PRELIMINARY DRAINAGE REPORT

FOR

EBERLY PLACE

10070 Potomac Street
Commerce City, CO

Prepared: April 15, 2021
Updated: October 26, 2021
January 25, 2022

Prepared for:

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HKS Project No. 201237

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ENGINEER CERTIFICATION

I hereby certify that this preliminary study for the Eberly Place Development was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Commerce City *Storm Drainage Design and Technical Criteria Manual* for the owners thereof.

By: Mark A West, P.E., C.F.M.
Registered Professional Engineer
State of Colorado No. 38561
On behalf of Harris Kocher Smith

I. GENERAL LOCATION AND DESCRIPTION

A. Location

The proposed Eberly Place development (hereinafter referred to as "Site") is located in Commerce City in the southwest ¼ of the northwest ¼ of Section 18, Township 2 south, Range 66 west of the sixth Principal Meridian, Adams County, State of Colorado. The Site is bounded by Potomac Street to the west and Blackhawk Street to the east. To the north the Site is bounded by un-developed farmland and two residences. To the Site is bounded by a residence and un-developed farmland. See Appendix A for the Vicinity Map. Adjacent developments include Reunion Ridge Filing No. 1 to the west and Foxton Village to the east. Ragweed Draw runs along the south side of the Site.

B. Description of Property

The Site is approximately 33.50 acres of undeveloped land, except for a homestead including a house and two outbuildings located on the east side of the Site. The Site is otherwise covered with native grasses, and some trees and shrubs around the homestead. There is an unpaved road that runs generally east west alongside the house, between Blackhawk Street and Potomac Street. The Site generally falls from the northeast corner towards the southwest corner at slopes no greater than 3% except for the area around the house. The house and outbuildings are located on a plateau. The ground slopes away from the house at a rate of no greater than 17%. There is a berm along the south property line of the Site.

Pre-development flows from the Site follows historical patterns. Generally, runoff flows from the northeast corner of the Site towards the southwest corner. The unpaved road that bisects the Site diverts flows north of the road to the roadside ditch on Potomac Street. Runoff south of the road flows to the existing swale along the south side of the Site, which then flows to the roadside ditch on Potomac Street. The roadside ditch on Potomac Street flows towards Ragweed Draw and outfalls to it at the culvert under Potomac Street.

The Site is being developed into single family detached residential homes. The total number of residential units being proposed is 154. On-Site detention and water quality treatment will be provided as a full spectrum extended detention basin (EDB) for this development. An EDB that will treat the EURV and 100-year volume will be in the southwest portion of the property. In the future, the Site EDB will be expanded and become part of regional detention Pond B with the construction of the Reunion Village 9. See appendix B for more information about the future regional pond. Water quality will be provided in a separate pond located just before the main pond.

A soil map was obtained from the Natural Resources Conservation Service (NRCS) Web Soil Survey which indicated that the Site is primarily a mix of Ascalon-Vona sandy loams and Truckton loamy sand. These underlying soils are predominantly Hydrologic Soil Group (HSG) A, with the remainder being primarily HSG B. For the purposes of this study, HSG B was used in calculations. A copy of the soil map is included in Appendix B.

A geotechnical site development study has been performed by A. G. Wassenaar, Inc. A copy of the report can be found in Appendix E. The subsurface materials encountered in the test borings consisted of topsoil, clay, sand, and gravel overlying sedimentary bedrock. Claystone bedrock was encountered at depths of 32 and 34 feet. Ground water was not encountered.

There are three culverts located along Potomac Street. One culvert carries stormwater for Ragweed Draw under Potomac Street. The other two culverts convey flows under driveways in the swale along Potomac Street. There are other existing utilities associated with the homestead.

The Site is shown to be in a Zone X (unshaded) Area of Minimal Flood Hazard, according to Flood Insurance Rate Map (FIRM) 08001C0339H Adams County, Colorado, effective March 4, 2007. There is no known history of flooding for the Site. The Site is outside the 100-year floodplain. An excerpt (FIRMette) is included in Appendix A.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basins

The Site is within Basin DFA-0053 of the *Second Creek, Third Creek DFA 0053 & Barr Lake Drainage Basin Planning* report by Kiowa Engineering Corporation, dated January 1989. Basin DFA-0053 is located between First Creek and Second Creek and is 9.3 square miles. The Basin is part of the South Platte River floodplain.

The Site will be constructed east of Reunion Village 9 and is a part of Major Basin 9OS2b. Reunion Village 9 proposes a series of regional detention ponds in-line with the major drainageway of Ragweed Draw. One of the ponds, Pond B, is proposed to be built partially within the Eberly parcel and partially within Reunion Village 9 south of the Site.

The Eberly development timeline is far ahead of the construction timeline for the overall regional detention facility. On March 9, 2021, the City issued a letter (see Appendix B) in part stating specific detention requirements for the Eberly parcel to account for the timing discrepancy. This letter generally states that the project should provide a minimum of Full Spectrum Detention (FSD) volume for the Site area within the project limits in an interim condition. At the time of full regional Pond B construction, the EDB embankment along the Site's southern boundary will be removed and the Site's Pond will be merged with Pond B south of the parcel. It is proposed that the outfall structure for the ultimate regional facility be constructed with the Eberly development, as this outfall lies within the Site and is the historical outfall location.

The Site is delineated as 1 major basin. Runoff will flow by curb & gutter, sheet flow over landscaping, and storm sewer to the FSD EDB. The EDB will be in the southwest corner of the site. Pond location and the basin is detailed in the Drainage Plan included in the appendix F. There is no known existing irrigation on the Site.

Basin A (33.50 acres, 52.25% impervious) will consist of houses, roads, walks, and grass swales. There are two grass swales located between the walk and houses along Potomac Street. The grass swales will drain to the storm sewer system. The runoff from the rest of the basin will flow by overland flow and curb and gutter to inlets located throughout the basin.

B. Sub-basins

Historically drainage flows from the northeast corner to the southwest corner. Runoff enters a roadside ditch that flows to Ragweed Draw. Ragweed draw runs along the south side of the Site and through the EDB.

When developed, drainage from the site will overland flow to curb and gutter or swales and ultimately the storm sewer system. The storm sewer system outfalls to the EDB located in the southwest corner of the Site.

III. DRAINAGE DESIGN CRITERIA

A. Development Criteria References and Constraints

The Master Report, *Second Creek, Third Creek DFA 0053 & Barr Lake Drainage Basin Planning* by Kiowa Engineering Corporation, dated January 1989, places the Site in Basin DFA-0053. The Master Report states that Basin DFA-0053 is not well suited for detention because of basin shape and flatness, but it does provide locations for three possible detention sites. The EDB for the Site will be in a different location than those stated in the Master Report.

The principal design guidelines that will be sourced for the Site's development are the most current versions of the City of Commerce City Storm Drainage and Technical Criteria Manual (June 2021) (hereinafter referred to as "Commerce City Criteria") and the Mile High Flood Control District, Volume 1 (August 2018), Volume 2 (September 2017), and Volume 3 (October 2019) (hereinafter referred to as "District Manual").

The drainage design will be affected by the Master Report, Reunion Village 9 Drainage Report, proposed grading, building footprints, and legal boundaries of the Site.

B. Hydrologic Criteria

The following formula, from the District Manual, has been used to determine rainfall intensities:

$$I = \frac{28.5P_1}{(10 + T_C)^{0.786}}$$

One-hour rainfall P_1 values were obtained from the Commerce City Criteria. The P_1 values for the 2-Year and 100-year storms are 0.97 inches and 2.58 inches, respectively.

As previously noted, the Site's underlying soils are HSG A and B.

The Rational Method, as presented in the Commerce City Criteria and District Manual, has been used to calculate the projected maximum rate of runoff for the 2-year and 100-year minor and major storm events. "C" coefficients were taken from Table 501 of the Commerce City Criteria. Rational Method calculation results, including composite C-values, time of concentration, and flow rates can be found in Appendix C.

MHFD methodology for full-spectrum detention will be used in sizing the EDB. MHFD-Detention v4.04 will be used to size the EDB. The EDB was designed to accept and detain flows from the entire site. See appendix D for spreadsheet printouts.

C. Hydraulic Criteria

Hydraulic capacity for proposed storm sewer system will be designed in accordance with the Commerce City Criteria and the Streets/Inlets/Storm Sewers chapter of the District Manual.

The Hydraulic Grade Line (HGL) and head loss in the proposed storm sewer system will be designed in accordance with the Commerce City Criteria and the Streets/Inlets/Storm Sewers chapter of the District Manual.

The routing method for the proposed storm sewer system will be designed in accordance with the Commerce City Criteria and the Streets/Inlets/Storm Sewers chapter of the District Manual. StormCAD software will be used for design calculations.

The methods to be used for hydraulic calculations will be performed via StormCAD v.8i for the Final Drainage Report. Inlet and street capacities will be determined utilizing MHFD spreadsheet MHFD Inlet v.5.01. The storm sewer will be sized to accommodate the 100-year storm event.

D. Stormwater Quality

The future regional pond will be in-line with Ragweed Draw therefore the WQCV will be detained and treated separate from the detention pond that will be converted into the future regional pond. Water quality will be treated through various methods of low impact development (LID) throughout the Site and by a WQCV pond.

The Site will demonstrate adherence to the minimizing directly connected impervious area (MDCIA) criteria by demonstrating that rooftop runoff over adjacent landscape areas satisfies the requirement.

IV. DRAINAGE FACILITY DESIGN

A. General Concept

The general drainage concept for the Site is to capture runoff from the rooftops, landscaped areas, and roadways. This runoff is then routed through landscape drains, grass swales, and storm sewer pipes to the on-site EDB. The Drainage Plan can be found in the Appendix F.

There are no known off-site flows that enter the site other than Ragweed Draw.

B. Specific Details

Currently on the Site there are no existing stormwater conveyance or storage facilities. Stormwater sheet flows overland and ultimately is conveyed to Ragweed Draw on the south side of the Site or to the roadside ditch along Potomac Street.

All runoff from the Site will be directed to the EDB. Arrows shown on the Drainage Plan indicate the direction of flow. This direction of flow can be inferred by reading the spot elevations on the detailed grading plans included in the public improvement plans. Detailed calculations for the basin can be found in the tables located in Appendix C.

The Site Pond is in-line with Ragweed Draw and as such there will need to be two ponds to allow the WQCV to be treated prior to Ragweed Draw entering the pond. The WQCV pond will be located at the inflow to the ponds. An outlet structure with an orifice plate will control the outflow to allow for the treatment of the WQCV. The outflow of the WQCV Pond will flow into the trickle channel for the Detention Pond. The Detention Pond will consist of a trickle channel, micropool, and outlet structure. The EURV and 100 year flows will be treated in the Detention Pond. The WQCV is not treated in this pond.The outlet structure will have an orifice plate and restrictor plate. The pond outfalls to the proposed location by Commerce City in Ragweed Draw. Maintenance access to the ponds is provided from Potomac Street.

The Site will adhere to the Commerce City minimizing directly connected impervious area (MDCIA) criteria by demonstrating that homesite rooftop drainage will runoff over adjacent landscape areas to satisfy the requirement.

Per Table 14-1 of the CCC Drainage Criteria Manual, runoff reduction or minimizing directly connected impervious area (MDCIA) is required for development sites with a total disturbance of greater than or equal to one acre.

C. Variances

At this time, no deviation from required design criteria is anticipated. To the greatest extent possible, the Site will comply with current City of Commerce City criteria, including water quality, low impact development, and source control BMPs, as applicable.

V. CONCLUSIONS

A. Compliance with Standards

Drainage design for the Site will be performed in accordance with Commerce City Criteria and District Criteria, when appropriate.

The Site will demonstrate adherence to the MDCIA criteria for the MS4 Permit by demonstrating that rooftop runoff over adjacent landscape areas satisfies the requirement.

Major Drainageway Planning Studies implicated an EDB will be required for the Site. This requirement is being met through the construction of two EDB located in the southwest corner of the Site. One of the EDB will treat WQCV and the other will treat the EURV and 100-year flows.

The District Manual was used for the design of the Site only when instructed to by Commerce City Criteria. All criteria will be met.

B. Drainage Concept

The drainage design for this Site will result in improvements to the drainage control for this area. The proposed development will have no adverse drainage impacts on upstream or downstream properties. The proposed development will have no adverse drainage impacts on the Major Drainageway Planning Study. The proposed drainage controls will allow for seamless construction of the Reunion Pond B in the future.

C. Water Quality

The Site meets the MDCIA post-construction design standard by demonstrating that rooftop runoff over adjacent areas satisfies the requirements.

VI. LIST OF REFERENCES

1. *City of Commerce City Storm Drainage Design and Technical Criteria Manual; City of Commerce City, Colorado, December 2021*

2. *Urban Storm Drainage Criteria Manual (USDCM),* Mile High Flood District (MHFD, formerly known as Urban Drainage and Flood Control District, UDFCD)*:*
   Volume 1, Management, Hydrology and Hydraulics, Revised August 2018*.*
   Volume 2, Structures, Storage and Recreation, Revised September 2017*.*
   Volume 3, Stormwater Quality, Updated October 2019*.*

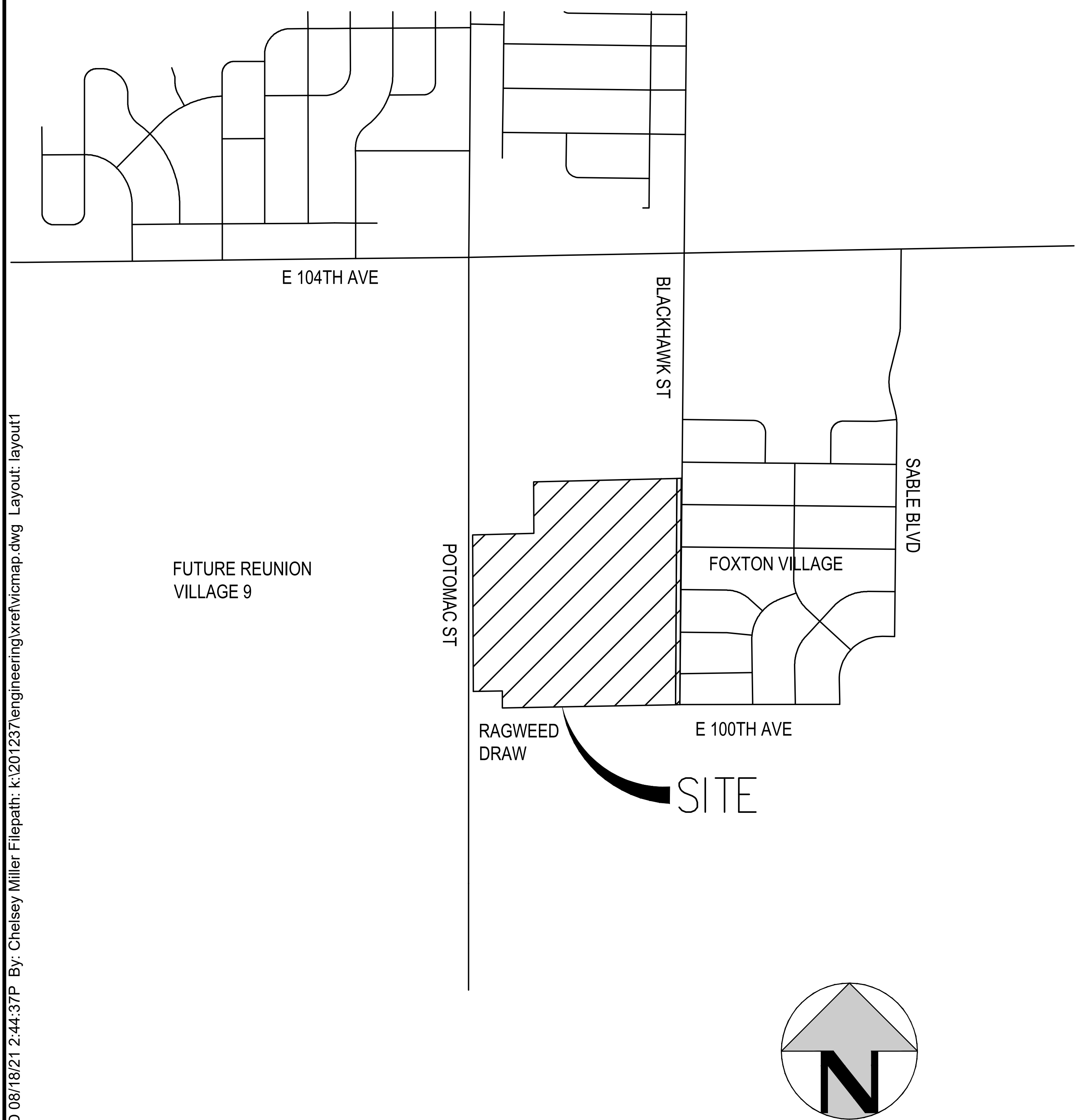
3. *Flood Insurance Rate Map, Adams County, Colorado, Map #08001C0339H, FEMA, revised October 2020.*

4. *Preliminary Drainage Report for Reunion Village 9; JR Engineering, LLC, May 20, 2020.*

5. *Second Creek, Third Creek, DFA 0053 & Barr Lake Drainage Basin Planning; Kiowa Engineering Corporation, January 1989.*

6. *Geotechnical Site Development Study Eberly Commerce City, Colorado; A. G. Wassenaar, Inc, January 26, 2021.*

APPENDIX A – Vicinity Map and FIRMette



VICINITY MAP

SCALE: 1"=800'

Plotted: WED 08/18/21 2:44:37P By: Chelsey Miller Filepath: k:\201237\engineering\xref\vicmap.dwg Layout: layout1

National Flood Hazard Layer FIRMette

FEMA

104°49'51"W 39°53'3"N

104°49'14"W 39°52'35"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
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 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 3/12/2021 at 2:46 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.

APPENDIX B – Reference Material and Supporting Documents

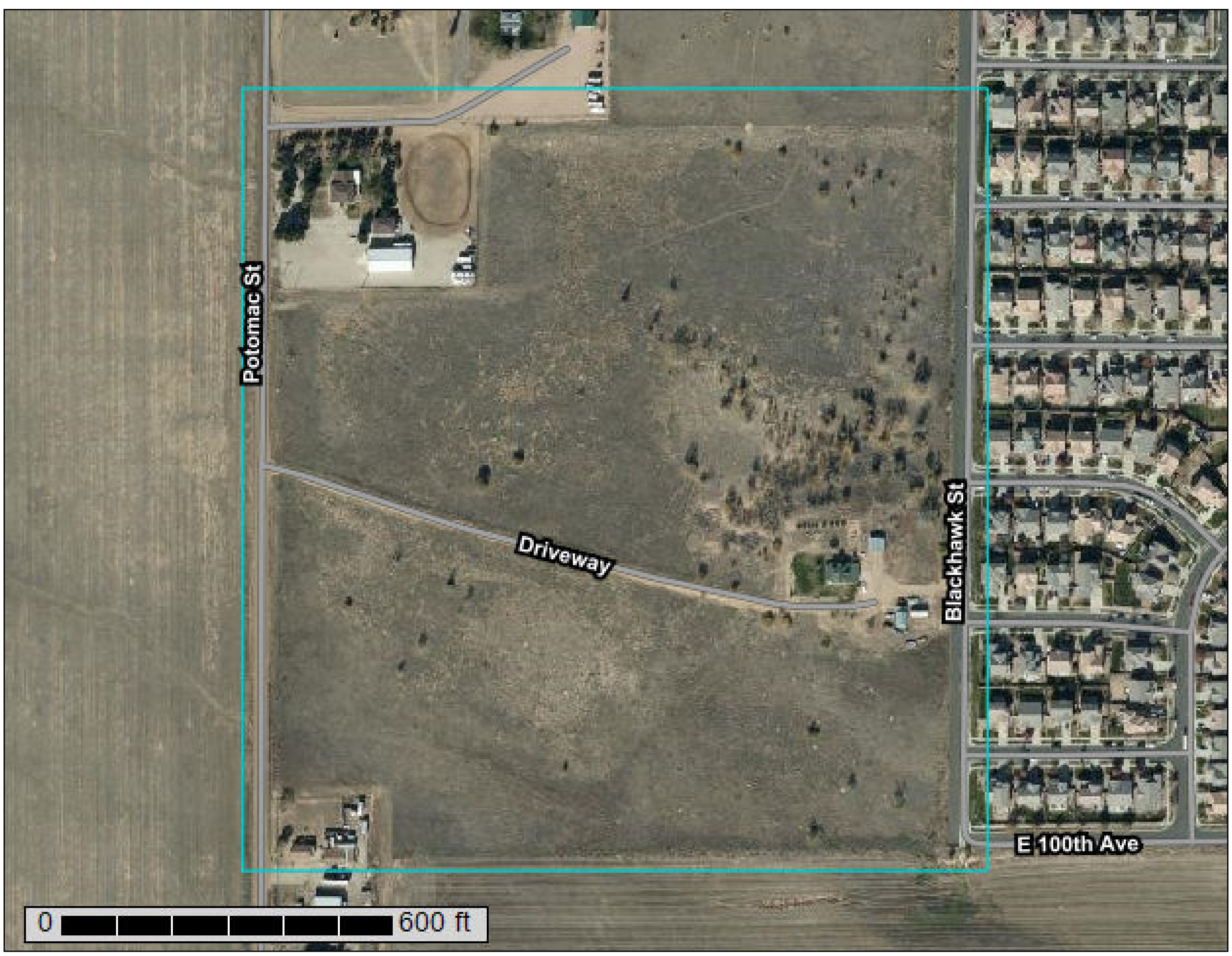
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

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



March 11, 2021

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.

Soil Map

Map Scale: 1:3,180 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

N

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Adams County Area, Parts of Adams and Denver Counties, Colorado
Survey Area Data: Version 17, Jun 4, 2020

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

Date(s) aerial images were photographed: Oct 3, 2018—Dec 4, 2018

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AsB	Ascalon sandy loam, 0 to 3 percent slopes	0.0	0.0%
AvC	Ascalon-Vona sandy loams, 1 to 5 percent slopes	25.7	58.6%
PlB	Platner loam, 0 to 3 percent slopes	1.3	2.9%
TtD	Truckton loamy sand, 3 to 9 percent slopes	16.8	38.5%
Totals for Area of Interest		**43.8**	**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.

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

AsB—Ascalon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2swl3
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 135 to 160 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

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

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk - 19 to 35 inches: sandy clay loam
C - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 3 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 (0.60 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
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

AvC—Ascalon-Vona sandy loams, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2xst1
Elevation: 4,750 to 5,560 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

Ascalon and similar soils: 45 percent
Vona and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 10 inches: sandy loam

Bt - 10 to 15 inches: sandy clay loam
Btk - 15 to 21 inches: sandy loam
Bk1 - 21 to 35 inches: sandy loam
Bk2 - 35 to 80 inches: sandy loam

Properties and qualities

Slope: 1 to 3 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 (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Description of Vona

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands

Typical profile

Ap - 0 to 9 inches: sandy loam
Bt - 9 to 22 inches: sandy loam
Bk1 - 22 to 27 inches: sandy loam
Bk2 - 27 to 39 inches: sandy loam
Bk3 - 39 to 80 inches: loamy sand

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 (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 3.0

Available water capacity: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Ascalon, loamy sand surface

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Vona, loamy sand surface

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

PIB—Platner loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tln0
Elevation: 4,000 to 4,930 feet
Mean annual precipitation: 14 to 17 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 135 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Platner

Setting

Landform: Interfluves

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian deposits over tertiary aged alluvium derived from igneous, metamorphic and sedimentary rock

Typical profile

Ap - 0 to 6 inches: loam
Bt1 - 6 to 11 inches: clay
Bt2 - 11 to 20 inches: clay
Bk1 - 20 to 27 inches: loam
Bk2 - 27 to 37 inches: sandy clay loam
C - 37 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Available water capacity: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Minor Components

Ascalon

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Rago, rarely flooded

Percent of map unit: 4 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R067BY036CO - Overflow
Hydric soil rating: No

Rago, ponded

Percent of map unit: 1 percent
Landform: Playas
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R067BY010CO - Closed Upland Depression
Hydric soil rating: No

TtD—Truckton loamy sand, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 34wz
Elevation: 4,400 to 6,000 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 125 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Truckton

Setting

Landform: Plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from mixed

Typical profile

H1 - 0 to 9 inches: loamy sand
H2 - 9 to 21 inches: sandy loam
H3 - 21 to 32 inches: loamy sand
H4 - 32 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 9 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 (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water capacity: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Vona

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

Blakeland

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

Loup

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Tryon

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

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PRELIMINARY DRAINAGE REPORT
FOR
REUNION VILLAGE 9

May 20, 2020

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City of Commerce City Engineering Approval

Project No. 14421.29
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Proposed Sub-Basin Description

The full build-out condition of Reunion Village 9 has been subdivided into 39 Sub-Basins with 12 off-site Sub-Basins. Of the 51 total Sub-Basins, 49 Sub-Basins will be routed to the existing double 11'x3' box culvert at E 104th Avenue in the DFA-0053 Basin. Two Sub-Basins are within the First Creek Basin and will undergo detention and water quality prior to being routed to First Creek.

Of the 49 Sub-Basins within the DFA-0053 Basin, five Sub-Basins (Sub-Basins 9F1-9F5), will undergo detention and water quality in Pond F prior to being routed to an existing 9'x3' box culvert which connects to the double 11'x3' box culvert at E 104th Avenue. Of these five Sub-Basins, Sub-Basin 9F5 is routed to a proposed detention pond, Pond F5, for peak attenuation prior to discharging into Full-Spectrum Detention Pond F.

Of the 49 Sub-Basins within the DFA-0053 Basin, 34 Sub-Basins within the Ragweed Draw Basin will be routed through three on-line Full-Spectrum detention ponds prior to discharging at E 104th Avenue. The ponds are named Pond A, Pond B and Pond C respectively, with Pond A being the last pond final pond before discharging at E 104th Avenue. These three ponds will to reduce the developed 100-year peak discharge at the downstream end of the site to 50 percent of historic levels, which is proposed in order to provide a benefit to downstream property owners and existing undersized receiving infrastructure along the Ragweed Draw drainageway

Of the Ragweed Draw Sub-Basins, thirteen sub-basins are routed to Pond A, fourteen sub-basins are routed to Pond B and seven sub-basins are routed to Pond C. Per the MS4 permit requirements effective July 1, 2019 (COR090000), or the standards in place at the time of submittal, the runoff from the areas tributary to Ponds B and C will be required to provide water quality prior to discharging into Ragweed Draw. Phase 1 of the Reunion Village 9 development was submitted prior to the July 1, 2019 deadline and is <u>not</u> required to meet the new MS4 permit criteria. Phase 1 includes the area tributary to Pond A and is not required to provide water quality prior to discharging into Ragweed Draw. Phase 1 will be required to provide for sediment capture by means of one-foot sumps in the last storm sewer inlets prior to discharging into Ragweed Draw.

Of the 49 Sub-Basins within the DFA-0053 Basin, seven Sub-Basins will be routed to an off-line Full-Spectrum regional detention Pond T before discharging at E 104th Avenue. Off-site Sub-Basins (Sub-Basins 9OS6 and 9OS10), primarily located in the Turnberry property and located west of the Reunion Village 9 site, are proposed to undergo over-detention and water quality in Pond T prior to being routed to the existing double 11'x3' box culvert at E 104th Avenue in the DFA-0053 Basin. Sub-Basin 9OS10 includes a portion of Reunion Ridge Way and is within the Turnberry and Reunion properties. Per the *Turnberry South Final Drainage Study*, by CVL Consultants, dated May 2019, the Turnberry site within Sub-Basin 9OS6 is planned to be primarily residential with an imperviousness of 55%. The proposed Sub-Basin 9OS6 delineation is primarily based on the Turnberry Drainage Report. Per the report, the Sub-basin 9OS6 was planned to outfall into an on-site Full-Spectrum detention pond and has since then been revised to outfall into Pond T which lies in both the Reunion and Turnberry properties. This Turnberry Drainage Report has not yet been approved. Excerpts from the Turnberry Drainage Report are included in **Appendix E.**

Of the 12 off-site basins, three Sub-Basins (Sub-Basins 9OS7-9OS9) are currently discharging at E 104th Avenue un-detained/untreated and will continue to do so in the developed condition.

Within the Reunion Village 9 site, 2 Sub-Basins (Sub-Basin 9E1 and Sub-Basin 9D1), are within the First Creek Basin and will undergo detention and water quality in proposed Full-Spectrum Detention Pond D prior to outfalling into First Creek.

The general flow patterns are in conformance with the previously approved studies except for Sub-basin 204 (reclassified as proposed conditions Sub-basin OS2c) of the 2017 Second Creek OSP and the proposed conditions Sub-basins that include the existing Sub-basins HS07, H13a, H13b, H79a and H79b. Per the previously approved studies, Sub-Basins HS07, HS13a, and HS13b were assumed to be routed to the Henderson Creek Basin and not the Ragweed Draw Basin prior to outfalling into the South Platte River. It is expected that the Sub-basin HS07, HS13a, and HS13b flows will be routed to Ragweed Draw when developed. Per the 2004 DFA-0053 OSP, the flows from the Henderson Creek and Ragweed Draw basins are planned to be combined north of 112th Avenue so the deviation is expected to cause minimal impact. Per the 2017 Second Creek OSP, Sub-Basins HS79a and HS79b were assumed to be routed to Second Creek and not the Ragweed Draw Basin prior to outfalling into the South Platte River. It is expected that the flows with Sub-basin H79a from the site will be routed to Ragweed Draw when developed and a majority of the flows with H79b will be routed to the Ragweed Draw basin. Except for the Sub-Basins stated above, the general flow patterns are in conformance with previously approved studies and no transfer of runoff is proposed with these improvements.

Basin percent impervious values were calculated based on proposed/future land use. Weighted percent impervious values (as specified in Table 6-3 from the USDCM) were utilized to calculate the composite percent impervious values for each Sub-Basin. The impervious value determined for the residential developments was an overall average of the residential lots combined with the internal roadways and equates to an approximate 55% imperviousness. The acreages chosen for the future asphalt, concrete and tree-lawn areas within the roadway right-of-way are based on the typical roadway cross-sections per Commerce City criteria. Percentages for the asphalt, concrete and lawns were applied to the overall area within the right-of-way were based on the roadway classification and the typical cross section.

Within the proposed future right-of-way, the asphalt, concrete and tree lawn percentages were applied as follows dependent on the road classification:

- Minor Arterial - (Asphalt – 45%, Concrete – 15%, Tree Lawn – 40%)
- Multimodal Arterial - (Asphalt – 50%, Concrete – 20%, Tree Lawn – 30%)
- Major Collector - (Asphalt – 65%, Concrete – 15%, Tree Lawn – 20%)
- Minor Collector – (Asphalt – 65%, Concrete – 25%, Tree Lawn – 10%)

Sub-Basin 9E2	
Total Area (ac): 5.0	% Imperviousness: 59.3%
Description/Location:	
Includes a portion of the proposed 96th Avenue Right-of-Way. The Sub-basin is located south of Sub-basin 9A7. The runoff is expected to flow west to Node JA13 and piped to Pond T.	

Sub-Basin 9OS5	
Total Area (ac): 4.1	% Imperviousness: 2.0%
Description/Location:	
An off-site sub-basin with primarily undeveloped land within the Rocky Mountain Arsenal. The Sub-basin is located south of 96th Avenue and Sub-basins 9E2. The runoff flows north to 96th Avenue to Node JA13 and piped to Pond T.	

Sub-Basin 9OS6	
Total Area (ac): 18.8	% Imperviousness: 60.0%
Description/Location:	
Includes the future Turnberry Site to the west of the site and is expected to be residential. The runoff is expected to be detained and treated for water quality prior in Pond T before discharging at Node J3. The flows are then routed to the existing 11'x3' RCBC at Node J1 at E. 104th Avenue.	

Sub-Basin 9OS10	
Total Area (ac): 0.9	% Imperviousness: 56.2%
Description/Location:	
Includes a portion of the PSCO Right-of-Way and the future Reunion Ridge Way located east of the future Revere Street and is located within the Turnberry and Reunion properties. The runoff is planned to flow to a future sump inlet in Reunion Ridge Way. The flows are treated and detained in Pond T before discharging at Node J3. The flows are then routed to the existing 11'x3' RCBC at Node J1 at E. 104th Avenue.	

Ragweed Draw Basin (Basin DFA 0053) – Full-Spectrum Detention Pond B

Sub-Basin 9B3	
Total Area (ac): 2.9	% Imperviousness: 87.7%
Description/Location:	
Includes the northern portion of the proposed Sable Boulevard south of 100th Avenue. The Sub-basin is located west of Sub-basin 9OS1 and east of Sub-Basin 9B2a. The runoff is expected to flow the low point at Node JB3 and then piped to Node JB1 before discharging into Pond B.	

Sub-Basin 9B2a	
Total Area (ac): 105.4	% Imperviousness: 55.0%
Description/Location:	
Planned to be primarily a mixed use development with a portion of single-family residential and parks. The Sub-basin is located north of 96th Ave, west of Sub-basins 9C1 and 9OS1, and east of Sub-Basin 9A7. The runoff is expected to flow northwest to the low point at Node JB1 and piped to Pond B.	

Sub-Basin 9B2b	
Total Area (ac): 4.9	% Imperviousness: 55.0%
Description/Location:	
Planned to be primarily a single-family residential and parks. The Sub-basin is located north of Sub-basin 9B2a, west of Sub-basins 9B1b, and south/east of Sub-Basin 9B3. The runoff is expected to flow to the low point at Node JB3, piped to Node JB1 and then piped to Pond B.	

Sub-Basin 9B1a	
Total Area (ac): 9.4	% Imperviousness: 73.4%
Description/Location:	
Includes a portion of the school site and 100th Avenue. The Sub-basin is located south of Pond B and adjacent to Sub-basin 9A5c. The runoff is expected to flow north and discharge into Pond B.	

Sub-Basin 9B1b	
Total Area (ac): 6.8	% Imperviousness: 67.8%
Description/Location:	
Includes a portion of the school site and 100th Avenue. The Sub-basin is located east of Pond B and adjacent to Sub-basin 9B2b. The runoff is expected to flow west and discharge into Pond B.	

Sub-Basin 9B0	
Total Area (ac): 13.3	% Imperviousness: 100.0%
Description/Location:	
Contains the full-spectrum detention Pond B tract and is located south Sub-Basin OS2b. The runoff flows directly into Pond B.	

Sub-Basin 9E5	
Total Area (ac): 0.9	% Imperviousness: 59.3%
Description/Location:	
Includes a portion of the proposed 96th Avenue Right-of-Way. The Sub-basin is located south of Sub-basin 9B2a, north of the Rocky Mountain Arsenal, west of Sub-basin 9E6 and east of Sub-basin 9E4. The runoff is expected to flow east to Sable Boulevard and then north to Node JB2 before discharging into Ragweed Draw routed to Pond B.	

Sub-Basin 9E4	
Total Area (ac): 3.0	% Imperviousness: 59.3%
Description/Location:	
Includes a portion of the proposed 96th Ave Right-of-Way. The Sub-basin is located south of Sub-basin 9B2a, north of the Rocky Mountain Arsenal, west of Sub-basins 9E5 and 9E6 and east of Sub-basin 9E3. The runoff is expected to flow to Node JB5 in 96th Ave and piped to Node JB5 and piped to Pond B.	

Sub-Basin 9E3	
Total Area (ac): 2.9	% Imperviousness: 59.3%
Description/Location:	
Includes a portion of the proposed 96th Avenue Right-of-Way. The Sub-basin is located south of Sub-basin 9B2a, north of the Rocky Mountain Arsenal, west of Sub-basin 9E2 and east of Sub-basin 9E4. The runoff is expected to flow to Node JB4 in 96th Avenue and piped to Pond B.	

Sub-Basin 9OS1	
Total Area (ac): 9.3	% Imperviousness: 2.0%
Description/Location:	
An off-site sub-basin with primarily undeveloped land. The Sub-basin is located east of the Sable Boulevard and north of Sub-basin 9C0. The runoff flows west to the low point in Sable Boulevard (Node JB2) before discharging into Pond B.	

Sub-Basin 9OS2b	
Total Area (ac): 33.8	% Imperviousness: 25.0%
Description/Location:	
An off-site sub-basin with primarily undeveloped land and is expected to be converted to a park/playground. The Sub-basin is located east of Potomac Street, west of the existing Foxton Village residential property and Sub-basin 9OS2c, and south of Sub-basin 9OS2a. The runoff is planned to flow south to the proposed Pond B.	

Sub-Basin 9OS2c	
Total Area (ac): 3.6	% Imperviousness: 55.0%
Description/Location:	
An off-site sub-basin within the existing Foxton Village residential property. The Sub-basin is located east of Sub-basin 9OS2b and north of the proposed 100th Avenue. The runoff flows south to 100th Avenue before discharging into Pond B.	

Sub-Basin 9OS4	
Total Area (ac): 22.8	% Imperviousness: 2.0%
Description/Location:	
An off-site sub-basin with primarily undeveloped land within the Rocky Mountain Arsenal. The Sub-basin is located south of 96th Avenue and Sub-basin 9E4. The runoff flows north and is expected to be routed to the low point in 96th Avenue (Node JB5) before discharging into Pond B.	

Ragweed Draw Basin (Basin DFA 0053) – Full-Spectrum Detention Pond C

Sub-Basin 9C2	
Total Area (ac): 40.1	% Imperviousness: 55.0%
Description/Location:	
Planned to be single-family residential. The Sub-basin is located north of 96th Avenue, south of the existing property under Adams County jurisdiction, west of Chambers Road and east of Sub-basin 9C1. The runoff is expected to flow north/south to Ragweed Draw (Node JC2) before discharging into Pond C.	

Sub-Basin 9C1	
Total Area (ac): 22.7	% Imperviousness: 55.0%
Description/Location:	
Planned to be single-family residential. The Sub-basin is located north of 96th Ave, south of the existing property under Adams County jurisdiction and Sub-basin 9OS1, east of Sable Blvd, and west of Sub-basin 9C2. The runoff is expected to flow north/south to Ragweed Draw (Node JC1) before discharging into Pond C.	

February 2017) was utilized to determine the required WQCV and EURV volumes for the Pond Basins. Detention times for the pond basins are in accordance with the State Law CRS 37-92-602(8).

Hydrologic routing is performed using the U.S. Environmental Protection Agency's Stormwater Management Model (EPA-SWMM) Version 5.1, Release 5.1.012. The site has been modeled with the channel and includes the detention provided by Ponds A, B, C, D, T, F and F5.

All hydrologic calculations and applicable charts and graphs are included in **Appendix B** of this report.

V. DRAINAGE FACILITY DESIGN

General Concept

The drainage plan for Reunion Village 9 and District roadways generally follows the patterns established in the *Master Drainage Report for Reunion*. The overall plan for Village 9 involves conveying stormwater discharges to District water quality/detention facilities which then discharge to existing and planned infrastructure. A majority of Reunion Village 9 ultimately drains to the existing double 11'x3' box culvert at E 104th Avenue and through the continuation of Ragweed Draw to the DFA-0053 Basin. Another portion of the Reunion Village 9 site outfalls into First Creek.

One of the major elements proposed herein is the voluntary over-detention of stormwater runoff in Reunion Village 9 in detention ponds along Ragweed Draw. The intent is to reduce the 100-year peak discharge at the downstream end of the site to 50 percent of historic levels, which is proposed in order to provide a benefit to downstream property owners and existing undersized receiving infrastructure along the Ragweed Draw drainageway.

E 104th Avenue Outfall

The E 104th Avenue Outfall was introduced in the *Second Creek (Downstream of DIA) and DFA 0053 Watersheds Outfall Systems Planning Study Update*, by Kiowa Engineering Corporation, dated July 2004 (Second Creek OSP). In the Second Creek DFA-0053 OSP, the Ragweed Draw Channel was shown as a grass-lined channel from Chambers Road to E 104th Avenue. At the time of the study, channels were designed with drop structures for hydraulic grade control and adjust for steep grades. Per MHFD criteria, naturalized channel designs are now preferred and will be proposed with Reunion Village 9. At E 104th Avenue, the Ragweed Draw channel outfalls beyond to the north and continues northwest through the DFA-0053 Basin. Reunion Village 9 is proposing to reduce offsite discharges in Ragweed Draw to 50 percent of historic levels.

Stormwater Detention and Allowable Discharges

The Ragweed Draw Channel from Chambers Road to E 104th Avenue has been designed with three proposed Full-Spectrum detention ponds in-line with the channel. The ponds are named Pond A, Pond B and Pond C respectively, with Pond A being the last and final pond before discharging at E 104th Avenue. The series of ponds have been designed to over-detain the flows for the entire site outside of the Pond D, Pond F, and Pond T Basins. Pond T is intended to over-detain and treat the southern half of the Ragweed Draw Basin including portions of Village 9 and portions of the Turnberry development.

The pre-development 100-year storm flows that outfall to DFA-0053 at E 104th Avenue is **466.7 cfs** (pre-development release rate calculations are provided in **Appendix B).** The DFA-0053 Basin includes the Ragweed Draw Basin and the Henderson Creek (Morning Glory) Basin. The 5-year minor storm pre-development release rate for the overall DFA-0053 Basin is **9.9 cfs** (pre-development release rate calculations included in **Appendix B)**. The existing double 3'x11' box culvert has been sized to carry **43 cfs** and **480 cfs** in the minor and major storms per the approved *E 104th Avenue Corridor Improvement Plans Phase One (East of CSH 2) Final Drainage Report*; CVL Consultants of Colorado Inc., June 23, 2005.

The existing drainage infrastructure downstream of E 104th Avenue is estimated to be unable to handle 90% of the pre-development 100-year peak stormwater discharge from Village 9. The detention pond within the Turnberry property downstream did not account for connecting the Ragweed Draw Basin upstream of E 104th Avenue and this on-line pond is undersized to accommodate the discharges from traditional Full-Spectrum Detention in Reunion Village 9. Accordingly, the allowable peak discharge from Village 9 Ponds A and T have been designed to target **50% of the pre-development 100-year peak runoff rate** for the entire Ragweed Draw Basin. This lower release will minimize the impact on the existing and future drainage infrastructure downstream of E 104th Avenue. In the minor storm, the allowable release will meet City and MHFD criteria with respect to peak runoff rate.

Pond F is designed to detain and treat the flows from the basin area south of E 104th Avenue and Pond F5 is designed to detain the flows from Basin 9F5 to reduce the peak discharges before outfalling into Pond F. With the tributary area less than 130 acres, Ponds F and F5 cannot be classified as regional detention. **The detention provided in Pond F and F5 cannot be accounted for in determining Ragweed Draw regional hydrology downstream of 104th Avenue.** Mile High Flood District is currently commissioning a study of Ragweed Draw by RESPEC, and the Reunion Village 9 Preliminary Drainage Report hydrology (excluding Ponds F and F5) has been provided.

The 50% over-detention target discharges at E 104th Avenue are 233.3 cfs (100-year) and 9.9 cfs (5-year).

This allowable discharge also complies with the approved *E 104th Avenue Improvement Plans Phase One (East of CSH 2) Final Drainage Report*, by CVL Consultants of Colorado, Inc., dated June 2005. Per the report, the box culverts were sized based on the design flows of 43 cfs (5-year) and 480 cfs (100-year) per the 2004 DFA-0053 OSP.

With over-detention provided in Ponds A, B, C, T, and F, the full basin build-out developed discharges at 104th Avenue are 225.6 cfs (100-year) and 9.3 cfs (5-year). Omitting detention provided in Ponds F and F5, the discharges at E 104th Avenue are 53.5 cfs (5-year) and 245.1 cfs (100-year).

Pond D is proposed to provide Full-Spectrum Detention for the portion of Village 9 tributary to First Creek at the ordinary required volumes and discharges.

The water quality/detention calculations and allowable release rate determinations are included in **Appendix C** of this report.

The historic/pre-development conditions CUHP output peak flows and runoff volumes are as follows:

Table 2 - Historic/Pre-development Discharges and Volumes at E 104th Avenue

Historic/Pre-development SWMM Node	Based on CUHP Output 100-year Volume (ac-ft)
Ragweed Draw Basin	**63.4**
Henderson Creek (Morning Glory)	**6.1**
Overall DFA-0053 Outfall (incl. Ragweed Draw and Henderson Creek Basins)	**69.4**
Second Creek Basin	**1.2**
First Creek Basin	**4.7**

Allowable Release Rates		Based on Release Rate Calculations	
		5-year (cfs)	100-year (cfs)
Ragweed Draw Basin Historic Rates		8.1	401.4
Henderson Creek (Morning Glory) Historic Rates		1.7	65.3
Overall DFA-0053 Outfall (incl. Ragweed Draw and Henderson Creek Basins)	**Historic Rates**	9.9	466.7
	Allowable Release Rates **5yr - 100% Historic** **100yr - 50% Historic**	**9.9**	**233.3**
Second Creek Basin	**Historic Rates**	**0.2**	**16.7**
First Creek Basin	**Historic Rates**	0.4	35.2
	Allowable Release Rates **5yr - 100% Historic** **100yr - 90% Historic**	**0.4**	**31.7**

Table 3 - Proposed Discharges at E 104th Avenue

Hydrograph Routing		
Discharge	**Peak $Q_{outflow}$ (cfs)**	
	5-Year	**100-Year**
DFA-0053 w/ Detention Provided in Ponds F and F5	9.3	225.6
J0 (w/ Detained JF0 Flows)	2.5	53.8
J1	7.3	176.6
J3 (Pond A and T)	6.4	173.3
DFA-0053 without Detention Provided in Ponds F and F5	53.5	245.1
JF0 – Detained	0.7	40.2
JF0 - Un-detained	45.8	140.9
1ST_CREEK	1.8	27.6

	Hydrograph Routing Based on SWMM Routing			
Outfall	Peak Inflow Volume (ac-ft)		Peak $Q_{outflow}$ (cfs)	
	5-YR	100-YR	5-YR	100-YR
DFA-0053	35.9	125.5	9.3	225.6
JF0	3.6	11.7	0.7	40.2
1ST_CREEK	1.0	4.2	1.8	27.6

Stormwater Detention Specific Details

All pond volume calculations and applicable charts and graphs are included in **Appendix C** of this report. The pond drain times for the routed 5-year and 100-year storms can be referenced in the EPA-SWMM pond graphs. The pre-development release rates and the pond basin drain times for the 5-year and 100-year storms are presented in the UD-Detention workbook and are based on the direct tributary area and meet maximum drain times from CRS §37-92-602 (8). The drain time results presented in the UD-Detention workbooks are not expected to be the same as in the SWMM routing due to the inclusion of upstream ponds' discharges in the hydrograph routing.

