100TH AVENUE MULTIMODAL PATH
FINAL DRAINAGE REPORT
MARCH 2026

CITY OF THORNTON PROJECT # 23-105
CDOT PROJECT # TAP M286-053
CDOT SUB ACCOUNT # 25467

PREPARED FOR:

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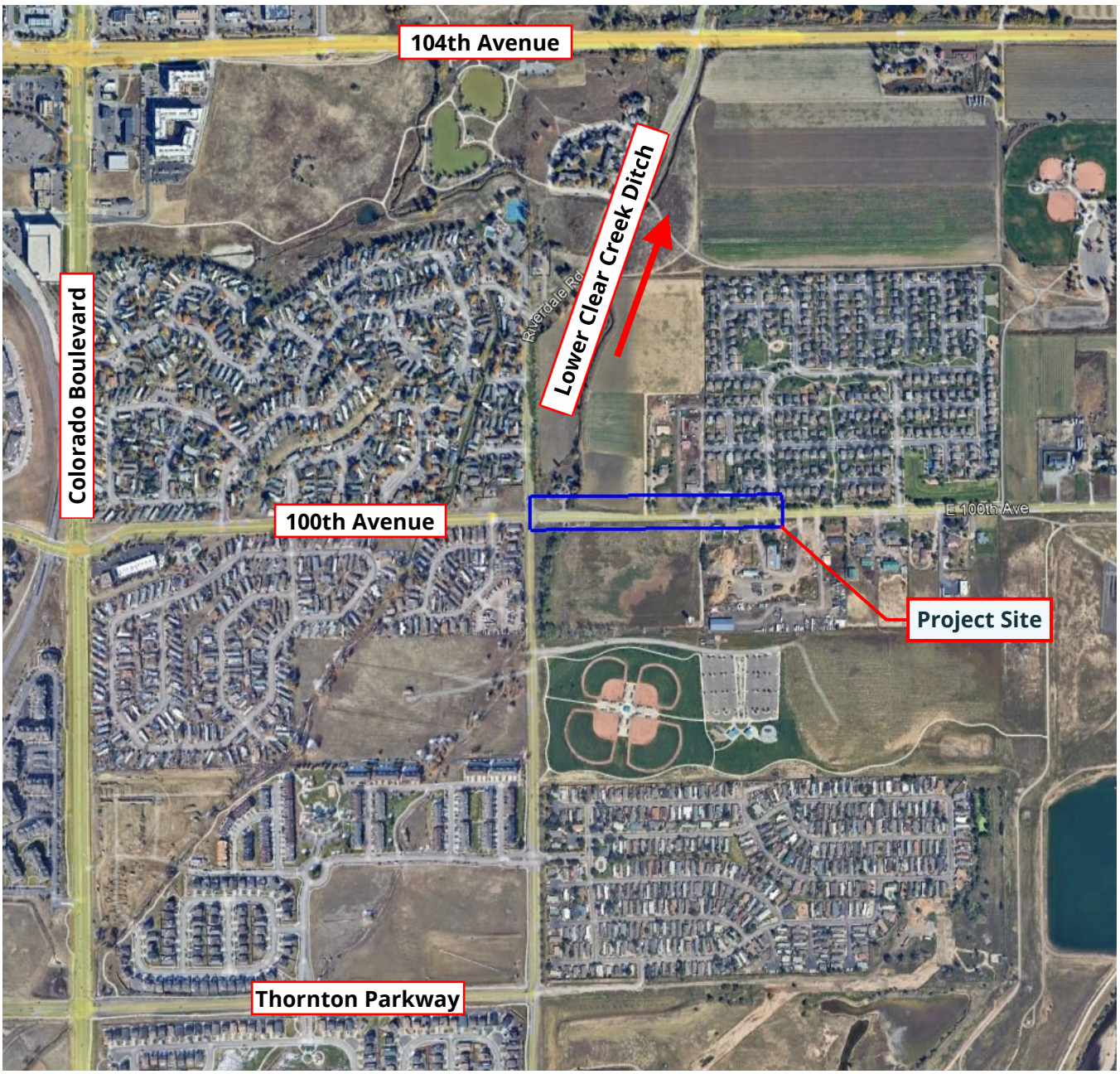
INTRODUCTION

The subject project occurs along 100TH Avenue from Riverdale Road to Forest Circle in the City of Thornton, Colorado. The project site is located within Section 18, Township 2 South, Range 67 West of the 6th Principal Meridian, Adams County. A map of the project site is shown in the figure below.



The project includes retrofitting an existing collector road with curb, gutter, and a concrete multimodal path. The purpose of the project is to provide a safe pathway for pedestrians and cyclists along the project corridor. The project also includes minor drainage and roadway improvements. The total project corridor spans approximately 1,200 feet along 100th Avenue.

HYDROLOGY

The drainage basin for the project site primarily consists of Right-of-way, residential neighborhoods, and agricultural land. Stormwater generally flows from southwest to northeast, and discharges to the Lower Clear Creek Ditch system, or the City of Thornton's storm sewer network. According to the National Resource Conservation Service (NRCS), the soils within the project site consist of clay loam and belong to Hydrologic Soil Group C. The soil report can be seen in Appendix A.

Existing drainage facilities within the drainage basin consists of roadside ditches, storm drain pipes, inlets, driveway culverts, and curb & gutter. This project includes minor modifications to the existing storm drain system to accommodate the proposed improvements.

The project site is located within FEMA FIRM map number 08001C0318J, FIRM Panel 318 of 1150. The FIRM map indicates the site is located within Zone X and there are no FEMA regulated floodplains within the project site area. A FEMA FIRMette of the project site can be seen in Appendix B.

The Lower Clear Creek Ditch is located within the project limits. The proposed curb, gutter, and sidewalk crosses over the existing culvert for the Ditch. The project will not impact this Ditch. However, there is a ditch lateral built by downstream customers to deliver ditch water to their respective properties. This ditch lateral flows parallel to the proposed curb, gutter, and sidewalk. This ditch lateral will be relocated to the north of the proposed curb, gutter and sidewalk, and new driveway culverts for this ditch lateral will be installed with this project. There will be no reduction in ditch capacity or delivery as a result of the proposed improvements.

Flood history of the subject site is not directly known. The City staff has met with a current property owner at 5115 100th Avenue to discuss the project. The property owner informed the City that their property experiences ponding stormwater from time to time. In addition, the ditch lateral drains onto this property. This property is located at the local low point of the surrounding area, and is represented by DP2 and is shown on the drainage exhibits found in Appendix C. Currently, two type C inlets drain stormwater and local ditch flows at the local low point. This project is anticipated to reduce the impact from stormwater and ditch water at 5115 100th Avenue through the following improvements: 1. Proposed curb & gutter will redirect roadway drainage to inlets versus direct flow onto the property.; 2. A new storm drain inlet is being added upstream of the property to intercept flow before entering the property.

Hydrology for hydraulic analysis of proposed drainage infrastructure was calculated using the Rational Method. The minor and major storms used for analysis and design of the proposed drainage infrastructure are the 5-year and 100-year storms, respectively. Precipitation data for the Rational Method came from the current data found on NOAA Atlas 14 Precipitation Data Frequency Server for the project site. Rational method calculations can be found in Appendix D.

EXISTING STRUCTURE

The existing drainage structures to be modified include the existing storm drain system. The existing storm drain system will be modified to include storm drain inlets and laterals to accommodate the proposed curb, gutter, and sidewalk. Modifications to the existing storm drain system will occur at four locations.

The first location is near the NE corner of the 100th and Riverdale intersection. At this location, an inlet will be added to the system to drain nuisance flow from the Right-of-Way and adjacent property. This location is represented by DP1 on the Proposed Conditions Drainage Exhibit found in Appendix C.

The second location is at the eastern end of the project. There is an existing 5-foot Type R inlet that was built in anticipation of curb & gutter along 100th Avenue. The project will relocate this inlet approximately 12 feet to the east to accommodate the proposed curb, gutter, and sidewalk. This Type R inlet will continue to collect stormwater runoff from 100th Avenue and the adjacent right-of-way. This location is represented by DP3 on the Proposed Conditions Drainage Exhibit found in Appendix C.

The third location where modification to existing storm drain system is to occur is located near the eastern edge of the project. The existing storm drain system will be extended upstream to install a Type C inlet at this location. This Type C inlet will drain ditch lateral water and storm water runoff. This location is represented by DP4 on the Proposed Conditions Drainage Exhibit found in Appendix C.

The fourth location is located near the eastern edge of the project. The existing storm drain system will be extended upstream to install a Type R inlet at this location. This Type R inlet will drain stormwater runoff from the roadway and proposed sidewalk. This location is represented by DP5 on the Proposed Conditions Drainage Exhibit found in Appendix C.

DESIGN DISCUSSION

The proposed improvements are anticipated to improve drainage conditions and the safety of pedestrians along the subject corridor, while limiting impacts to Right-Of-Way and existing structures to the maximum extent practicable. The design of the drainage infrastructure was intended to be simple yet effective. Proposed drainage infrastructure includes curb & gutter, storm drain inlets and laterals. The curb & gutter is designed to collect roadway runoff, and convey to Type R inlets at the east end of the project. The storm drain inlets will be used to drain stormwater runoff and ditch lateral flows from the surface. As the project drainage basin is primarily from roadway and Right-of-Way runoff, and are assumed to be fully developed, design discharges are anticipated to remain unchanged in the future. Tables showing a summary of the hydrologic calculations in the existing and proposed conditions can be found below. Drainage exhibits showing the locations of these design points can be found in Appendix C.

