PRELIMINARY DRAINAGE REPORT

FOR

Aurora Centretech Park Filing No. 3 and a Portion of Aurora Community College Filing No. 1

COMMUNITY COLLEGE OF AURORA CENTER FOR STEM

OWNER: COMMUNITY COLLEGE OF
AURORA
710 ALTON WAY
DENVER, CO 80230

ENGINEER: JVA, INC.
1319 SPRUCE ST
BOULDER, CO 80302
ATTN. WYATT DUBOIS (303)-565-4962

July 26, 2023

Approved For One Year From This Date

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City Engineer	**Date**
Water Department	**Date**

NOTE: APPROVAL OF THIS PDR IS REQUIRED PRIOR TO CIVIL PLAN APPROVAL

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July 26, 2023

George Slovensky
City of Aurora
15151 East Alameda Parkway
Aurora, CO 80012

RE: Aurora Centretech Park Subdivision Filing No. 3 and a portion of Aurora Community College Filing No. 1
CCA Center for STEM
Preliminary Drainage Report
JVA No. 3681c

The following Preliminary Drainage Report and attached drainage map have been prepared for the Community College of Aurora (CCA) Center for STEM in the City of Aurora, CO. The drainage report and drainage map have been produced in accordance with the City of Aurora Storm Drainage Design and Technical Criteria, Aurora Roadway Specifications, and the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual (USDCM), and comply with provisions thereof.

It is our understanding that the information provided herein meets all requirements of the City of Aurora's drainage criteria.

Please contact us if you have any questions regarding this submission.

Sincerely,

JVA, Inc.

Anthony M. Perez, P.E.
Project Engineer

Engineer's Statement:

"I hereby certify that this report and the enclosed plan for the preliminary drainage design of the Aurora Centretech Park Filing No. 3 and a portion of Aurora Community College Filing No. 1 **(**CCA Center for STEM) project were prepared under my direct supervision in accordance with the provisions of the City of Aurora Storm Drainage Design and Technical Criteria and the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual (USDCM) and supplemental City of Aurora requirements for the owners thereof. I understand that the City of Aurora does not and shall not assume liability for drainage facilities designed by others."

Signature:

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Kevin A. Tone, P.E.
Registered Professional Engineer
State of Colorado No. 28699

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A. INTRODUCTION

1. LOCATION

a. The subject property, a portion of Lot 2, Block 1, Aurora Community College Subdivision Filing No. 1, and all of Lot 1, Aurora Centretech Park Subdivision Filing No. 3, totaling approximately 16.66 acres of land is located in the south half of section 8, Township 4 South, Range 66 West of the 6th P.M., City of aurora, County of Arapahoe, State of Colorado. The site is bound by East Centretech Parkway to the northeast, East 1st Avenue to the northwest, South Memphis Street to the southeast, and by the Highline Canal to the southwest.

b. Vicinity Map (image is from Google Earth and is not to scale).

c. Surrounding developments include Aurora Community College Subdivision Filing No. 1 to the northwest, Aurora Centretech Parkway Filing No. 19 to the northeast, and Paytheon Subdivision Filing No. 1 to the southeast.

2. PROPOSED DEVELOPMENT

a. The Western portion of the fsite is currently developed with an existing educational facility. The existing eastern portion of the site proposed for development (6-acres) is approximately 2.0% impervious. Native soils found onsite are classified by the Natural Resource Conservation Service (NRCS) as Renohill-Buick Loams with a Hydrologic Soil Group rating of “C/D”. A copy of the NRCS soils classification map is included in the appendix. The site contains 3% to 9% slopes draining generally to the south and east.

b. The project proposes the construction of a new school building (total roof area approximately 1.33 acres), concrete drives, gravel maintenance path, concrete flatwork, utility and storm infrastructure, storm drainage system, and water quality pond and has a developed composite imperviousness of 44.7%. The site’s proposed private storm drainage system will convey drainage to existing storm infrastructure which outfalls at

East Tollgate Creek via an existing 30" public storm pipe located at the southwest corner of the site. The proposed addition and site improvements will disturb approximately 6.24 acres within the property.

The development site has been designed to conform to general drainage characteristics as described in the City of Aurora Storm Drainage Design and Technical Criteria, Aurora Roadway Specifications, Preliminary Drainage Report for Community College of Aurora, Aurora Centretech Park Subdivision Filings 2 and 9, Alamosa Subdivision Filing No. 1 (henceforth referred to as "the 1990 Community College of Aurora PDR") (Job No. 900078), and the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual (USDCM). The site will convey drainage into the existing storm system which outfalls at E Tollgate Creek south of the site.

A city of Aurora Inspection and Maintenance plan will be submitted for review with the Civil Engineering Plans. A drainage easement will be dedicated for the area that encompasses the water quality pond and the associated access path.

c. The following variances are being requested for this project:

    a. Storm runoff from the site is historically discharged directly into either the Highline Canal or into E Tollgate Creek which is a major improved drainageway. According to the 1990 Community College of Aurora PDR (EDN 90078), which analyzed the future buildout of the area including this proposed project site, runoff from the developed site would be sent either to a 30" RCP pipe at the site's southwest corner or to an existing storm manhole at the site's southeast corner near South Memphis Street. Both of these existing storm systems ultimately outfall to E Tollgate Creek. The capacities of both pipes have been analyzed to determine that their capacities would be sufficient to accept flows from this project with no adverse impacts to downstream facilities. Please see the Historic Drainage and Design Criteria sections of the report for analyses of existing drainage facilities. Per section 3.64 of the City of Aurora Storm Drainage Design and Technical criteria, an exemption from detention may be granted if storm runoff is discharged directly into an improved major drainageway. Treatment will only be provided for stormwater quality/EURV.
    b. A variance is requested to use rainfall data from the NOAA Atlas 14 with Rational Method runoff calculations.

B. HISTORIC DRAINAGE

3. OVERALL BASIN DESCRIPTION

a. Runoff from the majority of the site generally988888888/.sheet flows from north to south. Runoff from the existing developed portions of the site bypasses the Highline Canal via an existing public 30” RCP pipe which outfalls to East Tollgate Creek. Runoff from undeveloped portions of the site sheet flow to the south and are intercepted by the Highline Canal. Offsite runoff from the north is intercepted by the existing East Centretech Parkway curb and gutter and is conveyed east into the existing drainage pan and into the existing public storm system which outfalls at East tollgate Creek. Flows from the parking lot to the west are conveyed via sheet flow into two curb cuts which outfall to the existing water quality pond directly southwest of the existing parking lot. The existing pond provides water quality for the eastern portion of the parking lot and releases flows through an outlet structure. These flows are conveyed via an 18” RCP pipe to the existing public 30” RCP pipe which passes beneath the Highline Canal and outfalls at East Tollgate Creek. Runoff from a small eastern portion of the site sheet flow into the existing curb and gutter of South Memphis Street and are conveyed to the existing storm sewer system within South Memphis Street which outfalls at East Tollgate Creek.

b. East Tollgate Creek and the Highline Canal are adjacent to the site to the south. FEMA flood insurance rate map number 08005C0181L dated September 04, 2020, locates the development site in zone X, or an area of minimal flood hazard with 0.2% Annual Chance Flood Hazard. A copy of the referenced flood map is included in the appendix.

4. DRAINAGE PATTERNS THROUGH PROPERTY

a. Historic flows within the project area generally sheet flow from north to south. An existing water quality pond is located south of the parking lot near the west property line. The pond treats runoff from the eastern portion of the parking lot which is located on the project site. The pond releases runoff via an 18” RCP pipe to an existing storm system which conveys both this runoff and runoff from the remainder of the developed portion of the site to East Tollgate Creek. The majority of the undeveloped site’s runoff flows south overland and is intercepted by the Highline Canal. A small portion of the site to the east is captured by the existing public storm system within South Memphis Street which also outfalls to E Tollgate Creek.

5. OUTFALLS DOWNSTREAM FROM THE PROPERTY

a. All flows from the property outfall to either E Tollgate Creek or to the Highline Canal. The main outfall for the site is a 30” RCP pipe which conveys flows to E tollgate creek. Per the Master Plan and Master Drainage Report for the site, this pipe was sized with the capacity to convey flows from the fully developed site with future parking lot and building expansions. Please see the following section of the report for references and further analysis of the existing 30” RCP pipe.

C. DESIGN CRITERIA

1. LIST OF REFERENCES

a. The 1990 Community College of Aurora PDR (900078) includes pertinent information regarding the site's historic drainage patterns and the future drainage patterns of the developed site.

The basins from the referenced PDR (C and H)(EDN 900078) which correlate to the western portion of this project's site are routed to the existing storm system which outfalls to E Tollgate Creek via a 30" RCP pipe.

"*Runoff from Basin H (Q100 = 10.8 cfs) will flow to a proposed inlet in sump by means of grassed swales. This flow will be combined with flows from Basins B, C, and G (total Q100 = 42.3 cfs) and will be piped south under the highline canal and discharge directly into Tollgate Creek"*

The calculations contained in this report show that all downstream pipes which convey drainage from this site were sized sufficiently to provide capacity for future buildout conditions. Please see the attached 1990 Community College of Aurora PDR (EDN 900078). Specifically, the 30" RCP pipe to E Tollgate Creek is able to accept 64.8 cfs, while the 100-yr design flow to the pipe for the Master Plan site condition is 42.3 cfs. This leaves an approximate remaining usable capacity of 22.3 cfs. Please see the attached calculation sheets 23 and 27 as well as the attached Preliminary Master Drainage pan which delineates future basins and details flowrates to the 30" RCP pipe.

