

DRAINAGE LETTER

for

WATER TREATMENT PLANT BUILDING ADDITION

Prepared for the

SECURITY WATER DISTRICT

GMS, Inc.
Consulting Engineers

DRAINAGE LETTER
FOR
WATER TREATMENT PLANT BUILDING ADDITION

PROJECT NO. 2022-076.130

AUGUST 2025
FINAL: APRIL 2026

OWNER:

SECURITY WATER DISTRICT ENTERPRISE
231 SECURITY BOULEVARD
COLORADO SPRINGS, CO 80911

PREPARED BY:

GMS, INC.
CONSULTING ENGINEERS
611 NORTH WEBER, SUITE 300
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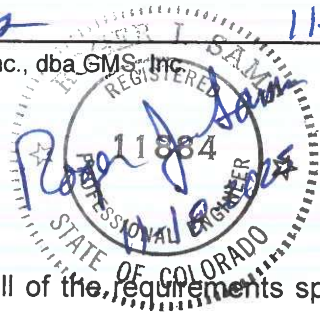
DRAINAGE LETTER
for
SECURITY WATER DISTRICT
WATER TREATMENT PLANT BUILDING ADDITION

1.0 CERTIFICATION STATEMENTS

Engineer's Statement

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

SIGNATURE (Affix Seal): Roger J. Sams 11-18-2025
For and on behalf of Meyer & Sams, Inc., dba GMS, Inc. Date
Roger J. Sams, P.E. #11884



Developer's Statement

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

Roy E. Heald 11/19/2025
Authorized Signature By: Roy E. Heald, General Manager Date
Security Water District Acting by and Through It's Water Enterprise

EI Paso County

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

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

Conditions:

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SECTION I PURPOSE AND BACKGROUND

A. PURPOSE AND SCOPE

This drainage letter and report has been prepared in support of the Security Water District Enterprise (“District”) water treatment plant (WTP) building addition improvements. The purpose of this report is to present the findings of a hydrologic evaluation and development of stormwater management infrastructure at the WTP site.

The stormwater management plan is to conform with criteria established by El Paso County as the local land use authority having jurisdiction. The construction of the existing WTP was accomplished by the United States Air Force by agreement with the U.S. Army Corps of Engineers as project manager. At the beginning of that design and construction effort, the federal agencies agreed to comply with and provide submittals consistent with the El Paso County stormwater management criteria applicable at that time. Those submittals were not subject to the “approval” of El Paso County. The file materials submitted are identified as File Number AASI192 in the El Paso County Planning and Community Development system (EDARP).

B. BACKGROUND

The Security Water District Enterprise currently owns, operates and maintains a water treatment plant (WTP) in the unincorporated Security community in central El Paso County, Colorado. The WTP was constructed as a joint project between the District and the United States Air Force to address per- and polyfluoroalkyl (PFAS) compounds in the District’s local source water supply. Due to funding constraints, the water treatment plant was built without personnel accommodations such as toilet rooms, workspaces, and designated storage areas for expendable supplies utilized in the water treatment management, record keeping and daily operations.

This project will add to the existing WTP building, providing toilet facilities, maintenance and janitorial space, areas for record keeping and technical reference material storage, and

improved access for periodic delivery of large quantities of ion exchange media. The addition will include a building with a similar profile, height and geometric configuration as the existing WTP building. The building will be a slab-on grade, pre-engineered metal building with an exterior foundation footprint of 51-feet by 40-feet and a projected floor area of 2,040 square feet.

As part of the project, hot mix bituminous pavement will replace the existing gravel vehicular travel ways within the treatment plant facility. This site is not accessible to the public and is enclosed with a 6-foot-high chain link fence with top treatment to deter intrusion.

SECTION II GENERAL LOCATION AND DESCRIPTION

A. SITE LOCATION

The Security Water District is located in the northwest area of the Security-Widefield region, south and west of the municipal limits of Colorado Springs in El Paso County, Colorado. The WTP is located within the Northeast one quarter Southeast one quarter of Section 2, Township 15 South, Range 66 West of the Sixth Meridian.

The District's WTP is located on a parcel of land encompassing 70.041 acres north of the Bradley Road and Lincoln Plaza Drive intersection. This larger parcel of land, owned by the District is confined by Bradley Road to the south, Hancock Expressway to the east, Milton Proby Parkway to the north, and Academy Boulevard to the west. The eastern edge of the District's property is constrained by the Fountain Mutual Irrigation Canal and Clearview Loop as platted in Clearview Industrial Park Filing No. 1.

Figure II-1 provides an area map showing the generalized project limits, surrounding street configurations, topography, drainage features, and irrigation canal and ditches. The map is adapted from a U.S. Geological Survey 7.5 minutes quadrangle.

B. DESCRIPTION OF PROPERTY

The District-owned parcel of land is identified as El Paso County Assessor's schedule number 65020-00-138. The 1.7-acre fenced WTP site contains the treatment plant building, a raw water storage tank, and an on-site power generator. The proposed improvements will not change the property's current land use as the property is already being used for water treatment.

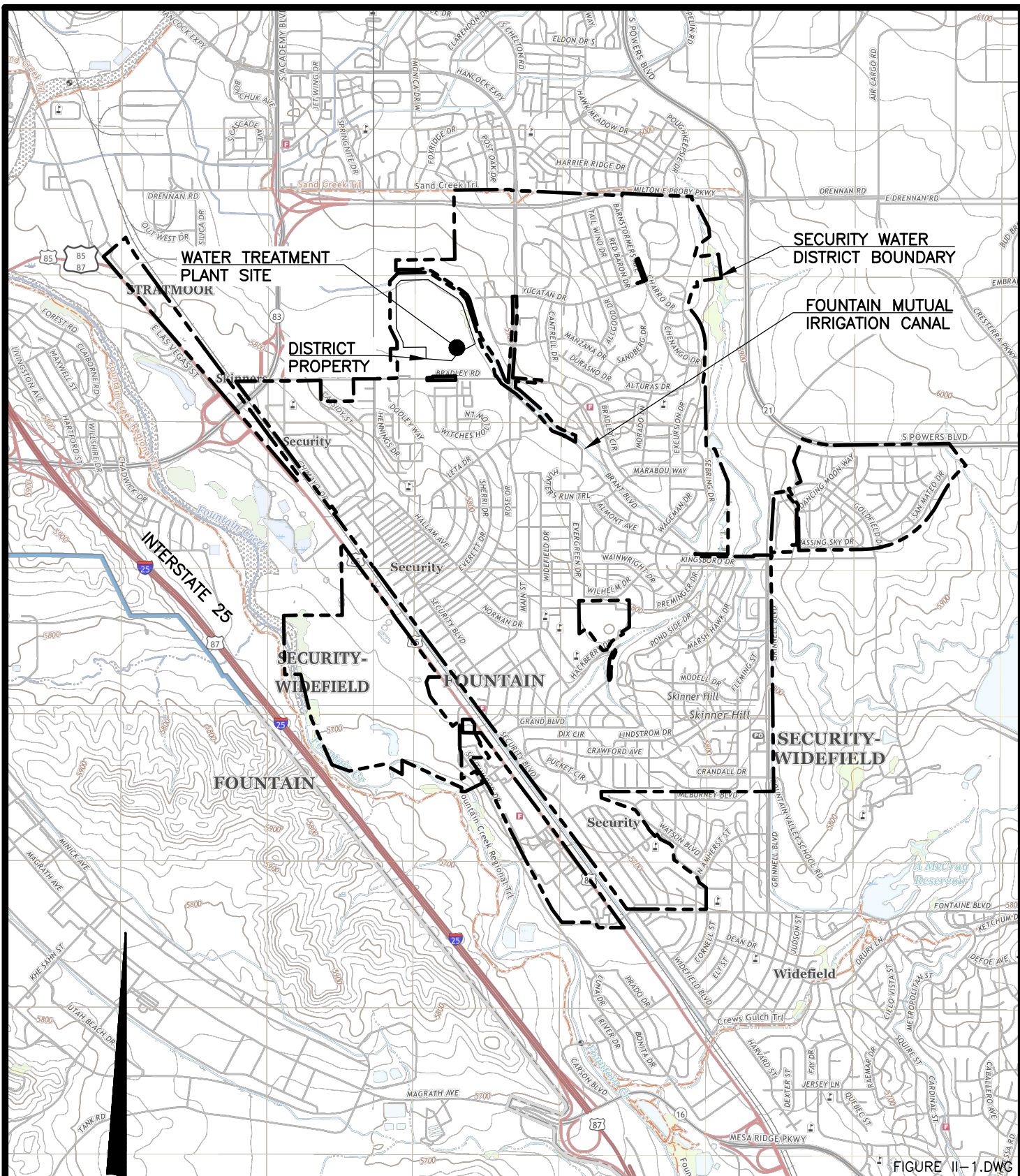


FIGURE II-1.DWG

SCALE: 1" = 3,000'

SOURCE: COLORADO SPRINGS, ELSMERE, CHEYENNE MOUNTAIN, AND FOUNTAIN QUADRANGLE MAPS

**FIGURE II-1
LOCATION MAP
SECURITY WATER DISTRICT**

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COLORADO SPRINGS, COLORADO 80903

AUGUST 2025

C. PHYSIOGRAPHY, TOPOGRAPHY AND VEGETATION

The District's WTP is located at approximately 5,859 feet AMSL in elevation. The general topography in the area falls from the northeast to the southwest. No prominent topographic features exist within the District's WTP property. Figure II-1 shows the general topography in and around the District's WTP.

The area immediately north of the WTP within the District's ownership is currently leased by the District for solar power generation. The land to the southeast outside the District's ownership is occupied by a self-storage commercial business. There are no delineated wetlands around the WTP site. The only wetlands associated around the District's property are delineated as riverine and a freshwater pond. The riverine is the Fountain Mutual Irrigation Canal, which flows southeasterly through the majority of the District and just east of the District's property. The 37-acre delineated freshwater pond mapped in published wetlands inventory documents was formerly a portion of a facility commonly referred to as the Little Johnson Reservoir. This reservoir use no longer exists and is replaced by land leased for solar power generation. A smaller 0.5-acre pond exists at the topographic low point subject to local runoff conditions.

The Little Johnson Reservoir ceased to be used for irrigation impoundment/storage purposes by the Fountain Mutual Irrigation Company approximately 65 to 70 years ago. The topographic geometry remains as it was last used and serves as a permanent detention area for local runoff. The Security Water District has no intention of modifying that historical topographic condition and will maintain the runoff from its property on the historic site and within the District's ownership. Current runoff entering the former Little Johnson Reservoir will ultimately collect in the smaller 0.5-acre pond located at the low point within the former reservoir. From there, stormwater will either infiltrate into the ground or evaporate into the atmosphere. Since use of this reservoir as an irrigation storage facility ceased about 65 years ago, it has never been known to overflow from natural precipitation in the local watershed. The District's WTP is located in the plains/grassland region of Colorado. Native vegetation includes blue grama and buffalo grass, with scattered species such as rabbitbrush, sagebrush, yucca, and various wildflowers.

D. SOILS

The US Department of Agriculture through the National Resources Conservation Service (NRCS) has compiled detailed soil information for

If the pond continuously retains water it cannot be assumed that it will infiltrate. Please demonstrate how the WQCV will be infiltrated. If it cannot be demonstrated that the WQCV will be infiltrated then an alternative treatment method will be necessary (runoff reduction?). If the design will be changed I recommend forming alternatives and discussing options with EPC review staff.

the NRCS' web soil survey website. Soil type information within and surrounding the District's WTP is relevant as it relates to constructability within the area and the soil's ability to convey surface water.

The following soils have been identified in the NRCS mapping of the Security WTP area as shown on the following Figures II-2A, II-2B and II-2C. General information is presented in terms of the characteristics of these different soil classifications. None of the identified soils are classified as prime farmland.

8 - Blakeland Loamy Sand - 1 to 9% Slopes:

This is the primary soil group within the District's WTP property, found in the southeastern part of the property and extending northwest of the property. This soil group consists of loamy sand; these soils are somewhat excessively drained with a low runoff class. These soils are classified as hydrologic soil group "A". Depth to water table is more than 80 inches.

111 – Water:

This group is prevalent in the northwest corner of the District's 70-acre property. This group is entirely composed of open water with high runoff potential. The soil survey still depicts the former Little Johnson Reservoir, which is no longer in use and remains unfilled except for ponding of local runoff in the property's topographic low point.

E. MAJOR DRAINAGEWAYS

The District's WTP resides in the Little Johnson Drainage Basin which drains to the Windmill Gulch Basin upstream of its confluence with Fountain Creek. The Security-Widefield area generally drains southwest towards Fountain Creek, which is ultimately tributary to the Arkansas River. A minor drainageway near the District's WTP is the Fountain Mutual Irrigation Canal, owned by Fountain Mutual Irrigation Company who supports agricultural irrigation uses and water resource management in the surrounding region. This 20-foot-wide canal flows four miles southeast, passing 400 feet east of the District's WTP, and into Big Johnson Reservoir. The company typically fills the reservoir in the fall and winter, then releases water in the spring for downstream irrigation and release to Fountain Creek as replacement water for out-of-priority diversions, usually by pumping of alluvial ground water tributary to Fountain Creek. This canal intercepts storm water runoff from areas to the north and east of the District's property. That stormwater is released from the irrigation ditch at it's

Soil Map—El Paso County Area, Colorado
(Security Water District - Soils Map)

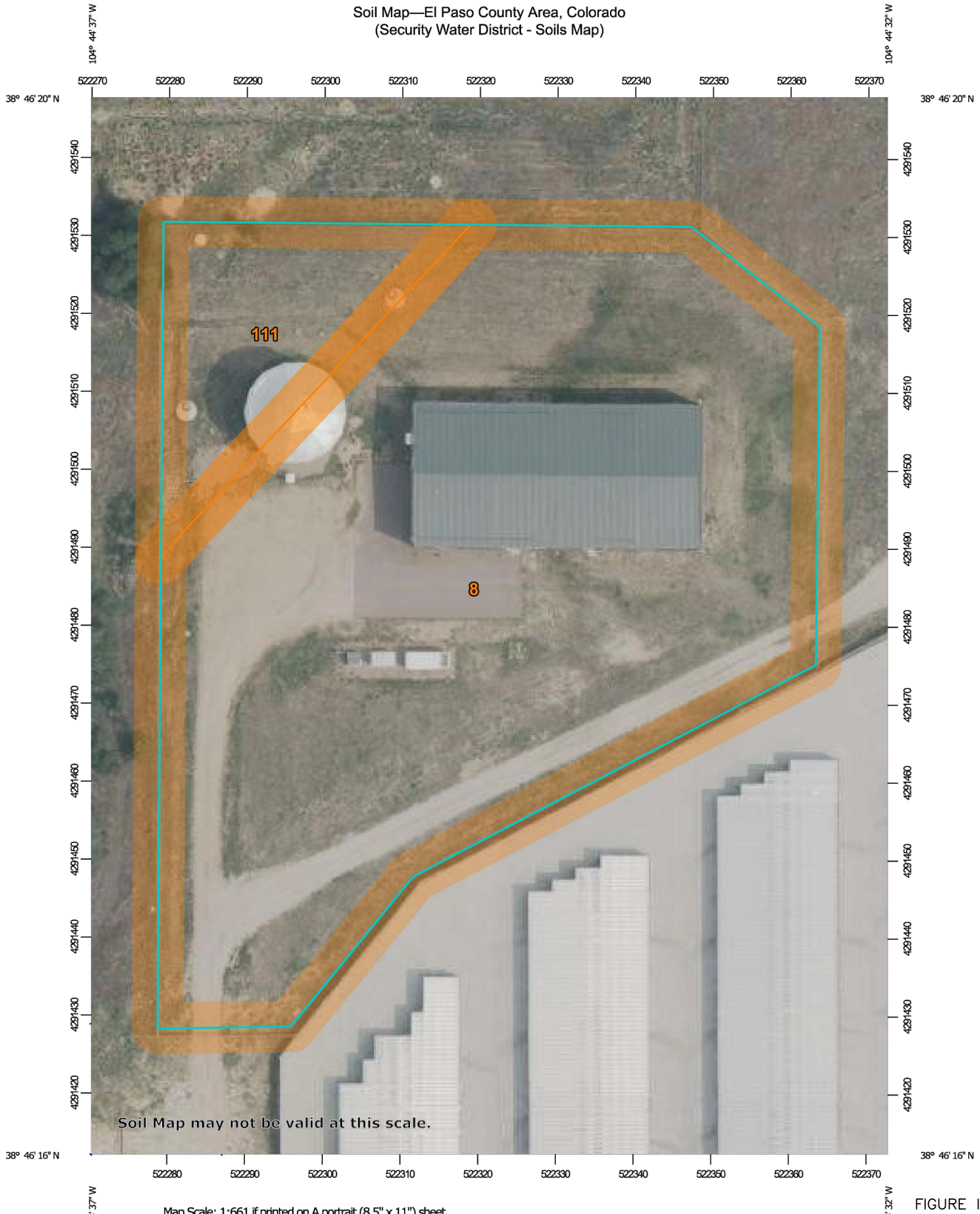


FIGURE II-2A.DWG

Map Scale: 1:661 if printed on A portrait (8.5" x 11") sheet.
 0 5 10 20 30 Meters
 0 30 60 120 180 Feet
 Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

FIGURE II-2A
SOILS MAP
SECURITY WATER DISTRICT


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 611 N. WEBER, SUITE 300
 COLORADO SPRINGS, COLORADO 80903
 AUGUST 2025

G:\SECURITY\2022-07\6130\Drainage Report\Figure II-2A.dwg, 8.5x11, 11/25/2025 4:28:45 PM, sc, DWG To PDF.pc3, 1:1


Soil Map—El Paso County Area, Colorado
(Security Water District - Soils Map)


MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)


Soils

 Soil Map Unit Polygons


 Soil Map Unit Lines


 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit


 Clay Spot


 Closed Depression

 Gravel Pit


 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water


 Perennial Water


 Rock Outcrop


 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole


 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot


 Very Stony Spot

 Wet Spot


 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

FIGURE II-2B.DWG

**FIGURE II-2B
SOILS MAP LEGEND
SECURITY WATER DISTRICT**

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COLORADO SPRINGS, COLORADO 80903

AUGUST 2025

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	1.5	87.4%
111	Water	0.2	12.6%
Totals for Area of Interest		1.7	100.0%

FIGURE II-2C.DWG

**FIGURE II-2C
SOILS MAP UNIT LEGEND
SECURITY WATER DISTRICT**

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AUGUST 2025

crossing of Windmill Gulch in accordance with the requirements of local water rights administration.

F. UTILITIES

There is no additional utility service required to accommodate the building addition. Gas and electric are provided to this site by Colorado Springs Utilities. Additional energy delivery capacity is not required, either as a result of prior planning for the demand of the building addition or through analysis of the energy demand over the last five years in accordance with the policy of Colorado Springs Utilities.

Wastewater services are provided to this site by Security Sanitation District. The existing waste piping from floor drains in the treatment plant facility will convey wastewater generated by the new toilet room, employee accommodations and additional floor drains in the building addition. Potable water is provided to this site by the Security Water District. The building addition provides potable water for handwashing, drinking and sanitary accommodations. Potable water delivery to this facility is not required to be enlarged to accommodate the building addition. Communications to facilitate operations are owned, operated, maintained, renewed and replaced in accordance with District policy and federal regulation.

SECTION III
BASIN DESCRIPTION AND FLOODPLAIN IMPACTS

A. MAJOR BASIN DESCRIPTION

The Little Johnson / Security Creek Drainage Basin Planning Study was prepared in April 1988 for the El Paso County Planning Commission. This basin study consisted of three drainage zones: (1) area to the north of Canal No. 4 (aka Fountain Mutual Irrigation Canal), (2) area between Canal No. 4 and U.S. Highway 85, and (3) area between U.S. Highway 85 and Fountain Creek. The report evaluated existing drainage conditions within the basin and identified flooding risks due to insufficient stormwater infrastructure and channel capacity. The study recommended improvements including channel widening and stabilization, construction of detention basins, upgrades to culverts and storm sewer systems, and erosion control measures to mitigate flooding and enhance stormwater management with future developments.

