FINAL DRAINAGE REPORT
FOR
WESTWOOD

Job Number: D-1104

August 9, 2019
Revised: February 10, 2020
Revised: May 5, 2020
Revised: September 4, 2020
Revised: November 25, 2020
Revised: December 30, 2020
Revised: February 2, 2021

RICK ENGINEERING COMPANY

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FOR
WESTWOOD
CITY OF THORNTON, COLORADO

Job Number: D-1104

Developer:

VENTANA CAPITAL, INC.
9801 East Easter Avenue
Centennial, Colorado 80112
(303) 346-7006

Engineer:
RICK ENGINEERING COMPANY
9801 East Easter Avenue
Centennial, Colorado 80112
(303) 537-8020

August 9, 2019
Revised: February 10, 2020
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Certification

Developer:

"Andrew Trietley hereby certifies that the drainage facilities for Westwood will be constructed according to the design presented in this report. I understand that the City of Thornton does not and shall not assume liability for the drainage facilities designed and/or certified by my engineer. I understand that the City of Thornton reviews drainage plans but cannot, on behalf of Westwood, guarantee that final drainage design review will absolve Andrew Trietley and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Plat and/or Development Permit does not imply approval of my engineer's drainage design."

Attest:
Name of Responsible Party

ALANA WESTER
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20204039896
MY COMMISSION EXPIRES NOVEMBER 13, 2024

Andrew Trietley

Notary Public

Authorized Signature

Professional Engineer:

"I hereby certify that this report (plan) for the final drainage design of Westwood was prepared by me (or under by direct supervision) in accordance with the provisions of the City of Thornton Standards and Specifications for the Design and Construction of Public and Private Improvements for the Responsible Parties thereof. I understand that the City of Thornton does not and shall not assume liability for drainage facilities designed by others."

Troy Bales
Registered Professional Engineer
State of Colorado No. 50961

COLORADO LICENSED
TROY W. BALES
50961
PROFESSIONAL ENGINEER

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I. GENERAL LOCATION AND DESCRIPTION

A. Location

The Westwood residential subdivision is in the City of Thornton, Adams County, Colorado. Westwood subdivision is in the Northwest one-quarter of Section 8, Township 1 South, Range 67 West of the Sixth Principal Meridian. North Holly Street (150' ROW) is located along the western boundary. North Monaco Street (80' ROW) is located along the eastern boundary. Talon Pointe, a proposed residential subdivision, is located east of Westwood.

Westwood is part of the Todd Creek watershed. Todd Creek Tributary 2 originates at the southeast corner of the Westwood property. There is an existing 12-inch drainage culvert located under North Monaco Street conveying Todd Creek Tributary 2 runoff to the east through the proposed Talon Pointe subdivision.

Major facilities and easements within and adjacent to the site includes an existing oil and gas infrastructure at the southeastern corner of the property, another existing oil and gas infrastructure just outside the southern edge of the property and an irrigation ditch namely, Signal Ditch that runs along the northern property line.

Westwood is bounded by Brighton Farms property to the west and northwest, Laurie Winters property to the northeast, Talon Pointe subdivision to its east and Harvey & Marilyn Brown property to its south.

B. Description of Property

The current zoning on the property is SFD. There are 161 single family detached residential lots proposed for the Westwood development with associated "local" streets to provide vehicle and pedestrian circulation. The southeast portion of the site is where the proposed detention facility will be located. The eastern half of North Holly Street and the western of North Monaco Street will be constructed as well as the southern half of 156th Avenue (80' ROW). Please note that 156th Avenue will be cash-in-lieu. However, the construction drawings will include the design for reference purposes.

Westwood subdivision is 61.45 acres. Currently, the property hosts two natural gas production sites. The production sites will be abandoned prior to construction activity. The property also hosts agriculture activity.

Located at the northeast corner of the property, there is a farmhouse, out buildings with a small livestock operation. The property is sparsely populated with deciduous trees. The land slopes gently from the northwest to the southeast at grades varying between 1% and 4%. There are tilled fields present.

Signal Ditch is an irrigation ditch that meanders along the north property line from North Holly Street to the northeast and is assumed to flow in full capacity. Portions of Signal Ditch occur within the Westwood property. Signal Ditch will not be altered to accommodate the Westwood Subdivision and it is assumed to flow in full capacity. The project however proposes to replace the existing irrigation culvert underneath Holly Street.

Westwood contains Hydrologic Group Type “C” soils. Type “C” soils are described to having a slow infiltration rate when thoroughly wet. Type “C” soils have a very slow rate of water transmission. According to the Natural Resources Conservation Service (NRCS), the predominate soil type is “Planter Loam”. Please refer to Appendix C for the NRCS Web Soil Survey.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

The Westwood development is in the Todd Creek watershed. There is an existing Outfall Systems Planning Study (OSP) (Ref 2), December 2003 for Todd Creek. Relevant excerpts from the OSP are provided in Appendix C for reference. Based on Figure III-1 of the OSP the eastern and western edges of the property is 15% impervious and the remainder is 5% impervious. However, based on site visit and aerial imagery the existing onsite imperviousness was calculated to be 3% and the project uses this value to be more conservative. Figure III-2 of the OSP assigns Westwood development area (Basin 50) a future imperviousness of 50% for the purposes of estimating developed runoff from this area. The project conforms with the OSP assumption with a calculated post-project composite percent imperviousness of 45%. The OSP does not contain any recommended improvements for the Westwood property. The Westwood development is upstream of any proposed Todd Creek improvements per Figure ES-2 of the OSP.

The existing land use of the project is agriculture and per the future planned land use map of City of Thornton (included in Appendix C), the site is categorized as Single-Family Neighborhoods (SFN). The proposed project honors this classification by proposing a single-family neighborhood with 161 single family detached residential lots.

Based on Figures III-3 of the OSP, the project area is split between Basin 50 and Basin 41. The project area is a portion of a larger Basin 50 and 41. Basins 50 and 41 consists of 104.6 acres and 102.4 acres, respectively while the Westwood subdivision is approximately 61.45 acres. Basin 50 is tributary to Design Point (DP) 122 and Basin 41 is tributary to DP 120. DP 122 is upstream of DP 120.

The SWMM flow routing in the OSP Figure III-4 do not represent the intricate drainage patterns and flow routing in and around the project site. However, based on site investigation and best available survey information all basins are delineated to reflect the existing site drainage patterns in and around the project site. The project site maintains the overall major drainage patterns post-project and routes the flows to their historic locations.

Westwood has one (1) historic onsite major basin, H1 and seven (7) offsite basins namely O1 thru O7. The project analyzes all onsite basins, offsite basins to be either disturbed by the project development and any offsite basins that contribute run-on flows to the project site. Additional adjacent offsite basins are shown in the Historic Drainage Map included in Appendix D of this report to clearly show and verify that the flows from these basins do not flow on-site. However, these additional offsite basins have not been analyzed and are not a part of this project.

Historic Basin H1: Historic Basin 1 encompasses approximately 63.1 acres and covers majority of the project area. The existing percent imperviousness was calculated to be 3% and this corresponds to a 5-year and 100-year runoff of 5.1 cfs and 88.1 cfs respectively. Runoff from this basin generally sheet flows from northwest to southeast to an existing culvert beneath Monaco Street identified as Existing Monaco Culvert 1 in the Historic Drainage Map. This culvert further conveys the flows east to the Talon Pointe Subdivision. Majority of the project development occurs in this major basin. In the post-project condition, this major basin is broken down to multiple minor basins and sub-basins. This is discussed in more detail in Section II.B.

Offsite Basin O1: This historic offsite basin is on the northwestern corner of the site. It comprises approximately 0.4 acres and includes portions of the signal ditch. The Signal Ditch could intercept runoff from this area. For the purposes of this drainage report, it is assumed that Signal Ditch does not intercept storm runoff, to replicate the ditch flowing full; therefore, the tributary runoff from this area is calculated to route through the Westwood development to Basin H1. The 5-year and 100-year runoff from this basin is approximately 0.1 cfs and 1.8 cfs. The project proposes no improvements in this basin and the post-project peak flow remains the same as the pre-project peak flow.

Offsite Basins O2, O3 & O4: These historic offsite basins are north of the property boundary and signal ditch runs along their southern edge. Basin O2, O3, and O4 are approximately 2.8 acres, 2.4 acres and 1.6 acres respectively. These basins contribute to a 5-year peak flow of 0.3 cfs each. Their 100-year peak flow is 6.3 cfs, 5.2 cfs and 3.5 cfs respectively. The signal ditch is assumed to flow full (same as Basin O1) and the runoff from these basins are assumed to flow south onsite to Basin H1. The project proposes no improvements in these basins. However, the project provides storm drain stub for any future developments in these basins (more detail discussion included at the end Section II.A).

Offsite Basin O5: This historic offsite basin is approximately 0.8 acres and lies along the southern eastern perimeter of the project site. Basin H1 and Basin O5 confluence at existing Monaco Culvert 1 and gets conveyed to Talon Pointe subdivision east of Monaco St. The 5-year and 100-year runoff from this basin is approximately 0.1 cfs and 2.0 cfs. In the post-project condition, the project proposes minor grading improvements to facilitate the conveyance of the flows from the proposed detention basin and the post-project peak flow remains the same as the pre-project peak flow.

Offsite Basin O6: Offsite basin O6 is located on northwestern corner of the site and west of Holly Street. It encompasses approximately 0.8 acres and flows north in a roadside ditch west of Holly St. The 5-year and 100-year runoff is approximately 0.6 cfs and 3.0 cfs respectively. In the post-project condition, the project proposes improvements to the Holly Street, but the peak flows remain the same.

Offsite Basin O7: Offsite basin O7 is located on northwestern corner of the site and east of Holly Street. It encompasses approximately 0.5 acres in the pre-project condition and 0.6 acres in the post-project condition. The runoff from this basin flows north in a roadside ditch east of Holly St. The pre-project 5-year and 100-year runoff is approximately 1.0 cfs and 2.6 cfs. The post-project 5-year and 100-year runoff is approximately 1.3 cfs and 3.1 cfs respectively. The increase in 100-year peak flow is 0.5 cfs and is due to the increase (+0.1 acres) in post-project area. This increase is considered negligible and adverse impacts to downstream drainage facilities are not anticipated at this time.

Offsite Basin O10: This offsite basin is located southwest of the intersection between E 152nd Avenue and Holly Street and encompasses approximately 8.2 acres. Flow from this basin sheet flows east to an existing culvert beneath Holly Street identified as Existing Holly Culvert 2 in the Historic Drainage Map. The culvert further conveys the flows east to offsite basin O12. The project proposes no improvements to this basin and the basin is only delineated to show the area is not tributary to the project site. No hydrologic analysis has been performed for this basin.

Offsite Basin O11: This offsite basin is located West of Holly Street and along the western edge of the project boundary. It encompasses approximately 43.3 acres. Flow from this basin generally sheet flows east to an existing culvert beneath Holly Street identified as Existing Holly Culvert 1 in the Historic Drainage Map. The culvert further conveys the flows east to offsite basin O12. The 5-year and 100-year runoff from this basin is approximately 5.3 cfs and 79.4 cfs. The project proposes minor surface improvements to the Holly Street. However, the pre-project and post-project peak flow remains the same for both minor and major storms.

Offsite Basin O12: This offsite basin is located south of the property boundary and encompasses approximately 89.2 acres and receives flows from Basins O10 and O11. The flow generally flows east to an existing culvert beneath Monaco Street identified as Existing Monaco Culvert 2 in the Historic Drainage Map. This culvert further conveys the flows east to the Talon Pointe Subdivision. It is important to note that there are two different Monaco Culverts. Basin H1, O1, O2, O3, O4 and O5 are all tributary to Existing Monaco Culvert 1. Basins O10, O11 and O12 are tributary to Existing Monaco Culvert 2. The project proposes no improvements to Basin O12, and the basin is only delineated to show the area is not tributary to the project site. No hydrologic analysis has been performed for this basin.

Offsite Basin O13: This offsite basin is located northeast of the property and encompasses approximately 36.8 acres. The flow generally flows southeast and crosses the Monaco Street overland to Talon Pointe Subdivision. The project proposes no improvements to Basin O13, and the basin is only delineated to show the area is not tributary to the project site. No hydrologic analysis has been performed for this basin.

For more information on the drainage area tributary to Talon Pointe Subdivision please refer to the report titled, "Final Drainage Report for Talon Pointe", prepared by Manhard Consulting.

The project provides storm drain stub for any future developments in the offsite basins that are tributary to Westwood development specifically Basins O1, O2, O3 and O4. The storm drain stub runs through proposed Tract B and are designed to convey the historic flows of the offsite tributary area and not their developed flows. Any future development in these offsite basins would have to provide their own on-site detention prior to discharge into the Westwood storm drains.

There is a small portion of Zone A FEMA floodplain located at the southeast corner of the property, where the existing culvert is under North Monaco Street. The FEMA floodplain location is also the upper limit of the study. Zone A is defined as "areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analysis has not been performed, no Base Flood Elevations (BFEs) or flood depths are shown." FEMA FIRM maps are included in the reference section.

B. Sub-Basin Description

Developed Basins: The following drainage basins are a portion of the Historic Basin H1 and the project proposes various developments as shown in the Post-Project Drainage Map in Appendix D. Basins 1 through 51 discussed below together make up historical drainage basin H1.

Basin 1: This basin lies in the western portion of the project site and is proposed to have single family residential lots, local street Ivanhoe Ct and sidewalk. The area of the basin is approximately 0.7 acres. The 5-year and 100-year runoff from the basin is 1.3 cfs and 3.6 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP1 (SDI-31). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin. Please refer to the post-project drainage map in Appendix D.

Basin 2: This basin lies in the western portion of the project site and is proposed to have single family residential lots, local street Ivy St, minor collector street E 154th Ave and sidewalk. The area of the basin is approximately 1.5 acres. The 5-year and 100-year runoff from the basin is 2.7 cfs and 7.6 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP2 (SDI-42). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin. This basin is further subdivided to differentiate the flows between E 154th Ave and Ivy St. The Sub-Basin 2A carries the flow from E 154th Ave and Sub-Basin 2B carries the flow from Ivy St. Peak flow is calculated for the longest flow path to DP2 (SDI-42) using rational method and prorated for the Sub-Basins 2A and 2B. Please refer to Appendix A for the peak flow calculation and the prorated peak flow backup.

Basin 3: This basin lies in the central portion of the project site and is proposed to have single family residential lots, local street Jersey Ct and sidewalk. The area of the basin is approximately 1.1 acres. The 5-year and 100-year runoff from the basin is 1.7 cfs and 5.0 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP3 (SDI-39). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 4: This basin lies in the central portion of the project site and is proposed to have single family residential lots, local street Jasmine St and sidewalk. The area of the basin is approximately 1.2 acres. The 5-year and 100-year runoff from the basin is 1.5 cfs and 5.0 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP4 (SDI-48). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 5: This basin lies in the western portion of the project site and is proposed to have single family residential lots, local street Ivanhoe Ct and sidewalk. The area of the basin is approximately 2.5 acres. The 5-year and 100-year runoff from the basin is 2.9 cfs and 9.4 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP5 (SDI-30). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 6: This basin lies in the central portion of the project site and is proposed to have single family residential lots, local street E 153rd Pl and sidewalk. The area of the basin is approximately 1.5 acres. The 5-year and 100-year runoff from the basin is 2.4 cfs and 6.8 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP6 (SDI-34). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 7: This basin lies in the central portion of the project site and is proposed to have single family residential lots, local street Jasmine St and sidewalk. The area of the basin is approximately 1.0 acres. The 5-year and 100-year runoff from the basin is 1.6 cfs and 4.8 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP7 (SDI-47). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 8: This basin lies along the western edge of the project site and is proposed to house an arterial street North Holly Street and sidewalk. The area of the basin is approximately 0.3 acres. The 5-year and 100-year runoff from the basin is 0.9 cfs and 2.1 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP8 (SDI-45). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 9: This basin lies in the western portion of the project site and is proposed to house a minor collector street E 154th Ave and sidewalk. The area of the basin is approximately 0.5 acres. The 5-year and 100-year runoff from the basin is 1.4 cfs and 3.2 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP9 (SDI-40). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 10: This basin lies in the central portion of the project site and is proposed to have single family residential lots, sidewalk, local streets E 154th Pl and Jasmine St. The area of the basin is approximately 1.2 acres. The 5-year and 100-year runoff from the basin is 2.0 cfs and 5.9 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP10 (SDI-12). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 11: This basin lies in the central portion of the project site and is proposed to house just a small portion of the Jasmine St and its sidewalk. The area of the basin is approximately 0.1 acres. The 5-year and 100-year runoff from the basin is 0.3 cfs and 0.7 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP11 (SDI-13). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 12: This basin lies in the central portion of the project site and is proposed to have single family residential lots, sidewalk and local street E 154th Pl. The area of the basin is approximately 1.4 acres. The 5-year and 100-year runoff from the basin is 2.1 cfs and 6.5 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP12 (SDI-07). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 13: This basin lies in the northern portion of the project site and is proposed to have single family residential lots, sidewalk and western half of the local Kearney St. The area of the basin is approximately 1.2 acres. The 5-year and 100-year runoff from the basin is 2.2 cfs and 6.3 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP13 (SDI-24). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 14: This basin lies in the northern portion of the project site and is proposed to have single family residential lots, sidewalk and eastern half of the local Kearney St. The area of the basin is approximately 0.7 acres. The 5-year and 100-year runoff from the basin is 1.4 cfs and 3.9 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP14 (SDI-11). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 15: This basin lies in the northern portion of the project site and is proposed to have single family residential lots, sidewalk and western half of the local Krameria St. The area of the basin is approximately 1.6 acres. The 5-year and 100-year runoff from the basin is 2.4 cfs and 7.1 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP15 (SDI-27). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 16: This basin lies in the northern portion of the project site and is proposed to have single family residential lots, sidewalk and eastern half of the local Krameria St. The area of the basin is approximately 0.9 acres. The 5-year and 100-year runoff from the basin is 1.9 cfs and 5.0 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP16 (SDI-16). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 17: This basin lies in the northeastern portion of the project site and is proposed to have single family residential lots, sidewalk and western half of the local Leyden St. The area of the basin is approximately 1.5 acres. The 5-year and 100-year runoff from the basin is 2.4 cfs and 6.9 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP17 (SDI-10). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 18: This basin lies in the central portion of the project site and is proposed to have single family residential lots, sidewalk and western half of the local Leyden St. The area of the basin is approximately 1.1 acres. The 5-year and 100-year runoff from the basin is 1.7 cfs and 5.0 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP18 (SDI-08). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 19: This basin lies in the south-central portion of the project site and is proposed to have single family residential lots, sidewalk and minor collector E 154th Ave. The area of the basin is approximately 0.9 acres. The 5-year and 100-year runoff from the basin is 1.5 cfs and 4.3 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP19 (SDI-46). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 20: This basin lies in the southeastern portion of the project site and is proposed to have single family residential lots, sidewalk, local E 154th Pl and minor collector E 154th Ave. The area of the basin is approximately 1.6 acres. The 5-year and 100-year runoff from the basin is 2.9 cfs and 7.7 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the upstream flanking inlet (SDI-04) and a sump inlet (SDI-05) at DP20. After being intercepted by the inlets, runoff enters the storm drain system and eventually enters the proposed detention basin. This basin is further subdivided to differentiate the flows between E 154th Pl and E 154th Ave. The Sub-Basin 20A carries the flow from E 154th Pl and Sub-Basin 20B carries the flow from E 154th Ave. Peak flow is calculated for the longest flow path to DP20 using rational method and prorated for the Sub-Basins 20A and 20B. Please refer to Appendix A for the peak flow calculation and the prorated peak flow backup.

Basin 21: This basin lies on the northern portion of the project site and is proposed to have single family residential lots, sidewalk and local street E 155th Pl. The area of the basin is approximately 1.9 acres. The 5-year and 100-year runoff from the basin is 2.7 cfs and 8.5 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP21 (SDI-03). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 22: This basin lies on the northeastern portion of the project site and is proposed to have single family residential lots, sidewalk, local streets E 155th Pl and Locust St. The area of the basin is approximately 1.7 acres. The 5-year and 100-year runoff from the basin is 2.6 cfs and

7.5 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP22 (SDI-23). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 23: This basin lies on the eastern portion of the project site and is proposed to have single family residential lots, sidewalk and local street Locust St. The area of the basin is approximately 1.2 acres. The 5-year and 100-year runoff from the basin is 2.1 cfs and 6.2 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP23 (SDI-22). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 24: This basin lies on the eastern portion of the project site and is proposed to have single family residential lots, sidewalk, local streets Locust St and E 154th Pl. The area of the basin is approximately 1.2 acres. The 5-year and 100-year runoff from the basin is 1.8 cfs and 5.3 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP24 (SDI-21). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin

Basin 25: This basin lies in the eastern portion of the project site and is proposed to have single family residential lots, sidewalk and eastern half of the local Leyden St. The area of the basin is approximately 1.0 acres. The 5-year and 100-year runoff from the basin is 1.9 cfs and 5.3 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP25 (SDI-09). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 26: This basin lies in the southeastern portion of the project site and is proposed to have single family residential lots, sidewalk, local streets E 154th Pl & Leyden St. The area of the basin is approximately 0.4 acres. The 5-year and 100-year runoff from the basin is 1.1 cfs and 2.4 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP26 (SDI-06). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 30: This basin lies in the southeastern portion of the project site and is proposed to have single family residential lots, sidewalk, minor collector E 154th Ave, major collector E 156th Ave and Monaco St. The area of the basin is approximately 5.4 acres. The 5-year and 100-year runoff from the basin is 5.0 cfs and 16.2 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the upstream flanking inlet (SDI-20) and a sump inlet (SDI-02) at DP30. After being intercepted by the inlets, runoff enters the storm drain system and eventually enters the proposed detention basin. This basin is further subdivided to differentiate the flows between E 154th Pl, E 154th Ave and Monaco St. The Sub-Basin 30A carries the flow from E 156th Ave, Sub-Basin 30B from Monaco St and Sub-Basin 30C from E 154th Ave. Peak flow is calculated for the longest flow path to DP30 using rational method and prorated for the Sub-Basins 30A, 30B and 30C. Please refer to Appendix A for the peak flow calculation and the prorated peak flow backup.

Basin 31: This basin lies in the southern portion of the project site and is proposed to have single family residential lots, sidewalk, local street Krameria Ct and minor collector E 154th Ave. The area of the basin is approximately 1.8 acres. The 5-year and 100-year runoff from the basin is 2.6 cfs and 6.5 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP31 (SDI-26). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin. This basin is further subdivided to differentiate the flows between E 154th Ave, western half of Krameria Ct and the eastern half of Krameria Ct. The Sub-Basin 31A carries the flow from E 154th Ave, Sub-Basin 31B from western half of Krameria Ct and Sub-Basin 31C from eastern half of Krameria Ct. Peak flow is calculated for the longest flow path to DP31 using rational method and prorated for the Sub-Basins 31A, 31B and 31C. Please refer to Appendix A for the peak flow calculation and the prorated peak flow backup.

Basin 32: This basin lies in the southeastern corner of the project site and is proposed to house the Monaco Street south of the E 154th Ave and Monaco St intersection. The area of the basin is approximately 0.3 acres. The 5-year and 100-year runoff from the basin is 0.9 cfs and 2.2 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP32 (SDI-49). After being intercepted by the inlet, runoff outlets directly east of Monaco without any storm water quality control measures. Detailed discussion on the MS4 exemption is provided in Section III.A.

Basin 33: This basin lies along the southwestern edge of the project site and is proposed to house arterial street North Holly Street and sidewalk. The area of the basin is approximately 0.9 acres. The 5-year and 100-year runoff from the basin is 1.9 cfs and 4.1 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP33 (SDI-44). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 34: This basin lies along the southern edge of the project boundary and is proposed to house a park and small portions of single-family residential lots. The area of the basin is approximately 6.1 acres. The 5-year and 100-year runoff from the basin is 2.3 cfs and 16.4 cfs respectively. Runoff from this basin sheet flows across the park and gets intercepted by the in-sump grate inlet at DP34 (SDI-32). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 35: This basin lies along the southeastern edge of the project boundary and is proposed to house the proposed detention facility and small portions of single-family residential lots. The area of the basin is approximately 4.3 acres. The 5-year and 100-year runoff from the basin is 12.0 cfs and 25.3 cfs respectively. Runoff from this basin sheet flows across the park and gets intercepted by the in-sump grate inlet at DP34 (SDI-32). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 36: This basin lies along the northwestern edge of the project boundary and is proposed to house a park. The area of the basin is approximately 3.3 acres. The 5-year and 100-year runoff from the basin is 0.9 cfs and 8.0 cfs respectively. Runoff from this basin sheet flows across the park and gets intercepted by two in-sump grate inlets at DP36 (SDI-25 and SDI-41). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin. This basin is further subdivided to differentiate the flows between the eastern and western half of the park. The Sub-Basin 36A carries the flow from western half and Sub-Basin 36B carries the flow from eastern half. Peak flow is calculated for the longest flow path to DP36 using rational method and prorated for the Sub-Basins 36A and 36B. Please refer to Appendix A for the peak flow calculation and the prorated peak flow backup.

Basin 41: This basin lies along the northern boundary of the project site and is proposed to house a park. The area of the basin is approximately 2.5 acres. The 5-year and 100-year runoff from the basin is 0.7 cfs and 6.3 cfs respectively. Runoff from this basin sheet flows across the park and gets intercepted by two in-sump grate inlets at DP41 (SDI-28 and SDI-50). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin. This basin is further subdivided to differentiate the flows between the eastern and western half of the park. The Sub-Basin 41A carries the flow from western half and Sub-Basin 41B carries the flow from eastern half. Peak flow is calculated for the longest flow path to DP41 using rational method and prorated for the Sub-Basins 41A and 41B. Please refer to Appendix A for the peak flow calculation and the prorated peak flow backup.

Basin 42: This basin lies in the central portion of the project site and is proposed to have single family residential lots, sidewalk and local street E 154th Pl. The area of the basin is approximately 1.4 acres. The 5-year and 100-year runoff from the basin is 2.4 cfs and 6.6 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP42 (SDI-17). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 43: This basin lies in the southern portion of the project site and is proposed to have single family residential lots, sidewalk, local streets Ivy St and E 153rd Pl. The area of the basin is approximately 1.0 acres. The 5-year and 100-year runoff from the basin is 2.2 cfs and 5.9 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP43 (SDI-33). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 44: This basin lies in the southern portion of the project site and is proposed to have single family residential lots, sidewalk, local streets Jersey Ct and E 153rd Pl. The area of the basin is approximately 0.9 acres. The 5-year and 100-year runoff from the basin is 2.1 cfs and 5.5 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the on-grade curb inlet at DP44 (SDI-35). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 45: This basin lies in the central portion of the project site and is proposed to house the southern half of the minor collector from Ivy Street to Jasmine St. The area of the basin is approximately 0.4 acres. The 5-year and 100-year runoff from the basin is 1.0 cfs and 2.4 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP45 (SDI-37). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 46: This basin lies in the central portion of the project site and is proposed to house the northern half of the minor collector from Ivy Street to Jasmine St and few portions of single family residential lots. The area of the basin is approximately 0.7 acres. The 5-year and 100-year runoff from the basin is 1.2 cfs and 3.1 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP46 (SDI-38). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 47: This basin lies in the central portion of the project site and is proposed to have single family residential lots, sidewalk and local street E 154th Pl. The area of the basin is approximately 0.9 acres. The 5-year and 100-year runoff from the basin is 1.5 cfs and 4.3 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP47 (SDI-14). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 48: This basin lies in the central portion of the project site and is proposed to have single family residential lots, sidewalk, local streets Kearney St and E 154th Pl. The area of the basin is approximately 0.8 acres. The 5-year and 100-year runoff from the basin is 1.5 cfs and 4.1 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP48 (SDI-15). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 49: This basin lies in the central portion of the project site and is proposed to have single family residential lots, sidewalk and local streets Krameria St & E 154th Pl. The area of the basin is approximately 1.2 acres. The 5-year and 100-year runoff from the basin is 2.2 cfs and 5.9 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP49 (SDI-18)). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 50: This basin lies in the eastern portion of the project site and is proposed to have single family residential lots, sidewalk and local street E 154th Pl. The area of the basin is approximately 1.1 acres. The 5-year and 100-year runoff from the basin is 2.2 cfs and 5.9 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP50 (SDI-19)). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

Basin 51: This basin lies in the southeastern portion of the project site and is proposed to have sidewalk and E 154th Ave. The area of the basin is approximately 0.4 acres. The 5-year and 100-year runoff from the basin is 1.2 cfs and 2.7 cfs respectively. Runoff from this basin flows along the street curb and gutter and gets intercepted by the in-sump curb inlet at DP51 (SDI-01). After being intercepted by the inlet, runoff enters the storm drain system and eventually enters the proposed detention basin.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

Due to horizontal and vertical constraints Basin 32, which consists of North Monaco Street improvements south of the intersection between North Monaco Street and East 154th Avenue, will outlet directly east of North Monaco Street without any storm water quality control measures. The Colorado Department of Public Safety General Permit Order No. COR09000, Section 4.IV.A.I (page 29 of 63) (issued March 30th, 2018 effective May 1, 2018), explicitly states that the "permittee may exclude up to 20 percent not to exceed 1 acre of the applicable development site area when the permittee has determined that it is not practicable to capture runoff from portions of the site that will not drain towards control measures". In compliance with the permit, Basin 32 proposes an impervious area of approximately 0.25 acres and is well within the 1-acre threshold. The various variances sought in the Construction Documents are discussed in Section III.E to follow.

B. Development Criteria Reference and Constraints

The City of Thornton's "Standards and Specifications for the Design and Construction of Public and Private Improvements" (Ref 1) provides the standards to which the Westwood development will follow. The project also follows and refers to the Mile High Flood District's, "Urban Storm Drainage Criteria Manual Volumes 1, 2 and 3" for additional guidance. This drainage report also references and conforms to, "Todd Creek and DFA 0052 Watersheds Outfall Systems Planning Study", prepared by Kiowa Engineering Corporation, 2003 as discussed earlier in the report.

The project proposes to replace the Existing Monaco Culvert 1 (12-inch) located under North Monaco Street conveying Todd Creek Tributary 2 runoff to the east through the proposed Talon Pointe subdivision for the interim condition. The interim condition assumes the completion of Westwood development and as-is condition for the Talon Pointe subdivision. The interim culvert has been designed to convey only the on-site un-detained 100-year flow without overtopping. Upon coordination, Talon Pointe has agreed to design the ultimate condition culvert which will convey the flows from the entire Todd Creek Tributary 2 area including the Westwood development. The project also proposes to replace the existing irrigation culvert along the Signal irrigation ditch underneath Holly Street. The design requirements were provided by the Signal Ditch Company. Design flow for the culvert is 60 CFS. Required freeboard inside the culvert is 2 feet. Constant tailwater elevation is 2 feet above channel invert. Moreover, a HEC-RAS riprap analysis was required to demonstrate hydraulic jump within the proposed riprap apron and velocity less than 3 FPS. The proposed Signal Ditch Irrigation culvert has been designed to meet all these requirements.

C. Hydrological Criteria

The one-hour design rainfalls for Thornton are 0.97" for the 2-year storm event; 1.38" for the 5-year storm; 2.69" for the 100-year storm. The minor storm is the 5-year storm recurrence interval. The major storm is the 100-year storm recurrence interval. Storm runoff has been calculated using the Rational Method. The Rational Method is acceptable to use for urban catchments smaller than 90 acres.

The detention basin volume is calculated using the inbuilt CUHP inflow hydrograph generator in the MHFD's UD-Detention spreadsheet. The project proposes full-spectrum detention for the Water Quality Control Volume (WQCV), Excess Urban Runoff Volume (EURV), 5-year (minor) storm, and the 100-year (major) storm as required per the Section 402.12 of the City of Thornton's Standards and Specifications. The outlet works of the proposed detention basin are also designed using the latest version of the UD-Detention spreadsheet.

D. Hydraulic Criteria

Street capacity, street corner capacity, curb and grate inlets have been designed utilizing the latest version of Mile High Flood District (MHFD) Street and Inlet Hydraulics spreadsheet UD-Inlet. Inlets are provided at all the locations where runoff exceeds street capacity. Streets are designed per Table 7-2 and 7-3 in Chapter 7 of the MHFD's Urban Storm Drainage Criteria Manual (USDCM) Volume 1. Cross-Pans are designed per Table 7-4 in Chapter 7 of the USDCM.

Swales and roadside ditches have been designed using the Federal Highway Administrations (FHWA) Hydraulic Toolbox 4.4 computer program. All swales are designed to have at least 1-foot of freeboard for the major storm, per City of Thornton Criteria. It is important to note that the stability charts provided in Section 6 of Chapter 8 USDCM are only applicable for swales with side slopes 5:1 or flatter. Therefore, the proposed swales have been designed to maintain velocities less than 7 fps and maximum shear stress less than 1.2 lb/sf per Table 8-3 in Section 5.8 of the USDCM, Volume 1 (page 8-50) to preserve bank stability. This eliminates the need for any additional armoring in the swales.

Roadside ditches are designed to meet the criteria per Section 402.6 of the City of Thornton's Standard and Specifications. They are designed to adequately carry the minor storm with 6-inches of freeboard. Maximum proposed side slope of 4:1 has been maintained and maximum velocity for all roadside ditches is less than 5 fps. Roadside ditches have been designed to maintain velocities less than 5 fps (during minor storm) and maximum shear stress less than 1.2 lb/sf per Table 8-3 in Section 5.8 of the USDCM, Volume 1 (page 8-50) to preserve bank stability. This eliminates the need for any additional armoring in the swales.

The proposed storm drain system has been designed using the Hydraflow Storm Sewers Extension for Autodesk Civil3D. A minimum pipe size of 18-inches has been used. Applicable storm sewer losses have been calculated and hydraulic grade lines have been computed for the proposed storm sewers per criteria set forth by the USDCM. The proposed interim culvert under Monaco Street and the Signal Irrigation Culvert under Holly Street have been designed using HY-8 software per Chapter 11 of the USDCM Volume 2.

Riprap apron for pipe and culvert outlets, have been designed per Chapter 8 and Chapter 9 of the USDCM. Emergency overflow spillway riprap has been designed per Chapter 12 of the USDCM.

E. Variances from Criteria

CITY SPEC. NO.	DESCRIPTION OF VARIANCE	SPECIFIC LOCATIONS
Section 303(G)	Reduce the required horizontal separation between storm and sewer to 7ft	Local Streets
Section 402.13(E)	Reduce the minimum pond bottom slope to 2%	Detention Pond
Section 402.7(B)(1)	Reduce the allowable cover on storm drain with a roadway to be 18in to finish surface	Temporary culvert in Monaco and storm drain in 154th Ave west of Monaco intersection
Section 402.5(B)	Reduce the minimum pavement cross slope to 1.00%	Cul de sacs, knuckles and intersections
Section 203.6(B)	Place the waterline on the west side of the street	Holly Street
Section 203.13(A)(1)	Place the water service on the low side of the lot and reduce the min separation to lot line to 3ft	Throughout Westwood subdivision Filing 1
Section 303(G)	Reduce the allowable cover between sewer and future storm drain	Monaco at culvert crossing
Section 402.8.1	Drainage easements on residential lots to convey stormwater flows in clogged inlet scenario	Block 1, Lot 18 & Block 6, Lots 29 and 30
Section 303.9 (E)	Reduction in 0.3ft drop in sewer manhole	Sew MH # 1 and 63 in Monaco St

IV. WETLAND MITIGATION AND PRESERVATION

There are no jurisdictional wetlands on the areas disturbed by the Westwood development.

V. DRAINAGE FACILITY DESIGN

A. General Concept

The drainage concept of the Westwood development is to maintain existing drainage patterns by routing developed runoff via curb and gutter in local and collector roads to proposed storm sewer to the southeast portion of the property where a Full Spectrum Extended Detention Basin (EDB-1), will detain developed runoff and release the runoff at near historic rates to Todd Creek Tributary 2. Full spectrum detention is the process where a detention pond controls peak discharges over the range of storm events from frequently occurring storms up to the 100-year flood. Full spectrum detention facilities are designed to produce outflow hydrographs that replicate the shape of pre-development hydrographs.

Runoff from offsite basins, O1, O2, O3 and O4 will be conveyed through the Westwood Development by side lot swales (Section 3 and 4) and will be intercepted by grate inlets connected to the proposed storm sewer. In case of an emergency, when the grate inlets fail the flow from the side lot swales will be conveyed through Tract B to Kearney Street.

The proposed improvements to North Holly Street (Basins 8 and 33) and North Monaco Street (Basin 30) will convey developed runoff onto the Westwood development. All onsite and offsite sub-basins tributary to the Westwood development will be conveyed to the proposed full spectrum detention facility except for Basin 32. Due to horizontal and vertical constraints Basin 32, which consists of North Monaco Street improvements south of the intersection between North Monaco Street and East 154th Avenue, will outlet directly east of North Monaco Street without any storm water quality control measures as discussed earlier in section III.A.

Appendix A contains Hydrologic Computations that quantify the peak runoff for the minor and major storm. Impervious calculations tabulate the existing and proposed land use characteristics that are used to calculate the Rational runoff coefficients and percent impervious that are dependent variables to calculate peak runoff and required full spectrum detention volumes. Times of Concentration are calculated to estimate the relative duration of peak storm events to quantify, at design points, the peak runoff. It also includes full spectrum detention basin design backup.

Appendix B contains the Hydraulic Computations which includes, street capacity calculations, inlet design, emergency sump overflow design, cross-pan design, swale design, roadside ditch design, culvert design, hydraulic grade line calculations and riprap apron sizing. All relevant reference documents are included in Appendix C.

Westwood development is divided into 52 design points. All design points except for Design Point 32 ultimately discharges to the Full Spectrum Detention Basin (EDB-1) through a combination of natural sheet flow, urban street drainage and proposed storm sewers. Tract H includes the proposed extended detention basin facility and will house an emergency overflow spillway in case the detention outlet structure fails. Please refer to Appendix B for the emergency spillway sizing. Tract B will contain a storm sewer stub for future adjacent development to connect to the Westwood storm drain system. Please refer to Appendix D for the Proposed Drainage Plan.

B. Specific Details

The full spectrum extended detention basin (EDB-1) has been designed per the City of Thornton and USDCM criteria. The detention basin has a side slope of 4:1 and a micropool is also provided within the outlet structure per City of Thornton criteria. The pond contains a trickle channel that routes minor storm runoff to the proposed detention pond outlet structure. The trickle channel is sized for 2% of the undetained 100-year flow per USDCM Volume 3. An external concrete pool is provided for the initial surcharge volume. Initial surcharge volume is 0.3% of the WQCV per USDCM Volume 3. The emergency spillway for the proposed detention basin has been designed to convey twice the onsite un-detained 100-year storm while maintaining the minimum freeboard of 1 foot within the spillway embankment. A maintenance path has been included in the design of the detention basin to allow utility trucks access to the detention basin.

In accordance with the Detention Criteria for the City of Thornton, the detention basin has been designed to provide detention of the Water Quality Capture Volume (WQCV), Excess Urban Runoff Volume (EURV), 5-Year and the 100-Year storm event. The post-project flow rate for the 100-year storm event will be detained back to historic rates per the USDCM criteria.

Detention basin (EDB-1) has been designed utilizing the latest version of the UD-Detention spreadsheet for all design return periods to mitigate for the additional impervious area in the proposed condition.

The proposed detention basin provides 1.02 ac-ft of storage for the WQCV, 1.89 ac-ft for the EURV, 2.06 ac-ft for the 5-year and 5.89 ac-ft for the 100-year storm event. The undetained 100-year peak flow rate from the pond is 182.4 cfs. The detained 100-year peak flow rate is 110.3 cfs.

Riprap for pipe outlets into the extended detention basin has been designed to mitigate high exit velocities and reduce erosion. Type M Soil Riprap has been designed for the emergency overflow spillway pursuant to Chapter 12 of the USDCM Volume 2.

Maximum length of 10 feet has been maintained for all the proposed CDOT Type R curb inlets in residential areas per City request. Upstream flanking inlets have been used where necessary to meet the requirement.

Street corner capacity checks have been included wherever flows turn corner. Capacity checks are also provided upstream of sump, upstream of cross-pan.

VI. CONCLUSIONS

A. Compliance with Standards

The drainage plan and concept for the Westwood development follow the City of Thornton Standards and Specifications and the Mile High Flood District Urban Storm Drainage Criteria Manuals.

B. Drainage Concept

The drainage design will be effective in controlling damage from storm runoff by safely conveying developed runoff to local and collector roads where curb and gutter and storm sewer will route runoff to the proposed full spectrum detention facility. The detention facility will store developed runoff and release runoff downstream at rates that mimic historic drainage volumes and rates.

VII. REFERENCES

1. "Standards and Specifications for the Design and Construction of Public and Private Improvements". City of Thornton, 2012.
2. "Todd Creek and DFA 0052 Watersheds Outfall Systems Planning Study" Preliminary Design Report. Kiowa Engineering Corporation, 2003.
3. "Urban Storm Drainage Criteria Manual Volumes 1, 2 and 3". Urban Drainage and Flood Control District, 2016.

Appendix A

Hydrologic Computations

- **Pre-Project**
- **Post-Project**
- **Detention Design**

Appendix A - Hydrologic Computations
Pre-Project

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Runoff Coefficients
Pre-Project

Job Name: Westwood
Job Number: D1104
Date:

Basin ID / Design Point	Total Area		Single Family (<0.25 Acres)					Single Family (0.25 - 0.75 Acres)					Streets (Paved) / Storage Areas					Historic / Undeveloped / Landscape					Composite		
	sq-ft	acres	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	Imperviousness[3]	C5[4]	C100[5]
Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14	Column15	Column16	Column17	Column18	Column19	Column30	Column31	Column32	Column33	Column34	Column35	Column36	Column37
H1	2748111	63.1		0.00	45	0.40	0.67		0.00	30	0.28	0.61	14666	0.34	100	0.86	0.89	2733445	62.75	2	0.05	0.49	0.03	0.06	0.49
O1	17725	0.4		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89	17725	0.41	2	0.05	0.49	0.02	0.05	0.49
O2	123102	2.8		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89	123102	2.83	2	0.05	0.49	0.02	0.05	0.49
O3	103568	2.4		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89	103568	2.38	2	0.05	0.49	0.02	0.05	0.49
O4	67958	1.6		0.00	45	0.40	0.67		0.00	30	0.28	0.61	3206	0.07	100	0.86	0.89	64752	1.49	2	0.05	0.49	0.07	0.09	0.51
O5	36371	0.8		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89	36371	0.83	2	0.05	0.49	0.02	0.05	0.49
O6	33046	0.8		0.00	45	0.40	0.67		0.00	30	0.28	0.61	6451	0.15	100	0.86	0.89	26595	0.61	2	0.05	0.49	0.21	0.21	0.57
O7	21976	0.5		0.00	45	0.40	0.67		0.00	30	0.28	0.61	12783	0.29	100	0.86	0.89	9193	0.21	2	0.05	0.49	0.59	0.52	0.73
O11	1885162	43.3		0.00	45	0.40	0.67		0.00	30	0.28	0.61	30322	0.70	100	0.86	0.89	1854839	42.58	2	0.05	0.49	0.04	0.06	0.50

[1] Refer to Table 6-3 Urban Storm Drainage Criteria Manual, March 2017 Edition
[2] Refer to Table 6-5 Urban Storm Drainage Criteria Manual, March 2017 Edition
[3] Refer to Table 6-5 Urban Storm Drainage Criteria Manual, March 2017 Edition
[4] Weighted imperviosuness
[5] Weighted C5
[6] Weighted C100

RICK ENGINEERING COMPANY

Time of Concentration
Pre-Project

Job Name: Westwood
Job Number: D1104
Date:

Basin Data				Initial Overland Time (t_i)					Travel/Channelized Time (t_t)								Minimum Time of Concentration (t_c)		Final t_c	Remarks
Basin ID / Design Point	Area	Composite Imperviousness	C_5[1]	Starting Elevation	Ending Elevation	Length (If length of Overland Flow is > 300 ft, use 300 ft)	Slope	t_i[2]	Starting Elevation	Ending Elevation	Length	Slope	Conveyance Factor, K[3]	Channel Velocity[4]	t_t[5]	t_c[6] $=t_i+t_t$	Comp. t_c[7]	Final t_c[8] (If <5, use 5)		
	ac			*ft*	*ft*	*ft*	*ft/ft*	*min*	*ft*	*ft*	*ft*	*ft/ft*		*ft/s*	*min*	*min*	min	*min*	*min*	
H1	63.1	0.03	0.06	5211	5204	300	0.023	24.69	5204	5169	2200	0.016	5	0.63	58.14	82.83	56.65	56.65	56.65	
O1	0.4	0.02	0.05					5.00	0							5.00		5.00	5.00	
O2	2.8	0.02	0.05	5211	5201.5	300	0.032	22.42	5201.5	5195	220	0.030	5	0.86	4.27	26.68	27.96	26.68	26.68	
O3	2.4	0.02	0.05	5210	5201	300	0.030	22.82	5201	5195	215	0.028	5	0.84	4.29	27.11	27.97	27.11	27.11	
O4	1.6	0.07	0.09	5211	5204	300	0.023	23.90	5204	5194	305	0.033	5	0.91	5.61	29.51	27.70	27.70	27.70	
O5	0.8	0.02	0.05	5176.5	5176	50	0.010	13.39	5176	5161	1120	0.013	15	1.74	10.75	24.14	43.04	24.14	24.14	
O6	0.8	0.21	0.21	5209	5208	50	0.020	9.06	5208	5193	400	0.038	15	2.90	2.30	11.35	25.29	11.35	11.35	
O7	0.5	0.59	0.52	5209	5208	50	0.020	5.90	5208	5189	665	0.029	15	2.54	4.37	10.27	19.77	10.27	10.27	
O11	43.3	0.04	0.06	5243	5238	300	0.017	27.36	5238	5198	1247	0.032	5	0.90	23.21	50.57	37.61	37.61	37.61	

[1] Refer to C spreadsheet
[2] Refer to Equation 6-3 Urban Storm Drainage Criteria Manual, March 2017 Edition
[3] Refer to Table 6-2 Urban Storm Drainage Criteria Manual, March 2017 Edition
[4] $Vt = K\sqrt{S_0}$ S_0 = Waterway Slope
[5] Refer to Equation 6-4 Urban Storm Drainage Criteria Manual, March 2017 Edition
[6] Refer to Equation 6-2 Urban Storm Drainage Criteria Manual, March 2017 Edition
[7] Refer to Equation 6-5 Urban Storm Drainage Criteria Manual, March 2017 Edition
[8] Smaller of the two t_c values

Job Name: Westwood
Job Number: D1104
Date:

5-Year 1-Hr Point Rainfall = 1.38 in

Q5				
Basin ID / Design Point	C5[1]	I[2]	A	Q[3]
		in/hr	*acres*	cfs
H1	0.06	1.4	63.1	5.1
O1	0.05	4.7	0.4	0.1
O2	0.05	2.3	2.8	0.3
O3	0.05	2.3	2.4	0.3
O4	0.09	2.3	1.6	0.3
O5	0.05	2.5	0.8	0.1
O6	0.21	3.5	0.8	0.6
O7	0.52	3.7	0.5	1.0
O11	0.06	1.9	43.3	5.3

[1] Refer to Post-Project Runoff Coefficients spreadsheet

[2] Refer to Equation 5-1 Urban Storm Drainage Criteria Manual, March 2017

[3] Refer to Equation 6-1 Urban Storm Drainage Criteria Manual, March 2017

RICK ENGINEERING COMPANY

Job Name: Westwood
Job Number: D1104
Date:

100-Year 1-Hr Point Rainfall = 2.69 in

Q100				
Basin ID / Design Point	C100[1]	I[2]	A	Q[3]
		in/hr	*acres*	*cfs*
H1	0.49	2.8	63.1	88.1
O1	0.49	9.1	0.4	1.8
O2	0.49	4.5	2.8	6.3
O3	0.49	4.5	2.4	5.2
O4	0.51	4.4	1.6	3.5
O5	0.49	4.8	0.8	2.0
O6	0.57	6.9	0.8	3.0
O7	0.73	7.2	0.5	2.6
O11	0.50	3.7	43.3	79.4

[1] Refer to Post-Project Runoff Coefficients spreadsheet

[2] Refer to Equation 5-1 Urban Storm Drainage Criteria Manual, March 2017

[3] Refer to Equation 6-1 Urban Storm Drainage Criteria Manual, March 2017

Appendix A - Hydrologic Computations
Post-Project

RICK ENGINEERING COMPANY

Runoff Coefficients
Post-Project

Job Name: Westwood
Job Number: D1104
Date:

Basin ID / Design Point	Total Area		Single Family (<0.25 Acres)					Single Family (0.25 - 0.75 Acres)					Streets (Paved) / Storage Areas					Parks					Historic / Undeveloped / Landscape					Composite		
	sq-ft	acres	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	sq-ft	acres	Imperviousness[1]	C5[2]	C100[2]	Imperviousness[3]	C5[4]	C100[5]
Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14	Column15	Column16	Column17	Column18	Column19	Column25	Column26	Column27	Column28	Column29	Column30	Column31	Column32	Column33	Column34	Column35	Column36	Column37
1	28714	0.7	13016	0.30	45	0.40	0.67	5401	0.12	30	0.28	0.61	10297	0.24	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.62	0.54	0.74
2	64092	1.5	38623	0.89	45	0.40	0.67	2135	0.05	30	0.28	0.61	19324	0.44	100	0.86	0.89		0.00	10	0.12	0.53	4010	0.09	2	0.05	0.49	0.58	0.51	0.72
3	48403	1.1	42230	0.97	45	0.40	0.67		0.00	30	0.28	0.61	6172	0.14	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.52	0.46	0.70
4	51093	1.2		0.00	45	0.40	0.67	38719	0.89	30	0.28	0.61	10932	0.25	100	0.86	0.89		0.00	10	0.12	0.53	1442	0.03	2	0.05	0.49	0.44	0.40	0.67
5	107092	2.5	61556	1.41	45	0.40	0.67	17176	0.39	30	0.28	0.61	15811	0.36	100	0.86	0.89		0.00	10	0.12	0.53	12549	0.29	2	0.05	0.49	0.46	0.41	0.67
6	63670	1.5	52892	1.21	45	0.40	0.67		0.00	30	0.28	0.61	10778	0.25	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.54	0.48	0.71
7	44119	1.0	26108	0.60	45	0.40	0.67	5036	0.12	30	0.28	0.61	9916	0.23	100	0.86	0.89		0.00	10	0.12	0.53	3059	0.07	2	0.05	0.49	0.53	0.46	0.70
8	12513	0.3		0.00	45	0.40	0.67		0.00	30	0.28	0.61	10506	0.24	100	0.86	0.89		0.00	10	0.12	0.53	2008	0.05	2	0.05	0.49	0.84	0.73	0.83
9	21724	0.5		0.00	45	0.40	0.67		0.00	30	0.28	0.61	17808	0.41	100	0.86	0.89		0.00	10	0.12	0.53	3916	0.09	2	0.05	0.49	0.82	0.71	0.82
10	53747	1.2	25067	0.58	45	0.40	0.67	15531	0.36	30	0.28	0.61	13149	0.30	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.54	0.48	0.71
11	3659	0.1		0.00	45	0.40	0.67		0.00	30	0.28	0.61	3299	0.08	100	0.86	0.89		0.00	10	0.12	0.53	359	0.01	2	0.05	0.49	0.90	0.78	0.85
12	61085	1.4	40869	0.94	45	0.40	0.67	11895	0.27	30	0.28	0.61	8321	0.19	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.50	0.44	0.69
13	52228	1.2	44296	1.02	45	0.40	0.67		0.00	30	0.28	0.61	7932	0.18	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.53	0.47	0.70
14	32300	0.7	15311	0.35	45	0.40	0.67	6441	0.15	30	0.28	0.61	9503	0.22	100	0.86	0.89		0.00	10	0.12	0.53	1044	0.02	2	0.05	0.49	0.57	0.50	0.72
15	69296	1.6	35316	0.81	45	0.40	0.67	21210	0.49	30	0.28	0.61	12769	0.29	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.51	0.45	0.69
16	38073	0.9	27195	0.62	45	0.40	0.67		0.00	30	0.28	0.61	10878	0.25	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.61	0.53	0.73
17	63988	1.5	51168	1.17	45	0.40	0.67		0.00	30	0.28	0.61	12820	0.29	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.56	0.49	0.71
18	47519	1.1	42331	0.97	45	0.40	0.67		0.00	30	0.28	0.61	5189	0.12	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.51	0.45	0.69
19	37547	0.9	23122	0.53	45	0.40	0.67		0.00	30	0.28	0.61	10950	0.25	100	0.86	0.89		0.00	10	0.12	0.53	3475	0.08	2	0.05	0.49	0.57	0.50	0.72
20	71386	1.6	39820	0.91	45	0.40	0.67		0.00	30	0.28	0.61	26499	0.61	100	0.86	0.89		0.00	10	0.12	0.53	5067	0.12	2	0.05	0.49	0.62	0.54	0.74
21	80989	1.9	53576	1.23	45	0.40	0.67	12579	0.29	30	0.28	0.61	10610	0.24	100	0.86	0.89		0.00	10	0.12	0.53	4224	0.10	2	0.05	0.49	0.48	0.42	0.68
22	74345	1.7	52111	1.20	45	0.40	0.67	3763	0.09	30	0.28	0.61	16917	0.39	100	0.86	0.89		0.00	10	0.12	0.53	1553	0.04	2	0.05	0.49	0.56	0.49	0.71
23	51813	1.2	21021	0.48	45	0.40	0.67	20216	0.46	30	0.28	0.61	10575	0.24	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.50	0.45	0.69
24	53667	1.2	45659	1.05	45	0.40	0.67		0.00	30	0.28	0.61	8008	0.18	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.53	0.47	0.70
25	44238	1.0	25193	0.58	45	0.40	0.67	6650	0.15	30	0.28	0.61	12395	0.28	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.58	0.51	0.72
26	15441	0.4	5680	0.13	45	0.40	0.67		0.00	30	0.28	0.61	9760	0.22	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.80	0.69	0.81
30	233495	5.4	54305	1.25	45	0.40	0.67	21152	0.49	30	0.28	0.61	72093	1.66	100	0.86	0.89		0.00	10	0.12	0.53	85945	1.97	2	0.05	0.49	0.45	0.40	0.67
31	79484	1.8	32076	0.74	45	0.40	0.67		0.00	30	0.28	0.61	39363	0.90	100	0.86	0.89		0.00	10	0.12	0.53	8045	0.18	2	0.05	0.49	0.68	0.59	0.76
32	14110	0.3		0.00	45	0.40	0.67		0.00	30	0.28	0.61	10592	0.24	100	0.86	0.89		0.00	10	0.12	0.53	3519	0.08	2	0.05	0.49	0.76	0.65	0.79
33	37166	0.9		0.00	45	0.40	0.67		0.00	30	0.28	0.61	32864	0.75	100	0.86	0.89		0.00	10	0.12	0.53	4303	0.10	2	0.05	0.49	0.89	0.76	0.85
34	267666	6.1	22853	0.52	45	0.40	0.67	7034	0.16	30	0.28	0.61		0.00	100	0.86	0.89	237778	5.46	10	0.12	0.53		0.00	2	0.05	0.49	0.14	0.15	0.54
35	186843	4.3	22288	0.51	45	0.40	0.67		0.00	30	0.28	0.61	164555	3.78	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.93	0.80	0.87
36	143707	3.3		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89	143707	3.30	10	0.12	0.53		0.00	2	0.05	0.49	0.10	0.12	0.53
O1	17544	0.4		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89		0.00	10	0.12	0.53	17544	0.40	2	0.05	0.49	0.02	0.05	0.49
O2	123102	2.8		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89		0.00	10	0.12	0.53	123102	2.83	2	0.05	0.49	0.02	0.05	0.49
O3	103568	2.4		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89		0.00	10	0.12	0.53	103568	2.38	2	0.05	0.49	0.02	0.05	0.49
O4	67958	1.6		0.00	45	0.40	0.67		0.00	30	0.28	0.61	3206	0.07	100	0.86	0.89		0.00	10	0.12	0.53	64752	1.49	2	0.05	0.49	0.07	0.09	0.51
41	107795	2.5		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89	107795	2.47	10	0.12	0.53		0.00	2	0.05	0.49	0.10	0.12	0.53
42	60389	1.4	43468	1.00	45	0.40	0.67		0.00	30	0.28	0.61	16921	0.39	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.60	0.53	0.73
43	45176	1.0	24921	0.57	45	0.40	0.67	4570	0.10	30	0.28	0.61	14306	0.33	100	0.86	0.89		0.00	10	0.12	0.53	1379	0.03	2	0.05	0.49	0.60	0.52	0.73
44	40656	0.9	17033	0.39	45	0.40	0.67	7759	0.18	30	0.28	0.61	15865	0.36	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.64	0.55	0.75
45	16218	0.4		0.00	45	0.40	0.67		0.00	30	0.28	0.61	12555	0.29	100	0.86	0.89		0.00	10	0.12	0.53	3664	0.08	2	0.05	0.49	0.78	0.67	0.80
46	29522	0.7	13454	0.31	45	0.40	0.67		0.00	30	0.28	0.61	12668	0.29	100	0.86	0.89		0.00	10	0.12	0.53	3400	0.08	2	0.05	0.49	0.64	0.56	0.75
47	37349	0.9	30829	0.71	45	0.40	0.67		0.00	30	0.28	0.61	6520	0.15	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.55	0.48	0.71
48	33277	0.8	22483	0.52	45	0.40	0.67		0.00	30	0.28	0.61	9837	0.23	100	0.86	0.89		0.00	10	0.12	0.53	957	0.02	2	0.05	0.49	0.60	0.52	0.73
49	52317	1.2	38878	0.89	45	0.40	0.67		0.00	30	0.28	0.61	13439	0.31	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.59	0.52	0.73
50	47362	1.1	29505	0.68	45	0.40	0.67	3504	0.08	30	0.28	0.61	14352	0.33	100	0.86	0.89		0.00	10	0.12	0.53		0.00	2	0.05	0.49	0.61	0.53	0.73
51	17672	0.4		0.00	45	0.40	0.67		0.00	30	0.28	0.61	13954	0.32	100	0.86	0.89		0.00	10	0.12	0.53	3718	0.09	2	0.05	0.49	0.79	0.69	0.81
O5	36371	0.8		0.00	45	0.40	0.67		0.00	30	0.28	0.61		0.00	100	0.86	0.89		0.00	10	0.12	0.53	36371	0.83	2	0.05	0.49	0.02	0.05	0.49
O6	33046	0.8		0.00	45	0.40	0.67		0.00	30	0.28	0.61	6451	0.15	100	0.86	0.89		0.00	10	0.12	0.53	26595	0.61	2	0.05	0.49	0.21	0.21	0.57
O7	25550	0.6		0.00	45	0.40	0.67		0.00	30	0.28	0.61	16177	0.37	100	0.86	0.89		0.00	10	0.12	0.53	9373	0.22	2	0.05	0.49	0.64	0.56	0.75
O8	15792	0.4		0.00	45	0.40	0.67		0.00	30	0.28	0.61	6187	0.14	100	0.86	0.89		0.00	10	0.12	0.53	9606	0.22	2	0.05	0.49	0.40	0.37	0.65
O9	54847	1.3		0.00	45	0.40	0.67		0.00	30	0.28	0.61	23741	0.55	100	0.86	0.89		0.00	10	0.12	0.53	31106	0.71	2	0.05	0.49	0.44	0.40	0.67
O11	1885162	43.3		0.00	45	0.40	0.67		0.00	30	0.28	0.61	30322	0.70	100	0.86	0.89		0.00	10	0.12	0.53	1854839	42.58	2	0.05	0.49	0.04	0.06	0.50

[1] Refer to Table 6-3 Urban Storm Drainage Criteria Manual, March 2017 Edition
[2] Refer to Table 6-5 Urban Storm Drainage Criteria Manual, March 2017 Edition
[3] Refer to Table 6-5 Urban Storm Drainage Criteria Manual, March 2017 Edition
[4] Weighted imperviousness
[5] Weighted C5
[6] Weighted C100

RICK ENGINEERING COMPANY

Time of Concentration
Post-Project

Job Name: Westwood
Job Number: D1104
Date:

Basin Data				Initial Overland Time (t_i)					Travel/Channelized Time (t_t)								Minimum Time of Concentration (t_c)		Final t_c	Remarks
Basin ID / Design Point	Area	Composite Imperviousness	C_5[1]	Starting Elevation	Ending Elevation	Length (If length of Overland Flow is > 300 ft, use 300 ft)	Slope	t_i[2]	Starting Elevation	Ending Elevation	Length	Slope	Conveyance Factor, K[3]	Channel Velocity[4]	t_t[5]	t_c[6] $=t_i+t_t$	Comp. t_c[7]	Final t_c[8] (If <5, use 5)		
	ac			*ft*	*ft*	*ft*	*ft/ft*	*min*	*ft*	*ft*	*ft*	*ft/ft*		*ft/s*	*min*	*min*	min	*min*	*min*	
1	0.7	0.62	0.54	5196	5195	60	0.017	6.61	5195	5191.5	365	0.010	20	1.96	3.11	9.72	18.99	9.72	9.72	
2	1.5	0.58	0.51	5200	5199	50	0.020	5.98	5199	5188	700	0.016	20	2.51	4.65	10.63	21.49	10.63	10.63	
3	1.1	0.52	0.46	5191	5187	185	0.022	12.22	5187	5183	200	0.020	20	2.83	1.18	13.40	18.61	13.40	13.40	
4	1.2	0.44	0.40	5186	5183	150	0.020	12.37	5183	5178	230	0.022	20	2.95	1.30	13.67	20.20	13.67	13.67	
5	2.5	0.46	0.41	5198	5196	140	0.014	13.16	5196	5192	460	0.009	20	1.87	4.11	17.27	23.58	17.27	17.27	
6	1.5	0.54	0.48	5194	5191	120	0.025	9.11	5191	5185.5	470	0.012	20	2.16	3.62	12.73	21.13	12.73	12.73	
7	1.0	0.53	0.46	5188	5185	115	0.026	8.97	5185	5182	320	0.009	20	1.94	2.75	11.72	20.41	11.72	11.72	
8	0.3	0.84	0.73	5209	5208	75	0.013	5.32	5208	5202	180	0.033	20	3.65	0.82	6.14	12.46	6.14	6.14	
9	0.5	0.82	0.71	5202	5201	75	0.013	5.54	5201	5192	475	0.019	20	2.75	2.88	8.42	14.81	8.42	8.42	
10	1.2	0.54	0.48	5193	5189.8	130	0.025	9.53	5189.8	5184	375	0.015	20	2.49	2.51	12.05	19.83	12.05	12.05	
11	0.1	0.90	0.78					5.00	0							5.00		5.00	5.00	
12	1.4	0.50	0.44	5193	5189.8	130	0.025	10.11	5189.8	5185	320	0.015	20	2.45	2.18	12.29	20.30	12.29	12.29	
13	1.2	0.53	0.47	5191	5188	90	0.033	7.26	5188	5180	350	0.023	20	3.02	1.93	9.19	19.27	9.19	9.19	
14	0.7	0.57	0.50	5188	5187	60	0.017	7.11	5187	5181	420	0.014	20	2.39	2.93	10.03	19.80	10.03	10.03	
15	1.6	0.51	0.45	5190.7	5187.5	150	0.021	11.24	5187.5	5180	350	0.021	20	2.93	1.99	13.24	19.89	13.24	13.24	
16	0.9	0.61	0.53	5189	5187.5	60	0.025	5.89	5187.5	5176	460	0.025	20	3.16	2.42	8.32	18.45	8.32	8.32	
17	1.5	0.56	0.49	5184	5180	175	0.023	11.07	5180	5174	300	0.020	20	2.83	1.77	12.84	18.58	12.84	12.84	
18	1.1	0.51	0.45	5179	5173	175	0.034	10.34	5173	5169	300	0.013	20	2.31	2.17	12.51	20.01	12.51	12.51	
19	0.9	0.57	0.50	5183	5182	70	0.014	8.05	5182	5177	425	0.012	20	2.17	3.27	11.32	20.14	11.32	11.32	
20	1.6	0.62	0.54	5177	5176	100	0.010	10.04	5176	5168	565	0.014	20	2.38	3.96	13.99	19.86	13.99	13.99	
21	1.9	0.48	0.42	5197	5188	160	0.056	8.75	5188	5182	475	0.013	20	2.25	3.52	12.27	22.40	12.27	12.27	
22	1.7	0.56	0.49	5185	5182	140	0.021	10.13	5182	5175	600	0.012	20	2.16	4.63	14.76	22.01	14.76	14.76	
23	1.2	0.50	0.45	5182	5179	90	0.033	7.53	5179	5175	230	0.017	20	2.64	1.45	8.98	19.25	8.98	8.98	
24	1.2	0.53	0.47	5177	5174	170	0.018	12.34	5174	5169.5	345	0.013	20	2.28	2.52	14.85	20.02	14.85	14.85	
25	1.0	0.58	0.51	5181	5180	60	0.017	6.98	5180	5169	535	0.021	20	2.87	3.11	10.09	19.74	10.09	10.09	
26	0.4	0.80	0.69	5172.6	5171	65	0.025	4.46	5171	5170	185	0.005	20	1.47	2.10	6.56	14.52	6.56	6.56	
30	5.4	0.45	0.40	5196	5195	100	0.010	12.62	5195	5167	2000	0.014	20	2.37	14.09	26.70	36.83	26.70	26.70	
31	1.8	0.68	0.59	5183	5182	185	0.005	15.34	5182	5175	1000	0.007	20	1.67	9.96	25.30	25.23	25.23	25.23	
32	0.3	0.76	0.65	5167.5	5166	50	0.030	3.96	5166	5163	300	0.010	20	2.00	2.50	6.46	15.71	6.46	6.46	
33	0.9	0.89	0.76	5204	5203	150	0.007	8.54	5203	5201	600	0.003	20	1.15	8.66	17.21	19.02	17.21	17.21	
34	6.1	0.14	0.15	5183	5180.5	110	0.023	13.79	5180.5	5172	492	0.017	7	0.92	8.91	22.70	29.43	22.70	22.70	
35	4.3	0.93	0.80	5171	5170	75	0.013	4.26	5170	5161	450	0.020	7	0.99	7.58	11.83	12.52	11.83	11.83	
36	3.3	0.10	0.12	5206.3	5196.5	300	0.033	20.80	5196.5	5193	240	0.015	7	0.85	4.73	25.53	27.48	25.53	25.53	
O1	0.4	0.02	0.05					5.00	0							5.00		5.00	5.00	
O2	2.8	0.02	0.05	5211	5201.5	300	0.032	22.42	5201.5	5195	220	0.030	5	0.86	4.27	26.68	27.96	26.68	26.68	
O3	2.4	0.02	0.05	5210	5201	300	0.030	22.82	5201	5195	215	0.028	5	0.84	4.29	27.11	27.97	27.11	27.11	
O4	1.6	0.07	0.09	5211	5204	300	0.023	23.90	5204	5194	305	0.033	5	0.91	5.61	29.51	27.70	27.70	27.70	
41	2.5	0.10	0.12	5196	5185	300	0.037	20.02	5185	5183	170	0.012	7	0.76	3.73	23.75	26.81	23.75	23.75	
42	1.4	0.60	0.53	5182	5181	70	0.014	7.69	5181	5171.5	730	0.013	20	2.28	5.33	13.02	21.84	13.02	13.02	
43	1.0	0.60	0.52	5193.5	5192	60	0.025	5.98	5192	5185	360	0.019	20	2.79	2.15	8.13	18.35	8.13	8.13	
44	0.9	0.64	0.55	5188.9	5187	75	0.025	6.27	5187	5180	305	0.023	20	3.03	1.68	7.95	17.06	7.95	7.95	
45	0.4	0.78	0.67	5193.5	5192.5	45	0.022	3.97	5192.5	5186	480	0.014	20	2.33	3.44	7.41	16.22	7.41	7.41	
46	0.7	0.64	0.56	5193.6	5193	100	0.006	11.64	5193	5186	505	0.014	20	2.35	3.57	15.22	19.17	15.22	15.22	
47	0.9	0.55	0.48	5187.9	5185	117	0.025	8.98	5185	5180	270	0.019	20	2.72	1.65	10.64	18.70	10.64	10.64	
48	0.8	0.60	0.52	5186.4	5183.5	117	0.025	8.33	5183.5	5177	235	0.028	20	3.33	1.18	9.51	17.15	9.51	9.51	
49	1.2	0.59	0.52	5183.8	5179.5	175	0.025	10.35	5179.5	5173	275	0.024	20	3.07	1.49	11.84	17.67	11.84	11.84	
50	1.1	0.61	0.53	5178.6	5177	65	0.025	6.17	5177	5171	475	0.013	20	2.25	3.52	9.70	19.74	9.70	9.70	
51	0.4	0.79	0.69	5171.6	5171	30	0.020	3.26	5171	5167	435	0.009	20	1.92	3.78	7.04	16.26	7.04	7.04	
O5	0.8	0.02	0.05	5176.5	5176	50	0.010	13.39	5176	5161	1120	0.013	15	1.74	10.75	24.14	43.04	24.14	24.14	
O6	0.8	0.21	0.21	5209	5208	50	0.020	9.06	5208	5193	400	0.038	15	2.90	2.30	11.35	25.29	11.35	11.35	

Basin Data				Initial Overland Time (t_i)					Travel/Channelized Time (t_t)								Minimum Time of Concentration (t_c)		Final t_c	Remarks
Basin ID / Design Point	Area	Composite Imperviousness	C_5 [1]	Starting Elevation	Ending Elevation	Length (If length of Overland Flow is > 300 ft, use 300 ft)	Slope	t_i [2]	Starting Elevation	Ending Elevation	Length	Slope	Conveyance Factor, K [3]	Channel Velocity [4]	t_t [5]	t_c [6] $=t_i+t_t$	Comp. t_c [7]	Final t_c [8] (If <5, use 5)		
O7	0.6	0.64	0.56	5207	5205	75	0.027	6.11	5205	5187	665	0.027	15	2.47	4.49	10.60	18.86	10.60	10.60	
O8	0.4	0.40	0.37	5198.8	5198	50	0.016	8.02	5198	5196.5	290	0.005	15	1.08	4.48	12.50	23.72	12.50	12.50	
O9	1.3	0.44	0.40	5177.5	5176	60	0.025	7.24	5176	5160	1300	0.012	15	1.66	13.02	20.26	31.28	20.26	20.26	
O11	43.3	0.04	0.06	5243	5238	300	0.017	27.36	5238	5198	1247	0.032	5	0.90	23.21	50.57	37.61	37.61	37.61	

[1] Refer to C spreadsheet
[2] Refer to Equation 6-3 Urban Storm Drainage Criteria Manual, March 2017 Edition
[3] Refer to Table 6-2 Urban Storm Drainage Criteria Manual, March 2017 Edition
[4] $Vt = K\sqrt{S_0}$ S_0 = Waterway Slope
[5] Refer to Equation 6-4 Urban Storm Drainage Criteria Manual, March 2017 Edition
[6] Refer to Equation 6-2 Urban Storm Drainage Criteria Manual, March 2017 Edition
[7] Refer to Equation 6-5 Urban Storm Drainage Criteria Manual, March 2017 Edition
[8] Smaller of the two t_c values

Job Name: Westwood
Job Number: D1104
Date:

5-Year 1-Hr Point Rainfall = 1.38 in

Q5				
Basin ID / Design	C5[1]	I[2] in/hr	A acres	Q[3] cfs
1	0.54	3.8	0.7	1.3
2	0.51	3.6	1.5	2.7
3	0.46	3.3	1.1	1.7
4	0.40	3.3	1.2	1.5
5	0.41	2.9	2.5	2.9
6	0.48	3.4	1.5	2.4
7	0.46	3.5	1.0	1.6
8	0.73	4.4	0.3	0.9
9	0.71	4.0	0.5	1.4
10	0.48	3.5	1.2	2.0
11	0.78	4.7	0.1	0.3
12	0.44	3.4	1.4	2.1
13	0.47	3.9	1.2	2.2
14	0.50	3.7	0.7	1.4
15	0.45	3.3	1.6	2.4
16	0.53	4.0	0.9	1.9
17	0.49	3.4	1.5	2.4
18	0.45	3.4	1.1	1.7
19	0.50	3.6	0.9	1.5
20	0.54	3.2	1.6	2.9
21	0.42	3.4	1.9	2.7
22	0.49	3.2	1.7	2.6
23	0.45	3.9	1.2	2.1
24	0.47	3.1	1.2	1.8
25	0.51	3.7	1.0	1.9
26	0.69	4.3	0.4	1.1
30	0.40	2.3	5.4	5.0
31	0.59	2.4	1.8	2.6
32	0.65	4.4	0.3	0.9
33	0.76	2.9	0.9	1.9
34	0.15	2.5	6.1	2.3
35	0.80	3.5	4.3	12.0
36	0.12	2.4	3.3	0.9
O1	0.05	4.7	0.4	0.1
O2	0.05	2.3	2.8	0.3
O3	0.05	2.3	2.4	0.3

5-Year 1-Hr Point Rainfall = 1.38 in

Q5				
Basin ID /	C5[1]	I[2]	A	Q[3]
O4	0.09	2.3	1.6	0.3
41	0.12	2.5	2.5	0.7
42	0.53	3.3	1.4	2.4
43	0.52	4.0	1.0	2.2
44	0.55	4.1	0.9	2.1
45	0.67	4.2	0.4	1.0
46	0.56	3.1	0.7	1.2
47	0.48	3.6	0.9	1.5
48	0.52	3.8	0.8	1.5
49	0.52	3.5	1.2	2.2
50	0.53	3.8	1.1	2.2
51	0.69	4.2	0.4	1.2
O5	0.05	2.5	0.8	0.1
O6	0.21	3.5	0.8	0.6
O7	0.56	3.6	0.6	1.2
O8	0.37	3.4	0.4	0.5
O9	0.40	2.7	1.3	1.4
O11	0.06	1.9	43.3	5.3

[1] Refer to Post-Project Runoff Coefficients spreadsheet

[2] Refer to Equation 5-1 Urban Storm Drainage Criteria Manual, March 2017

[3] Refer to Equation 6-1 Urban Storm Drainage Criteria Manual, March 2017

Job Name: Westwood
Job Number: D1104
Date:

100-Year 1-Hr Point Rainfall = 2.69 in

Q100				
Basin ID / Design Point	C100[1]	I[2]	A	Q[3]
		in/hr	*acres*	*cfs*
1	0.74	7.4	0.7	3.6
2	0.72	7.1	1.5	7.6
3	0.70	6.4	1.1	5.0
4	0.67	6.4	1.2	5.0
5	0.67	5.7	2.5	9.4
6	0.71	6.6	1.5	6.8
7	0.70	6.8	1.0	4.8
8	0.83	8.6	0.3	2.1
9	0.82	7.8	0.5	3.2
10	0.71	6.7	1.2	5.9
11	0.85	9.1	0.1	0.7
12	0.69	6.7	1.4	6.5
13	0.70	7.5	1.2	6.3
14	0.72	7.3	0.7	3.9
15	0.69	6.5	1.6	7.1
16	0.73	7.8	0.9	5.0
17	0.71	6.6	1.5	6.9
18	0.69	6.6	1.1	5.0
19	0.72	6.9	0.9	4.3
20	0.74	6.3	1.6	7.7
21	0.68	6.7	1.9	8.5
22	0.71	6.2	1.7	7.5
23	0.69	7.6	1.2	6.2
24	0.70	6.1	1.2	5.3
25	0.72	7.3	1.0	5.3
26	0.81	8.4	0.4	2.4
30	0.67	4.5	5.4	16.2
31	0.76	4.7	1.8	6.5
32	0.79	8.5	0.3	2.2
33	0.85	5.7	0.9	4.1
34	0.54	4.9	6.1	16.4
35	0.87	6.8	4.3	25.3
36	0.53	4.6	3.3	8.0
O1	0.49	9.1	0.4	1.8
O2	0.49	4.5	2.8	6.3

100-Year 1-Hr Point Rainfall = 2.69 in

Q100				
Basin ID /	C100[1]	I[2]	A	Q[3]
O3	0.49	4.5	2.4	5.2
O4	0.51	4.4	1.6	3.5
41	0.53	4.8	2.5	6.3
42	0.73	6.5	1.4	6.6
43	0.73	7.9	1.0	5.9
44	0.75	7.9	0.9	5.5
45	0.80	8.1	0.4	2.4
46	0.75	6.1	0.7	3.1
47	0.71	7.1	0.9	4.3
48	0.73	7.4	0.8	4.1
49	0.73	6.8	1.2	5.9
50	0.73	7.4	1.1	5.9
51	0.81	8.3	0.4	2.7
O5	0.49	4.8	0.8	2.0
O6	0.57	6.9	0.8	3.0
O7	0.75	7.1	0.6	3.1
O8	0.65	6.6	0.4	1.6
O9	0.67	5.3	1.3	4.4
O11	0.50	3.7	43.3	79.4

[1] Refer to Post-Project Runoff Coefficients spreadsheet

[2] Refer to Equation 5-1 Urban Storm Drainage Criteria Manual, March 2017

[3] Refer to Equation 6-1 Urban Storm Drainage Criteria Manual, March 2017

RICK ENGINEERING COMPANY

Job Name: Westwood
Job Number: D1104
Date:

Pro-Rated Sub-Basin Q5 Backup						
Basin ID [1]	**Basin Area [2]**	**Basin Q5 [3]**	**Sub-Basin ID [4]**	**Inlet ID**	**Sub-Basin Area [5]**	**Sub-Basin Pro-Rated Q5 [6]**
Unit	**acres**	**cfs**			**acres**	**cfs**
2	1.5	2.7	2A	-	0.4	0.8
			2B	SDI-42	1.1	2.0
20	1.6	2.9	20A	SDI-4 (U/S Flanking Inlet)	0.8	1.3
			20B	SDI-5 (Sump)	0.9	1.6
36	3.3	0.9	36A	SDI-25	2.7	0.7
			36B	SDI-41	0.6	0.2
41	2.5	0.7	41A	SDI-50	1.7	0.5
			41B	SDI-28	0.8	0.2
30	5.4	5.0	30A	-	1.6	1.5
			30B	-	2.8	2.6
			30C	SDI-20 (U/S Flanking Inlet) & SDI-2 (Sump)	1.0	0.9
31	1.8	2.6	31A	-	0.6	0.8
			31B	-	0.5	0.7
			31C	SDI-26	0.8	1.1

[1] Refer to Post-Project Q5 spreadsheet
[2] Refer to Post-Project Q5 spreadsheet
[3] Refer to Post-Project Q5 spreadsheet
[4] Refer to Post-Project Drainage Map
[5] Refer to Post-Project Drainage Map
[6] ([5]/[2])*[3]

Job Name: Westwood
Job Number: D1104
Date:

Pro-Rated Sub-Basin Q100 Backup						
Basin ID [1]	Basin Area [2]	Basin Q100 [3]	Sub-Basin ID [4]	Inlet ID	Sub-Basin Area [5]	Sub-Basin Pro-Rated Q100 [6]
Unit	acres	cfs			acres	cfs
2	1.5	7.6	2A	-	0.4	2.1
			2B	SDI-42	1.1	5.5
20	1.6	7.7	20A	SDI-4 (U/S Flanking	0.8	3.5
			20B	SDI-5 (Sump)	0.9	4.2
36	3.3	8.0	36A	SDI-25	2.7	6.6
			36B	SDI-41	0.6	1.5
41	2.5	6.3	41A	SDI-50	1.7	4.3
			41B	SDI-28	0.8	1.9
30	5.4	16.2	30A	-	1.6	4.8
			30B	-	2.8	8.3
			30C	SDI-20 (U/S Flanking Inlet) & SDI-2 (Sump)	1.0	3.1
31	1.8	6.5	31A	-	0.6	2.0
			31B	-	0.5	1.7
			31C	SDI-26	0.8	2.8

[1] Refer to Post-Project Q100 spreadsheet
[2] Refer to Post-Project Q100 spreadsheet
[3] Refer to Post-Project Q100 spreadsheet
[4] Refer to Post-Project Drainage Map
[5] Refer to Post-Project Drainage Map
[6] ([5]/[2])*[3]

Design Point	Inlet ID	Contributing Area (acres)	Direct Q5 (CFS)	Direct Q100 (CFS)	Total Q5 (CFS)	Total Q100 (CFS)	Notes
1	SDI-31	0.7	1.3	3.6	1.3	3.6	No bypass flow received
2A	-	0.4	0.8	2.1	0.8	2.1	No bypass flow received
2B	SDI-42	1.1	2.0	5.5	2.7	7.6	Bypass flow from Sub-Basin 2A
3	SDI-39	1.1	1.7	5.0	1.7	5.0	No bypass flow received
4	SDI-48	1.2	1.5	5.0	1.5	6.5	Bypass flow from Basin 44 (SDI-35)
5	SDI-30	2.5	2.9	9.4	2.9	9.4	No bypass flow received
6	SDI-34	1.5	2.4	6.8	2.4	8.7	Bypass flow from Basin 5 (SDI-30)
7	SDI-47	1.0	1.6	4.8	1.6	6.4	Bypass flow from Basin 6 (SDI-34)
8	SDI-45	0.3	0.9	2.1	0.9	2.1	No bypass flow received
9	SDI-40	0.5	1.4	3.2	1.4	3.2	No bypass flow received
10	SDI-12	1.2	2.0	5.9	2.0	5.9	No bypass flow received
11	SDI-13	0.1	0.3	0.7	0.3	0.7	No bypass flow received
12	SDI-07	1.4	2.1	6.5	2.1	6.5	No bypass flow received
13	SDI-24	1.2	2.2	6.3	2.2	6.3	No bypass flow received
14	SDI-11	0.7	1.4	3.9	1.4	3.9	No bypass flow received
15	SDI-27	1.6	2.4	7.1	2.4	7.1	No bypass flow received
16	SDI-16	0.9	1.9	5.0	1.9	5.0	No bypass flow received
17	SDI-10	1.5	2.4	6.9	2.4	6.9	No bypass flow received
18	SDI-08	1.1	1.7	5.0	1.7	5.7	Bypass flow from Basin 17 (SDI-10)
19	SDI-46	0.9	1.5	4.3	1.5	4.3	No bypass flow received
20A	SDI-4 (U/S Flanking Inlet)	0.8	1.3	3.5	2.9	10.3	Bypass flow from Basin 18 (SDI-08) + Basin 42 (SDI-17) + Basin 49 (SDI-18)
20B	SDI-5 (Sump)	0.9	1.6	4.2	0.5	6.2	Bypass flow from Basin 19 (SDI-46) + Sub-Basin 20A (SDI-04)
21	SDI-03	1.9	2.7	8.5	2.7	7.0	No bypass flow received
22	SDI-23	1.7	2.6	7.5	2.6	7.1	Bypass flow from Basin 21 (SDI-03)
23	SDI-22	1.2	2.1	6.2	2.1	6.2	No bypass flow received
24	SDI-21	1.2	1.8	5.3	2.0	8.0	Bypass flow from Basin 23 (SDI-22)
25	SDI-09	1.0	1.9	5.3	1.9	5.3	No bypass flow received
26	SDI-06	0.4	1.1	2.4	1.1	5.0	Bypass flow from Basin 24 (SDI-21) + Basin 25 (SDI-09) + Basin 50 (SDI-19)
30A	-	1.6	1.5	4.8	1.5	4.8	No bypass flow received
30B	-	2.8	2.6	8.3	4.1	13.1	Bypass flow from Sub-Basin 30A
30C	SDI-20 (U/S Flanking Inlet)	1.0	1.0	3.1	4.0	8.1	Bypass flow from Sub-Basin 30B (this already includes flow from Sub-Basin 30A)
	SDI-2 (Sump)				1.0	8.0	Bypass flow from SDI-20 (U/S Flanking Inlet)
31A	-	0.6	0.8	2.0	0.8	2.0	No bypass flow received
31B	-	0.5	0.7	1.7	0.7	1.7	No bypass flow received
31C	SDI-26	0.8	1.1	2.8	2.6	6.5	Bypass flow from Sub-Basin 31A & 31B
32	SDI-49	0.3	0.9	2.2	0.9	2.2	No bypass flow received
33	SDI-44	0.9	1.9	4.1	1.9	4.1	No bypass flow received
34	SDI-32	6.1	2.3	16.4	2.3	16.4	No bypass flow received
35	-	4.3	12.0	25.3	64.0	182.4	Total Flow = Peak inflow for the detention basin from UD-Detention Spreadsheet

Design Point	Inlet ID	Contributing Area (acres)	Direct Q5 (CFS)	Direct Q100 (CFS)	Total Q5 (CFS)	Total Q100 (CFS)	Notes
36A	SDI-25	2.7	0.7	6.6	0.8	8.4	Bypass flow from Offsite Basin O1
36B	SDI-41	0.6	0.2	1.5	0.2	1.5	No bypass flow received
O1	-	0.4	0.1	1.8	0.1	1.8	No bypass flow received
O2	-	2.8	0.3	6.3	0.3	6.3	No bypass flow received
O3	-	2.4	0.3	5.2	0.3	5.2	No bypass flow received
O4	-	1.6	0.3	3.5	0.3	3.5	No bypass flow received
41A	SDI-50	1.7	0.5	4.3	0.8	10.6	Bypass flow from Offsite Basin O2
41B	SDI-28	0.8	0.2	1.9	0.8	10.6	Bypass flow from Offsite Basin O3 & O4
42	SDI-17	1.4	2.4	6.6	2.4	6.6	No bypass flow received
43	SDI-33	1.0	2.2	5.9	2.2	7.8	Bypass flow from Basin 1 (SDI-31) + Basin 2 (SDI-42)
44	SDI-35	0.9	2.1	5.5	2.1	8.4	Bypass flow from Basin 43 (SDI-33) + Basin 3 (SDI-39)
45	SDI-37	0.4	1.0	2.4	1.0	2.4	No bypass flow received
46	SDI-38	0.7	1.2	3.1	1.2	4.0	Bypass flow from Basin 9 (SDI-40)
47	SDI-14	0.9	1.5	4.3	1.7	7.2	Bypass flow from Basin 12 (SDI-07)
48	SDI-15	0.8	1.5	4.1	1.7	8.7	Bypass flow from Basin 13 (SDI-24) + Basin 14 (SDI-11) + Basin 47 (SDI-14)
49	SDI-18	1.2	2.2	5.9	2.2	8.3	Bypass flow from Basin 15 (SDI-27) + Basin 16 (SDI-16) + Basin 48 (SDI-15)
50	SDI-19	1.1	2.2	5.9	2.2	6.6	Bypass flow from Basin 22 (SDI-23)
51	SDI-01	0.4	1.2	2.7	1.2	3.7	Bypass flow from Basin 31 (SDI-26)
O5		0.8	0.1	2.0	64.1	184.4	Total Flow = Undetained Q100 from the detention basin + Flow from Offsite Basin
O6		0.8	0.6	3.0	0.6	3.0	No bypass flow received
O7		0.6	1.2	3.1	1.2	3.1	No bypass flow received
O8		0.4	0.5	1.6	0.5	1.7	Bypass flow from Basin 33 (SDI-44)
O9		1.3	1.4	4.4	1.4	4.4	No bypass flow received
O11		43.3	5.3	79.4	5.3	79.4	No bypass flow received

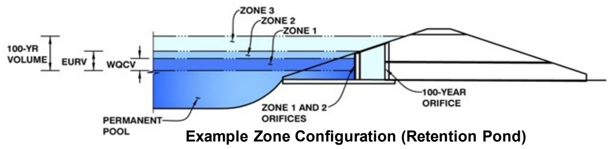
Appendix A - Hydrologic Computations
Detention Design

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)

Project: Westwood

Basin ID: EDB-1



Example Zone Configuration (Retention Pond)

Depth Increement = ft

Watershed Information

Selected BMP Type =	**EDB**				
Watershed Area =	69.90	acres			
Watershed Length =	2,500	ft			
Watershed Length to Centroid =	1,250	ft			
Watershed Slope =	0.015	ft/ft			
Watershed Imperviousness =	45.00%	percent			
Percentage Hydrologic Soil Group A =	0.0%	percent			
Percentage Hydrologic Soil Group B =	0.0%	percent			
Percentage Hydrologic Soil Groups C/D =	100.0%	percent			
Target WQCV Drain Time =	40.0	hours			
Location for 1-hr Rainfall Depths =	Thornton - Civic Center				

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.124	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.951	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.97 in.) =	2.428	acre-feet	0.97	inches
5-yr Runoff Volume (P1 = 1.38 in.) =	4.518	acre-feet	1.38	inches
10-yr Runoff Volume (P1 = 1.37 in.) =	4.387	acre-feet		inches
25-yr Runoff Volume (P1 = 1.77 in.) =	6.980	acre-feet		inches
50-yr Runoff Volume (P1 = 2.1 in.) =	8.951	acre-feet		inches
100-yr Runoff Volume (P1 = 2.69 in.) =	12.767	acre-feet	2.69	inches
500-yr Runoff Volume (P1 = 3.4 in.) =	17.121	acre-feet		inches
Approximate 2-yr Detention Volume =	2.111	acre-feet		
Approximate 5-yr Detention Volume =	3.629	acre-feet		
Approximate 10-yr Detention Volume =	3.524	acre-feet		
Approximate 25-yr Detention Volume =	4.341	acre-feet		
Approximate 50-yr Detention Volume =	4.754	acre-feet		
Approximate 100-yr Detention Volume =	6.285	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.124	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.827	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.334	acre-feet
Total Detention Basin Volume =	6.285	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	139	0.003		
	--	0.31	--	--	--	159	0.004	46	0.001
	--	0.81	--	--	--	1,253	0.029	399	0.009
	--	1.31	--	--	--	5,302	0.122	2,038	0.047
	--	1.81	--	--	--	13,591	0.312	6,761	0.155
	--	2.31	--	--	--	25,147	0.577	16,445	0.378
	--	2.81	--	--	--	37,336	0.857	32,066	0.736
	--	3.31	--	--	--	51,104	1.173	54,176	1.244
	--	3.81	--	--	--	67,400	1.547	83,802	1.924
	--	4.31	--	--	--	82,225	1.888	121,208	2.783
	--	4.81	--	--	--	92,560	2.125	164,905	3.786
	--	5.31	--	--	--	98,858	2.269	212,759	4.884
	--	5.81	--	--	--	104,280	2.394	263,544	6.050
	--	6.31	--	--	--	106,903	2.454	316,339	7.262
	--	6.81	--	--	--	109,552	2.515	370,453	8.504
	--	7.31	--	--	--	112,227	2.576	425,898	9.777
	--	7.81	--	--	--	114,928	2.638	482,687	11.081
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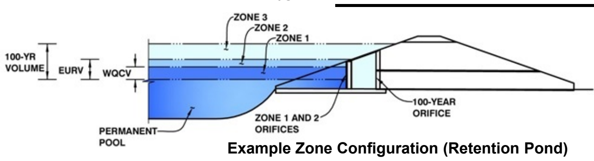
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)

Project: **Westwood**

Basin ID: **EDB-1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.21	1.124	Orifice Plate
Zone 2 (EURV)	4.40	1.827	Orifice Plate
Zone 3 (100-year)	5.91	3.334	Weir&Pipe (Restrict)
Total (all zones)		6.285	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.46	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	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.50	2.67					
Orifice Area (sq. inches)	4.00	4.00	6.25					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.33	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	35.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	6.40	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.93	N/A	feet
Overflow Weir Slope Length =	6.60	N/A	feet
Grate Open Area / 100-yr Orifice Area =	14.44	N/A	
Overflow Grate Open Area w/o Debris =	161.63	N/A	ft^2
Overflow Grate Open Area w/ Debris =	80.81	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	40.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	11.19	N/A	ft^2
Outlet Orifice Centroid =	1.80	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.30	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	130.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.59	feet
Stage at Top of Freeboard =	7.84	feet
Basin Area at Top of Freeboard =	2.64	acres
Basin Volume at Top of Freeboard =	11.08	acre-ft

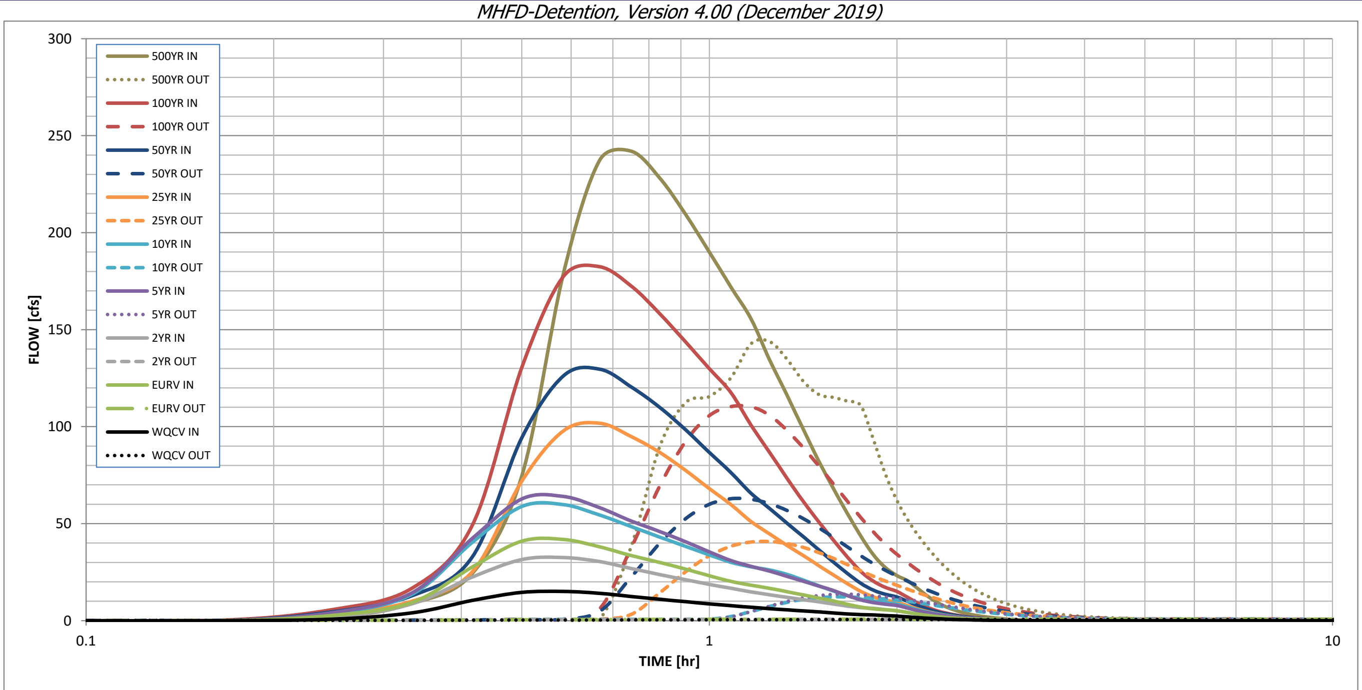
Routed Hydrograph Results

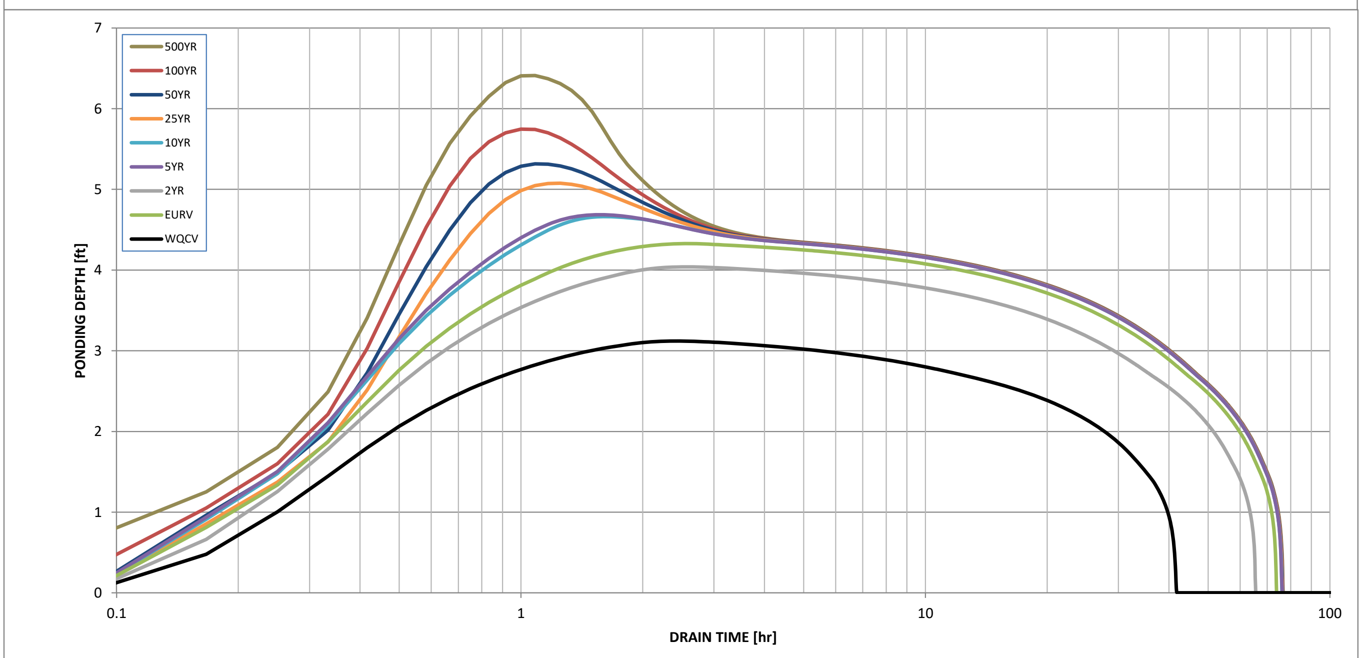
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

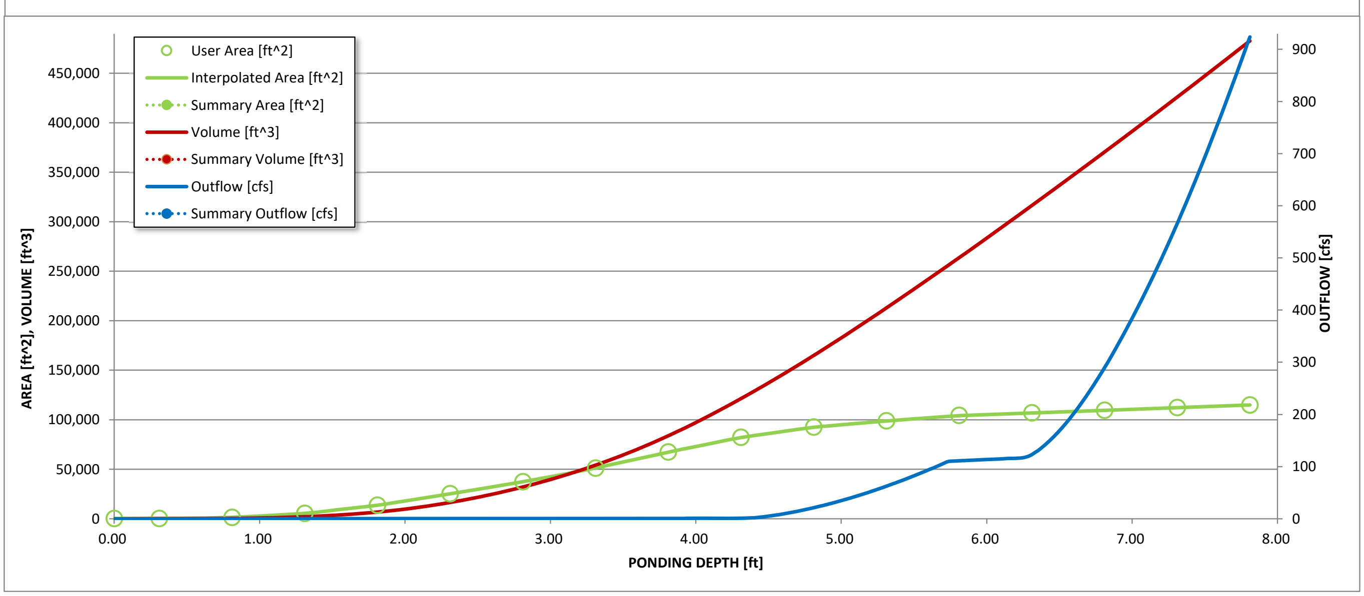
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.97	1.38	1.37	1.77	2.10	2.69	3.40
CUHP Runoff Volume (acre-ft) =	1.124	2.951	2.428	4.518	4.387	6.980	8.951	12.767	17.121
Inflow Hydrograph Volume (acre-ft) =	1.124	2.951	2.428	4.518	4.387	6.980	8.951	12.767	17.121
CUHP Predevelopment Peak Q (cfs) =	0.0	0.0	1.8	21.3	18.5	47.2	65.4	101.8	141.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	0.0	0.0							
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.03	0.30	0.27	0.68	0.94	1.46	2.03
Peak Inflow Q (cfs) =	15.1	41.8	32.5	64.0	59.8	101.7	129.6	182.4	242.0
Peak Outflow Q (cfs) =	0.5	0.8	0.7	13.7	12.2	40.8	62.8	110.3	143.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.7	0.9	1.0	1.1	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.1	0.2	0.4	0.7	0.7
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) =	38	66	59	66	66	63	61	56	52
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	63	72	72	70	69	67	65
Maximum Ponding Depth (ft) =	3.12	4.32	4.04	4.69	4.66	5.07	5.32	5.74	6.41
Area at Maximum Ponding Depth (acres) =	1.05	1.89	1.70	2.06	2.05	2.20	2.27	2.38	2.47
Maximum Volume Stored (acre-ft) =	1.022	2.801	2.281	3.513	3.472	4.348	4.884	5.883	7.508

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.33	1.59
	0:15:00	0.79	2.80	1.70	4.28	3.92	3.21	4.64	5.84	8.80
	0:20:00	4.02	9.36	8.68	14.33	13.57	9.99	12.86	16.72	24.37
	0:25:00	10.41	27.68	22.48	42.39	40.39	25.21	32.84	49.21	74.26
	0:30:00	14.57	40.96	31.47	62.71	58.81	71.78	94.13	130.24	178.89
	0:35:00	15.07	41.82	32.55	64.03	59.79	97.83	126.15	177.45	237.22
	0:40:00	14.09	38.02	30.43	58.21	54.41	101.74	129.65	182.42	241.96
	0:45:00	12.44	33.50	26.88	51.28	48.45	94.79	120.35	172.36	228.02
	0:50:00	10.98	29.99	23.72	45.91	43.03	86.65	109.87	158.10	209.23
	0:55:00	9.76	26.52	21.07	40.61	38.23	77.33	98.26	143.50	189.97
	1:00:00	8.64	23.14	18.67	35.43	33.86	68.05	86.67	129.89	171.90
	1:05:00	7.72	20.22	16.67	30.95	30.09	59.80	76.32	117.47	155.55
	1:10:00	6.87	18.29	14.85	28.01	27.73	51.11	65.62	100.81	134.27
	1:15:00	6.16	16.66	13.31	25.51	26.08	44.63	57.77	86.63	116.06
	1:20:00	5.55	14.91	11.99	22.82	23.81	38.72	50.14	73.27	98.26
	1:25:00	5.00	13.22	10.81	20.23	20.85	33.45	43.18	61.20	81.95
	1:30:00	4.48	11.62	9.67	17.78	17.93	28.27	36.38	50.76	67.84
	1:35:00	3.96	10.12	8.55	15.50	15.23	23.44	30.07	41.30	55.08
	1:40:00	3.48	8.42	7.51	12.89	12.87	19.01	24.31	32.73	43.58
	1:45:00	3.11	6.97	6.72	10.67	11.07	15.09	19.25	25.38	33.91
	1:50:00	2.92	6.09	6.30	9.32	10.01	12.25	15.69	20.31	27.37
	1:55:00	2.63	5.55	5.68	8.50	9.26	10.56	13.56	17.14	23.24
	2:00:00	2.34	5.10	5.06	7.80	8.46	9.48	12.20	15.03	20.45
	2:05:00	1.93	4.20	4.16	6.42	6.98	7.67	9.87	11.90	16.23
	2:10:00	1.52	3.28	3.28	5.02	5.48	5.89	7.57	8.91	12.16
	2:15:00	1.19	2.55	2.58	3.91	4.26	4.51	5.78	6.59	8.99
	2:20:00	0.93	1.98	2.01	3.04	3.29	3.43	4.38	4.85	6.63
	2:25:00	0.72	1.53	1.56	2.34	2.51	2.62	3.33	3.65	4.98
	2:30:00	0.56	1.16	1.21	1.78	1.89	1.98	2.50	2.75	3.74
	2:35:00	0.43	0.87	0.93	1.33	1.41	1.48	1.87	2.07	2.82
	2:40:00	0.32	0.64	0.70	0.98	1.07	1.11	1.40	1.57	2.14
	2:45:00	0.24	0.48	0.53	0.73	0.81	0.84	1.06	1.20	1.63
	2:50:00	0.17	0.34	0.38	0.52	0.59	0.62	0.78	0.88	1.19
	2:55:00	0.12	0.23	0.25	0.35	0.40	0.43	0.54	0.61	0.82
	3:00:00	0.07	0.15	0.15	0.23	0.25	0.28	0.35	0.39	0.52
	3:05:00	0.04	0.08	0.08	0.13	0.14	0.16	0.19	0.21	0.28
	3:10:00	0.02	0.04	0.03	0.06	0.06	0.07	0.09	0.09	0.12
	3:15:00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	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

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

Hydraulic Analysis Report

Project Data

Project Title: JN:1104 Westwood - EDB 1 Emergency Spillway Sizing (2 X Undetained Q100)

Designer:

Project Date: Tuesday, January 7, 2020

Project Units: U.S. Customary Units

Notes:

Weir Analysis: EDB-1 Emergency Spillway Sizing - 2 X Undetained Q100

Notes:

Standard Cipolletti Weir assumes 4:1 side slope

Input Parameters

Weir Type: Cipolletti

Coefficient: 3.3670

Length: 130.0000 ft

Flow: 364.8000 cfs

Head Required for 2 X Undetained Q100 = 2 X 182.4 CFS = 364.8 CFS

Result Parameters

Head: 0.8856 ft

Emergency Spillway Unit Discharge = 364.8 CFS / 130 FT = 2.81 CFS/FT

This detail is provided for reference only. For project specific detail please refer to CDs

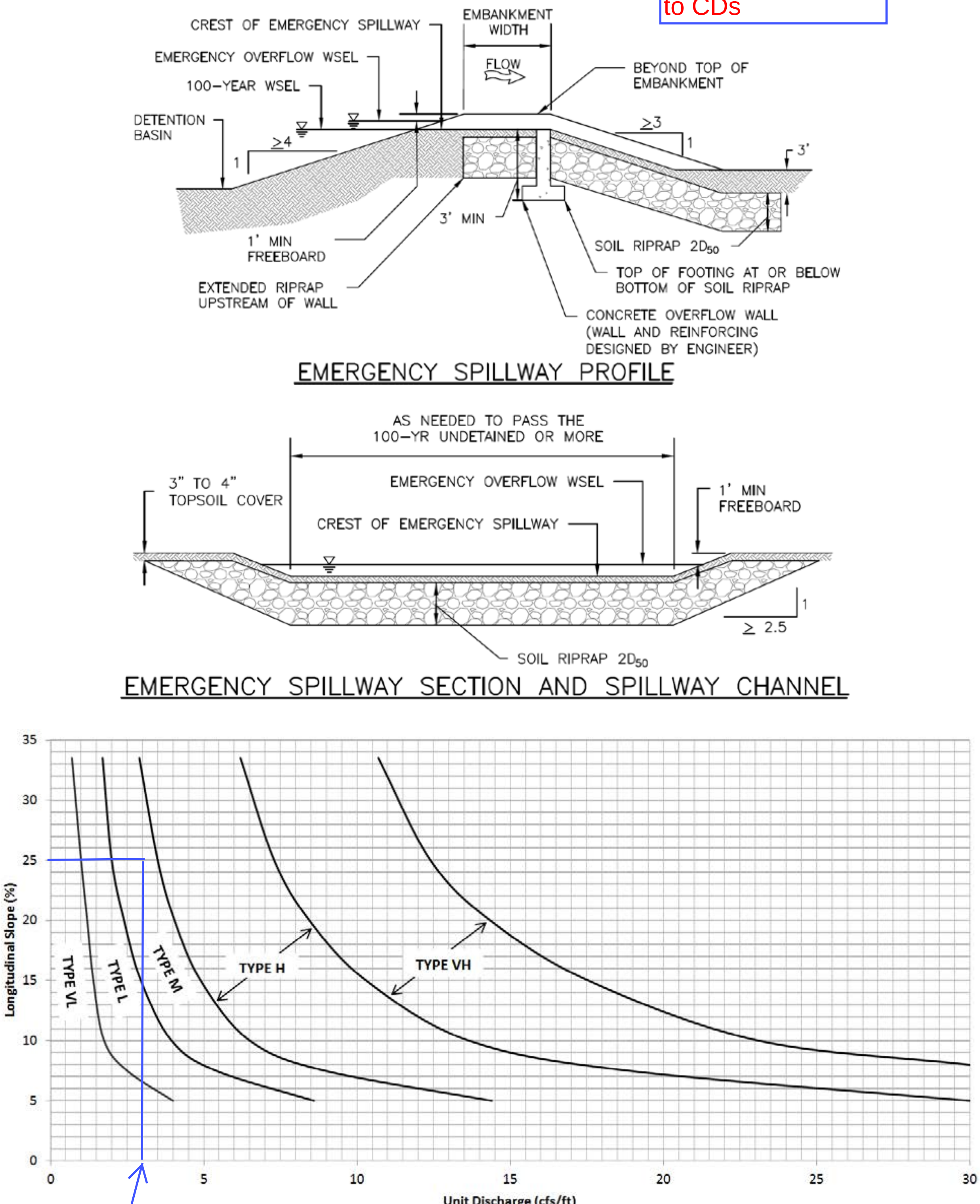


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

Unit Discharge = 2.81 CFS/FT

Type M Soil Riprap Thickness = 2 X D50 = 2 FT

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

Channel Analysis: Trickle Channel Capacity Check - 2% of Undetained Q100 (0.02 X 182.4 = 3.648 CFS)

Notes:

Input Parameters

Channel Type: Rectangular

Channel Width: 2.0000 ft

Longitudinal Slope: 0.0075 ft/ft

Manning's n: 0.0130

Flow: 3.6480 cfs

2% of Undetained Q100 = 0.02*182.4 = 3.648 CFS

Result Parameters

Flow Depth < 0.5'
Ok

Depth: 0.4169 ft

Area of Flow: 0.8339 ft^2

Wetted Perimeter: 2.8339 ft

Hydraulic Radius: 0.2943 ft

Average Velocity: 4.3747 ft/s

Top Width: 2.0000 ft

Froude Number: 1.1939

Critical Depth: 0.4692 ft

Critical Velocity: 3.8871 ft/s

Critical Slope: 0.0053 ft/ft

Critical Top Width: 2.00 ft

Calculated Max Shear Stress: 0.1951 lb/ft^2

Calculated Avg Shear Stress: 0.1377 lb/ft^2

RICK™ ENGINEERING COMPANY
5620 Friars Road
San Diego, CA 92110-2596
Tel: (619) 291-0707
Fax: (619) 291-4165

Date: August 26, 2020
Job No.: 1104
Page: 1
Done By: Ash
Checked By:

Initial Surcharge Volume = 0.3% of the WQCV (Table EDB-4, USDCM Vol. 3)

$$= \frac{0.3}{100} \times 1.124 \text{ ac-ft} \times \frac{43560 \text{ ft}^2}{1 \text{ ac}}$$

$$= 146.9 \text{ ft}^3$$

$$\simeq 150 \text{ ft}^3$$

External Concrete Initial Surcharge Pool has been provided just upstream of the detention basin outlet structure. Please refer to Section C-C and D-D of DTL-11.

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ENGINEERING COMPANY
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San Diego, CA 92110-2596
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Fax: (619) 291-4165

Date: August 1, 2019
Job No.: 1104
Page: 2
Done By: Ash
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Trash Rack Sizing

WQ x EURV Orifice Size = 2 X 4 sq.in and 1 X 6.25 sq.in

No. of WQ & EURV Orifices = 3

Total Orifice or Outlet Area, A_{ot} = 14.25 sq.in

Orifice Dimension = 2" X 2" and 2.5" X 2.5"

Minimum Dimension of Orifice, D = 2"

Trash Rack Sizing Equation, (Figure OS-1. USDCM Vol. 3)

$$\frac{A_t}{A_{ot}} = 38.5\, e^{-0.095D}$$

$$\frac{A_t}{14.25} = 38.5\, e^{-0.095 \times 2}$$

Total grate open area or Net open area, A_t = 453.7 in^2 = 3.15 ft^2

R Value = 0.71 for cross rods on 2" centers (Figure OS-6 USDCM Vol.3)

$$R\ Value = \frac{Net\ Open\ Area}{Gross\ Rack\ Area}$$

$$0.71 = \frac{3.15}{Gross\ Rack\ Area}$$

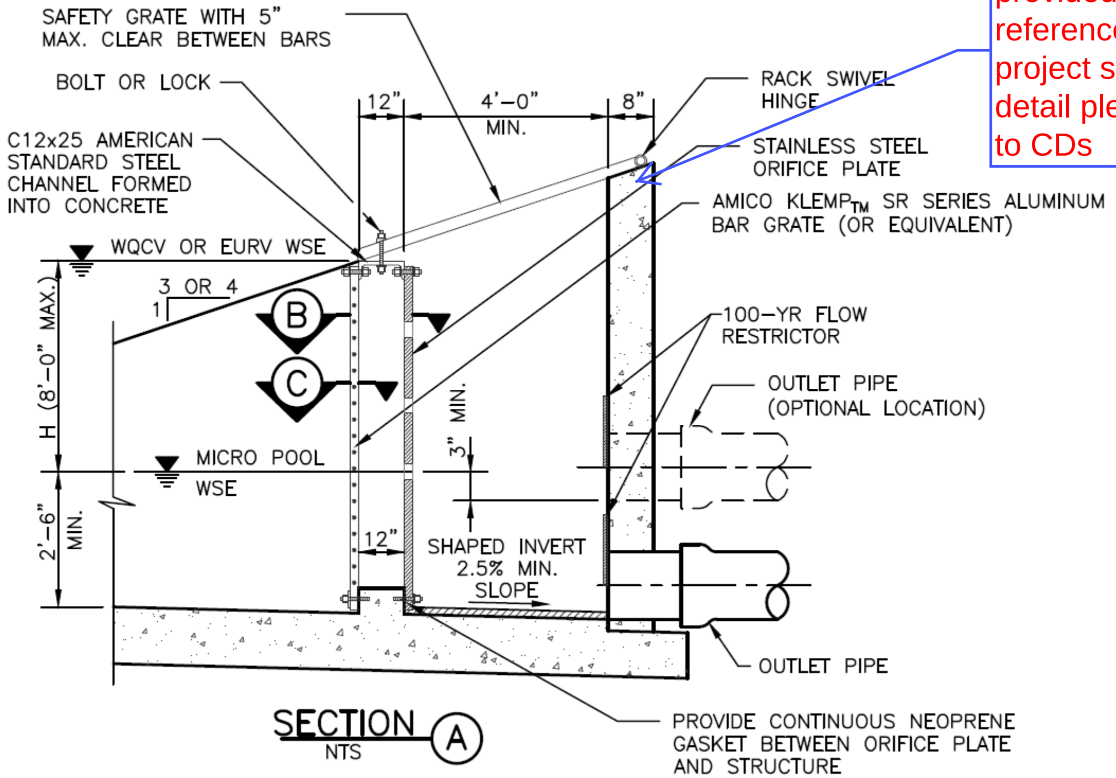
Gross Rack Area = 4.44 sq.ft

Trash Rack Height = Micropool Depth + H = 2.54' + 4.12' = 6.66'

Trash Rack Width, $W_{opening}$ = $\frac{4.44}{6.66}$ = 0.67'

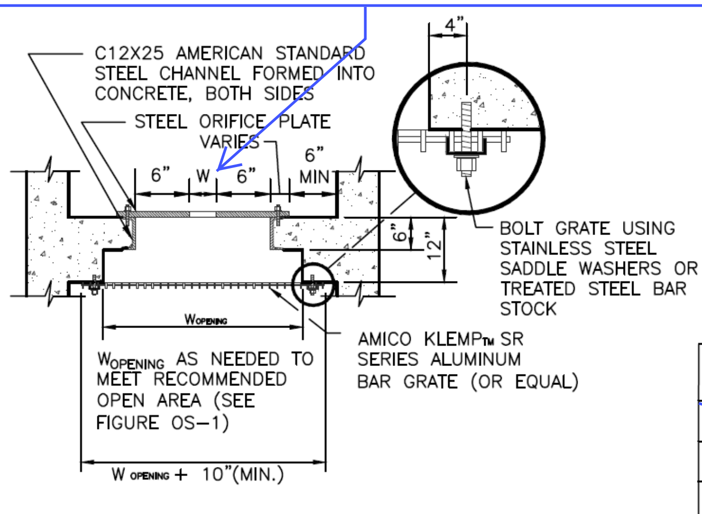
Calculated trash rack clear width (W opening) less than the minimum width required per Figure OS-6 USDCM Vol.3 (see next page) for attachment to the outlet structure.

This detail is provided for reference only. For project specific detail please refer to CDs

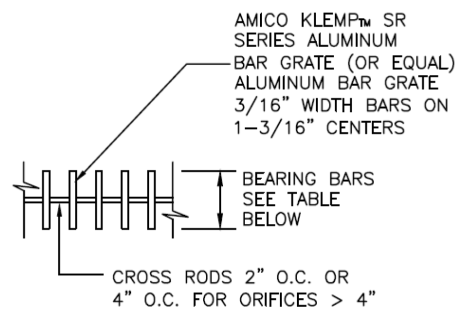


SECTION A
NTS

W = 2.5"
Therefore, Orifice plate clear width = 6" + 2.5" + 6" = 14.5" = 1.21'



SECTION B
NTS

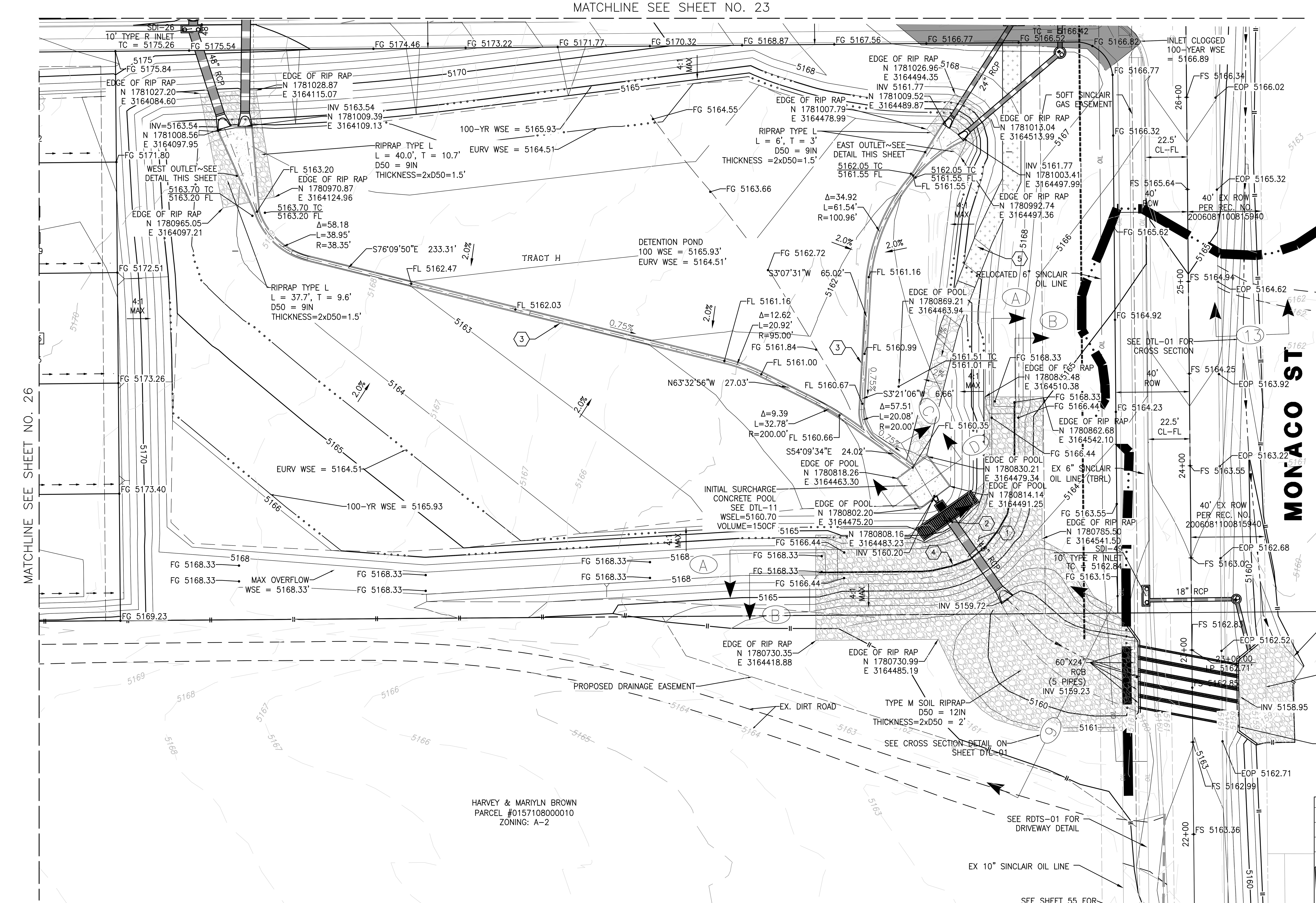


WATER DEPTH ABOVE LOWEST OPENING, H	MINIMUM BEARING BAR SIZE, BARS ALIGNED VERTICALLY
2.0 FT.	1" x 3/16"
3.0 FT.	1-1/4" x 3/16"
4.0 FT.	1-3/4" x 3/16"
5.0 FT.	2" x 3/16"
6.0 FT.	2-1/4" x 3/16"

R VALUE=(NET OPEN AREA)/GROSS RACK AREA)
=0.71 FOR CROSS RODS ON 2" CENTERS
~~=0.77 FOR CROSS RODS ON 4" CENTERS~~

SECTION C

Calculated trash rack clear width (W opening) less than the minimum width required per Figure OS-6, USDCM Vol.3. Therefore, providing 6" min on either side of the orifice plate clear width.
Trash rack clear width, W opening = 2.21'
Trash rack clear dimension = 6.66' (H) X 2.21' (W)
Trash rack overall dimension (including overlap) = 6.66' (H) X 3.54' (W)



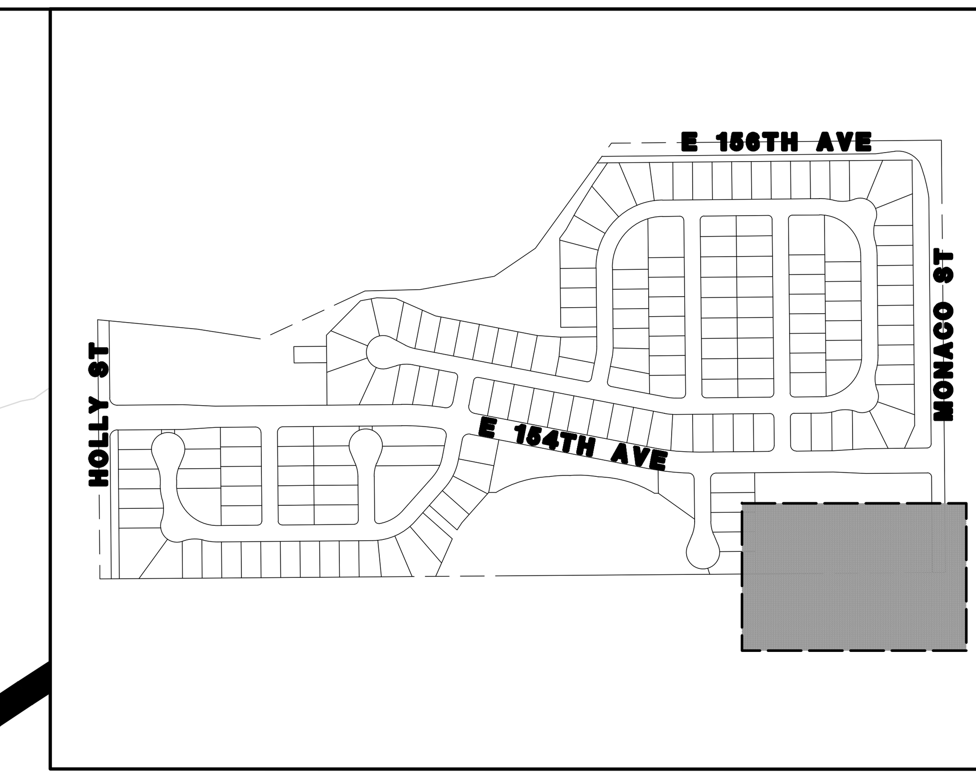
GRAPHIC SCALE: 1"=30'

GRADING CONSTRUCTION NOTES

1. EMERGENCY SPILLWAY PER DETAIL ON SHEET DTL-10
2. DETENTION BASIN OUTLET STRUCTURE PER DETAIL ON SHEET DTL-10
3. LOW FLOW TRICKLE CHANNEL PER DETAIL ON SHEET DTL-10
4. CUTOFF WALL PER DETAIL ON SHEET DTL-10
5. 10FT WIDE EMERGENCY ACCESS ROAD PER DETAIL ON SHEET DTL-10

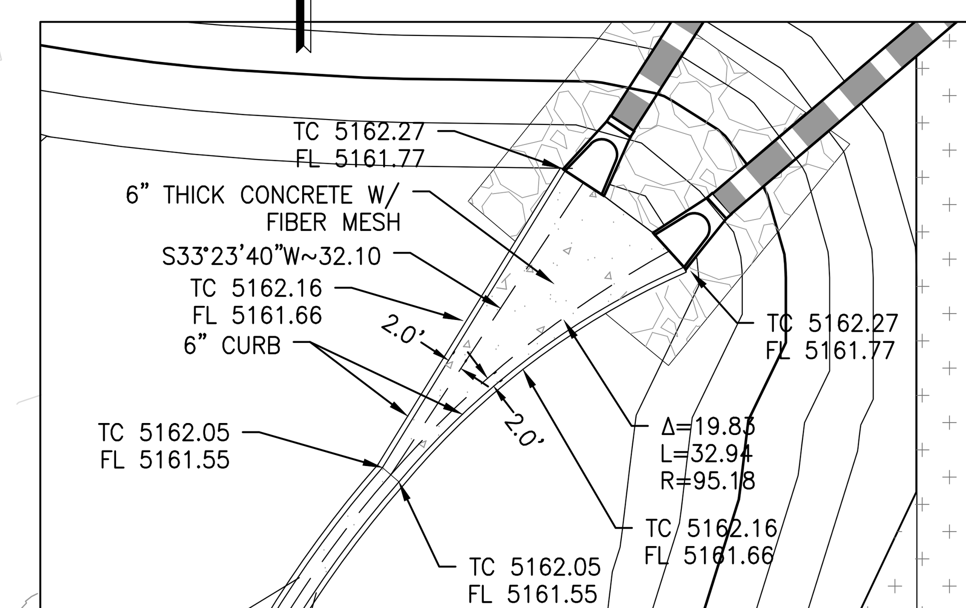
CONTRACTOR SHALL VERIFY MINIMUM SLOPE IN BOTTOM OF POND PERPENDICULAR TO THE TRICKLE CHANNEL IS NOT FLATTER THAN THE 2% DESIGN SLOPE PRIOR TO POND CERTIFICATION.

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.



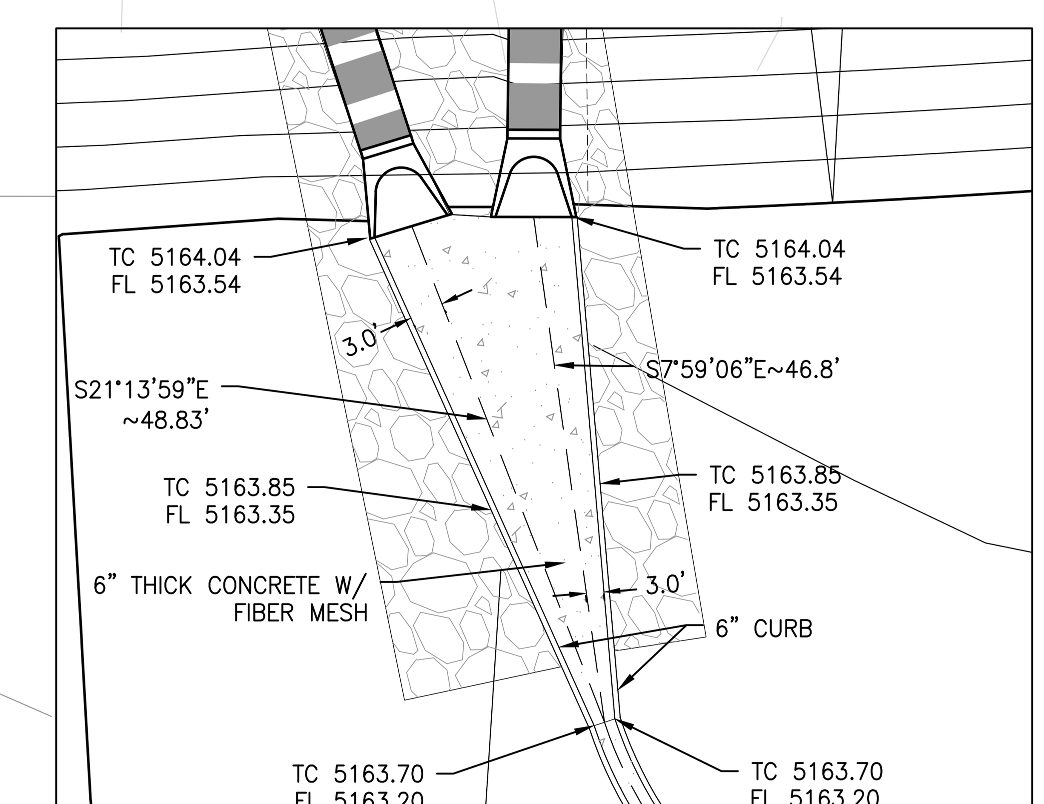
KEY MAP

SCALE 1"=500'



EAST OUTLET

NTS



WEST OUTLET

NTS

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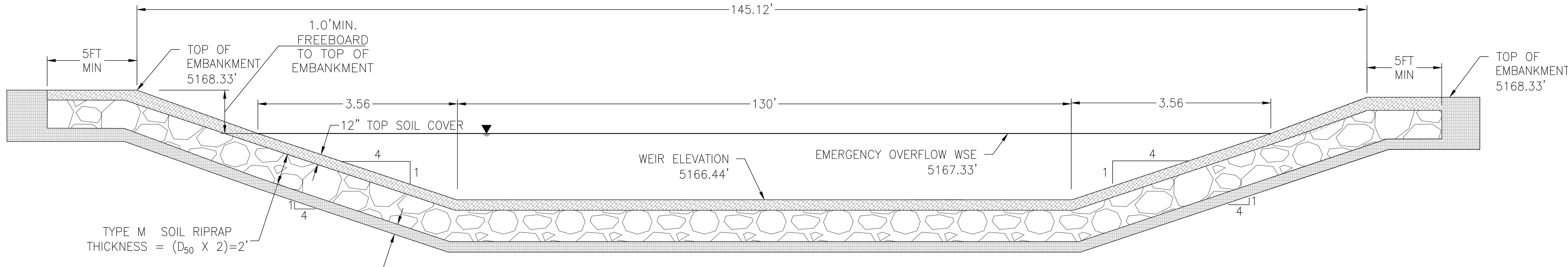
CHECKED BY:	TB
JOB NO:	D01104-A

GRADING PLAN

DETENTION POND

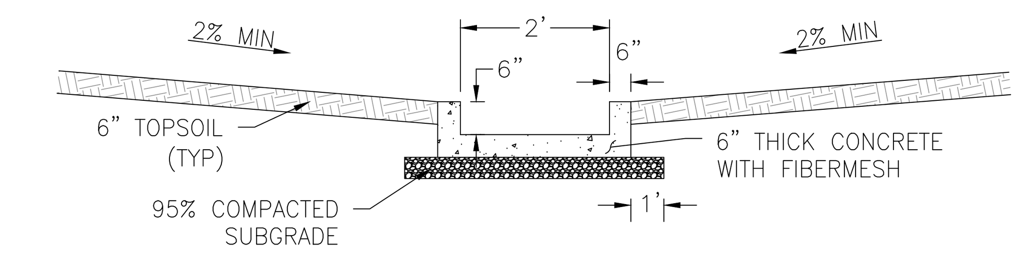
PROJECT NO. D01104-A

DRAWING NO. GRD-14



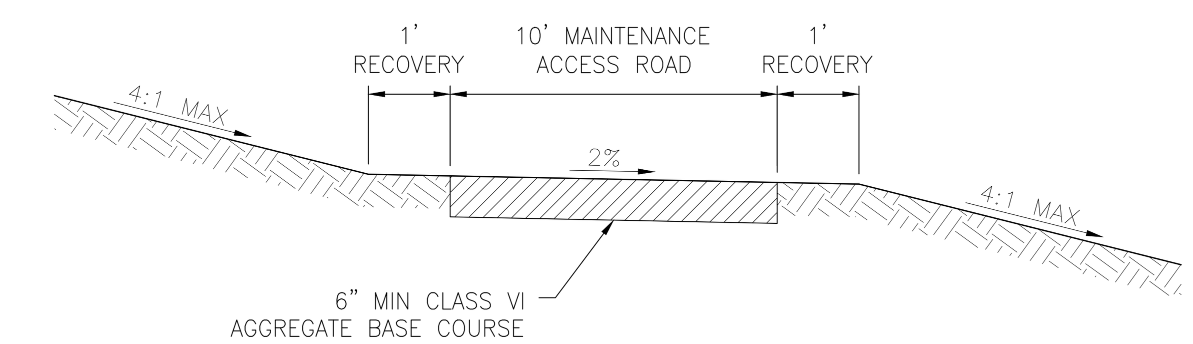
SECTION A-A

NTS



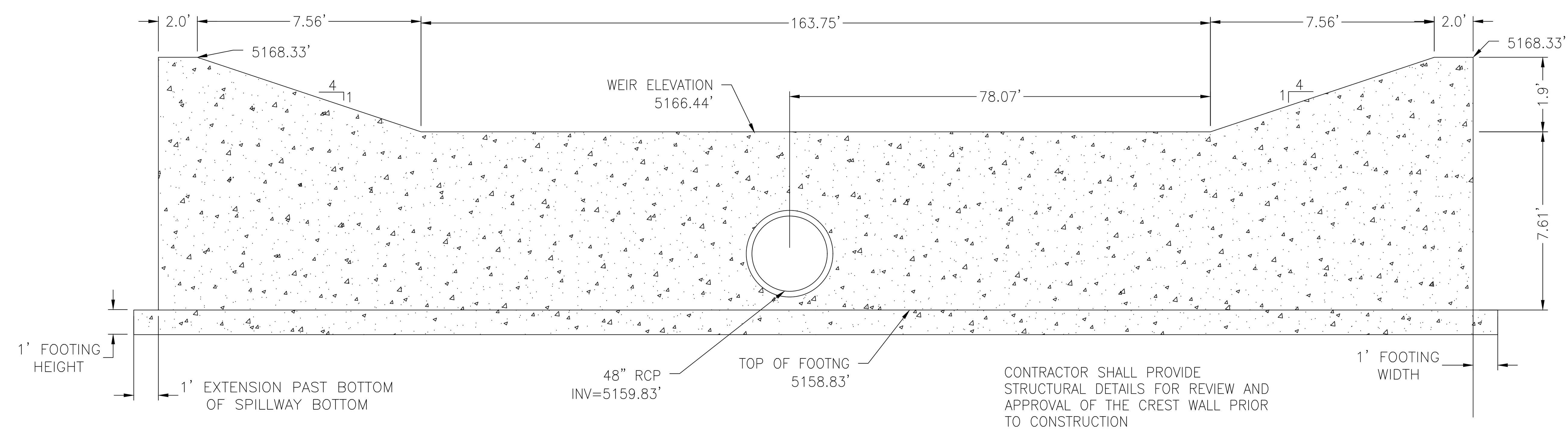
TRICKLE CHANNEL

NTS



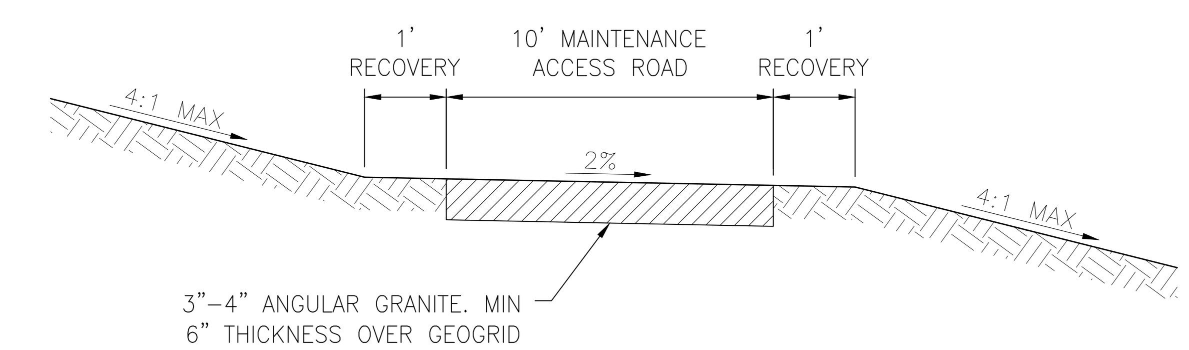
MAINTENANCE ACCESS RD – ABOVE EURV WATER SURFACE

NTS



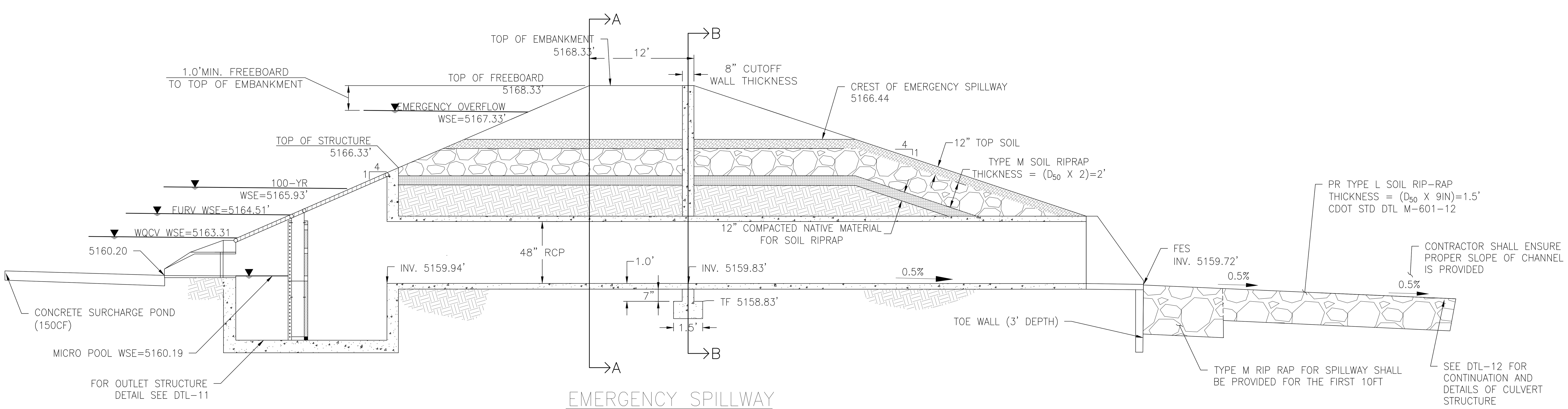
SPILLWAY CREST WALL/SECTION B-B

NTS



MAINTENANCE ACCESS RD – BELOW EURV WATER SURFACE

NTS



EMERGENCY SPILLWAY

NTS

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FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

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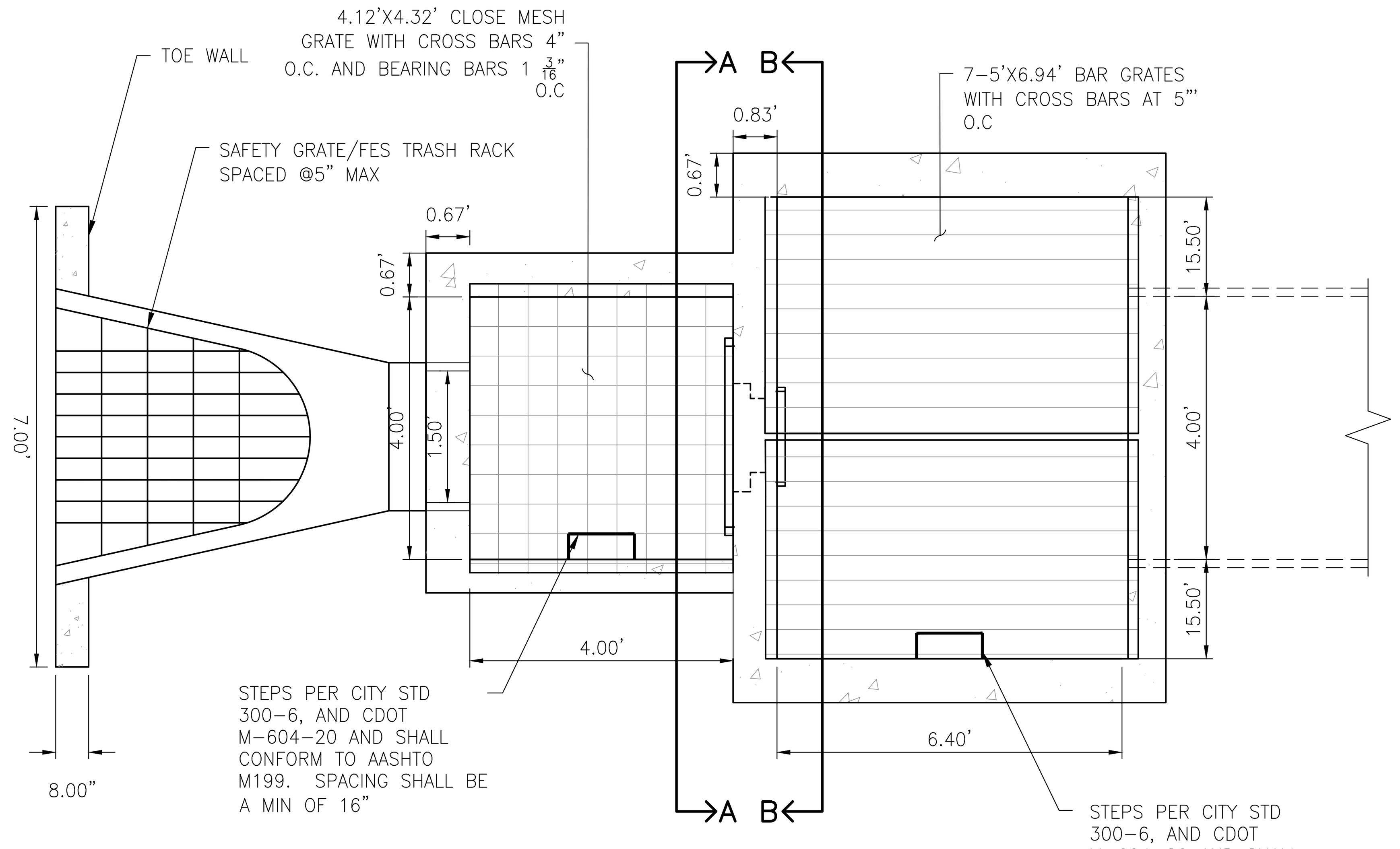
DETENTION POND STRUCTURE DETAILS

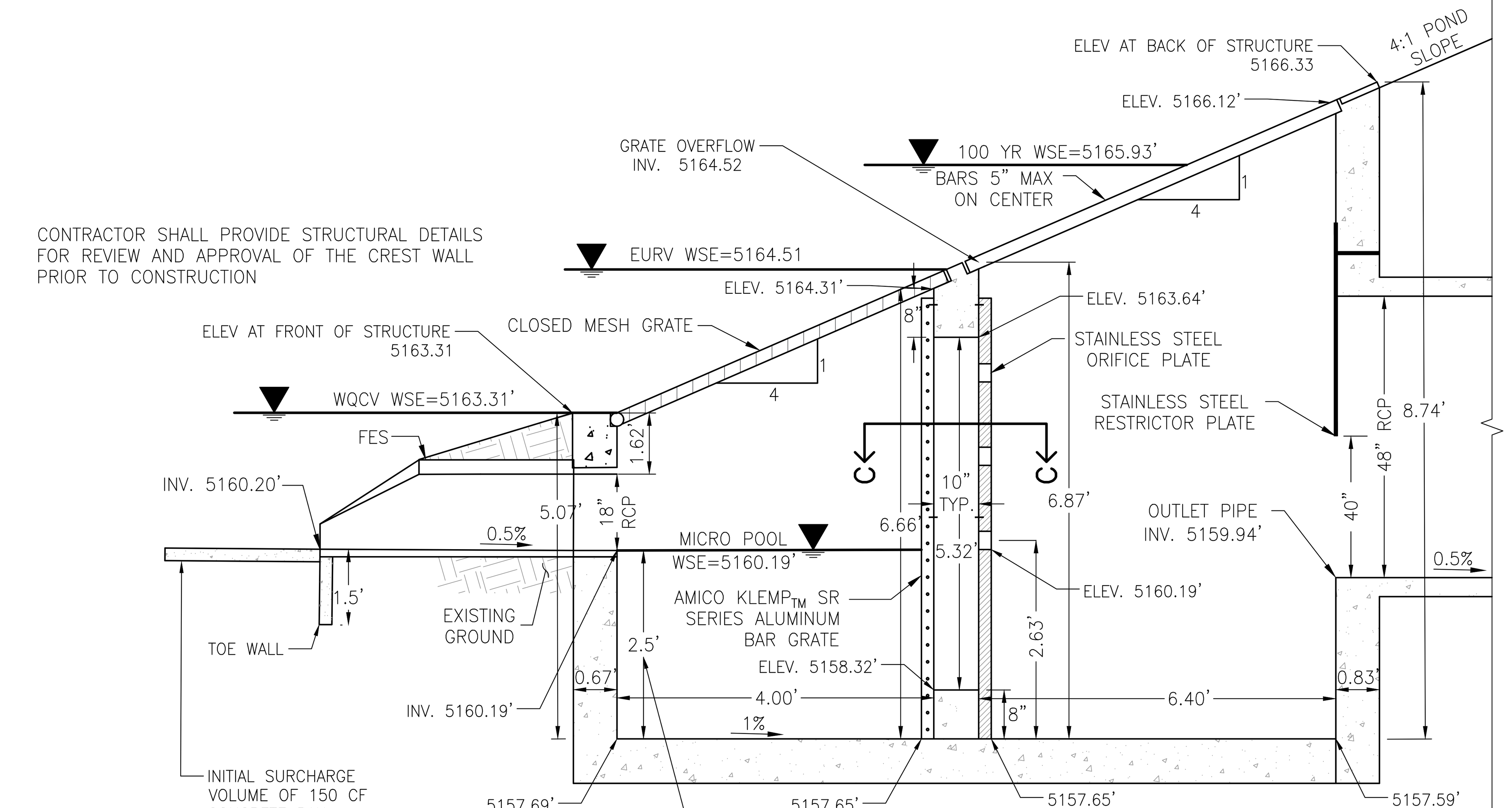
PROJECT NO. D01104-A

DRAWING NO. DTL-10

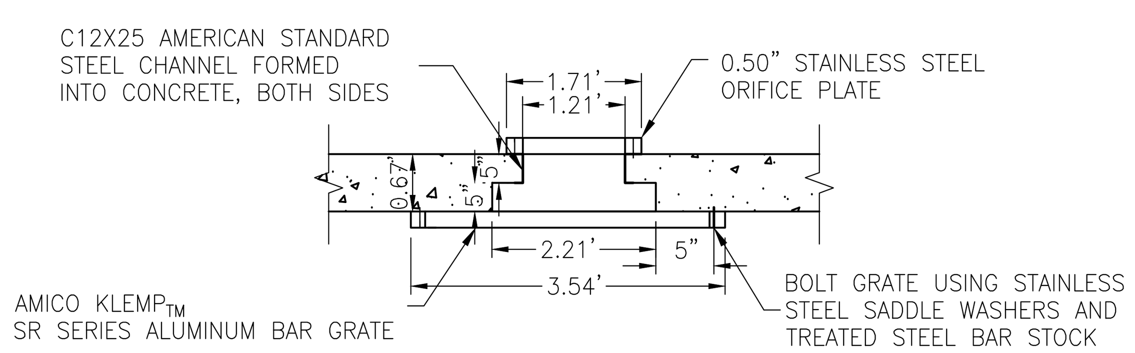
SHEET NO. 161 OF172 SHEETS



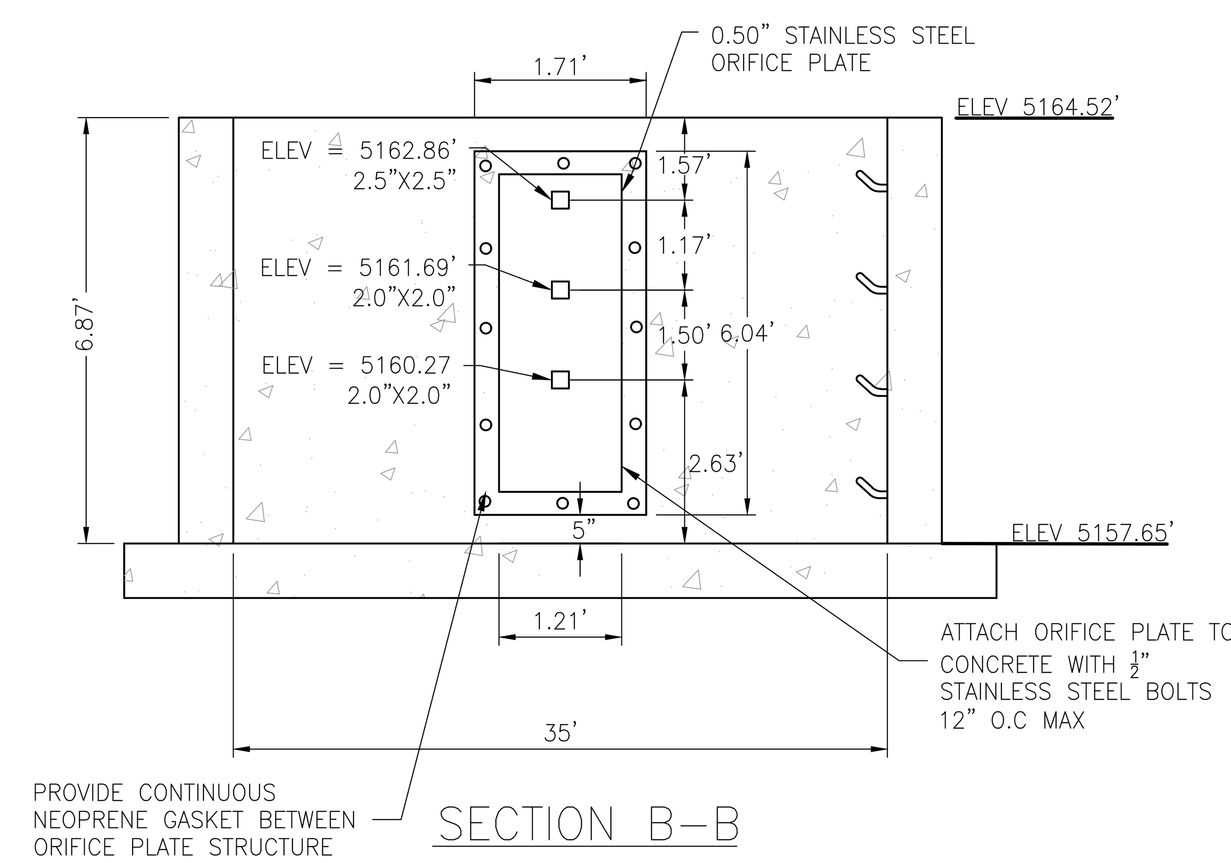
TOP VIEW
NTS



SECTION B-B
NTS



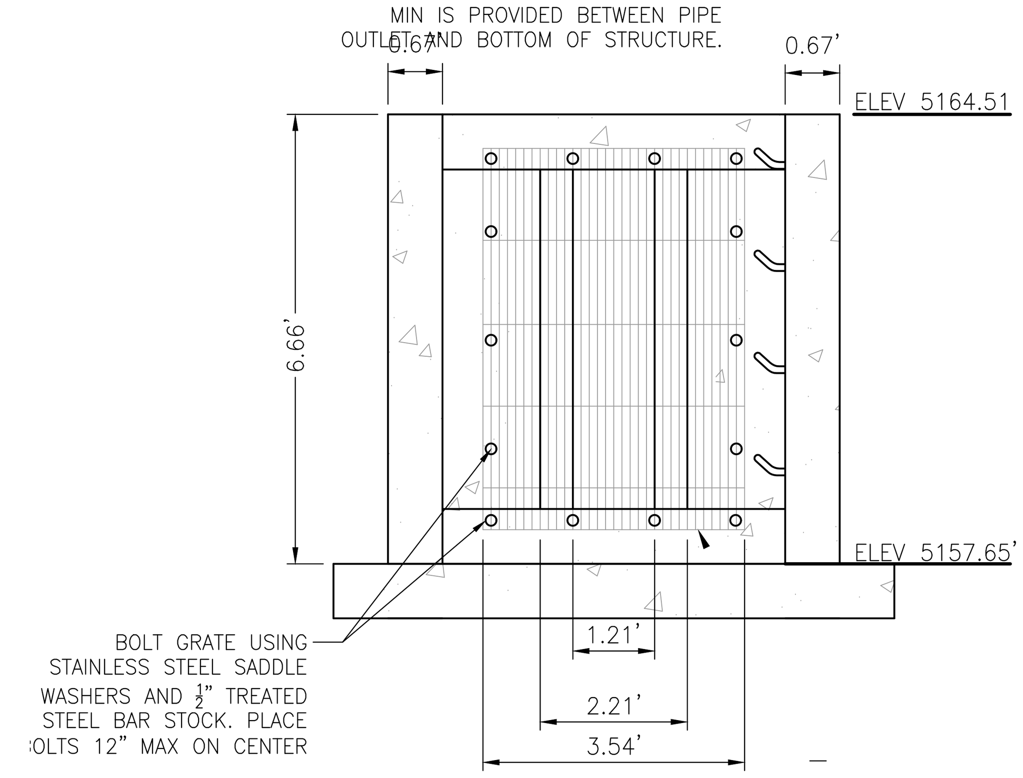
SECTION C-C
NTS



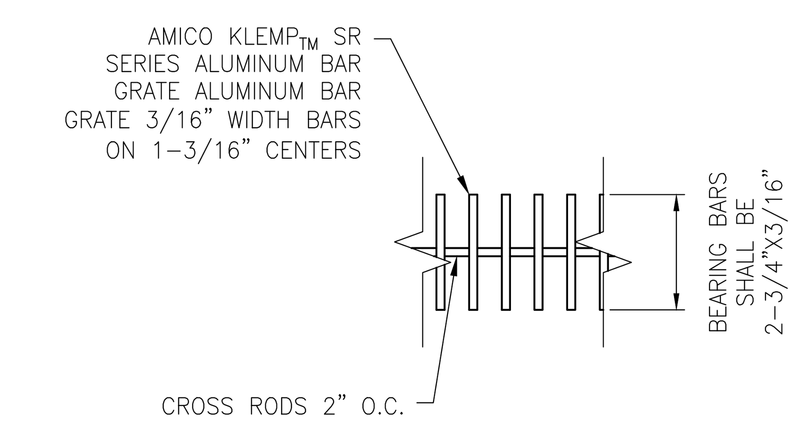
SECTION B-B
NTS

ORIFICE PLATE NOTES:

1. PROVIDE CONTINUOUS NEOPRENE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE.
2. BOLT PLATE TO CONCRETE 12" MAX. ON CENTER. SEE TABLE OS-2 FOR PLATE THICKNESS.



SECTION A-A
NTS

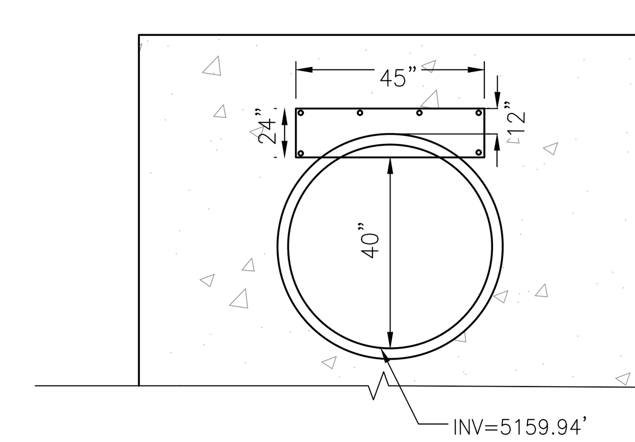


EURV AND WQCV RACK NOTES:

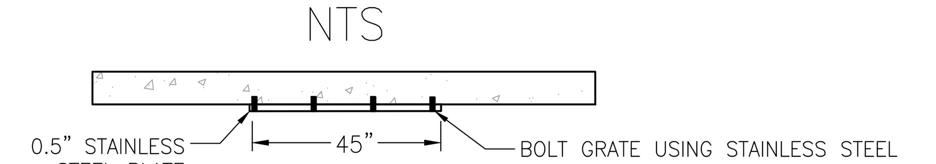
1. WELL-SCREEN TRASH RACK SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.
2. BAR GRATE TRASH RACKS SHALL BE ALUMINUM AND SHALL BE BOLTED USING STAINLESS STEEL HARDWARE.
3. TRASH RACK OPEN AREAS ARE FOR SPECIFIED TRASH RACK MATERIALS. TOTAL TRASH RACK SIZE MAY HNEED TO BE ADJUSTED FOR MATERIALS HAVING DIFFERENT OPEN AREA/GROSS AREA RATIO (R VALUE).
4. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.
5. "STANDARD BAR GRATING" REFERS TO METAL BAR GRATING WITH A NOMINAL OPENING OF 1" BY 4". BEARING BARS FOR STANDARD BAR GRATING SHALL BE SIZED FOR A UNIFORM LOAD BETWEEN 100 AND 150 POUNDS PER SQUARE FOOT.
6. "COARSE BAR GRATING" REFERS TO METAL BAR GRATING WITH A MAXIMUM CLEAR SPACING OF 5".

OVERFLOW SAFETY GRATE NOTES:

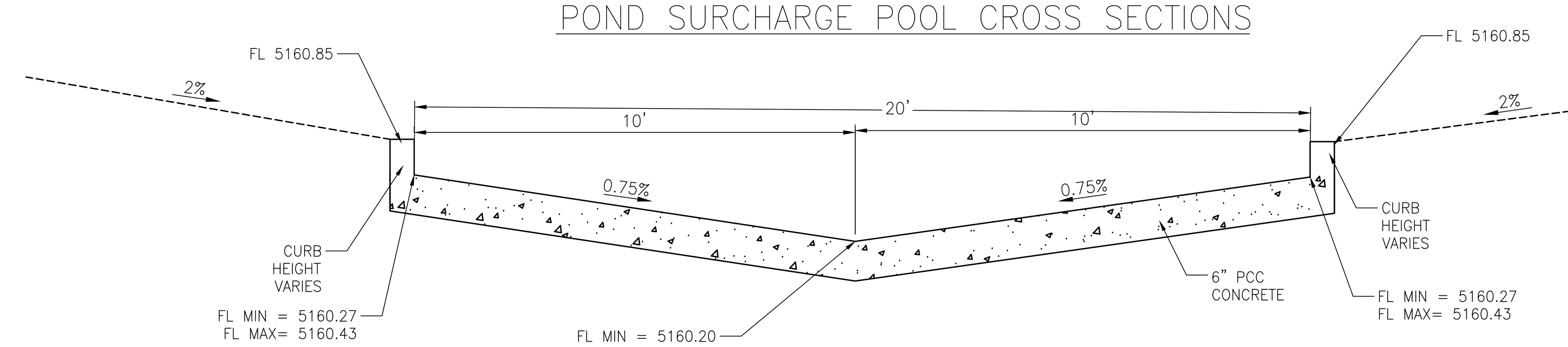
1. ALL SAFETY GRATES SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
2. SAFETY GRATES SHALL BE STAINLESS STEEL,ALUMINUM, OR STEEL. STEEL GRATES SHALL BE HOT DIP GALVANIZED AND MAY BE HOT POWDER COATED AFTER GALVANIZING.
3. SAFETY GRATES SHALL BE DESIGNED SUCH THAT THE DIAGONAL DIMENSION OF EACH OPENING IS SMALLER THAN THE DIAMETER OF THE OUTLET PIPE.
4. STRUCTURAL DESIGN OF SAFETY GRATES SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.



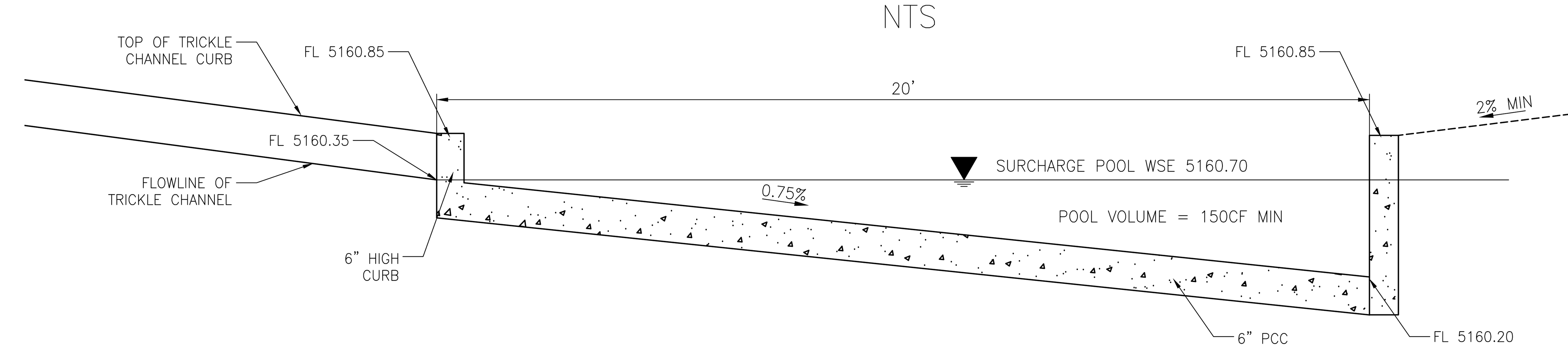
100 YR CONTROL PLATE DETAIL
NTS



POND SURCHARGE POOL CROSS SECTIONS



SECTION D-D
NTS



SECTION C-C
NTS

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DETENTION POND OUTLET DETAILS

PROJECT NO. D01104-A

DRAWING NO. DTL-11

Appendix B

Hydraulic Computations

- **Inlet Management Sheet**
- **Curb Inlet Sizing**
- **Grate Inlet Sizing**
- **Street Capacity Check**
- **Upstream of Sump Street Capacity Check**
- **Upstream of Cross-Pan Street Capacity Check**
- **Street Corner Capacity Check**
- **Emergency Overflow Weir Section Analyses**
- **Cross-Pan Capacity Check**
- **Swale & Roadside Ditch Design**
- **Culvert Design**
- **Storm Drain Design**
- **Rip-Rap Apron Design**

Appendix B – Hydraulic Computations
Inlet Management Sheet

Version 4.06 Released August 2018

INLET MANAGEMENT

Worksheet Protected

INLET NAME	1 (SDI-31)	2 (SDI-42)	3 (SDI-39)	4 (SDI-48)	5 (SDI-30)	6 (SDI-34)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	In Sump	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.3	2.7	1.7	1.5	2.9	2.4
Major Q_{Known} (cfs)	3.6	7.6	5.0	5.0	9.4	6.8

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	44 (SDI-35)	No Bypass Flow Received	5 (SDI-30)
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	1.5	0.0	1.9

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.3**	**2.7**	**1.7**	**1.5**	**2.9**	**2.4**
Major Total Design Peak Flow, Q (cfs)	**3.6**	**7.6**	**5.0**	**6.5**	**9.4**	**8.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0	N/A	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.9	1.0	1.8	N/A	1.9	1.6

Minor Storm (Calculated) Analysis of Flow Time

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

Major Storm (Calculated) Analysis of Flow Time

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

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	7 (SDI-47)	8 (SDI-45)	9 (SDI-40)	10 (SDI-12)	11 (SDI-13)	12 (SDI-07)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	On Grade	In Sump	In Sump	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.6	0.9	1.4	2.0	0.3	2.1
Major Q_{Known} (cfs)	4.8	2.1	3.2	5.9	0.7	6.5

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	6 (SDI-34)	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	1.6	0.0	0.0	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.6**	**0.9**	**1.4**	**2.0**	**0.3**	**2.1**
Major Total Design Peak Flow, Q (cfs)	**6.4**	**2.1**	**3.2**	**5.9**	**0.7**	**6.5**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0	N/A	N/A	0.2
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.9	N/A	N/A	2.9

Minor Storm (Calculated) Analysis of Flow T

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

Major Storm (Calculated) Analysis of Flow T

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

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	13 (SDI-24)	14 (SDI-11)	15 (SDI-27)	16 (SDI-16)	17 (SDI-10)	18 (SDI-08)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	2.2	1.4	2.4	1.9	2.4	1.7
Major Q_{Known} (cfs)	6.3	3.9	7.1	5.0	6.9	5.0

Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	17 (SDI-10)
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.7

Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

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

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

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.2**	**1.4**	**2.4**	**1.9**	**2.4**	**1.7**
Major Total Design Peak Flow, Q (cfs)	**6.3**	**3.9**	**7.1**	**5.0**	**6.9**	**5.7**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.2	0.0	0.0	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	2.7	1.1	0.7	0.1	0.7	0.3

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

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

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	19 (SDI-46)	42 (SDI-17)	20 (SDI-05)	21 (SDI-03)	22 (SDI-23)	23 (SDI-22)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.5	2.4	0.0	2.7	2.6	2.1
Major Q_{Known} (cfs)	4.3	6.6	0.0	8.5	7.5	6.2

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	User-Defined	No Bypass Flow Received	21 (SDI-03)	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.5	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	6.2	0.0	1.5	0.0

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.5**	**2.4**	**0.5**	**2.7**	**2.6**	**2.1**
Major Total Design Peak Flow, Q (cfs)	**4.3**	**6.6**	**6.2**	**8.5**	**9.0**	**6.2**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	N/A	0.0	0.0	0.2
Major Flow Bypassed Downstream, Q_b (cfs)	0.1	0.7	N/A	1.5	1.9	2.7

Minor Storm (Calculated) Analysis of Flow T

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

Major Storm (Calculated) Analysis of Flow T

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

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	24 (SDI-21)	25 (SDI-09)	26 (SDI-06)	32 (SDI-49)	33 (SDI-44)	30 (SDI-02)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	On Grade	On Grade	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	1.8	1.9	1.1	0.9	1.9	0.9
Major Q_{Known} (cfs)	5.3	5.3	2.4	2.2	4.1	3.1

Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	23 (SDI-22)	No Bypass Flow Received	User-Defined	No Bypass Flow Received	No Bypass Flow Received	30 (SDI-20)
Minor Bypass Flow Received, Q_b (cfs)	0.2	0.0	0.0	0.0	0.0	0.1
Major Bypass Flow Received, Q_b (cfs)	2.7	0.0	2.6	0.0	0.0	5.0

Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

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

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

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.0**	**1.9**	**1.1**	**0.9**	**1.9**	**1.0**
Major Total Design Peak Flow, Q (cfs)	**8.0**	**5.3**	**5.0**	**2.2**	**4.1**	**8.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	N/A	0.0	0.0	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	1.3	0.2	N/A	0.0	0.1	N/A

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

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

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	30 (SDI-20)	20 (SDI-04)	31 (SDI-26)	51 (SDI-01)	43 (SDI-33)	44 (SDI-35)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	In Sump	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	4.1	2.9	2.6	1.2	2.2	2.1
Major Q_{Known} (cfs)	13.1	7.7	6.5	2.7	5.9	5.5

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	User-Defined	No Bypass Flow Received	31 (SDI-26)	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	2.6	0.0	1.0	1.9	2.9

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**4.1**	**2.9**	**2.6**	**1.2**	**2.2**	**2.1**
Major Total Design Peak Flow, Q (cfs)	**13.1**	**10.3**	**6.5**	**3.7**	**7.8**	**8.4**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.1	0.5	0.0	N/A	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	5.0	6.1	1.0	N/A	1.1	1.5

Minor Storm (Calculated) Analysis of Flow T

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

Major Storm (Calculated) Analysis of Flow T

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

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	45 (SDI-37)	46 (SDI-38)	47 (SDI-14)	48 (SDI-15)	49 (SDI-18)	50 (SDI-19)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	On Grade	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.0	1.2	1.5	1.5	2.2	2.2
Major Q_{Known} (cfs)	2.4	3.1	4.3	4.1	5.9	5.9

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	9 (SDI-40)	12 (SDI-07)	User-Defined	User-Defined	22 (SDI-23)
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.2	0.2	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.9	2.9	4.6	2.4	1.9

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.0**	**1.2**	**1.7**	**1.7**	**2.2**	**2.2**
Major Total Design Peak Flow, Q (cfs)	**2.4**	**4.0**	**7.2**	**8.7**	**8.3**	**7.8**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	0.0	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	0.9	1.6	1.6	1.2

Minor Storm (Calculated) Analysis of Flow T

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

Major Storm (Calculated) Analysis of Flow T

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

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	Monaco St Cap Ult Max Slope	Monaco St Cap	E 156th Av Cap	34 (SDI-32)	36A (SDI-25)	36B (SDI-41)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	RURAL	RURAL	RURAL
Inlet Application (Street or Area)	STREET	STREET	STREET	AREA	AREA	AREA
Hydraulic Condition	On Grade	On Grade	On Grade	Swale	Swale	Swale
Inlet Type				CDOT Type C (Depressed)	CDOT Type C (Depressed)	CDOT Type C (Depressed)
USER-DEFINED INPUT						
User-Defined Design Flows						
Minor Q_{Known} (cfs)	0.0	4.1	1.5	2.3	0.8	0.2
Major Q_{Known} (cfs)	0.0	13.1	4.8	16.4	8.4	1.5
Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	No Bypass Flow Receive	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						
Watershed Profile						
Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						
Minor Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						
Major Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						
CALCULATED OUTPUT						
Minor Total Design Peak Flow, Q (cfs)	**0.0**	**4.1**	**1.5**	**2.3**	**0.8**	**0.2**
Major Total Design Peak Flow, Q (cfs)	**0.0**	**13.1**	**4.8**	**16.4**	**8.4**	**1.5**
Minor Flow Bypassed Downstream, Q_b (cfs)				0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)				0.0	0.0	0.0
Minor Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A
Major Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

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INLET MANAGEMENT

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INLET NAME	41A (SDI-50)	41B (SDI-28)	USofSump DP4 (SDI-48)	USofSump DP7 (SDI-47)	USofSump DP10 (SDI-12)	USofSump SBasin2B (SDI-05)
Site Type (Urban or Rural)	RURAL	RURAL	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	AREA	STREET	STREET	STREET	STREET
Hydraulic Condition	Swale	Swale	On Grade	On Grade	On Grade	On Grade
Inlet Type	CDOT Type C	CDOT Type C				

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	0.8	0.8	1.5	1.6	2.0	1.6
Major Q_{Known} (cfs)	10.6	10.6	5.0	4.8	5.9	4.9
Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	19 (SDI-46)
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.1
Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						
Watershed Profile						
Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						
Minor Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						
Major Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.8**	**0.8**	**1.5**	**1.6**	**2.0**	**1.6**
Major Total Design Peak Flow, Q (cfs)	**10.6**	**10.6**	**5.0**	**4.8**	**5.9**	**5.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0				
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0				
Minor Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A
Major Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	USofSump DP26 (SDI-06)	USofSump DP45 (SDI-37)	USofSump DP46 (SDI-38)	USofSump DP51 (SDI-01)	Ivy&153rdPl DP43 (SDI33)	Jrsy&153Pl DP44 (SDI35)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade
Inlet Type						

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	1.1	1.0	1.2	1.2	2.2	2.1
Major Q_{Known} (cfs)	2.4	2.4	3.1	2.7	5.9	5.5

Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	User-Defined	No Bypass Flow Received	User-Defined	User-Defined	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	2.6	0.0	0.9	1.0	0.0	0.0

Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

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

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

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.1**	**1.0**	**1.2**	**1.2**	**2.2**	**2.1**
Major Total Design Peak Flow, Q (cfs)	**5.0**	**2.4**	**4.0**	**3.7**	**5.9**	**5.5**
Minor Flow Bypassed Downstream, Q_b (cfs)						
Major Flow Bypassed Downstream, Q_b (cfs)						

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

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

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	Krney&154Pl DP48 (SDI15)	Krmr&154Pl DP49 (SDI18)	Krmr&154Av DP31 (SDI26)	Cor 154Av&Ivy Sub-Basin2A	USofSump DP30 (SDI-02)	Cor1 154Av&Ivy SBas2A
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade
Inlet Type						

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	1.5	2.2	0.7	0.8	1.0	0.8
Major Q_{Known} (cfs)	4.1	5.9	1.7	2.1	3.1	2.1
Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	User-Defined	User-Defined	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.2	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	2.7	0.7	0.0	0.0	0.0	0.0
Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						
Watershed Profile						
Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						
Minor Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						
Major Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.7**	**2.2**	**0.7**	**0.8**	**1.0**	**0.8**
Major Total Design Peak Flow, Q (cfs)	**6.8**	**6.6**	**1.7**	**2.1**	**3.1**	**2.1**
Minor Flow Bypassed Downstream, Q_b (cfs)						
Major Flow Bypassed Downstream, Q_b (cfs)						
Minor Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A
Major Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

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INLET MANAGEMENT

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INLET NAME	Cor2 154Av&Ivy SBas2A	Cor3 154Av&Ivy SBas2A	Cor1 154Pl&Jsmn DP10	Cor2 154Pl&Jsmn DP10	Cor3 154Pl&Jsmn DP10	Cor1 155Pl&KrmrSt DP15
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade
Inlet Type						

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	0.8	0.8	2.0	2.0	2.0	2.4
Major Q_{Known} (cfs)	2.1	2.1	5.9	5.9	5.9	7.1
Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						
Watershed Profile						
Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						
Minor Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						
Major Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.8**	**0.8**	**2.0**	**2.0**	**2.0**	**2.4**
Major Total Design Peak Flow, Q (cfs)	**2.1**	**2.1**	**5.9**	**5.9**	**5.9**	**7.1**
Minor Flow Bypassed Downstream, Q_b (cfs)						
Major Flow Bypassed Downstream, Q_b (cfs)						
Minor Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A
Major Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	Cor2 155Pl&KrmrSt DP15	Cor3 155Pl&KrmrSt DP15	Cor1 155Pl&LydnSt DP17	Cor2 155Pl&LydnSt DP17	Cor3 155Pl&LydnSt DP17	Cor1 154Av&LydSt SBas20B
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade
Inlet Type						

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	2.4	2.4	2.4	2.4	2.4	1.6
Major Q_{Known} (cfs)	7.1	7.1	6.9	6.9	6.9	4.2
Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						
Watershed Profile						
Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						
Minor Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						
Major Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.4**	**2.4**	**2.4**	**2.4**	**2.4**	**1.6**
Major Total Design Peak Flow, Q (cfs)	**7.1**	**7.1**	**6.9**	**6.9**	**6.9**	**4.2**
Minor Flow Bypassed Downstream, Q_b (cfs)						
Major Flow Bypassed Downstream, Q_b (cfs)						
Minor Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A
Major Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	Cor2 154Av&LydSt SBas20B	Cor3 154Av&LydSt SBas20B	Cor1 Mon&154Av SBas30B	Cor2 Mon&154Av SBas30B	Cor3 Mon&154Av SBas30B	Cor1 156Av&Mon SBas30A
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade	On Grade	On Grade
Inlet Type						

USER-DEFINED INPUT

User-Defined Design Flows						
Minor Q_{Known} (cfs)	1.6	1.6	4.1	4.1	4.1	1.5
Major Q_{Known} (cfs)	4.2	4.2	13.1	13.1	13.1	4.8
Bypass (Carry-Over) Flow from Upstream						
Receive Bypass Flow from:	User-Defined	User-Defined	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	0.0	0.0
Watershed Characteristics						
Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						
Watershed Profile						
Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						
Minor Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						
Major Storm Rainfall Input						
Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.6**	**1.6**	**4.1**	**4.1**	**4.1**	**1.5**
Major Total Design Peak Flow, Q (cfs)	**4.2**	**4.2**	**13.1**	**13.1**	**13.1**	**4.8**
Minor Flow Bypassed Downstream, Q_b (cfs)						
Major Flow Bypassed Downstream, Q_b (cfs)						
Minor Storm (Calculated) Analysis of Flow T						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A
Major Storm (Calculated) Analysis of Flow Ti						
C	N/A	N/A	N/A	N/A	N/A	N/A
C_5	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Velocity, Vi	N/A	N/A	N/A	N/A	N/A	N/A
Channel Flow Velocity, Vt	N/A	N/A	N/A	N/A	N/A	N/A
Overland Flow Time, Ti	N/A	N/A	N/A	N/A	N/A	N/A
Channel Travel Time, Tt	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Time of Concentration, T_c	N/A	N/A	N/A	N/A	N/A	N/A
Regional T_c	N/A	N/A	N/A	N/A	N/A	N/A
Recommended T_c	N/A	N/A	N/A	N/A	N/A	N/A
T_c selected by User	N/A	N/A	N/A	N/A	N/A	N/A
Design Rainfall Intensity, I	N/A	N/A	N/A	N/A	N/A	N/A
Calculated Local Peak Flow, Q_p	N/A	N/A	N/A	N/A	N/A	N/A

Appendix B – Hydraulic Computations

Curb Inlet Sizing

Manning's n of 0.016 has been used for all crown to curb sections per Chapter 7 of the USDCM Vol.7, Page 7-7.
Manning's n of 0.018 has been used for all local street sidewalks as requested by the City of Thornton.
Manning's n of 0.02 has been used for all collector sidewalks to account for lawns and trees. This is the highest value recommended per UD-Inlet spreadsheet for manning's n behind curb.

