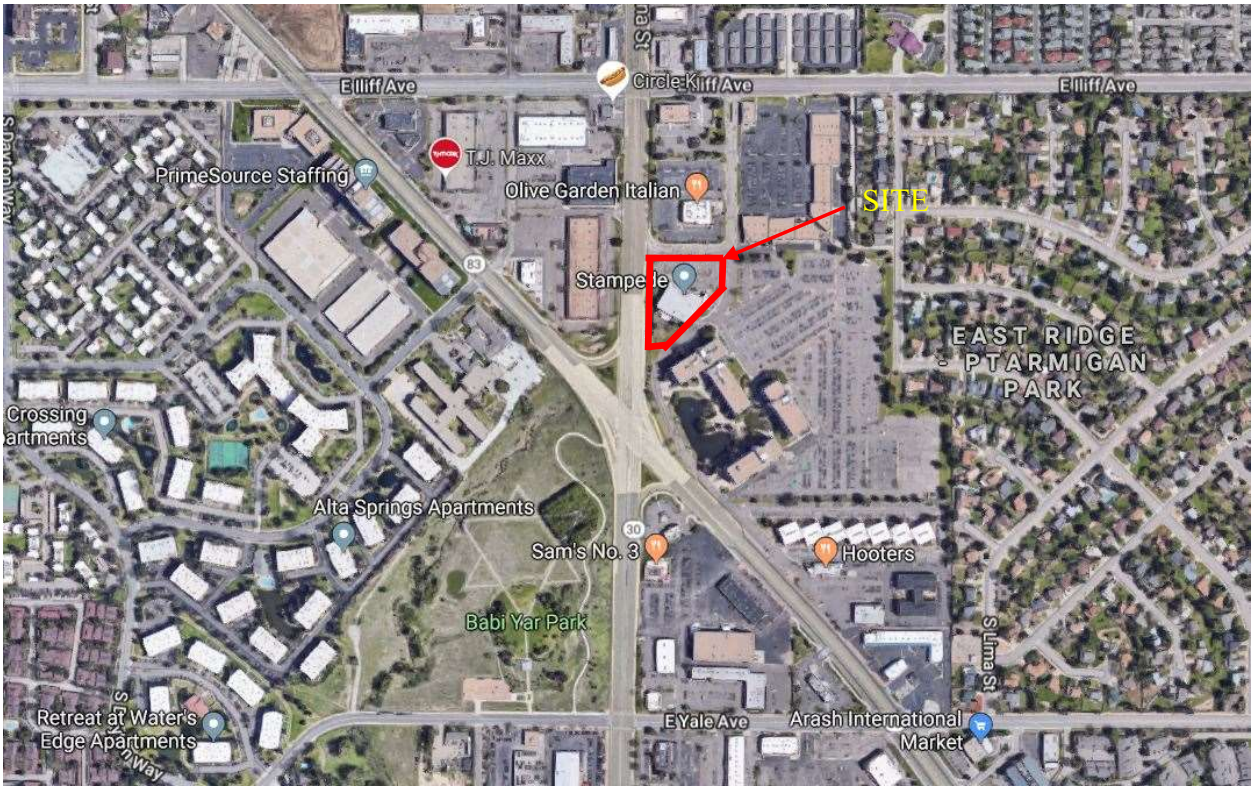
ALTITUDE
LAND CONSULTANTS INC
CIVIL | SURVEY | PLANNING | LANDSCAPE

DRAINAGE STUDY FOR

WATERPARK SUBDIVISION FILING NO. 2 PER PLAT (TYP.)
2430 S. Havana Street
City of Aurora, County of Arapahoe, Colorado

JOB NUMBER 18-224
Southeast 1/4 of Section 26, Township 04 South, Range 67 West of 6th P.M.,
City of Aurora, County of Arapahoe, State of Colorado



APPROVED FOR ONE YEAR FROM THIS DATE

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_____ _____
City Engineer **Date**

_____ _____
Water Department **Date**

PREPARED BY:
Salvatore C. Cambria, P.E.
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PREPARATION DATE:
August 31, 2023

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STATEMENT PAGE

Engineer's Statement

The attached drainage plan was prepared under my direction and supervision and are correct to the best of my knowledge and belief. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Printed Name: Salvatore C. Cambria, P.E. Date: 08/31/2023

Seal:

A. INTRODUCTION

1.0 – Location

"Waterpark Subdivision Filing No. 2" is an existing office park and subdivision in the southwest quarter of Section 26, Township 4 South, Range 67 West of the Sixth Principal Meridian, Arapahoe County, Colorado. The subject site is located at 2430 South Havana Street and bounded by South Havana Street on the West, an existing private road on the East, and an existing private road to the North. See **Exhibit 1 – Vicinity Map** for visual reference. Figure 1 below shows the site in relation to the Airport Detention Pond Buffers.

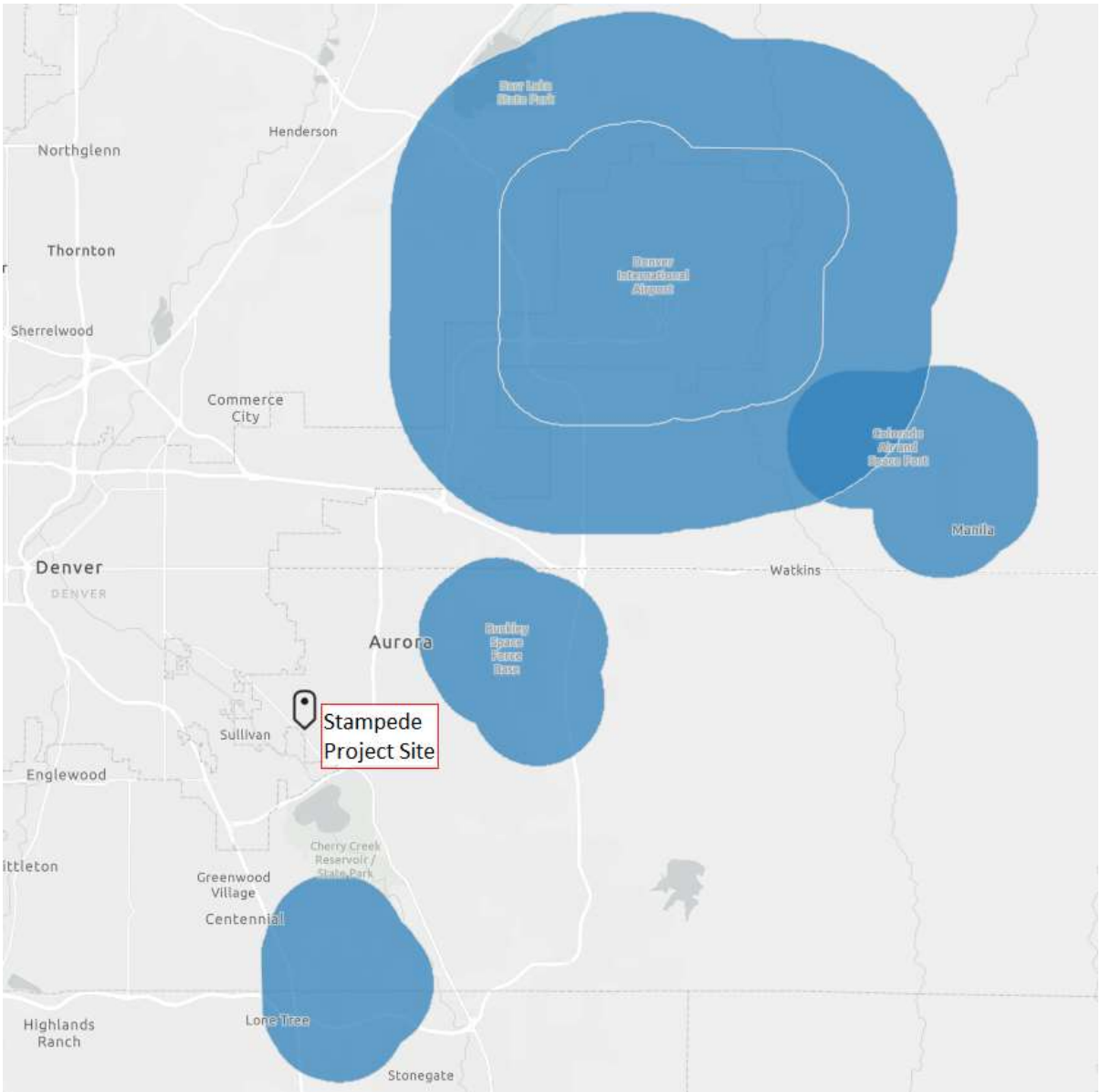

Figure 1: Site Relation to Airport Detention Pond Buffers.

2.0 – Existing Development

The existing development is a restaurant/bar facility located on a 2.28-acre site with an existing detention pond located in the Southwesterly portion of the site. The detention pond has been designed per the "Addendum to Drainage Study for Waterpark Subdivision Filing No. 1". The detention pond has been designed to capture the subject site as well as the adjacent site to the east, a total of 7.33 acres of runoff. The bottom of pond currently sits at 5557.00', the top of pond is roughly 5563.00', and the invert of the outlet pipe currently sits at 5556.98'. The pond currently releases to an existing public 14C-IR13 5' Type 'R' inlet via 35.7LF 24" RCP storm sewer at 8.8cfs. Per the approved report, the pond was sized to detain 36,000 cu ft of volume although 35,000 was required based on their calculations.

3.0 – Proposed Development

The proposed additions to the existing development consist of an additional 3,915 square feet of impervious area. This increases the imperviousness from 82% to 86%. The existing detention pond was designed to capture all the runoff from the neighboring parking lot. However, the new design routes flows from the proposed additions to the existing detention pond. So, included in the proposed development will be the reshaping of the detention pond to capture all the runoff from the proposed development, and the runoff from the existing parking lot.

B. HISTORIC DRAINAGE

1.0 – Description of Property

The existing site is 319,151 square feet (7.33 acres). Currently the site is an existing restaurant with a dec, and a parking area. The current topography of the land slopes from the northeast to the southwest. The site has an existing average slope of 1.6%. Existing flows are conveyed overland to an existing detention pond located south of the Stampede restaurant structure. The pond has a current release rate of 8.8cfs, into a 35.7LF 24" Reinforced Concrete Storm Pipe. This outfalls into an existing public 14C IR13 5' Type 'R' Inlet located on South Havana Street which connects to the Aurora Storm System.

2.0 – Overall Basin Description

There at two basins which flow into the existing detention pond on site. These basins consists of two soil types TrE – Truckton loamy sand and BvC – Bresser-Truckton sandy loams, both classified as hydrologic group A soil, per the US Department of Agriculture, Natural Resources Conservation Service Web Soil Survey for Arapahoe County included in **Exhibit 2**. The site is not located within any FEMA floodplains. The Flood Insurance Rate Map number 08005C0186K, revised December 17, 2010, has been provided in **Exhibit 3**.

There are 2 historic basins which flow into the existing detention pond:

Basin H1 is 227,122.06 SF consisting mostly of parking lot, with several small landscape areas. Basin H1 drains southeast overland, and flow is collected in the detention pond on the southern portion of H2.
Basin H2 is 92,029.14 SF and consist of the restaurant structure, parking lot, existing detention pond, and landscaped areas.

Basin ID	Area (AC)	Imperviousness	C5	I_5 (in/hr)	Q_5 (CFS)	C_{100}	I_{100} (in/hr)	Q_{100} (CFS)
H1	5.21	86.59%	0.74	3.51	13.48	0.81	6.75	28.58
H2	2.11	71.89%	0.61	3.48	4.50	0.72	6.70	10.13

Historic drainage basins have been delineated and illustrated in the associated Waterpark Subdivision Filing No. 2 drainage plan.

Runoff from the site and surrounding areas are collected in an existing storm sewer system located on S Havana Street, between S Parker Road and the entrance to the private road which accesses the site from S Havana Street. The City's infrastructure in this area is routed to the Babi Yar tributary, which flows into Cherry Creek to Basin 4600-04 - Cheery Creek Reservoir, as shown in the extracted pages from the Denver Storm Drainage Master Plan Revised October 2019 **Exhibit 4**. The proposed development will not alter the historic flow patterns.

C. Design Criteria

1.0 References

Drainage design reference include the following:
Urban Storm Drainage Criteria Manual Vol. 1-3, By Mile High Flood District
City of Aurora Storm Drainage and Technical Criteria Manual, and FEMA flood plain maps.
Outfall Systems Planning of Westerly Creek Downstream of Westerly Creek Dam, Dated March 17, 2022 by Bohannan Huston

2.0 Hydrologic Criteria

The runoff coefficients "C" are taken from the City of Aurora Storm Drainage Design and Technical Criteria Manual. A Composite "C" value has been calculated for each separate basin. Time of Concentration (Tc) and Rainfall Intensities were calculated based on MHFD equations and Aurora Storm Drainage Design and Technical Criteria Manual, the UDFCD Velocity Chart and the Depth Rainfall is derived from Figures RA-1 though RA-6 of the UDFCD Volume 1. WQCV reduction was calculated utilizing the Mile High Flood District's Stormwater Best Management Practice Design Workbook – Runoff Reduction.

Peak runoff values were calculated using the rational method:
Q = CIA, where
Q = Storm runoff in cubic feet per second (cfs)

C = Rainfall coefficients - ratio runoff to rainfall
I = Rainfall intensity in inches per hour
A = Drainage area in acres

The required, new development, Water Quality Control Volume (WQCV), Excess Urban Runoff Volume (EURV) and 100-year detention volume were calculated utilizing the Mile High Flood District Detention Basin Design Workbook version 4.04 dated February 2021 (Rational Method). Per the City of Aurora Drainage Criteria, the detention basin will include storage for the 100-year storm volume plus 120% WQCV, for detention. This approach will be used for this site.

3.0 Hydraulic Criteria

Channels have been analyzed utilizing the rational method for the tributary flow. The sizing of the channels was completed in Hydraflow (Manning's equations). Manning coefficient of 0.012 for finished concrete channel.

Emergency spillway have been analyzed utilizing the rational method for the tributary flow. The sizing of the emergency spillway was completed in Hydraflow (Manning's equations). Manning coefficient of 0.012 was used for finished concrete.

The UDFCD spreadsheets were used to size the inlets. The UDFCD's criteria and the City of Aurora Storm Drainage Design & Technical Criteria Manual.

D. Drainage Plan

1.0 General Concept

The site has been designed to keep the historic drainage patterns to the City's infrastructure at the intersection of S Parker Road and S Havana Street. The existing detention pond on the property will be enlarged, and a storm control structure added, to account for water quality and to capture the 100 year storm event.

2.0 Specific Details

The main issue or challenge with this site is the existing nature of the site. The site has been built up with stockpiles anywhere from 3 feet to 12 feet above the adjacent right of way grades. The stockpiles also extend across multiple properties. The solution to this issue was to regrade and remove the stockpiles, in coordination with the neighboring properties, to allow for the site private improvements to service all peoples and allow for City right of way upgrades to be installed, as requested by the City. The regrading, as described above, causes for two offsite area to be developed. These offsite areas will be accounted for in the proposed detention design. The removal of the stockpiles also created a tight vertical clearance for the underground detention system and associated storm sewer due to the lowering of the surface grade and the high elevation of the available sewer connections.

