EPC STORMWATER REVIEW COMMENTS
IN ORANGE BOXES WITH BLACK TEXT

MVE, INC.
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Final Drainage Report

4190 Hancock Expressway

Lot 3, Block A, Resub of Lots 4 and 5, Block 1, Clear View Industrial Park Filing No. 1

Project No. 61179

August 4, 2023

PCD File No. PPR2348

Final Drainage Report

for

4190 Hancock Expressway
Lot 3, Block A, Resub of Lots 4 and 5, Block 1, Clear View Industrial Park Filing No. 1
Project No. 61179

August 4, 2023

prepared for

Braylen Properties, LLC LLC
523 Southern Cross Drive
Colorado Springs, CO 80906
719.475.0922

prepared by

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

61179-4190 Hancock 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.

Date

Braylen Properties, LLC
523 Southern Cross Drive
Colorado Springs, CO 80906

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, P.E., Date
County Engineer / ECM Administrator

Contents

Final Drainage Report 1

1 General Location and Description 1
- 1.1 Location 1
- 1.2 Description of Property 1
- 1.3 Soils 1
- 1.4 Flood Insurance 2

2 Drainage Basins and Sub-Basins 2
- 2.1 Major Basin Descriptions 2
- 2.2 Other Drainage Reports 2
- 2.3 Sub-Basin Description 2

3 Drainage Design Criteria 2
- 3.1 Development Criteria Reference 2
- 3.2 Hydrologic Criteria 3

4 Drainage Facility Design 3
- 4.1 General Concept 3
- 4.2 Specific Details 3
- 4.3 Erosion Control 4
- 4.4 Water Quality Enhancement Best Management Practices 4

5 Opinion of Probable Cost for Drainage Facilities 5

6 Drainage and Bridge Fees 5

7 Conclusion 5

References 7

Appendices

8 General Maps and Supporting Data

9 Hydrologic Calculations

10 Report Maps

Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed 4190 Hancock Expressway site. The report will discuss the recommended drainage improvements to the site and identify drainage requirements relative to the existing conditions and 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.

1 General Location and Description

1.1 Location

The proposed 4190 Hancock Expressway site is located within a portion of Section 2, Township 15 South, Range 66 west of the 6th principal meridian in El Paso County, Colorado. The site is platted as Lot 4, Block A, A Resubdivision of Lots 4 and 5, Block 1, "Clear View Industrial Park Filing No. 1". The is situated west of Hancock Expressway and south of Clear View Loop South. The EPC Assessor's Schedule Number for the site is 65020-02-012 with the address of 4190 Hancock Expressway. Commercial properties and Canal #4 are located to the west, industrial lots are located north and south and Hancock Expressway is to the east. A **Vicinity Map** is included in the **Appendix**.

Canal #4 is a Fountain Mutual Irrigation Canal facility correct? Please add text to clarify.

1.2 Description of Property

The 4190 Hancock Expressway site is 0.978± acres and zoned M CAD-O (Industrial). This site is currently vacant. The Hancock Expressway Frontage Road runs through the east side of the Lot. Additionally, existing fencing surrounds the majority of the north, west and south property lines.

Ground cover in most of the Lot is undisturbed pasture/meadow conditions with fair to good ground cover featuring native grasses with a few vehicle tracked areas.

The site slopes from east to west with grades averaging 6%. The western side of the property is surrounded by timber retaining walls creating a localized depression. No significant drainageways flow through the site and no significant drainage improvements or drainage facilities currently exist on the site.

1.3 Soils

According to the National Resource Conservation Service, there is one (1) soil type identified in the 4190 Hancock Expressway site. The primary soil is Blakeland loamy sand, 1 to 9 percent slopes (map unit 8).

Blakeland loamy sand (map unit 8) is deep and somewhat excessively drained. Permeability is rapid, surface runoff is slow, the hazard of erosion is moderate. Blakeland loamy sand is classified as being part of Hydrologic Soil Group A.

A portion of the Soil Map and data tables from the National Cooperative Soil Survey and relevant Official Soil Series Descriptions (OSD) are included in the **Appendix**.[1] [2]

---

[1] WSS

[2] OSD

1.4 Flood Insurance

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRM), effective on December 7, 2018.[3] The proposed subdivision is included in Community Panel Numbered 08041C0763 G of the Flood Insurance Rate Maps for the El Paso County. No part of the site is shown to be included in a 100-year flood hazard area as determined by FEMA. A portion of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the **Appendix**.

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The 4190 Hancock Expressway site is located in the Little Johnson Drainage Basin (FOFO3200) of the Fountain Creek Major Drainage Basin (FO). This basin drains to the adjacent Fountain Creek west of the site. The Little Johnson Drainage Basin encompasses a portion of El Paso County south of Colorado Springs extending from Drenan Road south to Bradley Road, east and west of Hancock Expressway and generally drains southeasterly into Fountain Creek.

2.2 Other Drainage Reports

The Drainage Report for “A Resubdivisionof Lots 4 & 5, Block 1, “Clear View Industrial Park Filing No. 1” contains 4190 Hancock Expressway and is shown as Basin 3 in said drainage report.

2.3 Sub-Basin Description

The existing drainage patterns of the 4190 Hancock Expressway are described by one off-site and two 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 Map**.

2.3.1 Existing Drainage Patterns (Off-Site)

There is one offsite sub-basins that drain into this site from the north consisting of the Hancock Expressway Frontage Road.

2.3.2 Existing Drainage Patterns (On-Site)

Existing Sub-Basin EX-A (0.14± acres) represents the Hancock Expressway Frontage Road along the east side of the existing site. This sub-basin slopes approximately 3% from north to south. The flows are contained in a roadside ditch west of the frontage road or along the curb on the east side of the frontage road and continue south off of the south property line onto the adjacent lot.

Existing Sub-Basin EX-B (0.85± acres) represents the majority of the existing undeveloped site. This sub-basin features moderate slopes of 6% eventually draining to the west edge of the site. This flow ponds in a local depression and infiltrates into the existing well drained soils. Additional runoff above and beyond what ponds, exits the site along the entire western edge in flows into Canal #4.

The previous drainage report identified this as Basin 3 with 4.6 cfs existing the west side of the Lot and into the existing Canal #4.

provide excerpts from the previous drainage report that identifies this.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Final Drainage Report for 4190 Hancock Expressway has been prepared according to the report guidelines presented in the latest edition of *El Paso County Drainage Criteria Manual* (DCM)[4]. 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.[5] [6] The hydrologic analysis is based on a collection of data from the DCM, the NRCS Web Soil Survey[7], and existing topographic data by Polaris Surveying.

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[3] FIRM

[4] DCM Section 4.3 and Section 4.4

[5] CS DCM Vol 1

[6] CS DCM Vol 2

[7] WSS

3.2 Hydrologic Criteria

For this Final Drainage Report, the Rational Method as described in the D*rainage Criteria Manual* 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 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.[8]

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 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

Sub-Basin **OSA1** (0.26± acres) represents the existing Hancock Expressway Frontage Road lying north of the site. This sub-basin drains from north to south at approximately 3%. Existing runoff discharges for this sub-basin are Q_5 = 0.6 cfs and Q_{100} = 1.4 cfs (existing flows). This flow enters the site at the northeast corner..