The basins from the referenced PDR (D, E, L, and M)(EDN 900078) which correlate to the central and eastern portion of this project's site either flow offsite or are routed to the existing storm system in South Memphis Street which ultimately outfalls to E Tollgate Creek.

"*The 100-year runoff from Basins D and E (19.4 cfs and 10.9cfs, respectively) flows southeast to proposed inlets and then into pipes which connect to the existing 48-inc/60-inch storm line east of the site"*

"The 100-year runoff from Basin L (1.6 cfs) will flow south to the existing sump area of the relocated Highline Canal and will then flow by grassed swale to a proposed inlet. It will then be piped to the existing manhole east of the site. The runoff from basin M (!100 = 0.4cfs) will flow off-site to the east along an existing asphalt roadway".

The general drainage concept was designed to direct runoff to East Tollgate Creek. The drainage design detailed in this report is based on an exemption from detention due to the site's proximity to East Tollgate Creek.

"An exemption from on-site drainage is being requested due to the close proximity of the site to Tollgate Creek, a major drainage channel"

The Final Drainage Report for the Community College of Aurora Phase I, Aurora Community College Subdivision, Filing No. 1 (EDN 900115) details plans and calculations for the initial campus infrastructure. These calculations show a design flow of 48.9 cfs to the 30" RCP pipe. This is 6.6 cfs higher than was estimated in the Master Plan drainage calculations, but based on the initial calculated capacity of 64.8 cfs, leaves 15.9 cfs of flow capacity remaining. Please see the attached sheet 3/10 (EDN 900115) and the attached Storm Drainage System Design (dated 07-24-90 – EDN 900115) which show the storm design conveying flows to the 30" RCP pipe as well as the above referenced calculations.

The drainage design for this project is intended to match historic drainage conditions and patterns and, more specifically, the proposed water quality facility is designed to maintain the function of the existing facility. The design of the existing on-site water quality facility is detailed 2009 Final Drainage Report (EDN 209046).

"Site runoff will be conveyed as surface flow…to a landscape swale. The swale will convey runoff to a PLD (Porous Landscape Detention area) *. The PLD will discharge through an outlet structure and proposed outfall pipe to the existing underground storm sewer system previously described. Runoff in excess of the PLD volume will be conveyed undetained through the outlet structure and outfall pipe to the existing underground storm sewer system. An emergency overflow is designed as a part of the PLD in case the outlet structure or outfall pipe fails to perform as designed"*

As is demonstrated by the proposed site's grading and calculations, the site and drainage features have been designed to uphold the drainage conditions to which the existing facilities were designed.

The Civil Plans for The Community College of Aurora Fine Arts Building Expansion (EDN 200079) show the drainage concept for an approximate 7,700 SF building expansion and grading of the surrounding site. A majority of the site flows offsite to the northwest, and the impervious roof area and a portion of the landscaping to the west of the building is piped to what appears to be a landscaped water quality area with a 6" underdrain. This underdrain is connected to a storm system which eventually connects to the 30" RCP pipe which outfalls to E Tollgate Creek. A Final Drainage Report for the fine arts building expansion was not found on the City of Aurora website, but it is assumed that flows to the 30" RCP pipe from this project do not exceed the remaining pipe capacity between the pipe's 68.4 cfs capacity and the 48.9 cfs which was calculated with the Final Drainage Report (EDN 900115) for the initial campus infrastructure.

Both the 1990 and the 2009 Final Drainage Reports (EDN 900115 and EDN 209046 respectively) state that detention is not required due to direct discharge to E Tollgate Creek.

Based on the information provided in the reports, it is understood that the proposed site is complying with the Master Drainage Report of the subdivision by the proposed drainage characteristics not exceeding these assumed parameters. Acknowledging the presented analyses of the existing drainage facilities and respective flow calculations, it is our understanding that the drainage design of this proposed project does not exceed the design parameters of the 30" RCP pipe which conveys flows to E Tollgate Creek.

b. The proposed private storm drainage facilities for the project are designed to comply with the City of Aurora Storm Drainage Design and Technical Criteria and the Mile High Flood District Urban Storm Drainage Criteria Manual (USDCM).

c. There are no City Master Plan or floodplain studies for this site.

2. HYDROLOGIC CRITERIA

a. Rainfall source and P_1 is based on the USDCM criteria manual.
b. The Rational Method (Q=CIA) was used to determine the storm runoff (Q) from the areas tributary to the proposed storm system, with composite runoff coefficients (C) and contributing areas (A) given for design points in sub-basins. Intensity (I) for the various storm events was determined using point rainfall figures from the NOAA Atlas 14 and runoff coefficients for various land usages were obtained from the latest USDCM prescribed methodology. A variance is requested to use the NOAA Rainfall data. Basin coefficients, and other calculated site characteristics are shown in the appendix.
c. Water quality is provided on site in the southwest corner. The MHFD Detention v4.04 spreadsheet was used to calculate the required Excess Urban Runoff Volume (EURV). The EURV was calculated using the total site area plus the offsite area that drains onto the project site to prevent the wash through of pollutants. Excess Urban Runoff Volume is also included due to disturbance exceeding 5 acres. The proposed water quality/EURV pond for this project has been designed to account for the volume of the existing water quality pond.
d. Design frequencies are per Aurora Storm Criteria for residential, business, and industrial facility. The minor storm is the 2-year event and the major storm is the 100-year event

3. HYDRAULIC CRITERIA

a. Reference sources include the USDCM and the City of Aurora Storm Drainage Design and Technical Criteria.

b. Public and private pipes and inlets have been designed for the 2-year minor storm event and the 100-year storm event. Please refer to inlet calculations provided in the appendix for sizing and ponding depth calculations. All 100-yr ponding WSE's are greater than 1' below the building FFE.
c. Water surface profiles and pipe hydraulic grade line computations will be included in the Final Drainage Report and will be performed using Autodesk Storm Sewers software, version year 2022.
d. The East Tollgate Creek and Highline Canal drainageways are located south of the site.

D. DRAINAGE PLAN

1. GENERAL CONCEPT

a. Proposed drainage on site will maintain historic drainage patterns. The majority of flows from the site will be captured and conveyed to E Tollgate Creek with a minor portion of the site historically flowing to the Highline Canal. Onsite drainage will be conveyed via overland flow at both vegetated and paved areas, curb and gutter flow, grassed swales, and the proposed storm infrastructure.
b. Coordination with surrounding developments is not necessary as all work will take place within the site boundaries.
c. The proposed water quality pond has been designed to treat the WQCV/EURV before releasing flows to E Tollgate Creek via the existing storm system to the west pond. The proposed water quality/EURV pond for this project has been designed to account for the volume of the existing water quality pond. The Community College of Aurora will work with the City of Aurora to develop an inspection and maintenance agreement which will be submitted with the Civil Engineering Plans. A drainage easement will be dedicated for the area that encompasses the water quality pond and is accessible via the existing fire access path and a proposed pond access path at the west side of the proposed pond.

2. SPECIFIC DETAILS

a. The developed site has been analyzed and divided into two major Basins (P, and OS) and their respective sub-basins as described below.

   The majority of the site lies within Basin P which consists of all areas tributary to and including the water quality pond.

   Sub-Basin P1 is a portion of the existing parking lot to the northwest of the proposed improvements. The area consists of asphalt pavement, concrete curb and gutter, and landscaping islands. Runoff from this area is conveyed via overland/sheet flow and curb and gutter flow to a curb cut which drains to a sidewalk chase at Design Point 1. The sidewalk chase channelizes drainage from the parking lot to a rip rap rundown into the water quality pond to the south.

   Sub-Basin P2 is the portion of the site to the north of the proposed building and consists of concrete walk and drive, concrete curb and gutter, and vegetated area. Much of the basin is native vegetation which will remain undisturbed with the proposed development. Runoff from this area is conveyed via sheet flow and curb and gutter flow to a double combination inlet at Design Point 2 which conveys flows to the water quality pond via a storm pipe.

   Sub-Basin P3 consists of the proposed building’s roof area. Roof flows will sheet flow directly from the roof (Design Point 3) to the south where a grassed swale will intercept and convey runoff to the water quality pond.

Sub-Basin P4 is the portion of the site to the south and west of the proposed building. The area consists of landscaping, concrete walks, the water quality pond, and gravel access path. Runoff from this area is conveyed to the water quality pond and outlet structure at Design Point 4 via overland sheet flow or via the grassed swale running from east to west. The outlet structure is connected to the existing 30” RCP pipe which outfalls at East Tollgate Creek.

b. Offsite runoff was analyzed and divided into three sub-basins as described below.

Sub-Basin OS-1 is formed by the public ROW of East Centretech Parkway and consists of asphalt paving, concrete sidewalks and curb and gutter, and landscaping buffers. Runoff from this basin is conveyed via curb and gutter flow to a low point with storm inlets on either side of the street at Design Point 5which are connected to the existing public storm system. The existing storm system ultimately outfalls to E Tollgate Creek.

Sub-Basin OS-2 is formed by the public ROW of Street and consists of asphalt paving, concrete sidewalks and curb and gutter, and landscaping buffers. Runoff from this basin is conveyed via curb and gutter flow from north to south and is ultimately captured by a 2’x2’ inlet (Design Point 6) at the existing parking lot to the south. It is assumed that this inlet is connected to an existing storm system which outfalls to E Tollgate Creek.

Sub-Basin OS-3 is formed by south and west portions of the site and consists of landscaping, gravel drive, concrete walks and plaza areas, existing asphalt pavement, and existing concrete pavement and curb and gutter. Runoff from this area is conveyed via sheet flow to the Highline Canal at Design Point 7.