The site will consist of one offsite basin, B1, and one onsite basin, B2. These basins have been delineated and illustrated the associated Waterpark Subdivision Filing No. 2 drainage plans. Below is a table illustrating the key elements and calculations for each basin as described. For full tributary area runoff calculations refer to Exhibit 4.

Basin ID	Area (AC)	Imperviousness	C_5	I_5 (in/hr)	Q_5 (CFS)	C_{100}	I_{100} (in/hr)	Q_{100} (CFS)
B1	5.20	86.67%	0.74	2.96	11.38	0.81	6.29	26.65
B2	2.12	84.02%	0.72	3.23	4.93	0.79	6.85	11.50

Basin B1 is 226,656.84 SF (5.20 acres) consists of the adjacent property on the western side of the property line, mostly of asphalt parking lot, and a small amount of landscaping. The basin flows overland from the northwestern portion of the lot in the southeastern direction and is detained in the detention pond located in basin B2.

Basin B2 is 92,498.40 SF (2.12 acres) and consists of the landscaping, walkways, parking lot, restaurant structure and detention pond on site. The basin flows overland from north to south and will be detained in the detention pond on site.

There are no permeant BMPs to in included with this development. In lieu of permeant BMPs the 100-year detention volume will be increased by 120% of the WQCV volume. Locations for sewers can be found in associated Grand Ave. drainage plans. The required detention for this development is 2,295.61 cubic feet. The detention has been provided in a subsurface detention tank along the north end of the site within a drainage, access, and maintenance tract beneath the private access drive, refer to Exhibit 5 Subsurface Detention Tank Plans for more information. The 100-year emergency overflow for the detention system will be located at the southwest corner of the site. The detention system will overflow to the intersection of E 14th Avenue and Akron Street. The freeboard from the emergency spillway was calculated to be 2.62' from the lowest finished floor elevation on site.

There is one type C inlets, three 2' diameter open access grates and, one 2' diameter sump inlet utilized to capture on-site flows. All inlets and associated piping has been designed to convey the 100 year storm. All sump inlets have been designed to provide a minimum 1 foot freeboard from the sump inlet water surface elevation to the nearest finished floor elevations and a 0.5 foot freeboard from the sump inlet water surface elevation to the nearest back of garage elevations. Refer to Exhibit 4 for full inlet calculations.

There are two channels that were analyzed on site. Channel CHA1 is a concrete channel from basin B1 to basin B2 at the northwestern corner of the detention pond. The depth of flow in channel CHA1 is 0.18'. The freeboard for this channel is 1.02' to the nearest finished floor elevation and 1.53' to the nearest back of garage elevation. Channel CHA2 is a concrete lined channel and is the detention pond overflow. The

depth of flow in channel CHA2 is 0.05'. The freeboard for this channel is 0.62' to the nearest front of garage elevation.

E. CONCLUSIONS

1.0 Compliance with Standards

This report has been prepared in accordance with the City of Aurora for Final Drainage Studies and with Urban Storm Drainage Criteria. Prior to final approval, a Storm Drainage and Erosion Control Plan will be submitted to the City of Aurora for this project. The plan will fulfill the criteria for erosion control and stormwater quality control requirements of the City of Aurora. The owner understands that additional erosion control measures may be needed if unforeseen erosion problems occur or if the submitted plan does not function as intended. The requirements of this plan shall run with the land and be the obligation of the landowner until such time as the plan is properly completed, modified, or voided.

2.0 Summary of Concepts

This report outlines the routing of the 5-year and 100-year storm events though the project drainage system. The flow from site and the adjacent parking lot will be managed by the detention pond on site and will account for water quality and the 100-year storm event.

These proposed improvements provide adequate protection to this site without adverse impacts on adjoining upstream and downstream properties. The historic runoff patterns are not being significantly altered.

F. REFERENCES

- Urban Drainage Flood Control District Criteria Manual Vol. 1-3, By Mile High Flood District

- City of Aurora Storm Drainage Design and Technical Criteria Manual, September 2010.

- Final Drainage Study for Waterpark Subdivision Filing No. 1(C4-2-451)

- Addendum to Drainage Study for Waterpark Subdivision Filing No. 1 (C4-2-451A)

G. EXHIBITS

1 – Vicinity Map
2 – Soils Map
3 – Flood Plain Map
4 – Denver Storm Drainage Master Plan
5 – Grading Plan
6 – Calculations
7 – MHFD Detention

Please contact me directly with any questions or concerns at sal@altitudelandco.com or directly at 720.427.3017.

Thank you for your time,

Salvatore C. Cambria, P.E.
Vice President

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G. EXHIBITS

Exhibit 1

Vicinity Map

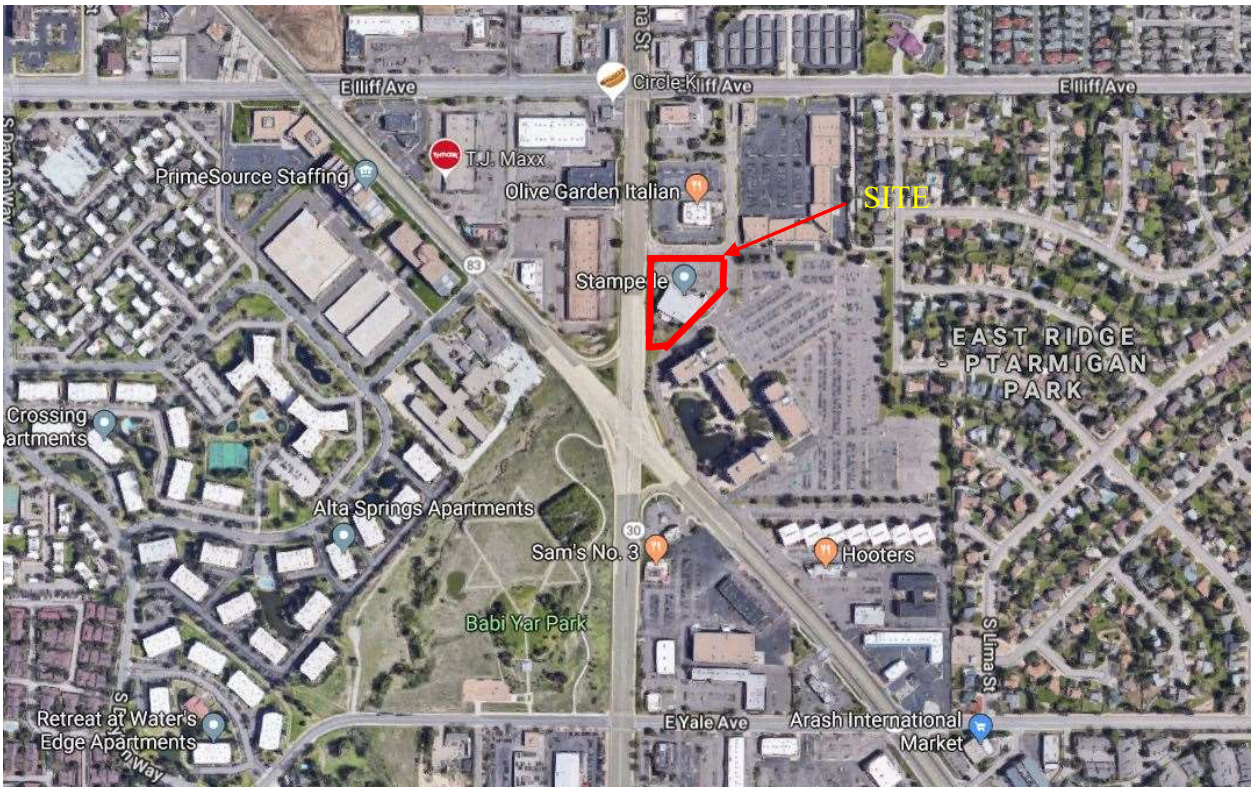


Exhibit 2

Soils Map

United States Department of Agriculture

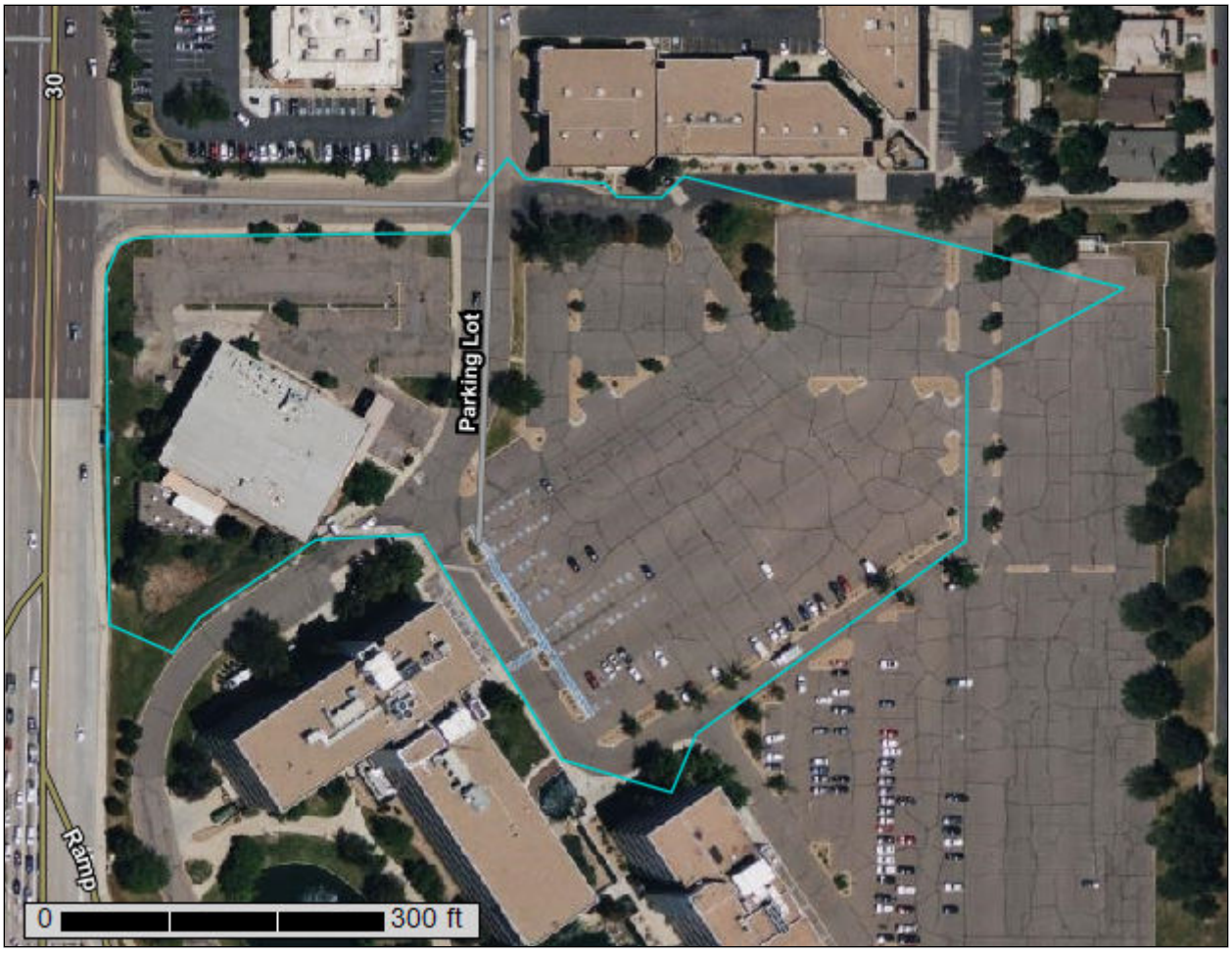
NRCS

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 Arapahoe County, Colorado

2430 S Havana St, Aurora CO 80014



October 28, 2022

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

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

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: 1:1,580 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

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: Arapahoe County, Colorado
Survey Area Data: Version 18, Sep 1, 2022

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BvC	Bresser-Truckton sandy loams, 3 to 5 percent slopes	0.2	2.1%
TrE	Truckton loamy sand, 5 to 20 percent slopes	7.2	97.9%
Totals for Area of Interest		**7.4**	**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.

Arapahoe County, Colorado

BvC—Bresser-Truckton sandy loams, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 34y5
Elevation: 4,500 to 6,800 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 125 to 180 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

Bresser and similar soils: 55 percent
Truckton and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bresser

Setting

Landform: Stream terraces, drainageways, playas
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Noncalcareous sandy alluvium and/or noncalcareous sandy eolian deposits

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 26 inches: sandy clay loam
H3 - 26 to 32 inches: gravelly sandy loam
H4 - 32 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Description of Truckton

Setting

Landform: Ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits

Typical profile

H1 - 0 to 5 inches: sandy loam
H2 - 5 to 20 inches: sandy loam
H3 - 20 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Nunn

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

Ascalon

Percent of map unit: 7 percent
Hydric soil rating: No

TrE—Truckton loamy sand, 5 to 20 percent slopes

Map Unit Setting

National map unit symbol: 34zp
Elevation: 4,500 to 6,500 feet
Mean annual precipitation: 12 to 18 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 125 to 180 days

Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Truckton

Setting

Landform: Drainageways, gullies
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sand loamy eolian sands and/or loam sandy eolian sands

Typical profile

H1 - 0 to 5 inches: loamy sand
H2 - 5 to 27 inches: sandy loam
H3 - 27 to 60 inches: sandy loam

Properties and qualities

Slope: 5 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Blakeland

Percent of map unit: 13 percent
Hydric soil rating: No

Bresser

Percent of map unit: 5 percent
Hydric soil rating: No

Samsil

Percent of map unit: 2 percent
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Exhibit 3

Flood Plain Map

104°52'30.46"W 39°41'21.65"N

104°50'37.11"W 39°39'15.98"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT 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
- 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 the United States Geological Survey (USGS). The basemap shown is the USGS National Map: Orthoimagery. Last refreshed October, 2020.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **2/23/2023 1:10 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: No elevation features on this FIRM
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

0 50 100 200 300 400 Meters

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

PANEL **186** OF **675**

Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF AURORA	080002	0186
ARAPAHOE COUNTY	080011	0186
CITY AND COUNTY OF DENVER	080046	0186

MAP NUMBER
08005C0186K
EFFECTIVE DATE
December 17, 2010

Exhibit 4

Denver Storm Drainage Master Plan

DESCRIPTION / CURRENT SYSTEM

EXISTING SYSTEM: This collection system basin consists of 3,675 acres (5.74 square miles). Two major storm drainage projects, Hampden Heights Phases I and II, have been recently constructed to mitigate repetitive flooding issues in the Hampden Heights neighborhood.

There are numerous detention basins within this collection system basin. Many were constructed as part of the Hampden Town Center Development in Aurora, and serve to reduce runoff in the 100-year system to a release flow rate of 56 cfs from the detention basin at the southwest corner of E. Hampden Ave. and S. Dayton St., in accordance with an intergovernmental agreement between Denver and Aurora, executed on September 10th, 2007 (Denver City Clerk Filing No. 2007-0103-A). Another detention basin is located near the intersection of Hampden Ave. and Dayton St. A detention basin is also located on the Hampden Heights Park at the northeast corner to the intersection of Dayton St. and Dayton Ct.