Existing Sub-Basin **EX-A** (0.14± acres) represents the Hancock Expressway Frontage Road along the east side of the existing site. This sub-basin slopes approximately 3% from north to south. The flows are contained in a roadside ditch west of the frontage road or along the curb on the east side of the frontage road and continue south off of the south property line onto the adjacent lot. Existing runoff discharges for this sub-basin are Q_5 = 0.4 cfs and Q_{100} = 0.8 cfs (existing flows). This runoff combines with additional flows from OSA1 before existing the property along the south side and continue south in the frontage road at **Design Point 1 (DP1)**. The combined existing runoff discharges for this design point are Q_5 = 1.0 cfs and Q_{100} = 2.1 cfs (existing flows).

Existing Sub-Basin **EX-B** (0.85± acres) represents the majority of the existing undeveloped site. This sub-basin features moderate slopes of 6% eventually draining to the west edge of the site. This flow ponds in a local depression and infiltrates into the existing well drained soils. Additional runoff above and beyond what ponds, exits the site along the entire western edge and flows into Canal #4. Existing runoff discharges for this sub-basin are Q_5 = 0.3 cfs and Q_{100} = 1.9 cfs (existing flows).

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.

4.2.2 Proposed Hydrologic Conditions

Sub-Basin **OSA1** (0.26± acres) represents the existing Hancock Expressway Frontage Road lying north of the site. This sub-basin drains from north to south at approximately 3%. Existing runoff discharges for this sub-basin are Q_5 = 0.6 cfs and Q_{100} = 1.4 cfs (existing flows). This flow enters the site at the northeast corner..

---

[8] DCM

Provide discussion/description of the existing canal. Analyze whether it is adequate to accept this sites developed flows.

Also contact FMIC and confirm they are ok with the increase of flows into their canal.

Proposed Sub-Basin **A** (0.14± acres) represents t
east side of the existing site and a small portic
building. This sub-basin slopes approximately 3%
roadside ditch west of the frontage road or along t
continue south off of the south property line onto
this sub-basin are Q_5 = 0.4 cfs and Q_{100} = 0.9 cfs (existing flows). This runoff combines with additional flows from OSA1 before existing the property along the south side and continue south in the frontage road at **Design Point 1 (DP1)**. The combined proposed runoff discharges for this design point are Q_5 = 1.0 cfs and Q_{100} = 2.2 cfs (proposed flows). This represents an increase of 0.01 cfs in the 100 year.

Proposed Sub-Basin **B** (0.85± acres) represents the majority developed site. Flows from the building will drain south into the parking and drive area that drains from east to west where they enter a local depression and infiltrates into the existing well drained soils. Additional proposed runoff above and beyond what ponds, will exit the site along the entire western edge and flows into Canal #4. No point of concentrated flows are proposed to enter the existing Canal #4. Proposed runoff discharges for this sub-basin are Q_5 = 2.6 cfs and Q_{100} = 5.3 cfs (proposed flows).

The **Proposed Drainage Map** depicts the existing topographic mapping, proposed grading, proposed building, proposed pavement, drainage basin delineations, drainage patterns, and runoff quantities with a data table including drainage areas and flow rates.

Please revise this statement accordingly. See stormwater engineers comment below.

4.3 Erosion Control

During future construction, control measures (CM's) for erosion control will be employe
the previously referenced City of Colorado Springs Drainage Criteria Manual Volume
Erosion Control Plan for the site. During Construction, silt fencing, sediment control l
tracking control, concrete washout area will be in place to minimize erosion from the site. Silt Fencing will be placed along the south and east portions of the disturbed areas. This will inhibit suspended sediment from leaving the site during construction. Silt fencing is to remain in place until the proposed berms are stabilized and vegetation is reestablished in the other disturbed areas which are to be reseeded. Vehicle tracking control will be placed at the access point in the private driveway connecting to the Hancock Expressway Frontage Road. CM's will be utilized as deemed necessary by the contractor, engineer, owner, or County inspector and are not limited to the measures described above.

4.4 Water Quality Enhancement Best Management Practices

This project will only disturb 0.87 ± acres and is not subject to water quality or detention mitigation as the overall disturbance of this project is less than 1 acre. Therefore, a Grading & Erosion Control Plan (GEC) & an Erosion and Stormwater Quality Control Permit (ESQCP) will not be required for the scope of this project.

FYI - the 1 acre threshold applies only to water quality control measures. Detention must be analyzed separately and the project disturbing less than 1 acre does not remove the requirement for analyzing the need for detention.

The El Paso County Engineering Criteria Manual (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. Minimized Directly Connected Impervious Areas (MDCIA) is employed on the project because all runoff from the developed portion of the site will flow to a localized depression which provides infiltration.
2) The site is exempted from the use of WQCV CMs by virtue of disturbing less than 1 acre. The runoff generated from the impervious areas of the roofs, paved areas and gravel storage is treated for water quality by being collected in the localized depression along the west edge of the site where it may infiltrate into the ground, evaporate, or evapotranspire.
3) There are no significant drainage paths through the site. The Canal #4 located west of the site will not be impacted by thid project. No points of concentrated inflows to the Canal will

be constructed. Flows from this site will overtop the existing timber retaining wall in a uniform manner and will sheet flow into Canal #4.

4) The commercial lot is not anticipated to contain storage of potentially harmful substances or use of potentially harmful substances. No site specific or other source control BMPs are required.

5 Opinion of Probable Cost for Drainage Facilities

There are no public or private storm water facilities required.

drainage and bridge fees are not assessed/collected with site development plan applications. Only subdivision actions is when fees are assessed/collected. Please revise the report

6 Drainage and Bridge Fees

The site is located within the Little Johnson Drainage Basin of Fountain Creek, El Paso Basin Number FOMO3200, which was last studied in 1988. Fees associated with this basin are Drainage Fees of $14,077 per impervious acre and Bridge Fees of $0 per impervious acre. The percent Imperiousness of the Industrial site is 85% in accordance with El Paso County Engineering Criteria Manual Appendix L Table 3-1. The actual percent imperiousness of the site is 66.4%. The 4190 Hancock Expressway site contains 0.978 acres. Drainage and Bridge Fees for the site are calculated below using the actual percent imperiousness.

FEE CALCULATION (Fountain Creek 2023 Drainage Fees)

Drainage Fee = 0.978 Ac. x $14,077/Imp. Ac. x 0.664 Imp. = $ 9,141.49

Bridge Fee = 0.978 Ac. x $ 0/Imp. Ac. x 0.664 Imp. = 0.00

Subtotal = $ 9,141.49

Grand Total Fees = $ 9,141.49

7 Conclusion

This Final Drainage Report presents existing and proposed drainage conditions for the proposed 4190 Hancock Expressway project. The development will have negligible and inconsequential effects on the existing site drainage and drainage conditions downstream. The proposed project will not, with respect to stormwater runoff, negatively impact the adjacent properties and downstream properties.

References

NRCS Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service ("http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx", accessed March, 2018).

NRCS Official Soil Series Descriptions. United States Department of Agriculture, Natural Resources Conservation Service ("http://soils.usda.gov/technical/classification/osd/index.html", accessed March, 2018).

Flood Insurance Rate Map. Federal Emergency Management Agency, National Flood Insurance Program (Washingon D.C.: FEMA, March 17, 1997).

