



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 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
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	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 x 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

Below is a cost estimate 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

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

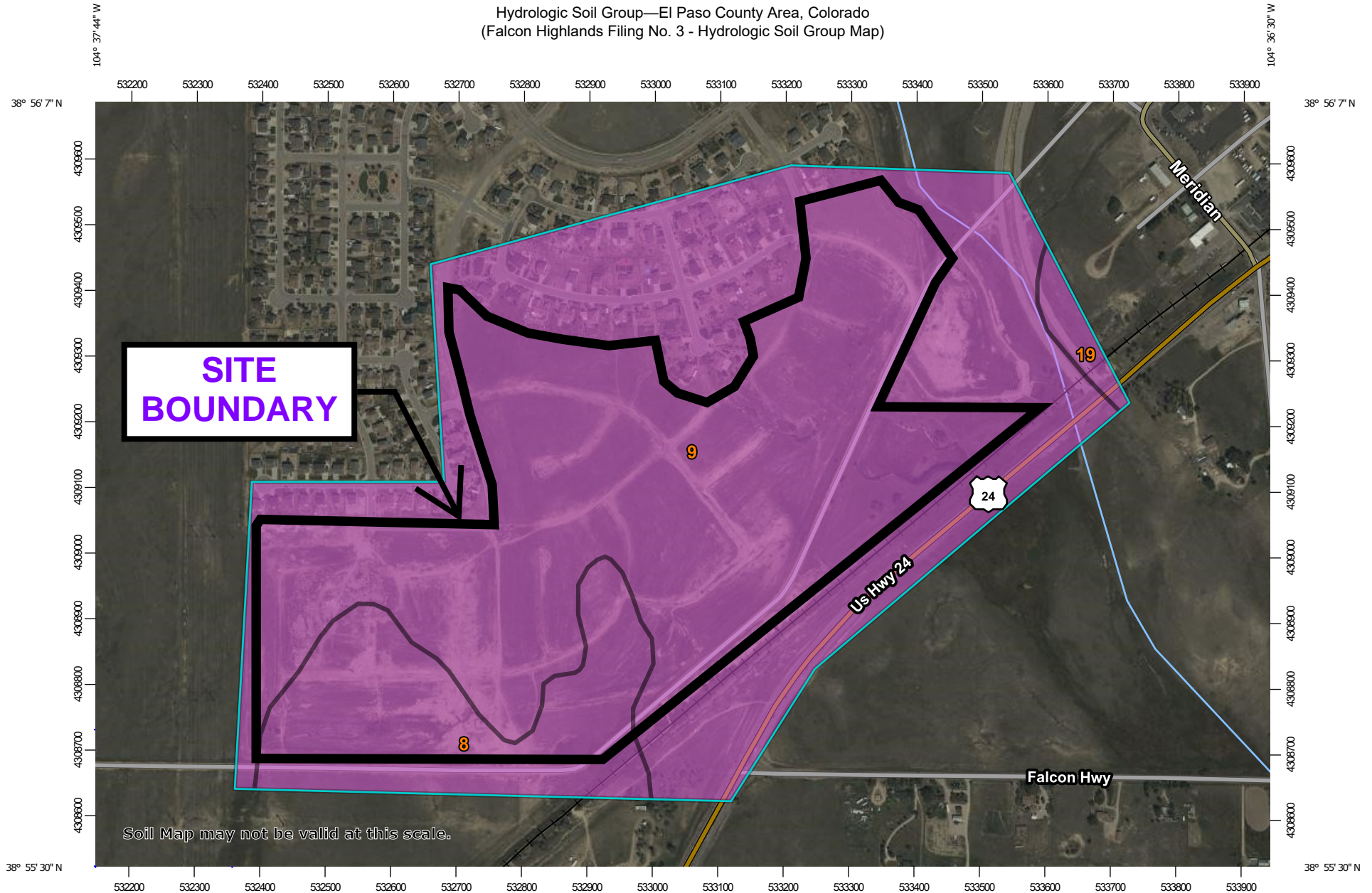
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

CONTACT: DANIEL MADRUGA
DMADRUGA@ATWELL.COM

Appendix B

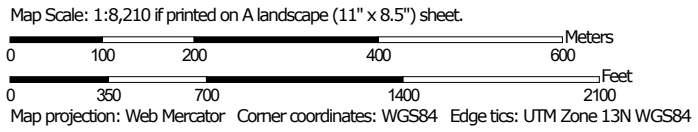
Soils Report

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




**SITE
BOUNDARY**

Soil Map may not be valid at this scale.



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, 1657, 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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Central Office:
 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



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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:	3/27/2025

LOT LAYOUT

SHEET No. FIG-2



ROCKY MOUNTAIN GROUP

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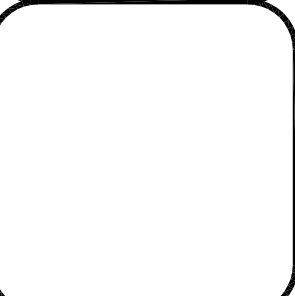
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FALCON HIGHLANDS SOUTH
 FILING NO. 1, PHASE 1
 EL PASO COUNTY, COLORADO
 CHALLENGER COLORADO, LLC

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

ENGINEERING AND GEOLOGY MAP

SHEET No. FIG-3

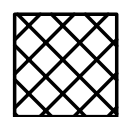


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⊕ DENOTES APPROXIMATE LOCATION OF TEST BORINGS AS PERFORMED FOR OUR ORIGINAL SOILS AND GEOLOGY STUDY, JOB NO. 184041, LAST DATED SEPTEMBER 7, 2022

- *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



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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








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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

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 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 DATE DRILLED: 6/8/21 GROUNDWATER @ 16.0' 10/6/21	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	TEST BORING: 2 DATE DRILLED: 6/8/21 GROUNDWATER @ 14.6' 10/6/21	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
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
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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
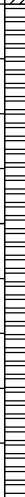



SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 184041

FIGURE No. 2

DATE Oct/25/2024

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

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SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

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



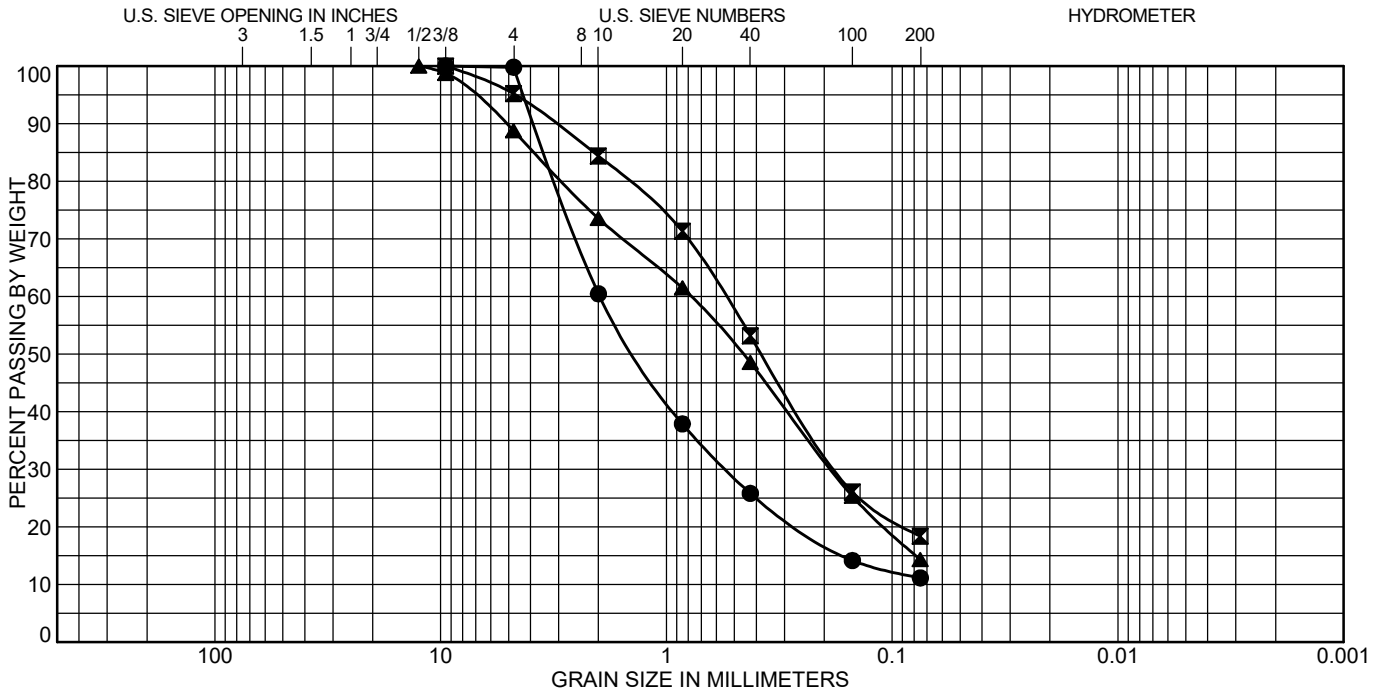
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5085 List Drive, Suite 200
Colorado Springs, CO 80918
(719) 548-0600

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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Structural Forensics Geotechnical Materials Testing

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Colorado Springs, CO 80918
(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 restricted where the following conditions apply:
 1. Underdrains are installed at the bottom of sanitary sewer trenches within drive lanes;
 2. A long groundwater monitoring study has been undertaken, and the results indicate groundwater is sufficiently deep to allow basement construction;
 3. 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.

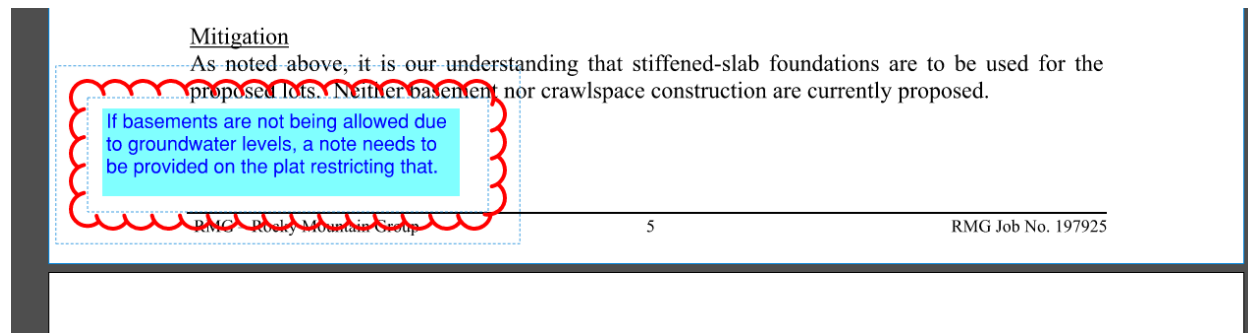
Based on mitigation measures below, basements and crawlspace are not recommended/proposed. If this is the case, why are we providing conditions where a basement could be constructed?

...ations, as noted in our original study, were that basement construction should be restricted where the following conditions apply:
 1. Underdrains are installed at the bottom of sanitary sewer trenches within drive lanes;
 2. A long groundwater monitoring study has been undertaken, and the results indicate groundwater is sufficiently deep to allow basement construction;
 3. 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



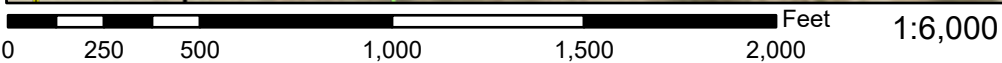
Appendix C

FEMA Map

National Flood Hazard Layer FIRMette



104°37'40"W 38°56'3"N



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

104°37'3"W 38°55'35"N

Legend

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

- | | |
|---|---|
| <p>SPECIAL FLOOD HAZARD AREAS</p> | <ul style="list-style-type: none"> Without Base Flood Elevation (BFE)
<i>Zone A, V, A99</i> With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i> Regulatory Floodway |
| <p>OTHER AREAS OF FLOOD HAZARD</p> | <ul style="list-style-type: none"> 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i> Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i> Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i> Area with Flood Risk due to Levee <i>Zone D</i> |
| <p>OTHER AREAS</p> | <ul style="list-style-type: none"> NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i> Effective LOMRs Area of Undetermined Flood Hazard <i>Zone D</i> |
| <p>GENERAL STRUCTURES</p> | <ul style="list-style-type: none"> Channel, Culvert, or Storm Sewer Levee, Dike, or Floodwall |
| <p>OTHER FEATURES</p> | <ul style="list-style-type: none"> Cross Sections with 1% Annual Chance Water Surface Elevation Cross Sections with 1% Annual Chance Water Surface Elevation Coastal Transect Base Flood Elevation Line (BFE) Limit of Study Jurisdiction Boundary Coastal Transect Baseline Profile Baseline Hydrographic Feature |
| <p>MAP PANELS</p> | <ul style="list-style-type: none"> Digital Data Available No Digital Data Available Unmapped |
-
- The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **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

Designer: LMS
 Company: Atwell, LLC
 Date: 5/28/2025
 Project: Falcon Highlands
 Location: El Paso County

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

$$t_c = 0.3 \text{ Computed } t_c = t_i + t_t$$

$$t_{\text{minimum}} = 5 \text{ (urban)}$$

$$t_{\text{minimum}} = 10 \text{ (non-urban)}$$

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)

1-hour rainfall depth, P1 (in) =

2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1.16	1.44	1.68	1.92	2.16	2.42

$$t_t = \text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)}$$

$$\text{Selected } t_c = \max\{t_{\text{minimum}}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Rainfall Intensity Equation Coefficients =

a	b	c
28.50	10.00	0.786

$$I(\text{in/hr}) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(\text{cfs}) = CIA$$

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

Designer: LMS
 Company: Atwell, LLC
 Date: 5/30/2025
 Project: Falcon Highlands
 Location: El Paso County, CO

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

$t_i = 0.3$ Computed $t_c = t_i + t_t$

$t_{\text{minimum}} = 5$ (urban)
 $t_{\text{minimum}} = 10$ (non-urban)

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)

1-hour rainfall depth, P1 (in) =

2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1.16	1.44	1.68	1.92	2.16	2.42

$t_t = \frac{L_t}{60(14i + 9)}$ Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)}$ Selected $t_c = \max\{t_{\text{minimum}}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Rainfall Intensity Equation Coefficients =

a	b	c
28.50	10.00	0.786

$I(\text{in/hr}) = \frac{a \cdot P_1}{(b + t_c)^c}$

$Q(\text{cfs}) = CIA$

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
A-1	4.49	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	200.00	0.020	21.96	1600.00	0.005	10	0.71	37.71	59.67	64.03	59.67	1.18	1.46	1.70	1.95	2.19	2.45	0.09	0.12	0.17	0.27	0.67	1.64
A-2	4.83	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48	200.00	0.020	17.76	650.00	0.013	20	2.24	4.84	22.61	27.02	22.61	2.14	2.65	3.10	3.54	3.98	4.46	2.21	2.89	3.58	4.64	6.23	8.24
A-3	2.46	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48	200.00	0.020	17.76	625.00	0.013	20	2.24	4.66	22.42	26.75	22.42	2.15	2.66	3.11	3.55	4.00	4.48	1.13	1.48	1.83	2.37	3.19	4.22
A-6	2.75	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48	200.00	0.020	17.76	975.00	0.020	20	2.83	5.75	23.51	28.32	23.51	2.09	2.60	3.03	3.46	3.90	4.36	1.23	1.61	2.00	2.59	3.47	4.59
A-4	2.55	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48	200.00	0.020	17.76	550.00	0.010	20	2.00	4.58	22.35	26.64	22.35	2.15	2.67	3.11	3.56	4.00	4.49	1.17	1.54	1.90	2.47	3.31	4.38
A-5	3.52	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48	100.00	0.020	12.56	700.00	0.010	20	2.00	5.83	18.39	28.44	18.39	2.38	2.96	3.45	3.94	4.44	4.97	1.80	2.35	2.91	3.77	5.06	6.70
B	38.75	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48	100.00	0.020	12.56	1900.00	0.005	20	1.41	22.39	34.95	52.27	34.95	1.66	2.06	2.40	2.75	3.09	3.46	13.78	18.02	22.32	28.93	38.81	51.37
C	41.08	A	35.0	0.21	0.23	0.24	0.27	0.32	0.38	0.48	120.00	0.020	13.76	600.00	0.005	20	1.41	7.07	20.83	30.22	20.83	2.23	2.77	3.23	3.70	4.16	4.66	19.65	25.69	31.82	41.25	55.34	73.24
D	8.26	A	65.0	0.48	0.50	0.51	0.54	0.58	0.62	0.67	120.00	0.020	9.49	600.00	0.020	10	1.41	7.07	16.56	18.86	16.56	2.51	3.12	3.64	4.16	4.68	5.24	9.94	12.79	15.42	18.70	22.40	26.67
E	1.41	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	150.00	0.020	19.02	0.00	0.020	10	1.41	0.00	19.02	25.15	19.02	2.34	2.91	3.39	3.88	4.36	4.89	0.06	0.08	0.10	0.17	0.42	1.03
F	5.91	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00	0.020	26.90	240.00	0.020	20	2.83	1.41	28.31	28.07	28.07	1.89	2.35	2.74	3.13	3.52	3.95	0.19	0.26	0.35	0.56	1.41	3.48
G	8.38	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00	0.020	26.90	240.00	0.020	20	2.83	1.41	28.31	28.07	28.07	1.89	2.35	2.74	3.13	3.52	3.95	0.27	0.37	0.50	0.80	2.00	4.93
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	0.020	20	2.83	3.83	10.15	25.72	10.15	3.12	3.87	4.52	5.16	5.81	6.51	4.15	5.43	6.73	8.75	11.78	15.66
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	0.006	20	1.55	6.54	18.50	28.16	18.50	2.38	2.95	3.44	3.93	4.42	4.96	36.09	47.03	57.92	74.00	96.69	124.58
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	0.020	20	2.83	1.77	25.48	24.58	24.58	2.04	2.53	2.96	3.38	3.80	4.26	1.82	2.41	3.03	4.07	5.86	8.39

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

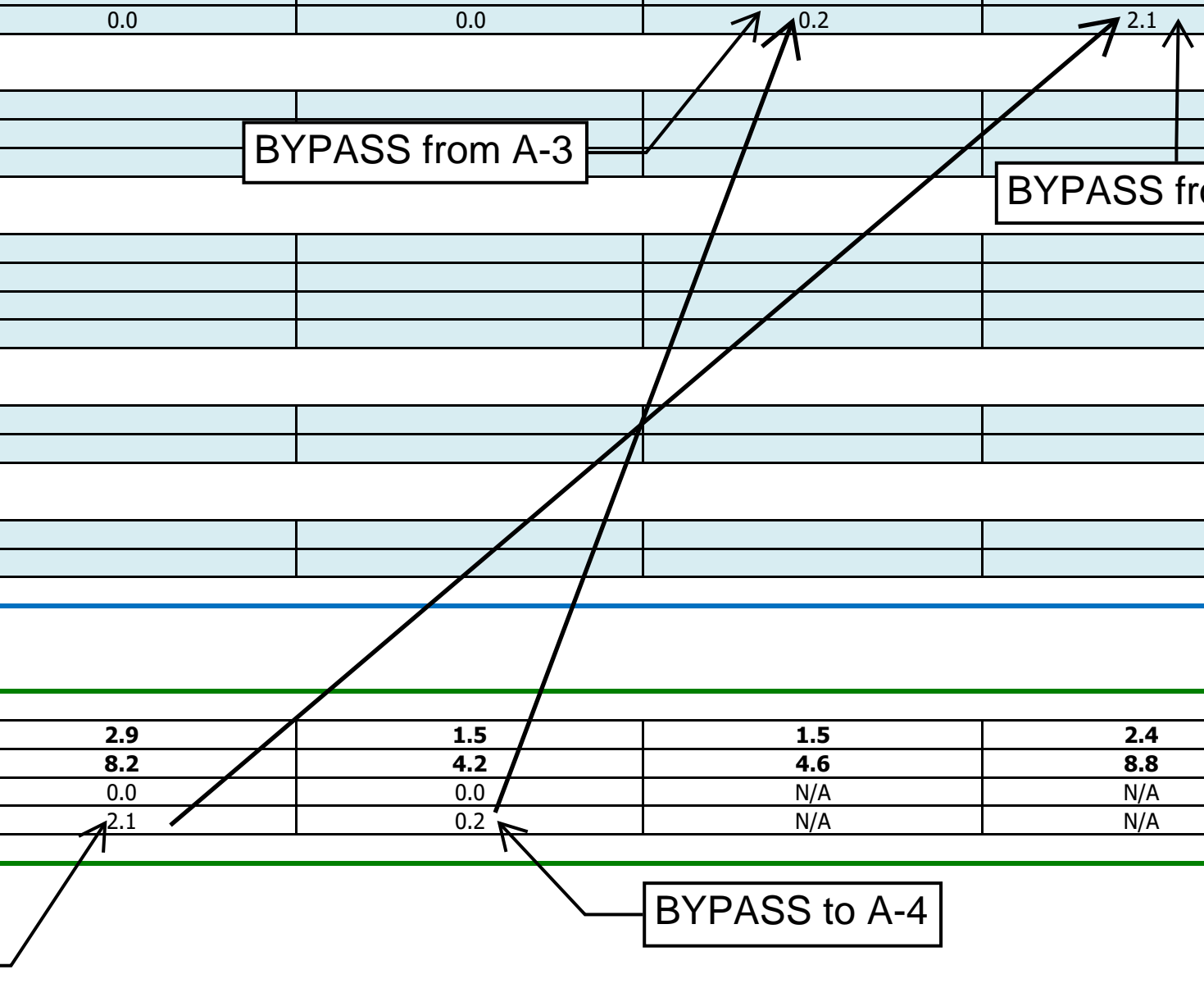
Minor Total Design Peak Flow, Q (cfs)	0.1	2.9	1.5	1.5	2.4
Major Total Design Peak Flow, Q (cfs)	1.6	8.2	4.2	4.6	8.8
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	2.1	0.2	N/A	N/A

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

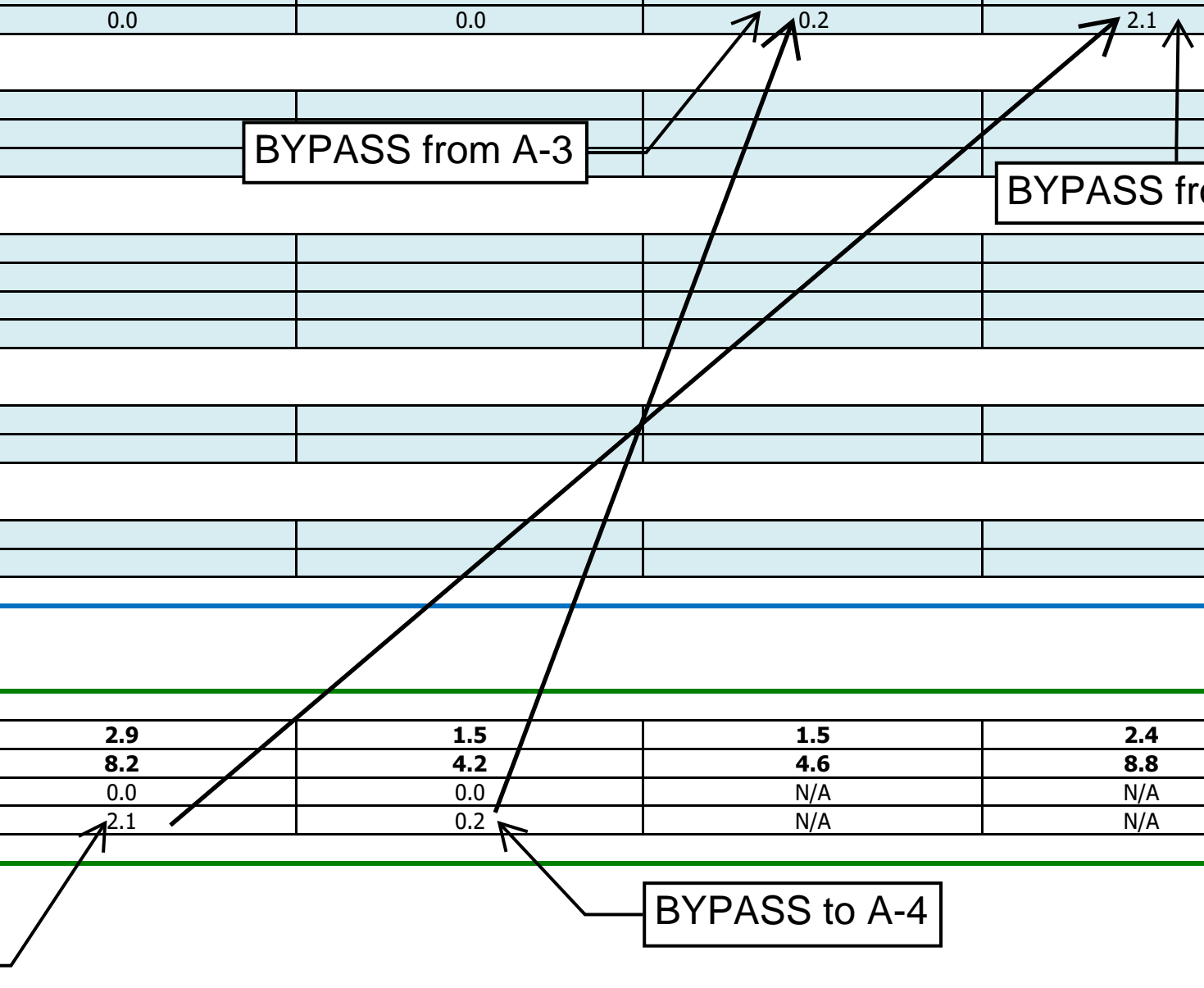
Minor Total Design Peak Flow, Q (cfs)	0.1	2.9	1.5	1.5	2.4
Major Total Design Peak Flow, Q (cfs)	1.6	8.2	4.2	4.6	8.8
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	2.1	0.2	N/A	N/A

BYPASS to A-5

BYPASS to A-4

BYPASS from A-3

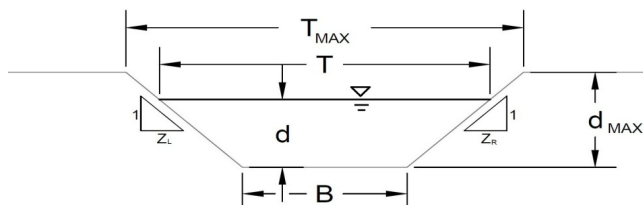
BYPASS from A-2



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

A, B, C, D, or E =	E
n =	see details below
S ₀ =	0.0050 ft/ft
B =	2.00 ft
Z ₁ =	4.00 ft/ft
Z ₂ =	4.00 ft/ft

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

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	ft
d _{MAX} =	2.00	2.00	ft

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	cfs
d _{allow} =	0.75	0.75	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow
 Water Depth

	Minor Storm	Major Storm	
Q _o =	0.1	1.6	cfs
d =	0.13	0.48	ft

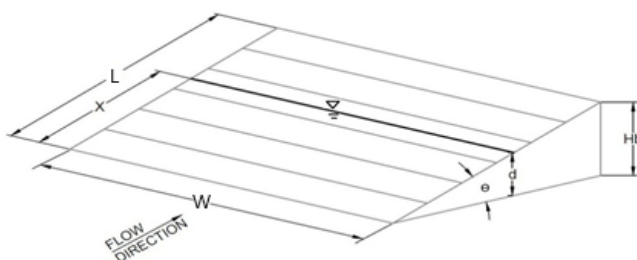
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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	

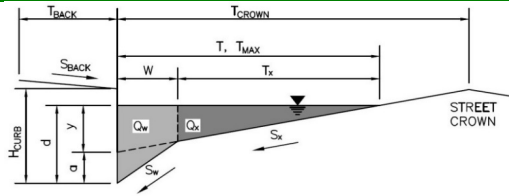
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)
 Total Inlet Interception Capacity (assumes clogged condition)
 Bypassed Flow
 Capture Percentage = Q_a/Q_o

	MINOR	MAJOR	
d =	0.13	0.48	
Q _a =	0.9	6.1	cfs
Q _b =	0.0	0.0	cfs
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)

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

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)

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_0 =	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)

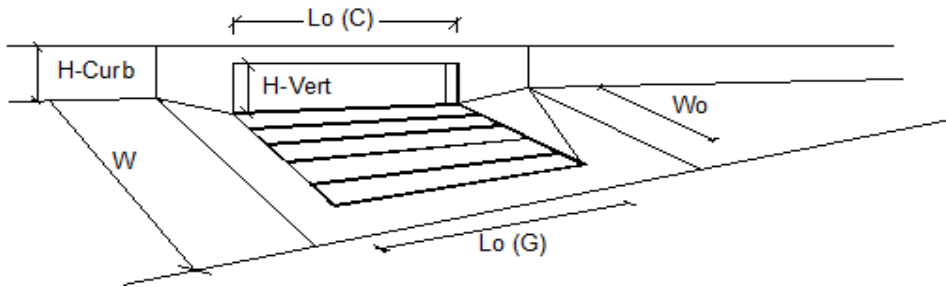
	Minor Storm	Major Storm	
T_{MAX} =	17.0	17.0	ft
d_{MAX} =	6.0	7.2	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

MINOR STORM Allowable Capacity is based on Spread Criterion
 MAJOR STORM Allowable Capacity is based on Spread Criterion

	Minor Storm	Major Storm	
Q_{allow} =	18.9	18.9	cfs

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'

INLET ON A CONTINUOUS GRADE



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)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a_{LOCAL} =	3.0	3.0	inches
No =	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	

Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$

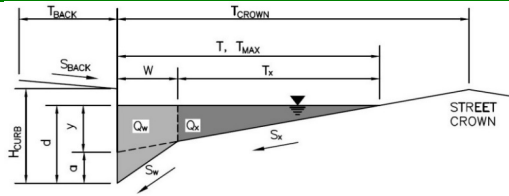
Total Inlet Interception Capacity
 Total Inlet Carry-Over Flow (flow bypassing inlet)
 Capture Percentage = Q_a/Q_o

