MVE, INC.
ENGINEERS SURVEYORS
1903 lelaray street, suite 200
colorado springs, co 80909
719.635.5736

Final Drainage Report

Ellicott School Addition - 2 Buildings

Project No. 61183

PCD File No. PPR-22-50

November 28, 2022

Final Drainage Report

for

Ellicott School Addition - 2 Buildings

Project No. 61183

November 28, 2022

prepared for

Ellicott School District No 22
322 S Ellicott Hwy
Calhan, CO 80808
719.683.2700

prepared by

MVE, Inc.
1903 Lelaray Street, Suite 200
Colorado Springs, CO 80909
719.635.5736

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61183-Final Drainage Report.odt

Statements and Acknowledgments

Engineer's Statement

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

______________________________ ______________

David R. Gorman, P.E. Colorado No. 31672 Date
For and on Behalf of MVE, Inc.

Developer's Statement

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

______________________________ ______________

School District Board of Education President, Date
Ellicott School District No 22

El Paso County

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

______________________________ ______________

Joshua Palmer, PE Date
County Engineer / ECM Administrator

Contents

Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed Ellicott School Addition - 2 Buildings site. The report will "identify specific solutions to problems on-site and off-site resulting from the proposed project. The report and included maps present results of hydrologic and drainage facilities analyses. The report will discuss the recommended drainage improvements to the site and identify drainage requirements relative to the proposed project. This report has been prepared and submitted in accordance with the requirements of the El Paso County development approval process. An Appendix is included with this report with pertinent calculations and graphs used in the drainage analyses and design. The scope of this report does not include the entirety of the site but is limited to the regions of the site where grading and construction will be occurring.

1 General Location and Description

1.1 Location

The proposed Ellicott School Addition - 2 Buildings site is located within the southwest quarter of Section 18, Township 14 South, Range 62 West of the 6th Principal Meridian, El Paso County, Colorado. The 28.51± acre site is situated north of Handle Road and east of South Ellicott Highway in El Paso County. The site contains an elementary school building that uses the address of 399 S Ellicott Highway, Calhan, CO 80808 and El Paso County Assessor's Schedule Number 2418000019. A **Vicinity Map** is included in the **Appendix**.

The south edge of the site is adjacent to Handle Road, and to the south of Handle road is an unplatted lot containing 109.82 acres, is owned by Bailey Teresa D and is zoned Agricultural (A-35) with El Paso County Assessor's Schedule Number 2400000220. An unplatted lot containing 40.45 acres, is owned by Jerry R Sales and Kathy A Sales, zoned Agricultural (A-35) is adjacent to the east of the site with El Paso County Assessor's Schedule Number 2418000013.

The western edge of the site is adjacent to South Ellicott highway, and adjacent to the highway on the west are two unplatted lots owned by Ellicott School District No. 22 and zoned Agricultural (A-35). The northern parcel to the east has El Paso County Assessor's Schedule Number 3413000024, containing 29.3 acres, and the southern parcel has El Paso County Assessor's Schedule Number 3413000025, containing 10.7 acres.

An unplatted lot containing 30 acres, is owned by Schubert Beverly J Living Trust and zoned Agricultural (A-35) is adjacent to the north of the site with El Paso County Assessor's Schedule Number 2418000006. Unplatted lot, containing 5.35 acres, is owned by El Paso County School District No 22 is zoned Agricultural (A-35), is also adjacent to the north of the site with El Paso County Assessor's Schedule Number 2418000018.

The site is located in El Paso County's Ellicott Consolidated Major Drainage Basin. The ultimate receiving water is Black Squirrel Creek which flows approximately 6,000 feet east of the east property line of the site.

1.2 Description of Property

The Ellicott School Addition - 2 Buildings site is zoned Agricultural - 35 Acres (A-35). The property is the location of an elementary school with existing elementary school building, a superintendent office building, and various ancillary buildings as well as gravel drives, parking lots and grass covered ball fields. There are existing 12” CMP culverts below the driveways connecting the site to the roadway at 5 locations along the edge of the site.

The site is covered with native prairie grasses and weeds in average condition having approximately 80% ground coverage with sparse trees and shrubs scattered. The existing site topography slopes easterly and southerly towards Handle Road with grades that range from 1% to 10% with areas in the northern and eastern portions with slopes that reach 22%. The main access to this project is from the existing public South Ellicott Highway. There is one (1) access point directly in front of Ellicott Sr High School at 375 S Ellicott Hwy as well as another access directly in front of Ellicott Elementary School at 399 S Ellicott Hwy.

The lowest point on the site is in the southeastern portion of the site. No major drainageways flow through the site and no significant drainage improvements or drainage facilities currently exist on the site except for the existing 12” CMP culverts below the driveways.

According to the National Resource Conservation Service, there are three (3) soil types in the immediate area of the Ellicott School Addition - 2 Buildings site. Columbine Gravelly Sandy Loam (map unit 19) makes up a portion of the soil in the eastern portion of the site and Truckton Loamy Sand (map unit 95) makes up a portion of the soil in the western portion. Truckton Sandy Loam (map unit 96) makes up a small portion of approximately 0.1 acres in the center portion of the site. A portion of the **Soil Map** and data tables from the **NRCS/USDA Web Soil Survey** and relevant Soil Descriptions from the **Soil Survey of El Paso County Area, Colorado** are included in the **Appendix**.[1] [2]

Columbine Gravelly Sandy Loam is typically deep and well drained excessively drained. Permeability is very rapid, surface runoff is very low, and the hazard of erosion is slight to moderate. Columbine Gravelly Sandy Loam is classified as being part of Hydrologic Soil Group “A”.

Truckton Loamy Sand is typically deep and well drained. Permeability is moderately rapid, surface runoff is low, and the hazard of erosion is moderate to high. Truckton Loamy Sand is classified as being part of Hydrologic Soil Group “A”.

Truckton Sandy Loam is typically deep and well drained. Permeability is moderately rapid, surface runoff is very low, and the hazard of erosion is moderate. Truckton Sandy Loam is classified as being part of Hydrologic Soil Group “A”.

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRMs), effective December 7, 2018. The project site is included in Community Panel Number 08041C0809 G of the FIRMs for El Paso County, Colorado. No portion of the site lies within FEMA designated Special Flood Hazard Areas (SFHAs). An excerpt of the current **FEMA Flood Insurance Rate Maps** with the site delineated is included in the **Appendix**.[3] [4]

1.3 Description of Development

The development on this site include site grading and construction of two (2) new buildings along with sidewalks, gravel drives, and connected utilities. Construction will be done in two phases, Phase I and Phase II. Phase I will consist of constructing one (1) Votech building having two (2) stories and 11,499 sf building footprint with a gravel access road, paved sidewalks, a rain garden, and landscaping. Phase I will serve Ellicott Sr High School at 375 S Ellicott Hwy. Phase II will consist of one (1) classroom building having one (1) story and 19,123 sf building footprint containing 13 classrooms, paved sidewalks, gravel access roads, a rain garden, and landscaping. Phase II will

1 WSS
2 SS-EPC
3 FIS
4 FIRM, Map No. 08041C0809G

serve Ellicott Elementary School at 399 S Ellicott Hwy. The project also includes connecting internal potable water and sanitary sewer service lines.

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The Ellicott School Addition - 2 Buildings site is located in the Ellicott Consolidated Major Drainage Basin (CHBS1200). This basin drains to Black Squirrel Creek. The Ellicott School Addition - 2 Buildings site is located approximately 6,000 feet west of Black Squirrel Creek. The scope of this report does not include the entirety of the site but is limited to the regions of the site where grading and construction will be occurring. The site is not included in a Drainage Basin Planning Study.

2.2 Sub-Basin Description

The scope of this report does not include the entirety of the site but is limited to the regions of the site where grading and construction will be occurring. The existing drainage patterns of said region can be described by five (5) on-site drainage basins. All of these basins are previously disturbed or developed to a degree as described below. All existing basin delineations and data are depicted on the attached **Existing Drainage Maps**.

The northern edge of the site is located along a natural drainage basin boundary. The topography shows no offsite flows entering the on-site sub-basins mentioned in this report. All flows entering the project area are accounted for in the sub-basins mentioned in this report. All on-site sub-basins currently drain in a combination of sheet flow and concentrated flow across the site and exit the site at the southeastern corner going offsite into the north ditch of Handle Road and continuing east. The north ditch of Handle Road is a well vegetated, grassed ditch in good condition with existing CMP culverts underneath all driveways accessing the site that allow the flows in the north roadside ditch of Handle Road to remain uninterrupted. Flows continue east in the roadside ditch until reaching Black Squirrel Creek approximately 6,000 feet east of the east property line of the site.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Final Drainage Report for Ellicott School Addition - 2 Buildings has been prepared according to the report guidelines presented in the latest edition of *El Paso County Drainage Criteria Manual*[5]. The County has also adopted portions of the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, especially concerning the calculation of rainfall runoff flow rates.[6] [7] The hydrologic analysis is based on a collection of data from the DCM, the NRCS/USDA Web Soil Survey[8], Existing topographic data by Clark Land Surveying Inc., and proposed site plan by Architivity, Ltd and MVE, Inc. The proposed rain gardens will be constructed per the recommendations of the Urban Storm Drainage Criteria Manual, Volume 3.[9] The bioretention calculation was made with the aid of the "UD-BMP_v3.07" spreadsheet developed by Mile High Flood District and is attached in the **Appendix**.[10]

3.2 Hydrologic Criteria

For this Final Drainage Report, the Rational Method as described in the *City of Colorado Springs Drainage Criteria Manual (DCM)* has been used for all Storm Runoff calculations, as the development and all sub-basins are less than 130 acres in area. "Colorado Springs Rainfall Intensity Duration Frequency" curves, Figure 6-5 in the DCM, was used to obtain the design rainfall values; a copy is included in the **Appendix**. The "Overland (Initial) Flow Equation" (Eq. 6-8) in the DCM, and

5 DCMSection I, Chapter 4.3 and 4.4
6 CS DCM Vol 1
7 CS DCM Vol 2
8 WSS
9 USDCM-V.3
10 UD-BMP

For sites where full infiltration for WQ is proposed, an on-site infiltration test using double-ring infiltrometer is required. Infiltration tests should be performed or supervised by a licensed professional engineer and conducted at a minimum depth equal to the bottom of the sand filter. Underdrains are required for sand filters and should be provided if infiltration tests show rates slower than 2 times that required to drain the WQCV over 12 hours. Refer to the City's guidance policy (link provided)

Manning's equation with estimated depths were used in time of concentration calculations. "Runoff Coefficients for Rational Method", Table 6-6 in the DCM, was utilized as a guide in estimating runoff coefficient and Percent Impervious values; a copy is included in the **Appendix**. Peak runoff discharges were calculated for each drainage sub-basin for both the 5-year storm event and the 100-year storm event with the Rational Method formula, (Eq. 6-5) in the DCM.[11]

Porous Landscape Detention Areas (PLDs), more commonly known as **Rain Gardens** "utilizes bioretention is an engineered, depressed landscape area designed to capture and filter or infiltrate the water quality capture volume (WQCV)". Two rain gardens are proposed for this project site intended to provide water quality enhancement to their respective phase of development. The areas of the site designated as rain gardens are called out on the Proposed Drainage Map attached to the **Appendix**.

Provide discussion of soils to support this statement.

3.3 Previous Drainage Studies

There is no effective and official Drainage Basin Planning Study for the Ellicott Consolidated major drainage basin. No previous drainage report addresses flows relevant to the project site, and so non were used in the drainage design for this site. All properties adjacent to the site are unplatted and no drainage reports for these properties are expected to exist.

typo

4 Drainage Facility Design

4.1 General Concept

The intent of the drainage concept presented in this Final Drainage Report is to maintain the existing drainage patterns on the site while addressing water quality requirements for the site. Major and minor storm flows will continue to be safely conveyed through the site and downstream.

The existing and proposed drainage hydrologic conditions are described in more detail below. Input data and results for all calculations are included in the **Appendix**. Drainage maps for the hydrology are also included in the **Appendix**.

4.2 Specific Details

4.2.1 Existing Hydrologic Conditions

The northern edge of the site is located along a natural drainage basin boundary. The topography shows no offsite flows entering the on-site sub-basins mentioned in this report. All flows entering the project area are accounted for in the sub-basins mentioned in this report. Flows exit the site at the southeastern corner of the site, without forming a concentrated path, and allowing the existing north roadside ditches on handle road to carry the flows. The existing stable flow path is adequate to carry the existing and developed flows. Flow velocities in the existing flow path are not erosive and require no special lining. The flow path delivers the flows east to Black Squirrel Creek located 6,000 feet east of the east property line of the site.

Existing sub-basin EX-A is 4.71 acres in area located on the northern portion of the site and contains a gravel parking, a portion of a paved asphalt drive, concrete pavement and meadow/pasture area. Sub-basin EX-A produces peak discharges of Q_5 = 4.1 cfs and Q_{100} = 13.3 cfs (existing flows). Flows from the western portion of sub-basin EX-A drain easterly towards the existing depression located at Design Point 1 (DP1) in a combination of sheet flow and an area of concentrated flow in the central portion of the basin. The concentrated flow occurs in an existing swale flowing easterly and into the depression. Flows from the eastern portion of sub-basin EX-A drain in the form of sheet flow into the existing depression located at Design Point 1 (DP1). The depression overflows to drain flows south towards Design Point 3 (DP3).

Existing sub-basin EX-B, located in the northern portion of the site and just south of sub-basin EX-A, is 0.44 acres in area. Sub-basin EX-B contains a portion of the paved asphalt drive and concrete

11 CS DCM Vol 1

pavement, gravel parking area, and meadow/pasture area. Peak storm runoff rates are Q_5 = 0.8 cfs and Q_{100} = 1.8 cfs (existing flows) which drain easterly towards Design Point 2 (DP2).

Existing sub-basin EX-C (1.47 acres) is comprised of meadow/pasture area. The sub-basin generates flows of Q_5 = 0.5 cfs and Q_{100} = 3.3 cfs (existing flow), which drain westerly towards Design Point 3 (DP3). These flows combine with the flows from existing DP1 and DP2 and drain into the existing swale located west of the existing ball field. Flows then drain in a combination of sheet flow and concentrated flow across the site and exit the site at the southeastern corner going offsite into the north ditch of Handle Road and then continues east into Black Squirrel Creek.

Existing sub-basin EX-D, located in the southern portion of the site, is 0.87 acres in area. Sub-basin EX-D contains meadow/pasture area, and small portions of concrete pavement. Peak storm runoff rates are Q_5 = 0.4 cfs and Q_{100} = 2.1 cfs (existing flows) which drain westerly towards Design Point 4 (DP4). Flows then drain further south into the parking lot and offsite into the north ditch of Handle Road and then continues east into Black Squirrel Creek.

Existing sub-basin EX-E, located in the southern portion of the site, is 1.29 acres in area. Sub-basin EX-E contains a small area of concrete pavement and meadow/pasture area. Peak storm runoff rates are Q_5 = 0.5 cfs and Q_{100} = 3.0 cfs (existing flows) which drain southeast towards Design Point 5 (DP5). Flows from DP5 enter the existing swale southwest of the sub-basin and flow east then southerly and offsite into the north ditch of Handle Road and then continues east into Black Squirrel Creek.

The **Existing Drainage Map** depicts the existing topographic mapping, drainage basin delineations, drainage patterns, existing drives, drainage facilities, and runoff quantities with a data table including drainage areas and flow rates.

Each basin paragraph should also discuss the proposed improvements to occur in each (only some paragraphs do so currently).

4.2.2 Proposed Hydrologic Conditions

and existing roadside ditch?