Sub-Basin OS-4 is formed by a small portion to the south of the site consisting of landscaping and concrete walk which flows offsite to the south at Design Point 8.

c. The proposed water quality pond is located to the west of the proposed building and south of the existing parking lot. The pond is an expansion of the existing water quality pond and has been designed to treat the EURV for the site. Water quality treatment is provided with an outlet structure and orifice plate on the west side of the pond. The outlet structure will release the EURV with a 72 hour drain time and will be connected to the existing 18” RCP pipe utilized by the existing water quality pond. This 18” RCP pipe is connected to the existing storm system which outfalls to East Tollgate Creek via a 30” RCP pipe. According to the 1990 Community College of Aurora PDR, all existing pipes have been oversized to account for future developments and have sufficient capacity to convey flows from this proposed development. Please see the pipe sizing calcs within the attached historic PDR. As noted in the Design Criteria section of the report referencing the 1990 Community College of Aurora PDR (Master Plan), the 30” RCP pipe to E Tollgate Creek is able to accept 64.8 cfs, while the 100-yr design flow to the pipe for the Master Plan site condition is 42.3 cfs, which grants an additional 22.5 cfs of remaining capacity for the WQCV/EURV flows from this project.

d. All inlets and connected pipes have been designed to accept and convey flows from the 100-yr storm event. The inlets have also been designed with elevations providing ample difference between inlet grate elevations and the building's finished floor elevation. The grading surrounding the proposed inlets has been designed to convey any bypassing or surcharging flows away from the building. Please refer to the overall grading plan for the site grading showing inlet locations and overflow paths.

   The water quality pond berm elevation varies but has an elevation of 5456.50' at its highest point, which is 2.0' below the proposed building finished floor. Due to restrictions on releasing emergency overflow runoff into the Highline Canal, the pond has been designed to include and emergency overflow outlet structure on the east side of the pond which is connected to the existing 48" RCP storm system within South Memphis St. The pond and emergency outlet have been designed such that flows from the 100-yr event will not reach overtop the emergency overflow outlet structure and will be released through the outlet structure and 18" RCP pipe.

e. At this time there are no site drainage problems anticipated and the current design is not anticipated to have any negative impacts on downstream facilities.

f. The site has been designed to maximize opportunities for LID (low impact design) and provide sufficient water quality treatment for resultant flows. Water quality will be provided through grass buffers, grassed swales, and through the proposed water quality pond. Impervious areas have been designed such that runoff will flow through adjacent vegetated areas prior to being captured by the site's proposed storm system or to flowing off site. A grassed swale is proposed along the site's southern border which will capture runoff from the site and building to the north and provide additional water quality treatment before outfalling to the water quality pond. The storm system and water quality pond have been designed to capture and treat the EURV for the site in order to minimize untreated offsite flows.

g. Phasing of construction and provisions for drainage during phasing will follow typical best management practices and construction sequencing.

h. Open-channel flows will be provided in onsite curb and gutter and in grassed swales.

i. There are no known existing or proposed roadside ditches which will be affected by this development.

j. This project intends to utilize the existing public 30" East Tollgate Creek storm pipe in adherence to historic drainage patterns and drainage patterns planned for in historic reports.

E. CONCLUSIONS

1. COMPLIANCE WITH STANDARDS

a. The recommendations of this report are in conformance with all applicable storm drainage regulations. Calculations and other reference materials used are attached in the Appendix.

2. Summary of Concept

a. The proposed drainage plan has been designed to treat the WQCV/EURV.

b. The proposed water quality pond, grassed swale, and the overall site have been designed with LID in mind to provide the most effective drainage and stormwater treatment possible.

c. No adverse downstream conditions are anticipated with this project.

3. Advisory Approval Note

a. Please note that approval of this PDR is required prior to Civil Plan Approval.

F. APPENDIX

National Flood Hazard Layer FIRMette

FEMA

104°48'28"W 39°43'18"N

104°47'51"W 39°42'51"N

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

1:6,000

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

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/4/2022 at 12:40 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

United States Department of Agriculture

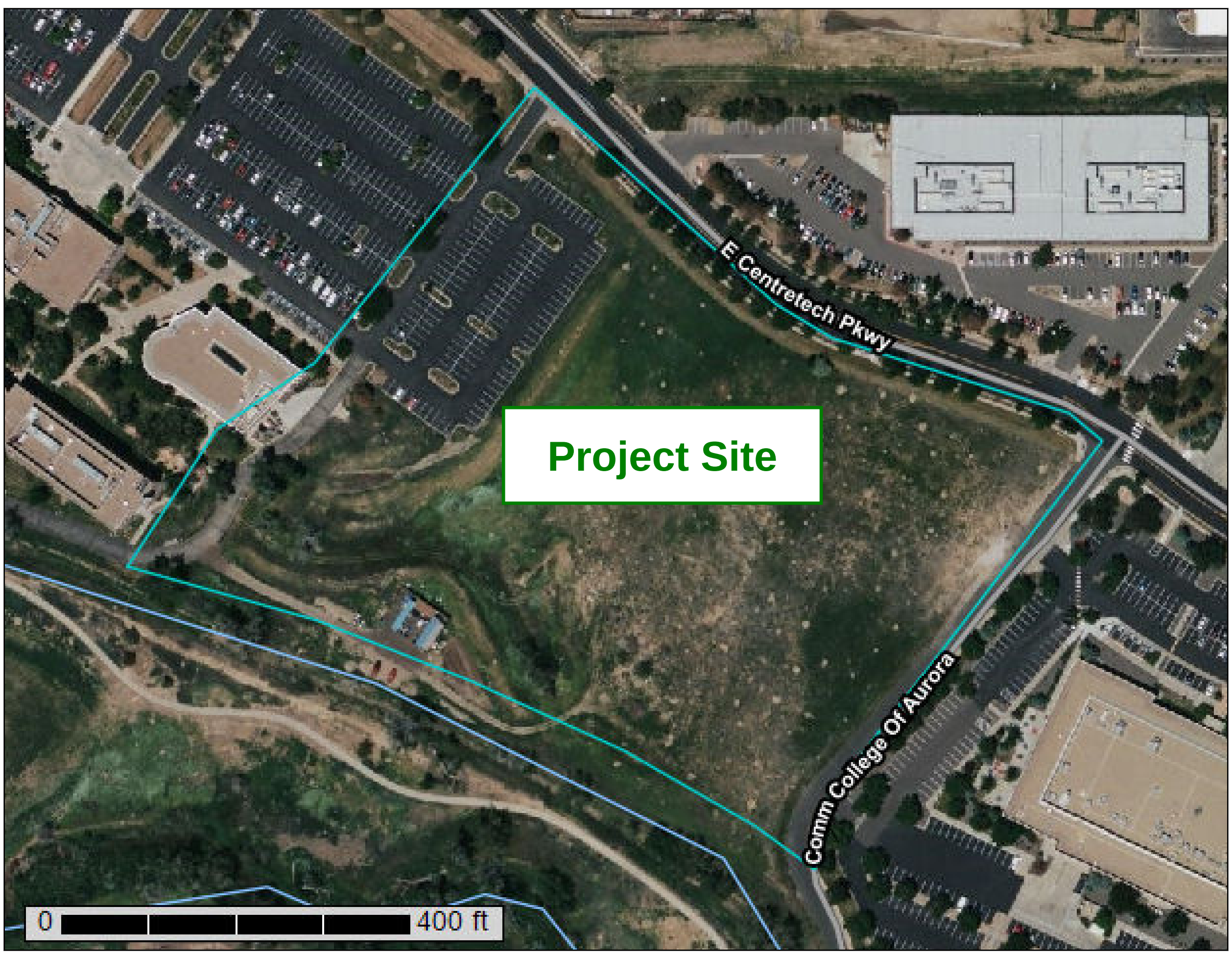
NRCS

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



November 4, 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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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.

Soil Map


104° 48' 11" W
104° 47' 50" W
39° 43' 6" N
39° 42' 56" N
516860
516910
516960
517010
517060
517110
517160
517210
517260
517310
517360
4396530
4396480
4396430
4396380
4396330
4396280
4396230
E Centretech Pkwy
Project Site
Lv
Comm College Of Aurora
Soil Map may not be valid at this scale.
Map Scale: 1:2,310 if printed on A landscape (11" x 8.5") sheet.
N
0 30 60 120 180 Meters
0 100 200 400 600 Feet
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
Lv	Loamy alluvial land	1.4	12.9%
RhD	Renohill-Buick loams, 3 to 9 percent slopes	9.4	87.1%
Totals for Area of Interest		**10.8**	**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

Lv—Loamy alluvial land

Map Unit Setting

National map unit symbol: 34yt
Elevation: 4,000 to 6,000 feet
Mean annual precipitation: 11 to 15 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Loamy alluvial land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Loamy Alluvial Land

Setting

Landform: Streams, drainageways, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

H1 - 0 to 6 inches: loam
H2 - 6 to 60 inches: stratified loam to clay loam

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: B
Ecological site: R067BY036CO - Overflow
Hydric soil rating: No

Minor Components

Nunn

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

Satanta

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

RhD—Renohill-Buick loams, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 34z0

Elevation: 3,600 to 6,200 feet
Mean annual precipitation: 11 to 16 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 100 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Renohill and similar soils: 65 percent
Buick and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Renohill

Setting

Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loam silty and clayey alluvium

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 18 inches: clay
H3 - 18 to 30 inches: clay loam
H4 - 30 to 34 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Description of Buick

Setting

Landform: Ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and/or eolian deposits

Typical profile

H1 - 0 to 4 inches: loam

H2 - 4 to 20 inches: clay loam
H3 - 20 to 60 inches: sandy clay loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water supply, 0 to 60 inches: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Minor Components