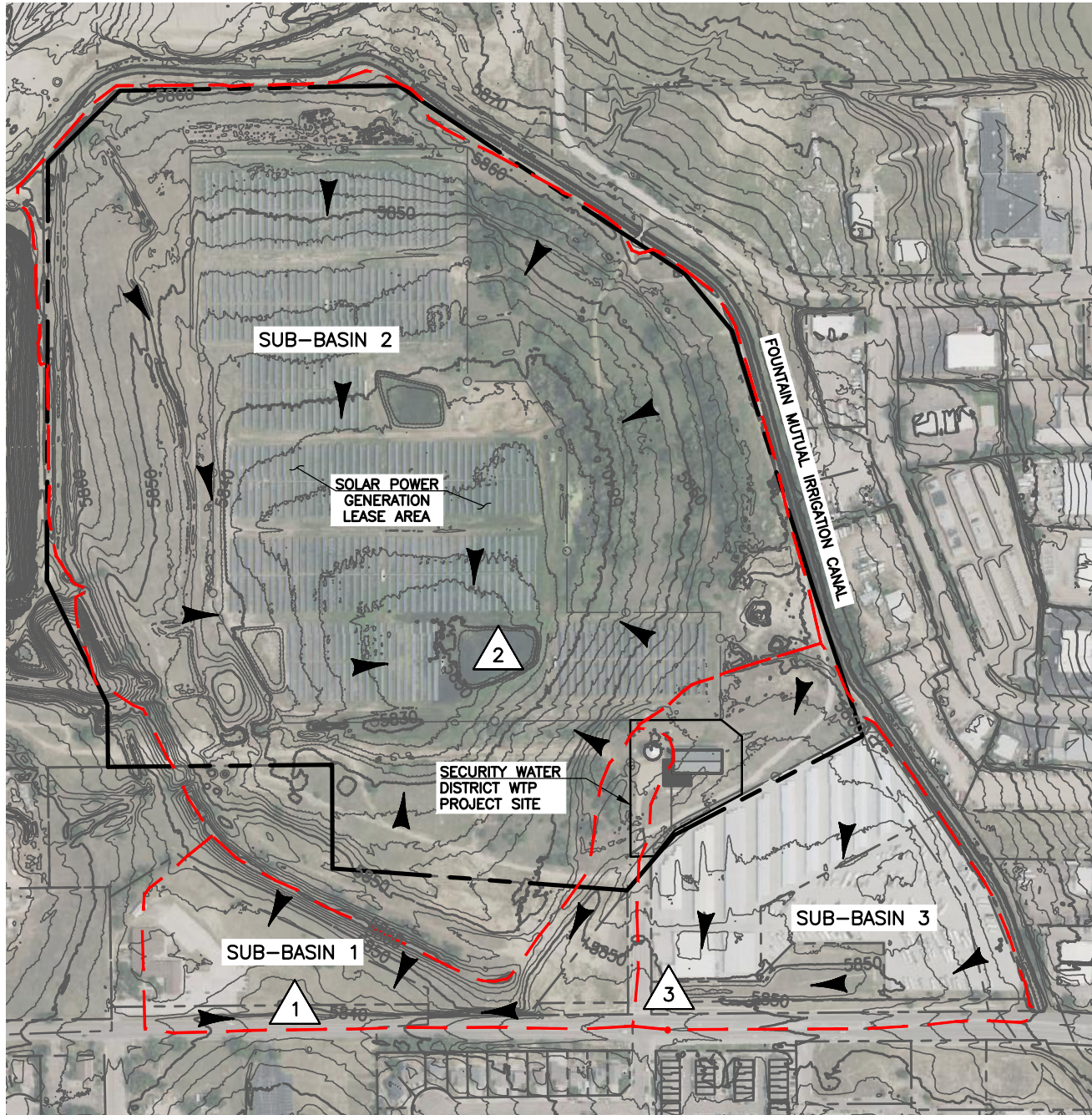
The considerations for development and associated stormwater infrastructure at the project site has not been implemented. The residential development contemplated in the DBPS has not occurred, and, due to the Security Water District's ownership, the probability of it ever occurring is low. That future development will be responsible for supporting stormwater management infrastructures. In the meantime, the use of the Little Johnson reservoir land will serve the purpose of a detention basin as proposed in the DBPS. The District's Water Treatment Plant (WTP) is located on a 1.7-acre fenced area situated in the southeast portion of the District's larger 70-acre property. The following figure provides contour mapping in 2- and 10-foot increments of the District's entire property, generated using LiDAR data from 2018 through the Colorado Hazard Mapping and Risk Map Portal maintained by the Colorado Water Conservation Board.

Much of the District's property was formerly a reservoir, as evidenced by the contour mapping around its perimeter. This sub-basin, comprising the majority of the District's property, is bounded by the Fountain Mutual Irrigation Canal to the north and east, and by the remnants of the Little Johnson Reservoir dam embankment to the west and south. Existing structures on the property include solar panels, a water storage tank, the WTP building, and an on-site power generator.





To use Little Johnson as a true detention basin an outlet structure would be required, as stated in the DBPS. Currently the low pond area only holds water and does not release outside of evaporation.

A description of the major sub-basins that the WTP site is tributary to is identified in the following table, Table III-1. The Security Water District ownership extends over the majority of Sub-Basin 2 and includes about 35 to 40 percent of Sub-Basin 1. In addition to the designated 1.7 acre water treatment plant site, an area of approximately one acre is used for temporary storage of waste soil and street surfacing material by the District. When the District must repair underground distribution system infrastructure due to failure of pipelines, saturated soil is removed from excavation and temporarily stored on the District's property near the water treatment plant site. In addition street surfacing consisting of hot mix asphalt (HMA) pavement is required to be removed and is likewise temporarily stored at this site. When sufficient quantities are accumulated, it has been the District's practice in the past to pulverize or otherwise recover the HMA for use as aggregate and temporary surfacing of excavations and drive surfaces.

The area surrounding this temporary storage area is protected from runoff and erosion with low earthen berms and wattles which are periodically maintained. The District's operations require 24/7 access to this site, often at times other than daylight hours. With these conditions for haul truck access, a complete perimeter enclosure of silt fence or other runoff retention means is not practical. However, the District's use of this site over the last 30 years for this purpose has proven to be successful in preventing unacceptable erosion or sediment transport. This area is accessed through the secure water treatment site.



SCALE: 1" = 400'

-  DRAINAGE BOUNDARY
-  DISTRICT PROPERTY LINE
-  DESIGN POINT
-  FLOW ARROW

SOURCE: CONTOUR MAPPING FROM LIDAR DATA FROM THE COLORADO HAZARD MAPPING AND RISK MAP PORTAL BY THE COLORADO WATER CONSERVATION BOARD. DATED 2018.

FIGURE III-1.DWG

FIGURE III-1 MAJOR DRAINAGE BASIN SECURITY WATER DISTRICT

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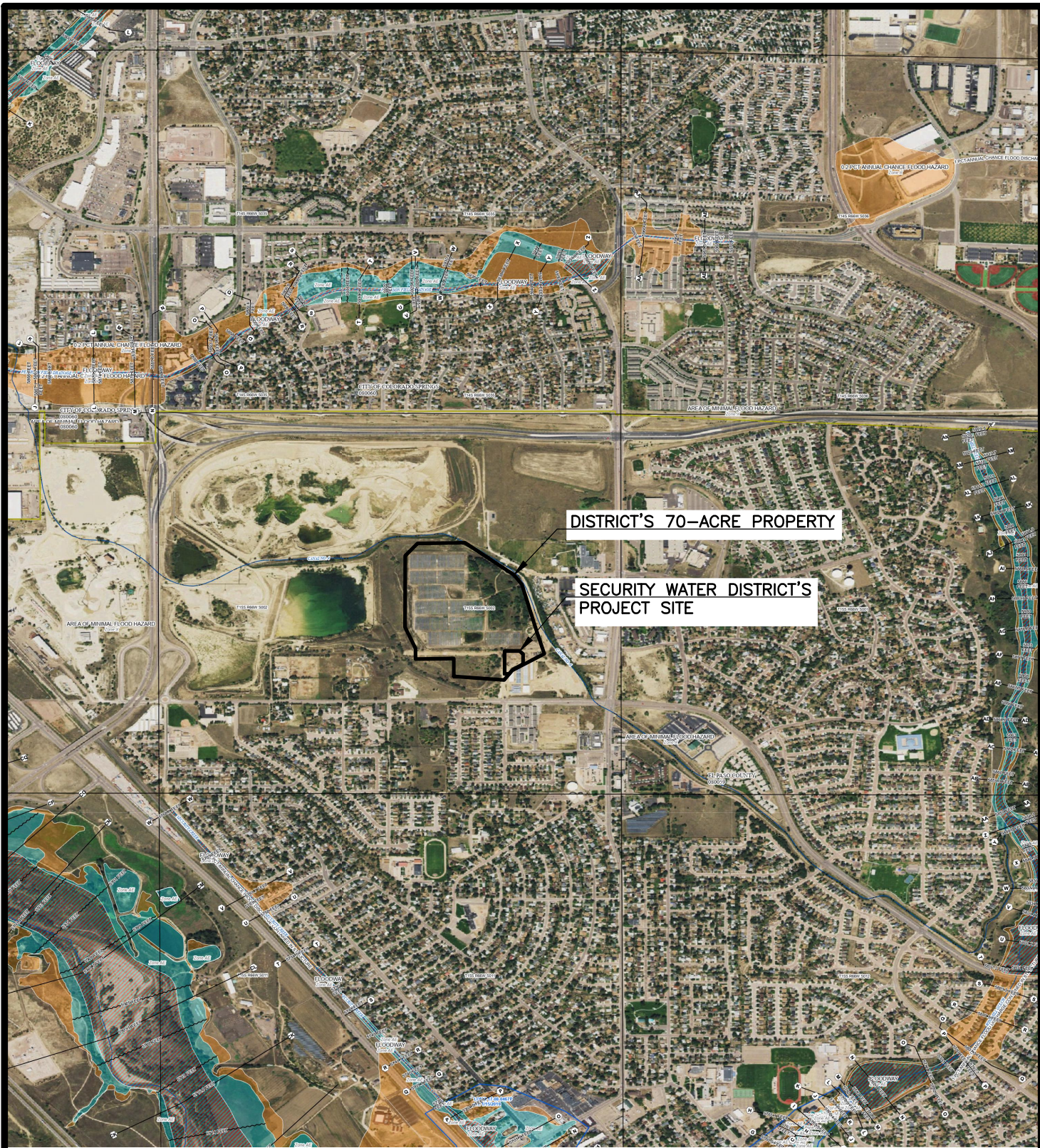
AUGUST 2025

TABLE III-1
 MAJOR DRAINAGE BASIN CHARACTERISTICS
 SECURITY WATER DISTRICT

Basin ID	Area (ac)	Slopes	Description
SUB 1	9.56	5 to 20%	SUB 1 is located southwest of the District's fenced WTP site, south of the District's larger 70-acre property. Flow is conveyed to the south and southwest, extending to the low point on the north side of Bradley Road. This sub-basin is mostly comprised in adjacent property lots to the southwest of the WTP. The primary ground cover consists of bare soil, sparse native grass and asphalt roadways.
SUB 2	69.62	4 to 9%	SUB 2 primarily covers the District's 70-acre property and consists mostly of native grasses and shrubs. Runoff is directed by existing topographic conditions to the existing retention area within the impoundment area of the Little Johnson Reservoir.
SUB 3	15.57	4 to 12%	SUB 3 is located to the southeast of the 1.7-acre fenced WTP property. At the present time, there is a graded swale adjacent to the south edge of the access road through the District's WTP property. That graded swale generally intercepts runoff from the District's property naturally flowing southerly and directs it to culverts under the District's access road (extension of Lincoln Plaza Drive). At the present time, it is not recognized that any runoff from the District's property enters the adjacent mini storage development (Bradley Storage Subdivision). The Bradley Storage Subdivision is completely drained to an on-site detention facility with a piped outlet to the roadside ditch along the north side of Badley Road.

B. FLOODPLAIN IMPACTS

There is no FEMA designated floodplain associated with Fountain Mutual Irrigation Canal. The 2018 Flood Insurance Rate Maps (FIRM) for the District's property, produced by Federal Emergency Management Agency (FEMA), are shown in the following figure. These FIRM maps indicate that the District's entire property lies outside of the 100-year floodplains of Fountain Creek located approximately 1.5 miles west of the WTP and the Peterson Field Drainageway located approximately 1.0 miles north of the WTP.



DISTRICT'S 70-ACRE PROPERTY

SECURITY WATER DISTRICT'S PROJECT SITE

FLOOD HAZARD INFORMATION
SEE FIG REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT FIRM PANEL LAYOUT

- SPECIAL FLOOD HAZARD AREAS**
 - Without Base Flood Elevation (BFE) Zone A, B, C, D, E, X
 - With BFE or Depth Zone A, AE, AH, AL, VE, VE1
 - Regulatory Floodway
- OTHER AREAS OF FLOOD HAZARD**
 - 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with average depth less than one foot or with drainage width of less than one square mile Zone X
 - Future Conditions 1% Annual Chance Flood Hazard Zone X
 - Area with Reduced Flood Risk due to Levee See Note Zone X
 - Area with Flood Risk due to Levee Zone D
 - NO SCREEN Area of Minimal Flood Hazard Zone X
 - Effective LDMs
 - Area of Undetermined Flood Hazard Zone D
- OTHER AREAS**
 - Channel, Culvert, or Storm Sewer
 - Levee, Dike, or Floodwall
- GENERAL STRUCTURES**
 - Cross Sections with 1% Annual Chance
 - Water Surface Elevation
 - Profile Baseline
 - Coastal Transect
 - Coastal Transect Baseline
 - Hydrographic Feature
 - Base Flood Elevation Line (BFE)
 - Limit of Study
 - Jurisdiction Boundary
- OTHER FEATURES**

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), evaluate products associated with this map. For more information on FEMA Flood Insurance Programs, please visit the FEMA website at www.fema.gov. For information about the specific vertical datum for elevation features, datum conversions, or vertical measurements used to create this map, please see the Flood Insurance Study (FIS) Report for your community at <https://www.fema.gov>.

This map was prepared by FEMA's National Flood Insurance Program (NFIP) and is not intended to be used for any purpose other than the NFIP. It is not intended to be used for any purpose other than the NFIP. It is not intended to be used for any purpose other than the NFIP.

SCALE

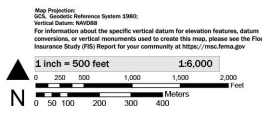


FIGURE III-2.DWG

**FIGURE III-2
FEMA FLOODPLAIN MAP
SECURITY WATER DISTRICT**

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611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903
AUGUST 2025

FEMA FLOODPLAIN MAP NUMBERS:
08041C0763G
08041C0744G
08041C0761G
08041C0742G

SECTION IV HYDROLOGY

A. HYDROLOGIC CRITERIA

This drainage analysis has been prepared in accordance with the current El Paso County Drainage Criteria Manual (DCM) and the City of Colorado Springs DCM Volume 1 dated May 2014 and revised in January 2021 and Volume 2 revised in December 2020. The Urban Storm Drainage Criteria Manual is referenced when applicable. Hydrologic calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for existing and developed conditions using the Rational Method as required for basins having areas less than 130 acres according to Chapter 6 of the El Paso County DCM Volume 1 Update.

A variance from the Full Spectrum Detention (FSD) is requested. Full spectrum detention facilities are required in accordance with Section 3.2.1. of Chapter 13 of the City/County DCM Volume 1, dated May 2014, effective January 31, 2015. However, an existing downstream regional detention facility on the District's larger 70-acre property provides detention, or retention in this case, for minor and major storm events. The 2014 City of Colorado Springs DCM Volume 1 - "On-Site Detention Requirements When Regional Detention is Provided" Policy Verification dated August 2017 and revised September 2017 states if the downstream regional detention provides detention for the minor (5-year) and major (100-year) storm events, then only the water quality capture volume (WQCV) is required on-site. The pond on the District's property is sized for minor and major storm events; thus, only the WQCV is designed for the proposed improvements.

B. PRECIPITATION DATA

Precipitation data for the Security-Widefield area was taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Server to calculate rainfall intensity. The table below contains the 1-hour point precipitation values in inches for the average recurrence intervals in years. See Appendix A for NOAA Atlas 14 data.

TABLE IV-1
PRECIPITATION DATA
SECURITY WATER DISTRICT

Point Precipitation Frequency (in inches)							
Duration	Average Recurrence Interval (years)						
	2	5	10	25	50	100	500
60-min	1	1.28	1.55	1.96	2.32	2.72	3.78

C. RATIONAL METHOD

A runoff coefficient was established for each of the sub-basins that make up the 1.7-acre WTP site and drain to their respective basins. This component of the hydrologic calculation has been developed utilizing the existing land uses and the land surface conditions.

Since all the basins are less than 130 acres, the rational method is used to calculate runoff from all the on-site basins. The rational formula is as follows:

$$Q = C \cdot i \cdot A$$

Where,

Q = Peak runoff rate, in cubic feet per second (cfs)

C = Runoff coefficient representing a ratio of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration

i = average rainfall intensity, in inches per hour (in/hr)

A = Area of basin, in acres (ac)

D. FOUR STEP PROCESS

The proposed improvements consist of a 51-foot by 40-foot building addition with new asphalt travel ways replacing the existing gravel drives. These improvements will follow the Urban Drainage Flood Control District “Four Step Process” to reduce runoff volumes, stabilize drainage ways, treat the WQCV, and implement long-term source controls.

1. Proposed Runoff Management

The improvements include new asphalt around the perimeter of the existing building and the building addition, which will increase the peak stormwater flows for downstream users. These flows will be retained on District property with the addition of grass lined swales along the perimeter of the WTP property to redirect the increased flow back to the District's larger 70-acre property. Newly developed swales along the west and south sides will direct flow to a culvert, that traverses under the paved road, and discharges to the southwest of the property. A swale to the north and along the east will flow into a temporary detention pond, where an overflow concrete crossspan will cross the asphalt drive to the south swale. At the discharge of the swales and culverts, a newly constructed berm will be placed to the southwest of the site to convey the increased flow to the center of the District's property to be captured by the basins low point, which is currently a pond. This receiving area outside the WTP property consists primarily of pervious surfaces such as grass, trees, and shrubs and will retain the District's increased onsite drainage from downstream developments.

2. Stabilization of Drainageways

New grass lined swales will redirect runoff from entering any adjacent properties to the south. A newly constructed berm at the WTP's main discharge point will prevent stormwater runoff from flowing downstream onto adjacent properties. The berm will also be utilized as a WQCV to dissipate flows exiting the culvert and slowly release onto the District's larger property.

3. Proposed Water Quality Capture Volume (WQCV)

WQCVs have been incorporated into the improvements with one basin on the east side of the property, and the second basin to the southwest of the property, at the discharge of the 18-inch culvert. These WQCVs have been added to provide adequate water quality benefits. No full-size spectrum detention basin or WQCVs are required on-site since a regional facility is located on the District's larger property and the increased flows will be retained on site.

4. Industrial and Commercial Best Management Practices (BMPs)

This report provides a final grading and erosion control plans with BMPs in place. The proposed project will use silt fences, swales, mulching and reseeding to mitigate the potential for erosion across the site.

E. EXISTING MINOR SUB-BASIN DRAINAGE CONDITIONS

The focus of this Drainage Report is on the District's 1.7-acre fenced in property. The District's WTP is located approximately 400 feet west of the Fountain Mutual Irrigation Canal. The, "Security PFOS / PFOAS Drinking Water Mitigation System Drainage Letter," was prepared for El Paso County in May 2019 by URS Group, Inc. for the original construction of the District's existing water treatment plant. The report stated that existing drainage patterns would be maintained as part of the improvements. Existing facilities were not analyzed as part of the project, and no new drainage infrastructure was constructed as part of the treatment plant project.

For the purposes of this analysis, the minor drainage basins were further delineated using on-site survey using modern methods with 1- and 5- contours. The WTP site resides on a topographical high point; thus, off-site runoff is not a consideration for this report. The WTP site drains to three primary sub-basins as previously denoted. The sub-basin delineations in the WTP site were subdivided to Sub-Basins 1A, 2A, and 3A with Sub-Basin 1A contributing to Sub-Basin 1, -2A contributing -2, and -3A contributing to -3. A description and the peak runoff for the 5-year and 100-year storm events are included in the following table. Imperviousness was determined using surveyed data. The peak runoff calculations for the existing site are attached in Appendix B along with the tributary area, weighted C coefficients, impervious areas, and rain intensity. Rainfall intensities differ between Sub-Basins 1A and 3A compared to Sub-Basin 2A, primarily due to the variations in time of concentration. Per the Mile High Flood District "Calculation of Peak Runoff using Rational Method" worksheet in Appendix B and C, rainfall intensity is a factor of 1-hour precipitation depths and time of concentrations. A smaller time of concentration equals a larger rainfall intensity and vice versa. Sub-Basin 2A is significantly smaller than the other sub-basins, resulting in a much shorter flow path and a greater rainfall intensity. The following figure delineates the existing sub-basins through the District's WTP site along with the relevant hydraulic data.

G:\SECURITY\2022-076\130\Drainage Report\Figure IV-1.dwg, 11/25/2025 4:40:17 PM, sc, DWG To PDF, pc3, 1:1

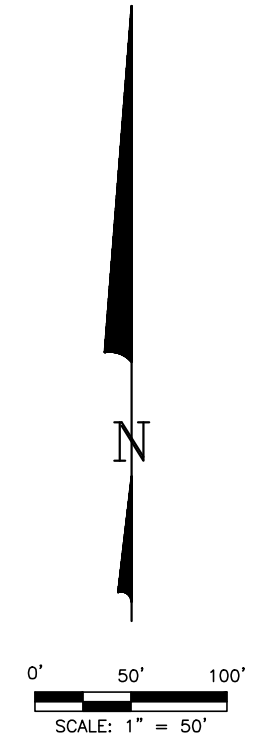
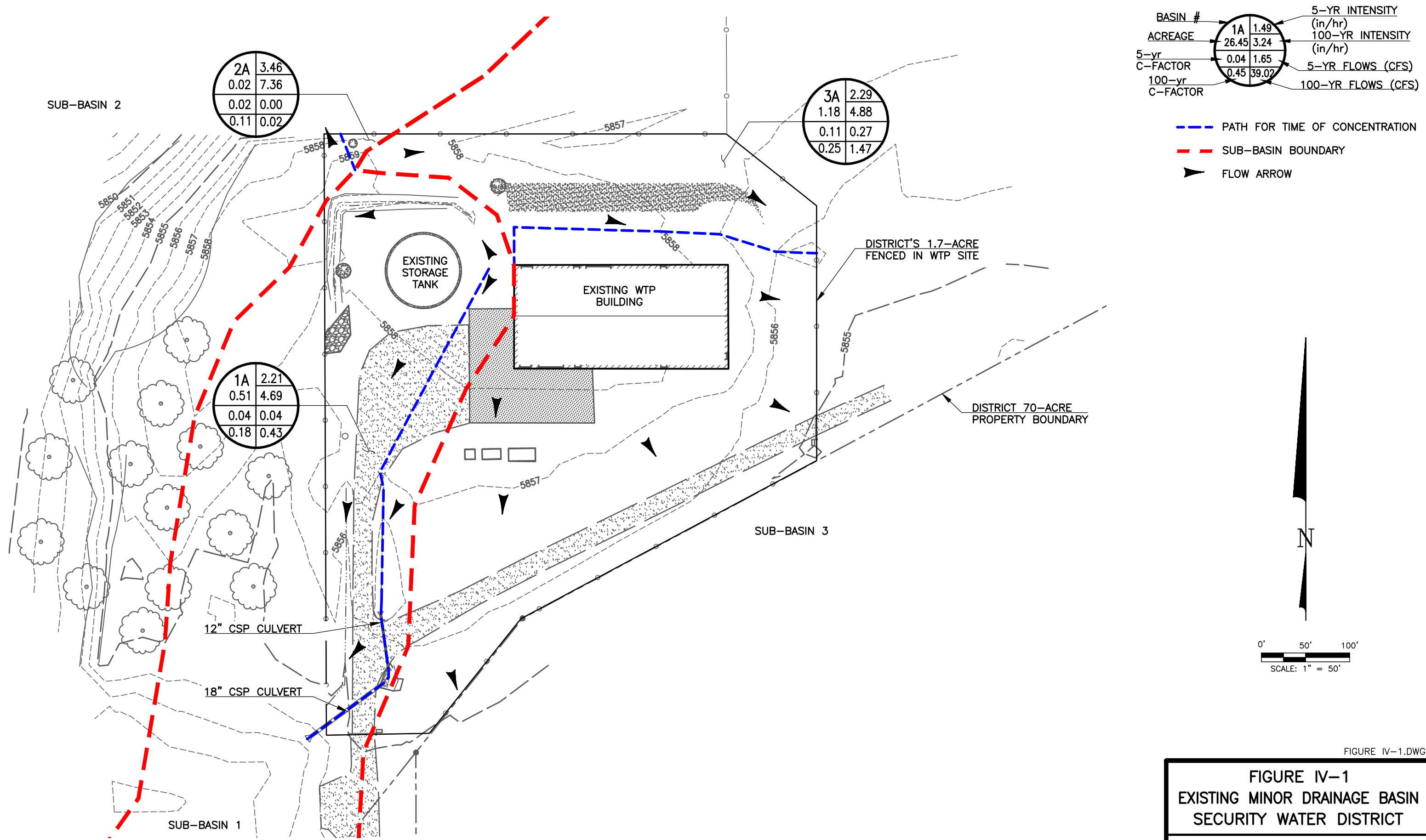


FIGURE IV-1.DWG

FIGURE IV-1
EXISTING MINOR DRAINAGE BASIN
SECURITY WATER DISTRICT

GMS, INC.
 CONSULTING ENGINEERS
 611 N. WEBER, SUITE 300
 COLORADO SPRINGS, COLORADO 80903
 AUGUST 2025

TABLE IV-2
EXISTING MINOR DRAINAGE BASIN CHARACTERISTICS
SECURITY WATER DISTRICT

Basin ID	Area (AC)	Slopes (%)	5-Year Flow (Minor Storm) (cfs)	100-Year Flow (Major Storm) (cfs)	Description
SUB 1A	0.51	1 to 5%	0.04	0.43	SUB 1A is the area to the west of the WTP building. Flow is conveyed to the southwest, through two existing culverts and off the secured WTP site. The primary ground cover consists of the metal roofing from the storage tank, native grasses, concrete walkways, bare soil and gravel drives.
SUB 2A	0.02	1 to 6%	0.0	0.02	SUB 2 is a small portion of land on the northwest corner of the WTP site. Runoff is conveyed to the north and northeast towards the District's larger property. The primary ground cover is native grass.
SUB 3A	1.18	5 to 9%	0.27	1.47	SUB 3 is the land to the north, east, and south of the WTP area. Runoff flows to the south and east. The primary ground cover is native grasses and gravel drives. Runoff was historically conveyed to adjacent properties.

