Preliminary Drainage Report

Meadowbrook Park
El Paso County, Colorado

PCD File No.: PUDSP208

Prepared for:
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Project #: 096956009

Prepared: March 18th, 2021
Revision 1: June 2, 2021
Revision 2: July 14, 2021

Table of Contents

CERTIFICATION

ENGINEERS 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.

JOHN ROBERT HEIBERGER
50096
07/29/2021

SIGNATURE (Affix Seal): ______________________________
Colorado P.E. No. 50096 Date

DEVELOPER'S STATEMENT

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

Meadowbrook Development LLC
Business Name

Kelly Nelson
By: Kelly Nelson
Development Manager
Title:

90 S. Cascade, Ste. 1500, Colorado Springs, CO 80903
Address:

EL PASO COUNTY STATEMENT

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

APPROVED
Engineering Department
08/23/2021 12:35:46 PM
dsdnijkamp
EPC Planning & Community Development Department

____
Jennifer Irving, P.E.
County Engineer/ECM Administrator

Conditions:

GENERAL LOCATION AND DESCRIPTION

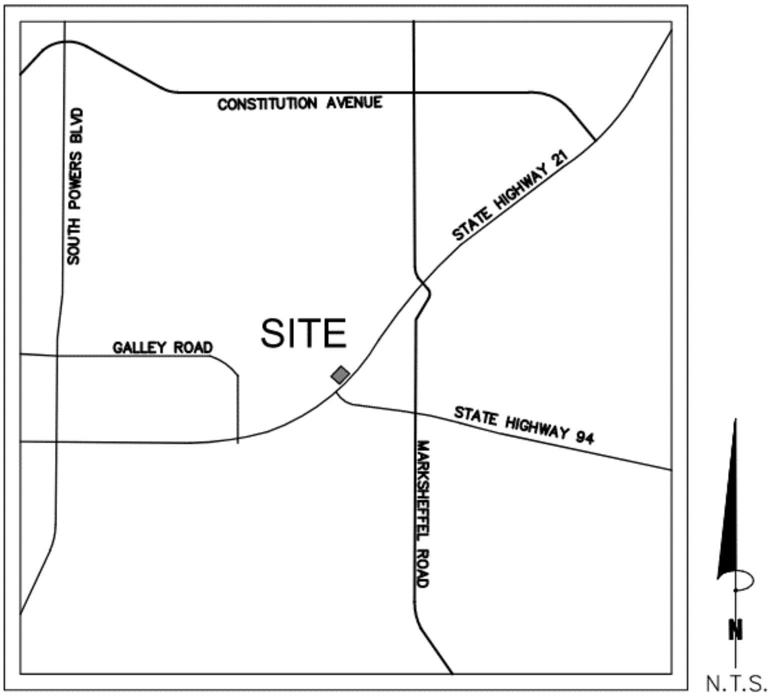
PURPOSE AND SCOPE OF STUDY

The purpose of this Preliminary Drainage Report (FDR) is to provide the hydrologic and hydraulic calculations and to document and finalize the drainage design methodology in support of the proposed Meadowbrook Park development (“the Project”) for Meadowbrook Development LLC. The Project is located within the jurisdictional limits of El Paso County (“the County”). Thus, the guidelines for the hydrologic and hydraulic design components were based on the criteria outlined by the County.

LOCATION

The Project is located northwest of the Meadowbrook Parkway and US Highway 24 intersection in El Paso County, Colorado. More specifically, the Project is made up of Tract A 94/24 Business Park Filing No. 1, Tract I Meadowbrook Crossing Filing No. 1, and a Tract within the Claremont Business park Filing No. 2 (parcel number 5408000053) plat within the southeast quarter of Section 8, Township 14 South, Range 65 West of the 6th Principal Meridian, County of El Paso, State of Colorado. The site is bounded by Meadowbrook Parkway and the Meadowbrook Crossing Filings No. 1 and No. 2 to the west, Lot 46A Claremont Business Park Filing No. 2A, a commercial storage development to the north, US Highway 24 (CDOT Right of Way) to the east, and Lot 1 24/94 Business Park Filing No. 1, a commercial gas station to the south. A vicinity map has been provided in the Appendix of this report.

VICINITY MAP



VICINITY MAP
N.T.S

DESCRIPTION OF PROPERTY

The Project is located on approximately 8.01 acres of undeveloped land with limited vegetation and grass cover. The site currently does not provide stormwater quality or detention and there are no known major drainage ways or irrigation facilities on the site. The site generally drains from the east to west with slopes ranging from 2% to 25% with the steeper slopes along the east side of the site adjacent to US Highway 24 and Lot 46A Claremont Business Park Filing No. 2A, the commercial storage facility to the north. There is an existing 30" CMP CDOT culvert that outfalls onto the site, conveying flow from the median of Hwy 24. This runoff flows across the Site to an existing storm area inlet located in the southwest corner of the Site. The Project is not adjacent to any major drainageways and does not outfall directly to any major drainageways.

NRCS soil data is available for the Site (See Appendix) and the onsite soils are USCS Hydrologic Soil Group A. Group A soils have higher infiltration rates compared to other soil groups and are generally made up of well drained, cohesive sands or gravelly sands. A Soils and Geology Study has also been prepared for the site by Rocky Mountain Group dated August 26, 2020 and is attached in the Appendix of this report for reference.

PROJECT CHARACTERISTICS

The Project is a proposed single family development that will include 67 lots. The project will include the construction of private streets, sidewalks, driveways, hardscape/landscape, and associated utility infrastructure required to serve each lot. Water quaility and detention is required for the site improvements and will be accomplished with the construction of a Full Spectrum Extended Detention Basin located in the southeast corner of the site and a water quailtiy Rain Garden located in the southwest corner of the Site. As part of the utility infrastructure improvements, a proposed storm sewer system will be constructed to collect runoff. Stormwater will be conveyed via overland flow across the lots, within the curb and gutter of the proposed streets before being captured in proposed storm inlets. Additionally, the corridors between homes shall not be graded flat. Swales proposed within the six foot corridor in-between each set of single-family homes will convey stormwater from the roof drains and from landscape areas inbetween the homes. The swales will be centered in the 6-foot corridor between the homes on the two adjacent lots and will convey stormwater to the proposed storm inlets in the proposed streets. The storm sewer system will then convey runoff into the Full Spectrum Extended Detention Basin before being discharged offsite. A small portion of the Site drains to curb chase that outfalls into the Rain Garden for water quality treatment, only. The Full Spectrum Extended Detention Basin will overdetain to inlcude the area flowing to the Rain Garden to provide detention volume.

DRAINAGE BASINS AND SUB-BASINS

MAJOR BASIN DESCRIPTIONS

The site is located within the Sand Creek Drainage Basin Study (DBPS). It is not directly adjacent to East Fork Sand Creek, but East Fork Sand Creek is the ultimate receiving water for the discharge from this Site. The Sand Creek DBPS calls for bank stabilization improvements and two drop structures which were constructed with the Meadowbrook Crossing Filings No. 1

and No. 2 developments. No additional creek improvements are included with the development of this Project.

The Site is also located outside the 100-year floodplain and within Zone X (an area of minimal flood hazard) as noted on the FEMA FIRM Map No. 08041C0752G revised on December 7, 2018 (See Appendix).

There are no identified nearby irrigation facilities or other obstructions which could influence the local drainage, other than the CDOT off-site flow from the 30” CMP culvert previously mentioned.

SUB-BASIN DESCRIPTION

Historic Drainage Patterns

The existing runoff onsite generally drains from east to west and is collected by an existing storm area inlet located in the southwest corner of the site. The runoff is then conveyed via storm sewer through the neighboring site to the southwest before discharging into the County storm sewer system within Meadowbrook Parkway. Runoff from offsite enters to the east of the site from US Highway 24 and drains to the same inlet as the onsite runoff in the southeast corner.

The existing drainage is divided into three sub-basins, Basin EX-A, EX-B, and EX-C. Sub-Basin EX-A is approximately 8.18 acres on consists of most of the on-site area within the property line. Runoff generated from this Sub-Basin drains overland from east to west towards the existing storm area inlet. The weighted imperviousness for Sub-Basin EX-A with existing conditions is 2% and the runoff for the 5-year and 100-year storm events are 2.49 cfs and 16.70 cfs respectively.

Off-Site Drainage Flow Patterns

Sub-Basin EX-B is approximately 1.34 acres and consists of the area within the CDOT Right of Way, downstream of the existing 30” CMP culvert and area inlet within the median. It comprises of the west portion of US Highway 24 (US-24) travel lanes, shoulder and existing 4:1 slope down to Site. The flows generated from the east portion of US-24 and within the median flow south to another area inlet and culvert away from the project area. The weighted imperviousness for Sub-Basin EX-A with existing conditions is 51.1% and the runoff for the 5-year and 100-year storm events are 3.01 cfs and 6.73 cfs respectively.

Sub-Basin EX-C is approximately 3.87 acres and consists of the area within the CDOT Right of Way upstream of the existing 30” CMP culvert and area inlet within the median. It comprises of runoff generated from all four travel lanes on US-24 and runoff generated within the existing median. Runoff is either conveyed overland onto the Site or through an existing area inlet within the median and then into a 30” CMP culvert. The culvert outfalls onto the Site and flows overland to the southwest corner to the existing storm area inlet. The weighted imperviousness for Sub-Basin EX-C with existing conditions is 54.0%% and the runoff for the 5-year and 100-year storm events are 7.71 cfs and 16.89 cfs respectively.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm facilities follow the El Paso County Drainage Criteria Manual (the “CRITERIA”), El Paso Engineering Criteria Manual (the “ECM”), and the Mile High Flood District Urban Storm Drainage Criteria Manual (the “MANUAL”). Site drainage is not significantly impacted by such constraints as utilities or existing development. Further detail regarding onsite drainage patterns is provided in the Proposed Drainage Conditions Section.

There are previous drainage studies that include portions of the Project Site limits:

24/94 Business Park Final Drainage Report- This report completed by Core Engineering Group, LLC dated, July 14, 2016 details the existing 2- Type D inlets in the southwest corner of the Site. It also shows the storm alignment from the existing Type D inlet, across Meadowbrook Parkway and to the outfall in East Fork Sand Creek. This alignment will be the ultimate outfall for the discharge from this project. Proposed flows from the Site are less than the historic flows through the existing infrastructure shown in this drainage report.

Claremont Business Park Filing No. 2 Final Drainage Report- This report completed by Matrix Design Group, Inc. dated, November 2006. This report shows that the runoff from Lot 46A Claremont Business Park Filing No. 2A is maintained on the lot as does not generate runoff onto the Site that would be classified as off-site drainage for this Project.

Meadowbrook Crossing Filings No. 1 and No. 2 Preliminary and Final Drainage Report- This report completed by Kiowa Engineering Corporation dated, July 25, 2017 does not specifically include area on Site on the Drainage Map, but provides details about the improvements made to East Fork Sand Creek for stabilization and documents the extension of Meadowbrook Parkway.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per chapter 6 of the CRITERIA. Table 6-2 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-6 of the CRITERIA by calculating weighted impervious values for each specific site basin. The detention storage requirement was calculated using Full Spectrum Detention methods as specified in the CRITERIA and MANUAL. The Full Spectrum Extended Detention Basin’s outlet structure was designed to release the Water Quality Capture Volume (WQCV) in 40 hours. The Rain Garden was designed to release the WQCV in 12 hours. Based upon this approach, we feel that the drainage design provided for the Site is conservative and in keeping with the historic drainage patterns for the Site.

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA and information provided in the CRITERIA. Hydraulic calculations were computed using StormCAD for the proposed storm sewer system. Results of the hydraulic calculations are summarized in the Appendix.

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

COMPLIANCE WITH OFF-SITE RUNOFF

The runoff generated from US-24 currently outfalls onto the Site through an existing 30” CMP culvert. The off-site drainage basins were analyzed and found to include parts of the travel lanes, median and Right of Way. Currently, there is not a CDOT stormwater quality and detention facility that captures and treats this area. For that reason, each off-site Sub-Basin is collected in a swale parallel to US-24 roadway and within the CDOT Right of Way and conveyed to the southeast property corner of the Site. Off-site flows will be captured from the proposed swale by a proposed private CDOT Type D inlet (depressed and in series) and by-pass the property in a proposed 36” RCP storm pipe. This storm pipe runs along the southern property line within a proposed 15’ private drainage easement and will connect to the existing 36” RCP storm pipe with a proposed manhole. Hydrologic and hydraulic analysis was completed to verify the capacity of the downstream facilities to handle the by-passed flows. All generated from the off-site Sub-Basins will be by-passed through the Site.

PROPOSED DRAINAGE PATTERNS

The developed runoff from the Project will generally be collected by means of a private storm sewer system with inlets located in the private streets (Nova View, Tenebris Point, Spatium View, Solum Grove and Lux Point) within each delineated sub-basin area. Side lot swales will be located within the 5' side yard setback and corresponding 1' side yard setback on the adjacent lot for a combined 6' setback corridor in-between homes. The low point of elevation/flood line will be centered in the 6-foot corridor. Side lot swales will convey stormwater to the proposed storm sewer system. The runoff collected form each Sub-Basin A, C-J will be captured by storm inlets and conveyed through storm pipes to a Full Spectrum Extended Detention Basin located in the southeast corner of the site. The controlled stormwater will be treated, detained, and released from an outlet structure which will convey stormwater through a proposed storm pipe that runs along the southern property line with a 15’ private drainage easement. Eventually the outfall pipe connects to the existing private storm sewer in the southwest corner. A portion of the site Sub-Basin B, surface drains to the southwest corner, entering a proposed rain garden through a concrete chase. The WQCV in the rain garden will be treated and released through an outlet structure and conveyed through a storm pipe to a connection in the existing private 36” RCP pipe.

The existing 36” extends long the northern property line of Lot 1 24/94 Business Park Filing No. 1, a commercial gas station to the north east corner of the lot and stubbed into an existing public 10’ Type R Inlet. The inlet is used as a junction structure and runoff is conveyed through an existing public 42” RCP storm pipe across Meadowbrook Parkway and long Newt Drive until it ultimately outfalls into the East Fork Sand Creek. This is depicted in the proposed drainage map as part of the Meadowbrook Crossing Filings No. 1 and No. 2 Preliminary and Final Drainage Report

SPECIFIC DETAILS

The property has been divided into fourteen sub-basins, A through J and OS-A- OS-C. Sub-basins A through J make up the Project on-site area and Sub-Basins OS-A -OS-C are the offsite basins consisting of runoff from US Highway 24.

The weighted imperviousness of the Site area (Sub-basins A through J) with proposed conditions is 43.3%. Cumulative runoff for the 5-year and 100-year storm events are 15.15 cfs and 34.11 cfs, respectively. The weighted imperviousness of the offsite area (Sub-basin OS-A-OS-C) with Sub-Bains A through J on site is 46.8%. Cumulative runoff for the 5-year and 100-year storm events are 25.84 cfs and 59.19 cfs, respectively.

Sub-Basin A

Sub-basin A consists of approximately 2.47 acres and is the area along the eastern property line, east of Nova View and north of the Extended Detention Basin. Swales between the lots capture the roof drainage and the landscape areas between homes and direct it to the east (backside) of the lots. The runoff is then collected in swales along the backside of the lots and is conveyed directly into a grass lined swale that conveys runoff to the Extended Detention Basin down a riprap rundown/ rock chute into a forebay (Design Point 1). Additionally, this area comprises of the areas uphill of the proposed big block retaining walls. Runoff not captured from the off-stie Sub-Basins is captured in a swale on top of the retaining walls and is conveyed towards the Extended Detention Basin down a riprap rundown/ rock chute into a forebay. Developed runoff during the 5-year and 100-year events are 2.08 cfs and 7.19 cfs respectively.

Sub-Basin B

Sub-basin B consists of approximately 1.85 acres and is made up of a majority of the Solum Grove runoff and the lots adjacent to Solum Grove. The lots on the south side of Tenebris Point are also included within this sub-basin. This Sub-Basin is the only Sub-Basin contributing to the Rain Garden. Swales between the lots capture the roof drainage and the landscape areas between homes and is conveyed in the curb and gutter to a curb chase (Design Point 2) in the southwest corner of the Site, directly entering the proposed Rain Garden. The remaining runoff from the lots drain into the Solum Grove and is also conveyed in the curb and gutter to a curb chase in the southwest corner of the Site, directly entering the proposed Rain Garden. Developed runoff during the 5-year and 100-year events are 4.04 cfs and 8.86 cfs respectively.

Sub-Basin C

Sub-basin C consists of approximately 0.20 acres and consists of driveway runoff from six lots and the west portion of Nova View between Spatium View and Tenebris Point. The runoff from the lots drains into the Celeste Heights and is conveyed in the curb and gutter before being collected a private 5-foot curb Type R inlet (Design Point 3). Developed runoff during the 5-year and 100-year events are 0.82 cfs and 1.53 cfs respectively.

Sub-Basin D

Sub-basin D consists of approximately 0.87 acres and consists of Tenebris Point runoff and the lots north to Tenebris Point and the tract north the associated lots. To prevent the runoff from the Tract to drain out towards Meadowbrook Parkway, a swale will collect runoff along the west property line and convey to a small area inlet. This area inlet will connect to the 5' Type R inlet at the end of Tenebris Point (Design Point 4). Swales between the lots capture the roof drainage and the landscape areas between homes and is conveyed in the curb and gutter before being collected by a 5-foot curb Type R inlet at the end of the road (Design Point 4). The remaining runoff from the lots drains into the Tenebris Point and is also conveyed in the curb and gutter before being collected by the proposed 5-foot curb Type R inlet at the end of the road. Developed runoff during the 5-year and 100-year events are 1.43 cfs and 3.43 cfs respectively.

Sub-Basin E

Sub-basin E consists of approximately 0.42 acres and consists of the eastern half of the Nova View from Tenebris Point to Lux Point and the adjacent driveway sections. The runoff flows along Nova View and is conveyed in the curb and gutter before being collected by a 5-foot Type R inlet (Design Point 5). Developed runoff during the 5-year and 100-year events are 1.38 cfs and 2.70 cfs respectively.

Sub-Basin F

Sub-basin F consists of approximately 0.10 acres and consists of the southern half of Spatium View. The runoff from Spatium View and is conveyed in the curb and gutter before being collected by a 5-foot curb Type R inlet (Design Point 6). Developed runoff during the 5-year and 100-year events are 0.44 cfs and 0.80 cfs respectively.

Sub-Basin G

Sub-basin G consists of approximately 0.92 acres and consists of the northern half of Spatium View, the adjacent tract, and the western half of Nova View from Spatium View to Lux Point. Swales between the lots capture the roof drainage and the landscape areas between homes and is conveyed in the curb and gutter before being collected by a 5-foot curb Type R inlet (Design Point 7). The remaining runoff from the lots and driveways drain into Spatium View and Nova View and is conveyed in the curb and gutter before being collected by the 5-foot curb Type R inlet. To prevent the runoff from the Tract to drain out towards Meadowbrook Parkway, a swale will collect runoff along the west property line and convey to a small area inlet. This area inlet will connect to the 5' Type R inlet withing Spatium View (Design Point 7). Developed runoff during the 5-year and 100-year events are 1.72 cfs and 4.02 cfs respectively.

Sub-Basin H

Sub-basin H consists of approximately 0.83 acres and consists of Lux Point and the adjacent driveways to the west and entire lots to the east. The runoff from the lots drains into Lux Point and is conveyed in the curb and gutter before being collected by a 5-foot curb Type R inlet (Design Point 8). Developed runoff during the 5-year and 100-year events are 1.66 cfs and 3.85 cfs respectively.

Sub-Basin I

Sub-basin I consists of approximately 0.28 acres and consists of the western half of Nova view north of Lux Point. It also included the driveways directly adjacent to the west. The runoff from the driveways drains into Nova View and is conveyed in the curb and gutter and collected by a 5-foot curb Type R inlet (Design Point 9). Developed runoff during the 5-year and 100-year events are 0.82 cfs and 1.73 cfs respectively.

Sub-Basin J

Sub-basin J consists of approximately 0.23 acres and consists of the eastern half of Nova View north of Lux Point. It also included the driveways directly adjacent to the east. The runoff from the driveways drains into Nova View and is conveyed in the curb and gutter and is collected by a 5-foot curb Type R inlet (Design Point 10). Developed runoff during the 5-year and 100-year events are 0.77 cfs and 1.54 cfs respectively.

Sub-Basin OS-A

Sub-basin OS-A consists of approximately 1.77 acres and consists of the eastern half of US 24 (both travel lanes, shoulder and Right of Way) upstream and north of the existing CDOT 30" CMP culvert. Runoff from this Sub-Basin is conveyed in an already existing roadside ditch that converges with the outfall of the CMP culvert at Design Point 11. From Design Point 11 the flows will be routed through a proposed swale on CDOT Right of Way parallel to the property line and will eventually be captured into a Type D inlet and by-passed through the Site in a 36" RCP storm pipe. Developed runoff during the 5-year and 100-year events are 3.76 cfs and 8.14 cfs respectively.

Sub-Basin OS-B

Sub-basin OS-B consists of approximately 1.34 acres and consists of the eastern half of US 24 (both travel lanes, shoulder and Right of Way) downstream and south of the existing CDOT 30" CMP culvert. Runoff from this Sub-Basin be captured and routed through a proposed swale on CDOT Right of Way parallel to the property line and will eventually be captured into a Type D inlet and by-passed through the Site in a 36" RCP storm pipe. Developed runoff during the 5-year and 100-year events are 3.01 cfs and 6.73 cfs respectively.

Sub-Basin OS-C

Sub-basin OS-C consists of approximately 2.10 acres and consists of the western half of US 24 (both travel lanes and vegetated median) upstream and north of the existing CDOT 30" CMP culvert. Runoff from this Sub-Basin is collected in the already existing swale within the roadway median and is conveyed through the 30" CMP culvert to Design Point 11. From Design Point 11 the flows will be routed through a proposed swale on CDOT Right of Way parallel to the property line and will eventually be captured into a Type D inlet and by-passed through the Site in a 36" RCP storm pipe. Developed runoff during the 5-year and 100-year events are 3.92 cfs and 8.67 cfs respectively.

EMERGENCY OVERFLOW ROUTING

Emergency overflow routing consists of flows following the proposed drainage pattern of northeast to southwest along the proposed roadways. Once the flows reach the southwest portion of the site, they will flow through the access driveway to Meadowbrook Parkway for Lot 1 24/94 Business Park Filing No. 1.

DETENTION AND WATER QUALITY

The WQCV and 100-year detention is required for this Project. This is accomplished through the proposed private Full Spectrum Extended Detention Basin on the southeast corner of the Site and a private Rain Garden on the southwest corner of the Site. The Extended Detention Basin was sized to provide detention for the entire Site (Sub-Basins A-J) per UDFCD criteria. WQCV will be provided in the Extended Detention Basin for Sub-Basins A, C-J only. WQCV for Sub-Basin B will be provided by the Rain Garden. The water quality and detention calculations are provided in the Appendix of this report. The proposed Extended Detention Basin and Rain Garden will be maintained by the Meadowbrook Park HOA.

Four-Step Process

The four-step process per the MANUAL provides guidance and requirements for the selection of siting of structural Construction Control Measures (CCMs) for new development and significant redevelopment.

Step 1: Employ Runoff Reduction Practices

Currently the site is vacant undeveloped land with surrounding development. Development of the site will increase current runoff conditions due to increased imperviousness values. However, implementation the of landscaping throughout the site, the proposed storm sewer infrastructure, and the proposed Extended Detention Basin will help slow runoff and encourage infiltration.

Step 2: Provide Water Quality Capture Volume (WQCV)

The water quality capture volume will be detained using Full Spectrum Extended Detention Basin on the southeast corner of the Site and a Rain Garden on the southwest corner of the Site. The outfall pipes from the water quality outlet structures will control the release of stormwater to less than historic rates.

Step 3: Stabilize Drainageways

There are no current drainageways conveyed through this property. No improvements to stabilize drainageways are a part of this Project.

Step 4: Consider need for Industrial and Commercial BMPs

Erosion control features for the final stages of the Project will be designed to reduce contamination. Source control BMPs will include the use of, inlet protection, silt fences, concrete washout areas, stockpile management, and stabilized staging areas. The Grading and Erosion Control Plans will be submitted as a separate construction document set.

Detention and Water Quality Design

The proposed private Full Spectrum Extended Detention Basin is designed with an outlet structure that is fitted with an orifice plat and restrictor plate to release the WQCV in a 40-hour time period per the MANUAL. The proposed private Rain Garden is designed with an outlet structure that is fitted with a restrictor plate to release the WQCV in a 12-hour time period per the MANUAL.

Calculations included in the Appendix provide details regarding the private water quality and detention basins design. The calculations include determination of the storage volumes required for full spectrum detention for the WQCV and 100 year detention and allowable release rates.

Overall, 0.101 acre-feet of WQCV is required for Sub-Basins A, C-J, and 0.648 acre-feet of detention volume is required for the proposed Extended Detention Basin (Sub-Basins A-J). The total area contributing to the Extended Detention Basin consists of 8.17 acres (43.3% imperviousness). The outlet structure and orifice releases approximately 0.1 cfs in the 5-year event and 5.5 cfs in the 100-year event. This is less than the historic flows of 2.49 cfs in the 5-year event and 16.70 cfs in the 100-year event.

The WQCV requirement for Sub-Basin B (1.85 acres and 54.5% imperiousness), is 1,176 cubic feet and is provided by a Rain Garden with this a 1,215 Square Foot bottom and 12” WQCV depth. See the Appendix for calculations.

Outlet Requirements

The water quality standards established by the CRITERIA are met by the proposed Full Spectrum Extended Detention Basin and Rain Garden. The water quality outlet structures were designed per the specifications in the CRITERIA. The outlet structure for the Extended Detention Basin meets the micro-pool requirement that it be integrated into the design of the structure with an additional initial surcharge volume. The orifice plates of the structures were designed based on the CRITERIA. The orifice plates will allow the WQCV to be drained from the structure in 40 hours for the Extended Detention Basin and 12 hours for the Rain Garden. The calculations for the design of the outlet structures are presented in the Appendix.

Channel Design and Soil Erodibility

A proposed concrete lined trickle channel within the basin was designed per the MANUAL. A forebay structure is located at both upstream entrances to the Extended Detention Base. The forebay structures were designed per the MANUAL. The surrounding protection is designed as Type L riprap. Calculations detailing the design and dimensions of the trickle channel and forebay structure are included in the Appendix. Additionally, a riprap rundown or rock chute is provided to stabilize the flows coming from swales and entering the Extended Detention Basin. Calculations for the rock chute are included in the Appendix.

Emergency Spillway Path

The emergency overflow from the Extended Detention Basin is designed to spill over the sidewalk and curb and gutter into Solum Grove and run west towards the access to Lot 1 24/94 Business Park Filing No. 1. Calculations are provided in the Appendix, showing that the flow from the emergency spillway will not overtop the curb in the 500-year event.

COST OF PROPOSED DRAINAGE FACILITIES

An Opinion of Probable Construction Cost (OPCC) is provided in the Appendix of the report. There are no public drainage facilities. All improvements with this Project will be private.

DRAINAGE AND BRIDGE FEES

The Site is located in the Sand Creek Drainage Basin. The total acreage of three parcels (5408403001, 5408000053 and 5408008002) is 8.01 acres. The site imperviousness is 46.8%. The total drainage and bridge fees due for the Site is $107,722.50

	2021 Fees ($ / Impervious acre)	**Impervious Area (Acre)**	**Amount Due ($)**
Drainage Fee	$20,387	3.75	$76,451.25
Bridge Fee	$8,339	3.75	$31,271.25
		Total amount due:	**$107,722.50**

GRADING AND EROSION CONTROL

The GEC plans have been submitted to El Paso County Planning and Community Development Department for review and approval prior to construction. The GEC plans are consistent with this drainage report.

MAINTENANCE AND OPERATIONS

Twice per year inspections (spring and fall) of the stormwater detention and water quality structures are recommended. The owner/operator will be responsible for maintenance. A copy of this report will be provided to the owner/operator. This satisfies the EDB Operation and Maintenance (O&M) Manual.

OTHER GOVERNMENT AGENCY REQUIREMENTS

Approval from other agencies such as the FEMA, the Army Corps of Engineers, Colorado State Engineer, Colorado Water Conservation Board, and others are not needed with this Project.

SUMMARY

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for Meadowbrook Park, conforms to the El Paso County Drainage Criteria Manual and the Mile High Flood District Urban Storm Drainage Criteria Manual. Additionally, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments. The proposed developed flows entering the Extended Detention Basin and are greater than the existing ultimate outfall of the site due to the greater imperviousness of the site, however the implementation of the drainage basins will disperse the flow of an extended period of time therefore releasing at equal to or less than the historic rate.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, May 2014.

