

**FINAL DRAINAGE REPORT**

for  
**HAVEN VALLEY**

El Paso County, Colorado

July 2024

EL PASO COUNTY PCD FILE NO. SF2323

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Project #21085-03

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**FINAL DRAINAGE REPORT**

for  
**HAVEN VALLEY**  
Security, Colorado

**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 El Paso County for drainage reports, and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omission on my part in preparing this report.



7/11/24

Tim D. McConnell, P.E.

Date

Colorado P.E. License No. 33797

For and on Behalf of Drexel, Barrell & Co.

**DEVELOPER'S STATEMENT**

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

Business Name: Midco Investments, LLC

By:



7/11/24

Robert C. Irwin

Date

Title:

Manager

Address:

P.O. Box 60069

Colorado Springs, CO 80960

**EL PASO COUNTY**

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

Joshua Palmer, P.E.

Date

County Engineer/ECM Administrator

CONDITIONS:

# FINAL DRAINAGE REPORT

for  
**HAVEN VALLEY**  
Security, Colorado

## 2.0 PURPOSE

This report is prepared by Drexel, Barrell & Co in support of the Haven Valley in Security, CO. The purpose of this report is to identify onsite and offsite drainage patterns, storm sewer, inlet locations, and areas tributary to the site, and to safely route developed storm water runoff to adequate outfall facilities.

## 3.0 GENERAL SITE DESCRIPTION

### Location

Haven Valley is a 11.768 acre subdivision within the northwest quarter of Section 12, Township 15 South, Range 66 West of the 6th Principle Meridian in El Paso County, Colorado. The site is located southwest of Cable Ln and west of Hunters Run. The site is bounded on the north by Calvary Fellowship Fountain Valley church and Cable Ln, the west by Good Shepherd United Methodist church, and the south and the east by residential subdivision Pheasant Run Ranch Filing No. 1. See Vicinity Map in Appendix.

### Existing Site Conditions

The site is approximately 11.768 acres in size surrounded by existing development. There are no existing structures on the site, only native grasses, a few invasive trees and shrubs. There are no existing irrigation facilities on the project site. The project site slopes moderately from the northeast to southwest at approximately 5-7%. Existing drainage flows to the southwest where it drains overland between two houses to Pecos Drive, then south on Widefield Drive. Severe flooding has been observed between these two houses and one of the houses has experienced mold issues in the past.

### Proposed Site Conditions

Haven Valley is a small lot single-family development, consisting of approximately 98 lots, streets, landscape areas and open space. A proposed full-spectrum detention pond (Pond 1) is proposed to be constructed in an existing off-site drainage easement adjacent to the west side of the site. The flows will be released from the detention pond and be carried by pipe between the two houses and outlet via two bubblers in Widefield Drive. There is an existing drainage and utility easement located between the two houses.

### Soils

According to the Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the site is underlain by the Blakeland loamy sand (Soil No. 8). This soil is a type 'A' hydrologic soil group. This type of soil typically

exhibits rapid infiltration rates and slow runoff characteristics with moderate erosion potential. See appendix for Soil Map.

### Climate

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation ranges from 12 to 14 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

### Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel 08041C0763G (December 7, 2018), the site does not lie within a designated 100-year floodplain. The site is in Zone X, an area of minimal flood hazard. See Appendix for FIRMette map.

### Previous Drainage Studies

The site is located within the Security Drainage Basin, as studied in the Little Johnson/Security Drainage Basin Planning Study, prepared by Simons Li & Associates, Inc., 1987.

## **4.0 EXISTING CONDITIONS HYDROLOGY SUMMARY**

**Basin OS-1** is an offsite basin to the north. This basin drains the Elm Grove Subdivision (town homes, age restricted) and several commercial buildings on the east side of Main St. and the Wilson Elementary School on the west side of Main St. The runoff path begins on Main Street near the intersection of Bradley Road, then flows southerly down Main Street via curb and gutter. The runoff at this intersection is collected by a storm sewer constructed as part of the 1993 Main Street reconstruction by El Paso County. The storm drain system conveys runoff east underground via storm sewer and discharges into a valley gutter within the Elm Grove Subdivision. The valley gutter drains south to an existing detention pond (roughly 3-4' deep) where it is detained slightly. The pond discharges via a 24" CMP to the south. The 24" CMP is undersized for the 100-year which overtops the pond and drains into a swale which in turn drains south overland between two houses in the Security Colorado Addition 4, then south to the curb and gutter in Pecos Drive and Widefield Drive. The runoff generated by Basin OS1 is calculated to be 46.0 cfs and 88.8 cfs for the 5-year and 100-year storm respectively into the detention pond. After detention, the pond outflows are 18.1 cfs and 52.3 cfs respectively for the 5-year and 100-year storms.

**Basin OS-2** is an offsite basin to the north of the site. Runoff from this basin is primarily generated from roof, parking lot and vacant land. The runoff path begins on Cable Lane and generally flows southerly along the west property line until it reaches Design Point A. Design Point A collects the flow from Basin OS2 and the release from the detention pond in Basin OS1. This flow is routed southerly through a small swale that divides Basins OS3 and H1. The calculated runoff from Basin OS2 is 11.8 cfs and 21.5 cfs for the 5-year and 100-

year storm respectively.

**Design Point A.** The drainage swale previously mentioned conveys the flow from Design Point A to Design Point B. The calculated flow at Design Point A is 29.9 cfs and 73.8 cfs for the 5-year and 100-year storm respectively. This flow includes detained flow from the Elm Grove pond and from Basin OS-2 which is conveyed south in an existing swale to a historic low point just north of Security Colorado Addn. No. 4 (Des. Pt. B).

**Basin OS-3** is an offsite basin to the west of the site. Runoff from this basin is generated from roof, street, parking lot and vacant land. The runoff path flows southerly down Main Street via curb and gutter and then easterly onto Leta Drive. The flow then continues south through a parking lot until it empties onto vacant land, then travels to the southeast to Design Point B. Design Point B collects the flow from all basins; OS1, OS2, OS3 and H1 and drains them overland between two houses in the Security Colorado Addition 4, then south to the curb and gutter in Pecos Drive and Widefield Drive. Severe flooding between these houses has been observed on numerous occasions in the past. The calculated runoff from Basin OS3 is 15.6 cfs and 37.4 cfs for the 5-year and 100-year storm respectively.

**Basin H-1** is an onsite basin which drains the site plus street runoff from Alturas Drive and Cable Lane. The east half of Alturas Drive drains is not included in this basin which drains overland eastward into the Windmill Creek Subdivision per the approved drainage report by Jefferies Engineering, October 10, 2001. Runoff from the undeveloped lot west of Alturas Drive is currently collected in a swale west of the ROW and directed south into a detention pond which outlets into the FMIC superditch. Future conditions for this undeveloped lot will need to remain the same as existing since additional runoff down Alturas would severely affect downstream properties. Runoff from Alturas Drive is included in this basin per existing conditions. The runoff path for Basin H1 begins near the intersection of Alturas Drive and Bradley Road (west half), and then flows southwesterly via an asphalt curb southward and over the top of the FMIC superditch. The flow then crosses Cable Lane and generally flows southwesterly through vacant land to Design Point B. The calculated runoff for Basin H1 is 6.9 cfs and 30.4 cfs for the 5-year and 100-year storm respectively.

**Design Point B** includes flow from Design Point A, Basin OS-3, and H-1. Design Point B discharges through the Security Colorado Addition No. 4 Refile Subdivision overland between two houses, then to the curb and gutter on the north side of Pecos Drive and the east side of Widefield Drive. The total flow at Design Point B is 46.1 cfs and 129.0 cfs for the 5-year and 100-year storm respectively between the two houses. Both of these two homeowners have indicated that they have experienced severe flooding of the backyard and crawl spaces of their homes.

**Basin OS-4** is an offsite basin to the west of the site including Main Street and a portion of land west of Main Street. Runoff from this basin is generated from roof, street, and parking lot. The runoff path flows southerly down Main Street via curb and gutter to the intersection of Pecos Drive. An existing storm sewer system was constructed in 1993 as part of the 1993 Main Street reconstruction project by El Paso County. The storm system picks up street flow and discharges it to a 15' bubbler located just east of the intersection of Pecos Drive and Main Street. From the bubbler, all runoff is carried overland east to Widefield Drive (Design Pt C), then south on Widefield Drive via curb and gutter. There is no existing storm sewer

system within Pecos or Widefield Drive. None of the storm infrastructure east of this bubbler or within Widefield Dr. shown on the DBPS were ever installed. The existing bubbler was not proposed in the DBPS. The calculated runoff from Basin OS4 is 39.6 cfs and 82.3 cfs for the 5-year and 100-year storm respectively. The existing street capacity of Widefield Drive as it flows south from Pecos Drive is 7 cfs and 41 cfs for the 5-year and 100-year storm respectively. As shown, the flow from this basin alone exceeds the street capacity of Widefield Drive. Therefore, the flows from Basin OS-4 are split between the curb and gutter on each side of the street.

**Design Point C** is located at the intersection of Pecos Drive and Widefield Drive and includes flow from Design Point B and Basin OS-4. At Design Point C the existing flow with detention from the Elm Grove pond is 80.3 cfs and 200.0 cfs for the 5-year and 100-year storms respectively, which is all overland flow.

Per the ½ street section street capacity chart Figure 7-9, the existing street capacity of Widefield Drive as it flows south from Pecos Drive is approximately 7 cfs and 41 cfs for the 5-year and 100-year storm events respectively. Per the MHFD-Inlet\_v.01 spreadsheet for street capacity, the existing street capacity of Widefield Drive as it flows south from Pecos Drive is 8.9 cfs and 39.6 cfs for the 5-year and 100-year storm events respectively. As shown, the existing street capacity is severely exceeded in existing conditions which is echoed by the residents in this area experiencing chronic flooding at this intersection. This development is proposing to reduce the flooding issues in this area which will be discussed later in this report. Since street capacity is being exceeded, the flows at DP-C are split evenly on each side of the street. Therefore, the west side of the street carries 40.1 cfs and the east side of the street carries 40.1 cfs for the 5-year storm and the west side of the street carries 100.0 cfs and the east side of the street carries 100.0 cfs for the 100-year storm. Per the ½ street section street capacity chart Figure 7-9, the capacity of the existing streets is exceeded by 33.1 cfs for the 5-year storm and by 59.0 cfs for the 100-year storm. Per the MHFD-Inlet\_v.01 spreadsheet for street capacity, the capacity of the existing streets is exceeded by 31.2 cfs for the 5-year storm and by 60.4 cfs for the 100-year storm. These existing excess flows are currently being conveyed via the street and adjacent sidewalks and front yards.

## **5.0 PROPOSED HYDROLOGY (RATIONAL METHOD) & HYDRAULIC SUMMARY**

The Rational Method was used to determine runoff quantities for the 5- and 100-year storm recurrence intervals. Urban Drainage UD-Detention and Flowmaster were used to determine pond (Pond 1) and storm system sizing. UD-Inlet and UD-Sewer were also used to identify pond and storm system sizing (see appendix for calculations). See below for a summary runoff table of the basins and for descriptions of each design point. See appendix for Proposed Drainage Map showing the proposed drainage basin locations.

### Rational Method Runoff Summary

BASIN	AREA (AC)	Q5 (cfs)	Q100 (cfs)
A	0.44	0.5	1.5
OS-1	16.90	46.0	88.8
OS-2	2.85	11.8	21.5
B	1.42	3.2	6.6
C	3.43	6.4	14.0
D	0.98	1.2	3.5
E	3.09	6.4	14.0
F	0.69	1.4	3.1
G	1.61	2.8	6.2
OS-3	9.74	15.6	37.4
H	0.84	1.0	2.9
OS-4	20.04	39.6	82.3
OS-5	0.15	0.3	0.7
OS-6	0.41	0.9	2.0
I	0.69	0.6	2.2

**North Swale** carries the flows from Basin A, 1.5 cfs, and Basin OS-2, 21.5 cfs, for a total of 23 cfs to the proposed private area inlet at DP-1. The velocity within this swale is greater than allowable per DCM 6.5.2, therefore the swale will need to be lined. See Appendix for swale calculations.

**Design Point 1 (DP-1)** represents flows generated from existing Elm Grove pond release in offsite basin OS-1, as well as flows from offsite basin OS-2 and onsite Basin A. The flows are conveyed via a swale and are then captured by a proposed private Double Type D area inlet. The flows leave this inlet via a proposed private 36" RCP storm pipe and are conveyed to the proposed Extended Detention Basin to the south. The total flow at DP-1 is 28.1 cfs and 71.0 cfs for the 5-year and 100-year storm respectively. The Double Type D area inlet can capture all of the DP-1 flows.

**Design Point 2 (DP-2)** represents flows generated from onsite Basin B. The flows are captured by a proposed private at-grade 5' Type R inlet in Basin B. The flows leave this inlet via a proposed private 18" RCP storm pipe and are carried south to DP-J1. The total flow at DP-2 is 3.2 cfs and 6.6 cfs for the 5-year and 100-year storm respectively.

**Design Point 3 (DP-3)** represents flows generated from Basin C. The flows are captured by a proposed private at-grade 15' Type R inlet in Basin C. The flows leave this inlet via a proposed private 24" RCP storm pipe and are carried west to DP-J1. The total flow at DP-3 is 6.4 cfs and 14.0 cfs for the 5-year and 100-year storm respectively.

**Design Point J1 (DP-J1)** represents flows generated from Basins B and C. This design point is located at a proposed junction with a Type II manhole in Basin C. The flows leave this



manhole via a proposed private 24" RCP storm pipe and are carried south to DP-J2. The total flow at DP-J1 is 9.5 cfs and 20.3 cfs for the 5-year and 100-year storm respectively.

**East Swale** carries the flows from Basin D, 3.5 cfs, to the proposed private area inlet at DP-4. The Froude number within this swale is greater than allowable per DCM 6.5.2, therefore the swale will need to be grass-lined. See Appendix for swale calculations.

**Design Point 4 (DP-4)** represents flows generated from Basin D. The flows are conveyed via a swale and are then captured by a proposed private sump condition Type C area inlet in Basin D. The flows leave this inlet via a proposed private 18" RCP storm pipe and are carried west to DP-J2. The total flow at DP-4 is 1.2 cfs and 3.5 cfs for the 5-year and 100-year storm respectively.

**Design Point 5 (DP-5)** represents flows generated from Basin E, which includes a portion of Cable Ln as shown on the proposed drainage map in the Appendix. This design point represents the flows at the intersection of New Haven Point and Hawk Haven View. The street capacity is sufficient at this point for these flows as can be seen in the street capacity charts included in the Appendix. These flows continue to the west where they are captured by the proposed inlet at DP-6. The total flow at DP-5 is 6.4 cfs and 14.0 cfs for the 5-year and 100-year storm respectively. Cable Lane is an existing public two-lane paved roadway. As part of this project, the roadway will be widened and curb and gutter added. Basin E will collect runoff from a portion the existing and proposed Cable Lane. The remainder of the roadway drainage will follow historic patterns.

**Design Point J2 (DP-J2)** represents flows generated from Basins B, C and D. This design point is located at a proposed junction with a Type II manhole in Basin E. The flows leave this manhole via a proposed private 30" RCP storm pipe and are carried west to DP-J3. The total flow at DP-J2 is 10.6 cfs and 23.4 cfs for the 5-year and 100-year storm respectively.

**Design Point 6 (DP-6)** represents flows generated from Basin F. The flows are captured by a proposed private at-grade 15' Type R inlet in Basin F. The flows leave this inlet via a proposed private 24" RCP storm pipe and are carried south to DP-J3. The total flow at DP-6 is 7.7 cfs and 17.0 cfs for the 5-year and 100-year storm respectively.

**Design Point J3 (DP-J3)** represents flows generated from Basins B, C, D, E and F. This design point is located at a proposed junction with a Type II manhole in Basin G. The flows leave this manhole via a proposed private 30" RCP storm pipe and are carried west to DP-J4. The total flow at DP-J3 is 17.4 cfs and 38.4 cfs for the 5-year and 100-year storm respectively.

**Design Point 7 (DP-7)** represents flows generated from Basin G. The flows are captured by a proposed private sump 5' Type R inlet in Basin G. The flows leave this inlet via a proposed private 18" RCP storm pipe and are carried north to DP-J4. The total flow at DP-7 is 2.8 cfs and 6.2 cfs for the 5-year and 100-year storm respectively.

**Design Point J4 (DP-J4)** represents flows generated from Basins B, C, D, E, F and G. This design point is located at a proposed junction with a Type II manhole in Basin G. The flows leave this manhole via a proposed private 30" RCP storm pipe and are carried west

to the proposed private full-spectrum Extended Detention Basin. The total flow at DP-J4 is 20.0 cfs and 44.1 cfs for the 5-year and 100-year storm respectively.

**Design Point 8 (DP-8)** represents flows generated from Basin H only. The flows from the existing Elm Grove pond release are captured by the proposed private area inlet in Basin A at DP-1. See DP-1 discussion above. The flows from Basin H are captured by a proposed east swale and are carried to the proposed Extended Detention Basin. The total flow at DP-8 is 1.0 cfs and 2.9 cfs for the 5-year and 100-year storm respectively.

**Design Point P1 (DP-P1)** represents all of the flows generated from Basins OS-1, Exist. Elm Pond release and Basins A through G. These are all of the flows that are captured by the proposed Extended Detention Basin. Further detail is provided on the EDB (Pond 1) in the following section of this report. The total flows at DP-P1 is 63.9 cfs and 153.8 cfs for the 5-year and 100-year storm respectively.

**South Swale** carries the flows from Basin I, 2.2 cfs, Basin OS-5, 0.7 cfs, and Basin OS-6, 2.0 cfs, for a total of 5.0 cfs to the proposed private area inlet at DP-9. The Froude number within this swale is greater than allowable per DCM 6.5.2, therefore the swale will need to be lined. See Appendix for swale calculations.

**Design Point 9 (DP-9)** represents flows generated from Basin I, OS-5 and OS-6 combined with the released flows from the proposed EDB (Pond 1). The flows are conveyed via a swale and are then captured by a proposed private sump condition Type C area inlet in Basin I. The flows leave this inlet via a proposed public 24" RCP storm pipe and are carried south to DP-J5. This pipe system is identified as a public reimbursable facility in the DBPS. By piping these flows between the two houses, flooding for these two existing residences will be eliminated in this area. In the event of a storm event that overtops the EDB spillway, a concrete channel is proposed between the two existing residences to help prevent flooding. The concrete channel is to be 2.5' high x 6.5' wide and is directly over the 24" RCP pipe below. The total flow at DP-9 is 2.9 cfs and 27.7 cfs for the 5-year and 100-year storm respectively. The flow depth in the concrete channel is 1.3', as shown in the calculations in the Appendix, and therefore the flows will be contained by the 2.5' high concrete walls and channel. Basin I is not being captured for water quality control, however it is under 1 acre, which is acceptable per ECM Appendix I.7.1.C.1. Basins OS-5 and OS-6 will also not be captured in the EDB. It is not necessary for these flows to be treated because they are offsite basins that will not mix with runoff that needs to be treated.

**Design Point O4 (DP-O4)** represents flows generated from Basin OS-4. A proposed public at-grade 15' Type R inlet is to be installed on existing Pecos Dr/Widefield Dr. knuckle. This inlet will not be able to capture all of the flows generated from the existing basin but will capture some of the street flows and relieve some of the flooding experienced by the residents in this area. The total flow at DP-O4 is 39.6 cfs and 82.3 cfs for the 5-year and 100-year storms respectively. These flows are split evenly on each side of the street due to the existing street capacity of Pecos Dr. and Widefield Dr. being exceeded, so the flows on the north side of Pecos Dr. approaching the proposed inlet are 19.8 cfs and 41.1 cfs for the 5-year and 100-year storm respectively. The proposed 15' Type R inlet can capture approximately 7 cfs of the 5-yr storm flows and 20 cfs of the 100-yr storm flows. The remaining approximate 12.8 cfs for the 5-yr and 21.1 cfs for the 100-yr will continue to

the south along the east curb and gutter of Widefield Drive along historic drainage routes as outlined in the DBPS.

Per the ½ street section street capacity chart Figure 7-9, the street capacity of Pecos Dr. and Widefield Dr. is 7 cfs for the 5-year storm and 41 cfs for the 100-yr storm. Therefore, the street capacity will be exceeded by 5.8 cfs for the 5-yr storm (down from 33.1 cfs at DP-C in the existing condition) and will not be exceeded at all in the 100-yr condition. See street capacity charts in the Appendix.

Per the MHFD-Inlet\_v.01 spreadsheet for street capacity, the capacity of Pecos Dr. and Widefield Dr. is 8.9 cfs for the 5-year storm and 39.6 cfs for the 100-yr storm. Therefore, the street capacity will be exceeded by 3.9 cfs for the 5-year storm (down from 33.1 cfs at DP-C in the existing condition) and will not be exceeded at all in the 100-yr condition. See spreadsheet with capacity calculations in the Appendix.

The depth of gutter flow for the existing conditions, 100 cfs, is 0.93' and for the proposed conditions, 21.1 cfs, is 0.45'. See flow depth calculations in the Appendix.

**Design Point J5 (DP-J5)** represents flows generated from Basins I, OS-4 (captured by the proposed inlet), OS-5, OS-6 and the flows released from the proposed EDB (Pond 1). This design point is located at a proposed junction with a Type I manhole in Basin OS-4. The total flow at DP-J5 is 9.9 cfs and 47.7 cfs for the 5-year and 100-year storm respectively. The flows leave this manhole via a proposed public 36" RCP storm pipe (or equivalent elliptical pipe - this pipe system was also identified in the DBPS as public and reimbursable) and are carried south where they will outlet via two proposed 15' Type R inlets to be used as bubblers in Widefield Drive and continue to the south along historic drainage routes as outlined in the DBPS. The bubbler inlet will serve to release the developed upstream flows into Widefield Drive as street flow at the end of the storm sewer system. The inlet will fill and overtop/exit the inlet throat into the street. A small pipe will be provided at the bottom of the inlet to release nuisance flows and allow the inlet to drain after filling. This pipe will daylight downstream and release flows to the curb and gutter in Widefield Dr. The small pipes to drain the bubbler inlets is planned to be designed similar to a grease interceptor to avoid clogging issues experienced by the county on other similar facilities. Design detail will be provided with the construction documents.

**Design Point 10 (DP-10)** is located at the bubbler outfall pipes. It represents the flows from the bubblers themselves, the flows released through the 4" PVC bubbler outfall pipes, and the flows in the curb and gutter that previously bypassed DP-O4. The flows that bypass the inlet at DP-O4 and flow south along the east curb and gutter of Widefield Dr. are approximately 12.8 cfs for the 5-year storm and 21.1 cfs for the 100-yr storm. The flows being conveyed via the 36" RCP storm pipe exiting the manhole at DP-J5 is 9.9 cfs for the 5-yr storm (DP-9 flows are 2.9 cfs plus the 7 cfs captured by the inlet at DP-O4 equals 9.9 cfs) and 47.7 cfs for the 100-yr storm (DP-9 flows are 27.7 cfs plus the 20 cfs captured by the inlet at DP-O4 equals 47.7 cfs). See Rational Method calculations for each basin and design point in the Appendix. Therefore, the combined flows just past the bubblers are 22.7 cfs for the 5-yr storm and 68.8 cfs for the 100-yr storm. The existing flows at this point are 40.1 cfs for the 5-yr storm and 100.0 cfs for the 100-yr storm. Therefore, the development of Haven Valley will not increase but decrease the flows and flooding issues

in the area and downstream on Widefield Drive due to the proposed detention facility which has been sized to not just handle the development of Haven Valley, but all surrounding areas that had no detention required of them in the DBPS. None of the storm infrastructure along Pecos Dr. or Widefield Dr. shown on the DBPS was ever installed. The existing street capacities are exceeded and the homes along Widefield Dr. currently experience flooding. See previous discussion in Existing Conditions DP-C. Since the proposed flows will be less than the existing flows, no new flooding issues will be created, but instead alleviated to the same extent. Also, since the proposed flows are being decreased from the existing flows, there will be no negative impact from our proposed development to the outfall of the existing County pond (in Pheasant Run Ranch Filing No. 1) south of the proposed bubblers. For the 100-yr storm the depth of flow for the existing condition, 100 cfs, is 0.93' at the curb flowline. The depth of flow for the proposed condition, 68.8 cfs, is 0.84'. This depth has a spread of 23' from the centerline of Widefield Dr. to the east, which is within the 60' ROW (30' on each side). While both existing and proposed conditions exceed street capacity (See street capacity discussion under DP-O4), the proposed conditions are an improvement from the existing conditions. See Depth of Flow calculations in the Appendix.

None of the proposed on-site streets exceed capacity, see Appendix for Street Capacity Charts. See also inlet capacity charts for inlet sizing in the Appendix.

A portion of Cable Ln. will be reconstructed and its drainage patterns shall remain the same as existing. The runoff from much of Cable Lane adjacent to the Haven Valley site (with the exception of flows captured by Basins B, C & E) will not be captured by the project's detention facility. This roadway redevelopment falls under the exclusions listed in the ECM I.7.1.B.2 & 3. The total added paved area will be 0.10 acres, which is under the 1 acre of added paved area per 1 mile of roadway. The average width of the existing paved roadway is 22'+, the proposed mat width is 30', which is also less than the 8.25' added width requirement. The roadway width is also not being increased by 2 times or more of the original roadway.

## **6.0 PROPOSED DETENTION/WATER QUALITY FACILITIES**

The proposed private full spectrum Extended Detention Basin (EDB) is located southwest of the project site within a 1.29 acre drainage easement. This detention pond (Pond 1) will fulfill on-site detention needs as well as providing detention for upstream properties, since there is a lack of detention facilities upstream which has caused chronic flooding issues between the two residences that the flows currently pass between on their way to Widefield Dr. The 1.29 acre easement is proposed to be a private drainage/detention easement and Pond 1 to be maintained by Homeowners Association. The Security DBPS does not address the need for a pond in this area, rather it shows roughly 188 cfs (100-year storm) passing between the two houses with only a 24" storm sewer and no swale to convey the flow. The developed peak 100-year flow calculated in this report is 152.1 cfs at this location. The difference in flow is attributed to the DBPS bypassing Elm Grove Pond. The proposal shown in the DBPS does not work and will flood the two residences. Even though the DBPS does not adequately address flooding issues in this area, we are proposing to construct a facility nearly three times the size of a facility necessary to detain runoff from our project site alone.

The proposed detention facility has been designed to capture flows from Basins OS-1, OS-2, OS-3, OS-4 and Basins A through H. A total of 41.99 acres is tributary to this EDB (Pond 1) with a composite imperviousness of 57.8%. The required pond volume for 100-year detention is 4.464 acre-feet. The actual pond volume will be 4.268 acre-feet. Concrete forebays with energy dissipaters will be placed where the flows enter Pond 1 on the west, northeast and the east sides of the pond. The combined volume of the three forebays will be 3% of the WQCV volume for the pond and will be divided proportionally. The flows will exit the forebays through a notch and into the concrete trickle channel at the bottom of Pond 1 that conveys the flows to the micropool. It will capture then release the flows at a reduced flow rate with the use of a plate with orifice holes into a proposed 24" pipe with a restrictor plate. This pipe connects to an area inlet, then a 24" pipe continues to the south, between the two existing residences, and outfalls into two bubblers in Widefield Dr. where they continue in historic patterns to the south.

Test borings of the site were taken as part of the Geotech report by CTL Thompson. These borings show that at worse case, the groundwater elevation is approximately 5 feet below the bottom of the pond, therefore the pond does not need to be lined. See test borings included in the Appendix.

In accordance with El Paso County criteria, the modified Type C outlet structure with a permanent micropool will release the WQCV over a 40-hour period. The outlet structure will result in release rates of 1.0 cfs and 22.7 cfs for the 5-year and 100-year storm respectively.

A 46-ft wide riprap emergency spillway will be located on the south side of Pond 1. In the event that water overtops the spillway, flow will discharge into a 2.5' high x 6.5' wide concrete channel between the two residences before discharging into Widefield Dr. curb and gutter and continuing to the south. A 2.5' high concrete wall will be installed on the west end of the spillway down to the concrete channel to guide the flows as well as to the east of the concrete channel to guide the flows and prevent flows from entering existing residential properties adjacent to the spillway and concrete channel. A concrete pan will be installed between the end of the channel and the back of the existing sidewalk. Final design and details of these items will be provided with the construction documents on sheet SD03. In order to design the concrete channel conservatively, the flows from existing DP-B were used, which is 129.0 cfs. The depth of this flow would be 1.3', as can be seen in the calculations included in the Appendix.

Pond 1 calculations are provided in the appendix as well as forebay volumes, micropool sizing, outlet structure design, discharge pipe and spillway design.

Pond 1 will have a 12' wide maintenance road that will provide access to the pond bottom. The maintenance road can be accessed at the west end of New Haven Point. It then ramps down at 12% to the bottom of the pond and around its perimeter. Private maintenance agreements and O&M manuals will be established for Pond 1 as required by the County.

## 7.0 FOUR-STEP PROCESS

This project conforms to the City of Colorado Springs/El Paso County Four Step Process. The process focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls.

1. **Employ Runoff Reduction Practices:** Proposed impervious areas on this site (roofs, asphalt/sidewalk) will sheet flow across landscaped ground as much as possible to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets and storm sewer system. This will minimize directly connected impervious areas within the project site.
2. **Implement BMP's that provide a Water Quality Capture Volume with slow release:** Runoff from this project will be treated through capture and slow release of the WQCV in a permanent Extended Detention Basin facility designed per current City of Colorado Springs/El Paso County drainage criteria.
3. **Stabilize Drainage Ways:** Flows from Pond 1 are released into Widefield Dr. curb and gutter and no stabilization will be necessary.
4. **Implement Site Specific and Other Source Control BMP's:** The site is proposed as a residential development, and as such standard household source control will be utilized in order to minimize potential pollutants entering the storm system. Example source control measures consist of: garages for storage of household chemicals, trash receptacles for individual households and in common areas for pet waste. The need for Industrial and Commercial BMP's was considered, however per ECM 1.7.2.A the need for industrial and commercial BMP's are not applicable for this project.

## 8.0 GEOTECHNICAL HAZARDS

In accordance with geotechnical recommendations, the project design is intended to direct runoff away from structures at a minimum slope of six inches over ten feet, and into the receiving water quality basin. This will be accomplished by a variety of means, i.e. curb and gutter and storm sewer.

## 9.0 DRAINAGE & BRIDGE FEES

### 2023 Drainage and Bridge Fees

The project lies within the Security Drainage Basin and is previously un-platted. The following fees are required at time of plat recordation:

Impervious area = 11.768 acres x 58.1% = 6.84 acres

### **Drainage Fees**

\$24,832 x 6.84 Impervious Acres = \$169,850.88

## Bridge Fees

None

Drainage fees are requested to be deferred. The total reimbursable costs (see Section 10.0 below) are \$256,704. This exceeds the drainage fees by \$86,853. Therefore the amount being requested to be deferred is \$169,851.

Reimbursement for construction of some of the drainage facilities exceeding the drainage fees due for Haven Valley and the storm sewer outfall in accordance with DCM Section 3.3, is anticipated as identified by the Little Johnson/Security Drainage Basin Planning Study. See Appendix for excerpts from DBPS showing the cost and location for the reimbursable facilities. Construction costs are listed below and the drainage fee is requested to be adjusted accordingly.

## 10.0 CONSTRUCTION COST ESTIMATE

Private (Non-Reimbursable)

<u>Description</u>	<u>Quantity</u>	<u>Unit Cost</u>	<u>Cost</u>
Type C Area Inlet	2 EA	\$4,800/EA	\$9,600
Double Type D Area Inlet	1 EA	\$11,800/EA	\$11,800
5' Type R Inlet	2 EA	\$5,700/EA	\$11,400
15' Type R Inlet	2 EA	\$11,995/EA	\$23,990
Type I Manhole	1 EA	\$7,000/EA	\$7,000
Type II Manhole	5 EA	\$5,000/EA	\$25,000
18" RCP storm	930 LF	\$67/LF	\$62,310
24" RCP storm	49 LF	\$91/LF	\$4,459
30" RCP storm	152 LF	\$114/LF	\$17,328
36" RCP storm	391 LF	\$140/LF	\$54,740
Extended Detention Basin	0.5 EA	\$250,000/EA	\$125,000
		Subtotal	\$352,627
		Engineering & Contingency (10%)	<u>\$35,263</u>
		TOTAL	\$387,890

Public (Reimbursable) – Facilities identified in the DBPS

<b>Description</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Cost</b>
15' Type R Inlet	3 EA	\$12,907/EA	\$38,721
Type I Manhole	2 EA	\$15,130/EA	\$30,260
24" RCP storm	40 LF	\$98/LF	\$3,920
30" RCP storm	15 LF	\$123/LF	\$1,845
36" RCP storm	335 LF	\$151/LF	\$50,585
Demo asphalt	670 SY	\$16/SY	\$10,720
Demo concrete sidewalk/ driveway	305 SY	\$35/SY	\$10,675
Demo curb & gutter	669 LF	\$19/LF	\$12,711
Aggregate Base Course (6")	112 CY	\$66/CY	\$7,392
Replace asphalt	140 TONS	\$200/TON	\$28,000
Replace concrete sidewalk/ driveway	305 SY	\$103/SY	\$31,415
Replace curb & gutter (hand set)	669 LF	\$50/LF	\$33,450
Sanitary service relocate/splice	7 EA	\$1500/EA	\$10,500
Water service relocate/replace	6 EA	\$1500/EA	\$9,000
Gas service relocate	7 EA	\$1000/EA	\$7,000
Landscape restoration	1 LS	\$50,000	\$50,000
		Subtotal	\$336,194
		Engineering & Contingency (10%)	<u>\$33,619</u>
		TOTAL	\$340,261

Private (Reimbursable) – per ECM Appendix L (see below)

<b>Description</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Cost</b>
*24" RCP storm	167 LF	\$98/LF	\$16,366
**Extended Detention Basin	0.5 EA	\$250,000/EA	\$125,000
		Subtotal	\$141,366
		Engineering & Contingency (10%)	<u>\$14,137</u>
		TOTAL	\$155,503

\*This pipe is identified in the DBPS as being reimbursable.