SUMMARY OF HYDROLOGIC CALCULATIONS - EXISTING CONDITION						
Design Point	Contributing Area (ac)	Impervious Area (ac)	5-Year Runoff Coefficient 'C'	100-Year Runoff Coefficient 'C'	Peak Flow 'Q' (cfs)	
					5-YR	100-YR
DP1	0.45	46.3%	0.41	0.67	0.55	2.01
DP2	12.31	12.4%	0.14	0.53	2.61	22.93
DP3	0.33	51.5%	0.45	0.69	0.45	1.54

SUMMARY OF HYDROLOGIC CALCULATIONS - PROPOSED CONDITION						
Design Point	Contributing Area (ac)	Impervious Area (ac)	5-Year Runoff Coefficient 'C'	100-Year Runoff Coefficient 'C'	Peak Flow 'Q' (cfs)	
					5-YR	100-YR
DP1	0.33	27.7%	0.26	0.60	0.24	1.21
DP2	1.09	20.0%	0.20	0.57	0.51	3.28
DP3	0.18	81.9%	0.70	0.82	0.45	1.17
DP4	10.64	10.3%	0.12	0.53	2.03	20.02
DP5	0.62	100.0%	0.85	0.89	1.84	4.33

Storm drain lateral pipes are designed to keep the 5-year storm hydraulic grade line (HGL) within the pipe, and to keep the 100-year storm HGL below the ground surface. The storm drain pipe design achieves this objective. Results of the HGL calculation can be found in Appendix F.

Driveway culverts are included in the design to pass irrigation ditch lateral flows under the driveways. The culverts are designed to maintain the existing capacity of the ditch lateral. Currently, there is a 10-inch pipe that is the bottleneck of the ditch lateral. This project will replace this pipe, and 2 others with 12-inch pipes. As such, the capacity of the ditch lateral will be greater in the proposed condition than in the existing condition. Culvert capacity calculations can be found in Appendix G.

The project includes an erosion and sediment control plan to control erosion and limit the transportation of sediment during the course of construction, and provides permanent stabilization measures such as pavement, riprap, erosion control blankets, seeding and mulching.

Due to limited right-of-way width along the subject corridor, several temporary construction easements are required to accommodate the proposed improvements.

The total limits of construction and total limits of disturbance for the project site are 0.80 and 0.56 acres, respectively. As the project disturbs less than one acre, a stormwater discharge permit for construction will not be required for this project. However, an erosion and sediment control plan, and stormwater management plan have been prepared and can be found in the project's Construction Plans.

RECOMMENDED DESIGN

The City of Thornton's Section 400 – Storm Drainage Design, Grading, and Water Quality Technical Criteria manual was used as the design criteria for this project.

There are four inlets proposed for the subject project. These inlets are provided at the locations described in the EXISTING STRUCTURE section above.

The recommended design for the inlet at the first location (DP1) is to install a Type C inlet. According to the inlet calculations found in Appendix E of the report, the proposed Type C inlet is able to drain the minor and major storms effectively, and there are no known flooding issues associated with this area. As such, this storm drain improvement is anticipated to function adequately in the proposed condition.

The recommended design for the inlet at the section location (DP3) is to remove the existing 5-foot Type R inlet and install a new 5-foot Type R inlet. According to the inlet calculations found in Appendix E of the report, the proposed Type R inlet is able to drain the minor and major storms effectively, and there are no known flooding issues associated with this area. As such, this storm drain improvement is anticipated to function adequately in the proposed condition.

The recommended design for the inlet at the third location (DP4) is to install a Type C inlet. According to the inlet calculations found in Appendix E of the report, the proposed Type C inlet is able to drain the minor and major storms effectively. The property downstream of this location has been known to accumulate ponding stormwater. This inlet has been added to intercept stormwater before entering the property. Should this inlet become clogged, the two existing area inlets at the southeast corner of this property will continue to drain stormwater. This storm

drain improvement is anticipated to function adequately in the proposed condition, and will have more capacity to drain stormwater than in the existing condition.

The recommended design for the inlet at the fourth location (DP5) is to install a 10-foot Type R inlet. According to the inlet calculations found in Appendix E of the report, the proposed Type R inlet is able to drain the minor and major storms effectively. This proposed inlet will also intercept stormwater which would have drained to 5115 100th Avenue. Should this inlet become clogged, there is a 5-foot Type R inlet downstream (DP3) that will drain any bypass stormwater. This storm drain improvement is anticipated to function adequately in the proposed condition, and will have more capacity to drain stormwater than in the existing condition.

The recommended design for the storm drain lateral pipes can be seen in Appendix F. The recommended design keeps the 5-year HGL within the pipes, and keeps the 100-year HGL below the ground surface.

The recommended design for the ditch lateral culvert pipes is to install 12-inch pipes under the driveways. This design will exceed the capacity of the existing ditch lateral as the existing ditch lateral is limited by an existing 10-inch pipe. This project will replace this 10-inch pipe with a 12-inch pipe. Culvert capacity calculations can be found in Appendix G.

The proposed drainage improvements are anticipated to improve the capacity of the existing storm drain system to intercept and drain surface runoff, and the site improvements will reduce erosion and limit sedimentation by providing temporary and permanent stabilization practices. In addition, the project will provide pedestrians a safe pathway to walk through the project corridor. For more information on proposed improvements, please refer to the project's Construction Plans.

APPENDIX

APPENDIX A

NRCS Soil Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Adams County Area, Parts of Adams and Denver Counties, Colorado

September 9, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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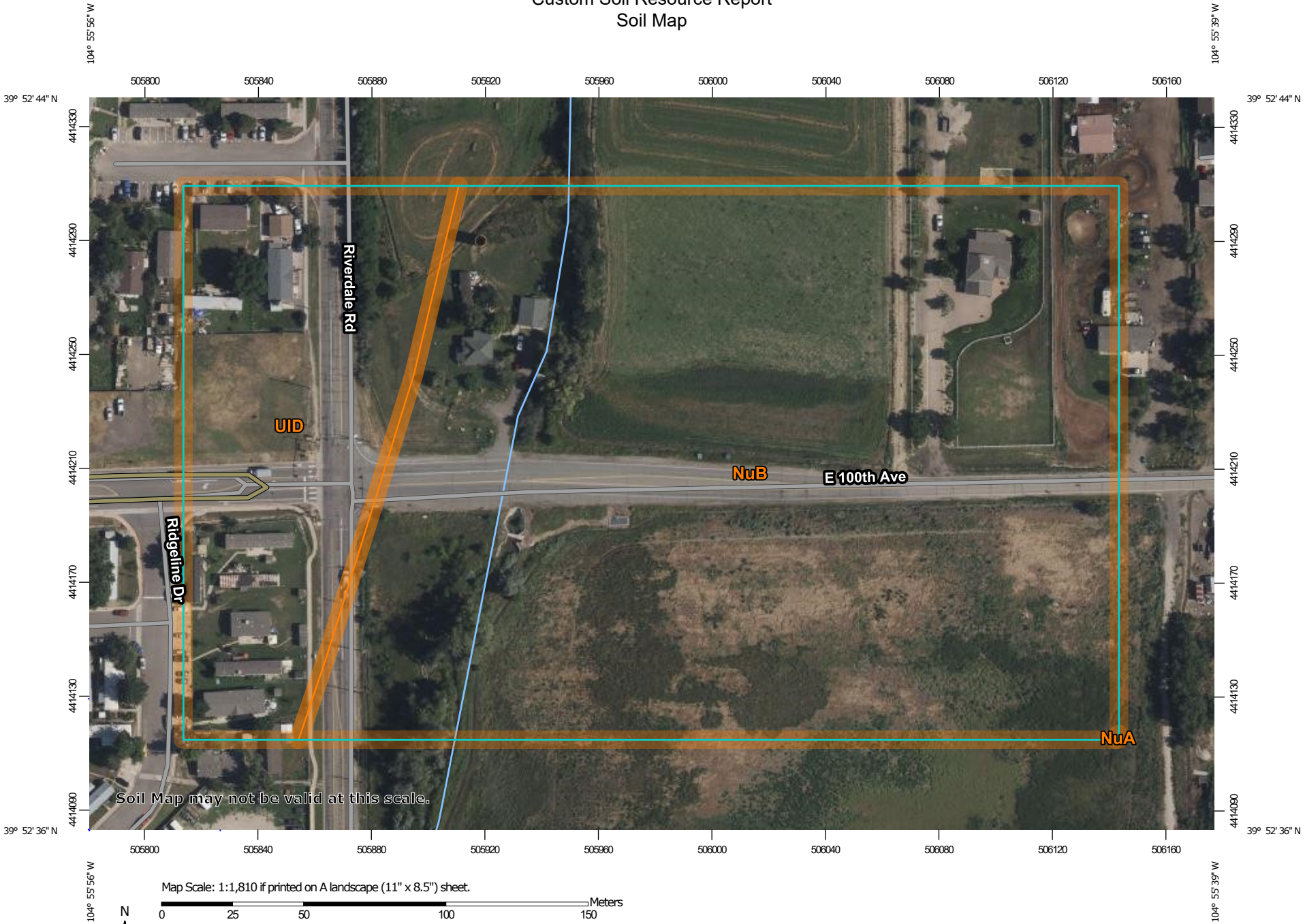
Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,810 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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 20, Aug 24, 2023

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NuA	Nunn clay loam, 0 to 1 percent slopes	0.0	0.0%
NuB	Nunn clay loam, 1 to 3 percent slopes	12.5	78.5%
UlD	Ulm loam, 5 to 9 percent slopes	3.4	21.4%
Totals for Area of Interest		**15.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Adams County Area, Parts of Adams and Denver Counties, Colorado

NuA—Nunn clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2tlng
Elevation: 4,100 to 5,700 feet
Mean annual precipitation: 14 to 15 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 152 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Pleistocene aged alluvium and/or eolian deposits

Typical profile

Ap - 0 to 6 inches: clay loam
Bt1 - 6 to 10 inches: clay loam
Bt2 - 10 to 26 inches: clay loam
Btk - 26 to 31 inches: clay loam
Bk1 - 31 to 47 inches: loam
Bk2 - 47 to 80 inches: loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 7 percent
Maximum salinity: Nonsaline (0.1 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 0.5
Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Minor Components

Heldt

Percent of map unit: 10 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Wages

Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

NuB—Nunn clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tlpl
Elevation: 3,900 to 5,840 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Pleistocene aged alluvium and/or eolian deposits

Typical profile

Ap - 0 to 9 inches: clay loam
Bt - 9 to 13 inches: clay loam
Btk - 13 to 25 inches: clay loam
Bk1 - 25 to 38 inches: clay loam
Bk2 - 38 to 80 inches: clay loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 7 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 0.5
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Minor Components