The EPA-SWMM graphs provided in **Appendix C** have annotations which show that the inflow volume for the respective direct drainage basins will fully drain from the ponds within the State-mandated drain times (72 hours for 97% of the 5-year or lower runoff; 120 hours for 99% of greater than 5-year runoff).

Proposed Full-Spectrum Detention and Water Quality Pond A

In the developed conditions, flows from the Ragweed Draw Basin of Reunion Village 9 (Sub-Basins 9A0, 9A5a – 9A5d, 9A4a – 9A4b, 9A3a – 9A3b, 9A2a – 9A2c, and 9OS2a) receive water quality and detention for peak attenuation in proposed Detention Pond A before E 104th Avenue. The Pond A watershed area is 138 acres and the imperviousness is 55%. Pond A will include a concrete forebay and a concrete trickle channel leading to an outlet structure.

As shown below, Pond A will release at approximately 38% of the pre-development peak runoff rate for the Pond A Basin. The design of the Pond A infrastructure was preliminarily designed based on the UD-Detention workbook for the immediately tributary Sub-Basins. Hydrologic routing confirms Pond A's sizing and release rates for the full basin build-out.

As shown in the table below, the drain times of the overall watershed routed to Pond A exceeds the minor and major year storm allowable drain times of 72 hours and 120 hours of CRS §37-92-602 (8). With Pond A in-line with Ragweed Draw, the pond will receive continuous flow from the upstream Ponds B and C but the direct drainage basin (Basin A) will fully drain from the pond within the CRS §37-92-602 (8)-prescribed drain times. As a result, the allowable pond drain time has been based on the immediate tributary area inflow volume of Pond A rather than the overall watershed routed to Pond A. In the minor storm, the EPA-SWMM pond graphs provided show that the discharge volume is approximately **13.7** ac-ft at 72 hours and exceeds the pond basin inflow volume of **7.1** ac-ft. In the major storm, the EPA-SWMM pond graphs provided show that the discharge volume is approximately **68.0** ac-ft at 120 hours and exceeds the pond basin inflow volume of **23.6** ac-ft.

Where the volume of the EURV in the most downstream basin is equal to or greater than the WQCV for the entire tributary area, MHFD considers this designed to provide equivalent treatment to sizing the most downstream basin for the entire tributary area. **The combined WQCV of Ponds A, B and C will be provided in Pond A and totals 8.22 ac-ft.** The WQCV and the EURV stages of the pond will still meet CRS §37-92-602 (8) drain times and the WQCV volume will meet the minimum 40-hour release.

Table 4 – Full-Spectrum Over-Detention Pond A Parameters

Hydrograph Routing / UD-Detention Workbook_v3.07							
	Inflow Volume (ac-ft)	Stored Volume (ac-ft)	Drain Time (99%) (hrs)	Stage (ft)	WSEL (ft)	Peak Q_{inflow} (cfs)	Peak $Q_{outflow}$ (cfs)
UD-Detention Workbook_v3.07 (Pond Basin only) - Combined WQCV for Ponds A, B, and C Tributary Area							
WQCV	2.53	2.32	41	3.90	5124.57	38.0	1.3
EURV	8.22	7.79	76	5.68	5126.35	120.7	2.3
5-YR	7.07	6.71	See SWMM Routing				
100-YR	23.55	19.10					
Hydrograph Routing - EPA-SWMM Version 5.1 (Overall Watershed)							
5-YR	21.42	8.64	148	5.86	5126.53	90.3	2.4
100-YR	75.49	20.65	200	7.89	5128.56	341.3	61.9

	Pre-development Release (cfs)	90% Pre-development Release (cfs)	Provided (%) Peak Discharge to Pre-development Release
100-YR	164.4	148.0	38%

Proposed Full-Spectrum Detention and Water Quality Pond B

In the developed conditions, flows from the Ragweed Draw Basin of Reunion Village 9 (Sub-Basins 9B0, 9B1a – 9B1b, 9B2a – 9B2b, 9B3, 9B4, 9E3-9E5, 9OS1, 9OS2b, 9OS2c and 9OS4) receive water quality and detention for peak attenuation in proposed Detention Pond B before releases are allowed to enter the proposed Ragweed Draw Channel west of Potomac Street. Pond B provides over-detention to minimize the peak flows entering Ragweed Draw and Pond A. The proposed over-detention Pond B will include a forebay and a trickle channel leading to an outlet structure. Flows will leave the pond via storm sewer and enter the Ragweed Draw channel west of Potomac Street.

As shown below, Pond B will release at approximately 9% of the pre-development peak runoff rate for the Pond B Basin. The design of the Pond B infrastructure was preliminarily designed based on the UD-Detention workbook for the immediately tributary Sub-Basins. Hydrologic routing confirms Pond B's sizing and release rates for the full basin build-out.

As shown in the table below, the drain times of the overall watershed routed to Pond B exceeds the minor and major year storm prescribed drain times of CRS §37-92-602 (8). With Pond B in-line with Ragweed Draw, the pond will receive continuous flow from the upstream Pond C but the direct drainage basin (Basin B) will fully drain from the pond within the CRS §37-92-602 (8)-prescribed drain times. As a result, the allowable pond drain time has been based on the immediate tributary area inflow volume of Pond B rather than the overall watershed routed to Pond B. In the minor storm, the EPA-SWMM pond graph provided shows that the discharge volume is approximately **12.6** ac-ft at 72 hours and exceeds the pond basin inflow volume of **8.6** ac-ft. In the major storm, the EPA-SWMM pond graph provided shows that the discharge volume is approximately **50.7** ac-ft at 120 hours and exceeds the pond basin inflow volume of **31.4** ac-ft.

The WQCV and the EURV stages of the pond will still meet CRS §37-92-602 (8) drain times and the WQCV volume will meet the minimum 40-hour release. The WQCV and EURV volumes of Pond B have been based on the direct tributary area to the pond, and not the overall Ragweed Draw Basin (which includes the watershed area upstream of Pond C).

The Pond B watershed area is 221 acres and the imperviousness is 47%.

Table 5 - Full-Spectrum Over-Detention Pond B Parameters

Hydrograph Routing / UD-Detention Workbook_v3.07							
	Inflow Volume (ac-ft)	Stored Volume (ac-ft)	Drain Time (99%) (hrs)	Stage (ft)	WSEL (ft)	Peak Q_{inflow} (cfs)	Peak $Q_{outflow}$ (cfs)
UD-Detention Workbook_v3.07 (Pond Basin only)							
WQCV	3.65	3.45	40	4.51	5147.51	78.7	1.5
EURV	11.34	10.88	71	6.25	5149.25	237.2	3.9
5-YR	8.61	8.20	See SWMM Routing				
100-YR	31.44	28.90					
Hydrograph Routing - EPA-SWMM Version 5.1 (Overall Watershed)							
5-YR	14.27	8.89	94	5.89	5148.89	173.9	3.5
100-YR	51.56	30.23	126	8.73	5151.73	630.6	24.5

	Pre-development Release (cfs)	90% Pre-development Release (cfs)	Provided (%) Peak Discharge to Pre-development Release
100-YR	289.5	260.6	8.5%

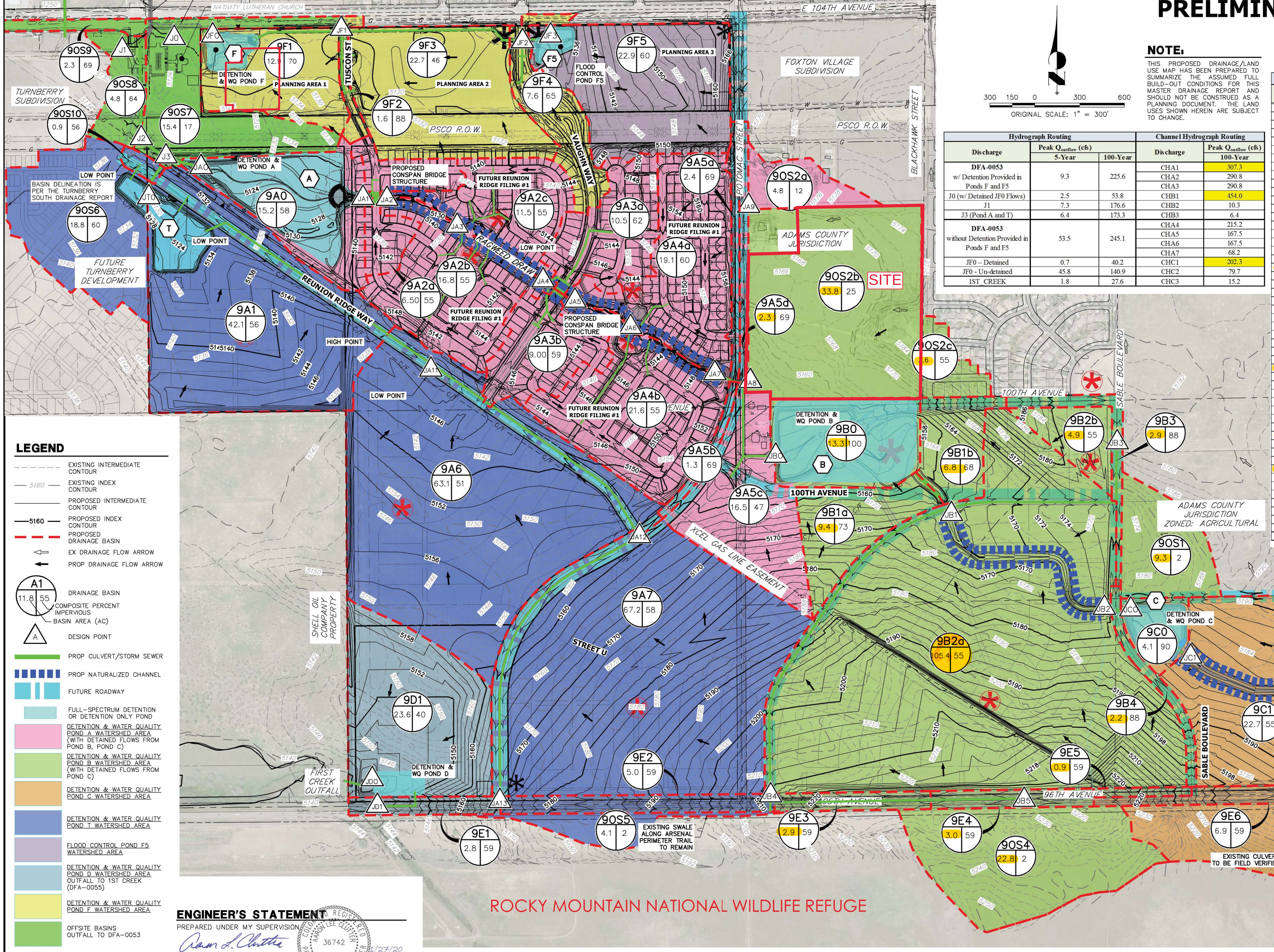
REUNION VILLAGE 9

COMMERCE CITY, ADAMS COUNTY

PRELIMINARY DRAINAGE REPORT

DRAINAGE MAP

WITH CONCEPTUAL GRADING



300 150 0 300 600
ORIGINAL SCALE: 1" = 300'

NOTE:

THIS PROPOSED DRAINAGE/LAND USE MAP HAS BEEN PREPARED TO SUMMARIZE THE ASSUMED FULL BUILD-OUT CONDITIONS FOR THIS MASTER DRAINAGE REPORT AND SHOULD NOT BE CONSTRUED AS A PLANNING DOCUMENT. THE LAND USES SHOWN HEREIN ARE SUBJECT TO CHANGE.

Hydrograph Routing			Channel Hydrograph Routing	
Discharge	Peak $Q_{outflow}$ (cfs) 5-Year	Peak $Q_{outflow}$ (cfs) 100-Year	Discharge	Peak $Q_{outflow}$ (cfs) 100-Year
DFA-0053 w/ Detention Provided in Ponds F and F5	9.3	225.6	CHA1	307.3
			CHA2	290.8
			CHA3	290.8
J0 (w/ Detained JF0 Flows)	2.5	53.8	CHB1	454.0
J1	7.3	176.6	CHB2	10.3
J3 (Pond A and T)	6.4	173.3	CHB3	6.4
DFA-0053 without Detention Provided in Ponds F and F5	53.5	245.1	CHA4	215.2
			CHA5	167.5
			CHA6	167.5
			CHA7	68.2
JF0 – Detained	0.7	40.2	CHC1	202.3
JF0 - Un-detained	45.8	140.9	CHC2	79.7
1ST_CREEK	1.8	27.6	CHC3	15.2

BASIN SUMMARY TABLE

Tributary Sub-basin	Total Area (ac)	Composite Percent Impervious	% A Soils	% B Soils	% C/D Soils	Q_5 (cfs)	Q_{100} (cfs)
9101a	4.3	59.3%	100.0%	0.0%	0.0%	5.5	17.4
9101b	22.6	55.0%	59.9%	40.1%	0.0%	17.7	65.2
9A0	15.2	57.8%	0.0%	39.2%	60.8%	9.9	34.8
9A1	42.1	56.3%	0.0%	59.9%	40.1%	36.3	128.8
9A2a	6.5	55.0%	0.0%	25.5%	74.5%	5.2	18.4
9A2b	16.8	55.0%	0.0%	30.8%	69.2%	13.1	46.3
9A2c	11.5	55.0%	0.0%	25.0%	75.0%	10.9	38.2
9A3a	10.5	62.0%	0.0%	61.6%	38.4%	7.3	24.4
9A3b	9.0	59.4%	0.0%	0.0%	100.0%	7.9	25.9
9A4a	19.1	60.0%	0.0%	64.6%	35.4%	17.4	58.9
9A4b	21.6	55.0%	0.0%	26.5%	73.5%	18.0	63.5
9A5a	2.4	68.6%	10.8%	82.1%	7.1%	0.9	3.1
9A5b	1.3	68.6%	0.0%	35.4%	64.6%	0.6	2.0
9A5c	16.5	47.1%	0.0%	96.5%	3.5%	7.8	33.2
9A5d	2.3	68.6%	13.0%	84.3%	2.6%	0.9	2.9
9A6	63.1	51.4%	0.0%	59.6%	40.4%	39.4	150.5
9A7	67.2	58.1%	2.7%	88.6%	8.7%	55.1	195.5
9B0	13.3	100.0%	47.4%	52.6%	0.0%	22.5	53.4
9B1a	9.4	73.4%	0.0%	100.0%	0.0%	12.3	36.2
9B1b	6.8	67.8%	26.6%	73.4%	0.0%	8.6	26.8
9B2a	105.4	55.0%	29.5%	70.5%	0.0%	113.5	416.1
9B2b	4.9	55.0%	59.2%	40.8%	0.0%	4.2	15.4
9B3	2.9	87.7%	29.3%	70.7%	0.0%	3.0	7.9
9B4	2.2	87.7%	0.0%	100.0%	0.0%	1.4	3.9
9C0	4.1	90.4%	0.0%	100.0%	0.0%	7.3	18.3
9C1	22.7	55.0%	1.4%	98.6%	0.0%	22.7	83.4
9C2	40.1	55.0%	50.2%	49.8%	0.0%	30.9	113.9
9D1	23.6	40.0%	0.0%	94.5%	5.5%	11.1	52.9
9E1	2.8	59.3%	1.8%	98.2%	0.0%	1.6	5.8
9E2	5.0	59.3%	25.0%	75.0%	0.0%	2.8	9.9
9E3	2.9	59.3%	33.4%	66.6%	0.0%	1.4	22.1
9E4	3.0	59.3%	100.0%	0.0%	0.0%	1.2	4.2
9E5	0.9	59.3%	100.0%	0.0%	0.0%	0.3	1.0
9E6	6.9	59.3%	43.5%	56.5%	0.0%	2.8	10.1
9F1	12.9	69.9%	0.0%	100.0%	0.0%	15.4	47.1
9F2	1.6	87.7%	0.0%	100.0%	0.0%	1.5	3.9
9F3	22.7	45.6%	0.0%	99.1%	0.9%	9.9	43.9
9F4	7.6	65.0%	0.0%	100.0%	0.0%	4.9	16.5
9F5	22.9	60.3%	41.9%	58.1%	0.0%	18.1	62.5
9OS1	9.3	2.0%	58.5%	41.5%	0.0%	0.1	9.2
9OS10	0.88	56.2%	0.0%	100.0%	0.0%	0.9	3.3
9OS2a	4.8	12.0%	0.0%	100.0%	0.0%	0.5	7.1
9OS2b	33.8	25.0%	28.1%	71.9%	0.0%	7.4	53.8
9OS2c	3.6	55.0%	50.0%	50.0%	0.0%	2.9	10.6
9OS3	23.9	2.0%	55.5%	44.5%	0.0%	0.1	6.5
9OS4	22.8	2.0%	99.6%	0.4%	0.0%	0.1	17.4
9OS5	4.1	2.0%	52.0%	48.0%	0.0%	0.0	2.9
9OS6	18.8	60.0%	0.0%	92.0%	8.0%	17.9	61.5
9OS7	15.4	17.4%	0.0%	94.4%	5.6%	2.1	19.6
9OS8	4.8	64.1%	0.0%	100.0%	0.0%	4.0	13.1
9OS9	2.3	69.1%	0.0%	100.0%	0.0%	1.2	3.9
TOTAL	**801.0**	**50.7%**					

LEGEND

- EXISTING INTERMEDIATE CONTOUR
- EXISTING INDEX CONTOUR (5160)
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED INDEX CONTOUR (5160)
- PROPOSED DRAINAGE BASIN
- EX DRAINAGE FLOW ARROW
- PROP DRAINAGE FLOW ARROW
- DRAINAGE BASIN (A1 / 11.8 / 55): BASIN AREA (AC), COMPOSITE PERCENT IMPERVIOUS
- DESIGN POINT (A)
- PROP CULVERT/STORM SEWER
- PROP NATURALIZED CHANNEL
- FUTURE ROADWAY
- FULL-SPECTRUM DETENTION OR DETENTION ONLY POND
- DETENTION & WATER QUALITY POND A WATERSHED AREA (WITH DETAINED FLOWS FROM POND B, POND C)
- DETENTION & WATER QUALITY POND B WATERSHED AREA (WITH DETAINED FLOWS FROM POND C)
- DETENTION & WATER QUALITY POND C WATERSHED AREA
- DETENTION & WATER QUALITY POND T WATERSHED AREA
- FLOOD CONTROL POND F5 WATERSHED AREA
- DETENTION & WATER QUALITY POND D WATERSHED AREA OUTFALL TO 1ST CREEK (DFA-0055)
- DETENTION & WATER QUALITY POND F WATERSHED AREA
- OFFSITE BASINS OUTFALL TO DFA-0053
- PROPOSED PARK

ENGINEER'S STATEMENT

PREPARED UNDER MY SUPERVISION

Aaron L. Clutter

AARON L. CLUTTER, P.E.
COLORADO P.E. 36742
FOR AND ON BEHALF OF JR ENGINEERING

1/27/20
DATE

COLORADO REGISTERED AARON LEE CLUTTER 36742 PROFESSIONAL ENGINEER

PRELIMINARY DRAINAGE MAP
REUNION VILLAGE 9
JOB NO. 14421.29
1/27/20
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

REUNION VILLAGE 9

COMMERCE CITY, ADAMS COUNTY

MASTER DRAINAGE REPORT

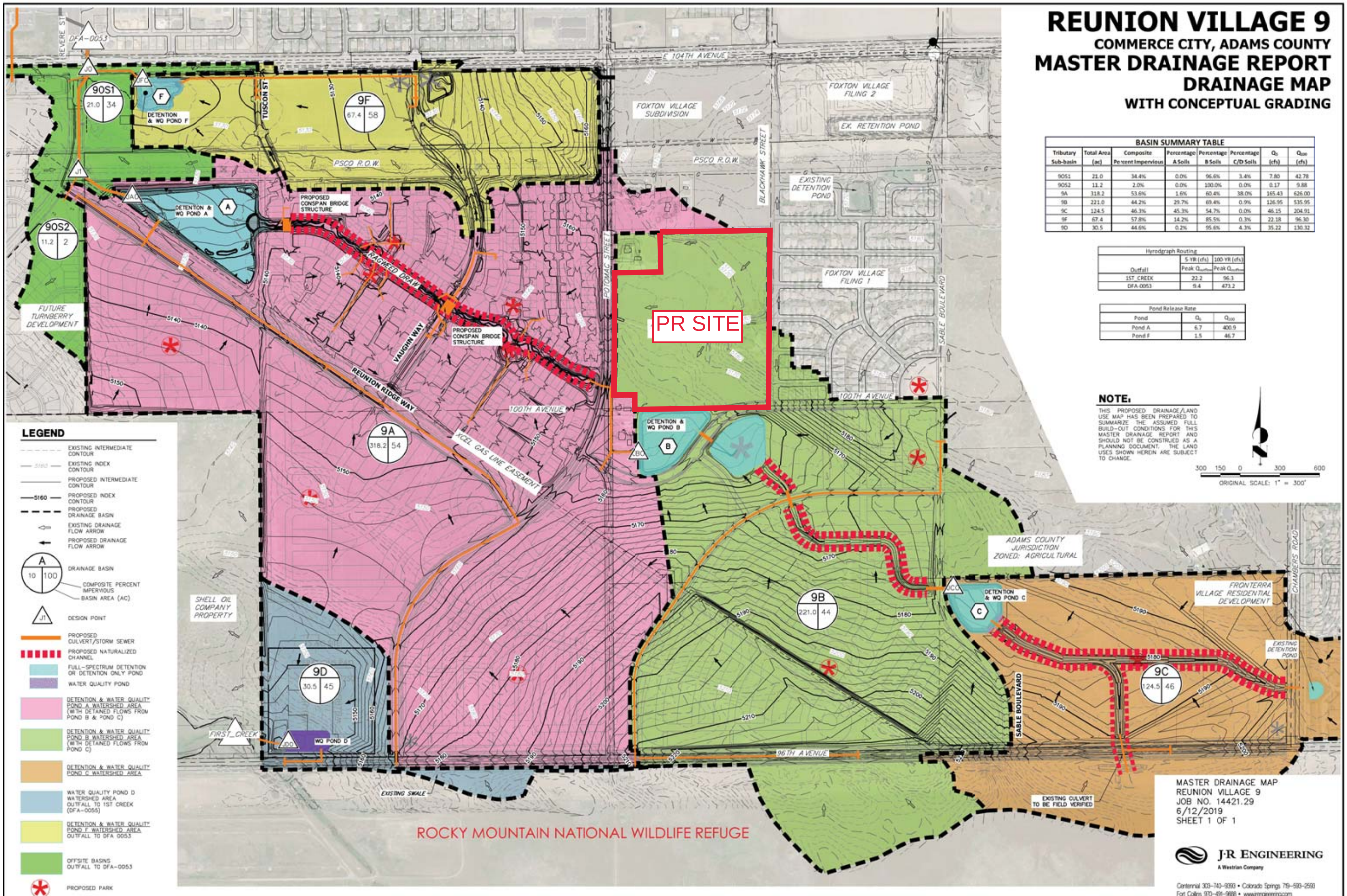
DRAINAGE MAP

WITH CONCEPTUAL GRADING

BASIN SUMMARY TABLE							
Tributary Sub-basin	Total Area (ac)	Composite Percent Impervious	Percentage A Soils	Percentage B Soils	Percentage C/D Soils	Q_5 (cfs)	Q_{100} (cfs)
9OS1	21.0	34.4%	0.0%	96.6%	3.4%	7.80	42.78
9OS2	11.2	2.0%	0.0%	100.0%	0.0%	0.17	9.88
9A	318.2	53.6%	1.6%	60.4%	38.0%	165.43	626.00
9B	221.0	44.2%	29.7%	69.4%	0.9%	126.95	535.95
9C	124.5	46.3%	45.3%	54.7%	0.0%	46.15	204.91
9F	67.4	57.8%	14.2%	85.5%	0.3%	22.18	96.30
9D	30.5	44.6%	0.2%	95.6%	4.3%	35.22	130.32

Hyrodgraph Routing		
	5-YR (cfs)	100-YR (cfs)
Outfall	Peak Q	Peak Q
1ST_CREEK	22.2	96.3
DFA-0053	9.4	473.2

Pond Release Rate		
Pond	Q_5	Q_{100}
Pond A	6.7	400.9
Pond F	1.5	46.7



Ronald P Eberly
10070 Potomac St.
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Managing Principal
United Development Companies
6900 E. Belleview Avenue, Ste. 300
Greenwood Village, CO 80111

James Hayes
Director of Land Acquisition and Development
Oakwood Homes, LLC

Craig Campbell
President – West Region
Starwood Land Ventures

March 9, 2021

Re: Regional Pond for Ragweed Draw at Potomac Street

To all:

Background

Phase 1 Final Drainage Report for Reunion Village 9 was approved by the City on June 16, 2020. The report references a Temporary Detention Pond B to be converted to a full spectrum detention facility in the "Ultimate Condition" and also references a preliminary drainage report. The preliminary drainage report shows sub-basin 9OS2b; hereafter referred to as the Eberly property (Parcel Number: 0172300000147) contributing to a regional detention facility to be located on Reunion Village Filing 9 property (Parcel Number: 0172318300002).

In order to limit Stormwater peak discharge rates from overwhelming downstream drainage facilities on Ragweed Draw, it was proposed to maximize the attenuation capabilities of Pond B and reduce the peak discharge rates to 50% of their pre-developed condition. To that end, the plan was to have a large almost 10-acre regional stormwater facility at the Pond B location. A Land Acquisition exhibit, developed by JR Engineering, shows that half of Pond B would be located on the Eberly property (currently located in unincorporated Adams County) and half located on Reunion Village 9 property (due south of the Eberly property). In a February 23rd, 2020 meeting to discuss the issue, the developers of the Eberly property objected to a large regional pond and would rather have an option to "pay into" the use of a regional pond that would be located entirely on the Reunion Village 9 property.

Currently, the Reunion Village 9 development is taking fill from the site of the pond using the fill from it for development west of Potomac. The site currently does not have an outfall structure located on their property.

Commerce City's Position

It is Commerce City's position that portions of a regional pond should be located both on the Eberly property and Reunion Village 9 properties. The regional facility should, at a minimum, be designed to provide Full Spectrum Detention (FSD) in accordance with the Storage chapter of the MHFD Manual. This will determine the amount of land that the Eberly property needs to contribute to the regional facility.

Since development on the two properties is to proceed on different timeline, with the Eberly property expected to occur first, design of the Eberly Pond needs to occur with possible future expansion in mind. Commerce City and MHFD also indicated that the preferred outfall of the regional facility should be located on the Eberly property as this is where Ragweed Draw currently crosses Potomac Street.

Commerce City also recommends to both developers Low Impact Development (LID) strategies that minimize directly connected impervious areas (MDCIA) and promote onsite storage and infiltration in order to minimize retention requirements. MHFD Volume 3 Urban Storm Drainage Criteria demonstrates ways of quantifying these volume reductions.

When the final design of the regional detention facility is to be completed, it is to be designed in accordance with the MHFD Manual and the requirements in Colorado Revised Statues (CRS) §32-11-221(1) for drainage facilities. The regional facility must be design to meet the MHFD's Maintenance Eligibility requirements and must satisfy the design, construction, and vegetation criteria and requirements in the most current version of the MHFD Manual and Maintenance Eligibility Guidelines (downloadable from MHFD's website).

Regarding a residential collector to serve a future park/school site, it is the City's position that the proposed 100th Ave alignment not run northward through the Eberly property but that it run south through Reunion Village 9.

Regarding the possibility of Commerce City contributing funds for the design and construction of this regional facility in the Henderson/Ragweed Basin, it has been determined that the City does not have enough funds to assist.

If you have any question, please feel free to contact me at 303-289-8175.

Respectfully,

Brent Soderlin

Brent Soderlin, P.E., CFM, City Engineer

BS/ca

cc: Roger Tinklenberg, Interim City Manager
Joe Wilson, Director of Public Works
Jason Rogers, Community Development Director
Steve Timms, Planning Manager
Chris Hodyl, Development Review Manager
Jenna Lowery, Management Analyst II

e-file: O:\Development\Subject\Ragweed Draw\Ragweed Draw_030921_V2.docx

SECOND CREEK, THIRD CREEK DFA 0053 & BARR LAKE

DRAINAGE BASIN PLANNING

ALTERNATIVE DEVELOPMENT & EVALUATION

URBAN DRAINAGE & FLOOD CONTROL DISTRICT

ADAMS COUNTY

CITY OF AURORA

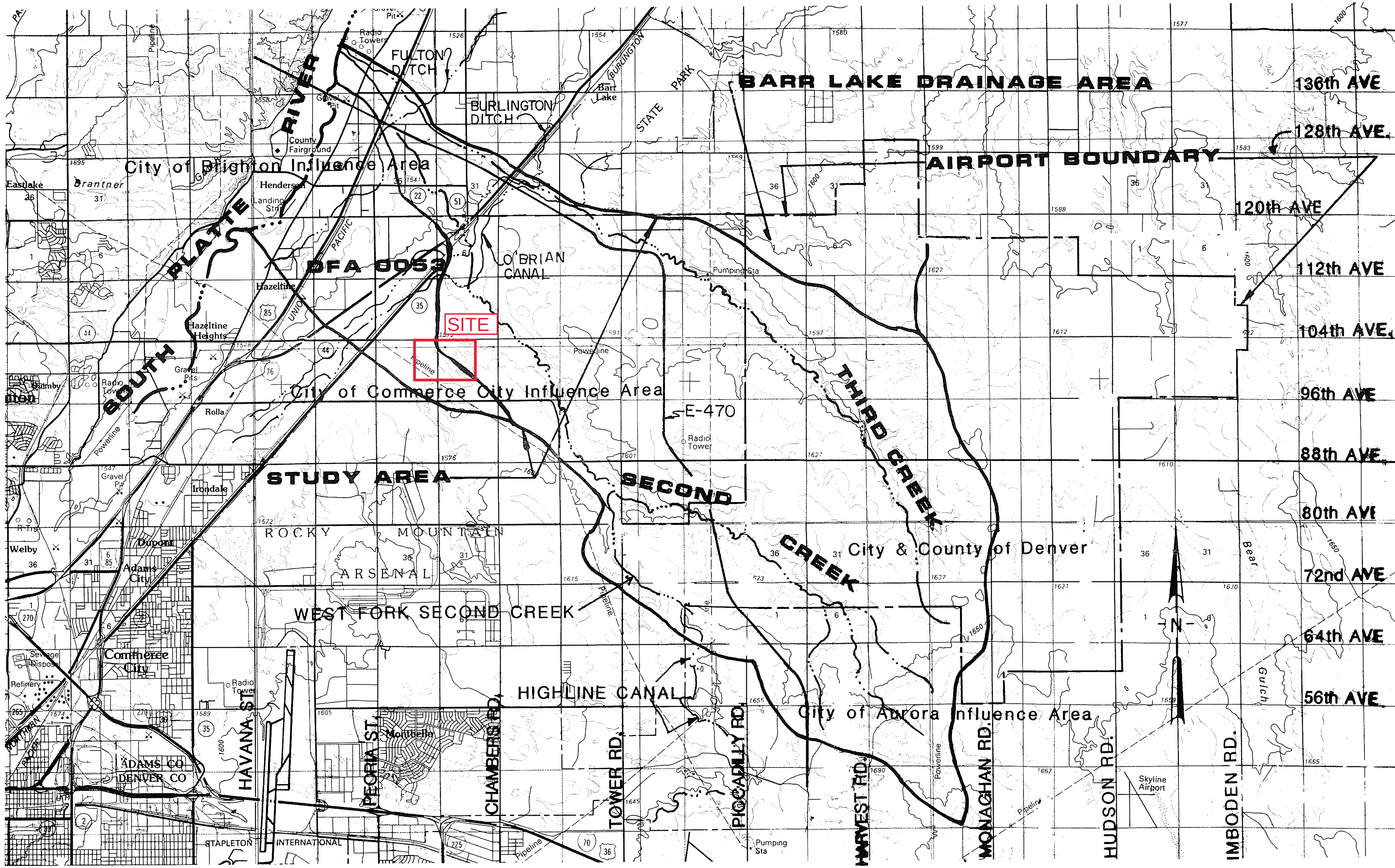
CITY OF BRIGHTON

CITY OF COMMERCE CITY

CITY AND COUNTY OF DENVER

JANUARY, 1989

KIOWA ENGINEERING CORPORATION



Kiowa Engineering Corporation	DESIGNED TF DATE 4/88 CHECKED JC DATE 4/88 DRAWN EK DATE 4/88 REVISED DATE	SECOND CREEK, THIRD CREEK & DFA 0053 OUTFALL PLAN	URBAN DRAINAGE & FLOOD CONTROL DISTRICT	STUDY AREA MAP	1

Third Creek

Third Creek drains approximately 31 square miles of area to the South Platte River. The basin is about 14 miles long and about 3.2 miles wide at the widest location. The basin elevation ranges from 4,960 at the South Platte River to 5,485 at the basin divide. The average stream slope is 33.1 feet per mile.

Existing development is mainly agricultural with some large-lot residential parcels. Irrigated farmland is found in the lower portion of the Third Creek Basin with non-irrigated farmland and pasture in the upper portions of the basin.

The basin is crossed by the Fulton Ditch, Burlington Ditch, and O'Brian Canal. U.S. 85 and I-76 cross the creek as do the Burlington-Northern and Union Pacific Railroads. The O'Brian Canal and Burlington Ditch intercept Third Creek flows from minor storms and divert them to Barr Lake. The Fulton Ditch diverts some of these flows into the City of Brighton. All road and railroad crossings have capacity substantially less than the existing 100-year peak flow. Major floods overtop the irrigation canals.

The Third Creek floodplain is wide and depths are fairly shallow. The channel sections are well defined above the O'Brian Canal but small and poorly defined below the canal. Tributaries to Third Creek are poorly defined, and have wide gently-sloping overbanks.

Past floods have caused property damage along Third Creek in the form of structural damage, agricultural damage (both crop and livestock losses), and washed out roads and irrigation facilities.

Direct Flow Area 0053

DFA 0053 is located between First Creek and Second Creek. The area covers 9.3 square miles and drains to the South Platte River in eight separate flow paths. DFA 0053 ranges in elevation from 4,990 at the South Platte River to 5,280 at the basin divide. Land use is mainly agricultural. The basin is crossed by U.S. 85, I-76, Burlington Northern and Union Pacific Railroads, the O'Brian Canal, Burlington Ditch, and Fulton Ditch.

and silts, the higher the erosional hazard. Prior to any drainageway improvement construction, detailed soils investigations should be performed.

The surface geology of the area consists predominantly of eolian deposits with alluvial deposits found along the major drainages. Underlying bedrock is in the Denver Formation. Depth to bedrock is highly variable, but no outcrops were observed in the study area.

2.4 Hydrologic Setting

2.4.1 Flood History

The Second Creek and Third Creek Basins have been somewhat sparsely populated in the past. As a result, past floods have caused relatively minor damages. No stream gages are located within the basins so no estimates of peak flows have been made. Flooding has been reported five times in the past 40 years. All of these floods were the result of heavy rain in the months of May and June. Flooding was reported in the Brighton Blade to have occurred on May 30, 1948; June 13, 1949; May 8, 1957; June 15, 1965; and May 6-7, 1973.

The 1948 flood was reported to close traffic for May 30 and 31 at U.S. 85, U.S. 6, and Sable Avenue. Water at U.S. 85 was about three feet above the road. In the 1949 event, 144th Avenue was completely washed out, and U.S. 85 partially damaged.

The 1957 flood was caused by heavy rains with 3.71 inches reported at Brighton. Agricultural damages were heavy to specialty crops and siltation of pastures was reported. The Burlington Ditch was breached. The extreme rainfall of June, 1965, also caused flooding on Second and Third Creeks. The Wagon Wheel Roller Rink located at Third Creek and Old Brighton Road was surrounded by floodwater. Major irrigation ditches were out of their banks and agricultural losses were heavy. Flooding in May, 1973, caused thousands of acres of lowland farmland to be inundated.

2.4.2 Basin Hydrology

Hydrologic information for the Second Creek, Third Creek, DFA 0053, and Barr Lake Basins was previously published in the hydrology phase of this study. Existing and future basin development conditions were assessed. The future condition was modelled for two conditions at full basin development, namely, with and without the New Denver Airport. Peak flows were predicted and runoff hydrographs were developed for the 2-, 5-, 10-, and 100-year recurrence intervals using the Colorado Urban Hydrograph Procedure (Computer model CUHPE-PC) and the Storm Water Management Model (Computer model UDSWM2-PC). Runoff hydrographs and discharge-probability profiles are given in Appendix B.

The 100-year peak flow on Second Creek will almost double at full basin development. The 2-year future peak flow on Second Creek will increase by almost 300 times over the existing 2-year flow. The Third Creek Basin peak runoff will increase by about 50 percent for the 100-year storm and the 1-year will increase over 160 times. Direct Flow Area 0053 will see the 10-year peak flow triple and the 2-year storm increase 40 times over the existing. The Barr Lake Basin will experience a 25 percent increase in the 100-year peak flow and a 1000 percent increase in the 2-year flow.

The tremendous increases in low flows is caused by several factors. The soils of the basin are relatively pervious and the existing drainageways are relatively flat and wide. The 2-year rainfall infiltrates almost totally into the ground for the existing condition while about one-half of the basin surface will be impervious in the future. Future drainageways will also carry runoff faster than the existing drainageways, which will result in the runoff peaking several hours faster in the future.

The 100-year rain storm is much more intense than the 2-year storm and causes considerable runoff from existing pervious areas. While all peak flows increase due to development, the ratio of increase between the developed and undeveloped runoff decreases as the storm intensity (and recurrence interval) increases.

2.5 Environmental Setting

The study area is bordered by the South Platte River on the west, the City of Brighton and Barr Lake on the north, the drainage divide to Box Elder Creek on the east, and the drainage divide to First Creek on the south. The major environmentally significant areas are the South Platte River and Barr Lake State Park. Within the study area are scattered areas of riparian and wetland vegetation. The South Platte River floodplain encompasses the lower reaches of Second Creek, Third Creek, and DFA 0053. Large cottonwoods, willows, and wetland vegetation are found along the South Platte River. The concrete, or soil cement channel lining), diversion of flows out of the basin, and floodplain regulation without any physical improvement.

4.3 Drainage System Alternatives

Three types of drainage improvements were selected in the preliminary screening (see Table 2 and 3). The alternatives selected are regional detention, low flow stabilization, channelization, and combinations.

Regional Detention Alternatives

General Discussion

Potential sites for regional detention facilities were identified by examining topographic maps, future land uses and transportation facilities, hydrologic information, and floodplain maps. Once a potential detention site was identified, the approximate available storage volume was determined, and the storage-outflow relationship was developed. The storage-outflow information was then input into the Stormwater Management Model (SWMM), and the effect on downstream peak flows was established.

Detention facilities can be on-stream or off-stream. An on-stream facility intercepts all incoming flow, while off-stream facilities only store runoff that exceeds the channel capacity. Off-stream facilities have the advantage of bypassing low flows which reduces sediment accumulation and also allows multiple uses within the flood storage area. On-stream facilities make better sediment ponds. Detention facilities may be normally dry or have a permanent pool of water. Dry facilities, in general, have lower maintenance requirements than wet ponds, but they do not remove sediment as effectively for enhanced water quality. Only dry facilities are proposed on the NDA because of the potential hazards created by wildlife and birds drawn to wet ponds. In areas considered to be environmentally significant because of habitat potential or because of existing vegetation, wet ponds are preferred, however, are not recommended on major drainageway channels (i.e., on-stream) because they are expected to silt in very rapidly. Wet ponds are suggested for off-stream locations and for smaller tributary watersheds.

In order for detention facilities to be functional during periods of repeated rainfall, the facilities must drain quickly. All ponds are proposed to drain completely within 24 hours.

Detention storage behind road, railroad, canal or runway embankments is preferred because embankment costs are shared between facilities and also because of the special classification given to embankment storage by the State Engineer's Office. The State Engineer currently regulates all impoundments where the embankment height is over ten feet, the surface area is greater than 20 acres, or the storage volume is greater than 200 acre feet. Storage behind road or other embankments may be determined to be incidental storage in many cases. An example of incidental storage behind a road is the ponding caused by a 100-year flow behind a bridge with 50-year capacity. Another example of incidental storage occurs at Third Creek and I-76. The Third Creek floodplain above I-76 provides over 200 acre feet of storage which is created by lack of bridge capacity in combination with a wide, flat floodplain.

The location of the detention facility in the drainage basin has an effect on the peak flow attenuation downstream of the facility. In general, detention storage is more effective when placed in the upper portions of the drainage basin. Detention storage is most effective for short duration, high intensity storms where the volume of runoff is low. During basin development, the channels will be subjected to excessive sediment loads if erosion control is not enforced. Erosion control is a necessity to ensure proper performance of the flood control alternatives. The location of the detention facilities shown in Appendix C is not intended to be exact. The facilities may be moved upstream or downstream about one-half mile without affecting the overall hydrology of the basins.

Second Creek

In the Second Creek Basin, a total of 11 potential detention facility sites were identified. The sites are: (1) at the O'Brian Canal, (2) at the confluence of Second Creek and the West Fork of Second Creek, (3) at the proposed Airport Boulevard on the West Fork of Second Creek, (4) at E-470, (5) at the Airport Boulevard on the main stem of Second Creek, (6) at Runway 8L-26R on the NDA, and (7 - 11) at five sites between 56th Avenue and 68th Avenue on the main stem of Second Creek and on tributaries upstream of the NDA.

Several combinations of these detention facilities were examined, including: (1) maximum detention (detaining as much as possible) on the NDA without upstream facilities, (2) maximum detention on the NDA with five upstream facilities, (3) mid-level detention (detaining to approximately the existing condition) including NDA detention and five upstream facilities, and (4) the previous combinations with or without the O'Brian Canal detention facility. Figures 3 and 4 give the discharge profile for the Second Creek 2- and 100-year storms with the detention options.

Third Creek

Seven regional detention facility sites were evaluated in the Third Creek Basin. The upper Third Creek Basin is within the boundary of the NDA. The proposed airport layout and runway slopes require significant embankments to be constructed. The runways over Third Creek will be 40 to 60 feet above the existing creek bed. Because of FAA runway requirements, the embankments will be over 1,000 feet wide. Culverts under the runways will be very expensive due to their great length. Detention upstream of the runway, taxiway, and major road crossings can greatly reduce culvert costs.

The proposed terminal area on the NDA lies at the top of the Third Creek drainage basin. The large impervious surface required around the terminal area will create rapid runoff with high peak flows of short duration. Detention adjacent to the terminal area can be highly effective in reducing peak flow rates.

Five of the seven Third Creek Basin regional detention facilities are proposed on the NDA. Three facilities are proposed on the main stem of Third Creek above runways, and two facilities are proposed on Third Creek tributaries. Many additional on-site detention areas should be considered on the NDA to reduce pipe or culvert costs, or when necessary to treat water considered contaminated by Airport operations such as deicing, fueling, etc. The smaller, on-site facilities should be on tributaries that must cross airfield facilities in pipes. Smaller, on-site facilities are more likely to reduce costs of tributary pipes and channels than to reduce peak flows in the main stem of Third Creek.

Two of the seven regional detention facilities on Third Creek were considered downstream of the NDA at I-76 and at 120th Avenue. The proposed facility at I-76 is contained partly in the E-470/I-76 interchange. Much of the existing area is a wetland, and part of the area is proposed for wetland creation by the E-470 Authority. The other facility is proposed to be located upstream of the O'Brian Canal near 120th Avenue.

Two levels of detention storage were considered on the NDA, namely; mid-level and maximum storage. The mid-level option detains Third Creek to about 4,000 cfs at the runway crossings. Maximum level detention would reduce the peak flow to 1,000 cfs. Several options were considered for the two lower facilities. One option is to use both facilities in conjunction with the airport facilities. Other options include using only one of the two facilities or not using any downstream storage facilities. The use of the downstream facilities without detention on the NDA is not feasible due to very large storage volumes needed to substantially reduce peak flows. The discharge profiles for the different Third Creek detention options are given in Figures 5 and 6.

Barr Lake Basin

The Barr Lake drainage area within the NDA will be developed in the terminal area. Only one tributary will be affected by NDA Phase I construction. Detention is proposed on this tributary at 120th Avenue.

DFA 0053 Basin

The DFA 0053 basin is not well suited for detention due to the basin shape and the flatness of the basin. However, three potential sites were identified in DFA 0053. The sites are all gravel pits located west of U.S. Highway 85. The pits have sufficient storage volume to provide significant peak flow reduction but are relatively close the the South Platte River. The channels downstream of the detention facilities are fairly short. Two of the gravel pits are currently in operation and the detention facilities could not be implemented until after the pits close.

Channel Alternatives

Two channel alternatives were developed for Second and Third Creeks. The alternatives consist of low flow stabilization and 100-year capacity channels.

