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Final Drainage Report

I68 Training Facility

+/-158.45 Acre Parcel

Project No. 61224

February 14, 2025

PCD File No. PPR2440

Final Drainage Report

for

I68 Training Facility

Project No. 61224

February 14, 2025

prepared for

K. Marc Fitzwater
9758 Vistas Park Drive
Peyton, CO 80831

prepared by

MVE, Inc.
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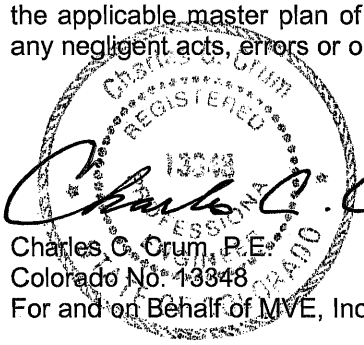
Statements and Acknowledgments

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 El Paso 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.



Charles C. Crum, P.E.
Colorado No. 13348
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.

K. Marc Fitzwater
Owner
9758 Vistas Park Dr.
Peyton, CO 80831

03 Jan 2025
Date

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.
County Engineer / ECM Administrator

Date

Conditions:

Contents

Final Drainage Report

The purpose of this Final Drainage Report is to identify drainage patterns and quantities within and affecting the proposed I68 Training Facility site. The I68 Training facility is approved as a 'Special Use AL249' on 08/08/24 has been split into four Phases. Phases 1, 2, & 3 will be composed of six Flat Shooting Ranges and one long distance range. Phase 4 will consist of the Connex City, Administrative Building, Lodging Building, Operational Support buildings, and Driving Track. This Final Drainage Report will address Phases 1, 2, & 3. Phase 4 will be addressed and submitted in the future as a separate Site Development Plan and Final Drainage Report. The development project is to build an elite firearms training facility. The report will identify specific solutions to drainage concerns 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.

1 General Location and Description

1.1 Location

The proposed I68 Training Facility site is a tract of property located in Section 7, Township 13 South, Range 61 W of the 6th P.M. in El Paso County, Colorado. The 158.45 acre site is situated to the west of Calhan Highway, and this would be the road in which the site will be accessed from. The property is currently zoned as A-35.

The properties to the north and to the south of the site are also zoned as A-35 and are undeveloped. To the west of the site is Liberty Road.

A **Vicinity Map** is included in the **Appendix**. The entire site is located in El Paso County's Upper Big Springs Creek Drainage Basin.

1.2 Description of Property

The I68 Training Facility site 158.45 acres and is zoned A-35 (Agriculture). The property is undeveloped. El Paso County Tax Assessor's Schedule Number: 1300000712. The proposed I68 Training Facility includes a gravel access driveway, gravel parking areas, 6 shooting range areas each with a shooting overhead cover structure and one long distance shooting range.

The ground cover, which is in good condition, consists of native grasses. The land use is categorized as grazing.

The existing site topography slopes to the south-west with grades that range from 3% to 5%.

There is a large drainage path on the western portion of the I68 Training Facility site. Also, small drainage swales exist on the southern portion of said site and exiting at the southern site boundary. No construction is proposed in said large drainage path and small drainage swale areas. The will

remain undisturbed. For the entire site, all storm runoff flows drain to the south-west. There is no storm drain system in the surrounding area. The site is located in El Paso County's Upper Big Springs Creek Drainage Basin and the flows from the site flow south-west and eventually enter Big Springs Creek.

According to the National Resource Conservation Service, there are three (3) soil types in the I68 Training Facility site. Yoder gravelly-sandy loam (map unit 110) makes up about 80.9% of the site, Truckton sandy loam (map unit 97) makes up about 18.7% of the site and Bresser Sandy Loam (map unit 11) makes up about 0.3% of the soil on the site.

Yoder gravelly sandy loam is deep and somewhat excessively drained. Permeability is moderately rapid, surface runoff is medium to rapid, and the hazard of erosion is moderate. Yoder gravelly sandy loam is classified as being part of Hydrologic Soil Group A.

Truckton sandy loam is deep and well drained. Permeability is moderately rapid, surface runoff is slow to medium, and the hazard of erosion is moderate. Truckton sandy loam is classified as being part of Hydrologic Soil Group A.

The other soil type located on the site is Bresser sandy loam and this soil type makes up a very small portion of the site @ 0.3%. The soil is deep and well drained. Permeability is moderate, surface runoff is slow, and the hazard of erosion is moderate. Bresser sandy loam is classified as being part of Hydrologic Soil Group B.

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]

2 Drainage Basins and Sub-Basins

2.1 Major Basin Descriptions

The I68 Training Facility site is located in the Upper Big Springs Creek Drainage Basin (CHBG0400). No Drainage Basin Planning Studies are on file for this drainage basin.

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRM), effective on December 7, 2018.[3] The proposed training facility is included in the Community Panel Numbered 08041C0625 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**.

2.2 Sub-Basin Description

The existing and developed drainage patterns of the I68 Training Facility project are described by four (4) on-site drainage basins and five (5) offsite basins. All of these basins are previously undisturbed. All existing basin delineations and data are depicted on the attached **Existing Drainage Map**.

2.2.1 Existing Drainage Patterns (Off-Site)

Off-site sub-basin OS-1 is located north and to the east end of the site, containing pasture/meadow areas, drains south onto the site. This flow enters the onsite sub-basin EX-A and continues through the site.

Off-site sub-basin OS-2 is located north of the site, containing pasture/meadow areas, drains south onto the site. This flow enters the onsite sub-basin EX-B and continues through the site.

Off-site sub-basin OS-3 is located north of the site and to the east of off-site sub-basin OS-2, containing pasture/meadow areas, drains south onto the site. This flow enters the onsite sub-basin EX-C and continues through the site.

1 WSS
2 OSD
3 FIRM

Off-site sub-basin OS-4 is located north and to the west end of the site, containing pasture/meadow areas, drains south onto the site. This flow enters the onsite sub-basin EX-D and continues through the site.

Off-site sub-basin OS-5 is located north and to the west end of the site, containing pasture/meadow areas, drains south onto the site. This flow enters the onsite sub-basin EX-D and continues through the site.

2.2.2 Existing Drainage Patterns (On-Site)

Sub-basin EX-A is to the eastern portion of the site, containing pasture/meadow, drains south. The combined flows of sub-basin OS-1 and EX-A drains to the south and exits the site into the adjacent property.

Sub-basin EX-B is to the eastern-middle portion of the site, containing pasture/meadow, drains south-west. The combined flows of sub-basin OS-2 and EX-B drains to the south-west and exits the site into the adjacent property.

Sub-basin EX-C is to the western-middle portion of the site, containing pasture/meadow, drains south. The combined flows of sub-basin OS-3 and EX-C drains to the south and exits the site into the adjacent property.

Sub-basin EX-D is to the western portion of the site, containing pasture/meadow, drains south-west. The combined flows of sub-basin OS-4 and EX-D drains to the south-west and exits the site into the adjacent property.

3 Drainage Design Criteria

3.1 Development Criteria Reference

This Final Drainage Report for I68 Training Facility 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.

3.2 Previous Drainage Studies

No drainage reports were found for any of the surrounding developments.

3.3 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 consistent in ground cover with prairie type attributes. The larger off-site basin OS-4 drains into the future Phase 4 area which will be planned in the future with a Phase 4 Site Development Plan and a Final Drainage Report addressing calculation requirements. The calculations utilizing the Rational Method for this report are consistent with the western non-developed area of this submittal. “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

4 DCM Section 4.3 and Section 4.4
5 CS DCM Vol 1
6 CS DCM Vol 2
7 WSS

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 allow for the development of Phases 1, 2, & 3 of the 158.45+/- acres while maintaining the existing drainage patterns for the remainder the site. Phase 4 will be addressed and submitted in the future as a separate Site Development Plan and Final Drainage Report as previously stated. The site will be in compliance with the County's Stormwater Management regulations without the need for permanent water quality treatment facilities. Major and minor storm flows will continue to be safely conveyed through the site and downstream.

The site is expected to be constructed in several Phases as detailed in the Site Development Plan. This Drainage Report reflects the ultimate build out conditions Phases 1, 2, & 3 of the project.

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**. A Drainage map for the hydrology are also included in the **Appendix**.