F. PROPOSED MINOR SUB-BASIN DRAINAGE CONDITIONS

The proposed improvements to the District's WTP site include a new 51-feet by 40-feet building addition, with hot mix bituminous pavement to replace the existing gravel travel ways around the treatment complex. New swales will be included around the perimeter of the District's site to better control and convey stormwater runoff. A map of the proposed improvements is included in the back of this report, denoted Figure IV-2.

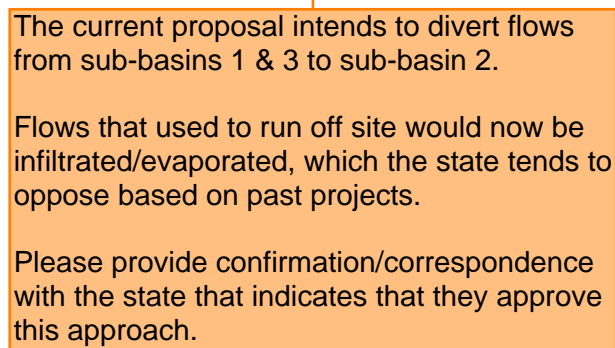
The proposed swales will increase the number of sub-basins to seven (7). Of these seven sub-basins, two of the sub-basins will continue to flow onto adjacent properties the same as has historically occurred with "undeveloped" hydrologic conditions.. The peak runoff calculations for the proposed site are attached in Appendix C along with the tributary area, weighted C coefficients, impervious areas, and rain intensity. The following Figure IV-3 delineates the proposed sub-basins through the District's WTP site along with the relevant

hydraulic data. The sub-basins are identified as Design Points (DP), which is the location of flow before a hydraulic structure conveys the runoff to other sub-basins.

These improvements aim to redirect flow from draining to adjacent properties and to retain the runoff generated within the secured site on District owned property. Because both parcels are under District ownership, directing runoff between them does not constitute an offsite discharge concern. Refer to Figure IV-4 for the flow path of the generated runoff from the 1.7-acre water treatment plant to the low point of the District's larger 70-acre property. The terminal destination of runoff is a 0.5-acre pond located at the low point on the District's downstream property. This pond is designed to retain runoff from the entire contributing area, with water dissipating through infiltration and evaporation. Runoff will not be pumped or discharged offsite under the analyzed storm events.

The proposed improvements retain and manage stormwater runoff generated solely from precipitation on the site and do not intercept, divert, or diminish flows from any natural watercourse or decreed water right. As such, no injury to existing water rights is anticipated.

A water quality capture volume is not required by El Paso County, as all runoff generated by the proposed improvements is contained and managed within the District's property boundaries. These WQCVs are included to enhance water quality flowing to the District's larger property.



The current proposal intends to divert flows from sub-basins 1 & 3 to sub-basin 2.

Flows that used to run off site would now be infiltrated/evaporated, which the state tends to oppose based on past projects.

Please provide confirmation/correspondence with the state that indicates that they approve this approach.

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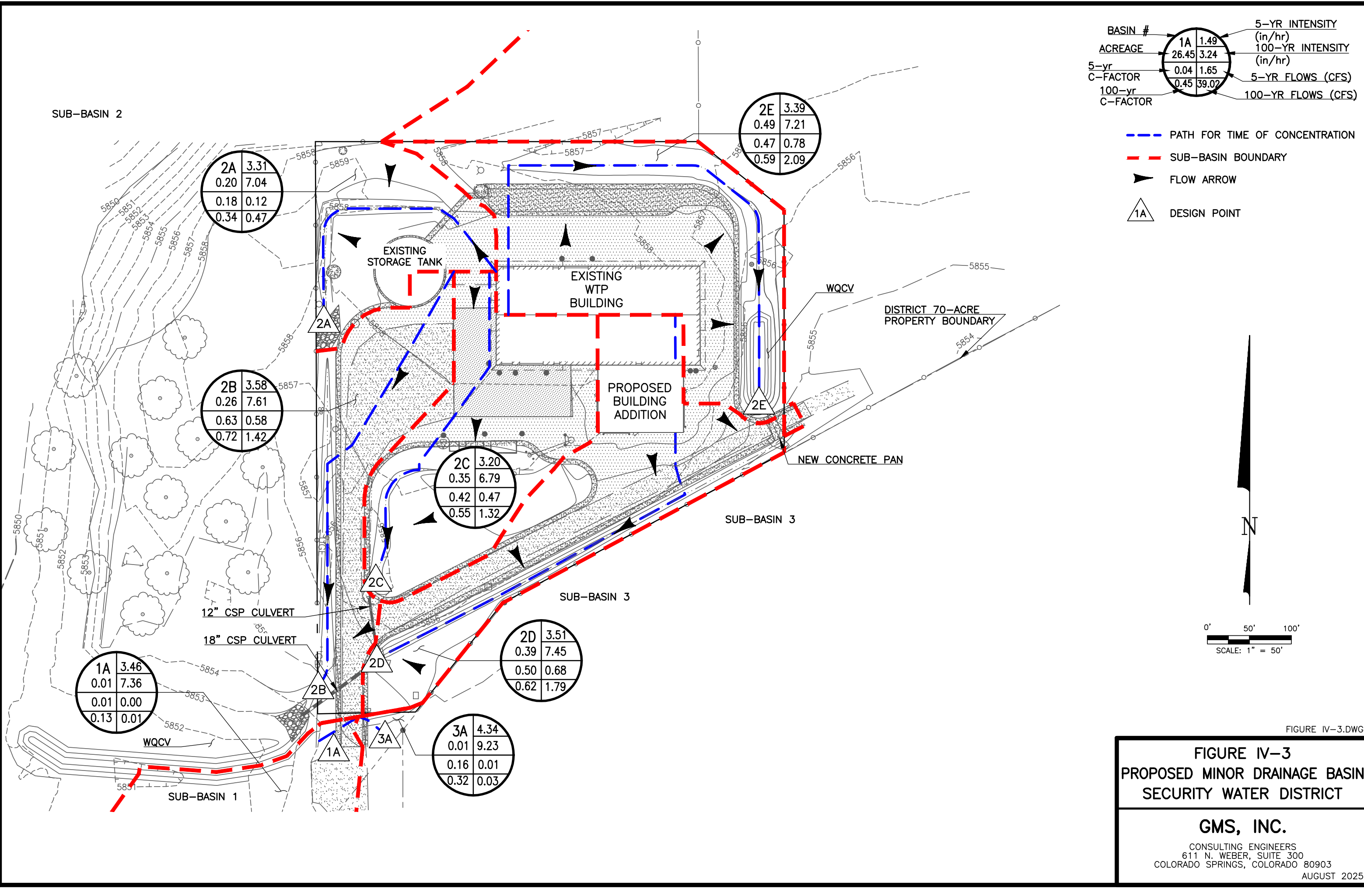
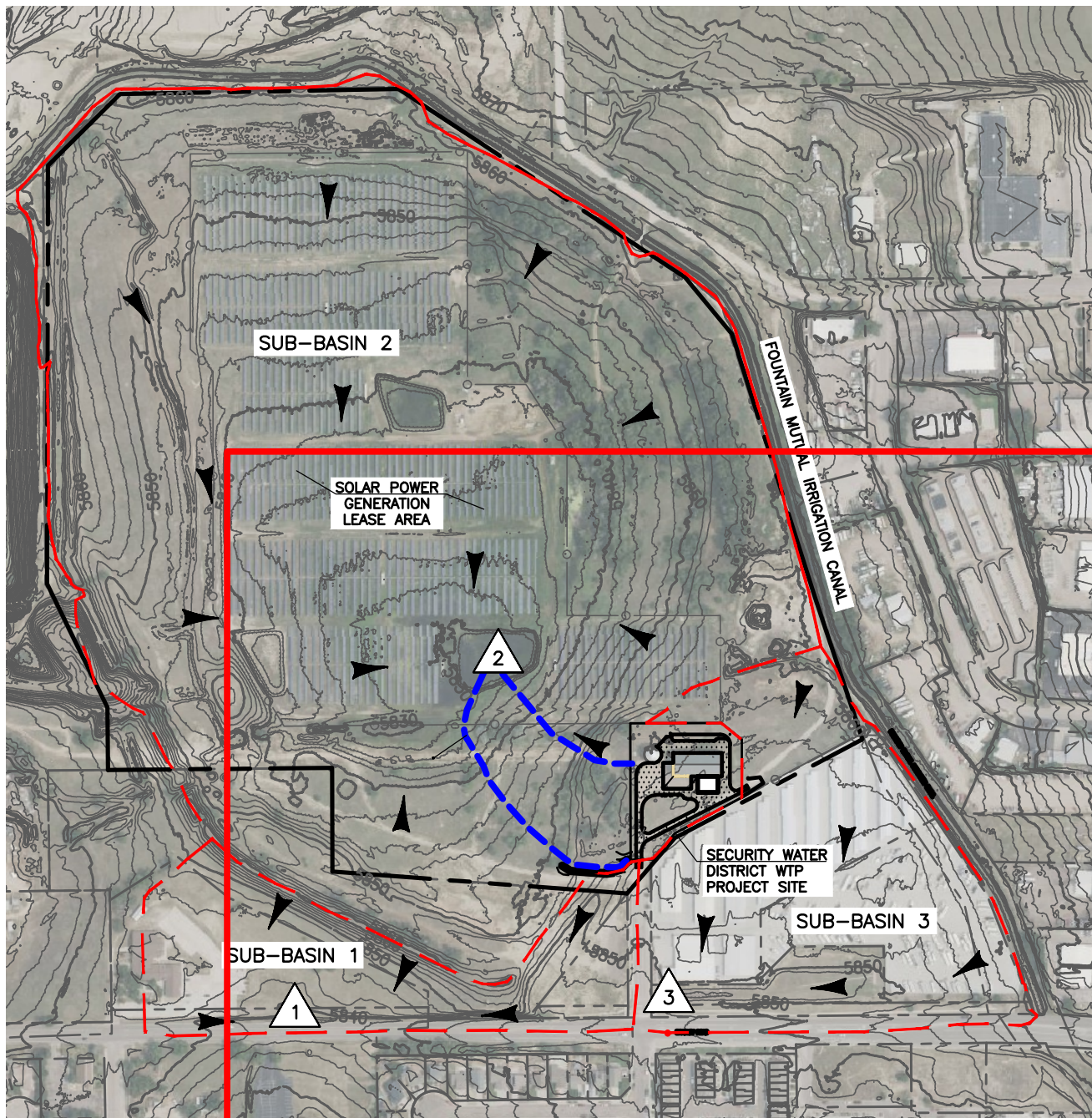


FIGURE IV-3.DWG

**FIGURE IV-3
PROPOSED MINOR DRAINAGE BASIN
SECURITY WATER DISTRICT**

GMS, INC.
CONSULTING ENGINEERS
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903
AUGUST 2025



SCALE: 1" = 400'

- DRAINAGE BOUNDARY
- DISTRICT PROPERTY LINE
- TIME OF CONCENTRATION
- 1 DESIGN POINT
- ▶ FLOW ARROW

SOURCE: CONTOUR MAPPING FROM LIDAR DATA FROM THE COLORADO HAZARD MAPPING AND RISK MAP PORTAL BY THE COLORADO WATER CONSERVATION BOARD. DATED 2018.

FIGURE IV-4.DWG

FIGURE IV-4
PROPOSED MAJOR DRAINAGE BASIN
SECURITY WATER DISTRICT

GMS, INC.
 CONSULTING ENGINEERS
 611 N. WEBER, SUITE 300
 COLORADO SPRINGS, COLORADO 80903
 AUGUST 2025

TABLE IV-3
 PROPOSED MINOR DRAINAGE BASIN CHARACTERISTICS
 SECURITY WATER DISTRICT

Proposed Design Point (DP)	Tributary Area (AC)	Slopes (%)	5-Year Flow (Minor Storm) (cfs)	100-Year Flow (Major Storm) (cfs)	Description
DP 1A	0.01	2 to 8%	0.00	0.01	SUB 1A is the area of improvement just to the south of the District's property, outside of the fenced property line. These improvements include the new asphalt drive. Runoff sheet flows to the southwest and off the District's property. The primary ground cover consists of native grasses, bare soil and an asphalt drive.
DP 2A	0.20	2 to 4%	0.12	0.47	SUB 2A is the northwest corner of the WTP site. Runoff is conveyed to an existing swale that discharges into riprap, and onto the District's larger property. The primary ground cover is native grass and the existing storage tank.
DP 2B	0.26	1 to 3%	0.58	1.42	SUB 2B primarily consists of the asphalt drive to the east of the WTP building. Runoff flows to the south and west. The primary ground cover is asphalt. Runoff sheet flows to an enhanced swale along the western boundary of the secured site, and discharges into the District's new WQCV.
DP 2C	0.35	1 to 4%	0.47	1.32	SUB 2C consists of the center of the District's site. Runoff sheet flows to the south, where a newly developed swale conveys the flow to the District's existing 12-inch culvert. The primary ground cover is native grass, asphalt pavement, and the existing metal building.
DP 2D	0.39	2 to 7%	0.68	1.79	SUB 2D consists of the southern areas of the WTP site. Runoff sheet flows to the south, and channelizes along the proposed southern swale and discharges at the District's existing 18-inch culvert. The primary ground cover is the proposed asphalt drives, proposed building addition, and vegetated swale.

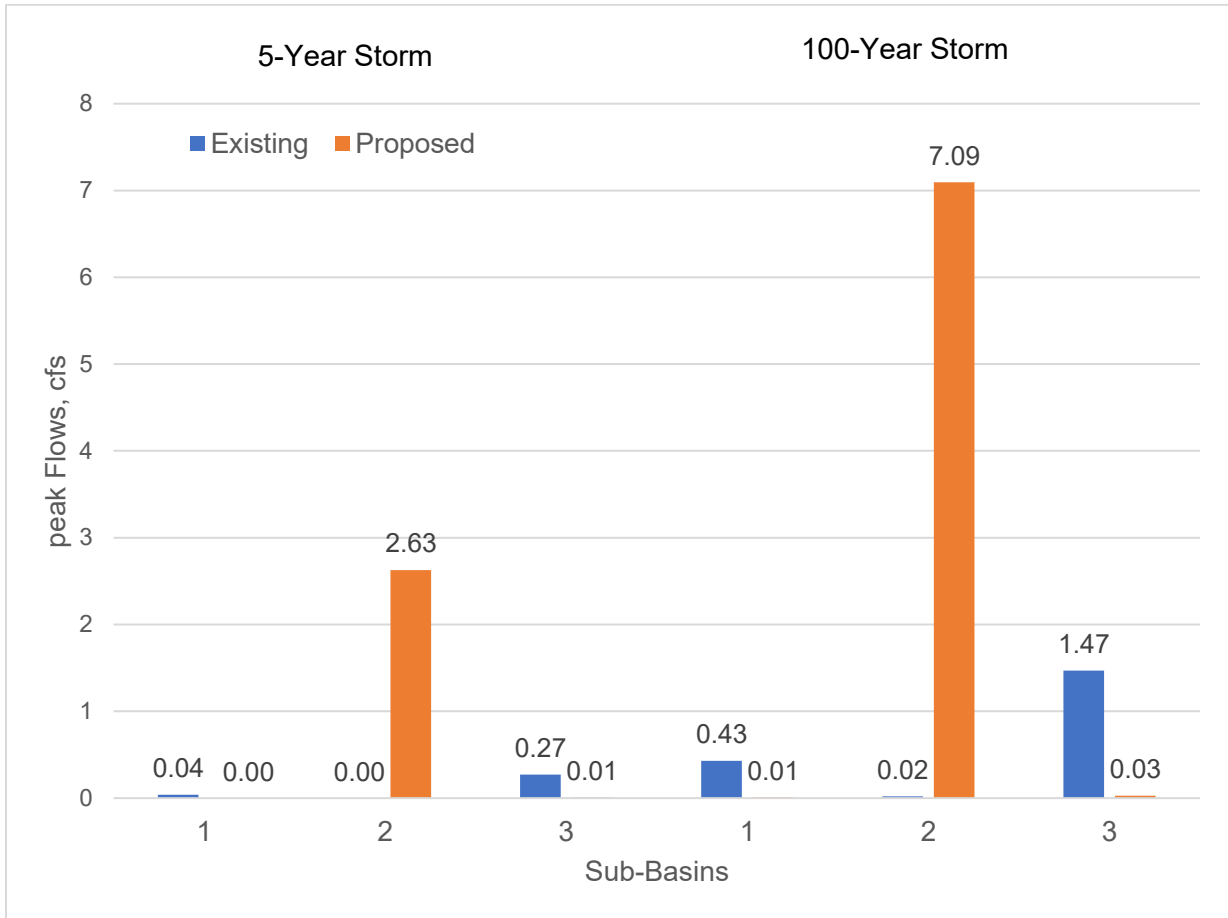
TABLE IV-3, Cont'd

Proposed Design Point (DP)	Tributary Area (AC)	Slopes (%)	5-Year Flow (Minor Storm) (cfs)	100-Year Flow (Major Storm) (cfs)	Description
DP 2E	0.49	1 to 3%	0.78	2.09	SUB 2E consists of the northern and eastern areas of the WTP building. Runoff sheet flows off the asphalt drives into the newly developed swale. The swale ends at the District's WQCV along the east of the WTP building. Overflow discharges across the asphalt drive and into the southern swale.
DP 3A	0.01	8%	0.01	0.03	SUB 3A is the area of improvement just to the south of the District's property, outside of the fenced property line. These improvements include the new asphalt paved drive. Runoff sheet flows to the southeast and off the District's property. The primary ground cover consists of native grasses and asphalt drives.

G. EXISTING AND PROPOSED WTP SUB-BASIN COMPARISONS

The existing and proposed improvements have been compared side by side to compare the existing versus the proposed discharges to their respective major basins. The following graph displays the minor sub-basin runoffs for both the 5- and 100-year storm events.

FIGURE IV-5
5- AND 100-YEAR RUNOFF COMPARISONS
SECURITY WATER DISTRICT



The figure above shows that the proposed improvements reduce on-site runoff from Sub-Basins 1 and 3 for both the 5-year and 100-year storm events. These improvements redirect flow toward the District's larger 70-acre property (Sub-Basin 2). As a result, the proposed improvements do not affect downstream properties, and any increase in runoff due to the improvements will be retained on District property.

SECTION V STORMWATER MANAGEMENT FACILITY DESIGN

A. CULVERTS

The proposed improvements will leverage existing facilities to optimize construction and maintenance costs. The existing facilities include a 12-inch and 18-inch culverts that traverse underneath the gravel drives at the southwest corner of the WTP secured site. These culverts are constructed of corrugated steel pipe (CSP).

The 12-inch CSP culvert is approximately 30 feet in length with a longitudinal slope of 2.0%. This culvert traverses underneath the east/west gravel drive that passes through the WTP site and onto the larger 70-acre property. With the newly paved drives, an added 10-feet of the 12-inch culvert will be added to the north of the existing culvert to maintain adequate slopes and discharges with the new pavement grading. The 18-inch CSP is approximately 50 feet in length with a longitudinal slope of 1.1%. This culvert underlies the north/south gravel drive providing primary access to the entrance of the WTP building. No modifications will be made to this culvert.

