4.6	8.0	cfs
$Q_{PEAK REQUIRED}$	1.5	4.6	cfs

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

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

Project: **Falcon Highlands South**Inlet ID: **A-5****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.013	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	17.7	ft
W	=	2.00	ft
S_x	=	0.020	ft/ft
S_w	=	0.083	ft/ft
S_o	=	0.000	ft/ft
n_{STREET}	=	0.013	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
T_{MAX}	17.0	17.0	ft
d_{MAX}	6.0	7.2	inches

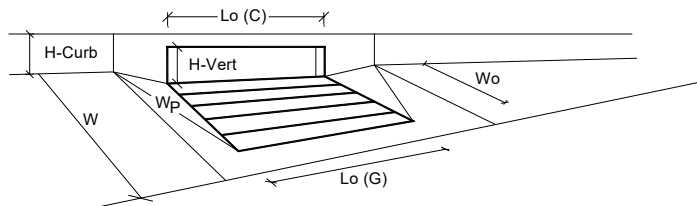
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow}	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

**Design Information (Input)**

Type of Inlet

CDOT Type R Curb Opening

Local Depression (additional to continuous gutter depression 'a' from above)

Number of Unit Inlets (Grate or Curb Opening)

Water Depth at Flowline (outside of local depression)

Grate Information

Length of a Unit Grate

Width of a Unit Grate

Open Area Ratio for a Grate (typical values 0.15-0.90)

Clogging Factor for a Single Grate (typical value 0.50 - 0.70)

Grate Weir Coefficient (typical value 2.15 - 3.60)

Grate Orifice Coefficient (typical value 0.60 - 0.80)

Curb Opening Information

Length of a Unit Curb Opening

Height of Vertical Curb Opening in Inches

Height of Curb Orifice Throat in Inches

Angle of Throat

Side Width for Depression Pan (typically the gutter width of 2 feet)

Clogging Factor for a Single Curb Opening (typical value 0.10)

Curb Opening Weir Coefficient (typical value 2.3-3.7)

Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth

Depth for Curb Opening Weir Equation

Grated Inlet Performance Reduction Factor for Long Inlets

Curb Opening Performance Reduction Factor for Long Inlets

Combination Inlet Performance Reduction Factor for Long Inlets

	MINOR	MAJOR	
Type	CDOT Type R Curb Opening		
a_{local}	3.00	3.00	inches
No	1	1	
Ponding Depth	5.6	7.2	inches
	MINOR	MAJOR	☒ Override Depths
$L_o (G)$	N/A	N/A	feet
W_o	N/A	N/A	feet
A_{ratio}	N/A	N/A	
$C_r (G)$	N/A	N/A	
$C_w (G)$	N/A	N/A	
$C_o (G)$	N/A	N/A	
	MINOR	MAJOR	
$L_o (C)$	10.00	10.00	feet
H_{vert}	6.00	6.00	inches
H_{throat}	6.00	6.00	inches
Theta	63.40	63.40	degrees
W_p	2.00	2.00	feet
$C_r (C)$	0.10	0.10	
$C_w (C)$	3.60	3.60	
$C_o (C)$	0.67	0.67	
	MINOR	MAJOR	
d_{Grate}	N/A	N/A	ft
d_{Curb}	0.30	0.43	ft
RF_{Grate}	N/A	N/A	
RF_{Curb}	0.91	1.00	
$RF_{Combination}$	N/A	N/A	

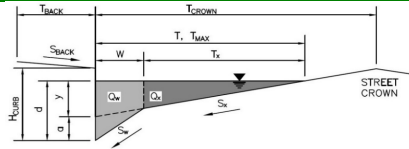
Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)

	MINOR	MAJOR	
Q_a	6.9	13.1	cfs
$Q_{PEAK REQUIRED}$	2.4	8.8	cfs

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

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

Project: **Falcon Highlands South**Inlet ID: **Existing inlet****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

$T_{BACK} =$	5.0	ft
$S_{BACK} =$	0.020	ft/ft
$n_{BACK} =$	0.013	

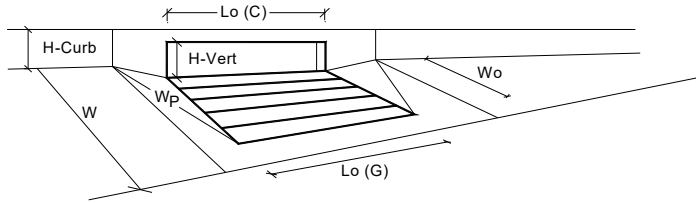
$H_{CURB} =$	6.00	inches
$T_{CROWN} =$	21.1	ft
$W =$	2.00	ft
$S_X =$	0.010	ft/ft
$S_W =$	0.083	ft/ft
$S_D =$	0.000	ft/ft
$n_{STREET} =$	0.013	

	Minor Storm	Major Storm	
$T_{MAX} =$	21.0	21.0	ft
$d_{MAX} =$	6.0	7.2	inches

	Minor Storm	Major Storm	
$Q_{allow} =$	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

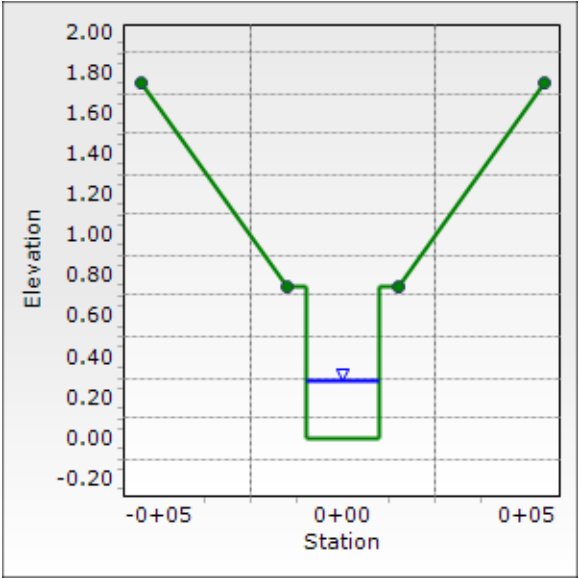
MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	7.2	inches
Grate Information			MINOR	MAJOR	☒ Override Depths
Length of a Unit Grate		$L_o (G)$ =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		$C_f (G)$ =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		$C_w (G)$ =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		$C_o (G)$ =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		$L_o (C)$ =	20.00	20.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		$C_f (C)$ =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		$C_w (C)$ =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		$C_o (C)$ =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.43	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.79	0.85	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		Q_a =	12.5	20.1	cfs
		$Q_{PEAK REQUIRED}$ =	1.6	4.6	cfs

Cross Section for Basin A-1 Bypass Swale

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	3.3 in
Discharge	1.60 cfs



Detailed Rept for Basin A-1 Bypass Swale

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Discharge	1.60 cfs

Section Definitions

Station (ft)	Elevation (ft)
-0+05.50	1.75
-0+01.50	0.75
-0+01.00	0.75
-0+01.00	0.00
0+01.00	0.00
0+01.00	0.75
0+01.50	0.75
0+05.50	1.75

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+05.50, 1.75)	(-0+01.50, 0.75)	0.030
(-0+01.50, 0.75)	(0+01.50, 0.75)	0.013
(0+01.50, 0.75)	(0+05.50, 1.75)	0.030

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	3.3 in
Roughness Coefficient	0.013
Elevation	0.28 ft
Elevation Range	0.00 to 1.75 ft
Flow Area	0.6 ft ²
Wetted Perimeter	2.55 ft
Hydraulic Radius	2.6 in
Top Width	2.00 ft
Normal Depth	3.3 in
Critical Depth	3.3 in
Critical Slope	0.005 ft/ft

Detailed Rept for Basin A-1 Bypass Swale

Results	
Velocity	2.91 ft/s
Velocity Head	0.13 ft
Specific Energy	0.41 ft
Froude Number	0.976
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	3.3 in
Critical Depth	3.3 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Channel Report

Off-site Swale for Drainage Basin C Berm

Trapezoidal

Bottom Width (ft)	= 2.50
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.032

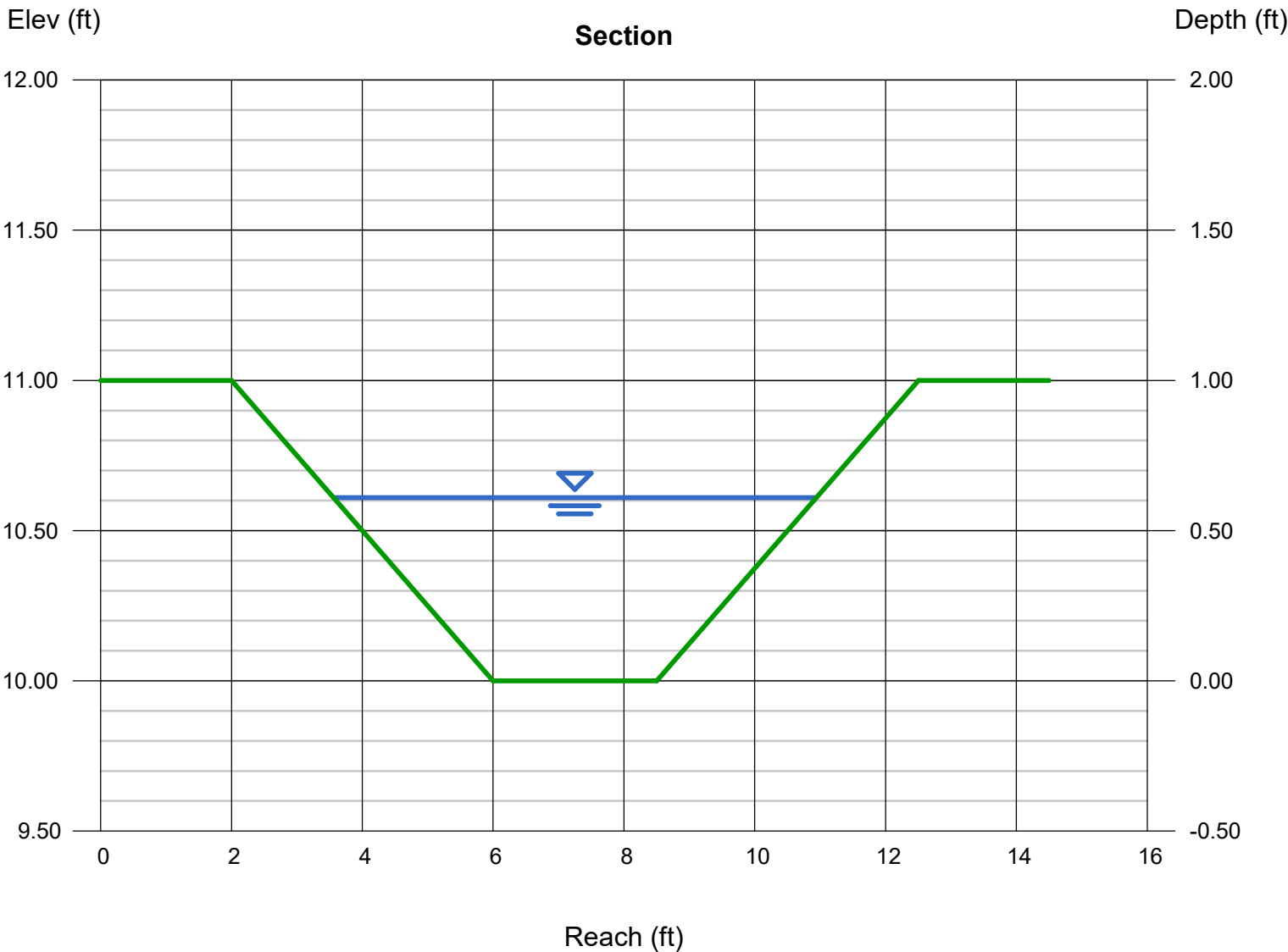
Highlighted

Depth (ft)	= 0.61
Q (cfs)	= 7.550
Area (sqft)	= 3.01
Velocity (ft/s)	= 2.51
Wetted Perim (ft)	= 7.53
Crit Depth, Yc (ft)	= 0.51
Top Width (ft)	= 7.38
EGL (ft)	= 0.71

Calculations

Compute by:	Known Q
Known Q (cfs)	= 7.55

THIS FLOW IS ONLY FROM A PORTION OF BASIN C, AS DISCUSSED WE ARE CREATING A BERM WHERE OUR PROPOSED STORM SEWER IS BEING PLACED AND CREATING A SWALE/DIVERSION DITCH. WE ARE PROVIDING AN ANALYSIS TO SO SHOW THAT FLOW WILL NOT OVERTOP THE BERM, BUT WILL FOLLOW THE BERM TO A TEMPORARY INLET PIPE INTO POND 2



Temporary pipe 1 - From Basin C Berm

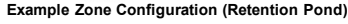
Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.032 ft/ft
Diameter	18.0 in
Discharge	7.55 cfs
Results	
Normal Depth	7.9 in
Flow Area	0.7 ft ²
Wetted Perimeter	2.2 ft
Hydraulic Radius	4.1 in
Top Width	1.49 ft
Critical Depth	12.8 in
Percent Full	44.0 %
Critical Slope	0.007 ft/ft
Velocity	10.07 ft/s
Velocity Head	1.58 ft
Specific Energy	2.24 ft
Froude Number	2.503
Maximum Discharge	20.28 cfs
Discharge Full	18.85 cfs
Slope Full	0.005 ft/ft
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	44.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.9 in
Critical Depth	12.8 in
Channel Slope	0.032 ft/ft
Critical Slope	0.007 ft/ft

Temp pipe 2 from existing channel

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.021 ft/ft
Diameter	30.0 in
Discharge	61.54 cfs
Results	
Normal Depth	25.7 in
Flow Area	4.5 ft ²
Wetted Perimeter	5.9 ft
Hydraulic Radius	9.1 in
Top Width	1.76 ft
Critical Depth	28.8 in
Percent Full	85.6 %
Critical Slope	0.020 ft/ft
Velocity	13.76 ft/s
Velocity Head	2.94 ft
Specific Energy	5.08 ft
Froude Number	1.521
Maximum Discharge	63.94 cfs
Discharge Full	59.44 cfs
Slope Full	0.023 ft/ft
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	85.6 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	25.7 in
Critical Depth	28.8 in
Channel Slope	0.021 ft/ft
Critical Slope	0.020 ft/ft

MHFD-Detention, Version 4.06 (July 2022)

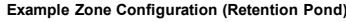
Basin ID: Temporary Pond 1 (Existing Conditions)



Values only used to
compare to master drainage
report by Terra Nova

MHFD-Detention, Version 4.06 (July 2022)

Basin ID: Temporary Pond 2 (Existing Conditions)



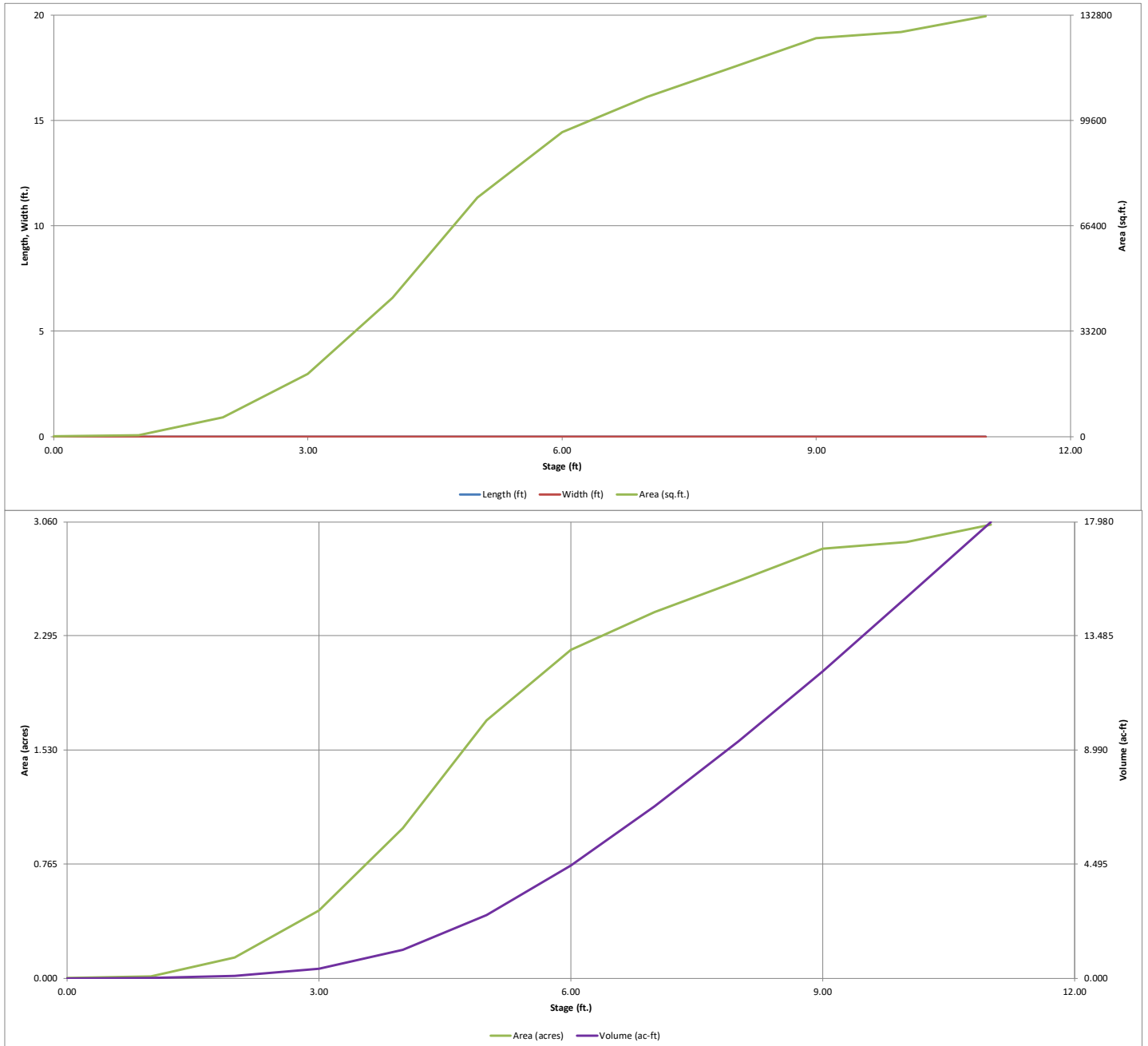
Area Tributary to Existing Pond 2

Values only used to
compare to master drainage
report by Terra Nova

6/2/2025, 3:32 AM

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

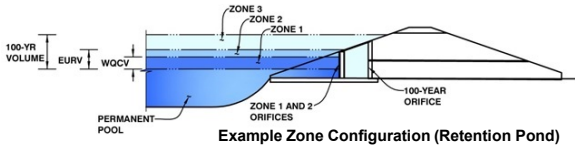


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Falcon Highlands

Basin ID: Pond 1 Final Condition (Trib Basins = A-6, 8, OS-1, OS-2, OS-5)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.93	2.342	Orifice Plate
Zone 2 (EURV)	7.85	6.579	Orifice Plate
Zone 3 (100-year)	9.42	4.372	Weir&Pipe (Restrict)
Total (all zones)		13.293	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area = N/A ft²
Underdrain Orifice Centroid = N/A feet

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

Calculated Parameters for Plate

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 8.25 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = N/A inches
Orifice Plate: Orifice Area per Row = N/A sq. inches

WQ Orifice Area per Row = N/A ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

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	2.00	4.00	5.00				
Orifice Area (sq. inches)	6.20	6.20	6.50	54.00				

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

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

Invert of Vertical Orifice = Not Selected ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = Not Selected ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = Not Selected inches

Vertical Orifice Area = Not Selected ft²
Vertical Orifice Centroid = Not Selected feet

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

Calculated Parameters for Overflow Weir

Overflow Weir Front Edge Height, H_o = 8.25 ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = 5.67 feet
Overflow Weir Gate Slope = 4.00 H:V
Horiz. Length of Weir Sides = 2.91 feet
Overflow Gate Type = Type C Gate
Debris Clogging % = 50%

Height of Gate Upper Edge, H_u = 8.98 feet
Overflow Weir Slope Length = 3.00 feet
Gate Open Area / 100-yr Orifice Area = 3.07
Overflow Gate Open Area w/o Debris = 11.84 ft²
Overflow Gate Open Area w/ Debris = 5.92 ft²

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Depth to Invert of Outlet Pipe = 0.37 ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = 30.00 inches
Restrictor Plate Height Above Pipe Invert = 22.00 inches

Outlet Orifice Area = 3.86 ft²
Outlet Orifice Centroid = 1.02 feet
Half-Central Angle of Restrictor Plate on Pipe = 2.06 radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage = 9.95 ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = 50.00 feet
Spillway End Slopes = 10.00 H:V
Freeboard above Max Water Surface = 1.00 feet

Spillway Design Flow Depth = 1.43 feet
Stage at Top of Freeboard = 12.38 feet
Basin Area at Top of Freeboard = 3.04 acres
Basin Volume at Top of Freeboard = 17.98 acre-ft

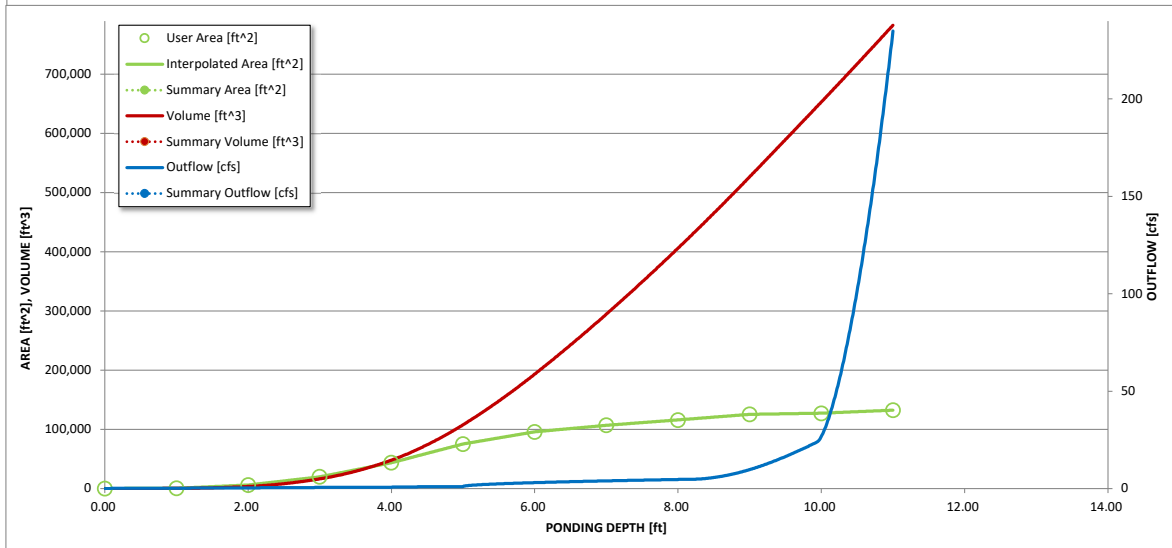
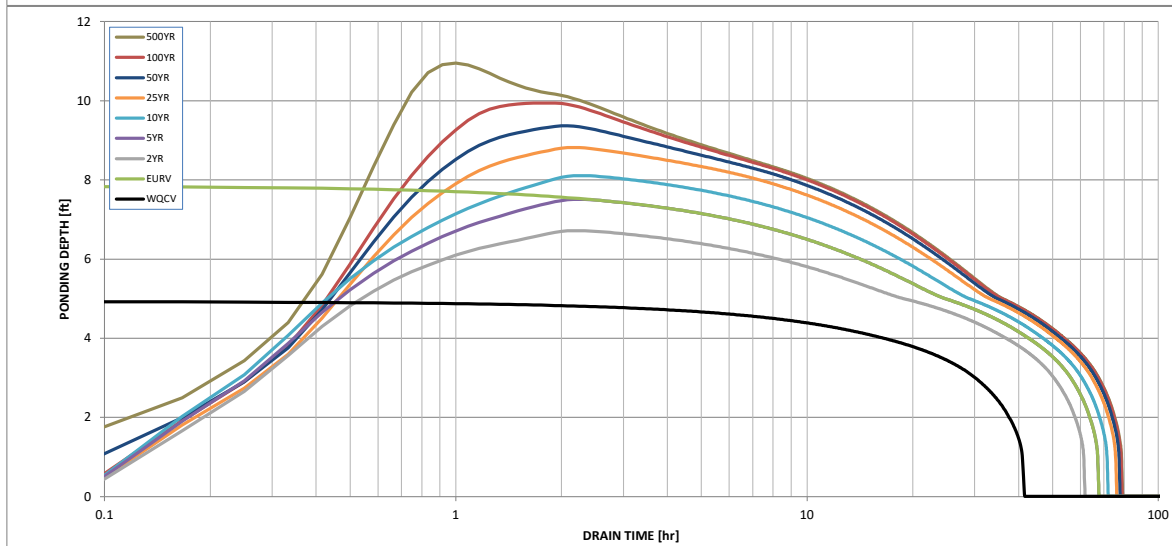
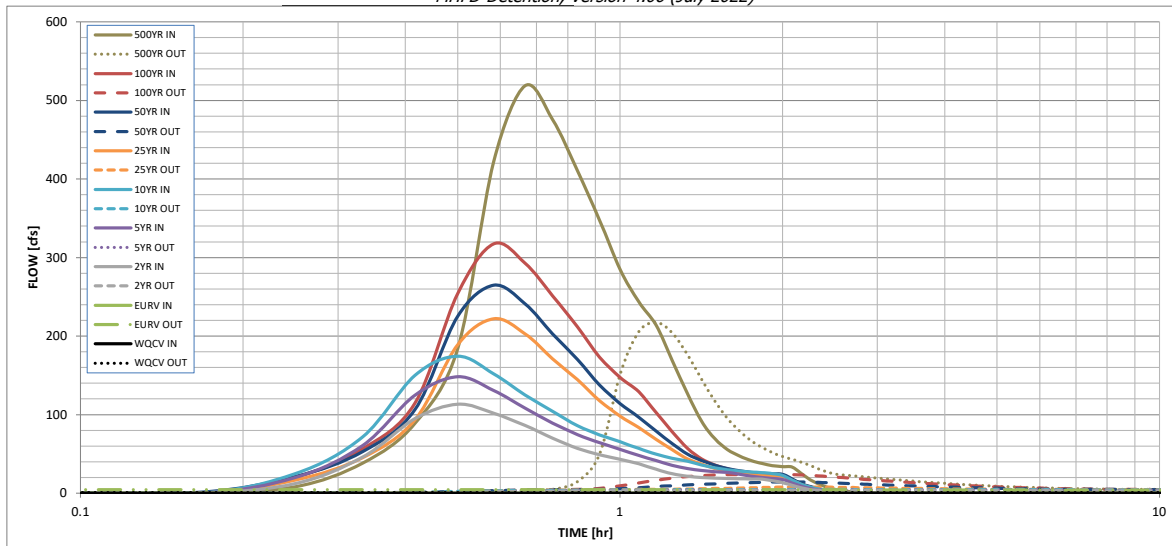
Routed Hydrograph Results

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	3.68
One-Hour Rainfall Depth (in)	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft)	2.342	8.921	6.601	8.655	10.307	12.465	14.584	17.158	27.895
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	6.601	8.655	10.307	12.465	14.584	17.158	27.895
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.8	1.7	2.3	21.0	42.0	70.0	181.0
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A		28.8	28.8				
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.26	0.26	0.19	0.38	0.63	1.64
Peak Inflow Q (cfs)	N/A	N/A	113.2	148.1	174.4	222.0	264.6	317.4	518.5
Peak Outflow Q (cfs)	1.0	4.6	3.7	4.3	4.7	7.9	14.4	23.9	217.4
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.1	0.2	0.4	0.3	0.3	1.2
Structure Controlling Flow	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	N/A	0.2	0.8	1.5	3.3
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	59	55	59	62	65	65	65	59
Time to Drain 99% of Inflow Volume (hours)	40	64	59	64	67	71	72	72	70
Maximum Ponding Depth (ft)	4.93	7.85	6.72	7.50	8.10	8.82	9.37	9.94	10.94
Area at Maximum Ponding Depth (acres)	1.68	2.63	2.38	2.56	2.69	2.84	2.89	2.92	3.03
Maximum Volume Stored (acre-ft)	2.353	8.925	6.063	8.017	9.590	11.551	13.133	14.790	17.795

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-*Detention*, Version 4.06 (July 2022)



DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

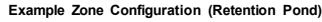
Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	0.14	8.30
	0:15:00	0.00	0.00	12.33	20.04	24.85	16.71	21.10	20.43	38.44
	0:20:00	0.00	0.00	45.85	60.72	71.63	45.38	52.96	56.58	88.66
	0:25:00	0.00	0.00	94.75	124.82	150.00	93.23	106.34	114.65	183.94
	0:30:00	0.00	0.00	113.22	148.10	174.41	189.03	225.14	254.18	421.55
	0:35:00	0.00	0.00	101.88	130.83	151.94	221.97	264.63	317.35	518.45
	0:40:00	0.00	0.00	86.17	108.21	125.27	203.03	241.35	292.74	475.64
	0:45:00	0.00	0.00	70.18	89.41	104.13	171.05	202.81	251.54	410.81
	0:50:00	0.00	0.00	57.19	74.76	85.94	144.45	170.46	211.65	347.55
	0:55:00	0.00	0.00	49.06	64.23	74.29	117.55	137.67	173.29	285.03
	1:00:00	0.00	0.00	43.00	55.83	65.41	98.06	114.19	147.56	243.58
	1:05:00	0.00	0.00	37.34	48.14	57.00	83.44	96.72	128.98	213.97
	1:10:00	0.00	0.00	30.39	41.54	49.75	68.60	79.10	102.79	169.07
	1:15:00	0.00	0.00	24.67	35.44	44.62	55.26	63.22	78.27	126.75
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	1:25:00	0.00	0.00	20.16	29.01	36.04	36.90	41.71	43.73	69.11
	1:30:00	0.00	0.00	19.22	27.49	32.40	31.55	35.56	35.76	55.50
	1:35:00	0.00	0.00	18.74	26.47	29.95	27.79	31.28	30.92	47.21
	1:40:00	0.00	0.00	18.36	24.00	28.24	25.25	28.41	27.61	41.50
	1:45:00	0.00	0.00	18.08	21.68	27.08	23.69	26.65	25.45	37.76
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	2:10:00	0.00	0.00	6.86	8.98	11.46	11.03	12.39	11.82	17.21
	2:15:00	0.00	0.00	4.64	6.07	7.83	7.54	8.46	8.11	11.78
	2:20:00	0.00	0.00	3.11	3.99	5.23	5.06	5.68	5.44	7.88
	2:25:00	0.00	0.00	1.97	2.55	3.39	3.28	3.68	3.52	5.10
	2:30:00	0.00	0.00	1.21	1.67	2.17	2.16	2.42	2.31	3.33
	2:35:00	0.00	0.00	0.64	0.98	1.23	1.27	1.42	1.35	1.94
	2:40:00	0.00	0.00	0.27	0.47	0.56	0.62	0.68	0.65	0.92
	2:45:00	0.00	0.00	0.09	0.14	0.16	0.19	0.21	0.20	0.27
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	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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
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	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

MHFD-Detention, Version 4.06 (July 2022)

Basin ID: Pond 1 Interim Condition (Trib Basins = A-6, B, OS-1, OS-2, OS-5)



Location for 1-hr Rainfall Depths = User Input

Optional User Overrides

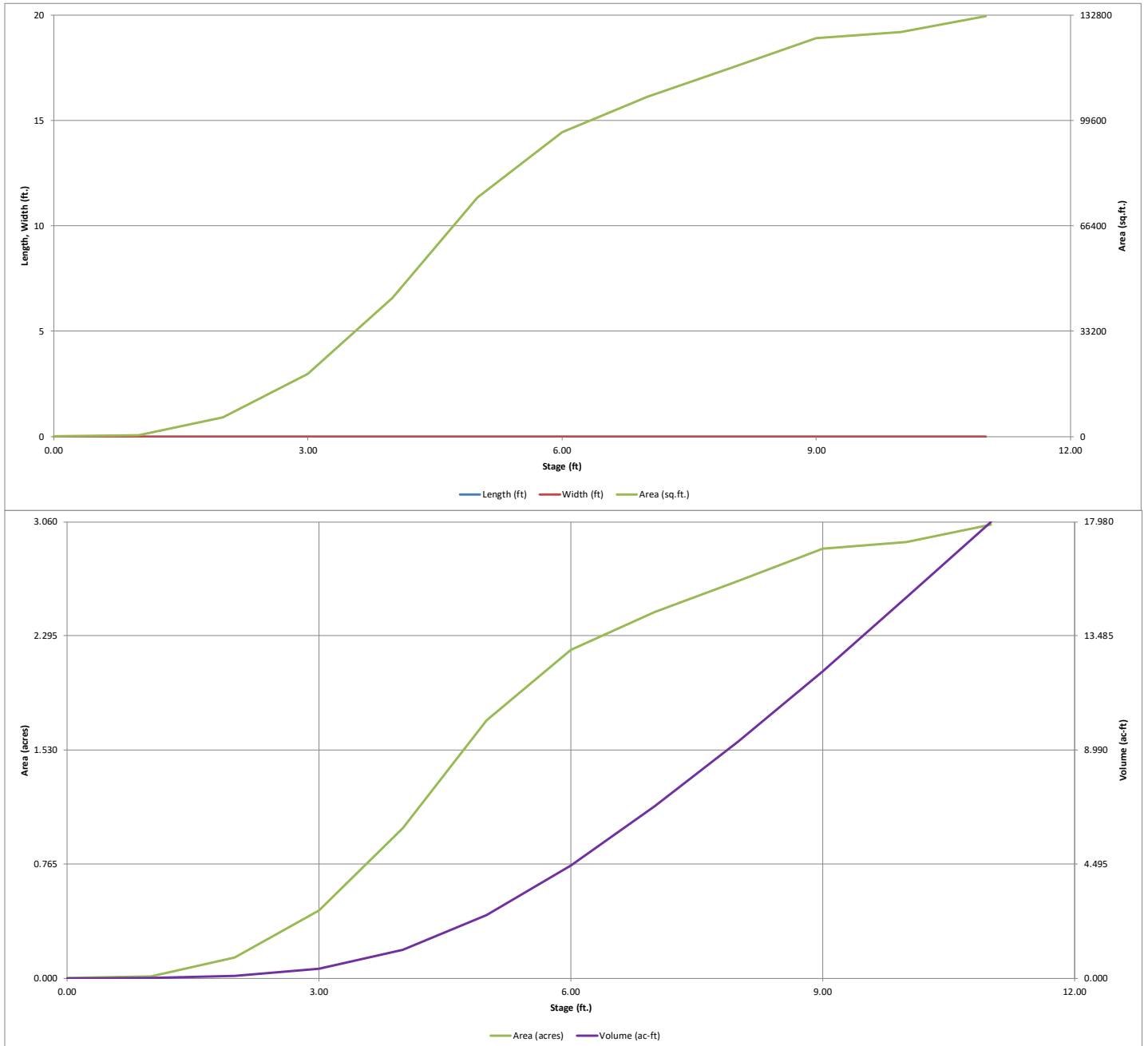
	acre-feet
	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.68	inches

Zone 1 Volume (WQCV) =	1.568	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.679	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.166	acre-feet
Total Detention Basin Volume =	7.413	acre-feet

Depth Increment = f

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

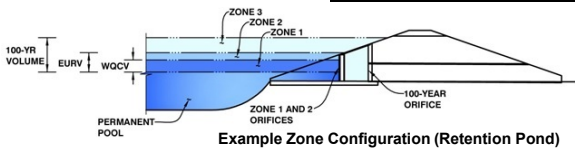


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Falcon Highlands

Basin ID: Pond 1 Interim Condition (Trib Basins = A-6, B, OS-1, OS-2, OS-5)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.41	1.568	Orifice Plate
Zone 2 (EURV)	5.92	2.679	Orifice Plate
Zone 3 (100-year)	7.27	3.166	Weir&Pipe (Restrict)
Total (all zones)		7.413	

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

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

Calculated Parameters for Underdrain
Underdrain Orifice Area = N/A ft²
Underdrain Orifice Centroid = N/A feet

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

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 8.25 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = N/A inches
Orifice Plate: Orifice Area per Row = N/A sq. inches

Calculated Parameters for Plate
WQ Orifice Area per Row = N/A ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

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)	0.0000	2.1700	4.3300	6.50				
Orifice Area (sq. inches)	5.00	5.25	12.00	432.00				
				18x24				
	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)

Invert of Vertical Orifice = Not Selected Not Selected ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = N/A N/A ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = N/A N/A inches

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = Not Selected Not Selected ft²
Vertical Orifice Centroid = N/A N/A feet

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

Overflow Weir Front Edge Height, H_o = Zone 3 Weir Not Selected ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = 8.25 N/A feet
Overflow Weir Grate Slope = 5.67 N/A H:V
Horiz. Length of Weir Sides = 4.00 N/A feet
Overflow Grate Type = 2.91 N/A Type C Grate
Debris Clogging % = 50% N/A %

Calculated Parameters for Overflow Weir
Height of Grate Upper Edge, H_t = Zone 3 Weir Not Selected feet
Overflow Weir Slope Length = 8.98 N/A feet
Grate Open Area / 100-yr Orifice Area = 3.00 N/A
Overflow Grate Open Area w/o Debris = 3.07 N/A ft²
Overflow Grate Open Area w/ Debris = 11.84 N/A ft²
Overflow Grate Open Area w/ Debris = 5.92 N/A ft²

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

Depth to Invert of Outlet Pipe = Zone 3 Restrictor Not Selected ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = 0.37 N/A inches
Restrictor Plate Height Above Pipe Invert = 30.00 N/A inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = Zone 3 Restrictor Not Selected ft²
Outlet Orifice Centroid = 1.02 N/A feet
Half-Central Angle of Restrictor Plate on Pipe = 2.06 N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = 9.95 ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = 50.00 feet
Spillway End Slopes = 10.00 H:V
Freeboard above Max Water Surface = 1.00 feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = 0.99 feet
Stage at Top of Freeboard = 11.94 feet
Basin Area at Top of Freeboard = 3.04 acres
Basin Volume at Top of Freeboard = 17.98 acre-ft

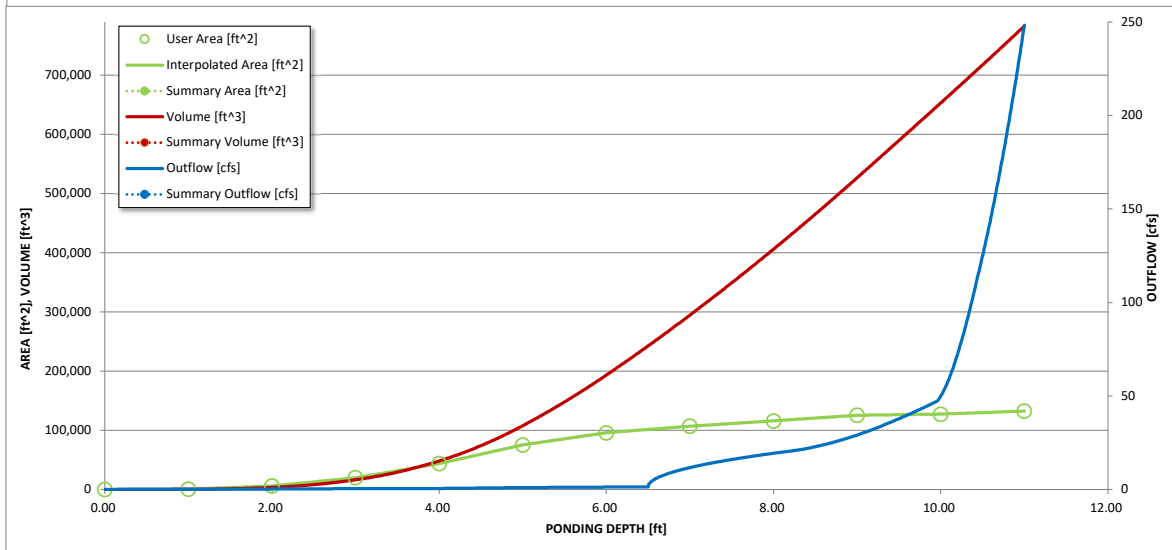
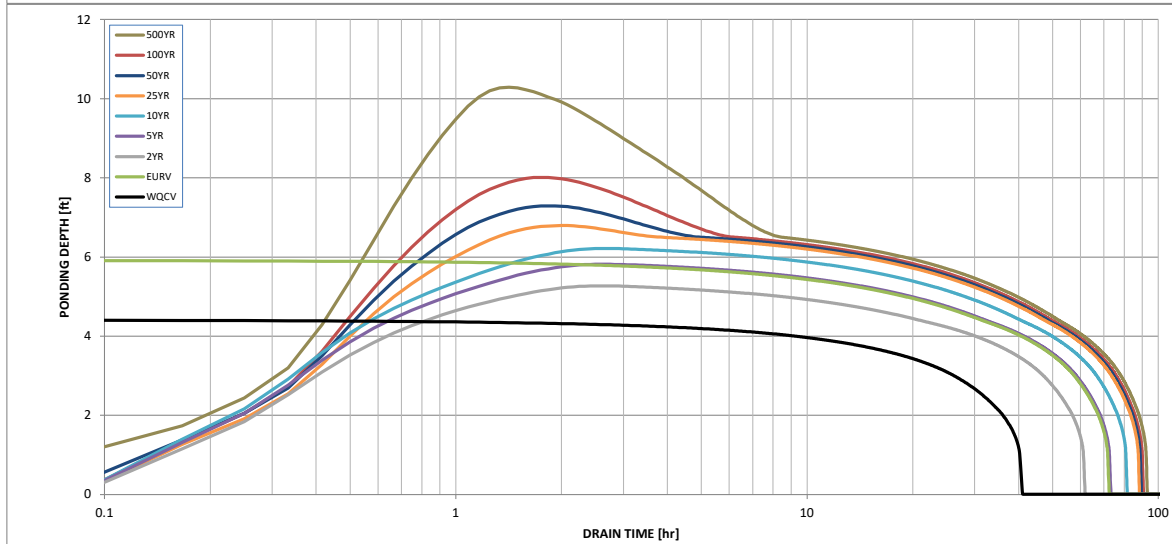
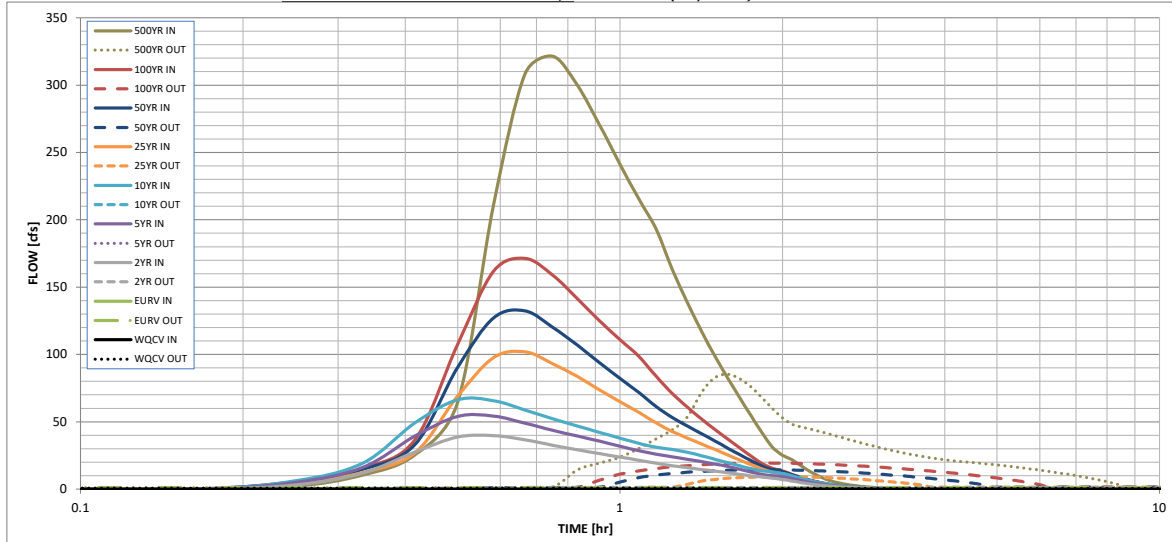
Routed Hydrograph Results

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	3.68
One-Hour Rainfall Depth (in)	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft)	1.568	4.247	3.144	4.260	5.156	7.047	8.851	11.232	21.174
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	3.144	4.260	5.156	7.047	8.851	11.232	21.174
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.8	1.7	2.3	21.0	42.0	70.0	181.0
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.02	0.02	0.19	0.38	0.63	1.64
Peak Inflow Q (cfs)	N/A	N/A	39.7	54.2	66.4	102.0	132.3	171.3	321.5
Peak Outflow Q (cfs)	0.7	1.3	1.1	1.2	1.3	9.2	14.4	19.4	85.3
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.7	0.6	0.4	0.3	0.3	0.5
Structure Controlling Flow	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.1
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	56	66	74	78	78	77	72
Time to Drain 99% of Inflow Volume (hours)	40	70	60	71	78	84	84	84	83
Maximum Ponding Depth (ft)	4.41	5.92	5.27	5.81	6.21	6.79	7.29	8.01	10.28
Area at Maximum Ponding Depth (acres)	1.30	2.16	1.85	2.11	2.25	2.40	2.51	2.66	2.96
Maximum Volume Stored (acre-ft)	1.578	4.262	2.938	4.027	4.905	6.254	7.459	9.322	15.818

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)



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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.04	2.14
	0:15:00	0.00	0.00	3.03	4.93	6.18	4.20	5.42	5.20	10.40
	0:20:00	0.00	0.00	11.97	16.06	19.22	12.34	14.64	15.56	25.38
	0:25:00	0.00	0.00	27.61	39.36	49.20	26.85	33.10	36.50	64.68
	0:30:00	0.00	0.00	38.69	54.05	66.38	69.04	90.43	107.74	211.20
	0:35:00	0.00	0.00	39.73	54.25	65.69	97.71	127.15	161.88	308.30
	0:40:00	0.00	0.00	36.66	48.97	58.80	102.01	132.31	171.32	321.55
	0:45:00	0.00	0.00	32.67	43.63	52.31	93.15	120.19	158.96	299.89
	0:50:00	0.00	0.00	29.21	39.39	46.86	83.56	106.91	141.48	270.39
	0:55:00	0.00	0.00	26.35	35.57	42.19	73.73	93.79	124.92	241.17
	1:00:00	0.00	0.00	23.78	31.90	37.87	64.80	82.12	110.97	215.61
	1:05:00	0.00	0.00	21.47	28.57	33.99	56.94	71.82	98.71	193.15
	1:10:00	0.00	0.00	19.18	26.00	31.15	49.14	61.43	83.83	163.34
	1:15:00	0.00	0.00	17.35	24.05	29.38	42.89	53.27	71.09	138.42
	1:20:00	0.00	0.00	15.90	22.19	27.38	37.89	46.76	60.75	117.20
	1:25:00	0.00	0.00	14.61	20.35	24.79	33.61	41.18	51.99	98.74
	1:30:00	0.00	0.00	13.39	18.60	22.14	29.39	35.74	44.29	82.65
	1:35:00	0.00	0.00	12.19	16.92	19.62	25.35	30.53	37.20	68.00
	1:40:00	0.00	0.00	10.98	14.81	17.26	21.56	25.63	30.56	54.39
	1:45:00	0.00	0.00	9.87	12.72	15.20	18.06	21.10	24.42	41.87
	1:50:00	0.00	0.00	9.01	11.00	13.63	14.95	17.11	19.05	31.26
	1:55:00	0.00	0.00	8.05	10.02	12.69	12.68	14.40	15.46	25.31
	2:00:00	0.00	0.00	7.21	9.32	11.77	11.45	12.97	13.49	21.77
	2:05:00	0.00	0.00	6.02	7.90	9.93	9.54	10.77	10.96	17.32
	2:10:00	0.00	0.00	4.85	6.35	7.98	7.54	8.48	8.46	13.06
	2:15:00	0.00	0.00	3.86	5.04	6.34	5.90	6.62	6.46	9.73
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	2:40:00	0.00	0.00	1.16	1.46	1.80	1.64	1.81	1.69	2.36
	2:45:00	0.00	0.00	0.89	1.12	1.39	1.26	1.39	1.31	1.82
	2:50:00	0.00	0.00	0.67	0.84	1.06	0.96	1.06	1.00	1.37
	2:55:00	0.00	0.00	0.49	0.61	0.77	0.71	0.78	0.72	0.98
	3:00:00	0.00	0.00	0.33	0.42	0.54	0.50	0.54	0.50	0.65
	3:05:00	0.00	0.00	0.20	0.28	0.34	0.32	0.34	0.31	0.39
	3:10:00	0.00	0.00	0.11	0.17	0.19	0.18	0.19	0.17	0.20
	3:15:00	0.00	0.00	0.05	0.08	0.09	0.08	0.08	0.07	0.07
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	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
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	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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

Falcon Highlands South Fil. No. 1 Pond 1 Forebay Designs

Project Name: Falcon Highlands South Fil. No. 1
 Company: Atwell, LLC
 Date: 07/30/25
 Engineer: LMS
 Location: EL PASO COUNTY

Pond 1 FOREBAY DESIGN

WQCV: 2.411 AC

FOREBAY RELEASE NOTCH DESIGN						
Q=C _w LH^1.5						
FOREBAY	Q100=	2% OF Q100=	C _w	H	L	
	CFS	CFS		FT	FT	
1.1	89.51	1.79	0.33	2.5	1.37	*USE 1.5'
1.2	160.7	3.21	0.33	2.5	2.46	*USE 2.5'
1.3	47.45	0.95	0.33	1.5	1.57	*USE 1.60'

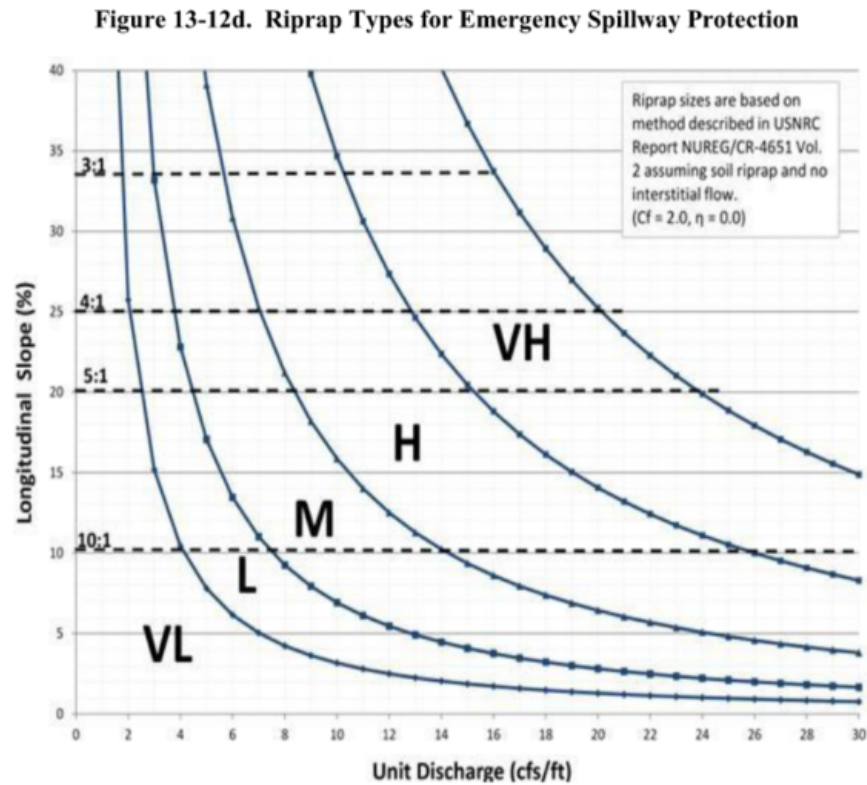
FOREBAY VOLUME DESIGN				
	1.1	1.2	1.3	
FLOW (cfs)	89.51	160.7	47.45	297.66
WQCV (CF)	31,581.75	56,699.66	16,741.75	105023.2
MIN. FOREBAY VOLUME (CF)	947.45	1700.99	502.25	
HEIGHT (FT)	2.50	2.50	2.50	
MIN. AREA (SF)	378.98	680.40	200.90	
WIDTH (FT)	18.00	25.00	12.00	
LENGTH (FT)	21.05	27.22	16.74	

*USE 18'x21.25'x2.5' *USE Stiling basin calcs below *USE 12'16.75'x2.5'

TYPE VI IMPACT STILLING BASIN (60") (MODIFIED)

D (FT)	5	
V (FT/SEC)	10.24	
W (FT)	13.05	
H (FT)	6.50	
L (FT)	16.31	
a (FT)	6.52	
b (FT)	4.00	
t (FT)	1.09	*USE 1.0'
c (FT)	6.52	
d (FT)	2.17	*USE 2.5'
e (FT)	1.09	
f (FT)	1.63	

PROPOSED RIPRAP CALCULATIONS FOR POND 1 SPILLWAY



Longitudinal slope = 25%

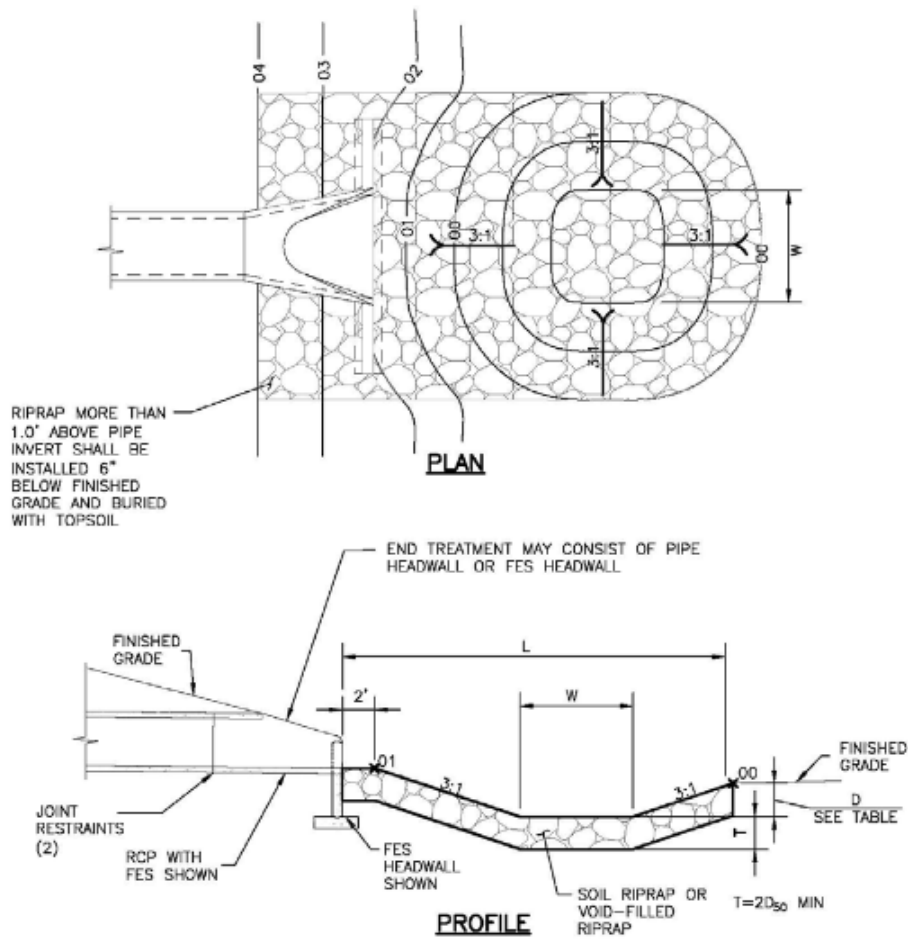
100-year developed & undetained inflow (Q100) = 309.4 cfs

Spillway crest width (W) = 50 ft

Unit discharge (q) = $Q/W = 6.19$ cfs/ft

****USE TYPE M RIPRAP****

PROPOSED POND 1 OUTFALL RIP-RAP OUTFALL CALCULATIONS



PIPE SIZE OR BOX HEIGHT	D	W*	L
18" - 24"	1'-0"	4'	15'
30" - 36"	1'-6"	6'	20'
42" - 48"	2'-0"	7'	24'
54" - 60"	2'-6"	8'	28'
66" - 72"	3'-0"	9'	32'

* IF OUTLET PIPE IS A BOX CULVERT WITH A WIDTH GREATER THAN W, THEN W = CULVERT WIDTH

Figure 9-37. Low tailwater riprap basin

D = 36 inches

Use type M riprap

D₅₀ = 12 inches

T = 24"