4.2 Existing Hydrologic Conditions

The I68 Training Facility site is impacted by nine (9) existing sub-basins, four (4) on-site and five (5) off-site. The site generally drains south and southwest. The sub-basins are described in more detail below.

Design Point 1 – DP-1 Off-site sub-basin OS-1 (25.98 acres) is located north at the northeast end of the site, containing pasture/meadow areas, draining south onto the site. This flow enters the on-site sub-basin EX-A (19.76 acres) containing pasture/meadow, and continue flowing southerly through the site. The combined flows of sub-basins OS-1 and EX-A are Q_5 = 4.7 cfs and Q_{100} = 34.8 cfs draining to the south and exiting the site at **DP-1** into the adjacent property.

Design Point 2 – DP-2 Off-site sub-basin OS-2 (111.10 acres) is located north of the site, containing pasture/meadow areas, draining south onto the site. This flow enters the on-site sub-basin EX-B (55.08 acres) containing pasture/meadow, and continue flowing southerly through the site. The combined flows of sub-basins OS-2 and EX-B are Q_5 = 11.5 cfs and Q_{100} = 84.0 cfs draining to the southwest and exiting the site at **DP-2** into the adjacent property.

Design Point 2A – DP-2A On-site sub-basin EX-B1 (27.22 acres) is located adjacent to the southerly boundary within the eastern third of the site, containing pasture/meadow areas. The flows of sub-basins EX-B1 are Q_5 = 5.4 cfs and Q_{100} = 39.4 cfs draining to the southerly and exiting the site at **DP-2A** into the adjacent property.

Design Point 3 – DP-3 Off-site sub-basin OS-3 (17.00 acres) is located north of the site and to the west of sub-basin OS-2, containing pasture/meadow areas, draining south onto the site. This flow enters the on-site sub-basin EX-C (48.04 acres) containing pasture/meadow, and continues flowing southerly through the site. The combined flows of sub-basins OS-3 and EX-C are Q_5 = 10.6 cfs and Q_{100} = 77.8 cfs draining to the southwest and exiting the site at **DP-3** into the adjacent property.

Design Point 4 – DP-4 Off-site sub-basins OS-4 (157.08 acres) and OS-5 (11.95 Acres) are located at the northwest end of the site, containing pasture/meadow areas, draining south onto the site. This flow enters the on-site sub-basin EX-D (35.58 acres) containing pasture/meadow, and continues flowing southwesterly through the site. The combined flows of sub-basins OS-4, OS-5, and EX-D are Q_5 = 10.0 cfs and Q_{100} = 73.3 cfs draining to the southwest and exiting the site at **DP-4** into the adjacent property.

8 DCM

Developed Hydrologic Conditions

The I68 Training Facility site is impacted by thirteen (13) sub-basins, eight (8) on-site and the existing five (5) off-site. The site generally drains south and southwest. The sub-basins are described in more detail below.

Design Point A1 – DP-A1 Off-site sub-basin OS-1 (25.98 acres) is located north at the northeast end of the site, containing pasture/meadow areas, draining south onto the site. This flow enters the on-site sub-basin PR-A1 (1.35 acres) containing pasture/meadow, and continues flowing southerly. The combined flows of sub-basin OS-1 and PR-A1 are Q_5 = 3.4 cfs and Q_{100} = 25.0 cfs draining to the proposed 24" CM Pipe w/ flared end sections. Said pipe to be placed under the proposed private gravel driveway exiting said pipe via proposed 7'W x 13'L riprap outfall at **DP-A1** into sub-basin PR-A2. Approximately Q_{100} =10 cfs over tops the private drive at a depth of 0.11'. The private driveway will be maintained by the owner. Calculations for pipe and outfall riprap is included in the **Appendix.**

Design Point A2 – DP-A2 On-site sub-basin PR-A2 (18.41 acres) is located along the eastern boundary of the site, containing pasture/meadow areas with said private driveway and 24" culvert combining with flows of **DP-A1** and draining southerly through the site. The combined flows of **DP-Al** and sub-basin PR-A2 are Q_5 = 5.1 cfs and Q_{100} = 34.9 cfs drain southerly and exit the site at **DP-A2** into the adjacent property via the existing natural swale.

Design Point B – DP-B On-site sub-basin PR-B (31.17 acres) is located in the eastern-middle portion of the site. Sub-basin PR-B contains meadow/pasture, roofs from the shooting overhead cover structure, lawn/turf field, landscaping, private gravel driveway, and gravel parking areas. The Hesco Barriers adjacent to the 'Long Distance Shooting Range' will be spaced 10' between sections to allow natural drainage flow. Storm runoff flows through these 10' spacing areas range from Q_{100} = 0.6 cfs to Q_{100} = 0.9 cfs with non-erosive velocities from 1.0 ft/sec to 1.3 ft/sec.

Sub-basin EX-B produces peak existing storm runoff rates of approximately Q_5 = 5.4 cfs and Q_{100} = 39.4 cfs. Sub-basin PR-B runoff rates of Q_5 = 7.9 cfs and Q_{100} = 45.6 cfs (developed flows) that will drain southerly and onto the adjacent property over the length of the southern property line and the flow is not concentrated. This is an increase of Q_5 = 2.5 cfs and Q_{100} = 6.2 cfs. Comparing the change in flows for the existing and proposed conditions in this sub-basin, the difference is minimal. The proposed construction of water basins within the three (3) shooting ranges further limits peak storm runoff. The capture volumes of about 20,250 CF act as a form of detention and thereby reducing the Q_5 and Q_{100} outflows by about one half. These increases have no negative impact on downstream areas. The overland flows generally sheet flow off of the site to the south.

Design Point C1 – DP-C1 OS-2 (114.90 acres) is located north of the site, containing pasture/meadow areas, draining south onto the site. This flow enters the on-site sub-basin PR-C1 (4.49 acres) containing pasture/meadow, and the proposed shooting berm directing the flows westerly and than southerly via a proposed swale formed by the proposed shooting berms. The disturbed areas will be re-vegetated and no issue is seen with erosive velocities. Velocities in the area along the northerly toe of the proposed berm construction disturbance are in the range of 3.1 ft/sec to 6.0 ft/sec and not seen as erosive once re-vegetation is established. The velocities in the proposed central channel directing storm water flows south toward **DP-C1** are in the range of 3.8 ft/sec to 6.6 ft/sec and seen to be erosive until re-vegetation is established. Erosion protection consisting of straw bales will be placed within the channel section to control erosion. The combined flows of sub-basin OS-2 and PR-C1 are Q_5 = 8.7 cfs and Q_{100} = 63.9 cfs draining to the proposed 2 - 24" CM Pipes w/ flared end sections. Said pipes are to be placed under the proposed private gravel driveway exiting the pipes via proposed 9'W x 13'L riprap outfall at **DPC1** into sub-basin PR-C2. Approximately Q_{100} = 33 cfs over tops the private drive at a depth of 0.36'. The private driveway will

be maintained by the owner. Calculations for shooting berm swales, pipes and outfall riprap is included in the **Appendix.**

Design Point C2 – DP-C2 On-site sub-basin PR-C2 (14.10 acres) is located in the middle portion of the site. Sub-basin PR-C2 contains meadow/pasture, roofs from the shooting overhead cover structure, lawn/turf field, landscaping, private gravel driveway, and gravel parking areas. The Hesco Barriers adjacent to the 'Long Distance Shooting Range' will be spaced 10' between sections to allow natural drainage flow. Where the existing natural swale traverses the north & south Hesco Barriers a riprap swale will be constructed at each crossing. These riprap swales will be 20' x 20' narrowed to 10' in between the Hesco Barriers. This will eliminate potential erosion at the narrowed swale areas once the re-vegetation is established. Calculations for these riprap swales are included in the **Appendix.**

The existing **DP-2** produces peak existing storm runoff rates of approximately Q_5 = 9.7 cfs and Q_{100} = 71.3 cfs. The proposed **DP-C2** runoff rates of Q_5 = 8.8 cfs and Q_{100} = 62.1 cfs (developed flows) that will drain southerly and onto the adjacent property in an existing defined shallow swale. This is an decrease of Q_5 = 0.9 cfs and Q_{100} = 9.2 cfs. Comparing the change in the flows for the existing and proposed conditions in this sub-basin, the difference is minimal and less. The proposed construction of a water basin within the shooting range further limits peak storm runoff. The capture volumes of about 7,750 CF acts as a form of detention and thereby reducing the Q_5 and Q_{100} outflows. These decreases have no negative impact on downstream areas. The flows leave the site to the south in an existing defined shallow swale which is not showing any signs of erosion. Calculation for this existing swale is included in the **Appendix.**