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

3. Mile High Flood District Drainage Criteria Manual (MHFDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

4. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0459G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

APPENDIX

SOILS MAP AND FEMA FIRM PANEL

NOTES TO USERS

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

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

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

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

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

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

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

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

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

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

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

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

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

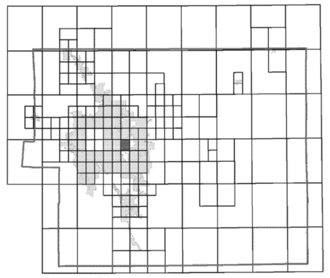
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

El Paso County Vertical Datum Offset Table

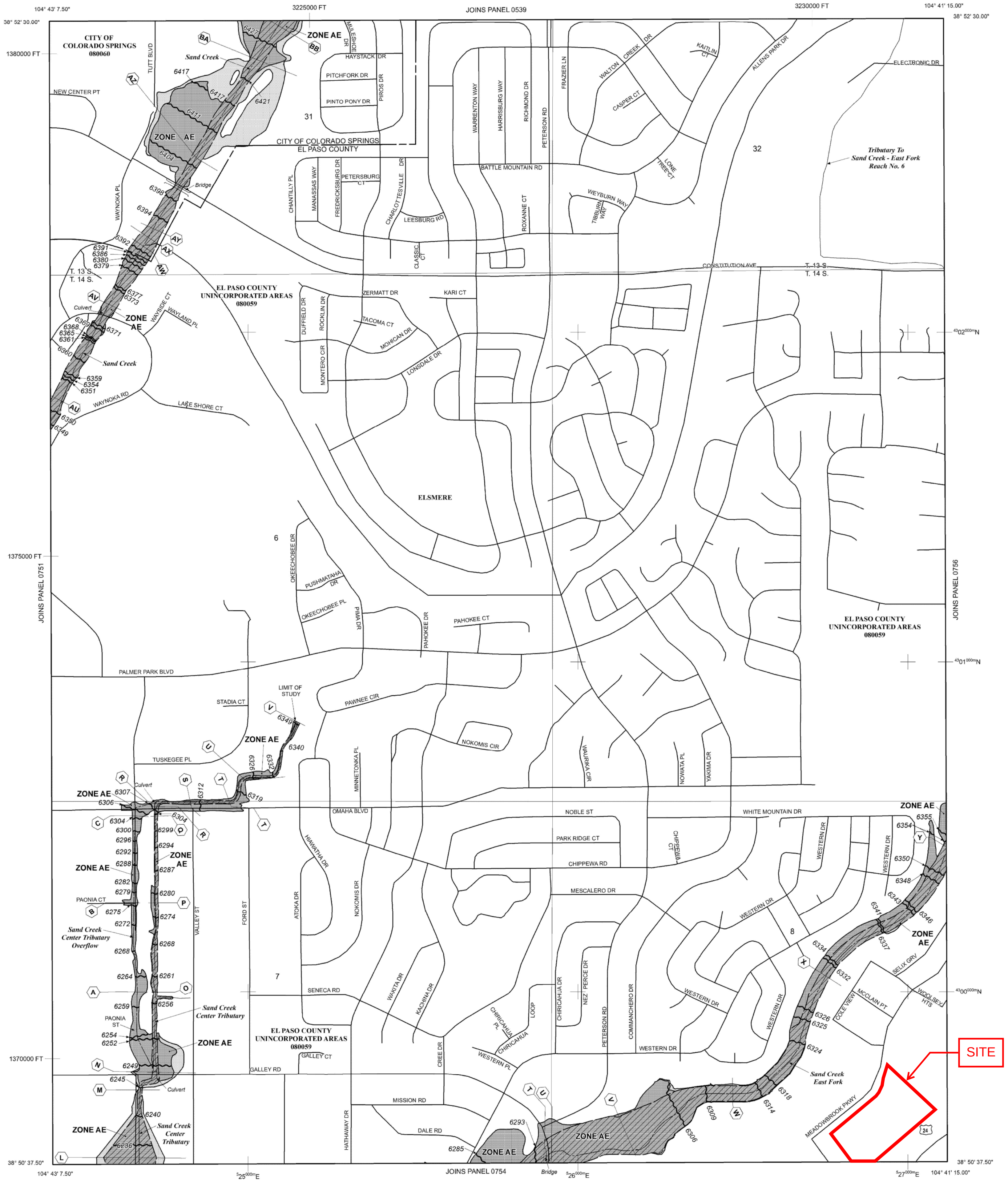
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



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

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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 13 SOUTH, RANGE 65 WEST, AND TOWNSHIP 14 SOUTH, RANGE 65 WEST.

LEGEND

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

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

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

▨ FLOODWAY AREAS IN ZONE AE

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

▨ OTHER FLOOD AREAS

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

☐ OTHER AREAS

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

▨ COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

▨ OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

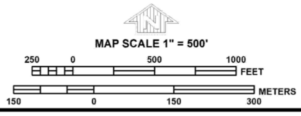
EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

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

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

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

MAP SCALE 1" = 500'



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0752G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 752 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0752	G
EL PASO COUNTY	080059	0752	G

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

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

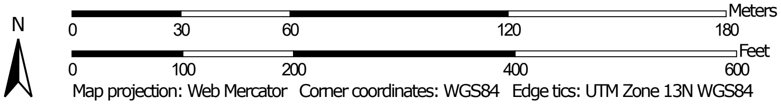
MAP NUMBER
08041C0752G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Hydrologic Soil Group—El Paso County Area, Colorado

Map Scale: 1:2,080 if printed on A landscape (11" x 8.5") sheet.



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

MAP LEGEND

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

Soils

Soil 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: Aug 19, 2018—Sep 23, 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	7.4	100.0%
Totals for Area of Interest			**7.4**	**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

EXISTING HYDROLOGIC CALCULATIONS

IDF Equations:

I_{100} = -2.52ln(D) + 12.735
I_{50} = -2.25ln(D) + 11.375
I_{25} -2.00ln(D) + 10.111
I_{10} -1.75ln(D) + 8.847
I_{5} -1.50ln(D) + 7.583
I_{2} -1.19ln(D) + 6.035

Where:
I = Rainfall Intensity (in/hr)
D= Duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.5	1.75	2.52

Time Intensity Frequency Tabulation

Time	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
5	4.12	5.17	6.03	6.89	7.75	8.68
10	3.29	4.13	4.82	5.51	6.19	6.93
15	2.81	3.52	4.11	4.69	5.28	5.91
30	1.99	2.48	2.89	3.31	3.72	4.16
60	1.16	1.44	1.68	1.92	2.16	2.42
120	0.34	0.40	0.47	0.54	0.60	0.67

*The Design Point Rainfall Values and Time Intensity Frequency Tabulation are found in Table 6-2 and Figure 6-5 respectively, of the Colorado Springs Drainage Criteria Manual, Volume 1

Weighted Imperviousness Calculations (Existing Conditions)

SUB-	AREA	AREA	ROOF	ROOF	ROOF				LANDSCAPE	LANDSCAPE	LANDSCAPE				PAVEMENT	PAVEMENT	PAVEMENT				WEIGHTED	WEIGHTED COEFFICIENTS			
BASIN	(SF)	(Acres)	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	IMPERVIOUSNESS	C2	C5	C10	C100
EX-A	356,327	8.18	0	90%	0.71	0.73	0.75	0.81	356,327	2%	0.03	0.09	0.17	0.36	0	100%	0.89	0.90	0.92	0.96	2.0%	0.03	0.09	0.17	0.36
EX-B	58,532	1.34	0	90%	0.71	0.73	0.75	0.81	29,227	2%	0.03	0.09	0.17	0.36	29,305	100%	0.89	0.90	0.92	0.96	51.1%	0.46	0.50	0.55	0.66
EX-C	168,766	3.87	0	90%	0.71	0.73	0.75	0.81	79,173	2%	0.03	0.09	0.17	0.36	89,593	100%	0.89	0.90	0.92	0.96	54.0%	0.49	0.52	0.57	0.68
TOTAL	583,625	13.40	0	90%	0.71	0.73	0.75	0.81	385,554	2%	0.03	0.09	0.17	0.36	29,305	100%	0.89	0.90	0.92	0.96	6.3%	0.06	0.10	0.16	0.29

Meadowbrook Park - Drainage Report
Existing Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
1	EX-A	356,327	8.18	0.09	300	11.5%	14.2	867	2.0%	15.00	2.1	6.8	21.0	1167	16.5	16.5
2	EX-B	58,532	1.34	0.50	65	4.5%	5.4	405	3.8%	15.00	2.9	2.3	7.7	470	12.6	7.7
3	EX-C	168,766	3.87	0.52	65	4.5%	5.2	1000	2.5%	15.00	2.4	7.0	12.2	1065	15.9	12.2

Meadowbrook Park - Drainage Report
Existing Runoff Calculations *Design Storm* *5 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-A	8.18	0.09	16.5	0.74	3.38	2.49					Existing On-Site Property (Vacant Undeveloped Land
2	EX-B	1.34	0.50	7.7	0.67	4.52	3.01					Flows from CDOT ROW, sheet flowing onto property
3	EX-C	3.87	0.52	12.2	2.01	3.83	7.71					Flows from CDOT ROW at the culvert outlet design point

Meadowbrook Park - Drainage Report
Existing Runoff Calculations *Design Storm* *100 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	EX-A	8.18	0.36	16.5	2.94	5.67	16.70					Existing On-Site Property (Vacant Undeveloped Land
2	EX-B	1.34	0.66	7.7	0.89	7.59	6.73					Flows from CDOT ROW, sheet flowing onto property
3	EX-C	3.87	0.68	12.2	2.63	6.43	16.89					Flows from CDOT ROW at the culvert outlet design point

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	EX-A	8.18	2.49	16.70		
2	EX-B	1.34	3.01	6.73		
3	EX-C	3.87	7.71	16.89		
TOTAL		13.40	13.21	40.32		

PROPOSED HYDROLOGIC CALCULATIONS

IDF Equations:

$I_{100} = -2.52\ln(D) + 12.735$
$I_{50} = -2.25\ln(D) + 11.375$
I_{25} $-2.00\ln(D) + 10.111$
I_{10} $-1.75\ln(D) + 8.847$
I_{5} $-1.50\ln(D) + 7.583$
I_{2} $-1.19\ln(D) + 6.035$

Where:
I = Rainfall Intensity (in/hr)
D= Duration (minutes)

	<u>2-yr</u>	<u>5-yr</u>	<u>10-yr</u>	<u>100-yr</u>
P_1 =	1.19	1.5	1.75	2.52

Time Intensity Frequency Tabulation

Time	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
5	4.12	5.17	6.03	6.89	7.75	8.68
10	3.29	4.13	4.82	5.51	6.19	6.93
15	2.81	3.52	4.11	4.69	5.28	5.91
30	1.99	2.48	2.89	3.31	3.72	4.16
60	1.16	1.44	1.68	1.92	2.16	2.42
120	0.34	0.40	0.47	0.54	0.60	0.67

*The Design Point Rainfall Values and Time Intensity Frequency Tabulation are found in Table 6-2 and Figure 6-5 respectively, of the Colorado Springs Drainage Criteria Manual, Volume 1

Weighted Imperviousness Calculations

	AREA	AREA	ROOF	ROOF	ROOF				LANDSCAPE	LANDSCAPE	LANDSCAPE				PAVEMENT	PAVEMENT	PAVEMENT				WEIGHTED	WEIGHTED COEFFICIENTS			
SUB-BASIN	(SF)	(Acres)	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	IMPERVIOUSNESS	C2	C5	C10	C100
A	107,496	2.47	21,654	90%	0.71	0.73	0.75	0.81	85,842	0%	0.03	0.09	0.17	0.36	0	100%	0.89	0.90	0.92	0.96	18.1%	0.17	0.22	0.29	0.45
B	80,559	1.85	22,073	90%	0.71	0.73	0.75	0.81	34,457	0%	0.03	0.09	0.17	0.36	24,029	100%	0.89	0.90	0.92	0.96	54.5%	0.47	0.51	0.55	0.66
C	8,878	0.20	0	90%	0.71	0.73	0.75	0.81	1,377	0%	0.03	0.09	0.17	0.36	7,501	100%	0.89	0.90	0.92	0.96	84.5%	0.76	0.77	0.80	0.87
D	38,113	0.87	10,260	90%	0.71	0.73	0.75	0.81	20,629	0%	0.03	0.09	0.17	0.36	7,224	100%	0.89	0.90	0.92	0.96	43.2%	0.38	0.42	0.47	0.59
E	18,246	0.42	0	90%	0.71	0.73	0.75	0.81	4,546	0%	0.03	0.09	0.17	0.36	13,700	100%	0.89	0.90	0.92	0.96	75.1%	0.68	0.70	0.73	0.81
F	4,229	0.10	0	90%	0.71	0.73	0.75	0.81	79	0%	0.03	0.09	0.17	0.36	4,150	100%	0.89	0.90	0.92	0.96	98.1%	0.87	0.88	0.91	0.95
G	40,228	0.92	8,808	90%	0.71	0.73	0.75	0.81	20,973	0%	0.03	0.09	0.17	0.36	10,447	100%	0.89	0.90	0.92	0.96	45.7%	0.40	0.44	0.49	0.61
H	35,948	0.83	6,289	90%	0.71	0.73	0.75	0.81	18,616	0%	0.03	0.09	0.17	0.36	11,043	100%	0.89	0.90	0.92	0.96	46.5%	0.41	0.45	0.50	0.62
I	12,368	0.28	0	90%	0.71	0.73	0.75	0.81	5,168	0%	0.03	0.09	0.17	0.36	7,200	100%	0.89	0.90	0.92	0.96	58.2%	0.53	0.56	0.61	0.71
J	9,994	0.23	0	90%	0.71	0.73	0.75	0.81	3,127	0%	0.03	0.09	0.17	0.36	6,867	100%	0.89	0.90	0.92	0.96	68.7%	0.62	0.65	0.69	0.77
OS-A	77,099	1.77	0	90%	0.71	0.73	0.75	0.81	34,833	2%	0.03	0.09	0.17	0.36	42,266	100%	0.89	0.90	0.92	0.96	55.7%	0.50	0.53	0.58	0.69
OS-B	58,532	1.34	0	90%	0.71	0.73	0.75	0.81	29,227	2%	0.03	0.09	0.17	0.36	29,305	100%	0.89	0.90	0.92	0.96	51.1%	0.46	0.50	0.55	0.66
OS-C	91,667	2.10	0	90%	0.71	0.73	0.75	0.81	44,340	2%	0.03	0.09	0.17	0.36	47,327	100%	0.89	0.90	0.92	0.96	52.6%	0.47	0.51	0.56	0.67
TOTAL (A-J)	356,059	8.17	69,084	90%	0.71	0.73	0.75	0.81	194,814	0%	0.03	0.09	0.17	0.36	92,161	100%	0.89	0.90	0.92	0.96	43.3%	0.38	0.42	0.48	0.60
TOTAL	583,357	13.39	69084	90%	0.71	0.73	0.75	0.81	303,214	0%	0.03	0.09	0.17	0.36	211,059	100%	0.89	0.90	0.92	0.96	46.8%	0.42	0.46	0.51	0.63

Meadowbrook Park - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
1	A	107,496	2.47	0.22	100	15.0%	6.5	745	2.3%	15.00	2.3	5.5	12.0	845	14.7	12.0
2	B	80,559	1.85	0.51	90	2.9%	7.2	200	1.0%	20.00	2.0	1.7	8.9	290	11.6	8.9
3	C	8,878	0.20	0.77	30	1.3%	3.0	225	3.0%	20.00	3.5	1.1	5.0	255	11.4	5.0
4	D	38,113	0.87	0.42	100	3.0%	8.7	235	0.5%	20.00	1.4	2.8	11.5	335	11.9	11.5
5	E	18,246	0.42	0.70	70	2.8%	4.4	420	2.3%	20.00	3.0	2.3	6.7	490	12.7	6.7
6	F	4,229	0.10	0.88	6	2.0%	0.8	150	2.0%	20.00	2.8	0.9	5.0	156	10.9	5.0
7	G	40,228	0.92	0.44	100	3.0%	8.4	170	2.0%	20.00	2.8	1.0	9.4	270	11.5	9.4
8	H	35,948	0.83	0.45	100	8.5%	5.8	190	0.5%	20.00	1.4	2.2	8.0	290	11.6	8.0
9	I	12,368	0.28	0.56	100	10.0%	4.6	109	2.7%	20.00	3.3	0.6	5.2	209	11.2	5.2
10	J	9,994	0.23	0.65	70	5.5%	3.9	160	2.8%	20.00	3.3	0.8	5.0	230	11.3	5.0
11	OS-A	77,099	1.77	0.53	100	4.3%	6.4	665	2.5%	15.00	2.4	4.7	11.1	765	14.3	11.1
12	OS-B	58,532	1.34	0.50	65	4.5%	5.4	405	3.8%	15.00	2.9	2.3	7.7	470	12.6	7.7
13	OS-C	91,667	2.10	0.51	65	4.5%	5.3	1035	1.9%	15.00	2.1	8.3	13.6	1100	16.1	13.6

Meadowbrook Park - Drainage Report

Proposed Runoff Calculations

Design Storm *5 Year*

(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	A	2.47	0.22	12.0	0.54	3.85	2.08					
2	B	1.85	0.51	8.9	0.94	4.31	4.04					
3	C	0.20	0.77	5.0	0.16	5.17	0.82					
4	D	0.87	0.42	11.5	0.36	3.92	1.43					
5	E	0.42	0.70	6.7	0.29	4.73	1.38					
6	F	0.10	0.88	5.0	0.09	5.17	0.44					
7	G	0.92	0.44	9.4	0.41	4.22	1.72					
8	H	0.83	0.45	8.0	0.37	4.46	1.66					
9	I	0.28	0.56	5.2	0.16	5.12	0.82					
10	J	0.23	0.65	5.0	0.15	5.17	0.77					
11	OS-A	1.77	0.53	11.1	0.95	3.98	3.76					
12	OS-B	1.34	0.50	7.7	0.67	4.52	3.01					
13	OS-C	2.10	0.51	13.6	1.07	3.66	3.92					

Meadowbrook Park - Drainage Report
Proposed Runoff Calculations *Design Storm* *100 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
1	A	2.47	0.45	12.0	1.11	6.47	7.19					
2	B	1.85	0.66	8.9	1.22	7.24	8.86					
3	C	0.20	0.87	5.0	0.18	8.68	1.53					
4	D	0.87	0.59	11.5	0.52	6.59	3.43					
5	E	0.42	0.81	6.7	0.34	7.94	2.70					
6	F	0.10	0.95	5.0	0.09	8.68	0.80					
7	G	0.92	0.61	9.4	0.57	7.09	4.02					
8	H	0.83	0.62	8.0	0.51	7.48	3.85					
9	I	0.28	0.71	5.2	0.20	8.60	1.73					
10	J	0.23	0.77	5.0	0.18	8.68	1.54					
11	OS-A	1.77	0.69	11.1	1.22	6.68	8.14					
12	OS-B	1.34	0.66	7.7	0.89	7.59	6.73					
13	OS-C	2.10	0.67	13.6	1.41	6.15	8.67					

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	A	2.47	2.08	7.19		
2	B	1.85	4.04	8.86		
3	C	0.20	0.82	1.53		
4	D	0.87	1.43	3.43		
5	E	0.42	1.38	2.70		
6	F	0.10	0.44	0.80		
7	G	0.92	1.72	4.02		
8	H	0.83	1.66	3.85		
9	I	0.28	0.82	1.73		
10	J	0.23	0.77	1.54		
11	OS-A	1.77	3.76	8.14		
12	OS-B	1.34	3.01	6.73		
13	OS-C	2.10	3.92	8.67		
14	POND OUTFALL		0.10	5.50		
TOTAL		13.39	25.84	59.19		

HYDRAULIC CALCULATIONS

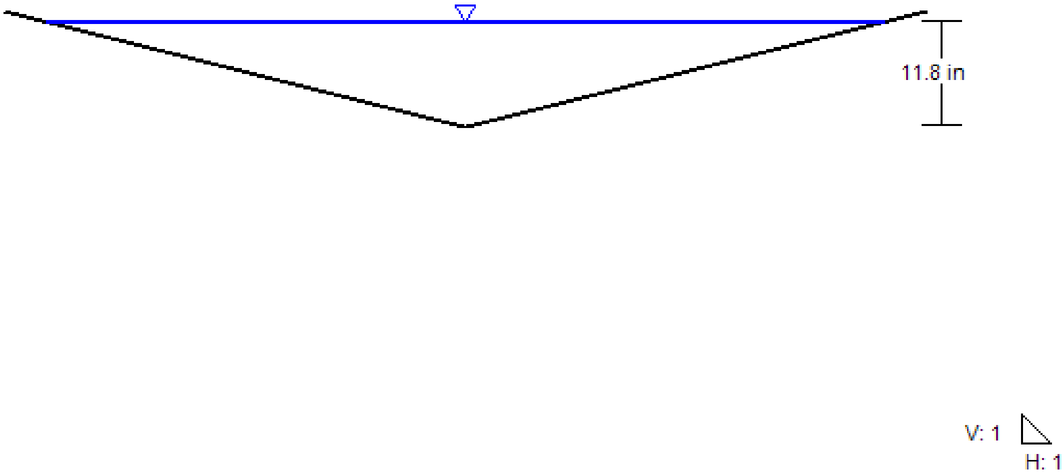
Cross Section for CDOT By Pass Ditch

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.040 ft/ft
Normal Depth	11.8 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	23.54 cfs



Worksheet for CDOT By Pass Ditch

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.040 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	23.54 cfs

Results

Normal Depth	11.8 in
Flow Area	3.9 ft²
Wetted Perimeter	8.1 ft
Hydraulic Radius	5.7 in
Top Width	7.89 ft
Critical Depth	14.0 in
Critical Slope	0.016 ft/ft
Velocity	6.06 ft/s
Velocity Head	0.57 ft
Specific Energy	1.56 ft
Froude Number	1.521
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.8 in
Critical Depth	14.0 in
Channel Slope	0.040 ft/ft
Critical Slope	0.016 ft/ft

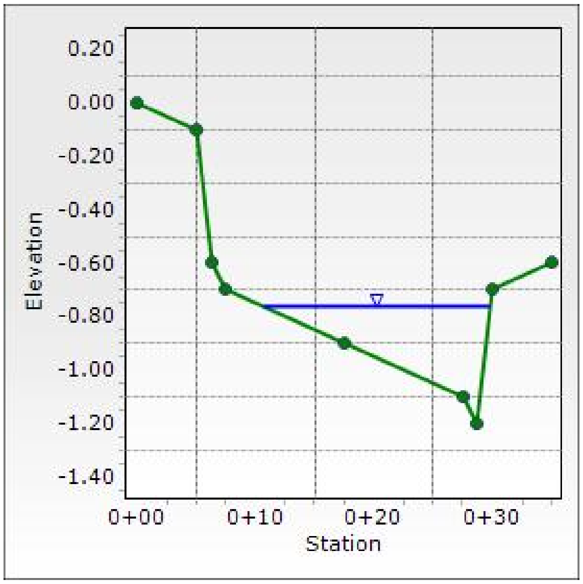
Cross Section for Emergency Overflow Spillway

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.011 ft/ft
Normal Depth	5.2 in
Discharge	11.20 cfs



Worksheet for Emergency Overflow Spillway

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.011 ft/ft
Discharge	11.20 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.00
0+05	-0.09
0+06	-0.60
0+08	-0.70
0+18	-0.90
0+28	-1.10
0+29	-1.20
0+30	-0.70
0+35	-0.60

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.00)	(0+05, -0.09)	0.013
(0+05, -0.09)	(0+06, -0.60)	0.013
(0+06, -0.60)	(0+08, -0.70)	0.013
(0+08, -0.70)	(0+18, -0.90)	0.016
(0+18, -0.90)	(0+28, -1.10)	0.016
(0+28, -1.10)	(0+29, -1.20)	0.013
(0+29, -1.20)	(0+30, -0.70)	0.013
(0+30, -0.70)	(0+35, -0.60)	0.013

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	5.2 in
Roughness Coefficient	0.016
Elevation	-0.76 ft
Elevation Range	-1.2 to 0.0 ft
Flow Area	3.5 ft²
Wetted Perimeter	19.2 ft

Worksheet for Emergency Overflow Spillway

Results

Hydraulic Radius	2.2 in
Top Width	19.08 ft
Normal Depth	5.2 in
Critical Depth	5.7 in
Critical Slope	0.006 ft/ft
Velocity	3.20 ft/s
Velocity Head	0.16 ft
Specific Energy	0.59 ft
Froude Number	1.319
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.2 in
Critical Depth	5.7 in
Channel Slope	0.011 ft/ft
Critical Slope	0.006 ft/ft

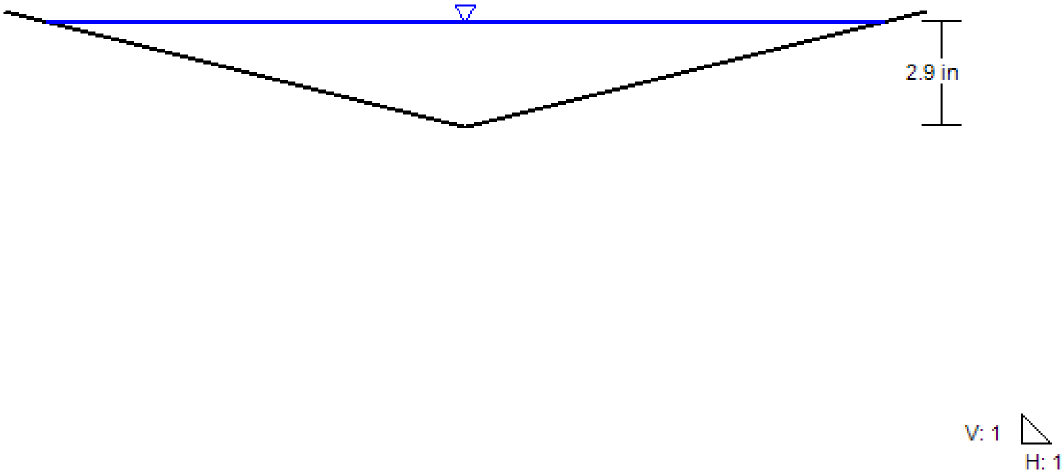
Cross Section for Meadowbrook Ditch North

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.010 ft/ft
Normal Depth	2.9 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	0.27 cfs



Worksheet for Meadowbrook Ditch North

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.010 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	0.27 cfs

Results

Normal Depth	2.9 in
Flow Area	0.2 ft²
Wetted Perimeter	2.0 ft
Hydraulic Radius	1.4 in
Top Width	1.91 ft
Critical Depth	2.3 in
Critical Slope	0.030 ft/ft
Velocity	1.18 ft/s
Velocity Head	0.02 ft
Specific Energy	0.26 ft
Froude Number	0.601
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.9 in
Critical Depth	2.3 in
Channel Slope	0.010 ft/ft
Critical Slope	0.030 ft/ft

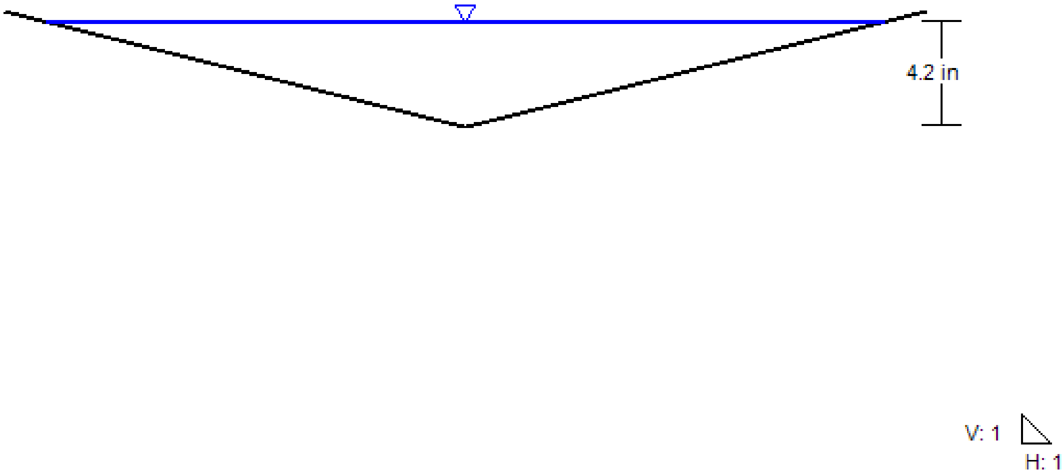
Cross Section for Meadowbrook Ditch-South

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.010 ft/ft
Normal Depth	4.2 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	0.73 cfs



Worksheet for Meadowbrook Ditch-South

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.010 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	0.73 cfs

Results

Normal Depth	4.2 in
Flow Area	0.5 ft²
Wetted Perimeter	2.9 ft
Hydraulic Radius	2.0 in
Top Width	2.78 ft
Critical Depth	3.5 in
Critical Slope	0.026 ft/ft
Velocity	1.51 ft/s
Velocity Head	0.04 ft
Specific Energy	0.38 ft
Froude Number	0.638
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	4.2 in
Critical Depth	3.5 in
Channel Slope	0.010 ft/ft
Critical Slope	0.026 ft/ft

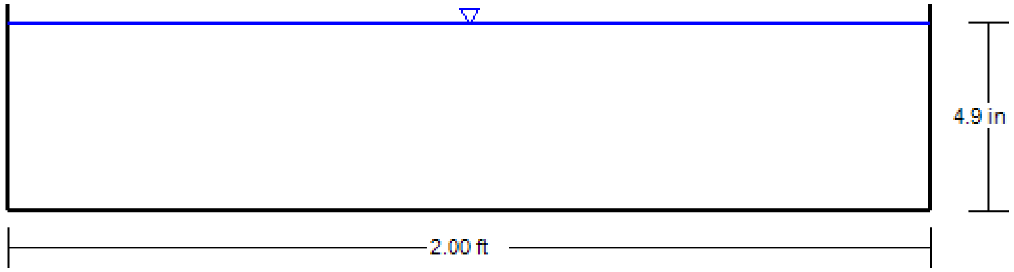
Cross Section for Rain Garden- Curb Chase

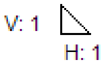
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.010	ft/ft
Normal Depth	4.9	in
Bottom Width	2.00	ft
Discharge	4.04	cfs





Worksheet for Rain Garden- Curb Chase

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Bottom Width	2.00 ft
Discharge	4.04 cfs