\*\*Per ECM Appendix L 3.10.4a, the proposed detention facility qualifies for a 50% reimbursement. The following requirements for the reimbursement have been met:

1. Allowed only where regional system is not yet in place. (The DBPS infrastructure along Widefield Dr. is not in place)
2. The pond is less than 15 acre-feet in volume from the lowest outlet structure to the crest of the emergency spillway. (The proposed pond volume is 4.54 ac-ft)
3. The on-site pond is not part of the regional plan. (It's not)
4. The outlet of the pond must be designed to release at historical levels for all precipitation events from the 2-year storm to the 100-year storm. A smaller outlet may be required by the County if adequate downstream channel improvements are not in place to protect residents from the 2-year storm flows. (Even better, the



proposed pond is designed to release at LESS than historical levels for all storm events)

5. County approved design and construction. (Pond design plans have been submitted to the County for approval, no construction will take place without this approval)
6. Landowners assume responsibility for maintenance. (The detention facility is to be maintained by the Haven Valley Metropolitan District)

## **11.0 CONCLUSIONS**

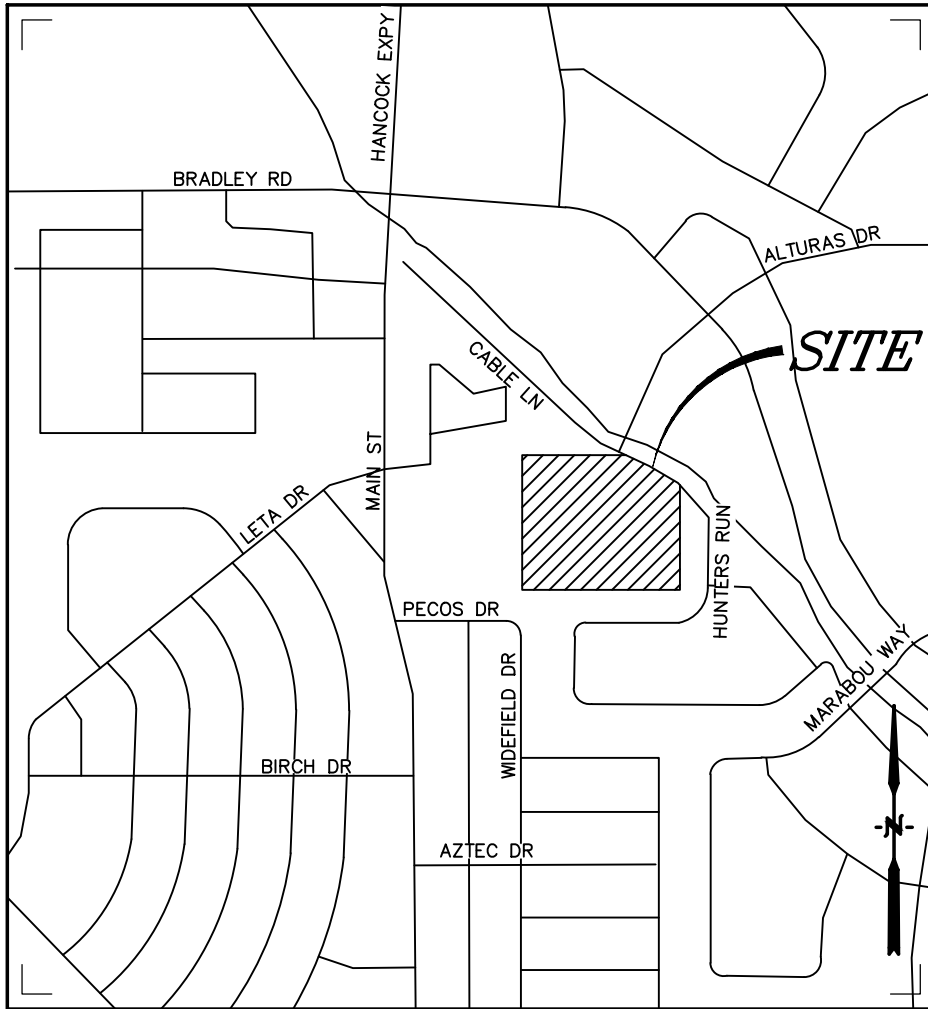
The Haven Valley project has been designed in accordance with El Paso County criteria. The detention pond and water quality basin (Pond 1) have been designed to limit the release of storm runoff to less than historic flows. This development will not negatively impact the downstream facilities. This development will improve the downstream conditions by lessening the flows where there are currently flooding issues.

## **12.0 REFERENCES**

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

1. City of Colorado Springs/El Paso County Drainage Criteria Manual, May 2014.
2. Urban Storm Drainage Criteria Manuals, Urban Drainage and Flood Control District. June 2001, Revised April 2008.
3. Preliminary & Final Drainage Report for Patriot Village. Prepared by Core Engineering Group, LLC, December 2013.
4. Natural Resources Conservation Service (NRCS) Web Soil Survey
5. Federal Emergency Management Agency, Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Map Number 08041C0763G, Effective Date December 7, 2018
6. EL Paso County Board Resolution No 15-042: El Paso County adoption of Chapter 6 and Section 3.2.1, Chapter 13 of the City of Colorado Springs Drainage Criteria Manual, May 2014.
7. Little Johnson/Security Drainage Basin Planning Study. Prepared by Simons Li & Associates, Inc., 1988.
8. Soil Investigation Report for Patriot Village. Prepared by Colorado Engineering & Geotechnical Group, Inc., November 15, 2004.

## APPENDIX



*Vicinity Map*  
Not to scale



**HAVEN HILLS  
COLORADO SPRINGS, CO  
VICINITY MAP**

**Drexel, Barrell & Co.**  
Engineers • Surveyors

DATE:

DWG. NO.

JOB NO:

**21085-03CSCV**

**VMAP**

SHEET 1 OF 1

Hydrologic Soil Group—El Paso County Area, Colorado



Soil Map may not be valid at this scale.

Map Scale: 1:1,860 if printed on A landscape (11" x 8.5") sheet.




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



### MAP LEGEND

**Area of Interest (AOI)**









 Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**





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

**Soil Rating Lines**

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

**Soil Rating Points**




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

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


**Water Features**

 Streams and Canals

**Transportation**

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

**Background**

 Aerial Photography

### MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado  
 Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	12.7	100.0%
<b>Totals for Area of Interest</b>			<b>12.7</b>	<b>100.0%</b>

### Description

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

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

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

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

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

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

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

### Rating Options

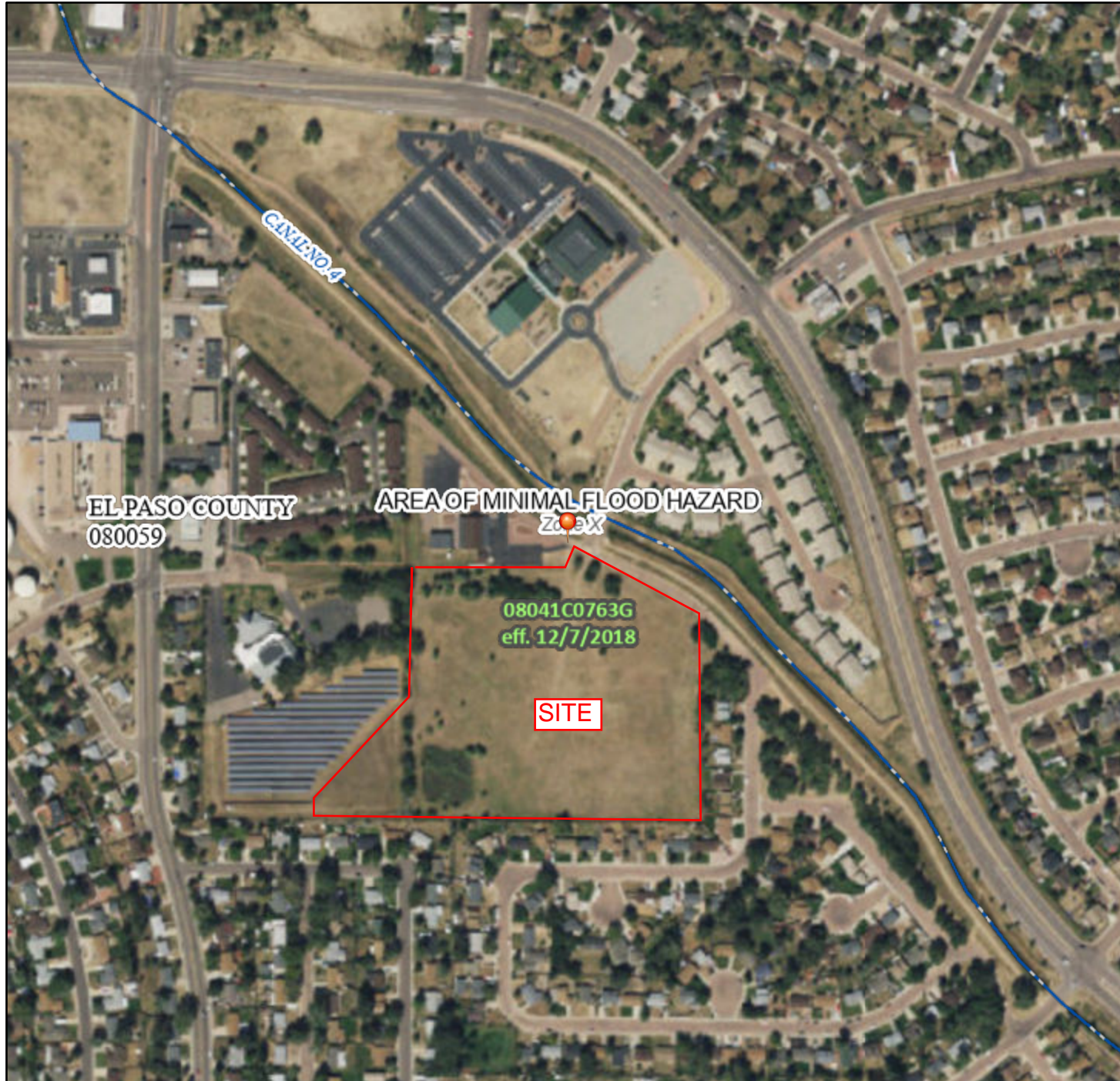
*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

# National Flood Hazard Layer FIRMette



104°44'26"W 38°46'14"N



104°43'49"W 38°45'46"N

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

## Legend

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

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



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

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

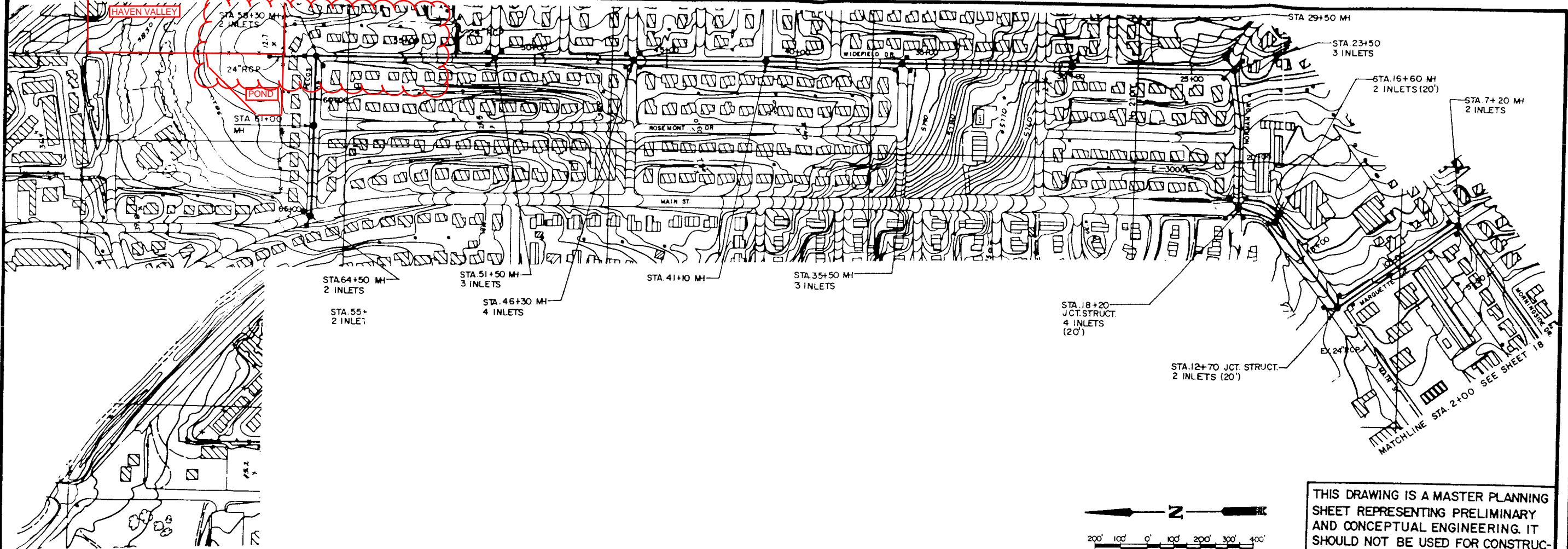
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **4/8/2021 at 1:19 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

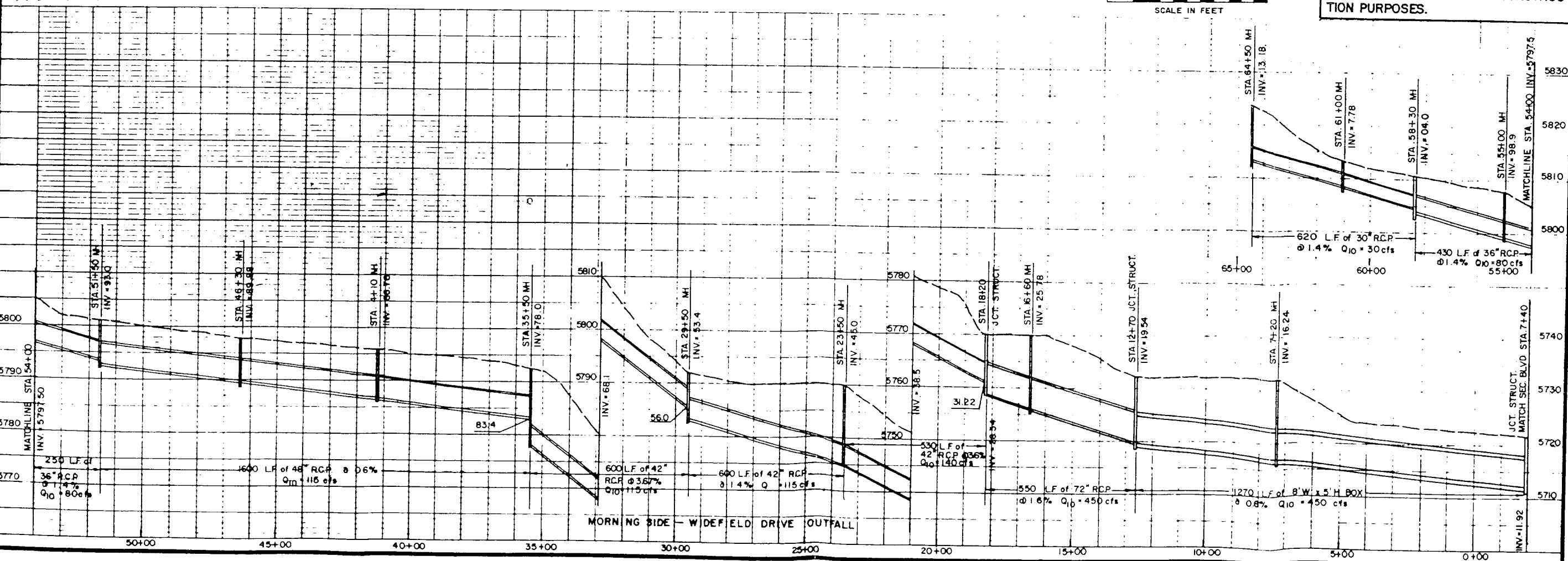
Table 7. Preliminary Cost Estimates: Security Basin-Storm Sewer System.

Item Description	Unit	Estimated Unit Price (\$)	Total System Cost	
			Quantity	Item Cost (\$)
<b>REINFORCED CONCRETE PIPE</b>				
→ 24-inch	LF	50	570	28,500
30-inch	LF	60	1,490	89,400
→ 36-inch	LF	85	2,260	192,100
42-inch	LF	95	1,730	164,350
48-inch	LF	110	4,580	503,800
54-inch	LF	135	0	0
60-inch	LF	155	1,290	199,950
72-inch	LF	205	1,490	305,450
144-inch CSP (Tunnel)	LF	1,000	200	200,000
<b>CONCRETE BOX CULVERT</b>				
5 ft. x 6 ft.	LF	300	0	0
5 ft. x 8 ft.	LF	325	1,680	546,000
8 ft. x 12 ft.	LF	700	900	630,000
<b>CURB INLETS</b>				
→ 10 ft.	EA	3,000	77	231,000
<b>MANHOLES</b>				
5 ft. diameter	EA	2,500	16	40,000
6 ft. diameter	EA	3,500	25	87,500
Box Base (Junction Structure)	EA	4,500	6	27,000
Inlet Structure	EA	10,000	1	10,000
Outlet Structure	EA	10,000	4	40,000
REMOVE AND RELOCATE EXISTING UTILITIES	LS			<u>380,000</u>
Subtotal				\$3,675,050
Plus Contingency (5% of Construction Cost)				183,752
Plus Engineering (10% of Construction Cost & Contingency)				<u>385,880</u>
<b>TOTAL ESTIMATED CONSTRUCTION COST</b>				<b>\$4,244,682</b>





THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.



**SIB** Simons, Li & Associates, Inc.  
 410 West 8th St., Colorado Springs, Colorado 80907 Phone 303-539-7742

LITTLE JOHNSON / SECURITY CREEK  
 DRAINAGE BASIN PLANNING STUDY  
 PRELIMINARY DESIGN  
 PLAN & PROFILE: MORNINGSIDE - WIDEFIELD DRIVE OUTFALL

Project No.	PCOEPC-01
Date:	10/87
Design:	TCF
Drawn:	EAK
Checked:	TCF
Revisions:	

# PROJECT INFORMATION

PROJECT: Haven Valley  
 PROJECT NO: 21085-03  
 DESIGN BY: SBN  
 REV. BY: TDM  
 AGENCY: El Paso County  
 REPORT TYPE: Final  
 DATE: 2/3/2022



Drexel, Barrell & Co.

Soil Type: A	C2*	C5*	C10*	C100*	% IMPERV
Pasture/Meadow		0.08		0.35	0
Commercial		0.81		0.88	95
1/8 Acre Residential		0.45		0.59	65
Asphalt/Sidewalk		0.90		0.96	100

\*C-Values and Basin Imperviousness based on Table 6-6, El Paso County "Drainage Criteria Manual"

## EXISTING

SUB-BASIN	SURFACE DESIGNATION	AREA ACRE	COMPOSITE RUNOFF COEFFICIENTS				% IMPERV
			C2	C5	C10	C100	
OS-1	Pasture/Meadow	0.00		0.08		0.35	0
	Commercial	8.10		0.81		0.88	95
	1/8 Acre Residential	7.20		0.45		0.59	65
	Asphalt/Sidewalk	1.60		0.90		0.96	100
	WEIGHTED AVERAGE			0.67		0.76	83%
<b>TOTAL OS-1</b>		16.90					
OS-2	Pasture/Meadow	0.00		0.08		0.35	0
	Commercial	2.85		0.81		0.88	95
	1/8 Acre Residential	0.00		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.81		0.88	95%
<b>TOTAL OS-2</b>		2.85					
OS-3	Pasture/Meadow	4.93		0.08		0.35	0
	Commercial	4.05		0.81		0.88	95
	1/8 Acre Residential	0.76		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.41		0.59	45%
<b>TOTAL OS-3</b>		9.74					
OS-4	Pasture/Meadow	0.00		0.08		0.35	0
	Commercial	4.20		0.81		0.88	95
	1/8 Acre Residential	15.84		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.53		0.65	71%
<b>TOTAL OS-4</b>		20.04					
H-1	Pasture/Meadow	12.03		0.08		0.35	0
	Commercial	0.00		0.81		0.88	95
	1/8 Acre Residential	0.39		0.45		0.59	65
	Asphalt/Sidewalk	1.02		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.40	9%
<b>TOTAL H-1</b>		13.44					
<b>TOTAL SITE</b>		<b>62.97</b>		<b>0.48</b>		<b>0.63</b>	<b>58.1%</b>

**PROJECT INFORMATION**

PROJECT: Haven Valley  
 PROJECT NO: 21085-03  
 DESIGN BY: SBN  
 REV. BY: TDM  
 AGENCY: El Paso County  
 REPORT TYPE: Final  
 DATE: 2/3/2022



**RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF**

EXISTING TIME OF CONCENTRATION STANDARD FORM SF-2

SUB-BASIN DATA					INITIAL/OVERLAND TIME (t <sub>i</sub> )				TRAVEL TIME (t <sub>t</sub> )					TIME OF CONC. t <sub>c</sub>		FINAL t <sub>c</sub>
BASIN	DESIGN PT.	C <sub>s</sub>	C <sub>100</sub>	AREA	LENGTH	HT	SLOPE	t <sub>i</sub>	LENGTH	HT	SLOPE	VEL.	t <sub>t</sub>	COMP.	MINIMUM	
				Ac	Ft	FT	%	Min	Ft	FT	%	FPS	Min	t <sub>c</sub>	t <sub>c</sub>	Min
OS-1		0.67	0.76	16.90	100	2	2.0	6.5	1600	26	1.6	7.4	3.6	10.1	5	<b>10.1</b>
OS-2		0.81	0.88	2.85	100	2	2.0	4.3	400	13	3.3	10.6	0.6	4.9	5	<b>5.0</b>
	A	0.69	0.78	19.75										10.1	5	<b>10.1</b>
OS-3		0.41	0.59	9.74	100	2.5	2.5	9.5	1200	34	2.8	9.8	2.0	11.5	5	<b>11.5</b>
H-1		0.15	0.40	13.44	100	2	2.0	14.1	1600	73	4.6	12.5	2.1	16.2	5	<b>16.2</b>
	B	0.32	0.52	26.03					700	20	2.9	5.28	2.2	16.2	5	<b>16.2</b>
OS-4		0.53	0.65	20.04	100	2	2.0	8.5	2000	41	2.1	8.48	3.9	12.5	5	<b>12.5</b>
	C	0.41	0.58	46.07					100	1	1	3.10	0.5	16.7	5	<b>16.7</b>



Drexel, Barrell & Co.

## PROJECT INFORMATION

PROJECT: Haven Valley  
 PROJECT NO: 21085-03  
 DESIGN BY: SBN  
 REV. BY: TDM  
 AGENCY: El Paso County  
 REPORT TYPE: Final  
 DATE: 2/3/2022

## RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

EXISTING                      RUNOFF                      5 YR STORM                      P1=                      **1.50**

BASIN (S)	DESIGN POINT	AREA (AC)	DIRECT RUNOFF		C * A	I (IN/HR)	Q (CFS)
			RUNOFF COEFF	t <sub>c</sub> (MIN)			
OS-1		16.90	0.67	10.1	11.24	4.09	46.0
Exist. Elm Grove Pond Release							18.1
OS-2		2.85	0.81	5.0	2.31	5.10	11.8
	A						29.9
OS-3		9.74	0.41	11.5	4.02	3.88	15.6
H-1		13.44	0.15	16.2	2.06	3.34	6.9
	B	26.03	0.32	16.2	8.38	3.34	46.1
OS-4		20.04	0.53	12.5	10.53	3.76	39.6
	C	46.07	0.41	16.7	18.91	3.29	80.3

**PROJECT INFORMATION**

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Drexel, Barrell & Co.

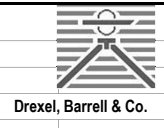
**RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF**

EXISTING                      RUNOFF                      100 YR STORM                      P1=                      **2.52**

BASIN (S)	DESIGN POINT	AREA (AC)	DIRECT RUNOFF		C * A	I (IN/HR)	Q (CFS)
			RUNOFF COEFF	t <sub>c</sub> (MIN)			
OS-1		16.90	0.76	10.1	12.91	6.88	88.8
Exist. Elm Grove Pond Release							52.3
OS-2		2.85	0.88	5.0	2.51	8.58	21.5
	A						73.8
OS-3		9.74	0.59	11.5	5.74	6.52	37.4
H-1		13.44	0.40	16.2	5.42	5.62	30.4
	B	26.03	0.52	16.2	13.67	5.62	129.0
OS-4		20.04	0.65	12.5	13.04	6.31	82.3
	C	46.07	0.58	16.7	26.71	5.53	200.0

**PROJECT INFORMATION**

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 DATE: 2/3/2022  
 Soil Type: A



	C2*	C5*	C10*	C100*	% IMPERV
Pasture/Meadow		0.08		0.35	0
1/8 acre Residential		0.45		0.59	65
Asphalt/Sidewalk		0.90		0.96	100

\*C-Values and Basin Imperviousness based on Table 6-6, El Paso County "Drainage Criteria Manual"

**PROPOSED**

SUB-BASIN	SURFACE DESIGNATION	AREA ACRE	COMPOSITE RUNOFF COEFFICIENTS				% IMPERV
			C2	C5	C10	C100	
A	Pasture/Meadow	0.20		0.08		0.35	0
	1/8 acre Residential	0.24		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.28		0.48	35%
<b>TOTAL A</b>		0.44					
B	Pasture/Meadow	0.00		0.08		0.35	0
	1/8 acre Residential	1.11		0.45		0.59	65
	Asphalt/Sidewalk	0.31		0.90		0.96	100
	WEIGHTED AVERAGE			0.55		0.67	73%
<b>TOTAL B</b>		1.42					
C	Pasture/Meadow	0.32		0.08		0.35	0
	1/8 acre Residential	2.69		0.45		0.59	65
	Asphalt/Sidewalk	0.42		0.90		0.96	100
	WEIGHTED AVERAGE			0.47		0.61	63%
<b>TOTAL C</b>		3.43					
D	Pasture/Meadow	0.43		0.08		0.35	0
	1/8 acre Residential	0.55		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.29		0.48	36%
<b>TOTAL D</b>		0.98					
E	Pasture/Meadow	0.16		0.08		0.35	0
	1/8 acre Residential	2.72		0.45		0.59	65
	Asphalt/Sidewalk	0.21		0.90		0.96	100
	WEIGHTED AVERAGE			0.46		0.60	64%
<b>TOTAL E</b>		3.09					
F	Pasture/Meadow	0.00		0.08		0.35	0
	1/8 acre Residential	0.69		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
<b>TOTAL F</b>		0.69					
G	PROPOSED	0.00		0.00		0.00	0
	1/8 acre Residential	1.61		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
<b>TOTAL G</b>		1.61					
H	Pasture/Meadow	0.40		0.08		0.35	0
	1/8 acre Residential	0.44		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.27		0.48	34%
<b>TOTAL H</b>		0.84					
I	Pasture/Meadow	0.47		0.08		0.35	0
	1/8 acre Residential	0.22		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.20		0.43	21%
<b>TOTAL I</b>		0.69					
<b>TOTAL</b>		<b>13.19</b>		<b>0.43</b>		<b>0.58</b>	<b>57.7%</b>
<b>TOTAL POND TRIBUTARY</b>		<b>41.99</b>		<b>0.55</b>		<b>0.68</b>	<b>57.8%</b>

**PROJECT INFORMATION**

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 AGENCY: El Paso County  
 REPORT TYPE: Final  
 DATE: 2/3/2022



**RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF**  
 PROPOSED TIME OF CONCENTRATION STANDARD FORM SF-2

SUB-BASIN DATA					INITIAL/OVERLAND TIME (t <sub>i</sub> )				TRAVEL TIME (t <sub>t</sub> )					PIPE TRAVEL TIME (t <sub>p</sub> )				TIME OF CONC. t <sub>c</sub>		FINAL t <sub>c</sub>
BASIN	DESIGN PT.	C <sub>5</sub>	C <sub>100</sub>	AREA	LENGTH	HT	SLOPE	t <sub>i</sub>	LENGTH	HT	SLOPE	VEL.	t <sub>t</sub>	LENGTH	SLOPE	VEL.	t <sub>t</sub>	COMP.	MINIMUM	
				Ac	Ft	FT	%	Min	Ft	FT	%	FPS	Min	Ft	%	FPS	Min	t <sub>c</sub>	t <sub>c</sub>	Min
A	1	0.28	0.48	0.44	100	8	8.0	7.7	350	14	4.0	6.2	0.9					8.6	5	8.6
OS-1		0.67	0.76	16.90	100	2	2	6.5	1600	26	1.6	7.4	3.6					10.1	5	10.1
OS-2		0.81	0.88	2.85	100	2	2	4.3	400	13	3.3	10.6	0.6					4.9	5	5.0
B	2	0.55	0.67	1.42	100	2	2.0	8.2	1300	57.0	4.4	12.3	1.8					10.0	5	10.0
C	3	0.47	0.61	3.43	100	2	2.0	9.3	250	11	4.4	6.5	0.6	600	3.3	10.6	0.9	10.9	5	10.9
	J1	0.49	0.63	4.85										5	0.5	3.4	0.0	10.9	5	10.9
D	4	0.29	0.48	0.98	100	7	7.0	7.9	250	9	3.6	5.9	0.7					8.6	5	8.6
E	5	0.46	0.60	3.09	55	1.5	2.7	6.3	915	28	3.1	10.3	1.5					7.8	5	7.8
	J2	0.46	0.61	5.83										40	2.0	8.3	0.1	11.0	5	11.0
F		0.45	0.59	0.69	50	1	2.0	6.8	470	16	3.4	10.8	0.7					7.5	5	7.5
	6	0.46	0.60	3.78										50	3.1	10.3	0.1	7.9	5	7.9
	J3	0.46	0.60	9.61										40	2.5	9.3	0.1	11.1	5	11.1
G	7	0.45	0.59	1.61	80	1	1.3	10.1	720	17	2.4	9.1	1.3					11.4	5	11.4
	J4	0.46	0.60	11.22										20	1.0	5.9	0.1	11.5	5	11.5
OS-3		0.41	0.59	9.74	100	2.5	2.5	9.5	1200	34	2.8	9.8	2.0					11.5	5	11.5
H	8	0.27	0.48	0.84	100	7	7.0	8.1	350	17	4.9	6.9	0.8					8.9	5	8.9
	P1	0.55	0.68	41.99														11.5	5	11.5
OS-5		0.45	0.59	0.15	50	2	4.0	5.4										5.4	5	5.4
OS-6		0.45	0.59	0.41	70	4	5.7	5.7										5.7	5	5.7
I		0.20	0.43	0.69	20	1	5.0	4.4	850	18	2.1	4.5	3.2					7.6	5	7.6
	9	0.31	0.50	1.25														13.3	5	13.3
OS-4	O4	0.53	0.65	20.04	100	2	2	8.5	2000	41	2.1	8.5	3.9					12.5	5	12.5

**PROJECT INFORMATION**

PROJECT: Haven Valley  
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 AGENCY: El Paso County  
 REPORT TYPE: Final  
 DATE: 7/10/2024



**RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF**

PROPOSED RUNOFF 5 YR STORM P1= 1.50

BASIN (S)	DESIGN POINT	AREA (AC)	DIRECT RUNOFF		C * A	I (IN/HR)	Q (CFS)
			RUNOFF COEFF	t <sub>c</sub> (MIN)			
A		0.44	0.28	8.6	0.12	4.34	0.5
OS-1		16.90	0.67	10.1	11.24	4.09	46.0
Exist. Elm Grove Pond Release							18.1
OS-2		2.85	0.81	5.0	2.31	5.10	11.8
	1	3.29	0.74	10.1	2.43	4.09	28.1
B	2	1.42	0.55	10.0	0.78	4.11	3.2
C	3	3.43	0.47	10.9	1.61	3.96	6.4
	J1	4.85	0.49	10.9	2.39	3.96	9.5
D	4	0.98	0.29	8.6	0.28	4.33	1.2
E	5	3.09	0.46	7.8	1.43	4.48	6.4
	J2	5.83	0.46	11.0	2.67	3.95	10.6
F		0.69	0.45	7.5	0.31	4.53	1.4
	6	3.78	0.46	7.9	1.74	4.46	7.7
	J3	9.61	0.46	11.1	4.41	3.94	17.4
G	7	1.61	0.45	11.4	0.72	3.89	2.8
	J4	11.22	0.46	11.5	5.14	3.89	20.0
OS-3		9.74	0.41	11.5	4.02	3.88	15.6
H	8	0.84	0.27	8.9	0.23	4.28	1.0
	P1	25.10	0.47	11.5	11.80	3.88	63.9
POND RELEASE							1.0
OS-5		0.15	0.45	5.4	0.07	5.00	0.3
OS-6		0.41	0.45	5.7	0.18	4.93	0.9
I		0.69	0.20	7.6	0.14	4.53	0.6
	9						2.9
OS-4	O4	20.04	0.53	12.5	10.53	3.76	39.6
	J5						9.9
	10						22.7



**PROJECT INFORMATION**

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 DATE: 7/10/2024



Drexel, Barrell & Co.

**RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF**

PROPOSED

RUNOFF 100 YR STORM

P1= 2.52

BASIN (S)	DESIGN POINT	AREA (AC)	DIRECT RUNOFF			I (IN/HR)	Q (CFS)	PIPE SIZING		
			RUNOFF COEFF	t <sub>c</sub> (MIN)	C * A			n	Slope (ft/ft)	Pipe Diameter (in)
A		0.44	0.48	8.6	0.21	7.29	1.5			
OS-1		16.90	0.76	10.1	12.91	6.88	88.8			
Exist. Elm Grove Pond Release							52.3			
OS-2		2.85	0.88	5.0	2.51	8.58	21.5			
	1	3.29	0.83	10.1	2.72	6.88	71.0	0.016	0.038	36
B	2	1.42	0.67	10.0	0.95	6.90	6.6	0.016	0.035	18
C	3	3.43	0.61	10.9	2.10	6.66	14.0	0.016	0.005	24
	J1	4.85	0.63	10.9	3.05	6.65	20.3	0.016	0.035	24
D	4	0.98	0.48	8.6	0.48	7.27	3.5	0.016	0.023	18
E	5	3.09	0.60	7.8	1.86	7.52	14.0			
	J2	5.83	0.61	11.0	3.53	6.63	23.4	0.016	0.023	24
F		0.69	0.59	7.5	0.41	7.61	3.1			
	6	3.78	0.60	7.9	2.27	7.50	17.0	0.016	0.005	24
	J3	9.61	0.60	11.1	5.80	6.62	38.4	0.016	0.023	24
G	7	1.61	0.59	11.4	0.95	6.54	6.2	0.016	0.005	18
	J4	11.22	0.60	11.5	6.75	6.53	44.1	0.016	0.125	24
OS-3		9.74	0.59	11.5	5.74	6.52	37.4			
H	8	0.84	0.48	8.9	0.40	7.19	2.9			
	P1	25.10	0.62	11.5	15.56	6.52	153.8			
POND RELEASE							22.7	0.016	0.006	24
OS-5		0.15	0.59	5.4	0.09	8.40	0.7			
OS-6		0.41	0.59	5.7	0.24	8.29	2.0			
I		0.69	0.43	7.6	0.29	7.61	2.2			
	9						27.7	0.016	0.029	24
OS-4	O4	20.04	0.65	12.5	13.04	6.31	82.3	0.016	0.005	30
	J5						47.7	0.016	0.006	36 or elp. eqvlt
	10						68.8			

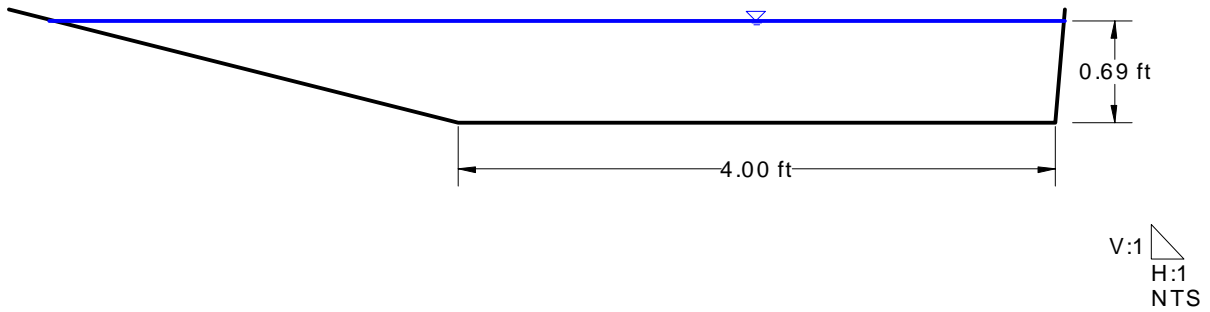
# Cross Section

## Cross Section for Trapezoidal Channel

North Swale

Project Description	
Worksheet	Trapezoidal Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.030
Slope	0.40000 ft/ft
Depth	0.69 ft
Left Side Slope	0.25 V : H
Right Side Slope	10.00 V : H
Bottom Width	4.00 ft
Discharge	23.00 cfs



# Worksheet

## Worksheet for Trapezoidal Channel

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### Project Description

---

Worksheet	East Swale
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

---

---

### Input Data

---

Mannings Coeffic	0.030
Slope	030000 ft/ft
Left Side Slope	0.25 V : H
Right Side Slope	0.25 V : H
Bottom Width	2.00 ft
Discharge	3.50 cfs

---

---

### Results

---

Depth	0.33 ft
Flow Area	1.1 ft <sup>2</sup>
Wetted Perim	4.70 ft
Top Width	4.62 ft
Critical Depth	0.36 ft
Critical Slope	0.021252 ft/ft
Velocity	3.23 ft/s
Velocity Head	0.16 ft
Specific Energ	0.49 ft
Froude Numb	1.17
Flow Type	supercritical

---

# Worksheet

## Worksheet for Trapezoidal Channel

---

### Project Description

---

Worksheet	South Swale
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

---

---

### Input Data

---

Mannings Coeffic	0.030
Slope	020000 ft/ft
Left Side Slope	0.15 V : H
Right Side Slope	0.25 V : H
Bottom Width	4.00 ft
Discharge	5.00 cfs

---

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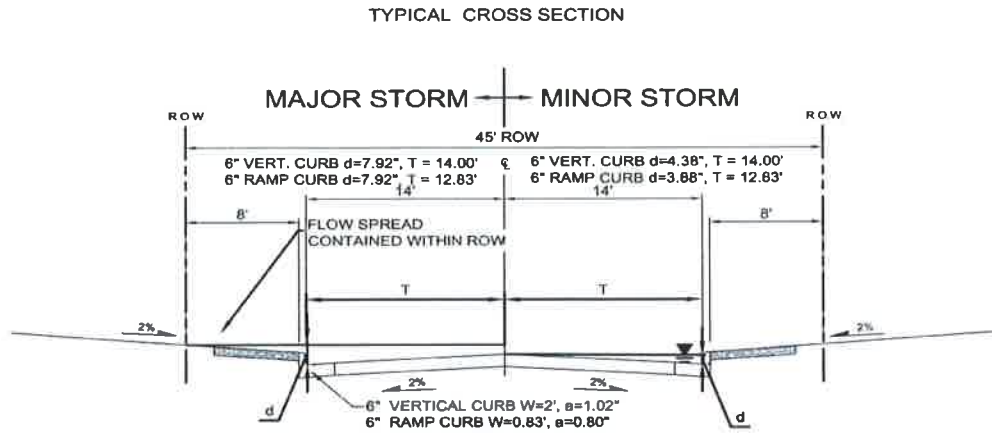
### Results

---

Depth	0.32 ft
Flow Area	1.8 ft <sup>2</sup>
Wetted Perim	7.48 ft
Top Width	7.41 ft
Critical Depth	0.31 ft
Critical Slope	0.021254 ft/ft
Velocity	2.74 ft/s
Velocity Head	0.12 ft
Specific Enerç	0.44 ft
Froude Numb	0.97
Flow Type	Subcritical

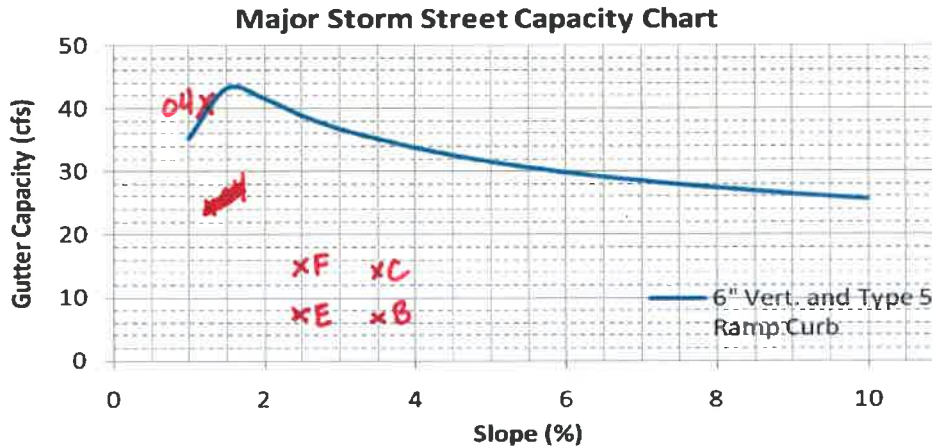
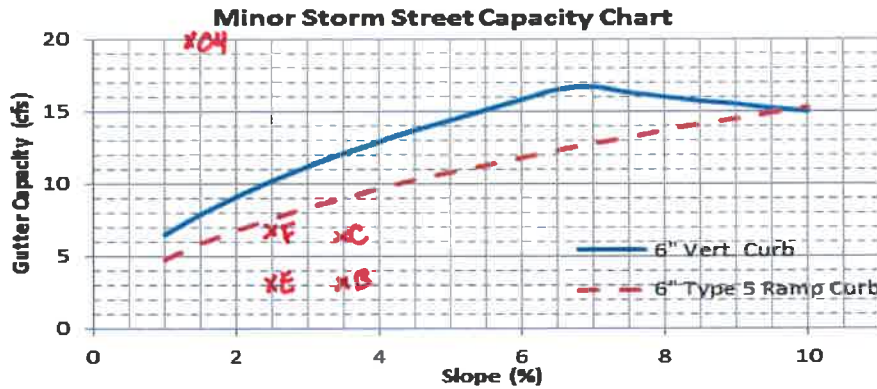
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Figure 7-9. Street Capacity Charts Minor Residential (Attached Sidewalk)



Points correspond to proposed Basin flows. See proposed drainage map for locations.

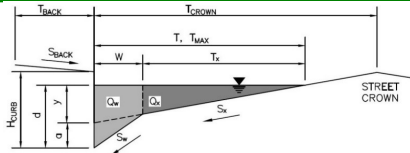
x Letter or number represents Basin flows



These charts shall only be used for the standard street sections as shown. The capacity shown is based on 1/2 the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being contained within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n<sub>STREET</sub>' of 0.016 and 'n<sub>BACK</sub>' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**  
 (Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:  
 Inlet ID: **Inlet OS-4**



<b>Gutter Geometry:</b>	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches
Distance from Curb Face to Street Crown	$T_{CROWN} = 16.5$ ft
Gutter Width	$W = 1.00$ ft
Street Transverse Slope	$S_x = 0.020$ ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.006$ ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.013$
Max. Allowable Spread for Minor & Major Storm	$T_{MAX} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 16.5 & 16.5 \end{matrix}$ ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 6.0 & 8.0 \end{matrix}$ inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<input type="checkbox"/> <input checked="" type="checkbox"/>
<a href="#">MINOR STORM Allowable Capacity is based on Spread Criterion</a>	$Q_{allow} = \begin{matrix} \text{Minor Storm} & \text{Major Storm} \\ 8.9 & 39.6 \end{matrix}$ cfs
<a href="#">MAJOR STORM Allowable Capacity is based on Depth Criterion</a>	
<b>WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'</b>	
<b>Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'</b>	

## Exist. depth of flow on Widefield Dr. Worksheet for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formu
Solve For	Channel Depth

Input Data	
Slope	0.012500 ft/ft
Discharge	100.00 cfs

Options	
Current Roughness Method	Selected: Lotter's Method
Open Channel Weighting	Selected: Lotter's Method
Closed Channel Weighting	Selected: Horton's Method

Results	
Mannings Coefficient	0.017
Water Surface Elev.	0.93 ft
Elevation Range	0.00 to 0.66
Flow Area	14.6 ft <sup>2</sup>
Wetted Perimeter	24.05 ft
Top Width	23.00 ft
Actual Depth	0.93 ft
Critical Elevation	1.14 ft
Critical Slope	0.005095 ft/ft
Velocity	6.84 ft/s
Velocity Head	0.73 ft
Specific Energy	1.66 ft
Froude Number	1.51
Flow Type	Supercritical

Calculation Messages:  
Water elevation exceeds lowest end station by 0.65343054 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
-0+09	-0+01	0.020
-0+01	0+14	0.016

Natural Channel Points	
Station (ft)	Elevation (ft)
-0+09	0.66
-0+01	0.50
0+00	0.00
0+14	0.28

## Prop. depth of flow just past DP-04 Worksheet for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data	
Slope	012500 ft/ft
Discharge	21.10 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.016
Water Surface Elev.	0.45 ft
Elevation Range	0.00 to 0.66
Flow Area	4.5 ft <sup>2</sup>
Wetted Perimeter	15.18 ft
Top Width	14.90 ft
Actual Depth	0.45 ft
Critical Elevation	0.56 ft
Critical Slope	0.005457 ft/ft
Velocity	4.65 ft/s
Velocity Head	0.34 ft
Specific Energy	0.79 ft
Froude Number	1.48
Flow Type	Supercritical

Calculation Messages:  
Water elevation exceeds lowest end station by 0.1699811 ft.

Roughness Segments		
Start Station	End Station	Mannings Coefficient
-0+09	-0+01	0.020
-0+01	0+14	0.016

Natural Channel Points	
Station (ft)	Elevation (ft)
-0+09	0.66
-0+01	0.50
0+00	0.00
0+14	0.28



# Prop. depth of flow at DP-10

## Worksheet for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data	
Slope	012500 ft/ft
Discharge	68.8 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.017
Water Surface Elev.	0.84 ft
Elevation Range	0.00 to 0.66
Flow Area	12.5 ft <sup>2</sup>
Wetted Perimeter	23.87 ft
Top Width	23.00 ft
Actual Depth	0.84 ft
Critical Elevation	1.00 ft
Critical Slope	0.005312 ft/ft
Velocity	6.20 ft/s
Velocity Head	0.60 ft
Specific Energy	1.44 ft
Froude Number	1.48
Flow Type	supercritical

Calculation Messages:  
 Water elevation exceeds lowest end station by 0.56152969 ft.

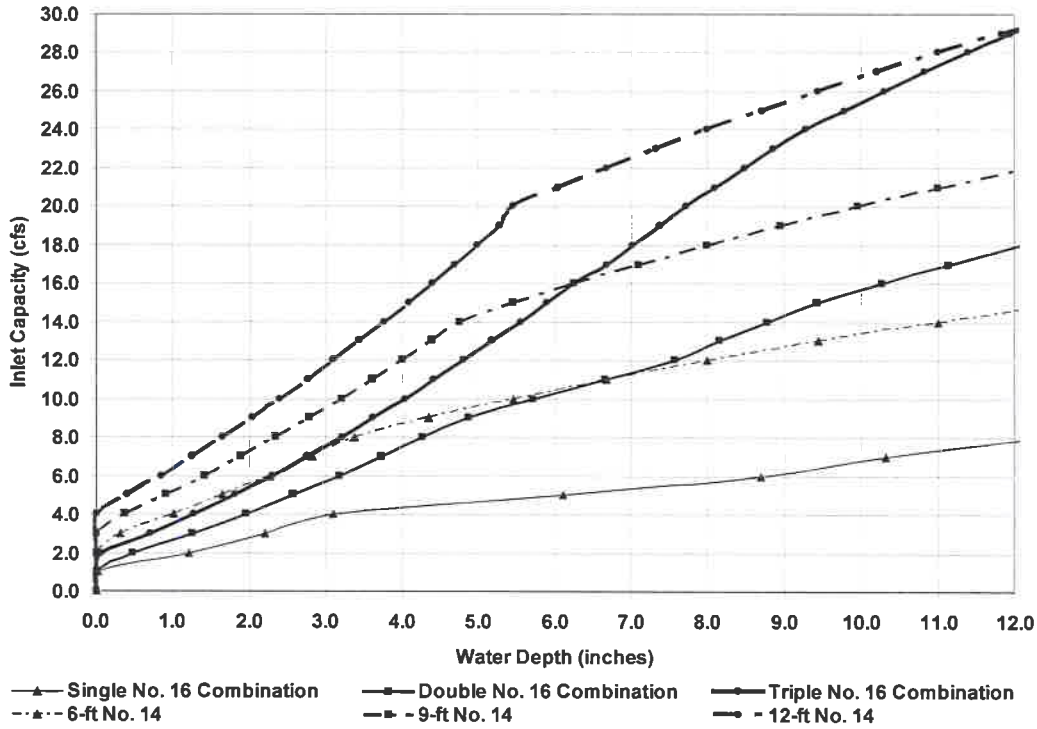
Roughness Segments		
Start Station	End Station	Mannings Coefficient
-0+09	-0+01	0.020
-0+01	0+14	0.016

Natural Channel Points	
Station (ft)	Elevation (ft)
-0+09	0.66
-0+01	0.50
0+00	0.00
0+14	0.28

**Figure 8.1. Allowable Inlet Capacity— Sump Conditions**

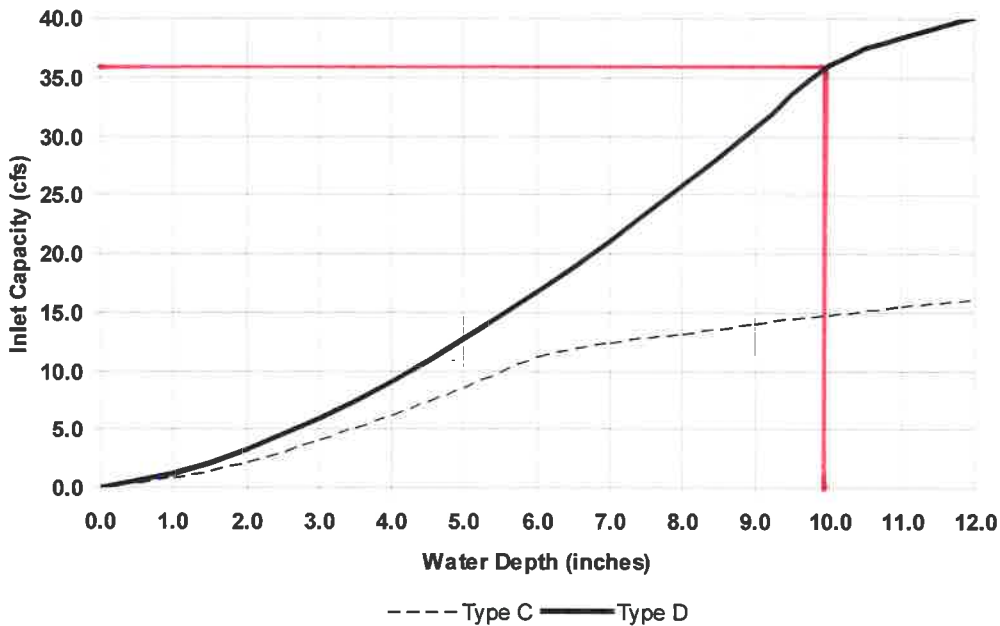
Note: See Section 8.3.2 for assumptions.

**Type 16 and Type 14 Inlets for Sump Conditions**



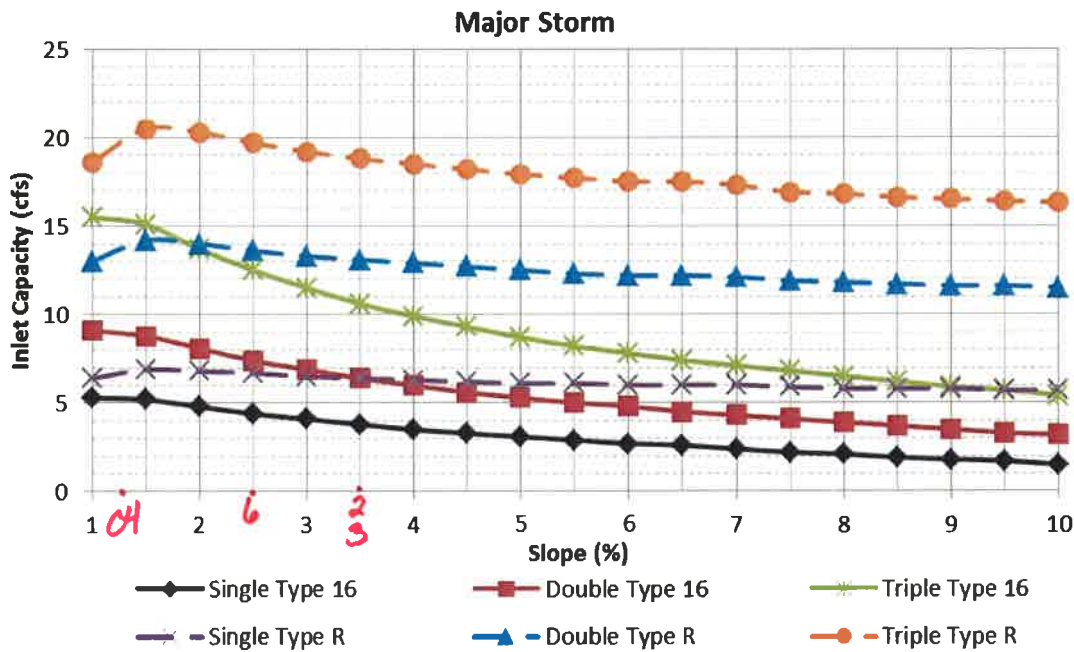
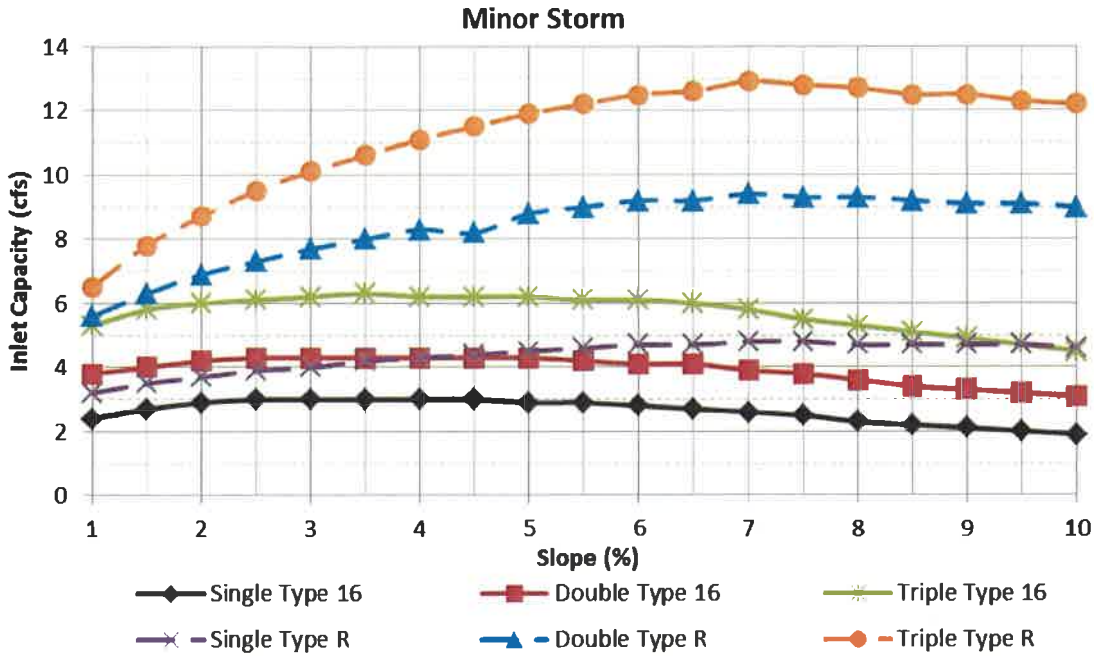
DL-1: Q<sub>100</sub> = 71.0 cfs → Double Type D inlet

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



**Figure 8-9. Inlet Capacity Chart Continuous Grade Conditions, Minor Residential (Local) (Attached Sidewalk)**

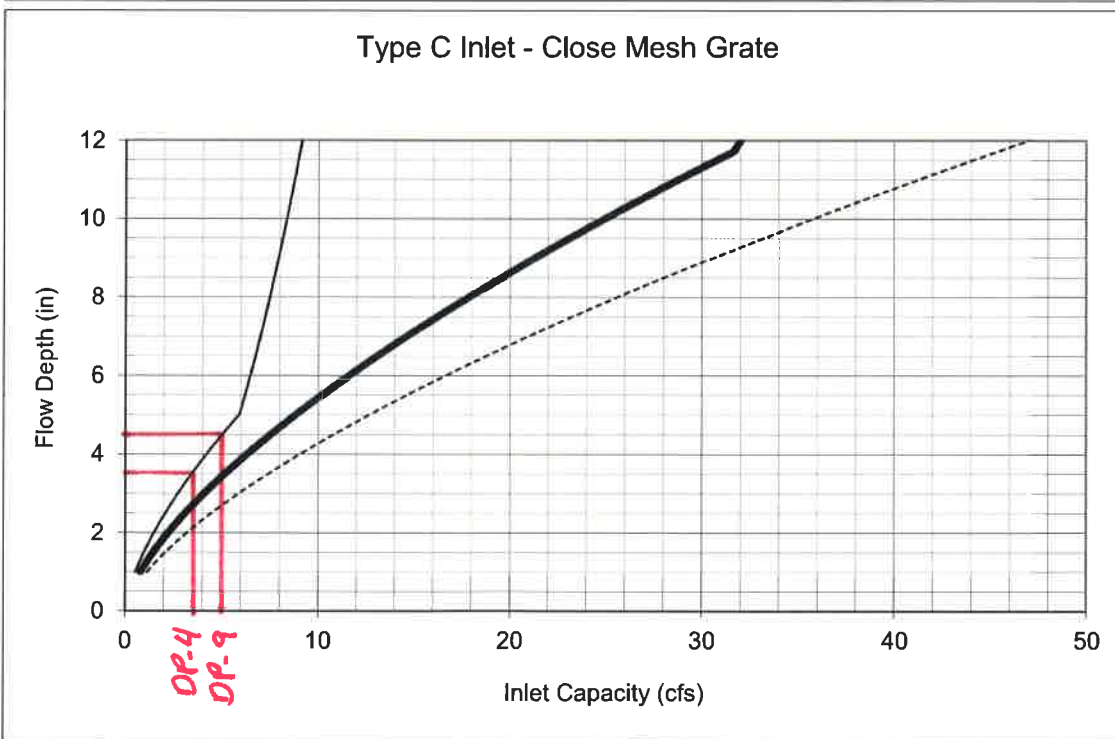
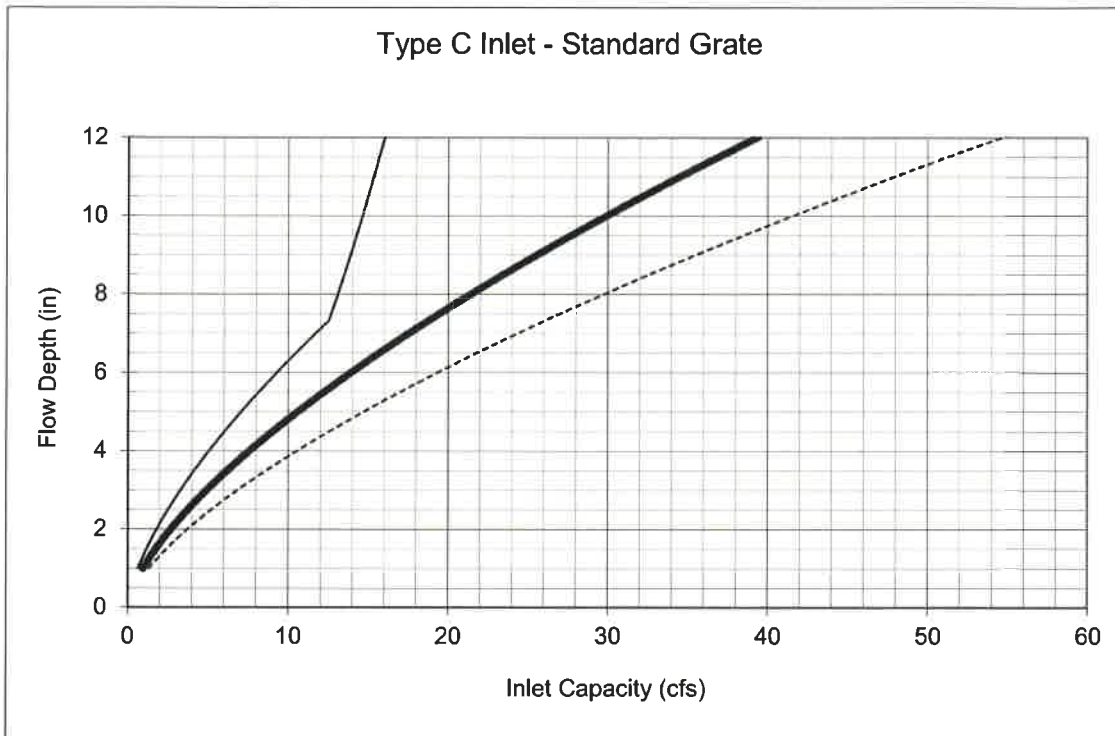
Street Section Data: Street Width Flowline to Flowline = 28'  
Type of Curb and Gutter = 6" vertical



*Handwritten notes in red:*  
 DP-2: Q<sub>100</sub> = 6.6 cfs → Single Type R  
 DP-3: Q<sub>100</sub> = 14.0 cfs → triple Type R  
 DP-6: Q<sub>100</sub> = 17.0 cfs → triple Type R  
 DP-04: Q<sub>100</sub> = 41.1 cfs → triple Type R

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

Figure 8-10. Inlet Capacity Chart Sump Conditions, Area (Type C) Inlet



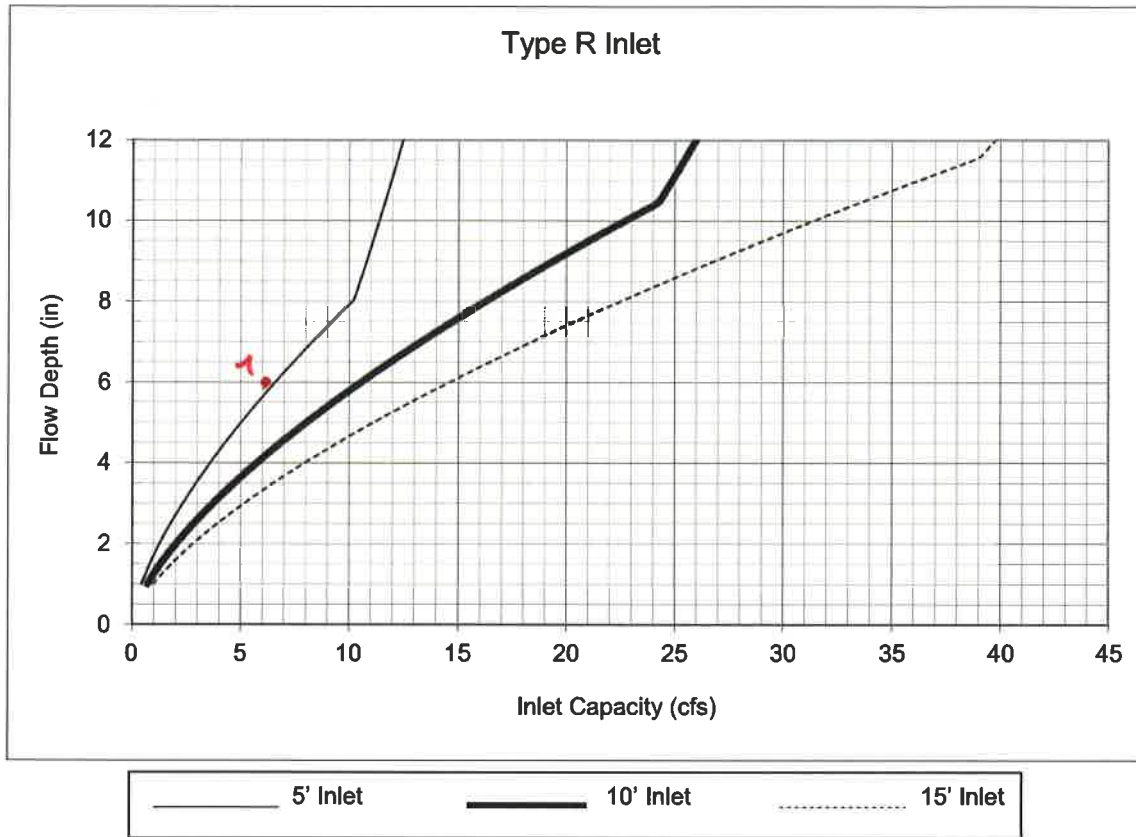
DP-4: Q<sub>100</sub> = 3.5 cfs  
 DP-9: Q<sub>100</sub> = 4.9 cfs

— One Grate    — Two Grates    ..... Three Grates

Notes:

1. The standard inlet parameters must apply to use these charts.

**Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet**

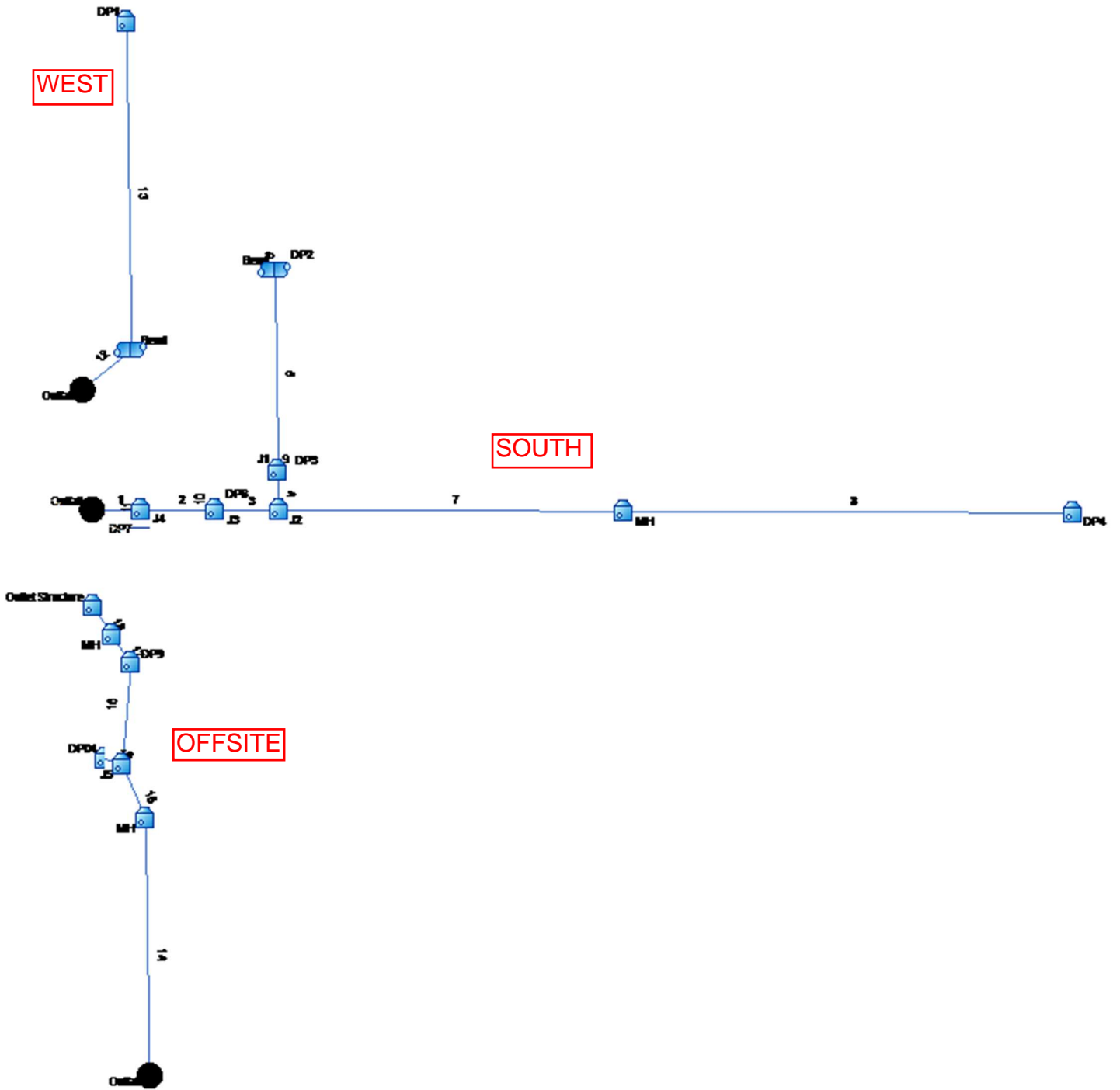


*OP-7:  $Q_{100} = 6.2$  cfs  $\rightarrow$  single Type R*

Notes:

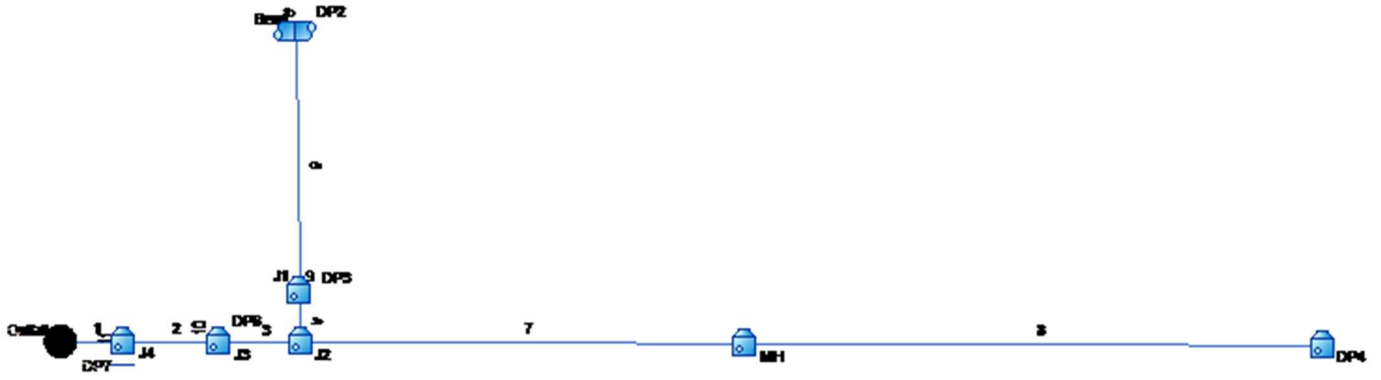
1. The standard inlet parameters must apply to use this chart.