Fondis

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

Litle

Percent of map unit: 5 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

NOAA Atlas 14, Volume 8, Version 2
Location name: Aurora, Colorado, USA*
Latitude: 39.7179°, Longitude: -104.8027°
Elevation: 5459.07 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)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.223 (0.180-0.279)	0.276 (0.221-0.345)	0.369 (0.295-0.462)	0.453 (0.360-0.571)	0.580 (0.450-0.767)	0.686 (0.518-0.915)	0.799 (0.583-1.09)	0.922 (0.644-1.29)	1.10 (0.736-1.57)	1.24 (0.805-1.79)
10-min	0.327 (0.263-0.409)	0.404 (0.324-0.505)	0.540 (0.432-0.677)	0.663 (0.528-0.835)	0.849 (0.659-1.12)	1.00 (0.759-1.34)	1.17 (0.853-1.60)	1.35 (0.944-1.89)	1.61 (1.08-2.30)	1.81 (1.18-2.62)
15-min	0.399 (0.321-0.499)	0.492 (0.395-0.616)	0.658 (0.527-0.826)	0.809 (0.643-1.02)	1.03 (0.804-1.37)	1.23 (0.925-1.64)	1.43 (1.04-1.95)	1.65 (1.15-2.31)	1.96 (1.31-2.81)	2.21 (1.44-3.19)
30-min	0.561 (0.451-0.702)	0.691 (0.554-0.864)	0.919 (0.735-1.15)	1.13 (0.895-1.42)	1.43 (1.11-1.89)	1.69 (1.27-2.25)	1.96 (1.43-2.68)	2.26 (1.58-3.16)	2.67 (1.79-3.84)	3.01 (1.96-4.35)
60-min	0.711 (0.571-0.889)	0.864 (0.693-1.08)	1.14 (0.910-1.43)	1.39 (1.10-1.75)	1.77 (1.37-2.34)	2.08 (1.57-2.78)	2.42 (1.77-3.31)	2.79 (1.95-3.91)	3.32 (2.23-4.77)	3.74 (2.44-5.41)
2-hr	0.860 (0.696-1.07)	1.04 (0.838-1.29)	1.36 (1.09-1.69)	1.65 (1.32-2.06)	2.10 (1.64-2.76)	2.48 (1.89-3.28)	2.89 (2.12-3.91)	3.33 (2.35-4.63)	3.97 (2.69-5.65)	4.48 (2.94-6.42)
3-hr	0.948 (0.769-1.17)	1.13 (0.919-1.40)	1.47 (1.19-1.83)	1.79 (1.44-2.23)	2.27 (1.79-2.97)	2.68 (2.05-3.54)	3.13 (2.31-4.22)	3.61 (2.56-4.99)	4.31 (2.93-6.10)	4.87 (3.21-6.94)
6-hr	1.13 (0.923-1.39)	1.35 (1.10-1.65)	1.74 (1.42-2.14)	2.11 (1.70-2.60)	2.66 (2.10-3.44)	3.12 (2.40-4.08)	3.62 (2.69-4.84)	4.16 (2.97-5.70)	4.94 (3.39-6.93)	5.57 (3.70-7.86)
12-hr	1.37 (1.13-1.67)	1.65 (1.35-2.00)	2.13 (1.74-2.60)	2.56 (2.08-3.13)	3.19 (2.53-4.07)	3.71 (2.87-4.79)	4.26 (3.18-5.62)	4.85 (3.47-6.55)	5.67 (3.91-7.85)	6.32 (4.24-8.84)
24-hr	1.66 (1.37-2.00)	1.99 (1.64-2.40)	2.55 (2.10-3.08)	3.03 (2.48-3.68)	3.73 (2.97-4.70)	4.29 (3.33-5.47)	4.87 (3.66-6.35)	5.49 (3.96-7.33)	6.34 (4.40-8.68)	7.01 (4.73-9.70)
2-day	1.97 (1.64-2.36)	2.32 (1.93-2.78)	2.91 (2.41-3.50)	3.42 (2.82-4.13)	4.16 (3.33-5.19)	4.75 (3.71-5.99)	5.36 (4.05-6.91)	6.00 (4.36-7.93)	6.88 (4.81-9.32)	7.57 (5.15-10.4)
3-day	2.13 (1.78-2.53)	2.50 (2.09-2.98)	3.13 (2.60-3.74)	3.67 (3.04-4.40)	4.44 (3.57-5.51)	5.05 (3.97-6.34)	5.69 (4.32-7.30)	6.35 (4.64-8.35)	7.26 (5.10-9.78)	7.96 (5.45-10.9)
4-day	2.24 (1.88-2.67)	2.64 (2.21-3.14)	3.30 (2.75-3.93)	3.87 (3.21-4.62)	4.67 (3.76-5.77)	5.31 (4.18-6.63)	5.96 (4.54-7.61)	6.64 (4.86-8.69)	7.57 (5.34-10.2)	8.29 (5.70-11.3)
7-day	2.56 (2.16-3.02)	3.00 (2.52-3.54)	3.72 (3.12-4.41)	4.34 (3.62-5.16)	5.20 (4.21-6.37)	5.89 (4.66-7.29)	6.58 (5.04-8.33)	7.30 (5.37-9.46)	8.27 (5.86-11.0)	9.01 (6.23-12.1)
10-day	2.86 (2.42-3.36)	3.32 (2.80-3.90)	4.08 (3.43-4.81)	4.72 (3.95-5.59)	5.62 (4.56-6.84)	6.32 (5.02-7.79)	7.04 (5.41-8.87)	7.78 (5.75-10.0)	8.77 (6.24-11.6)	9.53 (6.62-12.8)
20-day	3.71 (3.16-4.33)	4.22 (3.59-4.93)	5.06 (4.29-5.92)	5.76 (4.86-6.76)	6.73 (5.50-8.11)	7.48 (5.98-9.13)	8.24 (6.38-10.3)	9.01 (6.71-11.5)	10.0 (7.21-13.1)	10.8 (7.58-14.4)
30-day	4.40 (3.76-5.10)	4.98 (4.25-5.79)	5.93 (5.05-6.90)	6.71 (5.68-7.84)	7.78 (6.37-9.31)	8.60 (6.90-10.4)	9.40 (7.31-11.6)	10.2 (7.64-12.9)	11.3 (8.13-14.6)	12.1 (8.51-15.9)
45-day	5.22 (4.48-6.03)	5.95 (5.10-6.88)	7.11 (6.08-8.24)	8.05 (6.84-9.36)	9.30 (7.63-11.0)	10.2 (8.23-12.3)	11.1 (8.68-13.7)	12.0 (9.02-15.1)	13.2 (9.52-16.9)	14.0 (9.90-18.3)
60-day	5.89 (5.07-6.78)	6.78 (5.83-7.81)	8.18 (7.00-9.44)	9.28 (7.91-10.8)	10.7 (8.82-12.7)	11.8 (9.50-14.1)	12.8 (10.00-15.6)	13.8 (10.4-17.2)	15.0 (10.9-19.2)	15.8 (11.2-20.7)

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

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

Please refer to NOAA Atlas 14 document for more information.