APPENDIX C – Hydrologic Calculations

Project Name:	Eberly Place
	Composite C-Value Computations
	Post-Development
Project No:	201237
Date:	03/29/21
Revised:	04/21/21
Design by:	CAM
Checked by:	MAW

BASIN	TOTAL AREA (ACRES)	ROOFS (90%)	DRIVES & WALKS (90%)	STREETS (100%)	LANDSCAPE AREA (0%)	PERCENT IMPERVIOUS	C_2=	C_5=	C_{10}=	C_{100}=
A-1	1.50	0.62	0.00	0.00	0.88	37.38%	0.27	0.29	0.36	0.60
A-2	0.25	0.08	0.02	0.11	0.05	77.64%	0.62	0.65	0.69	0.79
A-3	0.12	0.00	0.02	0.09	0.01	86.79%	0.71	0.74	0.76	0.83
A-4	0.27	0.16	0.03	0.03	0.06	72.56%	0.58	0.61	0.64	0.77
A-5	0.43	0.23	0.04	0.00	0.16	57.44%	0.44	0.47	0.52	0.70
A-6	0.46	0.00	0.09	0.16	0.21	53.25%	0.40	0.43	0.49	0.68
A-7	0.43	0.16	0.04	0.11	0.12	67.63%	0.53	0.56	0.60	0.74
B-1	0.88	0.39	0.00	0.00	0.49	39.82%	0.29	0.32	0.38	0.61
B-2	1.21	0.31	0.18	0.26	0.46	57.73%	0.44	0.47	0.52	0.70
B-3	1.30	0.62	0.09	0.12	0.47	58.43%	0.45	0.48	0.53	0.70
B-4	1.30	0.62	0.11	0.27	0.29	71.93%	0.57	0.60	0.64	0.76
B-5	0.91	0.47	0.11	0.15	0.18	73.87%	0.59	0.62	0.66	0.77
B-6	1.95	0.55	0.08	0.15	1.18	36.55%	0.26	0.29	0.35	0.60
B-7	0.11	0.00	0.02	0.07	0.03	75.81%	0.61	0.64	0.67	0.78
B-8	1.43	0.78	0.15	0.32	0.18	80.64%	0.65	0.68	0.71	0.81
B-9	0.95	0.62	0.06	0.09	0.18	73.73%	0.59	0.62	0.65	0.77
B-10	2.34	0.39	0.01	0.00	1.94	15.33%	0.09	0.11	0.18	0.50
C-1	1.32	0.39	0.19	0.37	0.37	67.38%	0.53	0.56	0.60	0.74
C-2	0.22	0.08	0.02	0.07	0.05	72.28%	0.57	0.60	0.64	0.77
C-3	1.52	0.39	0.10	0.20	0.83	42.13%	0.31	0.34	0.40	0.62
C-4	0.28	0.00	0.05	0.18	0.05	80.36%	0.65	0.68	0.71	0.80
C-5	0.23	0.00	0.03	0.16	0.05	78.57%	0.63	0.66	0.69	0.80
C-6	0.94	0.47	0.06	0.16	0.26	67.15%	0.53	0.56	0.60	0.74
C-7	0.15	0.00	0.02	0.10	0.03	80.22%	0.65	0.68	0.71	0.80
C-8	0.87	0.55	0.04	0.07	0.21	68.59%	0.54	0.57	0.61	0.75
C-9	0.60	0.31	0.04	0.11	0.14	70.32%	0.56	0.59	0.63	0.76
C-10	0.53	0.00	0.13	0.21	0.19	60.96%	0.47	0.50	0.55	0.71
C-11	1.71	0.93	0.12	0.22	0.43	68.67%	0.54	0.57	0.61	0.75
C-12	0.64	0.16	0.08	0.20	0.20	64.31%	0.50	0.53	0.58	0.73
D-1	0.16	0.00	0.05	0.05	0.06	59.38%	0.46	0.49	0.54	0.71
D-2	0.84	0.16	0.05	0.05	0.58	28.00%	0.19	0.22	0.28	0.56
D-3	0.28	0.00	0.07	0.11	0.10	60.84%	0.47	0.50	0.55	0.71
D-4	2.52	0.78	0.23	0.45	1.06	53.92%	0.41	0.44	0.49	0.68
D-5	1.00	0.23	0.17	0.28	0.31	64.53%	0.00	0.00	0.06	0.43
D-6	0.62	0.08	0.08	0.19	0.28	53.09%	0.00	0.00	0.06	0.43
D-7	0.84	0.31	0.08	0.21	0.24	66.96%	0.53	0.56	0.60	0.74
D-8	0.25	0.00	0.08	0.10	0.07	69.94%	0.55	0.58	0.62	0.75
D-9	2.15	1.01	0.00	0.00	1.14	42.38%	0.31	0.34	0.40	0.63
Total On-Site	33.51	11.84	2.70	5.43	13.54	55.26%	0.79	0.82	0.88	1.06
Total Detained	33.51	11.84	2.70	5.43	13.54	55.26%	0.79	0.82	0.88	1.06
Total	33.51	11.84	2.70	5.43	13.54	55.26%	0.79	0.82	0.88	1.06

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A= 0.84i^{1.302}$	$C_A= 0.86i^{1.276}$	$C_A= 0.87i^{1.232}$	$C_A = 0.88i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B= 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B= 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B= 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C/D}= 0.83i^{1.122}$	$C_{C/D}= 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$	$C_{C/D} = 0.32i+0.588$

Where:

i = % imperviousness (expressed as a decimal)

C_A = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

C_B = Runoff coefficient for NRCS HSG B soils

$C_{C/D}$ = Runoff coefficient for NRCS HSG C and D soils.

Project Name: Eberly Place
Project No: 201237
Date: 44284

Revised: 44307

STANDARD FORM SF-2
TIME OF CONCENTRATION

Designed By: CAM
Checked By: MAW

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK (URBANIZED BASINS)			FINAL	REMARKS
BASIN	AREA (AC)	C_5	LENGTH (FT)	SLOPE %	Ti (MIN)	LENGTH (FT)	SLOPE %	C_v	VELOCITY (FPS)	Tt (MIN)	COMPOS. Tc (MIN)	TOTAL LENGTH	Tc = (L/180) + 10 (MIN)	Tc (MIN)	
A-1	1.50	0.29			0.00				0.00	0.00	0.00	-	0.00	5.00	
A-2	0.25	0.65	66.5	1.67	5.63	71.06	2.50	20.00	3.16	0.37	6.01	138	10.76	6.01	
A-3	0.12	0.74			0.00				0.00	0.00	0.00	-	0.00	5.00	
A-4	0.27	0.61	105	1.50	8.10	54	0.23	20.00	0.96	0.94	9.03	159	10.88	9.03	
A-5	0.43	0.47			0.00				0.00	0.00	0.00	-	0.00	5.00	
A-6	0.46	0.43	44	1.00	8.11	298	1.00	20.00	2.00	2.48	10.59	342	11.90	10.59	
A-7	0.43	0.56	115	2.00	8.40	251	1.00	20.00	2.00	2.09	10.49	366	12.03	10.49	
B-1	0.88	0.32	169	3.00	12.96	305	3.36	15.00	2.75	1.85	14.81	474	12.63	12.63	
B-2	1.21	0.47	40	1.66	6.14	412	1.00	20.00	2.00	3.43	9.57	452	12.51	9.57	
B-3	1.30	0.48	248	3.26	12.09	274	3.55	20.00	3.77	1.21	13.30	522	12.90	12.90	
B-4	1.30	0.60	115	2.56	7.17	311	1.00	20.00	2.00	2.59	9.76	426	12.37	9.76	
B-5	0.91	0.62	26	3.00	3.12	356	1.25	20.00	2.24	2.65	5.77	382	12.12	5.77	
B-6	1.95	0.29	223	3.20	15.09	364	1.28	20.00	2.26	2.68	17.77	587	13.26	13.26	
B-7	0.11	0.64	11	4.50	1.71	158	3.00	20.00	3.46	0.76	5.00	169	10.94	5.00	
B-8	1.43	0.68	118	3.00	5.79	370	1.00	20.00	2.00	3.08	8.88	488	12.71	8.88	
B-9	0.95	0.62	231	3.50	8.86	118	1.24	20.00	2.23	0.88	9.74	349	11.94	9.74	
B-10	2.34	0.11	46	20.00	4.53	439	0.50	15.00	1.06	6.90	11.43	485	12.69	11.43	
C-1	1.32	0.56	260	2.20	12.28	180	2.00	20.00	2.83	1.06	13.34	440	12.44	12.44	
C-2	0.22	0.60			0.00				0.00	0.00	0.00	-	0.00	5.00	
C-3	1.52	0.34			0.00				0.00	0.00	0.00	-	0.00	5.00	
C-4	0.28	0.68	30	0.89	4.41	217	1.00	20.00	2.00	1.81	6.22	247	11.37	6.22	
C-5	0.23	0.66	23	2.40	2.88	298	3.30	20.00	3.63	1.37	5.00	321	11.78	5.00	
C-6	0.94	0.56	14	2.00	2.95	296	3.30	20.00	3.63	1.36	5.00	310	11.72	5.00	
C-7	0.15	0.68	12	3.83	1.72	146	1.26	20.00	2.24	1.08	5.00	158	10.88	5.00	
C-8	0.87	0.57	250	4.00	9.67	108	1.30	20.00	2.28	0.79	10.46	358	11.99	10.46	
C-9	0.60	0.59	115	2.00	8.02	172	2.60	20.00	3.22	0.89	8.91	287	11.59	8.91	
C-10	0.53	0.50	10	4.45	2.11	476	1.25	20.00	2.24	3.55	5.66	486	12.70	5.66	
C-11	1.71	0.57	120	3.00	7.36	375	1.25	20.00	2.24	2.80	10.16	495	12.75	10.16	
C-12	0.64	0.53	33.5	6.00	3.32	431	2.50	20.00	3.16	2.27	5.59	465	12.58	5.59	
D-1	0.16	0.49	31	1.00	6.25	122	2.00	20.00	2.83	0.72	6.97	153	10.85	6.97	
D-2	0.84	0.22			0.00				0.00	0.00	0.00	-	0.00	5.00	
D-3	0.28	0.50	24	2.00	4.27	228	3.00	20.00	3.46	1.10	5.37	252	11.40	5.37	
D-4	2.52	0.44	288	3.65	13.35	41	0.37	20.00	1.22	0.56	13.92	329	11.83	11.83	
D-5	1.00	0.00	126	10.50	10.34	598	2.68	20.00	3.27	3.04	13.38	724	14.02	13.38	
D-6	0.62	0.00	33	5.74	6.47	423	3.00	20.00	3.46	2.04	8.51	456	12.53	8.51	
D-7	0.84	0.56	139	4.00	7.41	298	1.50	20.00	2.45	2.03	9.44	437	12.43	9.44	
D-8	0.25	0.58	27	0.2	8.42	219	2.50	20.00	3.16	1.15	9.58	246	11.37	9.58	
D-9	2.15	0.34			0.00				0.00	0.00	0.00	-	0.00	5.00	

1-HR Rainfall

Return Interval (YR)	1-hour Rainfall
WQ	0.6
2	0.84
5	1.12
10	1.37
100	2.43

tc	WQ	2yr	5yr	5yr	100yr
5	2.035	2.849	3.799	4.647	8.242
6	1.934	2.708	3.611	4.417	7.835
7	1.844	2.582	3.443	4.211	7.470
8	1.763	2.469	3.292	4.026	7.142
9	1.690	2.366	3.155	3.859	6.845
10	1.623	2.273	3.030	3.706	6.574
11	1.562	2.187	2.916	3.567	6.327
12	1.506	2.109	2.811	3.439	6.100
13	1.454	2.036	2.715	3.321	5.890
14	1.407	1.969	2.626	3.212	5.696
15	1.362	1.907	2.543	3.110	5.517
16	1.321	1.849	2.465	3.016	5.349
17	1.282	1.795	2.393	2.928	5.193
18	1.246	1.744	2.326	2.845	5.046
19	1.212	1.697	2.263	2.768	4.909
20	1.180	1.652	2.203	2.695	4.780

Project Name: Eberly Place
Project No: 201237
Date: 03/29/21
Revised: 04/21/21

STANDARD FORM SF-2
Post-Development
Rational Method Procedure

Designed By: CAM
Checked By: MAW
Design Storm: 5 YR

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE				TRAVEL TIME			CARRYOVER FLOWS					
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	T_c (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	T_c (MAX)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	T_t (min)	BYPASS RUNOFF, Q (CFS)	LENGTH (FT)	SLOPE (%)	VELOCITY (FPS)	T_t (min)	REMARKS
A-1		1.50	0.29	5.00	0.44	3.80	1.68	5.00	0.44	3.80	1.68		1.68		1.68	0.00													
A-2		0.25	0.65	6.01	0.16	3.61	0.59	6.01	0.16	3.61	0.59																		
A-3		0.12	0.74	5.00	0.09	3.80	0.34	5.00	0.09	3.80	0.34																		
A-4		0.27	0.61	9.03	0.16	3.15	0.52	9.03	0.16	3.15	0.52																		
A-5		0.43	0.47	5.00	0.20	3.80	0.77	5.00	0.20	3.80	0.77																		
A-6		0.46	0.43	10.59	0.20	2.96	0.59	10.59	0.20	2.96	0.59																		
A-7		0.43	0.56	10.49	0.24	2.97	0.72	10.49	0.24	2.97	0.72																		
B-1		0.88	0.32	12.63	0.28	2.75	0.76	12.63	0.28	2.75	0.76																		
B-2		1.21	0.47	9.57	0.57	3.08	1.76	9.57	0.57	3.08	1.76																		
B-3		1.30	0.48	12.90	0.62	2.72	1.70	12.90	0.62	2.72	1.70																		
B-4		1.30	0.60	9.76	0.78	3.06	2.39	9.76	0.78	3.06	2.39																		
B-5		0.91	0.62	5.77	0.56	3.65	2.06	5.77	0.56	3.65	2.06																		
B-6		1.95	0.29	13.26	0.56	2.69	1.51	13.26	0.56	2.69	1.51																		
B-7		0.11	0.64	5.00	0.07	3.80	0.27	5.00	0.07	3.80	0.27																		
B-8		1.43	0.68	8.88	0.97	3.17	3.09	8.88	0.97	3.17	3.09																		
B-9		0.95	0.62	9.74	0.59	3.06	1.80	9.74	0.59	3.06	1.80																		
B-10		2.34	0.11	11.43	0.26	2.87	0.75	11.43	0.26	2.87	0.75																		
C-1		1.32	0.56	12.44	0.74	2.77	2.04	12.44	0.74	2.77	2.04																		
C-2		0.22	0.60	5.00	0.13	3.80	0.50	5.00	0.13	3.80	0.50																		
C-3		1.52	0.34	5.00	0.51	3.80	1.94	5.00	0.51	3.80	1.94																		
C-4		0.28	0.68	6.22	0.19	3.57	0.68	6.22	0.19	3.57	0.68																		
C-5		0.23	0.66	5.00	0.15	3.80	0.58	5.00	0.15	3.80	0.58																		
C-6		0.94	0.56	5.00	0.52	3.80	1.99	5.00	0.52	3.80	1.99																		
C-7		0.15	0.68	5.00	0.10	3.80	0.39	5.00	0.10	3.80	0.39																		
C-8		0.87	0.57	10.46	0.50	2.98	1.48	10.46	0.50	2.98	1.48																		
C-9		0.60	0.59	8.91	0.35	3.17	1.11	8.91	0.35	3.17	1.11																		
C-10		0.53	0.50	5.66	0.27	3.67	0.98	5.66	0.27	3.67	0.98																		
C-11		1.71	0.57	10.16	0.98	3.01	2.94	10.16	0.98	3.01	2.94																		
C-12		0.64	0.53	5.59	0.34	3.69	1.25	5.59	0.34	3.69	1.25																		
D-1		0.16	0.49	6.97	0.08	3.45	0.27	6.97	0.08	3.45	0.27																		
D-2		0.84	0.22	5.00	0.18	3.80	0.69	5.00	0.18	3.80	0.69																		
D-3		0.28	0.50	5.37	0.14	3.73	0.52	5.37	0.14	3.73	0.52																		
D-4		2.52	0.44	11.83	1.11	2.83	3.13	11.83	1.11	2.83	3.13																		
D-5		1.00	0.00	13.38	0.00	2.68	0.00	13.38	0.00	2.68	0.00																		
D-6		0.62	0.00	8.51	0.00	3.22	0.00	8.51	0.00	3.22	0.00																		
D-7		0.84	0.56	9.44	0.47	3.10	1.45	9.44	0.47	3.10	1.45																		
D-8		0.25	0.58	9.58	0.15	3.08	0.45	9.58	0.15	3.08	0.45																		
D-9		2.15	0.34	5.00	0.73	3.80	2.76	5.00	0.73	3.80	2.76																		

Allowed Detained Release	5.70	cfs
Undetained Release		cfs
Total Release	5.70	cfs

Project Name: Eberly Place
Project No: 201237
Date: 03/29/21
Revised: 04/21/21

STANDARD FORM SF-2
Post-Development
Rational Method Procedure

Designed By: CAM
Checked By: MAW
Design Storm: 100 YR

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE				TRAVEL TIME			CARRYOVER FLOWS					
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	T_c (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	T_c (MAX)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	T_t (min)	BYPASS RUNOFF, Q (CFS)	LENGTH (FT)	SLOPE (%)	VELOCITY (FPS)	T_t (min)	REMARKS
A-1		1.50	0.60	5.00	0.90	8.24	7.44	5.00	0.90	8.24	7.44		7.44		7.44	0.00													
A-2		0.25	0.79	6.01	0.20	7.83	1.55	6.01	0.20	7.83	1.55						1.55												
A-3		0.12	0.83	5.00	0.10	8.24	0.82	5.00	0.10	8.24	0.82																		
A-4		0.27	0.77	9.03	0.21	6.83	1.42	9.03	0.21	6.83	1.42																		
A-5		0.43	0.70	5.00	0.30	8.24	2.47	5.00	0.30	8.24	2.47																		
A-6		0.46	0.68	10.59	0.31	6.43	2.00	10.59	0.31	6.43	2.00																		
A-7		0.43	0.74	10.49	0.32	6.45	2.06	10.49	0.32	6.45	2.06																		
B-1		0.88	0.61	12.63	0.54	5.97	3.22	12.63	0.54	5.97	3.22																		
B-2		1.21	0.70	9.57	0.84	6.69	5.64	9.57	0.84	6.69	5.64																		
B-3		1.30	0.70	12.90	0.91	5.91	5.38	12.90	0.91	5.91	5.38																		
B-4		1.30	0.76	9.76	0.99	6.64	6.59	9.76	0.99	6.64	6.59																		
B-5		0.91	0.77	5.77	0.70	7.92	5.57	5.77	0.70	7.92	5.57																		
B-6		1.95	0.60	13.26	1.17	5.84	6.81	13.26	1.17	5.84	6.81																		
B-7		0.11	0.78	5.00	0.09	8.24	0.71	5.00	0.09	8.24	0.71																		
B-8		1.43	0.81	8.88	1.15	6.88	7.92	8.88	1.15	6.88	7.92																		
B-9		0.95	0.77	9.74	0.73	6.64	4.87	9.74	0.73	6.64	4.87																		
B-10		2.34	0.50	11.43	1.17	6.23	7.26	11.43	1.17	6.23	7.26																		
C-1		1.32	0.74	12.44	0.98	6.00	5.89	12.44	0.98	6.00	5.89																		
C-2		0.22	0.77	5.00	0.17	8.24	1.39	5.00	0.17	8.24	1.39																		
C-3		1.52	0.62	5.00	0.95	8.24	7.82	5.00	0.95	8.24	7.82																		
C-4		0.28	0.80	6.22	0.23	7.75	1.74	6.22	0.23	7.75	1.74																		
C-5		0.23	0.80	5.00	0.18	8.24	1.51	5.00	0.18	8.24	1.51																		
C-6		0.94	0.74	5.00	0.70	8.24	5.75	5.00	0.70	8.24	5.75																		
C-7		0.15	0.80	5.00	0.12	8.24	0.99	5.00	0.12	8.24	0.99																		
C-8		0.87	0.75	10.46	0.65	6.46	4.21	10.46	0.65	6.46	4.21																		
C-9		0.60	0.76	8.91	0.45	6.87	3.12	8.91	0.45	6.87	3.12																		
C-10		0.53	0.71	5.66	0.38	7.97	3.01	5.66	0.38	7.97	3.01																		
C-11		1.71	0.75	10.16	1.28	6.53	8.37	10.16	1.28	6.53	8.37																		
C-12		0.64	0.73	5.59	0.47	8.00	3.73	5.59	0.47	8.00	3.73																		
D-1		0.16	0.71	6.97	0.11	7.48	0.84	6.97	0.11	7.48	0.84																		
D-2		0.84	0.56	5.00	0.47	8.24	3.86	5.00	0.47	8.24	3.86																		
D-3		0.28	0.71	5.37	0.20	8.09	1.61	5.37	0.20	8.09	1.61																		
D-4		2.52	0.68	11.83	1.71	6.14	10.51	11.83	1.71	6.14	10.51																		
D-5		1.00	0.43	13.38	0.43	5.81	2.48	13.38	0.43	5.81	2.48																		
D-6		0.62	0.43	8.51	0.26	6.99	1.85	8.51	0.26	6.99	1.85																		
D-7		0.84	0.74	9.44	0.62	6.72	4.18	9.44	0.62	6.72	4.18																		
D-8		0.25	0.75	9.58	0.19	6.69	1.26	9.58	0.19	6.69	1.26																		
D-9		2.15	0.63	5.00	1.34	8.24	11.08	5.00	1.34	8.24	11.08																		

Allowed Detained Release	33.51	cfs
Undetained Release		cfs
Total Release	33.51	cfs

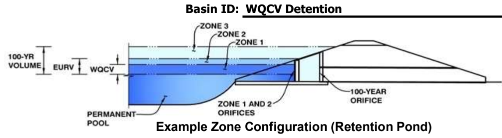
APPENDIX D – Water Quality and Detention Calculations

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Eberly Place

Basin ID: WQCV Detention



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	33.51	acres		
Watershed Length =	1,590	ft		
Watershed Length to Centroid =	795	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	53.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	Commerce City - Civic Center			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.599	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.908	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	1.108	acre-feet		inches
5-yr Runoff Volume (P1 = 1.12 in.) =	1.590	acre-feet		inches
10-yr Runoff Volume (P1 = 1.37 in.) =	2.181	acre-feet		inches
25-yr Runoff Volume (P1 = 1.75 in.) =	3.348	acre-feet		inches
50-yr Runoff Volume (P1 = 2.08 in.) =	4.261	acre-feet		inches
100-yr Runoff Volume (P1 = 2.43 in.) =	5.367	acre-feet		inches
500-yr Runoff Volume (P1 = 3.35 in.) =	8.041	acre-feet		inches
Approximate 2-yr Detention Volume =	1.023	acre-feet		
Approximate 5-yr Detention Volume =	1.475	acre-feet		
Approximate 10-yr Detention Volume =	2.030	acre-feet		
Approximate 25-yr Detention Volume =	2.472	acre-feet		
Approximate 50-yr Detention Volume =	2.728	acre-feet		
Approximate 100-yr Detention Volume =	3.154	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.599	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.599	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	

Total detention volume is less than 100-year volume.

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	--	--	--	6,195	0.142		
	--	0.86	--	--	--	6,195	0.142	5,328	0.122
	--	1.86	--	--	--	6,195	0.142	11,523	0.265
	--	2.86	--	--	--	6,195	0.142	17,718	0.407
	--	3.86	--	--	--	6,195	0.142	23,913	0.549
	--	4.86	--	--	--	6,195	0.142	30,108	0.691
	--	5.86	--	--	--	6,195	0.142	36,303	0.833
	--	6.86	--	--	--	6,195	0.142	42,498	0.976
	--	7.86	--	--	--	6,195	0.142	48,693	1.118
	--	8.86	--	--	--	6,195	0.142	54,888	1.260
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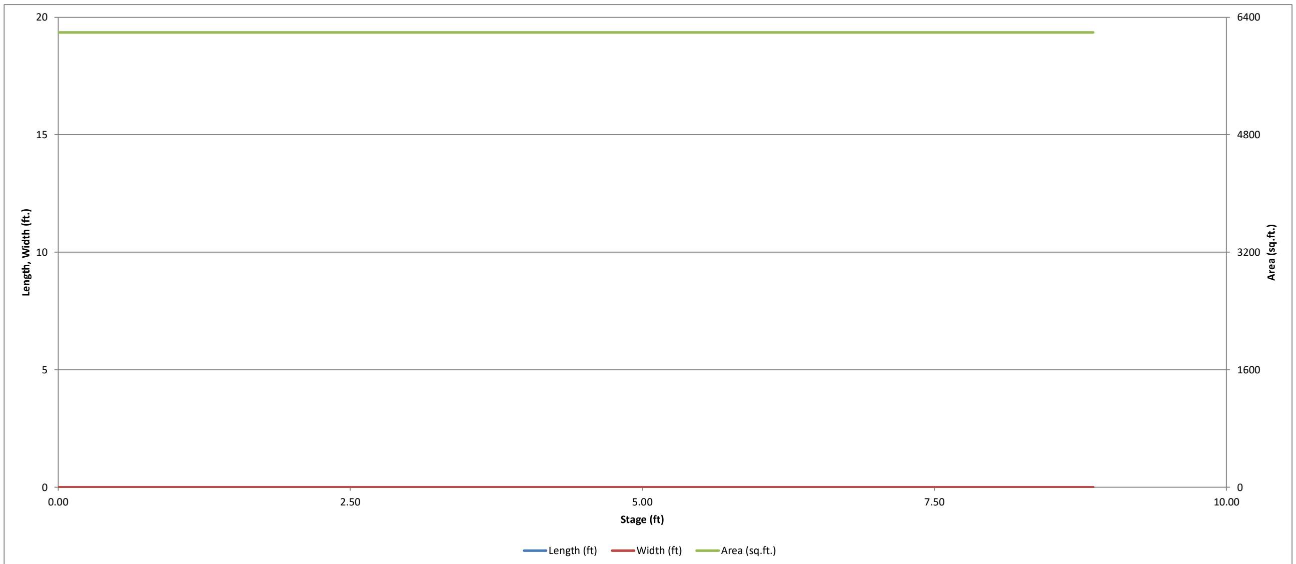
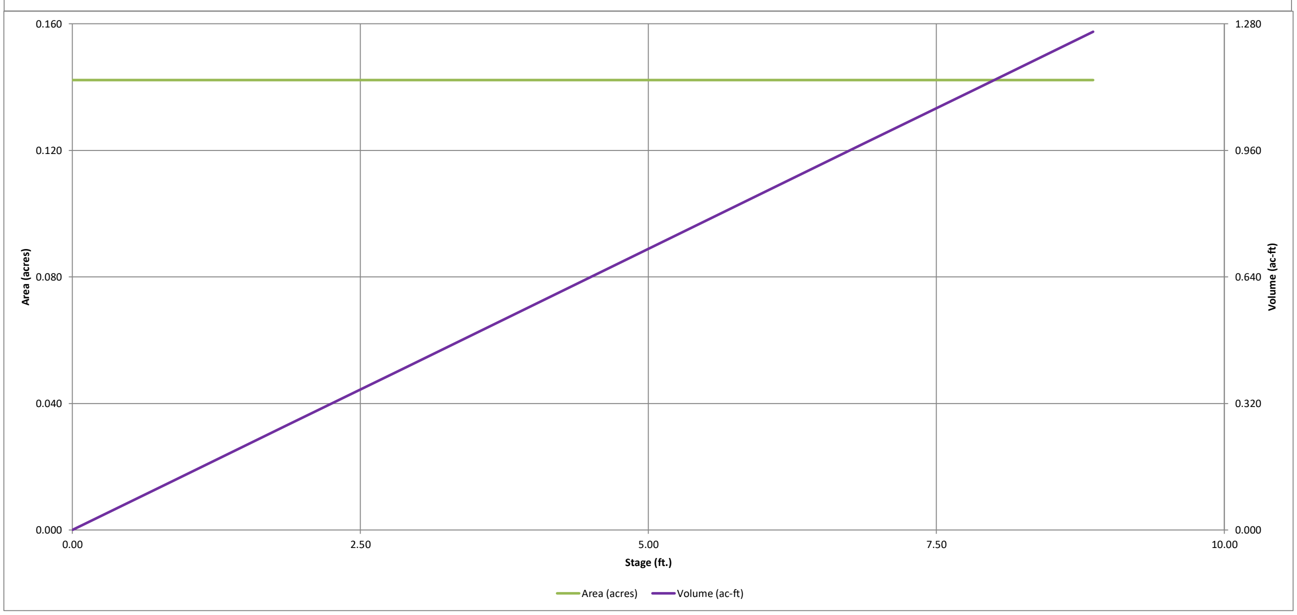
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

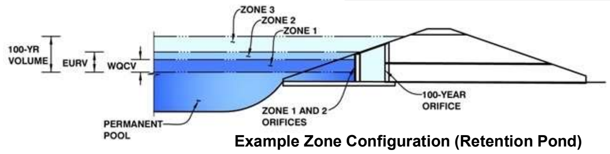




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Eberly Place**
Basin ID: **WQCV Detention**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.22	0.599	Orifice Plate
Zone 2			Not Utilized
Zone 3			Not Utilized
Total (all zones)		0.599	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.22	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	16.90	inches
Orifice Plate: Orifice Area per Row =	3.40	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.361E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.41	2.81					
Orifice Area (sq. inches)	3.40	3.40	3.40					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

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

Calculated Parameters for Overflow Weir

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

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	4.00	feet
Spillway End Slopes =	0.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	3.92	feet
Stage at Top of Freeboard =	12.42	feet
Basin Area at Top of Freeboard =	0.14	acres
Basin Volume at Top of Freeboard =	1.26	acre-ft

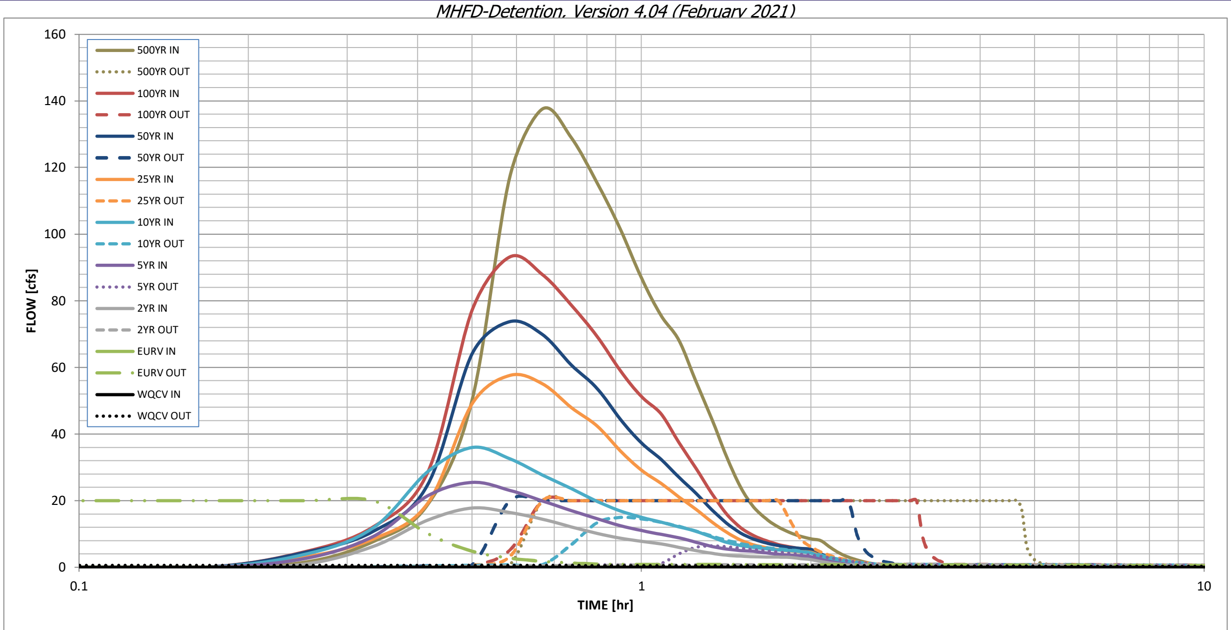
Routed Hydrograph Results

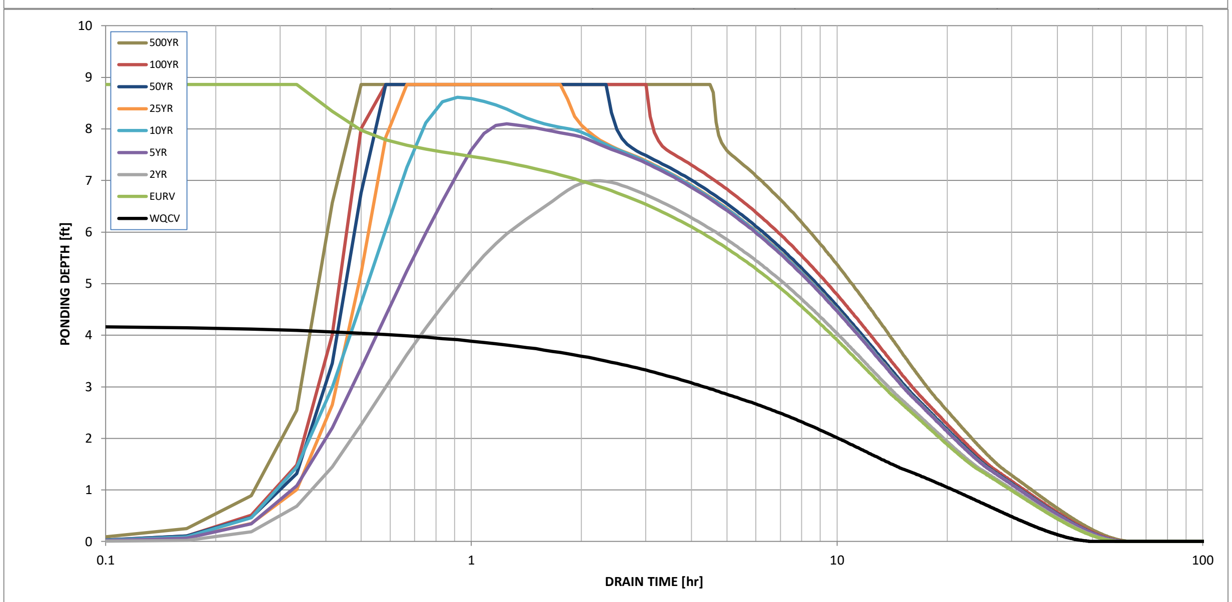
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

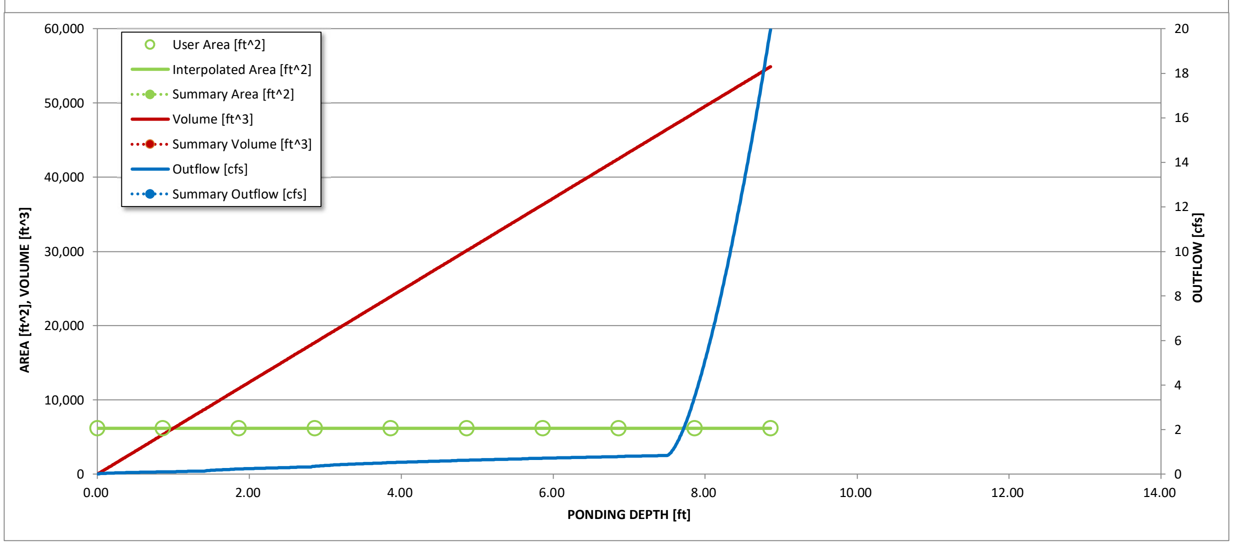
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.12	1.37	1.75	2.08	2.43	3.35
CUHP Runoff Volume (acre-ft) =	0.599	1.908	1.108	1.590	2.181	3.348	4.261	5.367	8.041
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.108	1.590	2.181	3.348	4.261	5.367	8.041
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.7	6.4	21.3	30.8	43.1	70.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.19	0.64	0.92	1.29	2.09
Peak Inflow Q (cfs) =	N/A	N/A	17.8	25.4	35.9	57.6	73.7	93.2	137.6
Peak Outflow Q (cfs) =	0.6	20.0	0.8	6.4	15.0	20.0	20.0	20.0	20.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	8.8	2.3	0.9	0.6	0.5	0.3
Structure Controlling Flow =	Plate	N/A	Plate	Spillway	Spillway	N/A	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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) =	40	41	46	44	41	37	34	31	26
Time to Drain 99% of Inflow Volume (hours) =	**45**	49	52	52	50	47	46	44	42
Maximum Ponding Depth (ft) =	4.22	8.86	7.00	8.10	8.61	8.86	8.86	8.86	8.86
Area at Maximum Ponding Depth (acres) =	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Maximum Volume Stored (acre-ft) =	0.600	1.260	0.994	1.151	1.224	1.260	1.260	1.260	1.260

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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.

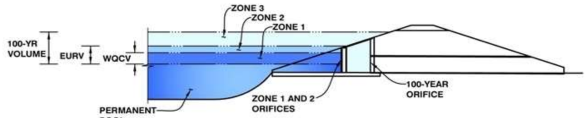
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43
	0:15:00	0.00	0.00	0.86	2.52	3.74	2.97	4.33	4.56	7.72
	0:20:00	0.00	0.00	6.23	9.27	11.79	8.43	10.73	12.11	18.74
	0:25:00	0.00	0.00	14.17	21.39	28.65	19.13	24.69	28.32	50.09
	0:30:00	0.00	0.00	17.79	25.45	35.93	49.03	64.01	77.05	117.08
	0:35:00	0.00	0.00	16.43	23.12	32.55	57.59	73.75	93.19	137.58
	0:40:00	0.00	0.00	14.43	19.93	27.70	55.07	69.85	87.87	128.95
	0:45:00	0.00	0.00	12.13	17.03	23.61	47.96	60.78	78.74	115.50
	0:50:00	0.00	0.00	10.18	14.65	19.85	42.44	53.78	69.40	101.65
	0:55:00	0.00	0.00	8.72	12.49	16.92	35.04	44.52	59.10	86.76
	1:00:00	0.00	0.00	7.75	11.01	15.01	29.15	37.25	51.21	75.57
	1:05:00	0.00	0.00	7.02	9.87	13.56	25.20	32.40	46.04	68.09
	1:10:00	0.00	0.00	5.99	8.81	12.15	21.08	26.98	37.40	55.72
	1:15:00	0.00	0.00	5.02	7.52	10.81	17.43	22.19	29.70	44.65
	1:20:00	0.00	0.00	4.20	6.28	9.09	13.68	17.35	22.24	33.32
	1:25:00	0.00	0.00	3.63	5.46	7.51	10.54	13.31	16.04	24.09
	1:30:00	0.00	0.00	3.33	5.03	6.54	8.20	10.31	11.95	18.11
	1:35:00	0.00	0.00	3.18	4.78	5.95	6.77	8.45	9.51	14.49
	1:40:00	0.00	0.00	3.10	4.30	5.53	5.89	7.28	7.95	12.11
	1:45:00	0.00	0.00	3.04	3.91	5.23	5.30	6.49	6.87	10.46
	1:50:00	0.00	0.00	3.00	3.63	5.03	4.93	5.98	6.13	9.33
	1:55:00	0.00	0.00	2.63	3.42	4.75	4.68	5.63	5.61	8.51
	2:00:00	0.00	0.00	2.31	3.17	4.30	4.50	5.39	5.29	8.00
	2:05:00	0.00	0.00	1.74	2.38	3.20	3.38	4.04	3.94	5.95
	2:10:00	0.00	0.00	1.27	1.72	2.29	2.42	2.89	2.83	4.24
	2:15:00	0.00	0.00	0.92	1.24	1.65	1.75	2.07	2.05	3.07
	2:20:00	0.00	0.00	0.66	0.88	1.18	1.25	1.48	1.47	2.20
	2:25:00	0.00	0.00	0.46	0.61	0.82	0.87	1.03	1.03	1.53
	2:30:00	0.00	0.00	0.32	0.41	0.57	0.60	0.71	0.71	1.06
	2:35:00	0.00	0.00	0.21	0.28	0.38	0.41	0.49	0.48	0.72
	2:40:00	0.00	0.00	0.12	0.18	0.23	0.26	0.30	0.30	0.44
	2:45:00	0.00	0.00	0.06	0.10	0.12	0.14	0.16	0.16	0.23
	2:50:00	0.00	0.00	0.03	0.04	0.05	0.06	0.07	0.06	0.09
	2:55:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Eberly**

Basin ID: **EURV and 100YR Detention**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	33.51	acres		
Watershed Length =	1,590	ft		
Watershed Length to Centroid =	795	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	53.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	Commerce City - Civic Center			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.599	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.908	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	1.108	acre-feet		inches
5-yr Runoff Volume (P1 = 1.12 in.) =	1.590	acre-feet		inches
10-yr Runoff Volume (P1 = 1.37 in.) =	2.181	acre-feet		inches
25-yr Runoff Volume (P1 = 1.75 in.) =	3.348	acre-feet		inches
50-yr Runoff Volume (P1 = 2.08 in.) =	4.261	acre-feet		inches
100-yr Runoff Volume (P1 = 2.43 in.) =	5.367	acre-feet		inches
500-yr Runoff Volume (P1 = 3.35 in.) =	8.041	acre-feet		inches
Approximate 2-yr Detention Volume =	1.023	acre-feet		
Approximate 5-yr Detention Volume =	1.475	acre-feet		
Approximate 10-yr Detention Volume =	2.030	acre-feet		
Approximate 25-yr Detention Volume =	2.472	acre-feet		
Approximate 50-yr Detention Volume =	2.728	acre-feet		
Approximate 100-yr Detention Volume =	3.154	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (EURV-WQCV) =	1.308	acre-feet	**WQCV not provided!**
Zone 2 Volume (100-year - Zone 1) =	1.846	acre-feet	
Select Zone 3 Storage Volume (Optional) =		acre-feet	
Total Detention Basin Volume =	3.154	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	--	--	--	105.6	0.002		
5141.17	--	0.75	--	--	--	108.0	0.002	80	0.002
5141.18	--	0.76	--	--	--	113	0.003	81	0.002
5142	--	1.58	--	--	--	617	0.014	374	0.009
5143	--	2.58	--	--	--	3,572	0.082	2,440	0.056
5144	--	3.58	--	--	--	12,312	0.283	10,295	0.236
5145	--	4.58	--	--	--	26,774	0.615	29,693	0.682
5146	--	5.58	--	--	--	30,255	0.695	58,172	1.335
5147	--	6.58	--	--	--	33,658	0.773	90,094	2.068
5148	--	7.58	--	--	--	37,160	0.853	125,468	2.880
5149	--	8.58	--	--	--	40,760	0.936	164,392	3.774
5150	--	9.58	--	--	--	44,475	1.021	206,972	4.751
5151	--	10.58	--	--	--	48,329	1.109	253,335	5.816
5152	--	11.58	--	--	--	55,924	1.284	305,386	7.011
5153	--	12.58	--	--	--	55,569	1.276	361,136	8.291
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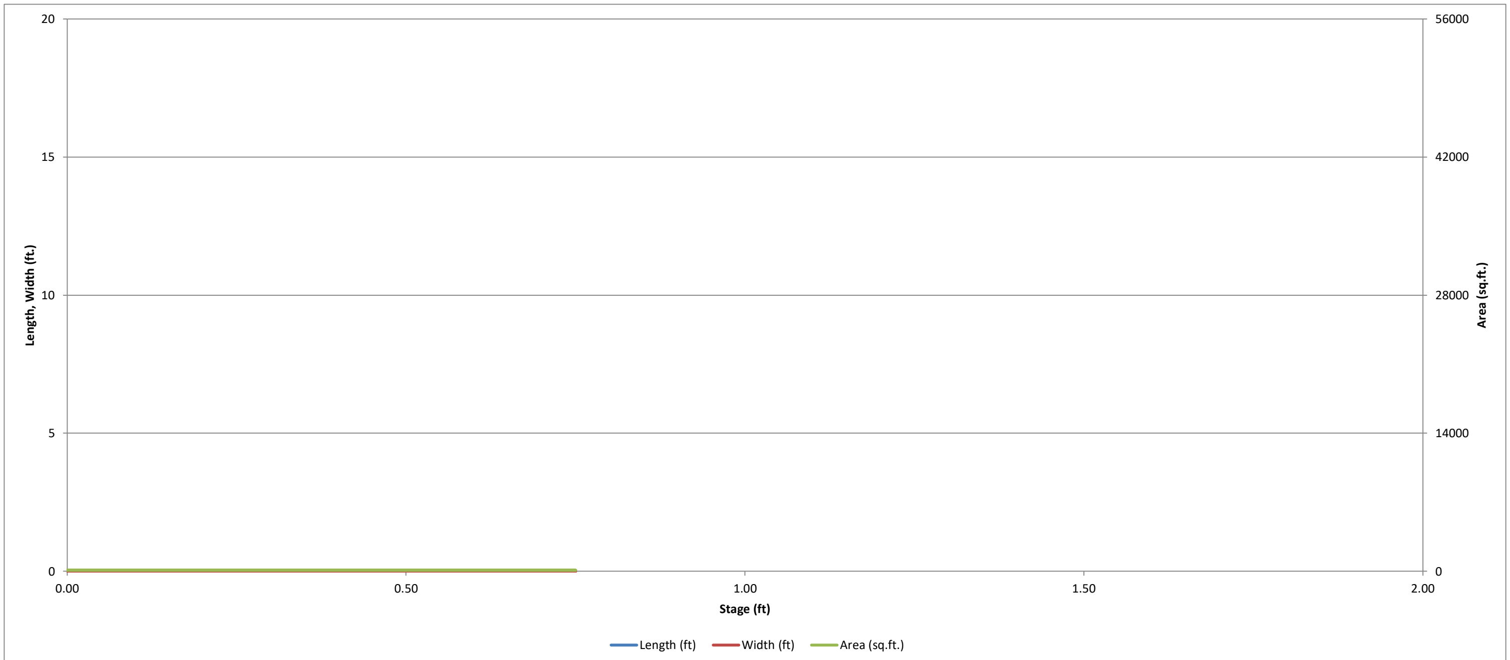
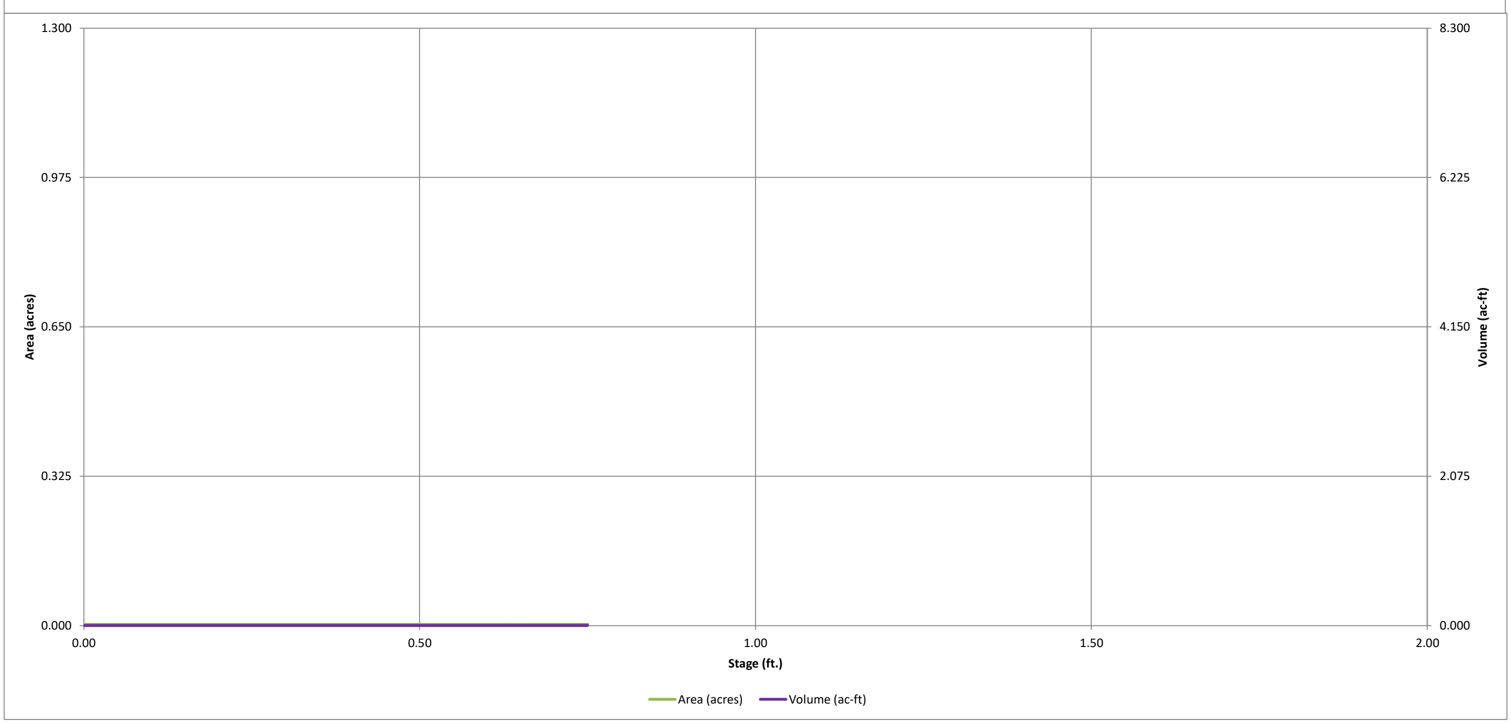
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