	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	17.0	ft
$d_{MAX} =$	6.0	7.2	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

MINOR STORM Allowable Capacity is based on Spread Criterion
 MAJOR STORM Allowable Capacity is based on Spread Criterion

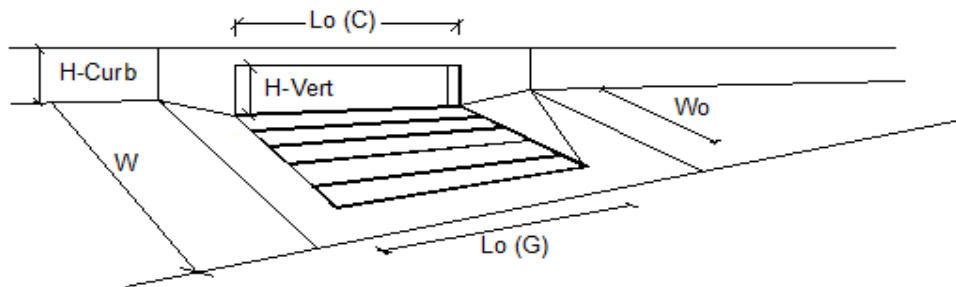
$Q_{allow} =$

18.9	18.9
------	------

 cfs

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'

INLET ON A CONTINUOUS GRADE



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)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
$a_{LOCAL} =$	3.0	3.0	inches
No =	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	

Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$

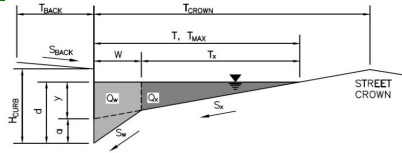
Total Inlet Interception Capacity
 Total Inlet Carry-Over Flow (flow bypassing inlet)
 Capture Percentage = Q_a/Q_o

	MINOR	MAJOR	
$Q =$	1.5	4.0	cfs
$Q_b =$	0.0	0.2	cfs
$C\% =$	100	95	%

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

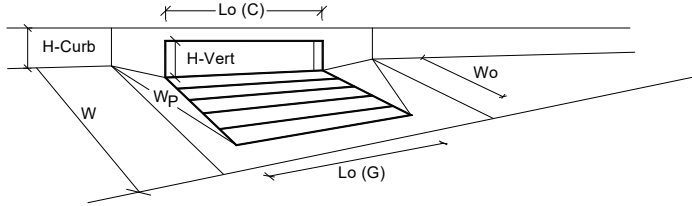
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Falcon Highlands South
Inlet ID: A-4



Gutter Geometry:					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 5.0$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.013$				
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches				
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.7$ ft				
Gutter Width	$W = 2.00$ ft				
Street Transverse Slope	$S_x = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.013$				
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="text-align: center;">Minor Storm</th> <th style="text-align: center;">Major Storm</th> </tr> <tr> <td style="text-align: center;">$T_{MAX} = 17.0$</td> <td style="text-align: center;">17.0</td> </tr> </table> ft	Minor Storm	Major Storm	$T_{MAX} = 17.0$	17.0
Minor Storm	Major Storm				
$T_{MAX} = 17.0$	17.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="text-align: center;">Minor Storm</th> <th style="text-align: center;">Major Storm</th> </tr> <tr> <td style="text-align: center;">$d_{MAX} = 6.0$</td> <td style="text-align: center;">7.2</td> </tr> </table> inches <input type="checkbox"/> <input type="checkbox"/>	Minor Storm	Major Storm	$d_{MAX} = 6.0$	7.2
Minor Storm	Major Storm				
$d_{MAX} = 6.0$	7.2				
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					
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="text-align: center;">Minor Storm</th> <th style="text-align: center;">Major Storm</th> </tr> <tr> <td style="text-align: center;">$Q_{allow} = \text{SUMP}$</td> <td style="text-align: center;">SUMP</td> </tr> </table> cfs	Minor Storm	Major Storm	$Q_{allow} = \text{SUMP}$	SUMP
Minor Storm	Major Storm				
$Q_{allow} = \text{SUMP}$	SUMP				

INLET IN A SUMP OR SAG LOCATION



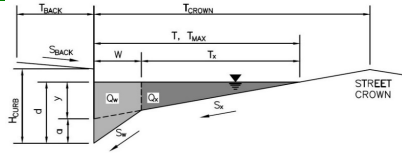
Design Information (Input)	
Type of Inlet	CDOT Type R Curb Opening
Local Depression (additional to continuous gutter depression 'a' from above)	
Number of Unit Inlets (Grate or Curb Opening)	
Water Depth at Flowline (outside of local depression)	
Grate Information	
Length of a Unit Grate	
Width of a 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	
Total Inlet Interception Capacity (assumes clogged condition)	
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	

	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	<input checked="" type="checkbox"/> 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	
	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)

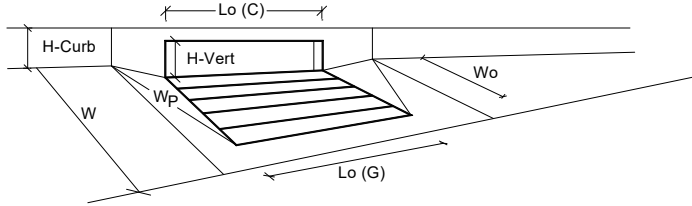
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Falcon Highlands South
Inlet ID: A-5



Gutter Geometry:					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 5.0$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.013$				
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches				
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.7$ ft				
Gutter Width	$W = 2.00$ ft				
Street Transverse Slope	$S_x = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.013$				
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="width: 50%;">Minor Storm</th> <th style="width: 50%;">Major Storm</th> </tr> <tr> <td>$T_{MAX} = 17.0$</td> <td>17.0</td> </tr> </table> ft	Minor Storm	Major Storm	$T_{MAX} = 17.0$	17.0
Minor Storm	Major Storm				
$T_{MAX} = 17.0$	17.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="width: 50%;">Minor Storm</th> <th style="width: 50%;">Major Storm</th> </tr> <tr> <td>$d_{MAX} = 6.0$</td> <td>7.2</td> </tr> </table> inches	Minor Storm	Major Storm	$d_{MAX} = 6.0$	7.2
Minor Storm	Major Storm				
$d_{MAX} = 6.0$	7.2				
Check boxes are not applicable in SUMP conditions	<input type="checkbox"/> <input type="checkbox"/>				
MINOR STORM Allowable Capacity is not applicable to Sump Condition					
MAJOR STORM Allowable Capacity is not applicable to Sump Condition					
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="width: 50%;">Minor Storm</th> <th style="width: 50%;">Major Storm</th> </tr> <tr> <td>$Q_{allow} = \text{SUMP}$</td> <td>SUMP</td> </tr> </table> cfs	Minor Storm	Major Storm	$Q_{allow} = \text{SUMP}$	SUMP
Minor Storm	Major Storm				
$Q_{allow} = \text{SUMP}$	SUMP				

INLET IN A SUMP OR SAG LOCATION

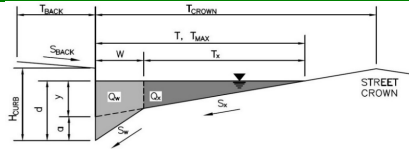


Design Information (Input)	
Type of Inlet	CDOT Type R Curb Opening
Local Depression (additional to continuous gutter depression 'a' from above)	
Number of Unit Inlets (Grate or Curb Opening)	No = 1
Water Depth at Flowline (outside of local depression)	Ponding Depth = 5.6 inches
Grate Information	
Length of a Unit Grate	$L_o (G) = N/A$ feet
Width of a Unit Grate	$W_o = N/A$ feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	$A_{ratio} = N/A$
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	$C_r (G) = N/A$
Grate Weir Coefficient (typical value 2.15 - 3.60)	$C_w (G) = N/A$
Grate Orifice Coefficient (typical value 0.60 - 0.80)	$C_o (G) = N/A$
Curb Opening Information	
Length of a Unit Curb Opening	$L_o (C) = 10.00$ feet
Height of Vertical Curb Opening in Inches	$H_{vert} = 6.00$ inches
Height of Curb Orifice Throat in Inches	$H_{throat} = 6.00$ inches
Angle of Throat	Theta = 63.40 degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	$W_p = 2.00$ feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	$C_r (C) = 0.10$
Curb Opening Weir Coefficient (typical value 2.3-3.7)	$C_w (C) = 3.60$
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	$C_o (C) = 0.67$
Low Head Performance Reduction (Calculated)	
Depth for Grate Midwidth	$d_{Grate} = N/A$ ft
Depth for Curb Opening Weir Equation	$d_{Curb} = 0.30$ ft
Grated Inlet Performance Reduction Factor for Long Inlets	$RF_{Grate} = N/A$
Curb Opening Performance Reduction Factor for Long Inlets	$RF_{Curb} = 0.91$
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination} = N/A$
Total Inlet Interception Capacity (assumes clogged condition)	$Q_a = 6.9$ cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK REQUIRED} = 2.4$ 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)

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

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)

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 21.1$ ft
 $W = 2.00$ ft
 $S_x = 0.010$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_o = 0.000$ 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	
$T_{MAX} =$	21.0	21.0	ft
$d_{MAX} =$	6.0	7.2	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
 MAJOR STORM Allowable Capacity is not applicable to Sump Condition

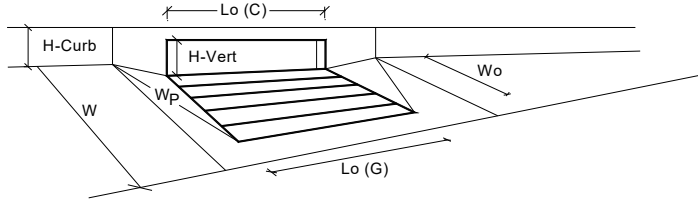
$Q_{allow} =$

Minor Storm	Major Storm
SUMP	SUMP

 cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

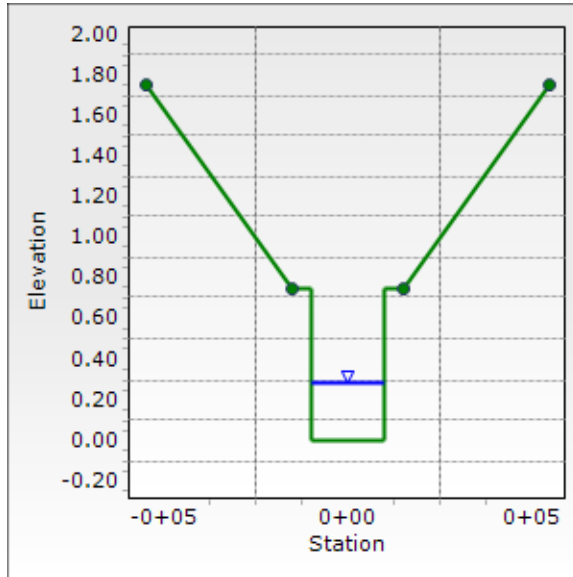


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	7.2	inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	20.00	20.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.43	ft
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	0.79	0.85	
Combination Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	12.5	20.1	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>0 Peak)	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

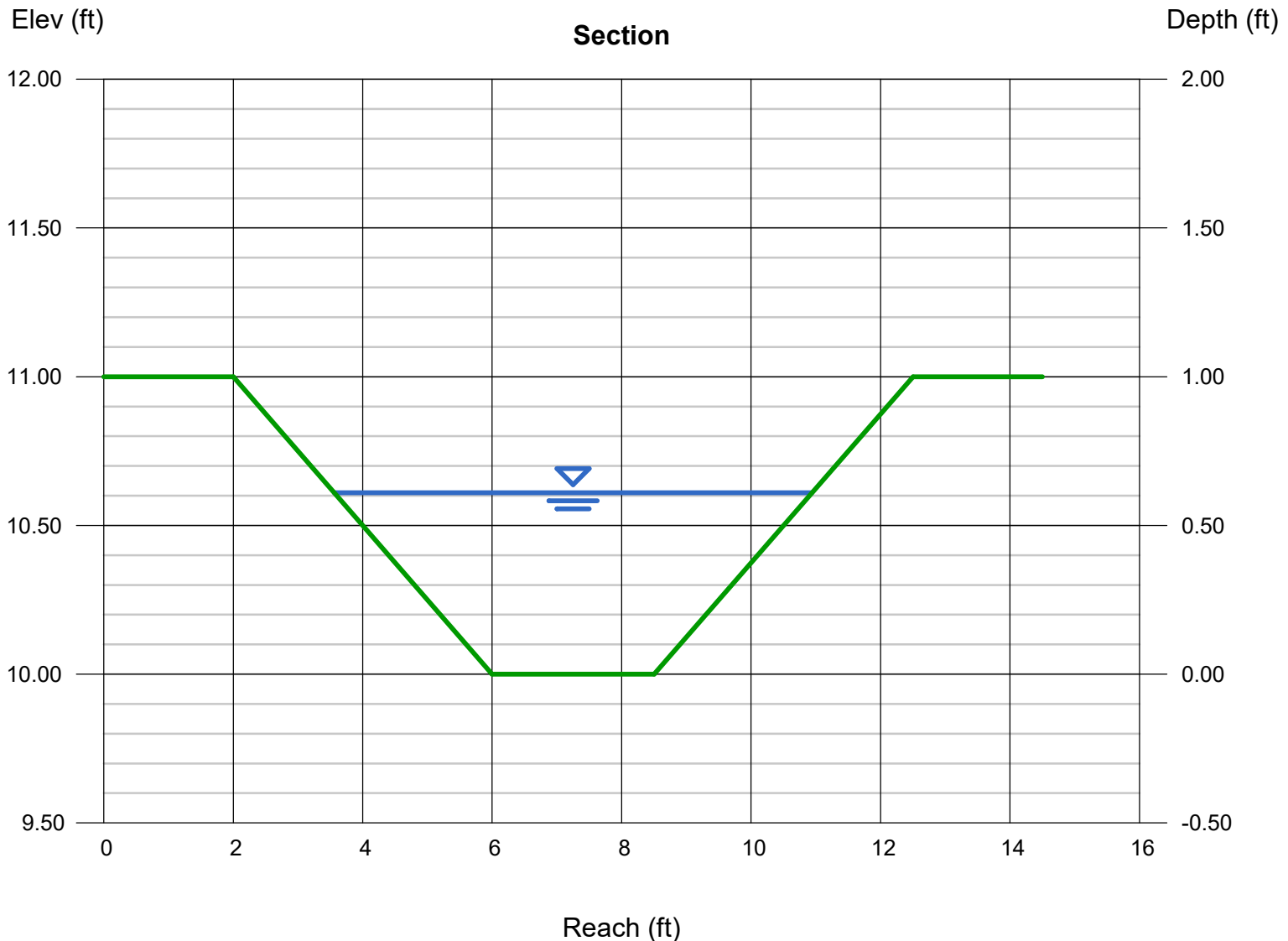
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Depth (ft)	= 0.61
Q (cfs)	= 7.550
Area (sqft)	= 3.01
Velocity (ft/s)	= 2.51
Wetted Perim (ft)	= 7.53
Crit Depth, Yc (ft)	= 0.51
Top Width (ft)	= 7.38
EGL (ft)	= 0.71

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

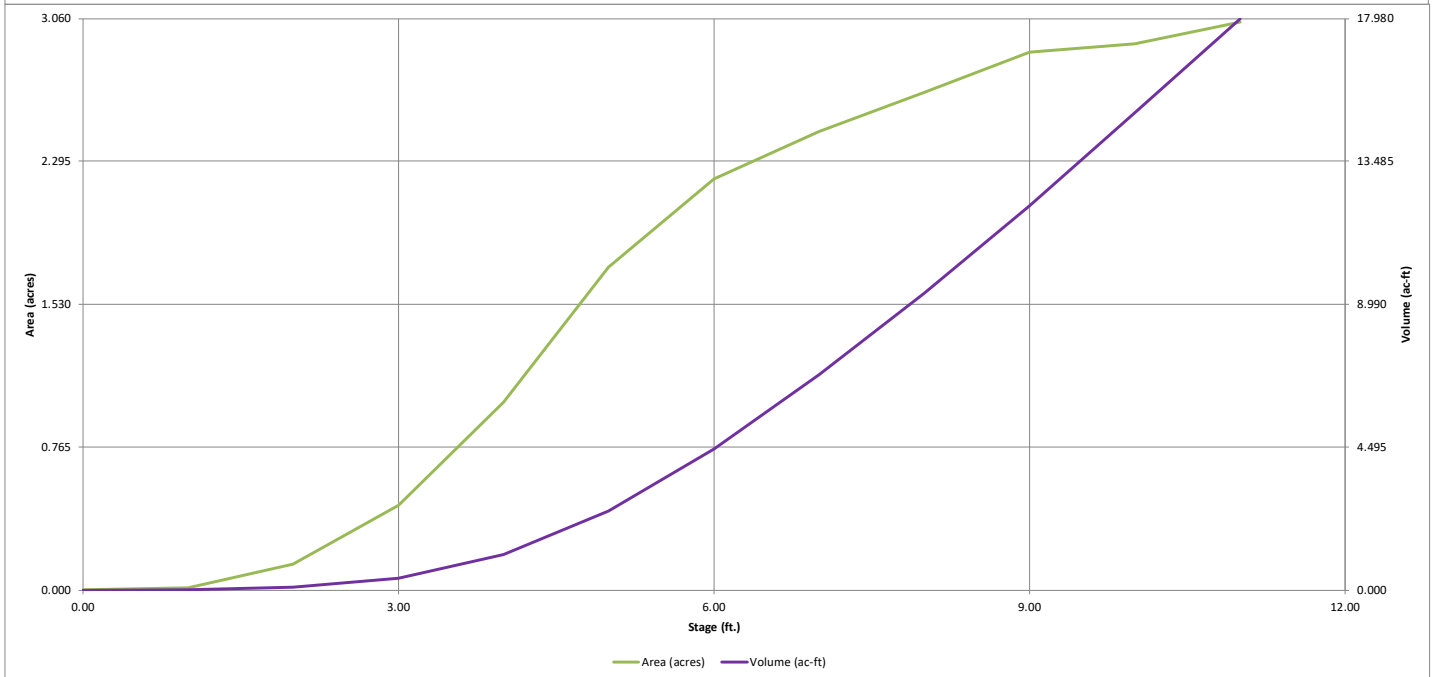
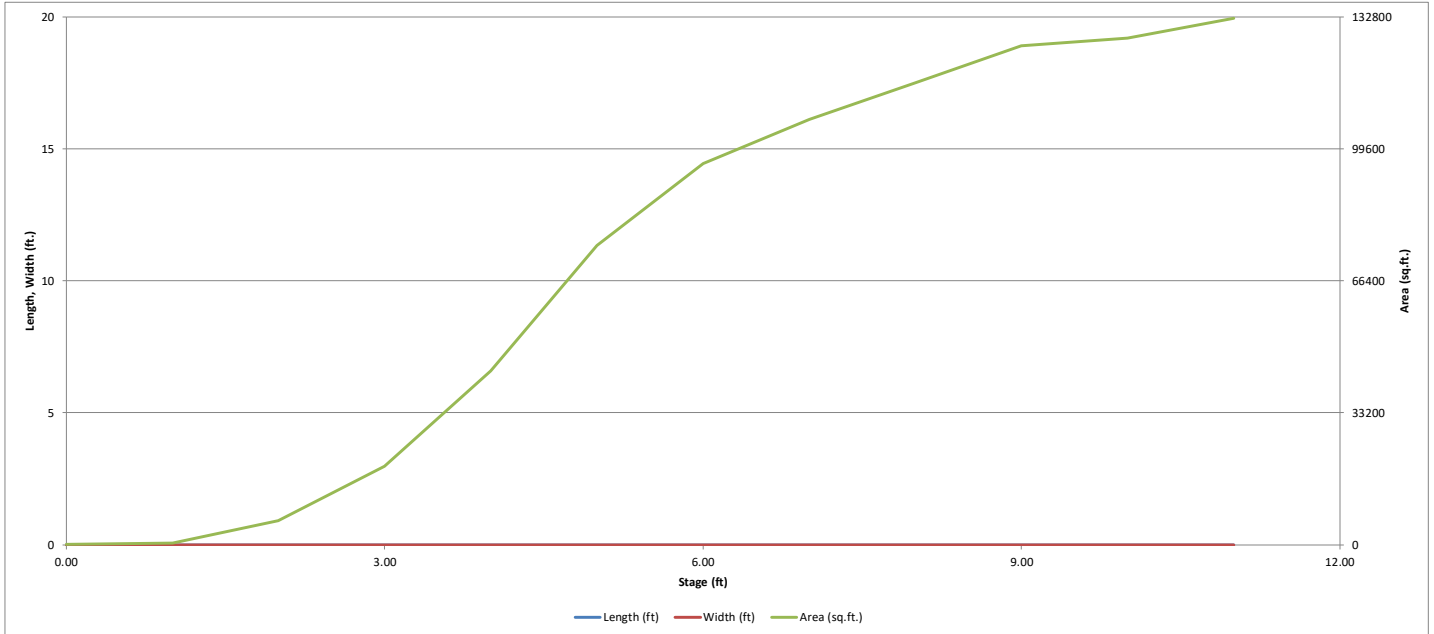
Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.032 ft/ft
Diameter	18.0 in
Discharge	7.55 cfs
Results	
Normal Depth	7.9 in
Flow Area	0.7 ft ²
Wetted Perimeter	2.2 ft
Hydraulic Radius	4.1 in
Top Width	1.49 ft
Critical 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 Formula
Solve For	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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

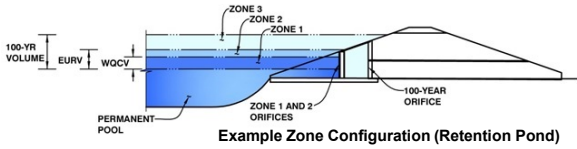


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Falcon Highlands

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



	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	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

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	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	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)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	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

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft ²
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)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	8.25	N/A	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 =	2.91	N/A	feet
Overflow Gate Type =	Type C Gate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Gate Upper Edge, H _g =	8.98	N/A	feet
Overflow Weir Slope Length =	3.00	N/A	feet
Gate Open Area / 100-yr Orifice Area =	3.07	N/A	
Overflow Gate Open Area w/o Debris =	11.84	N/A	ft ²
Overflow Gate Open Area w/ Debris =	5.92	N/A	ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.37	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	22.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.86	N/A	ft ²
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 =	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

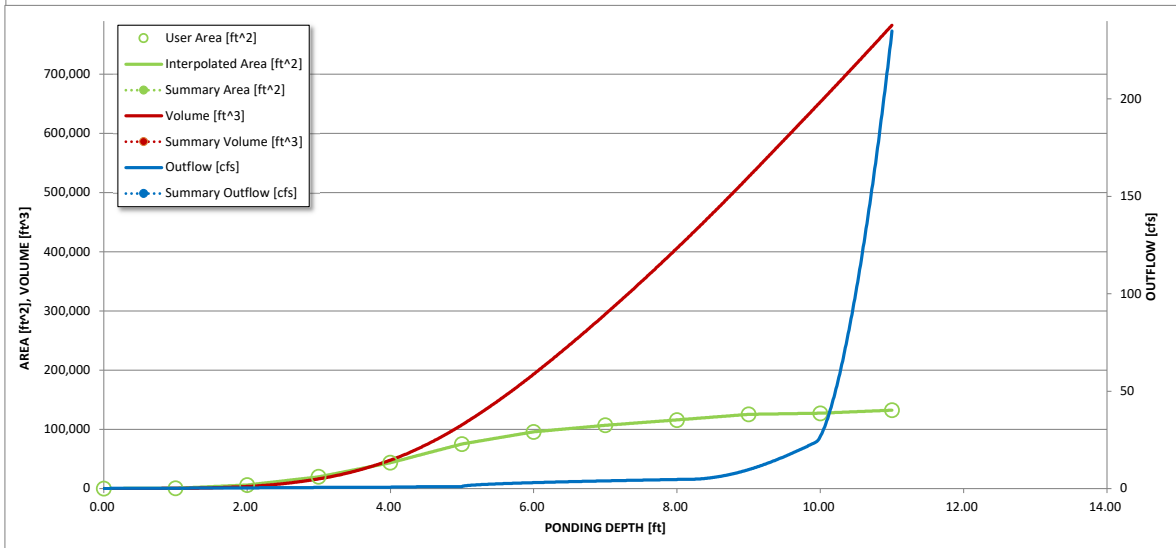
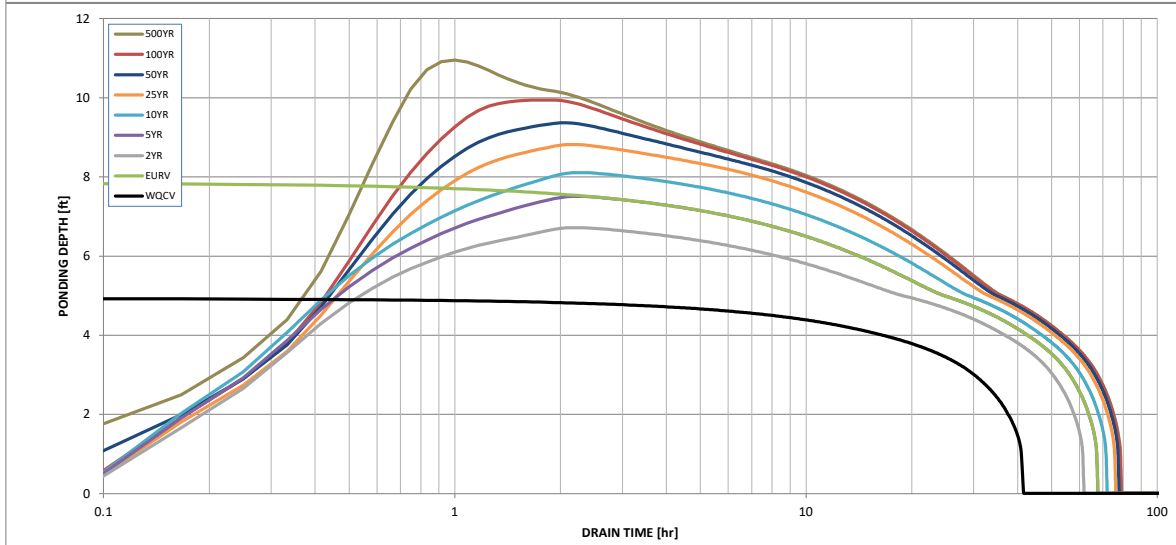
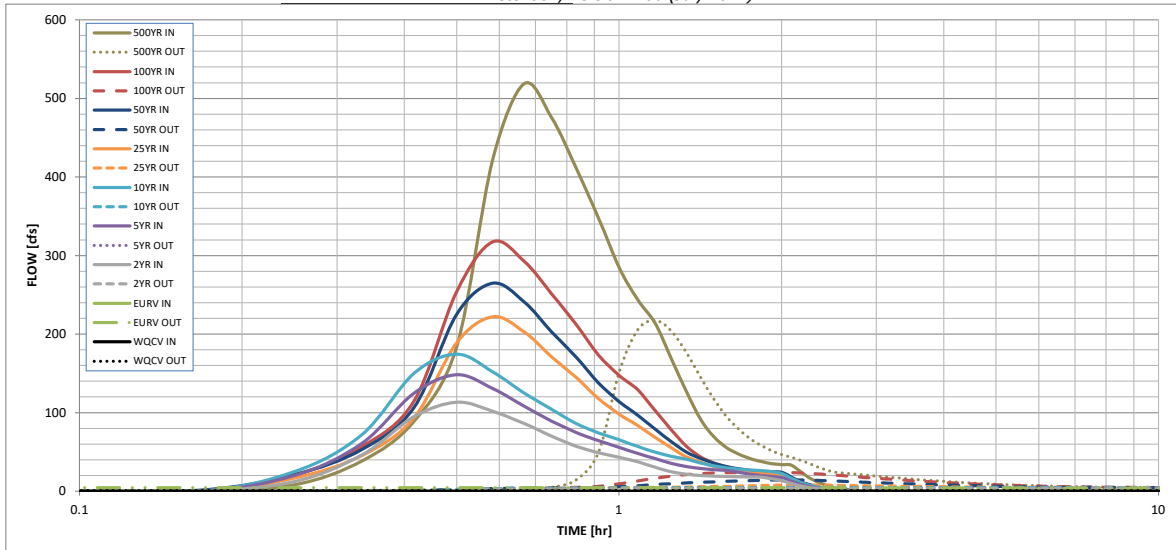
Routed Hydrograph Results