Water quality treatment for the new disturbed and impervious areas on the site will be provided by two (2) rain gardens, each one located downstream of each new building addition. No detention for flood control is being provided because the downstream effects of the minor increases in peak flow rates are negligible. The small increase in flows have no effect on peak flows in Black Squirrel Creek and do not present a hazard to the downstream properties, drainage basin, or drainageways and no storm detention is required. Calculations are provided in the **Appendix** for all proposed swales.

Please discuss/tabulate the difference in flows from existing to proposed at the outfalls of the two RGs or the overall outfall of the site to quantify that the increase is negligible.

Proposed sub-basin A (4.24 acres) located in the north of site, contains the existing gravel parking, a portion of the existing paved asphalt drive, and existing concrete pavement and meadow/pasture area. Sub-basin A produces peak developed discharges of Q_5 = 3.8 cfs and Q_{100} = 11.9 cfs (proposed flows). Flows from the western portion of sub-basin A drain easterly in a combination of sheet flow and an area of concentrated flow in the central portion of the basin towards the proposed swale. Flows exit the basin at Design Point 1 (DP1) in the form of concentrated flow to enter sub-basin C where the swale continues.

Proposed sub-basin B1 (0.35 acres) will contain a portion of the existing gravel parking, a portion of the existing paved asphalt drive, and existing concrete pavement and meadow/pasture area. The developed discharges from sub-basin B are Q_5 = 0.8 cfs and Q_{100} = 1.6 cfs (proposed flows). These flows travel overland easterly towards the southeastern corner of the basin. The flows continue south towards Design Point 3 (DP3).

Discuss WQ treatment for the flows from disturbed areas in this basin and/or any applicable WQ treatment exclusions.

Proposed sub-basin B2 (0.70 acres) will be more developed, containing the proposed Phase I building addition, proposed gravel drive, proposed concrete sidewalks, and the proposed rain garden. The developed discharges from sub-basin B2 are Q_5 = 1.5 cfs and Q_{100} = 3.4 cfs (proposed flows). Flows from the southern portion of the sub-basin combine in a proposed swale south of the new building and are transported through a 12" HDPE culvert to the proposed rain garden to the east at Design Point 2 (DP2). Flows from the northern portion of the sub-basin drain to the proposed swale north of the new building and flow in a concentrated path to the rain garden at DP2. Flows leave the rain garden through the rip-rap lined spillway to continue south towards Design Point 3 (DP3).

Clarify that this is only for flows exceeding the WQCV and that the WQCV will be infiltrated.

Clarify that this is "Phase I Rain Garden" since there are 2 proposed RG's.

Discuss WQ treatment for the flows from disturbed areas in this basin and/or any applicable WQ treatment exclusions.

Proposed sub-basin C (1.33 acres) will contain pasture/meadow area. The developed discharges from sub-basin C are Q_5 = 0.4 cfs and Q_{100} = 3.1 cfs (proposed flows). Flows from this basin drain easterly towards the proposed swale and combine will flows from Design Point 1 (DP1) and continue in the form of concentrated flow towards Design Point 3 (DP3). Flows from Design Point 3 (DP3) drain south to the existing swale located approximately 70' to the south located west of the existing ball field. Flows then drain in a combination of sheet flow and concentrated flow across the site and exit the site at the southeastern edge going offsite into the north ditch of Handle Road and then continues east into Black Squirrel Creek.

Proposed sub-basin D (0.95 acres) will be more developed with the western portion of the proposed new Classroom Building and adjacent concrete sidewalk, as well as proposed gravel access road. The sub-basin generates flows of Q_5 = 1.3 cfs and Q_{100} = 3.3 cfs (proposed flow), which drain westerly towards the prposed swale. Flows from the proposed swale exit the sub-basin at Design Point 4 (DP4). Flows then drain further south into the parking lot and offsite into the north ditch of Handle Road and then continues east into Black Squirrel Creek.

Clarify that this is "Phase II Rain Garden" since there are 2 proposed RG's.

Proposed sub-basin E (1.35 acres) will be more developed with the eastern portion of the proposed new Classroom Building and adjacent concrete sidewalk, proposed gravel access road, and proposed rain garden. The sub-basin generates flows of Q_5 = 1.4 cfs and Q_{100} = 4.2 cfs (proposed flow), which drain easterly towards Design Point 5 (DP5) and enter the proposed rain garden. These flows exit the rain garden spillway and continue southerly across the site and exit the site at the southeastern edge going offsite into the north ditch of Handle Road and then continues east into Black Squirrel Creek.

Clarify which flows utilize the spillway. I think the intention is to have the WQCV infiltrate, while anything exceeding the WQCV exits via the spillway untreated.

The proposed conditions will allow the flows to exit the site at the same location, the southeastern corner of the site, without forming a concentrated path and with no considerable increase in flow rate making it a suitable outfall for the site and allowing the existing north roadside ditches on handle road to sufficiently carry the flows. The existing north roadside ditches on handle road should have the capacity to handle the developed flows which contain an inconsequentially minor increase in flow rate at the point of reaching the site outfall and so the existing stable flow path is adequate to carry flows leaving the property. Flow velocities in the existing flow path are not erosive and require no special lining. The flow path delivers the flows east to Black Squirrel Creek located 6,000 feet east of the east property line of the site.

Aren't all flows concentrated through the RG spillways?

"should?" or "does?"

Please discuss/tabulate the difference in flows from existing to proposed at the outfalls of the two RGs or the overall outfall of the site to quantify "no considerable increase."

provide and reference calculations

4.3 Erosion Control

During future construction, Control Measures (CMs) for erosion control will be employed based on the previously referenced City of Colorado Springs Drainage Criteria Manual Volume 2 and the Erosion Control Plan for the site. During Construction, silt fencing, sediment control logs, vehicle tracking control and concrete washout area will be in place to minimize erosion from the site. Silt Fencing will be placed along the downstream sides of the disturbed areas. This will inhibit suspended sediment form leaving the site during construction. Silt fencing, Inlet Protection, and sediment control logs are to remain in place until the disturbed area is stabilized and until vegeta tion is reestablished in the other disturbed areas which are to be reseeded. Vehicle tracking control will be placed at the access points to the areas of construction/disturbance. Inlet protection will be placed at the outlet location, in the southern portion of the site. Temporary Sediment basins will be utilized on site for all areas of disturbance exceeding an acre in size. CMs will be utilized as deemed necessary by the contractor, engineer, owner, or County inspector and are not limited to the measures described above.

Use this section to discuss how RGs will function (ie: infiltrate the WQCV and overflow any flows exceeding the WQCV).

4.4 Water Quality Enhancement Control Measures

There is no storage for the Water Quality Capture Volume (WQCV) for the site. A Grading and Erosion Control Plan for the construction of the site has been prepared in accordance with the provisions of the DCM.

Isn't this what the RGs are for? And this contradicts what is listed in Step 3 of the Four-Step Process below.

Provide discussion and analysis of existing roadside ditches along property and Handle Road and capacity to handle total flows from property

The El Paso County Engineering Criteria Manual[12] (Appendix I, Section I.7.2) requires the consideration of a “Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long term source controls”. The Four Step Process is incorporated in this project and the elements are discussed below.

1) Runoff Reduction Practices are employed in this project. Impervious surfaces have been reduced as much as practically possible. There is only minimal concrete or other hard surfaces proposed. The proposed drive area will be stabilized with gravel, which remains a partially pervious surface. Minimized Directly Connected Impervious Areas (MDCIA) is employed on the project because runoff passes through the eastern open space meadow area before leaving the site.

2) All drainage paths on the site are stabilized with pavement or appropriate landscape treatment.

3) The project contains no potentially hazardous uses. All developed areas drain into a proposed WQCV BMP.

4) The site contains no storage of potentially harmful substances or use of potentially harmful substances. No Site Specific or Other Source Control CMs are required.

5 Opinion of Probable Cost for Drainage Facilities

Costs for the drainage improvements for Ellicott School Addition - 2 Buildings are listed in the table below.

Item	Quantity	Unit	Unit Cost	Cost
12” HDPE Culvert Pipe	43	LF	$52.00	$2,236.00
12” HDPE Flared End Section	2	EA	$330.00	$660.00
Rain Garden – Earthwork	36	CY	$8.00	$288.00
Rain Garden – Type VL Rip Rap	53	Ton	$89.00	$4,717.00
Rain Garden – Growing Media	71	CY	$60.00	$4,260.00
Sub-Total				$12,161.00
25% Contingency				$3,040.25
GRAND TOTAL				**$15,201.25**

6 Drainage and Bridge Fees

The site is not being platted. No Drainage or Bridge Fees are due for this project.

12 ECM, Appendix I

7 Conclusion

This Final Drainage Report presents existing and proposed drainage conditions for the proposed Ellicott School Addition - 2 Buildings project. The development will have negligible and inconsequential effects on the existing site drainage and drainage conditions downstream. Water Quality treatment will be provided. The proposed project will not, with respect to stormwater runoff, negatively impact the adjacent properties and downstream properties.

Provide comparison of existing and developed flows at the downstream conveyance

References

NRCS/USDA Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service ("https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx", accessed August, 2022).

Soil Survey of El Paso County Area, Colorado. Lynn Seymour Larsen (: National Cooperative Soil Survey, June, 1981).

Flood Insurance Rate Map. Federal Emergency Management Agency, National Flood Insurance Program (Washington D.C.: FEMA, December 7, 2018).

Flood Insurance Study for El Paso County, Colorado and incorporated Areas. Federal Emergency Management Agency (Washington D.C.: FEMA, December 7, 2018).

City of Colorado Springs Drainage Criteria Manual, Volume 2: Stormwater Quality Policies, Procedures and Best Management Practices (BMPs). City of Colorado Springs Engineering Division (Colorado Springs: , May 2014).

City of Colorado Springs Drainage Criteria Manual, Volume 1. City of Colorado Springs Engineering Division (Colorado Springs: , May 2014).

El Paso County Drainage Criteria Manual. City of Colorado Springs, Department of Public Works; HDR Infrastructure, Inc.; El Paso County, Department of Public Works (: , Revised October 31, 2018).

Design Procedure Form: Rain Garden Spreadsheet. Mile High Flood District ("https://mhfd.org/wp-content/uploads/2020/03/UD-BMP_v3.07.xlsm", accessed August, 2022).

Urban Storm Drainage Criteria Manual Volume 3. Mile High Flood District (Denver, Colorado: MHFD, October, 2019).

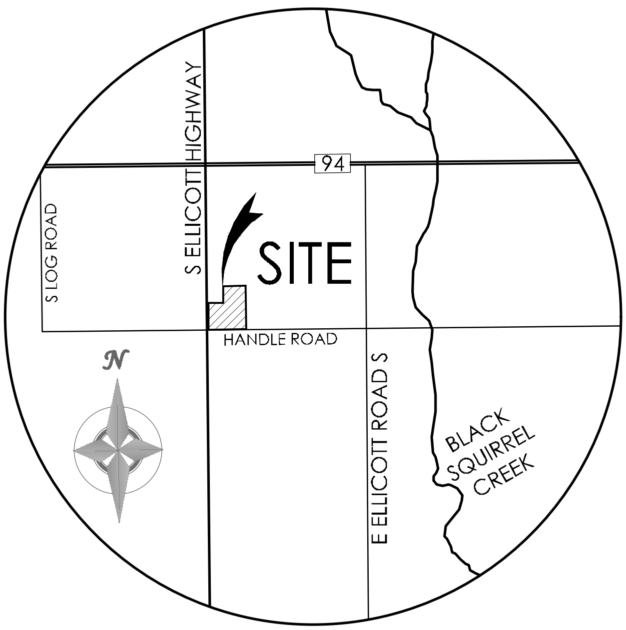
Engineering Criteria Manual County Of El Paso. County Of El Paso (: , Revised: December 13, 2016).

October 14, 2020

Appendices

8 General Maps and Supporting Data

Vicinity Map
Portions of Flood Insurance Rate Map
Portion of Drainage Area Identification Study Map
NRCS Soil Map and Tables
Soil Descriptions from Soil Survey of El Paso County Area, Colorado
Hydrologic Soil Group Map and Tables



VICINITY MAP

NOT TO SCALE

National Flood Hazard Layer FIRMette

FEMA

104°23'28"W 38°49'46"N

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

1:6,000

104°22'50"W 38°49'18"N

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

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/6/2022 at 1:10 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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.


Mcdaniels Rd
Ranchette Pl
Antelope Dr
Spotted Owl Way
Chesley Dr
Ian Vw
Dragoo Pt
Langness Cir
N Baggett Rd
Ellicott
SITE
Ellicott
CHBS1600
Lower
Big
Spring
Creek
CHBS1
elephone
Exchange
CHWS0200
S Log Rd
Ellicott
Consolidated
CHBS1200
Brass Eagle Ln
Biggs Rd
HANDLE ROAD
East Ellicott Rd S
S Baggett Rd
100 0
500
1,000
2,000
1" = 1,000' 1:12,000
N
Fix Run Pt
S Ellicott Hwy
Buck Rd
Lucky Ln
Impala Cir
Sanborn Rd
Sanborn Rd

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

El Paso County Area, Colorado

August 6, 2022

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

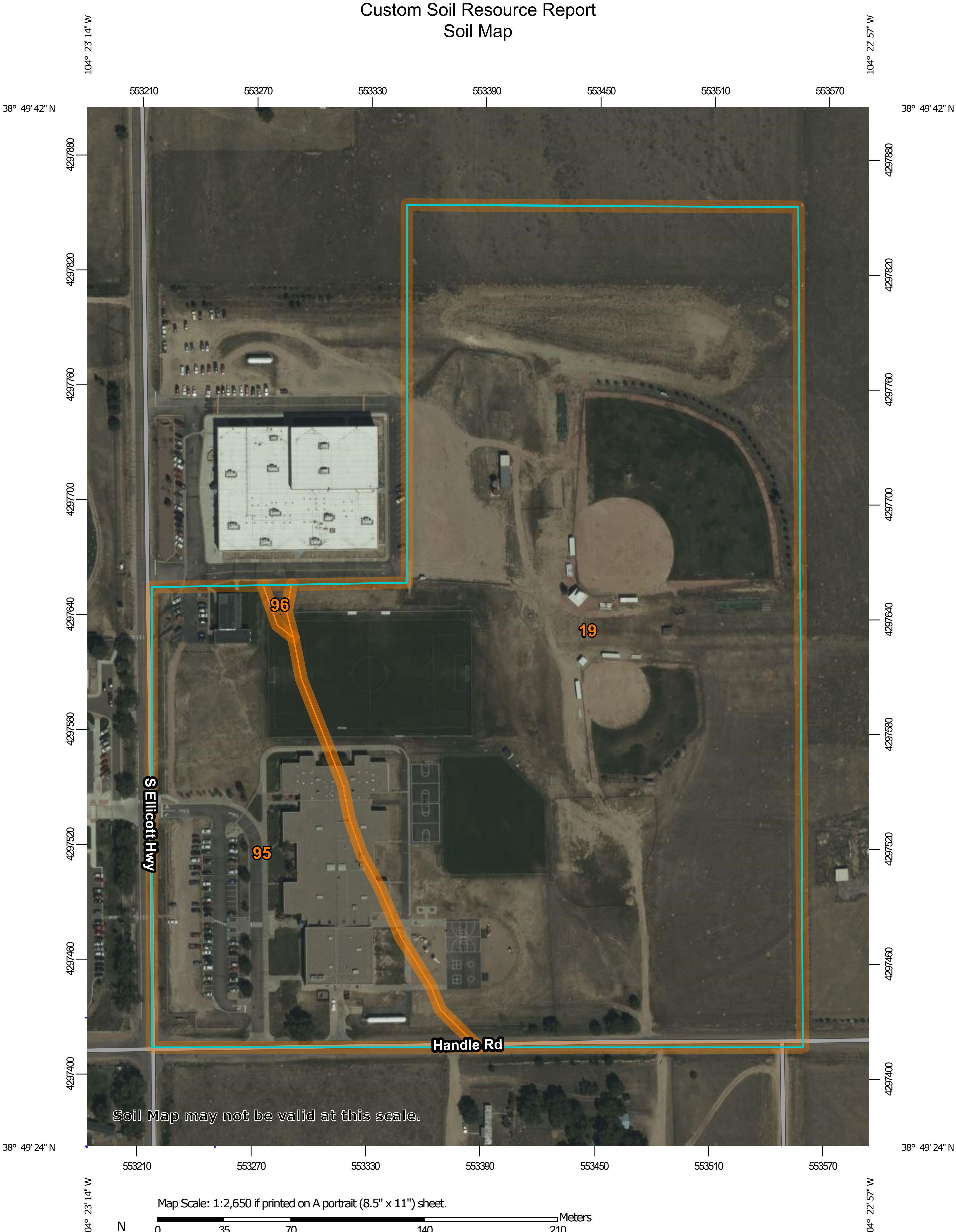
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Soil Map



Map Scale: 1:2,650 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

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 1:24,000.