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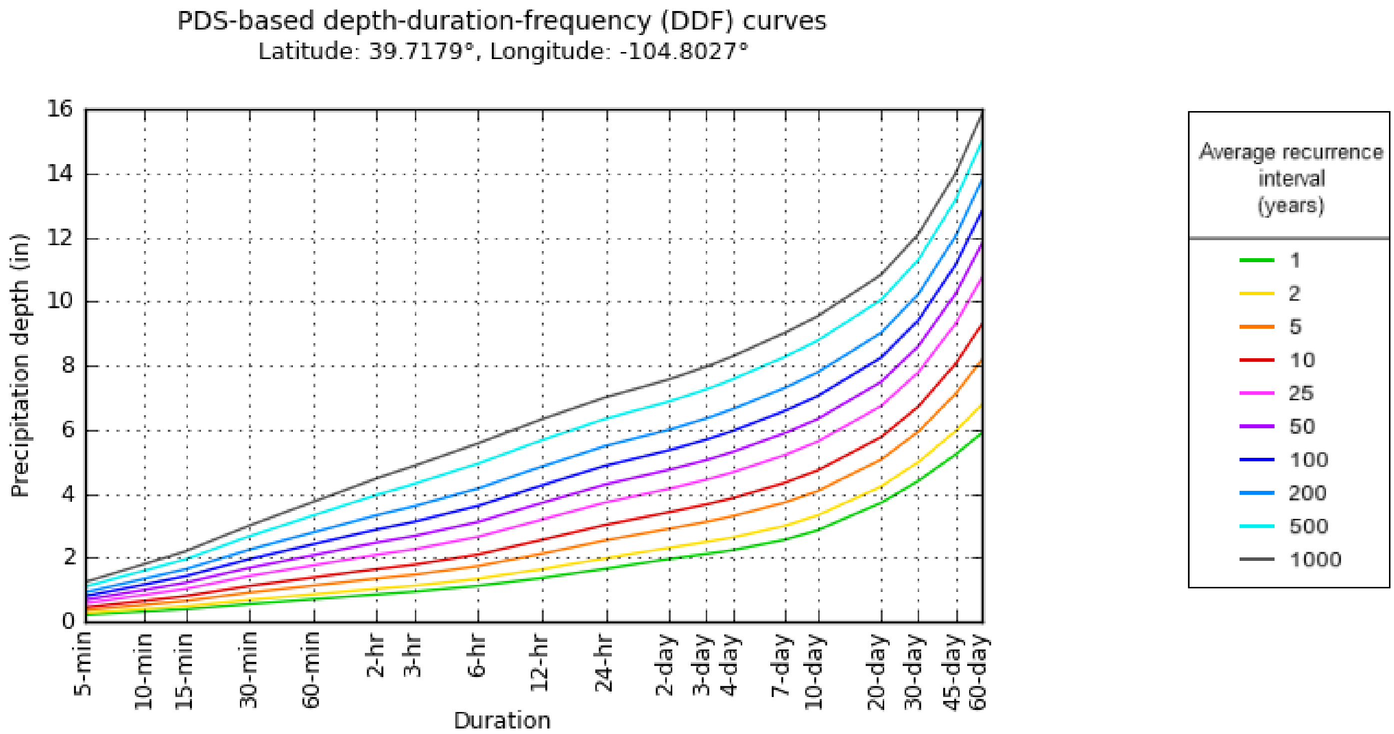
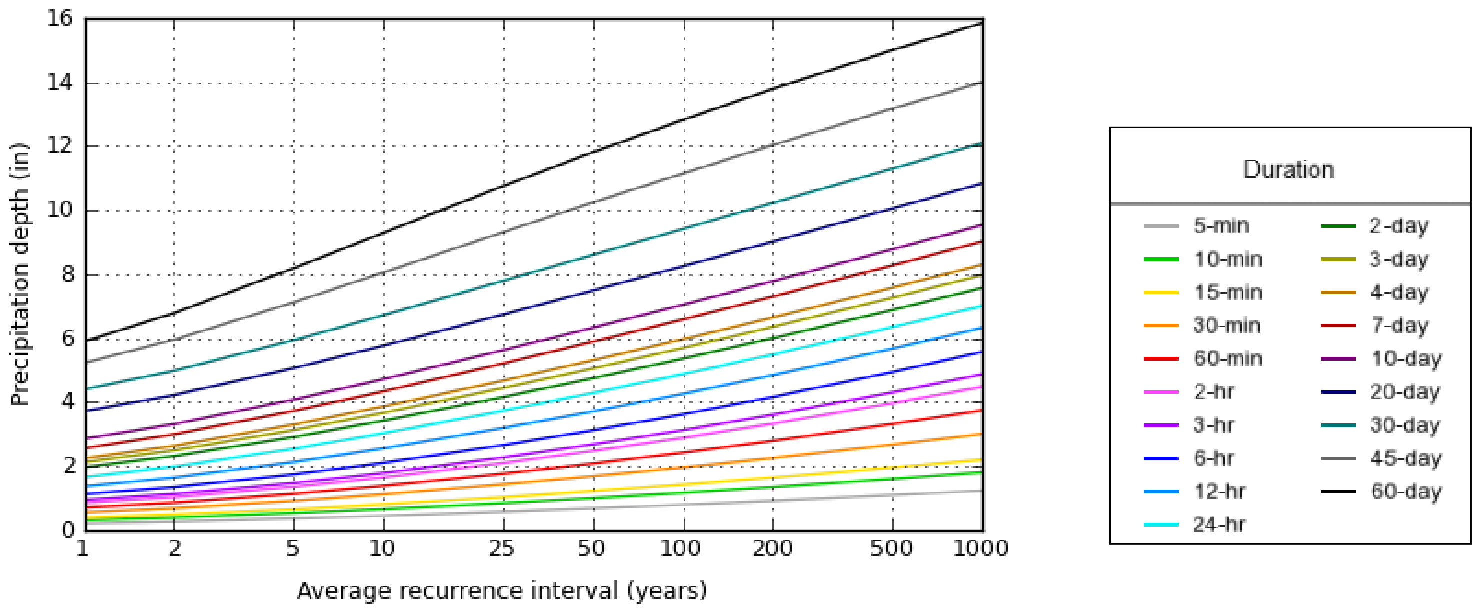
PF graphical





NOAA Atlas 14, Volume 8, Version 2 Created (GMT): Fri Nov 4 16:10:13 2022

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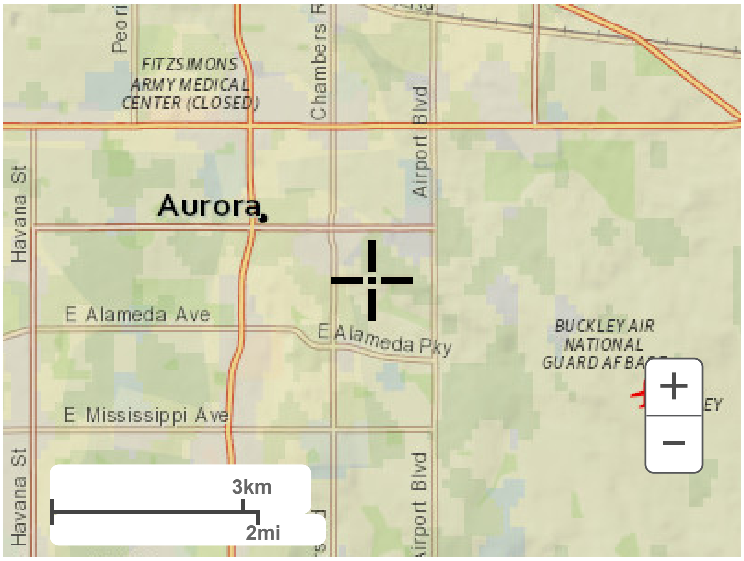
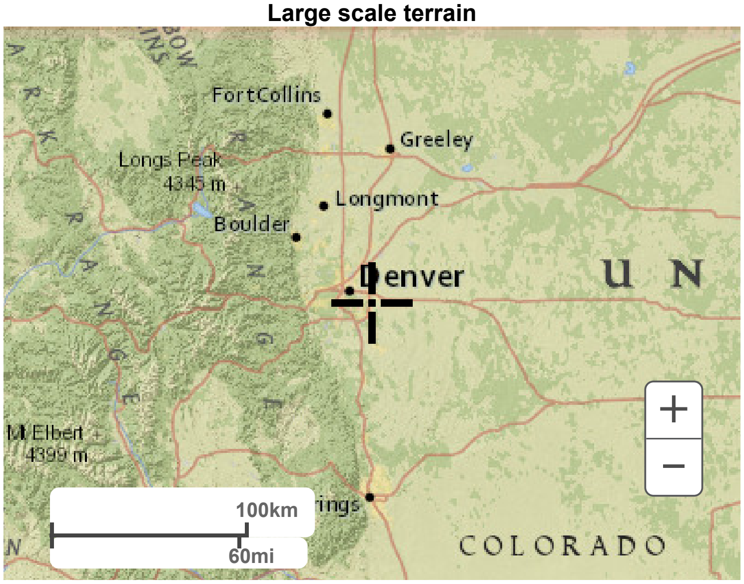
Maps & aerials

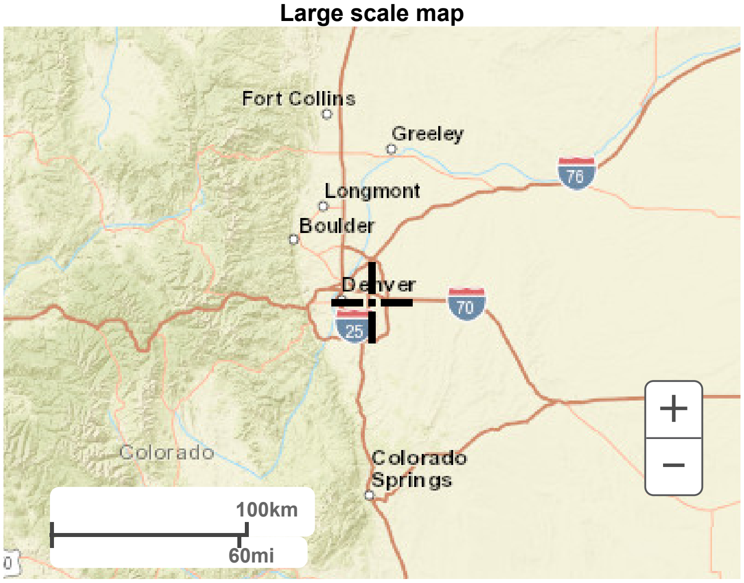
Small scale terrain



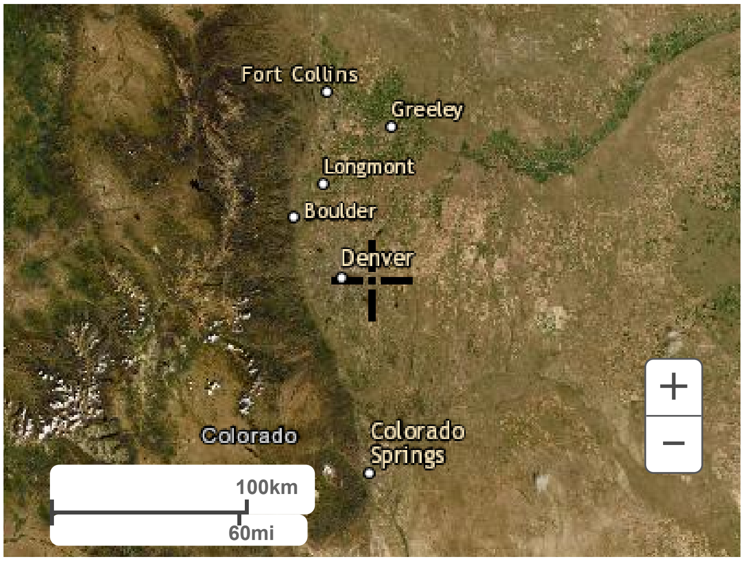
Large scale terrain



Large scale map



Large scale aerial



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National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