Channel Report

POND 1 TRICKLE CHANNEL

Rectangular

Bottom Width (ft) = 4.00
Total Depth (ft) = 0.50

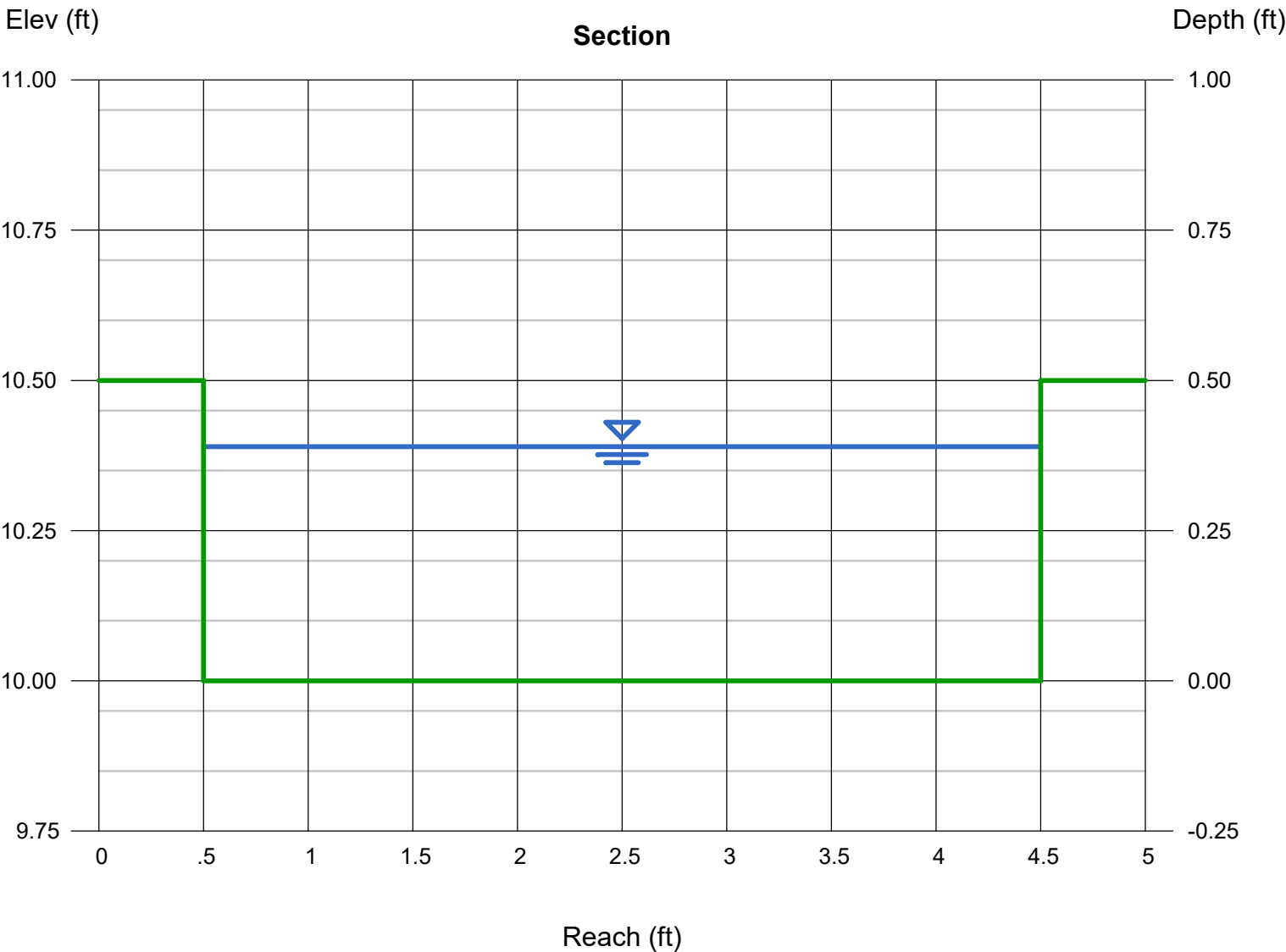
Invert Elev (ft) = 10.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 5.95

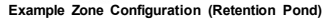
Highlighted

Depth (ft) = 0.39
Q (cfs) = 5.950
Area (sqft) = 1.56
Velocity (ft/s) = 3.81
Wetted Perim (ft) = 4.78
Crit Depth, Yc (ft) = 0.41
Top Width (ft) = 4.00
EGL (ft) = 0.62



MHFD-Detention, Version 4.06 (July 2022)

Basin ID: Pond 2 Final Condition (Trib Basins A1-A6, C, OS-3, OS-6)



Location for 1-hr Rainfall Depths = User Input

Optional User Overrides

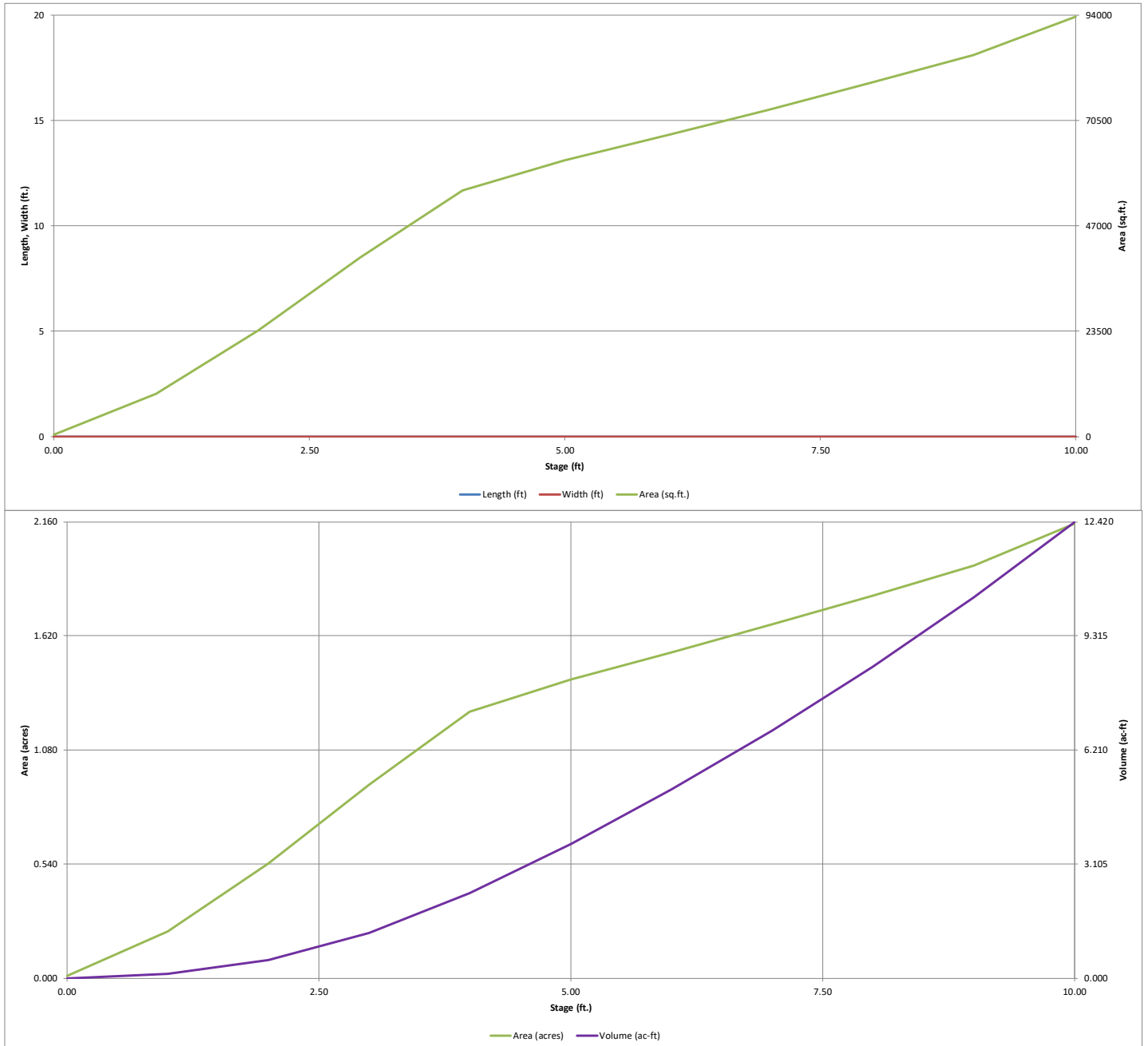
	acre-feet
	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Initial Surcharge Area (A_{ISV})	user	ft ²
Surcharge Volume Length (L_{ISV})	user	ft
Surcharge Volume Width (W_{ISV})	user	ft
Depth of Basin Floor (H_{FLOOR})	user	ft
Length of Basin Floor (L_{FLOOR})	user	ft
Width of Basin Floor (W_{FLOOR})	user	ft
Area of Basin Floor (A_{FLOOR})	user	ft ²
Volume of Basin Floor (V_{FLOOR})	user	ft ³
Depth of Main Basin (H_{MAIN})	user	ft
Length of Main Basin (L_{MAIN})	user	ft
Width of Main Basin (W_{MAIN})	user	ft
Area of Main Basin (A_{MAIN})	user	ft ²
Volume of Main Basin (V_{MAIN})	user	ft ³
Calculated Total Basin Volume (V_{total})	user	acre-feet

Depth Increment = f

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

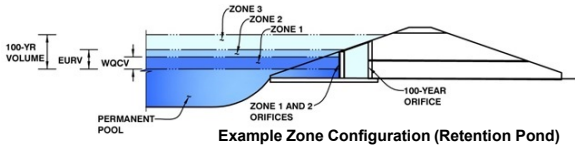


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Falcon Highlands

Basin ID: Pond 2 Final Condition (Trib Basins A1-A6, C, OS-3, OS-6)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.77	2.030	Orifice Plate
Zone 2 (EURV)	7.59	5.703	Orifice Plate
Zone 3 (100-year)	9.58	3.790	Weir&Pipe (Restrict)
Total (all zones)		11.523	

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 = ft²
Underdrain Orifice Centroid = feet

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

Calculated Parameters for Plate

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = 8.00 ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = N/A inches
Orifice Plate: Orifice Area per Row = N/A sq. inches

WQ Orifice Area per Row = N/A ft²
Elliptical Half-Width = N/A feet
Elliptical Slot Centroid = N/A feet
Elliptical Slot Area = N/A ft²

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)	0.0000	2.8333	5.6667					
Orifice Area (sq. inches)	10.50	12.50	60.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

Calculated Parameters for Vertical Orifice

Invert of Vertical Orifice = Not Selected Not Selected ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = N/A N/A ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = N/A N/A inches

Vertical Orifice Area = Not Selected Not Selected ft²
Vertical Orifice Centroid = N/A N/A feet

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

Calculated Parameters for Overflow Weir

Overflow Weir Front Edge Height, H_o = Zone 3 Weir Not Selected ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = 5.67 N/A feet
Overflow Weir Gate Slope = 4.00 N/A H:V
Horiz. Length of Weir Sides = 5.82 N/A feet
Overflow Gate Type = Type C Gate N/A
Debris Clogging % = 50% N/A %

Height of Gate Upper Edge, H_t = Zone 3 Weir Not Selected feet
Overflow Weir Slope Length = 6.00 N/A feet
Gate Open Area / 100-yr Orifice Area = 3.35 N/A
Overflow Gate Open Area w/o Debris = 23.67 N/A ft²
Overflow Gate Open Area w/ Debris = 11.84 N/A ft²

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Depth to Invert of Outlet Pipe = Zone 3 Restrictor Not Selected ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = 36.00 N/A inches
Restrictor Plate Height Above Pipe Invert = 36.00 inches

Outlet Orifice Area = Zone 3 Restrictor Not Selected ft²
Outlet Orifice Centroid = 7.07 N/A feet
Half-Central Angle of Restrictor Plate on Pipe = 1.50 N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

Spillway Invert Stage = 9.95 ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = 30.00 feet
Spillway End Slopes = 10.00 H:V
Freeboard above Max Water Surface = 1.00 feet

Spillway Design Flow Depth = 1.68 feet
Stage at Top of Freeboard = 12.63 feet
Basin Area at Top of Freeboard = 2.15 acres
Basin Volume at Top of Freeboard = 12.41 acre-ft

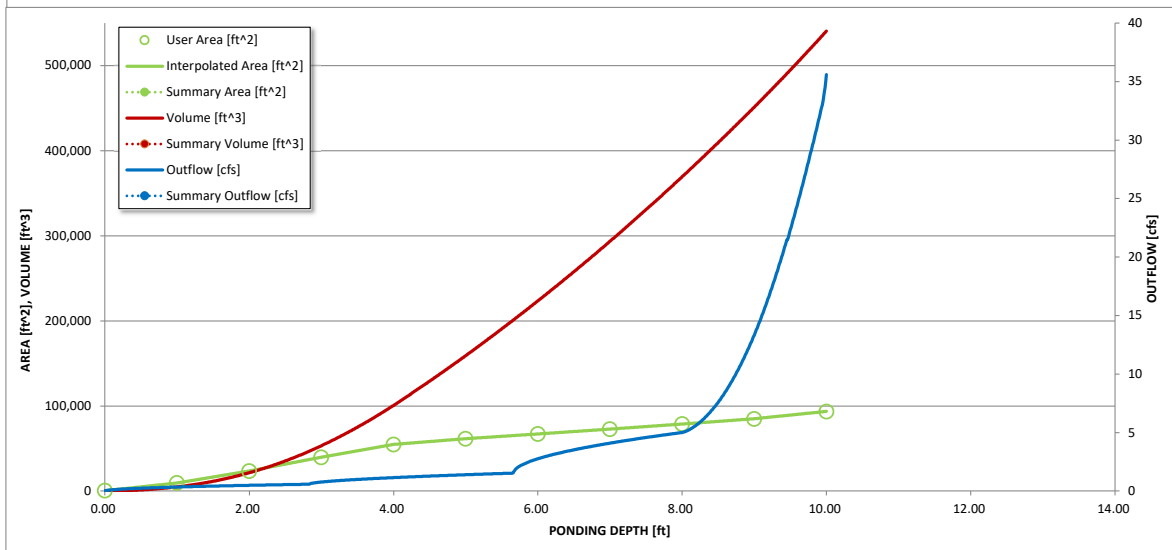
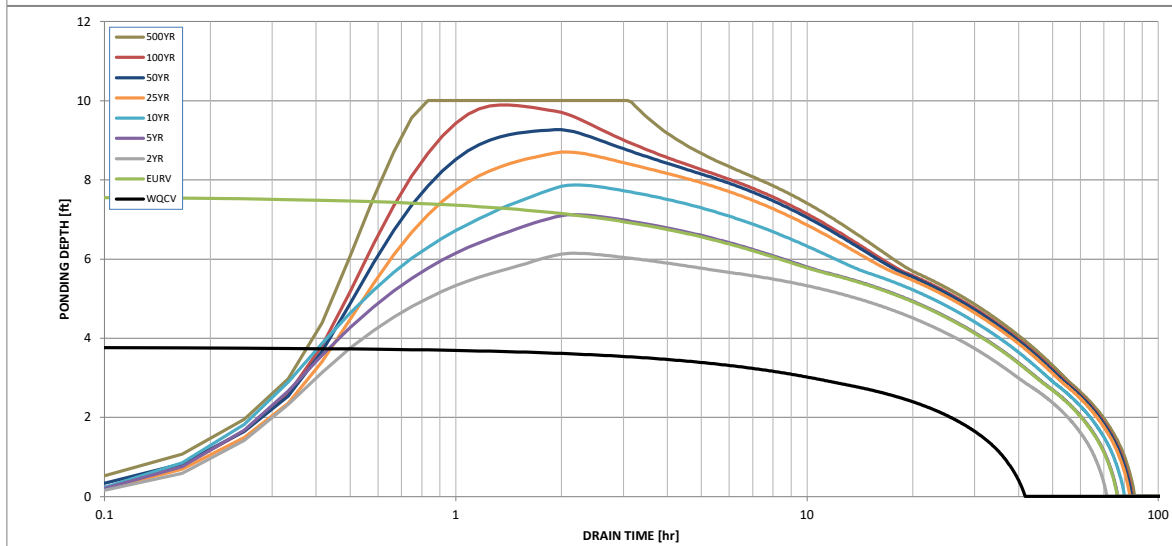
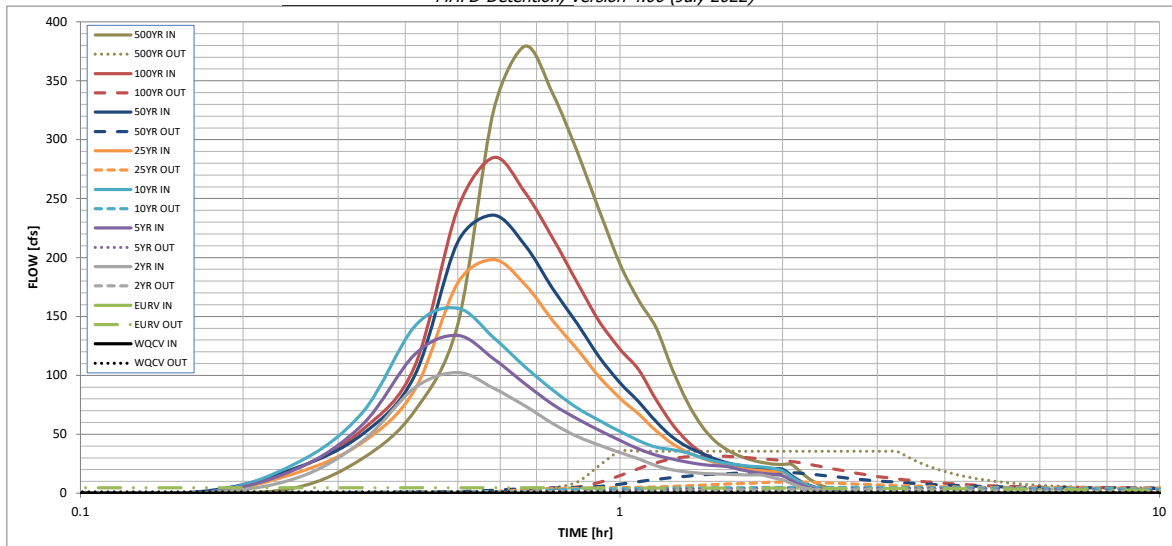
Routed Hydrograph Results

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)	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft)	2.030	7.733	5.692	7.464	8.883	10.730	12.550	14.761	19.601
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	5.692	7.464	8.883	10.730	12.550	14.761	19.601
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.8	1.6	2.2	20.0	39.7	64.7	116.4
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A		46.1	46.1				
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.48	0.48	0.21	0.41	0.68	1.21
Peak Inflow Q (cfs)	N/A	N/A	102.4	133.8	157.0	198.1	236.0	285.0	379.4
Peak Outflow Q (cfs)	N/A	N/A	3.0	4.2	4.9	9.5	17.7	31.6	35.6
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.1	0.1	0.5	0.4	0.5	0.3
Structure Controlling Flow	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	N/A
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	N/A	0.2	0.5	1.1	1.2
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	67	64	68	70	71	71	70	67
Time to Drain 99% of Inflow Volume (hours)	40	72	68	73	76	78	78	78	78
Maximum Ponding Depth (ft)	3.77	7.59	6.14	7.12	7.87	8.70	9.26	9.89	10.00
Area at Maximum Ponding Depth (acres)	1.18	1.75	1.56	1.69	1.79	1.91	2.00	2.13	2.15
Maximum Volume Stored (acre-ft)	2.034	7.748	5.346	6.922	8.226	9.780	10.874	12.154	12.411

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-*Detention*, Version 4.06 (July 2022)



DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

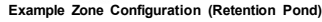
Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	1.41	0.14	4.54
	0:15:00	0.00	0.00	12.37	20.11	24.94	16.91	21.12	20.64	29.68
	0:20:00	0.00	0.00	44.45	58.38	68.67	43.30	50.34	54.03	70.05
	0:25:00	0.00	0.00	89.52	117.98	141.90	88.01	100.25	108.06	143.04
	0:30:00	0.00	0.00	102.42	133.82	157.05	178.42	213.09	241.33	324.82
	0:35:00	0.00	0.00	89.10	114.03	132.08	198.13	235.98	284.98	379.45
	0:40:00	0.00	0.00	74.17	92.90	107.40	177.20	210.58	255.38	339.56
	0:45:00	0.00	0.00	59.18	75.43	87.72	146.70	173.81	216.79	289.38
	0:50:00	0.00	0.00	48.08	63.09	72.32	122.07	143.70	178.56	239.13
	0:55:00	0.00	0.00	40.69	53.27	61.53	98.44	115.12	145.43	194.43
	1:00:00	0.00	0.00	34.49	44.71	52.40	80.56	93.64	122.30	163.55
	1:05:00	0.00	0.00	29.17	37.59	44.63	67.02	77.52	104.67	140.39
	1:10:00	0.00	0.00	23.31	32.38	39.04	52.93	60.76	79.34	105.43
	1:15:00	0.00	0.00	19.78	28.95	37.03	42.07	47.80	58.64	77.02
	1:20:00	0.00	0.00	18.02	26.30	34.32	34.70	39.26	43.91	57.25
	1:25:00	0.00	0.00	16.94	24.47	30.28	30.02	33.84	34.39	44.35
	1:30:00	0.00	0.00	16.35	23.30	27.24	25.92	29.18	28.64	36.55
	1:35:00	0.00	0.00	15.95	22.52	25.23	22.90	25.76	24.97	31.59
	1:40:00	0.00	0.00	15.65	20.22	23.85	21.08	23.71	22.54	28.32
	1:45:00	0.00	0.00	15.45	18.20	22.92	19.82	22.28	20.91	26.12
	1:50:00	0.00	0.00	15.36	16.87	22.26	19.00	21.36	19.96	24.86
	1:55:00	0.00	0.00	13.29	15.95	21.19	18.53	20.84	19.64	24.46
	2:00:00	0.00	0.00	11.39	14.87	19.14	18.24	20.51	19.48	24.27
	2:05:00	0.00	0.00	8.09	10.66	13.61	13.18	14.80	14.13	17.58
	2:10:00	0.00	0.00	5.29	6.96	8.97	8.70	9.77	9.36	11.64
	2:15:00	0.00	0.00	3.46	4.53	5.91	5.79	6.50	6.22	7.72
	2:20:00	0.00	0.00	2.17	2.84	3.75	3.70	4.14	3.96	4.91
	2:25:00	0.00	0.00	1.28	1.77	2.31	2.32	2.60	2.48	3.07
	2:30:00	0.00	0.00	0.69	1.04	1.31	1.38	1.54	1.47	1.81
	2:35:00	0.00	0.00	0.29	0.50	0.61	0.68	0.76	0.72	0.88
	2:40:00	0.00	0.00	0.10	0.16	0.18	0.22	0.24	0.23	0.28
	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

MHFD-Detention, Version 4.06 (July 2022)

Basin ID: Pond 2 Interim Condition (Trib Basins A1-A6, C, OS-3, OS-6)



Location for 1-hr Rainfall Depths = User Input

Optional User Overrides

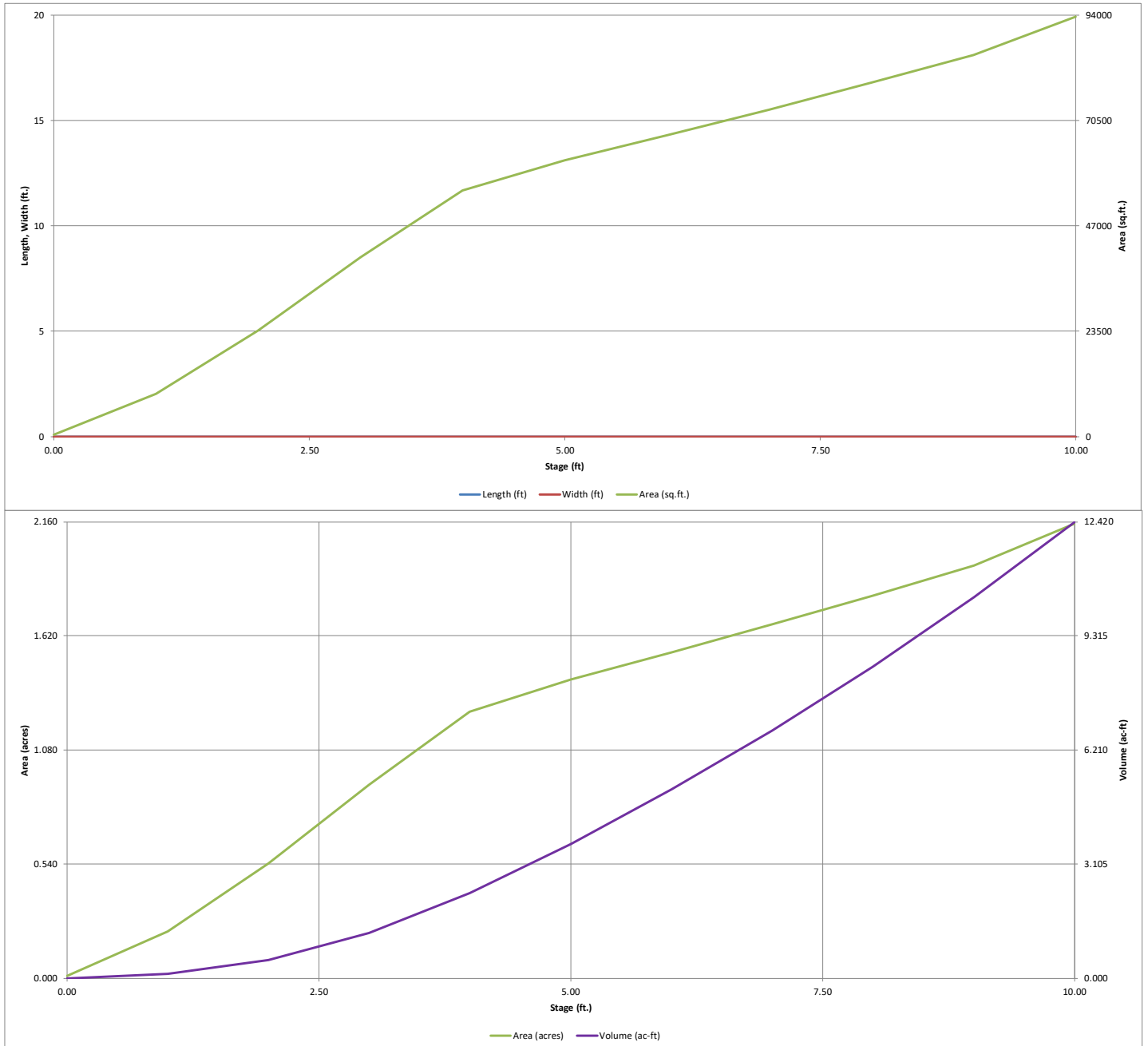
	acre-feet
	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Initial Surcharge Area (A_{ISV})	=	user	ft ²
Surcharge Volume Length (L_{ISV})	=	user	ft
Surcharge Volume Width (W_{ISV})	=	user	ft
Depth of Basin Floor (H_{FLOOR})	=	user	ft
Length of Basin Floor (L_{FLOOR})	=	user	ft
Width of Basin Floor (W_{FLOOR})	=	user	ft
Area of Basin Floor (A_{FLOOR})	=	user	ft ²
Volume of Basin Floor (V_{FLOOR})	=	user	ft ³
Depth of Main Basin (H_{MAIN})	=	user	ft
Length of Main Basin (L_{MAIN})	=	user	ft
Width of Main Basin (W_{MAIN})	=	user	ft
Area of Main Basin (A_{MAIN})	=	user	ft ²
Volume of Main Basin (V_{MAIN})	=	user	ft ³
Calculated Total Basin Volume (V_{total})	=	user	acre-feet

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

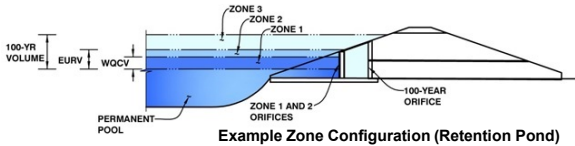


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Falcon Highlands

Basin ID: Pond 2 Interim Condition (Trib Basins A1-A6, C, OS-3, OS-6)



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.06	1.280	Orifice Plate
Zone 2 (EURV)	4.71	1.955	Orifice Plate
Zone 3 (100-year)	6.46	2.605	Weir&Pipe (Restrict)
Total (all zones)		5.840	

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 = ft²
Underdrain Orifice Centroid = feet

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

Calculated Parameters for Plate

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches

WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

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	2.67	5.33	6.50				
Orifice Area (sq. inches)	8.00	8.00	8.00	240.00				
	12x20							
	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)

Calculated Parameters for Vertical Orifice

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = inches

Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

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

Calculated Parameters for Overflow Weir

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Gate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Gate Type =
Debris Clogging % = %

Height of Gate Upper Edge, H_u = feet
Overflow Weir Slope Length = feet
Gate Open Area / 100-yr Orifice Area =
Overflow Gate Open Area w/o Debris = ft²
Overflow Gate Open Area w/ Debris = ft²

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = inches
Restrictor Plate Height Above Pipe Invert = inches

Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

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

Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = acre-ft

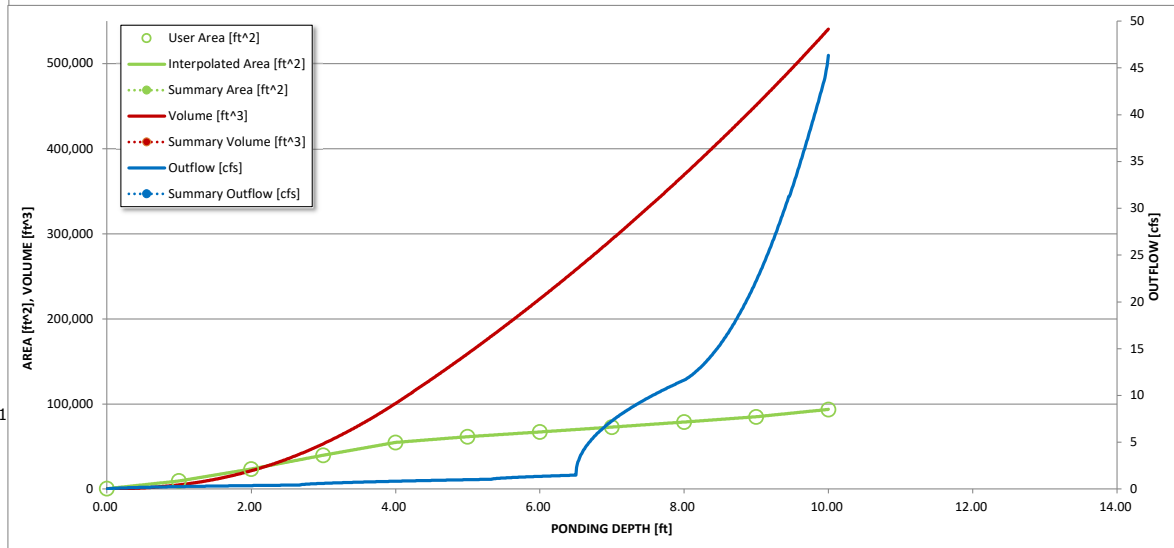
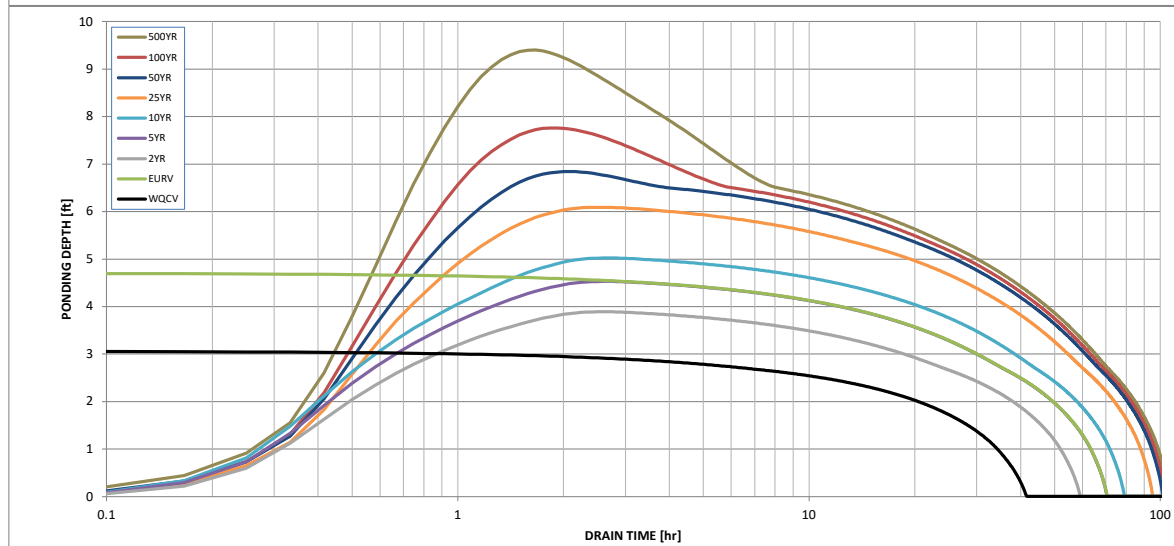
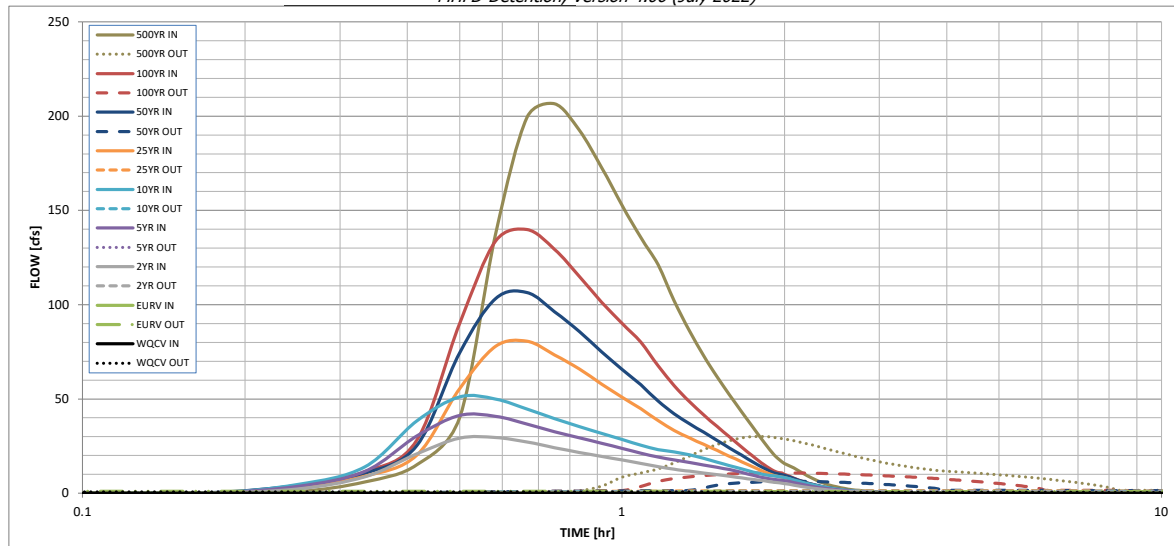
Routed Hydrograph Results

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)	N/A	N/A	1.280	3.235	2.323	3.173	3.871	5.501	7.031
CUHP Runoff Volume (acre-ft)	N/A	N/A	2.323	3.173	3.871	5.501	7.031	9.070	13.440
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	2.323	3.173	3.871	5.501	7.031	9.070	13.440
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.8	1.6	2.2	20.0	39.7	64.7	116.4
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.02	0.02	0.21	0.41	0.68	1.21
Peak Inflow Q (cfs)	N/A	N/A	29.6	41.3	51.0	80.6	106.4	139.8	206.6
Peak Outflow Q (cfs)	0.6	1.0	0.8	0.9	1.0	1.4	6.3	10.8	30.1
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.6	0.5	0.1	0.2	0.2	0.3
Structure Controlling Flow	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	overflow Weir
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.6
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	64	54	64	72	86	91	90	88
Time to Drain 99% of Inflow Volume (hours)	40	68	57	68	76	91	97	98	98
Maximum Ponding Depth (ft)	3.06	4.71	3.89	4.53	5.02	6.09	6.84	7.76	9.40
Area at Maximum Ponding Depth (acres)	0.94	1.37	1.22	1.34	1.42	1.55	1.65	1.78	2.03
Maximum Volume Stored (acre-ft)	1.282	3.248	2.166	2.990	3.665	5.253	6.471	8.030	11.136

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-*Detention*, Version 4.06 (July 2022)



DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.03	0.87
	0:15:00	0.00	0.00	2.25	3.66	4.60	3.13	4.03	3.90	5.91
	0:20:00	0.00	0.00	8.68	11.58	13.89	8.93	10.59	11.30	15.10
	0:25:00	0.00	0.00	20.94	30.34	38.38	20.29	25.36	28.21	40.21
	0:30:00	0.00	0.00	29.24	41.26	51.03	55.60	74.54	90.16	137.46
	0:35:00	0.00	0.00	29.58	40.81	49.96	77.91	103.21	133.81	199.21
	0:40:00	0.00	0.00	27.16	36.69	44.60	80.57	106.41	139.80	206.58
	0:45:00	0.00	0.00	24.15	32.63	39.57	73.35	96.29	129.40	192.45
	0:50:00	0.00	0.00	21.58	29.40	35.34	65.88	85.67	114.96	172.75
	0:55:00	0.00	0.00	19.48	26.53	31.79	57.92	75.03	101.38	152.69
	1:00:00	0.00	0.00	17.59	23.80	28.49	50.91	65.72	90.06	135.70
	1:05:00	0.00	0.00	15.84	21.26	25.46	44.79	57.51	80.07	121.11
	1:10:00	0.00	0.00	14.05	19.18	23.17	38.52	48.97	67.63	101.97
	1:15:00	0.00	0.00	12.68	17.67	21.88	33.35	42.17	57.02	86.10
	1:20:00	0.00	0.00	11.65	16.30	20.38	29.31	36.85	48.58	73.01
	1:25:00	0.00	0.00	10.72	14.98	18.44	25.96	32.39	41.58	61.83
	1:30:00	0.00	0.00	9.85	13.72	16.49	22.71	28.08	35.46	52.11
	1:35:00	0.00	0.00	8.99	12.50	14.64	19.61	23.99	29.80	43.21
	1:40:00	0.00	0.00	8.12	10.97	12.88	16.69	20.13	24.47	34.86
	1:45:00	0.00	0.00	7.30	9.44	11.28	13.95	16.51	19.50	27.08
	1:50:00	0.00	0.00	6.60	8.11	9.93	11.45	13.24	15.05	20.29
	1:55:00	0.00	0.00	5.79	7.23	9.10	9.41	10.76	11.79	15.86
	2:00:00	0.00	0.00	5.14	6.65	8.39	8.32	9.48	10.01	13.37
	2:05:00	0.00	0.00	4.27	5.61	7.05	6.83	7.74	7.99	10.52
	2:10:00	0.00	0.00	3.46	4.53	5.69	5.40	6.09	6.13	7.96
	2:15:00	0.00	0.00	2.77	3.62	4.56	4.23	4.75	4.68	5.98
	2:20:00	0.00	0.00	2.22	2.90	3.63	3.34	3.72	3.56	4.46
	2:25:00	0.00	0.00	1.76	2.31	2.87	2.61	2.91	2.70	3.33
	2:30:00	0.00	0.00	1.39	1.82	2.25	2.03	2.25	2.07	2.53
	2:35:00	0.00	0.00	1.09	1.42	1.73	1.56	1.72	1.59	1.92
	2:40:00	0.00	0.00	0.86	1.09	1.32	1.20	1.31	1.22	1.47
	2:45:00	0.00	0.00	0.67	0.84	1.02	0.92	1.01	0.95	1.14
	2:50:00	0.00	0.00	0.51	0.64	0.79	0.71	0.78	0.73	0.87
	2:55:00	0.00	0.00	0.38	0.47	0.58	0.53	0.57	0.53	0.63
	3:00:00	0.00	0.00	0.26	0.34	0.41	0.38	0.40	0.37	0.43
	3:05:00	0.00	0.00	0.17	0.23	0.27	0.25	0.26	0.24	0.27
	3:10:00	0.00	0.00	0.10	0.14	0.16	0.15	0.15	0.13	0.14
	3:15:00	0.00	0.00	0.05	0.08	0.08	0.07	0.07	0.06	0.06
	3:20:00	0.00	0.00	0.02	0.03	0.03	0.02	0.02	0.02	0.01
	3:25:00	0.00	0.00	0.00	0.01	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

Falcon Highlands South Fil. No. 1 Pond 2 Forebay Designs

Project Name: Falcon Highlands South Fil. No. 1
 Company: Atwell, LLC
 Date: 07/30/25
 Engineer: LMS
 Location: EL PASO COUNTY

Pond 2 FOREBAY DESIGN

WQCV: 2.033 AC 88557.48

FOREBAY RELEASE NOTCH DESIGN						
Q=C _w LH^1.5						
FOREBAY	Q100=	2% OF Q100=	C _w	H	L	
	CFS	CFS		FT	FT	
2.1	89.51	1.79	0.33	2.5	1.37	*USE 1.5'
2.2	50.49	1.01	0.33	2.5	0.77	*USE 0.8'

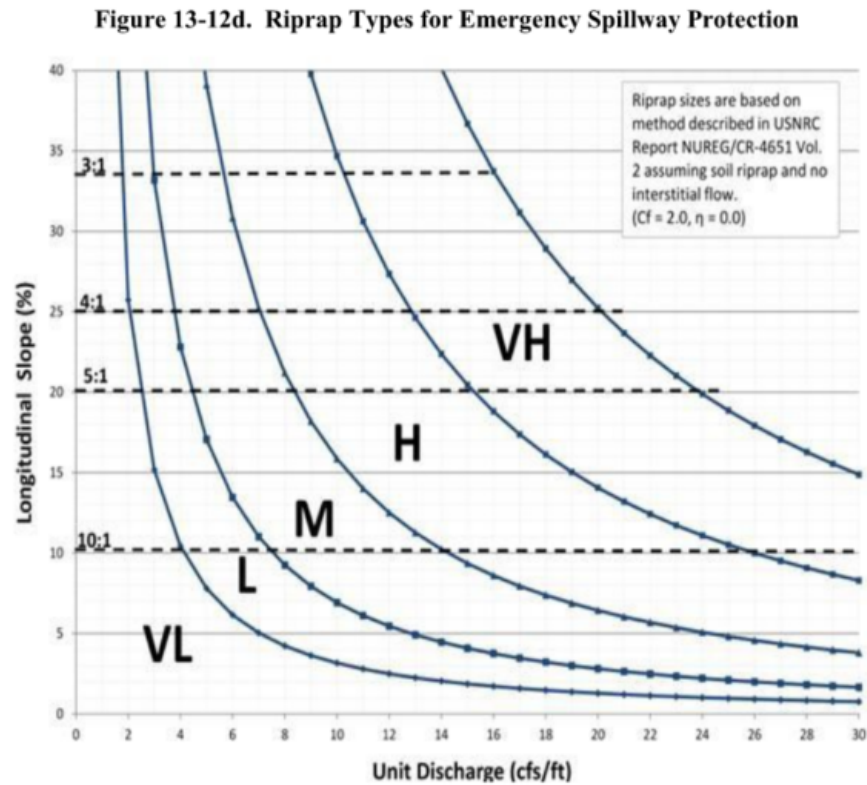
FOREBAY VOLUME DESIGN

		2.2	
FLOW (cfs)		50.49	140
1/2 WQCV (CF)		31,937.62	
MIN. FOREBAY VOLUME (CF)		958.13	
HEIGHT (FT)		2.50	
MIN. AREA (SF)		383.25	
WIDTH (FT)		16.00	
LENGTH (FT)		23.95	
*USE 16'x24'x2.5'			

TYPE VI IMPACT STILLING BASIN (54")

D (FT)	4.5	
V (FT/SEC)	6.33	
W (FT)	9.26	
H (FT)	6.50	
L (FT)	11.57	
a (FT)	4.63	
b (FT)	3.47	*USE 4.0'
t (FT)	0.77	*USE 1.0'
c (FT)	4.63	
d (FT)	1.54	*USE 2.5'
e (FT)	0.77	
f (FT)	1.16	

PROPOSED RIPRAP CALCULATIONS FOR POND 2 SPILLWAY



Longitudinal slope = 25%

100-year developed & undetained flow (Q100) = 346.9 cfs

Spillway crest width (W) = 50 ft

Unit discharge (q) = $Q/W = 6.94$ cfs/ft

****USE TYPE M RIPRAP****

PROPOSED POND 2 OUTFALL RIP-RAP OUTFALL CALCULATIONS

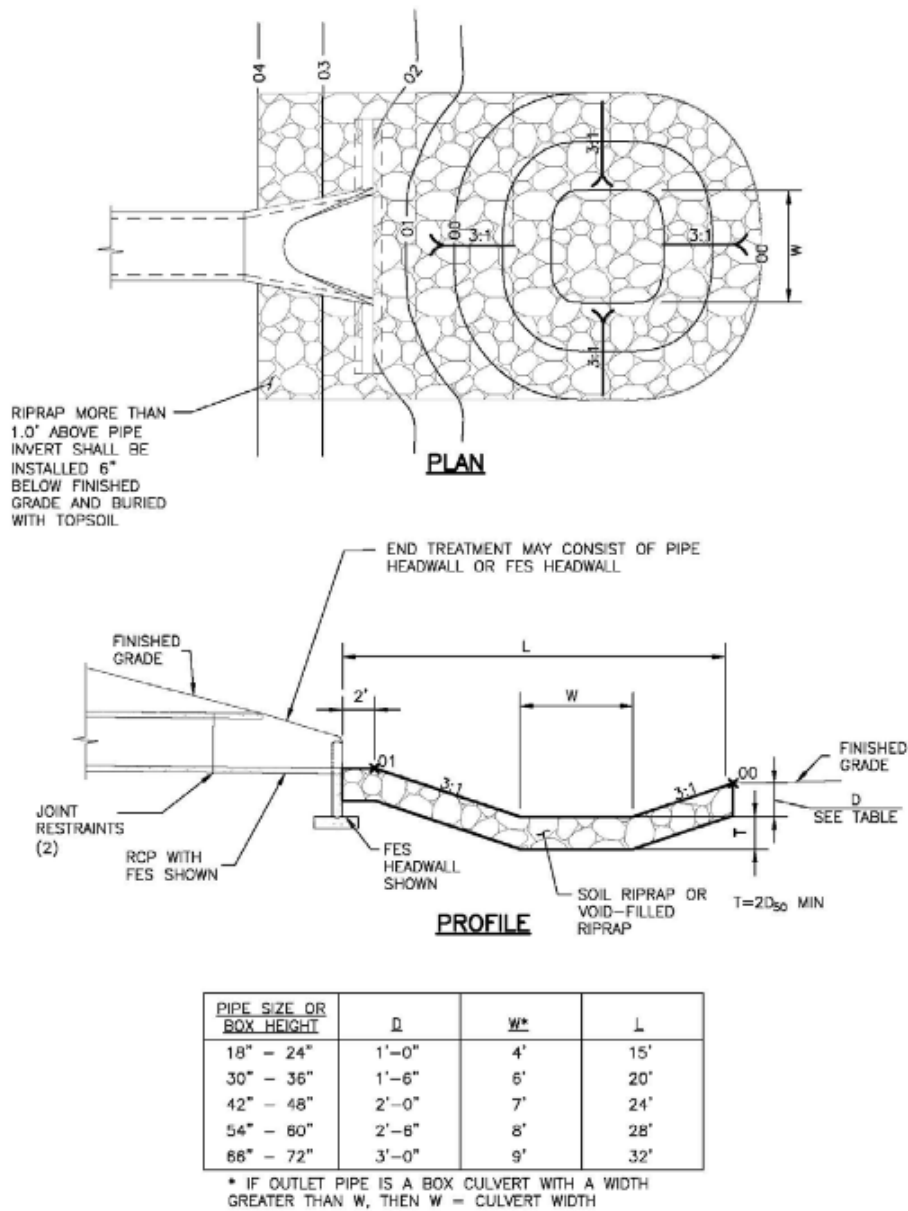


Figure 9-37. Low tailwater riprap basin

D = 36 inches

Use type M riprap

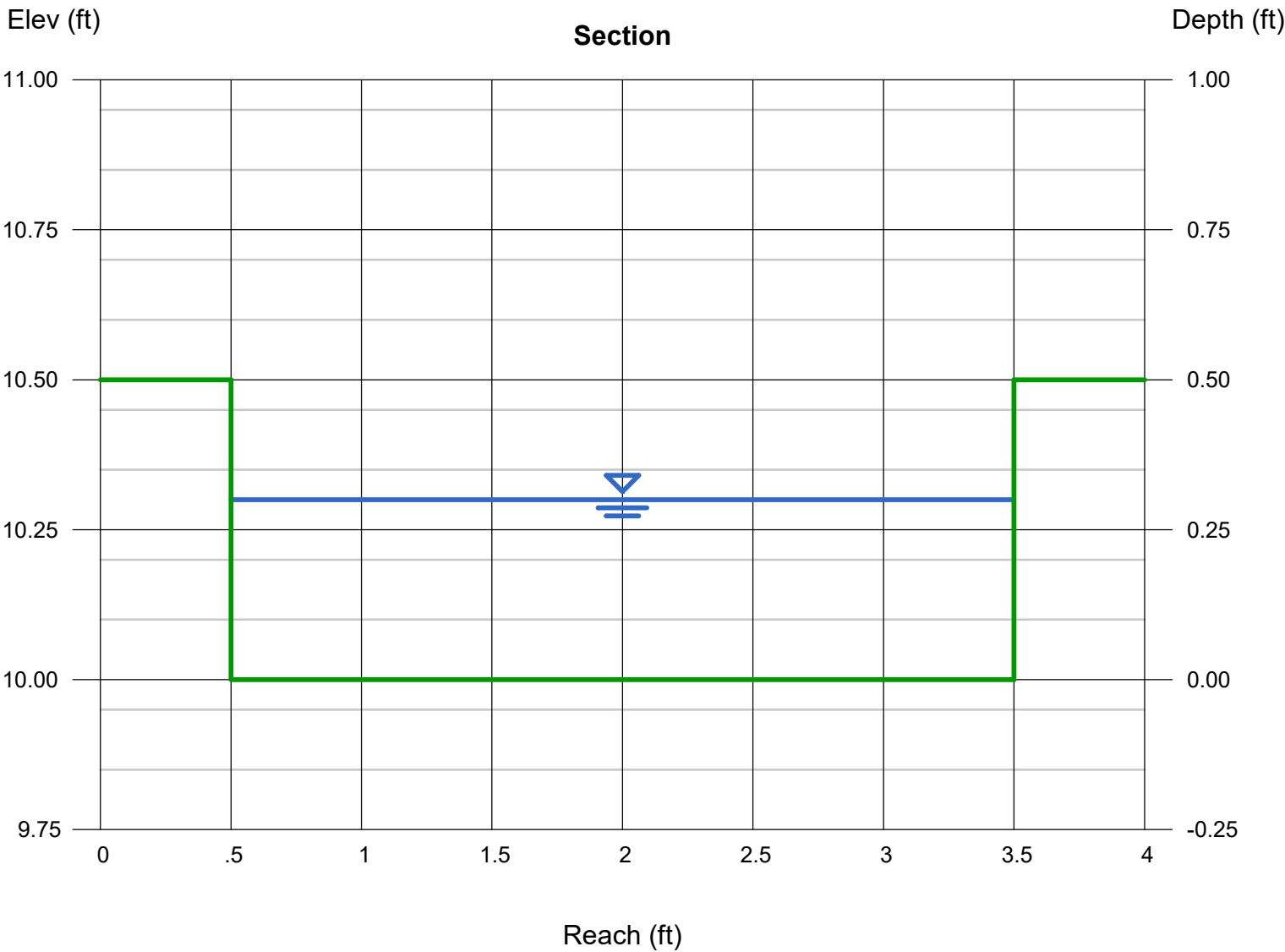
D₅₀ = 12 inches

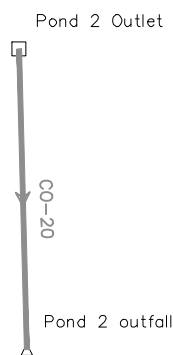
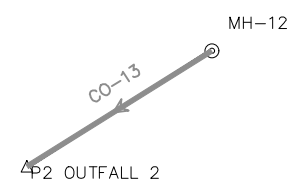
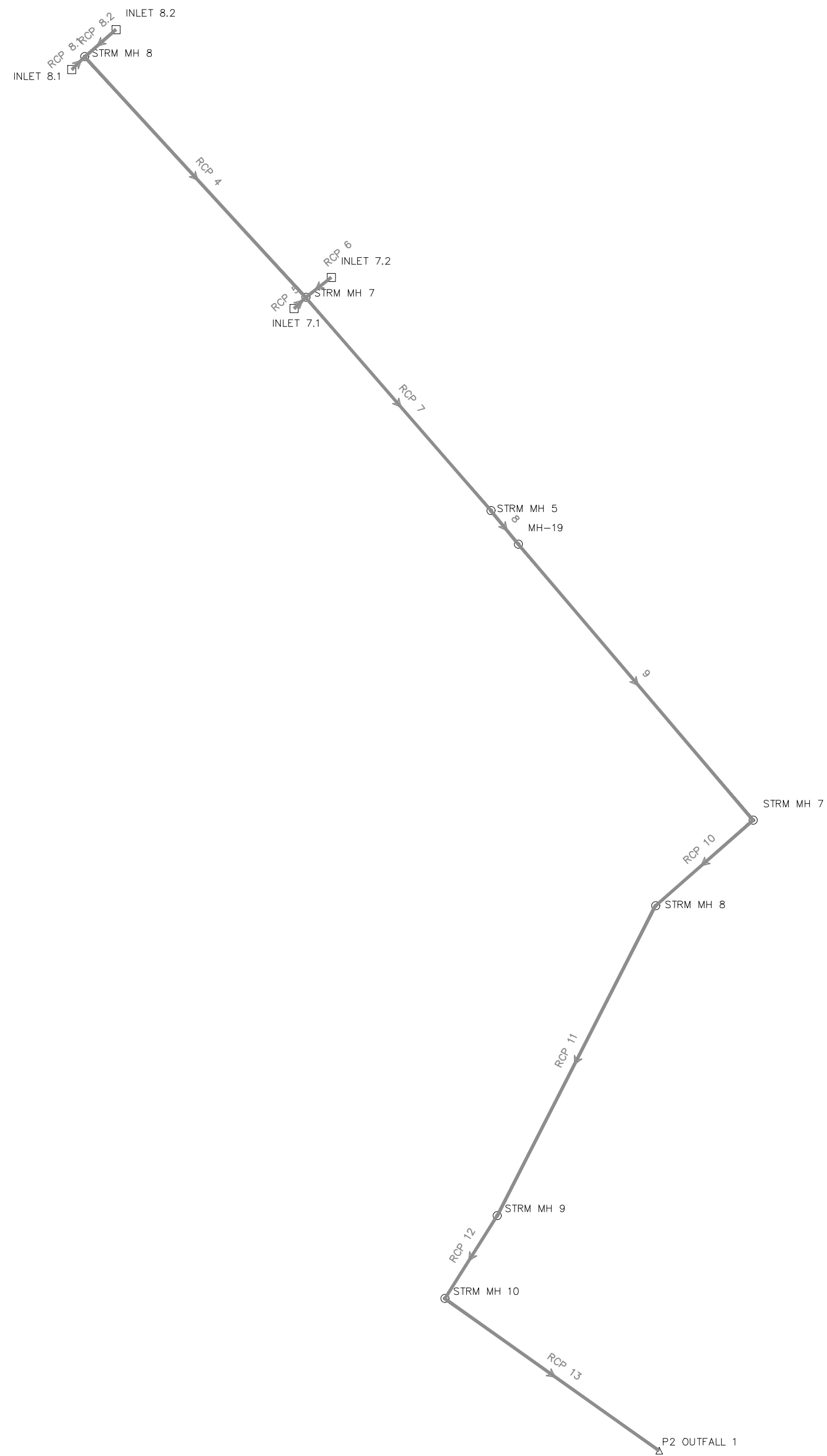
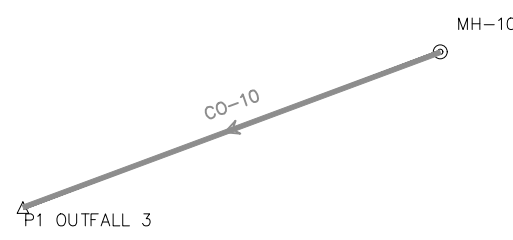
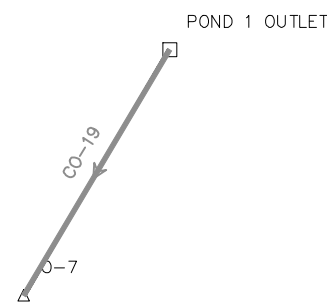
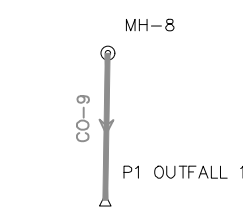
T = 24"

Channel Report

POND 2 TRICKLE CHANNEL

Rectangular		Highlighted	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.30
Total Depth (ft)	= 0.50	Q (cfs)	= 2.800
		Area (sqft)	= 0.90
Invert Elev (ft)	= 10.00	Velocity (ft/s)	= 3.11
Slope (%)	= 0.50	Wetted Perim (ft)	= 3.60
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.31
		Top Width (ft)	= 3.00
		EGL (ft)	= 0.45
Calculations			
Compute by:	Known Q		
Known Q (cfs)	= 2.80		



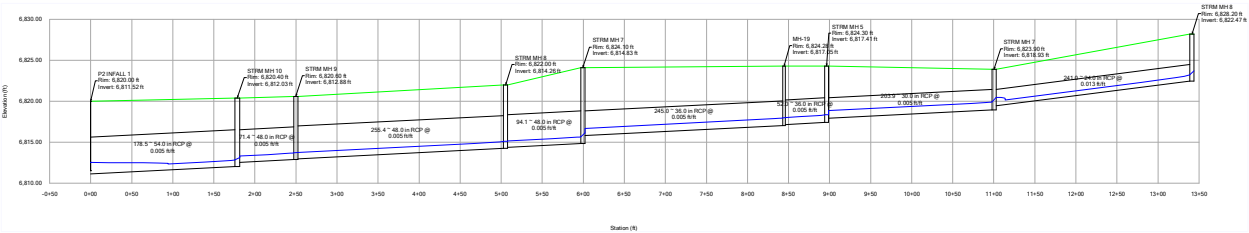


Unresolved:
Inconsistencies between stormcad design and CDs. See CD's for highlighted information that does not match. Please check entire system for accuracy.
It would be helpful if naming convention was consistent between stormcad and CDs.