Results

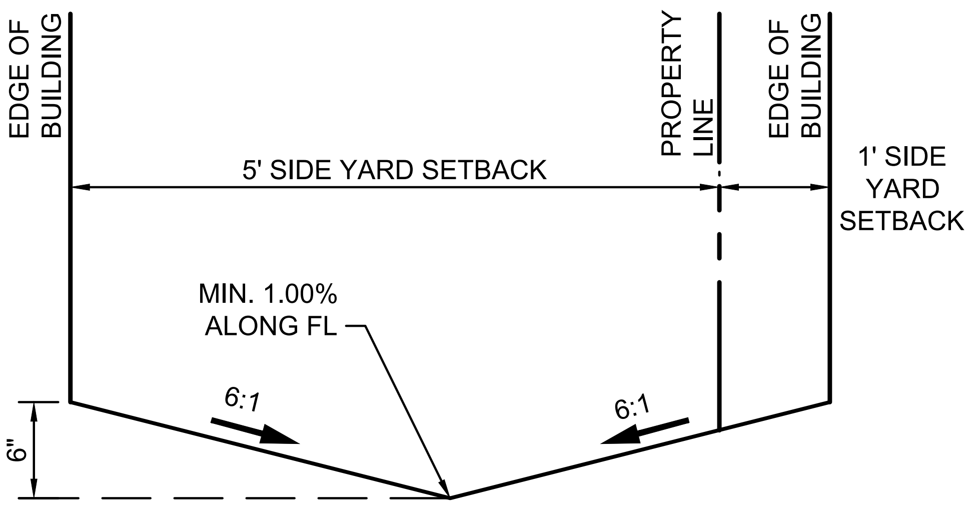
Normal Depth	4.9 in
Flow Area	0.8 ft²
Wetted Perimeter	2.8 ft
Hydraulic Radius	3.5 in
Top Width	2.00 ft
Critical Depth	6.0 in
Critical Slope	0.005 ft/ft
Velocity	4.99 ft/s
Velocity Head	0.39 ft
Specific Energy	0.79 ft
Froude Number	1.382
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.9 in
Critical Depth	6.0 in
Channel Slope	0.010 ft/ft
Critical Slope	0.005 ft/ft



PROPOSED SIDE LOT SWALE TYP. CROSS SECTION

NTS

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06/01/2021

Kimley»Horn

2 N NEVADA AVE., SUITE 300, COLORADO SPRINGS, 80903
PHONE: 719-453-0180

Worksheet for Side Lot Swale - Worst Case

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.010 ft/ft
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	2.92 cfs

Results

Normal Depth	6.0 in
Flow Area	1.5 ft²
Wetted Perimeter	6.1 ft
Hydraulic Radius	3.0 in
Top Width	6.00 ft
Critical Depth	5.2 in
Critical Slope	0.022 ft/ft
Velocity	1.95 ft/s
Velocity Head	0.06 ft
Specific Energy	0.56 ft
Froude Number	0.686
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	6.0 in
Critical Depth	5.2 in
Channel Slope	0.010 ft/ft
Critical Slope	0.022 ft/ft

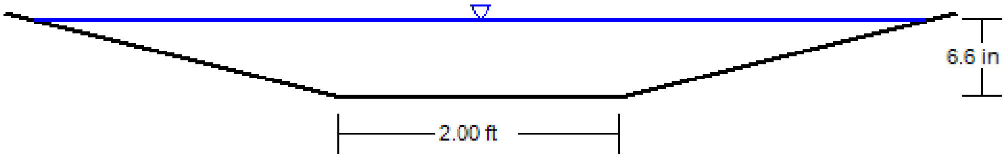
Cross Section for Trapezoidal Channel -Sub-Basin A

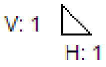
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.016 ft/ft
Normal Depth	6.6 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	2.00 ft
Discharge	7.19 cfs





Worksheet for Trapezoidal Channel -Sub-Basin A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030
Channel Slope	0.016 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	2.00 ft
Discharge	7.19 cfs

Results

Normal Depth	6.6 in
Flow Area	2.3 ft²
Wetted Perimeter	6.5 ft
Hydraulic Radius	4.2 in
Top Width	6.39 ft
Critical Depth	6.3 in
Critical Slope	0.019 ft/ft
Velocity	3.13 ft/s
Velocity Head	0.15 ft
Specific Energy	0.70 ft
Froude Number	0.919
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	6.6 in
Critical Depth	6.3 in
Channel Slope	0.016 ft/ft
Critical Slope	0.019 ft/ft

Ditches

Description	Drainage Area (DA)	Drainage Area (DA)	Runoff Coefficient (C)	Intensity (100-Year)	Flow (Q)	Velocity (V)	Liner	Ditch Shape	Bottom Width	Side Slope (H:V)	Total Depth	Running Slope	Depth of Flow	Manning's Number (n)	Freeboard	Channel Top Width	Ridge Width	Ridge Height
ID	sf	ac		in/hr	cfs	ft/s			ft	x:1	ft	%	ft		ft	ft	ft	ft
1) CDOT By Pass Ditch	226,948	5.21	0.69	8.67	23.54	6.09	Ch-2	Triangular	0	4:1	2.00	4.00	0.98	0.030	1.02	9.0	4	2.00
2) Meadowbrook Ditch North	4,792	0.11	0.35	6.79	0.26	1.20	N/A	Triangular	0	4:1	1.40	1.00	0.23	0.030	1.17	13.2	4	1.40
3) Meabowbrook Ditch South	13,939	0.32	0.35	6.65	0.74	2.75	N/A	Triangular	0	4:1	1.40	1.00	0.26	0.030	1.14	1.9	4	1.40
4) Trapezoidal Channel Sub-basin A	107,593	2.47	0.45	6.47	7.19	3.11	Ch-1	Trapizoidal	2	4:1	2.00	1.60	0.55	0.030	1.45	6.4	4	2.00

SITE DATA

Location:	Colorado Springs
Frequency:	100-Year
Cover Desc.:	Graded Soil (Sandy 5-10%)
Channel Material:	Bare Soil

Blue = User Entered (Verify they reflect the current design)

Green = Calculated

Channel Lining

Description	BMP
Bare Soil	N/A
Synthetic Mat	Ch-1
Gravel Riprap	Ch-2
Rock Riprap	Ch-2
Concrete	Ch-3
Asphalt	Ch-3

ALLOWABLE VELOCITY AND MAXIMUM SHEAR STRESS
Streambank and Shoreland Protection Code 580

Type of Treatment	Allowable Shear lb/sq ft	Velocity ft/sec
Brush Mattresses[1]		
Staked only w/ rock riprap toe (initial)	0.8 - 4.1	5
Staked only w/ rock riprap toe (grown)	4.0 - 8.0	12
Coir Geotextile Roll[2]		
Roll with coir rope mesh staked only without rock riprap toe	0.2 - 0.8	< 5
Roll with Polypropylene rope mesh staked only without rock riprap toe	0.8 - 3.0	< 8
Roll with Polypropylene rope mesh staked and with rock riprap toe	3.0 - 4.0	< 12
Live Fascine[3]		
LF Bundle w/ rock riprap toe	2.0 - 3.1	8
Soils[4]		
Fine colloidal sand	0.02-0.03	1.5
Sandy loam (noncolloidal)	0.03-0.04	1.75
Alluvial silt (noncolloidal)	0.045-0.05	2
Silty loam (noncolloidal)	0.045-0.05	1.75-2.25
Firm loam	0.075	2.5
Fine gravels	0.075	2.5
Stiff clay	0.26	3-4.5
Alluvial silt (colloidal)	0.26	3.75
Graded loam to cobbles	0.38	3.75
Graded silts to cobbles	0.43	4
Shales and hardpan	0.67	6
Gravel/Cobble[4]		
1-inch	0.33	2.5-5
2-inch	0.67	3-6
6-inch	2	4-7.5
12-inch	4	5.5-12
Vegetation[4]		
Class A turf (ret class)	3.7	6-8
Class B turf (ret class)	2.1	4-7
Class C turf (ret class)	1	3.5
Retardance Class D	0.6	Design of roadside channels HEC-15
Retardance Class E	0.35	
Long native grasses	1.2-1.7	4-6
Short native and bunch grass	0.7-0.95	3-4

Tractive Forces (psf)= 62.4 lb/cf x normal depth (ft) x S (ft/ft)- 62.4 x (11.8/12) x 0.04 = 2.5 psf

Type of Treatment	Allowable Shear lb/sq ft	Velocity ft/sec
Soil Bioengineering[4]		
Wattles	0.2-1.0	3
Reed fascine	0.6-1.25	5
Coir roll	3-5	8
Vegetated coir mat	4-8	9.5
Live brush mattress (initial)	0.4-4.1	4
Live brush mattress (grown)	3.90-8.2	12
Brush layering (initial/grown)	0.4-6.25	12
Live fascine	1.25-3.10	6-8
Live willow stakes	2.10-3.10	3-10
Hard Surfacing[4]		
Gabions	10	14-19
Concrete	12.5	>18
Boulder Clusters[5]		
Boulder		
Very large (>80-inch diameter)	37.4	25
Large (>40-in diameter)	18.7	19
Medium (>20-inch diameter)	9.3	14
Small (>10-inch diameter)	4.7	10
Cobble		
Large (>5-inch diameter)	2.3	7
Small (>2.5-inch diameter)	1.1	5
Gravel		
Very Course (>1.25-inch diameter)	0.54	3
Course (>.63-inch diameter)	0.25	2.5

[1] Brush mattresses (ERDC TN EMRRP-SR-23): http://el.erdc.usace.army.mil/emrrp/pdf/sr23.pdf.
[2] Coir Geotextile roll (ERDC TN EMRRP-SR-04): http://el.erdc.usace.army.mil/emrrp/pdf/sr04.pdf.
[3] Live Fascine (ERDC TN EMRRP-SR-31): http://el.erdc.usace.army.mil/emrrp/pdf/sr31.pdf.
[4] Stream Restoration Materials (ERDC TN EMRRP-SR-29): http://el.erdc.usace.army.mil/emrrp/pdf/sr29.pdf.
[5] Boulder Clusters (ERDC TN EMRRP-SR-11): http://el.erdc.usace.army.mil/emrrp/pdf/sr11.pdf.

Additional Sources:

Wisconsin Department of Transportation, Erosion Control - Product Acceptability List (PAL):
http://www.dot.wisconsin.gov/library/research/docs/finalreports/tau-finalreports/erosion.pdf

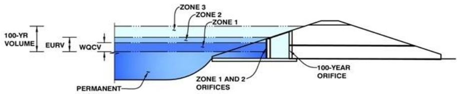
Texas Department of Transportation, Approved Products List:
http://www.dot.state.tx.us/mnt/erosion/contents.htm

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Meadowbrook Park

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type = EDB
Watershed Area = 8.17 acres
Watershed Length = 1,090 ft
Watershed Length to Centroid = 350 ft
Watershed Slope = 0.040 ft/ft
Watershed Imperviousness = 43.30% percent
Percentage Hydrologic Soil Group A = 100.0% percent
Percentage Hydrologic Soil Group B = 0.0% percent
Percentage Hydrologic Soil Groups C/D = 0.0% percent
Target WQCV Drain Time = 40.0 hours
Location for 1-hr Rainfall Depths = User Input

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.101	acre-feet	0.101	acre-feet
Excess Urban Runoff Volume (EURV) =	0.392	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.288	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.386	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.463	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.600	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.734	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.908	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.282	acre-feet		inches
Approximate 2-yr Detention Volume =	0.250	acre-feet		
Approximate 5-yr Detention Volume =	0.331	acre-feet		
Approximate 10-yr Detention Volume =	0.406	acre-feet		
Approximate 25-yr Detention Volume =	0.502	acre-feet		
Approximate 50-yr Detention Volume =	0.565	acre-feet		
Approximate 100-yr Detention Volume =	0.648	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) = 0.101 acre-feet
Zone 2 Volume (EURV - Zone 1) = 0.291 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) = 0.256 acre-feet
Total Detention Basin Volume = 0.648 acre-feet
Initial Surcharge Volume (ISV) = user ft^3
Initial Surcharge Depth (ISD) = user ft
Total Available Detention Depth (H_{total}) = user ft
Depth of Trickle Channel (H_{TC}) = user ft
Slope of Trickle Channel (S_{TC}) = user ft/ft
Slopes of Main Basin Sides (S_{main}) = user H:V
Basin Length-to-Width Ratio ($R_{L/W}$) = user

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

Depth Increement = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	16	0.000		
Top of ISV	--	0.55	--	--	--	22	0.001	10	0.000
	--	0.65	--	--	--	57	0.001	14	0.000
	--	0.75	--	--	--	147	0.003	25	0.001
	--	0.85	--	--	--	278	0.006	46	0.001
	--	0.95	--	--	--	434	0.010	81	0.002
	--	1.05	--	--	--	615	0.014	134	0.003
	--	1.15	--	--	--	814	0.019	205	0.005
	--	1.25	--	--	--	1,026	0.024	297	0.007
	--	1.35	--	--	--	1,287	0.030	413	0.009
	--	1.45	--	--	--	1,556	0.036	555	0.013
	--	1.55	--	--	--	1,823	0.042	724	0.017
	--	1.65	--	--	--	2,124	0.049	921	0.021
	--	1.75	--	--	--	2,458	0.056	1,151	0.026
	--	1.85	--	--	--	2,846	0.065	1,416	0.033
	--	1.95	--	--	--	3,816	0.088	1,749	0.040
	--	2.05	--	--	--	4,437	0.102	2,161	0.050
	--	2.15	--	--	--	5,224	0.120	2,644	0.061
	--	2.25	--	--	--	6,307	0.145	3,221	0.074
	--	2.35	--	--	--	6,666	0.153	3,870	0.089
	--	2.45	--	--	--	7,002	0.161	4,553	0.105
	--	2.55	--	--	--	7,449	0.171	5,276	0.121
	--	2.65	--	--	--	7,916	0.182	6,044	0.139
	--	2.75	--	--	--	8,441	0.194	6,862	0.158
	--	2.85	--	--	--	9,005	0.207	7,734	0.178
	--	2.95	--	--	--	9,556	0.219	8,662	0.199
	--	3.05	--	--	--	10,096	0.232	9,645	0.221
	--	3.15	--	--	--	10,634	0.244	10,681	0.245
	--	3.25	--	--	--	11,191	0.257	11,772	0.270
	--	3.35	--	--	--	12,559	0.288	12,960	0.298
	--	3.45	--	--	--	12,056	0.277	14,191	0.326
	--	3.55	--	--	--	12,386	0.284	15,413	0.354
	--	3.65	--	--	--	12,718	0.292	16,668	0.383
	--	3.75	--	--	--	13,050	0.300	17,956	0.412
	--	3.85	--	--	--	13,384	0.307	19,278	0.443
	--	3.95	--	--	--	13,720	0.315	20,633	0.474
	--	4.05	--	--	--	14,057	0.323	22,022	0.506
	--	4.15	--	--	--	14,395	0.330	23,445	0.538
	--	4.25	--	--	--	14,734	0.338	24,901	0.572
	--	4.35	--	--	--	15,080	0.346	26,392	0.606
	--	4.45	--	--	--	15,434	0.354	27,918	0.641
	--	4.55	--	--	--	15,793	0.363	29,479	0.677
	--	4.65	--	--	--	17,002	0.390	31,119	0.714
	--	4.75	--	--	--	17,444	0.400	32,841	0.754
	--	4.85	--	--	--	17,833	0.409	34,605	0.794
	--	4.95	--	--	--	18,199	0.418	36,406	0.836
	--	5.05	--	--	--	18,586	0.427	38,246	0.878
	--	5.15	--	--	--	18,965	0.435	40,123	0.921
	--	5.25	--	--	--	19,308	0.443	42,037	0.965
	--	5.35	--	--	--	19,656	0.451	43,985	1.010
	--	5.45	--	--	--	20,089	0.461	45,972	1.055
	--	5.55	--	--	--	20,410	0.469	47,997	1.102
	--	5.65	--	--	--	20,747	0.476	50,055	1.149
	--	5.75	--	--	--	21,001	0.482	52,143	1.197
	--	5.85	--	--	--	21,480	0.493	54,267	1.246
	--	5.95	--	--	--	21,646	0.497	56,423	1.295
	--	6.05	--	--	--	21,700	0.498	58,590	1.345
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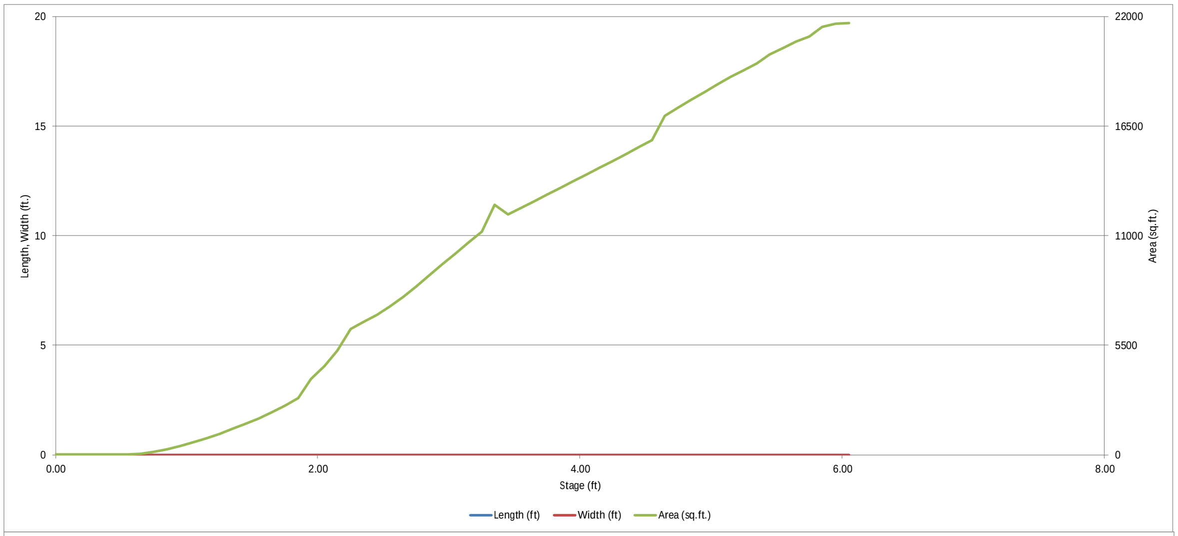
Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
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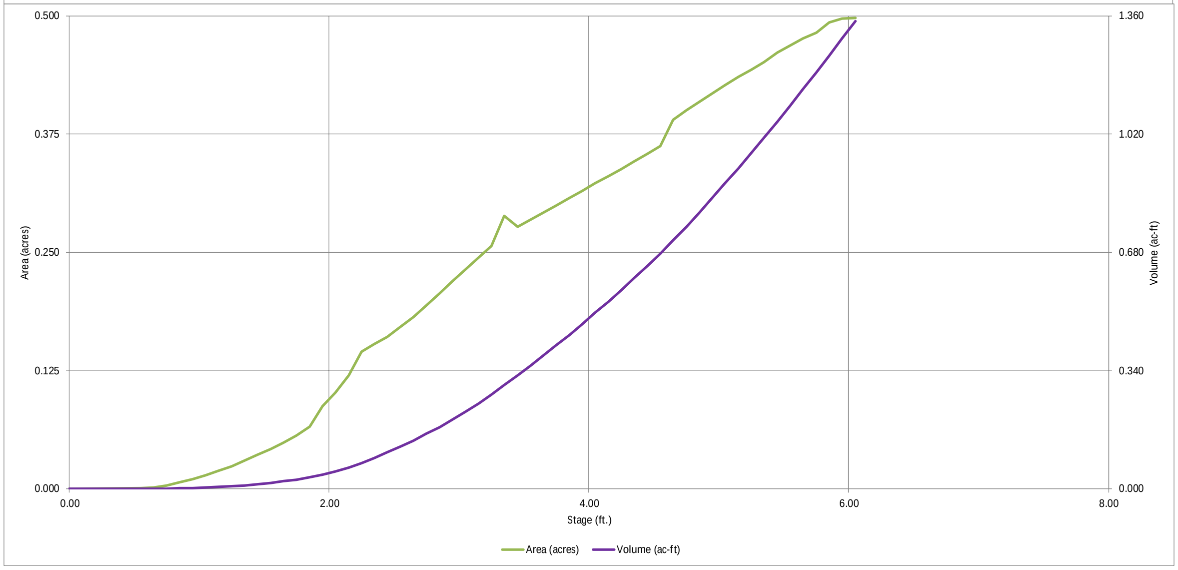
10
15
20
0
5500
11000
16500
22000
0.00
2.00
4.00
6.00
8.00
Length (ft)
Width (ft)
Area (sq.ft.)


Area (acres)
Volume (ac-ft)
Stage (ft.)
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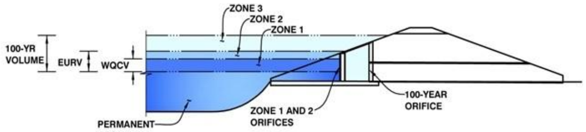
0.375
0.500
0.000
0.340
0.680
1.020
1.360
0.00
2.00
4.00
6.00
8.00
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Meadowbrook Park
Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.43	0.101	Orifice Plate
Zone 2 (EURV)	3.69	0.291	Circular Orifice
Zone 3 (100-year)	4.48	0.256	Weir&Pipe (Restrict)
Total (all zones)		0.648	

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.69	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.47	sq. inches (diameter = 3/4 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	3.264E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.50						
Orifice Area (sq. inches)	0.47	0.47						

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.43	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.69	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	1.88	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.02	N/A	ft^2
Vertical Orifice Centroid =	0.08	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.69	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.67	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.79	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.69	N/A	feet
Overflow Weir Slope Length =	2.79	N/A	feet
Grate Open Area / 100-yr Orifice Area =	13.24	N/A	
Overflow Grate Open Area w/o Debris =	7.12	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.56	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 =	0.50	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 =	5.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.54	N/A	ft^2
Outlet Orifice Centroid =	0.25	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.84	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.52	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.35	feet
Stage at Top of Freeboard =	5.87	feet
Basin Area at Top of Freeboard =	0.49	acres
Basin Volume at Top of Freeboard =	1.25	acre-ft

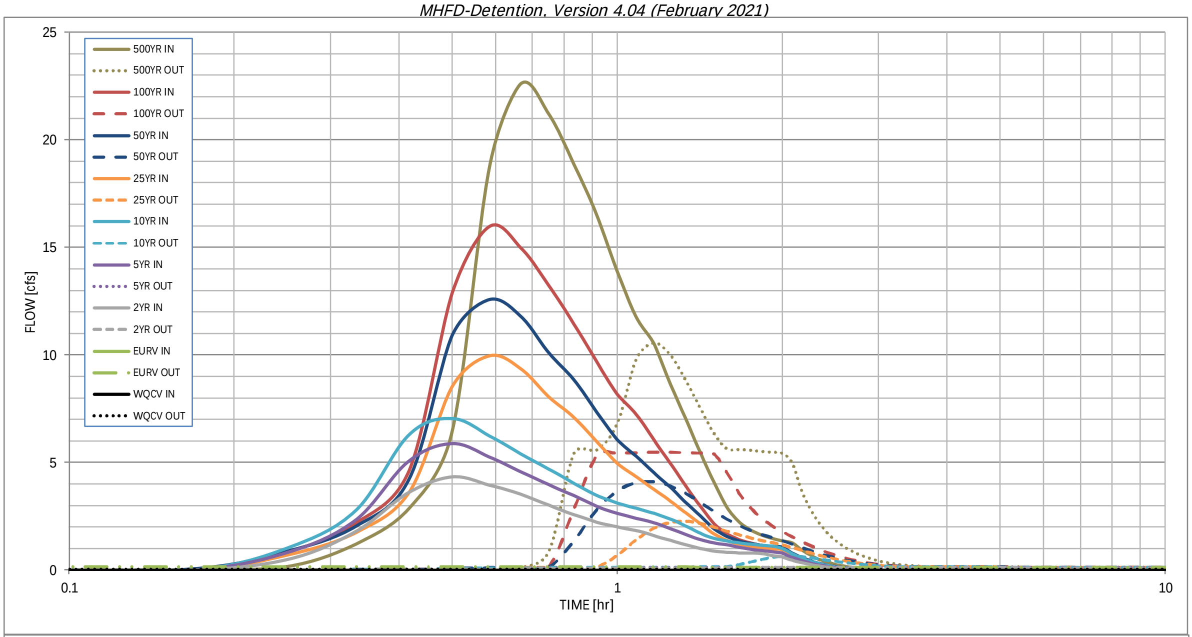
Routed Hydrograph Results

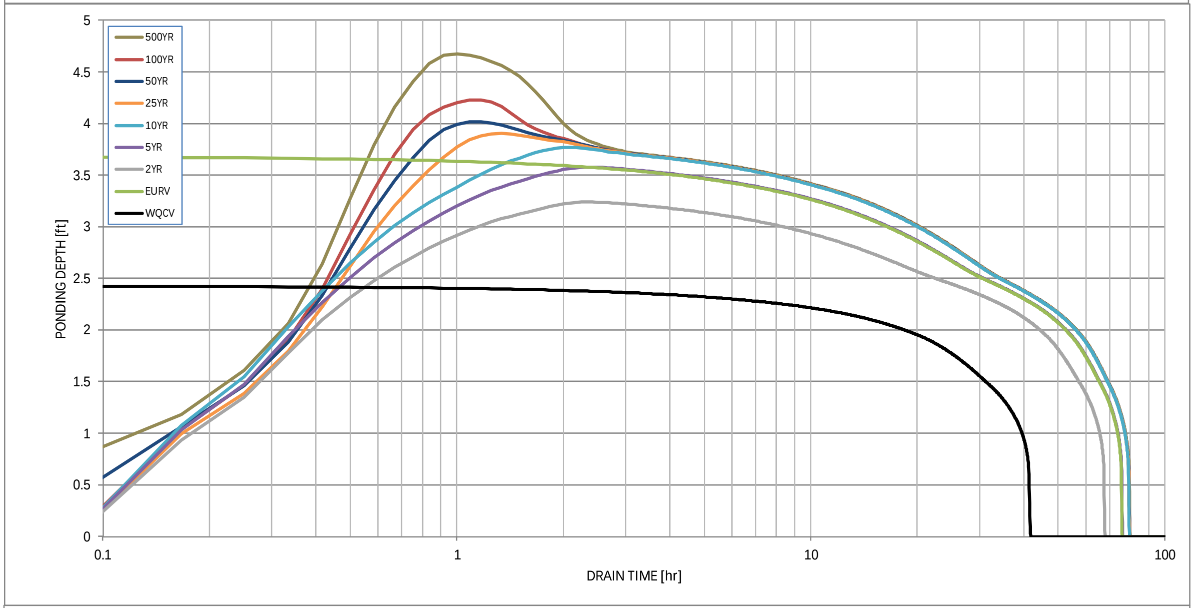
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

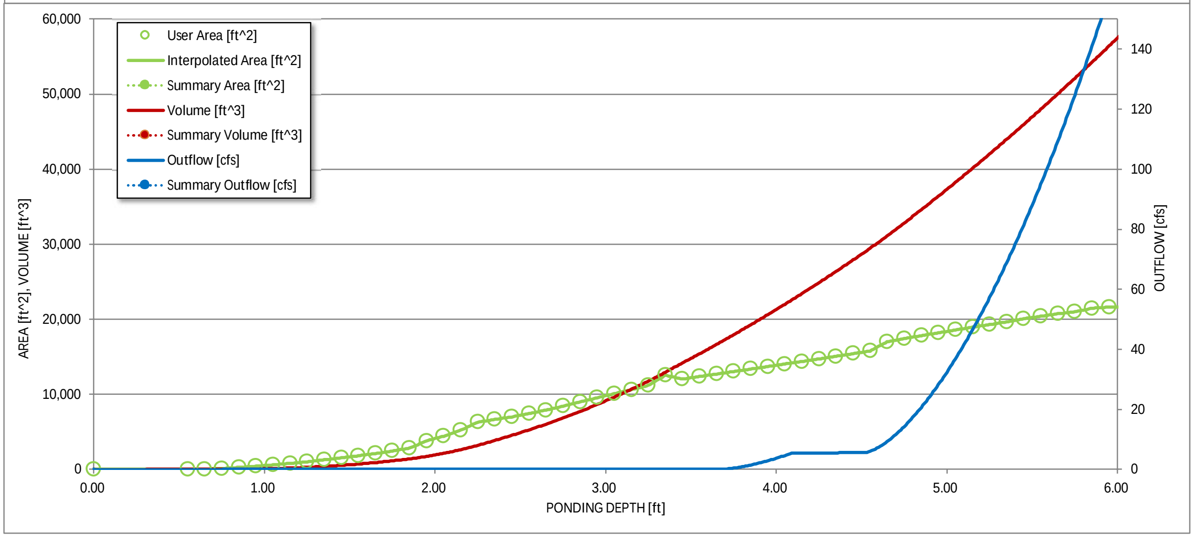
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.101	0.392	0.288	0.386	0.463	0.600	0.734	0.908	1.282
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.288	0.386	0.463	0.600	0.734	0.908	1.282
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.7	3.4	5.6	9.9
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	0.42	0.68	1.22
Peak Inflow Q (cfs) =	N/A	N/A	4.3	5.9	7.1	10.0	12.6	16.0	22.6
Peak Outflow Q (cfs) =	0.0	0.2	0.1	0.1	0.7	2.3	4.1	5.5	10.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	3.5	1.3	1.2	1.0	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.3	0.6	0.7	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	67	61	67	69	67	65	63	59
Time to Drain 99% of Inflow Volume (hours) =	41	72	65	73	76	75	74	73	70
Maximum Ponding Depth (ft) =	2.43	3.69	3.24	3.58	3.77	3.91	4.02	4.23	4.68
Area at Maximum Ponding Depth (acres) =	0.16	0.30	0.26	0.29	0.30	0.31	0.32	0.34	0.39
Maximum Volume Stored (acre-ft) =	0.101	0.394	0.268	0.360	0.418	0.458	0.493	0.565	0.722