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: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	24.1	78.8%
95	Truckton loamy sand, 1 to 9 percent slopes	6.4	21.0%
96	Truckton sandy loam, 0 to 3 percent slopes	0.1	0.2%
Totals for Area of Interest		**30.5**	**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.

El Paso County Area, Colorado

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Flood plains, fan terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 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 to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquolls

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

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

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

95—Truckton loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2yvrm
Elevation: 5,800 to 7,100 feet
Mean annual precipitation: 12 to 19 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 90 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Truckton and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landform: Fan remnants, interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind re-worked alluvium derived from arkose

Typical profile

A - 0 to 4 inches: loamy sand
Bt1 - 4 to 12 inches: sandy loam
Bt2 - 12 to 19 inches: sandy loam
C - 19 to 80 inches: sandy loam

Properties and qualities

Slope: 1 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
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Blakeland

Percent of map unit: 5 percent
Landform: Hills, interfluves
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Bresser

Percent of map unit: 5 percent
Landform: Terraces, interfluves
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Urban land

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

Ellicott, occasionally flooded

Percent of map unit: 1 percent
Landform: Drainageways, flood plains
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: R067BY031CO - Sandy Bottomland
Hydric soil rating: No

96—Truckton sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2yvrd
Elevation: 5,400 to 7,000 feet
Mean annual precipitation: 14 to 23 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 90 to 155 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

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: Interfluves, fan remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind re-worked alluvium derived from arkose

Typical profile

A - 0 to 4 inches: sandy loam
Bt1 - 4 to 12 inches: sandy loam
Bt2 - 12 to 19 inches: sandy loam
C - 19 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: 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: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.6 inches)

Interpretive groups

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

Minor Components

Blakeland

Percent of map unit: 5 percent
Landform: Interfluves, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Bresser

Percent of map unit: 5 percent

Landform: Interfluves, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Pleasant, frequently ponded

Percent of map unit: 2 percent
Landform: Closed depressions
Down-slope shape: Concave, linear
Across-slope shape: Concave
Ecological site: R067BY010CO - Closed Upland Depression
Hydric soil rating: Yes

Urban land

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

Ellicott, occasionally flooded

Percent of map unit: 1 percent
Landform: Flood plains, drainageways
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: R067BY031CO - Sandy Bottomland
Hydric soil rating: No

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gravelly subsoil is exposed during site preparation. Access roads must be designed to control surface runoff and help stabilize cut slopes. The Midway soil has poor potential for homesites and roads because of shallow depth to shale, high frost-action potential, and high shrink-swell potential. Special designs are necessary to overcome these limitations. Capability subclass VIIe.

19—Columbine gravelly sandy loam, 0 to 3 percent slopes. This deep, well drained to excessively drained soil formed in coarse textured material on alluvial terraces and fans and on flood plains. Elevation ranges from 6,500 to 7,300 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown gravelly sandy loam about 14 inches thick. The underlying material is light yellowish brown very gravelly loamy sand.

Included with this soil in mapping are small areas of Stapleton sandy loam, 3 to 8 percent slopes; Blendon sandy loam, 0 to 3 percent slopes; Louviers silty clay loam, 3 to 18 percent slopes; and Fluvaquentic Haplaquolls, nearly level. In places the parent arkose beds of sandstone or shale are at a depth of 0 to 40 inches.

Permeability of this Columbine soil is very rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate.

This soil is used mainly for grazing livestock and for wildlife habitat. It is also used for homesites.

Native vegetation is mainly western wheatgrass, sideoats grama, needleandthread, and little bluestem. The main shrub is true mountainmahogany.

Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal limitations to the establishment of trees and shrubs. The soil is so loose that trees need to be planted in the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

Rangeland wildlife, such as pronghorn antelope, cottontail, coyote, and scaled quail, is best adapted to life on this droughty soil. Forage production is typically loam, and proper livestock grazing management is necessary if wildlife and livestock share the range. Livestock watering developments are also important and are used by various wildlife species.

The main limitation of this soil for urban development is a hazard of flooding in some areas. Care must be taken when locating septic tank absorption fields because of possible pollution as a result of the very rapid permeability of this soil. Capability subclass VIe.

20—Connerton-Rock outcrop complex, 8 to 90 percent slopes. This moderately sloping to extremely steep complex is in the Garden of the Gods area, west of Colorado Springs. Elevation ranges from 6,200 to 6,500 feet. The average annual precipitation is about 16 inches, and the average annual air temperature is about 47 degrees F.

The Connerton soil makes up about 45 percent of the complex and has slopes of 8 to 30 percent, Rock outcrop makes up about 40 percent, and other soils about 15 percent.

Included with this complex in mapping are areas of Neville fine sandy loam, 3 to 9 percent slopes; Penrose-Manvel complex, 3 to 45 percent slopes; and Fortwingate-Rock outcrop complex, 15 to 60 percent slopes. Also included are small areas of soils that contain more sand than is typical for the series.

The Connerton soil is deep and well drained. It formed in alluvium derived from reddish sandstone on moderately sloping alluvial fans and valley side slopes. Typically, the surface layer is reddish brown loam about 13 inches thick. The substratum is reddish brown sandy clay loam.

Permeability of the Connerton soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium to rapid, and the hazard of erosion is moderate. A few gullies are in areas of this soil, especially along paths and trails and in drainageways.

Rock outcrop is in long, narrow bands in the form of cliffs or as monoliths and monuments. It consists of red to gray sandstone and limestone.

This complex is used for recreation, wildlife habitat, homesites, and limited livestock grazing.

Native vegetation is mainly western wheatgrass, needlegrasses, big bluestem, side-oats grama, blue grama, and native bluegrasses.

If the range has deteriorated, blue grama, junegrass, and native bluegrasses increase. Sleepygrass and annuals replace these grasses if the range has seriously deteriorated. Seeding is a good practice if the range is in poor condition. Seeding of the native vegetation is desirable, but the range can also be seeded with tame species of grasses such as Nordan crested wheatgrass, Russian wildrye, pubescent wheatgrass, or intermediate wheatgrass.

This complex is suited to the production of juniper and pinyon pine. It is capable of producing 4 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. The limitations for the production of wood crops are the presence of stones on the surface and a high hazard of erosion. Stones on the surface can influence felling, yarding, and other operations involving the use of equipment. Special care must be taken to minimize erosion when harvesting timber.

This complex is relatively unproductive for vegetation, especially in times of drought, when annual production may be as low as 300 pounds per acre. Rangeland wildlife, such as antelope and scaled quail, can be encouraged by properly managing livestock grazing, installing livestock watering facilities, and reseeding range where needed.

Permeability of the Crowfoot soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate. Some gullies are present in some drainageways and along stock trails.

The soils in this complex are used as rangeland, for recreation and wildlife habitat, and as homesites.

Native vegetation is mainly mountain muhly, bluestem, mountain brome, needleandthread, and blue grama. These soils are subject to invasion by Kentucky bluegrass and Gambel oak. Noticeable forbs are hairy goldenrod, geranium, milkvetch, low larkspur, fringed sage, and buckwheat.

Proper location of livestock watering facilities helps to control grazing. Timely deferment of grazing is needed to protect the plant cover.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and moderate available water capacity are the main limitations for the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

These soils are best suited to habitat for openland wildlife species, such as pronghorn antelope and sharp-tailed grouse. Although sharp-tailed grouse are not plentiful, they could be encouraged on these soils, especially where brush species are interspersed with grasses and forbs. If these soils are used as rangeland, wildlife production can be increased by managing livestock grazing to preclude overuse of the more desirable grass species and depletion of the various brush species.

The main limitations for urban uses are frost-action potential and slope on the Crowfoot soil and slope on the Tomah soil. Buildings and roads must be designed to overcome these limitations. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Maintaining the existing vegetation on building sites during construction helps to control erosion. Capability subclass VIe.

94—Travessilla-Rock outcrop complex, 8 to 90 percent slopes. This moderately sloping to extremely steep complex is mostly on rocky uplands (fig. 5). Elevation ranges from 6,200 to 6,700 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 140 days.

The Travessilla soil makes up about 45 percent of the complex, Rock outcrop about 30 percent, and included areas about 25 percent.

Included with this complex in mapping are areas of Bresser sandy loam, 5 to 9 percent slopes, Elbeth sandy loam, 8 to 15 percent slopes, Kettle gravelly loamy sand, 8 to 40 percent slopes, and Louviers silty clay loam, 3 to 18 percent slopes. The Elbeth and Kettle soils commonly are on the north-facing slopes.

The Travessilla soil is shallow and well drained. It formed in residuum derived from sandstone. Typically, the surface layer is light brownish gray sandy loam about 3 inches thick. The underlying material is pale brown sandy loam about 8 inches thick. Hard arkosic sandstone that has some fractures is at a depth of about 11 inches.

Permeability of the Travessilla soil is moderately rapid. Effective rooting depth is 6 to 20 inches. Available water capacity is low. Surface runoff is medium to rapid, and the hazard of erosion is high. Gullies are common along drainageways and trails.

Rock outcrop occurs mostly as ledges on cliffs.

This complex is used for urban development, as homesites, and for recreation and wildlife habitat.

This complex is suited to the production of ponderosa pine. The main limitations are the presence of stones and rock outcrop on the surface and a high hazard of erosion. Stones on the surface can hinder felling, yarding, and other operations involving the use of equipment. Practices must be used to minimize soil erosion when harvesting timber. The low available water capacity can influence seedling survival.

Wildlife on these soils is limited mostly to small animals such as cottontail, squirrel, and birds because of the extent of urban development. Ponderosa pine, mountain-mahogany, Gambel oak, and various grasses provide food, cover, and nesting areas.

This complex is extensively used for urban development and as homesites (fig. 6). The main limitations for these uses are depth to bedrock, rock outcrop, and steep slopes. Septic tank absorption fields do not function properly because of the depth to bedrock. Special designs for buildings and roads and streets are needed to overcome the limitations. Plans for homesite development should provide for the preservation of as many trees as possible because of their esthetic value. Capability subclass VIIe.

95—Truckton loamy sand, 1 to 9 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown loamy sand about 8 inches thick. The subsoil is brown sandy loam about 18 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Blakeland loamy sand, 1 to 9 percent slopes; Bresser sandy loam, 3 to 5 percent sloeps; Bresser sandy loam, 5 to 9 percent slopes; Truckton sandy loam, 0 to 3 percent slopes; and Truckton sandy loam, 3 to 9 percent slopes.

Permeability of this Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is moderate to high.

Almost all areas of this soil are used as rangeland. A few areas of crops such as alfalfa and corn are grown under sprinkler irrigation.

This soil is well suited to the production of native vegetation suitable for grazing. It is best suited to deep-rooted grasses. The native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, sideoats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover. Interseeding is used to improve the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand is the main limitation for the establishment of trees and shrubs. The soil is so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to openland and rangeland wildlife habitat. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for use as homesites. The main limitation of this soil for roads and streets is frost action potential. Special designs for roads are needed to minimize this limitation. Practices are needed to control soil blowing and water erosion on construction sites where the plant cover has been removed. Capability subclass VIe, nonirrigated.

96—Truckton sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperatue is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 5 inches thick. The next layer is dark grayish brown sandy loam about 3 inches thick. The subsoil is brown sandy loam about 16 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Blakeland loamy sand, 1 to 9 percent slopes; Bresser sandy loam, 0 to 3 percent slopes; Ellicott loamy coarse sand, 0 to 5 percent slopes; and Ustic Torrifluvents, loamy.

Permeability of this Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

This soil is used mainly for cultivated crops. It is also used for livestock grazing, for wildlife habitat, and as homesites.

Crops are commonly grown in combination with summer fallow because moisture is insufficient for annual cropping. Alfalfa can also be grown on this soil. When this soil is used as cropland, crop residue management and minimum tillage are necessary conservation practices.

This soil is well suited to the production of native vegetation suitable for grazing (fig. 7). It favors deep-rooted grasses. The native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, sideoats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover. Interseeding is used to improve the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings generally are suited to this soil. Soil blowing is the main limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

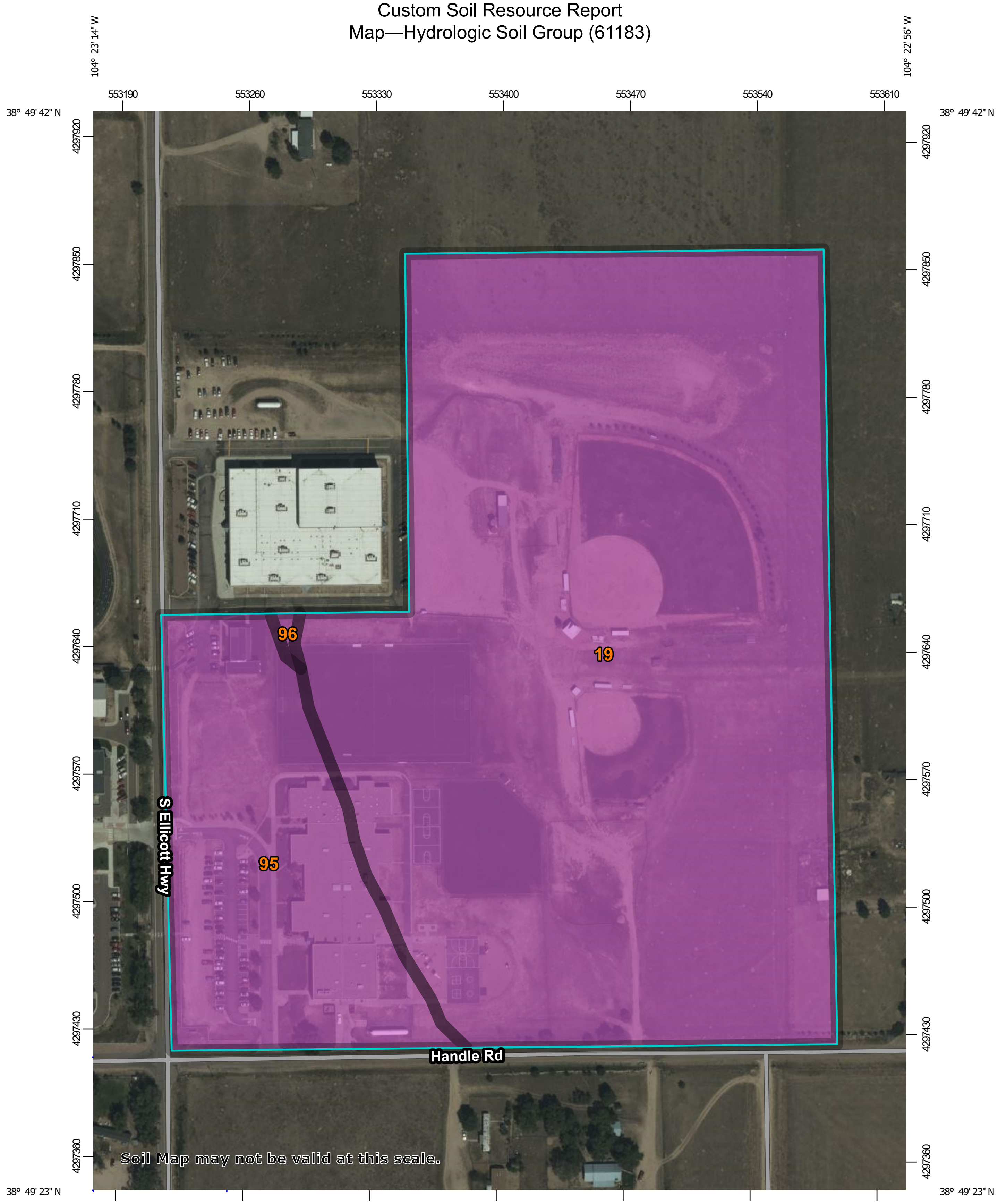
This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, undisturbed nesting cover is vital and should be provided in plans for habitat development. This is especially true in areas of intensive farming. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for use as homesites. The main limitation of this soil for roads and streets is frost-action potential. Special designs for roads are needed to overcome this limitation. Capability subclasses IIIe, nonirrigated, and IIe, irrigated.