NCSS Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service ("http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx", accessed May, 2017).

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

City of Colorado Springs Drainage Criterial Manual, Volume 1. City of Colorado Springs Engineering Division Staff, Matrix Desgin Group/Wright Water Engineers (Colorado Springs: , May 2014).

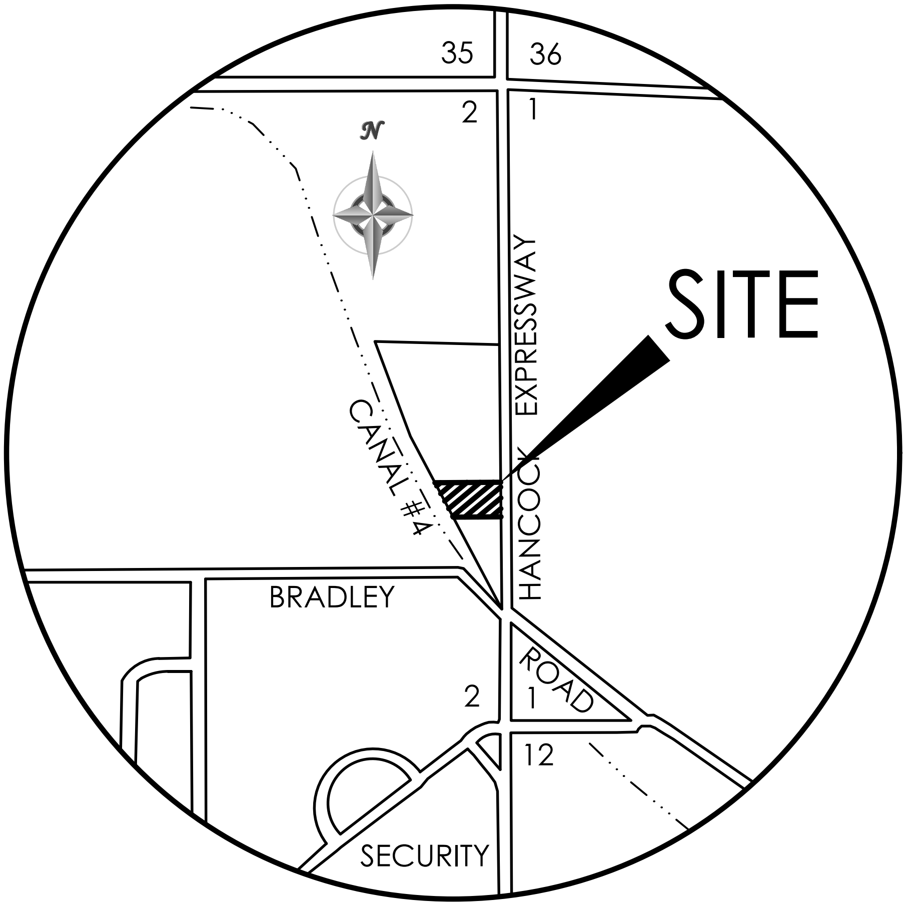
City of Colorado Springs/El Paso County Drainage Criteria Manual. City of Colorado Springs, Department of Public Works, Engineering Division; HDR Infrastructure, Inc.; El Paso County, Department of Public Works, Engineering Division (Colorado Springs: City of Colorado Springs, Revised November 1991).

City of Colorado Springs Drainage Criteria Manual Volume 1. City of Colorado Springs Engineering Division with Matrix Design Group and Wright Water Engineers (Colorado Springs, Colorado: , May 2014).

Appendices

8 General Maps and Supporting Data

Vicinity Map
Portions of Flood Insurance Rate Map
NRCS Soil Map and Tables
SCS Soil Type Descriptions
Hydrologic Soil Group Map and Tables



VICINITY MAP

NOT TO SCALE

National Flood Hazard Layer FIRMette

104°44'42"W 38°46'31"N

104°44'5"W 38°46'3"N

Feet

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

1:6,000

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

Legend

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

SPECIAL FLOOD HAZARD AREAS	🟦	Without Base Flood Elevation (BFE) *Zone A, V, A99* With BFE or Depth *Zone AE, AO, AH, VE, AR*
	▨	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	🟧	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	▨	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	▨	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
	▭	Effective LOMRs
	🟧	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	– – –	Channel, Culvert, or Storm Sewer
	IIIIIII	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 6/8/2022 at 6:11 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

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

Custom Soil Resource Report for

El Paso County Area, Colorado

August 3, 2023

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

Preface.. 2
How Soil Surveys Are Made.. 5
Soil Map.. 8
  Soil Map.. 9
  Legend.. 10
  Map Unit Legend.. 11
  Map Unit Descriptions.. 11
    El Paso County Area, Colorado.. 13
      8—Blakeland loamy sand, 1 to 9 percent slopes.. 13
Soil Information for All Uses.. 15
  Soil Properties and Qualities.. 15
    Soil Qualities and Features.. 15
      Hydrologic Soil Group.. 15
References.. 20

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

Soil Map may not be valid at this scale.

Map Scale: 1:880 if printed on A landscape (11" x 8.5") 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 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
- Λ 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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 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
8	Blakeland loamy sand, 1 to 9 percent slopes	1.5	100.0%
Totals for Area of Interest		**1.5**	**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

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: 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
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

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

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Qualities and Features

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

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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