Heldt

Percent of map unit: 10 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Satanta

Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

UlD—Ulm loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 34x5
Elevation: 4,000 to 5,600 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 125 to 155 days

Farmland classification: Not prime farmland

Map Unit Composition

Ulm and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ulm

Setting

Landform: Plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 13 inches: silty clay
H3 - 13 to 30 inches: clay
H4 - 30 to 48 inches: clay loam
H5 - 48 to 52 inches: unweathered bedrock

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Minor Components

Shingle

Percent of map unit: 10 percent
Hydric soil rating: No

Renohill

Percent of map unit: 8 percent
Hydric soil rating: No

Apishapa

Percent of map unit: 2 percent
Landform: Swales
Ecological site: R067BY035CO - Salt Meadow

Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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:

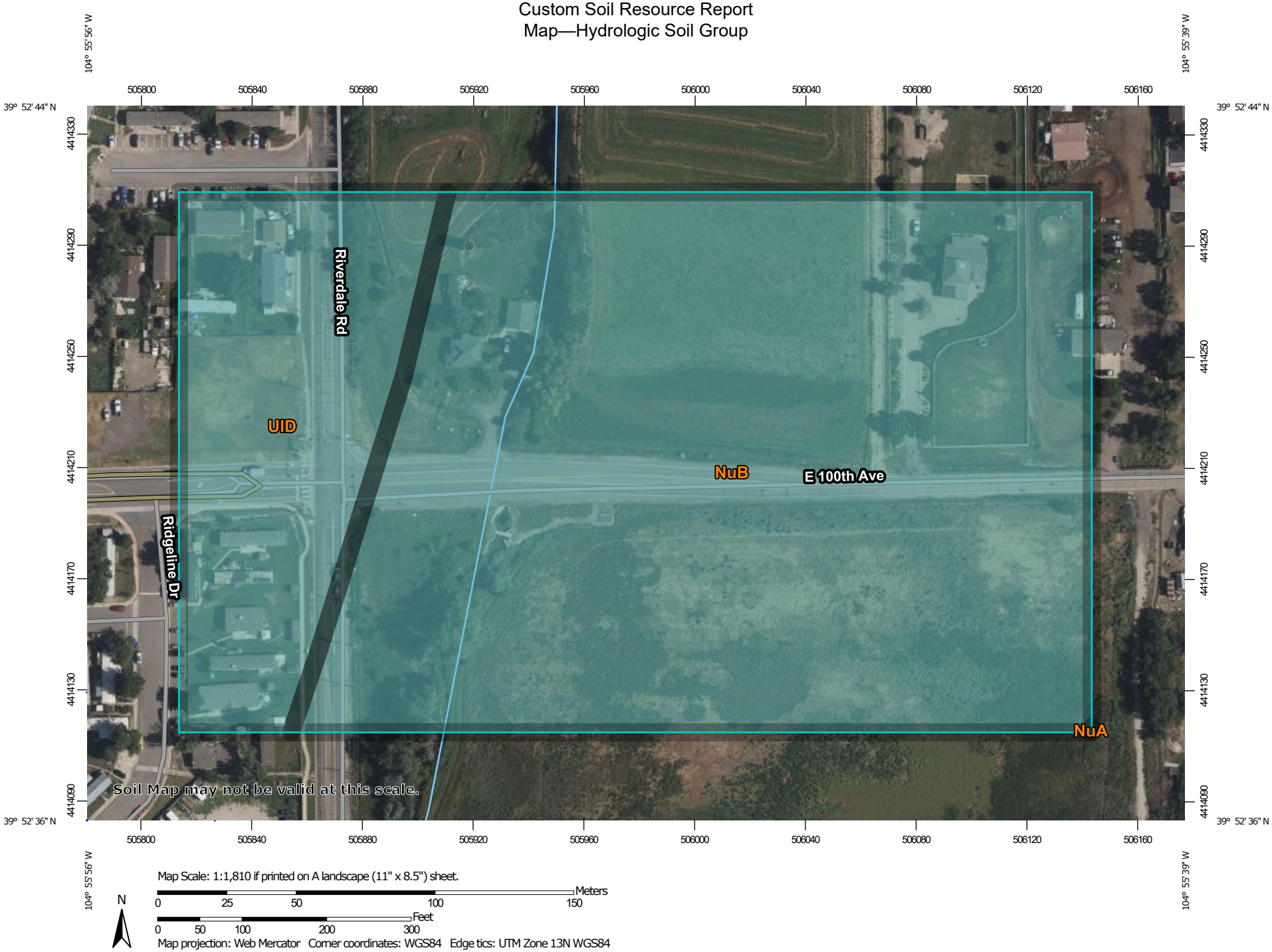
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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.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104° 55' 39" W
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505840
505880
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505960
506000
506040
506080
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506160
39° 52' 44" N
39° 52' 36" N
4414330
4414290
4414250
4414210
4414170
4414130
4414090
Riverdale Rd
Ridgeline Dr
E 100th Ave
UID
NuB
NuA
Soil Map may not be valid at this scale.
N
Map Scale: 1:1,810 if printed on A landscape (11" x 8.5") sheet.
Meters
0 25 50 100 150
Feet
0 50 100 200 300
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 20, Aug 24, 2023

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
NuA	Nunn clay loam, 0 to 1 percent slopes	C	0.0	0.0%
NuB	Nunn clay loam, 1 to 3 percent slopes	C	12.5	78.5%
UlD	Ulm loam, 5 to 9 percent slopes	C	3.4	21.4%
Totals for Area of Interest			**15.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

FEMA FIRMette

National Flood Hazard Layer FIRMette

FEMA

104°56'10"W 39°52'56"N

104°55'33"W 39°52'29"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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
- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/9/2024 at 10:20 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX C

Drainage Exhibits

100TH AVENUE MULTIMODAL PATH

EXISTING CONDITIONS DRAINAGE EXHIBIT

DESIGN POINT

DP#

FLOW PATTERN

SUB-BASIN BOUNDARY

BASIN ID

X

XX.X

0.45

0.60

EXISTING 5-YR RUNOFF COEFFICIENT

EXISTING BASIN AREA (AC)

EXISTING 100-YR RUNOFF COEFFICIENT

N

0 80' 160'

SUMMARY OF HYDROLOGIC CALCULATIONS - EXISTING CONDITION						
Design Point	Contributing Area (ac)	Impervious Area (ac)	5-Year Runoff Coefficient 'C'	100-Year Runoff Coefficient 'C'	Peak Flow 'Q' (cfs)	
					5-YR	100-YR
DP1	0.45	46.3%	0.41	0.67	0.55	2.01
DP2	12.31	12.4%	0.14	0.53	2.61	22.93
DP3	0.33	51.5%	0.45	0.69	0.45	1.54

RIVERDALE ROAD

LOWER CLEAR CREEK DITCH

DP1 - EXISTING CULVERT INLET

DP1

0.45 | 0.41 | 0.67

DP1

DP2

12.31 | 0.14 | 0.53

100TH AVENUE

5115 100TH AVENUE

DP2

DP3

DP2 - EXISTING TYPE C INLET

DP3

0.33 | 0.45 | 0.69

DP3 - EXISTING TYPE R INLET

LOWER CLEAR CREEK DITCH

THORNTON

ICON ENGINEERING

100TH AVENUE MULTIMODAL PATH

PROPOSED CONDITIONS DRAINAGE EXHIBIT

DESIGN POINT
DP#
FLOW PATTERN
SUB-BASIN BOUNDARY
BASIN ID
X
XX.X
0.45
0.60
PROPOSED 5-YR RUNOFF COEFFICIENT
PROPOSED BASIN AREA (AC)
PROPOSED 100-YR RUNOFF COEFFICIENT

N
0
80'
160'

SUMMARY OF HYDROLOGIC CALCULATIONS - PROPOSED CONDITION						
Design Point	Contributing Area (ac)	Impervious Area (ac)	5-Year Runoff Coefficient 'C'	100-Year Runoff Coefficient 'C'	Peak Flow 'Q' (cfs)	
					5-YR	100-YR
DP1	0.33	27.7%	0.26	0.60	0.24	1.21
DP2	1.09	20.0%	0.20	0.57	0.51	3.28
DP3	0.18	81.9%	0.70	0.82	0.45	1.17
DP4	10.64	10.3%	0.12	0.53	2.03	20.02
DP5	0.62	100.0%	0.85	0.89	1.84	4.33

RIVERDALE ROAD
LOWER CLEAR CREEK DITCH
DP1 - PROPOSED TYPE C INLET
DP1
0.33
0.26
0.60
DP1
DP4
10.64
0.12
0.53
DP4 - PROPOSED TYPE C INLET
DP3
0.18
0.70
0.82
DP2
1.09
0.20
0.57
5115 100TH AVENUE
DP2
DP3
DP4
100TH AVENUE
DP5
DP5 - PROPOSED TYPE R INLET
DP2 - EXISTING TYPE C INLETS
DP3 - PROPOSED TYPE R INLET
DP5
0.62
0.85
0.89
LOWER CLEAR CREEK DITCH

THORNTON
ICON ENGINEERING

APPENDIX D

Rational Method Calculations

Calculation of Peak Runoff using Rational Method

Designer: Taylor Domin, PE
Company: ICON Engineering
Date: 1/26/2026
Project: 100th Avenue Multimodal Path
Location: Thornton, CO

Version 2.00 released May 2017

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

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_{t_t}}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

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

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

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

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.83	1.11	1.37	1.77	2.11	2.48	3.45
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

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

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-Existing	0.45	C	46.3	0.35	0.41	0.47	0.58	0.62	0.67	0.73	190.00	5117.00	5108.00	0.047	10.24	0.00									10.24	2.23	2.97	3.67	4.74	5.66	6.65	9.25	0.35	0.55	0.78	1.23	1.58	2.01	3.05
2-Existing	12.31	C	12.4	0.08	0.14	0.22	0.39	0.45	0.53	0.63	300.00	5104.00	5096.00	0.027	21.81	1180.00	5096.00	5086.00	0.008	15	1.38	14.24	36.05	43.79	36.05	1.17	1.56	1.92	2.49	2.96	3.48	4.85	1.15	2.61	5.29	11.89	16.57	22.93	37.40
3-Existing	0.33	C	51.5	0.40	0.45	0.51	0.61	0.65	0.69	0.75	110.00	5089.00	5087.00	0.018	10.03	0.00									10.03	2.25	3.00	3.70	4.78	5.70	6.70	9.32	0.29	0.45	0.62	0.96	1.22	1.54	2.31