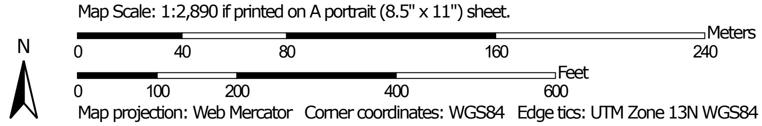
97—Truckton sandy loam, 3 to 9 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 5 inches thick. The next layer is dark grayish brown sandy loam about 3 inches thick. The subsoil is brown sandy loam about 16 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Map—Hydrologic Soil Group (61183)



Map Scale: 1:2,890 if printed on A portrait (8.5" x 11") sheet.



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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group (61183)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	26.8	80.9%
95	Truckton loamy sand, 1 to 9 percent slopes	A	6.3	18.9%
96	Truckton sandy loam, 0 to 3 percent slopes	A	0.1	0.2%
Totals for Area of Interest			**33.2**	**100.0%**

Rating Options—Hydrologic Soil Group (61183)

Aggregation Method: Dominant Condition

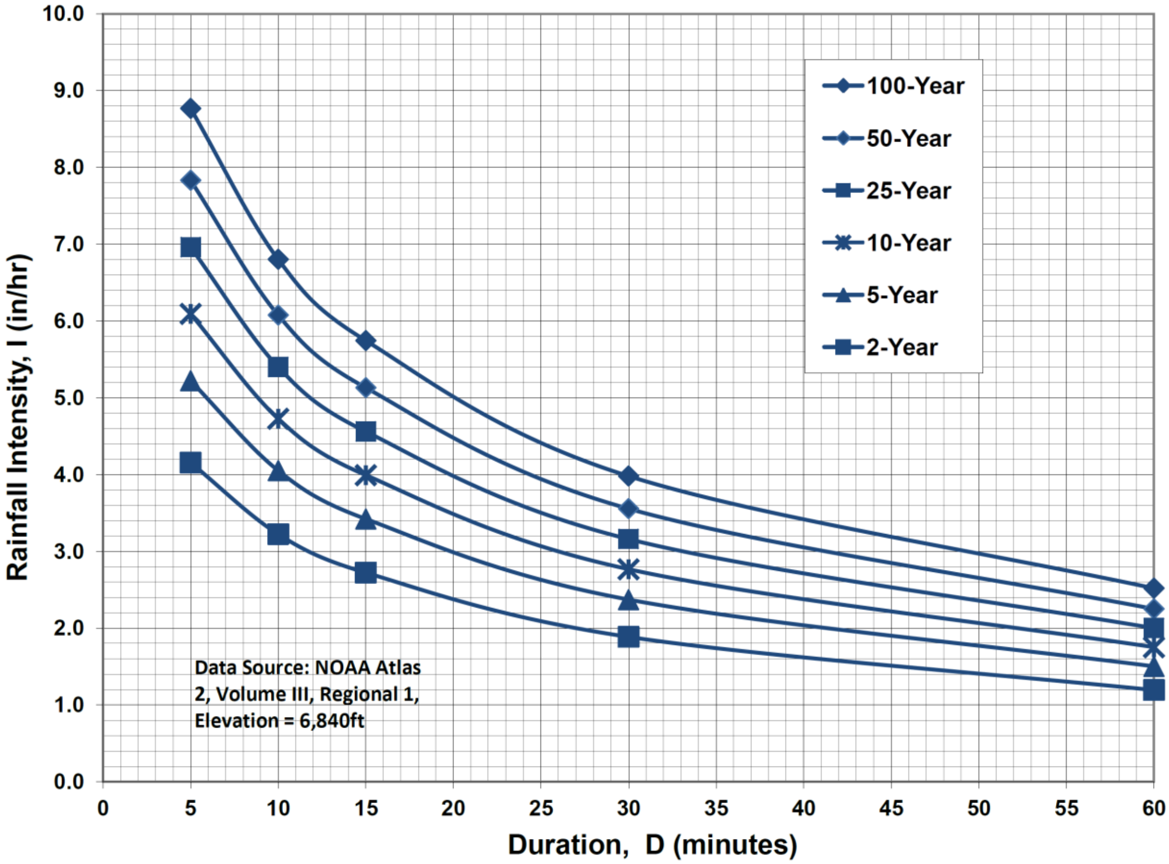
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

9 Hydrologic Calculations

Colorado Springs Rainfall Intensity Duration Frequency Figure 6-5
Runoff Coefficients and Percent Imperviousness Table 6-6
Hydrologic Calculations Summary Form SF-1 for Existing & Developed Conditions
Hydrologic Calculations Summary 5-yr Form SF-2 for Existing & Developed Conditions
Hydrologic Calculations Summary 100-yr Form SF-2 for Existing & Developed Conditions

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Sub-Basin EX-A (DP1) Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	36,530	0.84	0.57	0.59	0.63	0.66	0.68	0.7	80%
Paved	17,216	0.40	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	354	0.01	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	151,100	3.47	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**205,200**	**4.71**	**0.19**	**0.24**	**0.30**	**0.38**	**0.42**	**0.46**	**22.8%**
	205,200								

Basin Travel Time

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 100 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	741	2	-	-	-	-	
Initial Time	100	3	0.025	-	11.5	14.1	DCM Eq. 6-8
Shallow Channel	524	5	0.009	1.9	4.7	-	DCM Eq. 6-9
Channelized	117	2	0.013	0.7	2.9	-	V-Ditch
				t_c	**14.1**	**min.**	

Storage Volume

40 -hr release time

a = 1

Detention is NOT required

Water Quality is NOT required

EURV	0.00	(in)
WQCV	0.00	(in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0.21136
V_i (ft^3)	0	0	9,207

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	2.88	3.61	4.21	4.82	5.42	6.06
Runoff (cfs)	2.6	**4.1**	6.0	8.7	10.8	**13.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.6	**4.1**	6.0	8.7	10.8	**13.3**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin EX-B (DP2) Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	3,064	0.07	0.89	0.9	0.92	0.94	0.95	0.96	100%
Gravel	8,415	0.19	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	283	0.01	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	7,278	0.17	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**19,040**	**0.44**	**0.41**	**0.45**	**0.49**	**0.55**	**0.58**	**0.61**	**52.8%**
	19,040								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft $\quad C_v$ 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	273	4	-	-	-	-	
Initial Time	99	3	0.025	-	8.6	11.5	DCM Eq. 6-8
Shallow Channel	174	2	0.009	0.6	4.5	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**11.5**	**min.**	

Storage Volume

40 -hr release time $\quad$ Detention is NOT required

a = 1 $\quad$ Water Quality is NOT required

EURV 0.00 (in)

WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0.04801
V_i (ft^3)	0	0	2,091

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.13	3.92	4.57	5.22	5.88	6.58
Runoff (cfs)	0.6	**0.8**	1.0	1.3	1.5	**1.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.6	**0.8**	1.0	1.3	1.5	**1.8**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin EX-C (DP3) Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	64,092	1.47	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**64,092**	**1.47**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	64,092								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	510	3	-	-	-	-	
Initial Time	100	0	0.000	-	0.0	12.8	DCM Eq. 6-8
Shallow Channel	410	3	0.006	0.5	12.5	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**12.5**	**min.**	

Storage Volume

40 -hr release time   a = 1

Detention is NOT required
Water Quality is NOT required

EURV	0.00 (in)		
WQCV	0.00 (in)		
i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	-0.01471
V_i (ft^3)	0	0	-641

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.03	3.79	4.43	5.06	5.69	6.37
Runoff (cfs)	0.1	**0.4**	1.0	1.9	2.5	**3.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.4**	1.0	1.9	2.5	**3.3**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin EX-D (DP4) Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	1,031	0.02	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	36,928	0.85	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**37,959**	**0.87**	**0.04**	**0.10**	**0.17**	**0.27**	**0.32**	**0.37**	**2.7%**
	37959								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft; C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	322	6	-	-	-	-	
Initial Time	100	2	0.020	-	14.3	11.8	DCM Eq. 6-8
Shallow Channel	222	4	0.016	0.9	4.2	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	C&G
				t_c	**11.8**	**min.**	

Storage Volume

40 -hr release time

a = 1

Detention is NOT required

Water Quality is NOT required

EURV 0.00 (in)

WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	-0.0028
V_i (ft^3)	0	0	-122

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.10	3.88	4.53	5.18	5.82	6.52
Runoff (cfs)	0.1	**0.3**	0.7	1.2	1.6	**2.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.3**	0.7	1.2	1.6	**2.1**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin EX-E (DP5) Runoff Calculations

Job No.:	**61183**	Date:		**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**A**	
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**	

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	1,240	0.03	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	54,765	1.26	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**56,005**	**1.29**	**0.04**	**0.10**	**0.17**	**0.27**	**0.31**	**0.36**	**2.2%**
	56005								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	406	5	-	-	-	-	
Initial Time	100	3	0.025	-	13.4	12.3	DCM Eq. 6-8
Shallow Channel	187	2	0.011	0.7	4.3	-	DCM Eq. 6-9
Channelized	119	1	0.004	0.8	2.4	-	C&G
				t_c	**12.3**	**min.**	

Storage Volume

40 -hr release time
a = 1

Detention is NOT required
Water Quality is NOT required

EURV 0.00 (in)
WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	-0.00573
V_i (ft^3)	0	0	-250

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.05	3.82	4.46	5.10	5.74	6.42
Runoff (cfs)	0.2	**0.5**	1.0	1.7	2.3	**3.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.2	**0.5**	1.0	1.7	2.3	**3.0**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin A (DP1) Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Gravel	36,530	0.84	0.57	0.59	0.63	0.66	0.68	0.7	80%
Paved	17,216	0.40	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	354	0.01	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	130,441	2.99	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**184,541**	**4.24**	**0.21**	**0.26**	**0.32**	**0.40**	**0.44**	**0.48**	**25.3%**

184541

Basin Travel Time

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 100 ft C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	924	2	-	-	-	-	
Initial Time	100	3	0.030	-	10.6	15.1	DCM Eq. 6-8
Shallow Channel	210	1	0.005	1.4	2.5	-	DCM Eq. 6-9
Channelized	614	2	0.002	0.6	18.3	-	V-Ditch
				t_c	**15.1**	**min.**	

Storage Volume

40 -hr release time a = 1

Detention is NOT required
Water Quality is NOT required

EURV 0.00 (in)
WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0.21485
V_i (ft^3)	0	0	9,359

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.80	3.51	4.09	4.68	5.26	5.89
Runoff (cfs)	2.5	**3.8**	5.5	7.9	9.7	**11.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.5	**3.8**	5.5	7.9	9.7	**11.9**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin B1 Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Paved	3,052	0.07	0.89	0.9	0.92	0.94	0.95	0.96	100%
Gravel	8,722	0.20	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	3,315	0.08	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	283	0.01	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**15,372**	**0.35**	**0.52**	**0.54**	**0.59**	**0.63**	**0.65**	**0.68**	**66.9%**

15372

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	277	4	-	-	-	-	
Initial Time	100	2	0.015	-	8.8	11.5	DCM Eq. 6-8
Shallow Channel	177	2	0.011	0.7	4.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**11.5**	**min.**	

Storage Volume

40 -hr release time

a = 1

Detention is NOT required

Water Quality is NOT required

EURV 0.00 (in)

WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0.04855
V_i (ft^3)	0	0	2,115

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.12	3.91	4.57	5.22	5.87	6.57
Runoff (cfs)	0.6	**0.8**	0.9	1.2	1.4	**1.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.6	**0.8**	0.9	1.2	1.4	**1.6**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin B2 (DP2) Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Paved	3,904	0.09	0.89	0.9	0.92	0.94	0.95	0.96	100%
Gravel	3,228	0.07	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	11,737	0.27	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	11,504	0.26	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**30,373**	**0.70**	**0.45**	**0.49**	**0.53**	**0.58**	**0.61**	**0.64**	**55.4%**

30373

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	313	11	-	-	-	-	
Initial Time	51	8	0.157	-	3.2	11.7	DCM Eq. 6-8
Shallow Channel	21	1	0.048	1.5	0.2	-	DCM Eq. 6-9
Channelized	241	2	0.008	0.9	4.5	-	V-Ditch
				t_c	**8.0**	**min.**	

Storage Volume

40 -hr release time

a = 1

Detention is NOT required

Water Quality is NOT required

EURV	0.00 (in)		
WQCV	0.00 (in)		
i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0.08033
V_i (ft^3)	0	0	3,499

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.57	4.47	5.22	5.96	6.71	7.51
Runoff (cfs)	1.1	**1.5**	1.9	2.4	2.9	**3.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.1	**1.5**	1.9	2.4	2.9	**3.3**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin C Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	58,072	1.33	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**58,072**	**1.33**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	58072								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	497	3	-	-	-	-	
Initial Time	100	0	0.000	-	0.0	12.8	DCM Eq. 6-8
Shallow Channel	368	3	0.007	0.6	10.6	-	DCM Eq. 6-9
Channelized	29	1	0.017	1.2	0.4	-	V-Ditch
				t_c	**11.0**	**min.**	

Storage Volume

40 -hr release time

Detention is NOT required

Water Quality is NOT required

EURV	0.00	(in)	a =	1
WQCV	0.00	(in)		

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	-0.01333
V_i (ft^3)	0	0	-581

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.18	3.98	4.64	5.31	5.97	6.68
Runoff (cfs)	0.1	**0.4**	0.9	1.8	2.4	**3.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.4**	0.9	1.8	2.4	**3.1**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Combined Sub-Basin Runoff Calculations (DP3)

Includes Basins A B2 C

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Gravel	39,758	0.91	0.57	0.59	0.63	0.66	0.68	0.7	80%
Paved	21,120	0.48	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	200,250	4.60	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	11,858	0.27	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**272,986**	**6.27**	**0.20**	**0.25**	**0.31**	**0.39**	**0.43**	**0.47**	**23.3%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	A	-	924	2	-	-	-	-	15.1
Channelized-1	V-Ditch	1	200	1	12	0	2	2.2	1.5
Channelized-2									
Channelized-3									
Total			1,124	2					