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: _____

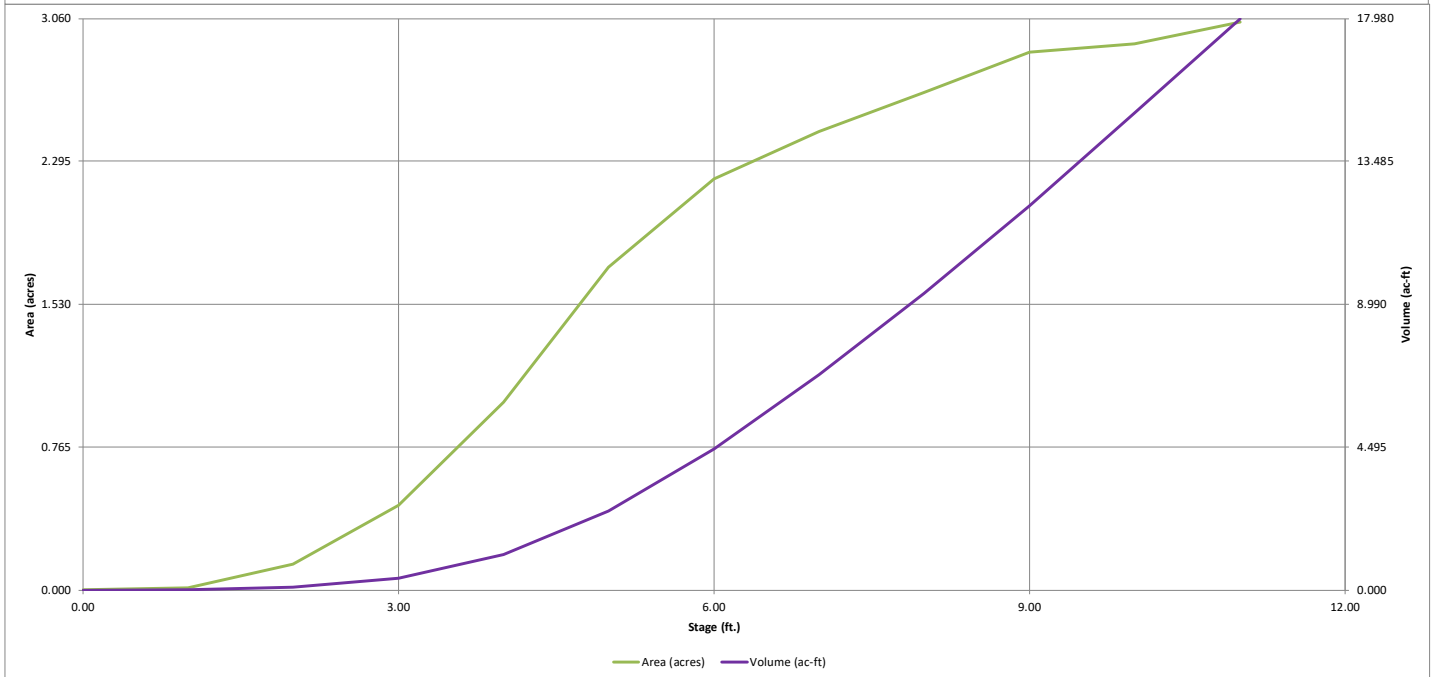
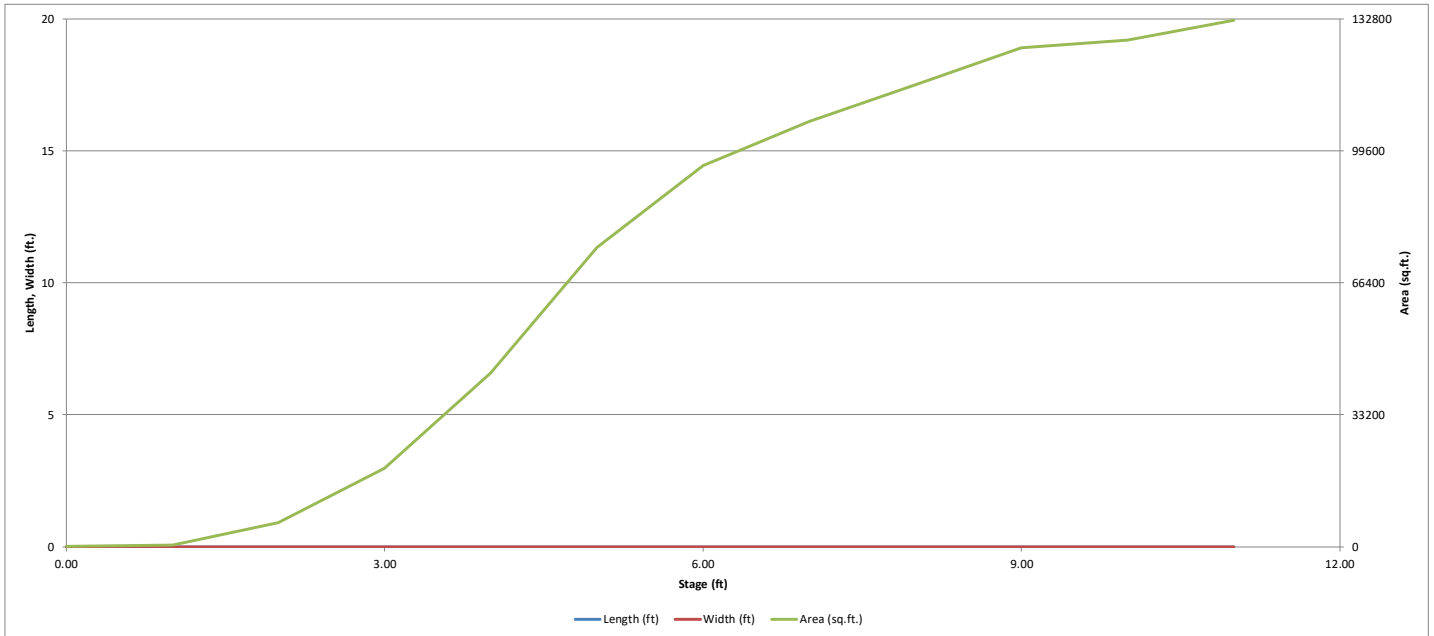
Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	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	109.03	125.14	134.18	215.55
	0:35:00	0.00	0.00	101.88	130.83	151.94	97.97	112.63	120.75	191.45
	0:40:00	0.00	0.00	86.17	108.21	125.27	83.03	94.35	101.74	164.64
	0:45:00	0.00	0.00	70.18	89.41	104.13	69.05	78.81	84.54	131.81
	0:50:00	0.00	0.00	57.19	74.76	85.94	57.45	65.46	70.65	113.55
	0:55:00	0.00	0.00	49.06	64.23	74.29	48.55	56.67	60.79	98.03
	1:00:00	0.00	0.00	43.00	55.83	65.41	42.06	49.06	52.19	87.58
	1:05:00	0.00	0.00	37.34	48.14	57.00	36.44	41.72	44.98	77.97
	1:10:00	0.00	0.00	30.39	41.54	49.75	29.60	34.10	36.79	64.07
	1:15:00	0.00	0.00	24.67	35.44	44.62	24.26	28.22	30.78	52.75
	1:20:00	0.00	0.00	21.69	31.37	40.63	21.80	25.70	27.21	46.58
	1:25:00	0.00	0.00	20.16	29.01	36.04	20.90	24.71	26.73	43.11
	1:30:00	0.00	0.00	19.22	27.49	32.40	19.55	23.56	25.76	40.50
	1:35:00	0.00	0.00	18.74	26.47	29.95	18.79	22.79	24.82	38.71
	1:40:00	0.00	0.00	18.36	24.00	28.24	18.25	22.41	24.61	37.50
	1:45:00	0.00	0.00	18.08	21.68	27.08	17.69	22.65	24.45	36.76
	1:50:00	0.00	0.00	17.90	20.06	26.27	17.56	22.37	24.34	36.16
	1:55:00	0.00	0.00	15.75	18.91	25.04	16.85	21.57	23.88	35.75
	2:00:00	0.00	0.00	13.59	17.60	22.75	14.41	20.08	22.78	33.28
	2:05:00	0.00	0.00	10.07	13.23	16.85	10.26	18.28	17.36	25.31
	2:10:00	0.00	0.00	6.86	8.98	11.46	7.03	12.39	11.82	17.21
	2:15:00	0.00	0.00	4.64	6.07	7.83	5.54	8.46	8.11	11.78
	2:20:00	0.00	0.00	3.11	3.99	5.23	4.06	5.68	5.44	7.88
	2:25:00	0.00	0.00	1.97	2.55	3.39	2.58	3.68	3.52	5.10
	2:30:00	0.00	0.00	1.21	1.67	2.17	1.66	2.42	2.31	3.33
	2:35:00	0.00	0.00	0.64	0.98	1.23	0.97	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
	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	

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

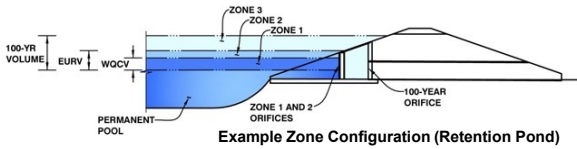
MHFD-Detention, Version 4.06 (July 2022)



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	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

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	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.0000	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)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	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 =	N/A	ft ²
Vertical Orifice Centroid =	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	8.25	N/A	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 =	2.91	N/A	feet
Overflow Gate Type =	Type C Gate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir		
Height of Gate Upper Edge, H _t =	8.98	N/A
Overflow Weir Slope Length =	3.00	N/A
Gate Open Area / 100-yr Orifice Area =	3.07	N/A
Overflow Gate Open Area w/o Debris =	11.84	N/A
Overflow Gate Open Area w/ Debris =	5.92	N/A

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.37	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	22.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate		
Outlet Orifice Area =	3.86	N/A
Outlet Orifice Centroid =	1.02	N/A
Half-Central Angle of Restrictor Plate on Pipe =	2.06	N/A

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

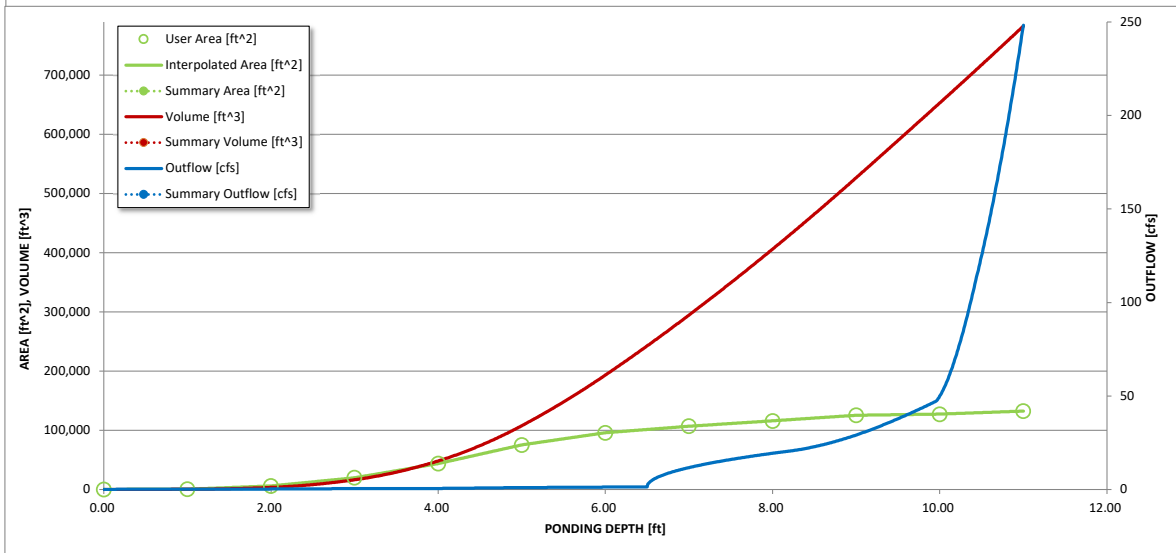
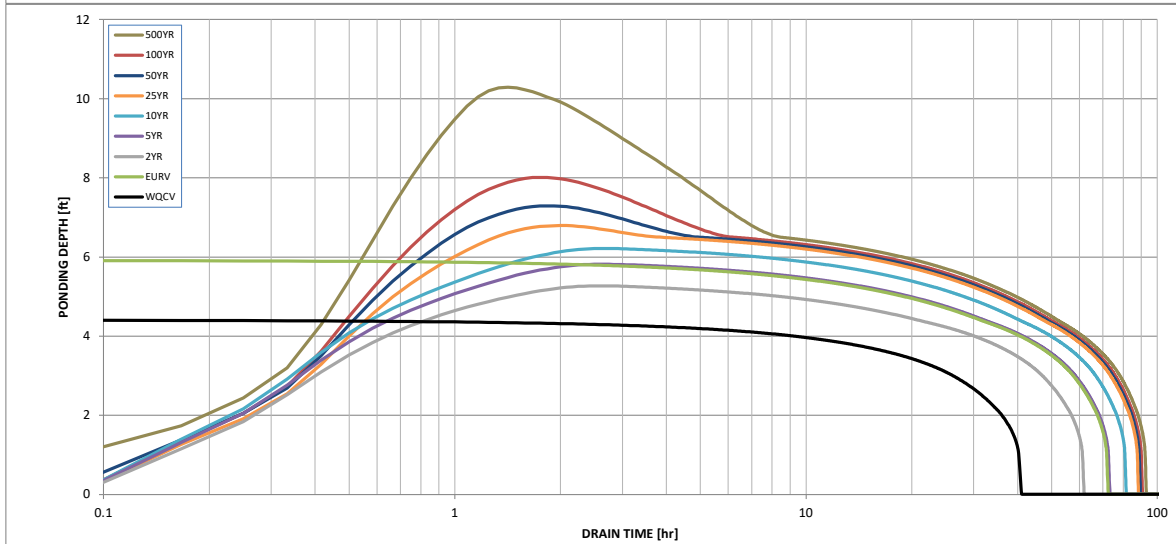
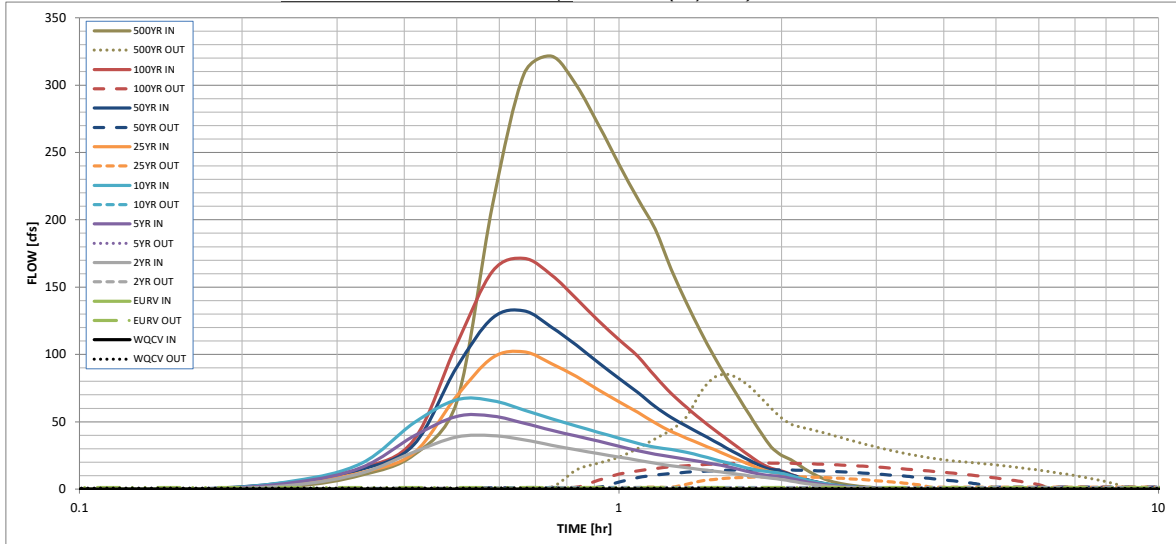
Routed Hydrograph Results

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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	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
	2:20:00	0.00	0.00	3.07	4.01	5.03	4.64	5.17	4.92	7.18
	2:25:00	0.00	0.00	2.43	3.18	3.96	3.63	4.03	3.75	5.33
	2:30:00	0.00	0.00	1.90	2.49	3.08	2.81	3.12	2.88	4.08
	2:35:00	0.00	0.00	1.49	1.92	2.36	2.16	2.38	2.21	3.09
	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
	3:20:00	0.00	0.00	0.02	0.03	0.02	0.02	0.02	0.01	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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					
$Q=C_wLH^{1.5}$					
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
1.2	160.7	3.21	0.33	2.5	2.46
1.3	47.45	0.95	0.33	1.5	1.57

*USE 1.5'
 *USE 2.5'
 *USE 1.60'

FOREBAY VOLUME DESIGN			
	1.1	1.2	1.3
FLOW (cfs)	89.51	160.7	47.45
WQCV (CF)	31,581.75	56,699.66	16,741.75
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

297.66
 105023.2

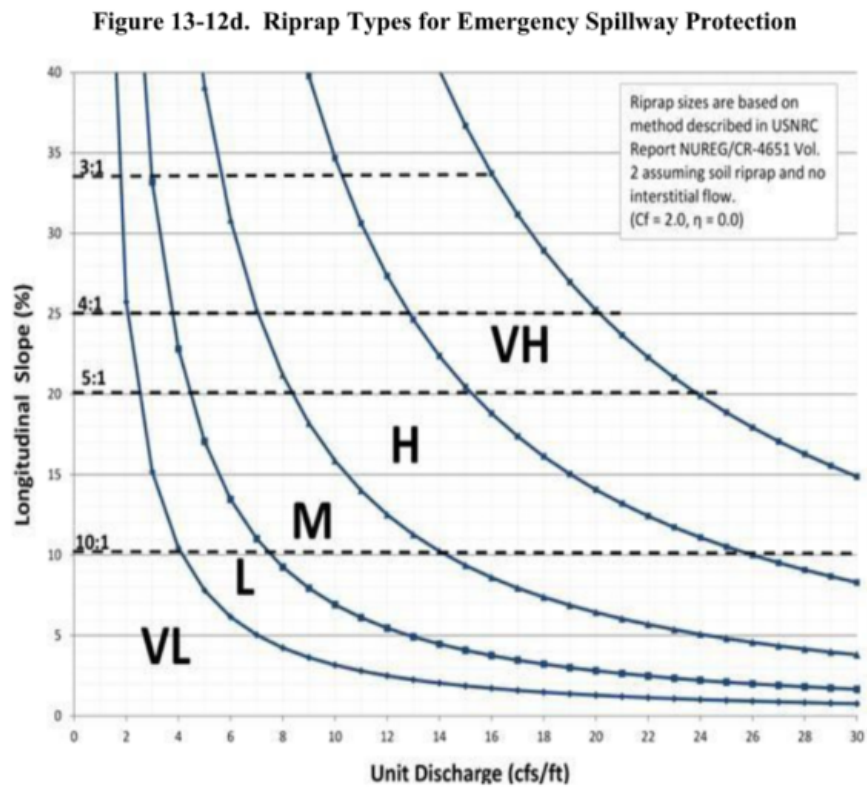
*USE 18'x21.25'x2.5'
 *USE Stilling basin calcs below
 *USE 12'16.75'x2.5'

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
c (FT)	6.52
d (FT)	2.17
e (FT)	1.09
f (FT)	1.63

*USE 1.0'
 *USE 2.5'

PROPOSED RIPRAP CALCULATIONS FOR POND 1 SPILLWAY



Longitudinal slope = 25%

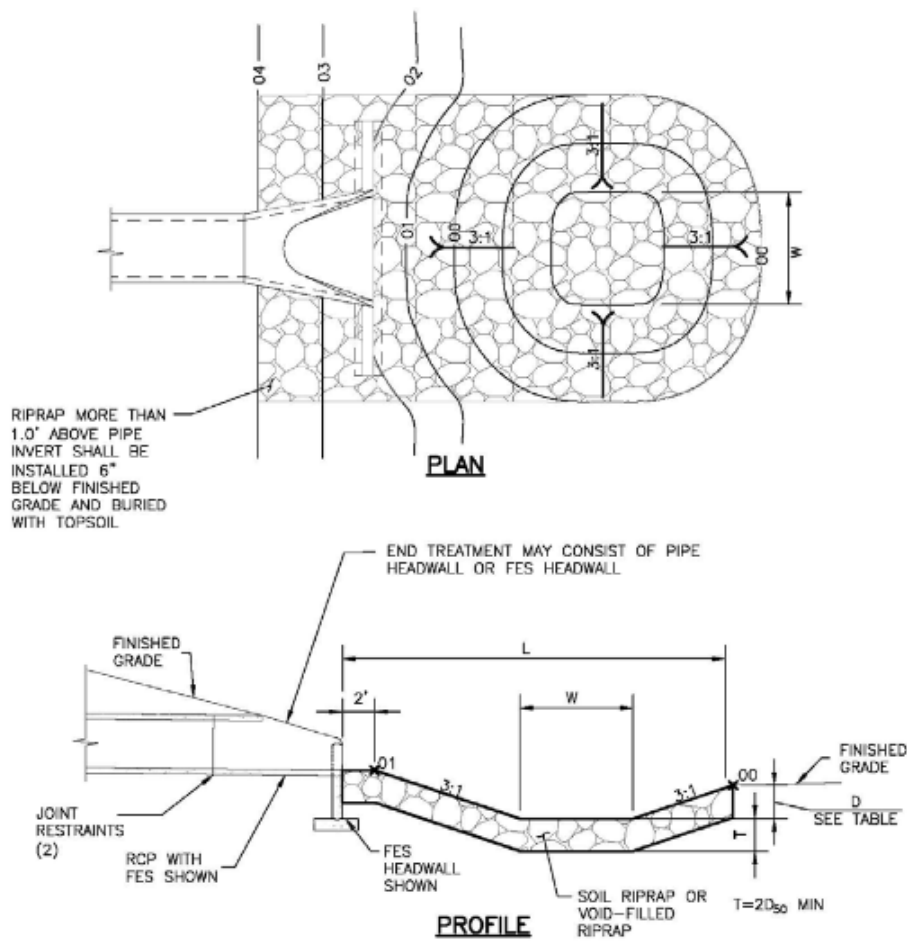
100-year developed & undetained inflow (Q100) = 309.4 cfs

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

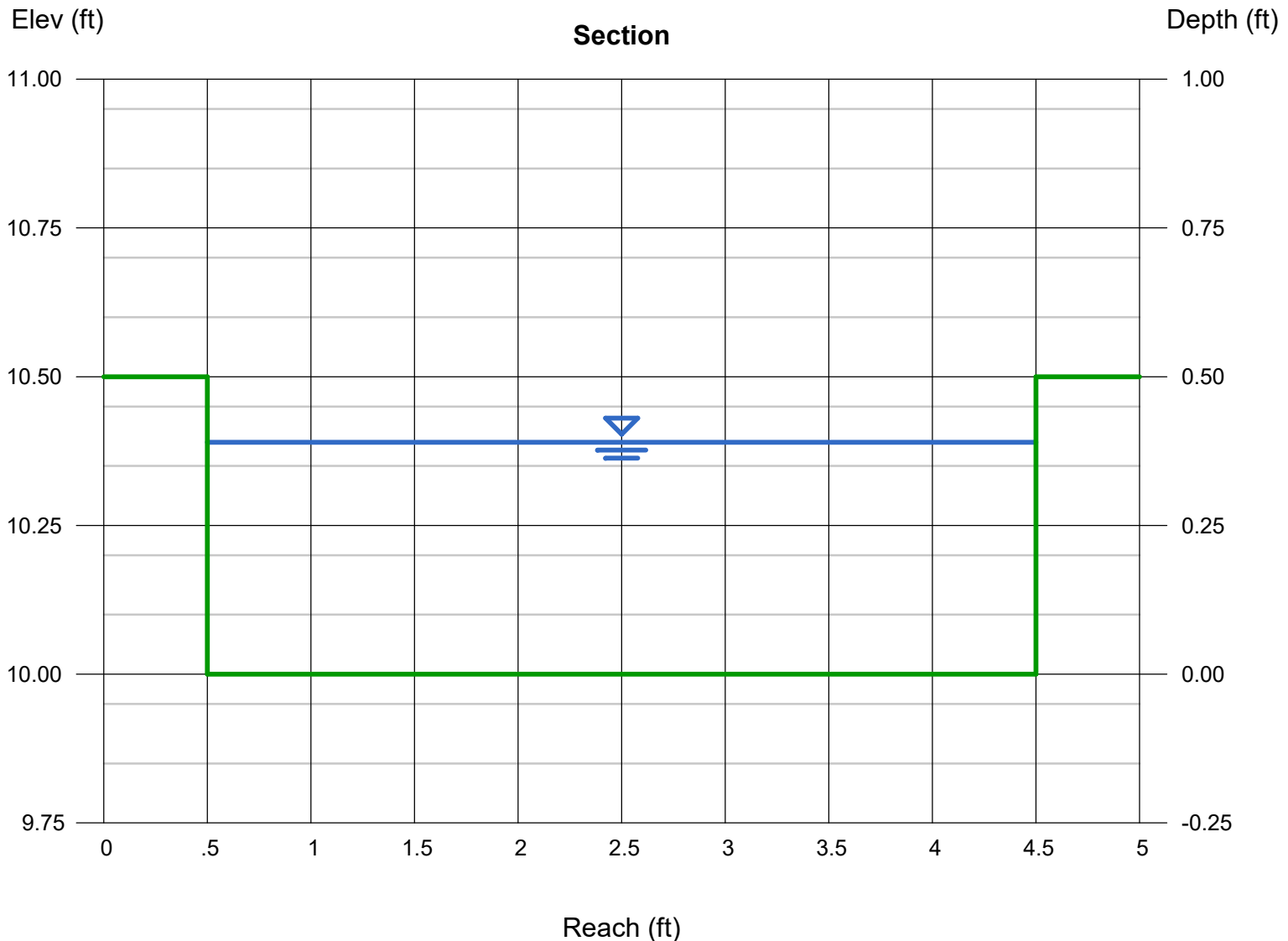
Invert Elev (ft) = 10.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

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

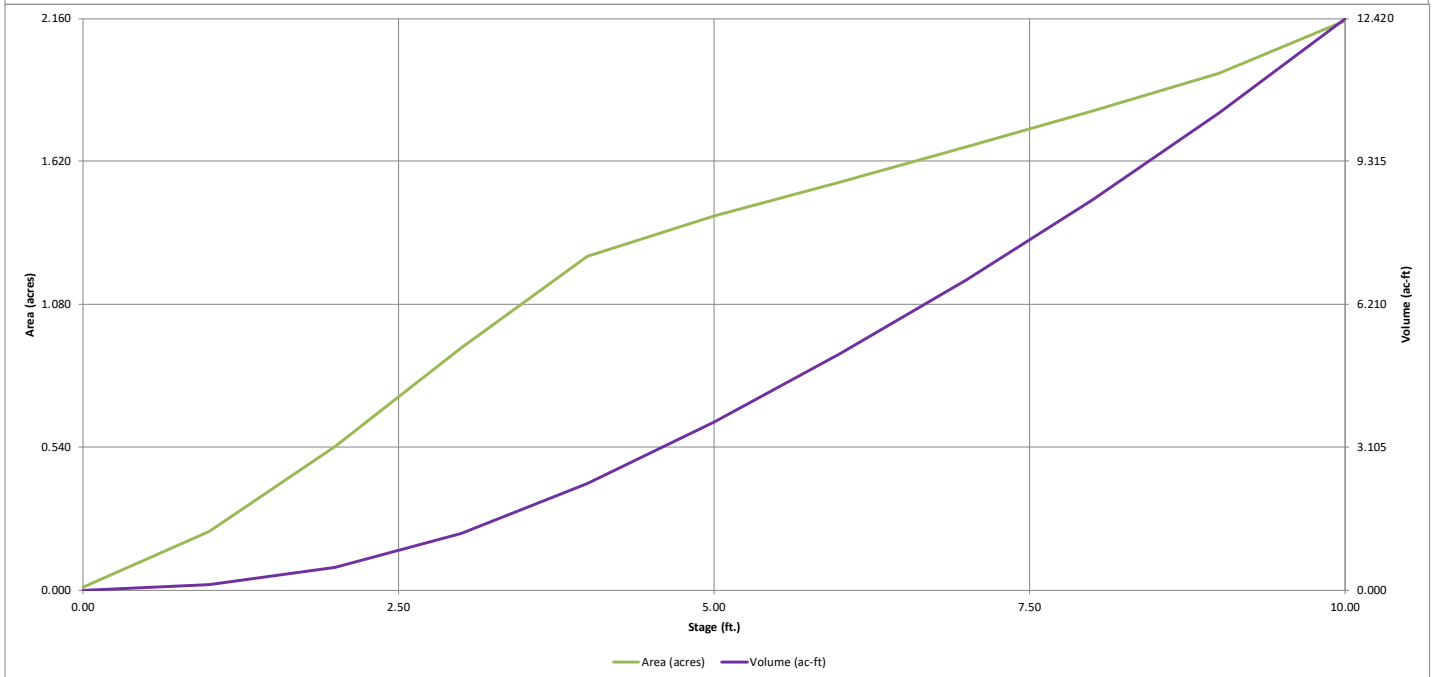
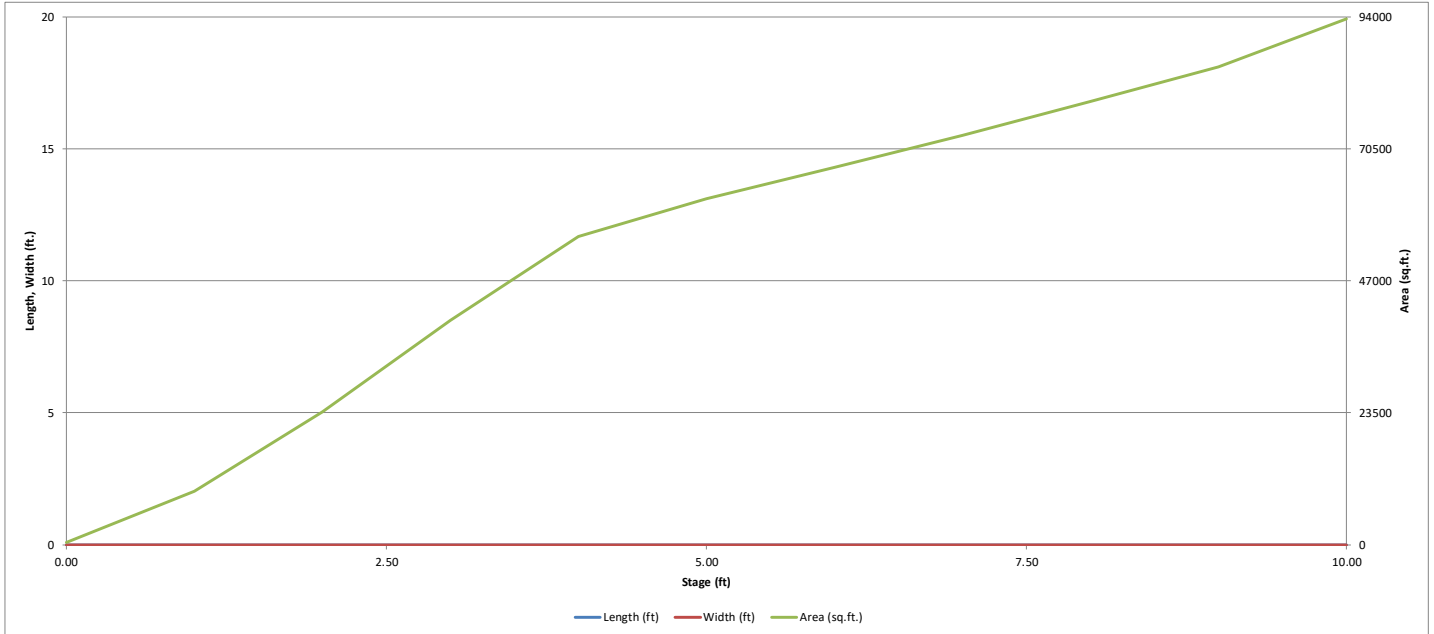
Highlighted