Calculation of Peak Runoff using Rational Method

Designer: Taylor Domin, PE
Company: ICON Engineering
Date: 1/26/2026
Project: 100th Avenue Multimodal Path
Location: Thornton, CO

Version 2.00 released May 2017

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

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

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

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

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

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.83	1.11	1.37	1.77	2.11	2.48	3.45
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

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

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-Proposed	0.33	C	27.7	0.20	0.26	0.34	0.47	0.53	0.60	0.68	190.00	5117.00	5108.00	0.047	12.50											12.50	2.05	2.74	3.38	4.37	5.20	6.12	8.51	0.13	0.24	0.37	0.68	0.91	1.21	1.90
2-Proposed	1.09	C	20.0	0.14	0.20	0.28	0.43	0.49	0.57	0.65	120.00	5091.00	5088.00	0.025	13.18	280.00	5088.00	5086.00	0.007	15	1.27	3.68	16.87	27.28	16.87	1.79	2.38	2.94	3.80	4.53	5.32	7.40	0.27	0.51	0.89	1.78	2.43	3.28	5.25
3-Proposed	0.18	C	81.9	0.67	0.70	0.73	0.78	0.80	0.82	0.85	110.00	5089.00	5087.00	0.018	6.18											6.18	2.66	3.55	4.38	5.66	6.74	7.93	11.03	0.32	0.45	0.58	0.79	0.97	1.17	1.68
4-Proposed	10.64	C	10.3	0.07	0.12	0.21	0.38	0.44	0.53	0.62	300.00	5104.00	5096.00	0.027	22.20	995.00	5096.00	5088.00	0.008	15	1.35	12.33	34.53	41.96	34.53	1.20	1.60	1.98	2.55	3.04	3.58	4.98	0.83	2.03	4.37	10.23	14.37	20.02	32.85
5-Proposed	0.62	C	100.0	0.83	0.85	0.87	0.88	0.89	0.89	0.90	24.00	5116.00	5115.00	0.042	1.38	990.00	5115.00	5089.00	0.026	20	3.24	5.09	6.47	13.43	6.47	2.63	3.50	4.32	5.58	6.65	7.82	10.87	1.36	1.84	2.32	3.04	3.66	4.33	6.09

APPENDIX E

Inlet Calculations

Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 19 2024

100th Avenue Multimodal - DP1 - Type C Inlet - 2-Year Storm

Drop Grate Inlet

Location	= Sag
Curb Length (ft)	= -0-
Throat Height (in)	= -0-
Grate Area (sqft)	= 7.00
Grate Width (ft)	= 2.50
Grate Length (ft)	= 3.50

Gutter

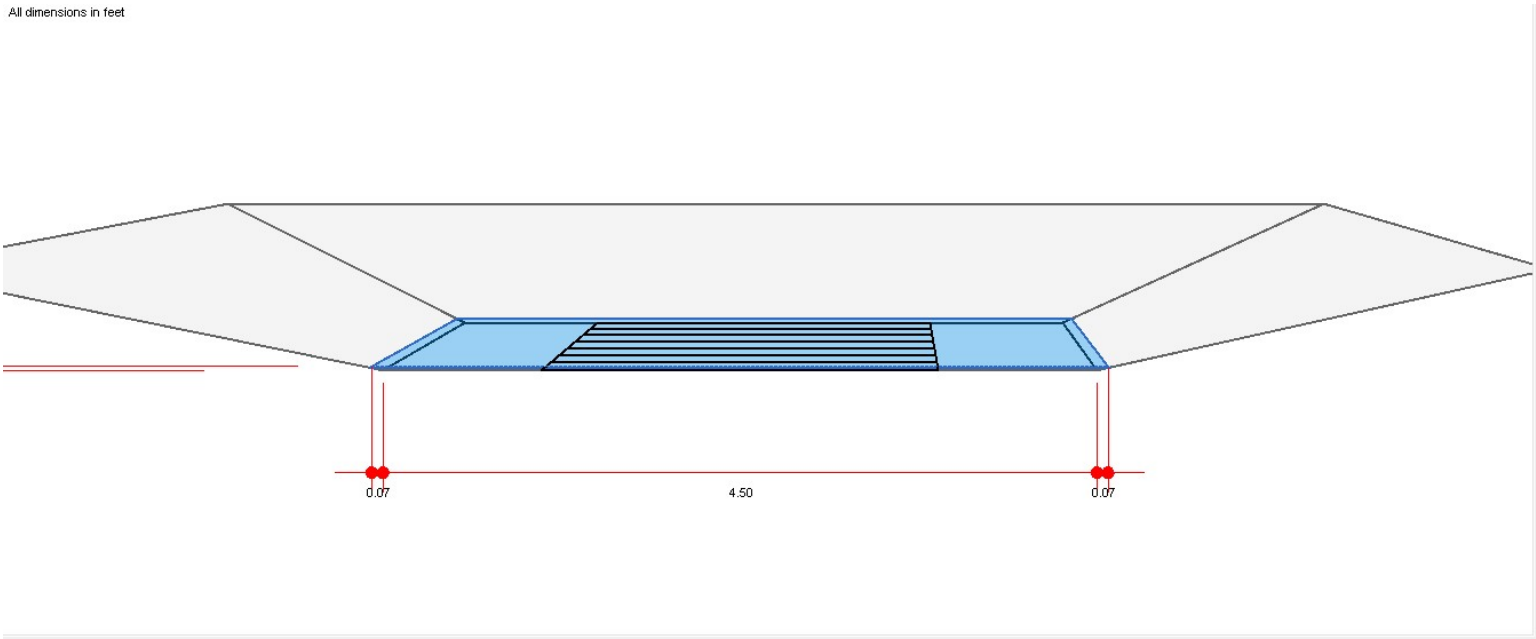
Slope, Sw (ft/ft)	= 0.200
Slope, Sx (ft/ft)	= 0.200
Local Depr (in)	= -0-
Gutter Width (ft)	= 4.50
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

Compute by:	Known Q
Q (cfs)	= 0.06

Highlighted

Q Total (cfs)	= 0.06
Q Capt (cfs)	= 0.06
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 0.17
Efficiency (%)	= 100
Gutter Spread (ft)	= 4.64
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 19 2024

100th Avenue Multimodal - DP1 - Type C Inlet - 100 -Year Storm

Drop Grate Inlet

Location	= Sag
Curb Length (ft)	= -0-
Throat Height (in)	= -0-
Grate Area (sqft)	= 7.00
Grate Width (ft)	= 2.50
Grate Length (ft)	= 3.50

Gutter

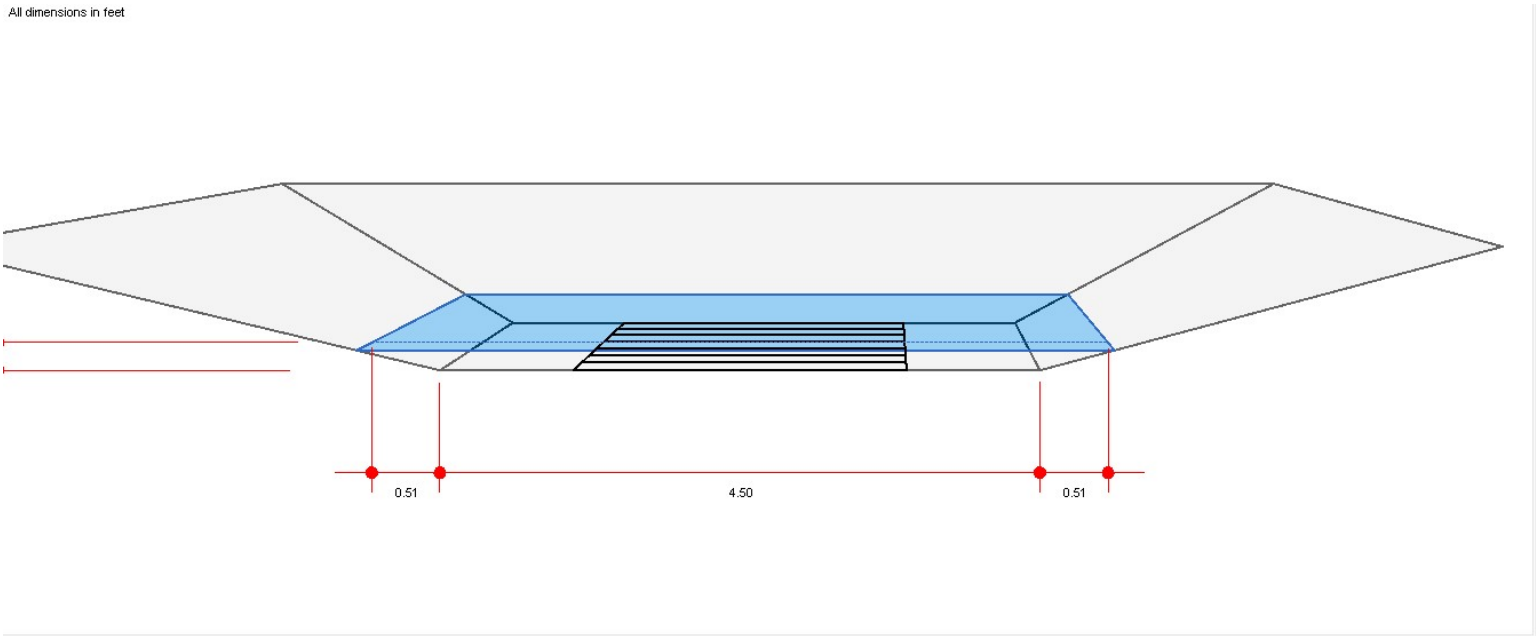
Slope, Sw (ft/ft)	= 0.200
Slope, Sx (ft/ft)	= 0.200
Local Depr (in)	= -0-
Gutter Width (ft)	= 4.50
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