According to Chapter 9 of the El Paso County DCM Volume 1, culverts will be chosen which will not cause damage to adjacent properties for the 100-year storm. The Urban Drainage Criteria Manual (UDCM) Volume 2 Chapter 11 was used to verify the capacity of the existing culvert. The UDCM also recommends that the headwater depth to culvert diameter ratio (HW/D) should not exceed 1.5 for the 100-year event peak flow, a minimum pipe diameter of 15 inches for culverts, and that the culvert must be sloped to provide a minimum outlet pipe velocity of 3 feet per second (fps). The Federal Highway Administration HY-8 Culvert Analysis Program was used to analyze the performance of the existing 12-inch and 18-inch CSP culverts with the increase in flow rates from the proposed improvements. Design calculations for each culvert can be found in Appendix D.

The results indicate that the existing culverts are adequate to handle the increased flows from the impervious areas. The 12-inch CSP culvert had a HW/D ratio of 0.8 and the 18-inch CSP culvert has a HW/D ratio of 1.0. Outlet velocities were 3.5 fps and 4.8 fps, respectively.

Based on the modeling, the flows will not cause overtopping of the roadways. Thus, these culverts are adequate for the increase flows from the improvements.

It is noted that the existing 12-inch culvert is below the recommended size; however, the culvert is adequate to convey the required flows from the minor basin. If the culvert needs to be replaced in the future, it can be upsized to the recommended minimum size.

B. SWALES

Swales provide a cost-effective solution to convey stormwater while preventing flooding and erosion, and providing some level of water quality control or maintenance. The UDCM Volume 1 Chapter 8 provides some design criteria for determining channel lining, geometry, and depth based on flow rate and channel slope. Where possible, it is recommended that channels be designed to provide a minimum of one-foot of freeboard, referring to the distance from the top of the water surface to the top of the ditch, for the minor storm event. However, the City/County Swale Freeboard Policy Clarification, dated March 9, 2023 states that no freeboard is required for swales less than 18-inches deep.

The proposed minor drainage channels have been sized utilizing Manning's equation for open channel flow, assuming a friction factor ("n") of 0.030 for grass vegetated channels. The proposed channel improvements have generally been designed as grass-lined channels designed to convey 100-year flows, with a trapezoidal cross-section, 4:1 maximum side slope, freeboard of 1-foot and a minimum slope of 0.5%. Maximum allowable velocities have been evaluated based on the City/County drainage criteria, typically allowing for a maximum 100-year velocity of 5 feet per second for native grass channels. The proposed channel segments will generally be seeded with native grasses for erosion control. All the swale flows will be conveyed to the WQCV near the southwest extent of the District's secured WTP site.

For this analysis, the swales were divided and named for the basin it conveys flow from. The proposed improvements have four proposed channels and one existing channel. The analysis also includes the concrete cross pan overflow for the WQCV on the east side of the secured site. Hydraulic calculations were conducted with Federal Highway Administration Hydraulic Toolbox. The hydraulic calculations can be seen in Appendix E, along with the

modeling inputs and results. These calculations show the longitudinal and side slopes, velocity, water depth, and freeboard depth for the 5- and 100-year storm events.

All channels meet the 4:1 side slope requirement, except for the swale serving sub-basin 2D that has a side slope of 2.5:1 on the pavement side of the swale. A variance is requested to increase the channel's side slopes serving this basin. The required side slopes cannot be attained due to property ownership constraints. An erosion control blanket will be provided on the portions of the swale that are steeper than 3:1. Swales serving Sub-Basins 2A, 2B, 2C and the concrete crossspan overflow are less than 18 inches deep, thus a 1-foot freeboard is not required. Sub-Basins 2D and 2E have freeboard depths of at least two feet. All other criteria satisfy the drainage regulations.

The proposed swales provide more than enough capacity to handle runoff from a 100-year storm event. The WQCV basin at the southwest corner of the District's WTP property will aid in dissipating the higher velocity flows and limit or mitigate downstream erosion on the District's owned property.

C. STORMWATER STORAGE FACILITIES

The 2014 City/County DCM Volume 1 - "On-Site Detention Requirements When Regional Detention is Provided" Policy Verification, dated August 2017 and revised September 2017, states if the downstream regional detention provides detention for the minor (5-year) and major (100-year) storm events, then only the WQCV is required on-site. The pond on the District's 70-acre property has a surface area of 0.5-acres, providing adequate storage for minor and major storm events. The WQCV is not required by El Paso County since all the runoff is retained on the District's larger 70-acre property. Therefore, the WQCV is solely designed for the proposed improvements to enhance water quality benefits.

D. WATER QUALITY ENHANCEMENT BEST MANAGEMENT PRACTICES

Two WQCV detention basins are proposed to be included in the improvements for water quality benefits. The WQCV's were sized using simplified methods according Chapter 6 of the Volume 1 Update in the City/County DCM. According to the UDCM Volume 2 Chapter

12, the simplified equations can be used when the watershed is less than 10-acres. In UDCM Volume 3 Chapter 3, the WQCV can be calculated as follows:

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$$

Where,

WQCV = Water quality capture volume, watershed-inches

a = coefficient corresponding to BMP type and WQCV design drain time

I = imperviousness, as a decimal

The first WQCV captures runoff from Sub-Basin 2E and resides on the east side of the property. An overflow is provided via a 6-foot cross pan across the proposed asphalt paved drive. The overflow channel is approximately 10-inches below the top of the berm. This overflow discharges into the southern swale, and subsequently onto the District's larger property. Based off the watershed area for this sub-basin, the WQCV needs to be minimum of 0.010 acre-feet. The WQCV has been graded and designed to hold a maximum of 0.03 acre-feet. Thus, this WQCV is adequate for providing water quality benefits.

The second WQCV captures the entirety of the WTP's runoff to the southwest of the secured WTP site. Excess runoff then overflows westerly upstream from the pre-existing reservoir embankment down to the District's low point which is currently a pond. Based off the watershed area for the entirety of the District's sub-basins, the WQCV needs to be a minimum of 0.033 acre-feet. The WQCV is proposed to hold a maximum of 0.21 acre-feet, before overtopping into the District's larger property. Thus, this WQCV is also adequate for providing water quality benefits.

The WQCV detailed calculations are included in Appendix E. Cut and fill approximations for the proposed WQCVs have been included and calculated from AutoCAD Civil 3D Volumes Dashboard. Both WQCVs will provide water quality enhancement by capturing sediment and subsequently to the District's pond. Routine inspections of the WQCVs shall be conducted monthly during dry weather in order to identify sediment that accumulates and needs to be removed as part of regular maintenance activities and after significant storm events.

The Contractor will be required to implement Best Management Practices (BMPs) for erosion control throughout the construction project. Silt fences will provide sediment control at the toe of disturbed slopes and downgradient from areas disturbed by construction. Cut slopes will be stabilized during excavation and vegetation will be established on disturbed soils as soon as possible.

E. COST ESTIMATE AND DRAINAGE FEES

The portion of total project construction costs pertinent to temporary and permanent stormwater management infrastructure are presented on the El Paso County 2026 Financial Assurance Form (FAE). That estimated cost per the El Paso County process and procedure is \$85,425. This includes all grading (earthwork) and vehicle travel surfacing and shouldering. The two WQCV ponds are included in the earthwork calculation as indicated in Section 1 – Grading and Erosion Control of the FAE. The 2026 Financial Assurance Form is provided in Appendix G.

No drainage basin or bridge fees are applicable with this site development plan.

SECTION VI
CONCLUSIONS AND RECOMMENDATIONS FOR IMPLEMENTATION

The proposed improvements to the Security Water District's WTP will increase the impervious areas on the property, thus increasing the on-site runoff volume. Modifications to the on-site drainage patterns will reduce the runoff impact on downstream land. New drainage facilities, designed and constructed in accordance with El Paso County standards, will safely convey increased flows to outfalls located on the District's property. The proposed stormwater swales and water quality facilities have been designed to mitigate the effects of added impervious surfaces on flow rates and to meet the County's stormwater quality requirements. These flows will be directed to the District's 70-acre site, where a 0.5-acre surface area pond has sufficient capacity to retain both the 5-year and 100-year storm events. Proper maintenance of these facilities by the District will ensure their long-term functionality and prevent impacts to downstream or adjacent properties.

SECTION VII
REFERENCES

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SECURITY WATER DISTRICT LITTLE JOHNSON RESERVOIR
PROPERTY

SCALE VERIFICATION
BAR IS ONE INCH
ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET
ADJUST SCALES ACCORDINGLY

THIS DRAWING IS THE
PROPERTY OF GMS, INC., AND
IS NOT TO BE RE-PRODUCED,
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OTHER PROJECT WITHOUT THE
WRITTEN CONSENT OF GMS,
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AGREEMENT WITH THIS
COMPANY.
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REVISIONS	
NO.	DESCRIPTION
1	01/13/2025 UPDATED WITH ADDENDA 1 FOR BIDDING
2	06/30/2025 UPDATED WITH PERM FOR PERM PLAN REVIEW SUBMITTAL

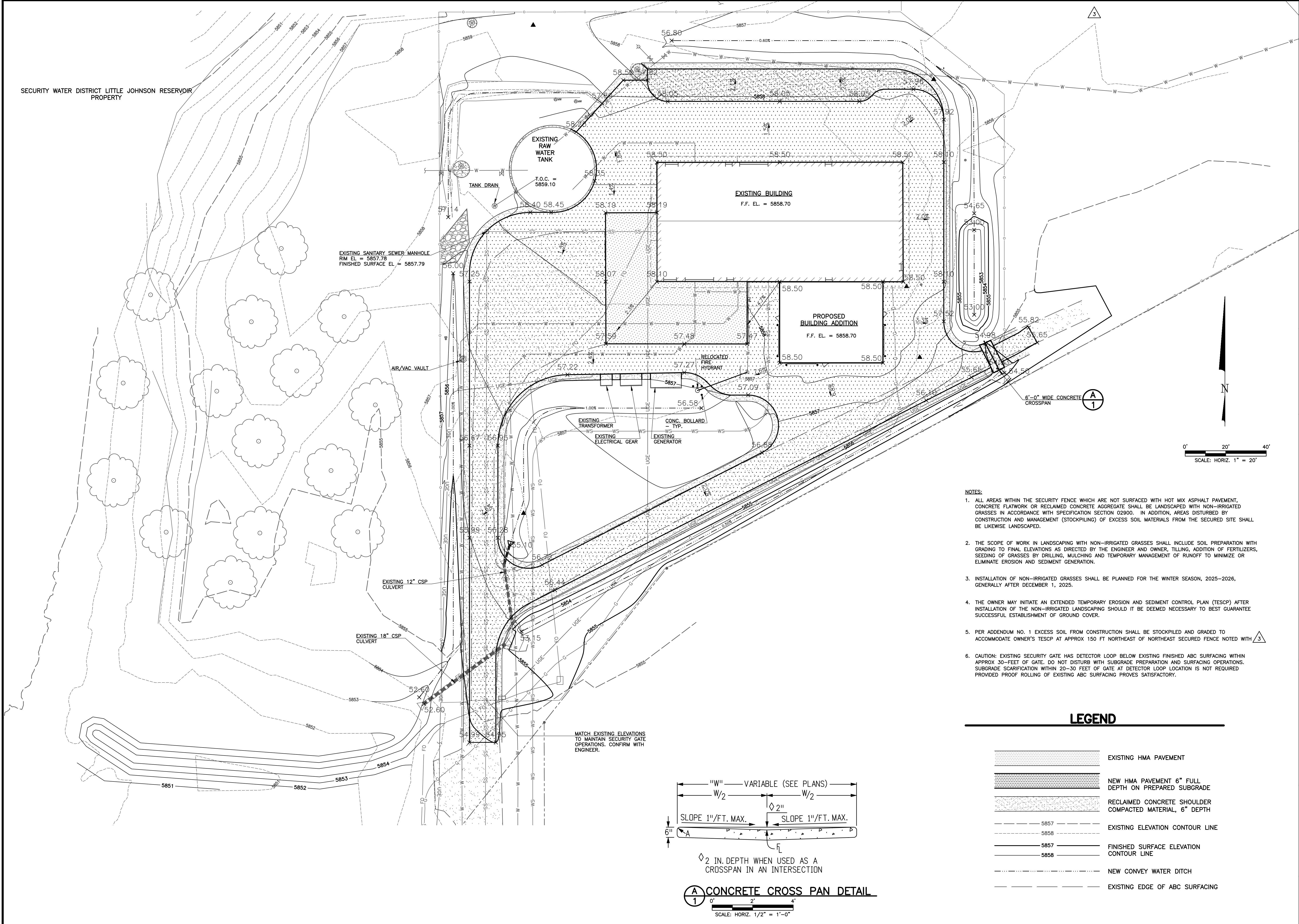
DATE	DESCRIPTION
01/13/2025	UPDATED WITH ADDENDA 1 FOR BIDDING
06/30/2025	UPDATED WITH PERM FOR PERM PLAN REVIEW SUBMITTAL

FIGURE IV-2
SITE GRADING, DRAINAGE, AND LANDSCAPING PLAN
SECURITY WATER DISTRICT

GMS
CONSULTING ENGINEERS
INC.
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903
719-475-2935

DESIGNED	SKC
RJS/SLW/MAL	
CHECKED	RJS
OCTOBER 2024	
DATE	PROJECT NO.
	2023-053.116
DATE	GMS FILE NO.
	3803

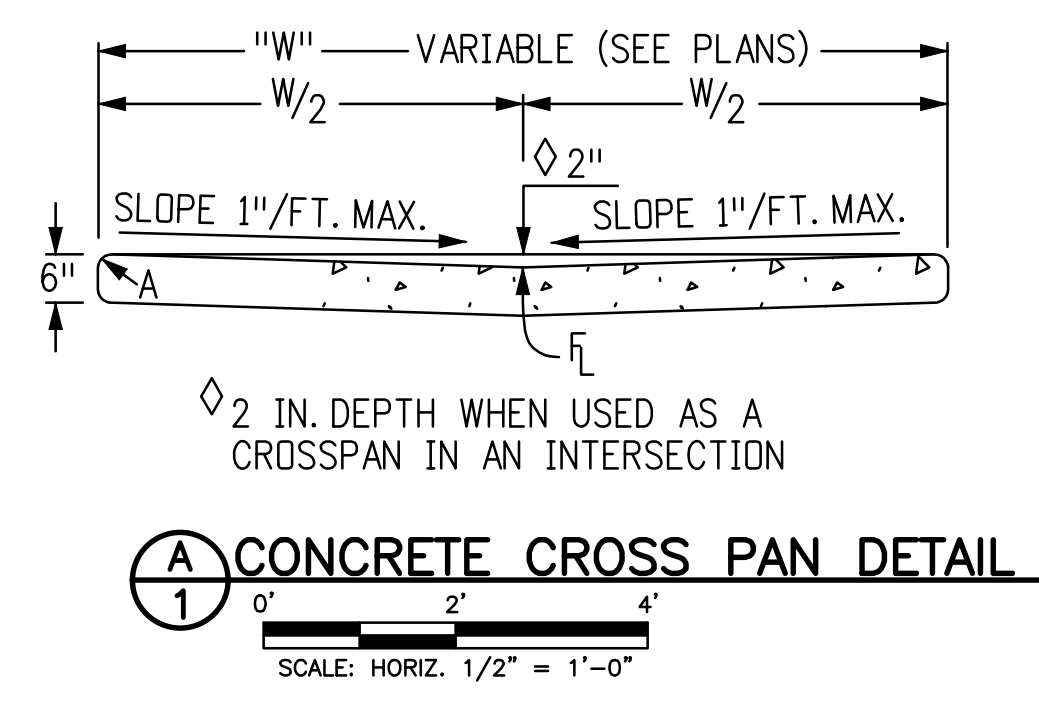
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- NOTES:**
- ALL AREAS WITHIN THE SECURITY FENCE WHICH ARE NOT SURFACED WITH HOT MIX ASPHALT PAVEMENT, CONCRETE FLATWORK OR RECLAIMED CONCRETE AGGREGATE SHALL BE LANDSCAPED WITH NON-IRRIGATED GRASSES IN ACCORDANCE WITH SPECIFICATION SECTION 02900. IN ADDITION, AREAS DISTURBED BY CONSTRUCTION AND MANAGEMENT (STOCKPILING) OF EXCESS SOIL MATERIALS FROM THE SECURED SITE SHALL BE LIKEWISE LANDSCAPED.
 - THE SCOPE OF WORK IN LANDSCAPING WITH NON-IRRIGATED GRASSES SHALL INCLUDE SOIL PREPARATION WITH GRADING TO FINAL ELEVATIONS AS DIRECTED BY THE ENGINEER AND OWNER, TILLING, ADDITION OF FERTILIZERS, SEEDING OF GRASSES BY DRILLING, MULCHING AND TEMPORARY MANAGEMENT OF RUNOFF TO MINIMIZE OR ELIMINATE EROSION AND SEDIMENT GENERATION.
 - INSTALLATION OF NON-IRRIGATED GRASSES SHALL BE PLANNED FOR THE WINTER SEASON, 2025-2026, GENERALLY AFTER DECEMBER 1, 2025.
 - THE OWNER MAY INITIATE AN EXTENDED TEMPORARY EROSION AND SEDIMENT CONTROL PLAN (TESCP) AFTER INSTALLATION OF THE NON-IRRIGATED LANDSCAPING SHOULD IT BE DEEMED NECESSARY TO BEST GUARANTEE SUCCESSFUL ESTABLISHMENT OF GROUND COVER.
 - PER ADDENDUM NO. 1 EXCESS SOIL FROM CONSTRUCTION SHALL BE STOCKPILED AND GRADED TO ACCOMMODATE OWNER'S TESCP AT APPROX 150 FT NORTHEAST OF NORTHEAST SECURED FENCE NOTED WITH 3.
 - CAUTION: EXISTING SECURITY GATE HAS DETECTOR LOOP BELOW EXISTING FINISHED ABC SURFACING WITH APPROX 30- FEET OF GATE. DO NOT DISTURB WITH SUBGRADE PREPARATION AND SURFACING OPERATIONS. SUBGRADE SCARIFICATION WITHIN 20-30 FEET OF GATE AT DETECTOR LOOP LOCATION IS NOT REQUIRED PROVIDED PROOF ROLLING OF EXISTING ABC SURFACING PROVES SATISFACTORY.

LEGEND

[Pattern]	EXISTING HMA PAVEMENT
[Pattern]	NEW HMA PAVEMENT 6" FULL DEPTH ON PREPARED SUBGRADE
[Pattern]	RECLAIMED CONCRETE SHOULDER COMPACTED MATERIAL, 6" DEPTH
--- 5857	EXISTING ELEVATION CONTOUR LINE
--- 5858	EXISTING ELEVATION CONTOUR LINE
--- 5857	FINISHED SURFACE ELEVATION CONTOUR LINE
--- 5858	FINISHED SURFACE ELEVATION CONTOUR LINE
---	NEW CONVEY WATER DITCH
---	EXISTING EDGE OF ABC SURFACING