The Kennedy Ball Fields, near the intersection of S. Parker Rd. and Dartmouth Ave., includes a detention basin on site. Based on available information, the existing detention facility has been in existence since 1976. With the development of the Broadstone Apartment Complex, a berm was constructed to prevent potential stormwater overflows from impacting the development site and the multi-family residential area to the southwest. The detention basin and berm were not included in the uses within the lease held by Denver Parks from the United States Army Corps of Engineers (USACE). It was agreed between United States Army Corps of Engineers (USACE) and the City and County of Denver that the storage volume within the Kennedy Ball Fields would be limited to the approximate volume below the constructed berm, or 6.7 acre-feet (ac-ft).

POTENTIAL INUNDATION AREAS (PIA): A FLO-2D analysis indicates that the surface flow would cross S. Parker Rd. at the drive entrance approximately 680 feet northwest of the intersection of S. Parker Rd. and E. Dartmouth Ave. After splitting in the private parking area, the surface flow makes its way back to Dartmouth Ave. and continues west. Details of the analysis can be found in the *Hydrologic and Hydraulics Report for Kennedy Ball Fields Outfall* prepared by PB Americas, Inc., for the City and County of Denver in July, 2010.

DRAINAGE DEFICIENCIES: The Kennedy Ball Fields report by PB Americas recommended a 100-year outfall system from the Kennedy Ball Fields detention basin be constructed. This study also noted that runoff, which exceeds the capacity of the storm drains in S. Parker Rd., will be converged west along E. Dartmouth Ave.

OTHER STUDIES

Regional drainage and major drainageway planning studies within this basin include:

+ Four Square Mile Area Outfall System Planning Study, August 1985
+ Hydrologic and Hydraulics Report for Kennedy Ball Fields Outfall, July 2010.
+ Cherry Creek Stabilization Plan, December 2011

RECOMMENDED IMPROVEMENTS

COLLECTION SYSTEM

PROJECT B - SYRACUSE WAY STORM DRAIN: This project includes upsizing the existing storm from a 30-inch to a 48-inch in Syracuse Way from Uinta St. to Yale Ave.

PROJECT C - HAMPDEN HEIGHTS PARK OUTFALL: This project includes reshaping the ground surface to a 2' deep trapezoidal channel to convey surface flow from East Cornell Ave. to Cherry Creek and minimize flood risk to adjacent properties.

PROJECT D - S. ELMIRA STREET OUTFALL: Replace the existing 24-inch storm in South Elmira St. to Cherry Creek with a 60-inch pipe to meet drainage criteria.

PROJECT E - DARTMOUTH AVENUE OUTFALL: The outfall to Cherry Creek needs to be upsized to a 90-inch storm. The 54-inch storm in Dartmouth Avenue east of Cherry Creek at Bethany Drive needs to be upsized to a 90-inch storm, and a 72-inch storm. The 54-inch storm north of Kennedy Ball Fields and along Kenton Street needs to be upsized to a 60-inch storm.

PROJECT F - HAMPDEN AVENUE STORM DRAIN: This project includes upsizing the existing 42-inch storm to a 54-inch, and 60-inch storm in Hampden Ave.

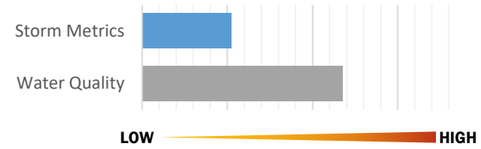
PROJECT G - S. YOSEMITE STREET STORM DRAIN: This project consists of upsizing storm in Yosemite Street south of Hampden Avenue from 18-inch to 36-inch. It also consists of upsizing the outfall to Cherry Creek on Yosemite Street to a 6-foot x 4-foot RCBC.

STORM DRAINAGE SYSTEM

EXISTING SYSTEM: 20.9 MI

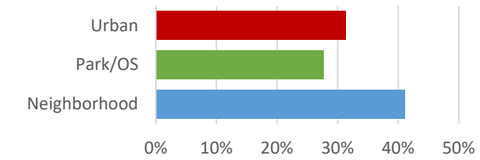
COLLECTION SYSTEM NEEDS: 0.9 MI

WATER QUALITY & STORM METRICS PRIORITY SCORING*



** Based on Storm Metrics and Stormwater Quality Prioritization reports*

FUTURE LAND USE / PROJECTED BUILDOUT



** Based on Blueprint Denver land use*

MAJOR DRAINAGEWAY

CHERRY CREEK

RECOMMENDED MAJOR DRAINAGE WAY IMPROVEMENTS: YES

100-YEAR FEMA FLOODPLAIN AREA: 33 AC / 1% OF BASIN

BASIN LAYOUT & STATISTICS

NEIGHBORHOODS: Hampden, Hampden South, Kennedy

COUNCIL DISTRICT(S): 4

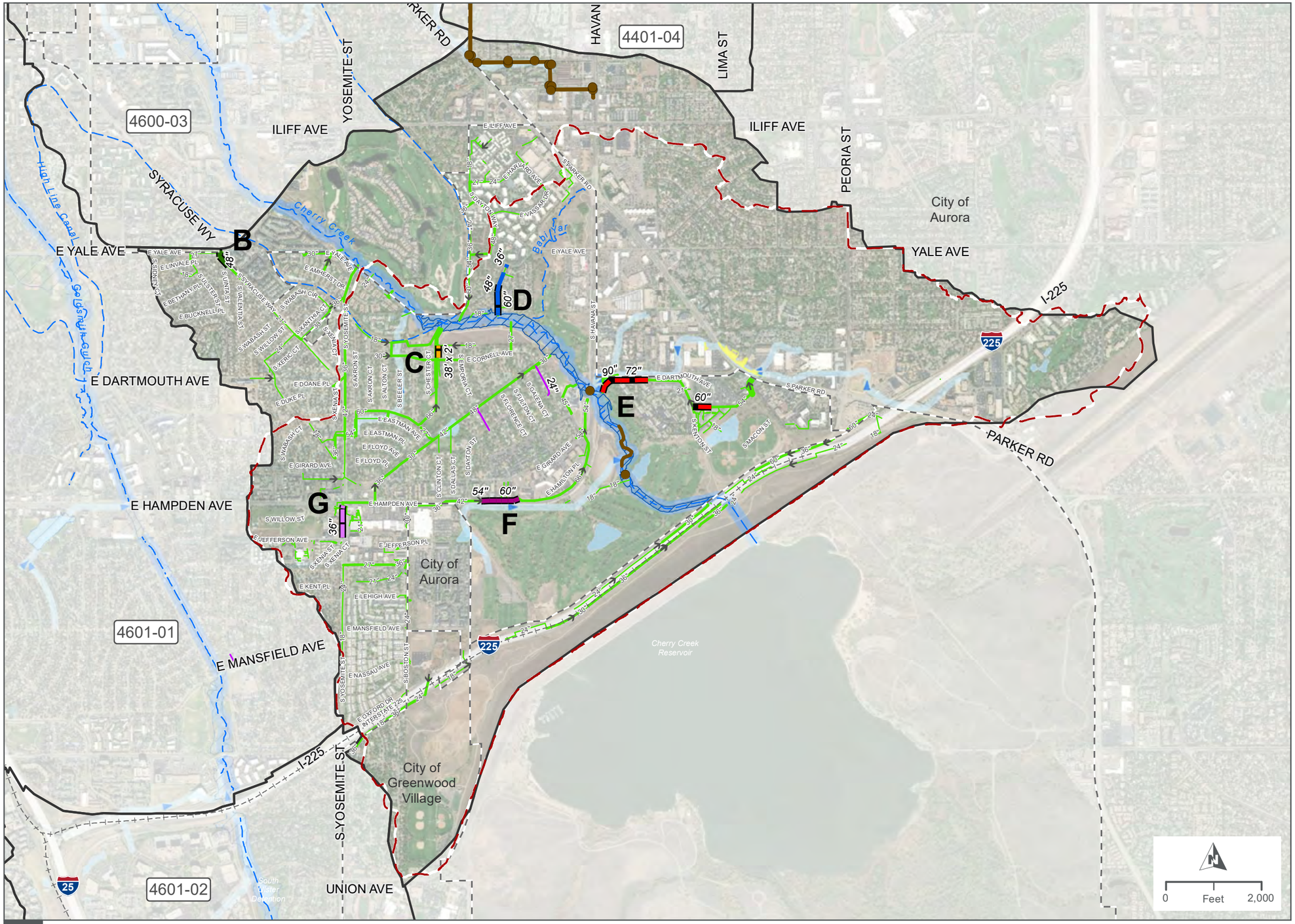
PARK/OS AREA: 501 AC

EXISTING DETENTION: 28 AC

SIZE: 3,675 AC / 5.74 Sq. Mi.

AVERAGE IMPERVIOUS: 50%

PIPE INSTALLATION DATE: MIN: 1969 MAX: 2017 AVG: 2000



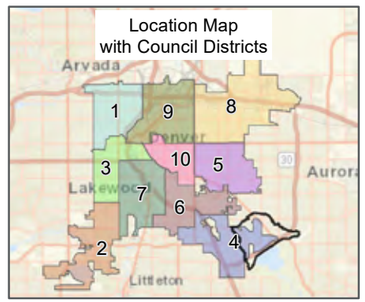
RECOMMENDATIONS

- Modeled Recommendation
- Unmodeled Recommendation

Project Name

- B: Syracuse Way Storm Drain
- D: S Elmira St Outfall
- E: Dartmouth Ave
- F: Hampden Ave Storm
- G: S Yosemite St Storm Drain
- C: Hampden Heights Park Outfall (Open Channel)

- UDFCD Study Recommendations
- Potential Storm Inundation
- FEMA 100-Year Floodplain
- Existing Storm Main
- Recently Constructed & Designed Storm Main
- Collection System Basin
- Topographic Basin Boundary
- Major Drainageway
- Thalweg
- Existing Storm Detention
- Light Rail
- City Boundary



DATA SOURCE: City and County of Denver, Enginuity Engineering, HDR Engineering, UDFCD

DENVER THE MILE HIGH CITY

SDMP

BASIN 4600-04

CHERRY CREEK RESERVOIR

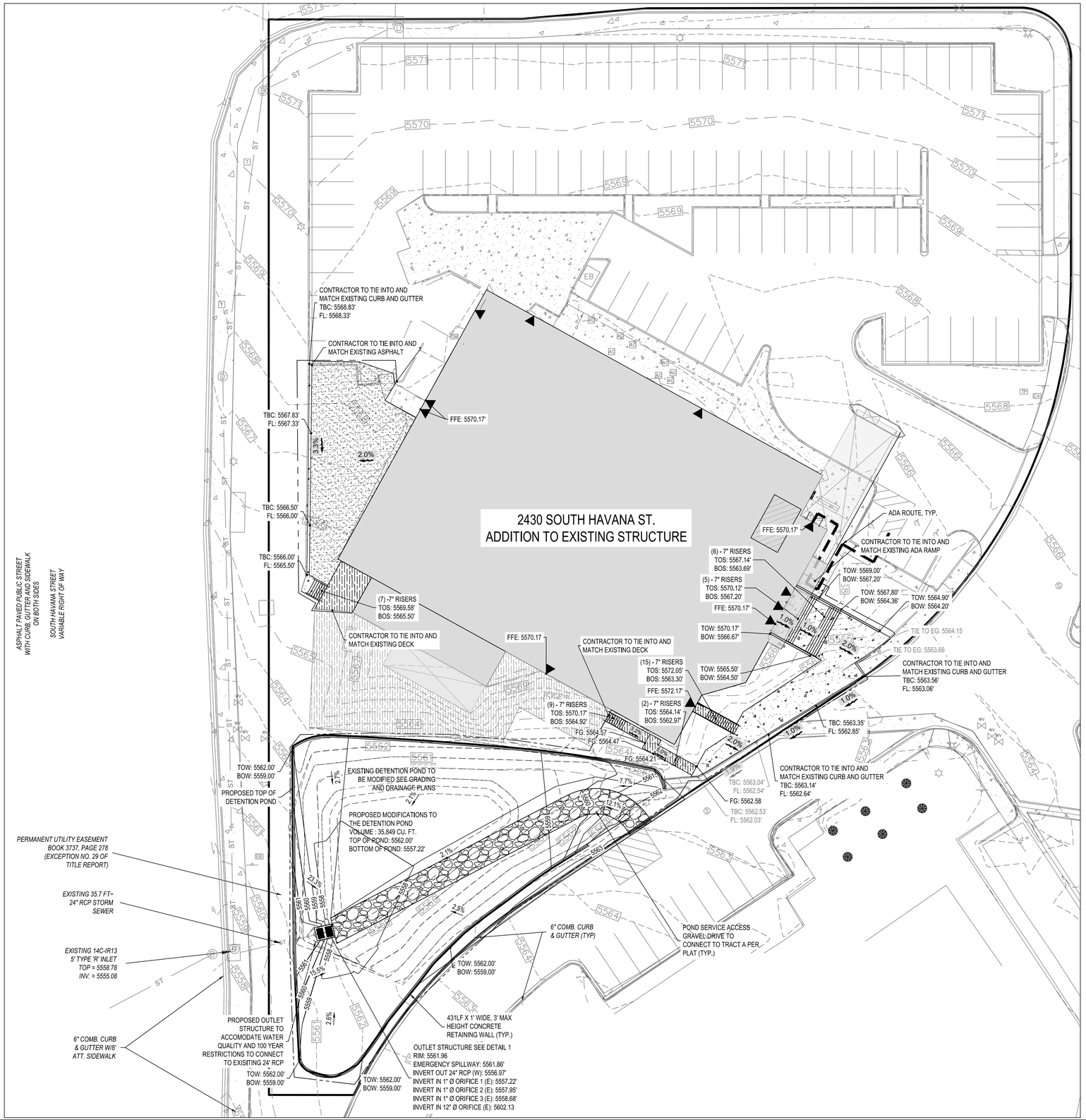
2019 SDMP

PATH: \\DEN-GISSRV1\GISDATA\PROJECTS\10125417_DENVER_SDMP_2019_PHASE_B\MAP_DOCS\CCD_SDMP_2019_11X17_MAPBOOK_2019.MXD - USER: WWHEELER - DATE: 10/24/2019

2019 STORM DRAINAGE MASTER PLAN UPDATE

Exhibit 5

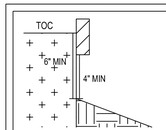
Grading & Drainage Plan



GRADING PLAN NOTES:

1. **BENCHMARK:** TOP OF A FOUND 1.5" DIAMETER ALUMINUM CAP, NO. ILLEGIBLE, AT THE NORTHWEST PROPERTY CORNER, ELEVATION = 5571.02, NAVD 88 DATUM.
2. ALL FINISHED FLOOR ELEVATIONS HAVE BEEN ASSUMED.

FOUNDATION DETAIL



- MINIMUM 4" CLEARANCE FROM BOTTOM OF BUILDING FACE TO EXISTING GRADE AGAINST FOUNDATION
OR
- MINIMUM 6" CLEARANCE FROM TOP OF FOUNDATION TO EXISTING GRADE AGAINST FOUNDATION

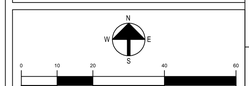
ABBREVIATION LEGEND

FG: FINISHED GRADE
EG: EXISTING GRADE
FL: FLOW LINE
TC: TOP OF CURB
BC: BOTTOM OF CURB
BS: BOTTOM OF STEP
TS: TOP OF STEP
GB: GRADE BREAK
GS: GROUND SHOT
TW: TOP OF WALL
BW: BOTTOM OF WALL
DS: DOWNSPOUT
FFE: FINISHED FLOOR ELEVATION
HP: HIGH POINT

LEGEND:

- PROPERTY LINE
- ADJACENT PROPERTY LINE
- LIMIT OF CONSTRUCTION
- ADA ROUTE
- PROPOSED CONCRETE
- EXISTING CONCRETE
- PROPOSED WOOD
- PROPOSED WOOD
- PROPOSED ASPHALT
- 5280' SPOT ELEVATION

ALL PLANIMETRIC LINEWORK THAT IS FADED BACK SHOWN HEREIN INDICATES AN EXISTING FEATURE (IMPROVEMENT, TOPOGRAPHY, UTILITY, ETC.). ALL PLANIMETRIC TEXT THAT IS FADED BACK AND ITALICIZED SHOWN HEREIN INDICATES A CALLOUT TO AN EXISTING FEATURE.