Compute by:	Known Q
Q (cfs)	= 1.18

Highlighted

Q Total (cfs)	= 1.18
Q Capt (cfs)	= 1.18
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 1.23
Efficiency (%)	= 100
Gutter Spread (ft)	= 5.52
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 28 2026

100th Avenue Multimodal - DP3 - Type R Inlet - 5-Year Storm

Curb Inlet

Location	= Sag
Curb Length (ft)	= 5.00
Throat Height (in)	= 6.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-

Gutter

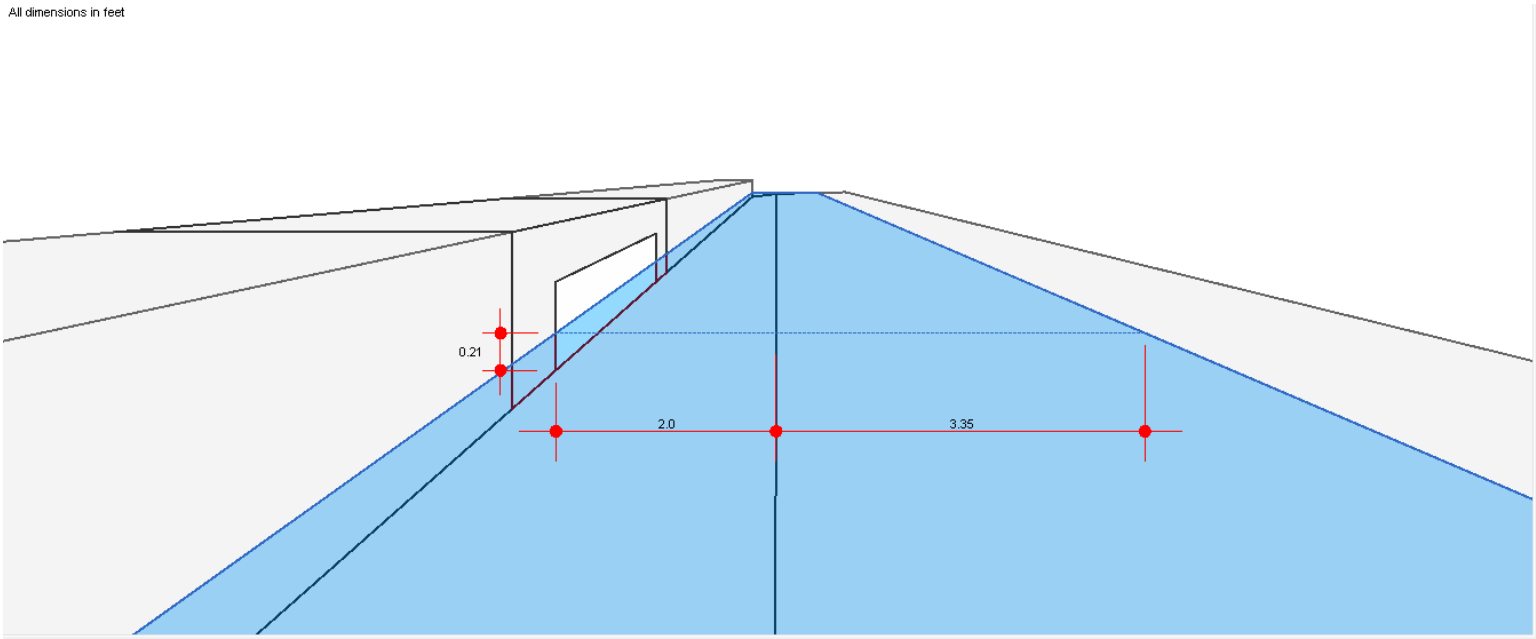
Slope, Sw (ft/ft)	= 0.080
Slope, Sx (ft/ft)	= 0.015
Local Depr (in)	= -0-
Gutter Width (ft)	= 2.00
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

Compute by:	Known Q
Q (cfs)	= 0.45

Highlighted

Q Total (cfs)	= 0.45
Q Capt (cfs)	= 0.45
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 2.52
Efficiency (%)	= 100
Gutter Spread (ft)	= 5.35
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 28 2026

100th Avenue Multimodal - DP3 - Type R Inlet - 100-Year Storm

Curb Inlet

Location	= Sag
Curb Length (ft)	= 5.00
Throat Height (in)	= 6.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-

Gutter

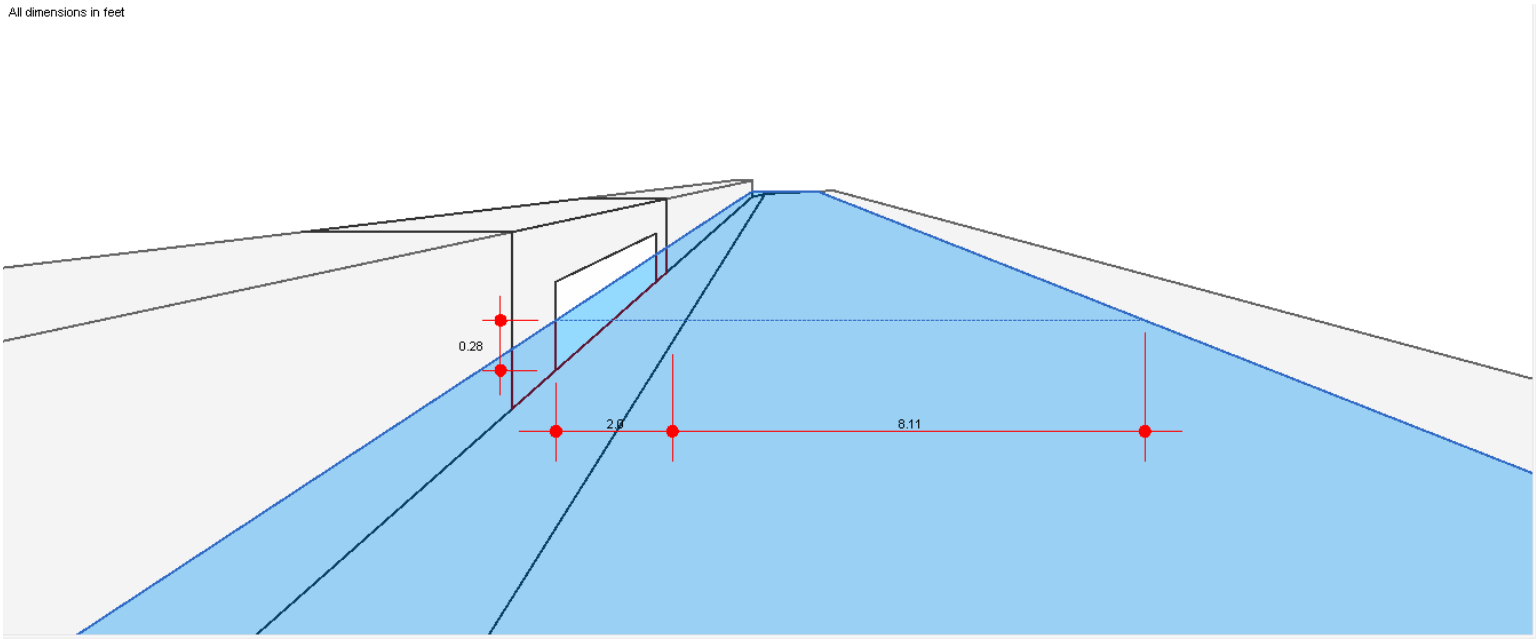
Slope, Sw (ft/ft)	= 0.080
Slope, Sx (ft/ft)	= 0.015
Local Depr (in)	= -0-
Gutter Width (ft)	= 2.00
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

Compute by:	Known Q
Q (cfs)	= 1.17

Highlighted

Q Total (cfs)	= 1.17
Q Capt (cfs)	= 1.17
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 3.38
Efficiency (%)	= 100
Gutter Spread (ft)	= 10.11
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 28 2026

100th Avenue Multimodal - DP4 - Type C Inlet - 5-Year Storm

Drop Grate Inlet

Location	= Sag
Curb Length (ft)	= -0-
Throat Height (in)	= -0-
Grate Area (sqft)	= 7.00
Grate Width (ft)	= 2.50
Grate Length (ft)	= 3.50

Gutter

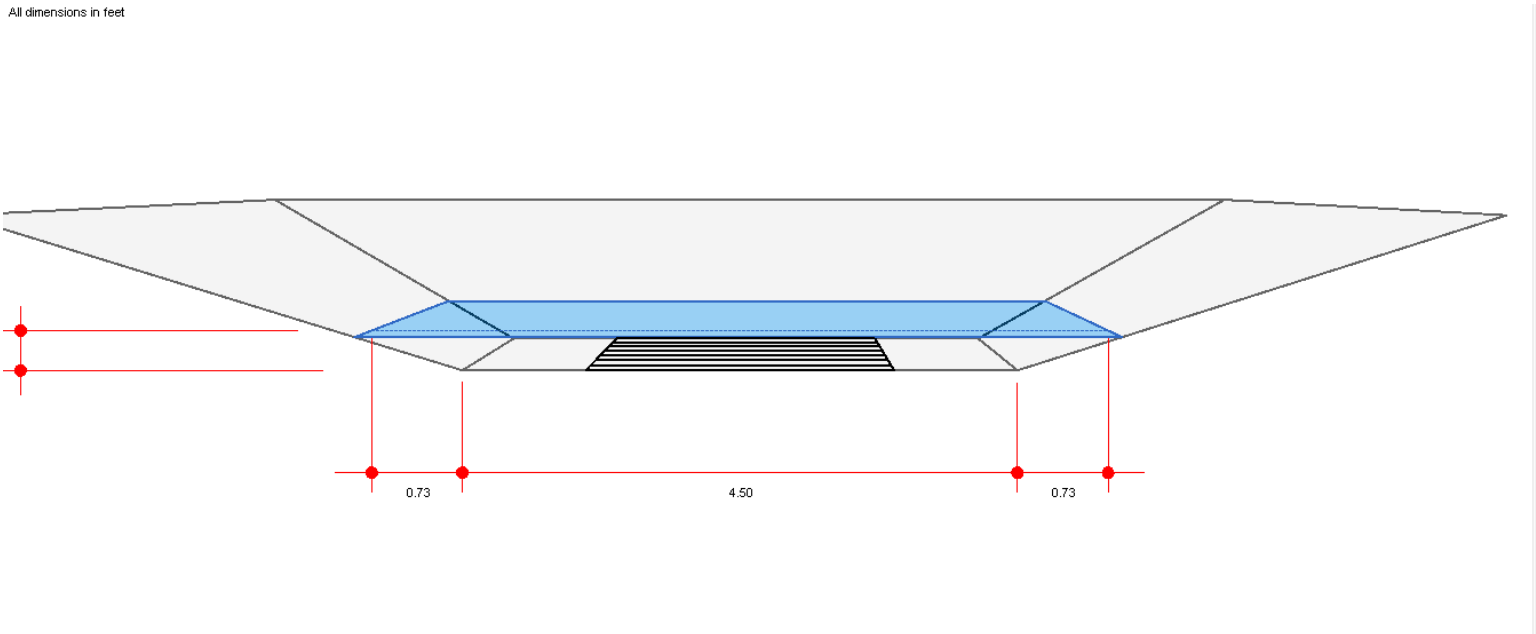
Slope, Sw (ft/ft)	= 0.200
Slope, Sx (ft/ft)	= 0.200
Local Depr (in)	= -0-
Gutter Width (ft)	= 4.50
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