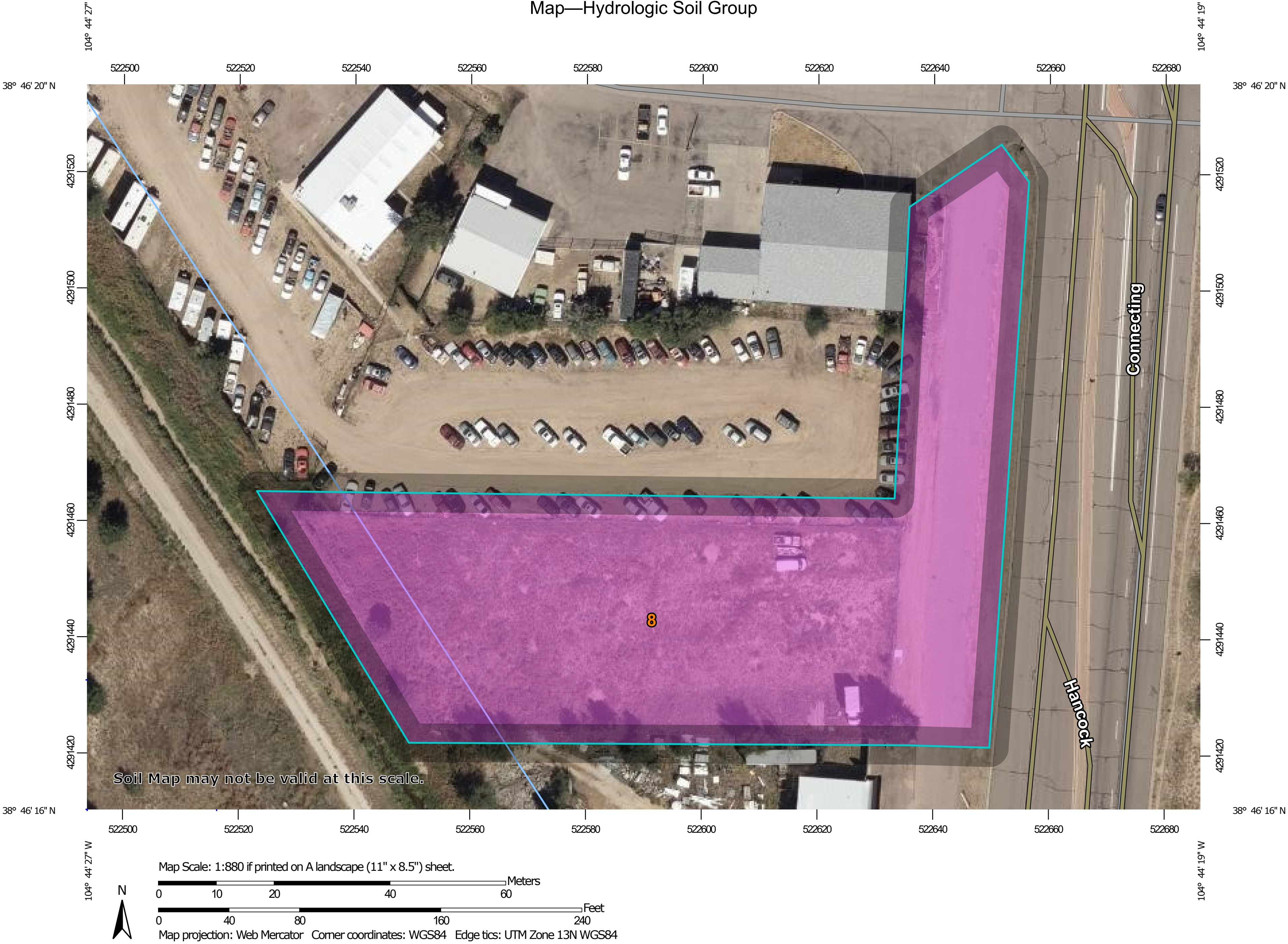
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:880 if printed on A landscape (11" x 8.5") 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)

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Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	1.5	100.0%
Totals for Area of Interest			**1.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

is severely eroded and blowouts have developed, the new seeding should be fertilized.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing is the main limitation for 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 necessary 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, the provision of undisturbed nesting cover is vital and should be included in plans for habitat development. 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. Shallow excavation is severely limited because cut banks cave in. This sandy soil requires special management practices to reduce water erosion and soil blowing. Capability subclasses IIIe, irrigated, and IVe, nonirrigated.

7—Bijou sandy loam, 3 to 8 percent slopes. This deep, well drained soil is on flood plains, terraces, and uplands. It formed in sandy alluvium and eolian material derived from arkose deposits. Elevation ranges from 5,400 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is about 145 days.

Typically, the surface layer is brown sandy loam about 4 inches thick. The subsoil is brown or grayish brown sandy loam about 24 inches thick. The substratum is pale brown loamy coarse sand.

Included with this soil in mapping are small areas of Olney sandy loam, 3 to 5 percent slopes; Valent sand, 1 to 9 percent slopes; Vona sandy loam, 3 to 9 percent slopes; and Wigton loamy sand, 1 to 8 percent slopes.

Permeability of this Bijou soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Organic matter content of the surface layer is low. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

Almost all areas of this soil are used for range.

This soil is suited to the production of native vegetation suitable for grazing. Because of the hazards of water erosion and soil blowing, the soil is not suited to nonirrigated crops.

Native vegetation is dominantly blue grama, sand dropseed, needleandthread, side-oats grama, and buckwheat.

Seeding is a suitable practice if the range has deteriorated. Seeding the native grasses is a good practice. If the range is severely eroded and blowouts have developed, the new seeding should be fertilized. Brush control and grazing management may be needed to improve the depleted range. Grazing should be managed so that enough forage is left standing to protect the soil from blowing, to increase infiltration of water, and to catch and hold snow.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing is the main limitation for 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. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, by properly managing livestock grazing, and by reseeding range where needed.

This soil has good potential for use as homesites. Shallow excavation is severely limited because cut banks cave in. This soil requires special management practices to reduce water erosion and soil blowing. Capability subclass VIe.

8—Blakeland loamy sand, 1 to 9 percent slopes. This deep, somewhat excessively drained soil formed in alluvial and eolian material derived from arkosic sedimentary rock on uplands. 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 dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches.

Included with this soil in mapping are small areas of Bresser sandy loam, 0 to 3 percent slopes; Bresser sandy loam, 3 to 5 percent slopes; Truckton sandy loam, 0 to 3 percent slopes; Truckton sandy loam, 3 to 9 percent slopes; and Stapleton sandy loam, 3 to 8 percent slopes. In some areas, mainly north of Colorado Springs in the Cottonwood Creek area, arkosic beds of sandstone and shale are at a depth of 0 to 40 inches.

Permeability of this Blakeland soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Organic matter content of the surface layer is medium. Surface runoff is slow, the hazard of erosion is moderate, and the hazard of soil blowing is severe.

Most areas of this soil are used for range, homesites, and wildlife habitat.

Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. This soil is best suited to deep-rooted grasses.

Proper range management is necessary to prevent excessive removal of plant cover from the soil. Interseeding improves the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. 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 main limitations 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 habitat for openland and rangeland wildlife. 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 urban development. Soil blowing is a hazard if protective vegetation is removed. Special erosion control practices must be provided to minimize soil losses. Capability subclass VIe.

9—Blakeland complex, 1 to 9 percent slopes. This complex is on uplands, mostly in the Falcon area. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the frost-free period is about 135 days.

This complex is about 60 percent Blakeland loamy sand, about 30 percent Fluvaquentic Haplaquolls, and 10 percent other soils.

Included with these soils in mapping are areas of Columbine gravelly sandy loam, 0 to 3 percent slopes, Ellicott loamy coarse sand, 0 to 5 percent slopes, and Ustic Torrifluvents, loamy.

The Blakeland soil is in the more sloping areas. It is deep and somewhat excessively drained. It formed in sandy alluvium and eolian material derived from arkosic sedimentary rock. Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches or more.

Permeability of the Blakeland soil is rapid. The effective rooting depth is more than 60 inches. The available water capacity is moderate to low. Surface runoff is slow, and the hazard of erosion is moderate.

The Fluvaquentic Haplaquolls are in swale areas. They are deep, poorly drained soils. They formed in alluvium derived from arkosic sedimentary rock. Typically, the surface layer is brown. The texture is variable throughout. The water table is at a depth of 0 to 3 feet.

The Blakeland soil is well suited to deep-rooted grasses. Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. Rangeland vegetation on the Fluvaquentic Haplaquolls is dominantly tall grasses, including sand bluestem, switchgrass, prairie cordgrass, little bluestem, and sand reedgrass. Cattails and bulrushes are common in the swampy areas.

Proper range management is needed to prevent excess removal of plant cover from these soils. It is also needed to maintain the productive grasses. Interseeding improves the existing vegetation. Deferment of grazing during the growing season increases plant vigor and soil stability, and it helps to maintain and improve range condition. Proper location of livestock watering facilities helps to control grazing of animals.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and low available water capacity are the main limitations to 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.