Hydraflow Storm Sewer Extension for Autodesk Civil 3D

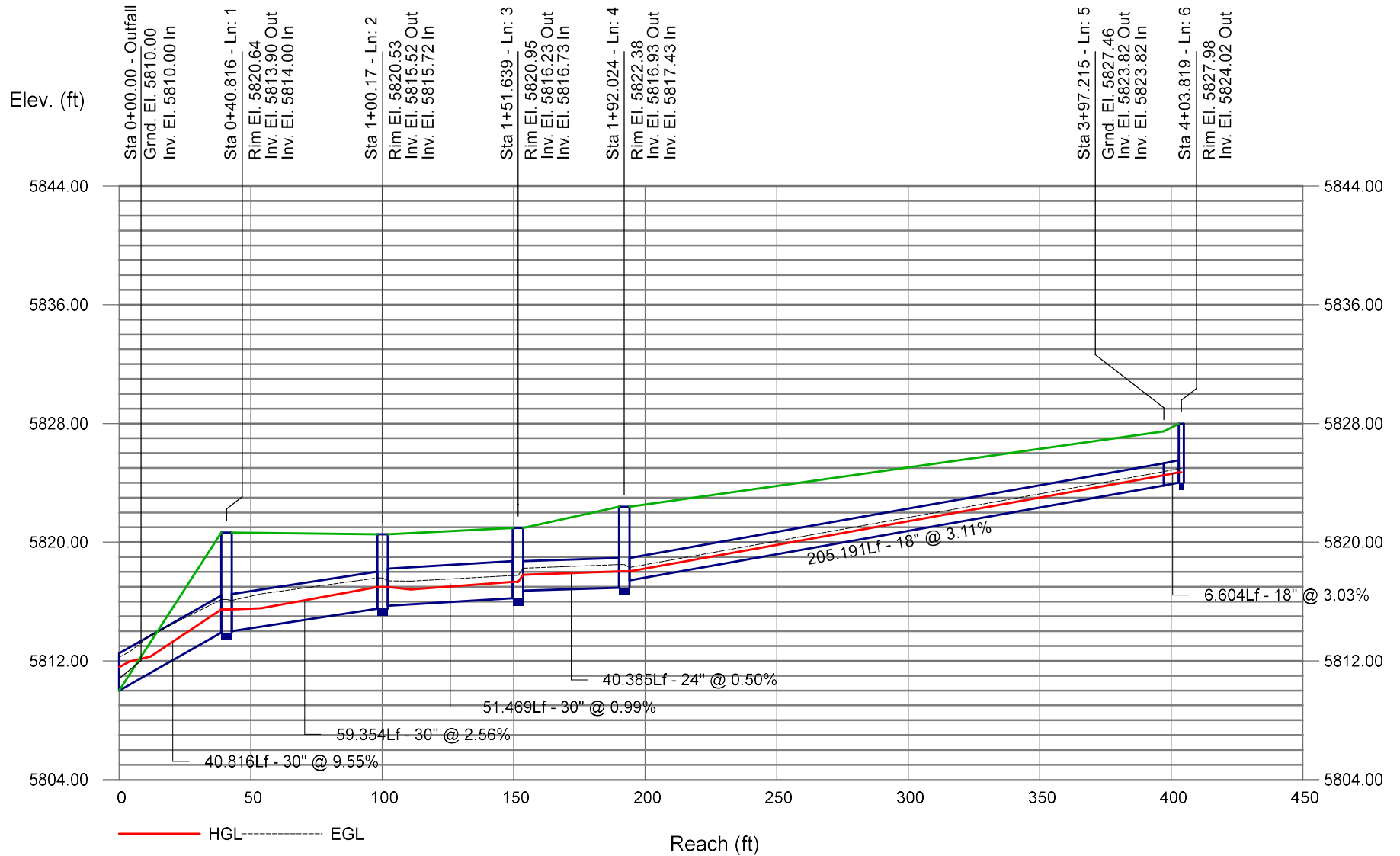


Hydraflow Storm Sewer Extension for Autodesk Civil 3D

SOUTH  
LINES 1-11

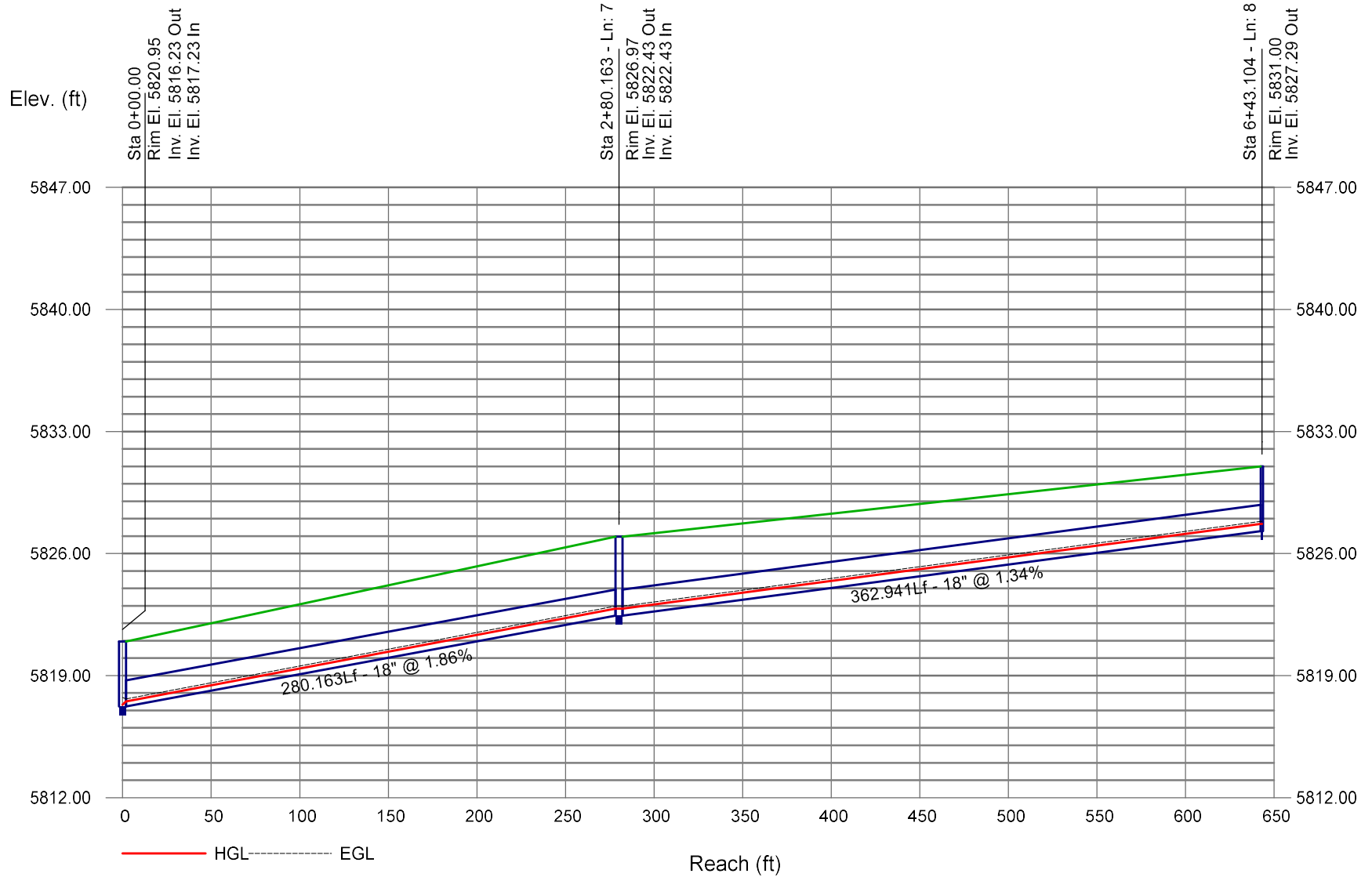


# Storm Sewer Profile

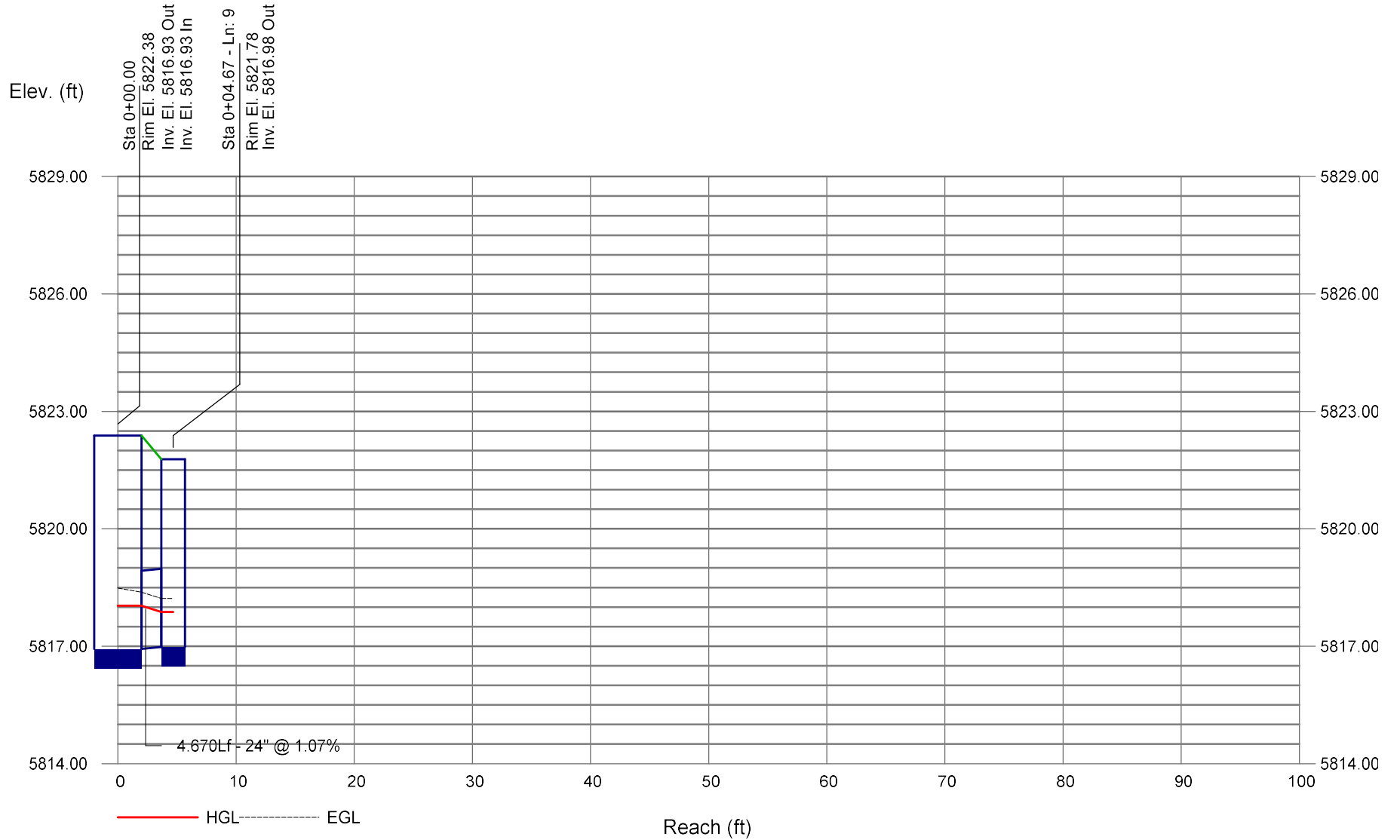




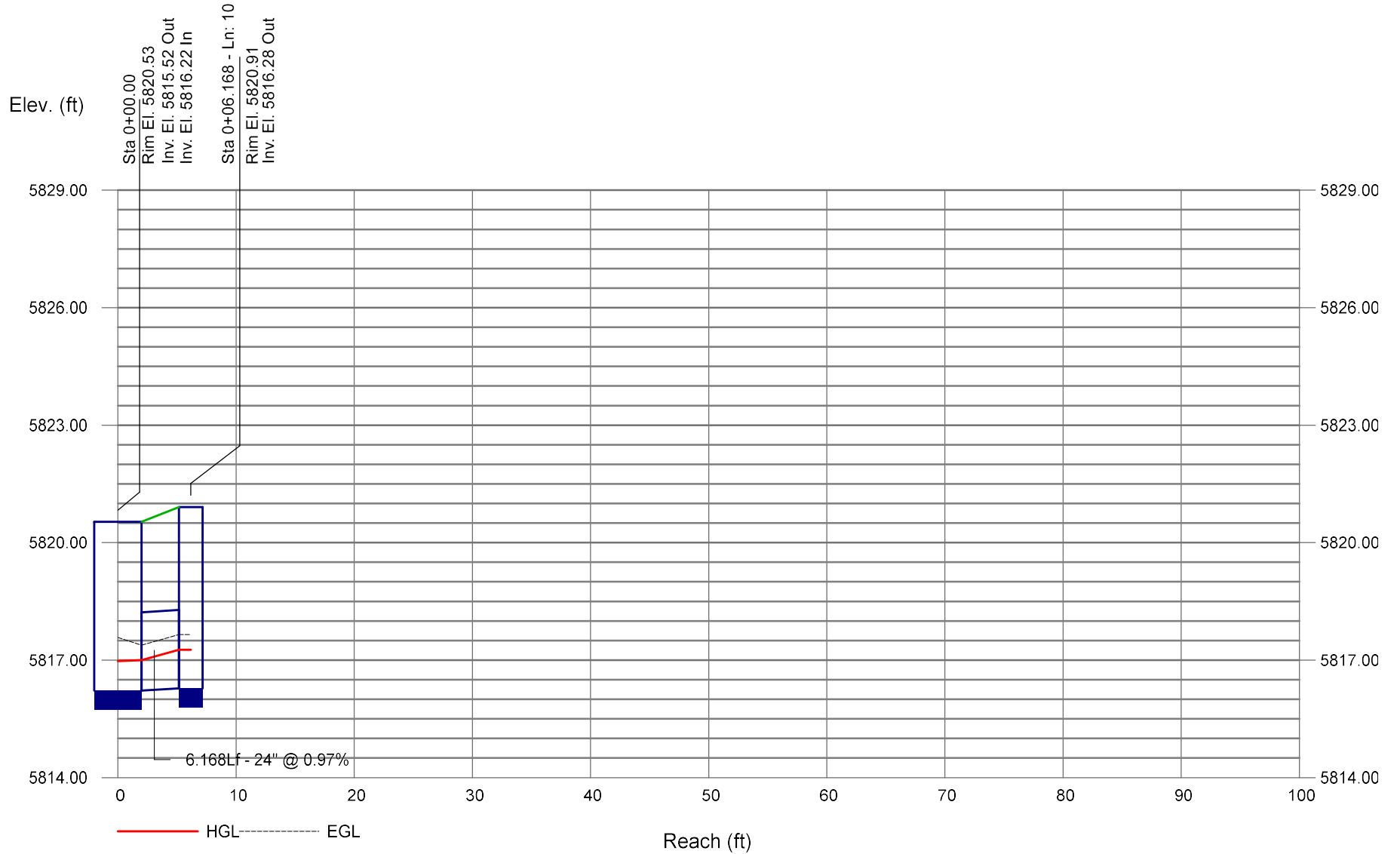
# Storm Sewer Profile



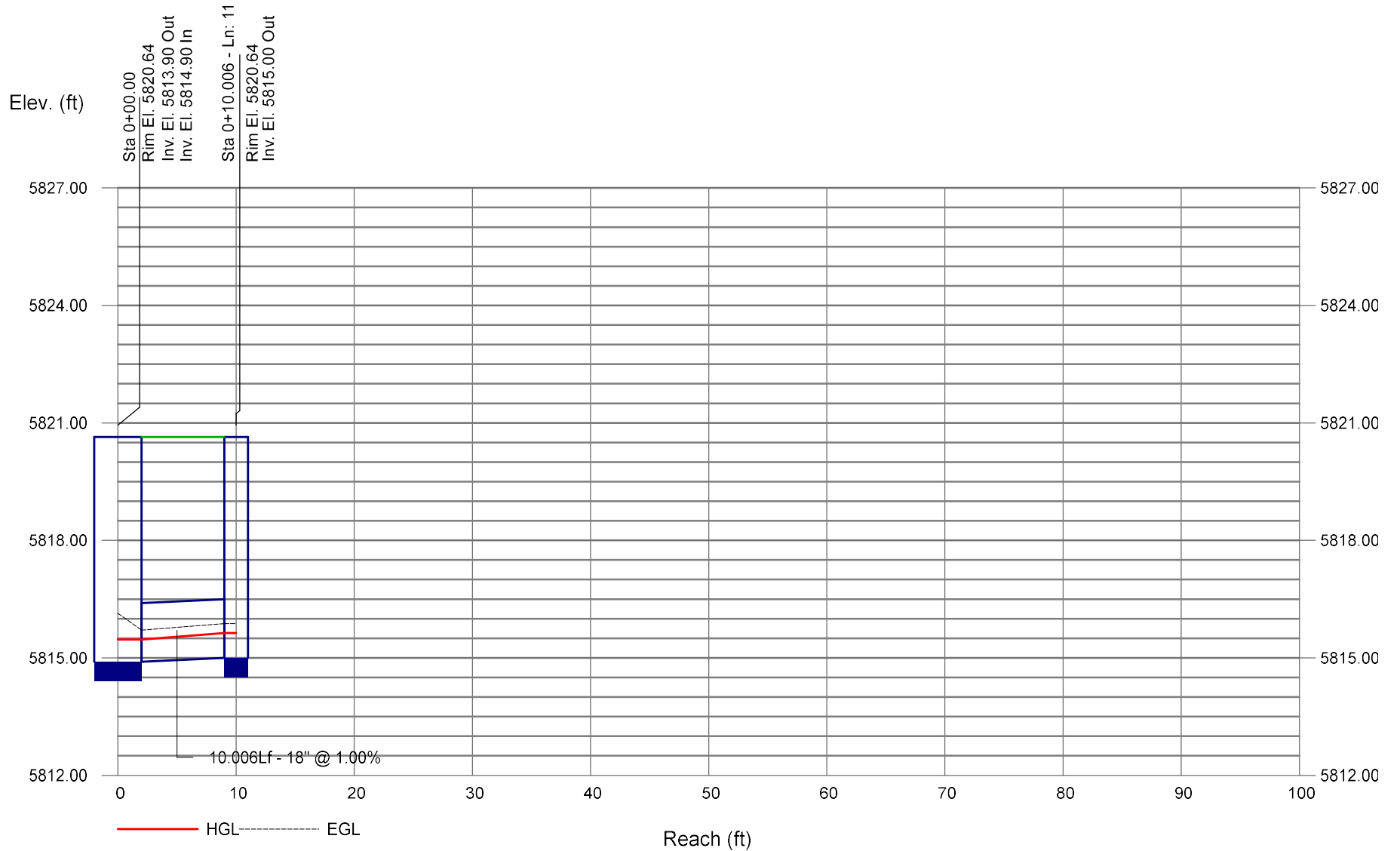
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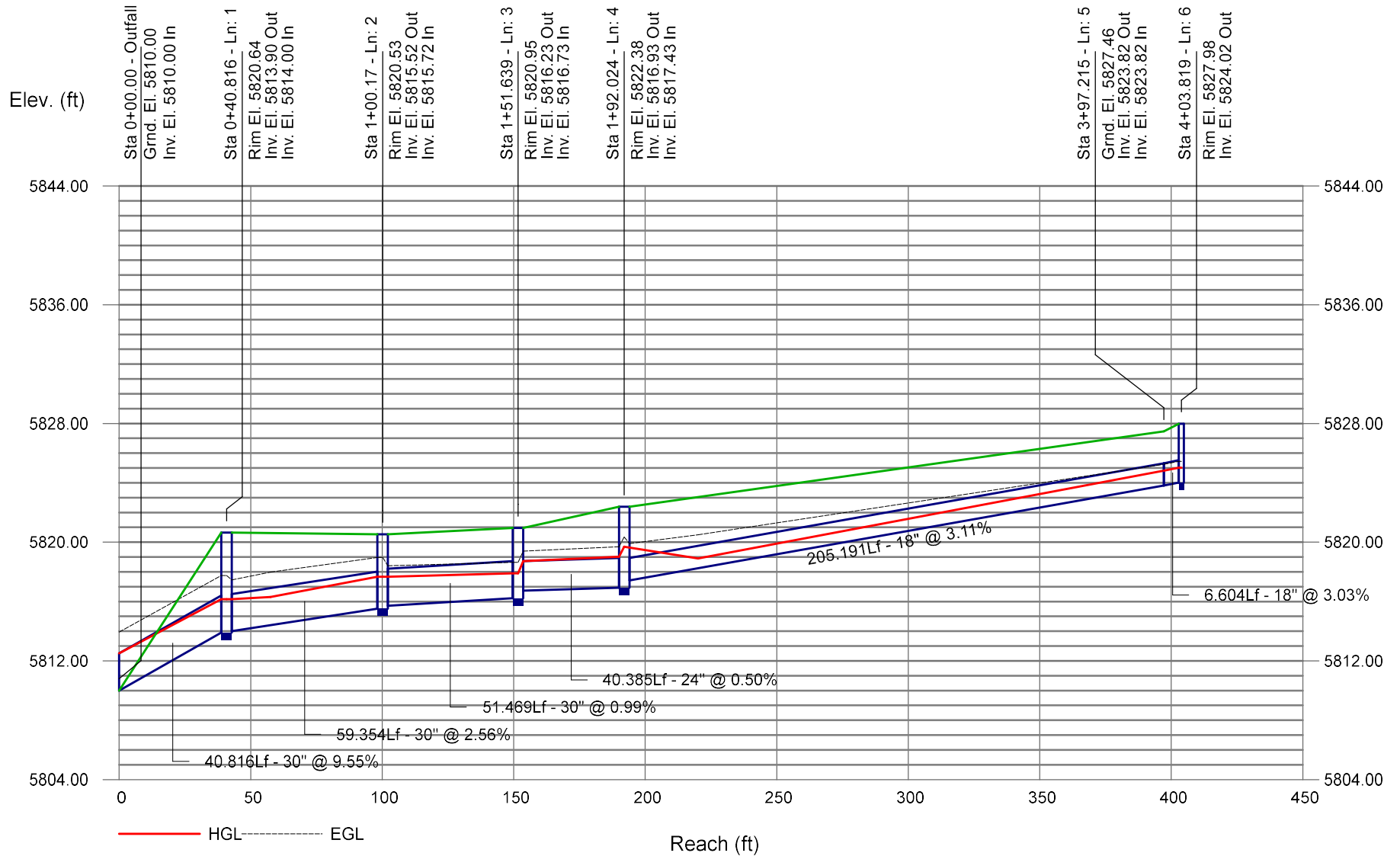
# Storm Sewer Profile



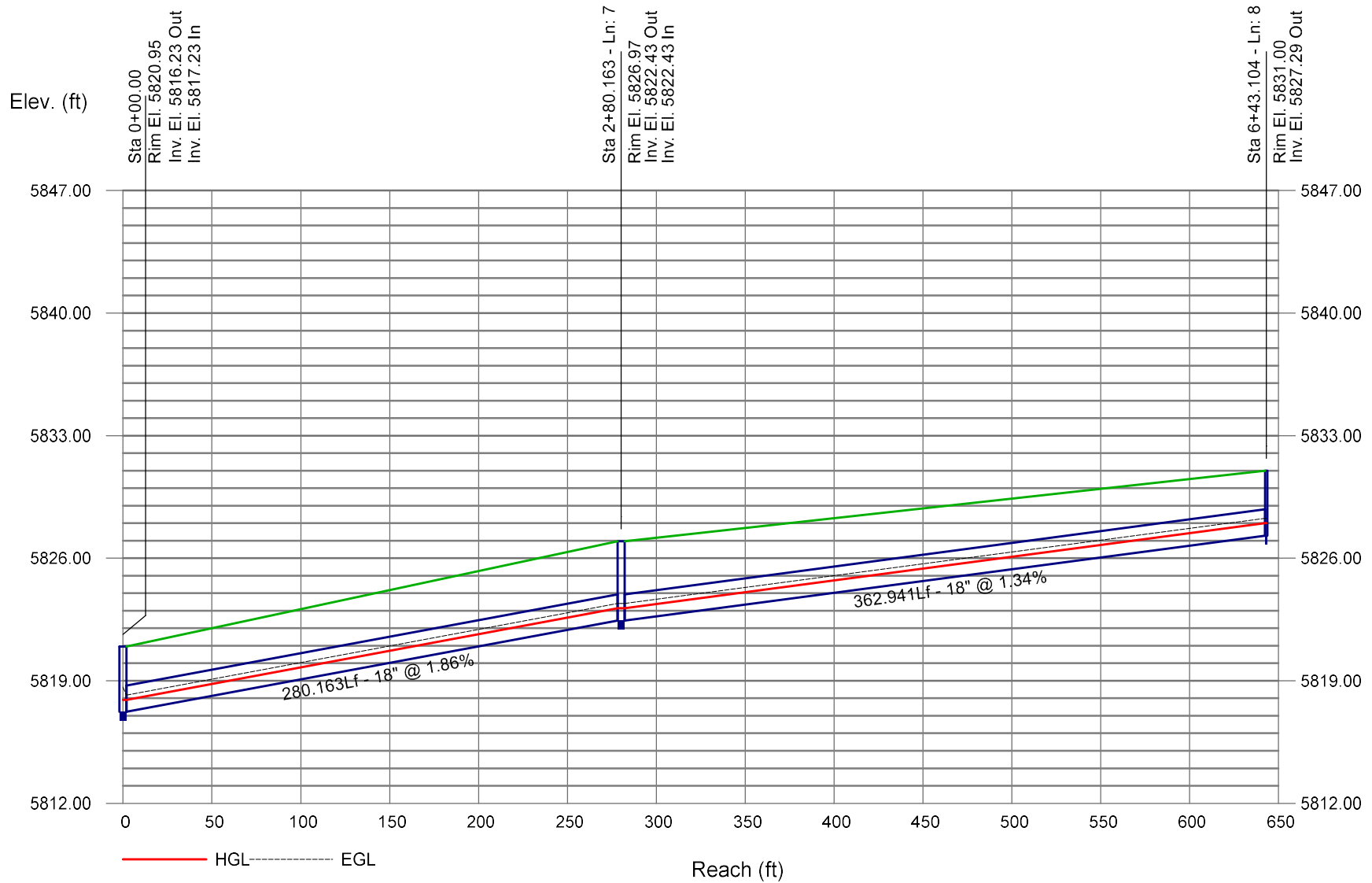
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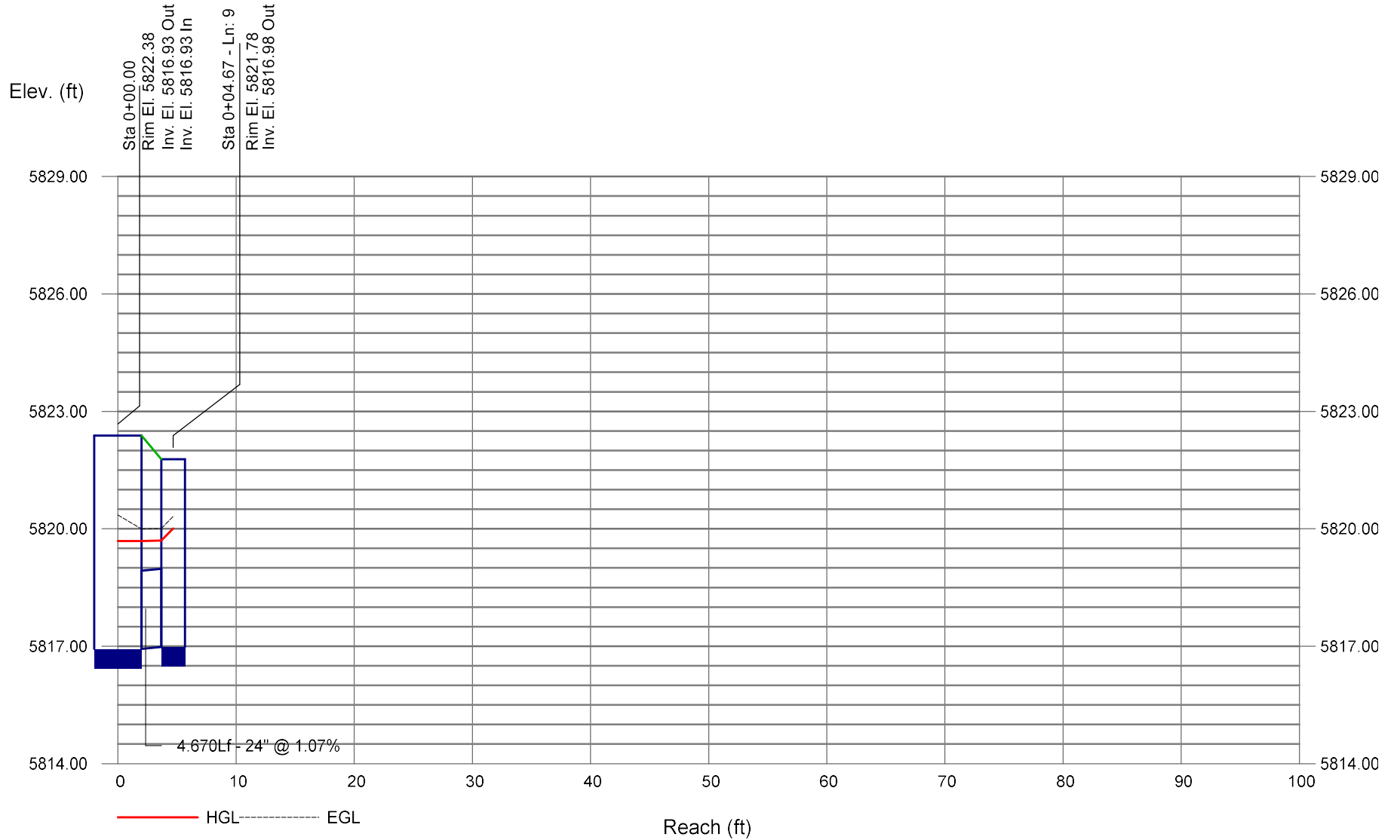
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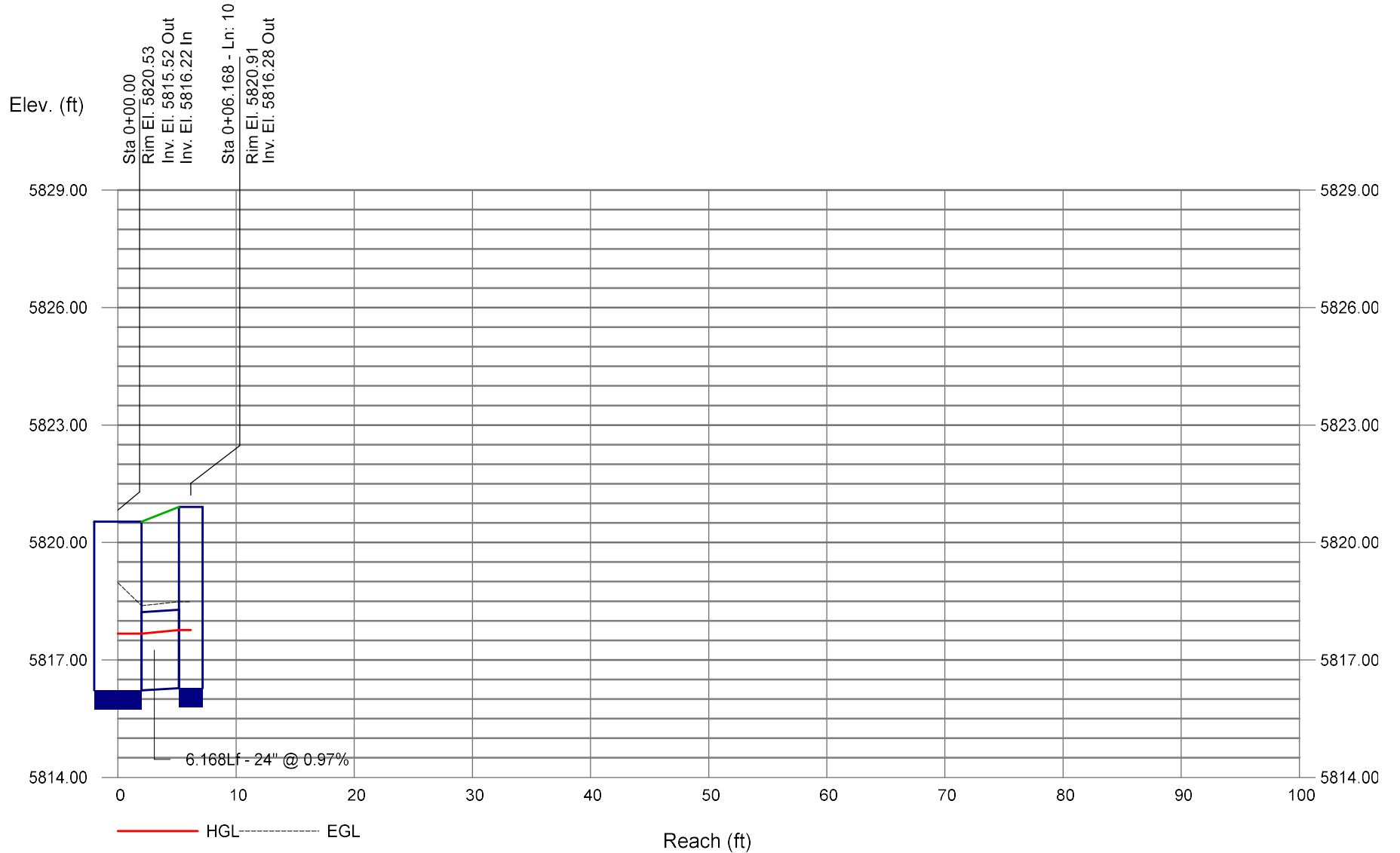
# Storm Sewer Profile