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



DETENTION BASIN STAGE-STORAGE TABLE BUILDER

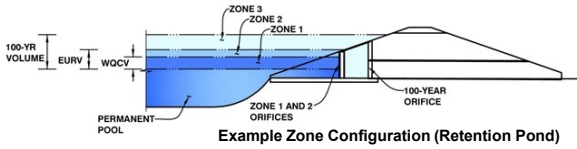
MHFD-Detention, Version 4.06 (July 2022)



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)



	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)

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

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	2.8333	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)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	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

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft ²
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)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	8.00	N/A	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	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Gate Upper Edge, H _g =	9.46	N/A	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	ft ²
Overflow Gate Open Area w/ Debris =	11.84	N/A	ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.20	N/A	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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	7.07	N/A	ft ²
Outlet Orifice Centroid =	1.50	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	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 = 30.00 feet
 Spillway End Slopes = 10.00 H:V
 Freeboard above Max Water Surface = 1.00 feet

Calculated Parameters for Spillway

Spillway Design Flow Depth = 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

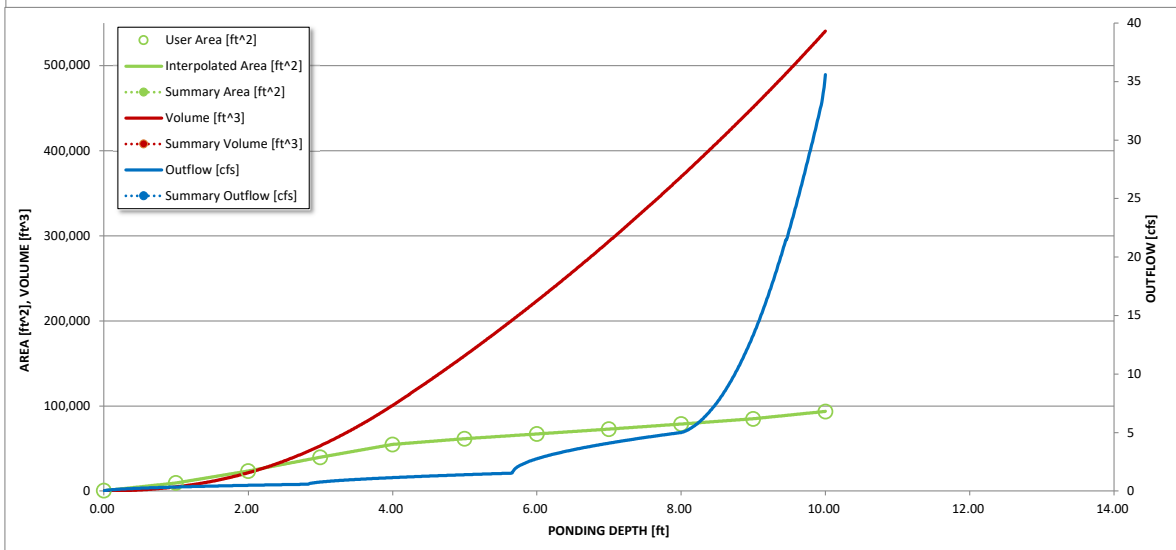
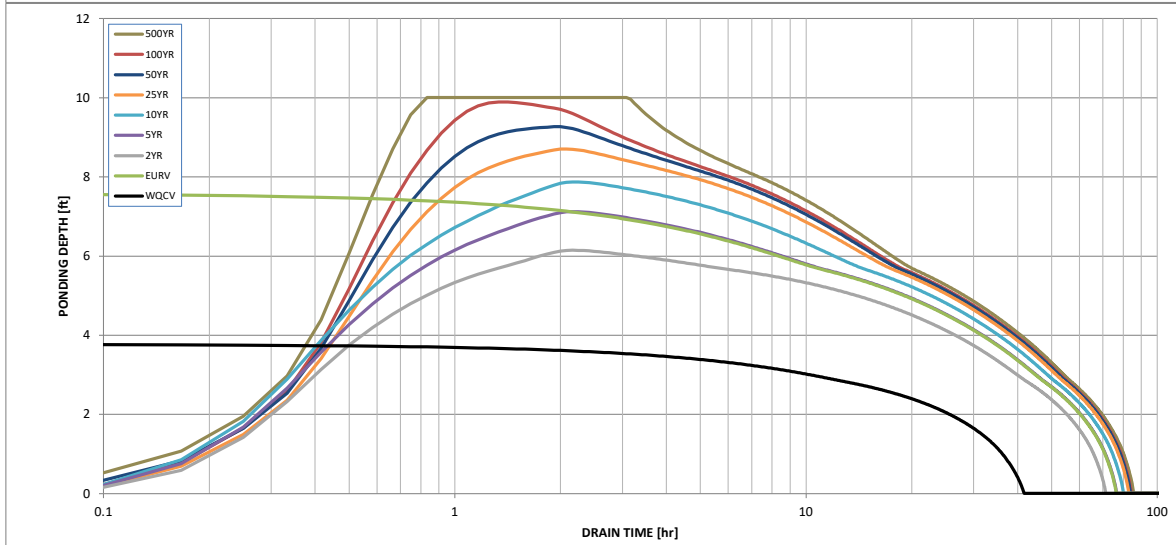
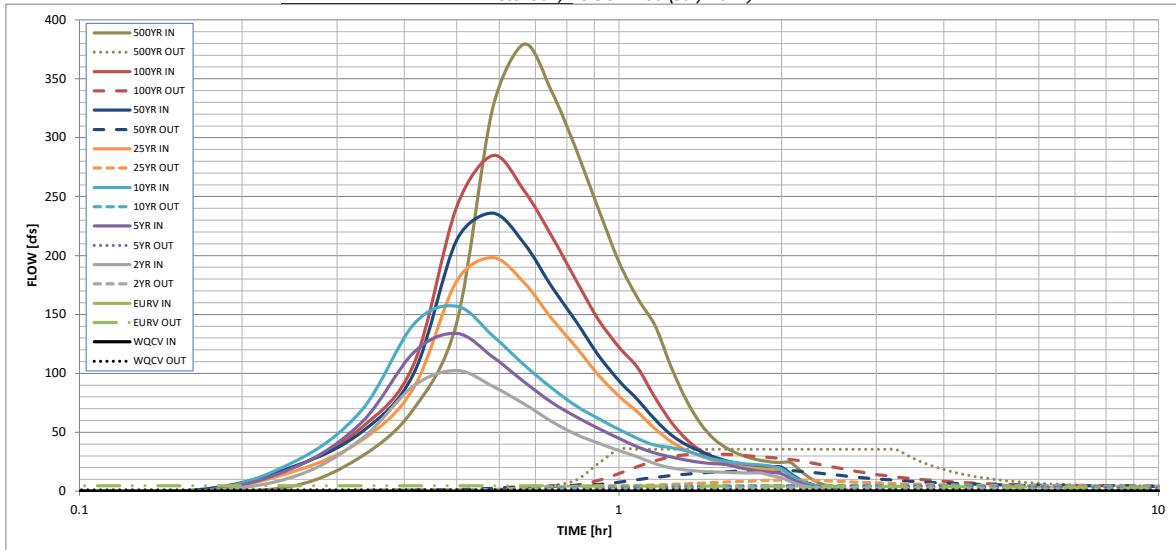
Routed Hydrograph Results

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)	1.1	4.6	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: _____

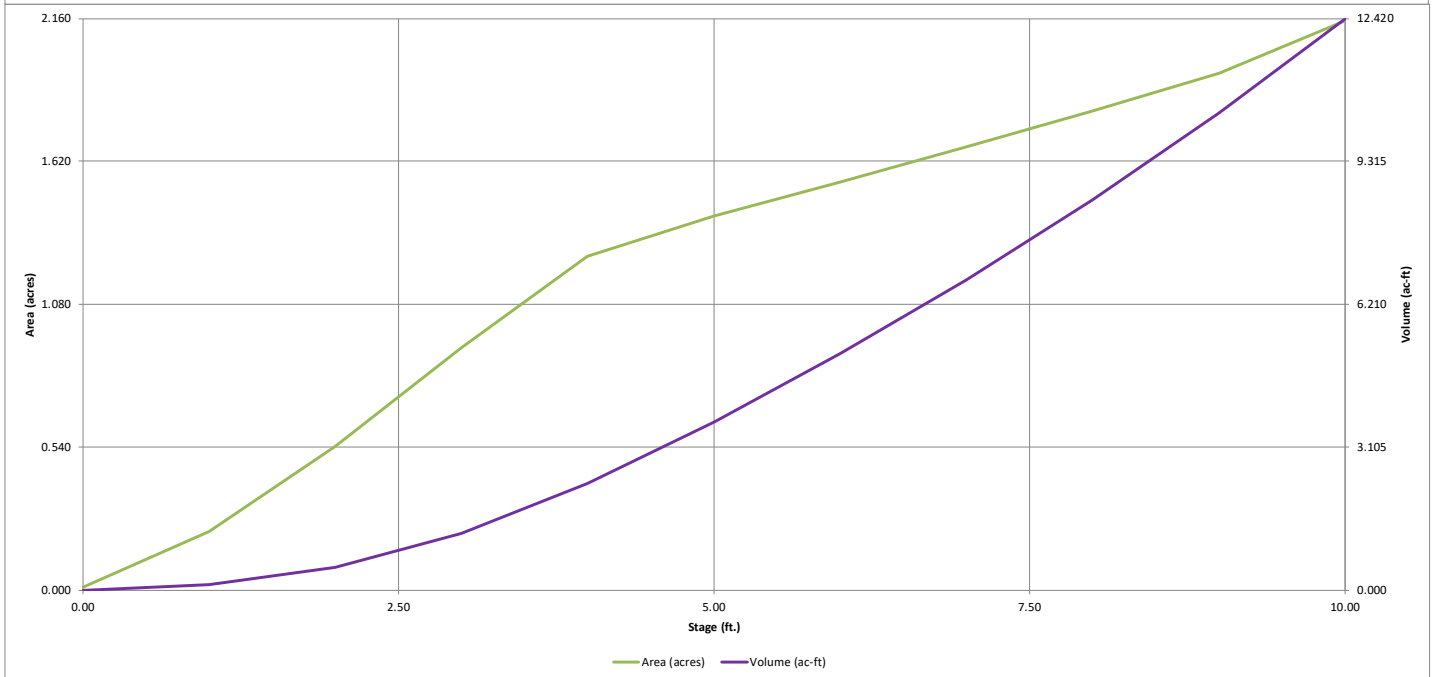
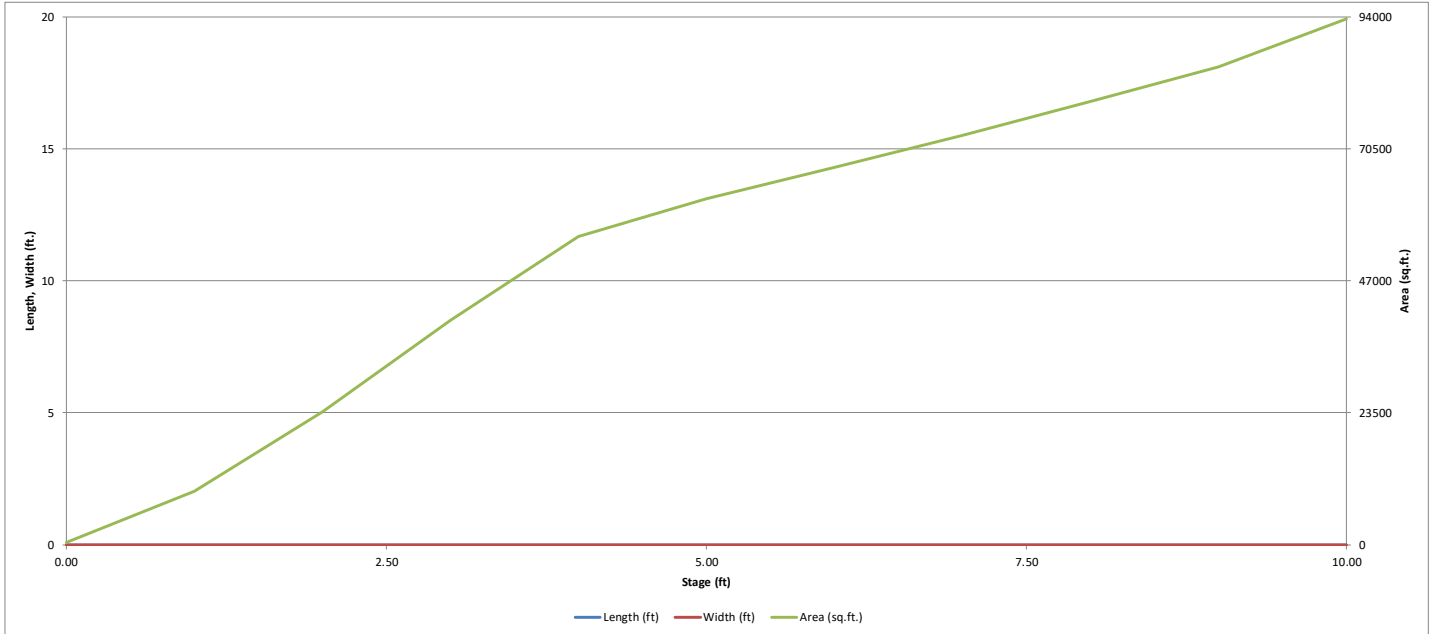
Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41	0.14
	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
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	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
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	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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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
	3:00:00	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
	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
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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	
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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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5:25:00	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	

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

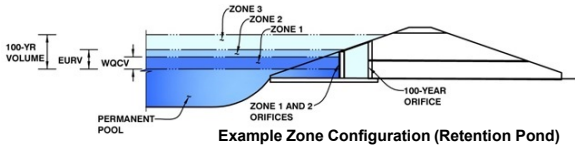
MHFD-Detention, Version 4.06 (July 2022)



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

	Not Selected	Not Selected	
Invert of Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	inches

	Not Selected	Not Selected	
Vertical Orifice Area =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft ²
Vertical Orifice Centroid =	<input type="text" value="N/A"/>	<input type="text" value="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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	<input type="text" value="8.00"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	<input type="text" value="5.67"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Gate Slope =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	H:V
Horiz. Length of Weir Sides =	<input type="text" value="5.82"/>	<input type="text" value="N/A"/>	feet
Overflow Gate Type =	<input type="text" value="Type C Gate"/>	<input type="text" value="N/A"/>	
Debris Clogging % =	<input type="text" value="50%"/>	<input type="text" value="N/A"/>	%

	Zone 3 Weir	Not Selected	
Height of Gate Upper Edge, H _g =	<input type="text" value="9.46"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Slope Length =	<input type="text" value="6.00"/>	<input type="text" value="N/A"/>	feet
Gate Open Area / 100-yr Orifice Area =	<input type="text" value="3.35"/>	<input type="text" value="N/A"/>	
Overflow Gate Open Area w/o Debris =	<input type="text" value="23.67"/>	<input type="text" value="N/A"/>	ft ²
Overflow Gate Open Area w/ Debris =	<input type="text" value="11.84"/>	<input type="text" value="N/A"/>	ft ²

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	<input type="text" value="0.20"/>	<input type="text" value="N/A"/>	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	<input type="text" value="36.00"/>	<input type="text" value="N/A"/>	inches
Restrictor Plate Height Above Pipe Invert =	<input type="text" value="36.00"/>	<input type="text" value="N/A"/>	inches

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	<input type="text" value="7.07"/>	<input type="text" value="N/A"/>	ft ²
Outlet Orifice Centroid =	<input type="text" value="1.50"/>	<input type="text" value="N/A"/>	feet
Half-Central Angle of Restrictor Plate on Pipe =	<input type="text" value="3.14"/>	<input type="text" value="N/A"/>	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

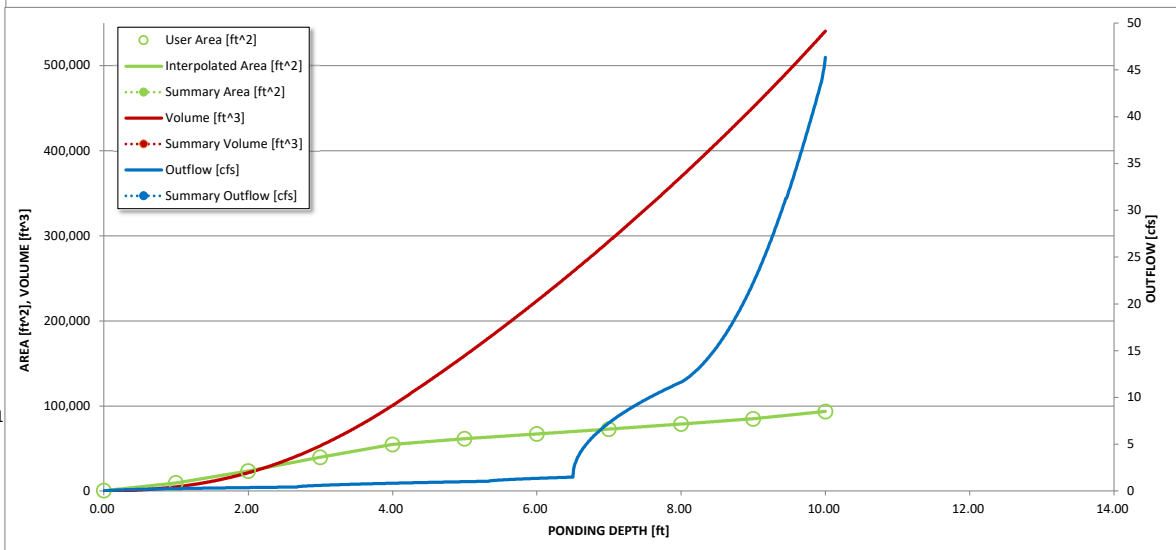
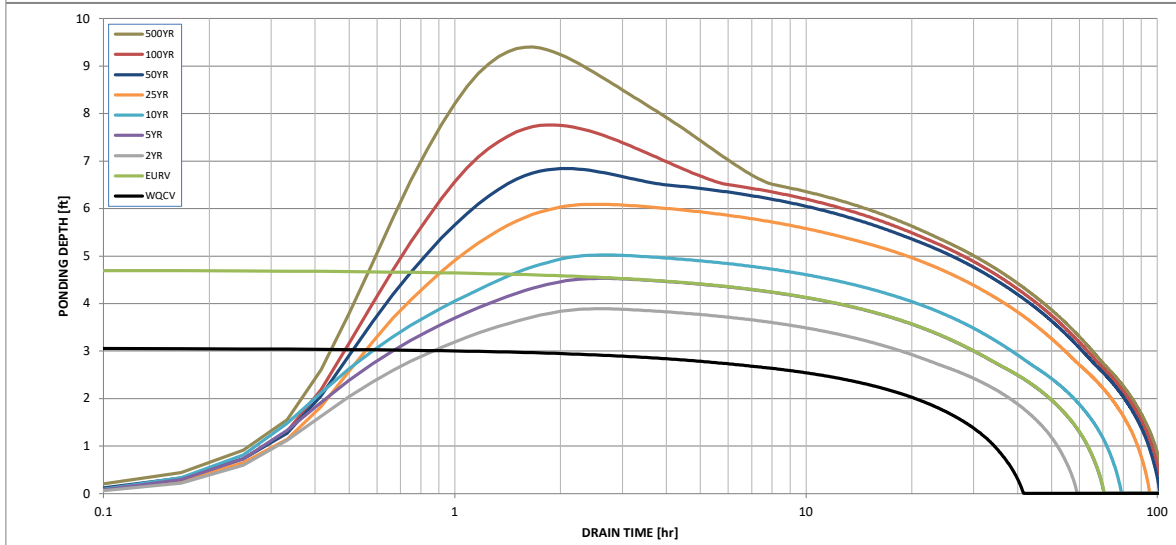
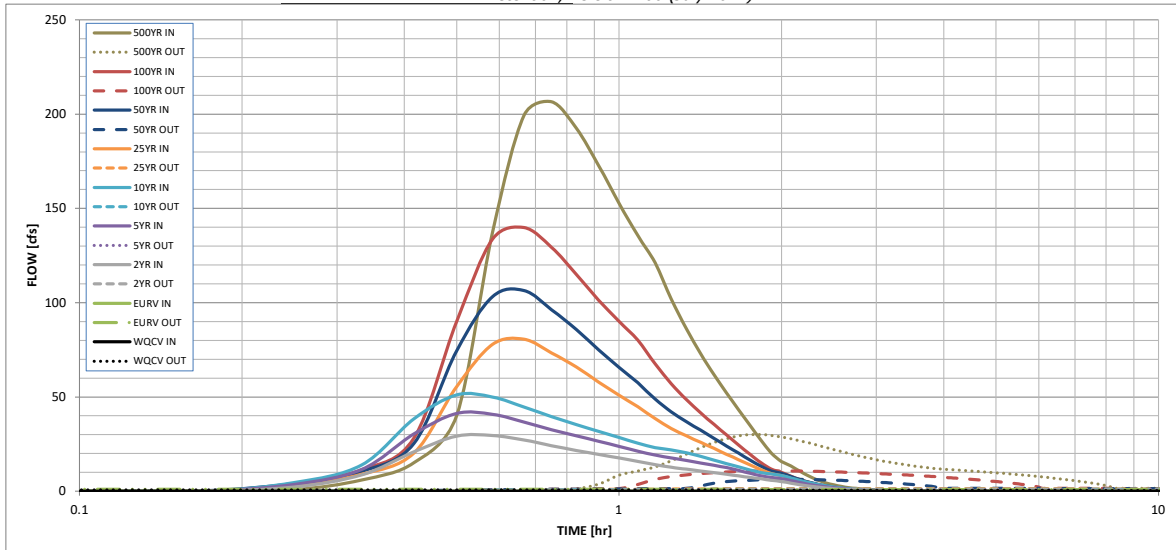
Routed Hydrograph Results

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) =	1.280	3.235	2.323	3.173	3.871	5.501	7.031	9.070	13.440
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	0.8	1.6	2.2	20.0	39.7	64.7	116.4
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.03
	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	
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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	
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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

WQCW: 2.033 AC 88557.48

FOREBAY RELEASE NOTCH DESIGN					
$Q=C_w L H^{1.5}$					
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
2.2	50.49	1.01	0.33	2.5	0.77

***USE 1.5'**

***USE 0.8'**

FOREBAY VOLUME DESIGN

	2.2
FLOW (cfs)	50.49
1/2 WQCW (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

140

***USE**

16'x24'x2.5'

TYPE VI IMPACT STILLING BASIN (54")

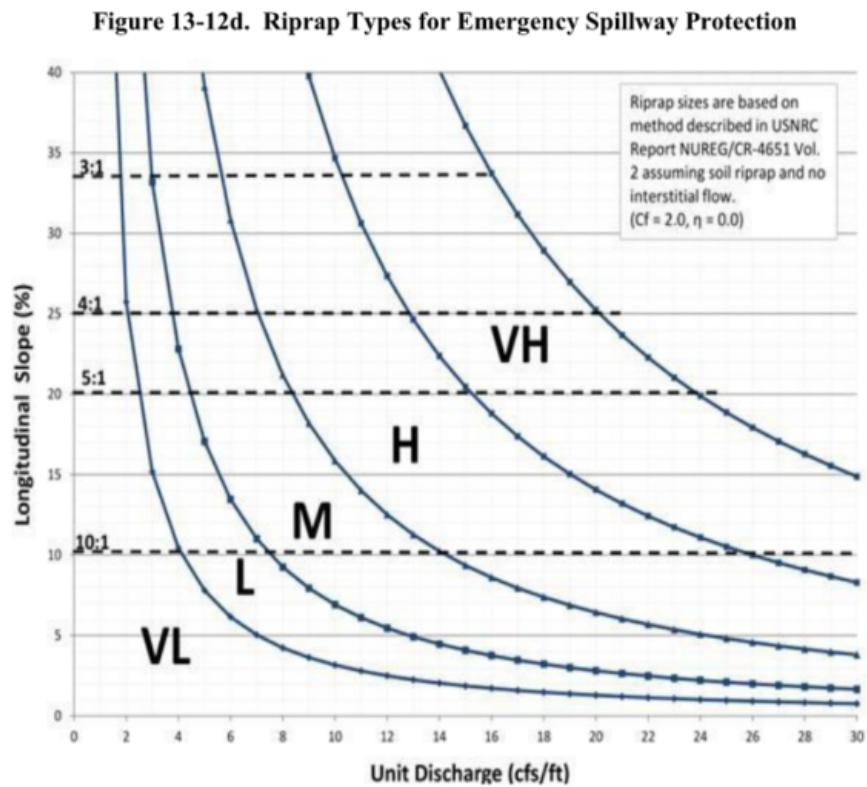
D (FT)	4.5
V (FT/SEC)	6.33
W (FT)	9.26
H (FT)	6.50
L (FT)	11.57
a (FT)	4.63
b (FT)	3.47
t (FT)	0.77
c (FT)	4.63
d (FT)	1.54
e (FT)	0.77
f (FT)	1.16

***USE 4.0'**

***USE 1.0'**

***USE 2.5'**

PROPOSED RIPRAP CALCULATIONS FOR POND 2 SPILLWAY



Longitudinal slope = 25%

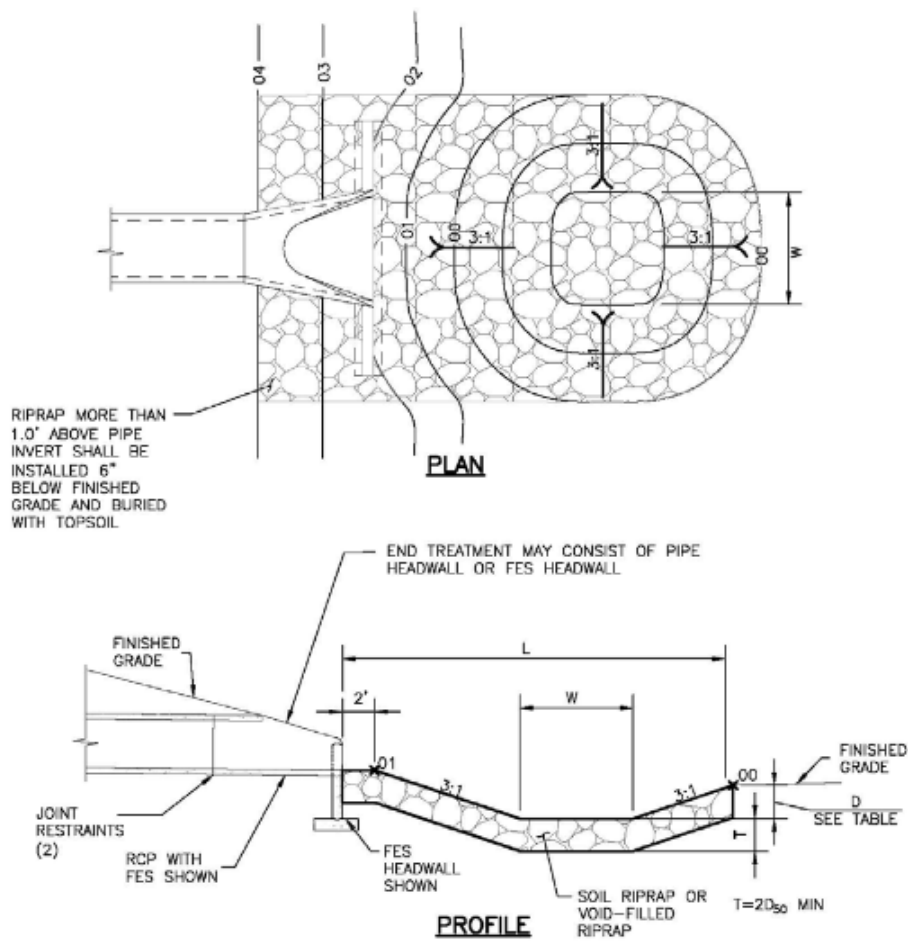
100-year developed & undetained flow (Q100) = 346.9 cfs

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



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

D_{50} = 12 inches

T = 24"