The Blakeland soil is well suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed. Wetland wildlife can be attracted to the Fluvaquentic Haplaquolls and the wetland habitat can be enhanced by several means. Shallow water developments can be created by digging or by blasting potholes to create open-water areas. Fencing to control livestock grazing is beneficial, and it allows wetland plants such as cattails, reed canarygrass, and rushes to grow. Control of unplanned burning and prevention of drainage that would remove water from the wetlands are good practices. Openland wildlife use the vegetation on these soils for nesting and escape cover. These shallow marsh areas are especially important for winter cover if natural vegetation is allowed to grow.

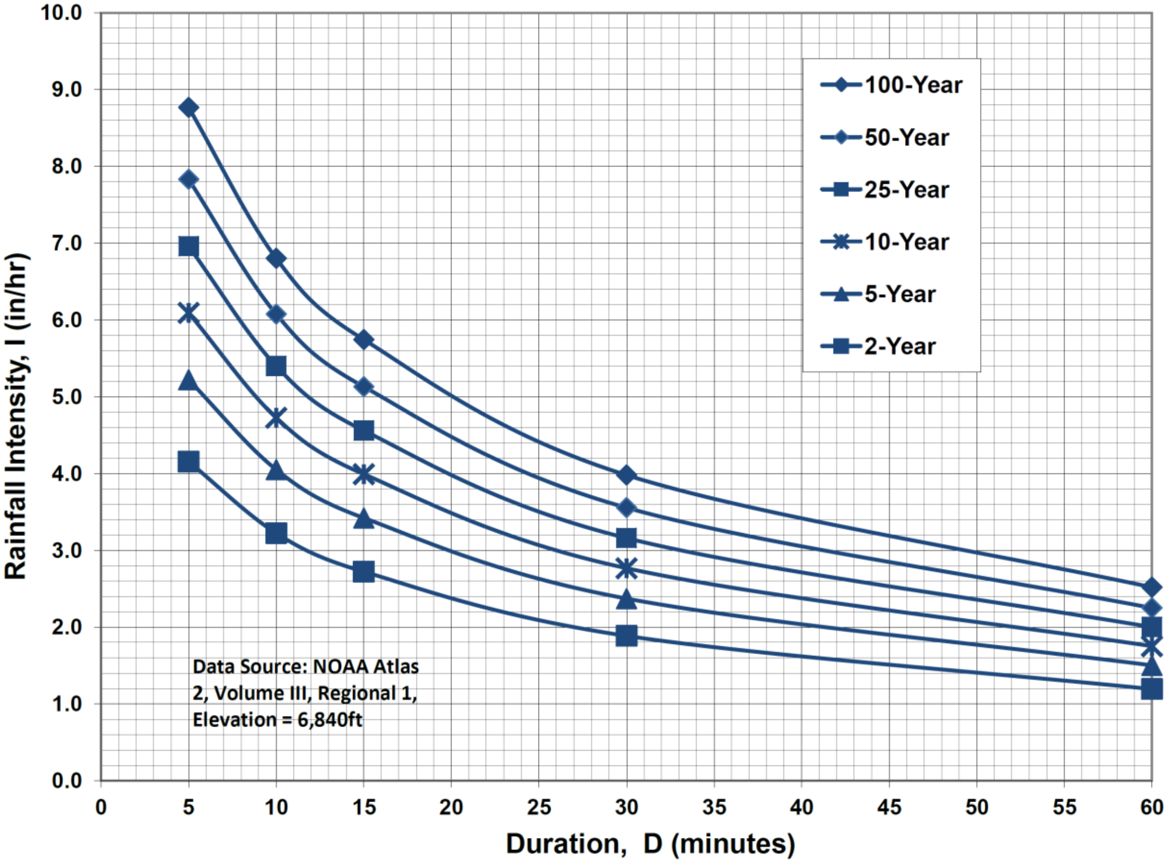
The Blakeland soil has good potential for homesites, roads, and streets. It needs to be protected from erosion when vegetation has been removed from building sites. The Fluvaquentic Haplaquolls have poor potential for homesites. Their main limitations for this use are the high water table and the hazard of flooding. Capability subclass VIe.

10—Blendon sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in sandy arkosic alluvium on alluvial fans and terraces. The average annual precipitation is about 15 inches, the mean annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

9 Hydrologic Calculations

Runoff Coefficients and Percent Imperviousness Table 6-6
Colorado Springs Rainfall Intensity Duration Frequency Table 6-5
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

Job No.: **61179**
Project: **4190 Hancock Expy**

Date: **8/3/2023 15:41**
Calcs By: **JO**
Checked By:

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

	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		
Sub-Basin	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)
Offsite Sub-basin																		
OSA1	0.26	0.48	0.64	48%	33.07	4%	4.0	116.3	0.030	1.7	1.1	61.25	0.054	2.6	0.4	210.7	N/A	5.5
Existing On-site																		
EX-A	0.14	0.50	0.66	52%	31.08	5%	3.6	38.42	0.026	1.1	0.6	64.84	0.046	2.2	0.5	134.3	N/A	5.0
EX-B	0.85	0.08	0.35	0%	88.69	7%	9.2	78.98	0.063	0.6	2.1	69.7	0.057	1.6	0.7	237.4	N/A	12.0
Proposed Onsite																		
A	0.14	0.52	0.68	54%	31.08	5%	3.5	38.42	0.026	1.1	0.6	64.84	0.046	2.2	0.5	134.3	N/A	5.0
B	0.85	0.60	0.72	68%	50	25%	2.2	120.4	0.033	3.6	0.6	117	0.068	5.9	0.3	287.4	N/A	5.0

Job No.: **61179**
Project: **4190 Hancock Expy**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **8/3/2023 15:41**
Calcs By: **JO**
Checked By:

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

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C5	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{0sc} (ft/s)	t_t (min)
OFFSITE SUB-BASIN																						
	OSA1	0.26	0.48	5.5	0.12	5.04	0.63															
EXISTING ONSITE																						
	EX-A	0.14	0.50	5.0	0.07	5.17	0.38															
	EX-B	0.85	0.08	12.0	0.07	3.85	0.26															
EX-DP1	OSA1, EX-A	0.41	0.49					6.3	0.20	4.83	1.0											
PROPOSED ONSITE																						
	A	0.14	0.52	5.0	0.08	5.17	0.39															
	B	0.85	0.60	5.0	0.51	5.17	2.61															
DP1	OSA1, A	0.41	0.49					6.3	0.20	4.83	1.0											

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

Job No.: **61179**
Project: **4190 Hancock Expy**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **DCM**

Date: **8/3/2023 15:41**
Calcs By: **JO**
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)
OFFSITE SUB-BASIN																						
	OSA1	0.26	0.64	5.5	0.17	8.46	1.42															
EXISTING ONSITE																						
	EX-A	0.14	0.66	5.0	0.10	8.68	0.84															
EX-DP2	EX-B	0.85	0.35	12.0	0.30	6.46	1.92															
EX-DP1	OSA1, EX-A	0.41	0.65					6.3	0.26	8.10	2.1											
PROPOSED ONSITE																						
	A	0.14	0.68	5.0	0.10	8.68	0.86															
DP2	B	0.85	0.72	5.0	0.61	8.68	5.32															
DP1	OSA1, A	0.41	0.66					6.3	0.27	8.10	2.2											