# Storm Sewer Profile

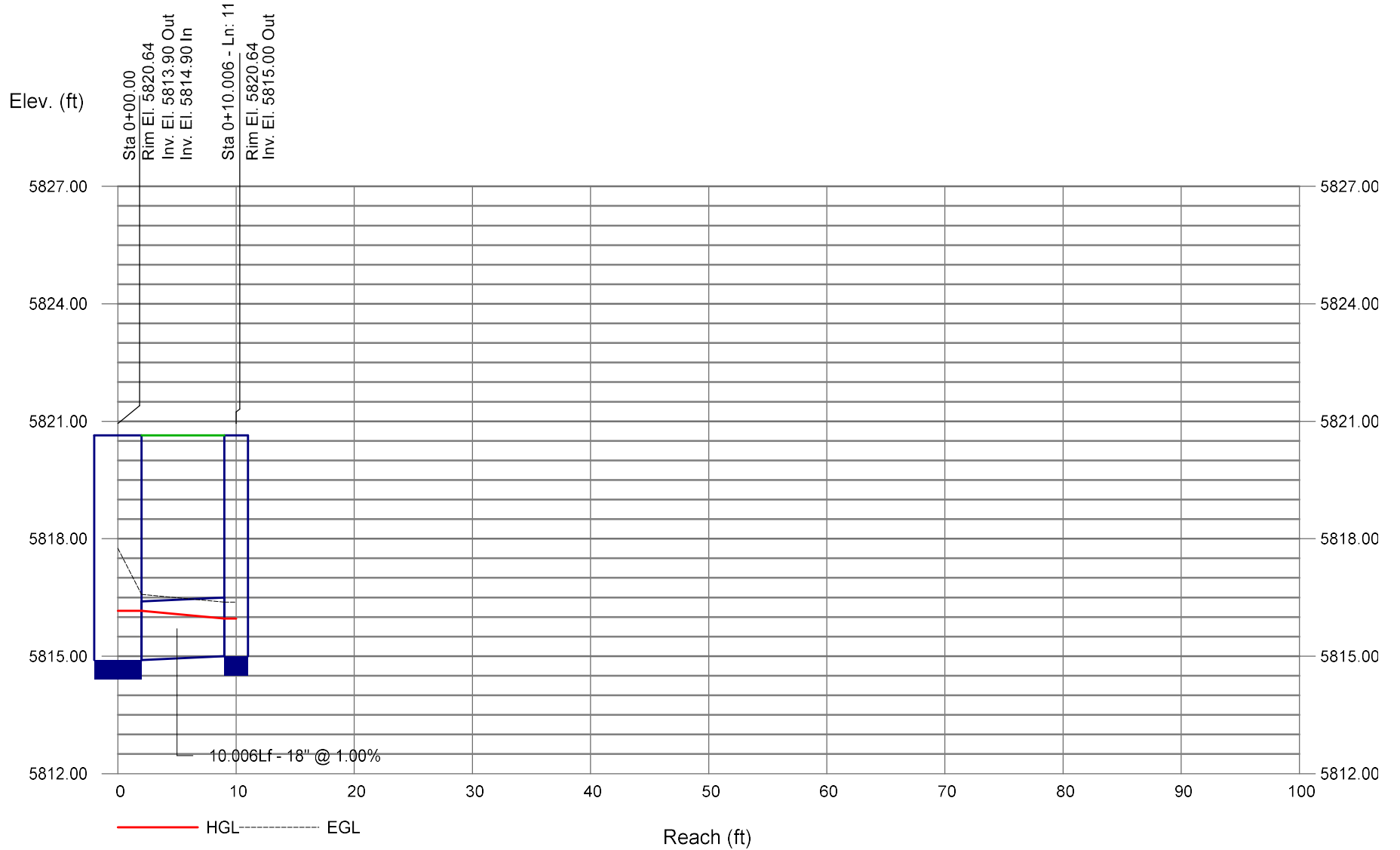


# Storm Sewer Profile





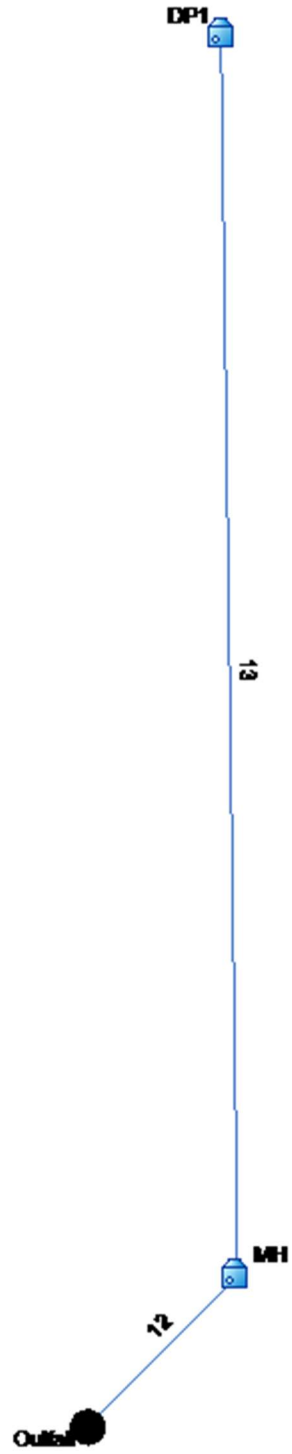
# Storm Sewer Profile



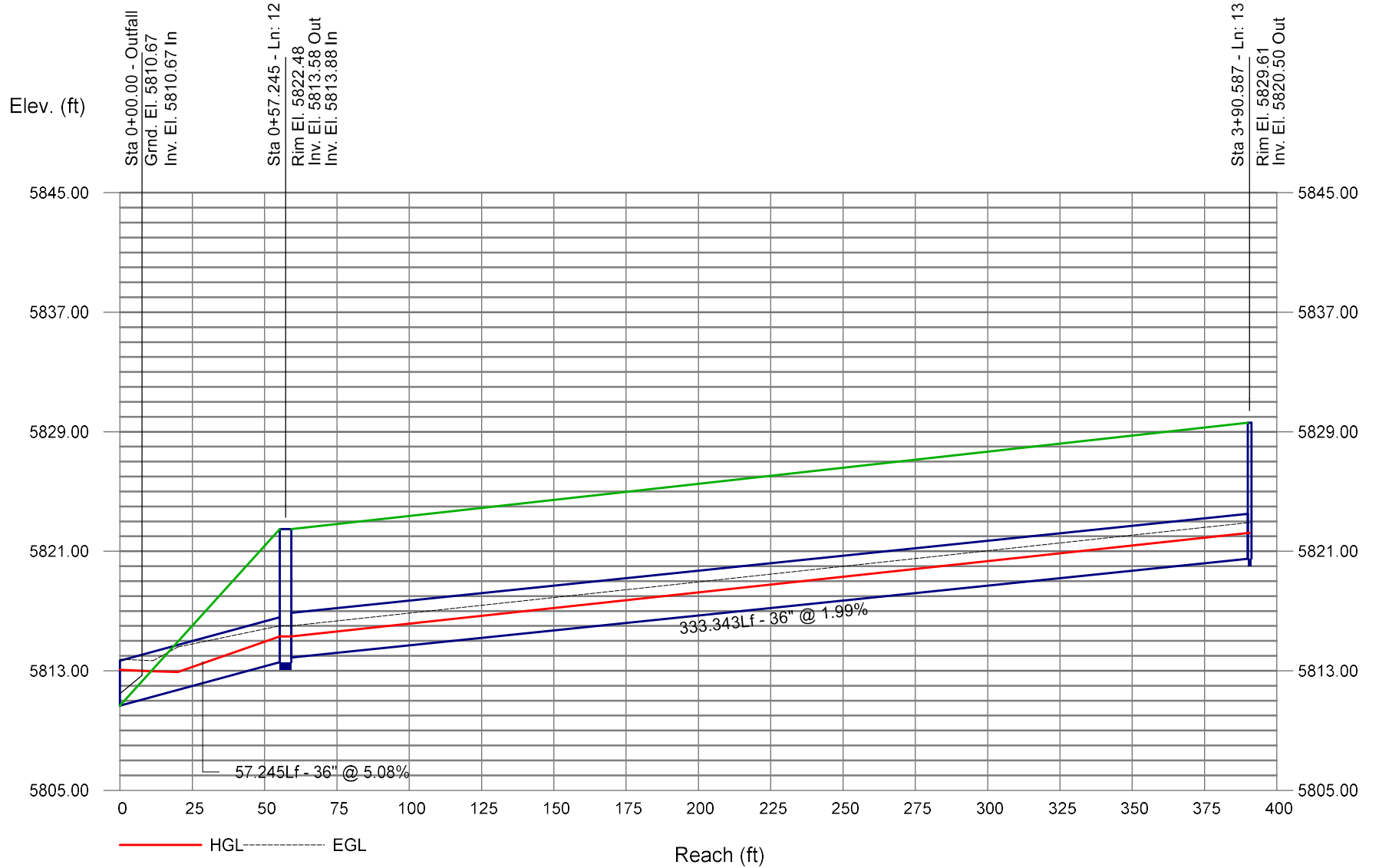
Hydraflow Storm Sewer Extension for Autodesk Civil 3D

WEST

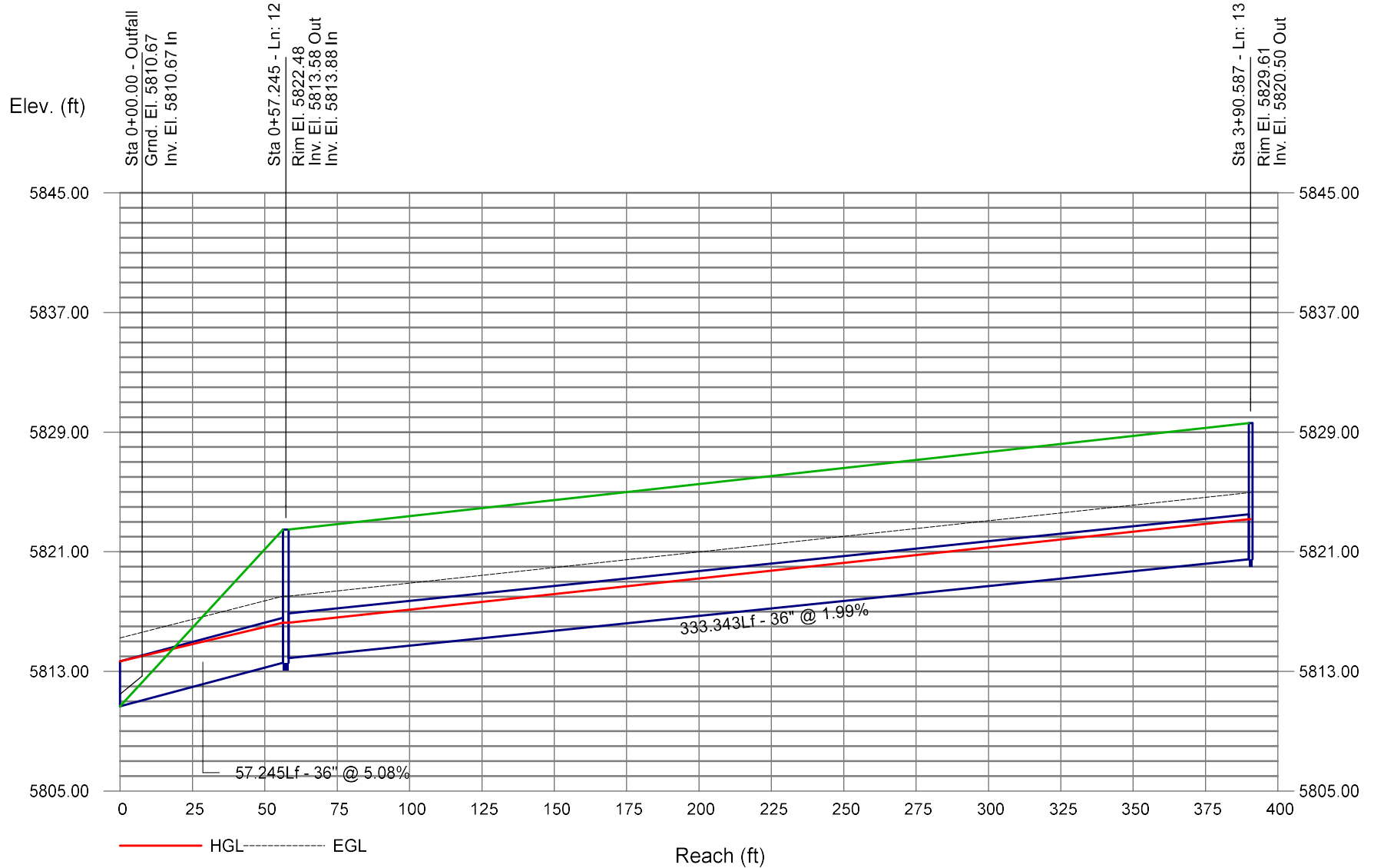
LINES 12-13



# Storm Sewer Profile



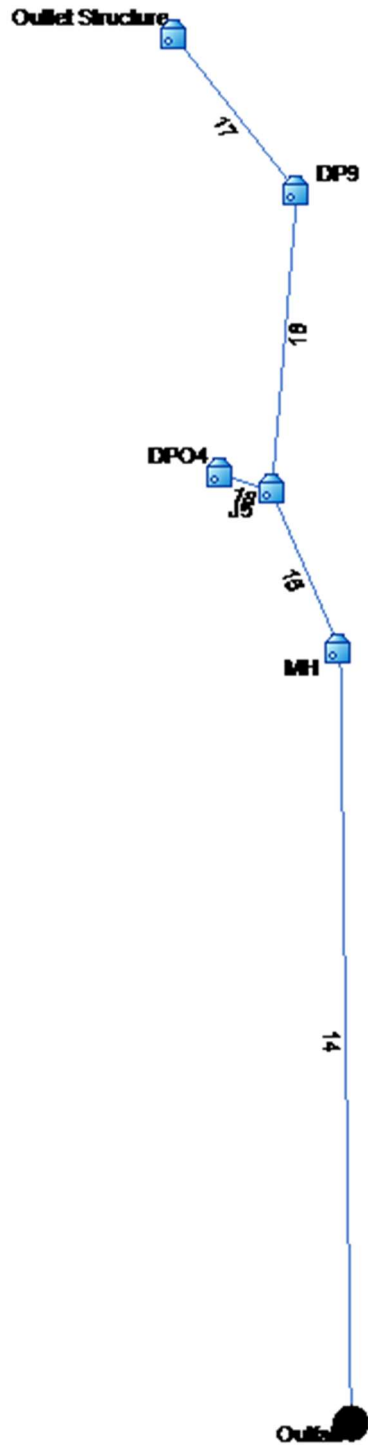
# Storm Sewer Profile



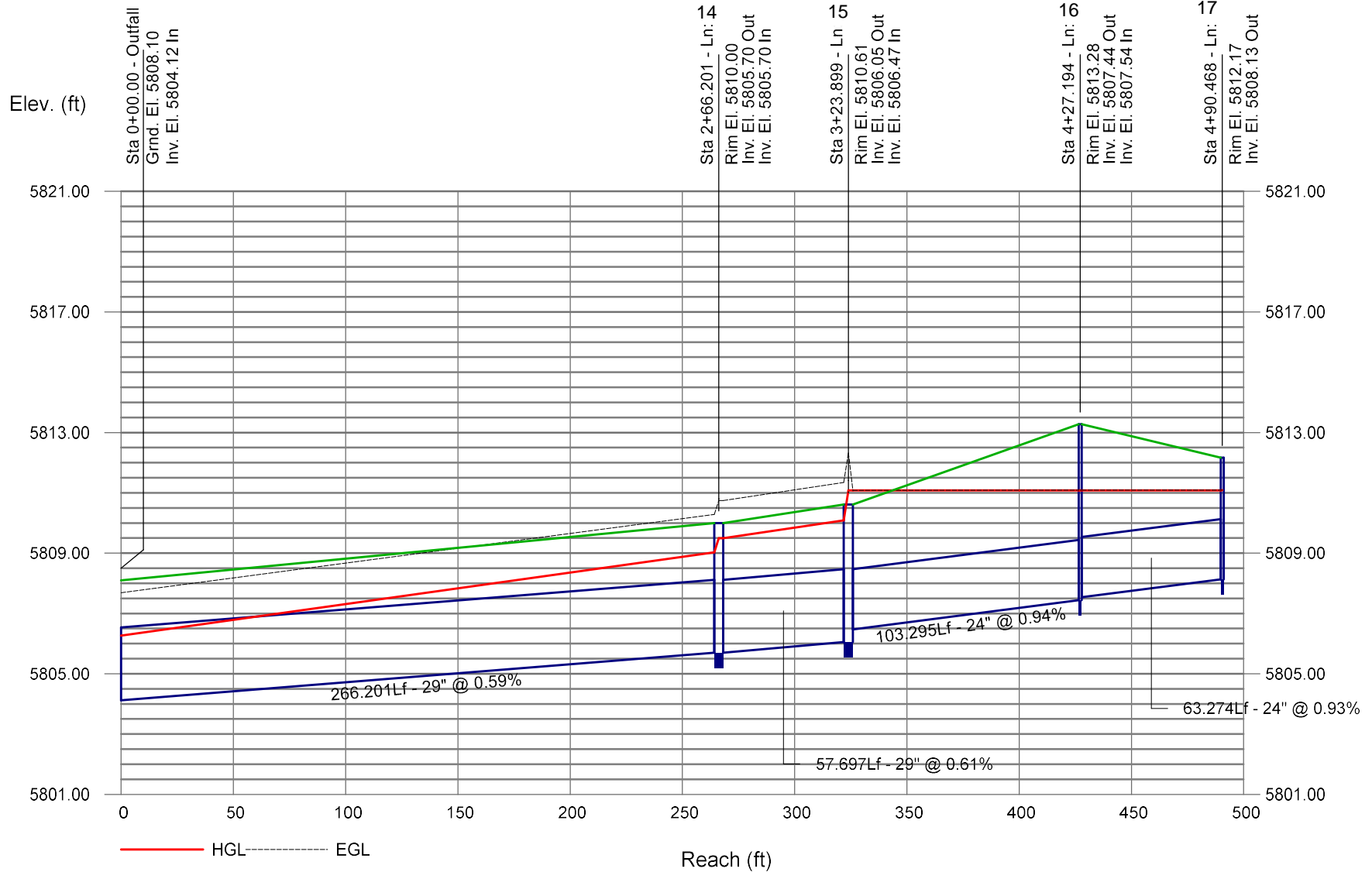
Hydraflow Storm Sewer Extension for Autodesk Civil 3D

OFFSITE

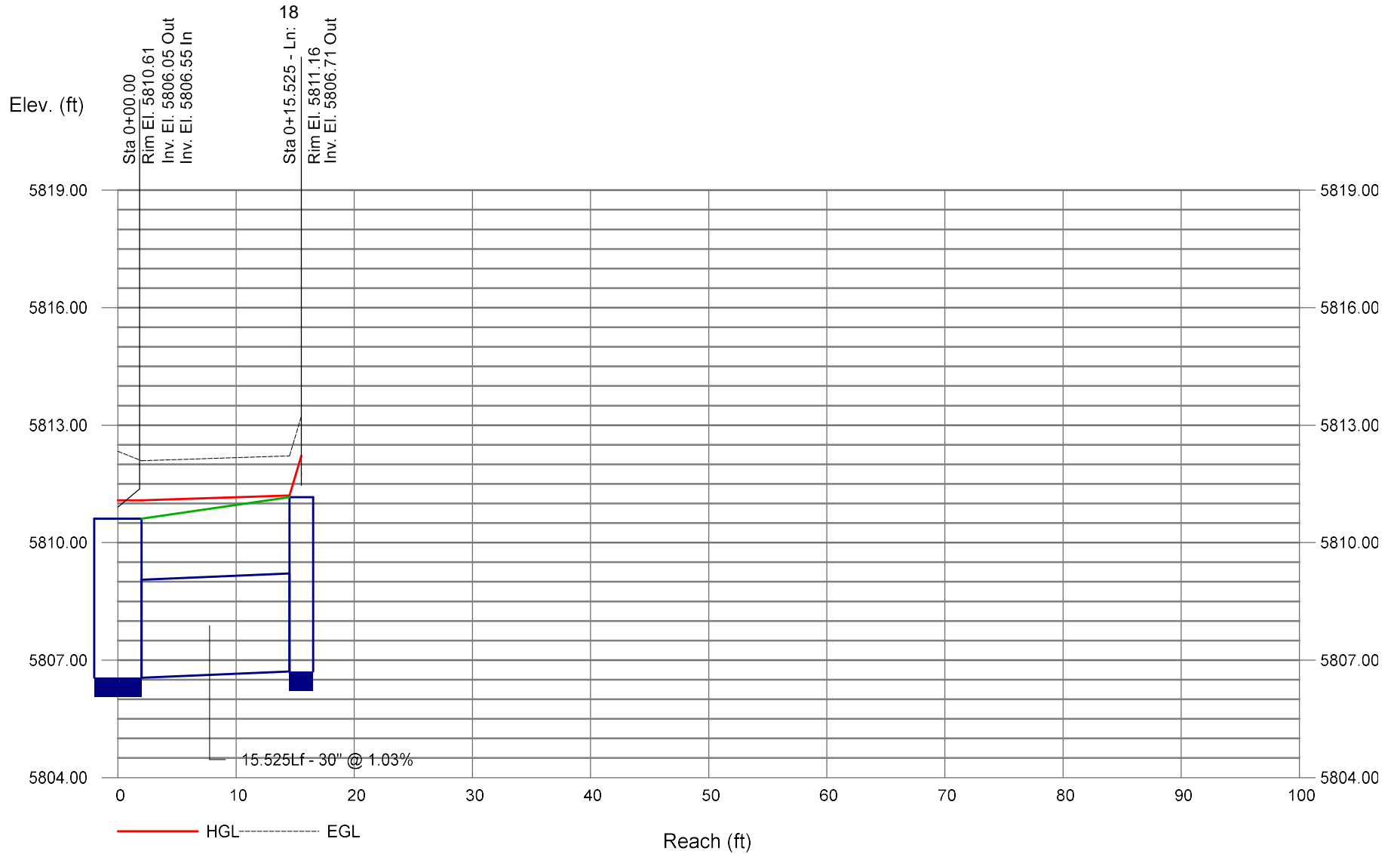
LINES 14-18



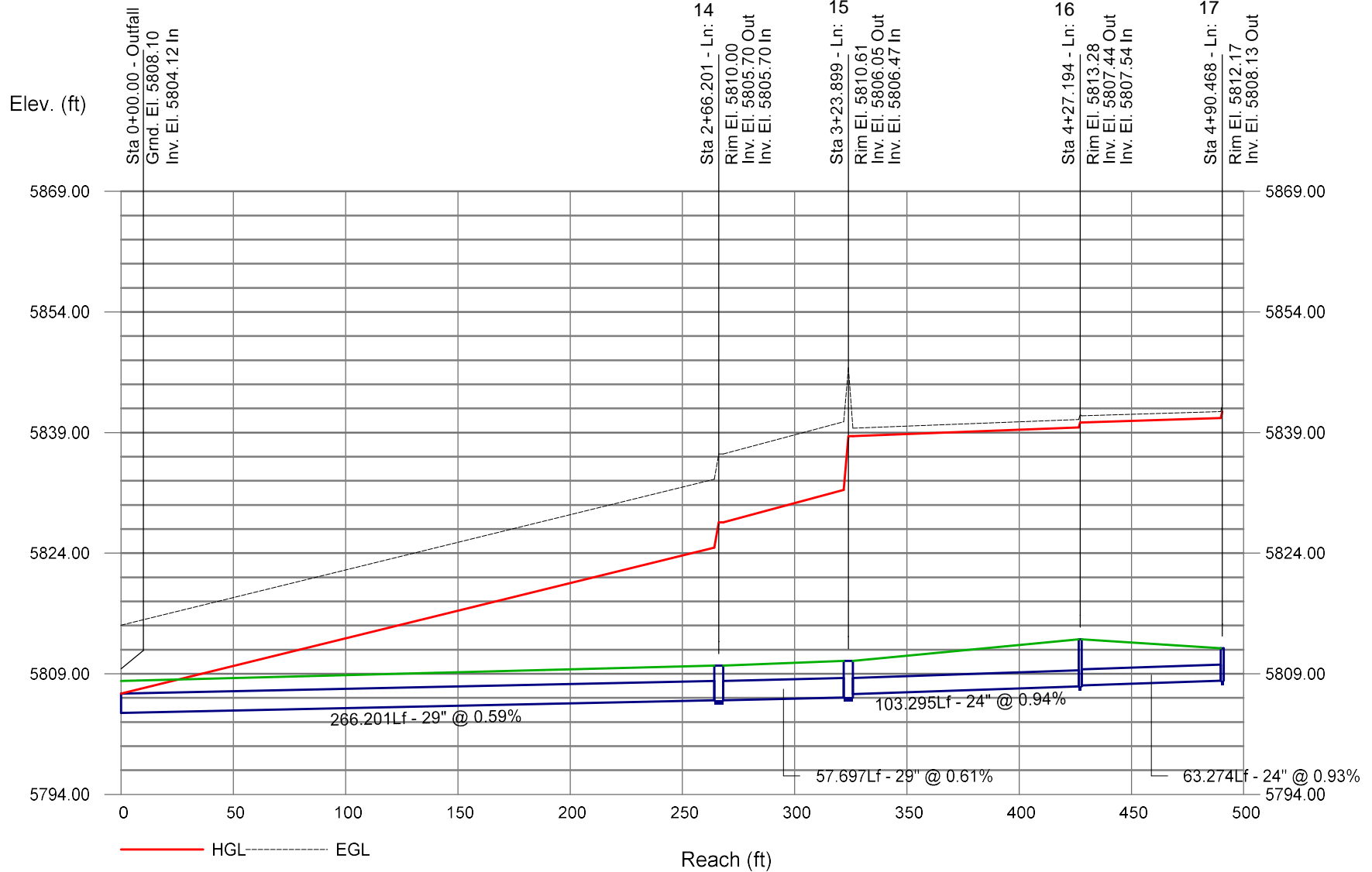
# Storm Sewer Profile



# Storm Sewer Profile

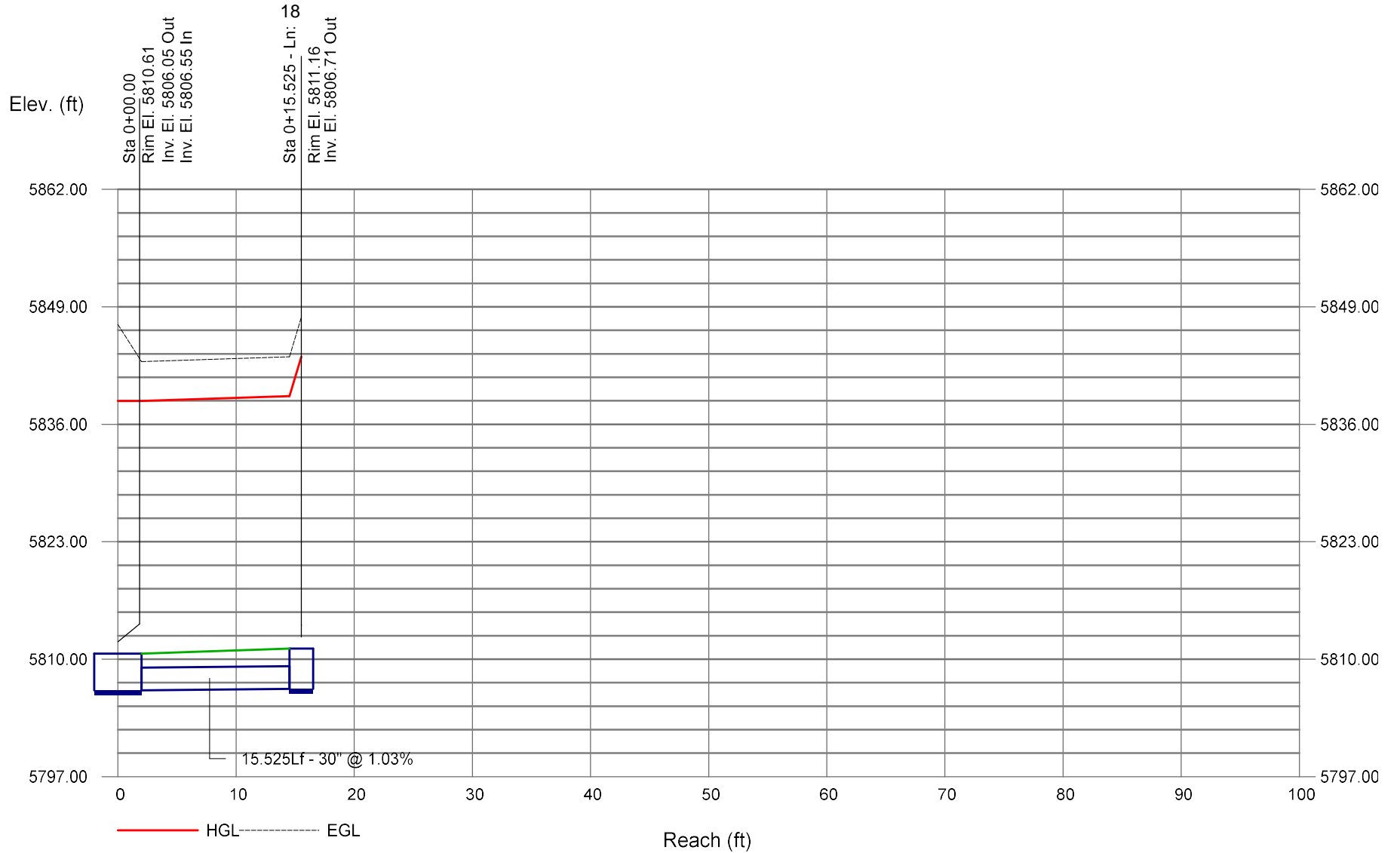


# Storm Sewer Profile





# Storm Sewer Profile



5-yr

Line No.	Flow Rate (cfs)	Line Size (in)	Line Type	Line Length (ft)	Invert Dn (ft)	Invert Up (ft)	Line Slope (%)	HGL Up (ft)	HGL Dn (ft)	Minor Loss (ft)	HGL Jnct (ft)	Vel Ave (ft/s)	J-Loss Coeff
1	21.30	30	Cir	40.816	5810.00	5813.90	9.55	5815.47 j	5811.57	n/a	5815.47	6.57	1.00 z
2	18.50	30	Cir	59.354	5814.00	5815.52	2.56	5816.98 j	5815.47	n/a	5816.98	6.21	1.00 z
3	10.80	30	Cir	51.469	5815.72	5816.23	0.99	5817.33 j	5816.98	n/a	5817.33	4.79	1.00 z
4	9.60	24	Cir	40.385	5816.73	5816.93	0.50	5818.04	5817.80	n/a	5818.04	5.51	1.00 z
5	3.20	18	Cir	205.191	5817.43	5823.82	3.11	5824.50	5818.04	0.20	5824.50	4.44	0.75 z
6	3.20	18	Cir	6.604	5823.82	5824.02	3.03	5824.70	5824.50	0.26	5824.70	4.10	1.00 z
7	1.20	18	Cir	280.163	5817.23	5822.43	1.86	5822.84	5817.51	0.02	5822.84	4.13	0.15 z
8	1.20	18	Cir	362.941	5822.43	5827.29	1.34	5827.70	5822.84	0.15	5827.70	3.07	1.00 z
9	6.40	24	Cir	4.670	5816.93	5816.98	1.07	5817.88	5818.04	0.34	5817.88	4.15	1.00 z
10	7.70	24	Cir	6.168	5816.22	5816.28	0.97	5817.27	5817.00	0.39	5817.27	5.90	1.00 z
11	2.80	18	Cir	10.006	5814.90	5815.00	1.00	5815.64	5815.47	0.24	5815.64	4.25	1.00 z
12	28.10	36	Cir	57.245	5810.67	5813.58	5.08	5815.29 j	5813.07	n/a	5815.29	5.69	0.75 z
13	28.10	36	Cir	333.343	5813.88	5820.50	1.99	5822.21	5815.29	0.71	5822.21	7.66	1.00 z
Notes: j-Line contains hyd. jump; z-Zero Junction Loss													