FlexTable: Conduit Table
Active Scenario: 5-year

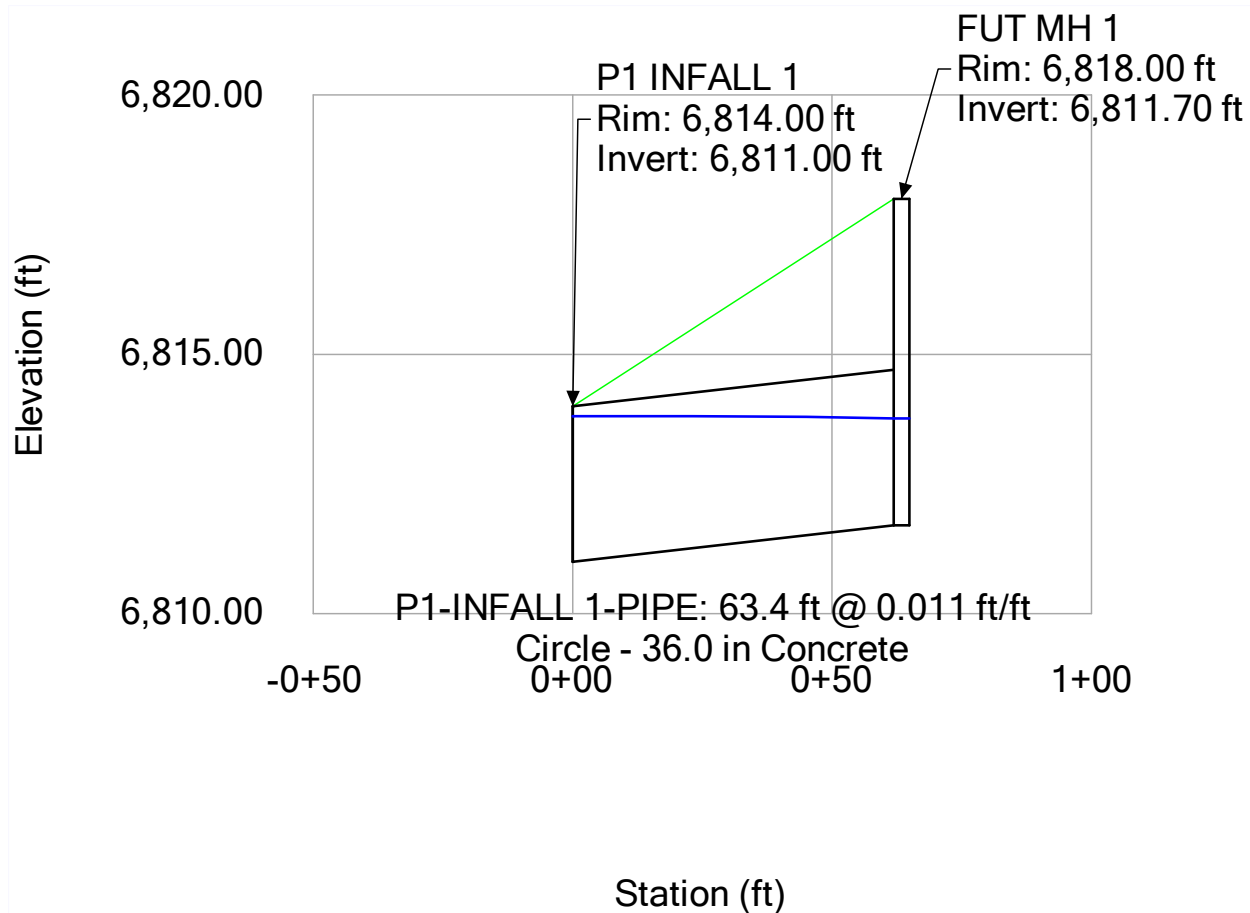
			(ft)	Invert (Stop) (ft)	Flow (cfs)	Length (3D) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Velocity (ft/s)	Capacity (Design) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
RCP 8.3	STRM MH 8	STRM MH 7	6,822.47	6,819.43	4.91	239.1	0.013	24.0	0.013	6.25	25.41	19.3	6,823.25	6,820.48	6,823.54	6,820.61
RCP 6	INLET 7.2	STRM MH 7	6,820.70	6,820.56	2.39	23.8	0.005	18.0	0.013	3.69	7.28	32.8	6,821.29	6,821.14	6,821.50	6,821.36
RCP 5	INLET 7.1	STRM MH 7	6,820.60	6,820.56	1.68	11.9	0.004	18.0	0.013	3.24	6.94	24.3	6,821.10	6,821.05	6,821.27	6,821.23
RCP 10	STRM MH 7	STRM MH 8	6,814.83	6,814.36	8.49	94.9	0.005	48.0	0.013	4.90	101.51	8.4	6,815.68	6,815.14	6,815.97	6,815.52
RCP 11	STRM MH 8	STRM MH 9	6,814.26	6,812.98	8.43	254.8	0.005	48.0	0.013	4.90	101.68	8.3	6,815.10	6,813.76	6,815.40	6,814.13
RCP 12	STRM MH 9	STRM MH 10	6,812.88	6,812.53	8.29	71.7	0.005	48.0	0.013	4.84	100.56	8.2	6,813.72	6,813.31	6,814.01	6,813.67
RCP 13	STRM MH 10	P2 INFALL 1	6,812.03	6,811.13	8.25	192.4	0.005	54.0	0.013	4.81	139.63	5.9	6,812.84	6,812.53	6,813.12	6,812.59
P1-INFALL 1-PIPE	FUT MH 1	P1 INFALL 1	6,811.70	6,811.00	21.56	63.4	0.011	36.0	0.013	8.73	70.09	30.8	6,813.77	6,813.81	6,814.03	6,813.96
P1-INFALL 2-PIPE	FUT MH 2	P1 INFALL 3	6,814.96	6,814.00	23.88	191.7	0.005	36.0	0.013	6.70	47.20	50.6	6,816.54	6,815.51	6,817.16	6,816.21
P2 INFALL 2	FUT MH 3	P2 INFALL 2	6,814.00	6,812.70	16.56	93.8	0.014	36.0	0.013	8.81	78.54	21.1	6,815.30	6,813.65	6,815.79	6,814.81
RCP 7	STRM MH 7	STRM MH 5	6,818.93	6,817.91	8.81	206.7	0.005	30.0	0.013	5.19	29.01	30.4	6,819.92	6,818.85	6,820.29	6,819.27
RCP 8.1	INLET 8.1	STRM MH 8	6,822.51	6,822.47	3.25	13.3	0.004	18.0	0.013	3.86	6.93	47.0	6,823.70	6,823.69	6,823.77	6,823.76
RCP 8.2	INLET 8.2	STRM MH 8	6,822.61	6,822.47	1.66	30.3	0.005	18.0	0.013	3.34	7.27	22.9	6,823.70	6,823.69	6,823.72	6,823.71
P1 OUTFALL PIPE	POND 1 OUTLET	O-7	6,808.55	6,806.75	2.10	123.1	0.016	24.0	0.013	5.29	28.39	7.4	6,809.05	6,807.12	6,809.23	6,807.55
P2 OUTFALL PIPE	Pond 2 Outlet	Pond 2 outfall	6,810.99	6,810.00	2.00	129.6	0.008	24.0	0.013	4.04	19.77	10.1	6,811.48	6,810.43	6,811.65	6,810.68
8	STRM MH 5	MH-19	6,817.41	6,817.15	8.68	31.8	0.005	36.0	0.013	5.09	47.16	18.4	6,818.34	6,818.02	6,818.68	6,818.42
9	MH-19	STRM MH 7	6,817.05	6,815.83	8.64	265.2	0.005	36.0	0.013	5.07	47.06	18.4	6,817.98	6,816.70	6,818.31	6,817.10

Profile Report
Engineering Profile - STORM RUN 1 (24004308-StormCAD-2024-12-11.stsw)
Active Scenario: 5-year



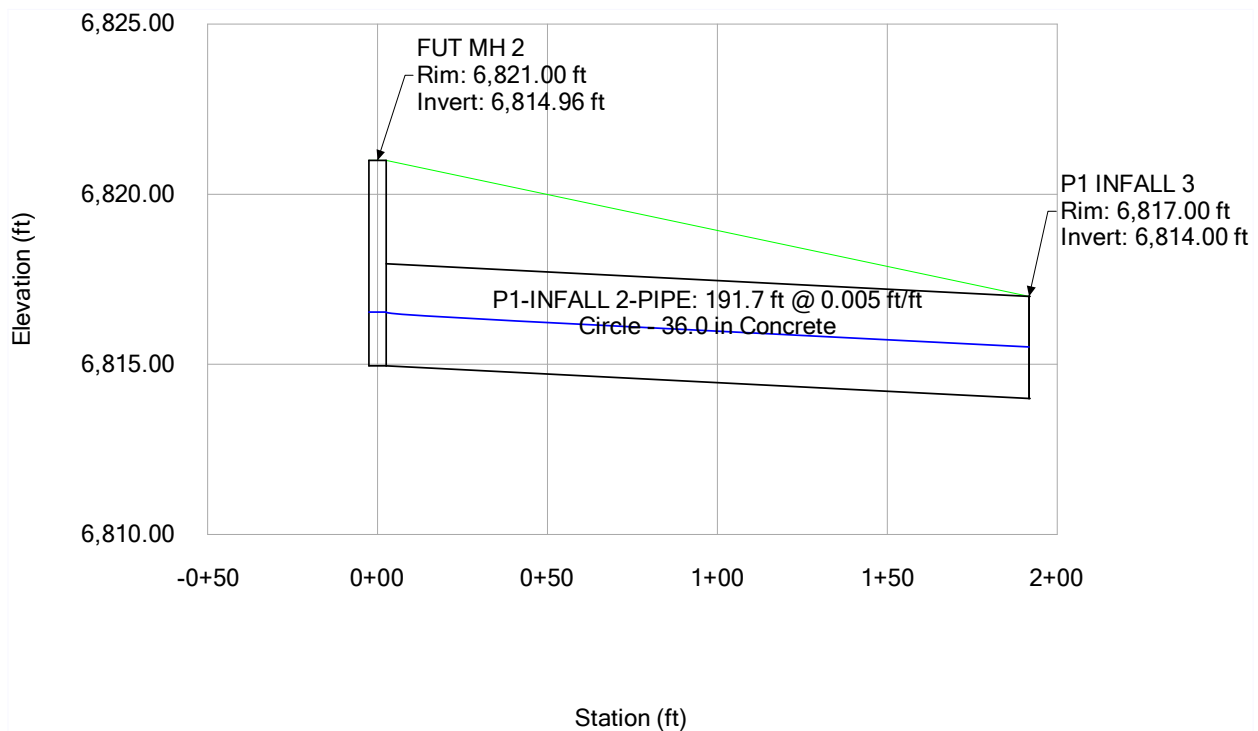
Profile Report
Engineering Profile - POND 1-INLET 1 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year



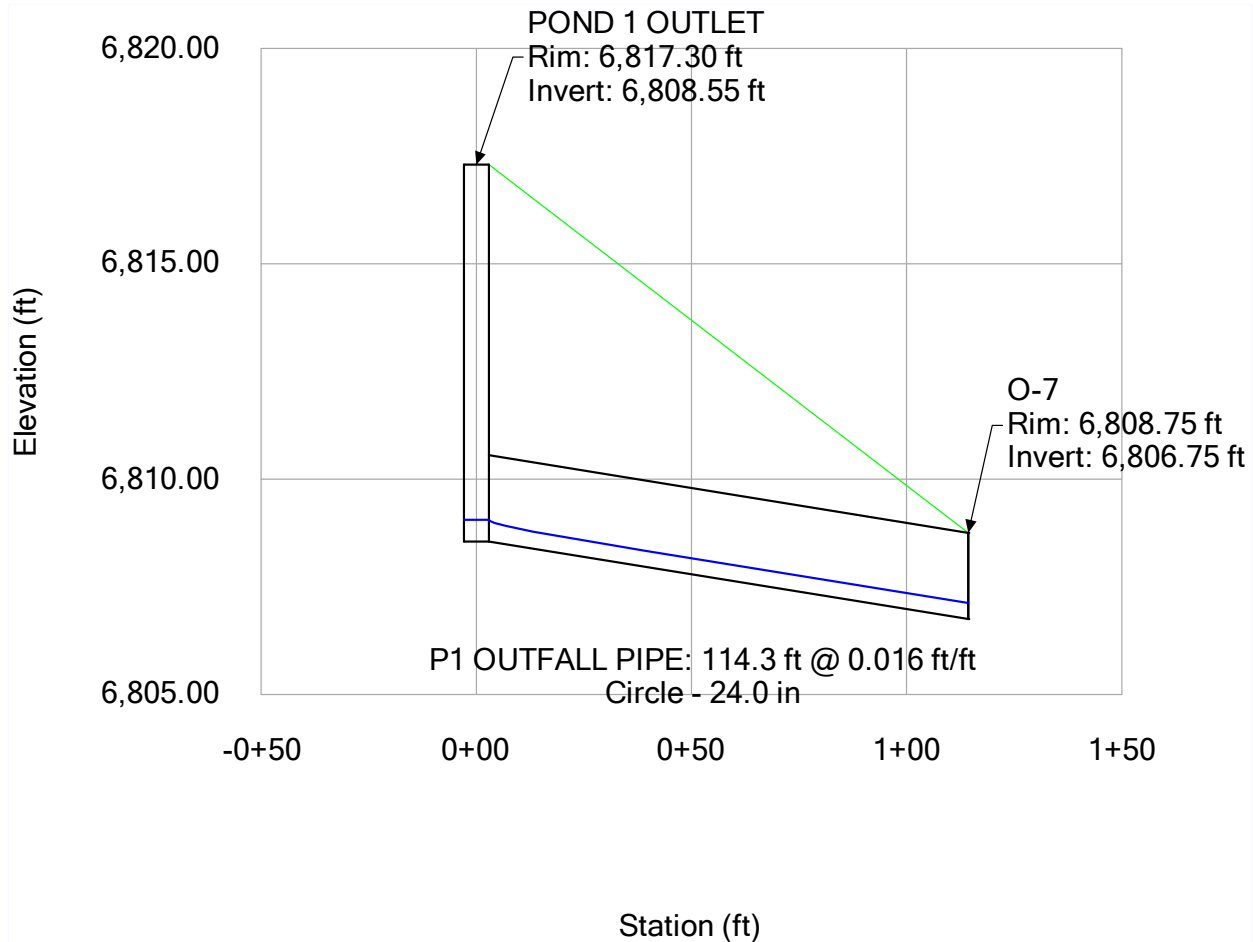
Profile Report
Engineering Profile - POND 1-INLET 2 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year



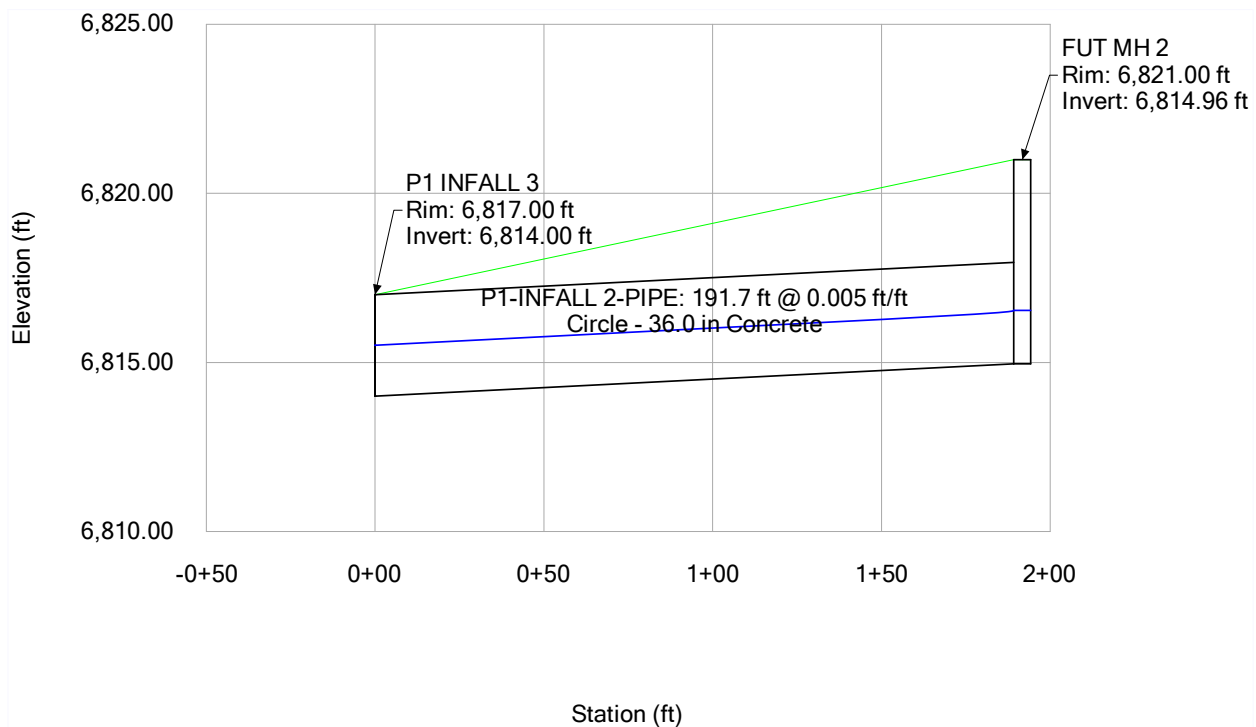
Profile Report
Engineering Profile - POND 1 OUTFALL (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year



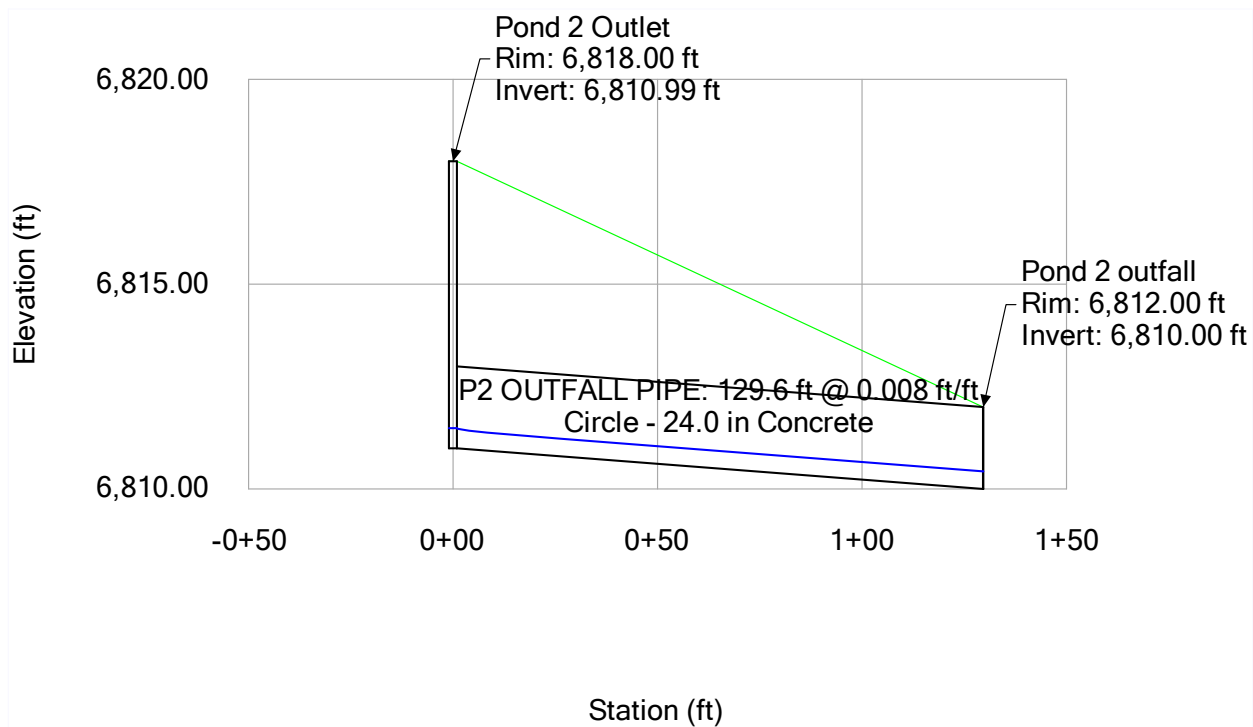
Profile Report
Engineering Profile - pond 2 inlet 2 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year

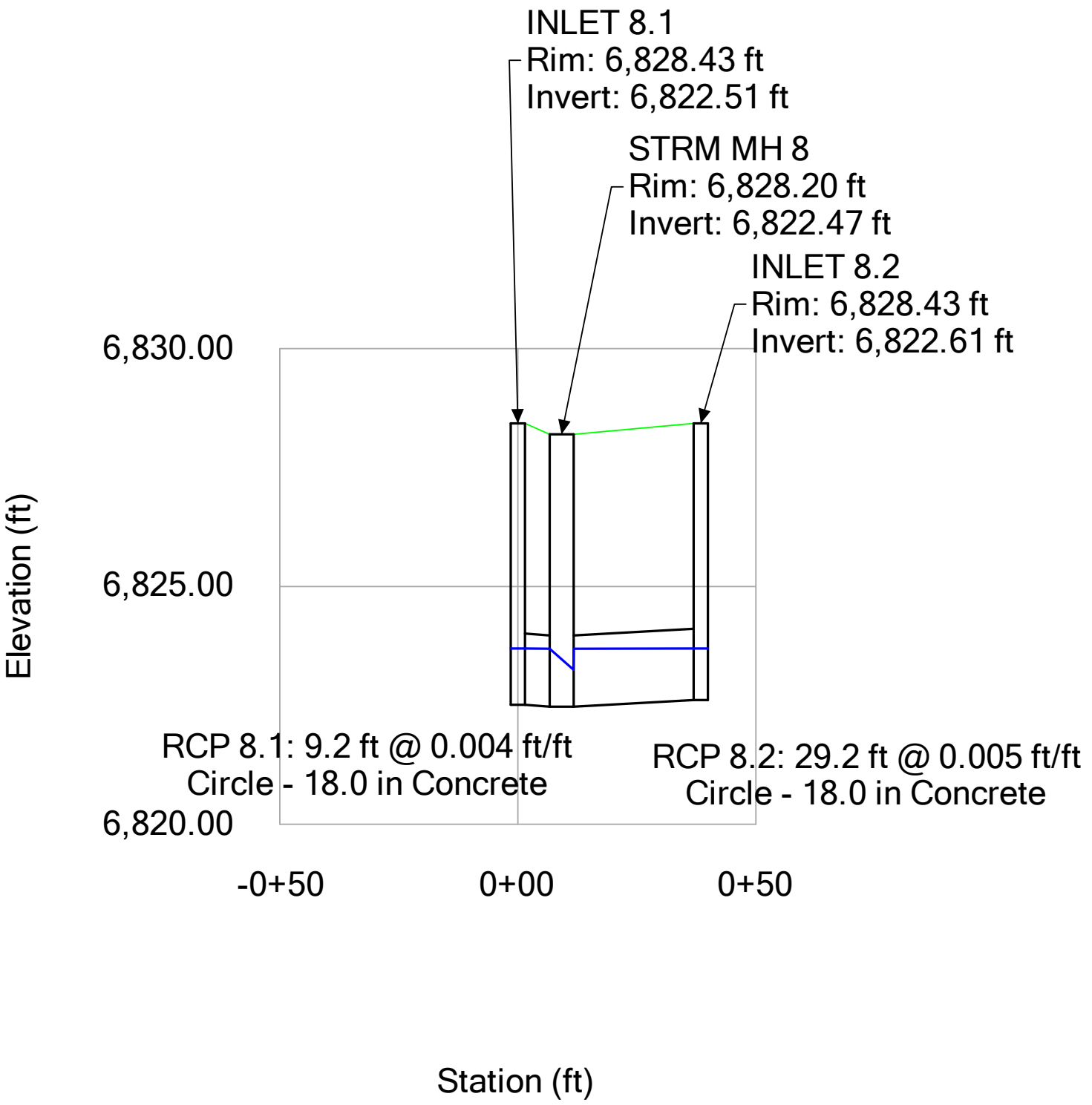


Profile Report
Engineering Profile - pond 2 oufall (24004308-StormCAD-2024-12-11.stsw)

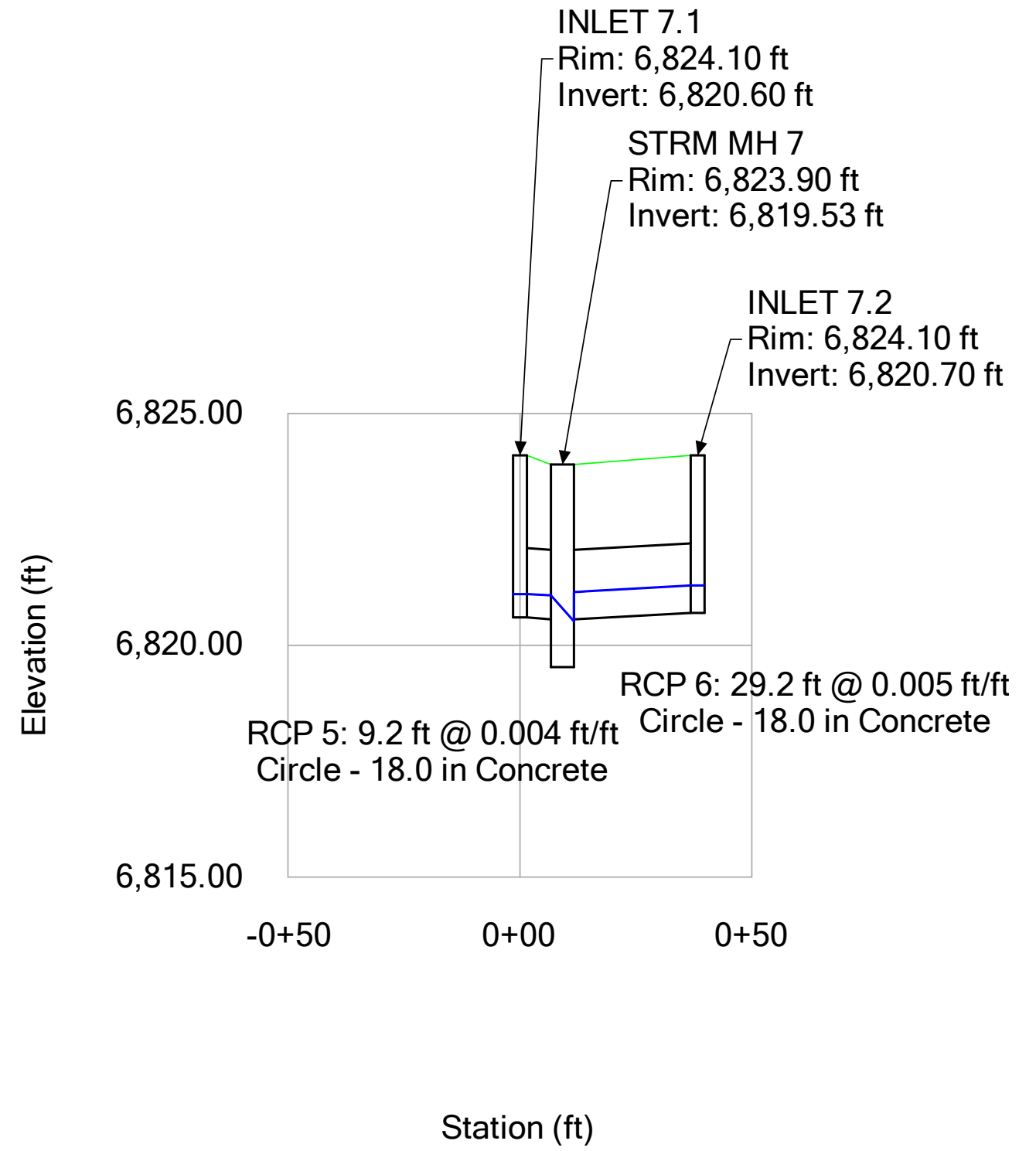
Active Scenario: 5-year



Profile Report
Engineering Profile - STORM RUN 1.1 (24004308-StormCAD-2024-12-11.stsw)
Active Scenario: 5-year



Profile Report
Engineering Profile - STORM RUN 1.2 (24004308-StormCAD-2024-12-11.stsw)
Active Scenario: 5-year



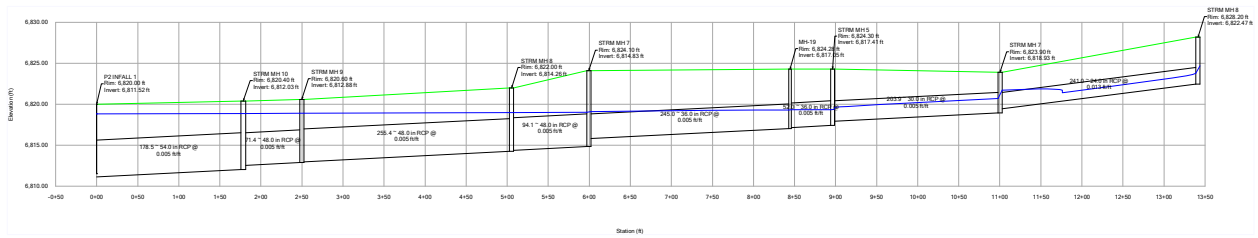
FlexTable: Conduit Table
Active Scenario: 100-year