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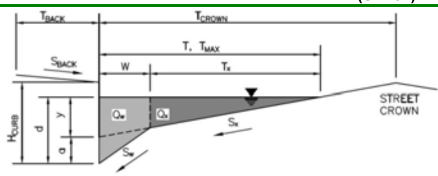
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: Westwood
Inlet ID: 1 (SDI-31)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	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} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.018	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	9.5	9.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.1	5.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.1	1.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**15.6**	**15.6**	**cfs**
Flow Velocity within the Gutter Section	V =	6.7	6.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.1	3.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.0	9.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.0	9.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.5	5.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.5	15.7	cfs
Average Flow Velocity Within the Gutter Section	V =	5.1	6.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.7	3.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.5**	**15.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

MINOR STORM Allowable Capacity is based on Depth Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.5**	**15.6**	**cfs**

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

INLET ON A CONTINUOUS GRADE

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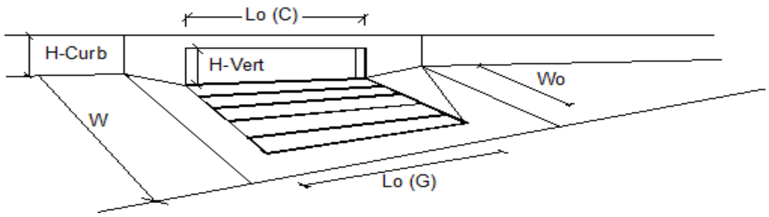


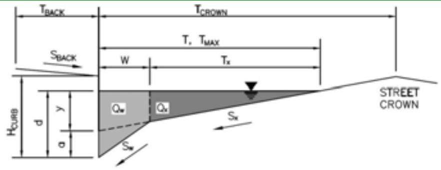
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**1.3**	**3.6**	cfs
Water Spread Width		T =	5.4	9.3	ft
Water Depth at Flowline (outside of local depression)		d =	2.8	3.8	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.866	0.613	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.2	1.4	cfs
Discharge within the Gutter Section W		Q_w =	1.1	2.2	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.30	0.46	sq ft
Velocity within the Gutter Section W		V_W =	3.7	4.8	fps
Water Depth for Design Condition		d_{LOCAL} =	7.8	8.8	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.255	0.186	ft/ft
Required Length L_T to Have 100% Interception		L_T =	4.33	8.40	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	4.33	5.00	ft
Interception Capacity		Q_i =	1.3	2.9	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.10	0.10	
Effective (Unclogged) Length		L_e =	4.50	4.50	ft
Actual Interception Capacity		**Q_a =**	**1.3**	**2.7**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**0.9**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.3**	**2.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**75**	**%**

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 2 (SDI-42)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	9.7	9.7	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.2	5.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.0	1.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**15.9**	**15.9**	**cfs**
Flow Velocity within the Gutter Section	V =	6.8	6.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.2	3.2	

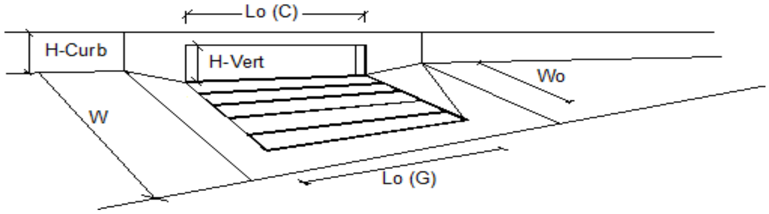
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.0	9.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.0	9.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.6	5.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.6	16.0	cfs
Average Flow Velocity Within the Gutter Section	V =	5.2	6.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.7	3.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.6**	**16.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.6**	**15.9**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**2.7**	**7.6**	cfs
Water Spread Width		T =	8.0	12.8	ft
Water Depth at Flowline (outside of local depression)		d =	3.4	4.6	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.688	0.462	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.8	4.1	cfs
Discharge within the Gutter Section W		Q_w =	1.9	3.5	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W		A_W =	0.41	0.60	sq ft
Velocity within the Gutter Section W		V_W =	4.6	5.8	fps
Water Depth for Design Condition		d_{LOCAL} =	8.4	9.6	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.206	0.145	ft/ft
Required Length L_T to Have 100% Interception		L_T =	6.94	13.75	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	6.94	10.00	ft
Interception Capacity		Q_i =	2.7	6.8	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		**Q_a =**	**2.7**	**6.6**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**1.0**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.7**	**6.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.0**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**87**	**%**

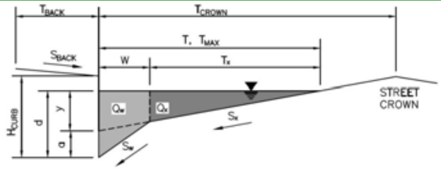
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 3 (SDI-39)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.034	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	13.0	13.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	7.0	7.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.3	1.3	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**21.2**	**21.2**	**cfs**
Flow Velocity within the Gutter Section	V =	9.1	9.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.2	4.2	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.7	13.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.7	13.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.5	7.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.3	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.2	21.4	cfs
Average Flow Velocity Within the Gutter Section	V =	6.9	9.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.3	4.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.71	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.2**	**15.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.11	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

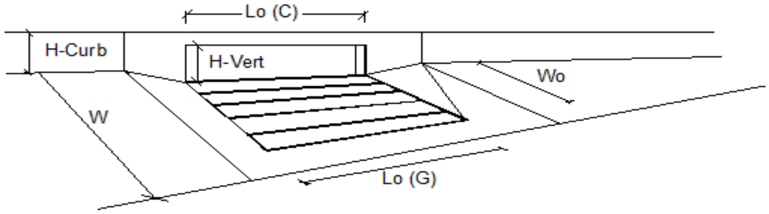
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.2**	**15.2**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**1.7**	**5.0**	cfs
Water Spread Width	T =	5.2	9.4	ft
Water Depth at Flowline (outside of local depression)	d =	2.8	3.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.876	0.609	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.2	2.0	cfs
Discharge within the Gutter Section W	Q_w =	1.5	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.29	0.46	sq ft
Velocity within the Gutter Section W	V_W =	5.1	6.6	fps
Water Depth for Design Condition	d_{LOCAL} =	7.8	8.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.258	0.185	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.12	10.33	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.7	3.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	**1.7**	**3.2**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**1.8**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.7**	**3.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**64**	**%**

Sump Emergency Overflow Weir Section Analyses for all sump inlets have been provided as a separate section to follow in Appendix B.

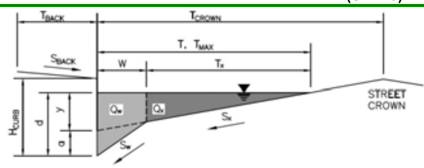
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 4 (SDI-48)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

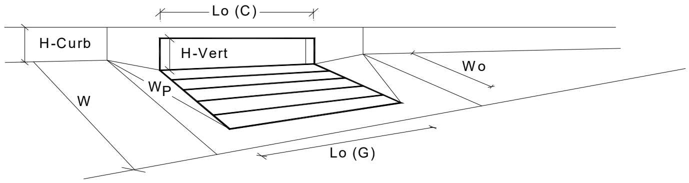
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	5.00	5.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.0	5.6	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.6	7.3	cfs
Interception with Clogging	Q_{wa} =	2.5	6.9	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	19.5	21.8	cfs
Interception with Clogging	Q_{oa} =	18.3	20.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.7	11.8	cfs
Interception with Clogging	Q_{ma} =	6.3	11.0	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**2.5**	**6.9**	**cfs**

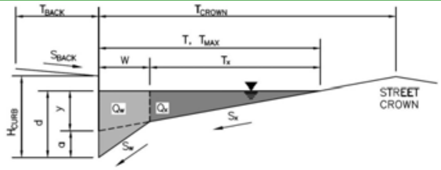
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	10.4	17.0	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.17	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.38	0.53	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.91	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.5**	**6.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.5	6.5	cfs

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 5 (SDI-30)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.018	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	9.5	9.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.1	5.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.0	1.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**15.5**	**15.5**	**cfs**
Flow Velocity within the Gutter Section	V =	6.7	6.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.1	3.1	

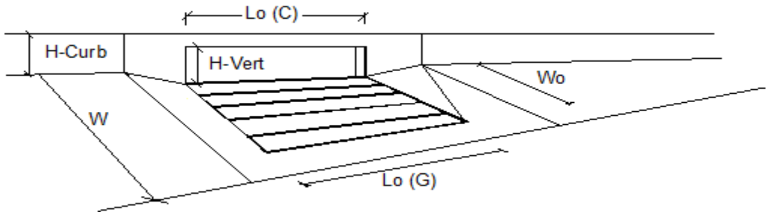
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.0	9.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.0	9.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.5	5.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.5	15.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.1	6.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.7	3.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.5**	**15.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.5**	**15.5**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**2.9**	**9.4**	cfs
Water Spread Width	T =	8.4	14.1	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	4.9	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.664	0.422	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.0	5.3	cfs
Discharge within the Gutter Section W	Q_w =	1.9	3.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.2	cfs
Flow Area within the Gutter Section W	A_W =	0.42	0.65	sq ft
Velocity within the Gutter Section W	V_W =	4.6	6.0	fps
Water Depth for Design Condition	d_{LOCAL} =	8.5	9.9	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.200	0.135	ft/ft
Required Length L_T to Have 100% Interception	L_T =	7.28	15.73	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	7.28	10.00	ft
Interception Capacity	Q_i =	2.9	7.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**2.9**	**7.5**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**1.9**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.9**	**7.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**79**	**%**

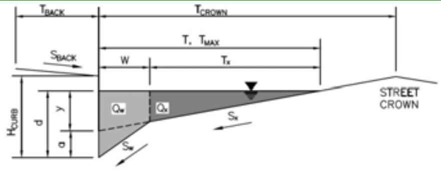
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 6 (SDI-34)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.5	8.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.6	4.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**14.0**	**14.0**	**cfs**
Flow Velocity within the Gutter Section	V =	6.0	6.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.8	2.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.8	8.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.8	8.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.3	4.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.1	14.1	cfs
Average Flow Velocity Within the Gutter Section	V =	4.6	6.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.5	2.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.1**	**14.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

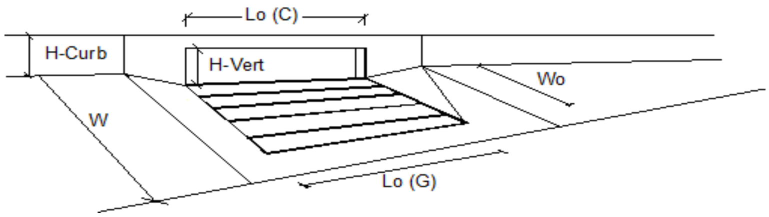
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.1**	**14.0**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**2.4**	**8.7**	cfs
Water Spread Width		T =	8.1	14.3	ft
Water Depth at Flowline (outside of local depression)		d =	3.4	4.9	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.685	0.417	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.8	5.0	cfs
Discharge within the Gutter Section W		Q_w =	1.6	3.6	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.2	cfs
Flow Area within the Gutter Section W		A_W =	0.41	0.66	sq ft
Velocity within the Gutter Section W		V_W =	4.0	5.4	fps
Water Depth for Design Condition		d_{LOCAL} =	8.4	9.9	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.206	0.133	ft/ft
Required Length L_T to Have 100% Interception		L_T =	6.44	15.03	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	6.44	10.00	ft
Interception Capacity		Q_i =	2.4	7.3	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		**Q_a =**	**2.4**	**7.1**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**1.6**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.4**	**7.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.6**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**81**	**%**

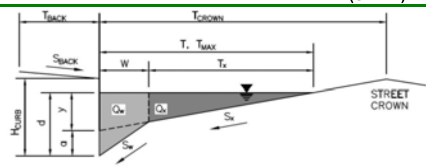
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 7 (SDI-47)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

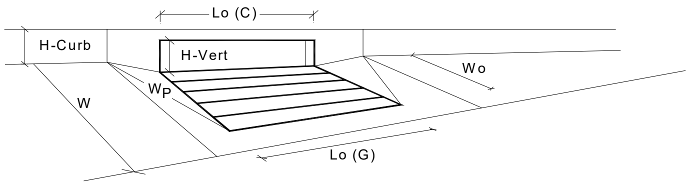
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	5.00	5.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.0	5.6	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.25	1.25	
Clogging Factor for Multiple Units		Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	2.6	7.3	cfs
Interception with Clogging		Q_{wa} =	2.5	6.9	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	19.5	21.8	cfs
Interception with Clogging		Q_{oa} =	18.3	20.5	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	6.7	11.8	cfs
Interception with Clogging		Q_{ma} =	6.3	11.0	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		Q_{Curb} =	**2.5**	**6.9**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	10.4	17.0	ft
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.17	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.38	0.53	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.79	0.91	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**2.5**	**6.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.6	6.4	cfs

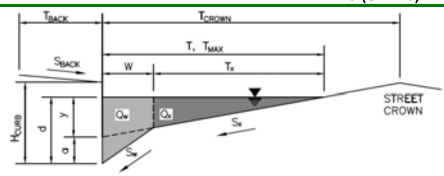
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 8 (SDI-45)



Manning's n of 0.02 has been used for all collector sidewalks to account for lawns and trees. This is the highest value recommended per UD-Inlet spreadsheet for manning's n behind curb.

Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	22.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	52.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.024	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.7	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	7.20	7.20	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	8.71	8.71	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	28.0	28.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.194	0.194	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	57.3	57.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	13.8	13.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	4.1	4.1	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**75.1**	**75.1**	**cfs**
Flow Velocity within the Gutter Section	V =	10.7	10.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	7.8	7.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	30.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	28.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.194	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	14.4	57.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	14.4	57.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	6.7	13.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	4.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	21.2	74.8	cfs
Average Flow Velocity Within the Gutter Section	V =	8.1	10.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.0	7.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.90	0.73	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**19.1**	**54.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.82	7.94	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

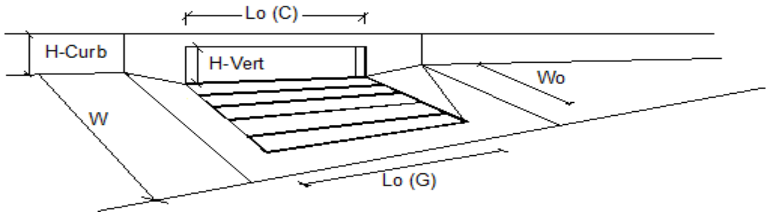
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**19.1**	**54.6**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



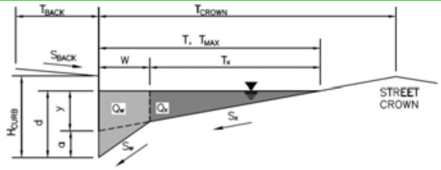
		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	Q_o =	**0.9**	**2.1**	cfs
Water Spread Width	T =	3.7	6.6	ft
Water Depth at Flowline (outside of local depression)	d =	2.4	3.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.966	0.780	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.5	cfs
Discharge within the Gutter Section W	Q_w =	0.9	1.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.23	0.35	sq ft
Velocity within the Gutter Section W	V_W =	3.7	4.7	fps
Water Depth for Design Condition	d_{LOCAL} =	5.4	6.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.202	0.166	ft/ft
Required Length L_T to Have 100% Interception	L_T =	4.06	6.83	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	4.06	6.83	ft
Interception Capacity	Q_i =	0.9	2.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	Q_a =	**0.9**	**2.1**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	**0.0**	**0.0**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.9**	**2.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 9 (SDI-40)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	3.1	9.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.6	4.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**5.7**	**13.4**	**cfs**
Flow Velocity within the Gutter Section	V =	4.3	5.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.6	2.6	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	3.1	9.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.1	9.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.6	4.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.7	13.5	cfs
Average Flow Velocity Within the Gutter Section	V =	4.3	5.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.7	2.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**5.7**	**13.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

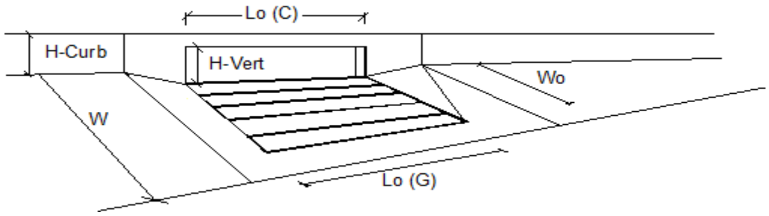
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**5.7**	**13.4**	**cfs**

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

Please note that Table 7-2 of USDCM Vol.1 specifically calls for one dry lane in "each direction" of traffic for arterial streets. However, for collector streets the table does not specify that one dry lane needs to be maintained in "each direction". So collectors only need to maintain one dry lane combined for both directions of traffic. This corresponds to 5.5' of dry lane for collector in each direction. Street capacity calcs for all collectors have been updated to reflect this.

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**1.4**	**3.2**	cfs
Water Spread Width	T =	6.7	10.1	ft
Water Depth at Flowline (outside of local depression)	d =	3.1	3.9	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.773	0.572	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.3	1.4	cfs
Discharge within the Gutter Section W	Q_w =	1.1	1.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.35	0.49	sq ft
Velocity within the Gutter Section W	V_W =	3.1	3.7	fps
Water Depth for Design Condition	d_{LOCAL} =	6.1	6.9	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.165	0.128	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.30	9.10	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.4	2.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	**1.4**	**2.3**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.9**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**2.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**97**	**71**	**%**

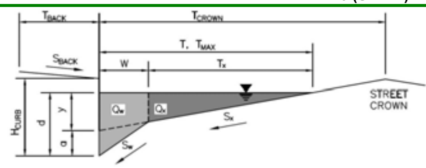
Version 4.06 Released August 2018

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

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

Project: **Westwood**

Inlet ID: **10 (SDI-12)**



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018		
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

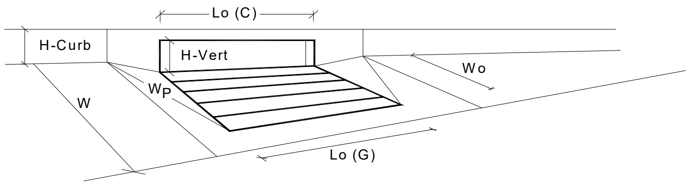
		Minor Storm	Major Storm	
Maximum Capacity for 1/2 Street based On Allowable Spread				
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

		Minor Storm	Major Storm	
Maximum Capacity for 1/2 Street based on Allowable Depth				
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



	Design Information (Input)		MINOR	MAJOR	
	Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Warning 1	Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.0	5.6	inches
	Grate Information		MINOR	MAJOR	☐ Override Depths
	Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
	Width of a Unit Grate	W_o =	N/A	N/A	feet
	Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
	Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
	Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
	Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
	Curb Opening Information		MINOR	MAJOR	
	Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Warning 1	Height of Vertical Curb Opening in Inches	H_{vert} =	4.00	4.00	inches
Warning 1	Height of Curb Orifice Throat in Inches	H_{throat} =	4.00	4.00	inches
	Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
	Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
	Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
	Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
	Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
	Grate Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
	Clogging Factor for Multiple Units	Clog =	N/A	N/A	
	Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
	Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
	Grate Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
	Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
	Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
	Clogging Factor for Multiple Units	Clog =	0.06	0.06	
	Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	2.6	7.3	cfs
	Interception with Clogging	Q_{wa} =	2.5	6.9	cfs
	Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	11.8	13.5	cfs
	Interception with Clogging	Q_{oa} =	11.1	12.7	cfs
	Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	5.2	9.2	cfs
	Interception with Clogging	Q_{ma} =	4.9	8.7	cfs
	Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**2.5**	**6.9**	**cfs**
	Resultant Street Conditions		MINOR	MAJOR	
	Total Inlet Length	L =	10.00	10.00	feet
	Resultant Street Flow Spread (based on street geometry from above)	T =	10.4	17.0	ft
	Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
	Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
	Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
	Depth for Curb Opening Weir Equation	d_{Curb} =	0.17	0.30	ft
	Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.38	0.53	
	Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.91	
	Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.5**	**6.9**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	5.9	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

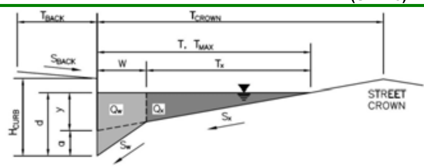
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 11 (SDI-13)



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018		
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	2.8	5.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

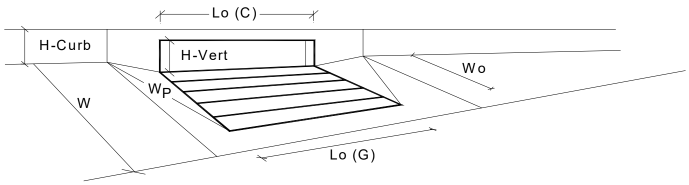
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	5.5	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	3.5	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.853	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



			MINOR	MAJOR	
	Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
	Type of Inlet	Type =	CDOT Type R Curb Opening		
Warning 1	Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	2.8	5.6	inches
	Grate Information		MINOR	MAJOR	Override Depths
	Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
	Width of a Unit Grate	W_o =	N/A	N/A	feet
	Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
	Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
	Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
	Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
	Curb Opening Information		MINOR	MAJOR	
	Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Warning 1	Height of Vertical Curb Opening in Inches	H_{vert} =	4.00	4.00	inches
Warning 1	Height of Curb Orifice Throat in Inches	H_{throat} =	4.00	4.00	inches
	Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
	Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
	Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
	Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
	Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
	Grate Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
	Clogging Factor for Multiple Units	Clog =	N/A	N/A	
	Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
	Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
	Grate Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
	Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
	Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
	Clogging Factor for Multiple Units	Clog =	0.10	0.10	
	Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	0.5	5.1	cfs
	Interception with Clogging	Q_{wa} =	0.5	4.6	cfs
	Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	5.2	6.7	cfs
	Interception with Clogging	Q_{oa} =	4.7	6.1	cfs
	Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	1.5	5.4	cfs
	Interception with Clogging	Q_{ma} =	1.4	4.9	cfs
	Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**0.5**	**4.6**	**cfs**
	Resultant Street Conditions		MINOR	MAJOR	
	Total Inlet Length	L =	5.00	5.00	feet
	Resultant Street Flow Spread (based on street geometry from above)	T =	5.5	17.0	ft
	Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
	Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
	Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
	Depth for Curb Opening Weir Equation	d_{Curb} =	0.07	0.30	ft
	Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.36	0.72	
	Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.92	1.00	
	Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**0.5**	**4.6**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.3	0.7	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

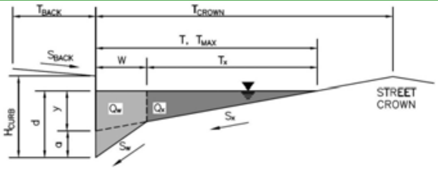
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 12 (SDI-07)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.5	10.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.6	5.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.1	1.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**17.2**	**17.2**	**cfs**
Flow Velocity within the Gutter Section	V =	7.4	7.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.4	3.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	2.2	10.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.2	10.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.8	5.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.0	17.3	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	7.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.9	3.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.0**	**17.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

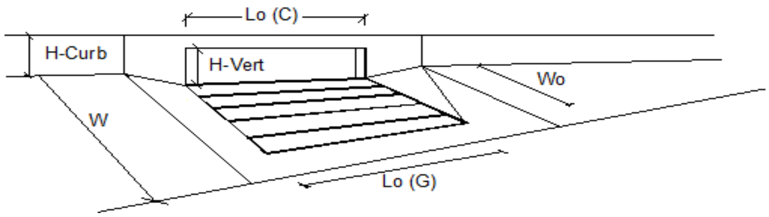
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**5.0**	**17.2**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	Q_o =	**2.1**	**6.5**	cfs
Water Spread Width	T =	6.8	11.6	ft
Water Depth at Flowline (outside of local depression)	d =	3.1	4.3	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.771	0.506	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.5	3.2	cfs
Discharge within the Gutter Section W	Q_w =	1.6	3.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.36	0.55	sq ft
Velocity within the Gutter Section W	V_W =	4.6	6.0	fps
Water Depth for Design Condition	d_{LOCAL} =	8.1	9.3	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.229	0.157	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.87	12.40	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	2.0	3.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	Q_a =	**1.9**	**3.6**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	**0.2**	**2.9**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.9**	**3.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**2.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**55**	**%**

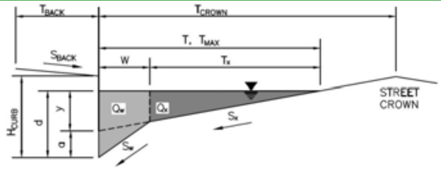
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 13 (SDI-24)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.037	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	13.6	13.6	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	7.3	7.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.4	1.4	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**22.3**	**22.3**	**cfs**
Flow Velocity within the Gutter Section	V =	9.6	9.6	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.5	4.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	2.9	13.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.9	13.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.6	7.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.5	22.4	cfs
Average Flow Velocity Within the Gutter Section	V =	7.3	9.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.4	4.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.66	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**6.5**	**14.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.01	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

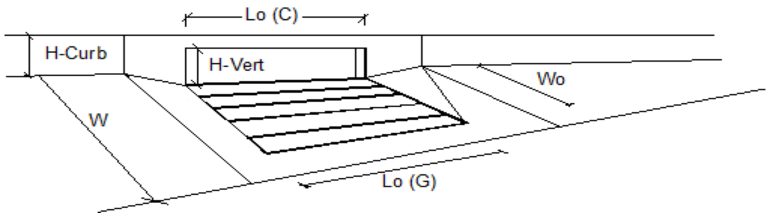
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**6.5**	**14.8**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



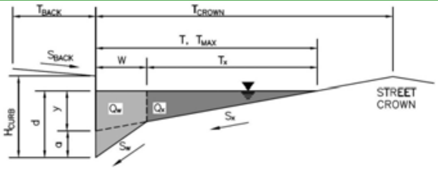
Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		Q_o =	**2.2**	**6.3**	cfs
Water Spread Width		T =	6.0	10.2	ft
Water Depth at Flowline (outside of local depression)		d =	2.9	4.0	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.826	0.567	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.4	2.7	cfs
Discharge within the Gutter Section W		Q_w =	1.8	3.6	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.32	0.49	sq ft
Velocity within the Gutter Section W		V_W =	5.6	7.2	fps
Water Depth for Design Condition		d_{LOCAL} =	7.9	9.0	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.243	0.174	ft/ft
Required Length L_T to Have 100% Interception		L_T =	6.02	12.02	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	5.00	5.00	ft
Interception Capacity		Q_i =	2.1	3.9	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.10	0.10	
Effective (Unclogged) Length		L_e =	4.50	4.50	ft
Actual Interception Capacity		Q_a =	**2.0**	**3.6**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		Q_b =	**0.2**	**2.7**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		Q =	**2.0**	**3.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	**0.2**	**2.7**	**cfs**
Capture Percentage = Q_a/Q_o =		C% =	**92**	**57**	**%**

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 14 (SDI-11)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.035	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	13.3	13.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	7.2	7.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.3	1.3	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**21.8**	**21.8**	**cfs**
Flow Velocity within the Gutter Section	V =	9.3	9.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.4	4.4	

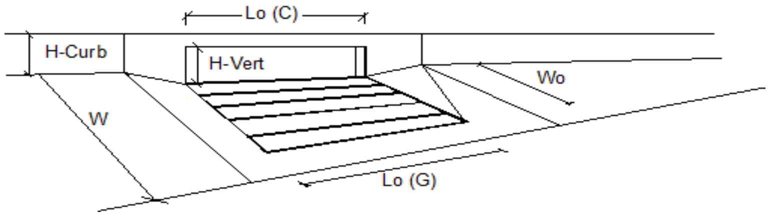
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.8	13.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.8	13.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.6	7.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.4	21.9	cfs
Average Flow Velocity Within the Gutter Section	V =	7.1	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.4	4.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.68	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**6.4**	**15.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.06	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**6.4**	**15.0**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**1.4**	**3.9**	cfs
Water Spread Width	T =	4.5	8.2	ft
Water Depth at Flowline (outside of local depression)	d =	2.6	3.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.924	0.675	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.1	1.3	cfs
Discharge within the Gutter Section W	Q_w =	1.3	2.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.26	0.42	sq ft
Velocity within the Gutter Section W	V_W =	4.9	6.3	fps
Water Depth for Design Condition	d_{LOCAL} =	7.6	8.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o-GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.271	0.203	ft/ft
Required Length L_T to Have 100% Interception	L_T =	4.54	8.75	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	4.54	5.00	ft
Interception Capacity	Q_i =	1.4	3.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	**1.4**	**2.8**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**1.1**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**2.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**73**	**%**

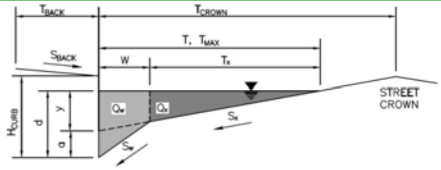
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 15 (SDI-27)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.4	10.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.6	5.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.1	1.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**17.1**	**17.1**	**cfs**
Flow Velocity within the Gutter Section	V =	7.3	7.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.4	3.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.2	10.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.2	10.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.8	5.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.0	17.2	cfs
Average Flow Velocity Within the Gutter Section	V =	5.6	7.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.9	3.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.0**	**17.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

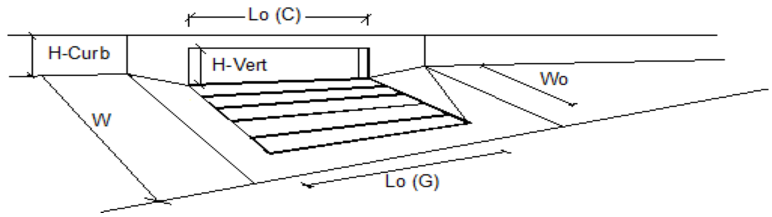
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**5.0**	**17.1**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



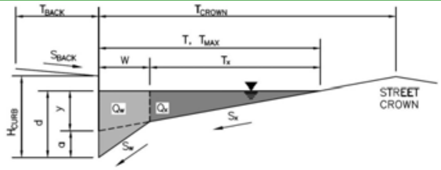
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	Q_o =	**2.4**	**7.1**	cfs
Water Spread Width	T =	7.3	12.1	ft
Water Depth at Flowline (outside of local depression)	d =	3.3	4.4	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.736	0.488	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.6	3.6	cfs
Discharge within the Gutter Section W	Q_w =	1.8	3.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.38	0.57	sq ft
Velocity within the Gutter Section W	V_W =	4.7	6.1	fps
Water Depth for Design Condition	d_{LOCAL} =	8.3	9.4	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.220	0.153	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.40	13.14	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.40	10.00	ft
Interception Capacity	Q_i =	2.4	6.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	Q_a =	**2.4**	**6.4**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	**0.0**	**0.7**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	Q =	**2.4**	**6.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	C% =	**100**	**90**	**%**

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 16 (SDI-16)



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018		
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.8	8.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.7	4.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**14.4**	**14.4**	**cfs**
Flow Velocity within the Gutter Section	V =	6.2	6.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.9	2.9	

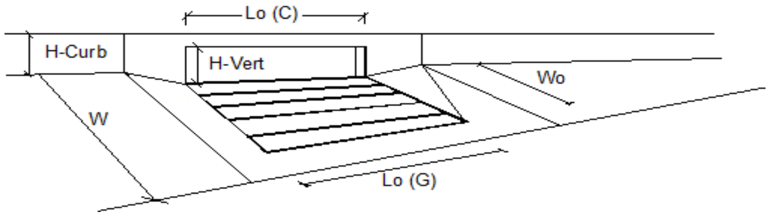
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.8	8.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.8	8.8	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.4	4.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.2	14.4	cfs
Average Flow Velocity Within the Gutter Section	V =	4.7	6.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.6	2.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**4.2**	**14.4**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**4.2**	**14.4**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**1.9**	**5.0**	cfs
Water Spread Width	T =	7.0	11.2	ft
Water Depth at Flowline (outside of local depression)	d =	3.2	4.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.751	0.523	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.5	2.4	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.37	0.53	sq ft
Velocity within the Gutter Section W	V_W =	3.9	4.9	fps
Water Depth for Design Condition	d_{LOCAL} =	8.2	9.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.224	0.162	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.52	10.49	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.52	10.00	ft
Interception Capacity	Q_i =	1.9	5.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**1.9**	**4.9**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.1**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.9**	**4.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**98**	**%**

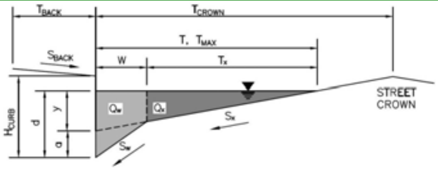
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 17 (SDI-10)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.012	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.6	7.6	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.1	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.5**	**12.5**	**cfs**
Flow Velocity within the Gutter Section	V =	5.4	5.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.5	2.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.6	7.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.6	7.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.0	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.7	12.6	cfs
Average Flow Velocity Within the Gutter Section	V =	4.1	5.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.4	2.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**3.7**	**12.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

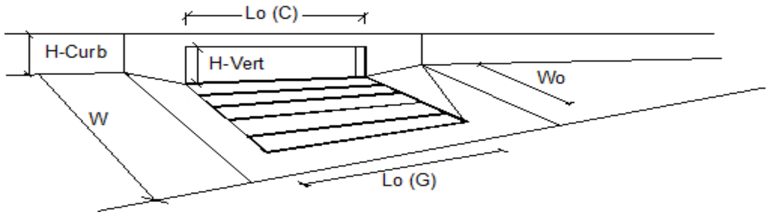
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**3.7**	**12.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**2.4**	**6.9**	cfs
Water Spread Width	T =	8.5	13.6	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	4.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.658	0.438	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.8	3.8	cfs
Discharge within the Gutter Section W	Q_w =	1.6	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W	A_W =	0.43	0.63	sq ft
Velocity within the Gutter Section W	V_W =	3.7	4.7	fps
Water Depth for Design Condition	d_{LOCAL} =	8.6	9.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.198	0.139	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.47	12.96	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.47	10.00	ft
Interception Capacity	Q_i =	2.4	6.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**2.4**	**6.2**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.7**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.4**	**6.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**89**	**%**

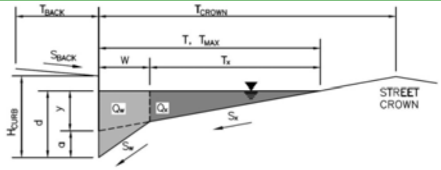
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 18 (SDI-08)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.2	7.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.9	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**11.9**	**11.9**	**cfs**
Flow Velocity within the Gutter Section	V =	5.1	5.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.4	2.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.5	7.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.5	7.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.5	11.9	cfs
Average Flow Velocity Within the Gutter Section	V =	3.9	5.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.3	2.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**3.5**	**11.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

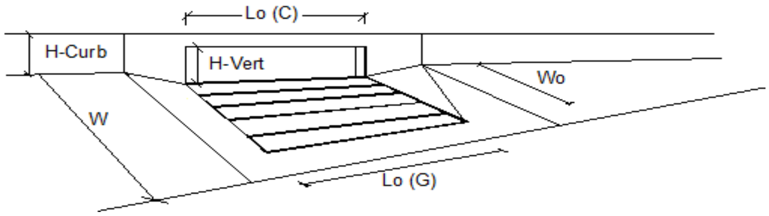
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**3.5**	**11.9**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	Q_o =	**1.7**	**5.7**	cfs
Water Spread Width	T =	7.4	12.9	ft
Water Depth at Flowline (outside of local depression)	d =	3.3	4.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.730	0.460	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.5	3.1	cfs
Discharge within the Gutter Section W	Q_w =	1.2	2.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W	A_W =	0.38	0.60	sq ft
Velocity within the Gutter Section W	V_W =	3.3	4.4	fps
Water Depth for Design Condition	d_{LOCAL} =	8.3	9.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.218	0.145	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.16	11.54	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.16	10.00	ft
Interception Capacity	Q_i =	1.7	5.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	Q_a =	**1.7**	**5.4**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	**0.0**	**0.3**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	Q =	**1.7**	**5.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.0**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o =	C% =	**100**	**95**	**%**

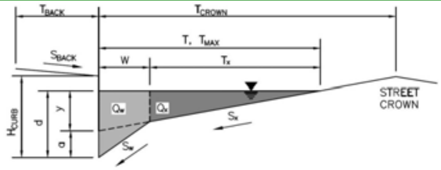
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 19 (SDI-46)



Gutter Geometry (Enter data in the blue cells)

Parameter	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	2.7	7.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.2	3.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**4.9**	**11.6**	**cfs**
Flow Velocity within the Gutter Section	V =	3.7	4.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.4	2.2	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	2.7	7.9	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.7	7.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.2	3.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.9	11.7	cfs
Average Flow Velocity Within the Gutter Section	V =	3.7	4.5	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.4	2.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**4.9**	**11.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

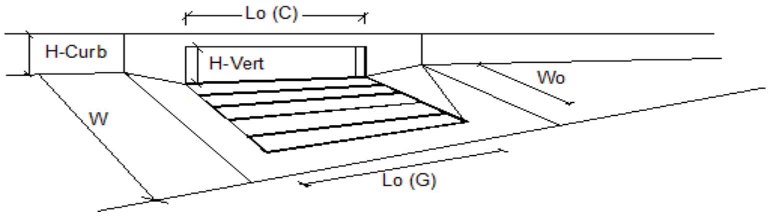
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**4.9**	**11.6**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**1.5**	**4.3**	cfs
Water Spread Width	T =	7.5	12.3	ft
Water Depth at Flowline (outside of local depression)	d =	3.3	4.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.720	0.481	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.4	2.2	cfs
Discharge within the Gutter Section W	Q_w =	1.1	2.1	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.39	0.58	sq ft
Velocity within the Gutter Section W	V_W =	2.8	3.6	fps
Water Depth for Design Condition	d_{LOCAL} =	6.3	7.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.155	0.110	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.56	11.11	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.56	10.00	ft
Interception Capacity	Q_i =	1.5	4.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**1.5**	**4.2**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.1**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.5**	**4.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**97**	**%**

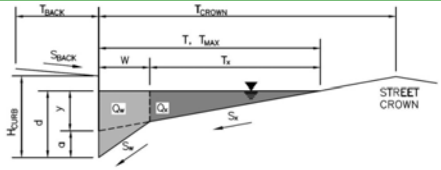
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 42 (SDI-17)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	6.1	6.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.3	3.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.6	0.6	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**10.0**	**10.0**	**cfs**
Flow Velocity within the Gutter Section	V =	4.3	4.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.0	2.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.3	6.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.3	6.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.6	3.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	2.9	10.1	cfs
Average Flow Velocity Within the Gutter Section	V =	3.3	4.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.1	2.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**2.9**	**10.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

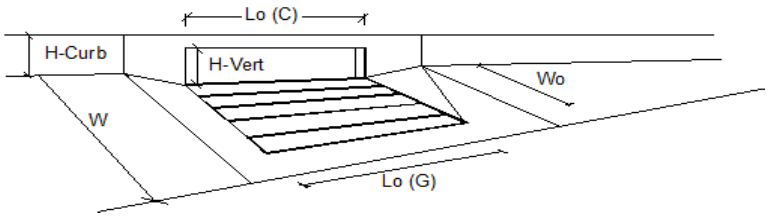
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**2.9**	**10.0**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	Q_o =	**2.4**	**6.6**	cfs
Water Spread Width	T =	9.5	14.6	ft
Water Depth at Flowline (outside of local depression)	d =	3.8	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.605	0.409	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.9	3.8	cfs
Discharge within the Gutter Section W	Q_w =	1.5	2.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.2	cfs
Flow Area within the Gutter Section W	A_W =	0.46	0.67	sq ft
Velocity within the Gutter Section W	V_W =	3.1	3.9	fps
Water Depth for Design Condition	d_{LOCAL} =	8.8	10.0	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	Q_b =	**N/A**	**N/A**	cfs

Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.184	0.131	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.53	12.61	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.53	10.00	ft
Interception Capacity	Q_i =	2.4	6.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	Q_a =	**2.4**	**5.9**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	**0.0**	**0.7**	cfs

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.4**	**5.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**89**	**%**

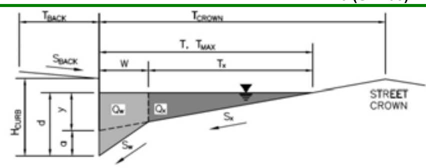
This inlet has an upstream flanking inlet SDI-04. Sized in the following pages of this section.

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 20 (SDI-05)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

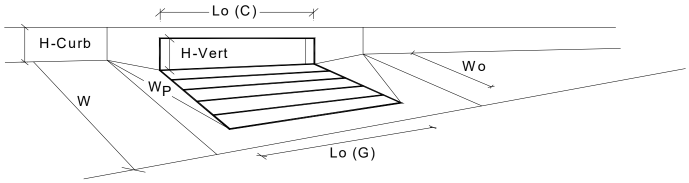
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



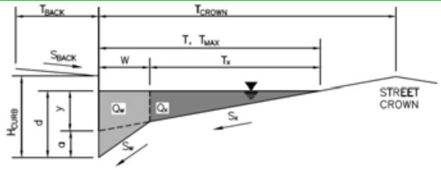
		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	5.00	5.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.0	5.6	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.6	7.3	cfs
Interception with Clogging	Q_{wa} =	2.5	6.9	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	19.5	21.8	cfs
Interception with Clogging	Q_{oa} =	18.3	20.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.7	11.8	cfs
Interception with Clogging	Q_{ma} =	6.3	11.0	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**2.5**	**6.9**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	10.4	17.0	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.17	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.38	0.53	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.91	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.5**	**6.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.5	6.2	cfs

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

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

Project: Westwood

Inlet ID: 21 (SDI-03)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.013	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.2	8.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.4	4.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.4**	**13.4**	**cfs**
Flow Velocity within the Gutter Section	V =	5.7	5.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.7	2.7	

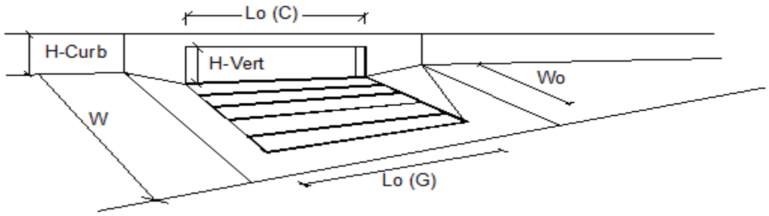
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	1.7	8.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.7	8.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.2	4.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.9	13.5	cfs
Average Flow Velocity Within the Gutter Section	V =	4.4	5.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.5	2.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**3.9**	**13.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**3.9**	**13.4**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**2.7**	**8.5**	cfs
Water Spread Width		T =	8.7	14.4	ft
Water Depth at Flowline (outside of local depression)		d =	3.6	5.0	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.646	0.415	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	1.0	4.9	cfs
Discharge within the Gutter Section W		Q_w =	1.7	3.4	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.2	cfs
Flow Area within the Gutter Section W		A_W =	0.43	0.66	sq ft
Velocity within the Gutter Section W		V_W =	4.0	5.2	fps
Water Depth for Design Condition		d_{LOCAL} =	8.6	10.0	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o-GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.195	0.133	ft/ft
Required Length L_T to Have 100% Interception		L_T =	6.98	14.77	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	6.98	10.00	ft
Interception Capacity		Q_i =	2.7	7.2	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		**Q_a =**	**2.7**	**7.0**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**1.5**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.7**	**7.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.5**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**82**	**%**

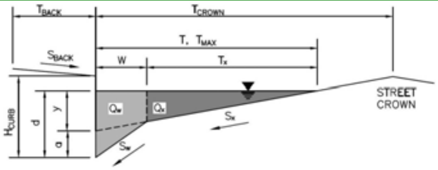
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 22 (SDI-23)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.1	7.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.8	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**11.6**	**11.6**	**cfs**
Flow Velocity within the Gutter Section	V =	5.0	5.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	2.3	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	1.5	7.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.5	7.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.4	11.6	cfs
Average Flow Velocity Within the Gutter Section	V =	3.8	5.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.3	2.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**3.4**	**11.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

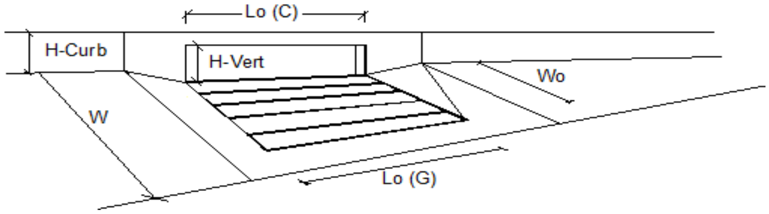
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.4**	**11.6**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



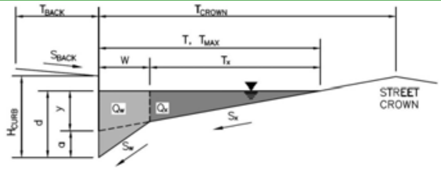
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**2.6**	**9.0**	cfs
Water Spread Width		T =	9.2	15.5	ft
Water Depth at Flowline (outside of local depression)		d =	3.7	5.2	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.620	0.384	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	1.0	5.3	cfs
Discharge within the Gutter Section W		Q_w =	1.6	3.3	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.4	cfs
Flow Area within the Gutter Section W		A_W =	0.45	0.71	sq ft
Velocity within the Gutter Section W		V_W =	3.5	4.7	fps
Water Depth for Design Condition		d_{LOCAL} =	8.7	10.2	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.188	0.124	ft/ft
Required Length L_T to Have 100% Interception		L_T =	6.84	15.29	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	6.84	10.00	ft
Interception Capacity		Q_i =	2.6	7.4	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		**Q_a =**	**2.6**	**7.1**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**1.9**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.6**	**7.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.9**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**79**	**%**

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 23 (SDI-22)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.1	7.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.8	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**11.6**	**11.6**	**cfs**
Flow Velocity within the Gutter Section	V =	5.0	5.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	2.3	

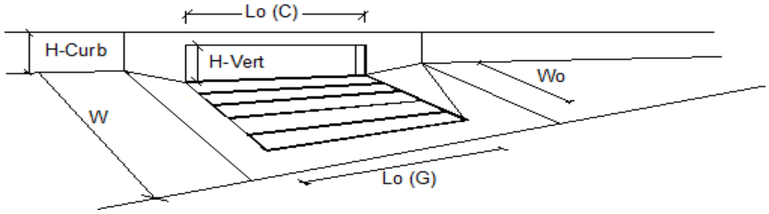
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.5	7.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.5	7.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.4	11.6	cfs
Average Flow Velocity Within the Gutter Section	V =	3.8	5.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.3	2.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**3.4**	**11.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**3.4**	**11.6**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**2.1**	**6.2**	cfs
Water Spread Width	T =	8.3	13.4	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	4.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.671	0.442	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.7	3.4	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W	A_W =	0.42	0.62	sq ft
Velocity within the Gutter Section W	V_W =	3.4	4.3	fps
Water Depth for Design Condition	d_{LOCAL} =	8.5	9.7	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.202	0.140	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.94	12.12	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	2.0	3.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	**1.9**	**3.5**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.2**	**2.7**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.9**	**3.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**2.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**92**	**56**	**%**

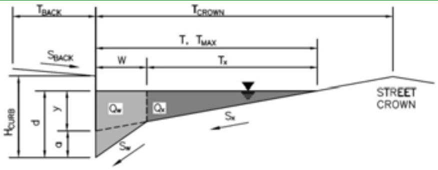
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 24 (SDI-21)



Gutter Geometry (Enter data in the blue cells)

Description	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

Description	Symbol	Minor Storm	Major Storm	Units
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Description	Symbol	Minor Storm	Major Storm	Units
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.5	7.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.0	4.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**12.2**	**12.2**	**cfs**
Flow Velocity within the Gutter Section	V =	5.3	5.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.4	2.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

Description	Symbol	Minor Storm	Major Storm	Units
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	1.6	7.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.6	7.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.0	4.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.6	12.3	cfs
Average Flow Velocity Within the Gutter Section	V =	4.0	5.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.3	2.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**3.6**	**12.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

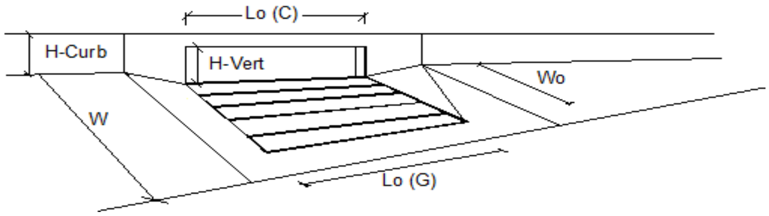
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.6**	**12.2**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**2.0**	**8.0**	cfs
Water Spread Width	T =	7.8	14.5	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.702	0.410	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.6	4.6	cfs
Discharge within the Gutter Section W	Q_w =	1.4	3.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.2	cfs
Flow Area within the Gutter Section W	A_W =	0.40	0.67	sq ft
Velocity within the Gutter Section W	V_W =	3.5	4.8	fps
Water Depth for Design Condition	d_{LOCAL} =	8.4	10.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.210	0.131	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.67	14.26	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.67	10.00	ft
Interception Capacity	Q_i =	2.0	6.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**2.0**	**6.7**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**1.3**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.0**	**6.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**84**	**%**

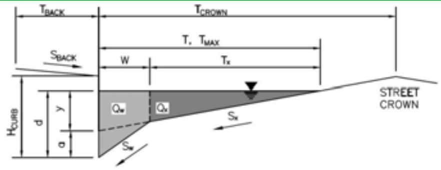
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 25 (SDI-09)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.2	7.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.9	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**11.9**	**11.9**	**cfs**
Flow Velocity within the Gutter Section	V =	5.1	5.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.4	2.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	1.5	7.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.5	7.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.5	11.9	cfs
Average Flow Velocity Within the Gutter Section	V =	3.9	5.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.3	2.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**3.5**	**11.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

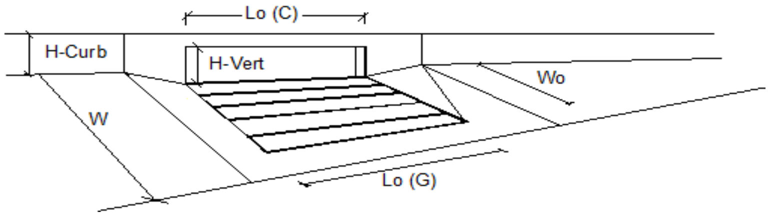
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.5**	**11.9**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**1.9**	**5.3**	cfs
Water Spread Width	T =	7.8	12.5	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	4.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.703	0.474	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.6	2.8	cfs
Discharge within the Gutter Section W	Q_w =	1.3	2.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.40	0.58	sq ft
Velocity within the Gutter Section W	V_W =	3.4	4.3	fps
Water Depth for Design Condition	d_{LOCAL} =	8.4	9.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.210	0.149	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.56	10.96	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.56	10.00	ft
Interception Capacity	Q_i =	1.9	5.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**1.9**	**5.1**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.2**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.9**	**5.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**97**	**%**

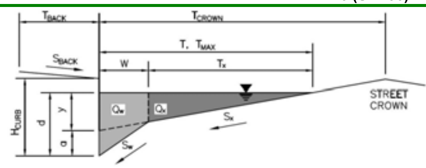
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 26 (SDI-06)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

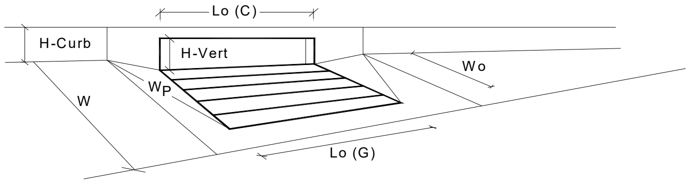
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	5.00	5.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.0	5.6	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.25	1.25	
Clogging Factor for Multiple Units		Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	2.6	7.3	cfs
Interception with Clogging		Q_{wa} =	2.5	6.9	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	19.5	21.8	cfs
Interception with Clogging		Q_{oa} =	18.3	20.5	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	6.7	11.8	cfs
Interception with Clogging		Q_{ma} =	6.3	11.0	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		Q_{Curb} =	**2.5**	**6.9**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	10.4	17.0	ft
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.17	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.38	0.53	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.79	0.91	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**2.5**	**6.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.1	5.0	cfs

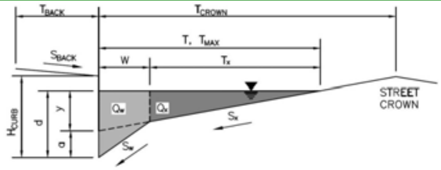
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 32 (SDI-49)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	22.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	22.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.6	6.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	5.40	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	6.91	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	20.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.262	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.1	16.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.8	5.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.9**	**22.2**	**cfs**
Flow Velocity within the Gutter Section	V =	5.0	5.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	3.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.0	22.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	15.0	20.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.349	0.262	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	7.1	16.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	7.1	16.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.8	5.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	10.9	22.2	cfs
Average Flow Velocity Within the Gutter Section	V =	5.0	5.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.3	3.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**10.9**	**22.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.60	6.92	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

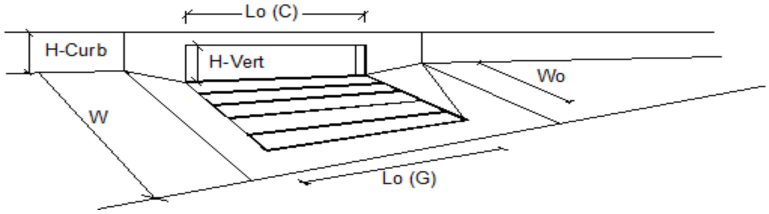
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**10.9**	**22.2**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



			MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**0.9**	**2.2**	cfs
Water Spread Width		T =	5.1	8.5	ft
Water Depth at Flowline (outside of local depression)		d =	2.7	3.5	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.883	0.660	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.1	0.7	cfs
Discharge within the Gutter Section W		Q_w =	0.8	1.5	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.29	0.42	sq ft
Velocity within the Gutter Section W		V_W =	2.7	3.4	fps
Water Depth for Design Condition		d_{LOCAL} =	5.7	6.5	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.186	0.144	ft/ft
Required Length L_T to Have 100% Interception		L_T =	4.01	7.11	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	4.01	7.11	ft
Interception Capacity		Q_i =	0.9	2.2	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		**Q_a =**	**0.9**	**2.2**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**0.0**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.9**	**2.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**100**	**%**

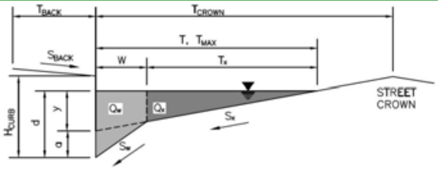
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 33 (SDI-44)



Gutter Geometry (Enter data in the blue cells)

Description	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	22.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	52.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

Description	Symbol	Minor Storm	Major Storm	Units
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.7	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Description	Symbol	Minor Storm	Major Storm	Units
Water Depth without Gutter Depression (Eq. ST-2)	y =	7.20	7.20	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	8.71	8.71	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	28.0	28.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.194	0.194	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	33.3	33.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	8.0	8.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	2.4	2.4	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**43.7**	**43.7**	**cfs**
Flow Velocity within the Gutter Section	V =	6.2	6.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.5	4.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

Description	Symbol	Minor Storm	Major Storm	Units
Theoretical Water Spread	T_{TH} =	18.7	30.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	28.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.194	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	8.4	33.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.4	33.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.9	8.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	2.3	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.3	43.5	cfs
Average Flow Velocity Within the Gutter Section	V =	4.7	6.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.3	4.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.3**	**43.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	8.70	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

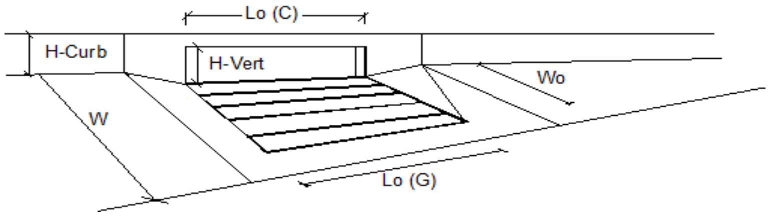
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.3**	**43.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		Q_o =	**1.9**	**4.1**	cfs
Water Spread Width		T =	8.3	11.9	ft
Water Depth at Flowline (outside of local depression)		d =	3.5	4.4	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.669	0.497	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.6	2.1	cfs
Discharge within the Gutter Section W		Q_w =	1.3	2.0	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.42	0.56	sq ft
Velocity within the Gutter Section W		V_W =	3.0	3.6	fps
Water Depth for Design Condition		d_{LOCAL} =	6.5	7.4	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.146	0.113	ft/ft
Required Length L_T to Have 100% Interception		L_T =	6.48	10.76	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	6.48	10.00	ft
Interception Capacity		Q_i =	1.9	4.1	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		Q_a =	**1.9**	**4.0**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		Q_b =	**0.0**	**0.1**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		Q =	**1.9**	**4.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =		C% =	**100**	**98**	**%**

Flow goes to roadside ditch section 12. Ditch has been sized for this bypass flow and the flow from its own tributary area basin O8. Ditch sizing has been provided in a separate section to follow in Appendix B.

This inlet has an upstream flanking inlet SDI-20. Sized in the following pages of this section. Street Capacity for E 156th Ave, Monaco St, corner capacity check for Monaco St & E 156th Ave are also provided in separate sections to follow in Appendix B.

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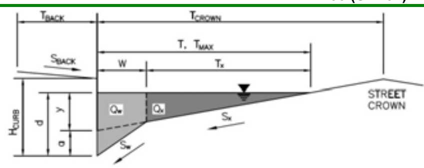
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: Westwood

Inlet ID: 30 (SDI-02)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

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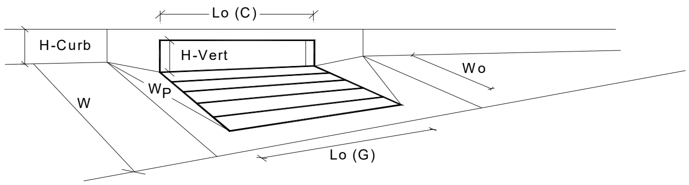

		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet: CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.3	8.6	cfs
Interception with Clogging	Q_{wa} =	4.0	8.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	17.3	19.4	cfs
Interception with Clogging	Q_{oa} =	16.2	18.2	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	8.0	12.1	cfs
Interception with Clogging	Q_{ma} =	7.5	11.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**4.0**	**8.1**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	13.0	18.5	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.22	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.44	0.56	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.84	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**4.0**	**8.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	8.0	cfs

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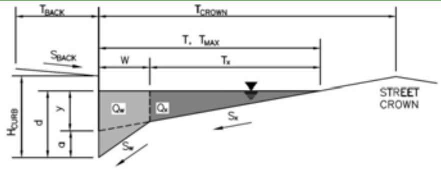
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: Westwood

Inlet ID: 30 (SDI-20)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	4.2	12.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.6	5.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**7.8**	**18.4**	**cfs**
Flow Velocity within the Gutter Section	V =	5.9	7.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	3.6	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	4.3	12.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	4.3	12.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.6	5.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.8	18.5	cfs
Average Flow Velocity Within the Gutter Section	V =	5.9	7.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.3	3.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.89	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**7.9**	**16.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.76	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**7.8**	**16.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

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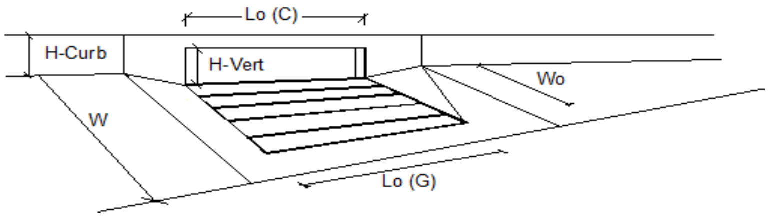


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**4.1**	**13.1**	cfs
Water Spread Width	T =	9.8	16.1	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.4	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.588	0.370	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.7	8.3	cfs
Discharge within the Gutter Section W	Q_w =	2.4	4.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.48	0.73	sq ft
Velocity within the Gutter Section W	V_W =	5.1	6.6	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.4	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.131	0.089	ft/ft
Required Length L_T to Have 100% Interception	L_T =	10.60	22.81	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	4.1	8.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**4.0**	**8.1**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**5.0**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.0**	**8.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**5.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**62**	**%**

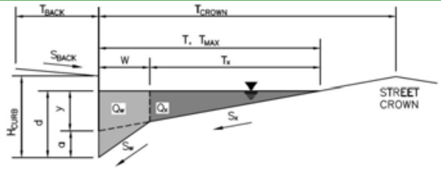
Version 4.06 Released August 2018

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

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

Project: **Westwood**

Inlet ID: **20 (SDI-04)**



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.09	4.09	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.60	5.60	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.349	0.349	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	6.4	6.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.4	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.6	0.6	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**10.4**	**10.4**	**cfs**
Flow Velocity within the Gutter Section	V =	4.4	4.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.1	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.346	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.3	6.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.3	6.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	3.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.0	10.7	cfs
Average Flow Velocity Within the Gutter Section	V =	3.4	4.5	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.1	2.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**3.0**	**10.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.64	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.04	inches

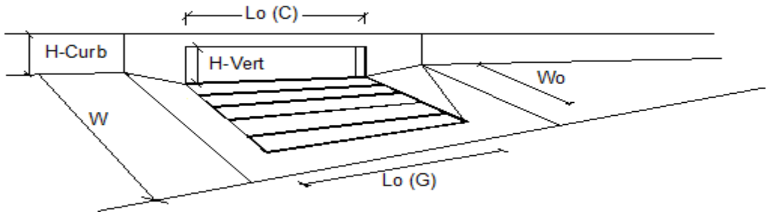
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.0**	**10.4**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



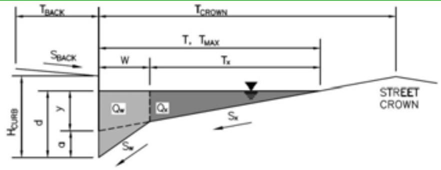
		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**2.9**	**10.3**	cfs
Water Spread Width	T =	10.2	17.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.0	5.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.570	0.350	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.2	6.3	cfs
Discharge within the Gutter Section W	Q_w =	1.7	3.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.6	cfs
Flow Area within the Gutter Section W	A_W =	0.49	0.77	sq ft
Velocity within the Gutter Section W	V_W =	3.4	4.4	fps
Water Depth for Design Condition	d_{LOCAL} =	9.0	10.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.174	0.115	ft/ft
Required Length L_T to Have 100% Interception	L_T =	7.39	16.57	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	2.5	4.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	**2.4**	**4.2**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.5**	**6.0**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.4**	**4.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.5**	**6.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**82**	**41**	**%**

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 31 (SDI-26)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	2.8	8.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.3	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**5.1**	**12.0**	**cfs**
Flow Velocity within the Gutter Section	V =	3.8	4.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.5	2.3	

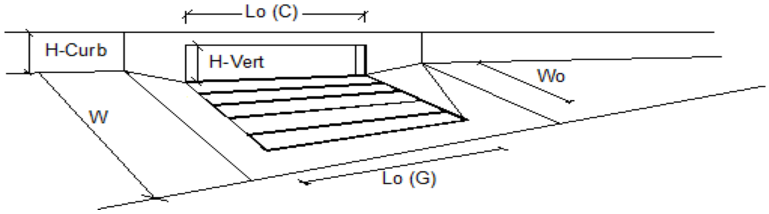
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	2.8	8.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.8	8.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.3	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.1	12.0	cfs
Average Flow Velocity Within the Gutter Section	V =	3.8	4.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.5	2.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.1**	**12.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**5.1**	**12.0**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



			MINOR	MAJOR	
Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**2.6**	**6.5**	cfs
Water Spread Width		T =	9.6	14.4	ft
Water Depth at Flowline (outside of local depression)		d =	3.8	5.0	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.599	0.413	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	1.0	3.8	cfs
Discharge within the Gutter Section W		Q_w =	1.5	2.7	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.47	0.66	sq ft
Velocity within the Gutter Section W		V_W =	3.3	4.0	fps
Water Depth for Design Condition		d_{LOCAL} =	6.8	8.0	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.132	0.098	ft/ft
Required Length L_T to Have 100% Interception		L_T =	7.86	14.58	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	7.86	10.00	ft
Interception Capacity		Q_i =	2.5	5.7	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		**Q_a =**	**2.5**	**5.5**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**1.0**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.5**	**5.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.0**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**85**	**%**

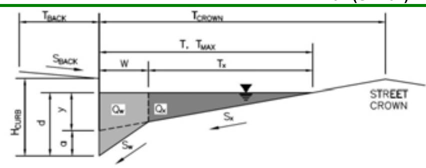
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 51 (SDI-01)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

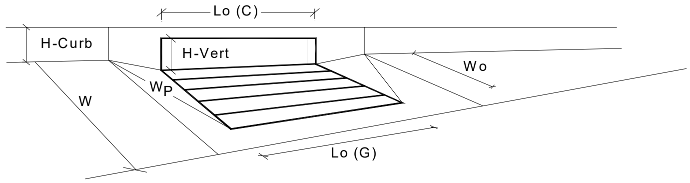
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	6.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.3	8.6	cfs
Interception with Clogging	Q_{wa} =	4.0	8.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	17.3	19.4	cfs
Interception with Clogging	Q_{oa} =	16.2	18.2	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	8.0	12.1	cfs
Interception with Clogging	Q_{ma} =	7.5	11.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**4.0**	**8.1**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	13.0	18.5	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.22	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.44	0.56	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.84	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**4.0**	**8.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.2	3.7	cfs

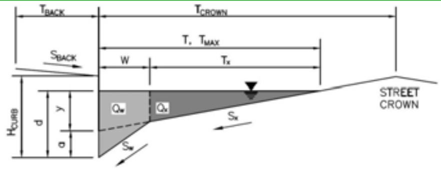
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 43 (SDI-33)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.016	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	9.0	9.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.8	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**14.7**	**14.7**	**cfs**
Flow Velocity within the Gutter Section	V =	6.3	6.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.9	2.9	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.9	9.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.9	9.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.4	4.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.3	14.8	cfs
Average Flow Velocity Within the Gutter Section	V =	4.8	6.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.6	3.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.3**	**14.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

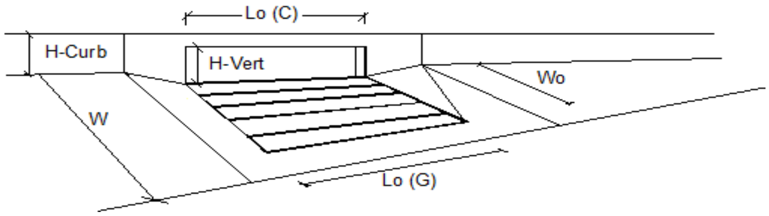
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.3**	**14.7**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**2.2**	**7.8**	cfs
Water Spread Width		T =	7.5	13.4	ft
Water Depth at Flowline (outside of local depression)		d =	3.3	4.7	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.720	0.445	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.6	4.3	cfs
Discharge within the Gutter Section W		Q_w =	1.6	3.4	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W		A_W =	0.39	0.62	sq ft
Velocity within the Gutter Section W		V_W =	4.1	5.5	fps
Water Depth for Design Condition		d_{LOCAL} =	8.3	9.7	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o-GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.215	0.141	ft/ft
Required Length L_T to Have 100% Interception		L_T =	6.08	13.98	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	6.08	10.00	ft
Interception Capacity		Q_i =	2.2	6.9	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		**Q_a =**	**2.2**	**6.7**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**1.1**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.2**	**6.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.1**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**86**	**%**

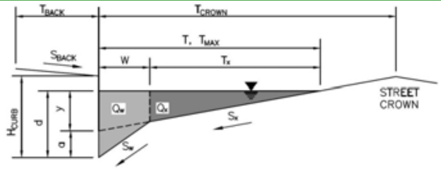
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 44 (SDI-35)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.9	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**12.0**	**12.0**	**cfs**
Flow Velocity within the Gutter Section	V =	5.1	5.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.4	2.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.5	7.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.5	7.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.0	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.5	12.0	cfs
Average Flow Velocity Within the Gutter Section	V =	3.9	5.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.3	2.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**3.5**	**12.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

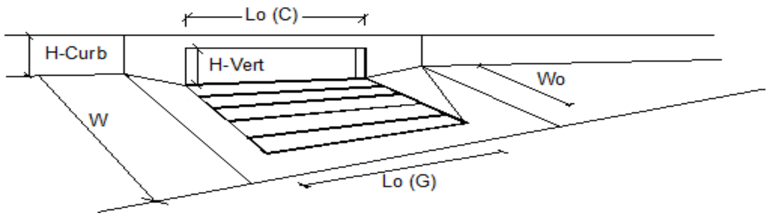
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.5**	**12.0**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	Q_o =	**2.1**	**8.4**	cfs
Water Spread Width	T =	8.2	14.9	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	5.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.675	0.400	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.7	4.9	cfs
Discharge within the Gutter Section W	Q_w =	1.4	3.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.3	cfs
Flow Area within the Gutter Section W	A_W =	0.41	0.68	sq ft
Velocity within the Gutter Section W	V_W =	3.5	4.8	fps
Water Depth for Design Condition	d_{LOCAL} =	8.5	10.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.203	0.128	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.01	14.63	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.01	10.00	ft
Interception Capacity	Q_i =	2.1	7.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	Q_a =	**2.1**	**6.9**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	**0.0**	**1.5**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.1**	**6.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.0**	**1.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**82**	**%**

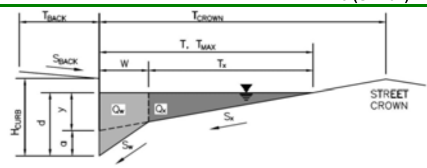
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 45 (SDI-37)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

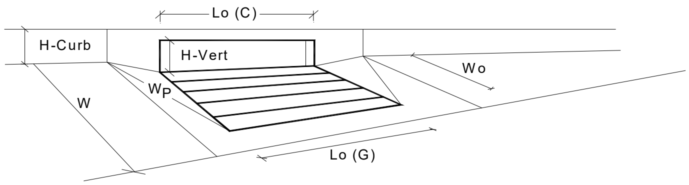
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	5.9	cfs
Interception with Clogging	Q_{wa} =	2.9	5.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.6	9.7	cfs
Interception with Clogging	Q_{oa} =	7.8	8.7	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	4.9	7.0	cfs
Interception with Clogging	Q_{ma} =	4.4	6.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**2.9**	**5.3**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	13.0	18.5	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.22	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.59	0.76	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.9**	**5.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	2.4	cfs

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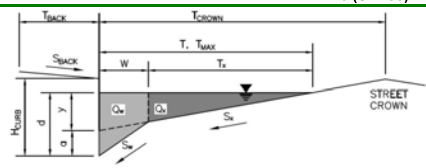
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: Westwood
Inlet ID: 46 (SDI-38)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

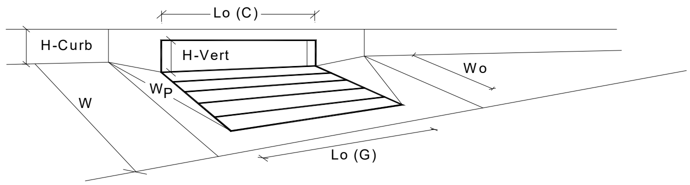
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	5.9	cfs
Interception with Clogging	Q_{wa} =	2.9	5.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.6	9.7	cfs
Interception with Clogging	Q_{oa} =	7.8	8.7	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	4.9	7.0	cfs
Interception with Clogging	Q_{ma} =	4.4	6.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**2.9**	**5.3**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	13.0	18.5	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.22	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.59	0.76	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**2.9**	**5.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.2	4.0	cfs

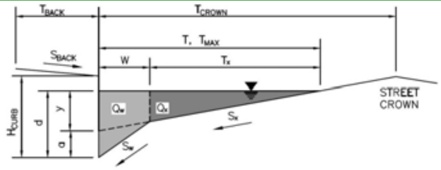
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 47 (SDI-14)



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018		
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.014		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.2	8.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.4	4.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**13.4**	**13.4**	**cfs**
Flow Velocity within the Gutter Section	V =	5.8	5.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.7	2.7	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.7	8.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.7	8.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.2	4.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.9	13.5	cfs
Average Flow Velocity Within the Gutter Section	V =	4.4	5.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.5	2.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**3.9**	**13.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

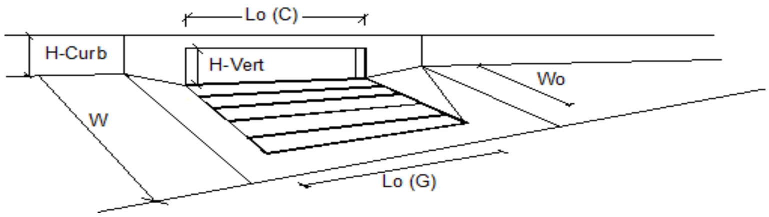
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.9**	**13.4**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



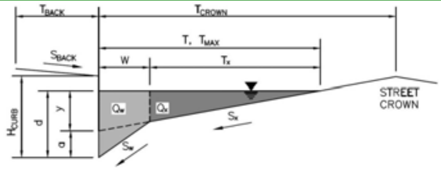
			MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		Q_o =	**1.7**	**7.2**	cfs
Water Spread Width		T =	6.8	13.4	ft
Water Depth at Flowline (outside of local depression)		d =	3.1	4.7	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.770	0.443	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.4	4.0	cfs
Discharge within the Gutter Section W		Q_w =	1.3	3.1	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W		A_W =	0.36	0.62	sq ft
Velocity within the Gutter Section W		V_W =	3.6	5.0	fps
Water Depth for Design Condition		d_{LOCAL} =	8.1	9.7	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.228	0.140	ft/ft
Required Length L_T to Have 100% Interception		L_T =	5.05	13.30	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	5.05	10.00	ft
Interception Capacity		Q_i =	1.6	6.5	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		Q_a =	**1.6**	**6.3**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		Q_b =	**0.0**	**0.9**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		Q =	**1.6**	**6.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_b =	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o =		C% =	**100**	**88**	**%**

Version 4.06 Released August 2018

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

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

Project: Westwood
Inlet ID: 48 (SDI-15)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.014	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.4	8.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.5	4.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**13.7**	**13.7**	**cfs**
Flow Velocity within the Gutter Section	V =	5.9	5.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.7	2.7	

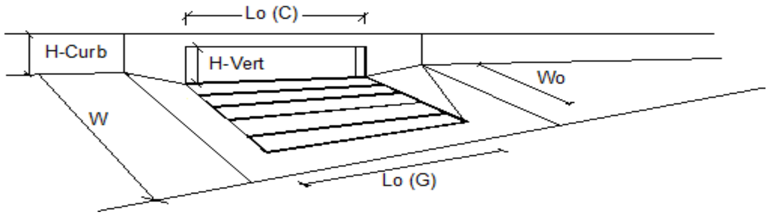
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.8	8.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.8	8.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.2	4.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.0	13.8	cfs
Average Flow Velocity Within the Gutter Section	V =	4.5	5.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.5	2.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**4.0**	**13.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**4.0**	**13.7**	**cfs**

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

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)		**Q_o =**	**1.7**	**8.7**	cfs
Water Spread Width		T =	6.8	14.4	ft
Water Depth at Flowline (outside of local depression)		d =	3.1	5.0	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.769	0.414	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.4	5.0	cfs
Discharge within the Gutter Section W		Q_w =	1.3	3.5	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.2	cfs
Flow Area within the Gutter Section W		A_W =	0.36	0.66	sq ft
Velocity within the Gutter Section W		V_W =	3.6	5.3	fps
Water Depth for Design Condition		d_{LOCAL} =	8.1	10.0	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.228	0.132	ft/ft
Required Length L_T to Have 100% Interception		L_T =	5.13	15.01	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	5.13	10.00	ft
Interception Capacity		Q_i =	1.7	7.3	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	8.75	8.75	ft
Actual Interception Capacity		**Q_a =**	**1.7**	**7.1**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**1.6**	cfs
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.7**	**7.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**1.6**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**81**	**%**

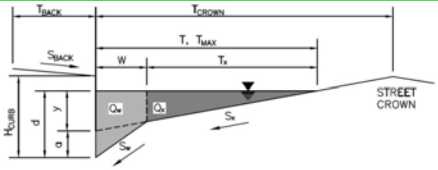
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 49 (SDI-18)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	6.1	6.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.3	3.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.6	0.6	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.0**	**10.0**	**cfs**
Flow Velocity within the Gutter Section	V =	4.3	4.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.0	2.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.3	6.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.3	6.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.6	3.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	2.9	10.1	cfs
Average Flow Velocity Within the Gutter Section	V =	3.3	4.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.1	2.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**2.9**	**10.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**2.9**	**10.0**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

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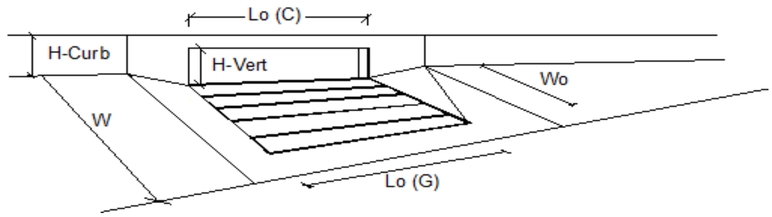


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	**Q_o =**	**2.2**	**8.3**	cfs
Water Spread Width	T =	9.1	15.9	ft
Water Depth at Flowline (outside of local depression)	d =	3.7	5.3	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.626	0.375	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.8	5.0	cfs
Discharge within the Gutter Section W	Q_w =	1.4	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.4	cfs
Flow Area within the Gutter Section W	A_W =	0.45	0.72	sq ft
Velocity within the Gutter Section W	V_W =	3.1	4.1	fps
Water Depth for Design Condition	d_{LOCAL} =	8.7	10.3	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.190	0.122	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.16	14.54	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.16	10.00	ft
Interception Capacity	Q_i =	2.2	7.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**2.2**	**6.8**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**1.6**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.2**	**6.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**81**	**%**

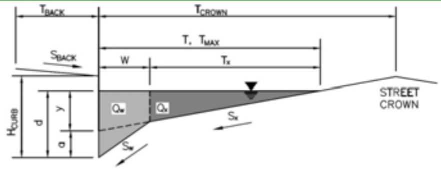
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: 50 (SDI-19)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.011	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.5	7.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.0	4.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**12.2**	**12.2**	**cfs**
Flow Velocity within the Gutter Section	V =	5.3	5.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.4	2.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	1.6	7.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.6	7.5	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.0	4.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.6	12.3	cfs
Average Flow Velocity Within the Gutter Section	V =	4.0	5.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.3	2.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**3.6**	**12.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.6**	**12.2**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

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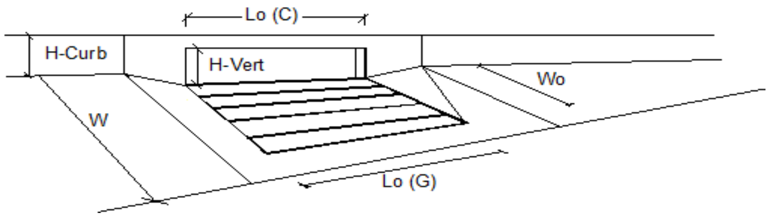

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	5.0	5.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet *Inlet Management*)	Q_o =	**2.2**	**7.8**	cfs
Water Spread Width	T =	8.3	14.3	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.674	0.415	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.7	4.4	cfs
Discharge within the Gutter Section W	Q_w =	1.5	3.1	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.2	cfs
Flow Area within the Gutter Section W	A_W =	0.42	0.66	sq ft
Velocity within the Gutter Section W	V_W =	3.6	4.8	fps
Water Depth for Design Condition	d_{LOCAL} =	8.5	10.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	Q_a =	**N/A**	**N/A**	cfs
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	Q_b =	**N/A**	**N/A**	cfs
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.203	0.133	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.11	13.95	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.11	10.00	ft
Interception Capacity	Q_i =	2.2	6.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	Q_a =	**2.2**	**6.6**	cfs
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	Q_b =	**0.0**	**1.2**	cfs
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.2**	**6.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q_b =	**0.0**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**85**	**%**

Appendix B – Hydraulic Computations
Grate Inlet Sizing

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths (Typical for all area inlets in a swale)

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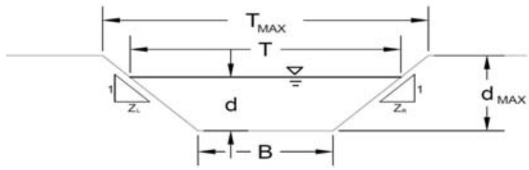
AREA INLET IN A SWALE

Westwood

34 (SDI-32)



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.040	
Channel Invert Slope	S_O =	0.0200	ft/ft
Bottom Width	B =	8.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**16.00**	**16.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**1.00**	**1.00**	**feet**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**16.00**	**16.00**	**ft**
Water Depth	d =	1.00	1.00	ft
Flow Area	A =	12.00	12.00	sq ft
Wetted Perimeter	P =	16.25	16.25	ft
Hydraulic Radius	R =	0.74	0.74	ft
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	4.30	4.30	fps
Velocity-Depth Product	VR =	3.18	3.18	ft^2/s
Hydraulic Depth	D =	0.75	0.75	ft
Froude Number	Fr =	0.88	0.88	
Max. Flow Based On Allowable Top Width	Q_T =	**51.7**	**51.7**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**1.00**	**1.00**	**feet**
Top Width	T =	16.00	16.00	feet
Flow Area	A =	12.00	12.00	square feet
Wetted Perimeter	P =	16.25	16.25	feet
Hydraulic Radius	R =	0.74	0.74	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	4.30	4.30	fps
Velocity-Depth Product	VR =	3.18	3.18	ft^2/s
Hydraulic Depth	D =	0.75	0.75	feet
Froude Number	Fr =	0.88	0.88	
Max. Flow Based On Allowable Water Depth	Q_d =	**51.7**	**51.7**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**51.7**	**51.7**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**1.00**	**1.00**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**2.3**	**16.4**	**cfs**
Water Depth	**d =**	**0.17**	**0.53**	**feet**
Top Width	T =	9.37	12.27	feet
Flow Area	A =	1.49	5.41	square feet
Wetted Perimeter	P =	9.42	12.40	feet
Hydraulic Radius	R =	0.16	0.44	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	1.54	3.03	fps
Velocity-Depth Product	VR =	0.24	1.32	ft^2/s
Hydraulic Depth	D =	0.16	0.44	feet
Froude Number	Fr =	0.68	0.80	

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

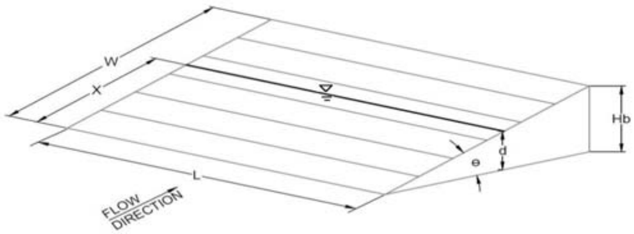
AREA INLET IN A SWALE

Westwood

34 (SDI-32)

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)



		Value	Units
Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.17	1.53	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	feet
Inclined Side Weir Flow	Q_{ws} =	12.0	18.0	cfs
Base Weir Flow	Q_{wb} =	17.2	25.7	cfs
Interception without Clogging	Q_{wi} =	41.2	61.8	cfs
Interception with Clogging	Q_{wa} =	20.6	30.9	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	30.8	35.2	cfs
Interception with Clogging	Q_{oa} =	15.4	17.6	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**15.4**	**17.6**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

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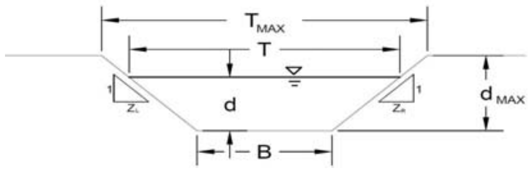
AREA INLET IN A SWALE

Westwood

36A (SDI-25)



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E			
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.040		
Channel Invert Slope	S_O =	0.0100		ft/ft
Bottom Width	B =	24.00		ft
Left Side Slope	Z1 =	10.00		ft/ft
Right Side Slope	Z2 =	10.00		ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**34.00**	**34.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.50**	**0.50**	**feet**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**34.00**	**34.00**	**ft**
Water Depth	d =	0.50	0.50	ft
Flow Area	A =	14.50	14.50	sq ft
Wetted Perimeter	P =	34.05	34.05	ft
Hydraulic Radius	R =	0.43	0.43	ft
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	2.11	2.11	fps
Velocity-Depth Product	VR =	0.90	0.90	ft^2/s
Hydraulic Depth	D =	0.43	0.43	ft
Froude Number	Fr =	0.57	0.57	
Max. Flow Based On Allowable Top Width	Q_T =	**30.6**	**30.6**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**0.50**	**0.50**	**feet**
Top Width	T =	34.00	34.00	feet
Flow Area	A =	14.50	14.50	square feet
Wetted Perimeter	P =	34.05	34.05	feet
Hydraulic Radius	R =	0.43	0.43	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	2.11	2.11	fps
Velocity-Depth Product	VR =	0.90	0.90	ft^2/s
Hydraulic Depth	D =	0.43	0.43	feet
Froude Number	Fr =	0.57	0.57	
Max. Flow Based On Allowable Water Depth	Q_d =	**30.6**	**30.6**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**30.6**	**30.6**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.50**	**0.50**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.8**	**8.4**	**cfs**
Water Depth	**d =**	**0.06**	**0.24**	**feet**
Top Width	T =	25.17	28.74	feet
Flow Area	A =	1.44	6.24	square feet
Wetted Perimeter	P =	25.18	28.76	feet
Hydraulic Radius	R =	0.06	0.22	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	0.55	1.35	fps
Velocity-Depth Product	VR =	0.03	0.29	ft^2/s
Hydraulic Depth	D =	0.06	0.22	feet
Froude Number	Fr =	0.41	0.51	

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

Version 4.06 Released August 2018

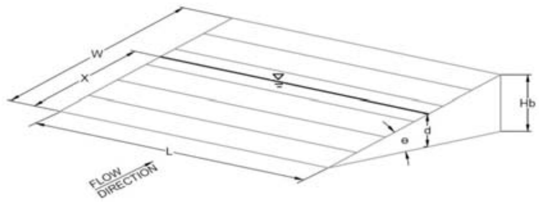
AREA INLET IN A SWALE

Westwood

36A (SDI-25)

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)



Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00		degrees
Width of Grate	W =	3.00		feet
Length of Grate	L =	3.00		feet
Open Area Ratio	A_{RATIO} =	0.70		
Height of Inclined Grate	H_B =	0.00		feet
Clogging Factor	C_f =	0.50		
Grate Discharge Coefficient	C_d =	0.84		
Orifice Coefficient	C_o =	0.56		
Weir Coefficient	C_w =	1.81		

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.06	1.24	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	feet
Inclined Side Weir Flow	Q_{ws} =	10.3	13.0	cfs
Base Weir Flow	Q_{wb} =	14.8	18.6	cfs
Interception without Clogging	Q_{wi} =	35.4	44.7	cfs
Interception with Clogging	Q_{wa} =	17.7	22.4	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	29.3	31.6	cfs
Interception with Clogging	Q_{oa} =	14.6	15.8	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**14.6**	**15.8**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

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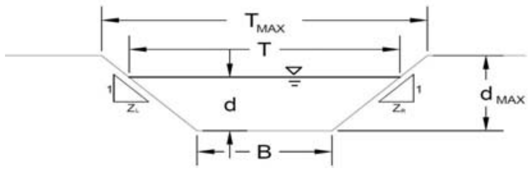
AREA INLET IN A SWALE

Westwood

36B (SDI-41)



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.040	
Channel Invert Slope	S_O =	0.0100	ft/ft
Bottom Width	B =	24.00	ft
Left Side Slope	Z1 =	10.00	ft/ft
Right Side Slope	Z2 =	10.00	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive (selected)
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**34.00**	**34.00**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.50**	**0.50**	**feet**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**34.00**	**34.00**	**ft**
Water Depth	d =	0.50	0.50	ft
Flow Area	A =	14.50	14.50	sq ft
Wetted Perimeter	P =	34.05	34.05	ft
Hydraulic Radius	R =	0.43	0.43	ft
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	2.11	2.11	fps
Velocity-Depth Product	VR =	0.90	0.90	ft^2/s
Hydraulic Depth	D =	0.43	0.43	ft
Froude Number	Fr =	0.57	0.57	
Max. Flow Based On Allowable Top Width	Q_T =	**30.6**	**30.6**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**0.50**	**0.50**	**feet**
Top Width	T =	34.00	34.00	feet
Flow Area	A =	14.50	14.50	square feet
Wetted Perimeter	P =	34.05	34.05	feet
Hydraulic Radius	R =	0.43	0.43	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	2.11	2.11	fps
Velocity-Depth Product	VR =	0.90	0.90	ft^2/s
Hydraulic Depth	D =	0.43	0.43	feet
Froude Number	Fr =	0.57	0.57	
Max. Flow Based On Allowable Water Depth	Q_d =	**30.6**	**30.6**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**30.6**	**30.6**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.50**	**0.50**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.2**	**1.5**	**cfs**
Water Depth	d =	**0.03**	**0.09**	**feet**
Top Width	T =	24.51	25.71	feet
Flow Area	A =	0.62	2.12	square feet
Wetted Perimeter	P =	24.52	25.72	feet
Hydraulic Radius	R =	0.03	0.08	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	0.32	0.71	fps
Velocity-Depth Product	VR =	0.01	0.06	ft^2/s
Hydraulic Depth	D =	0.03	0.08	feet
Froude Number	Fr =	0.36	0.43	

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

Version 4.06 Released August 2018

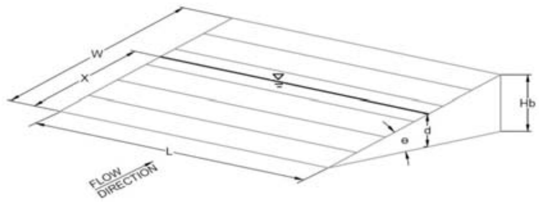
AREA INLET IN A SWALE

Westwood

36B (SDI-41)

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)



Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	

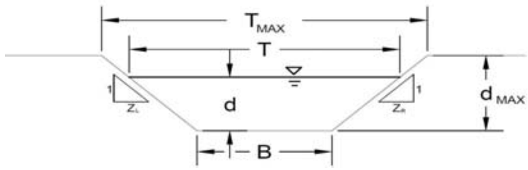
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.03	1.09	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	feet
Inclined Side Weir Flow	Q_{ws} =	9.9	10.7	cfs
Base Weir Flow	Q_{wb} =	14.1	15.3	cfs
Interception without Clogging	Q_{wi} =	33.8	36.8	cfs
Interception with Clogging	Q_{wa} =	16.9	18.4	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	28.8	29.6	cfs
Interception with Clogging	Q_{oa} =	14.4	14.8	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**14.4**	**14.8**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

Version 4.06 Released August 2018

AREA INLET IN A SWALE

Westwood

41A (SDI-50)



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.040	
Channel Invert Slope	S_O =	0.0100	ft/ft
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**9.36**	**9.36**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.92**	**0.92**	**feet**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**9.36**	**9.36**	**ft**
Water Depth	d =	0.92	0.92	ft
Flow Area	A =	5.23	5.23	sq ft
Wetted Perimeter	P =	9.59	9.59	ft
Hydraulic Radius	R =	0.55	0.55	ft
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	2.49	2.49	fps
Velocity-Depth Product	VR =	1.35	1.35	ft^2/s
Hydraulic Depth	D =	0.56	0.56	ft
Froude Number	Fr =	0.59	0.59	
Max. Flow Based On Allowable Top Width	Q_T =	**13.0**	**13.0**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**0.92**	**0.92**	**feet**
Top Width	T =	9.36	9.36	feet
Flow Area	A =	5.23	5.23	square feet
Wetted Perimeter	P =	9.59	9.59	feet
Hydraulic Radius	R =	0.55	0.55	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	2.49	2.49	fps
Velocity-Depth Product	VR =	1.35	1.35	ft^2/s
Hydraulic Depth	D =	0.56	0.56	feet
Froude Number	Fr =	0.59	0.59	
Max. Flow Based On Allowable Water Depth	Q_d =	**13.0**	**13.0**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**13.0**	**13.0**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.92**	**0.92**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.8**	**10.6**	**cfs**
Water Depth	**d =**	**0.23**	**0.84**	**feet**
Top Width	T =	3.87	8.71	feet
Flow Area	A =	0.69	4.49	square feet
Wetted Perimeter	P =	3.93	8.92	feet
Hydraulic Radius	R =	0.17	0.50	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	1.16	2.36	fps
Velocity-Depth Product	VR =	0.20	1.19	ft^2/s
Hydraulic Depth	D =	0.18	0.52	feet
Froude Number	Fr =	0.49	0.58	

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

Version 4.06 Released August 2018

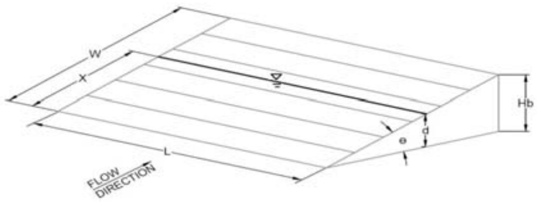
AREA INLET IN A SWALE

Westwood

41A (SDI-50)

Inlet Design Information (Input)

Type of Inlet	CDOT Type C	Inlet Type =	CDOT Type C	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	feet
Length of Grate		L =	3.00	feet
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	feet
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.96	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	

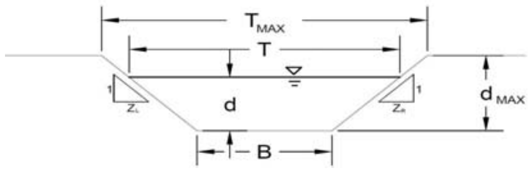


		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.23	0.84	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	feet
Inclined Side Weir Flow	Q_{ws} =	1.2	8.3	cfs
Base Weir Flow	Q_{wb} =	1.7	11.8	cfs
Interception without Clogging	Q_{wi} =	4.2	28.4	cfs
Interception with Clogging	Q_{wa} =	2.1	14.2	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	15.6	29.6	cfs
Interception with Clogging	Q_{oa} =	7.8	14.8	cfs
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.1**	**14.2**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

AREA INLET IN A SWALE

Westwood

41B (SDI-28)



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E			
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.040		
Channel Invert Slope	S_O =	0.0170		ft/ft
Bottom Width	B =	2.00		ft
Left Side Slope	Z1 =	4.00		ft/ft
Right Side Slope	Z2 =	4.00		ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**8.24**	**8.24**	**feet**
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.78**	**0.78**	**feet**

Maximum Channel Capacity Based On Allowable Top Width

		Minor Storm	Major Storm	
Max. Allowable Top Width	T_{MAX} =	**8.24**	**8.24**	**ft**
Water Depth	d =	0.78	0.78	ft
Flow Area	A =	3.99	3.99	sq ft
Wetted Perimeter	P =	8.43	8.43	ft
Hydraulic Radius	R =	0.47	0.47	ft
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	2.95	2.95	fps
Velocity-Depth Product	VR =	1.40	1.40	ft^2/s
Hydraulic Depth	D =	0.48	0.48	ft
Froude Number	Fr =	0.75	0.75	
Max. Flow Based On Allowable Top Width	Q_T =	**11.8**	**11.8**	**cfs**

Maximum Channel Capacity Based On Allowable Water Depth

		Minor Storm	Major Storm	
Max. Allowable Water Depth	d_{MAX} =	**0.78**	**0.78**	**feet**
Top Width	T =	8.24	8.24	feet
Flow Area	A =	3.99	3.99	square feet
Wetted Perimeter	P =	8.43	8.43	feet
Hydraulic Radius	R =	0.47	0.47	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	2.95	2.95	fps
Velocity-Depth Product	VR =	1.40	1.40	ft^2/s
Hydraulic Depth	D =	0.48	0.48	feet
Froude Number	Fr =	0.75	0.75	
Max. Flow Based On Allowable Water Depth	Q_d =	**11.8**	**11.8**	**cfs**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**11.8**	**11.8**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.78**	**0.78**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**0.8**	**10.6**	**cfs**
Water Depth	**d =**	**0.20**	**0.74**	**feet**
Top Width	T =	3.62	7.94	feet
Flow Area	A =	0.57	3.69	square feet
Wetted Perimeter	P =	3.67	8.13	feet
Hydraulic Radius	R =	0.16	0.45	feet
Manning's n	n =	0.040	0.040	
Flow Velocity	V =	1.40	2.87	fps
Velocity-Depth Product	VR =	0.22	1.30	ft^2/s
Hydraulic Depth	D =	0.16	0.46	feet
Froude Number	Fr =	0.62	0.74	

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

Version 4.06 Released August 2018

AREA INLET IN A SWALE

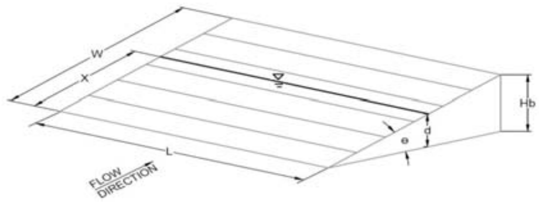
Westwood

41B (SDI-28)

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C

Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	feet
Length of Grate	L =	3.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	feet
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.96	
Orifice Coefficient	C_o =	0.64	
Weir Coefficient	C_w =	2.05	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.20	0.74	
Grate Capacity as a Weir				
Submerged Side Weir Length	X =	3.00	3.00	feet
Inclined Side Weir Flow	Q_{ws} =	1.0	6.9	cfs
Base Weir Flow	Q_{wb} =	1.4	9.9	cfs
Interception without Clogging	Q_{wi} =	3.4	23.7	cfs
Interception with Clogging	Q_{wa} =	1.7	11.8	cfs
Grate Capacity as an Orifice				
Interception without Clogging	Q_{oi} =	14.6	27.9	cfs
Interception with Clogging	Q_{oa} =	7.3	13.9	cfs
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**1.7**	**11.8**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

Appendix B – Hydraulic Computations
Street Capacity Check

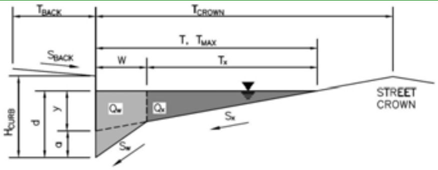
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Monaco St Ultimate Condition Capacity Check



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	22.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	22.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.6	6.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	5.40	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	6.91	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	20.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.262	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	6.1	14.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.3	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.1	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**9.4**	**19.2**	**cfs**
Flow Velocity within the Gutter Section	V =	4.3	5.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.0	2.9	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.0	22.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	15.0	20.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.349	0.262	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	6.1	14.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	6.1	14.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.3	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.5	19.3	cfs
Average Flow Velocity Within the Gutter Section	V =	4.3	5.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.0	2.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**9.5**	**19.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.60	6.92	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**9.4**	**19.2**	**cfs**

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

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

Compares against flow from Sub-Basin 30A & 30B

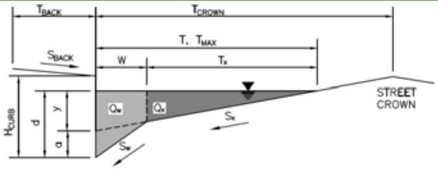
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: E 156th Ave Ultimate Condition Capacity Check



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	22.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	22.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.6	6.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	5.40	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	6.91	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	20.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.262	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.1	16.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.8	5.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.9**	**22.2**	**cfs**
Flow Velocity within the Gutter Section	V =	5.0	5.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	3.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.0	22.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	15.0	20.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.349	0.263	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	7.1	16.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	7.1	16.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.8	5.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	10.9	22.0	cfs
Average Flow Velocity Within the Gutter Section	V =	5.0	5.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.3	3.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**10.9**	**22.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.60	6.90	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**10.9**	**22.0**	**cfs**

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

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

Compares against flow from Sub-Basin 30A

Appendix B – Hydraulic Computations
Upstream of Sump Street Capacity Check

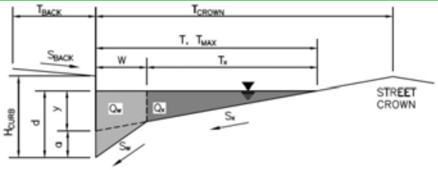
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump DP4 (SDI-48) - Jasmine Street Capacity Check



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.012	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.7	7.7	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.1	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.6**	**12.6**	**cfs**
Flow Velocity within the Gutter Section	V =	5.4	5.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.5	2.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.6	7.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.6	7.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.1	4.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.7	12.7	cfs
Average Flow Velocity Within the Gutter Section	V =	4.1	5.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.4	2.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**3.7**	**12.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**3.7**	**12.6**	**cfs**

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

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

Compares against flow from Basin 4 to SDI-48

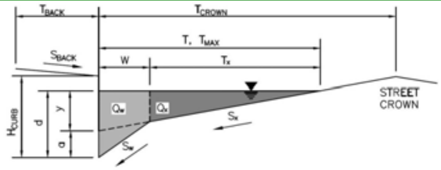
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump DP7 (SDI-47) - Jasmine Street Capacity Check



Gutter Geometry (Enter data in the blue cells)

Description	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.012	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

Description	Symbol	Minor Storm	Major Storm	Units
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Description	Symbol	Minor Storm	Major Storm	Units
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.7	7.7	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.1	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**12.6**	**12.6**	**cfs**
Flow Velocity within the Gutter Section	V =	5.4	5.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.5	2.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

Description	Symbol	Minor Storm	Major Storm	Units
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.6	7.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.6	7.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.1	4.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.7	12.7	cfs
Average Flow Velocity Within the Gutter Section	V =	4.1	5.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.4	2.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**3.7**	**12.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

Description	Symbol	Minor Storm	Major Storm	Units
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**3.7**	**12.6**	**cfs**

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

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

Compares against flow from Basin 7 to SDI-47

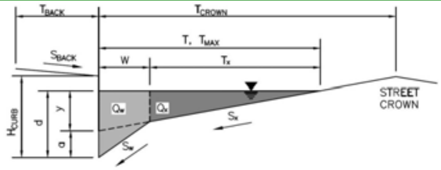
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump DP10 (SDI-12) - E 154th Pl Capacity Check



Gutter Geometry (Enter data in the blue cells)

Description	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

Description	Symbol	Minor Storm	Major Storm	Units
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	14.1	14.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	7.6	7.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.4	1.4	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**23.1**	**23.1**	**cfs**
Flow Velocity within the Gutter Section	V =	9.9	9.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.6	4.6	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.0	14.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.0	14.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.8	7.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.8	23.3	cfs
Average Flow Velocity Within the Gutter Section	V =	7.6	9.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.5	4.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.62	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.8**	**14.4**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.93	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.8**	**14.4**	**cfs**

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

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

Compares against flow from Basin 10 to SDI-12

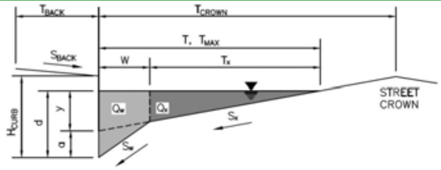
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump in Sub-Basin 20B (SDI-05) - E 154th Av Capacity Check



Gutter Geometry (Enter data in the blue cells)

Description	Symbol	Minor Storm	Major Storm	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.016		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Description	Symbol	Minor Storm	Major Storm	Units
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	3.9	11.6	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.3	5.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**7.2**	**17.1**	**cfs**
Flow Velocity within the Gutter Section	V =	5.5	6.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.1	3.3	

Maximum Capacity for 1/2 Street based on Allowable Depth

Description	Symbol	Minor Storm	Major Storm	Units
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	4.0	11.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	4.0	11.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.3	5.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.3	17.2	cfs
Average Flow Velocity Within the Gutter Section	V =	5.5	6.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.1	3.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.3**	**17.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**7.2**	**17.1**	**cfs**

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

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

Compares against flow from Sub-Basin 20B to SDI-05 + bypass flow SDI-46

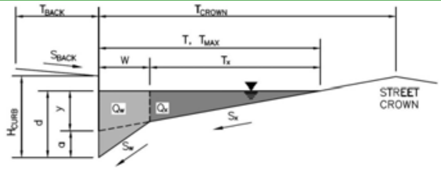
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump DP26 (SDI-06) - E 154th Pl Capacity Check



Gutter Geometry (Enter data in the blue cells)

Parameter	Symbol	Value	Unit
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

Parameter	Symbol	Minor Storm	Major Storm	Unit
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Parameter	Symbol	Minor Storm	Major Storm	Unit
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.1	7.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.8	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**11.6**	**11.6**	**cfs**
Flow Velocity within the Gutter Section	V =	5.0	5.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	2.3	

Maximum Capacity for 1/2 Street based on Allowable Depth

Parameter	Symbol	Minor Storm	Major Storm	Unit
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.5	7.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.5	7.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.4	11.6	cfs
Average Flow Velocity Within the Gutter Section	V =	3.8	5.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.3	2.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**3.4**	**11.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

	Symbol	Minor Storm	Major Storm	Unit
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**3.4**	**11.6**	**cfs**

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

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

Compares against flow from Basin 26 to SDI-06 + bypass flows from SDI-21, SDI-09 & SDI-19

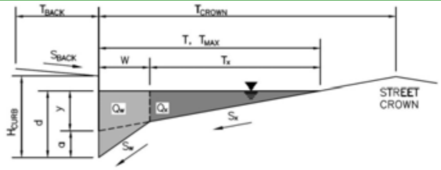
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump DP45 (SDI-37) - E 154th Ave Capacity Check



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	4.5	13.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.8	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.3**	**19.7**	**cfs**
Flow Velocity within the Gutter Section	V =	6.3	7.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.4	3.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	4.6	13.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	4.6	13.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.8	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.4	19.8	cfs
Average Flow Velocity Within the Gutter Section	V =	6.3	7.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.4	3.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.80	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.4**	**15.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.58	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.3**	**15.9**	**cfs**

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

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

Compares against flow from Basin 45 to SDI-37

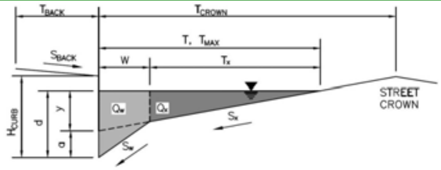
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump DP46 (SDI-38) - E 154th Ave Capacity Check



Gutter Geometry (Enter data in the blue cells)

Parameter	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

Parameter	Symbol	Minor Storm	Major Storm	Units
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Parameter	Symbol	Minor Storm	Major Storm	Units
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	4.5	13.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.8	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**8.3**	**19.7**	**cfs**
Flow Velocity within the Gutter Section	V =	6.3	7.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.4	3.8	

Maximum Capacity for 1/2 Street based on Allowable Depth

Parameter	Symbol	Minor Storm	Major Storm	Units
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	4.6	13.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	4.6	13.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.8	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.4	19.8	cfs
Average Flow Velocity Within the Gutter Section	V =	6.3	7.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.4	3.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.80	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**8.4**	**15.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.58	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

	Symbol	Minor Storm	Major Storm	Units
MINOR STORM Allowable Capacity is based on Spread Criterion **MAJOR STORM Allowable Capacity is based on Depth Criterion**	Q_{allow} =	**8.3**	**15.9**	**cfs**

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

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

Compares against flow from Basin 46 to SDI-38 + bypass flows from SDI-40

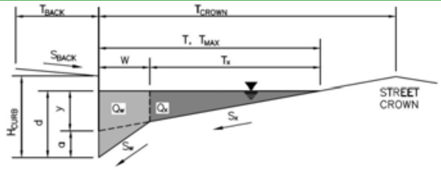
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump DP51 (SDI-01) - E 154th Ave Capacity Check



Gutter Geometry (Enter data in the blue cells)

Parameter	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	2.8	8.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.3	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**5.1**	**12.0**	**cfs**
Flow Velocity within the Gutter Section	V =	3.8	4.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.5	2.3	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.8	8.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.8	8.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.3	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.1	12.0	cfs
Average Flow Velocity Within the Gutter Section	V =	3.8	4.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.5	2.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.1**	**12.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**5.1**	**12.0**	**cfs**

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

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

Compares against flow from Basin 51 to SDI-01 + bypass flows from SDI-26

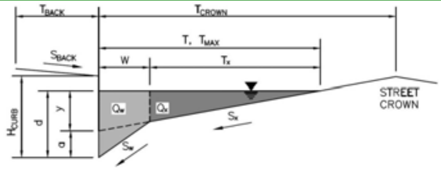
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: U/S of Sump in Sub-Basin 30C (SDI-02) - E 154th Ave Capacity Check



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	2.8	8.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.3	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**5.1**	**12.0**	**cfs**
Flow Velocity within the Gutter Section	V =	3.8	4.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.5	2.3	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	18.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.321	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.8	8.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.8	8.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.3	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.1	12.0	cfs
Average Flow Velocity Within the Gutter Section	V =	3.8	4.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.5	2.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.1**	**12.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**5.1**	**12.0**	**cfs**

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

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

Compares against flow from Sub-Basin 30C to SDI-02

Appendix B – Hydraulic Computations
Upstream of Cross-Pan Street Capacity Check

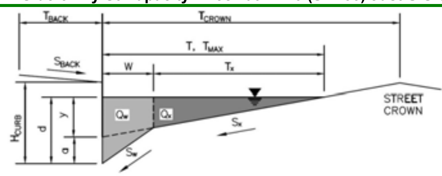
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Eastern Side of Ivy St Capacity Check at DP43 (SDI-33) Just U/S of Cross-Pan at Intersection of Ivy St & E 153rd Pl



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018		
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.7	8.7	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	4.7	4.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**14.3**	**14.3**	**cfs**
Flow Velocity within the Gutter Section	V =	6.1	6.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.9	2.9	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.8	8.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.8	8.8	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.3	4.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.2	14.3	cfs
Average Flow Velocity Within the Gutter Section	V =	4.7	6.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.6	2.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.2**	**14.4**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

MINOR STORM Allowable Capacity is based on Depth Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.2**	**14.3**	**cfs**

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

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

Compares against flow from Basin 43 to SDI-33

Cross-Pan Capacity Check for all cross-pans have been provided in a separate section to follow in Appendix B.

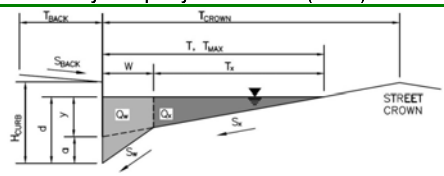
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Eastern Side of Jersey Ct Capacity Check at DP44 (SDI-35) Just U/S of Cross-Pan at Intersection of Jersey Ct & E 153rd Pl



Gutter Geometry (Enter data in the blue cells)

Description	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.024	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

Description	Symbol	Minor Storm	Major Storm	Units
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

Description	Symbol	Minor Storm	Major Storm	Units
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.08	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.59	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.350	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.9	10.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.9	5.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.1	1.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**17.9**	**17.9**	**cfs**
Flow Velocity within the Gutter Section	V =	7.7	7.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.6	3.6	

Maximum Capacity for 1/2 Street based on Allowable Depth

Description	Symbol	Minor Storm	Major Storm	Units
Theoretical Water Spread	T_{TH} =	10.4	17.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	8.4	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.560	0.349	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	2.3	11.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.3	11.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.9	5.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.2	18.0	cfs
Average Flow Velocity Within the Gutter Section	V =	5.9	7.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.0	3.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.93	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.2**	**16.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.50	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

	Symbol	Minor Storm	Major Storm	Units
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.2**	**16.8**	**cfs**

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

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

Compares against flow from Basin 44 to SDI-35

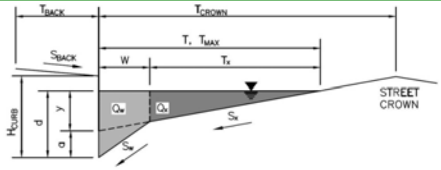
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Western Side of Kearney St Capacity Check at DP48 (SDI-15) - Just U/S of Cross-Pan at Intersection of Kearney St & E 154th Pl



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	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 =	0.029	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.04	2.04	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.75	1.75	inches
Water Depth at Gutter Flowline	d =	3.79	3.79	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.431	0.431	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	3.8	3.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.9	2.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**6.7**	**6.7**	**cfs**
Flow Velocity within the Gutter Section	V =	6.2	6.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.9	1.9	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	34.6	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	32.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.389	0.194	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	5.1	29.9	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	5.1	24.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.2	7.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.3	33.3	cfs
Average Flow Velocity Within the Gutter Section	V =	6.4	8.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.1	4.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.65	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.3**	**21.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.21	1.40	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.7**	**21.8**	**cfs**

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

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

Compares against flow from Basin 48 to SDI-15 + bypass flow from SDI-24

Flow goes over street crown and flows to the downstream cross-pan at the intersection of Kearney St & E 154th Pl. This cross-pan capacity check has been provided in a separate section to follow in Appendix B. Cross-pan capacity check accounts for flow from DP48 to SDI-15 + all bypass flows from DP13 (SDI-24), DP14 (SDI-11), & DP47 (SDI-14).

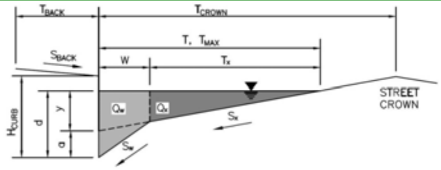
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Western Side of Krameria St Capacity Check at DP49 (SDI-18) - Just U/S of Cross-Pan at Intersection of Krameria St & E 154th Pl



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.008	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 =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	1.63	1.63	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.80	1.80	inches
Water Depth at Gutter Flowline	d =	3.43	3.43	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.468	0.468	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	1.4	1.4	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.2	1.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**2.6**	**2.6**	**cfs**
Flow Velocity within the Gutter Section	V =	3.0	3.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.9	0.9	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	22.9	42.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	20.9	40.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.337	0.161	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	3.3	19.9	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.2	14.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.9	18.9	cfs
Average Flow Velocity Within the Gutter Section	V =	3.4	4.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.1	2.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.9**	**18.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.92	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.57	2.49	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**2.6**	**18.9**	**cfs**

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

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

Compares against flow from Basin 49 to SDI-18 + bypass flow from SDI-27

Flow goes over street crown and flows to the downstream cross-pan at the intersection of Krameria St & E 154th Pl. This cross-pan capacity check has been provided in a separate section to follow in Appendix B. Cross-pan capacity check accounts for flow from DP49 to SDI-18 + all bypass flows from DP15 (SDI-27), DP16 (SDI-16), & DP48 (SDI-15).

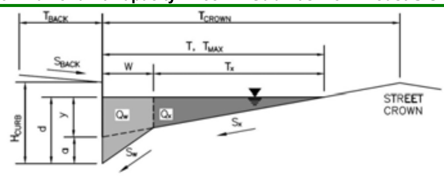
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Western Side of Krameria Ct Capacity Check in Sub-Basin 31B - Just U/S of Cross-Pan at Intersection of Krameria Ct & E 154th Ave



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.002	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 =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	0.49	0.49	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.93	1.93	inches
Water Depth at Gutter Flowline	d =	2.42	2.42	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.740	0.740	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.2	0.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.5	0.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**0.7**	**0.7**	**cfs**
Flow Velocity within the Gutter Section	V =	2.2	2.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	71.7	138.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	69.7	136.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.133	0.054	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	11.1	66.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	5.3	17.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.0	22.6	cfs
Average Flow Velocity Within the Gutter Section	V =	3.4	4.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.1	2.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.0**	**22.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.92	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	1.58	3.50	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**0.7**	**22.6**	**cfs**

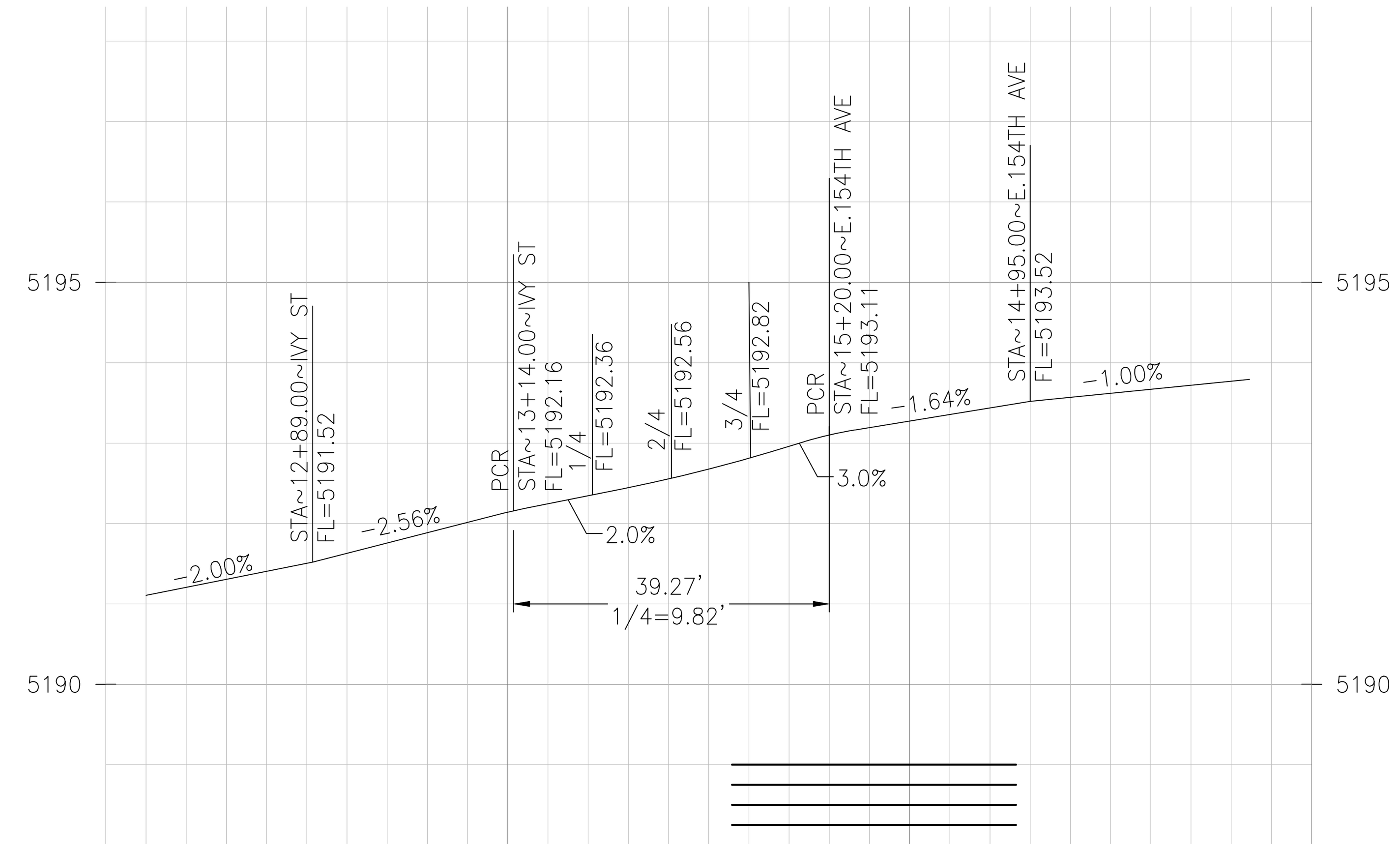
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Compares against flow from Sub-Basin 31B

Flow goes over street crown and flows to the downstream cross-pan at the intersection of Krameria Ct & E 154th Ave This cross-pan capacity check has been provided in a separate section to follow in Appendix B. Cross-pan capacity check accounts for full flow from DP31 to SDI-26

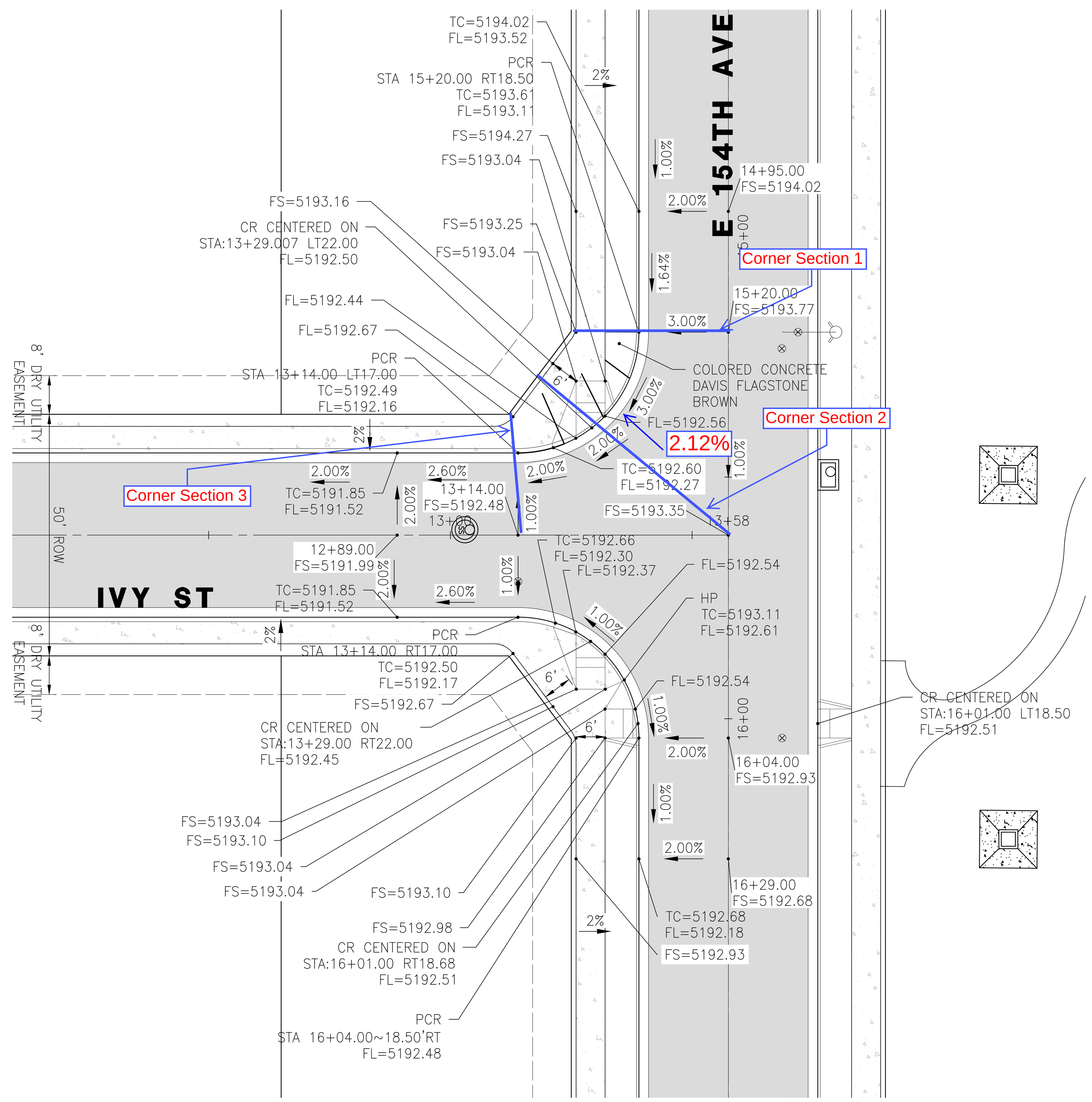
Appendix B – Hydraulic Computations
Street Corner Capacity Check

Street corner capacity has been checked for three sections identified. The next three pages of street capacity sheets correspond to these three sections respectively.



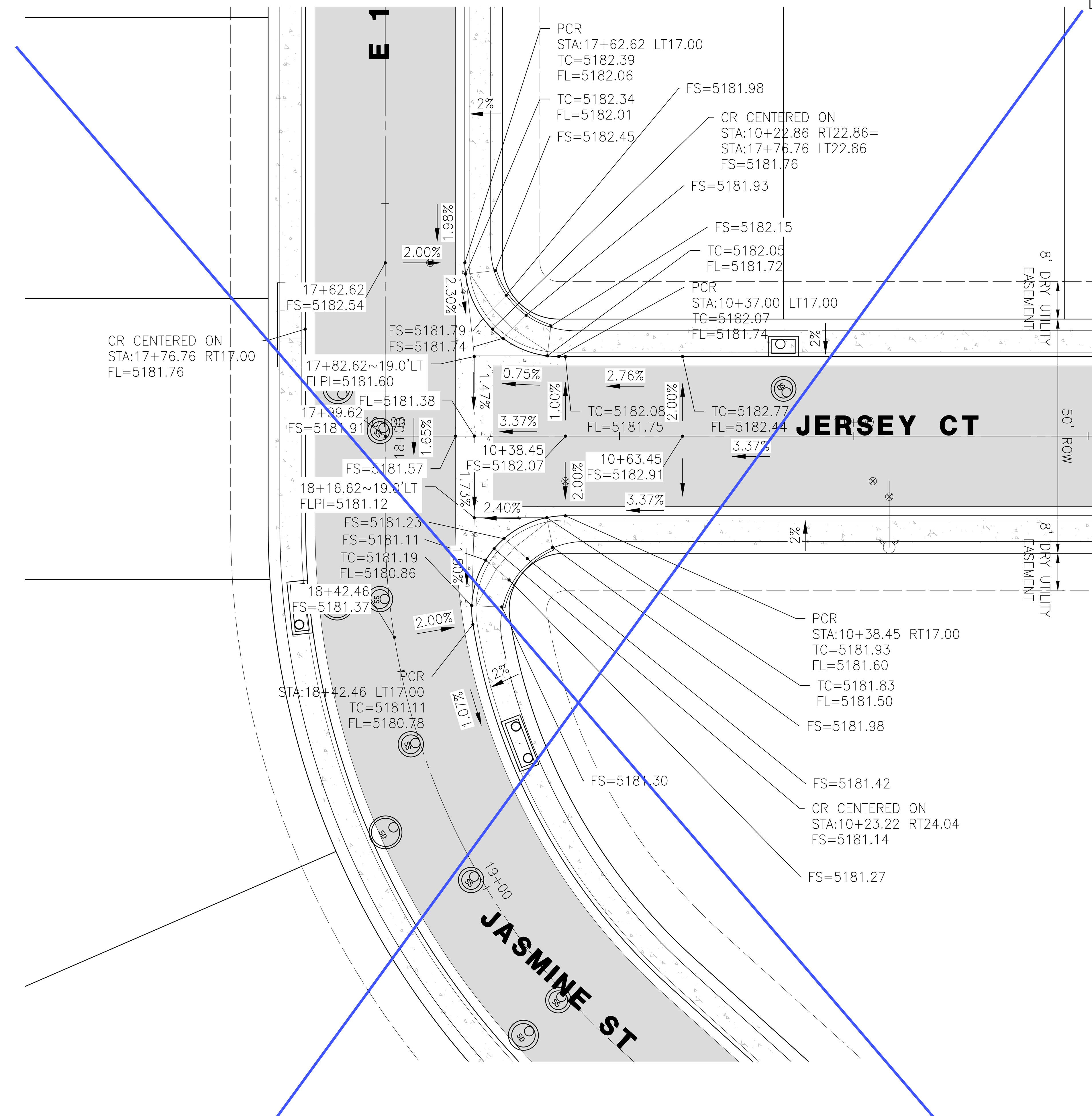
PROFILE — WEST CURB RETURN PROFILE

SCALE: HORIZ=1"=20' ~ VERT=1"=2'



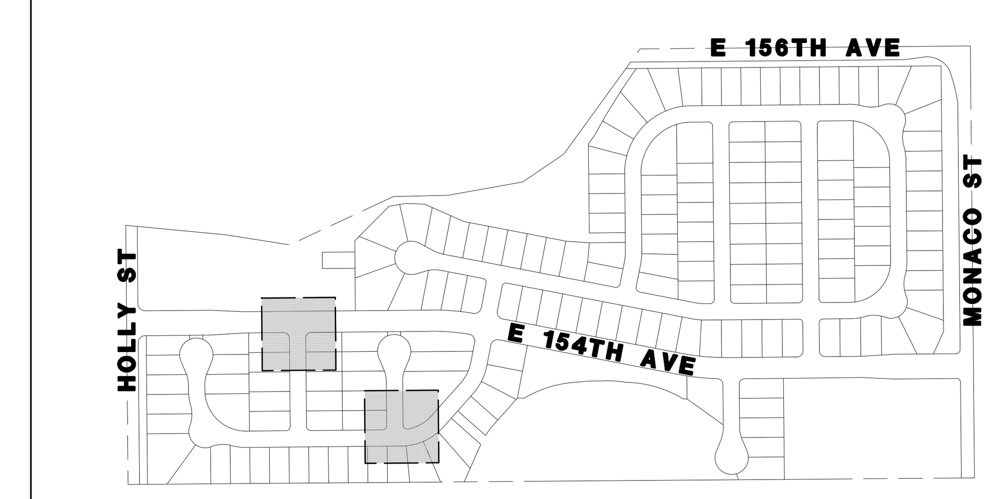
PLAN — INTERSECTION GRADING DETAIL

20 10 0 20
GRAPHIC SCALE: 1"=20'



PLAN — INTERSECTION GRADING DETAIL

20 10 0 20
GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

PRELIMINARY NOT FOR CONSTRUCTION

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

SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-03

SHEET NO. 61 OF 172 SHEETS

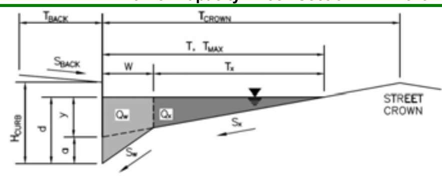
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 1 - E 154th Av & Ivy St in Sub-Basin 2A



Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.030		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 =	0.016		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.68	6.66	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.27	1.27	inches
Water Depth at Gutter Flowline	d =	5.95	7.93	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.415	0.296	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.8	22.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.5	9.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.4	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**13.3**	**33.9**	**cfs**
Flow Velocity within the Gutter Section	V =	6.7	8.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.3	5.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	13.1	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	11.0	11.1	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.415	0.411	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	7.8	8.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	7.8	8.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	5.5	5.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	13.3	13.6	cfs
Average Flow Velocity Within the Gutter Section	V =	6.7	6.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.3	3.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.98	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**13.3**	**13.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.96	5.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**13.3**	**13.3**	**cfs**

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

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

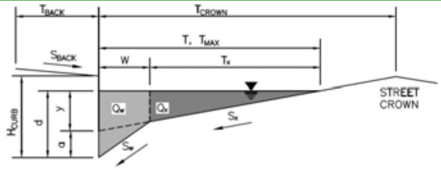
Compares against Q from Sub-Basin 2A

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 2 - E 154th Av & Ivy St in Sub-Basin 2A



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.5	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} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	36.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.021	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.5	36.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	7.76	9.16	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.48	1.48	inches
Water Depth at Gutter Flowline	d =	9.24	10.64	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	28.5	34.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.189	0.159	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	52.8	84.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	12.3	15.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	20.2	34.9	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**85.2**	**135.3**	**cfs**
Flow Velocity within the Gutter Section	V =	8.9	9.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	6.9	8.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	9.9	16.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	7.9	14.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.574	0.363	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.7	8.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.7	8.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.3	4.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.0	13.8	cfs
Average Flow Velocity Within the Gutter Section	V =	4.6	6.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.5	2.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**4.0**	**13.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**4.0**	**13.8**	**cfs**

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

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

Compares against Q from Sub-Basin 2A

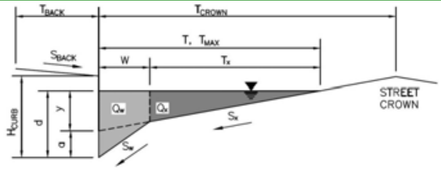
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 3 - E 154th Av & Ivy St in Sub-Basin 2A



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.4	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.04	2.04	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.75	1.75	inches
Water Depth at Gutter Flowline	d =	3.79	3.79	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.431	0.431	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	3.1	3.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.4	2.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**5.5**	**5.5**	**cfs**
Flow Velocity within the Gutter Section	V =	5.1	5.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.6	1.6	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	30.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	28.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.389	0.225	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	4.2	17.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	4.2	14.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.7	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.9	20.6	cfs
Average Flow Velocity Within the Gutter Section	V =	5.3	6.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.8	3.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.9**	**20.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.40	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.21	1.61	inches

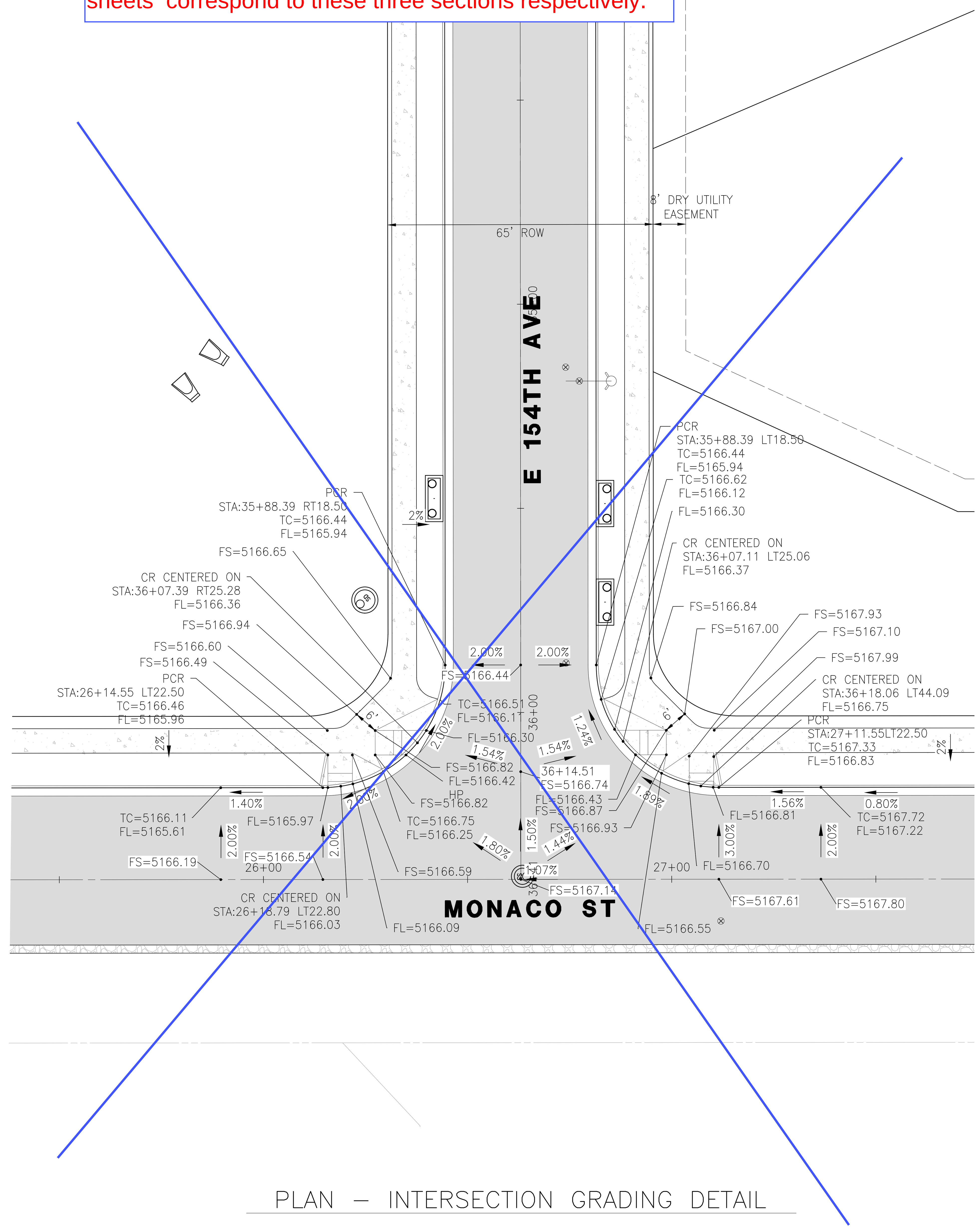
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**5.5**	**5.5**	**cfs**

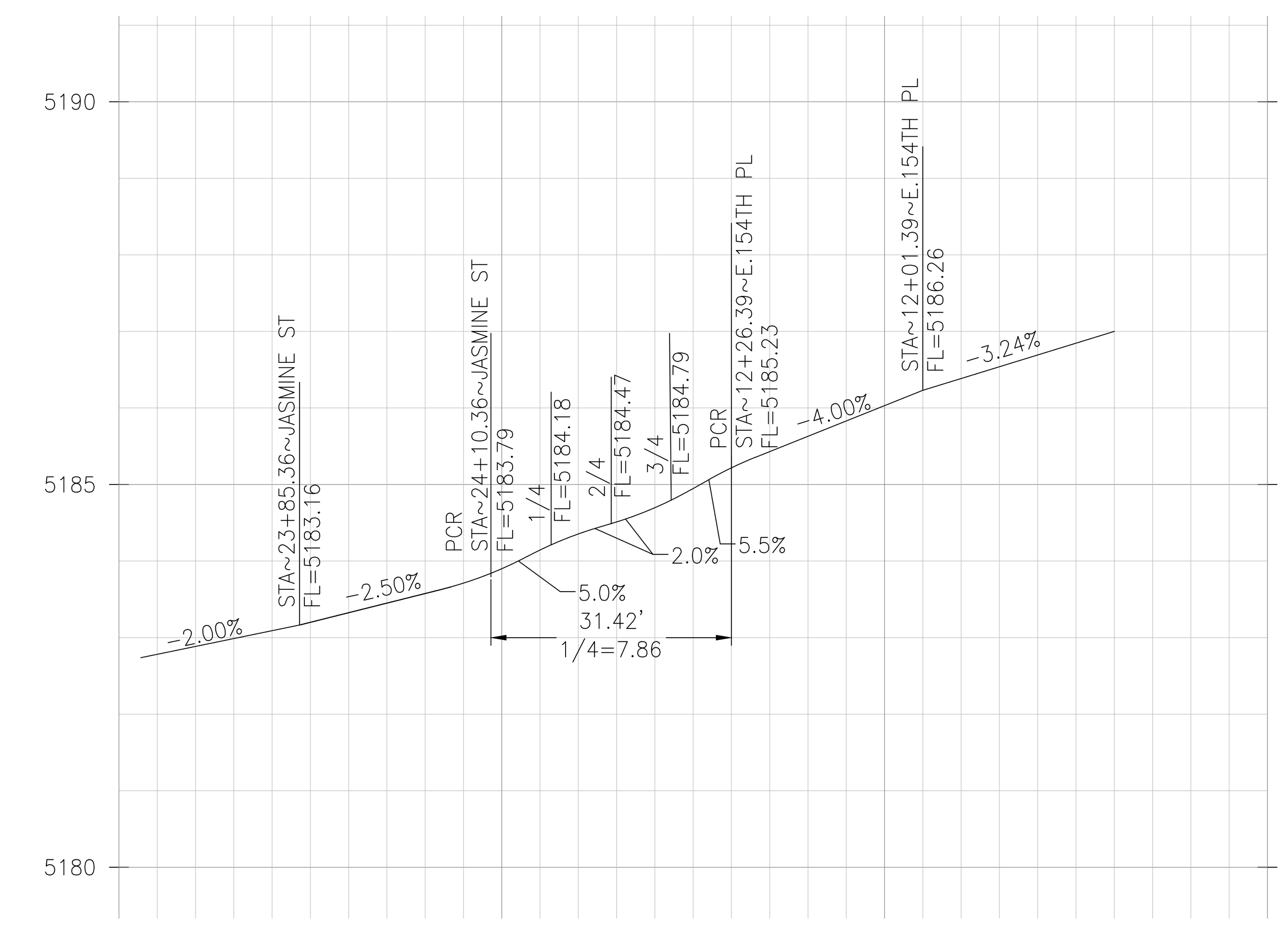
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

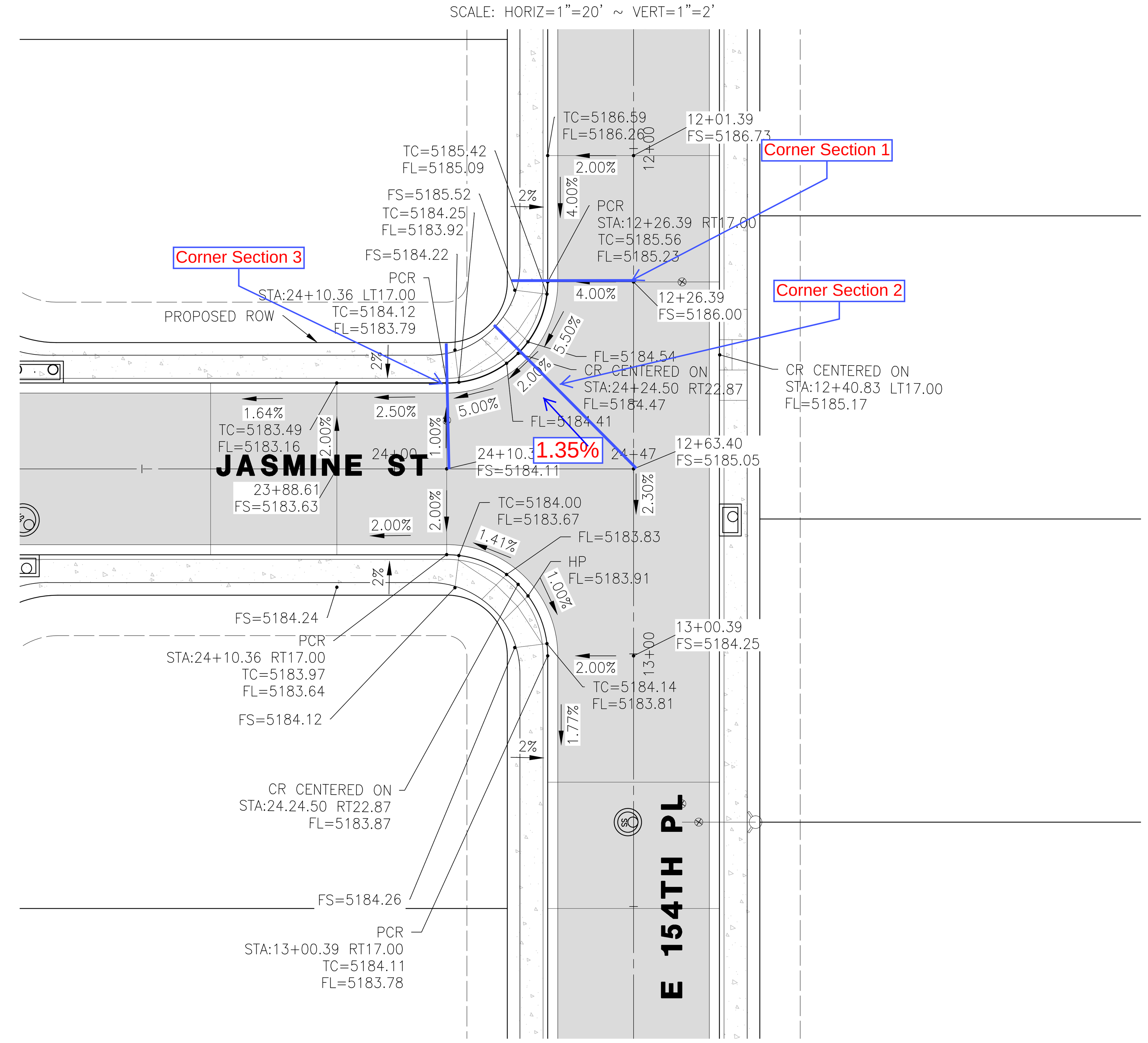
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

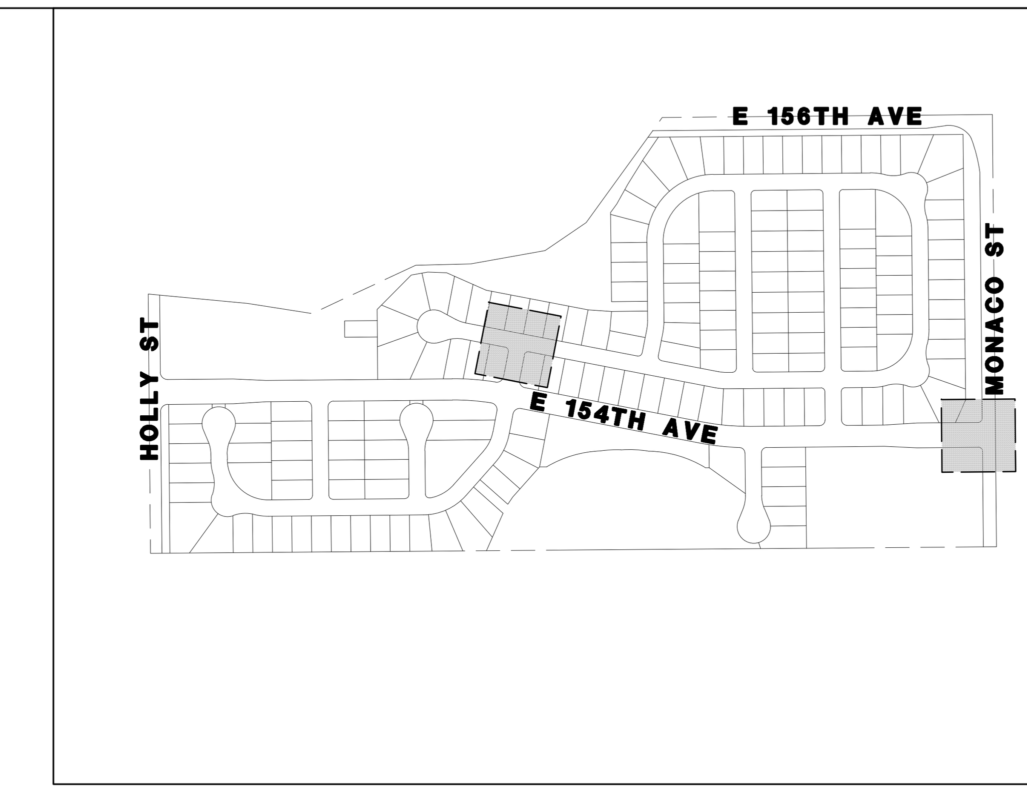
Compares against Q from Sub-Basin 2A

Street corner capacity has been checked for three sections identified. The next three pages of street capacity sheets correspond to these three sections respectively.









KEY MAP
SCALE 1"=500'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

PRELIMINARY NOT FOR CONSTRUCTION

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

SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-05

SHEET NO. 63 OF 172 SHEETS

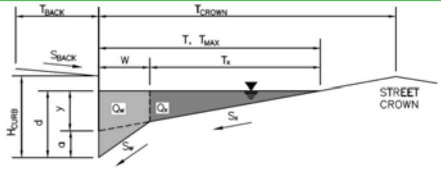
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 1 - E 154th Pl & Jasmine St in DP10 (SDI-12)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.040	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 =	0.040	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	8.16	8.16	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.03	1.03	inches
Water Depth at Gutter Flowline	d =	9.19	9.19	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.307	0.307	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	44.8	44.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	19.8	19.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	23.6	23.6	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**88.2**	**88.2**	**cfs**
Flow Velocity within the Gutter Section	V =	14.5	14.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	11.1	11.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	6.2	10.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	4.2	8.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.718	0.489	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.5	8.9	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.5	8.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.8	8.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	2.3	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.3	19.8	cfs
Average Flow Velocity Within the Gutter Section	V =	7.6	10.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.5	5.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	1.00	0.50	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.3**	**10.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	4.88	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.3**	**10.0**	**cfs**

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

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

Compares against Q from Basin 10 to SDI-12

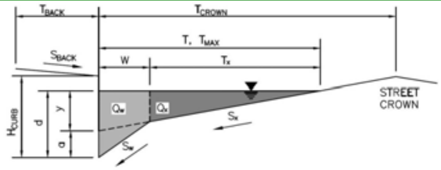
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 2 - E 154th Pl & Jasmine St in DP10 (SDI-12)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	32.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.014	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	32.0	32.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	5.18	5.18	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.67	1.67	inches
Water Depth at Gutter Flowline	d =	6.85	6.85	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	30.0	30.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.196	0.196	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	32.9	32.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	8.0	8.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	4.5	4.5	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**45.5**	**45.5**	**cfs**
Flow Velocity within the Gutter Section	V =	8.2	8.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.7	4.7	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	14.4	26.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	12.4	24.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.462	0.244	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	3.1	18.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.1	18.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.7	6.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.8	26.3	cfs
Average Flow Velocity Within the Gutter Section	V =	5.3	7.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.8	3.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.88	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.8**	**23.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.72	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.8**	**23.1**	**cfs**

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

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

Compares against Q from Basin 10 to SDI-12

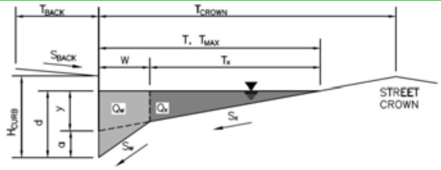
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 3 - E 154th Pl & Jasmine St in DP10 (SDI-12)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	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 =	0.050	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.8	3.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.04	2.04	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.75	1.75	inches
Water Depth at Gutter Flowline	d =	3.79	3.79	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.431	0.431	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	5.0	5.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.8	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.7**	**8.7**	**cfs**
Flow Velocity within the Gutter Section	V =	8.1	8.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.6	2.6	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.4	17.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	15.4	15.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.421	0.421	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	5.3	5.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	5.3	5.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.9	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.2	9.2	cfs
Average Flow Velocity Within the Gutter Section	V =	8.2	8.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.6	2.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.2**	**9.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	3.84	3.84	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.05	0.05	inches

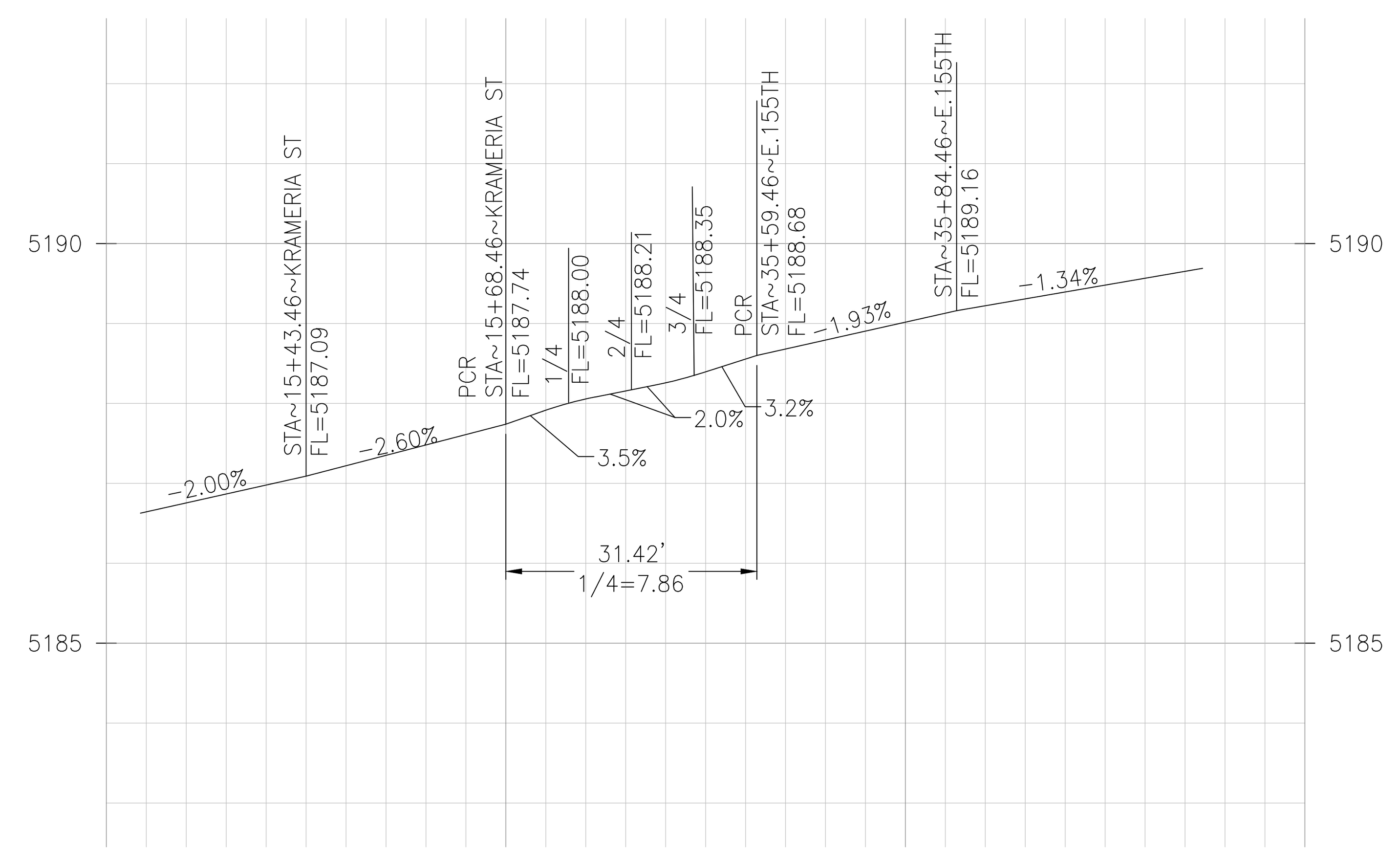
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**8.7**	**8.7**	**cfs**

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

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

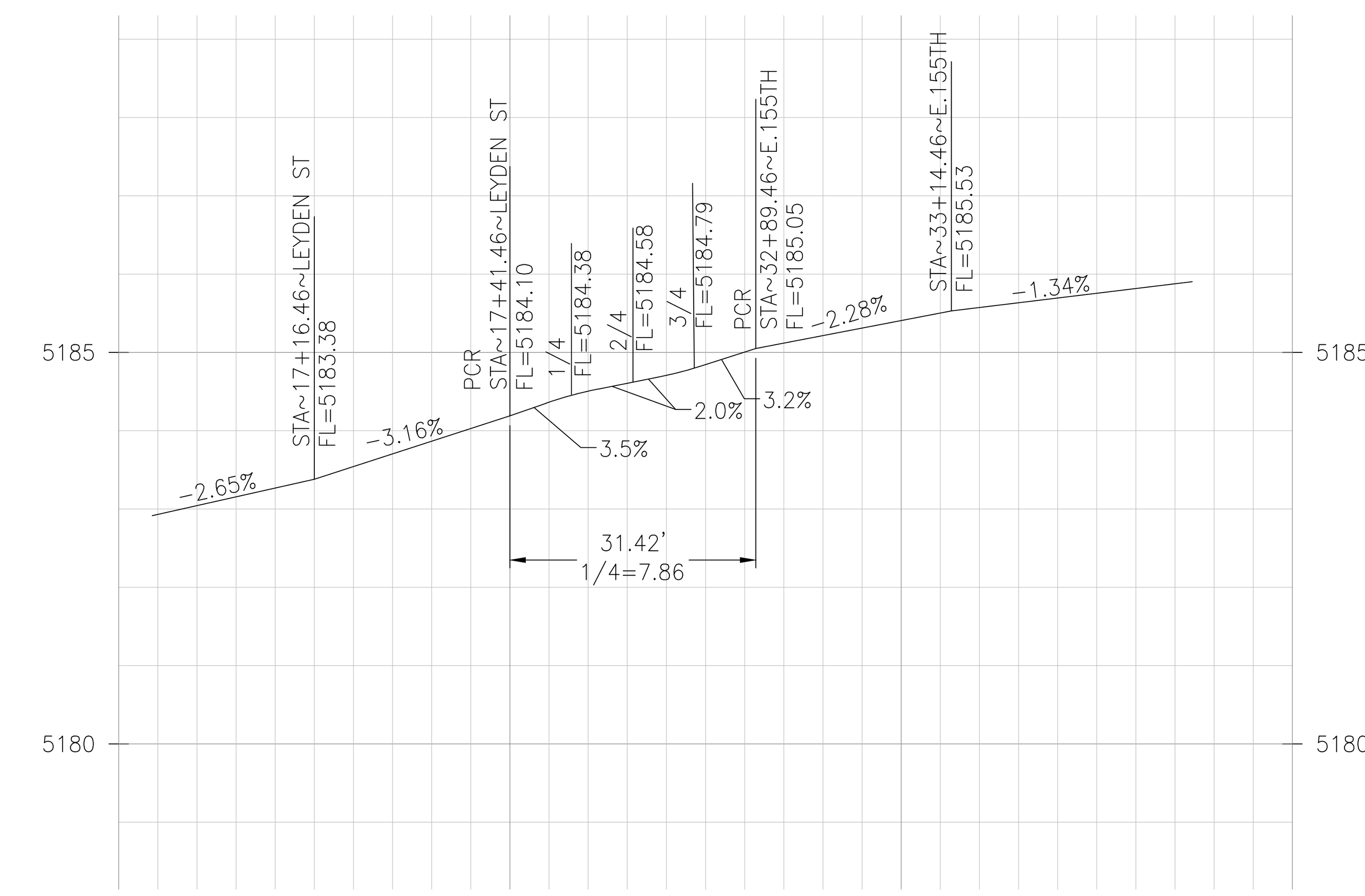
Compares against Q from Basin 10 to SDI-12

Street corner capacity has been checked for three sections identified. The next three pages of street capacity sheets correspond to these three sections respectively.



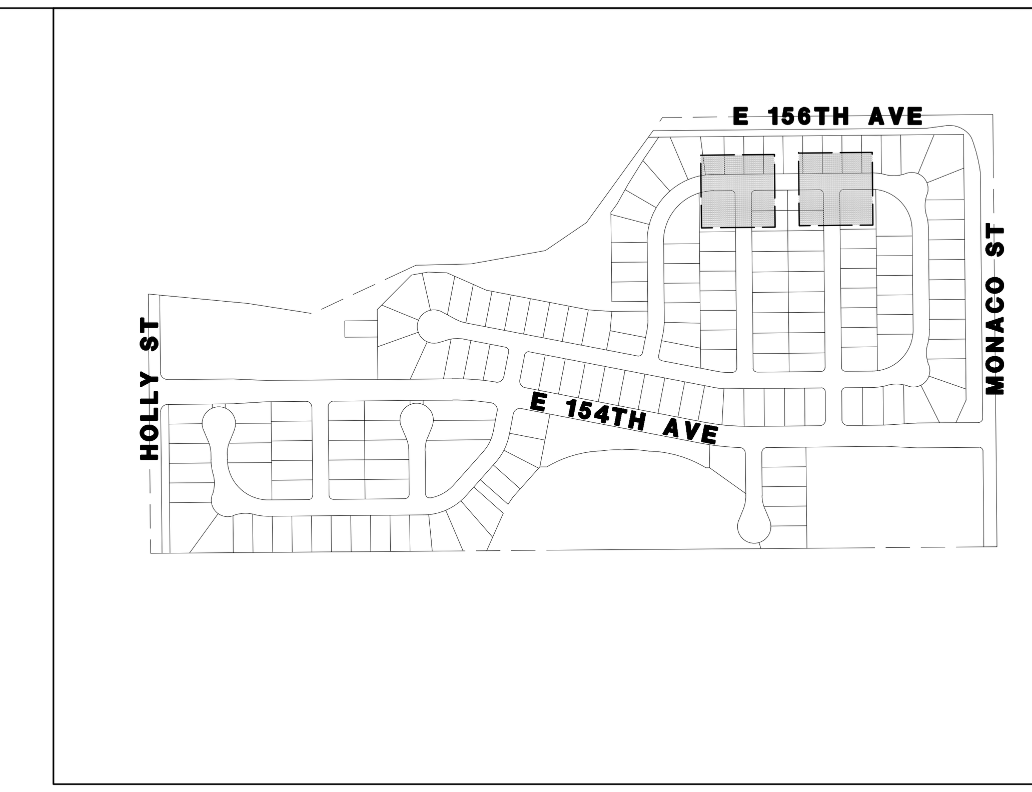
PROFILE – WEST CURB RETURN PROFILE

SCALE: HORIZ=1"=20' ~ VERT=1"=2'



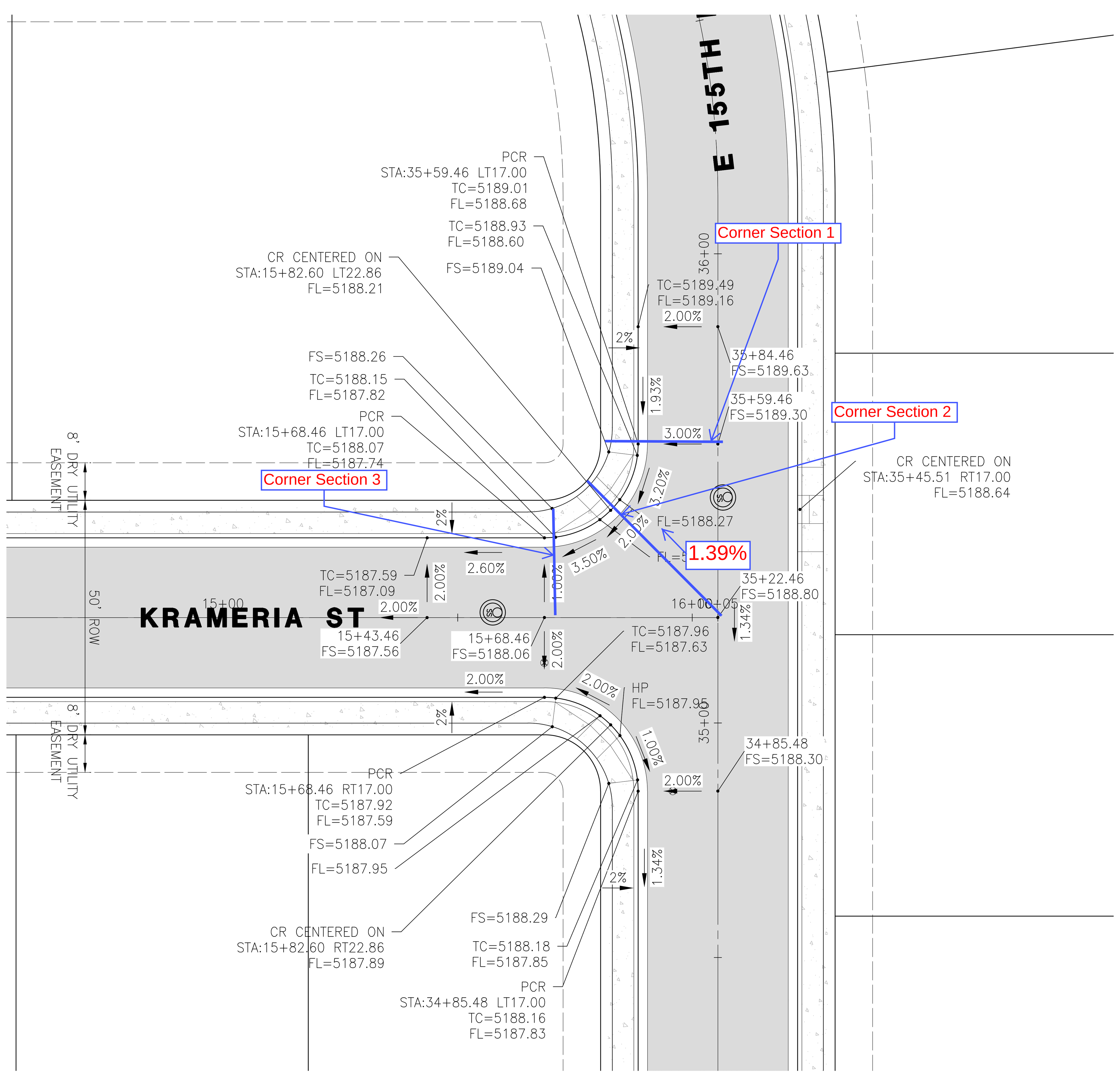
PROFILE – WEST CURB RETURN PROFILE

SCALE: HORIZ=1"=20' ~ VERT=1"=2'



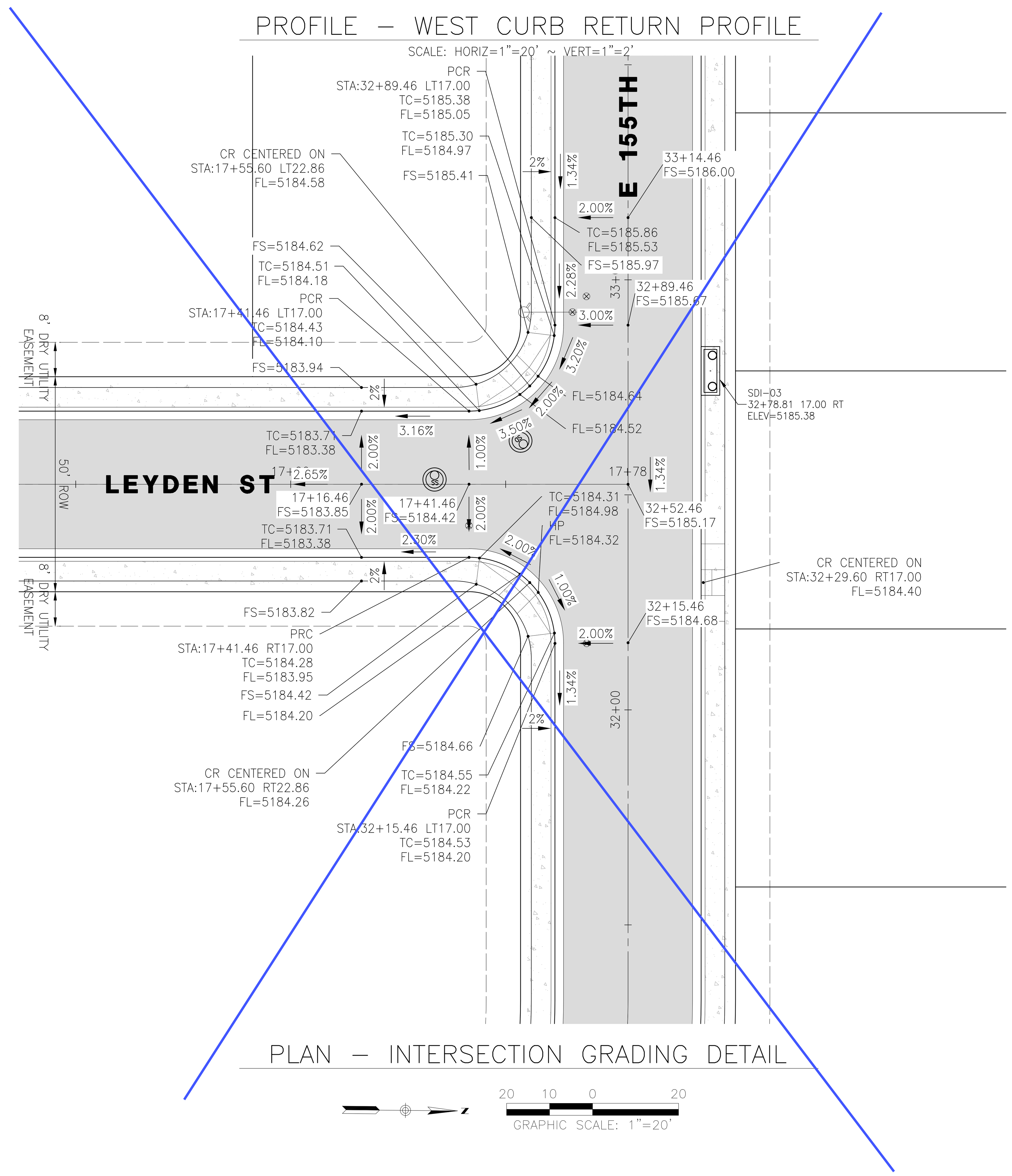
KEY MAP

SCALE 1"=500'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

PRELIMINARY NOT FOR CONSTRUCTION

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

SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-07

SHEET NO. 65 OF172 SHEETS

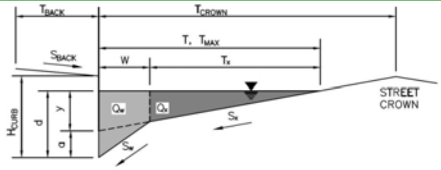
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 1 - E 155th Pl & Krameria St in DP15 (SDI-27)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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 =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	6.12	6.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.27	1.27	inches
Water Depth at Gutter Flowline	d =	7.39	7.39	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.321	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	19.3	19.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	9.1	9.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	6.6	6.6	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**35.0**	**35.0**	**cfs**
Flow Velocity within the Gutter Section	V =	8.6	8.6	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.3	5.3	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	7.6	12.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	5.6	10.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.656	0.418	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	1.4	8.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.4	8.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.6	5.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.0	15.8	cfs
Average Flow Velocity Within the Gutter Section	V =	5.3	7.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.8	3.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.90	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.0**	**14.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.76	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**4.0**	**14.3**	**cfs**

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

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

Compares against Q from Basin 15 to SDI-27

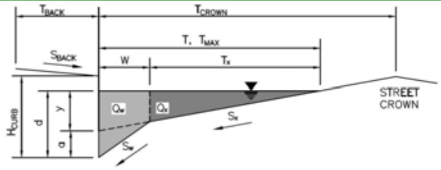
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 2 - E 155th Pl & Krameria St in DP15 (SDI-27)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	32.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.014	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	32.0	32.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	5.34	5.34	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.66	1.66	inches
Water Depth at Gutter Flowline	d =	7.00	7.00	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	30.0	30.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.195	0.195	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	34.6	34.6	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	8.4	8.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	5.1	5.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**48.0**	**48.0**	**cfs**
Flow Velocity within the Gutter Section	V =	8.4	8.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.9	4.9	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	14.0	25.5	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	12.0	23.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.469	0.250	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	3.0	18.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.0	18.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.7	6.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.7	25.8	cfs
Average Flow Velocity Within the Gutter Section	V =	5.3	7.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.8	3.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	1.00	0.88	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.7**	**22.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.72	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.7**	**22.7**	**cfs**

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

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

Compares against Q from Basin 15 to SDI-27

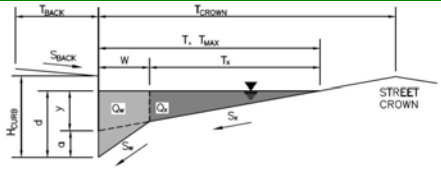
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 3 - E 155th Pl & Krameria St in DP15 (SDI-27)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	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 =	0.033	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.8	3.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.04	2.04	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.75	1.75	inches
Water Depth at Gutter Flowline	d =	3.79	3.79	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.431	0.431	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	4.0	4.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.1	3.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**7.1**	**7.1**	**cfs**
Flow Velocity within the Gutter Section	V =	6.6	6.6	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.1	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.4	17.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	15.4	15.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.421	0.421	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	4.3	4.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	4.3	4.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.1	3.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.5	7.5	cfs
Average Flow Velocity Within the Gutter Section	V =	6.6	6.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.1	2.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.5**	**7.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	3.84	3.84	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.05	0.05	inches

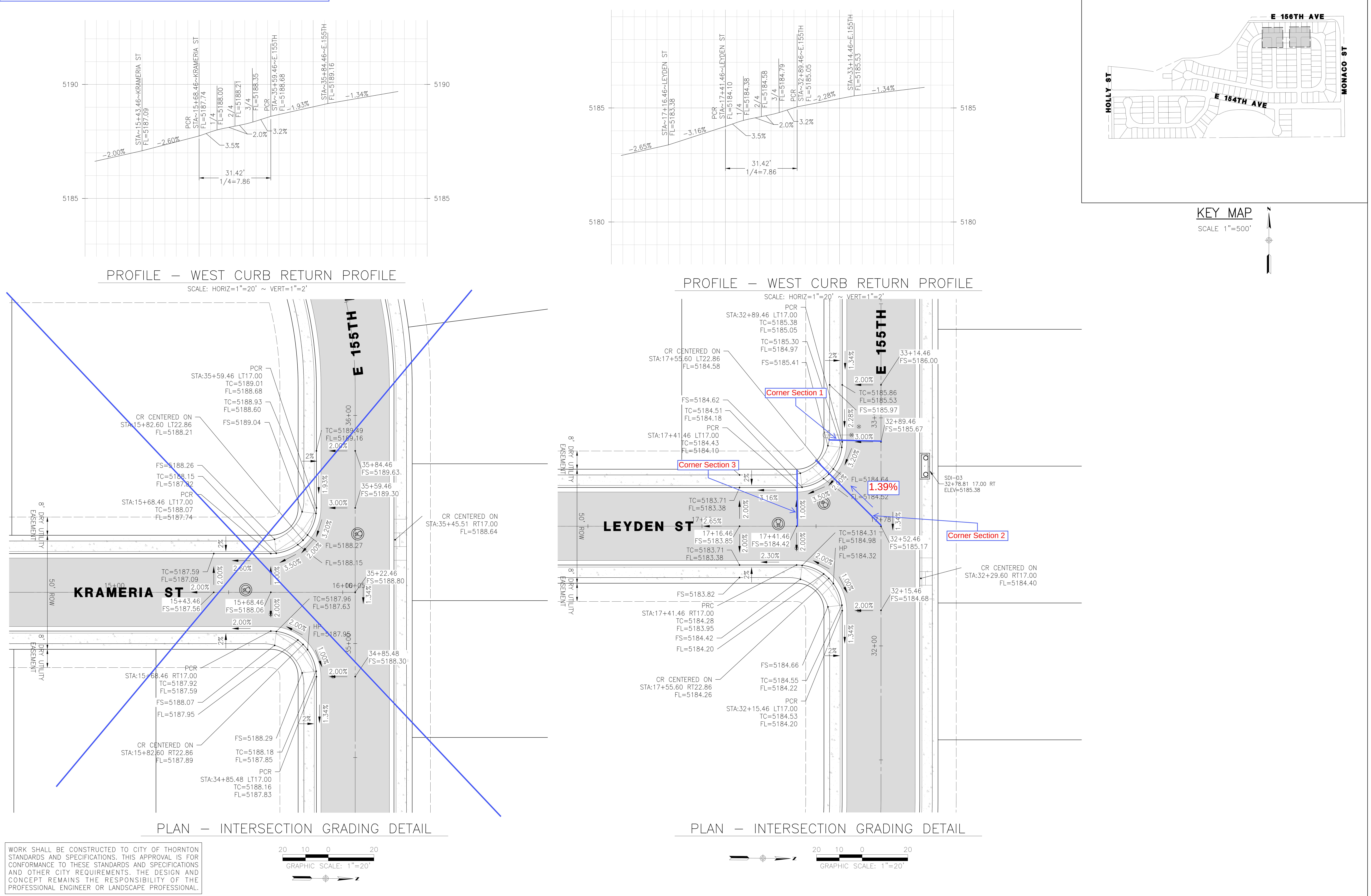
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**7.1**	**7.1**	**cfs**

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

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

Compares against Q from Basin 15 to SDI-27

Street corner capacity has been checked for three sections identified. The next three pages of street capacity sheets correspond to these three sections respectively.



WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

PRELIMINARY NOT FOR CONSTRUCTION

Know what's below. Call before you dig.

SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-07

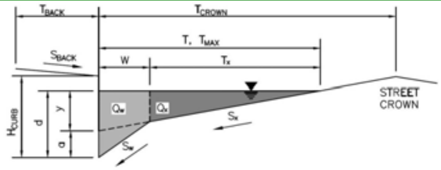
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 1 - E 155th Pl & Leyden St in DP17 (SDI-10)



Gutter Geometry (Enter data in the blue cells)

Description	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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 =	0.023	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

Description	Symbol	Minor Storm	Major Storm	Units
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	6.12	6.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.27	1.27	inches
Water Depth at Gutter Flowline	d =	7.39	7.39	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.321	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	20.9	20.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	9.9	9.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	7.2	7.2	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**38.1**	**38.1**	**cfs**
Flow Velocity within the Gutter Section	V =	9.3	9.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.7	5.7	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	7.6	12.9	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	5.6	10.9	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.656	0.420	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	1.5	8.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	1.5	8.8	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.9	6.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.4	17.0	cfs
Average Flow Velocity Within the Gutter Section	V =	5.7	7.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.9	3.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.80	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.4**	**13.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.55	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**4.4**	**13.6**	**cfs**

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

Compares against Q from Basin 17 to SDI-10

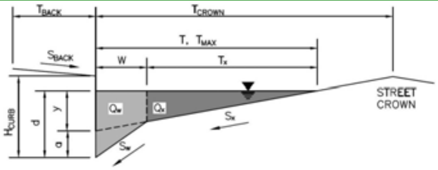
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 2 - E 155th Pl & Leyden St in DP17 (SDI-10)



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	32.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.014	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	32.0	32.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	5.34	5.34	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.66	1.66	inches
Water Depth at Gutter Flowline	d =	7.00	7.00	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	30.0	30.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.195	0.195	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	34.6	34.6	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	8.4	8.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	5.1	5.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**48.0**	**48.0**	**cfs**
Flow Velocity within the Gutter Section	V =	8.4	8.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.9	4.9	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	14.0	25.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	12.0	23.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.469	0.251	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	3.0	17.9	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.0	17.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.7	6.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	5.7	25.5	cfs
Average Flow Velocity Within the Gutter Section	V =	5.3	7.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.8	3.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.89	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**5.7**	**22.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.72	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.7**	**22.7**	**cfs**

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

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

Compares against Q from Basin 17 to SDI-10

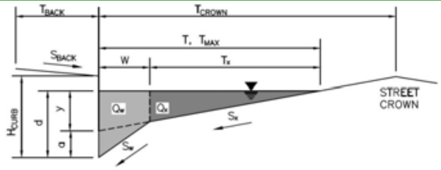
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 3 - E 155th Pl & Leyden St in DP17 (SDI-10)



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	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 =	0.033	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.8	3.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.04	2.04	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.75	1.75	inches
Water Depth at Gutter Flowline	d =	3.79	3.79	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.431	0.431	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	4.1	4.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.1	3.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**7.1**	**7.1**	**cfs**
Flow Velocity within the Gutter Section	V =	6.6	6.6	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.1	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.4	17.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	15.4	15.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.421	0.421	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	4.4	4.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	4.4	4.4	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.2	3.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.5	7.5	cfs
Average Flow Velocity Within the Gutter Section	V =	6.7	6.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.1	2.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**7.5**	**7.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	3.84	3.84	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.05	0.05	inches

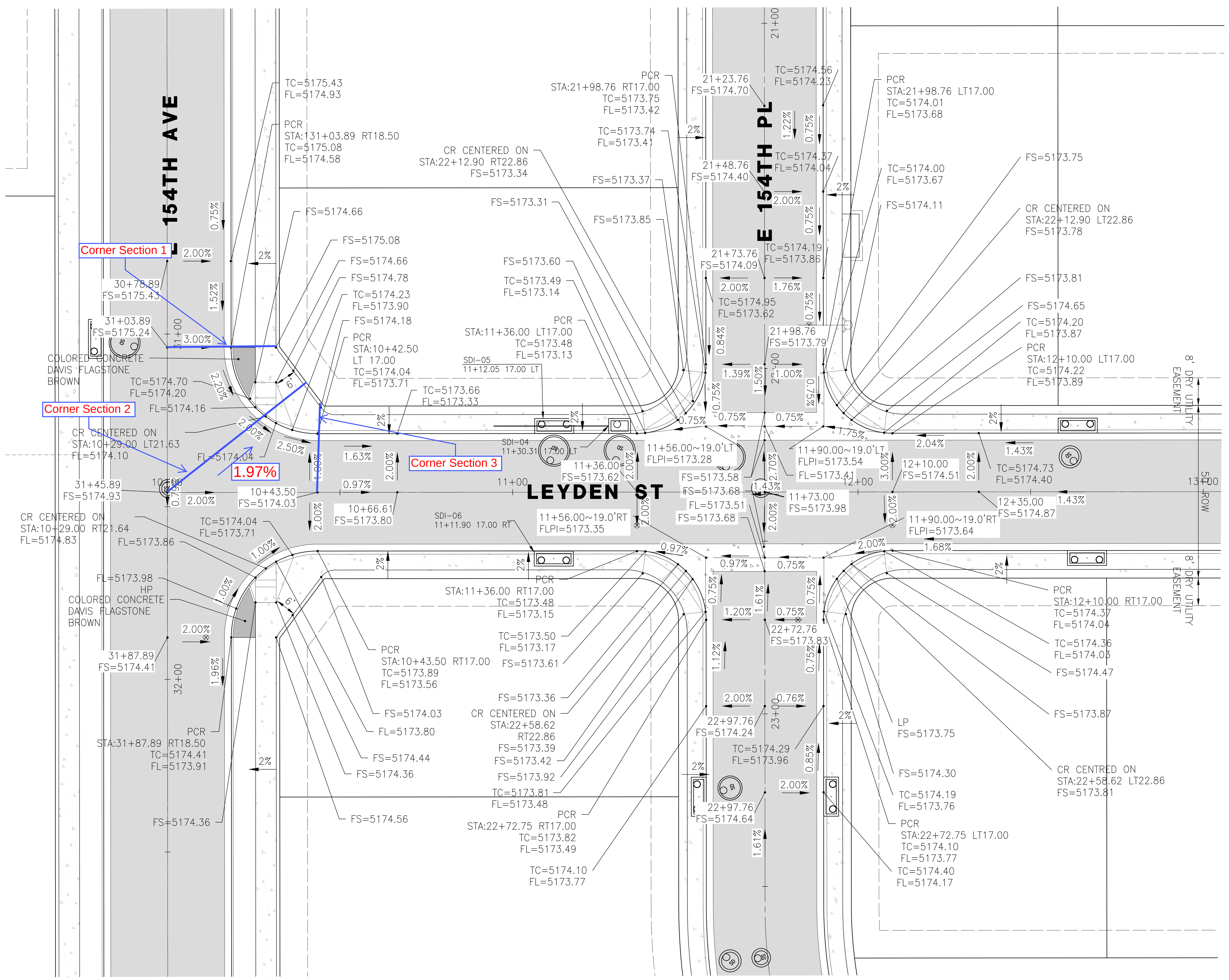
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**7.1**	**7.1**	**cfs**

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

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

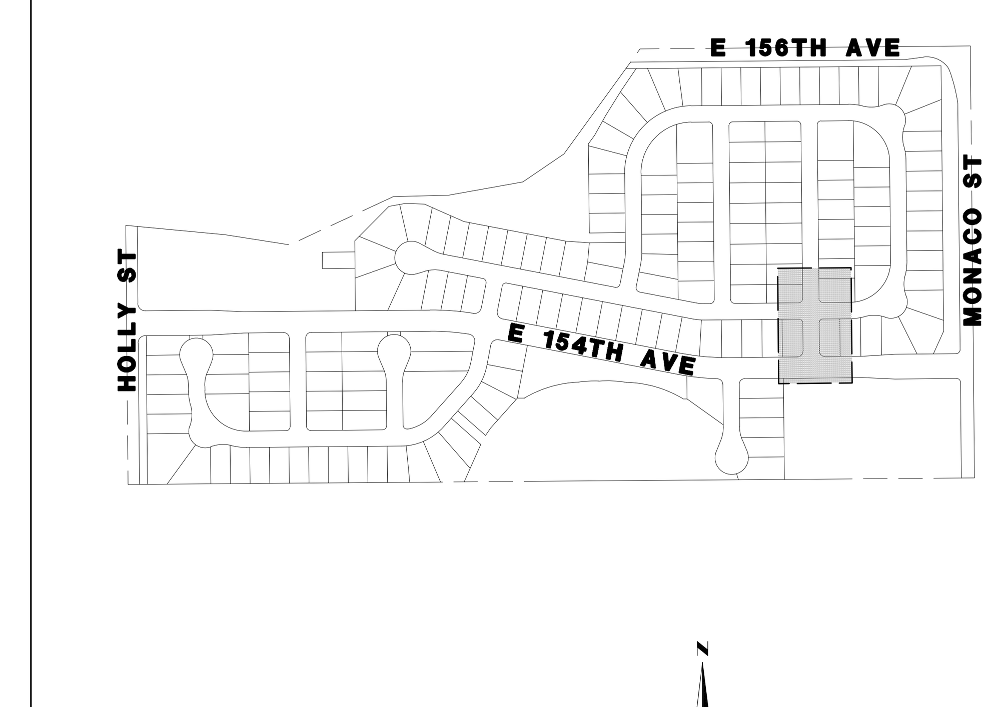
Compares against Q from Basin 17 to SDI-10

Street corner capacity has been checked for three sections identified. The next three pages of street capacity sheets correspond to these three sections respectively.



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

PRELIMINARY NOT FOR CONSTRUCTION

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

SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-04

SHEET NO. 62 OF 172 SHEETS

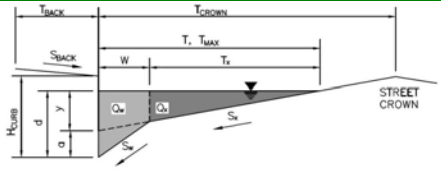
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 1 - E 154th Av & Leyden St Flow from Sub-Basin 20B



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.5	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	4.86	6.66	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.27	1.27	inches
Water Depth at Gutter Flowline	d =	6.13	7.93	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.5	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.401	0.296	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.4	22.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	5.6	9.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.3	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**14.1**	**32.6**	**cfs**
Flow Velocity within the Gutter Section	V =	6.6	8.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.4	5.3	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.1	13.1	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.1	11.1	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.411	0.411	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	7.7	7.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	7.7	7.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	5.4	5.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	13.1	13.1	cfs
Average Flow Velocity Within the Gutter Section	V =	6.5	6.5	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.2	3.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**13.1**	**13.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	6.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**13.1**	**13.1**	**cfs**

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

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

Compares against Q from Sub-Basin 20B

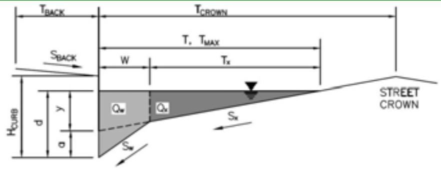
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 2 - E 154th Av & Leyden St Flow from Sub-Basin 20B



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	15.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	36.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.5	36.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	5.6	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	7.21	8.51	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.52	1.52	inches
Water Depth at Gutter Flowline	d =	8.73	10.03	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	28.5	34.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.191	0.160	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	53.9	86.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	12.7	16.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	16.3	29.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**82.9**	**131.9**	**cfs**
Flow Velocity within the Gutter Section	V =	9.9	10.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	7.2	9.1	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	10.5	17.3	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	8.5	15.3	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.556	0.346	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	2.1	10.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.1	10.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.7	5.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	4.8	16.5	cfs
Average Flow Velocity Within the Gutter Section	V =	5.3	7.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.8	3.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**4.8**	**16.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.00	5.60	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**4.8**	**16.5**	**cfs**

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

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

Compares against Q from Sub-Basin 20B

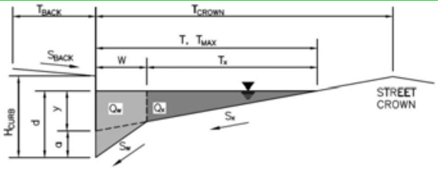
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 3 - E 154th Av & Leyden St Flow from Sub-Basin 20B



Gutter Geometry (Enter data in the blue cells)			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.018	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	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 =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.8	3.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.04	2.04	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.75	1.75	inches
Water Depth at Gutter Flowline	d =	3.79	3.79	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.431	0.431	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	3.5	3.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.7	2.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**6.2**	**6.2**	**cfs**
Flow Velocity within the Gutter Section	V =	5.7	5.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.8	1.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.4	17.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	15.4	15.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.421	0.421	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.8	3.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	3.8	3.8	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.7	2.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.5	6.5	cfs
Average Flow Velocity Within the Gutter Section	V =	5.8	5.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.8	1.8	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.5**	**6.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	3.84	3.84	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.05	0.05	inches

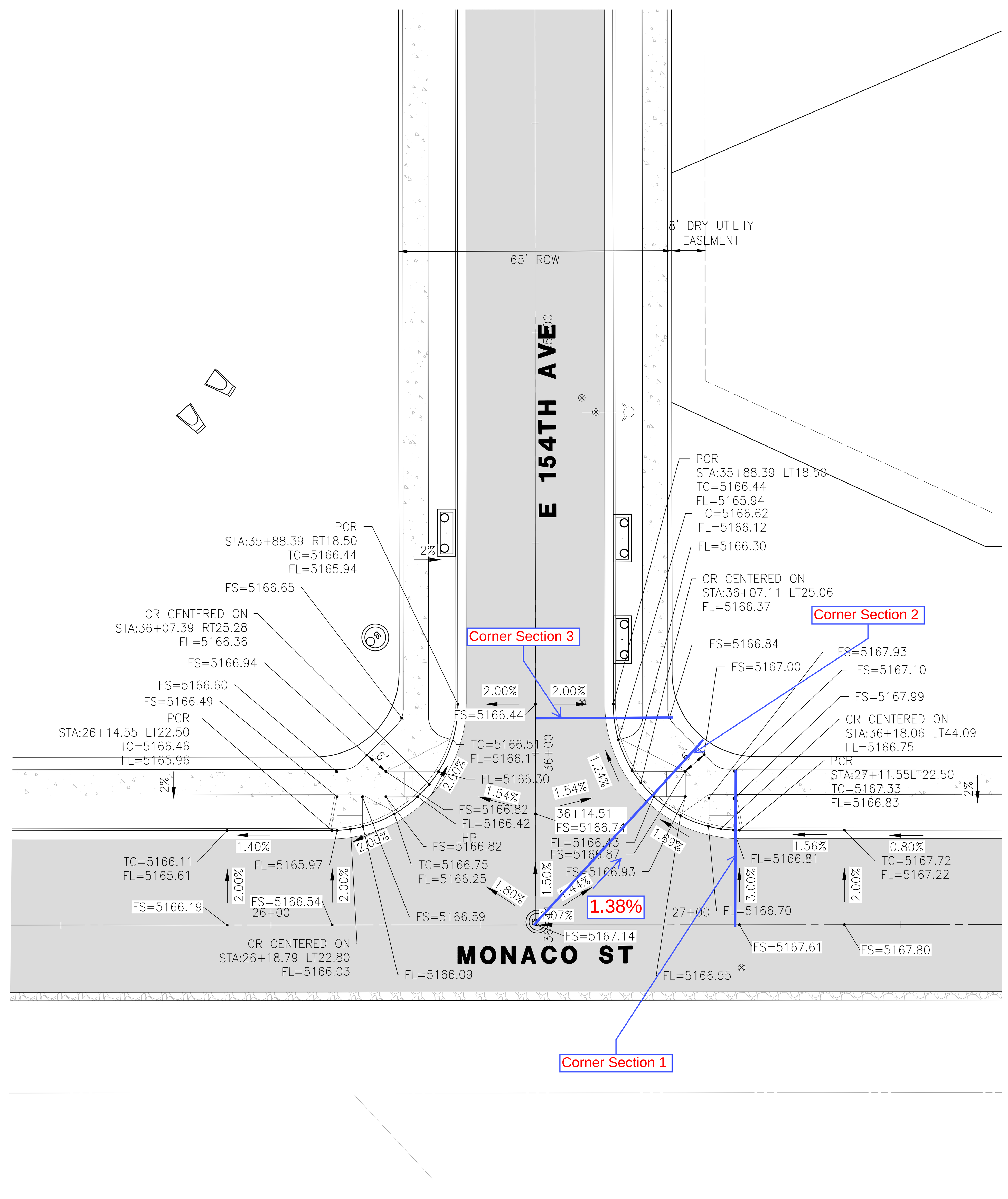
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**6.2**	**6.2**	**cfs**

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

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

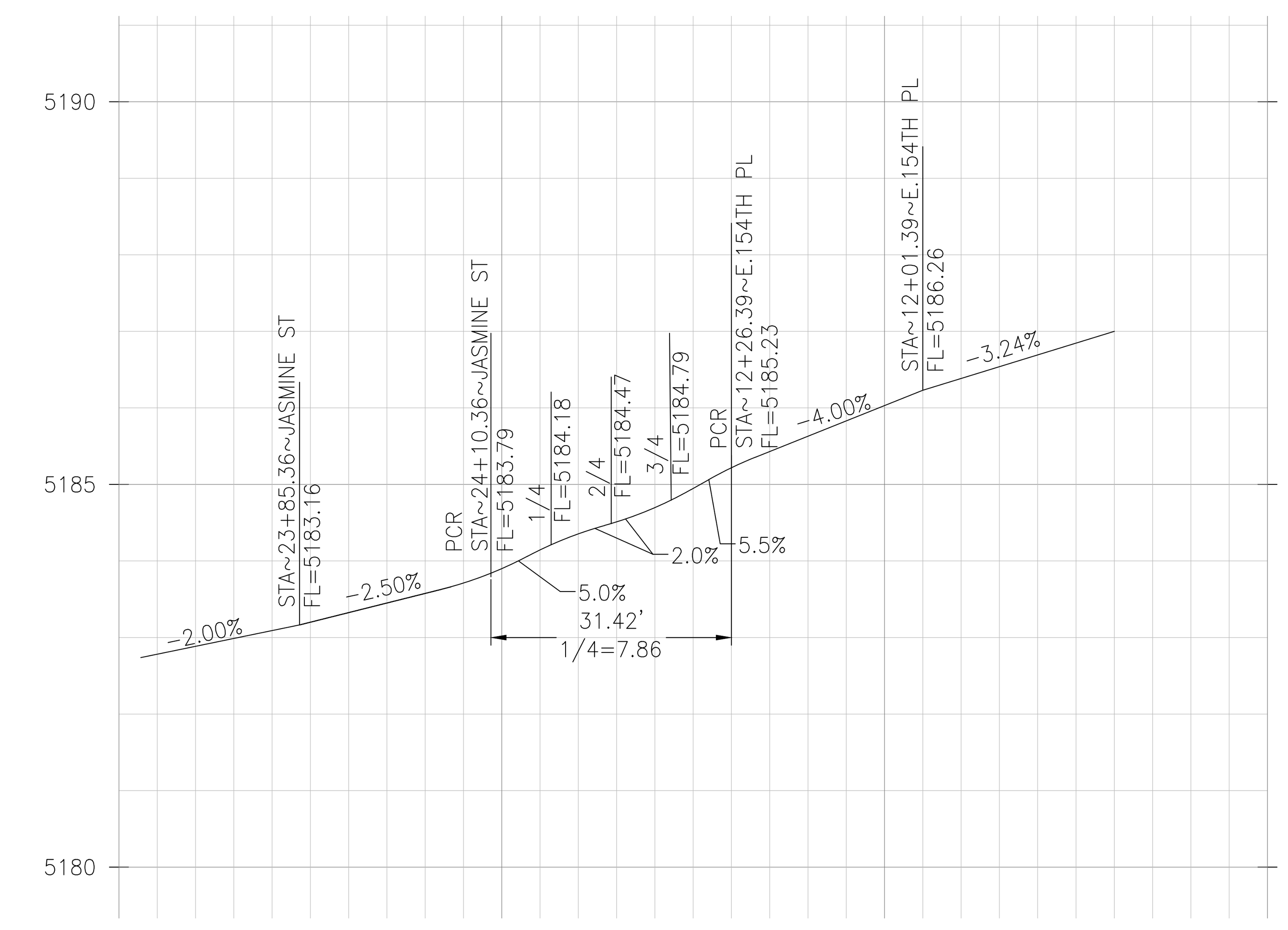
Compares against Q from Sub-Basin 20B

Street corner capacity has been checked for three sections identified. The next three pages of street capacity sheets correspond to these three sections respectively.



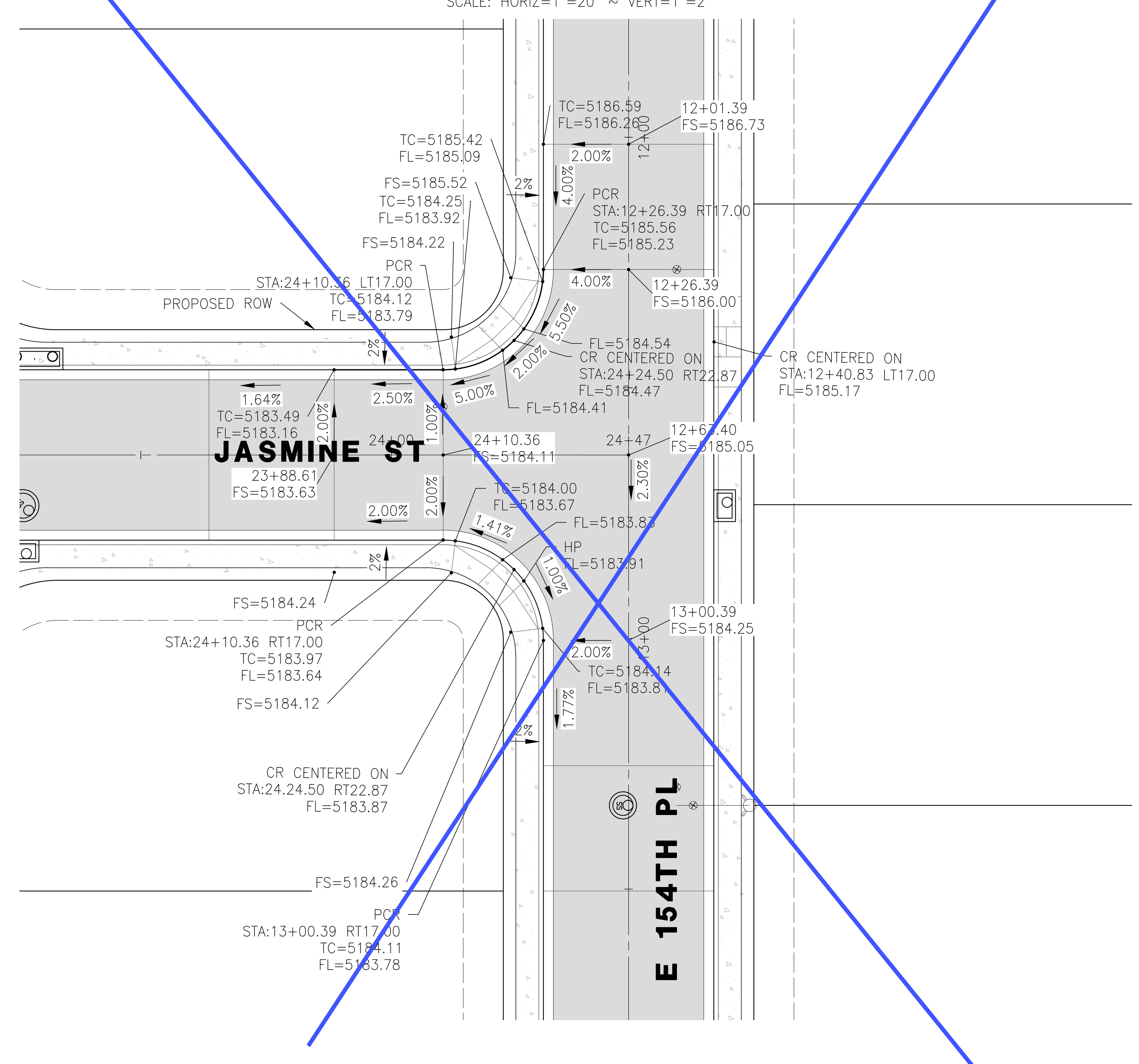
PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



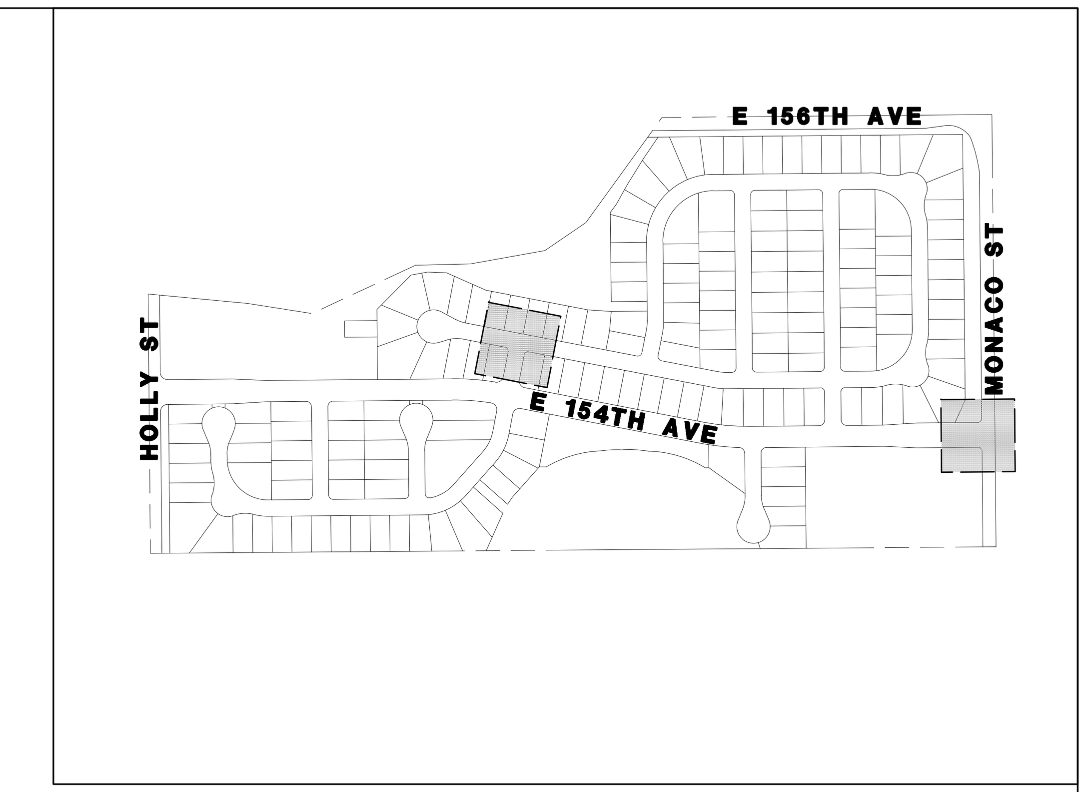
PROFILE – WEST CURB RETURN PROFILE

SCALE: HORIZ=1"=20' ~ VERT=1"=2'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

PRELIMINARY NOT FOR CONSTRUCTION

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

SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-05

SHEET NO. 63 OF172 SHEETS

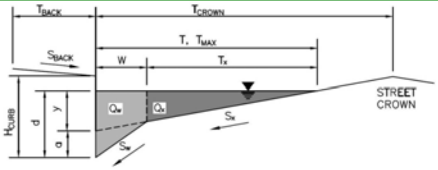
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 1 - Monaco St & E 154th Av Flow from Sub-Basin 30A & 30B



Gutter Geometry (Enter data in the blue cells)

Description	Symbol	Value	Units
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	22.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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 =	0.016	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	22.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.6	6.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	6.12	8.10	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.27	1.27	inches
Water Depth at Gutter Flowline	d =	7.39	9.37	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	20.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.321	0.244	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	17.3	39.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	8.2	12.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.6	5.9	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**26.1**	**58.6**	**cfs**
Flow Velocity within the Gutter Section	V =	7.7	9.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.7	7.2	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	12.0	15.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	10.0	13.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.446	0.347	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	5.9	13.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	5.9	13.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	4.8	7.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	10.7	21.0	cfs
Average Flow Velocity Within the Gutter Section	V =	6.2	7.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.9	4.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**10.7**	**21.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.60	6.92	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**10.7**	**21.0**	**cfs**

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

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

Compares against Q from Sub-Basin 30A (E 156th Av) & 30B (Monaco St)

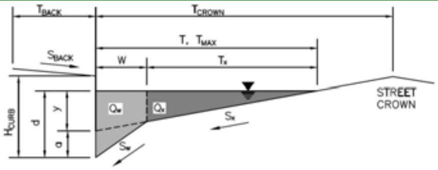
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 2 - Monaco St & E 154th Av Flow from Sub-Basin 30A & 30B



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	42.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.014	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 =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	36.5	42.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	6.04	6.96	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.66	1.66	inches
Water Depth at Gutter Flowline	d =	7.71	8.62	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	34.5	40.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.169	0.145	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	48.2	71.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	9.8	12.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.1	3.3	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**59.0**	**86.9**	**cfs**
Flow Velocity within the Gutter Section	V =	8.7	9.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.6	6.8	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	26.2	26.2	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	24.2	24.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.243	0.243	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	18.7	18.7	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	18.7	18.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	6.0	6.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	24.7	24.7	cfs
Average Flow Velocity Within the Gutter Section	V =	7.2	7.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.6	3.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**24.7**	**24.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.00	6.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**24.7**	**24.7**	**cfs**

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

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

Compares against Q from Sub-Basin 30A (E 156th Av) & 30B (Monaco St)

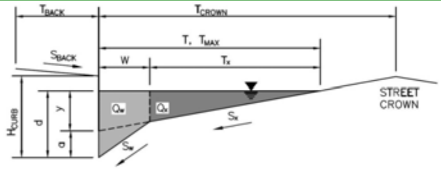
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check Section 3 - Monaco St & E 154th Av Flow from Sub-Basin 30A & 30B



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	18.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	5.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.12	4.44	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.63	5.95	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	11.0	16.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.456	0.321	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	4.2	12.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	3.6	5.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**7.8**	**18.4**	**cfs**
Flow Velocity within the Gutter Section	V =	5.9	7.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.3	3.6	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.0	17.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.0	15.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.455	0.336	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	4.3	11.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	4.3	11.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	3.6	5.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.8	16.5	cfs
Average Flow Velocity Within the Gutter Section	V =	5.9	7.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.3	3.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.9**	**16.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.64	5.76	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**7.8**	**16.5**	**cfs**

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

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

Compares against Q from Sub-Basin 30A (E 156th Av) & 30B (Monaco St)

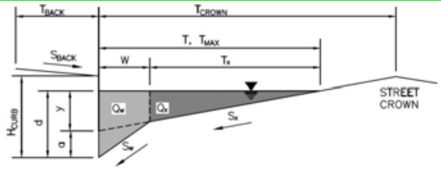
Version 4.06 Released August 2018

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

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

Project: Westwood

Inlet ID: Corner Capacity Check - E 156 Av & Monaco St Flow from Sub-Basin 30A



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	22.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	22.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	3.8	4.5	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.04	2.70	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.75	1.75	inches
Water Depth at Gutter Flowline	d =	3.79	4.45	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.0	20.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.431	0.318	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	2.2	5.1	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.7	2.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**3.9**	**7.5**	**cfs**
Flow Velocity within the Gutter Section	V =	3.6	4.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.1	1.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.1	22.6	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	15.1	20.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.429	0.317	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	2.2	5.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	2.2	5.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	2.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	3.9	7.5	cfs
Average Flow Velocity Within the Gutter Section	V =	3.6	4.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.1	1.5	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**3.9**	**7.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	3.80	4.46	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.01	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**3.9**	**7.5**	**cfs**

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

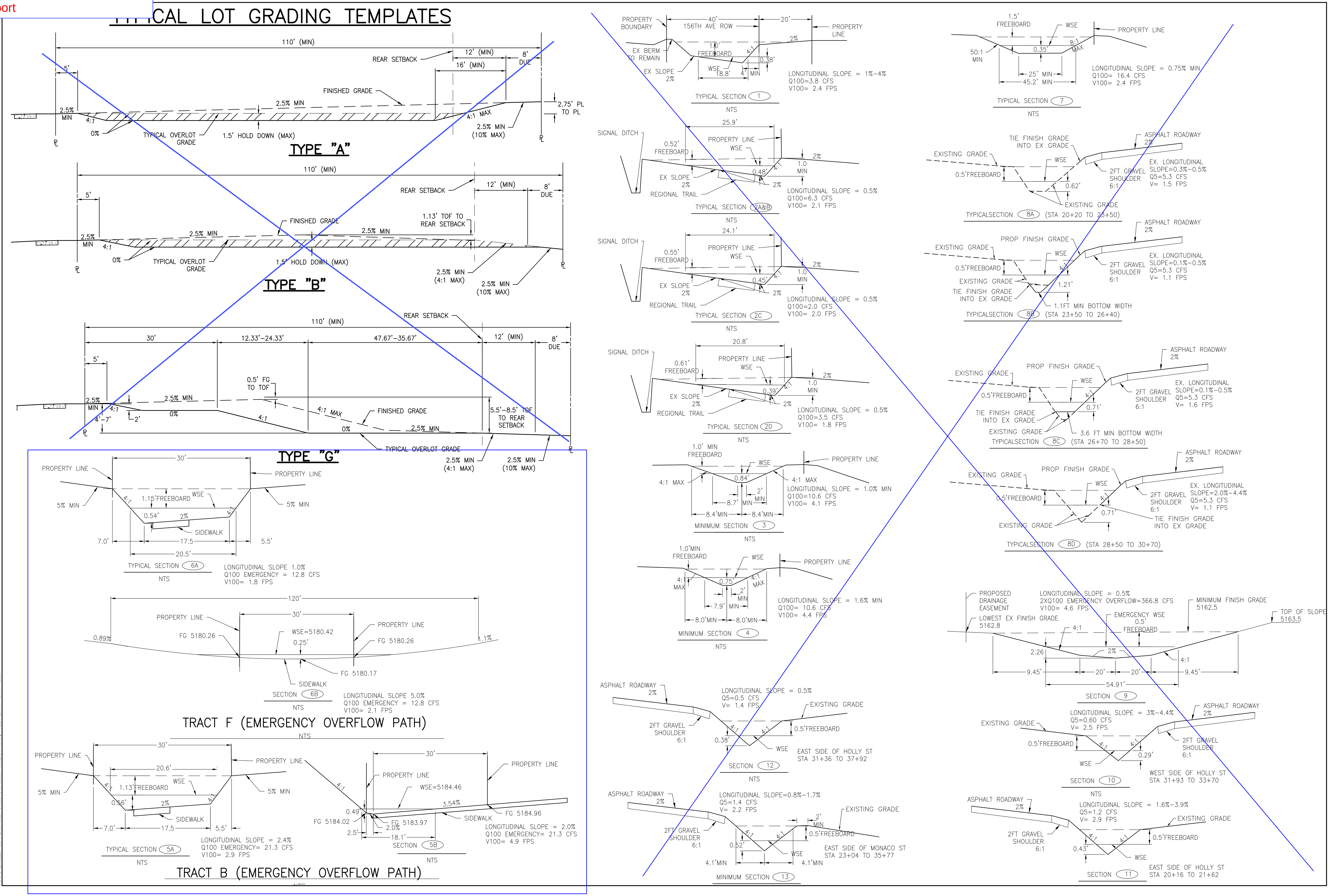
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

There is no intersection detail for E 156th Ave & Monaco. However, conservatively a 1% cross-slope and 1% longitudinal slope has been used to check corner capacity.

Compares against Q from Sub-Basin 30A (E 156th Av)

Appendix B – Hydraulic Computations
Emergency Overflow Weir Section Analyses

Crossed out portions are not applicable to this section of the report



FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

Know what's below. Call before you dig.

SCALE:	N/A
DATE:	2/1/2021
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. DTL-01

SHEET NO. 152 OF 172 SHEETS

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

Hydraulic Analysis Report

Project Data

Project Title: JN:1104 Westwood - Emergency Overflow Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Tract B Section 5A - Emergency Overflow Sizing

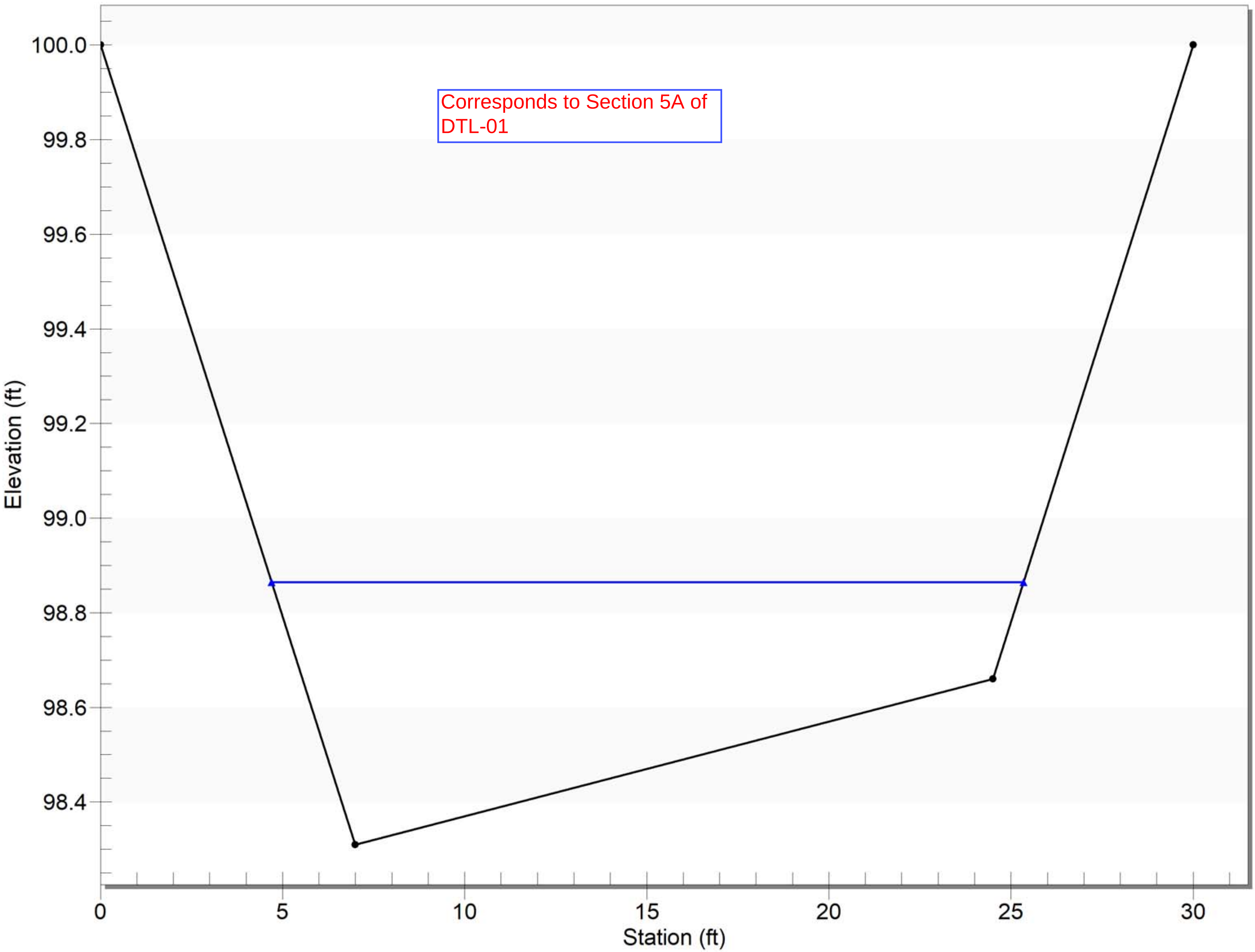
Notes:

Input Parameters

Channel Type: Custom Cross Section

Flow from offsite basins O2, O3 & O4 + Sub-Basin 41A (SDI-50) & Sub-Basin 41B (SDI-28)

Tract B Section 5A - Emergency Overflow Weir



Cross Section Data

~~Elevation (ft)~~ Station (Typical)	Elevation (ft)	Manning's n
0.00	100.00	0.0400
7.00	98.31	0.0400
24.50	98.66	0.0400
30.00	100.00	-----

Corresponds to Section 5A of DTL-01 & the cross-section plotted in the previous page

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths

Longitudinal Slope: 0.0240 ft/ft

Flow: 21.3000 cfs

Flow from offsite basins O2, O3 & O4 + Sub-Basin 41A (SDI-50) & Sub-Basin 41B (SDI-28)

Result Parameters

Depth: 0.5550 ft

Area of Flow: 7.3733 ft^2

Wetted Perimeter: 20.7340 ft

Hydraulic Radius: 0.3556 ft

Average Velocity: 2.8888 ft/s

Top Width: 20.6399 ft

Froude Number: 0.8517

Critical Depth: 0.5168 ft

Critical Velocity: 3.2315 ft/s

Critical Slope: 0.0342 ft/ft

Critical Top Width: 20.33 ft

Calculated Max Shear Stress: 0.8311 lb/ft^2

Calculated Avg Shear Stress: 0.5326 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0400

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

Channel Analysis: Tract B Section 5B (Back of Sidewalk) - Emergency Overflow Sizing

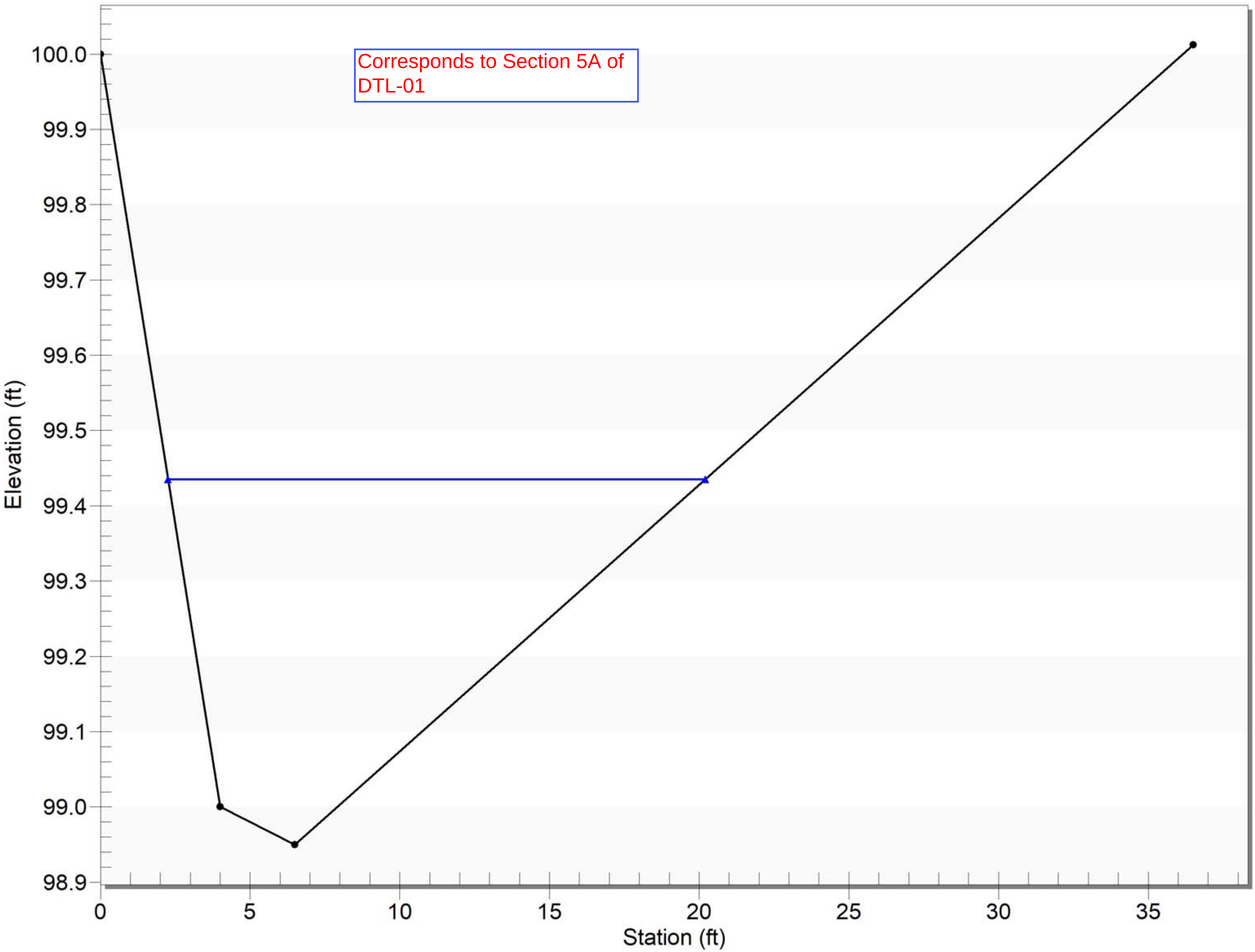
Notes:

Input Parameters

Channel Type: Custom Cross Section

Flow from offsite basins O2, O3 & O4 + Sub-Basin 41A (SDI-50) & Sub-Basin 41B (SDI-28)

Tract B Section 5B (Back of Walk) - Emergency Overflow Weir



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	100.00	0.0200
4.00	99.00	0.0200
6.50	98.95	0.0200
36.50	100.01	-----

Corresponds to Section 5B of DTL-01 & the cross-section plotted in the previous page

Back of sidewalk manning's. Conservatively assuming 0.02 as recommended in UD-Inlet

Longitudinal Slope: 0.0200 ft/ft

Flow: 21.3000 cfs

Flow from offsite basins O2, O3 & O4 + Sub-Basin 41A (SDI-50) & Sub-Basin 41B (SDI-28)

Result Parameters

Depth: 0.4853 ft

Area of Flow: 4.8571 ft^2

Wetted Perimeter: 18.0144 ft

Hydraulic Radius: 0.2696 ft

Average Velocity: 4.3854 ft/s

Top Width: 17.9518 ft

Froude Number: 1.4857

Critical Depth: 0.5779 ft

Critical Velocity: 3.1997 ft/s

Critical Slope: 0.0086 ft/ft

Critical Top Width: 20.94 ft

Calculated Max Shear Stress: 0.6057 lb/ft^2

Calculated Avg Shear Stress: 0.3365 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0200

Back of sidewalk manning's. Conservatively assuming 0.02 as recommended in UD-Inlet

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

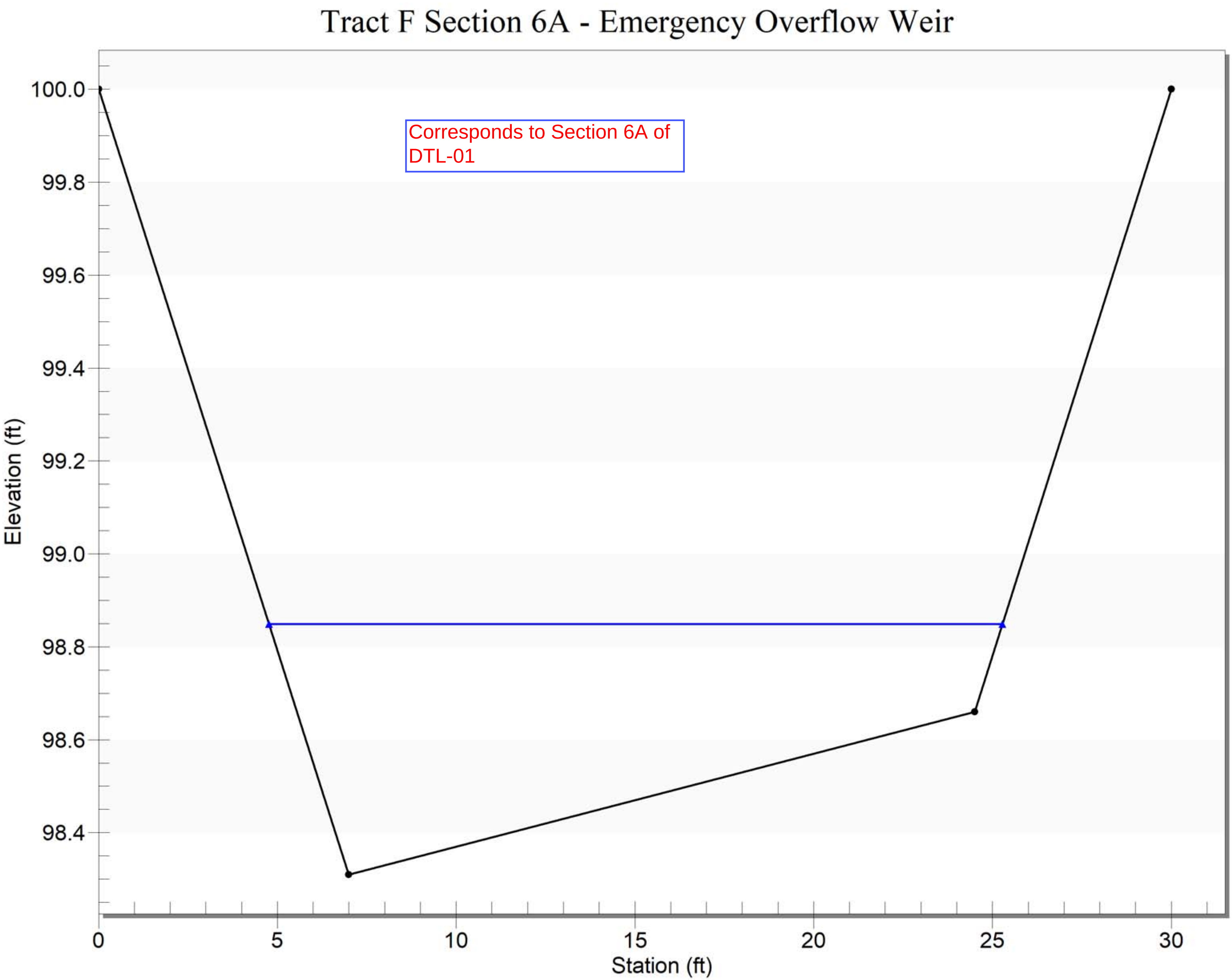
Channel Analysis: Tract F Section 6A - Emergency Overflow Sizing

Notes:

Input Parameters

Channel Type: Custom Cross Section

Flow from DP4 (SDI-48), DP7 (SDI-47) + Bypass flow from DP6 (SDI-34) & DP44 (SDI-35)



Tract F Section 6A - Emergency Overflow Weir
Corresponds to Section 6A of DTL-01
100.0
99.8
99.6
99.4
99.2
99.0
98.8
98.6
98.4
Elevation (ft)
0
5
10
15
20
25
30
Station (ft)

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	100.00	0.0400
7.00	98.31	0.0400
24.50	98.66	0.0400
30.00	100.00	-----

Corresponds to Section 6A of DTL-01 & the cross-section plotted in the previous page

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths

Longitudinal Slope: 0.0100 ft/ft

Flow: 12.8000 cfs

Flow from Basin 4 (SDI-48), Basin 7 (SDI-47) + Bypass flow from SDI-34 & SDI-35

Result Parameters

Depth: 0.5390 ft

Area of Flow: 7.0451 ft^2

Wetted Perimeter: 20.5987 ft

Hydraulic Radius: 0.3420 ft

Average Velocity: 1.8169 ft/s

Top Width: 20.5083 ft

Froude Number: 0.5463

Critical Depth: 0.4183 ft

Critical Velocity: 2.7643 ft/s

Critical Slope: 0.0378 ft/ft

Critical Top Width: 19.51 ft

Calculated Max Shear Stress: 0.3363 lb/ft^2

Calculated Avg Shear Stress: 0.2134 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0400

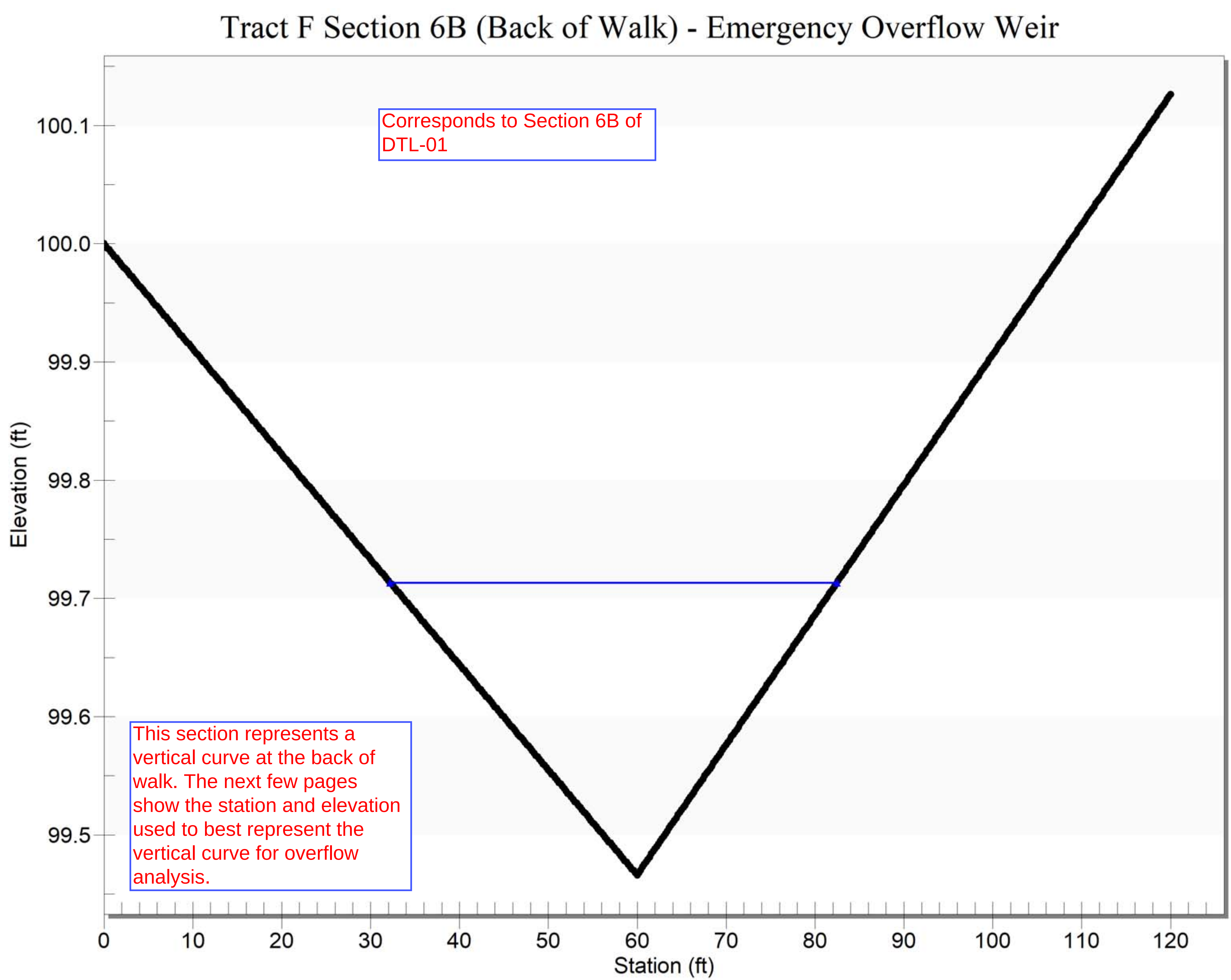
Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths

Channel Analysis: Tract F Section 6B (Back of Sidewalk) - Emergency Overflow Sizing

Notes:

Input Parameters

Channel Type: Custom Cross Section


Tract F Section 6B (Back of Walk) - Emergency Overflow Weir
Corresponds to Section 6B of DTL-01
This section represents a vertical curve at the back of walk. The next few pages show the station and elevation used to best represent the vertical curve for overflow analysis.
Elevation (ft)
100.1
100.0
99.9
99.8
99.7
99.6
99.5
Station (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120

Cross Section Data

~~Elevation (ft)~~ Station	Elevation (ft)	Manning's n
0.00	100.00	0.0400
0.20	100.00	0.0400
0.40	100.00	0.0400
0.60	100.00	0.0400
0.80	99.99	0.0400
1.00	99.99	0.0400
1.20	99.99	0.0400
1.40	99.99	0.0400
1.60	99.99	0.0400
1.80	99.98	0.0400
2.00	99.98	0.0400
2.20	99.98	0.0400
2.40	99.98	0.0400
2.60	99.98	0.0400
2.80	99.97	0.0400
3.00	99.97	0.0400
3.20	99.97	0.0400
3.40	99.97	0.0400
3.60	99.97	0.0400
3.80	99.97	0.0400
4.00	99.96	0.0400
4.20	99.96	0.0400
4.40	99.96	0.0400
4.60	99.96	0.0400
4.80	99.96	0.0400
5.00	99.96	0.0400
5.20	99.95	0.0400
5.40	99.95	0.0400
5.60	99.95	0.0400
5.80	99.95	0.0400
6.00	99.95	0.0400
6.20	99.94	0.0400
6.40	99.94	0.0400
6.60	99.94	0.0400
6.80	99.94	0.0400
7.00	99.94	0.0400
7.20	99.94	0.0400
7.40	99.93	0.0400
7.60	99.93	0.0400
7.80	99.93	0.0400
8.00	99.93	0.0400
8.20	99.93	0.0400
8.40	99.92	0.0400
8.60	99.92	0.0400
8.80	99.92	0.0400
9.00	99.92	0.0400
9.20	99.92	0.0400
9.40	99.92	0.0400
9.60	99.92	0.0400
9.80	99.91	0.0400
10.00	99.91	0.0400

10.20	99.91	0.0400
10.40	99.91	0.0400
10.60	99.91	0.0400
10.80	99.90	0.0400
11.00	99.90	0.0400
11.20	99.90	0.0400
11.40	99.90	0.0400
11.60	99.90	0.0400
11.80	99.89	0.0400
12.00	99.89	0.0400
12.20	99.89	0.0400
12.40	99.89	0.0400
12.60	99.89	0.0400
12.80	99.89	0.0400
13.00	99.88	0.0400
13.20	99.88	0.0400
13.40	99.88	0.0400
13.60	99.88	0.0400
13.80	99.88	0.0400
14.00	99.88	0.0400
14.20	99.87	0.0400
14.40	99.87	0.0400
14.60	99.87	0.0400
14.80	99.87	0.0400
15.00	99.87	0.0400
15.20	99.86	0.0400
15.40	99.86	0.0400
15.60	99.86	0.0400
15.80	99.86	0.0400
16.00	99.86	0.0400
16.20	99.86	0.0400
16.40	99.85	0.0400
16.60	99.85	0.0400
16.80	99.85	0.0400
17.00	99.85	0.0400
17.20	99.85	0.0400
17.40	99.84	0.0400
17.60	99.84	0.0400
17.80	99.84	0.0400
18.00	99.84	0.0400
18.20	99.84	0.0400
18.40	99.84	0.0400
18.60	99.83	0.0400
18.80	99.83	0.0400
19.00	99.83	0.0400
19.20	99.83	0.0400
19.40	99.83	0.0400
19.60	99.83	0.0400
19.80	99.82	0.0400
20.00	99.82	0.0400
20.20	99.82	0.0400
20.40	99.82	0.0400
20.60	99.82	0.0400
20.80	99.81	0.0400
21.00	99.81	0.0400
21.20	99.81	0.0400
21.40	99.81	0.0400

21.60	99.81	0.0400
21.80	99.81	0.0400
22.00	99.80	0.0400
22.20	99.80	0.0400
22.40	99.80	0.0400
22.60	99.80	0.0400
22.80	99.80	0.0400
23.00	99.80	0.0400
23.20	99.79	0.0400
23.40	99.79	0.0400
23.60	99.79	0.0400
23.80	99.79	0.0400
24.00	99.79	0.0400
24.20	99.78	0.0400
24.40	99.78	0.0400
24.60	99.78	0.0400
24.80	99.78	0.0400
25.00	99.78	0.0400
25.20	99.78	0.0400
25.40	99.77	0.0400
25.60	99.77	0.0400
25.80	99.77	0.0400
26.00	99.77	0.0400
26.20	99.77	0.0400
26.40	99.77	0.0400
26.60	99.76	0.0400
26.80	99.76	0.0400
27.00	99.76	0.0400
27.20	99.76	0.0400
27.40	99.76	0.0400
27.60	99.75	0.0400
27.80	99.75	0.0400
28.00	99.75	0.0400
28.20	99.75	0.0400
28.40	99.75	0.0400
28.60	99.75	0.0400
28.80	99.74	0.0400
29.00	99.74	0.0400
29.20	99.74	0.0400
29.40	99.74	0.0400
29.60	99.74	0.0400
29.80	99.73	0.0400
30.00	99.73	0.0400
30.20	99.73	0.0400
30.40	99.73	0.0400
30.60	99.73	0.0400
30.80	99.73	0.0400
31.00	99.72	0.0400
31.20	99.72	0.0400
31.40	99.72	0.0400
31.60	99.72	0.0400
31.80	99.72	0.0400
32.00	99.72	0.0400
32.20	99.71	0.0400
32.40	99.71	0.0400
32.60	99.71	0.0400
32.80	99.71	0.0400

33.00	99.71	0.0400
33.20	99.70	0.0400
33.40	99.70	0.0400
33.60	99.70	0.0400
33.80	99.70	0.0400
34.00	99.70	0.0400
34.20	99.70	0.0400
34.40	99.69	0.0400
34.60	99.69	0.0400
34.80	99.69	0.0400
35.00	99.69	0.0400
35.20	99.69	0.0400
35.40	99.69	0.0400
35.60	99.68	0.0400
35.80	99.68	0.0400
36.00	99.68	0.0400
36.20	99.68	0.0400
36.40	99.68	0.0400
36.60	99.67	0.0400
36.80	99.67	0.0400
37.00	99.67	0.0400
37.20	99.67	0.0400
37.40	99.67	0.0400
37.60	99.67	0.0400
37.80	99.66	0.0400
38.00	99.66	0.0400
38.20	99.66	0.0400
38.40	99.66	0.0400
38.60	99.66	0.0400
38.80	99.66	0.0400
39.00	99.65	0.0400
39.20	99.65	0.0400
39.40	99.65	0.0400
39.60	99.65	0.0400
39.80	99.65	0.0400
40.00	99.64	0.0400
40.20	99.64	0.0400
40.40	99.64	0.0400
40.60	99.64	0.0400
40.80	99.64	0.0400
41.00	99.64	0.0400
41.20	99.63	0.0400
41.40	99.63	0.0400
41.60	99.63	0.0400
41.80	99.63	0.0400
42.00	99.63	0.0400
42.20	99.62	0.0400
42.40	99.62	0.0400
42.60	99.62	0.0400
42.80	99.62	0.0400
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43.20	99.62	0.0400
43.40	99.61	0.0400
43.60	99.61	0.0400
43.80	99.61	0.0400
44.00	99.61	0.0400
44.20	99.61	0.0400

44.40	99.61	0.0400
44.60	99.60	0.0400
44.80	99.60	0.0400
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45.20	99.60	0.0400
45.40	99.60	0.0400
45.60	99.59	0.0400
45.80	99.59	0.0400
46.00	99.59	0.0400
46.20	99.59	0.0400
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46.80	99.58	0.0400
47.00	99.58	0.0400
47.20	99.58	0.0400
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47.60	99.58	0.0400
47.80	99.58	0.0400
48.00	99.57	0.0400
48.20	99.57	0.0400
48.40	99.57	0.0400
48.60	99.57	0.0400
48.80	99.57	0.0400
49.00	99.56	0.0400
49.20	99.56	0.0400
49.40	99.56	0.0400
49.60	99.56	0.0400
49.80	99.56	0.0400
50.00	99.56	0.0400
50.20	99.55	0.0400
50.40	99.55	0.0400
50.60	99.55	0.0400
50.80	99.55	0.0400
51.00	99.55	0.0400
51.20	99.54	0.0400
51.40	99.54	0.0400
51.60	99.54	0.0400
51.80	99.54	0.0400
52.00	99.54	0.0400
52.20	99.53	0.0400
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52.80	99.53	0.0400
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55.00	99.51	0.0400
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55.60	99.50	0.0400

55.80	99.50	0.0400
56.00	99.50	0.0400
56.20	99.50	0.0400
56.40	99.50	0.0400
56.60	99.50	0.0400
56.80	99.49	0.0400
57.00	99.49	0.0400
57.20	99.49	0.0400
57.40	99.49	0.0400
57.60	99.49	0.0400
57.80	99.49	0.0400
58.00	99.48	0.0400
58.20	99.48	0.0400
58.40	99.48	0.0400
58.60	99.48	0.0400
58.80	99.48	0.0400
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59.20	99.47	0.0400
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59.60	99.47	0.0400
59.80	99.47	0.0400
60.00	99.47	0.0400
60.20	99.47	0.0400
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65.60	99.53	0.0400
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66.00	99.53	0.0400
66.20	99.53	0.0400
66.40	99.54	0.0400
66.60	99.54	0.0400
66.80	99.54	0.0400
67.00	99.54	0.0400

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67.80	99.55	0.0400
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72.60	99.61	0.0400
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73.00	99.61	0.0400
73.20	99.61	0.0400
73.40	99.61	0.0400
73.60	99.62	0.0400
73.80	99.62	0.0400
74.00	99.62	0.0400
74.20	99.62	0.0400
74.40	99.62	0.0400
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78.60	99.67	0.0400
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79.20	99.68	0.0400
79.40	99.68	0.0400
79.60	99.68	0.0400
79.80	99.68	0.0400
80.00	99.69	0.0400
80.20	99.69	0.0400
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80.60	99.69	0.0400
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81.00	99.70	0.0400
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81.40	99.70	0.0400
81.60	99.70	0.0400
81.80	99.71	0.0400
82.00	99.71	0.0400
82.20	99.71	0.0400
82.40	99.71	0.0400
82.60	99.72	0.0400
82.80	99.72	0.0400
83.00	99.72	0.0400
83.20	99.72	0.0400
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83.60	99.73	0.0400
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88.80	99.78	0.0400
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89.80	99.79	0.0400

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101.40	99.92	0.0400
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102.80	99.94	0.0400
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103.80	99.95	0.0400
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104.20	99.95	0.0400
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106.60	99.98	0.0400
106.80	99.98	0.0400
107.00	99.98	0.0400
107.20	99.98	0.0400
107.40	99.99	0.0400
107.60	99.99	0.0400
107.80	99.99	0.0400
108.00	99.99	0.0400
108.20	100.00	0.0400
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110.80	100.03	0.0400
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111.80	100.04	0.0400
112.00	100.04	0.0400
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112.60	100.05	0.0400

112.80	100.05	0.0400
113.00	100.05	0.0400
113.20	100.05	0.0400
113.40	100.05	0.0400
113.60	100.06	0.0400
113.80	100.06	0.0400
114.00	100.06	0.0400
114.20	100.06	0.0400
114.40	100.06	0.0400
114.60	100.07	0.0400
114.80	100.07	0.0400
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115.20	100.07	0.0400
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115.60	100.08	0.0400
115.80	100.08	0.0400
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116.60	100.09	0.0400
116.80	100.09	0.0400
117.00	100.09	0.0400
117.20	100.10	0.0400
117.40	100.10	0.0400
117.60	100.10	0.0400
117.80	100.10	0.0400
118.00	100.10	0.0400
118.20	100.11	0.0400
118.40	100.11	0.0400
118.60	100.11	0.0400
118.80	100.11	0.0400
119.00	100.11	0.0400
119.20	100.12	0.0400
119.40	100.12	0.0400
119.60	100.12	0.0400
119.80	100.12	0.0400
120.00	100.13	-----

Longitudinal Slope: 0.0500 ft/ft

Flow: 12.8000 cfs

Flow from Basin 4 (SDI-48), Basin 7 (SDI-47) + Bypass flow from SDI-34 & SDI-35

Result Parameters

Depth: 0.2473 ft

Area of Flow: 6.2134 ft^2

Wetted Perimeter: 50.3118 ft

Hydraulic Radius: 0.1235 ft

Average Velocity: 2.0601 ft/s

Top Width: 50.3092 ft

Froude Number: 1.0330

Critical Depth: 0.2504 ft

Critical Velocity: 2.0083 ft/s

Critical Slope: 0.0466 ft/ft

Critical Top Width: 50.88 ft

Calculated Max Shear Stress: 0.7714 lb/ft^2

Calculated Avg Shear Stress: 0.3853 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0400

Flow goes over sidewalk to tract F. Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

Hydraulic Analysis Report

Project Data

Project Title: JN:1104 Westwood - Emergency Overflow Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes:

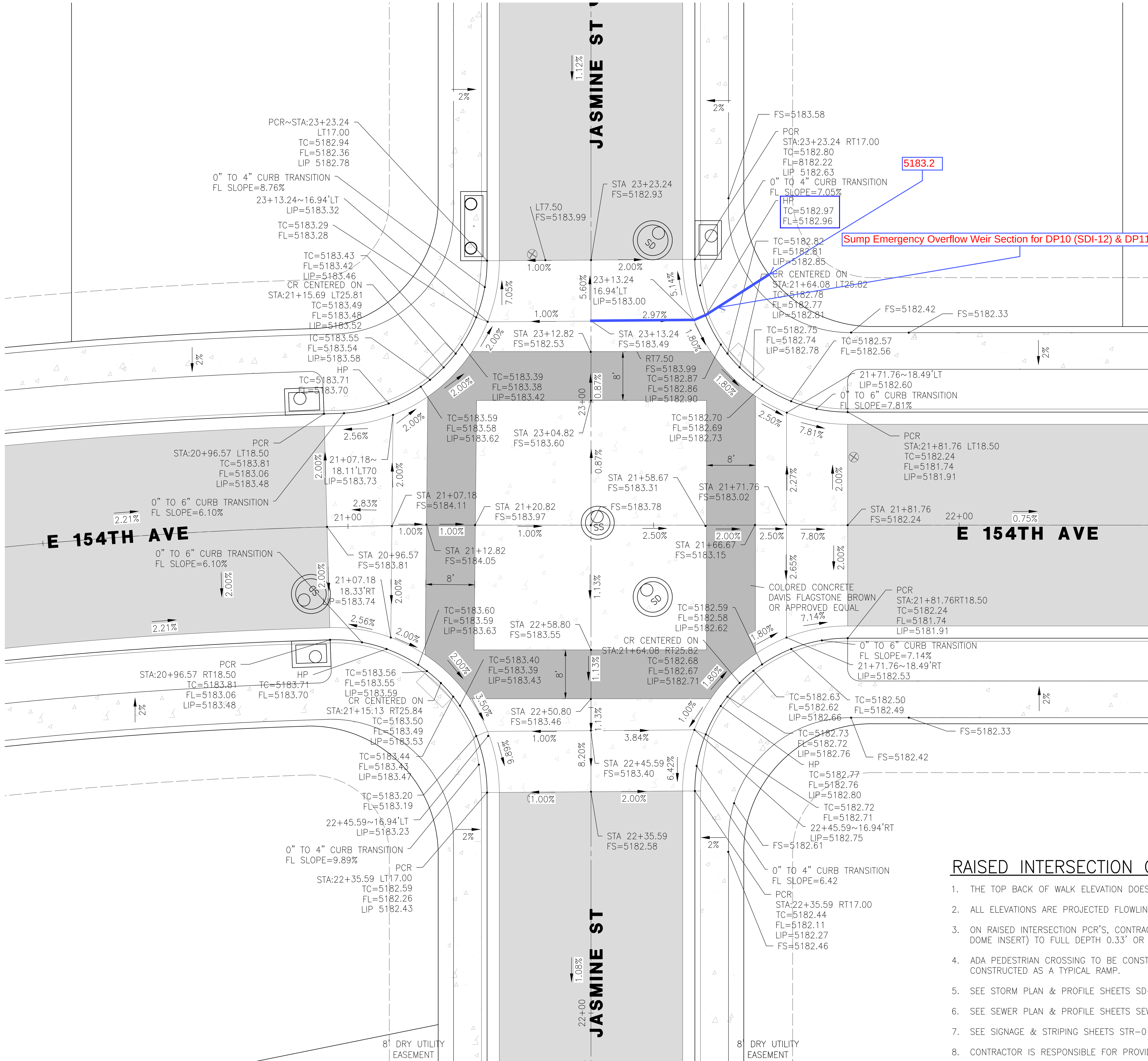
Channel Analysis: Sump Overflow Weir - DP10 (SDI-12) & DP11 (SDI-13)

Notes:

Input Parameters

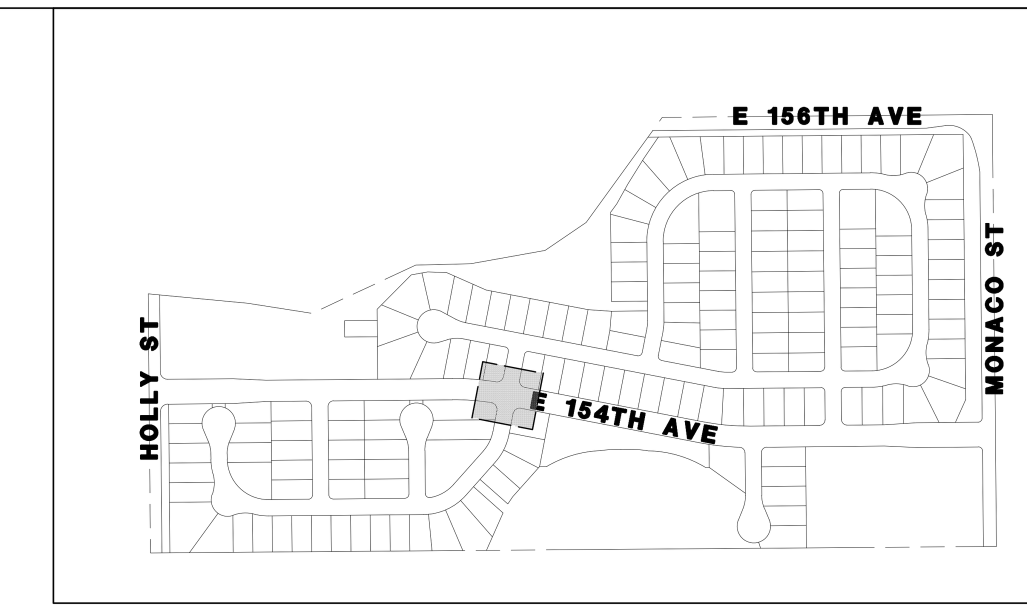
Channel Type: Custom Cross Section

Flow from Basin 10 (SDI-12) & Basin 11 (SDI-13)



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=10'



KEY MAP

SCALE 1"=500'

RAISED INTERSECTION GENERAL NOTES

1. THE TOP BACK OF WALK ELEVATION DOES NOT CHANGE IN THE RAISED INTERSECTION AREA.
2. ALL ELEVATIONS ARE PROJECTED FLOWLINE UNLESS OTHERWISE NOTED.
3. ON RAISED INTERSECTION PCR'S, CONTRACTOR TO CONSTRUCT CURB & GUTTER THAT TRANSITIONS FROM 0.00' (AT TRUNCATED DOME INSERT) TO FULL DEPTH 0.33' OR 0.50' (SPECIFIC PER SHEET) (AT START/END) OF RAISED INTERSECTIONS.
4. ADA PEDESTRIAN CROSSING TO BE CONSTRUCTED FLUSH WITH THE RAISED SECTION OF THE INTERSECTION AND SHALL NOT BE CONSTRUCTED AS A TYPICAL RAMP.
5. SEE STORM PLAN & PROFILE SHEETS SD-01 THRU SD-19 FOR STORM SEWER INFORMATION.
6. SEE SEWER PLAN & PROFILE SHEETS SEW-01 THRU SEW-20 FOR SANITARY SEWER INFORMATION.
7. SEE SIGNAGE & STRIPING SHEETS STR-01 THRU STR-05 FOR SPEED TABLE INFORMATION.
8. CONTRACTOR IS RESPONSIBLE FOR PROVIDING FINAL JOINT AND REINFORCEMENT LAYOUT TO CITY FOR APPROVAL.
9. INLETS SHALL BE CONSTRUCTED WITH A 4" CURB OPENING FOR 4" CURB, AND STANDARD 6" CURB OPENING FOR 6" CURB.
10. THE INSPECTION OF FORMS IS REQUIRED BY THE CITY PRIOR TO POURING/PLACEMENT OF CONCRETE.
11. CONCRETE SHALL CONFIRM TO THE CITY OF THORNTON SECTION 600-CONCRETE, 4500 PSI CDOT CLASS D CONCRETE WITH FIBER MESH REINFORCEMENT.
12. FOR CONCRETE JOINTS, CONTRACTOR SHALL REFER TO CDOT M&S STANDARD PLANS (M-412-1, SHEETS 1-5) FOR CONCRETE REINFORCEMENT.
13. REFER TO CONCRETE PAVEMENT DESIGN FOR CONCRETE PAVEMENT THICKNESS, BUT NOT TO BE LESS THAN 8" THICK.

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

PRELIMINARY
NOT FOR CONSTRUCTION

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

SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

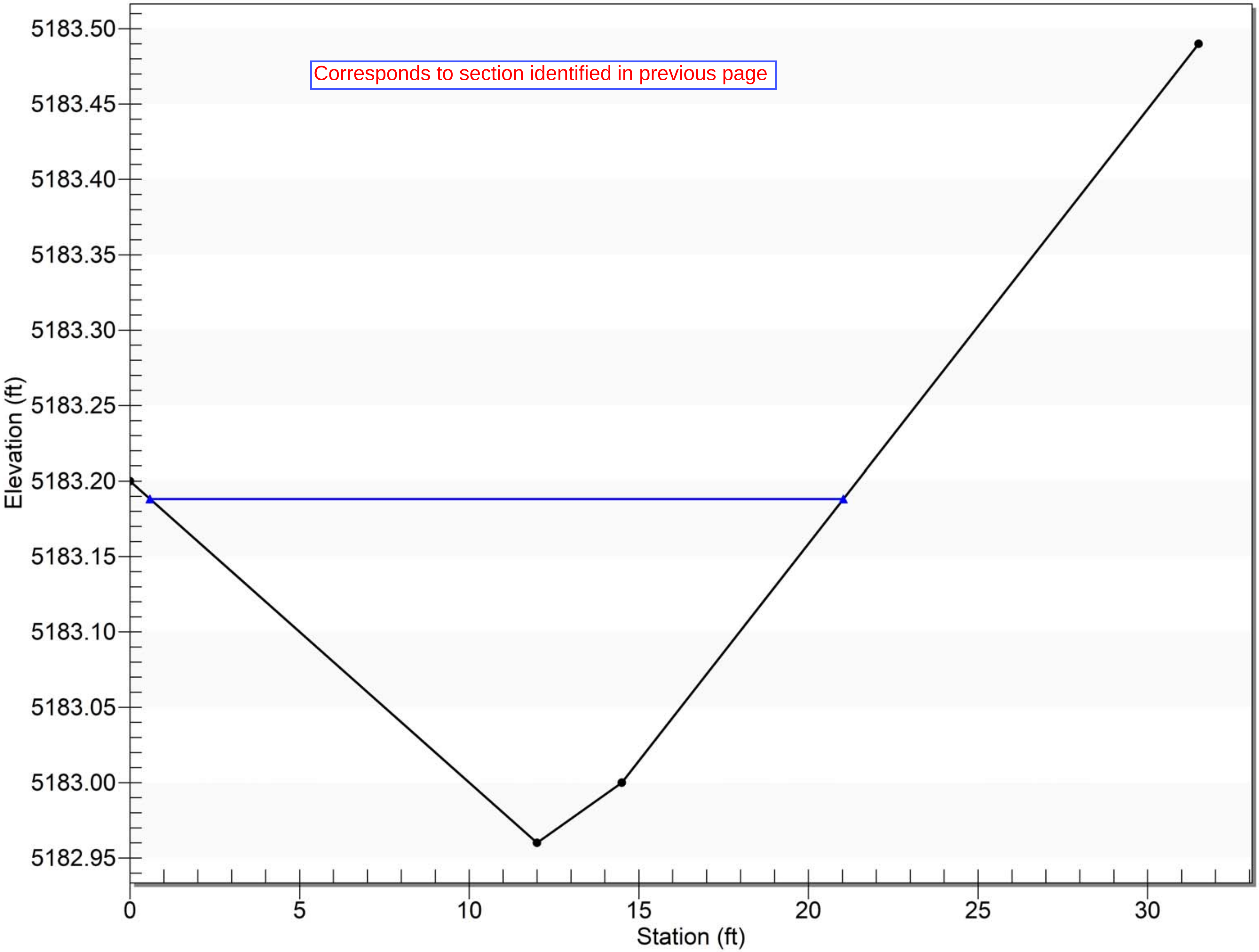
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-01

SHEET NO. 59 OF 172 SHEETS

DP10 (SDI-12) & DP11 (SDI-13) - Emergency Overflow Weir



Cross Section Data

~~Elevation (ft)~~ Station	Elevation (ft)	Manning's n
0.00	5183.20	0.0200
12.00	5182.96	0.0160
14.50	5183.00	0.0160
31.50	5183.49	-----

Corresponds to section identified in last two pages

0.016 for asphalt street with concrete gutter
per Chapter 7, USDCM Vol.1, page 7-7
0.02 for behind curb, which is the highest
recommended by UD-Inlet (Typical)

Longitudinal Slope: 0.0180 ft/ft

Flow: 6.6000 cfs

Flow from Basin 10 (SDI-12) & Basin 11 (SDI-13)

Result Parameters

Depth: 0.2282 ft

Area of Flow: 2.4367 ft^2

Wetted Perimeter: 20.4445 ft

Hydraulic Radius: 0.1192 ft

Average Velocity: 2.7085 ft/s

Top Width: 20.4392 ft

Froude Number: 1.3824

Critical Depth: 0.2593 ft

Critical Velocity: 2.1263 ft/s

Critical Slope: 0.0090 ft/ft

Critical Top Width: 22.11 ft

Calculated Max Shear Stress: 0.2563 lb/ft^2

Calculated Avg Shear Stress: 0.1339 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0178

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

Hydraulic Analysis Report

Project Data

Project Title: JN:1104 Westwood - Emergency Overflow Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes:

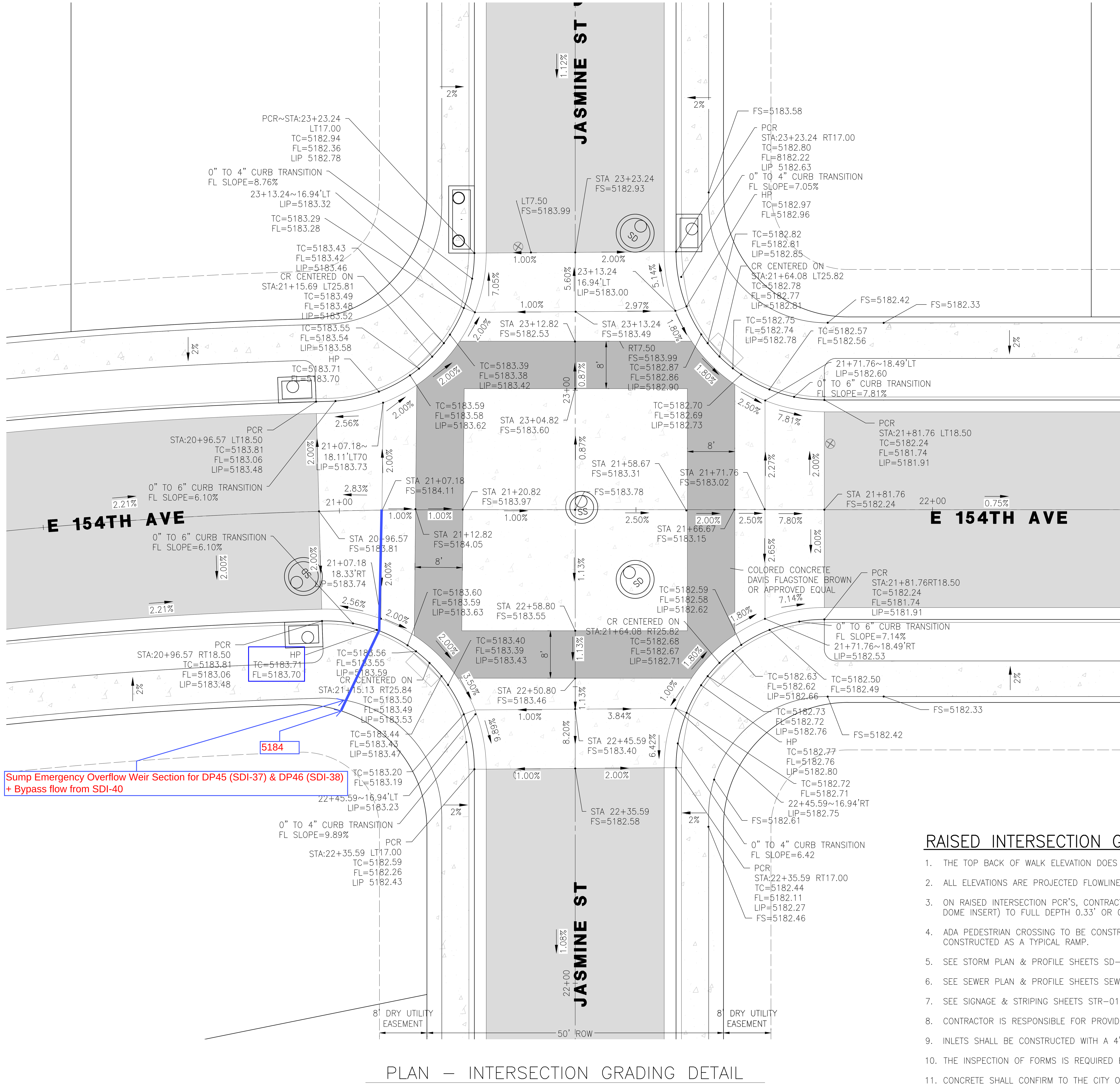
Channel Analysis: Sump Overflow Weir - DP45 (SDI-37) & DP46 (SDI-38)

Notes:

Input Parameters

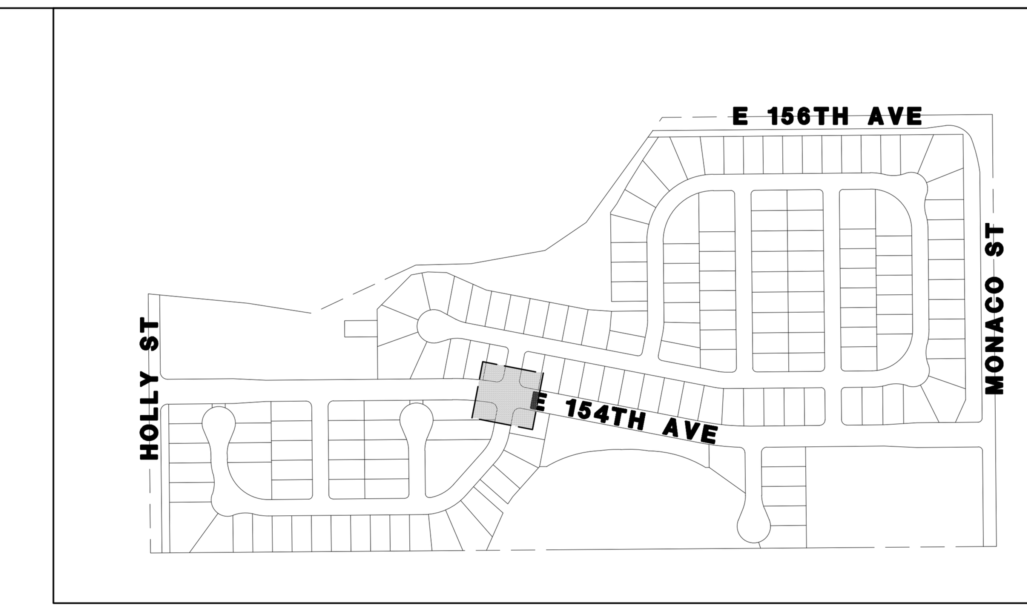
Channel Type: Custom Cross Section

Flow from Basin 45 (SDI-37) & Basin 46 (SDI-38) + Bypass flow from SDI-40



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=10'



KEY MAP

SCALE 1"=500'

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1. THE TOP BACK OF WALK ELEVATION DOES NOT CHANGE IN THE RAISED INTERSECTION AREA.
2. ALL ELEVATIONS ARE PROJECTED FLOWLINE UNLESS OTHERWISE NOTED.
3. ON RAISED INTERSECTION PCR'S, CONTRACTOR TO CONSTRUCT CURB & GUTTER THAT TRANSITIONS FROM 0.00' (AT TRUNCATED DOME INSERT) TO FULL DEPTH 0.33' OR 0.50' (SPECIFIC PER SHEET) (AT START/END) OF RAISED INTERSECTIONS.
4. ADA PEDESTRIAN CROSSING TO BE CONSTRUCTED FLUSH WITH THE RAISED SECTION OF THE INTERSECTION AND SHALL NOT BE CONSTRUCTED AS A TYPICAL RAMP.
5. SEE STORM PLAN & PROFILE SHEETS SD-01 THRU SD-19 FOR STORM SEWER INFORMATION.
6. SEE SEWER PLAN & PROFILE SHEETS SEW-01 THRU SEW-20 FOR SANITARY SEWER INFORMATION.
7. SEE SIGNAGE & STRIPING SHEETS STR-01 THRU STR-05 FOR SPEED TABLE INFORMATION.
8. CONTRACTOR IS RESPONSIBLE FOR PROVIDING FINAL JOINT AND REINFORCEMENT LAYOUT TO CITY FOR APPROVAL.
9. INLETS SHALL BE CONSTRUCTED WITH A 4" CURB OPENING FOR 4" CURB, AND STANDARD 6" CURB OPENING FOR 6" CURB.
10. THE INSPECTION OF FORMS IS REQUIRED BY THE CITY PRIOR TO POURING/PLACEMENT OF CONCRETE.
11. CONCRETE SHALL CONFIRM TO THE CITY OF THORNTON SECTION 600-CONCRETE, 4500 PSI CDOT CLASS D CONCRETE WITH FIBER MESH REINFORCEMENT.
12. FOR CONCRETE JOINTS, CONTRACTOR SHALL REFER TO CDOT M&S STANDARD PLANS (M-412-1, SHEETS 1-5) FOR CONCRETE REINFORCEMENT.
13. REFER TO CONCRETE PAVEMENT DESIGN FOR CONCRETE PAVEMENT THICKNESS, BUT NOT TO BE LESS THAN 8" THICK.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

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PRELIMINARY NOT FOR CONSTRUCTION

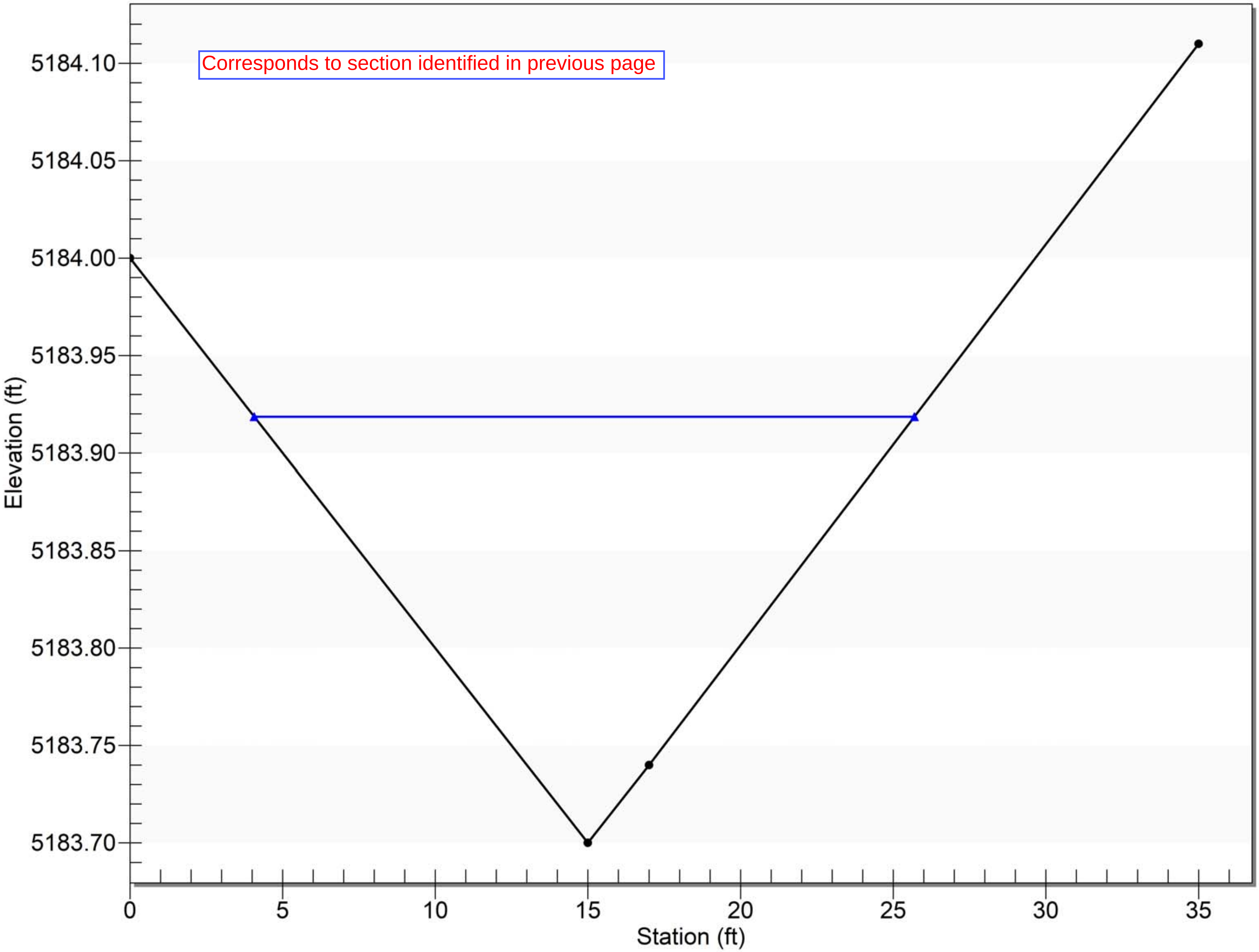
SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-01

DP45 (SDI-37) & DP46 (SDI-38) - Emergency Overflow Weir



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5184.00	0.0200
15.00	5183.70	0.0160
17.00	5183.74	0.0160
35.00	5184.11	-----

Corresponds to section identified in last two pages

Longitudinal Slope: 0.0200 ft/ft

Flow: 6.4000 cfs

Flow from Basin 45 (SDI-37) & Basin 46 (SDI-38) + Bypass flow from SDI-40

Result Parameters

Depth: 0.2186 ft

Area of Flow: 2.3675 ft^2

Wetted Perimeter: 21.6221 ft

Hydraulic Radius: 0.1095 ft

Average Velocity: 2.7032 ft/s

Top Width: 21.6177 ft

Froude Number: 1.4395

Critical Depth: 0.2529 ft

Critical Velocity: 2.0201 ft/s

Critical Slope: 0.0092 ft/ft

Critical Top Width: 25.01 ft

Calculated Max Shear Stress: 0.2728 lb/ft^2

Calculated Avg Shear Stress: 0.1367 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0178

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

Hydraulic Analysis Report

Project Data

Project Title: JN:1104 Westwood - Emergency Overflow Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes:

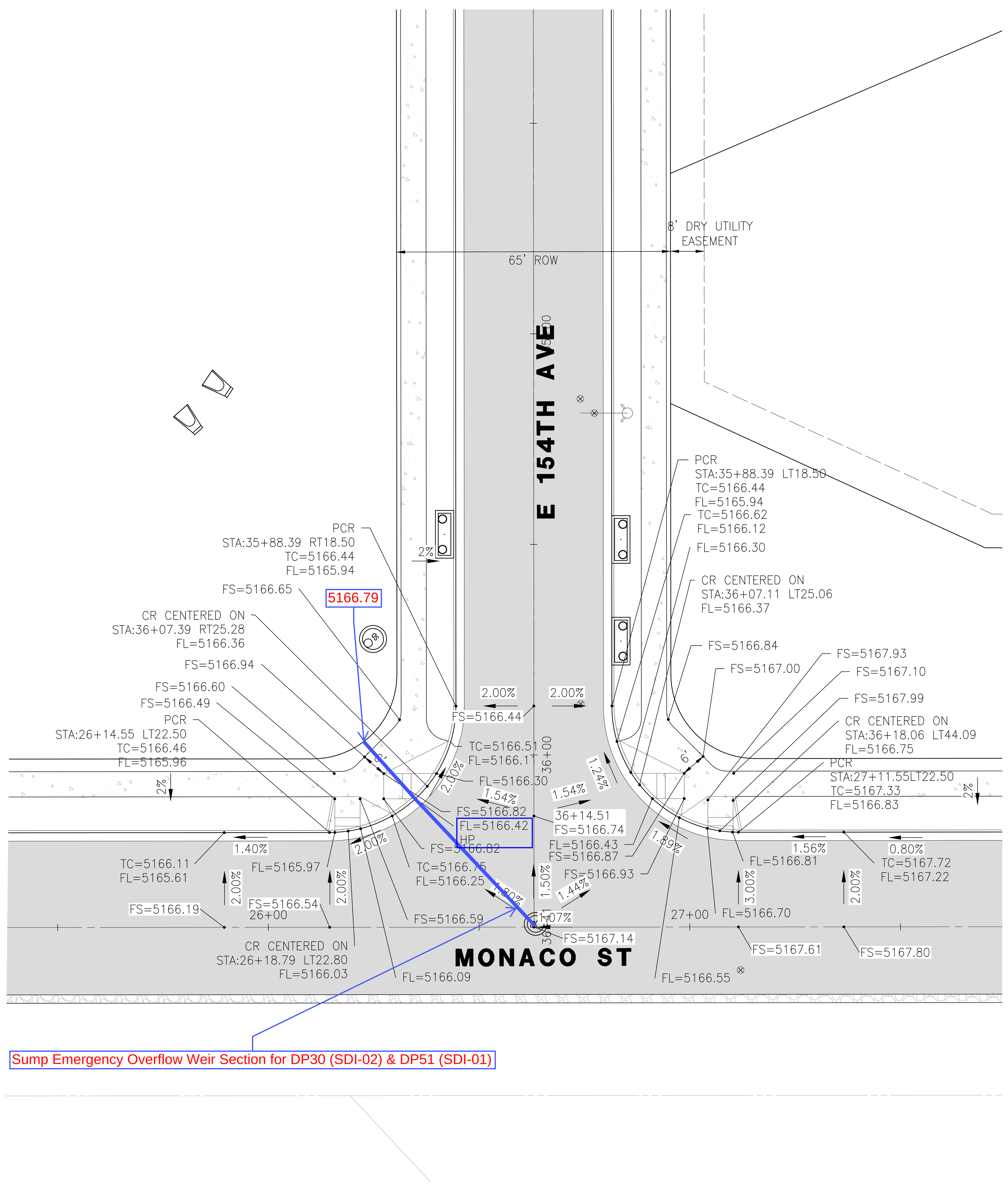
Channel Analysis: Sump Overflow Weir - DP30 (SDI-02) & DP51 (SDI-01)

Notes:

Input Parameters

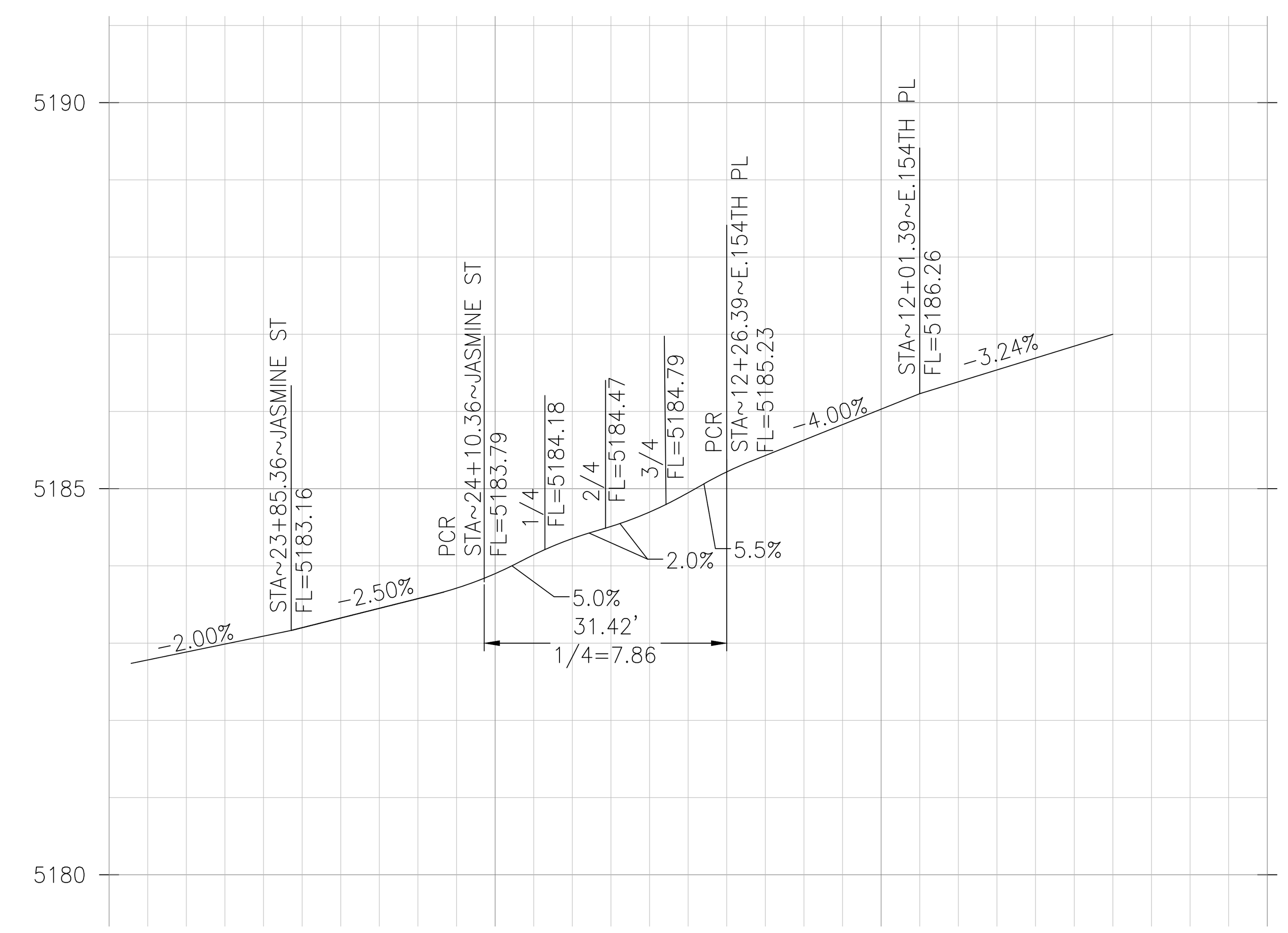
Channel Type: Custom Cross Section

Flow from Basin 30 (SDI-02) & Basin 51 (SDI-01) + bypass flow from SDI-20 & SDI-26



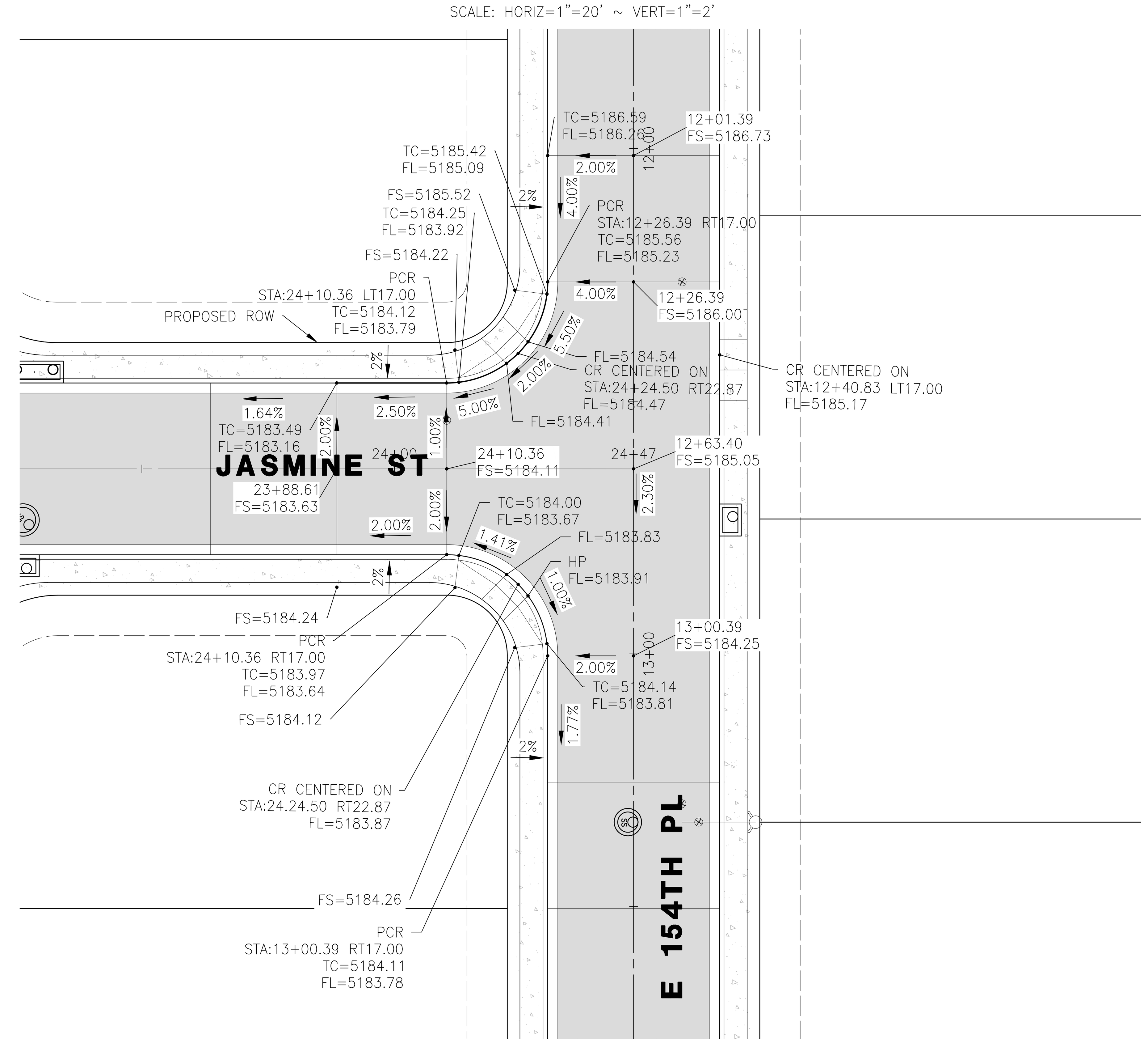
PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



PROFILE – WEST CURB RETURN PROFILE

SCALE: HORIZ=1"=20' ~ VERT=1"=2'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

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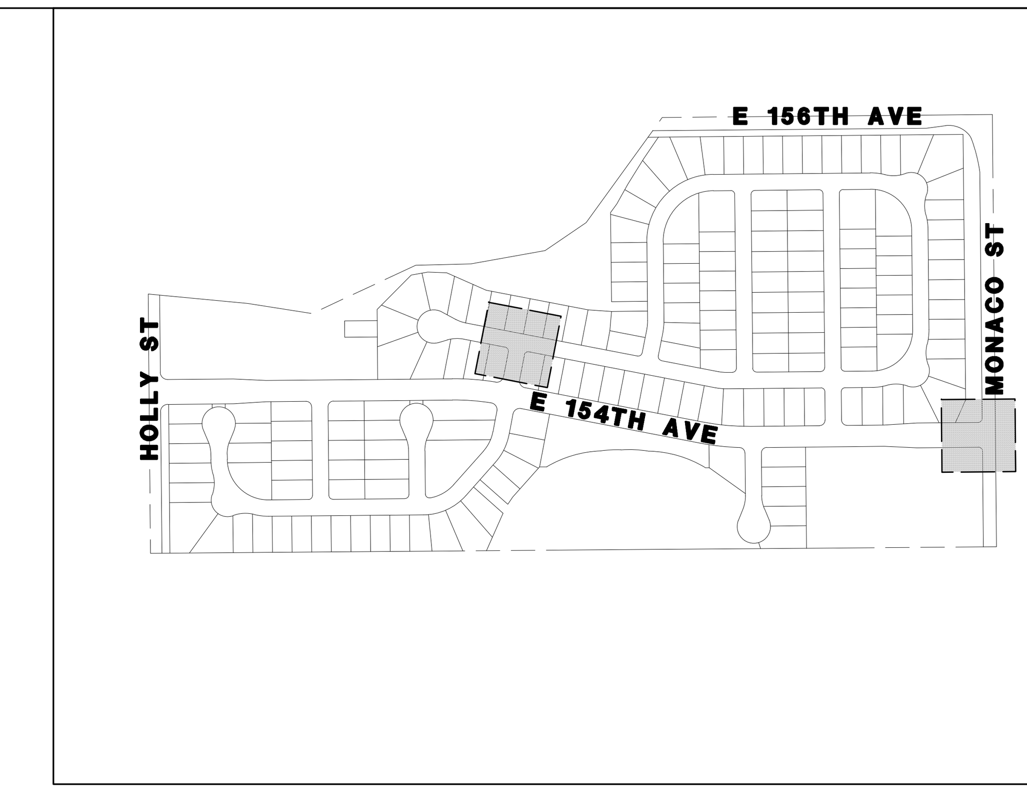

KEY MAP

SCALE 1"=500'

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

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SCALE:	N/A
DATE:	11/20/2020
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JOB NO:	D01104-A

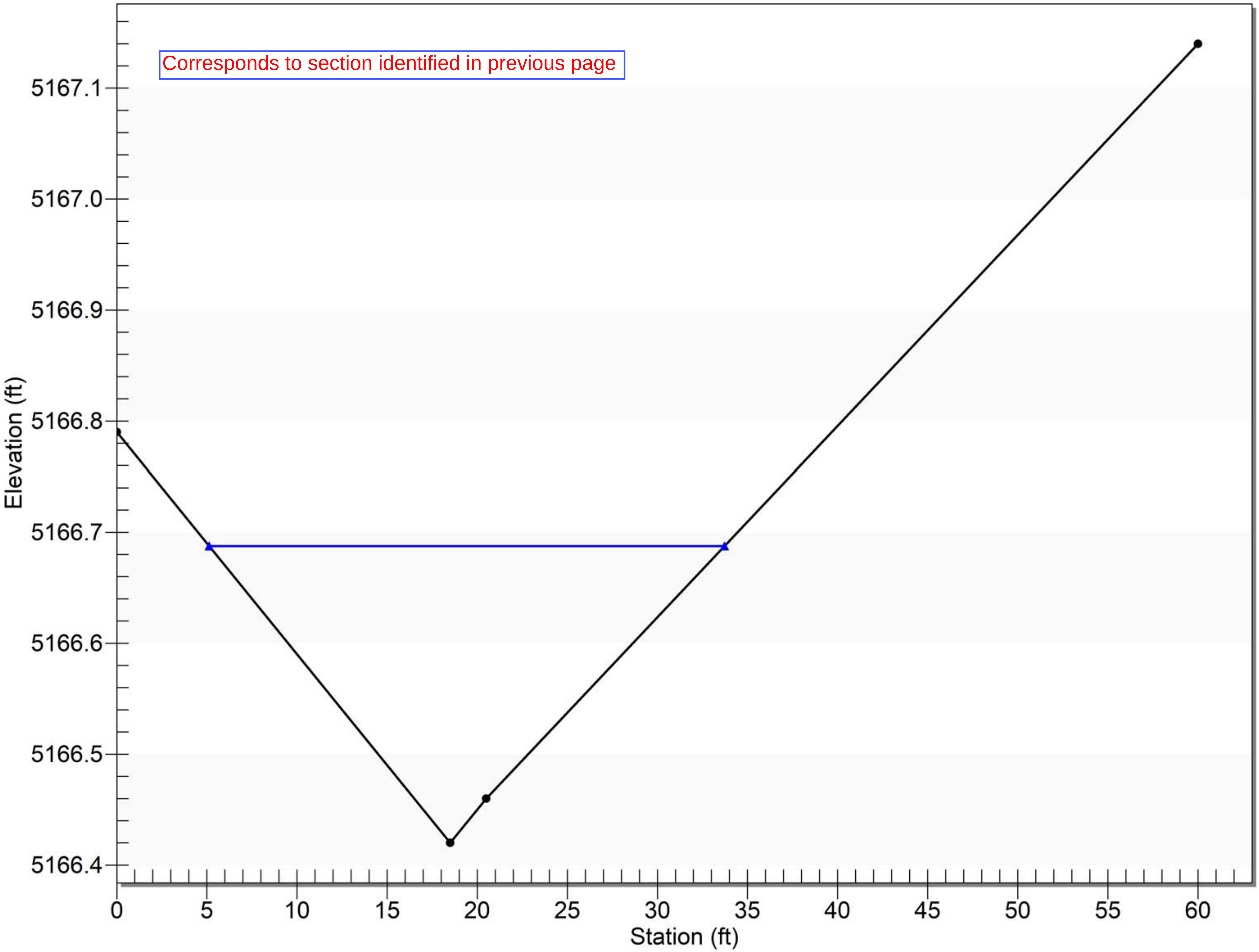
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-05

SHEET NO. 63 OF 172 SHEETS

DP30 (SDI-02) & DP51 (SDI-01) - Emergency Overflow Weir



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5166.79	0.0200
18.50	5166.42	0.0160
20.50	5166.46	0.0160
60.00	5167.14	-----

Corresponds to section identified in last two pages

Longitudinal Slope: 0.0200 ft/ft

Flow: 11.7000 cfs

Flow from Basin 30 (SDI-02) & Basin 51 (SDI-01) + bypass flow from SDI-20 & SDI-26

Result Parameters

Depth: 0.2675 ft

Area of Flow: 3.7881 ft^2

Wetted Perimeter: 28.5989 ft

Hydraulic Radius: 0.1325 ft

Average Velocity: 3.0886 ft/s

Top Width: 28.5939 ft

Froude Number: 1.4954

Critical Depth: 0.3137 ft

Critical Velocity: 2.2396 ft/s

Critical Slope: 0.0085 ft/ft

Critical Top Width: 33.59 ft

Calculated Max Shear Stress: 0.3339 lb/ft^2

Calculated Avg Shear Stress: 0.1653 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0177

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4

Hydraulic Analysis Report

Project Data

Project Title: JN:1104 Westwood - Emergency Overflow Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes:

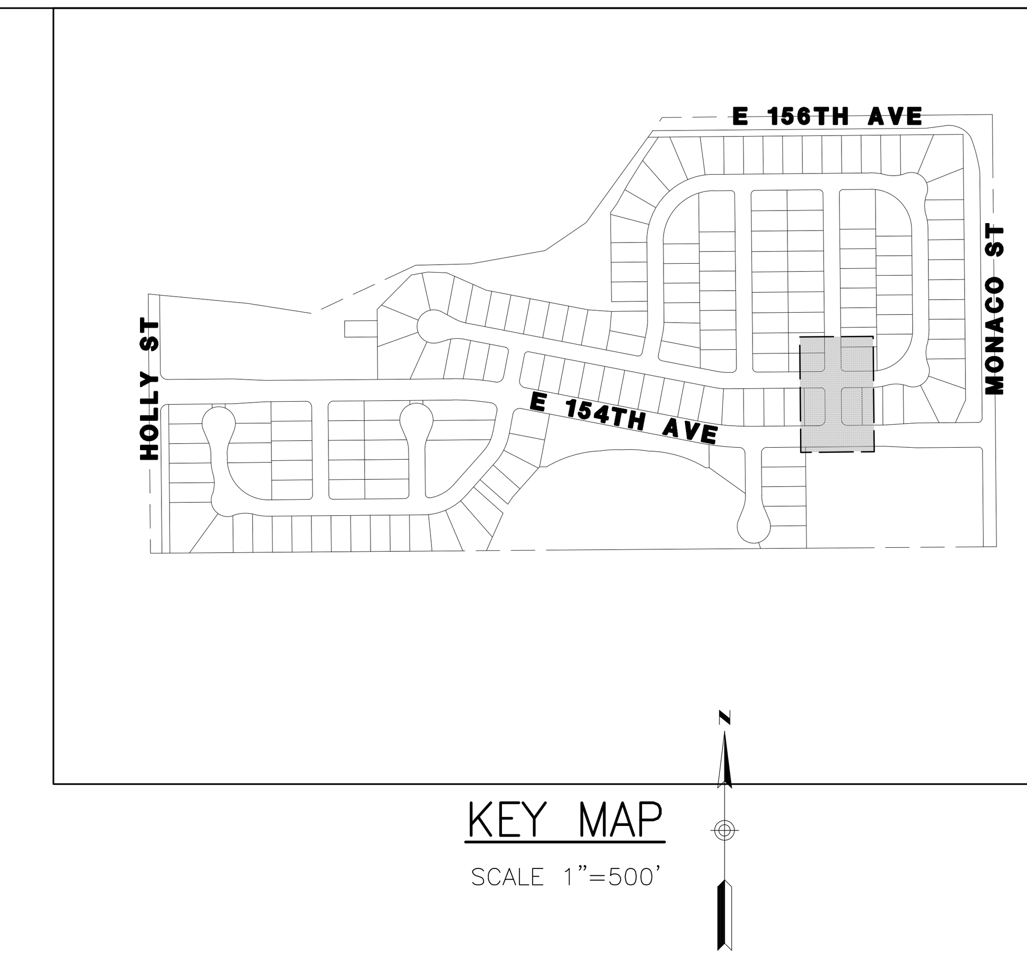
Channel Analysis: Sump Overflow Weir - DP20 (SDI-05) & DP26 (SDI-06)

Notes:

Input Parameters

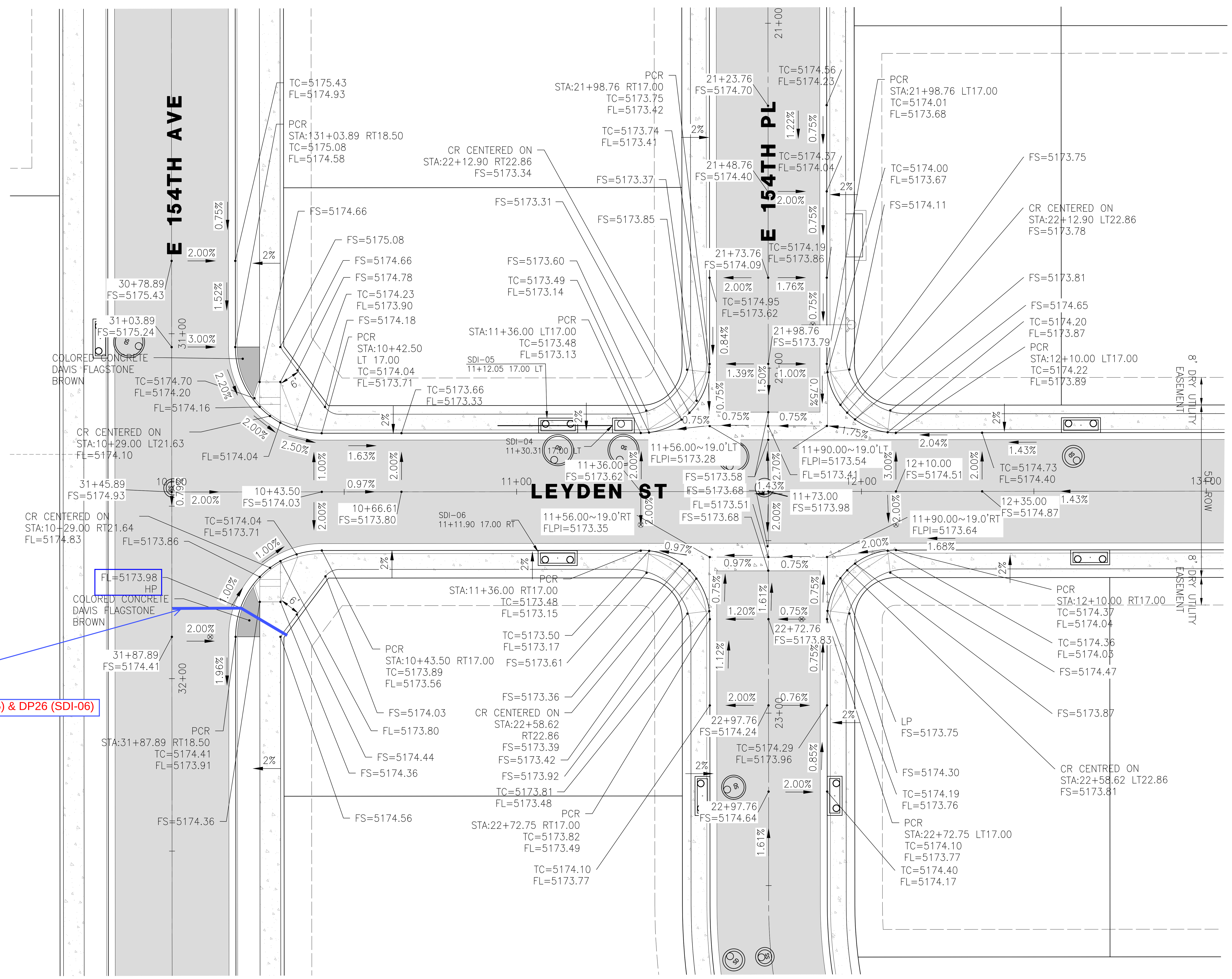
Channel Type: Custom Cross Section

Flow from Sub-Basin 20B (SDI-05) & Basin 26 (SDI-06) + bypass flow from SDI-04, SDI-21, SDI-09 & SDI-19



KEY MAP

SCALE 1"=500'



Sump Emergency Overflow Weir Section for DP20 (SDI-05) & DP26 (SDI-06)

PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

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JOB NO:	D01104-A

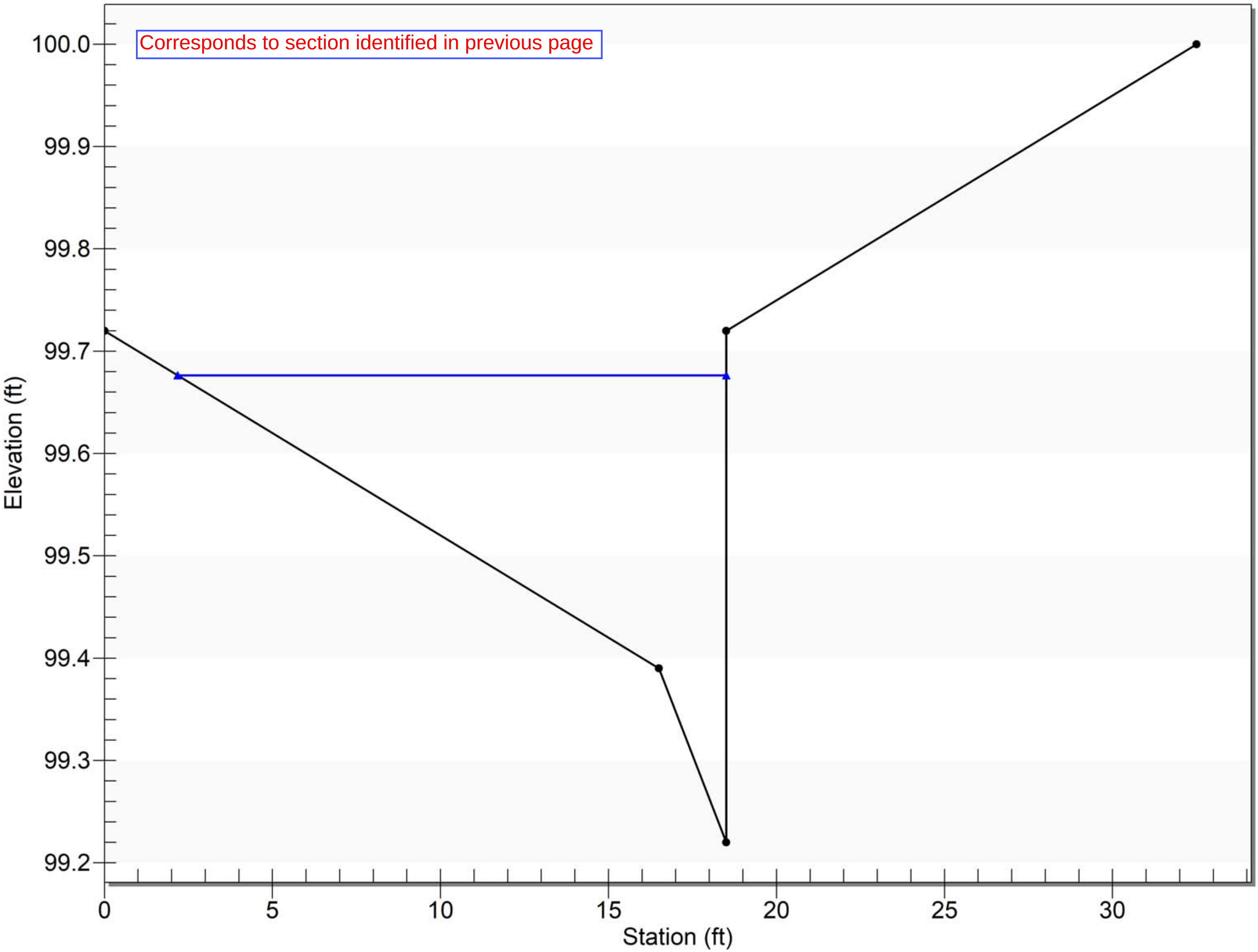
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-04

SHEET NO. 62 OF 172 SHEETS

DP20 (SDI-05) & DP26 (SDI-06) - Emergency Overflow Weir



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	99.72	0.0160
16.50	99.39	0.0160
18.50	99.22	0.0200
18.50	99.72	0.0200
32.50	100.00	-----

Corresponds to section identified in last two pages

Longitudinal Slope: 0.0196 ft/ft

Flow: 11.2000 cfs

Flow from Sub-Basin 20B (SDI-05) & Basin 26 (SDI-06) + bypass flow from SDI-04, SDI-21, SDI-09 & SDI-19

Result Parameters

Depth: 0.4565 ft

Area of Flow: 2.7948 ft^2

Wetted Perimeter: 16.7909 ft

Hydraulic Radius: 0.1664 ft

Average Velocity: 4.0074 ft/s

Top Width: 16.3243 ft

Froude Number: 1.7068

Critical Depth: 0.5385 ft

Critical Velocity: 2.6041 ft/s

Critical Slope: 0.0057 ft/ft

Critical Top Width: 20.42 ft

Calculated Max Shear Stress: 0.5583 lb/ft^2

Calculated Avg Shear Stress: 0.2036 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0157

Appendix B – Hydraulic Computations
Cross-Pan Capacity Check

All cross-pans have depth less than 3 inches during minor storm. Per Table 1-4, Chapter 1 of USDCM Vol.1 (page 1-19), 6 inches of depth allowed in local and collector streets.
All cross-pans have depth less than 4.3 inches during major storm. Per Table 1-4, Chapter 1 of USDCM Vol.1 (page 1-19), 12 inches of depth allowed in local and collector streets.

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4 (Typical)

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Cross-Pan Capacity Check

Designer:

Project Date: Sunday, November 22, 2020

Project Units: U.S. Customary Units

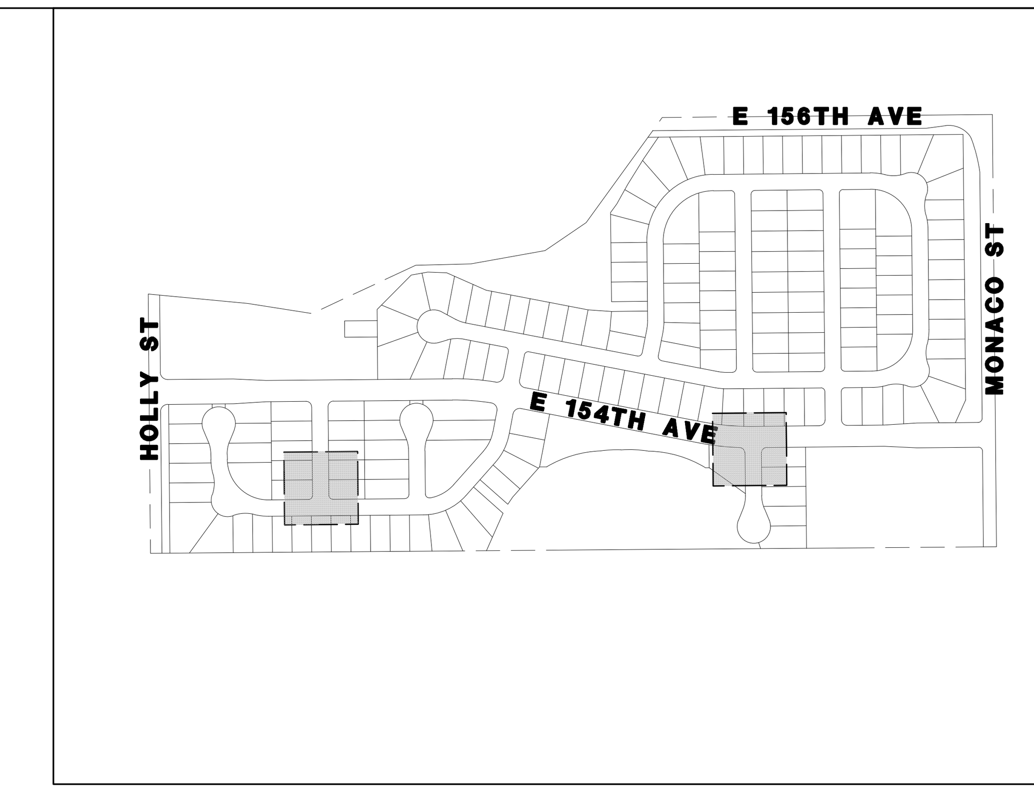
Notes:

Channel Analysis: Cross-Pan in Basin 43 - Ivy St & E 153rd Pl (Minor Storm)

Notes:

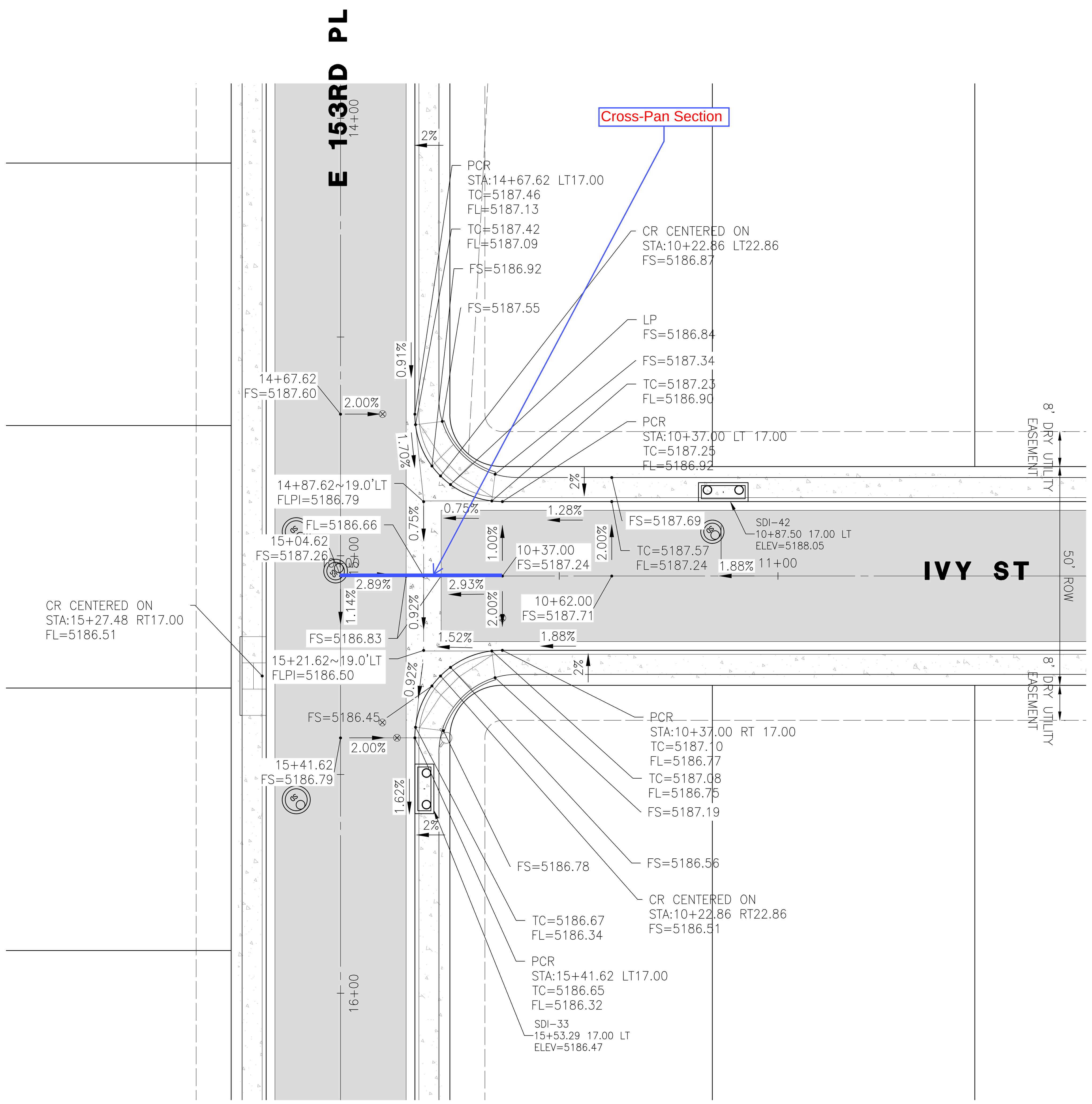
Input Parameters

Channel Type: Custom Cross Section



KEY MAP

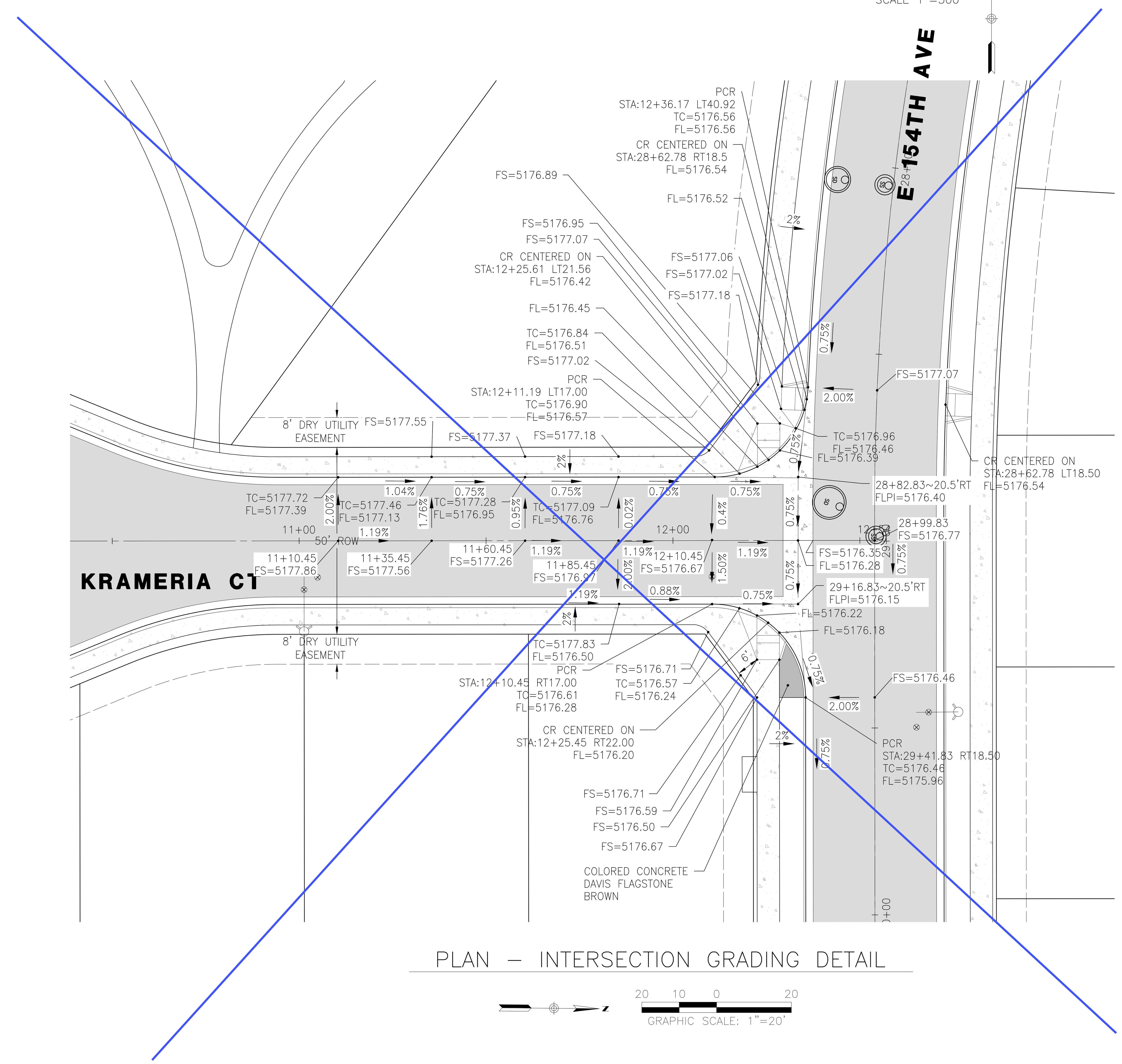
SCALE 1"=500'



PLAN – INTERSECTION GRADING DETAIL

20 10 0 20

GRAPHIC SCALE: 1"=20'



PLAN – INTERSECTION GRADING DETAIL

20 10 0 20

GRAPHIC SCALE: 1"=20'

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SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

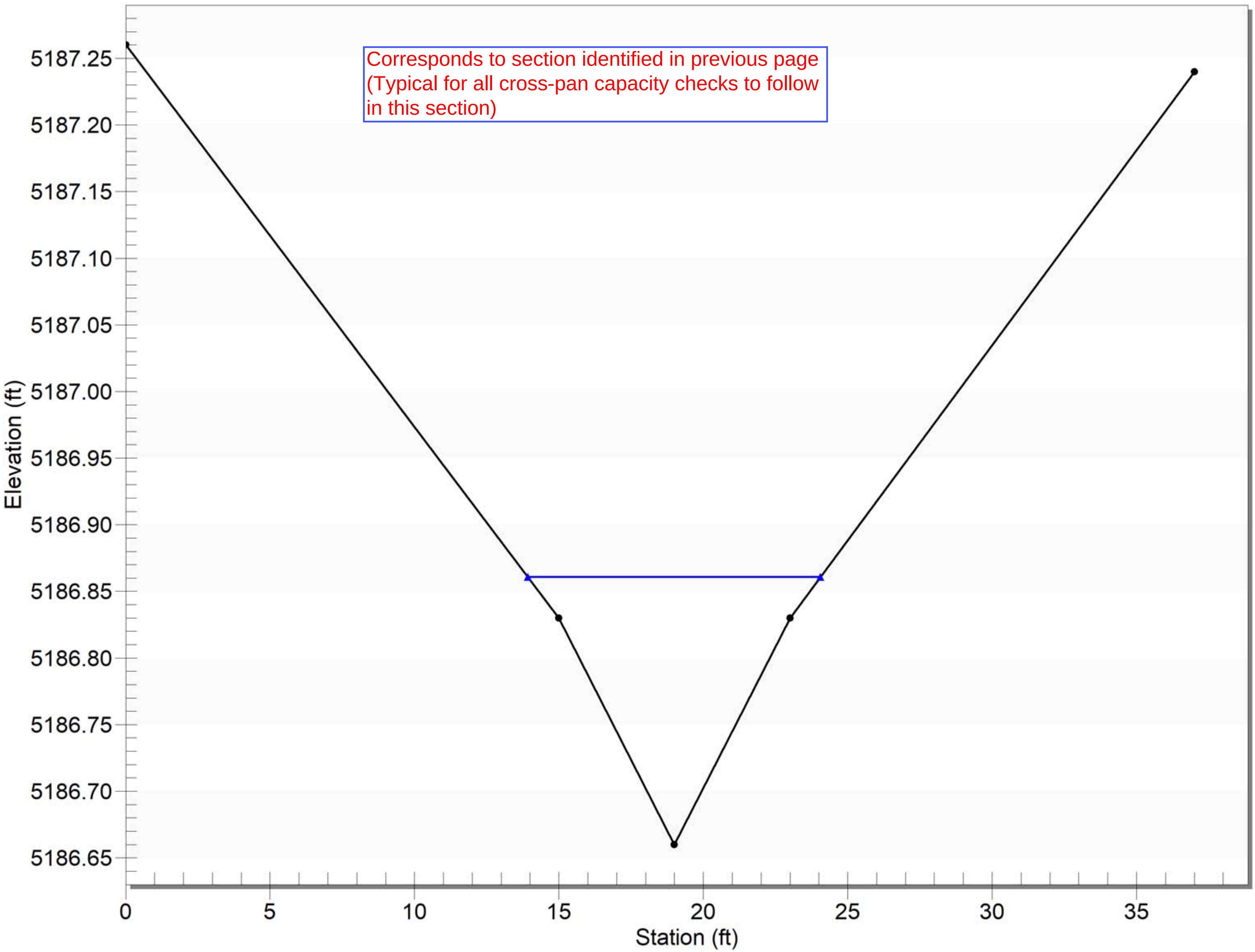
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IDG-08

SHEET NO. 66 OF 172 SHEETS

Cross-Pan in Basin 43 - Ivy St & E 153rd Pl (Minor Storm)



Corresponds to section identified in last two pages (Typical for all cross-pan capacity checks to follow in this section)

Cross Section Data

~~Elevation (ft)~~ Station (Typical)	Elevation (ft)	Manning's n
0.00	5187.26	0.0160
15.00	5186.83	0.0130
19.00	5186.66	0.0130
23.00	5186.83	0.0160
37.00	5187.24	-----

0.016 for asphalt street per Chapter 7, USDCM Vol.1, page 7-7
0.013 for concrete street and gutter per Chapter 7, USDCM Vol.1, page 7-7 (Typical for all cross-pan sections to follow)

Longitudinal Slope: 0.0075 ft/ft

Flow: 2.2000 cfs

Minor storm flow from Basin 43 to SDI-33

Result Parameters

Depth: 0.2010 ft

Area of Flow: 0.9611 ft^2

Wetted Perimeter: 10.1474 ft

Hydraulic Radius: 0.0947 ft

Average Velocity: 2.2891 ft/s

Top Width: 10.1393 ft

Froude Number: 1.3103

Critical Depth: 0.2235 ft

Critical Velocity: 1.8230 ft/s

Critical Slope: 0.0040 ft/ft

Critical Top Width: 11.69 ft

Calculated Max Shear Stress: 0.0941 lb/ft^2

Calculated Avg Shear Stress: 0.0443 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0117

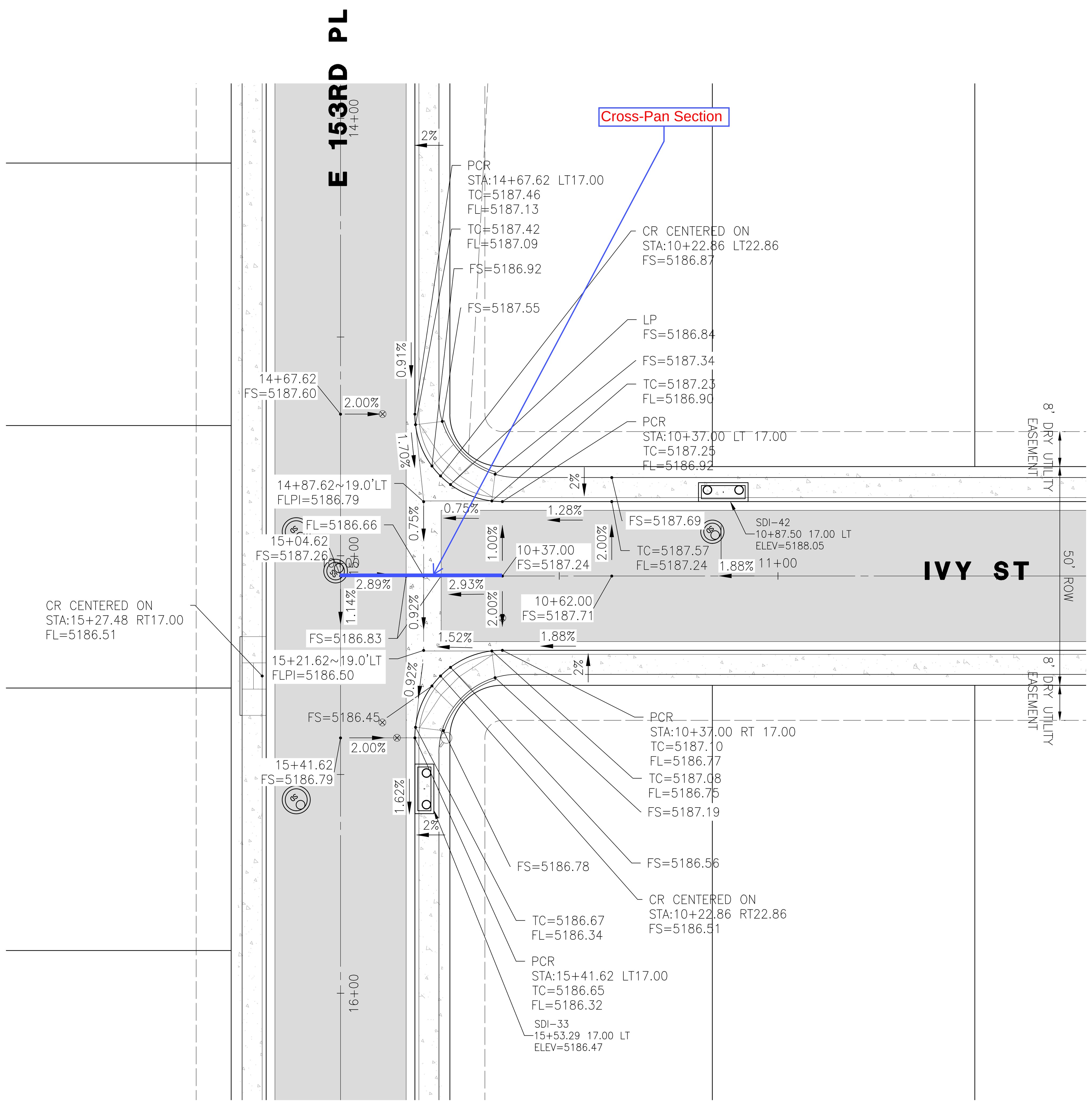
Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4 (Typical)

Channel Analysis: Cross-Pan in Basin 43 - Ivy St & E 153rd Pl (Major Storm)

Notes:

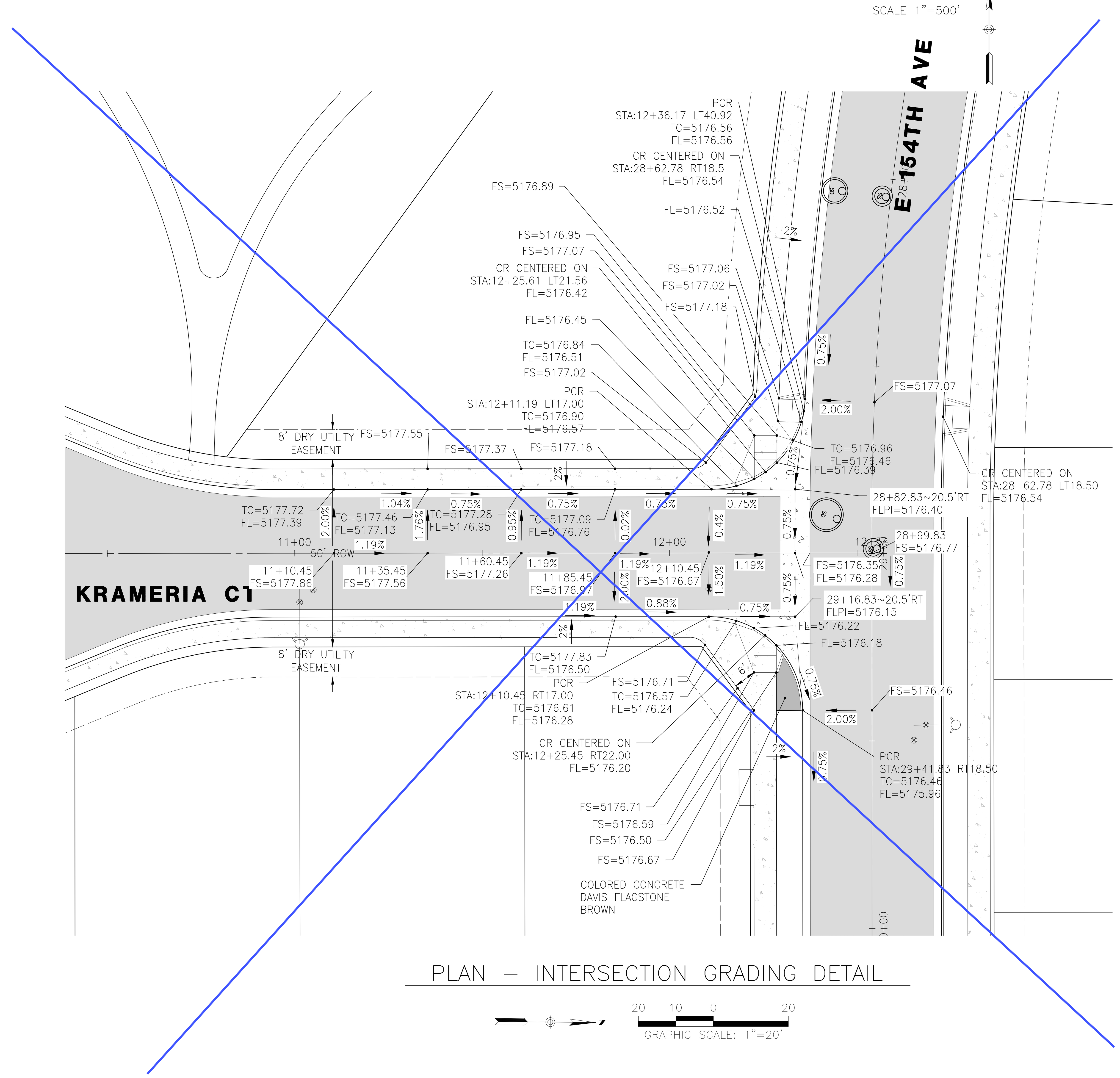
Input Parameters

Channel Type: Custom Cross Section



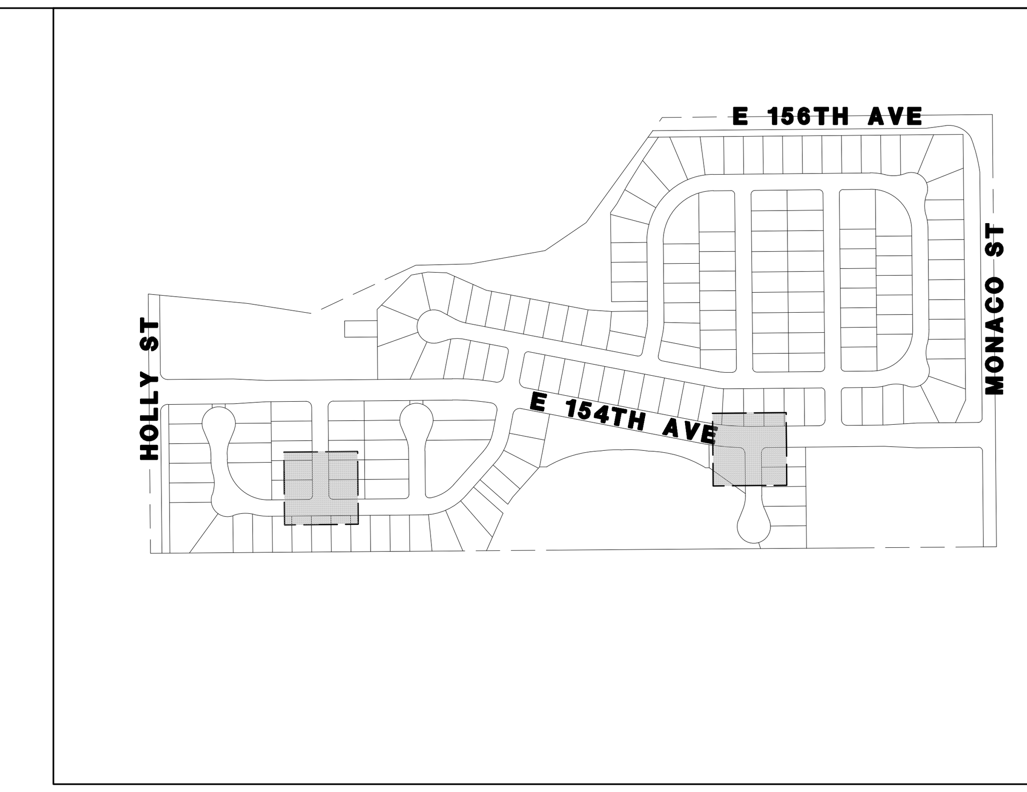
PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

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FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

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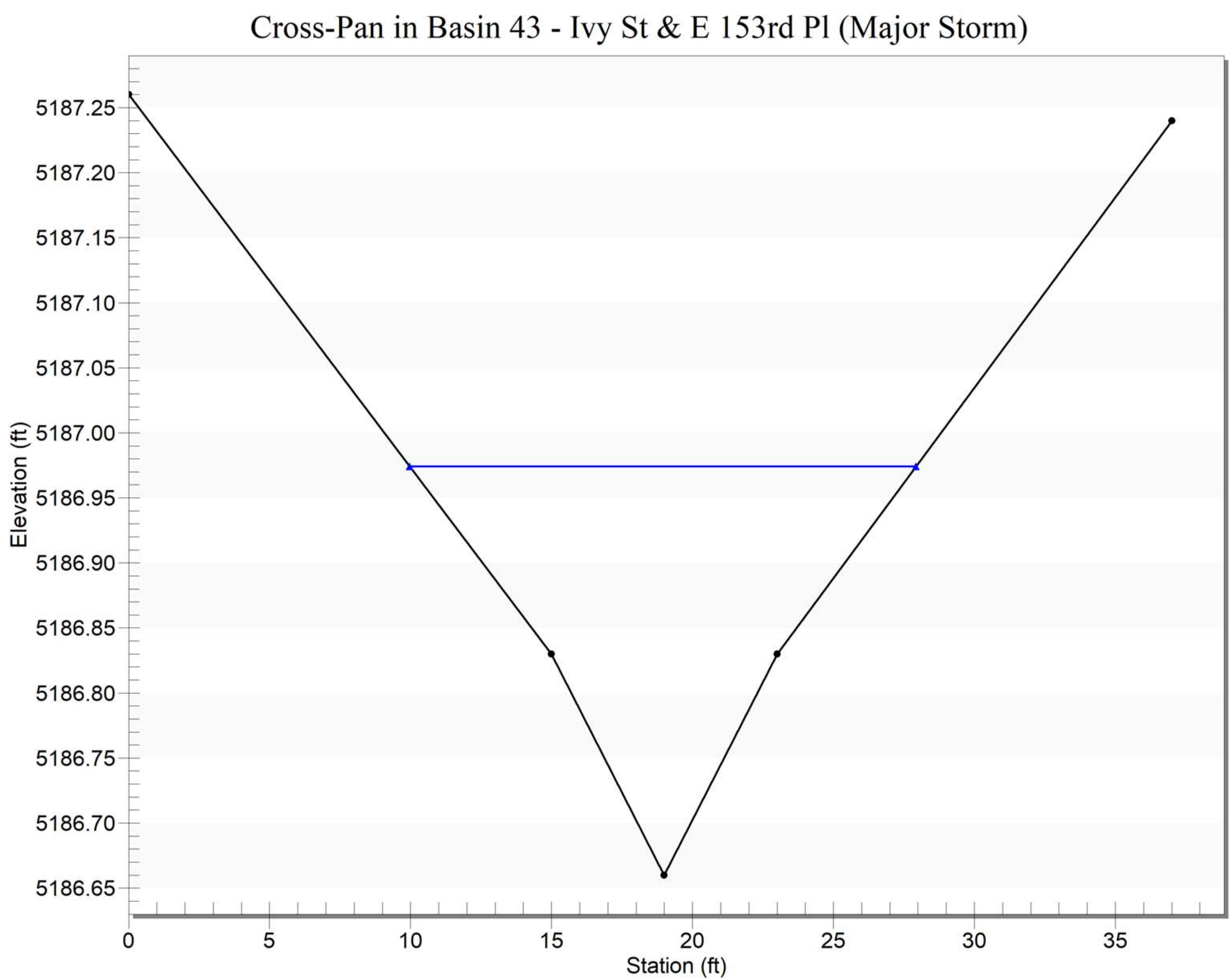
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IDG-08

SHEET NO. 66 OF 172 SHEETS


Cross-Pan in Basin 43 - Ivy St & E 153rd Pl (Major Storm)
Elevation (ft)
5187.25
5187.20
5187.15
5187.10
5187.05
5187.00
5186.95
5186.90
5186.85
5186.80
5186.75
5186.70
5186.65
Station (ft)
0
5
10
15
20
25
30
35

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5187.26	0.0160
15.00	5186.83	0.0130
19.00	5186.66	0.0130
23.00	5186.83	0.0160
37.00	5187.24	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 7.8000 cfs

Major storm flow from Basin 43 (SDI-33) + bypass flow from SDI-31 & SDI-42

Result Parameters

Depth: 0.3143 ft

Area of Flow: 2.5530 ft^2

Wetted Perimeter: 17.9719 ft

Hydraulic Radius: 0.1421 ft

Average Velocity: 3.0553 ft/s

Top Width: 17.9605 ft

Froude Number: 1.4281

Critical Depth: 0.3583 ft

Critical Velocity: 2.2869 ft/s

Critical Slope: 0.0037 ft/ft

Critical Top Width: 21.00 ft

Calculated Max Shear Stress: 0.1471 lb/ft^2

Calculated Avg Shear Stress: 0.0665 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0115

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Cross-Pan Capacity Check

Designer:

Project Date: Sunday, November 22, 2020

Project Units: U.S. Customary Units

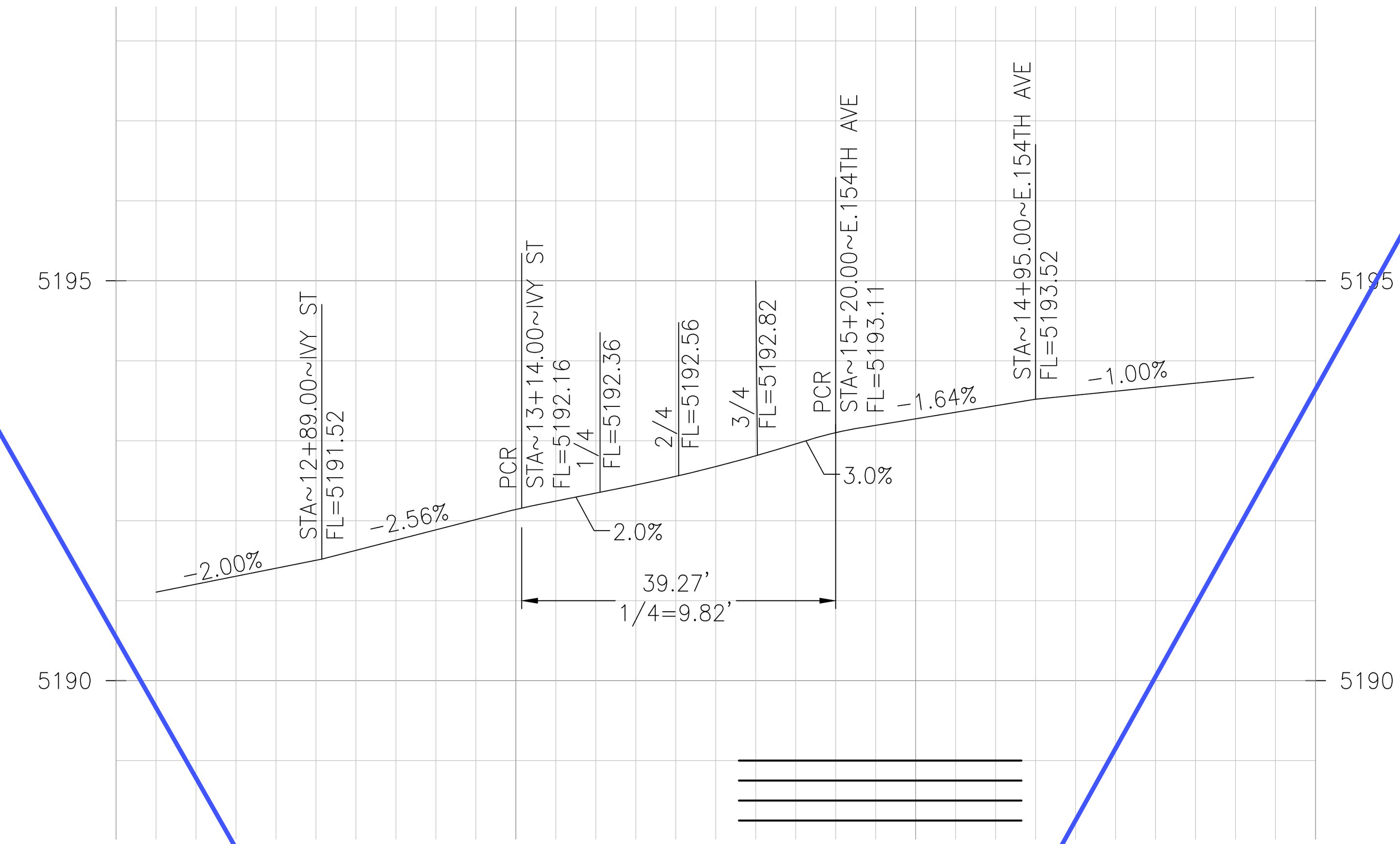
Notes:

Channel Analysis: Cross-Pan in Basin 44 - Jersey Ct & E 153rd Pl (Minor Storm)

Notes:

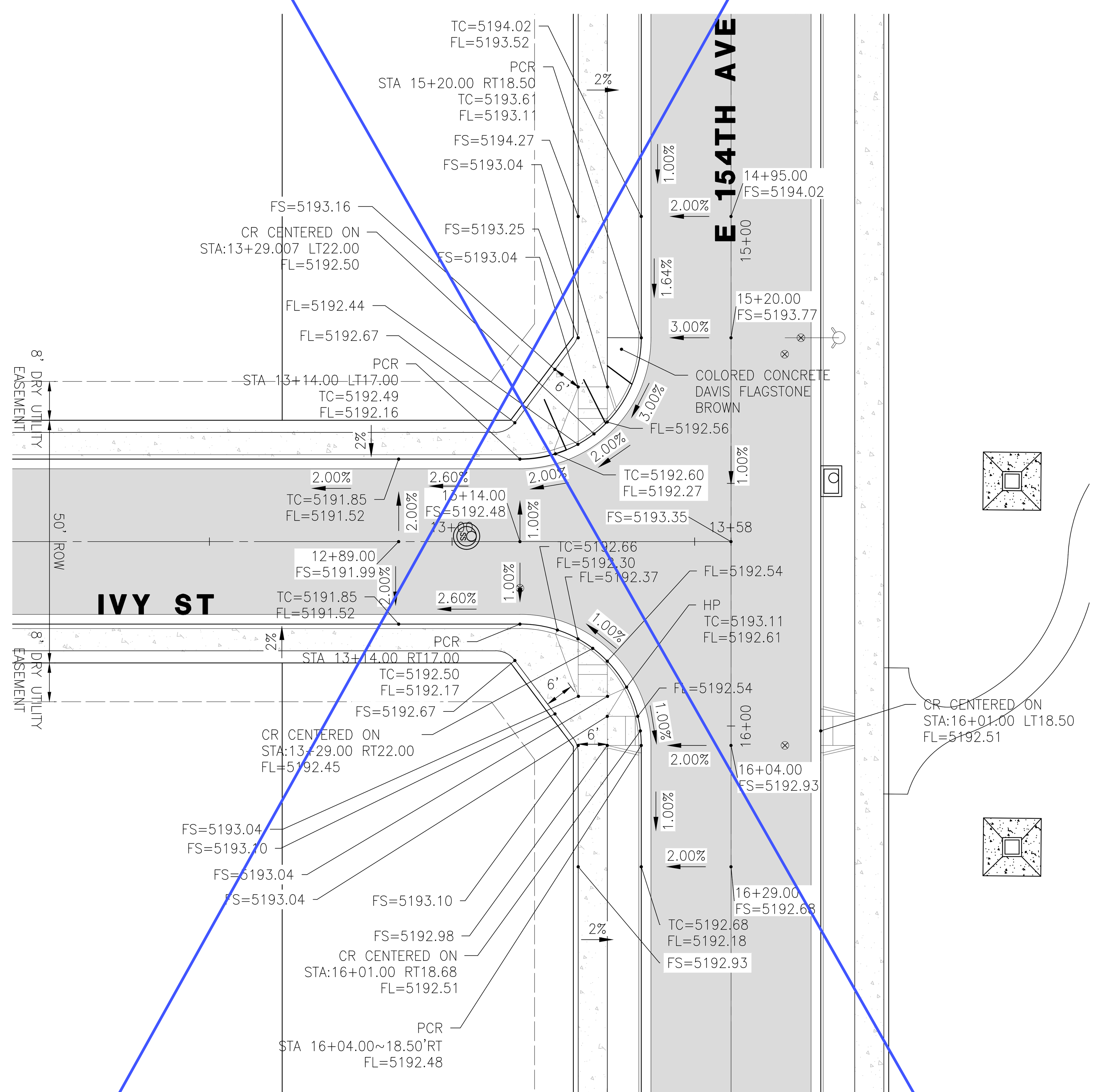
Input Parameters

Channel Type: Custom Cross Section



PROFILE — WEST CURB RETURN PROFILE

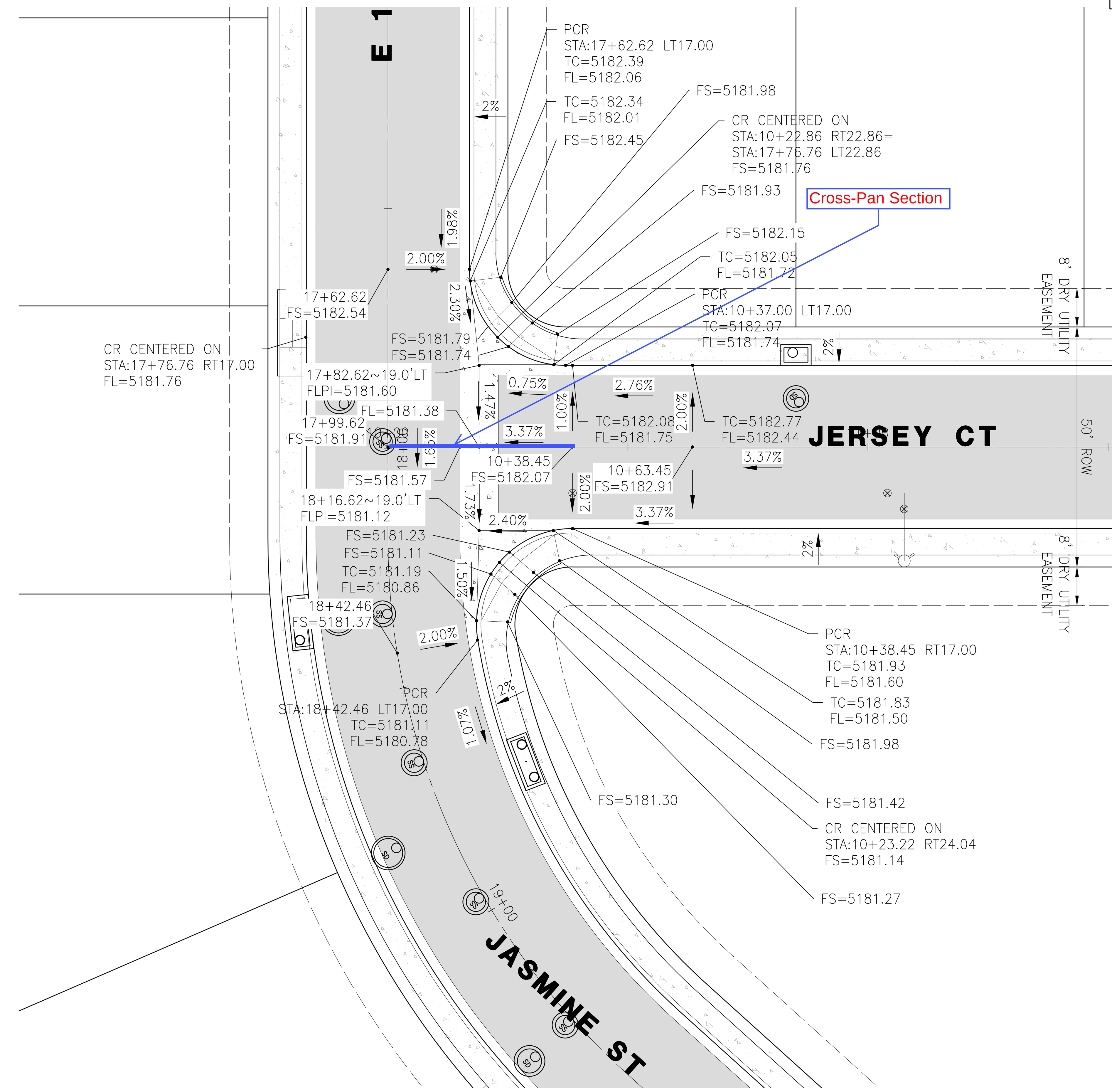
SCALE: HORIZ=1"=20' ~ VERT=1"=2'



PLAN — INTERSECTION GRADING DETAIL

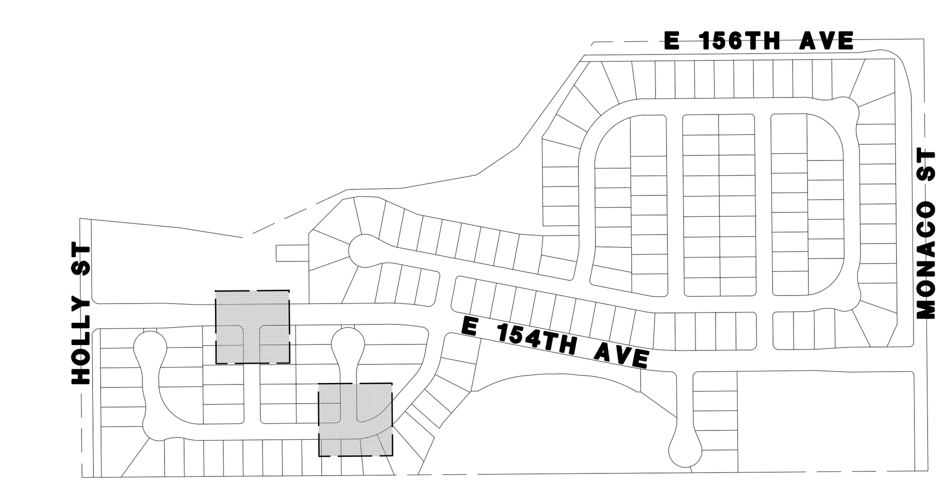
20 10 0 20
GRAPHIC SCALE: 1"=20'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.