100-yr

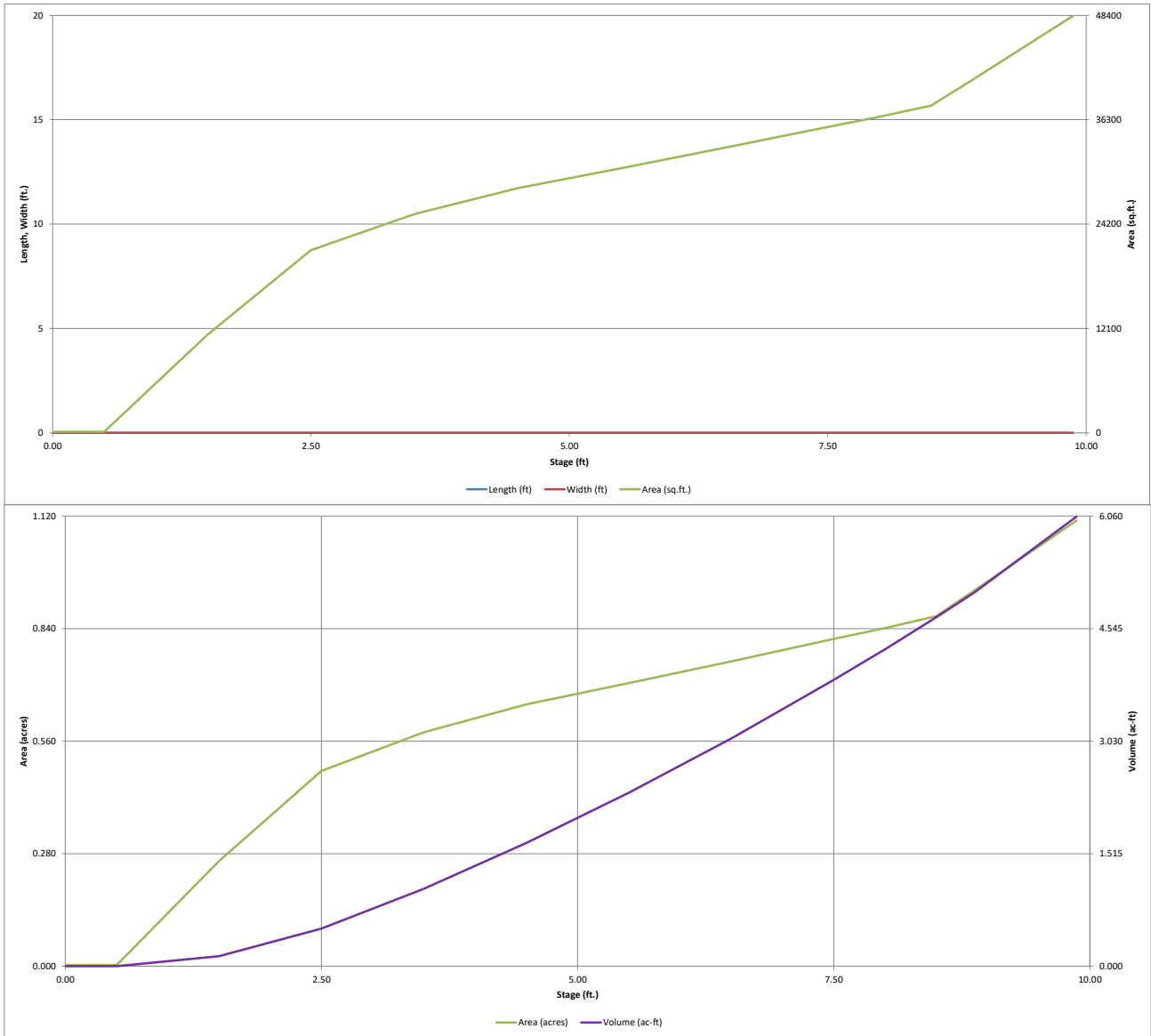
Line No.	Flow Rate (cfs)	Line Size (in)	Line Type	Line Length (ft)	Invert Dn (ft)	Invert Up (ft)	Line Slope (%)	HGL Up (ft)	HGL Dn (ft)	Minor Loss (ft)	HGL Jnct (ft)	Vel Ave (ft/s)	J-Loss Coeff
1	47.30	30	Cir	40.816	5810.00	5813.90	9.55	5816.16	5812.50	1.60	5816.16	9.88	1.00 z
2	41.10	30	Cir	59.354	5814.00	5815.52	2.56	5817.67 j	5816.16	n/a	5817.67	9.13	1.00 z
3	24.10	30	Cir	51.469	5815.72	5816.23	0.99	5817.90	5817.67	n/a	5817.90	6.39	1.00 z
4	20.60	24	Cir	40.385	5816.73	5816.93	0.50	5819.02	5818.73	0.67	5819.69	6.56	1.00
5	6.60	18	Cir	205.191	5817.43	5823.82	3.11	5824.81 j	5819.69	n/a	5824.81	4.53	0.75 z
6	6.60	18	Cir	6.604	5823.82	5824.02	3.03	5825.01	5824.81	0.44	5825.01	5.31	1.00 z
7	3.50	18	Cir	280.163	5817.23	5822.43	1.86	5823.14	5817.90	n/a	5823.14	4.40	0.15 z
8	3.50	18	Cir	362.941	5822.43	5827.29	1.34	5828.00	5823.14	n/a	5828.00	4.23	1.00 z
9	14.00	24	Cir	4.670	5816.93	5816.98	1.07	5819.70	5819.69	0.31	5820.01	4.46	1.00
10	17.00	24	Cir	6.168	5816.22	5816.28	0.97	5817.77	5817.67	0.72	5817.77	6.88	1.00 z
11	6.20	18	Cir	10.006	5814.90	5815.00	1.00	5815.96	5816.16	0.42	5815.96	4.55	1.00 z
12	71.00	36	Cir	57.245	5810.67	5813.58	5.08	5816.25	5813.67	n/a	5816.25	10.37	0.75 z
13	71.00	36	Cir	333.343	5813.88	5820.50	1.99	5823.17	5816.25	n/a	5823.17	11.27	1.00 z
Notes: j-Line contains hyd. jump; z-Zero Junction Loss													





# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

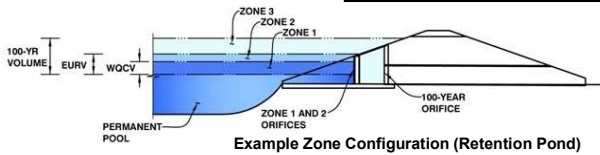
*MHFD-Detention, Version 4.06 (July 2022)*



# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

**Project:** Haven Valley  
**Basin ID:** Pond 1



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.08	0.801	Orifice Plate
Zone 2 (EURV)	6.30	2.113	Orifice Plate
Zone 3 (100-year)	8.24	1.550	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>4.464</b>	

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

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

Calculated Parameters for Underdrain  
Underdrain Orifice Area =  ft<sup>2</sup>  
Underdrain Orifice Centroid =  feet

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

Centroid of Lowest Orifice =  0.00 ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate =  5.89 ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing =  N/A inches  
Orifice Plate: Orifice Area per Row =  N/A sq. inches

Calculated Parameters for Plate  
WQ Orifice Area per Row =  N/A ft<sup>2</sup>  
Elliptical Half-Width =  N/A feet  
Elliptical Slot Centroid =  N/A feet  
Elliptical Slot Area =  N/A ft<sup>2</sup>

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.00	4.00					
Orifice Area (sq. inches)	4.17	4.17	7.50					
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

**User Input:** Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice  
Vertical Orifice Area =  N/A ft<sup>2</sup>  
Vertical Orifice Centroid =  N/A feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir  
Height of Grate Upper Edge, H<sub>u</sub> =  6.50 feet  
Overflow Weir Slope Length =  N/A feet  
Grate Open Area / 100-yr Orifice Area =  6.41  
Overflow Grate Open Area w/o Debris =  11.14 ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris =  5.57 ft<sup>2</sup>

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	13.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
Outlet Orifice Area =  1.74 ft<sup>2</sup>  
Outlet Orifice Centroid =  0.62 feet  
Half-Central Angle of Restrictor Plate on Pipe =  1.65 radians

**User Input:** Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =  8.00 ft (relative to basin bottom at Stage = 0 ft)  
Spillway Crest Length =  46.00 feet  
Spillway End Slopes =  4.00 H:V  
Freeboard above Max Water Surface =  1.00 feet

Calculated Parameters for Spillway  
Spillway Design Flow Depth =  0.87 feet  
Stage at Top of Freeboard =  9.87 feet  
Basin Area at Top of Freeboard =  1.11 acres  
Basin Volume at Top of Freeboard =  6.05 acre-ft

## Routed Hydrograph Results

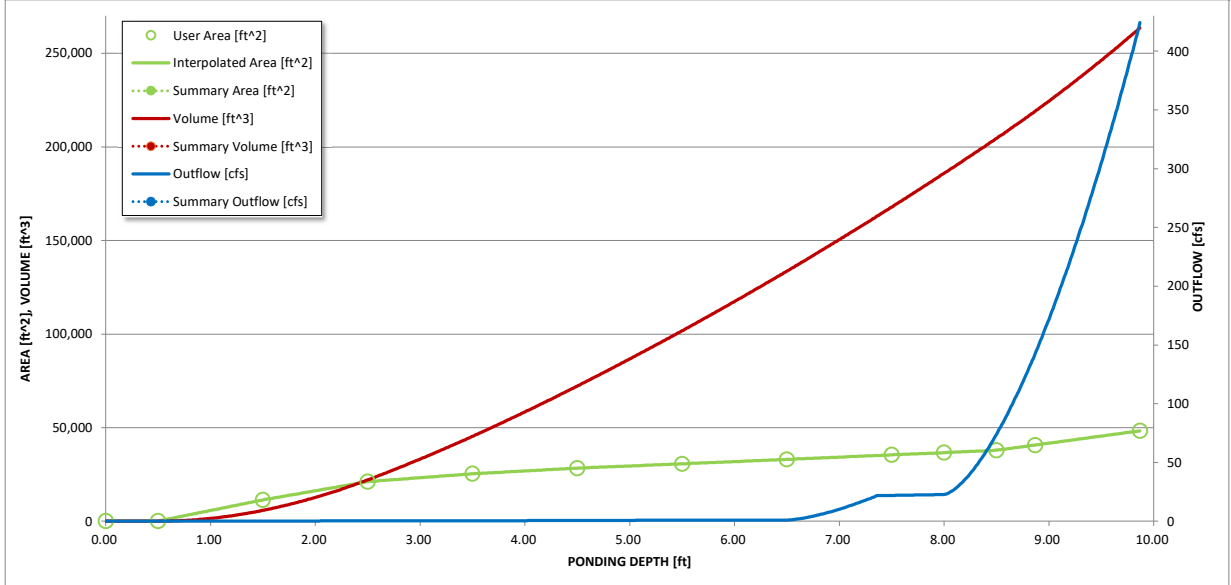
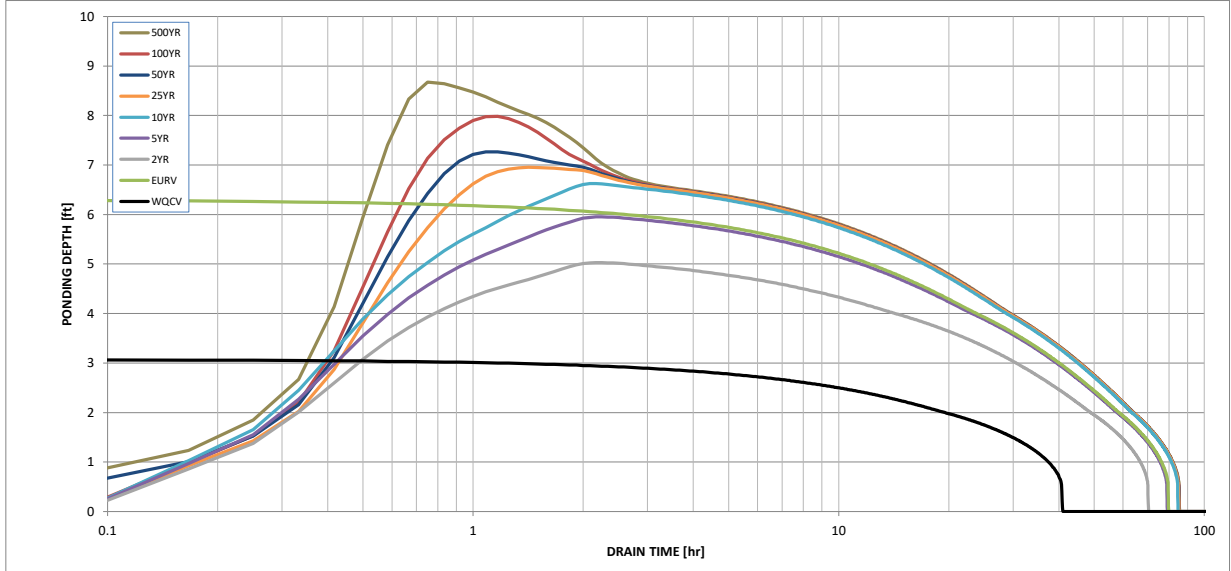
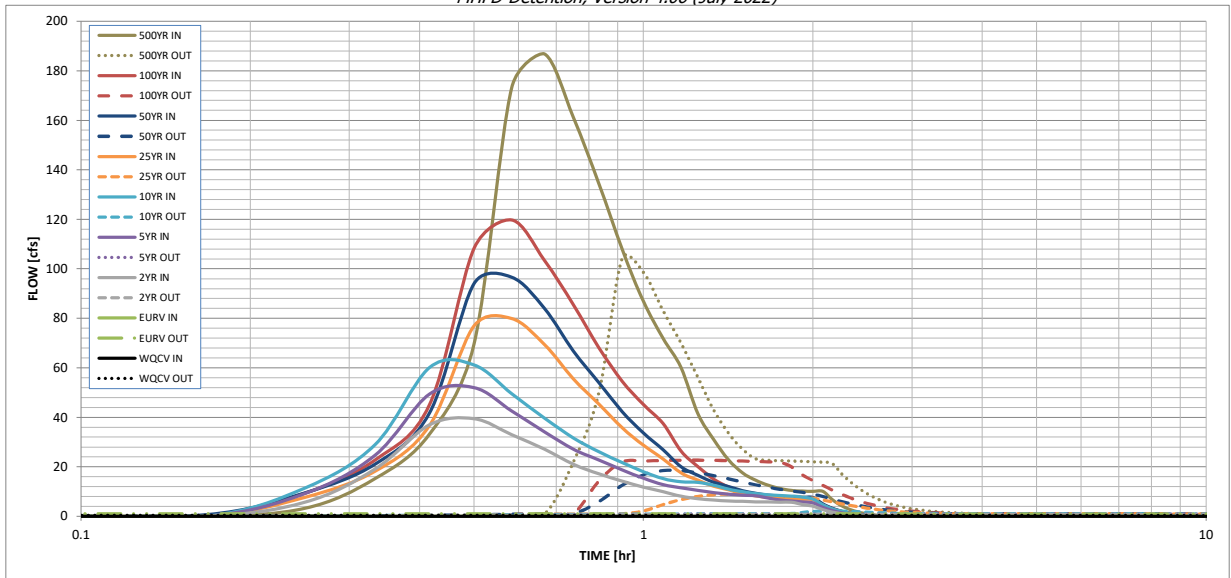
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.49
One-Hour Rainfall Depth (in) =	0.801	2.914	2.123	2.801	3.345	4.111	4.864	5.798	9.040
CUHP Runoff Volume (acre-ft) =	N/A	N/A	2.123	2.801	3.345	4.111	4.864	5.798	9.040
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.4	0.8	1.1	10.1	19.9	32.7	74.0
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.24	0.47	0.78	1.76
Peak Inflow Q (cfs) =	N/A	N/A	39.4	52.0	61.2	79.9	96.6	119.8	186.8
Peak Outflow Q (cfs) =	0.4	1.0	0.8	1.0	2.2	9.0	18.5	22.7	104.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.2	2.0	0.9	0.9	0.7	1.4
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.7	1.6	1.9	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	72	65	72	76	75	73	72	65
Time to Drain 99% of Inflow Volume (hours) =	40	77	68	76	82	81	81	80	78
Maximum Ponding Depth (ft) =	3.08	6.30	5.03	5.95	6.62	6.95	7.27	7.98	8.68
Area at Maximum Ponding Depth (acres) =	0.54	0.75	0.68	0.73	0.77	0.78	0.80	0.84	0.90
Maximum Volume Stored (acre-ft) =	0.805	2.917	2.004	2.659	3.159	3.415	3.661	4.243	4.847



# DETENTION BASIN OUTLET STRUCTURE DESIGN

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



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

# DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

### Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
5.00 min	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.06	3.20
	0:15:00	0.00	0.00	5.66	9.19	11.41	7.68	9.48	9.37	15.23
	0:20:00	0.00	0.00	19.11	24.72	29.00	18.23	21.11	22.81	33.20
	0:25:00	0.00	0.00	37.00	49.38	60.10	36.67	41.73	45.18	69.52
	0:30:00	0.00	0.00	39.40	52.03	61.16	76.89	94.01	108.19	173.19
	0:35:00	0.00	0.00	32.97	42.49	49.49	79.88	96.63	119.78	186.79
	0:40:00	0.00	0.00	27.10	34.15	39.65	69.44	84.01	103.39	161.36
	0:45:00	0.00	0.00	21.04	27.13	31.70	55.59	66.87	85.63	134.48
	0:50:00	0.00	0.00	17.15	22.76	26.07	45.35	54.02	68.14	107.93
	0:55:00	0.00	0.00	14.28	18.76	21.73	35.78	42.31	54.61	86.75
	1:00:00	0.00	0.00	11.78	15.36	18.03	28.72	33.64	45.15	71.94
	1:05:00	0.00	0.00	9.95	12.80	15.20	23.18	26.91	37.49	60.07
	1:10:00	0.00	0.00	8.10	11.54	14.02	17.52	19.99	26.37	41.37
	1:15:00	0.00	0.00	7.10	10.53	13.66	14.62	16.58	20.06	31.05
	1:20:00	0.00	0.00	6.54	9.58	12.55	12.19	13.76	15.05	22.85
	1:25:00	0.00	0.00	6.21	8.96	10.97	10.74	12.09	11.87	17.59
	1:30:00	0.00	0.00	6.02	8.55	9.91	9.22	10.37	10.04	14.57
	1:35:00	0.00	0.00	5.88	8.31	9.19	8.25	9.28	8.80	12.53
	1:40:00	0.00	0.00	5.78	7.32	8.72	7.63	8.58	8.01	11.21
	1:45:00	0.00	0.00	5.73	6.61	8.41	7.21	8.11	7.53	10.42
	1:50:00	0.00	0.00	5.72	6.15	8.19	6.98	7.85	7.36	10.19
	1:55:00	0.00	0.00	4.78	5.84	7.78	6.84	7.69	7.28	10.08
	2:00:00	0.00	0.00	4.11	5.44	6.97	6.77	7.62	7.28	10.08
	2:05:00	0.00	0.00	2.72	3.60	4.63	4.50	5.05	4.84	6.69
	2:10:00	0.00	0.00	1.73	2.30	2.98	2.91	3.27	3.13	4.31
	2:15:00	0.00	0.00	1.10	1.44	1.89	1.85	2.08	1.98	2.72
	2:20:00	0.00	0.00	0.64	0.87	1.13	1.12	1.25	1.19	1.63
	2:25:00	0.00	0.00	0.36	0.53	0.67	0.68	0.76	0.72	0.98
	2:30:00	0.00	0.00	0.16	0.27	0.33	0.35	0.39	0.36	0.49
	2:35:00	0.00	0.00	0.06	0.10	0.11	0.13	0.14	0.13	0.16
	2:40:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

### TOTAL FOREBAY VOLUME

$$V = 3\% \times \text{WQCV}$$

$$\begin{aligned} \text{WQCV} &= 0.801 \text{ ac-ft} \\ V &= 0.0240 \text{ ac-ft} \end{aligned}$$

$$\begin{aligned} Q_{\text{in NE}} &= 71 \text{ cfs} \\ Q_{\text{in E}} &= 44.1 \text{ cfs} \\ Q_{\text{in W}} &= 37.4 \text{ cfs} \\ Q_{\text{total}} &= 152.5 \text{ cfs} \end{aligned}$$

### NORTHEAST FOREBAY VOLUME

$$\frac{71 \text{ cfs}}{152.5 \text{ cfs}} = \frac{x \text{ ac-ft}}{0.0240 \text{ ac-ft}}$$

$$\begin{aligned} x &= 0.0112 \text{ ac-ft} \\ &= 487.3 \text{ ft}^3 \end{aligned}$$

### EAST FOREBAY VOLUME

$$\frac{44.1 \text{ cfs}}{152.5 \text{ cfs}} = \frac{x \text{ ac-ft}}{0.0240 \text{ ac-ft}}$$

$$\begin{aligned} x &= 0.0069 \text{ ac-ft} \\ &= 302.7 \text{ ft}^3 \end{aligned}$$

### WEST FOREBAY VOLUME

$$\frac{37.4 \text{ cfs}}{152.5 \text{ cfs}} = \frac{x \text{ ac-ft}}{0.0240 \text{ ac-ft}}$$

$$\begin{aligned} x &= 0.0059 \text{ ac-ft} \\ &= 256.7 \text{ ft}^3 \end{aligned}$$

### FOREBAY RELEASE NOTCH WIDTH

$$Q = CLH^{2/3}$$

$$\begin{aligned} Q_{100} &= 71 \text{ cfs} \\ 2\% \text{ of } Q &= 1.42 \text{ cfs} \\ C &= 2.6 \\ H \text{ (height of forebay wall)} &= 1 \text{ ft} \\ L &= 7 \text{ in} \end{aligned}$$

### FOREBAY RELEASE NOTCH WIDTH

$$Q = CLH^{2/3}$$

$$\begin{aligned} Q_{100} &= 44.1 \text{ cfs} \\ 2\% \text{ of } Q &= 0.88 \text{ cfs} \\ C &= 2.6 \\ H \text{ (height of forebay wall)} &= 1 \text{ ft} \\ L &= 4 \text{ in} \end{aligned}$$

### FOREBAY RELEASE NOTCH WIDTH

$$Q = CLH^{2/3}$$

$$\begin{aligned} Q_{100} &= 37.4 \text{ cfs} \\ 2\% \text{ of } Q &= 0.75 \text{ cfs} \\ C &= 2.6 \\ H \text{ (height of forebay wall)} &= 1 \text{ ft} \\ L &= 3 \text{ in} \end{aligned}$$

**Worksheet**  
**Worksheet for Rectangular Channel**  
Trickle Channel

---

Project Description

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Worksheet	Rectangular Chann
Flow Element	Rectangular Chann
Method	Manning's Formula
Solve For	Channel Depth

---

---

Input Data

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Mannings Coeffic	0.016
Slope	005000 ft/ft
Bottom Width	6.00 ft
Discharge	2.84 cfs

---

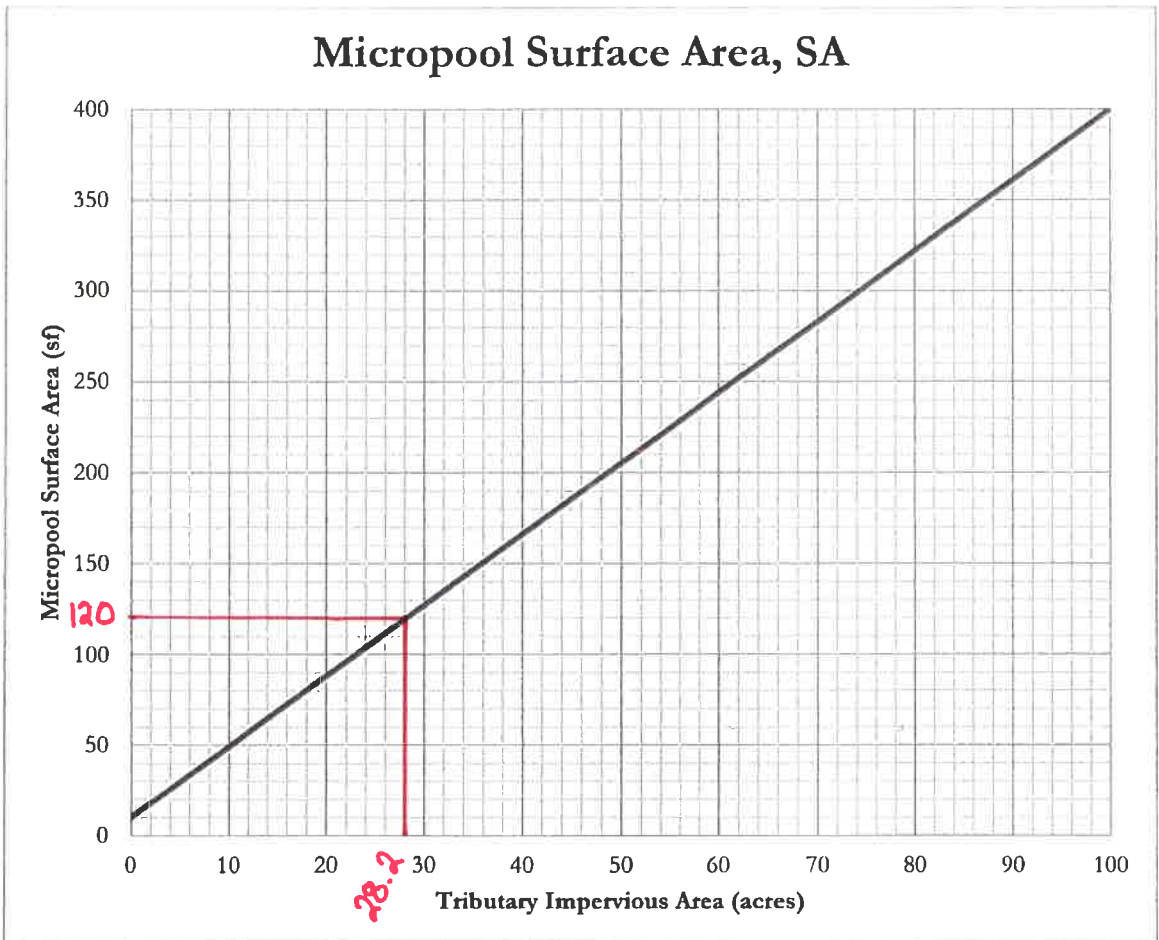
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Results

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Depth	0.21 ft
Flow Area	1.3 ft <sup>2</sup>
Wetted Perim	6.42 ft
Top Width	6.00 ft
Critical Depth	0.19 ft
Critical Slope	0.007034 ft/ft
Velocity	2.23 ft/s
Velocity Head	0.08 ft
Specific Enerç	0.29 ft
Froude Numb	0.85
Flow Type	Subcritical

---



**Figure 1 – Micropool surface area (SA) determination chart**

The tributary impervious area is the effective number of impervious acres that will be treated by the extended detention basin (EDB). It is calculated by multiplying the tributary area to be treated by the impervious fraction of that area.

$$TIA = I \times A$$

$\frac{68}{100} \times 41.47 = 28.2 \text{ ac}$

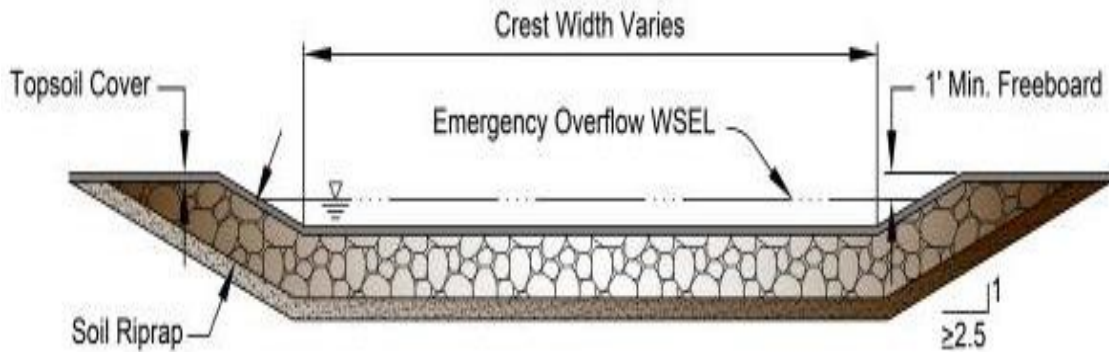
*TIA* = Tributary impervious area (acres)  
*I* = Imperviousness (fraction)  
*A* = Tributary catchment area upstream (acres)

For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is thus calculated by multiplying the micropool surface area by 4 inches.

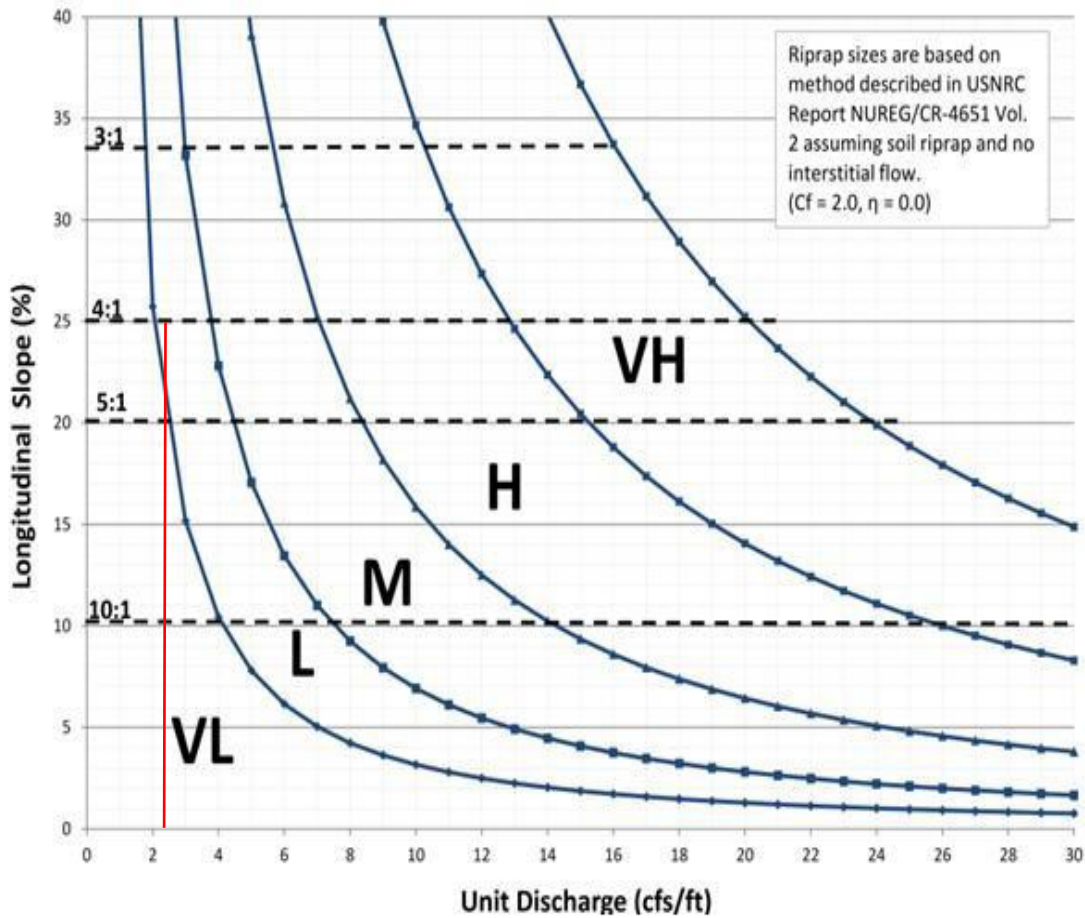
$$ISV = SA \times 4 \text{ inches}$$

*ISV* = Initial surcharge volume (cf)  
*SA* = Surface area (from Figure 1, sf)

**Figure 13-12c. Emergency Spillway Protection**



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



**Worksheet**  
**Worksheet for Rectangular Channel**  
**Concrete channel between existing homes**

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Project Description

---

Worksheet	Rectangular Chann
Flow Element	Rectangular Chann
Method	Manning's Formula
Solve For	Channel Depth

---

---

Input Data

---

Mannings Coeffic	0.016
Slope	030000 ft/ft
Bottom Width	6.50 ft
Discharge	129.00 cfs

---

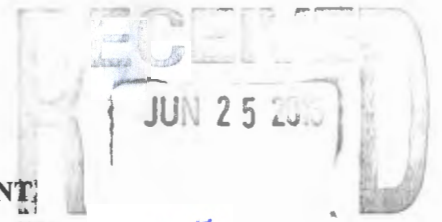
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Results

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Depth	1.30 ft
Flow Area	8.4 ft <sup>2</sup>
Wetted Perim	9.09 ft
Top Width	6.50 ft
Critical Depth	2.30 ft
Critical Slope	0.005771 ft/ft
Velocity	15.30 ft/s
Velocity Head	3.64 ft
Specific Energ	4.93 ft
Froude Numb	2.37
Flow Type	supercritical

---



**DRAINAGE AND UTILITY EASEMENT AGREEMENT**

BY: \_\_\_\_\_  
This Drainage and Utility Easement Agreement ("Agreement") is entered into this 18<sup>th</sup> day of June, 2013, by and between **Bradley D. Schlund and Victoria L. Schlund**, whose address is 3734 Astrozon Drive, Colorado Springs, CO 80910 (collectively the "Grantor") and Midco Investments, LLC, whose address is 1765 S. 8<sup>th</sup> Street, Suite T-1, Colorado Springs, CO 80905.