ALTITUDE LAND CONSULTANTS
CIVIL | SURVEY | PLANNING | LANDSCAPE
3461 RINGSBY CT., SUITE #125
DENVER, CO 80216

720.594.9494
INFO@ALTITUDELANDCO.COM
WWW.ALTITUDELANDCO.COM

REVISIONS: DATE:
MINOR SITE PLAN AMENDMENT

WATERPARK SUBDIVISION FILING #2 MINOR
PRELIMINARY DRAINAGE REPORT

2430 S. HAVANA ST.
AURORA, CO. 80014

DRAWN BY: DPT
CHECKED BY: SCC
DATE: 08-31-23
ALC # 18-224
CAD FILE:
DIR:

PRELIMINARY DRAINAGE REPORT

GRADING PLAN

D1.0

SHEET 01OF 03

ALTITUDE
LAND CONSULTANTS INC
CIVIL | SURVEY | PLANNING | LANDSCAPE
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REVISIONS: MINOR SITE PLAN AMENDMENT
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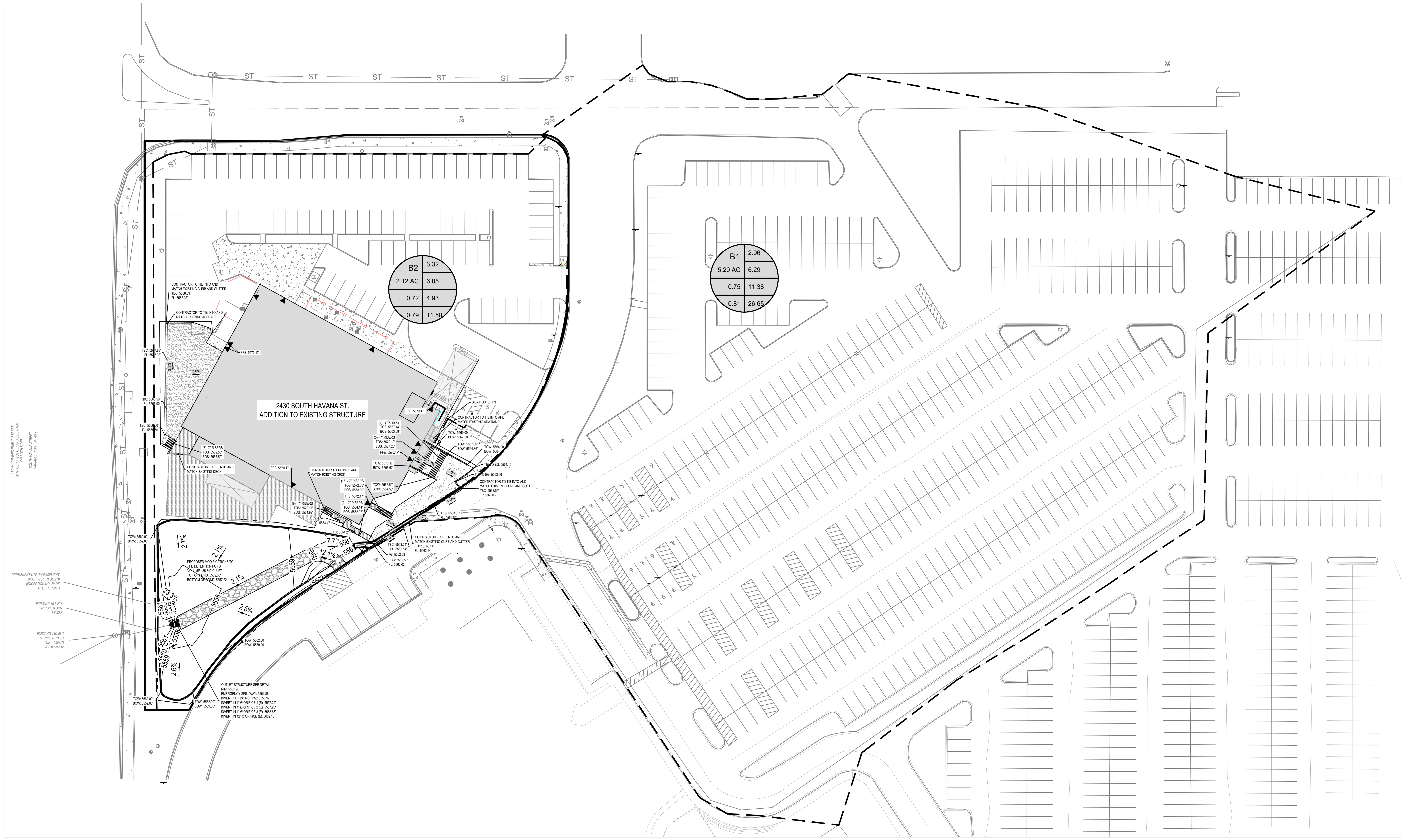
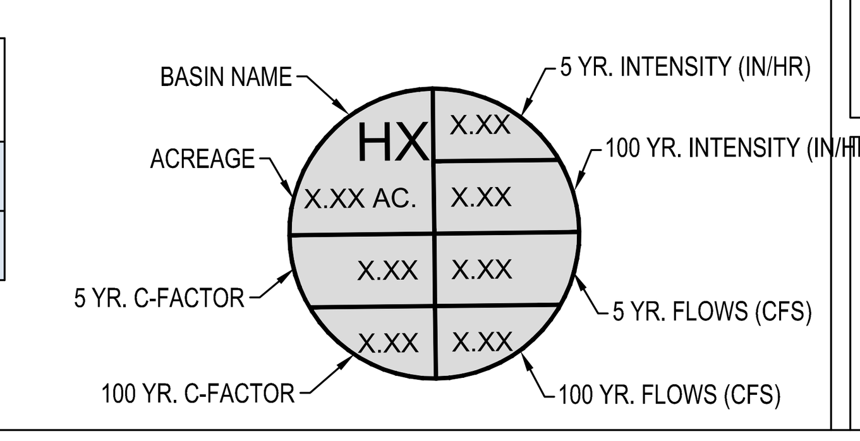
AURORA, CO. 80014



GENERAL NOTES:

1. BASE INFORMATION SHOWN HEREIN HAS BEEN PROVIDED BY OWNER AND IS BASED ON CIVIL DRAWINGS AND DESIGN FILES FROM CHESSNOE AND ASSOCIATES MAY 2018
2. SITE ADDRESS IS: 2430 S. HAVANA ST., AURORA, CO 80014
3. **BENCHMARK**: TOP OF A FOUND 1.5" DIAMETER ALUMINUM CAP, NO. ILLEGIBLE, AT THE NORTHWEST PROPERTY CORNER, ELEVATION = 5571.02' VAD 88 DATUM.

Basin ID	Area (AC)	Imperviousness	C5	I5 (in/hr)	Q5 (CFS)	C100	I100 (in/hr)	Q100 (CFS)
B1	5.20	86.67%	0.74	2.96	11.38	0.81	6.29	26.65
B2	2.12	84.02%	0.72	3.23	4.93	0.79	6.85	11.50



LEGEND:

- PROPERTY LINE
- ST — EXISTING STORM SEWER MAIN
- EXISTING STORM SEWER MANHOLE
- 5556 — EXISTING CONTOUR
- 5555 — PROPOSED CONTOUR
- PROPOSED CONCRETE
- PROP. CONCRETE RETAINING WALL
- STOMRWATER CONTROL OULET
- PROP. CONCRETE TRICKLE CHANNEL
- PROP. GRAVEL SERVICE ACCESS

ALL PLANAMETRIC LINEWORK THAT IS FADED BACK SHOWN HEREIN INDICATES AN EXISTING FEATURE (IMPROVEMENT, TOPOGRAPHY, UTILITY, ETC.). ALL PLANIMETRIC TEXT THAT IS FADED BACK AND ITALICIZED SHOWN HEREIN INDICATES A CALLOUT TO AN EXISTING FEATURE.

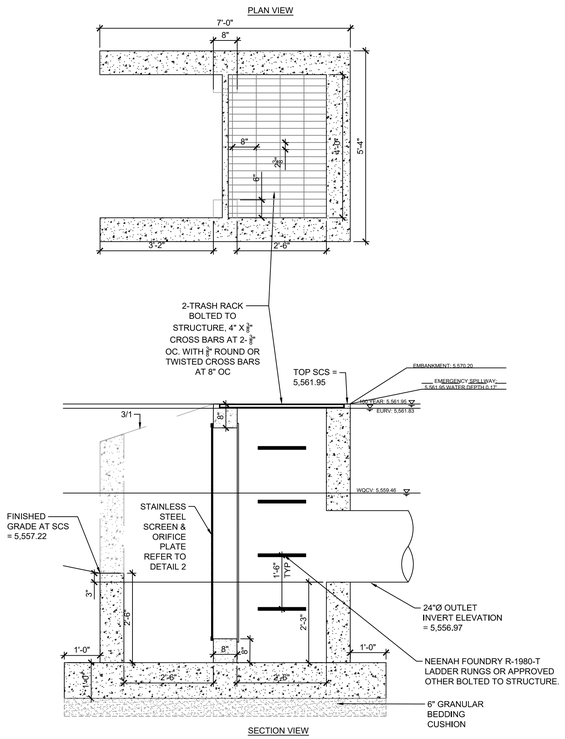
N W E S
0 20 40 80 120
(IN FEET)
1 inch = 40 ft.

DRAWN BY: DPT
CHECKED BY: SCC
DATE: 08-31-23
ALC # 18-224
CAD FILE:
DIR:

PRELIMINARY DRAINAGE REPORT

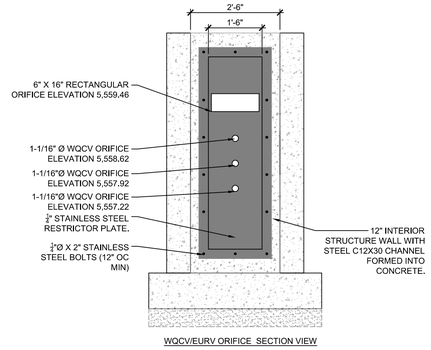
DRAINAGE PLAN

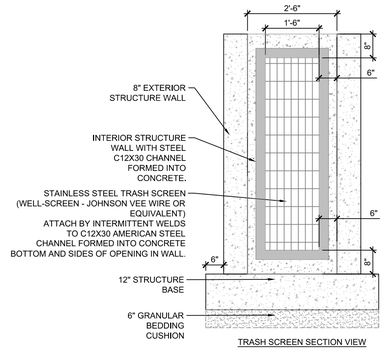
D2.0
SHEET 02 OF 03

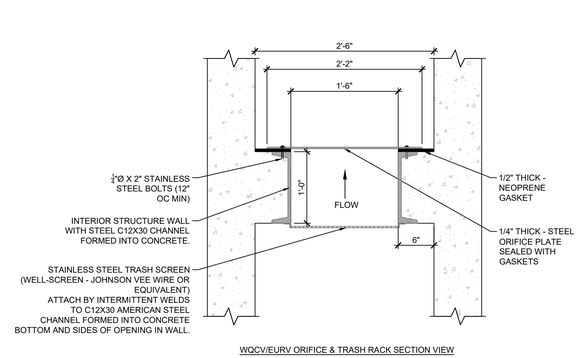


1 OUTLET CONTROL STRUCTURE

SCALE: 1/2" = 1'-0"







2 WQCV EURV AND TRASH RACK

SCALE: 1/2" = 1'-0"

ALTITUDE LAND CONSULTANTS
CIVIL | SURVEY | PLANNING | LANDSCAPE
3461 RINGSBY CT., SUITE #125
DENVER, CO 80216

720.594.9494
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WWW.ALTITUDELANDCO.COM

REVISIONS: DATE:

MINOR SITE PLAN AMENDMENT

WATERPARK SUBDIVISION FILING #2 MINOR PRELIMINARY DRAINAGE REPORT

2430 S. HAVANA ST.
AURORA, CO. 80014

DRAWN BY: DPT
CHECKED BY: SCC
DATE: 08-31-23
ALC # 18-224
CAD FILE:
DIR:

PRELIMINARY DRAINAGE REPORT

DRAINAGE DETAILS

D2.1
SHEET 03 OF 03

Appendix E

Calcuclations

Composite Runoff Workbook
Altitude Land Consultants

Project Name: Stampede
Project number: 18-224
Project Location: Aurora Colorado
Calculated By: DPT
Checked By: SLR

DATE: 8/31/2023

Legend

	ID Cell
	Input Cell
	NRCS Soil Group A
	NRCS Soil Group B
	NRCS Soil Group C/D
	Calculated Cell

Table 6-5 DCM Volume 1

Calculated By: DPT
Checked By: SLR
DATE: 8/31/2023

Imperviousness

	Roof	Walk/Drive	Gravel	WQCV	Landscape
I (%)	95%	96%	40%	100%	5%

"C" Factors for NRCS Group A Soils.

	Roof	Walk/Drive	Gravel	WQCV	Landscape
C2	0.79	0.80	0.19	0.89	0.00
C5	0.81	0.82	0.25	0.90	0.02
C10	0.82	0.84	0.30	0.92	0.10
C25	0.83	0.86	0.35	0.94	0.16
C50	0.84	0.87	0.38	0.95	0.20
C100	0.85	0.88	0.41	0.96	0.24

Recommended Percentage Imperviousnedd Values derived from Aurora Storm Drainage Design and Technical Criteria Table 1
Runoff Coefficients derived from Aurora Storm Drainage Design and Technical Criteria Table 1 and DCM Table RO-5

"C" Factors for NRCS Group B Soils.

	Roof	Walk/Drive	Gravel	WQCV	Landscape
C2	0.51	0.82	0.23	0.89	0.04
C5	0.54	0.83	0.30	0.90	0.10
C10	0.58	0.85	0.36	0.92	0.19
C25	0.62	0.87	0.42	0.94	0.28
C50	0.64	0.89	0.46	0.95	0.33
C100	0.66	0.90	0.50	0.96	0.38

Recommended Percentage Imperviousnedd Values derived from Aurora Storm Drainage Design and Technical Criteria Table 1
Runoff Coefficients derived from Aurora Storm Drainage Design and Technical Criteria Table 1 and DCM Table RO-5

"C" Factors for NRCS Group C/D Soils.