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Flow (cfs)	Length (3D) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Velocity (ft/s)	Capacity (Design) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
RCP 8.3	STRM MH 8	STRM MH 7	6,822.47	6,819.43	13.62	239.1	0.013	24.0	0.013	8.23	25.41	53.6	6,823.80	6,821.73	6,824.39	6,822.02
RCP 6	INLET 7.2	STRM MH 7	6,820.70	6,820.56	6.62	23.8	0.005	18.0	0.013	4.67	7.28	91.0	6,821.85	6,821.73	6,822.17	6,822.04
RCP 5	INLET 7.1	STRM MH 7	6,820.60	6,820.56	4.67	11.9	0.004	18.0	0.013	4.21	6.94	67.3	6,821.74	6,821.73	6,821.90	6,821.88
RCP 10	STRM MH 7	STRM MH 8	6,814.83	6,814.36	23.76	94.9	0.005	48.0	0.013	1.89	101.51	23.4	6,819.00	6,818.98	6,819.06	6,819.03
RCP 11	STRM MH 8	STRM MH 9	6,814.26	6,812.98	23.35	254.8	0.005	48.0	0.013	1.86	101.68	23.0	6,818.97	6,818.90	6,819.03	6,818.96
RCP 12	STRM MH 9	STRM MH 10	6,812.88	6,812.53	22.27	71.7	0.005	48.0	0.013	1.77	100.56	22.1	6,818.90	6,818.88	6,818.95	6,818.93
RCP 13	STRM MH 10	P2 INFALL 1	6,812.03	6,811.13	21.95	192.4	0.005	54.0	0.013	1.38	139.63	15.7	6,818.85	6,818.83	6,818.88	6,818.86
P1-INFALL 1-PIPE	FUT MH 1	P1 INFALL 1	6,811.70	6,811.00	47.45	63.4	0.011	36.0	0.013	6.71	70.09	67.7	6,816.71	6,816.39	6,817.41	6,817.09
P1-INFALL 2-PIPE	FUT MH 2	P1 INFALL 3	6,814.96	6,814.00	64.88	191.7	0.005	36.0	0.013	9.18	47.20	137.5	6,818.60	6,816.58	6,819.91	6,818.14
P2 INFALL 2	FUT MH 3	P2 INFALL 2	6,814.00	6,812.70	50.49	93.8	0.014	36.0	0.013	7.14	78.54	64.3	6,819.37	6,818.83	6,820.16	6,819.62
RCP 7	STRM MH 7	STRM MH 5	6,818.93	6,817.91	24.46	206.7	0.005	30.0	0.013	6.63	29.01	84.3	6,820.69	6,819.60	6,821.37	6,820.35
RCP 8.1	INLET 8.1	STRM MH 8	6,822.51	6,822.47	9.03	13.3	0.004	18.0	0.013	5.11	6.93	130.4	6,824.76	6,824.69	6,825.16	6,825.10
RCP 8.2	INLET 8.2	STRM MH 8	6,822.61	6,822.47	4.62	30.3	0.005	18.0	0.013	2.61	7.27	63.5	6,824.75	6,824.69	6,824.85	6,824.80
P1 OUTFALL PIPE	POND 1 OUTLET	O-7	6,808.55	6,806.75	17.00	123.1	0.016	24.0	0.013	9.44	28.39	59.9	6,810.04	6,807.87	6,810.75	6,809.24
P2 OUTFALL PIPE	Pond 2 Outlet	Pond 2 outfall	6,810.99	6,810.00	20.40	129.6	0.008	24.0	0.013	7.16	19.77	103.2	6,812.69	6,811.62	6,813.49	6,812.49
8	STRM MH 5	MH-19	6,817.41	6,817.15	24.17	31.8	0.005	36.0	0.013	6.71	47.16	51.3	6,819.35	6,819.33	6,819.74	6,819.63
9	MH-19	STRM MH 7	6,817.05	6,815.83	24.10	265.2	0.005	36.0	0.013	6.70	47.06	51.2	6,819.31	6,819.09	6,819.58	6,819.27

Profile Report

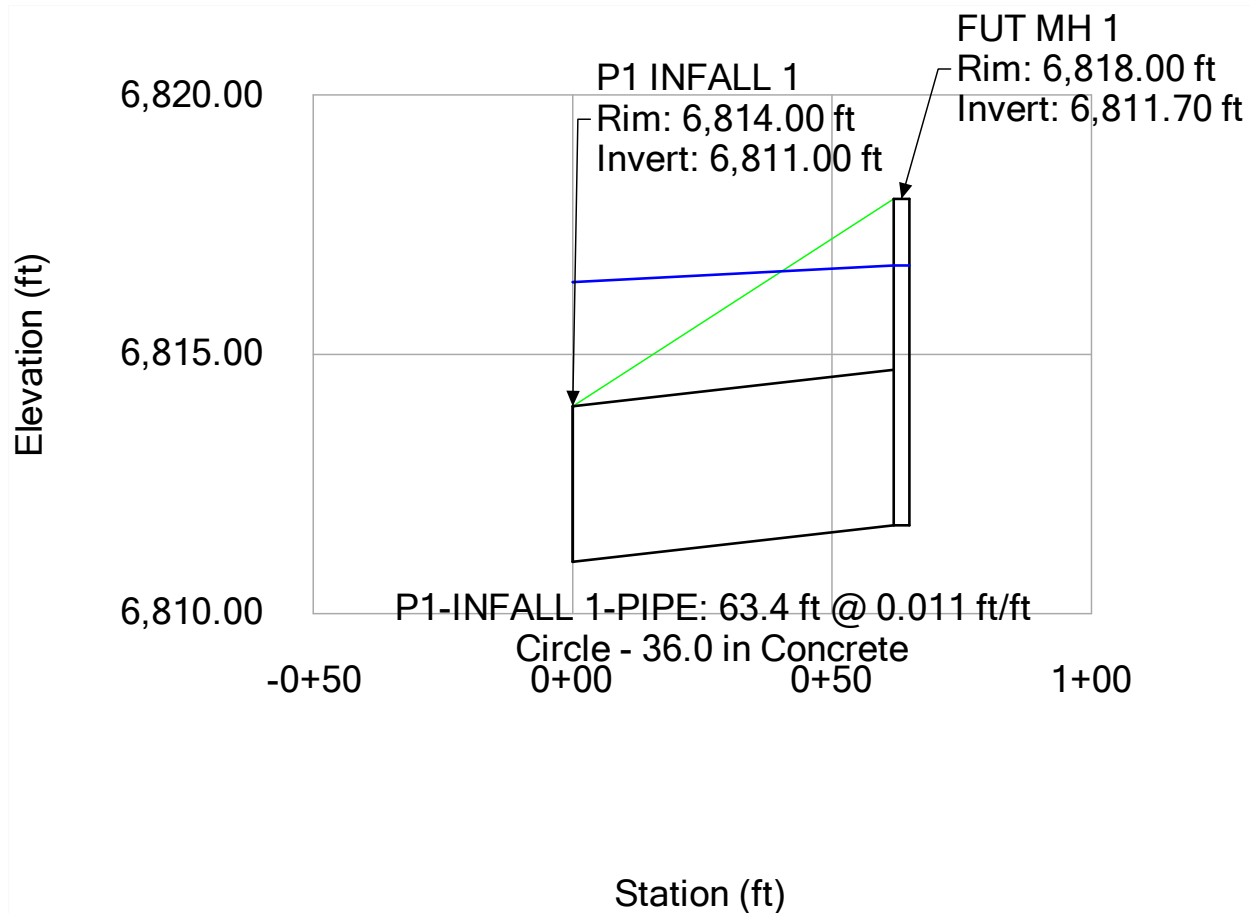
Engineering Profile - STORM RUN 1 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



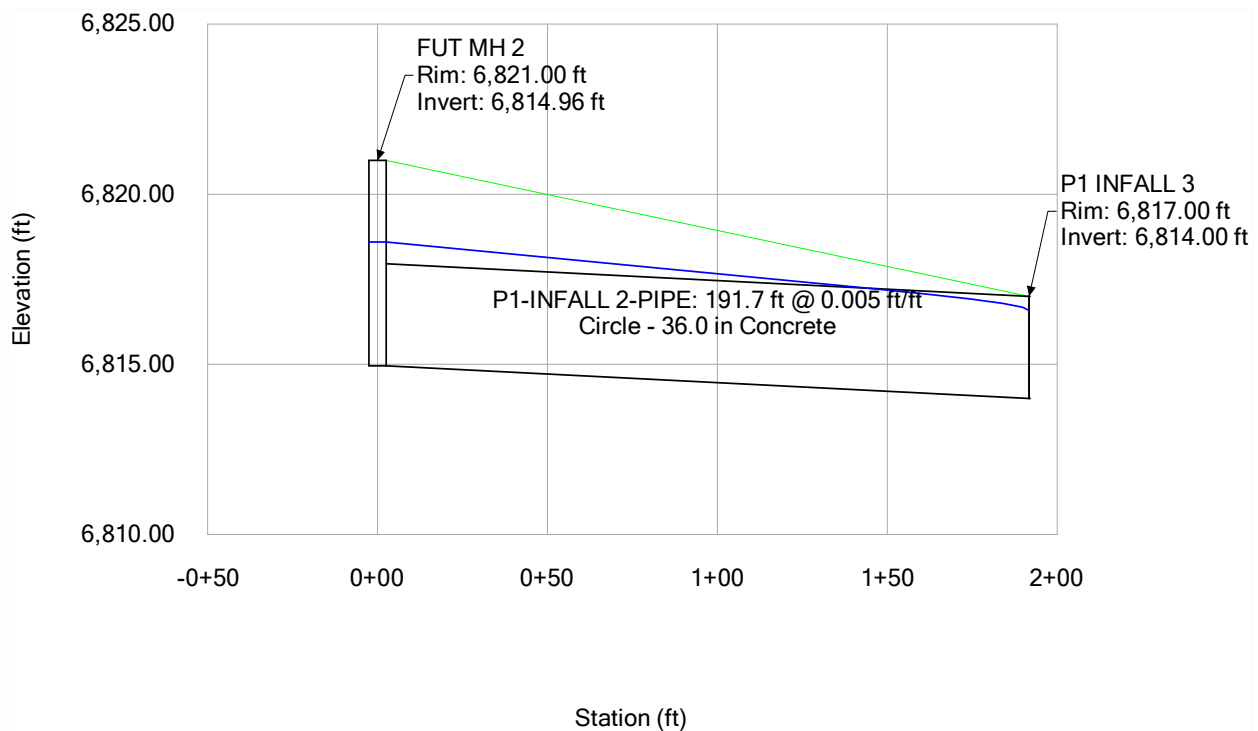
Profile Report
Engineering Profile - POND 1-INLET 1 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



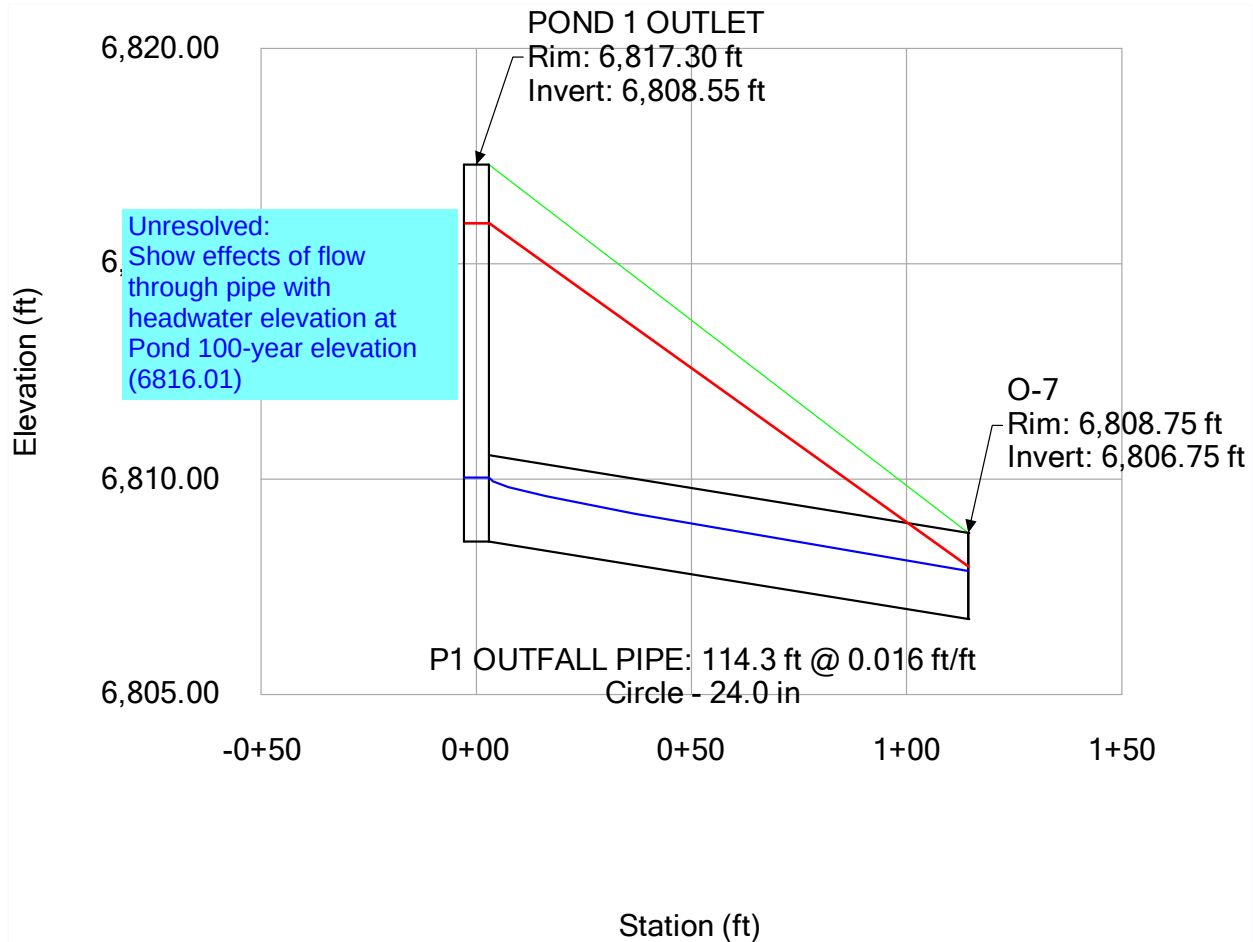
Profile Report
Engineering Profile - POND 1-INLET 2 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



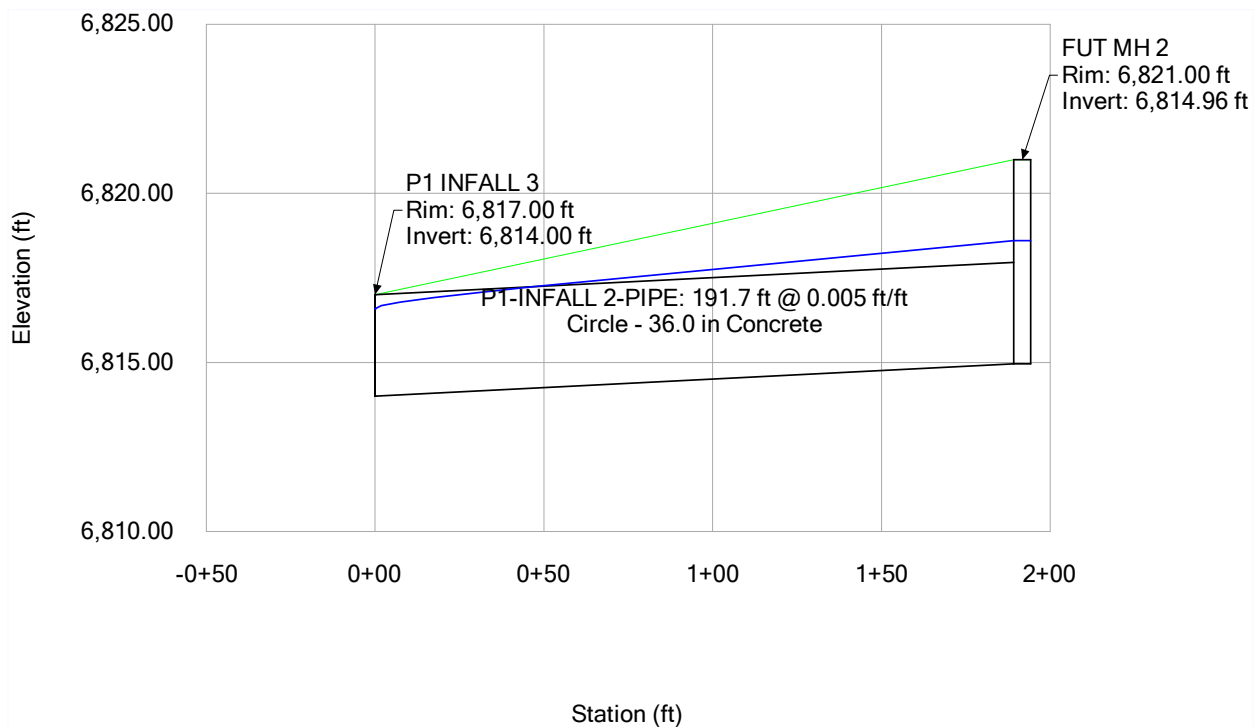
Profile Report
Engineering Profile - POND 1 OUTFALL (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



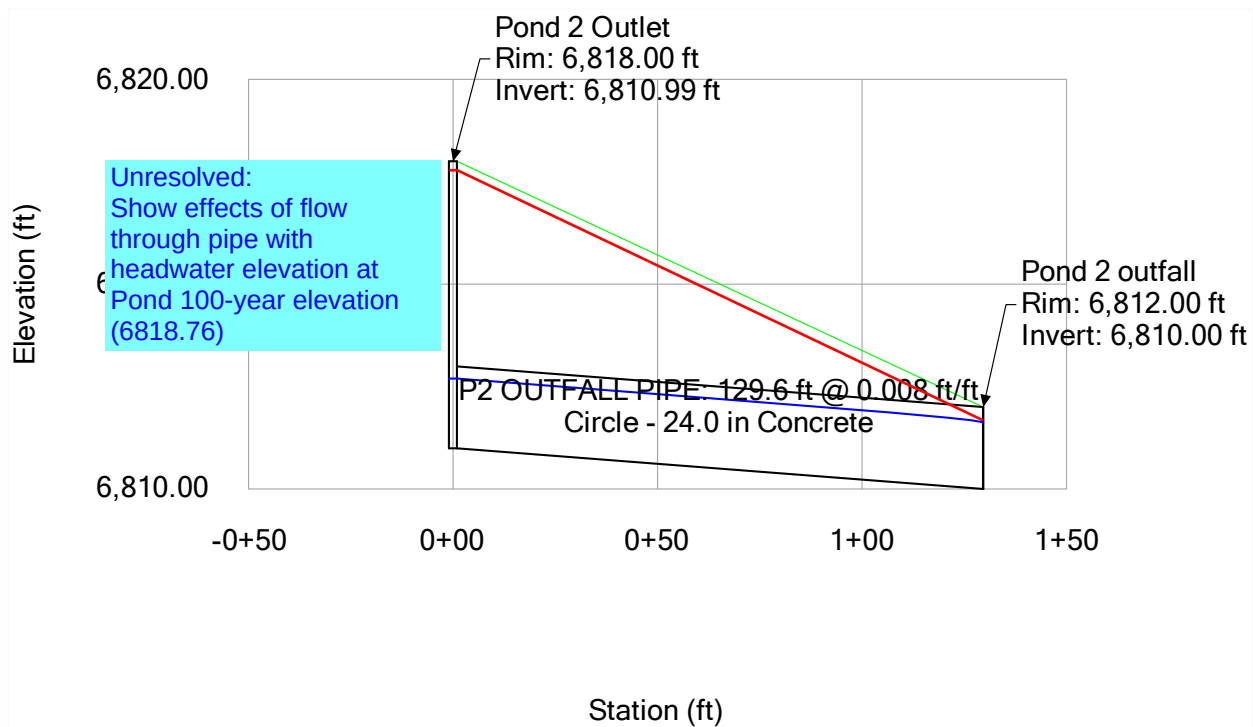
Profile Report
Engineering Profile - pond 2 inlet 2 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year

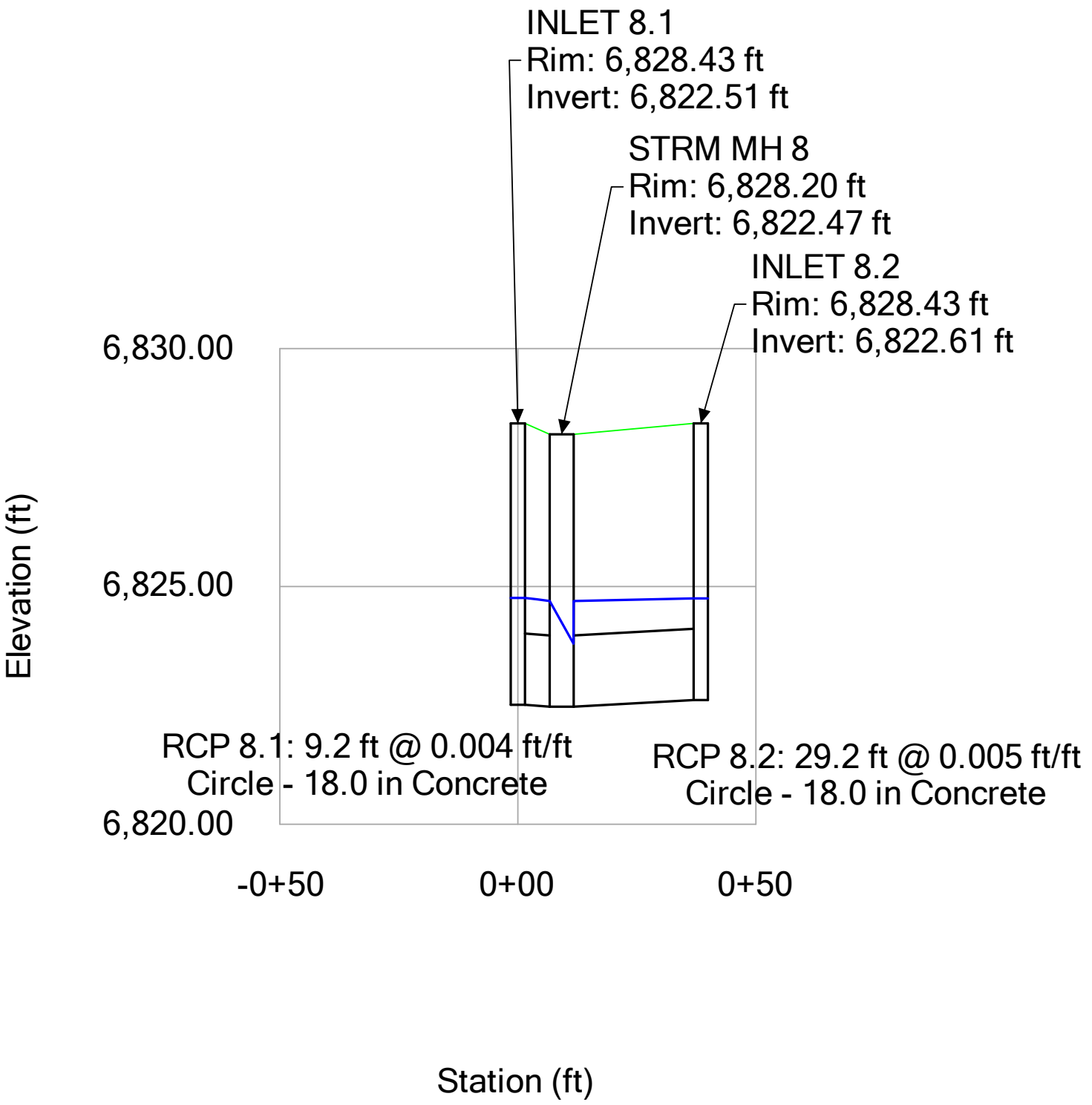


Profile Report
Engineering Profile - pond 2 oufall (24004308-StormCAD-2024-12-11.stsw)

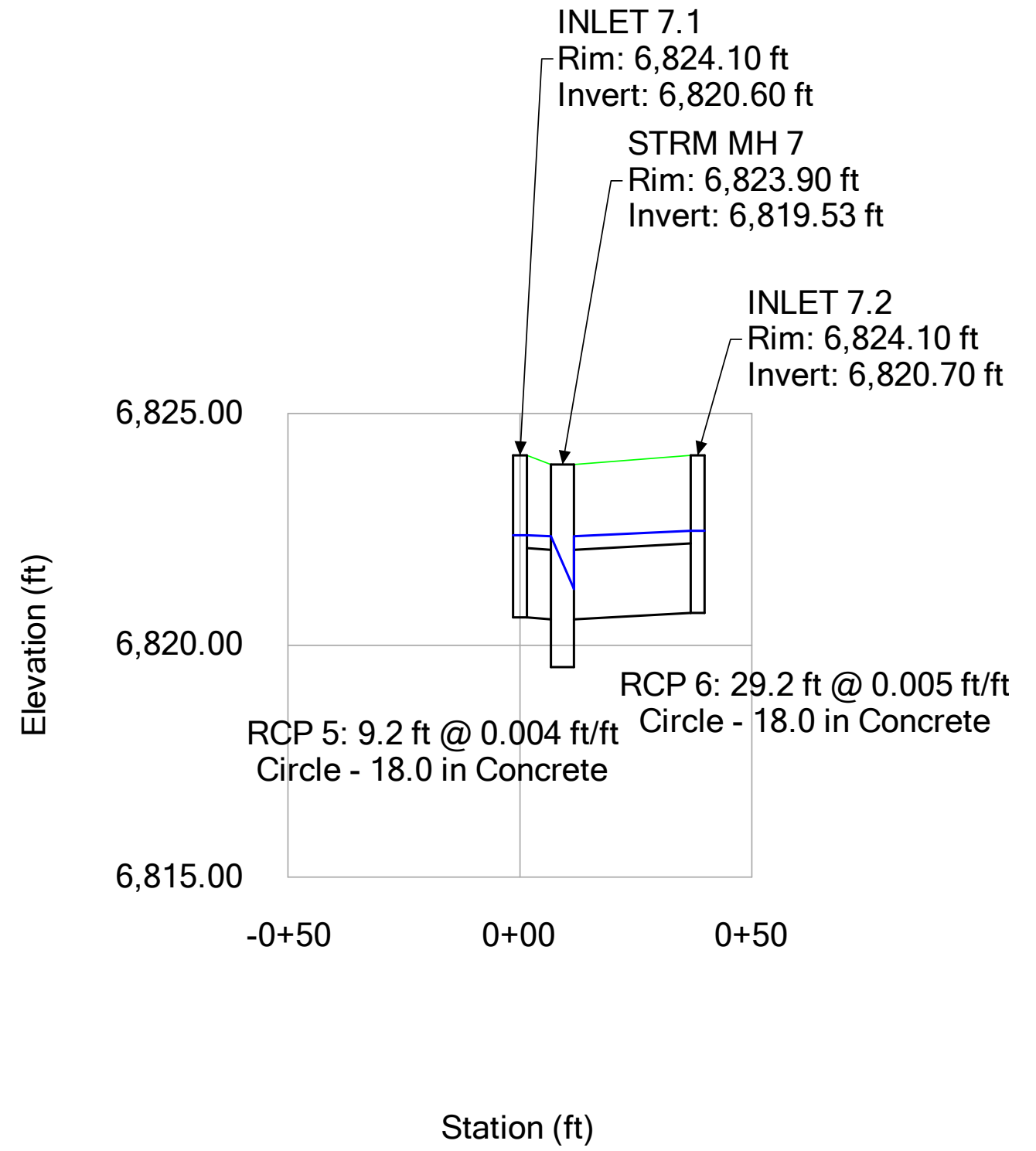
Active Scenario: 100-year



Profile Report
Engineering Profile - STORM RUN 1.1 (24004308-StormCAD-2024-12-11.stsw)
Active Scenario: 100-year



Profile Report
Engineering Profile - STORM RUN 1.2 (24004308-StormCAD-2024-12-11.stsw)
Active Scenario: 100-year



Channel Report

EXISTING POND 1 OUTFALL CHANNEL

Trapezoidal

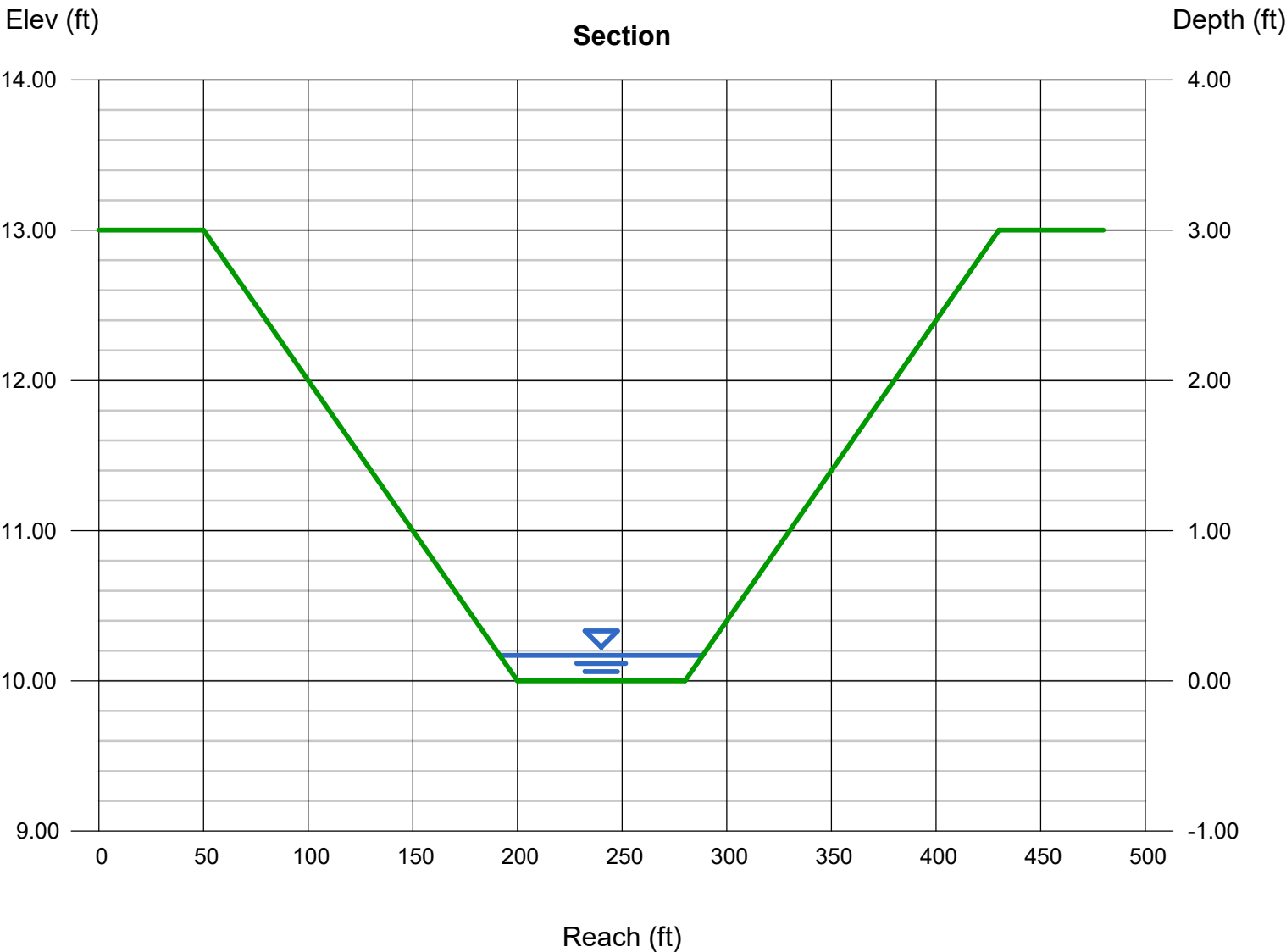
Bottom Width (ft)	= 80.00
Side Slopes (z:1)	= 50.00, 50.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Highlighted