APPENDIX A – PRECIPITATION FREQUENCY DATA SERVER



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

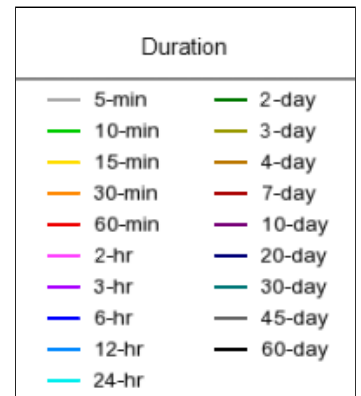
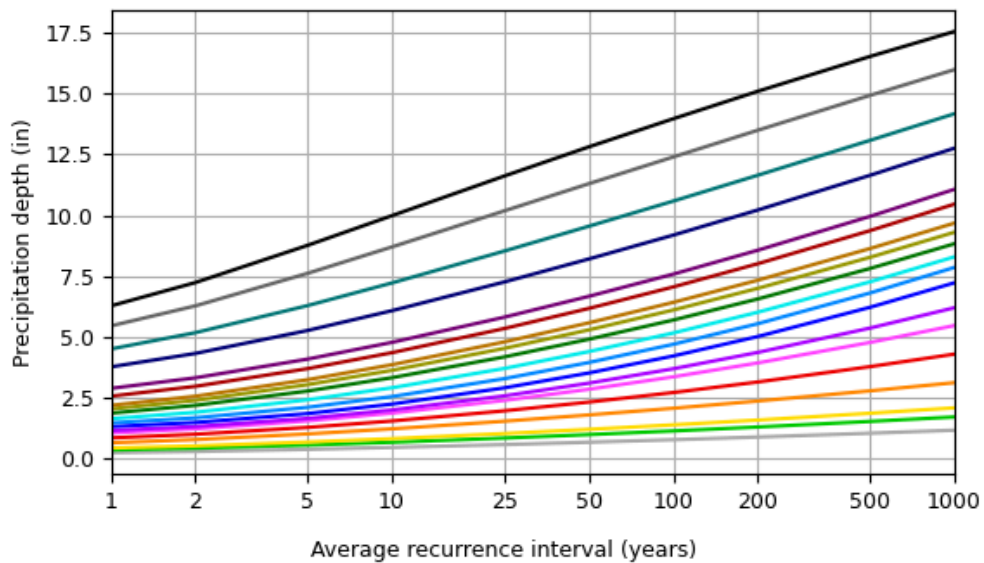
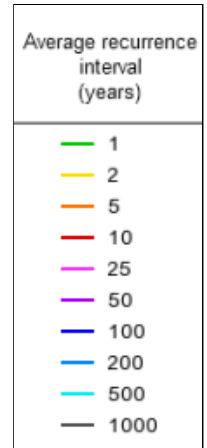
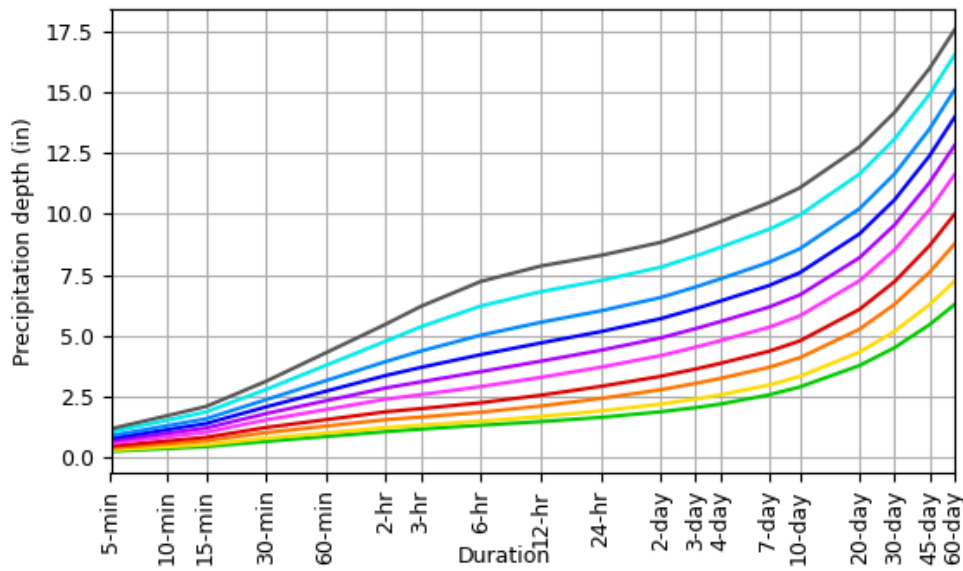
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.244 (0.202-0.298)	0.294 (0.243-0.360)	0.381 (0.314-0.468)	0.460 (0.376-0.567)	0.577 (0.458-0.749)	0.674 (0.519-0.886)	0.777 (0.576-1.05)	0.888 (0.628-1.24)	1.04 (0.707-1.50)	1.17 (0.767-1.69)
10-min	0.357 (0.295-0.437)	0.430 (0.355-0.526)	0.558 (0.459-0.686)	0.673 (0.551-0.831)	0.845 (0.670-1.10)	0.987 (0.761-1.30)	1.14 (0.844-1.54)	1.30 (0.920-1.81)	1.53 (1.04-2.19)	1.71 (1.12-2.48)
15-min	0.436 (0.360-0.533)	0.524 (0.433-0.642)	0.681 (0.560-0.836)	0.821 (0.672-1.01)	1.03 (0.817-1.34)	1.20 (0.928-1.58)	1.39 (1.03-1.87)	1.58 (1.12-2.20)	1.86 (1.26-2.67)	2.09 (1.37-3.02)
30-min	0.651 (0.539-0.797)	0.783 (0.647-0.958)	1.02 (0.836-1.25)	1.22 (1.00-1.51)	1.54 (1.22-1.99)	1.80 (1.38-2.36)	2.07 (1.54-2.80)	2.37 (1.68-3.29)	2.78 (1.89-3.99)	3.12 (2.05-4.52)
60-min	0.853 (0.706-1.04)	1.00 (0.828-1.23)	1.28 (1.06-1.57)	1.55 (1.26-1.91)	1.96 (1.57-2.57)	2.32 (1.80-3.07)	2.72 (2.02-3.69)	3.15 (2.24-4.41)	3.78 (2.57-5.44)	4.30 (2.82-6.22)
2-hr	1.06 (0.879-1.28)	1.22 (1.02-1.49)	1.55 (1.28-1.89)	1.87 (1.54-2.29)	2.39 (1.93-3.13)	2.85 (2.23-3.76)	3.36 (2.53-4.56)	3.93 (2.82-5.49)	4.77 (3.27-6.84)	5.47 (3.62-7.87)
3-hr	1.16 (0.967-1.40)	1.32 (1.10-1.60)	1.65 (1.38-2.01)	2.00 (1.65-2.44)	2.58 (2.10-3.39)	3.10 (2.44-4.10)	3.69 (2.80-5.01)	4.36 (3.15-6.09)	5.36 (3.70-7.68)	6.20 (4.12-8.89)
6-hr	1.32 (1.11-1.58)	1.48 (1.25-1.79)	1.85 (1.55-2.24)	2.24 (1.86-2.72)	2.90 (2.40-3.81)	3.52 (2.80-4.64)	4.22 (3.22-5.70)	5.02 (3.66-6.97)	6.22 (4.33-8.86)	7.23 (4.84-10.3)
12-hr	1.47 (1.24-1.75)	1.68 (1.42-2.00)	2.11 (1.78-2.53)	2.55 (2.14-3.07)	3.28 (2.72-4.26)	3.95 (3.15-5.15)	4.70 (3.61-6.29)	5.55 (4.06-7.63)	6.80 (4.77-9.62)	7.86 (5.30-11.1)
24-hr	1.64 (1.40-1.94)	1.90 (1.62-2.26)	2.42 (2.05-2.88)	2.91 (2.46-3.49)	3.70 (3.07-4.73)	4.40 (3.52-5.66)	5.16 (3.98-6.83)	6.02 (4.43-8.19)	7.26 (5.12-10.2)	8.29 (5.64-11.7)
2-day	1.87 (1.61-2.20)	2.19 (1.88-2.58)	2.78 (2.37-3.29)	3.33 (2.83-3.96)	4.18 (3.47-5.26)	4.90 (3.95-6.24)	5.70 (4.42-7.45)	6.56 (4.86-8.84)	7.81 (5.55-10.8)	8.83 (6.06-12.3)
3-day	2.04 (1.76-2.40)	2.40 (2.06-2.82)	3.04 (2.61-3.58)	3.63 (3.10-4.30)	4.53 (3.77-5.66)	5.29 (4.27-6.69)	6.11 (4.75-7.94)	7.00 (5.21-9.37)	8.27 (5.90-11.4)	9.30 (6.42-12.9)
4-day	2.19 (1.89-2.56)	2.56 (2.22-3.01)	3.24 (2.79-3.81)	3.86 (3.30-4.56)	4.79 (4.00-5.97)	5.58 (4.52-7.03)	6.42 (5.01-8.31)	7.33 (5.47-9.78)	8.63 (6.17-11.9)	9.68 (6.70-13.4)
7-day	2.56 (2.23-2.99)	2.97 (2.58-3.46)	3.70 (3.20-4.32)	4.35 (3.75-5.12)	5.34 (4.48-6.60)	6.17 (5.03-7.72)	7.06 (5.54-9.07)	8.01 (6.01-10.6)	9.37 (6.74-12.8)	10.5 (7.29-14.4)
10-day	2.89 (2.52-3.35)	3.32 (2.90-3.86)	4.09 (3.56-4.76)	4.78 (4.13-5.60)	5.81 (4.88-7.14)	6.67 (5.45-8.30)	7.58 (5.97-9.70)	8.56 (6.45-11.3)	9.95 (7.19-13.5)	11.1 (7.75-15.2)
20-day	3.77 (3.32-4.35)	4.32 (3.80-4.99)	5.26 (4.61-6.09)	6.08 (5.29-7.07)	7.26 (6.12-8.79)	8.20 (6.74-10.1)	9.18 (7.27-11.6)	10.2 (7.74-13.3)	11.6 (8.46-15.7)	12.8 (9.01-17.4)
30-day	4.50 (3.98-5.17)	5.18 (4.57-5.95)	6.29 (5.53-7.25)	7.22 (6.31-8.37)	8.52 (7.20-10.2)	9.55 (7.86-11.7)	10.6 (8.40-13.3)	11.6 (8.85-15.1)	13.1 (9.54-17.5)	14.2 (10.1-19.3)
45-day	5.45 (4.84-6.24)	6.28 (5.57-7.19)	7.61 (6.72-8.74)	8.70 (7.64-10.0)	10.2 (8.60-12.1)	11.3 (9.32-13.7)	12.4 (9.87-15.4)	13.5 (10.3-17.3)	14.9 (10.9-19.8)	16.0 (11.4-21.7)
60-day	6.28 (5.59-7.16)	7.24 (6.44-8.26)	8.76 (7.76-10.0)	9.98 (8.80-11.5)	11.6 (9.82-13.7)	12.8 (10.6-15.4)	14.0 (11.1-17.3)	15.1 (11.5-19.3)	16.5 (12.1-21.8)	17.6 (12.6-23.7)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

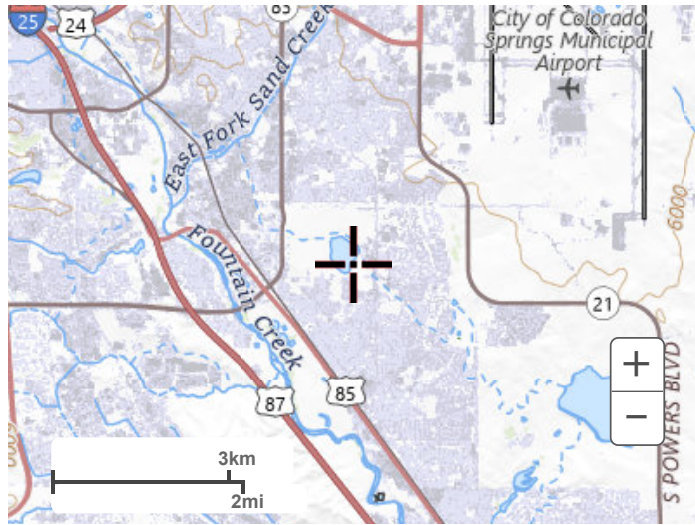
PDS-based depth-duration-frequency (DDF) curves
 Latitude: 38.7720°, Longitude: -104.7430°



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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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APPENDIX B – EXISTING SITE HYDRAULIC CALCULATIONS

APPENDIX C – PROPOSED SITE HYDRAULIC CALCULATIONS

Calculation of Peak Runoff using Rational Method

Designer: RMS
 Company: GMS Consulting Engineers
 Date: 8/28/2025
 Project: Security Water District
 Location: Security-Widefield, CO

Version 2.00 released May 2017

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

$$t_c = \frac{0.395(1.1 - C_p)\sqrt{L_t}}{S^{0.33}}$$

$$t_c = \frac{L_t}{60K\sqrt{S}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_1 + t_2$

$t_{\text{minimum}} = 5$ (urban)
 $t_{\text{minimum}} = 10$ (not-urban)

Regional $t_c = (26 - 17i) + \frac{L_t}{60(1.4i + 9)\sqrt{S_t}}$

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

Select IDFCD location for NOAA Atlas 14 Rainfall Depths from the pull-down list OR enter your own depths obtained from the NOAA website (click this link)

2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1.00	1.28	1.55	1.96	2.32	2.72	3.78

1-hour rainfall depth, P1 (in) = $\frac{a}{b + c}$
 Rainfall Intensity Equation Coefficients = $\frac{a}{29.50}$ $\frac{b}{10.00}$ $\frac{c}{0.786}$
 $I(h/hr) = \frac{a + P_1}{(b + t_c)^c}$

$Q(cfs) = CIA$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time							Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L _t (ft)	US Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S _t (ft/ft)	Overland Flow Time t ₁ (min)	Channelized Flow Length L _t (ft)	US Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V _t (ft/sec)	Channelized Flow Time t ₂ (min)	Computed t _c (min)	Regional t _c (min)	Selected t _c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr		
				0.01	0.01	0.01	0.01	0.04	0.13	0.27	26.38	5855.26	5854.05	0.046	6.14	1.00	5854.05	5854.00	0.050	20	4.47	0.00	6.14	25.67	10.00	2.71	3.46	4.19	5.30	6.28	7.36	10.23	0.00	0.00	0.00	0.00	0.00	0.01	0.03		
Sub-Basin 1A	0.01	A	2.0	0.01	0.01	0.01	0.01	0.04	0.13	0.27	26.38	5855.26	5854.05	0.046	6.14	1.00	5854.05	5854.00	0.050	20	4.47	0.00	6.14	25.67	10.00	2.71	3.46	4.19	5.30	6.28	7.36	10.23	0.00	0.00	0.00	0.00	0.00	0.01	0.03		
Sub-Basin 2A	0.20	A	29.0	0.17	0.18	0.19	0.22	0.27	0.34	0.44	40.39	5858.46	5857.91	0.014	9.56	138.75	5857.91	5857.19	0.005	20	1.44	1.61	11.16	23.53	11.16	2.59	3.31	4.01	5.07	6.00	7.04	9.78	0.09	0.12	0.15	0.22	0.33	0.47	0.86		
Sub-Basin 2B	0.26	A	78.0	0.61	0.63	0.64	0.67	0.69	0.72	0.76	138.27	5858.36	5855.37	0.022	7.78	134.33	5855.37	5854.50	0.006	20	1.61	1.39	9.18	14.14	9.18	2.80	3.58	4.33	5.48	6.49	7.61	10.57	0.44	0.58	0.72	0.95	1.17	1.42	2.08		
Sub-Basin 2C	0.35	A	57.0	0.40	0.42	0.44	0.47	0.51	0.55	0.62	133.93	5858.46	5855.90	0.019	11.47	79.91	5855.90	5855.10	0.010	20	2.00	0.67	12.13	17.09	12.13	2.50	3.20	3.87	4.90	5.80	6.79	9.44	0.35	0.47	0.59	0.81	1.04	1.32	2.05		
Sub-Basin 2D	0.39	A	65.0	0.48	0.50	0.51	0.54	0.58	0.62	0.67	103.84	5858.50	5854.22	0.041	6.95	224.38	5854.22	5853.17	0.005	20	1.37	2.73	9.69	17.97	9.69	2.74	3.51	4.25	5.37	6.36	7.45	10.35	0.51	0.68	0.85	1.14	1.44	1.79	2.72		
Sub-Basin 2E	0.49	A	62.0	0.45	0.47	0.48	0.52	0.55	0.59	0.65	89.01	5858.50	5856.80	0.019	6.70	265.12	5856.80	5853.00	0.014	20	2.39	1.85	10.54	17.55	10.54	2.65	3.39	4.11	5.19	6.15	7.21	10.01	0.59	0.78	0.97	1.31	1.67	2.09	3.21		
Sub-Basin 3A	0.01	A	27.0	0.15	0.16	0.17	0.20	0.26	0.32	0.43	18.14	5855.26	5854.05	0.067	3.86	1.00	5854.05	5854.00	0.050	20	4.47	0.00	3.86	21.42	5.00	3.39	4.34	5.26	6.65	7.87	9.23	12.82	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.05	

APPENDIX D – CULVERT HYDRAULIC ANALYSIS

HYDRAULIC ANALYSIS - HY-8 CULVERTS RESULTS
SECURITY WATER DISTRICT

Culvert ID	Slope (ft/ft)	Pipe Size	Pipe Material	Manning's Roughness Coefficient (n)	Flow Received From Sub-Basin	100-Year Storm Runoff (cfs)	Analyzed with the Federal Highway Administration's HY-8 Culvert Hydraulic Analysis Program		
							Overtopping Flow Rate (cfs)	Outlet Velocity, V100 (fps)	Headwater to Diameter Ratio for Q100
12" CSP	0.019	12	CSP	0.024	2B	1.3	1.6	3.5	0.8
18" CSP	0.011	18	CSP	0.024	2B, 2C and 2D	5.2	6.7	4.8	1.0

HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Outlet Velocity (ft/s)
12" CSP	12" CSP	100 year	1.32	1.32	5855.94	0.75	0.837	0.84	0.50	0.49	0.49	3.49
18" CSP	18" CSP	100 year	5.20	5.20	5854.68	1.43	1.509	1.01	1.07	0.88	0.88	4.84

Crossing Notes

Crossing Input: 12" CSP

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Recurrence	
Discharge List	Define...	
TAILWATER DATA		
Channel Type	Triangular Channel	
Side Slope (H:V)	2.000	:1
Channel Slope	0.1180	ft/ft
Manning's n (channel)	0.030	
Channel Invert Elevation	5854.330	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Irregular	
Irregular Shape	Define...	
Roadway Surface	Paved	
Top Width	30.000	ft

Culvert Input: 12" CSP

Parameter	Value	Units
CULVERT DATA		
Name	12" CSP	
Shape	Circular	
Material	Corrugated Steel	
Diameter	1.000	ft
Embedment Depth	0.000	in
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Thin Edge Projecting (Ke=0.9)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	5855.100	ft
Outlet Station	40.120	ft
Outlet Elevation	5854.330	ft
Number of Barrels	1	
Computed Culvert Slope	0.019192	ft/ft

Crossing Discharge Data

Discharge Selection Method: Recurrence

Table 2 - Summary of Culvert Flows at crossing: 12" CSP

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	12" CSP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5855.51	5 year	0.47	0.47	0.00	1
5855.94	100 year	1.32	1.32	0.00	1
5856.02	Overtopping	1.57	1.57	0.00	Overtopping

Table 3 - Culvert Summary Table: 12" CSP

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 year	0.47	0.47	5855.51	0.41	0.0*	0.41	1-S2n	0.28	0.28	0.28	0.25	2.57	3.90
100 year	1.32	1.32	5855.94	0.75	0.837	0.84	2-M2c	0.50	0.49	0.49	0.36	3.49	5.05
Overtopping	2.64	2.06	5856.17	1.01	1.075	1.07	7-M2c	0.66	0.61	0.61	0.47	4.08	6.01

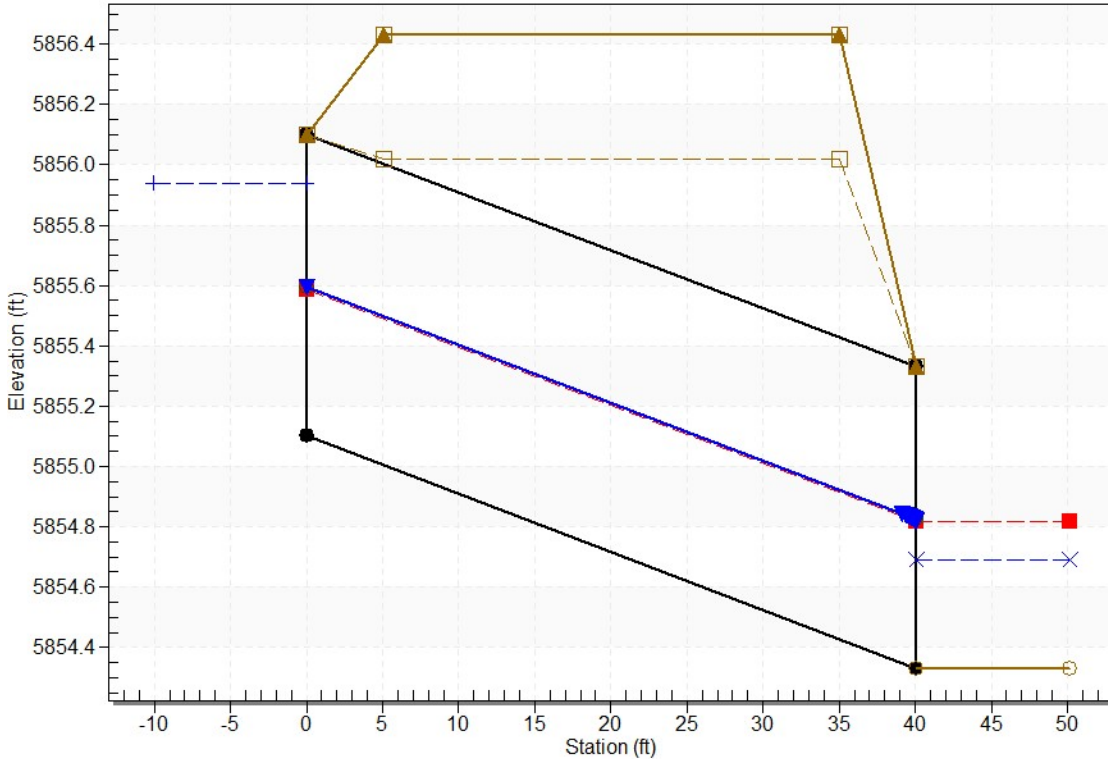
* Full Flow Headwater elevation is below inlet invert.