PLAN — INTERSECTION GRADING DETAIL

20 10 0 20
GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

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SCALE:	N/A
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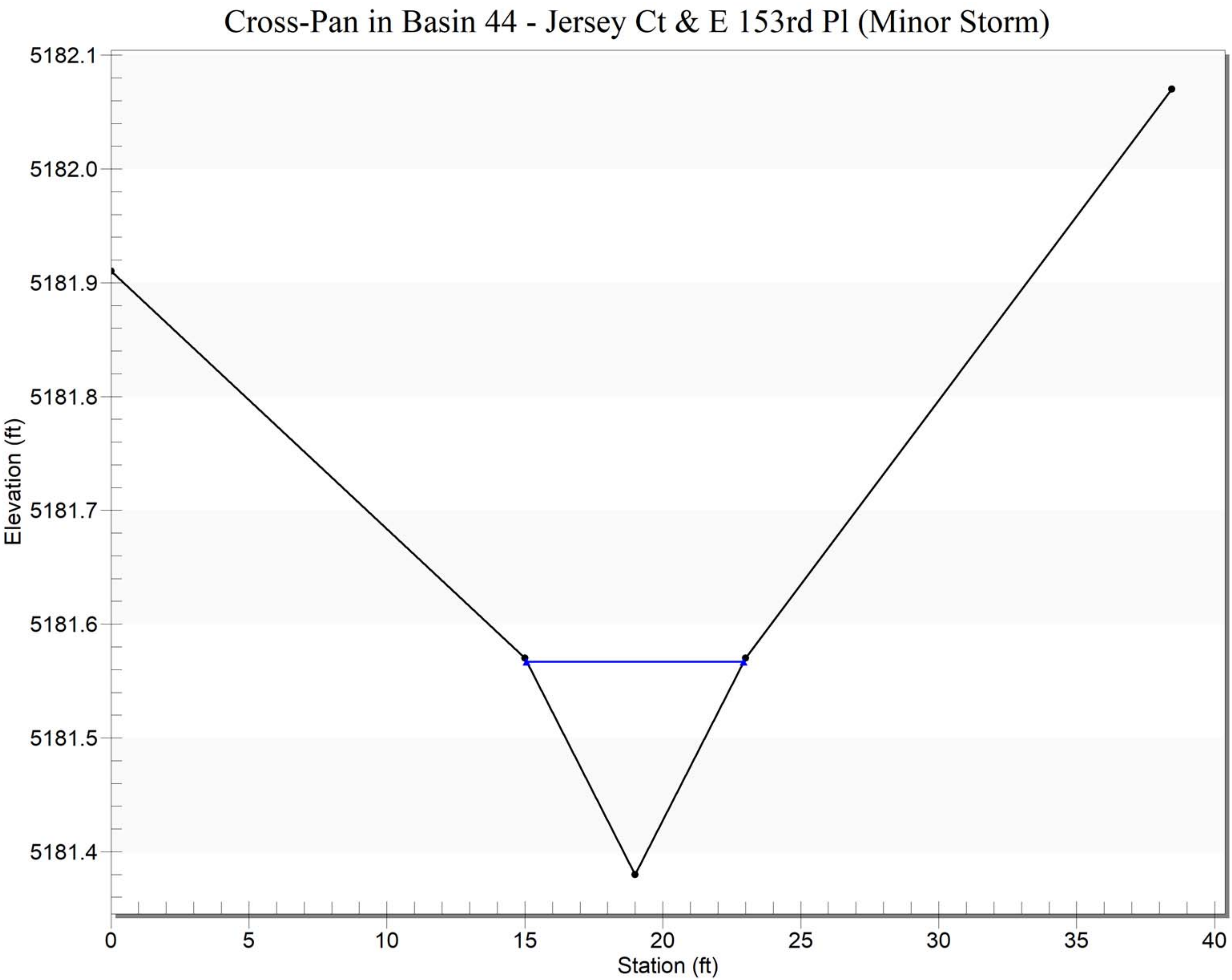
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-03

SHEET NO. 61 OF 172 SHEETS


Cross-Pan in Basin 44 - Jersey Ct & E 153rd Pl (Minor Storm)
Elevation (ft)
5182.1
5182.0
5181.9
5181.8
5181.7
5181.6
5181.5
5181.4
0
5
10
15
20
25
30
35
40
Station (ft)

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5181.91	0.0160
15.00	5181.57	0.0130
19.00	5181.38	0.0130
23.00	5181.57	0.0160
38.45	5182.07	-----

Longitudinal Slope: 0.0147 ft/ft

Flow: 2.1000 cfs

Minor storm flow from Basin 44 to SDI-35

Result Parameters

Depth: 0.1870 ft

Area of Flow: 0.7361 ft^2

Wetted Perimeter: 7.8822 ft

Hydraulic Radius: 0.0934 ft

Average Velocity: 2.8528 ft/s

Top Width: 7.8733 ft

Froude Number: 1.6442

Critical Depth: 0.2308 ft

Critical Velocity: 1.8287 ft/s

Critical Slope: 0.0040 ft/ft

Critical Top Width: 11.06 ft

Calculated Max Shear Stress: 0.1715 lb/ft^2

Calculated Avg Shear Stress: 0.0857 lb/ft^2

Composite Manning's n Equation: Lotter method

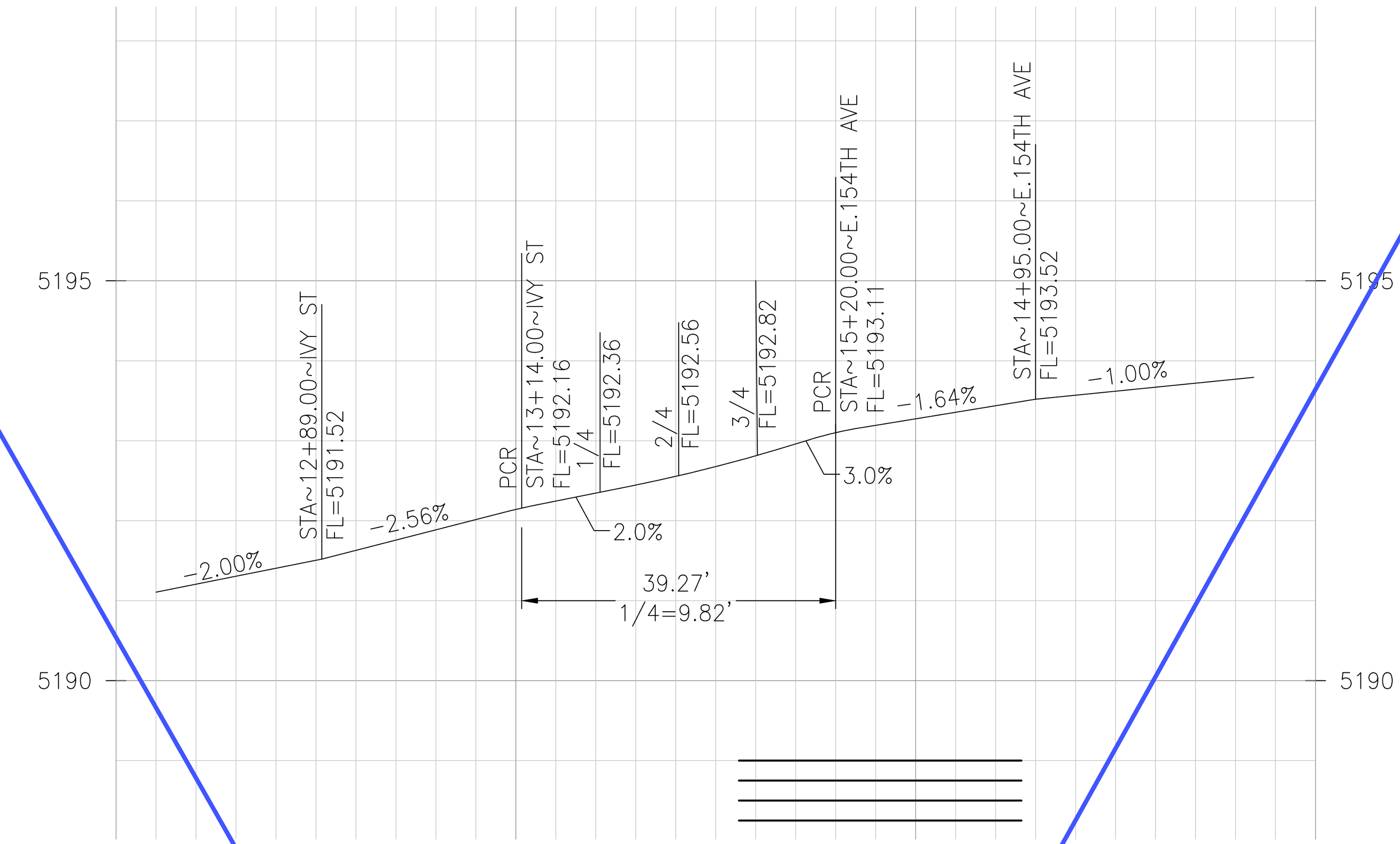
Manning's n: 0.0130

Channel Analysis: Cross-Pan in Basin 44 - Jersey Ct & E 153rd Pl (Major Storm)

Notes:

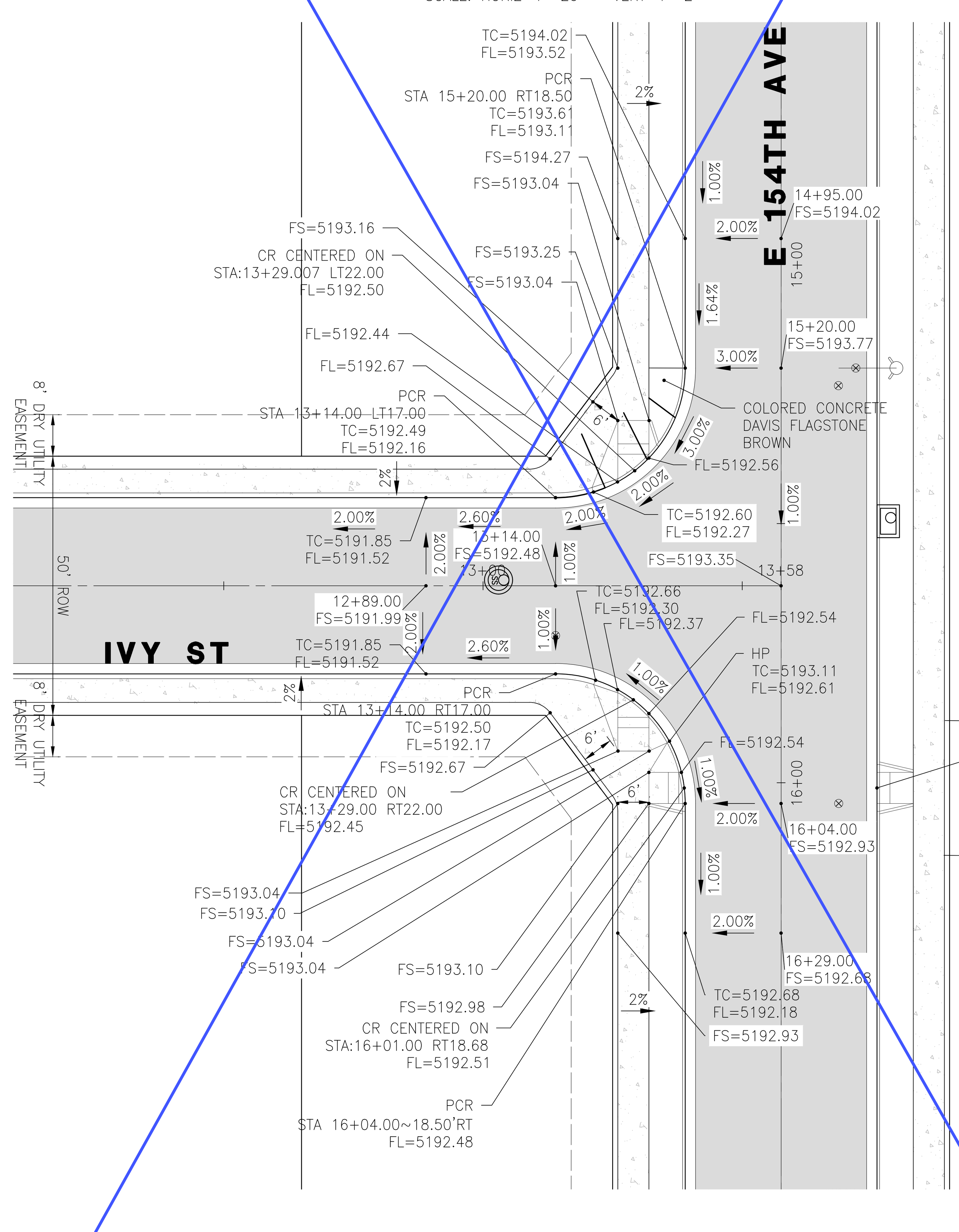
Input Parameters

Channel Type: Custom Cross Section



PROFILE – WEST CURB RETURN PROFILE

SCALE: HORIZ=1"=20' ~ VERT=1"=2'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

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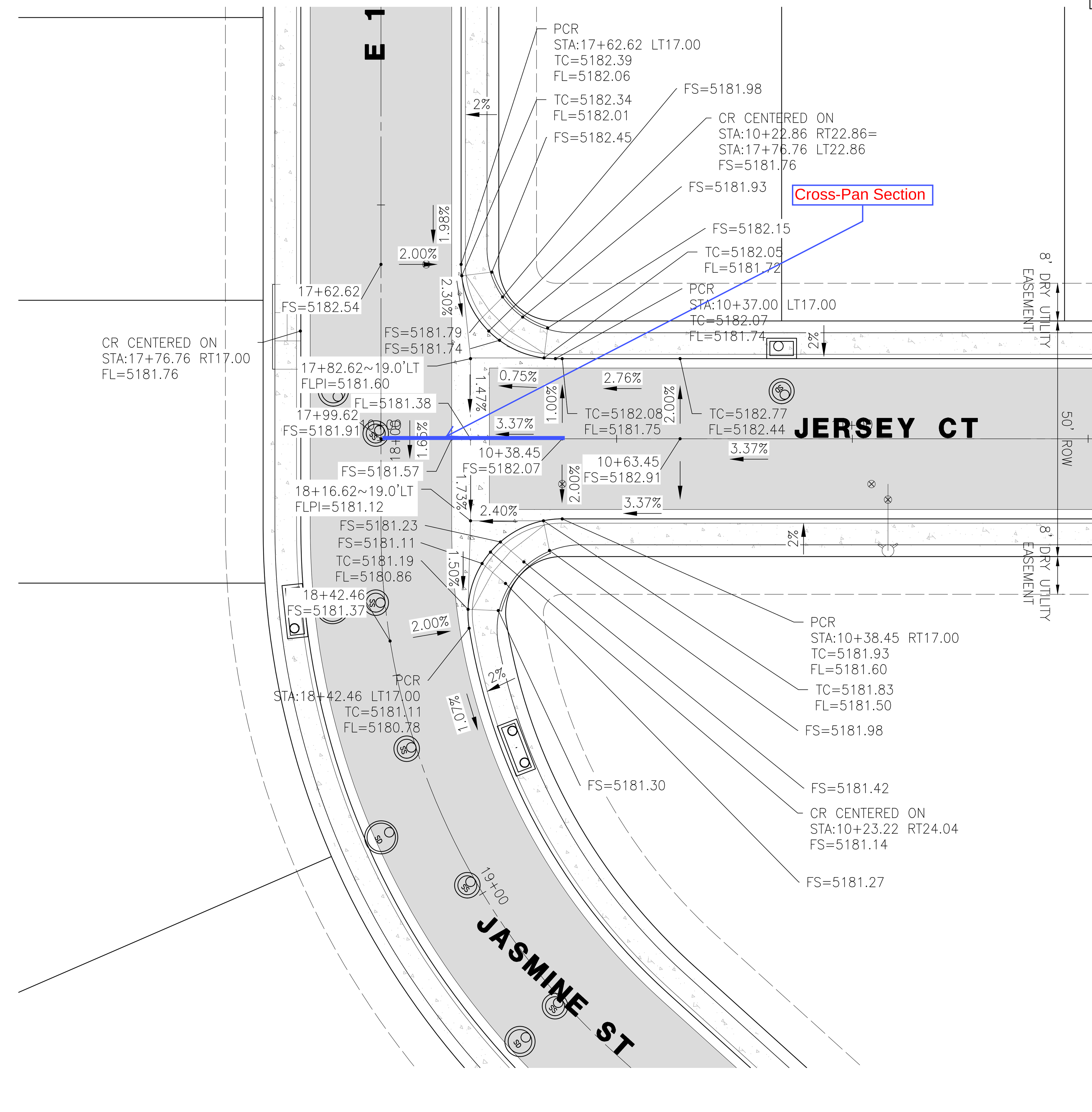
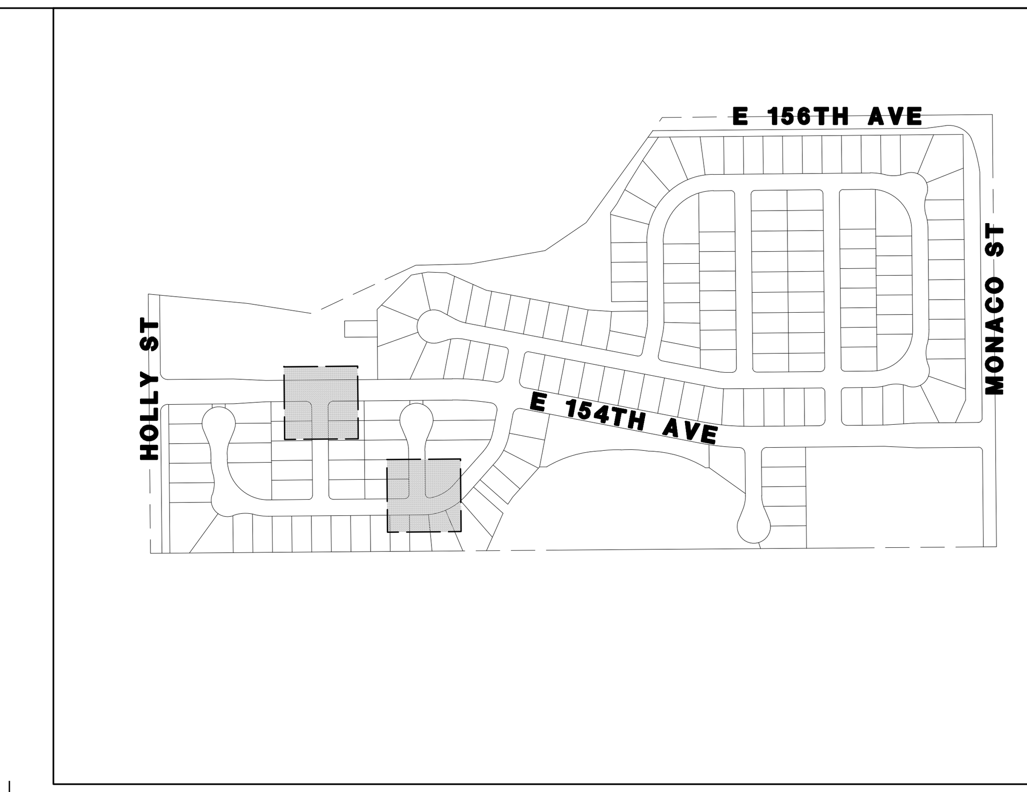


PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

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SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

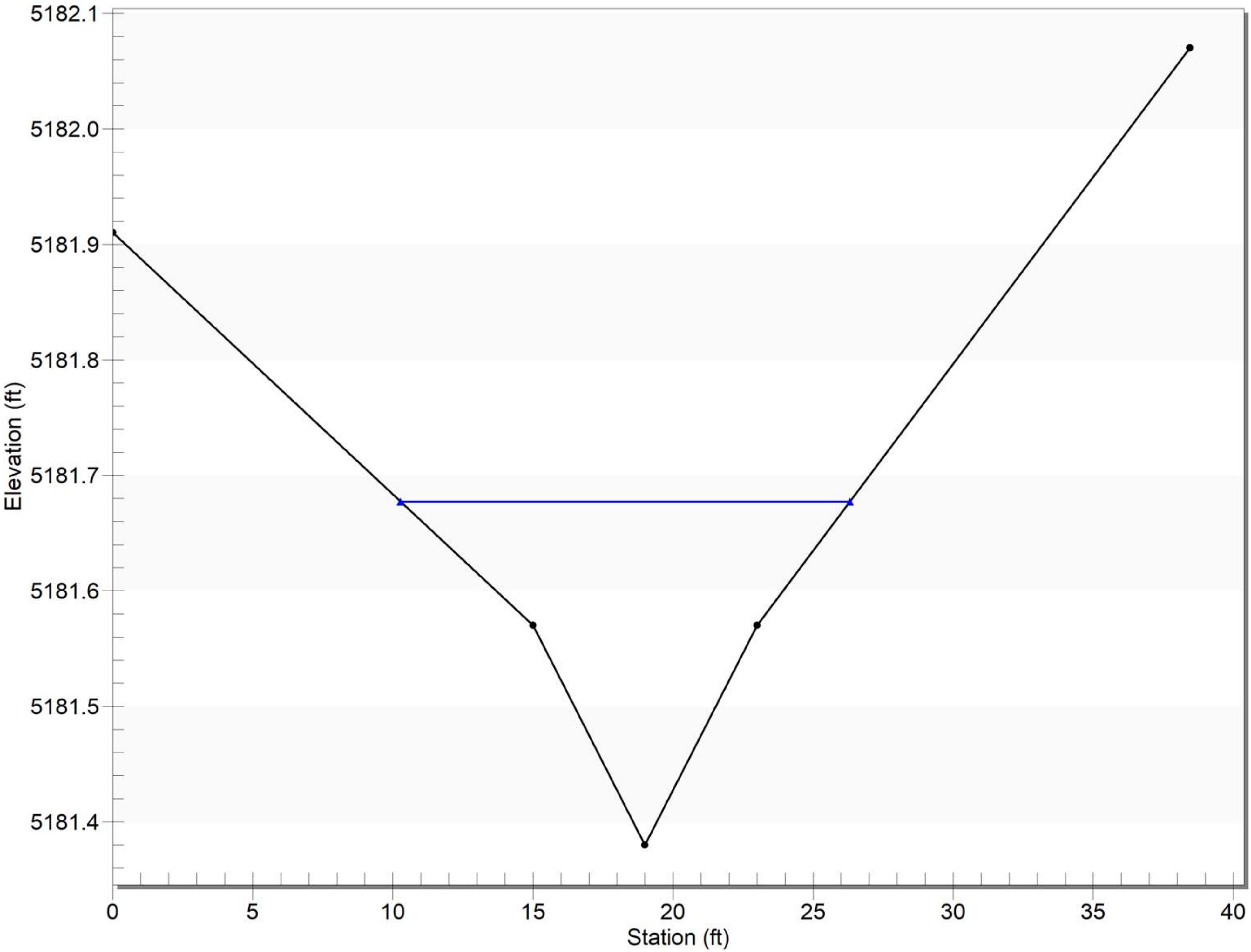
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-03

SHEET NO. 61 OF172 SHEETS

Cross-Pan in Basin 44 - Jersey Ct & E 153rd Pl (Major Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5181.91	0.0160
15.00	5181.57	0.0130
19.00	5181.38	0.0130
23.00	5181.57	0.0160
38.45	5182.07	-----

Longitudinal Slope: 0.0147 ft/ft

Flow: 8.4000 cfs

Major storm flow from Basin 44 (SDI-35) + bypass flow from SDI-39 & SDI-33

Result Parameters

Depth: 0.2971 ft

Area of Flow: 2.0472 ft^2

Wetted Perimeter: 16.0472 ft

Hydraulic Radius: 0.1276 ft

Average Velocity: 4.1031 ft/s

Top Width: 16.0352 ft

Froude Number: 2.0237

Critical Depth: 0.3811 ft

Critical Velocity: 2.2965 ft/s

Critical Slope: 0.0036 ft/ft

Critical Top Width: 22.33 ft

Calculated Max Shear Stress: 0.2725 lb/ft^2

Calculated Avg Shear Stress: 0.1170 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0111

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Cross-Pan Capacity Check

Designer:

Project Date: Sunday, November 22, 2020

Project Units: U.S. Customary Units

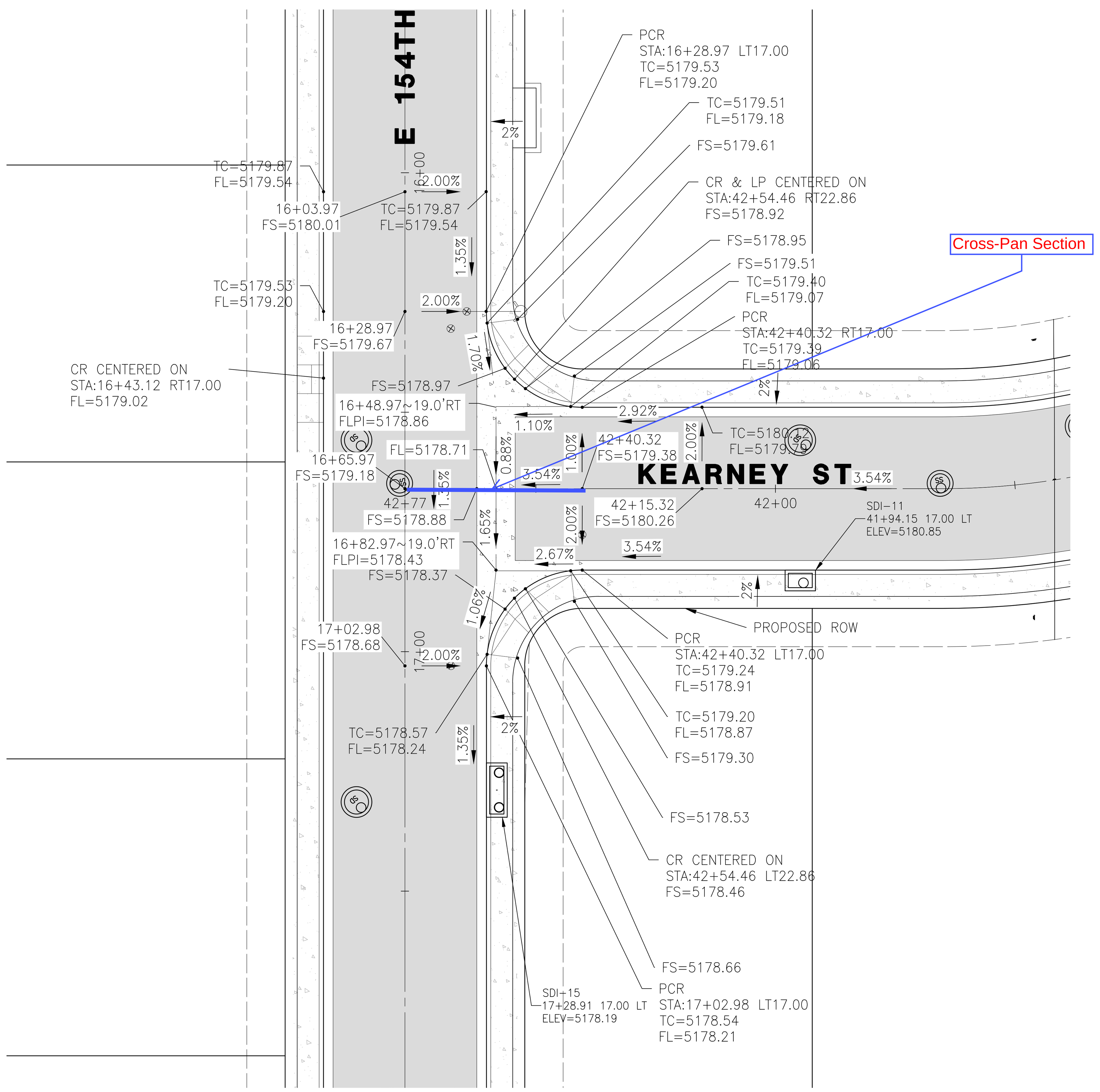
Notes:

Channel Analysis: Cross-Pan in Basin 48 - Kearney St & E 154th Pl (Minor Storm)

Notes:

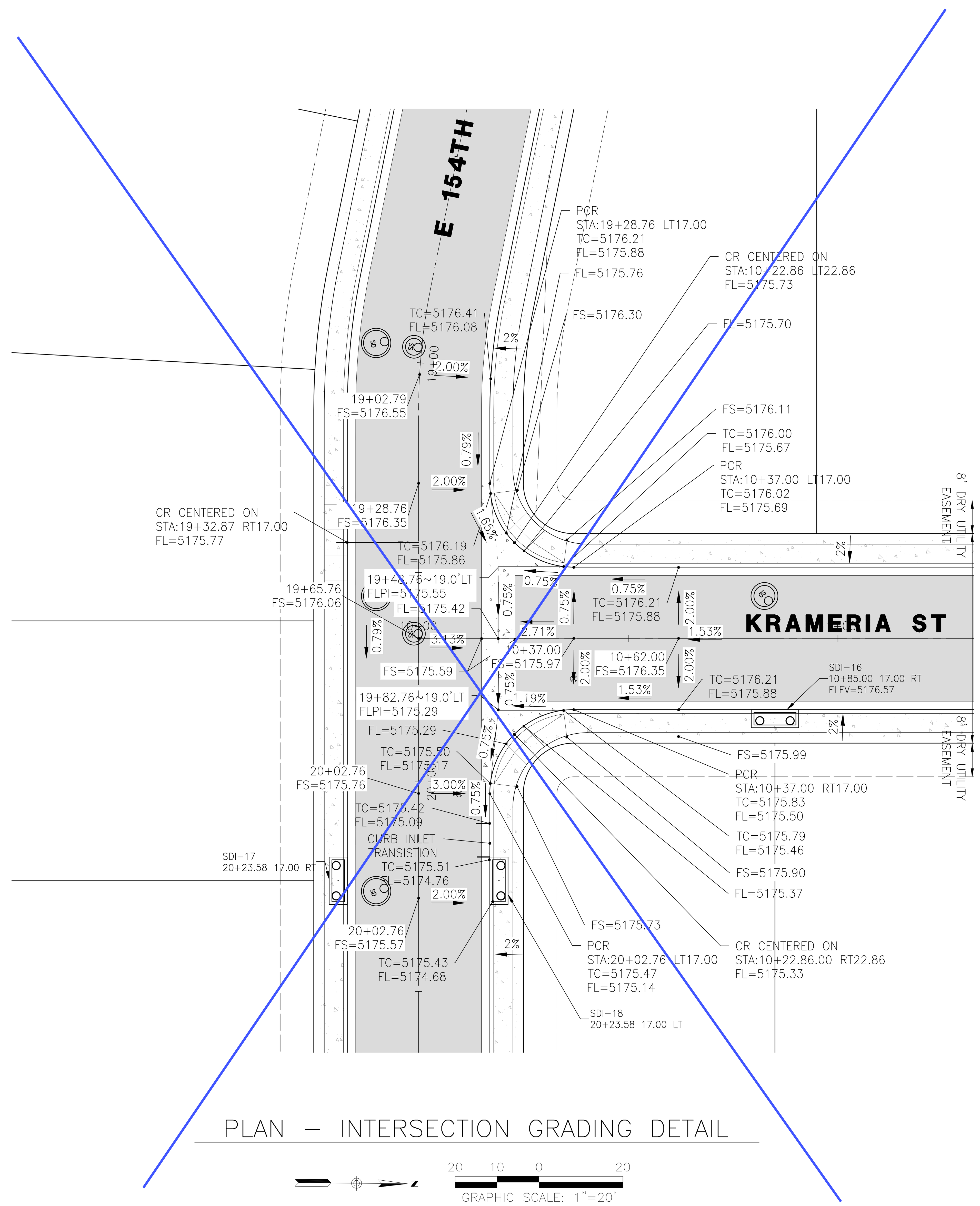
Input Parameters

Channel Type: Custom Cross Section



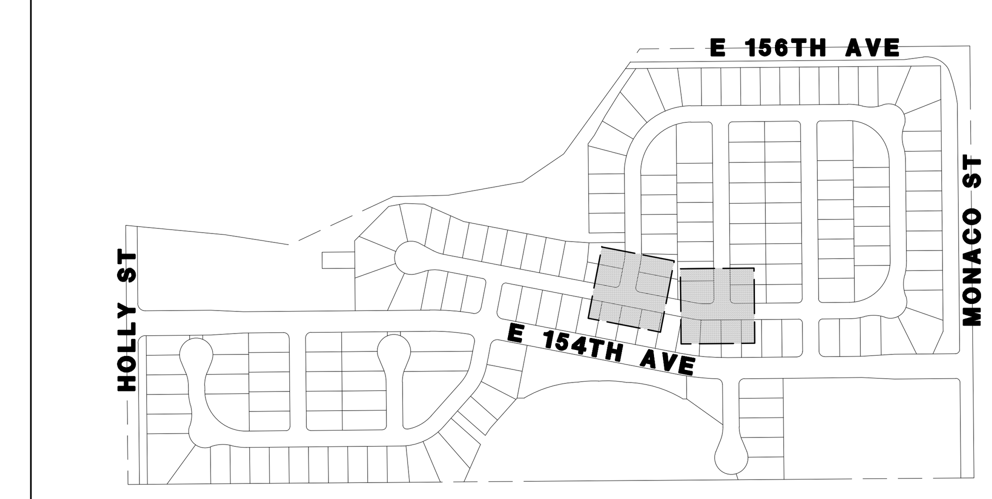
PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

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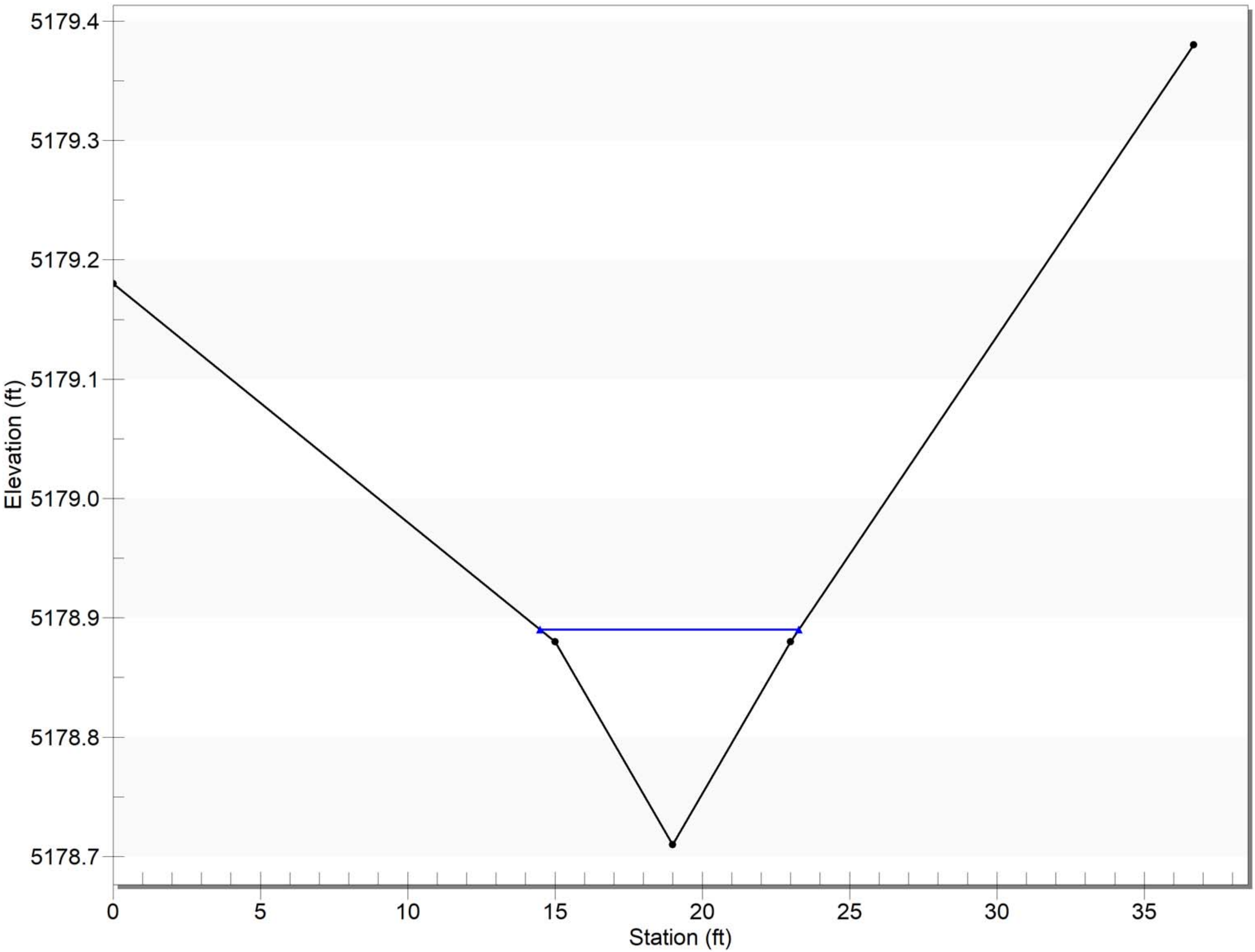
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-06

SHEET NO. 64 OF 172 SHEETS

Cross-Pan in Basin 48 - Kearney St & E 154th Pl (Minor Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5179.18	0.0160
15.00	5178.88	0.0130
19.00	5178.71	0.0130
23.00	5178.88	0.0160
36.68	5179.38	-----

Longitudinal Slope: 0.0088 ft/ft

Flow: 1.7000 cfs

Minor storm flow from Basin 48 to SDI-15

Result Parameters

Depth: 0.1801 ft

Area of Flow: 0.7648 ft^2

Wetted Perimeter: 8.7896 ft

Hydraulic Radius: 0.0870 ft

Average Velocity: 2.2227 ft/s

Top Width: 8.7821 ft

Froude Number: 1.3273

Critical Depth: 0.2025 ft

Critical Velocity: 1.7332 ft/s

Critical Slope: 0.0043 ft/ft

Critical Top Width: 10.51 ft

Calculated Max Shear Stress: 0.0989 lb/ft^2

Calculated Avg Shear Stress: 0.0478 lb/ft^2

Composite Manning's n Equation: Lotter method

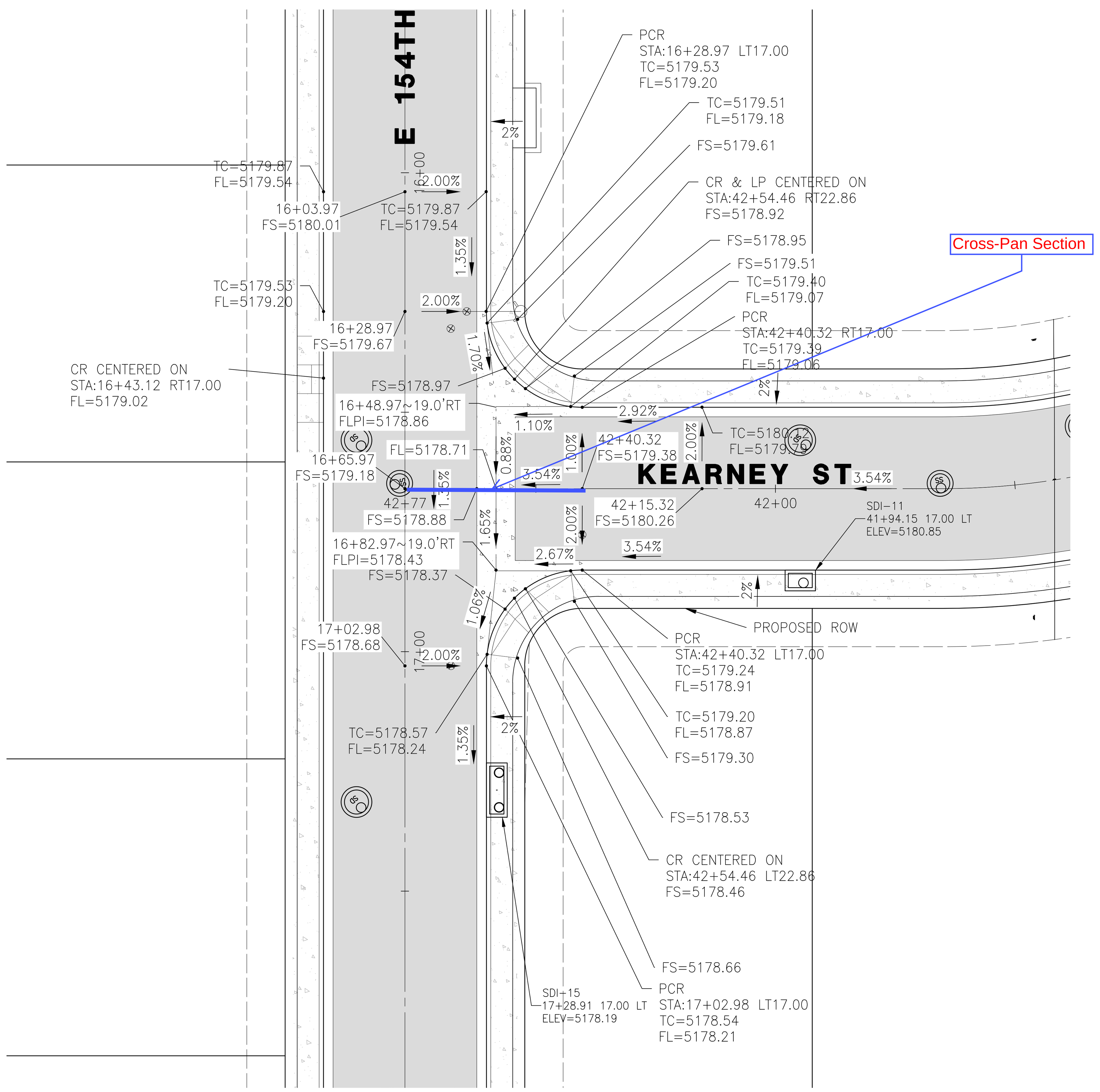
Manning's n: 0.0123

Channel Analysis: Cross-Pan in Basin 48 - Kearney St & E 154th Pl (Major Storm)

Notes:

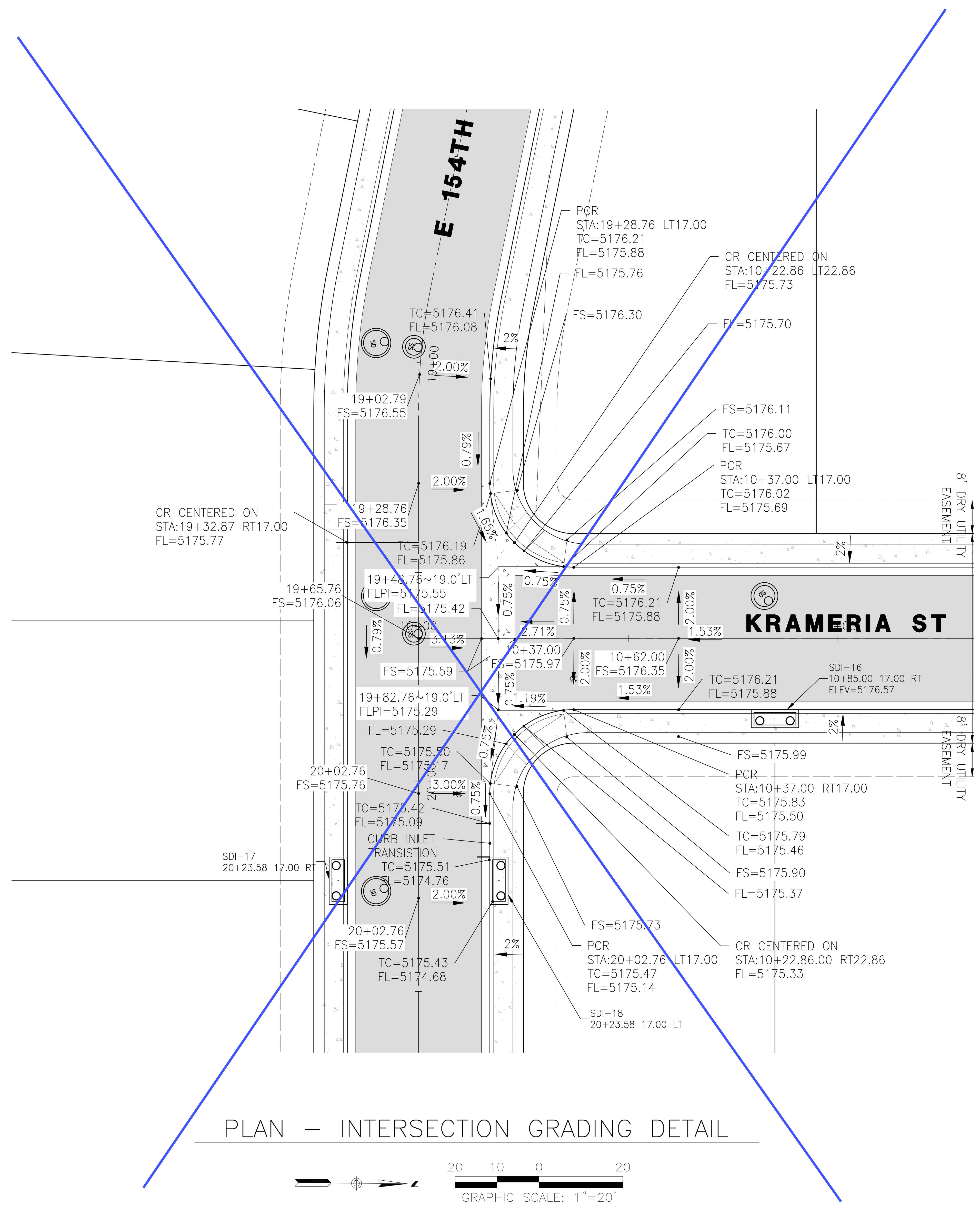
Input Parameters

Channel Type: Custom Cross Section



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



PLAN – INTERSECTION GRADING DETAIL

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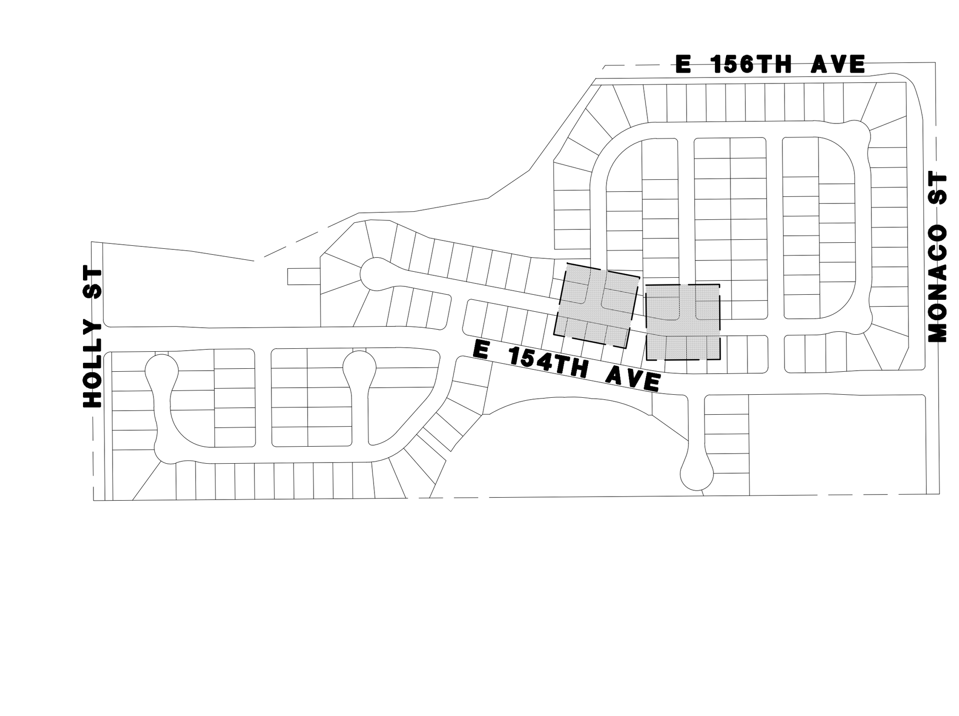

KEY MAP

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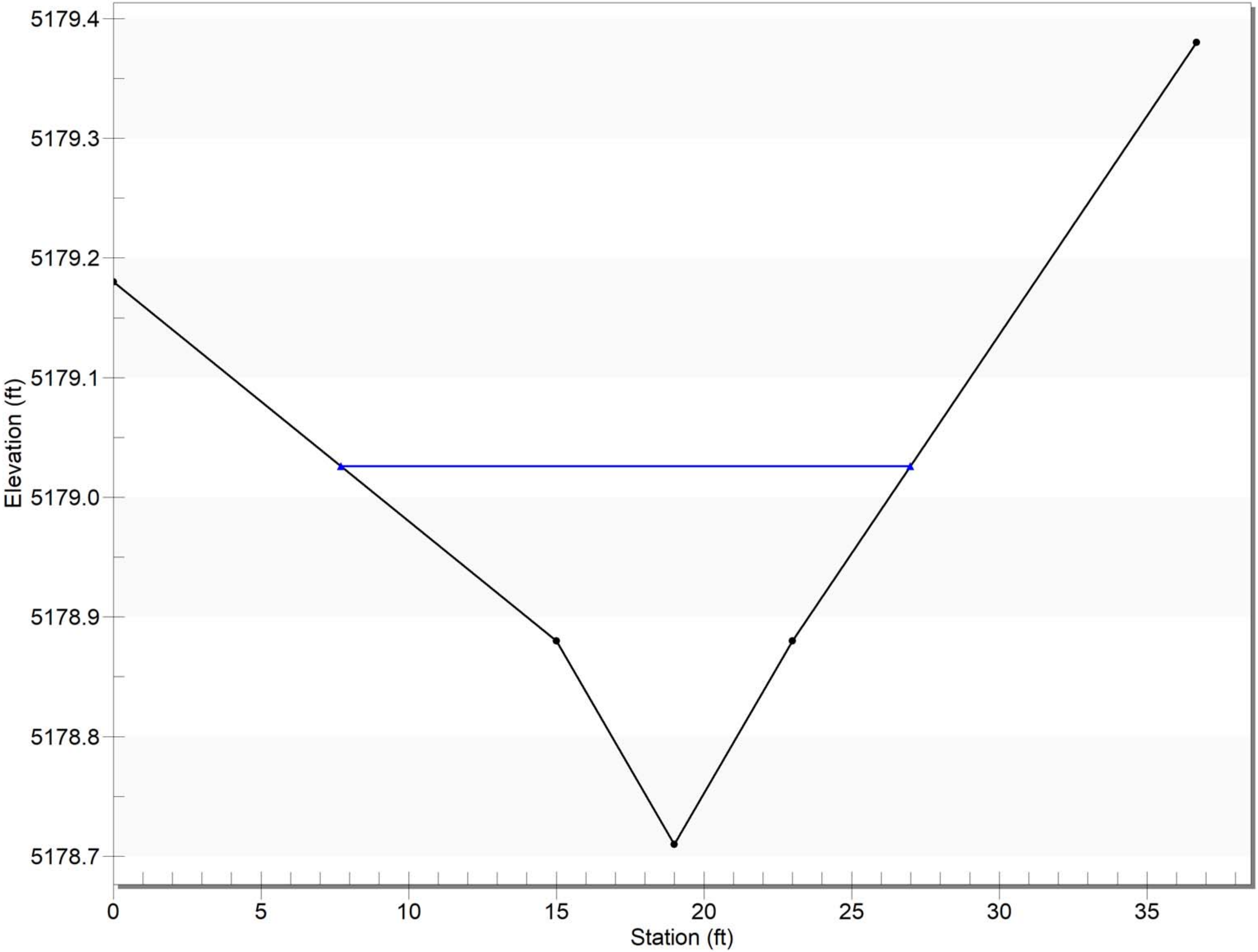
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-06

SHEET NO. 64 OF 172 SHEETS

Cross-Pan in Basin 43 - Kearney St & E 154th Pl (Major Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5179.18	0.0160
15.00	5178.88	0.0130
19.00	5178.71	0.0130
23.00	5178.88	0.0160
36.68	5179.38	-----

Longitudinal Slope: 0.0088 ft/ft

Flow: 8.7000 cfs

Major storm flow from Basin 48 (SDI-15) + bypass flow from SDI-24, SDI-11 & SDI-14

Result Parameters

Depth: 0.3159 ft

Area of Flow: 2.6699 ft^2

Wetted Perimeter: 19.2955 ft

Hydraulic Radius: 0.1384 ft

Average Velocity: 3.2585 ft/s

Top Width: 19.2842 ft

Froude Number: 1.5433

Critical Depth: 0.3688 ft

Critical Velocity: 2.2896 ft/s

Critical Slope: 0.0037 ft/ft

Critical Top Width: 23.38 ft

Calculated Max Shear Stress: 0.1734 lb/ft^2

Calculated Avg Shear Stress: 0.0760 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0114

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Cross-Pan Capacity Check

Designer:

Project Date: Sunday, November 22, 2020

Project Units: U.S. Customary Units

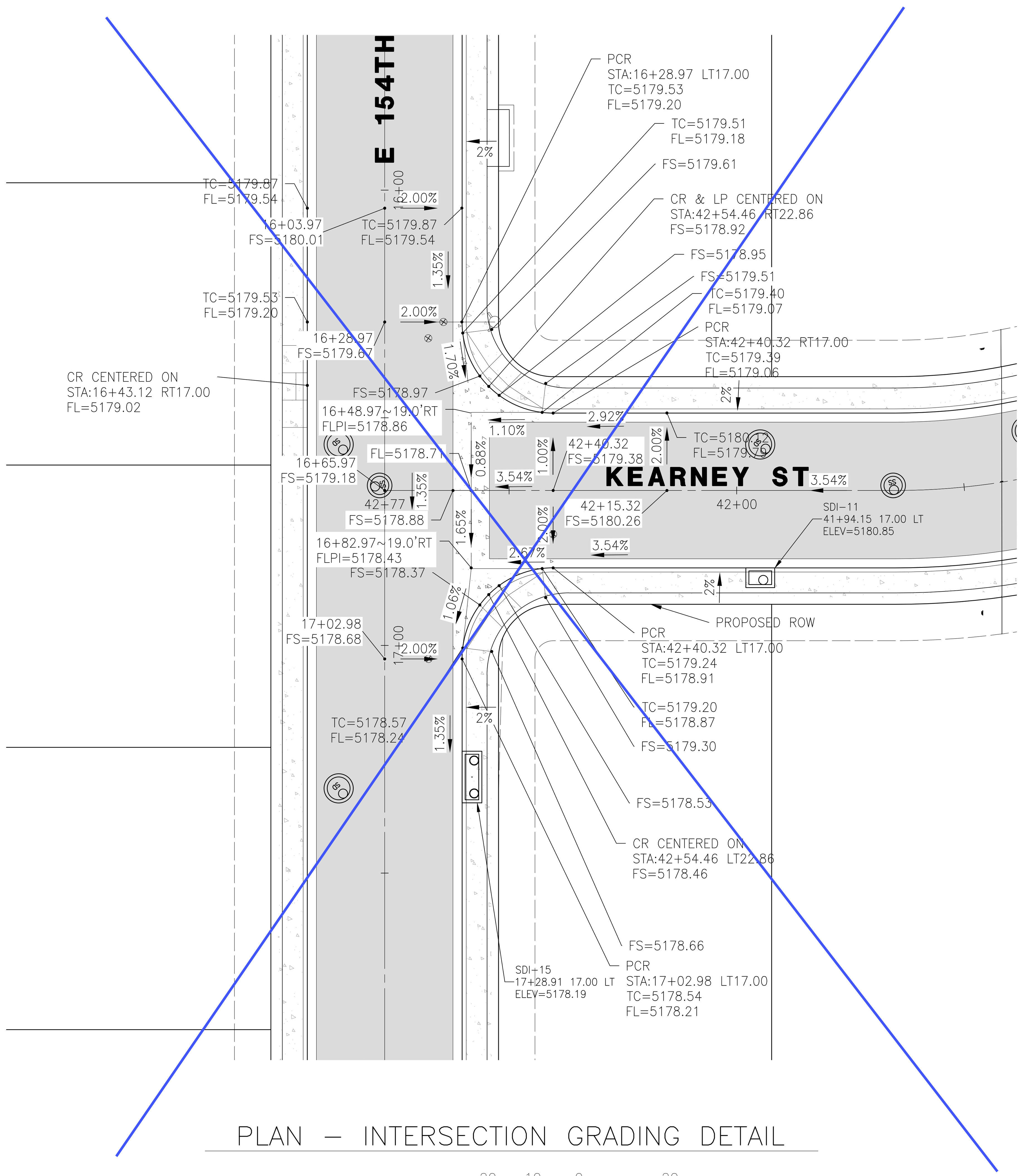
Notes:

Channel Analysis: Cross-Pan in Basin 49 - Krameria St & E 154th Pl (Minor Storm)

Notes:

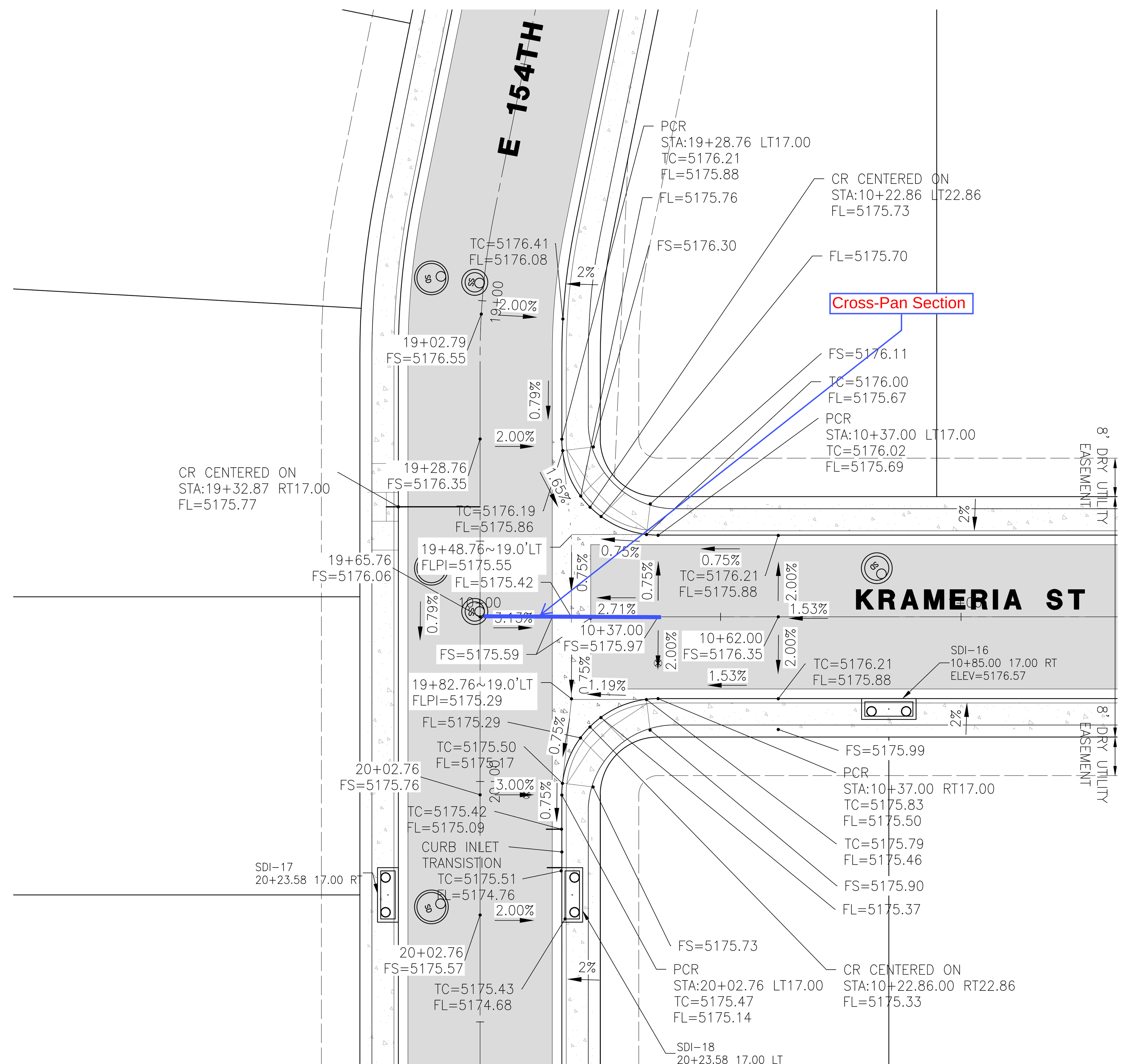
Input Parameters

Channel Type: Custom Cross Section



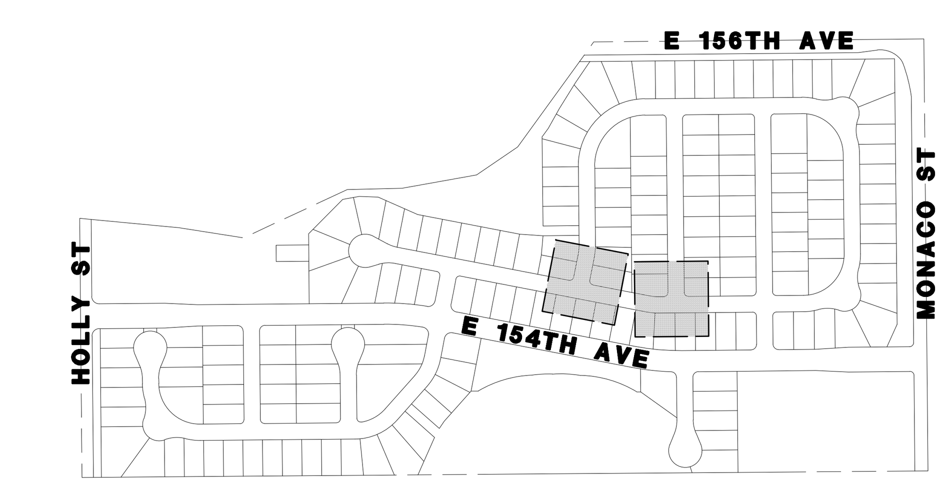
PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

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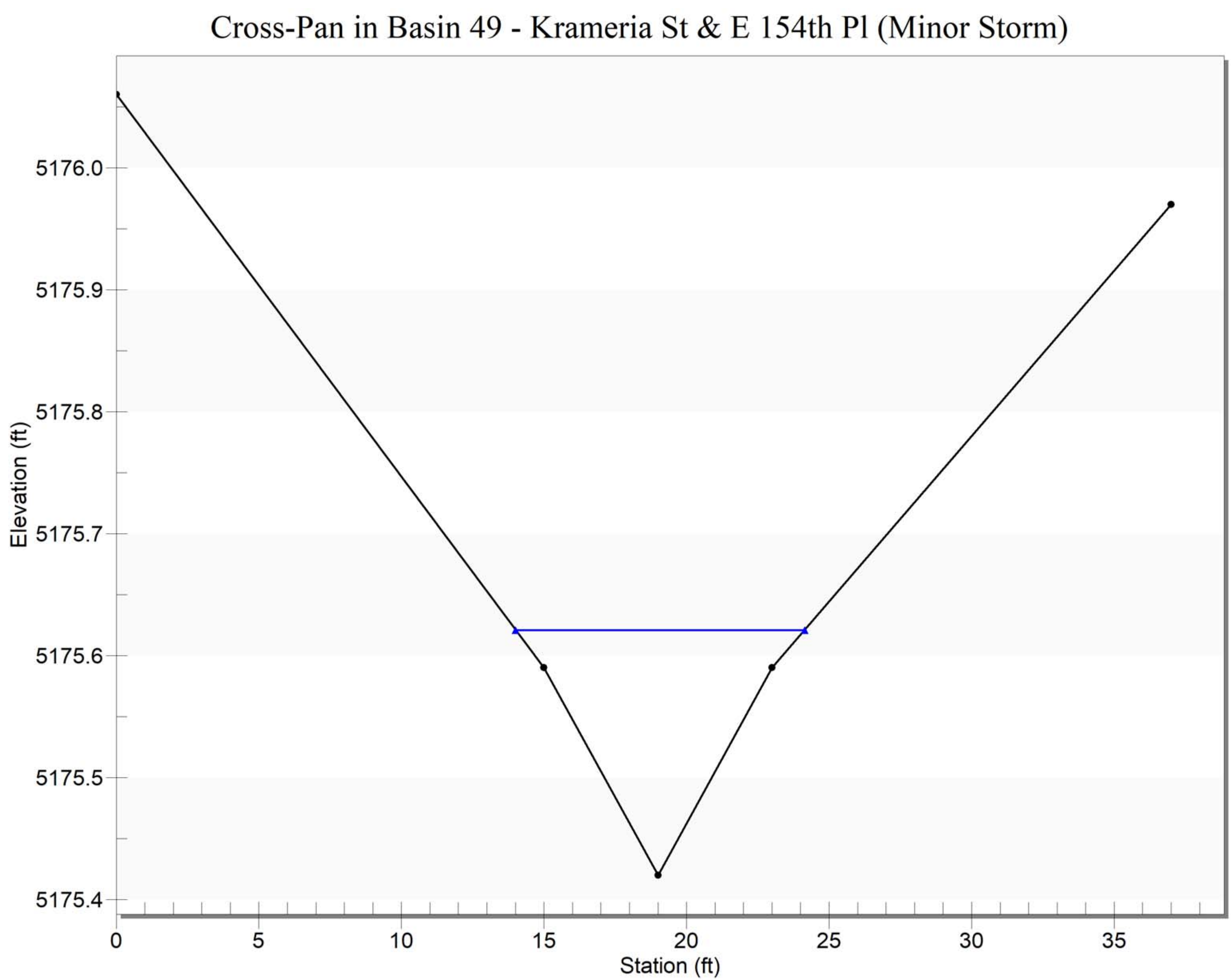
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-06

SHEET NO. 64 OF 172 SHEETS



Cross-Pan in Basin 49 - Krameria St & E 154th Pl (Minor Storm)
Elevation (ft)
5176.0
5175.9
5175.8
5175.7
5175.6
5175.5
5175.4
0
5
10
15
20
25
30
35
Station (ft)

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5176.06	0.0160
15.00	5175.59	0.0130
19.00	5175.42	0.0130
23.00	5175.59	0.0160
37.00	5175.97	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 2.2000 cfs

Minor storm flow from Basin 49 to SDI-18

Result Parameters

Depth: 0.2010 ft

Area of Flow: 0.9610 ft^2

Wetted Perimeter: 10.1391 ft

Hydraulic Radius: 0.0948 ft

Average Velocity: 2.2894 ft/s

Top Width: 10.1310 ft

Froude Number: 1.3100

Critical Depth: 0.2235 ft

Critical Velocity: 1.8238 ft/s

Critical Slope: 0.0040 ft/ft

Critical Top Width: 11.68 ft

Calculated Max Shear Stress: 0.0941 lb/ft^2

Calculated Avg Shear Stress: 0.0444 lb/ft^2

Composite Manning's n Equation: Lotter method

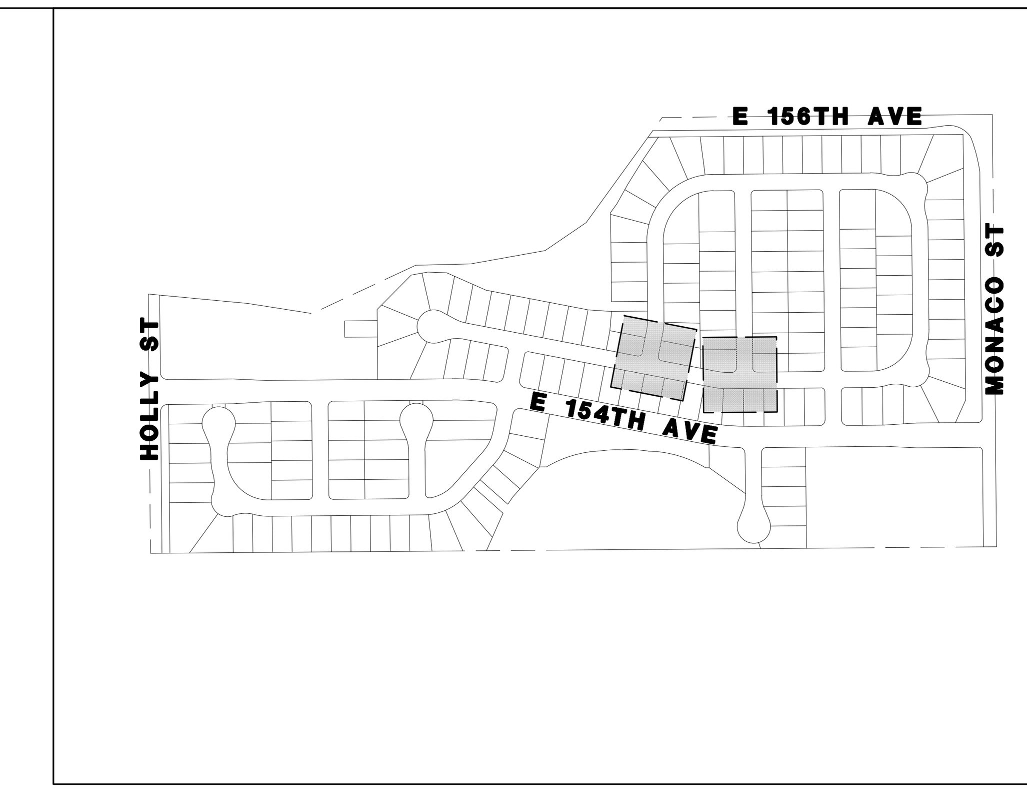
Manning's n: 0.0117

Channel Analysis: Cross-Pan in Basin 49 - Krameria St & E 154th Pl (Major Storm)

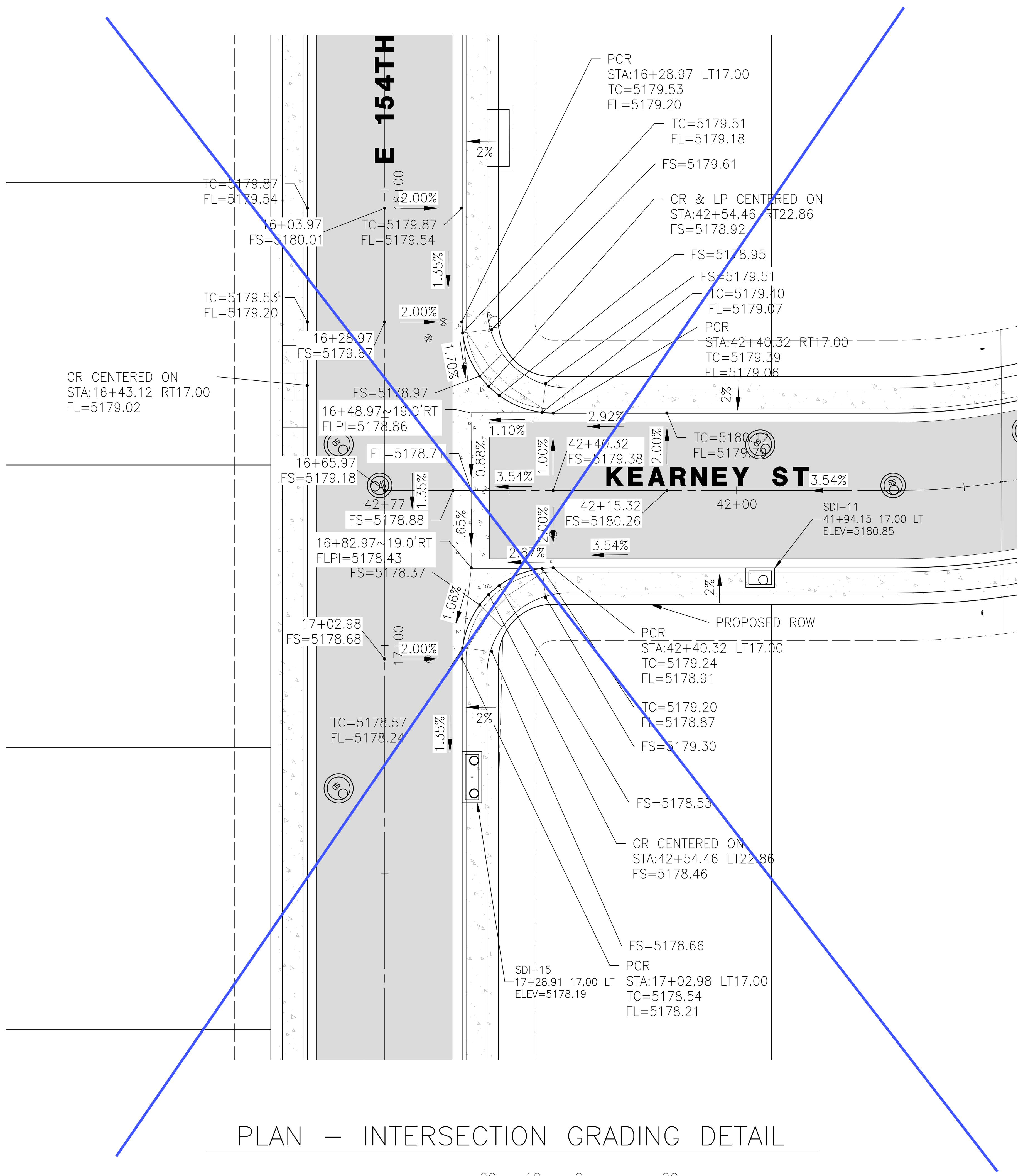
Notes:

Input Parameters

Channel Type: Custom Cross Section

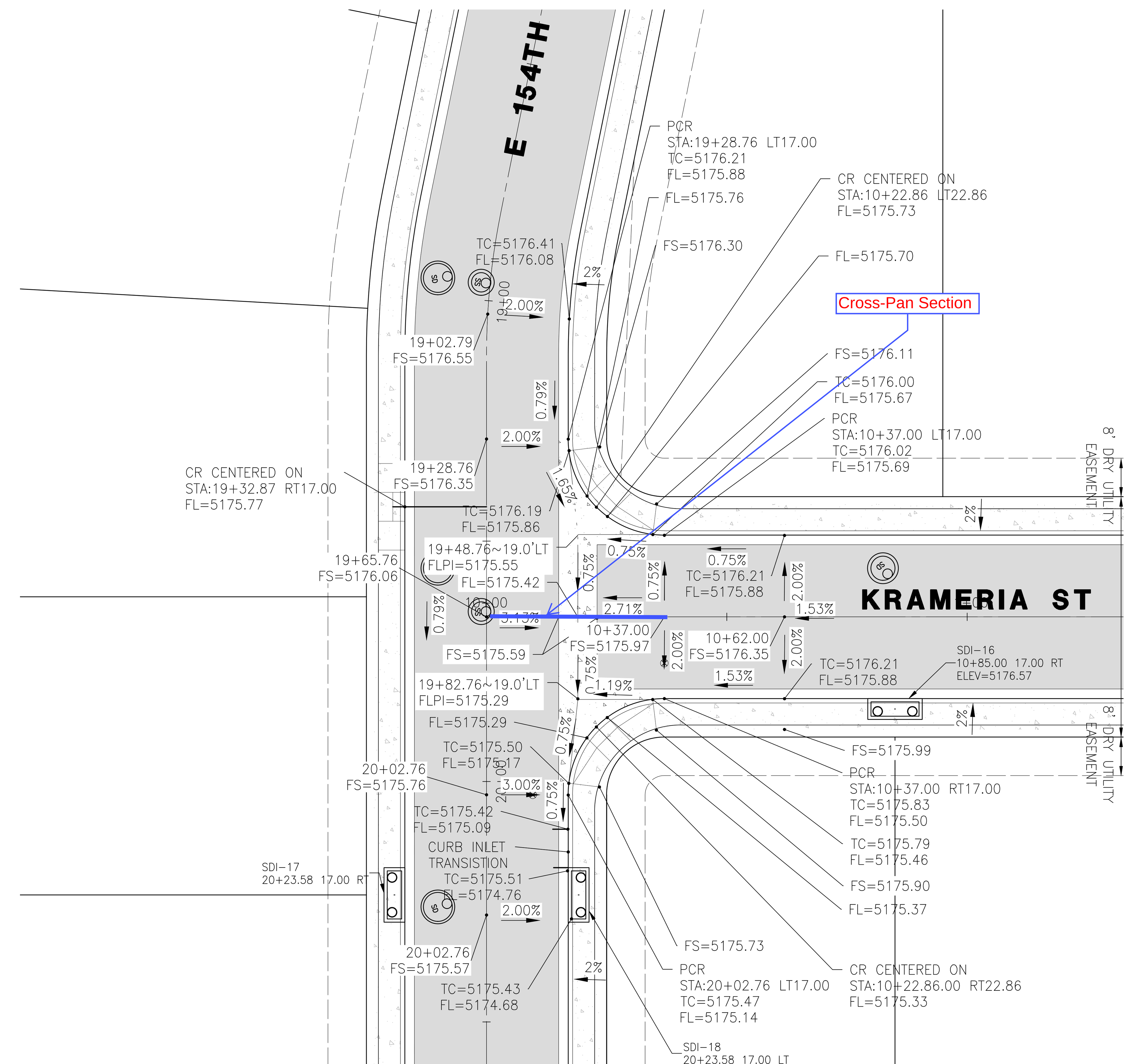


KEY MAP
SCALE 1"=500'



PLAN — INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



PLAN — INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

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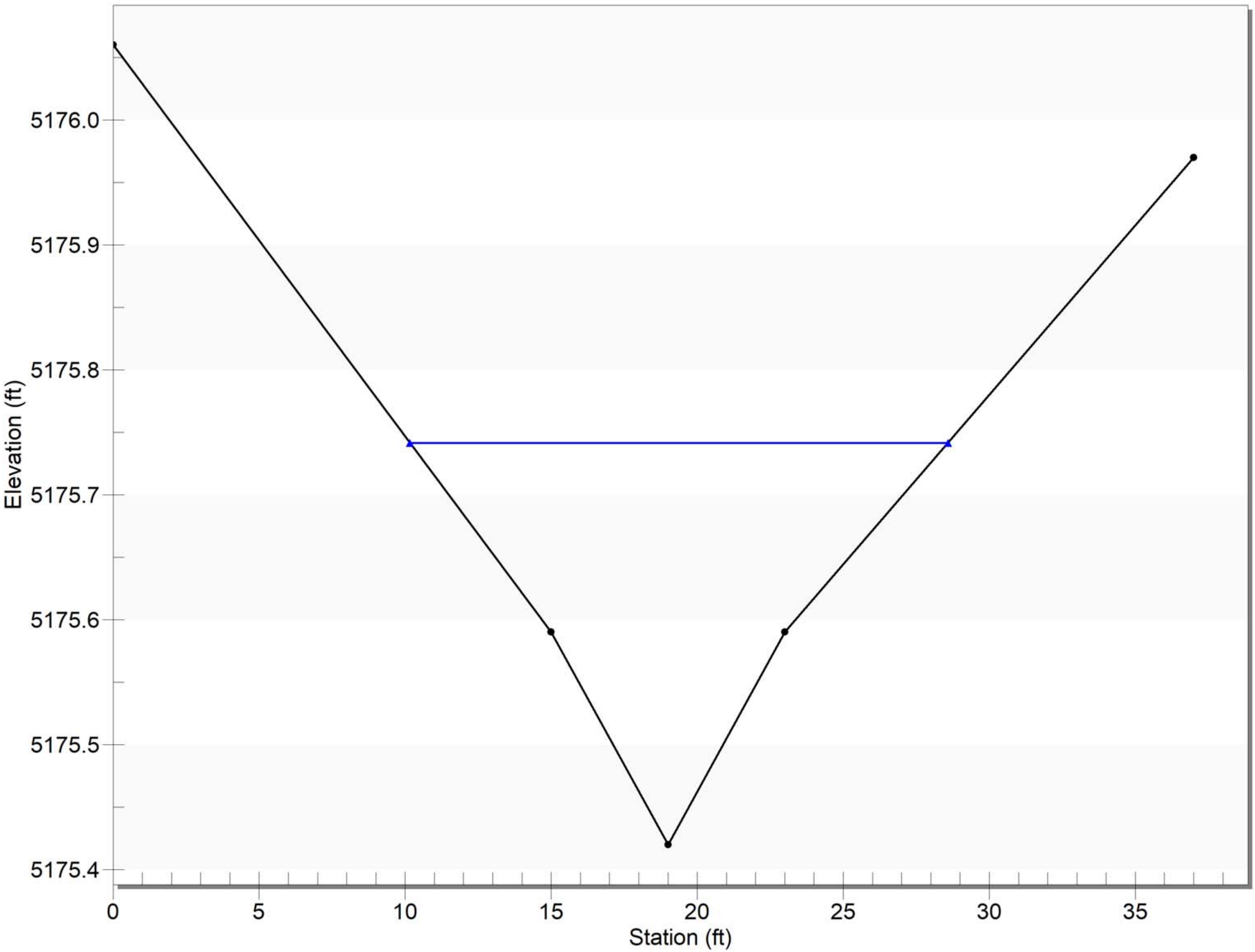
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-06

SHEET NO. 64 OF 172 SHEETS

Cross-Pan in Basin 49 - Krameria St & E 154th Pl (Major Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5176.06	0.0160
15.00	5175.59	0.0130
19.00	5175.42	0.0130
23.00	5175.59	0.0160
37.00	5175.97	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 8.3000 cfs

Major storm flow from Basin 49 to SDI-18 + bypass flow from SDI-27, SDI-16 & SDI-15

Result Parameters

Depth: 0.3216 ft

Area of Flow: 2.6825 ft^2

Wetted Perimeter: 18.4338 ft

Hydraulic Radius: 0.1455 ft

Average Velocity: 3.0941 ft/s

Top Width: 18.4222 ft

Froude Number: 1.4289

Critical Depth: 0.3667 ft

Critical Velocity: 2.3155 ft/s

Critical Slope: 0.0037 ft/ft

Critical Top Width: 21.53 ft

Calculated Max Shear Stress: 0.1505 lb/ft^2

Calculated Avg Shear Stress: 0.0681 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0115

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Cross-Pan Capacity Check

Designer:

Project Date: Sunday, November 22, 2020

Project Units: U.S. Customary Units

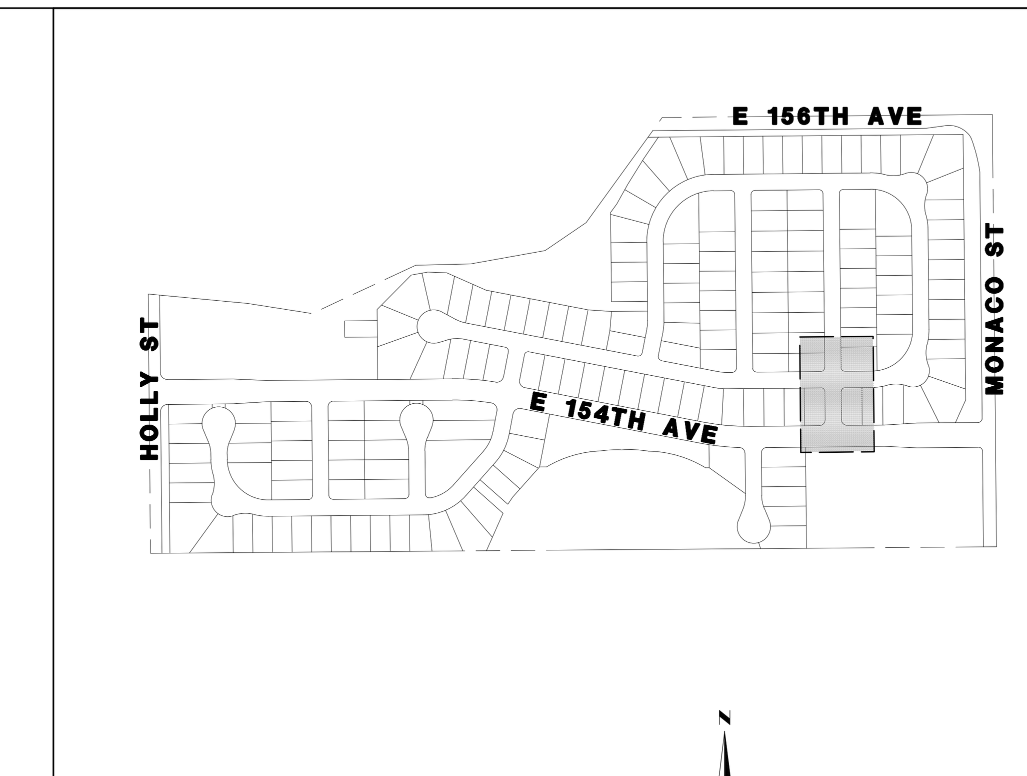
Notes:

Channel Analysis: Cross-Pan in Sub-Basin 20A - Leyden St & E 154th Pl (Minor Storm)

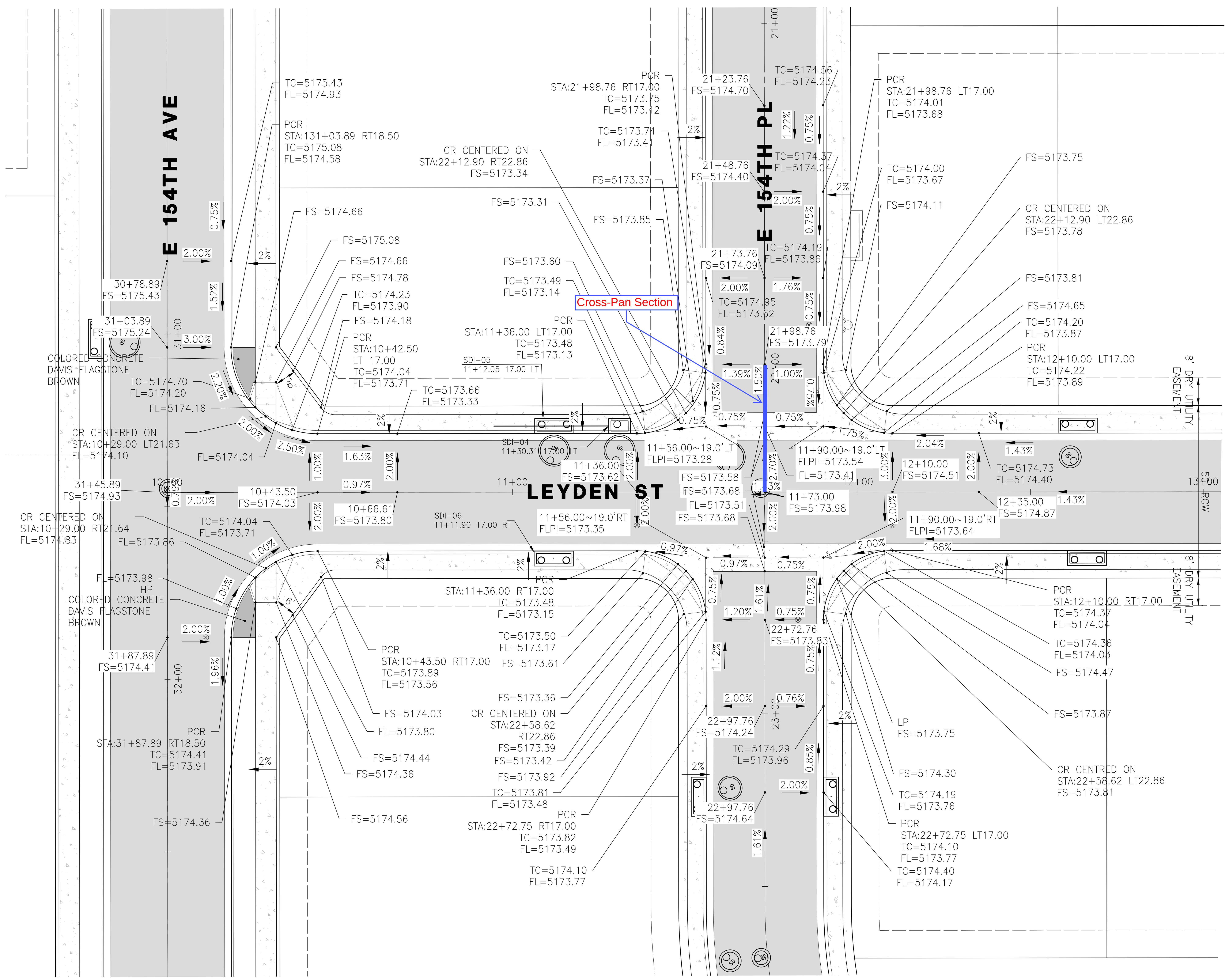
Notes:

Input Parameters

Channel Type: Custom Cross Section



KEY MAP
SCALE 1"=500'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

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JOB NO:	D01104-A

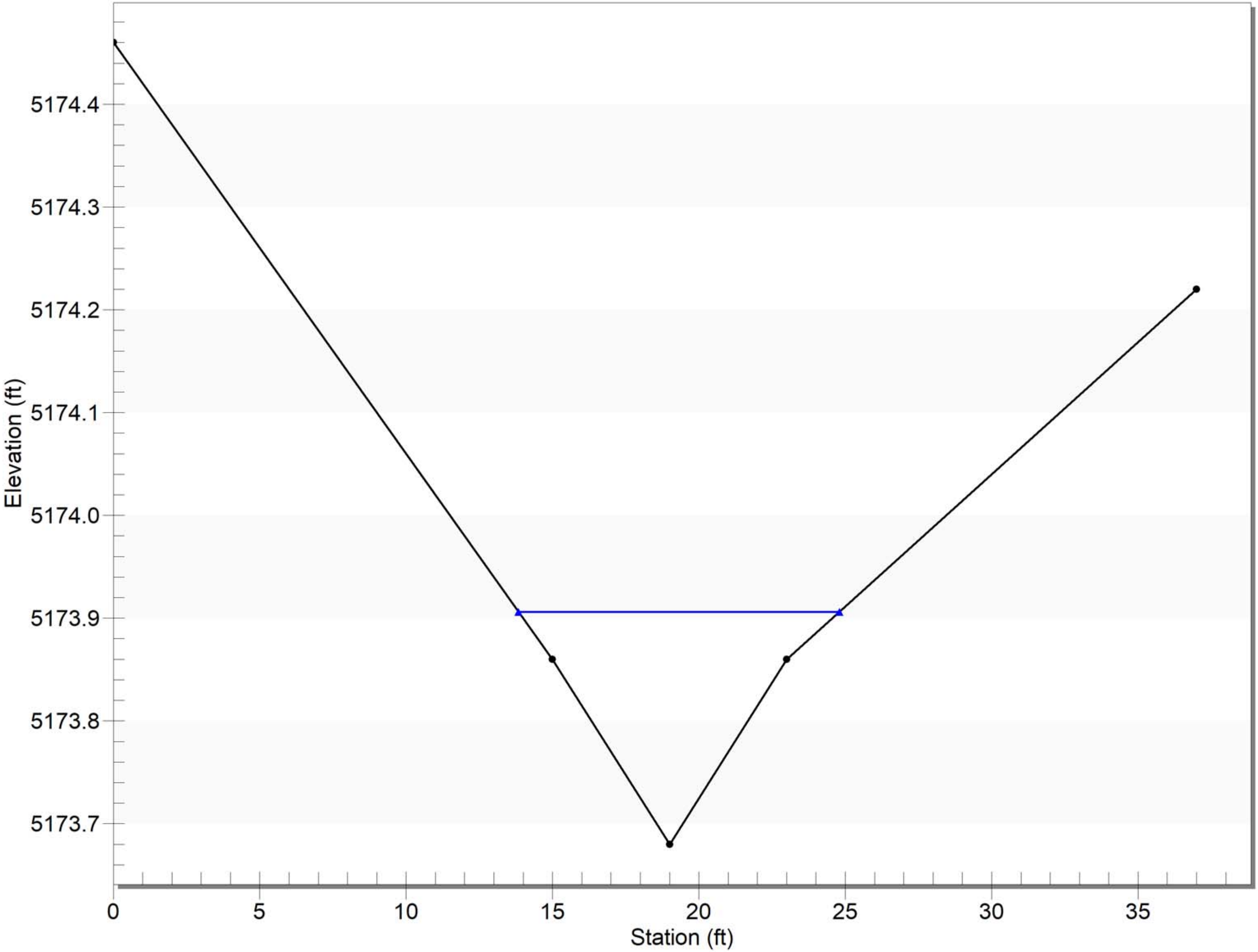
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-04

SHEET NO. 62 OF 172 SHEETS

Cross-Pan in Sub-Basin 20A - Leyden St & E 154th Pl (Minor Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5174.46	0.0160
15.00	5173.86	0.0130
19.00	5173.68	0.0130
23.00	5173.86	0.0160
37.00	5174.22	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 2.9000 cfs

Minor storm flow from Basin 20 to SDI-04

Result Parameters

Depth: 0.2263 ft

Area of Flow: 1.1584 ft^2

Wetted Perimeter: 10.9649 ft

Hydraulic Radius: 0.1056 ft

Average Velocity: 2.5034 ft/s

Top Width: 10.9553 ft

Froude Number: 1.3567

Critical Depth: 0.2545 ft

Critical Velocity: 1.9414 ft/s

Critical Slope: 0.0038 ft/ft

Critical Top Width: 12.76 ft

Calculated Max Shear Stress: 0.1059 lb/ft^2

Calculated Avg Shear Stress: 0.0494 lb/ft^2

Composite Manning's n Equation: Lotter method

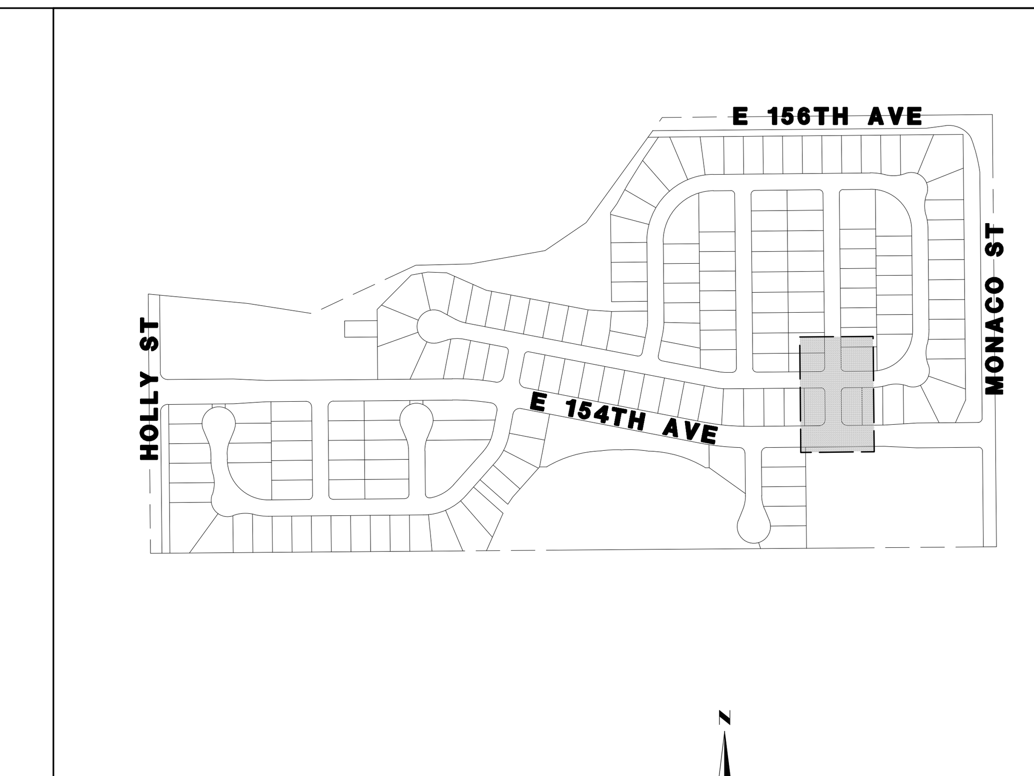
Manning's n: 0.0115

Channel Analysis: Cross-Pan in Sub-Basin 20A - Leyden St & E 154th Pl (Major Storm)

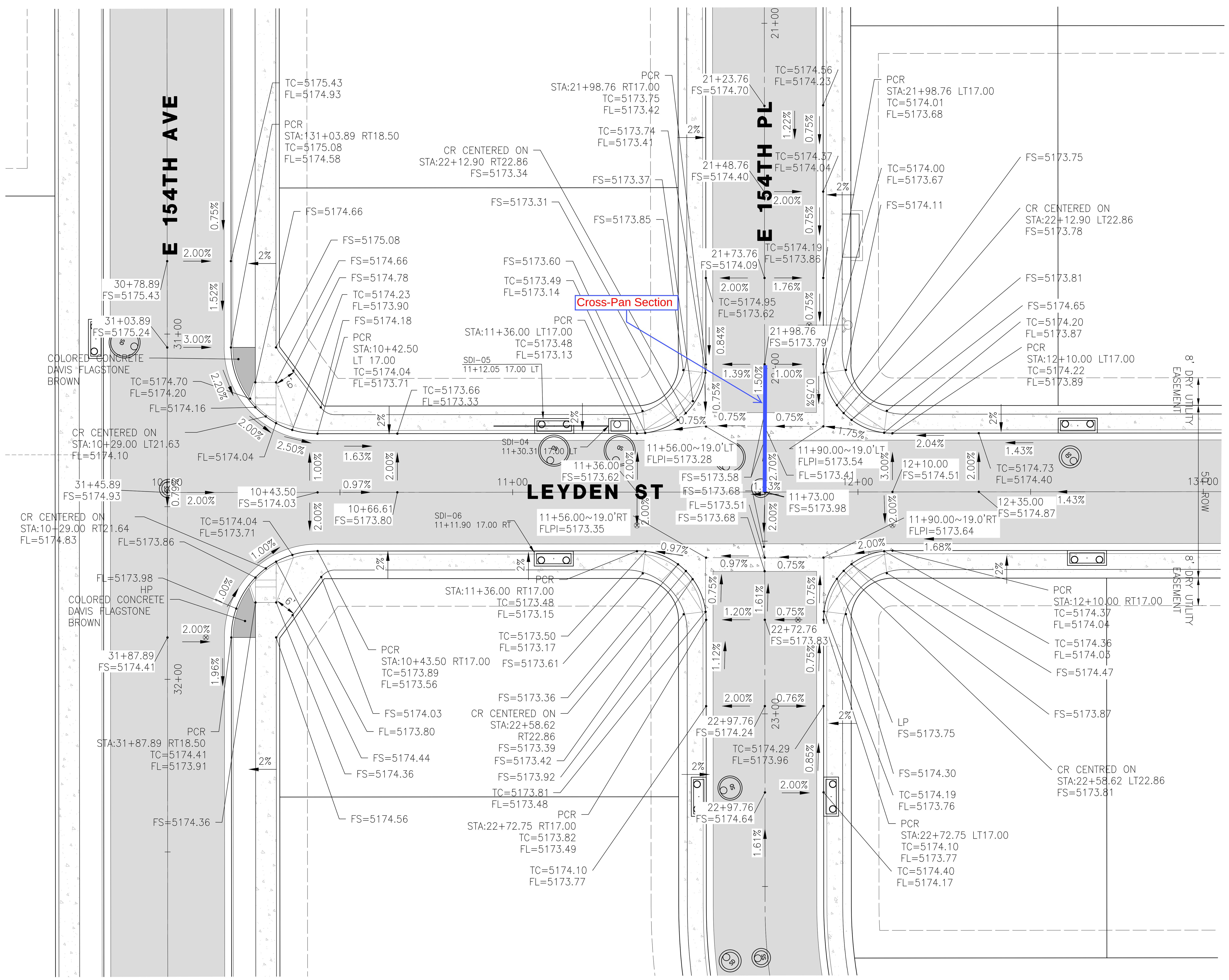
Notes:

Input Parameters

Channel Type: Custom Cross Section



KEY MAP
SCALE 1"=500'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

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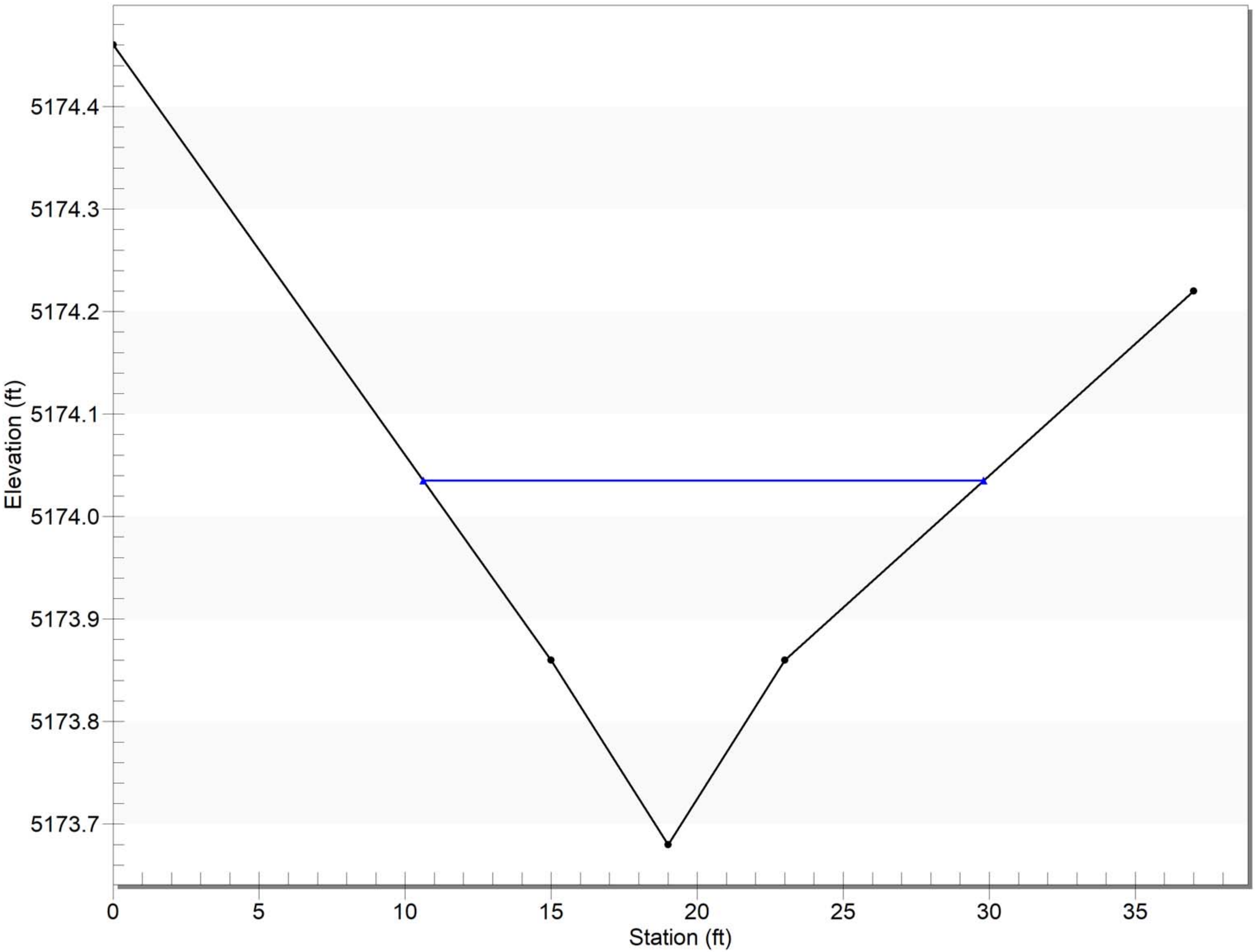
INTERSECTION GRADING DETAILS

PROJECT NO.
D01104-A

DRAWING NO.
IGD-04

SHEET NO. 62 OF 172 SHEETS

Cross-Pan in Sub-Basin 20A - Leyden St & E 154th Pl (Major Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5174.46	0.0160
15.00	5173.86	0.0130
19.00	5173.68	0.0130
23.00	5173.86	0.0160
37.00	5174.22	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 10.2000 cfs

Major storm flow from Basin 20 to SDI-04 + bypass flow from SDI-08, SDI-17 & SDI-18

Result Parameters

Depth: 0.3550 ft

Area of Flow: 3.0976 ft^2

Wetted Perimeter: 19.1920 ft

Hydraulic Radius: 0.1614 ft

Average Velocity: 3.2929 ft/s

Top Width: 19.1782 ft

Froude Number: 1.4439

Critical Depth: 0.4066 ft

Critical Velocity: 2.4449 ft/s

Critical Slope: 0.0036 ft/ft

Critical Top Width: 22.47 ft

Calculated Max Shear Stress: 0.1661 lb/ft^2

Calculated Avg Shear Stress: 0.0755 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0116

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Cross-Pan Capacity Check

Designer:

Project Date: Sunday, November 22, 2020

Project Units: U.S. Customary Units

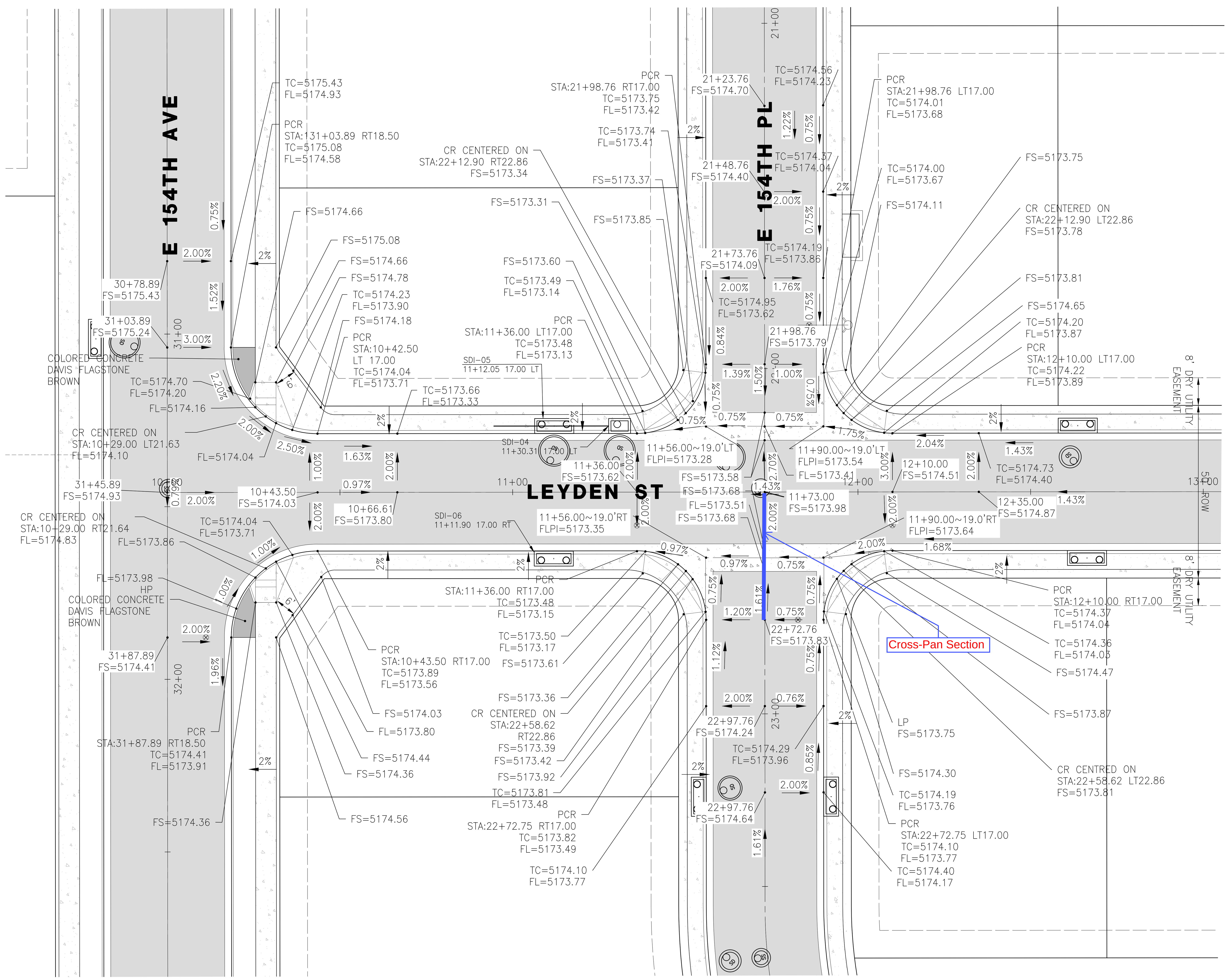
Notes:

Channel Analysis: Cross-Pan in Basin 26 - Leyden St & E 154th Pl (Minor Storm)

Notes:

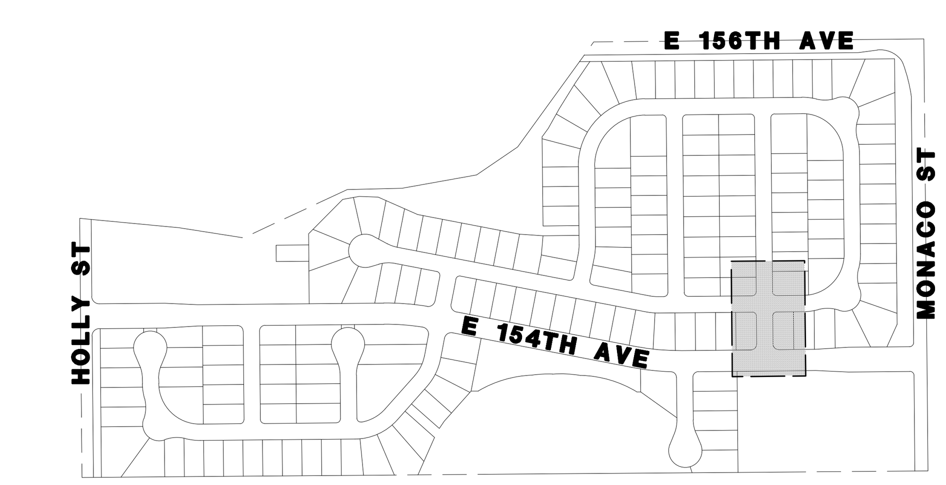
Input Parameters

Channel Type: Custom Cross Section



PLAN — INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

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SCALE:	N/A
DATE:	11/20/2020
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

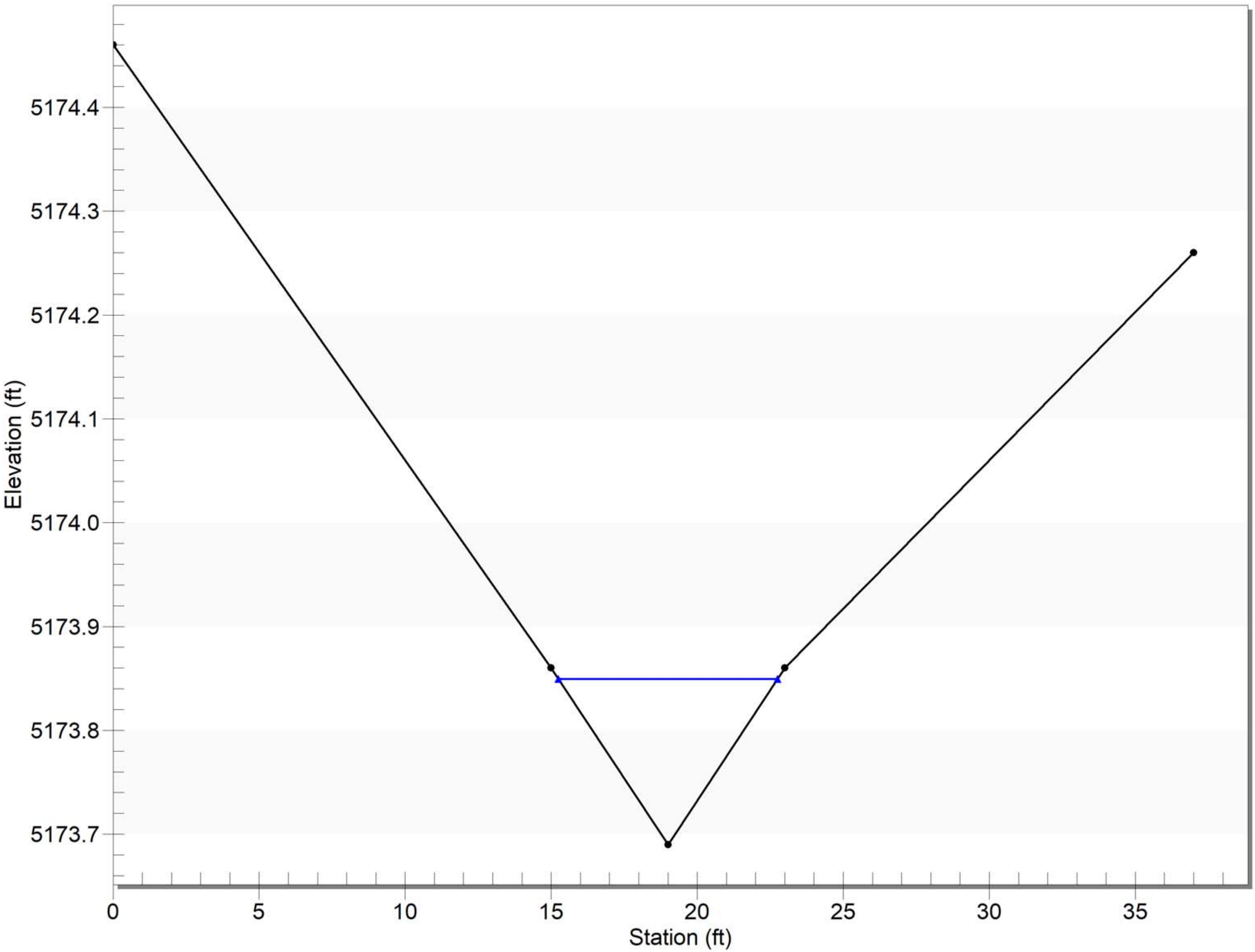
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-04

SHEET NO. 62 OF 172 SHEETS

Cross-Pan in Basin 26 - Leyden St & E 154th Pl (Minor Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5174.46	0.0160
15.00	5173.86	0.0130
19.00	5173.69	0.0130
23.00	5173.86	0.0160
37.00	5174.26	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 1.1000 cfs

Minor storm flow from Basin 26 to SDI-06

Result Parameters

Depth: 0.1597 ft

Area of Flow: 0.5997 ft^2

Wetted Perimeter: 7.5198 ft

Hydraulic Radius: 0.0798 ft

Average Velocity: 1.8342 ft/s

Top Width: 7.5130 ft

Froude Number: 1.1440

Critical Depth: 0.1685 ft

Critical Velocity: 1.6470 ft/s

Critical Slope: 0.0056 ft/ft

Critical Top Width: 7.93 ft

Calculated Max Shear Stress: 0.0747 lb/ft^2

Calculated Avg Shear Stress: 0.0373 lb/ft^2

Composite Manning's n Equation: Lotter method

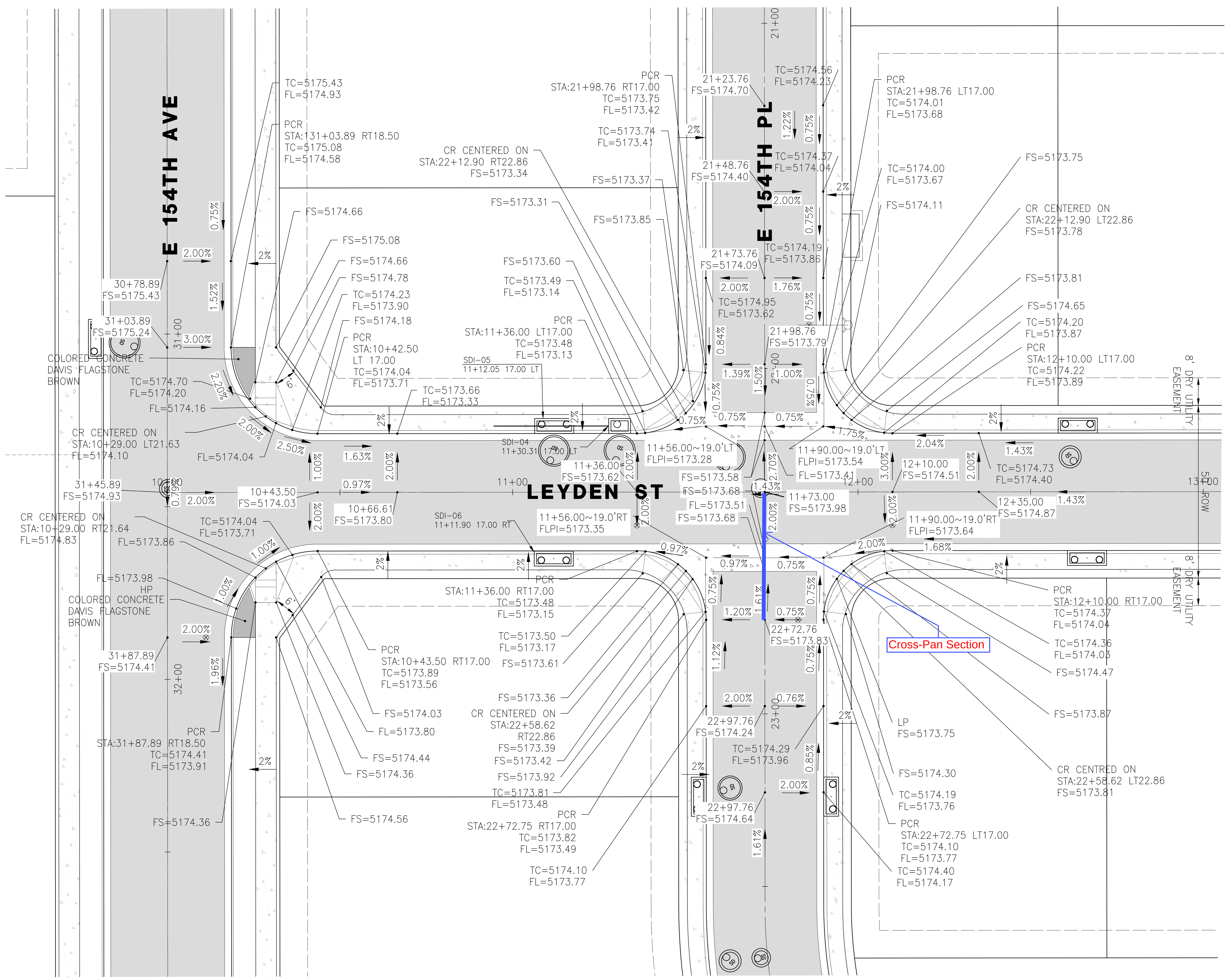
Manning's n: 0.0130

Channel Analysis: Cross-Pan in Basin 26 - Leyden St & E 154th Pl (Major Storm)

Notes:

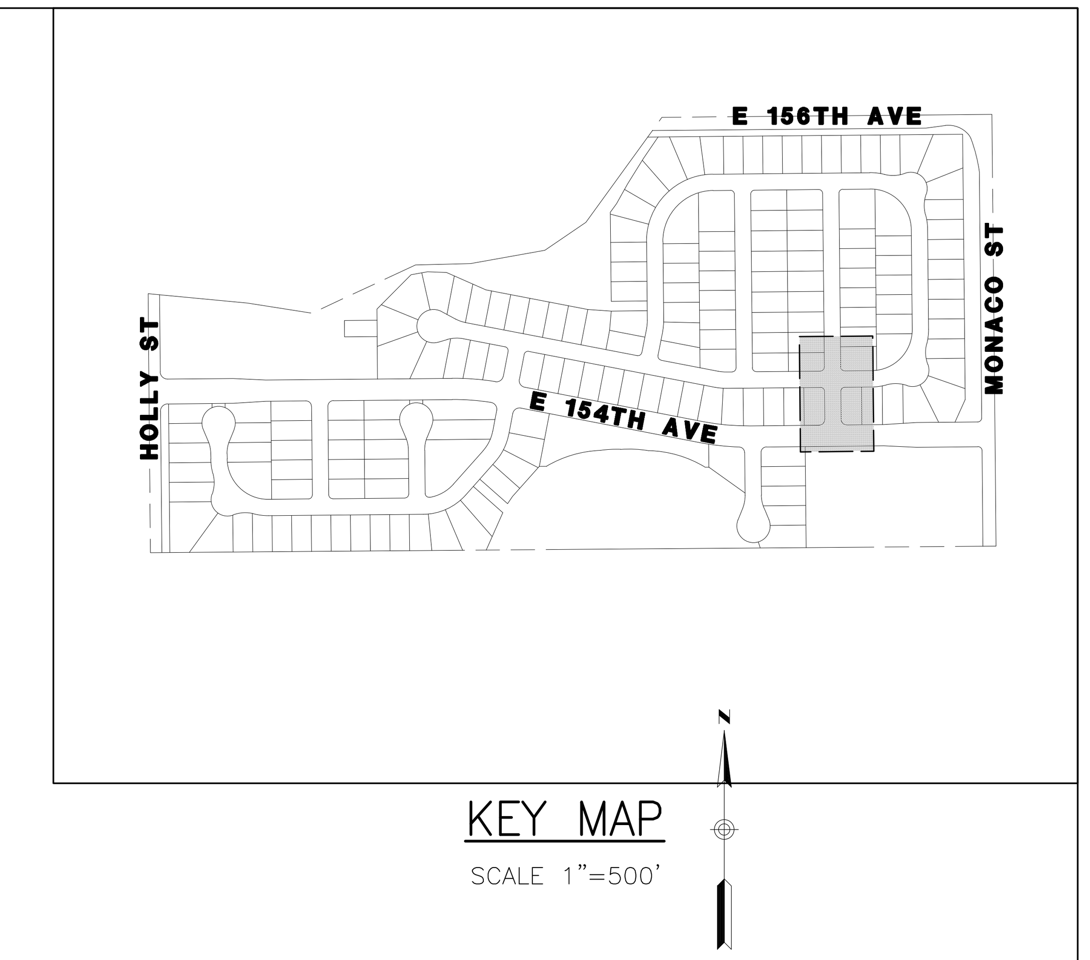
Input Parameters

Channel Type: Custom Cross Section



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

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SCALE:	N/A
DATE:	11/20/2020
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CHECKED BY:	TB
JOB NO:	D01104-A

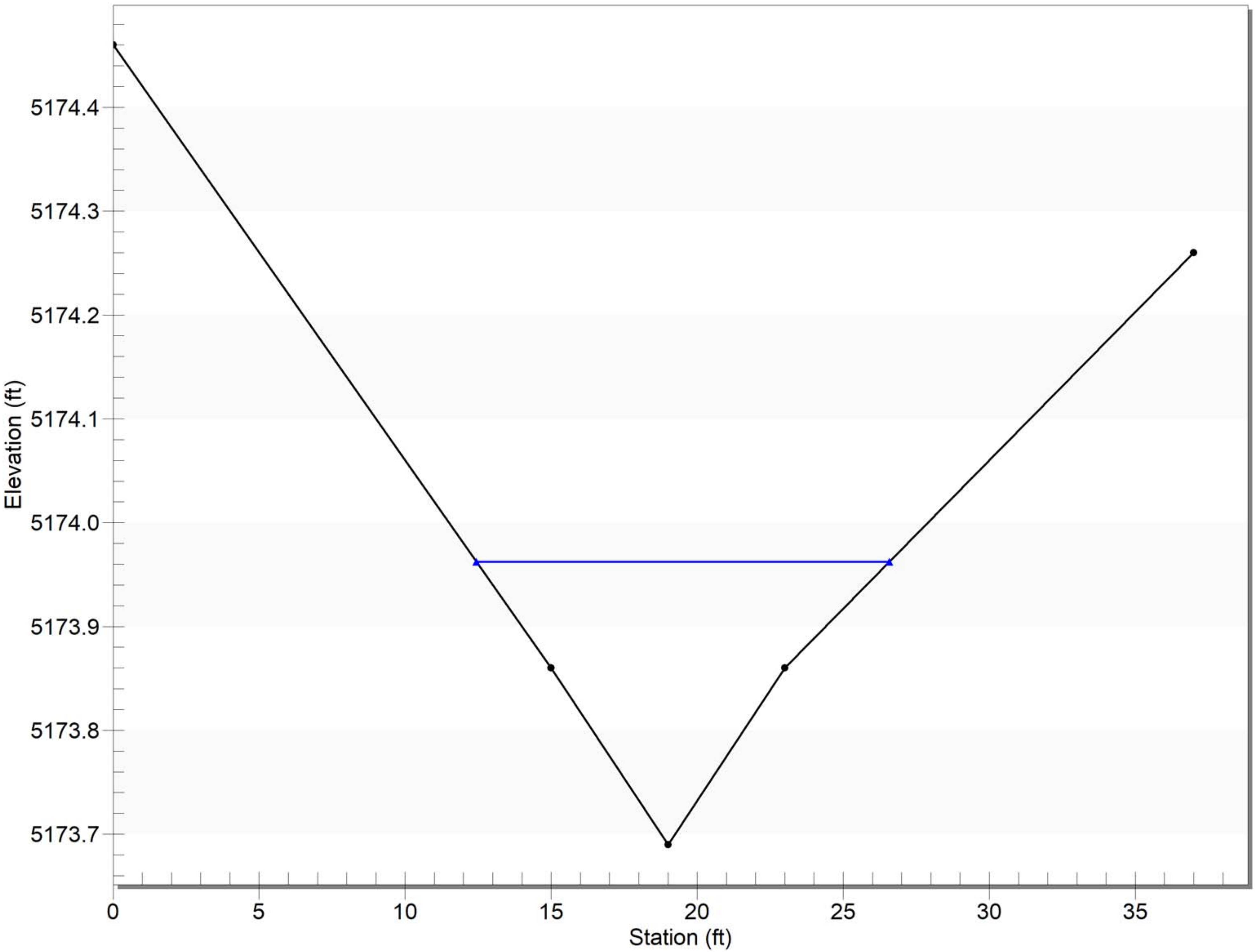
INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IGD-04

SHEET NO. 62 OF 172 SHEETS

Cross-Pan in Basin 26 - Leyden St & E 154th Pl (Major Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5174.46	0.0160
15.00	5173.86	0.0130
19.00	5173.69	0.0130
23.00	5173.86	0.0160
37.00	5174.26	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 5.2000 cfs

Major storm flow from Basin 26 to SDI-06 + bypass flow from SDI-21, SDI-09 & SDI-19

Result Parameters

Depth: 0.2723 ft

Area of Flow: 1.8122 ft^2

Wetted Perimeter: 14.1479 ft

Hydraulic Radius: 0.1281 ft

Average Velocity: 2.8695 ft/s

Top Width: 14.1372 ft

Froude Number: 1.4124

Critical Depth: 0.3107 ft

Critical Velocity: 2.1677 ft/s

Critical Slope: 0.0037 ft/ft

Critical Top Width: 16.44 ft

Calculated Max Shear Stress: 0.1274 lb/ft^2

Calculated Avg Shear Stress: 0.0599 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0114

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Cross-Pan Capacity Check

Designer:

Project Date: Sunday, November 22, 2020

Project Units: U.S. Customary Units

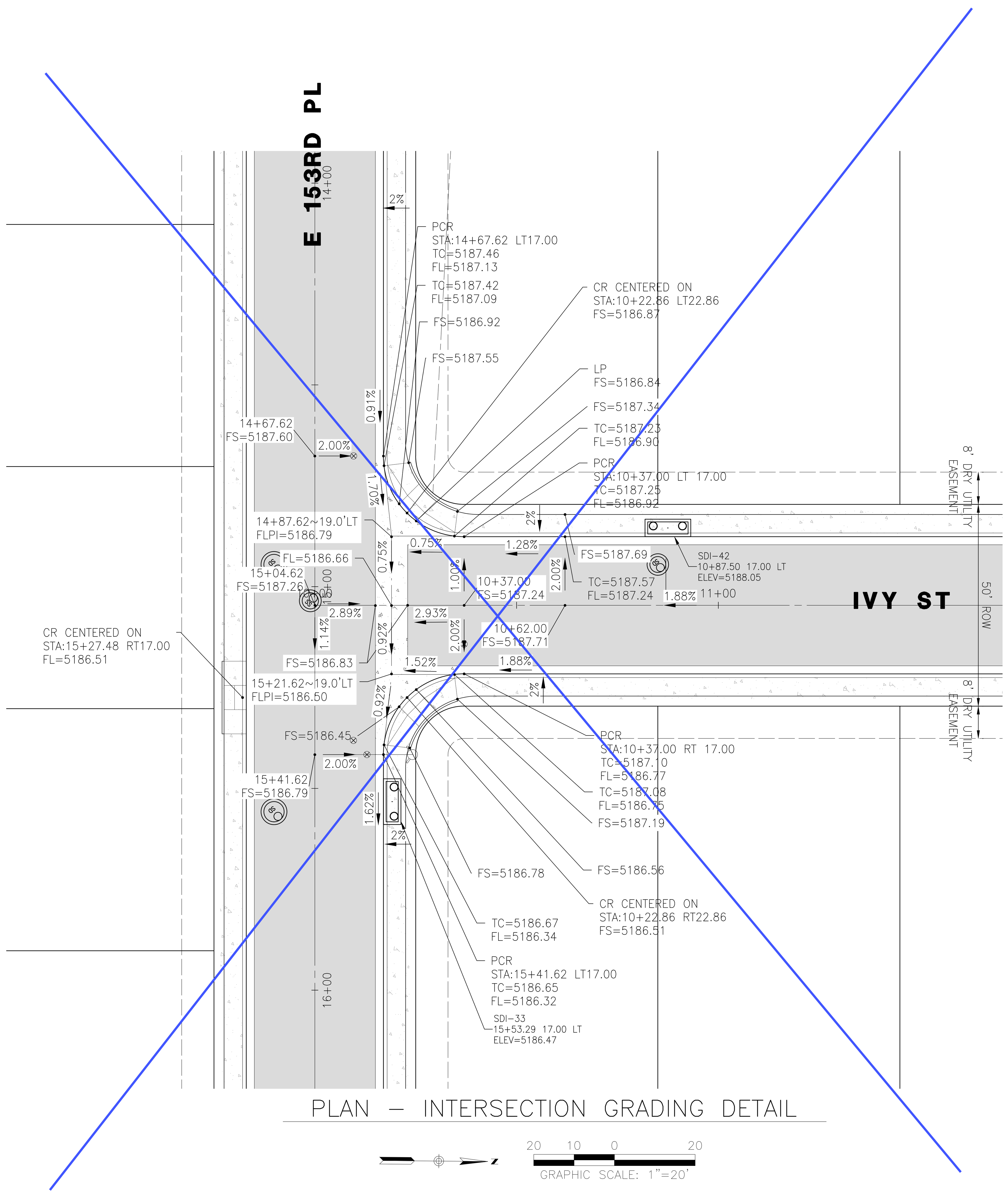
Notes:

Channel Analysis: Cross-Pan in Basin 31 - Krameria Ct & E 154th Ave (Minor Storm)

Notes:

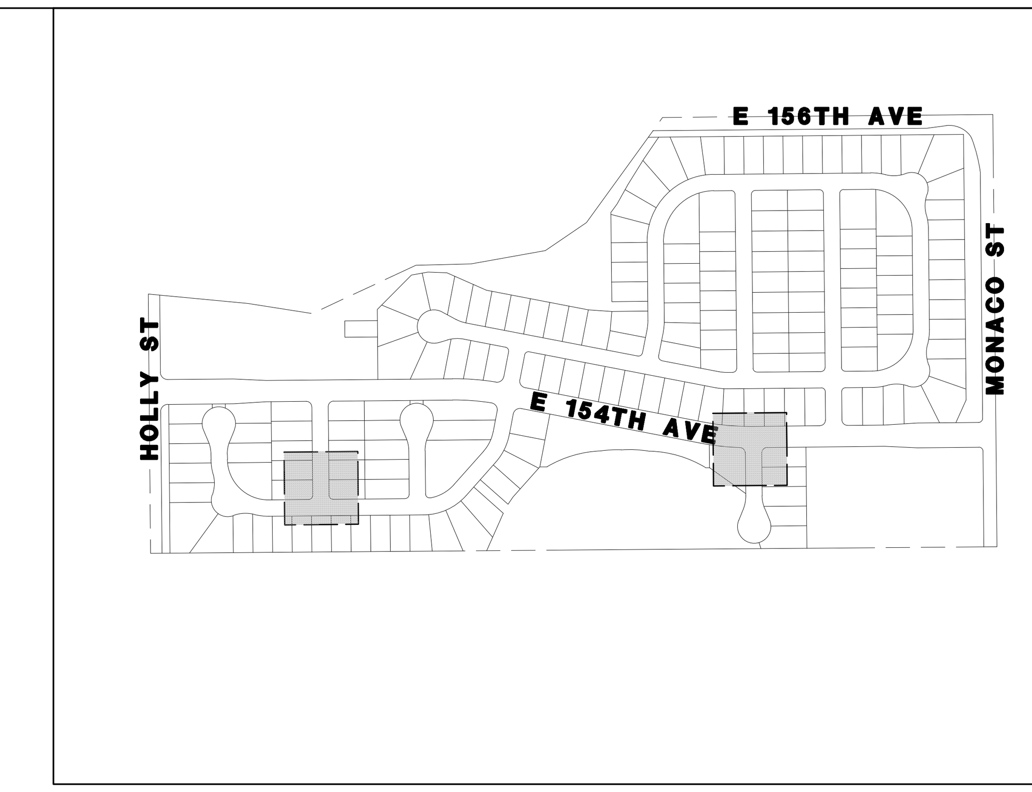
Input Parameters

Channel Type: Custom Cross Section



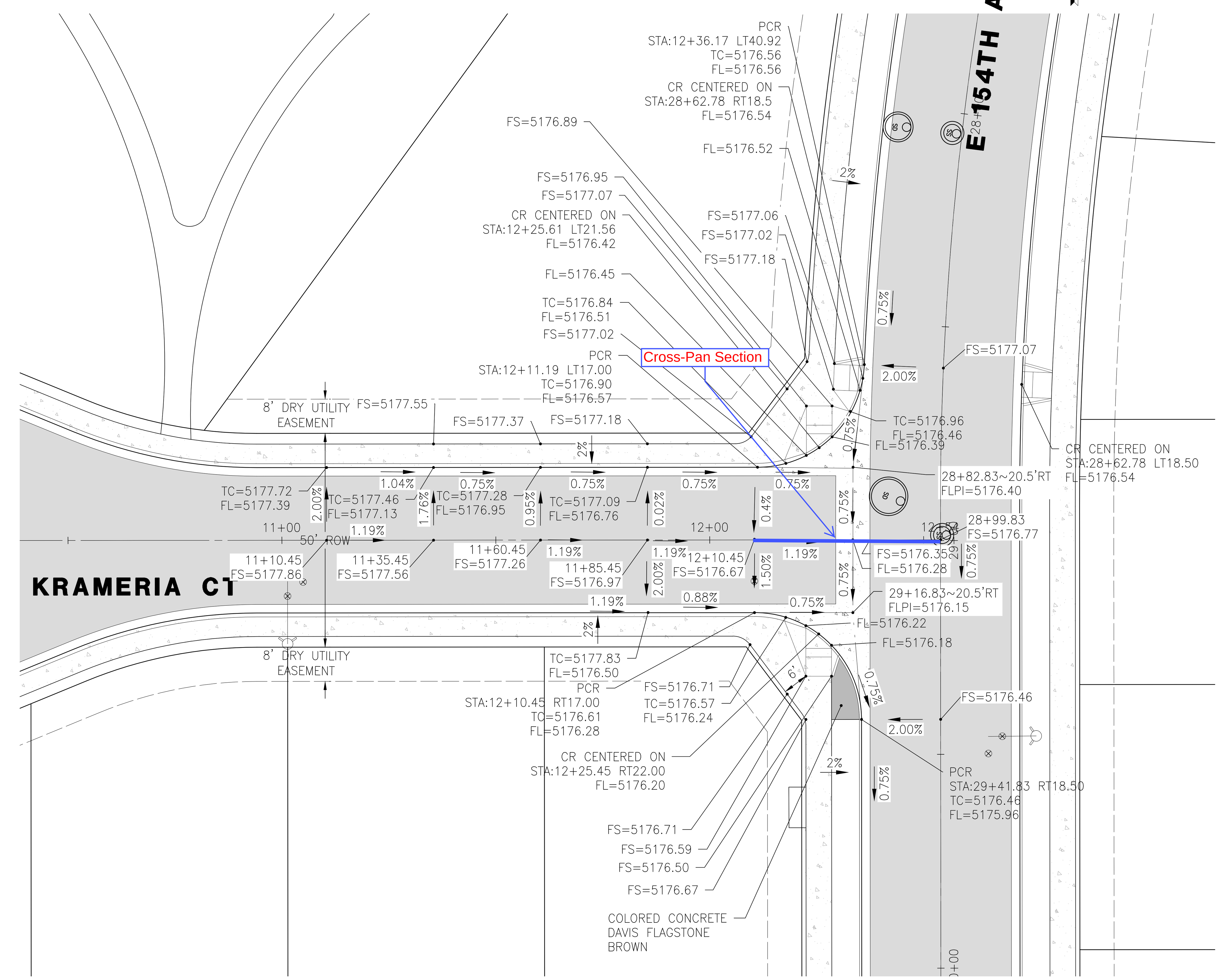
PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



KEY MAP

SCALE 1"=500'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

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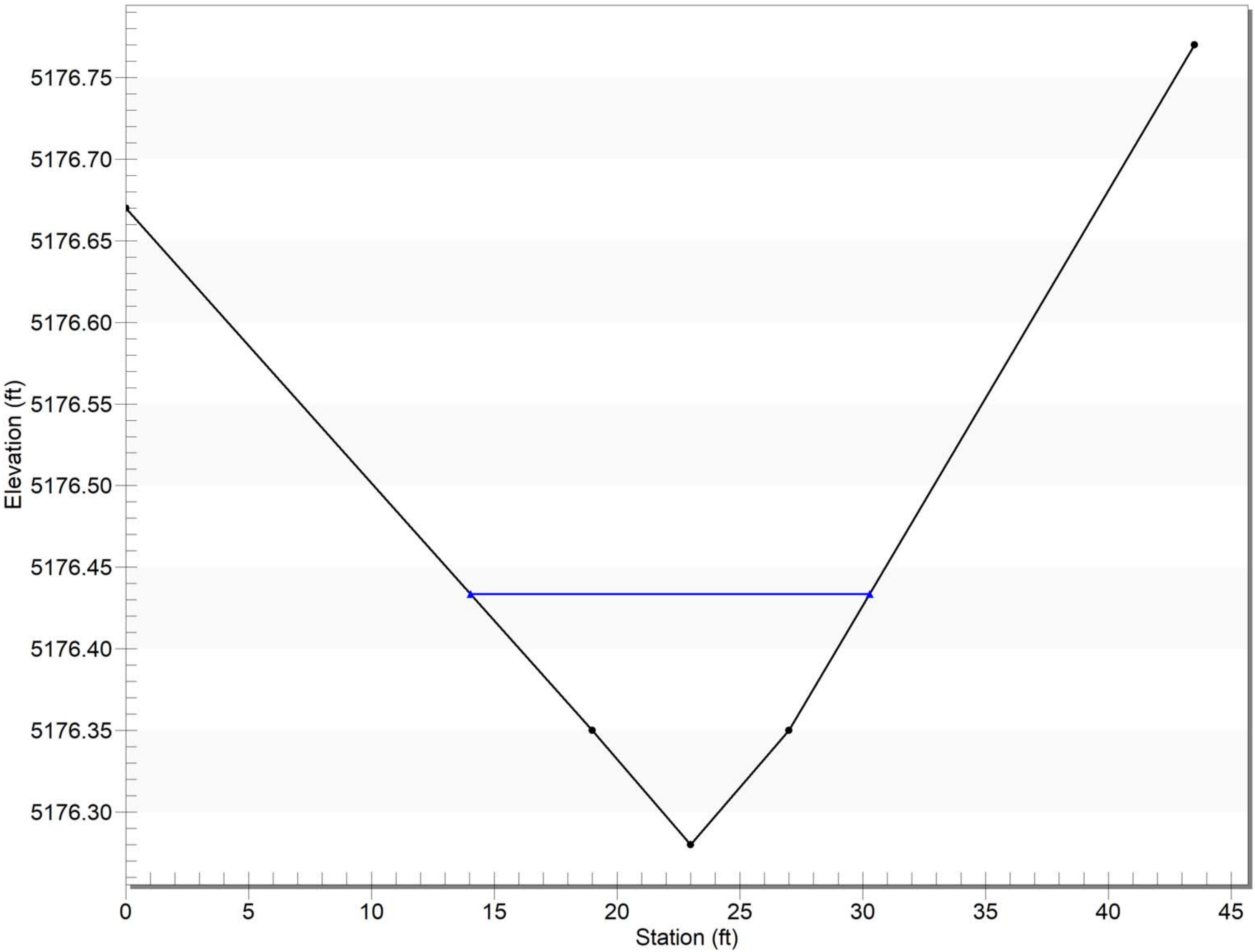
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IDG-08

Cross-Pan in Basin 31 - Krameria Ct & E 154th Ave (Minor Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5176.67	0.0160
19.00	5176.35	0.0130
23.00	5176.28	0.0130
27.00	5176.35	0.0160
43.50	5176.77	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 2.6000 cfs

Minor storm flow from Basin 31 to SDI-26

Result Parameters

Depth: 0.1536 ft

Area of Flow: 1.2932 ft^2

Wetted Perimeter: 16.2487 ft

Hydraulic Radius: 0.0796 ft

Average Velocity: 2.0105 ft/s

Top Width: 16.2457 ft

Froude Number: 1.2558

Critical Depth: 0.1687 ft

Critical Velocity: 1.6775 ft/s

Critical Slope: 0.0047 ft/ft

Critical Top Width: 17.74 ft

Calculated Max Shear Stress: 0.0719 lb/ft^2

Calculated Avg Shear Stress: 0.0372 lb/ft^2

Composite Manning's n Equation: Lotter method

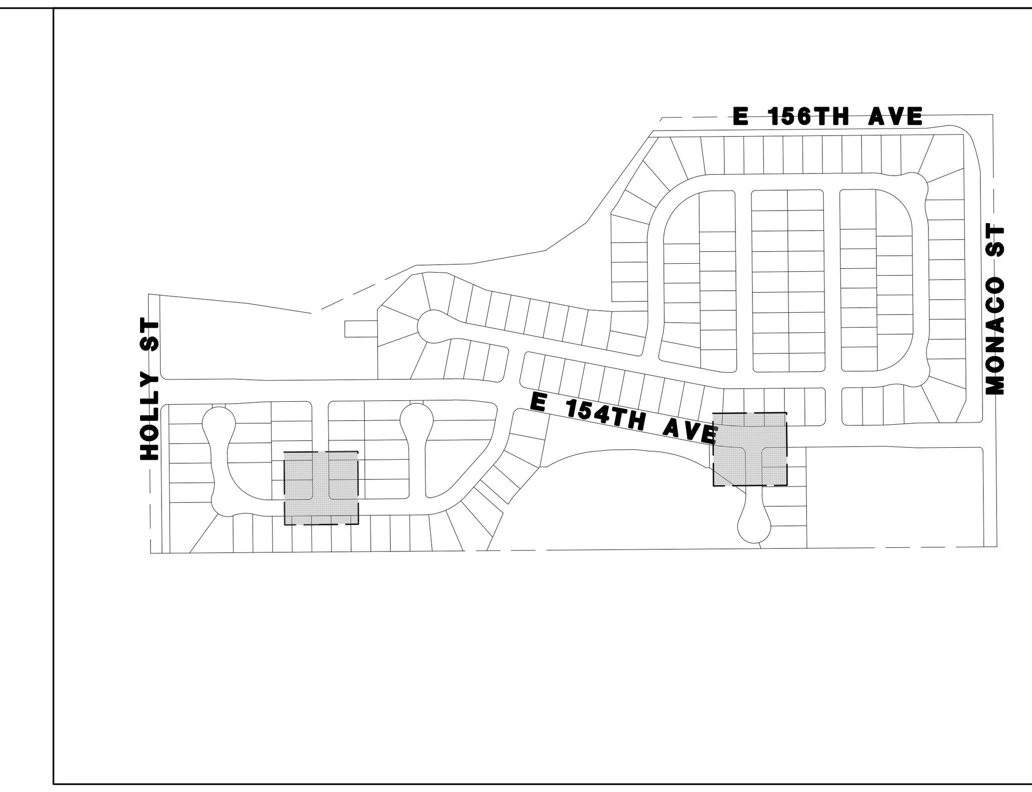
Manning's n: 0.0118

Channel Analysis: Cross-Pan in Basin 31 - Krameria Ct & E 154th Ave (Major Storm)

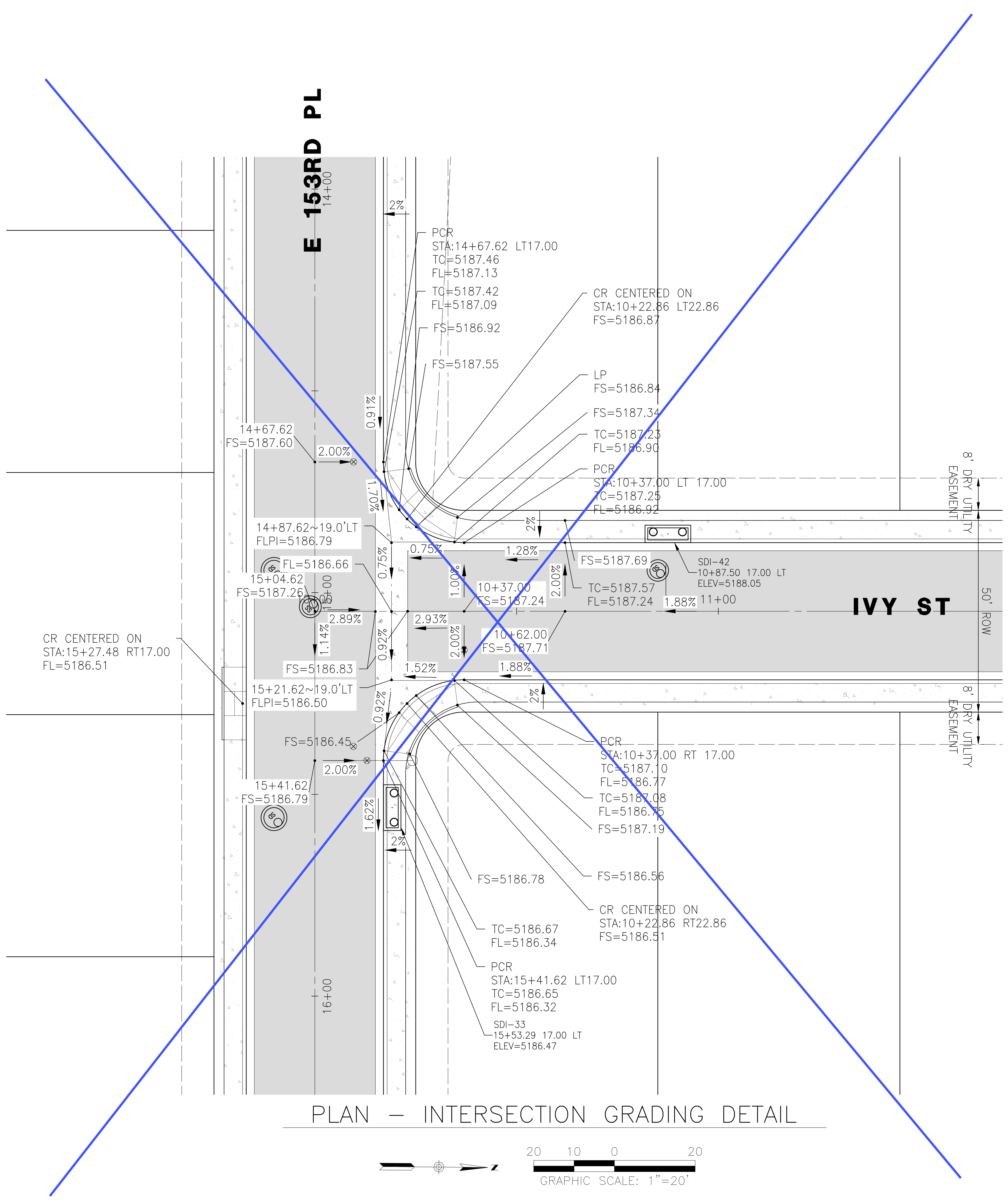
Notes:

Input Parameters

Channel Type: Custom Cross Section

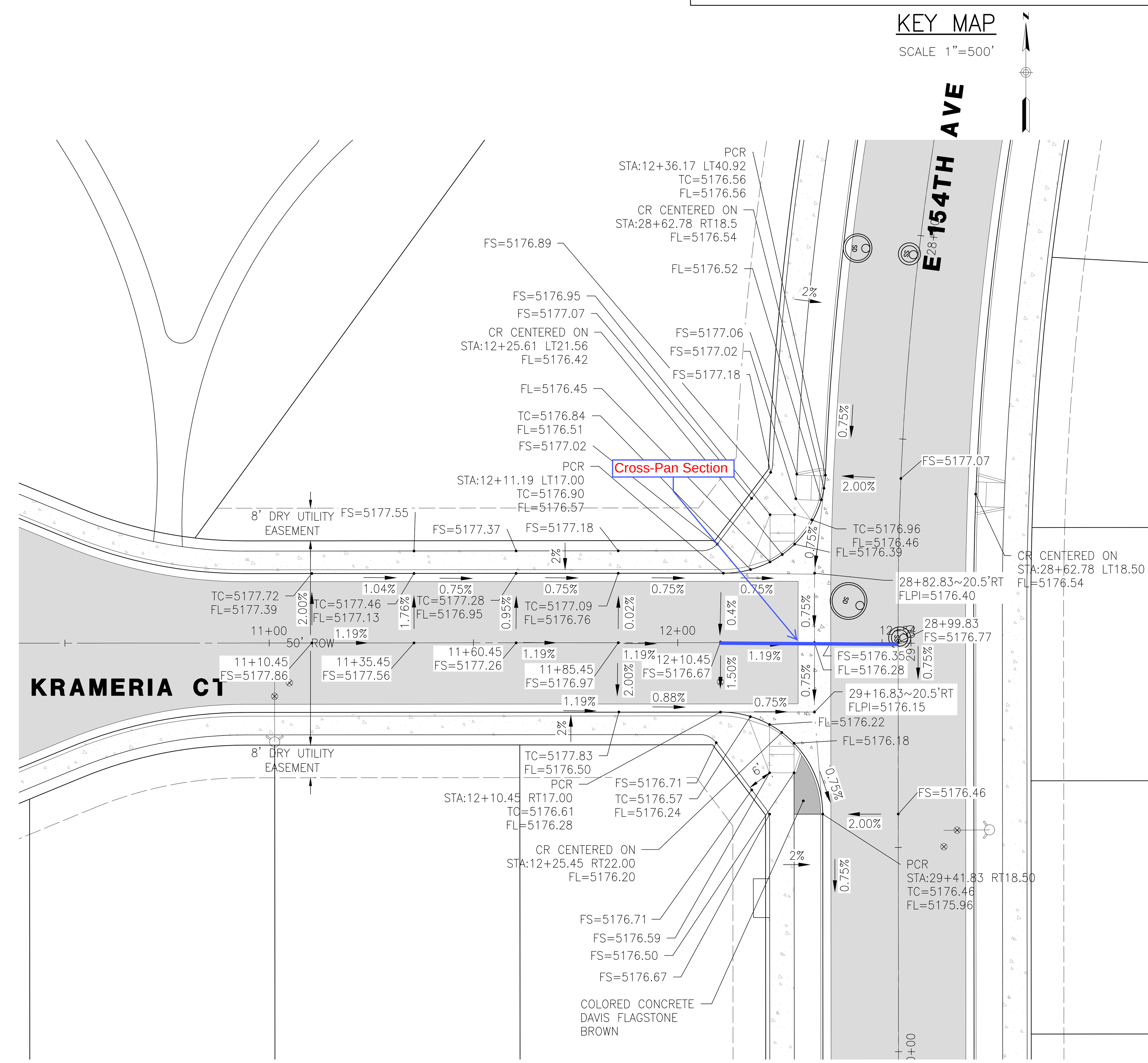


KEY MAP
SCALE 1"=500'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'



PLAN – INTERSECTION GRADING DETAIL

GRAPHIC SCALE: 1"=20'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.

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SCALE:	N/A
DATE:	11/20/2020
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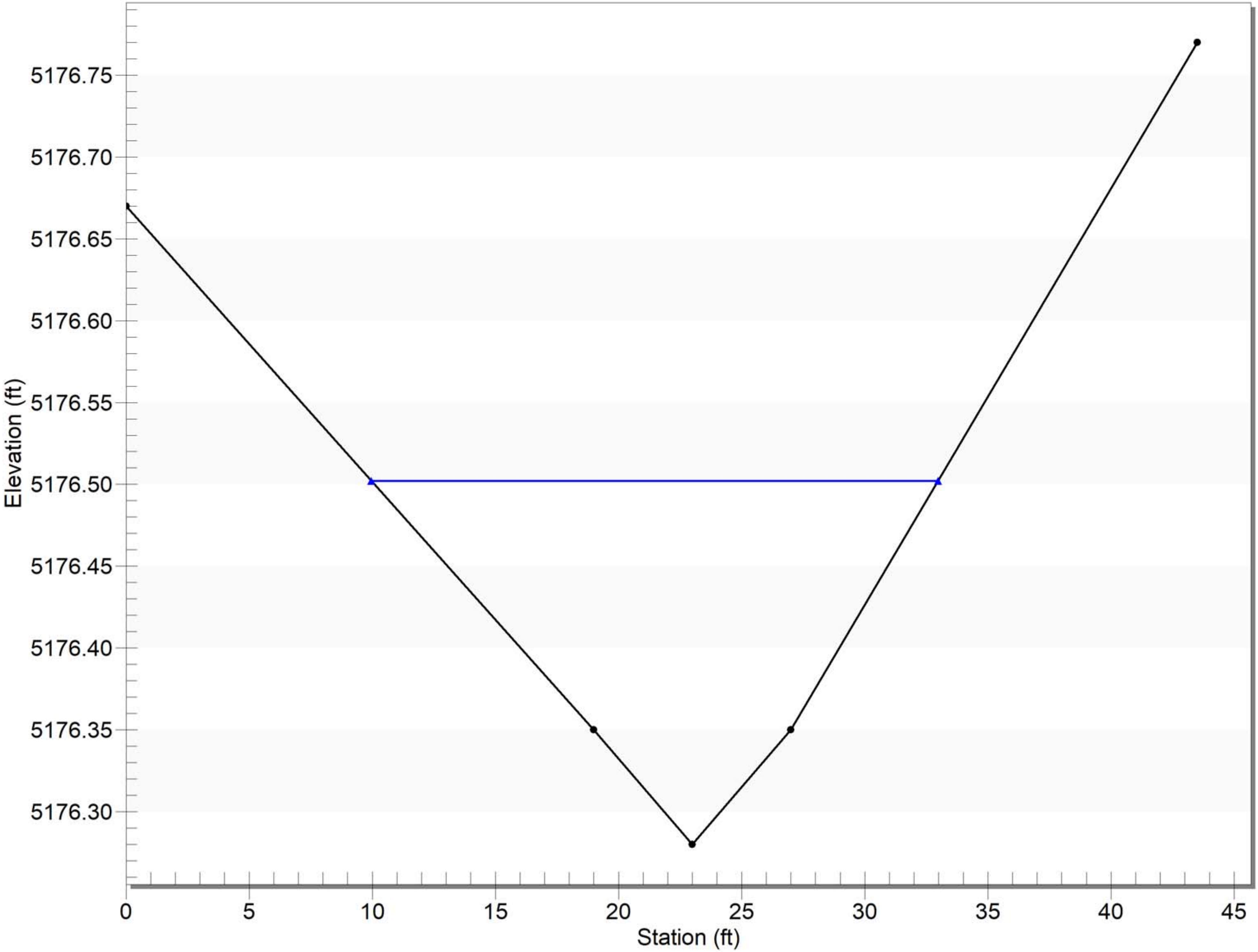
CHECKED BY:	TB
JOB NO:	D01104-A

INTERSECTION GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. IDG-08

Cross-Pan in Basin 31 - Krameria Ct & E 154th Ave (Major Storm)



Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5176.67	0.0160
19.00	5176.35	0.0130
23.00	5176.28	0.0130
27.00	5176.35	0.0160
43.50	5176.77	-----

Longitudinal Slope: 0.0075 ft/ft

Flow: 6.5000 cfs

Major storm flow from Basin 31 to SDI-26

Result Parameters

Depth: 0.2222 ft

Area of Flow: 2.6399 ft^2

Wetted Perimeter: 23.0188 ft

Hydraulic Radius: 0.1147 ft

Average Velocity: 2.4622 ft/s

Top Width: 23.0144 ft

Froude Number: 1.2811

Critical Depth: 0.2460 ft

Critical Velocity: 2.0210 ft/s

Critical Slope: 0.0045 ft/ft

Critical Top Width: 25.37 ft

Calculated Max Shear Stress: 0.1040 lb/ft^2

Calculated Avg Shear Stress: 0.0537 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0123

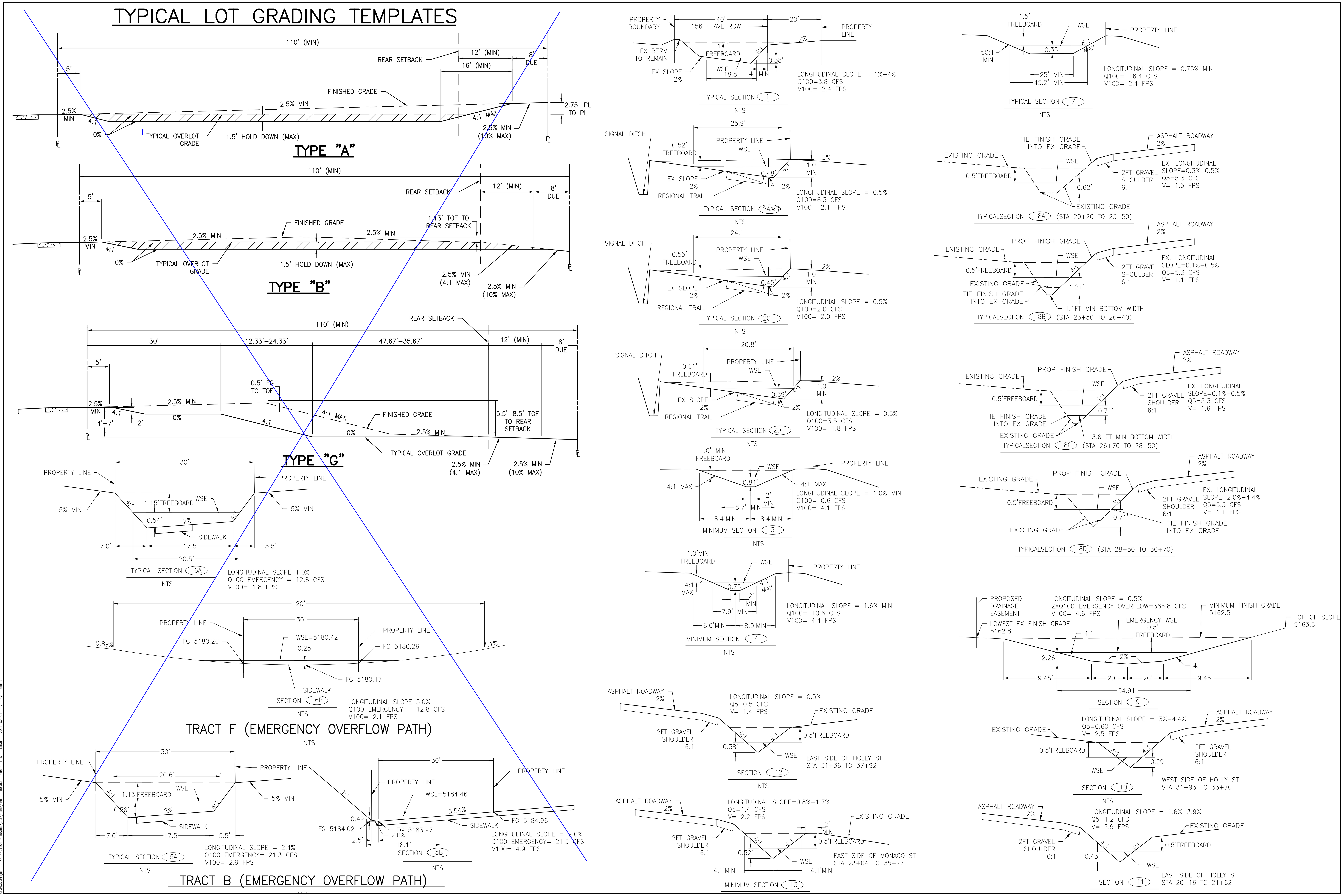
Appendix B – Hydraulic Computations
Swale & Roadside Ditch Design

Please note that stability charts provided in Section 6.0 of Chapter 8, USDCM Vol.1 are only applicable for swales with side slopes between 5:1 and 10:1. However, the proposed swales have been designed to maintain velocities less than 7 FPS and maximum shear stress less than 1.2 lb/sf per Table 8-3 in Section 5.8 of the USDCM, Vol.1 (page 8-50) to preserve bank stability.

All roadside ditches are designed to meet the criteria per Section 402.6 of the City of Thornton Standard and Specifications. They are designed to adequately carry the minor storm with 6-inches of freeboard. Maximum side slope of 4:1 has been maintained and maximum velocity for all roadside ditches is less than 5 FPS. Please note that stability charts provided in Section 6.0 of Chapter 8, USDCM Vol.1 are only applicable for swales with side slopes between 5:1 and 10:1. However, the roadside ditches have been designed to maintain velocities less than 5 FPS (during minor storm) and maximum shear stress less than 1.2 lb/sf per Table 8-3 in Section 5.8 of the USDCM, Vol.1 (page 8-50) to preserve bank stability.

The ditch/swale south of the property is only carrying its incidental runoff. There is no area tributary to this ditch except the swale itself. Hence, swale analysis is not warranted. Please refer to the drainage map for delineation.

Crossed out portions are not applicable to this section of the report.



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SCALE:	N/A
DATE:	2/1/2021
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

GRADING DETAILS

PROJECT NO. D01104-A

DRAWING NO. DTL-01

SHEET NO. 152 OF172 SHEETS

Output from Federal Highway Administration (FHWA) Hydraulic Toolbox 4.4 (Typical)

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Swale Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes: Swale Sizing

Channel Analysis: Swale 1 - Flow Depth Run (Min. Slope = 1%, n = 0.04)

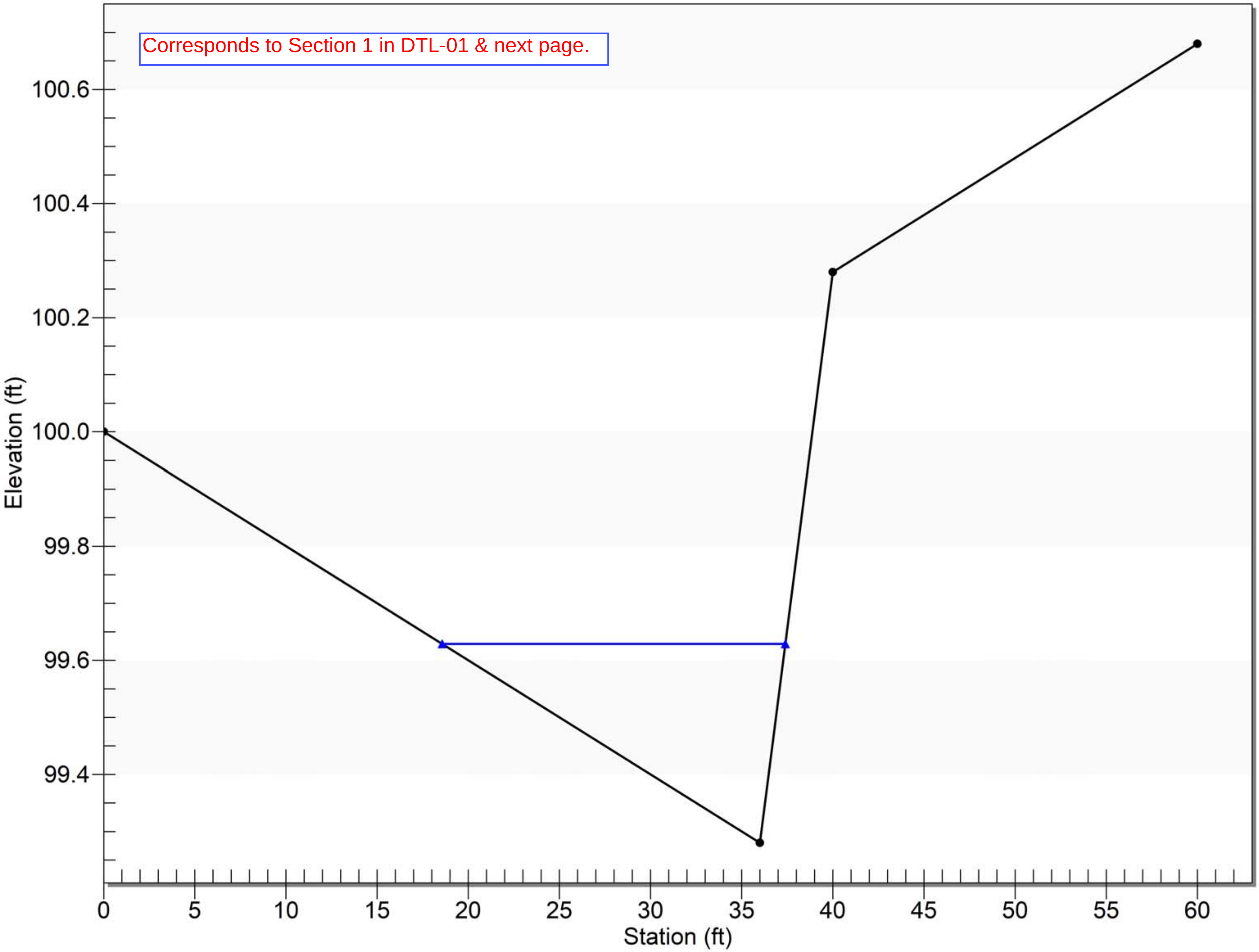
Notes:

Input Parameters

Channel Type: Custom Cross Section

Corresponds to Section 1 in DTL-01

Section 1 - Flow Depth Run



Corresponds to Section 1 in DTL-01
& the previous page output.

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	100.00	0.0400
36.00	99.28	0.0400
40.00	100.28	0.0400
60.00	100.68	-----

Table 8-5, Chapter 8, USDCM Vol. 1
recommends 0.04 for turfgrass sod
when assessing Water Depths
(Typical for all swale flow depth runs)

Longitudinal Slope: 0.0100 ft/ft

Flow: 4.8000 cfs

Flow from Sub-Basin 30A

Result Parameters

Depth: 0.3806 ft

Area of Flow: 3.9116 ft^2

Wetted Perimeter: 20.6043 ft

Hydraulic Radius: 0.1898 ft

Average Velocity: 1.2271 ft/s

Top Width: 20.5536 ft

Froude Number: 0.4957

Critical Depth: 0.2875 ft

Critical Velocity: 2.1513 ft/s

Critical Slope: 0.0447 ft/ft

Critical Top Width: 15.52 ft

Calculated Max Shear Stress: 0.2375 lb/ft^2

Calculated Avg Shear Stress: 0.1185 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0400

Corresponds to Section 1 in DTL-01

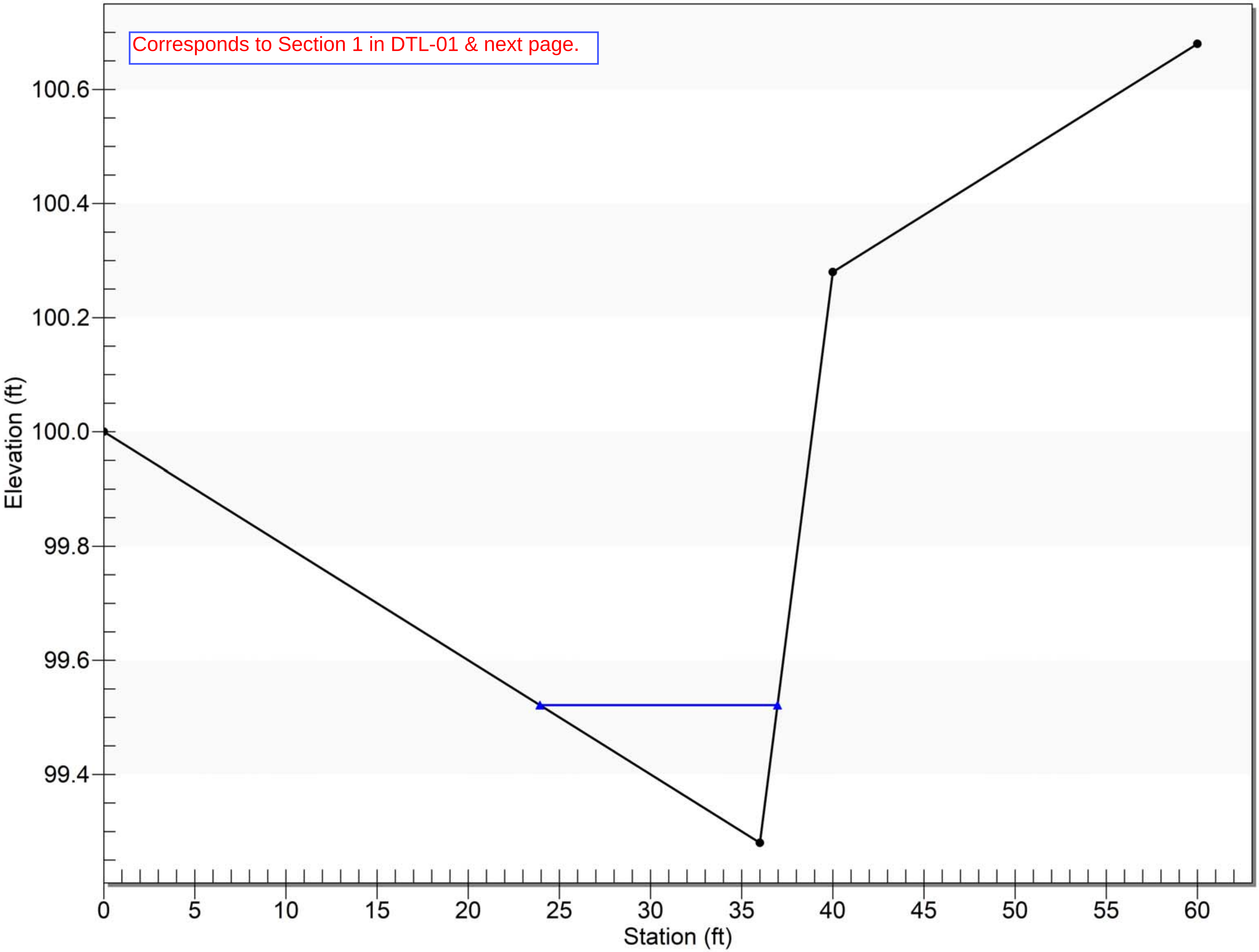
Channel Analysis: Swale 1 - Velocity Run (Max. Slope = 4%, n = 0.03)

Notes:

Input Parameters

Channel Type: Custom Cross Section

Section 1 - Velocity Run



Corresponds to Section 1 in DTL-01
& the previous page output.