Design Point D1 – DP-D1 OS-3 (17.00 acres) is located north of the site, containing pasture/meadow areas, draining south onto the site. This flow enters the on-site sub-basin PR-D1 (2.52 acres) containing pasture/meadow, and the proposed shooting berm directing the flows westerly via a proposed swale formed on the north side of the proposed shooting berm. The velocities in the swale are in the range of 3.8 ft/sec and not seen as erosive once the vegetation is established. The combined flows of sub-basin OS-3 and PR-D1 are Q_5 = 3.7 cfs and Q_{100} = 27.0 cfs draining within the proposed swale to outfall at **DP-D1** into sub-basin PR-D2. Calculations for the shooting berm swale are included in the **Appendix.**

Design Point D2 – DP-D2 On-site sub-basin PR-D2 (40.92 acres) is located along the western boundary of the site. Sub-basin PR-D2 contains meadow/pasture, roofs from the shooting overhead cover structure, lawn/turf field, landscaping, private gravel driveway, and gravel parking areas combining with flows of **DP-D1,** off-site basin OS-4 & OS-5 with all draining southerly through the site. These combined developed flows at **DP-D2** are Q_5 = 10.1 cfs and Q_{100} = 72.6 cfs which drain southwesterly and onto the adjacent property via an existing drainageway. This is an increase of Q_5 = 0.1 cfs and an decrease of Q_{100} = 0.7cfs. These comparative change in flows for the existing **DP-4** and proposed **DP-D2** conditions is minimal, thus, having no negative impact on downstream areas. The flows are generally flow overland to the existing natural drainageway and off of the site to the south. Their are no construction activities that would effect the existing drainageway in the western portion of the site. Flows leave the site southwesterly in the existing drainageway not showing any signs of erosion. Calculation for this existing drainageway is included in the **Appendix.**

Design Point E – DP-E On-site sub-basin PR-E (36.66 acres) is located in the western-middle portion of the site. Sub-basin PR-E contains meadow/pasture, roofs from the shooting overhead cover structure, lawn/turf field, landscaping, gravel driveway, and gravel parking areas. The Hesco Barriers adjacent to the 'Long Distance Shooting Range' will be spaced 10' between sections to allow natural drainage flow. Storm runoff flows through these 10' spacing areas range from Q_{100} = 0.6 cfs to Q_{100} = 0.9 cfs with non-erosive velocities from 1.0 ft/sec to 1.3 ft/sec.

Sub-basin **PR-E** en-compasses about 5% of sub-basin EX-B and 85% of sub-basin **EX-C** producing peak existing storm runoff rates of approximately Q_5 = 8.3 cfs and Q_{100} = 62.0 cfs. The developed flows at **DP-E** runoff rates of Q_5 = 9.0 cfs and Q_{100} = 53.6 cfs (developed flows) will drain southerly and onto the adjacent property over the length of the southern property line and the flow is not concentrated. This is a decrease of Q_5 = 1.6 cfs and a decrease of Q_{100} = 24.2 cfs. There is less flow for the proposed 100-yr. flows in this basin due to a difference in areas and the time of

concentrations. The area in the proposed basin condition is smaller and this is due to the proposed site grading which also changes the drainage path lengths. Based on the rational equation, the area and the time of concentration value, resulted in less flow volume. By comparing the change in flows for the existing and proposed conditions in this sub-basin, the difference is minimal even with the reduced for the 100-yr event, thus, having no negative impact on downstream areas. The overland flows continue to sheet flow off of the site to the south.

4.3 Erosion Control

Proposed grading for the site will be associated with the shooting berms construction, and private gravel driveway and gravel parking area installations. Control measures (CM's) for each phase of the project shall be installed individually for each phase and shall include temporary silt fencing.

4.4 Four Step Process

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.

The entire site consists of low impact development which is excluded from Post Construction Stormwater Management requirements by ECM I.7.1.B.5 due to the low development density as an agricultural zoned land, greater than 2.5 acres and having a total tract impervious area of less than 10%. There is no public roadway being dedicated or constructed as part of this project. Runoff Reduction Practices are employed in this project. Impervious surfaces have been reduced as much as practically possible. There is only minimal hard surfaces proposed. Minimized Directly Connected Impervious Areas (MDCIA) is employed on the project because runoff passes through an open space pasture/meadow area before leaving the site.

The site is not subject to Post Construction Stormwater Treatment requirements, with one exception. The portion of the shooting berms that surround the shooting range will not be vegetated due to the way maintenance procedures will be conducted. Therefore, these areas that will not be seeded with vegetative cover and will include water quality treatment using temporary sediment basins for treatment. The temporary sediment basins will be permanent and are shown on the Grading & Erosion Control Plans.

2) There are no drainage paths on the site that are required to be stabilized as they are well vegetated with no visual erosion.

3) The project contains no potentially hazardous uses. The site is exempted from the use of WQCV CMs by ECM 1.7.1.B.5 by virtue of the large agricultural lands zoning of the site and having percent imperiousness of less than 10%. Phases 1, 2, & 3 have a imperviousness of 4.1%. As previously stated, this Final Drainage Report addresses Phases 1, 2, & 3. Phase 4 will be addressed and submitted in the future as a separate Site Development Plan with a Phase 4 Final Drainage report which may require WQCV CMs.

4) The agricultural tract of land is not anticipated to contain storage of potentially harmful substances or use of potentially harmful substances. No site specific or other source control CMs are required.

5 Drainage and Bridge Fees

The site is located within the Upper Big Springs Creek Drainage Basin, El Paso Basin Number CHBG0400, which which has no DBPS. There are no fees associated with this basin.

6 Conclusion

This Final Drainage Report presents existing and proposed drainage conditions for the proposed I68 Training Facility project for Phases 1, 2, & 3. The development will have negligible and inconsequential effects on the existing site drainage and drainage conditions downstream.

The site is exempted from the use of WQCV CMs by ECM 1.7.1.B.5 by virtue low development density as an agricultural zoned land, greater than 2.5 acres and having a total tract impervious area of less than 10%. The entire site upon final development of Phases 1, 2, & 3 is 4.1% impervious. The site is not subject to Post Construction Stormwater Treatment requirements.

The storm water runoff from the existing hydrologic conditions produce peak existing storm runoff rates of approximately Q_5 = 46.0 cfs and Q_{100} = 294.0 cfs as compared to developed hydrologic conditions producing peak developed storm runoff rates of approximately Q_5 = 42.7 cfs and Q_{100} = 275.5 cfs. The net decrease of Q_5 = 3.3 cfs and Q_{100} = 18.5 cfs which is very minimal and coincides with the net increase of 4.1% imperviousness and longer developed travel times. With such a negligible decrease in stormwater flows from the site, detention will not be necessary for the proposed development and will not be provided. The proposed project will not, with respect to stormwater runoff, negatively impact the adjacent properties and downstream properties.

References

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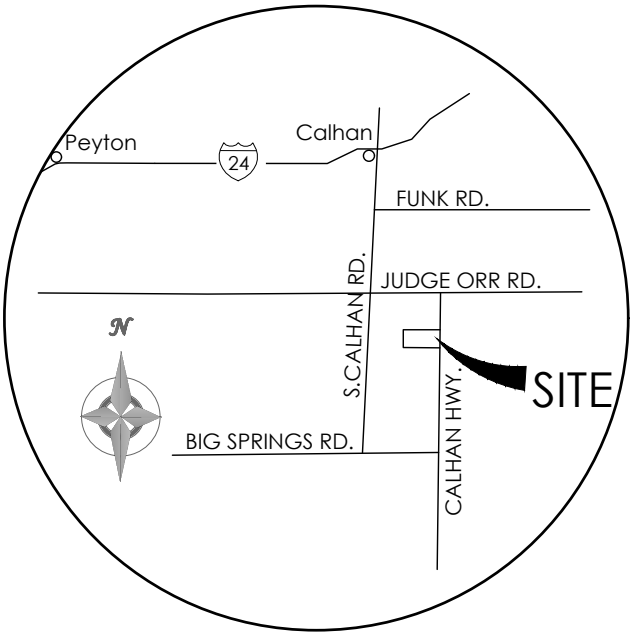
Appendices