Channel Report

POND 2 TRICKLE CHANNEL

Rectangular

Bottom Width (ft) = 3.00

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) = 2.80

Highlighted

Depth (ft) = 0.30

Q (cfs) = 2.800

Area (sqft) = 0.90

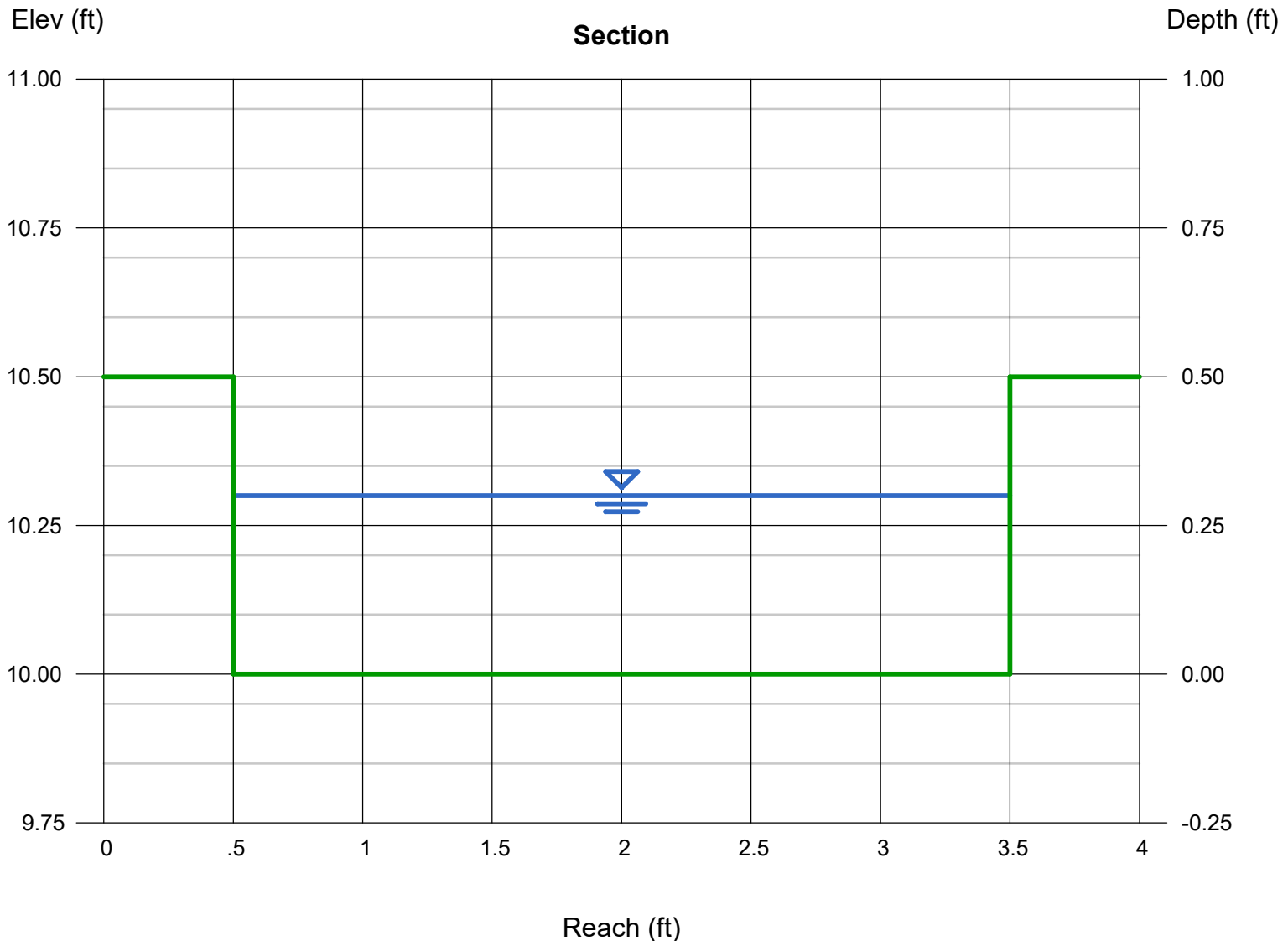
Velocity (ft/s) = 3.11

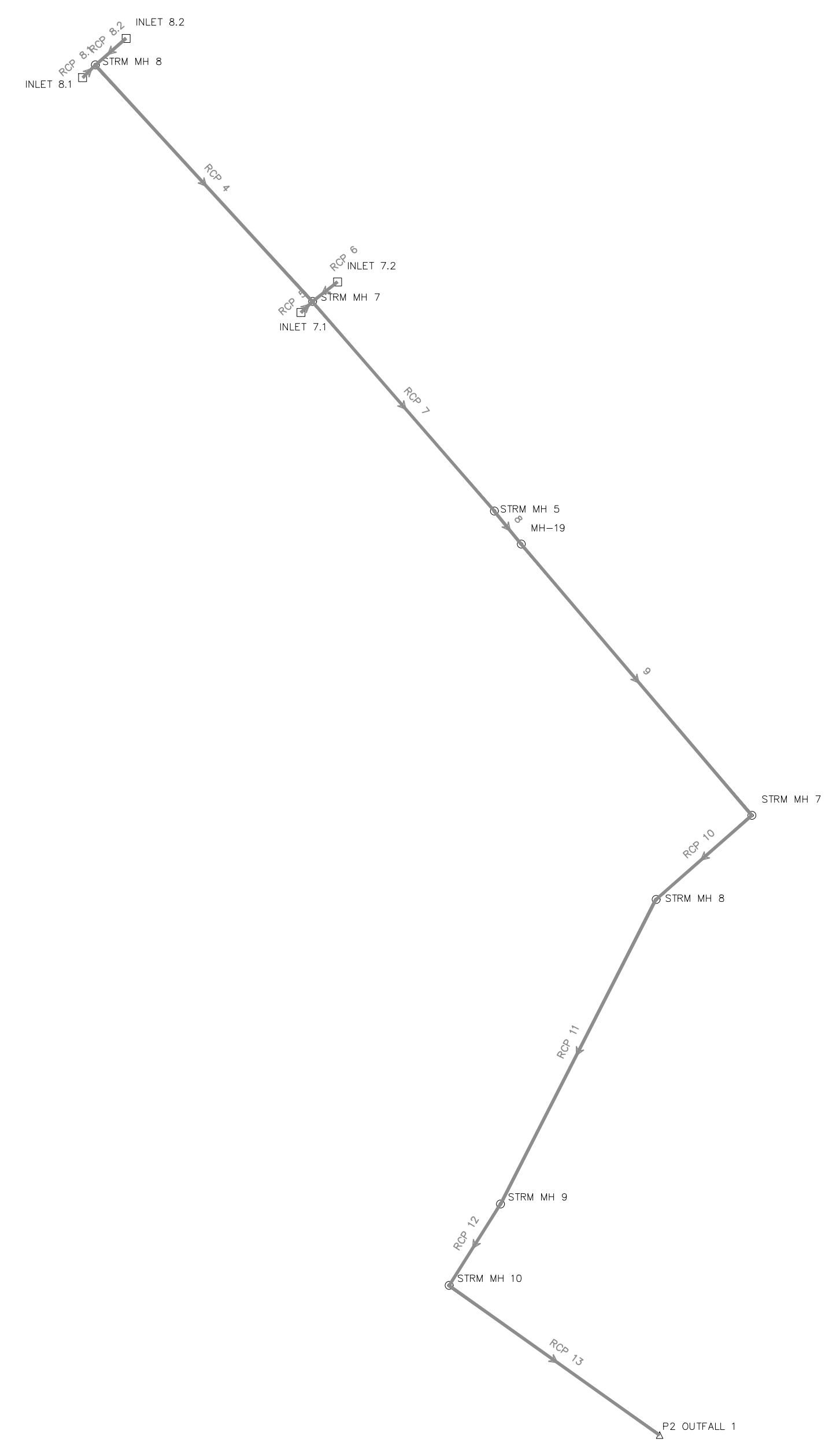
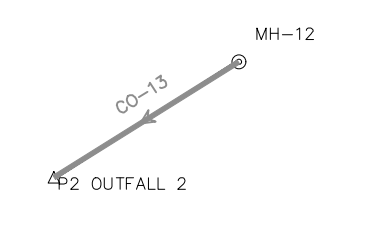
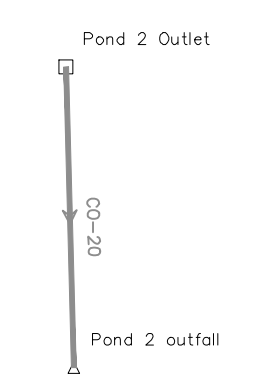
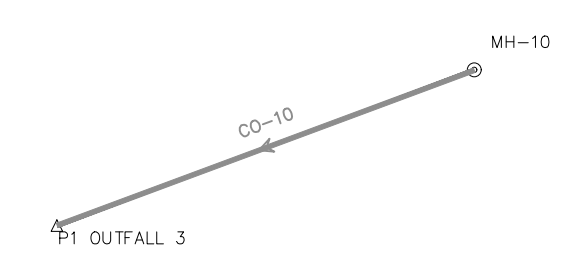
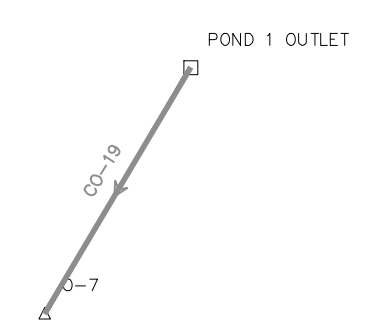
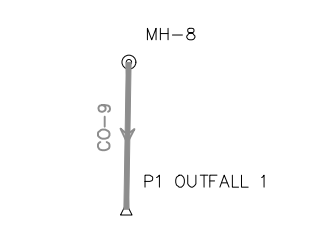
Wetted Perim (ft) = 3.60

Crit Depth, Y_c (ft) = 0.31

Top Width (ft) = 3.00

EGL (ft) = 0.45





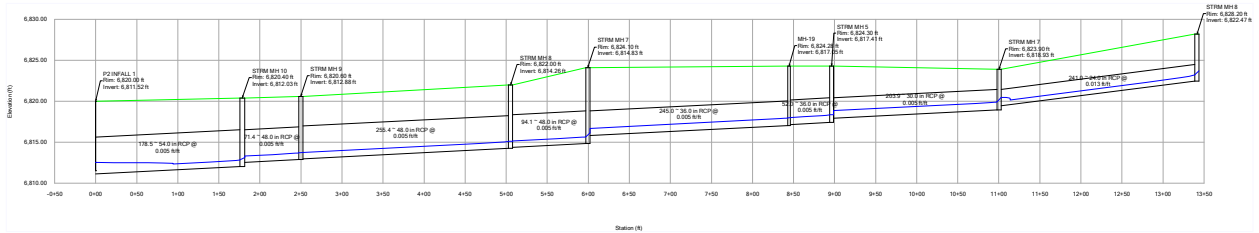
FlexTable: Conduit Table
Active Scenario: 5-year

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	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

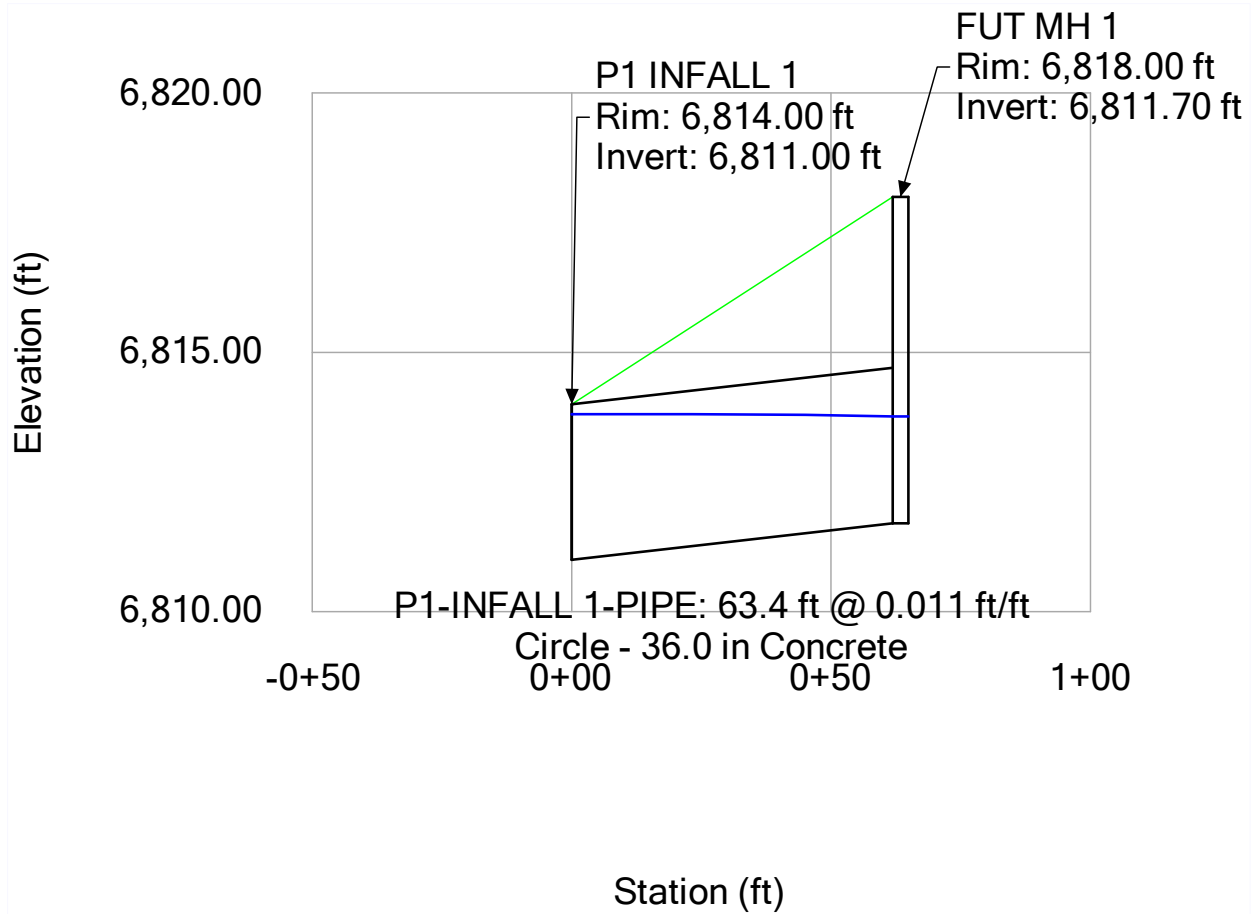
Engineering Profile - STORM RUN 1 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year



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

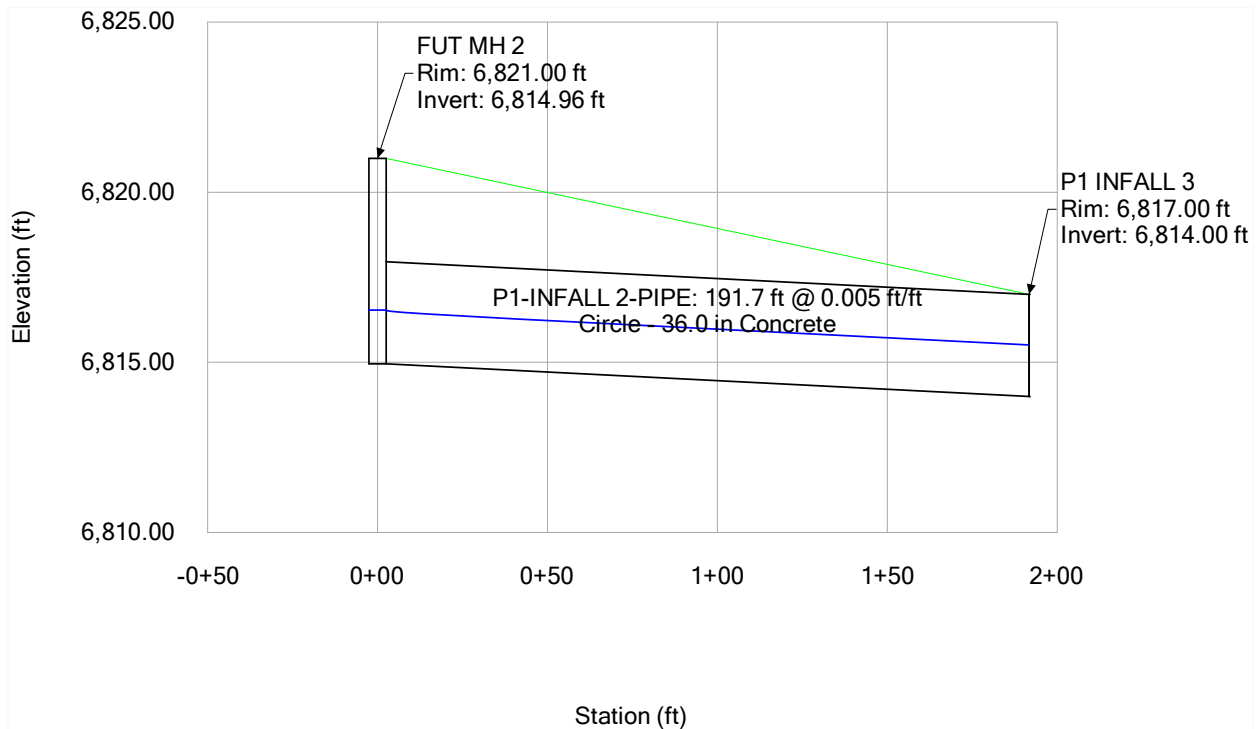
Active Scenario: 5-year



Profile Report

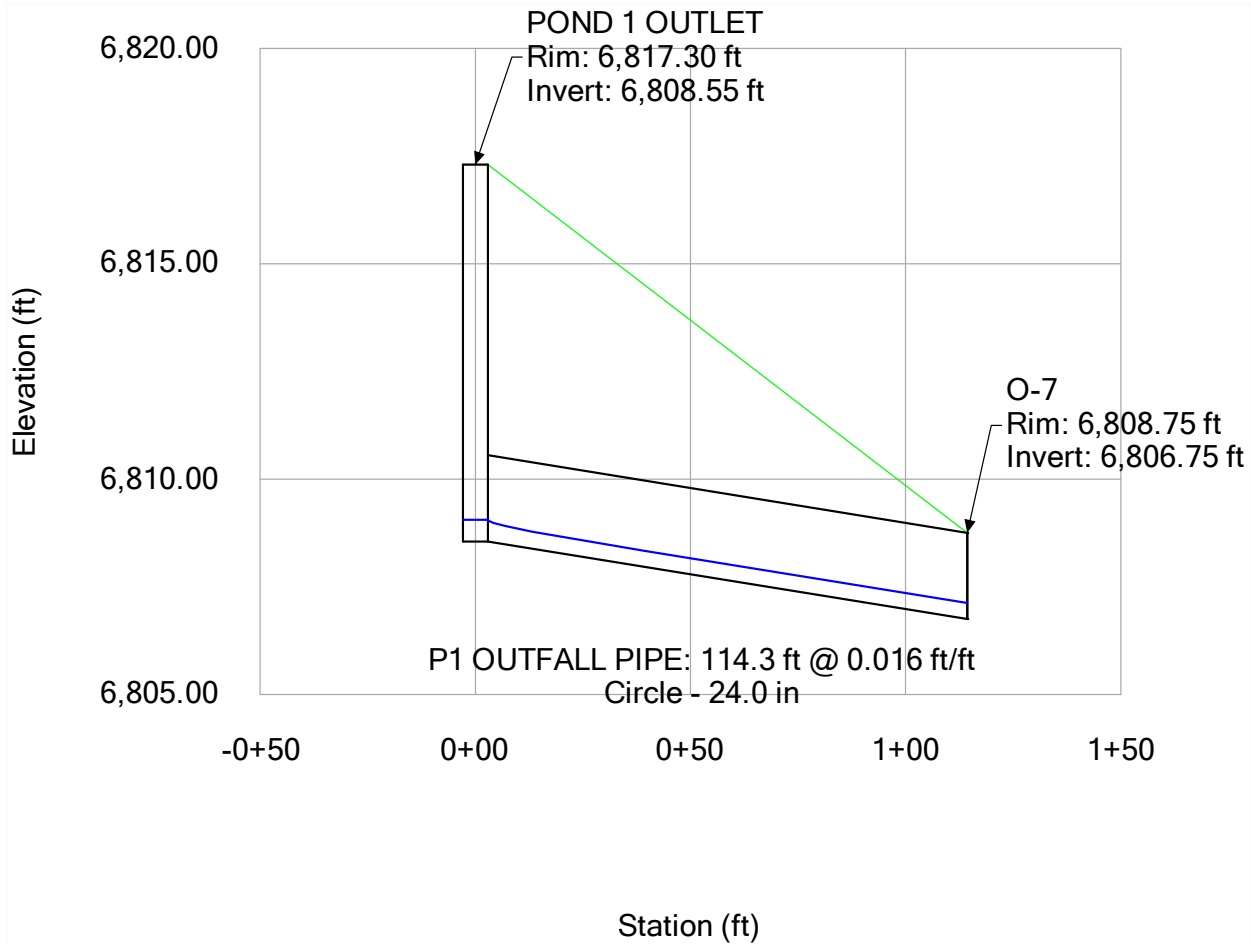
Engineering Profile - POND 1-INLET 2 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year



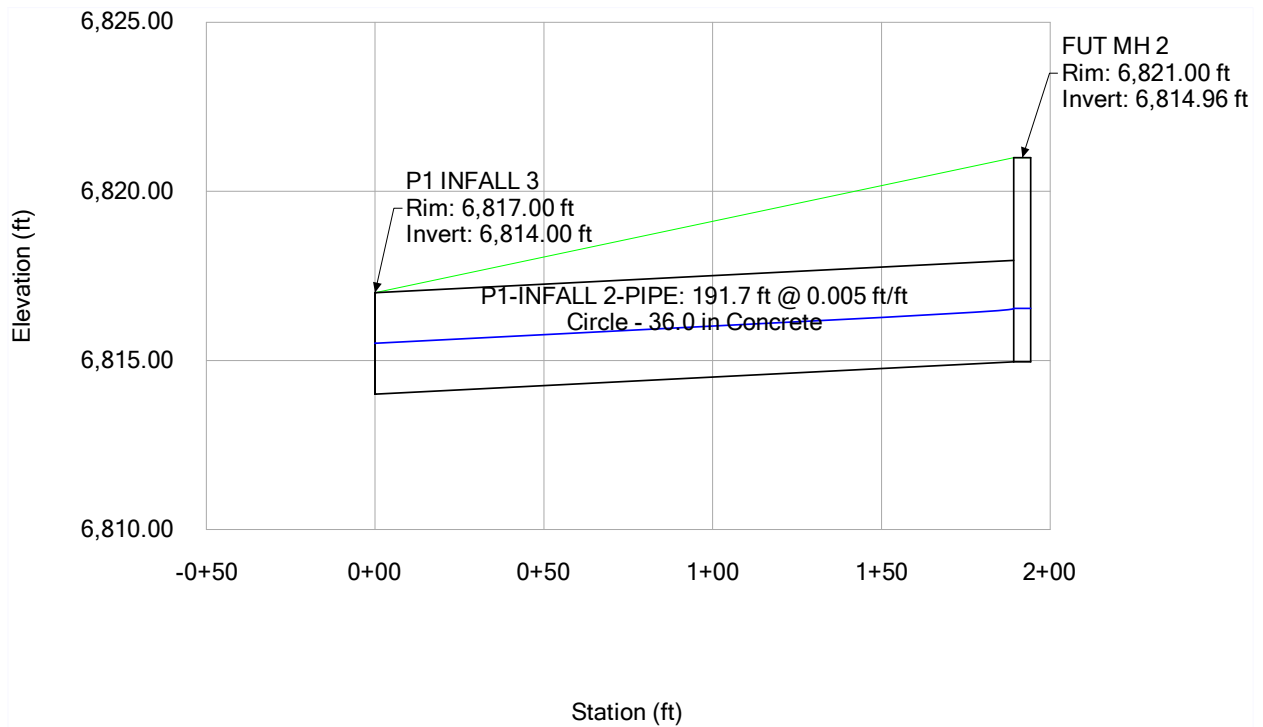
Profile Report
Engineering Profile - POND 1 OUTFALL (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year



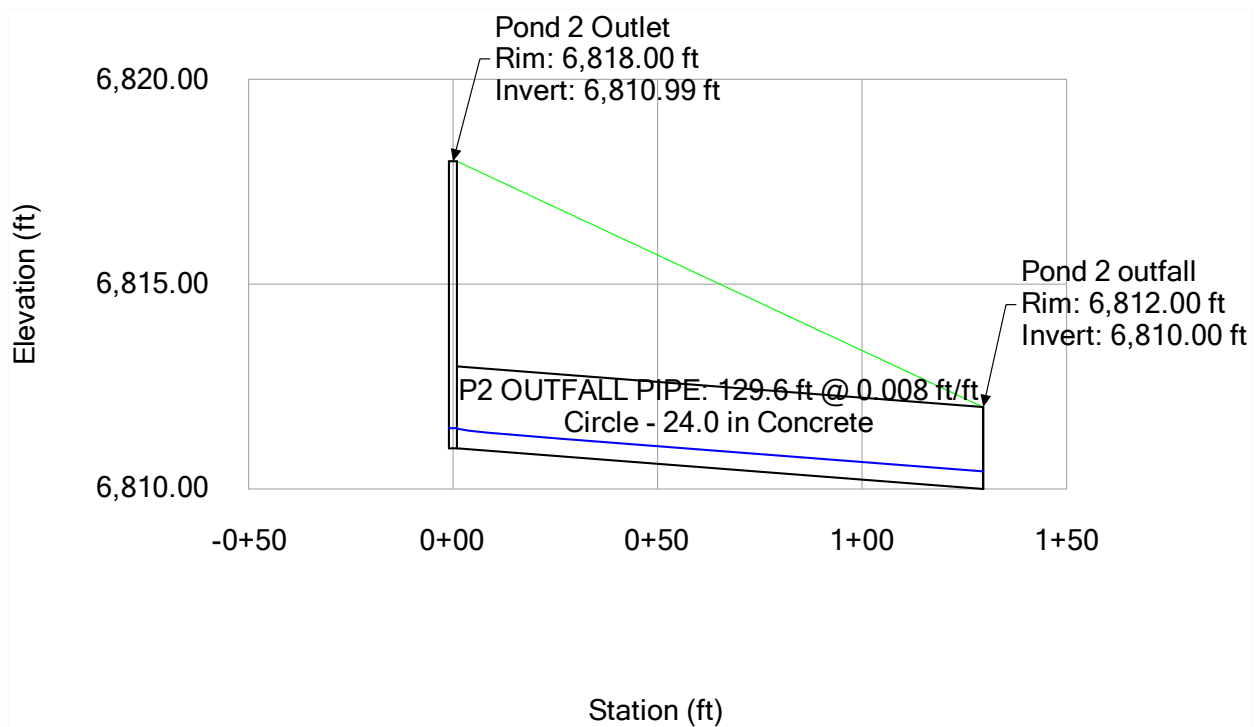
Profile Report
Engineering Profile - pond 2 inlet 2 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year



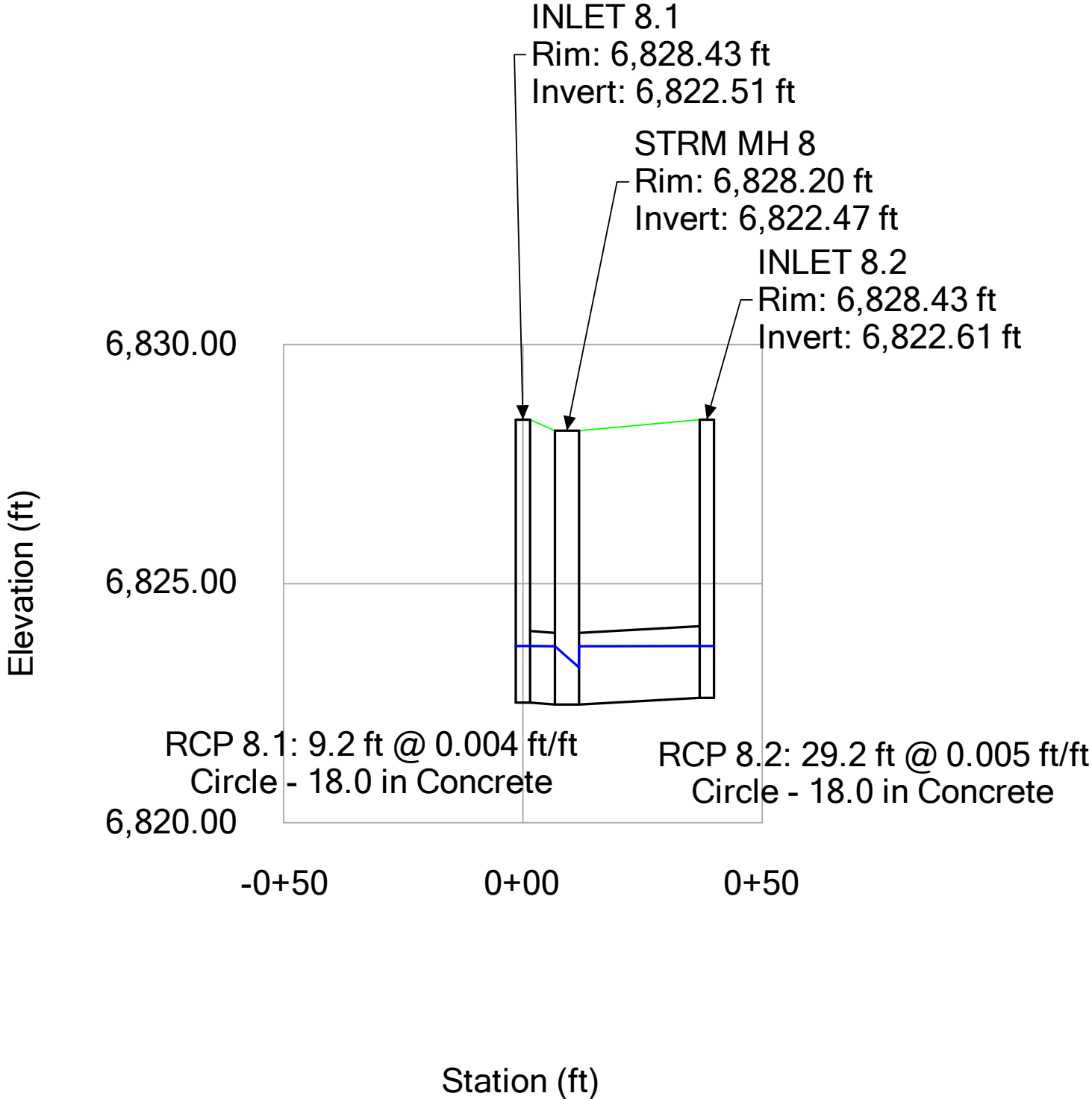
Profile Report
Engineering Profile - pond 2 outfall (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year