1 = Man-made, Smooth, Straight

t_c (min) **16.6**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.69	3.37	3.93	4.49	5.05	5.65
Site Runoff (cfs)	3.33	**5.19**	7.52	10.86	13.53	**16.58**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**5.2**	-	-	-	**16.6**
DCM: $I = C1 * \ln(tc) + C2$						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Sub-Basin D (DP4) Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	2,296	0.05	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	9,361	0.21	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	24,065	0.55	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	5,586	0.13	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**41,308**	**0.95**	**0.30**	**0.34**	**0.39**	**0.46**	**0.50**	**0.54**	**36.8%**
	41308								

Basin Travel Time

Shallow Channel Ground Cover: Short Pastures/Lawns

$L_{max,Overland}$ 100 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	335	5	-	-	-	-	
Initial Time	100	2	0.020	-	10.9	11.9	DCM Eq. 6-8
Shallow Channel	51	1	0.010	0.7	1.2	-	DCM Eq. 6-9
Channelized	184	3	0.014	1.0	3.1	-	V-Ditch
				t_c	**11.9**	**min.**	

Storage Volume

40 -hr release time; a = 1

Detention is NOT required
Water Quality is NOT required

EURV	0.00 (in)		
WQCV	0.00 (in)		
i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0.07225
V_i (ft^3)	0	0	3,147

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.09	3.87	4.52	5.16	5.81	6.50
Runoff (cfs)	0.9	**1.3**	1.7	2.3	2.8	**3.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.9	**1.3**	1.7	2.3	2.8	**3.3**
DCM: I = C1 * ln (tc) + C2						
C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin E (DP5) Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 13:42**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	2,435	0.06	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	9,761	0.22	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	40,071	0.92	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	6,555	0.15	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**58,822**	**1.35**	**0.23**	**0.28**	**0.33**	**0.41**	**0.45**	**0.49**	**28.0%**
	58592								

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft; C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	450	7	-	-	-	-	
Initial Time	94	3	0.027	-	10.4	12.5	DCM Eq. 6-8
Shallow Channel	284	3	0.011	0.7	6.6	-	DCM Eq. 6-9
Channelized	72	1	0.014	1.1	1.1	-	V-Ditch
				t_c	**12.5**	**min.**	

Storage Volume

40 -hr release time; a = 1

Detention is NOT required
Water Quality is NOT required

EURV	0.00 (in)		
WQCV	0.00 (in)		
i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0.0766
V_i (ft^3)	0	0	3,337

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	3.03	3.79	4.43	5.06	5.69	6.37
Runoff (cfs)	0.9	**1.4**	2.0	2.8	3.5	**4.2**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.9	**1.4**	2.0	2.8	3.5	**4.2**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Job No.:	**61183**														Date:			**11/9/2022 13:42**		
Project:	**Ellicott D22 – GS & HS Addition**														Calcs By:		**O. Ali**			
															Checked By:					

Time of Concentration (Modified from Standard Form SF-1)

Sub-Basin	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		
	Area (Acres)	C_5	C_{100}/CN	% Imp.	L_0 (ft)	S_0 (%)	t_i (min)	L_{0t} (ft)	S_{0t} (ft/ft)	v_{0sc} (ft/s)	t_t (min)	L_{0c} (ft)	S_{0c} (ft/ft)	v_{0c} (ft/s)	t_c (min)	L (min)	$t_{c,alt}$ (min)	t_c (min)
EX-A	4.71	0.24	0.46	23%	100	3%	11.5	524	0.009	1.9	4.7	117	0.013	0.7	2.9	741	14.1	14.1
EX-B	0.44	0.45	0.61	53%	98.5	3%	8.6	174	0.009	0.6	4.5	0	0.000	0.0	0.0	272.5	11.5	11.5
EX-C	1.47	0.08	0.35	0%	100	0%	0.0	410	0.006	0.5	12.5	0	0.000	0.0	0.0	510	12.8	12.5
EX-D	0.87	0.10	0.37	3%	100	2%	14.3	222	0.016	0.9	4.2	0	0.000	0.0	0.0	322	11.8	11.8
EX-E	1.29	0.10	0.36	2%	100	3%	13.4	187	0.011	0.7	4.3	119	0.004	0.8	2.4	406	12.3	12.3
A	4.24	0.26	0.48	25%	100	3%	10.6	210	0.005	1.4	2.5	613.5	0.002	0.6	18.3	923.5	15.1	15.1
B1	0.35	0.54	0.68	67%	100	2%	8.8	177	0.011	0.7	4.0	0	0.000	0.0	0.0	277	11.5	11.5
B2	0.70	0.49	0.64	55%	51	16%	3.2	21	0.048	1.5	0.2	241	0.008	0.9	4.5	313	11.7	8.0
C	1.33	0.08	0.35	0%	100	0%	0.0	368	0.007	0.6	10.6	29	0.017	1.2	0.4	497	12.8	11.0
D	0.95	0.34	0.54	37%	100	2%	10.9	51	0.010	0.7	1.2	184	0.014	1.0	3.1	335	11.9	11.9
E	1.35	0.28	0.49	28%	94	3%	10.4	284	0.011	0.7	6.6	72	0.014	1.1	1.1	450	12.5	12.5

Job No.: **61183**
Project: **Ellicott D22 – GS & HS Addition**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **11/9/2022 13:42**
Calcs By: **O. Ali**
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
	Sub-	Area		t_c	CA	I5	Q5	t_c	CA	I5	Q5	Slope	Length	Q	Q	Slope	Mnngs	Length	D_{Pipe}	Length	v_{0sc}	t_t
DP	Basin	(Acres)	C5	(min)	(Acres)	(in/hr)	(cfs)	(min)	(Acres)	(in/hr)	(cfs)	(%)	(ft)	(cfs)	(cfs)	(%)	n	(ft)	(in)	(ft)	(ft/s)	(min)
DP1	EX-A	4.71	0.24	14.1	1.13	3.61	4.10															
DP2	EX-B	0.44	0.45	11.5	0.20	3.92	0.77															
DP3	EX-C	1.47	0.08	12.5	0.12	3.79	0.45															
DP4	EX-D	0.87	0.10	11.8	0.09	3.88	0.35															
DP5	EX-E	1.29	0.10	12.3	0.13	3.82	0.48															
DP1	A	4.24	0.26	15.1	1.10	3.51	3.84															
	B1	0.35	0.54	11.5	0.19	3.91	0.75															
DP2	B2	0.70	0.49	8.0	0.34	4.47	1.51															
	C	1.33	0.08	11.0	0.11	3.98	0.42															
DP3	A, B1, C	6.27	0.25					16.6	1.54	3.37	5.2											
DP4	D	0.95	0.34	11.9	0.32	3.87	1.26															
DP5	E	1.35	0.28	12.5	0.38	3.79	1.43															

DCM: I = C1 * ln (tc) + C2
C1: 1.5
C1: 7.583

Job No.: **61183**
Project: **Ellicott D22 – GS & HS Addition**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **DCM**

Date: **11/9/2022 13:42**
Calcs By: **O. Ali**
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
	Sub-	Area		t_c	CA	I100	Q100	t_c	CA	I100	Q100	Slope	Length	Q	Q	Slope	Mnngs	Length	D_{Pipe}	Length	v_{0sc}	t_t
DP	Basin	(Acres)	C100	(min)	(Acres)	(in/hr)	(cfs)	(min)	(Acres)	(in/hr)	(cfs)	(%)	(ft)	(cfs)	(cfs)	(%)	n	(ft)	(in)	(ft)	(ft/s)	(min)
DP1	EX-A	4.71	0.46	14.1	2.19	6.06	13.26															
DP2	EX-B	0.44	0.61	11.5	0.27	6.58	1.75															
DP3	EX-C	1.47	0.35	12.5	0.51	6.37	3.28															
DP4	EX-D	0.87	0.37	11.8	0.32	6.52	2.08															
DP5	EX-E	1.29	0.36	12.3	0.47	6.42	3.00															
DP1	A	4.24	0.48	15.1	2.02	5.89	11.90															
	B1	0.35	0.68	11.5	0.24	6.57	1.57															
DP2	B2	0.70	0.64	8.0	0.45	7.51	3.35															
	C	1.33	0.35	11.0	0.47	6.68	3.12															
DP3	A, B1, C	6.27	0.47					16.6	2.93	5.65	16.6											
DP4	D	0.95	0.54	11.9	0.51	6.50	3.30															
DP5	E	1.35	0.49	12.5	0.66	6.37	4.22															

DCM: I = C1 * ln (tc) + C2
C1: 2.52
C1: 12.735

10 Hydraulic Calculations

MHFD Rain Garden Spreadsheet, “UD-BMP_v3.07”
Channel Calculation (Culvert)
Channel Calculation (Swales)

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Designer: O. Ali
Company: M.V.E. Inc.
Date: November 3, 2022
Project: Ellicott School Addition 2 bldgs
Location: Phase I Addition SE Corner

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 58.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.580
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.18 watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 27,171 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area	V_{WQCV} = cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 406 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = cu ft

2. Basin Geometry

A) WQCV Depth (12-inch maximum)	D_{WQCV} = 12 in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 3.00 ft / ft Z < 4:1
C) Mimimum Flat Surface Area	A_{Min} = 315 sq ft
D) Actual Flat Surface Area	A_{Actual} = 315 sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 516 sq ft
F) Rain Garden Total Volume (V_T= ((A_{Top} + A_{Actual}) / 2) * Depth)	V_T= 416 cu ft

recommended to not exceed 4:1 slopes

3. Growing Media

Choose One
- (●) 18" Rain Garden Growing Media
- ( ) Other (Explain):

4. Underdrain System

A) Are underdrains provided?	Choose One: ( ) YES (●) NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = N/A ft
ii) Volume to Drain in 12 Hours	Vol_{12} = N/A cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = N/A in

If no underdrain is provided, it must be shown that pond can infiltrate the WQCV within 12hrs. Otherwise provide an underdrain with orfice that allows WQCV to drain within 12hrs.

Design Procedure Form: Rain Garden (RG)

Designer: O. Ali
Company: M.V.E. Inc.
Date: November 3, 2022
Project: Ellicott School Addition 2 bldgs
Location: Phase I Addition SE Corner

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ○ YES ◉ NO
6. Inlet / Outlet Control A) Inlet Control	Choose One ○ Sheet Flow- No Energy Dissipation Required ◉ Concentrated Flow- Energy Dissipation Provided
7. Vegetation	Choose One ◉ Seed (Plan for frequent weed control) ○ Plantings ○ Sand Grown or Other High Infiltration Sod
8. Irrigation A) Will the rain garden be irrigated?	Choose One ○ YES ○ NO

Notes:

Per MHFD Detail T-3, need to provide temp or permanent irrigation for vegetation. Irrigation already discussed in notes in Landscape Plan. So can mark this as "Yes" above.

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Designer: O. Ali
Company: M.V.E., Inc.
Date: October 27, 2022
Project: Ellicott School Addition 2 bldgs
Location: Phase II Addition SE Corner

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 30.8 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.308
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.12 watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 52,657 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area	V_{WQCV} = cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 528 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = cu ft
2. Basin Geometry	
A) WQCV Depth (12-inch maximum)	D_{WQCV} = 6 in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 4.00 ft / ft
C) Mimimum Flat Surface Area	A_{Min} = 324 sq ft
D) Actual Flat Surface Area	A_{Actual} = 882 sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 1326 sq ft
F) Rain Garden Total Volume (V_T= ((A_{Top} + A_{Actual}) / 2) * Depth)	V_T= 552 cu ft
3. Growing Media	Choose One: (●) 18" Rain Garden Growing Media; ( ) Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One: ( ) YES; (●) NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = N/A ft
ii) Volume to Drain in 12 Hours	Vol_{12} = N/A cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = N/A in

If no underdrain is provided, it must be shown that pond can infiltrate the WQCV within 12hrs. Otherwise provide an underdrain with orfice that allows WQCV to drain within 12hrs.

Design Procedure Form: Rain Garden (RG)

Designer:	**O. Ali**
Company:	**M.V.E., Inc.**
Date:	**October 27, 2022**
Project:	**Ellicott School Addition 2 bldgs**
Location:	**Phase II Addition SE Corner**

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ◯ YES ◉ NO
6. Inlet / Outlet Control A) Inlet Control	Choose One ◯ Sheet Flow- No Energy Dissipation Required ◉ Concentrated Flow- Energy Dissipation Provided
7. Vegetation	Choose One ◉ Seed (Plan for frequent weed control) ◯ Plantings ◯ Sand Grown or Other High Infiltration Sod
8. Irrigation A) Will the rain garden be irrigated?	Choose One ◯ YES ◯ NO

Notes: Rain garden to be temporarily irrigated until vegetation cover is established as per alternative landscape plan.

Per MHFD Detail T-3, need to provide temp or permanent irrigation for vegetation. Irrigation already discussed in notes in Landscape Plan. So can mark this as "Yes" above.

Also add this note to the same Ph I sheet above.

Culvert Tributary Runoff Calculations

Job No.:	**61183**	Date:	**11/9/2022 11:56**
Project:	**Ellicott D22 – GS & HS Addition**	Calcs by:	**O. Ali**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**A**
Runoff Coefficient	**Surface Type**	Urbanization	**Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	3,114	0.07	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	6,470	0.15	0.71	0.73	0.75	0.78	0.8	0.81	90%
Pasture/Meadow	2,400	0.06	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	747	0.02	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**12,731**	**0.29**	**0.62**	**0.64**	**0.67**	**0.71**	**0.74**	**0.75**	**74.9%**

Basin Travel Time

Shallow Channel Ground Cover: Short Pasture/Lawns

$L_{max,Overland}$ 100 ft; C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	184	15	-	-	-	-	
Initial Time	50	12	0.240	-	2.1	11.0	DCM Eq. 6-8
Shallow Channel	55	2	0.027	1.2	0.8	-	DCM Eq. 6-9
Channelized	79	2	0.019	1.2	1.1	-	V-Ditch
				t_c	**5.0**	**min.**	

Storage Volume

40 -hr release time; a = 1

Detention is NOT required
Water Quality is NOT required

EURV 0.00 (in)
WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year
K_i (ft)	0.0000	0.0000	0
V_i (acre-ft)	0.000	0.000	0.04455
V_i (ft^3)	0	0	1,941

Design Volume (ft^3)

	% Storage	100-year	WQCV	Total
EURV	0%	0	0	**0**
WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	4.12	5.17	6.03	6.89	7.75	8.68
Runoff (cfs)	0.7	**1.0**	1.2	1.4	1.7	**1.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.7	**1.0**	1.2	1.4	1.7	**1.9**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Nov 9 2022