1 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

FEMA

104°16'22"W 38°56'11"N

104°15'45"W 38°55'43"N

Feet

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

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 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 10/9/2024 at 4:58 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.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eff. 12/7/2018
ENTIRE SITE BOUNDARY

United States Department of Agriculture

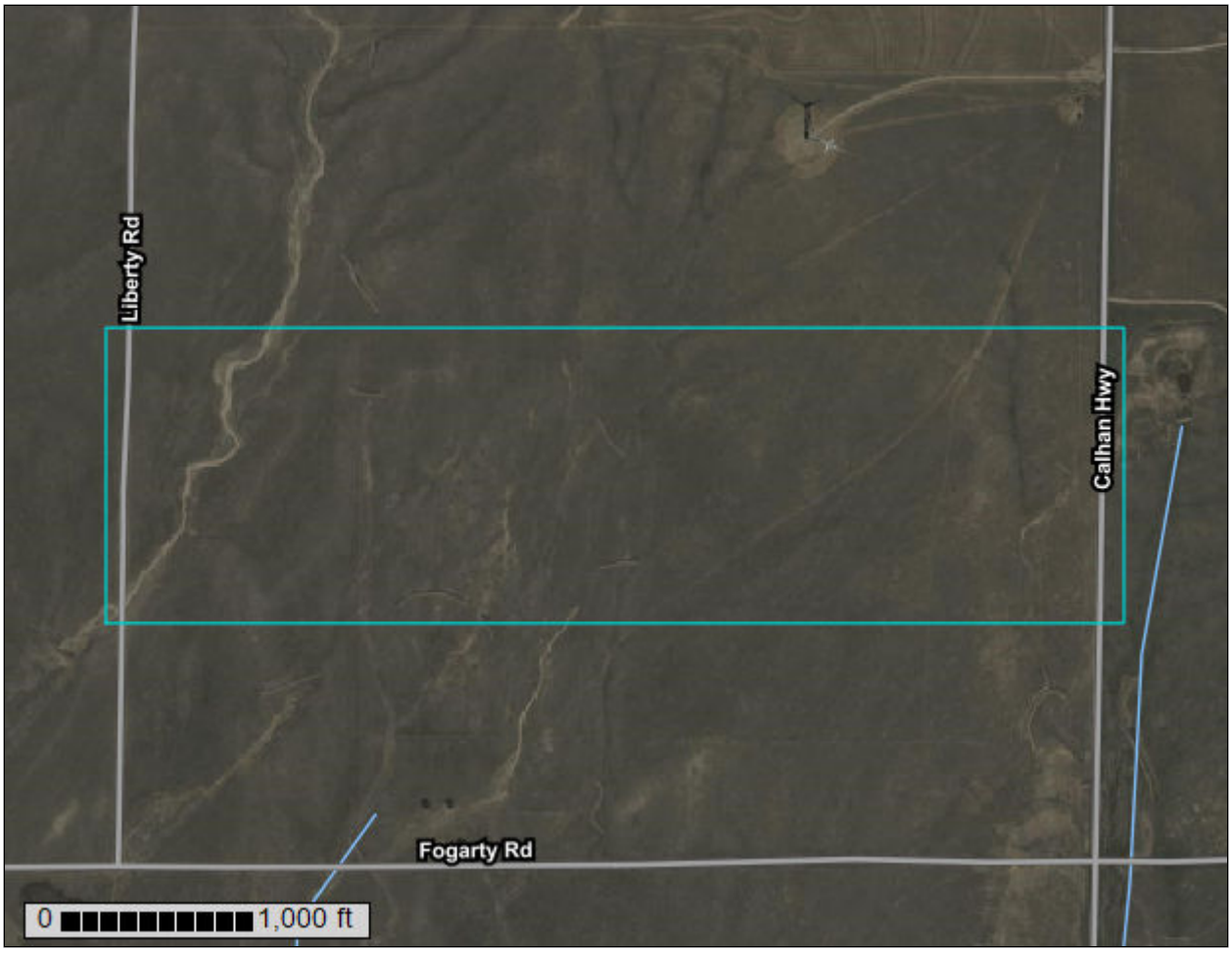
NRCS

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

168 Training Facility



October 9, 2024

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

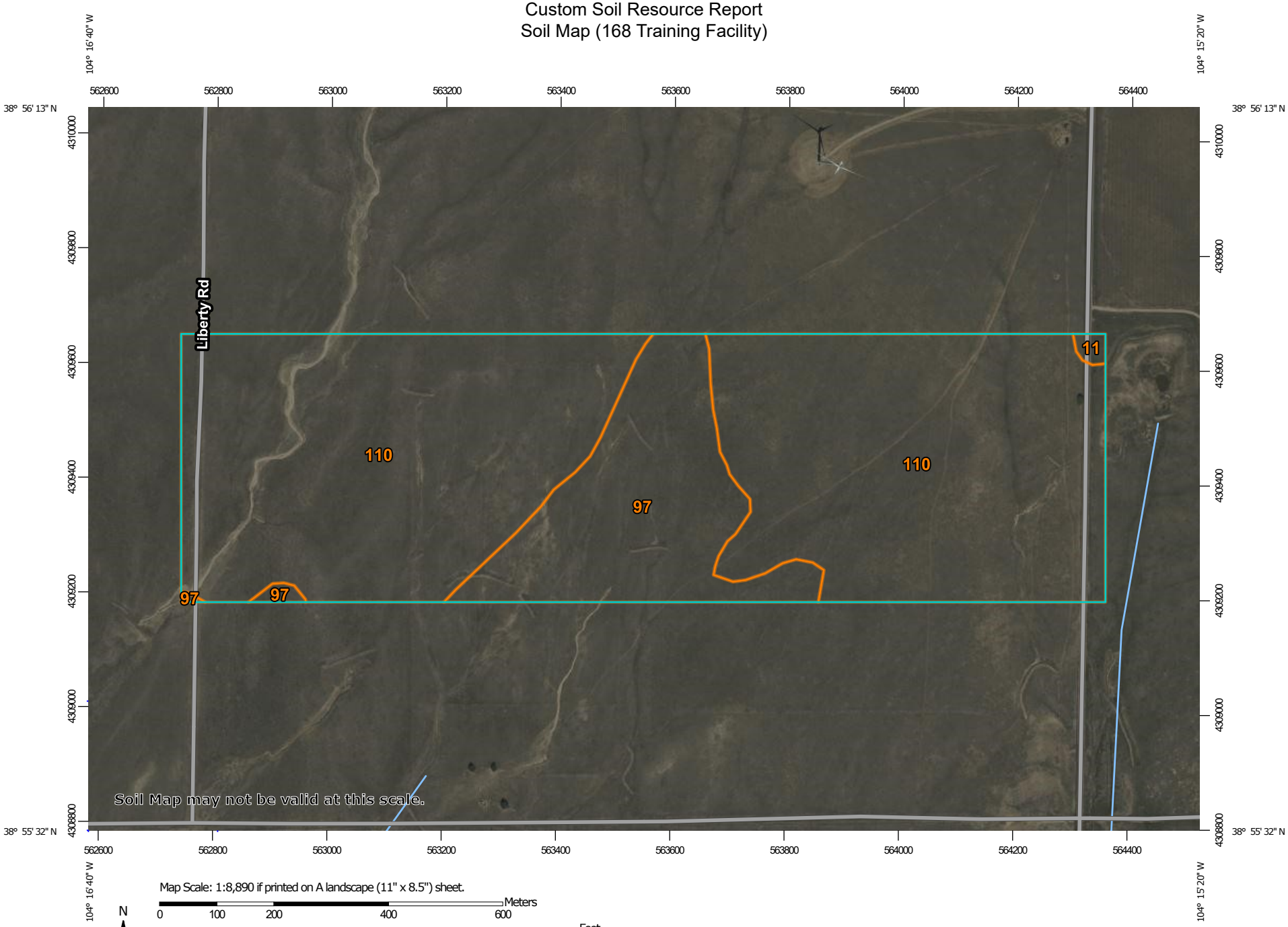
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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

Soil Map

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

Custom Soil Resource Report
Soil Map (168 Training Facility)



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 22, Sep 3, 2024

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 (168 Training Facility)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
11	Bresser sandy loam, cool, 0 to 3 percent slopes	0.6	0.3%
97	Truckton sandy loam, 3 to 9 percent slopes	35.2	18.7%
110	Yoder gravelly sandy loam, 8 to 25 percent slopes	151.8	80.9%
Totals for Area of Interest		**187.6**	**100.0%**