	Roof	Walk/Drive	Gravel	WQCV	Landscape
C2	0.54	0.82	0.28	0.89	0.08
C5	0.58	0.84	0.35	0.90	0.18
C10	0.62	0.86	0.42	0.92	0.28
C25	0.66	0.88	0.50	0.94	0.39
C50	0.68	0.89	0.54	0.95	0.46
C100	0.71	0.90	0.58	0.96	0.52

Recommended Percentage Imperviousnedd Values derived from Aurora Storm Drainage Design and Technical Criteria Table 1
Runoff Coefficients derived from Aurora Storm Drainage Design and Technical Criteria Table 1 and DCM Table RO-5

Composite Runoff C Factors

Project Site: B
Calculated By: DPT
Checked By: SLR
DATE: 8/31/2023

Historic Area Break Down per Soil Group

	NRCS Soil Group A					NRCS Soil Group B					NRCS Soil Group C/D				
	Roof	Walk/Drive	Gravel	WQCV	Landscape	Roof	Walk/Drive	Gravel	WQCV	Landscape	Roof	Walk/Driv	Gravel	WQCV	Landscape
H1	20453.66	183417.72	0.00	0.00	23250.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H2	0.00	57938.96	0.00	9302.36	24787.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Historic Area Break Down Totals

H1	20453.66	183417.72	0.00	0.00	23250.68	227122.06
H2	0.00	57938.96	0.00	9302.36	24787.82	92029.14

Area Totals

	Total	Total A	Total B	Total C/D	% Soil A	% Soil B	% Soil C/D
	(sf)	(sf)	(sf)	(sf)	(%)	(%)	(%)
Developed	319151.20	319151.20	0.00	0.00	100.00%	0.00%	0.00%

Composite C per Soil Group

	Impervious	C_A	C_A	C_A	C_A	C_A	C_A	C_B	C_B	C_B	C_B	C_B	C_B	$C_{C/D}$	$C_{C/D}$	$C_{C/D}$	$C_{C/D}$	$C_{C/D}$	$C_{C/D}$
	%	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
H1	86.59%	0.72	0.74	0.76	0.79	0.80	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H2	71.89%	0.59	0.61	0.65	0.68	0.70	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Historic Composite C

	Impervious	C	C	C	C	C	C
	%	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
H1	86.59%	0.72	0.74	0.76	0.79	0.80	0.81
H2	71.89%	0.59	0.61	0.65	0.68	0.70	0.72

T_c, Intensities, Runoff Flows

Project Site: B
Calculated By: DPT
Checked By: SLR
DATE: 8/31/2023

Historic Overland Flow Time				Historic Channelized Flow Time						Historic T_c
Basin ID	**Overland Flow Length (ft)**	**Overland Flow Slope (ft/ft)**	**Overland Flow Time (min)**	**Overland Flow Time Urbanized Basins (min)**	**Overland Flow Time**	**Channelized Flow Length (ft)**	**Channelized Flow Slope (ft/ft)**	**NRCS Conveyance Factors K**	**Channelized Flow Time (min)**	**Time of Concentration* (min)**
H1	300.00	0.016	9.72	11.67	9.72	204.93	0.016	20	1.35	11.07
H2	300.00	0.026	11.12	11.67	11.12	32.96	0.026	20	0.17	11.29

Overland Flow Time is Derived from DCM Volume 1, Chapter 6, Equation 6-3 City of Aurora Storm Drainge Design & Technical Criteria equation 5.4.
Channelized Flow Time is Derived from DCM Volume 1, Chapter 6, Equation 6-4
Channelized NRCS Conveyance Factors are Derived from DCM Volume 1, Chapter 6, Table 6-2
****Minimum Time of Concentration is 5 mins***

	2-yr	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
1-hour rainfall depth (in)=	0.95	1.35	1.55	2.00	2.25	2.60

Rainfall depth is derived from MHFD Detention Basin Design Workbook Aurora Municipal Center

Historic Intensity							Historic Runoff Flows						
Basin ID	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Basin ID**	**Q_2 (CFS)**	**Q_5 (CFS)**	**Q_{10} (CFS)**	**Q_{25} (CFS)**	**Q_{50} (CFS)**	**Q_{100} (CFS)**
H1	2.47	3.51	4.03	5.19	5.84	6.75	**H1**	9.25	13.48	16.00	21.28	24.34	28.58
H2	2.45	3.48	3.99	5.15	5.80	6.70	**H2**	3.08	4.50	5.47	7.40	8.54	10.13

Basin Table Summary

Project Site: B
Calculated By: DPT
Checked By: SLR
DATE: 8/31/2023

Historic Basin Summary Table

Basin ID	Area (AC)	Imperviousness	C5	I_5 (in/hr)	Q_5 (CFS)	C_{100}	I_{100} (in/hr)	Q_{100} (CFS)
H1	5.21	86.59%	0.74	3.51	13.48	0.81	6.75	28.58
H2	2.11	71.89%	0.61	3.48	4.50	0.72	6.70	10.13

	Total Area (sf)	Total Area (AC)	Imperviousness %
Historical	319151.20	7.33	82.36%

Composite Runoff C Factors

Calculated By: DPT
Checked By: SLR
DATE: 8/31/2023

Developed Area Break Down per Soil Group

	NRCS Soil Group A					NRCS Soil Group B					NRCS Soil Group C/D				
	Roof	Walk/Drive	Gravel	WQCV	Landscape	Roof	Walk/Drive	Gravel	WQCV	Landscape	Roof	Walk/Driv	Gravel	WQCV	Landscape
B1	0.00	203406.16	0.00	0.00	23250.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	44544.78	26558.30	0.00	9302.36	12092.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Developed Area Break Down Totals

B1	0.00	203406.16	0.00	0.00	23250.68	226656.84
B2	44544.78	26558.30	0.00	9302.36	12092.96	92498.40

Area Totals

	Total	**Total A**	**Total B**	**Total C/D**	**% Soil A**	**% Soil B**	**% Soil C/D**
	(sf)	**(sf)**	**(sf)**	**(sf)**	**(%)**	**(%)**	**(%)**
Developed	319155.24	319155.24	0.00	0.00	100.00%	0.00%	0.00%

Composite C per Soil Group

	Impervious	**C_A**	**C_A**	**C_A**	**C_A**	**C_A**	**C_A**	**C_B**	**C_B**	**C_B**	**C_B**	**C_B**	**C_B**	**$C_{C/D}$**	**$C_{C/D}$**	**$C_{C/D}$**	**$C_{C/D}$**	**$C_{C/D}$**	**$C_{C/D}$**
	%	**2 Year**	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**	**2 Year**	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**	**2 Year**	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
B1	86.67%	0.72	0.74	0.76	0.79	0.80	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	84.02%	0.70	0.72	0.74	0.76	0.78	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Developed Composite C

	Impervious	**C**	**C**	**C**	**C**	**C**	**C**
	%	**2 Year**	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
B1	86.67%	0.72	0.74	0.76	0.79	0.80	0.81
B2	84.02%	0.70	0.72	0.74	0.76	0.78	0.79

T_c, Intensities, Runoff Flows

Calculated By: DPT
Checked By: SLR
DATE: 8/31/2023

Developed Overland Flow Time				Developed Channelized Flow Time						Developed T_c
Basin ID	**Overland Flow Length (ft)**	**Overland Flow Slope (ft/ft)**	**Overland Flow Time (min)**	**Overland Flow Time Urbanized Basins (min)**	**Overland Flow Time**	**Channelized Flow Length (ft)**	**Channelized Flow Slope (ft/ft)**	**NRCS Conveyance Factors K**	**Channelized Flow Time (min)**	**Time of Concentration* (min)**
B1	300.00	0.016	9.70	11.67	9.70	204.93	0.016	20	1.35	11.05
B2	300.00	0.026	8.70	11.67	8.70	32.96	0.026	20	0.17	8.87

Overland Flow Time is Derived from DCM Volume 1, Chapter 6, Equation 6-3 City of Aurora Storm Drainge Design & Technical Criteria equation 5.4.
Channelized Flow Time is Derived from DCM Volume 1, Chapter 6, Equation 6-4
Channelized NRCS Conveyance Factors are Derived from DCM Volume 1, Chapter 6, Table 6-2
****Minimum Time of Concentration is 5 mins***

	2-yr	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
1-hour rainfall depth (in)=	0.87	1.14	1.39	1.76	2.08	2.42

Rainfall depth is derived from MHFD Detention Basin Design Workbook (v 4.06) Aurora Municipal Center

Developed Intensity							Developed Runoff Flows						
Basin ID	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Basin ID**	**Q_2 (CFS)**	**Q_5 (CFS)**	**Q_{10} (CFS)**	**Q_{25} (CFS)**	**Q_{50} (CFS)**	**Q_{100} (CFS)**
B1	2.26	2.96	3.61	4.57	5.41	6.29	**B1**	8.47	11.38	14.36	18.76	22.54	26.65
B2	2.46	3.23	3.94	4.98	5.89	6.85	**B2**	3.66	4.93	6.20	8.07	9.71	11.50

Basin Table Summary

Calculated By: DPT
Checked By: SLR
DATE: 8/31/2023

Developed Basin Summary Table

Basin ID	Area (AC)	Imperviousness	C_5	I_5 (in/hr)	Q_5 (CFS)	C_{100}	I_{100} (in/hr)	Q_{100} (CFS)
B1	5.20	86.67%	0.74	2.96	11.38	0.81	6.29	26.65
B2	2.12	84.02%	0.72	3.23	4.93	0.79	6.85	11.50

	Total Area (sf)	Total Area (AC)	Imperviousness %
Developed	319155.24	7.33	85.90%

NOAA Atlas 14, Volume 8, Version 2
Location name: Aurora, Colorado, USA*
Latitude: 39.674°, Longitude: -104.8659°
Elevation: 5577.63 ft**

* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**2.68** (2.12-3.38)	**3.29** (2.60-4.16)	**4.37** (3.44-5.54)	**5.34** (4.18-6.80)	**6.79** (5.18-9.10)	**7.99** (5.95-10.8)	**9.29** (6.67-12.9)	**10.7** (7.36-15.2)	**12.6** (8.36-18.5)	**14.2** (9.13-21.0)
10-min	**1.96** (1.55-2.48)	**2.41** (1.90-3.05)	**3.19** (2.52-4.06)	**3.91** (3.06-4.99)	**4.97** (3.80-6.67)	**5.86** (4.36-7.93)	**6.80** (4.88-9.44)	**7.81** (5.38-11.1)	**9.25** (6.13-13.5)	**10.4** (6.68-15.4)
15-min	**1.59** (1.26-2.02)	**1.96** (1.55-2.48)	**2.60** (2.05-3.30)	**3.18** (2.49-4.05)	**4.04** (3.09-5.42)	**4.76** (3.54-6.45)	**5.52** (3.97-7.67)	**6.35** (4.38-9.06)	**7.52** (4.98-11.0)	**8.45** (5.43-12.5)
30-min	**1.12** (0.886-1.42)	**1.37** (1.08-1.74)	**1.81** (1.43-2.30)	**2.21** (1.73-2.82)	**2.80** (2.14-3.75)	**3.29** (2.45-4.45)	**3.81** (2.73-5.28)	**4.36** (3.00-6.22)	**5.14** (3.41-7.53)	**5.77** (3.71-8.53)
60-min	**0.714** (0.565-0.904)	**0.860** (0.680-1.09)	**1.12** (0.885-1.43)	**1.36** (1.07-1.74)	**1.72** (1.32-2.32)	**2.03** (1.51-2.75)	**2.35** (1.69-3.27)	**2.71** (1.87-3.87)	**3.21** (2.13-4.71)	**3.62** (2.33-5.35)
2-hr	**0.434** (0.346-0.545)	**0.518** (0.412-0.650)	**0.668** (0.532-0.842)	**0.809** (0.639-1.02)	**1.02** (0.792-1.36)	**1.21** (0.907-1.62)	**1.40** (1.02-1.93)	**1.62** (1.13-2.29)	**1.93** (1.29-2.80)	**2.18** (1.41-3.18)
3-hr	**0.320** (0.257-0.400)	**0.378** (0.303-0.472)	**0.484** (0.387-0.606)	**0.584** (0.464-0.735)	**0.738** (0.575-0.980)	**0.871** (0.659-1.17)	**1.01** (0.742-1.39)	**1.17** (0.822-1.65)	**1.40** (0.944-2.02)	**1.59** (1.04-2.30)
6-hr	**0.192** (0.155-0.237)	**0.226** (0.183-0.280)	**0.289** (0.233-0.359)	**0.348** (0.279-0.434)	**0.438** (0.343-0.574)	**0.514** (0.392-0.680)	**0.596** (0.439-0.808)	**0.686** (0.485-0.954)	**0.815** (0.554-1.16)	**0.920** (0.606-1.32)
12-hr	**0.115** (0.093-0.140)	**0.138** (0.112-0.169)	**0.178** (0.144-0.218)	**0.213** (0.172-0.263)	**0.265** (0.209-0.342)	**0.308** (0.236-0.402)	**0.354** (0.262-0.472)	**0.402** (0.286-0.550)	**0.470** (0.321-0.660)	**0.523** (0.348-0.742)
24-hr	**0.070** (0.057-0.085)	**0.083** (0.069-0.101)	**0.107** (0.087-0.130)	**0.127** (0.103-0.155)	**0.156** (0.123-0.198)	**0.180** (0.139-0.231)	**0.204** (0.152-0.268)	**0.230** (0.165-0.310)	**0.265** (0.183-0.367)	**0.293** (0.197-0.410)
2-day	**0.042** (0.034-0.050)	**0.049** (0.040-0.059)	**0.061** (0.050-0.073)	**0.071** (0.059-0.087)	**0.087** (0.069-0.109)	**0.099** (0.077-0.126)	**0.112** (0.084-0.146)	**0.125** (0.091-0.167)	**0.144** (0.100-0.197)	**0.159** (0.108-0.220)
3-day	**0.030** (0.025-0.035)	**0.035** (0.029-0.042)	**0.044** (0.036-0.053)	**0.052** (0.043-0.062)	**0.063** (0.050-0.078)	**0.071** (0.056-0.090)	**0.080** (0.061-0.104)	**0.090** (0.065-0.119)	**0.102** (0.072-0.139)	**0.112** (0.077-0.154)
4-day	**0.023** (0.019-0.028)	**0.028** (0.023-0.033)	**0.035** (0.029-0.042)	**0.041** (0.034-0.049)	**0.050** (0.040-0.062)	**0.057** (0.044-0.071)	**0.064** (0.048-0.082)	**0.071** (0.052-0.093)	**0.081** (0.057-0.109)	**0.088** (0.060-0.120)
7-day	**0.015** (0.013-0.018)	**0.018** (0.015-0.021)	**0.022** (0.019-0.027)	**0.026** (0.022-0.031)	**0.032** (0.026-0.039)	**0.036** (0.028-0.044)	**0.040** (0.031-0.051)	**0.044** (0.033-0.058)	**0.050** (0.036-0.067)	**0.055** (0.038-0.074)
10-day	**0.012** (0.010-0.014)	**0.014** (0.012-0.016)	**0.017** (0.014-0.020)	**0.020** (0.017-0.024)	**0.024** (0.019-0.029)	**0.027** (0.021-0.033)	**0.030** (0.023-0.038)	**0.033** (0.024-0.043)	**0.037** (0.026-0.049)	**0.040** (0.028-0.054)
20-day	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.011** (0.009-0.012)	**0.012** (0.010-0.014)	**0.014** (0.011-0.017)	**0.016** (0.012-0.019)	**0.017** (0.013-0.021)	**0.019** (0.014-0.024)	**0.021** (0.015-0.027)	**0.023** (0.016-0.030)
30-day	**0.006** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.010)	**0.009** (0.008-0.011)	**0.011** (0.009-0.013)	**0.012** (0.010-0.014)	**0.013** (0.010-0.016)	**0.014** (0.011-0.018)	**0.016** (0.011-0.020)	**0.017** (0.012-0.022)
45-day	**0.005** (0.004-0.006)	**0.006** (0.005-0.006)	**0.007** (0.006-0.008)	**0.008** (0.006-0.009)	**0.009** (0.007-0.010)	**0.010** (0.008-0.011)	**0.010** (0.008-0.013)	**0.011** (0.008-0.014)	**0.012** (0.009-0.016)	**0.013** (0.009-0.017)
60-day	**0.004** (0.004-0.005)	**0.005** (0.004-0.006)	**0.006** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.006-0.009)	**0.008** (0.007-0.010)	**0.009** (0.007-0.011)	**0.010** (0.007-0.012)	**0.011** (0.008-0.013)	**0.011** (0.008-0.015)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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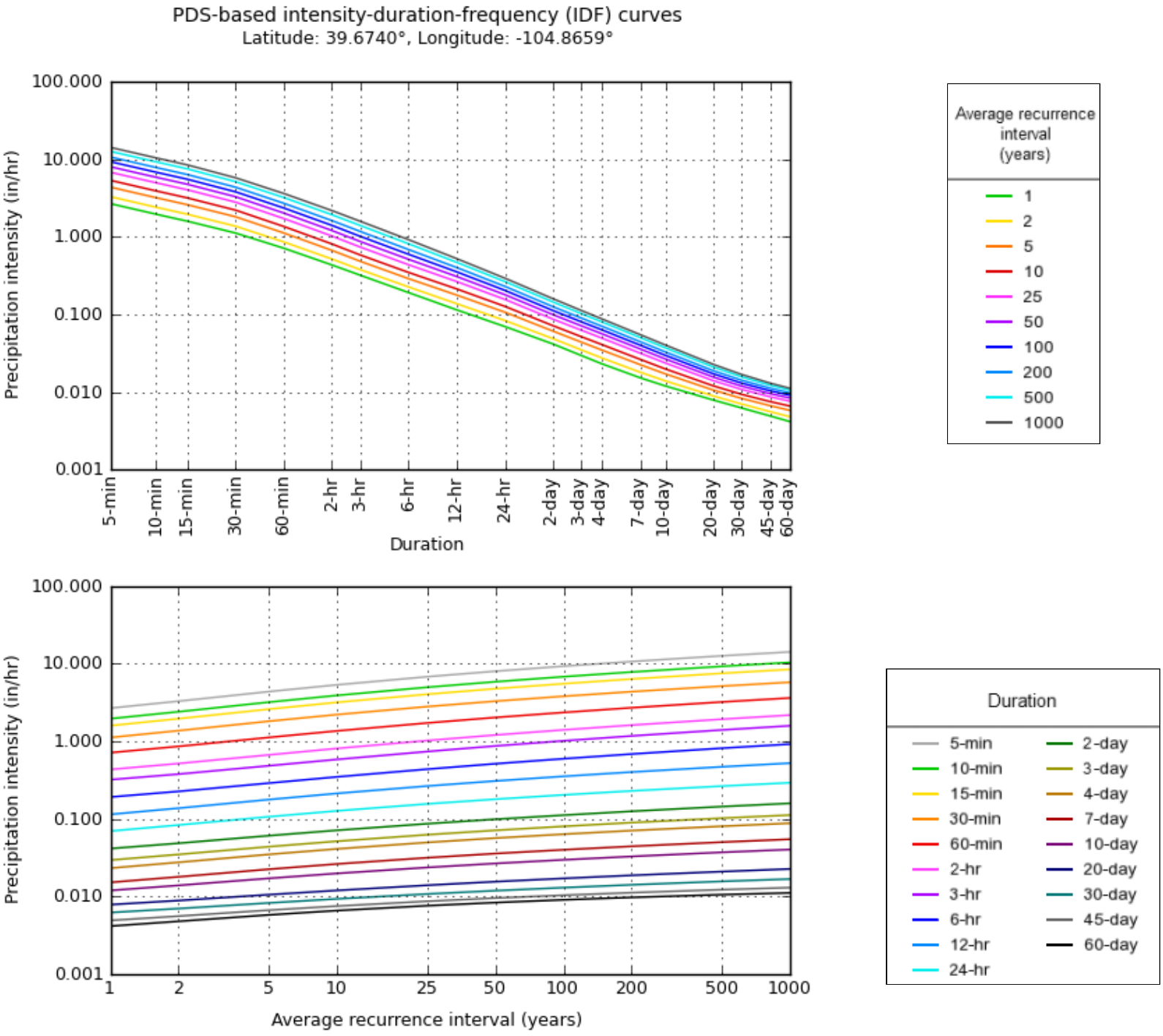
PF graphical



NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Wed Mar 1 05:35:57 2023

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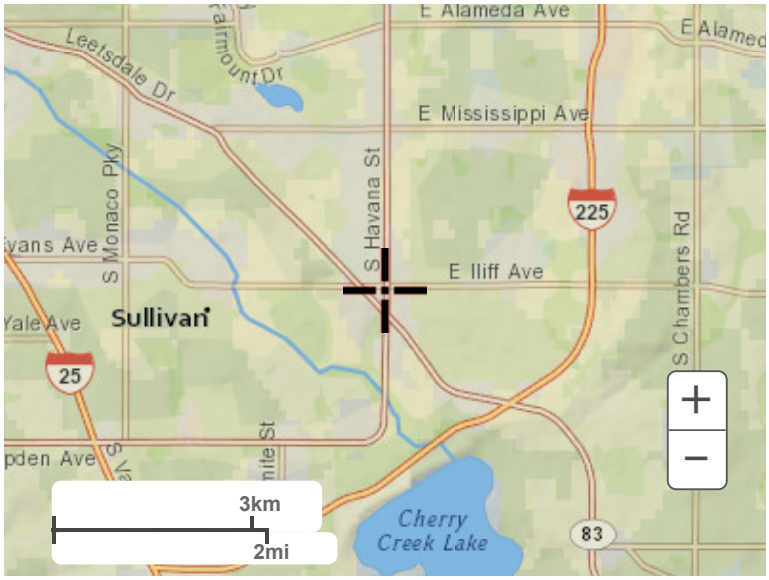
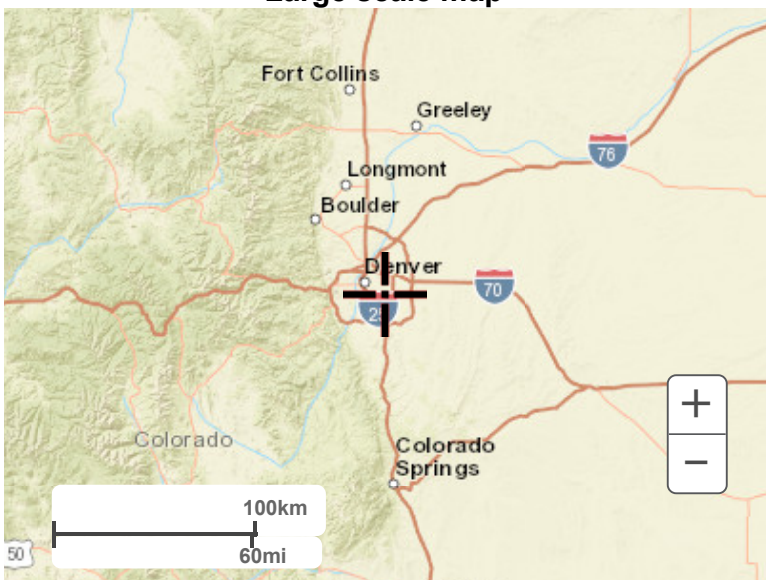
Maps & aerials

Small scale terrain

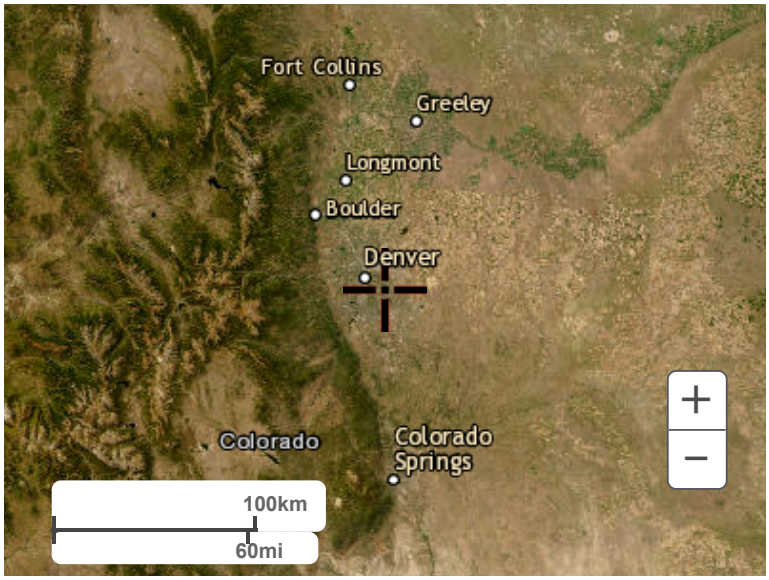


Large scale terrain

Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jun 8 2023

Stampede Pond Inlet (Channel 1) 100 Year

User-defined

Invert Elev (ft)	= 5561.96
Slope (%)	= 0.60
N-Value	= 0.012

Calculations

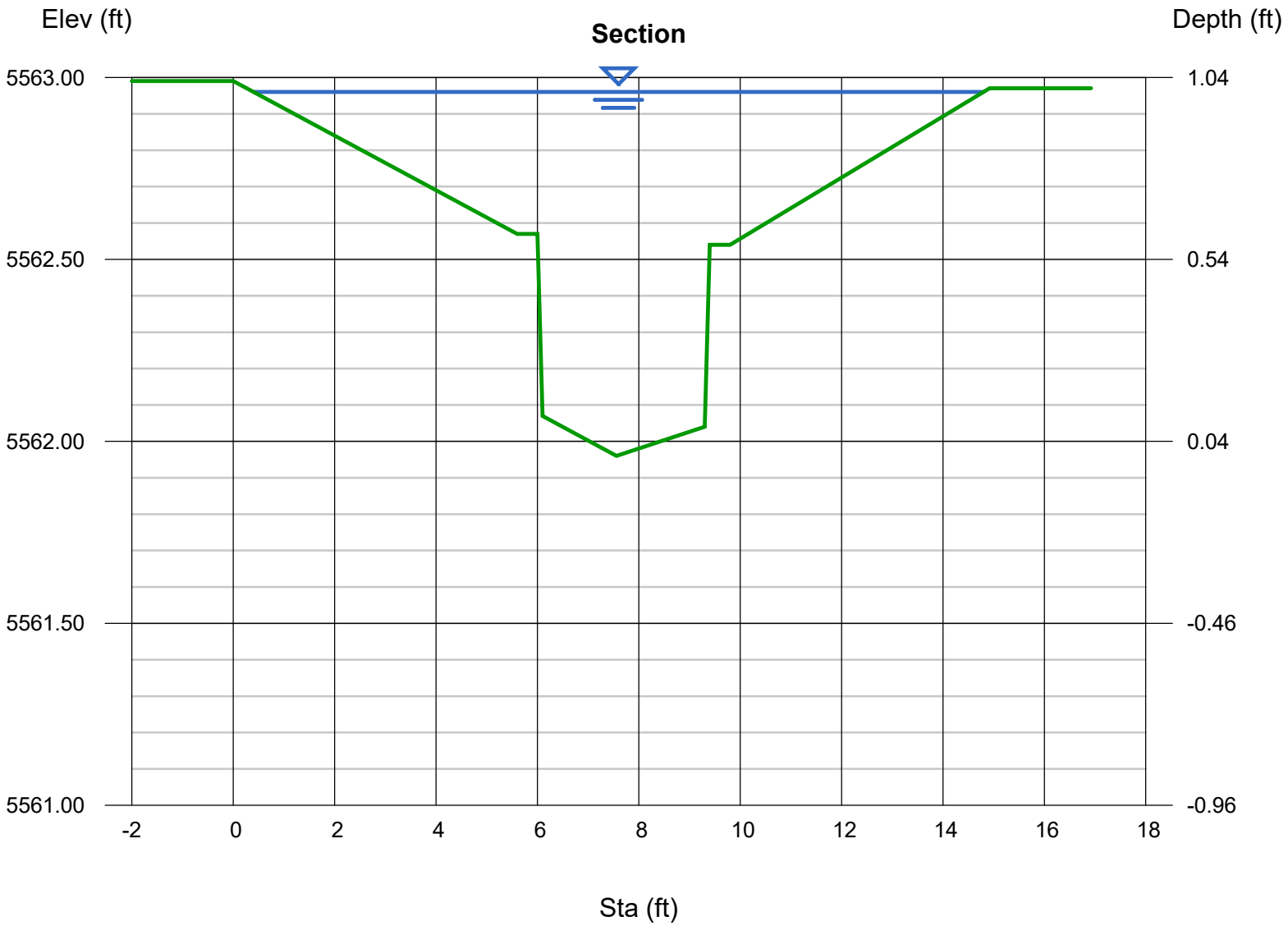
Compute by:	Known Q
Known Q (cfs)	= 26.65

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 26.65
Area (sqft)	= 5.57
Velocity (ft/s)	= 4.79
Wetted Perim (ft)	= 15.25
Crit Depth, Yc (ft)	= 1.03
Top Width (ft)	= 14.39
EGL (ft)	= 1.36

(Sta, El, n)-(Sta, El, n)...

(0.00, 5562.99)-(5.60, 5562.57, 0.012)-(6.00, 5562.57, 0.012)-(6.10, 5562.07, 0.012)-(7.56, 5561.96, 0.012)-(9.30, 5562.04, 0.012)-(9.40, 5562.54, 0.012)-(9.80, 5562.54, 0.012)-(14.92, 5562.97, 0.012)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Aug 31 2023

Stampede Overflow Weir - Channel 2

User-defined

Invert Elev (ft)	= 5561.86
Slope (%)	= 0.25
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.71

Highlighted

Depth (ft)	= 0.14
Q (cfs)	= 2.710
Area (sqft)	= 1.67
Velocity (ft/s)	= 1.63
Wetted Perim (ft)	= 12.40
Crit Depth, Yc (ft)	= 0.12
Top Width (ft)	= 12.35
EGL (ft)	= 0.18

(Sta, El, n)-(Sta, El, n)...