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

Offsite Sub-Basin OSA1 Runoff Calculations

Job No.: **61179**

Project: **4190 Hancock Expy**

Date: **8/3/2023 15:41**

Calcs by: **JO**

Checked by:

Jurisdiction **DCM**

Runoff Coefficient **Surface Type**

Soil Type **A**

Urbanization **Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	5,893	0.14	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	5,485	0.13	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**11,379**	**0.26**	**0.44**	**0.48**	**0.52**	**0.58**	**0.61**	**0.64**	**48.2%**

11378.5604

Basin Travel Time

Shallow Channel Ground Cover Nearly bare ground

$L_{max,Overland}$ 300 ft

C_v 10

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	211	8	-	-	-	-	
Initial Time	33	1	0.045	-	4.0	N/A	DCM Eq. 6-8
Shallow Channel	116	4	0.030	1.7	1.1	-	DCM Eq. 6-9
Channelized	61	3	0.054	2.6	0.4	-	V-Ditch

t_c **5.5 min.**

Rainfall Intensity & Runoff

	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
Intensity (in/hr)	4.02	5.04	5.88	6.72	7.56	8.46
Runoff (cfs)	0.5	**0.6**	0.8	1.0	1.2	**1.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.5	**0.6**	0.8	1.0	1.2	**1.4**

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

Existing Onsite Sub-Basin EX-A Runoff Calculations

Job No.:	**61179**	Date:		**8/3/2023 15:41**
Project:	**4190 Hancock Expy**	Calcs by:		**JO**
		Checked by:		
Jurisdiction	**DCM**	Soil Type		**A**
Runoff Coefficient	**Surface Type**	Urbanization		**Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	3,254	0.07	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	3,050	0.07	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**6,304**	**0.14**	**0.47**	**0.50**	**0.55**	**0.61**	**0.64**	**0.66**	**51.6%**
	6304.3256								

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	134	5	-	-	-	-	
Initial Time	31	1	0.046	-	3.6	N/A	DCM Eq. 6-8
Shallow Channel	38	1	0.026	1.1	0.6	-	DCM Eq. 6-9
Channelized	65	3	0.046	2.2	0.5	-	V-Ditch
				t_c	**5.0**	**min.**	

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)	0.3	**0.4**	0.5	0.6	0.7	**0.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**0.4**	0.5	0.6	0.7	**0.8**
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

Combined Sub-Basin Runoff Calculations (EX-DP1)

Includes Basins OSA1 EX-A

Job No.: **61179**

Date: **8/3/2023 15:41**

Project: **4190 Hancock Expy**

Calcs by: **JO**

Checked by:

Jurisdiction **DCM**

Soil Type **B**

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	8,944	0.21	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	8,739	0.20	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**17,683**	**0.41**	**0.45**	**0.49**	**0.53**	**0.59**	**0.62**	**0.65**	**49.4%**

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	OSA1	-	211	8	-	-	-	-	5.5
Channelized-1	V-Ditch	2	120	4	1	0	2	2.4	0.8
Channelized-2									
Channelized-3									
Total			331	13					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **6.3**

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)	3.85	4.83	5.63	6.44	7.24	8.10
Site Runoff (cfs)	0.70	**0.95**	1.21	1.54	1.83	**2.14**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**1.0**	-	-	-	**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

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

Existing Onsite Sub-Basin EX-B Runoff Calculations

Job No.: **61179**

Project: **4190 Hancock Expy**

Date: **8/3/2023 15:41**

Calcs by: **JO**

Checked by:

Jurisdiction **DCM**

Runoff Coefficient **Surface Type**

Soil Type **A**

Urbanization **Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Pasture/Meadow	36,925	0.85	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**36,925**	**0.85**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**
	36925.0601								

Basin Travel Time

Shallow Channel Ground Cover Heavy meadow

$L_{max,Overland}$ 300 ft

C_v 2.5

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	237	15	-	-	-	-	
Initial Time	89	6	0.068	-	9.2	N/A	DCM Eq. 6-8
Shallow Channel	79	5	0.063	0.6	2.1	-	DCM Eq. 6-9
Channelized	70	4	0.057	1.6	0.7	-	V-Ditch
				t_c	**12.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.07	3.85	4.49	5.13	5.77	6.46
Runoff (cfs)	0.1	**0.3**	0.6	1.1	1.5	**1.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.3**	0.6	1.1	1.5	**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

Proposed Onsite Sub-Basin A Runoff Calculations

Job No.: **61179**
Project: **4190 Hancock Expy**
Jurisdiction **DCM**
Runoff Coefficient **Surface Type**

Date: **8/3/2023 15:41**
Calcs by: **JO**
Checked by:
Soil Type **A**
Urbanization **Non-Urban**

Basin Land Use Characteristics

	Area		Runoff Coefficient						%
Surface	**(SF)**	**(Acres)**	**C2**	**C5**	**C10**	**C25**	**C50**	**C100**	**Imperv.**
Paved	3,418	0.08	0.89	0.9	0.92	0.94	0.95	0.96	100%
Pasture/Meadow	2,886	0.07	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**6,304**	**0.14**	**0.49**	**0.52**	**0.57**	**0.62**	**0.65**	**0.68**	**54.2%**

6304.3256

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	134	5	-	-	-	-	
Initial Time	31	1	0.046	-	3.5	N/A	DCM Eq. 6-8
Shallow Channel	38	1	0.026	1.1	0.6	-	DCM Eq. 6-9
Channelized	65	3	0.046	2.2	0.5	-	V-Ditch

t_c **5.0 min.**

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)	0.3	**0.4**	0.5	0.6	0.7	**0.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**0.4**	0.5	0.6	0.7	**0.9**

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

Proposed Combined Sub-Basin Runoff Calculations (DP1)

Includes Basins OSA1 A

Job No.:	**61179**	Date:		**8/3/2023 15:41**
Project:	**4190 Hancock Expy**	Calcs by:	**JO**	
		Checked by:		
Jurisdiction	**DCM**	Soil Type	**B**	
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	8,779	0.20	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	8,904	0.20	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**17,683**	**0.41**	**0.46**	**0.49**	**0.54**	**0.60**	**0.63**	**0.66**	**50.4%**

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	OSA1	-	211	8	-	-	-	-	5.5
Channelized-1	V-Ditch	2	120	4	1	0	2	2.4	0.8
Channelized-2									
Channelized-3									
Total			331	13					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) 6.3

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)	3.85	4.83	5.63	6.44	7.24	8.10
Site Runoff (cfs)	0.72	**0.97**	1.23	1.56	1.84	**2.16**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**1.0**	-	-	-	**2.2**

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

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

Proposed Onsite Sub-Basin B Runoff Calculations

Per the landscape plan there is only approx. 4100 sf of native grass. Revise accordingly.

the landscape plan indictes 6,800 sf of gravel storage. Please verify all areas and revise accordingly.

Job | **8/3/2023 15:41**
Pro **ncock Expy** | **JO**
Jur | **A**
Runoff Coefficient **Surface Type** | Urbanization **Non-Urban**

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Paved	11,906	0.27	0.89	0.9	0.92	0.94	0.95	0.96	100%
Roofs	10,000	0.23	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	5,454	0.13	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	9,564	0.22	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**36,925**	**0.85**	**0.57**	**0.60**	**0.63**	**0.68**	**0.70**	**0.72**	**68.4%**

36925.0601

Basin Travel Time

max 100 ft for overland flow for urban land uses per DCMV1 Ch6. revise accordingly.