Compute by:	Known Q
Q (cfs)	= 2.03

Highlighted

Q Total (cfs)	= 2.03
Q Capt (cfs)	= 2.03
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 1.76
Efficiency (%)	= 100
Gutter Spread (ft)	= 5.97
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Inlet Report

100th Avenue Multimodal - DP4 - Type C Inlet - 100-Year Storm

Drop Grate Inlet

Location	= Sag
Curb Length (ft)	= -0-
Throat Height (in)	= -0-
Grate Area (sqft)	= 7.00
Grate Width (ft)	= 2.50
Grate Length (ft)	= 3.50

Gutter

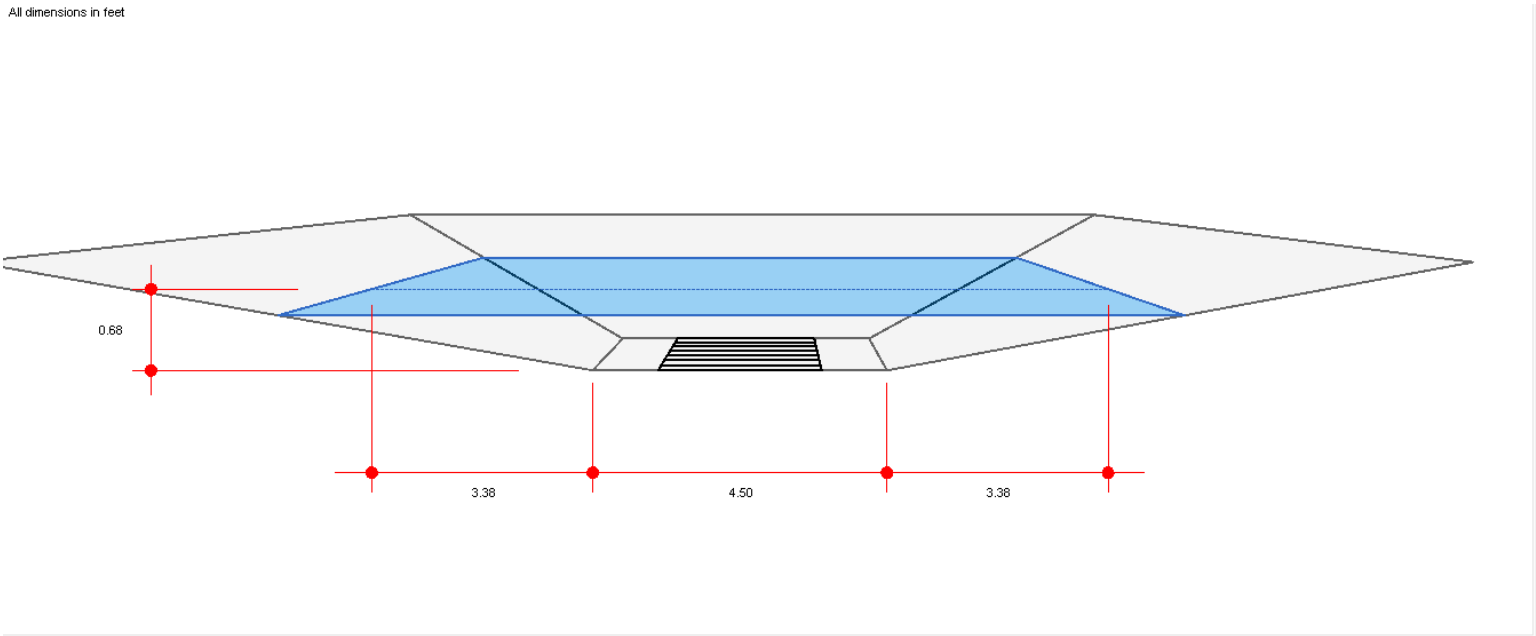
Slope, Sw (ft/ft)	= 0.200
Slope, Sx (ft/ft)	= 0.200
Local Depr (in)	= -0-
Gutter Width (ft)	= 4.50
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

Calculations

Compute by:	Known Q
Q (cfs)	= 20.02

Highlighted

Q Total (cfs)	= 20.02
Q Capt (cfs)	= 20.02
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 8.11
Efficiency (%)	= 100
Gutter Spread (ft)	= 11.26
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-



Inlet Report

100th Avenue Multimodal - DP5 - Type R Inlet - 5-Year Storm

Curb Inlet

Location	=	On grade
Curb Length (ft)	=	10.00
Throat Height (in)	=	6.00
Grate Area (sqft)	=	-0-
Grate Width (ft)	=	-0-
Grate Length (ft)	=	-0-

Gutter

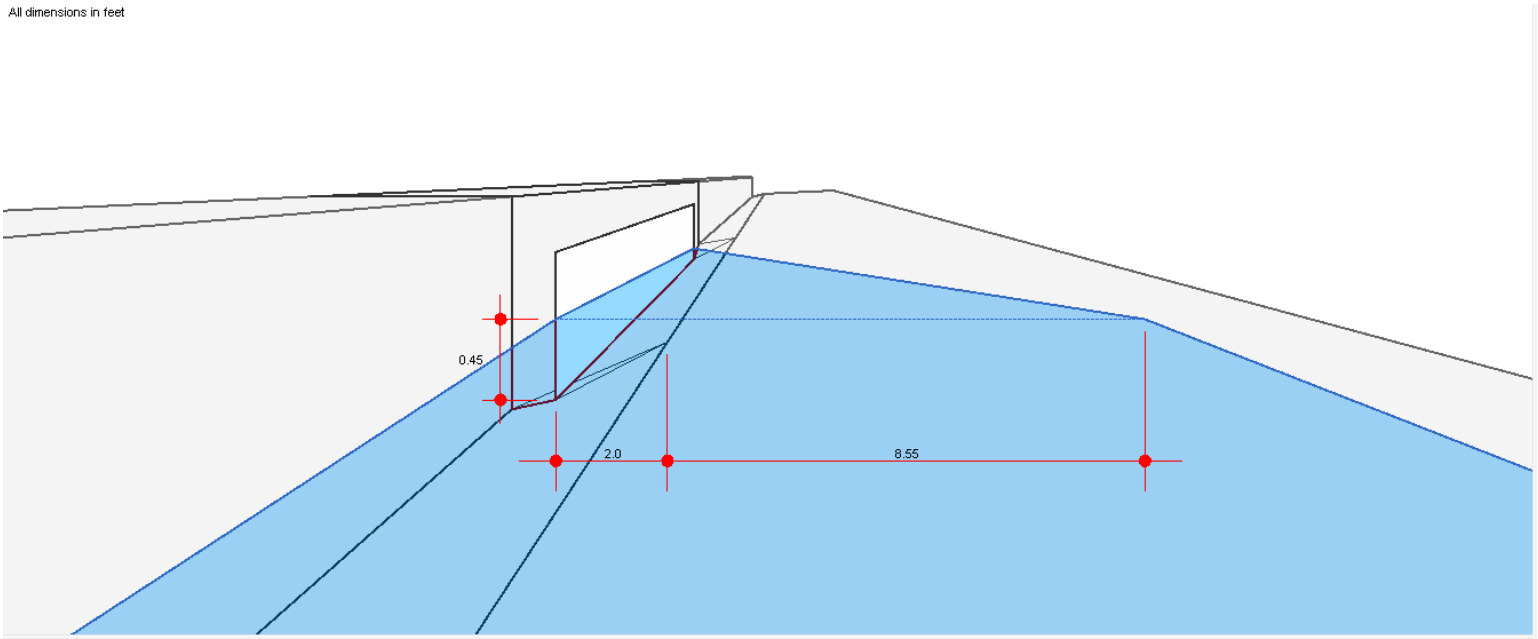
Slope, Sw (ft/ft)	=	0.080
Slope, Sx (ft/ft)	=	0.015
Local Depr (in)	=	2.00
Gutter Width (ft)	=	2.00
Gutter Slope (%)	=	0.60
Gutter n-value	=	0.016

Calculations

Compute by:		Known Q
Q (cfs)	=	1.84

Highlighted

Q Total (cfs)	=	1.84
Q Capt (cfs)	=	1.84
Q Bypass (cfs)	=	-0-
Depth at Inlet (in)	=	5.46
Efficiency (%)	=	100
Gutter Spread (ft)	=	10.55
Gutter Vel (ft/s)	=	1.91
Bypass Spread (ft)	=	-0-
Bypass Depth (in)	=	-0-



Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jan 28 2026

100th Avenue Multimodal - DP5 - Type R Inlet - 100-Year Storm

Curb Inlet

Location	= On grade
Curb Length (ft)	= 10.00
Throat Height (in)	= 6.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-