Map Unit Descriptions (168 Training Facility)

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

11—Bresser sandy loam, cool, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tlph
Elevation: 5,850 to 6,880 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 100 to 130 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

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

Description of Bresser, Cool

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Tertiary aged alluvium derived from arkose

Typical profile

Ap - 0 to 5 inches: sandy loam
Bt1 - 5 to 8 inches: sandy loam
Bt2 - 8 to 27 inches: sandy clay loam
Bt3 - 27 to 36 inches: sandy loam
C - 36 to 80 inches: loamy coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

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

Minor Components

Truckton

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Yoder

Percent of map unit: 5 percent
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

97—Truckton sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2x0j2
Elevation: 5,300 to 6,850 feet
Mean annual precipitation: 14 to 19 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 85 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Truckton

Setting

Landform: Hillslopes, interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: 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: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline (0.1 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.6 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: 8 percent
Landform: Hillslopes, 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: 7 percent
Landform: Low hills, interfluves
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

110—Yoder gravelly sandy loam, 8 to 25 percent slopes

Map Unit Setting

National map unit symbol: 367f
Elevation: 6,200 to 6,900 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

Yoder and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Yoder

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Noncalcareous alluvium derived from arkose

Typical profile

A - 0 to 6 inches: gravelly sandy loam
Bt - 6 to 12 inches: gravelly sandy clay loam
2C - 12 to 60 inches: very gravelly loamy coarse sand

Properties and qualities

Slope: 8 to 25 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 (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XY214CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

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

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Typically, the surface layer is dark grayish brown sandy loam about 10 inches thick. The subsoil is dark grayish brown and brown sandy loam about 26 inches thick. The substratum is light brownish gray gravelly sandy loam.

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; Truckton sandy loam, 0 to 3 percent slopes; Ellicott loamy coarse sand, 0 to 5 percent slopes; and Ustic Torrifluvents, loamy.

Permeability of this Blendon 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.

Most areas of this soil are used as rangeland, but some small areas are cultivated. Some homesite development has taken place on this soil.

Native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed 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 generally suited to this soil. Soil blowing is the principal 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 well 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 homesites. The main limitation for the construction of local roads and streets is a moderate frost action potential. Roads can be designed to overcome this limitation. Capability subclass IIIe.

11—Bresser sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in arkosic alluvium and residuum on terraces and uplands. Elevation ranges from 6,000 to 6,800 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 subsoil is brown sandy clay loam about 31 inches thick. The substratum is light yellowish brown loamy coarse sand to a depth of 60 inches.

Included with this soil in mapping are small areas of Truckton sandy loam, 0 to 3 percent slopes; Ascalon sandy loam, 1 to 3 percent slopes; Fort Collins loam, 0 to 3 percent slopes; and Yoder gravelly sandy loam, 1 to 8 percent slopes. Some areas of Ustic Torrifluvents, loamy, occur along narrow drainageways.

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

Most areas of this soil are cultivated. The remaining acreage is used as rangeland.

A rotation of winter wheat and fallow is used because precipitation is insufficient for annual cropping. A feed-grain crop such as millet or sorghum can be substituted for wheat in some years. Crop residue management and minimum tillage are needed to control erosion.

Native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed 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 generally suited to this soil. Soil blowing is the principal 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 well 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. 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 homesites. Limiting the disturbance of the soil and the removal of existing plant cover during construction helps to control erosion. Capability subclass IIIc.

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.

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 slopes; and Truckton sandy loam, 0 to 3 percent slopes. Also included are small areas of soils that have arkosic sandstone or shale at a depth of less than 40 inches.

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 to medium, and the hazards of erosion and soil blowing are moderate.

More than half of this soil is used as rangeland, for wildlife habitat, and as homesites. The rest, consisting of the less sloping areas, is used for wheat and sorghum. Rangeland or pastureland is the most suitable use because the permanent plant cover protects the soil.

This soil is well suited to the production of native vegetation suitable for grazing. Native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover from this soil. Interseeding improves 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 well 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 for 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.

The main limitation of this soil for construction is frost-action potential. Special designs for roads are needed to overcome this limitation. Because of the sandy nature of the soil, practices must be provided to minimize surface runoff and thus keep erosion to a minimum. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Capability subclasses VIe, nonirrigated, and IVe, irrigated.

98—Truckton-Blakeland complex, 9 to 20 percent slopes. These strongly sloping to moderately steep soils are 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.

The Truckton soil makes up about 60 percent of the complex, the Blakeland soil about 25 percent, and other soils about 15 percent.

Included with these soils in mapping are areas of Bresser sandy loam, 5 to 9 percent slopes, and Yoder gravelly sandy loam, 8 to 25 percent slopes.

The Truckton soil is deep and well drained. It formed in alluvium and residuum weathered from arkosic sedimentary rock. 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.

Permeability of the Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium to rapid, and the hazard of erosion is moderate to high. Soil slippage is common on the upper part of slopes.

The Blakeland soil is deep and somewhat excessively drained. It formed in arkosic sandy alluvium and eolian sediment derived from arkosic sedimentary rock. Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The underlying material is brown loamy sand about 16 inches thick; it grades to pale brown sand that extends to a depth of 60 inches or more.

Permeability of the Blakeland soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is medium, and the hazard of erosion is moderate to high, and the hazard of soil blowing is high. Soil slippage is common on the upper part of slopes.

The soils in this complex are used for grazing livestock and wildlife habitat.

These soils are suited to the production of native vegetation suitable for grazing. The native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread.

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

Soil blowing is the main limitation for the establishment of trees and shrubs on these soils. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Trees need to be planted in shallow furrows on the Blakeland soil because of its loose, sandy surface layer. 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, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac and lilac.

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.

The main limitation of this soil for excavations is the high gravel content, which causes cut banks to cave in. Excavations for underground utilities need to be designed to overcome this limitation. Capability subclass VIe.

110—Yoder gravelly sandy loam, 8 to 25 percent slopes. This deep, well drained, gravelly soil formed in noncalcareous alluvium derived from arkosic deposits on uplands. Elevation ranges from 6,200 to 6,900 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 6 inches thick. The subsoil is brown gravelly sandy clay loam about 6 inches thick. The substratum is very gravelly loamy coarse sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Louviers silty clay loam, 3 to 18 percent slopes, and Truckton-Bresser complex, 5 to 20 percent slopes.

Permeability of this Yoder soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is medium to rapid, and the hazard of erosion is moderate. Some gullies have developed along drainageways, and there is some soil slippage on the steeper slopes.

This soil is used as rangeland and for wildlife habitat.

The native vegetation is mainly western wheatgrass, side-oats grama, needleandthread, and little bluestem. The most prominent shrub on this soil is true mountain-mahogany.

Vegetation is very difficult to reestablish on this soil if the native vegetation is destroyed. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are suited to this soil. Low available water capacity is the main limitation for the establishment of tree and shrub plantings. Summer fallow a year in advance and continued cultivation for weed control are needed to insure the establishment and survival of plantings. Supplemental irrigation may also 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 and lilac.

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.