Culvert Barrel Data

Culvert Barrel Type: Straight Culvert
Inlet Elevation(invert): 5855.10 ft
Outlet Elevation (invert): 5854.33 ft
Culvert Length: 40.13 ft
Culvert Slope: 0.02 ft/ft

Water Surface Profile Plot for Culvert: 12" CSP

Crossing - 12" CSP, Design Discharge - 1.3 cfs
Culvert - 12" CSP, Culvert Discharge - 1.3 cfs



Site Data - 12" CSP

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 5855.10 ft
Outlet Station: 40.12 ft
Outlet Elevation: 5854.33 ft
Number of Barrels: 1

Culvert Data Summary - 12" CSP

Barrel Shape: Circular
Barrel Diameter: 1.00 ft
Barrel Material: Corrugated Steel
Embedment: 0.00 in
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting (Ke=0.9)

Inlet Depression: None

Tailwater Channel Data for Crossing: 12" CSP

Tailwater Channel Option: Triangular Channel

a_side Slope (H:V): 2.00 (.:1)

Channel Slope: 0.12 ft/ft

Channel Manning's n: 0.0300

Channel Invert Elevation: 5854.33 ft

Table 4 - Downstream Channel Rating Curve (crossing: 12" CSP)

Roadway Data for crossing: 12" CSP

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	5856.43
1	15.00	5856.27
2	30.00	5856.02

Roadway Surface: Paved

Roadway Top Width: 30.00 ft

Crossing Notes

Crossing Input: 18" CSP

Parameter	Value	Units
DISCHARGE DATA		
Discharge Method	Recurrence	
Discharge List	Define...	
TAILWATER DATA		
Channel Type	Triangular Channel	
Side Slope (H:V)	2.500	.:1
Channel Slope	0.0286	ft/ft
Manning's n (channel)	0.030	
Channel Invert Elevation	5852.600	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Irregular	
Irregular Shape	Define...	
Roadway Surface	Paved	
Top Width	25.000	ft

Culvert Input: 18" CSP

Parameter	Value	Units
CULVERT DATA		
Name	18" CSP	
Shape	Circular	

Material	Corrugated Steel	
Diameter	1.500	ft
Embedment Depth	0.000	in
Manning's n	0.024	
Culvert Type	Straight	
Inlet Configuration	Thin Edge Projecting (Ke=0.9)	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.000	ft
Inlet Elevation	5853.170	ft
Outlet Station	50.430	ft
Outlet Elevation	5852.600	ft
Number of Barrels	1	
Computed Culvert Slope	0.011303	ft/ft

Crossing Discharge Data

Discharge Selection Method: Recurrence

Table 5 - Summary of Culvert Flows at crossing: 18" CSP

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	18" CSP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5853.91	5 year	1.46	1.46	0.00	1
5854.68	100 year	5.20	5.20	0.00	1
5854.98	Overtopping	6.71	6.71	0.00	Overtopping

Table 6 - Culvert Summary Table: 18" CSP

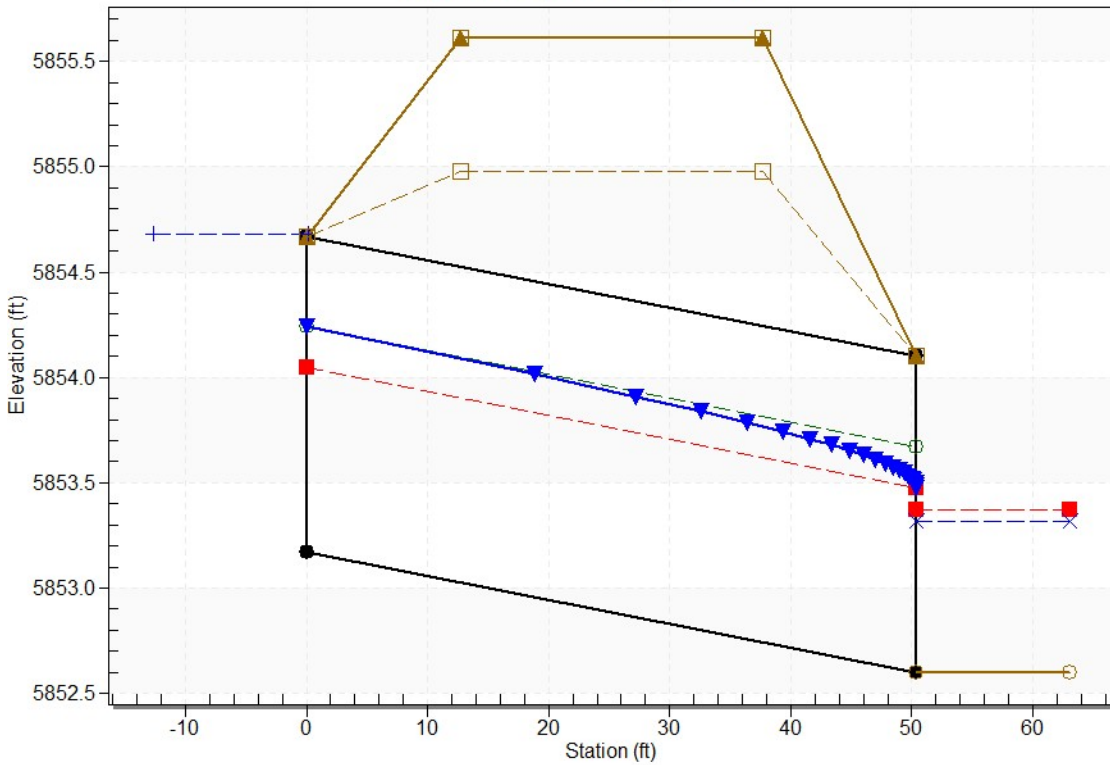
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	HW / D (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 year	1.46	1.46	5853.91	0.67	0.736	0.49	2-M2c	0.50	0.45	0.45	0.45	3.24	2.93
100 year	5.20	5.20	5854.68	1.43	1.509	1.01	7-M2c	1.07	0.88	0.88	0.72	4.84	4.03
Overtopping	10.40	7.90	5855.41	2.04	2.243	1.50	7-M2c	1.50	1.09	1.09	0.93	5.75	4.79

Culvert Barrel Data

Culvert Barrel Type: Straight Culvert
Inlet Elevation(invert): 5853.17 ft
Outlet Elevation (invert): 5852.60 ft
Culvert Length: 50.43 ft
Culvert Slope: 0.01 ft/ft

Water Surface Profile Plot for Culvert: 18" CSP

Crossing - 18" CSP, Design Discharge - 5.2 cfs
Culvert - 18" CSP, Culvert Discharge - 5.2 cfs



Site Data - 18" CSP

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 ft
Inlet Elevation: 5853.17 ft
Outlet Station: 50.43 ft
Outlet Elevation: 5852.60 ft
Number of Barrels: 1

Culvert Data Summary - 18" CSP

Barrel Shape: Circular
Barrel Diameter: 1.50 ft
Barrel Material: Corrugated Steel
Embedment: 0.00 in
Barrel Manning's n: 0.0240
Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting (Ke=0.9)
Inlet Depression: None

Tailwater Channel Data for Crossing: 18" CSP

Tailwater Channel Option: Triangular Channel
a_side Slope (H:V): 2.50 (:1)
Channel Slope: 0.03 ft/ft
Channel Manning's n: 0.0300
Channel Invert Elevation: 5852.60 ft

Table 7 - Downstream Channel Rating Curve (crossing: 18" CSP)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
1.46	5853.05	0.45	2.93	0.80	1.09
5.20	5853.32	0.72	4.03	1.28	1.18

Roadway Data for crossing: 18" CSP

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	5855.61
1	15.00	5855.50
2	25.00	5854.98

Roadway Surface: Paved
Roadway Top Width: 25.00 ft

APPENDIX E – CULVERT HYDRAULIC ANALYSIS

HYDRAULIC ANALYSIS - HYDRAULIC TOOLBOX SWALES RESULTS
SECURITY WATER DISTRICT

Swale Design Point	Proposed Slope, S (ft/ft)	Left Side Slope (H:1V)	Right Side Slope (H:1V)	Minor Event (5-YR)			Major Event Capacity (100-YR)			Depth of Swale (in)	Freeboard Required?	Freeboard Depth (ft)	Does Ditch have 100-YR Capacity?	Remarks
				Flow, Q (cfs)	Velocity, V (fps)	Water Depth, D (ft)	Flow, Q (cfs)	Velocity, V (fps)	Water Depth, D (ft)					
2A	0.005	5	4	0.12	0.60	0.08	0.47	0.92	0.18	8.0	No	0.49	Yes	Grass
2B	0.001	4	4	0.58	0.53	0.29	1.42	0.68	0.45	13.6	No	0.68	Yes	Grass
2C	0.010	5	7	0.47	1.15	0.15	1.32	1.55	0.25	9.8	No	0.57	Yes	Grass
2D	0.005	2.5	20	1.46	1.06	0.39	3.88	1.46	0.45	32.6	Yes	2.27	Yes	Grass
2E	0.006	5	20	0.78	1.06	0.21	2.09	1.39	0.34	38.4	Yes	2.86	Yes	Grass
2E	0.006	12	15	0.78	2.25	0.16	2.09	2.89	0.23	9.7	No	0.58	Yes	Concrete

Hydraulic Analysis Report

Project Data

Project Title: Security Water District – Water Treatment Plant Addition

Designer: JMS

Project Date: Thursday, August 21, 2025

Project Units: U.S. Customary Units

Notes:

Channel Analysis: DP 2A Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5858.00	0.0300
3.30	5857.33	0.0300
5.30	5857.33	0.0300
10.90	5858.42	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 0.4700 cfs

Result Parameters

Depth 0.1771 ft

Area of Flow 0.5121 ft²

Wetted Perimeter 3.8172 ft

Hydraulic Radius 0.1341 ft

Average Velocity 0.9178 ft/s

Top Width 3.7823 ft

Froude Number: 0.4396

Critical Depth 0.1087 ft

Critical Velocity 1.6976 ft/s

Critical Slope: 0.0296 ft/ft

Critical Top Width 3.09 ft

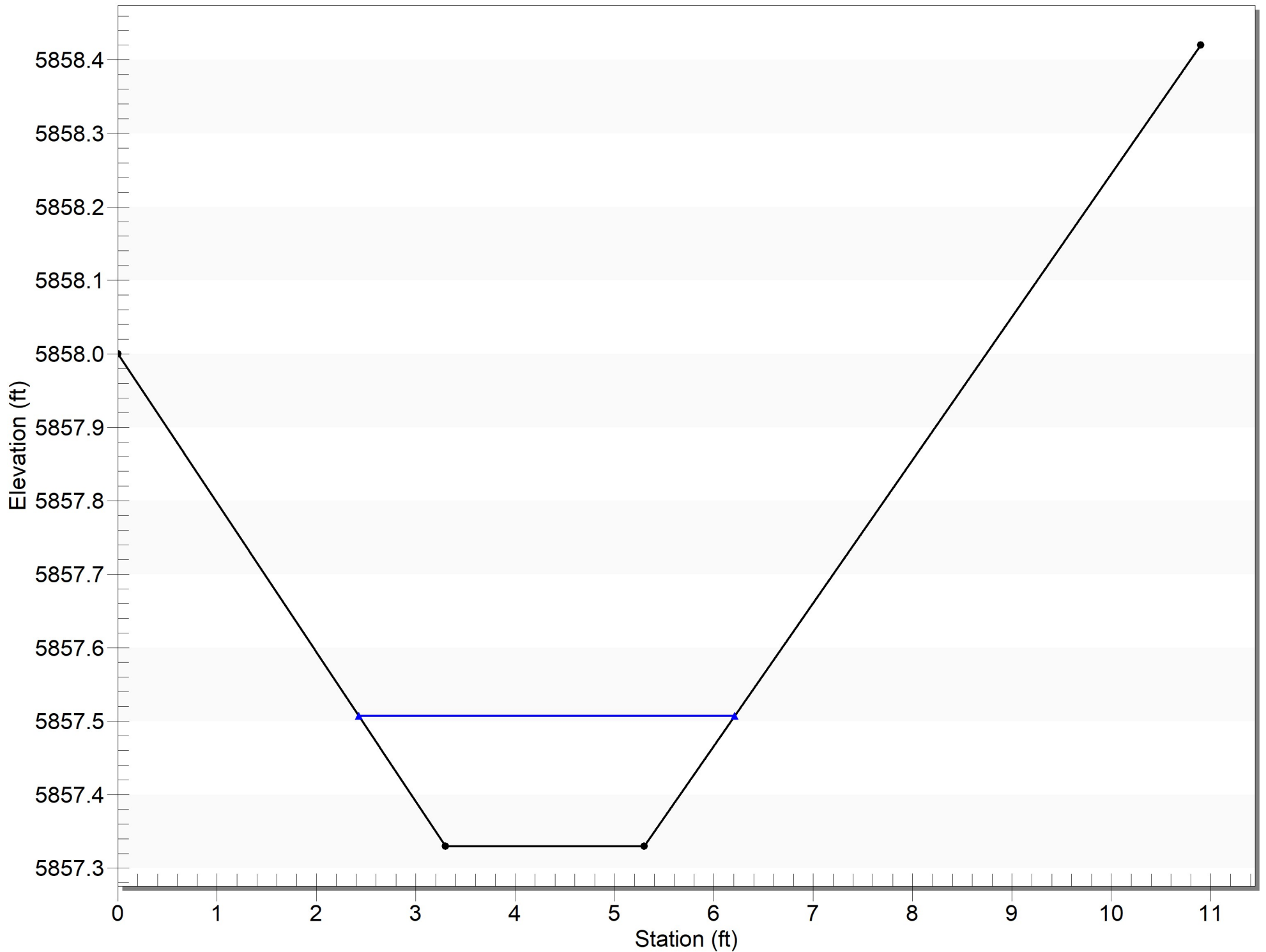
Calculated Max Shear Stress 0.0553 lb/ft²

Calculated Avg Shear Stress 0.0419 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2A Swale - 100 Year Storm



Channel Analysis: DP 2B Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5854.97	0.0300
3.88	5854.27	0.0300
5.88	5854.27	0.0300
12.80	5855.40	-----

Longitudinal Slope: 0.0010 ft/ft

Flow 1.4200 cfs

Result Parameters

Depth 0.4517 ft

Area of Flow 2.0935 ft²

Wetted Perimeter 7.3468 ft

Hydraulic Radius 0.2850 ft

Average Velocity 0.6783 ft/s

Top Width 7.2697 ft

Froude Number: 0.2227

Critical Depth 0.2037 ft

Critical Velocity 2.1861 ft/s

Critical Slope: 0.0251 ft/ft

Critical Top Width 4.38 ft

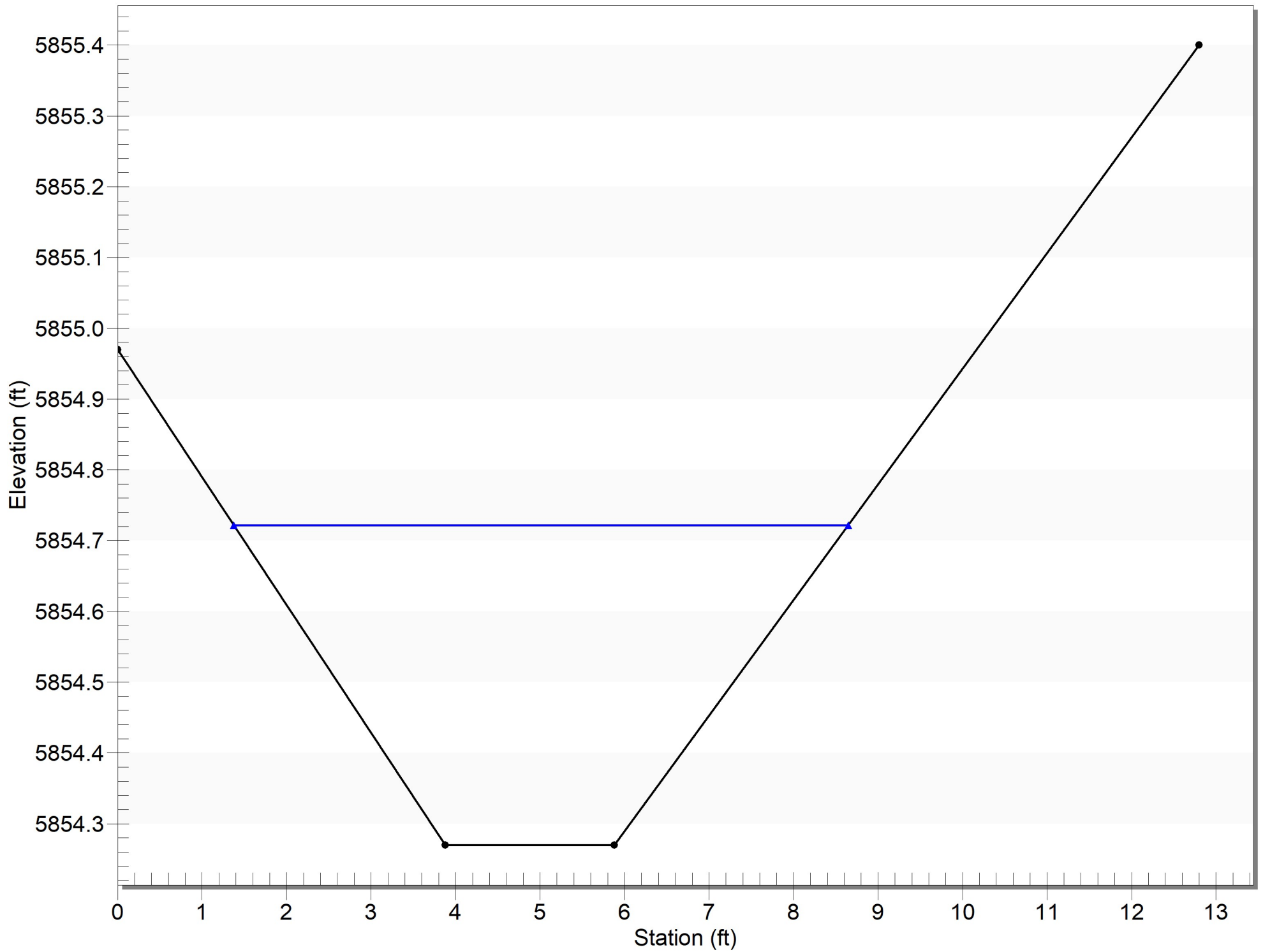
Calculated Max Shear Stress 0.0282 lb/ft²

Calculated Avg Shear Stress 0.0178 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2B Swale - 100 Year Storm



Channel Analysis: DP 2C Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5856.01	0.0300
4.03	5855.26	0.0300
6.03	5855.26	0.0300
13.19	5856.47	-----

Longitudinal Slope: 0.0100 ft/ft

Flow 1.3200 cfs

Result Parameters

Depth 0.2497 ft

Area of Flow 0.8515 ft²

Wetted Perimeter 4.8636 ft

Hydraulic Radius 0.1751 ft

Average Velocity 1.5502 ft/s

Top Width 4.8196 ft

Froude Number: 0.6499

Critical Depth 0.1965 ft

Critical Velocity 2.1598 ft/s

Critical Slope: 0.0253 ft/ft

Critical Top Width 4.22 ft

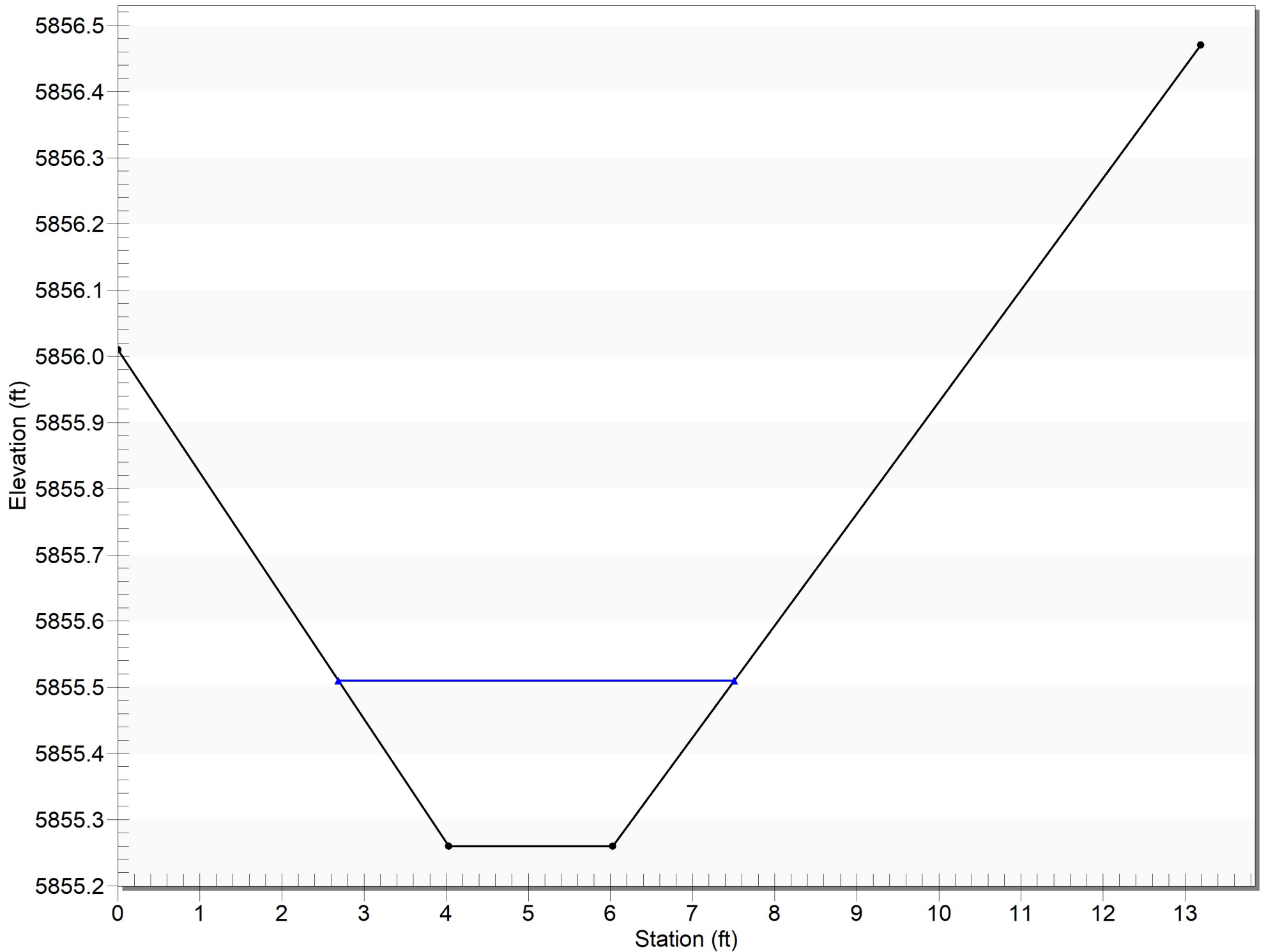
Calculated Max Shear Stress 0.1558 lb/ft²

Calculated Avg Shear Stress 0.1092 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2C Swale - 100 Year



Channel Analysis: DP 2D Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5856.00	0.0300
7.17	5853.28	0.0300
9.17	5853.28	0.0300
29.36	5854.65	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 3.8800 cfs