Shallow Channel Ground Cover: Paved areas/shallow paved swales

$L_{max,Overland}$ 300 ft | C_v 20

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	287	25	-	-	-	-	
Time	50	12.50	0.250	-	2.2	N/A	DCM Eq. 6-8
annel	120	4	0.033	3.6	0.6	-	DCM Eq. 6-9
elized	117	8	0.068	5.9	0.3	-	V-Ditch

t_c **5.0 min.**

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)	2.0	**2.6**	3.2	4.0	4.6	**5.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.0	**2.6**	3.2	4.0	4.6	**5.3**

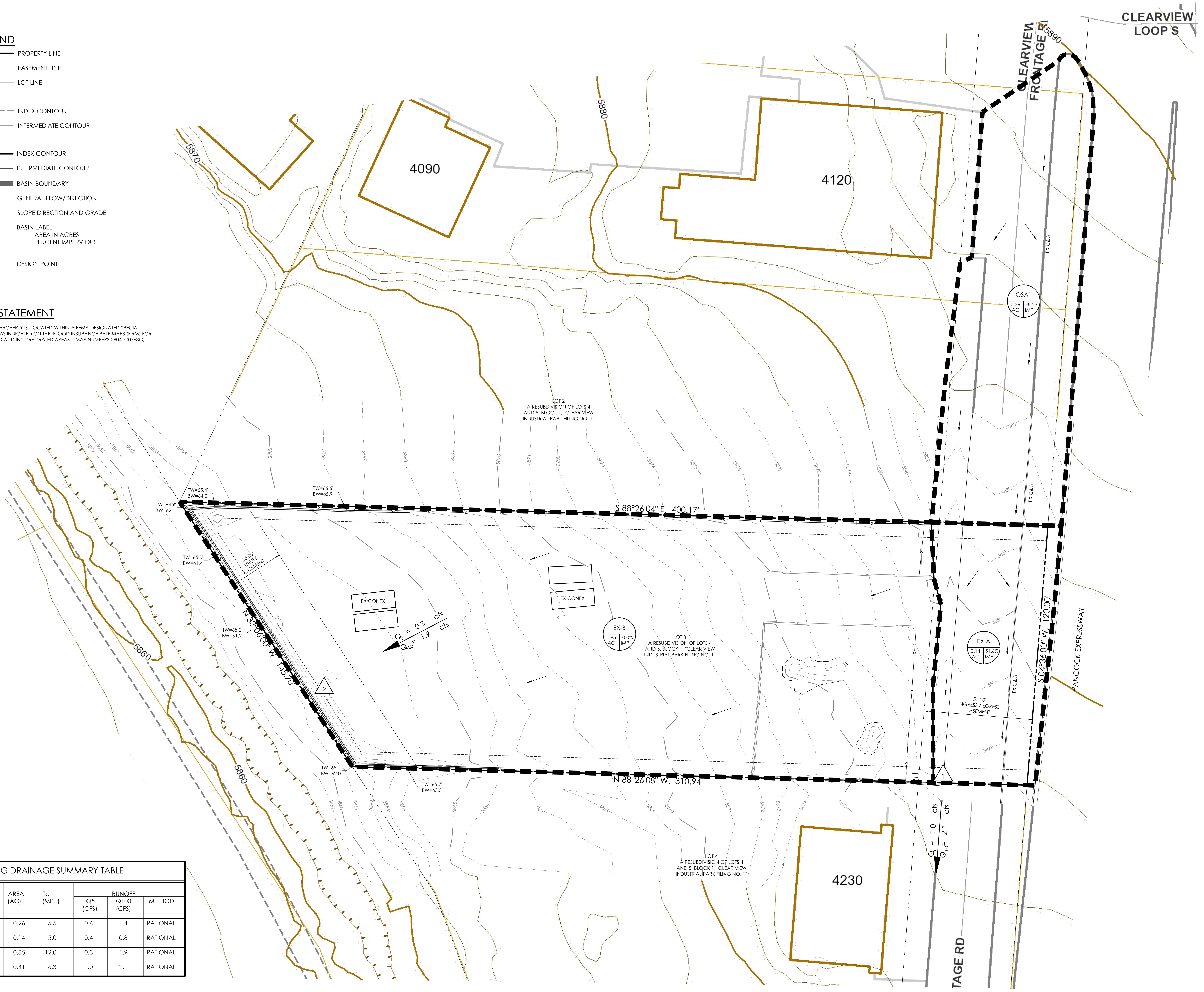
DCM: $I = C1 * \ln(tc) + C2$

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

10 Report Maps

Existing Condition Hydraulic Analysis Map (Map Pocket)
Proposed Condition Hydraulic Analysis Map (Map Pocket)



LEGEND

PROPERTY LINE
EASEMENT LINE
LOT LINE

EXISTING

5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR

PROPOSED

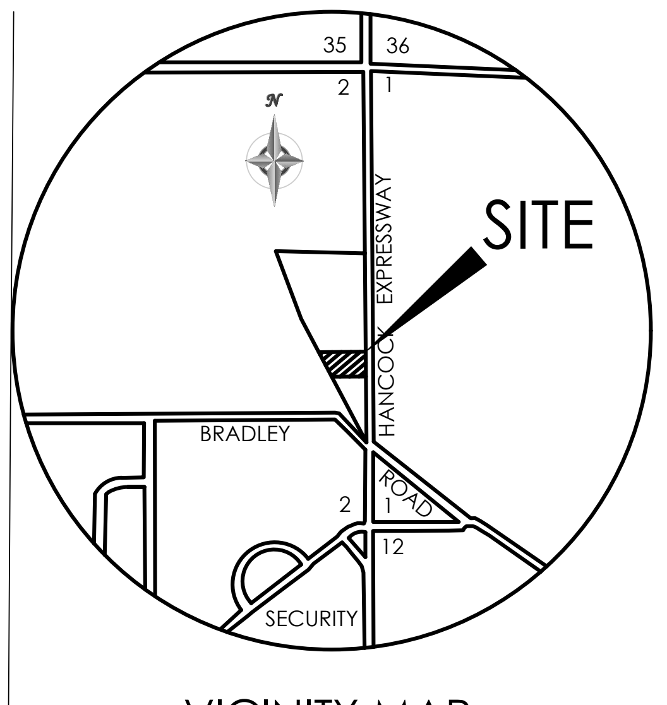
5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR
BASIN BOUNDARY
Q = 19.0 cfs, Q_{100} = 60.0 cfs GENERAL FLOW/DIRECTION
SLOPE DIRECTION AND GRADE
A1 1.0 AC 50% IMP BASIN LABEL
AREA IN ACRES
PERCENT IMPERVIOUS
1 DESIGN POINT

FLOODPLAIN STATEMENT

NO PORTION OF THE SUBJECT PROPERTY IS LOCATED WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA (SFHA) AS INDICATED ON THE FLOOD INSURANCE RATE MAPS (FIRM) FOR EL PASO COUNTY, COLORADO AND INCORPORATED AREAS - MAP NUMBERS 08041C0763G, EFFECTIVE DECEMBER 7, 2018.