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	100.00	0.0300
36.00	99.28	0.0300
40.00	100.28	0.0300
60.00	100.68	-----

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.03 for turfgrass sod when assessing velocity and shear stress (Typical for all swale velocity runs)

Longitudinal Slope: 0.0400 ft/ft

Flow: 4.8000 cfs

Flow from Sub-Basin 30A

Result Parameters

Depth: 0.2635 ft

Area of Flow: 1.8745 ft^2

Wetted Perimeter: 14.2633 ft

Hydraulic Radius: 0.1314 ft

Average Velocity: 2.5607 ft/s

Top Width: 14.2282 ft

Froude Number: 1.2433

Critical Depth: 0.2875 ft

Critical Velocity: 2.1513 ft/s

Critical Slope: 0.0251 ft/ft

Critical Top Width: 15.52 ft

Calculated Max Shear Stress: 0.6577 lb/ft^2

Calculated Avg Shear Stress: 0.3280 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

Corresponds to Section 2A & 2B in DTL-01 & the following page output.

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Swale Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes: Swale Sizing

Channel Analysis: Swale 2A & 2B - Flow Depth Run (Min. Slope = 0.5%, n = 0.04)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0400

Flow: 6.3000 cfs

Q100 from off-site basin O2

Result Parameters

Depth: 0.4800 ft

Area of Flow: 6.2203 ft^2

Wetted Perimeter: 25.9829 ft

Hydraulic Radius: 0.2394 ft

Average Velocity: 1.0128 ft/s

Top Width: 25.9190 ft

Froude Number: 0.3643

Critical Depth: 0.4151 ft

Critical Velocity: 1.3541 ft/s

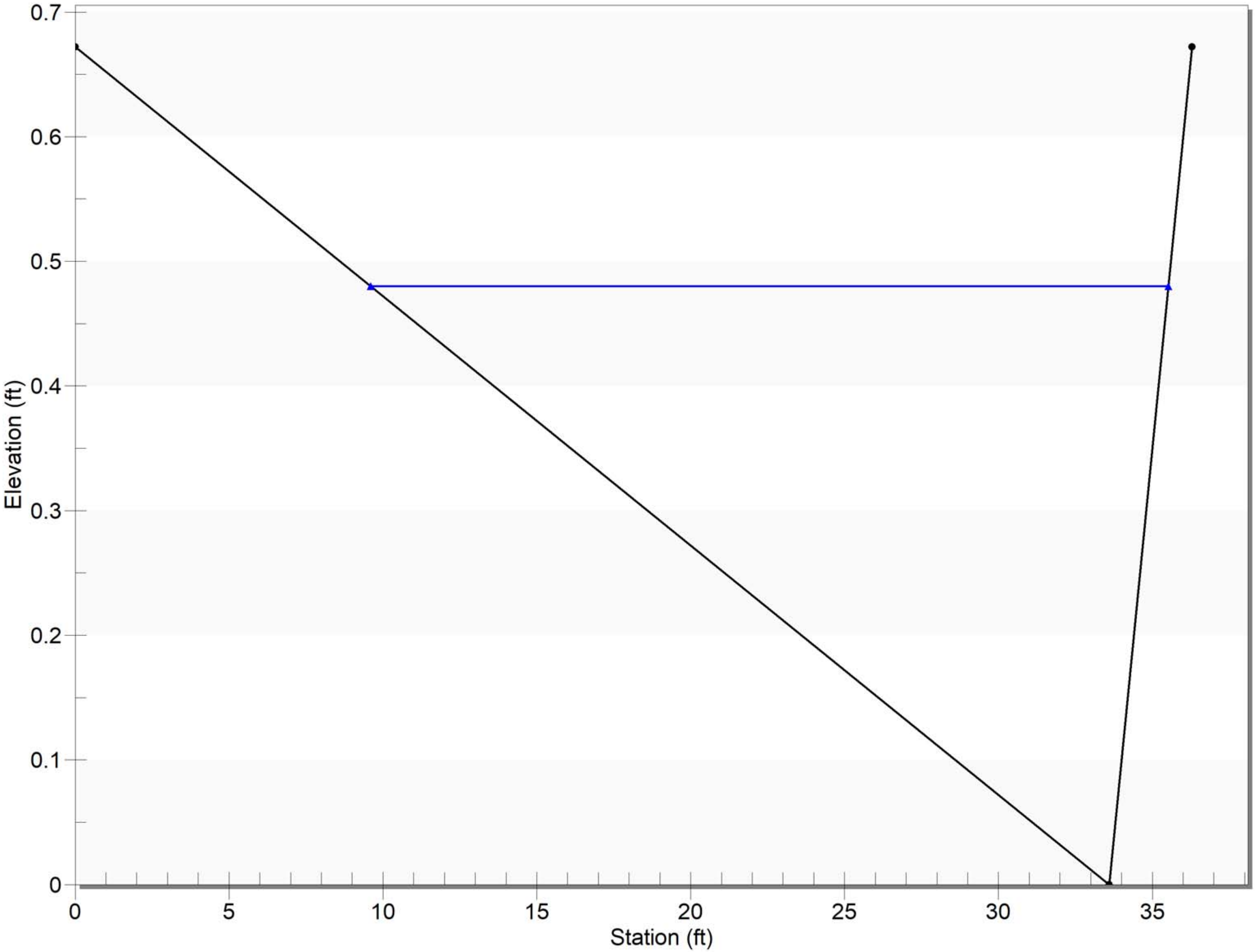
Critical Slope: 0.0108 ft/ft

Critical Top Width: 81.71 ft

Calculated Max Shear Stress: 0.1498 lb/ft^2

Calculated Avg Shear Stress: 0.0747 lb/ft^2

Section 2A & 2B - Flow Depth Run



Corresponds to Section 2A & 2B in
DTL-01 & the following page output.

Channel Analysis: Swale 2A & 2B - Velocity Run (Max. Slope = 2.0%, n = 0.03)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0300

Flow: 6.3000 cfs

Q100 from off-site basin O2

Result Parameters

Depth: 0.3323 ft

Area of Flow: 2.9808 ft^2

Wetted Perimeter: 17.9866 ft

Hydraulic Radius: 0.1657 ft

Average Velocity: 2.1135 ft/s

Top Width: 17.9424 ft

Froude Number: 0.9138

Critical Depth: 0.4151 ft

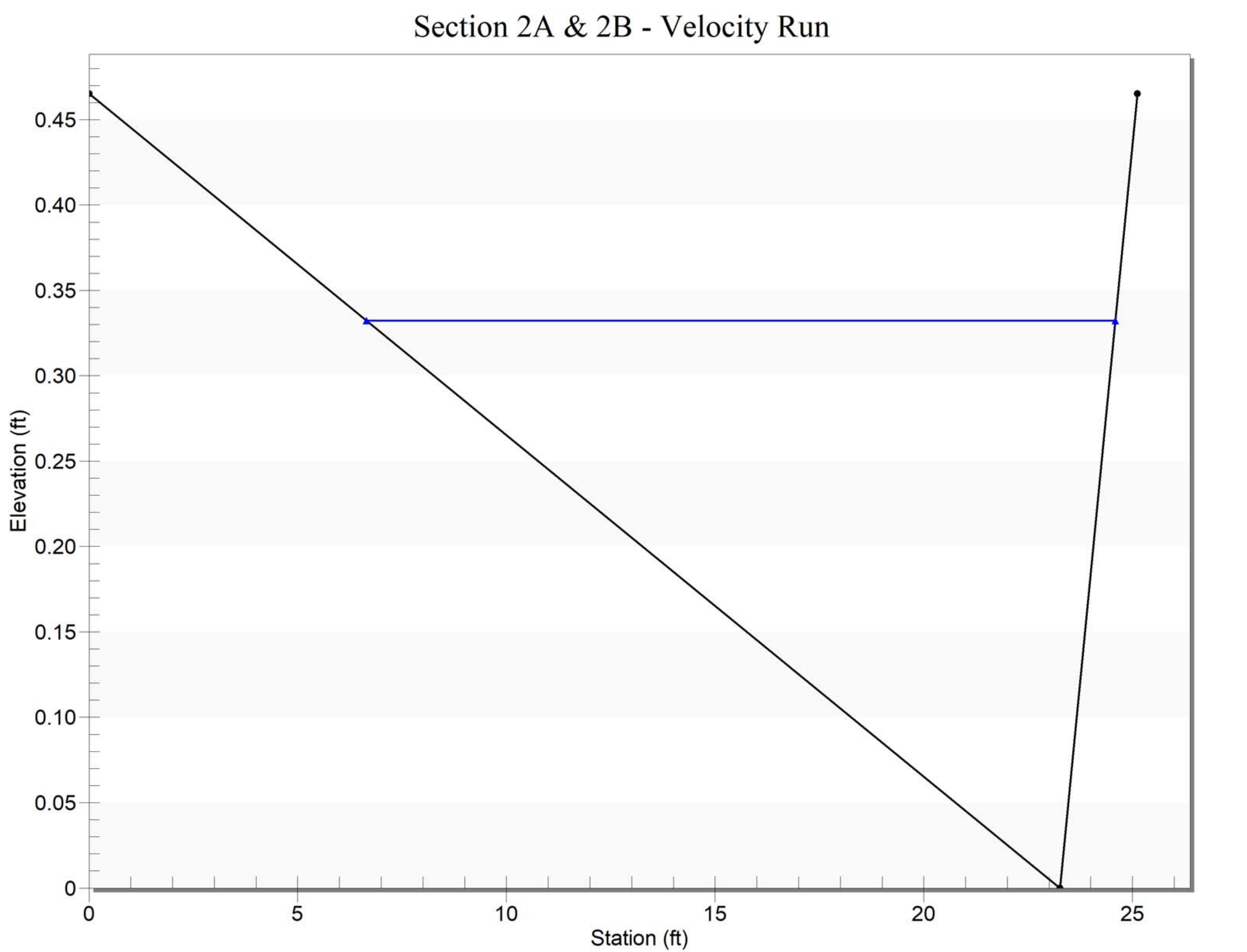
Critical Velocity: 1.3541 ft/s

Critical Slope: 0.0061 ft/ft

Critical Top Width: 81.71 ft

Calculated Max Shear Stress: 0.4147 lb/ft^2

Calculated Avg Shear Stress: 0.2068 lb/ft^2



Section 2A & 2B - Velocity Run
Elevation (ft)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
Station (ft)
0
5
10
15
20
25

Corresponds to Section 2C in DTL-01 & the following page output.

Channel Analysis: Swale 2C - Flow Depth Run (Min. Slope = 0.5%, n = 0.04)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0400

Flow: 5.2000 cfs

Q100 from off-site basin O3

Result Parameters

Depth: 0.4467 ft

Area of Flow: 5.3865 ft^2

Wetted Perimeter: 24.1789 ft

Hydraulic Radius: 0.2228 ft

Average Velocity: 0.9654 ft/s

Top Width: 24.1194 ft

Froude Number: 0.3600

Critical Depth: 0.3844 ft

Critical Velocity: 1.3031 ft/s

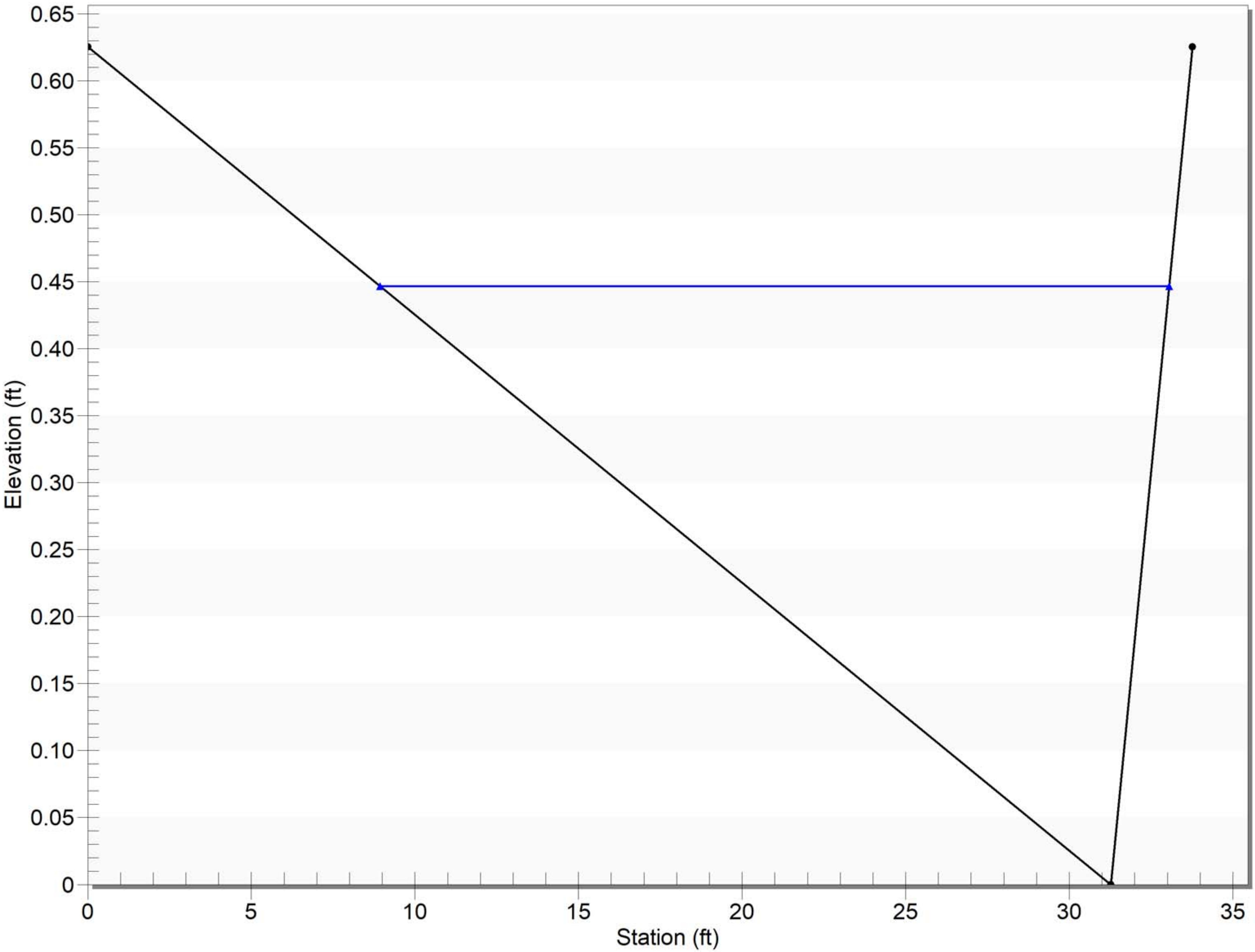
Critical Slope: 0.0111 ft/ft

Critical Top Width: 75.67 ft

Calculated Max Shear Stress: 0.1394 lb/ft^2

Calculated Avg Shear Stress: 0.0695 lb/ft^2

Section 2C - Flow Depth Run



Corresponds to Section 2C in DTL-01 & the following page output.

Channel Analysis: Swale 2C - Velocity Run (Max. Slope = 2.0%, n = 0.03)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0300

Flow: 5.2000 cfs

Q100 from off-site basin O3

Result Parameters

Depth: 0.3092 ft

Area of Flow: 2.5813 ft^2

Wetted Perimeter: 16.7378 ft

Hydraulic Radius: 0.1542 ft

Average Velocity: 2.0145 ft/s

Top Width: 16.6966 ft

Froude Number: 0.9029

Critical Depth: 0.3844 ft

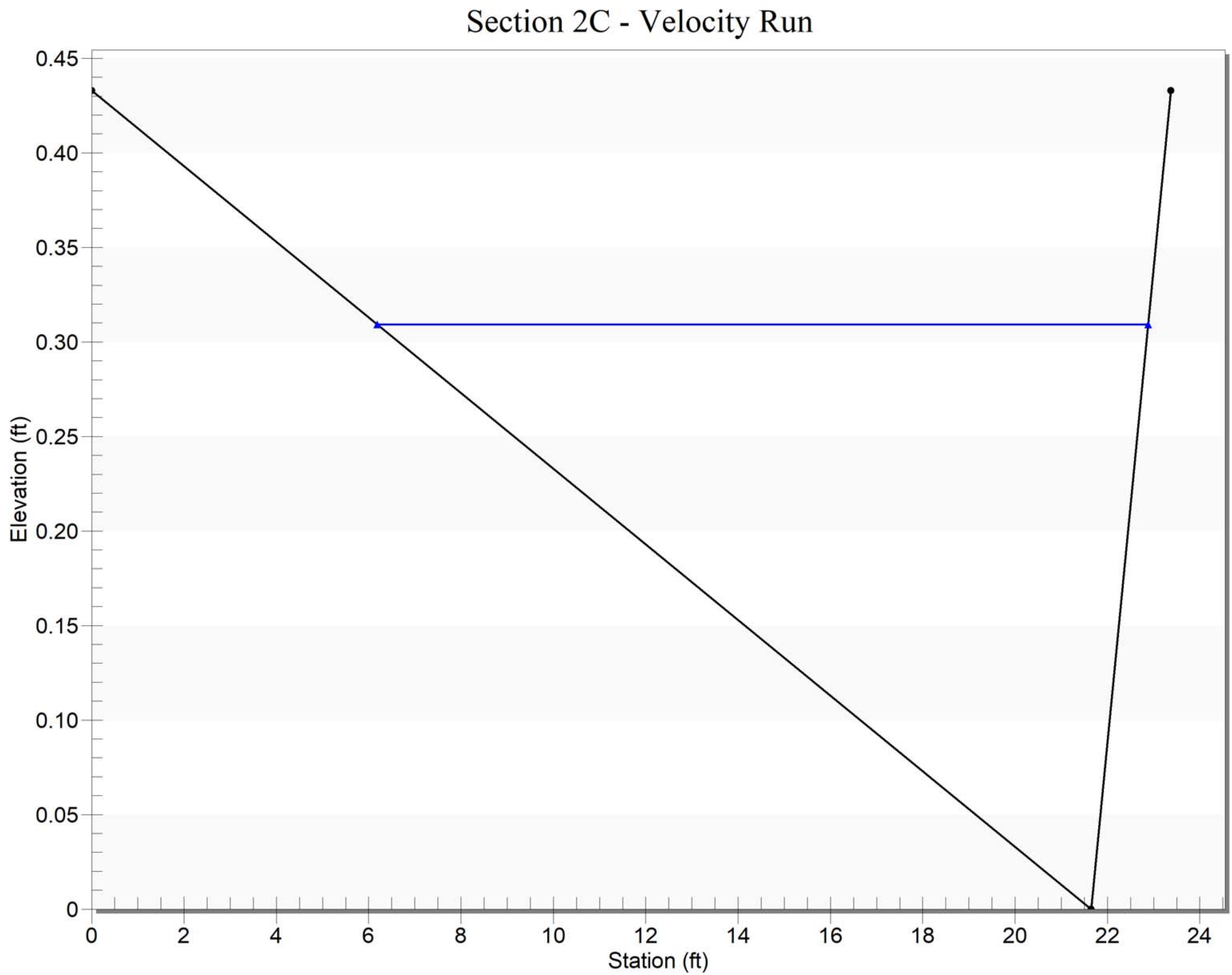
Critical Velocity: 1.3031 ft/s

Critical Slope: 0.0063 ft/ft

Critical Top Width: 75.67 ft

Calculated Max Shear Stress: 0.3859 lb/ft^2

Calculated Avg Shear Stress: 0.1925 lb/ft^2


Section 2C - Velocity Run
Elevation (ft)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Station (ft)

Corresponds to Section 2D in DTL-01 & the following page output.

Channel Analysis: Swale 2D - Flow Depth Run (Min. Slope = 0.5%, n = 0.04)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0400

Flow: 3.5000 cfs

Q100 from off-site basin O4

Result Parameters

Depth: 0.3850 ft

Area of Flow: 4.0028 ft^2

Wetted Perimeter: 20.8430 ft

Hydraulic Radius: 0.1920 ft

Average Velocity: 0.8744 ft/s

Top Width: 20.7918 ft

Froude Number: 0.3512

Critical Depth: 0.3281 ft

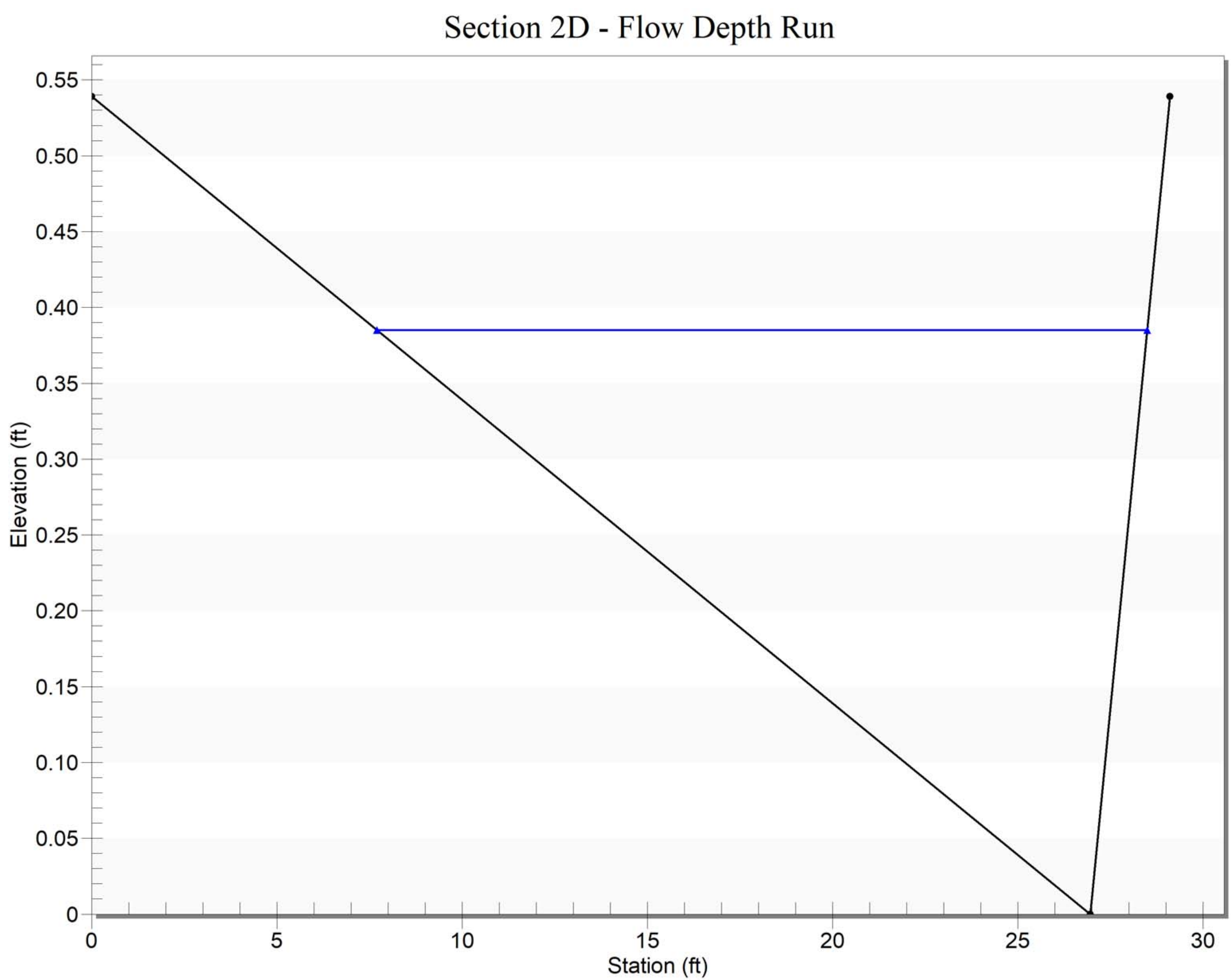
Critical Velocity: 1.2039 ft/s

Critical Slope: 0.0117 ft/ft

Critical Top Width: 64.59 ft

Calculated Max Shear Stress: 0.1201 lb/ft^2

Calculated Avg Shear Stress: 0.0599 lb/ft^2


Section 2D - Flow Depth Run
Elevation (ft)
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
0
5
10
15
20
25
30
Station (ft)

Corresponds to Section 2D in DTL-01 & the following page output.

Channel Analysis: Swale 2D - Velocity Run (Max. Slope = 2.0%, n = 0.03)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0300

Flow: 3.5000 cfs

Q100 from off-site basin O4

Result Parameters

Depth: 0.2665 ft

Area of Flow: 1.9181 ft^2

Wetted Perimeter: 14.4285 ft

Hydraulic Radius: 0.1329 ft

Average Velocity: 1.8247 ft/s

Top Width: 14.3931 ft

Froude Number: 0.8808

Critical Depth: 0.3281 ft

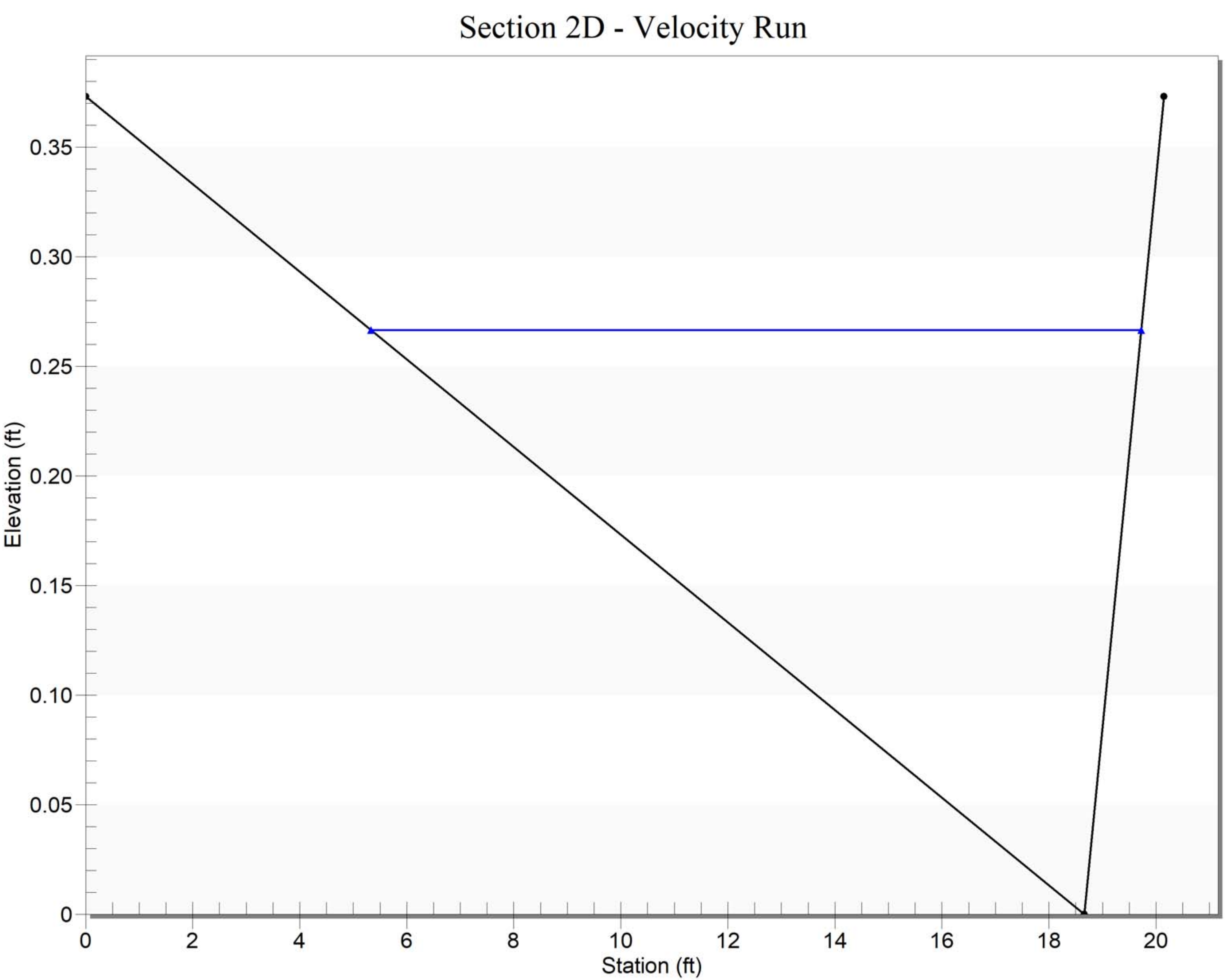
Critical Velocity: 1.2039 ft/s

Critical Slope: 0.0066 ft/ft

Critical Top Width: 64.59 ft

Calculated Max Shear Stress: 0.3326 lb/ft^2

Calculated Avg Shear Stress: 0.1659 lb/ft^2


Section 2D - Velocity Run
Elevation (ft)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
0
2
4
6
8
10
12
14
16
18
20
Station (ft)

Corresponds to Section 3 in DTL-01 & the following page output.

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Swale Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes: Swale Sizing

Channel Analysis: Swale 3 - Flow Depth Run (Min. Slope = 1%, n = 0.04)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 2.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0400

Flow: 10.6000 cfs

Q100 from off-site basin O2 + Sub-Basin 41A

Result Parameters

Depth: 0.8400 ft

Area of Flow: 4.5028 ft^2

Wetted Perimeter: 8.9272 ft

Hydraulic Radius: 0.5044 ft

Average Velocity: 2.3541 ft/s

Top Width: 8.7204 ft

Froude Number: 0.5773

Critical Depth: 0.6399 ft

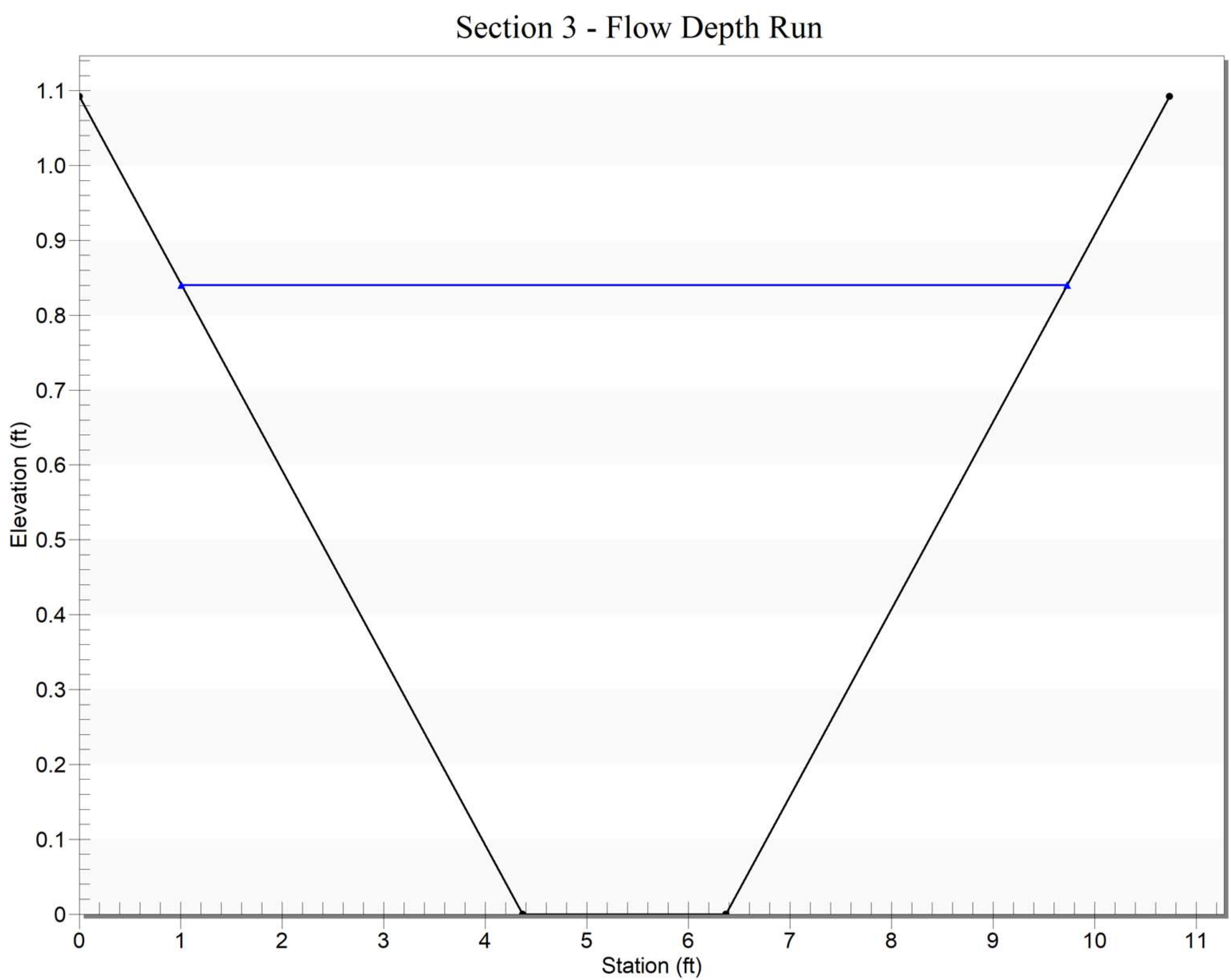
Critical Velocity: 3.6327 ft/s

Critical Slope: 0.0323 ft/ft

Critical Top Width: 7.12 ft

Calculated Max Shear Stress: 0.5242 lb/ft^2

Calculated Avg Shear Stress: 0.3147 lb/ft^2


Section 3 - Flow Depth Run
Elevation (ft)
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
6
7
8
9
10
11
Station (ft)

Corresponds to Section 3 in DTL-01 & the following page output.

Channel Analysis: Swale 3 - Velocity Run (Max. Slope = 2.5%, n = 0.03)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 2.0000 ft

Longitudinal Slope: 0.0250 ft/ft

Manning's n: 0.0300

Flow: 10.6000 cfs

Q100 from off-site basin O2 + Sub-Basin 41A

Result Parameters

Depth: 0.5933 ft

Area of Flow: 2.5944 ft^2

Wetted Perimeter: 6.8922 ft

Hydraulic Radius: 0.3764 ft

Average Velocity: 4.0858 ft/s

Top Width: 6.7461 ft

Froude Number: 1.1611

Critical Depth: 0.6402 ft

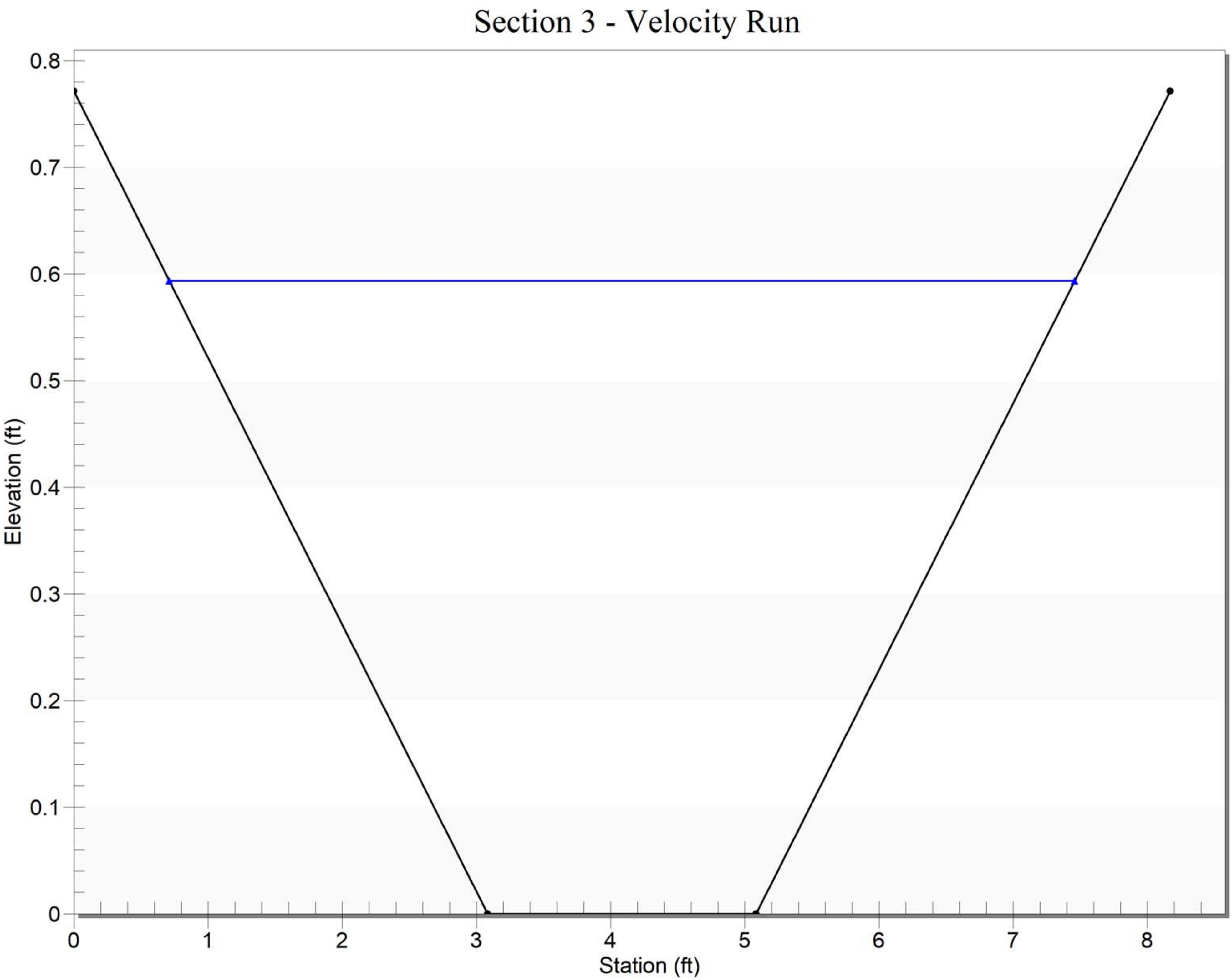
Critical Velocity: 3.6305 ft/s

Critical Slope: 0.0182 ft/ft

Critical Top Width: 7.12 ft

Calculated Max Shear Stress: 0.9255 lb/ft^2

Calculated Avg Shear Stress: 0.5872 lb/ft^2


Section 3 - Velocity Run
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Elevation (ft)
0
1
2
3
4
5
6
7
8
Station (ft)

Corresponds to Section 4 in DTL-01 & the following page output.

Channel Analysis: Swale 4 - Flow Depth Run (Min. Slope = 1.6%, n = 0.04)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 2.0000 ft

Longitudinal Slope: 0.0160 ft/ft

Manning's n: 0.0400

Flow: 10.6000 cfs

Q100 from off-site basin O3, O4 & Sub-Basin 41B

Result Parameters

Depth: 0.7544 ft

Area of Flow: 3.7852 ft^2

Wetted Perimeter: 8.2208 ft

Hydraulic Radius: 0.4604 ft

Average Velocity: 2.8004 ft/s

Top Width: 8.0351 ft

Froude Number: 0.7190

Critical Depth: 0.6401 ft

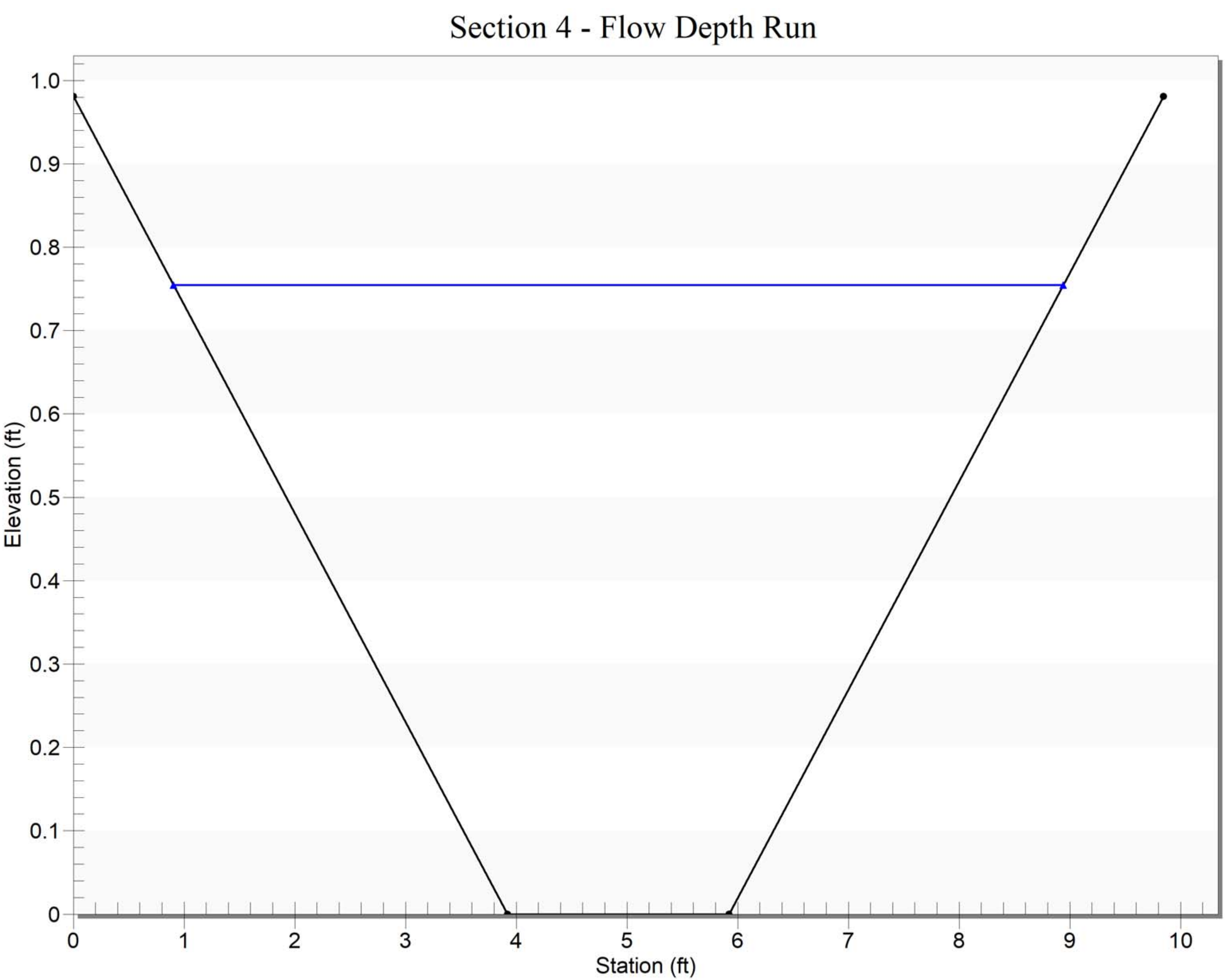
Critical Velocity: 3.6315 ft/s

Critical Slope: 0.0323 ft/ft

Critical Top Width: 7.12 ft

Calculated Max Shear Stress: 0.7532 lb/ft^2

Calculated Avg Shear Stress: 0.4597 lb/ft^2


Section 4 - Flow Depth Run
Elevation (ft)
Station (ft)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
6
7
8
9
10

Corresponds to Section 4 in DTL-01 & the following page output.

Channel Analysis: Swale 4 - Velocity Run (Max. Slope = 3%, n = 0.03)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 2.0000 ft

Longitudinal Slope: 0.0300 ft/ft

Manning's n: 0.0300

Flow: 10.6000 cfs

Q100 from off-site basin O3, O4 & Sub-Basin 41B

Result Parameters

Depth: 0.5685 ft

Area of Flow: 2.4296 ft^2

Wetted Perimeter: 6.6878 ft

Hydraulic Radius: 0.3633 ft

Average Velocity: 4.3629 ft/s

Top Width: 6.5478 ft

Froude Number: 1.2622

Critical Depth: 0.6399 ft

Critical Velocity: 3.6327 ft/s

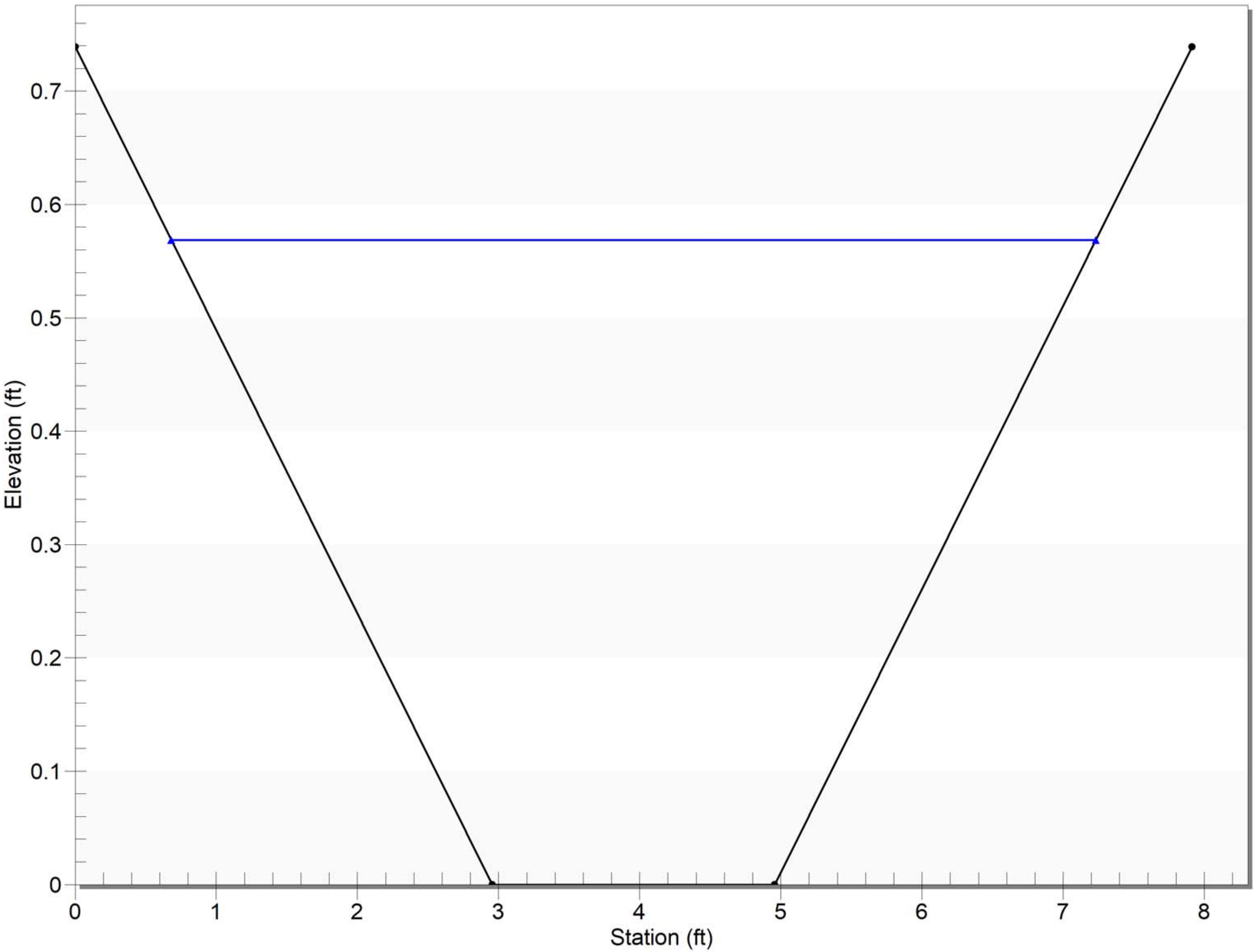
Critical Slope: 0.0182 ft/ft

Critical Top Width: 7.12 ft

Calculated Max Shear Stress: 1.0642 lb/ft^2

Calculated Avg Shear Stress: 0.6801 lb/ft^2

Section 4 - Velocity Run



Corresponds to Section 7 in DTL-01 & the following page output.

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Swale Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes: Swale Sizing

Channel Analysis: Swale 7 (South Park) - Flow Depth Run (Min. Slope = 0.75%, n = 0.04)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 8.0000 ft/ft

Channel Width: 25.0000 ft

Longitudinal Slope: 0.0075 ft/ft

Manning's n: 0.0400

Flow: 16.4000 cfs

Q100 from Basin 34 to (SDI-32)

Result Parameters

Depth: 0.3478 ft

Area of Flow: 12.2031 ft^2

Wetted Perimeter: 45.1976 ft

Hydraulic Radius: 0.2700 ft

Average Velocity: 1.3439 ft/s

Top Width: 45.1725 ft

Froude Number: 0.4557

Critical Depth: 0.2172 ft

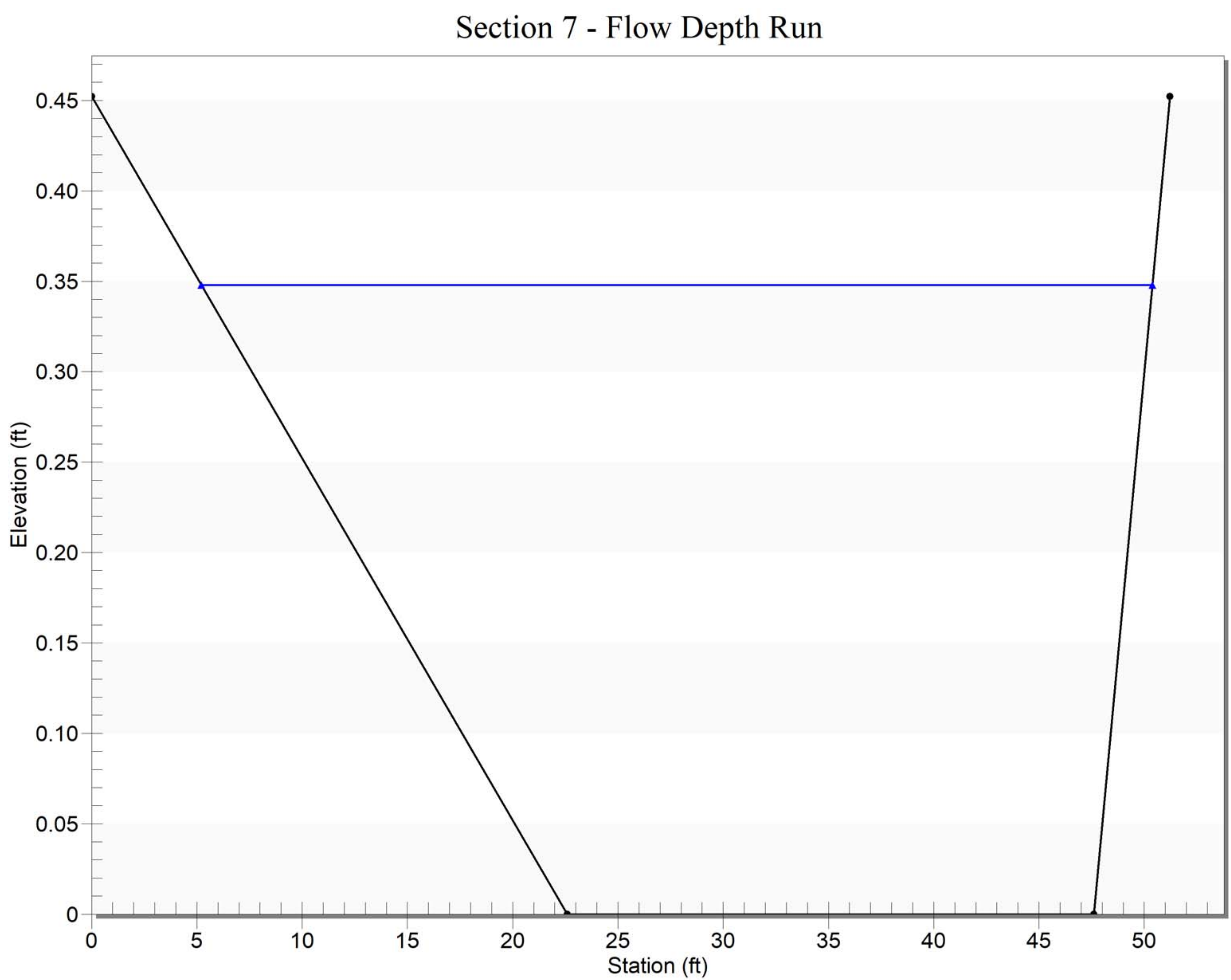
Critical Velocity: 2.4123 ft/s

Critical Slope: 0.0413 ft/ft

Critical Top Width: 37.60 ft

Calculated Max Shear Stress: 0.1628 lb/ft^2

Calculated Avg Shear Stress: 0.1264 lb/ft^2


Section 7 - Flow Depth Run
Elevation (ft)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
0
5
10
15
20
25
30
35
40
45
50
Station (ft)

Corresponds to Section 7 in DTL-01 & the following page output.

Channel Analysis: Swale 7 (South Park) - Velocity Run (Max. Slope = 2.4%, n = 0.03)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 8.0000 ft/ft

Channel Width: 25.0000 ft

Longitudinal Slope: 0.0240 ft/ft

Manning's n: 0.0300

Flow: 16.4000 cfs

Q100 from Basin 34 to (SDI-32)

Result Parameters

Depth: 0.2151 ft

Area of Flow: 6.7190 ft^2

Wetted Perimeter: 37.4910 ft

Hydraulic Radius: 0.1792 ft

Average Velocity: 2.4408 ft/s

Top Width: 37.4754 ft

Froude Number: 1.0158

Critical Depth: 0.2171 ft

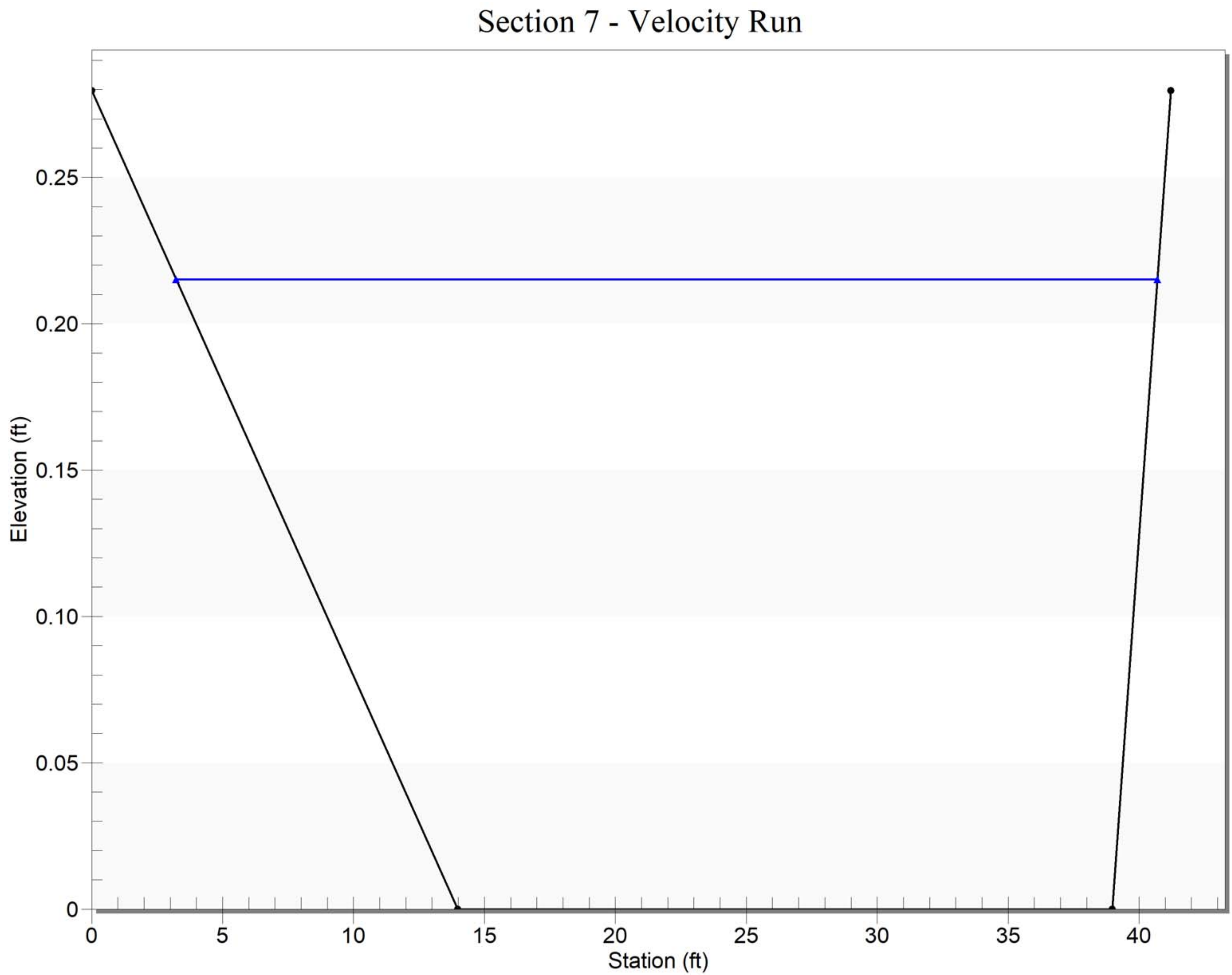
Critical Velocity: 2.4132 ft/s

Critical Slope: 0.0232 ft/ft

Critical Top Width: 37.59 ft

Calculated Max Shear Stress: 0.3221 lb/ft^2

Calculated Avg Shear Stress: 0.2684 lb/ft^2


Section 7 - Velocity Run
Elevation (ft)
0.25
0.20
0.15
0.10
0.05
0
0
5
10
15
20
25
30
35
40
Station (ft)

Corresponds to Section 9 in DTL-01

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Swale Sizing

Designer:

Project Date: Tuesday, August 25, 2020

Project Units: U.S. Customary Units

Notes: Swale Sizing

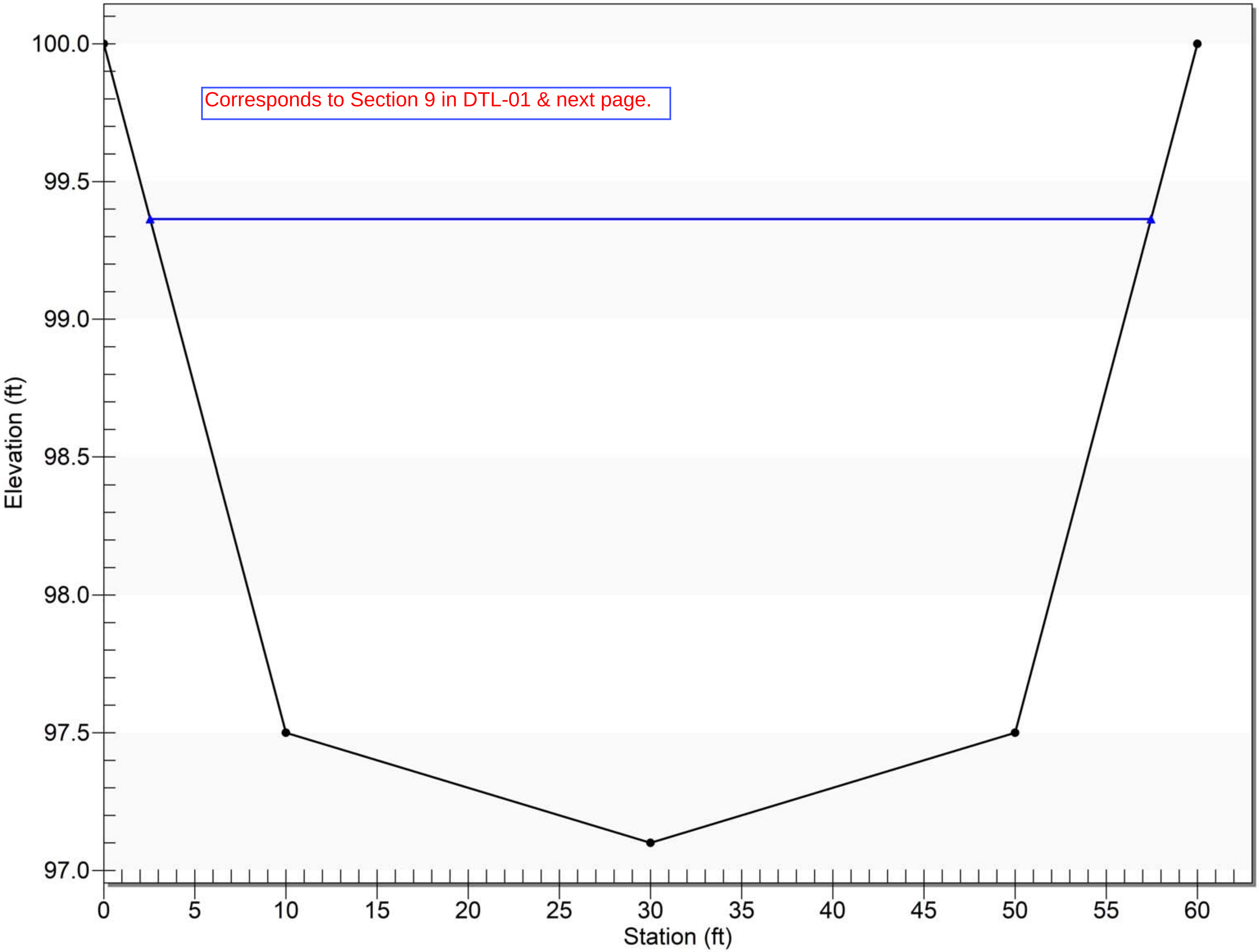
Channel Analysis: Swale 9 - 2 X Undetained Q100 Flow Depth Run (Slope = 0.5%, n = 0.04)

Notes:

Input Parameters

Channel Type: Custom Cross Section

Section 9 - Flow Depth Run



Corresponds to Section 9 in DTL-01
& the previous page output.

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	100.00	0.0400
40.00	90.00	0.0400
60.00	89.60	0.0400
80.00	90.00	0.0400
120.00	100.00	-----

Longitudinal Slope: 0.0050 ft/ft

Flow: 366.8000 cfs

2 X Undetained Q100 from Detention Basin + Q100 from offsite basin O5

Result Parameters

Depth: 2.2640 ft

Area of Flow: 96.4557 ft^2

Wetted Perimeter: 55.3786 ft

Hydraulic Radius: 1.7418 ft

Average Velocity: 3.8028 ft/s

Top Width: 54.9117 ft

Froude Number: 0.5056

Critical Depth: 1.5441 ft

Critical Velocity: 6.2172 ft/s

Critical Slope: 0.0221 ft/ft

Critical Top Width: 49.15 ft

Calculated Max Shear Stress: 0.7064 lb/ft^2

Calculated Avg Shear Stress: 0.5434 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0400

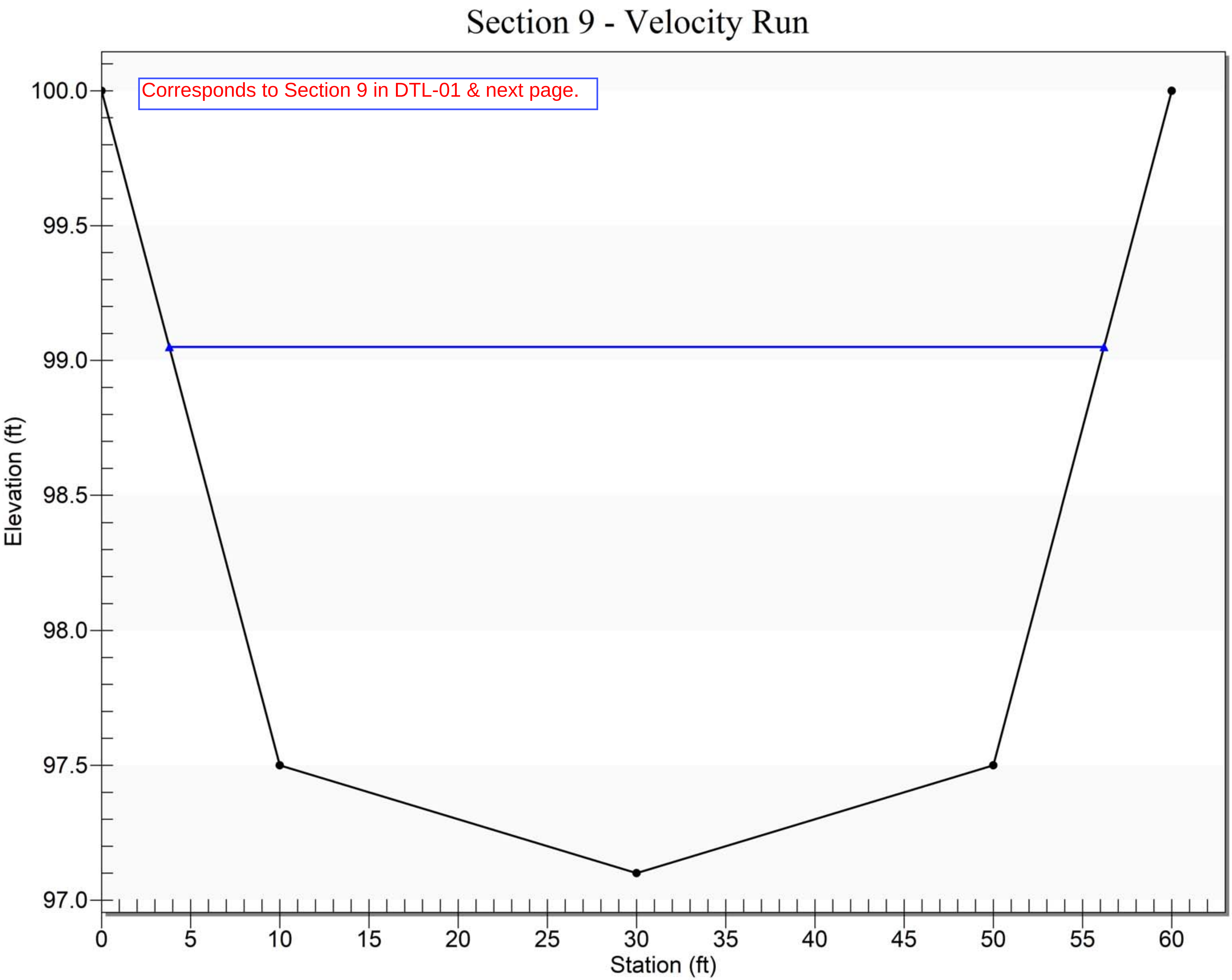
Corresponds to Section 9 in DTL-01

Channel Analysis: Swale 9 - 2 X Undetained Q100 Velocity Run (Slope = 0.5%, n = 0.03)

Notes:

Input Parameters

Channel Type: Custom Cross Section


Section 9 - Velocity Run
Corresponds to Section 9 in DTL-01 & next page.
100.0
99.5
99.0
98.5
98.0
97.5
97.0
Elevation (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Station (ft)

Corresponds to Section 9 in DTL-01
& the previous page output.

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	100.00	0.0300
40.00	90.00	0.0300
60.00	89.60	0.0300
80.00	90.00	0.0300
120.00	100.00	-----

Longitudinal Slope: 0.0050 ft/ft

Flow: 366.8000 cfs

2 X Undetained Q100 from Detention Basin + Q100 from offsite basin O5

Result Parameters

Depth: 1.9503 ft

Area of Flow: 79.6262 ft^2

Wetted Perimeter: 52.7922 ft

Hydraulic Radius: 1.5083 ft

Average Velocity: 4.6065 ft/s

Top Width: 52.4025 ft

Froude Number: 0.6586

Critical Depth: 1.5441 ft

Critical Velocity: 6.2172 ft/s

Critical Slope: 0.0124 ft/ft

Critical Top Width: 49.15 ft

Calculated Max Shear Stress: 0.6085 lb/ft^2

Calculated Avg Shear Stress: 0.4706 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

Corresponds to Section 8A Sta 22+00 in DTL-01. Section 8A Station 22+00 of the DTL-01 is the cross-section that best represents and the most restrictive of the cross-sections from Station 20+20 to 23+50

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Roadside Ditch Sizing

Designer:

Project Date: Thursday, November 19, 2020

Project Units: U.S. Customary Units

Notes:

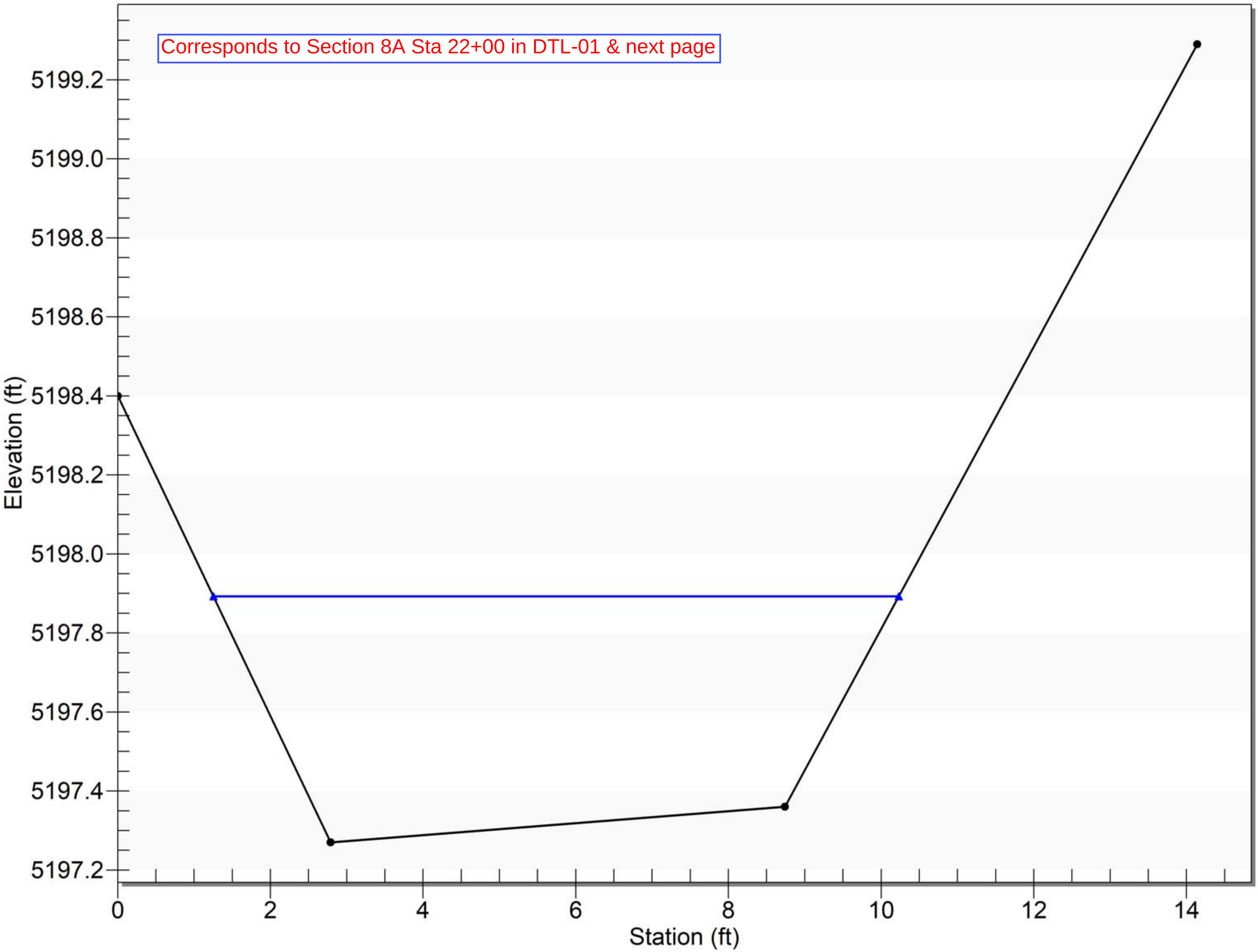
Channel Analysis: Swale 8 22+00 (Roadside Ditch) - Flow Depth Run (Slope = 0.3%, n = 0.04)

Notes:

Input Parameters

Channel Type: Custom Cross Section

Swale 8 Sta 22+00 - Flow Depth Run



Corresponds to Section 8A Sta 22+00 in DTL-01 & the previous page output

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5198.40	0.0400
2.79	5197.27	0.0400
8.74	5197.36	0.0400
14.14	5199.29	-----

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths (Typical for all roadside ditch flow depth runs)

Longitudinal Slope: 0.0030 ft/ft

Flow: 5.3000 cfs

Q5 from Offsite Basin O11

Result Parameters

Depth: 0.6228 ft

Area of Flow: 4.3135 ft^2

Wetted Perimeter: 9.1926 ft

Hydraulic Radius: 0.4692 ft

Average Velocity: 1.2287 ft/s

Top Width: 8.9782 ft

Froude Number: 0.3124

Critical Depth: 0.3234 ft

Critical Velocity: 2.8462 ft/s

Critical Slope: 0.0377 ft/ft

Critical Top Width: 7.40 ft

Calculated Max Shear Stress: 0.1166 lb/ft^2

Calculated Avg Shear Stress: 0.0878 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0400

Corresponds to Section 8A Sta 22+00 in DTL-01. Section 8A Station 22+00 of the DTL-01 is the cross-section that best represents and the most restrictive of the cross-sections from Station 20+20 to 23+50

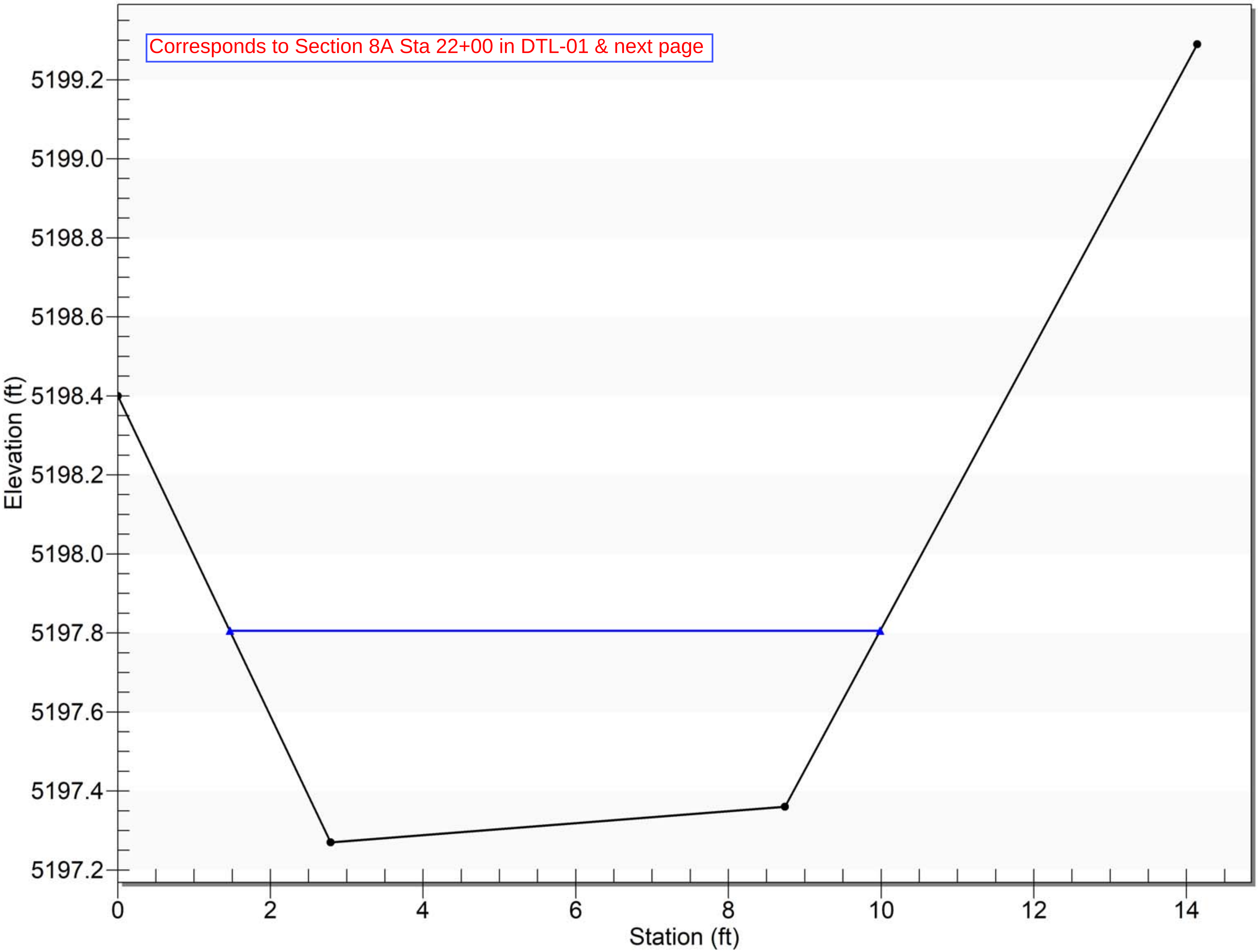
Channel Analysis: Swale 8 22+00 (Roadside Ditch) - Velocity Run (Slope = 0.3%, n = 0.03)

Notes:

Input Parameters

Channel Type: Custom Cross Section

Swale 8 Sta 22+00 - Velocity Run



Corresponds to Section 8A Sta 22+00 in DTL-01 &
the previous page output

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	5198.40	0.0300
2.79	5197.27	0.0300
8.74	5197.36	0.0300
14.14	5199.29	-----

Longitudinal Slope: 0.0030 ft/ft

Flow: 5.3000 cfs

Q5 from Offsite Basin O11

Result Parameters

Depth: 0.5356 ft

Area of Flow: 3.5508 ft^2

Wetted Perimeter: 8.7013 ft

Hydraulic Radius: 0.4081 ft

Average Velocity: 1.4926 ft/s

Top Width: 8.5190 ft

Froude Number: 0.4074

Critical Depth: 0.3234 ft

Critical Velocity: 2.8462 ft/s

Critical Slope: 0.0212 ft/ft

Critical Top Width: 7.40 ft

Calculated Max Shear Stress: 0.1003 lb/ft^2

Calculated Avg Shear Stress: 0.0764 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0300

Corresponds to Section 8B Sta 24+00 in DTL-01. Section 8B Station 24+00 of the DTL-01 is the cross-section that best represents and the most restrictive of the cross-sections from Station 23+50 to 26+40

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Roadside Ditch Sizing

Designer:

Project Date: Thursday, November 19, 2020

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Swale 8 24+00 (Roadside Ditch) - Flow Depth Run (Slope = 0.1%, n = 0.04)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.5000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 1.0700 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0400

Flow: 5.3000 cfs

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths (Typical for all roadside ditch flow depth runs)

Q5 from Offsite Basin O11

Result Parameters

Depth: 1.2066 ft

Area of Flow: 6.0226 ft^2

Wetted Perimeter: 9.2937 ft

Hydraulic Radius: 0.6480 ft

Average Velocity: 0.8800 ft/s

Top Width: 8.9128 ft

Froude Number: 0.1887

Critical Depth: 0.5555 ft

Critical Velocity: 3.3178 ft/s

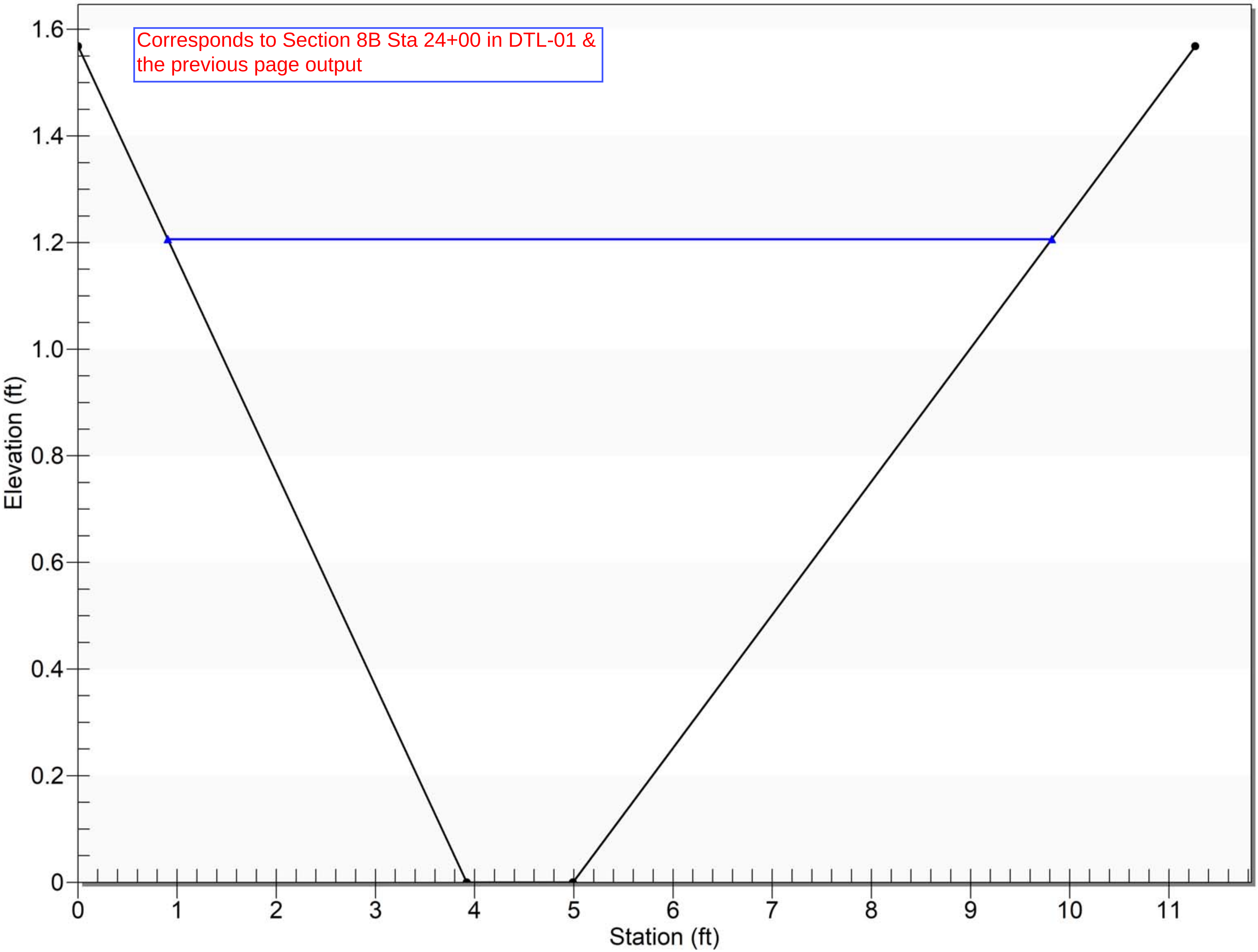
Critical Slope: 0.0351 ft/ft

Critical Top Width: 4.68 ft

Calculated Max Shear Stress: 0.0753 lb/ft^2

Calculated Avg Shear Stress: 0.0404 lb/ft^2

Swale 8 Sta 24+00 - Flow Depth Run



Corresponds to Section 8B Sta 24+00 in DTL-01. Section 8B Station 24+00 of the DTL-01 is the cross-section that best represents and the most restrictive of the cross-sections from Station 23+50 to 26+40

Channel Analysis: Swale 8 24+00 (Roadside Ditch) - Velocity Run (Slope = 0.1%, n = 0.03)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.5000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 1.0700 ft

Longitudinal Slope: 0.0010 ft/ft

Manning's n: 0.0300

Flow: 5.3000 cfs

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.03 for turfgrass sod when assessing Velocity and Shear Stress (Typical for all roadside ditch velocity runs)

Q5 from Offsite Basin O11

Result Parameters

Depth: 1.0691 ft

Area of Flow: 4.8584 ft^2

Wetted Perimeter: 8.3565 ft

Hydraulic Radius: 0.5814 ft

Average Velocity: 1.0909 ft/s

Top Width: 8.0190 ft

Froude Number: 0.2470

Critical Depth: 0.5557 ft

Critical Velocity: 3.3160 ft/s

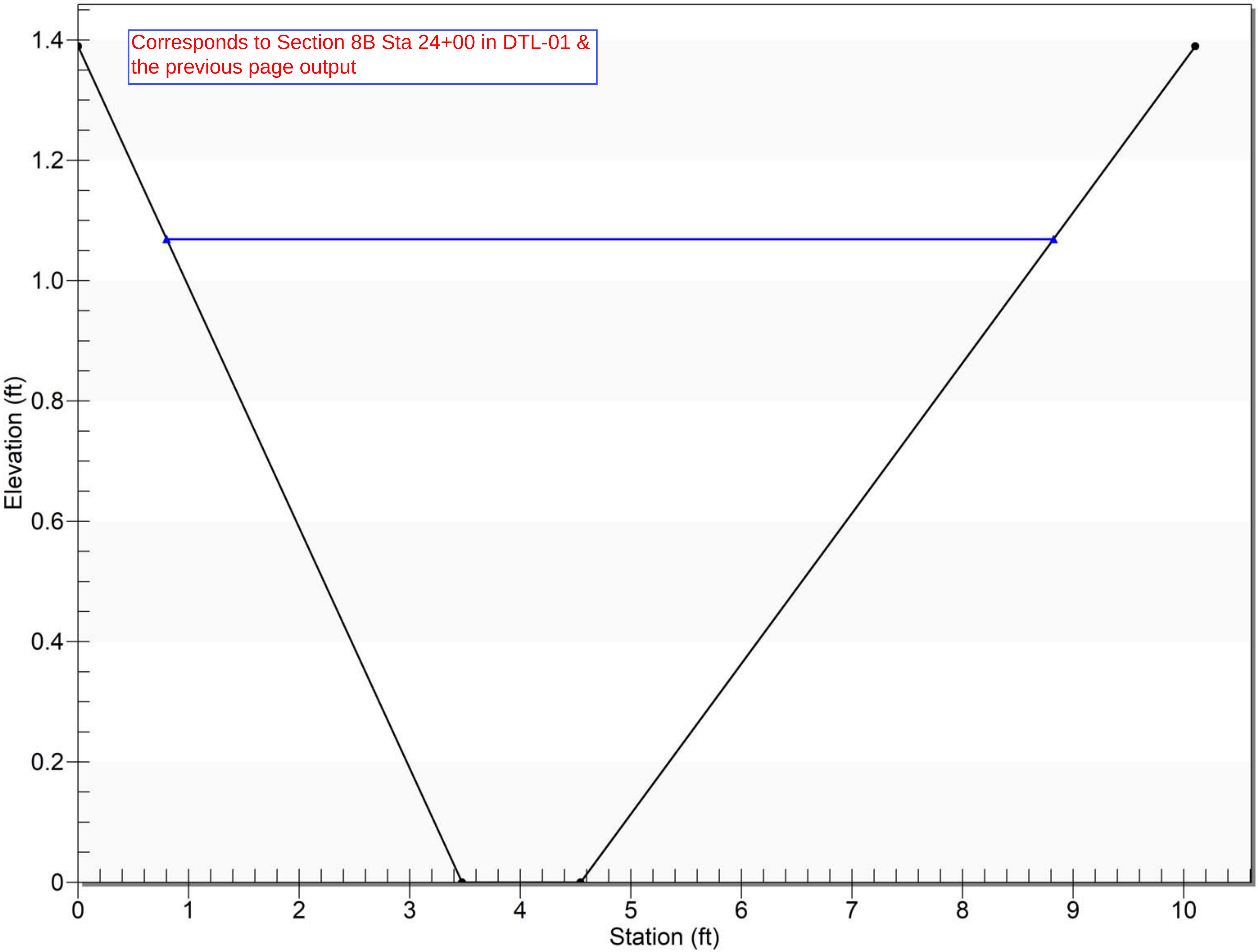
Critical Slope: 0.0197 ft/ft

Critical Top Width: 4.68 ft

Calculated Max Shear Stress: 0.0667 lb/ft^2

Calculated Avg Shear Stress: 0.0363 lb/ft^2

Swale 8 Sta 24+00 - Velocity Run



Corresponds to Section 8C Sta 28+00 in DTL-01. Section 8C Station 28+00 of the DTL-01 is the cross-section that best represents and the most restrictive of the cross-sections from Station 26+70 to 28+50

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Roadside Ditch Sizing

Designer:

Project Date: Thursday, November 19, 2020

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Swale 8 28+00 (Roadside Ditch) - Flow Depth Run (Slope = 0.3%, n = 0.04)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.4000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 3.6300 ft

Longitudinal Slope: 0.0030 ft/ft

Manning's n: 0.0400

Flow: 5.3000 cfs

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths (Typical for all roadside ditch flow depth runs)

Q5 from Offsite Basin O11

Result Parameters

Depth: 0.7057 ft

Area of Flow: 4.1556 ft^2

Wetted Perimeter: 8.3747 ft

Hydraulic Radius: 0.4962 ft

Average Velocity: 1.2754 ft/s

Top Width: 8.1467 ft

Froude Number: 0.3147

Critical Depth: 0.3617 ft

Critical Velocity: 3.0612 ft/s

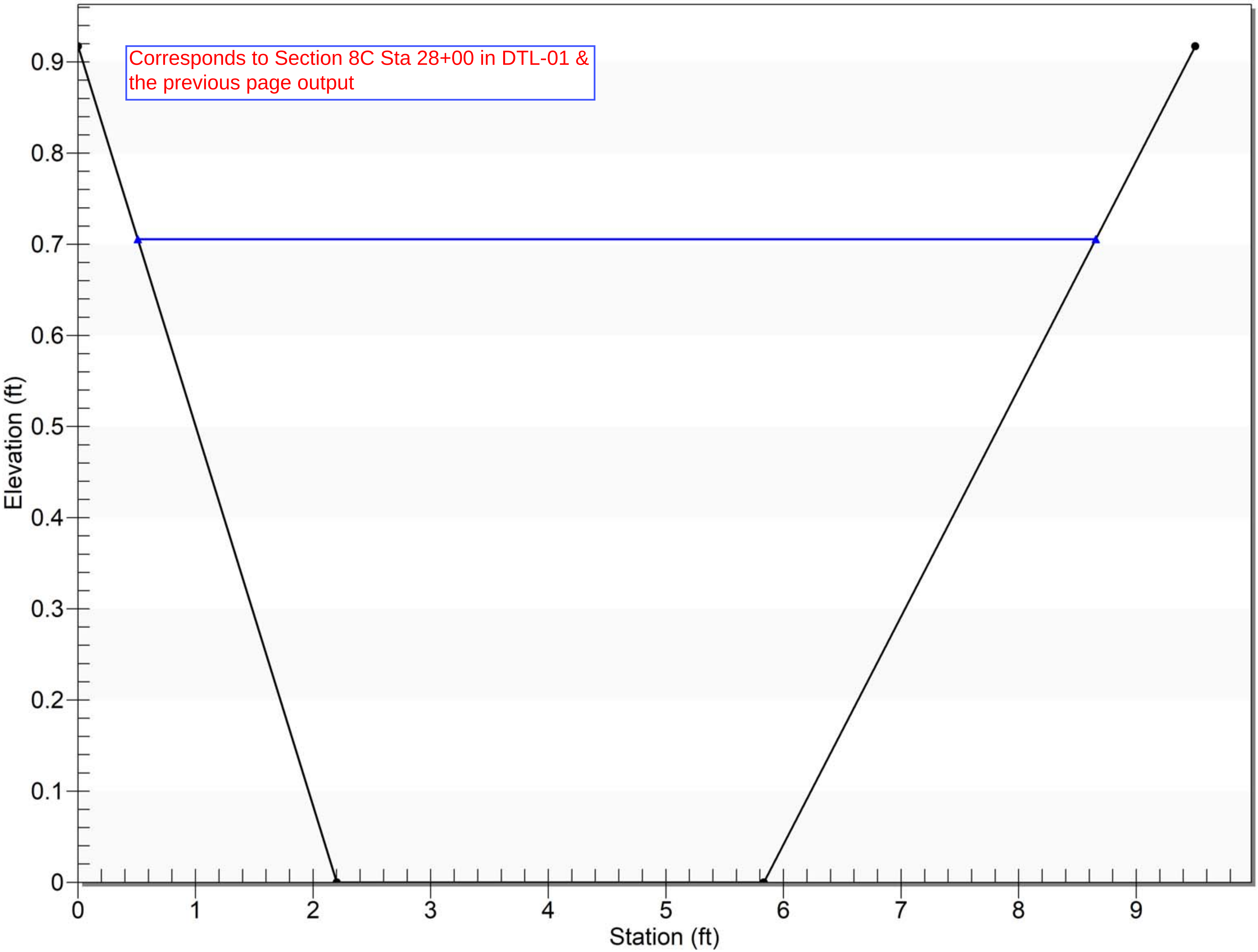
Critical Slope: 0.0361 ft/ft

Critical Top Width: 5.94 ft

Calculated Max Shear Stress: 0.1321 lb/ft^2

Calculated Avg Shear Stress: 0.0929 lb/ft^2

Swale 8 Sta 28+00 - Flow Depth Run



Corresponds to Section 8C Sta 28+00 in DTL-01. Section 8C Station 28+00 of the DTL-01 is the cross-section that best represents and the most restrictive of the cross-sections from Station 26+70 to 28+50

Channel Analysis: Swale 8 28+00 (Roadside Ditch) - Velocity Run (Slope = 0.3%, n = 0.03)

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.4000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 3.6300 ft

Longitudinal Slope: 0.0030 ft/ft

Manning's n: 0.0300

Flow: 5.3000 cfs

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.03 for turfgrass sod when assessing Velocity and Shear Stress (Typical for all roadside ditch velocity runs)

Q5 from Offsite Basin O11

Result Parameters

Depth: 0.6073 ft

Area of Flow: 3.3845 ft^2

Wetted Perimeter: 7.7128 ft

Hydraulic Radius: 0.4388 ft

Average Velocity: 1.5660 ft/s

Top Width: 7.5165 ft

Froude Number: 0.4113

Critical Depth: 0.3615 ft

Critical Velocity: 3.0634 ft/s

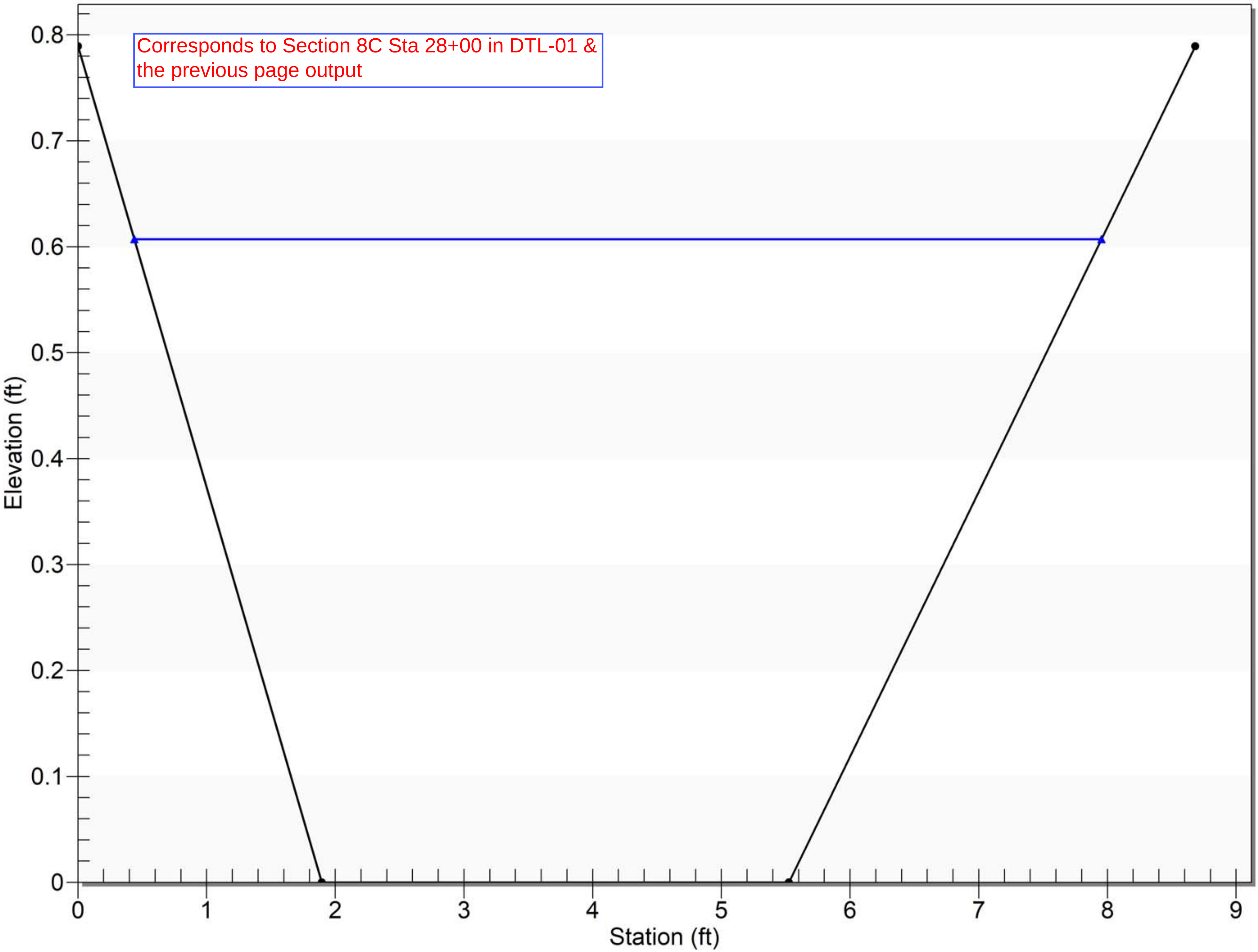
Critical Slope: 0.0203 ft/ft

Critical Top Width: 5.94 ft

Calculated Max Shear Stress: 0.1137 lb/ft^2

Calculated Avg Shear Stress: 0.0821 lb/ft^2

Swale 8 Sta 28+00 - Velocity Run



Corresponds to Section 8D Sta 29+00 in DTL-01. Section 8D Station 29+00 of the DTL-01 is the cross-section that best represents and the most restrictive of the cross-sections from Station 28+50 to 30+70

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Roadside Ditch Sizing

Designer:

Project Date: Thursday, November 19, 2020

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Swale 8 29+00 (Roadside Ditch) - Flow Depth Run (Slope = 2%, n = 0.04)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0400

Flow: 1.7700 cfs

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths (Typical for all roadside ditch flow depth runs)

1/3 rd of total Q5 (5.3 CFS) from Offsite Basin O11. This is the most upstream portion of the swale and the tributary area to this portion of the swale is far less than 1/3 of the total area of Basin O11. Hence, this analysis conservatively assumes 1/3rd of total Q5 from Basin O11.

Result Parameters

Depth: 0.4738 ft

Area of Flow: 0.8979 ft^2

Wetted Perimeter: 3.9070 ft

Hydraulic Radius: 0.2298 ft

Average Velocity: 1.9712 ft/s

Top Width: 3.7903 ft

Froude Number: 0.7137

Critical Depth: 0.4140 ft

Critical Velocity: 2.5817 ft/s

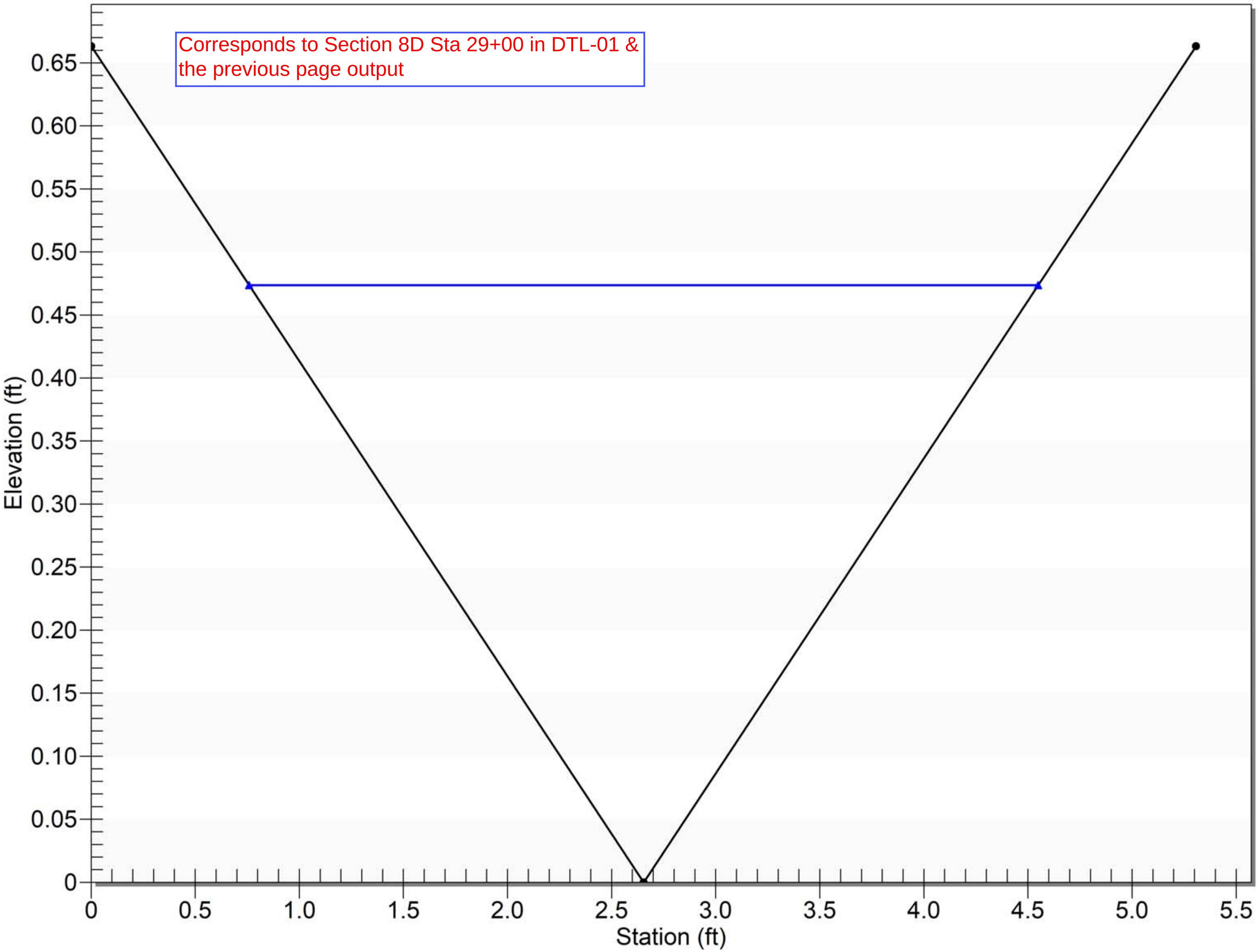
Critical Slope: 0.0411 ft/ft

Critical Top Width: 3.31 ft

Calculated Max Shear Stress: 0.5913 lb/ft^2

Calculated Avg Shear Stress: 0.2868 lb/ft^2

Swale 8 Sta 29+00 - Flow Depth Run



Corresponds to Section 8D Sta 29+00 in DTL-01. Section 8D Station 29+00 of the DTL-01 is the cross-section that best represents and the most restrictive of the cross-sections from Station 28+50 to 30+70

Channel Analysis: Swale 8 29+00 (Roadside Ditch) - Velocity Run (Slope = 2%, n = 0.03)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0300

Flow: 1.7700 cfs

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.03 for turfgrass sod when assessing Velocity and Shear Stress (Typical for all roadside ditch velocity runs)

1/3 rd of total Q5 (5.3 CFS) from Offsite Basin O11. This is the most upstream portion of the swale and the tributary area to this portion of the swale is far less than 1/3 of the total area of Basin O11. Hence, this analysis conservatively assumes 1/3rd of total Q5 from Basin O11.

Result Parameters

Depth: 0.4253 ft

Area of Flow: 0.7237 ft^2

Wetted Perimeter: 3.5074 ft

Hydraulic Radius: 0.2063 ft

Average Velocity: 2.4459 ft/s

Top Width: 3.4027 ft

Froude Number: 0.9347

Critical Depth: 0.4140 ft

Critical Velocity: 2.5817 ft/s

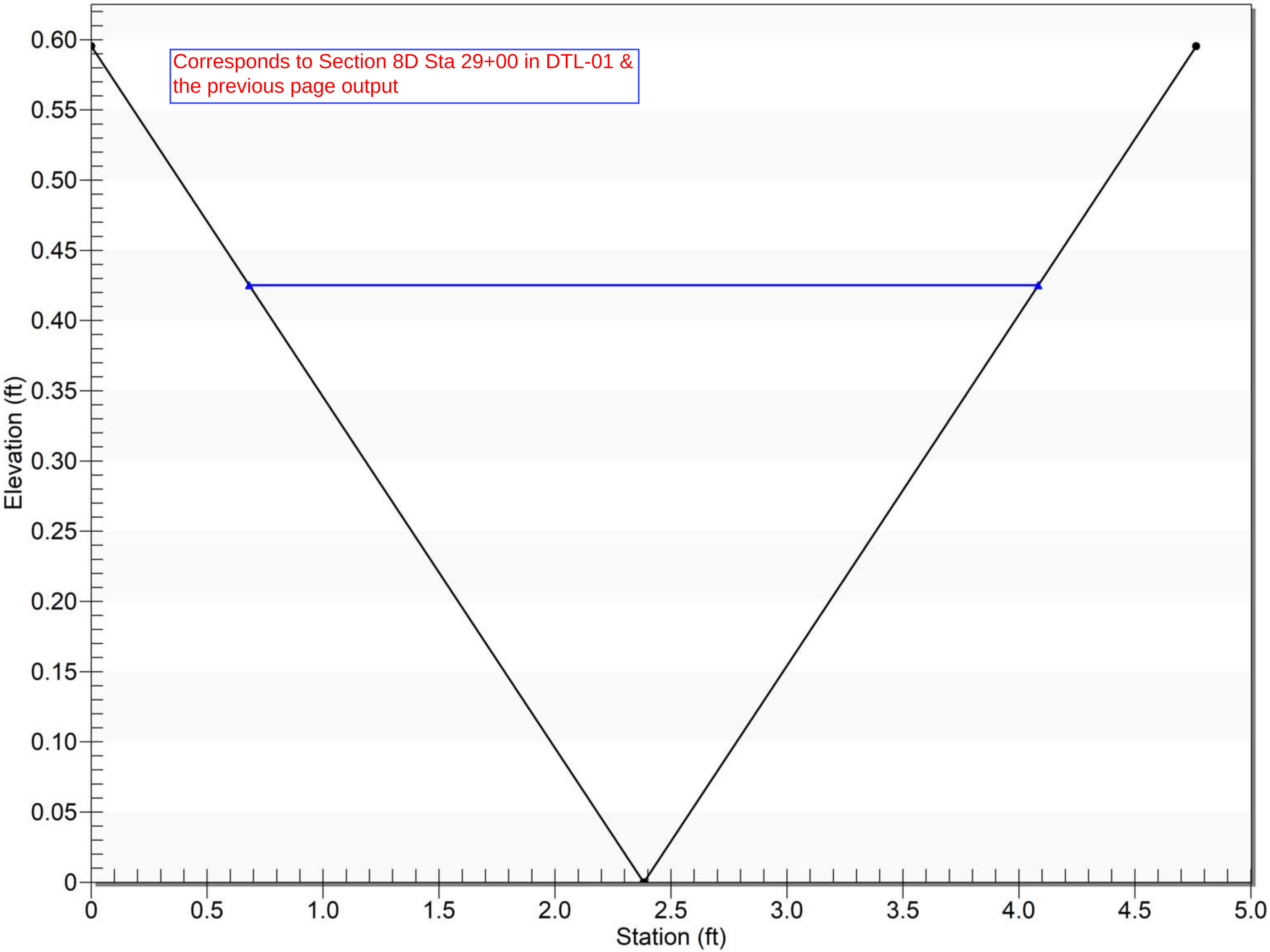
Critical Slope: 0.0231 ft/ft

Critical Top Width: 3.31 ft

Calculated Max Shear Stress: 0.5308 lb/ft^2

Calculated Avg Shear Stress: 0.2575 lb/ft^2

Swale 8 Sta 29+00 - Velocity Run



Corresponds to Section 10 in DTL-01

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Roadside Ditch Sizing

Designer:

Project Date: Thursday, November 19, 2020

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Swale 10 (Roadside Ditch) - Flow Depth Run (Min. Slope = 3%, n = 0.04)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0300 ft/ft

Manning's n: 0.0400

Flow: 0.6000 cfs

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.04 for turfgrass sod when assessing Water Depths (Typical for all roadside ditch flow depth runs)

Q5 from offsite basin O6

Result Parameters

Depth: 0.2927 ft

Area of Flow: 0.3426 ft^2

Wetted Perimeter: 2.4135 ft

Hydraulic Radius: 0.1420 ft

Average Velocity: 1.7511 ft/s

Top Width: 2.3414 ft

Froude Number: 0.8067

Critical Depth: 0.2686 ft

Critical Velocity: 2.0795 ft/s

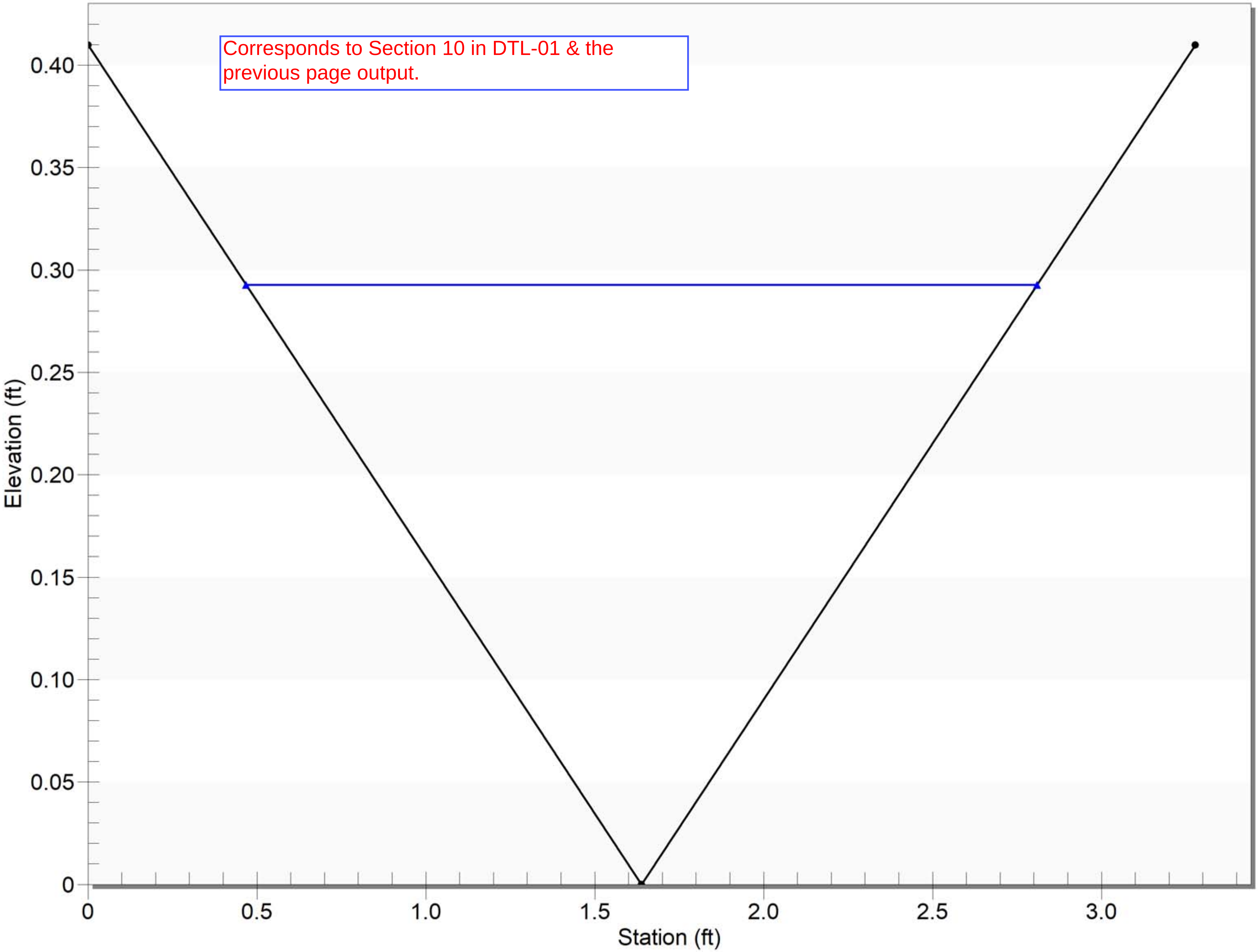
Critical Slope: 0.0474 ft/ft

Critical Top Width: 2.15 ft

Calculated Max Shear Stress: 0.5479 lb/ft^2

Calculated Avg Shear Stress: 0.2658 lb/ft^2

Section 10 - Flow Depth Run



Corresponds to Section 10 in DTL-01

Channel Analysis: Swale 10 (Roadside Ditch) - Velocity Run (Max. Slope = 4.4%, n = 0.03)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0440 ft/ft

Manning's n: 0.0300

Flow: 0.6000 cfs

Table 8-5, Chapter 8, USDCM Vol. 1 recommends 0.03 for turfgrass sod when assessing Velocity and Shear Stress (Typical for all roadside ditch velocity runs)

Q5 from offsite basin O6

Result Parameters

Depth: 0.2445 ft

Area of Flow: 0.2392 ft^2

Wetted Perimeter: 2.0165 ft

Hydraulic Radius: 0.1186 ft

Average Velocity: 2.5084 ft/s

Top Width: 1.9563 ft

Froude Number: 1.2642

Critical Depth: 0.2686 ft

Critical Velocity: 2.0795 ft/s

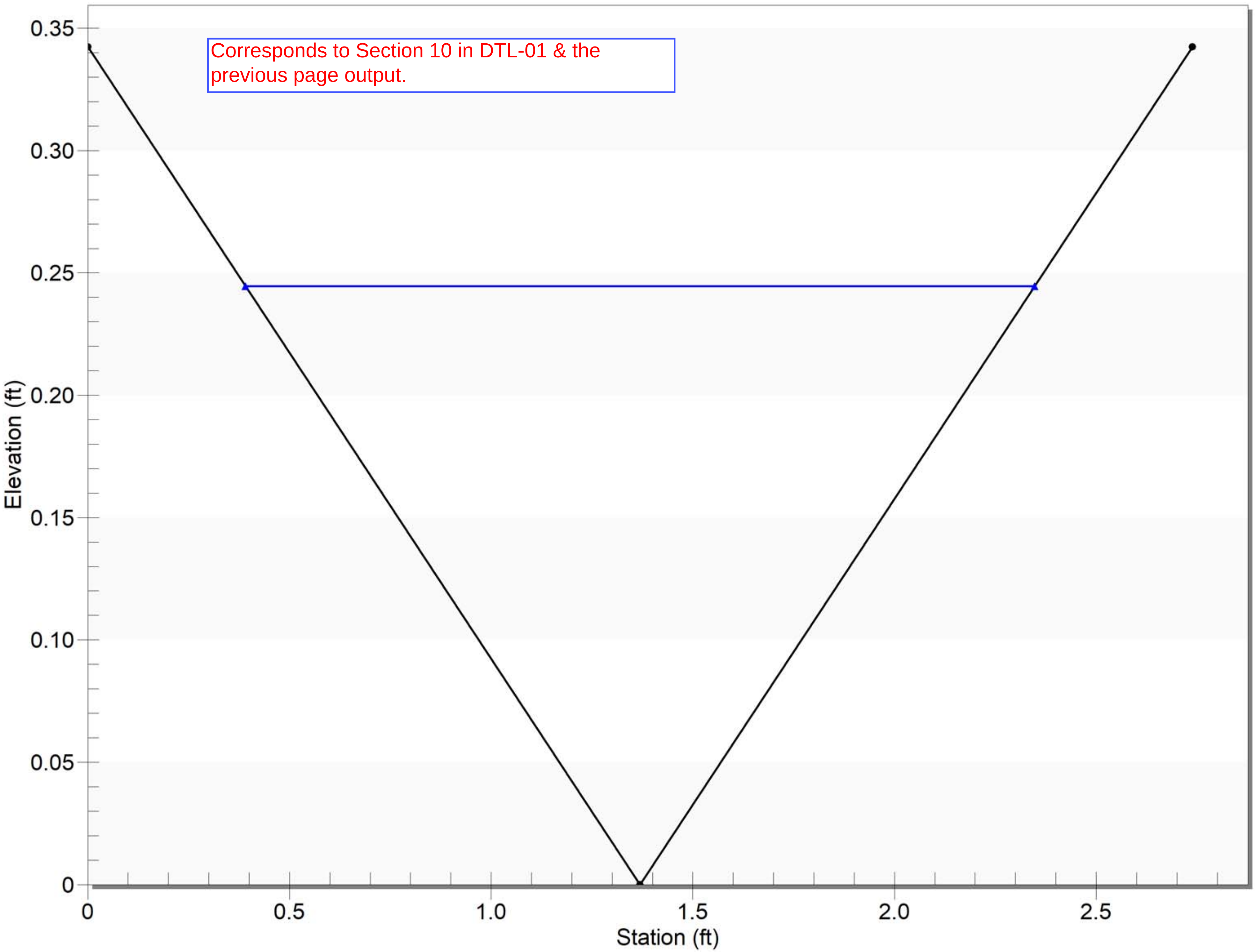
Critical Slope: 0.0267 ft/ft

Critical Top Width: 2.15 ft

Calculated Max Shear Stress: 0.6714 lb/ft^2

Calculated Avg Shear Stress: 0.3257 lb/ft^2

Section 10 - Velocity Run



Corresponds to Section 11 in DTL-01

Hydraulic Analysis Report

Project Data

Project Title: JN-1104: Westwood - Roadside Ditch Sizing

Designer:

Project Date: Thursday, November 19, 2020

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Swale 11 (Roadside Ditch) - Flow Depth Run (Min. Slope = 1.6%, n = 0.04)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0160 ft/ft

Manning's n: 0.0400

Flow: 1.2000 cfs

Q5 from offsite basin O7

Result Parameters

Depth: 0.4270 ft

Area of Flow: 0.7294 ft^2

Wetted Perimeter: 3.5214 ft

Hydraulic Radius: 0.2071 ft

Average Velocity: 1.6451 ft/s

Top Width: 3.4163 ft

Froude Number: 0.6274

Critical Depth: 0.3544 ft

Critical Velocity: 2.3887 ft/s

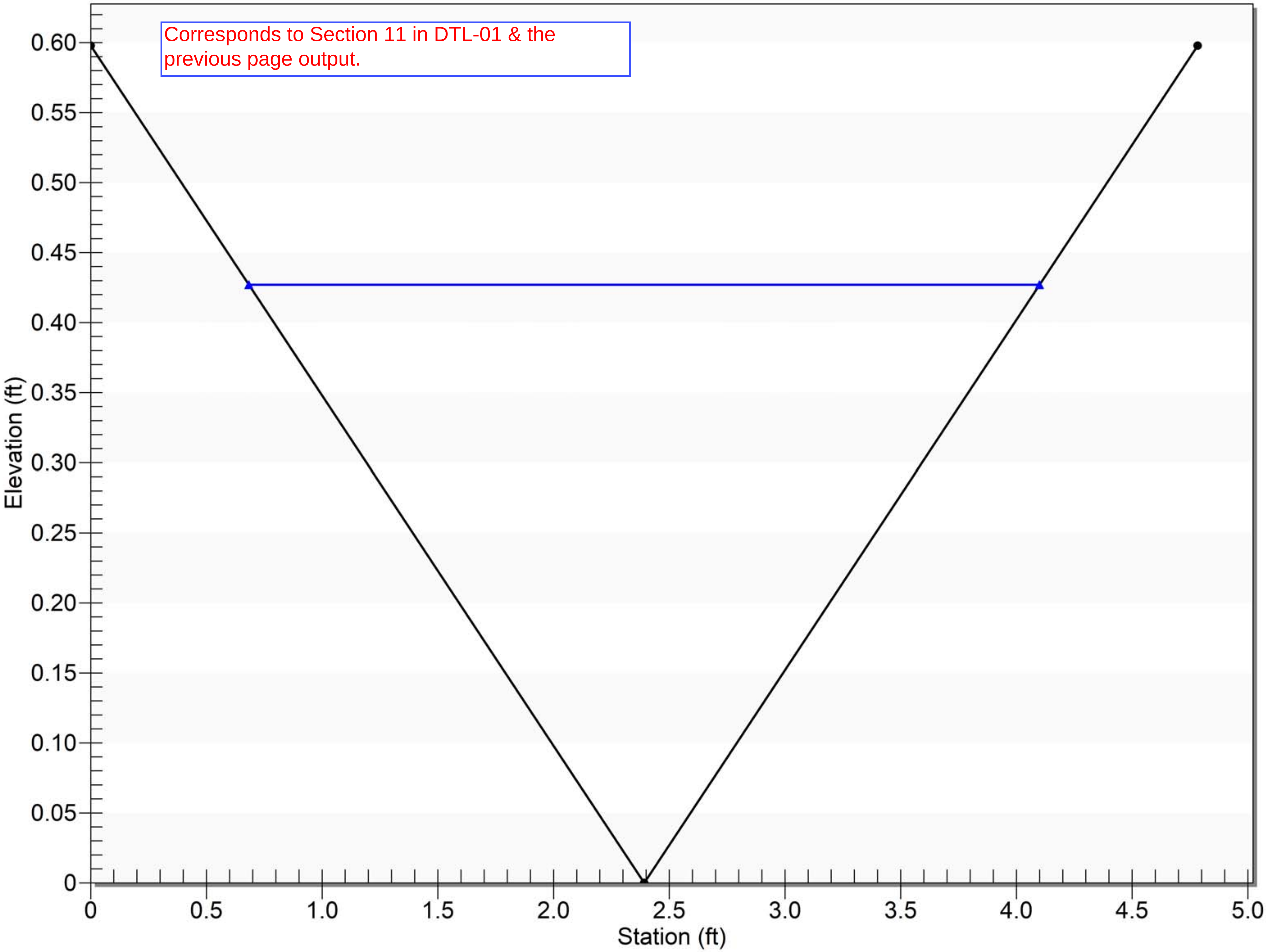
Critical Slope: 0.0433 ft/ft

Critical Top Width: 2.84 ft

Calculated Max Shear Stress: 0.4264 lb/ft^2

Calculated Avg Shear Stress: 0.2068 lb/ft^2

Section 11 - Flow Depth Run



Corresponds to Section 11 in DTL-01

Channel Analysis: Swale 11 (Roadside Ditch) - Velocity Run (Max. Slope = 3.9%, n = 0.03)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0390 ft/ft

Manning's n: 0.0300

Flow: 1.2000 cfs

Q5 from offsite basin O7

Result Parameters

Depth: 0.3244 ft

Area of Flow: 0.4209 ft^2

Wetted Perimeter: 2.6749 ft

Hydraulic Radius: 0.1573 ft

Average Velocity: 2.8511 ft/s

Top Width: 2.5951 ft

Froude Number: 1.2476

Critical Depth: 0.3544 ft

Critical Velocity: 2.3887 ft/s

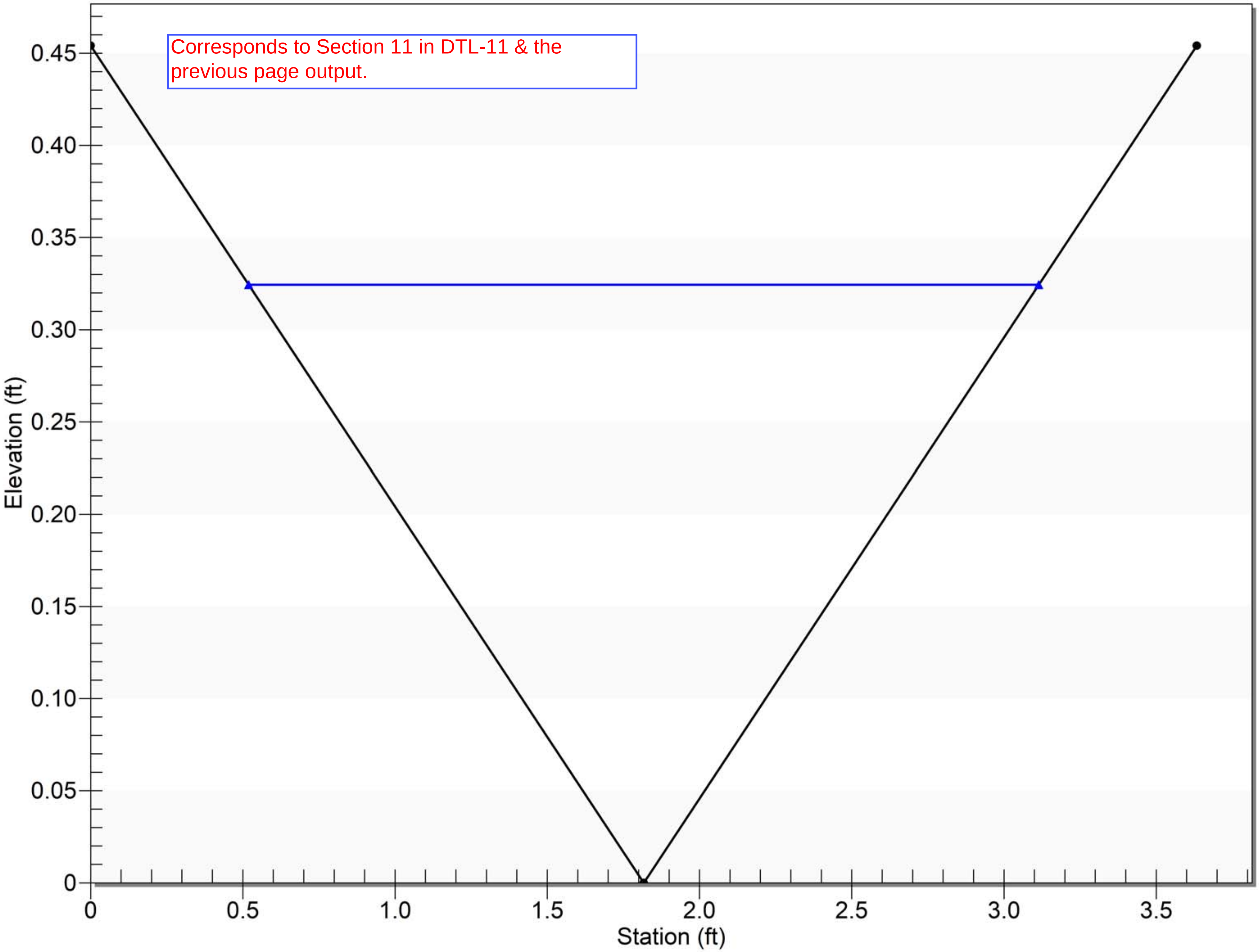
Critical Slope: 0.0243 ft/ft

Critical Top Width: 2.84 ft

Calculated Max Shear Stress: 0.7894 lb/ft^2

Calculated Avg Shear Stress: 0.3829 lb/ft^2

Section 11 - Velocity Run



Corresponds to Section 12 in DTL-01

Channel Analysis: Swale 12 (Roadside Ditch) - Flow Depth Run (Min. Slope = 0.5%, n = 0.04)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0400

Flow: 0.5000 cfs

Q5 from offsite basin O8

Result Parameters

Depth: 0.3825 ft

Area of Flow: 0.5851 ft^2

Wetted Perimeter: 3.1539 ft

Hydraulic Radius: 0.1855 ft

Average Velocity: 0.8545 ft/s

Top Width: 3.0598 ft

Froude Number: 0.3444

Critical Depth: 0.2497 ft

Critical Velocity: 2.0050 ft/s

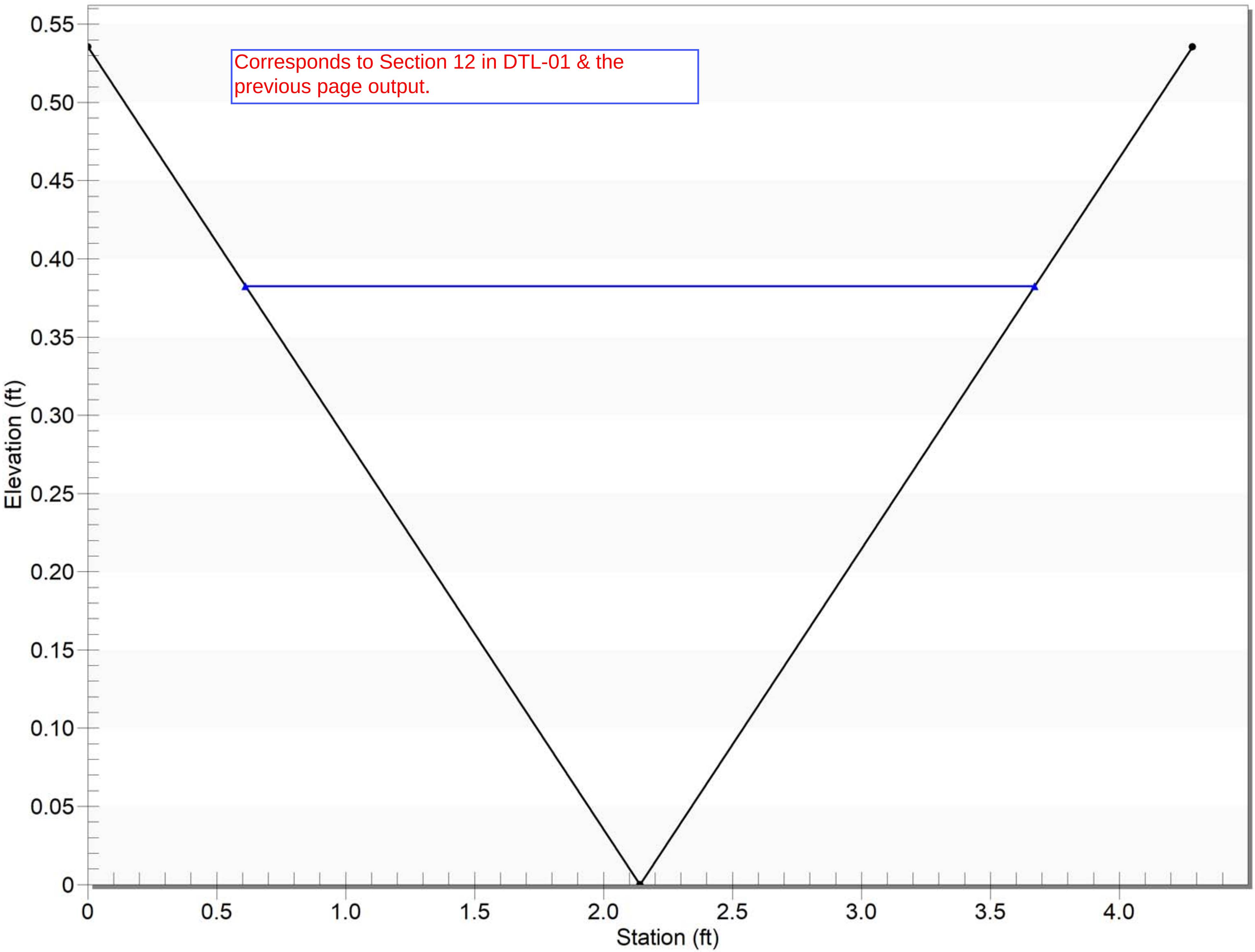
Critical Slope: 0.0486 ft/ft

Critical Top Width: 2.00 ft

Calculated Max Shear Stress: 0.1193 lb/ft^2

Calculated Avg Shear Stress: 0.0579 lb/ft^2

Section 12 - Flow Depth Run



Corresponds to Section 12 in DTL-01

Channel Analysis: Swale 12 (Roadside Ditch) - Velocity Run (Max. Slope = 1.0%, n = 0.03)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0300

Flow: 0.5000 cfs

Q5 from offsite basin O8

Result Parameters

Depth: 0.3015 ft

Area of Flow: 0.3636 ft^2

Wetted Perimeter: 2.4863 ft

Hydraulic Radius: 0.1463 ft

Average Velocity: 1.3750 ft/s

Top Width: 2.4121 ft

Froude Number: 0.6241

Critical Depth: 0.2497 ft

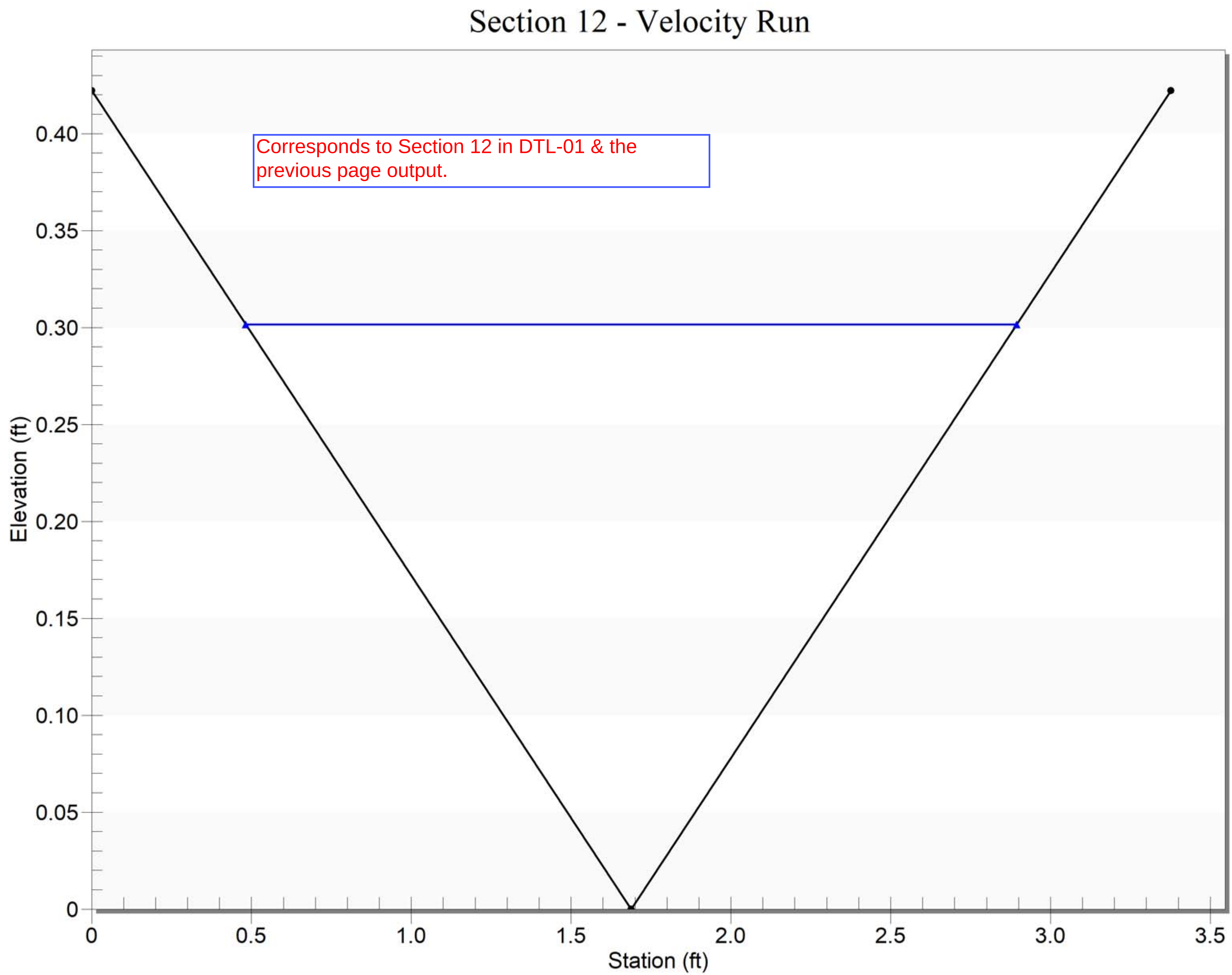
Critical Velocity: 2.0050 ft/s

Critical Slope: 0.0273 ft/ft

Critical Top Width: 2.00 ft

Calculated Max Shear Stress: 0.1881 lb/ft^2

Calculated Avg Shear Stress: 0.0913 lb/ft^2


Section 12 - Velocity Run
Corresponds to Section 12 in DTL-01 & the previous page output.
Elevation (ft)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Station (ft)

Corresponds to Section 13 in DTL-01

Channel Analysis: Swale 13 (Roadside Ditch) - Flow Depth Run (Min. Slope = 0.8%, n = 0.04)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0080 ft/ft

Manning's n: 0.0400

Flow: 1.4000 cfs

Q5 from offsite basin O9

Result Parameters

Depth: 0.5152 ft

Area of Flow: 1.0619 ft^2

Wetted Perimeter: 4.2488 ft

Hydraulic Radius: 0.2499 ft

Average Velocity: 1.3184 ft/s

Top Width: 4.1219 ft

Froude Number: 0.4578

Critical Depth: 0.3769 ft

Critical Velocity: 2.4635 ft/s

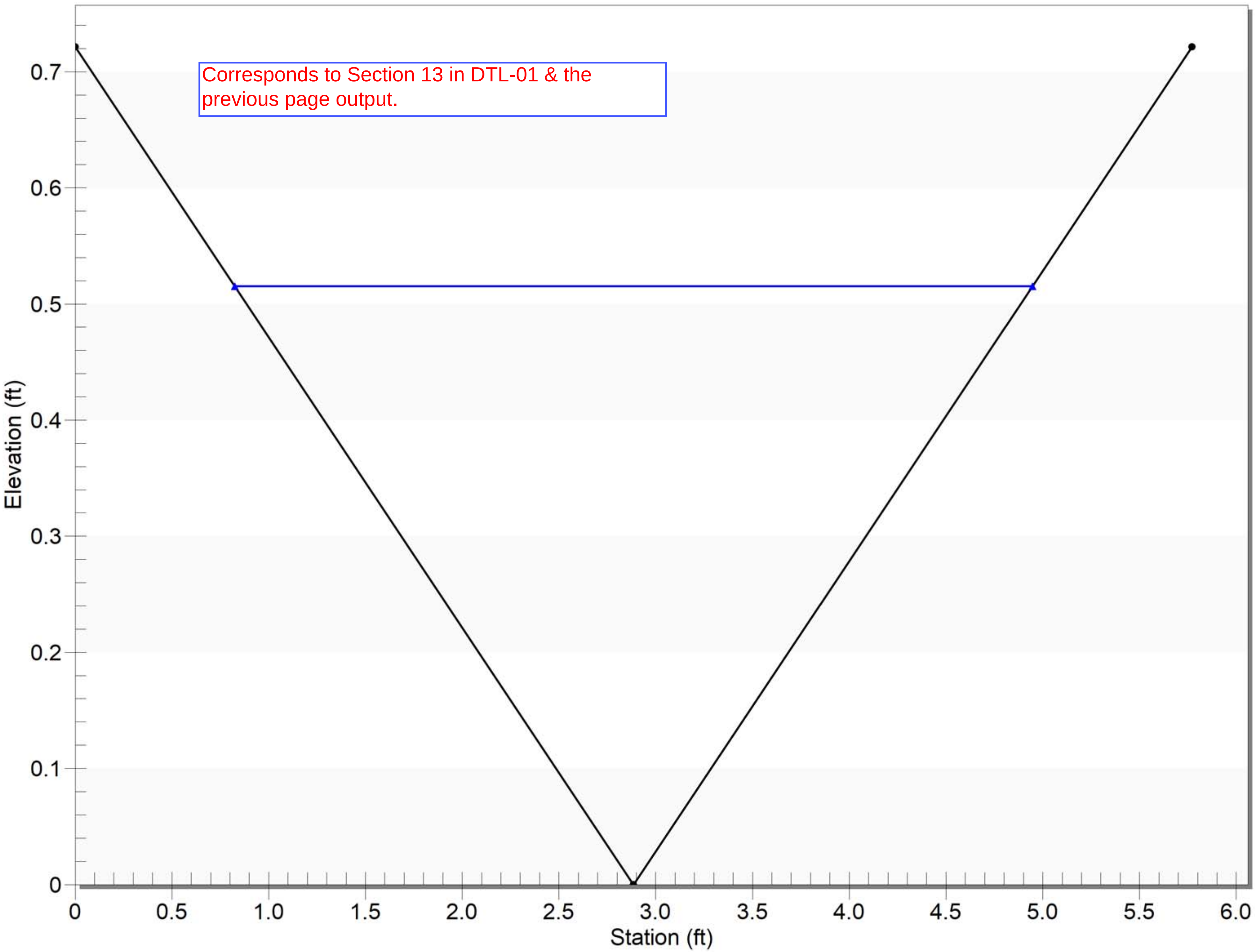
Critical Slope: 0.0424 ft/ft

Critical Top Width: 3.02 ft

Calculated Max Shear Stress: 0.2572 lb/ft^2

Calculated Avg Shear Stress: 0.1248 lb/ft^2

Section 13 - Flow Depth Run



Corresponds to Section 13 in DTL-01

Channel Analysis: Swale 13 (Roadside Ditch) - Velocity Run (Max. Slope = 1.7%, n = 0.03)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0170 ft/ft

Manning's n: 0.0300

Flow: 1.4000 cfs

Q5 from offsite basin O9

Result Parameters

Depth: 0.4016 ft

Area of Flow: 0.6451 ft^2

Wetted Perimeter: 3.3116 ft

Hydraulic Radius: 0.1948 ft

Average Velocity: 2.1703 ft/s

Top Width: 3.2127 ft

Froude Number: 0.8535

Critical Depth: 0.3769 ft

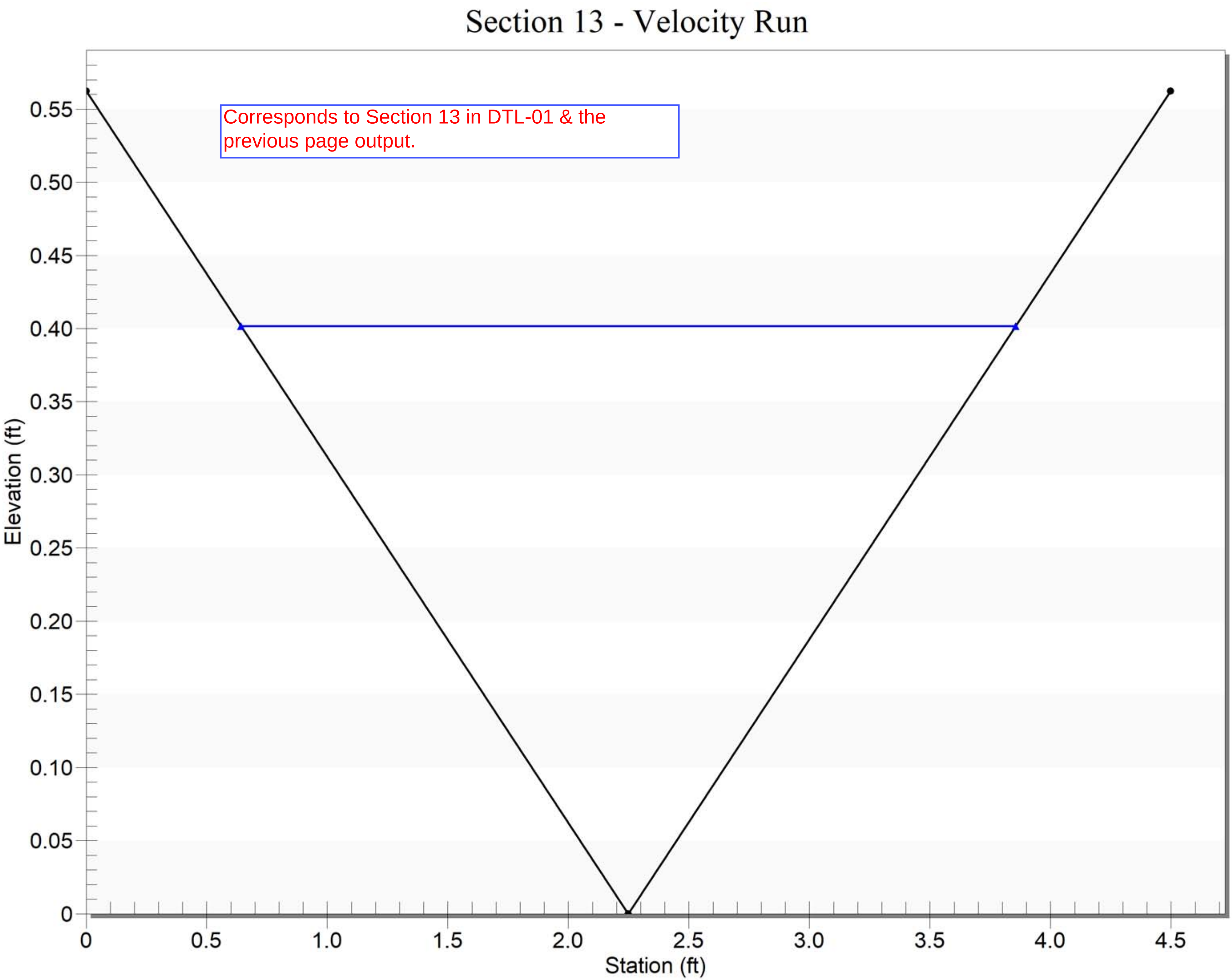
Critical Velocity: 2.4635 ft/s

Critical Slope: 0.0238 ft/ft

Critical Top Width: 3.02 ft

Calculated Max Shear Stress: 0.4260 lb/ft^2

Calculated Avg Shear Stress: 0.2066 lb/ft^2


Section 13 - Velocity Run
Corresponds to Section 13 in DTL-01 & the previous page output.
Elevation (ft)
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Station (ft)

Appendix B – Hydraulic Computations
Culvert Design

Monaco Street Interim Culvert

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 184.4 cfs

Maximum Flow: 366.8 cfs

Monaco Street Interim Culvert Sizing
Design Flow = Onsite Undetained Q100 from Detention Basin + Q100 from Offsite Basin O5
Maximum Flow = 2 X Onsite Undetained Q100 from Detention Basin + Q100 from Offsite Basin O5
Five (5) - 5'W X 2'H Rectangular Concrete Box (RCB) Culverts

The Interim Monaco Culvert has been designed for the on-site un-detained Q100 which is higher than the max. detained elease rate from pond. Hence, the existing design is more conservative.

Table 1 - Summary of Culvert Flows at Crossing: Monaco St Interim 5 Barrel Box

Headwater Elevation (ft)	Total Discharge (cfs)	Monaco St Interim 5 Barrel Box Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5159.23	0.00	0.00	0.00	1
5159.85	36.68	36.68	0.00	1
5160.22	73.36	73.36	0.00	1
5160.53	110.04	110.04	0.00	1
5160.81	146.72	146.72	0.00	1
5161.07	183.40	183.40	0.00	1
5161.07	184.40	184.40	0.00	1
5161.61	256.76	256.76	0.00	1
5161.91	293.44	293.44	0.00	1
5162.25	330.12	330.12	0.00	1
5162.63	366.80	366.80	0.00	1
5162.82	384.14	384.14	0.00	Overtopping

2 X Undetained Q100 WSEL

Undetained Q100 WSEL

Rating Curve Plot for Crossing: Monaco St Interim 5 Barrel Box Culvert

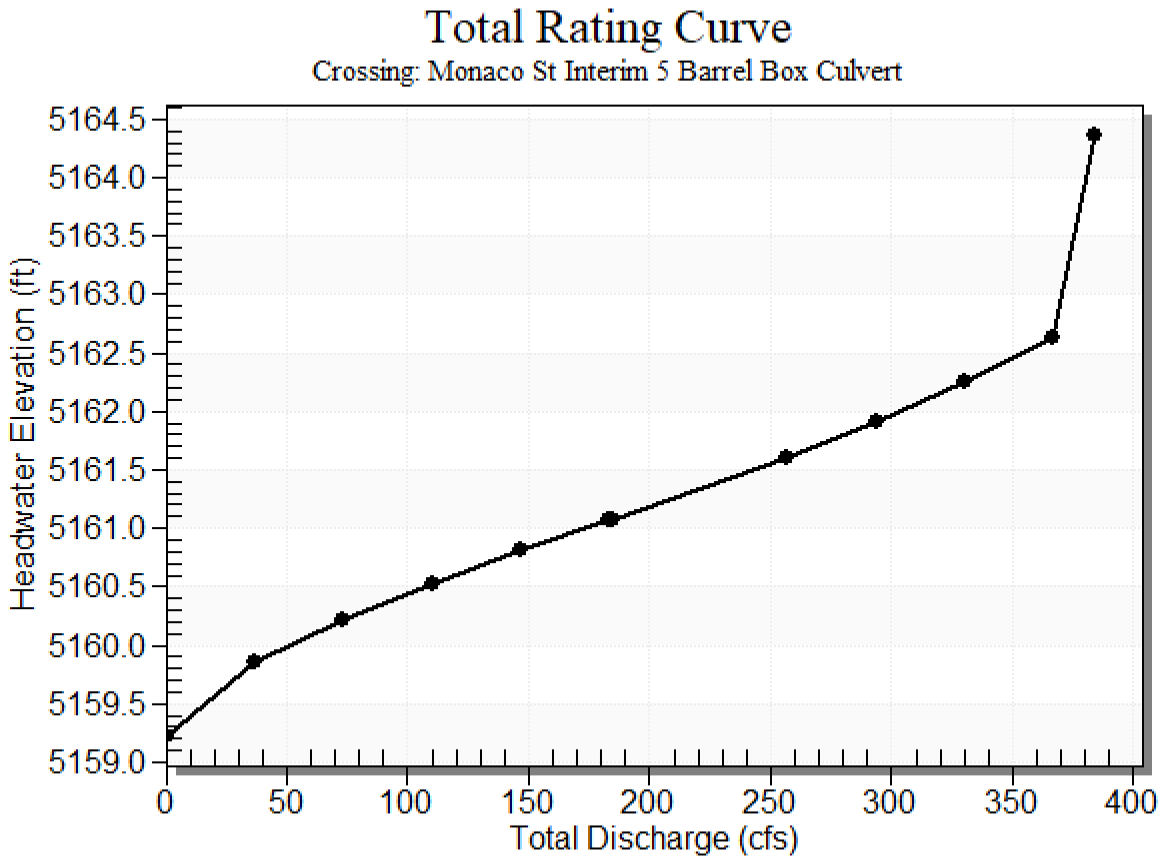


Table 2 - Culvert Summary Table: Monaco St Interim 5 Barrel Box Culvert

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5159.23	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
36.68	36.68	5159.85	0.621	0.141	1-S2n	0.368	0.406	0.368	0.308	3.992	2.202
73.36	73.36	5160.22	0.985	0.425	1-S2n	0.573	0.644	0.573	0.463	5.118	2.828
110.04	110.04	5160.53	1.299	0.701	1-S2n	0.748	0.844	0.770	0.586	5.720	3.261
146.72	146.72	5160.81	1.577	0.986	1-S2n	0.906	1.023	0.934	0.691	6.281	3.598
183.40	183.40	5161.07	1.838	1.287	1-S2n	1.054	1.187	1.088	0.785	6.741	3.879
184.40	184.40	5161.07	1.845	1.296	1-S2n	1.058	1.191	1.092	0.788	6.753	3.886
256.76	256.76	5161.61	2.378	1.951	5-S2n	1.330	1.485	1.373	0.950	7.480	4.334
293.44	293.44	5161.91	2.681	2.506	5-S2n	1.461	1.623	1.509	1.024	7.779	4.525
330.12	330.12	5162.25	3.019	2.831	5-S2n	1.588	1.756	1.640	1.094	8.052	4.699
366.80	366.80	5162.63	3.396	3.185	5-S2n	1.713	1.884	1.767	1.160	8.304	4.859

For tailwater rating curve information refer to Table 3 of the output.

****

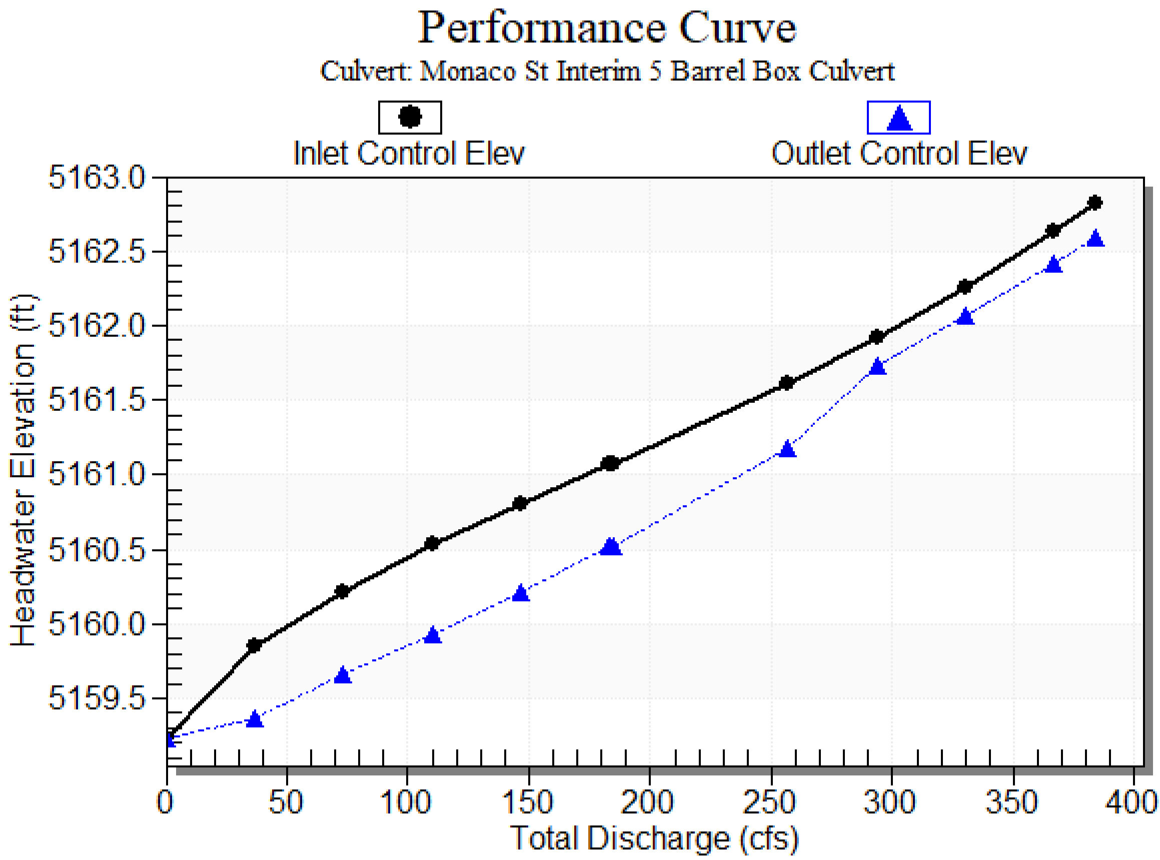
Straight Culvert

Inlet Elevation (invert): 5159.23 ft,   Outlet Elevation (invert): 5158.95 ft

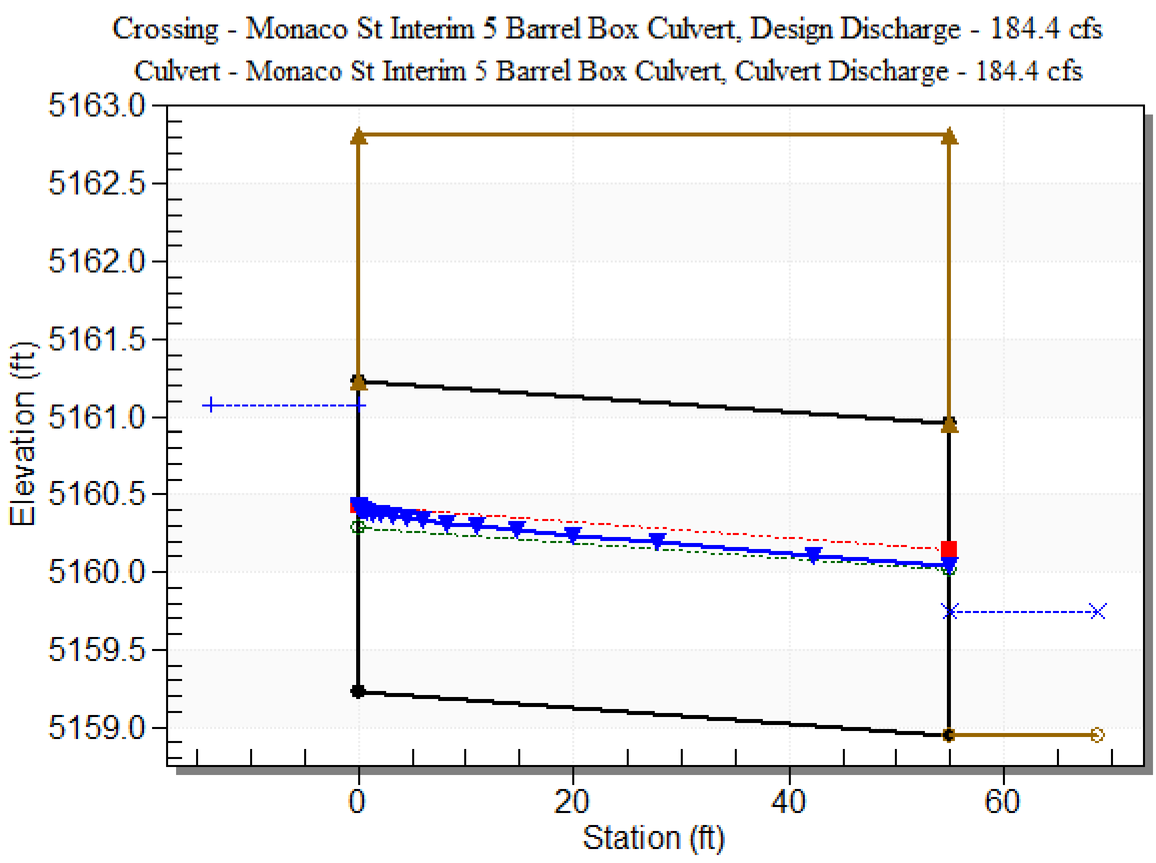
Culvert Length: 55.00 ft,   Culvert Slope: 0.0051

****

Culvert Performance Curve Plot: Monaco St Interim 5 Barrel Box Culvert



Water Surface Profile Plot for Culvert: Monaco St Interim 5 Barrel Box Culvert



Site Data - Monaco St Interim 5 Barrel Box Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5159.23 ft

Outlet Station: 55.00 ft

Outlet Elevation: 5158.95 ft

Number of Barrels: 5

Culvert Data Summary - Monaco St Interim 5 Barrel Box Culvert

Barrel Shape: Concrete Box

Barrel Span: 5.00 ft

Barrel Rise: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75º flare) Wingwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Monaco St Interim 5 Barrel

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	5158.95	0.00	0.00	0.00	0.00
36.68	5159.26	0.31	2.20	0.56	0.72
73.36	5159.41	0.46	2.83	0.84	0.77
110.04	5159.54	0.59	3.26	1.06	0.80
146.72	5159.64	0.69	3.60	1.25	0.82
183.40	5159.74	0.79	3.88	1.42	0.83
184.40	5159.74	0.79	3.89	1.43	0.83
256.76	5159.90	0.95	4.33	1.72	0.86
293.44	5159.97	1.02	4.52	1.85	0.87
330.12	5160.04	1.09	4.70	1.98	0.87
366.80	5160.11	1.16	4.86	2.10	0.88

Rip-rap apron sizing at the culvert outfall is included in the "Rip-rap Apron Sizing" section of Appendix B to follow.

Tailwater Channel Data - Monaco St Interim 5 Barrel Box Culvert

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 50.00 ft

Side Slope (H:V): 13.00 (_:1)

Based on the site topography at the tailwater channel in interim condition.

Channel Slope: 0.0290

Channel Manning's n: 0.0500

Channel Invert Elevation: 5158.95 ft

Roadway Data for Crossing: Monaco St Interim 5 Barrel Box Culvert

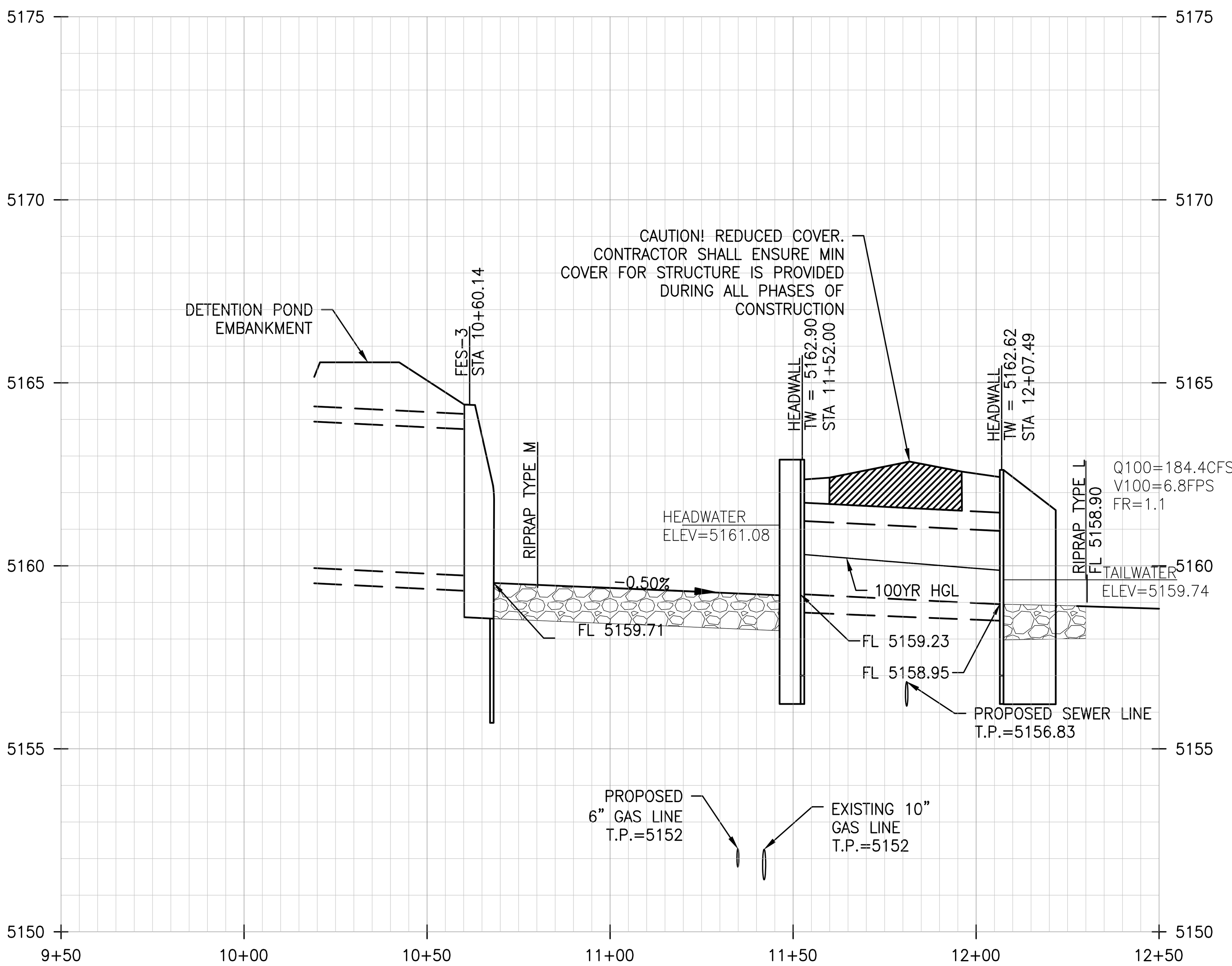
Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 5162.82 ft

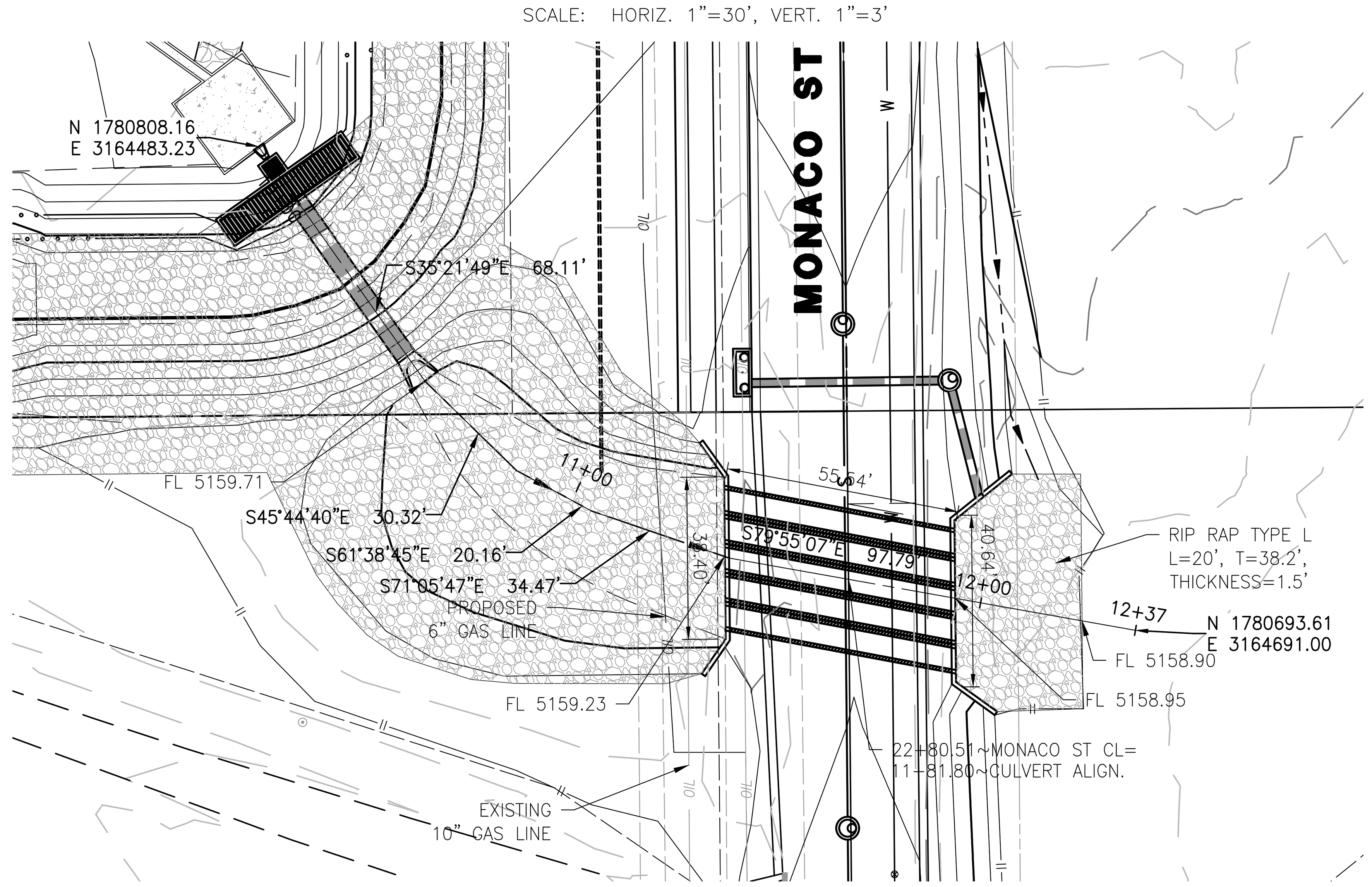
Roadway Surface: Paved

Roadway Top Width: 55.00 ft



MONACO ST INTERIM CULVERT X-ING

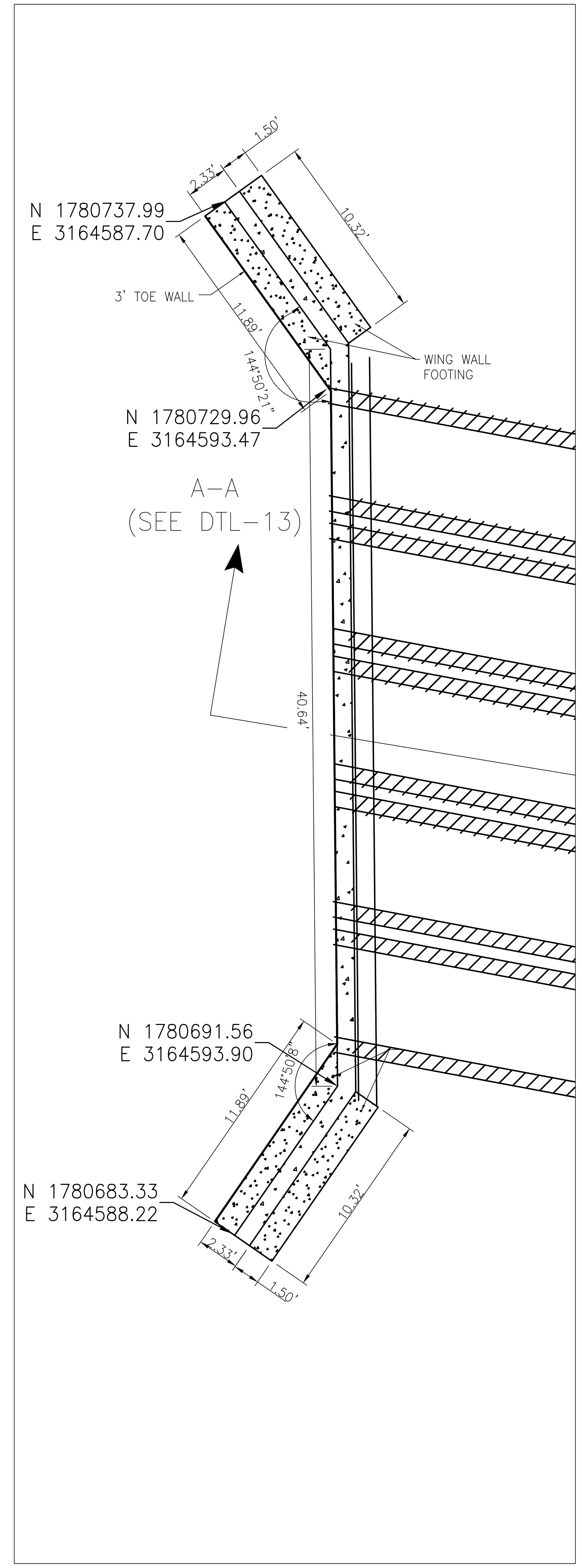
SCALE: HORIZ. 1"=30', VERT. 1"=3'



MONACO ST INTERIM CULVERT X-ING

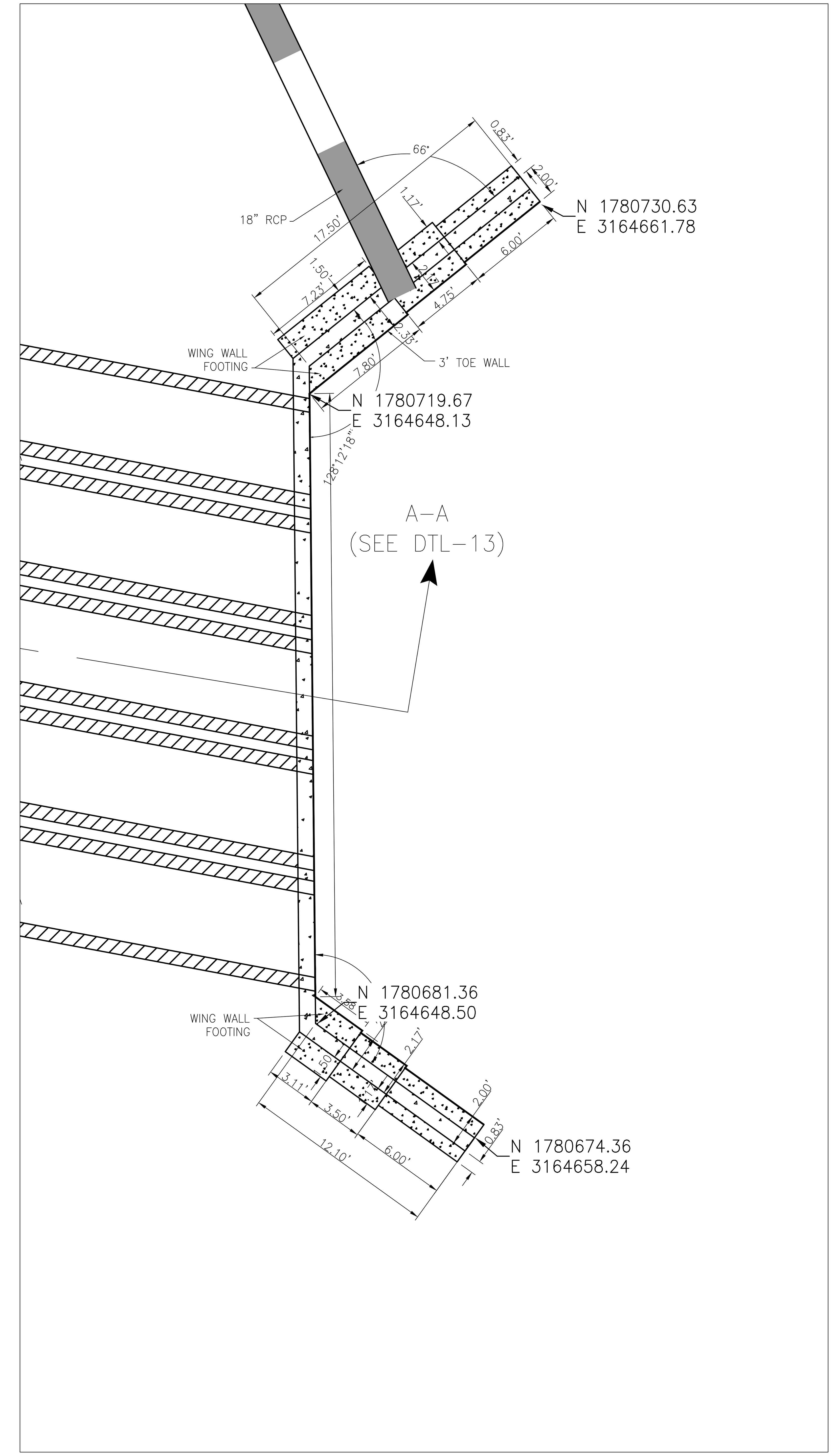
SCALE: 1"=30'

WORK SHALL BE CONSTRUCTED TO CITY OF THORNTON STANDARDS AND SPECIFICATIONS. THIS APPROVAL IS FOR CONFORMANCE TO THESE STANDARDS AND SPECIFICATIONS AND OTHER CITY REQUIREMENTS. THE DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER OR LANDSCAPE PROFESSIONAL.