Result Parameters

Depth 0.4504 ft

Area of Flow 2.6626 ft²

Wetted Perimeter 9.9221 ft

Hydraulic Radius 0.2684 ft

Average Velocity 1.4572 ft/s

Top Width 9.8243 ft

Froude Number: 0.4933

Critical Depth 0.3190 ft

Critical Velocity 2.5492 ft/s

Critical Slope: 0.0226 ft/ft

Critical Top Width 7.54 ft

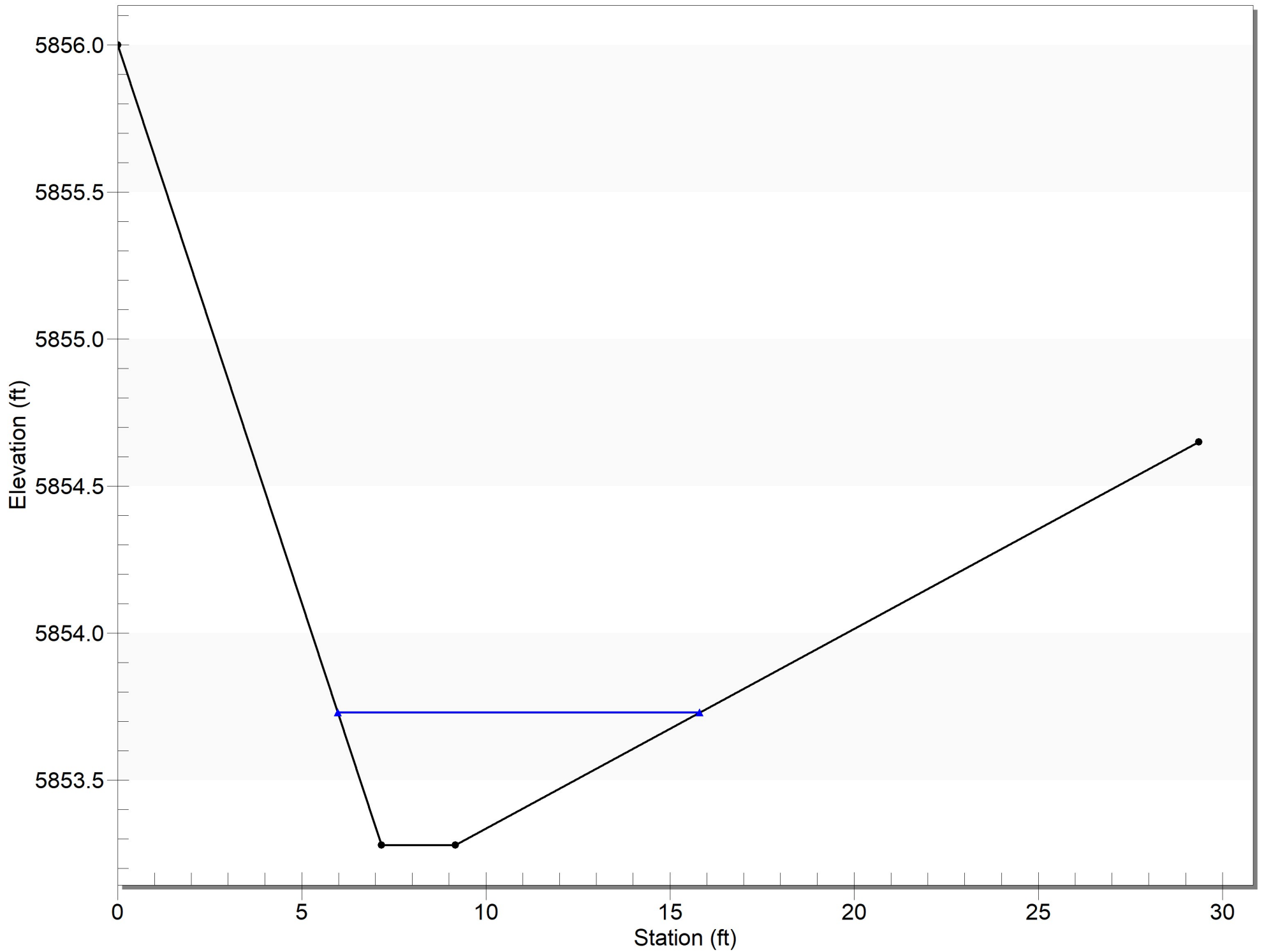
Calculated Max Shear Stress 0.1405 lb/ft²

Calculated Avg Shear Stress 0.0837 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2D Swale - 100 Year Storm



Channel Analysis: DP 2E Swale - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5857.85	0.0300
11.00	5854.65	0.0300
13.00	5854.65	0.0300
25.82	5855.84	-----

Longitudinal Slope: 0.0060 ft/ft

Flow 2.0900 cfs

Result Parameters

Depth 0.3404 ft

Area of Flow 1.5041 ft²

Wetted Perimeter 6.9016 ft

Hydraulic Radius 0.2179 ft

Average Velocity 1.3895 ft/s

Top Width 6.8373 ft

Froude Number: 0.5221

Critical Depth 0.2427 ft

Critical Velocity 2.3115 ft/s

Critical Slope: 0.0242 ft/ft

Critical Top Width 5.45 ft

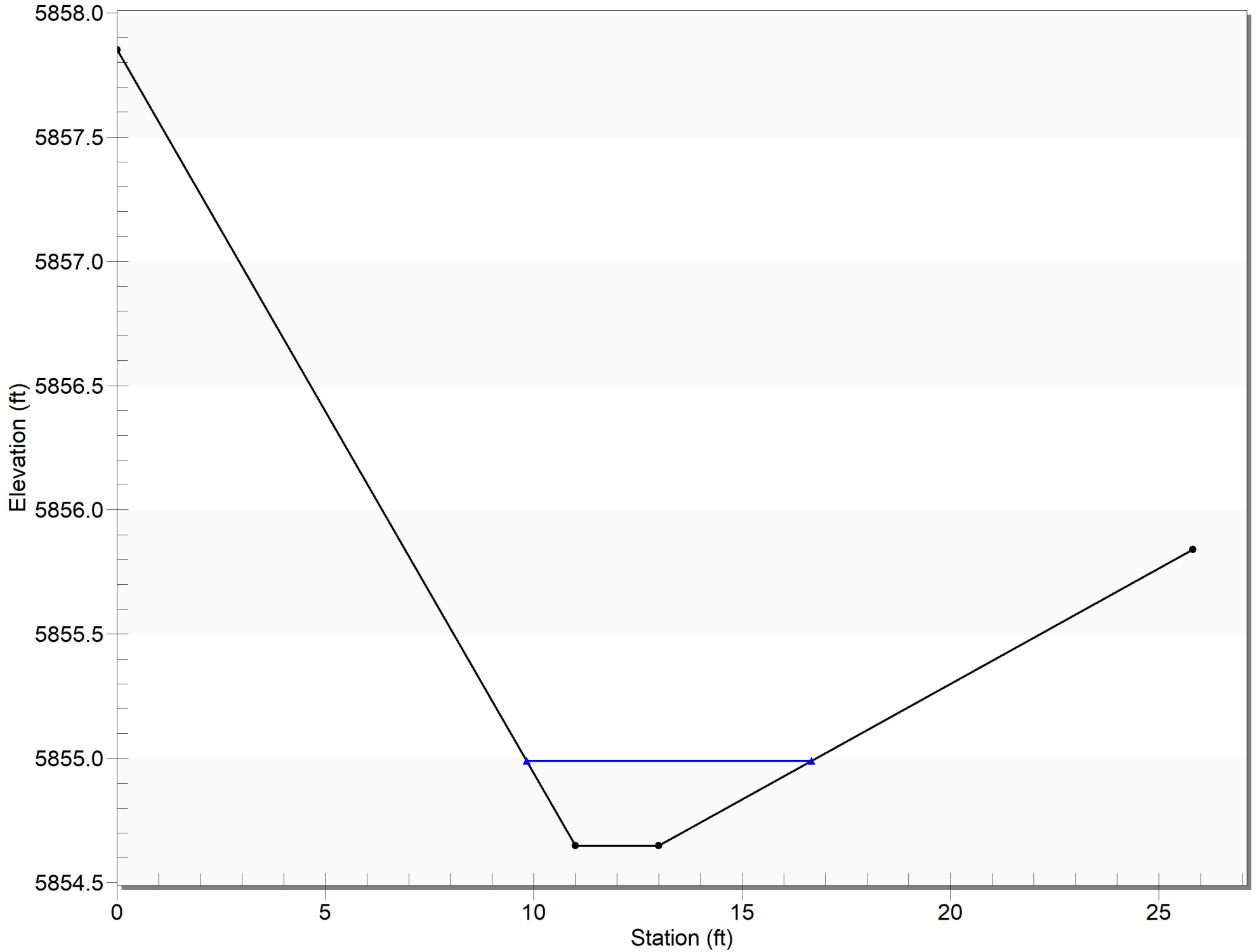
Calculated Max Shear Stress 0.1274 lb/ft²

Calculated Avg Shear Stress 0.0816 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2E Swale - 100 Year Storm



Channel Analysis: DP 2E Concrete Cross Pan - 100 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5855.79	0.0120
10.00	5854.98	0.0120
20.00	5855.60	-----

Longitudinal Slope: 0.0100 ft/ft

Flow 2.0900 cfs

Result Parameters

Depth 0.2255 ft

Area of Flow 0.7243 ft²

Wetted Perimeter 6.4384 ft

Hydraulic Radius 0.1125 ft

Average Velocity 2.8857 ft/s

Top Width 6.4223 ft

Froude Number: 1.5143

Critical Depth 0.2663 ft

Critical Velocity 2.0705 ft/s

Critical Slope: 0.0041 ft/ft

Critical Top Width 7.58 ft

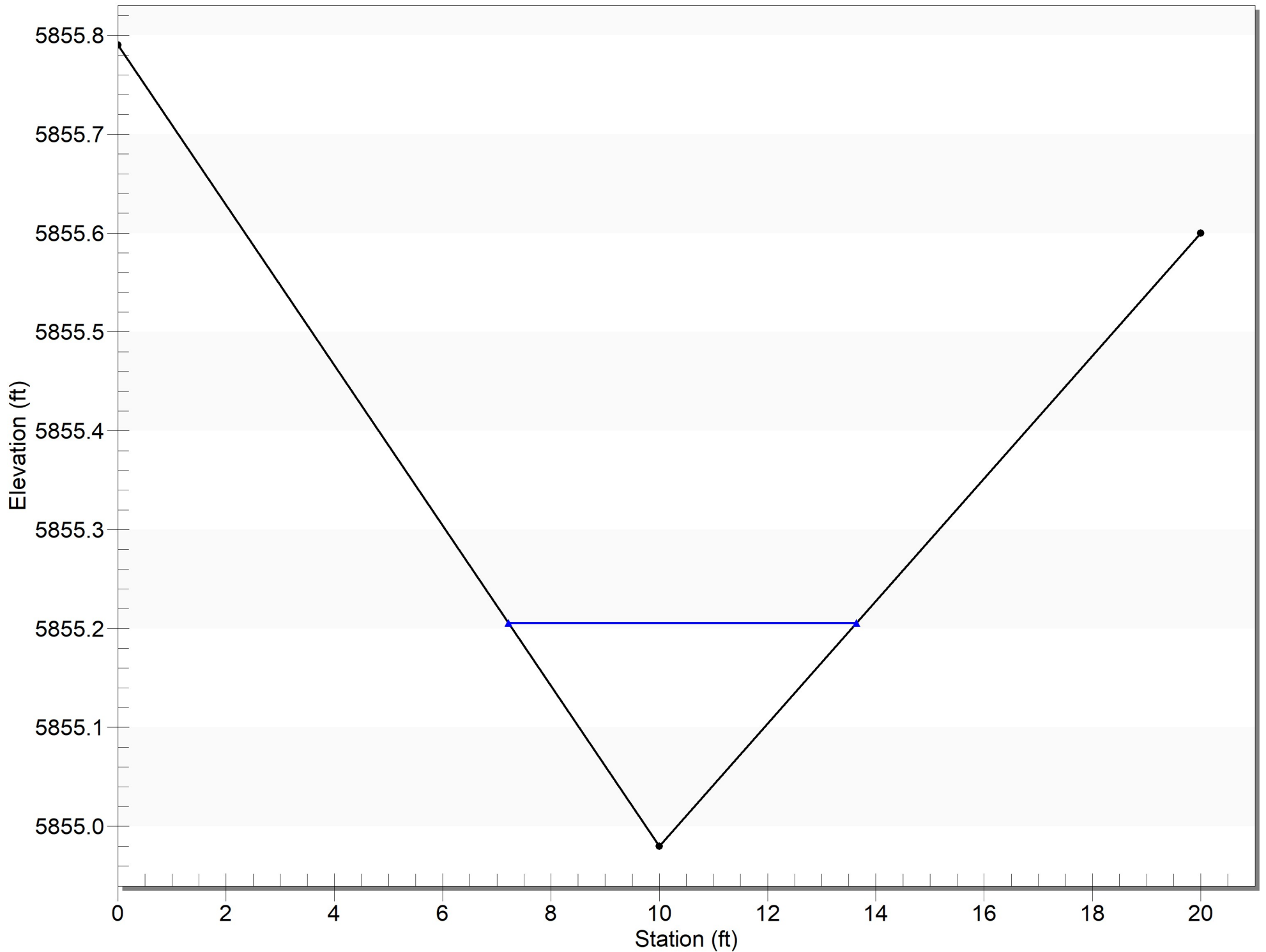
Calculated Max Shear Stress 0.1407 lb/ft²

Calculated Avg Shear Stress 0.0702 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0120

DP 2E Concrete Cross Pan - 100 Year Storm



Channel Analysis: DP 2A Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5858.00	0.0300
3.30	5857.33	0.0300
5.30	5857.33	0.0300
10.90	5858.42	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 0.1200 cfs

Result Parameters

Depth 0.0831 ft

Area of Flow 0.2009 ft²

Wetted Perimeter 2.8524 ft

Hydraulic Radius 0.0704 ft

Average Velocity 0.5973 ft/s

Top Width 2.8360 ft

Froude Number: 0.3955

Critical Depth 0.0463 ft

Critical Velocity 1.1616 ft/s

Critical Slope: 0.0380 ft/ft

Critical Top Width 2.47 ft

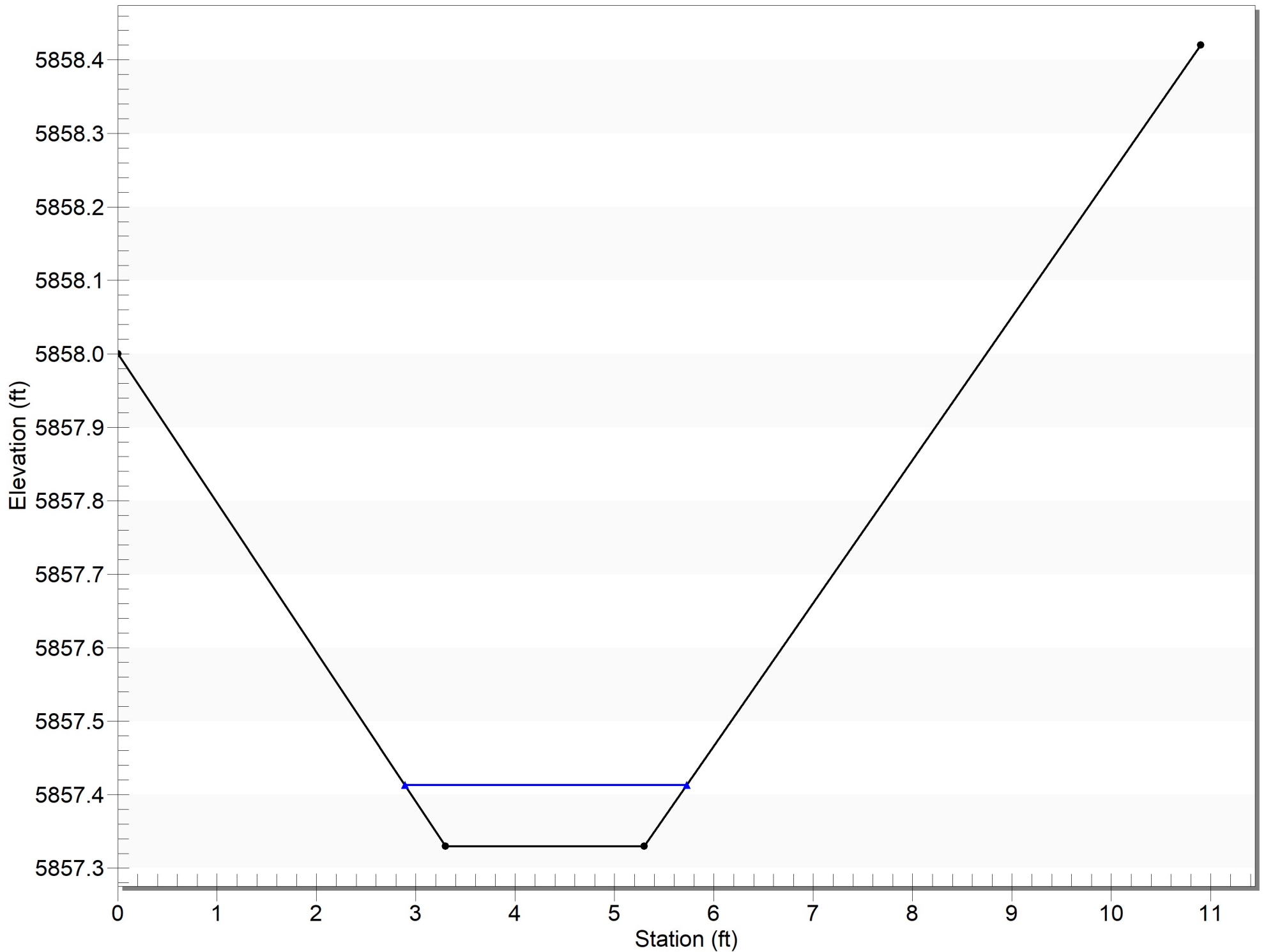
Calculated Max Shear Stress 0.0259 lb/ft²

Calculated Avg Shear Stress 0.0220 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2A Swale - 5 Year Storm



Channel Analysis: DP 2B Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5854.97	0.0300
3.88	5854.27	0.0300
5.88	5854.27	0.0300
12.80	5855.40	-----

Longitudinal Slope: 0.0010 ft/ft

Flow 0.5800 cfs

Result Parameters

Depth 0.2931 ft

Area of Flow 1.0871 ft²

Wetted Perimeter 5.4691 ft

Hydraulic Radius 0.1988 ft

Average Velocity 0.5335 ft/s

Top Width 5.4191 ft

Froude Number: 0.2099

Critical Depth 0.1216 ft

Critical Velocity 1.7613 ft/s

Critical Slope: 0.0289 ft/ft

Critical Top Width 3.42 ft

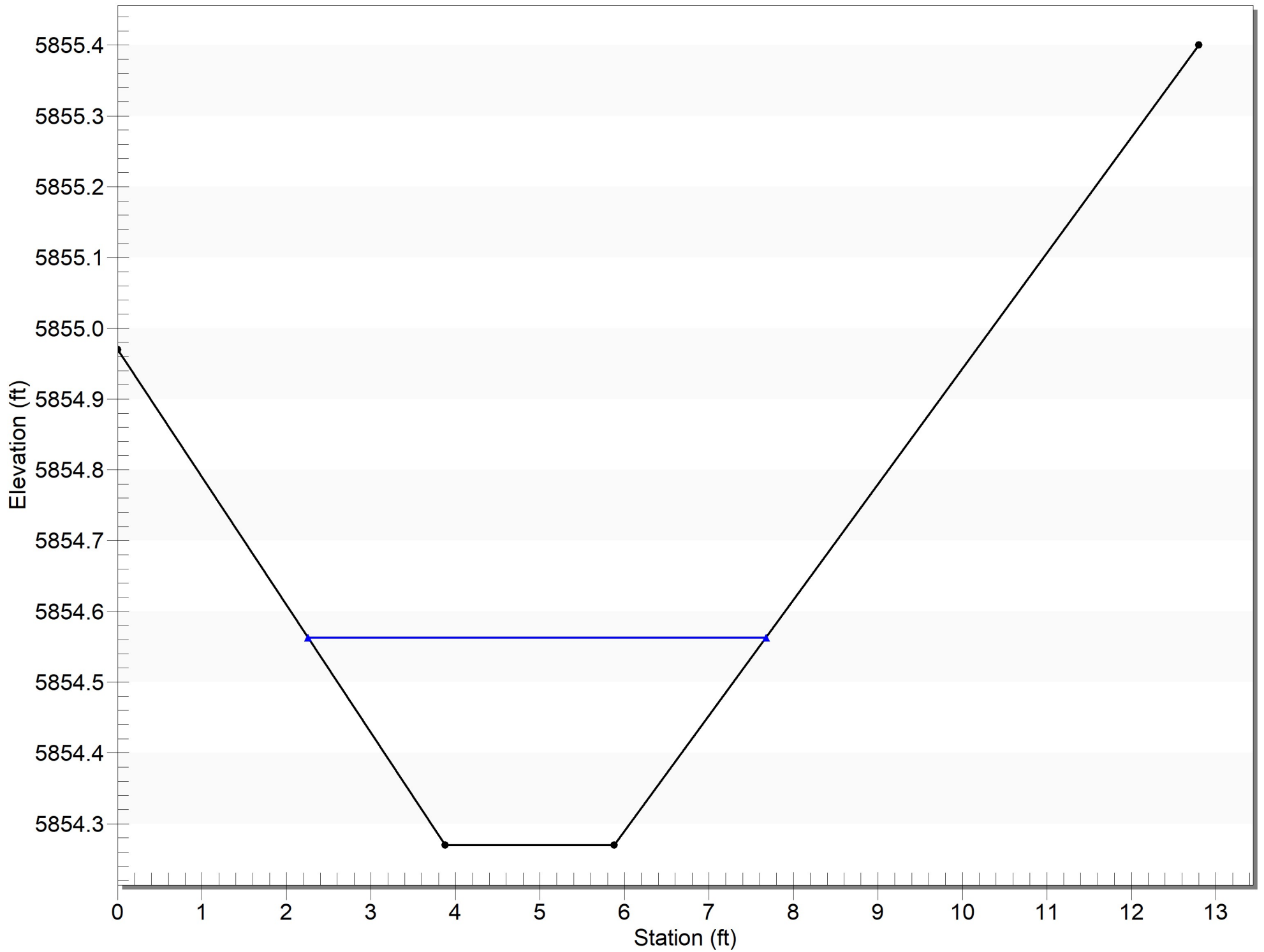
Calculated Max Shear Stress 0.0183 lb/ft²

Calculated Avg Shear Stress 0.0124 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2B Swale - 5 Year



Channel Analysis: DP 2C Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5856.01	0.0300
4.03	5855.26	0.0300
6.03	5855.26	0.0300
13.19	5856.47	-----