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.01	0.19
	0:15:00	0.00	0.00	0.51	0.83	1.04	0.70	0.88	0.86	1.23
	0:20:00	0.00	0.00	1.81	2.36	2.78	1.76	2.05	2.21	2.88
	0:25:00	0.00	0.00	3.63	5.09	6.31	3.63	4.24	4.65	6.44
	0:30:00	0.00	0.00	4.33	5.88	7.06	8.53	10.91	12.87	18.68
	0:35:00	0.00	0.00	3.97	5.27	6.26	9.98	12.58	15.98	22.60
	0:40:00	0.00	0.00	3.53	4.58	5.41	9.37	11.81	15.00	21.21
	0:45:00	0.00	0.00	3.02	3.98	4.71	8.06	10.11	13.23	18.88
	0:50:00	0.00	0.00	2.59	3.47	4.04	7.11	8.85	11.45	16.50
	0:55:00	0.00	0.00	2.24	2.98	3.47	5.97	7.35	9.69	13.89
	1:00:00	0.00	0.00	2.01	2.65	3.13	4.98	6.08	8.19	11.76
	1:05:00	0.00	0.00	1.84	2.42	2.88	4.34	5.28	7.24	10.49
	1:10:00	0.00	0.00	1.61	2.21	2.63	3.75	4.52	6.03	8.64
	1:15:00	0.00	0.00	1.39	1.94	2.39	3.23	3.86	4.98	7.04
	1:20:00	0.00	0.00	1.18	1.66	2.06	2.66	3.15	3.91	5.47
	1:25:00	0.00	0.00	1.01	1.42	1.71	2.17	2.53	2.98	4.10
	1:30:00	0.00	0.00	0.90	1.27	1.48	1.69	1.94	2.19	2.94
	1:35:00	0.00	0.00	0.84	1.19	1.36	1.38	1.57	1.69	2.26
	1:40:00	0.00	0.00	0.81	1.07	1.27	1.21	1.37	1.43	1.89
	1:45:00	0.00	0.00	0.80	0.98	1.21	1.10	1.25	1.26	1.64
	1:50:00	0.00	0.00	0.79	0.91	1.17	1.03	1.16	1.16	1.47
	1:55:00	0.00	0.00	0.69	0.86	1.12	0.99	1.11	1.08	1.36
	2:00:00	0.00	0.00	0.61	0.80	1.02	0.95	1.07	1.02	1.28
	2:05:00	0.00	0.00	0.47	0.61	0.77	0.73	0.81	0.76	0.95
	2:10:00	0.00	0.00	0.35	0.45	0.57	0.54	0.60	0.56	0.70
	2:15:00	0.00	0.00	0.26	0.34	0.42	0.40	0.44	0.42	0.52
	2:20:00	0.00	0.00	0.19	0.25	0.31	0.29	0.33	0.31	0.38
	2:25:00	0.00	0.00	0.14	0.18	0.23	0.21	0.23	0.22	0.27
	2:30:00	0.00	0.00	0.10	0.13	0.16	0.15	0.17	0.16	0.19
	2:35:00	0.00	0.00	0.07	0.09	0.12	0.11	0.12	0.11	0.14
	2:40:00	0.00	0.00	0.05	0.06	0.08	0.07	0.08	0.08	0.09
	2:45:00	0.00	0.00	0.03	0.04	0.05	0.05	0.05	0.05	0.06
	2:50:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.02	0.03
	2:55:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

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

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

Figure 13-12c. Emergency Spillway Protection

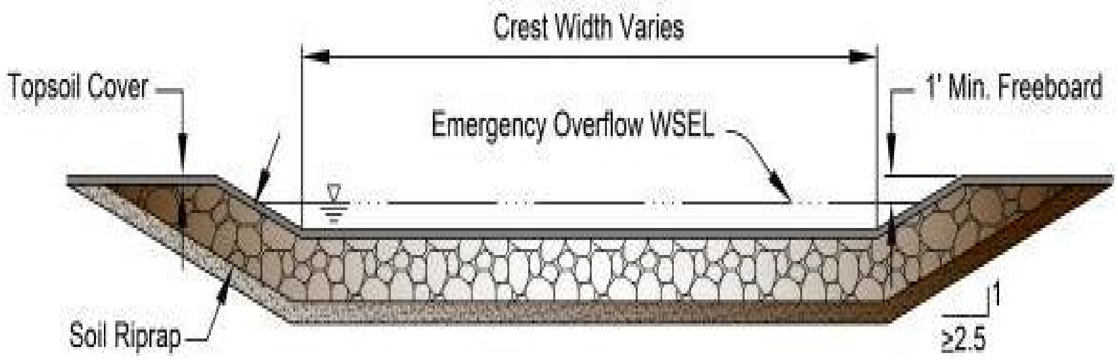
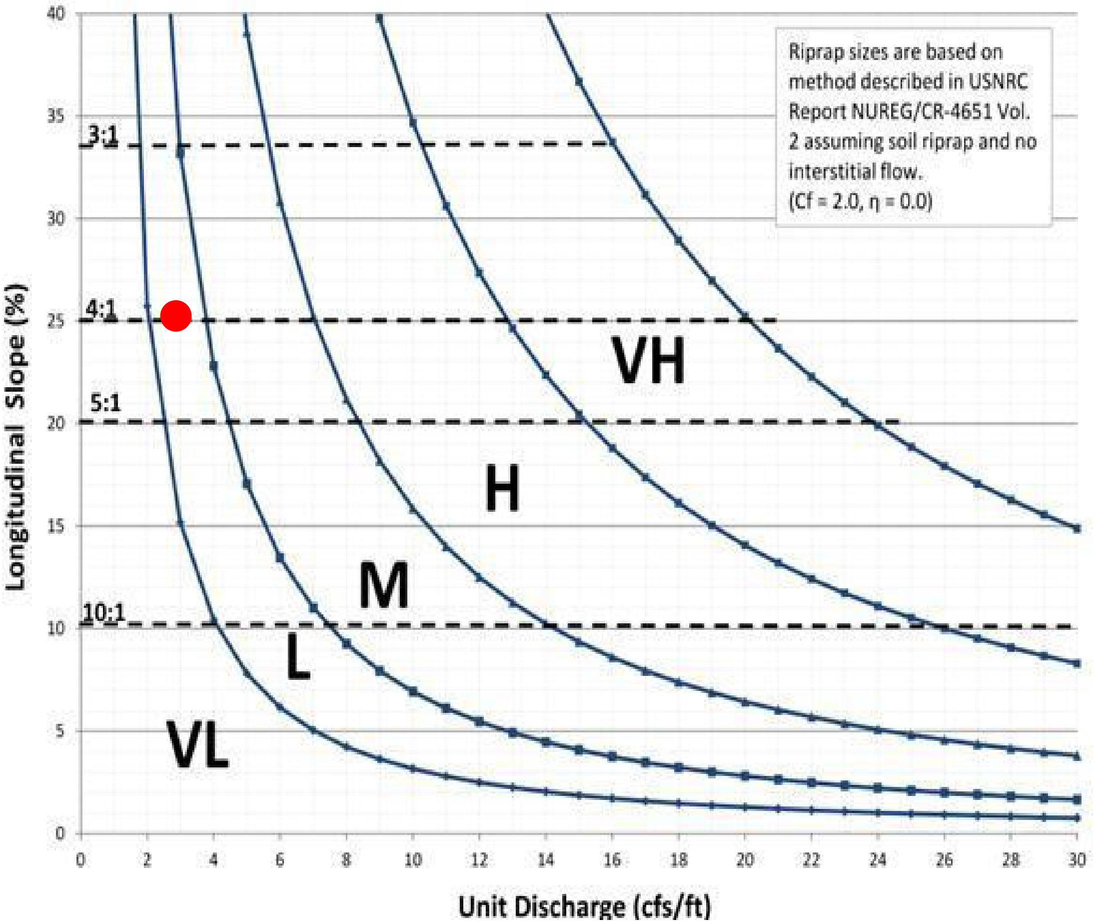


Figure 13-12d. Riprap Types for Emergency Spillway Protection



Kimley»Horn

Forebay Sizing Calculations- Detention Basin Forebay

Contributing Sub-Basins: C-J

Date 2/22/2021
Prepared By KRK
Checked By JRH

		Forebay A	
	Required	Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	19.60	0.39

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.641 A = 3.85 AC	70.07	84.00

	Required	Provided	
Maximum Forebay Depth	18" Max	18"	Concrete Forebay Structure

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.39	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.12	ft^2	
L_a	0.08	ft	
	0.92	in	3" Minimum per Criteria

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

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

Kimley»Horn

Forebay Sizing Calculations- Detention Basin Forebay

Contributing Sub-Basins: A

Date 2/22/2021
Prepared By KRK
Checked By JRH

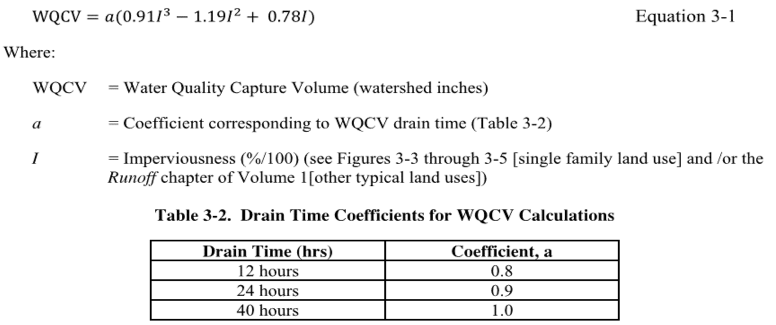
		Forebay B	
	Required	Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	7.19	0.14

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.197 A = 2.47 AC	20.52	154.00

	Required	Provided
Maximum Forebay Depth	12" Max	12"

Concrete Berm

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.14	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.04	ft^2	
L_a	0.03	ft	
	0.34	in	3" Minimum per Criteria



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

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

Version 4.06 Released August 2018

INLET MANAGEMENT

INLET NAME	Design Point 3	Design Point 4	Design Point 5	Design Point 6	Design Point 7	Design Point 8
Site Type (Urban or Rural)						
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	In Sump	On Grade	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	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)	0.8	1.4	1.4	0.4	1.7	1.7
Major Q_{Known} (cfs)	1.5	3.4	2.7	0.8	4.0	3.9

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	User-Defined	User-Defined	No Bypass Flow Received	No Bypass Flow Received	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.1	0.1	0.0	0.0	0.2

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)	**0.8**	**1.4**	**1.4**	**0.4**	**1.7**	**1.7**
Major Total Design Peak Flow, Q (cfs)	**1.5**	**3.5**	**2.8**	**0.8**	**4.0**	**4.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	0.0	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	0.1	N/A	0.7	N/A	N/A	N/A

Minor Storm (Calculated) Analysis of Flow Time

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow Time

C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Version 4.06 Released August 2018

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Design Point 9	Deisgn Point 10	Design Point 11
Site Type (Urban or Rural)			RURAL
Inlet Application (Street or Area)	STREET	STREET	AREA
Hydraulic Condition	On Grade	On Grade	Swale
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type D (In Series & Depressed)

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.8	0.8	10.7
Major Q_{Known} (cfs)	1.7	1.5	23.5

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

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)	**0.8**	**0.8**	**10.7**
Major Total Design Peak Flow, Q (cfs)	**1.7**	**1.5**	**23.5**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.2	0.1	0.0

Minor Storm (Calculated) Analysis of Flow T

C	N/A	N/A	N/A
C_5	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A

Major Storm (Calculated) Analysis of Flow T

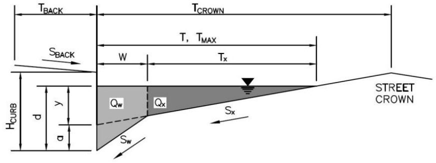
C	N/A	N/A	N/A
C_5	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A

Version 4.06 Released August 2018

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

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

Project: **Meadowbrook Park**
Inlet ID: **Design Point 3**



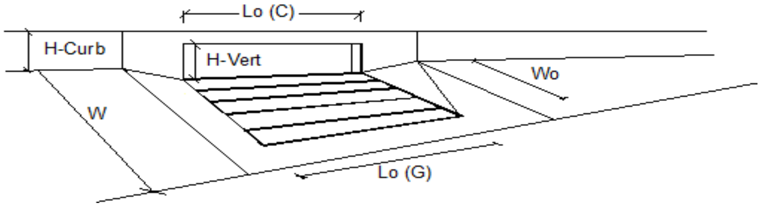
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018		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} =	22.0		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 =	0.005		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	22.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes
MINOR STORM Allowable Capacity is based on Spread Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**4.0**	**9.7**	**cfs**

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 ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



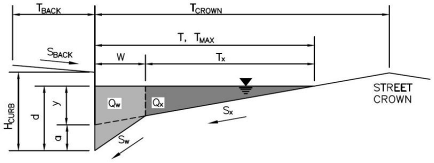
Design Information (Input)		MINOR	MAJOR	
Type of Inlet CDOT Type R Curb Openir	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.8**	**1.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**94**	**%**

Version 4.06 Released August 2018

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

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

Project: **Meadowbrook Park**
Inlet ID: **Design Point 4**



Gutter Geometry (Enter data in the blue cells)

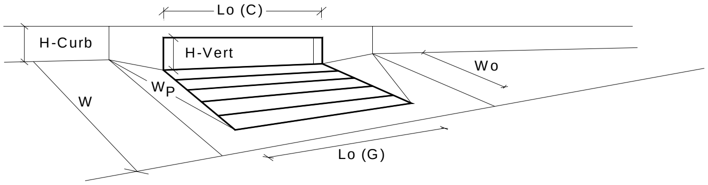
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	22.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	11.0	22.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



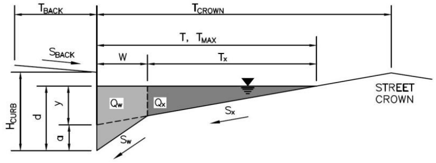
Design Information (Input) CDOT Type R Curb Openi		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.2	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.18	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.1**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.4	3.5	cfs

Version 4.06 Released August 2018

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

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

Project: **Meadowbrook Park**
Inlet ID: **Design Point 5**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	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} =	22.0	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 =	0.030	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

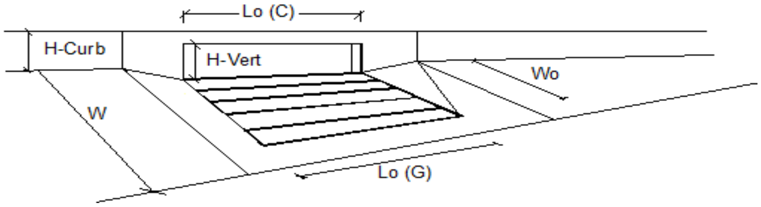
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	11.0	22.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.7**	**17.8**	**cfs**

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 ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



CDOT Type R Curb Openi

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.3**	**2.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**97**	**76**	**%**

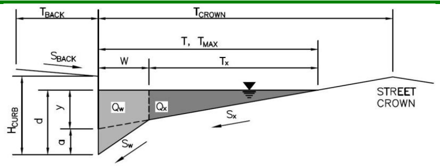
Version 4.06 Released August 2018

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

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

Project: **Meadowbrook Park**

Inlet ID: **Design Point 6**



Gutter Geometry (Enter data in the blue cells)

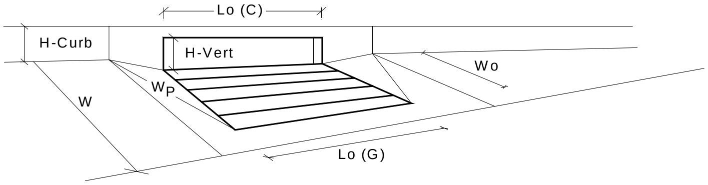
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



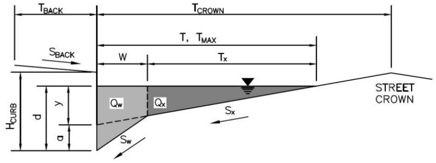
Design Information (Input)	CDOT Type R Curb Openi		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.6	5.6	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.30	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.72	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**4.6**	**4.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	0.4	0.8	cfs

Version 4.06 Released August 2018

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

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

Project: **Meadowbrook Park**
Inlet ID: **Design Point 7**



Gutter Geometry (Enter data in the blue cells)

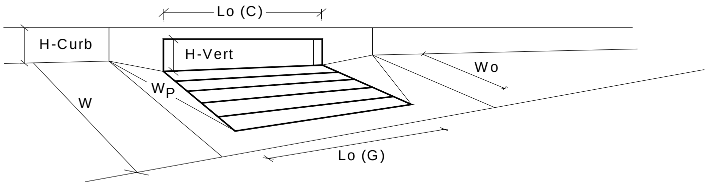
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Openi	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	5.6	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.72	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**4.6**	**4.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.7	4.0	cfs

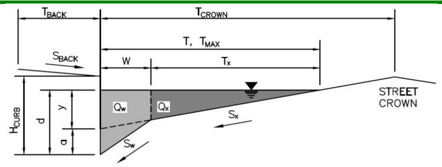
Version 4.06 Released August 2018

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

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

Project: **Meadowbrook Park**

Inlet ID: **Design Point 8**



Gutter Geometry (Enter data in the blue cells)

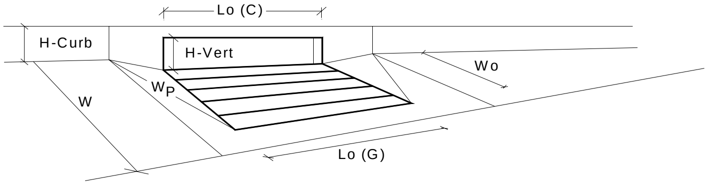
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



			MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Openi				
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.6	5.6	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.30	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.72	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**4.6**	**4.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.7	4.1	cfs

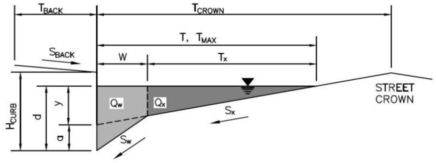
Version 4.06 Released August 2018

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

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

Project: **Meadowbrook Park**

Inlet ID: **Design Point 9**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	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} =	22.0	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 =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	11.0	22.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

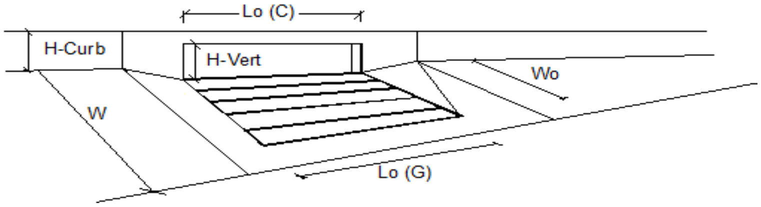
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**3.9**	**13.8**	**cfs**

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 ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



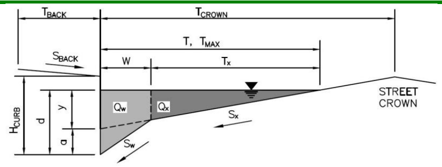
			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet	CDOT Type R Curb Openi	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.8**	**1.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**91**	**%**

Version 4.06 Released August 2018

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

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

Project: **Meadowbrook Park**
Inlet ID: **Deisgn Point 10**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	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} =	11.0	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 =	0.027	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

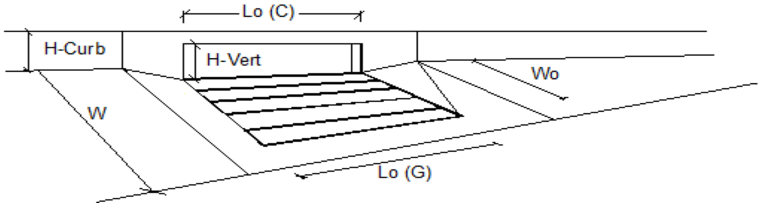
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	11.0	11.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**6.3**	**6.3**	**cfs**

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 ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



CDOT Type R Curb Openi

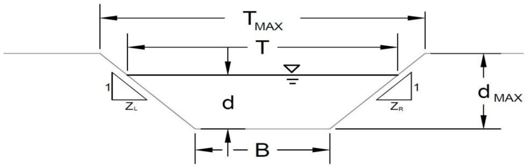
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.7**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**95**	**%**

Version 4.06 Released August 2018

AREA INLET IN A SWALE

Meadowbrook Park

Design Point 12



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.030	
Channel Invert Slope	S_O =	0.0340	ft/ft
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	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**

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**20.00**	**20.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.00**	**1.25**	**feet**

Allowable Channel Capacity Based On Channel Geometry		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**22.6**	**41.0**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**1.00**	**1.25**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**10.7**	**23.5**	**cfs**
Water Depth	d =	**0.76**	**1.02**	**feet**

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'

Version 4.06 Released August 2018

AREA INLET IN A SWALE

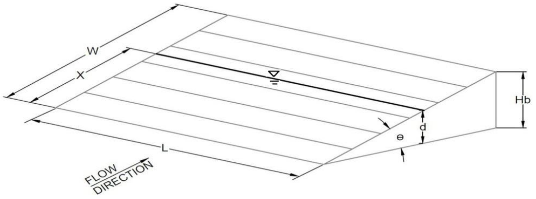
Meadowbrook Park

Design Point 12

Inlet Design Information (Input)

Type of Inlet CDOT Type D (In Series & Depresse ▾   Inlet Type = CDOT Type D (In Series & Depressed)

Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	6.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.38	
Grate Discharge Coefficient	C_d =	0.72	
Orifice Coefficient	C_o =	0.48	
Weir Coefficient	C_w =	1.53	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.76	2.02	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**39.9**	**42.8**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: **KRK**
Company: **Kimley-Horn and Associates**
Date: **March 12, 2021**
Project: **Meadowbrook Park**
Location: **RG SWC of Site**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 54.5 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.545
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= $0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)$	WQCV = 0.18 watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 80,559 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area	V_{WQCV} = cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.43 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 1,176 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = cu ft
2. Basin Geometry	
A) WQCV Depth (12-inch maximum)	D_{WQCV} = 12 in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 0.00 ft / ft
C) Mimimum Flat Surface Area	A_{Min} = 878 sq ft
D) Actual Flat Surface Area	A_{Actual} = 1215 sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 1215 sq ft
F) Rain Garden Total Volume (V_T= ((A_{Top} + A_{Actual}) / 2) * Depth)	V_T= 1,215 cu ft
3. Growing Media	Choose One ● 18" Rain Garden Growing Media ○ Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One ● YES ○ NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 0.3 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 1,176 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 1 3/16 in

Design Procedure Form: Rain Garden (RG)

Sheet 2 of 2

Designer: **KRK**
Company: **Kimley-Horn and Associates**
Date: **March 12, 2021**
Project: **Meadowbrook Park**
Location: **RG SWC of Site**

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ● YES ○ NO **PROVIDE A 30 MIL (MIN) PVC LINER WITH CDOT CLASS B GEOTEXTILE ABOVE IT. USE THE SAME GEOTEXTILE BELOW THE LINER IF THE SUBGRADE IS ANGULAR**
6. Inlet / Outlet Control A) Inlet Control	Choose One ○ Sheet Flow- No Energy Dissipation Required ● Concentrated Flow- Energy Dissipation Provided
7. Vegetation	Choose One ● Seed (Plan for frequent weed control) ○ Plantings ○ Sand Grown or Other High Infiltration Sod
8. Irrigation A) Will the rain garden be irrigated?	Choose One ○ YES ○ NO

Notes:

Rock Chute Design - Cut/Paste Plan

(Version WI-Nov. 2017, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Meadowbrook Park
Designer: KRK
Date: 3/12/2021

County: El Paso County
Checked by:
Date:

Design Values

D_{50} dia. = 9.0 in.
$Rock_{chute}$ thickness = 18.0 in.
Inlet apron length = 10 ft.
Outlet apron length = 15 ft.
Radius = 25 ft.
Will bedding be used? No

Rock Gradation Envelope

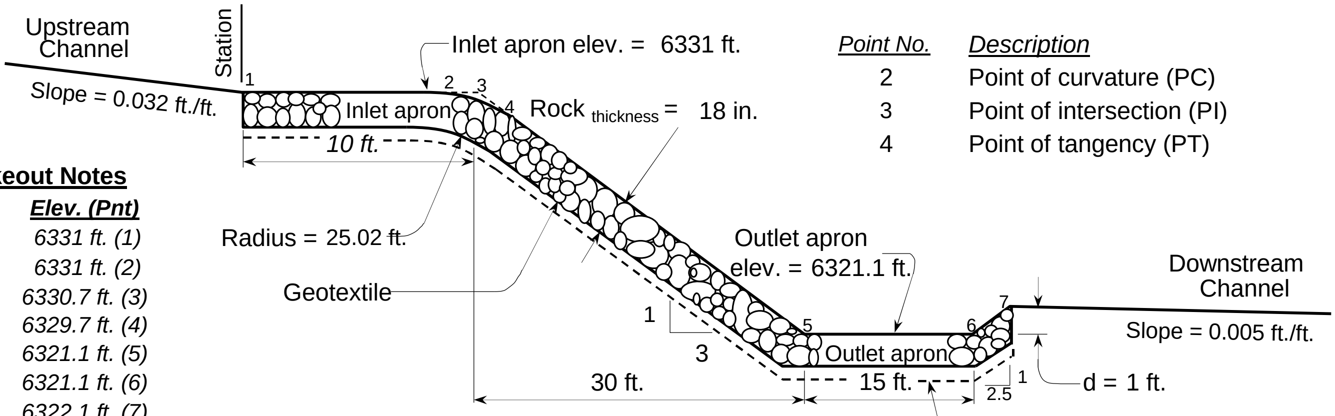
% Passing	*Diameter, in. (weight, lbs.)*
D_{100} ---------	14 - 18 (174 - 413)
D_{85} ---------	12 - 16 (113 - 301)
D_{50} ---------	9 - 14 (52 - 174)
D_{10} ---------	7 - 12 (26 - 113)

Coefficient of Uniformity, $(D_{60})/(D_{10}) < 1.7$

Quantities [a]

Rock = 111 yd^3
Geotextile (WCS-13)[b] = 263 yd^2
Bedding = 0 yd^3
Excavation = 0 yd^3
Earthfill = 0 yd^3
Seeding = 0.0 acres

Notes: [a] *Rock, bedding, and geotextile quantities are determined from x-section below (neglect radius).*
[b] *Geotextile Class I (Non-woven) shall be overlapped and anchored (18-in. minimum along sides and 24-in. minimum on the ends) --- quantity not included.*



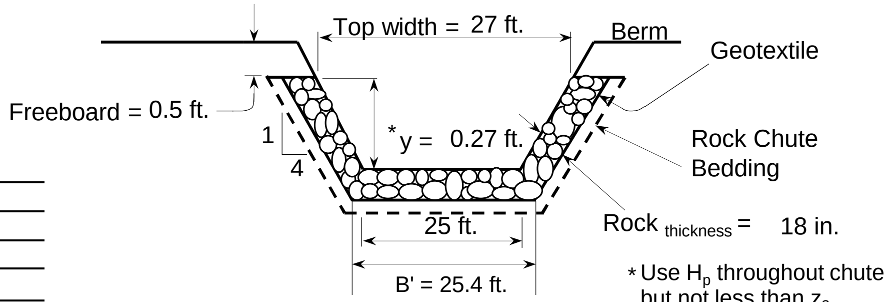
Point No.	*Description*
2	Point of curvature (PC)
3	Point of intersection (PI)
4	Point of tangency (PT)

Stakeout Notes

Sta.	***Elev. (Pnt)***
0+00.0	*6331 ft. (1)*
0+05.9	*6331 ft. (2)*
0+10.0	*6330.7 ft. (3)*
0+13.9	*6329.7 ft. (4)*
0+39.7	*6321.1 ft. (5)*
0+54.7	*6321.1 ft. (6)*
0+57.2	*6322.1 ft. (7)*

Profile Along Centerline of Rock Chute

Rock Chute Bedding



* Use H_p throughout chute but not less than z_2.