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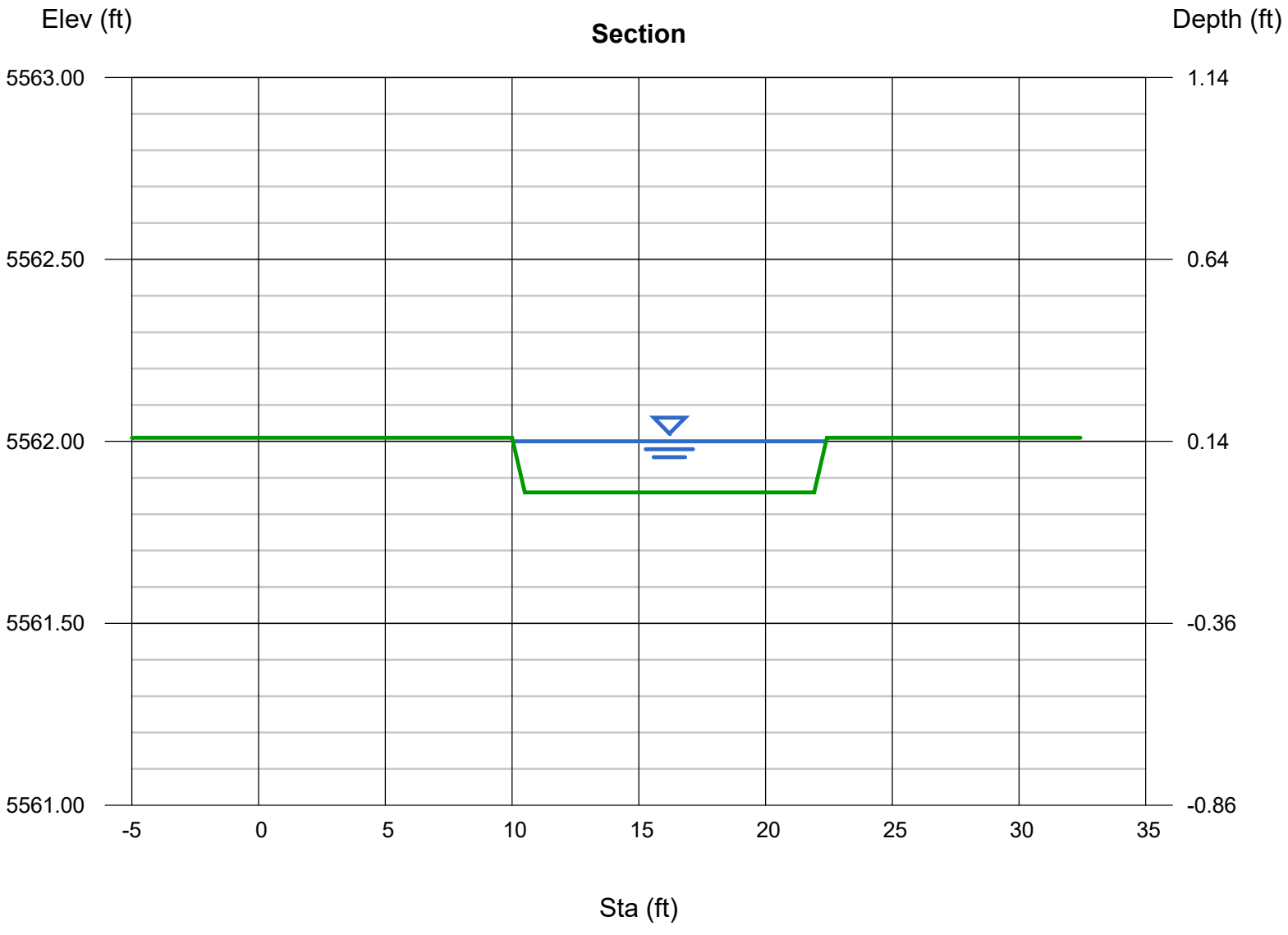


Appendix F

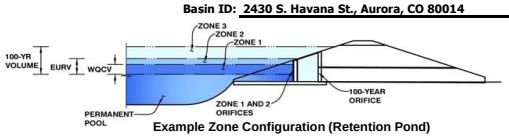
MHFD Detention

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Stampede Minor Site Amendment [18-224] EXISITNG CONDITIONS**

Basin ID: **2430 S. Havana St., Aurora, CO 80014**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	7.33	acres
Watershed Length =	1,116	ft
Watershed Length to Centroid =	558	ft
Watershed Slope =	0.016	ft/ft
Watershed Imperviousness =	82.36%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.210	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.800	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.95 in.) =	0.440	acre-feet	0.95 inches
5-yr Runoff Volume (P1 = 1.35 in.) =	0.652	acre-feet	1.35 inches
10-yr Runoff Volume (P1 = 1.55 in.) =	0.759	acre-feet	1.55 inches
25-yr Runoff Volume (P1 = 2 in.) =	1.022	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.172	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.6 in.) =	1.394	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.730	acre-feet	inches
Approximate 2-yr Detention Volume =	0.420	acre-feet	
Approximate 5-yr Detention Volume =	0.615	acre-feet	
Approximate 10-yr Detention Volume =	0.722	acre-feet	
Approximate 25-yr Detention Volume =	0.966	acre-feet	
Approximate 50-yr Detention Volume =	1.054	acre-feet	
Approximate 100-yr Detention Volume =	1.170	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.210	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.590	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.370	acre-feet
Total Detention Basin Volume =	1.170	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

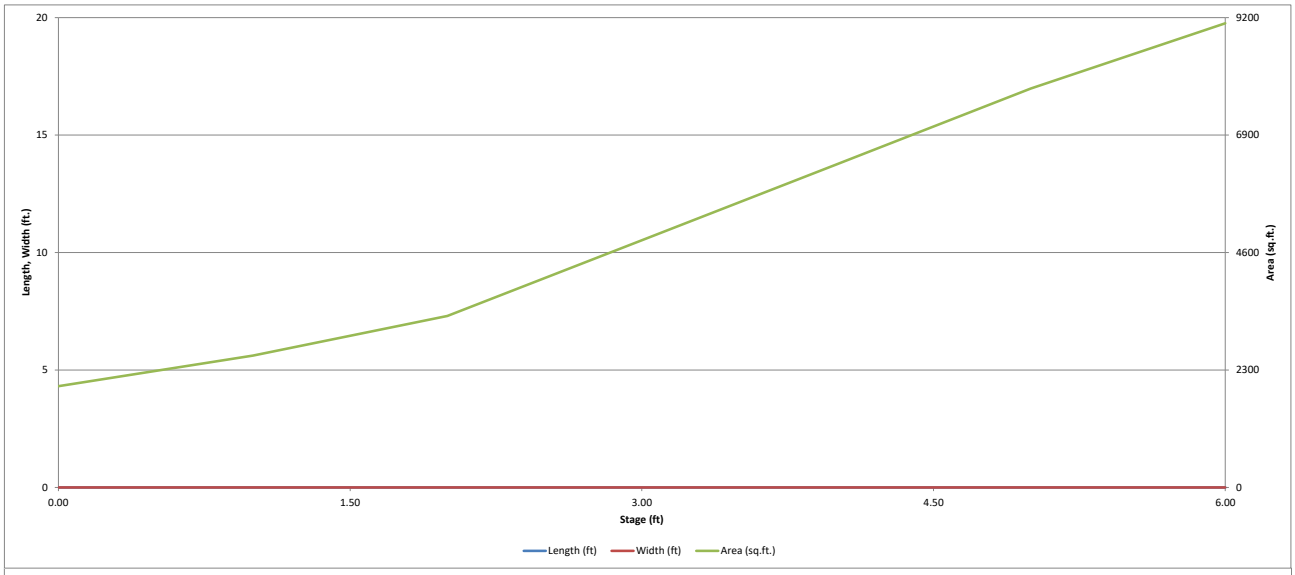
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

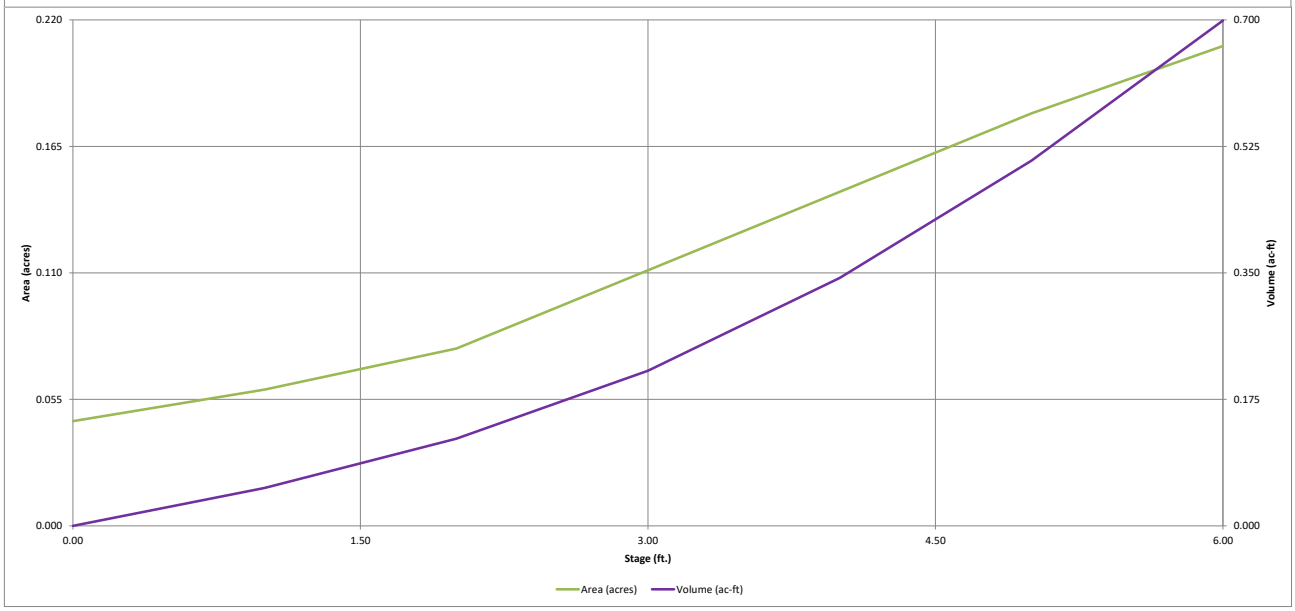
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	1,983	0.046		
	--	1.00	--	--	--	2,582	0.059	2,283	0.052
	--	2.00	--	--	--	3,358	0.077	5,253	0.121
	--	3.00	--	--	--	4,841	0.111	9,352	0.215
	--	4.00	--	--	--	6,325	0.145	14,935	0.343
	--	5.00	--	--	--	7,812	0.179	22,003	0.505
	--	6.00	--	--	--	9,089	0.209	30,453	0.699

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



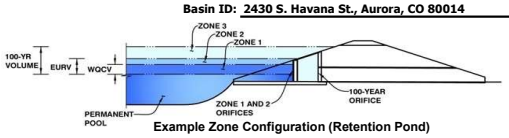


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Stampede Minor Site Amendment [18-224]**

Basin ID: **2430 S. Havana St., Aurora, CO 80014**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	7.32	acres
Watershed Length =	1,116	ft
Watershed Length to Centroid =	558	ft
Watershed Slope =	0.016	ft/ft
Watershed Imperviousness =	85.90%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.225	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.844	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.86 in.) =	0.413	acre-feet	0.86	inches
5-yr Runoff Volume (P1 = 1.12 in.) =	0.554	acre-feet	1.12	inches
10-yr Runoff Volume (P1 = 1.36 in.) =	0.688	acre-feet	1.36	inches
25-yr Runoff Volume (P1 = 1.72 in.) =	0.896	acre-feet	1.72	inches
50-yr Runoff Volume (P1 = 2.03 in.) =	1.082	acre-feet	2.03	inches
100-yr Runoff Volume (P1 = 2.35 in.) =	1.285	acre-feet	2.35	inches
500-yr Runoff Volume (P1 = 2.71 in.) =	1.508	acre-feet	2.71	inches
Approximate 2-yr Detention Volume =	0.402	acre-feet		
Approximate 5-yr Detention Volume =	0.538	acre-feet		
Approximate 10-yr Detention Volume =	0.667	acre-feet		
Approximate 25-yr Detention Volume =	0.872	acre-feet		
Approximate 50-yr Detention Volume =	0.997	acre-feet		
Approximate 100-yr Detention Volume =	1.106	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.225	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.619	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.263	acre-feet
Total Detention Basin Volume =	1.106	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

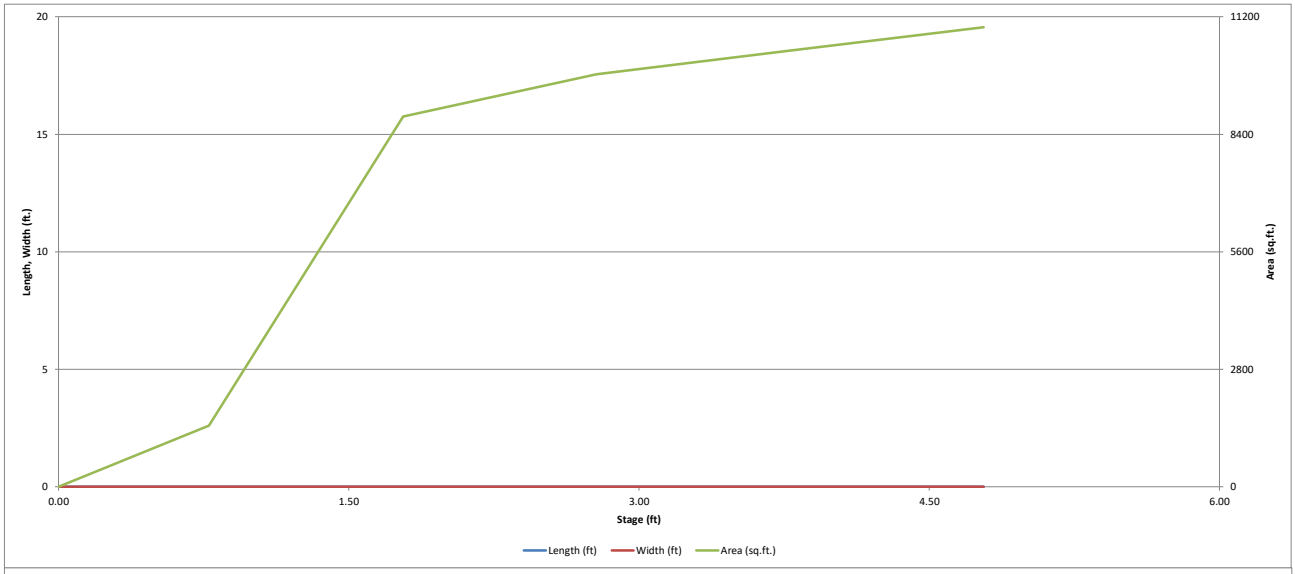
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user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