Gutter

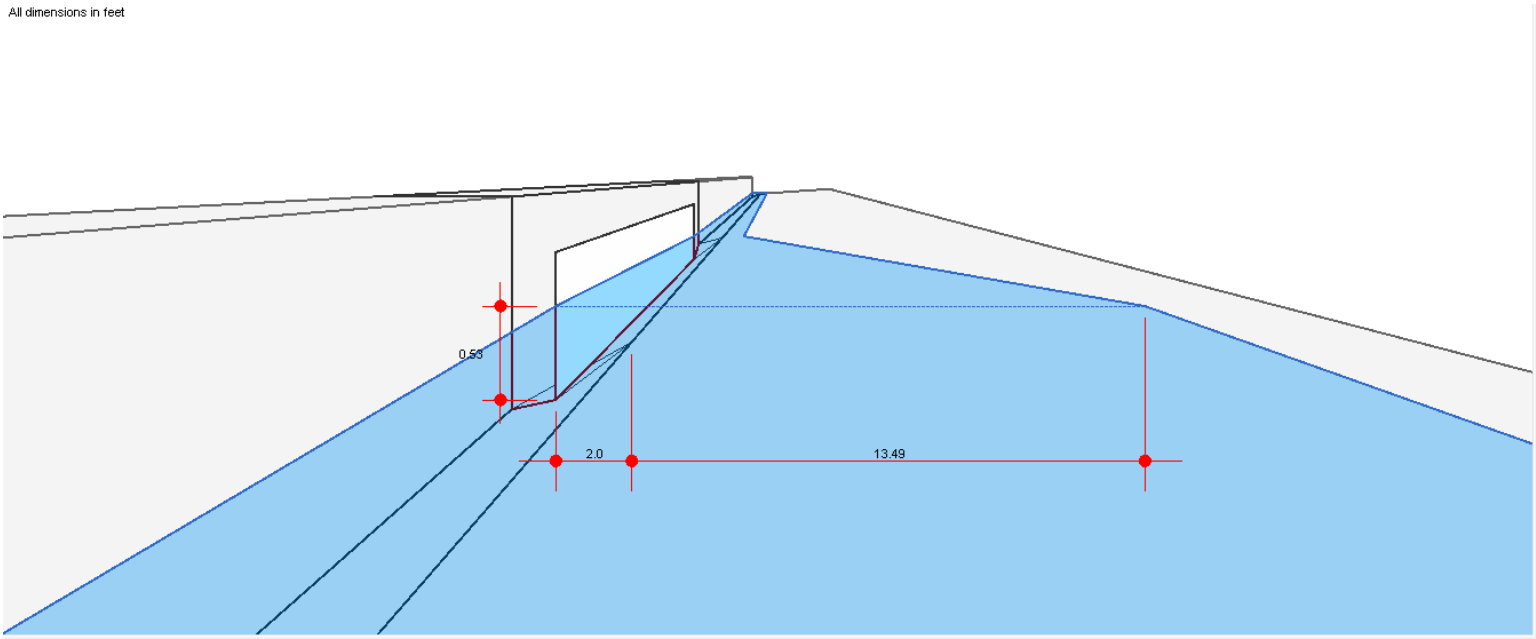
Slope, Sw (ft/ft)	= 0.080
Slope, Sx (ft/ft)	= 0.015
Local Depr (in)	= 2.00
Gutter Width (ft)	= 2.00
Gutter Slope (%)	= 0.60
Gutter n-value	= 0.016

Calculations

Compute by:	Known Q
Q (cfs)	= 4.33

Highlighted

Q Total (cfs)	= 4.33
Q Capt (cfs)	= 3.96
Q Bypass (cfs)	= 0.37
Depth at Inlet (in)	= 6.35
Efficiency (%)	= 91
Gutter Spread (ft)	= 15.49
Gutter Vel (ft/s)	= 2.24
Bypass Spread (ft)	= 3.51
Bypass Depth (in)	= 2.19



APPENDIX F

Storm Drain Pipe HGL Calculations

Figure 1 - SWMM 5-Year HGL Profile

Table 1 - SWMM 5-Year Node Summary

Summary Results

Topic: Node Depth — Click a column header to sort the column.

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Day of Maximum Depth	Hour of Maximum Depth	Maximum Reported Depth Feet
STM-I-4	JUNCTION	1.47	1.47	5077.77	0	00:00	1.47
STM-MH-3	JUNCTION	0.97	0.97	5078.45	0	00:00	0.97
STM-MH-2	JUNCTION	0.57	0.57	5078.93	0	00:00	0.57
STM-I-3	JUNCTION	0.47	0.47	5082.13	0	00:00	0.47
STM-I-2	JUNCTION	0.35	0.35	5082.45	0	00:00	0.35
EX-MH-1	OUTFALL	0.53	0.53	5072.28	0	00:00	0.53

Table 2 - SWMM 5-Year Link Summary

Summary Results

Topic: Link Flow — Click a column header to sort the column.

Link	Type	Maximum |Flow| CFS	Day of Maximum Flow	Hour of Maximum Flow	Maximum |Velocity| ft/sec	Max / Full Flow	Max / Full Depth
EX-42-1	CONDUIT	4.83	0	00:00	5.28	0.05	0.15
PR-30-1	CONDUIT	4.38	0	00:00	6.94	0.08	0.19
PR-24-1	CONDUIT	3.87	0	00:00	6.86	0.12	0.24
PR-24-2	CONDUIT	3.87	0	00:00	6.81	0.12	0.24
PR-24-3	CONDUIT	2.03	0	00:00	5.52	0.07	0.17

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... STEADY
Starting Date 03/19/2026 00:00:00
Ending Date 03/19/2026 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:15:00
Routing Time Step ..... 20.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	2.394	0.780
External Outflow	2.394	0.780
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****
Minimum Time Step : 20.00 sec
Average Time Step : 20.00 sec
Maximum Time Step : 20.00 sec

```
  % of Time in Steady State   :     0.00
  Average Iterations per Step :     1.00
  % of Steps Not Converging   :     0.00

  ******************
  Node Depth Summary
  ******************
  ---------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
  Node                 Type        Feet     Feet     Feet  days hr:min        Feet
  ---------------------------------------------------------------------------
  STM-I-4              JUNCTION    1.47     1.47  5077.77     0  00:00        1.47
  STM-MH-3             JUNCTION    0.97     0.97  5078.45     0  00:00        0.97
  STM-MH-2             JUNCTION    0.57     0.57  5078.93     0  00:00        0.57
  STM-I-3              JUNCTION    0.47     0.47  5082.13     0  00:00        0.47
  STM-I-2              JUNCTION    0.35     0.35  5082.45     0  00:00        0.35
  EX-MH-1              OUTFALL     0.53     0.53  5072.28     0  00:00        0.53

  *******************
  Node Inflow Summary
  *******************

-------------------------------------------------------------------------------
-------------
                                Maximum  Maximum                  Lateral
Total        Flow
                                Lateral    Total  Time of Max      Inflow
Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
Volume       Error
  Node                 Type         CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------
-------------
  STM-I-4              JUNCTION      0.45     4.83     0  00:00      0.0727
0.78       0.000
  STM-MH-3             JUNCTION      0.51     4.38     0  00:00      0.0824
0.707       0.000
  STM-MH-2             JUNCTION      0.00     3.87     0  00:00           0
0.625       0.000
  STM-I-3              JUNCTION      1.84     3.87     0  00:00       0.297
0.625       0.000
  STM-I-2              JUNCTION      2.03     2.03     0  00:00       0.328
0.328       0.000
  EX-MH-1              OUTFALL       0.00     4.83     0  00:00           0
0.78       0.000

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

Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
EX-MH-1	100.00	4.83	4.83	0.780
System	100.00	4.83	4.83	0.780

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
EX-42-1	CONDUIT	4.83	0 00:00	5.28	0.05	0.15
PR-30-1	CONDUIT	4.38	0 00:00	6.94	0.08	0.19
PR-24-1	CONDUIT	3.87	0 00:00	6.86	0.12	0.24
PR-24-2	CONDUIT	3.87	0 00:00	6.81	0.12	0.24
PR-24-3	CONDUIT	2.03	0 00:00	5.52	0.07	0.17

****
Conduit Surcharge Summary
****
No conduits were surcharged.

Analysis begun on: Wed Mar 25 09:53:58 2026
Analysis ended on: Wed Mar 25 09:53:58 2026
Total elapsed time: < 1 sec

Figure 2 - SWMM 100-Year HGL Profile

Table 3 - SWMM 100-Year Node Summary

Summary Results

Topic: Node Depth — Click a column header to sort the column.

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Day of Maximum Depth	Hour of Maximum Depth	Maximum Reported Depth Feet
STM-I-4	JUNCTION	1.72	1.72	5078.02	0	00:00	1.72
STM-MH-3	JUNCTION	2.31	2.31	5079.29	0	00:00	2.31
STM-MH-2	JUNCTION	1.42	1.42	5079.78	0	00:00	1.42
STM-I-3	JUNCTION	1.32	1.32	5082.98	0	00:00	1.32
STM-I-2	JUNCTION	1.18	1.18	5083.28	0	00:00	1.18
EX-MH-1	OUTFALL	1.30	1.30	5073.05	0	00:00	1.30

Table 4 - SWMM 100-Year Link Summary

Summary Results

Topic: Link Flow — Click a column header to sort the column.

Link	Type	Maximum |Flow| CFS	Day of Maximum Flow	Hour of Maximum Flow	Maximum |Velocity| ft/sec	Max / Full Flow	Max / Full Depth
EX-42-1	CONDUIT	28.80	0	00:00	8.82	0.30	0.37
PR-30-1	CONDUIT	27.63	0	00:00	11.61	0.48	0.49
PR-24-1	CONDUIT	24.35	0	00:00	11.17	0.76	0.65
PR-24-2	CONDUIT	24.35	0	00:00	11.07	0.77	0.66
PR-24-3	CONDUIT	20.02	0	00:00	10.37	0.66	0.59

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... STEADY
Starting Date 03/19/2026 00:00:00
Ending Date 03/19/2026 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:15:00
Routing Time Step ..... 20.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	14.274	4.651
External Outflow	14.274	4.651
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****
Minimum Time Step : 20.00 sec
Average Time Step : 20.00 sec
Maximum Time Step : 20.00 sec