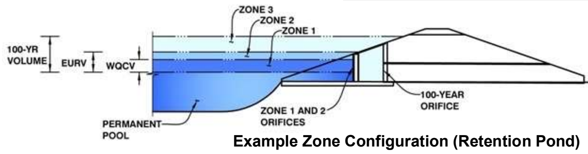


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Eberly**

Basin ID: **EURV and 100YR Detention**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
1 (EURV - WQCV)	5.54	1.308	Circular Orifice
Zone 2 (100-year)	7.89	1.846	Weir&Pipe (Circular)
Zone 3			Not Utilized
Total (all zones)		3.154	

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

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

Calculated Parameters for Underdrain

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

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

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

Calculated Parameters for Plate

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

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 1 Circular	Not Selected	
Invert of Vertical Orifice =	0.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	5.11	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	1.95	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 1 Circular	Not Selected	
Vertical Orifice Area =	0.02	N/A	ft^2
Vertical Orifice Centroid =	0.08	N/A	feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.13	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Close Mesh Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.38	N/A	feet
Overflow Weir Slope Length =	5.15	N/A	feet
Grate Open Area / 100-yr Orifice Area =	25.95	N/A	
Overflow Grate Open Area w/o Debris =	20.38	N/A	ft^2
Overflow Grate Open Area w/ Debris =	10.19	N/A	ft^2

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

	Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	12.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Circular	Not Selected	
Outlet Orifice Area =	0.79	N/A	ft^2
Outlet Orifice Centroid =	0.50	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	10.63	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.95	feet
Stage at Top of Freeboard =	12.58	feet
Basin Area at Top of Freeboard =	1.28	acres
Basin Volume at Top of Freeboard =	8.30	acre-ft

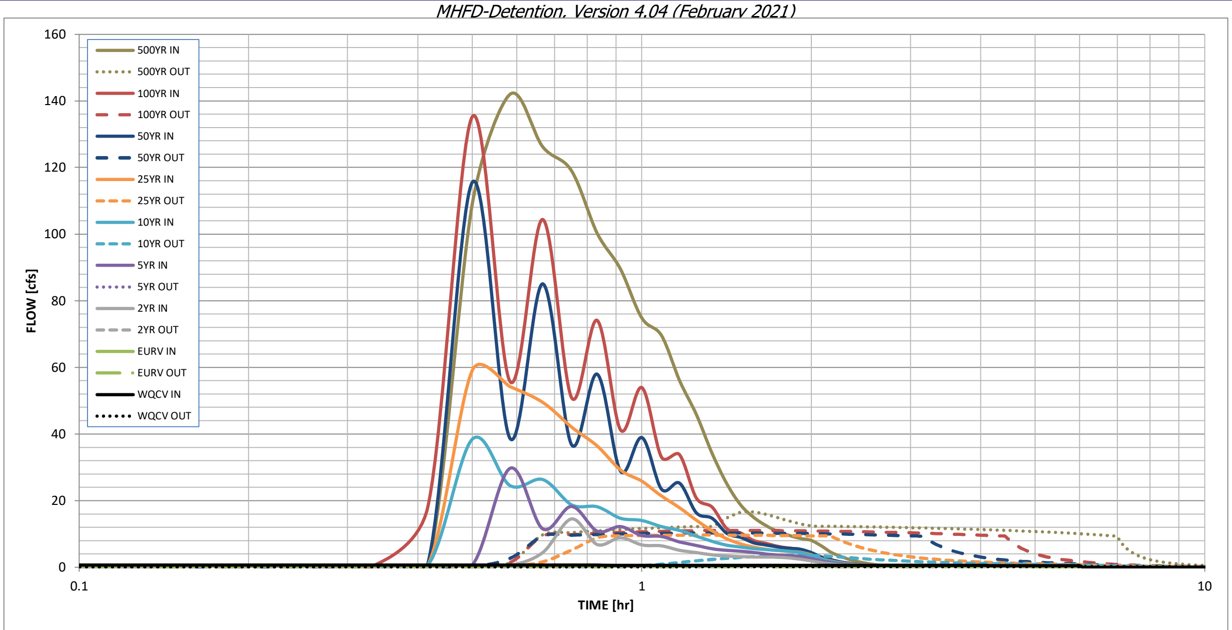
Routed Hydrograph Results

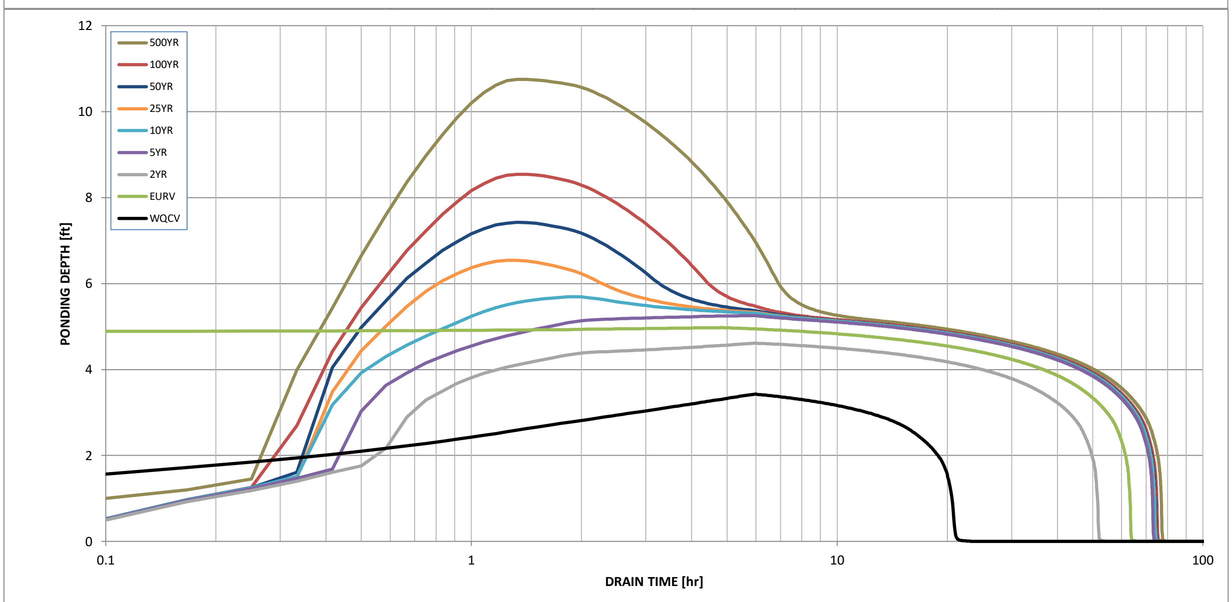
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

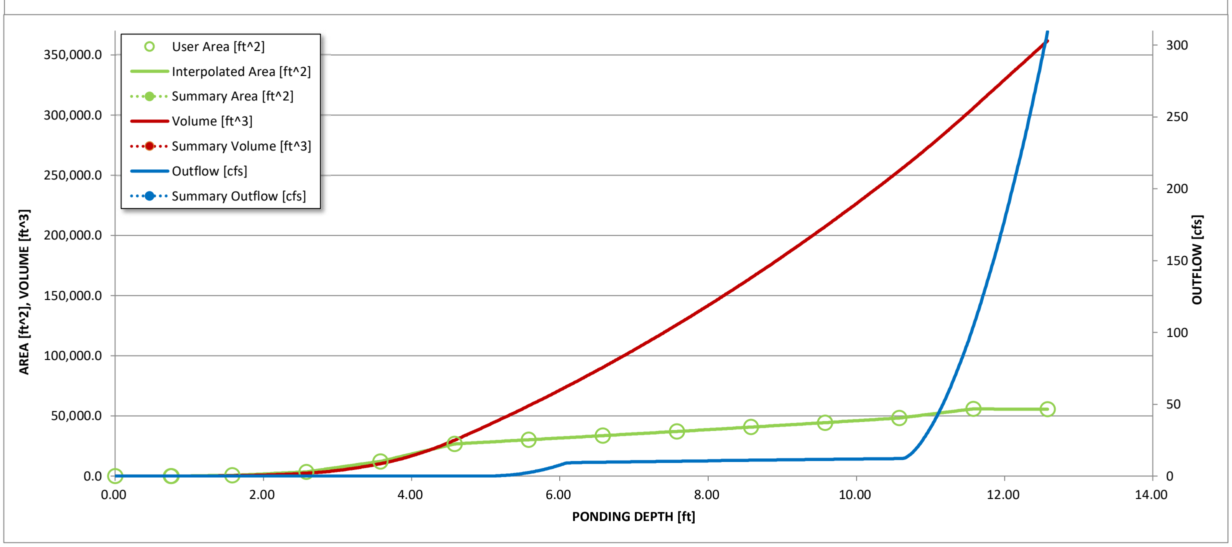
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.12	1.37	1.75	2.08	2.43	3.35
CUHP Runoff Volume (acre-ft) =	0.599	1.908	1.108	1.590	2.181	3.348	4.261	5.367	8.041
User Override Inflow Hydrograph Volume (acre-ft) =	0.284	1.908	0.806	1.285	1.874	3.040	3.952	5.058	7.729
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.7	6.4	21.3	30.8	43.1	70.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.19	0.64	0.92	1.29	2.09
Peak Inflow Q (cfs) =	0.7	255.6	14.5	29.7	38.4	59.2	115.5	135.2	142.0
Peak Outflow Q (cfs) =	0.18	0.22	0.21	0.51	3.68	9.67	10.31	11.05	16.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.6	0.5	0.3	0.3	0.2
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.2	0.5	0.5	0.5	0.6
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) =	20	59	50	70	69	67	65	63	60
Time to Drain 99% of Inflow Volume (hours) =	**21**	62	51	72	72	71	71	71	71
Maximum Ponding Depth (ft) =	3.43	4.98	4.61	5.26	5.70	6.54	7.43	8.55	10.76
Area at Maximum Ponding Depth (acres) =	0.25	0.65	0.62	0.67	0.70	0.77	0.84	0.93	1.14
Maximum Volume Stored (acre-ft) =	0.196	0.934	0.706	1.118	1.419	2.045	2.753	3.746	6.018

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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	USER	USER	USER	USER	USER	USER	USER	USER	USER
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	0.65	255.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.65	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.30
	0:10:00	0.65	0.43	0.30	0.30	0.31	0.30	0.31	0.31	0.33
	0:15:00	0.65	0.43	0.32	0.35	0.36	0.35	0.36	0.37	0.42
	0:20:00	0.64	0.43	0.39	0.44	0.48	0.43	0.47	0.48	0.58
	0:25:00	0.64	0.43	0.48	0.55	0.62	0.59	1.02	18.08	109.08
	0:30:00	0.64	0.42	0.56	0.65	38.41	59.15	115.51	135.21	142.01
	0:35:00	0.64	0.42	0.62	29.68	24.55	54.25	38.67	55.74	126.18
	0:40:00	0.63	0.42	4.39	11.57	26.37	49.52	85.03	104.39	119.05
	0:45:00	0.63	0.42	14.48	18.31	18.79	42.11	36.79	50.98	100.26
	0:50:00	0.63	0.41	6.85	10.85	18.14	36.39	58.00	74.12	89.47
	0:55:00	0.63	0.41	8.88	12.24	14.68	29.18	28.81	41.22	74.78
	1:00:00	0.62	0.41	6.69	9.49	14.06	25.86	38.92	53.94	69.60
	1:05:00	0.62	0.41	6.43	9.26	12.18	21.40	23.49	33.08	56.18
	1:10:00	0.62	0.40	5.13	7.64	11.10	17.93	25.29	33.87	45.84
	1:15:00	0.62	0.40	4.41	6.57	9.36	14.15	16.33	20.78	34.19
	1:20:00	0.61	0.40	3.74	5.58	7.79	10.97	14.75	18.12	25.05
	1:25:00	0.61	0.40	3.39	5.12	6.68	8.55	10.19	11.61	18.61
	1:30:00	0.61	0.39	3.21	4.83	6.06	6.99	8.97	10.27	14.92
	1:35:00	0.61	0.39	3.12	4.43	5.61	6.04	7.35	7.98	12.37
	1:40:00	0.60	0.39	3.06	3.99	5.29	5.41	6.68	7.15	10.69
	1:45:00	0.60	0.39	3.01	3.70	5.06	5.00	6.05	6.22	9.48
	1:50:00	0.60	0.38	2.76	3.47	4.82	4.73	5.71	5.73	8.64
	1:55:00	0.60	0.38	2.39	3.24	4.41	4.54	5.43	5.34	8.07
	2:00:00	0.59	0.38	1.94	2.64	3.52	3.73	4.43	4.34	6.48
	2:05:00	0.59	0.38	1.43	1.91	2.52	2.64	3.13	3.06	4.53
	2:10:00	0.59	0.38	1.07	1.41	1.85	1.95	2.30	2.26	3.35
	2:15:00	0.59	0.37	0.81	1.04	1.35	1.42	1.67	1.65	2.43
	2:20:00	0.58	0.37	0.65	0.77	0.99	1.04	1.21	1.20	1.74
	2:25:00	0.58	0.37	0.65	0.65	0.73	0.76	0.87	0.87	1.24
	2:30:00	0.58	0.37	0.65	0.65	0.65	0.65	0.67	0.67	0.89
	2:35:00	0.58	0.36	0.65	0.65	0.65	0.65	0.65	0.65	0.66
	2:40:00	0.57	0.36	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	2:45:00	0.57	0.36	0.65	0.65	0.65	0.65	0.65	0.65	0.65
	2:50:00	0.57	0.36	0.64	0.65	0.65	0.65	0.65	0.65	0.65
	2:55:00	0.57	0.35	0.64	0.64	0.64	0.64	0.65	0.65	0.65
	3:00:00	0.56	0.35	0.64	0.64	0.64	0.64	0.64	0.64	0.64
	3:05:00	0.56	0.35	0.64	0.64	0.64	0.64	0.64	0.64	0.64
	3:10:00	0.56	0.35	0.63	0.64	0.64	0.64	0.64	0.64	0.64
	3:15:00	0.56	0.34	0.63	0.63	0.63	0.64	0.64	0.64	0.64
	3:20:00	0.55	0.34	0.63	0.63	0.63	0.63	0.63	0.63	0.63
	3:25:00	0.55	0.34	0.63	0.63	0.63	0.63	0.63	0.63	0.63
	3:30:00	0.55	0.34	0.62	0.63	0.63	0.63	0.63	0.63	0.63
	3:35:00	0.55	0.33	0.62	0.62	0.62	0.63	0.63	0.63	0.63
	3:40:00	0.54	0.33	0.62	0.62	0.62	0.62	0.62	0.62	0.63
	3:45:00	0.54	0.33	0.62	0.62	0.62	0.62	0.62	0.62	0.62
	3:50:00	0.54	0.33	0.61	0.62	0.62	0.62	0.62	0.62	0.62
	3:55:00	0.54	0.32	0.61	0.61	0.62	0.62	0.62	0.62	0.62
	4:00:00	0.53	0.32	0.61	0.61	0.61	0.61	0.61	0.61	0.62
	4:05:00	0.53	0.32	0.61	0.61	0.61	0.61	0.61	0.61	0.61
	4:10:00	0.53	0.32	0.60	0.61	0.61	0.61	0.61	0.61	0.61
	4:15:00	0.53	0.31	0.60	0.60	0.61	0.61	0.61	0.61	0.61
	4:20:00	0.53	0.31	0.60	0.60	0.60	0.60	0.60	0.60	0.61
	4:25:00	0.52	0.31	0.60	0.60	0.60	0.60	0.60	0.60	0.60
	4:30:00	0.52	0.31	0.59	0.60	0.60	0.60	0.60	0.60	0.60
	4:35:00	0.52	0.30	0.59	0.59	0.60	0.60	0.60	0.60	0.60
	4:40:00	0.52	0.30	0.59	0.59	0.59	0.59	0.59	0.59	0.60
	4:45:00	0.51	0.30	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	4:50:00	0.51	0.30	0.58	0.59	0.59	0.59	0.59	0.59	0.59
	4:55:00	0.51	0.21	0.58	0.58	0.59	0.59	0.59	0.59	0.59
	5:00:00	0.51	0.00	0.58	0.58	0.58	0.58	0.58	0.58	0.59
	5:05:00	0.50	0.00	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	5:10:00	0.50	0.00	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	5:15:00	0.50	0.00	0.57	0.57	0.58	0.58	0.58	0.58	0.58
	5:20:00	0.50	0.00	0.57	0.57	0.57	0.57	0.57	0.57	0.58
	5:25:00	0.49	0.00	0.57	0.57	0.57	0.57	0.57	0.57	0.57
	5:30:00	0.49	0.00	0.57	0.57	0.57	0.57	0.57	0.57	0.57
	5:35:00	0.49	0.00	0.56	0.56	0.57	0.57	0.57	0.57	0.57
	5:40:00	0.49	0.00	0.56	0.56	0.56	0.56	0.56	0.56	0.57
	5:45:00	0.48	0.00	0.56	0.56	0.56	0.56	0.56	0.56	0.56
	5:50:00	0.48	0.00	0.56	0.56	0.56	0.56	0.56	0.56	0.56
	5:55:00	0.48	0.00	0.55	0.55	0.56	0.56	0.56	0.56	0.56
	6:00:00	0.48	0.00	0.55	0.55	0.55	0.55	0.55	0.55	0.56

Project Name:	Eberly Place
Title:	**MDCIA Calculation**
Project No:	201237
Date:	08/16/21
Revised:	
Design by:	MAW

Commerce City MDCIA Requirement: Before discharging to a water of the state, at least 20% of the upstream imperviousness of the applicable development site must be disconnected from the storm drainage system and drain through a receiving pervious area control measure comprising a footprint of at least 10% of the upstream disconnected impervious area of the applicable development site.

For the Eberly development the entire site is routed to the proposed full spectrum detention facility onsite.

Upstream Imperviousness of Development Site =	19.97	Acres (from Composite C-Value Computations - sum of roof, drives, walks, garages and streets)		
20% of Upstream Impervious Area =	**3.99**	**Acres**		
10% of Upstream Impervious Area =	**2.00**	**Acres**		
Number of Lots =	154			
Rooftop Acres Per Lot (see Average from Home Plan info below) =	0.042	Acres		
Total Area of Residential Rooftops =	**6.54**	**Acres**	**33%**	(check - greater than 20% of Upstream Impervious Area)

Rooftops drain to a 5' landscape or gravel filter buffer around the perimiter of each home

Total Area of 5' Perimiter Lanscape Strip =	**3.06**	**Acres**	**15%**	(check - greater than 10% of Upstream Impervious Area)

***Proposed Home Plans for information Only*

Plan	*Beds*	*Baths*	*Stories*	*Sq. Ft.*	*Width*	*Base Depth*	*Roof Area*	*5' Perimiter Landscape Strip*	
D942	*3*	*2.5*	*2*	*1,825*	*35*	*38*	*1330*	*730*	
D943	*3*	*2.5*	*2*	*1,979*	*35*	*45*	*1575*	*800*	
D915	*3*	*2.5*	*2*	*2,187*	*35*	*43*	*1505*	*780*	
D913	*3*	*2.5*	*2*	*2,427*	*35*	*48*	*1680*	*830*	
D914	*4*	*2.5*	*2*	*2,665*	*35*	*52*	*1820*	*870*	
D922	*3*	*2*	*1*	*2,082*	*40*	*67*	*2680*	*1070*	
D923	*3*	*2.5*	*2*	*2,721*	*40*	*54*	*2160*	*940*	
D924	*4*	*2.5*	*2*	*3,041*	*40*	*51*	*2040*	*910*	
						Average =	*1849*	*866*	*Square feet*
							0.042	*0.020*	*Acres*

APPENDIX E – Geotechnical Report

Geotechnical Site Development Study
Eberly
Commerce City, Colorado

United Development Companies, LLC
6900 East Belleview Avenue
Suite 300
Greenwood Village, Colorado 80111

A.G. WASSENAAR, INC.
3211 South Zuni Street
Englewood, Colorado 80110
www.agwco.com (303) 759-8100

Project Number 208100
January 26, 2021

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ATTACHMENTS

1.0 EXECUTIVE SUMMARY

A. G. Wassenaar, Inc. (AGW) completed the geotechnical site development study for the proposed residential development at the subject site. The data collected during our field exploration and laboratory work and our analysis, opinions, and conclusions are presented. The purpose of our study is to provide design recommendations for planning and site development and preliminary design concepts for foundation systems, interior floor support, and streets.

The subsurface materials encountered in our test borings consist of topsoil, clay, sand, and gravel overlying sedimentary bedrock. Claystone bedrock was encountered at depths of 32 and 34 feet. Ground water was not encountered during this study.

Site development considerations should include provisions for the presence of existing structures, existing fill, and underground utilities and for the presence of loose sand.

Based upon the results of this preliminary study, we anticipate that all of the structures could be founded on spread or pad-type footings bearing on the natural soils or on properly placed and compacted fill below frost depth. Preliminary foundation design concepts are presented.

Floors and flatwork being considered for construction on-grade will require a specific risk analysis by the Client because of the potential for movement of the soils and bedrock encountered. Where footings are constructed, slabs-on-grade may be possible depending on the expansion potential of the supporting materials and the Client's analysis of risk. Slabs supported by soil will be subject to movement. Options for floor support are discussed.

Foundation subsurface drainage systems will be necessary for all below grade areas. Water soluble sulfate test results indicate that site and foundation concrete may be designed for negligible sulfate exposure. Preliminary pavement and other geotechnical-related recommendations are presented in the following report. We encourage the Client to read this report in its entirety and not to solely rely on the cursory information contained in this summary.

2.0 PURPOSE

This report presents the results of a geotechnical site development study for the proposed residential development to be located southeast of Potomac Street and East 104th Avenue in Commerce City, Colorado. The study was conducted by AGW to assist in determining geotechnical design criteria for planning, site evaluation, and development considerations. Preliminary geotechnical design concepts are also presented for foundations, interior floor support, foundation drainage, and street construction. Factual data gathered during the field and laboratory work are summarized on Figures 1 through 5 and in Appendix A. Our opinions and recommendations presented in this report are based on the data generated during our field exploration, laboratory testing, our understanding of the proposed project, and our experience with similar projects and geotechnical conditions.

This study was performed in general conformance with our Proposal Number 208100, dated December 10, 2020. This report is not intended to provide design criteria for individual foundations or street construction. Additional geotechnical studies will be required to provide final design criteria and construction recommendations.

3.0 PROPOSED CONSTRUCTION

We understand the proposed 34-acre residential development will include 144 single family lots and the associated utility and roadway infrastructure. Basement products are planned. Preliminary overlot grading plans were not available at the time of this study. The contents of this report must be reviewed by AGW when grading plans are available.

4.0 SITE CONDITIONS

The site contains an existing residence with two outbuildings along the eastern portion of the site. A fill stockpile was observed in the vicinity of Test Boring 9. Vegetation consists of native grasses and weeds, bushes, and trees in the eastern portion of the site. The ground surface slopes gently to steeply to the southwest. The site is bounded by vacant parcels and rural residential properties to the north and south, a residential subdivision to the east, and Potomac Street to the west. No bodies of water or bedrock outcrops were observed on the site.

5.0 FIELD EXPLORATION

Subsurface conditions were explored by drilling 15 test borings at the approximate locations indicated on Figure 1. The test borings were advanced using a 4-inch diameter, continuous flight auger powered by a truck-mounted drill rig. At frequent intervals, samples of the subsurface materials were obtained using a Modified California sampler and a split spoon sampler which were driven into the soil by dropping a 140-pound hammer through a free fall of 30 inches. The Modified California sampler is a 2.5-inch outside diameter by 2-inch inside diameter device. The split spoon sampler is a 2.0-inch outside diameter by 1.375-inch inside diameter device. The number of blows required for the sampler to penetrate 12 inches and/or the number of inches that the sampler is driven by 50 blows gives an indication of the consistency or relative density of the soils and bedrock materials encountered. Results of the penetration tests and locations of sampling are presented on the "Test Boring Logs", Figures 2 through 5. Ground water measurements were made at the time of drilling and subsequent to drilling.

6.0 LABORATORY TESTING

The samples obtained during drilling were returned to the laboratory where they were visually classified by a geotechnical engineer. Laboratory testing was then assigned to specific samples to evaluate their engineering properties. The laboratory tests included swell-consolidation tests to evaluate the effect of wetting and loading on the selected samples. Gradation analysis and Atterberg limits tests were conducted to evaluate grain size distribution and plasticity. A standard Proctor test and a remolded swell-consolidation test were performed on a blended bulk sample of the soils anticipated to be used as fill. In addition, representative samples were tested for water soluble sulfates, pH, resistivity, and chlorides. The test results are summarized on Figures 2 through 5 and presented in Appendix A.

7.0 SUBSURFACE CONDITIONS

The subsurface materials encountered in our test borings consist of topsoil, clay, sand, and gravel overlying sedimentary bedrock. Claystone bedrock was encountered at depths of 32 and 34 feet. Ground water was not encountered during this study. A more complete description of the subsurface conditions is shown on Figures 2 through 5.

7.1 Fill

A fill stockpile was observed in the vicinity of Test Boring 9 and was approximately 4 feet high and 20 feet wide. The existing fill is more fully discussed under "Geotechnical Concerns".

7.2 Natural Soil

Topsoil was found in all 15 test borings. The topsoil encountered consisted of clayey sand up to ½-foot thick. It was organic, moist, and dark brown.

Clay was encountered in seven of the 15 test borings. The clay was stiff to very stiff, silty, sandy, with sand lenses, moist, and brown. The clay has low expansion and consolidation potential.

Sand was encountered in all 15 test borings. The sand was loose to dense, slightly silty to very silty, clayey to very clayey, with clay lenses and scattered gravel, moist, and brown to light brown. The sand has low expansion potential and low to moderate settlement potential.

Interbedded clay and sand was encountered in eight of the 15 test borings. The clay and sand consisted of sandy to very sandy clay and very silty, very clayey sand. It was stiff to very stiff/medium dense to dense, moist, and brown to light brown. The clay and sand has low expansion and consolidation/settlement potential.

Sand and gravel was encountered in eight of the 15 test borings. The sand and gravel was dense to very dense, silty, moist, and brown to gray. The sand and gravel has low expansion and settlement potential.

7.3 Bedrock

Claystone bedrock was encountered in two of the 15 test borings at depths of 32 and 34 feet. The claystone was hard, silty, sandy, moist, and brown to gray. The claystone has high expansion potential.

7.4 Ground Water

Ground water was not encountered at the time of drilling nor when checked one day after drilling. Test Boring 1 caved at a depth of 33 feet when checked after drilling. Ground water levels fluctuate with changing seasons and irrigation patterns and are expected to rise after construction is complete and landscape irrigation commences.

8.0 GEOTECHNICAL CONCERNS

8.1 Existing Structures, Existing Fill, and Underground Utilities

As discussed in "Site Conditions", structures currently occupy the eastern portion the site. The structures, including shallow foundation elements, must be removed from the site. If the existing structures were founded on piers, the piers should be removed or cut off down to a depth of at least 2 feet below the bottom of any planned construction. Any below grade appurtenances encountered should also be removed. All concrete pads should be removed from the site.

A fill stockpile was observed in the vicinity of Test Boring 9. Any existing fill encountered during development should be considered to have not been placed as fill capable of supporting a structure. The existing fill should be excavated prior to placement of new fill, structures, or other structural appurtenances. Any fill encountered should be evaluated for quality at the time of removal to determine its suitability for placement as new fill on the site.

Underground utilities that are to be abandoned should be removed. This includes any pipes and trench backfill. After removal, the existing utility trenches should be widened at the base to a minimum of 8-feet and the sides of the trench should be sloped per the soil types described in Appendix B. Any new fill placed in the trench area should be placed and compacted as described in Appendix B.

8.2 Loose Sand

Loose sand was encountered near the ground surface in Test Boring 1. The loose sand presents concerns for site grading, foundation excavations, and pavement construction. Movement of large, rubber-tired equipment may cause severe rutting which may result in not being able to traverse the areas. It may be necessary to stabilize the soft areas prior to fill placement. It may also be necessary to stabilize the soils prior to foundation and pavement construction.

9.0 SITE DEVELOPMENT

9.1 Overlot Grading

We understand the fill materials to be used at the site will be from on-site cut areas. In general, suitable inorganic on-site or off-site soils may be used for structural fill. Existing fill should be excavated prior to placement of new fill. Topsoil, soil containing significant vegetation, organic debris or other deleterious material should be excavated and removed from the structural areas. Off-site material considered for new fill should be evaluated by AGW prior to importing to the site.

Construction of the fill embankments throughout the site should consist of proper foundation preparation, constructing embankment benching where necessary, disposition of strippings, proper fill placement and compaction, and designing slopes in accordance with the recommendations provided in this report and the applicable governing regulations. The following are general site grading recommendations:

1. Grading plans should be provided to AGW prior to commencement of work at the site.

2. It is recommended that AGW be retained on an essentially full-time basis to observe and test the fill placement. We should also be retained to provide observations and/or testing of the other items discussed below. The purpose of this observation and testing is to provide the Client with a greater degree of confidence that the work is being performed within the recommendations of this geotechnical study and the project specifications.
3. Various structures were observed in the eastern portion of the site. All the existing structures, including their foundations, should be completely removed from the site. Our experience indicates that other below grade or undisclosed structures such as root cellars, wells, cisterns, etc. may be present. Any of these structures encountered should also be removed. Any wells encountered should be abandoned in accordance with the regulations of the Colorado State Engineer.
4. A fill stockpile was observed near Test Boring 9. We recommend that the fill stockpile be entirely excavated. The fill should be observed during excavation in order to determine whether the excavated material may be re-used in the structural areas as new fill. Excavation of isolated test pits (with or without density-compaction testing) will not provide enough information, in our opinion, to allow the fill to remain in place.
5. Utilities beneath structural areas that are to be abandoned should be entirely removed. The excavation should then be widened to allow access to a self-propelled compactor. New fill should be placed and compacted as described in this section and Appendix B.
6. All topsoil and vegetation should be stripped and removed prior to fill placement. The vegetation, organic soils, or topsoil should be wasted from the site, placed in non-structural areas (e.g., parks, landscaping, tracts, etc.) and/or stockpiled for future use in revegetating the surface of exposed slopes. In no case should these materials be used in the structural areas or where the stability of slopes will be affected. If placed in lots, topsoil must be placed outside of the structure setbacks and should not be placed where the fill depths exceed 5 feet. If placed in depth across the back of lots, movements of fences and dry utilities should be expected.
7. Where loose sands are found beneath planned fill areas, removal, or stabilization may be necessary. Stabilization prior to fill placement may be accomplished by placing crushed rock or equivalent material, which should be evaluated by AGW prior to use. The material should be spread across the area and worked into the underlying loose soils with fully-loaded rubber-tired equipment. This procedure should continue until scraper-type equipment can be supported on the rock fill with no significant deflection or rutting. In some instances, a geogrid or geotextile stabilization fabric may be economical for use in conjunction with rock stabilization.
8. Where the existing slopes are steeper than a 5:1 (horizontal:vertical), benching will be required for structural integrity of any fills (see Figure 6).
9. The stripped foundation areas should be observed by AGW prior to fill placement. Any soft soils found in these areas must be removed or stabilized as necessary prior to fill placement.

10. After the fill areas have been cleared, the exposed soils should be scarified to a minimum depth of 6 inches, brought to the proper moisture content, and then compacted according to Appendix B.
11. The compaction and moisture content of the soils will be dependent upon material types and the depth and location of placement. The specifications outlined in Appendix B are based upon providing a fill with sufficient shear strength to support structures and sufficient moisture to reduce the potential of swell of the expansive soil used in the fill.
12. The results of a Standard Proctor test performed on a bulk sample of the upper level soils likely to be used for fill is shown on Figure A-24 in Appendix A. These results can be used as guideline for contractors to estimate how much additional moisture may be required to bring the on-site soils to the required moisture content.
13. Particular attention should be paid to compaction of the exterior faces of slopes.
14. Placement and compaction of fill should continue to final overlot grade. We recommend that the lots not be left low or "dished-out" and that placement of fill not stop at foundation elevation.
15. Other specifications outlined in Appendix B should be followed.

9.2 Slopes and Retaining Walls

Slope stability and retaining wall analyses were not conducted as part of this study. In areas where existing slopes exceed 5:1 (horizontal:vertical), benching prior to fill placement will be required (see Figure 6). Construction of conventional fill slopes should be limited to 3 to 1 or flatter. Cut slopes steeper than 2 to 1 should be evaluated for stability. Specific analysis will also be necessary if retaining walls are to be constructed.

9.3 Construction Excavation

In our opinion, the majority of the site grading, utility, and foundation excavations may be constructed using conventional earth-moving equipment for the Front Range area. In some areas, unstable soils beneath earth-moving equipment may be encountered. Care should be taken so that the foundation soils are not disturbed or are properly stabilized. Excavations deeper than 3 feet should be properly sloped or braced to prevent collapse of potentially caving soils. For planning purposes, fills, sand, and gravel are "Type C", the clay is "Type B", and the underlying bedrock is "Type A" according to OSHA regulations. A final determination of the soil type must be made by the Contractor's "Competent Person" (as defined by OSHA Regulation). Local, city, county, state, and federal (OSHA) regulations should be followed.

9.4 Utility Construction

In our experience, utility excavations may be constructed using conventional earth-moving equipment for the Front Range area. All excavations should be sloped or shored in the interest of safety, following local and federal (OSHA) regulations. For planning purposes, OSHA soil type designations are discussed under "Construction Excavations". Final determination of the soil types must be made by the contractor's "Competent Person" (as defined by OSHA) at the time of construction.

Trench backfill within all structural areas should, as a minimum, be compacted using the same methods and to the same specifications as required for overlot grading. This is especially important where utility lines and laterals are constructed beneath foundation, alley, and driveway areas. Trenches in streets should be compacted Commerce City specifications. Observation and testing of fill placement must be performed during trench backfilling.

The choice of compaction equipment can have a significant effect on the performance of trench fills. It is our experience that utility trench backfills compacted with a compaction wheel attached to an excavator experience more settlement (both in area and magnitude) than those compacted with self-propelled equipment. While the contractor has control of the means and methods of construction, the Client should be aware of this issue.

9.5 Subsurface Drainage

Clay soils and bedrock were encountered in the test borings drilled for this study. These types of material have a relatively low permeability and can develop a perched water condition. Perched water conditions generally occur after development and construction have taken place, when landscape irrigation and surface drainage conditions are changed.

For these reasons, an overall area drain (underdrain) should be considered for the site. In addition, the overall area drain could also provide for a discharge and collection point for individual foundation drains. If an area drain discharge is not available, the individual foundation drains will discharge collected water to the ground surface near each residence. Surface discharge can result in water recycling to the foundation drain and ponding of water where surface grading is not sufficient for water flow. Foundation drain discharge can also result in algae growth where water continually crosses sidewalks which become ice hazards on walkways and gutters in the winter months.

Typically, overall area drains can be designed and constructed with installation of the sanitary sewer system. However, Commerce City should be consulted to determine where an overall system is allowed. The civil engineering company contracted to design the infrastructure should be able to provide this design. We are available to assist in drain design. For the system to work, the area drain must be graded to a positive discharge point. If a permanent outfall for an area drain cannot be determined, the area drain should not be constructed.

If it is decided not to install an overall area drain, an alternative would be to establish points of positive gravity discharge for the gravel bedding beneath the sewer. We also recommend any basement or below grade area be provided with a perimeter subsurface drainage system sloped to drain to a positive gravity discharge such as a sump or connected directly to the overall area drain system.

9.6 Surface Drainage

We recommend that provisions be made to divert surface runoff away from development areas. This may reduce potential problems associated with excess water in structure bearing soils. The site should be designed such that a 10% slope can be established near the structures after foundation construction. Slopes of at least 2% should be planned in landscaped areas once the water is away from the foundations.

10.0 SITE CONCRETE AND CORROSIVITY

Laboratory tests conducted on selected soil samples yielded water soluble sulfates ranging from less than 100 parts per million (ppm) to 200 ppm. Based upon these results and our experience in the area, the site soils and bedrock are assigned to possess negligible (S0 or RS0) sulfate exposure per ACI 318 or ACI 332. We recommend the "ACI Manual of Concrete Practice", of the most recent edition be used for proper concrete mix design properties as they relate to these conditions.

The pH test results were 8.1 and 8.2, resistivity test results at in-situ moisture were 948 and 3,801 ohm·cm, and chloride test results were 0.0003% and 0.0012%. These results are summarized on Figures 2 through 5 and in Appendix A. The results of this testing should be used as an aid in choosing the construction materials in contact with these soils which will be resistant to the various corrosive forces. Manufacturer's representatives should be contacted regarding the specific corrosivity resistance for their products. In addition, local specifications should be consulted when selecting pipe materials.

11.0 PRELIMINARY FOUNDATION DESIGN CONCEPTS

The foundation recommendations for each structure are dependent upon the subsurface profile and engineering properties of the materials encountered at and near the depth of the proposed foundation. These are dependent upon the final configuration of and construction methods used during overlot grading at the site. The information in the following sections presents preliminary foundation concepts which must be finalized for each building site upon completion of the overlot grading operations. AGW should be retained to perform design level soil and foundation studies after completion of site grading.

11.1 Footings

Foundations supported by spread footings or footing pads may be possible for structures where sufficient non- to low expansive clays, sands, or properly placed and compacted fills are encountered beneath the foundation elevation. The footings must be founded below frost depth. The footings will likely be designed for maximum soil bearing pressures ranging from 1,000 to 3,000 pounds per square foot (psf). Minimum dead load pressure on the order of 500 to 1,000 psf may be required.

11.2 Lateral Earth Pressures

Foundation walls with fill on only one side will need to be designed for lateral earth pressures. For this site, lateral earth pressures calculated based upon equivalent fluid densities on the order of 50 to 70 pcf should be anticipated. The preliminary estimates are for properly placed and compacted fill at foundation walls. They should not be used for site retaining walls.

11.3 Interior Floors

Where footing type foundations are constructed, it is likely that the sites will be assessed with a low slab risk performance. Slab-on-grade construction may be appropriate for full, unfinished basement construction on sites with low or moderate evaluations. Structural floors are generally recommended on sites with higher evaluations and for finished basements or any site where floor movement or cracking cannot be tolerated. If slab movement cannot be tolerated, structural floors should be constructed.

11.4 Drain Systems

Drain systems will be required around the lowest excavation level for below grade spaces for each structure. Either interior or exterior drains may be used for the site. The drains must be led to a positive gravity outfall or sump. If an overall subdivision area drain is constructed, individual drains should be connected into this system if allowed by the jurisdiction.

11.5 Backfill and Surface Drainage

Foundation backfill should be moistened and compacted to reduce future settlement. The site grading should consider a slope of 10% away from the foundation at the completion of construction. All other drainage swales in landscaped areas should slope at a minimum of 2%.

12.0 PRELIMINARY STREET PAVEMENT DESIGN

Pavement design is based on the engineering properties of the subgrade and pavement materials, the assumed design traffic conditions, and Commerce City pavement regulations. Effective pavement structures are composed of various pavement materials bearing upon properly prepared subgrade soils. The following preliminary pavement recommendations are based upon the subsurface conditions encountered and our experience in the area.

It appears the proposed subgrade materials will likely be clay, sand, or fill constructed from these materials. According to the AASHTO Soil Classification System, these materials classify as A-1-b, A-2-4, A-4, A-6, A-7-6 soils. Based upon the subgrade soil classifications, we have estimated the relative strengths of the subgrade soils presented above in order to determine the preliminary pavement thicknesses. Based on this information and utilizing the design methodology determined from the pavement design regulations for Commerce City, the alternatives presented below were calculated. Theses thickness recommendations are based on a design life of 20 years. It should be emphasized that the design alternatives provided are preliminary for the materials anticipated. The final design thicknesses could be more or less than indicated depending upon the materials sampled during the final pavement design.

Pavement Thickness Alternatives for Interior Streets

Traffic Category	HBP (in.)	HBP / CTS (in.)	HBP / ABC (in.)
Local Streets	6.0 to 7.5	4.0 to 5.0 / 12.0	4.0 to 5.5 / 6.0 to 8.0

HBP = Hot Bituminous Pavement CTS = Chemically Treated Subgrade ABC = Aggregate Base Course

Proper surface and subsurface drainage is essential for adequate performance of pavements. It has been our experience that water from landscaped areas can infiltrate pavement subgrade soils and result in softening of the subgrade followed by pavement damage. Therefore, provisions should be made to maintain adequate drainage and/or contain runoff from such areas. In addition, water and irrigation lines should be thoroughly pressure tested for leaks prior to placement of pavement materials.

It must be reiterated that the information contained in this section is preliminary in nature. More detailed information will be required by Commerce City prior to issuance of a paving permit. Therefore, when overlot grading is complete at the site, a final pavement evaluation must be performed.

13.0 FINAL DESIGN CONSULTATION AND CONSTRUCTION OBSERVATION

This report has been prepared for the exclusive use of United Development Companies, LLC for the purpose of providing geotechnical criteria for the proposed project. The data gathered and the conclusions and recommendations presented herein are based upon the consideration of many factors including, but not limited to, the type of structures proposed, the configuration of the structures, the proposed usage of the site, the configuration of surrounding structures, the geologic setting, the materials encountered, and our understanding of the level of risk acceptable to the Client. Therefore, the conclusions and recommendations contained in this report should not be considered valid for use by others unless accompanied by written authorization from AGW.

AGW should be contacted if the Client desires an explanation of the contents of this report. AGW should be retained to provide future geotechnical services for the site including, but not limited to, design level geotechnical studies, consultation during design, observation and testing during construction, and other geotechnically related services. Failure to contract with AGW for these services or selection of a firm other than AGW to provide these services will eliminate liability for AGW. We are available to discuss this with you.

14.0 GEOTECHNICAL RISK

The concept of risk is an important aspect of any geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be tempered by engineering judgment and experience. Therefore, the solutions or recommendations presented in any geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structures will perform as desired or intended. What the engineering recommendations presented in the preceding sections do constitute is our judgement of those measures that increase the chances for the structures and improvements performing satisfactorily. The Developer, Builder, and Owner must understand this concept of risk, as it is they who must ultimately decide what is an acceptable level of risk for the proposed development of the site.

15.0 LIMITATIONS

We believe the professional judgments expressed in this report are consistent with that degree of skill and care ordinarily exercised by practicing design professionals performing similar design services in the same locality, at the same time, at the same site and under the same or similar circumstances and conditions. No other warranty, express or implied, is made. In the event that any changes in the nature, design or location of the facility are made, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing. Because of the constantly changing state of the practice in geotechnical engineering, and the potential for site changes after our field exploration, this report must not be relied upon after a period of three years without AGW being given the opportunity to review and, if necessary, revise our findings.

The test borings drilled for this study were spaced to obtain an understanding of subsurface conditions for design purposes. Variations frequently occur from these conditions which are not indicated by the test borings. These variations are sometimes sufficient to necessitate modifications in the designs. If unexpected subsurface conditions are observed by any party during site development, we must be notified to review our recommendations.

Our scope of services for this project did not include, either specifically or by implication, any research, identification, testing, or assessment relative to past or present contamination of the site by any source, including biological (i.e., mold, fungi, bacteria, etc.). If such contamination were present, it is likely that the exploration and testing conducted for this report would not reveal its existence. If the Client is concerned about the potential for such contamination or pollution, additional studies should be undertaken. We are available to discuss the scope of such studies with you.

Our scope of services for this project did not include a local or global geological risk assessment. Therefore, issues such as mine subsidence, slope stability, faults, etc. were not researched or addressed as part of this study. If the Client is concerned about these issues, we are available to discuss the scope of such studies upon your request.