Depth (ft)	= 0.17
Q (cfs)	= 19.40
Area (sqft)	= 15.05
Velocity (ft/s)	= 1.29
Wetted Perim (ft)	= 97.00
Crit Depth, Yc (ft)	= 0.12
Top Width (ft)	= 97.00
EGL (ft)	= 0.20

Calculations

Compute by:	Known Q
Known Q (cfs)	= 19.40



Channel Report

EXISTING POND 2 OUTFALL CHANNEL

Trapezoidal

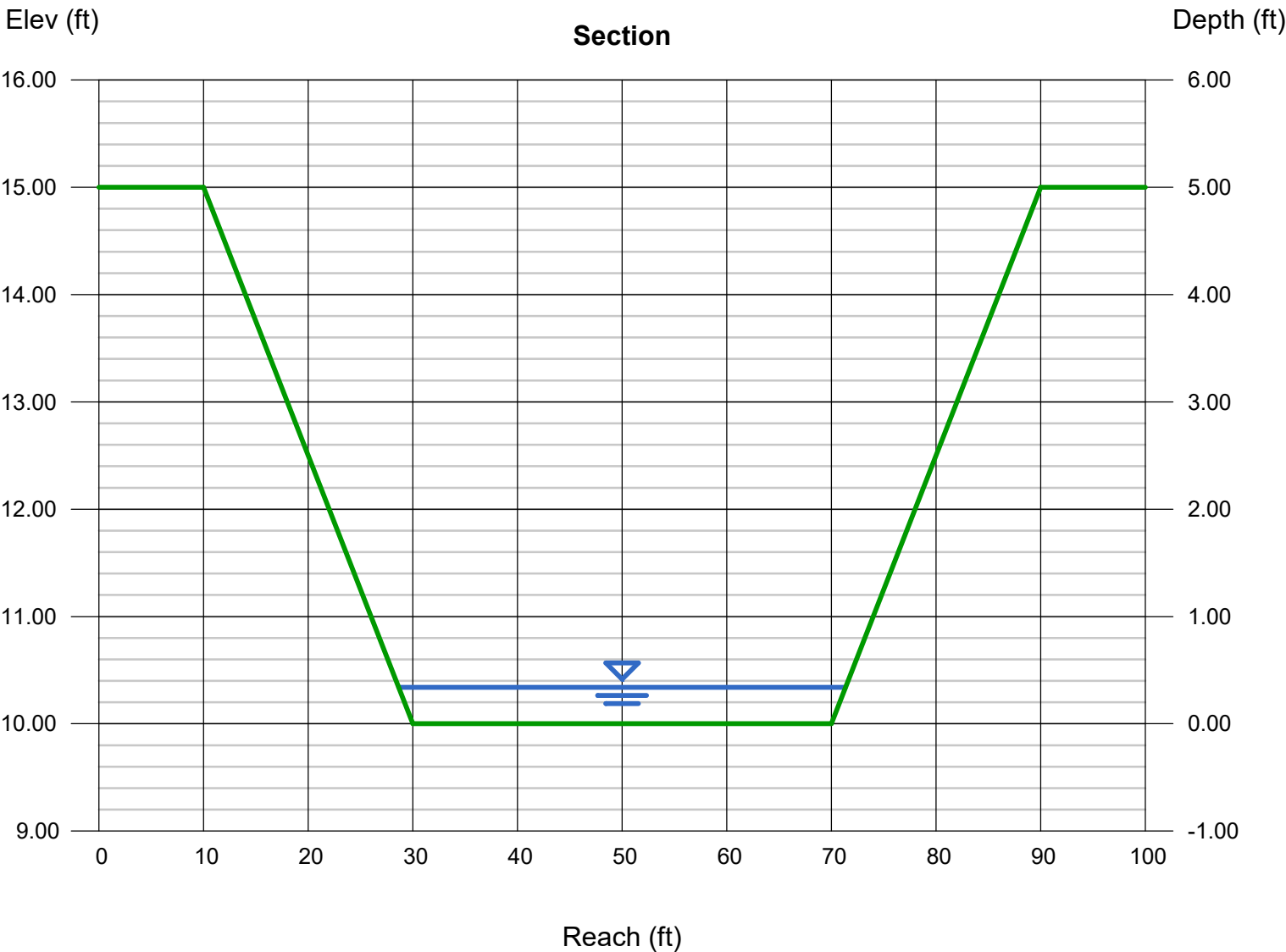
Bottom Width (ft)	= 40.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 5.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Highlighted

Depth (ft)	= 0.34
Q (cfs)	= 31.60
Area (sqft)	= 14.06
Velocity (ft/s)	= 2.25
Wetted Perim (ft)	= 42.80
Crit Depth, Yc (ft)	= 0.27
Top Width (ft)	= 42.72
EGL (ft)	= 0.42

Calculations

Compute by:	Known Q
Known Q (cfs)	= 31.60



Appendix F

Reference Material

Excerpts from:

Falcon Highlands Filing No. 2 & 3

Final Drainage Report

Terra Nova Engineering, Inc.

Rev'd Nov. 2005

SF-05-033

SF-D5-033

Terra Nova
Engineering, Inc.
"Creative Civil Engineering Solutions"

**FALCON HIGHLANDS FILING NO. 2 & 3
FINAL DRAINAGE REPORT
COLORADO SPRINGS, COLORADO**

*JULY 2005
REVISED OCTOBER 2005
REVISED NOVEMBER 2005*

Prepared For:

**TAMLIN ADVENTURES, LLC
25 N. TEJON STREET, Suite 300
Colorado Springs, CO 80903
(719) 227-1022**

Prepared By:

**TERRA NOVA ENGINEERING, INC.
125 N. Wahsatch Avenue Suite 101
Colorado Springs, CO 80903
(719) 635-6422**

Job No. 0429.00

60" Storm Main HYDRAULIC GRADE LINE CALCULATIONS

From Station	To Station	Loss Type	Start Inv. [ft]	Dia. [ft]			Flow [cfs]			Slope S ₁ [%]	Horiz Bend [°]	Manning n Coeff.	Friction Slope [%]			H.G.L. Elev. [ft]	Head Loss [ft]	Velocity fps
				D ₁	D ₂	D ₃	Q ₁	Q ₂	Q ₃				S _{f-1}	S _{f-3}	S _{f-3}			
1+50.00	3+76.49	1	6813.04	5			196			0.50%		0.013	0.57%	--	--	6816.10	0.00	9.98
3+76.49	3+76.49	2	6814.17	5			196			0.50%	45	0.013	0.57%	--	--	6818.62	0.22	9.98
3+76.49	4+23.02	1	6814.17	5			196			0.50%		0.013	0.57%	--	--	6818.84	0.26	9.98
4+23.02	4+23.02	2	6814.40	5			196			0.50%	45	0.013	0.57%	--	--	6819.10	0.22	9.98
4+23.02	7+17.62	1	6814.40	5			196			0.50%		0.013	0.57%	--	--	6819.32	1.67	9.98
7+17.62	7+17.62	3	6815.84	5			196			0.50%		0.013	0.57%	--	--	6820.99	0.08	9.98
7+17.62	7+23.33	1	6815.84	5			196			0.50%		0.013	0.57%	--	--	6821.07	0.03	9.98
7+23.33	9+35.99	1	6816.04	5			196			0.50%		0.013	0.57%	--	--	6821.10	1.20	9.98
9+35.99	9+35.99	2	6817.10	5			196			0.50%	2	0.013	0.57%	--	--	6822.30	0.05	9.98
9+35.99	11+21.12	1	6817.10	5			196			0.50%		0.013	0.57%	--	--	6822.35	1.05	9.98
11+21.12	11+21.12	3	6818.03	5			196			0.50%		0.013	0.57%	--	--	6823.39	0.08	9.98
11+21.12	11+26.87	1	6818.03	5			196			0.50%		0.013	0.57%	--	--	6823.47	0.03	9.98
11+26.87	11+26.87	6	6818.23	5	5	3	166	196	30	0.50%	45	0.013	0.41%	0.57%	0.20%	6823.50	0.73	8.45
11+26.87	11+95.80	1	6818.23	5			166			0.50%		0.013	0.41%	--	--	6824.24	0.28	8.45
11+95.80	11+95.80	3	6818.57	5			166			0.50%		0.013	0.41%	--	--	6824.52	0.06	8.45
11+95.80	12+01.55	1	6818.57	5			166			0.50%		0.013	0.41%	--	--	6824.57	0.02	8.45
12+01.55	12+01.55	6	6820.07	3.5	5	3	84	166	41	0.50%	45	0.013	0.70%	0.41%	0.38%	6824.60	1.07	8.73
12+01.55	16+79.95	1	6820.07	3.5			84			1.00%		0.013	0.70%	--	--	6825.66	3.33	8.73
16+79.95	16+79.95	3	6824.87	3.5			84			1.00%		0.013	0.70%	--	--	6828.99	0.06	8.73
16+79.95	16+84.86	1	6824.87	3.5			84			1.00%		0.013	0.70%	--	--	6829.05	0.03	8.73
16+84.86	19+24.03	1	6825.07	3.5			84			0.90%		0.013	0.70%	--	--	6829.09	1.67	8.73
19+24.03	19+24.03	6	6827.23	3.5	3.5	1.5	63	84	11	0.90%	45	0.013	0.39%	0.70%	1.10%	6830.75	0.88	6.55
19+24.03	19+28.53	1	6827.23	3.5			63			0.90%		0.013	0.39%	--	--	6831.63	0.02	6.55
19+28.53	22+22.51	1	6827.73	3.5			63			1.93%		0.013	0.39%	--	--	6831.65	1.15	6.55
22+22.51	22+22.51	6	6833.40	2.5	3.5	2.5	33	63	30	1.93%	45	0.013	0.65%	0.39%	0.53%	6835.05	0.26	6.72
22+22.51	22+42.51	1	6833.40	2.5			33			1.93%		0.013	0.65%	--	--	6835.31	0.13	6.72
22+42.51	22+42.51	2	6833.79	2.5			33			1.93%	45	0.013	0.65%	--	--	6835.44	0.10	6.72
22+42.51	22+53.36	1	6833.79	2.5			33			1.93%		0.013	0.65%	--	--	6835.53	0.07	6.72
22+53.36			6781.90									0.013	--	--	--	6835.60	--	

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW

RATIONAL C COEFFICIENT DATA

.....

[illegible]

Soil/Surface Description	C	Area acres	C x Area acres
-----	-----	-----	-----
basin b	1.0000	52.640	52.640

```
WEIGHTED C & TOTAL AREA --->      1.0000      52.640      52.640
.....
```

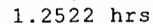

POND 1 WEST.PPW

---- Graphical Summary for Maximum Required Storage ----
Method I

```

*****
* RETURN FREQUENCY: 5 yr      | Allowable Outflow: 32.20 cfs *
* 'C' Adjustment: 1.000     | Required Storage: 4.756 ac-ft *
* ----- *
* Peak Inflow: 84.93 cfs *
* .HYG File: 5Y *
*****

```



Type.... Individual Outlet Curves
Name.... Outlet 3

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File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = R2 (Inlet Box)

Upstream ID = (Pond Water Surface)

DNstream ID = TW (Pond Outfall)

WS Elev, Device Q		Tail Water		Notes
WS Elev.	Q	TW Elev Converge		Computation Messages
ft	cfs	ft	+/-ft	
6812.00	.00	Free Outfall		WS below an invert; no flow.
6812.50	.00	Free Outfall		WS below an invert; no flow.
6813.00	.00	Free Outfall		WS below an invert; no flow.
6813.50	.00	Free Outfall		WS below an invert; no flow.
6814.00	.00	Free Outfall		WS below an invert; no flow.
6814.50	.00	Free Outfall		WS below an invert; no flow.
6814.61	.00	Free Outfall		WS below an invert; no flow.
6815.00	9.94	Free Outfall		Weir: H =.39
6815.50	31.79	Free Outfall		
		Orifice: H =.89		
6816.00	39.72	Free Outfall		
		Orifice: H =1.39		
6816.50	46.32	Free Outfall		
		Orifice: H =1.89		
6817.00	52.09	Free Outfall		
		Orifice: H =2.39		
6817.50	57.28	Free Outfall		
		Orifice: H =2.89		
6818.00	62.03	Free Outfall		
		Orifice: H =3.39		

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = R1 (Inlet Box)

 Upstream ID = (Pond Water Surface)
 DNstream ID = O1 (Orifice-Circular)

Pond WS. Elev. ft	Device Q cfs	(into) HW HGL ft	Converge DS HGL ft	Next DS HGL ft	DS HGL Error +/-ft	Q SUM Error +/-cfs	DS Chan. TW ft	TW Error +/-ft
6812.00	.00	...	...	...	...	...	Free Outfall	
		WS below an invert; no flow.						
6812.50	10.52	6812.50	Free	6809.25	.000	.000	Free Outfall	
		Weir: H = .50						
6813.00	24.90	6813.00	6813.00	6813.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6813.50	26.21	6813.50	6813.50	6813.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6814.00	27.46	6814.00	6814.00	6814.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6814.50	28.65	6814.50	6814.50	6814.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6814.61	28.91	6814.61	6814.61	6814.61	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6815.00	29.80	6815.00	6815.00	6815.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6815.50	30.90	6815.50	6815.50	6815.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6816.00	31.97	6816.00	6816.00	6816.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6816.50	33.00	6816.50	6816.50	6816.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6817.00	34.00	6817.00	6817.00	6817.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6817.50	34.97	6817.50	6817.50	6817.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6818.00	35.92	6818.00	6818.00	6818.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						

Type.... Individual Outlet Curves
 Name.... Outlet 3

Page 11.06

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = O1 (Orifice-Circular)

UPstream ID = R1 (Inlet Box)

DNstream ID = TW (Pond Outfall)

Pond WS. Elev. ft	Device Q cfs	(into) HW HGL ft	Converge DS HGL ft	Next DS HGL ft	DS HGL Error +/-ft	Q SUM Error +/-cfs	DS Chan. TW ft	TW Error +/-ft
6812.00	.00	.00	Free	Free	.000	.000	Free Outfall	
6812.50	10.52	6809.25	Free	Free	.000	.070	Free Outfall	
6813.00	24.90	CRIT.DEPTH 6813.00	Free	Free	.000	.000	Free Outfall	CRIT.DEPTH
6813.50	26.21	H =4.63 6813.50	Free	Free	.000	.000	Free Outfall	
6814.00	27.46	H =5.13 6814.00	Free	Free	.000	.000	Free Outfall	
6814.50	28.65	H =5.63 6814.50	Free	Free	.000	.000	Free Outfall	
6814.61	28.91	H =6.13 6814.61	Free	Free	.000	.000	Free Outfall	
6815.00	29.80	H =6.23 6815.00	Free	Free	.000	.000	Free Outfall	
6815.50	30.90	H =6.63 6815.50	Free	Free	.000	.000	Free Outfall	
6816.00	31.97	H =7.13 6816.00	Free	Free	.000	.000	Free Outfall	
6816.50	33.00	H =7.63 6816.50	Free	Free	.000	.000	Free Outfall	
6817.00	34.00	H =8.13 6817.00	Free	Free	.000	.000	Free Outfall	
6817.50	34.97	H =8.63 6817.50	Free	Free	.000	.000	Free Outfall	
6818.00	35.92	H =9.13 6818.00	Free	Free	.000	.000	Free Outfall	
		H =9.63						

Type.... Pond Routing Summary
Name.... POND WEST OUT Tag: 5Y
File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW
Storm... cos5yr Tag: 5Y

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Event: 5 yr

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\
Inflow HYG file = NONE STORED - POND WEST IN 5Y
Outflow HYG file = NONE STORED - POND WEST OUT 5Y

Pond Node Data = POND WEST
Pond Volume Data = POND WEST
Pond Outlet Data = Outlet 3

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 6812.00 ft
Starting Volume = .000 ac-ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout = .00 cfs
Time Increment = .0500 hrs

Value used as
override for Pond 1
interim and final
Predevelopment
Peak Flows for 5 and
10 year event

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

=====

Peak Inflow	=	84.93 cfs	at	.5500 hrs
Peak Outflow	=	28.88 cfs	at	1.2500 hrs

Peak Elevation = 6814.60 ft
Peak Storage = 3.919 ac-ft
=====

MASS BALANCE (ac-ft)

+ Initial Vol = .000
+ HYG Vol IN = 6.661
- Infiltration = .000
- HYG Vol OUT = 6.661
- Retained Vol = .000

Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

Type.... Mod. Rational Graph
 Name.... BASIN B, OS-1&2 Tag: 100y
 File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW
 Storm... cos100yr Tag: 100y

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Event: 100 yr

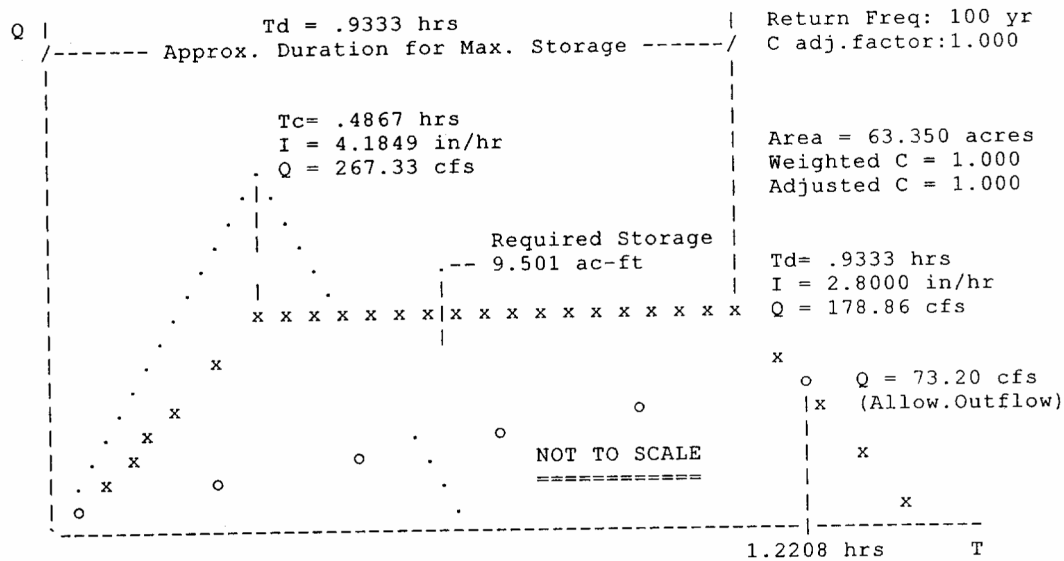
MODIFIED RATIONAL METHOD

---- Graphical Summary for Maximum Required Storage ----
 Method I

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

```

*****
* RETURN FREQUENCY: 100 yr | Allowable Outflow: 73.20 cfs *
* 'C' Adjustment: 1.000 | Required Storage: 9.501 ac-ft *
*-----*
* Peak Inflow: 178.86 cfs *
* .HYG File: 100y *
*****
  
```



Type.... Individual Outlet Curves
Name.... Outlet 3

Page 11.04

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = R2 (Inlet Box)

Upstream ID = (Pond Water Surface)

DNstream ID = TW (Pond Outfall)

WS Elev, Device Q		Tail Water		Notes
WS Elev.	Q	TW Elev Converge		Computation Messages
ft	cfs	ft	+/-ft	
6812.00	.00	Free Outfall		WS below an invert; no flow.
6812.50	.00	Free Outfall		WS below an invert; no flow.
6813.00	.00	Free Outfall		WS below an invert; no flow.
6813.50	.00	Free Outfall		WS below an invert; no flow.
6814.00	.00	Free Outfall		WS below an invert; no flow.
6814.50	.00	Free Outfall		WS below an invert; no flow.
6814.61	.00	Free Outfall		WS below an invert; no flow.
6815.00	9.94	Free Outfall		Weir: H =.39
6815.50	31.79	Free Outfall		
Orifice: H =.89				
6816.00	39.72	Free Outfall		
Orifice: H =1.39				
6816.50	46.32	Free Outfall		
Orifice: H =1.89				
6817.00	52.09	Free Outfall		
Orifice: H =2.39				
6817.50	57.28	Free Outfall		
Orifice: H =2.89				
6818.00	62.03	Free Outfall		
Orifice: H =3.39				

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = R1 (Inlet Box)

Upstream ID = (Pond Water Surface)

DNstream ID = O1 (Orifice-Circular)

Pond WS. Elev. ft	Device Q cfs	(into) HW HGL ft	Converge DS HGL ft	Next DS HGL ft	DS HGL Error +/-ft	Q SUM Error +/-cfs	DS Chan. TW ft	TW Error +/-ft
6812.00	.00	...	...	...	...	...	Free Outfall	
6812.50	10.52	WS below an invert; no flow. 6812.50	Free	6809.25	.000	.000	Free Outfall	
6813.00	24.90	Weir: H =.50 6813.00	6813.00	6813.00	.000	.000	Free Outfall	
6813.50	26.21	DS HGL+Loss > crest: Flow set to Downstream outlet. 6813.50	6813.50	6813.50	.000	.000	Free Outfall	
6814.00	27.46	DS HGL+Loss > crest: Flow set to Downstream outlet. 6814.00	6814.00	6814.00	.000	.000	Free Outfall	
6814.50	28.65	DS HGL+Loss > crest: Flow set to Downstream outlet. 6814.50	6814.50	6814.50	.000	.000	Free Outfall	
6814.61	28.91	DS HGL+Loss > crest: Flow set to Downstream outlet. 6814.61	6814.61	6814.61	.000	.000	Free Outfall	
6815.00	29.80	DS HGL+Loss > crest: Flow set to Downstream outlet. 6815.00	6815.00	6815.00	.000	.000	Free Outfall	
6815.50	30.90	DS HGL+Loss > crest: Flow set to Downstream outlet. 6815.50	6815.50	6815.50	.000	.000	Free Outfall	
6816.00	31.97	DS HGL+Loss > crest: Flow set to Downstream outlet. 6816.00	6816.00	6816.00	.000	.000	Free Outfall	
6816.50	33.00	DS HGL+Loss > crest: Flow set to Downstream outlet. 6816.50	6816.50	6816.50	.000	.000	Free Outfall	
6817.00	34.00	DS HGL+Loss > crest: Flow set to Downstream outlet. 6817.00	6817.00	6817.00	.000	.000	Free Outfall	
6817.50	34.97	DS HGL+Loss > crest: Flow set to Downstream outlet. 6817.50	6817.50	6817.50	.000	.000	Free Outfall	
6818.00	35.92	DS HGL+Loss > crest: Flow set to Downstream outlet. 6818.00	6818.00	6818.00	.000	.000	Free Outfall	

Type.... Individual Outlet Curves
 Name.... Outlet 3

Page 11.06

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = 01 (Orifice-Circular)

UPstream ID = R1 (Inlet Box)

DNstream ID = TW (Pond Outfall)

Pond WS. Elev. ft	Device Q cfs	(into) HW HGL ft	Converge DS HGL ft	Next DS HGL ft	DS HGL Error +/-ft	Q SUM Error +/-cfs	DS Chan. TW ft	TW Error +/-ft
6812.00	.00	.00	Free	Free	.000	.000	Free Outfall	
6812.50	10.52	6809.25	Free	Free	.000	.070	Free Outfall	
6813.00	24.90	6813.00	Free	Free	.000	.000	Free Outfall	
6813.50	26.21	6813.50	Free	Free	.000	.000	Free Outfall	
6814.00	27.46	6814.00	Free	Free	.000	.000	Free Outfall	
6814.50	28.65	6814.50	Free	Free	.000	.000	Free Outfall	
6814.61	28.91	6814.61	Free	Free	.000	.000	Free Outfall	
6815.00	29.80	6815.00	Free	Free	.000	.000	Free Outfall	
6815.50	30.90	6815.50	Free	Free	.000	.000	Free Outfall	
6816.00	31.97	6816.00	Free	Free	.000	.000	Free Outfall	
6816.50	33.00	6816.50	Free	Free	.000	.000	Free Outfall	
6817.00	34.00	6817.00	Free	Free	.000	.000	Free Outfall	
6817.50	34.97	6817.50	Free	Free	.000	.000	Free Outfall	
6818.00	35.92	6818.00	Free	Free	.000	.000	Free Outfall	

Type.... Pond Routing Summary
Name.... POND WEST OUT Tag: 100y
File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND 1 WEST.PPW
Storm... cos100yr Tag: 100y

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Event: 100 yr

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\
Inflow HYG file = NONE STORED - POND WEST IN 100y
Outflow HYG file = NONE STORED - POND WEST OUT 100y

Pond Node Data = POND WEST
Pond Volume Data = POND WEST
Pond Outlet Data = Outlet 3

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 6812.00 ft
Starting Volume = .000 ac-ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout = .00 cfs
Time Increment = .0500 hrs

Value used as
override for Pond 1
interim and final
Predevelopment
Peak Flows for 100
year event

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

=====

Peak Inflow	=	178.86 cfs	at	.5500 hrs
Peak Outflow	=	73.25 cfs	at	1.2000 hrs

Peak Elevation = 6816.10 ft
Peak Storage = 8.944 ac-ft
=====

MASS BALANCE (ac-ft)

+ Initial Vol = .000
+ HYG Vol IN = 13.795
- Infiltration = .000
- HYG Vol OUT = 13.795
- Retained Vol = .000

Unrouted Vol = - .000 ac-ft (.000% of Inflow Volume)

Type.... Mod. Rational Graph
 Name.... BASIN C & OS-2 Tag: 5YR
 File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW
 Storm... cos5yr Tag: 5YR

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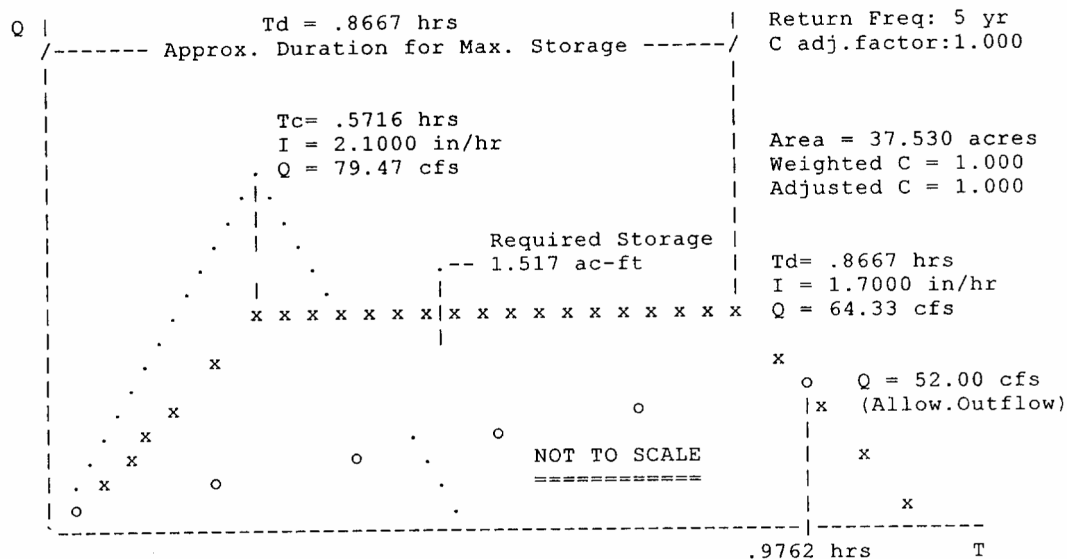
Event: 5 yr

MODIFIED RATIONAL METHOD

---- Graphical Summary for Maximum Required Storage ----
 Method I

$Q = CiA * \text{Units Conversion}$; Where Conversion = $43560 / (12 * 3600)$

```
*****
* RETURN FREQUENCY: 5 yr      | Allowable Outflow: 52.00 cfs      *
* 'C' Adjustment: 1.000      | Required Storage: 1.517 ac-ft  *
*-----*
* Peak Inflow: 64.33 cfs
* .HYG File: 5YR
*****
```