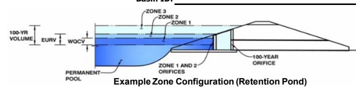
Disclaimer

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: ______________________

Basin ID: ______________________



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	8.73	acres
Watershed Length =	850	ft
Watershed Length to Centroid =	425	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	56.70%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	15.0%	percent
Percentage Hydrologic Soil Groups C/D =	85.0%	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) =	0.164	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.482	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.86 in.) =	0.318	acre-feet	0.86	inches
5-yr Runoff Volume (P1 = 1.14 in.) =	0.471	acre-feet	1.14	inches
10-yr Runoff Volume (P1 = 1.39 in.) =	0.632	acre-feet	1.39	inches
25-yr Runoff Volume (P1 = 1.77 in.) =	0.930	acre-feet	1.77	inches
50-yr Runoff Volume (P1 = 2.08 in.) =	1.154	acre-feet	2.08	inches
100-yr Runoff Volume (P1 = 2.42 in.) =	1.425	acre-feet	2.42	inches
500-yr Runoff Volume (P1 = 3.32 in.) =	2.097	acre-feet	3.32	inches
Approximate 2-yr Detention Volume =	0.303	acre-feet		
Approximate 5-yr Detention Volume =	0.458	acre-feet		
Approximate 10-yr Detention Volume =	0.556	acre-feet		
Approximate 25-yr Detention Volume =	0.666	acre-feet		
Approximate 50-yr Detention Volume =	0.720	acre-feet		
Approximate 100-yr Detention Volume =	0.833	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)
5450.9	**Top of Micropool**	--	0.00	--	--	--	0	0.000		
	5451	--	0.10	--	--	--	10,216	0.235	508	0.012
	5452	--	1.10	--	--	--	14,940	0.343	13,086	0.300
	5453	--	2.10	--	--	--	19,765	0.454	30,439	0.699
	5454	--	3.10	--	--	--	24,690	0.567	52,666	1.209
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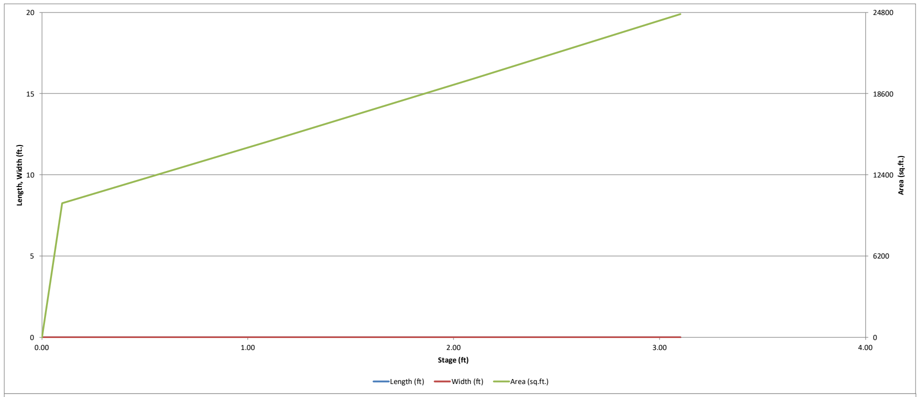
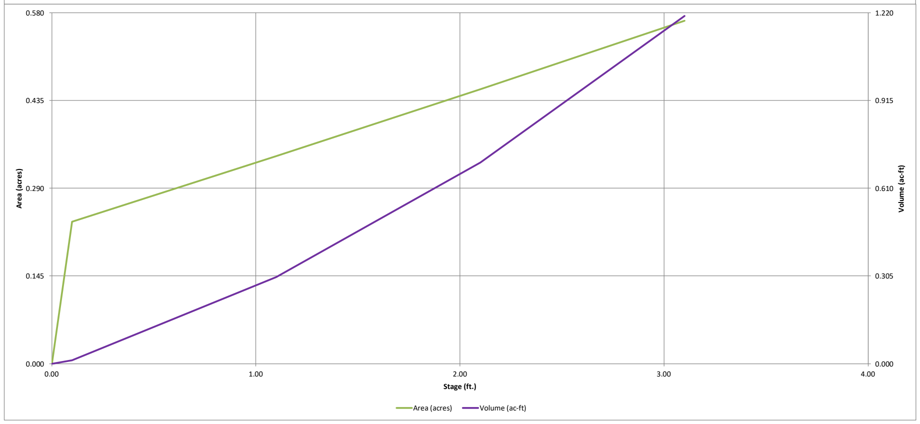
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





JVA Incorporated
1319 Spruce Street
Boulder, CO 80302
Ph: (303) 444 1951

Job Name: CCA Center for Stem
Job Number: 3681
Date: 7/25/23
By: DAM/AMP

	I%	C2	C5	C10	C100
Streets Paved	100%	0.87	0.88	0.90	0.93
Concrete Drives/Walks	96%	0.87	0.87	0.88	0.89
Roof	90%	0.80	0.85	0.90	0.90
Gravel	40%	0.15	0.25	0.35	0.65
Landscaping (B soil)	2%	0.10	0.11	0.13	0.15
Landscaping (C/D soil)	5%	0.18	0.19	0.20	0.22
Playground	25%	0.42	0.43	0.54	0.64
Artificial Turf	25%	0.42	0.43	0.54	0.64

CCA Center for Stem

Historic Runoff Coefficient & Time of Concentration Calculations

Location: Aurora
Minor Design Storm: 2
Major Design Storm: 100
Soil Type: C/D

Basin Design Data																													
	I (%) =	100%	96%	90%	40%	25%	25%	2%	5%			I (%)	Runoff Coeff's				Initial Overland Time (t_i)			Travel Time (t_t) x 60)					t_t=Length/(Velocity	t_c Comp	tc Urbanized Check ON		t_c Final
Basin Name	Design Point	$A_{paved\ streets}$ (sf)	$A_{drives/conc}$ (sf)	A_{roof} (sf)	A_{gravel} (sf)	A_{plygnd} (sf)	$A_{art.\ turf}$ (sf)	$A_{lscape\ (B\ soil)}$ (sf)	$A_{lscape\ (C/D\ soil)}$ (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100	Upper most Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Type of Land Surface	K	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$	Total Length (ft)	t_c=(L/180)+10 (min.)	Min t_c
A1	1	37,012	92	0	1,291	0	0	0	33,475	71,869	1.65	54.7%	0.54	0.55	0.56	0.59	300	4.3%	10.8	186	3.4%	Paved areas & shallow paved swales	20	3.7	0.8	11.6	486	12.7	11.6
A2	2		8,983	0	0	0	0	0	15,433	24,416	0.56	38.5%	0.43	0.44	0.45	0.47	60	3.0%	6.5	0	0.0%	Short Pasture and lawns	7	0.0	0.0	6.5	60	10.3	6.5
B	3	43,617	4,638	0	8,927	0	0	0	439,262	496,444	11.40	14.8%	0.25	0.26	0.27	0.30	300	2.8%	19.0	493	4.2%	Short Pasture and lawns	7	1.4	5.7	24.7	793	14.4	14.4
C	4	47,234	7,232	0	0	0	0	0	12,666	67,133	1.54	81.6%	0.74	0.75	0.77	0.79	29	2.9%	2.4	876	0.5%	Paved areas & shallow paved swales	20	1.4	10.3	12.8	905	15.0	12.8
D	5	24794.8	3216.75	0	0	0	0	0	27,917	55,929	1.28	52.3%	0.53	0.54	0.55	0.57	107	4.1%	6.7	470	1.5%	Paved areas & shallow paved swales	20	2.4	3.2	9.9	577	13.2	9.9
TOTAL SITE		152,658	24,162	0	10,218	0	0	0	528,753	715,791	16.43	28.8%	0.35	0.36	0.37	0.40													

I = (28.5 P1) / ((10 + TC) 0.786)

			Runoff Coeff's				Rainfall Intensities (in/hr)				Area		Flow Rates (cfs)			
Basin Name	Design Point	Time of Conc (tc)	C2	C5	C10	C100	2	5	10	100	A_{Total} (sf)	A_{Total} (ac)	Q2	Q5	Q10	Q100
A1	1	11.6	0.54	0.55	0.56	0.59	2.20	2.90	3.54	6.16	71,869	1.65	1.94	2.62	3.29	6.04
A2	2	6.5	0.43	0.44	0.45	0.47	2.72	3.59	4.37	7.62	24,416	0.56	0.66	0.89	1.10	1.99
B	3	14.4	0.25	0.26	0.27	0.30	2.00	2.64	3.22	5.60	496,444	11.40	5.62	7.76	9.92	18.91
C	4	12.8	0.74	0.75	0.77	0.79	2.11	2.78	3.39	5.91	67,133	1.54	2.40	3.21	4.00	7.21
D	5	9.9	0.53	0.54	0.55	0.57	2.35	3.10	3.78	6.57	55,929	1.28	1.58	2.13	2.66	4.84
										TOTAL SITE	715,791	16.43	12.21	16.60	20.98	38.99

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	I%	C2	C5	C10	C100
Streets Paved	100%	0.87	0.88	0.90	0.93
Concrete Drives/Walks	96%	0.87	0.87	0.88	0.89
Roof	90%	0.80	0.85	0.90	0.90
Gravel	40%	0.15	0.25	0.35	0.65
Landscaping (B soil)	2%	0.10	0.11	0.13	0.15
Landscaping (C/D soil)	5%	0.18	0.19	0.20	0.22
Playground	25%	0.42	0.43	0.54	0.64
Artificial Turf	25%	0.42	0.43	0.54	0.64