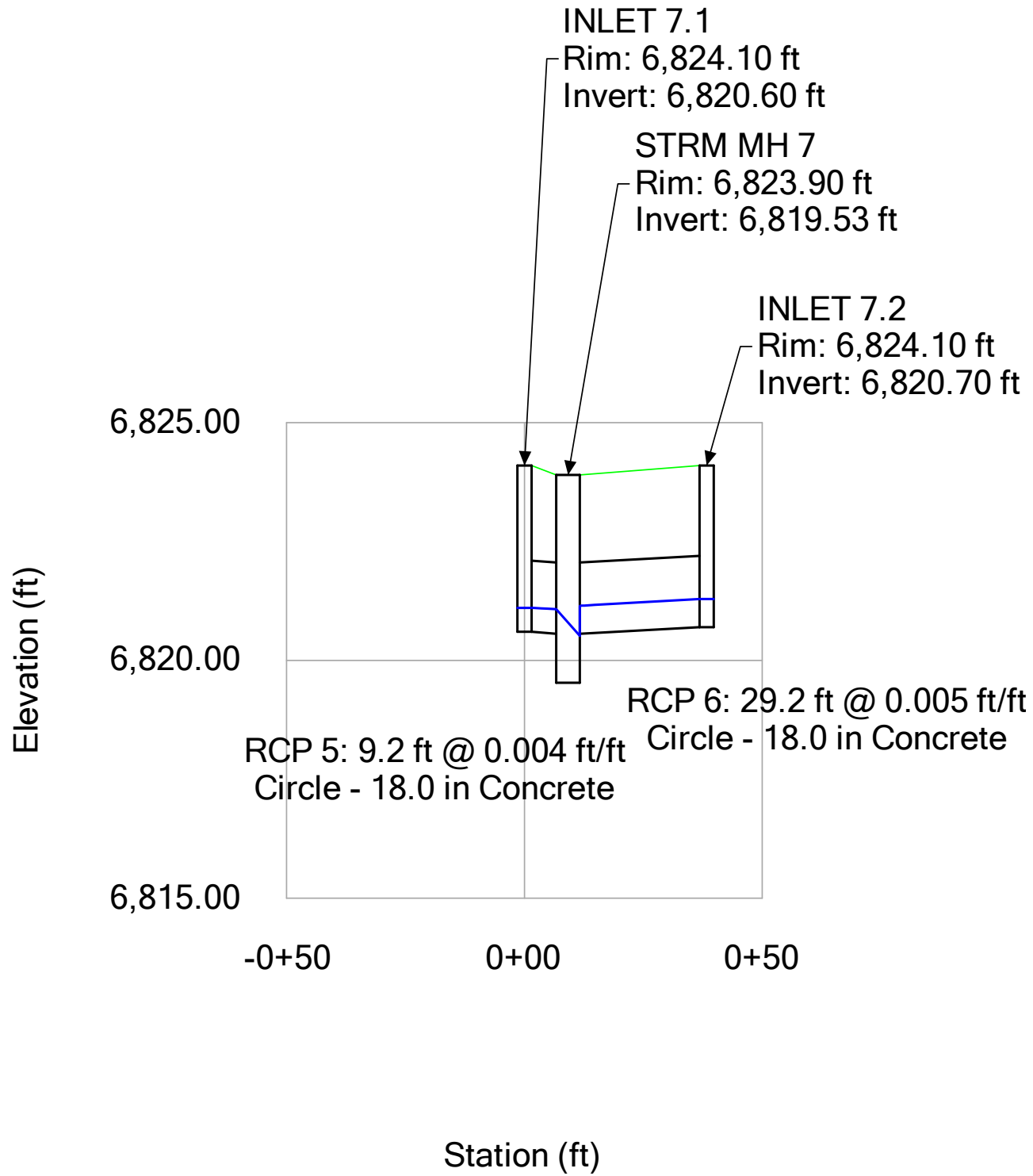


Profile Report
Engineering Profile - STORM RUN 1.1 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 5-year



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



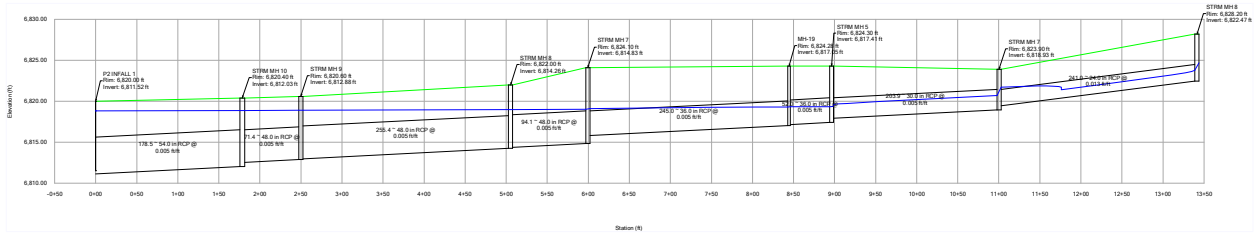
FlexTable: Conduit Table
Active Scenario: 100-year

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

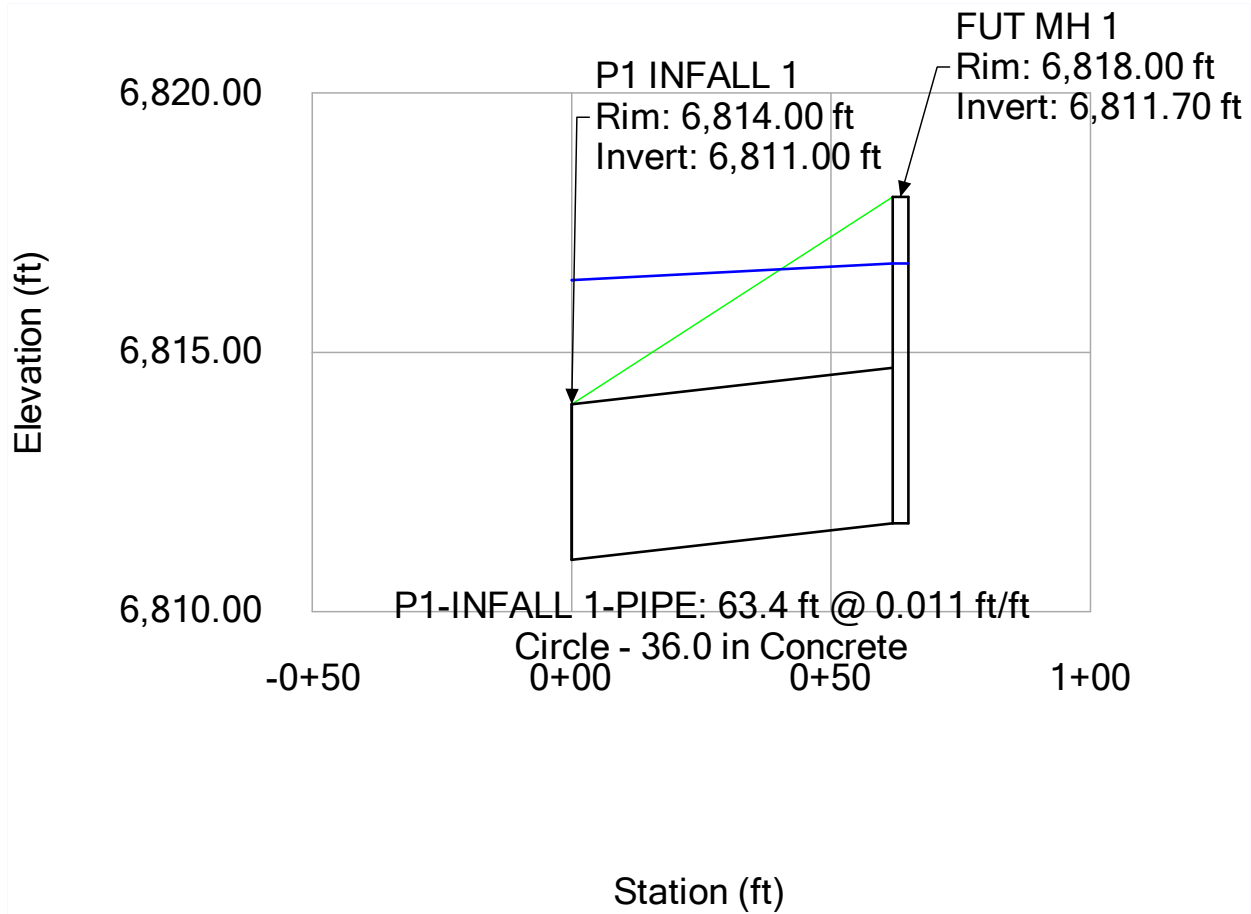
Engineering Profile - STORM RUN 1 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



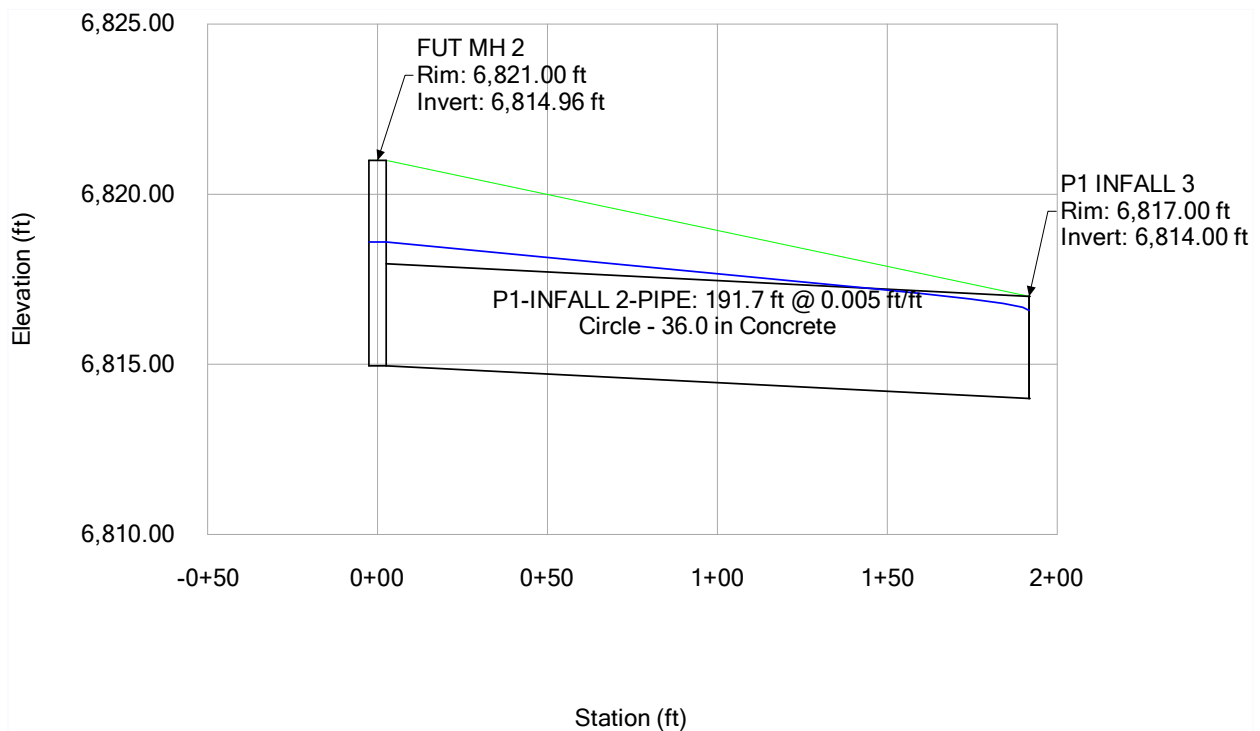
Profile Report
Engineering Profile - POND 1-INLET 1 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



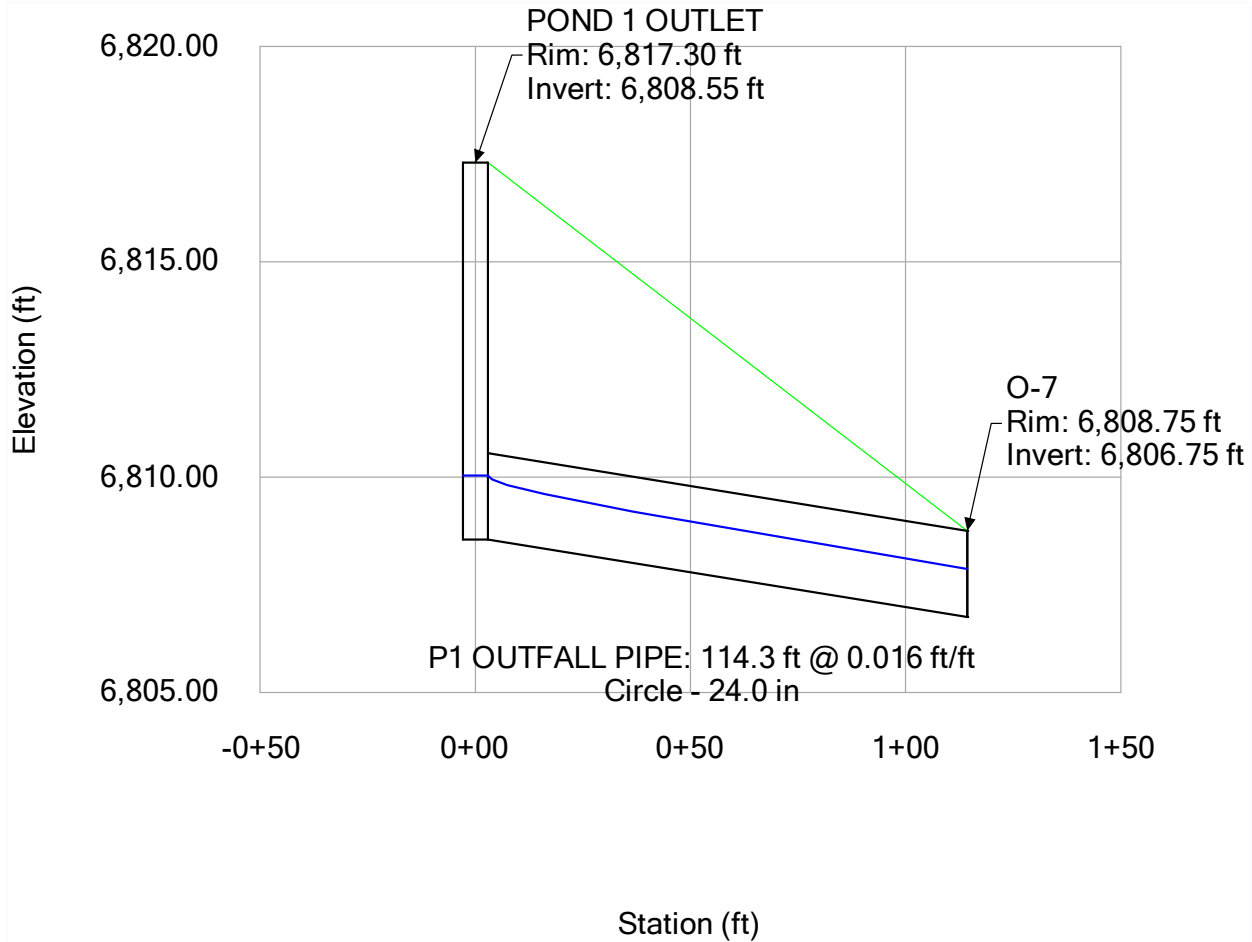
Profile Report
Engineering Profile - POND 1-INLET 2 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



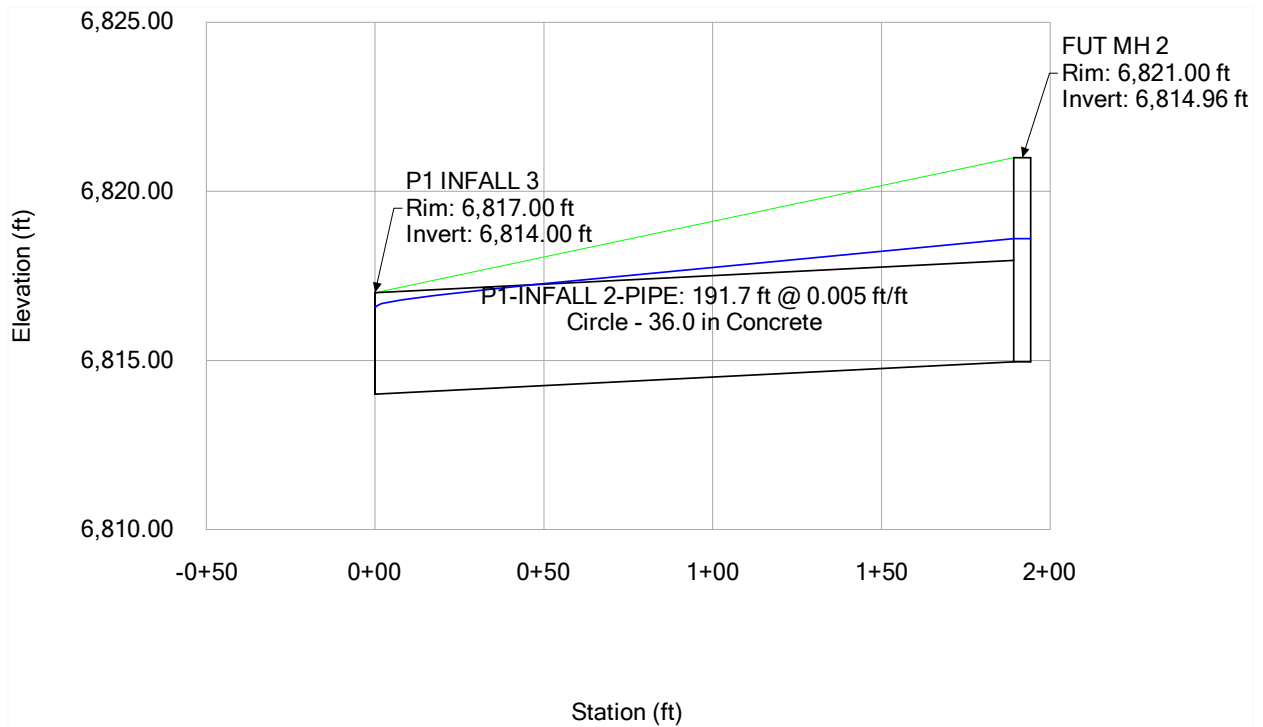
Profile Report
Engineering Profile - POND 1 OUTFALL (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



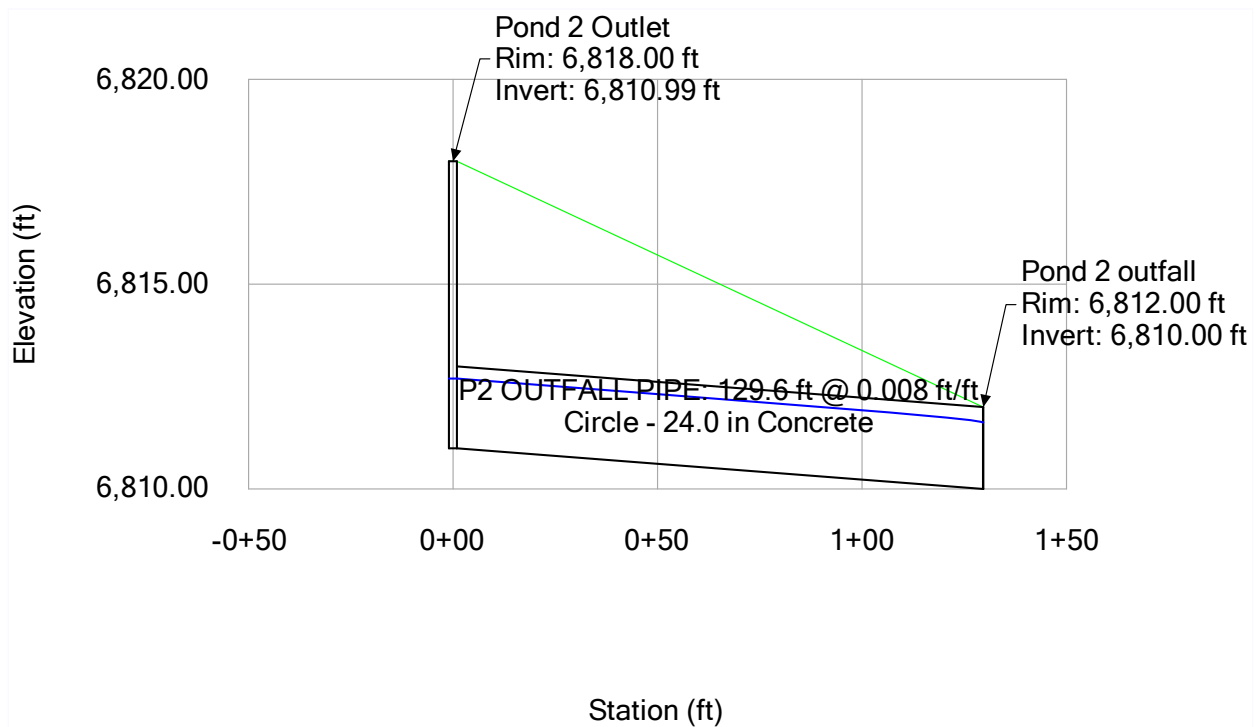
Profile Report
Engineering Profile - pond 2 inlet 2 (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



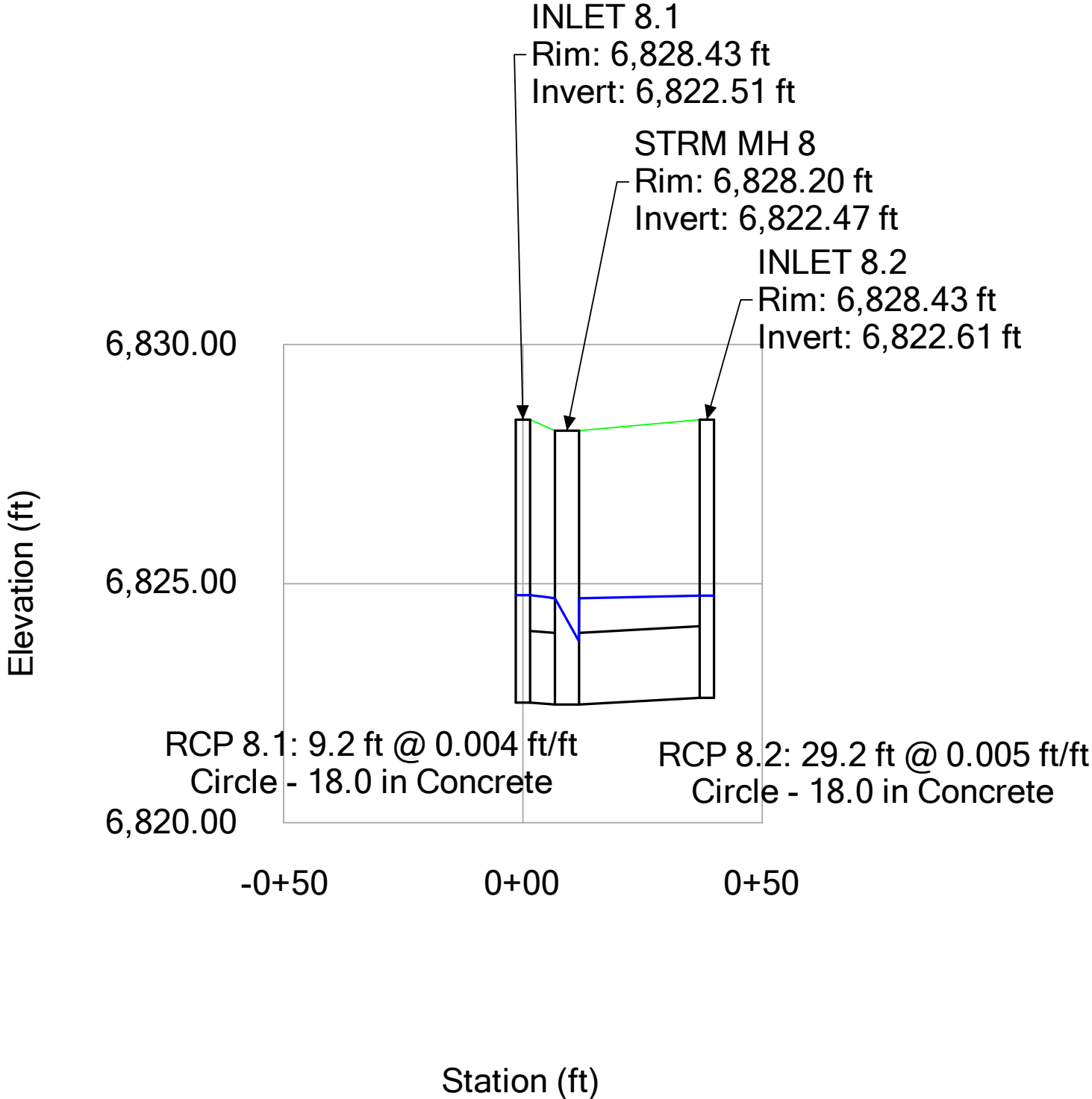
Profile Report
Engineering Profile - pond 2 outfall (24004308-StormCAD-2024-12-11.stsw)

Active Scenario: 100-year



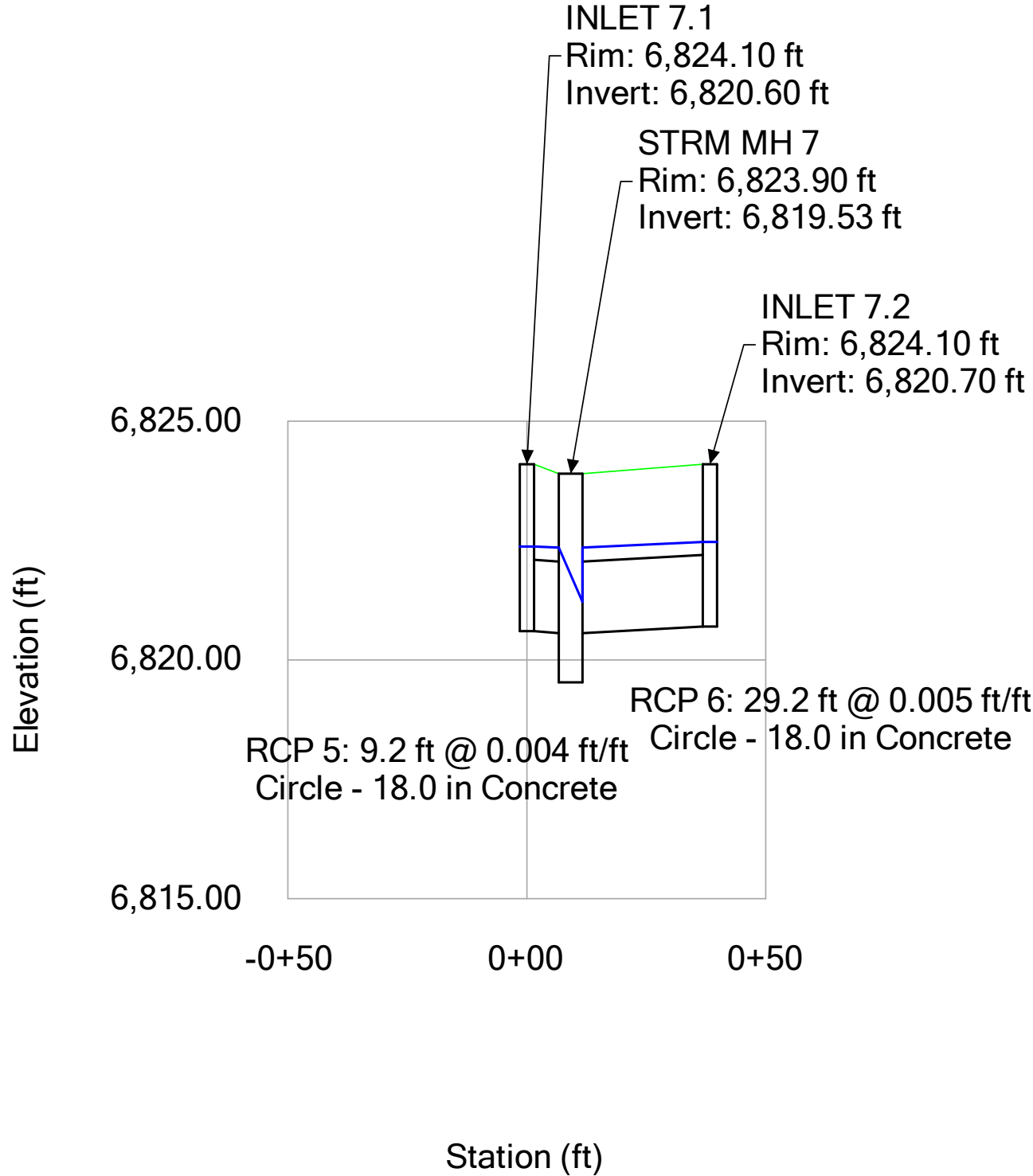
Profile Report
Engineering Profile - STORM RUN 1.1 (24004308-StormCAD-2024-12-11.stsw)