Longitudinal Slope: 0.0100 ft/ft

Flow 0.4700 cfs

Result Parameters

Depth 0.1451 ft

Area of Flow 0.4092 ft²

Wetted Perimeter 3.6642 ft

Hydraulic Radius 0.1117 ft

Average Velocity 1.1486 ft/s

Top Width 3.6387 ft

Froude Number: 0.6036

Critical Depth 0.1076 ft

Critical Velocity 1.6761 ft/s

Critical Slope: 0.0298 ft/ft

Critical Top Width 3.21 ft

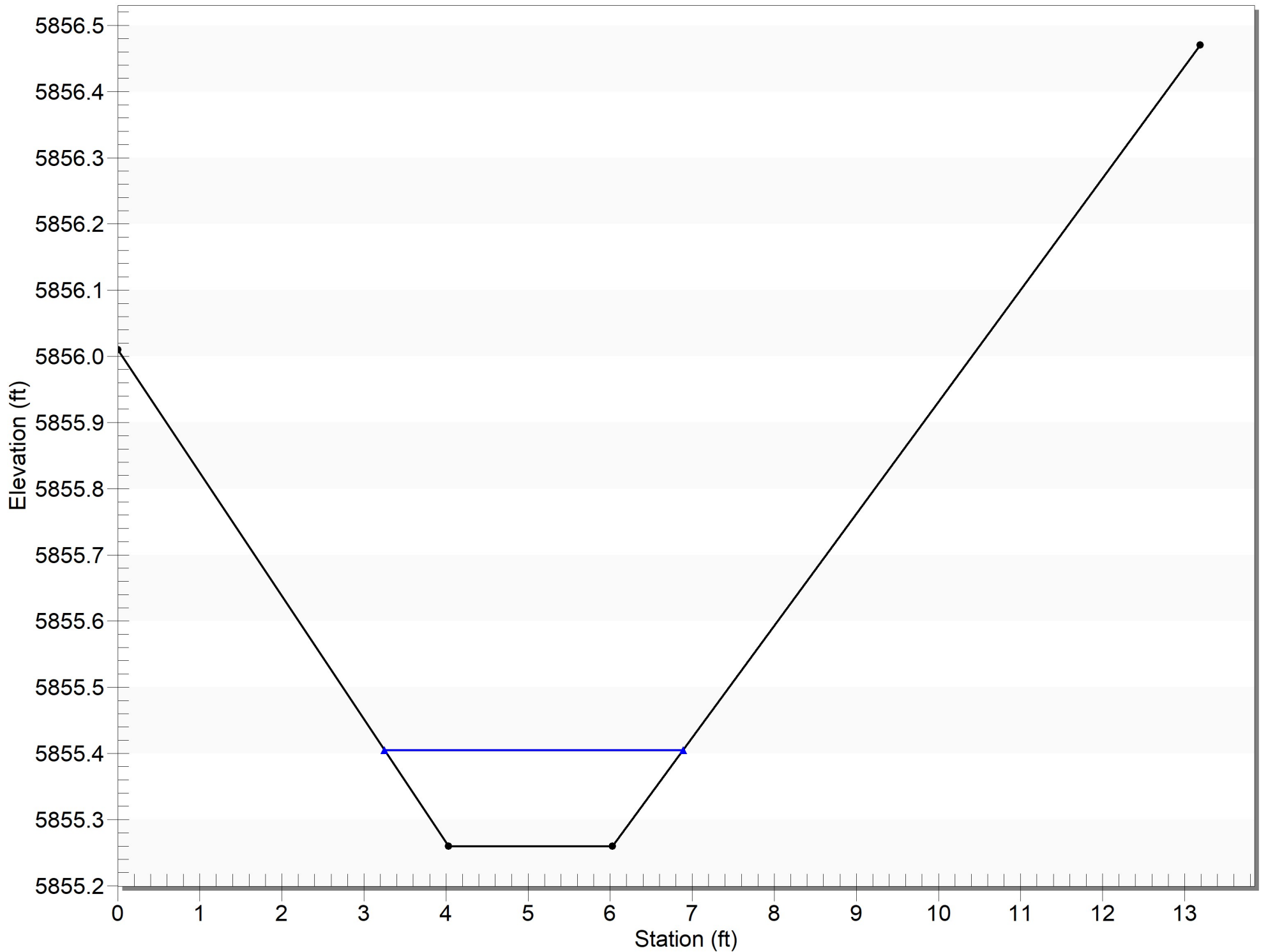
Calculated Max Shear Stress 0.0906 lb/ft²

Calculated Avg Shear Stress 0.0697 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2C Swale - 5 Year Storm



Channel Analysis: DP 2D Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5856.00	0.0300
7.17	5853.28	0.0300
9.17	5853.28	0.0300
29.36	5854.65	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 1.4600 cfs

Result Parameters

Depth 0.2874 ft

Area of Flow 1.2924 ft²

Wetted Perimeter 7.0558 ft

Hydraulic Radius 0.1832 ft

Average Velocity 1.1297 ft/s

Top Width 6.9933 ft

Froude Number: 0.4631

Critical Depth 0.1926 ft

Critical Velocity 2.0642 ft/s

Critical Slope: 0.0260 ft/ft

Critical Top Width 5.35 ft

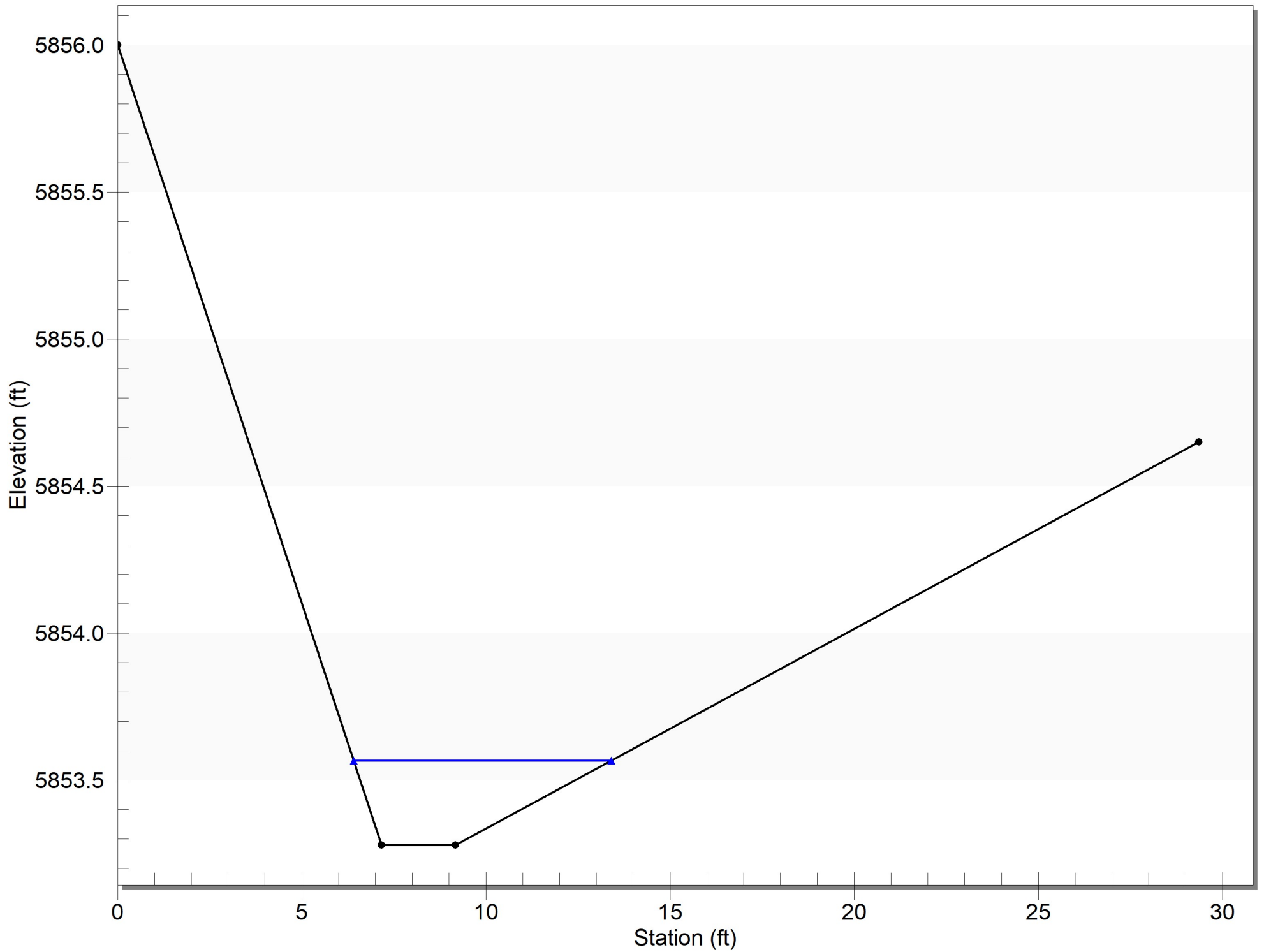
Calculated Max Shear Stress 0.0897 lb/ft²

Calculated Avg Shear Stress 0.0571 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2D Swale - 5 Year Storm



Channel Analysis: DP 2E Swale - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5857.85	0.0300
11.00	5854.65	0.0300
13.00	5854.65	0.0300
25.82	5855.84	-----

Longitudinal Slope: 0.0060 ft/ft

Flow 0.7800 cfs

Result Parameters

Depth 0.2100 ft

Area of Flow 0.7333 ft²

Wetted Perimeter 5.0238 ft

Hydraulic Radius 0.1460 ft

Average Velocity 1.0637 ft/s

Top Width 4.9841 ft

Froude Number: 0.4887

Critical Depth 0.1409 ft

Critical Velocity 1.8446 ft/s

Critical Slope: 0.0280 ft/ft

Critical Top Width 4.00 ft

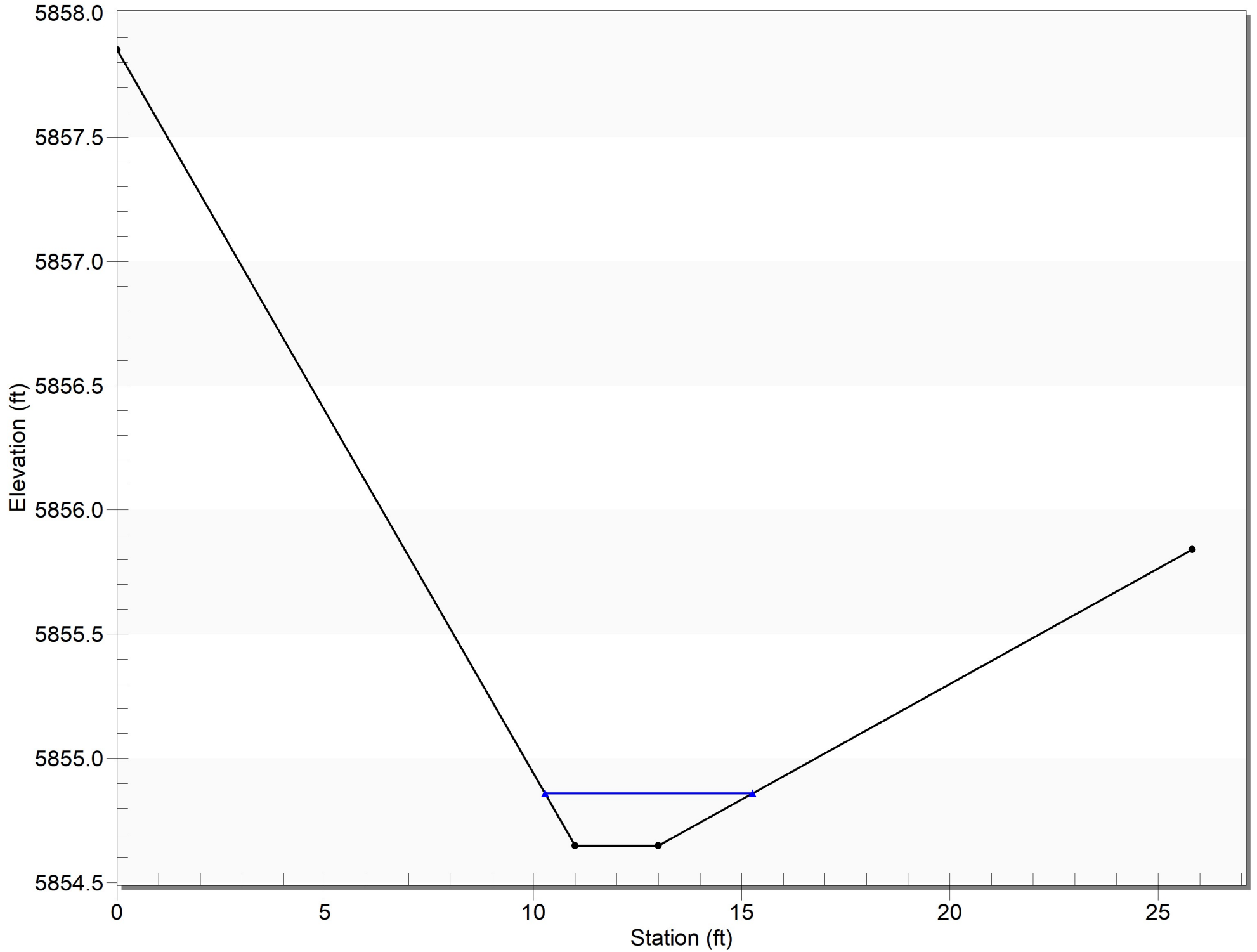
Calculated Max Shear Stress 0.0786 lb/ft²

Calculated Avg Shear Stress 0.0547 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

DP 2E Swale - 5 Year Storm



Channel Analysis: DP 2E Concrete Cross Pan - 5 Year

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station (ft)	Elevation (ft)	Manning's n
0.00	5855.79	0.0120
10.00	5854.98	0.0120
20.00	5855.60	-----

Longitudinal Slope: 0.0100 ft/ft

Flow 0.7800 cfs

Result Parameters

Depth 0.1559 ft

Area of Flow 0.3458 ft²

Wetted Perimeter 4.4490 ft

Hydraulic Radius 0.0777 ft

Average Velocity 2.2555 ft/s

Top Width 4.4379 ft

Froude Number: 1.4239

Critical Depth 0.1795 ft

Critical Velocity 1.7001 ft/s

Critical Slope: 0.0047 ft/ft

Critical Top Width 5.11 ft

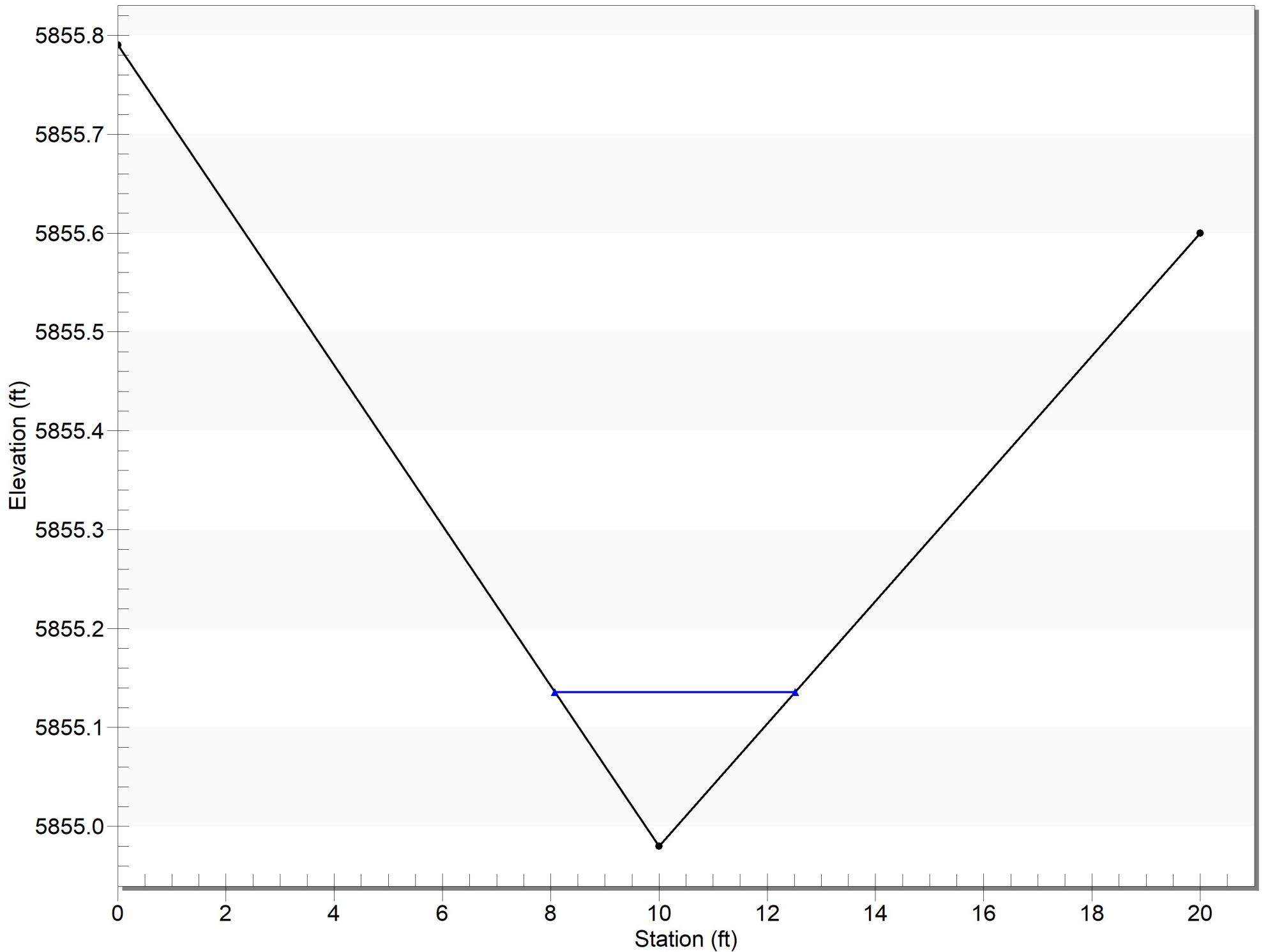
Calculated Max Shear Stress 0.0973 lb/ft²

Calculated Avg Shear Stress 0.0485 lb/ft²

Composite Manning's n Equation: Lotter method

Manning's n: 0.0120

DP 2E Concrete Cross Pan - 5 Year Storm



Selected Profile: FHWA Profile (read-only)

Culvert Assessment Profiles

Culvert Assessment Profile Name: Standard (read-only)

Maximum Excavation Depth: 20.00 ft

Maximum Shallow Cover: 4.00 ft

Maximum Small Pipe Size: 36.00 ft

Minimum Manned Entry Size: 48.00 in

Riprap Classes

Riprap Class Name:CLASS I

Riprap Class Order:1

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 304.80 mm

D85: 228.60 mm

D50: 165.10 mm

D15: 114.30 mm

Riprap Class Name:CLASS II

Riprap Class Order:2

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 457.20 mm

D85: 330.20 mm

D50: 241.30 mm

D15: 177.80 mm

Riprap Class Name:CLASS III

Riprap Class Order:3

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 609.60 mm

D85: 431.80 mm

D50: 317.50 mm

D15: 228.60 mm

Riprap Class Name:CLASS IV

Riprap Class Order:4

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 762.00 mm

D85: 533.40 mm

D50: 393.70 mm

D15: 266.70 mm

Riprap Class Name:CLASS V

Riprap Class Order:5

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 914.40 mm

D85: 647.70 mm

D50: 469.90 mm

D15: 330.20 mm

Riprap Class Name:CLASS VI

Riprap Class Order:6

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 1066.80 mm

D85: 762.00 mm

D50: 546.10 mm

D15: 381.00 mm

Riprap Class Name:CLASS VII

Riprap Class Order:7

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 1257.30 mm

D85: 889.00 mm

D50: 647.70 mm

D15: 444.50 mm

Riprap Class Name:CLASS VIII

Riprap Class Order:8

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 1524.00 mm

D85: 1079.50 mm

D50: 800.10 mm

D15: 558.80 mm

Riprap Class Name:CLASS IX

Riprap Class Order:9

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 1828.80 mm

D85: 1295.40 mm

D50: 965.20 mm

D15: 660.40 mm

Riprap Class Name:CLASS X

Riprap Class Order:10

The following values are an 'average' of the size fraction range for the selected riprap class.

D100: 2133.60 mm

D85: 1511.30 mm

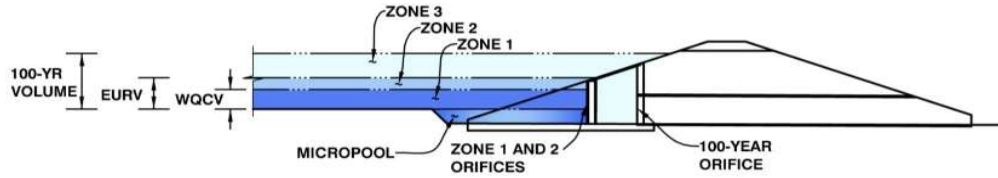
D50: 1130.30 mm

D15: 787.40 mm

APPENDIX F – WQCV ANALYSIS

Security Water District
 Water Quality Control Volume Sizing
 Simplified Equations

Designed in accordance with Chapter 12, Section 4.1 of Volume 2 of the Mile High Flood District Criteria



Zone 1: Water Quality Capture Volume

$$WQCV = a (0.91I^3 - 1.19I^2 + 0.78I)$$

East WQCV

α	1.0 (40 hours drain time)
I	62%
WQCV	0.24 watershed-inches
Area	0.49 acres

Required WQCV	0.010 acre-feet
Proposed WQCV	0.031 acre-feet

Southwest WQCV

α	1.0 (40 hours drain time)
I	60%
WQCV	0.24 watershed-inches
Area	1.69 acres

Required WQCV	0.033 acre-feet
Proposed WQCV	0.211 acre-feet

Cut/Fill Report

Generated: 2025-08-28 12:03:06

By user: jms

Drawing: G:\@GMT-2025.08.28-15.00.15\SECURITY\2022-076\130\Drainage
Report\G:\@GMT-2025.08.28-15.00.15\SECURITY\2022-076\130\Drainage
Report\Figure 6 WITH SURFACE.dwg

Volume Summary							
Name	Type	Cut Factor	Fill Factor	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
East WQCV	full	1.000	1.000	1305.08	56.18	5.47	50.71<Cut>
Southwest WQCV	full	1.000	1.000	7749.82	342.51	1.94	340.57<Cut>

Totals					
		2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Total		9054.90	398.69	7.41	391.28<Cut>

* Value adjusted by cut or fill factor other than 1.0

**APPENDIX G – 2026 FINANCIAL ASSURANCE ESTIMATE
FORM**