CULVERT WINGWALL DETAILS

N.T.S



CULVERT WINGWALL DETAILS

N.T.S.

FINAL CONSTRUCTION PLANS FOR WESTWOOD SUBDIVISION, FILING 1

CITY OF THORNTON, COLORADO

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
Tucson - San Diego - Riverside - Orange
Sacramento - San Luis Obispo - Phoenix
rickengineering.com

Know what's below. Call before you dig.

SCALE:	N/A
DATE:	2/1/2021
DRAWN BY:	FA/BG/JG
CHECKED BY:	TB
JOB NO:	D01104-A

MONACO INTERIM CULVERT DETAIL

PROJECT NO. D01104-A

DRAWING NO. DTL-12

SHEET NO. 163 OF172 SHEETS

RICK™
ENGINEERING COMPANY

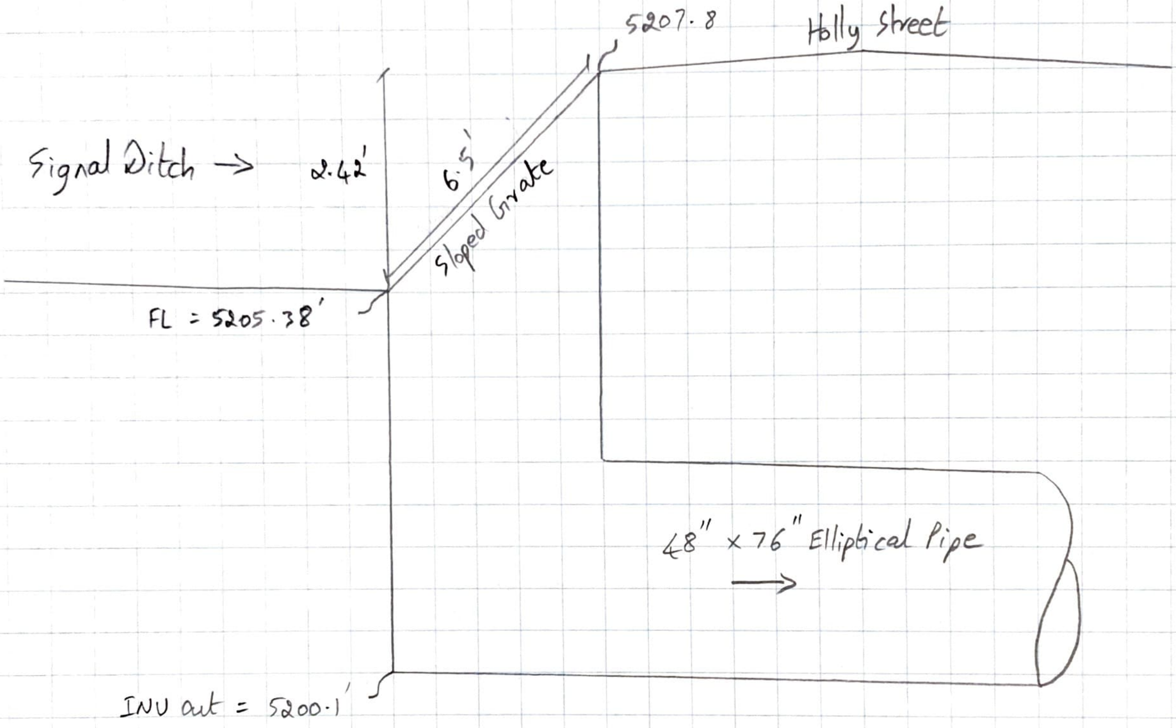
5620 Friars Road
San Diego, CA 92110-2596

Tel: (619) 291-0707
Fax: (619) 291-4165

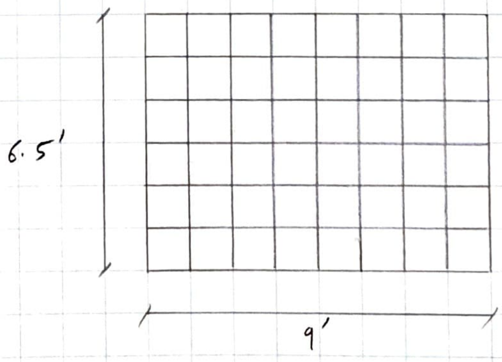
Date: August 31, 2020
Job No.: 1104
Page: 1
Done By: Ash
Checked By:

Signal Irrigation Ditch Outlet Structure Schematic.

Signal Ditch Company has already signed off on this design



Sloped Grate.



RICK™
ENGINEERING COMPANY
5620 Friars Road
San Diego, CA 92110-2596
Tel: (619) 291-0707
Fax: (619) 291-4165

Date: August 31, 2020
Job No.: 1104
Page: 2
Done By: Ash
Checked By:

Grate Capacity = $C_d A \sqrt{2gH}$ ← Standard orifice equation

Grate effective open area, $A = 9 \times 2.42 \times 0.7 \times 0.7 = 10.67\ ft^2$

Assuming 70% effective open area & 30% clogging (sloped grate)

Discharge coefficient, $C_d = 0.67$

Available Head, $H = 2.42/2 = 1.21'$

Grate Capacity, $Q = 0.67 \times 10.67 \times \sqrt{2 \times 32.2 \times 1.21}$

Grate Capacity, $Q = 63.11$ CFS > Design Flow 60 CFS

∴ ok

Design flow source - Signal Ditch Company

HY-8 Culvert Analysis Report

Project Notes

Project Title:JN-1104: Westwood

Designer:

Project Date:Monday, August 31, 2020

Notes:

Signal Ditch Irrigation Culvert

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 60 cfs

Design Flow: 60 cfs

Maximum Flow: 60 cfs

Table 1 - Summary of Culvert Flows at Crossing: Signal Irrigation Ditch Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	48" X 76" Elliptical Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5202.60	60.00	60.00	0.00	1
5208.50	248.68	248.68	0.00	Overtopping

Capacity of 48" X 76" culvert

Rating Curve Plot for Crossing: Signal Irrigation Ditch Culvert

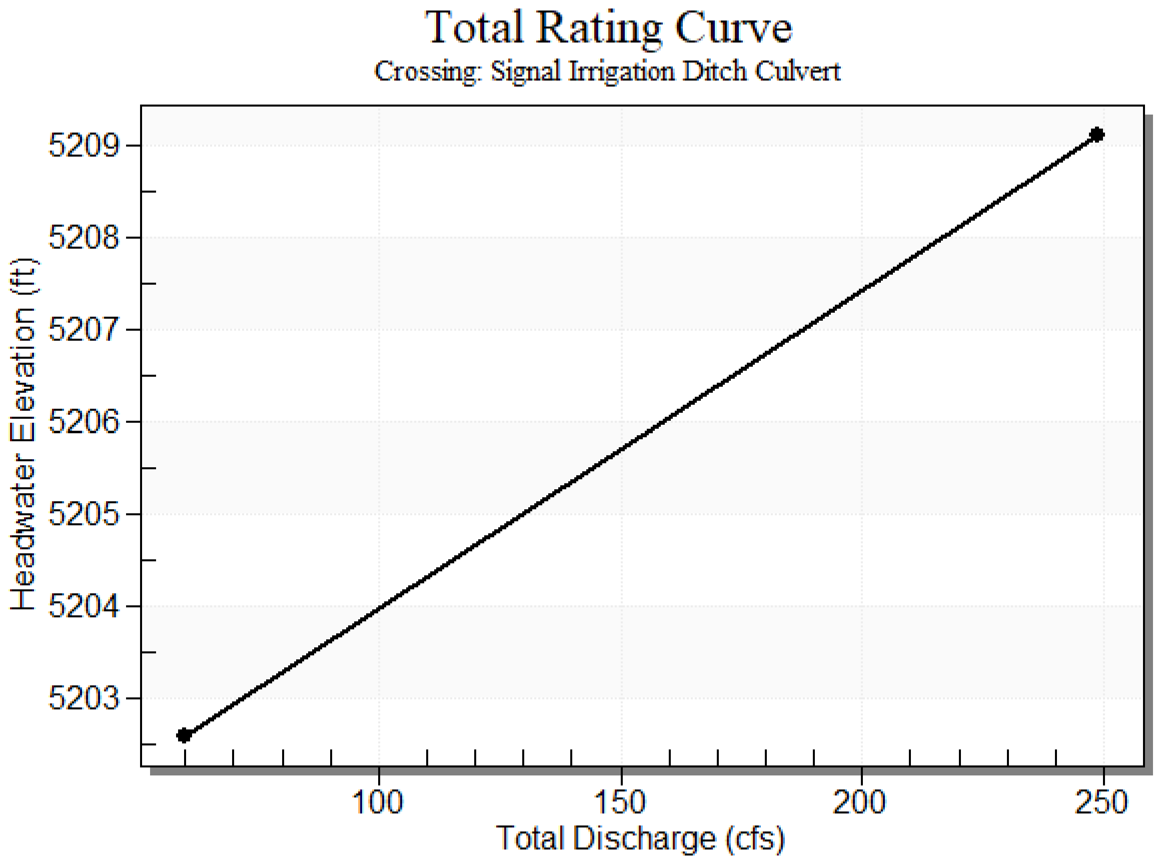


Table 2 - Culvert Summary Table: 48" X 76" Elliptical

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000
60.00	60.00	5202.60	2.501	0.0*	1-S2n	1.059	1.783	1.114	2.000	12.041	0.000

* Full Flow Headwater elevation is below inlet invert.

****

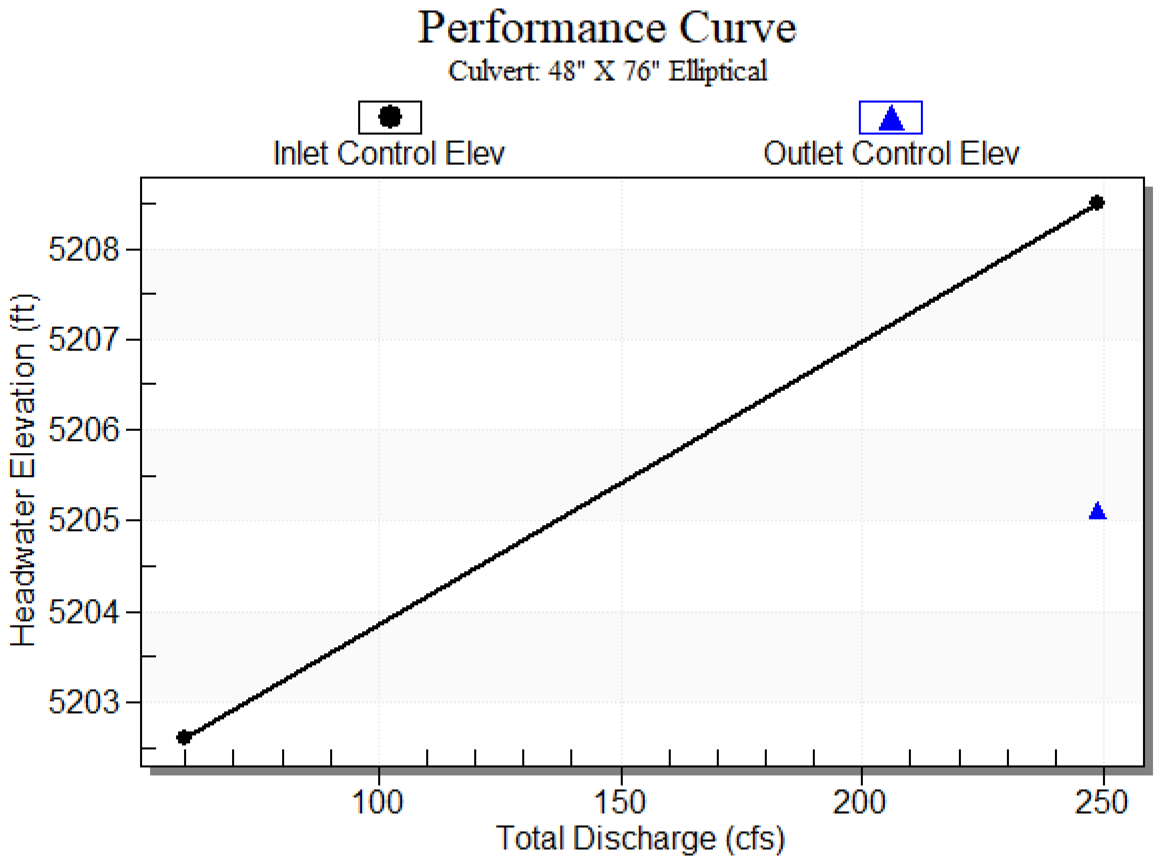
Straight Culvert

Inlet Elevation (invert): 5200.10 ft,   Outlet Elevation (invert): 5196.08 ft

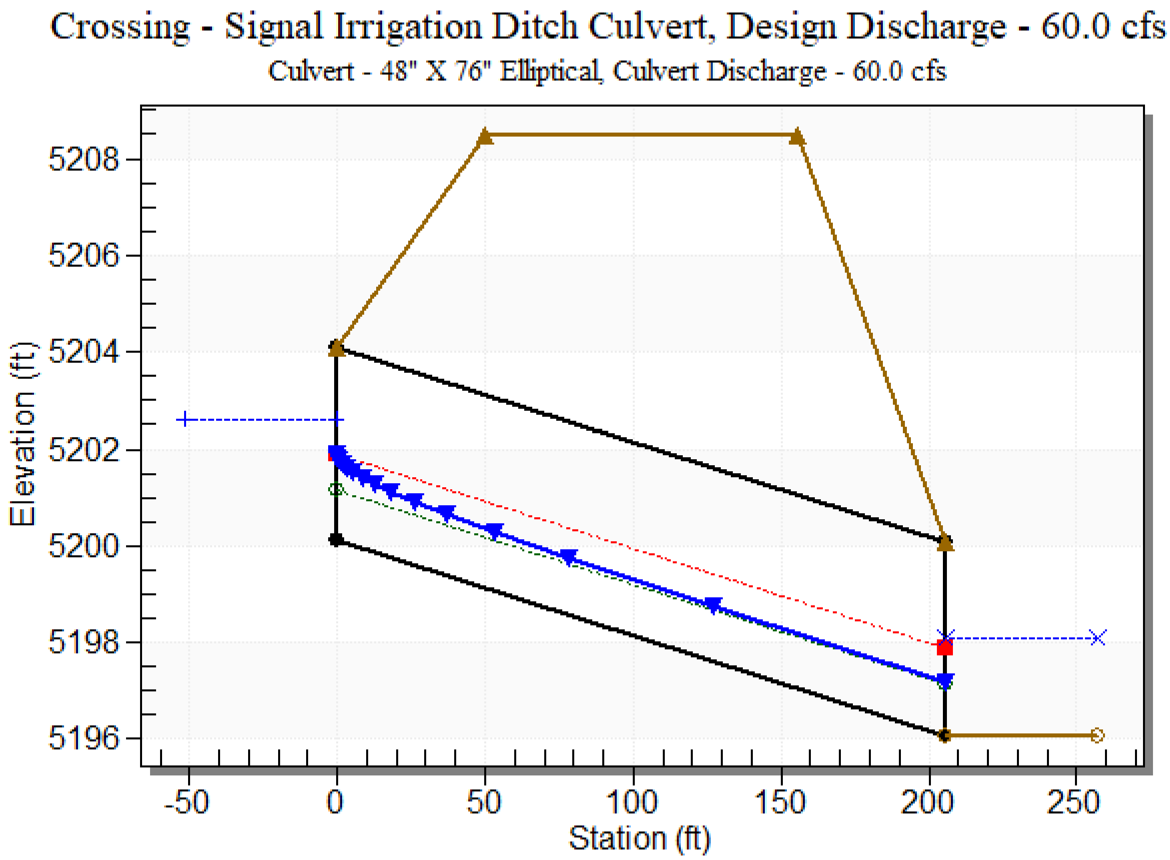
Culvert Length: 205.64 ft,   Culvert Slope: 0.0196

****

Culvert Performance Curve Plot: 48" X 76" Elliptical



Water Surface Profile Plot for Culvert: 48" X 76" Elliptical



Site Data - 48" X 76" Elliptical

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5200.10 ft

Outlet Station: 205.60 ft

Outlet Elevation: 5196.08 ft

Number of Barrels: 1

Culvert Data Summary - 48" X 76" Elliptical

Barrel Shape: Elliptical

Barrel Span: 76.00 in

Barrel Rise: 48.00 in

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Signal Irrigation Ditch Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00
60.00	5198.08	2.00

A constant tailwater elevation of 2 feet at the outfall invert has been used as requested by the third party reviewer of Signal Ditch company. So froude number is constant here.

Tailwater Channel Data - Signal Irrigation Ditch Culvert

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 5198.08 ft

2FT above channel invert

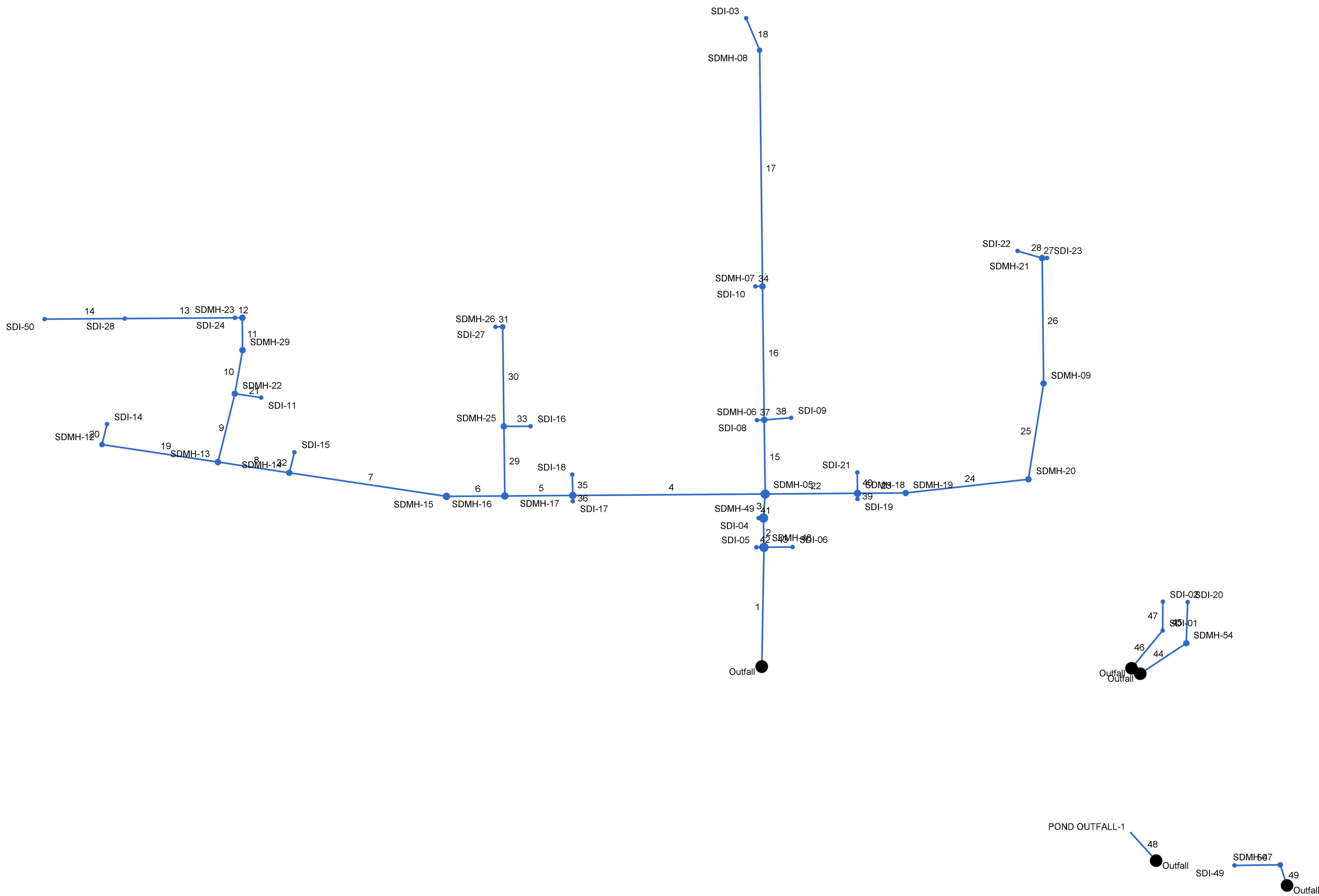
Appendix B – Hydraulic Computations
Storm Drain Design

Please note that it is not possible in Hydraflow to label Q, V, HGL IN and OUT in the profile output. However, the provided Summary Output Table tabulates the Line ID and Inlet/Manhole ID (matching CDs) and their corresponding length, slope, size, INV IN, INV OUT, HGL IN, HGL OUT, Q, Q capacity and Velocity. Everything required is already provided either in the Summary Output Table and/or the profile output. If you need more information please refer to pipe profiles in CDs. These outputs directly correspond to the pipe profiles on CDs.

User defined tailwater elevation was provided as input per request. Tailwater input is either 100-year or 5-year WSEL of the detention basin. However, in some cases the normal depth of the outfall pipe is higher (and consequently more conservative) than the 100-year or 5-year WSEL in the detention basin. In such cases, the program automatically defaults and uses the normal depth of the pipe as the tailwater. This gives a more conservative HGL result. Explanation of the design approach has been provided for all outfalls individually in the summary output table.

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan

System A



Project File: 1104_100YrHGL_SystemA.stm	Number of lines: 50	Date: 11/25/2020

Storm Sewers v2018.30

CustomRep

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
1	15	SDMH-48	48	48	158.752	0.92	128.90	137.76	11.89	5165.00	5163.54	5168.40	5166.61	5170.39	5168.61	0.013
2	100	SDMH-49	48	48	39.012	0.50	117.60	101.51	9.36	5165.40	5165.20	5169.46	5169.20	5170.82	5170.56	0.013
3	16	SDMH-05	48	48	31.950	0.50	113.40	101.55	9.02	5165.76	5165.60	5171.02	5170.82	5172.29	5172.09	0.013
4	35	SDMH-17	42	42	199.570	1.09	65.00	104.92	6.76	5168.43	5166.26	5173.12	5172.29	5173.83	5173.00	0.013
5	34	SDMH-16	42	42	70.430	0.84	52.30	92.11	5.44	5169.22	5168.63	5174.02	5173.83	5174.48	5174.29	0.013
6	33	SDMH-15	42	42	60.375	0.50	41.00	70.95	4.26	5169.72	5169.42	5174.58	5174.48	5174.87	5174.77	0.013
7	32	SDMH-14	42	42	165.993	1.00	41.00	100.61	4.31	5171.58	5169.92	5174.90	5174.65	5175.19	5174.93	0.013
8	31	SDMH-13	30	30	75.545	1.69	33.90	53.38	7.52	5173.86	5172.58	5175.84 j	5175.19	5176.87	5175.93	0.013
9	44	SDMH-22	24	24	92.610	1.85	27.60	30.76	10.14	5176.07	5174.36	5177.89	5175.84	5179.21	5177.16	0.013
10	63	SDMH-29	24	24	58.583	3.69	24.80	43.43	8.79	5178.43	5176.27	5180.19	5177.89	5181.31	5179.01	0.013
11	45	SDMH-23	24	24	43.133	2.99	24.80	39.12	8.97	5179.92	5178.63	5181.68	5180.19	5182.80	5181.31	0.013
12	46	SDI-24	24	24	7.557	1.06	24.80	23.28	8.34	5180.20	5180.12	5182.00	5181.92	5183.08	5183.00	0.013
13	47	SDI-28	24	24	114.334	0.50	21.20	15.97	6.75	5180.97	5180.40	5183.41	5182.40	5184.11	5183.11	0.013
14	105	SDI-50	24	24	83.121	0.51	10.60	16.08	3.37	5181.59	5181.17	5183.69	5183.51	5183.87	5183.69	0.013
15	17	SDMH-06	24	24	98.591	1.66	24.00	29.17	7.64	5169.40	5167.76	5173.40	5172.29	5174.31	5173.20	0.013
16	18	SDMH-07	24	24	177.835	0.50	13.50	16.00	4.30	5170.49	5169.60	5174.94	5174.31	5175.23	5174.60	0.013
17	19	SDMH-08	18	18	314.144	2.70	7.30	17.25	4.84	5179.57	5171.09	5180.62 j	5175.23	5181.09	5175.50	0.013
18	21	SDI-03	18	18	44.829	2.10	7.30	15.21	6.33	5180.71	5179.77	5181.76	5180.62	5182.23	5181.09	0.013
19	30	SDMH-12	18	18	122.391	1.37	6.30	12.30	5.19	5176.54	5174.86	5177.51 j	5175.84	5177.93	5176.26	0.013
20	43	SDI-14	18	18	27.776	0.50	6.30	7.45	4.73	5176.88	5176.74	5177.94	5177.80	5178.29	5178.15	0.013
21	49	SDI-11	18	18	27.777	0.50	2.80	7.46	1.58	5176.41	5176.27	5177.91	5177.89	5177.95	5177.93	0.013
22	36	SDMH-18	30	30	95.850	1.62	24.40	52.12	4.97	5168.81	5167.26	5172.63	5172.29	5173.01	5172.67	0.013
23	37	SDMH-19	24	24	50.043	1.16	10.90	24.39	3.47	5169.89	5169.31	5173.13	5173.01	5173.32	5173.20	0.013

TW = 5166.61' = Normal Depth > 100-Yr Detention Pond WSE (5165.93')

Detention basin 100-year WSE was given as user input. However, in this particular case normal depth of pipe is higher than the 100-year WSEL in the detention basin. So the program defaults to using normal depth of pipe as tailwater as opposed to using the 100-year detention pond WSEL. This results in a more conservative HGL estimation. The user defined tailwater is never lower than the 100-year WSE at the pond

Project File: 1104_100YrHGL_SystemA.stm

Number of lines: 50

NOTES: ** Critical depth

Sewers

CustomRep

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
24	38	SDMH-20	24	24	128.432	0.88	10.90	21.22	3.47	5171.22	5170.09	5173.46	5173.16	5173.65	5173.35	0.013
25	20	SDMH-09	24	24	128.432	0.74	10.90	19.45	3.90	5172.37	5171.42	5173.87	5173.64	5174.16	5173.83	0.013
26	39	SDMH-21	24	24	166.807	1.01	10.90	22.70	5.25	5174.25	5172.57	5175.43 j	5173.91	5175.93	5174.41	0.013
27	60	SDI-23	18	18	5.025	6.17	7.40	26.08	7.52	5175.06	5174.75	5176.11	5175.43	5176.60	5175.92	0.013
28	59	SDI-22	18	18	27.077	1.15	3.50	11.24	4.35	5175.06	5174.75	5175.77	5175.43	5176.05	5175.71	0.013
29	51	SDMH-25	24	24	92.610	0.59	11.30	17.32	3.60	5171.26	5170.72	5174.71	5174.48	5174.92	5174.68	0.013
30	52	SDMH-26	18	18	132.441	1.61	6.40	13.31	3.62	5173.89	5171.76	5175.39	5174.92	5175.59	5175.12	0.013
31	53	SDI-27	18	18	7.557	0.53	6.40	7.64	3.62	5174.13	5174.09	5175.62	5175.59	5175.82	5175.79	0.013
32	50	SDI-15	18	18	27.777	1.01	7.10	10.54	4.04	5173.86	5173.58	5175.30	5175.19	5175.56	5175.44	0.013
33	54	SDI-16	18	18	27.777	0.50	4.90	7.46	2.77	5171.90	5171.76	5174.98	5174.92	5175.10	5175.04	0.013
34	27	SDI-10	18	18	7.558	18.26	6.20	44.88	3.51	5172.47	5171.09	5175.26	5175.23	5175.45	5175.42	0.013
35	56	SDI-18	18	18	27.777	1.26	6.80	11.78	3.85	5170.78	5170.43	5173.95	5173.83	5174.18	5174.06	0.013
36	55	SDI-17	18	18	7.557	4.63	5.90	22.59	3.34	5170.78	5170.43	5173.86	5173.83	5174.03	5174.01	0.013
37	26	SDI-08	18	18	7.570	8.46	5.40	30.54	3.06	5170.54	5169.90	5174.33	5174.31	5174.47	5174.45	0.013
38	25	SDI-09	18	18	28.041	2.82	5.10	17.63	2.89	5170.69	5169.90	5174.37	5174.31	5174.50	5174.44	0.013
39	57	SDI-19	18	18	7.557	2.64	6.80	17.07	3.85	5170.01	5169.81	5173.05	5173.01	5173.28	5173.24	0.013
40	58	SDI-21	18	18	27.777	0.72	6.70	8.90	3.79	5170.01	5169.81	5173.13	5173.01	5173.35	5173.24	0.013
41	98	SDI-04	18	18	4.925	2.03	4.20	14.97	2.38	5168.00	5167.90	5170.83	5170.82	5170.92	5170.91	0.013
42	99	SDI-05	18	18	7.560	1.98	6.10	14.79	5.30	5167.64	5167.49	5168.59	5168.40	5169.01	5168.81	0.013
43	22	SDI-06	18	18	29.771	2.01	5.20	14.90	4.75	5168.09	5167.49	5168.97 j	5168.40	5169.33	5168.76	0.013
44	111	SDMH-54	24	24	62.559	0.50	8.10	15.92	2.58	5162.08	5161.77	5166.01	5165.93	5166.11	5166.03	0.013
45	110	SDI-20	24	24	54.820	0.51	8.10	16.16	2.58	5162.38	5162.10	5166.16	5166.09	5166.27	5166.19	0.013
46	02	SDI-01	24	24	59.634	0.50	11.70	16.04	3.72	5162.07	5161.77	5166.09	5165.93	5166.31	5166.15	0.013

Project File: 1104_100YrHGL_SystemA.stm

Number of lines: 50

NOTES: ** Critical depth

In this case the detention basin 100-year WSEL is higher than the normal depth of the pipe. So the program honors the user defined detention basin 100-yr tailwater elevation

100-Yr Detention Pond WSE (5165.93')

CustomRep

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
47	04	SDI-02	24	24	38.334	0.50	8.00	15.92	2.55	5162.28	5162.09	5166.26	5166.22	5166.36	5166.32	0.013
48	01	POND OUTFALL-1	48	48	45.588	0.48	110.30	99.73	8.78	5159.94	5159.72	5163.94	5163.72	5165.14	5164.92	0.013
49	106	SDMH-47	18	18	28.360	0.50	2.20	7.42	3.64	5159.09	5158.95	5159.66	5159.51	5159.86	5159.72	0.013
50	94	SDI-49	18	18	47.530	0.50	2.20	7.46	3.63	5159.53	5159.29	5160.09 j	5159.86	5160.30	5160.06	0.013

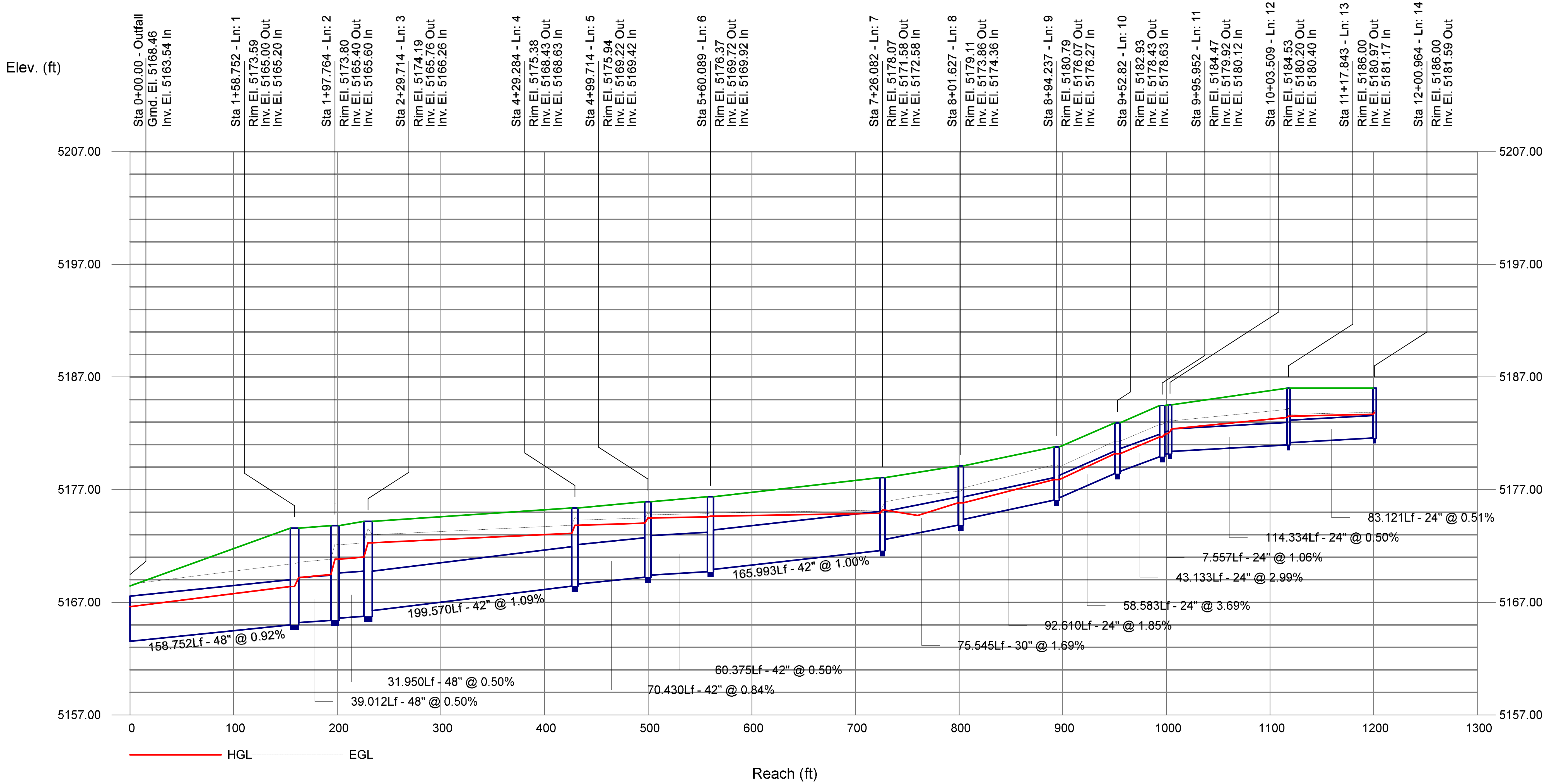
Project File: 1104_100YrHGL_SystemA.stm	Number of lines: 50	Date: 12/29/2020

NOTES: ** Critical depth

Storm Sewer Profile

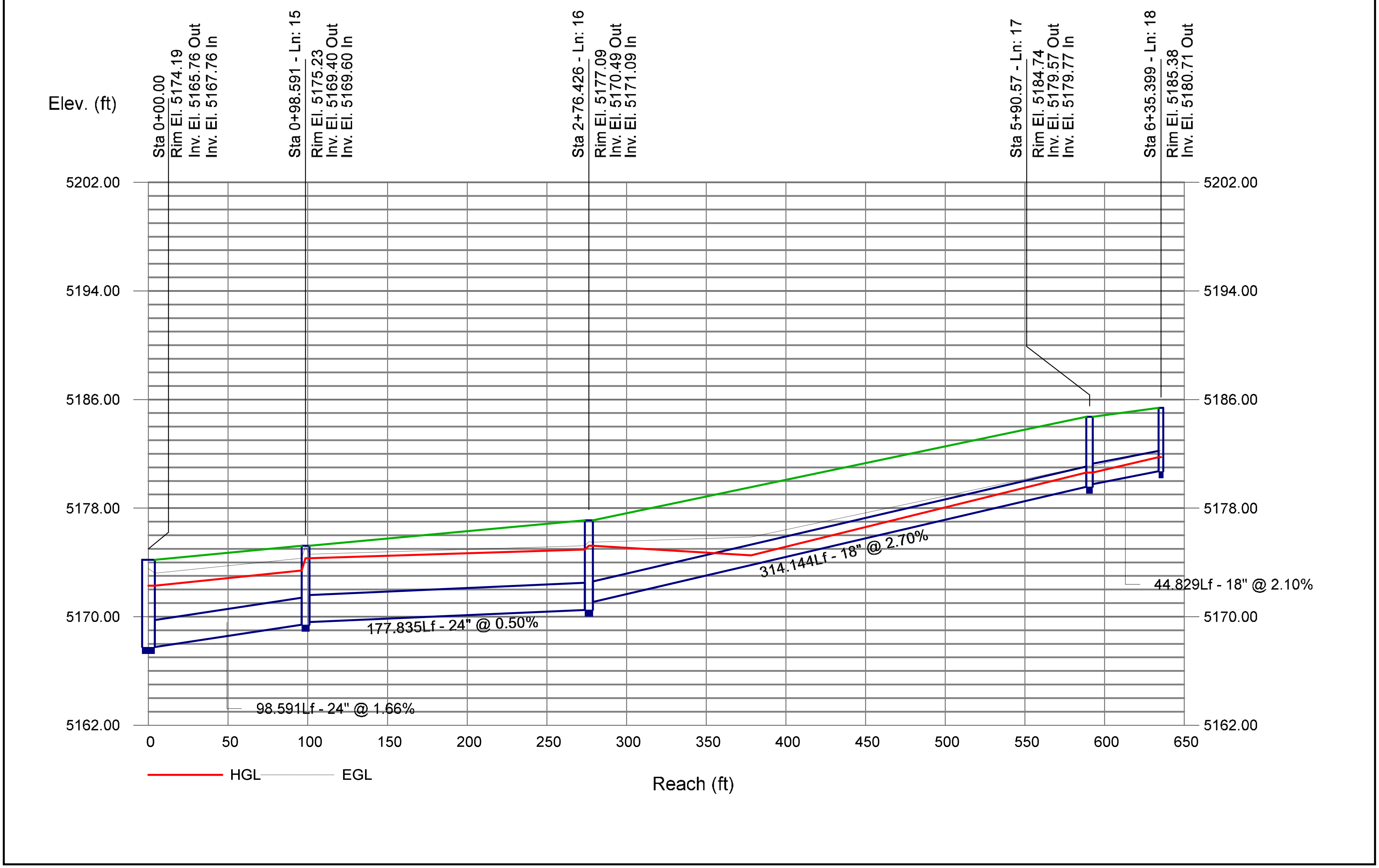
Proj. file: 1104_100YrHGL_SystemA.stm

Please note that it is not possible in Hydraflow to label Q, V, HGL IN and OUT in the profile output. However, the provided Summary Output Table tabulates the Line ID and Inlet/Manhole ID (matching CDs) and their corresponding length, slope, size, INV IN, INV OUT, HGL IN, HGL OUT, Q, Q capacity and Velocity. Everything required is already provided either in the Summary Output Table and/or the profile output. If you need more information please refer to pipe profiles in CDs. These outputs directly correspond to the pipe profiles on CDs.

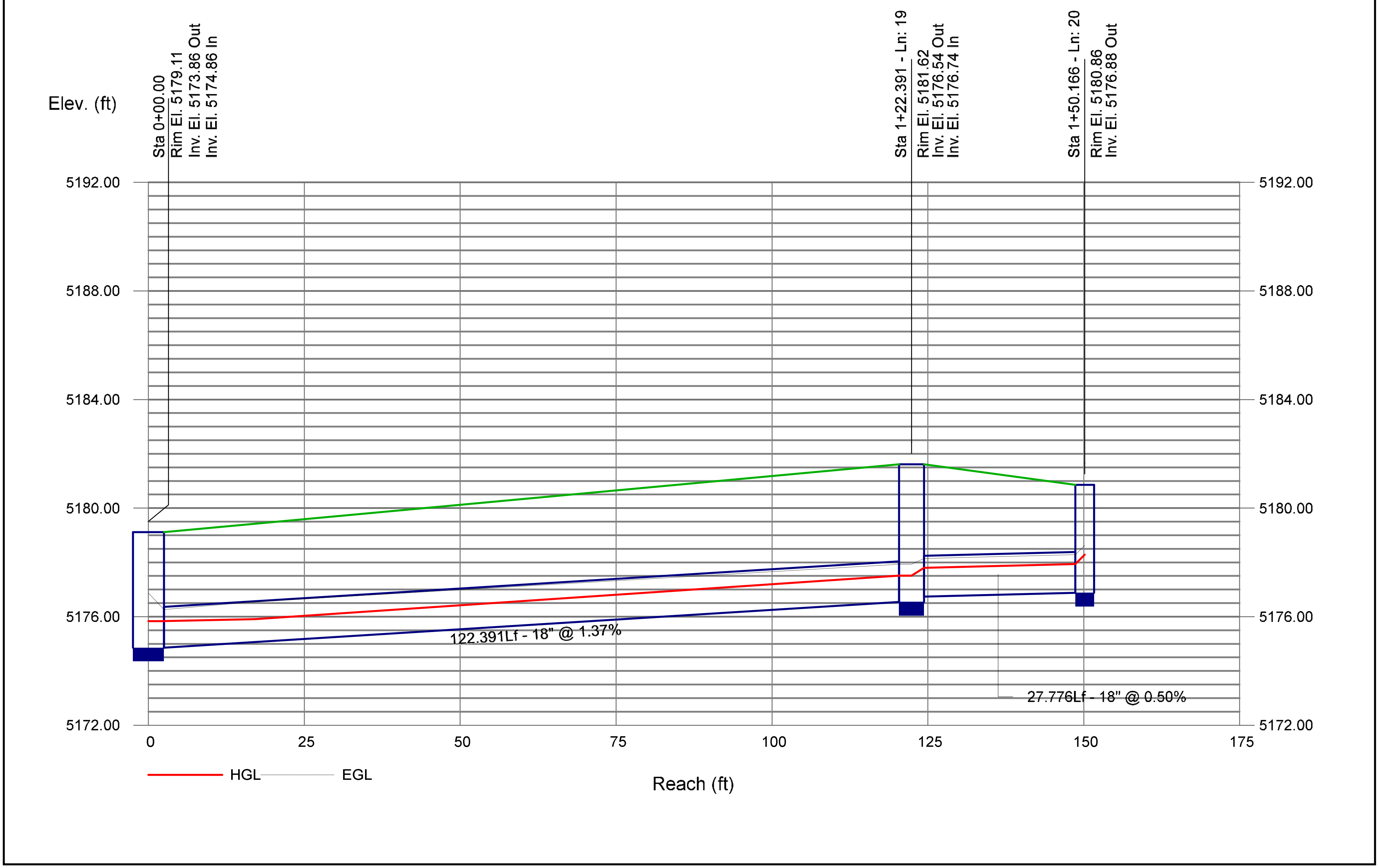


Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm

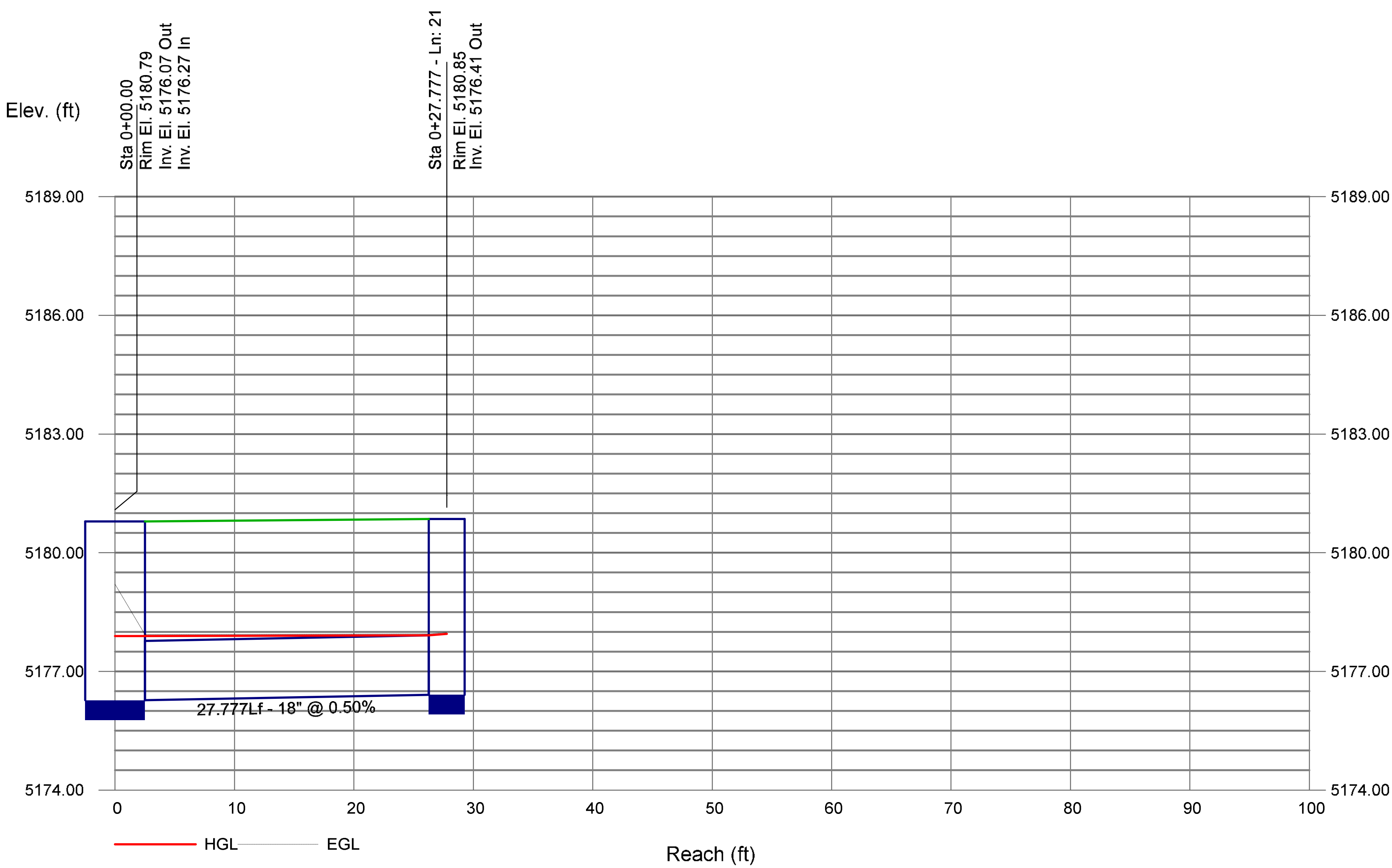


Storm Sewer Profile



Storm Sewer Profile

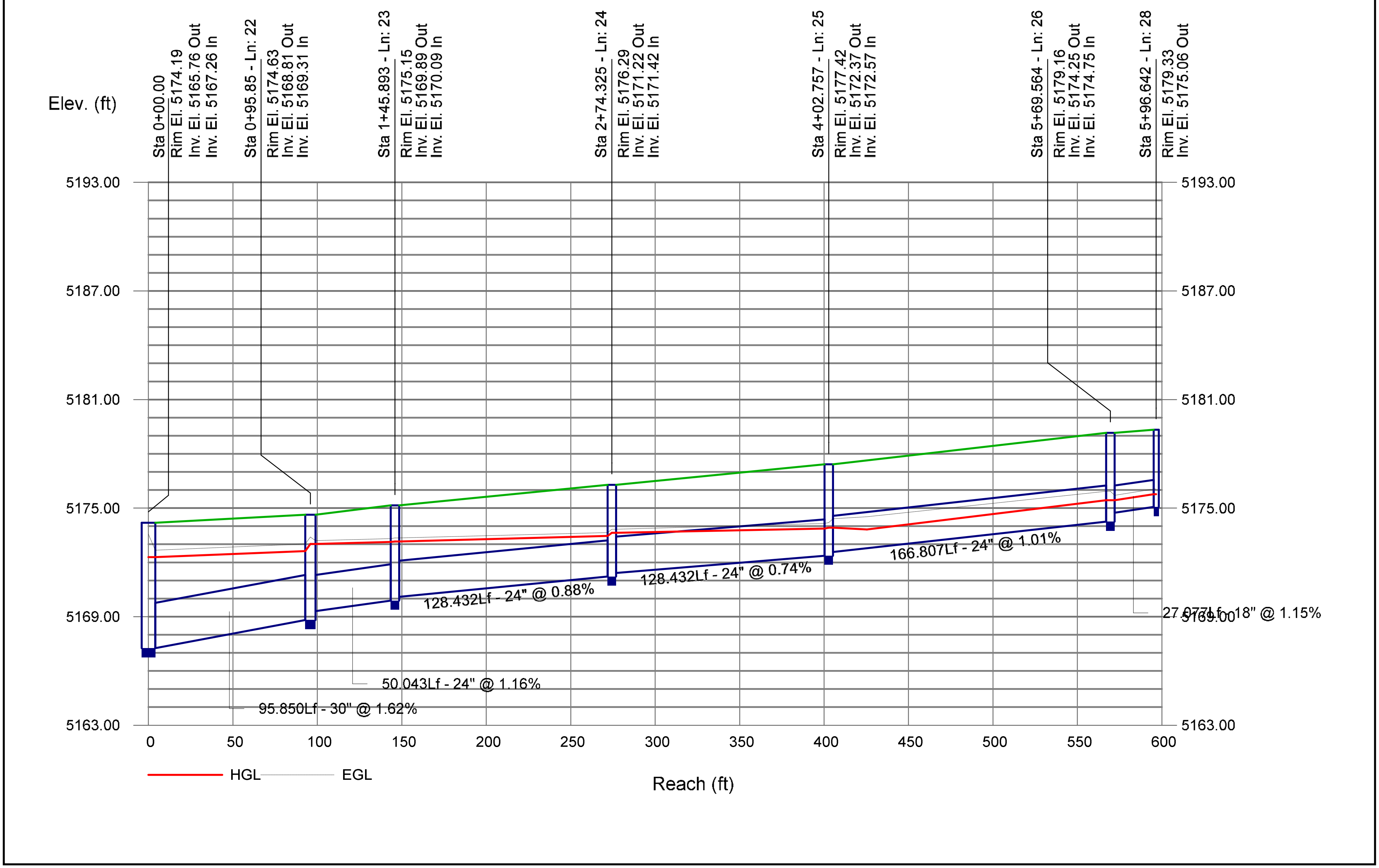
Proj. file: 1104_100YrHGL_SystemA.stm



Storm Sewers

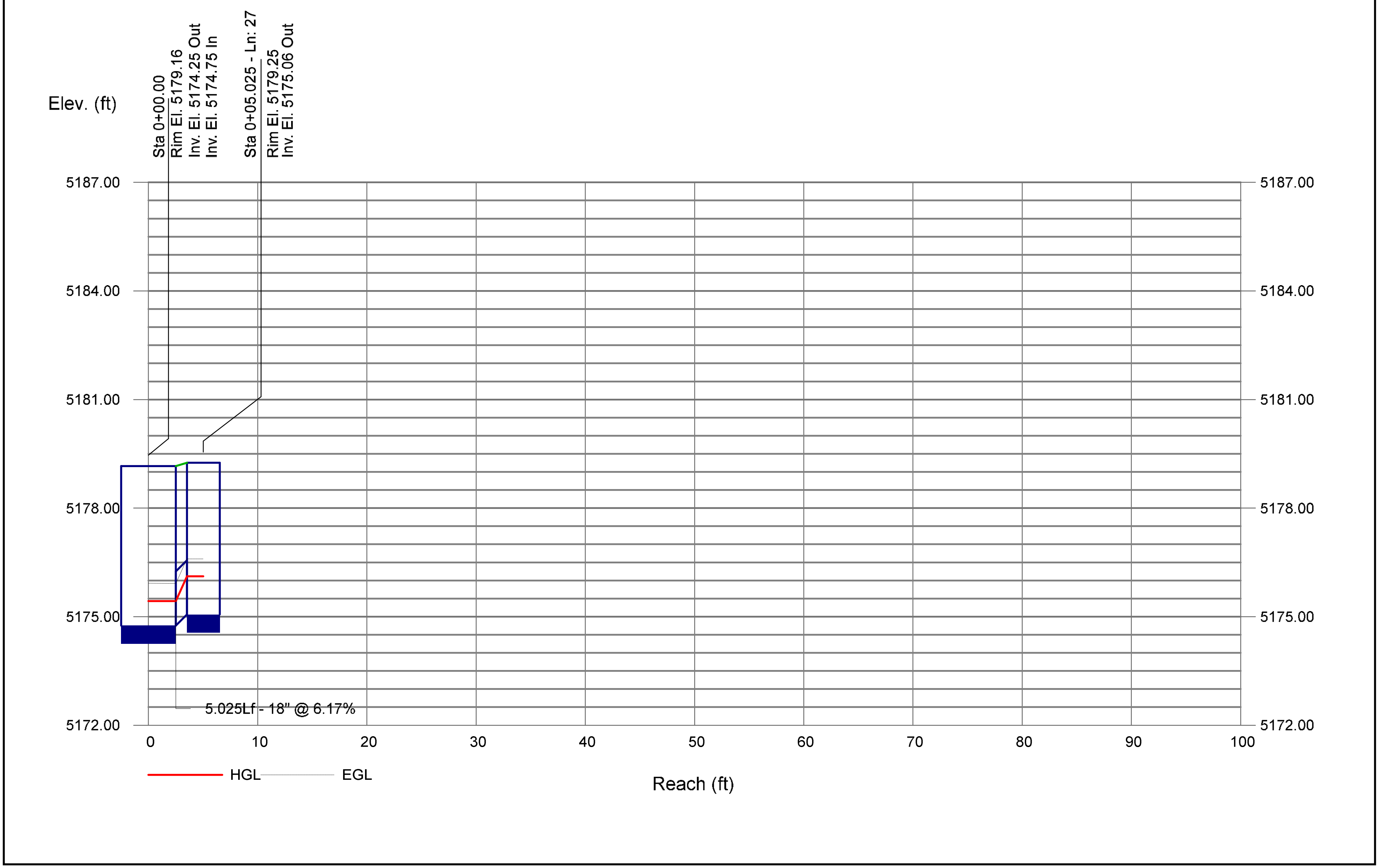
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



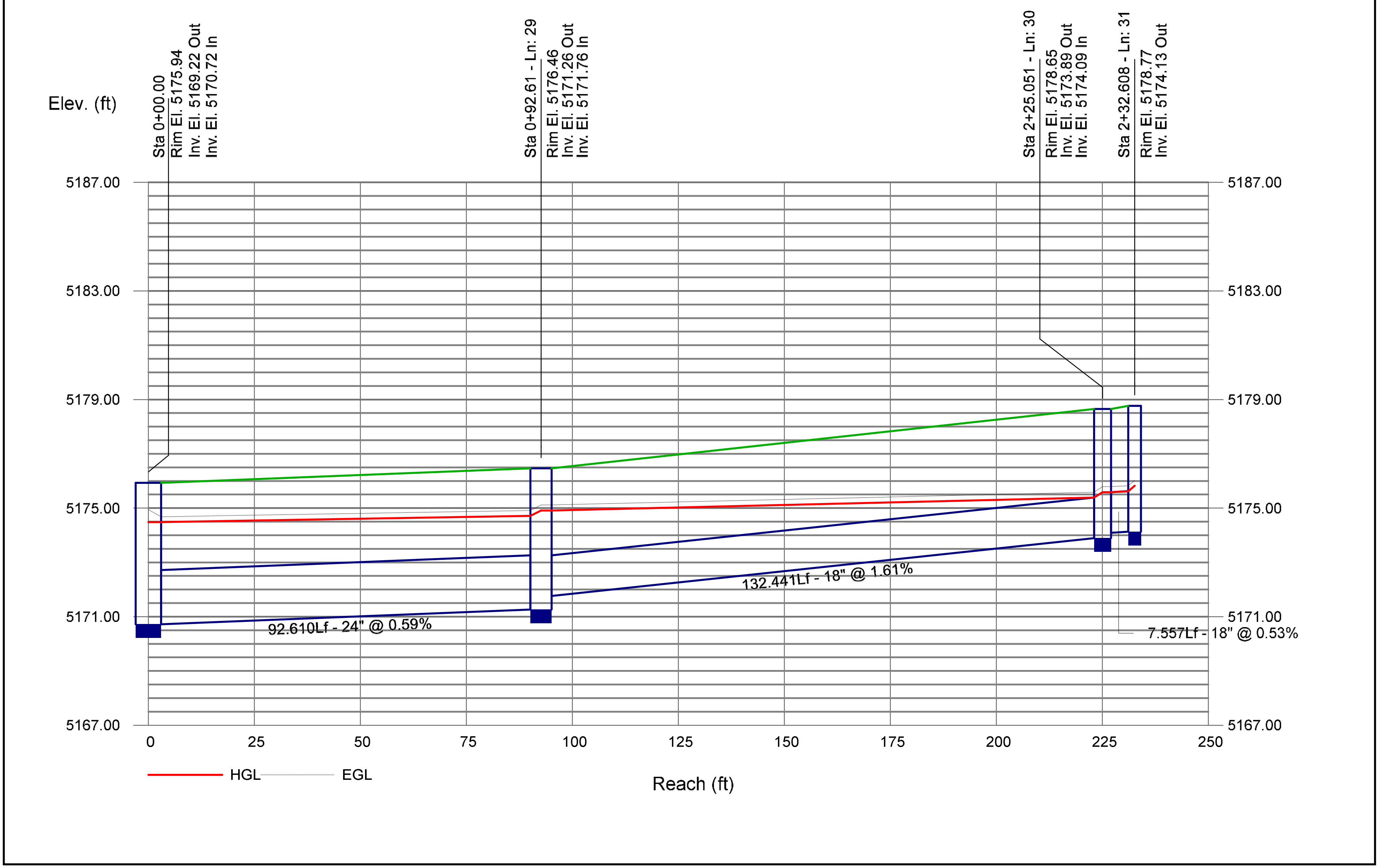
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



Storm Sewer Profile

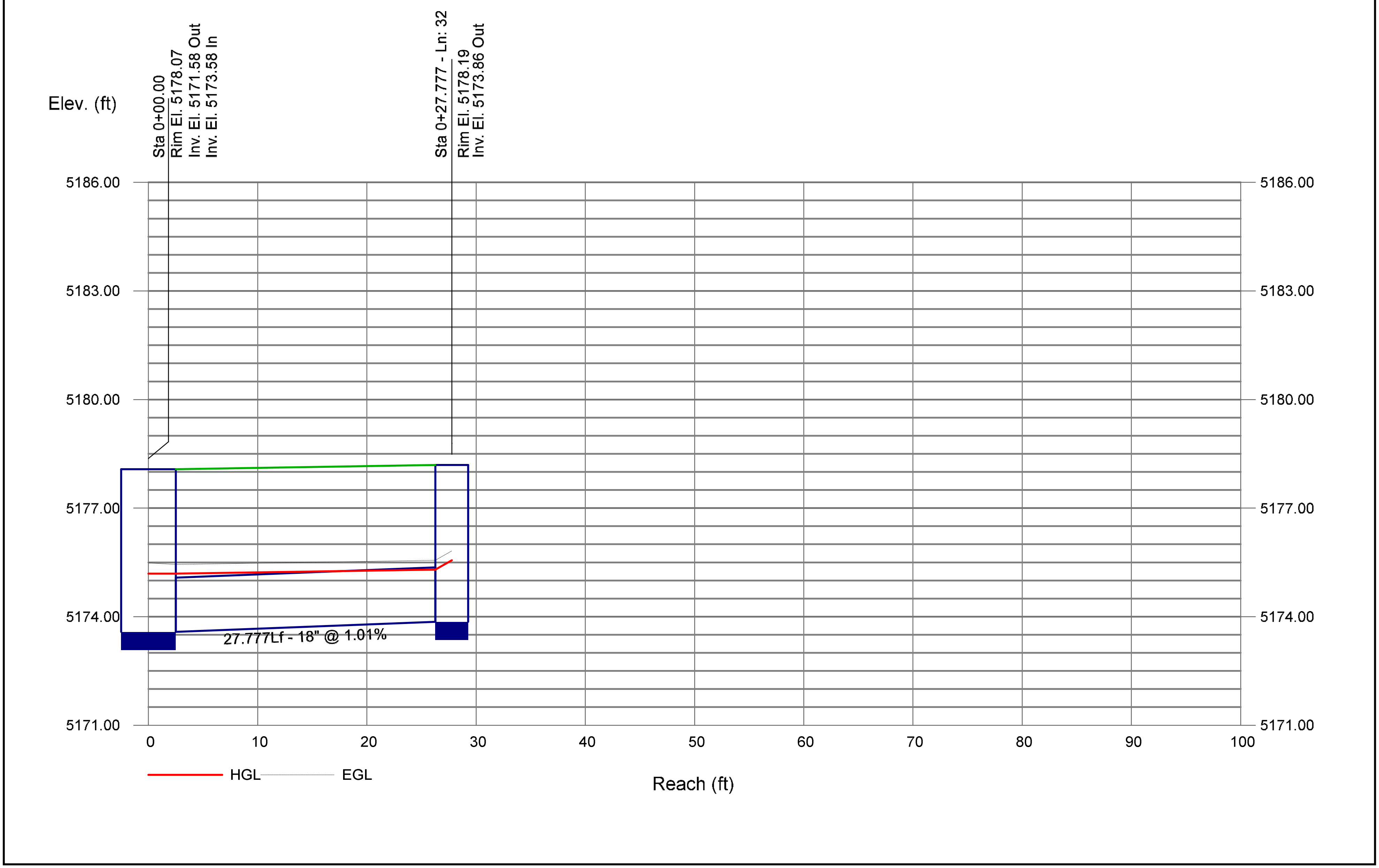
Proj. file: 1104_100YrHGL_SystemA.stm



Storm Sewers

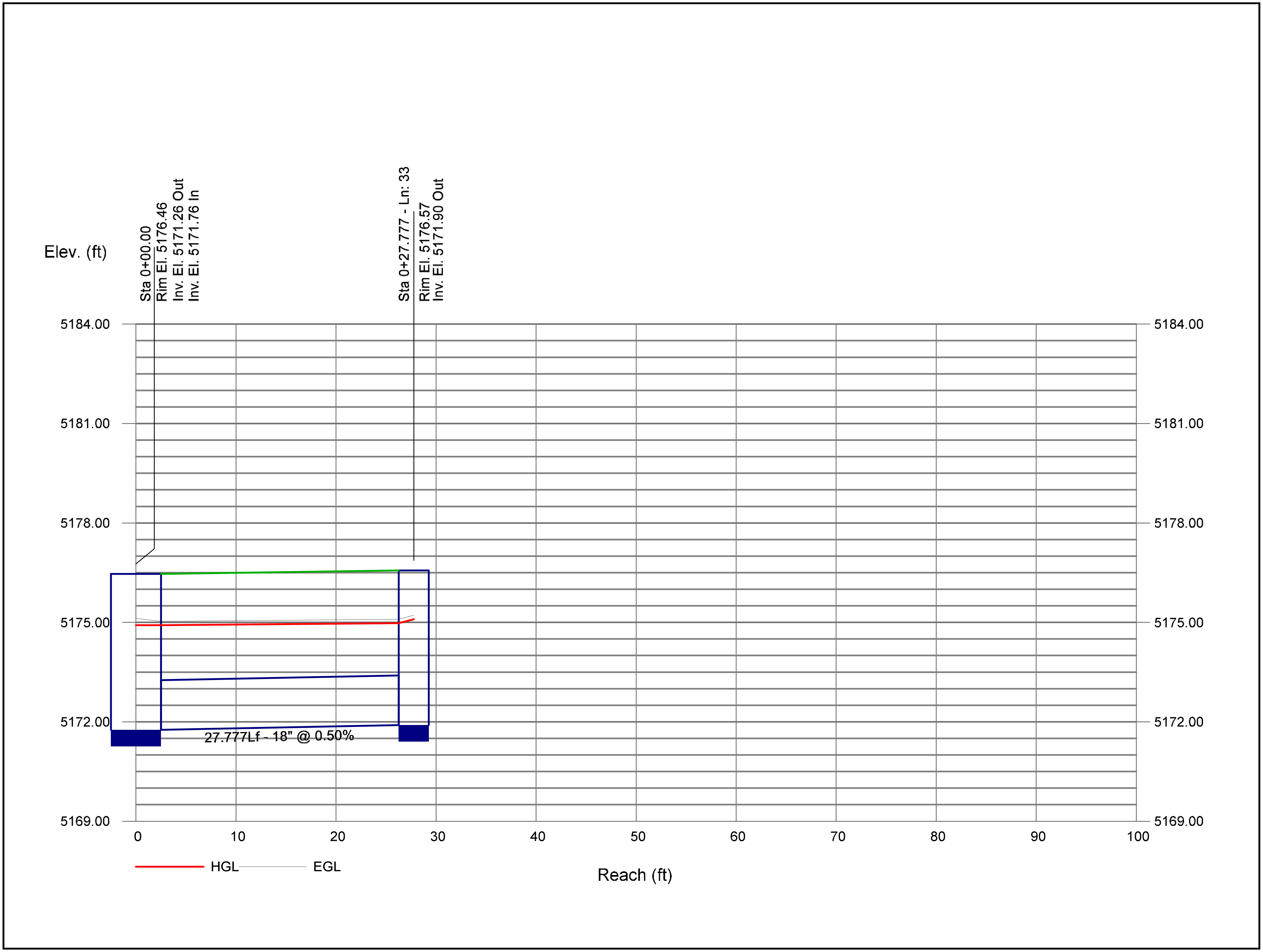
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



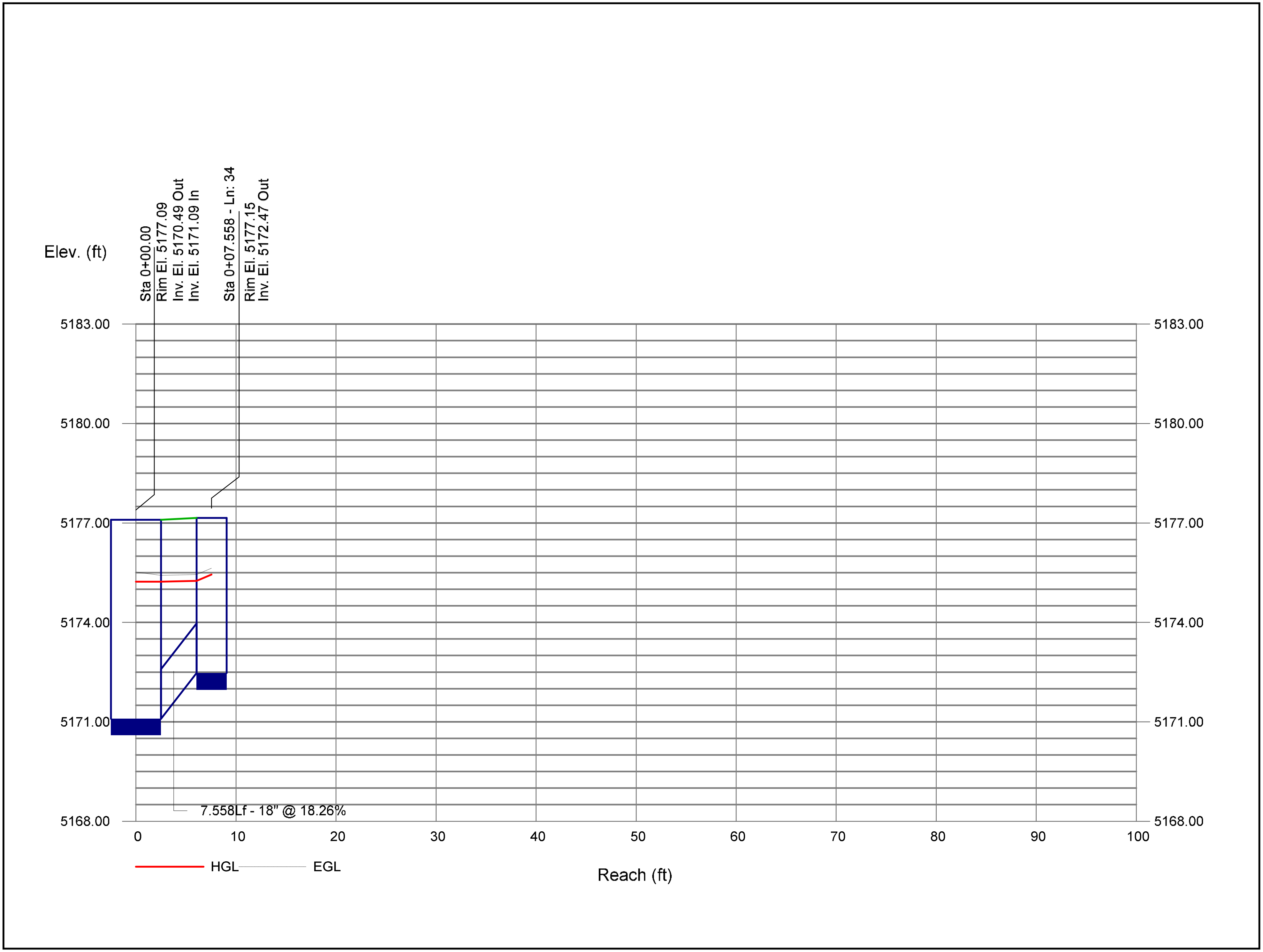
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



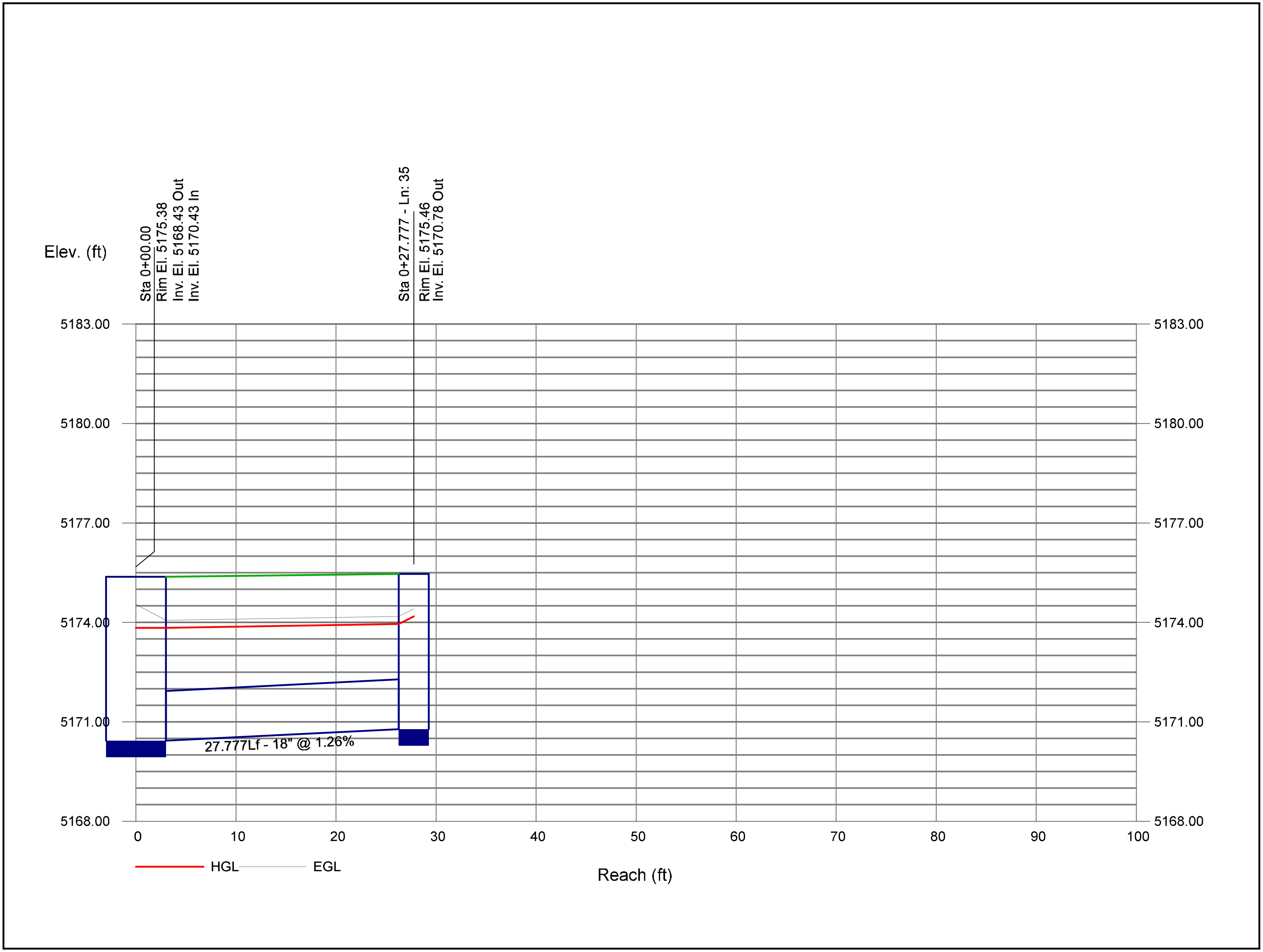
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



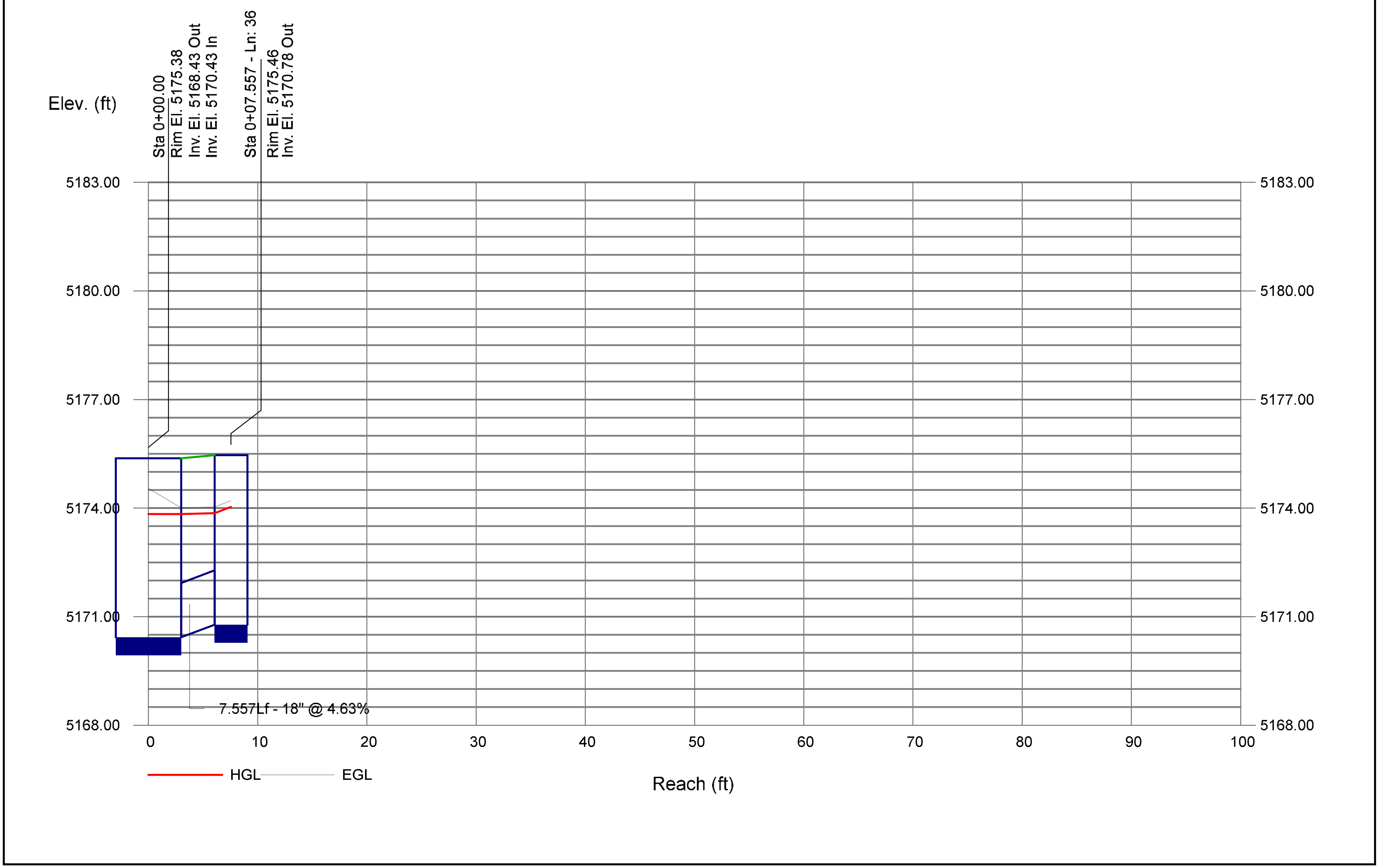
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



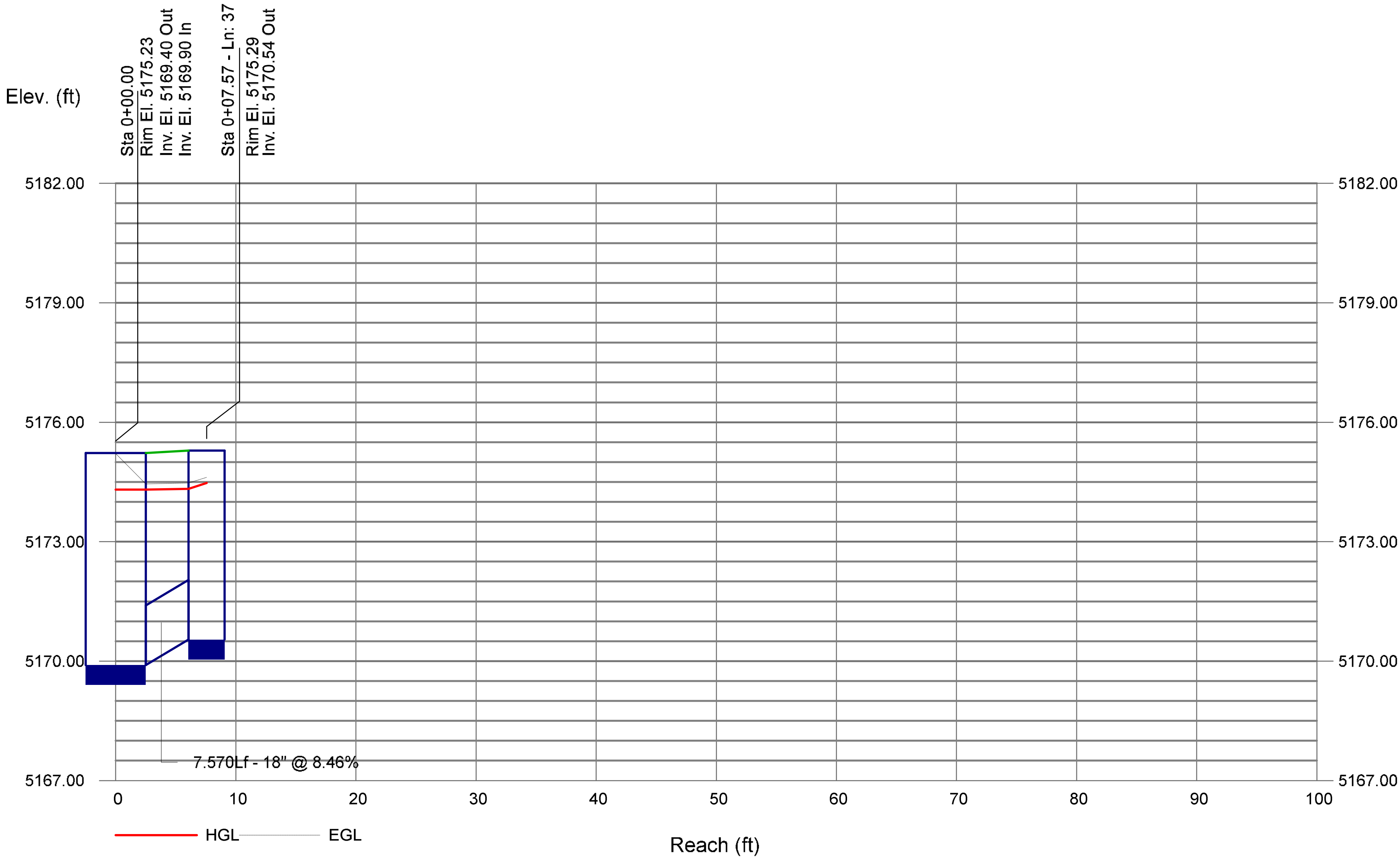
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



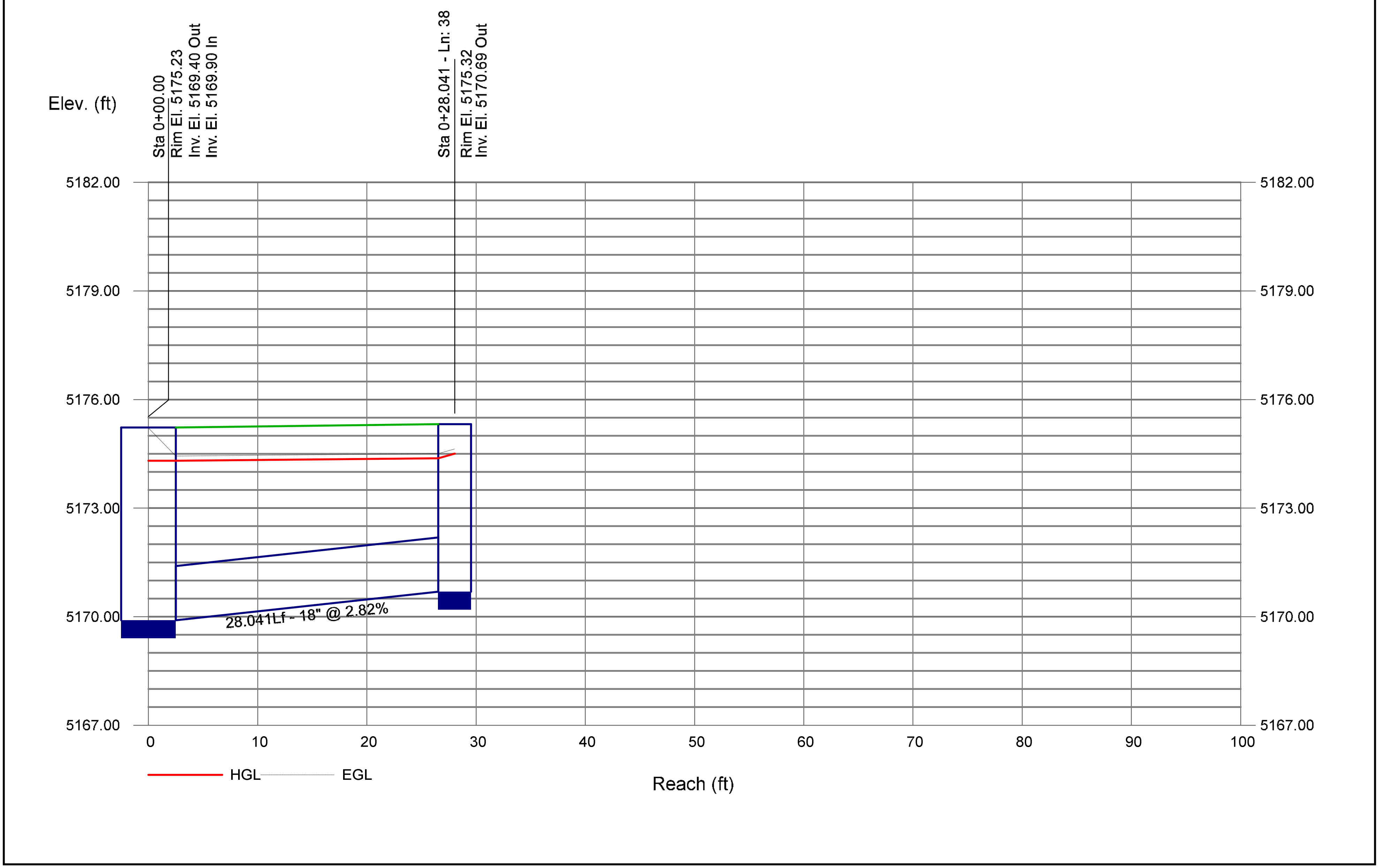
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



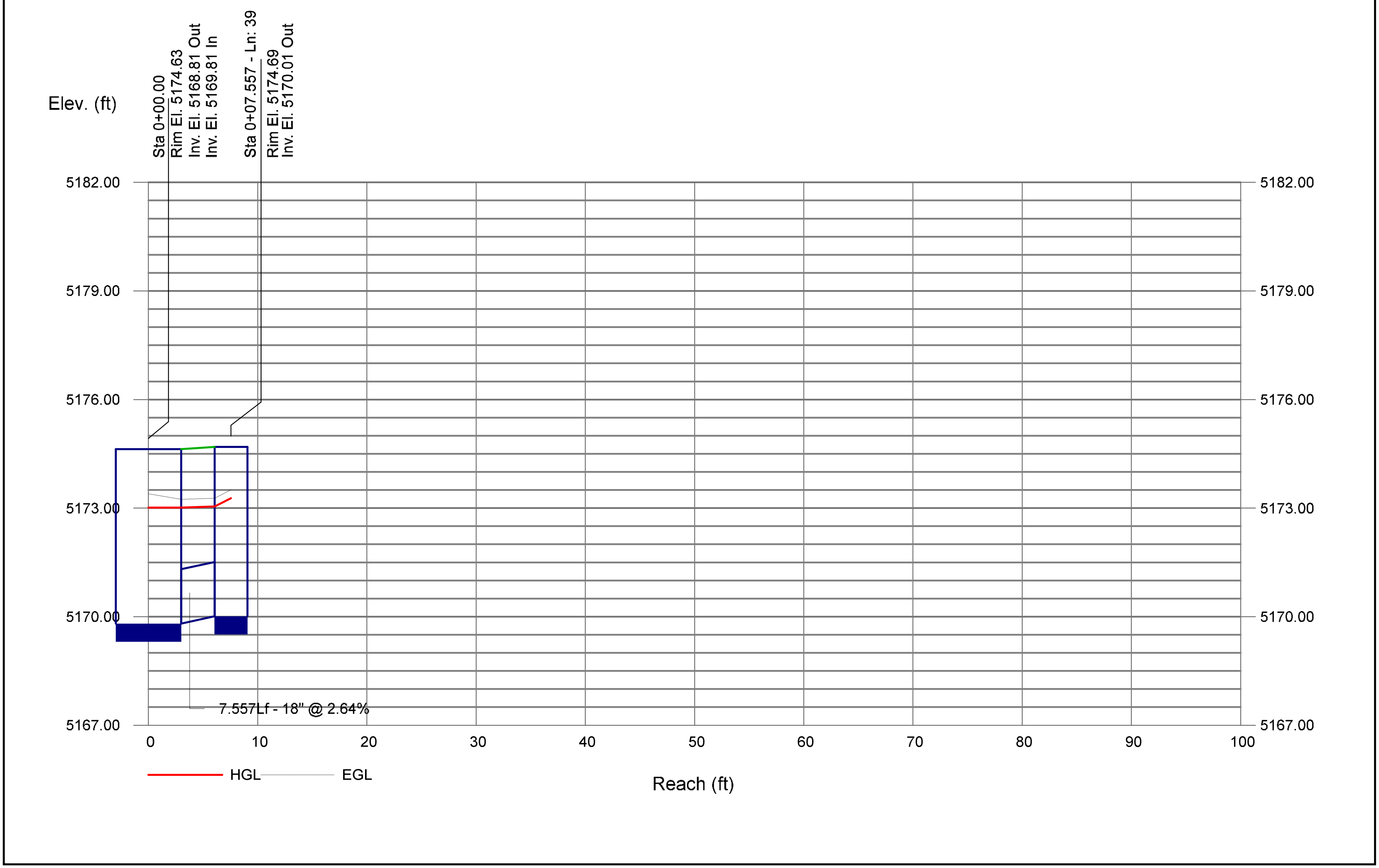
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



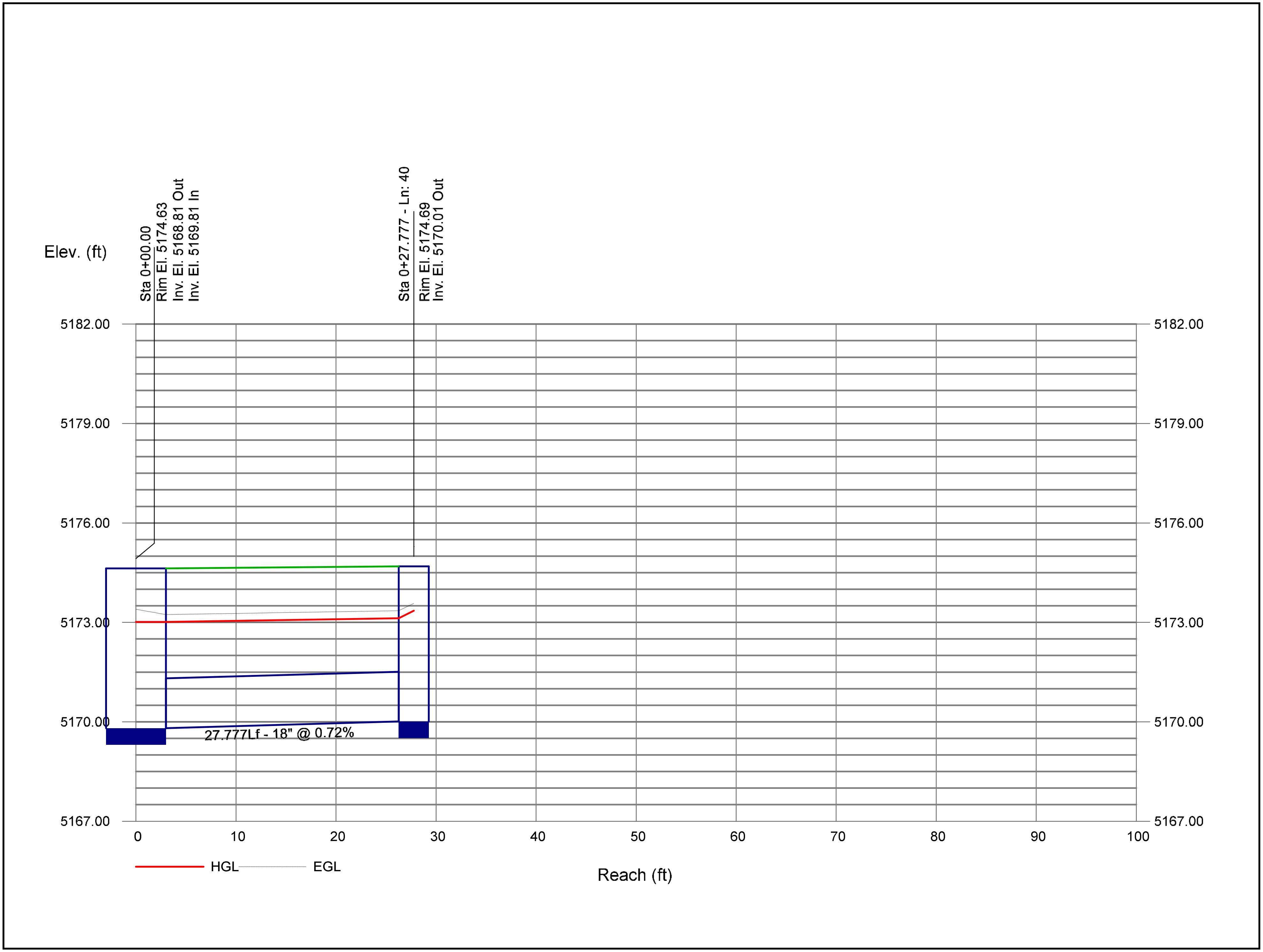
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



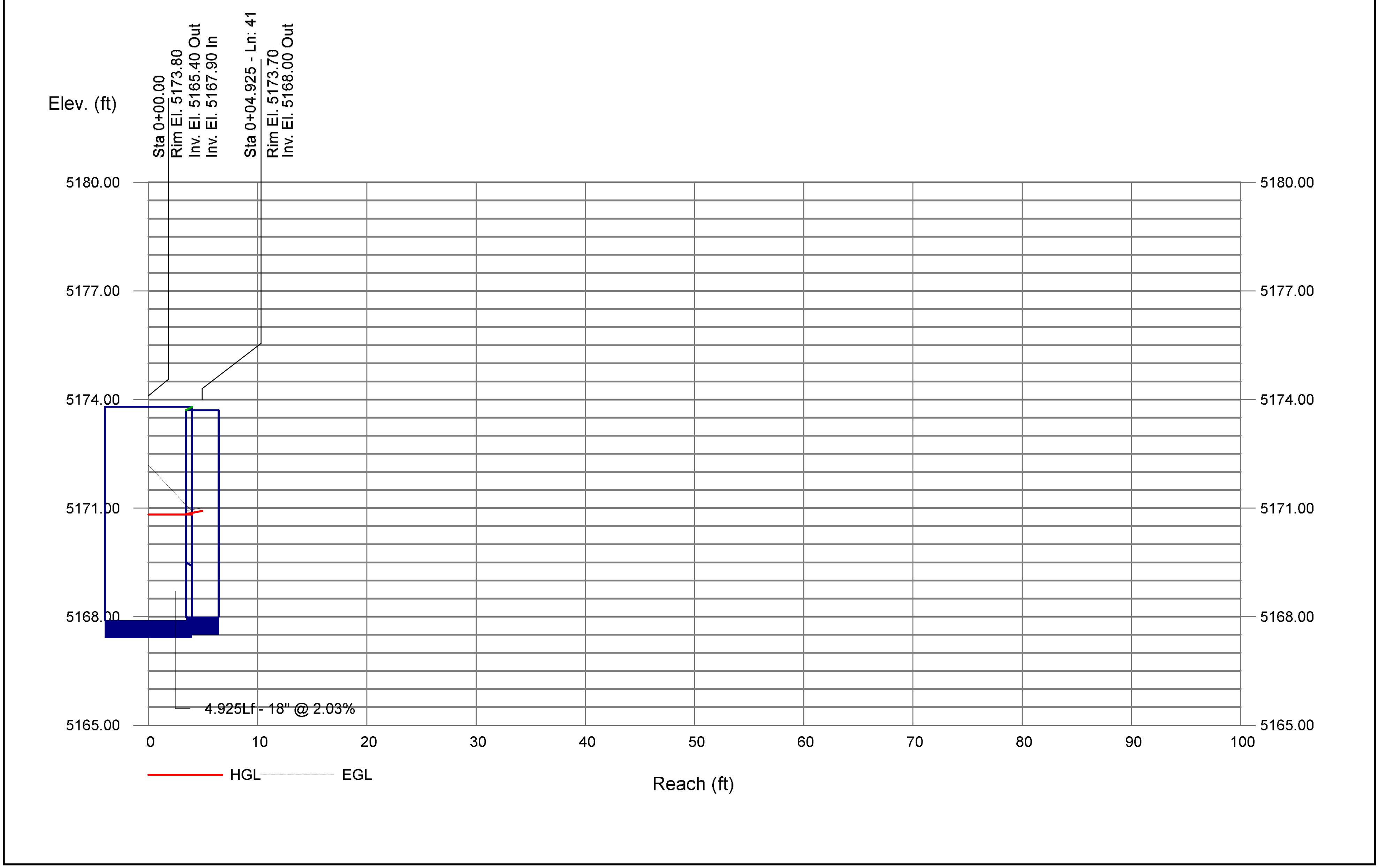
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



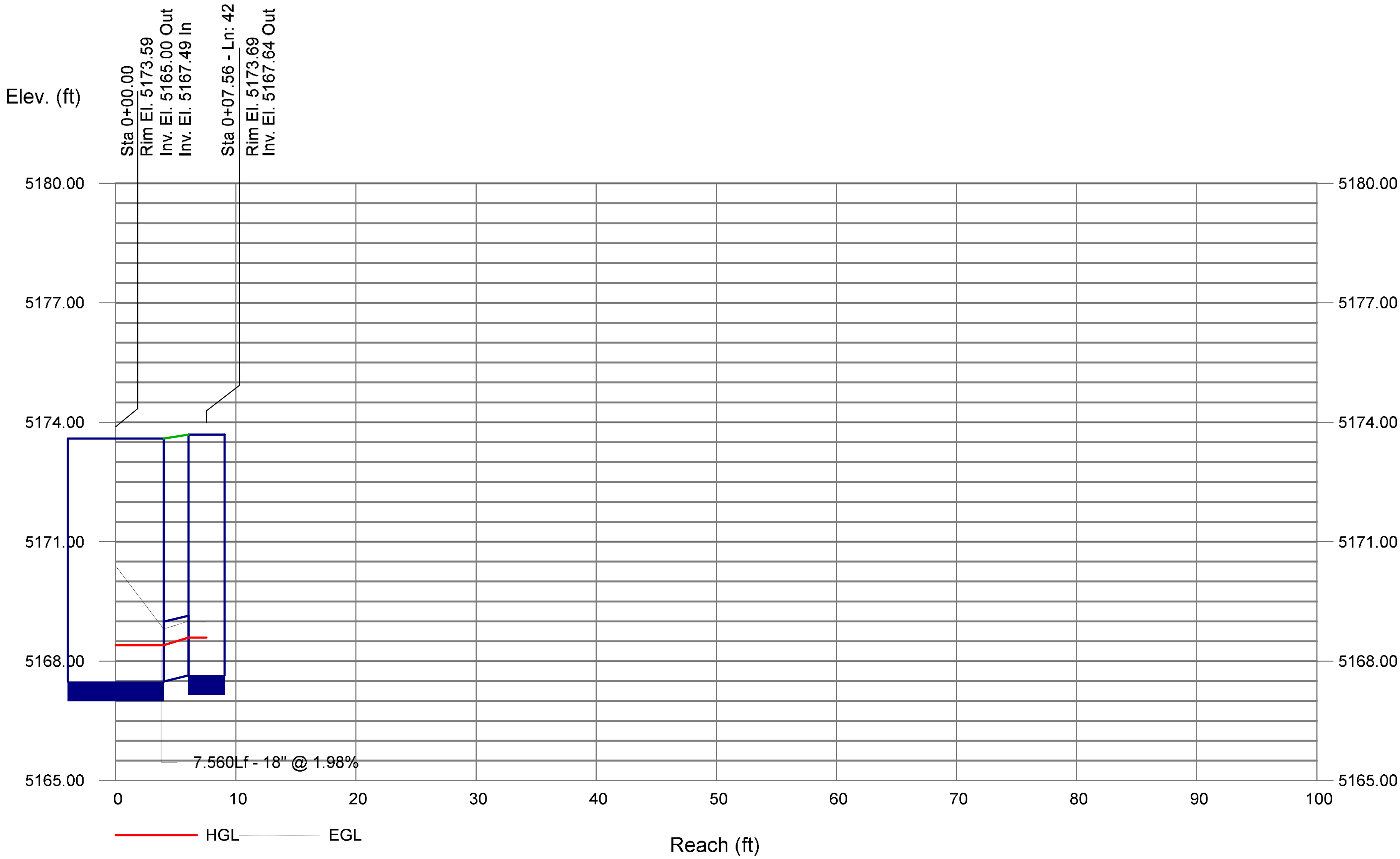
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



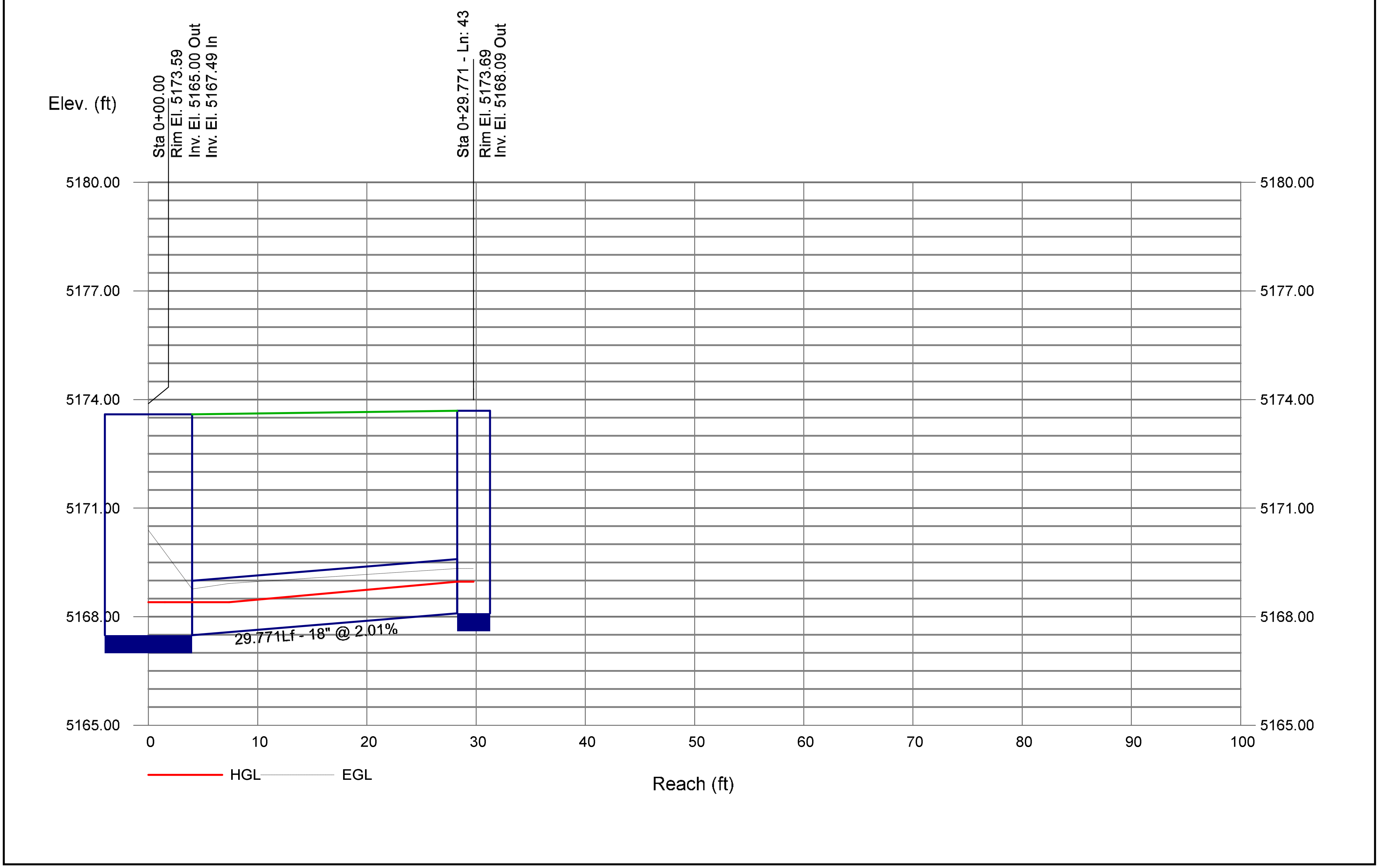
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



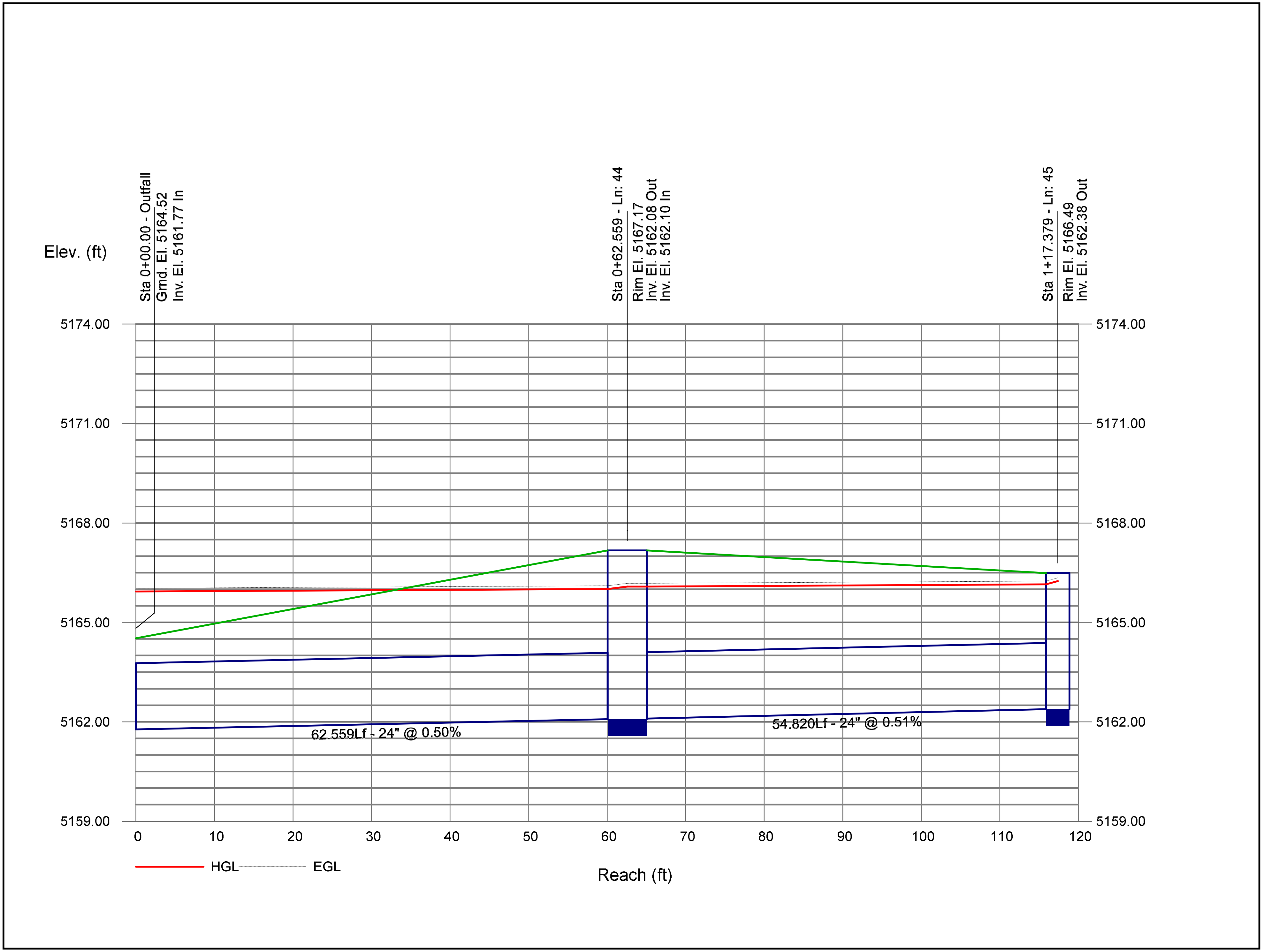
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemA.stm



Storm Sewer Profile

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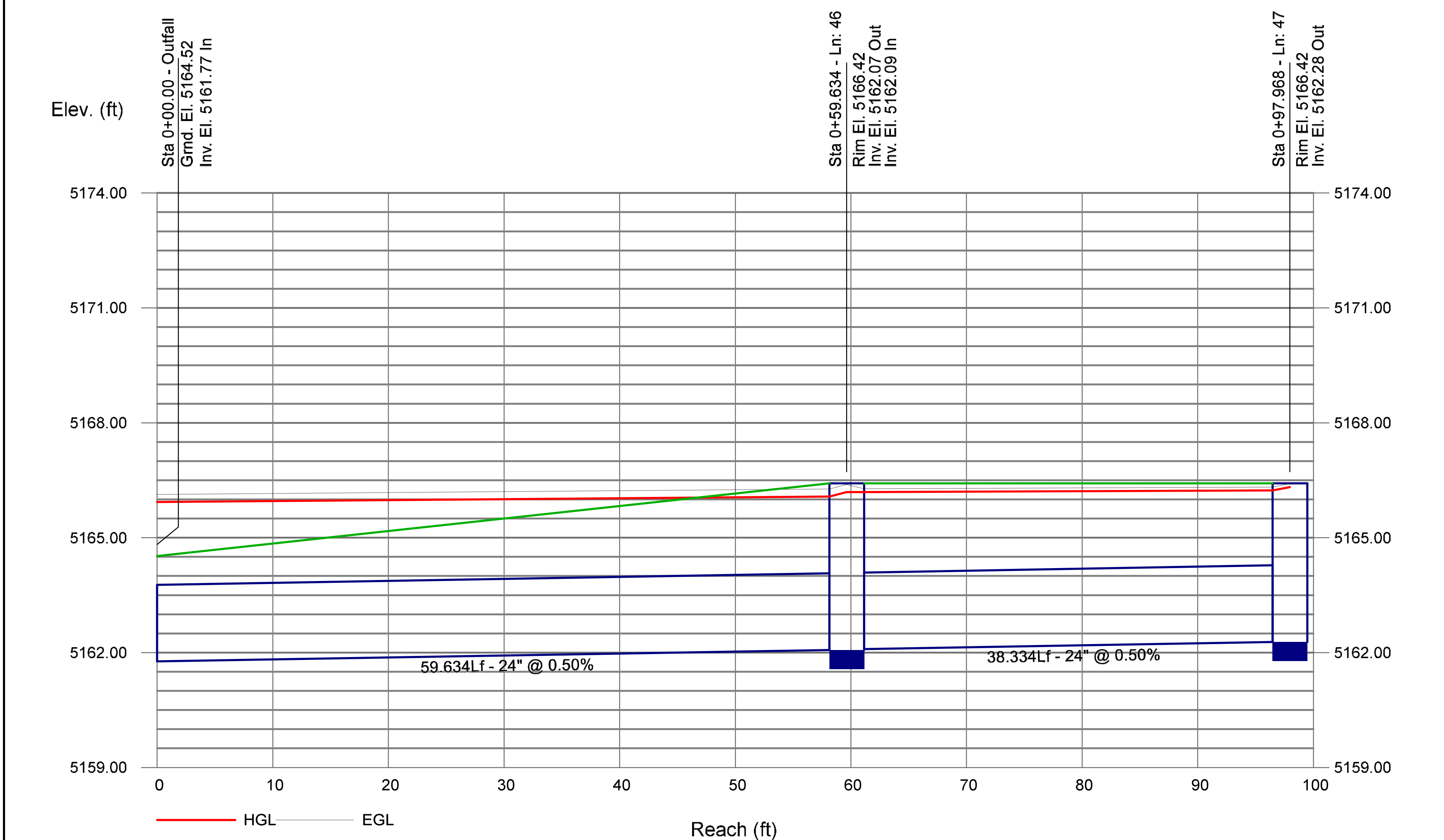

Storm Sewer Profile

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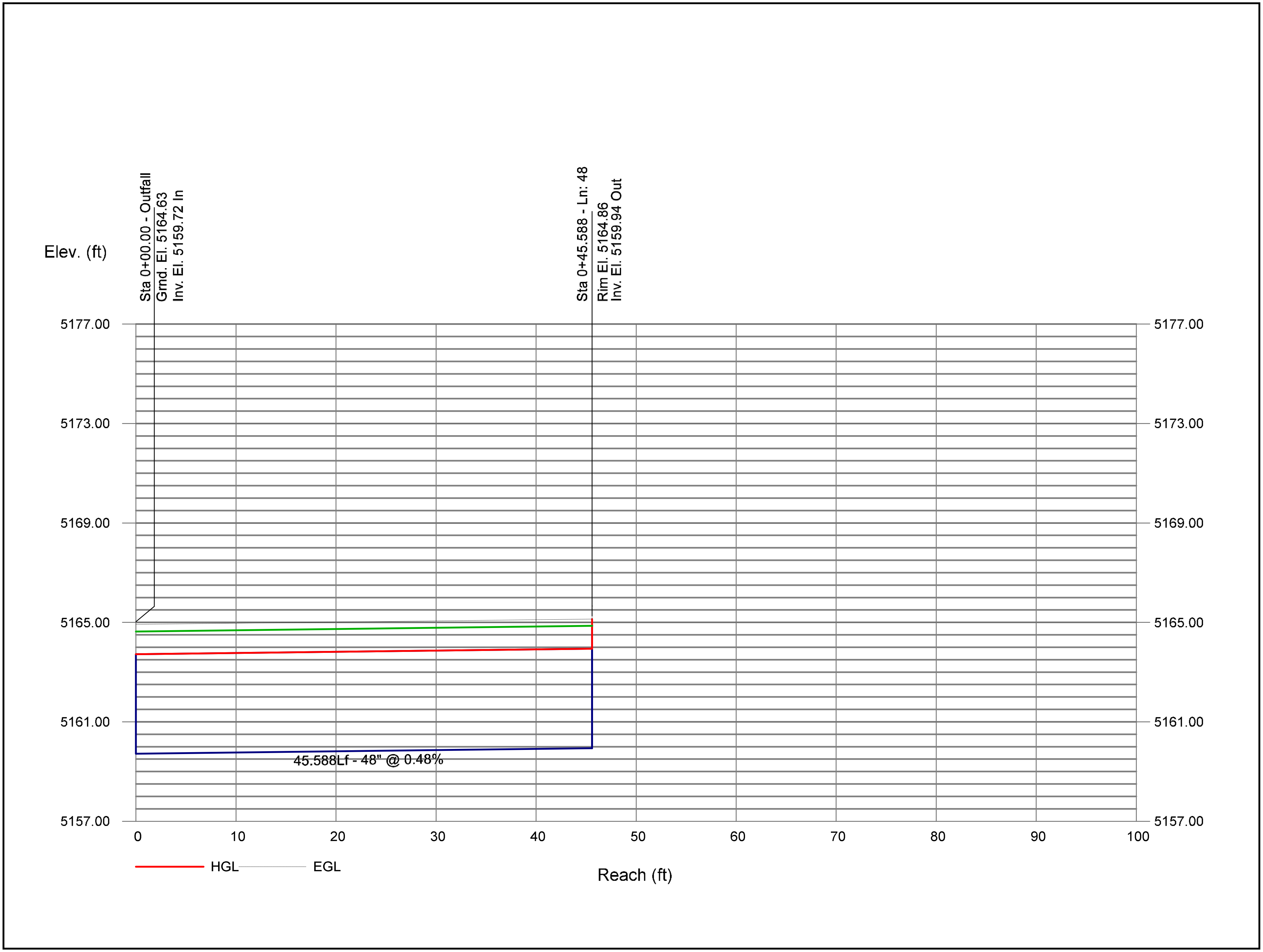

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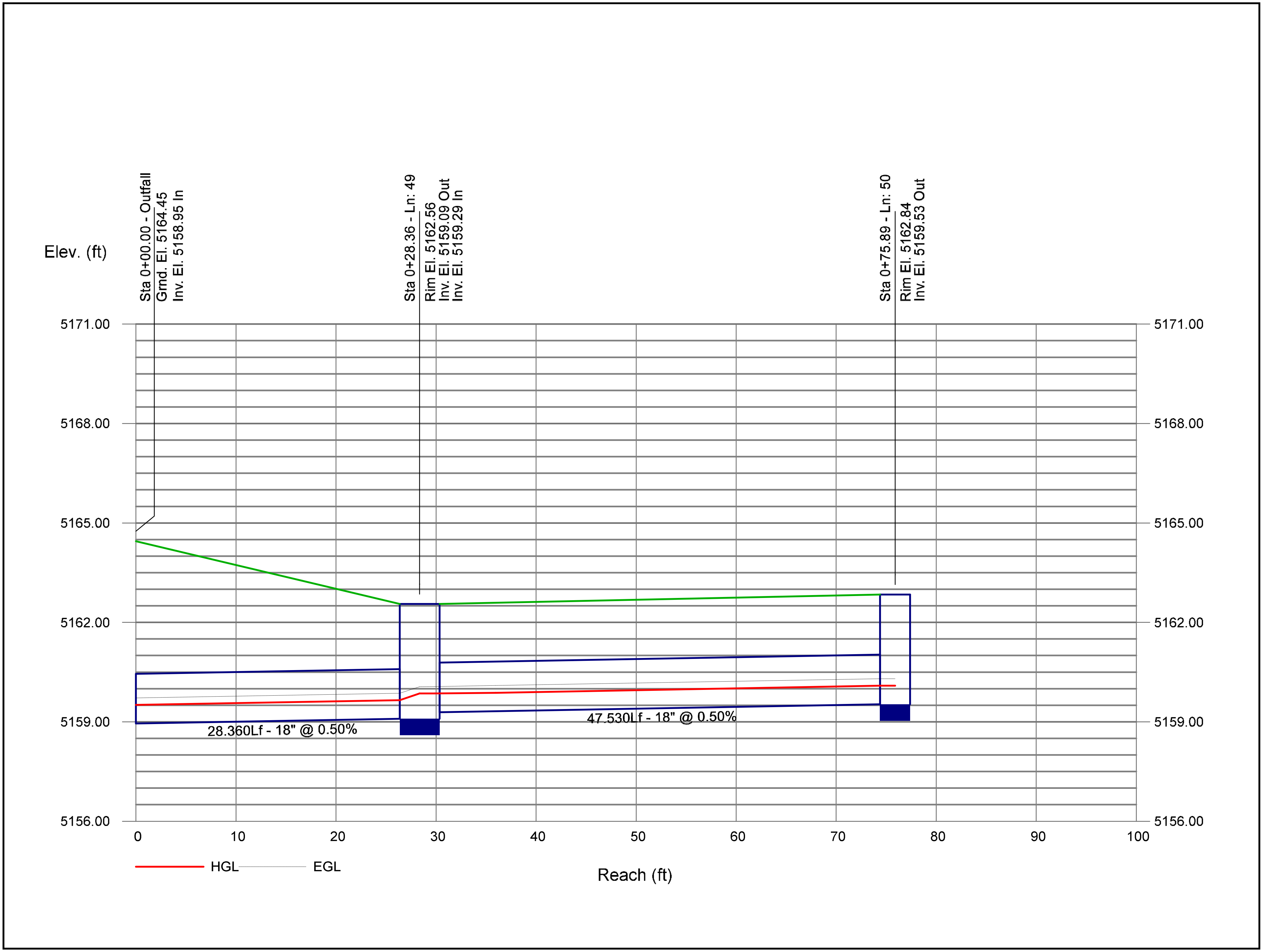


CustomRep

5165.0' > 5-YEAR DETENTION POND WSE (5164.88')

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
1	15	SDMH-48	48	48	158.752	0.92	39.00	137.76	8.10	5165.00	5163.54	5166.86	5165.00	5167.58	5165.72	0.013
2	100	SDMH-49	48	48	39.012	0.50	37.40	101.51	7.09	5165.40	5165.20	5167.22	5166.88	5167.92	5167.58	0.013
3	16	SDMH-05	48	48	31.950	0.50	35.00	101.55	6.95	5165.76	5165.60	5167.52	5167.22	5168.19	5167.89	0.013
4	35	SDMH-17	42	42	199.570	1.09	17.20	104.92	5.50	5168.43	5166.26	5169.70	5167.52	5170.16	5167.99	0.013
5	34	SDMH-16	42	42	70.430	0.84	12.60	92.11	5.05	5169.22	5168.63	5170.30	5169.70	5170.69	5170.09	0.013
6	33	SDMH-15	42	42	60.375	0.50	8.30	70.95	4.43	5169.72	5169.42	5170.59 j	5170.30	5170.90	5170.61	0.013
7	32	SDMH-14	42	42	165.993	1.00	8.30	100.61	5.39	5171.58	5169.92	5172.45	5170.60	5172.76	5170.91	0.013
8	31	SDMH-13	30	30	75.545	1.69	6.60	53.38	5.94	5173.86	5172.58	5174.71	5173.17	5175.02	5173.49	0.013
9	44	SDMH-22	24	24	92.610	1.85	5.00	30.76	5.78	5176.07	5174.36	5176.86	5174.91	5177.16	5175.20	0.013
10	63	SDMH-29	24	24	58.583	3.69	3.60	43.43	4.30	5178.43	5176.27	5179.09	5176.86	5179.34	5177.10	0.013
11	45	SDMH-23	24	24	43.133	2.99	3.60	39.12	5.23	5179.92	5178.63	5180.58	5179.09	5180.83	5179.34	0.013
12	46	SDI-24	24	24	7.557	1.06	3.60	23.28	4.66	5180.20	5180.12	5180.86	5180.65	5181.11	5180.89	0.013
13	47	SDI-28	24	24	114.334	0.50	1.60	15.97	3.02	5180.97	5180.40	5181.41 j	5180.86	5181.56	5181.02	0.013
14	105	SDI-50	24	24	83.121	0.51	0.80	16.08	2.64	5181.59	5181.17	5181.90	5181.47	5182.00	5181.58	0.013
15	17	SDMH-06	24	24	98.591	1.66	8.70	29.17	6.65	5169.40	5167.76	5170.45	5168.51	5170.87	5168.93	0.013
16	18	SDMH-07	24	24	177.835	0.50	5.10	16.00	4.19	5170.49	5169.60	5171.29	5170.45	5171.58	5170.75	0.013
17	19	SDMH-08	18	18	314.144	2.70	2.70	17.25	5.50	5179.57	5171.09	5180.19	5171.49	5180.43	5171.73	0.013
18	21	SDI-03	18	18	44.829	2.10	2.70	15.21	5.19	5180.71	5179.77	5181.33	5180.20	5181.57	5180.43	0.013
19	30	SDMH-12	18	18	122.391	1.37	1.60	12.30	4.07	5176.54	5174.86	5177.02	5175.23	5177.19	5175.40	0.013
20	43	SDI-14	18	18	27.776	0.50	1.60	7.45	3.35	5176.88	5176.74	5177.35	5177.21	5177.53	5177.39	0.013
21	49	SDI-11	18	18	27.777	0.50	1.40	7.46	2.69	5176.41	5176.27	5176.85	5176.86	5177.01	5177.02	0.013
22	36	SDMH-18	30	30	95.850	1.62	9.10	52.12	6.45	5168.81	5167.26	5169.81	5167.97	5170.19	5168.35	0.013
23	37	SDMH-19	24	24	50.043	1.16	4.50	24.39	5.07	5169.89	5169.31	5170.64	5169.89	5170.91	5170.17	0.013

Detention basin 100-year WSE was given as user input. However, in this particular case normal depth of pipe is higher than the 5-year WSEL in the detention basin. So the program defaults to using normal depth of pipe as tailwater as opposed to using the 5-year detention pond WSEL. This results in a more conservative HGL estimation. The user defined tailwater is never lower than the 5-year WSE at the pond

Project File: 1104_5YrHGL_SystemA.stm | Number of lines: 50 | Date: 11/24/2020

NOTES: ** Critical depth

CustomRep

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
24	38	SDMH-20	24	24	128.432	0.88	4.50	21.22	4.79	5171.22	5170.09	5171.97	5170.72	5172.24	5170.99	0.013
25	20	SDMH-09	24	24	128.432	0.74	4.50	19.45	4.63	5172.37	5171.42	5173.12	5172.07	5173.39	5172.35	0.013
26	39	SDMH-21	24	24	166.807	1.01	4.50	22.70	4.92	5174.25	5172.57	5175.00	5173.17	5175.27	5173.45	0.013
27	60	SDI-23	18	18	5.025	6.17	2.60	26.08	6.63	5175.06	5174.75	5175.67	5175.07	5175.90	5175.30	0.013
28	59	SDI-22	18	18	27.077	1.15	1.90	11.24	4.12	5175.06	5174.75	5175.58	5175.17	5175.77	5175.36	0.013
29	51	SDMH-25	24	24	92.610	0.59	4.30	17.32	4.37	5171.26	5170.72	5171.99	5171.40	5172.26	5171.67	0.013
30	52	SDMH-26	18	18	132.441	1.61	2.40	13.31	4.73	5173.89	5171.76	5174.48	5172.19	5174.70	5172.41	0.013
31	53	SDI-27	18	18	7.557	0.53	2.40	7.64	3.79	5174.13	5174.09	5174.72	5174.67	5174.94	5174.89	0.013
32	50	SDI-15	18	18	27.777	1.01	1.70	10.54	3.88	5173.86	5173.58	5174.35	5173.99	5174.53	5174.17	0.013
33	54	SDI-16	18	18	27.777	0.50	1.90	7.46	3.51	5171.90	5171.76	5172.42	5172.28	5172.61	5172.47	0.013
34	27	SDI-10	18	18	7.558	18.26	2.40	44.88	8.62	5172.47	5171.09	5173.06	5171.33	5173.28	5171.55	0.013
35	56	SDI-18	18	18	27.777	1.26	2.20	11.78	4.38	5170.78	5170.43	5171.34	5170.87	5171.55	5171.08	0.013
36	55	SDI-17	18	18	7.557	4.63	2.40	22.59	6.03	5170.78	5170.43	5171.37	5170.76	5171.59	5170.98	0.013
37	26	SDI-08	18	18	7.570	8.46	1.70	30.54	3.14	5170.54	5169.90	5171.03 j	5170.45	5171.21	5170.63	0.013
38	25	SDI-09	18	18	28.041	2.82	1.90	17.63	3.36	5170.69	5169.90	5171.21 j	5170.45	5171.40	5170.64	0.013
39	57	SDI-19	18	18	7.557	2.64	2.60	17.07	5.41	5170.01	5169.81	5170.62	5170.21	5170.85	5170.44	0.013
40	58	SDI-21	18	18	27.777	0.72	2.00	8.90	3.81	5170.01	5169.81	5170.54	5170.29	5170.74	5170.49	0.013
41	98	SDI-04	18	18	4.925	2.03	2.40	14.97	4.98	5168.00	5167.90	5168.59	5168.31	5168.81	5168.53	0.013
42	99	SDI-05	18	18	7.560	1.98	0.50	14.79	3.15	5167.64	5167.49	5167.90	5167.68	5167.99	5167.77	0.013
43	22	SDI-06	18	18	29.771	2.01	1.10	14.90	3.97	5168.09	5167.49	5168.48	5167.77	5168.62	5167.91	0.013
44	111	SDMH-54	24	24	62.559	0.50	3.90	15.92	1.24	5162.08	5161.77	5164.90	5164.88	5164.92	5164.90	0.013
45	110	SDI-20	24	24	54.820	0.51	3.90	16.16	1.24	5162.38	5162.10	5164.93	5164.92	5164.96	5164.94	0.013
46	02	SDI-01	24	24	59.634	0.50	2.30	16.04	0.73	5162.07	5161.77	5164.89	5164.88	5164.90	5164.89	0.013

Project File: 1104_5YrHGL_SystemA.stm | Number of lines: 50 | Date: 11/24/2020

NOTES: ** Critical depth

In this case the detention basin 5-year WSEL is higher than the normal depth of the pipe. So the program honors the user defined detention basin 5-yr tailwater elevation

5-YEAR DETENTION POND WSE (5164.88')

CustomRep

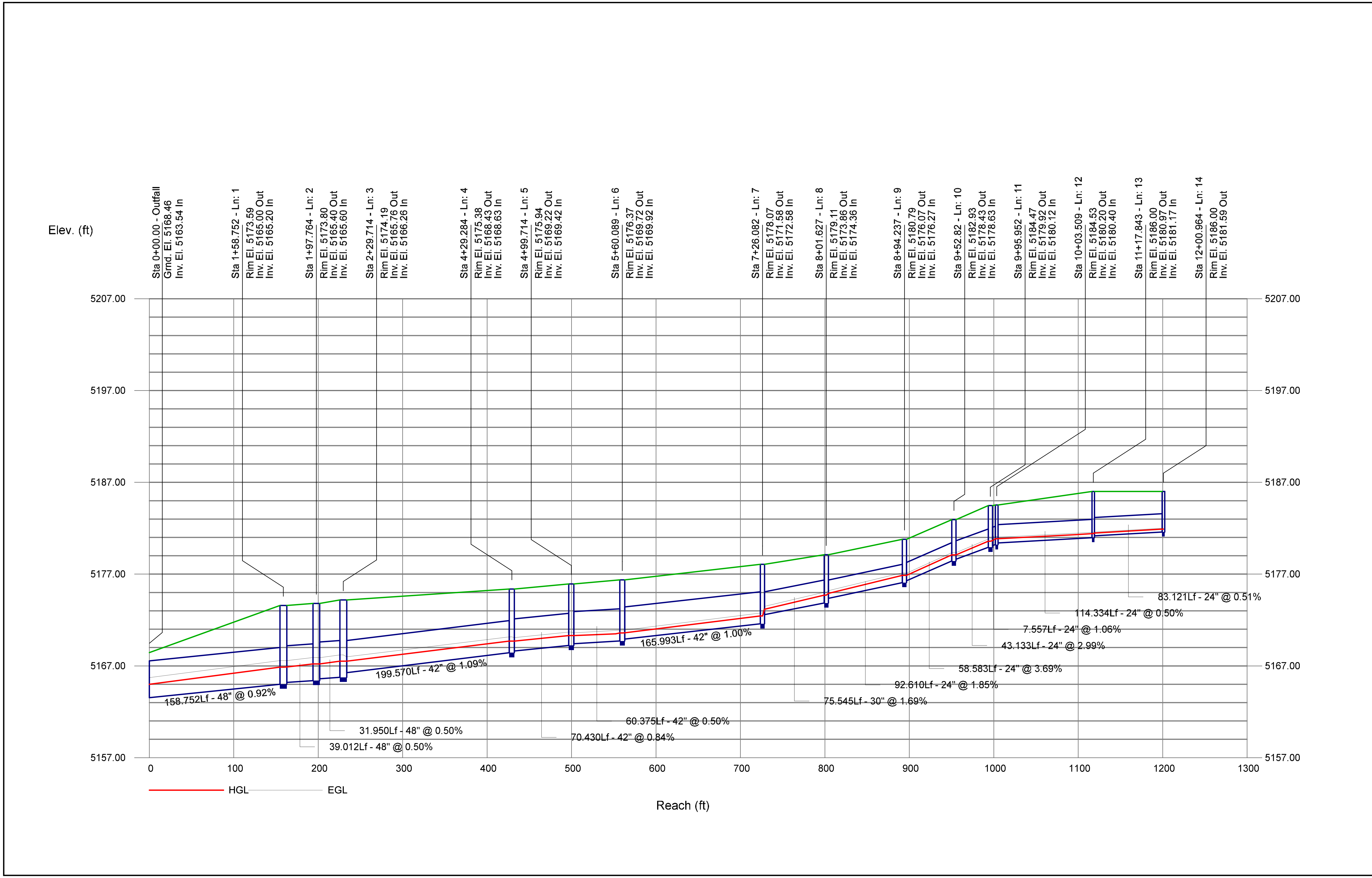
Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
47	04	SDI-02	24	24	38.334	0.50	1.10	15.92	0.35	5162.28	5162.09	5164.89	5164.89	5164.89	5164.89	0.013
48	01	POND OUTFALL-1	48	48	45.588	0.48	13.70	99.73	5.27	5159.94	5159.72	5161.02	5160.72	5161.41	5161.11	0.013
49	106	SDMH-47	18	18	28.360	0.50	0.90	7.42	1.84	5159.09	5158.95	5159.52	5159.51	5159.59	5159.54	0.013
50	94	SDI-49	18	18	47.530	0.50	0.90	7.46	2.84	5159.53	5159.29	5159.88	5159.64	5160.01	5159.77	0.013

Project File: 1104_5YrHGL_SystemA.stm	Number of lines: 50	Date: 11/24/2020

NOTES: ** Critical depth

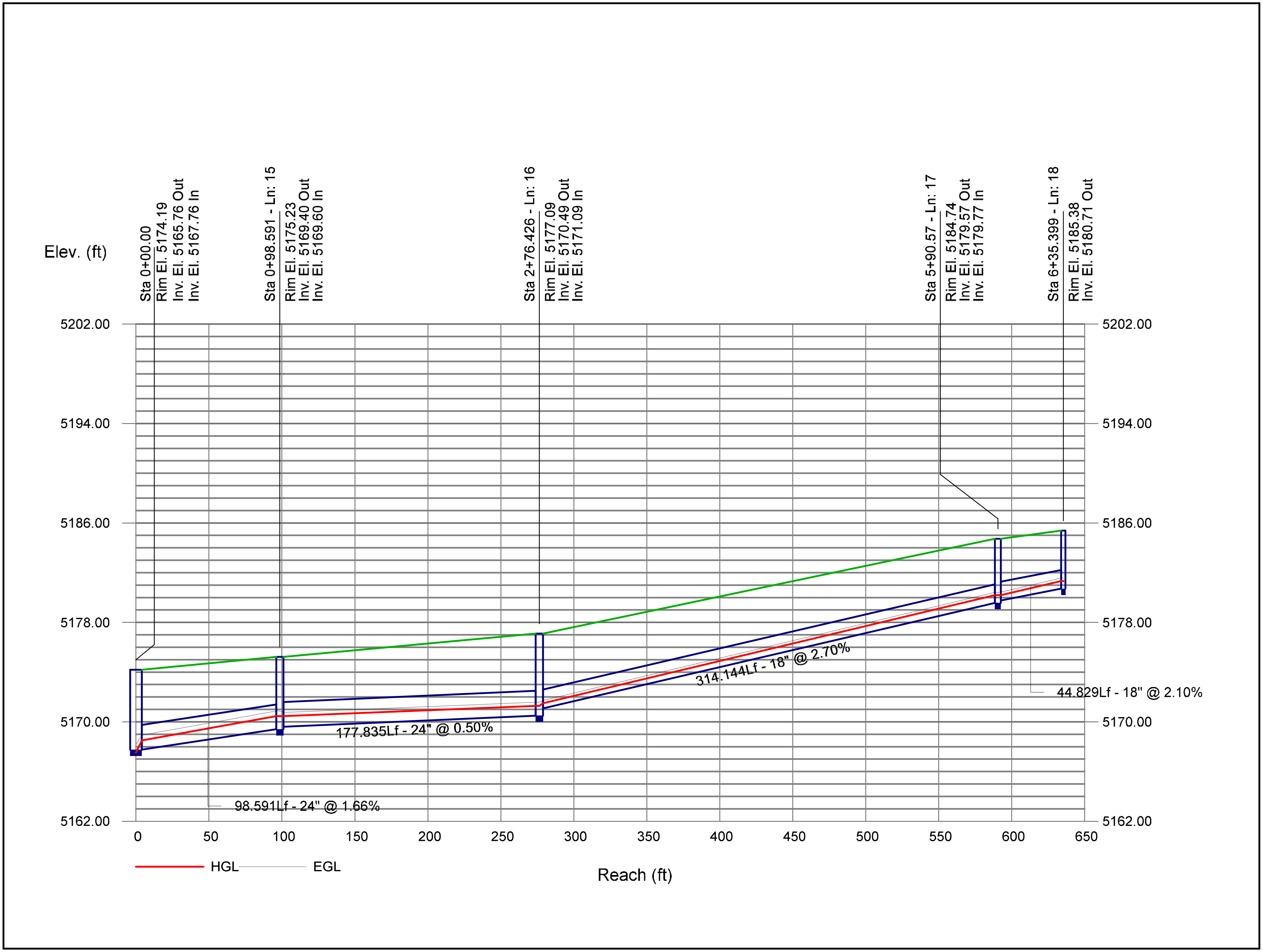
Storm Sewer Profile

Proj. file 1104_5YrHGL_SystemA.stm



Storm Sewer Profile

Proj. file: 1104_5YrHGL_SystemA.stm



Storm Sewer Profile

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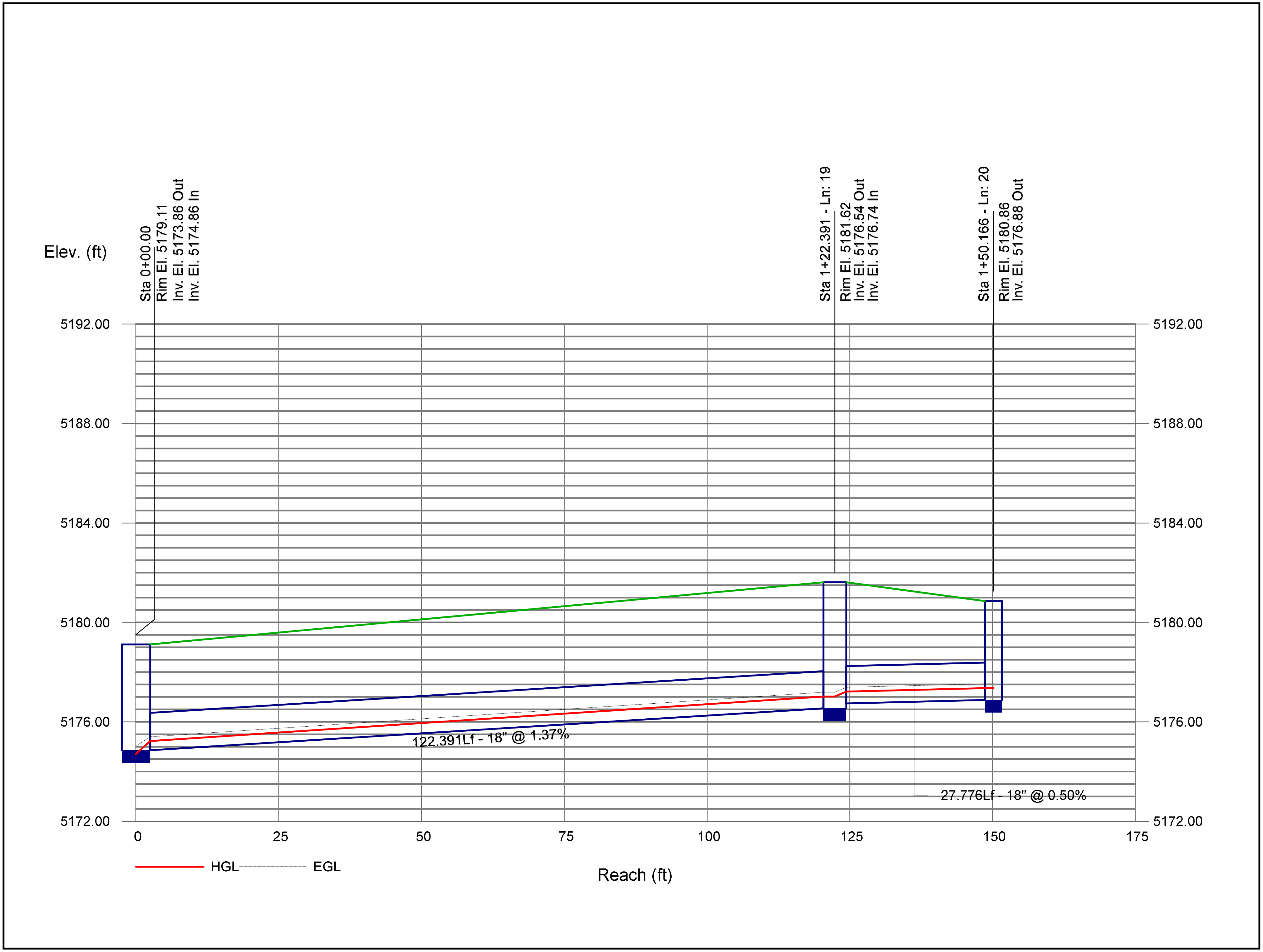

Storm Sewer Profile

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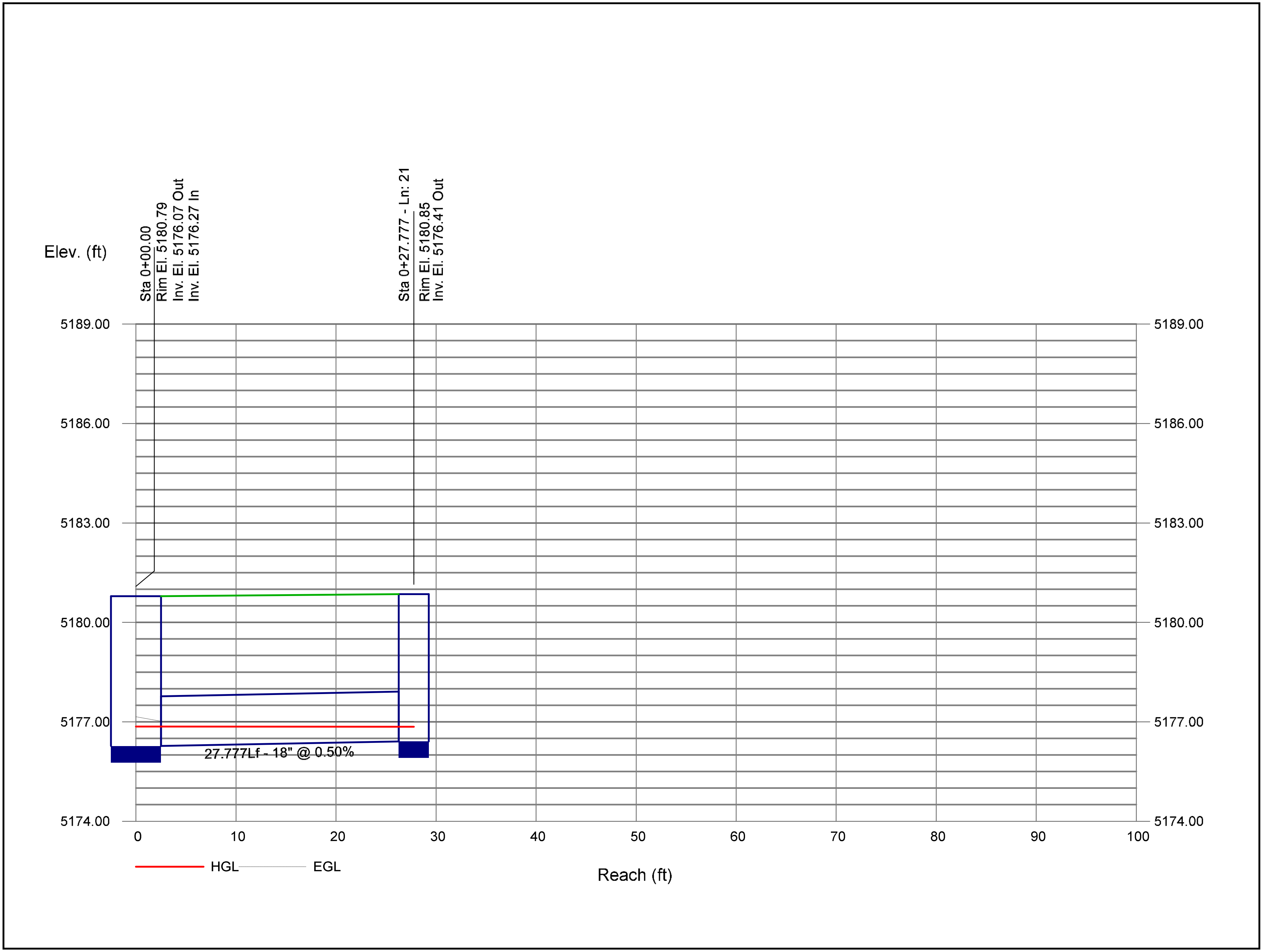

Storm Sewer Profile

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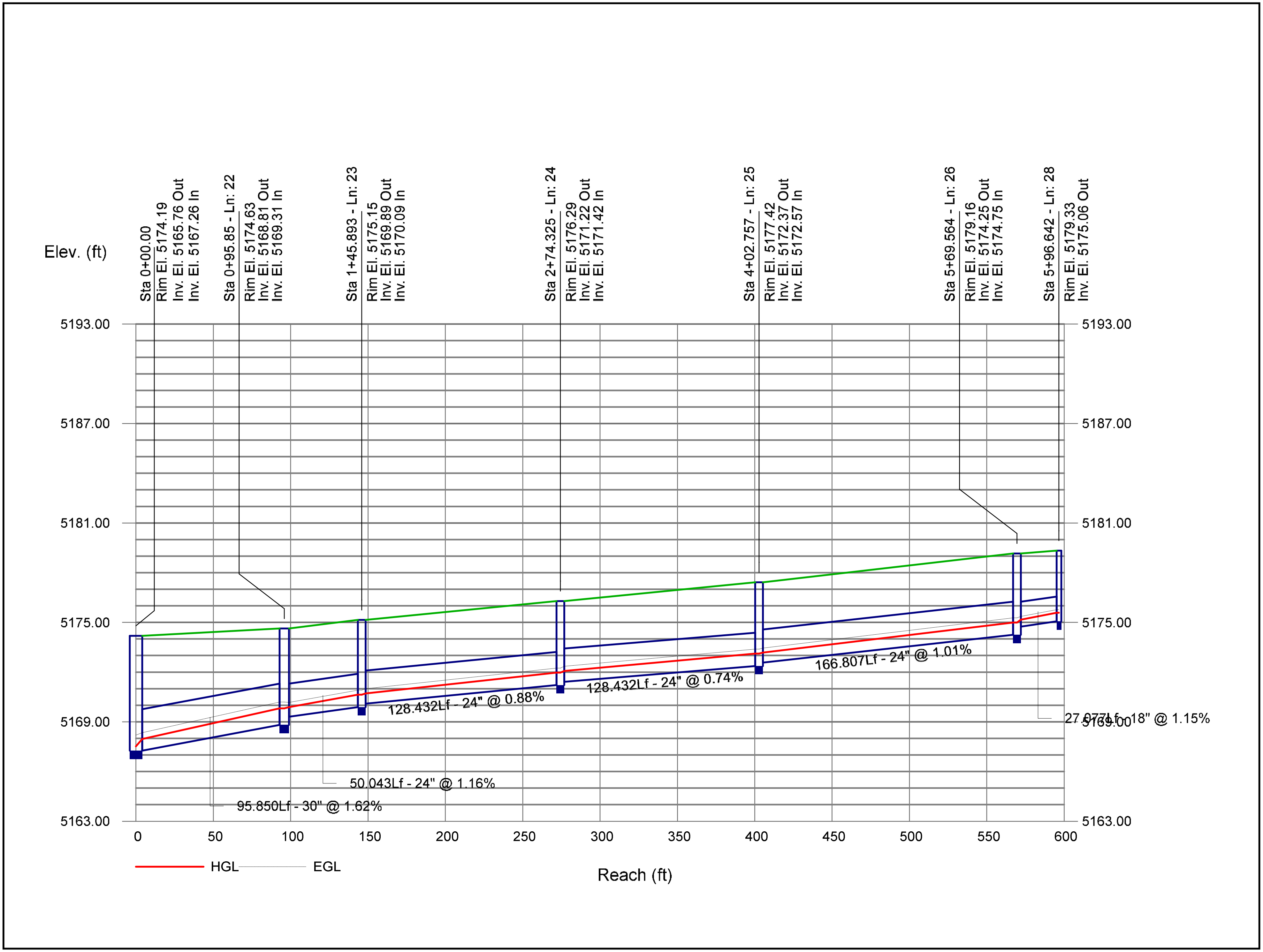

Storm Sewers

Storm Sewer Profile

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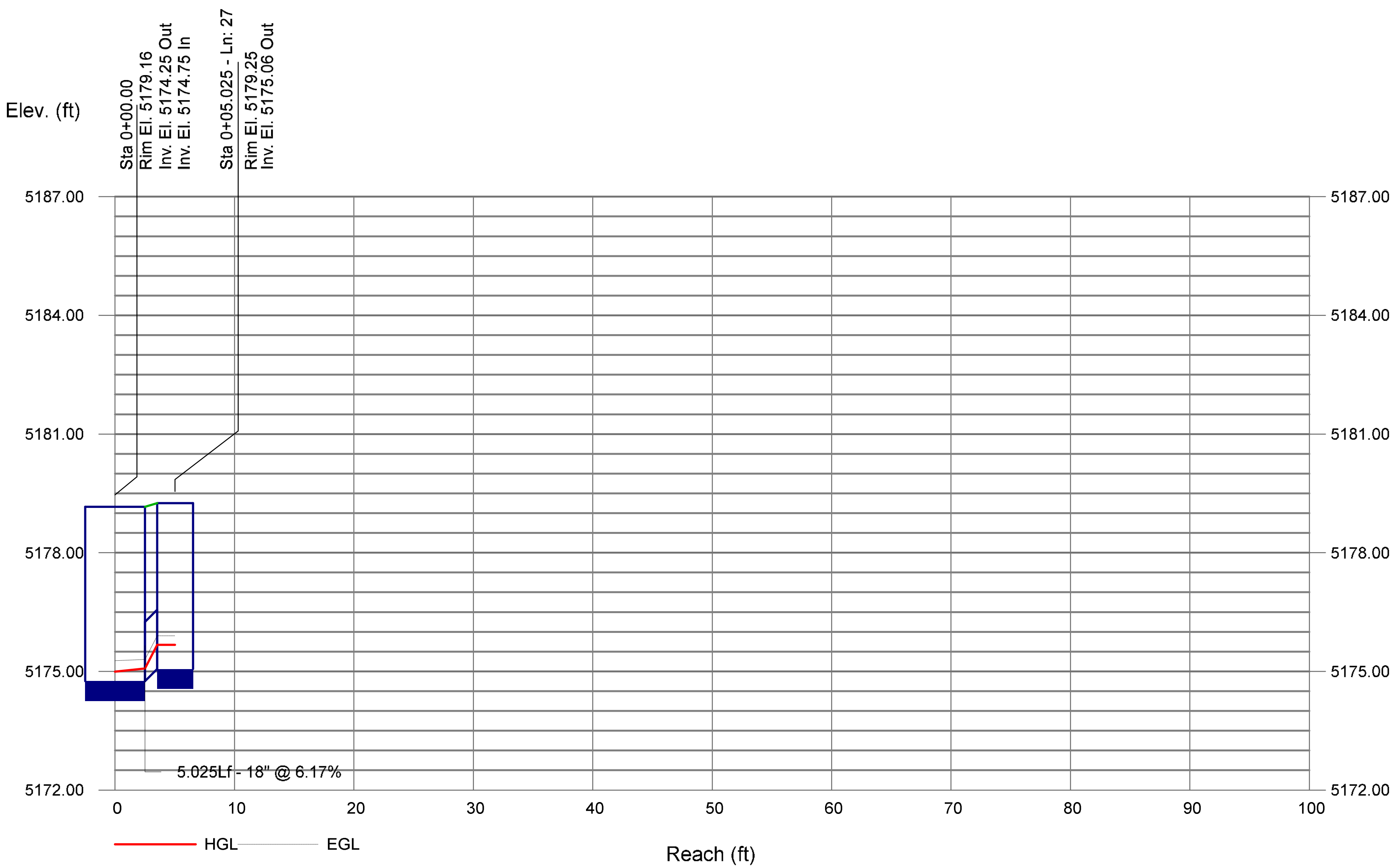
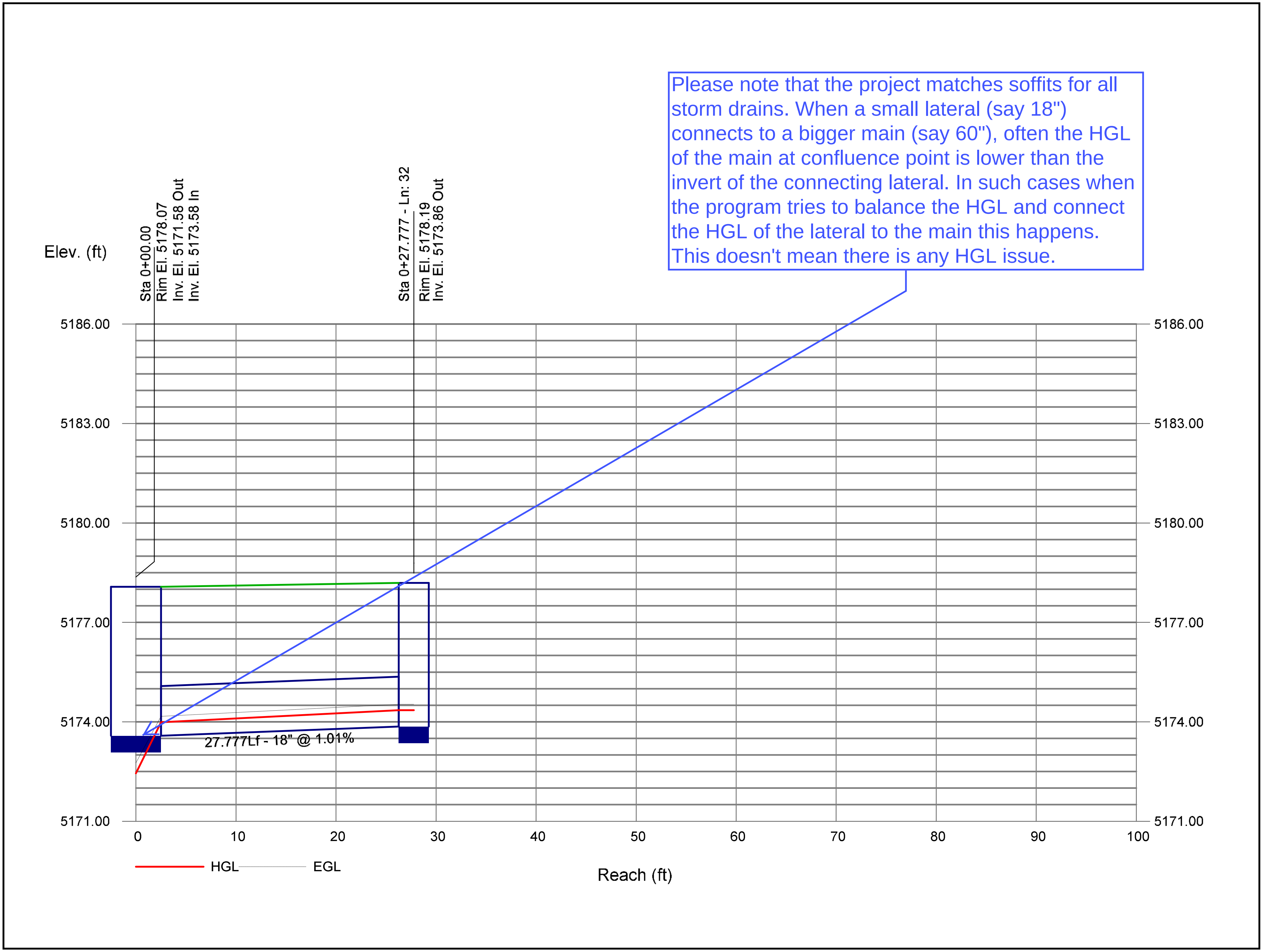


Storm Sewer Profile



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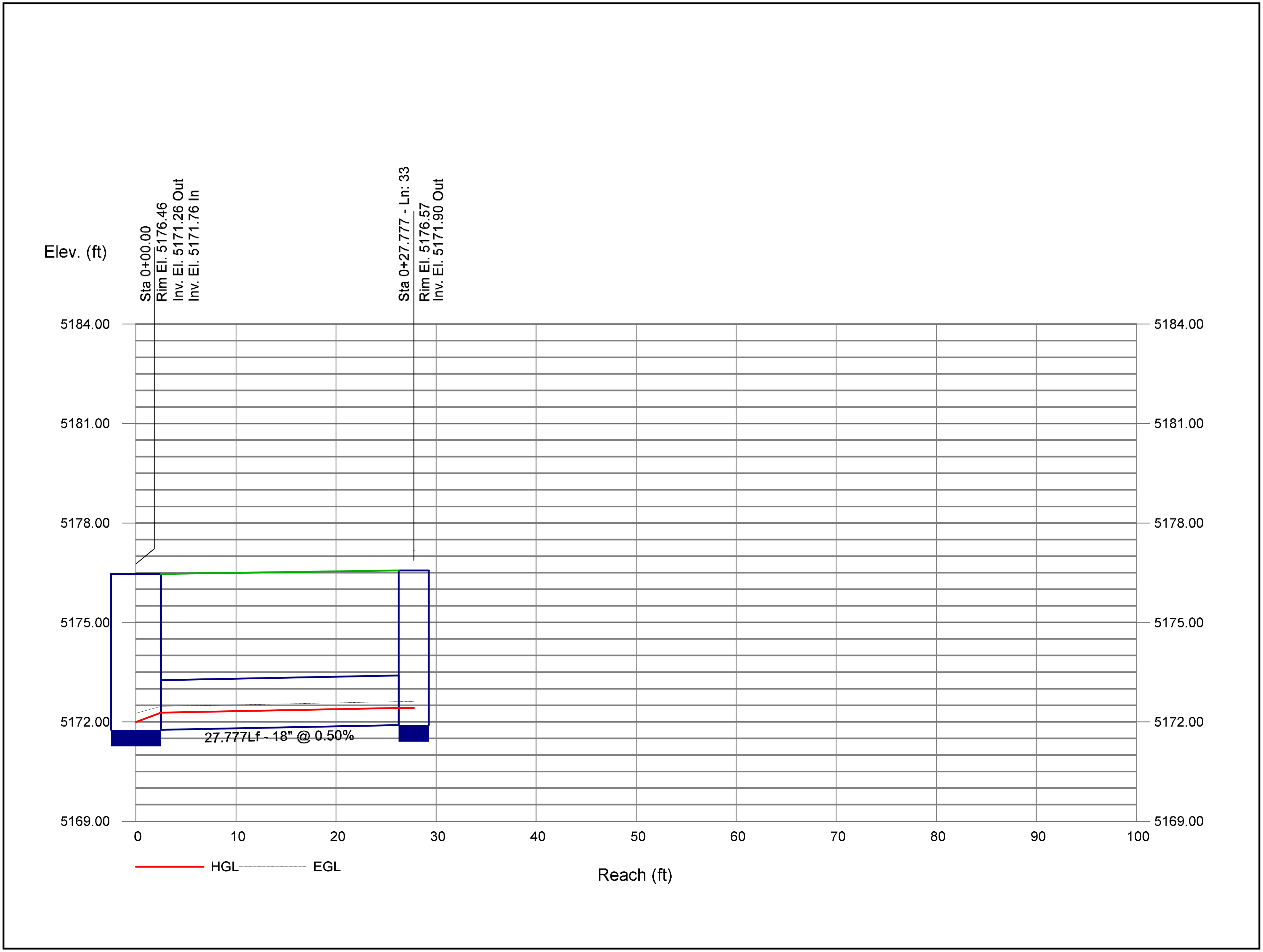

Storm Sewers

Storm Sewer Profile

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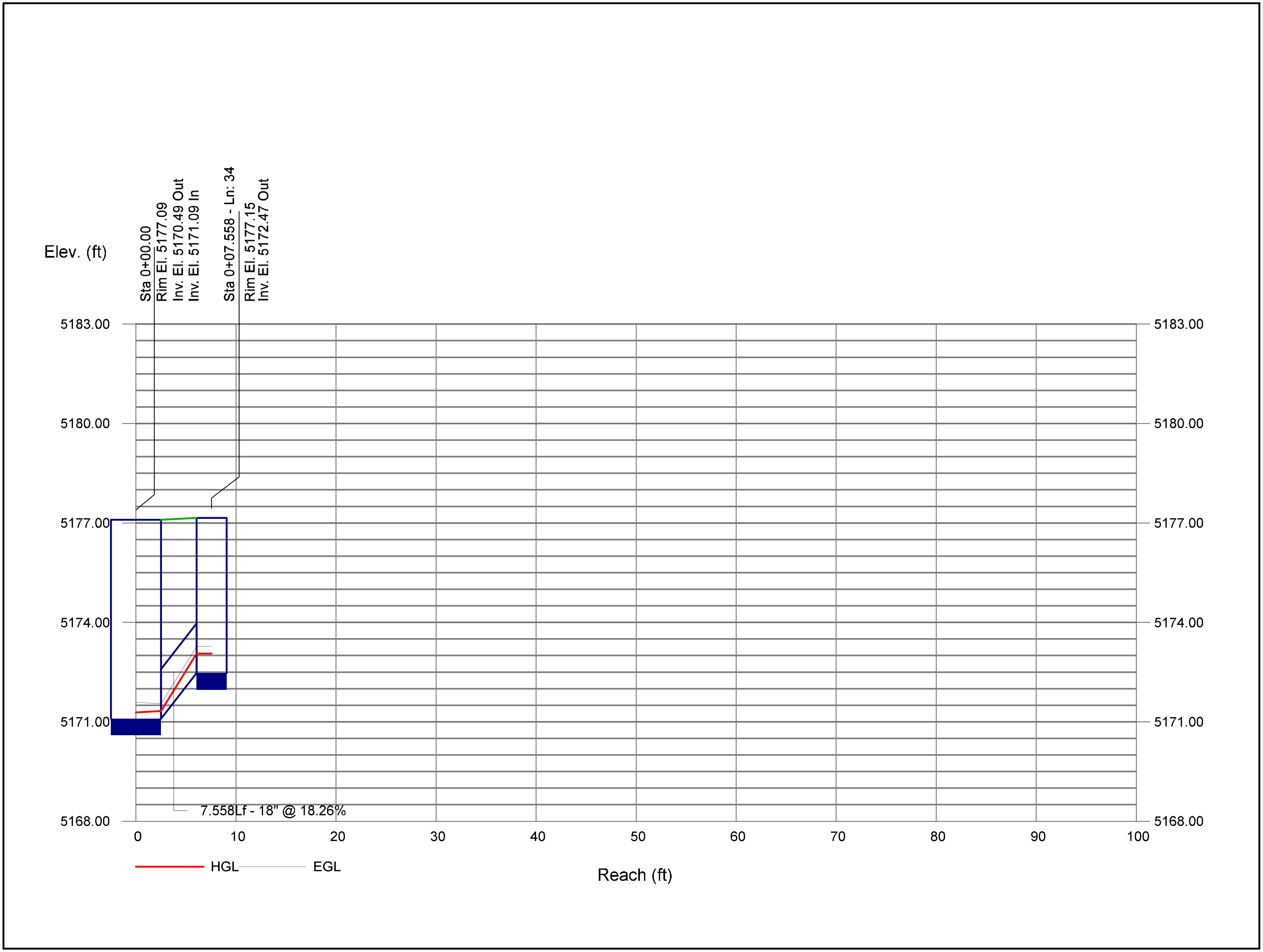

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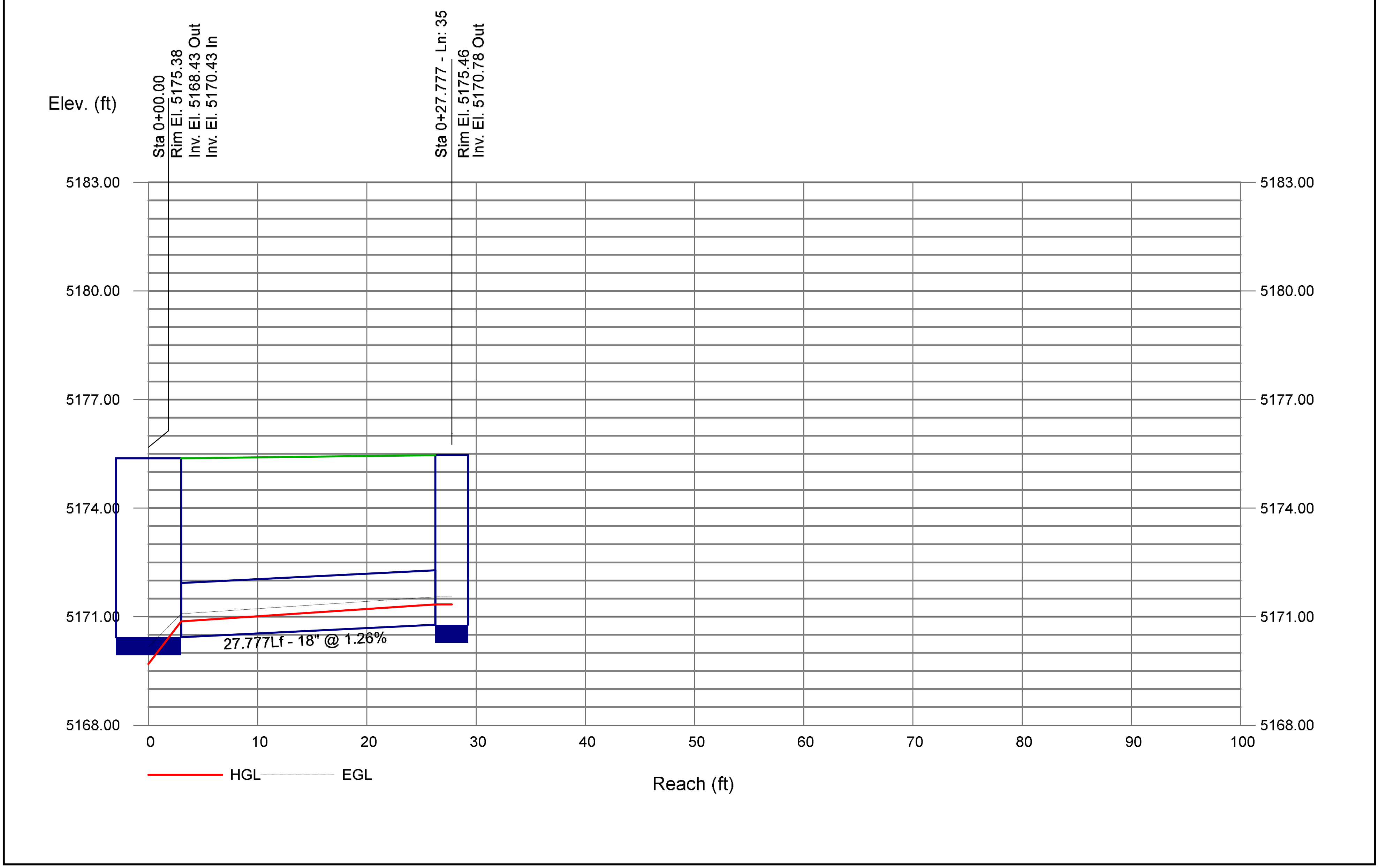

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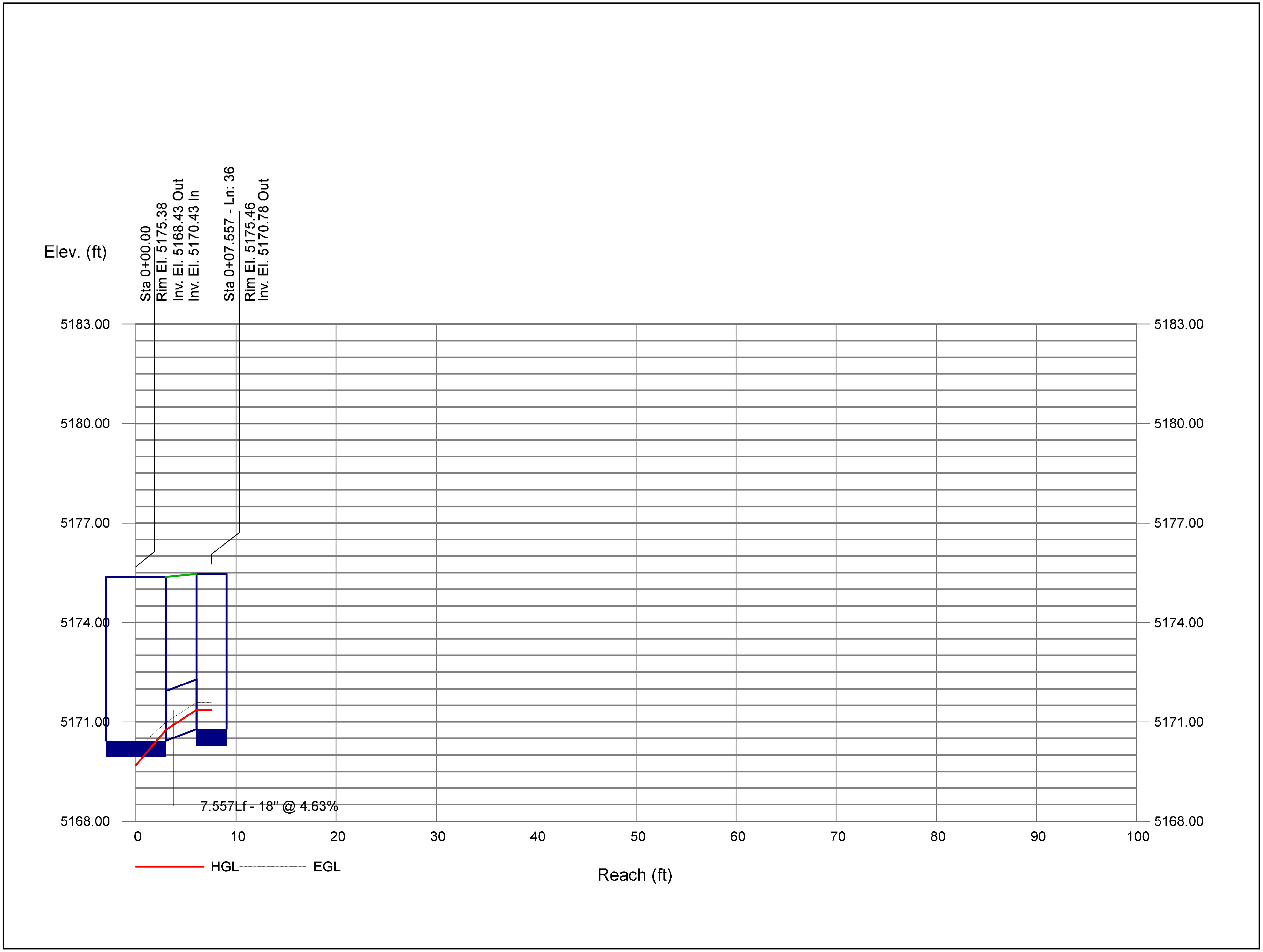

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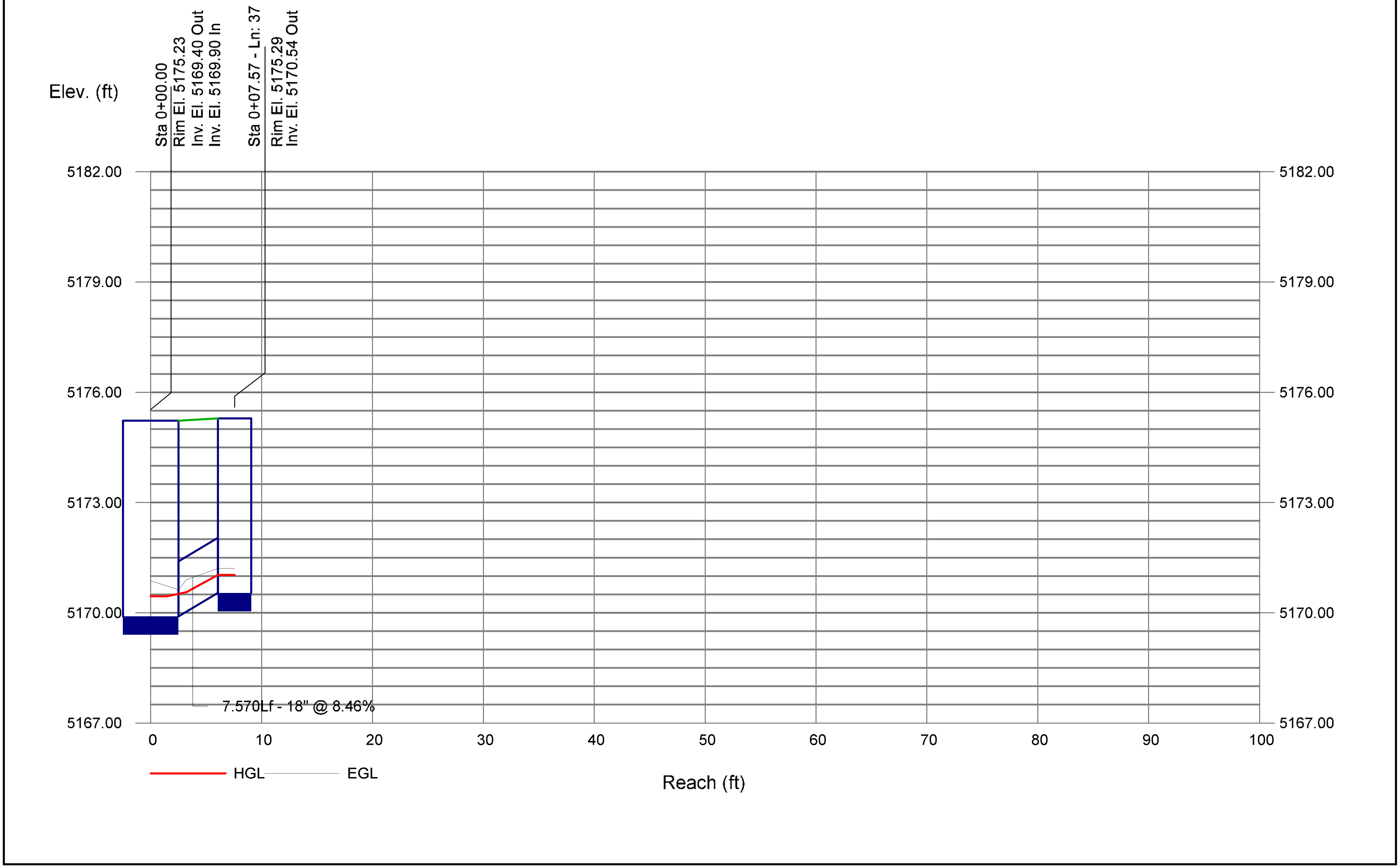