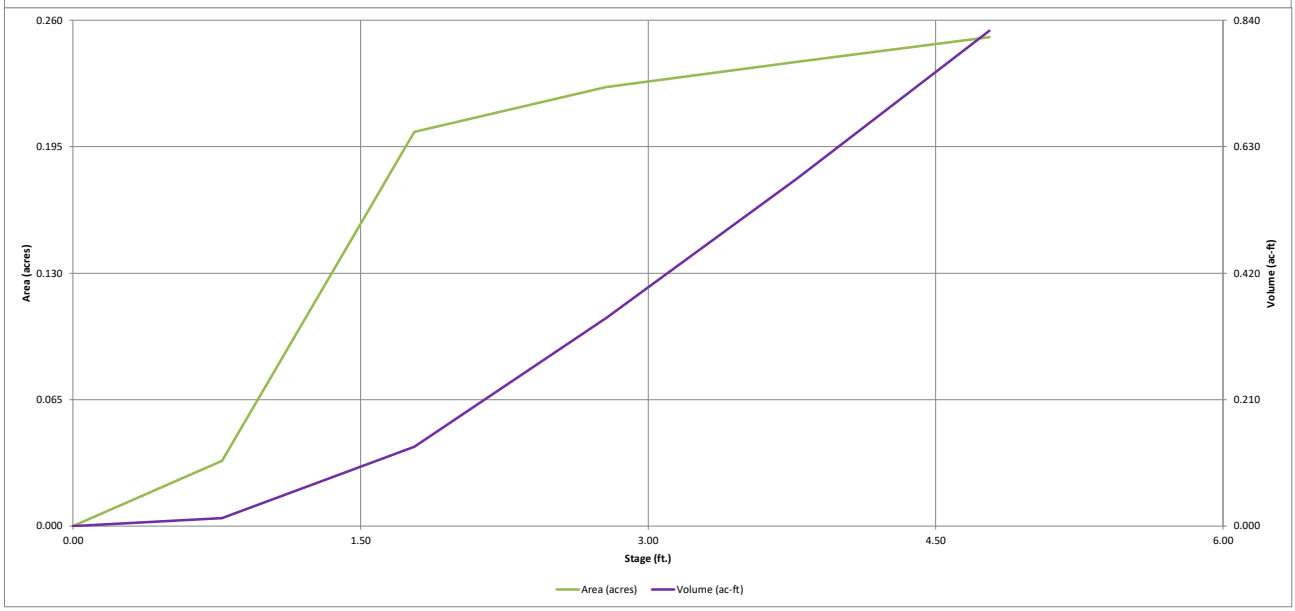
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	1	0.000		
5558	--	0.78	--	--	--	1,463	0.034	559	0.013
5559	--	1.78	--	--	--	8,824	0.203	5,728	0.131
5560	--	2.78	--	--	--	9,828	0.226	15,054	0.346
5561	--	3.78	--	--	--	10,395	0.239	25,165	0.578
5562	--	4.78	--	--	--	10,948	0.251	35,837	0.823

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



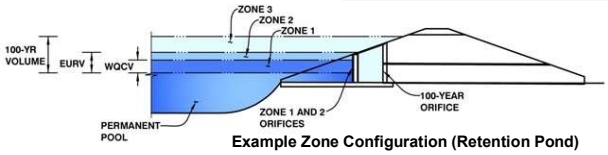


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Stampede Minor Site Amendment [18-224]**

Basin ID: **2430 S. Havana St., Aurora, CO 80014**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.23	0.225	Orifice Plate
Zone 2 (EURV)	#VALUE!	0.619	Rectangular Orifice
Zone 3 (100-year)	#VALUE!	0.263	Weir&Pipe (Circular)
Total (all zones)		1.106	

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.111E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.24	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.80	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.88	sq. inches (diameter = 1-1/16 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	0.70	1.40	2.10				
Orifice Area (sq. inches)	0.88	0.88	0.88	0.88				

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.24	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.67	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	4.61	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.25	N/A	feet
Vertical Orifice Height =	6.00	N/A	inches				
Vertical Orifice Width =	16.00		inches				

Calculated Parameters for Vertical Orifice

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			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.62	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.12	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	2.55	N/A	feet
Overflow Weir Grate Slope =	5.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	2.26	N/A	
Horiz. Length of Weir Sides =	2.50	N/A	feet	Overflow Grate Open Area w/o Debris =	7.10	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.55	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Circular	Not Selected			Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.14	N/A	ft^2
Circular Orifice Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	1.00	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.65	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.68	feet
Spillway Crest Length =	11.50	feet	Stage at Top of Freeboard =	5.46	feet
Spillway End Slopes =	0.00	H:V	Basin Area at Top of Freeboard =	0.25	acres
Freeboard above Max Water Surface =	0.13	feet	Basin Volume at Top of Freeboard =	0.82	acre-ft

Calculated Parameters for Spillway

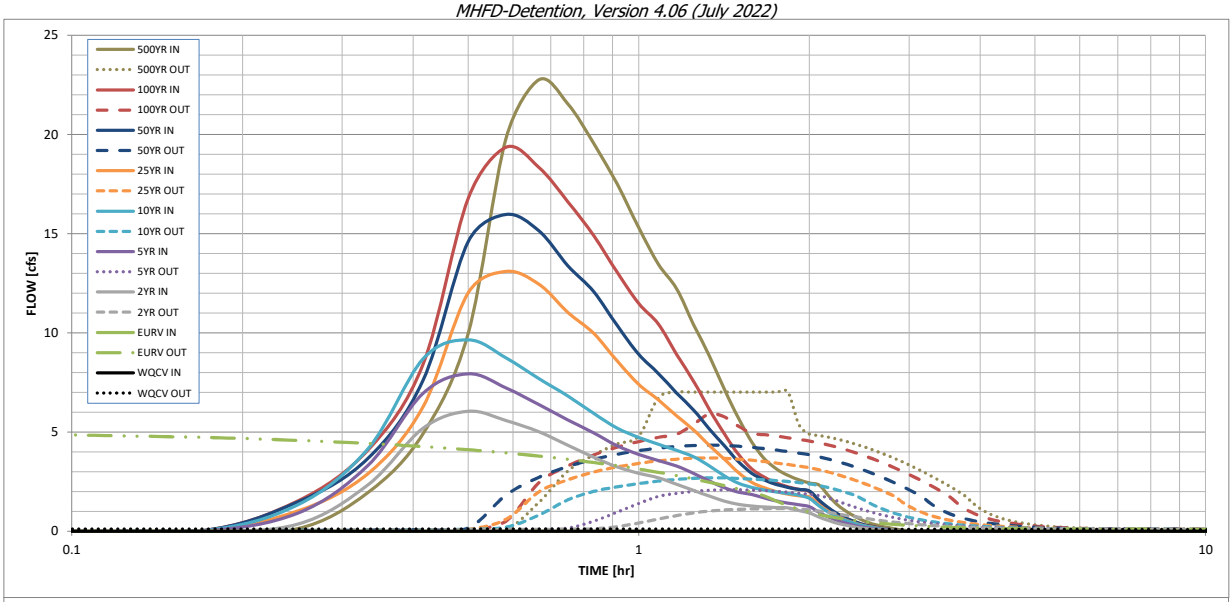
Routed Hydrograph Results

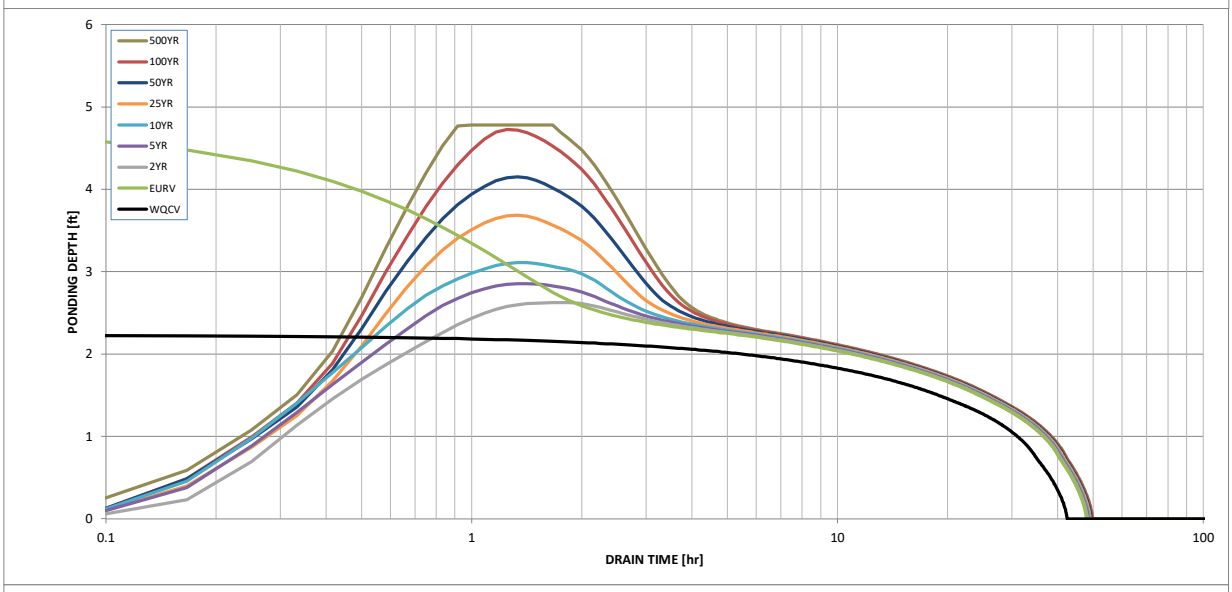
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

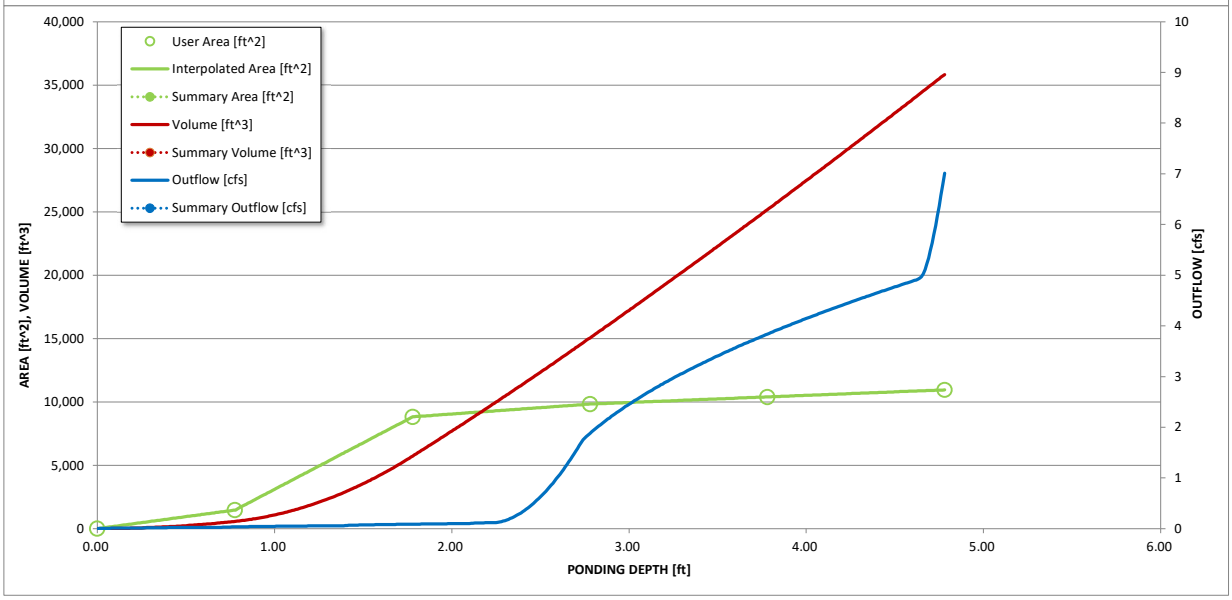
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.86	1.12	1.36	1.72	2.03	2.35	2.71
CUHP Runoff Volume (acre-ft) =	0.225	0.844	0.413	0.554	0.688	0.896	1.082	1.285	1.508
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.413	0.554	0.688	0.896	1.082	1.285	1.508
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.1	0.1	1.1	2.5	4.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						8.8	
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.00	0.01	0.02	0.15	1.20	0.55
Peak Inflow Q (cfs) =	N/A	N/A	6.1	7.9	9.7	13.1	16.0	19.4	22.8
Peak Outflow Q (cfs) =	0.1	6.8	1.1	2.1	2.7	3.7	4.3	5.9	7.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	90.2	52.8	29.4	4.0	0.7	1.7
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Spillway	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	37	41	39	39	37	36	35	34
Time to Drain 99% of Inflow Volume (hours) =	**40**	42	45	44	44	43	42	42	41
Maximum Ponding Depth (ft) =	2.24	4.61	2.63	2.86	3.11	3.68	4.15	4.73	4.78
Area at Maximum Ponding Depth (acres) =	0.21	0.25	0.22	0.23	0.23	0.24	0.24	0.25	0.25
Maximum Volume Stored (acre-ft) =	0.227	0.780	0.310	0.361	0.421	0.554	0.667	0.808	0.823

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	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	0.00	0.00	0.13
	0:15:00	0.00	0.00	0.35	0.91	1.32	1.02	1.48	1.52	1.97
	0:20:00	0.00	0.00	2.35	3.34	4.18	2.93	3.69	4.12	4.92
	0:25:00	0.00	0.00	5.19	6.96	8.69	6.27	7.61	8.43	9.97
	0:30:00	0.00	0.00	6.06	7.94	9.65	12.01	14.59	16.78	19.79
	0:35:00	0.00	0.00	5.59	7.23	8.74	13.10	15.97	19.35	22.75
	0:40:00	0.00	0.00	5.01	6.38	7.70	12.45	15.14	18.34	21.55
	0:45:00	0.00	0.00	4.34	5.62	6.82	11.04	13.39	16.62	19.53
	0:50:00	0.00	0.00	3.73	4.96	5.94	9.97	12.07	14.90	17.50
	0:55:00	0.00	0.00	3.25	4.31	5.20	8.58	10.37	13.05	15.31
	1:00:00	0.00	0.00	2.93	3.88	4.73	7.41	8.93	11.49	13.46
	1:05:00	0.00	0.00	2.70	3.57	4.39	6.62	7.96	10.45	12.23
	1:10:00	0.00	0.00	2.37	3.29	4.08	5.82	6.98	8.92	10.42
	1:15:00	0.00	0.00	2.06	2.92	3.76	5.11	6.11	7.57	8.83
	1:20:00	0.00	0.00	1.77	2.53	3.30	4.32	5.15	6.13	7.14
	1:25:00	0.00	0.00	1.53	2.20	2.79	3.63	4.32	4.90	5.70
	1:30:00	0.00	0.00	1.36	1.97	2.42	2.95	3.50	3.88	4.50
	1:35:00	0.00	0.00	1.27	1.86	2.22	2.47	2.93	3.15	3.65
	1:40:00	0.00	0.00	1.23	1.67	2.08	2.19	2.59	2.72	3.15
	1:45:00	0.00	0.00	1.20	1.53	1.98	2.00	2.36	2.44	2.82
	1:50:00	0.00	0.00	1.19	1.42	1.91	1.88	2.21	2.25	2.60
	1:55:00	0.00	0.00	1.04	1.34	1.82	1.79	2.11	2.11	2.43
	2:00:00	0.00	0.00	0.92	1.25	1.66	1.73	2.04	2.01	2.32
	2:05:00	0.00	0.00	0.71	0.95	1.27	1.32	1.56	1.52	1.75
	2:10:00	0.00	0.00	0.53	0.71	0.94	0.98	1.16	1.13	1.30
	2:15:00	0.00	0.00	0.40	0.53	0.70	0.73	0.86	0.84	0.97
	2:20:00	0.00	0.00	0.29	0.39	0.52	0.54	0.64	0.63	0.72
	2:25:00	0.00	0.00	0.21	0.28	0.38	0.39	0.46	0.46	0.53
	2:30:00	0.00	0.00	0.15	0.20	0.27	0.28	0.33	0.33	0.38
	2:35:00	0.00	0.00	0.11	0.14	0.19	0.21	0.24	0.24	0.28
	2:40:00	0.00	0.00	0.07	0.10	0.13	0.14	0.17	0.17	0.19
	2:45:00	0.00	0.00	0.04	0.06	0.08	0.09	0.11	0.11	0.12
	2:50:00	0.00	0.00	0.02	0.03	0.04	0.05	0.06	0.06	0.07
	2:55:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.03
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

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

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