Rock Chute Cross Section

Notes:
Rock gradation envelope can be met with
DOT Light riprap Gradation

Profile, Cross Sections, and Quantities

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

Meadowbrook Park

El Paso County County

		Date
Designed	KRK	
Drawn		
Checked		
Approved		

File Name
Drawing Name
Sheet __ of __

FlexTable: Conduit Table **5 Year**

Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Flow / Capacity (Design) (%)
MH A7	MH A6	6,328.31	6,327.71	55.4	0.011	18.0	0.013	2.48	5.00	10.93	6,328.91	6,328.40	22.7
MH A6	MH A5	6,327.51	6,327.19	29.9	0.011	18.0	0.013	2.48	4.98	10.87	6,328.11	6,327.94	22.8
INLET G1	MH A5	6,327.28	6,327.19	4.5	0.020	18.0	0.013	0.77	4.43	14.85	6,327.94	6,327.94	5.2
INLET H1	MH A7	6,328.60	6,328.51	4.7	0.019	18.0	0.013	0.82	4.45	14.59	6,329.12	6,329.13	5.6
MH A5	MH A4	6,326.99	6,324.92	191.1	0.011	18.0	0.013	3.25	5.39	10.92	6,327.67	6,325.48	29.8
INLET A8	MH A7	6,330.42	6,328.51	177.6	0.011	18.0	0.013	1.66	4.45	10.89	6,330.90	6,329.13	15.2
MH E1	MH A4	6,325.66	6,324.42	196.6	0.006	18.0	0.013	2.16	3.96	8.33	6,326.21	6,325.36	25.9
MH A4	MH A3	6,324.22	6,322.46	148.3	0.012	24.0	0.013	5.41	6.29	24.64	6,325.04	6,323.10	22.0
INLET F1	MH E1	6,326.00	6,325.86	25.0	0.006	18.0	0.013	0.44	2.39	7.82	6,326.53	6,326.53	5.6
INLET F2	MH E1	6,325.99	6,325.94	9.0	0.006	18.0	0.013	1.72	3.55	7.83	6,326.52	6,326.53	22.0
MH A3	MH A2	6,322.26	6,320.99	106.8	0.012	24.0	0.013	5.41	6.30	24.69	6,323.08	6,321.62	21.9
MH A2	Outfall A1	6,319.99	6,319.85	46.0	0.003	36.0	0.013	9.04	4.31	36.79	6,321.00	6,320.80	24.6
MH C1	MH A2	6,320.36	6,320.19	56.3	0.003	18.0	0.013	2.25	3.06	5.77	6,321.46	6,321.44	39.0
MH B1	MH A2	6,320.34	6,320.19	31.0	0.005	18.0	0.013	1.38	3.18	7.31	6,321.44	6,321.44	18.9
INLET B2	MH B1	6,320.57	6,320.54	4.5	0.007	18.0	0.013	1.38	3.56	8.58	6,321.46	6,321.46	16.1
MH C1	INLET D1	6,320.56	6,320.59	5.4	-0.006	18.0	0.013	0.82	2.88	7.85	6,321.50	6,321.50	10.4
INLET C2	MH C1	6,320.97	6,320.56	137.6	0.003	18.0	0.013	1.43	2.70	5.73	6,321.57	6,321.50	24.9
MH J3	INLET K1	6,317.16	6,317.25	18.0	-0.005	30.0	0.013	0.10	1.37	29.00	6,318.69	6,318.69	0.3
MH J3	MH J2	6,317.16	6,315.21	270.6	0.007	30.0	0.013	10.79	6.26	34.82	6,318.26	6,317.25	31.0
MH J3	INLET J4	6,317.16	6,318.31	43.2	-0.027	30.0	0.013	10.69	9.99	66.94	6,319.40	6,318.69	16.0
MH J2	MH J1	6,315.01	6,314.62	43.2	0.009	30.0	0.013	10.79	6.79	38.96	6,317.25	6,317.23	27.7
O-2	MH J1	6,314.18	6,314.40	53.8	-0.004	36.0	0.013	10.82	5.04	42.65	6,317.19	6,317.18	25.4
INLET I1	MH J1	6,315.40	6,314.62	162.5	0.005	18.0	0.013	0.03	0.02	7.28	6,317.23	6,317.23	0.4

FlexTable: Catch Basin Table **5 Year**

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Flow (Total Out) (cfs)	Headloss Coefficient (Standard)
INLET A8	6,334.79	6,330.42	6,330.91	6,330.90	1.66	0.050
INLET B2	6,324.98	6,320.57	6,321.46	6,321.46	1.38	0.050
INLET C2	6,324.27	6,320.97	6,321.57	6,321.57	1.43	0.050
INLET D1	6,324.79	6,320.59	6,321.50	6,321.50	0.82	0.050
INLET F1	6,329.50	6,325.99	6,326.53	6,326.53	0.44	0.050
INLET F2	6,329.50	6,325.99	6,326.52	6,326.52	1.72	0.050
INLET G1	6,336.35	6,327.28	6,327.94	6,327.94	0.77	0.050
INLET H1	6,336.24	6,328.60	6,329.13	6,329.12	0.82	0.050
INLET I1	6,318.36	6,315.40	6,317.23	6,317.23	0.03	0.050
INLET J4	6,323.01	6,318.31	6,319.42	6,319.40	10.69	0.050
INLET K1	6,320.21	6,317.25	6,318.69	6,318.69	0.10	0.050

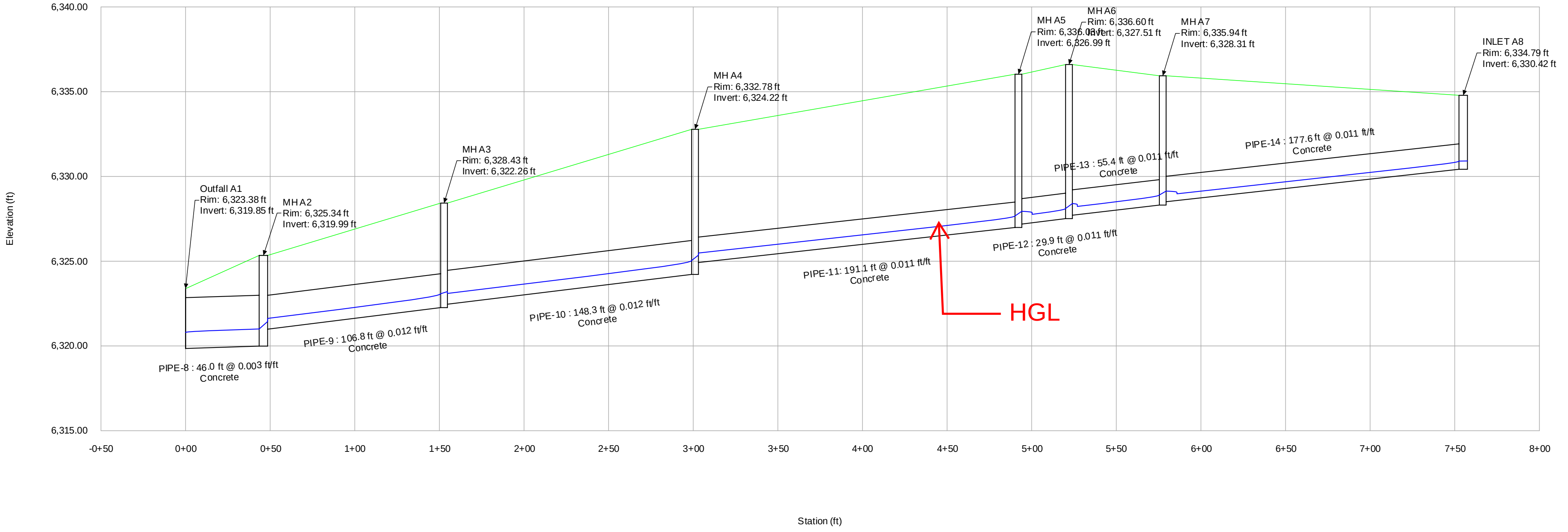
FlexTable: Manhole Table **5 Year**

Label	Elevation (Rim) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
MH A6	6,336.60	2.48	6,328.40	6,328.11	1.320	0.29
MH A5	6,336.03	3.25	6,327.94	6,327.67	1.020	0.27
MH A7	6,335.94	2.48	6,329.13	6,328.91	1.020	0.23
MH A4	6,332.78	5.41	6,325.36	6,325.04	1.020	0.31
MH E1	6,329.29	2.16	6,326.53	6,326.21	1.520	0.31
MH A3	6,328.43	5.41	6,323.20	6,323.08	0.400	0.12
MH A2	6,325.34	9.04	6,321.44	6,321.00	1.520	0.44
MH B1	6,324.51	1.38	6,321.46	6,321.44	1.320	0.02
MH C1	6,324.51	2.25	6,321.50	6,321.46	1.020	0.04
MH J3	6,323.40	10.79	6,318.69	6,318.26	1.020	0.43
MH J2	6,321.76	10.79	6,317.25	6,317.25	0.040	0.00
MH J1	6,320.86	10.82	6,317.23	6,317.19	1.020	0.04

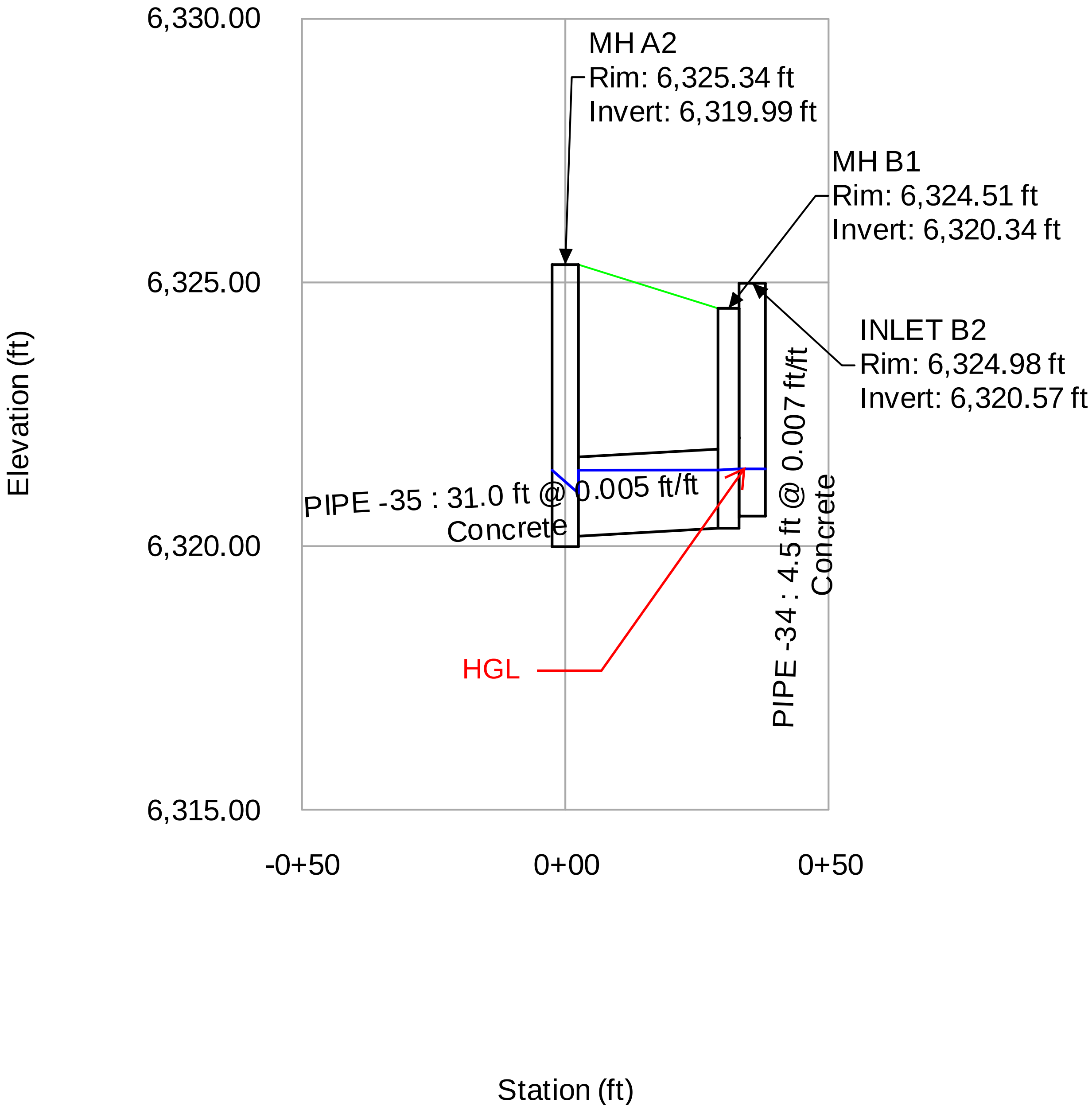
Profile Report

Engineering Profile - STRM LINE A (Meadowbrook Park.stsw)

5 Year



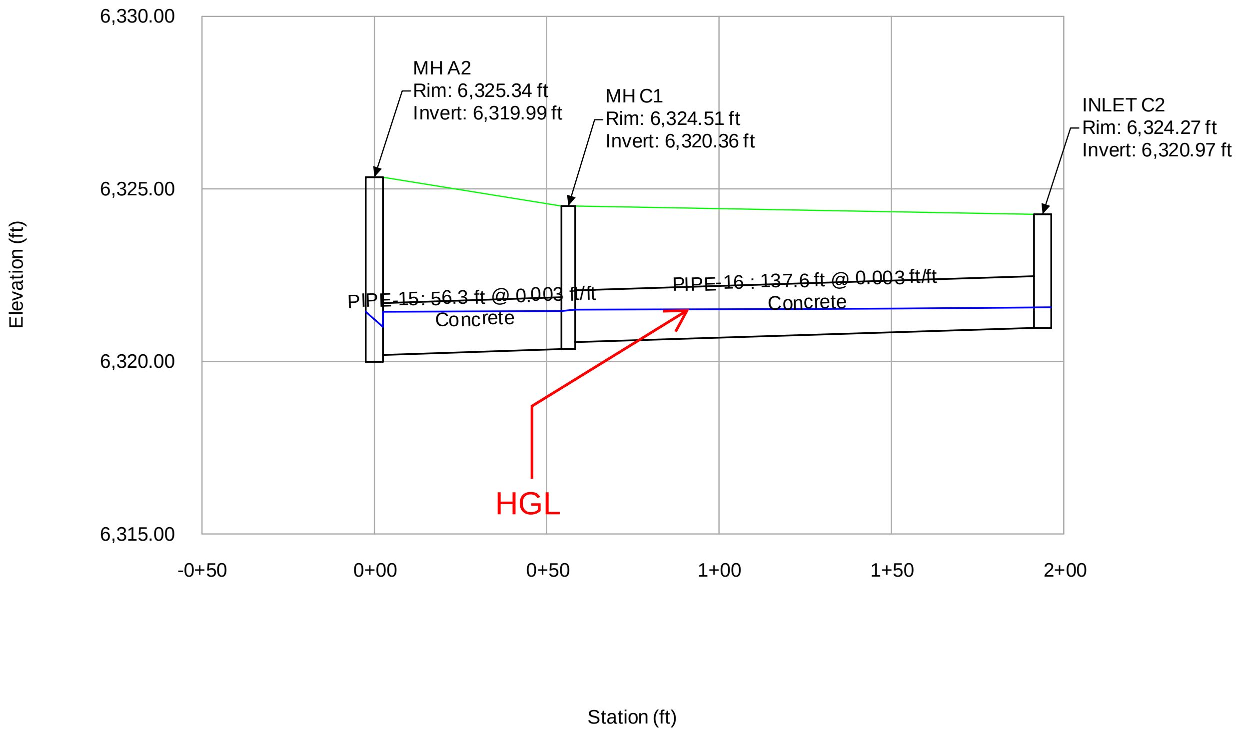
Profile Report
Engineering Profile - STRM LINE B (Meadowbrook Park.stsw)
5 Year



Profile Report

Engineering Profile - STRM LINE C (Meadowbrook Park.stsw)

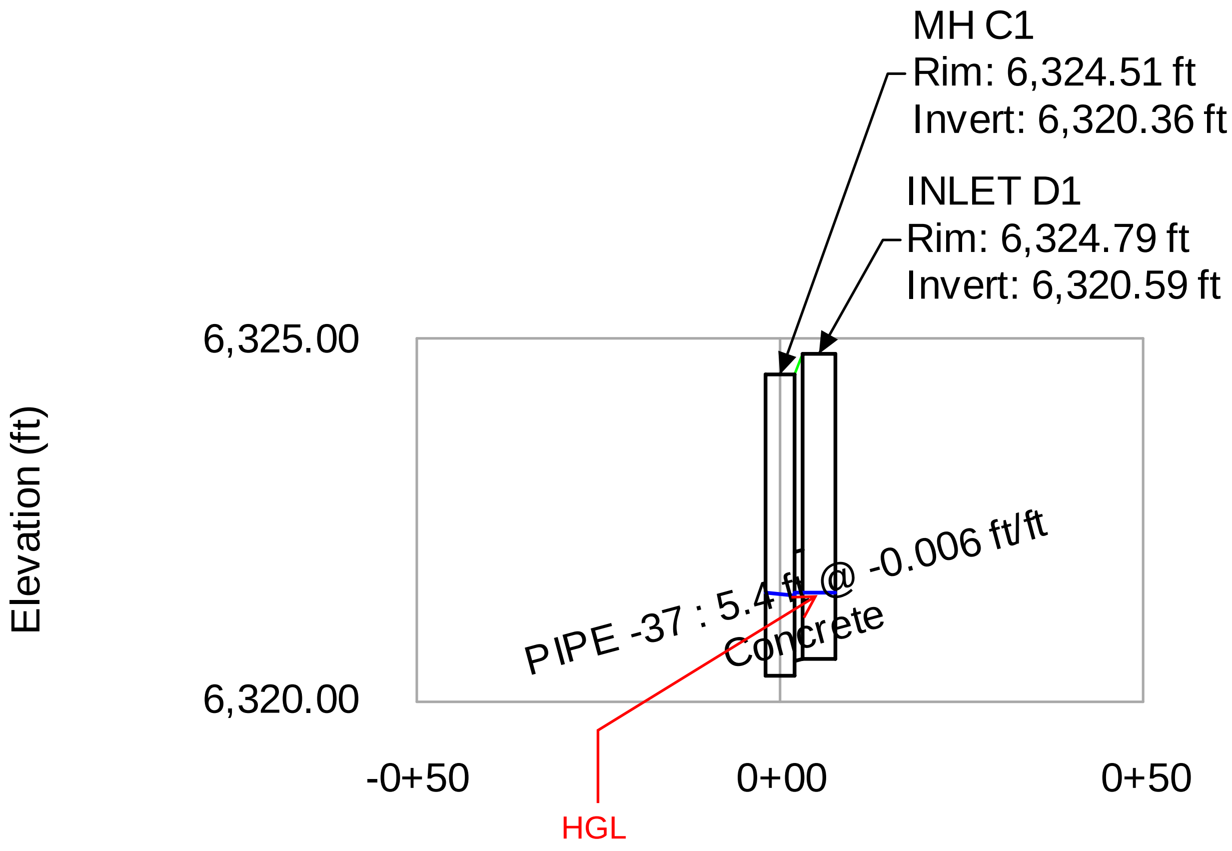
5 Year



Profile Report

Engineering Profile - STRM LINE D (Meadowbrook Park.stsw)

5 Year

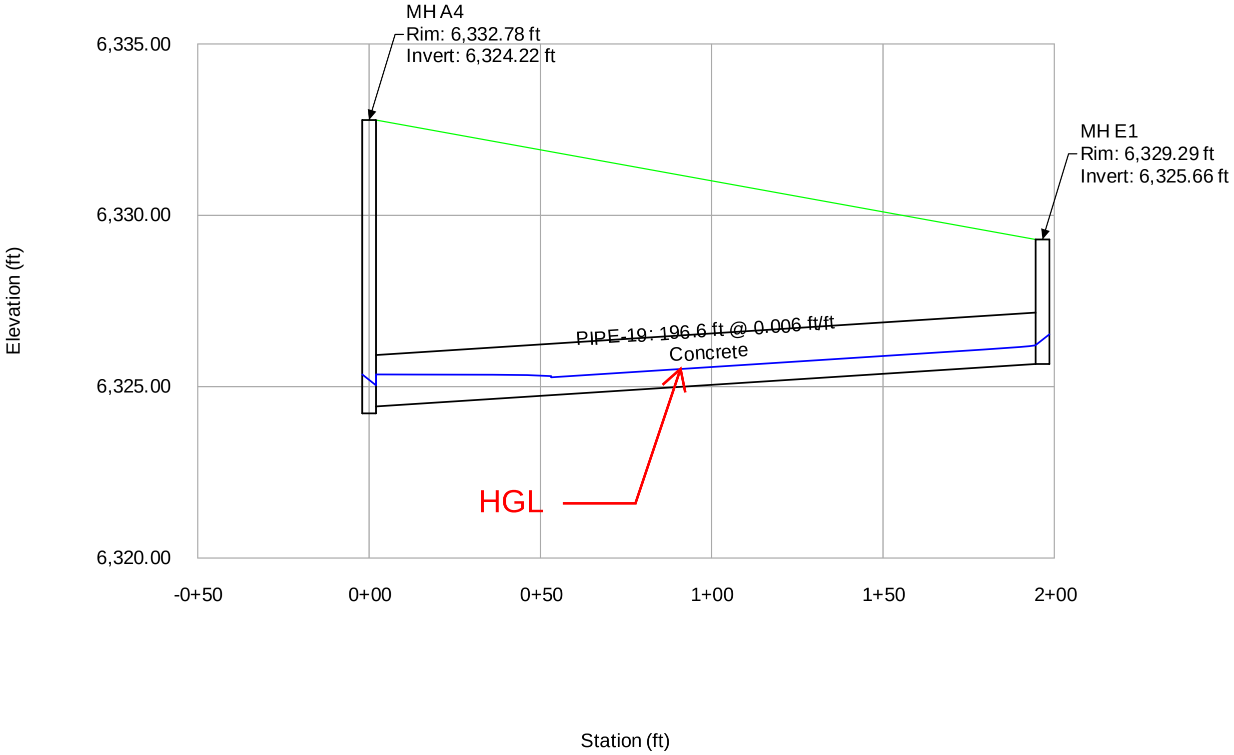


Station (ft)

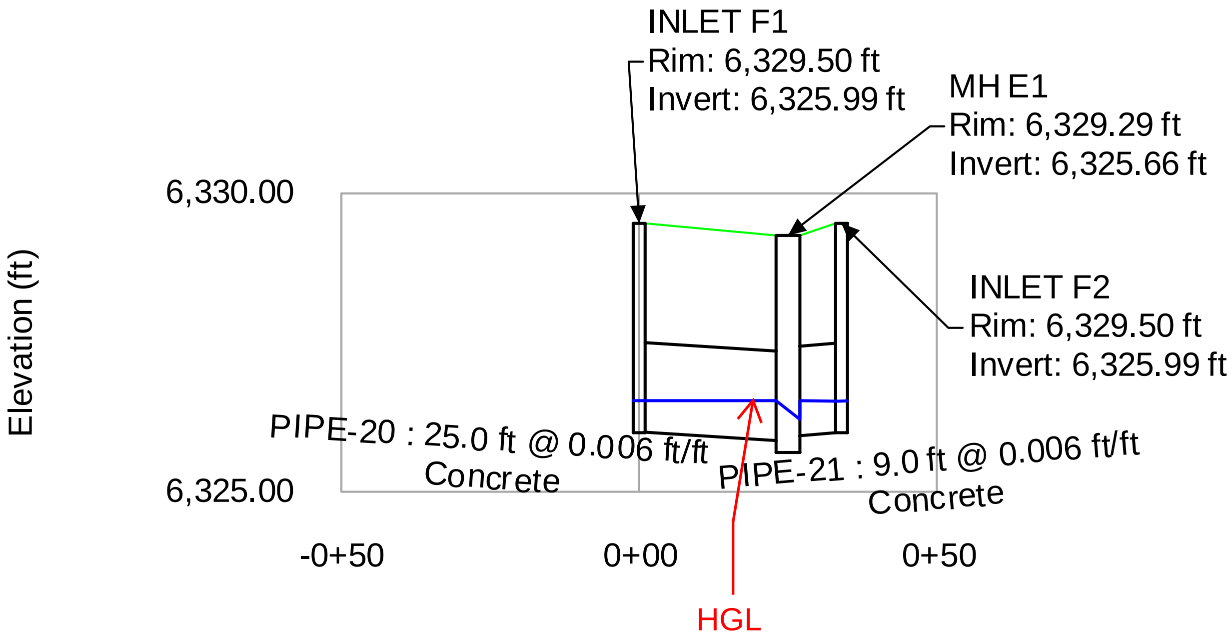
Profile Report

Engineering Profile - STRM LINE E (Meadowbrook Park.stsw)

5 Year



Profile Report
Engineering Profile - STRM LINE F (Meadowbrook Park.stsw)
5 Year

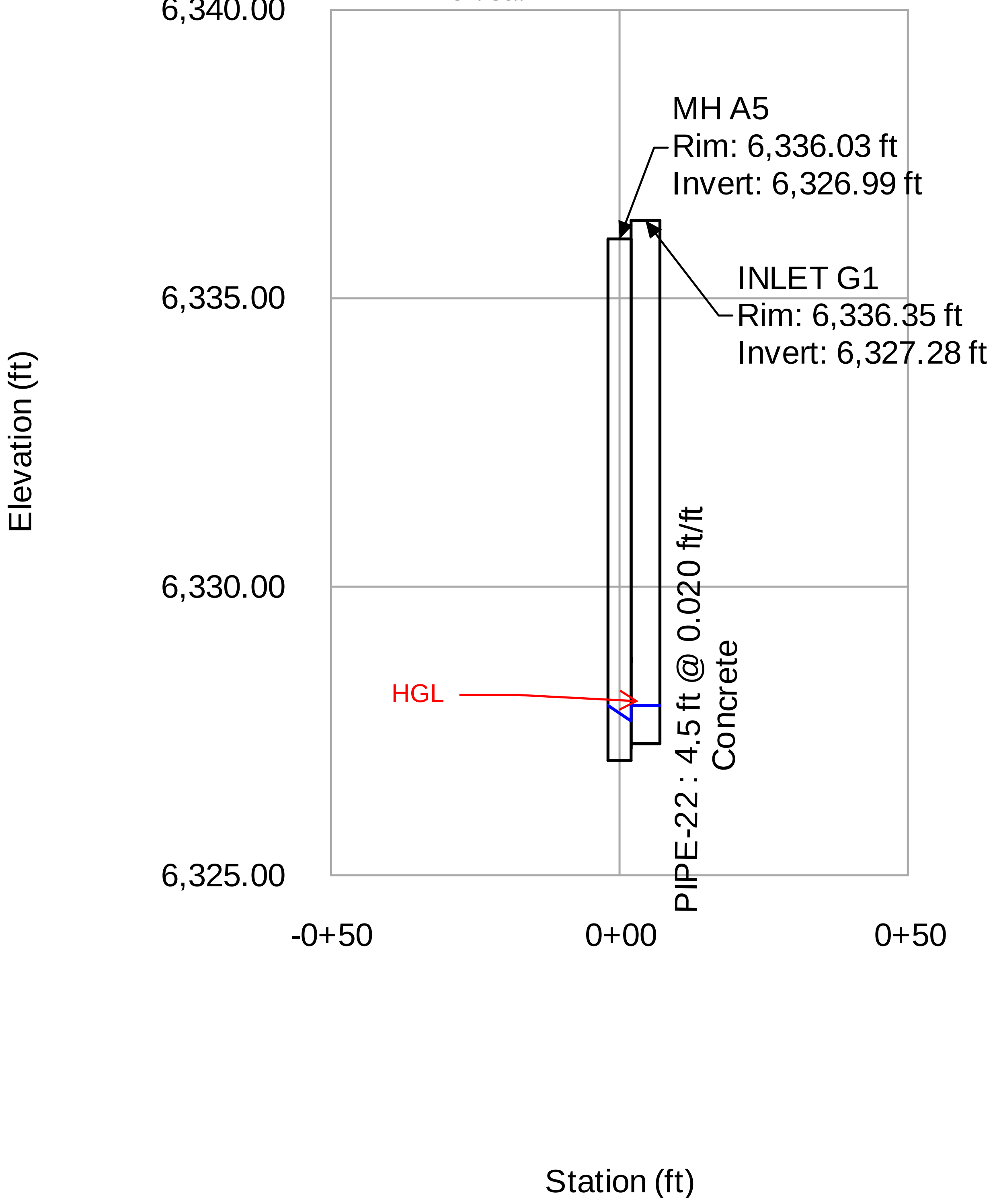


Station (ft)

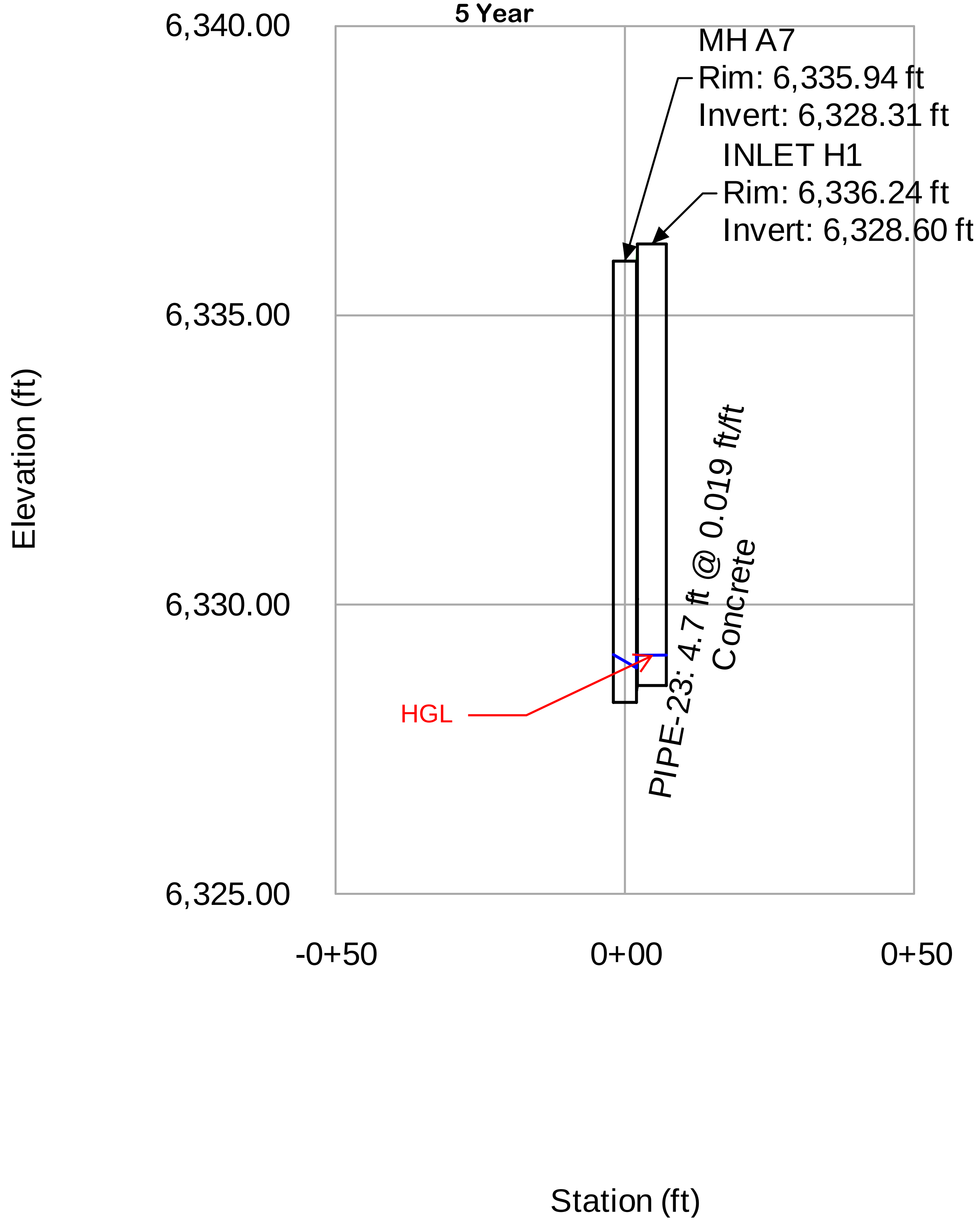
Profile Report

Engineering Profile - STRM LINE G (Meadowbrook Park.stsw)