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

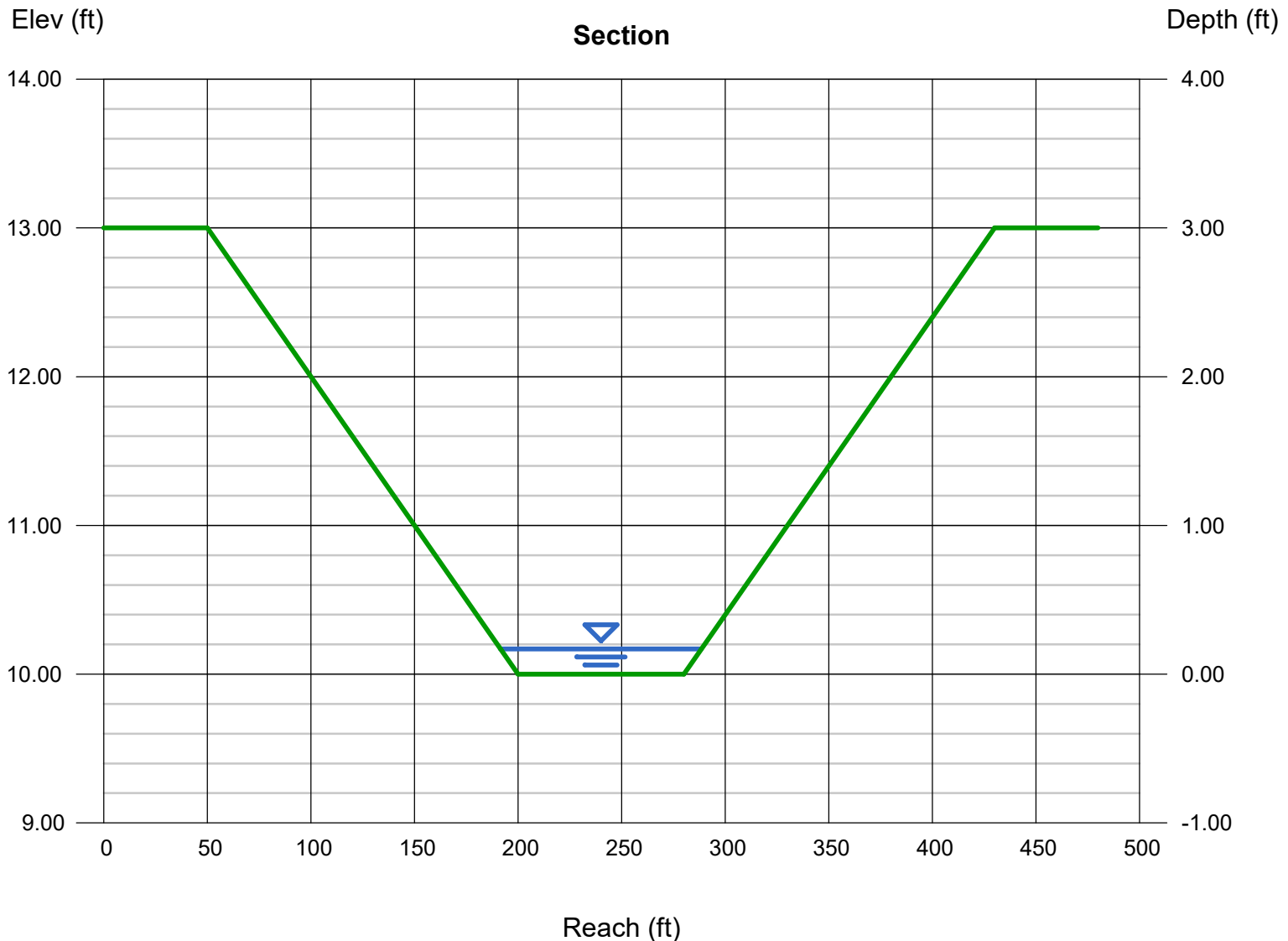
Bottom Width (ft) = 80.00
Side Slopes (z:1) = 50.00, 50.00
Total Depth (ft) = 3.00
Invert Elev (ft) = 10.00
Slope (%) = 1.00
N-Value = 0.030

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

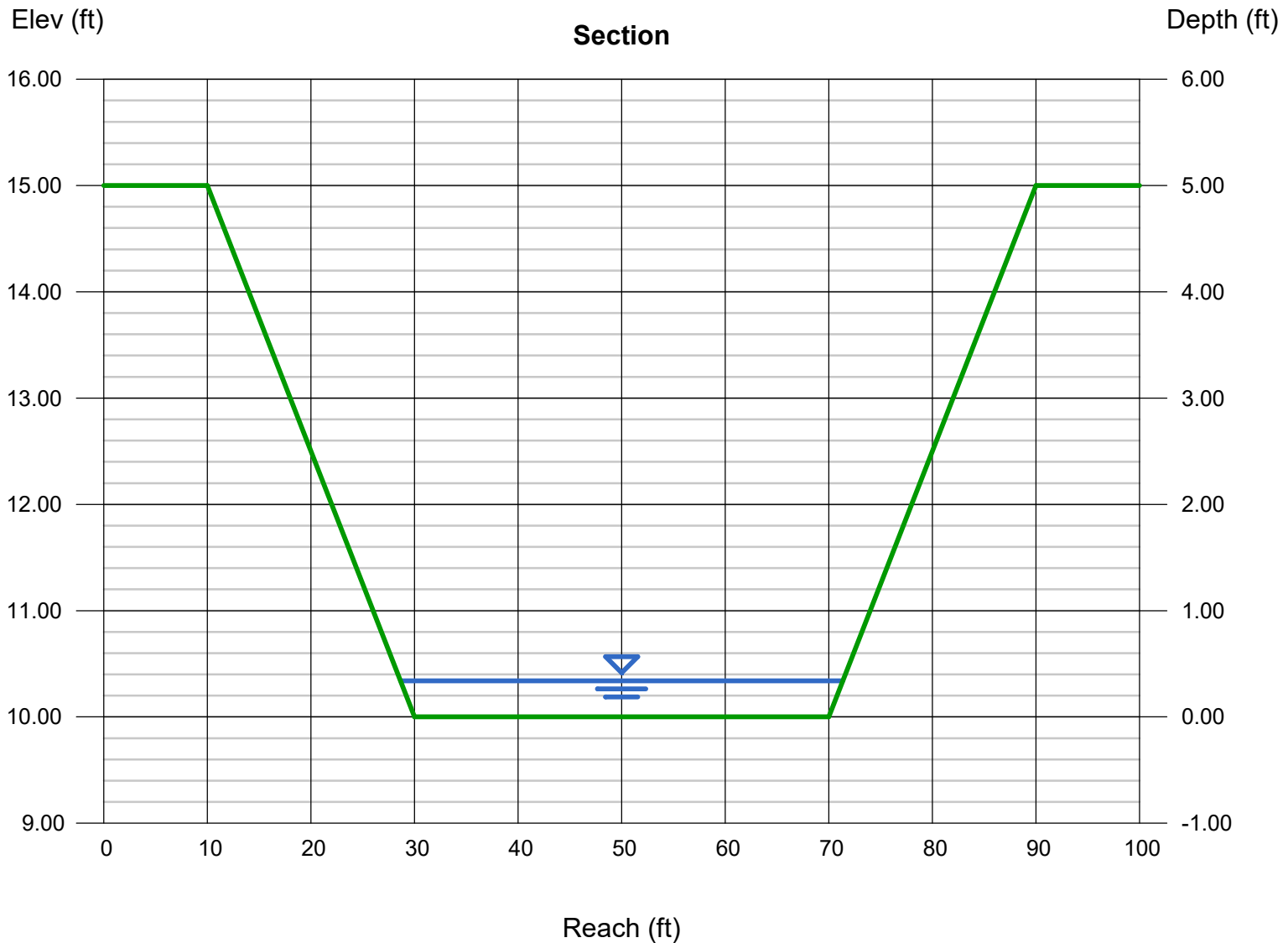
Bottom Width (ft) = 40.00
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 5.00
Invert Elev (ft) = 10.00
Slope (%) = 1.00
N-Value = 0.030

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
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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	--	

Type.... C and Area
Name.... BASIN B, OS-1&2 Tag: POST

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

RATIONAL C COEFFICIENT DATA

.....

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

.....

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
6812.00	.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.						

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	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	

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)

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
6812.00	.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
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
6813.50	26.21	6813.50	6813.50	6813.50	.000	.000	Free	Outfall
6814.00	27.46	6814.00	6814.00	6814.00	.000	.000	Free	Outfall
6814.50	28.65	6814.50	6814.50	6814.50	.000	.000	Free	Outfall
6814.61	28.91	6814.61	6814.61	6814.61	.000	.000	Free	Outfall
6815.00	29.80	6815.00	6815.00	6815.00	.000	.000	Free	Outfall
6815.50	30.90	6815.50	6815.50	6815.50	.000	.000	Free	Outfall
6816.00	31.97	6816.00	6816.00	6816.00	.000	.000	Free	Outfall
6816.50	33.00	6816.50	6816.50	6816.50	.000	.000	Free	Outfall
6817.00	34.00	6817.00	6817.00	6817.00	.000	.000	Free	Outfall
6817.50	34.97	6817.50	6817.50	6817.50	.000	.000	Free	Outfall
6818.00	35.92	6818.00	6818.00	6818.00	.000	.000	Free	Outfall

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	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

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

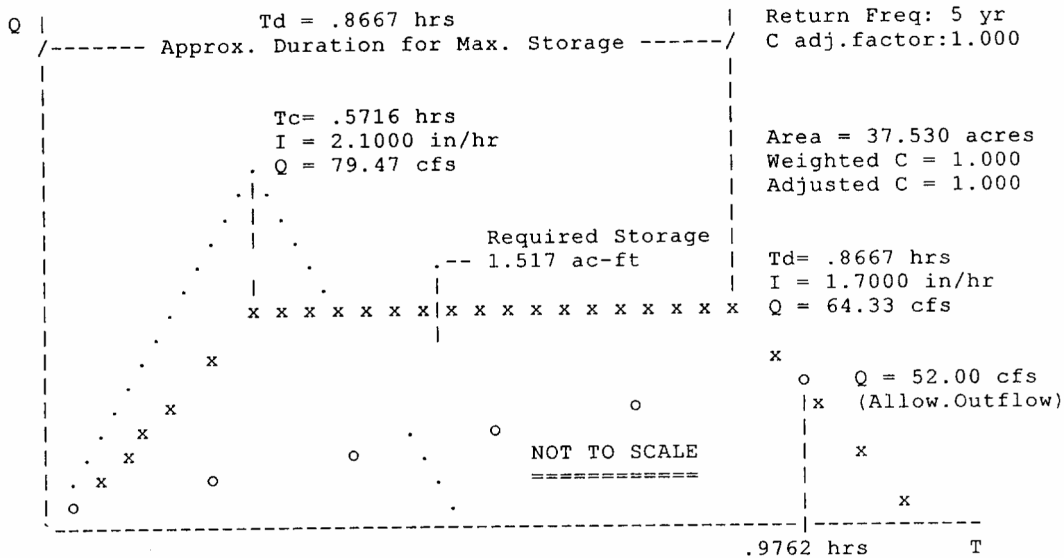
Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

MODIFIED RATIONAL METHOD
 ---- Graphical Summary for Maximum Required Storage ----
 Method I

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

```

*****
* 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
*****
  
```



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			

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.						

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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
6812.50	.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						

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

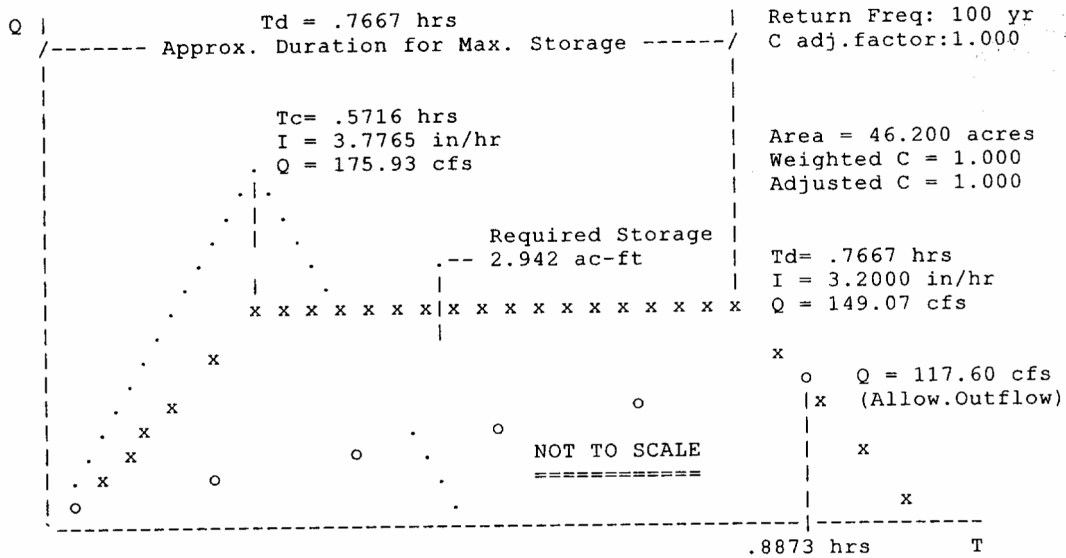
Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

MODIFIED RATIONAL METHOD
 ---- Graphical Summary for Maximum Required Storage ----
 Method I

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

```

*****
* 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 *
*****
  
```



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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		

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
6813.00	14.42	6813.00	Free	6810.12	.000	.000	Free	Outfall
6813.50	33.69	6813.50	Free	6811.09	.000	.000	Free	Outfall
6814.00	41.26	6814.00	Free	6811.42	.000	.000	Free	Outfall
6814.26	44.69	6814.26	Free	6811.57	.000	.000	Free	Outfall
6814.50	47.65	6814.50	Free	6811.69	.000	.000	Free	Outfall
6815.00	53.27	6815.00	Free	6811.90	.000	.000	Free	Outfall
6815.50	58.35	6815.50	Free	6812.26	.000	.000	Free	Outfall
6816.00	96.78	6816.00	6816.00	6816.00	.000	.000	Free	Outfall
6816.50	100.81	6816.50	6816.50	6816.50	.000	.000	Free	Outfall
6817.00	104.69	6817.00	6817.00	6817.00	.000	.000	Free	Outfall
6817.50	108.43	6817.50	6817.50	6817.50	.000	.000	Free	Outfall
6818.00	112.05	6818.00	6818.00	6818.00	.000	.000	Free	Outfall

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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
6812.50	.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

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

GENERAL NOTES:

ALL DRAINAGE CONSTRUCTION SHALL MEET THE SPECIFICATIONS OF THE CITY OF COLORADO SPRINGS AND EL PASO COUNTY CRITERIA MANUAL. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE NOTIFICATION AND FIELD LOCATION OF ALL EXISTING UTILITIES WHETHER SHOWN ON PLANS OR NOT, BEFORE BEGINNING CONSTRUCTION. LOCATION OF EXISTING UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO ACTUAL CONSTRUCTION. THE CONTRACTOR SHALL HAVE ONE (1) SIGNED COPY OF THESE APPROVED PLANS AND (1) COPY OF THE APPROPRIATE DESIGN AND CONSTRUCTION STANDARDS AND SPECIFICATION AT THE JOB SITE AT ALL TIMES. THE STATE OF COLORADO SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION. B. EL PASO COUNTY ENGINEERING CRITERIA MANUAL & WOODMEN HILLS METRO DISTRICT STANDARDS. C. CITY OF COLORADO SPRINGS/EL PASO COUNTY DRAINAGE CRITERIA MANUAL. D. CITY OF COLORADO SPRINGS WATER & WASTEWATER STANDARD SPECIFICATIONS. ALL DISTURBED AREAS SHALL BE RESTORED TO ORIGINAL GRADE WITHIN 30 DAYS FOLLOWING THE ESTABLISHMENT OF FINAL GRADE. AREAS TO RECEIVE PAVEMENT DURING THE CONSTRUCTION OF THE ROAD SYSTEM SHALL NOT RECEIVE ANY SEEDING. SEEDING SHOULD BE ACCOMPLISHED USING AN APPROPRIATE SEEDING METHOD SUCH AS BROADCASTING OR HYDROMULCHING. IF SEEDING BY THE BROADCAST METHOD IS SELECTED THE APPLICATION RATE SHOULD BE DOUBLED. IF HYDROMULCHING IS SELECTED TWO (2) OPERATIONS SHOULD BE CONSIDERED. APPLYING THE SEED FIRST AND THE MULCH IN A SECOND OPERATION. UPON COMPLETION OF THE SEEDING OPERATION THE SITE SHOULD BE COVERED WITH WEED FREE MULCH AT A RATE OF 4,000 LBS. PER ACRE. BELOW IS THE ACCEPTED GRASS MIX FOR COLORADO SPRINGS:

UNDERDRAIN NOTE:

THE FINAL UNDERDRAIN SIZE AND TYPE SHALL BE APPROVED BY THE THE GEOTECH ENGINEER PRIOR TO INSTALLATION

BASIS OF BEARING:

BEARINGS ARE BASED ON THE NORTH LINE OF THE NW 1/4 OF SECTION 12, T13S, R69W MONUMENTED ON EACH SIDE WITH A 1/2" METAL CAP LS # 17686 AND ASSUMED TO BEAR 8894°50'E

BENCHMARKS:

INTERSECTION OF WOODMEN RD AND MERIDIAN RD AT SW CORNER (BRASS CAP W/ NO. GP-9 ELEVATION = 6974.00)

GRADING GENERAL NOTES:

- IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE AND LOCATION OF ALL UNDERGROUND UTILITIES ALONG THE SITE. THE QUESTION OF THE INCLUSION OF UTILITY LOCATIONS ON THE PLAN IS NOT TO BE CONSIDERED AS THE NONEXISTENCE OF OR A DEFINITE LOCATION OF EXISTING UNDERGROUND UTILITIES.
- THE CONTRACTOR WILL TAKE THE NECESSARY PRECAUTIONS TO PROTECT EXISTING UTILITIES, BUILDINGS, FENCES, AND ROADWAYS FROM DAMAGE DUE TO THIS OPERATION. ANY DAMAGE TO THE ABOVE WILL BE REPAIRED AT THE CONTRACTOR'S EXPENSE, AND ANY SERVICE DISRUPTION WILL BE SETTLED BY THE CONTRACTOR.
- GRADING SHALL BE COMPLETED TO A SUBGRADE TOLERANCE OF PLUS OR MINUS 0.1".
- CONTRACTOR TO OBTAIN COPIES OF THE SOILS REPORT FROM THE GEOTECHNICAL ENGINEER AND BE KEPT ON SITE DURING ALL EARTHWORK OPERATIONS.
- MAXIMUM CUT/FILL SLOPES SHALL NOT EXCEED 3:1, UNLESS OTHERWISE NOTED.
- HEAVY EQUIPMENT SHALL NOT CROSS TAMLIN ROAD.
- REGIONAL FLOW/TAMLIN ROAD GRADING SHALL NOT OCCUR AS PART OF THIS PLAN.
- ALL PROPOSED MODIFICATIONS TO THE APPROVED GRADING AND EROSION CONTROL PLANS MUST BE SUBMITTED ALONG WITH SUPPORTING MATERIALS TO THE ENGINEERING DIVISION. NO WORK IN CONNECTION WITH THE PROPOSED MODIFICATIONS SHALL BE PERMITTED WITHOUT PRIOR APPROVAL. APPROVAL FOR WHICH MAY BE ISSUED IF THE APPLICANT CAN DEMONSTRATE THAT SUCH MODIFICATIONS WILL NOT CAUSE ADVERSE EFFECTS TO THE ENVIRONMENT, TO OTHER THAN THAT OF THE ORIGINALLY APPROVED SOIL DISTURBANCE PLANS.
- ANY AREA TO BE LEFT DORMANT FOR LONGER THAN 21 DAYS WILL NEED TO BE RESEED PER COUNTY CRITERIA. SEE NOTE CRITERIA.
- COUNTY CRITERIA FOR SEEDING.

NATIVE SEEDING

Soil preparation, fertilizer, seeding, mulching and mulch topdressing will be required for an estimated 14 acres of disturbed area within the right-of-way limits which are not surfaced. The following type and rates shall be used:

COMMON NAME	VARIETY	LBS PLS/ACRE
SIDEOTS GAMMA	EL RENO	3.0
WESTERN WHEATGRASS	BARTON	2.0
BLENDER WHEATGRASS	NATIVE	2.0
LITTLE BLUESTEM	PASTURA	2.0
SAND DROPS	NATIVE	0.8
SWITCH GRASS	NEBRASKA 28	3.0
KEEPING LOVE GRASS	MORPHA	1.0
TOTAL		14.0

- PRECONSTRUCTION MEETING REQUIRED PRIOR TO ANY CONSTRUCTION.
- CONTRACTOR SHALL HAVE A COPY OF ENTECH, INC.'S SOILS REPORTS - NO. 39451 ON SITE. MITIGATION MEASURES ARE REQUIRED FOR THIS SITE. SEE ENTECH REPORT.
- SWELLING SOILS OR MODERATE TO HIGH PLASTIC SOILS ARE NOT TO BE PLACED WITHIN UPPER TWO FEET OF THE ROADWAY AND SIDEWALK/SUBGRADE.
- GRADING ALLOWED UNDER THIS PLAN SHALL INCLUDE ONLY THE FOLLOWING: CLEARING, GRUBBING, EXCAVATION, EMBANKMENT AND GRADING FOR INSTALLATION OF DRAINAGE FACILITIES OR STRUCTURES ONLY WHEN SUCH ARE REQUIRED TO BE CONSTRUCTED AS PART OF THIS EARLY GRADING PLAN.
- IF OFFSITE GRADING BECOMES NECESSARY, OWNER SHALL OBTAIN ANY NECESSARY TEMPORARY CONSTRUCTION EASEMENTS.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY FEDERAL, STATE OR LOCAL PERMITS.
- THE CONTRACTOR SHALL ADHERE TO THE STORMWATER MANAGEMENT PLAN FOR THIS SITE.
- THE CONTRACTOR SHALL KEEP COPIES OF THE APPLICABLE COUNTY STANDARDS ON SITE AT ALL TIMES.

WOODMEN HILLS METROPOLITAN DISTRICT SANITARY SEWER NOTES:

- ALL UTILITY CONSTRUCTION TO BE CONDUCTED IN CONFORMANCE WITH THE CURRENT WOODMEN HILLS METROPOLITAN DISTRICT SPECIFICATIONS. COMPACTOR REQUIREMENTS SHALL BE 90% STANDARD PROCTOR AS DETERMINED BY ASTM D998, UNLESS OTHERWISE APPROVED BY THE WOODMEN HILLS METROPOLITAN DISTRICT OR A HIGHER STANDARD IS IMPOSED BY ANOTHER AGENCY HAVING RIGHT-OF-WAY JURISDICTION.
- ALL MATERIALS AND WORKMANSHIP SHALL BE SUBJECT TO INSPECTION BY THE WOODMEN HILLS METROPOLITAN DISTRICT. THE WOODMEN HILLS METROPOLITAN DISTRICT RESERVES THE RIGHT TO ACCEPT OR REJECT ANY SUCH MATERIALS AND WORKMANSHIP THAT DOES NOT CONFORM TO ITS STANDARDS AND SPECIFICATIONS.
- ALL MAINS SHALL BE INSTALLED WITH COATED NO. 12 COATED TRACER WIRE. TRACER WIRE ACCESS POINT SHALL BE LOCATED A MAXIMUM OF 500 FEET APART.
- THE CONTRACTOR IS REQUIRED TO NOTIFY THE WOODMEN HILLS METROPOLITAN DISTRICT (485-2500) A MINIMUM OF 48 HOURS AND A MAXIMUM OF 96 HOURS PRIOR TO THE START OF CONSTRUCTION. THE CONTRACTOR SHALL ALSO NOTIFY AFFILIATED UTILITY COMPANIES 48 HOURS PRIOR TO CONSTRUCTION ADJACENT TO THE KNOWN UTILITY LOCATIONS.
- THE LOCATION OF ALL UTILITIES AS SHOWN ON THESE DRAWINGS ARE APPROXIMATE ONLY. THE LOCATION OF ALL UTILITIES SHALL BE VERIFIED PRIOR TO CONSTRUCTION BY THE CONTRACTOR.
- THE CONTRACTOR SHALL FIELD EXCAVATE AND VERIFY THE VERTICAL AND HORIZONTAL LOCATION OF ALL "IN-TENS. CONSTRUCTION SHALL NOTIFY THE WOODMEN HILLS METROPOLITAN DISTRICT AND THE ENGINEER OF THE FIELD VERIFIED PRIOR TO CONSTRUCTION.
- ALL BENDS SHALL BE FIELD STAKED PRIOR TO CONSTRUCTION.
- THE CONTRACTOR SHALL AT HIS EXPENSE SUPPORT AND PROTECT ALL UTILITY MAINS SO THAT THEY WILL FUNCTION CONTINUOUSLY DURING CONSTRUCTION. SHOULD A UTILITY MAIN FAIL AS A RESULT OF THE CONTRACTOR'S OPERATION, IT WILL BE REPLACED IMMEDIATELY BY EITHER THE CONTRACTOR OR THE WOODMEN HILLS METROPOLITAN DISTRICT AT FULL COST OF LABOR AND MATERIALS TO THE CONTRACTOR.
- ANY PUMPING OR BYPASS OPERATIONS MUST BE REVIEWED AND APPROVED PRIOR TO EXECUTION BY BOTH THE WOODMEN HILLS METROPOLITAN DISTRICT AND THE ENGINEER.
- CONTRACTOR MUST REPLACE OR REPAIR ANY DAMAGE TO ALL SURFACE IMPROVEMENTS, INCLUDING BUT NOT LIMITED TO FENCES, CURB AND GUTTER AND/OR ASPHALT THAT MAY BE CAUSED DURING CONSTRUCTION.
- ALL SEWER LINES 18" AND LARGER, SHALL HAVE "AS-BUILT" PLANS PREPARED AND APPROVED PRIOR TO FINAL ACCEPTANCE BY THE WOODMEN HILLS METROPOLITAN DISTRICT.
- PRIOR TO CONSTRUCTION OF ANY CONSTRUCTION, THE CONTRACTOR SHALL OBTAIN A MINIMUM OF 48 HOURS IN ADVANCE OF COMMENCEMENT OF WORK, A REPRESENTATIVE OF THE OWNER OR DEVELOPER, A REPRESENTATIVE OF THE CONTRACTOR AND DESIGN ENGINEER ARE REQUIRED TO ATTEND TO SET THE PRE-CONSTRUCTION CONFERENCE. CONTACT TIM HUNKER (485-2500) OF THE WOODMEN HILLS METROPOLITAN DISTRICT FOR A TIME. NO PRE-CONSTRUCTION CONFERENCE TIMES WILL BE SET UNTIL 4 SETS OF SIGNED DRAWINGS ARE RECEIVED BY THE WOODMEN HILLS METROPOLITAN DISTRICT.

SOIL TYPES:

INSITE SOILS ARE TYPE "A", BLAKELAND LOAMY SOIL "B", BLAKELAND COMPLEX "C" AND A SMALL PORTION IS COLUMBIUM "D" PER SCS SOILS MAP

NOTE:

AT LEAST 10 DAYS PRIOR TO THE ANTICIPATED START OF CONSTRUCTION, FOR PROJECTS THAT WILL DISTURB 1 ACRE OR MORE, THE OWNER OR OPERATOR OF THE CONSTRUCTION ACTIVITY SHALL SUBMIT A PERMIT APPLICATION FOR STORMWATER DISCHARGE TO THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT. WATER QUALITY CONTROL DIVISION. THE APPLICATION CONTAINS CERTIFICATION OF COMPLETION OF A GRADING STORMWATER MANAGEMENT PLAN (SWMP), OF WHICH THIS GRADING AND EROSION CONTROL PLAN MAY BE A PART. FOR INFORMATION OR APPLICATION FOR A PERMIT, CONTACT:

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, WATER QUALITY CONTROL DIVISION, 1000-PERMITS, 300 CHERRY CREEK DRIVE SOUTH, DENVER, CO 80248-1530, WWW.PERMITS.UIT

88 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS 1-800-922-1987 CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

FALCON HIGHLANDS FILING NO. 2

COUNTY OF EL PASO

CONSTRUCTION DRAWINGS

SEPTEMBER 2005

CONTACT INFORMATION:

OWNER: FALCON HIGHLANDS, LLC
25 N. TEJON STREET, SUITE 300
COLORADO SPRINGS, CO 80903
MR. MIKE SCOTT, (719) 227-1022

CIVIL ENGINEER: TERRA NOVA ENGINEERING, INC.
125 N. WASHATCH AVENUE
COLORADO SPRINGS, CO 80903
MR. QUENTIN N. ARMUJO, P.E. (719) 835-6422

COUNTY ENGINEERING: EL PASO COUNTY-DEVELOPMENT SERVICES
2880 INTERNATIONAL CIRCLE, SUITE 110
COLORADO SPRINGS, CO 80903
MS. JENNIFER E. POWELL, P.E. (719) 520-6952

WATER DISTRICT: FALCON HIGHLANDS METRO DISTRICT
24 N. TEJON STREET
COLORADO SPRINGS, CO 80903
MR. JOHN POPOVICH, (719) 243-4997

SANITATION DISTRICT: WOODMEN HILLS METRO DISTRICT
11720 WOODMEN HILLS DRIVE
FALCON, CO 80803
MR. TIM HUNKER, (719) 485-2500

ELECTRIC: MOUNTAIN VIEW ELECTRIC ASSOCIATION
11140 E. WOODMEN ROAD
FALCON, CO 80831
(719) 485-2283

GAS: AQUILA NATURAL GAS SERVICE DISTRICT
1-800-303-0752

TELEPHONE: EL PASO COUNTY TELEPHONE COMPANY
MR. MATT SEARLE, (719) 683-2501

FIRE DISTRICT: FALCON FIRE PROTECTION DISTRICT
7039 MERIDIAN ROAD
PEYTON, CO 80831
(719) 494-4050

APPROVALS:

DETAILED DRAINAGE CONSTRUCTION PLANS & SPECIFICATIONS ENGINEER'S STATEMENT:
THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE COUNTY FOR DETAILED STREET AND DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICIPATING AGENCIES (IF ANY) FACILITIES IS DESIGNED. I ACCEPT RESPONSIBILITY FOR LIABILITY CAUSED BY NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.