Sincerely,

A. G. Wassenaar, Inc.

COLORADO LICENSED PROFESSIONAL ENGINEER
ASHLEY ANN MCDANIELS
51150

Ashley A. McDaniels, P.E.
Project Engineer

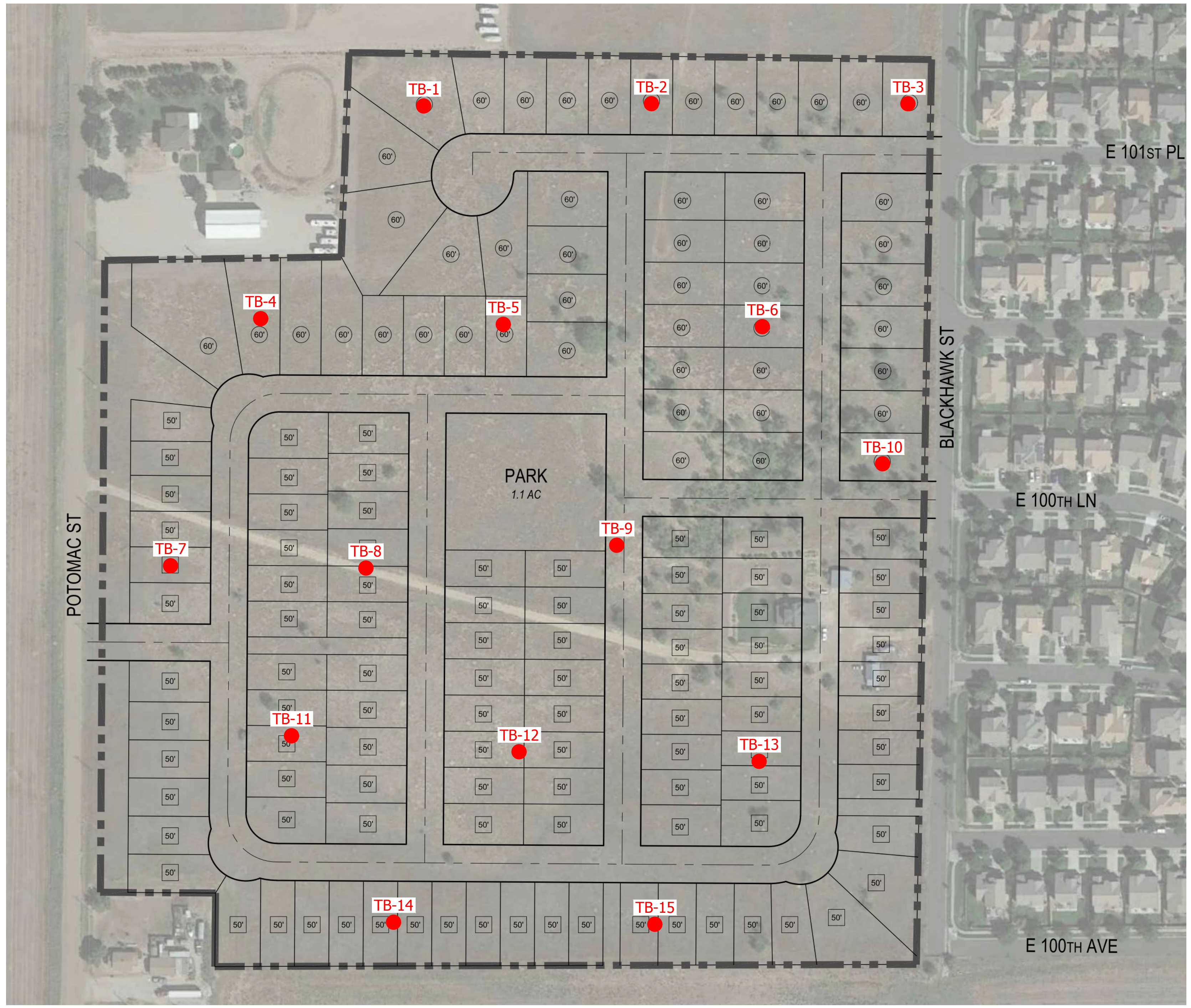
Reviewed by:

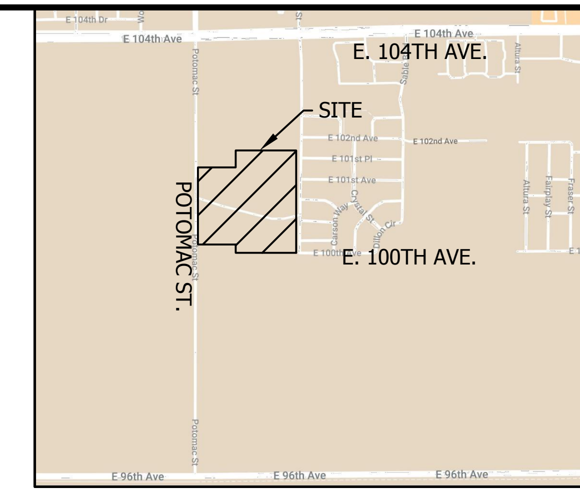
Kathleen A. Noonan, M.S., P.E.
Senior Geotechnical Engineer

AAM/KAN/aam

EBERLY
COMMERCE CITY, COLORADO

0 200 400
Scale in Feet





VICINITY MAP
NOT TO SCALE

NOTES:
1. TEST BORINGS ARE OVERLAID ON THE "EBERLY - CONCEPTUAL LOTTING PLAN, OPTION 2", PREPARED BY NORRIS DESIGN, DATED OCTOBER 14, 2020.
2. ALL LOCATIONS ARE APPROXIMATE.

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SITE PLAN AND VICINITY MAP	PROJECT NO. 208100 FIGURE 1

AGW
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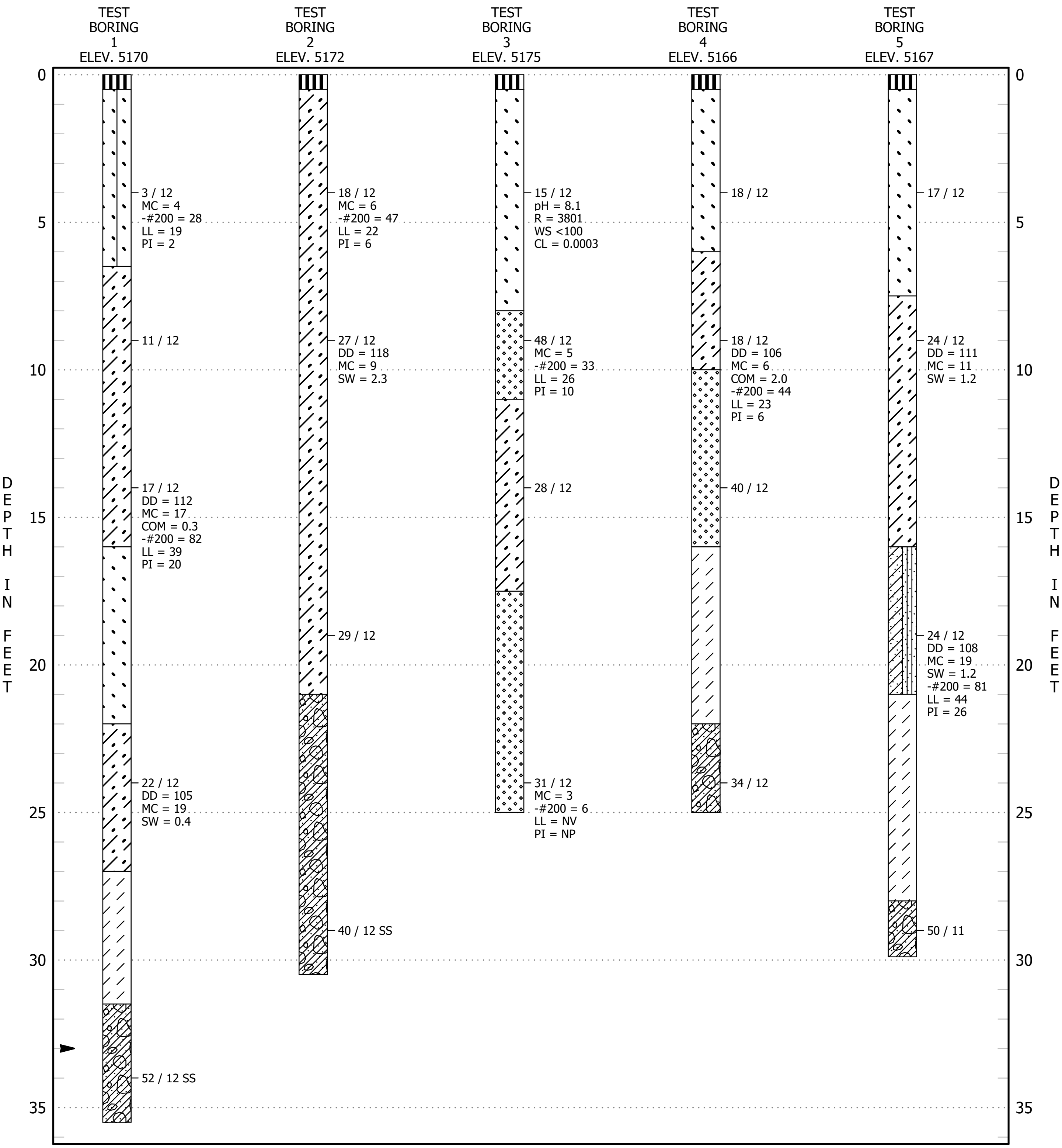
CLIENT United Development Companies, LLC **PROJECT NAME** Eberly

PROJECT NUMBER 208100 **PROJECT LOCATION** Commerce City, Colorado



SEE FIGURE 5 FOR LEGEND AND NOTES

TEST BORING LOGS

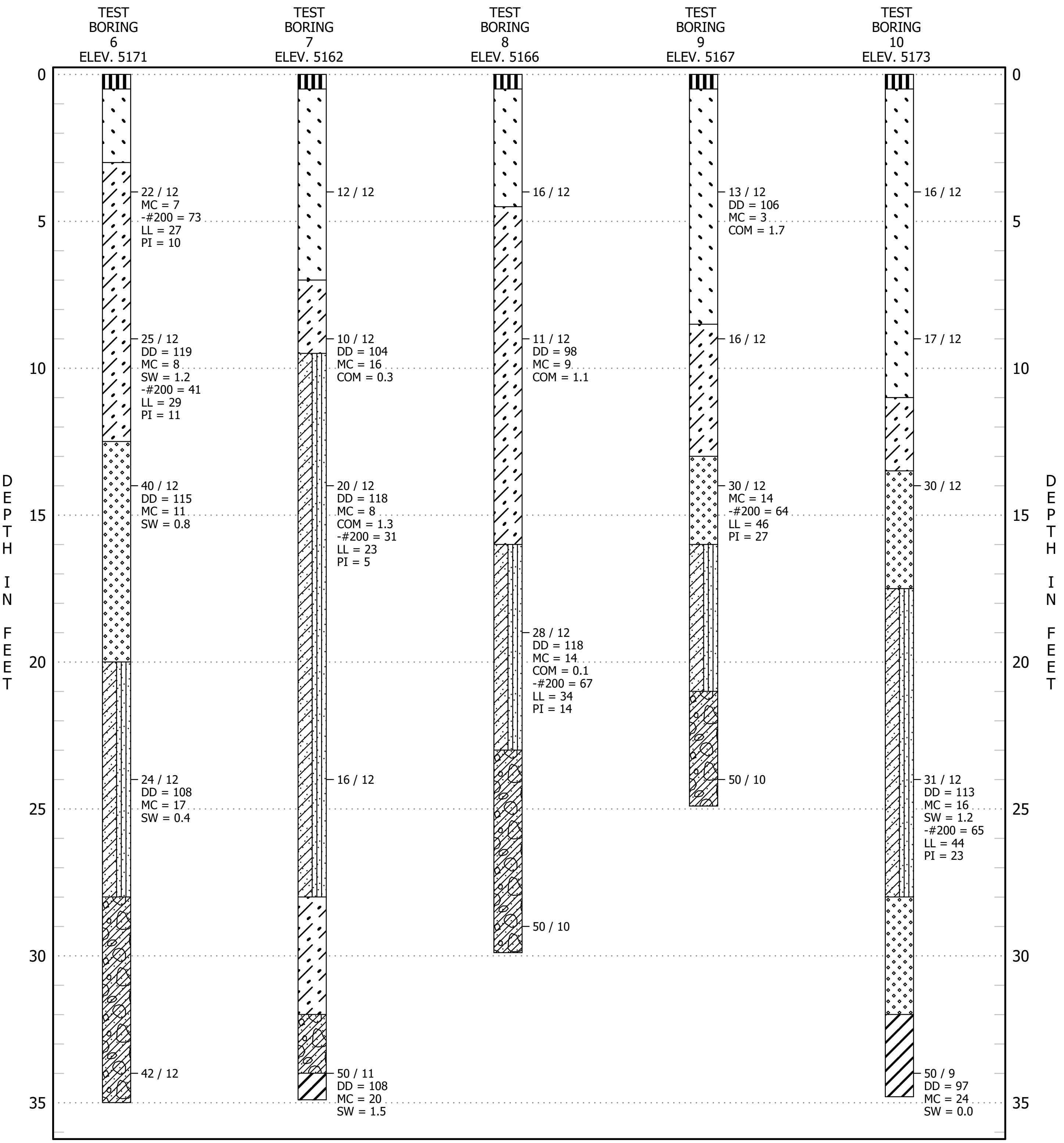
FIGURE 2

AGW

A.G. WASSENAAR, INC.

CLIENT United Development Companies, LLC **PROJECT NAME** Eberly

PROJECT NUMBER 208100 **PROJECT LOCATION** Commerce City, Colorado



SEE FIGURE 5 FOR LEGEND AND NOTES

TEST BORING LOGS

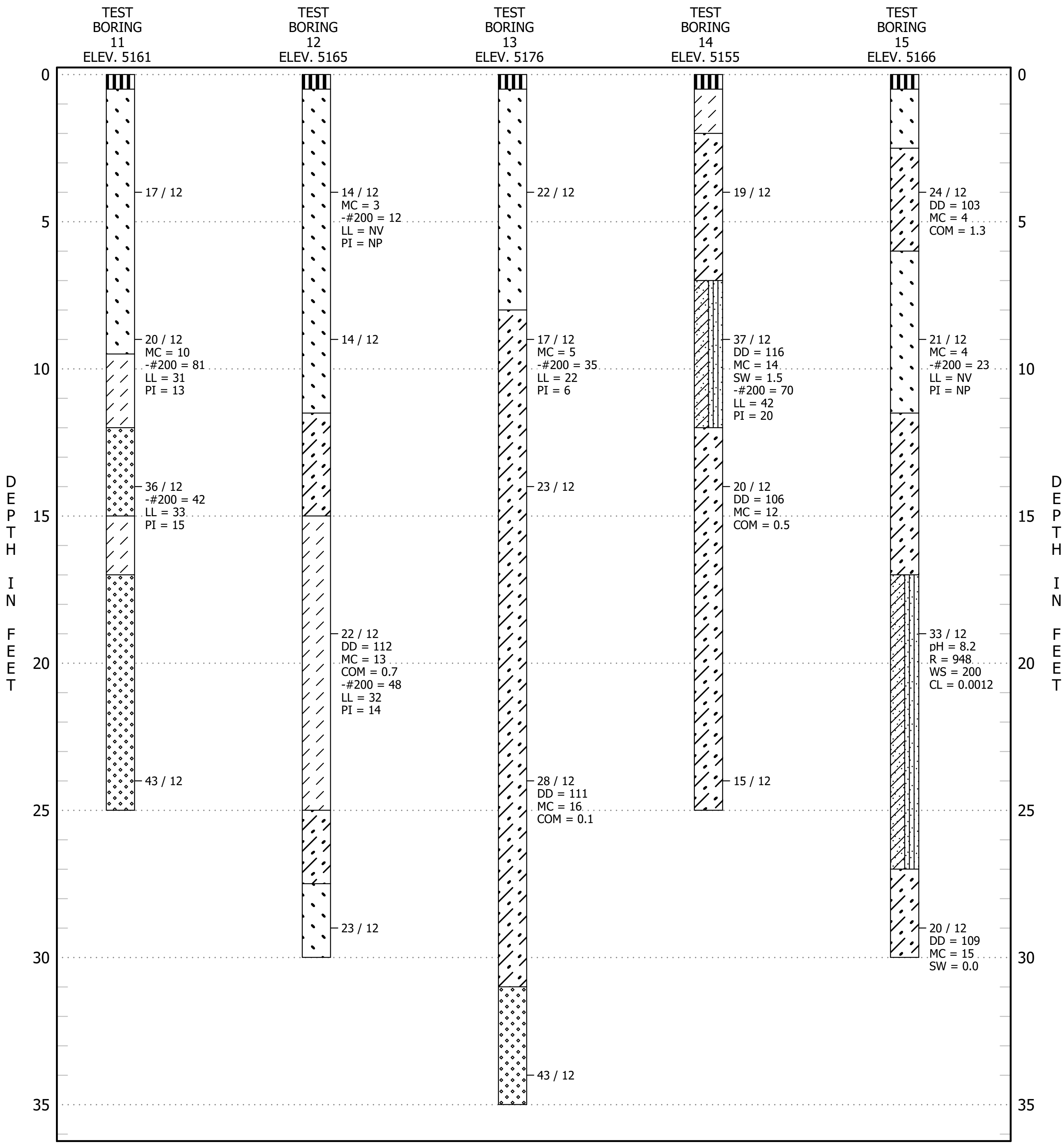
FIGURE 3

U:\PROJECT FILES\2 - GEOTECHNICAL\208100 EBERLY UNITED DEVELOPMENT SD KAN\TO BE SAVED\GINT\208100S_GT2021-01-08 EBERLY SD.GPJ

A.G. WASSENAAR, INC.

CLIENT United Development Companies, LLC **PROJECT NAME** Eberly

PROJECT NUMBER 208100 **PROJECT LOCATION** Commerce City, Colorado



SEE FIGURE 5 FOR LEGEND AND NOTES

TEST BORING LOGS

FIGURE 4

CLIENT United Development Companies, LLC
PROJECT NAME Eberly
PROJECT NUMBER 208100
PROJECT LOCATION Commerce City, Colorado

SOIL DESCRIPTIONS

- Topsoil, clay, sandy, organic
- Clay, stiff to very stiff
- Sand, loose
- Sand, medium dense, silty
- Sand, medium dense, silty, clayey
- Sand, dense to very dense, silty
- Clay/sand, interbedded, stiff/medium dense
- Sand and gravel, dense to very dense, clayey
- Claystone (Bedrock), hard to very hard

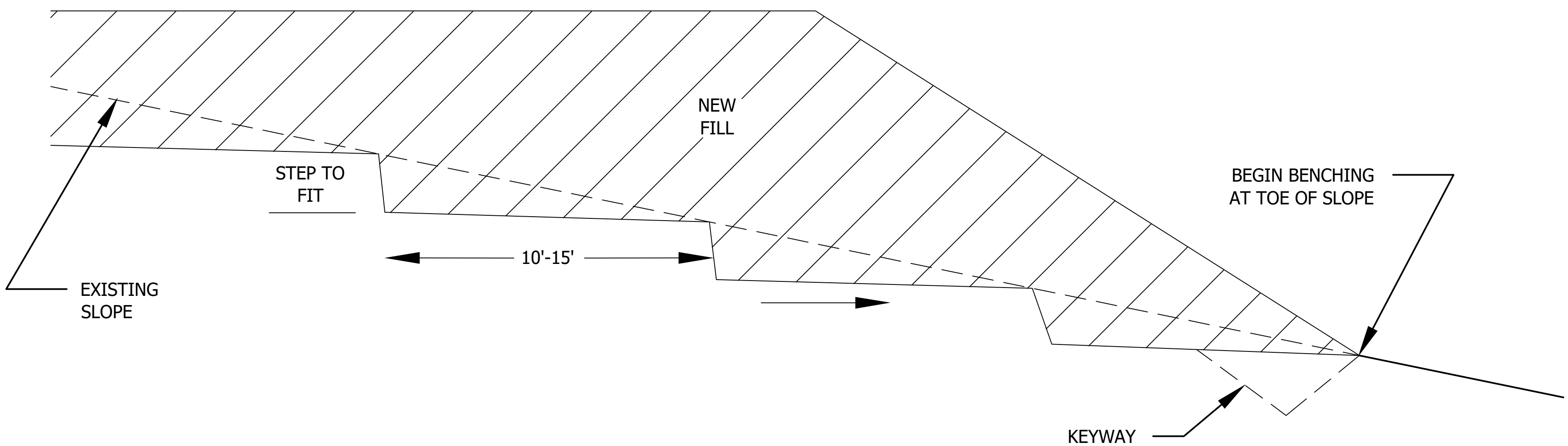
ABBREVIATIONS

DD	Dry density of sample in pounds per cubic foot (pcf)
MC	Moisture content as a percentage of dry weight of soil (%)
SW	Percent swell under a surcharge of 1000 pounds per square foot (psf) upon wetting (%)
COM	Percent compression under a surcharge of 1000 pounds per square foot (psf) upon wetting (%)
UC	Unconfined compressive strength in pounds per square foot (psf)
-#200	Percent passing the Number 200 sieve (%)
LL	Liquid Limit
PI	Plasticity Index
NP	Non-Plastic
NV	No Value
pH	Acidity or alkalinity of sample in pH units
R	Resistivity in ohms.cm
WS	Water soluble sufates in parts per million (ppm)
CL	Chlorides in percent (%)
x/y	X blows of a 140-pound hammer falling 30 inches were required to drive a 2.5-inch outside diameter sampler Y inches
x/y SS	X blows of a 140-pound hammer falling 30 inches were required to drive a 2.0-inch outside diameter sampler Y inches
C-x	Depth of cut to grade (rounded to the nearest foot)
F-x	Depth of fill to grade (rounded to the nearest foot)
FG	Finished grade (rounded to the nearest foot)
NR	No sample recovered
Bounce	Sampler bounced during driving
B	Bulk sample
AS	Auger sample
▤	Moderately to well cemented layer
—	Approximate depth of cut
▲	Depth at which practical drilling refusal was encountered
▽	Water level at time of drilling
▷	Caved depth at time of drilling
▼	Water level 1 to 5 day(s) after drilling
►	Caved depth 1 to 5 day(s) after drilling

Notes:

1. Test borings were drilled December 29, 2020 and December 30, 2020.
2. Location of the test borings were staked by others at locations chosen by this firm.
3. The horizontal lines shown on the logs are to differentiate materials and represent the approximate boundaries between materials. The transitions between materials may be gradual.
4. Elevations were obtained from staking provided by others and have been rounded to the nearest foot.
5. Boring logs shown in this report are subject to the limitations, explanations, and conclusions of this report.

LEGEND AND NOTES
FIGURE 5



NOTES:

1. BENCHING REQUIRED WHEN EXISTING SLOPE IS 5 : 1 (HORIZONTAL : VERTICAL) OR STEEPER
2. CONTINUE BENCHING UNTIL NATURAL SLOPE FLATTENS OR DAYLIGHTS
3. DRAINS MAY BE REQUIRED IF GROUND WATER IS ENCOUNTERED
4. ADDITIONAL EXCAVATION MAY BE REQUIRED BY AGW IF SLOPE INSTABILITY IS NOTED
5. A KEYWAY MAY BE REQUIRED BY AGW DEPENDING UPON SLOPE CONFIGURATION
6. NOT TO SCALE

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GENERALIZED BENCHING DETAIL	PROJECT NO. 208100 FIGURE 6

APPENDIX A

LABORATORY TEST RESULTS

TABLE A-1
SUMMARY OF LABORATORY TEST RESULTS
January 26, 2021

Test Boring Number	Depth (feet)	Soil Type	Natural Dry Density (pcf)	Natural Moisture (%)	Swell / Consolidation (-) (%) [1]	Swell Pressure (psf)	% Passing #200 Sieve	Atterberg Liquid Limit LL	Atterberg Plasticity Index PI	pH	Resistivity (ohm•cm)	Water Soluble Sulfates (ppm)	Chlorides (%)
1	4	Sand, silty		4			28	19	2				
1	14	Clay, slightly sandy, trace gravel (lens)	112	17	-0.3	NA	82	39	20				
1	24	Sand, very clayey	105	19	0.4	1,800							
2	4	Sand, very silty, very clayey		6			47	22	6				
2	9	Clay, very sandy (lens)	118	9	2.3	7,900							
3	4	Sand, silty								8.1	3,801	<100	0.0003
3	9	Sand, very clayey		5			33	26	10				
3	24	Sand, slightly silty		3			6	NV	NP				
4	9	Sand, very silty, very clayey	106	6	-2.0	NA	44	23	6				
5	9	Sand, clayey	111	11	1.2	3,300							
5	19	Clay, sandy	108	19	1.2	2,800	81	44	26				
6	4	Clay, sandy (lens)		7			73	27	10				
6	9	Sand, very clayey	119	8	1.2	2,400	41	29	11				
6	14	Sand, clayey	115	11	0.8	2,800							
6	24	Sand, clayey	108	17	0.4	—							
7	9	Sand, clayey	104	16	-0.3	NA							
7	14	Sand, very silty, very clayey	118	8	-1.3	NA	31	23	5				
7	34	Claystone, sandy	108	20	1.5	5,900							
8	9	Sand, clayey	98	9	-1.1	NA							
8	19	Clay, very sandy	118	14	-0.1	NA	67	34	14				
9	4	Sand, silty	106	3	-1.7	NA							
9	14	Clay, very sandy (lens)		14			64	46	27				
10	24	Clay, very sandy	113	16	1.2	4,200	65	44	23				
10	34	Claystone, sandy	97	24	0.0	NA							
11	9	Clay, sandy		10			81	31	13				

A.G. WASSENAAR, INC.

TABLE A-1
SUMMARY OF LABORATORY TEST RESULTS
January 26, 2021

Test Boring Number	Depth (feet)	Soil Type	Natural Dry Density (pcf)	Natural Moisture (%)	Swell / Consolidation (-) (%) [1]	Swell Pressure (psf)	% Passing #200 Sieve	Atterberg Liquid Limit LL	Atterberg Plasticity Index PI	pH	Resistivity (ohm•cm)	Water Soluble Sulfates (ppm)	Chlorides (%)
11	14	Sand, very clayey					42	33	15				
12	4	Sand, slightly silty		3			12	NV	NP				
12	19	Sand, very clayey (lens)	112	13	-0.7	NA	48	32	14				
13	9	Sand, very silty, very clayey		5			35	22	6				
13	24	Sand, very clayey	111	16	-0.1	NA							
14	9	Clay, sandy	116	14	1.5	6,200	70	42	20				
14	14	Sand, clayey	106	12	-0.5	NA							
15	4	Sand, clayey	103	4	-1.3	NA							
15	9	Sand, silty		4			23	NV	NP				
15	19	Clay, sandy								8.2	948	200	0.0012
15	29	Sand, clayey	109	15	0.0	NA							
Bulk [2]	NA	Sand, very silty, very clayey	116.1 [3]	12.4 [3]			50	21	4			200	
Bulk [2]	NA	Sand, very silty, very clayey	111	13	-0.1 [4]	NA							

Notes:

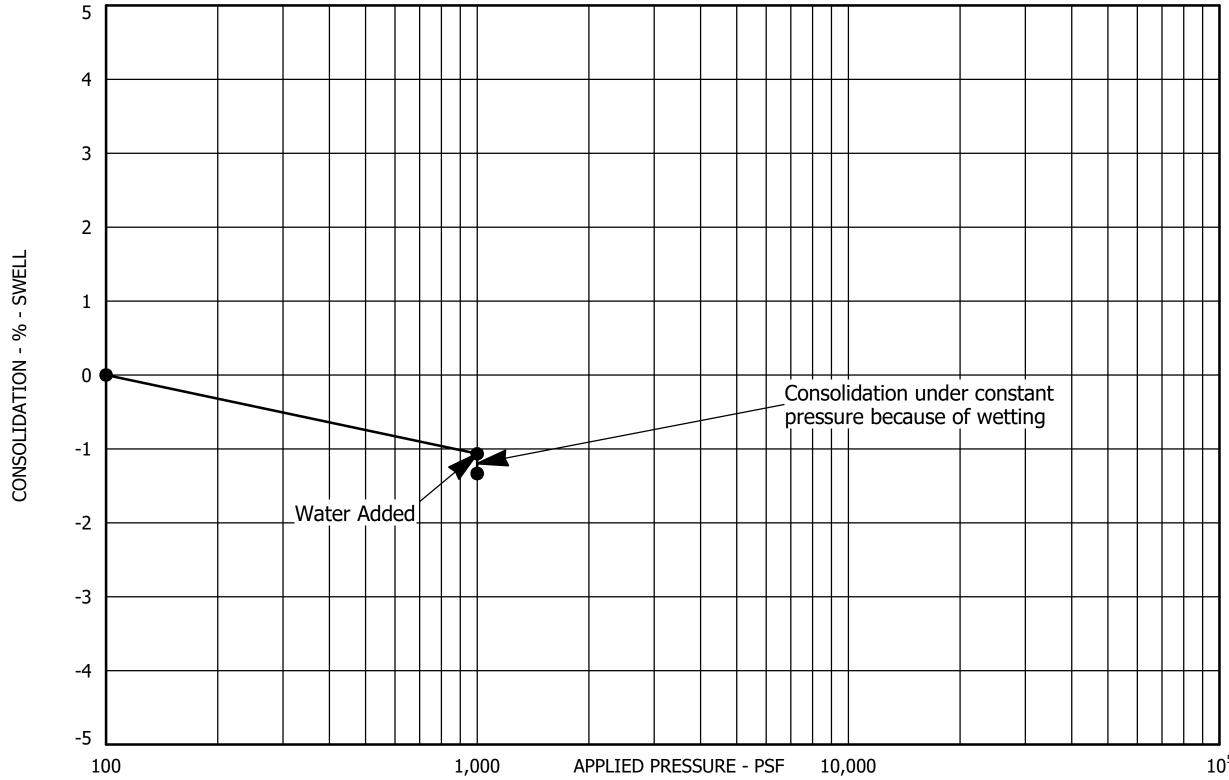
NA - Not Applicable, NV - No Value, NP - Nonplastic

[1] Indicates percent swell or consolidation (-) when wetted under a 1,000 psf load

[2] Bulk is a blended bulk sample obtained from the auger cuttings of various test borings

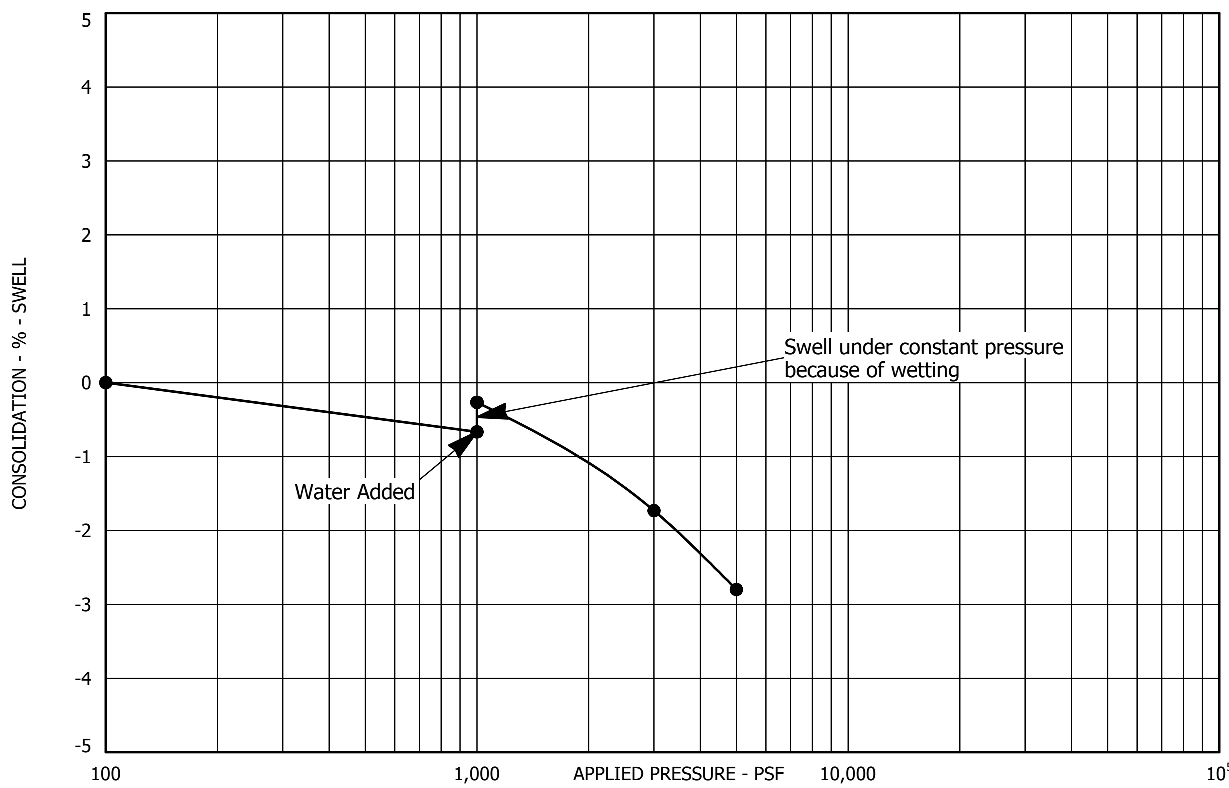
[3] Maximum dry density (MDD) and optimum moisture content (OMC)

[4] Sample was remolded to approximately 95% MDD



Sample Location: Test Boring No. 1 at a depth of 14 feet — Dry Unit Weight (pcf): 112

Sample Description: Clay, slightly sandy, trace gravel (lens) — Moisture Content (%): 17



Sample Location: Test Boring No. 1 at a depth of 24 feet — Dry Unit Weight (pcf): 105

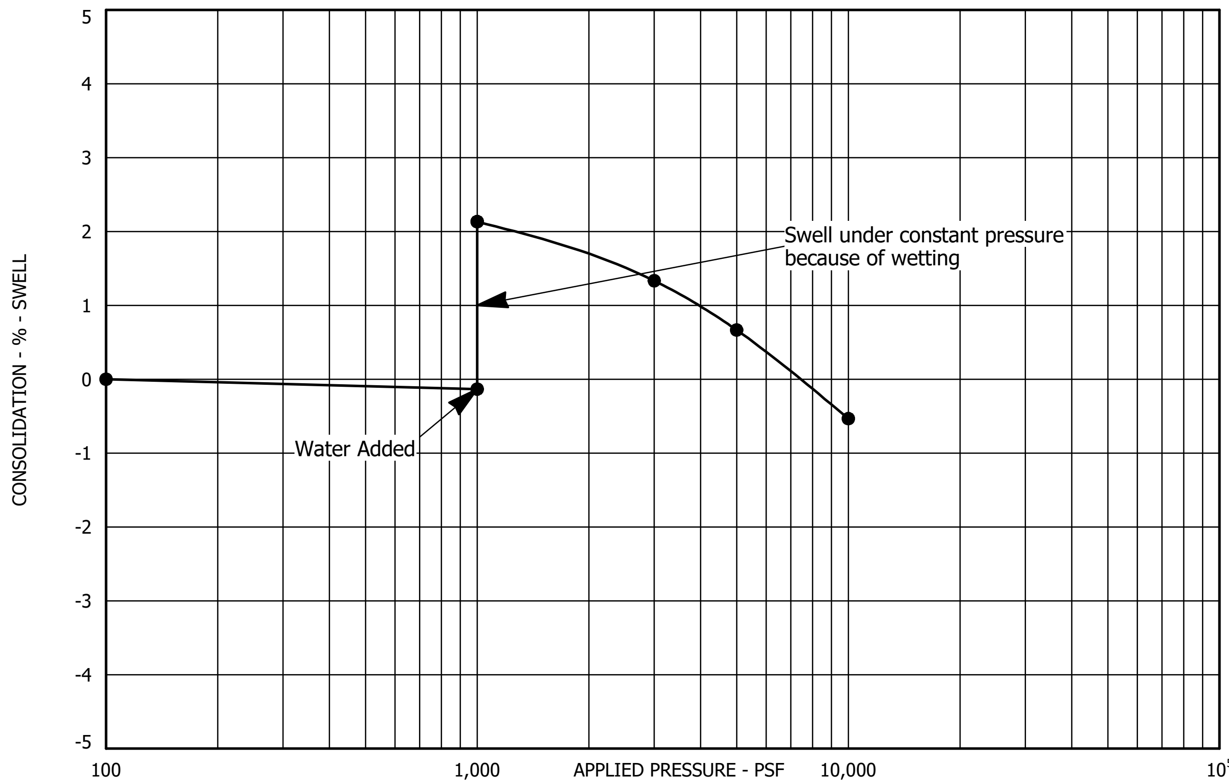
Sample Description: Sand, very clayey — Moisture Content (%): 19

SWELL - CONSOLIDATION TEST RESULTS

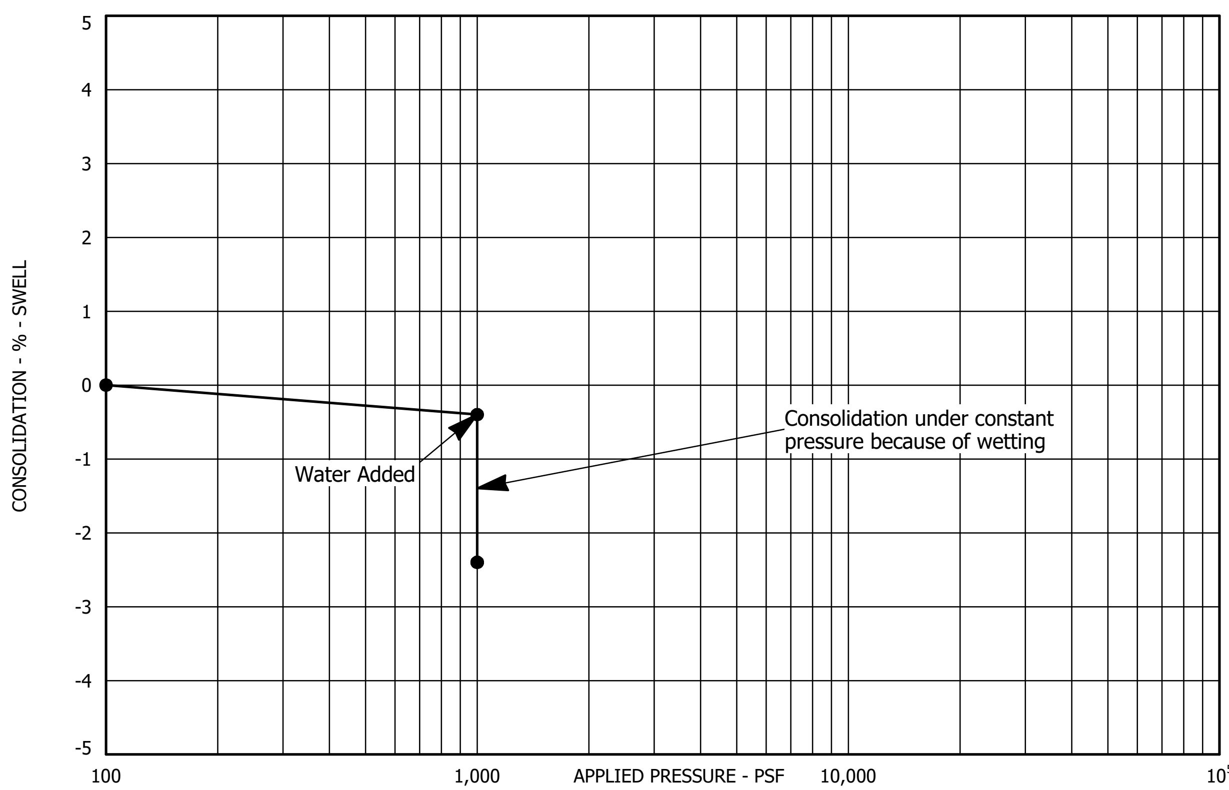
FIGURE A-1

PROJECT NO. 208100

A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 2 at a depth of 9 feet
Dry Unit Weight (pcf): 118
Sample Description: Clay, very sandy (lens)
Moisture Content (%): 9



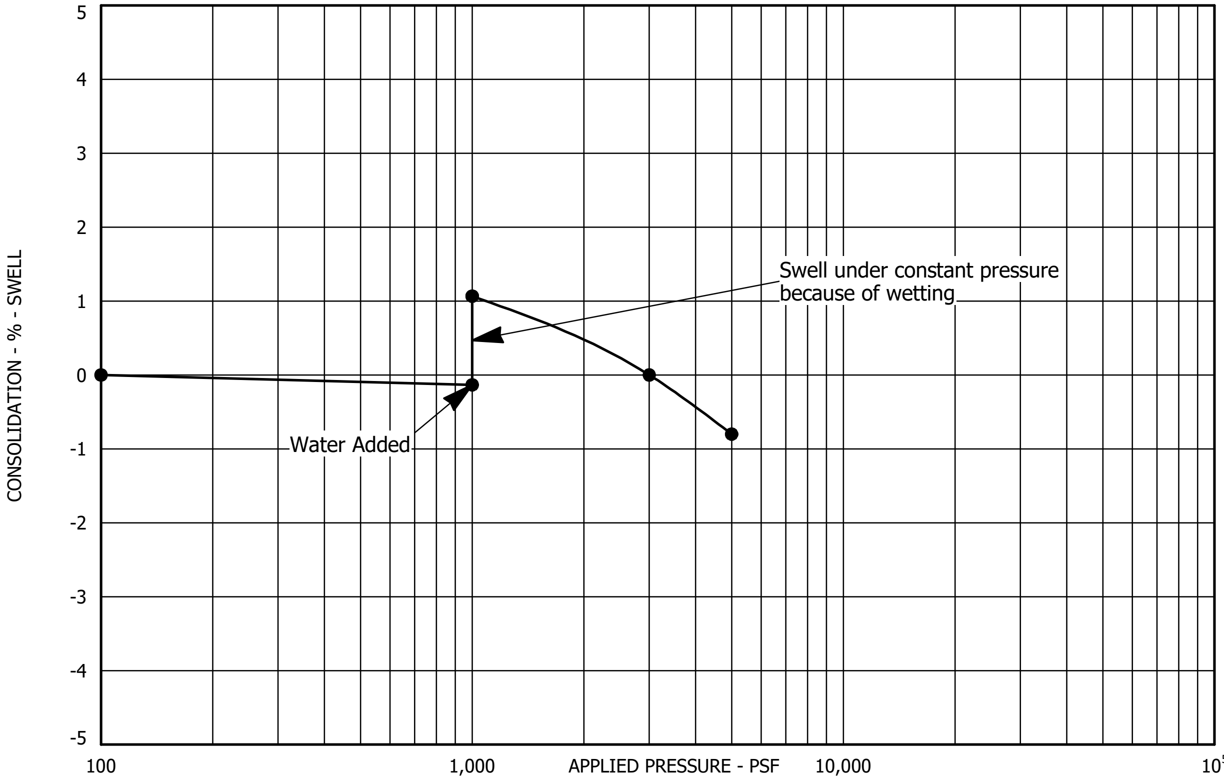
Sample Location: Test Boring No. 4 at a depth of 9 feet
Dry Unit Weight (pcf): 106
Sample Description: Sand, very silty, very clayey
Moisture Content (%): 6

SWELL - CONSOLIDATION TEST RESULTS

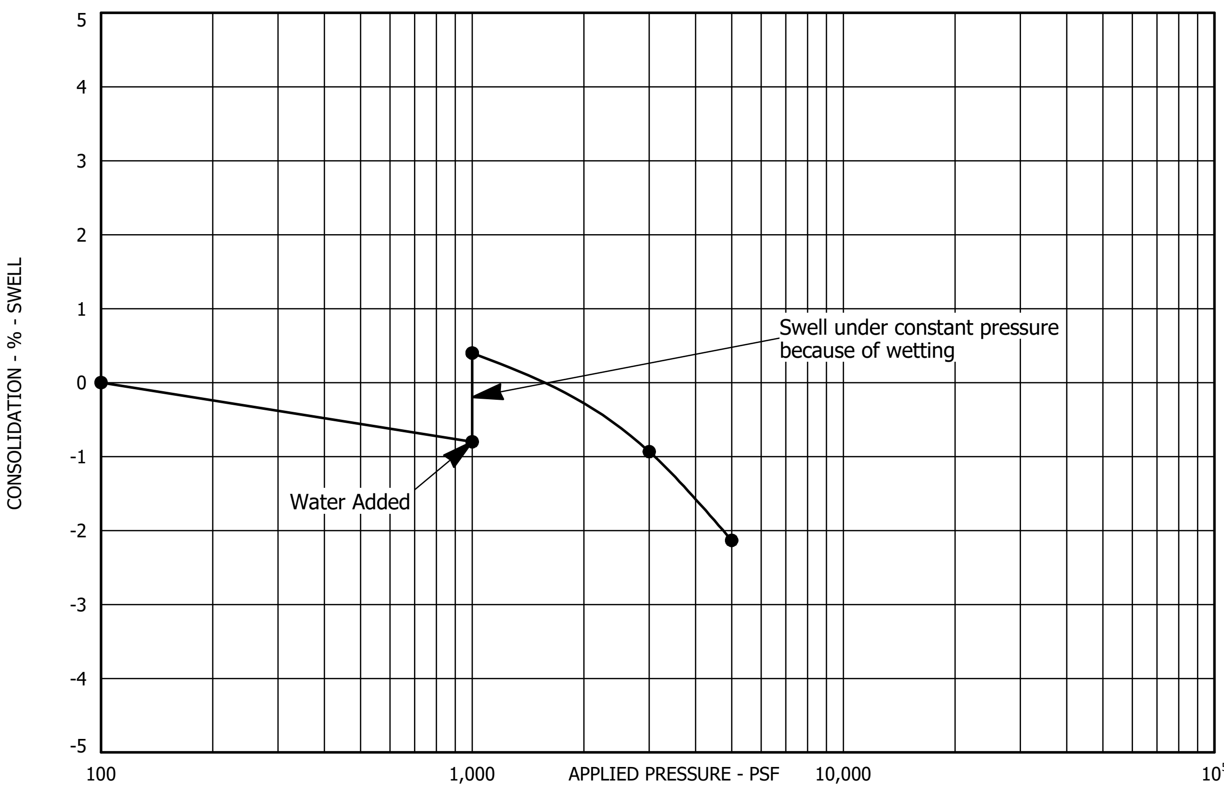
FIGURE A-2

PROJECT NO. 208100

A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 5 at a depth of 9 feet
Dry Unit Weight (pcf): 111
Sample Description: Sand, clayey
Moisture Content (%): 11



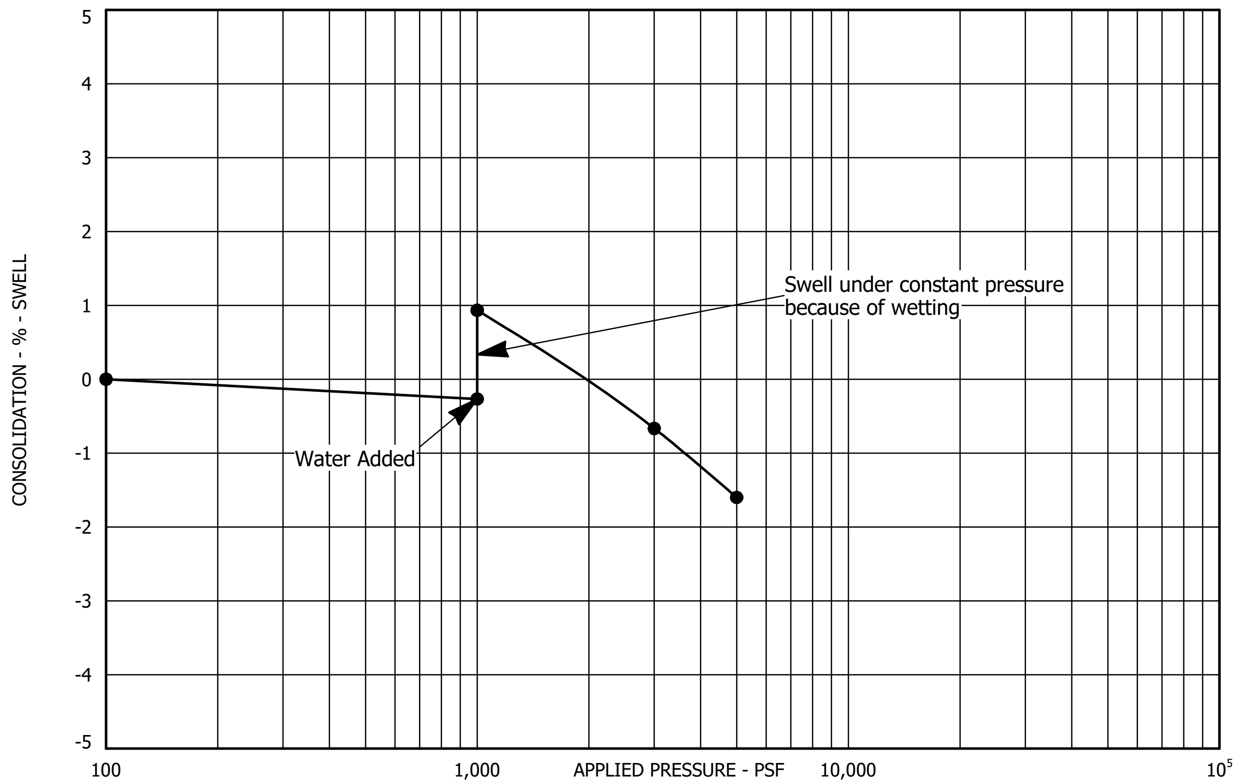
Sample Location: Test Boring No. 5 at a depth of 19 feet
Dry Unit Weight (pcf): 108
Sample Description: Clay, sandy
Moisture Content (%): 19

SWELL - CONSOLIDATION TEST RESULTS

FIGURE A-3

PROJECT NO. 208100

A.G. WASSENAAR, INC.