5 Year



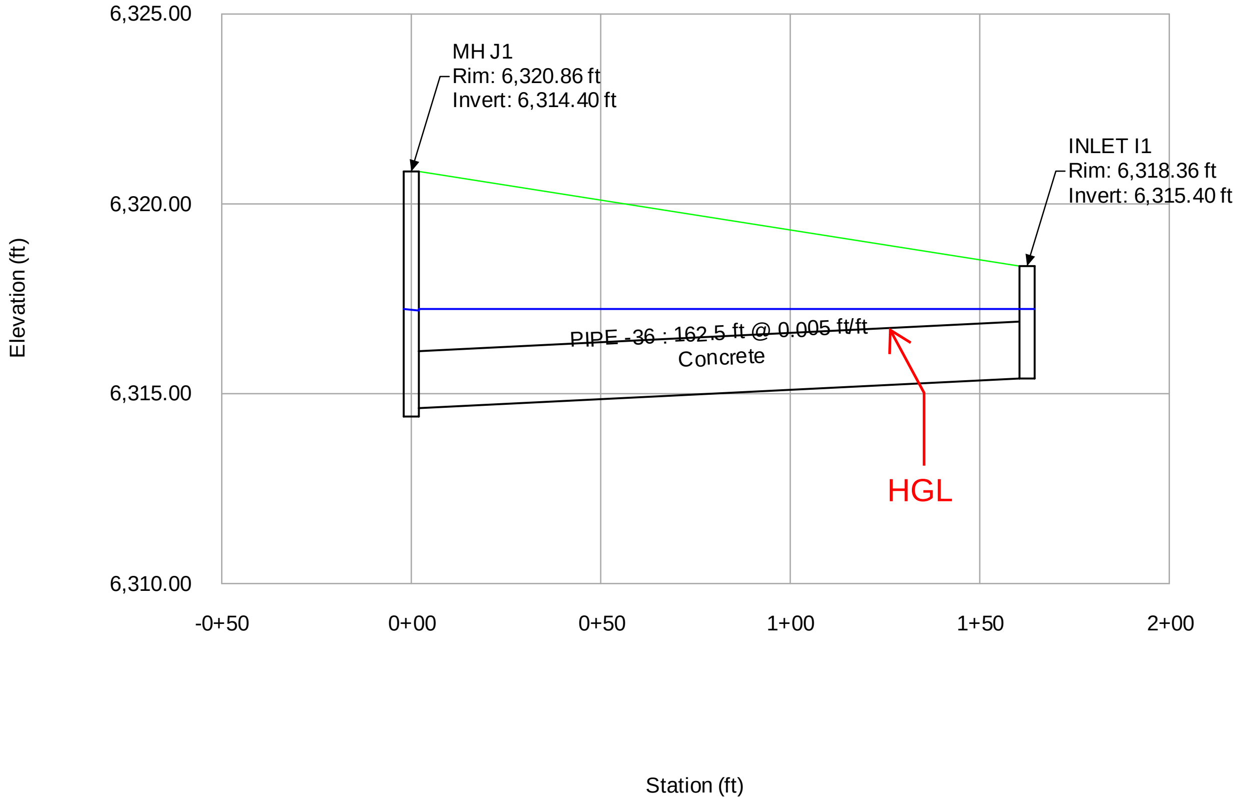
Profile Report
Engineering Profile - STRM LINE H (Meadowbrook Park.stsw)
5 Year



Profile Report

Engineering Profile - STRM LINE I (Meadowbrook Park.stsw)

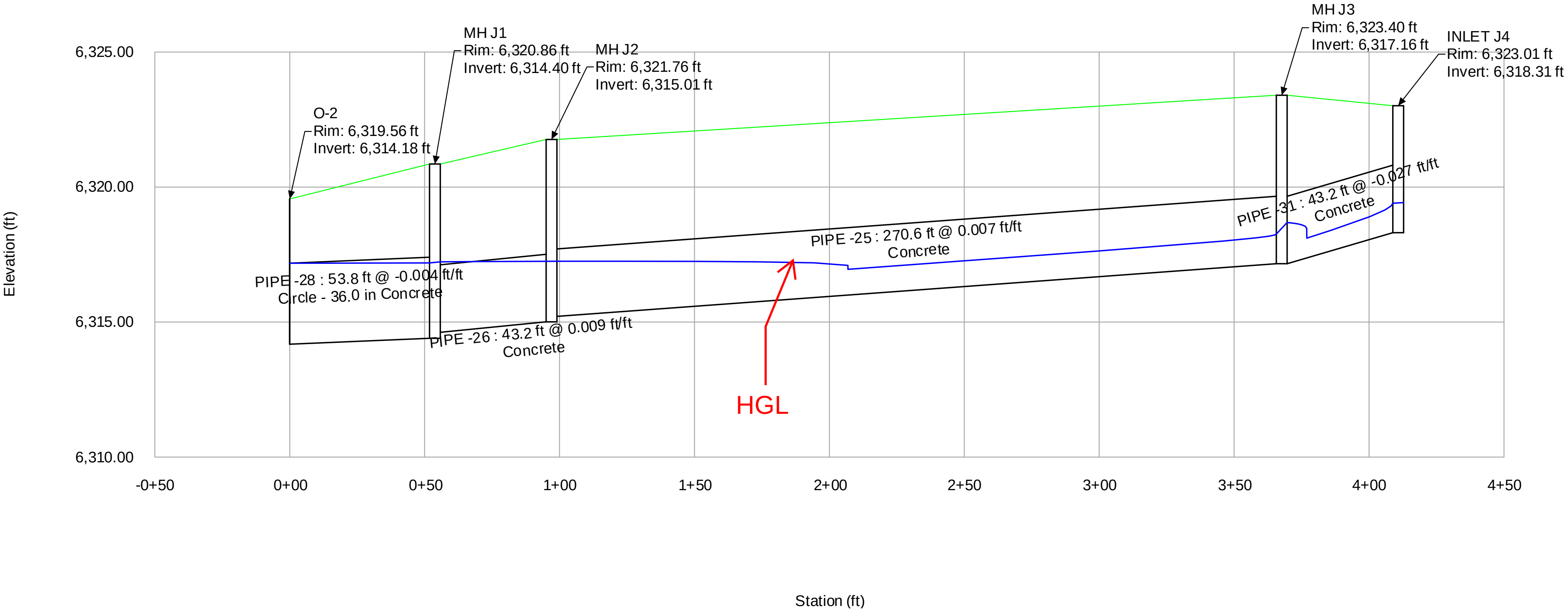
5 Year



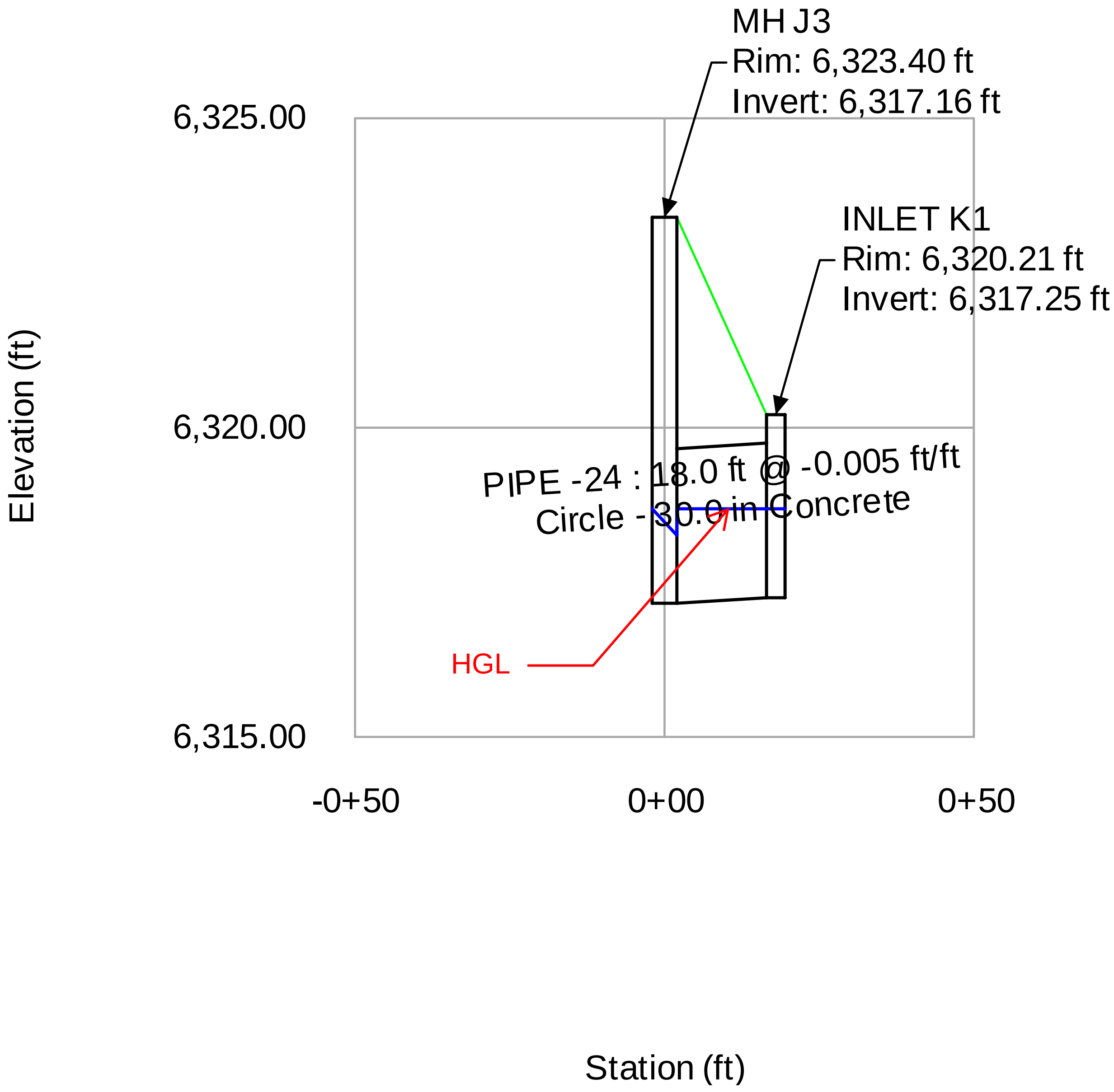
Profile Report

Engineering Profile - STRM LINE J (Meadowbrook Park.stsw)

5 Year



Profile Report
Engineering Profile - STRM LINE K (Meadowbrook Park.stsw)
5 Year



FlexTable: Conduit Table **100 Year**

Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Flow / Capacity (Design) (%)
MH A7	MH A6	6,328.31	6,327.71	55.4	0.011	18.0	0.013	5.57	6.22	10.93	6,329.22	6,328.93	51.0
MH A6	MH A5	6,327.51	6,327.19	29.9	0.011	18.0	0.013	5.57	6.19	10.87	6,328.42	6,328.49	51.2
INLET G1	MH A5	6,327.28	6,327.19	4.5	0.020	18.0	0.013	1.53	5.42	14.85	6,328.49	6,328.49	10.3
INLET H1	MH A7	6,328.60	6,328.51	4.7	0.019	18.0	0.013	1.72	5.54	14.59	6,329.61	6,329.61	11.8
MH A5	MH A4	6,326.99	6,324.92	191.1	0.011	18.0	0.013	7.10	6.58	10.92	6,328.02	6,326.00	65.0
INLET A8	MH A7	6,330.42	6,328.51	177.6	0.011	18.0	0.013	3.85	5.63	10.89	6,331.17	6,329.61	35.3
MH E1	MH A4	6,325.66	6,324.42	196.6	0.006	18.0	0.013	4.82	4.89	8.33	6,326.50	6,326.00	57.8
MH A4	MH A3	6,324.22	6,322.46	148.3	0.012	24.0	0.013	11.92	7.78	24.64	6,325.46	6,323.71	48.4
INLET F1	MH E1	6,326.00	6,325.86	25.0	0.006	18.0	0.013	0.80	2.85	7.82	6,327.03	6,327.03	10.2
INLET F2	MH E1	6,325.99	6,325.94	9.0	0.006	18.0	0.013	4.02	4.46	7.83	6,327.03	6,327.03	51.3
MH A3	MH A2	6,322.26	6,320.99	106.8	0.012	24.0	0.013	11.92	7.79	24.69	6,323.50	6,321.97	48.3
MH A2	Outfall A1	6,319.99	6,319.85	46.0	0.003	36.0	0.013	19.57	5.29	36.79	6,321.53	6,321.27	53.2
MH C1	MH A2	6,320.36	6,320.19	56.3	0.003	18.0	0.013	4.95	2.80	5.77	6,322.33	6,322.21	85.8
MH B1	MH A2	6,320.34	6,320.19	31.0	0.005	18.0	0.013	2.70	1.53	7.31	6,322.23	6,322.21	37.0
INLET B2	MH B1	6,320.57	6,320.54	4.5	0.007	18.0	0.013	2.70	1.53	8.58	6,322.28	6,322.28	31.5
MH C1	INLET D1	6,320.56	6,320.59	5.4	-0.006	18.0	0.013	1.52	0.86	7.85	6,322.46	6,322.46	19.4
INLET C2	MH C1	6,320.97	6,320.56	137.6	0.003	18.0	0.013	3.43	1.94	5.73	6,322.60	6,322.46	59.8
MH J3	INLET K1	6,317.16	6,317.25	18.0	-0.005	30.0	0.013	5.10	1.04	29.00	6,319.87	6,319.87	17.6
MH J3	MH J2	6,317.16	6,315.21	270.6	0.007	30.0	0.013	28.64	7.92	34.82	6,318.98	6,317.77	82.3
MH J3	INLET J4	6,317.16	6,318.31	43.2	-0.027	30.0	0.013	23.54	12.45	66.94	6,319.96	6,319.87	35.2
MH J2	MH J1	6,315.01	6,314.62	43.2	0.009	30.0	0.013	28.64	5.83	38.96	6,317.74	6,317.53	73.5
O-2	MH J1	6,314.18	6,314.40	53.8	-0.004	36.0	0.013	28.67	6.47	42.65	6,317.26	6,317.18	67.2
INLET I1	MH J1	6,315.40	6,314.62	162.5	0.005	18.0	0.013	0.03	0.02	7.28	6,317.53	6,317.53	0.4

FlexTable: Catch Basin Table **100 Year**

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Flow (Total Out) (cfs)	Headloss Coefficient (Standard)
INLET A8	6,334.79	6,330.42	6,331.19	6,331.17	3.85	0.050
INLET B2	6,324.98	6,320.57	6,322.28	6,322.28	2.70	0.050
INLET C2	6,324.27	6,320.97	6,322.61	6,322.60	3.43	0.050
INLET D1	6,324.79	6,320.59	6,322.46	6,322.46	1.52	0.050
INLET F1	6,329.50	6,325.99	6,327.03	6,327.03	0.80	0.050
INLET F2	6,329.50	6,325.99	6,327.04	6,327.03	4.02	0.050
INLET G1	6,336.35	6,327.28	6,328.49	6,328.49	1.53	0.050
INLET H1	6,336.24	6,328.60	6,329.61	6,329.61	1.72	0.050
INLET I1	6,318.36	6,315.40	6,317.53	6,317.53	0.03	0.050
INLET J4	6,323.01	6,318.31	6,320.00	6,319.96	23.54	0.050
INLET K1	6,320.21	6,317.25	6,319.87	6,319.87	5.10	0.050

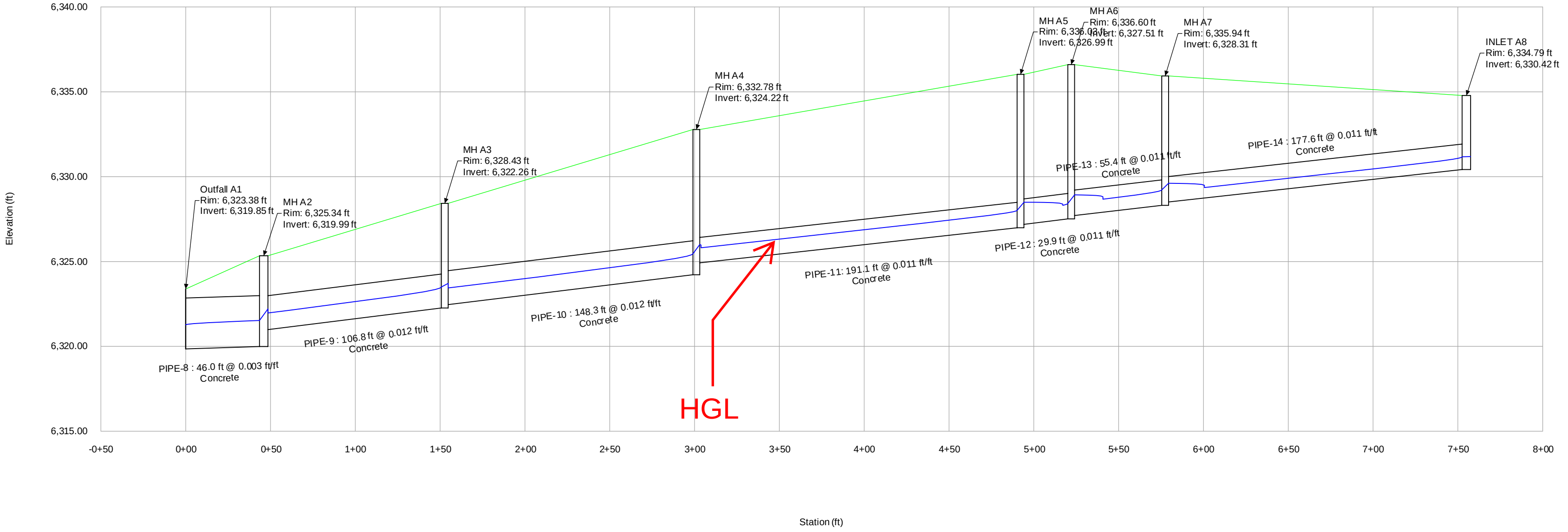
FlexTable: Manhole Table **100 Year**

Label	Elevation (Rim) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
MH A6	6,336.60	5.57	6,328.93	6,328.42	1.320	0.51
MH A5	6,336.03	7.10	6,328.49	6,328.02	1.020	0.48
MH A7	6,335.94	5.57	6,329.61	6,329.22	1.020	0.39
MH A4	6,332.78	11.92	6,326.00	6,325.46	1.020	0.54
MH E1	6,329.29	4.82	6,327.03	6,326.50	1.520	0.52
MH A3	6,328.43	11.92	6,323.71	6,323.50	0.400	0.21
MH A2	6,325.34	19.57	6,322.21	6,321.53	1.520	0.68
MH B1	6,324.51	2.70	6,322.28	6,322.23	1.320	0.05
MH C1	6,324.51	4.95	6,322.46	6,322.33	1.020	0.12
MH J3	6,323.40	28.64	6,319.87	6,318.98	1.020	0.88
MH J2	6,321.76	28.64	6,317.77	6,317.74	0.040	0.02
MH J1	6,320.86	28.67	6,317.53	6,317.26	1.020	0.27

Profile Report

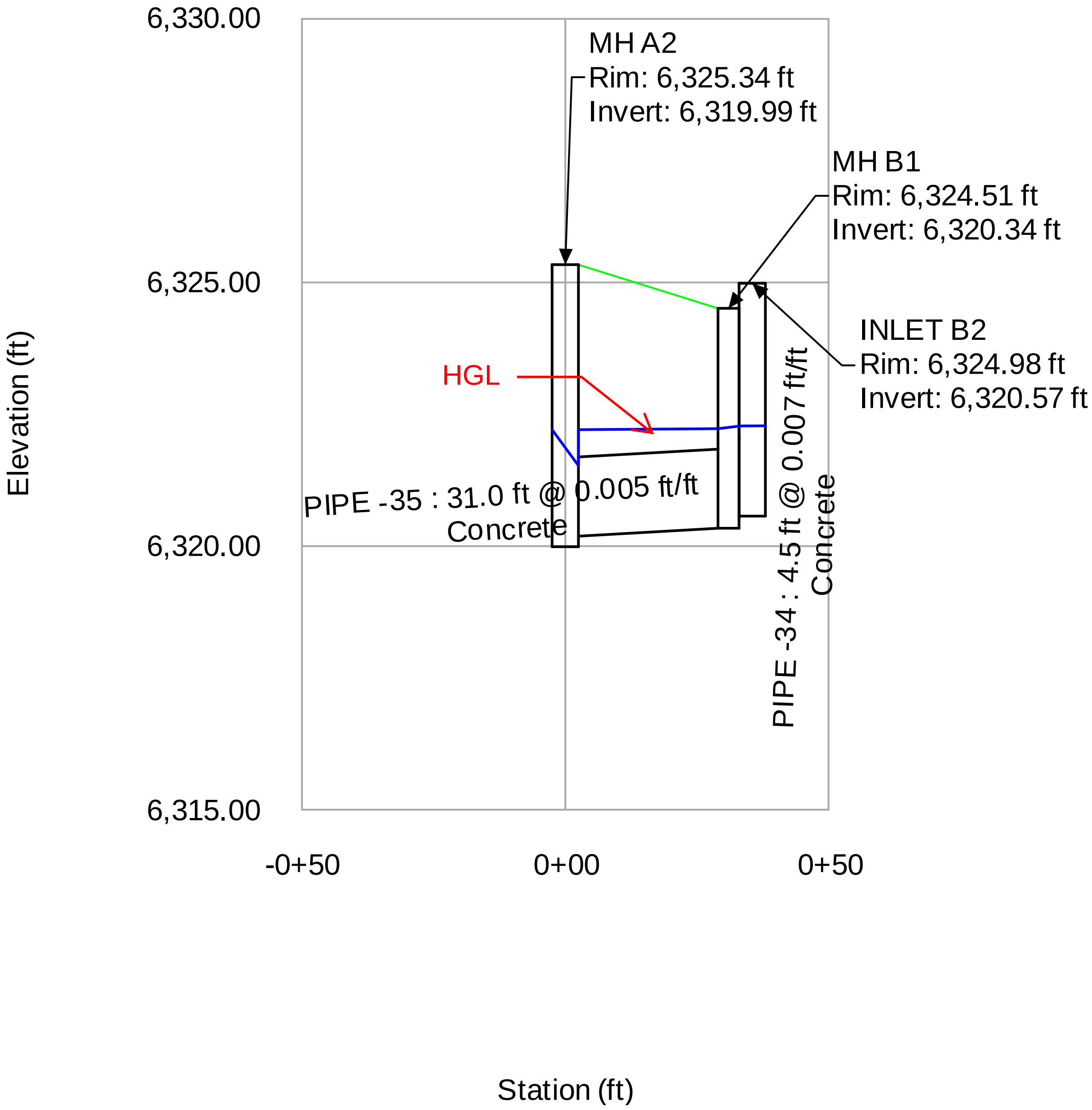
Engineering Profile - STRM LINE A (Meadowbrook Park.stsw)

100 Year



Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
+1-203-755-1666

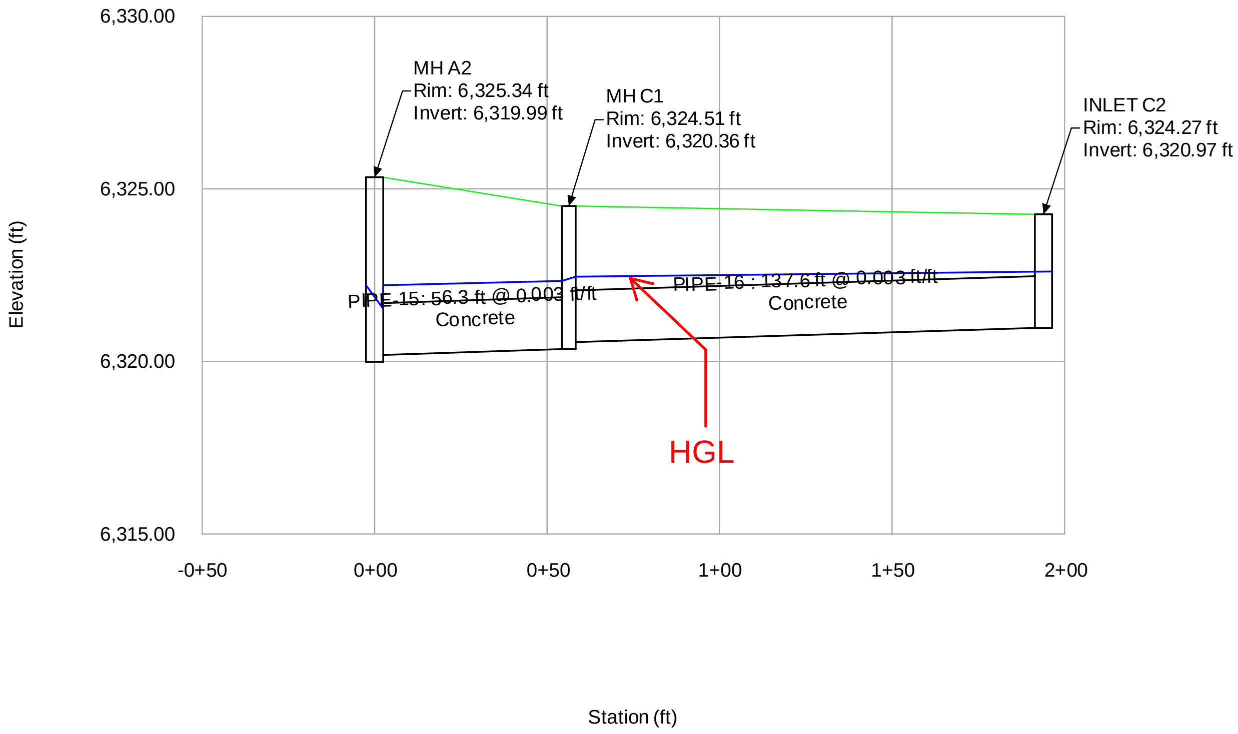
Profile Report
Engineering Profile - STRM LINE B (Meadowbrook Park.stsw)
100 Year



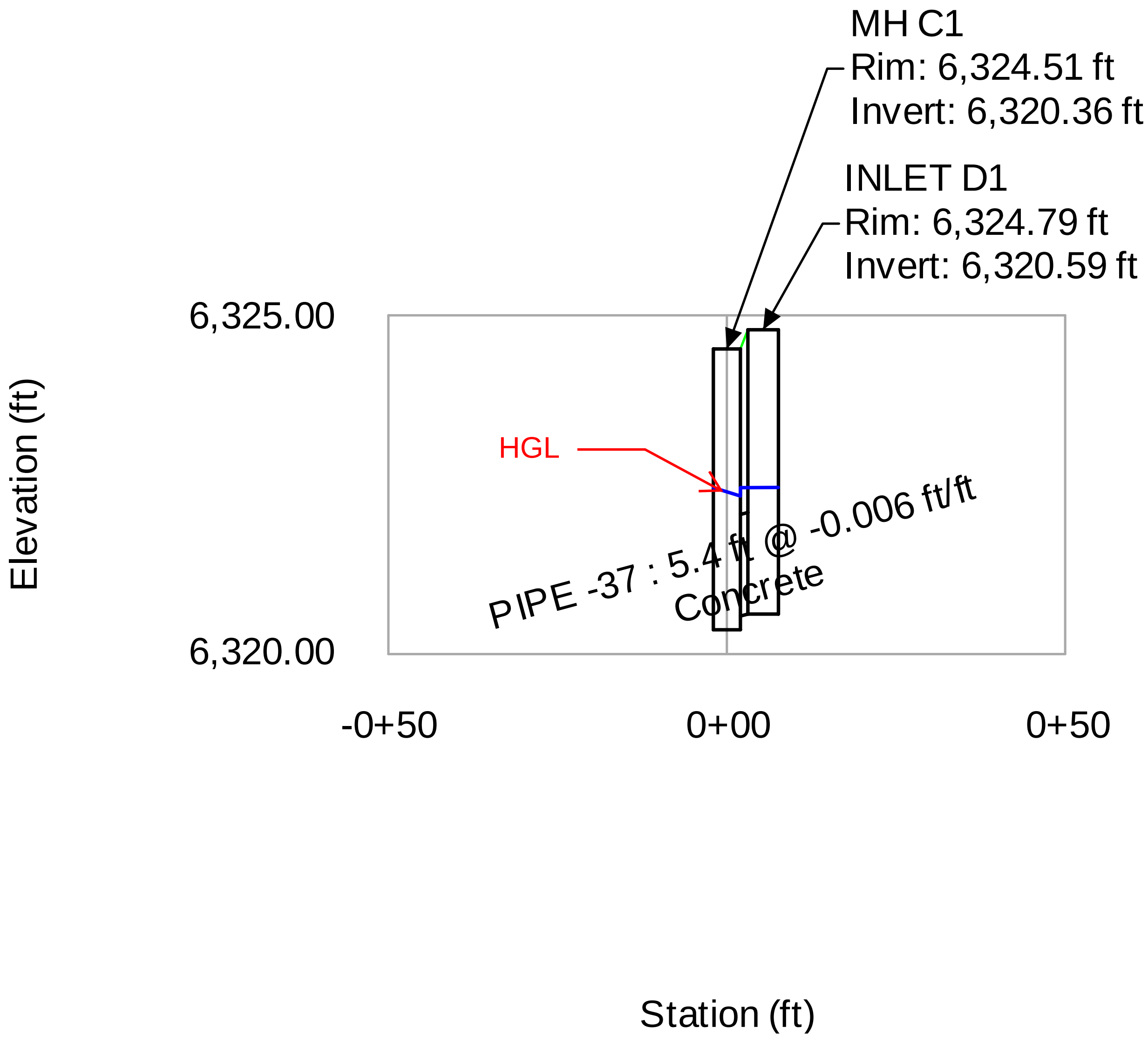
Profile Report

Engineering Profile - STRM LINE C (Meadowbrook Park.stsw)