The main limitation of this soil for homesites is slope. The high gravel content can cause some excavation problems, such as unstable cut banks. Special designs for buildings and roads are required to overcome this limitation. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff and keep soil losses to a minimum. Capability subclass VIe.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland; as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities; and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Drainage Basins

El Paso County
Colorado

Legend

- Drainage Basins Source: Muller Engineering Company (1988)
- US Interstate Highways
- US Highways
- Colorado State Highways
- Major Roadways
- Local Streets & Roads

Creeks

- Perennial
- Intermittent
- Lakes & Reservoirs
- Summits
- Unincorporated Urban Areas
- Incorporated Cities
- Military
- Forest
- County Lines

N W E S

Miles

0 0.5 1 2 3 4 5

Douglas County
Elbert County
Teller County
Lincoln County
Fremont County
Pueblo County

Upper Monument Creek FOMO5800
West Cherry Creek CYCY0400
Dirty Woman Creek FOMO5200
East Cherry Creek CYCY0200
West Kiowa Creek KIKI0200
East Kiowa Creek KIKI0400
Bijou Creek BIBI0200
Upper Big Sandy Creek BGBG1400
Antelope Creek BGBG0800
Lenard BGBG1200
Simla BGBG0400
Ramah BGBG0600
Calhan BGBG1000
Mustang Creek BGBG0200
Monument Rock FOMO5000
Jackson Creek FOMO4400
Black Forest FOMO4200
Black Squirrel Creek FOMO3600
Monument Branch FOMO3800
Beaver Creek FOMO4600
Pike National Forest
Air Force Academy FOMO3200
USAF Academy
Kettle Creek FOMO3000
Upper Black Squirrel CHBS2000
Upper Bracket Creek CHBR0600
North Fork HOHO0400
Peyton
Bennett Ranch CHWS1200
Geick Ranch CHMS0400
La Vega Ranch CHBR0400
Horse Creek HOHO0600
Hook And Line Ranch CHBS1800
Falcon CHWS1400
Falcon
Baggett CHBR0200
Little Horse Creek HOHO0200
Steels Fork HOPO1000
Cheyenne
Upper Fountain FOFO7600
Dry Creek FOMO2400
South Pine Creek FOMO2600
Pine Creek FOMO2800
Cottonwood Creek FOMO2200
Cheyenne Canon FOFO5800
Douglas Creek FOMO1000
Templeton Gap FOMO1200
Colorado Springs
Cascade
Williams Canyon FOFO7200
Solbers Ranch CHWS0800
Haegler Ranch CHMS0200
Curtis Ranch CHWS1000
Sand Creek FOFO4000
West Big Springs Creek CHBG0200
Upper Big Springs Creek CHBG0400
Rush HOPO0800
Manitou Springs
Manitou Reservoir FOFO7400
Livestock Company CHWS0400
West Squirrel CHWS0600
Ellicott
Yoder
Rush
Ruxton Creek FOFO7000
Upper Beaver Creek BEBE0400
Sutherland Creek FOFO6400
Bear Creek FOFO4800
Peterson AFB
Peterson Field FOFO3400
Jimmy Camp Creek FOFO2000
Upper East Chico CHEC0400
Schriever AFB
Telephone Exchange CHWS0200
Ellicott Consolidated CHBS1200
Ellicott CHBS1600
Lower Big Springs Creek CHBS1400
Upper Pond Creek HOPO0600
Lower Pond Creek HOPO0400
Windmill Gulch FOFO3000
Fishers Canyon FOFO3600
Southwest Area FOFO4600
Pike National Forest
Big Johnson Reservoir
Big Johnson FOFO2600
Crows Roost CHBS1000
Drennan CHDS0400
Middle East Chico CHEC0200
Upper Williams Creek FOWI0600
Upper Chico Creek CHCH1600
Upper Dry Squirrel CHDS0200
Truckton
Fort Carson FOFO2200
Upper Williams Tributary FOWI0400
West Chico Tributary CHCH1200
Haynes Creek HAHA0600
St.lukes HOPO0200
Lower Black Squirrel CHBS0600
Squirrel Creek CHBS0200
Little Fountain Creek FOFO1800
Calhan Reservoir FOFO1400
Chico Creek CHCH1400
Fountain
Fort Carson
Lower Williams Creek FOFO1000
Lower Williams Tributary FOWI0200
Lower Dry Squirrel CHBS0400
East Kramer KRKR0600
Sand Canyon FOFO1600
Lower East Chico CHCH0800
Kramer Creek KRKR0400
Turkey Creek TUTU0200
Sand Creek FOFO0600
Hammer Ranch CHCH0600
Williams Ranch FOFO0400
Finch Ranch CHCH0400
Windmill CHCH0200
East Haynes HAHA0400
West Haynes HAHA0200
Red Creek BEBE0200
Midway Ranch FOFO0800
West Chico Creek CHCH0600
West Kramer KRKR0200
Young Hollow FOFO0200

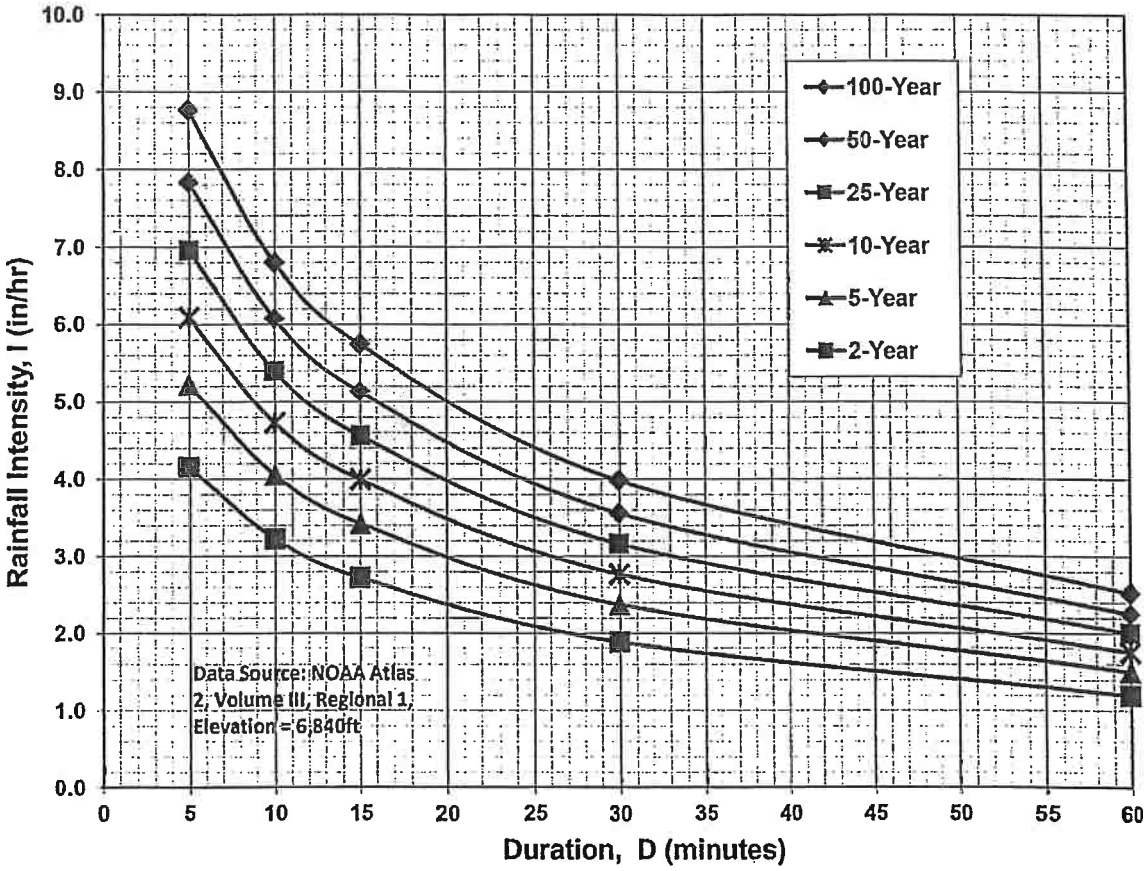
2 Hydrologic Calculations

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

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

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.

Job No.: **61224** Date: **2/17/2025 9:18**

Project: **168 Training Facility** Calcs By: **SLB**

Checked By:

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

Sub-Basin	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		t_c
	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)	(min)
OS-1	25.98	0.08	0.35	0%	300	1%	31.9	990	0.015	0.9	19.1	465	0.030	2.1	3.7	1755	N/A	54.8
OS-2	111.10	0.08	0.35	0%	300	2%	26.9	3635	0.028	1.2	52.2	200	0.040	3.3	1.0	4135	N/A	80.1
OS-3	17.00	0.08	0.35	0%	300	5%	18.8	1212	0.050	1.6	13.0	0	0.000	0.0	0.0	1512	N/A	31.7
OS-4	157.08	0.08	0.35	0%	300	2%	26.9	5048	0.034	1.3	65.5	0	0.000	0.0	0.0	5348	N/A	92.4
EX-A	19.76	0.08	0.35	0%	300	5%	18.8	1073	0.042	1.4	12.5	0	0.000	0.0	0.0	1373	N/A	31.2
EX-B	29.99	0.08	0.35	0%	300	6%	17.3	1596	0.046	1.5	17.6	0	0.000	0.0	0.0	1896	N/A	35.0
EX-B1	27.22	0.08	0.35	0%	300	4%	20.8	1089	0.073	1.9	9.6	0	0.000	0.0	0.0	1389	N/A	30.4
EX-C	45.90	0.08	0.35	0%	300	6%	17.7	1125	0.036	1.3	14.2	0	0.000	0.0	0.0	1425	N/A	31.9
EX-D	35.58	0.08	0.35	0%	300	5%	18.8	1101	0.035	1.3	13.9	267	0.026	2.9	1.5	1668	N/A	34.2
PR-A1	1.35	0.08	0.35	0%	50	8%	6.6	30	0.033	1.3	0.4	0	0.000	0.0	0.0	80	N/A	6.9
PR-A2	18.41	0.10	0.36	2%	300	5%	18.1	464	0.047	1.5	5.1	505	0.028	1.5	5.8	1269	N/A	28.9
PR-B	31.17	0.11	0.37	4%	300	4%	19.6	1221	0.051	1.6	12.9	0	0.000	0.0	0.0	1521	N/A	32.5
PR-C1	4.49	0.09	0.36	1%	300	3%	21.3	1374	0.044	1.5	15.7	422	0.038	4.8	1.5	2096	N/A	38.4
PR-C2	21.55	0.16	0.41	13%	300	12%	12.9	1229	0.031	1.2	16.6	187	0.053	3.8	0.8	1716	N/A	30.4
PR-D1	2.52	0.09	0.36	2%	300	1%	31.6	1030	0.038	1.4	12.6	172	0.041	1.5	1.9	1502	N/A	46.1
PR-D2	40.92	0.09	0.36	1%	300	7%	16.9	1289	0.040	1.4	15.3	267	0.030	3.2	1.4	1856	N/A	33.6
PR-E	38.06	0.10	0.37	4%	300	7%	16.2	1295	0.037	1.3	16.0	0	0.000	0.0	0.0	1595	N/A	32.2

Job No.: **61224**
Project: **168 Training Facility**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **2/17/2025 9:18**
Calcs By: **SLB**
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)
	OS-1	25.98	0.08	54.8	2.08	1.58	3.28															
	OS-2	111.10	0.08	80.1	8.89	1.01	8.95															
	OS-3	17.00	0.08	31.7	1.36	2.40	3.26															
	OS-4	157.08	0.08	92.4	12.57	0.79	9.97															
	OS-5	11.95	0.08	27.3	0.96	2.62	2.51															
	EX-A	19.76	0.08	31.2	1.58	2.42	3.83															
DP-1		45.75	0.08					66.1	3.66	1.30	4.7											
	EX-B	29.99	0.08	35.0	2.40	2.25	5.40															
DP-2		141.09	0.08					88.3	11.29	0.86	9.7											
DP-2A	EX-B1	27.22	0.08	30.4	2.18	2.46	5.36															
	EX-C	45.90	0.08	31.9	3.67	2.39	8.78															
DP-3		62.90	0.08					40.4	5.03	2.04	10.2											
	EX-D	35.58	0.08	34.2	2.85	2.28	6.50															
DP-4		204.61	0.08					104.3	16.37	0.61	10.0											
	PR-A1	1.35	0.08	6.9	0.11	4.68	0.50															
DP-A1		27.33	0.08					55.5	2.19	1.56	3.4											
	PR-A2	18.41	0.10	28.9	1.77	2.54	4.49															
DP-A2		45.75	0.09					66.7	3.96	1.28	5.1											
DP-B	PR-B	31.17	0.11	32.5	3.35	2.36	7.91															
	PR-C1	4.49	0.09	38.4	0.39	2.11	0.83															
DP-C1		115.60	0.08					83.7	9.28	0.94	8.7											
	PR-C2	21.55	0.16	30.4	3.46	2.46	8.52															
DP-C2		137.15	0.09					91.4	12.74	0.81	10.3											
	PR-D1	2.52	0.09	46.1	0.23	1.84	0.41															
DP-D1		19.52	0.08					32.7	1.59	2.35	3.7											
	PR-D2	40.92	0.09	33.6	3.63	2.31	8.40															
DP-D2		229.48	0.08					109.5	18.74	0.54	10.1											
DP-E	PR-E	38.06	0.10	32.2	3.92	2.38	9.31															

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

Job No.: **61224**
Project: **168 Training Facility**
Design Storm: **100-Year Storm** *(1% Probability)*
Jurisdiction: **DCM**

Date: **2/17/2025 9:18**
Calcs By: **SLB**
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)	C100	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (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)
	OS-1	25.98	0.35	54.8	9.09	2.65	24.07															
	OS-2	111.10	0.35	80.1	38.89	1.69	65.62															
	OS-3	17.00	0.35	31.7	5.95	4.02	23.94															
	OS-4	157.08	0.35	92.4	54.98	1.33	73.01															
	OS-5	11.95	0.35	27.3	4.18	4.40	18.40															
	EX-A	19.76	0.35	31.2	6.92	4.06	28.10															
DP-1		45.75	0.35					66.1	16.01	2.17	34.8											
	EX-B	29.99	0.35	35.0	10.50	3.78	39.63															
DP-2		141.09	0.35					88.3	49.38	1.44	71.3											
DP-2A	EX-B1	27.22	0.35	30.4	9.53	4.13	39.35															
	EX-C	45.90	0.35	31.9	16.06	4.01	64.45															
DP-3		62.90	0.35					40.4	22.02	3.42	75.2											
	EX-D	35.58	0.35	34.2	12.45	3.83	47.73															
DP-4		204.61	0.35					104.3	71.61	1.02	73.3											
	PR-A1	1.35	0.35	6.9	0.47	7.85	3.71															
DP-A1		27.33	0.35					55.5	9.57	2.62	25.0											
	PR-A2	18.41	0.36	28.9	6.65	4.26	28.31															
DP-A2		45.75	0.35					66.7	16.22	2.15	34.9											
DP-B	PR-B	31.17	0.37	32.5	11.51	3.96	45.57															
	PR-C1	4.49	0.36	38.4	1.60	3.54	5.68															
DP-C1		115.60	0.35					83.7	40.49	1.58	63.9											
	PR-C2	21.55	0.41	30.4	8.75	4.13	36.15															
DP-C2		137.15	0.36					91.4	49.24	1.36	66.8											
	PR-D1	2.52	0.36	46.1	0.91	3.08	2.79															
DP-D1		19.52	0.35					32.7	6.86	3.94	27.0											
	PR-D2	40.92	0.36	33.6	14.58	3.88	56.58															
DP-D2		229.48	0.35					109.5	80.60	0.90	72.6											
DP-E	PR-E	38.06	0.37	32.2	13.93	3.99	55.57															

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

Sub-Basin OS-1 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	1131832.821	25.98	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,131,833**	**25.98**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	1,755	32	-	-	-	-	
Initial Time	300	3	0.010	-	31.9	N/A	DCM Eq. 6-8
Shallow Channel	990	15	0.015	0.9	19.1	-	DCM Eq. 6-9
Channelized	465	14	0.030	2.1	3.7	-	Trap Ditch
				t_c	**54.8**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.27	1.58	1.84	2.10	2.37	2.65
Runoff (cfs)	0.7	**3.3**	7.2	13.7	18.5	**24.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.7	**3.3**	7.2	13.7	18.5	**24.1**

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 OS-2 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	4839623.914	111.10	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**4,839,624**	**111.10**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	4,135	113	-	-	-	-	
Initial Time	300	5	0.017	-	26.9	N/A	DCM Eq. 6-8
Shallow Channel	3,635	100	0.028	1.2	52.2	-	DCM Eq. 6-9
Channelized	200	8	0.040	3.3	1.0	-	V-Ditch
				t_c	**80.1**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	0.82	1.01	1.18	1.34	1.51	1.69
Runoff (cfs)	1.8	**9.0**	19.6	37.3	50.4	**65.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.8	**9.0**	19.6	37.3	50.4	**65.6**

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 OS-3 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	740706.1153	17.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**740,706**	**17.00**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	1,512	75	-	-	-	-	
Initial Time	300	15	0.050	-	18.8	N/A	DCM Eq. 6-8
Shallow Channel	1,212	60	0.050	1.6	13.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**31.7**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.92	2.40	2.80	3.20	3.60	4.02
Runoff (cfs)	0.7	**3.3**	7.1	13.6	18.3	**23.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.7	**3.3**	7.1	13.6	18.3	**23.9**