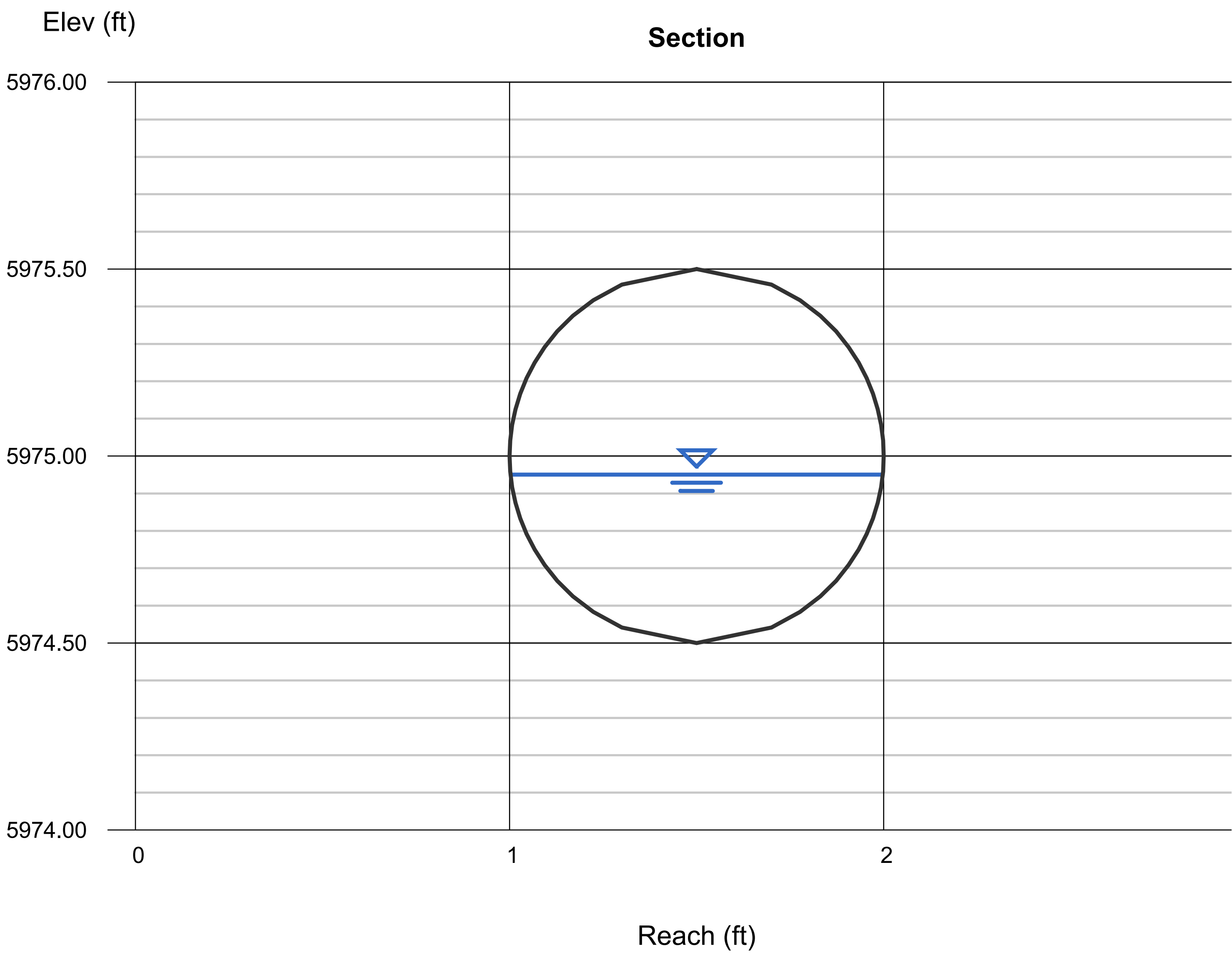
Phase I Culvert

Circular
Diameter (ft) = 1.00

Invert Elev (ft) = 5974.50
Slope (%) = 1.16
N-Value = 0.011

Calculations
Compute by: Known Q
Known Q (cfs) = 1.90

Highlighted
Depth (ft) = 0.45
Q (cfs) = 1.900
Area (sqft) = 0.34
Velocity (ft/s) = 5.51
Wetted Perim (ft) = 1.47
Crit Depth, Yc (ft) = 0.59
Top Width (ft) = 1.00
EGL (ft) = 0.92



Channel Report

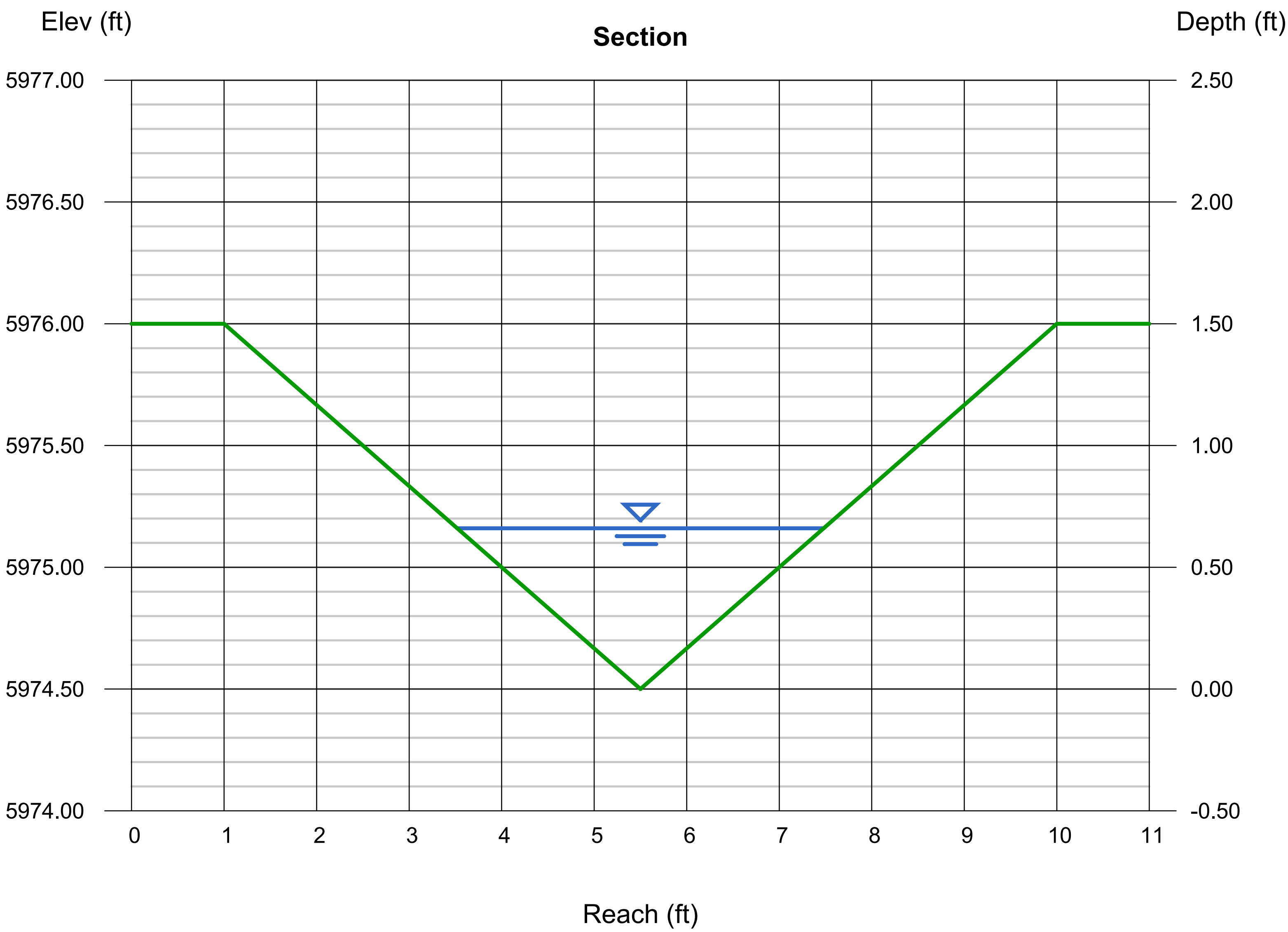
Culvert Swale

Triangular
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 1.50

Invert Elev (ft) = 5974.50
Slope (%) = 0.70
N-Value = 0.040

Calculations
Compute by: Known Q
Known Q (cfs) = 1.80

Highlighted
Depth (ft) = 0.66
Q (cfs) = 1.800
Area (sqft) = 1.31
Velocity (ft/s) = 1.38
Wetted Perim (ft) = 4.17
Crit Depth, Yc (ft) = 0.47
Top Width (ft) = 3.96
EGL (ft) = 0.69

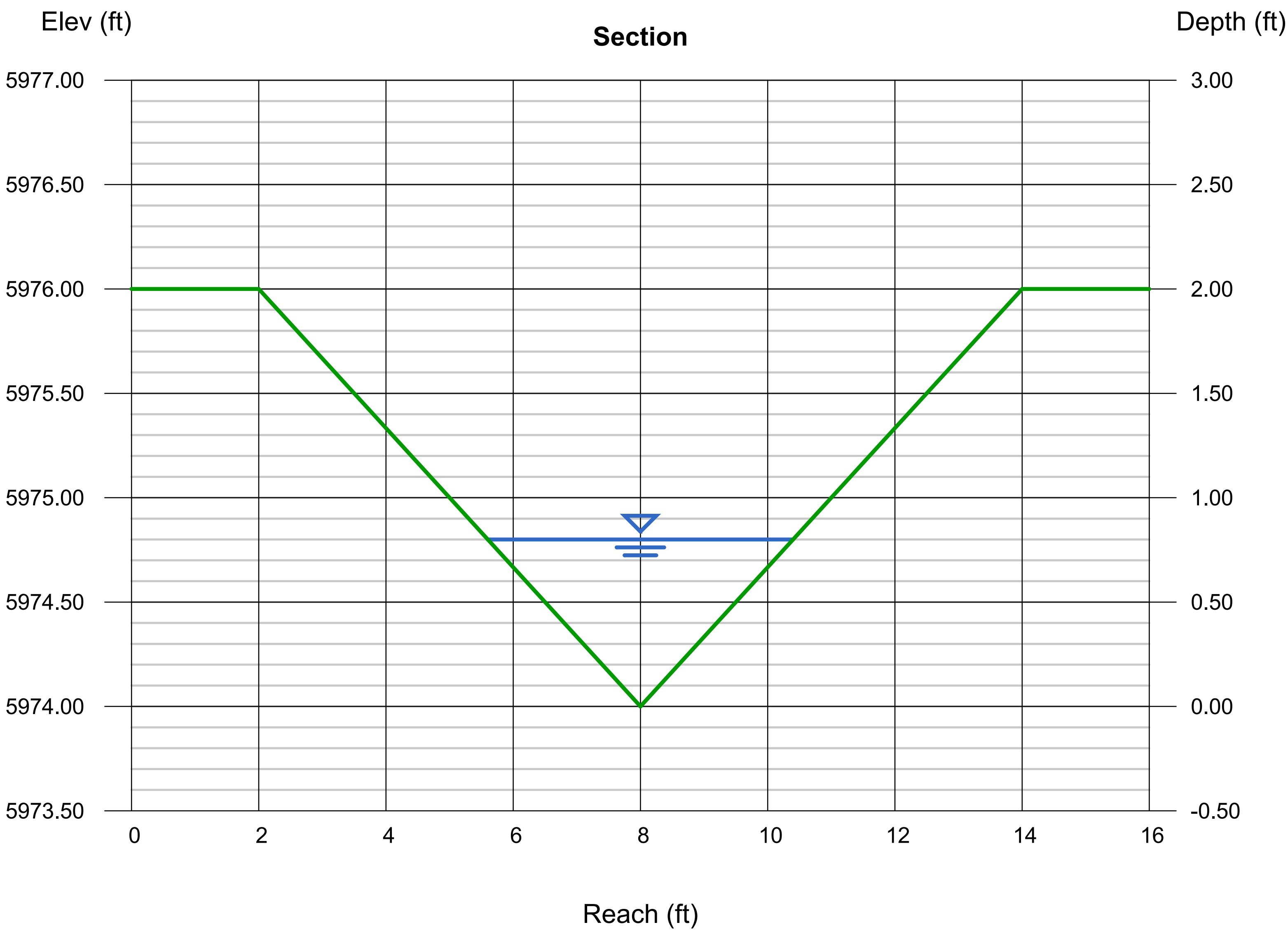


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Nov 9 2022

Rain Garden Swale (DP2)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.00	Depth (ft)	= 0.80
Total Depth (ft)	= 2.00	Q (cfs)	= 3.349
		Area (sqft)	= 1.92
Invert Elev (ft)	= 5974.00	Velocity (ft/s)	= 1.74
Slope (%)	= 0.83	Wetted Perim (ft)	= 5.06
N-Value	= 0.040	Crit Depth, Yc (ft)	= 0.60
		Top Width (ft)	= 4.80
Calculations		EGL (ft)	= 0.85
Compute by:	Known Q		
Known Q (cfs)	= 3.35		



Channel Report

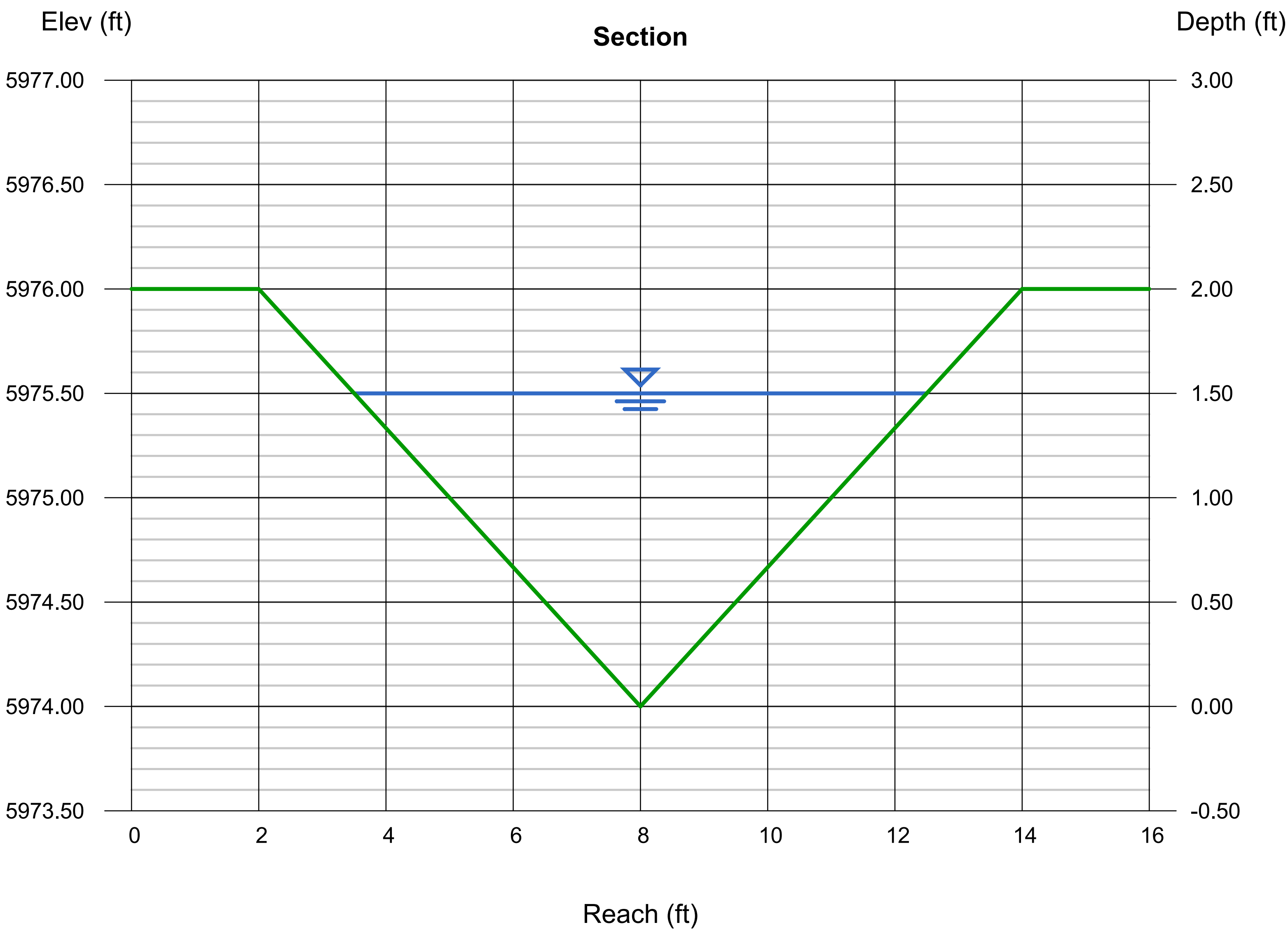
Basins A, C Swale (DP1)