100 Year



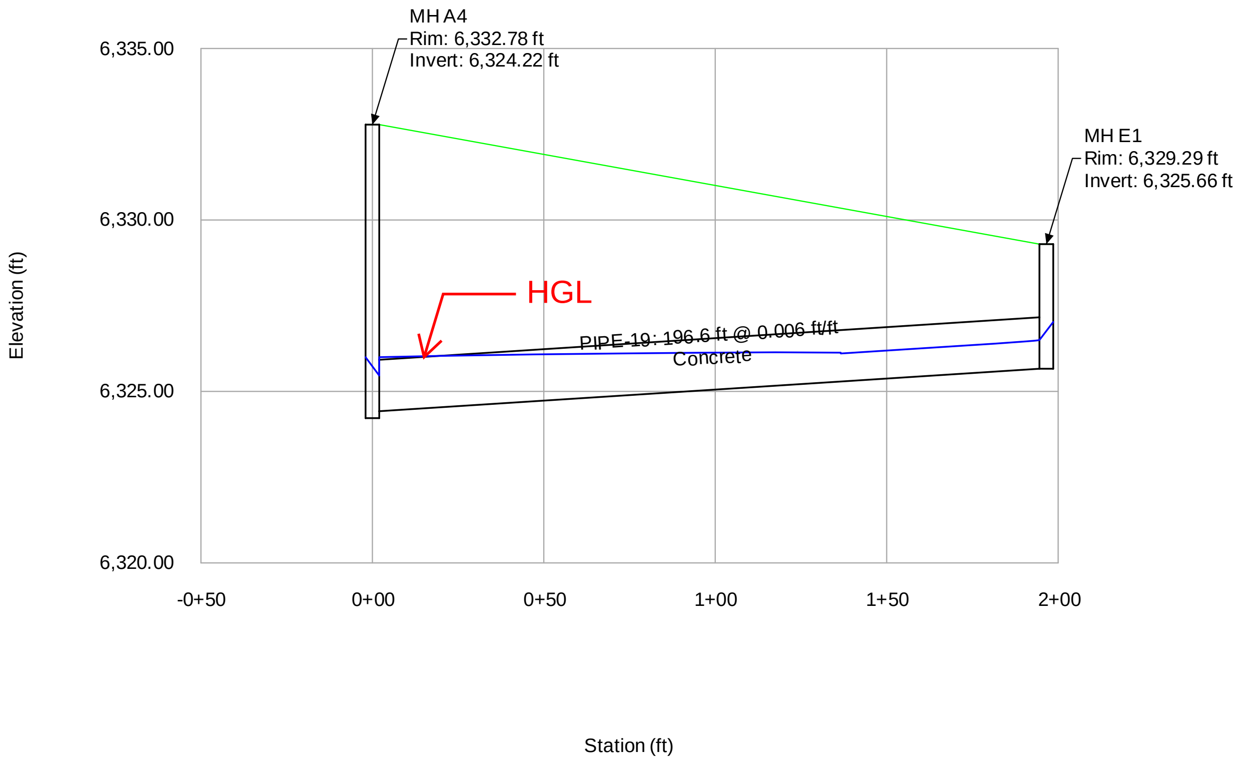
Profile Report
Engineering Profile - STRM LINE D (Meadowbrook Park.stsw)
100 Year



Profile Report

Engineering Profile - STRM LINE E (Meadowbrook Park.stsw)

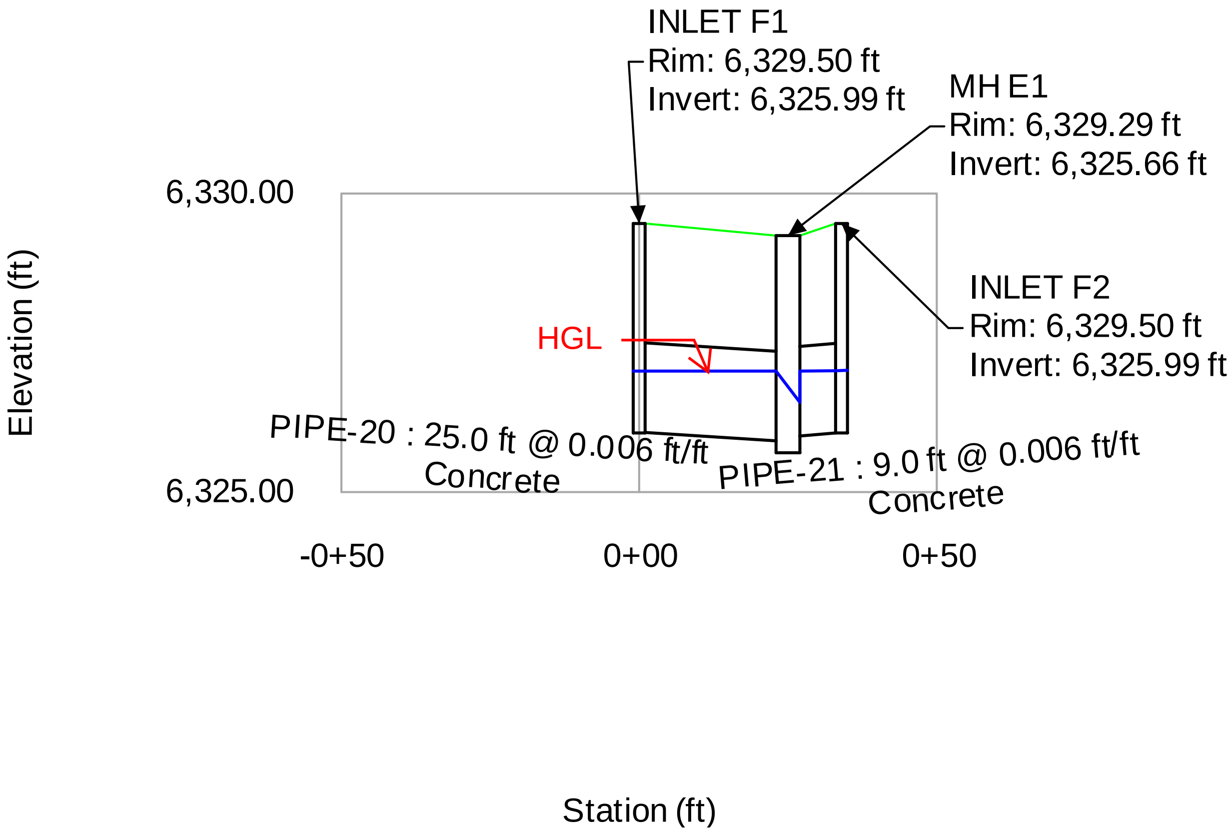
100 Year



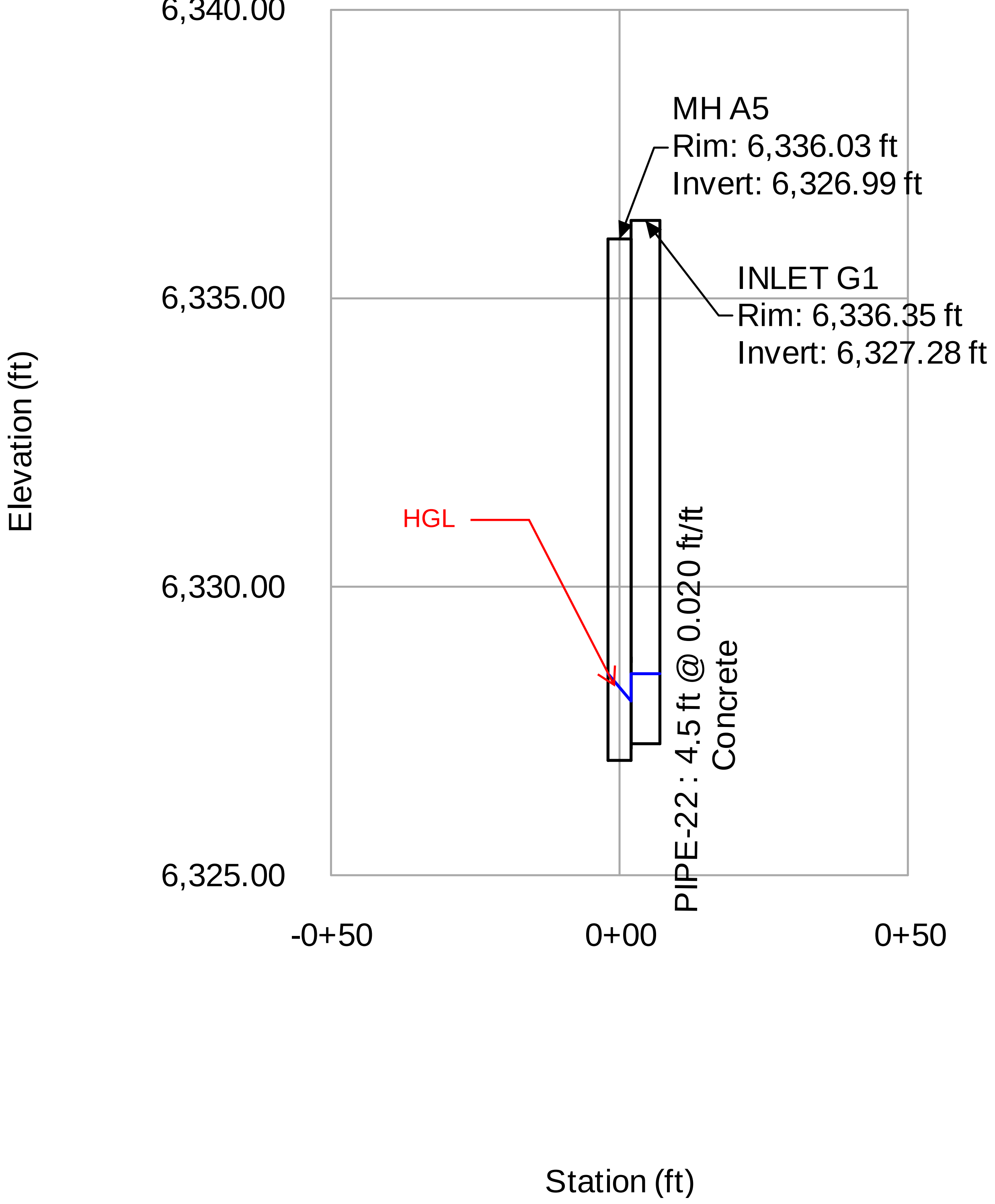
Profile Report

Engineering Profile - STRM LINE F (Meadowbrook Park.stsw)

100 Year



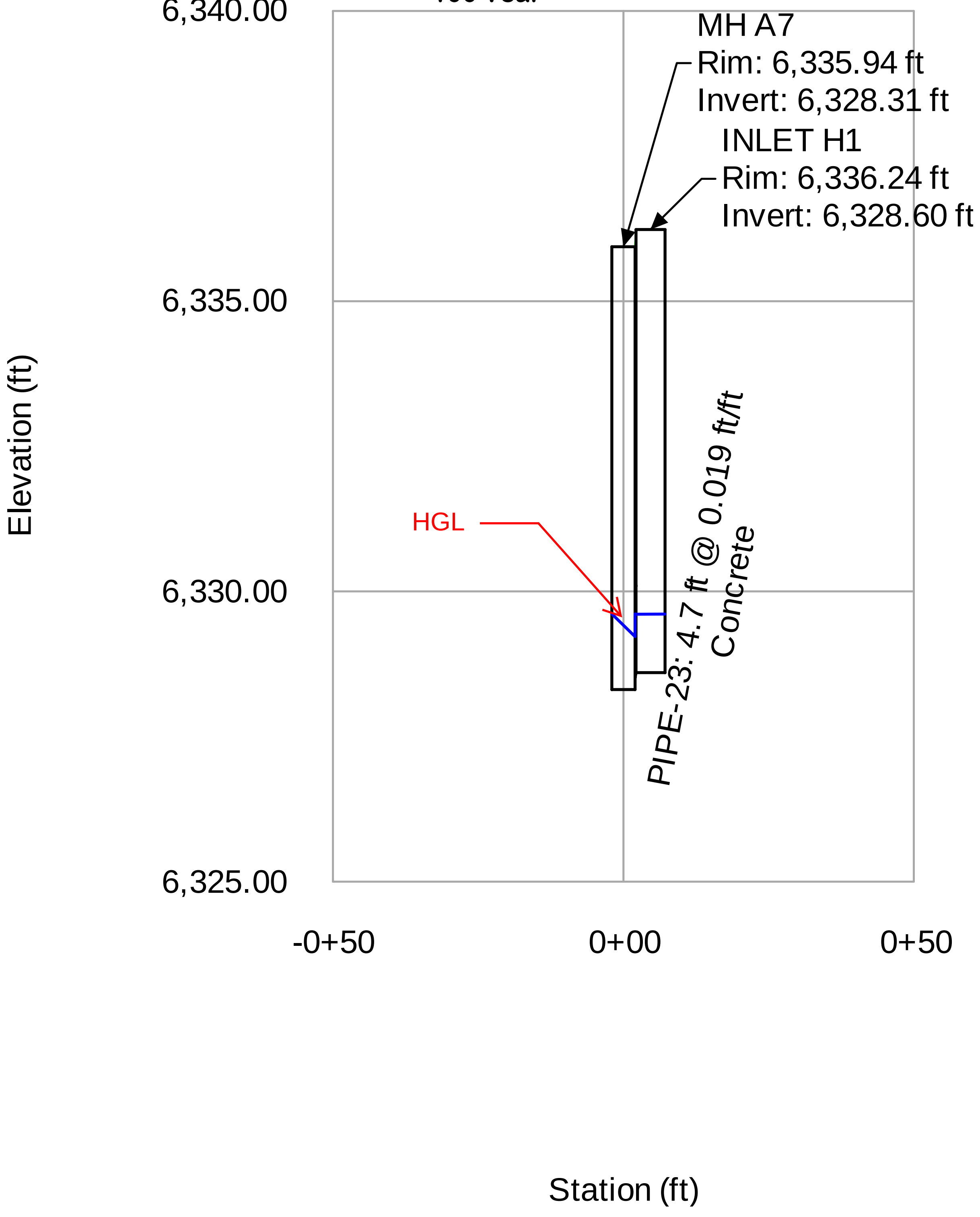
Profile Report
Engineering Profile - STRM LINE G (Meadowbrook Park.stsw)
100 Year



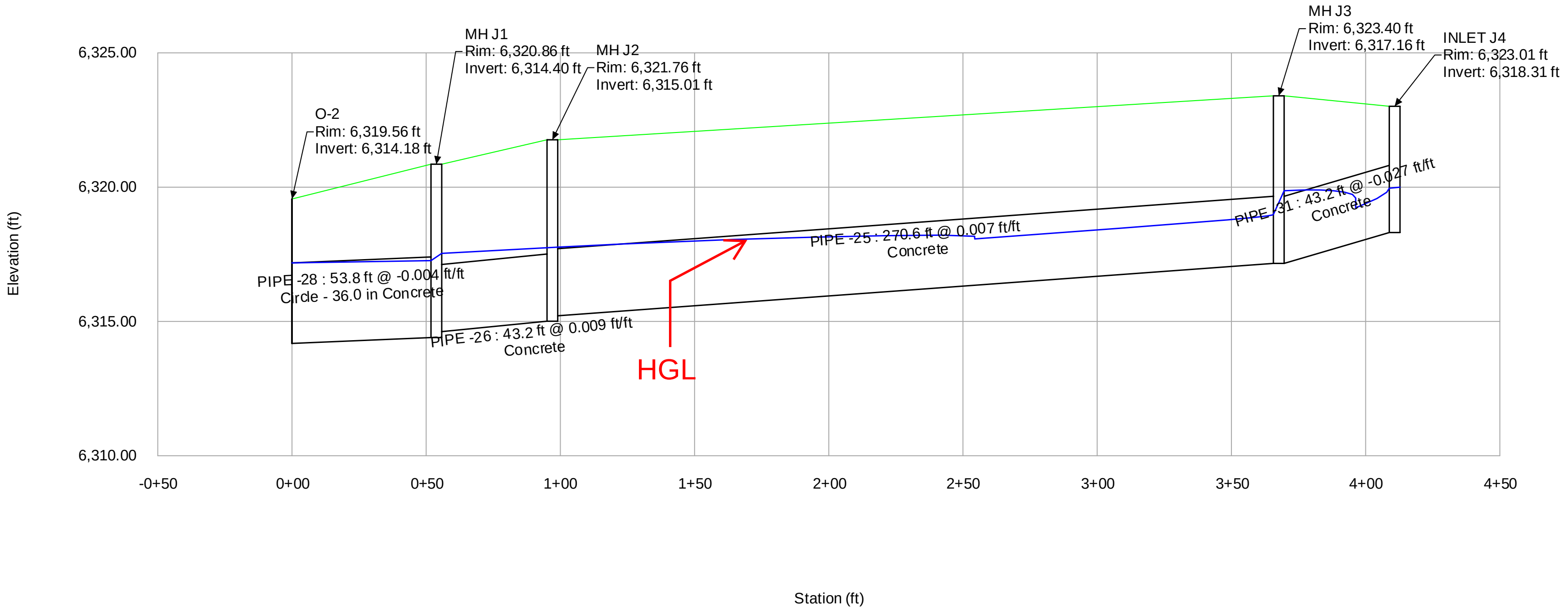
Profile Report

Engineering Profile - STRM LINE H (Meadowbrook Park.stsw)

100 Year



Profile Report
Engineering Profile - STRM LINE J (Meadowbrook Park.stsw)
100 Year

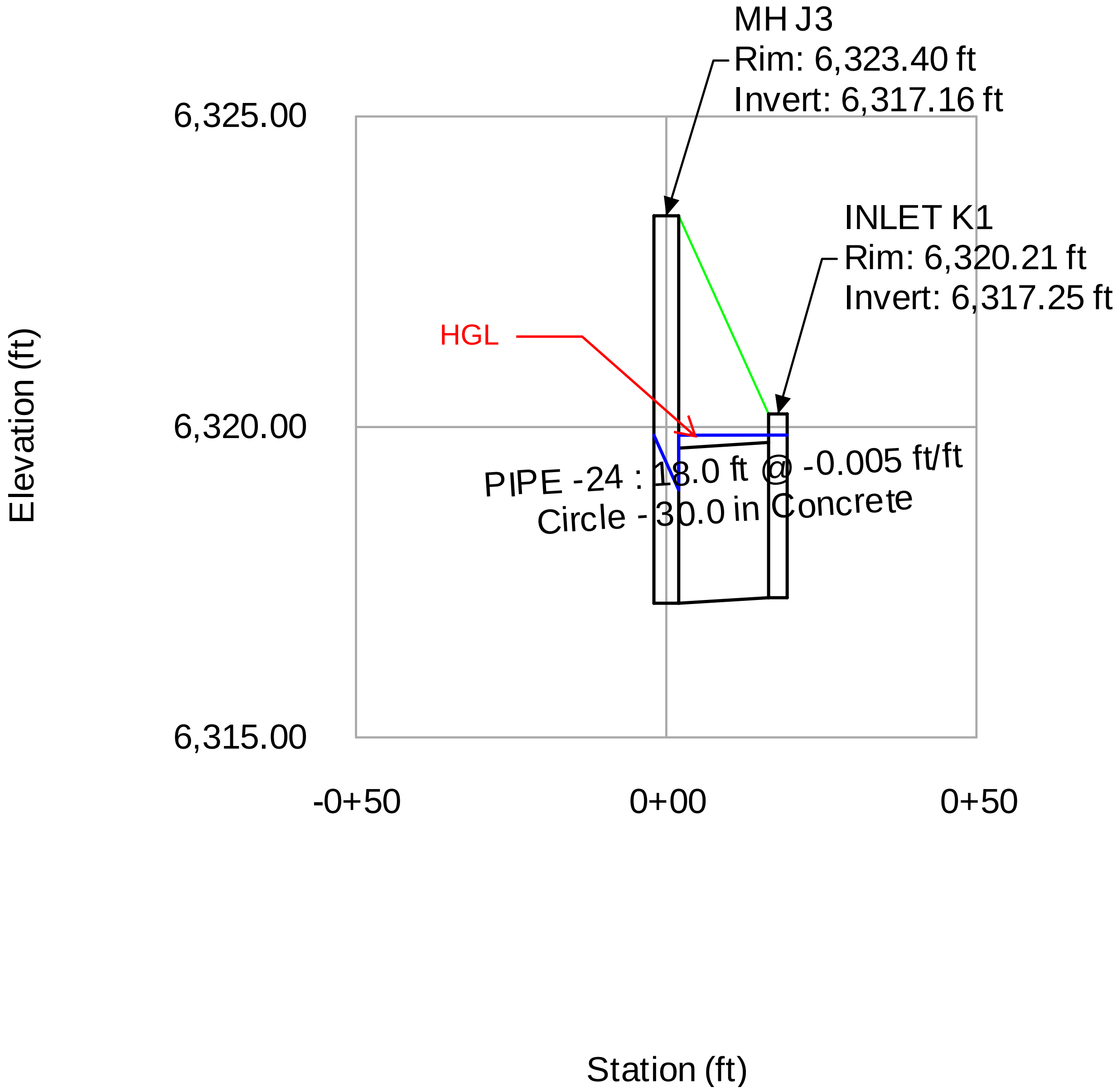


Meadowbrook Park.stsw
3/13/2021

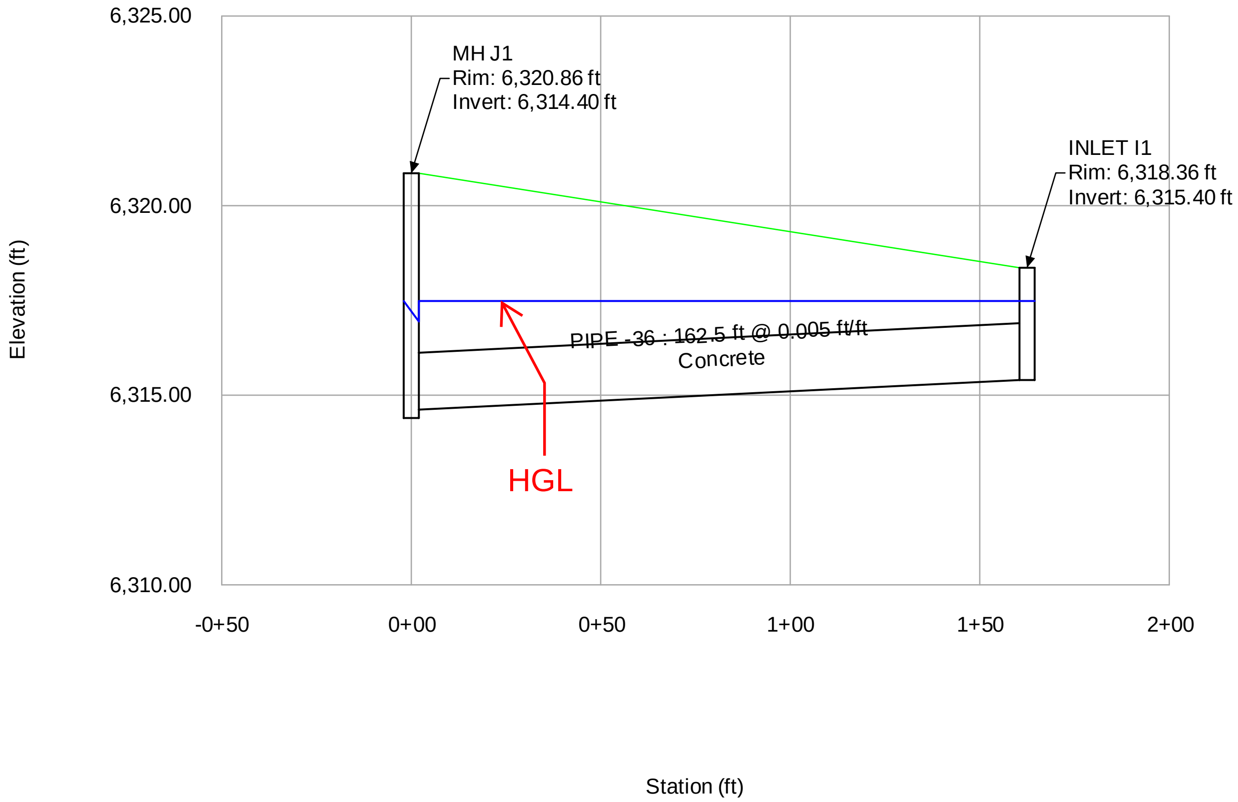
Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
+1-203-755-1666

StormCAD
[10.02.03.03]

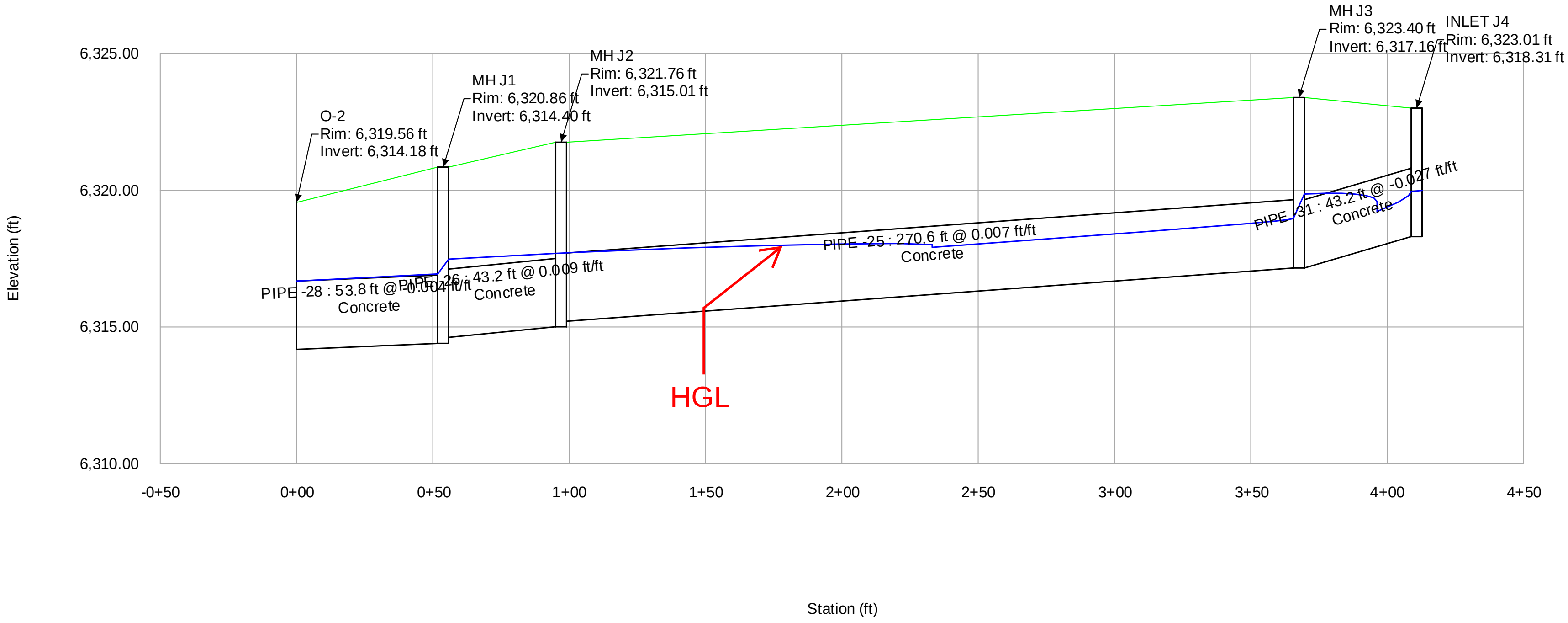
Profile Report
Engineering Profile - STRM LINE K (Meadowbrook Park.stsw)
100 Year



Profile Report
Engineering Profile - STRM LINE I (Meadowbrook Park.stsw)
100 Year



Profile Report
Engineering Profile - STRM LINE J (Meadowbrook Park.stsw)
100 Year



OPINION OF PROBABLE CONSTRUCTION COST

Kimley-Horn & Associates, Inc. **Opinion of Probable Construction Cost**

Client:	**Meadowbrook Development, LLC**	**Date:**	**3/12/2021**
Project:	**Meadowbrook Park**	**Prepared By:**	**KRK**
KHA No.:	**096956009**	**Checked By:**	**EJG**