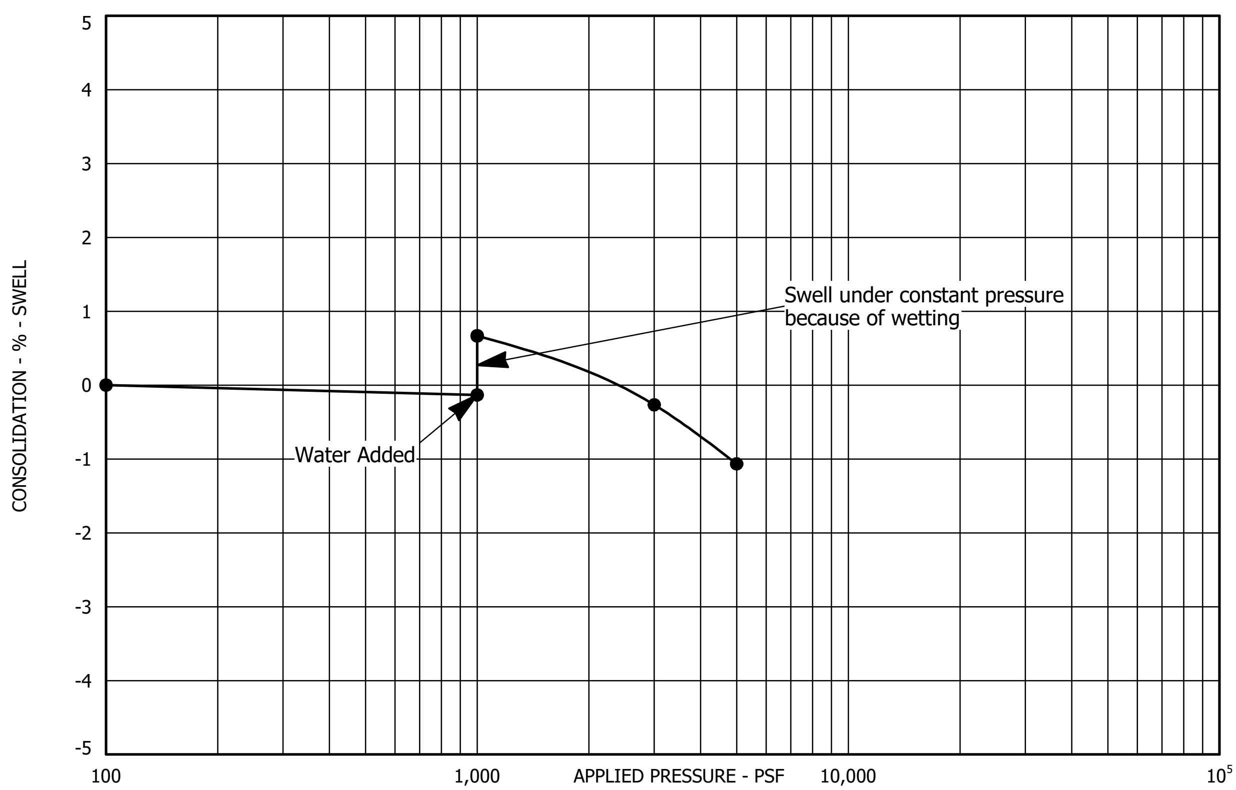


Sample Location Test Boring No. 6 at a depth of 9 feet

Sample Description Sand, very clayey

Dry Unit Weight (pcf) 119

Moisture Content (%) 8



Sample Location Test Boring No. 6 at a depth of 14 feet

Sample Description Sand, clayey

Dry Unit Weight (pcf) 115

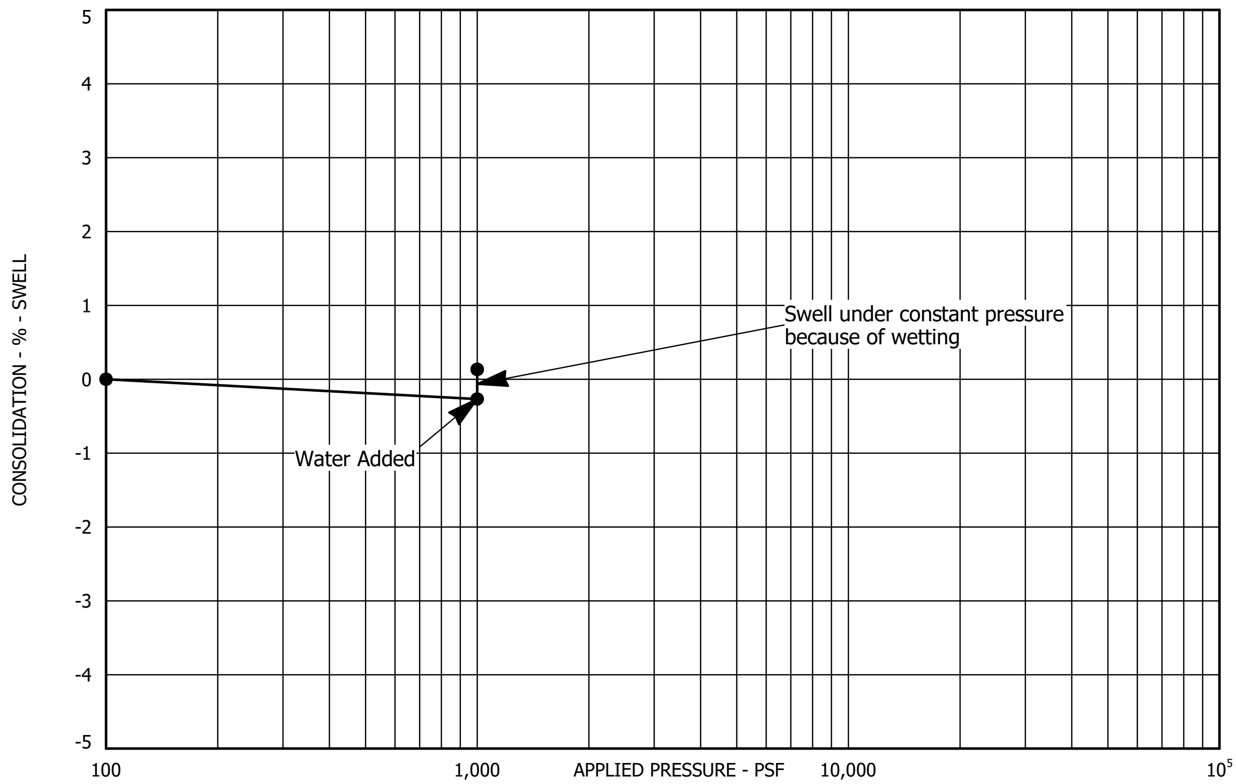
Moisture Content (%) 11

SWELL - CONSOLIDATION TEST RESULTS

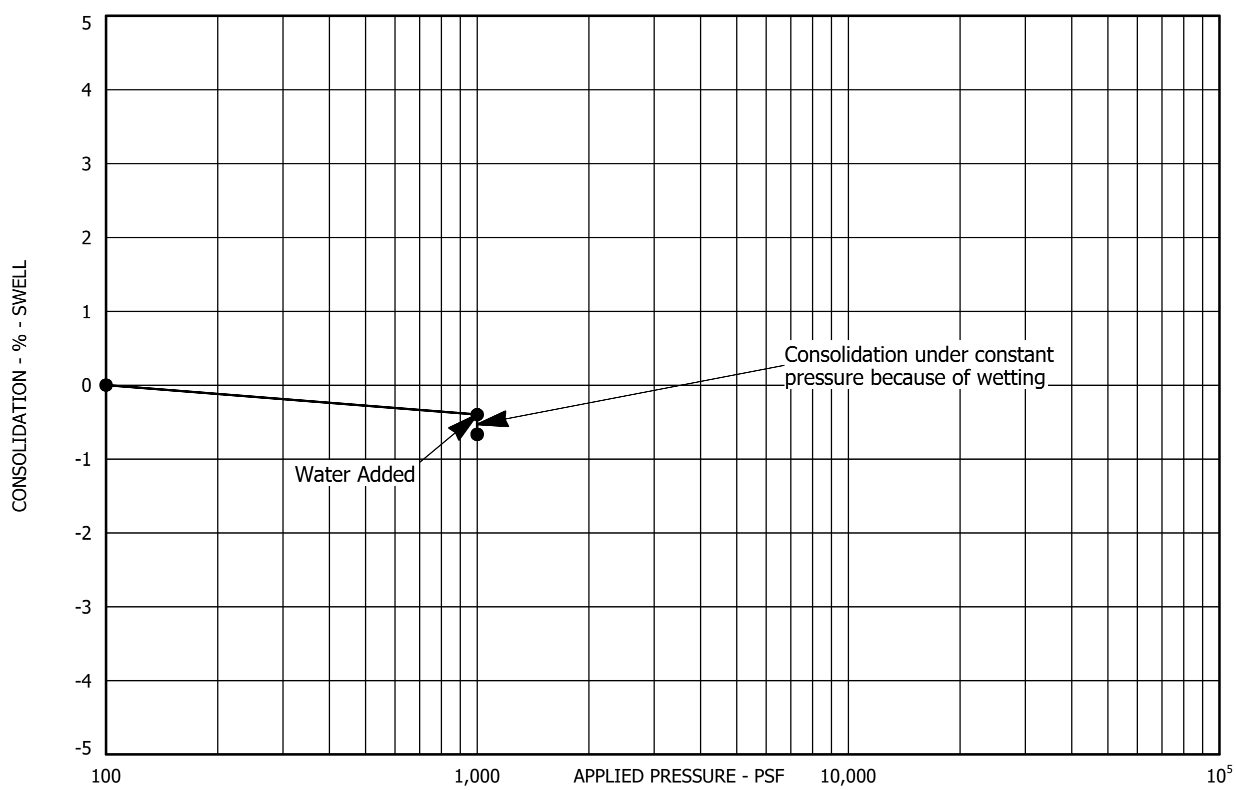
FIGURE A-4

PROJECT NO. 208100

A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 6 at a depth of 24 feet
Sample Description: Sand, clayey
Dry Unit Weight (pcf): 108
Moisture Content (%): 17

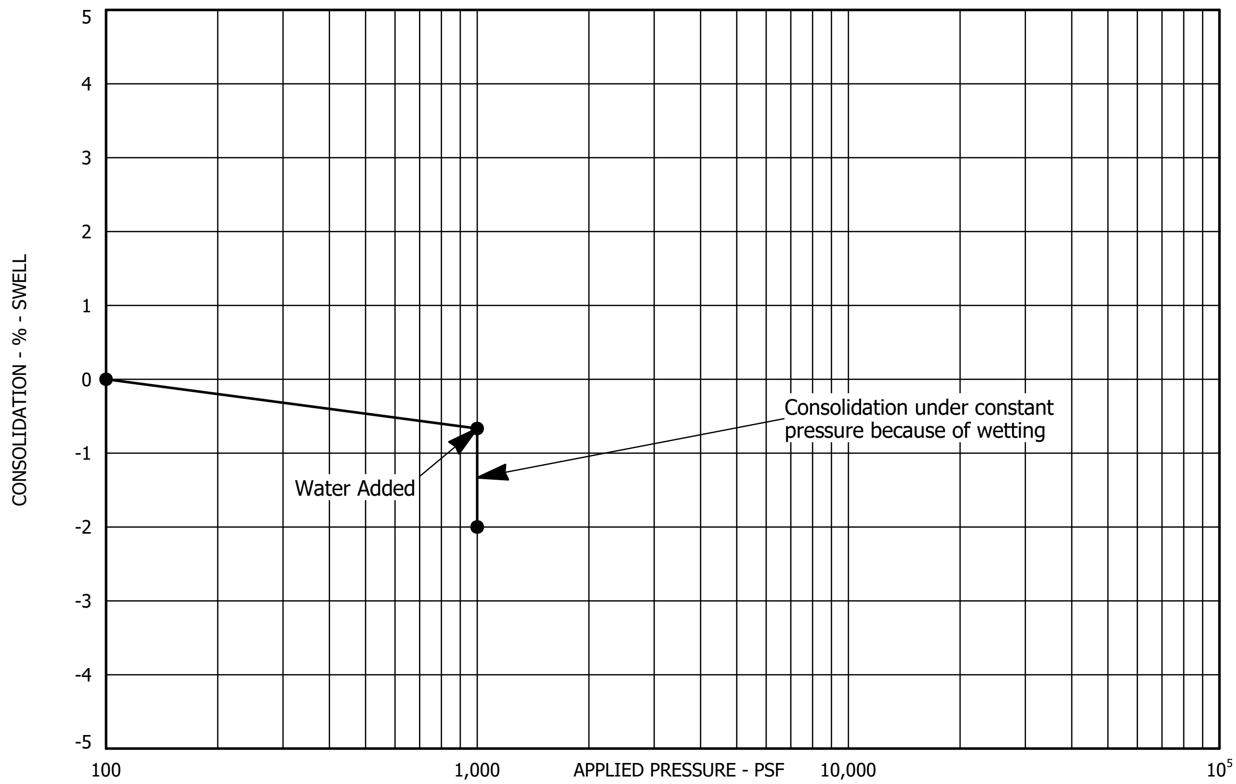


Sample Location: Test Boring No. 7 at a depth of 9 feet
Sample Description: Sand, clayey
Dry Unit Weight (pcf): 104
Moisture Content (%): 16

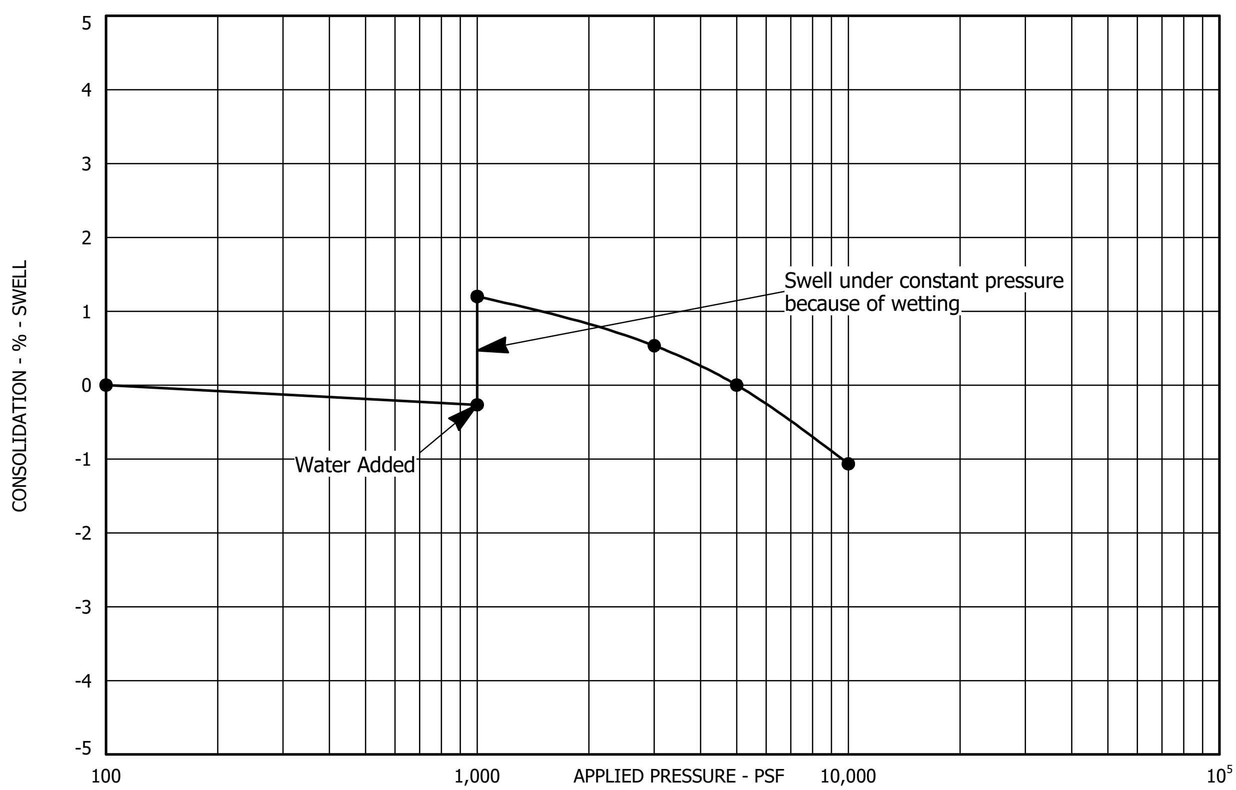
SWELL - CONSOLIDATION TEST RESULTS

FIGURE A-5

PROJECT NO. 208100



Sample Location: Test Boring No. 7 at a depth of 14 feet
Dry Unit Weight (pcf): 118
Sample Description: Sand, very silty, very clayey
Moisture Content (%): 8

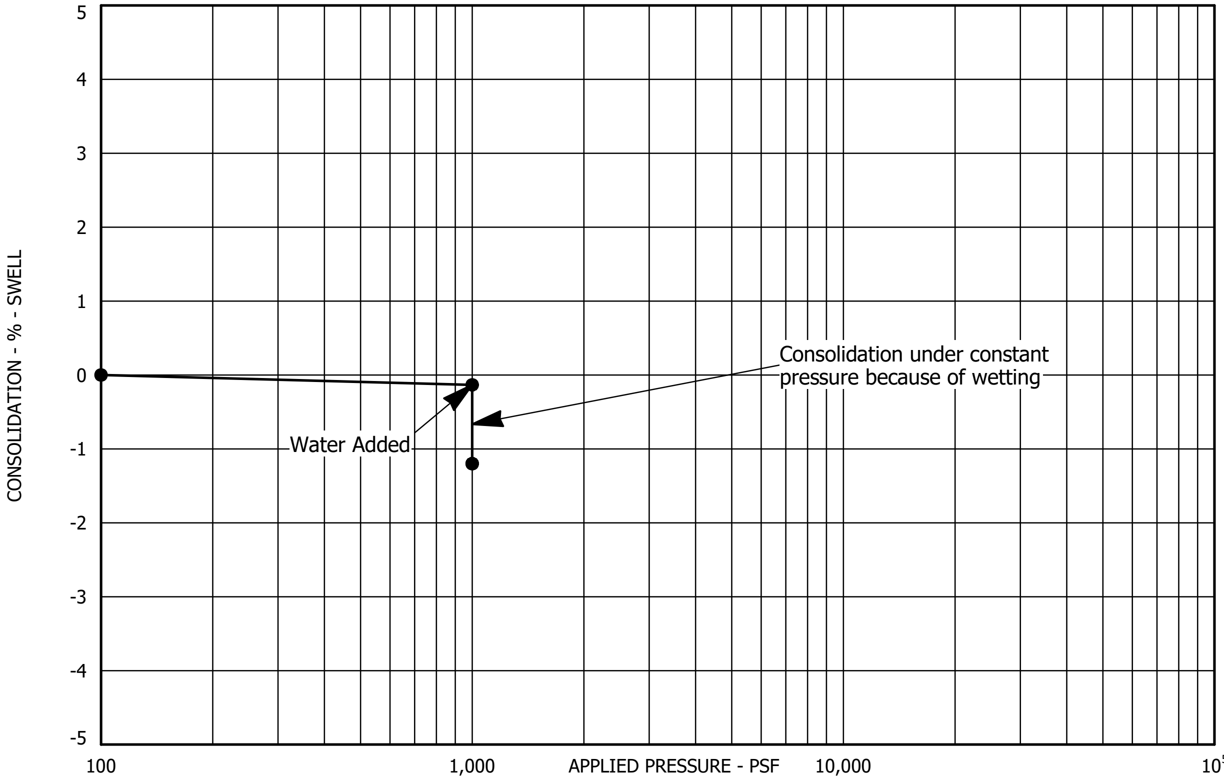


Sample Location: Test Boring No. 7 at a depth of 34 feet
Dry Unit Weight (pcf): 108
Sample Description: Claystone, sandy
Moisture Content (%): 20

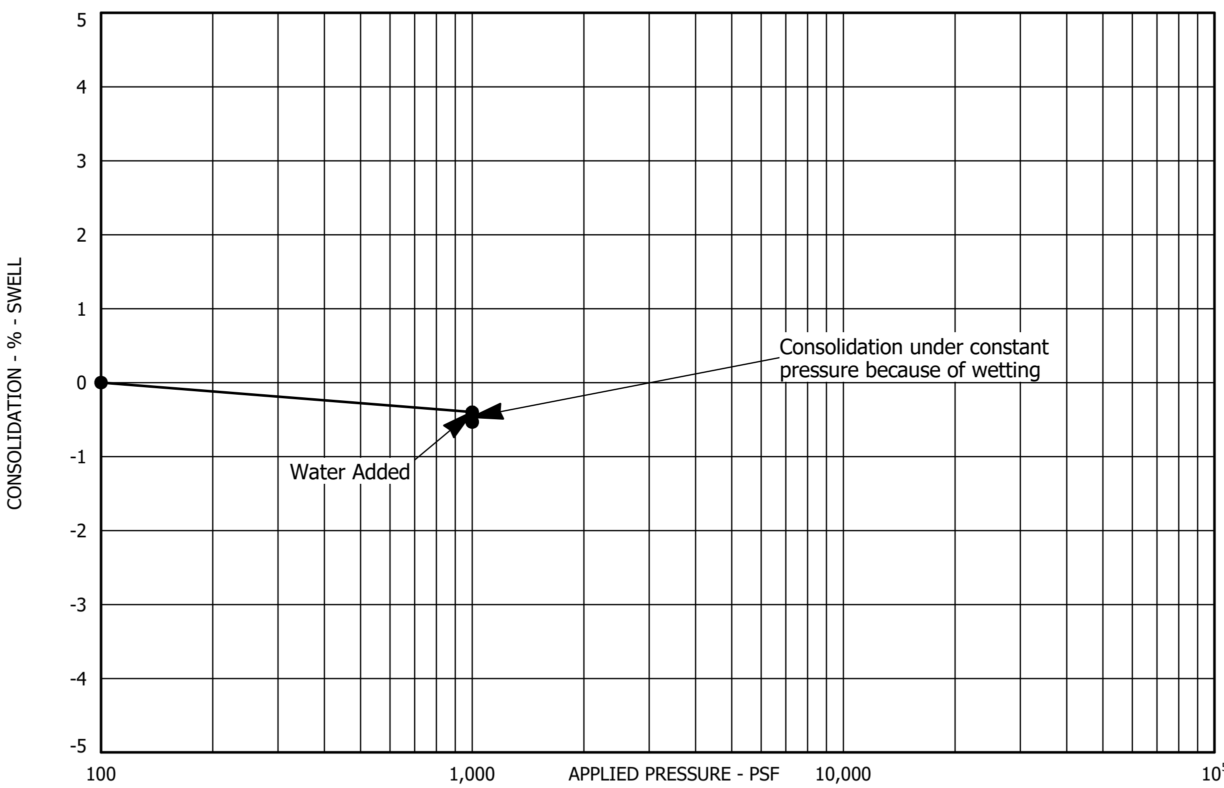
SWELL - CONSOLIDATION TEST RESULTS

FIGURE A-6

PROJECT NO. 208100



Sample Location: Test Boring No. 8 at a depth of 9 feet
Dry Unit Weight (pcf): 98
Sample Description: Sand, clayey
Moisture Content (%): 9



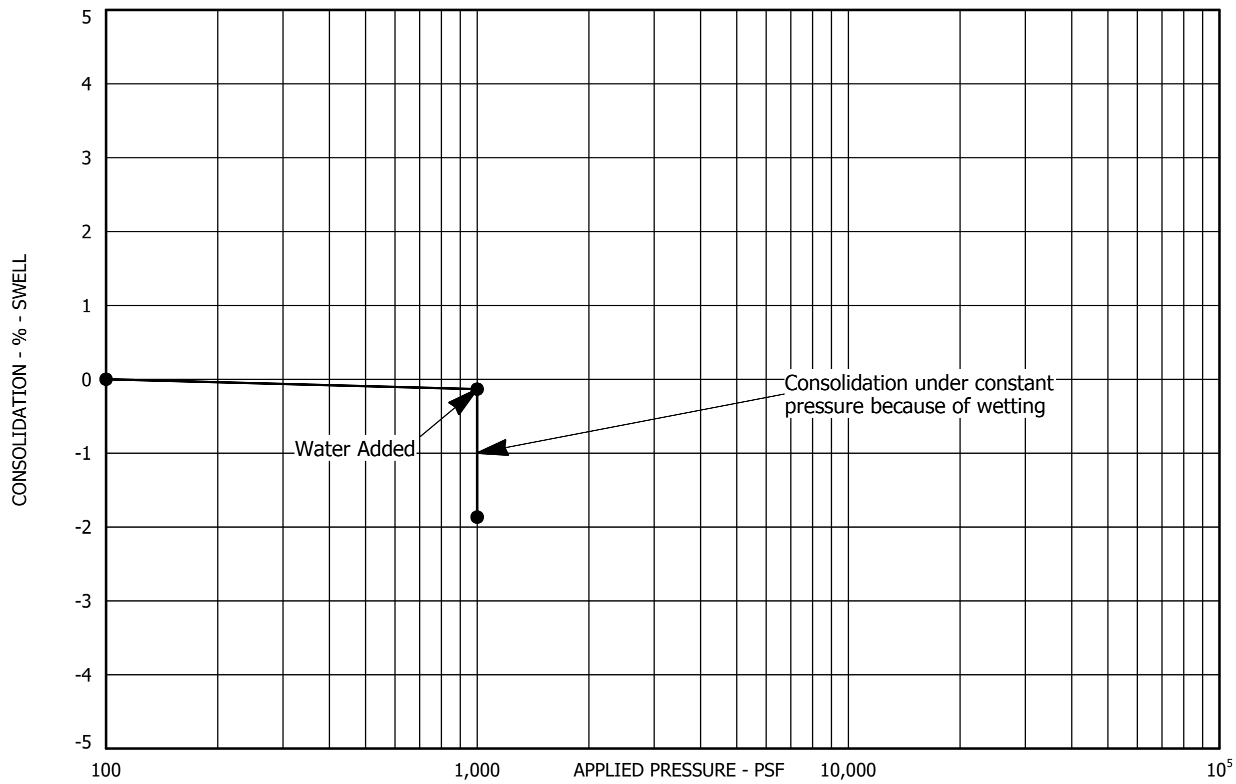
Sample Location: Test Boring No. 8 at a depth of 19 feet
Dry Unit Weight (pcf): 118
Sample Description: Clay, very sandy
Moisture Content (%): 14

SWELL - CONSOLIDATION TEST RESULTS

FIGURE A-7

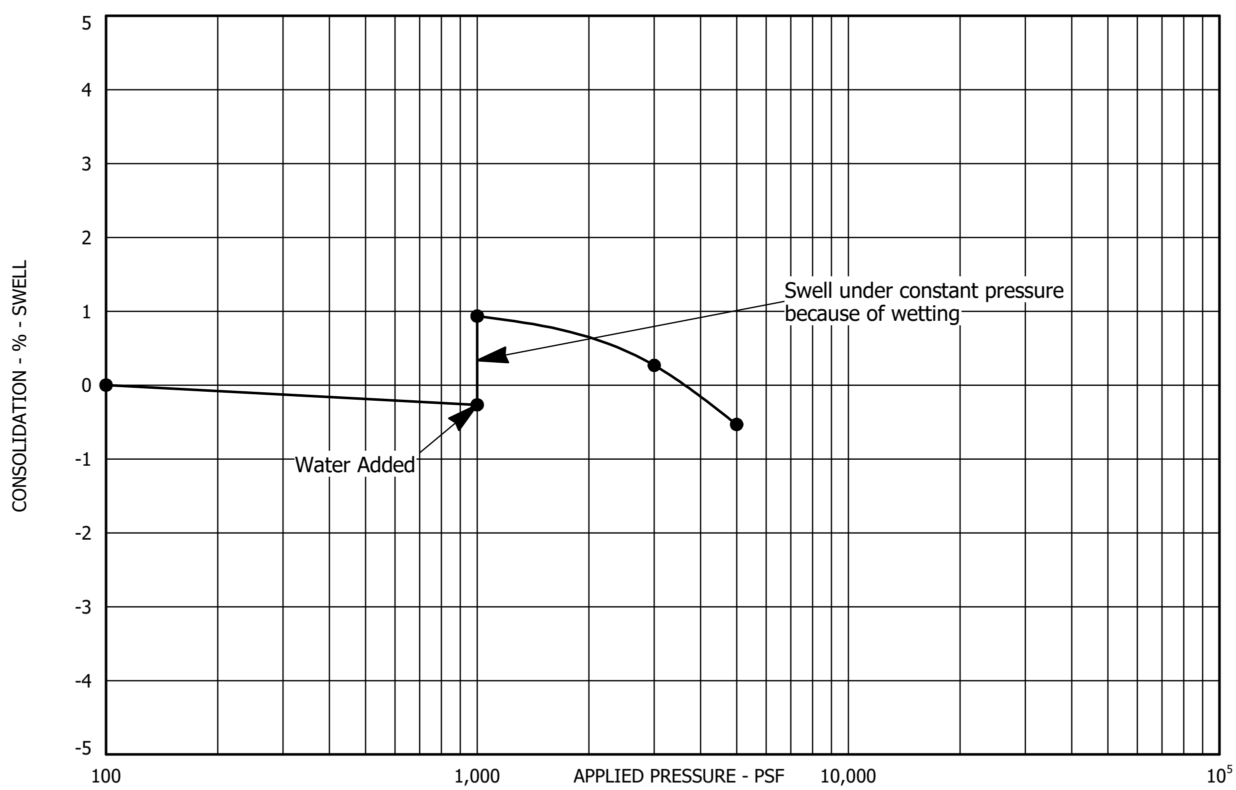
PROJECT NO. 208100

A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 9 at a depth of 4 feet — Dry Unit Weight (pcf): 106

Sample Description: Sand, silty — Moisture Content (%): 3



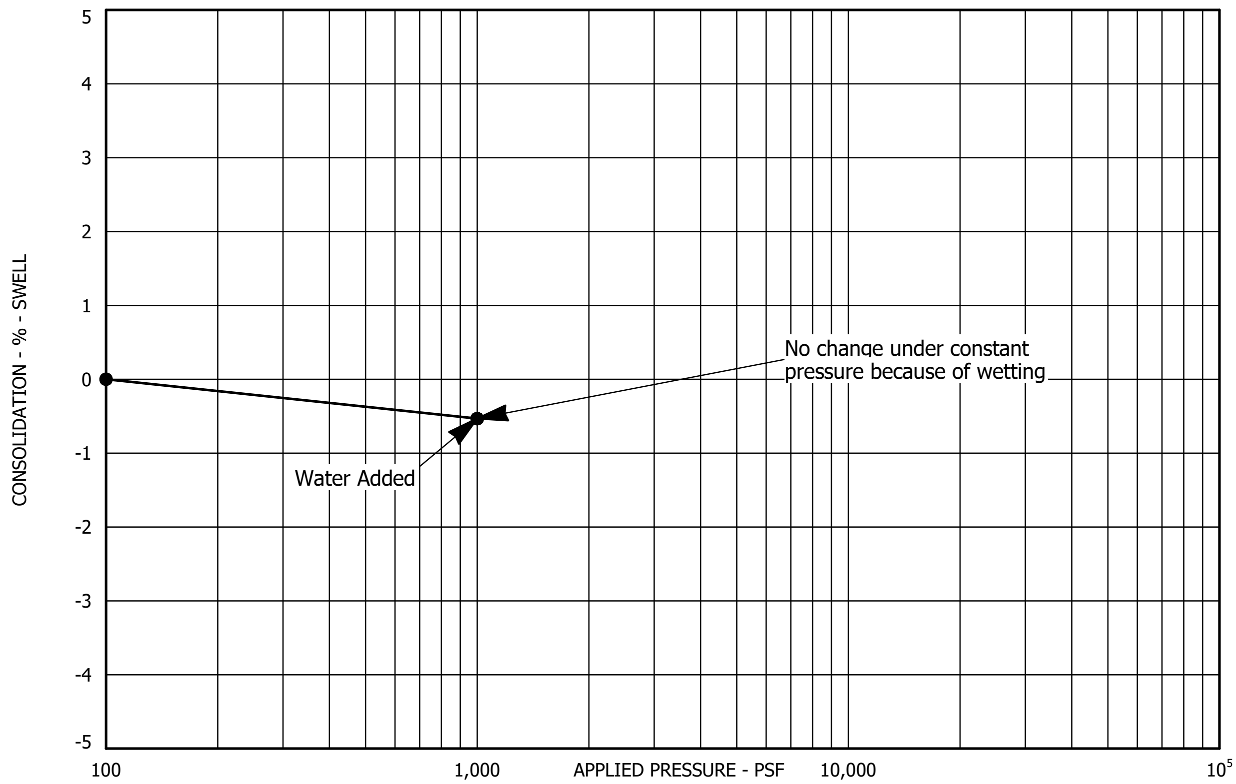
Sample Location: Test Boring No. 10 at a depth of 24 feet — Dry Unit Weight (pcf): 113

Sample Description: Clay, very sandy — Moisture Content (%): 16

SWELL - CONSOLIDATION TEST RESULTS

FIGURE A-8

PROJECT NO. 208100

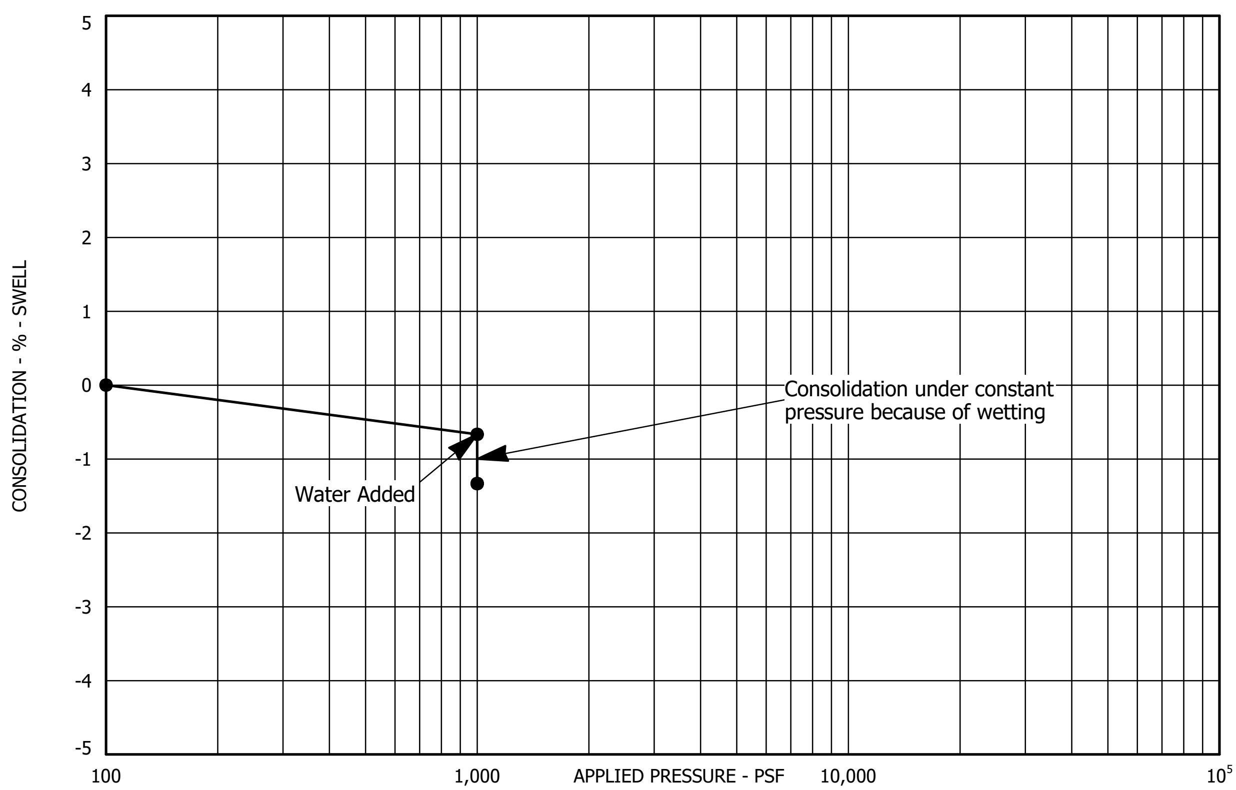


Sample Location Test Boring No. 10 at a depth of 34 feet

Dry Unit Weight (pcf) 97

Sample Description Claystone, sandy

Moisture Content (%) 24



Sample Location Test Boring No. 12 at a depth of 19 feet

Dry Unit Weight (pcf) 112

Sample Description Sand, very clayey (lens)

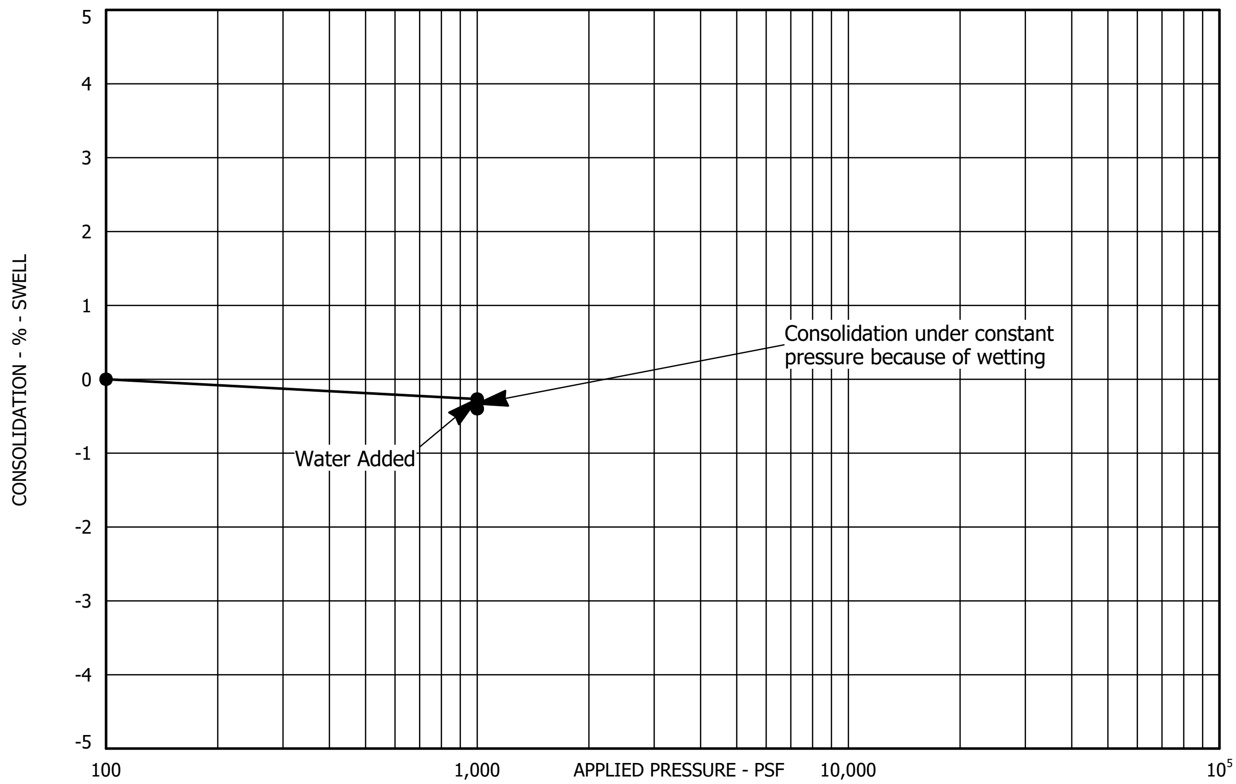
Moisture Content (%) 13

SWELL - CONSOLIDATION TEST RESULTS

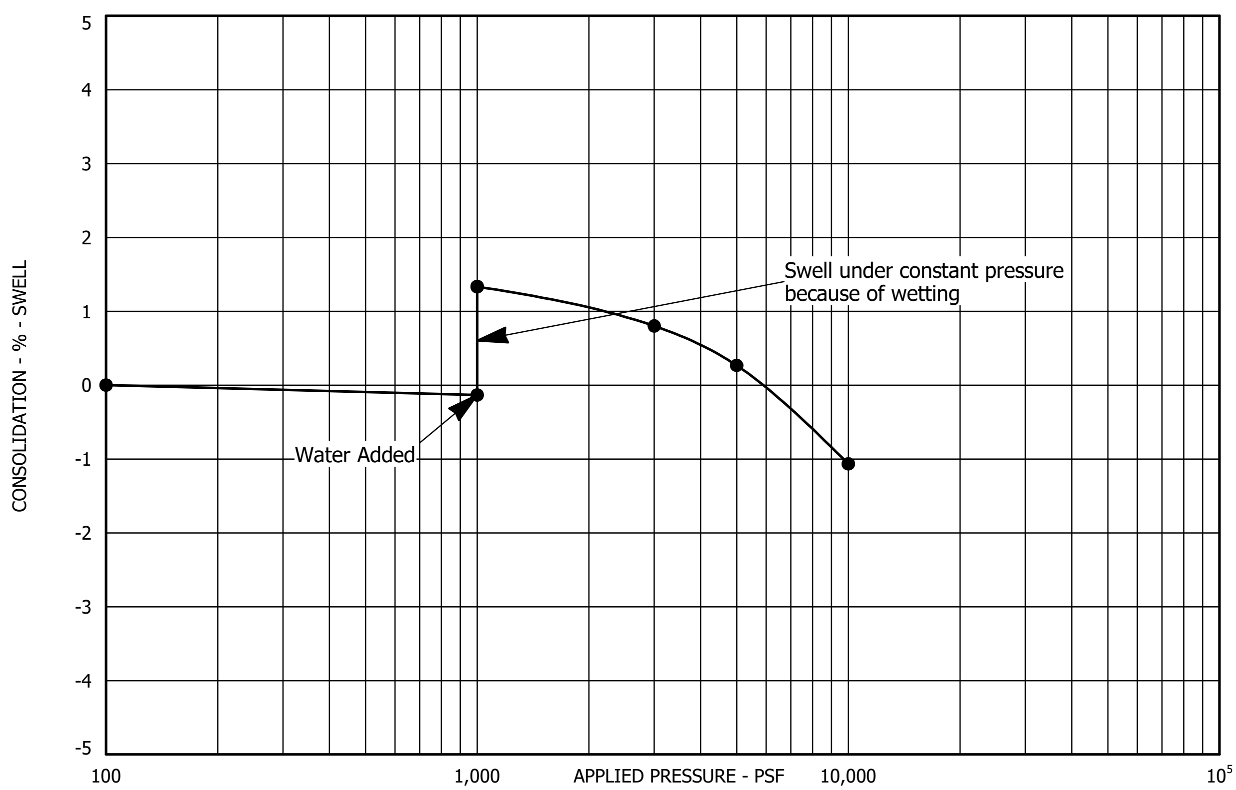
FIGURE A-9

PROJECT NO. 208100

AGW
A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 13 at a depth of 24 feet
Sample Description: Sand, very clayey
Dry Unit Weight (pcf): 111
Moisture Content (%): 16