Type.... Individual Outlet Curves
Name.... Outlet 3

Page 11.04

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = R2 (Inlet Box)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev, Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
6812.50	.00	Free Outfall		WS below an invert; no flow.
6813.00	.00	Free Outfall		WS below an invert; no flow.
6813.50	.00	Free Outfall		WS below an invert; no flow.
6814.00	.00	Free Outfall		WS below an invert; no flow.
6814.26	.00	Free Outfall		WS below an invert; no flow.
6814.50	4.80	Free Outfall		Weir: H =.24
6815.00	25.98	Free Outfall		Weir: H =.74
6815.50	37.52	Free Outfall		
	Orifice: H =1.24			
6816.00	44.44	Free Outfall		
	Orifice: H =1.74			
6816.50	50.43	Free Outfall		
	Orifice: H =2.24			
6817.00	55.77	Free Outfall		
	Orifice: H =2.74			
6817.50	60.65	Free Outfall		
	Orifice: H =3.24			
6818.00	65.16	Free Outfall		
	Orifice: H =3.74			

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = R1 (Inlet Box)

Upstream ID = (Pond Water Surface)

DNstream ID = O1 (Orifice-Circular)

Pond WS. Elev. ft	Device Q cfs	(into) HW HGL ft	Converge DS HGL ft	Next DS HGL ft	DS HGL Error +/-ft	Q SUM Error +/-cfs	DS Chan. TW ft	TW Error +/-ft
6812.50	.00	...	...	...	...	...	Free Outfall	
		WS below an invert; no flow.						
6813.00	14.42	6813.00	Free	6810.12	.000	.000	Free Outfall	
		Weir: H =.50						
6813.50	33.69	6813.50	Free	6811.09	.000	.000	Free Outfall	
		Orifice: H =1.00						
6814.00	41.26	6814.00	Free	6811.42	.000	.000	Free Outfall	
		Orifice: H =1.50						
6814.26	44.69	6814.26	Free	6811.57	.000	.000	Free Outfall	
		Orifice: H =1.76						
6814.50	47.65	6814.50	Free	6811.69	.000	.000	Free Outfall	
		Orifice: H =2.00						
6815.00	53.27	6815.00	Free	6811.90	.000	.000	Free Outfall	
		Orifice: H =2.50						
6815.50	58.35	6815.50	Free	6812.26	.000	.000	Free Outfall	
		Orifice: H =3.00						
6816.00	96.78	6816.00	6816.00	6816.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6816.50	100.81	6816.50	6816.50	6816.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6817.00	104.69	6817.00	6817.00	6817.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6817.50	108.43	6817.50	6817.50	6817.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6818.00	112.05	6818.00	6818.00	6818.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = 01 (Orifice-Circular)

UPstream ID = R1 (Inlet Box)

DNstream ID = TW (Pond Outfall)

Pond WS. Elev. ft	Device Q cfs	(into) HW HGL ft	Converge DS HGL ft	Next DS HGL ft	DS HGL Error +/-ft	Q SUM Error +/-cfs	DS Chan. TW ft	TW Error +/-ft
6812.50	.00	.00	Free	Free	.000	.000	Free Outfall	
6813.00	14.42	6810.12	Free	Free	.000	.010	Free Outfall	
		CRIT.DEPTH	CONTROL	Vh= .436ft	Dcr= 1.181ft		CRIT.DEPTH	
6813.50	33.69	6811.09	Free	Free	.000	.090	Free Outfall	
		CRIT.DEPTH	CONTROL	Vh= .751ft	Dcr= 1.837ft		CRIT.DEPTH	
6814.00	41.26	6811.42	Free	Free	.000	.042	Free Outfall	
		CRIT.DEPTH	CONTROL	Vh= .876ft	Dcr= 2.046ft		CRIT.DEPTH	
6814.26	44.69	6811.57	Free	Free	.000	.041	Free Outfall	
		CRIT.DEPTH	CONTROL	Vh= .934ft	Dcr= 2.132ft		CRIT.DEPTH	
6814.50	47.65	6811.69	Free	Free	.000	.029	Free Outfall	
		CRIT.DEPTH	CONTROL	Vh= .984ft	Dcr= 2.202ft		CRIT.DEPTH	
6815.00	53.27	6811.90	Free	Free	.000	.040	Free Outfall	
		H =1.78						
6815.50	58.35	6812.26	Free	Free	.000	.017	Free Outfall	
		H =2.13						
6816.00	96.78	6816.00	Free	Free	.000	.000	Free Outfall	
		H =5.88						
6816.50	100.81	6816.50	Free	Free	.000	.000	Free Outfall	
		H =6.38						
6817.00	104.69	6817.00	Free	Free	.000	.000	Free Outfall	
		H =6.88						
6817.50	108.43	6817.50	Free	Free	.000	.000	Free Outfall	
		H =7.38						
6818.00	112.05	6818.00	Free	Free	.000	.000	Free Outfall	
		H =7.88						

Type.... Pond Routing Summary
Name.... POND EAST OUT Tag: 5YR
File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW
Storm... cos5yr Tag: 5YR

Page 12.06

Event: 5 yr

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\
Inflow HYG file = NONE STORED - POND EAST IN 5YR
Outflow HYG file = NONE STORED - POND EAST OUT 5YR

Pond Node Data = POND EAST
Pond Volume Data = POND EAST
Pond Outlet Data = Outlet 3

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 6812.50 ft
Starting Volume = .000 ac-ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout= .00 cfs
Time Increment = .0500 hrs

Value used as
override for Pond 2
interim and final
Predevelopment
Peak Flows for 5 and
10 year event

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

=====

Peak Inflow	=	64.33 cfs	at	.6500 hrs
Peak Outflow	=	44.58 cfs	at	1.0500 hrs

Peak Elevation = 6814.25 ft
Peak Storage = 1.218 ac-ft
=====

MASS BALANCE (ac-ft)

+ Initial Vol	=	.000
+ HYG Vol IN	=	4.605
- Infiltration	=	.000
- HYG Vol OUT	=	4.605
- Retained Vol	=	.000

Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

Type.... Mod. Rational Graph
 Name.... BASIN C & OS-2 Tag: 100yr
 File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW
 Storm... cos100yr Tag: 100yr

Page 13.05

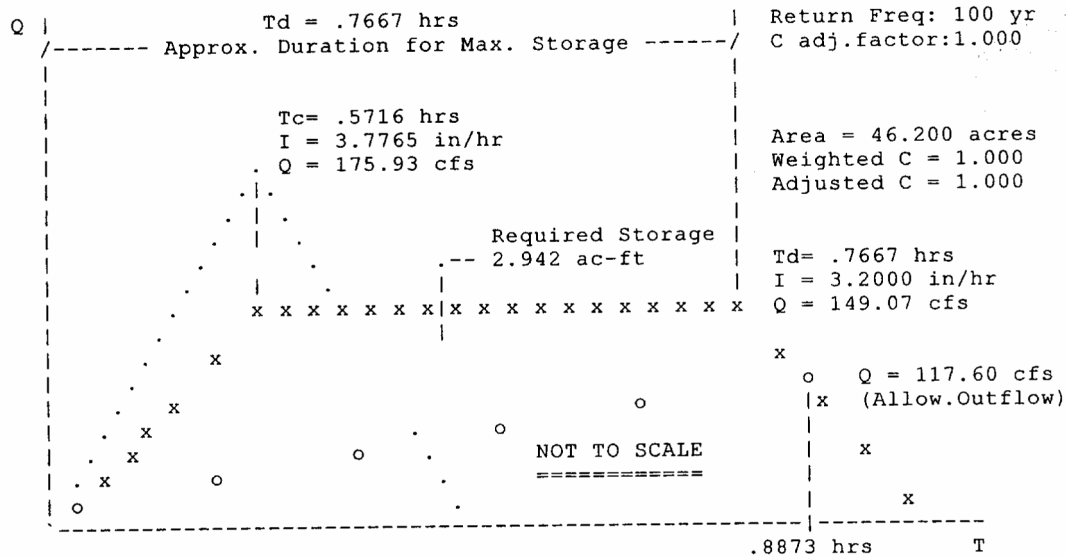
Event: 100 yr

MODIFIED RATIONAL METHOD

---- Graphical Summary for Maximum Required Storage ----
 Method I

$Q = CiA * \text{Units Conversion; Where Conversion} = 43560 / (12 * 3600)$

```
*****
* RETURN FREQUENCY: 100 yr | Allowable Outflow: 117.60 cfs *
* 'C' Adjustment: 1.000 | Required Storage: 2.942 ac-ft *
*-----*
* Peak Inflow: 149.07 cfs *
* .HYG File: 100yr *
*****
```



File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = R2 (Inlet Box)

Upstream ID = (Pond Water Surface)

DNstream ID = TW (Pond Outfall)

WS Elev, Device Q		Tail Water		Notes
WS Elev.	Q	TW Elev	Converge	Computation Messages
ft	cfs	ft	+/-ft	
6812.50	.00	Free Outfall		WS below an invert; no flow.
6813.00	.00	Free Outfall		WS below an invert; no flow.
6813.50	.00	Free Outfall		WS below an invert; no flow.
6814.00	.00	Free Outfall		WS below an invert; no flow.
6814.26	.00	Free Outfall		WS below an invert; no flow.
6814.50	4.80	Free Outfall		Weir: H =.24
6815.00	25.98	Free Outfall		Weir: H =.74
6815.50	37.52	Free Outfall		
		Orifice: H =1.24		
6816.00	44.44	Free Outfall		
		Orifice: H =1.74		
6816.50	50.43	Free Outfall		
		Orifice: H =2.24		
6817.00	55.77	Free Outfall		
		Orifice: H =2.74		
6817.50	60.65	Free Outfall		
		Orifice: H =3.24		
6818.00	65.16	Free Outfall		
		Orifice: H =3.74		

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = R1 (Inlet Box)

Upstream ID = (Pond Water Surface)

DNstream ID = O1 (Orifice-Circular)

Pond WS. Elev. ft	Device Q cfs	(into) HW HGL ft	Converge DS HGL ft	Next DS HGL ft	DS HGL Error +/-ft	Q SUM Error +/-cfs	DS Chan. TW ft	TW Error +/-ft
6812.50	.00	...	...	...	...	...	Free Outfall	
		WS below an invert; no flow.						
6813.00	14.42	6813.00	Free	6810.12	.000	.000	Free Outfall	
		Weir: H =.50						
6813.50	33.69	6813.50	Free	6811.09	.000	.000	Free Outfall	
		Orifice: H =1.00						
6814.00	41.26	6814.00	Free	6811.42	.000	.000	Free Outfall	
		Orifice: H =1.50						
6814.26	44.69	6814.26	Free	6811.57	.000	.000	Free Outfall	
		Orifice: H =1.76						
6814.50	47.65	6814.50	Free	6811.69	.000	.000	Free Outfall	
		Orifice: H =2.00						
6815.00	53.27	6815.00	Free	6811.90	.000	.000	Free Outfall	
		Orifice: H =2.50						
6815.50	58.35	6815.50	Free	6812.26	.000	.000	Free Outfall	
		Orifice: H =3.00						
6816.00	96.78	6816.00	6816.00	6816.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6816.50	100.81	6816.50	6816.50	6816.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6817.00	104.69	6817.00	6817.00	6817.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6817.50	108.43	6817.50	6817.50	6817.50	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						
6818.00	112.05	6818.00	6818.00	6818.00	.000	.000	Free Outfall	
		DS HGL+Loss > crest: Flow set to Downstream outlet.						

File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = 01 (Orifice-Circular)

UPstream ID = R1 (Inlet Box)

DNstream ID = TW (Pond Outfall)

Pond WS. Elev. ft	Device Q cfs	(into) HW HGL ft	Converge DS HGL ft	Next DS HGL ft	DS HGL Error +/-ft	Q SUM Error +/-cfs	DS Chan. TW ft	TW Error +/-ft
6812.50	.00	.00	Free	Free	.000	.000	Free Outfall	
6813.00	14.42	6810.12	Free	Free	.000	.010	Free Outfall	
6813.50	33.69	6811.09	Free	Free	.000	.090	Free Outfall	
6814.00	41.26	6811.42	Free	Free	.000	.042	Free Outfall	
6814.26	44.69	6811.57	Free	Free	.000	.041	Free Outfall	
6814.50	47.65	6811.69	Free	Free	.000	.029	Free Outfall	
6815.00	53.27	6811.90	Free	Free	.000	.040	Free Outfall	
6815.50	58.35	6812.26	Free	Free	.000	.017	Free Outfall	
6816.00	96.78	6816.00	Free	Free	.000	.000	Free Outfall	
6816.50	100.81	6816.50	Free	Free	.000	.000	Free Outfall	
6817.00	104.69	6817.00	Free	Free	.000	.000	Free Outfall	
6817.50	108.43	6817.50	Free	Free	.000	.000	Free Outfall	
6818.00	112.05	6818.00	Free	Free	.000	.000	Free Outfall	

Type.... Pond Routing Summary
Name.... POND EAST OUT Tag: 100yr
File.... C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\FDR POND EAST.PPW
Storm... cos100yr Tag: 100yr

Page 12.08

Event: 100 yr

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\Terra Nova Engineering\Jobs\0429.00\DRAINAGE\
Inflow HYG file = NONE STORED - POND EAST IN 100yr
Outflow HYG file = NONE STORED - POND EAST OUT 100yr

Pond Node Data = POND EAST
Pond Volume Data = POND EAST
Pond Outlet Data = Outlet 3

No Infiltration

INITIAL CONDITIONS

Starting WS Elev = 6812.50 ft
Starting Volume = .000 ac-ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout= .00 cfs
Time Increment = .0500 hrs

Value used as
override for Pond 2
interim and final
Predevelopment
Peak Flows for 100
year event

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

=====

Peak Inflow	=	149.07 cfs	at	.6500 hrs
Peak Outflow	=	101.18 cfs	at	.9500 hrs

Peak Elevation = 6815.56 ft
Peak Storage = 3.526 ac-ft
=====

MASS BALANCE (ac-ft)

+ Initial Vol	=	.000
+ HYG Vol IN	=	9.438
- Infiltration	=	.000
- HYG Vol OUT	=	9.438
- Retained Vol	=	.000

Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

Excerpts from:

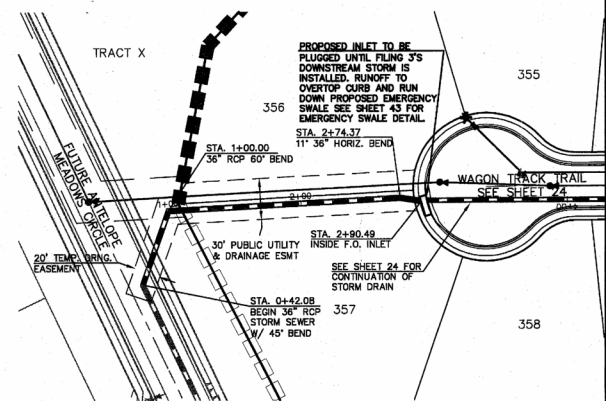
Falcon Highlands Filing No. 2

Construction Drawings, Sept. 2005

Terra Nova Engineering, Inc.

Approved Nov. 17, 2005

SF-05-033

[illegible]

NOTE:
SEE CONSTRUCTION DRAWINGS FOR FALCON
HIGHLANDS FILING NO. 3 BY TERRA NOVA
ENGINEERING FOR EXISTING SANITARY AND
STORM SEWER INFORMATION

NOTE:
SEE SHEET 35-39 FOR SANITARY,
WATER, STORM AND CURB
RETURN LINE TABLES

36" RCP STORM SEWER
STA. 1+00.00 ~ STA. 2+90.49 5

SCALE: 1"=50'

EL PASO COUNTY RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE COUNTY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.

RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE

ASPHALT DATA FOR: _____
 ASPHALT THICKNESS: _____
 ALT. 1: _____
 AC SURFACE: _____
 AC BASE: _____
 AGGREGATE BASE THICKNESS: _____
 ALT. 1: _____
 CLASS 6: _____
 CLASS 5: _____
 CLASS 4: _____

THIS DESIGN WAS PREPARED UNDER MY DIRECT SUPERVISION
FOR AND ON BEHALF OF TERRA NOVA ENGINEERING, INC.



 QUENTIN N. ARMILLO, PROFESSIONAL ENGINEER
 COLORADO P.E. NO. 11164, EXPIRATION DATE 11/11/05



Excerpts from:

Falcon Highlands South

Preliminary Drainage Report

Atwell, LLC

Approved April 22, 2024

PUDSP-22-005



Falcon Highlands South

Preliminary Drainage Report

Owner/Developer

Challenger Homes
8605 Explorer Drive Ste. 250
Colorado Springs, CO 80920
(719) 598-5192
Contact: Jim Byers

Engineer

Atwell, LLC
143 Union Blvd., Suite 700
Lakewood, CO 80228
303-462-1100
Contact: Daniel Madruga, PE

Atwell Project Number

21005234

Submitted by: Atwell, LLC

March 06, 2024

PUDSP-22-005

Engineer's Statement:

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


Daniel Madrug, PE 36834

3/12/24

Date

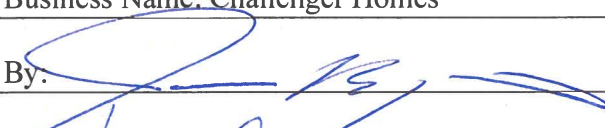
Seal:



Developer's Statement:

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

Business Name: Challenger Homes

By: 

Title: VP of Community Development

Address: 8605 Explorer Dr 80920

El Paso County Approval:

Filed in accordance with requirements of Section 51.1 of the El Paso Land Development Code as amended.

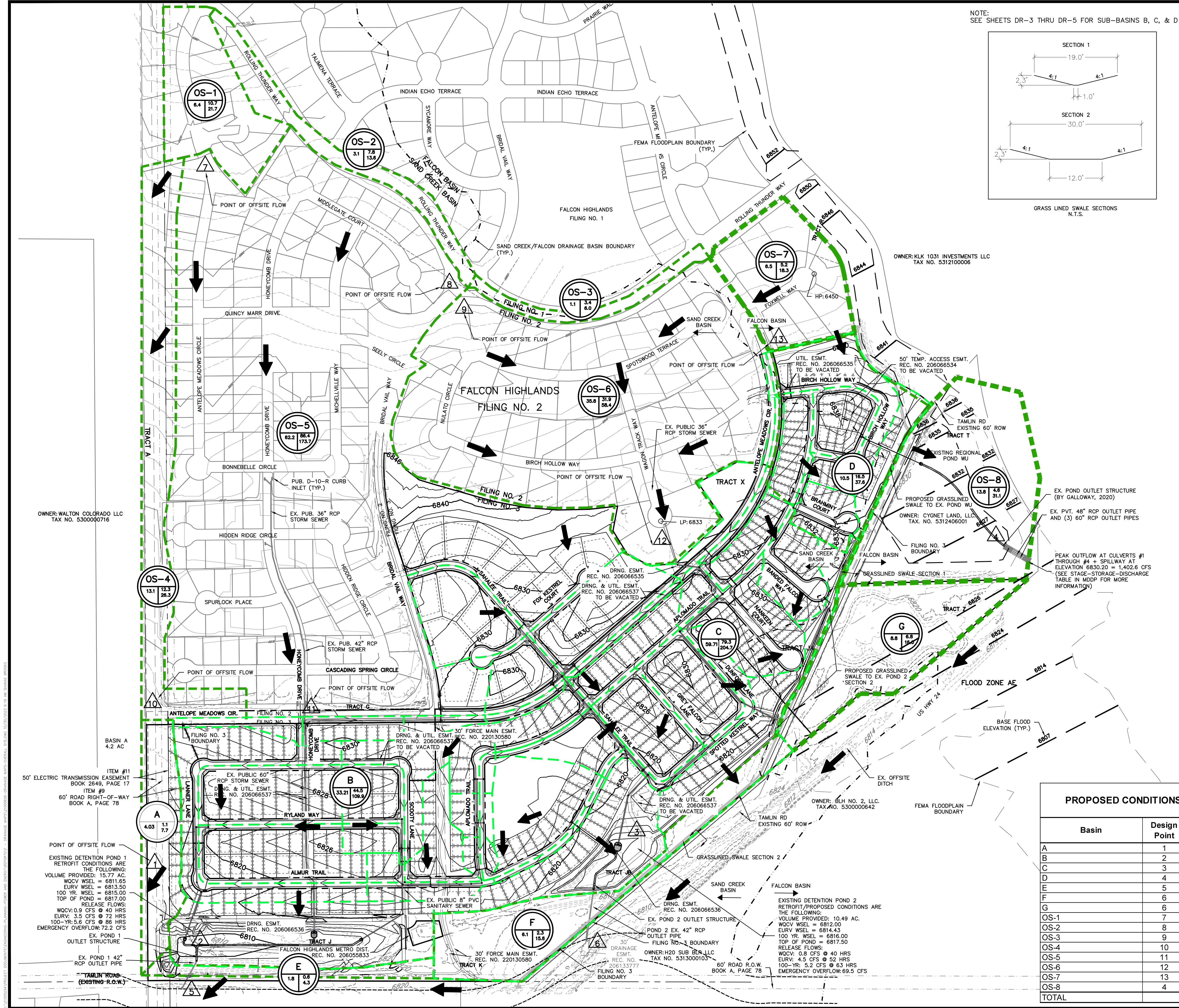
Gilbert LaForce, P.E.

Digitally signed by Gilbert LaForce, P.E.
Reason: On Behalf of the County Engineer
Date: 2024.04.22 13:30:26-06'00'

4/22/2024

Joshua Palmer, P.E.,
County Engineer, ECM Administrator
Conditions:

Date



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

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE CONTRACTOR. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR. NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

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CHALLENGER HOMES
8605 EXPLORER DRIVE, STE. 250
COLORADO SPRINGS, CO 80920
(719) 598-5192
JIM BYERS

CHALLENGER HOMES
FALCON HIGHLANDS FILING NO. 3
EL PASO COUNTY, COLORADO
DRAINAGE MAP
MAJOR BASINS PROPOSED CONDITIONS

DATE: 08/26/2022

REVISIONS

DR: SLP CH: DJM
P.M: DJM
JOB: 21002568
SHEET NO. 1
DR-02

On-site Basins (Falcon Highlands South, Undeveloped):

The site has been broken down into seven major on-site basins upstream within the limits of Falcon Highlands South. A drainage map is in the appendix.

Basin A (3.74 ac, $Q_5 = 1.15$ cfs, $Q_{100} = 7.7$ cfs) is the basin located southwest of Antelope Meadow Circle, just below basin OS-4, west of Basin B. The majority of the basin is comprised of Tract F and consists of some rear yard runoff from the PUD lots at the western edge of Basin B. The storm water runoff from this basin sheet flows south and off-site at **Design Point 1** with the combined flow of OS-4, and per existing drainage patterns is not tributary to on-site detention ponds.

Basin B (38.93 ac, $Q_5 = 11.65$ cfs, $Q_{100} = 78.20$ cfs) is located south of Antelope Meadow Circle, adjacent to basin A. The site is covered in native grasses with limited grading work from a previous development. Runoff from the site sheet flows southwesterly overland to existing Pond 1 (**Design Point 2**). The private 42" RCP outlet pipe from the outlet structure of the pond daylights at the grassland swale south of the abandoned future Tamlin Road right-of-way at **Design Point 5**.

Basin C (57.81 ac, $Q_5 = 18.4$ cfs, $Q_{100} = 123.57$ cfs) is located adjacent to Basin B and covered in native grasses and weeds. The site has limited grading due to work from a previous development that did not finish. Runoff from the site sheet flows southwesterly overland to an existing diversion ditch that spans from an existing public 24" RCP storm sewer main that daylights within Falcon Highlands South south of Wagon Track Way. The diversion ditch flows directly to existing Pond 2 (**Design Point 3**). The private 42" RCP outlet pipe from the outlet structure of the pond daylights at the grassland swale south of the project site at **Design Point 6**.

Basin D (10.54 ac, $Q_5 = 3.47$ cfs, $Q_{100} = 23.31$ cfs) is located to the northeast of the Filing and consists of undeveloped area with native grasses. The basin's runoff drains directly to existing Pond WU (**Design Point 4**).

Basin E (3.14 ac, $Q_5 = 1.12$ cfs, $Q_{100} = 7.5$ cfs) is the undeveloped, natural landscaped area between Tamlin Road and the existing Pond 1. Runoff from Basin E is directed by a ditch section to a low point between the future Dublin Road and Highway 24 (**Design Point 5**). This drainage concept and its associated storm infrastructure is presented in the previous master plan and is to remain as the intended plan. The 2005 PDR suggested that an inline grate inlet be installed but there is no evidence that this was installed. The existing drainage pattern consists of pooling within the local low point of the ditch that surcharges and is directed south through the grassland swale.

Basin F (3.67 ac, $Q_5 = 1.19$ cfs, $Q_{100} = 7.99$ cfs) is the undeveloped area between Tamlin Road and the existing Detention Pond 2. The runoff from Basin F is directed to the low point in the downstream grasslined swale between the Site and Tamlin Road (**Design Point 6**). This drainage concept and its associated storm infrastructure is presented in the previous master plan and is to remain as the intended plan. The 2005 PDR suggested that a 4'x4' area inlet be constructed but

there is no evidence that this was installed. The existing drainage pattern consists of pooling within the local low point of the ditch that surcharges and is directed south through the grassland swale.

Basin G (8.84 ac, $Q_5 = 6.8$ cfs, $Q_{100} = 16.0$ cfs) is the area east of Basin C that is not to be disturbed and remain as open, natural landscape. The runoff from Basin G is collected in a local topographic low point and when overtopping the low point, the runoff continues southeast to the low point in the grasslined swale along Highway 24, **Design Point 6**.

PROPOSED DRAINAGE BASINS

This report has been prepared in accordance with the EPC DCM and the MHFD Criteria Manual. The 5-year storm was used as the minor storm event, while the 100-year storm was used as the major event. The one-hour point rainfall depth used for the 5-year storm was 1.50 inches and 2.52 inches for the 100-year event.

Preliminary grading design of the site has been completed to include right of way design and assignment of lot type A, B, Transition (T), and Walkout (WO). The assigned lots drain per a typical lot template into roadways where sump inlets are located to convey stormwater through the public storm system and outfall to their respective ponds.

The overarching premise of the drainage design is to route overland flow from residential lots and units to adjacent rights-of-way where public storm infrastructure will be installed and ultimately convey the storm water to respective ponds to provide water quality treatment as well as flow attenuation and detention. Previous studies designed Ponds 1 and 2 in order to provide full spectrum detention and water quality for Filing Nos. 2 and 3. The analysis within this report provides more defined pond sizing requirements due to the change in layout for Falcon Highlands South as well as preliminary locations and sizes for inlets, pipes, culverts, and swales. This idea is intended to be followed for the entirety of the developed site. Basins which are not along the main drainageways within the proposed developed areas or which are expected to flow offsite have been analyzed. There are no engineered channels that exit the Site.

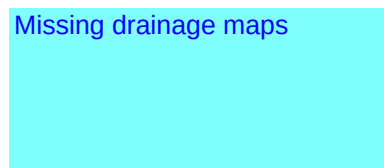
There is a proposed grass-lined, natural swale to convey stormwater from the rear of B-lot sites and cul-de-sacs that are the downstream area of roadways within Basin C to existing Pond 2. The design of this swale is to be included in the Final Drainage Report, but preliminary calculations and design have been done for the PDR to accurately assess the width and depth of the drainageway for the minor and major storm events including freeboard requirements. All Pond outlets daylight to south of the future Tamlin Road right-of-way via existing public RCP culvert pipes, but are not directed to any formal channels or drainageways.

The existing Ponds will be analyzed as part of this PDR to ensure that the design meets the standards set forward in the El Paso County Engineering Criteria Manual as well as the Mile-High Flood Control Criteria Manual. The existing pond's detention volume capacity will be confirmed as adequate and infrastructure will be retrofitted as required.

Appendix G

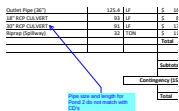
Drainage Maps

Missing drainage maps



V7_Drainage Report - Final.pdf Markup Summary

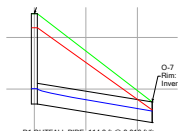
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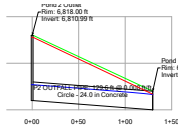
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Pipe size and length for Pond 2 do not match with CD's

PolyLine (2)

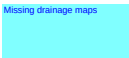


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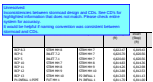
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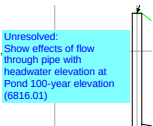
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Missing drainage maps



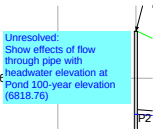
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Unresolved:
Inconsistencies between stormcad design and CD's. See CD's for highlighted information that does not match. Please check entire system for accuracy.
It would be helpful if naming convention was consistent between stormcad and CD's.



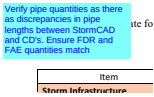
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Date: 7/10/2026 11:06:19 AM
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Unresolved:
Show effects of flow through pipe with headwater elevation at Pond 100-year elevation (6818.76)



Subject: Text Box
Page Label: 17
Author: CDurham
Date: 7/10/2026 11:14:39 AM
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Verify pipe quantities as there as discrepancies in pipe lengths between StormCAD and CD's. Ensure FDR and FAE quantities match