CCA Center for Stem

Composite Runoff Coefficient Calculations

Location: Aurora
Minor Design Storm: 2
Major Design Storm: 100
Soil Type: C/D

Basin Design Data

	I (%) =	100%	96%	90%	40%	25%	25%	2%	5%			I (%)	Runoff Coeff's			
Basin Name	Design Point	A_{paved} streets (sf)	$A_{drives/conc}$ (sf)	A_{roof} (sf)	A_{gravel} (sf)	A_{plygnd} (sf)	$A_{art.\ turf}$ (sf)	A_{lscape} (B soil) (sf)	A_{lscape} (C/D soil) (sf)	A_{Total} (sf)	A_{Total} (ac)	Imp (%)	C2	C5	C10	C100
P1	1	37,012	92	0	0	0	0	0	8,480	45,584	1.05	82.3%	0.74	0.75	0.77	0.80
P2	2	0	33,653	0	0	0	0	0	126,332	159,985	3.67	24.1%	0.33	0.33	0.34	0.36
P3	3	0	0	58,096	0	0	0	0	0	58,096	1.33	90.0%	0.80	0.85	0.90	0.90
P4	4	24,690	3,310	0	0	0	0	0	54,365	82,365	1.89	37.1%	0.41	0.42	0.44	0.46
OS-1	5	47,234	7,232	0	0	0	0	0	12,666	67,133	1.54	81.6%	0.74	0.75	0.77	0.79
OS-2	6	24,795	6,409	0	0	0	0	0	15,281	46,485	1.07	68.2%	0.64	0.65	0.67	0.69
OS-3	7	43,617	7,573	0	15,487	0	0	0	164,987	231,664	5.32	28.2%	0.33	0.35	0.36	0.40
OS-4	8	0	8,983	0	0	0	0	0	15,433	24,416	0.56	38.5%	0.43	0.44	0.45	0.47
	TOTAL SITE	177,348	67,253	58,096	15,487	0	0	0	397,545	715,729	16.43	44.7%	0.47	0.48	0.50	0.52

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Job Name: CCA Center for Stem
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Date: 7/25/23
By: DAM/AMP

CCA Center for Stem

Time of Concentration Calculations

Location: Aurora
Minor Design Storm: 2
Major Design Storm: 100
Soil Type: C/D

Sub-Basin Data				Initial Overland Time (t_i)			Travel Time (t_t) t_t=Length/(Velocity x 60)						t_c Comp	tc Urbanized Check ON		t_c Final
Basin Name	Design Point	A_{Total} (ac)	C5	Upper most Length (ft)	Slope (%)	t_i (min)	Length (ft)	Slope (%)	Type of Land Surface	C_v	Velocity (fps)	t_t (min)	Time of Conc $t_i + t_t = t_c$	Total Length (ft)	t_c=(L/180) +10 (min)	Min t_c
P1	1	1.05	0.75	300	4.1%	6.9	165	4.6%	Paved areas & shallow paved swales	20	4.3	0.6	7.6	465	12.6	7.6
P2	2	3.67	0.33	300	4.6%	14.7	270	0.2%	Paved areas & shallow paved swales	20	0.9	5.0	19.7	570	13.2	13.2
P3	3	1.33	0.85	38	5.0%	1.7	0	0.0%	Paved areas & shallow paved swales	20	0.0	0.0	1.7	38	10.2	5.0
P4	4	1.89	0.42	216	1.4%	16.3	454	1.1%	Paved areas & shallow paved swales	20	2.1	3.6	19.9	670	13.7	13.7
OS-1	5	1.54	0.75	29	2.9%	2.4	876	0.5%	Paved areas & shallow paved swales	20	1.4	10.3	12.8	905	15.0	12.8
OS-2	6	1.07	0.65	107	4.1%	5.3	470	1.5%	Paved areas & shallow paved swales	20	2.4	3.2	8.5	577	13.2	8.5
OS-3	7	5.32	0.35	300	3.9%	15.2	385	3.7%	Paved areas & shallow paved swales	20	3.8	1.7	16.9	685	13.8	13.8
OS-4	8	0.56	0.44	60	3.0%	6.5	0	0.0%	Paved areas & shallow paved swales	20	0.0	0.0	6.5	60	10.3	6.5

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Job Name: CCA Center for Stem
Job Number: 3681
Date: 7/25/23
By: DAM/AMP

CCA Center for Stem

Developed Storm Runoff Calculations

Design Storm : **100 Year**

Point Hour Rainfall (P_1) : **2.42**

I = (28.5 P1) / ((10 + TC)^0.786)

	Direct Runoff							Total Runoff				Inlets				Pipe					Pipe/Swale Travel Time				
Basin Name	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q intercepted	Q carryover	Q bypass	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	tt (min)	Total Time (min)	Notes
P1	1	1.05	0.80	7.60	0.83	7.23	6.04	7.60	0.83	7.24	6.04														
P2	2	3.67	0.36	13.20	1.33	5.82	7.72	13.20	1.33	5.83	7.72					15 in	PVC	1.0%	7.7	9.0	337	7.7	0.73	13.93	
P3	3	1.33	0.90	5.00	1.20	8.20	9.84	5.00	1.20	8.21	9.85														
P4	4	1.89	0.46	13.70	0.87	5.72	4.97	13.70	0.87	5.73	4.98														
		TOTAL FLOW TO WQCV/EURV POND						13.93	4.23	5.69	24.05														
OS-1	5	1.54	0.79	12.80	1.22	5.90	7.20	12.80	1.22	5.91	7.21														
OS-2	6	1.07	0.69	8.50	0.74	6.96	5.13	8.50	0.74	6.96	5.13														
OS-3	7	5.32	0.40	13.80	2.15	5.71	12.28	13.80	2.15	5.71	12.28														
OS-4	8	0.56	0.47	6.50	0.26	7.61	1.99	6.50	0.26	7.62	1.99														

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Job Name: CCA Center for Stem
Job Number: 3681
Date: 7/25/23
By: DAM/AMP

CCA Center for Stem

Developed Storm Runoff Calculations

Design Storm : **2 Year**

Point Hour Rainfall (P_1) : **0.86**

I = (28.5 P1) / ((10 + TC)^0.786)

	Direct Runoff							Total Runoff				Inlets				Pipe					Pipe/Swale Travel Time				
Basin Name	Design Point	Area (ac)	Runoff Coeff	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Total tc (min)	ΣC*A (ac)	I (in/hr)	Q (cfs)	Inlet Type	Q intercepted	Q carryover	Q bypass	Pipe Size (in) or equivalent	Pipe Material	Slope (%)	Pipe Flow (cfs)	Max Pipe Capacity (cfs)	Length (ft)	Velocity (fps)	tt (min)	Total Time (min)	Notes
P1	1	1.05	0.74	7.60	0.78	2.58	2.00	7.60	0.78	2.58	2.01														
P2	2	3.67	0.33	13.20	1.19	2.08	2.48	13.20	1.19	2.08	2.48					15 in	PVC	1.0%	2.5	9.0	337	5.8	0.96	14.16	
P3	3	1.33	0.80	5.00	1.07	2.93	3.13	5.00	1.07	2.93	3.13														
P4	4	1.89	0.41	13.70	0.78	2.04	1.60	13.70	0.78	2.05	1.60														
		TOTAL FLOW TO WQCV/EURV POND						14.16	3.82	2.01	7.70														
OS-1	5	1.54	0.74	12.80	1.14	2.10	2.39	12.80	1.14	2.11	2.40														
OS-2	6	1.07	0.64	8.50	0.69	2.48	1.70	8.50	0.69	2.49	1.71														
OS-3	7	5.32	0.33	13.80	1.76	2.03	3.57	13.80	1.76	2.04	3.58														
OS-4	8	0.56	0.43	6.50	0.24	2.71	0.66	6.50	0.24	2.72	0.66														

900078

PRELIMINARY DRAINAGE REPORT
COMMUNITY COLLEGE OF AURORA
AURORA CENTRETECH PARK SUBDIVISION FILINGS 3 AND 9
ALAMOSA SUBDIVISION FILING NO. 1

May 15, 1990
Revised June 25, 1990

900078

Approved For One Year From This Date

07-18-90

Director of Public Works 7/10/90 Date

7-12-90

Director of Utilities 7/12/90 Date

Prepared for: Community College of Aurora
791 Chambers Road
Aurora, CO 80011
President: Larry Carter
360-4700

Prepared by: MARTIN/MARTIN, Inc.
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6-26-90

DRAINAGE PLAN

General Concept

No off-site drainage will flow across the site. In accordance with Merrick's drainage plan for Filing No. 5, runoff in ACPS Filing No. 9, Block 1, Lots 1 through 4 will flow southeasterly to an existing storm sewer which crosses the southern portion of ACPS Filing No. 5. In accordance with Merrick's drainage plan for ACPS Filing No. 3, runoff from ACPS Filing No. 3, Lot 1, Block 2 will flow into an existing 60-inch storm sewer just east of the site. No drainage plan has been done for the southern portion of the site (Alamosa Subdivision [AS] Filing No. 1, Lot 1, Block 2). Most of the runoff from this area will flow into a sump inlet and be piped under the Highline Canal directly to Tollgate Creek. The remainder will flow off-site into the Highline Canal as it has done historically.

Specific Details

As stated above, runoff in ACPS Filing No. 9 will flow toward an existing manhole located near the southeast corner of ACPS Filing No. 5. This area is represented by Basins A and N. Proposed inlets in two corners of the proposed parking lot will intercept the 100-year storm (Q_{100} = 25 + 14.3 = 39.3 cfs) and pipe it to the existing manhole. The existing 24-inch line was designed to handle 21.6 cfs of flow. Excess flows will be routed to the abandoned canal (Basin G) and directed to the southeast.