Triangular
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 2.00

Invert Elev (ft) = 5974.00
Slope (%) = 0.36
N-Value = 0.040

Calculations
Compute by: Known Q
Known Q (cfs) = 11.90

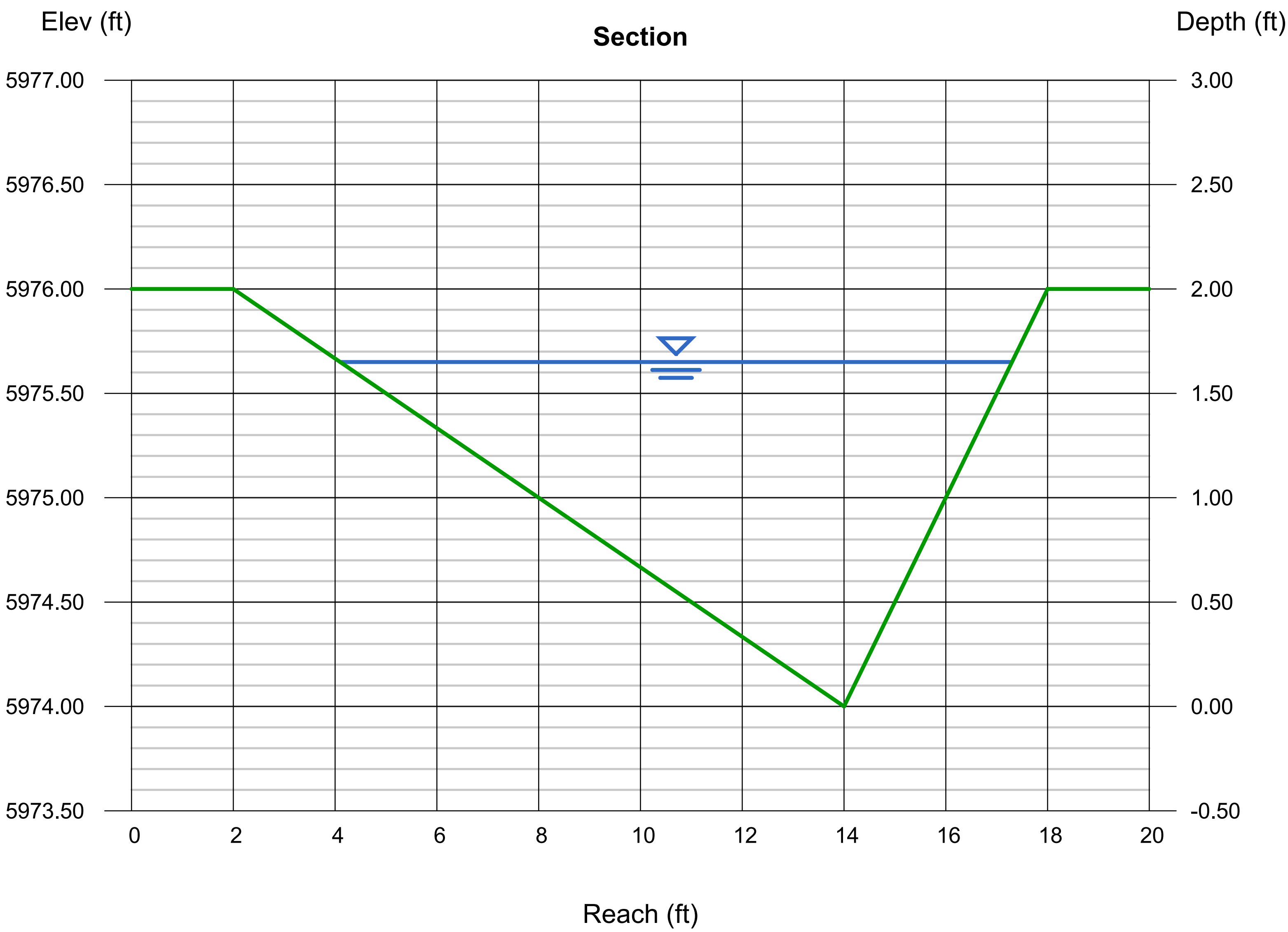
Highlighted
Depth (ft) = 1.50
Q (cfs) = 11.90
Area (sqft) = 6.75
Velocity (ft/s) = 1.76
Wetted Perim (ft) = 9.49
Crit Depth, Yc (ft) = 1.00
Top Width (ft) = 9.00
EGL (ft) = 1.55



Channel Report

Existing Swale (DP3)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 6.00, 2.00	Depth (ft)	= 1.65
Total Depth (ft)	= 2.00	Q (cfs)	= 16.60
		Area (sqft)	= 10.89
Invert Elev (ft)	= 5974.00	Velocity (ft/s)	= 1.52
Slope (%)	= 0.23	Wetted Perim (ft)	= 13.73
N-Value	= 0.040	Crit Depth, Yc (ft)	= 1.02
		Top Width (ft)	= 13.20
Calculations		EGL (ft)	= 1.69
Compute by:	Known Q		
Known Q (cfs)	= 16.60		

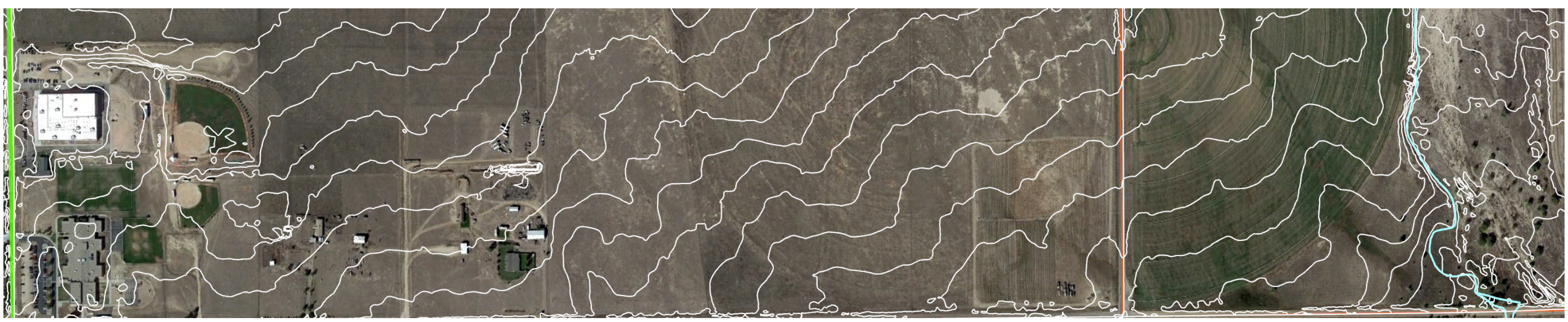


Replace BMP Area Map

11 Report Maps

Phase I Existing Condition Drainage Map
Phase II Existing Condition Drainage Map
Phase I Proposed Condition Drainage Map
Phase II Proposed Condition Drainage Map

Please provide an overall reference map showing the overall property and indicating the outfall and downstream conveyance location.

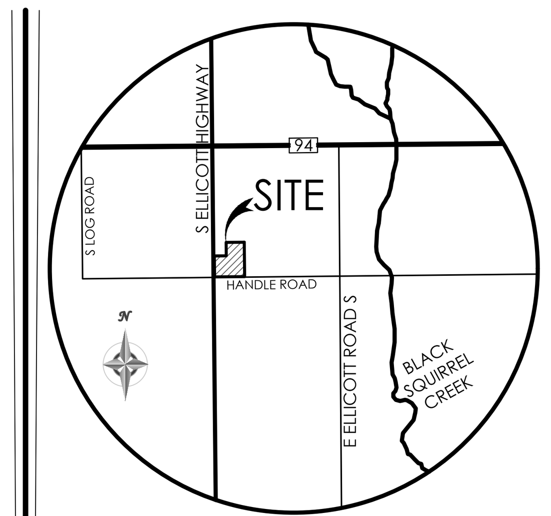


Note: below screenshot is only for Staff comparison of total site flows from MHFD spreadsheet "predevelopment" unit rates.

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).

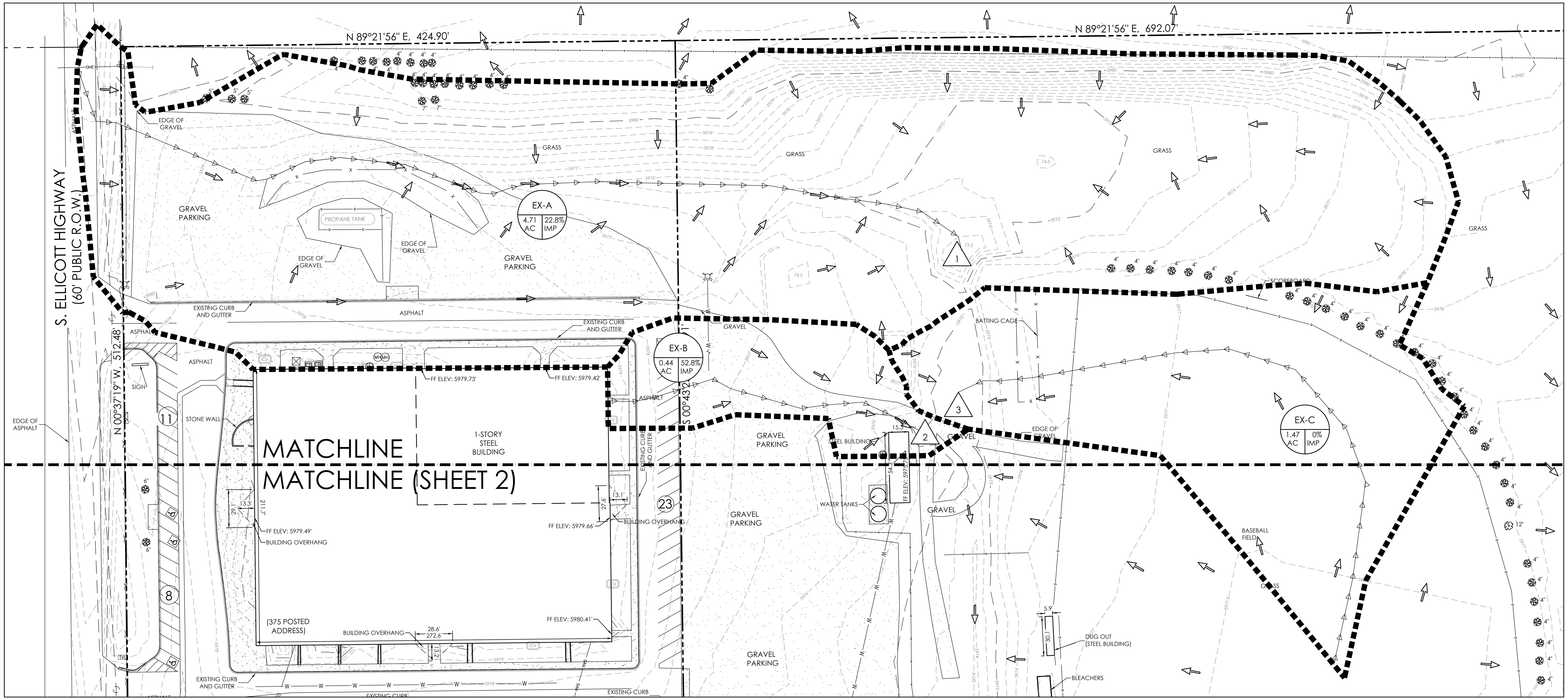
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.03	1.36	1.66	2.10	2.46	2.83	3.80
CUHP Runoff Volume (acre-ft) =	0.356	0.753	0.392	0.608	0.813	1.592	2.289	3.208	5.625
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.392	0.608	0.813	1.592	2.289	3.208	5.625
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.4	5.9	11.9	19.7	39.3



VICINITY MAP
NOT TO SCALE

BENCHMARK

THE EXISTING TOPOGRAPHY SHOWN ON THIS PLAN WAS PREPARED BY AND PROVIDED BY CLARK LAND SURVEYING INC.
ELEVATIONS SHOWN ARE RELATIVE TO THE NAVD 88 VERTICAL DATUM.



1" = 40' 1:480

REVISIONS

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ENGINEERS, SURVEYORS
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NOTE:
THE TOPOGRAPHY SHOWS NO OFFSITE FLOWS ENTERING THE ON-SITE SUB-BASINS FOR THIS PROJECT SITE. ALL FLOWS ENTERING THE PROJECT AREA ARE ACCOUNTED FOR IN THE SUB-BASIN SHOWN ON THIS MAP.

DRAINAGE BASIN SUMMARY TABLE

DESIGN POINT	INCLUDED BASINS	AREA (AC)	Tc (MIN)	RUNOFF Q5	RUNOFF Q100
1	EX-A	4.71	14.1	4.1	13.3
2	EX-B	0.44	11.5	0.8	1.8
3	EX-C	1.47	12.5	0.5	3.3

Provide combined flows

LEGEND

PROPERTY LINE
EASEMENT LINE
LOT LINE

EXISTING

5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR
TIME OF CONCENTRATION
BASIN BOUNDARY
Q_5 = 19.0 cfs, Q_{100} = 60.0 cfs — GENERAL FLOW/DIRECTION
1.50% — SLOPE DIRECTION AND GRADE
A1 1.0 AC 50% IMP — BASIN LABEL
AREA IN ACRES
PERCENT IMPERVIOUS
1 — DESIGN POINT