**RECITALS**

WHEREAS, Grantor is the owner of that certain real property described on Exhibit A attached hereto and incorporated herein by this reference ("Grantor Property").

WHEREAS, Grantee is or shall be the owner of the real property located north of the Grantor Property and described on Exhibit B attached hereto and incorporated herein by this reference ("Grantee Property").

WHEREAS, subject to the express terms and provisions of this Agreement, the parties desire to create a perpetual, exclusive easement over, across, and under a certain portion of the Grantor Property that will be utilized by Grantee to construct and maintain utility and drainage ditch improvements to benefit the Grantee Property.

NOW, THEREFORE, in consideration for the mutual promises contained herein and for other valuable consideration given and received, the receipt and sufficiency of which are hereby acknowledged, the parties hereto, intending to be legally bound, do hereby agree as follows:

**ARTICLE I**  
Creation and Use of Easement

1.1. Incorporation. Recitals set forth above are hereby incorporated herein as if fully set forth in this Article.

1.2. Grant of Easement/Scope of Use. Grantor does hereby sell, convey, grant, assign and transfer unto Grantee, and their respective successors and assigns, a perpetual, exclusive easement over, across, and under that portion of the Grantor Property legally described on Exhibit C attached hereto and incorporated herein by this reference, and illustrated on Exhibit D attached hereto and incorporated herein by this reference (the "Drainage and Utility Easement"). The Drainage and Utility Easement shall be utilized solely for the purpose of constructing and maintaining utility and drainage ditch improvements benefitting the Grantee Property. The Drainage and Utility Easement shall grant Grantee, its successors and assigns, the right and privilege to construct, reconstruct, inspect, alter, improve, remove, repair and maintain the Improvements (as defined below), including all rights and privileges necessary or convenient for the full enjoyment and use thereof, including but not limited to the right of ingress and egress over Grantor's Property for the purpose of exercising the easement rights granted herein.

1.3. No Barriers or Impediments. Grantor shall not construct, erect or install any fences, barrier, impediments, gates, landscaping, or other improvements ("Impediments") within the Drainage and Utility Easement which would impede the use of the Drainage and Utility Easement for



utility and storm water delivery. Grantee shall have the right to remove any Impediments from the Drainage and Utility Easement and shall have no liability to Grantee for any damage caused to such Impediment. The cost of such removal shall be paid by Grantor.

## ARTICLE II

### Construction: Maintenance and Repair: Indemnity

2.1 Construction of Improvements. Grantee shall, at Grantee's sole cost and expense, install and maintain utility service lines serving the Grantee Property and design and construct a utility and drainage ditch (the "Improvements") within the Drainage and Utility Easement sufficient to provide utility service to the Grantee Property and to accept and deliver storm water from the Grantee Property, as determined by Grantee at Grantee's sole discretion.

2.2 Maintenance and Repair. Grantee shall, at Grantee's sole cost and expense, maintain the Improvements in good working order, including but not limited to, maintaining the structures and side slopes of the Drainage and Utility Easement free of debris, impoundments or alterations to the flow of storm water drainage. After construction of Improvements which disturbs the surface, Grantee will restore the general surface of the ground as nearly as may reasonably be done to the condition it was in immediately prior to construction, except as necessarily modified to accommodate Improvements.

2.3 Indemnity. Grantee and their respective successors and assigns, hereby release, indemnify and hold Grantor harmless against and from any and all claims, causes of action, liabilities and damages (collectively "claims"), including attorney's fees, arising from any act or omission by Grantee or their successors and assigns in connection with the use and operation of the Improvements. This indemnification shall not extend to any claims arising from the negligent actions of Grantor, their successors, assigns or invitees.

## ARTICLE III

### Miscellaneous

3.1 Run with the Land. The provisions of this Agreement shall run with the Grantor Property and the Grantee Property and shall inure to the benefit of and be binding upon the owners, tenants, lessees thereof and their successors in interest and assigns, including their grantees, sub-lessees and assigns and all persons or entities claiming through them.

3.2 Amendment and Termination. This Agreement is perpetual and may only be amended or terminated by recordation of a written instrument in the official real property records of El Paso County, Colorado, executed by the owners of the Grantor Property and the Grantee Property.

3.3 Default: Attorneys' Fees. The failure of any party to this Agreement to comply with its responsibilities or obligations herein shall entitle the non-defaulting party to pursue any and all appropriate legal recourse, including the rights of injunction, damages, specific performance or any or all of the above. Should any party institute legal action or proceeding for the enforcement of the any responsibilities or obligations herein, the prevailing party shall be entitled to recover its reasonable attorneys' fees and costs incurred in the preparation and prosecution of such action or proceeding.

3.4 Governing Law; Venue. The laws of the State of Colorado shall govern the interpretation, validity, performance and enforcement of this Agreement. Venue shall be in El Paso County, Colorado.

3.5 No Joint Venture. Nothing in this Agreement shall be deemed or construed to create the relationship of partnership, joint venture, principal and agent, or any other association between or among the parties.

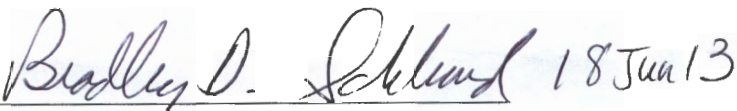
3.6 No Third Party Beneficiaries. Nothing in this Agreement shall be deemed to constitute a gift, grant or dedication of any portion of the Drainage and Utility Easement to the general public or for any public purpose. The provisions of this Agreement are for the exclusive benefit of the parties hereto (and their successors and assigns) and shall not be deemed to have conferred any rights, express or implied, upon any third person.

3.7 Assignment. Grantee may assign all of its right, title and interest in and under this Agreement to either El Paso County, Colorado or author applicable governing jurisdiction ("County") or a homeowner's association ("HOA") formed in connection with Grantee's development of the Grantee Property. In the event that either El Paso County or the HOA accepts conveyance of the Improvements and the rights and obligations set forth in this Agreement, including but not limited to the right to construct, maintain and repair the Improvements, the obligations of Grantee with respect to such construction, maintenance and repair shall thereafter cease and become the obligations of the County or the HOA, whichever is applicable.

3.8 Exhibits. Each of the exhibits referenced herein and attached hereto are made part of this Agreement as if fully set forth herein.

IN WITNESS WHEREOF, the parties have executed this Easement Agreement the day and year first above written.

**GRANTOR:**

  
Bradley D. Schlund

  
Victoria L. Schlund

STATE OF COLORADO )  
COUNTY OF EL PASO ) ss.

The foregoing instrument was acknowledged before me this 18 day of June, 2013, by Bradley D. Schlund and Victoria L. Schlund.

Witness my hand and official seal.

NOTARY PUBLIC STATE OF ALABAMA AT LARGE  
MY COMMISSION EXPIRES: Oct 11, 2014  
BONDED THRU NOTARY PUBLIC UNDERWRITERS



Tammie R. Shelton  
NOTARY PUBLIC

GRANTEE:

[Signature]  
Midco Investments, LLC  
By: Robert C. Irwin, Manager



STATE OF COLORADO )  
COUNTY OF EL PASO ) ss.

Subscribed and sworn to before me this 28th of June, 2013, by Robert C. Irwin, Manager, Midco Investments, LLC.

My commission expires: 7-8-15

Glenda R. Lee  
NOTARY PUBLIC

EXHIBIT A

LEGAL DESCRIPTION OF GRANTOR PROPERTY

**Lot 9, Block 12, Subdivision of Tract 1 of the Refiling of Security, Colorado Addition No. 4, as recorded in Plat Book Z at Page 76, El Paso County, Colorado**

**also known by street number 416 Pecos Drive (Schedule No. 6512201017)**

EXHIBIT B

LEGAL DESCRIPTION OF GRANTEE PROPERTY

The North Half of the Northwest Quarter of the Northwest Quarter of Section 12 in Township 15 South, Range 66 West of the 6th P.M., EXCEPT that portion conveyed in Warranty Deed recorded November 25, 1959 in Book 1779 at Page 409, and EXCEPT that portion lying within the existing right of way of former Bradley Road, now designated as Cable Lane.

Exhibit C

LEGAL DESCRIPTION:

AN EASEMENT OVER, UNDER AND ACROSS A PORTION OF LOT 9, BLOCK 12, SUBDIVISION OF TRACT NO. 1 OF THE REFILEING OF SECURITY, COLORADO ADDITION NO. 4 AS RECORDED IN PLAT BOOK Z AT PAGE 76 OF THE RECORDS OF THE EL PASO COUNTY, COLORADO CLERK AND RECORDER AND LOCATED IN THE NORTHWEST ONE-QUARTER (NW ¼) SECTION 12, TOWNSHIP 15 SOUTH, RANGE 66 WEST OF THE 6<sup>th</sup> P.M., EL PASO COUNTY, COLORADO, SAID TRACT BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHEAST CORNER OF SAID LOT 9; THENCE S 89° 57' 51" W (AN ASSUMED BEARING TO WHICH ALL OTHERS HEREIN ARE RELATIVE) ALONG THE NORTHERLY LINE OF SAID LOT, A DISTANCE OF 105.12 FEET TO THE POINT OF BEGINNING OF THE EASEMENT HEREIN DESCRIBED;

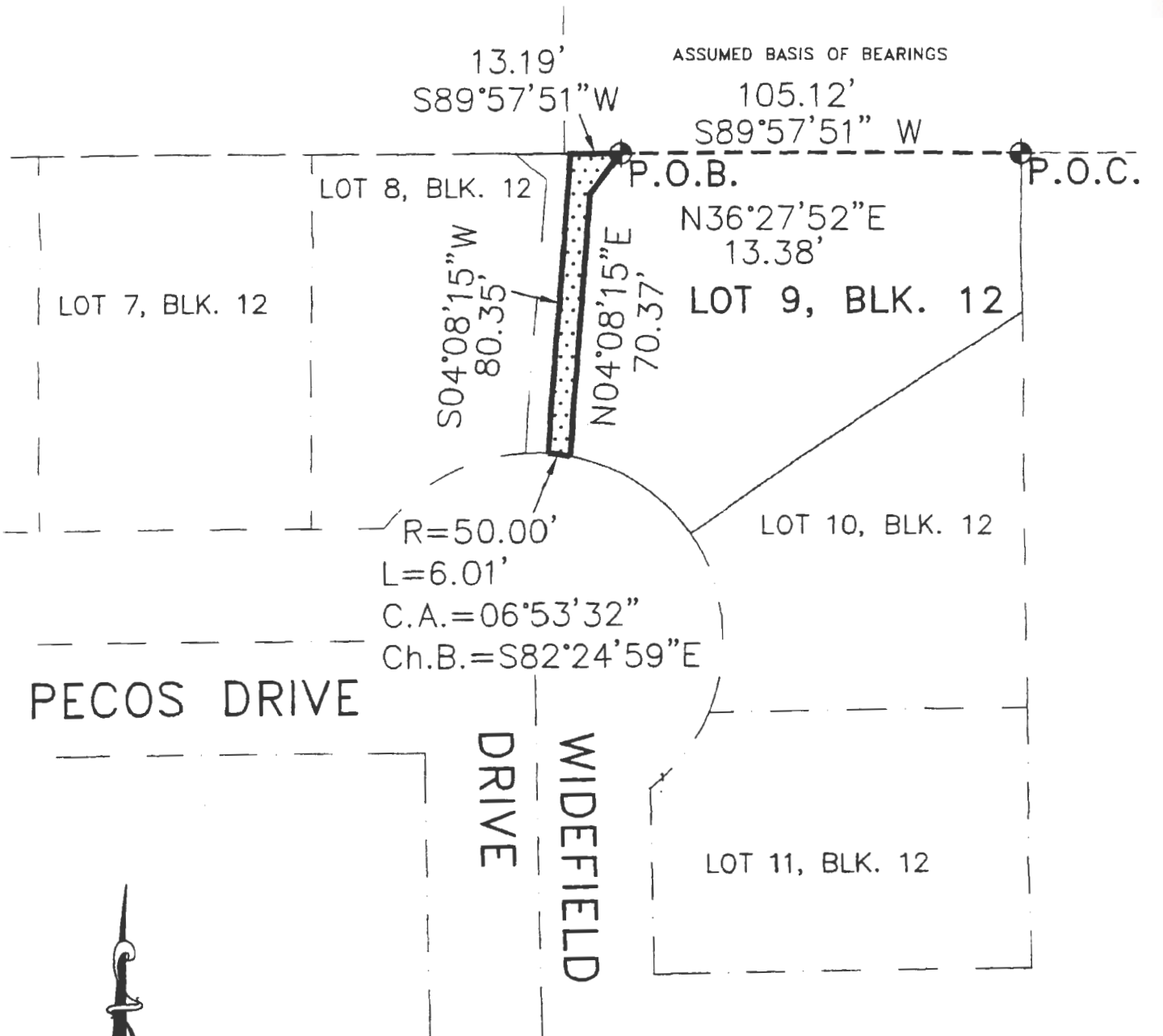
THENCE CONTINUING S 89° 57' 51" W ALONG SAID NORTHERLY LINE, A DISTANCE OF 13.19 FEET TO THE NORTHWEST CORNER OF SAID LOT; THENCE S 04° 08' 15" W ALONG THE WESTERLY BOUNDARY OF SAID LOT, A DISTANCE OF 80.35 FEET TO THE SOUTHWEST CORNER OF SAID LOT; THENCE EASTERLY ALONG THE SOUTHERLY BOUNDARY OF SAID LOT AND ALONG THE ARC OF A 50.00 FOOT RADIUS CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 06° 53' 32" (THE LONG CHORD OF WHICH BEARS S 82° 24' 59" E, A LONG CHORD DISTANCE OF 6.01 FEET), AN ARC LENGTH OF 6.01 FEET; THENCE N 04° 08' 15" E, A DISTANCE OF 70.37 FEET; THENCE N 36° 27' 52" E, A DISTANCE OF 13.38 FEET TO THE POINT OF BEGINNING. SAID EASEMENT CONTAINS 523 SQUARE FEET, MORE OR LESS.

PREPARED BY:

CHRISTOPHER THOMPSON  
COLORADO P.L.S. NO. 19625  
FOR AND ON BEHALF OF ROCKY MOUNTAIN LAND SERVICES  
1623 SOUTH TEJON STREET  
COLORADO SPRINGS, COLORADO 80906  
719-630-0559

# EXHIBIT FOR LEGAL DESCRIPTION

AN EASEMENT OVER A PORTION OF LOT 9, BLOCK 12, SUBDIVISION OF TRACT NO. 1, REFILEING OF SECURITY, COLORADO ADDITION NO. 4 NW 1/4 OF SECTION 12, TOWNSHIP 15 SOUTH, RANGE 66 WEST EL PASO COUNTY, COLORADO



SUBDIVISION OF TRACT NO. 1 OF THE REFILEING OF SECURITY, CO. ADDITION NO. 4 PLAT BOOK Z, PG. 76

  
  
 SCALE: 1" = 40'  
 JOB NO.: 24147  
 JUNE 1, 2007

  
 ROCKY MOUNTAIN LAND SERVICES  
 1823 SOUTH TEJON STREET  
 COLORADO SPRINGS, COLORADO  
 719-630-0659

**DRAINAGE AND UTILITY EASEMENT AGREEMENT**

This Drainage and Utility Easement Agreement ("Agreement") is entered into this 6<sup>TH</sup> day of November, 2012, by and between Christopher T. Pyle, whose address is 5395 Alturas Drive, Colorado Springs, CO 80911 ("Grantor"), and Midco Investments, LLC or assigns, whose address is 1765 S. 8<sup>th</sup> Street, Suite T-1, Colorado Springs, CO 80905 ("Grantee").

**RECITALS**

WHEREAS, Grantor is the owner of that certain real property described on Exhibit A attached hereto and incorporated herein by this reference ("Grantor Property").

WHEREAS, Grantee is or shall be the owner of the real property located north of the Grantor Property and described on Exhibit B attached hereto and incorporated herein by this reference ("Grantee Property").

WHEREAS, subject to the express terms and provisions of this Agreement, the parties desire to create a perpetual, exclusive easement over, across, and under a certain portion of the Grantor Property that will be utilized by Grantee to construct and maintain utility and drainage ditch improvements to benefit the Grantee Property.

NOW, THEREFORE, in consideration for the mutual promises contained herein and for other valuable consideration given and received, the receipt and sufficiency of which are hereby acknowledged, the parties hereto, intending to be legally bound, do hereby agree as follows:

**ARTICLE I**

Creation and Use of Easement

1.1. Incorporation. Recitals set forth above are hereby incorporated herein as if fully set forth in this Article.

1.2 Grant of Easement/Scope of Use. Grantor does hereby sell, convey, grant, assign and transfer unto Grantee, and their respective successors and assigns, a perpetual, exclusive easement over, across, and under that portion of the Grantor Property legally described on Exhibit C attached hereto and incorporated herein by this reference, and illustrated on Exhibit D attached hereto and incorporated herein by this reference (the "Drainage and Utility Easement"). The Drainage and Utility Easement shall be utilized solely for the purpose of constructing and maintaining utility and drainage ditch improvements benefitting the Grantee Property. The Drainage and Utility Easement shall grant Grantee, its successors and assigns, the right and privilege to construct, reconstruct, inspect, alter, improve, remove, repair and maintain the Improvements (as defined below), including all rights and privileges necessary or convenient for the full enjoyment and use thereof, including but not limited to the right of ingress and egress over Grantor's Property for the purpose of exercising the easement rights granted herein.

1.3 No Barriers or Impediments. Grantor shall not construct, erect or install any fences, barrier, impediments, gates, landscaping, or other improvements ("Impediments") within the Drainage and Utility Easement which would impede the use of the Drainage and Utility Easement for

212132860



utility and storm water delivery. Grantee shall have the right to remove any Impediments from the Drainage and Utility Easement and shall have no liability to Grantee for any damage caused to such Impediment. The cost of such removal shall be paid by Grantor.

## ARTICLE II

### Construction: Maintenance and Repair: Indemnity

2.1 Construction of Improvements. Grantee shall, at Grantee's sole cost and expense, install and maintain utility service lines serving the Grantee Property and design and construct a utility and drainage ditch (the "Improvements") within the Drainage and Utility Easement sufficient to provide utility service to the Grantee Property and to accept and deliver storm water from the Grantee Property, as determined by Grantee at Grantee's sole discretion.

2.2 Maintenance and Repair. Grantee shall, at Grantee's sole cost and expense, maintain the Improvements in good working order, including but not limited to, maintaining the structures and side slopes of the Drainage and Utility Easement free of debris, impoundments or alterations to the flow of storm water drainage. After construction of Improvements which disturbs the surface, Grantee will restore the general surface of the ground, including reconstructing or replacing existing fence or fences, as nearly as may reasonably be done to the condition it was in immediately prior to construction, except as necessarily modified to accommodate Improvements.

2.3 Indemnity. Grantee and their respective successors and assigns, hereby release, indemnify and hold Grantor harmless against and from any and all claims, causes of action, liabilities and damages (collectively "claims"), including attorney's fees, arising from any act or omission by Grantee or their successors and assigns in connection with the use and operation of the Improvements. This indemnification shall not extend to any claims arising from the negligent actions of Grantor, their successors, assigns or invitees.

## ARTICLE III

### Miscellaneous

3.1 Run with the Land. The provisions of this Agreement shall run with the Grantor Property and the Grantee Property and shall inure to the benefit of and be binding upon the owners, tenants, lessees thereof and their successors in interest and assigns, including their grantees, sub-lessees and assigns and all persons or entities claiming through them.

3.2 Amendment and Termination. This Agreement is perpetual and may only be amended or terminated by recordation of a written instrument in the official real property records of El Paso County, Colorado, executed by the owners of the Grantor Property and the Grantee Property.

3.3 Default: Attorneys' Fees. The failure of any party to this Agreement to comply with its responsibilities or obligations herein shall entitle the non-defaulting party to pursue any and all appropriate legal recourse, including the rights of injunction, damages, specific performance or any or all of the above. Should any party institute legal action or proceeding for the enforcement of the any responsibilities or obligations herein, the prevailing party shall be entitled to recover its reasonable attorneys' fees and costs incurred in the preparation and prosecution of such action or proceeding.

3.4 Governing Law; Venue. The laws of the State of Colorado shall govern the interpretation, validity, performance and enforcement of this Agreement. Venue shall be in El Paso County, Colorado.

3.5 No Joint Venture. Nothing in this Agreement shall be deemed or construed to create the relationship of partnership, joint venture, principal and agent, or any other association between or among the parties.

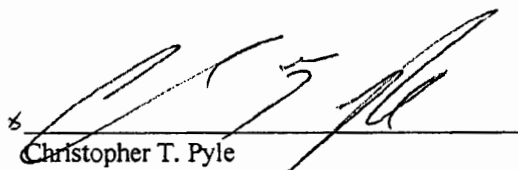
3.6 No Third Party Beneficiaries. Nothing in this Agreement shall be deemed to constitute a gift, grant or dedication of any portion of the Drainage and Utility Easement to the general public or for any public purpose. The provisions of this Agreement are for the exclusive benefit of the parties hereto (and their successors and assigns) and shall not be deemed to have conferred any rights, express or implied, upon any third person.

3.7 Assignment. Grantee may assign all of its right, title and interest in and under this Agreement to either El Paso County, Colorado or author applicable governing jurisdiction ("County") or a homeowner's association ("HOA") formed in connection with Grantee's development of the Grantee Property. In the event that either El Paso County or the HOA accepts conveyance of the Improvements and the rights and obligations set forth in this Agreement, including but not limited to the right to construct, maintain and repair the Improvements, the obligations of Grantee with respect to such construction, maintenance and repair shall thereafter cease and become the obligations of the County or the HOA, whichever is applicable.

3.8 Exhibits. Each of the exhibits referenced herein and attached hereto are made part of this Agreement as if fully set forth herein.

IN WITNESS WHEREOF, the parties have executed this Easement Agreement the day and year first above written.

GRANTOR

  
Christopher T. Pyle

STATE OF COLORADO     }  
COUNTY OF EL PASO    } ss.

The foregoing instrument was acknowledged before me this 6<sup>th</sup> day of NOVEMBER, 2012, by Christopher T. Pyle.

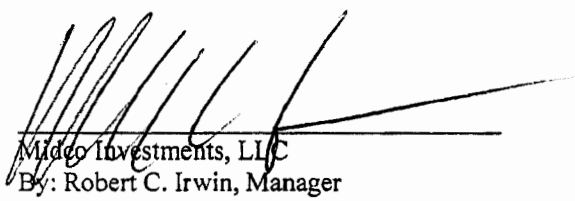
Witness my hand and official seal.

My commission expires: 8-6-15

AMELIA A WALSH  
Notary Public  
State of Colorado  
My Commission Expires: August 6, 2015  
LIC# 20034028175

  
NOTARY PUBLIC

**GRANTEE**

  
Midco Investments, LLC  
By: Robert C. Irwin, Manager

STATE OF COLORADO     )  
  ) ss.  
COUNTY OF EL PASO     )

Subscribed and sworn to before me this 6 of November, 2012, by Robert C. Irwin, Manager, Midco Investments, LLC.

My commission expires: \_\_\_\_\_

CINDY S STIMITS  
Notary Public  
State of Colorado  
My Commission Expires: August 9, 2013  
LIC# 19974012915

  
NOTARY PUBLIC

**EXHIBIT A**

**LEGAL DESCRIPTION OF GRANTOR PROPERTY**

**Lot 8, Block 12, Subdivision of Tract 1 of the Refilling of Security, Colorado Addition No. 4, as recorded in Plat Book Z at Page 76, El Paso County, Colorado**

**also known by street number 412 Pecos Drive (Schedule No. 6512201016)**

EXHIBIT B

LEGAL DESCRIPTION OF GRANTEE PROPERTY

The North Half of the Northwest Quarter of the Northwest Quarter of Section 12 in Township 15 South, Range 66 West of the 6th P.M., EXCEPT that portion conveyed in Warranty Deed recorded November 25, 1959 in Book 1779 at Page 409, and EXCEPT that portion lying within the existing right of way of former Bradley Road, now designated as Cable Lane.

# EXHIBIT C

## LEGAL DESCRIPTION:

AN EASEMENT OVER, UNDER AND ACROSS A PORTION OF LOT 8, BLOCK 12, SUBDIVISION OF TRACT NO. 1 OF THE REFILING OF SECURITY, COLORADO ADDITION NO. 4 AS RECORDED IN PLAT BOOK Z AT PAGE 76 OF THE RECORDS OF THE EL PASO COUNTY, COLORADO CLERK AND RECORDER AND LOCATED IN THE NORTHWEST ONE-QUARTER (NW ¼) SECTION 12, TOWNSHIP 15 SOUTH, RANGE 66 WEST OF THE 6<sup>th</sup> P.M., EL PASO COUNTY, COLORADO, SAID TRACT BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHEAST CORNER OF LOT 9, BLOCK 12; THENCE S 89° 57' 51" W (AN ASSUMED BEARING TO WHICH ALL OTHERS HEREIN ARE RELATIVE) ALONG THE NORTHERLY LINE OF SAID LOT, A DISTANCE OF 118.31 FEET TO THE NORTHEAST CORNER OF SAID LOT 8 AND ALSO BEING THE POINT OF BEGINNING OF THE EASEMENT HEREIN DESCRIBED;

THENCE S 04° 08' 15" W ALONG THE EASTERLY BOUNDARY OF SAID LOT 8, A DISTANCE OF 80.35 FEET TO THE SOUTHEAST CORNER OF SAID LOT; THENCE WESTERLY ALONG THE SOUTHERLY BOUNDARY OF SAID LOT AND ALONG THE ARC OF A 50.00 FOOT RADIUS CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 06° 53' 32" (THE LONG CHORD OF WHICH BEARS N 89° 18' 30" W, A LONG CHORD DISTANCE OF 6.01 FEET), AN ARC LENGTH OF 6.01 FEET; THENCE N 04° 08' 15" E, A DISTANCE OF 73.37 FEET; THENCE N 50° 18' 48" W, A DISTANCE OF 10.78 FEET TO A POINT ON THE NORTHERLY BOUNDARY OF SAID LOT 8; THENCE N 89° 57' 51" E ALONG SAID NORTHERLY BOUNDARY, A DISTANCE OF 14.81 FEET TO THE POINT OF BEGINNING. SAID EASEMENT CONTAINS 512 SQUARE FEET, MORE OR LESS.

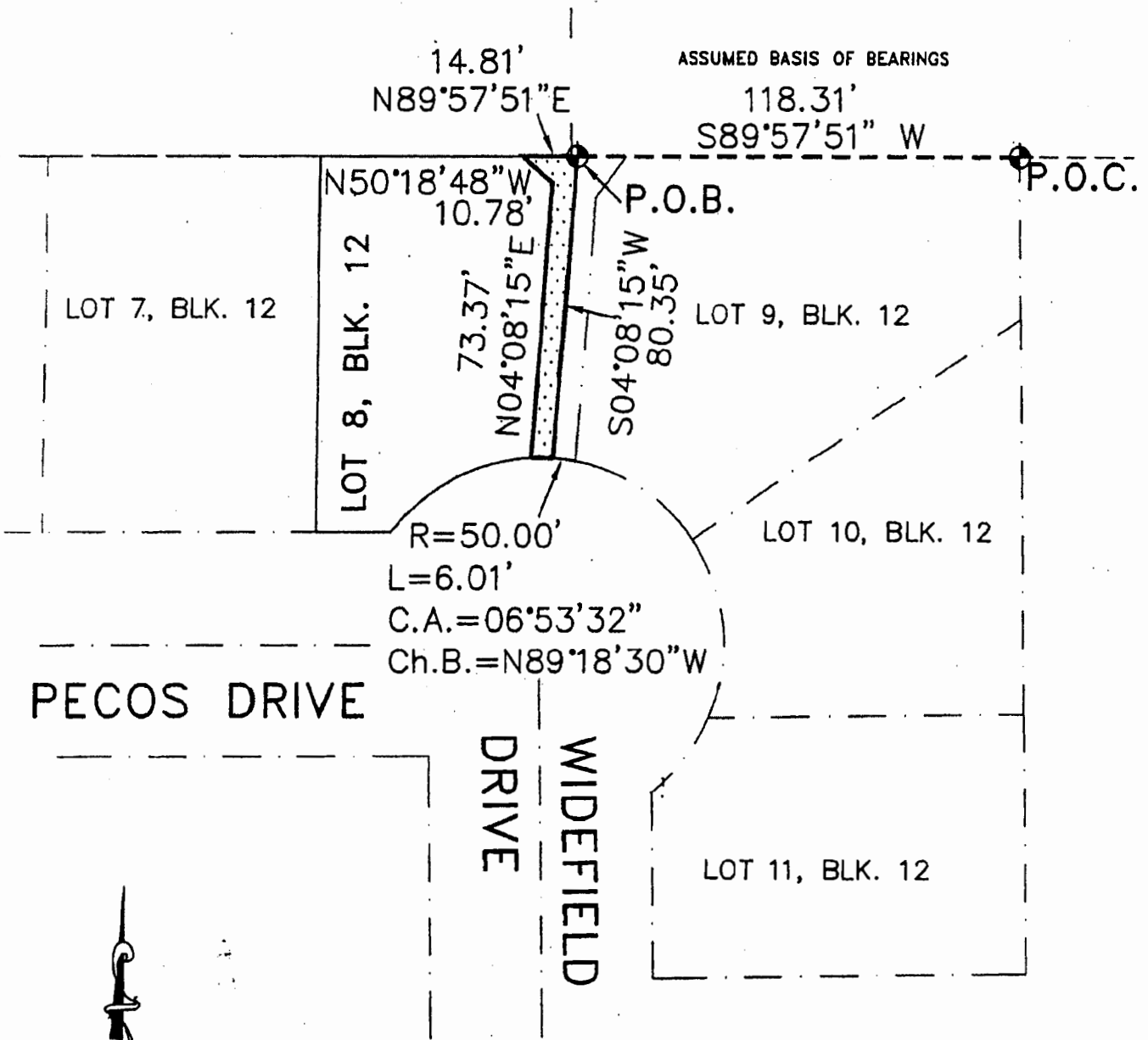
### PREPARED BY:

CHRISTOPHER THOMPSON  
COLORADO P.L.S. NO. 19625  
FOR AND ON BEHALF OF ROCKY MOUNTAIN LAND SERVICES  
1623 SOUTH TEJON STREET  
COLORADO SPRINGS, COLORADO 80906  
719-630-0559

EXHIBIT D

EXHIBIT FOR LEGAL DESCRIPTION

AN EASEMENT OVER A PORTION OF LOT 8, BLOCK 12, SUBDIVISION OF TRACT NO. 1, REFILEING OF SECURITY, COLORADO ADDITION NO. 4 NW 1/4 OF SECTION 12, TOWNSHIP 15 SOUTH, RANGE 66 WEST EL PASO COUNTY, COLORADO

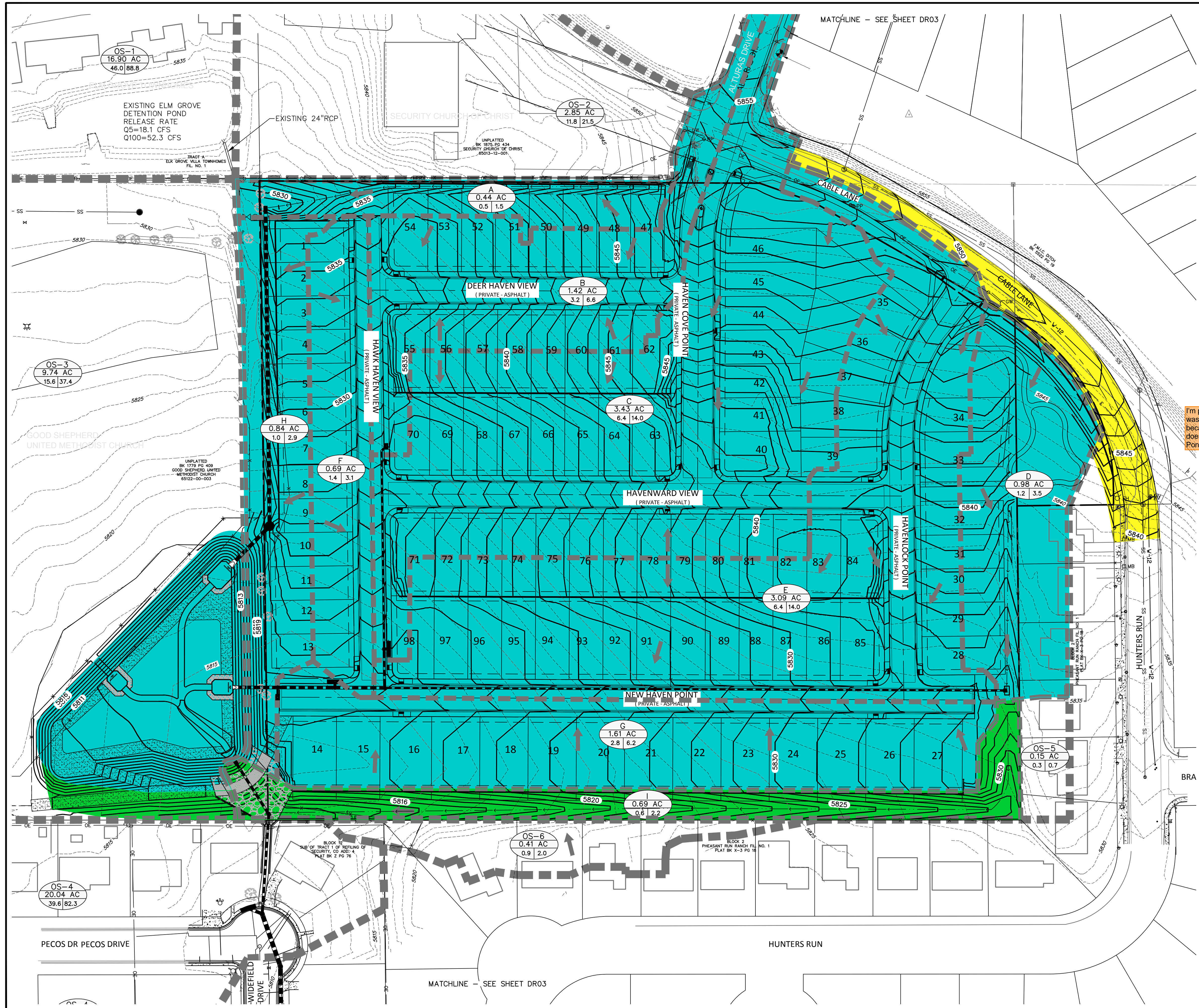


SUBDIVISION OF TRACT NO. 1 OF THE REFILEING OF SECURITY, CO. ADDITION NO. 4 PLAT BOOK Z, PG. 76



SCALE: 1" = 40'  
JOB NO.: 24147  
JUNE 1, 2007

ROCKY MOUNTAIN LAND SERVICES  
 1823 SOUTH TEJON STREET  
 COLORADO SPRINGS, COLORADO  
 719-430-0888



**LEGEND**

- EX. MINOR CONTOUR
- - - - - EX. MAJOR CONTOUR
- PR. MINOR CONTOUR
- - - - - PR. MAJOR CONTOUR
- PROPERTY LINE
- CURB FLOWLINE
- R.O.W.
- BASIN BOUNDARY
- FLOW DIRECTION
- ▲ DESIGN POINT
- BASIN

AREA OS-1  
Q5 (cfs) 16.90 AC  
Q100 (cfs) 46.0 | 88.8

**Disturbed Area Tributary to Pond 1**

Basin	Area (Ac)
A	0.44
B	1.42
C	3.43
D	0.98
E	3.09
F	0.69
G	1.61
H	0.84
Portion of Pond 1	0.88
<b>TOTAL</b>	<b>13.38</b>

**Disturbed Area NOT Tributary to Pond 1**

Basin	Area (Ac)
I	0.69
J	0.13
Portion of Pond 1	0.13
<b>TOTAL</b>	<b>0.82</b>

**Disturbed Area Cable Ln Reconstruction**

Portion of Cable Ln	Area (Ac)
Portion of Cable Ln	0.39
<b>TOTAL</b>	<b>0.39</b>

**ECM 1.7.1.C.1 & 3 EXCLUSION**

**ECM 1.7.1.B.2 & 3 EXCLUSION**

I'm pretty sure that this text was included in error because that road exclusion does not apply to Basin I or Pond 1. So please delete.