EXISTING DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
	OSA1	0.26	5.5	0.6	1.4	RATIONAL
	EX-A	0.14	5.0	0.4	0.8	RATIONAL
DP2 2	EX-B	0.85	12.0	0.3	1.9	RATIONAL
DP1 1	OSA1, EX-A	0.41	6.3	1.0	2.1	RATIONAL



VICINITY MAP
NOT TO SCALE

BENCHMARK

5 0 10 20 40
1" = 20' 1:240

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

REVISIONS

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

4190 HANCOCK
EXPY

EXISTING DRAINAGE
MAP

MVE PROJECT **61179**
MVE DRAWING **EX-DRN**

AUGUST 3, 2023
SHEET 1 OF 1

LEGEND

PROPERTY LINE
EASEMENT LINE
LOT LINE

EXISTING

5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR

PROPOSED

5985 INDEX CONTOUR
84 INTERMEDIATE CONTOUR
BASIN BOUNDARY
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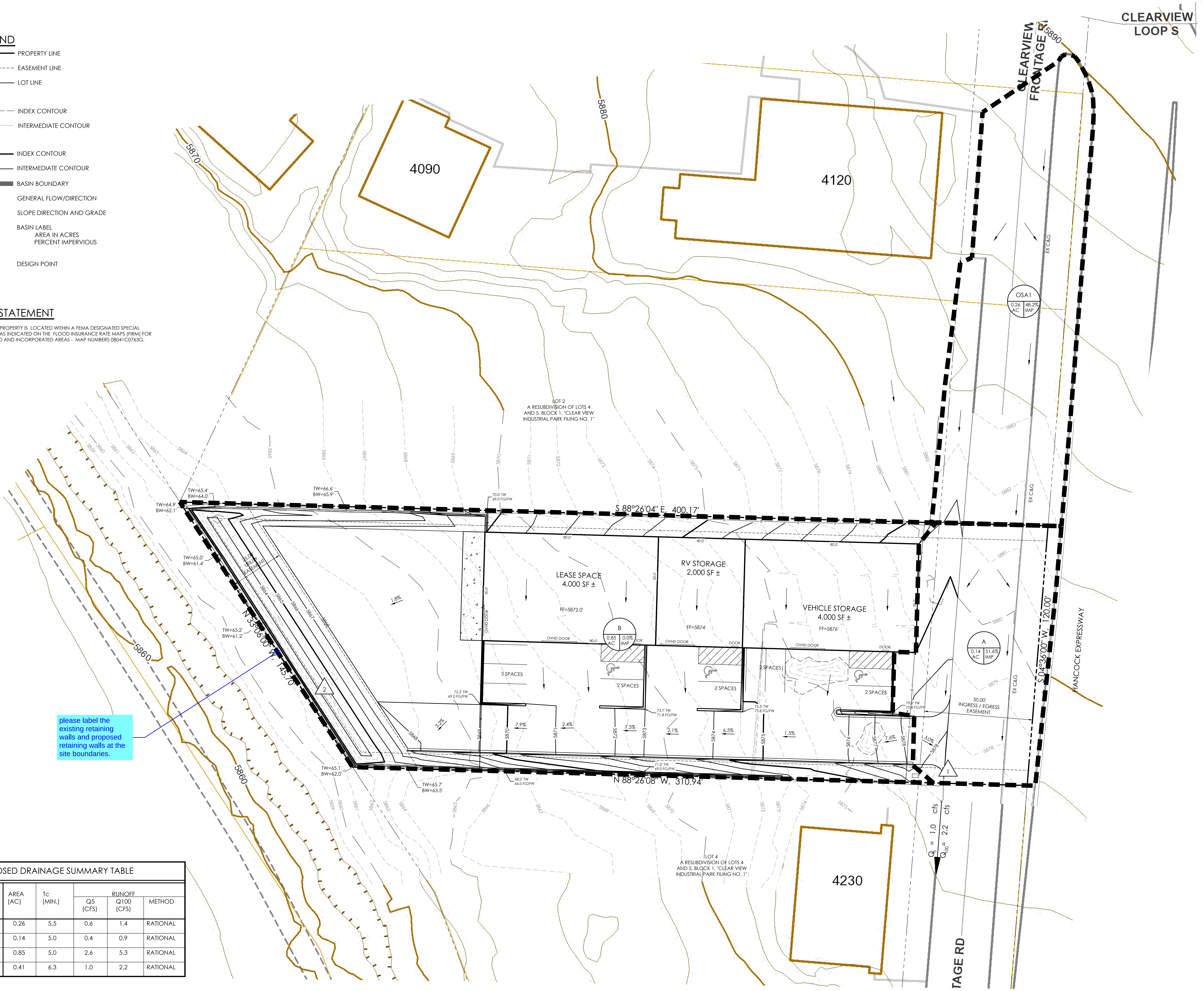
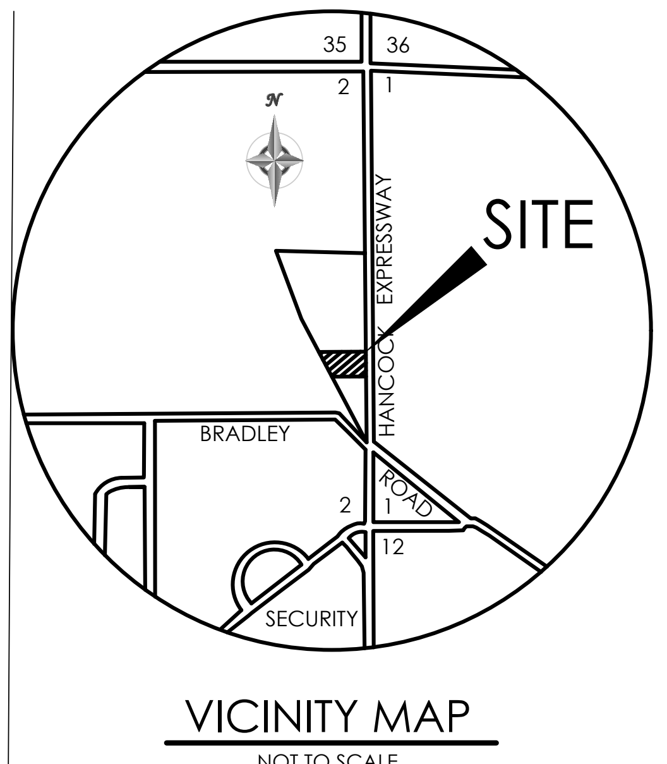


please label the existing retaining walls and proposed retaining walls at the site boundaries.

PROPOSED DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF		
				Q5 (CFS)	Q100 (CFS)	METHOD
	OSA1	0.26	5.5	0.6	1.4	RATIONAL
	A	0.14	5.0	0.4	0.9	RATIONAL
DP2 2	B	0.85	5.0	2.6	5.3	RATIONAL
DP1 1	OSA1, A	0.41	6.3	1.0	2.2	RATIONAL



VICINITY MAP
NOT TO SCALE

BENCHMARK

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1" = 20' 1:240

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REVISIONS

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

4190 HANCOCK EXPY

PROPOSED DRAINAGE MAP

MVE PROJECT **61179**
MVE DRAWING **EX-DRN**

AUGUST 3, 2023
SHEET 1 OF 1