```
  % of Time in Steady State   :     0.00
  Average Iterations per Step :     1.00
  % of Steps Not Converging   :     0.00

  ******************
  Node Depth Summary
  ******************
  ---------------------------------------------------------------------------
                                Average  Maximum  Maximum  Time of Max    Reported
                                  Depth    Depth      HGL   Occurrence   Max Depth
  Node                 Type        Feet     Feet     Feet  days hr:min        Feet
  ---------------------------------------------------------------------------
  STM-I-4              JUNCTION    2.22     2.22  5078.52     0  00:00        2.22
  STM-MH-3             JUNCTION    1.81     1.81  5079.29     0  00:00        1.81
  STM-MH-2             JUNCTION    1.42     1.42  5079.78     0  00:00        1.42
  STM-I-3              JUNCTION    1.32     1.32  5082.98     0  00:00        1.32
  STM-I-2              JUNCTION    1.18     1.18  5083.28     0  00:00        1.18
  EX-MH-1              OUTFALL     1.30     1.30  5073.05     0  00:00        1.30

  *******************
  Node Inflow Summary
  *******************

-------------------------------------------------------------------------------
-------------
                                Maximum  Maximum                  Lateral
Total        Flow
                                Lateral    Total  Time of Max      Inflow
Inflow     Balance
                                 Inflow   Inflow   Occurrence      Volume
Volume       Error
  Node                 Type         CFS      CFS  days hr:min    10^6 gal    10^6
gal     Percent

-------------------------------------------------------------------------------
-------------
  STM-I-4              JUNCTION     1.17    28.80     0  00:00       0.189
4.65       0.000
  STM-MH-3             JUNCTION     3.28    27.63     0  00:00        0.53
4.46       0.000
  STM-MH-2             JUNCTION     0.00    24.35     0  00:00           0
3.93       0.000
  STM-I-3              JUNCTION     4.33    24.35     0  00:00       0.699
3.93       0.000
  STM-I-2              JUNCTION    20.02    20.02     0  00:00        3.23
3.23       0.000
  EX-MH-1              OUTFALL      0.00    28.80     0  00:00           0
4.65       0.000

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

Node Flooding Summary
****
No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
EX-MH-1	100.00	28.80	28.80	4.651
System	100.00	28.80	28.80	4.651

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
EX-42-1	CONDUIT	28.80	0 00:00	8.82	0.30	0.37
PR-30-1	CONDUIT	27.63	0 00:00	11.61	0.48	0.49
PR-24-1	CONDUIT	24.35	0 00:00	11.17	0.76	0.65
PR-24-2	CONDUIT	24.35	0 00:00	11.07	0.77	0.66
PR-24-3	CONDUIT	20.02	0 00:00	10.37	0.66	0.59

****
Conduit Surcharge Summary
****
No conduits were surcharged.

Analysis begun on: Wed Mar 25 09:45:07 2026
Analysis ended on: Wed Mar 25 09:45:07 2026
Total elapsed time: < 1 sec

APPENDIX G

Ditch Lateral Culvert Capacity Calculations

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Mar 25 2026

Culvert Capacity - Culvert at Station 5+22

Invert Elev Dn (ft)	=	5091.43
Pipe Length (ft)	=	24.00
Slope (%)	=	2.08
Invert Elev Up (ft)	=	5091.93
Rise (in)	=	12.0
Shape	=	Circular
Span (in)	=	12.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

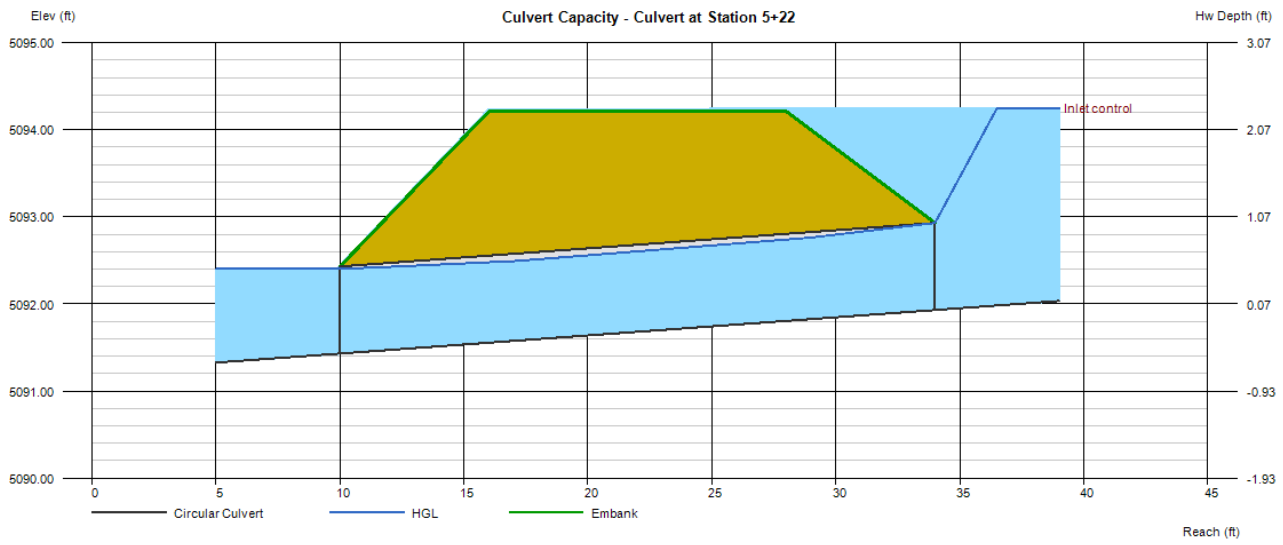
Top Elevation (ft)	=	5094.21
Top Width (ft)	=	12.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	10.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	6.00
Qpipe (cfs)	=	5.65
Qovertop (cfs)	=	0.35
Veloc Dn (ft/s)	=	7.25
Veloc Up (ft/s)	=	7.35
HGL Dn (ft)	=	5092.40
HGL Up (ft)	=	5092.88
Hw Elev (ft)	=	5094.25
Hw/D (ft)	=	2.32
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Mar 25 2026

Culvert Capacity - Culvert at Station 5+60

Invert Elev Dn (ft)	=	5090.54
Pipe Length (ft)	=	29.00
Slope (%)	=	2.07
Invert Elev Up (ft)	=	5091.14
Rise (in)	=	12.0
Shape	=	Circular
Span (in)	=	12.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

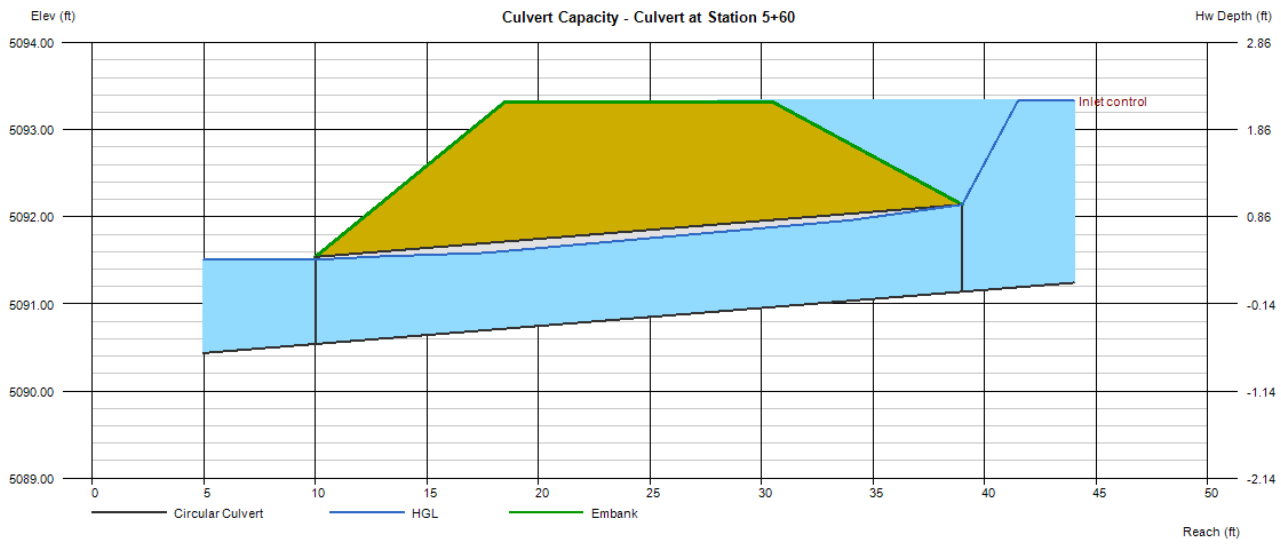
Top Elevation (ft)	=	5093.32
Top Width (ft)	=	12.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	10.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	5.50
Qpipe (cfs)	=	5.43
Qovertop (cfs)	=	0.07
Veloc Dn (ft/s)	=	6.98
Veloc Up (ft/s)	=	7.10
HGL Dn (ft)	=	5091.51
HGL Up (ft)	=	5092.08
Hw Elev (ft)	=	5093.33
Hw/D (ft)	=	2.19
Flow Regime	=	Inlet Control



Culvert Report

Culvert Capacity - Culvert at Station 7+90

Invert Elev Dn (ft)	=	5088.40
Pipe Length (ft)	=	35.00
Slope (%)	=	0.60
Invert Elev Up (ft)	=	5088.61
Rise (in)	=	12.0
Shape	=	Circular
Span (in)	=	12.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

Top Elevation (ft)	=	5090.59
Top Width (ft)	=	12.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	10.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	5.50
Qpipe (cfs)	=	5.10
Qovertop (cfs)	=	0.40
Veloc Dn (ft/s)	=	6.57
Veloc Up (ft/s)	=	6.49
HGL Dn (ft)	=	5089.36
HGL Up (ft)	=	5089.95
Hw Elev (ft)	=	5090.63
Hw/D (ft)	=	2.02
Flow Regime	=	Inlet Control