Basins D, E, L and M are part of ACPS Filing No. 3. The 100-year runoff from Basins D and E (19.4 cfs and 10.9 cfs, respectively) flows southeast to proposed inlets and then into pipes which connect to the existing 48-inch/60-inch storm line east of the site.

The 100-year runoff from Basin L (1.6 cfs) will flow south to the existing sump area of the relocated Highline Canal and will then flow by grassed swale to a proposed inlet. It will then be piped to the existing manhole east of the site. The runoff from Basin M (Q_{100} = 0.4 cfs) will flow off-site to the east along an existing asphalt roadway.

Runoff from Basin F (Q_{100} = 3.1 cfs) will flow northwesterly in a grassed swale to a proposed inlet. It will then be piped to an existing inlet located in the southwest corner of ACPS Filing No. 5.

The 100-year runoff from Basins B and C (20.8 cfs and 7.4 cfs, respectively) will flow south to proposed inlets and then be piped to a proposed inlet located in Basin H.

Basin G is an existing sump created when the Highline Canal was rerouted. Runoff from Basin G (Q_{100} = 3.3 cfs) will then flow into the sump and flow east by means of a french drain located under the proposed gravel walkway to a proposed inlet located in Basin H.

Runoff from Basin H (Q_{100} = 10.8 cfs) will flow to a proposed inlet in sump by means of grassed swales. This flow will be combined with flows from Basins B, C and G (total Q_{100} = 42.3 cfs) and will be piped south under the Highline Canal and discharge directly into Tollgate Creek. There is sufficient clearance to pass under the Highline Canal (<1').

Runoff from Basins I and J (Q_{100} = 1.6 and 1.2 cfs, respectively) will continue to flow south, off-site into the Highline Canal as they have done historically. This flow is 2.6 cfs less than the historic release to the canal and the area will continue to be undeveloped, natural terrain.

Runoff from Basin K (Q_{100} = 0.6 cfs) will flow west into East 1st Avenue where it will be intercepted by existing storm inlets.

As previously mentioned, no detention storage will be provided due to the discharge from the site being released directly into an improved channel (Tollgate Creek). Also, previously approved master drainage reports for ACPS Filings No. 3 and 5 do not require on-site detention.

Phasing

The site will be developed in three phases. In Phase I, Basins A, B, G and H will be developed. Inlets will be built at Design Points 1, 2, 7 and 8. Storm sewer will be built from Design Point 1 to the existing manhole east of ACPS Filing No. 5, from Design Point 2 to Design Point 8, from Design Point 7 to Design Point 8 and from Design Point 8 to Tollgate Creek. The existing canal berm in Basin H will remain to route flows to Point 8.

In Phase II, Basins F and N will be developed. An inlet will be built at Design Point 14 and will connect to the Phase I storm sewer coming from Design Point 1. An inlet will be built at Design Point 6 and a storm sewer will connect this inlet to an existing inlet located in ACPS Filing No. 5.

Basins C, D, E and J will be developed in Phase III. All inlets and storm sewer necessary to connect these basins to the existing 60-inch storm sewer just east of the property will be constructed in this phase.

CONCLUSIONS

Compliance with Standards

All criteria have been followed in determining storm flows for basins. An exemption from on-site detention is being requested due to the close proximity of the site to Tollgate Creek, a major drainage channel.

Summary of Concept

The proposed drainage plan will basically follow the drainage patterns established in Merrick's drainage plans for ACPS Filings No. 5 and 3. Runoff in ACPS Filing No. 9 will flow toward the existing storm sewer in ACPS Filing No. 5. Runoff in ACPS Filing No. 3 will flow toward the existing storm sewer located just east of the site. The rest of the site will flow to the sump area and piped to Tollgate Creek or flow off-site to the Highline Canal as it presently does.

All inlets and pipes which carry water off-site will be sized to carry the 100-year storm so no on-site flooding will occur.

Since most of the runoff from the site is being piped to existing storm sewers or Tollgate Creek, very little runoff (total Q_{100} = 3.8 cfs) will flow off-site and the effect of this development on downstream developments should be minimal.

LIST OF REFERENCES

1. "Storm Drainage Design and Technical Criteria," City of Aurora, June 1986.

2. "Urban Storm Drainage Criteria Manual," Urban Drainage and Flood Control District, May 1984.

MARTIN/MARTIN
Consulting Engineers

Title: Aurora Comm Coll Date: 5-14-90 Job no.

Subject: Drainage By: TMS Sheet 23 of

Basin	Des. Pt	Q_2	Q_{100}	Comments
A	1	5.6	14.3	To prop. Inlet
B	2	8.2	20.8	To Prop. Inlet
C	3	3	7.4	To Prop. Inlet
D	4	7.9	19.4	To Prop. Inlet
E	5	4.1	10.9	To Prop. Inlet then to Exist. MH
F	6	1.1	3.1	To Prop. Inlet then to Exist. Inlet
G	7	1.1	3.3	To prop. Inlet
H	8	3.0	10.8	To prop. Inlet then to Tollgate Cr.
I	9	0.2	1.6	Offsite to Highline Canal
J	10	0.1	1.3	Offsite to " "
K	11	0.1	0.6	Offsite to E. 1st Ave.
L	12	0.2	1.6	To prop. Inlet, then to Exist. MH
M	13	0	0.4	Offsite to East
N	14	9.7	25.0	To prop. Inlet, then to Exist MH

MARTIN/MARTIN
Consulting Engineers

Title: Aurora CC | Date: 5-15-90 (5-24-90) | Job no.
Subject: Drainage | By: TMS | Sheet 27 of

Preliminary Pipe Sizing (Cont.) -

DP 8 to FES @ Tollgate Cr

$Q_{100} = 20.8 + 7.4 + 3.3 + 10.8 = 42.3$ cfs
$S = \frac{34.7 - 25.0}{390} \approx 2.5\%$

Using 30" RCP - Q = 64.8 cfs > 42.3 OK
Try 24" RCP - Q = 35.7 < 42.3 NG

USE → 30" RCP

DP 12 to Exist MH

$Q_{100} = 1.6$ cfs
$S = \frac{46.5 - 45.7}{50} = 1.6\%$

Using 15" RCP - Q = 8.2 cfs > 1.6 OK
Try 15" RCP @ 0.5% - Q = 4.6 cfs > 1.6 OK

∴ Use → 15" RCP

DP 4 to DP 14

$Q_{100} = 25.0$ cfs
$S = \frac{50.7 - 49.5}{160} = 0.75\%$

Using 30" RCP - Q = 35.5 > 25 cfs OK
Try 24" RCP - Q = 19.6 < 25 NG

∴ USE → 30" RCP

SUBDIVISION *Aurora Comm. Coll.*
LOCATION *1st Ave & E. Centertech Blvd*
COMPUTATIONS BY *TMS* DATE *6-25-90*
SUBMITTED BY *Martin/Martin* DATE *6-26-90*
(Engineering Firm)

CITY OF AURORA, COLORADO
STORM DRAINAGE SPECIFICATIONS

STANDARD CULVERT DESIGN FORM

CAPACITY CHECK - OP (B) TO Tollgate Creek

PAGE *28* OF ____

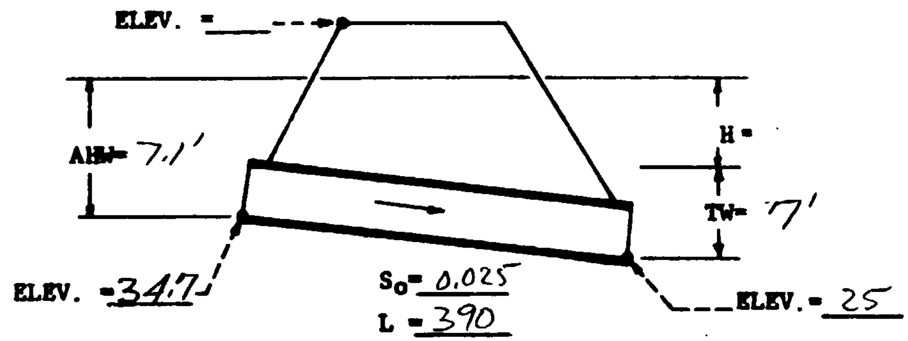
HYDROLOGIC AND CHANNEL INFORMATION

STORM FREQ. DATA: INITIAL DESIGN STORM = ______ YR
MAJOR DESIGN STORM = ______ YR

Q_1 = ______ cfs(Initial Storm), ; TW_1= ______ (Estimated)
Q_2 = ______ cfs (Major Storm) ; TW_2= ______

FOR OUTLET CONTROL
(1) $H.W. = H + h_o - L\,S_o$
(2) For TW<D ; $h_o = \frac{d_c+D}{2}$ or T.W. (whichever is greater)
TW≥D ; h_o = T.W.
(3) For Box Culvert: $d_c = 0.315(Q/B)^{3/2} \leq D$ Use Q/B = q

STATION: ______



CULVERT DESCRIPTION (Entrance Type)	Q or q	SIZE	HEADWATER COMPUTATION: INLET CONT. HW/D	INLET CONT. HW	OUTLET CONTROL HW=H + h_o - LS_o: K_e	H	d_c	$\frac{d_c+D}{2}$	TW	h_o	LS_o	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS
Headwall (Inlet)	*42.3*	*30"*	*1.9*	*4.8*	*0.5*	*6*	*2.2*	*2.4*	*7'*	*7*	*9.8*	*3.2*	*4.8*			*4.8<7.1 OK*