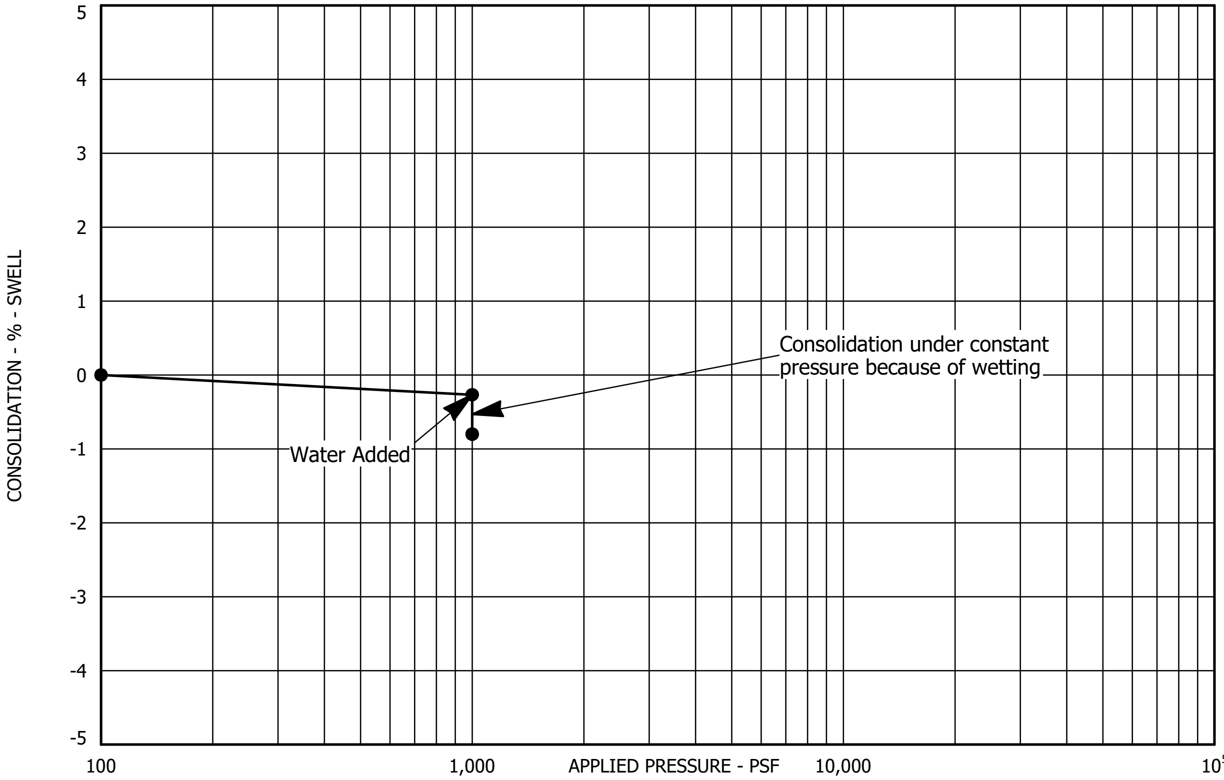


Sample Location: Test Boring No. 14 at a depth of 9 feet
Sample Description: Clay, sandy
Dry Unit Weight (pcf): 116
Moisture Content (%): 14

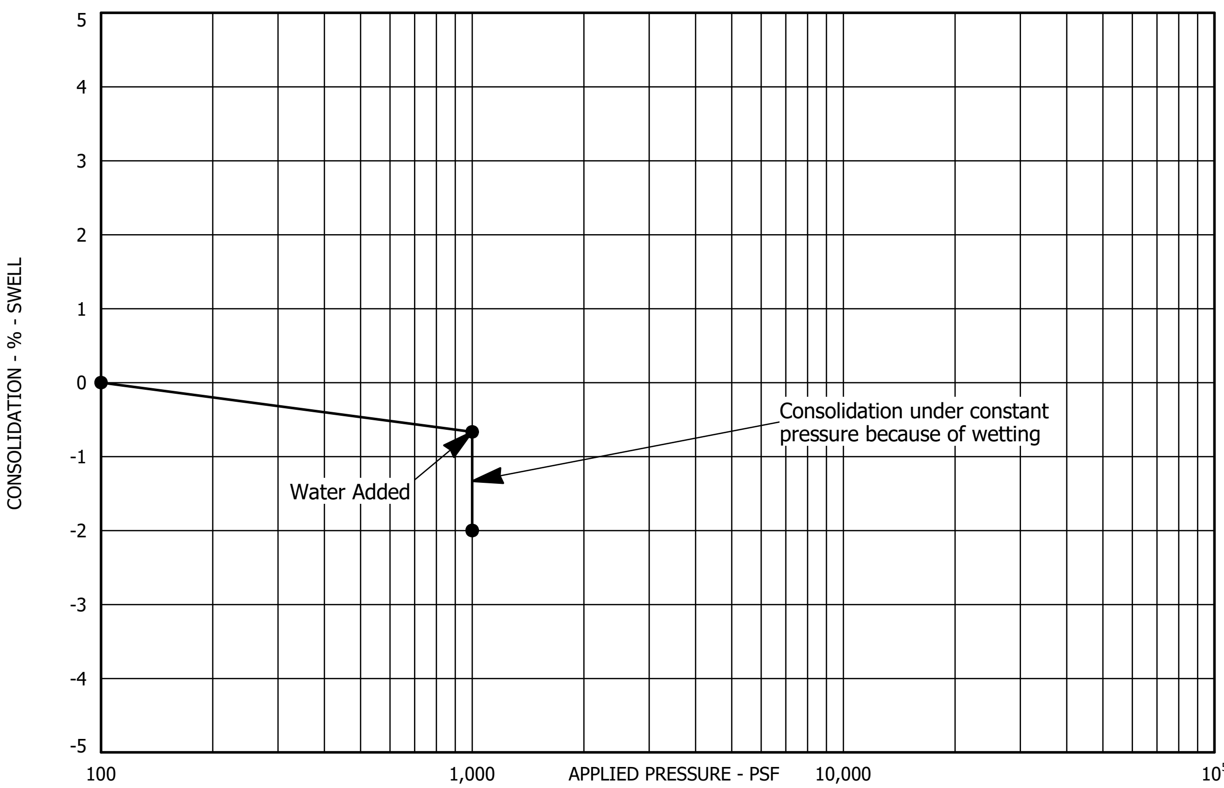
SWELL - CONSOLIDATION TEST RESULTS

FIGURE A-10

PROJECT NO. 208100



Sample Location	Test Boring No. 14 at a depth of 14 feet	Dry Unit Weight (pcf)	106
Sample Description	Sand, clayey	Moisture Content (%)	12

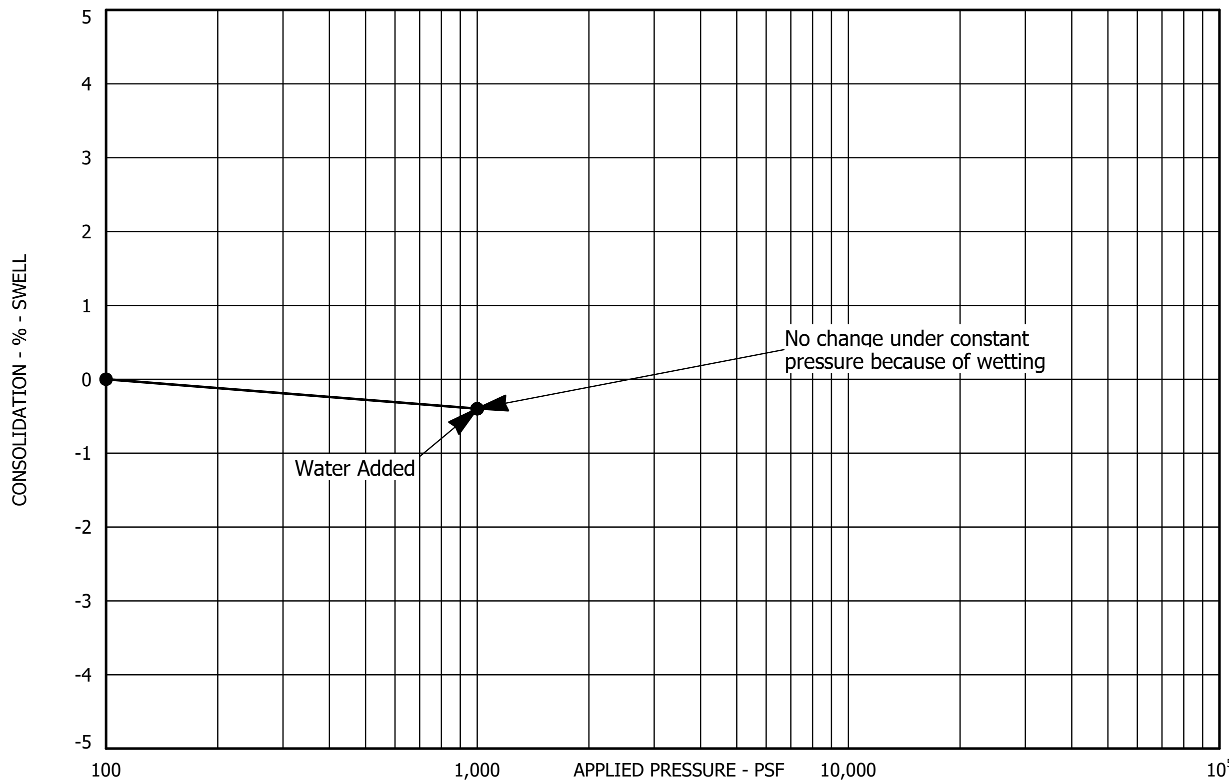


Sample Location	Test Boring No. 15 at a depth of 4 feet	Dry Unit Weight (pcf)	103
Sample Description	Sand, clayey	Moisture Content (%)	4

SWELL - CONSOLIDATION TEST RESULTS

FIGURE A-11

PROJECT NO. 208100

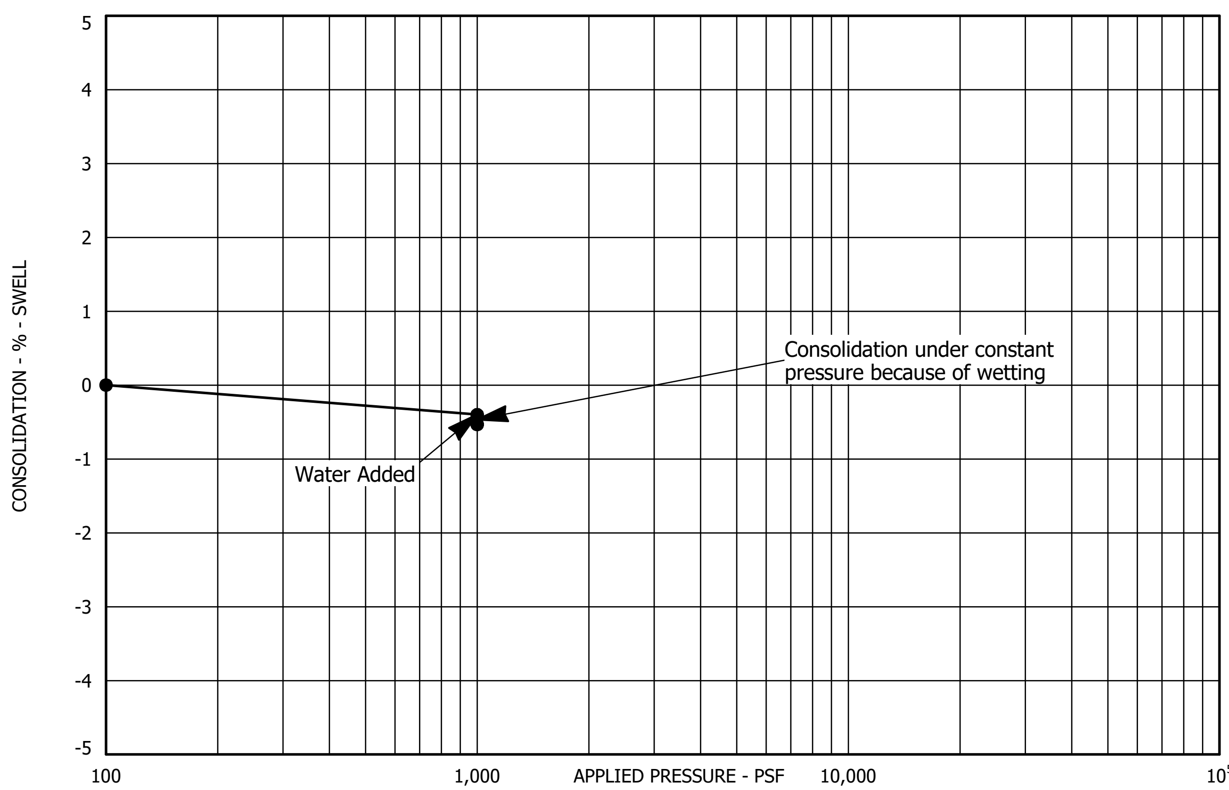


Sample Location: Test Boring No. 15 at a depth of 29 feet

Sample Description: Sand, clayey

Dry Unit Weight (pcf): 109

Moisture Content (%): 15



Sample Location: Blended Bulk Sample from Test Borings

Sample Description: Sand, very silty, very clayey

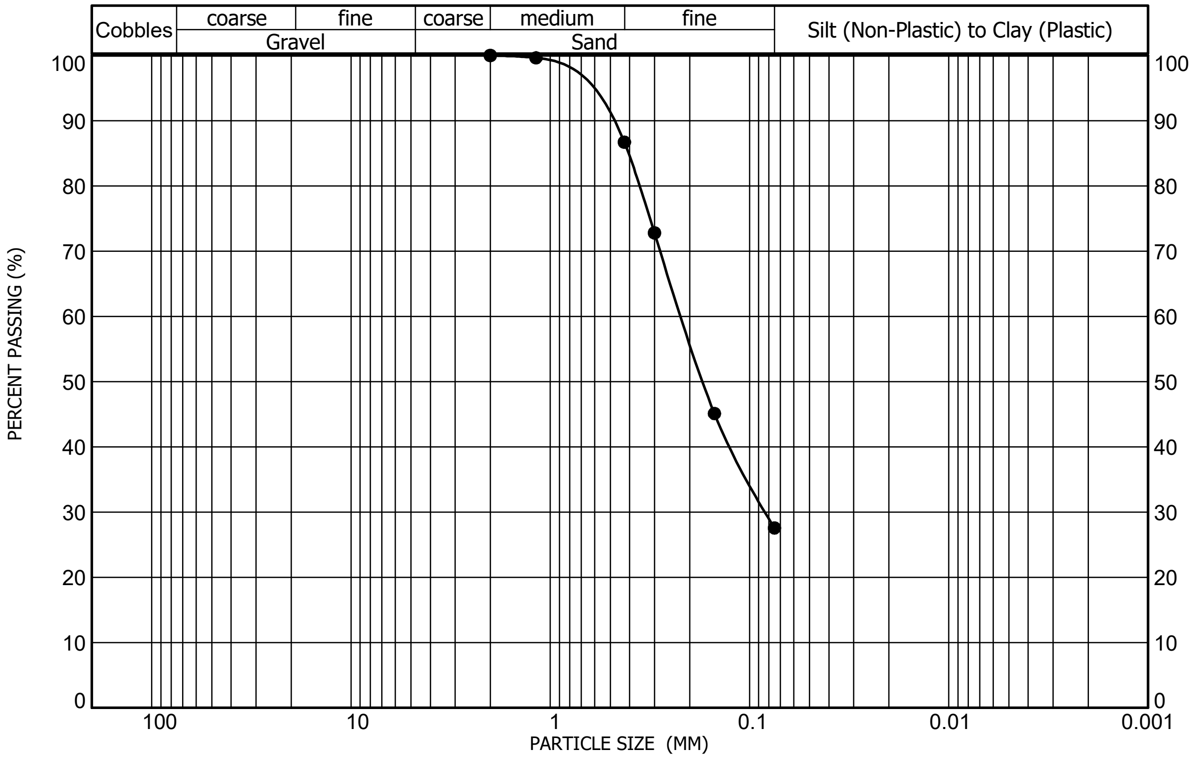
Dry Unit Weight (pcf): 111

Moisture Content (%): 13

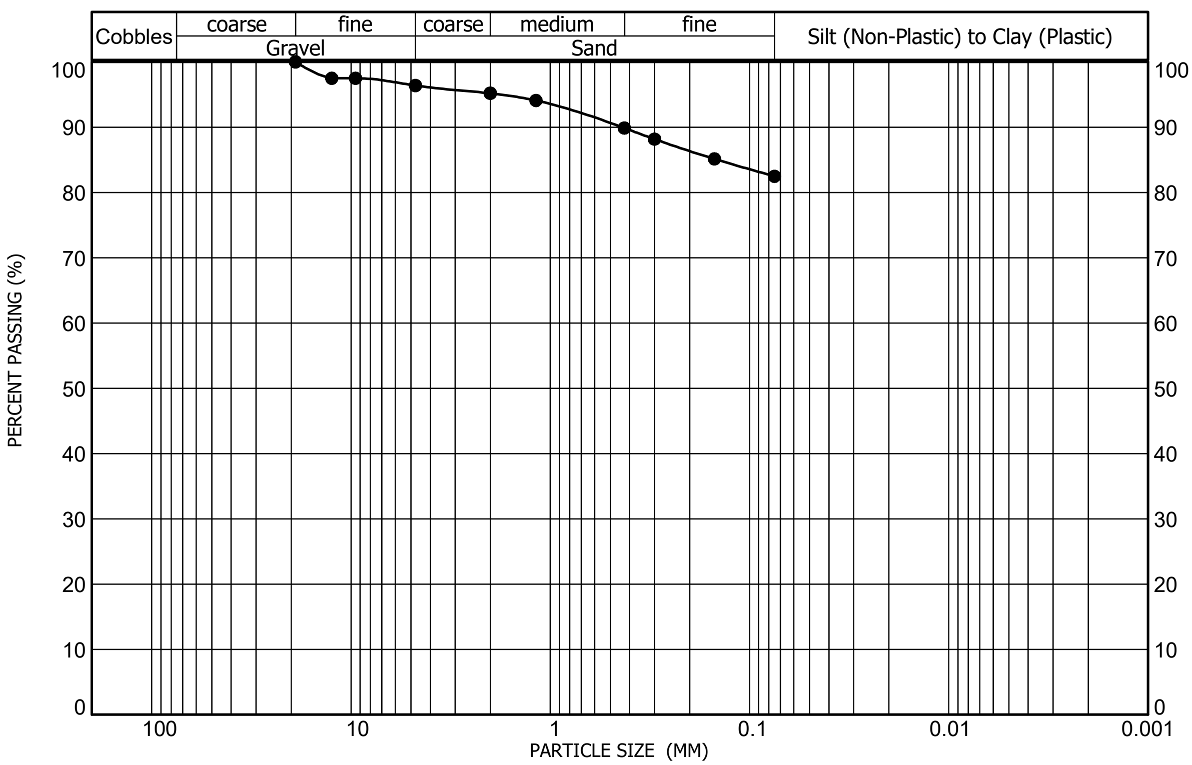
SWELL - CONSOLIDATION TEST RESULTS

FIGURE A-12

PROJECT NO. 208100



Sample Location: Test Boring No. 1 at a depth of 4 feet
Sample Description: Sand, silty
Classification: A-2-4(0), SILTY SAND(SM)
Gravel (%): 0
Sand (%): 72
Clay/Silt (%): 28
Liquid Limit: 19
Plasticity Index: 2



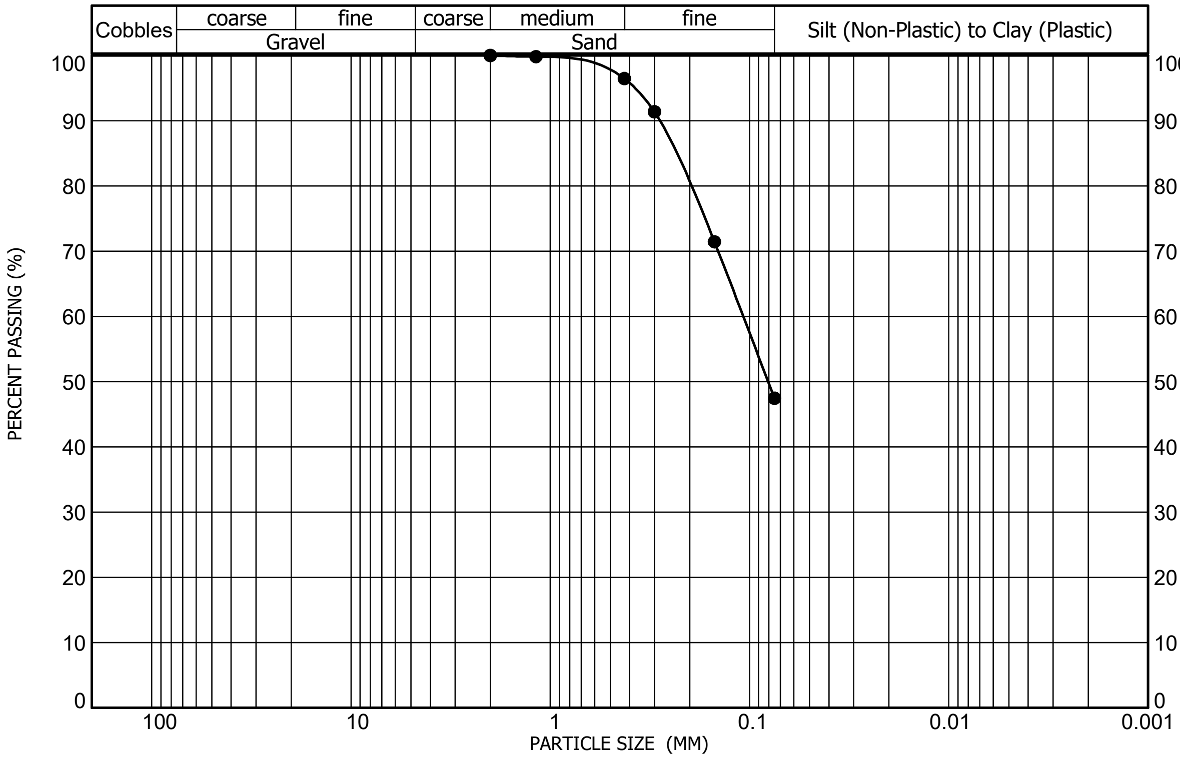
Sample Location: Test Boring No. 1 at a depth of 14 feet
Sample Description: Clay, slightly sandy, trace gravel (lens)
Classification: A-6(16), LEAN CLAY with SAND(CL)
Gravel (%): 4
Sand (%): 14
Clay/Silt (%): 82
Liquid Limit: 39
Plasticity Index: 20

GRADATION AND ATTERBERG TEST RESULTS

FIGURE A-13

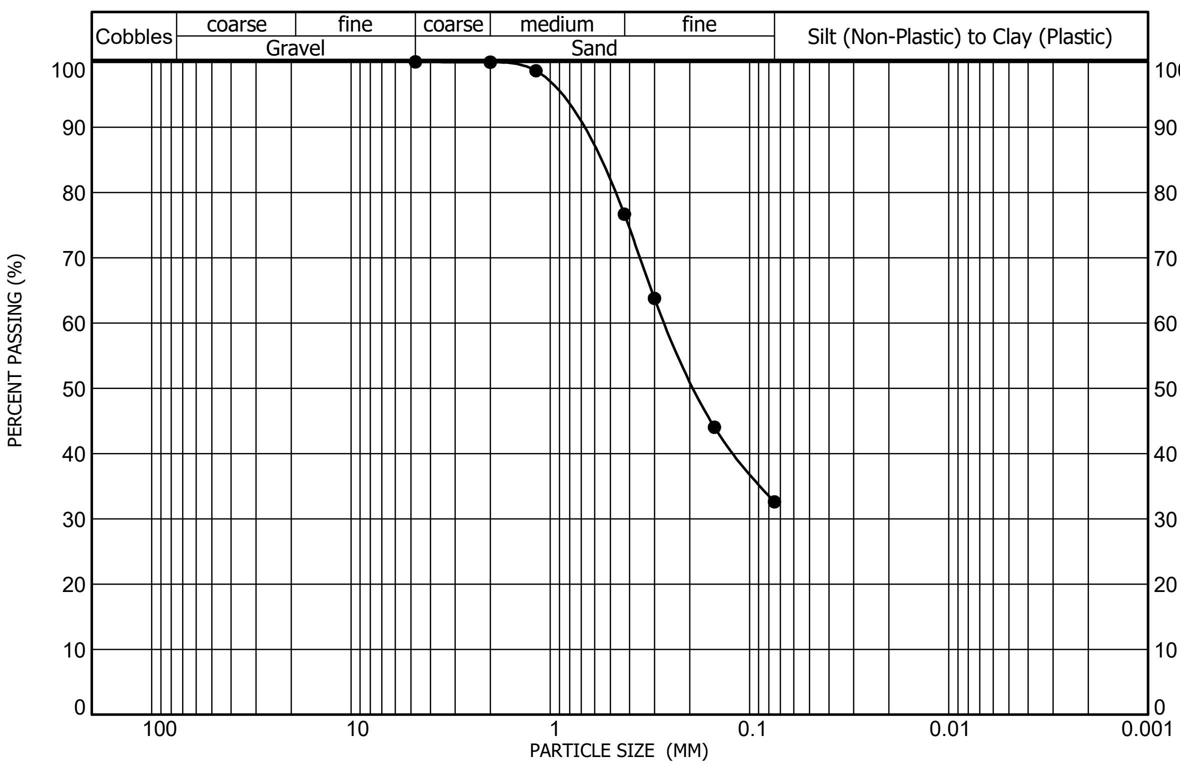
PROJECT NO. 208100

AGW
A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 2 at a depth of 4 feet
Sample Description: Sand, very silty, very clayey
Classification: A-4(0), SILTY, CLAYEY SAND(SC-SM)

Gravel (%): 0
Sand (%): 53
Clay/Silt (%): 47
Liquid Limit: 22
Plasticity Index: 6



Sample Location: Test Boring No. 3 at a depth of 9 feet
Sample Description: Sand, very clayey
Classification: A-2-4(0), CLAYEY SAND(SC)

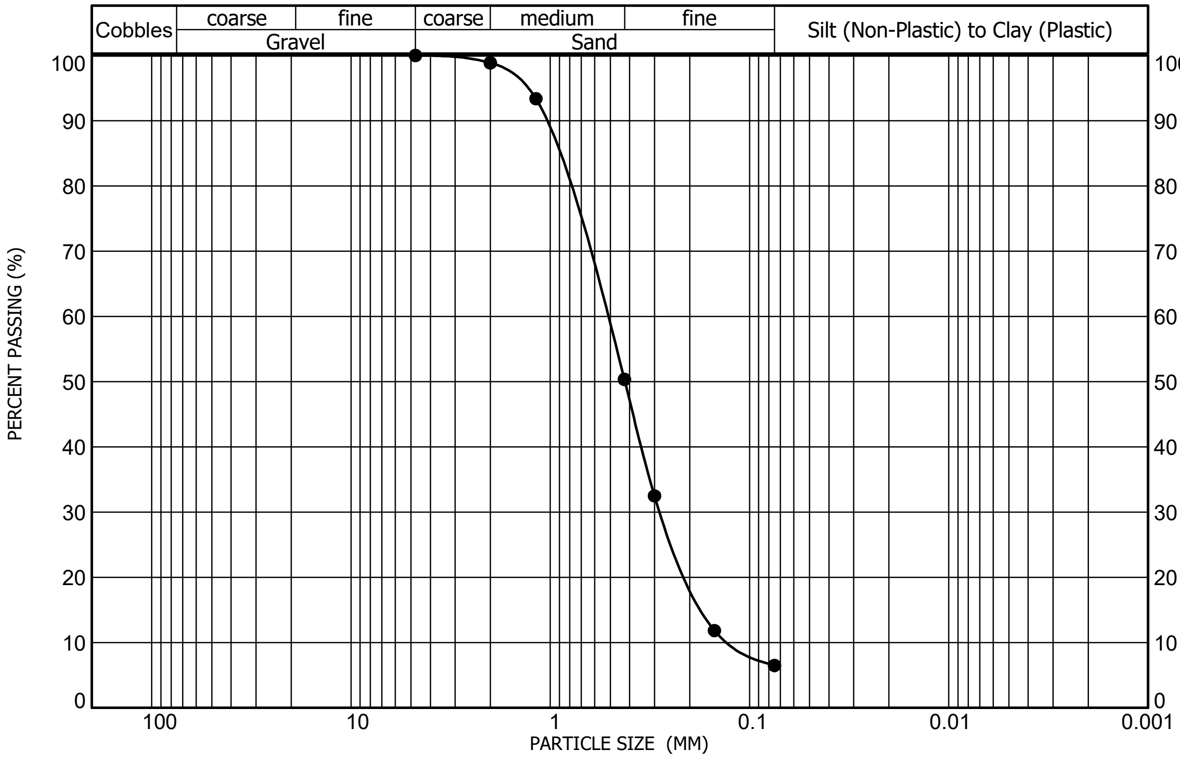
Gravel (%): 0
Sand (%): 67
Clay/Silt (%): 33
Liquid Limit: 26
Plasticity Index: 10

GRADATION AND ATTERBERG TEST RESULTS

FIGURE A-14

PROJECT NO. 208100

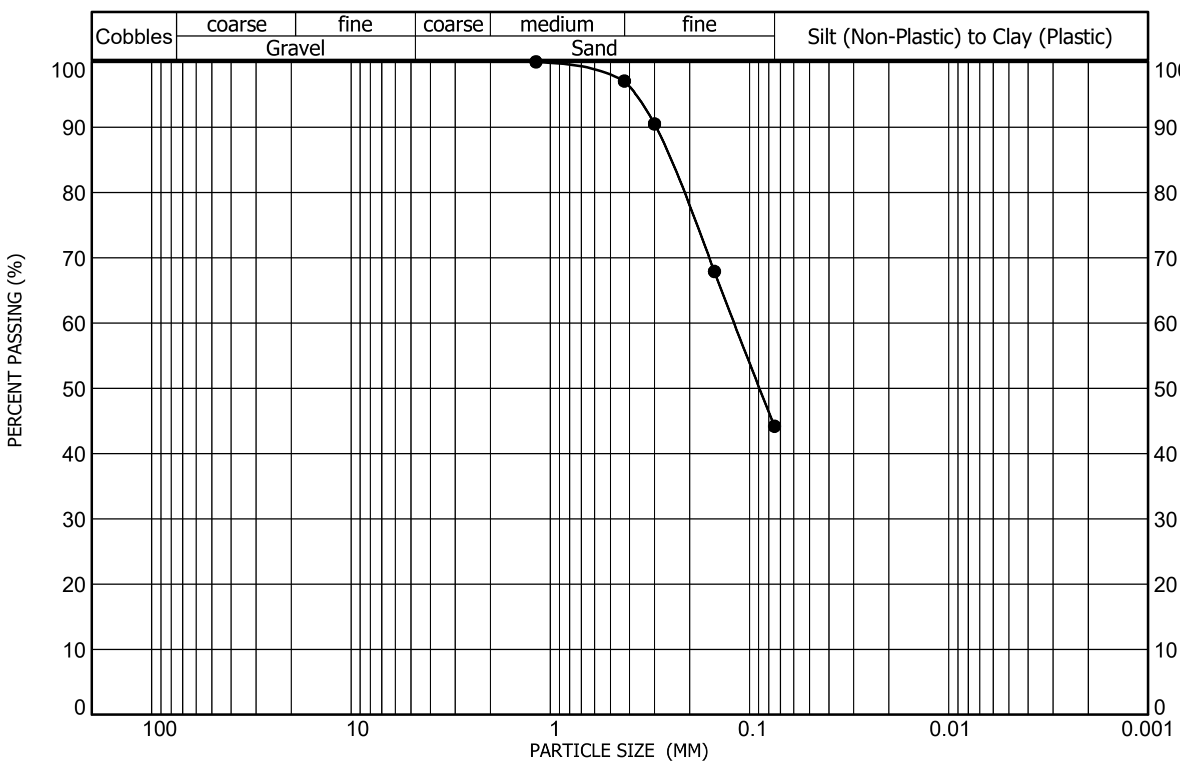
A.G. WASSENAAR, INC.



Sample Location Test Boring No. 3 at a depth of 24 feet
Sample Description Sand, slightly silty
Classification A-1-b(0), POORLY GRADED SAND with SILT(SP-SM)

Gravel (%) 0
Sand (%) 94
Clay/Silt (%) 6

Liquid Limit NV
Plasticity Index NP



Sample Location Test Boring No. 4 at a depth of 9 feet
Sample Description Sand, very silty, very clayey
Classification A-4(0), SILTY, CLAYEY SAND(SC-SM)

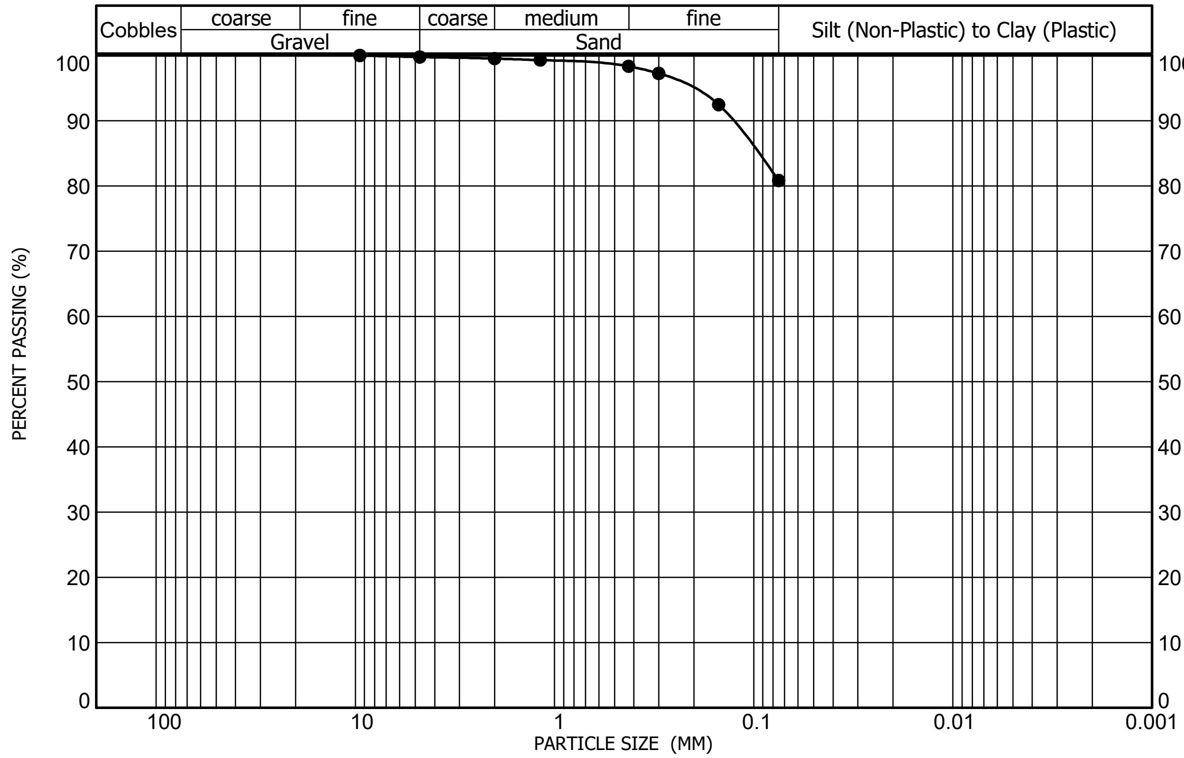
Gravel (%) 0
Sand (%) 56
Clay/Silt (%) 44

Liquid Limit 23
Plasticity Index 6

GRADATION AND ATTERBERG TEST RESULTS

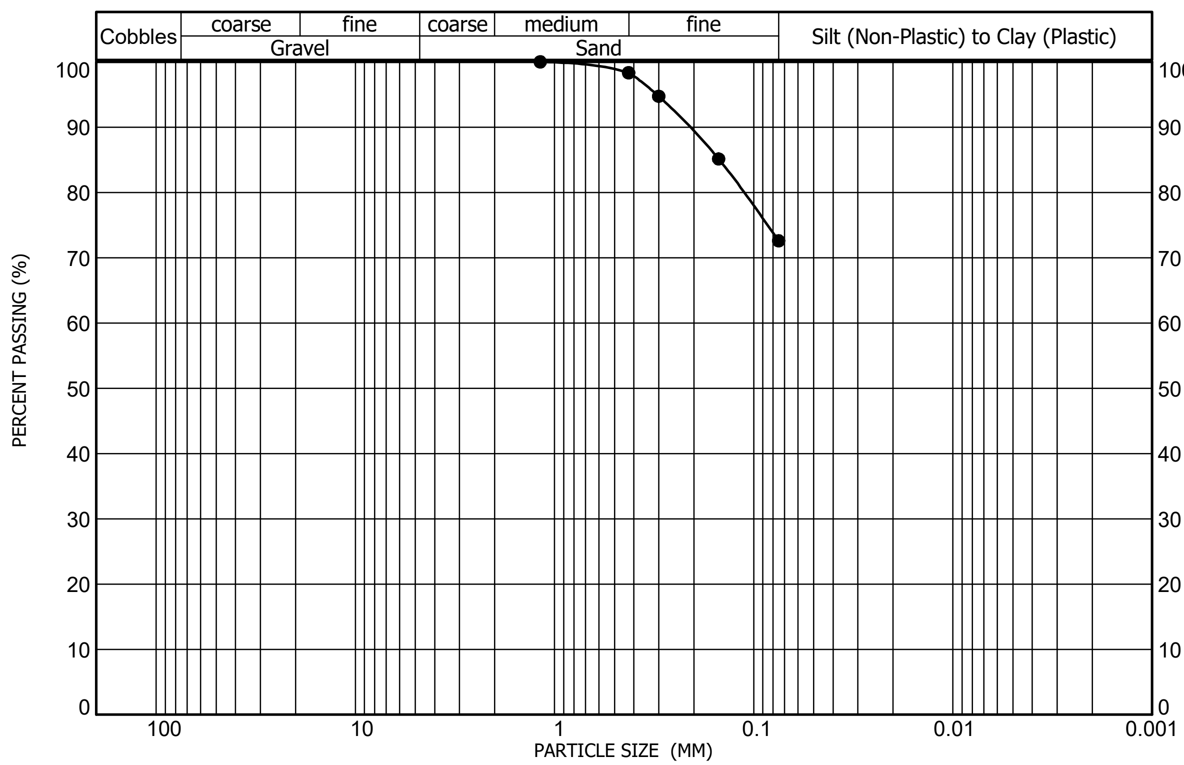
FIGURE A-15

PROJECT NO. 208100



Sample Location: Test Boring No. 5 at a depth of 19 feet
Sample Description: Clay, sandy
Classification: A-7-6(21), LEAN CLAY with SAND(CL)

Gravel (%): 0
Sand (%): 19
Clay/Silt (%): 81
Liquid Limit: 44
Plasticity Index: 26

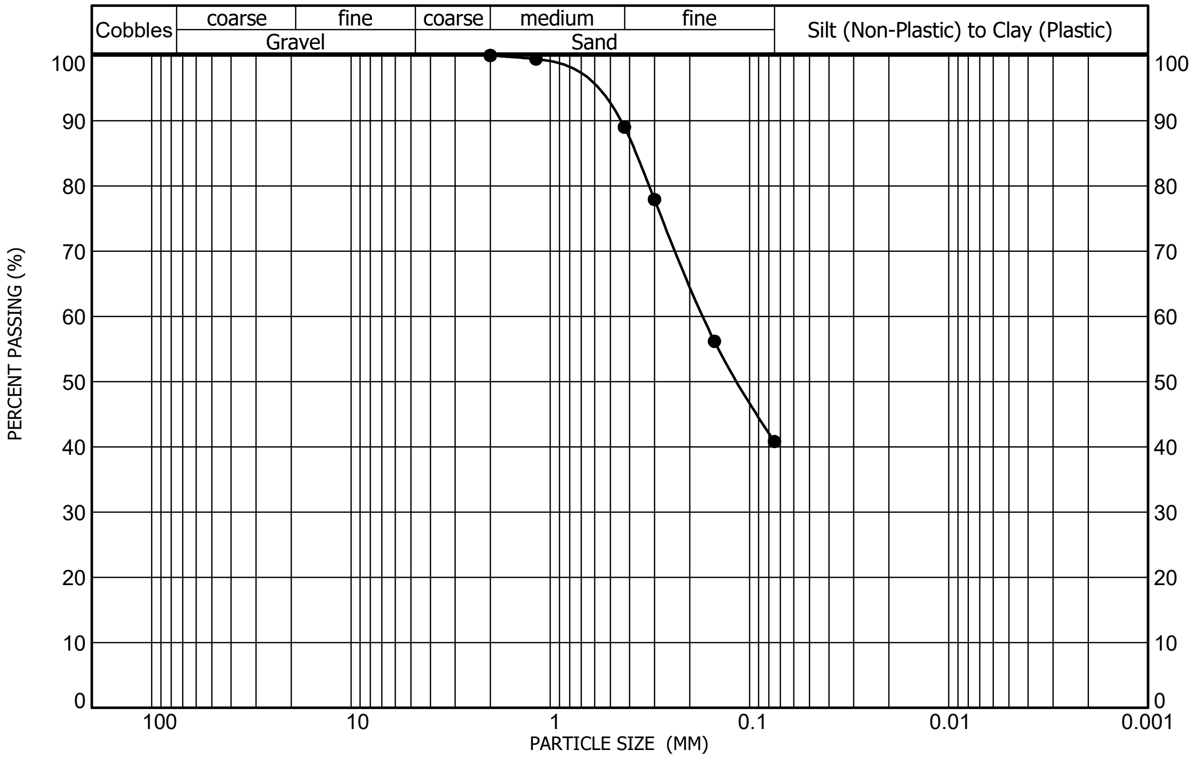


Sample Location: Test Boring No. 6 at a depth of 4 feet
Sample Description: Clay, sandy (lens)
Classification: A-4(5), LEAN CLAY with SAND(CL)

Gravel (%): 0
Sand (%): 27
Clay/Silt (%): 73
Liquid Limit: 27
Plasticity Index: 10

GRADATION AND ATTERBERG TEST RESULTS

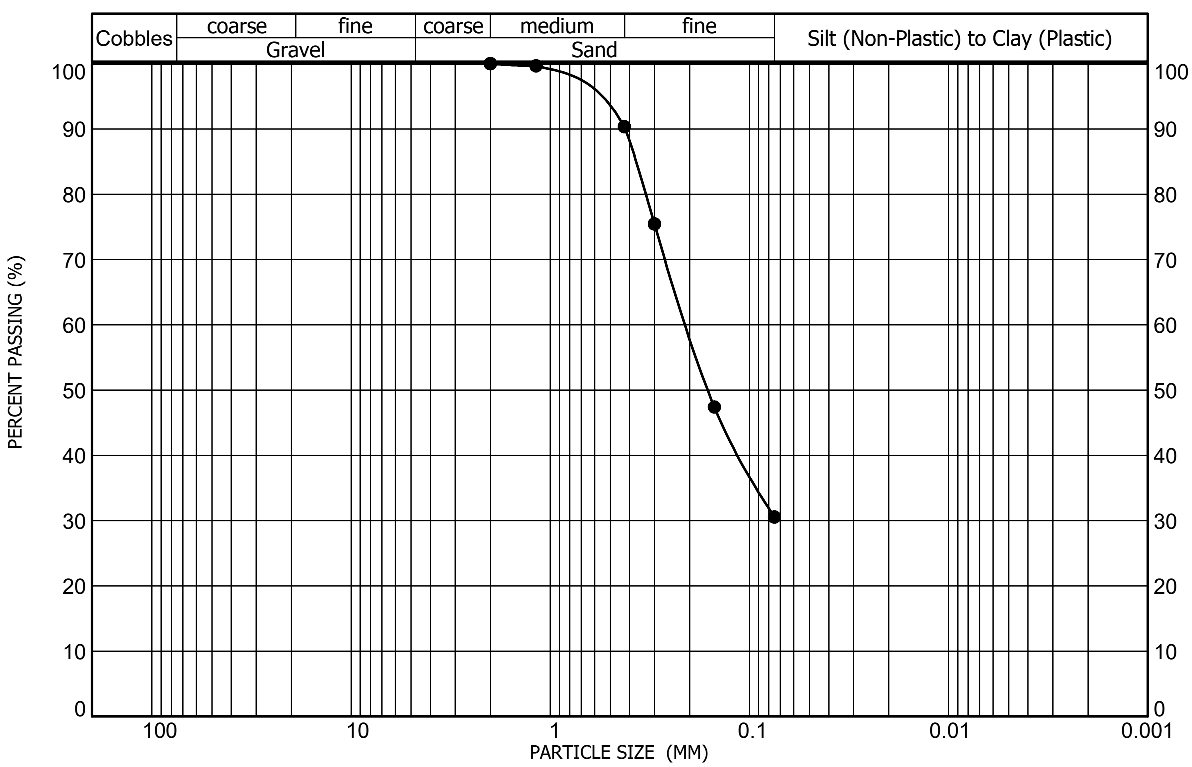
FIGURE A-16



Sample Location Test Boring No. 6 at a depth of 9 feet
Sample Description Sand, very clayey
Classification A-6(1), CLAYEY SAND(SC)

Gravel (%) 0
Sand (%) 59
Clay/Silt (%) 41

Liquid Limit 29
Plasticity Index 11



Sample Location Test Boring No. 7 at a depth of 14 feet
Sample Description Sand, very silty, very clayey
Classification A-2-4(0), SILTY, CLAYEY SAND(SC-SM)