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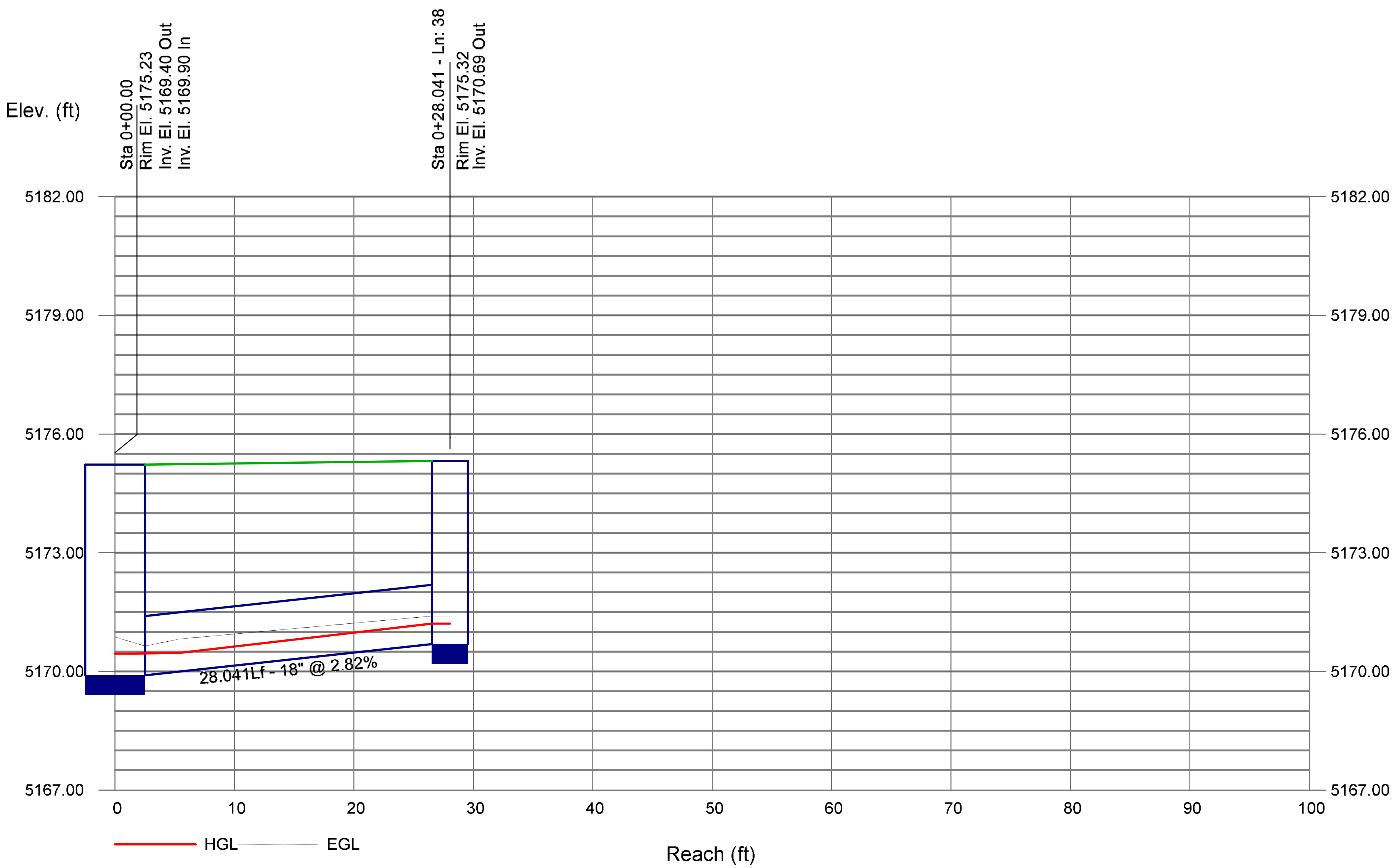

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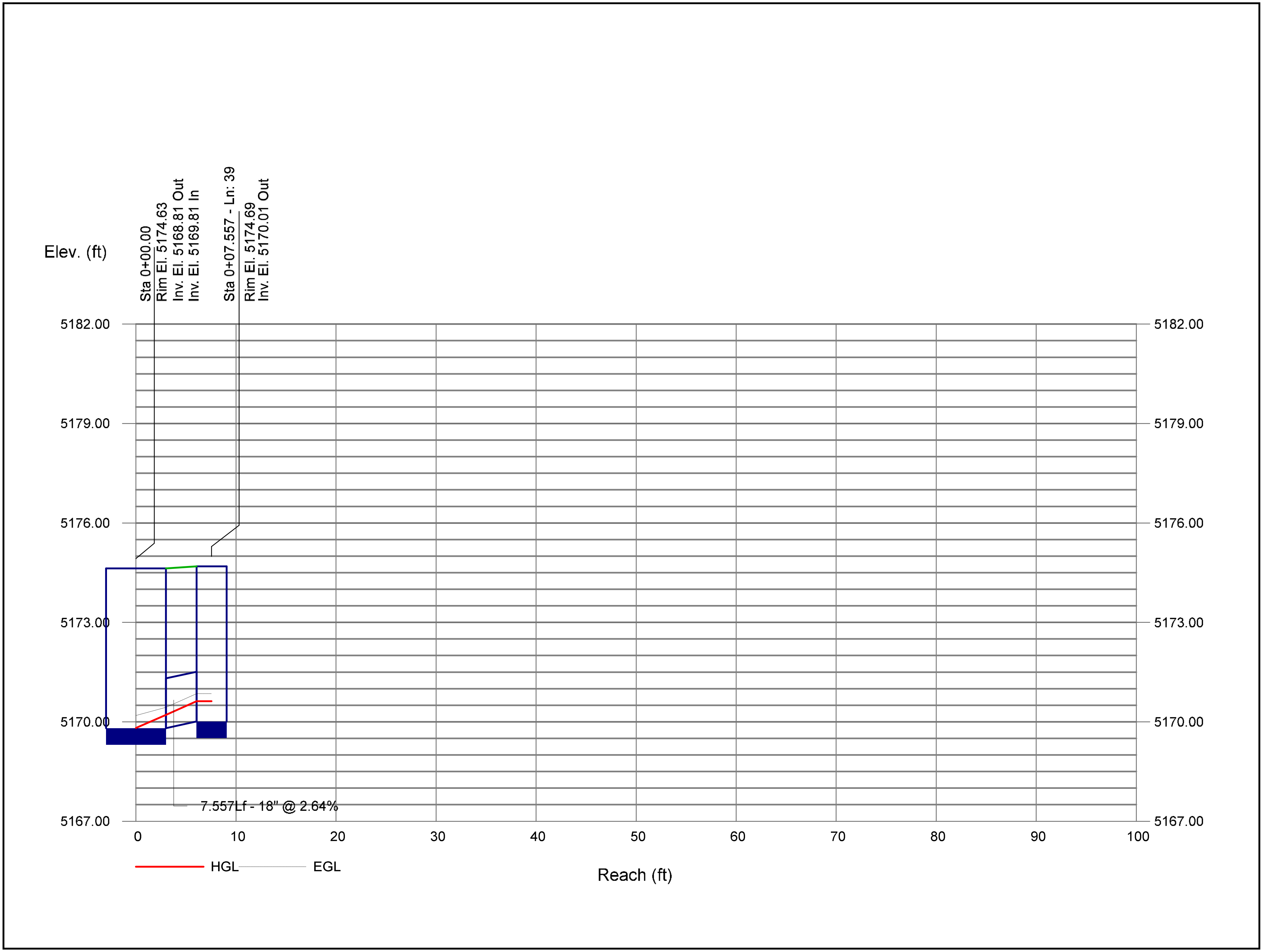

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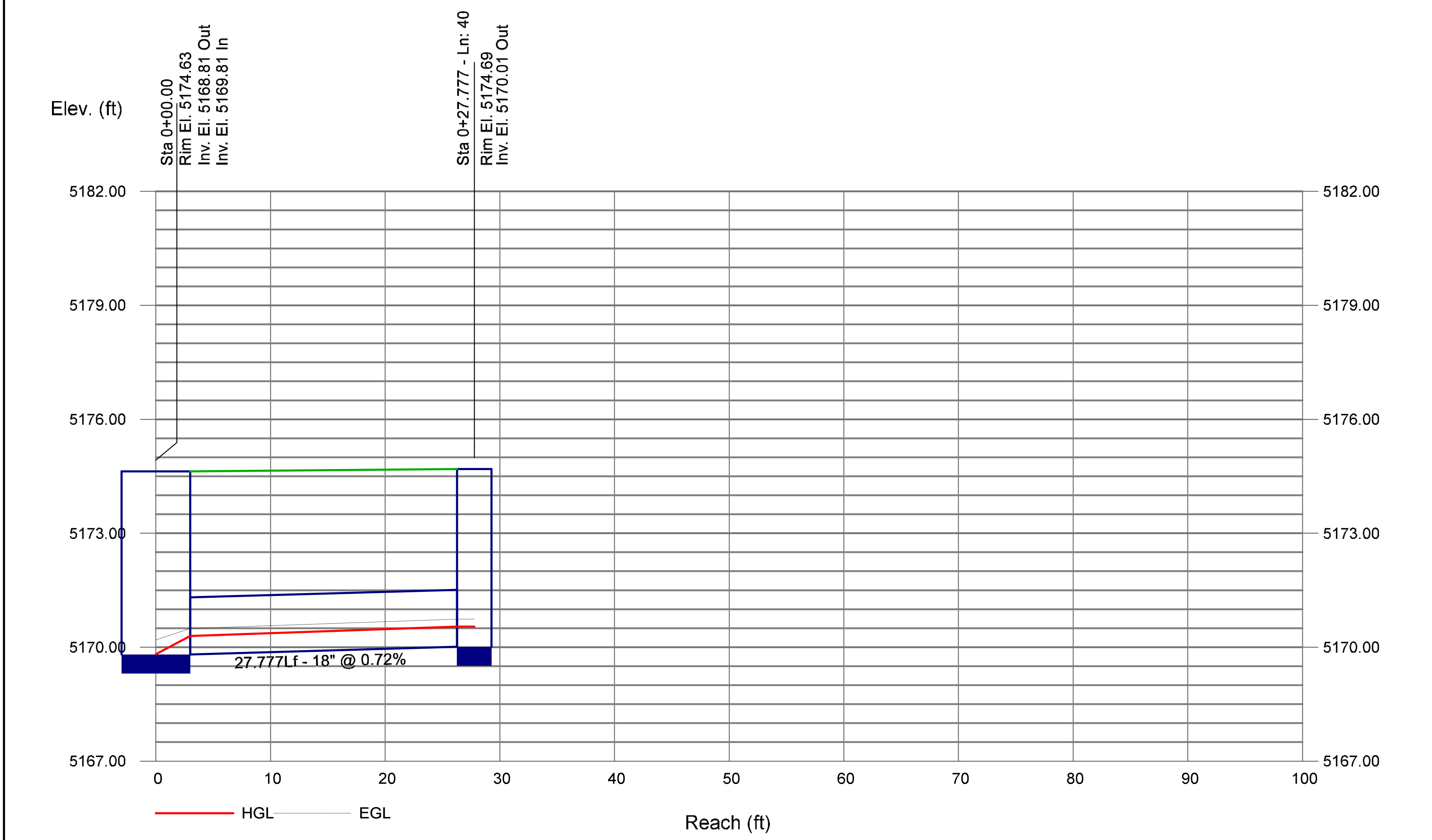
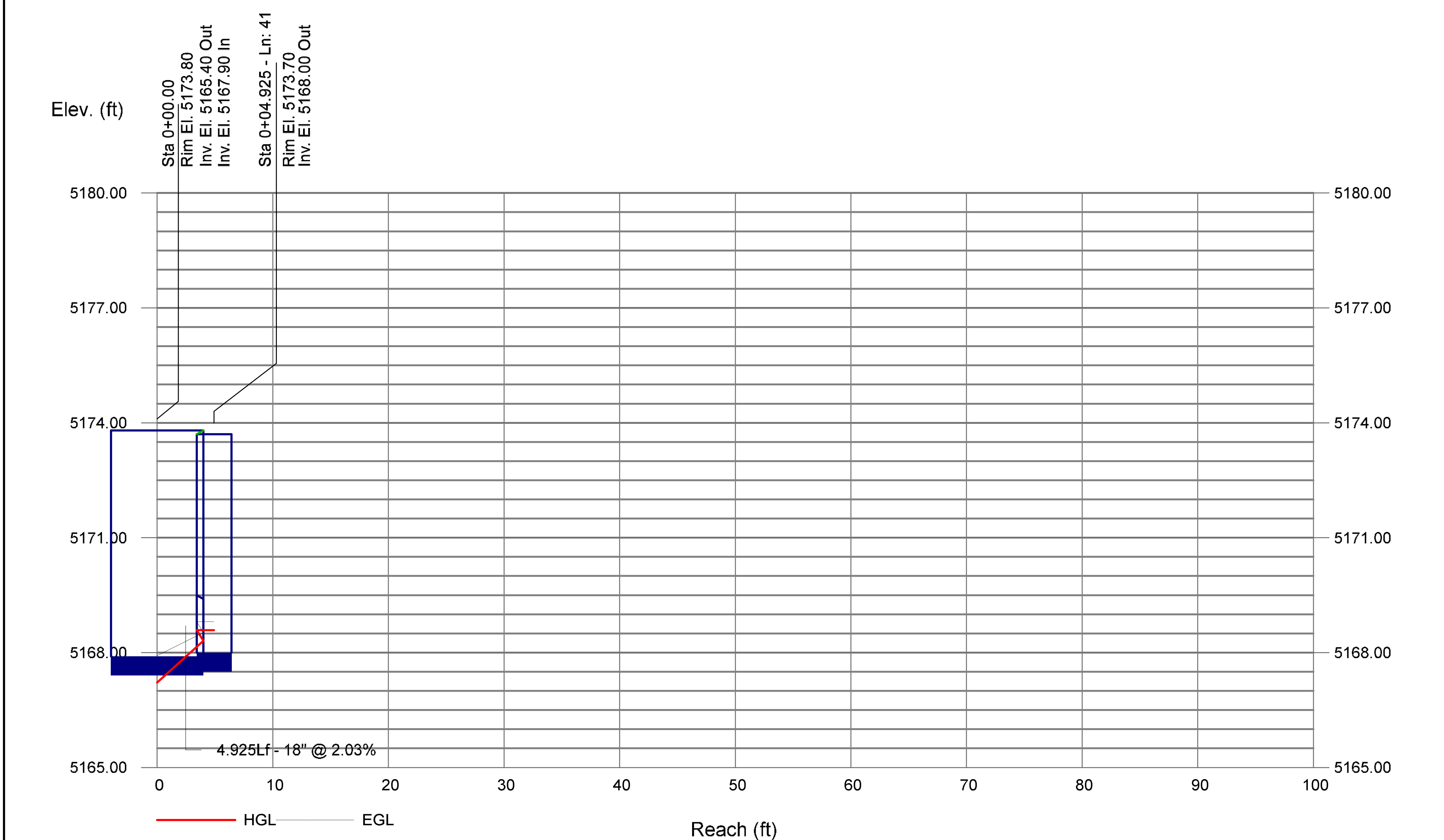


Storm Sewers

Storm Sewer Profile

Proj. file: 1104_5YrHGL_SystemA.stm



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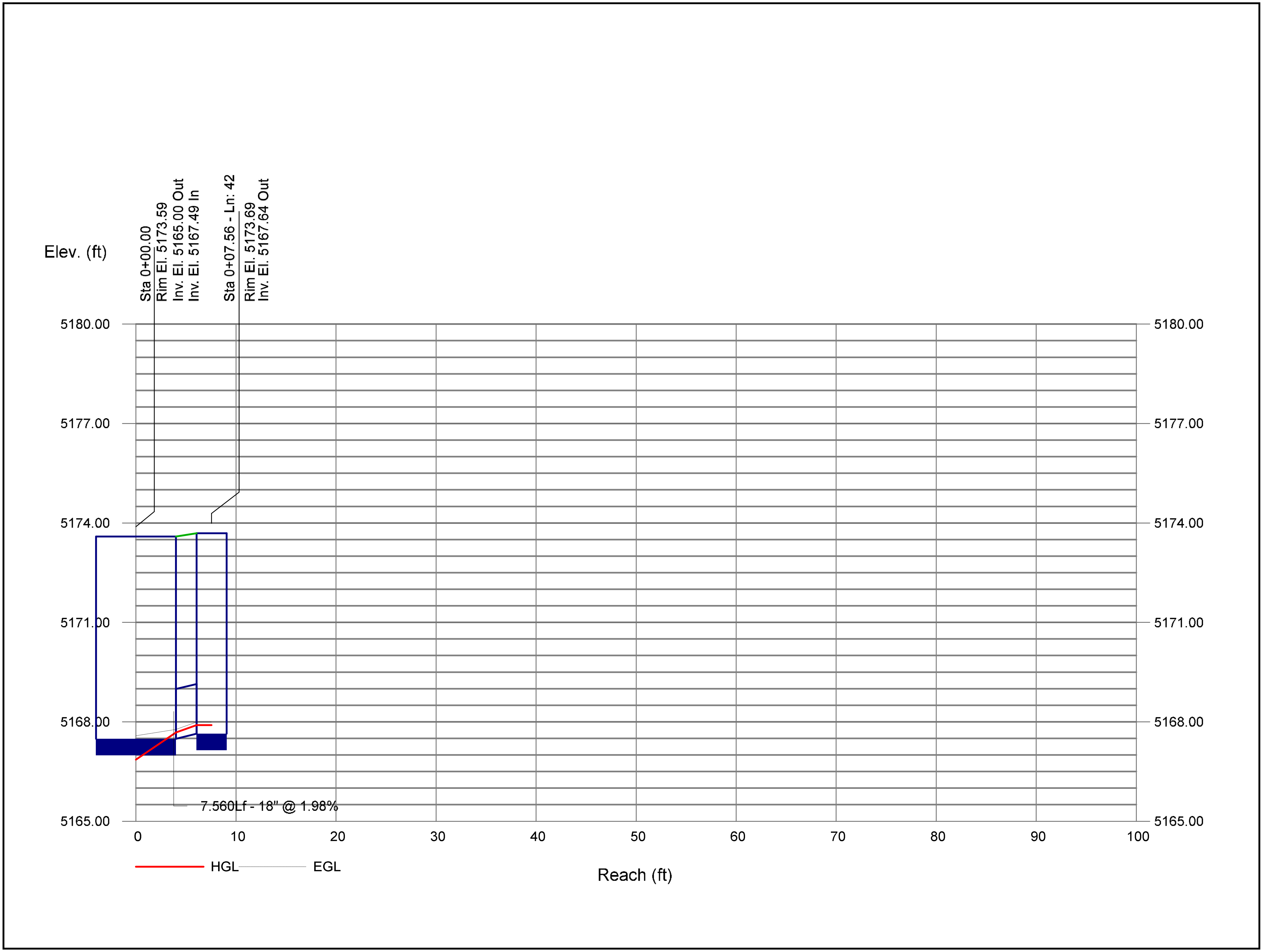

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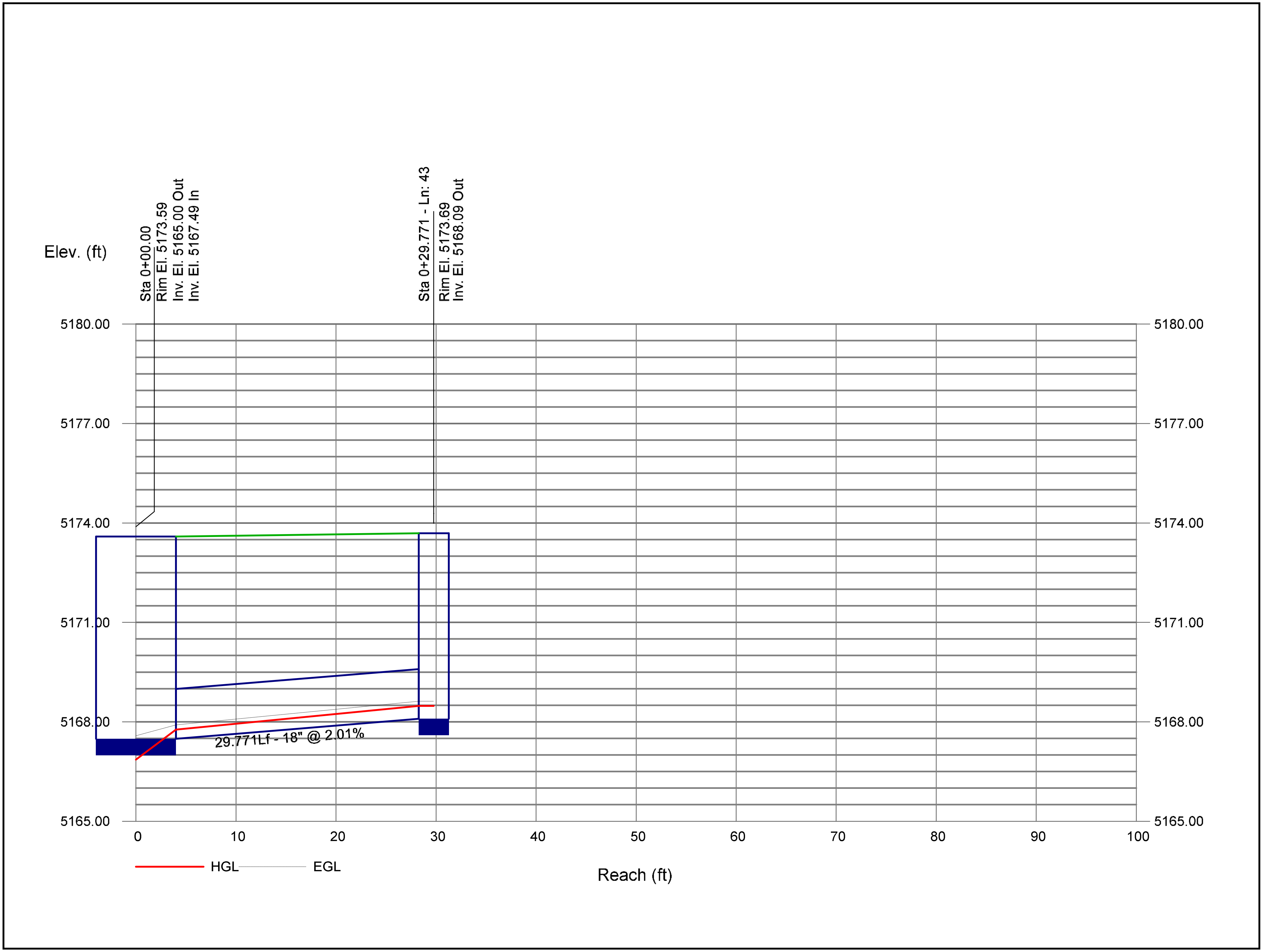

Storm Sewer Profile

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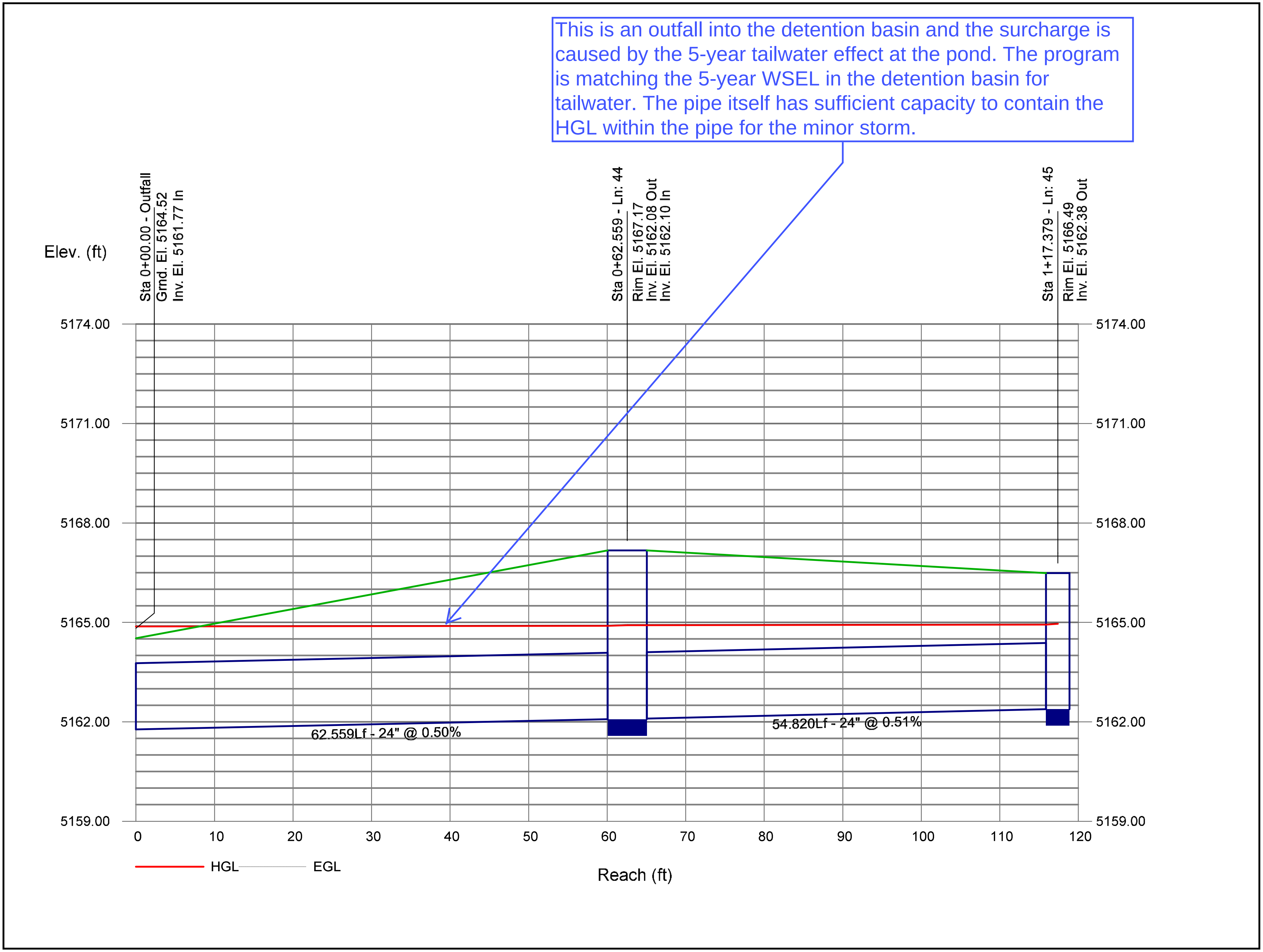

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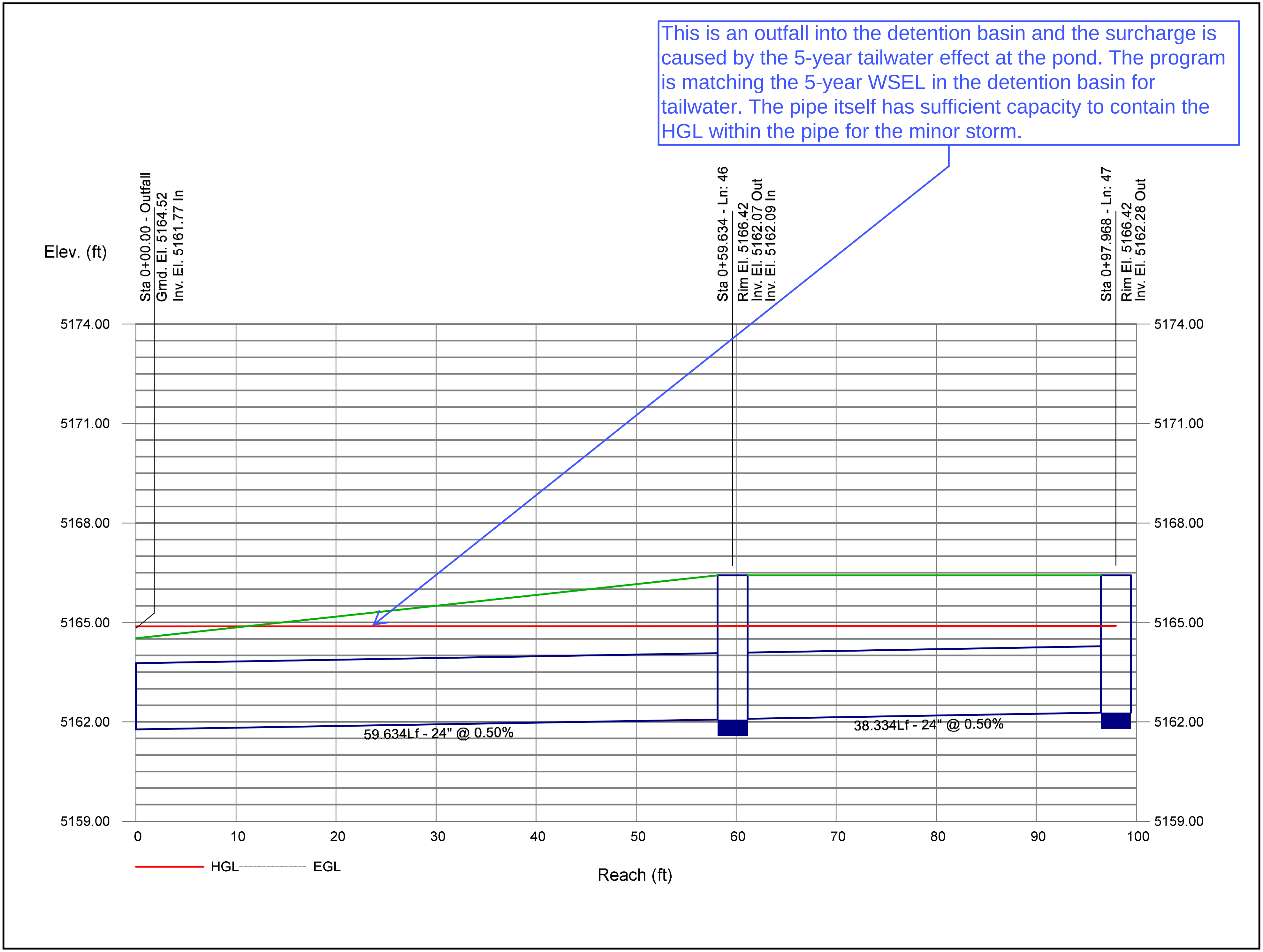

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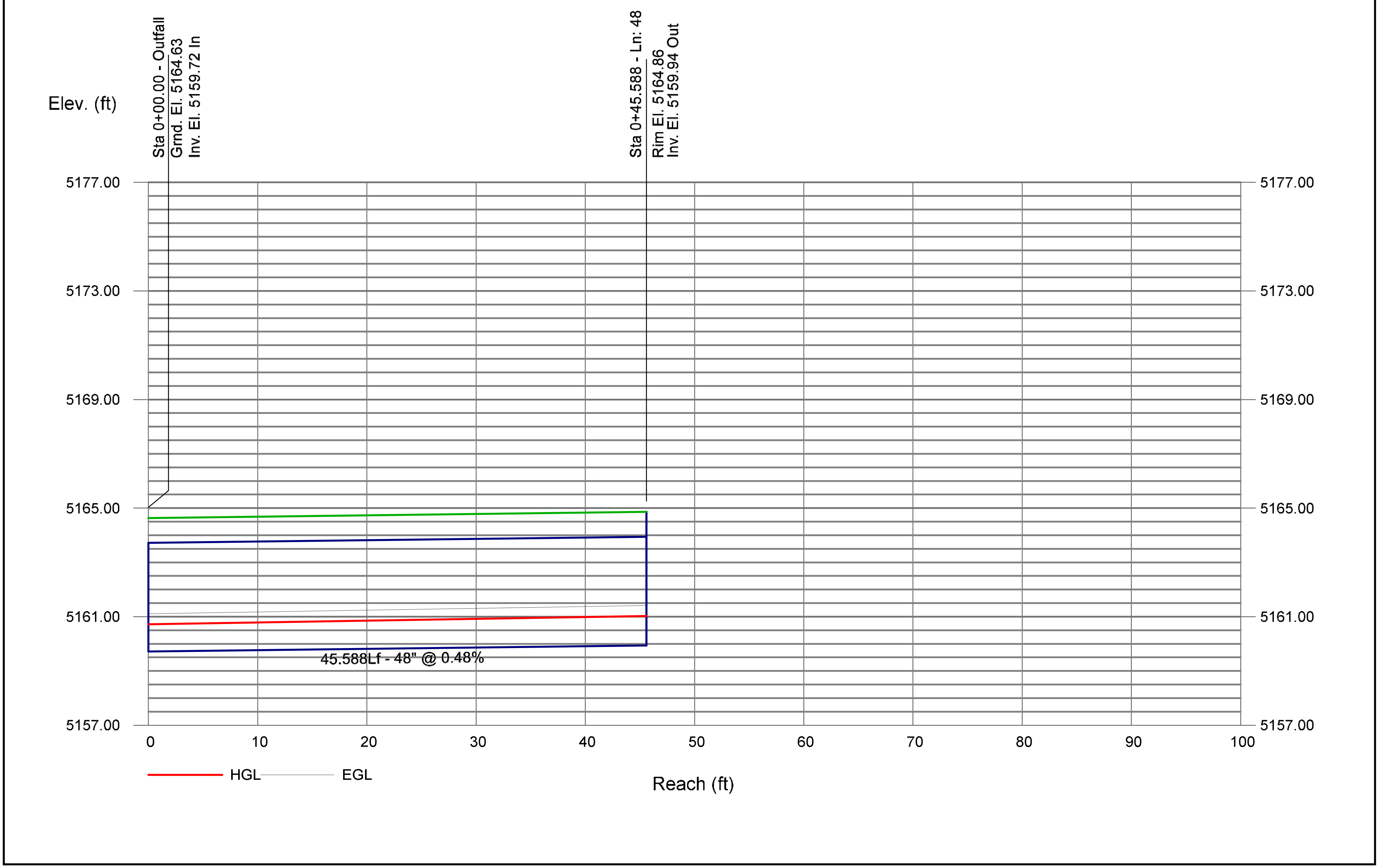

Storm Sewer Profile

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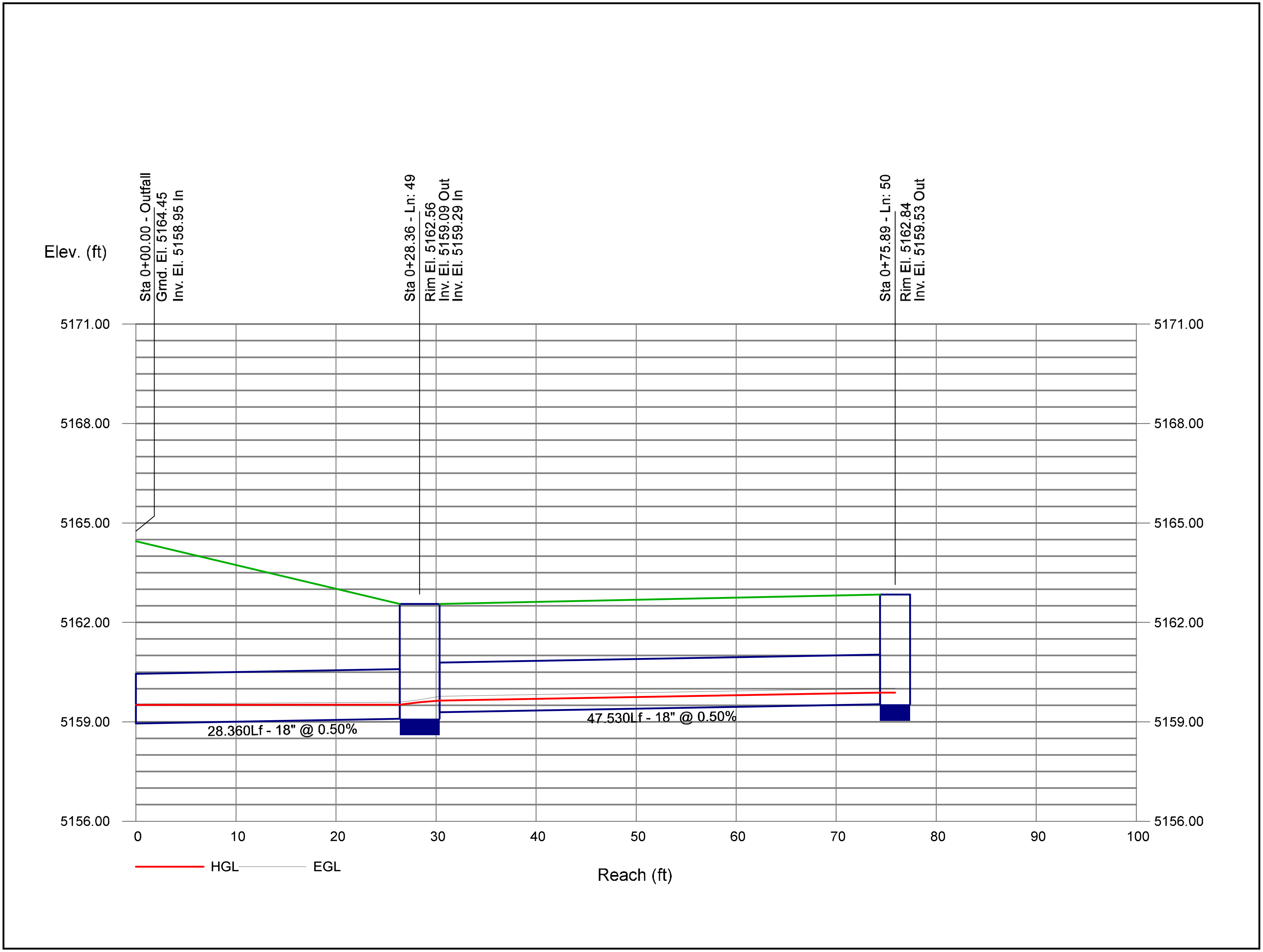
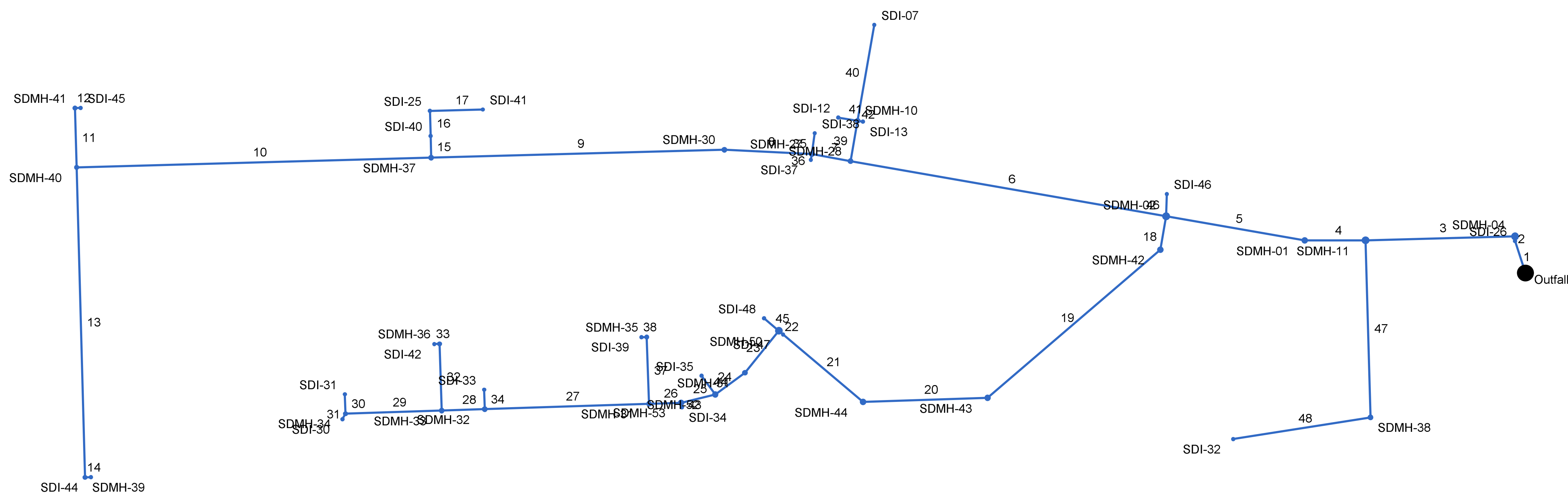


Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan

System B



Project File: 1104_100YrHGL_SystemB.stm	Number of lines: 48	Date: 11/25/2020

CustomRep

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
1	06	SDI-26	48	48	47.782	0.52	115.10	103.90	10.21	5163.79	5163.54	5167.30	5166.77	5168.81	5168.51	0.013
2	05	SDMH-04	48	48	6.807	0.49	109.60	101.06	8.72	5164.03	5163.99	5168.03	5167.99	5169.21	5169.18	0.013
3	07	SDMH-11	48	48	212.793	0.50	109.60	101.90	8.72	5165.30	5164.23	5170.45	5169.21	5171.63	5170.39	0.013
4	23	SDMH-01	48	48	86.410	0.51	93.20	102.72	7.42	5165.94	5165.50	5172.00	5171.63	5172.85	5172.49	0.013
5	08	SDMH-02	48	48	200.356	0.50	93.20	101.48	7.42	5167.14	5166.14	5173.02	5172.18	5173.88	5173.03	0.013
6	62	SDMH-28	30	30	455.773	1.72	35.40	53.79	7.78	5176.48	5168.64	5178.50 j	5173.88	5179.58	5174.69	0.013
7	61	SDMH-27	24	24	55.930	1.82	25.20	30.54	9.22	5178.00	5176.98	5179.77	5178.50	5180.91	5179.64	0.013
8	64	SDMH-30	24	24	124.481	1.90	18.80	31.21	7.14	5180.57	5178.20	5182.13 j	5179.77	5182.93	5180.56	0.013
9	79	SDMH-37	24	24	417.527	1.48	18.80	27.49	7.71	5186.94	5180.77	5188.50	5182.13	5189.30	5182.93	0.013
10	84	SDMH-40	18	18	504.580	1.03	6.60	10.64	5.13	5192.62	5187.44	5193.61 j	5188.50	5194.05	5188.94	0.013
11	87	SDMH-41	18	18	84.417	5.95	2.60	25.61	3.29	5197.84	5192.82	5198.45 j	5193.61	5198.68	5193.84	0.013
12	88	SDI-45	18	18	8.040	1.99	2.60	14.82	5.07	5198.20	5198.04	5198.81	5198.47	5199.04	5198.70	0.013
13	85	SDMH-39	18	18	441.637	0.57	4.00	7.96	4.32	5195.36	5192.82	5196.12 j	5193.61	5196.43	5193.92	0.013
14	86	SDI-44	18	18	8.378	0.48	4.00	7.26	4.21	5195.60	5195.56	5196.40	5196.36	5196.67	5196.63	0.013
15	80	SDI-40	24	24	30.917	1.03	12.20	23.00	5.62	5187.46	5187.14	5188.71 j	5188.50	5189.25	5189.04	0.013
16	81	SDI-25	24	24	35.763	0.50	9.90	16.05	5.38	5187.83	5187.65	5188.97 j	5188.79	5189.42	5189.24	0.013
17	82	SDI-41	24	24	75.390	0.50	1.50	16.07	1.87	5188.41	5188.03	5188.83	5189.42	5188.98	5189.56	0.013
18	09	SDMH-42	42	42	48.366	0.54	53.60	73.73	5.57	5167.90	5167.64	5174.01	5173.88	5174.50	5174.36	0.013
19	10	SDMH-43	42	42	323.702	0.50	53.60	71.18	5.57	5169.72	5168.10	5175.26	5174.34	5175.74	5174.83	0.013
20	11	SDMH-44	42	42	177.445	0.50	53.60	71.26	5.57	5170.81	5169.92	5176.09	5175.59	5176.58	5176.07	0.013
21	12	SDI-47	42	42	148.912	0.50	53.60	70.93	5.57	5171.75	5171.01	5176.87	5176.44	5177.35	5176.92	0.013
22	109	SDMH-50	42	42	7.819	0.49	47.20	70.67	4.91	5171.99	5171.95	5176.96	5176.94	5177.33	5177.31	0.013
23	101	SDMH-51	36	36	76.788	1.02	40.70	67.44	5.76	5172.98	5172.19	5177.62	5177.33	5178.13	5177.84	0.013

TW = 5166.77' = NORMAL DEPTH > 100-YEAR DETENTION POND WSE (5165.93')

Detention basin 100-year WSE was given as user input. However, in this particular case normal depth of pipe is higher than the 100-year WSEL in the detention basin. So the program defaults to using normal depth of pipe as tailwater as opposed to using the 100-year detention pond WSEL. This results in a more conservative HGL estimation. The user defined tailwater is never lower than the 100-year WSE at the pond

Project File: 1104_100YrHGL_SystemB.stm | Number of lines: 48 | Date: 11/23/2020

NOTES: ** Critical depth

CustomRep

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
24	65	SDMH-52	36	36	52.357	1.93	40.70	92.62	5.76	5174.19	5173.18	5177.96	5177.77	5178.48	5178.29	0.013
25	108	SDMH-53	36	36	49.919	0.51	33.80	47.47	4.78	5174.64	5174.39	5178.61	5178.48	5178.96	5178.84	0.013
26	66	SDMH-31	36	36	45.847	1.50	26.70	81.82	3.78	5175.53	5174.84	5179.04	5178.96	5179.26	5179.19	0.013
27	67	SDMH-32	24	24	233.724	1.79	23.50	30.28	7.83	5180.72	5176.53	5182.44 j	5179.26	5183.48	5180.13	0.013
28	68	SDMH-33	24	24	61.276	1.29	16.80	25.68	6.66	5181.71	5180.92	5183.19	5182.44	5183.90	5183.15	0.013
29	69	SDMH-34	18	18	136.890	1.13	10.20	11.14	6.87	5183.75	5182.21	5184.98	5183.34	5185.65	5184.01	0.013
30	71	SDI-31	18	18	27.777	0.50	2.70	7.45	2.27	5184.09	5183.95	5184.99	5184.98	5185.08	5185.05	0.013
31	70	SDI-30	18	18	8.995	3.00	7.50	18.19	5.71	5184.22	5183.95	5185.28	5184.98	5185.77	5185.47	0.013
32	78	SDMH-36	18	18	95.110	1.09	6.60	10.94	5.37	5183.24	5182.21	5184.24	5183.19	5184.67	5183.63	0.013
33	83	SDI-42	18	18	7.557	0.53	6.60	7.64	4.86	5183.48	5183.44	5184.56	5184.52	5184.92	5184.88	0.013
34	77	SDI-33	18	18	27.777	2.05	6.70	15.04	4.85	5181.79	5181.22	5182.79 j	5182.44	5183.24	5182.89	0.013
35	73	SDI-38	18	18	30.055	1.86	4.00	14.33	3.47	5179.06	5178.50	5179.83 j	5179.77	5180.13	5180.07	0.013
36	72	SDI-37	18	18	8.278	2.18	2.40	15.49	2.63	5178.68	5178.50	5179.27	5179.77	5179.49	5179.99	0.013
37	75	SDMH-35	18	18	95.110	0.96	3.20	10.27	1.81	5177.84	5176.93	5179.34	5179.26	5179.39	5179.31	0.013
38	76	SDI-39	18	18	7.557	1.32	3.20	12.09	3.01	5178.14	5178.04	5178.82	5179.39	5179.08	5179.65	0.013
39	29	SDMH-10	18	18	58.370	0.50	10.20	7.40	5.77	5177.77	5177.48	5179.53	5178.98	5180.05	5179.50	0.013
40	42	SDI-07	18	18	138.548	1.62	3.60	13.38	3.15	5180.22	5177.97	5180.94 j	5180.05	5181.23	5180.11	0.013
41	40	SDI-12	18	18	27.757	1.80	5.90	14.09	3.34	5178.47	5177.97	5180.14	5180.05	5180.31	5180.22	0.013
42	41	SDI-13	18	18	7.575	1.32	0.70	12.04	0.40	5178.07	5177.97	5180.05	5180.05	5180.05	5180.05	0.013
43	107	SDI-34	18	18	6.518	7.82	7.10	29.37	4.02	5176.65	5176.14	5178.99	5178.96	5179.25	5179.22	0.013
44	74	SDI-35	18	18	32.950	0.70	6.90	8.77	3.90	5175.92	5175.69	5178.62	5178.48	5178.86	5178.72	0.013
45	13	SDI-48	18	18	27.613	5.29	6.50	24.15	3.68	5175.45	5173.99	5177.44	5177.33	5177.65	5177.54	0.013
46	14	SDI-46	18	18	31.646	13.43	4.20	38.48	3.43	5173.89	5169.64	5174.68 j	5173.88	5174.99	5173.96	0.013

Project File: 1104_100YrHGL_SystemB.stm | Number of lines: 48 | Date: 11/23/2020

NOTES: ** Critical depth

CustomRep

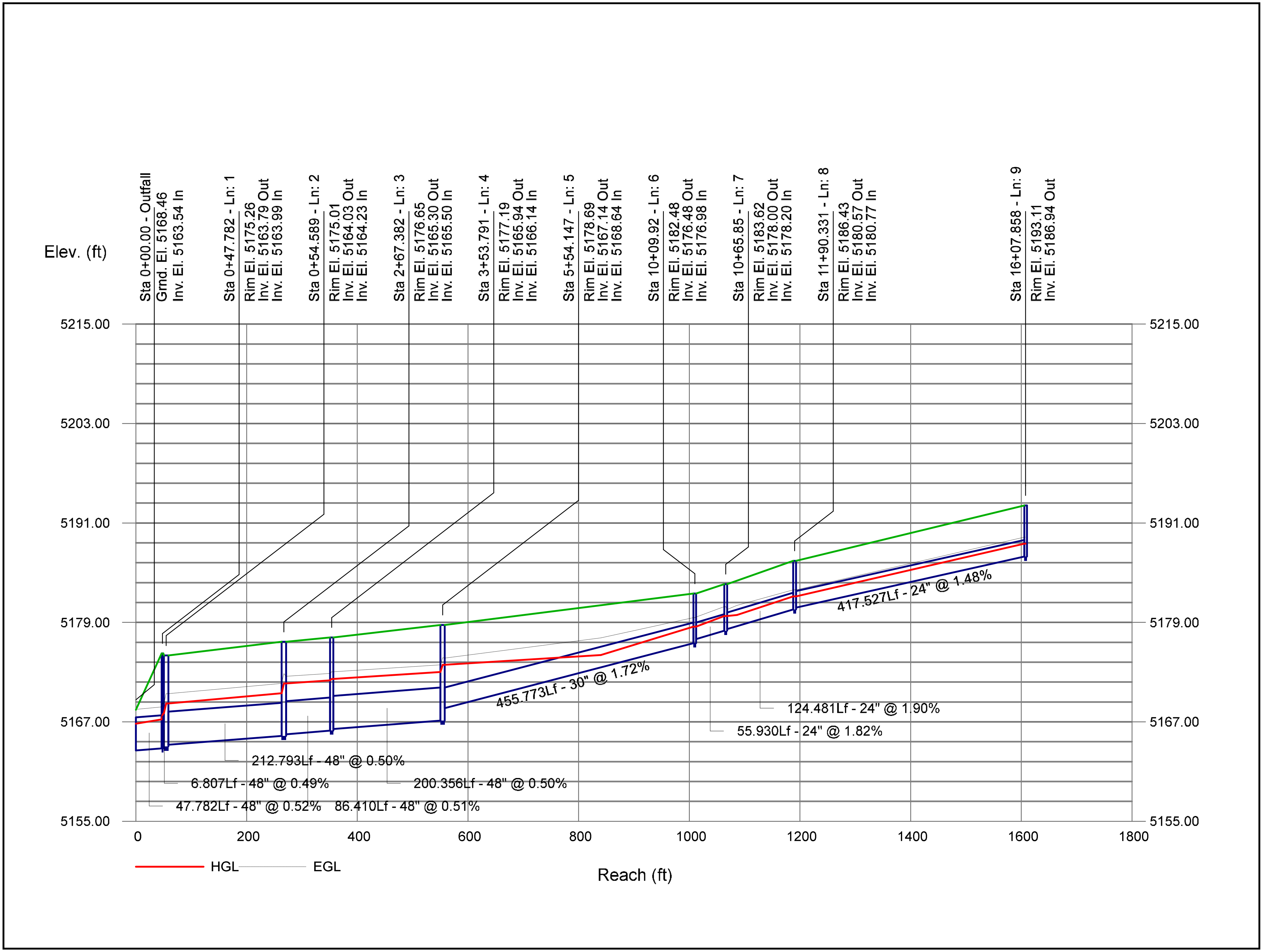
Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
47	97	SDMH-38	36	36	252.311	0.50	16.40	47.39	2.32	5166.77	5165.50	5171.79	5171.63	5171.87	5171.72	0.013
48	96	SDI-32	36	36	197.717	0.50	16.40	47.19	2.32	5167.96	5166.97	5171.99	5171.87	5172.07	5171.95	0.013

Project File: 1104_100YrHGL_SystemB.stm | Number of lines: 48 | Date: 11/23/2020

NOTES: ** Critical depth

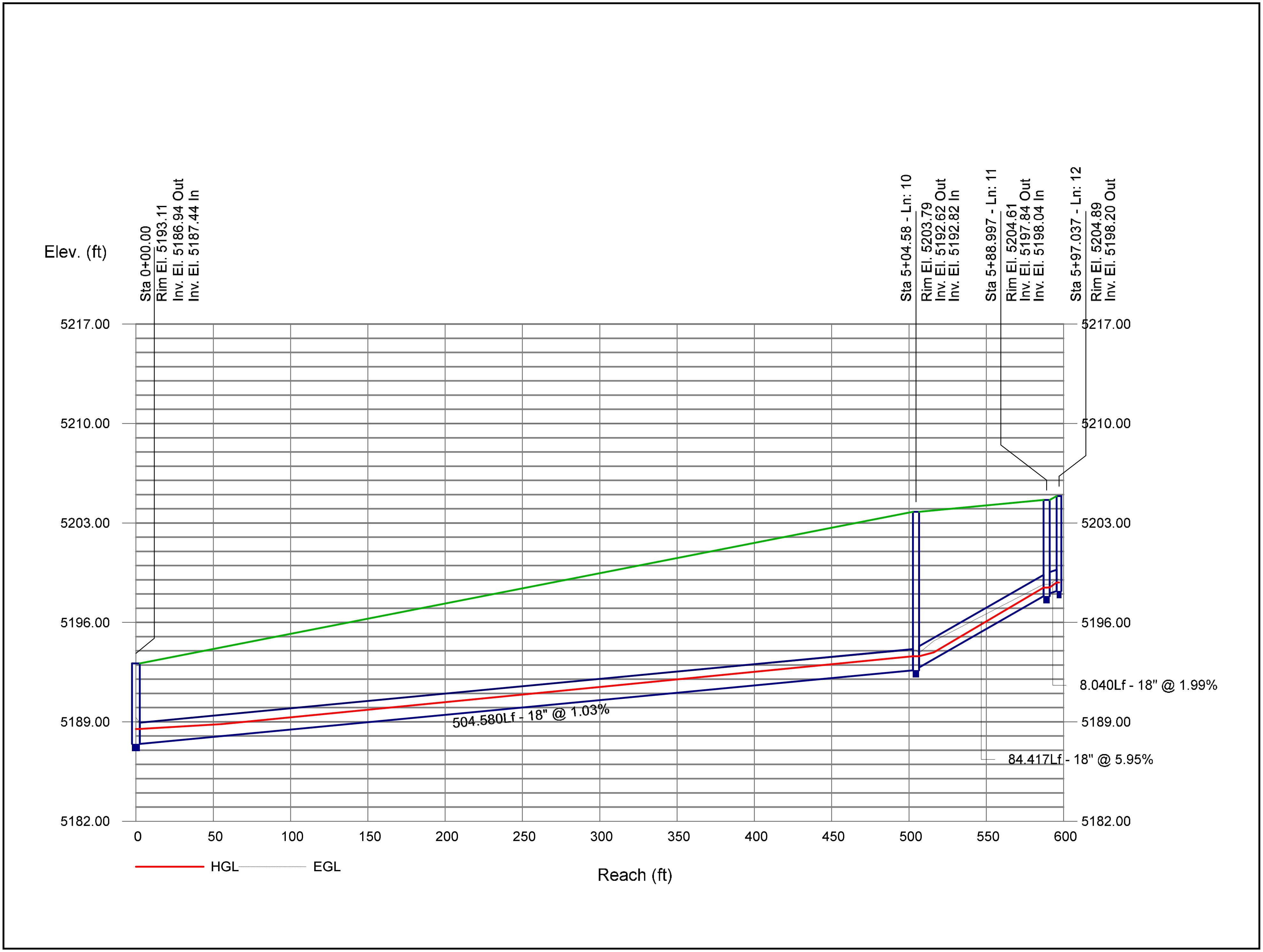
Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemB.stm



Storm Sewer Profile

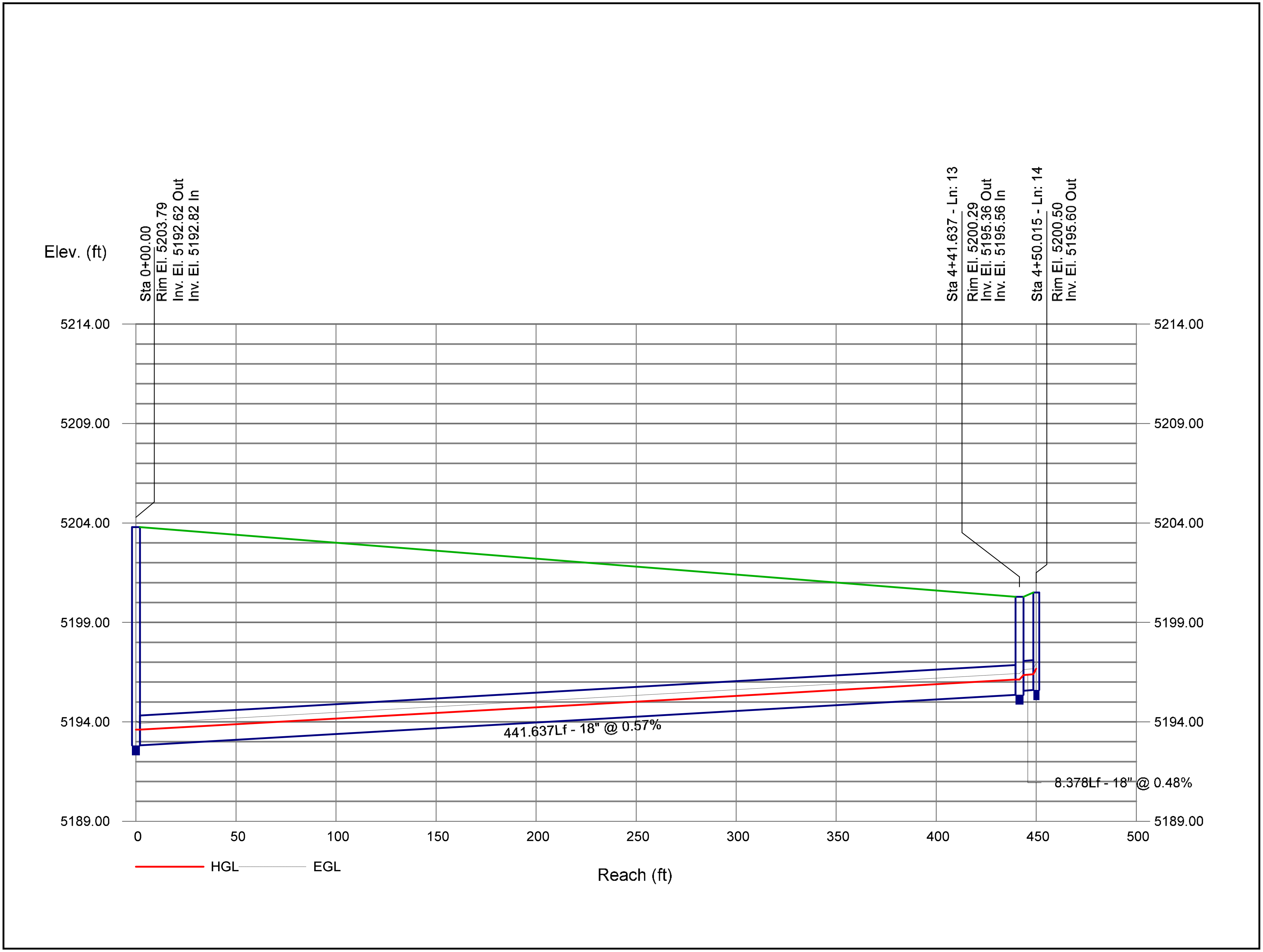
Proj. file: 1104_100YrHGL_SystemB.stm



Storm Sewers

Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemB.stm



Storm Sewer Profile

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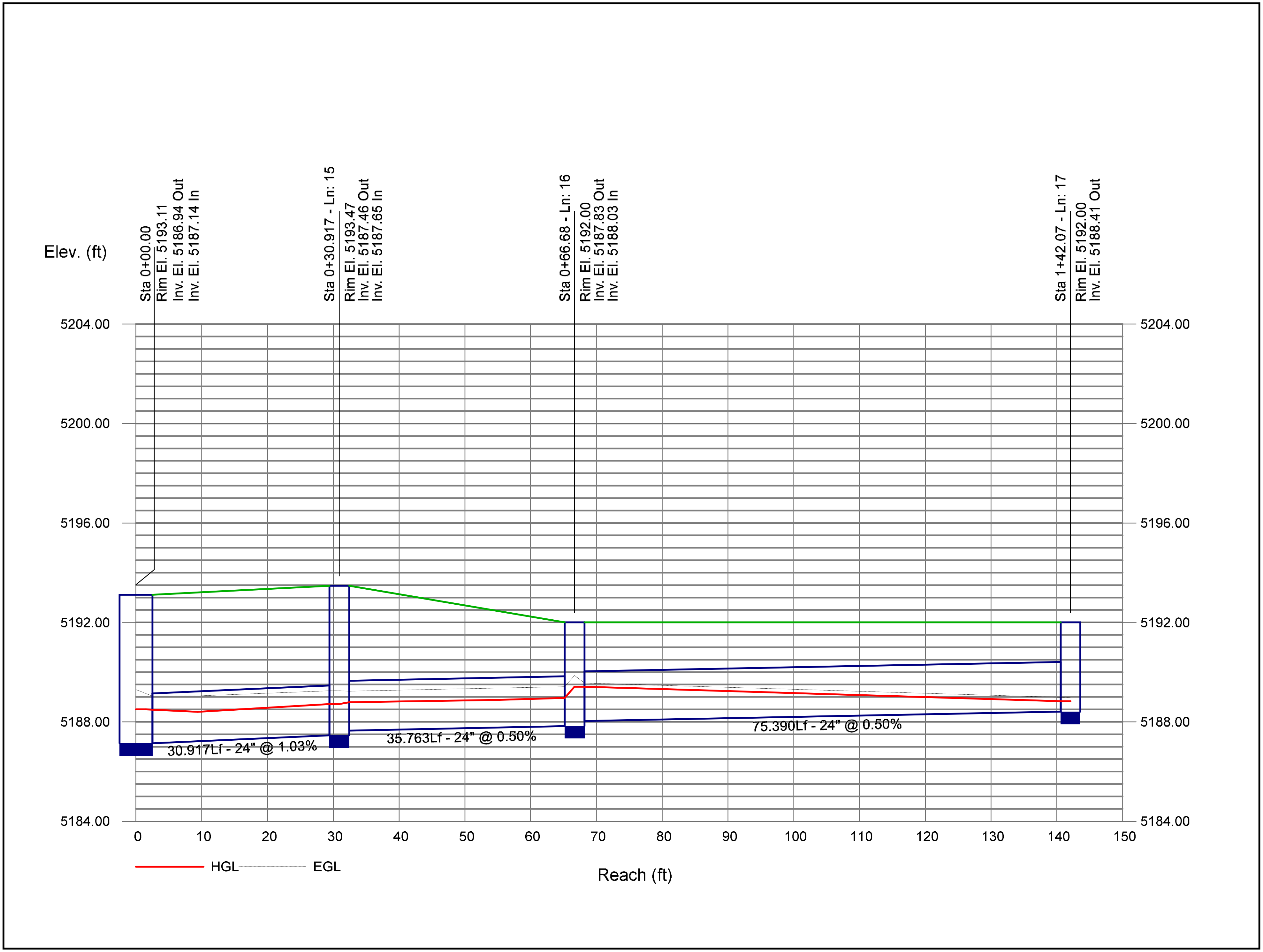

Storm Sewer Profile

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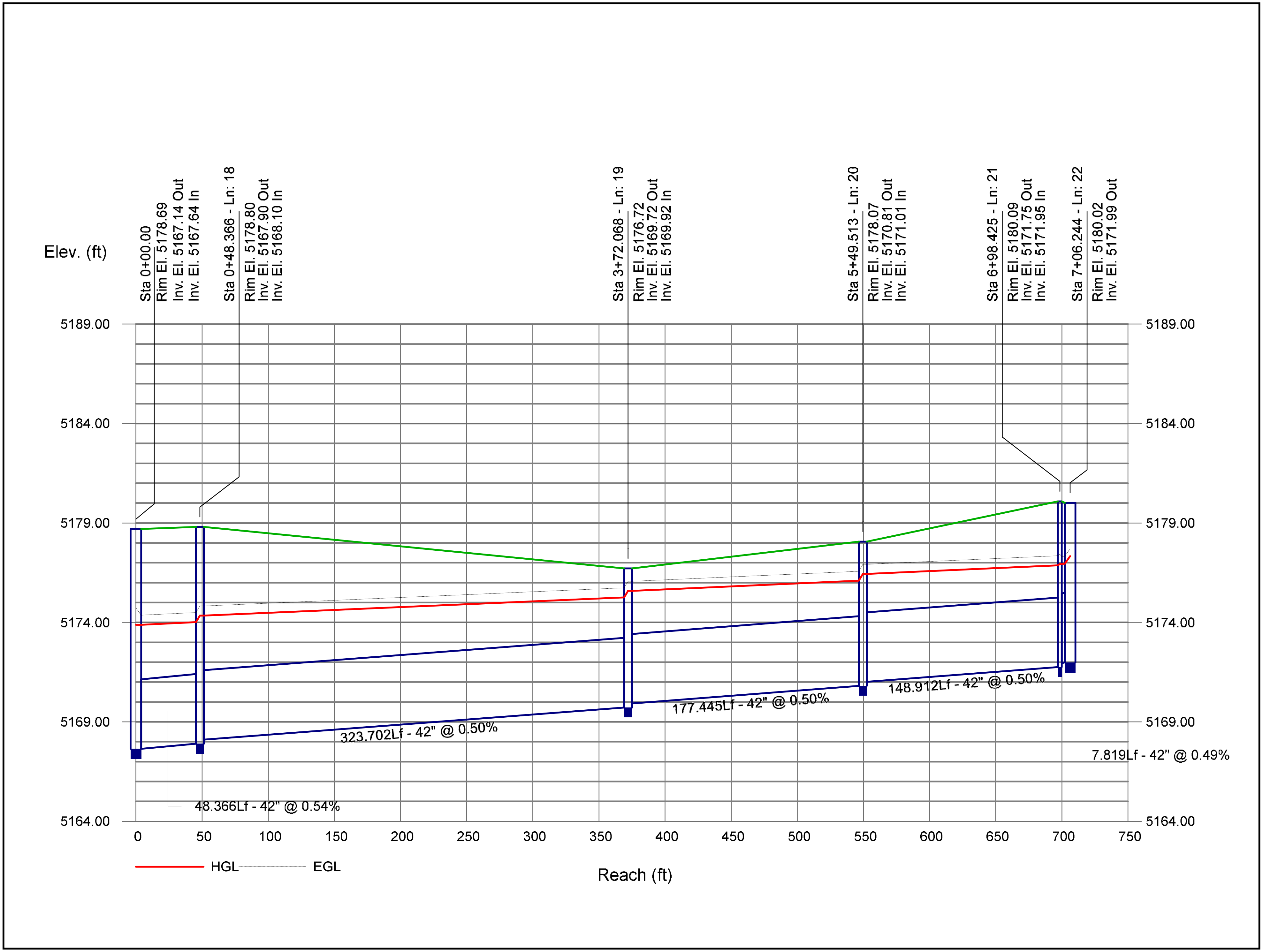

Storm Sewer Profile

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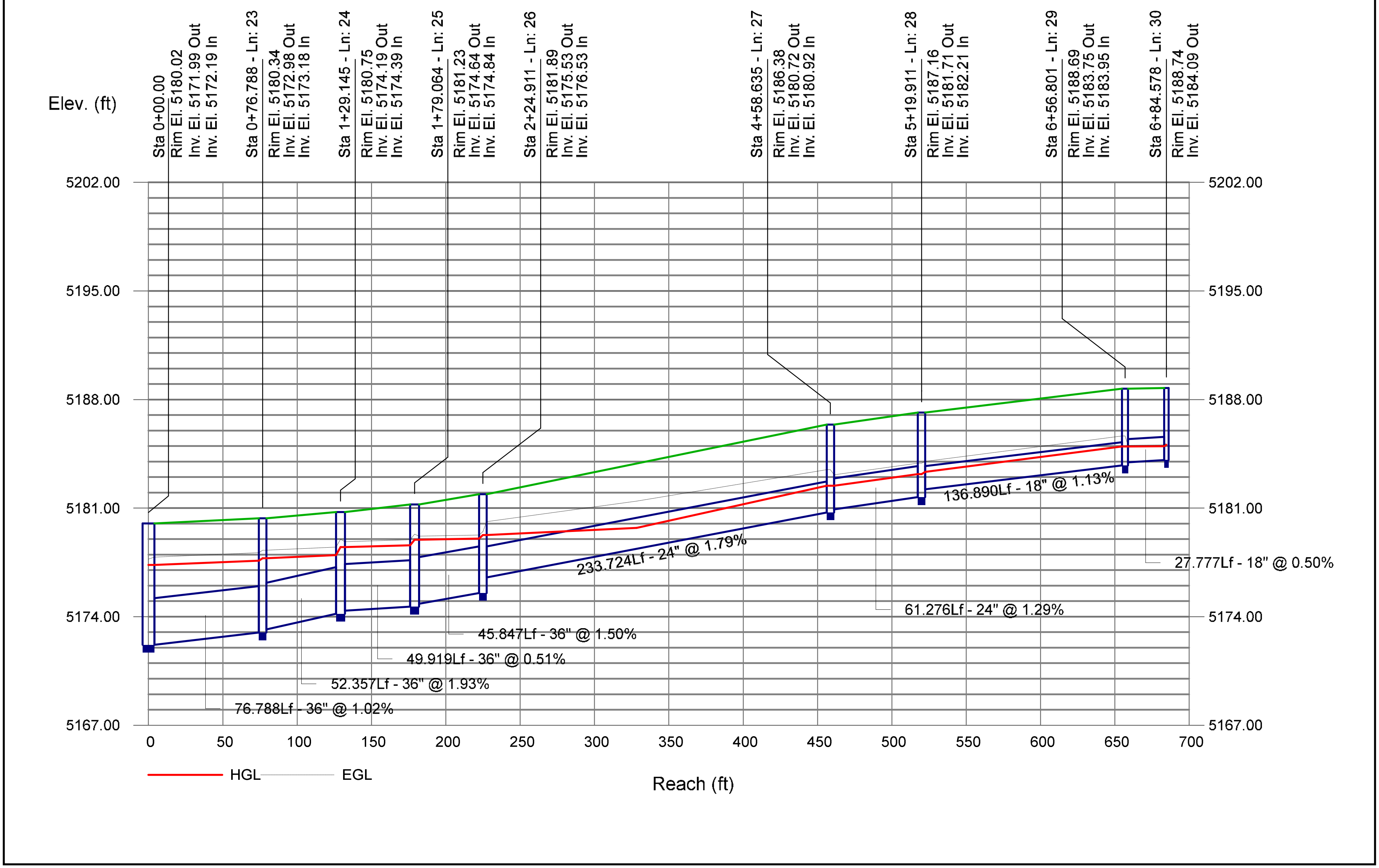

Storm Sewer Profile

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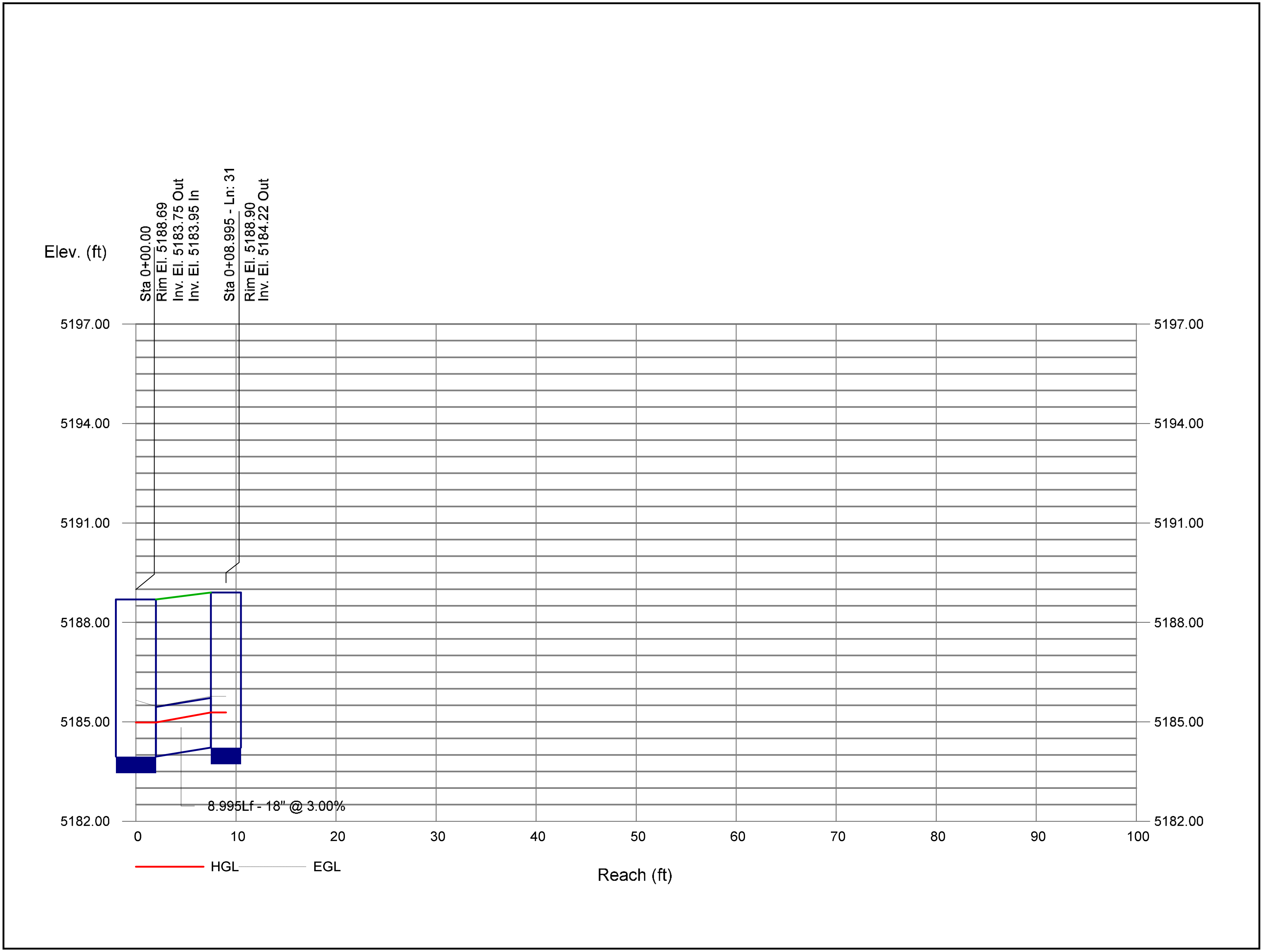

Storm Sewer Profile

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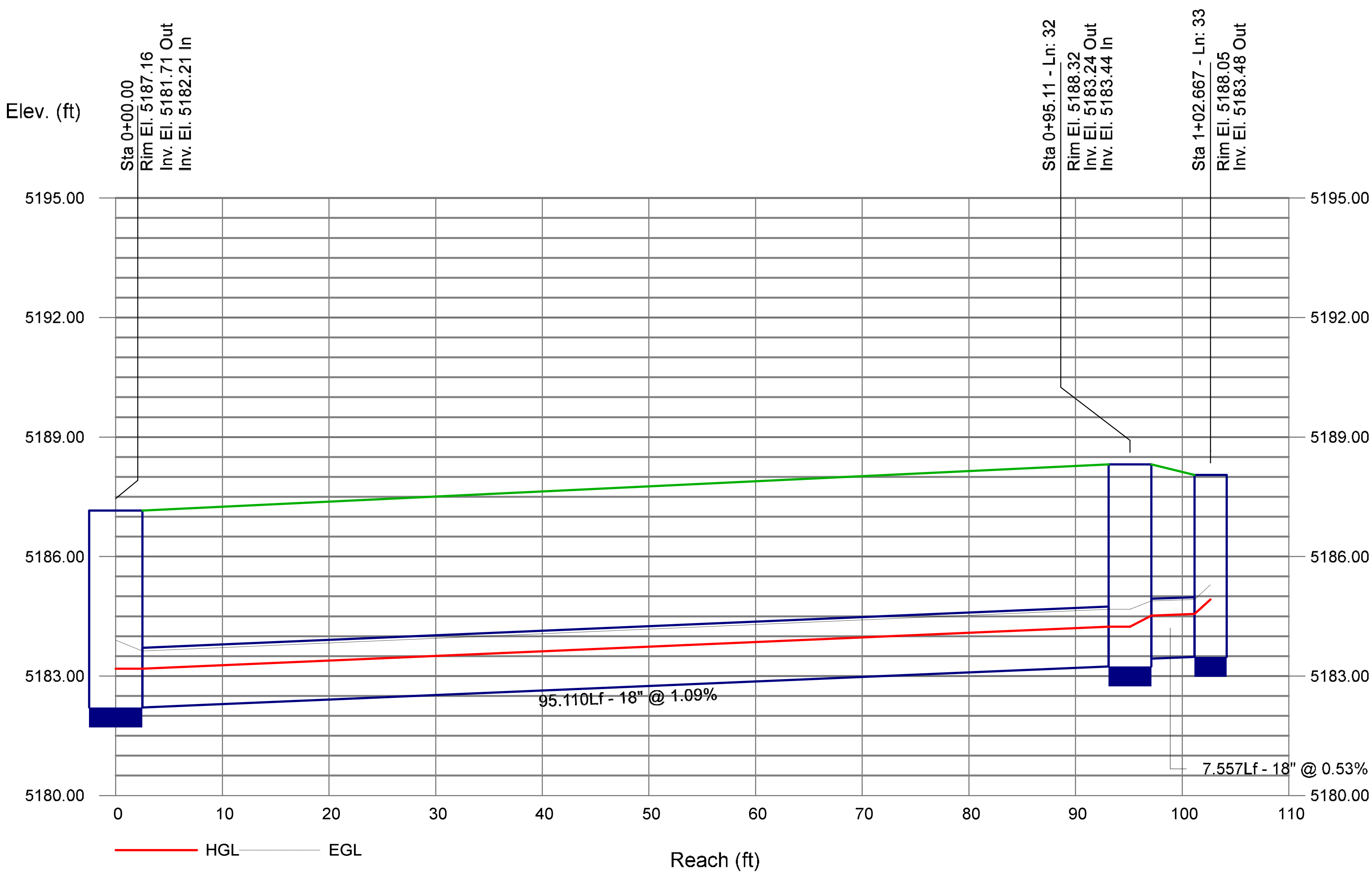

Storm Sewer Profile

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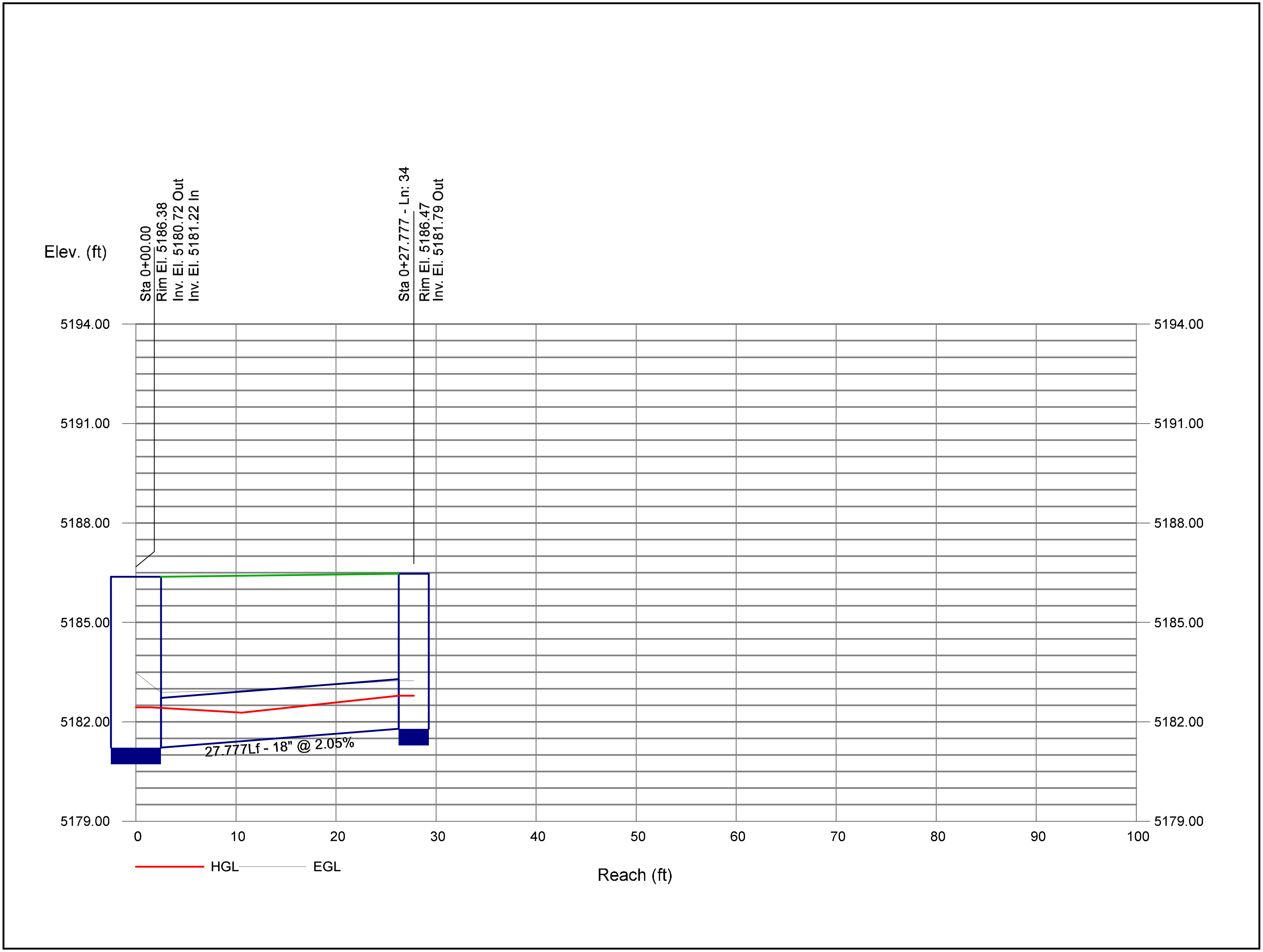
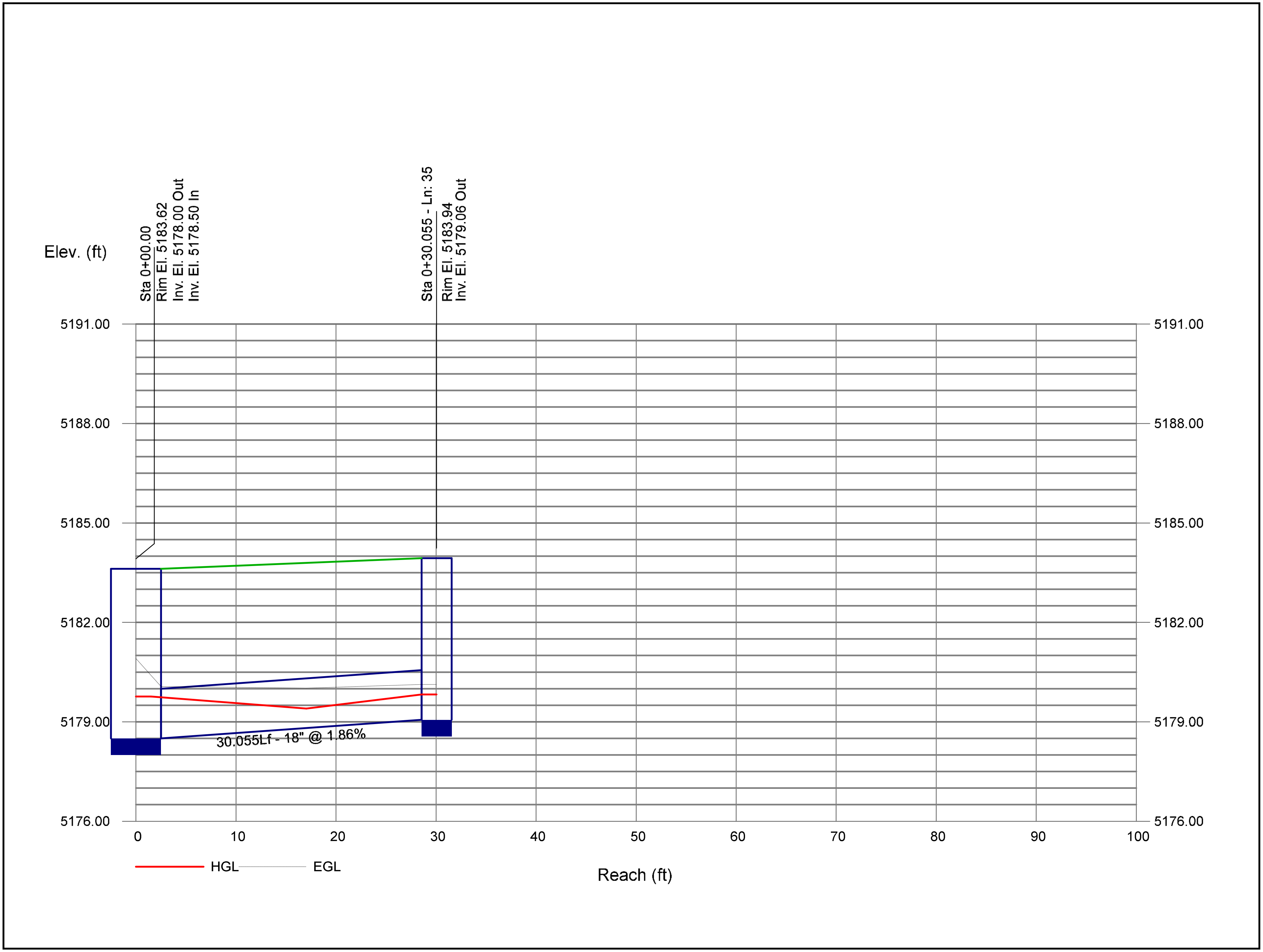


Storm Sewer Profile

Proj. file: 1104_100YrHGL_SystemB.stm



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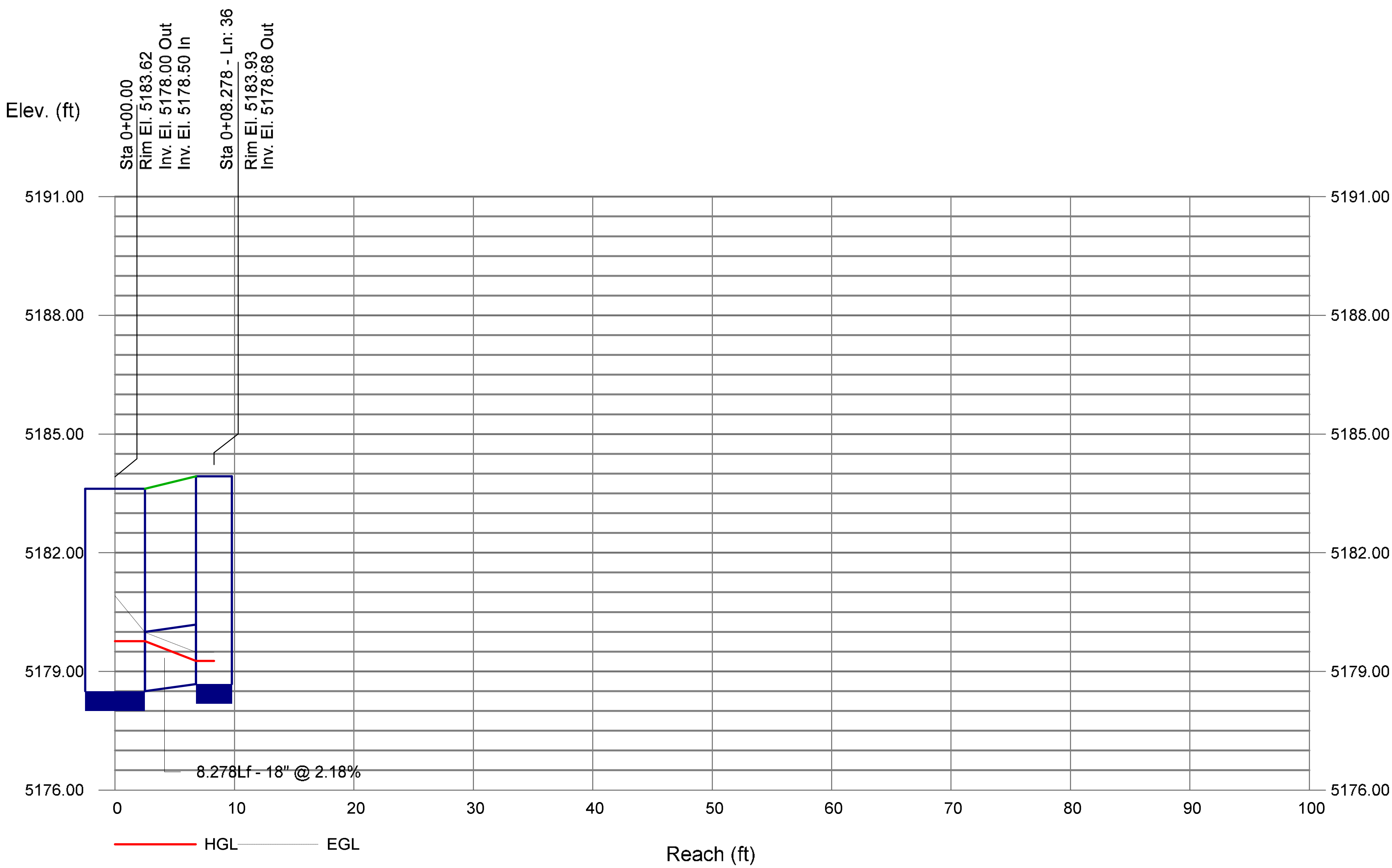

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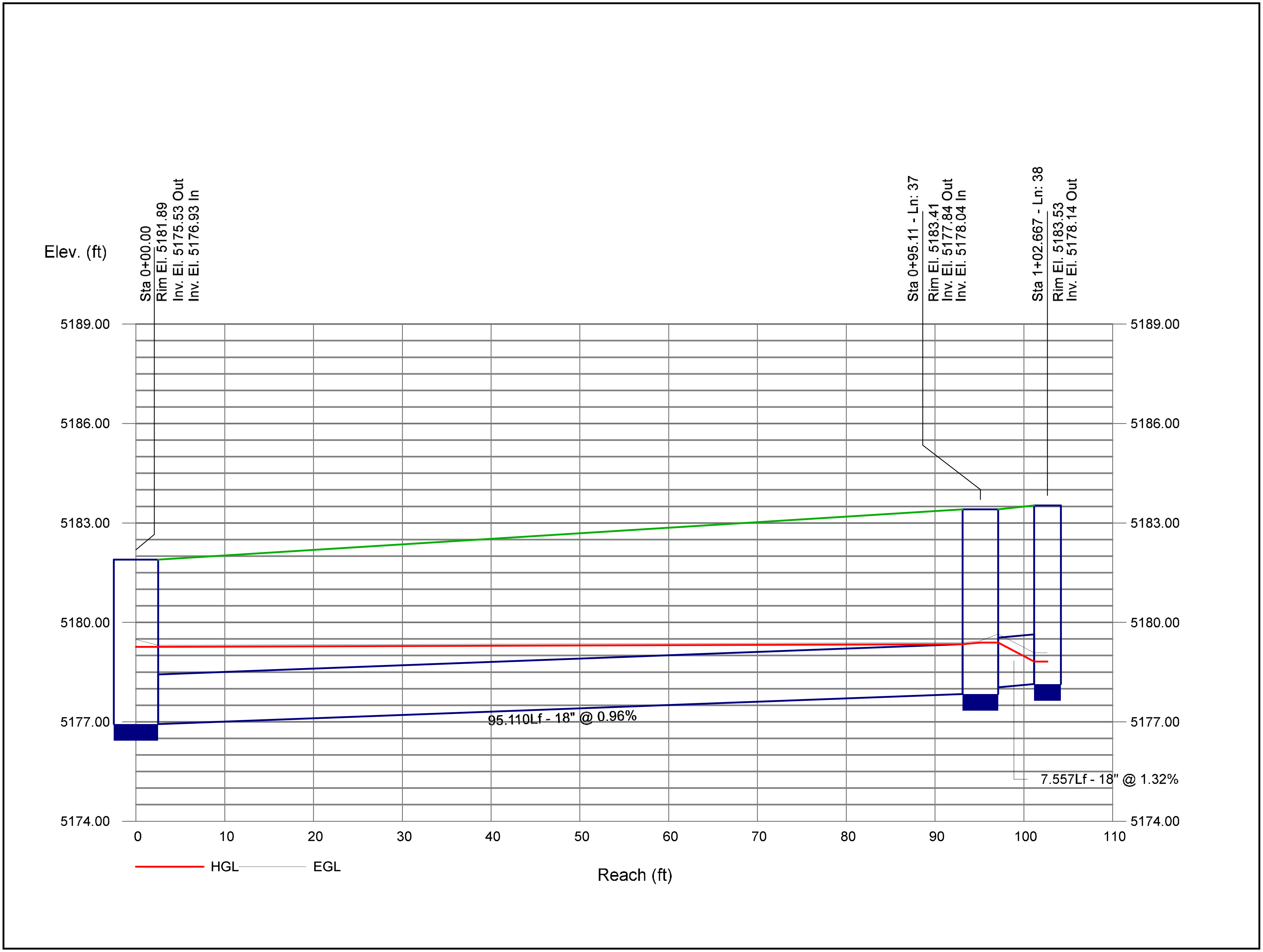

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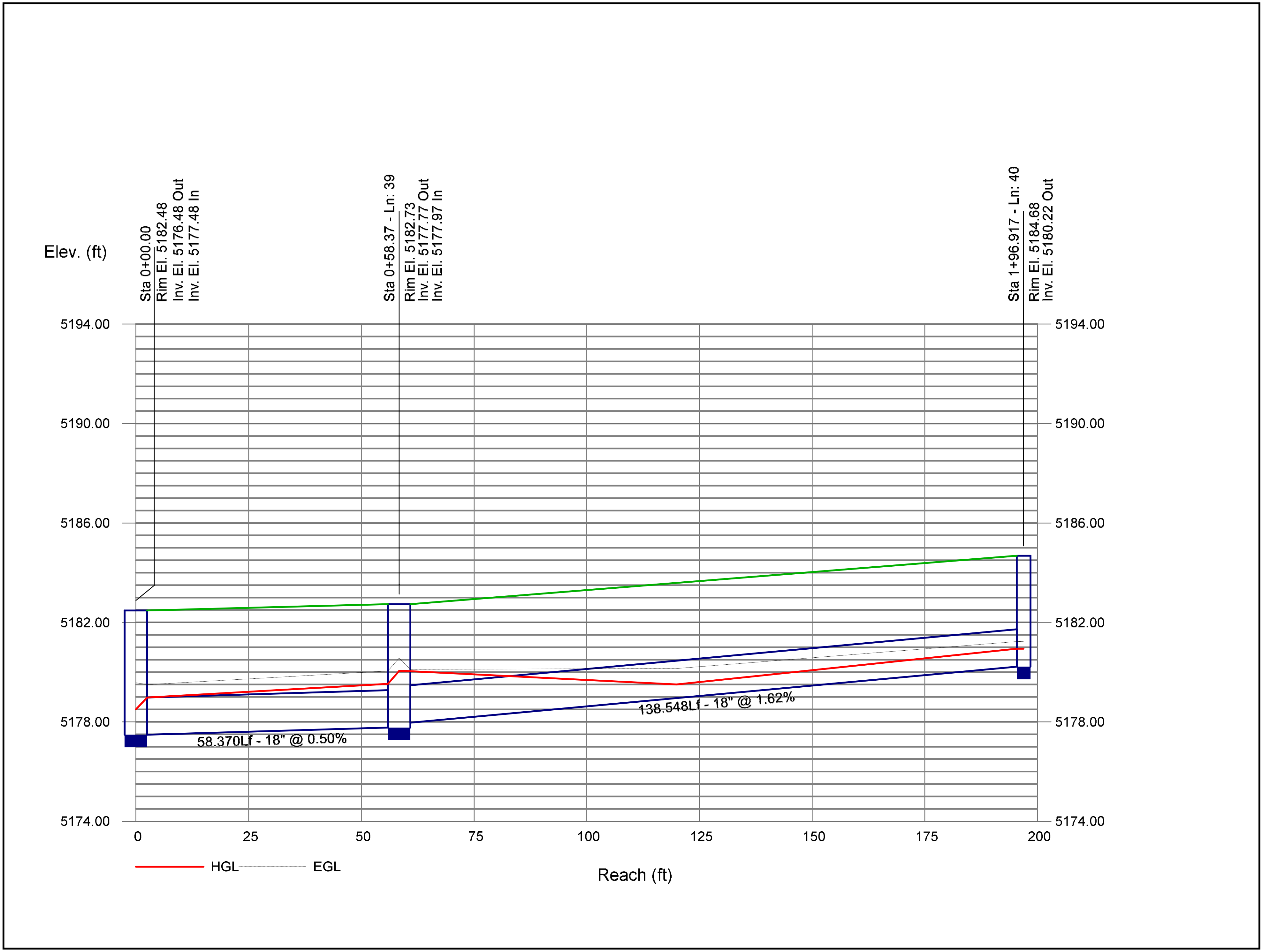

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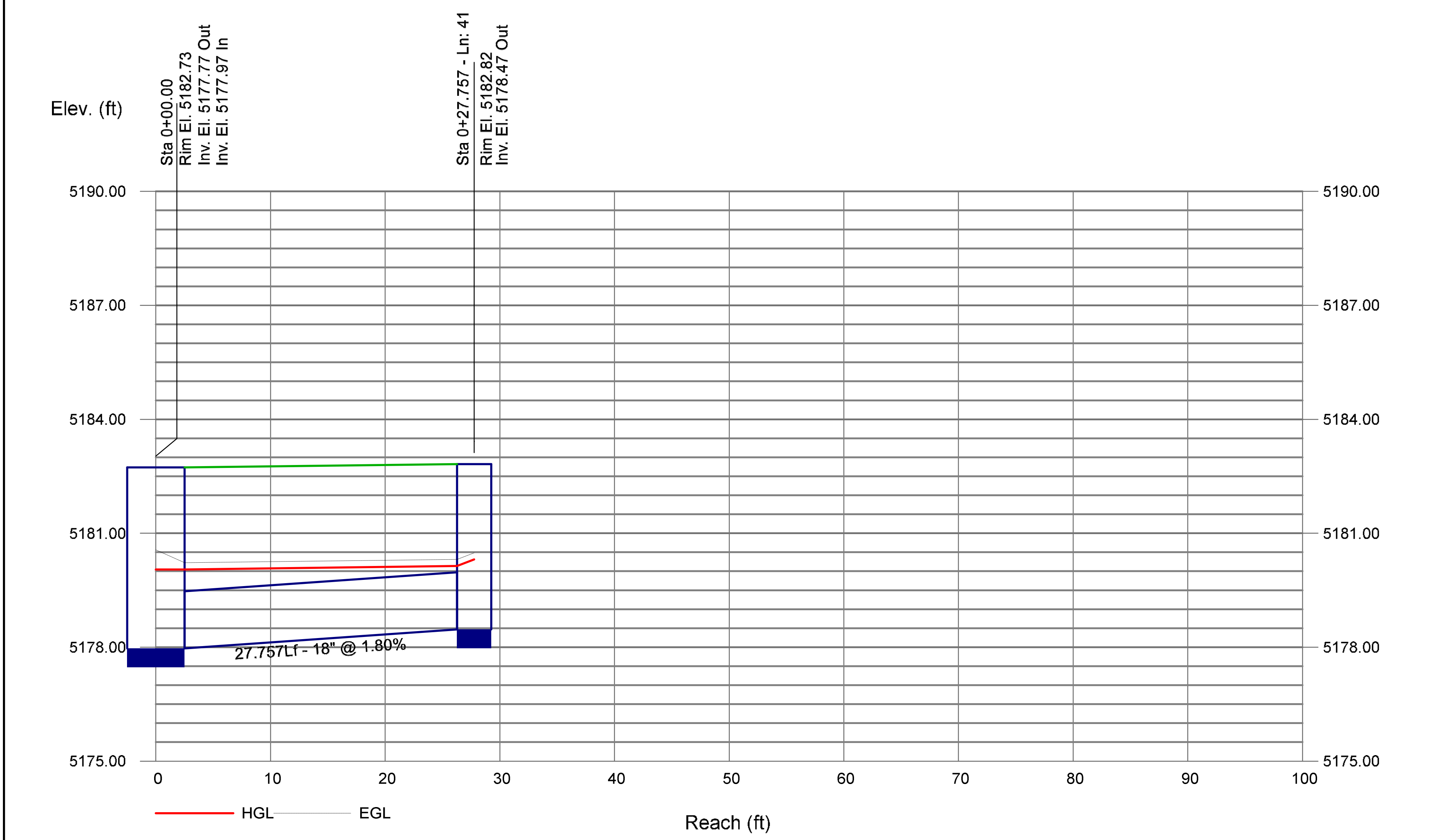

Storm Sewers

Storm Sewer Profile

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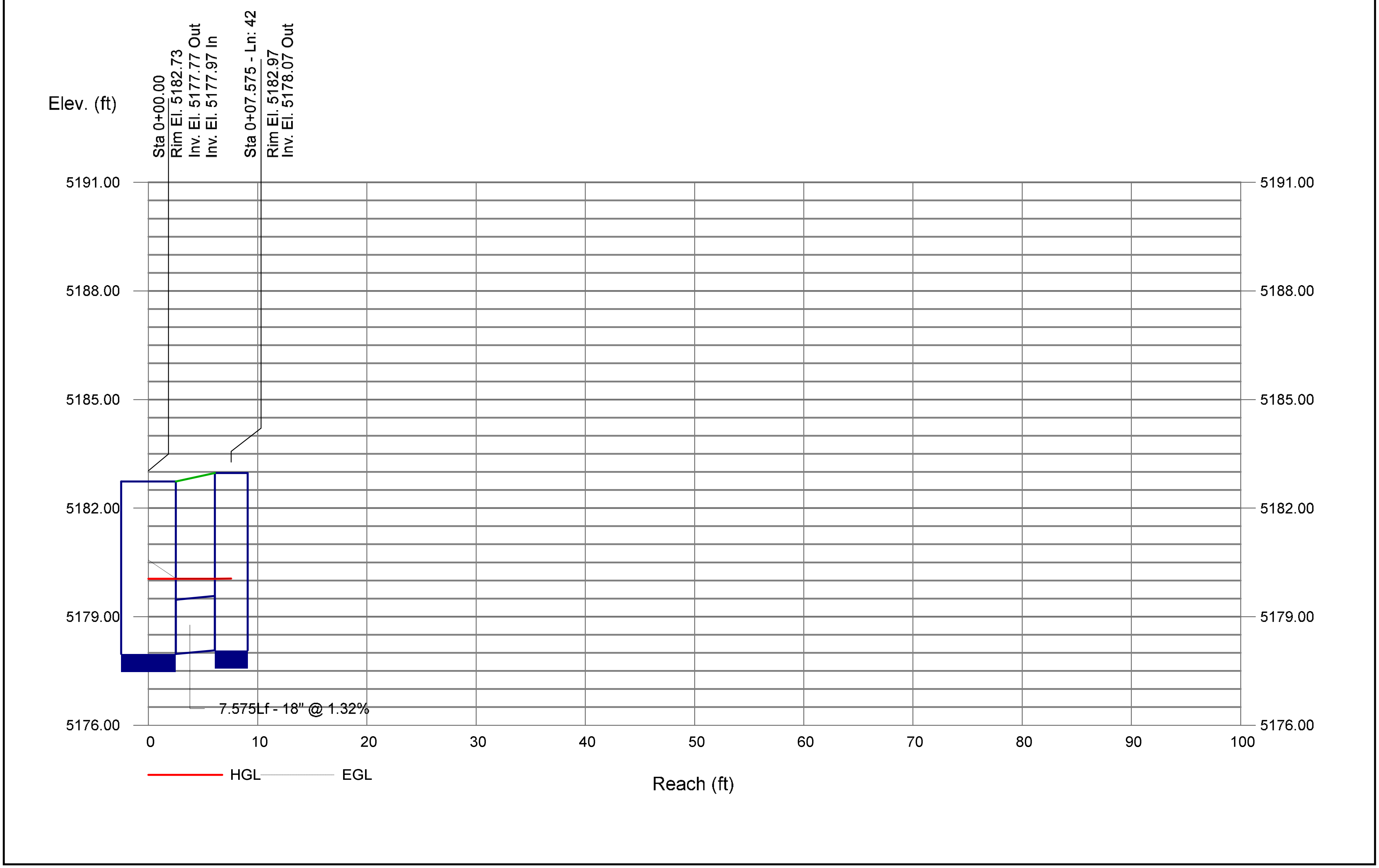

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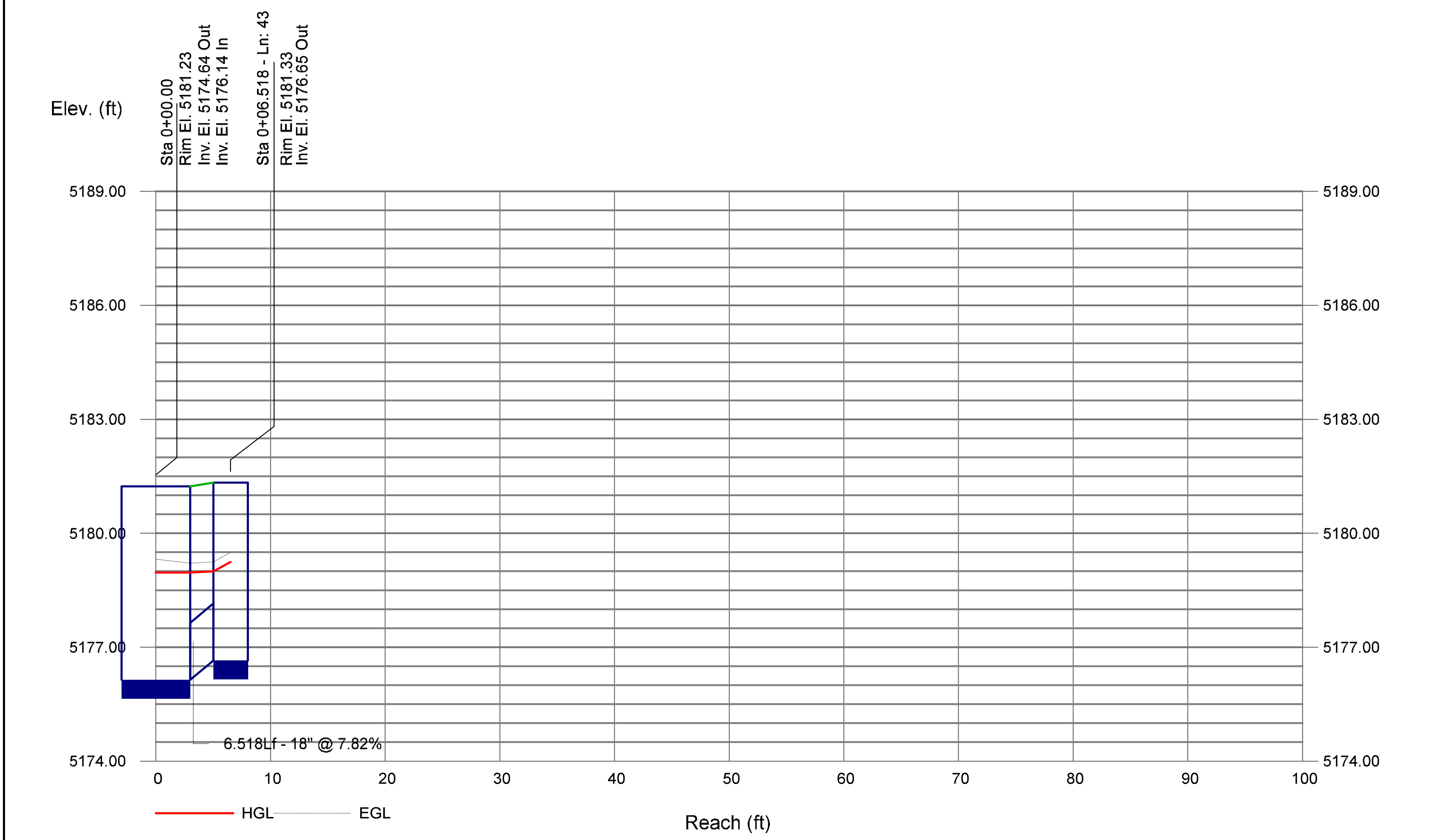

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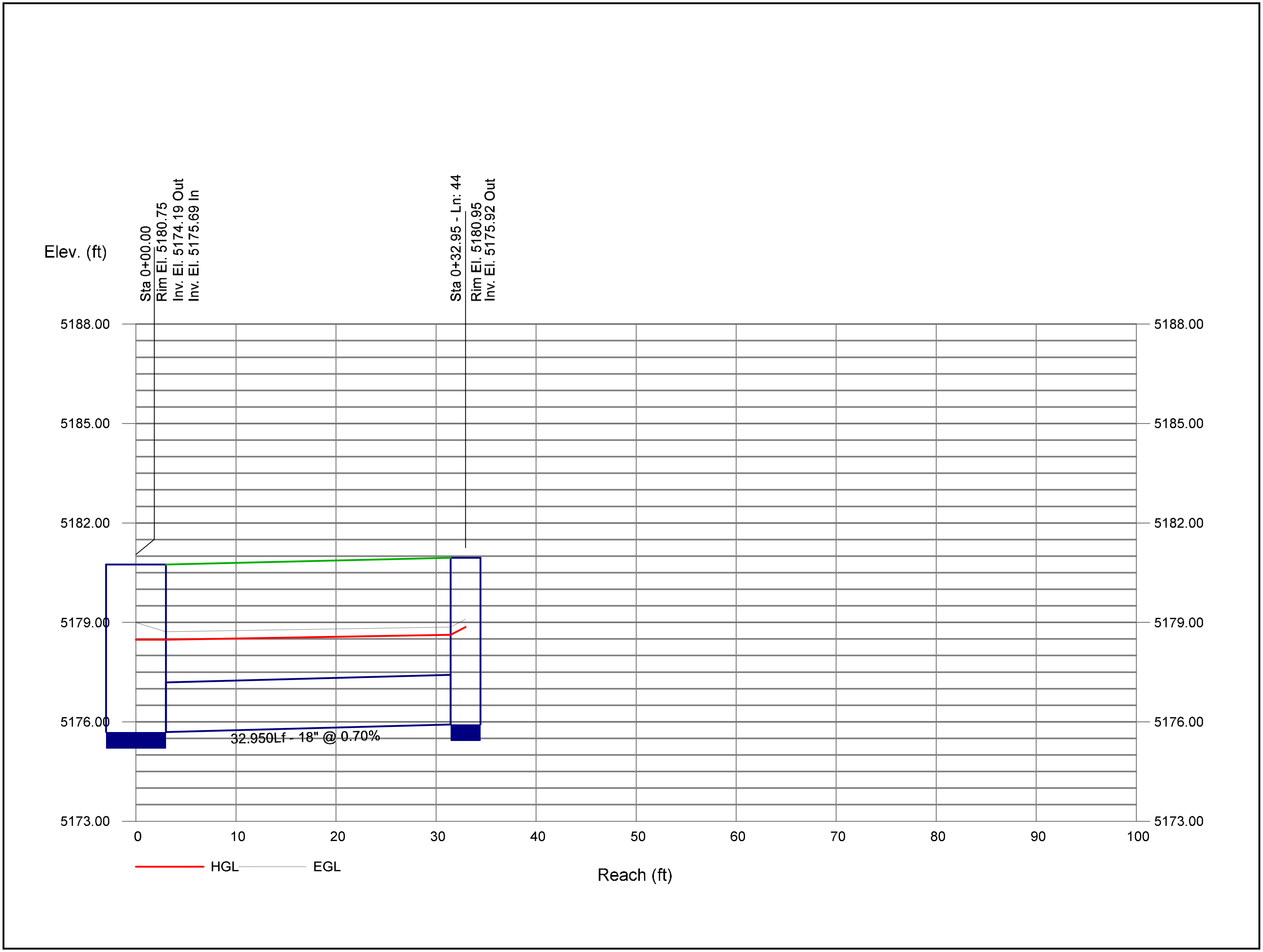

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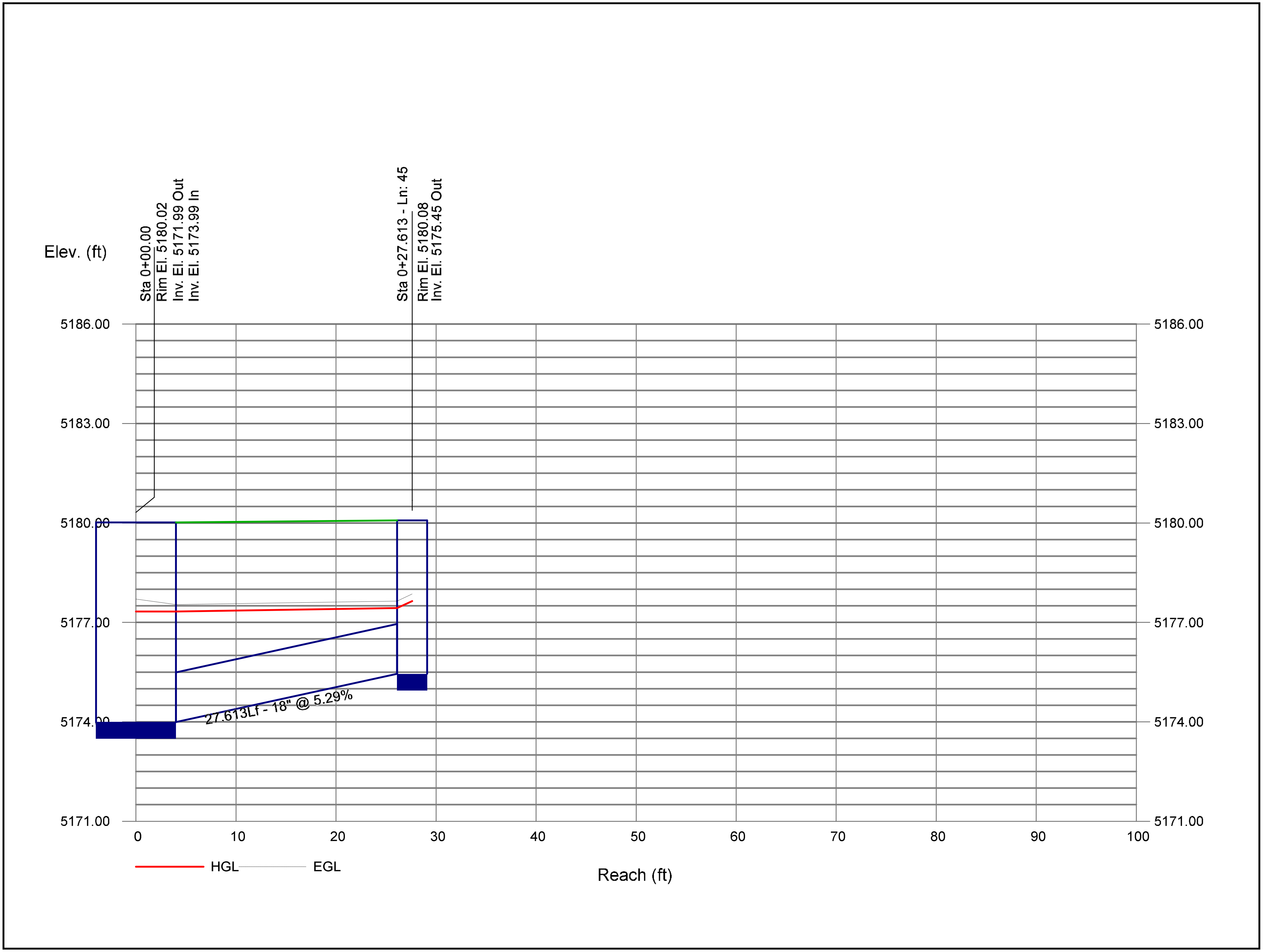

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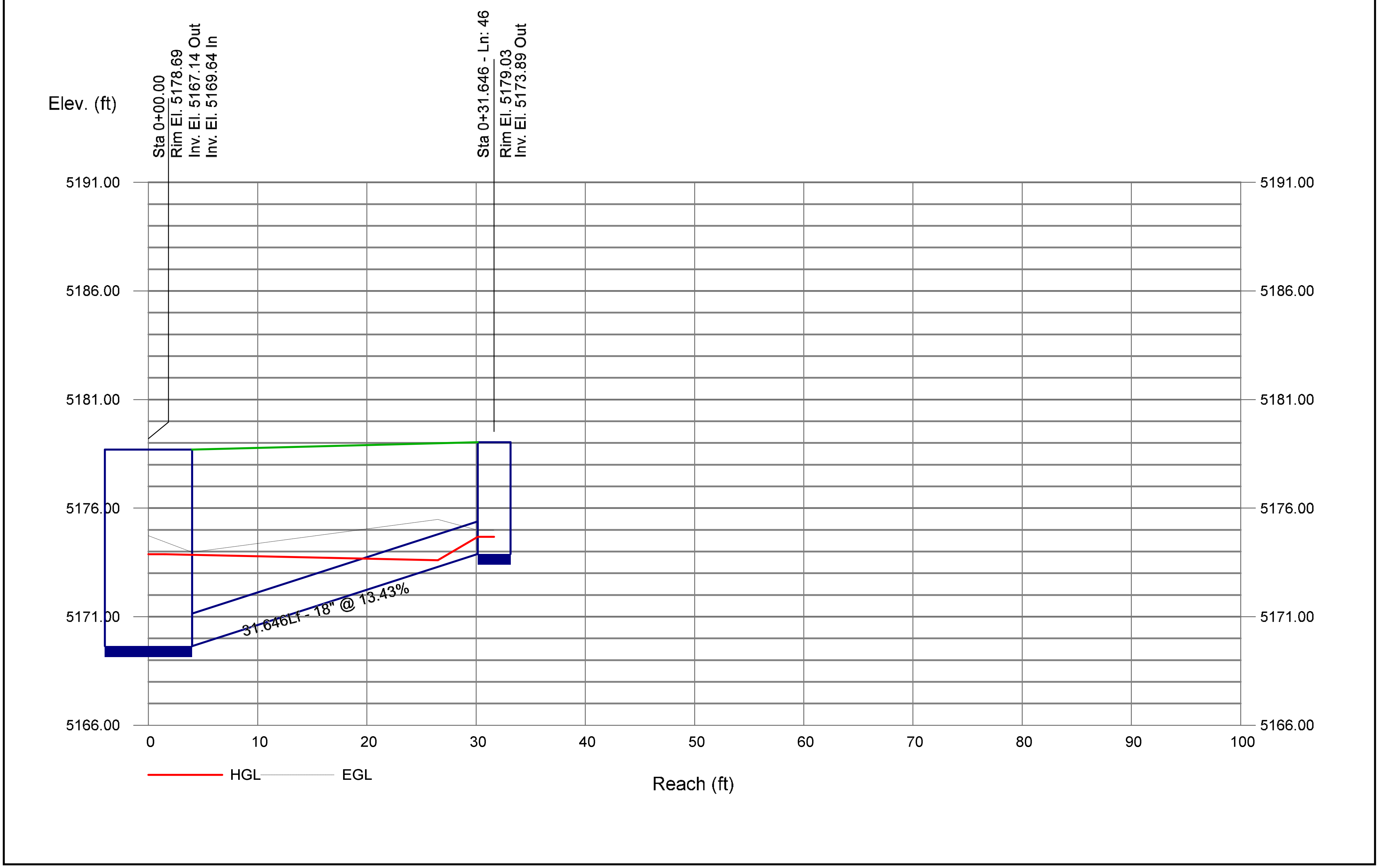

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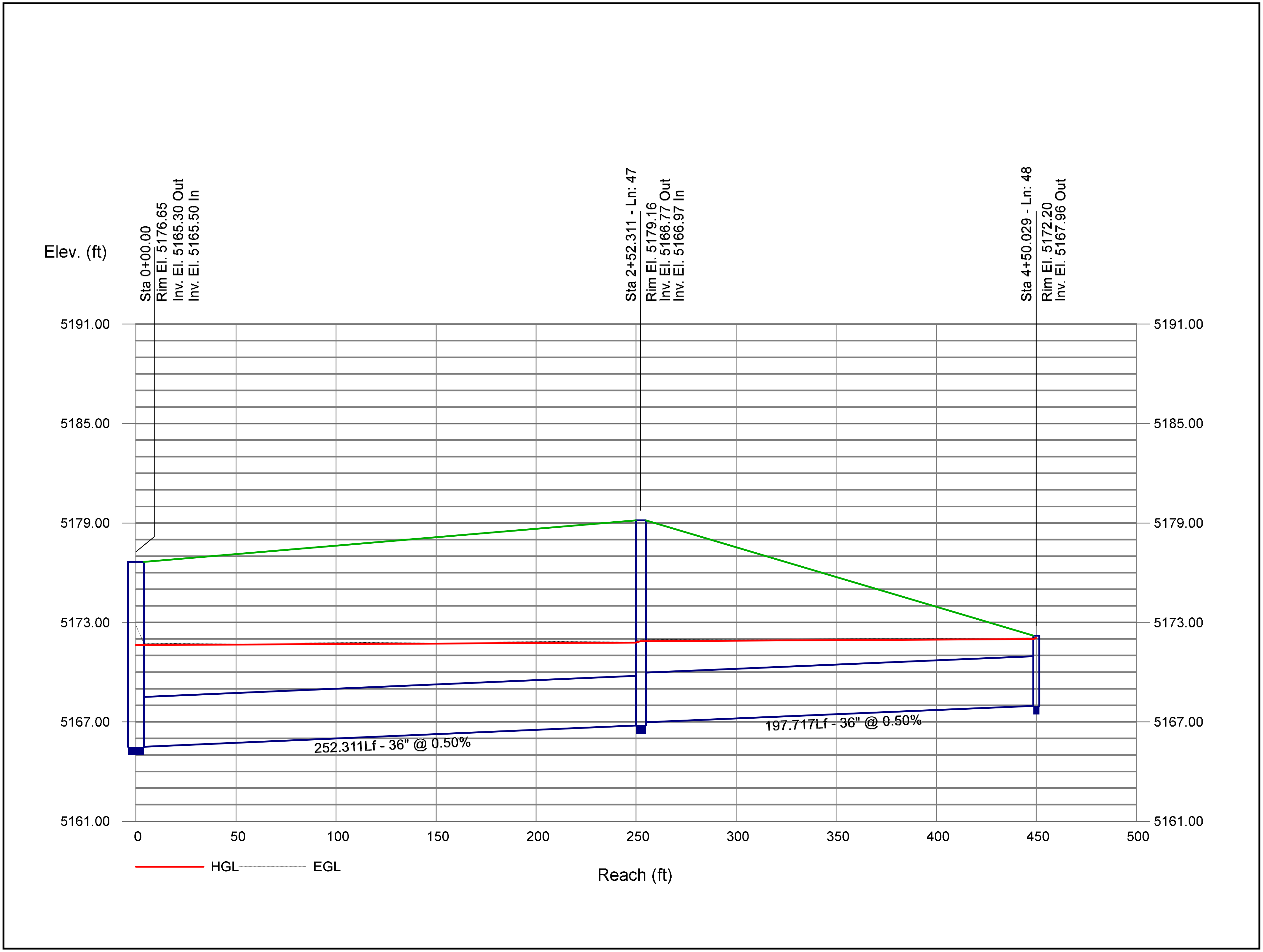


CustomRep

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
1	06	SDI-26	48	48	47.782	0.52	36.60	103.90	7.11	5163.79	5163.54	5165.59	5165.18	5166.28	5165.87	0.013
2	05	SDMH-04	48	48	6.807	0.49	34.10	101.06	6.89	5164.03	5163.99	5165.76	5165.60	5166.43	5166.26	0.013
3	07	SDMH-11	48	48	212.793	0.50	34.10	101.90	6.91	5165.30	5164.23	5167.04	5165.82	5167.70	5166.49	0.013
4	23	SDMH-01	48	48	86.410	0.51	31.80	102.72	6.77	5165.94	5165.50	5167.62	5167.04	5168.25	5167.67	0.013
5	08	SDMH-02	48	48	200.356	0.50	31.80	101.48	6.76	5167.14	5166.14	5168.81	5167.68	5169.45	5168.31	0.013
6	62	SDMH-28	30	30	455.773	1.72	11.90	53.79	7.08	5176.48	5168.64	5177.64	5169.44	5178.08	5169.89	0.013
7	61	SDMH-27	24	24	55.930	1.82	7.70	30.54	6.54	5178.00	5176.98	5178.99	5177.67	5179.37	5178.05	0.013
8	64	SDMH-30	24	24	124.481	1.90	5.50	31.21	4.64	5180.57	5178.20	5181.40	5178.99	5181.71	5179.30	0.013
9	79	SDMH-37	24	24	417.527	1.48	5.50	27.49	5.51	5186.94	5180.77	5187.77	5181.40	5188.08	5181.71	0.013
10	84	SDMH-40	18	18	504.580	1.03	3.10	10.64	4.64	5192.62	5187.44	5193.29	5188.00	5193.55	5188.25	0.013
11	87	SDMH-41	18	18	84.417	5.95	1.20	25.61	2.80	5197.84	5192.82	5198.25 j	5193.29	5198.40	5193.44	0.013
12	88	SDI-45	18	18	8.040	1.99	1.20	14.82	4.06	5198.20	5198.04	5198.61	5198.33	5198.76	5198.48	0.013
13	85	SDMH-39	18	18	441.637	0.57	1.90	7.96	3.60	5195.36	5192.82	5195.88	5193.32	5196.07	5193.51	0.013
14	86	SDI-44	18	18	8.378	0.48	1.90	7.26	3.46	5195.60	5195.56	5196.12 j	5196.08	5196.31	5196.27	0.013
15	80	SDI-40	24	24	30.917	1.03	2.40	23.00	3.18	5187.46	5187.14	5188.00 j	5187.77	5188.19	5187.96	0.013
16	81	SDI-25	24	24	35.763	0.50	1.00	16.05	2.75	5187.83	5187.65	5188.17	5188.00	5188.29	5188.12	0.013
17	82	SDI-41	24	24	75.390	0.50	0.20	16.07	1.76	5188.41	5188.03	5188.57	5188.19	5188.62	5188.23	0.013
18	09	SDMH-42	42	42	48.366	0.54	18.40	73.73	5.98	5167.90	5167.64	5169.21	5168.83	5169.70	5169.32	0.013
19	10	SDMH-43	42	42	323.702	0.50	18.40	71.18	5.90	5169.72	5168.10	5171.03	5169.32	5171.52	5169.80	0.013
20	11	SDMH-44	42	42	177.445	0.50	18.40	71.26	5.90	5170.81	5169.92	5172.12	5171.13	5172.61	5171.62	0.013
21	12	SDI-47	42	42	148.912	0.50	18.40	70.93	5.90	5171.75	5171.01	5173.06	5172.23	5173.55	5172.71	0.013
22	109	SDMH-50	42	42	7.819	0.49	16.80	70.67	5.73	5171.99	5171.95	5173.24	5173.11	5173.70	5173.57	0.013
23	101	SDMH-51	36	36	76.788	1.02	15.30	67.44	6.23	5172.98	5172.19	5174.22	5173.24	5174.69	5173.71	0.013

TW = 5165.18' = NORMAL DEPTH > 5-YEAR DETENTION POND WSE (5164.88')

In this particular case normal depth of pipe is higher than the 5-year WSEL in the detention basin. So the program defaults to using normal depth of pipe as tailwater as opposed to using the 5-year detention pond WSEL. This results in a more conservative HGL estimation.

Project File: 1104_5YrHGL_SystemB.stm	Number of lines: 48	Date: 11/23/2020

NOTES: ** Critical depth

CustomRep

Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
24	65	SDMH-52	36	36	52.357	1.93	15.30	92.62	6.26	5174.19	5173.18	5175.44	5174.22	5175.91	5174.69	0.013
25	108	SDMH-53	36	36	49.919	0.51	13.20	47.47	5.51	5174.64	5174.39	5175.80	5175.47	5176.23	5175.90	0.013
26	66	SDMH-31	36	36	45.847	1.50	10.80	81.82	5.27	5175.53	5174.84	5176.57	5175.80	5176.95	5176.18	0.013
27	67	SDMH-32	24	24	233.724	1.79	9.10	30.28	6.85	5180.72	5176.53	5181.80	5177.28	5182.23	5177.72	0.013
28	68	SDMH-33	24	24	61.276	1.29	6.90	25.68	5.01	5181.71	5180.92	5182.64	5181.80	5183.00	5182.16	0.013
29	69	SDMH-34	18	18	136.890	1.13	4.20	11.14	5.17	5183.75	5182.21	5184.54	5182.85	5184.85	5183.16	0.013
30	71	SDI-31	18	18	27.777	0.50	1.30	7.45	2.59	5184.09	5183.95	5184.52	5184.54	5184.67	5184.69	0.013
31	70	SDI-30	18	18	8.995	3.00	2.90	18.19	4.26	5184.22	5183.95	5184.87	5184.54	5185.11	5184.78	0.013
32	78	SDMH-36	18	18	95.110	1.09	2.70	10.94	4.51	5183.24	5182.21	5183.87	5182.72	5184.10	5182.95	0.013
33	83	SDI-42	18	18	7.557	0.53	2.70	7.64	3.92	5183.48	5183.44	5184.10	5184.06	5184.34	5184.29	0.013
34	77	SDI-33	18	18	27.777	2.05	2.20	15.04	3.59	5181.79	5181.22	5182.35 j	5181.80	5182.56	5182.00	0.013
35	73	SDI-38	18	18	30.055	1.86	1.20	14.33	2.75	5179.06	5178.50	5179.47 j	5178.99	5179.62	5179.13	0.013
36	72	SDI-37	18	18	8.278	2.18	1.00	15.49	2.47	5178.68	5178.50	5179.05 j	5178.99	5179.19	5179.12	0.013
37	75	SDMH-35	18	18	95.110	0.96	1.70	10.27	3.84	5177.84	5176.93	5178.33	5177.34	5178.51	5177.52	0.013
38	76	SDI-39	18	18	7.557	1.32	1.70	12.09	4.11	5178.14	5178.04	5178.63	5178.42	5178.81	5178.60	0.013
39	29	SDMH-10	18	18	58.370	0.50	4.20	7.40	4.33	5177.77	5177.48	5178.58	5178.29	5178.87	5178.58	0.013
40	42	SDI-07	18	18	138.548	1.62	1.90	13.38	2.61	5180.22	5177.97	5180.74 j	5178.87	5180.93	5179.06	0.013
41	40	SDI-12	18	18	27.757	1.80	2.00	14.09	2.68	5178.47	5177.97	5179.00 j	5178.87	5179.20	5179.07	0.013
42	41	SDI-13	18	18	7.575	1.32	0.30	12.04	1.19	5178.07	5177.97	5178.27	5178.87	5178.34	5178.94	0.013
43	107	SDI-34	18	18	6.518	7.82	2.40	29.37	6.88	5176.65	5176.14	5177.24	5176.43	5177.46	5176.65	0.013
44	74	SDI-35	18	18	32.950	0.70	2.10	8.77	3.84	5175.92	5175.69	5176.47	5176.19	5176.67	5176.39	0.013
45	13	SDI-48	18	18	27.613	5.29	1.50	24.15	5.44	5175.45	5173.99	5175.91	5174.24	5176.08	5174.41	0.013
46	14	SDI-46	18	18	31.646	13.43	1.50	38.48	6.89	5173.89	5169.64	5174.35	5169.84	5174.52	5170.01	0.013

Project File: 1104_5YrHGL_SystemB.stm | Number of lines: 48 | Date: 11/23/2020

NOTES: ** Critical depth

CustomRep

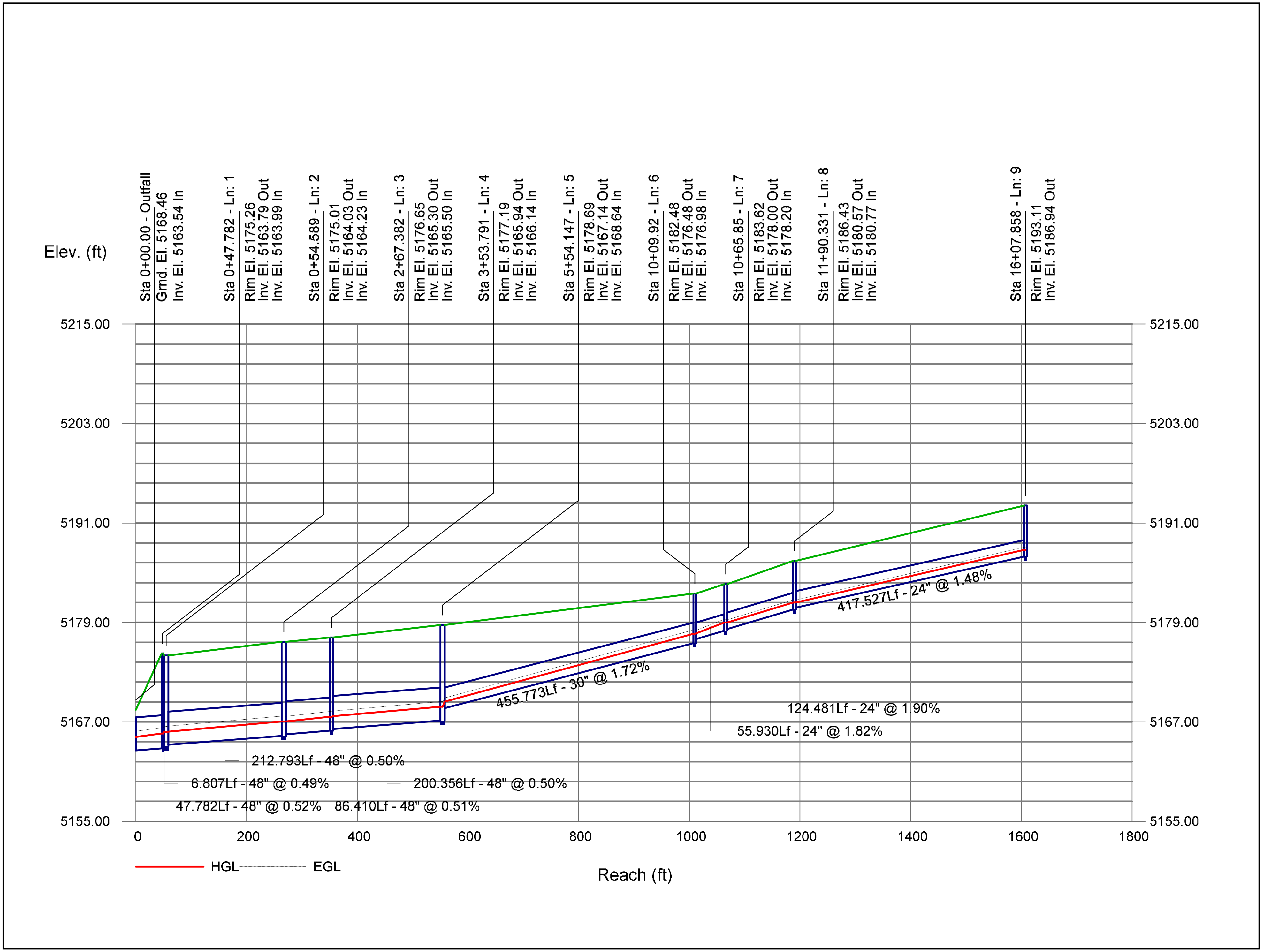
Line No.	Line ID	Inlet ID	Line Rise (in)	Line Span (in)	Line Length (ft)	Line Slope (%)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	n-val Pipe
47	97	SDMH-38	36	36	252.311	0.50	2.30	47.39	1.94	5166.77	5165.50	5167.25 j	5167.04	5167.41	5167.20	0.013
48	96	SDI-32	36	36	197.717	0.50	2.30	47.19	3.34	5167.96	5166.97	5168.43	5167.42	5168.59	5167.58	0.013

Project File: 1104_5YrHGL_SystemB.stm | Number of lines: 48 | Date: 11/23/2020

NOTES: ** Critical depth

Storm Sewer Profile

Proj. file: 1104_5YrHGL_SystemB.stm



Storm Sewer Profile

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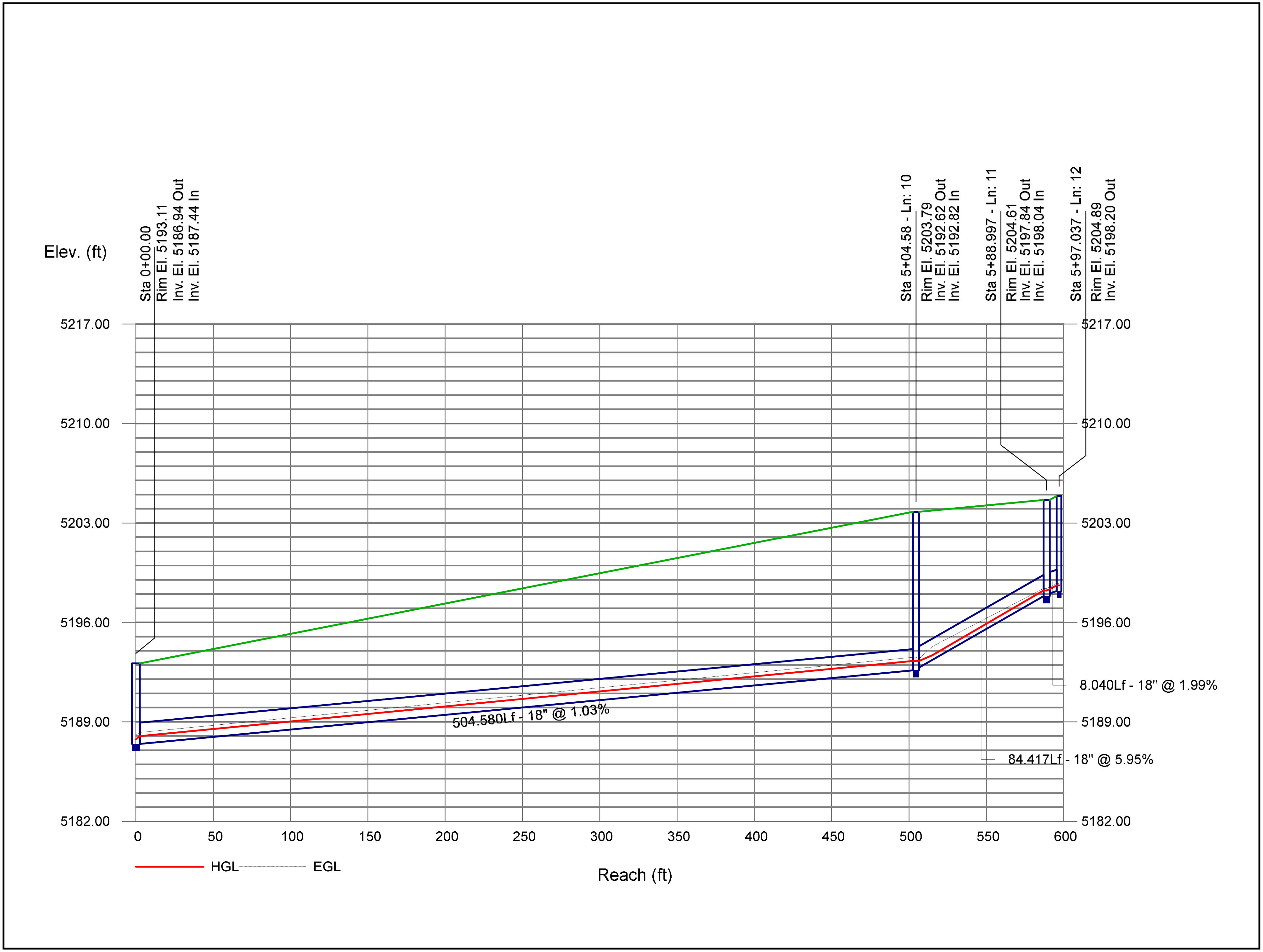

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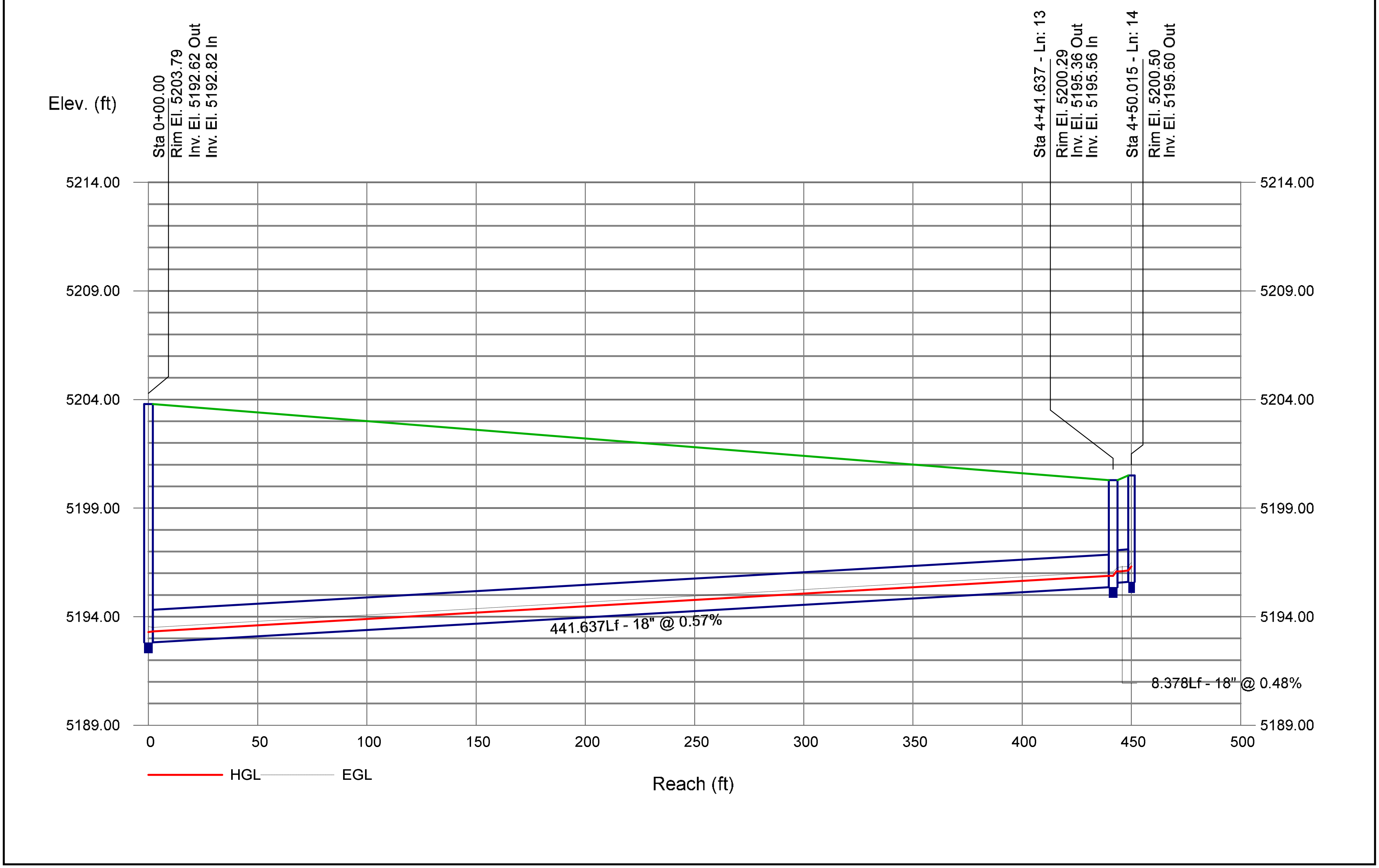

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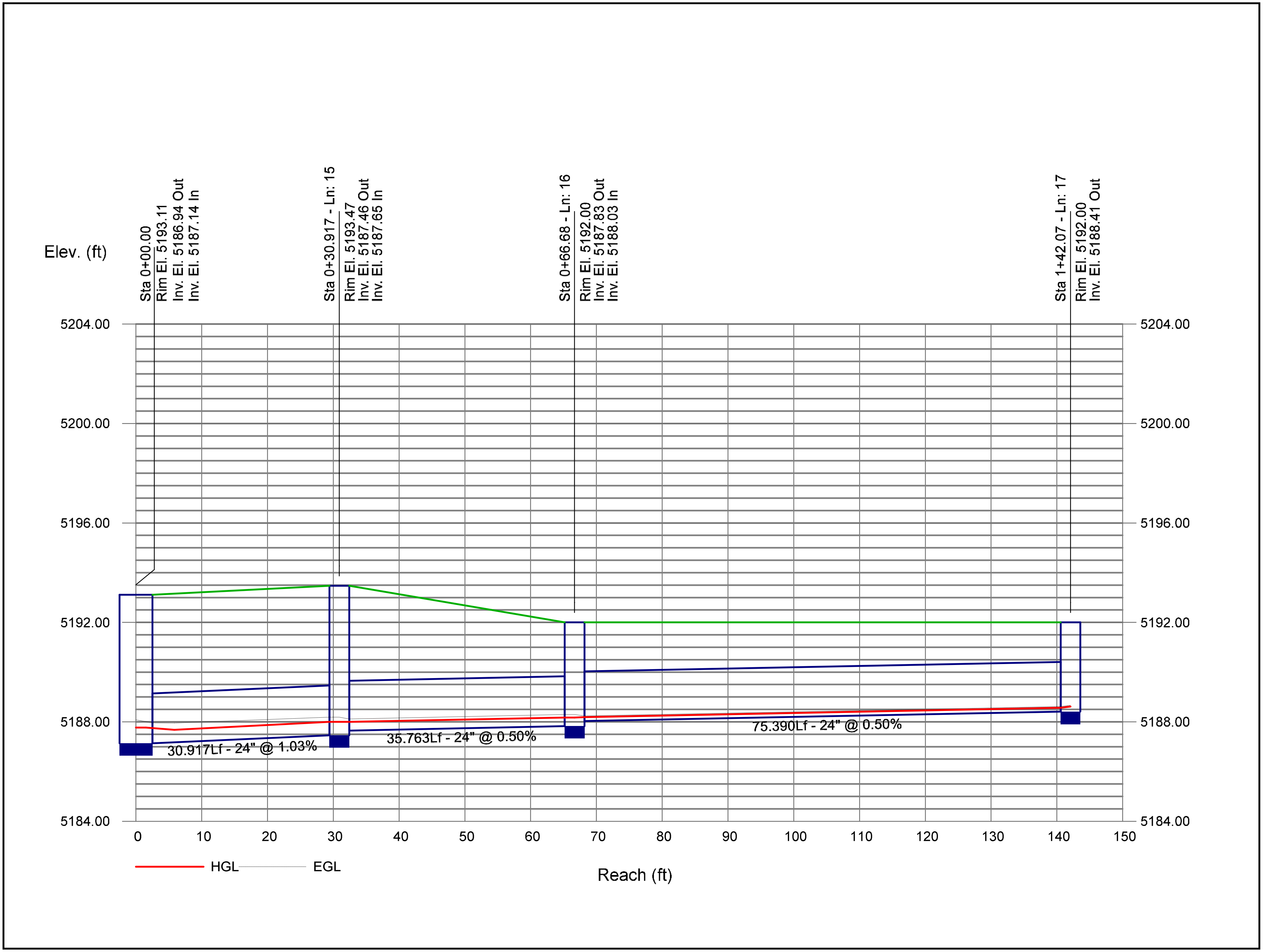

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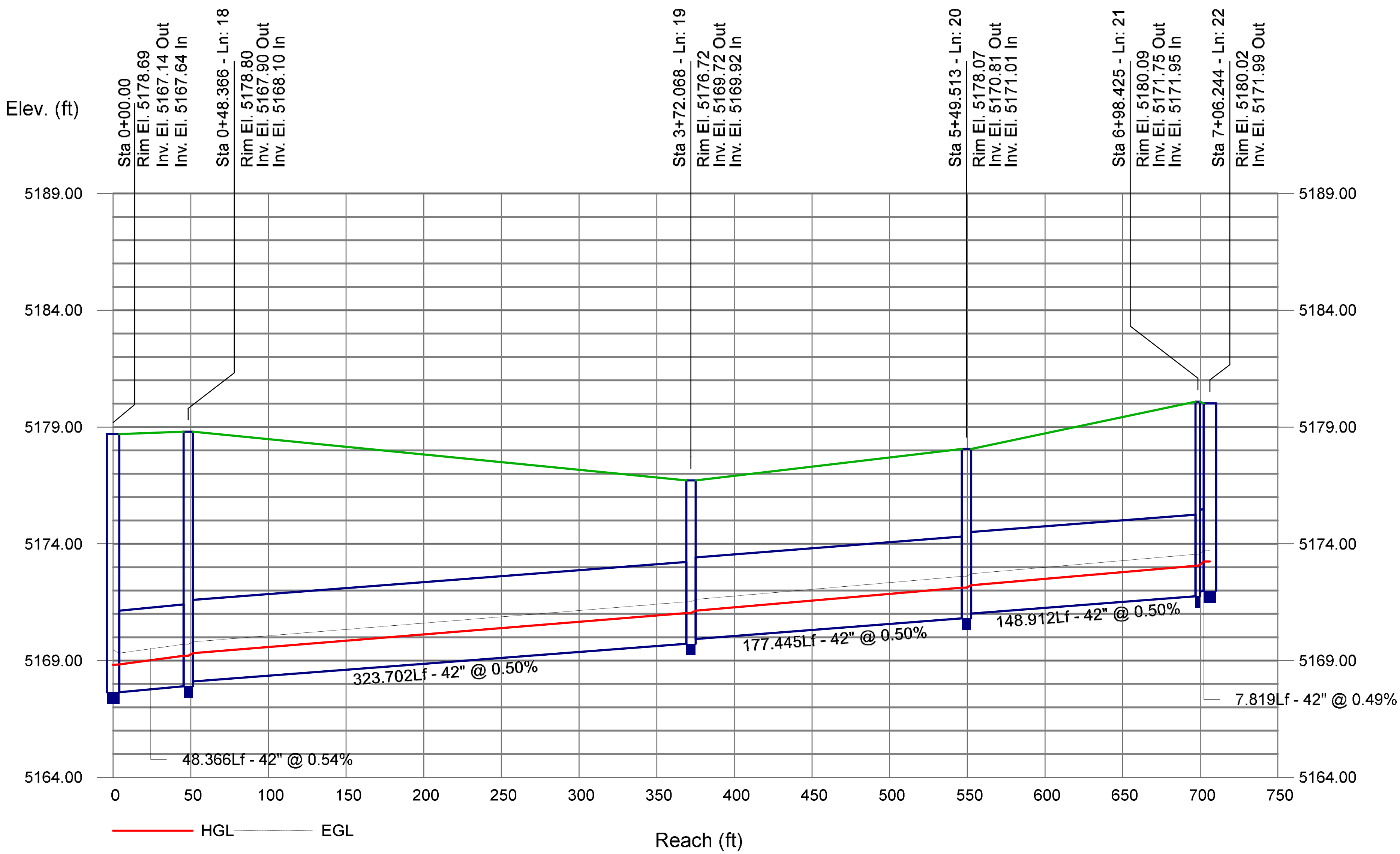

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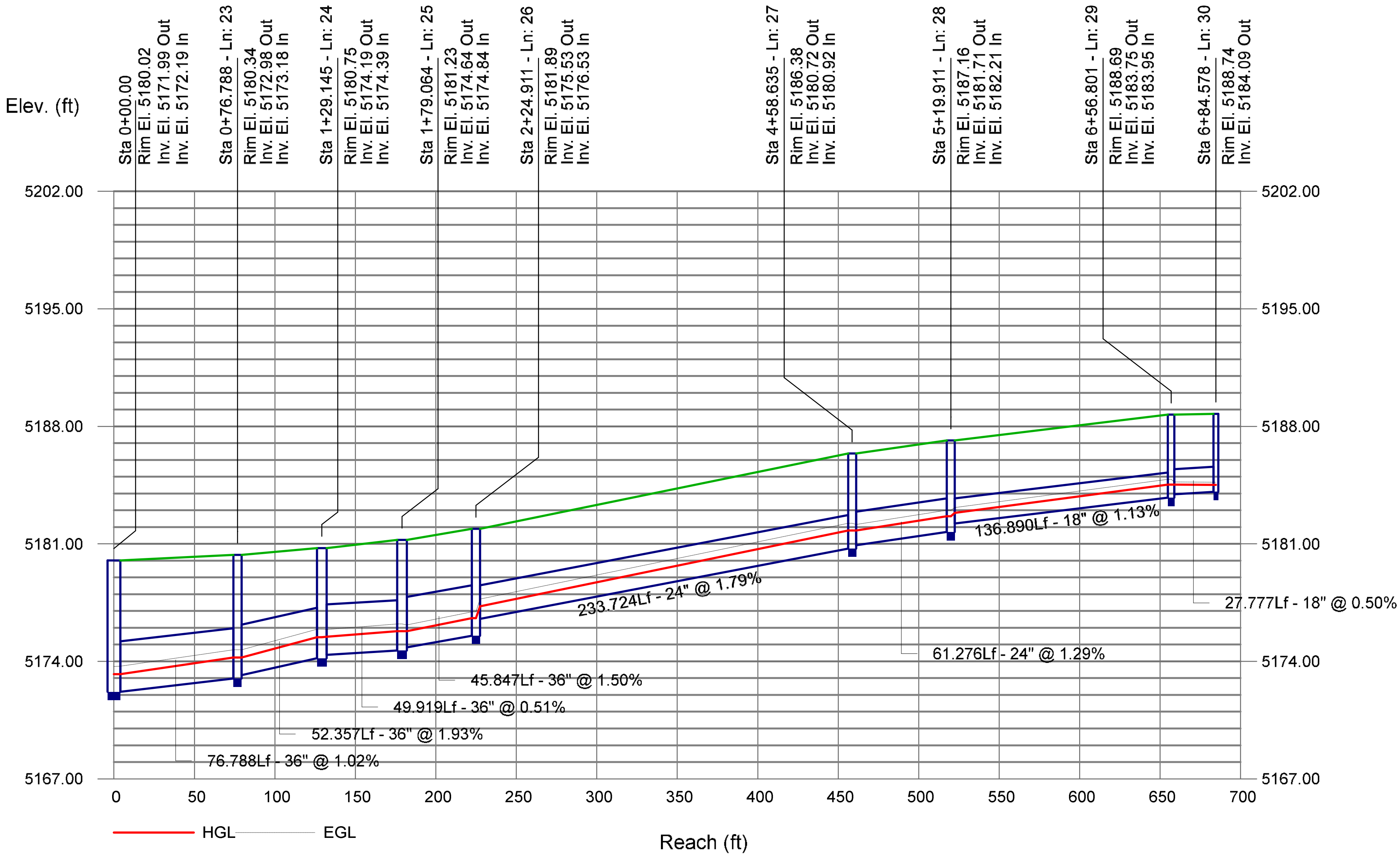

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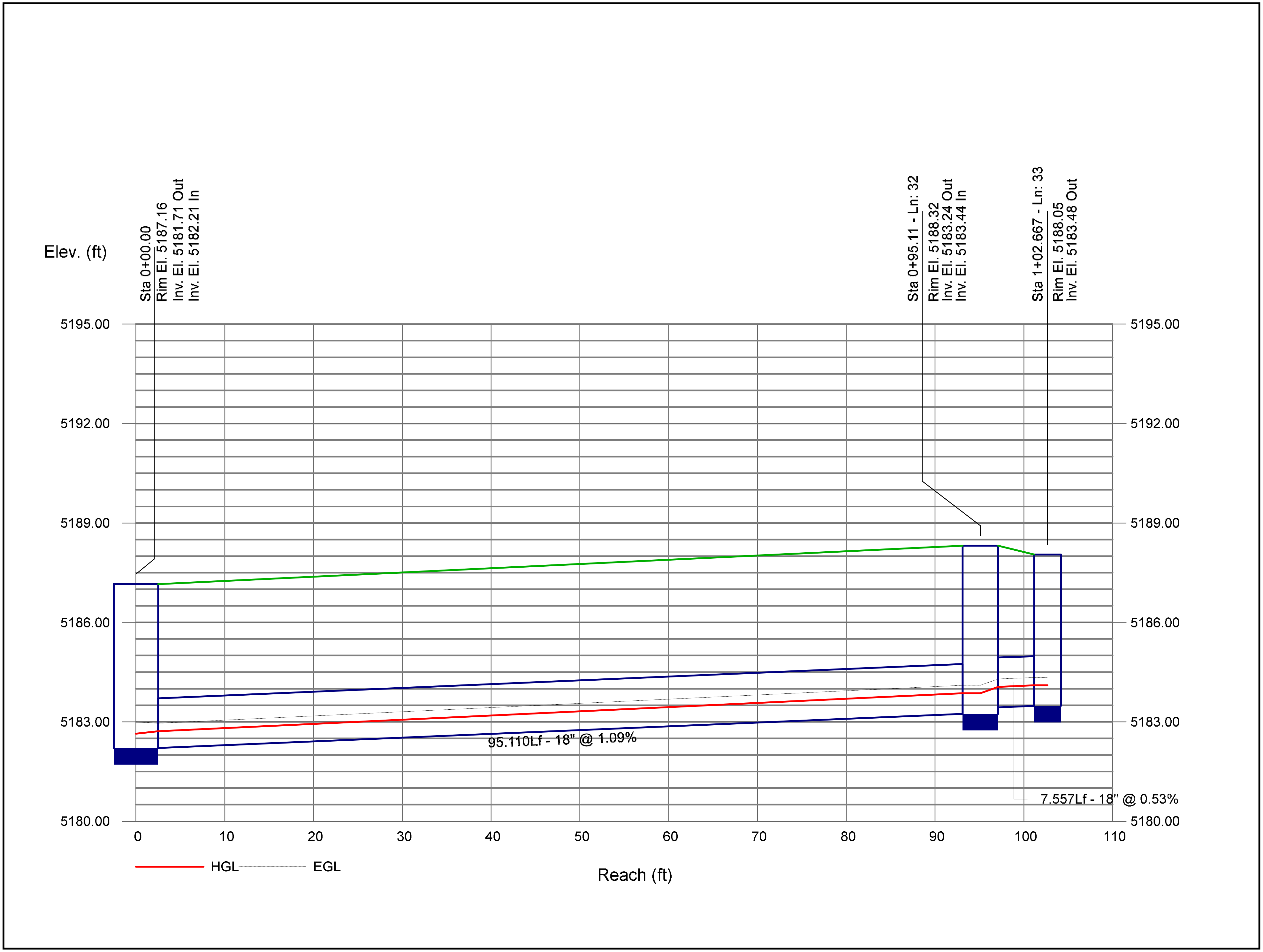

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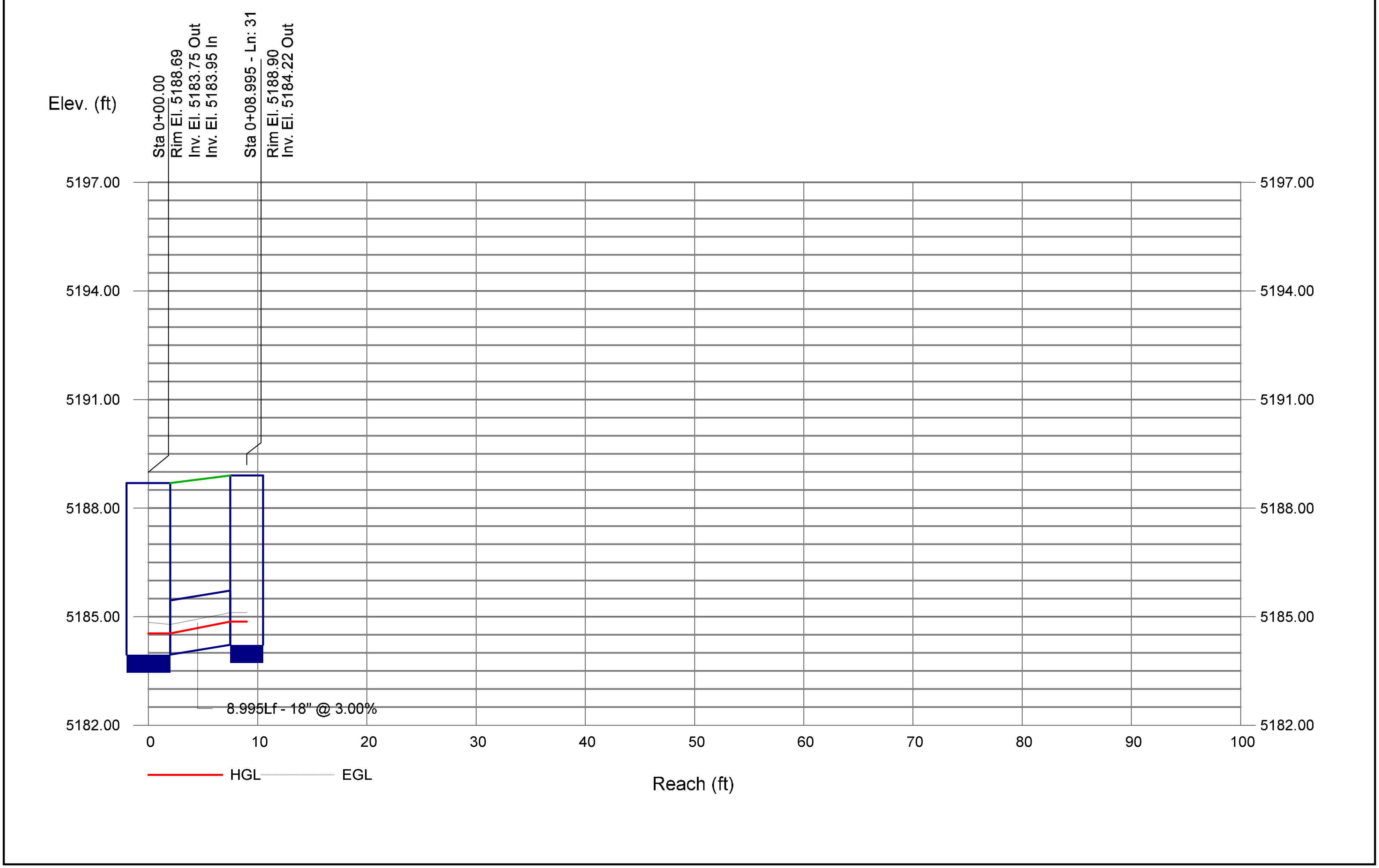

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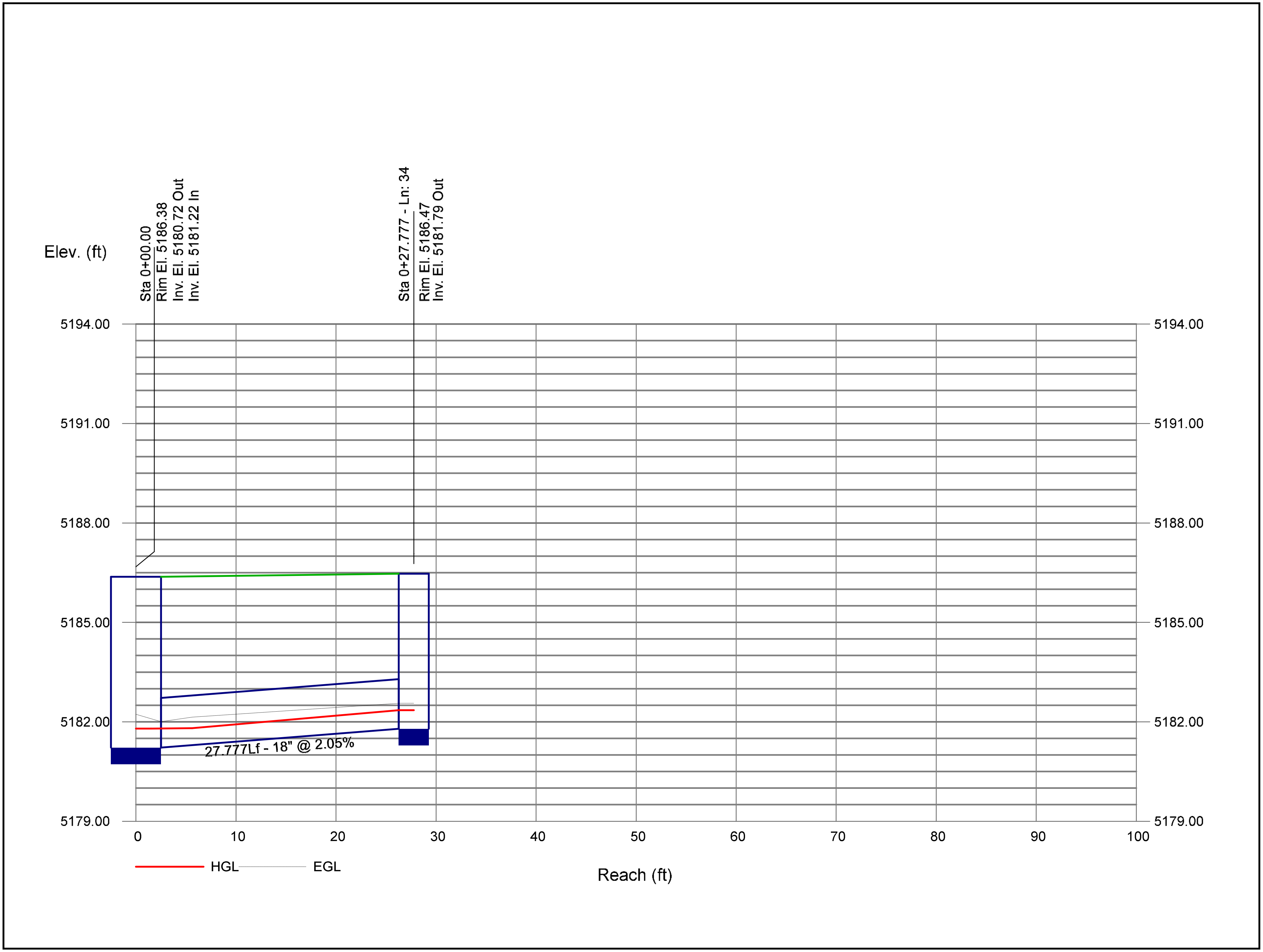

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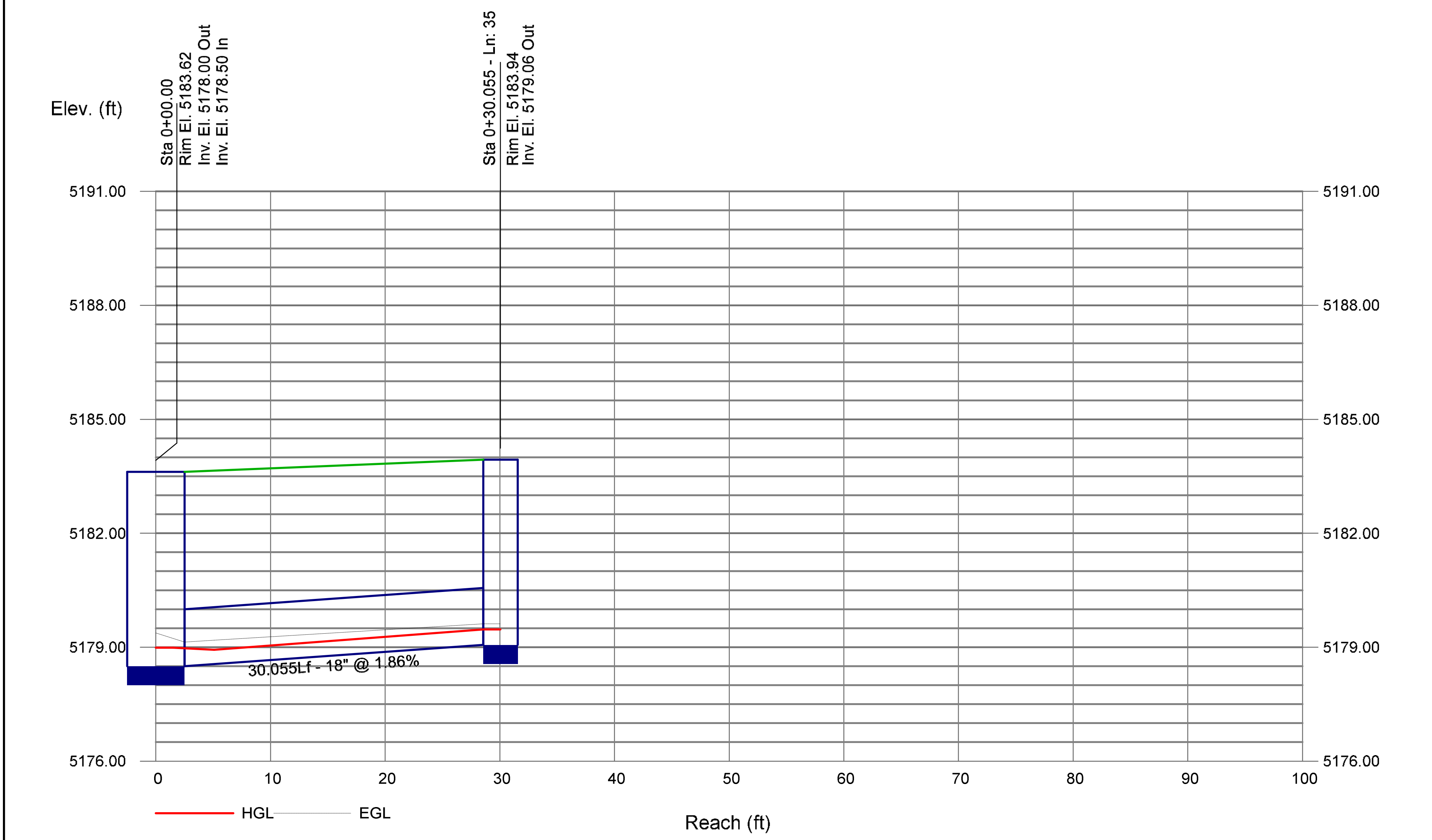

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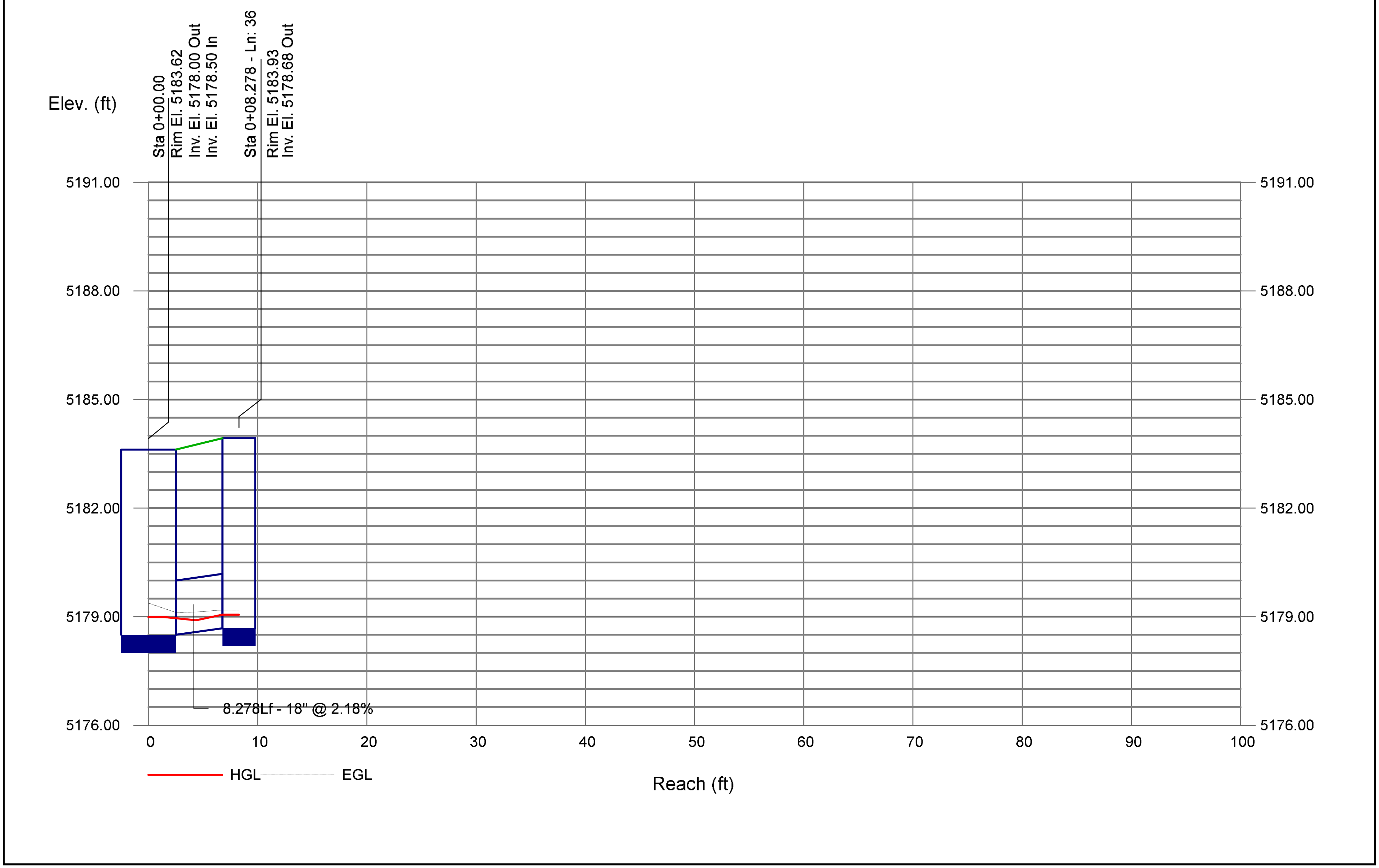