DESIGNED BY
DRAWN BY
CHECKED BY
AS-BUILTS BY
CHECKED BY

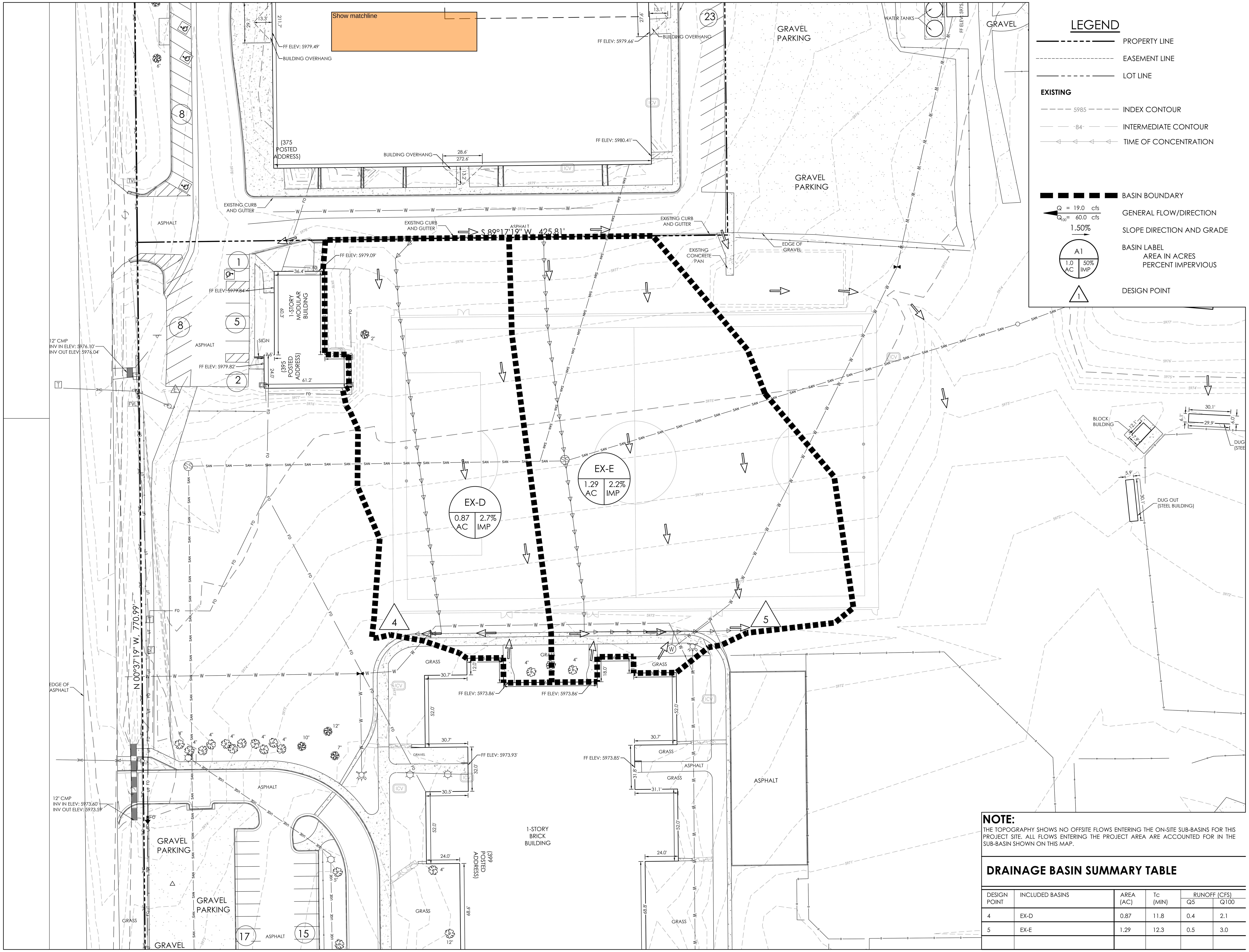
ELLICOTT SCHOOL
ADDITION 2 BLDGS

PHASE I
DRAINAGE MAP
EXISTING

MVE PROJECT 61183
MVE DRAWING DRAIN-EX-I

NOVEMBER 10, 2022

SHEET 1 OF 2



LEGEND

- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

EXISTING

- 5985 — INDEX CONTOUR
- 84 — INTERMEDIATE CONTOUR
- TIME OF CONCENTRATION
- BASIN BOUNDARY
- Q = 19.0 cfs / Q_{100} = 60.0 cfs — GENERAL FLOW/DIRECTION
- 1.50% — SLOPE DIRECTION AND GRADE
- A1 / 1.0 AC / 50% IMP — BASIN LABEL: AREA IN ACRES, PERCENT IMPERVIOUS
- 1 — DESIGN POINT

VICINITY MAP
NOT TO SCALE

SITE, S ELLICOTT HIGHWAY, 94, HANDLE ROAD, E ELLICOTT ROAD S, BLACK SQUIRREL CREEK

BENCHMARK

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N

5 0 10 30 60
1" = 30' 1:360

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DRAINAGE BASIN SUMMARY TABLE

DESIGN POINT	INCLUDED BASINS	AREA (AC)	Tc (MIN)	RUNOFF (CFS) Q5	Q100
4	EX-D	0.87	11.8	0.4	2.1
5	EX-E	1.29	12.3	0.5	3.0

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CHECKED BY

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ADDITION 2 BLDGS

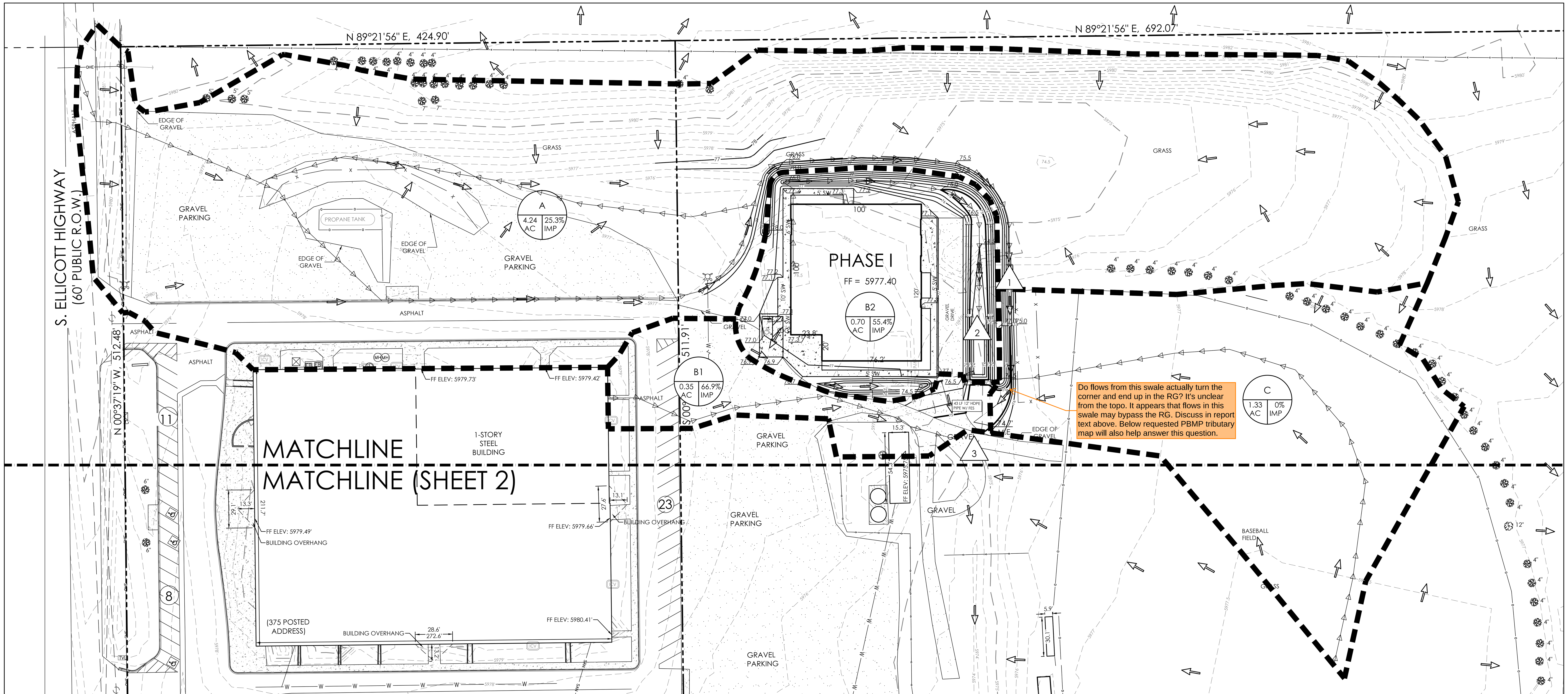
PHASE II
DRAINAGE MAP
EXISTING

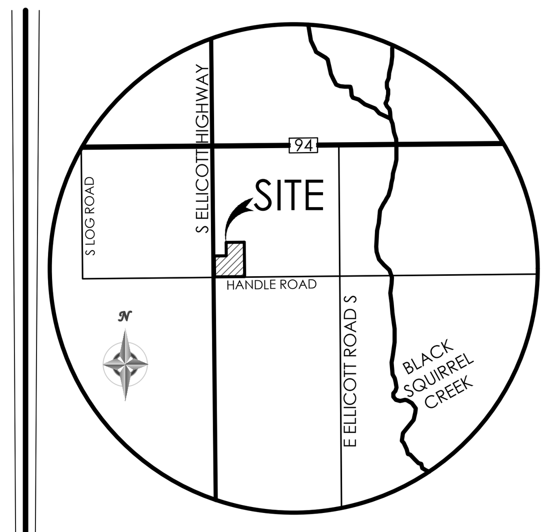
MVE PROJECT 61183
MVE DRAWING DRAIN-EX-II

NOVEMBER 10, 2022

SHEET 2 OF 2

Provide a DP for all site combined flows





VICINITY MAP

NOT TO SCALE

BENCHMARK

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1" = 40' 1:480

It is unclear which disturbed areas (and how much acreage) area not conveyed to the Rain Gardens. We need to know how much disturbed area is untreated and if there are any exclusions that apply to those areas.

So please create a basic overview map (or modify an existing drainage map) with color shading/hatching that shows areas tributary to each PBMP (pond, runoff reduction, etc) and those disturbed areas that are not treated by a PBMP, with the applicable exclusion labeled (ex: 20% up to 1ac of development can be excluded per ECM App I.7.1.C.1 and exclusions listed in ECM App I.7.1.B.#).

NOTE:

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DRAINAGE BASIN SUMMARY TABLE

DESIGN POINT	INCLUDED BASINS	AREA (AC)	Tc (MIN)	RUNOFF Q5	Q100
1	A	4.24	15.1	3.8	11.9
	B1	0.35	11.5	0.8	1.6
2	B2	0.70	8.0	1.5	3.4
	C	1.33	11.0	0.4	3.1
3	A, B1, C	6.27	16.6	5.2	16.6

LEGEND

PROPERTY LINE
EASEMENT LINE
LOT LINE

EXISTING
5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR

PROPOSED
5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR
TIME OF CONCENTRATION
BASIN BOUNDARY
Q = 19.0 cfs, Q_{100} = 60.0 cfs GENERAL FLOW/DIRECTION
1.50% SLOPE DIRECTION AND GRADE
A1 1.0 AC 50% IMP BASIN LABEL AREA IN ACRES PERCENT IMPERVIOUS
1 DESIGN POINT

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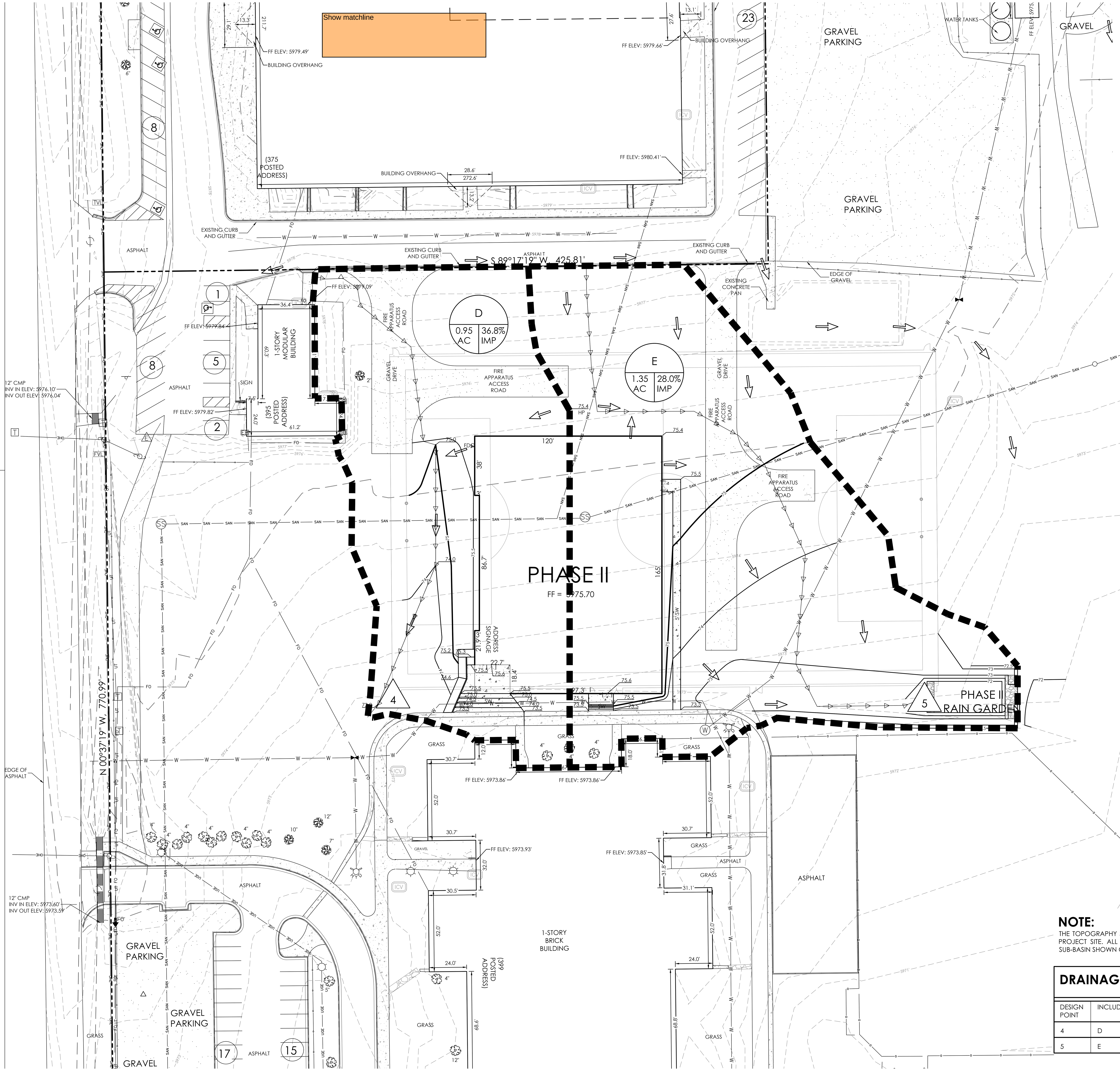
ADDITION 2 BLDGS

PHASE I
DRAINAGE MAP
PROPOSED

MVE PROJECT 61183
MVE DRAWING DRAIN-PP-I

NOVEMBER 10, 2022



LEGEND

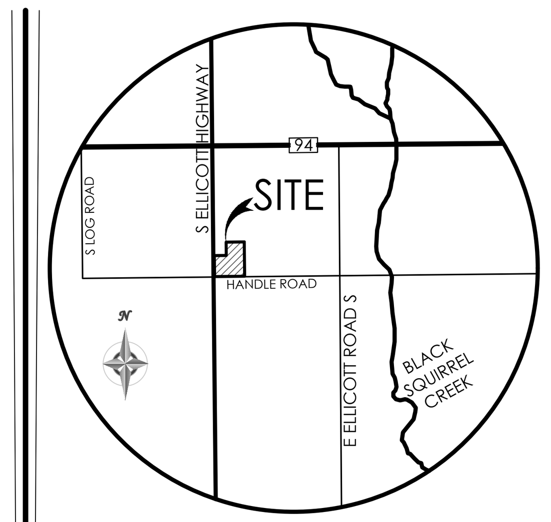
- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

EXISTING

- INDEX CONTOUR (5985)
- INTERMEDIATE CONTOUR (84)

PROPOSED

- INDEX CONTOUR (5985)
- INTERMEDIATE CONTOUR (84)
- TIME OF CONCENTRATION
- BASIN BOUNDARY
- GENERAL FLOW/DIRECTION (Q = 19.0 cfs, Q_{100} = 60.0 cfs)
- SLOPE DIRECTION AND GRADE (1.50%)
- BASIN LABEL (A1, 1.0 AC, 50% IMP) — AREA IN ACRES, PERCENT IMPERVIOUS
- DESIGN POINT (1)



VICINITY MAP
NOT TO SCALE

BENCHMARK

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1" = 30' 1:360

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DRAINAGE BASIN SUMMARY TABLE

DESIGN POINT	INCLUDED BASINS	AREA (AC)	Tc (MIN)	RUNOFF (CFS) Q5	Q100
4	D	0.95	11.9	1.3	3.3
5	E	1.35	12.5	1.4	4.2

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CHECKED BY

ELLICOTT SCHOOL
ADDITION 2 BLDGS

PHASE II
DRAINAGE MAP
PROPOSED

MVE PROJECT 61183
MVE DRAWING DRAIN-PP-II

NOVEMBER 10, 2022

SHEET 2 OF 2

Provide a DP for all site combined flows