Sheet: 1 of 1

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Private Storm Sewer - Non-Reimbursable				
1	18" RCP	1,092	LF	$65.00	$70,980
2	24" RCP	254	LF	$78.00	$19,812
3	30" RCP	375	LF	$97.00	$36,375
4	36" RCP	46	LF	$120.00	$960
5	5' Type R Inlet	8	EA	$5,736.00	$45,888
6	CDOT Type D Inlet	2	EA	$5,932.00	$11,864
7	CDOT Type C Inlet	1	EA	$4,802.00	$4,802
8	Modifed Type C Inlet	1	EA	$10,000.00	$10,000
9	8" Area Drain	2	EA	$500.00	$1,000
10	4' Type II Manhole	8	EA	$6,619.00	$52,952
11	5' Type II Manhole	4	EA	$12,034.00	$48,136
12	Concrete Forebay	2	EA	$7,500.00	$15,000
13	Concrete Trickle Channel	330	LF	$10.00	$3,300
14	Maintenance Road Material (CDOT Class 6 Base)	36	CY	$85.00	$3,060
15	Emergency Overflow (Type L Riprap)	20	Ton	$83.00	$1,660
16	Rock Chute (Type L Riprap)	110	Ton	$83.00	$9,130
		Subtotal:			$334,919
		Contingency (%,+/-)		10%	$33,492
		Project Total:			**$368,411**

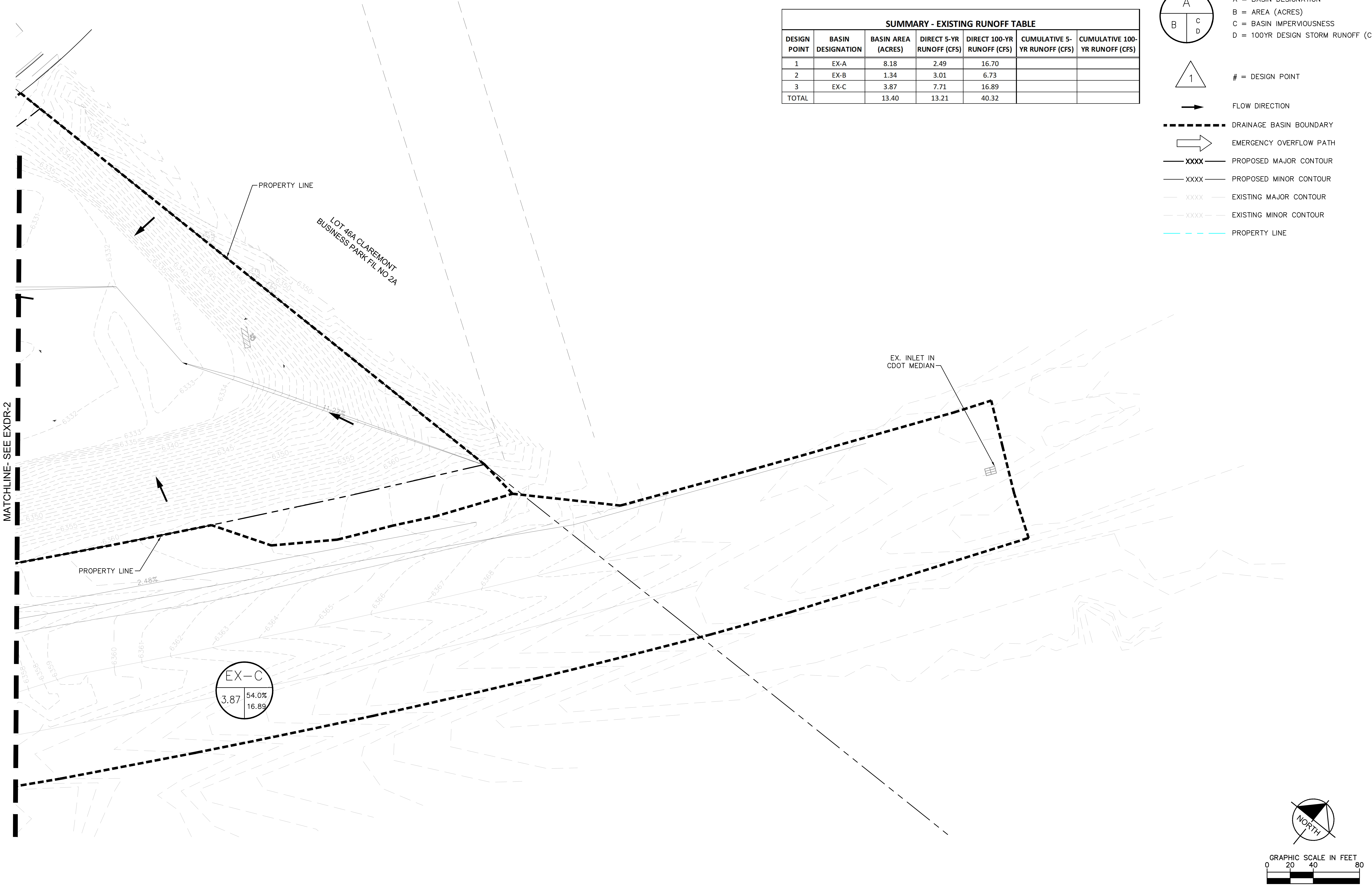
Basis for Cost Projection:

☐ No Design Completed
☐ Preliminary Design
☑ Final Design

Design Engineer:

John Heiberger
Registered Professional Engineer, State of Colorado No. 50096

EXISTING AND PROPOSED DRAINAGE MAP



SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	EX-A	8.18	2.49	16.70		
2	EX-B	1.34	3.01	6.73		
3	EX-C	3.87	7.71	16.89		
TOTAL		13.40	13.21	40.32		

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
EMERGENCY OVERFLOW PATH
XXXX PROPOSED MAJOR CONTOUR
XXXX PROPOSED MINOR CONTOUR
XXXX EXISTING MAJOR CONTOUR
XXXX EXISTING MINOR CONTOUR
PROPERTY LINE

NO.	REVISION	BY	DATE	APPR.

Kimley»Horn
2021 KIMLEY–HORN AND ASSOCIATES, INC.
2 North Nevada Avenue Suite 300
Colorado Springs, Colorado 80903 (719) 453–0180

DESIGNED BY: KK
DRAWN BY: KK
CHECKED BY: JH
DATE: 06/07/2021

MEADOWBROOK PARK
EL PASO COUNTY, COLORADO
CONSTRUCTION DOCUMENTS
EXISTING DRAINAGE MAP

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO.
096956009

SHEET
EXDR-1

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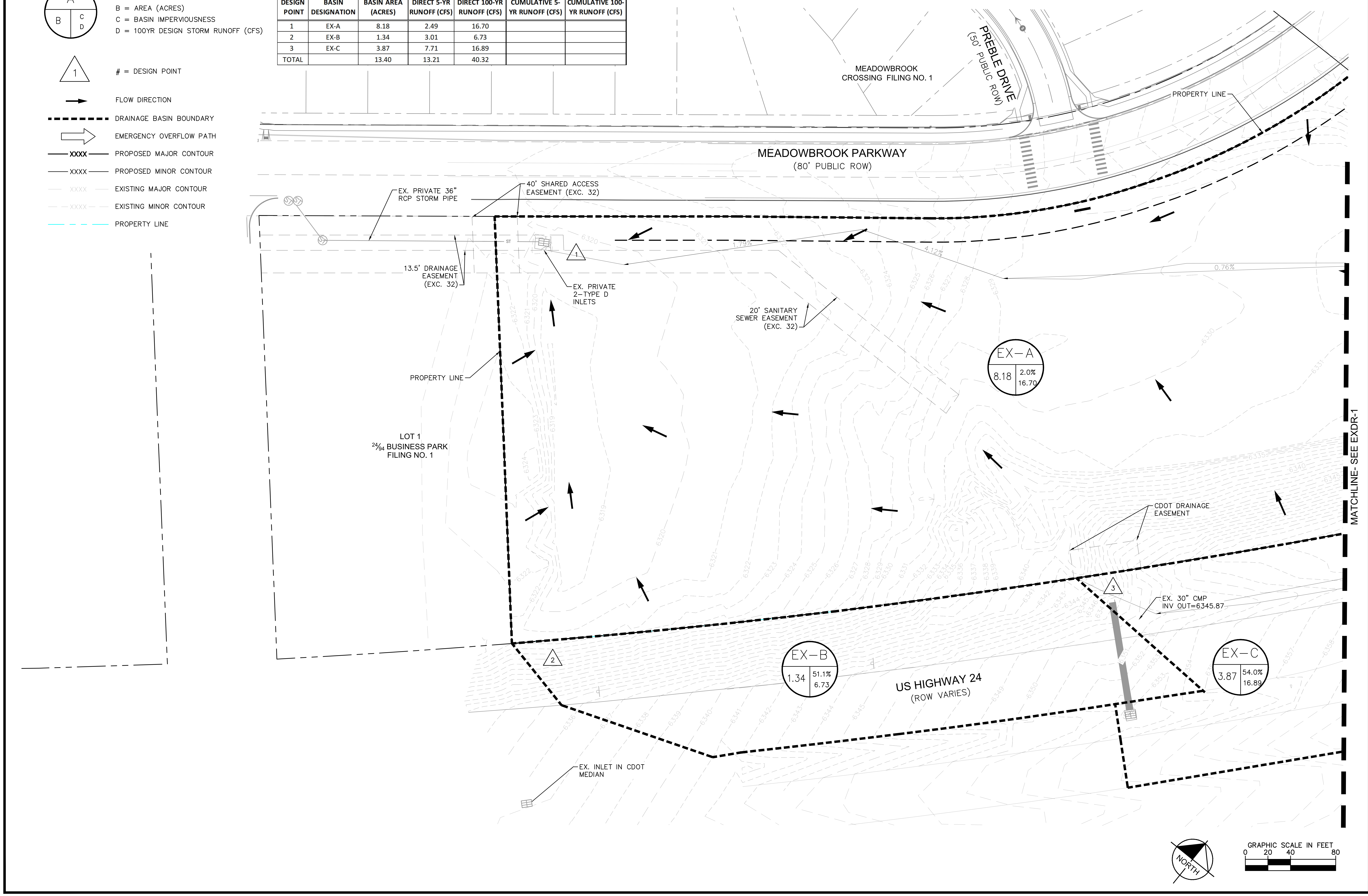
LEGEND

A	A = BASIN DESIGNATION
B	B = AREA (ACRES)
C	C = BASIN IMPERVIOUSNESS
D	D = 100YR DESIGN STORM RUNOFF (CFS)
△ 1	# = DESIGN POINT
→	FLOW DIRECTION
- - - -	DRAINAGE BASIN BOUNDARY
⇨	EMERGENCY OVERFLOW PATH
—XXXX—	PROPOSED MAJOR CONTOUR
—XXXX—	PROPOSED MINOR CONTOUR
- -XXXX- -	EXISTING MAJOR CONTOUR
- -XXXX- -	EXISTING MINOR CONTOUR
— — —	PROPERTY LINE

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	EX-A	8.18	2.49	16.70		
2	EX-B	1.34	3.01	6.73		
3	EX-C	3.87	7.71	16.89		
TOTAL		13.40	13.21	40.32		



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NO.	REVISION	DATE	BY	APPR.

Kimley»Horn

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2 North Nevada Avenue Suite 300
Colorado Springs, Colorado 80903 (719) 453-0180

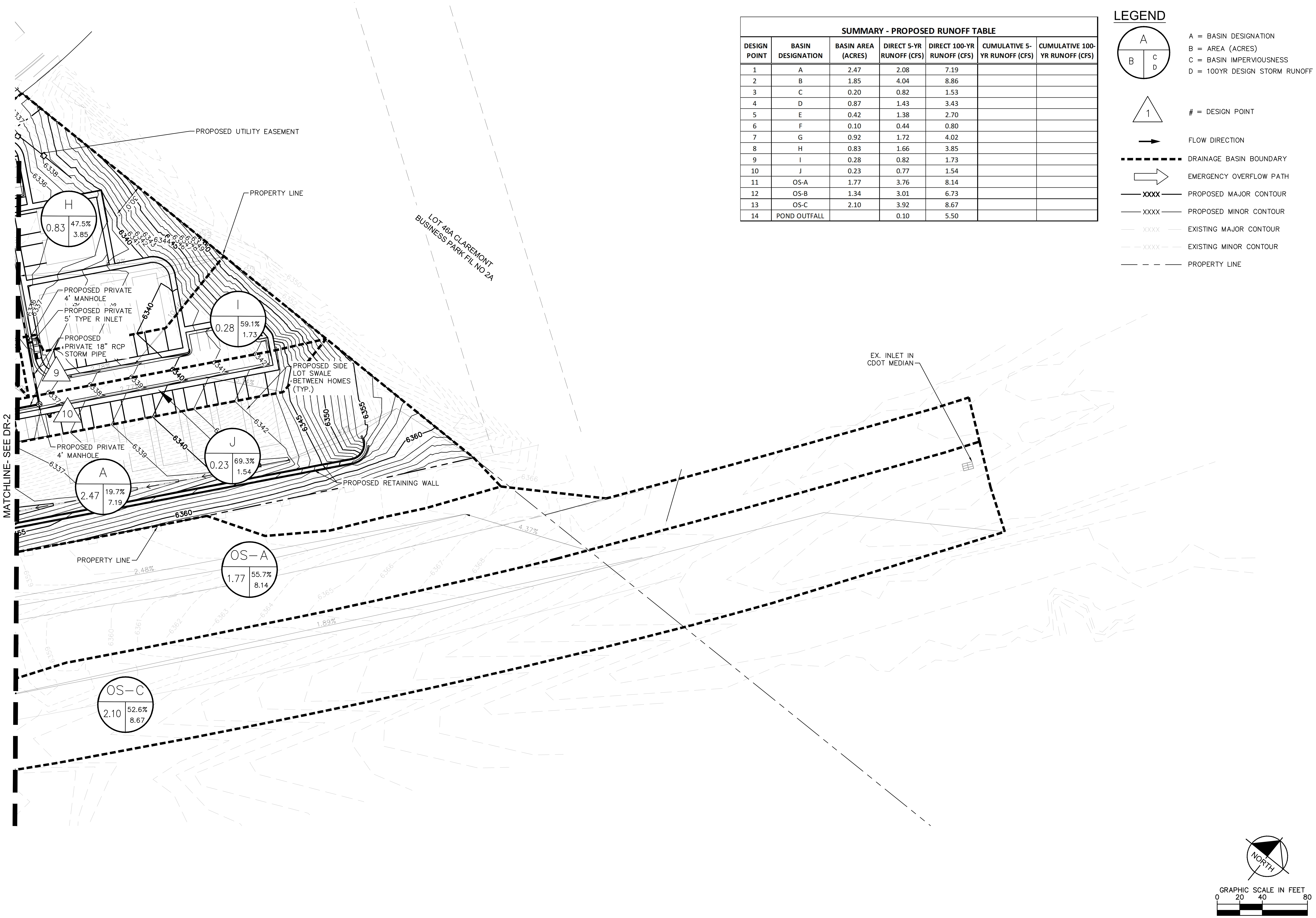
DESIGNED BY: KK
DRAWN BY: KK
CHECKED BY: JH
DATE: 06/07/2021

MEADOWBROOK PARK
EL PASO COUNTY, COLORADO
CONSTRUCTION DOCUMENTS
EXISTING DRAINAGE MAP

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION
Kimley»Horn
Kimley-Horn and Associates, Inc.

PROJECT NO.
096956009

SHEET
EXDR-2



SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
1	A	2.47	2.08	7.19		
2	B	1.85	4.04	8.86		
3	C	0.20	0.82	1.53		
4	D	0.87	1.43	3.43		
5	E	0.42	1.38	2.70		
6	F	0.10	0.44	0.80		
7	G	0.92	1.72	4.02		
8	H	0.83	1.66	3.85		
9	I	0.28	0.82	1.73		
10	J	0.23	0.77	1.54		
11	OS-A	1.77	3.76	8.14		
12	OS-B	1.34	3.01	6.73		
13	OS-C	2.10	3.92	8.67		
14	POND OUTFALL		0.10	5.50		

LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

\# = DESIGN POINT

→ FLOW DIRECTION
DRAINAGE BASIN BOUNDARY
⇨ EMERGENCY OVERFLOW PATH
XXXX PROPOSED MAJOR CONTOUR
XXXX PROPOSED MINOR CONTOUR
XXXX EXISTING MAJOR CONTOUR
XXXX EXISTING MINOR CONTOUR
PROPERTY LINE

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LEGEND

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△1 # = DESIGN POINT

→ FLOW DIRECTION

DRAINAGE BASIN BOUNDARY

⇨ EMERGENCY OVERFLOW PATH

XXXX PROPOSED MAJOR CONTOUR

XXXX PROPOSED MINOR CONTOUR

XXXX EXISTING MAJOR CONTOUR

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PROPERTY LINE

SUMMARY - PROPOSED RUNOFF TABLE

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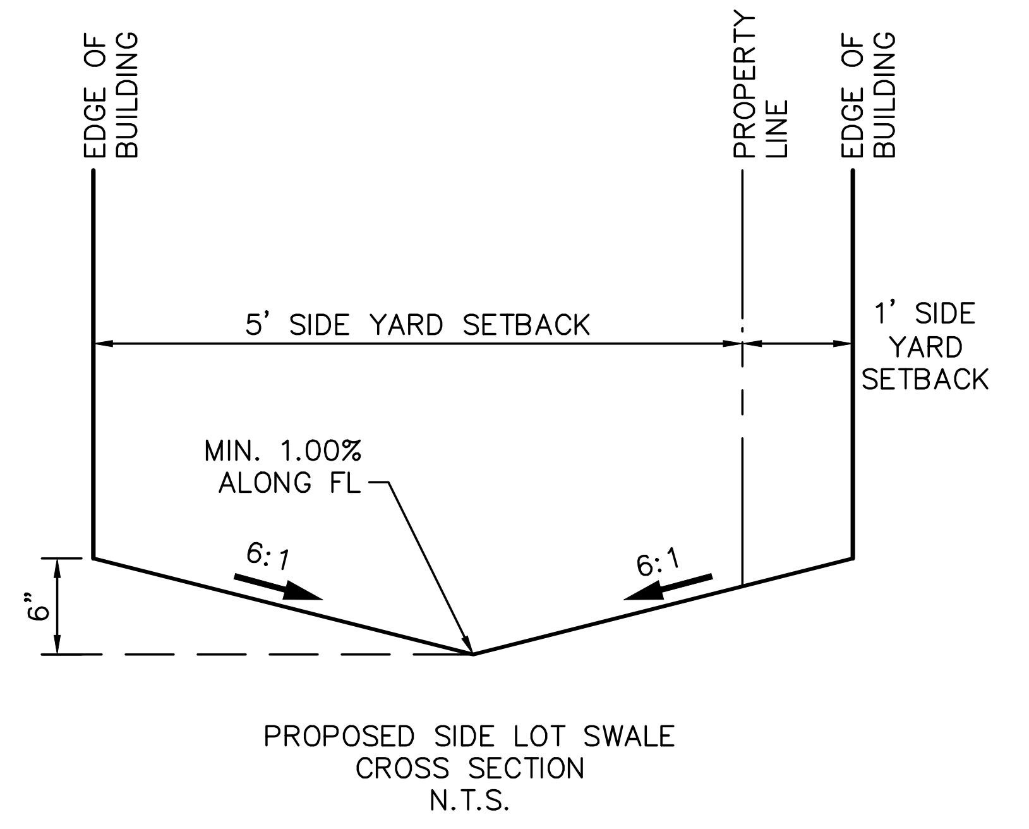
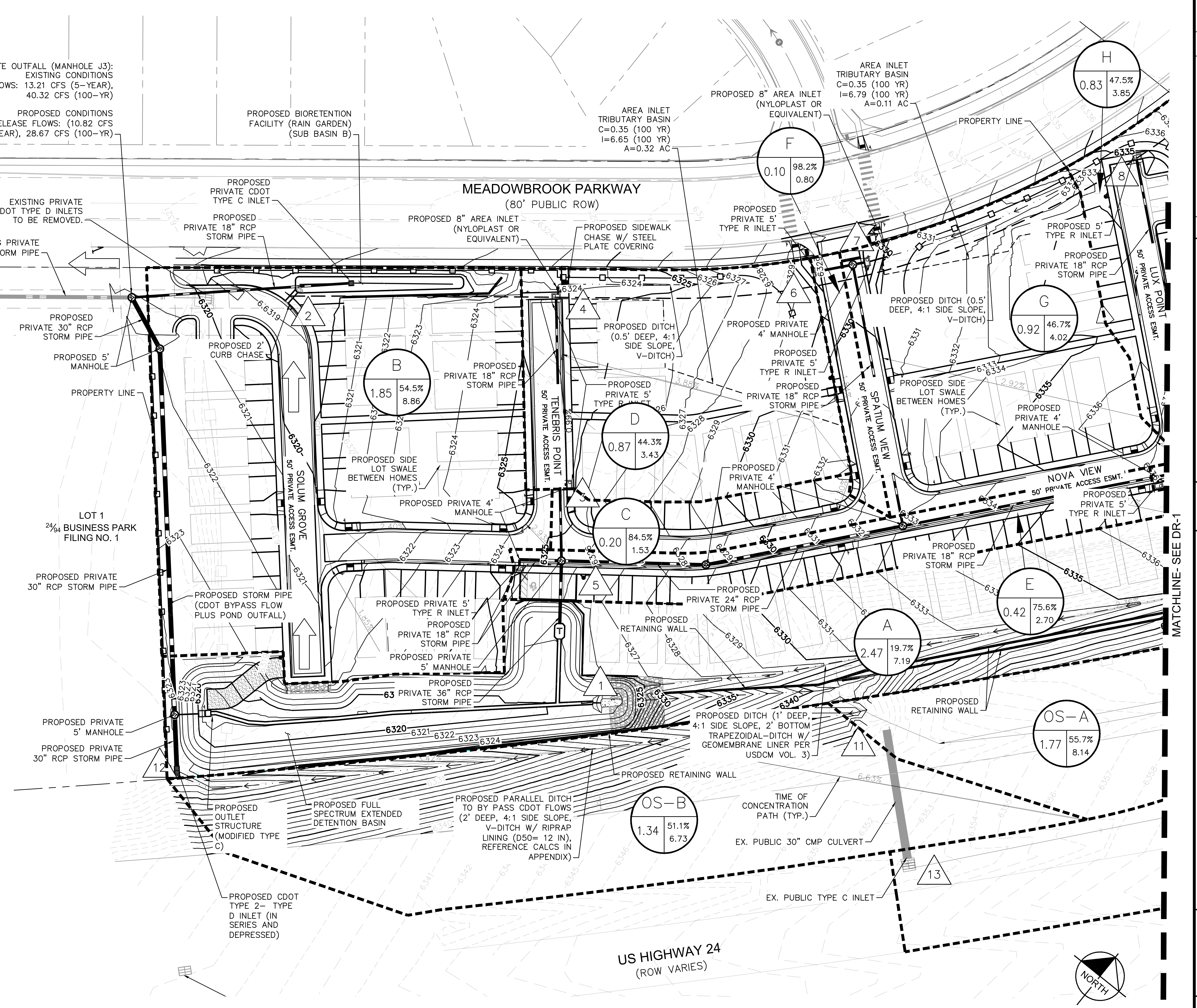


PROPOSED SIDE LOT SWALE
CROSS SECTION
N.T.S.



MEADOWBROOK PARK
EL PASO COUNTY, COLORADO
CONSTRUCTION DOCUMENTS
PROPOSED DRAINAGE MAP

NO.	REVISION	BY	DATE	APPR.

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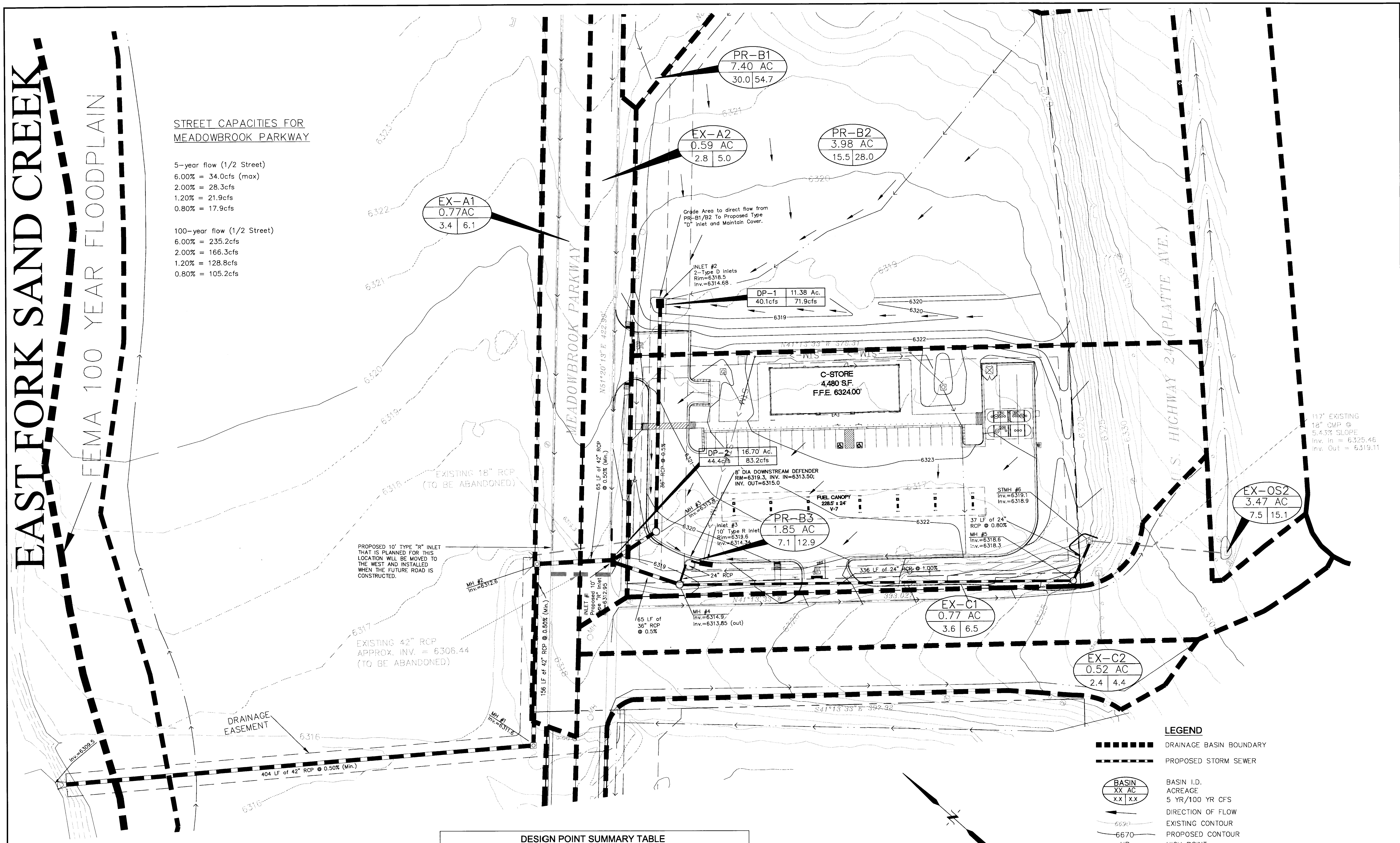

STREET CAPACITIES FOR MEADOWBROOK PARKWAY

5-year flow (1/2 Street)
6.00% = 34.0cfs (max)
2.00% = 28.3cfs
1.20% = 21.9cfs
0.80% = 17.9cfs

100-year flow (1/2 Street)
6.00% = 235.2cfs
2.00% = 166.3cfs
1.20% = 128.8cfs
0.80% = 105.2cfs

DESIGN POINT SUMMARY TABLE

DESIGN POINT	RUNOFF 5 YR (cfs)	RUNOFF 100 YR (cfs)	COMMENTS
DP-1	40.1	71.9	FLOW IN PIPE
DP-2	44.4	83.2	FLOW IN PIPE
INLET #3	7.1	12.9	ON-SITE INLET, 24" RCP TO WQ VAULT
STMH #6	7.5	15.1	FROM BASIN EX-OS2

LEGEND

■■■■■■■	DRAINAGE BASIN BOUNDARY
▬▫▬▫▬▫▬	PROPOSED STORM SEWER
BASIN XX AC X.X | X.X	BASIN I.D. ACREAGE 5 YR/100 YR CFS
←	DIRECTION OF FLOW
6690	EXISTING CONTOUR
6670	PROPOSED CONTOUR
HP	HIGH POINT
LP	LOW POINT
GB	GRADE BREAK
TC	TOP BACK OF CURB
FL	FLOWLINE
— · · → —	TIME OF CONCENTRATION

CORE
ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
Circle K Stores, Inc.
1199 South Beltline Road, Suite 160
COPPELL, TEXAS 75019
(940) 453-0015
CONTACT: Tim Peters

PROJECT:
24/94 BUSINESS PARK
Meadowbrook Parkway & Platte Avenue
COLORADO SPRINGS, COLORADO

DRAWN: LAB, 9/9/15
DESIGNED: LAB, 9/9/15
CHECKED: RLS, 9/10/15

PROPOSED CONDITIONS DRAINAGE PLAN
LOT 1 OF 24/94 BUSINESS PARK
Meadowbrook Pkwy., EL PASO COUNTY, CO

DATE:
JULY, 2016

PROJECT NO.
319.001

SHEET NUMBER
1

TOTAL SHEETS: 2