**PREPARED BY:**

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

**CLIENT:**

MIDCO INVESTMENTS, LLC

P.O. BOX 60069  
COLORADO SPRINGS, CO 80960  
CONTACT: ROBERT C. IRWIN  
(719) 475-7474

**DRAINAGE PLANS FOR:**

# HAVEN VALLEY

(LETA DR.) BRADLEY RD/ALTURAS DR.  
SECURITY, EL PASO COUNTY, COLORADO

ISSUE	DATE
INITIAL ISSUE	4/29/21
LATEST ISSUE	7/11/24

DESIGNED BY: TDM  
DRAWN BY: SBN  
CHECKED BY: TDM  
FILE NAME: 21085-03DR02

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

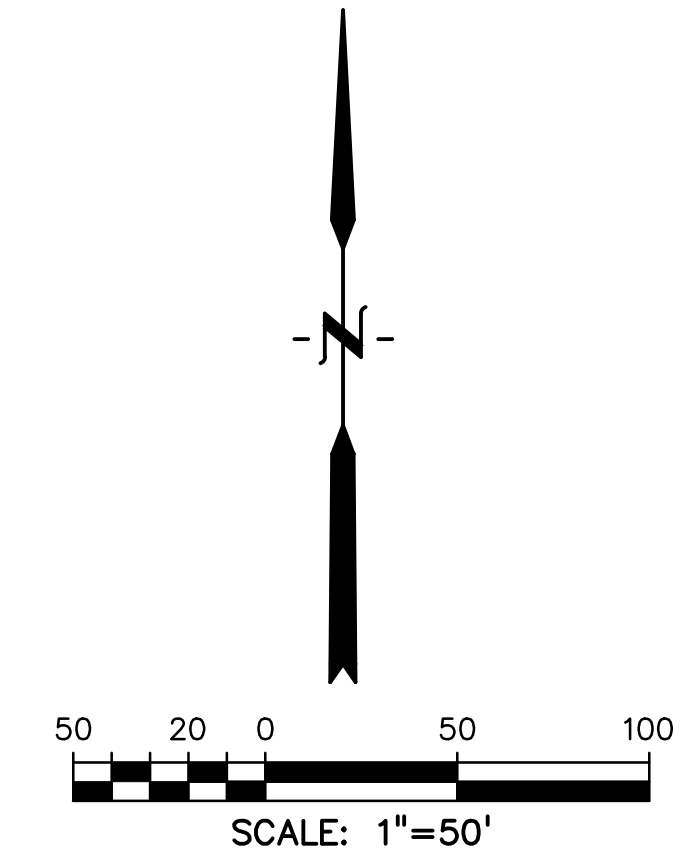
DRAWING SCALE:  
HORIZONTAL: 1" = 50'  
VERTICAL: N/A

**TREATED/  
UNTREATED  
AREAS EXHIBIT**

PROJECT NO. 21085-03CSCV  
DRAWING NO.

**TB**

SHEET: OF 3



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

CALL 3-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

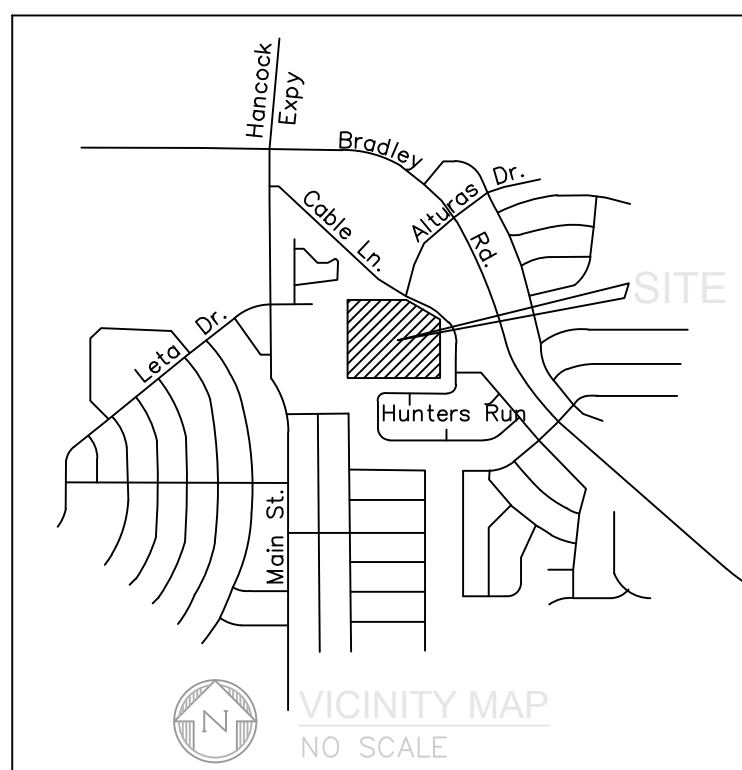
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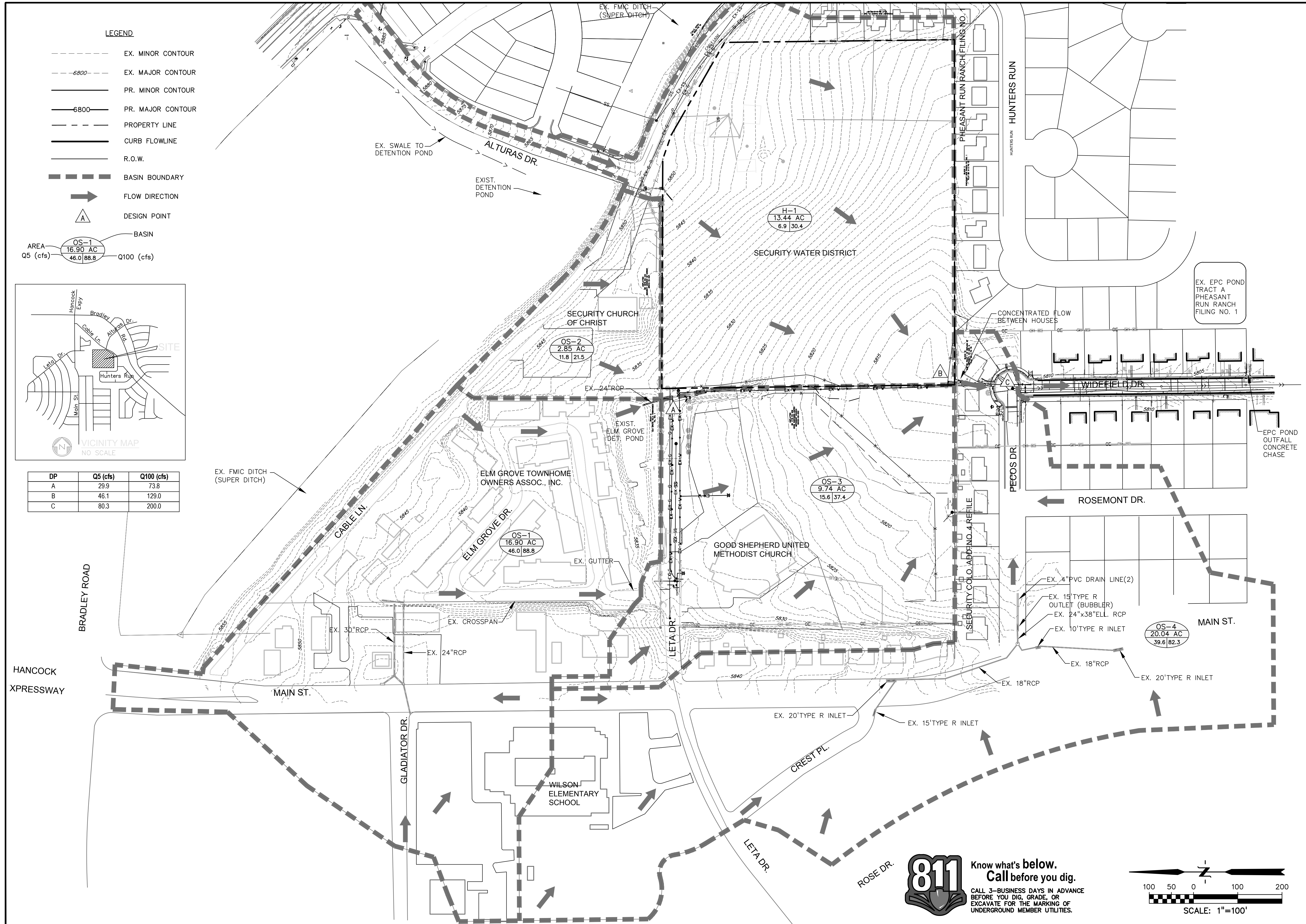
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- - - - - EX. MINOR CONTOUR
- 6800 - - - EX. MAJOR CONTOUR
- - - - - PR. MINOR CONTOUR
- 6800 - - - PR. MAJOR CONTOUR
- - - - - PROPERTY LINE
- - - - - CURB FLOWLINE
- - - - - R.O.W.
- - - - - BASIN BOUNDARY
- FLOW DIRECTION
- ▲ DESIGN POINT

BASIN  
 AREA OS-1  
 Q5 (cfs) 16.90 AC 46.0 88.8 Q100 (cfs)



DP	Q5 (cfs)	Q100 (cfs)
A	29.9	73.8
B	46.1	129.0
C	80.3	200.0



PREPARED BY:

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

CLIENT:

MIDCO INVESTMENTS, LLC

P.O. BOX 60069  
 COLORADO SPRINGS, CO 80960  
 CONTACT: ROBERT C. IRWIN  
 (719) 475-7474

DRAINAGE PLANS FOR:  
**HAVEN VALLEY**  
 (LETA DR.) BRADLEY RD/ALTURAS DR.  
 SECURITY, EL PASO COUNTY, COLORADO

ISSUE	DATE
INITIAL ISSUE	4/29/21
LATEST ISSUE	7/11/24

DESIGNED BY: TDM  
 DRAWN BY: GES  
 CHECKED BY: TDM  
 FILE NAME: 21085-03DR01

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.  
 DRAWING SCALE:  
 HORIZONTAL: 1" = 100'  
 VERTICAL: N/A

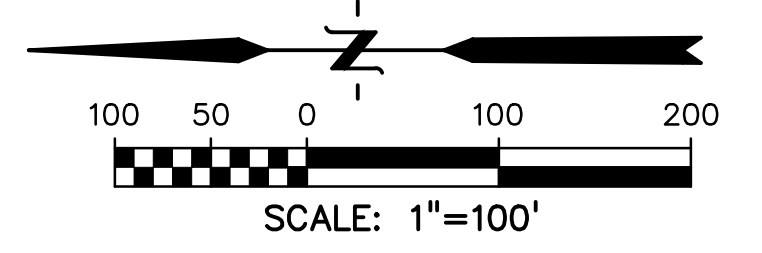
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 DRAINAGE PLAN

PROJECT NO. 21085-03CSCV  
 DRAWING NO.

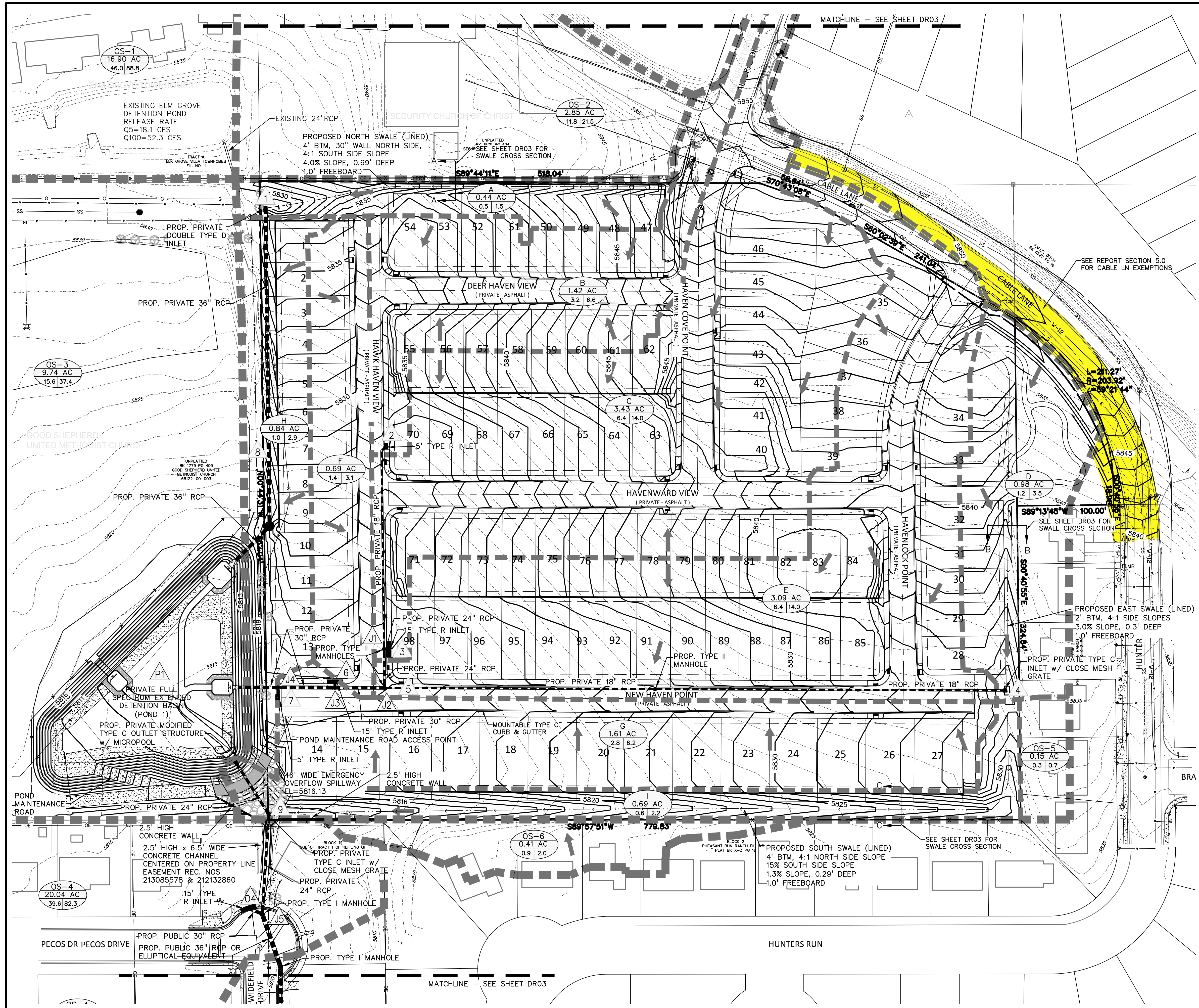
**DR01**

SHEET: 1 OF 3

**811** Know what's below.  
**Call before you dig.**  
 CALL 3-BUSINESS DAYS IN ADVANCE  
 BEFORE YOU DIG, GRADE, OR  
 EXCAVATE FOR THE MARKING OF  
 UNDERGROUND MEMBER UTILITIES.



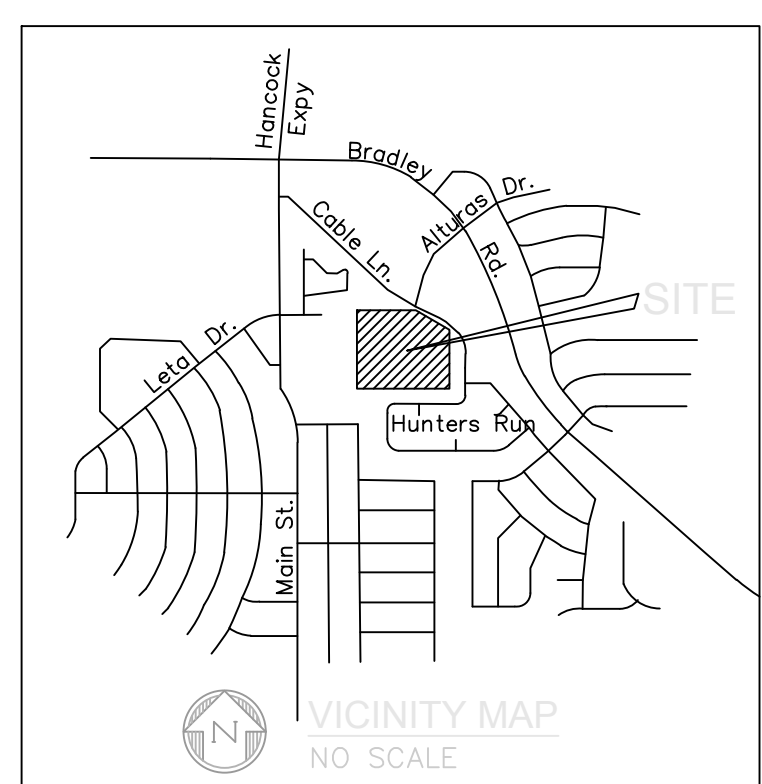
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**LEGEND**

- EX. MINOR CONTOUR
- - - - EX. MAJOR CONTOUR
- PR. MINOR CONTOUR
- - - - PR. MAJOR CONTOUR
- PROPERTY LINE
- CURB FLOWLINE
- R.O.W.
- BASIN BOUNDARY
- FLOW DIRECTION
- ▲ DESIGN POINT
- BASIN

AREA OS-1 16.90 AC Q5 (cfs) 46.0|88.8 Q100 (cfs)



DP	Q5 (cfs)	Q100 (cfs)
1	28.1	71.0
2	3.2	6.6
3	6.4	14.0
J1	9.5	20.3
4	1.2	3.5
5	6.4	14.0
J2	10.6	23.4
6	7.7	17.0
J3	17.4	38.4
7	2.8	6.2
J4	20.0	44.1
8	1.0	2.9
9	2.9	27.7
O4	39.6	82.3
J5	9.9	47.7
10	22.7	68.8

DESIGNED BY: TDM  
 DRAWN BY: SBN  
 CHECKED BY: TDM  
 FILE NAME: 21085-03DR02

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:  
 HORIZONTAL: 1" = 50'  
 VERTICAL: N/A

PROPOSED CONDITIONS DRAINAGE PLAN

PROJECT NO. 21085-03CSCV  
 DRAWING NO.

SCALE: 1"=50'

**811** Know what's below. Call before you dig.  
 CALL 3-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

PREPARED BY:  
  
**DREXEL, BARRELL & CO.**  
 Engineers • Surveyors  
 101 SAWATCH STREET, #100  
 COLORADO SPGS, COLORADO 80903  
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 (719)260-0887  
 COLORADO SPRINGS • LAFAYETTE

CLIENT:  
 MIDCO INVESTMENTS, LLC  
 P.O. BOX 60069  
 COLORADO SPRINGS, CO 80960  
 CONTACT: ROBERT C. IRWIN  
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DRAINAGE PLANS FOR:  
**HAVEN VALLEY**  
 (LETA DR.) BRADLEY RD/ALTURAS DR.  
 SECURITY, EL PASO COUNTY, COLORADO

ISSUE DATE  
 INITIAL ISSUE 4/29/21  
 LATEST ISSUE 7/11/24

DESIGNED BY: TDM  
 DRAWN BY: SBN  
 CHECKED BY: TDM  
 FILE NAME: 21085-03DR02

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

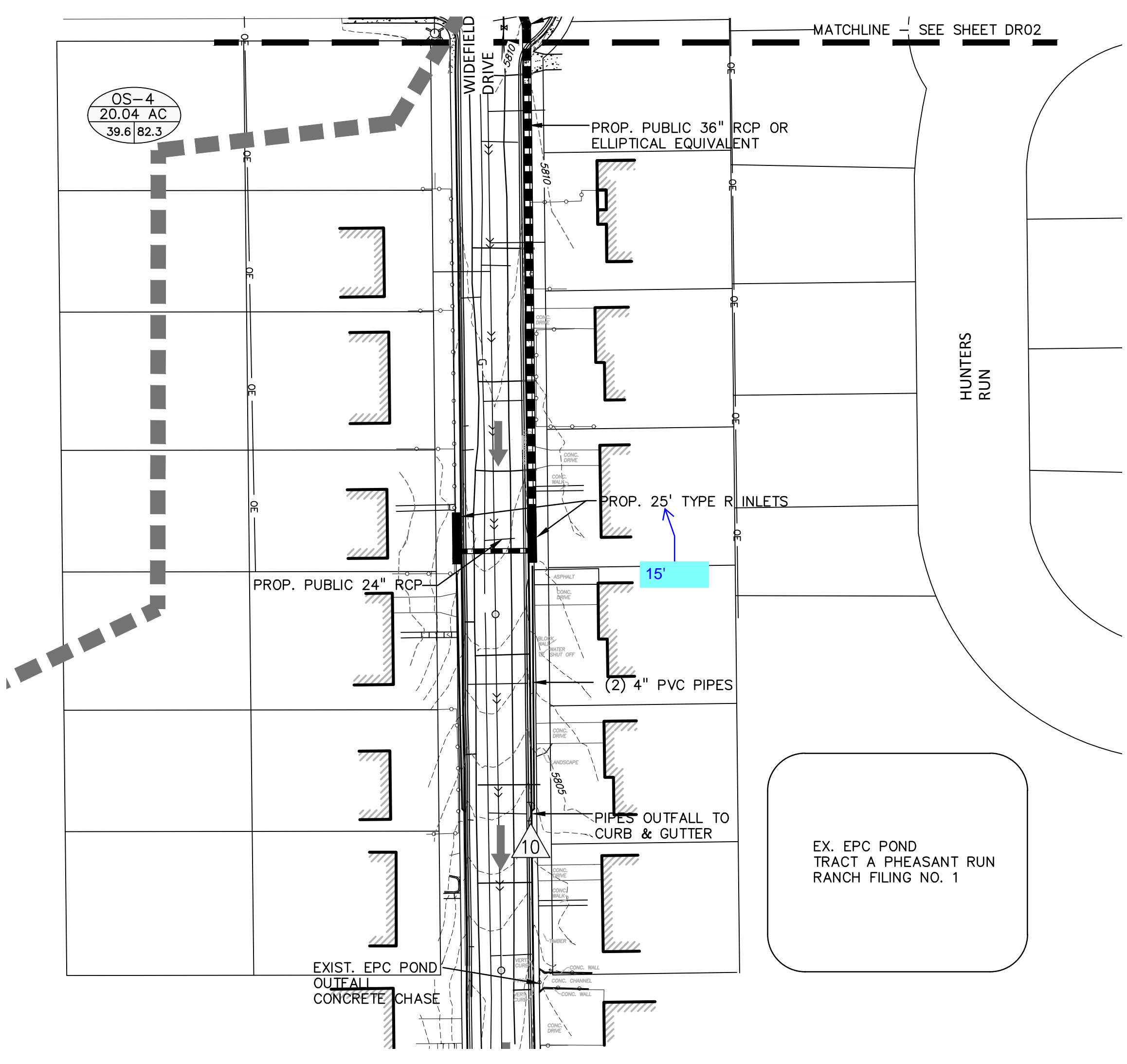
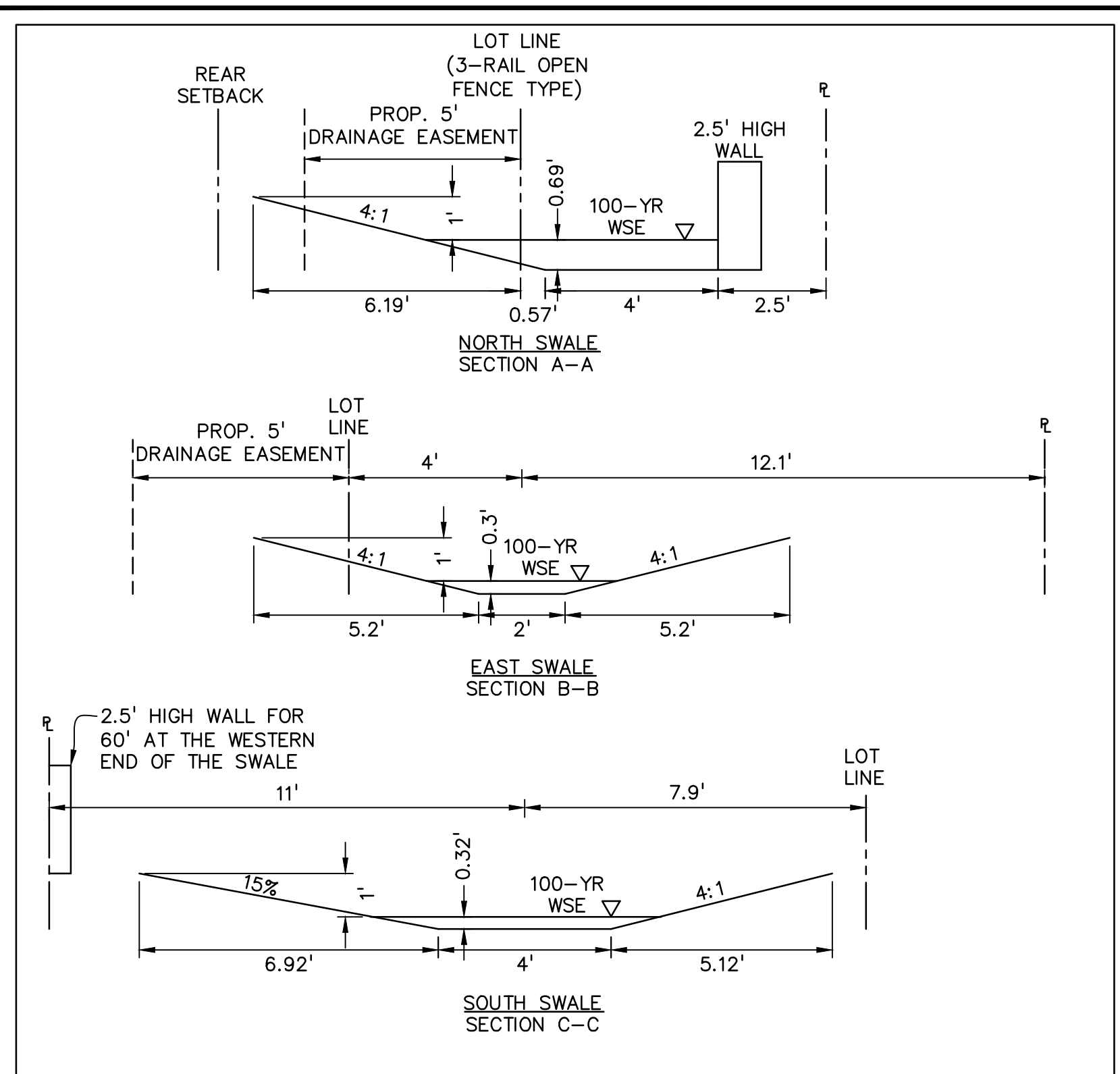
DRAWING SCALE:  
 HORIZONTAL: 1" = 50'  
 VERTICAL: N/A

PROPOSED CONDITIONS DRAINAGE PLAN

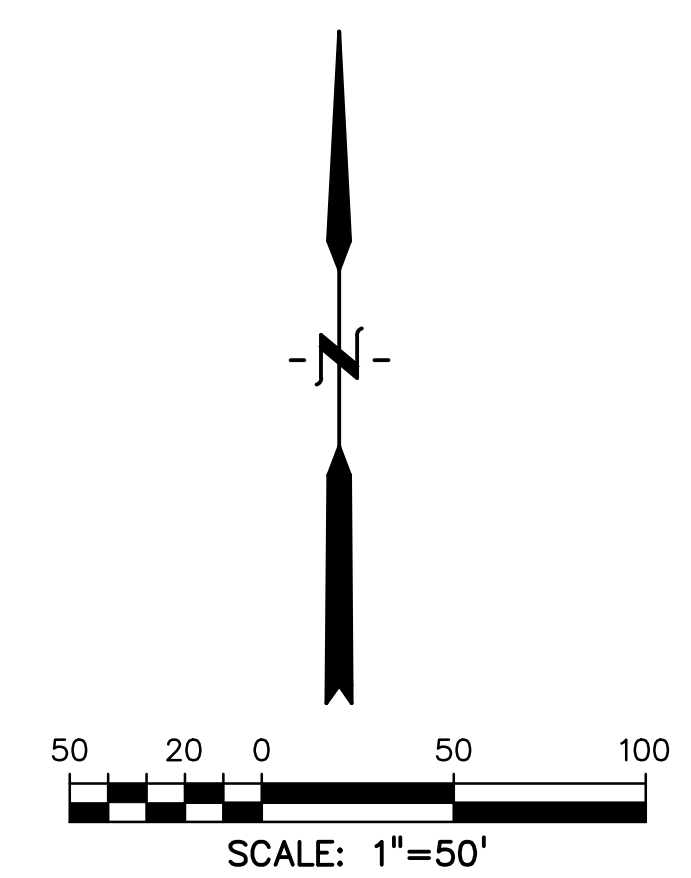
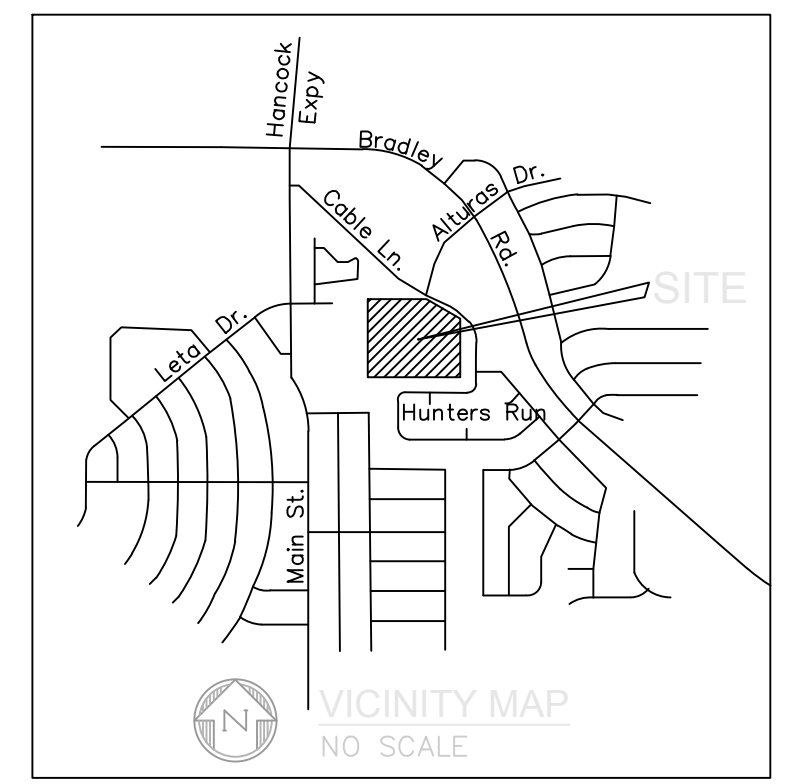
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 DRAWING NO.

**DR02**

SHEET: 2 OF 3



- LEGEND**
- EX. MINOR CONTOUR
  - - - - - EX. MAJOR CONTOUR
  - PR. MINOR CONTOUR
  - - - - - PR. MAJOR CONTOUR
  - PROPERTY LINE
  - CURB FLOWLINE
  - R.O.W.
  - BASIN BOUNDARY
  - FLOW DIRECTION
  - ▲ DESIGN POINT
  - BASIN
  - AREA Q5 (cfs) OS-1 16.90 AC 46.0 88.8 Q100 (cfs)



**PREPARED BY:**

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

**CLIENT:**

MIDCO INVESTMENTS, LLC

P.O. BOX 60069  
 COLORADO SPRINGS, CO 80960  
 CONTACT: ROBERT C. IRWIN  
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**DRAINAGE PLANS FOR:**

# HAVEN VALLEY

(LETA DR.) BRADLEY RD/ALTURAS DR.  
 SECURITY, EL PASO COUNTY, COLORADO

ISSUE	DATE
INITIAL ISSUE	4/29/21
LATEST ISSUE	7/11/24
DESIGNED BY:	TDM
DRAWN BY:	SBN
CHECKED BY:	TDM
FILE NAME:	21085-03DR02

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

**DRAWING SCALE:**  
 HORIZONTAL: 1" = 50'  
 VERTICAL: N/A

**PROPOSED CONDITIONS DRAINAGE PLAN**

PROJECT NO. 21085-03CSCV  
 DRAWING NO.

**DR03**

SHEET: 3 OF 3



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