Gravel (%) 0
Sand (%) 69
Clay/Silt (%) 31

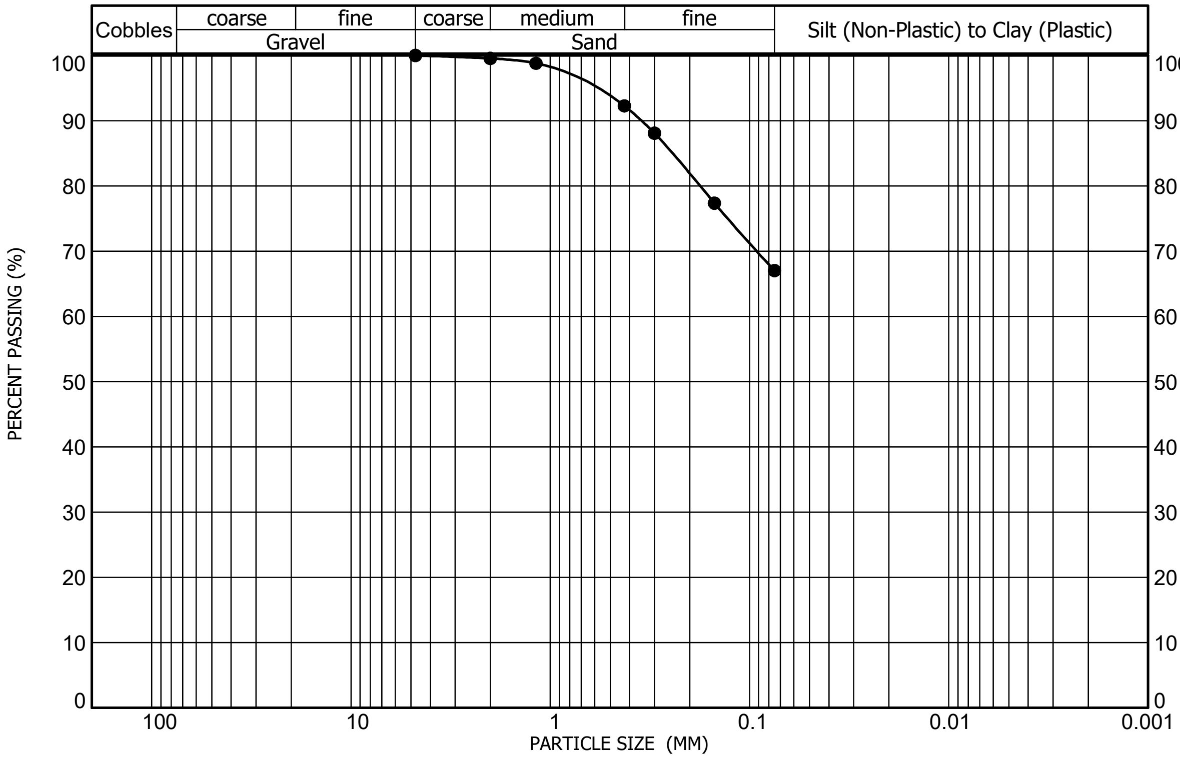
Liquid Limit 23
Plasticity Index 5

GRADATION AND ATTERBERG TEST RESULTS

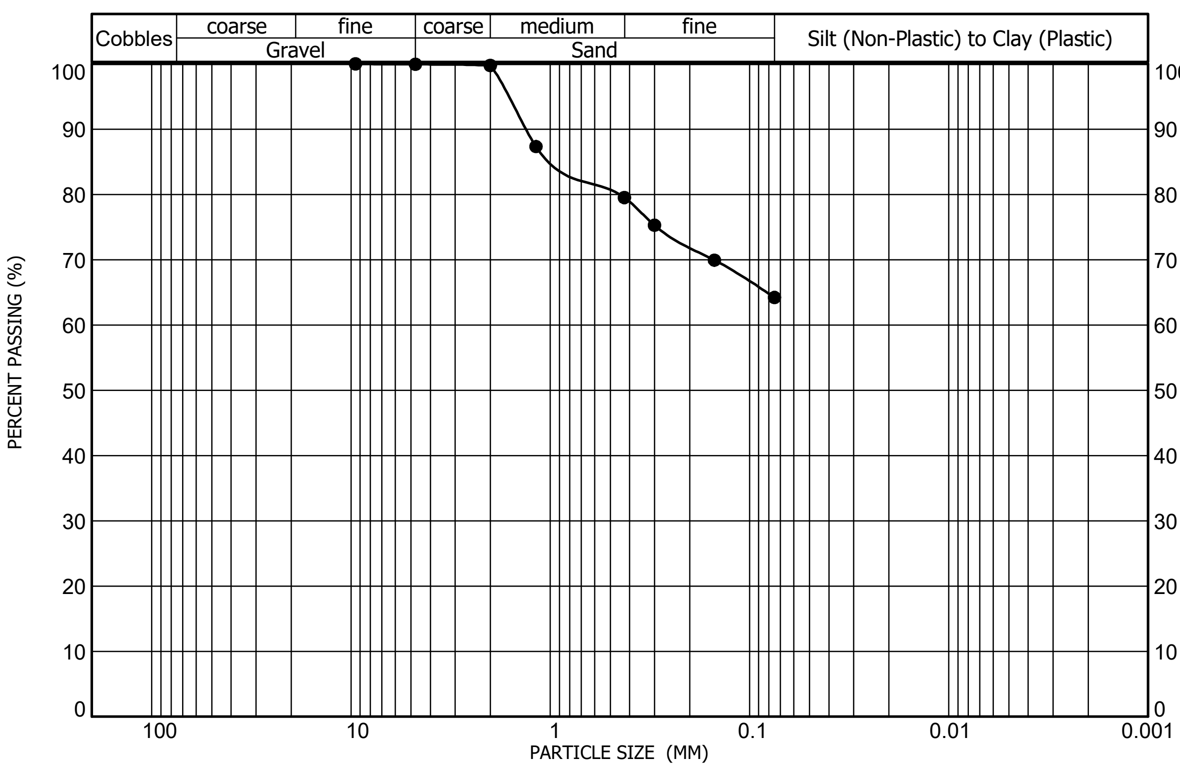
FIGURE A-17

PROJECT NO. 208100

A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 8 at a depth of 19 feet
Sample Description: Clay, very sandy
Classification: A-6(8), SANDY LEAN CLAY(CL)
Gravel (%): 0
Sand (%): 33
Clay/Silt (%): 67
Liquid Limit: 34
Plasticity Index: 14

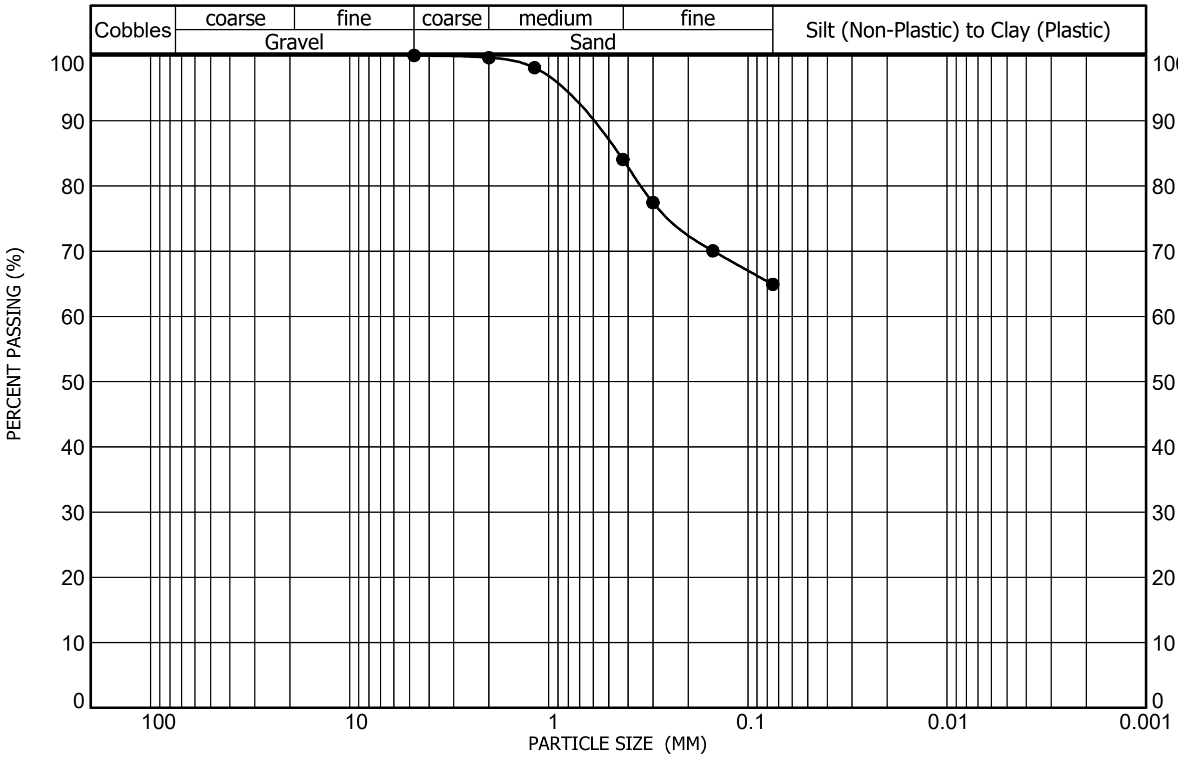


Sample Location: Test Boring No. 9 at a depth of 14 feet
Sample Description: Clay, very sandy (lens)
Classification: A-7-6(15), SANDY LEAN CLAY(CL)
Gravel (%): 0
Sand (%): 36
Clay/Silt (%): 64
Liquid Limit: 46
Plasticity Index: 27

GRADATION AND ATTERBERG TEST RESULTS

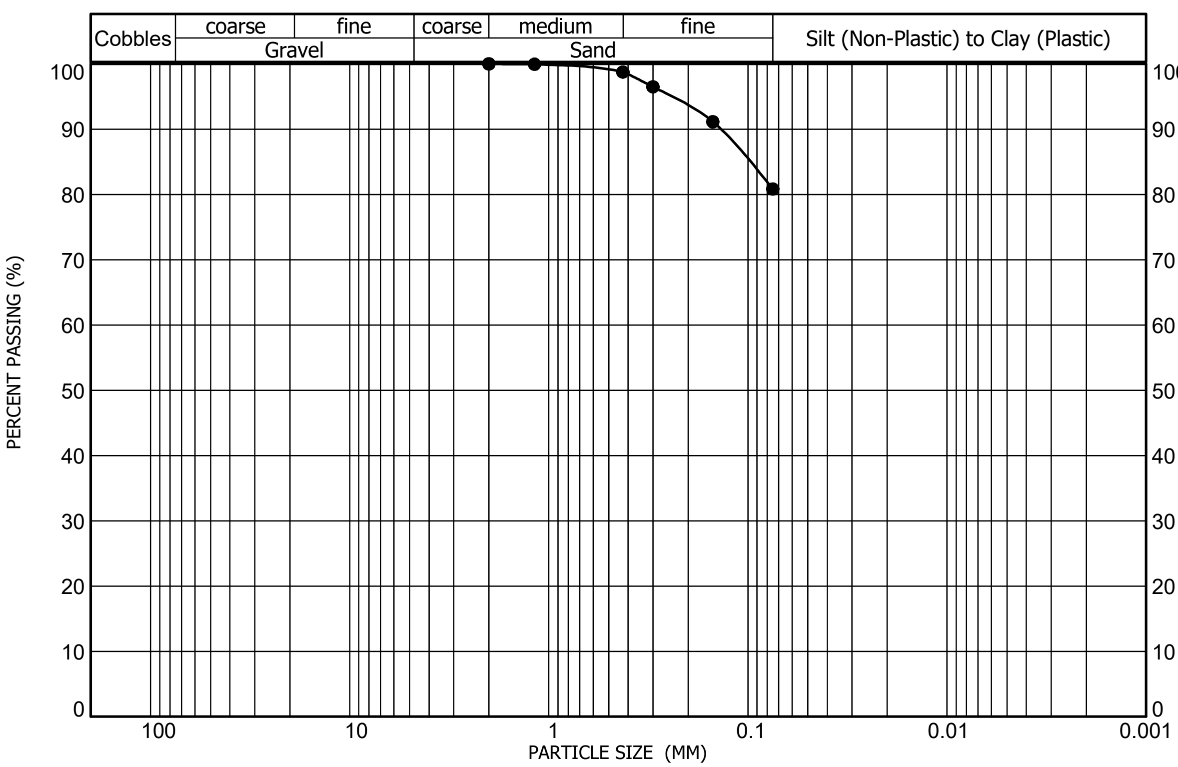
FIGURE A-18

PROJECT NO. 208100



Sample Location: Test Boring No. 10 at a depth of 24 feet
Sample Description: Clay, very sandy
Classification: A-7-6(13), SANDY LEAN CLAY(CL)

Gravel (%): 0
Sand (%): 35
Clay/Silt (%): 65
Liquid Limit: 44
Plasticity Index: 23



Sample Location: Test Boring No. 11 at a depth of 9 feet
Sample Description: Clay, sandy
Classification: A-6(9), LEAN CLAY with SAND(CL)

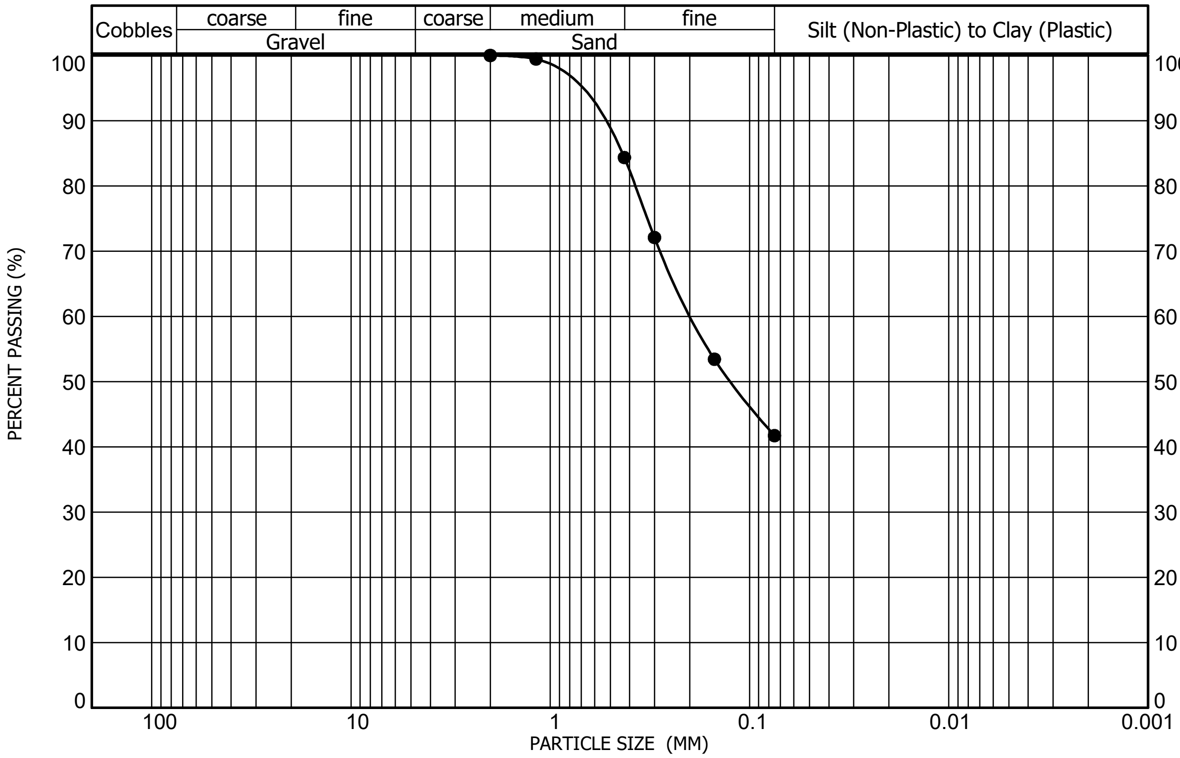
Gravel (%): 0
Sand (%): 19
Clay/Silt (%): 81
Liquid Limit: 31
Plasticity Index: 13

GRADATION AND ATTERBERG TEST RESULTS

FIGURE A-19

AGW

A.G. WASSENAAR, INC.



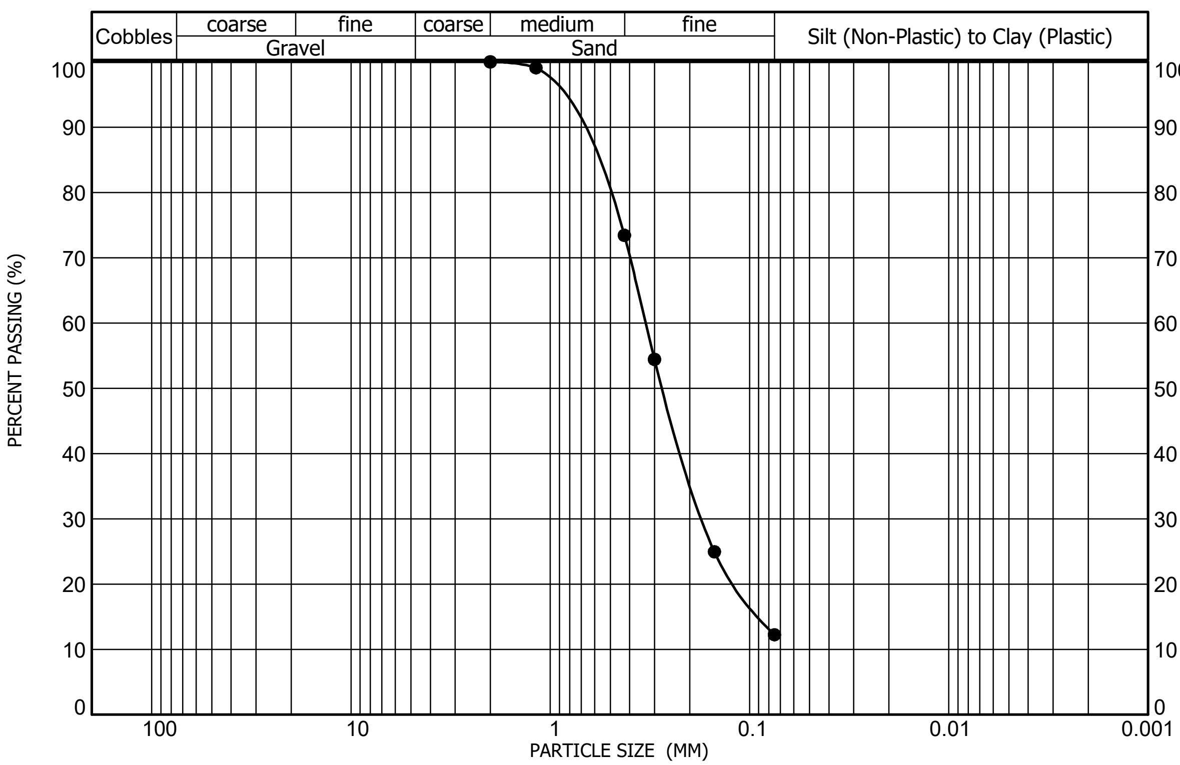
Sample Location: Test Boring No. 11 at a depth of 14 feet

Sample Description: Sand, very clayey

Classification: A-6(3), CLAYEY SAND(SC)

Gravel (%): 0 | Sand (%): 58 | Clay/Silt (%): 42

Liquid Limit: 33 | Plasticity Index: 15



Sample Location: Test Boring No. 12 at a depth of 4 feet

Sample Description: Sand, slightly silty

Classification: A-2-4(0), SILTY SAND(SM)

Gravel (%): 0 | Sand (%): 88 | Clay/Silt (%): 12

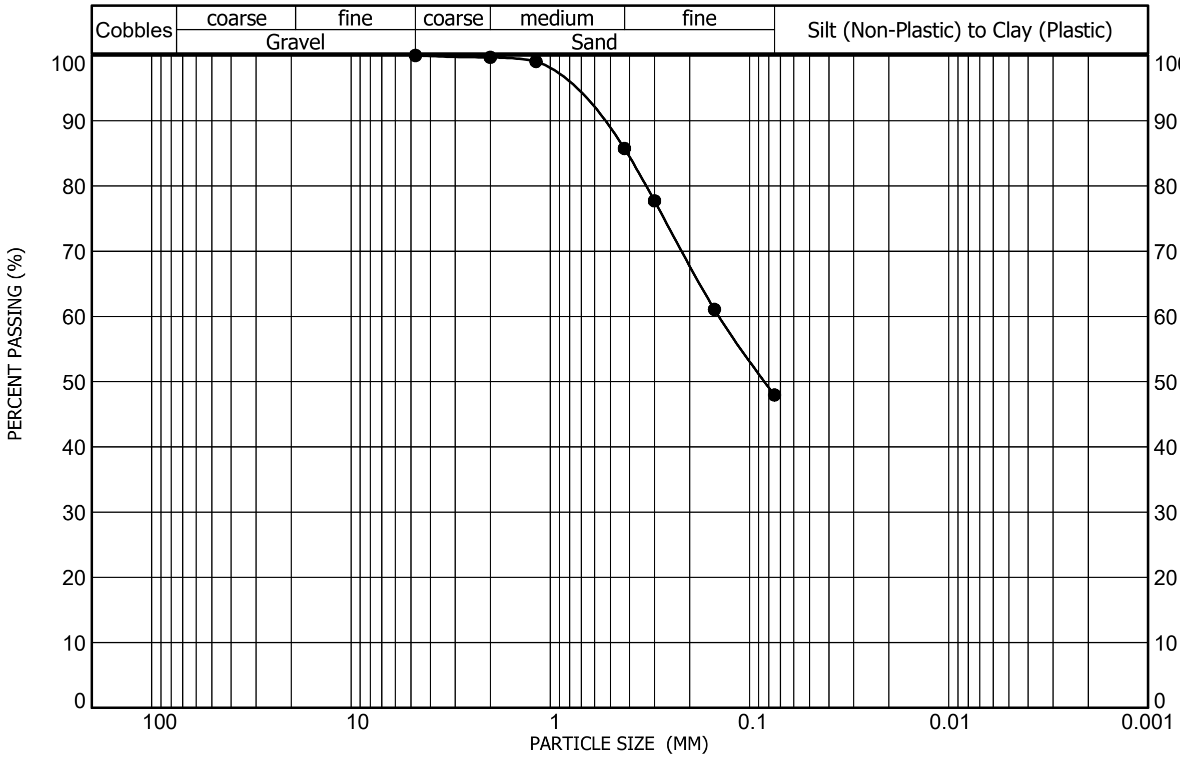
Liquid Limit: NV | Plasticity Index: NP

GRADATION AND ATTERBERG TEST RESULTS

FIGURE A-20

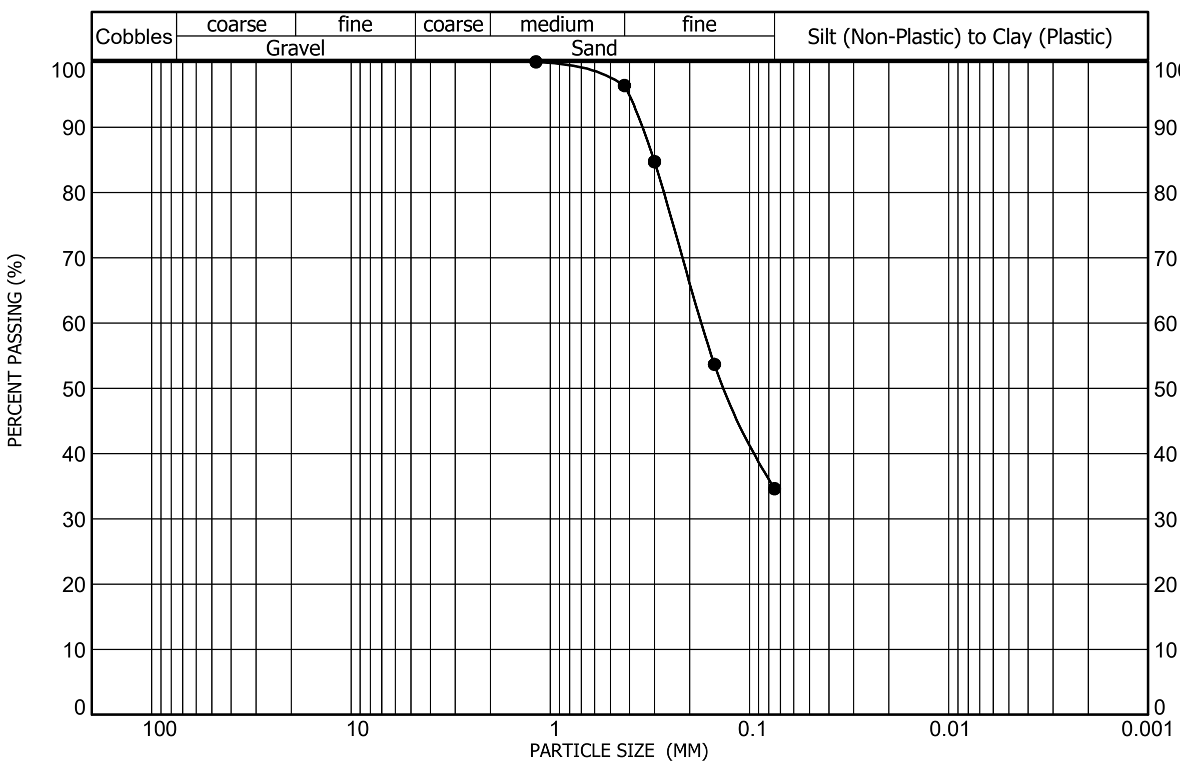
PROJECT NO. 208100

A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 12 at a depth of 19 feet
Sample Description: Sand, very clayey (lens)
Classification: A-6(3), CLAYEY SAND(SC)

Gravel (%): 0
Sand (%): 52
Clay/Silt (%): 48
Liquid Limit: 32
Plasticity Index: 14



Sample Location: Test Boring No. 13 at a depth of 9 feet
Sample Description: Sand, very silty, very clayey
Classification: A-2-4(0), SILTY, CLAYEY SAND(SC-SM)

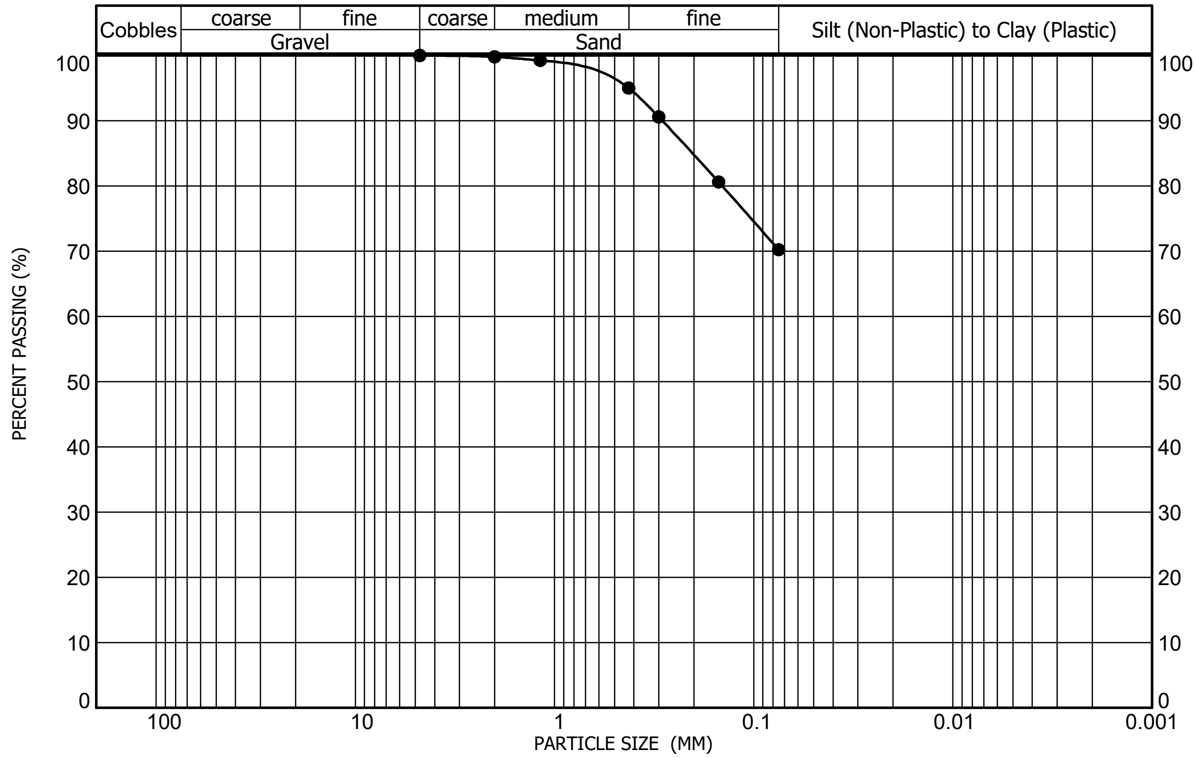
Gravel (%): 0
Sand (%): 65
Clay/Silt (%): 35
Liquid Limit: 22
Plasticity Index: 6

GRADATION AND ATTERBERG TEST RESULTS

FIGURE A-21

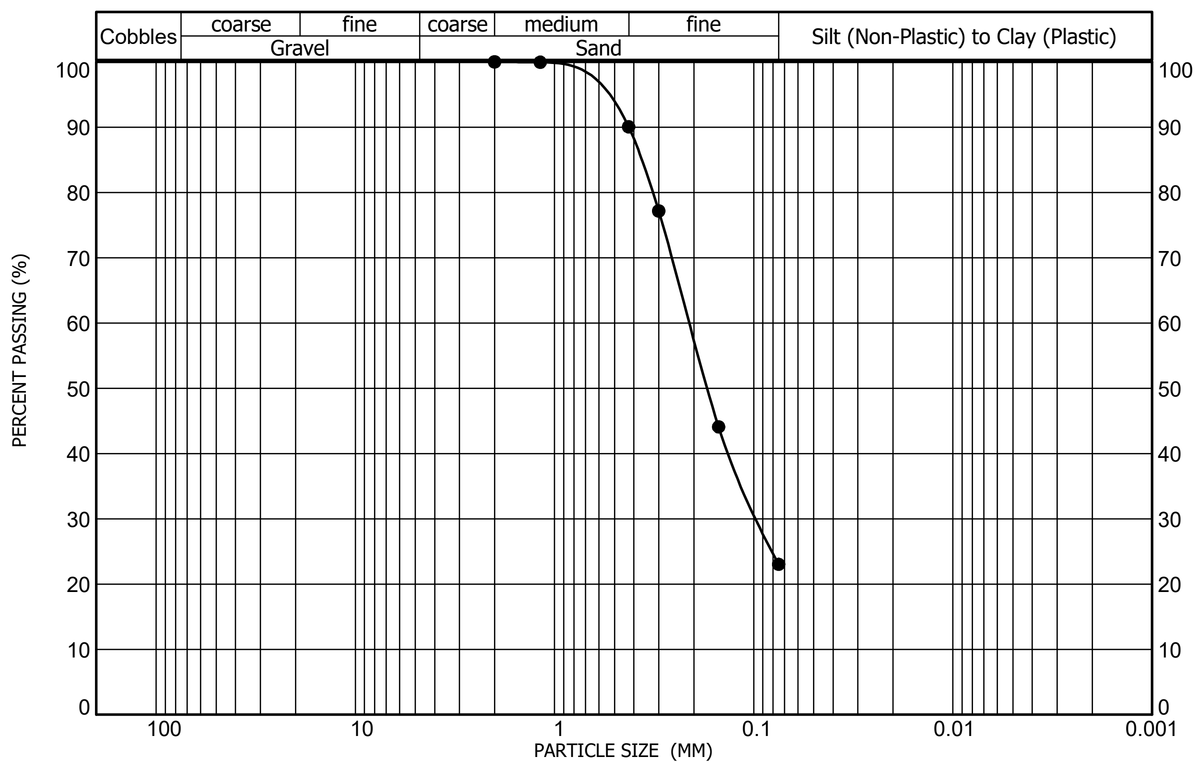
PROJECT NO. 208100

A.G. WASSENAAR, INC.



Sample Location: Test Boring No. 14 at a depth of 9 feet
Sample Description: Clay, sandy
Classification: A-7-6(13), LEAN CLAY with SAND(CL)

Gravel (%): 0
Sand (%): 30
Clay/Silt (%): 70
Liquid Limit: 42
Plasticity Index: 20



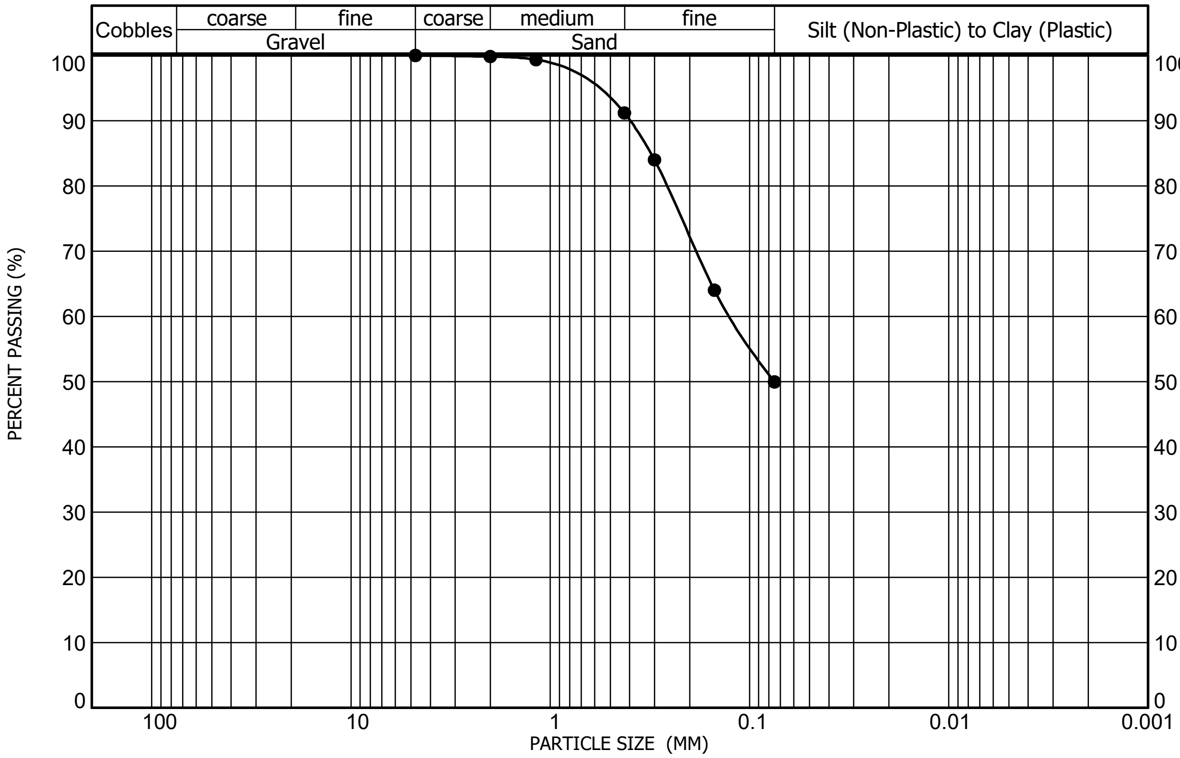
Sample Location: Test Boring No. 15 at a depth of 9 feet
Sample Description: Sand, silty
Classification: A-2-4(0), SILTY SAND(SM)

Gravel (%): 0
Sand (%): 77
Clay/Silt (%): 23
Liquid Limit: NV
Plasticity Index: NP

GRADATION AND ATTERBERG TEST RESULTS

FIGURE A-22

A.G. WASSENAAR, INC.



Sample Location: Blended Bulk Sample from Test Borings
Sample Description: Sand, very silty, very clayey
Classification: A-4(0), SILTY, CLAYEY SAND(SC-SM)

Gravel (%): 0
Sand (%): 50
Clay/Silt (%): 50
Liquid Limit: 21
Plasticity Index: 4

GRADATION AND ATTERBERG TEST RESULTS

FIGURE A-23

PROJECT NO. 208100

MOISTURE-DENSITY RELATIONSHIP

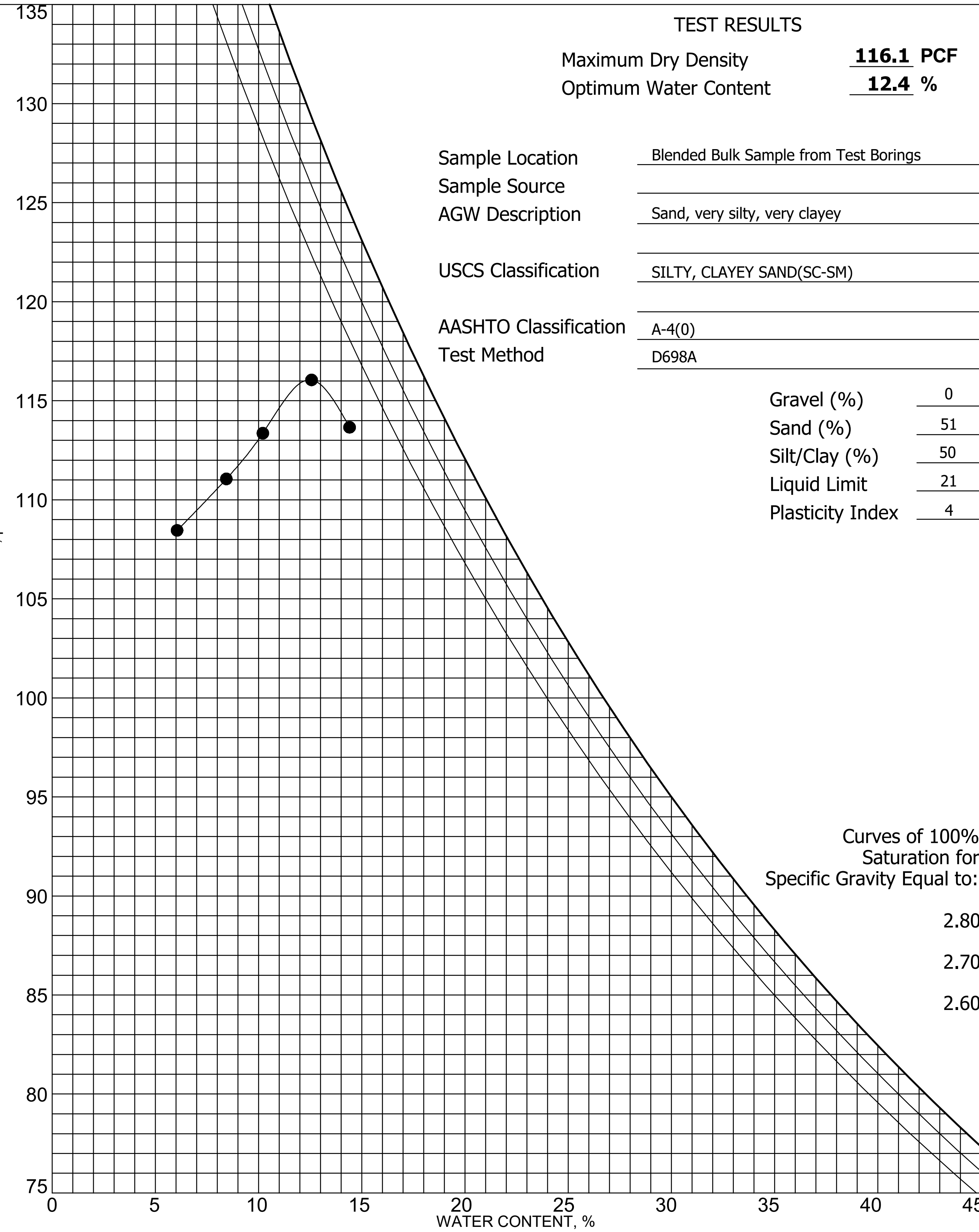
A.G. WASSENAAR, INC.

CLIENT United Development Companies, LLC

PROJECT NAME Eberly

PROJECT NUMBER 208100

PROJECT LOCATION Commerce City, Colorado



TEST RESULTS

Maximum Dry Density	**116.1**	**PCF**
Optimum Water Content	**12.4**	**%**

Sample Location	Blended Bulk Sample from Test Borings
Sample Source	
AGW Description	Sand, very silty, very clayey
USCS Classification	SILTY, CLAYEY SAND(SC-SM)
AASHTO Classification	A-4(0)
Test Method	D698A

Gravel (%)	0
Sand (%)	51
Silt/Clay (%)	50
Liquid Limit	21
Plasticity Index	4

FIGURE A-24

U:\PROJECT FILES\2 - GEOTECHNICAL\208100 EBERLY UNITED DEVELOPMENT SD KAN\TO BE SAVED\GINT\208100S_GT2021-01-08 EBERLY SD.GPJ

APPENDIX B
SPECIFICATIONS FOR PLACEMENT OF FILL

APPENDIX B
SPECIFICATIONS FOR PLACEMENT OF FILL

General
AGW, as the Client's representative, should observe fill placement and conduct tests to determine if the materials placed, methods of placement, and compaction are in reasonable conformance with these specifications. Specifications presented in this Appendix are general in nature. They should be used for construction except where specifically superseded by those presented in the attendant geotechnical study.

For the purpose of this specification, structural areas include those areas that will support constructed appurtenances (e.g., foundations, slabs, flatwork, pavements, etc.) and fill embankments or slopes that support significant fills or constructed appurtenances. Structural areas will be as defined by AGW.

Fill Material
Fill material should consist of on or off-site soils which are relatively free of vegetable matter and rubble. Off-site materials should be evaluated by AGW prior to importation. No organic, frozen, perishable, rock greater than 6 inches, or other unsuitable material should be placed in the fill. For the purpose of this specification, cohesive soil is defined as a mixture of clay, sand, and silt with more than 35% passing a U. S. Standard #200 sieve and a Plasticity Index of at least 11. These materials will classify as an A-6 or A-7 by the AASHTO Classification system. Granular soils are all materials which do not classify as cohesive.

Preparation of Fill Subgrade
Vegetation, organic topsoil, any existing fill, and any other deleterious materials should be removed from the fill area. The area to be filled should then be scarified, moistened or dried as necessary, and compacted to the moisture content and compaction level specified below prior to placement of subsequent layers of fill.

Placement of Fill Material
The materials should be delivered to the fill in a manner which will permit a well and uniformly compacted fill. Before compacting, the fill material should be properly broken down, mixed, and spread in approximately horizontal layers not greater than 8 inches in loose thickness.

Moisture Control
The material must contain uniformly distributed moisture for proper compaction. The Contractor will be required to add moisture to the materials if, in the opinion of AGW, sufficient and uniform moisture is not present in the fill. If the fill materials are too wet for proper compaction, aerating and/or mixing with drier materials will be required.

Moisture content should be controlled as a percentage deviation from optimum. Optimum moisture content is defined as the moisture content corresponding to the maximum density of a laboratory compacted sample performed according to ASTM D698 for cohesive soils or ASTM D1557 for granular soils. The moisture content specifications for the various areas are as follows:

		Cohesive Soils	Granular Soils
1.	Beneath Structural Areas:	0 to +4%	−2 to +2%
2.	Beneath Non-Structural Areas:	−3 to +3%	−3 to +3%

Compaction
When the moisture content and conditions of each layer spread are satisfactory, the fill should be compacted. Laboratory moisture-density tests should be performed on typical fill materials to determine the maximum density. Field density tests must then be made to determine fill compaction. The compaction standard to be utilized in determining the maximum density is ASTM D698 for cohesive soils or ASTM D1557 for granular soils. The following compaction specifications should be followed for each area:

1. Beneath Structural Areas: 95% of Maximum Dry Density
2. Beneath Non-Structural Areas: 90% of Maximum Dry Density

If the fill contains less than 10% passing the No. 200 sieve, it may be necessary to control compaction based on relative density (ASTM D2049). If this is the case, then compaction around the structures and beneath walkway or other slabs should be to at least 70% relative density, and compaction beneath foundations and vehicle supporting should be to at least 80% relative density.

Deep Fills
In areas where fill depths exceed 20 feet beneath structural areas, additional compaction considerations will be required to reduce fill settlement. Fill placed within 20 feet of final overlot grade should be compacted as required above. Deeper fills should be compacted to 100% of maximum dry density at a moisture content of ±2% of optimum moisture content. Relative density of at least 85% will be required when necessary.

Responsibility
Any mention of essentially full-time testing and observation does not mean AGW will accept responsibility for future fill performance. AGW shall not be responsible for constant or exhaustive inspection of the work, the means and methods of construction or the safety procedures employed by Client's contractor. Performance of construction observation services does not constitute a warranty or guarantee of any type, since even with diligent observation, some construction defects, deficiencies or omissions in the Contractor's work may occur undetected. Client shall hold its contractor solely responsible for the quality and completion of the project, including construction in accordance with the construction documents. Any duty hereunder is for the sole benefit of the Client and not for any third party, including the contractor or any subcontractor.

APPENDIX F – Preliminary Drainage Plan


TRACT FF FOXTON VILLAGE
SHERI DIEHL ET AL
REC. NO. C0743665
10180 POTOMAC STREET
WILLIAM D AND VERLANE EBERLY
REC. NO. 1968000841885
BLOCK 4
FOXTON VILLAGE
REC. NO.
C0743665
BLOCK 6
FOXTON VILLAGE
REC. NO.
C0743665
BLOCK 8
FOXTON VILLAGE
REC. NO.
C0743665
BLOCK 10
FOXTON VILLAGE
REC. NO.
C0743665
BLOCK 11
FOXTON VILLAGE
REC. NO.
C0743665
BLOCK 12
FOXTON VILLAGE
REC. NO.
C0743665
BLACKHAWK ST
(VARIABLE-WIDTH ROW)
POTOMAC ST
(VARIABLE-WIDTH ROW)
BLOCK 24
REUNION RIDGE FILING NO. 1
REC. NO. 202000006264
TRACT K
REUNION RIDGE FILING NO. 1
REC. NO. 202000006264
EX ROADSIDE DITCH
BLOCK 25
REUNION RIDGE FILING NO. 1
REC. NO. 202000006264
BLOCK 30
REUNION RIDGE FILING NO. 1
REC. NO. 202000006264
TRACT M
REUNION RIDGE FILING NO. 1
REC. NO. 202000006264
BLOCK 36
REUNION RIDGE FILING NO. 1
REC. NO. 202000006264
10000 POTOMAC STREET
UNPLATTED LAND
KYLE JOHNSON
REC. NO.
2000030643212
EX RAGWEED DRAW
UNPLATTED LAND
DIRC 96TH AND POTOMAC, LLC
REC. NO. 1998030365966
KEY MAP
SCALE: 1" = 400'
LEGEND:
EXISTING CONTOUR LINES
5173
5170
BASIN BOUNDARY
FLOW ARROW
NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF HARRIS KOCHER SMITH
FILEPATH: K:\201237\ENGINEERING\DRAINAGE\HISTORICAL DRAINAGE PLAN.DWG LAYOUT: LAYOUT1
PLOTTED: BY: CHELSEY MILLER
811 Know what's below. Call before you dig.
80 0 80 160
SCALE: 1" = 80'
DESIGNED BY: CAM
CHECKED BY: MAW
DRAWN BY: CAM
ISSUE DATE: ----
DATE
REVISION COMMENTS
HKS HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com
UNITED DEVELOPMENT COMPANIES
EBERLY PLACE
EXISTING CONDITIONS PLAN
PROJECT #: 201237
SHEET NUMBER
1
1 OF 2

LEGEND:

EXISTING CONTOUR LINES	5173 / 5170
BASIN BOUNDARY	
DESIGN POINT	1
FLOW ARROW	
PROPOSED CONTOUR LINES	5173 / 5170
PROPOSED STORM SEWER	

BASIN DESIGNATION — OS 1 — 5-YR RATIONAL C COEFFICIENT
BASIN SIZE IN ACRES — AREA 1.23 AC — C MINOR 0.45 — C MAJOR 0.67 — 100-YR RATIONAL C COEFFICIENT
1 BASIN DESIGN POINT

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

SCALE: 1" = 70'
70 0 70 140

DESIGNED BY: CAM
CHECKED BY: MAW
DRAWN BY: CAM

ISSUE DATE: 10-25-21

DATE	REVISION COMMENTS
####	####
####	####
####	####
####	####
####	####
####	####
####	####

HKS HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

UNITED DEVELOPMENT COMPANIES

EBERLY PLACE
PRELIMINARY DRAINAGE PLAN

PROJECT #: 201237
SHEET NUMBER
1
1 OF 1

FILEPATH: K:\201237\ENGINEERING\DRAINAGE\OLD\PRELIMINARY DRAINAGE PLAN.DWG LAYOUT: LAYOUT3
10 XREFs: e-base, e-legal, e-util, p-base-byot[U], p-base-fut-byot[U], p-base[U], p-legal-byot[U], p-legal[U], p-util-fut-byot[U], p-util[U]
PLOTTED: THU 01/20/22 11:11:10P BY CHELSEY MILLER