QUENTIN N. ARMUJO, COLORADO P.E. #37170
DATE: 10/24/05

WILLIAM E. LARBY, COLORADO P.E. #12415
DATE: 10/24/05

OWNER/DEVELOPER: TAMLIN VENTURES, LLC
25 N. TEJON STREET, SUITE 300
COLORADO SPRINGS, CO 80903
MR. MIKE SCOTT, (719) 227-1022

FALCON HIGHLANDS METRO DISTRICT
GREGORY W. HMM, PRESIDENT
DATE: 10/24/05

EL PASO COUNTY
COUNTY PLAN REVIEW IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH COUNTY DESIGN CRITERIA. THE COUNTY IS NOT RESPONSIBLE FOR THE ADEQUACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE COUNTY THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO OF THIS DOCUMENT. RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY.

JOHN A. MCCARTY, P.E.
COUNTY ENGINEER/DIRECTOR
DATE: 11-17-05

WOODMEN HILLS METRO DISTRICT
WATER AND SEWER MAIN EXTENSIONS
ANY CHANGES OR ALTERATIONS AFFECTING THE GRADE, ALIGNMENT, ELEVATION AND/OR DEPTH OF COVER OF ANY WATER OR SEWER MAINS OR OTHER APPURTENANCES SHOWN ON THIS DRAWING SHALL BE THE RESPONSIBILITY OF THE OWNER/DEVELOPER. THE OWNER/DEVELOPER SHALL BE RESPONSIBLE FOR ALL OPERATIONAL DAMAGES AND DEFECTS IN INSTALLATION AND MATERIAL FOR MAINS AND SERVICES FROM THE DATE OF APPROVAL UNTIL FINAL ACCEPTANCE IS ISSUED.

SIGNED: WILLIAM E. LARBY
OWNER/DEVELOPER
DATE: 10-24-05

PRINTED NAME: WILLIAM E. LARBY
DBA: TAMLIN VENTURES, LLC
ADDRESS: 25 N. TEJON ST., STE 300
COLORADO SPRINGS, CO 80903

FIRE AUTHORITY APPROVAL
THE NUMBER OF FIRE HYDRANTS AND HYDRANT LOCATIONS SHOWN ON THIS WATER INSTALLATION PLAN ARE CORRECT AND ADEQUATE TO SATISFY THE FIRE PROTECTION REQUIREMENTS AS SPECIFIED BY THE FIRE DISTRICT SERVING THE PROPERTY NOTED ON THE PLANS.

FIRE PROTECTION DISTRICT: _____ DATE: _____

SIGNED: _____ DATE: _____

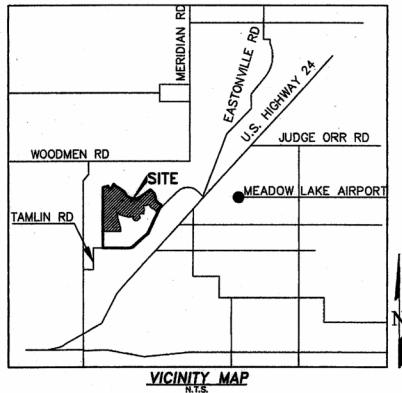
DISTRICT APPROVALS
THE WOODMEN HILLS METROPOLITAN DISTRICT RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE WOODMEN HILLS METROPOLITAN DISTRICT HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.

WOODMEN HILLS METROPOLITAN DISTRICT
WATER & SEWER DESIGNS APPROVAL
DISTRICT MANAGER: [Signature]
DISTRICT ENGINEER: [Signature]
DATE: 10/24/05
PROJECT NO.: 05-17

IN CASE OF ERRORS OR OMISSIONS WITH THE SEWER DESIGN AS SHOWN ON THIS DOCUMENT THE STANDARDS AS DEFINED IN THE "RULES AND REGULATIONS FOR INSTALLATION OF SEWER MAINS AND SERVICES" SHALL GOVERN.

GRADING APPROVALS
ENGINEER'S STATEMENT
THIS GRADING AND EROSION CONTROL PLAN WAS PREPARED UNDER MY DIRECTION AND SUPERVISION AND IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. IF INDICATED GRADING IS PERFORMED IN ACCORDANCE WITH THIS PLAN, THE WORK WILL NOT BECOME A HAZARD TO LIFE AND LIMB OR AN OBSTACLE TO THE SAFETY, USE OR STABILITY OF A PUBLIC WAY, DRAINAGE CHANNEL OR OTHER PROPERTY.

QUENTIN N. ARMUJO, COLORADO P.E. #37170
FOR AND ON BEHALF OF TERRA NOVA ENGINEERING, INC.
DATE: 10/24/05

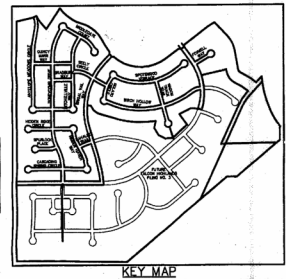
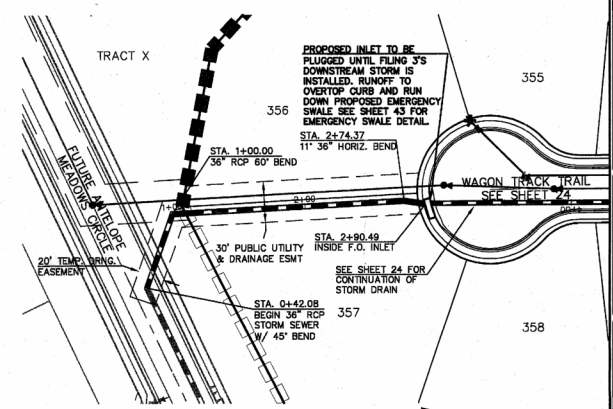
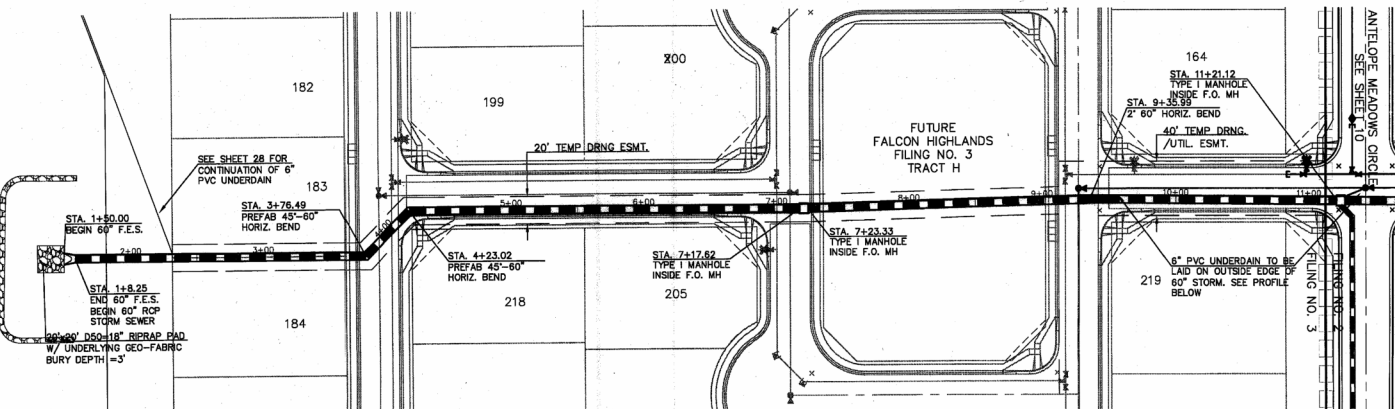


EL PASO COUNTY
FILED IN ACCORDANCE WITH SECTION 51-1 OF THE EL PASO COUNTY LAND DEVELOPMENT CODE, AS AMENDED.

JOHN A. MCCARTY, P.E.
COUNTY ENGINEER/DIRECTOR
DATE: 2-6-06

DEVELOPER'S STATEMENT
I, THE DEVELOPER, HAVE REVIEWED AND WILL COMPLY WITH THE REQUIREMENTS OF THIS GRADING AND EROSION CONTROL PLAN.

BY: WILLIAM E. LARBY
TAMLIN VENTURES, LLC
ADDRESS: 25 N. TEJON STREET, SUITE 300, COLORADO SPRINGS, COLORADO 80903



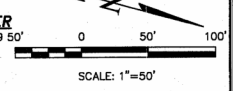
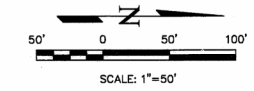
60" RCP STORM SEWER
STA. 1+50.00 ~ STA. 11+21.12

36" RCP STORM SEWER
STA. 1+00.00 ~ STA. 2+90.49 50'

NOTE: THESE PLANS FOR STORM SEWER PLAN AND PROFILE ONLY.

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

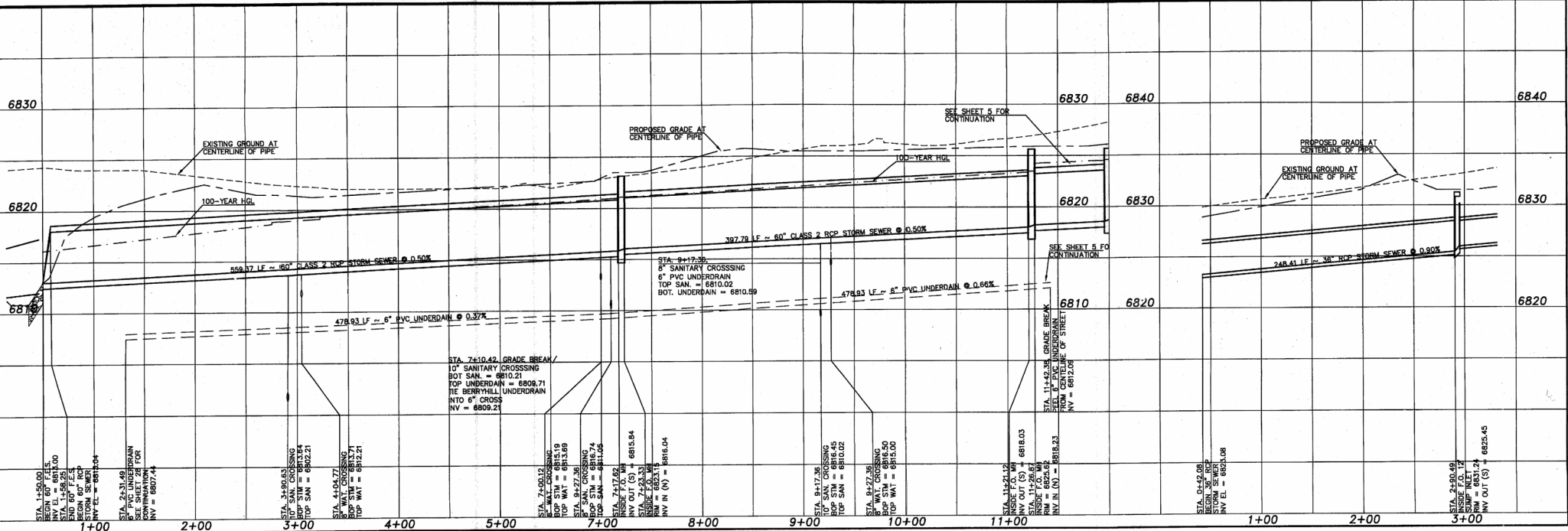


EL PASO COUNTY RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE COUNTY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY.
RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

ASPHALT DATA FOR:	ALT. 2:
ASPHALT THICKNESS:	
AC SURFACE:	
AC BASE:	
AGGREGATE BASE THICKNESS:	ALT. 1:
CLASS 6:	ALT. 2:
CLASS 5:	
CLASS 4:	

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

Quentin N. Armat
 QUENTIN N. ARMAT, P.E.
 REGISTERED PROFESSIONAL ENGINEER
 COLORADO P.E. NO. 10000



DATE: 10/17/05
 DESCRIPTION: 1. PER COUNTY/HOUSE COMMENTS 10/17/05
 2. PER WOODMAN DIST. COMMENTS 10/21/05

REVISIONS:

NO. 1
 DATE: 10/17/05
 BY: [Signature]
 DESCRIPTION: PER COUNTY/HOUSE COMMENTS

NO. 2
 DATE: 10/21/05
 BY: [Signature]
 DESCRIPTION: PER WOODMAN DIST. COMMENTS

PREPARED FOR:
 TAMLIN VENTURES, LLC
 MR. MIKE SCOTT
 275 N. TOLON AVENUE
 TERRA NOVA ENGINEERING

DESIGNED BY: [Signature]
 DRAWN BY: [Signature]
 CHECKED BY: [Signature]
 H-SCALE: [Blank]
 V-SCALE: [Blank]
 JOB NO. 04
 DATE ISSUED: [Blank]
 SHEET NO. [Blank]

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.

D. Madruga
Daniel Madruga, 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: [Signature]

Title: VP of Community Development

Address: 8605 Explorer DR 80920

El Paso County Approval:

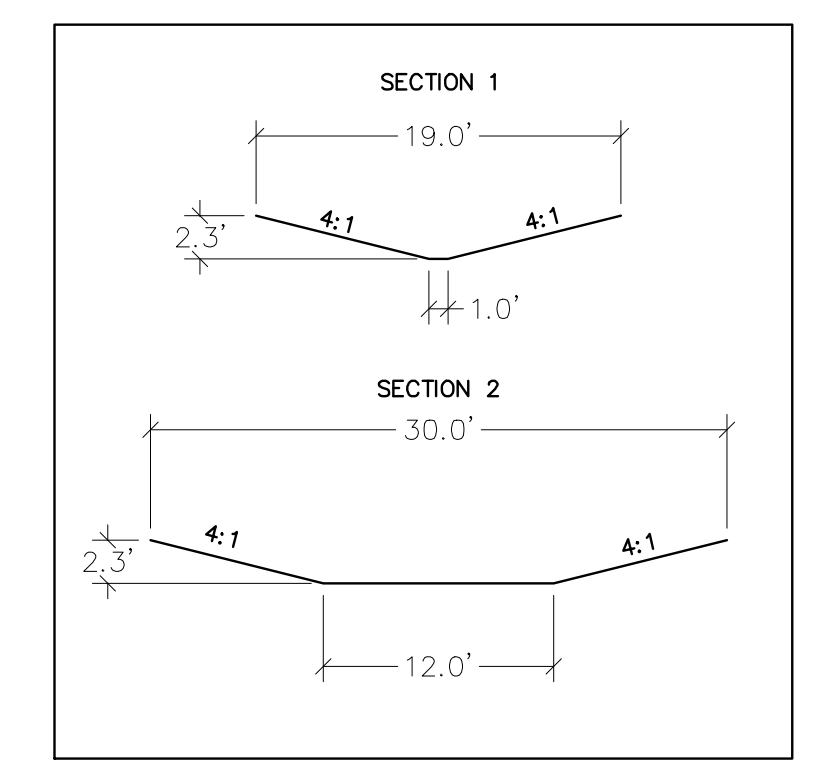
Filed in accordance with requirements of Section 51.1 of the El Paso Land Development Code as amended.

4/22/2024

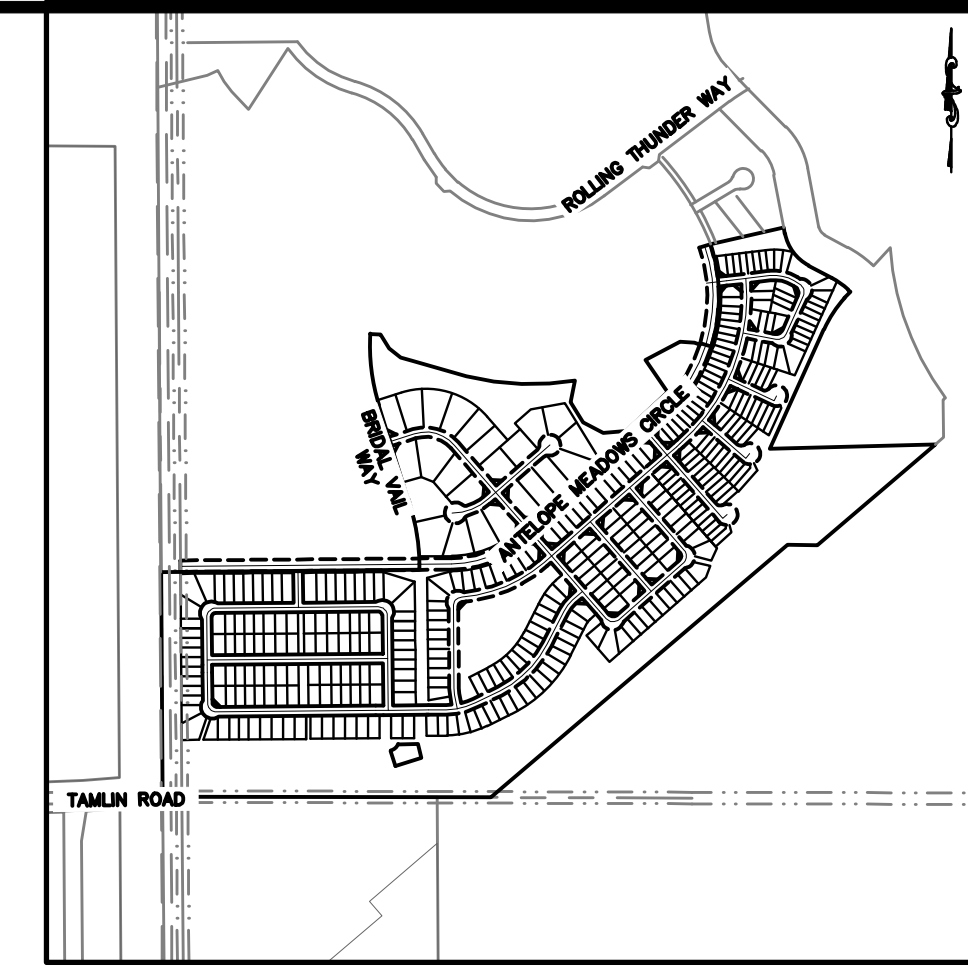
Joshua Palmer, P.E.,
County Engineer, ECM Administrator
Conditions:

Date

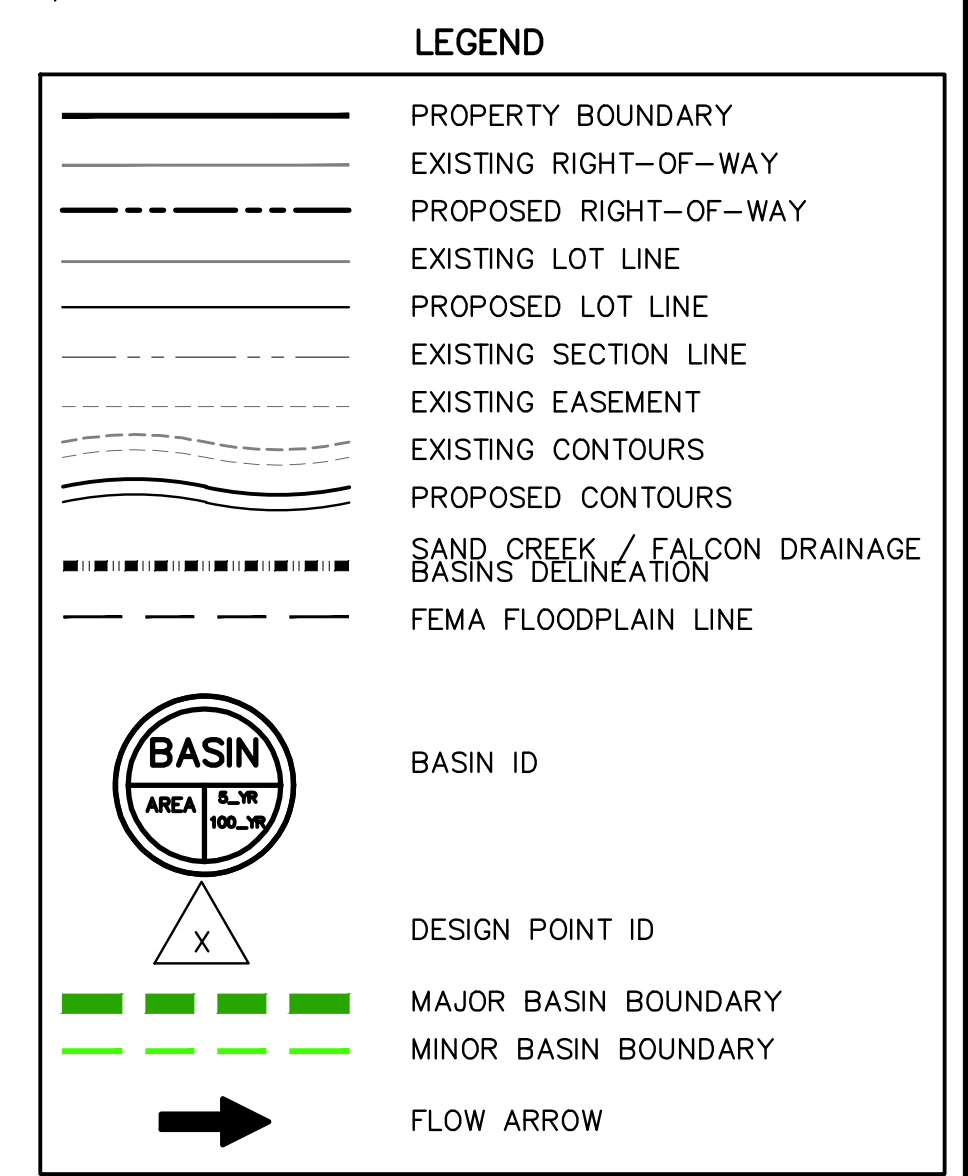
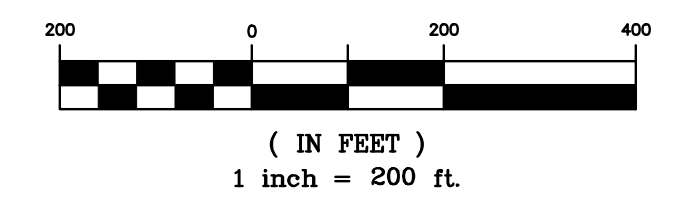
NOTE: SEE SHEETS DR-3 THRU DR-5 FOR SUB-BASINS B, C, & D



GRASS LINED SWALE SECTIONS
N.T.S.



KEY MAP
1" = 1000'



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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ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

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

A	1st SUBMITTAL TO EPIC	07/31/2022	- RDL
B	2nd SUBMITTAL TO EPIC	08/28/2022	- RDL
C	3rd SUBMITTAL TO EPIC	09/26/2023	- RDL
D	4TH SUBMITTAL TO EPIC	07/21/2023	- RDM

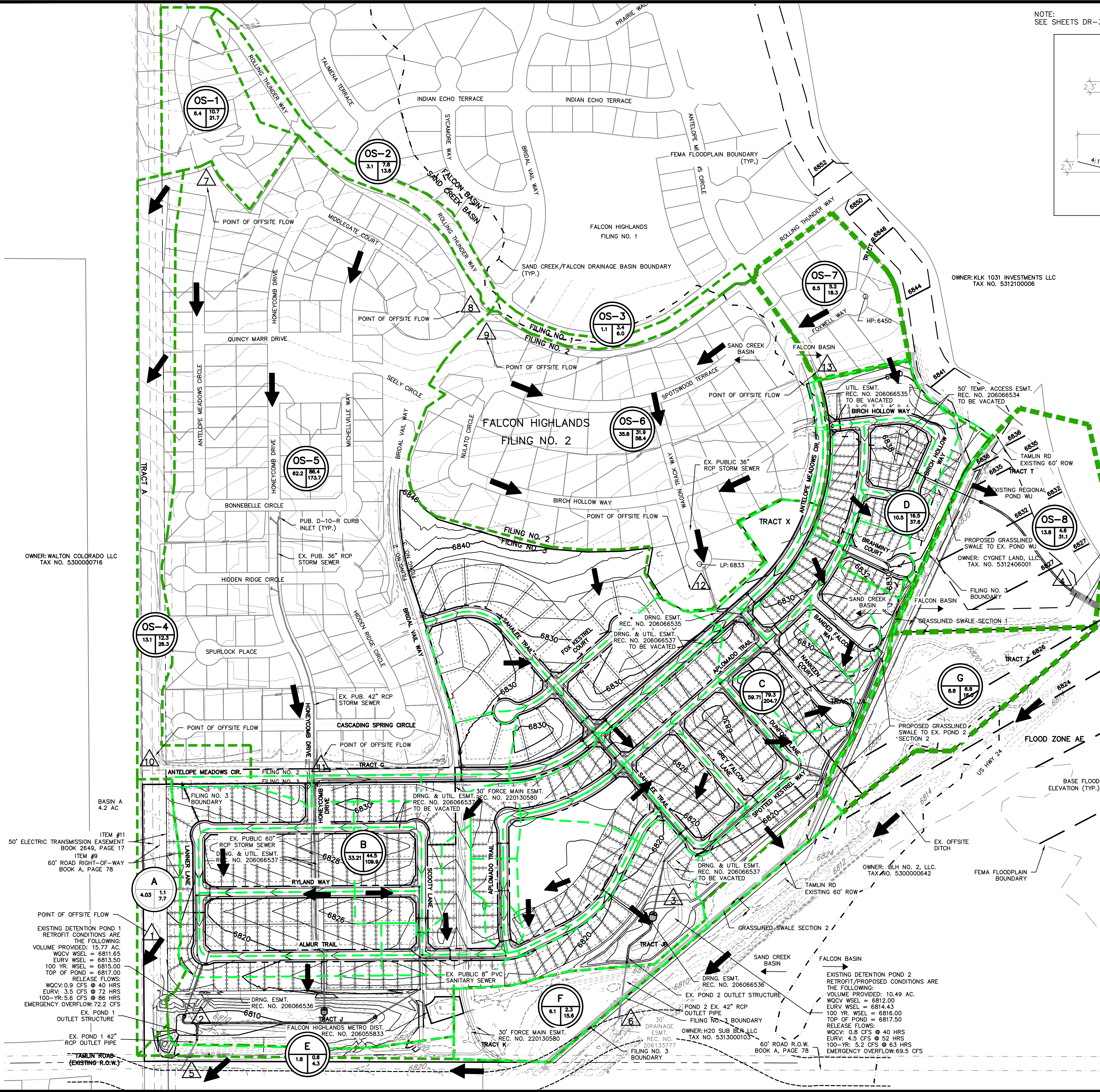
REVISIONS

DR.	SLP	CH.	DJM
P.M.	DJM		

JOB: 21002568
SHEET NO. 1
DR-02

PROPOSED CONDITIONS CUMULATIVE DRAINAGE BASIN SUMMARY

Basin	Design Point	Area (acres)	WEIGHTED		Q _s (cfs)	Q ₁₀₀ (cfs)
			C ₅	C ₁₀₀		
A	1	4.03	0.08	0.33	1.1	7.7
B	2	33.21	0.36	0.54	45.4	112.3
C	3	62.88	0.34	0.53	87.0	222.9
D	4	7.36	0.42	0.57	11.5	26.7
E	5	1.77	0.09	0.36	0.6	4.3
F	6	6.06	0.10	0.41	2.3	15.6
G	6	8.84	0.09	0.36	6.8	16.0
OS-1	7	6.38	0.27	0.48	10.7	21.7
OS-2	8	3.12	0.30	0.50	7.8	13.6
OS-3	9	1.14	0.90	0.96	3.4	6.0
OS-4	10	13.09	0.34	0.44	12.3	26.3
OS-5	11	62.20	0.34	0.55	86.4	173.7
OS-6	12	35.75	0.22	0.46	31.9	58.4
OS-7	13	6.47	0.22	0.46	5.4	19.1
OS-8	4	13.79	0.09	0.36	4.8	32.5
TOTAL		266.09			317.6	756.8



OWNER: WALTON COLORADO LLC
TAX NO. 530000716

ITEM #11
50' ELECTRIC TRANSMISSION EASEMENT
BOOK 2549, PAGE 17

ITEM #9
60' ROAD RIGHT-OF-WAY
BOOK A, PAGE 78

POINT OF OFFSITE FLOW

EXISTING DETENTION POND 1
RETROFIT CONDITIONS ARE
THE FOLLOWING:
VOLUME PROVIDED: 15.77 AC.
WQCV WSEL = 6811.65
EURV WSEL = 6813.50
100 YR. WSEL = 6815.00
TOP OF POND = 6817.00
RELEASE FLOWS:
WQCV: 0.9 CFS @ 40 HRS
EURV: 3.5 CFS @ 72 HRS
100-YR: 5.6 CFS @ 85 HRS
EMERGENCY OVERFLOW: 72.2 CFS

EX. POND 1
OUTLET STRUCTURE

EX. POND 1
42" RCP OUTLET PIPE

TAMLIN ROAD
(EXISTING R.O.W.)

POINT OF OFFSITE FLOW

EXISTING DETENTION POND 2
RETROFIT/PROPOSED CONDITIONS ARE
THE FOLLOWING:
VOLUME PROVIDED: 10.49 AC.
WQCV WSEL = 6812.00
EURV WSEL = 6814.43
100 YR. WSEL = 6816.00
TOP OF POND = 6817.50
RELEASE FLOWS:
WQCV: 0.8 CFS @ 40 HRS
EURV: 4.5 CFS @ 52 HRS
100-YR: 5.2 CFS @ 63 HRS
EMERGENCY OVERFLOW: 69.5 CFS

EX. POND 2
OUTLET STRUCTURE

POND 2 EX. 42" RCP
OUTLET PIPE

FILING NO. 3
BOUNDARY

OWNER: H2O SUB BLR LLC
TAX NO. 5313000103

30' DRAINAGE
ESMT.
REC. NO. 205133777

FILING NO. 3
BOUNDARY

30' FORCE MAIN ESMT.
REC. NO. 220130580

60' ROAD R.O.W.
BOOK A, PAGE 78

OWNER: KLK 1031 INVESTMENTS LLC
TAX NO. 5312100006

OWNER: CYGNET LAND, LLC
TAX NO. 5312406001

OWNER: ELH NO. 2, LLC
TAX NO. 5300006642

OWNER: H2O SUB BLR LLC
TAX NO. 5313000103

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OWNER: H2O SUB B

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