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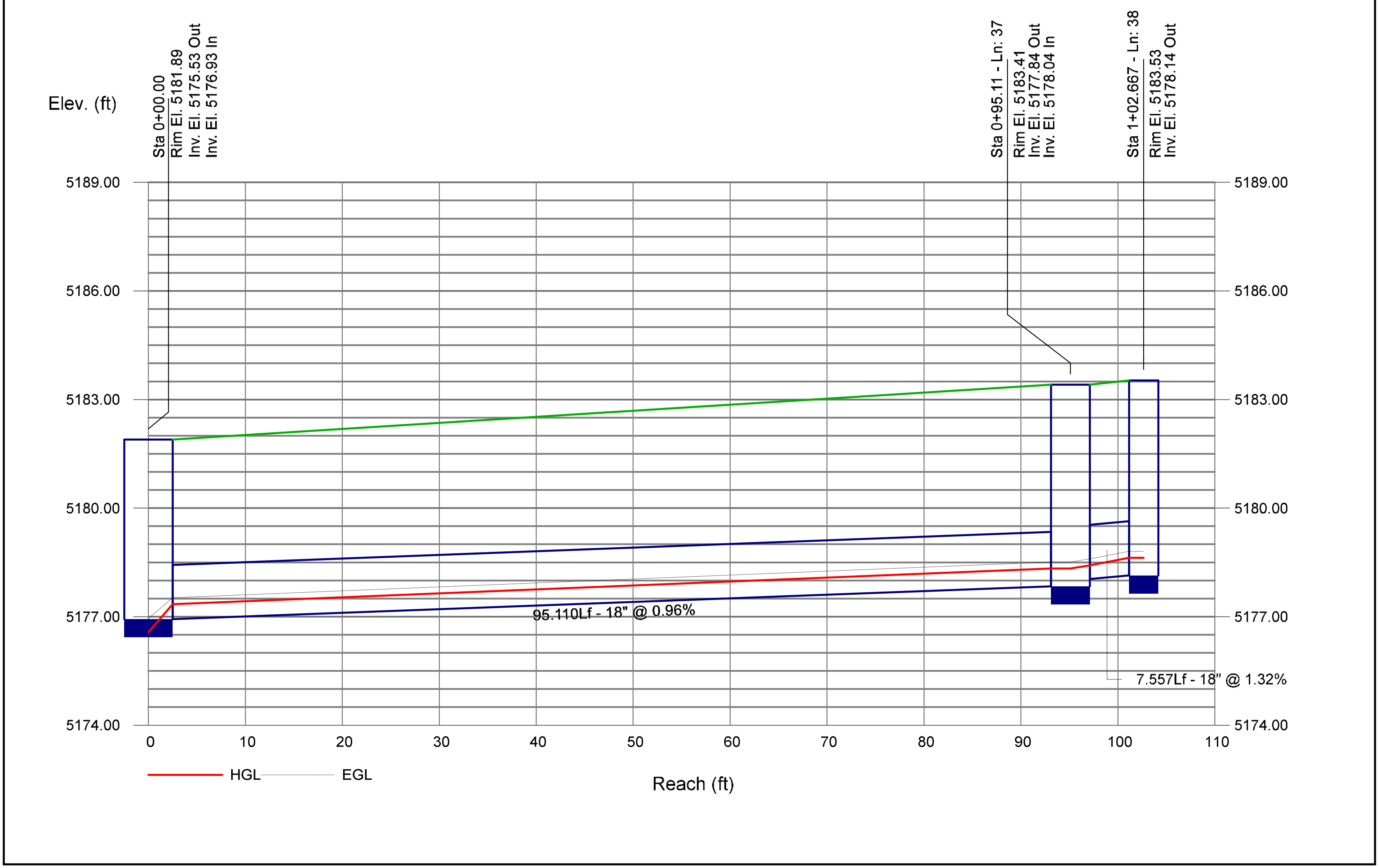

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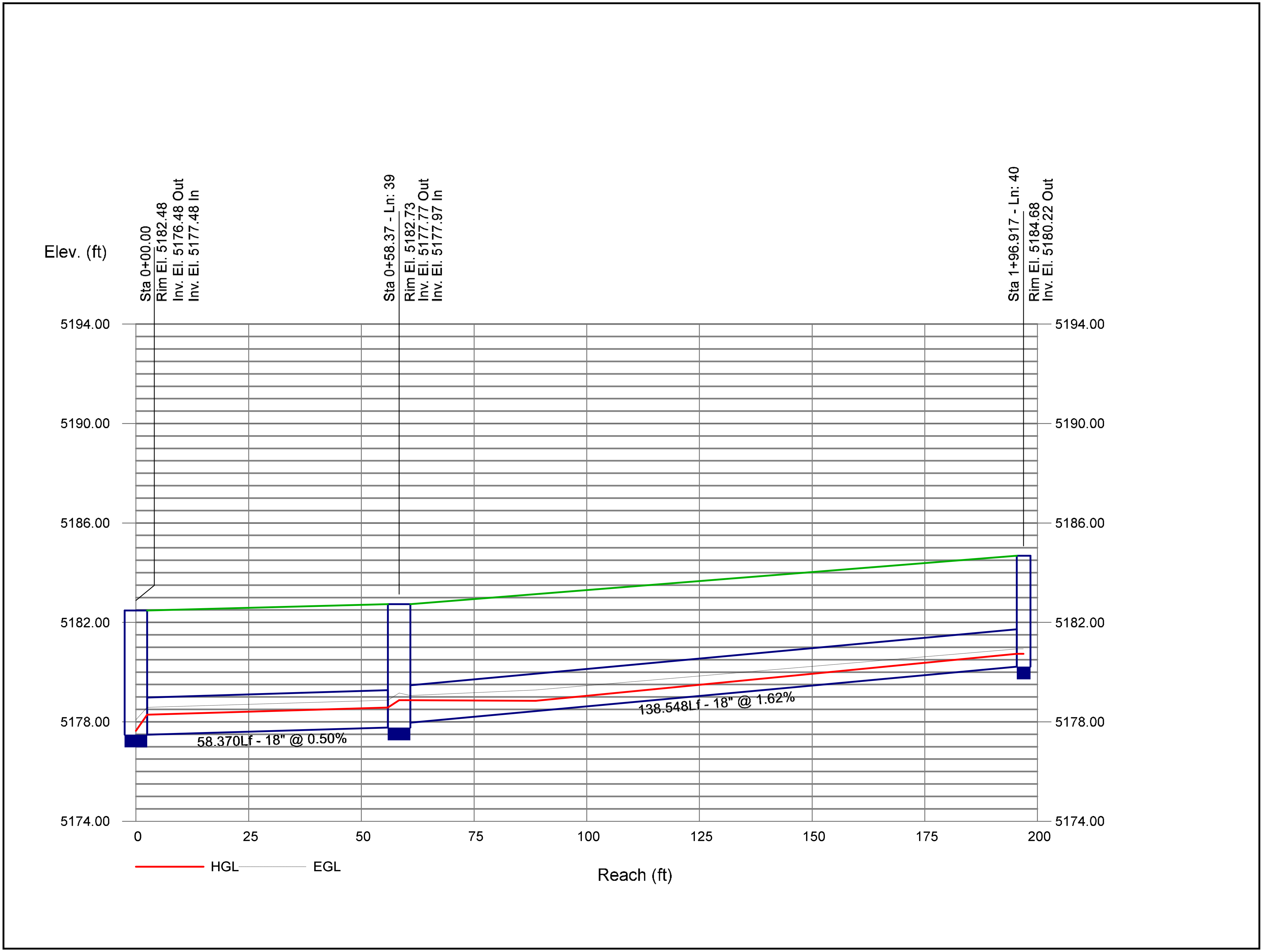

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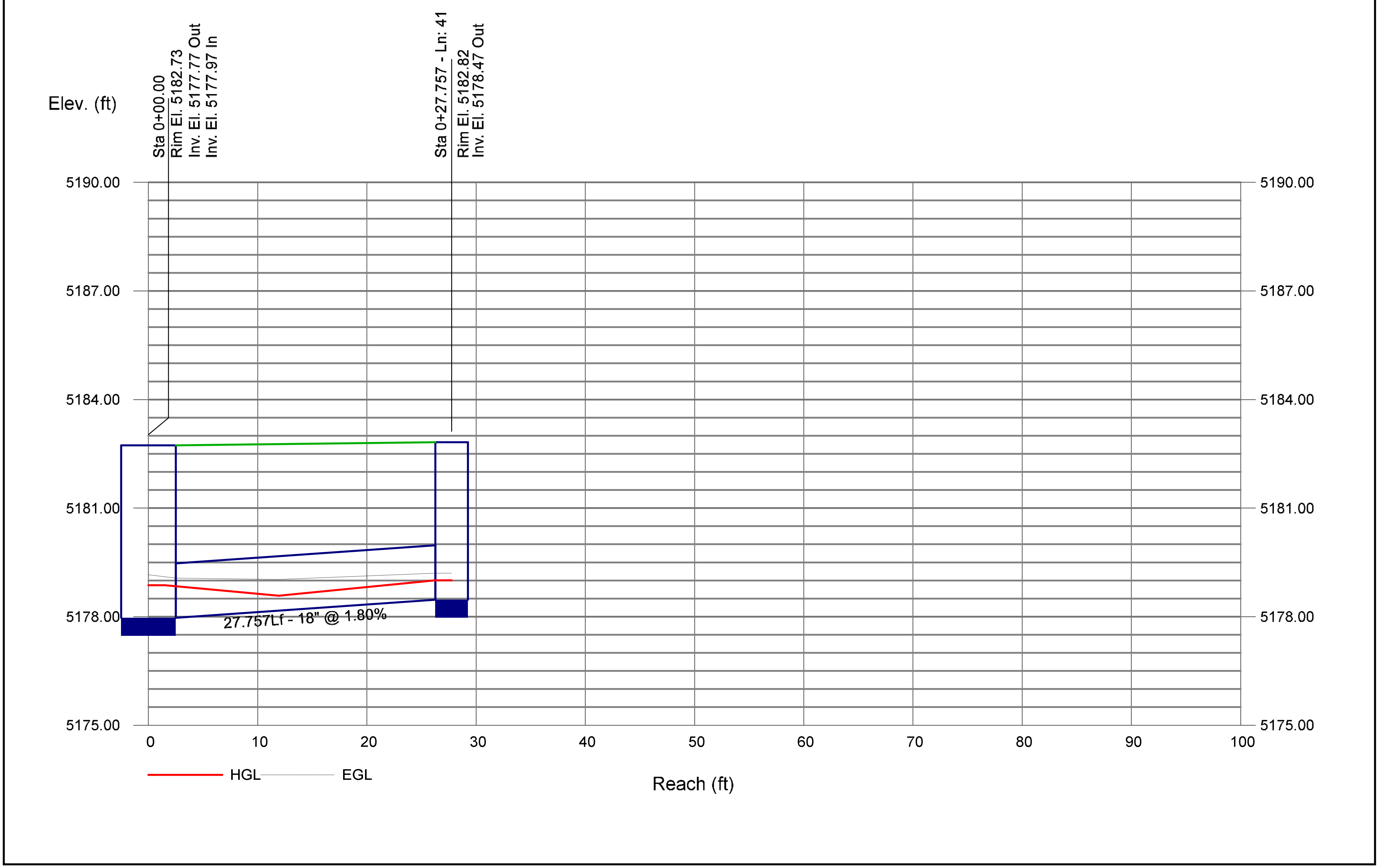

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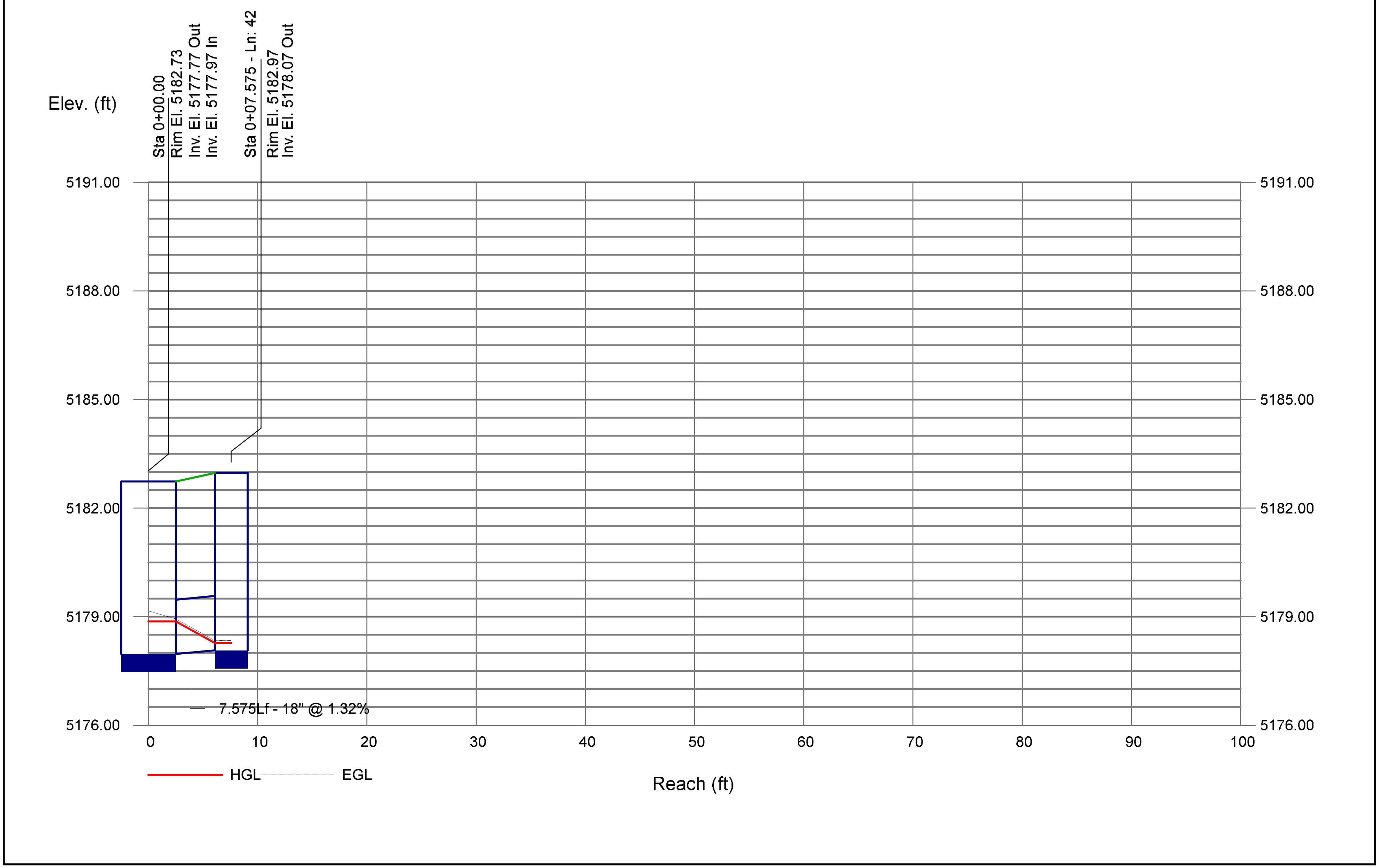

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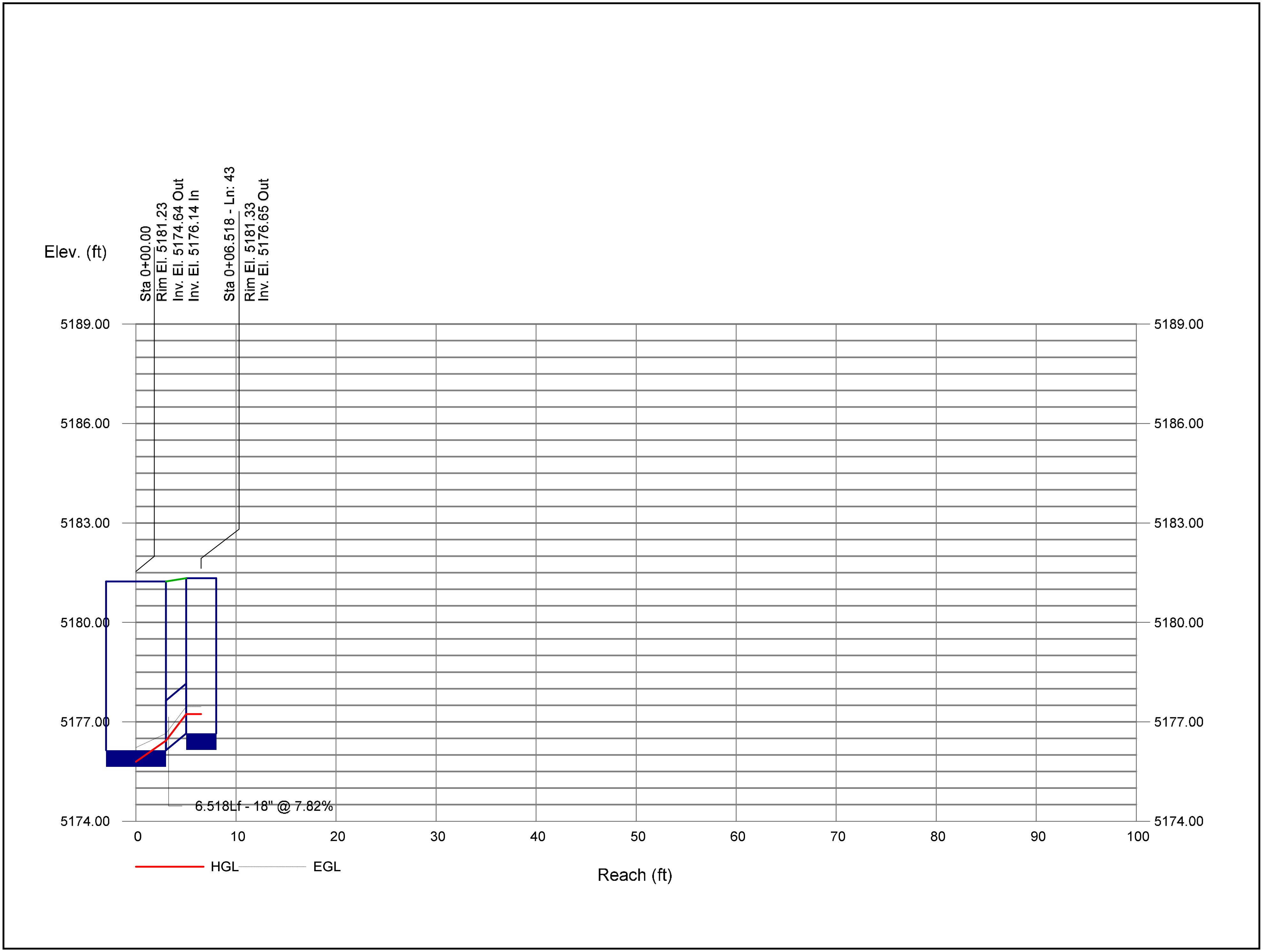

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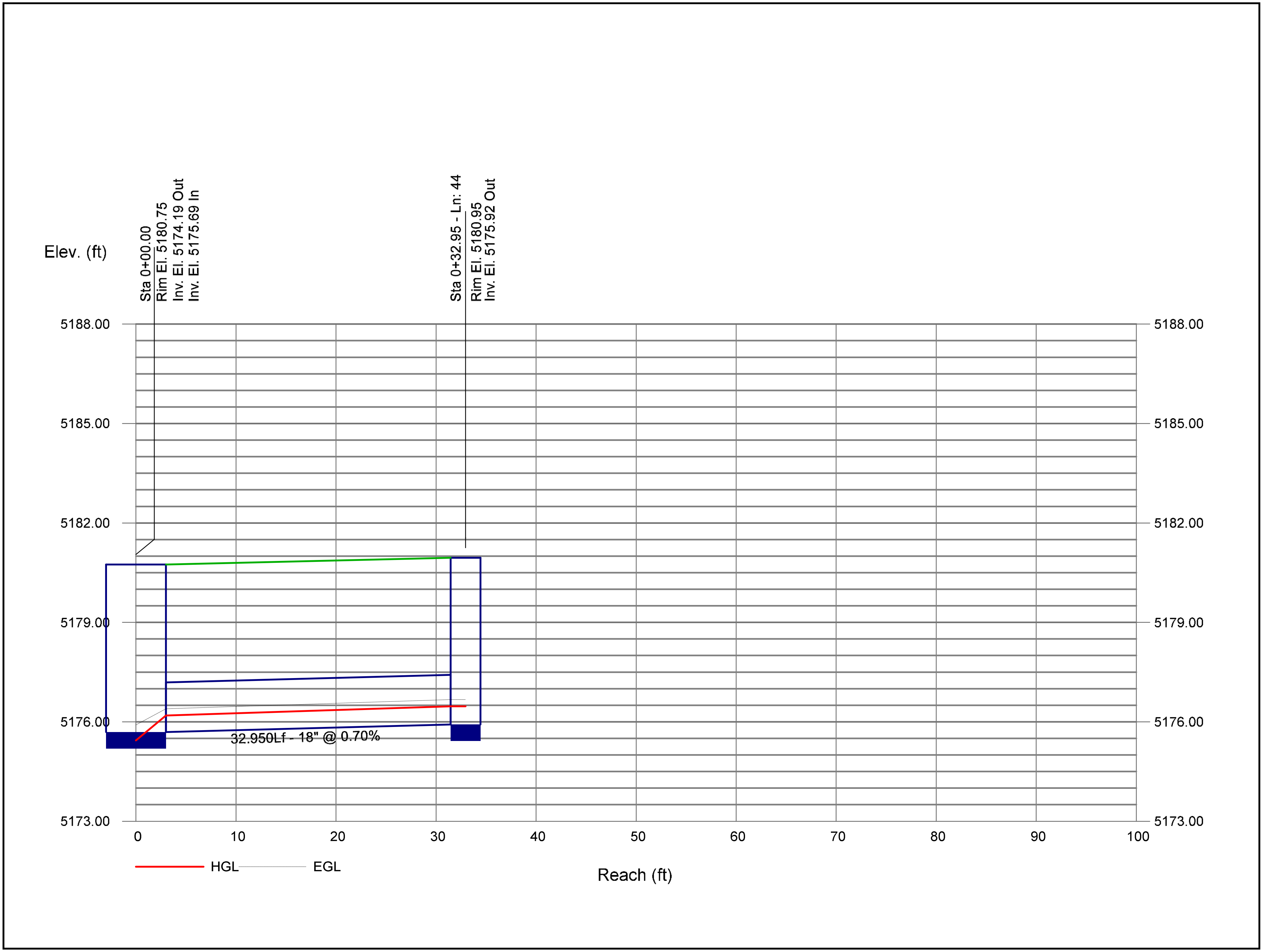

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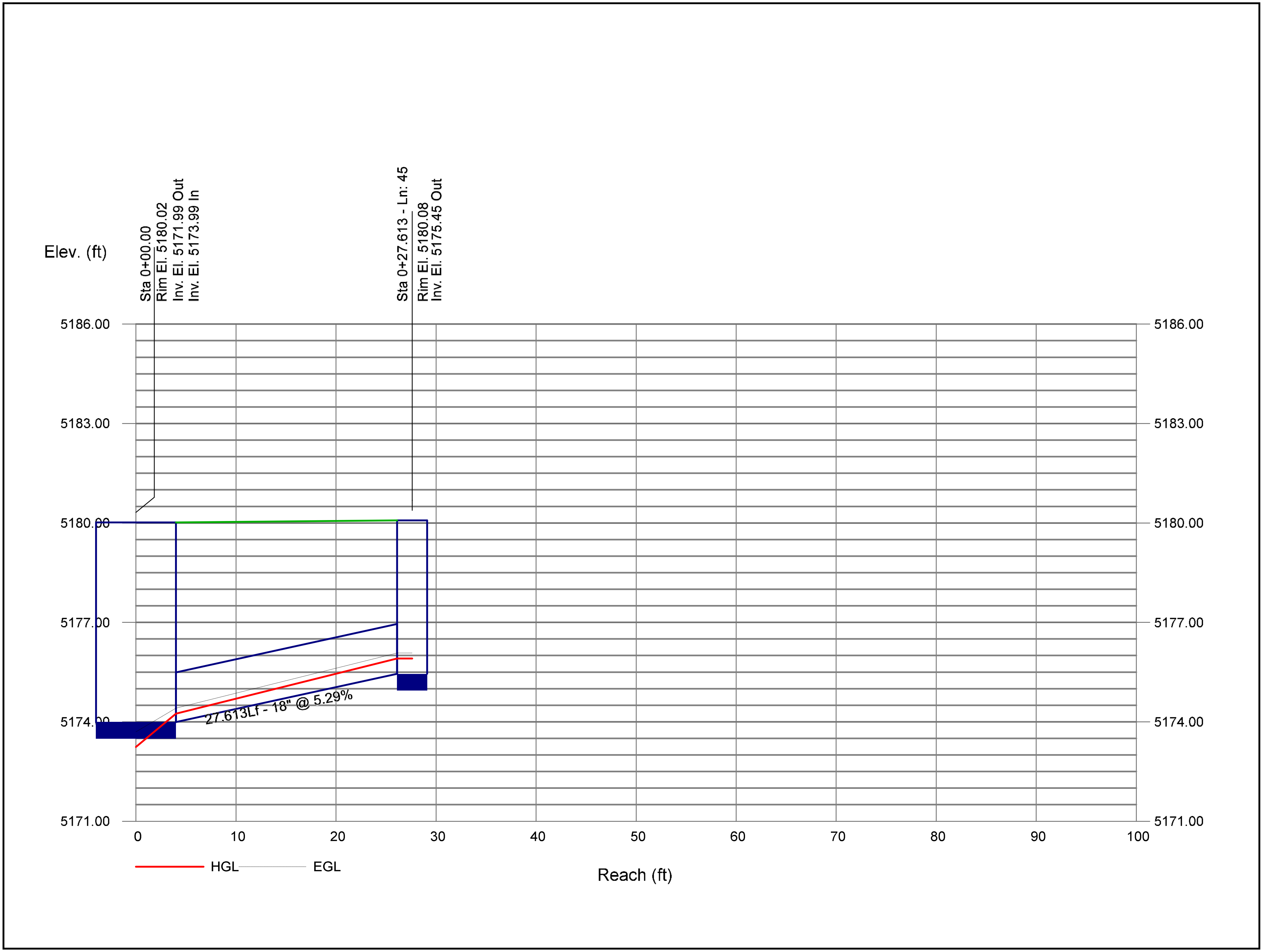

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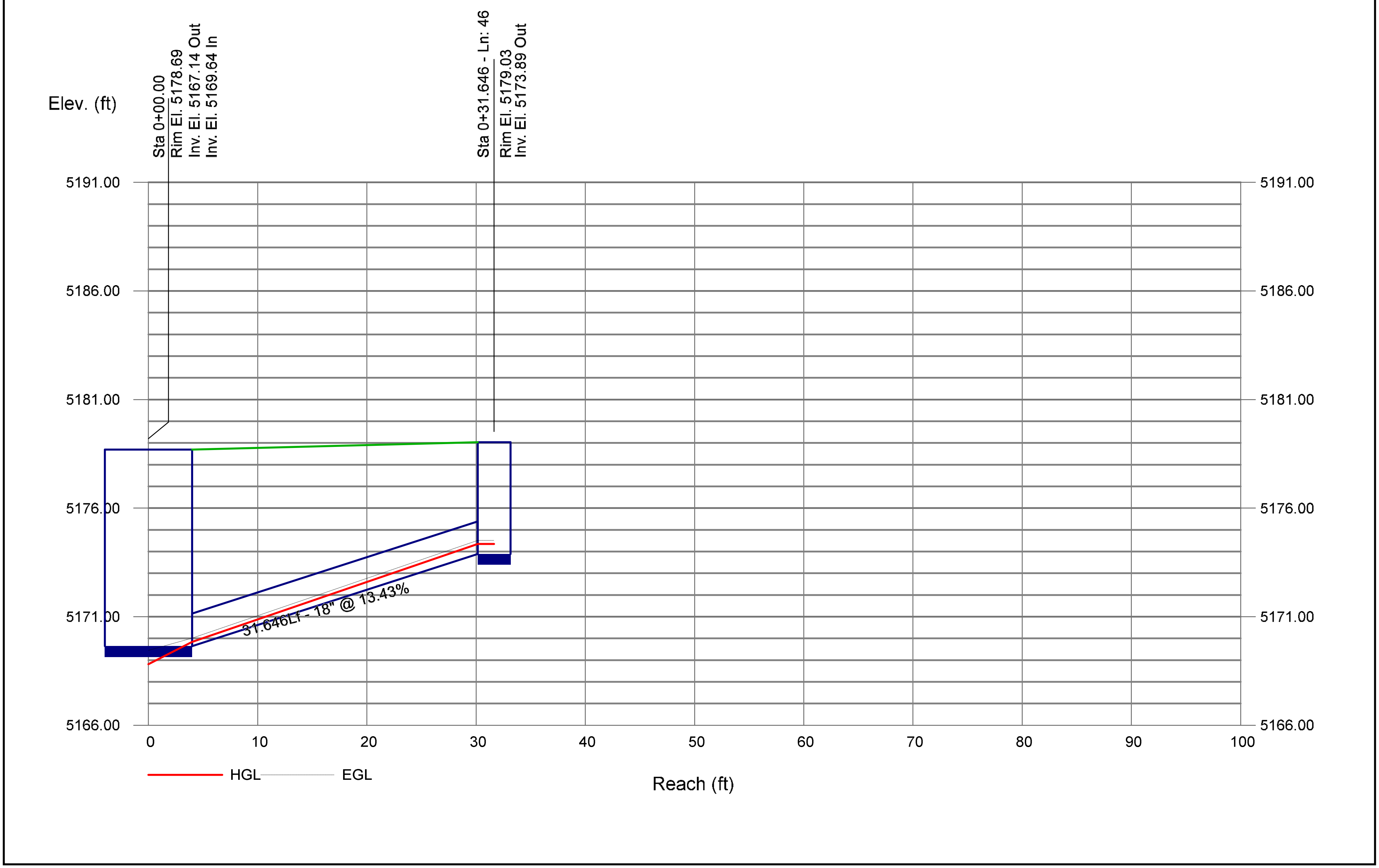

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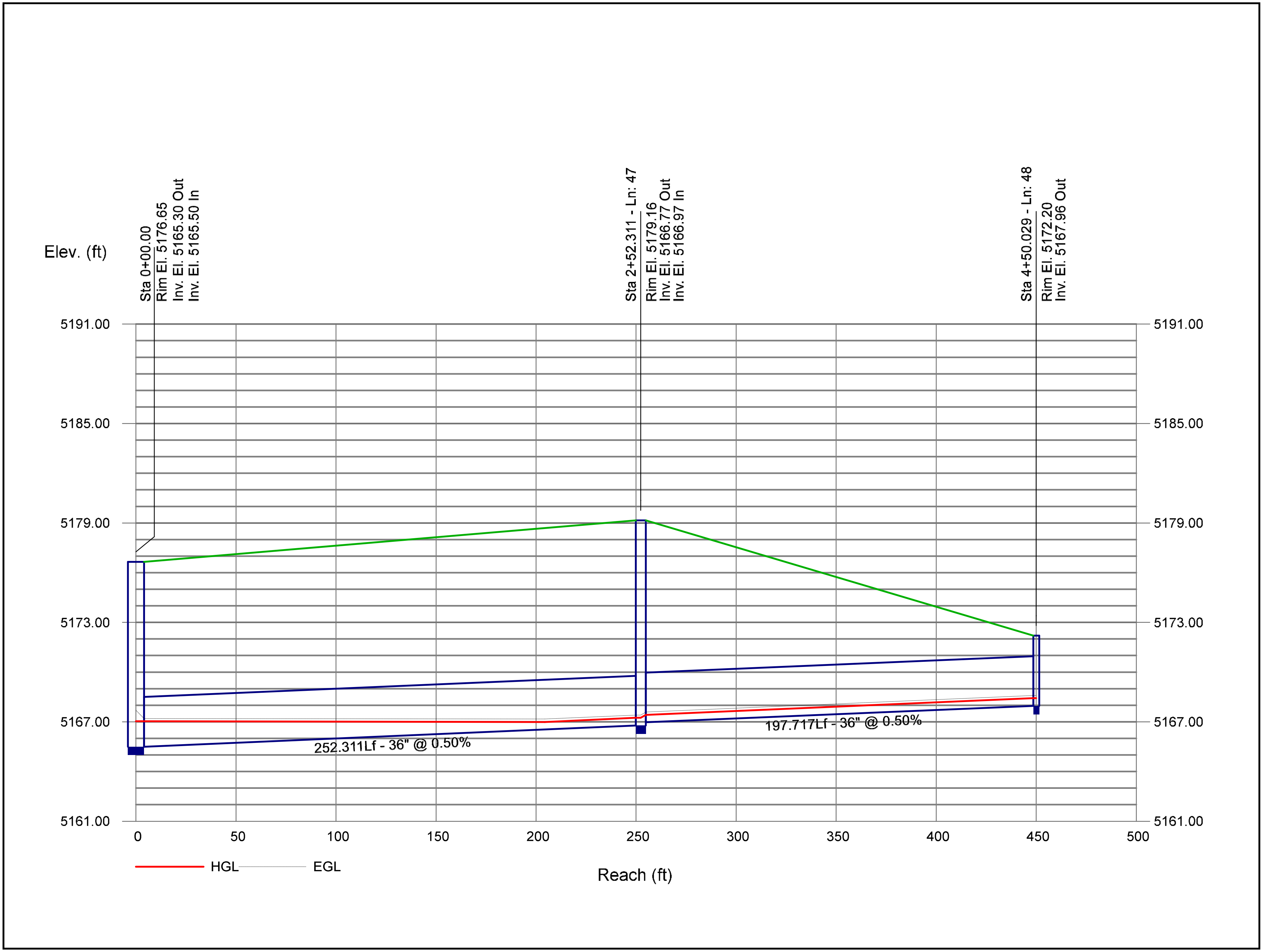


Appendix B – Hydraulic Computations
Rip-Rap Apron Design

Circular Conduit Outlet Riprap Pad Calculations

Job Name: Westwood
Job Number: 1104
Date: 11/24/2020

Pipe Outfall ID	Pipe Diameter/ Equivalent Conduit Diameter (in)	100-Year Flow (cfs)	Flow Source	Outlet Invert (ft)	Tailwater Elevation[5] (ft)	Trailwater Depth, Y_t (ft)	Allowable Non-Eroding Velocity[1] (fps)	A_t[4] (sqft)	Y_t/D	Q/D^2.5	Expansion Factor[6]	θ[7]	Minimum L_p[11] (ft)	Maximum L_p[11] (ft)	Calculated L_p[2] (ft)	Riprap Apron[3]		Low Tailwater[9]			d_{50}[8] (ft)	Riprap Class[10]	Class D_{50}[10] (in)	Riprap Thickness[3,9] (ft)
																L[3,11] (ft)	T[3,7] (ft)	D[9] (ft)	W[9] (ft)	L[9] (ft)				
System A Line No. 1 (CD Line ID: 15, Inlet ID: SDI-05)	48	128.9	Hydraflow Storm Sewer	5163.54	5165.93	2.4	5	25.8	0.6	4.0	6.0	0.08	12.0	40.0	40.7	40.0	10.7	-	-	-	0.69	L	9	1.5
System B Line No. 1 (CD Line ID: 06, Inlet ID: SDI-26)	48	115.1	Hydraflow Storm Sewer	5163.54	5165.93	2.4	5	23.0	0.6	3.6	6.7	0.07	12.0	40.0	37.7	37.7	9.6	-	-	-	0.61	L	9	1.5
System A Line No. 44 (CD Line ID: 111, Inlet ID: SDI-20)	24	7.9	Hydraflow Storm Sewer	5161.77	5165.93	4.2	5	1.6	2.1	1.4	6.7	0.07	6.0	20.0	-10.9	6.0	2.9	-	-	-	0.03	L	9	1.5
System A Line No. 46 (CD Line ID: 02, Inlet ID: SDI-01)	24	11.2	Hydraflow Storm Sewer	5161.77	5165.93	4.2	5	2.2	2.1	2.0	6.7	0.07	6.0	20.0	-9.8	6.0	2.9	-	-	-	0.04	L	9	1.5
System A Line No. 48 (CD Line ID: 01, Inlet ID: POND OUTFALL-1)	48	110.3	MHFD Detention Spreadsheet	5159.72	5163.72	4.0	5	22.1	1.0	3.4	6.7	0.07	12.0	40.0	10.2	12.0	5.8	-	-	-	0.32	L	9	1.5

1 - USDCM Volume 2: 5 ft/sec for non-cohesive soils and at 7 ft/sec for erosion resistant soils.
2 - USDCM Volume 2: Equation 9-11
3 - USDCM Volume 2: Figure 9-34
4 - USDCM Volume 2: Equation 9-12
5 - Based on MHFD Detention Spreadsheet Basin 100-Year WSE
6 - USDCM Volume 2: Figure 9-35
7 - USDCM Volume 2: Equation 9-14
8 - USDCM Volume 2: Equation 9-16
9 - USDCM Volume 2: Figure 9-37
10 - USDCM Volume 1: Figure 8-34
11 - USDCM Volume 2: Min L_p = 3D, Max L_p = 10D.

$$L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right)$$ Equation 9-11

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

and:

$$A_t = \frac{Q}{V}$$ Equation 9-12

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_t = required area of flow at allowable velocity (ft²)

$$\theta = \tan^{-1}\left(\frac{1}{2(\text{ExpansionFactor})}\right)$$ Equation 9-13

Where:

Expansion Factor = determined using Figure 9-35 or 9-36

T is then calculated using the following equation:

$$T = 2(L_p \tan\theta) + W$$ Equation 9-14

Circular culvert:

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$ Equation 9-16

D_c = diameter of circular culvert (ft)

RICK ENGINEERING COMPANY

Interim Monaco Culvert Riprap Apron Sizing

Rectangular Conduit Outlet Riprap Pad Calculations

Job Name: Westwood
Job Number: 1104
Date: 11/24/2020

Pipe Outfall ID	Width of Rectangular Conduit, W (in)	Height of Rectangular Conduit, H (in)	100-Year Flow (cfs)	Flow Source	Outlet Invert (ft)	Tailwater Elevation[5] (ft)	Allowable Non-Eroding Velocity[1] (fps)	Trailwater Depth, Y_t (ft)	A_t[4] (sqft)	Y_t/H	Q/WH^1.5	Expansion Factor[6]	θ[7]	Minimum L_P[11] (ft)	Maximum L_P[11] (ft)	Calculated L_P[2] (ft)	Recommended Riprap Apron[3]		Low Tailwater[9]			d_{50}[8] (ft)	Riprap Class[10]	Class D_{50}[10] (in)	Riprap Thickness[3,9] (ft)
																	L[3,11] (ft)	T[3,7] (ft)	D[9] (ft)	W[9] (ft)	L[9] (ft)				
N. Monaco St. Crossing	420	24	184.4	MHFD Detention Spreadsheet	5158.95	5159.74	5	0.79	36.9	0.4	1.9	6.3	0.08	6.0	20.0	74.4	20.0	38.2	-	-	-	0.13	L	9	1.5

1 - USDCM Volume 2: 5 ft/sec for non-cohesive soils and at 7 ft/sec for erosion resistant soils.
2 - USDCM Volume 2: Equation 9-11
3 - USDCM Volume 2: Figure 9-34
4 - USDCM Volume 2: Equation 9-12
5 - HY-8 Culvert Analysis Tailwater WSE
6 - USDCM Volume 2: Figure 9-36
7 - USDCM Volume 2: Equation 9-14
8 - USDCM Volume 2: Equation 9-17
9 - USDCM Volume 2: Figure 9-37
10 - USDCM Volume 1: Figure 8-34
11 - USDCM Volume 2: Min L_p = 3H, Max L_p = 10H.

0

$$L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) \quad \text{Equation 9-11}$$

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

and:

$$A_t = \frac{Q}{V} \quad \text{Equation 9-12}$$

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_t = required area of flow at allowable velocity (ft²)

$$\theta = \tan^{-1}\left(\frac{1}{2(\text{ExpansionFactor})}\right) \quad \text{Equation 9-13}$$

Where:

Expansion Factor = determined using Figure 9-35 or 9-36

T is then calculated using the following equation:

$$T = 2(L_p \tan\theta) + W \quad \text{Equation 9-14}$$

Circular culvert:

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}} \quad \text{Equation 9-16}$$

D_c = diameter of circular culvert (ft)

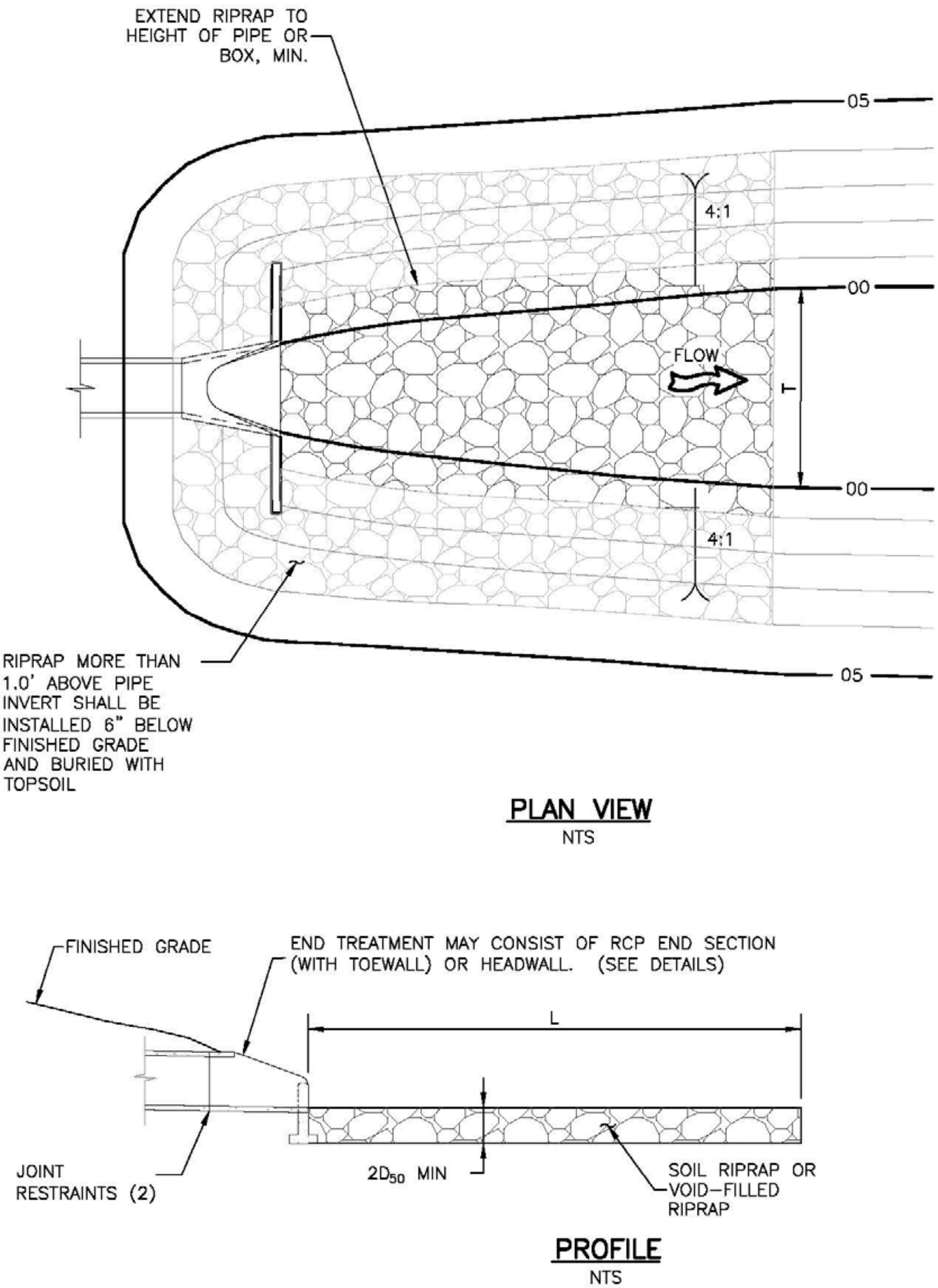


Figure 9-34. Riprap apron detail for culverts in-line with the channel

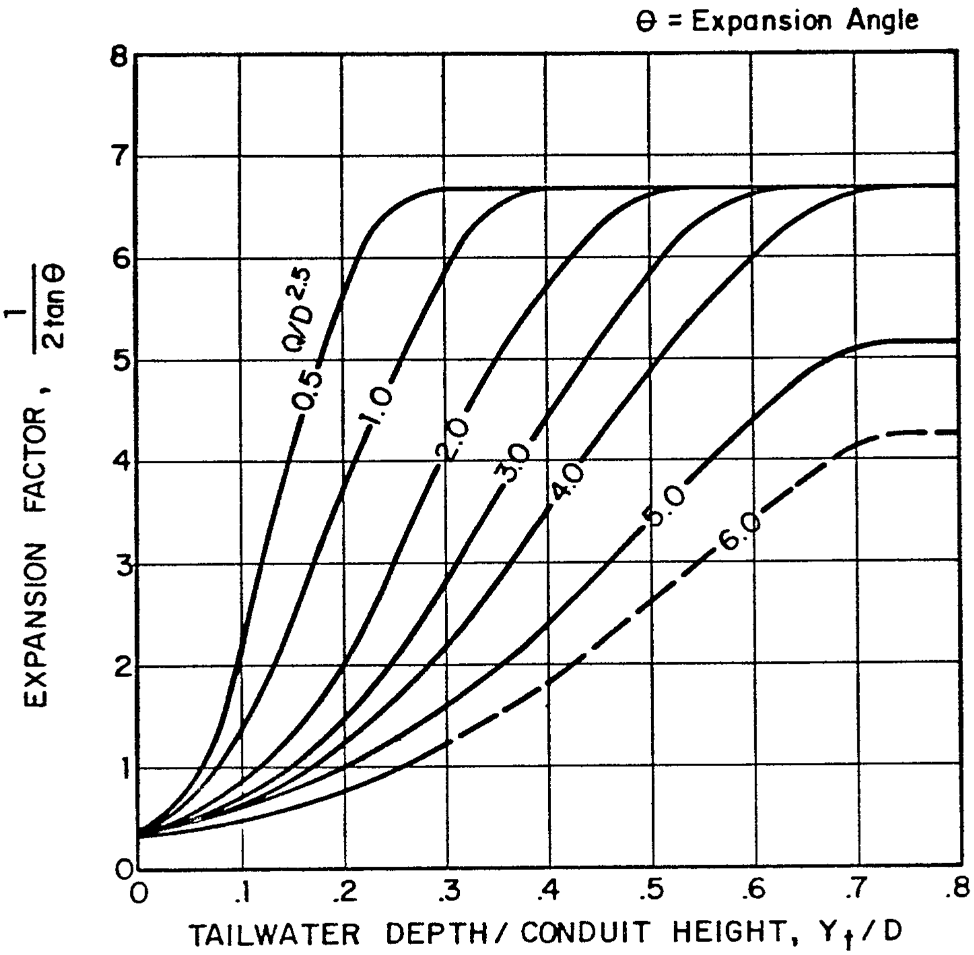


Figure 9-35. Expansion factor for circular conduits

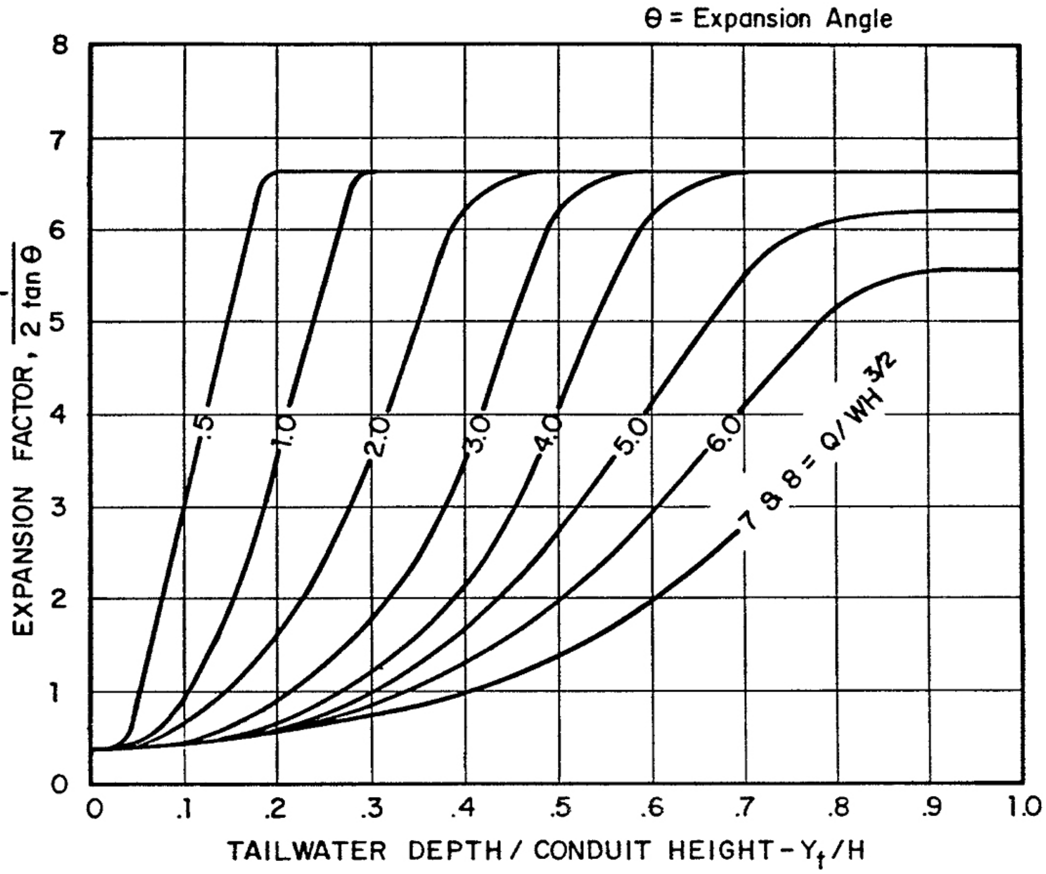
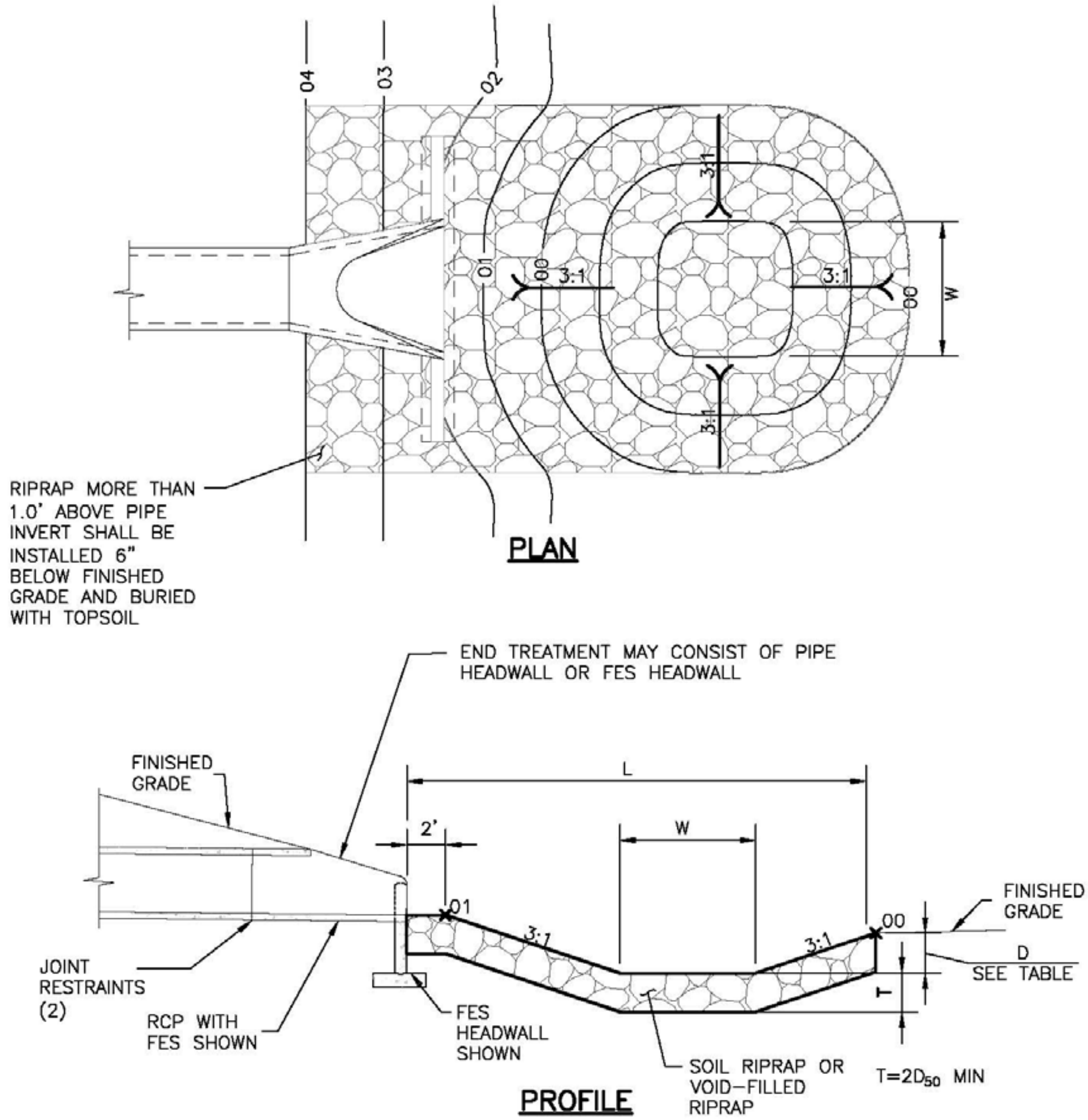


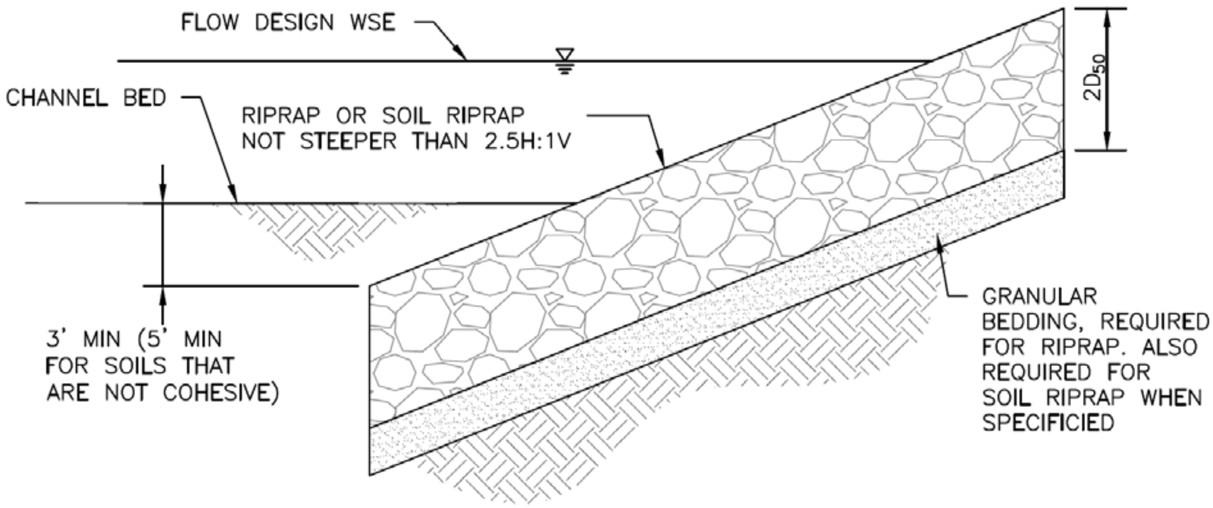
Figure 9-36. Expansion factor for rectangular conduits



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

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

Figure 9-37. Low tailwater riprap basin



RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D_{50}* (INCHES)
TYPE VL	70 – 100 50 – 70 35 – 50 2 – 10	12 9 6 2	6
TYPE L	70 – 100 50 – 70 35 – 50 2 – 10	15 12 9 3	9
TYPE M	70 – 100 50 – 70 35 – 50 2 – 10	21 18 12 4	12
TYPE H	70 – 100 50 – 70 35 – 50 2 – 10	30 24 18 6	18
*D_{50} = MEAN ROCK SIZE			

Figure 8-34. Riprap and soil riprap placement and gradation (part 1 of 3)

SOIL RIPRAP NOTES:

1. ELEVATION TOLERANCES FOR THE SOIL RIPRAP SHALL BE 0.10 FEET. THICKNESS OF SOIL RIPRAP SHALL BE NO LESS THAN THICKNESS SHOWN AND NO MORE THAN 2–INCHES GREATER THAN THE THICKNESS SHOWN.

2. WHERE "SOIL RIPRAP" IS DESIGNATED ON THE CONTRACT DRAWINGS, RIPRAP VOIDS ARE TO BE FILLED WITH NATIVE SOIL. THE RIPRAP SHALL BE PRE–MIXED WITH THE NATIVE SOIL AT THE FOLLOWING PROPORTIONS BY VOLUME: 65PERCENT RIPRAP AND 35 PERCENT SOIL. THE SOIL USED FOR MIXING SHALL BE NATIVE TOPSOIL AND SHALL HAVE A MINIMUM FINES CONTENT OF 15 PERCENT. THE SOIL RIPRAP SHALL BE INSTALLED IN A MANNER THAT RESULTS IN A DENSE, INTERLOCKED LAYER OF RIPRAP WITH RIPRAP VOIDS FILLED COMPLETELY WITH SOIL. SEGREGATION OF MATERIALS SHALL BE AVOIDED AND IN NO CASE SHALL THE COMBINED MATERIAL CONSIST PRIMARILY OF SOIL; THE DENSITY AND INTERLOCKING NATURE OF RIPRAP IN THE MIXED MATERIAL SHALL ESSENTIALLY BE THE SAME AS IF THE RIPRAP WAS PLACED WITHOUT SOIL.

3. WHERE SPECIFIED (TYPICALLY AS "BURIED SOIL RIPRAP"), A SURFACE LAYER OF TOPSOIL SHALL BE PLACED OVER THE SOIL RIPRAP ACCORDING TO THE THICKNESS SPECIFIED ON THE CONTRACT DRAWINGS. THE TOPSOIL SURFACE LAYER SHALL BE COMPACTED TO APPROXIMATELY 85% OF MAXIMUM DENSITY AND WITHIN TWO PERCENTAGE POINTS OF OPTIMUM MOISTURE IN ACCORDANCE WITH ASTM D698. TOPSOIL SHALL BE ADDED TO ANY AREAS THAT SETTLE.

4. ALL SOIL RIPRAP THAT IS BURIED WITH TOPSOIL SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO ANY TOPSOIL PLACEMENT.

GRADATION FOR GRANULAR BEDDING		
U.S. STANDARD SIEVE SIZE	PERCENT PASSING BY WEIGHT	
	TYPE I CDOT SECT. 703.01	TYPE II CDOT SECT. 703.09 CLASS A
3 INCHES	–	90 – 100
1½ INCHES	–	–
¾ INCHES	–	20 – 90
⅜ INCHES	100	–
#4	95 – 100	0 – 20
#16	45 – 80	–
#50	10 – 30	–
#100	2 – 10	–
#200	0 – 2	0 – 3

RIPRAP BEDDING

Figure 8-34. Riprap and soil riprap placement and gradation (part 2 of 3)

THICKNESS REQUIREMENTS FOR GRANULAR BEDDING			
RIPRAP DESIGNATION	MINIMUM BEDDING THICKNESS (INCHES)		
	FINE–GRAINED SOILS [1]		COARSE–GRAINED SOILS [2]
	TYPE I (LOWER LAYER)	TYPE II (UPPER LAYER)	TYPE II
VL (D_{50} = 6 IN)	4	4	6
L (D_{50} = 9 IN)	4	4	6
M (D_{50} = 12 IN)	4	4	6
H (D_{50} = 18 IN)	4	6	8
VH (D_{50} = 24 IN)	4	6	8

NOTES:
1. MAY SUBSTITUTE ONE 12–INCH LAYER OF TYPE II BEDDING. THE SUBSTITUTION OF ONE LAYER OF TYPE II BEDDING SHALL NOT BE PERMITTED AT DROP STRUCTURES. THE USE OF A COMBINATION OF FILTER FABRIC AND TYPE II BEDDING AT DROP STRUCTURES IS ACCEPTABLE.
2. FIFTY PERCENT OR MORE BY WEIGHT RETAINED ON THE #40 SIEVE.

Figure 8-34. Riprap and soil riprap placement and gradation (part 3 of 3)

Signal Irrigation Ditch Culvert - 48" X 76" Elliptical RCP Riprap Sizing

HEC-RAS Summary Output

Start of wing wall concrete apron

Velocity matches outlet velocity of HY-8 culvert analysis

HEC-RAS Plan: 48X76Q100 River: SignalDitch Reach: Reach1 Profile: PF 1

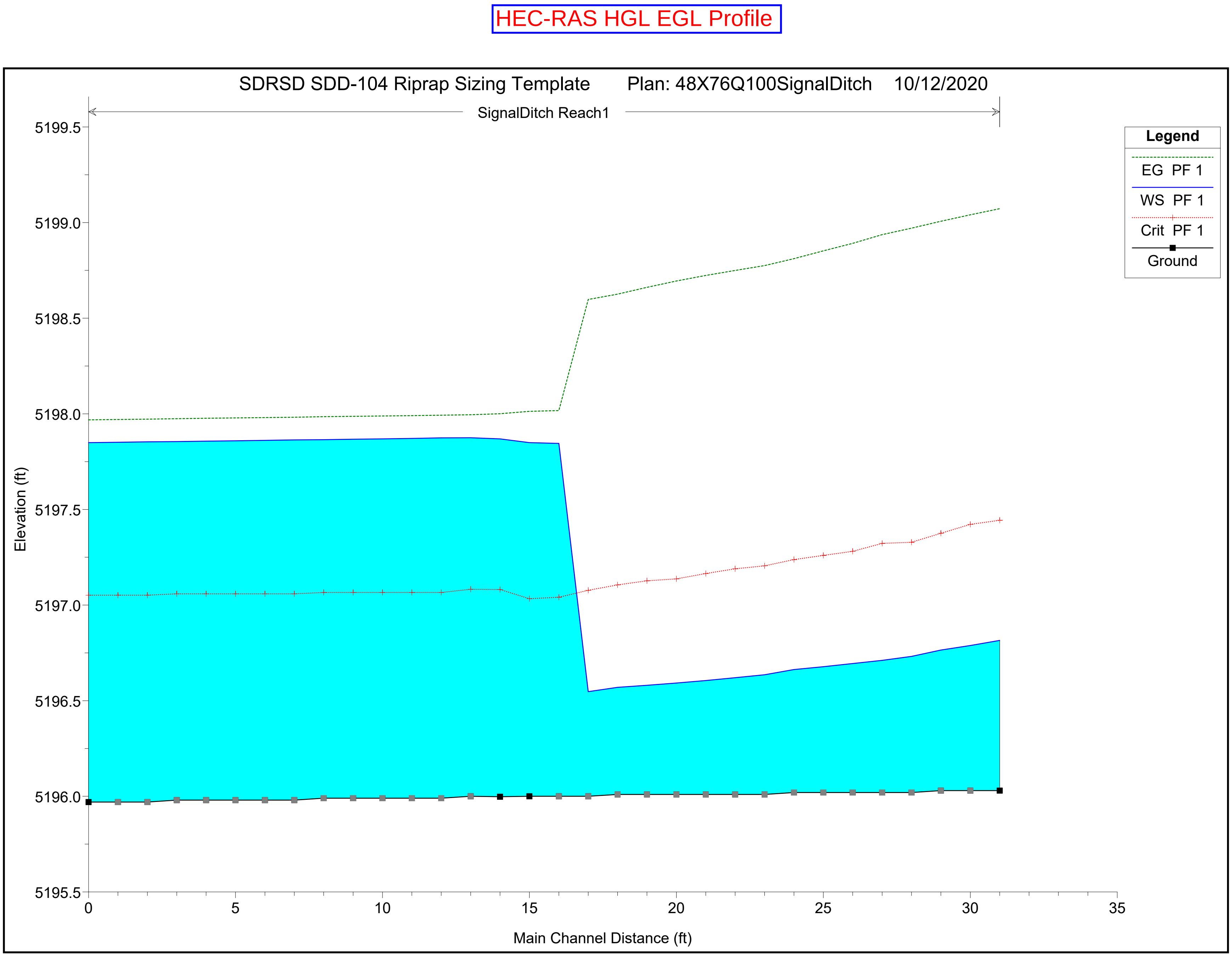
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach1	100	PF 1	60.00	5196.03	5196.82	5197.44	5199.07	0.023255	12.05	4.98	10.00	2.40
Reach1	99.000*	PF 1	60.00	5196.03	5196.79	5197.42	5199.04	0.024279	12.04	4.98	10.00	2.44
Reach1	98.000*	PF 1	60.00	5196.03	5196.77	5197.38	5199.01	0.025224	12.01	5.00	10.00	2.47
Reach1	97.000*	PF 1	60.00	5196.02	5196.73	5197.33	5198.97	0.026304	12.00	5.00	10.00	2.51
Reach1	96.000*	PF 1	60.00	5196.02	5196.71	5197.32	5198.94	0.027193	11.97	5.01	10.00	2.54
Reach1	95.000*	PF 1	60.00	5196.02	5196.69	5197.28	5198.89	0.027717	11.89	5.05	10.00	2.55
Reach1	94.000*	PF 1	60.00	5196.02	5196.68	5197.26	5198.85	0.028361	11.83	5.07	10.00	2.57
Reach1	93.000*	PF 1	60.00	5196.02	5196.66	5197.24	5198.81	0.028906	11.76	5.10	10.00	2.59
Reach1	92.000*	PF 1	60.00	5196.01	5196.64	5197.21	5198.78	0.029802	11.73	5.11	10.00	2.61
Reach1	91.000*	PF 1	60.00	5196.01	5196.62	5197.19	5198.75	0.030684	11.71	5.13	10.00	2.64
Reach1	90.000*	PF 1	60.00	5196.01	5196.61	5197.17	5198.72	0.031525	11.67	5.14	10.00	2.67
Reach1	89.000*	PF 1	60.00	5196.01	5196.59	5197.14	5198.69	0.032238	11.63	5.16	10.00	2.69
Reach1	88.000*	PF 1	60.00	5196.01	5196.58	5197.13	5198.66	0.032785	11.57	5.19	10.00	2.70
Reach1	87.000*	PF 1	60.00	5196.01	5196.57	5197.11	5198.63	0.033228	11.50	5.22	10.00	2.71
Reach1	86.000*	PF 1	60.00	5196.00	5196.55	5197.08	5198.60	0.034172	11.49	5.22	10.00	2.74
Reach1	85.000*	PF 1	60.00	5196.00	5197.85	5197.04	5198.02	0.000567	3.33	18.03	10.00	0.43
Reach1	84	PF 1	60.00	5196.00	5197.85	5197.03	5198.01	0.002874	3.24	18.50	10.00	0.42
Reach1	83	PF 1	60.00	5196.00	5197.87	5197.08	5198.00	0.001797	2.91	20.64	14.31	0.39
Reach1	82.000*	PF 1	60.00	5196.00	5197.88	5197.08	5198.00	0.001956	2.78	21.57	14.32	0.40
Reach1	81.000*	PF 1	60.00	5195.99	5197.87	5197.07	5197.99	0.001985	2.76	21.71	14.35	0.40
Reach1	80.000*	PF 1	60.00	5195.99	5197.87	5197.07	5197.99	0.001994	2.77	21.68	14.34	0.40
Reach1	79.000*	PF 1	60.00	5195.99	5197.87	5197.07	5197.99	0.002003	2.77	21.64	14.34	0.40
Reach1	78.000*	PF 1	60.00	5195.99	5197.87	5197.07	5197.99	0.002011	2.78	21.61	14.33	0.40
Reach1	77.000*	PF 1	60.00	5195.99	5197.87	5197.07	5197.99	0.002020	2.78	21.58	14.32	0.40
Reach1	76.000*	PF 1	60.00	5195.98	5197.86	5197.06	5197.98	0.001985	2.76	21.71	14.35	0.40
Reach1	75.000*	PF 1	60.00	5195.98	5197.86	5197.06	5197.98	0.001994	2.77	21.68	14.34	0.40
Reach1	74.000*	PF 1	60.00	5195.98	5197.86	5197.06	5197.98	0.002003	2.77	21.64	14.34	0.40
Reach1	73.000*	PF 1	60.00	5195.98	5197.86	5197.06	5197.98	0.002011	2.78	21.61	14.33	0.40
Reach1	72.000*	PF 1	60.00	5195.98	5197.85	5197.06	5197.98	0.002020	2.78	21.58	14.32	0.40
Reach1	71.000*	PF 1	60.00	5195.97	5197.85	5197.05	5197.97	0.001987	2.76	21.70	14.35	0.40
Reach1	70.000*	PF 1	60.00	5195.97	5197.85	5197.05	5197.97	0.001996	2.77	21.67	14.34	0.40
Reach1	69	PF 1	60.00	5195.97	5197.85	5197.05	5197.97	0.002003	2.77	21.64	14.34	0.40

Hydraulic Jump

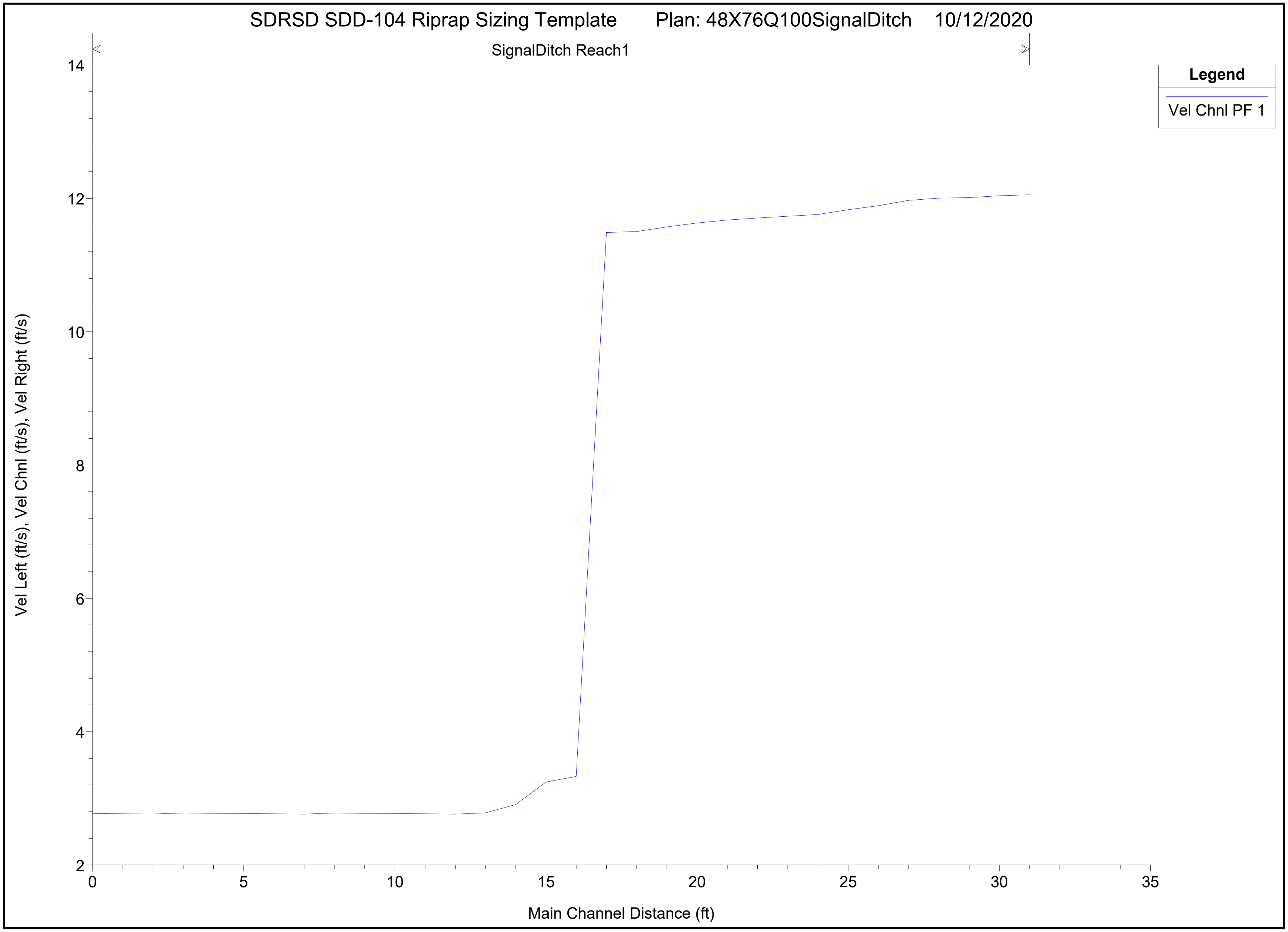
End of wing wall concrete apron

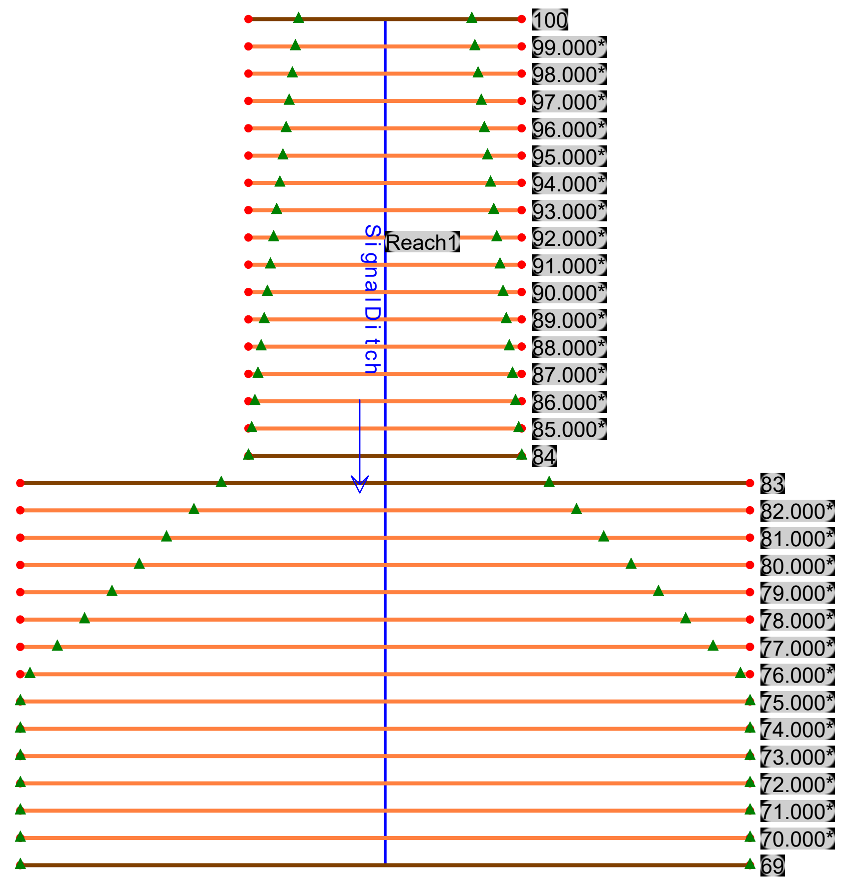
Start of Type M grouted riprap

End of Type M grouted riprap


HEC-RAS HGL EGL Profile
SDRSD SDD-104 Riprap Sizing Template
Plan: 48X76Q100SignalDitch
10/12/2020
SignalDitch Reach1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
5199.5
5199.0
5198.5
5198.0
5197.5
5197.0
5196.5
5196.0
5195.5
0
5
10
15
20
25
30
35
Main Channel Distance (ft)

HEC-RAS Velocity Profile

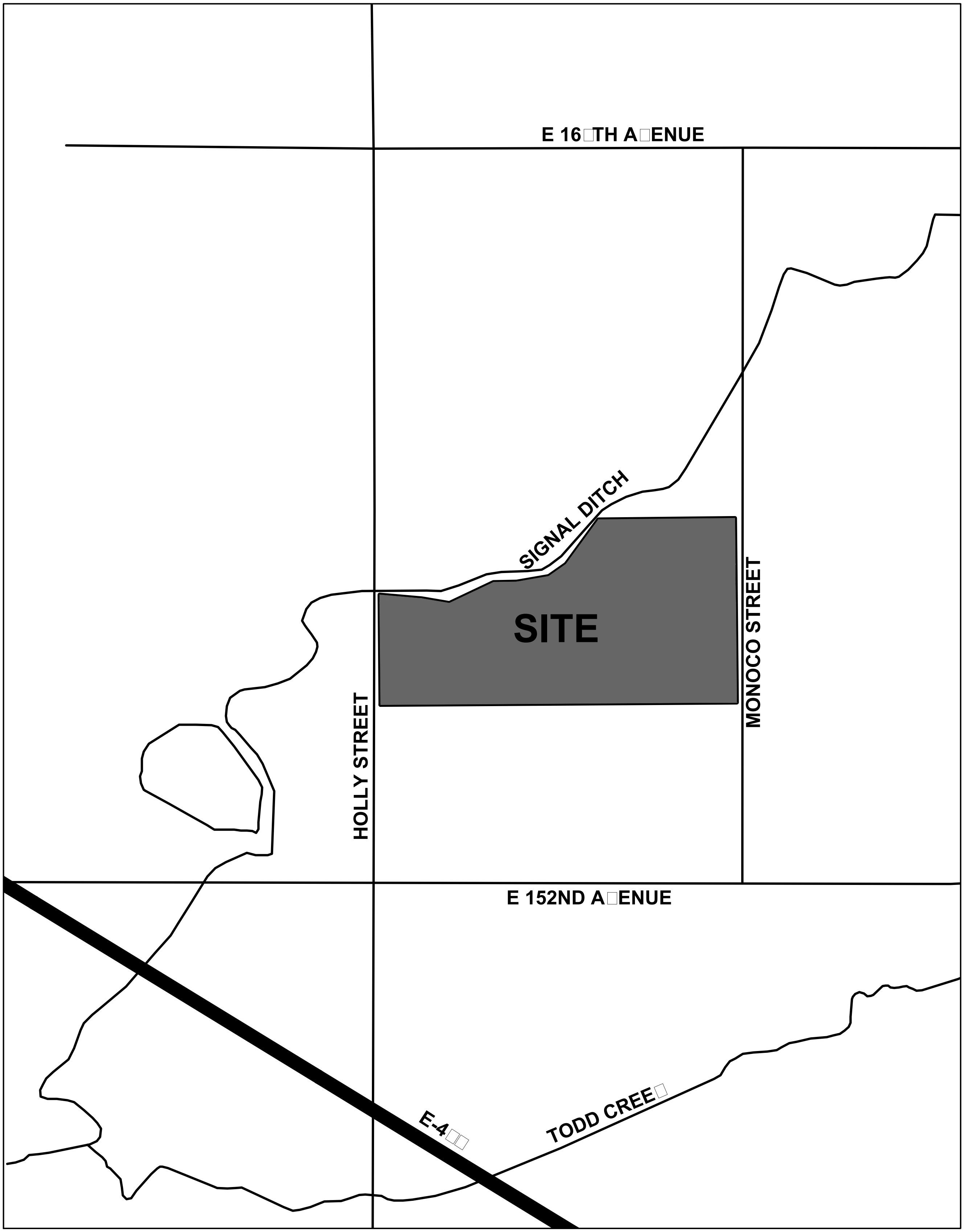




Some schematic data outside default extents (see View/Set Schematic Plot Extents...)

Appendix C

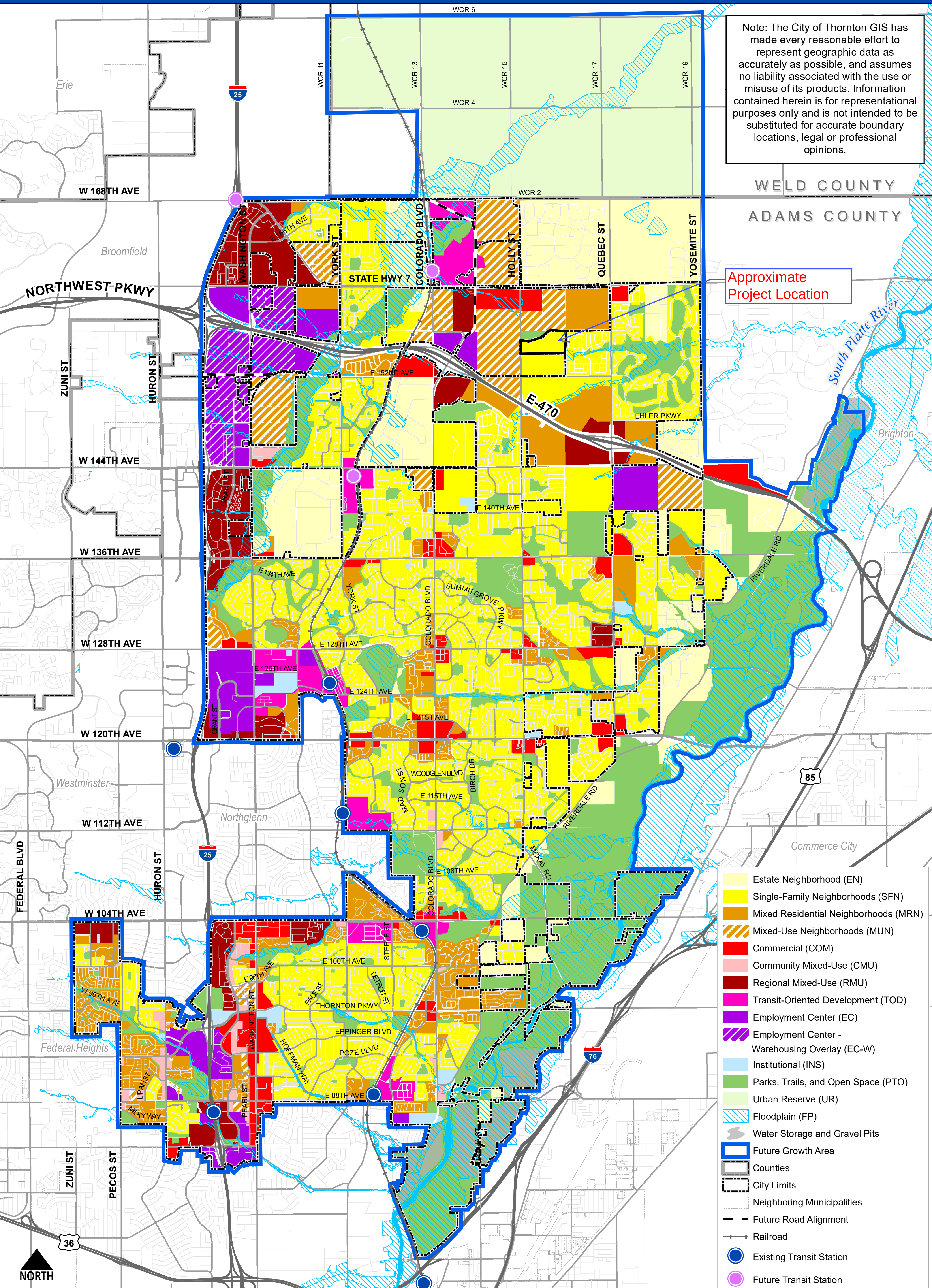
References



□ICINITY MAP

1"□1□□□□

Future Land Use Map



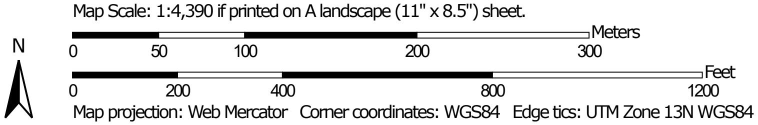
City of Thornton

0 1.25 2.5 5
Miles

Adopted by Thornton City Council
July 15, 2020

Hydrologic Soil Group—Adams County Area, Parts of Adams and Denver Counties, Colorado
(Westwood Hydrologic Soil Group)

Map Scale: 1:4,390 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 1:20,000.

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: Adams County Area, Parts of Adams and Denver Counties, Colorado
Survey Area Data: Version 15, Sep 13, 2018

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

Date(s) aerial images were photographed: Oct 20, 2018—Oct 26, 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
PlB	Platner loam, 0 to 3 percent slopes	C	46.9	63.3%
PlC	Platner loam, 3 to 5 percent slopes	C	24.1	32.6%
ReD	Renohill loam, 3 to 9 percent slopes	D	2.7	3.6%
UlD	Ulm loam, 5 to 9 percent slopes	C	0.4	0.6%
Totals for Area of Interest			**74.1**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

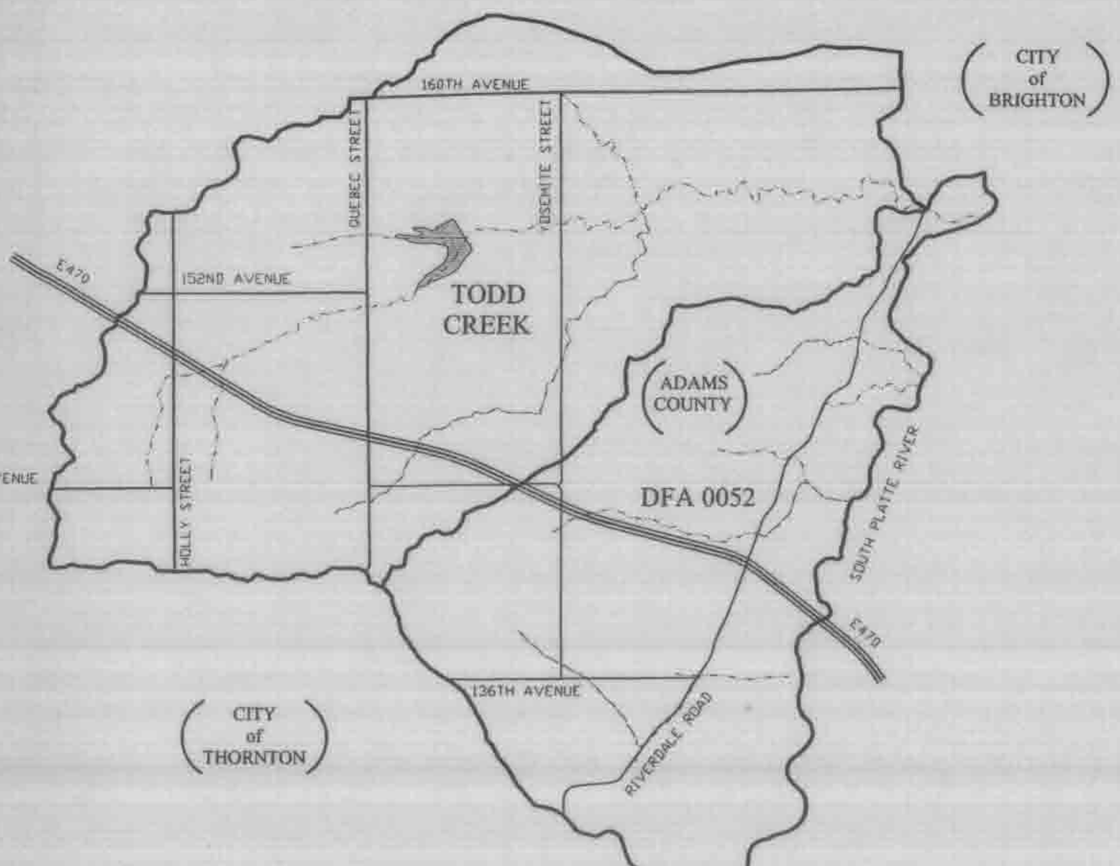
Tie-break Rule: Higher

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only)**:**	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

TODD CREEK AND DFA 0052 WATERSHEDS
OUTFALL SYSTEMS PLANNING STUDY

PRELIMINARY DESIGN REPORT



Sponsored by:

CITY OF THORNTON

ADAMS COUNTY

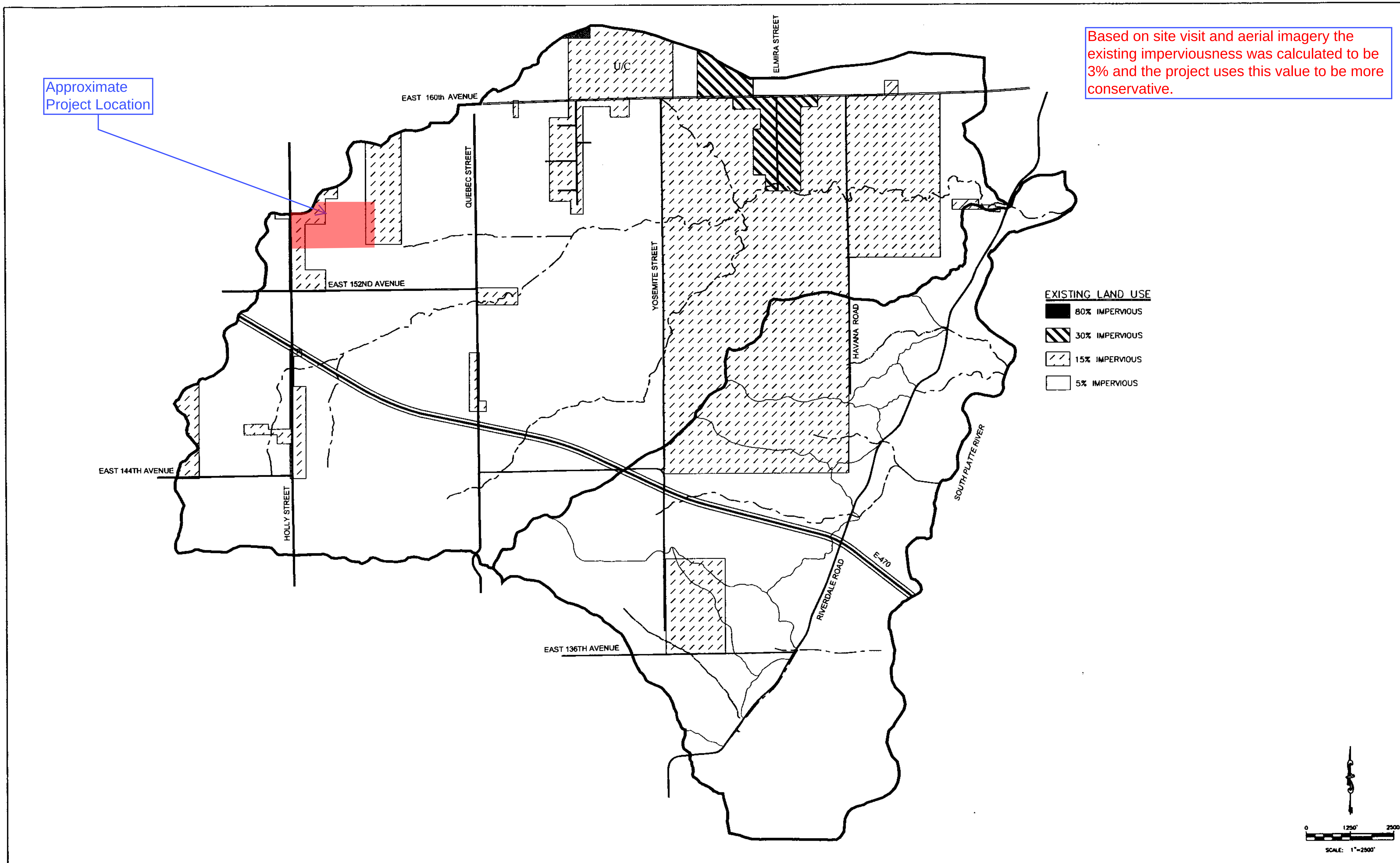
Urban Drainage and
Flood Control District

Prepared by:

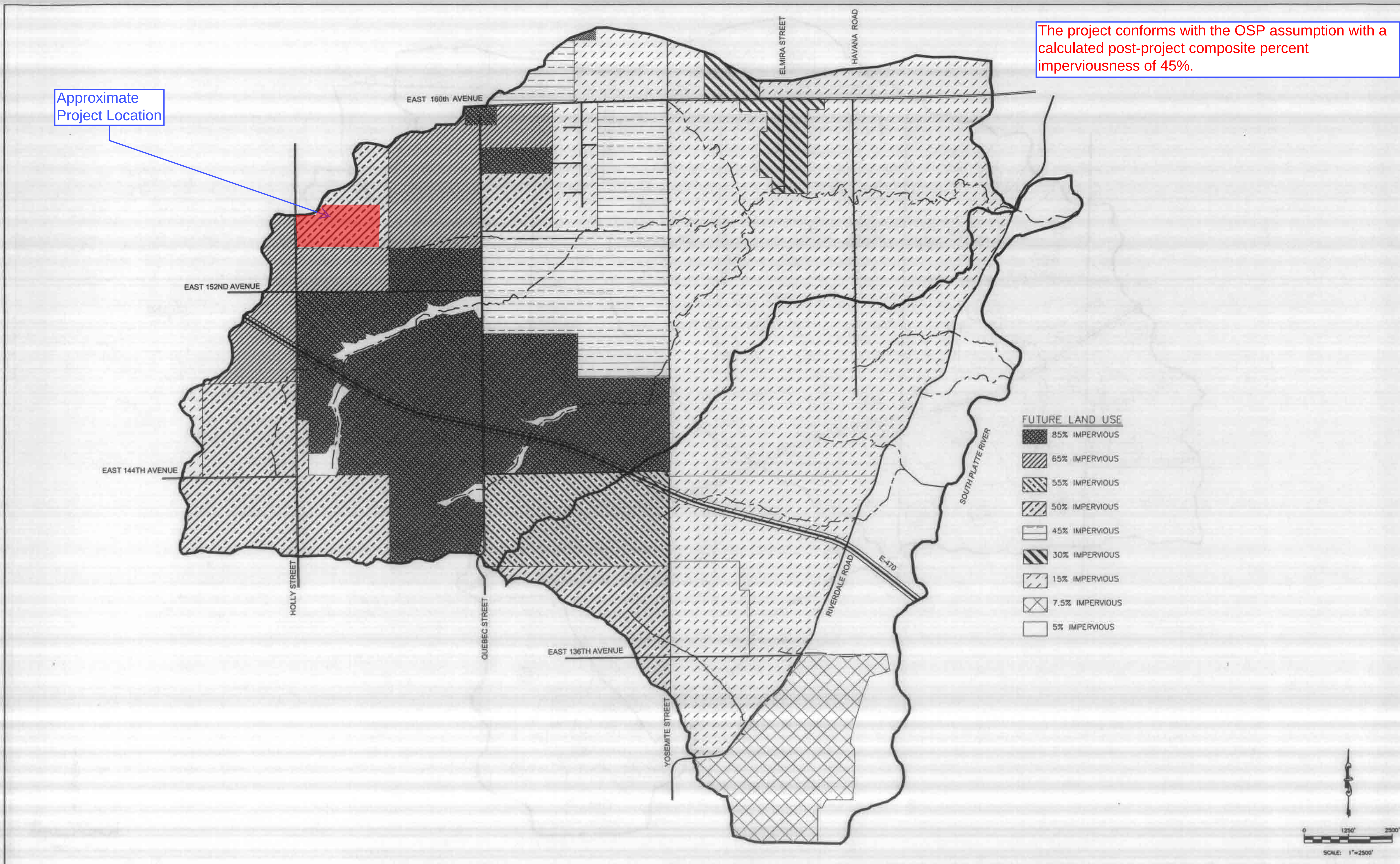
Kiowa Engineering Corporation

7175 West Jefferson Avenue, Suite 3400
Lakewood, Colorado 80235
www.kiowaengineering.com

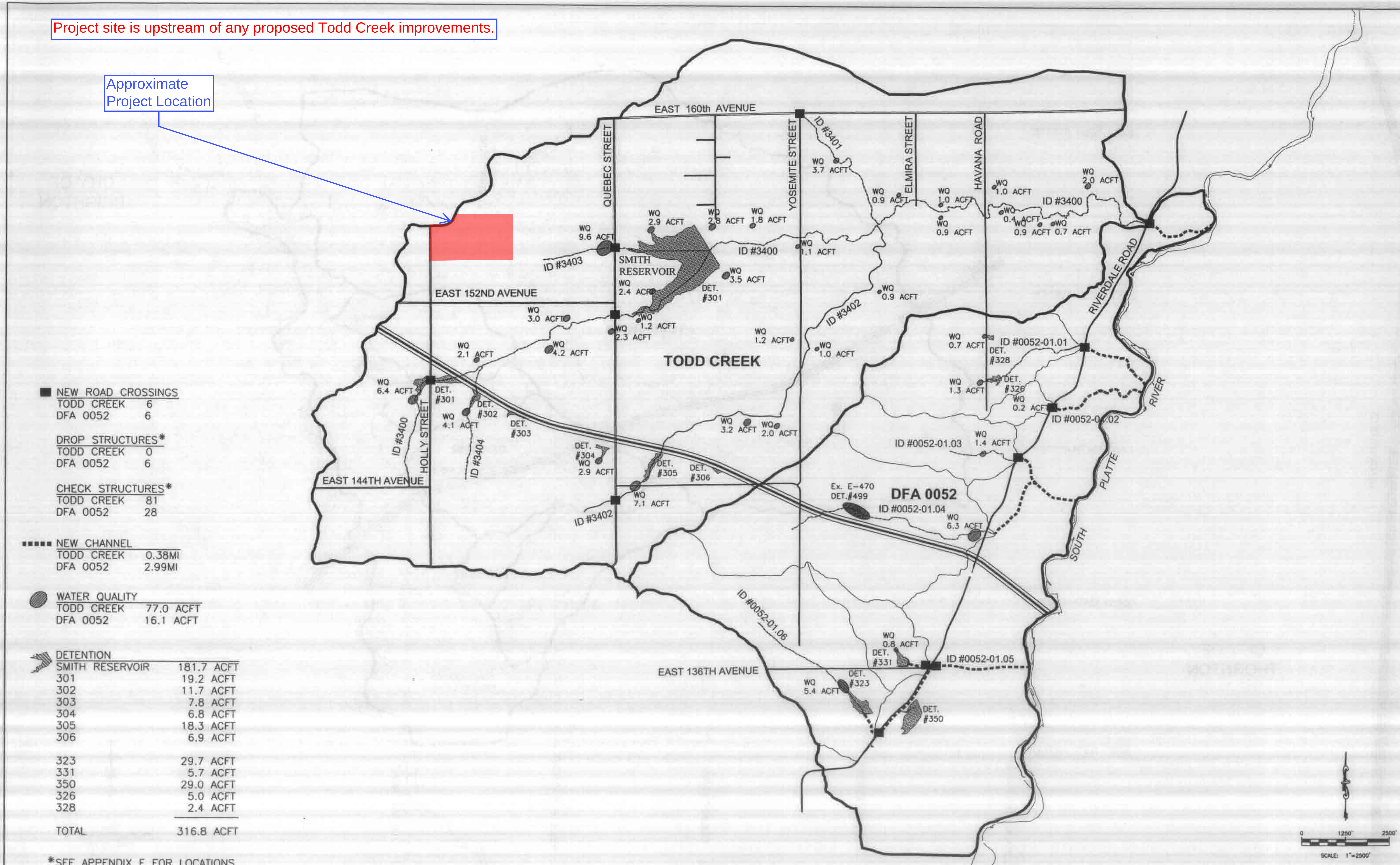
December 2003



Project mapping provided by Adams County Date: 1995 Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369 KIOWA PROJECT NO. 00053	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	EXISTING IMPERVIOUSNESS	FIGURE III-1 Existing_Imp.dwg/Dec. 03, 2003



Project mapping provided by Adams County Date: 1995 Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369 KIOWA PROJECT NO. 00053	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	FUTURE IMPERVIOUSNESS	FIGURE III-2 Future Imp.dwg/Dec. 03, 2003



Project mapping provided by Adams County
Date: 1995
Contour Interval: 2 ft.

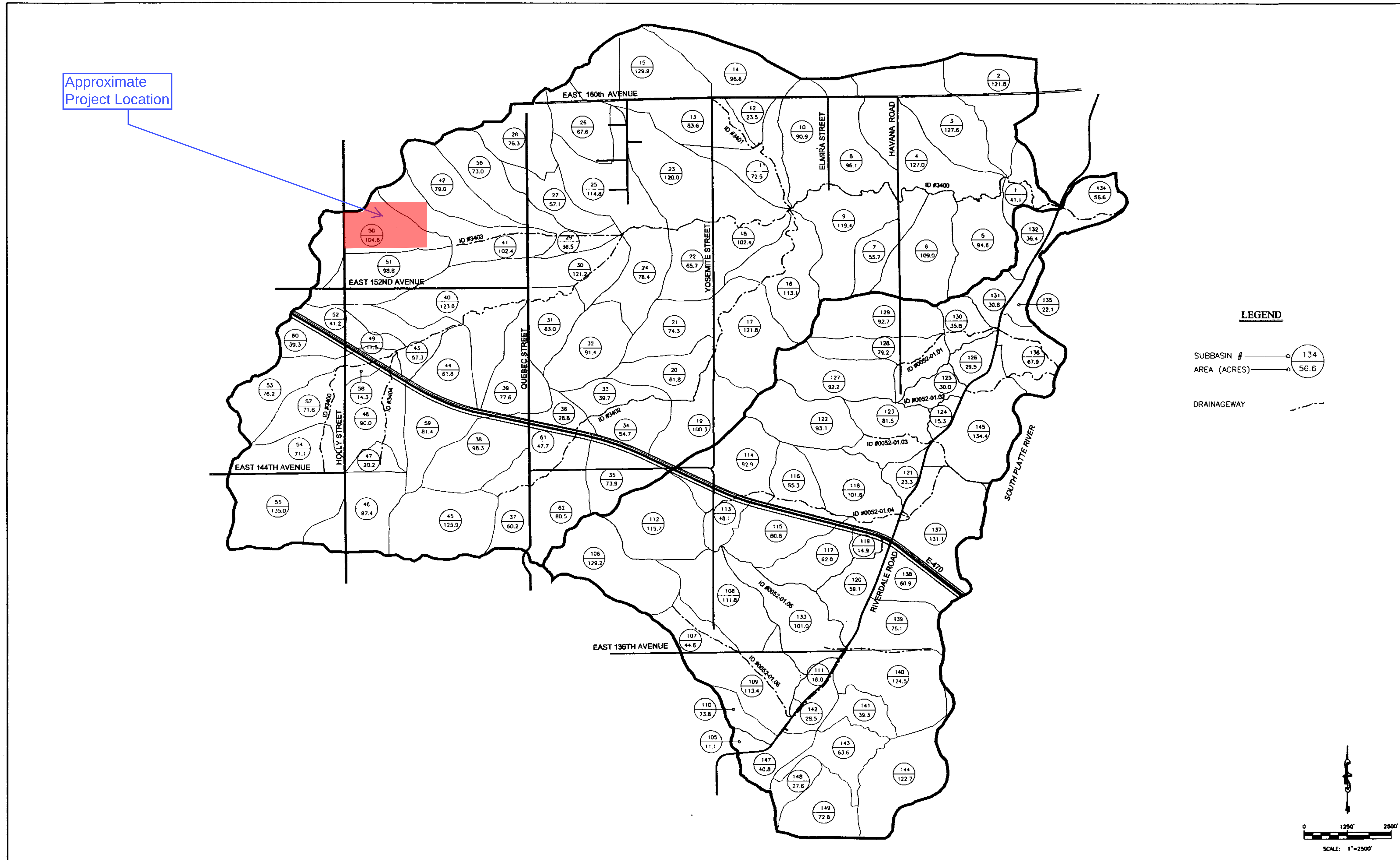
Kiowa Engineering Corporation
7175 W. Jefferson Avenue, Suite 3400
Lakewood, Colorado 80235
(303) 692-0369

CITY OF THORNTON
ADAMS COUNTY
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

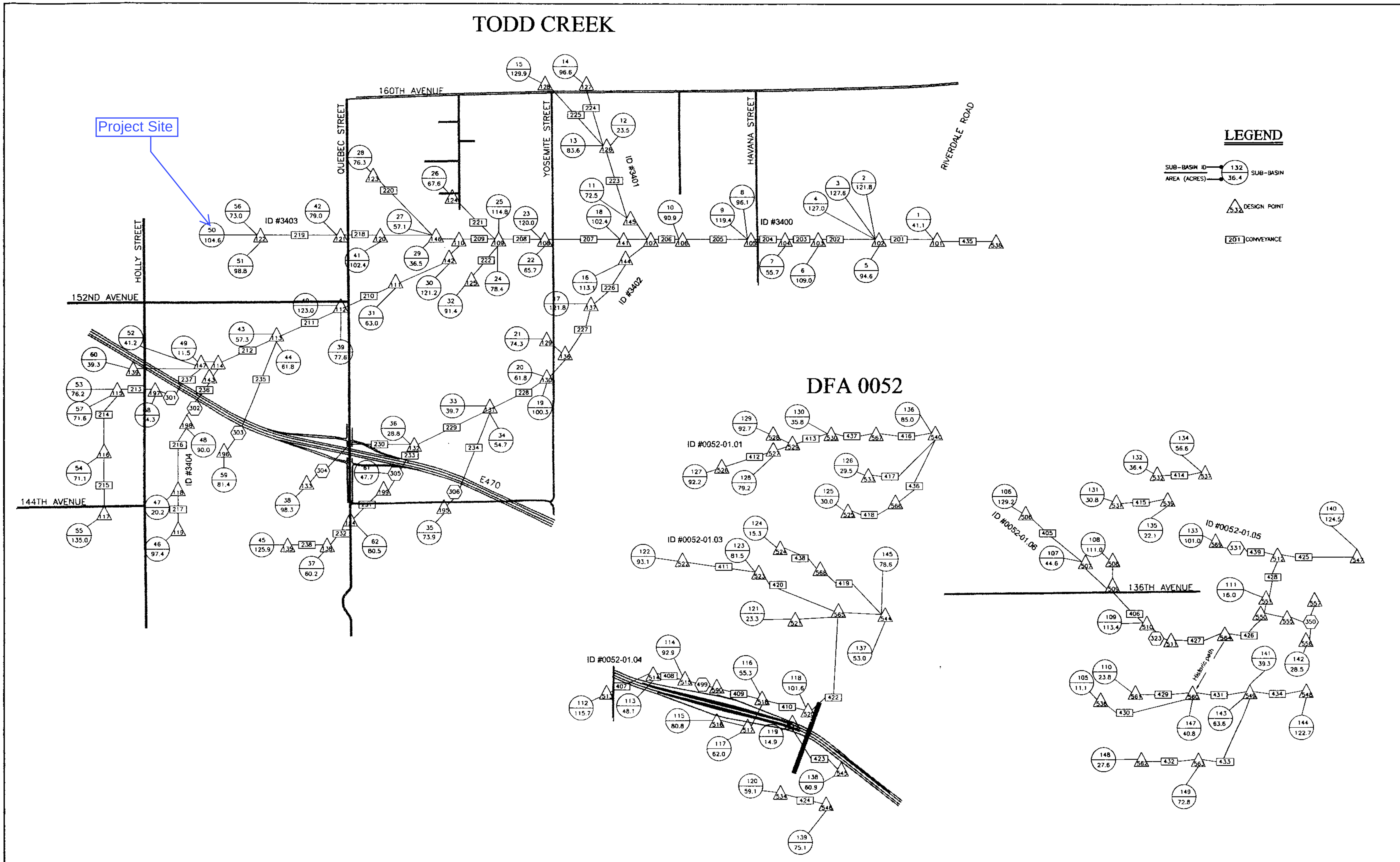
OUTFALL SYSTEMS PLANNING STUDY
TODD CREEK AND DFA 0052 WATERSHEDS

MASTER PLAN SUMMARY

FIGURE ES-2

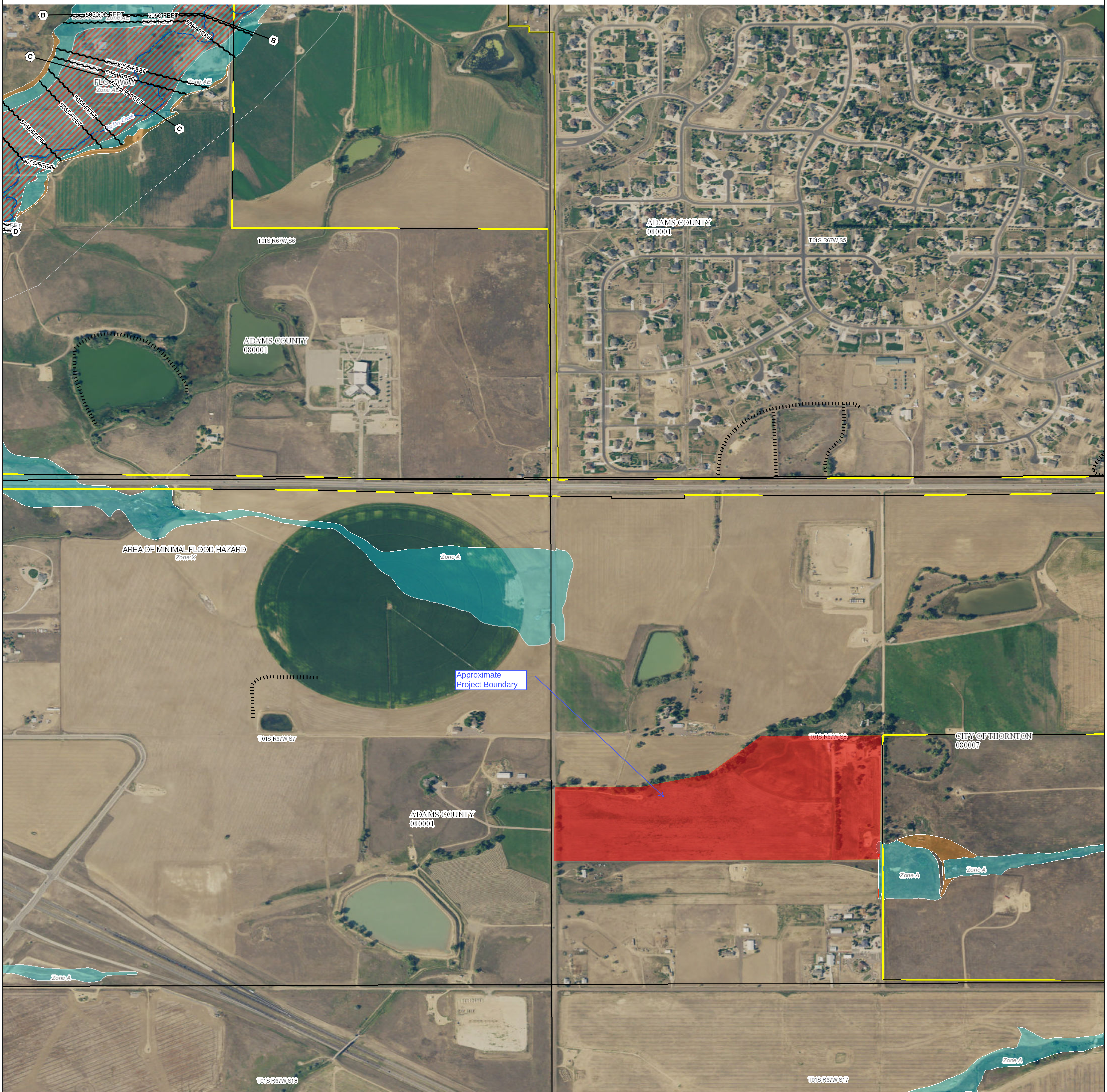


Project mapping provided by Adams County Date: 1995 Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369 KIOWA PROJECT NO. 00053	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	SUBWATERSHED DELINEATION	FIGURE III-3 Subwatershed Delin.dwg/Dec. 11, 2003



Project mapping provided by Adams County Date: 1995 Contour Interval: 2 ft.	Kiowa Engineering Corporation 7175 W. Jefferson Avenue, Suite 3400 Lakewood, Colorado 80235 (303) 692-0369 KIOWA PROJECT NO. 00053	CITY OF THORNTON ADAMS COUNTY URBAN DRAINAGE AND FLOOD CONTROL DISTRICT	OUTFALL SYSTEMS PLANNING STUDY TODD CREEK AND DFA 0052 WATERSHEDS	SWMM MODEL SCHEMATIC	FIGURE III-4 SWMM Schematic.dwg/Dec. 11, 2003

104°56'16.04"W 40°0'6.64"N



USGS The National Map: Orthoimagery. Data refreshed April 2020

104°54'22.68"W 39°58'N

FLOOD HAZARD INFORMATION

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

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99* With BFE or Depth *Zone AE, AO, AH, VE, AR* Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X* Future Conditions 1% Annual Chance Flood Hazard *Zone X* Area with Reduced Flood Risk due to Levee See Notes *Zone X* Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard *Zone X* Effective LOMRs Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 Cross Sections with 1% Annual Chance 17.5 Water Surface Elevation 8 Coastal Transect Coastal Transect Baseline Profile Baseline Hydrographic Feature 513 Base Flood Elevation Line (BFE) Limit of Study Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at https://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

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

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **8/24/2020 4:40 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. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

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. 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.

SCALE

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map, please see the Flood Insurance Study (FIS) Report for your community at https://msc.fema.gov

N

1 inch = 500 feet 1:6,000

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

Meters 0 50 100 200 300 400

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

ADAMS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 306 OF 1080

Panel Contains:

COMMUNITY	NUMBER	PANEL
ADAMS COUNTY	080001	0306
CITY OF THORNTON	080007	0306

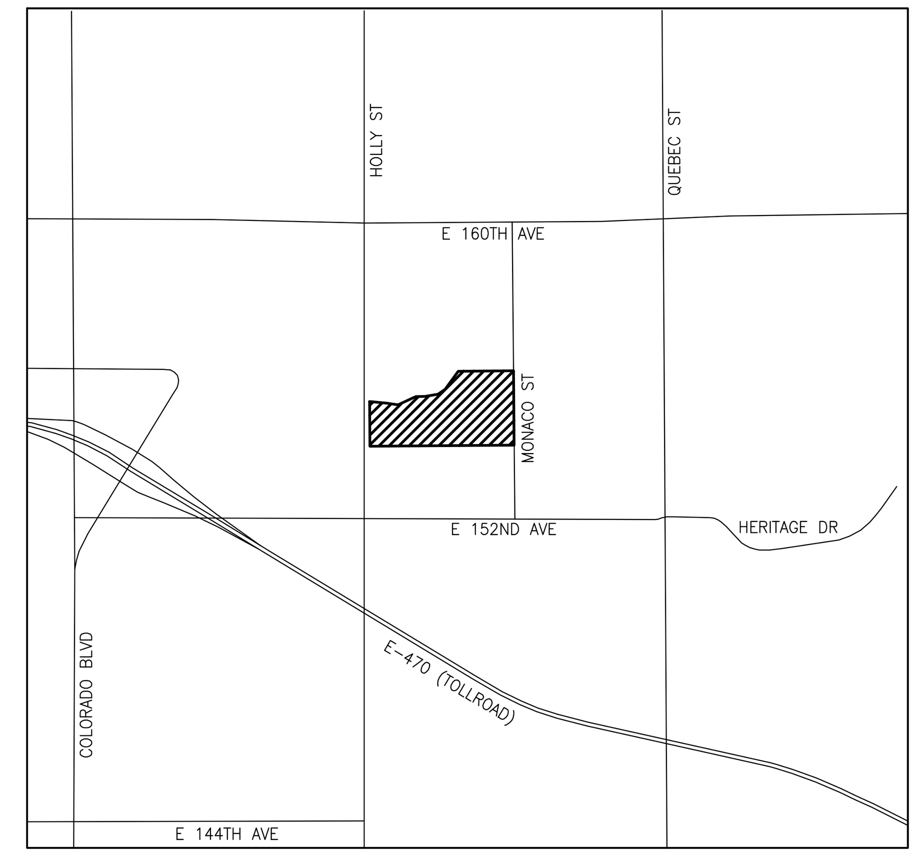
MAP NUMBER
08001C0306J
EFFECTIVE DATE
January 20, 2016

Appendix D

Drainage Plan

WESTWOOD DRAINAGE PLAN

A PARCEL OF LAND LOCATED IN SECTION 8, TOWNSHIP 1 SOUTH, RANGE 67
WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF THORNTON, COUNTY OF ADAMS, STATE OF COLORADO
SHEET 1 OF 6



VICINITY MAP
NOT TO SCALE

GENERAL NOTES

1. STORM DRAINAGE SHALL NOT ENTER ANY EXISTING IRRIGATION CHANNELS. THE DEVELOPER WILL BE RESPONSIBLE FOR BYPASSING THESE FACILITIES AS REQUIRED BY THE CITY AND THE APPROPRIATE DITCH COMPANY.
2. ALL OFF-SITE EASEMENTS REQUIRED TO CONVEY DEVELOPED DRAINAGE TO AN ACCEPTABLE OUTFALL LOCATION, AS DETERMINED BY THE CITY, SHALL BE ACQUIRED AND RECORDED BY THE DEVELOPER PRIOR TO APPROVAL OF THE SUBDIVISION PLAT. THE RECEPTION NUMBER(S) FOR THESE EASEMENTS SHALL BE SHOWN ON THE PLAT.
3. INFRASTRUCTURE SHALL BE PROVIDED TO ALLOW ALL UPSTREAM PARCELS WHO HISTORICALLY CONVEY DRAINAGE THROUGH THE DEVELOPMENT.
4. SEEPAGE ANALYSIS AND STRUCTURAL BANK INTEGRITY ANALYSIS FOR EACH EXISTING (IF IT IS UPSTREAM) AND EACH DRAINAGEWAY AND IRRIGATION DITCH WITHIN THE DEVELOPMENT SHALL BE SUBMITTED TO THE CITY WITH THE FIRST SUBDIVISION PLAT FOR THE PROPERTY.
5. NUISANCE FLOWS ARE NOT ANTICIPATED.
6. THE IMPROVEMENTS SHALL CONFORM TO THE CURRENT DRAINAGE MASTER PLAN AT THE TIME OF THE DEVELOPMENT. IF THERE IS NOT A MASTER PLAN AT THE TIME OF DEVELOPMENT, THE DEVELOPER WILL BE REQUIRED TO PREPARE A BASIN STUDY TO DETERMINE THE IMPACTS AND IDENTIFY MITIGATION MEASURE FOR THE PROPOSED PROJECT. APPROVAL IS REQUIRED FROM URBAN DRAINAGE AND FLOOD CONTROL DISTRICT (UDFCD) FOR THESE IMPROVEMENTS. STORM WATER QUALITY AND DETENTION ARE REQUIRED FOR ALL PORTIONS OF THE DEVELOPMENT INCLUDING THE ULTIMATE ROADWAY CONSTRUCTION.
7. CLOMR'S/LOMR'S WILL BE REQUIRED WITH THIS DEVELOPMENT FOR ANY ADJUSTMENTS TO THE FLOODPLAIN.
8. ALL WETLANDS AND BODIES OF WATER SHALL BE IDENTIFIED ON THE DRAINAGE PLAN. NO LOTS SHALL BE WITHIN A 50 FOOT RADIUS OF A DELINEATED WETLANDS AND 75 FOOT RADIUS OF ANY BODY OF WATER.
9. DETENTION PONDS SHALL BE COMBINED WHENEVER POSSIBLE AND SHALL BE SIZED USING CUHP OR AN EQUIVALENT INFLOW HYDROGRAPH METHOD.
10. ACCESS SHALL BE PROVIDED TO ALL DRAINAGEWAYS AND DETENTION PONDS FOR MAINTENANCE.

LEGEND

DRAINAGE BASIN BOUNDARY
FLOW ARROW
EXISTING MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING FENCE
ZONE X / ZONE A — FEMA FLOODPLAIN
SIGNAL DITCH
CITY OF THORNTON BOUNDARY

TROY W. BALES, REGISTERED PROFESSIONAL ENGINEER
STATE OF COLORADO, LICENSE NO. 50961
FOR AND ON BEHALF OF RICK ENGINEERING COMPANY

OWNER	DEVELOPER	ENGINEER	LANDSCAPE ARCHITECT
NICHOLAS AND DEBORAH CHIOVITTI 15555 MONACO ST. BRIGHTON, CO 80602 720-989-3525	VENTANA CAPITAL, INC. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-346-7006	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020

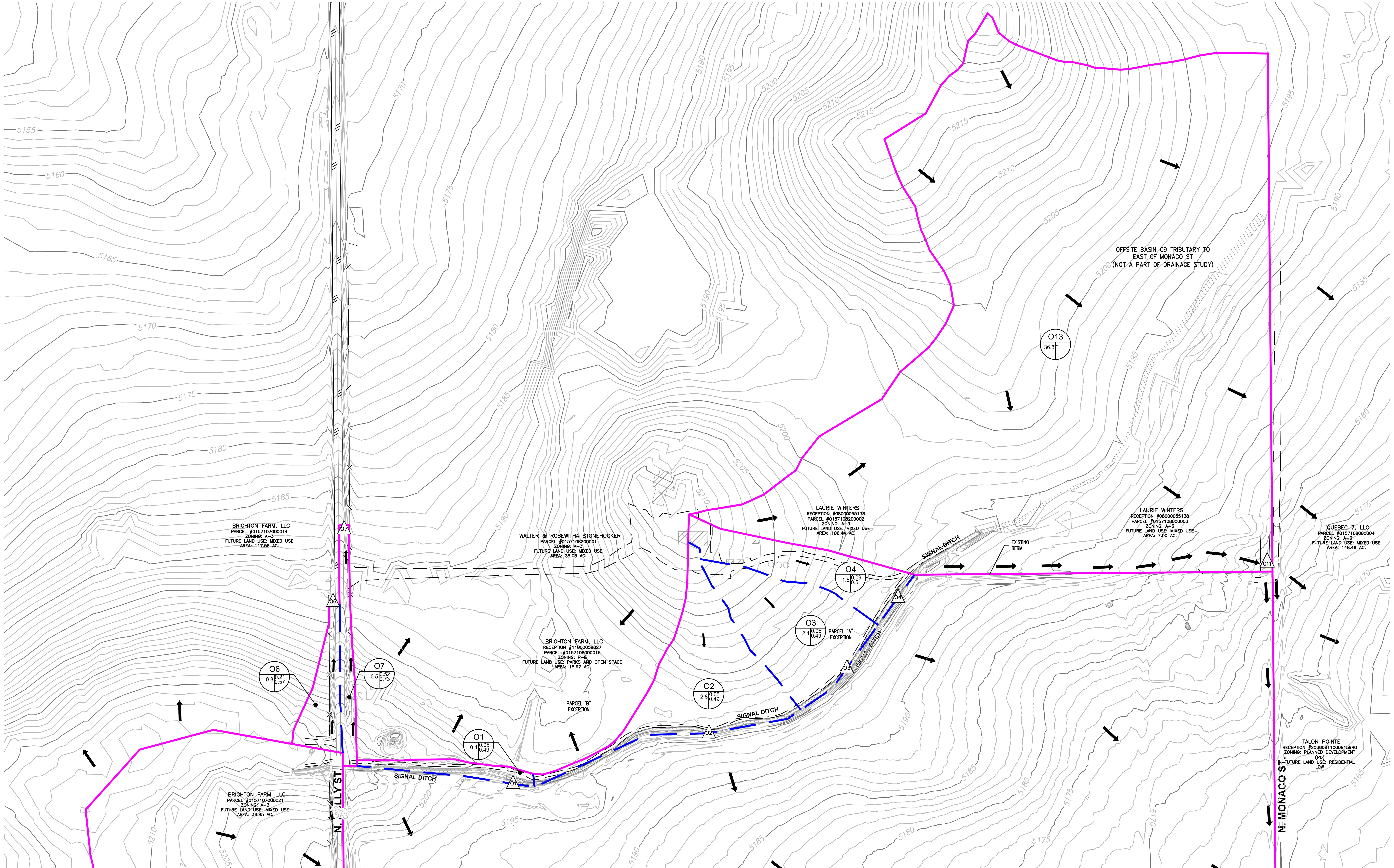
DATE: DECEMBER 30, 2020
SCALE: N/A

JOB NO. D01104
SHEET: 1 OF 6

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020

WESTWOOD HISTORIC DRAINAGE PLAN

A PARCEL OF LAND LOCATED IN SECTION 8, TOWNSHIP 1 SOUTH, RANGE 67
WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF THORNTON, COUNTY OF ADAMS, STATE OF COLORADO



RUNOFF SUMMARY TABLE

Design Point / Basin ID	Contributing Area (acres)	Q5 (CFS)	Q100 (CFS)
H1	63.1	5.1	88.1
O1	0.4	0.1	1.8
O2	2.8	0.3	6.3
O3	2.4	0.3	5.2
O4	1.6	0.3	3.5
O5	0.8	0.1	2.0
O6	0.8	0.6	3.0
O7	0.5	1.0	2.6
O11	43.3	5.3	79.4

150 0 75 150 300

ORIGINAL SCALE: 1"= 150' HORIZ.

LEGEND

- BASIN ID
- 2 YR. RUNOFF COEFFICIENT
- 100 YR. RUNOFF COEFFICIENT
- AREA IN ACRES
- DESIGN POINT
- MAJOR DRAINAGE BASIN BOUNDARY
- MINOR DRAINAGE BASIN BOUNDARY
- FLOW ARROW
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING FENCE
- FEMA FLOODPLAIN (ZONE X / ZONE A)
- SIGNAL DITCH
- CITY OF THORNTON BOUNDARY

OWNER	DEVELOPER	ENGINEER	LANDSCAPE ARCHITECT
NICHOLAS AND DEBORAH CHIOVITTI 15555 MONACO ST. BRIGHTON, CO 80602 720-989-3525	VENTANA CAPITAL, INC. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-346-7006	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020

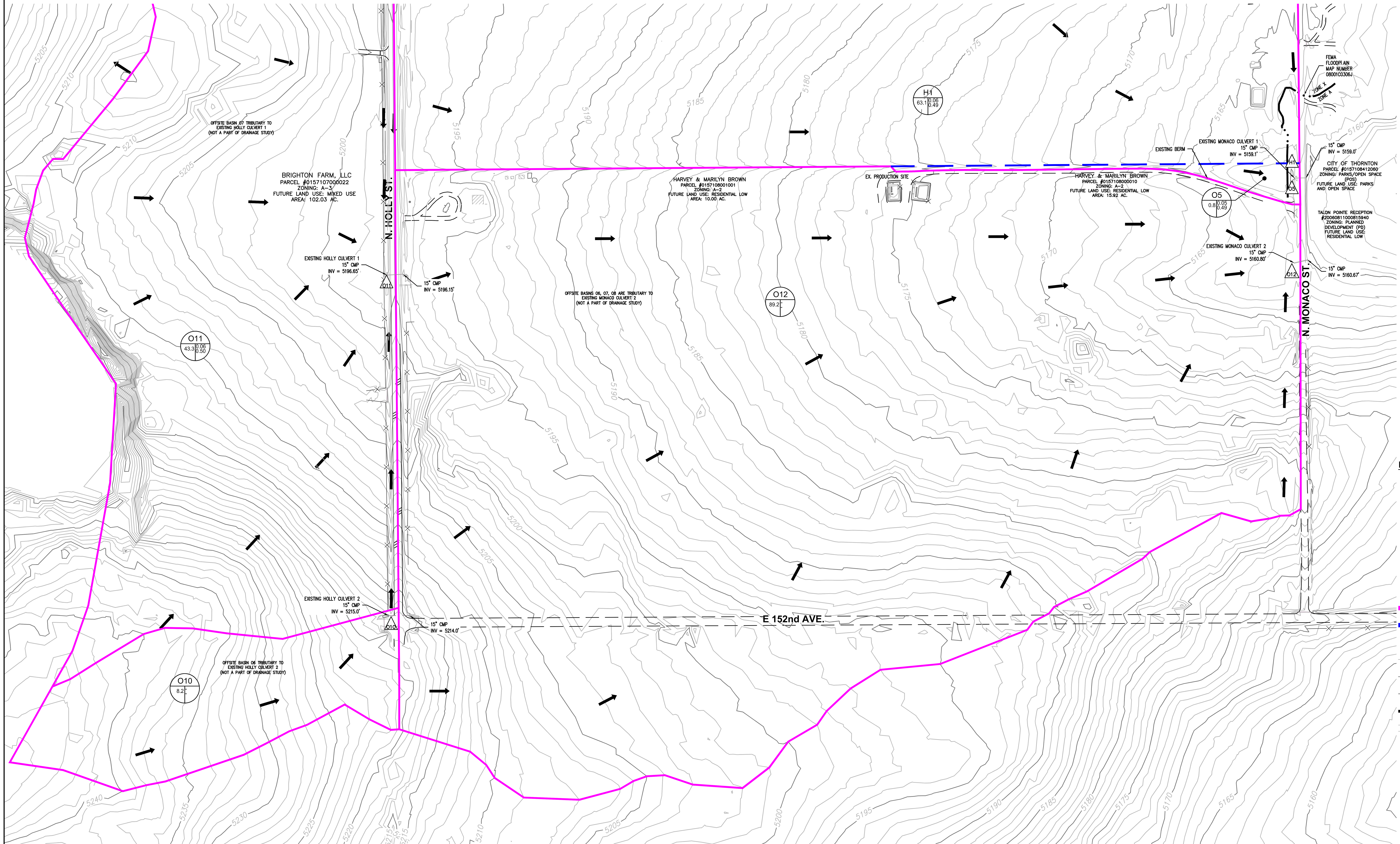
DATE: DECEMBER 30, 2020
SCALE: 1" = 150'

JOB NO. D01104
SHEET: 2 OF 6

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020

WESTWOOD HISTORIC DRAINAGE PLAN

A PARCEL OF LAND LOCATED IN SECTION 8, TOWNSHIP 1 SOUTH, RANGE 67
WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF THORNTON, COUNTY OF ADAMS, STATE OF COLORADO
SHEET 3 OF 6



RUNOFF SUMMARY TABLE

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O4	1.6	0.3	3.5
O5	0.8	0.1	2.0
O6	0.8	0.6	3.0
O7	0.5	1.0	2.6
O11	43.3	5.3	79.4

ORIGINAL SCALE: 1"= 150' HORIZ.

LEGEND

- BASIN ID
- 2 YR. RUNOFF COEFFICIENT
- 100 YR. RUNOFF COEFFICIENT
- AREA IN ACRES
- DESIGN POINT
- MAJOR DRAINAGE BASIN BOUNDARY
- MINOR DRAINAGE BASIN BOUNDARY
- FLOW ARROW
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING FENCE
- FEMA FLOODPLAIN (ZONE X / ZONE A)
- SIGNAL DITCH
- CITY OF THORNTON BOUNDARY

OWNER	DEVELOPER	ENGINEER	LANDSCAPE ARCHITECT
NICHOLAS AND DEBORAH CHIOVITTI 15555 MONACO ST. BRIGHTON, CO 80602 720-989-3525	VENTANA CAPITAL, INC. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-346-7006	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020

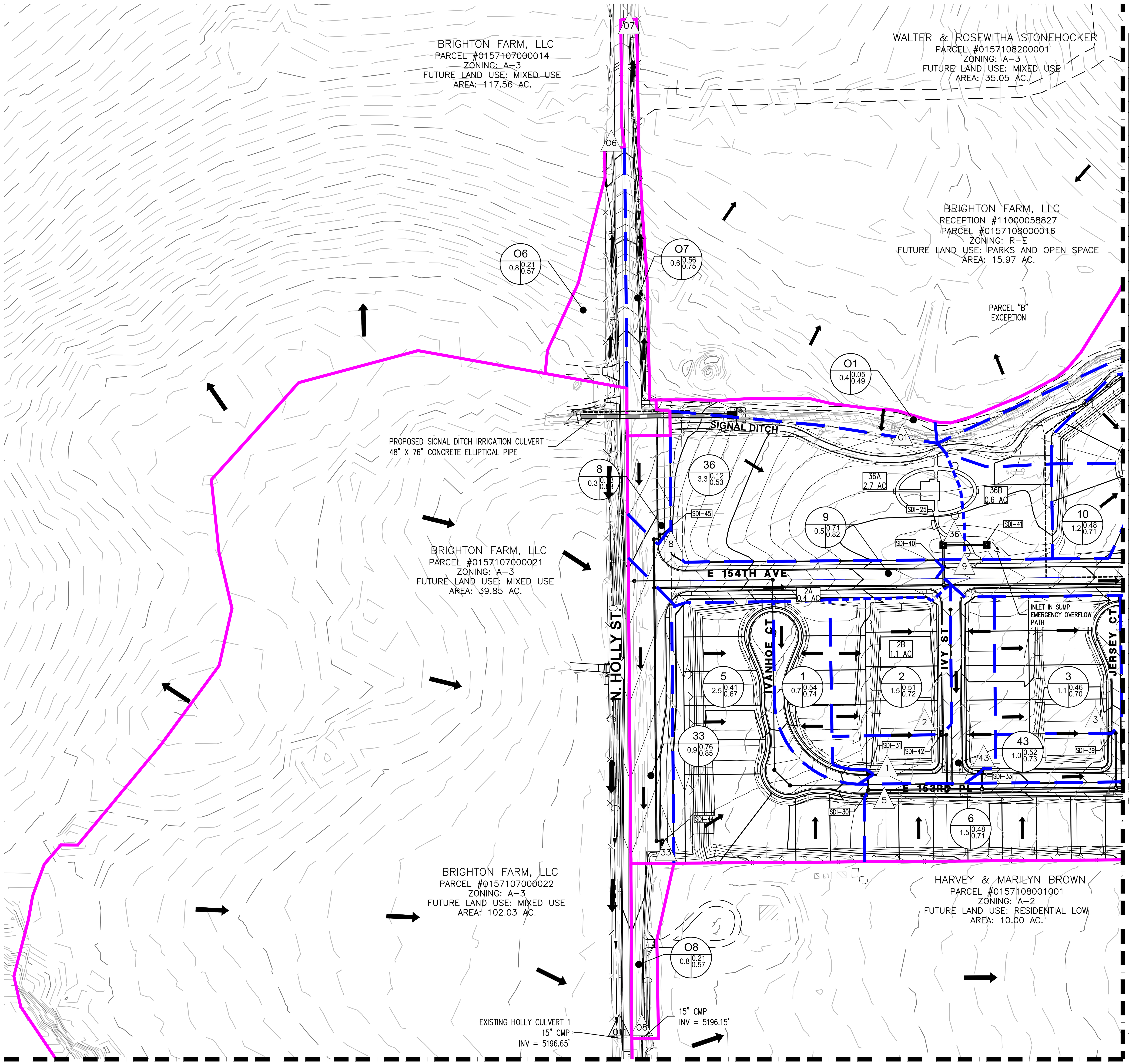
DATE: DECEMBER 30, 2020
SCALE: 1" = 150'

JOB NO. D01104
SHEET: 3 OF 6

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020

WESTWOOD PROPOSED DRAINAGE PLAN

A PARCEL OF LAND LOCATED IN SECTION 8, TOWNSHIP 1 SOUTH, RANGE 67
WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF THORNTON, COUNTY OF ADAMS, STATE OF COLORADO



RUNOFF SUMMARY TABLE

Design Point	Inlet ID	Contributing Area (acres)	Direct Q5 (CFS)	Direct Q100 (CFS)	Total Q5 (CFS)	Total Q100 (CFS)
1	SDI-31	0.7	1.3	3.6	1.3	3.6
2A	-	0.4	0.8	2.1	0.8	2.1
2B	SDI-42	1.1	2.0	5.5	2.7	7.6
3	SDI-39	1.1	1.7	5.0	1.7	5.0
4	SDI-48	1.2	1.5	5.0	1.5	6.5
5	SDI-30	2.5	2.9	9.4	2.9	9.4
6	SDI-34	1.5	2.4	6.8	2.4	8.7
7	SDI-47	1.0	1.6	4.8	1.6	6.4
8	SDI-45	0.3	0.9	2.1	0.9	2.1
9	SDI-40	0.5	1.4	3.2	1.4	3.2
10	SDI-12	1.2	2.0	5.9	2.0	5.9
11	SDI-13	0.1	0.3	0.7	0.3	0.7
12	SDI-07	1.4	2.1	6.5	2.1	6.5
13	SDI-24	1.2	2.2	6.3	2.2	6.3
14	SDI-11	0.7	1.4	3.9	1.4	3.9
15	SDI-27	1.6	2.4	7.1	2.4	7.1
16	SDI-16	0.9	1.9	5.0	1.9	5.0
17	SDI-10	1.5	2.4	6.9	2.4	6.9
18	SDI-08	1.1	1.7	5.0	1.7	5.7
19	SDI-46	0.9	1.5	4.3	1.5	4.3
20A	SDI-4 (U/S Flanking Inlet)	0.8	1.3	3.5	2.9	10.3
20B	SDI-5 (Sump)	0.9	1.6	4.2	0.5	6.2
21	SDI-03	1.9	2.7	8.5	2.7	7.0
22	SDI-23	1.7	2.6	7.5	2.6	7.1
23	SDI-22	1.2	2.1	6.2	2.1	6.2
24	SDI-21	1.2	1.8	5.3	2.0	8.0
25	SDI-09	1.0	1.9	5.3	1.9	5.3
26	SDI-06	0.4	1.1	2.4	1.1	5.0
30A	-	1.6	1.5	4.8	1.5	4.8
30B	-	2.8	2.6	8.3	4.1	13.1
30C	SDI-20 (U/S Flanking Inlet)	1.0	1.0	3.1	4.0	8.1
	SDI-2 (Sump)				1.0	8.0
31A	-	0.6	0.8	2.0	0.8	2.0
31B	-	0.5	0.7	1.7	0.7	1.7
31C	SDI-26	0.8	1.1	2.8	2.6	6.5
32	SDI-49	0.3	0.9	2.2	0.9	2.2
33	SDI-44	0.9	1.9	4.1	1.9	4.1
34	SDI-32	6.1	2.3	16.4	2.3	16.4
35	-	4.3	12.0	25.3	64.0	182.4
36A	SDI-25	2.7	0.7	6.6	0.8	8.4
36B	SDI-41	0.6	0.2	1.5	0.2	1.5
O1	-	0.4	0.1	1.8	0.1	1.8
O2	-	2.8	0.3	6.3	0.3	6.3
O3	-	2.4	0.3	5.2	0.3	5.2
O4	-	1.6	0.3	3.5	0.3	3.5
41A	SDI-50	1.7	0.5	4.3	0.8	10.6
41B	SDI-28	0.8	0.2	1.9	0.8	10.6
42	SDI-17	1.4	2.4	6.6	2.4	6.6
43	SDI-33	1.0	2.2	5.9	2.2	7.8
44	SDI-35	0.9	2.1	5.5	2.1	8.4
45	SDI-37	0.4	1.0	2.4	1.0	2.4
46	SDI-38	0.7	1.2	3.1	1.2	4.0
47	SDI-14	0.9	1.5	4.3	1.7	7.2
48	SDI-15	0.8	1.5	4.1	1.7	8.7
49	SDI-18	1.2	2.2	5.9	2.2	8.3
50	SDI-19	1.1	2.2	5.9	2.2	6.6
51	SDI-01	0.4	1.2	2.7	1.2	3.7
O5		0.8	0.1	2.0	64.1	184.4
O6		0.8	0.6	3.0	0.6	3.0
O7		0.6	1.2	3.1	1.2	3.1
O8		0.4	0.5	1.6	0.5	1.7
O9		1.3	1.4	4.4	1.4	4.4
O11		43.3	5.3	79.4	5.3	79.4

NOTES

REFER TO SHEET 6 FOR COMPLETE RUNOFF SUMMARY TABLE WITH BYPASS FLOW NOTES.

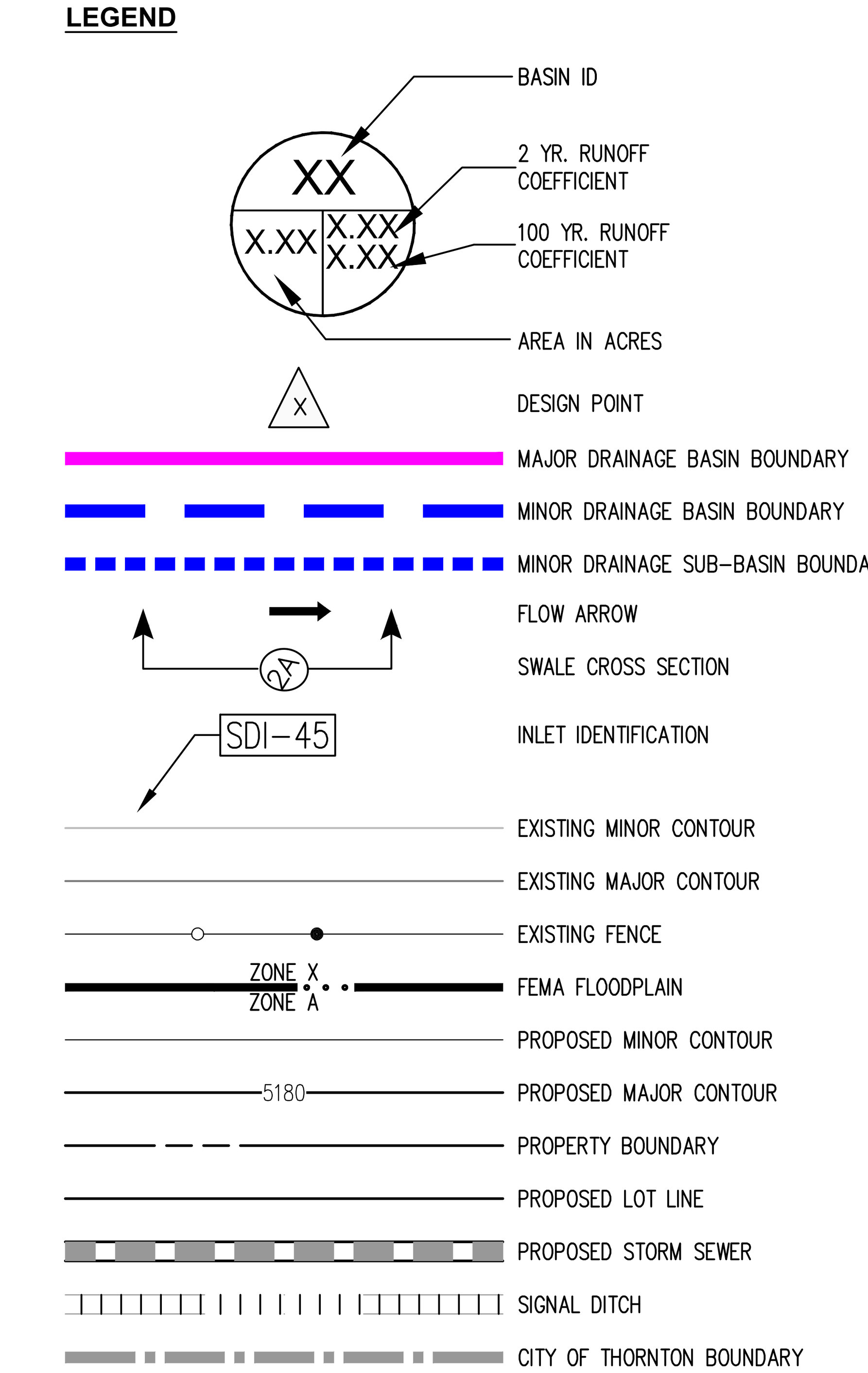
Pro-Rated Sub-Basin Q5 Backup

Basin ID [1]	Basin Area [2]	Basin Q5 [3]	Sub-Basin ID [4]	Inlet ID	Sub-Basin Area [5]	Sub-Basin Pro-Rated Q5 [6]
Unit	acres	cfs			acres	cfs
2	1.5	2.7	2A	-	0.4	0.8
			2B	SDI-42	1.1	2.0
20	1.6	2.9	20A	SDI-4 (U/S Flanking Inlet)	0.8	1.3
			20B	SDI-5 (Sump)	0.9	1.6
36	3.3	0.9	36A	SDI-25	2.7	0.7
			36B	SDI-41	0.6	0.2
41	2.5	0.7	41A	SDI-50	1.7	0.5
			41B	SDI-28	0.8	0.2
30	5.4	5.0	30A	-	1.6	1.5
			30B	-	2.8	2.6
			30C	SDI-20 (U/S Flanking Inlet) & SDI-2 (Sump)	1.0	0.9
31	1.8	2.6	31A	-	0.6	0.8
			31B	-	0.5	0.7
			31C	SDI-26	0.8	1.1

Pro-Rated Sub-Basin Q100 Backup

Basin ID [1]	Basin Area [2]	Basin Q100 [3]	Sub-Basin ID [4]	Inlet ID	Sub-Basin Area [5]	Sub-Basin Pro-Rated Q100 [6]
Unit	acres	cfs			acres	cfs
2	1.5	7.6	2A	-	0.4	2.1
			2B	SDI-42	1.1	5.5
20	1.6	7.7	20A	SDI-4 (U/S Flanking Inlet)	0.8	3.5
			20B	SDI-5 (Sump)	0.9	4.2
36	3.3	8.0	36A	SDI-25	2.7	6.6
			36B	SDI-41	0.6	1.5
41	2.5	6.3	41A	SDI-50	1.7	4.3
			41B	SDI-28	0.8	1.9
30	5.4	16.2	30A	-	1.6	4.8
			30B	-	2.8	8.3
			30C	SDI-20 (U/S Flanking Inlet) & SDI-2 (Sump)	1.0	3.1
31	1.8	6.5	31A	-	0.6	2.0
			31B	-	0.5	1.7
			31C	SDI-26	0.8	2.8

LEGEND



GRAPHIC SCALE: 1"=100'

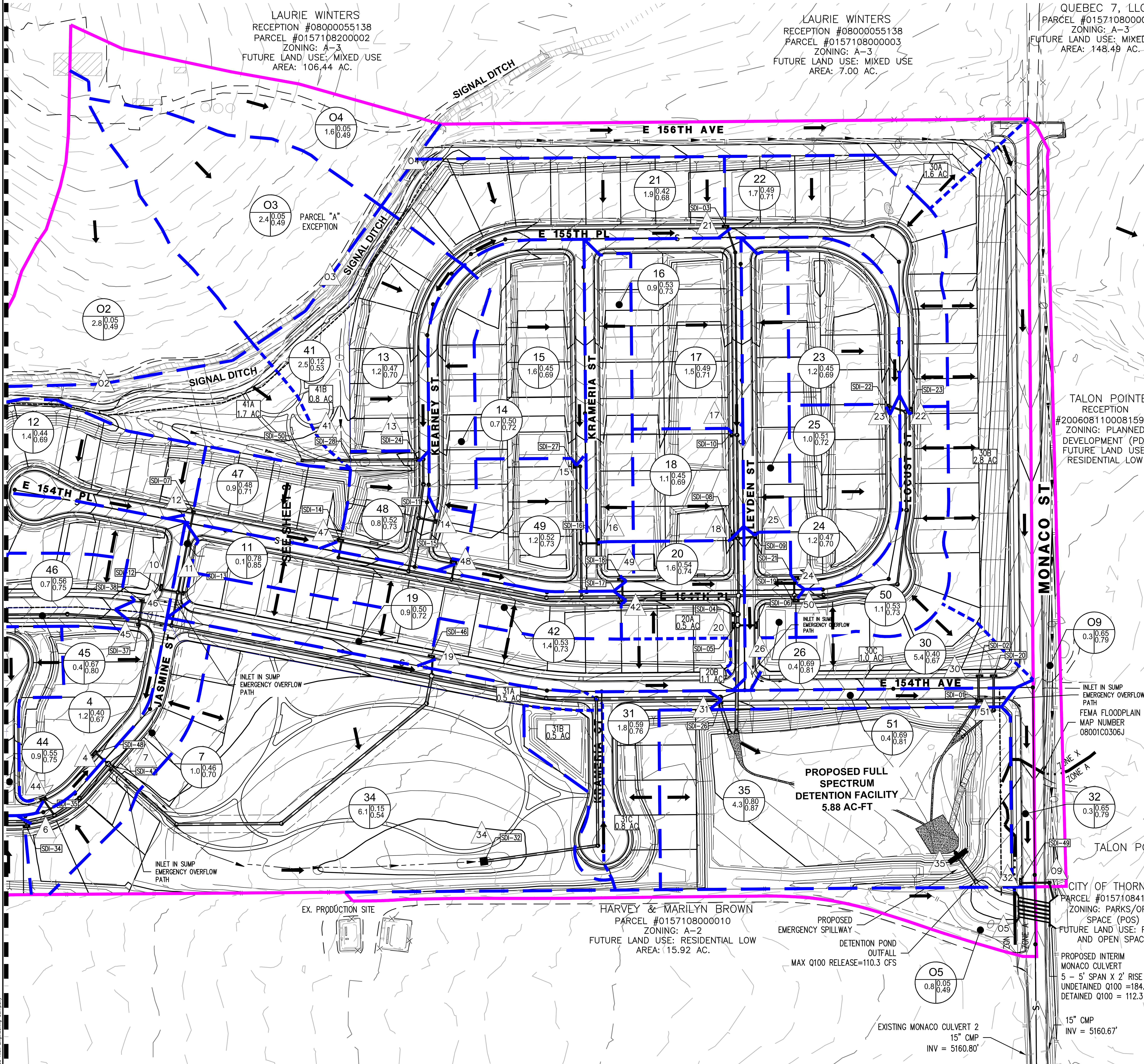
OWNER	DEVELOPER	ENGINEER	LANDSCAPE ARCHITECT
NICHOLAS AND DEBORAH CHIOVITTI 15555 MONACO ST. BRIGHTON, CO 80602 720-989-3525	VENTANA CAPITAL, INC. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-346-7006	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020

DATE: DECEMBER 30, 2020
SCALE: 1" = 100'
JOB NO. D01104
SHEET: 4 OF 6

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020

WESTWOOD PROPOSED DRAINAGE PLAN

A PARCEL OF LAND LOCATED IN SECTION 8, TOWNSHIP 1 SOUTH, RANGE 67
WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF THORNTON, COUNTY OF ADAMS, STATE OF COLORADO



RUNOFF SUMMARY TABLE

Design Point	Inlet ID	Contributing Area (acres)	Direct Q5 (CFS)	Direct Q100 (CFS)	Total Q5 (CFS)	Total Q100 (CFS)
1	SDI-31	0.7	1.3	3.6	1.3	3.6
2A	-	0.4	0.8	2.1	0.8	2.1
2B	SDI-42	1.1	2.0	5.5	2.7	7.6
3	SDI-39	1.1	1.7	5.0	1.7	5.0
4	SDI-48	1.2	1.5	5.0	1.5	6.5
5	SDI-30	2.5	2.9	9.4	2.9	9.4
6	SDI-34	1.5	2.4	6.8	2.4	8.7
7	SDI-47	1.0	1.6	4.8	1.6	6.4
8	SDI-45	0.3	0.9	2.1	0.9	2.1
9	SDI-40	0.5	1.4	3.2	1.4	3.2
10	SDI-12	1.2	2.0	5.9	2.0	5.9
11	SDI-13	0.1	0.3	0.7	0.3	0.7
12	SDI-07	1.4	2.1	6.5	2.1	6.5
13	SDI-24	1.2	2.2	6.3	2.2	6.3
14	SDI-11	0.7	1.4	3.9	1.4	3.9
15	SDI-27	1.6	2.4	7.1	2.4	7.1
16	SDI-16	0.9	1.9	5.0	1.9	5.0
17	SDI-10	1.5	2.4	6.9	2.4	6.9
18	SDI-08	1.1	1.7	5.0	1.7	5.7
19	SDI-46	0.9	1.5	4.3	1.5	4.3
20A	SDI-4 (U/S Flanking Inlet)	0.8	1.3	3.5	2.9	10.3
20B	SDI-5 (Sump)	0.9	1.6	4.2	0.5	6.2
21	SDI-03	1.9	2.7	8.5	2.7	7.0
22	SDI-23	1.7	2.6	7.5	2.6	7.1
23	SDI-22	1.2	2.1	6.2	2.1	6.2
24	SDI-21	1.2	1.8	5.3	2.0	8.0
25	SDI-09	1.0	1.9	5.3	1.9	5.3
26	SDI-06	0.4	1.1	2.4	1.1	5.0
30A	-	1.6	1.5	4.8	1.5	4.8
30B	-	2.8	2.6	8.3	4.1	13.1
30C	SDI-20 (U/S Flanking Inlet)	1.0	1.0	3.1	4.0	8.1
	SDI-2 (Sump)				1.0	8.0
31A	-	0.6	0.8	2.0	0.8	2.0
31B	-	0.5	0.7	1.7	0.7	1.7
31C	SDI-26	0.8	1.1	2.8	2.6	6.5
32	SDI-49	0.3	0.9	2.2	0.9	2.2
33	SDI-44	0.9	1.9	4.1	1.9	4.1
34	SDI-32	6.1	2.3	16.4	2.3	16.4
35	-	4.3	12.0	25.3	64.0	182.4
36A	SDI-25	2.7	0.7	6.6	0.8	8.4
36B	SDI-41	0.6	0.2	1.5	0.2	1.5
O1	-	0.4	0.1	1.8	0.1	1.8
O2	-	2.8	0.3	6.3	0.3	6.3
O3	-	2.4	0.3	5.2	0.3	5.2
O4	-	1.6	0.3	3.5	0.3	3.5
41A	SDI-50	1.7	0.5	4.3	0.8	10.6
41B	SDI-28	0.8	0.2	1.9	0.8	10.6
42	SDI-17	1.4	2.4	6.6	2.4	6.6
43	SDI-33	1.0	2.2	5.9	2.2	7.8
44	SDI-35	0.9	2.1	5.5	2.1	8.4
45	SDI-37	0.4	1.0	2.4	1.0	2.4
46	SDI-38	0.7	1.2	3.1	1.2	4.0
47	SDI-14	0.9	1.5	4.3	1.7	7.2
48	SDI-15	0.8	1.5	4.1	1.7	8.7
49	SDI-18	1.2	2.2	5.9	2.2	8.3
50	SDI-19	1.1	2.2	5.9	2.2	6.6
51	SDI-01	0.4	1.2	2.7	1.2	3.7
O5		0.8	0.1	2.0	64.1	184.4
O6		0.8	0.6	3.0	0.6	3.0
O7		0.6	1.2	3.1	1.2	3.1
O8		0.4	0.5	1.6	0.5	1.7
O9		1.3	1.4	4.4	1.4	4.4
O11		43.3	5.3	79.4	5.3	79.4

NOTES

REFER TO SHEET 6 FOR COMPLETE RUNOFF SUMMARY TABLE WITH BYPASS FLOW NOTES.

Pro-Rated Sub-Basin Q5 Backup

Basin ID [1]	Basin Area [2]	Basin Q5 [3]	Sub-Basin ID [4]	Inlet ID	Sub-Basin Area [5]	Sub-Basin Pro-Rated Q5 [6]
Unit	acres	cfs			acres	cfs
2	1.5	2.7	2A	-	0.4	0.8
			2B	SDI-42	1.1	2.0
20	1.6	2.9	20A	SDI-4 (U/S Flanking Inlet)	0.8	1.3
			20B	SDI-5 (Sump)	0.9	1.6
36	3.3	0.9	36A	SDI-25	2.7	0.7
			36B	SDI-41	0.6	0.2
41	2.5	0.7	41A	SDI-50	1.7	0.5
			41B	SDI-28	0.8	0.2
30	5.4	5.0	30A	-	1.6	1.5
			30B	-	2.8	2.6
			30C	SDI-20 (U/S Flanking Inlet) & SDI-2 (Sump)	1.0	0.9
31	1.8	2.6	31A	-	0.6	0.8
			31B	-	0.5	0.7
			31C	SDI-26	0.8	1.1

Pro-Rated Sub-Basin Q100 Backup

Basin ID [1]	Basin Area [2]	Basin Q100 [3]	Sub-Basin ID [4]	Inlet ID	Sub-Basin Area [5]	Sub-Basin Pro-Rated Q100 [6]
Unit	acres	cfs			acres	cfs
2	1.5	7.6	2A	-	0.4	2.1
			2B	SDI-42	1.1	5.5
20	1.6	7.7	20A	SDI-4 (U/S Flanking Inlet)	0.8	3.5
			20B	SDI-5 (Sump)	0.9	4.2
36	3.3	8.0	36A	SDI-25	2.7	6.6
			36B	SDI-41	0.6	1.5
41	2.5	6.3	41A	SDI-50	1.7	4.3
			41B	SDI-28	0.8	1.9
30	5.4	16.2	30A	-	1.6	4.8
			30B	-	2.8	8.3
			30C	SDI-20 (U/S Flanking Inlet) & SDI-2 (Sump)	1.0	3.1
31	1.8	6.5	31A	-	0.6	2.0
			31B	-	0.5	1.7
			31C	SDI-26	0.8	2.8

LEGEND

- BASIN ID
- 2 YR. RUNOFF COEFFICIENT
- 100 YR. RUNOFF COEFFICIENT
- AREA IN ACRES
- DESIGN POINT
- MAJOR DRAINAGE BASIN BOUNDARY
- MINOR DRAINAGE BASIN BOUNDARY
- MINOR DRAINAGE SUB-BASIN BOUNDARY
- FLOW ARROW
- SWALE CROSS SECTION
- SDI-45 INLET IDENTIFICATION
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING FENCE
- ZONE X / ZONE A FEMA FLOODPLAIN
- PROPOSED MINOR CONTOUR
- 5180 PROPOSED MAJOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED LOT LINE
- PROPOSED STORM SEWER
- SIGNAL DITCH
- CITY OF THORNTON BOUNDARY

GRAPHIC SCALE: 1"=100' (0 – 50 – 100 – 200 – 300)

OWNER	DEVELOPER	ENGINEER	LANDSCAPE ARCHITECT
NICHOLAS AND DEBORAH CHIOVITTI 15555 MONACO ST. BRIGHTON, CO 80602 720-989-3525	VENTANA CAPITAL, INC. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-346-7006	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020	RICK ENGINEERING CO. 9801 E. EASTER AVE. CENTENNIAL, CO 80112 303-537-8020

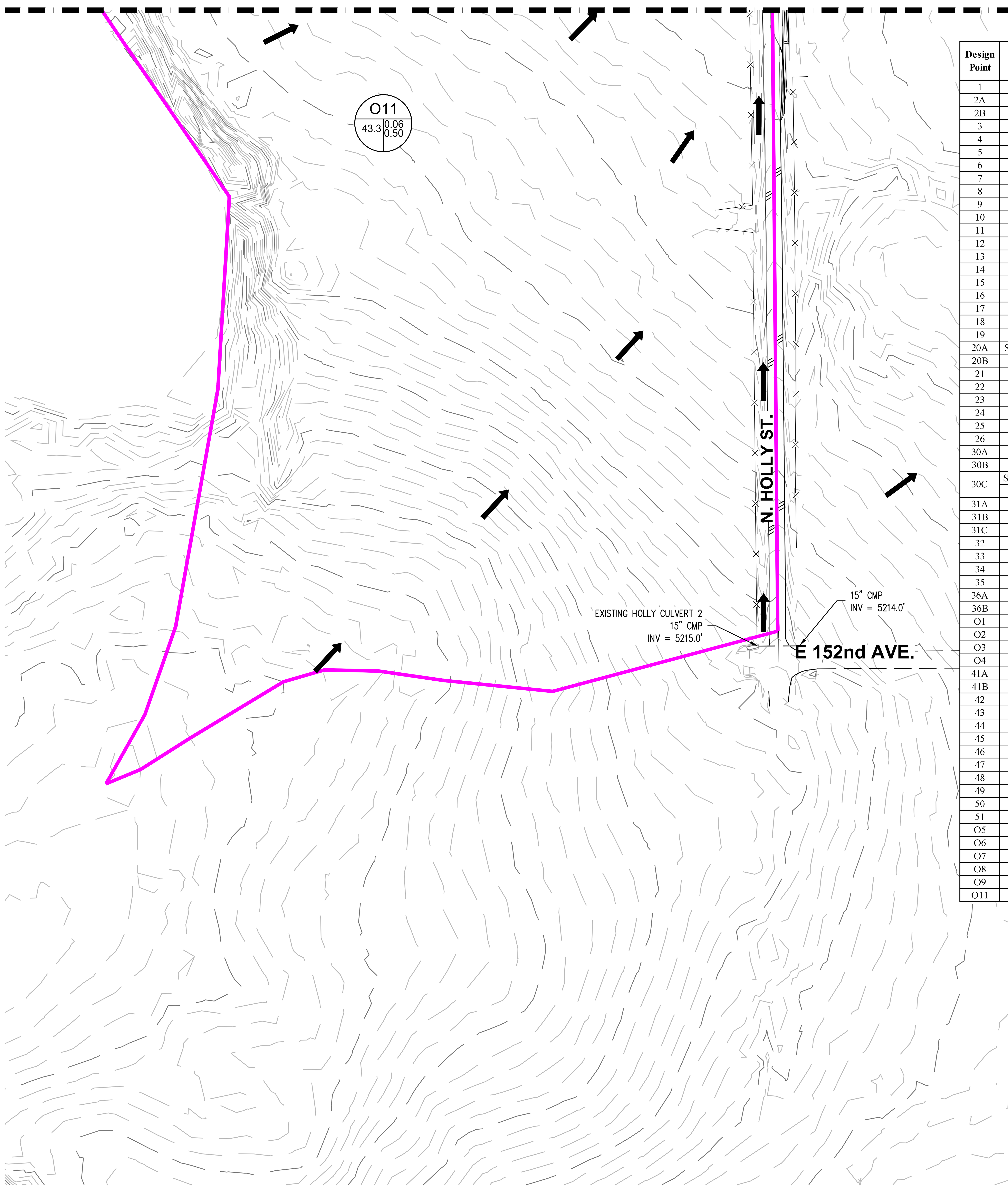
DATE: DECEMBER 30, 2020
SCALE: 1" = 100'

JOB NO. D01104

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020

WESTWOOD PROPOSED DRAINAGE PLAN

A PARCEL OF LAND LOCATED IN SECTION 8, TOWNSHIP 1 SOUTH, RANGE 67
WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF THORNTON, COUNTY OF ADAMS, STATE OF COLORADO



RUNOFF SUMMARY TABLE

Design Point	Inlet ID	Contributing Area (acres)	Direct Q5 (CFS)	Direct Q100 (CFS)	Total Q5 (CFS)	Total Q100 (CFS)	Notes
1	SDI-31	0.7	1.3	3.6	1.3	3.6	No bypass flow received
2A	-	0.4	0.8	2.1	0.8	2.1	No bypass flow received
2B	SDI-42	1.1	2.0	5.5	2.7	7.6	Bypass flow from Sub-Basin 2A
3	SDI-39	1.1	1.7	5.0	1.7	5.0	No bypass flow received
4	SDI-48	1.2	1.5	5.0	1.5	6.5	Bypass flow from Basin 44 (SDI-35)
5	SDI-30	2.5	2.9	9.4	2.9	9.4	No bypass flow received
6	SDI-34	1.5	2.4	6.8	2.4	8.7	Bypass flow from Basin 5 (SDI-30)
7	SDI-47	1.0	1.6	4.8	1.6	6.4	Bypass flow from Basin 6 (SDI-34)
8	SDI-45	0.3	0.9	2.1	0.9	2.1	No bypass flow received
9	SDI-40	0.5	1.4	3.2	1.4	3.2	No bypass flow received
10	SDI-12	1.2	2.0	5.9	2.0	5.9	No bypass flow received
11	SDI-13	0.1	0.3	0.7	0.3	0.7	No bypass flow received
12	SDI-07	1.4	2.1	6.5	2.1	6.5	No bypass flow received
13	SDI-24	1.2	2.2	6.3	2.2	6.3	No bypass flow received
14	SDI-11	0.7	1.4	3.9	1.4	3.9	No bypass flow received
15	SDI-27	1.6	2.4	7.1	2.4	7.1	No bypass flow received
16	SDI-16	0.9	1.9	5.0	1.9	5.0	No bypass flow received
17	SDI-10	1.5	2.4	6.9	2.4	6.9	No bypass flow received
18	SDI-08	1.1	1.7	5.0	1.7	5.7	Bypass flow from Basin 17 (SDI-10)
19	SDI-46	0.9	1.5	4.3	1.5	4.3	No bypass flow received
20A	SDI-4 (U/S Flanking Inlet)	0.8	1.3	3.5	2.9	10.3	Bypass flow from Basin 18 (SDI-08) + Basin 42 (SDI-17) + Basin 49 (SDI-18)
20B	SDI-5 (Sump)	0.9	1.6	4.2	0.5	6.2	Bypass flow from Basin 19 (SDI-46) + Sub-Basin 20A (SDI-04)
21	SDI-03	1.9	2.7	8.5	2.7	7.0	No bypass flow received
22	SDI-23	1.7	2.6	7.5	2.6	7.1	Bypass flow from Basin 21 (SDI-03)
23	SDI-22	1.2	2.1	6.2	2.1	6.2	No bypass flow received
24	SDI-21	1.2	1.8	5.3	2.0	8.0	Bypass flow from Basin 23 (SDI-22)
25	SDI-09	1.0	1.9	5.3	1.9	5.3	No bypass flow received
26	SDI-06	0.4	1.1	2.4	1.1	5.0	Bypass flow from Basin 24 (SDI-21) + Basin 25 (SDI-09) + Basin 50 (SDI-19)
30A	-	1.6	1.5	4.8	1.5	4.8	No bypass flow received
30B	-	2.8	2.6	8.3	4.1	13.1	Bypass flow from Sub-Basin 30A
30C	SDI-20 (U/S Flanking Inlet)	1.0	1.0	3.1	4.0	8.1	Bypass flow from Sub-Basin 30B (this already includes flow from Sub-Basin 30A)
	SDI-2 (Sump)				1.0	8.0	Bypass flow from SDI-20 (U/S Flanking Inlet)
31A	-	0.6	0.8	2.0	0.8	2.0	No bypass flow received
31B	-	0.5	0.7	1.7	0.7	1.7	No bypass flow received
31C	SDI-26	0.8	1.1	2.8	2.6	6.5	Bypass flow from Sub-Basin 31A & 31B
32	SDI-49	0.3	0.9	2.2	0.9	2.2	No bypass flow received
33	SDI-44	0.9	1.9	4.1	1.9	4.1	No bypass flow received
34	SDI-32	6.1	2.3	16.4	2.3	16.4	No bypass flow received
35	-	4.3	12.0	25.3	64.0	182.4	Total Flow = Peak inflow for the detention basin from UD-Detention Spreadsheet
36A	SDI-25	2.7	0.7	6.6	0.8	8.4	Bypass flow from Offsite Basin O1
36B	SDI-41	0.6	0.2	1.5	0.2	1.5	No bypass flow received
O1	-	0.4	0.1	1.8	0.1	1.8	No bypass flow received
O2	-	2.8	0.3	6.3	0.3	6.3	No bypass flow received
O3	-	2.4	0.3	5.2	0.3	5.2	No bypass flow received
O4	-	1.6	0.3	3.5	0.3	3.5	No bypass flow received
41A	SDI-50	1.7	0.5	4.3	0.8	10.6	Bypass flow from Offsite Basin O2
41B	SDI-28	0.8	0.2	1.9	0.8	10.6	Bypass flow from Offsite Basin O3 & O4
42	SDI-17	1.4	2.4	6.6	2.4	6.6	No bypass flow received
43	SDI-33	1.0	2.2	5.9	2.2	7.8	Bypass flow from Basin 1 (SDI-31) + Basin 2 (SDI-42)
44	SDI-35	0.9	2.1	5.5	2.1	8.4	Bypass flow from Basin 43 (SDI-33) + Basin 3 (SDI-39)
45	SDI-37	0.4	1.0	2.4	1.0	2.4	No bypass flow received
46	SDI-38	0.7	1.2	3.1	1.2	4.0	Bypass flow from Basin 9 (SDI-40)
47	SDI-14	0.9	1.5	4.3	1.7	7.2	Bypass flow from Basin 12 (SDI-07)
48	SDI-15	0.8	1.5	4.1	1.7	8.7	Bypass flow from Basin 13 (SDI-24) + Basin 14 (SDI-11) + Basin 47 (SDI-14)
49	SDI-18	1.2	2.2	5.9	2.2	8.3	Bypass flow from Basin 15 (SDI-27) + Basin 16 (SDI-16) + Basin 48 (SDI-15)
50	SDI-19	1.1	2.2	5.9	2.2	6.6	Bypass flow from Basin 22 (SDI-23)
51	SDI-01	0.4	1.2	2.7	1.2	3.7	Bypass flow from Basin 31 (SDI-26)
O5		0.8	0.1	2.0	64.1	184.4	Total Flow = Undetained Q100 from the detention basin + Flow from Offsite Basin O5
O6		0.8	0.6	3.0	0.6	3.0	No bypass flow received
O7		0.6	1.2	3.1	1.2	3.1	No bypass flow received
O8		0.4	0.5	1.6	0.5	1.7	Bypass flow from Basin 33 (SDI-44)
O9		1.3	1.4	4.4	1.4	4.4	No bypass flow received
O11		43.3	5.3	79.4	5.3	79.4	No bypass flow received

Pro-Rated Sub-Basin Q5 Backup

Basin ID [1]	Basin Area [2]	Basin Q5 [3]	Sub-Basin ID [4]	Inlet ID	Sub-Basin Area [5]	Sub-Basin Pro-Rated Q5 [6]
Unit	acres	cfs			acres	cfs
2	1.5	2.7	2A	-	0.4	0.8
			2B	SDI-42	1.1	2.0
20	1.6	2.9	20A	SDI-4 (U/S Flanking Inlet)	0.8	1.3
			20B	SDI-5 (Sump)	0.9	1.6
36	3.3	0.9	36A	SDI-25	2.7	0.7
			36B	SDI-41	0.6	0.2
41	2.5	0.7	41A	SDI-50	1.7	0.5
			41B	SDI-28	0.8	0.2
30	5.4	5.0	30A	-	1.6	1.5
			30B	-	2.8	2.6
			30C	SDI-20 (U/S Flanking Inlet) & SDI-2 (Sump)	1.0	0.9
31	1.8	2.6	31A	-	0.6	0.8
			31B	-	0.5	0.7
			31C	SDI-26	0.8	1.1

Pro-Rated Sub-Basin Q100 Backup

Basin ID [1]	Basin Area [2]	Basin Q100 [3]	Sub-Basin ID [4]	Inlet ID	Sub-Basin Area [5]	Sub-Basin Pro-Rated Q100 [6]
Unit	acres	cfs			acres	cfs
2	1.5	7.6	2A	-	0.4	2.1
			2B	SDI-42	1.1	5.5
20	1.6	7.7	20A	SDI-4 (U/S Flanking Inlet)	0.8	3.5
			20B	SDI-5 (Sump)	0.9	4.2
36	3.3	8.0	36A	SDI-25	2.7	6.6
			36B	SDI-41	0.6	1.5
41	2.5	6.3	41A	SDI-50	1.7	4.3
			41B	SDI-28	0.8	1.9
30	5.4	16.2	30A	-	1.6	4.8
			30B	-	2.8	8.3
			30C	SDI-20 (U/S Flanking Inlet) & SDI-2 (Sump)	1.0	3.1
31	1.8	6.5	31A	-	0.6	2.0
			31B	-	0.5	1.7
			31C	SDI-26	0.8	2.8

LEGEND

XX — BASIN ID
X.XX — 2 YR. RUNOFF COEFFICIENT
X.XX — 100 YR. RUNOFF COEFFICIENT
X.XX — AREA IN ACRES
X — DESIGN POINT
MAJOR DRAINAGE BASIN BOUNDARY
MINOR DRAINAGE BASIN BOUNDARY
MINOR DRAINAGE SUB-BASIN BOUNDARY
FLOW ARROW
SWALE CROSS SECTION
SDI-45 — INLET IDENTIFICATION
EXISTING MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING FENCE
ZONE X / ZONE A — FEMA FLOODPLAIN
PROPOSED MINOR CONTOUR
5180 — PROPOSED MAJOR CONTOUR
PROPERTY BOUNDARY
PROPOSED LOT LINE
PROPOSED STORM SEWER
SIGNAL DITCH
CITY OF THORNTON BOUNDARY

100 50 0 100 200 300
GRAPHIC SCALE: 1"=100'

OWNER
NICHOLAS AND DEBORAH CHIOVITTI
15555 MONACO ST.
BRIGHTON, CO 80602
720-989-3525

DEVELOPER
VENTANA CAPITAL, INC.
9801 E. EASTER AVE.
CENTENNIAL, CO 80112
303-346-7006

ENGINEER
RICK ENGINEERING CO.
9801 E. EASTER AVE.
CENTENNIAL, CO 80112
303-537-8020

LANDSCAPE ARCHITECT
RICK ENGINEERING CO.
9801 E. EASTER AVE.
CENTENNIAL, CO 80112
303-537-8020

DATE: DECEMBER 30, 2020
SCALE: 1" = 100'
JOB NO. D01104
SHEET: 6 OF 6

RICK ENGINEERING COMPANY
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020