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 OS-4 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	6842233.529	157.08	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**6,842,234**	**157.08**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	5,348	175	-	-	-	-	
Initial Time	300	5	0.017	-	26.9	N/A	DCM Eq. 6-8
Shallow Channel	5,048	170	0.034	1.3	65.5	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**92.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	0.65	0.79	0.93	1.06	1.19	1.33
Runoff (cfs)	2.0	**10.0**	21.8	41.5	56.1	**73.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.0	**10.0**	21.8	41.5	56.1	**73.0**

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 OS-5 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	520704.0662	11.95	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**520,704**	**11.95**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	1,062	49	-	-	-	-	
Initial Time	300	15	0.050	-	18.8	N/A	DCM Eq. 6-8
Shallow Channel	762	34	0.045	1.5	8.6	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**27.3**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.10	2.62	3.06	3.49	3.93	4.40
Runoff (cfs)	0.5	**2.5**	5.5	10.4	14.1	**18.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.5	**2.5**	5.5	10.4	14.1	**18.4**

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

Sub-Basin EX-A Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**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.
Pasture/Meadow	860850.524	19.76	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**860,851**	**19.76**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	1,373	60	-	-	-	-	
Initial Time	300	15	0.050	-	18.8	N/A	DCM Eq. 6-8
Shallow Channel	1,073	45	0.042	1.4	12.5	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**31.2**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.94	2.42	2.82	3.23	3.63	4.06
Runoff (cfs)	0.8	**3.8**	8.4	15.9	21.5	**28.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.8	**3.8**	8.4	15.9	21.5	**28.1**

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 (DP-1)

Includes Basins OS-1 EX-A

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	1,992,683	45.75	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	-	0.00	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	-	0.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,992,683**	**45.75**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	OS-1	-	1,755	32	-	-	-	-	54.8
Channelized-1	Trap Ditch	2	1,372	60	28	40	13	2.0	11.3
Channelized-2									
Channelized-3									
Total			3,127	92					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **66.1**

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)	1.05	1.30	1.51	1.73	1.95	2.17
Site Runoff (cfs)	0.96	**4.75**	10.38	19.78	26.71	**34.82**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**4.7**	-	-	-	**34.8**

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

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

Sub-Basin EX-B Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	1306388.745	29.99	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,306,389**	**29.99**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	1,896	93	-	-	-	-	
Initial Time	300	19	0.063	-	17.3	N/A	DCM Eq. 6-8
Shallow Channel	1,596	74	0.046	1.5	17.6	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**35.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.80	2.25	2.63	3.00	3.38	3.78
Runoff (cfs)	1.1	**5.4**	11.8	22.5	30.4	**39.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.1	**5.4**	11.8	22.5	30.4	**39.6**

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 EX-B1 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	1185727.473	27.22	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,185,727**	**27.22**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	1,389	90	-	-	-	-	
Initial Time	300	11	0.037	-	20.8	N/A	DCM Eq. 6-8
Shallow Channel	1,089	79	0.073	1.9	9.6	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**30.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.97	2.46	2.87	3.28	3.69	4.13
Runoff (cfs)	1.1	**5.4**	11.7	22.3	30.2	**39.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.1	**5.4**	11.7	22.3	30.2	**39.4**

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

Combined Sub-Basin Runoff Calculations (DP-2)

Includes Basins OS-2 EX-B

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	6,146,013	141.09	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	-	0.00	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	-	0.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**6,146,013**	**141.09**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	OS-2	-	4,135	113	-	-	-	-	80.1
Channelized-1	Trap Ditch	2	1,402	60	73	40	13	2.9	8.2
Channelized-2									
Channelized-3									
Total			5,537	173					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **88.3**

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)	0.70	0.86	1.01	1.15	1.29	1.44
Site Runoff (cfs)	1.98	**9.73**	21.28	40.55	54.74	**71.28**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**9.7**	-	-	-	**71.3**

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

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

Sub-Basin EX-C Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	1999240.791	45.90	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,999,241**	**45.90**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	1,425	58	-	-	-	-	
Initial Time	300	18	0.060	-	17.7	N/A	DCM Eq. 6-8
Shallow Channel	1,125	40	0.036	1.3	14.2	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**31.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.92	2.39	2.79	3.19	3.59	4.01
Runoff (cfs)	1.8	**8.8**	19.2	36.6	49.4	**64.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.8	**8.8**	19.2	36.6	49.4	**64.4**

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

Combined Sub-Basin Runoff Calculations (DP-3)

Includes Basins OS-3 EX-C

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	2,739,947	62.90	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	-	0.00	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	-	0.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**2,739,947**	**62.90**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	OS-3	-	1,512	75	-	-	-	-	31.7
Channelized-1	Trap Ditch	2	1,425	58	68	40	13	2.7	8.7
Channelized-2									
Channelized-3									
Total			2,937	133					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **40.4**

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)	1.63	2.04	2.37	2.71	3.05	3.42
Site Runoff (cfs)	2.06	**10.24**	22.41	42.68	57.62	**75.19**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**10.2**	-	-	-	**75.2**

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.

Sub-Basin EX-D Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	1549895.891	35.58	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,549,896**	**35.58**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	1,668	61	-	-	-	-	
Initial Time	300	15	0.050	-	18.8	N/A	DCM Eq. 6-8
Shallow Channel	1,101	39	0.035	1.3	13.9	-	DCM Eq. 6-9
Channelized	267	7	0.026	2.9	1.5	-	V-Ditch
				t_c	**34.2**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.83	2.28	2.66	3.05	3.43	3.83
Runoff (cfs)	1.3	**6.5**	14.2	27.1	36.6	**47.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.3	**6.5**	14.2	27.1	36.6	**47.7**

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 (DP-4)

Includes Basins OS-4 OS-5 EX-D

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	8,912,833	204.61	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	-	0.00	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	-	0.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**8,912,833**	**204.61**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	OS-4	-	5,348	175	-	-	-	-	92.4
Channelized-1	Trap Ditch	2	1,667	62	48	40	13	2.3	11.8
Channelized-2									
Channelized-3									
Total			7,015	237					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **104.3**

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)	0.50	0.61	0.71	0.82	0.92	1.02
Site Runoff (cfs)	2.07	**10.02**	21.93	41.77	56.40	**73.34**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**10.0**	-	-	-	**73.3**

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

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

Sub-Basin PR-A1 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Pasture/Meadow	58779.0444	1.35	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**58,779**	**1.35**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	80	5	-	-	-	-	
Initial Time	50	4	0.080	-	6.6	N/A	DCM Eq. 6-8
Shallow Channel	30	1	0.033	1.3	0.4	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**6.9 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.73	4.68	5.45	6.23	7.01	7.85
Runoff (cfs)	0.1	**0.5**	1.1	2.1	2.8	**3.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.5**	1.1	2.1	2.8	**3.7**

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 (DP-A1)

Includes Basins OS-1 PR-A1

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	1,190,612	27.33	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	-	0.00	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	-	0.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,190,612**	**27.33**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

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	OS-1	-	1,755	32	-	-	-	-	54.8
Channelized-1	Trap Ditch	2	81	4	24	40	13	2.0	0.7
Channelized-2									
Channelized-3									
Total			1,836	36					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **55.5**

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)	1.26	1.56	1.82	2.08	2.34	2.62
Site Runoff (cfs)	0.69	**3.41**	7.46	14.21	19.18	**25.02**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**3.4**	-	-	-	**25.0**

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

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

Sub-Basin PR-A2 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Gravel	21892.7062	0.50	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	778,034	17.86	0.02	0.08	0.15	0.25	0.3	0.35	0%
Paved	2,145	0.05	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**802,072**	**18.41**	**0.04**	**0.10**	**0.17**	**0.26**	**0.31**	**0.36**	**2.5%**

802071.4796

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	1,269	52	-	-	-	-	
Initial Time	300	16	0.053	-	18.1	N/A	DCM Eq. 6-8
Shallow Channel	464	22	0.047	1.5	5.1	-	DCM Eq. 6-9
Channelized	505	14	0.028	1.5	5.8	-	V-Ditch
				t_c	**28.9**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.03	2.54	2.96	3.38	3.80	4.26
Runoff (cfs)	1.4	**4.5**	9.0	16.4	21.9	**28.3**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	1.4	**4.5**	9.0	16.4	21.9	**28.3**

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

Combined Sub-Basin Runoff Calculations (DP-A2)

Includes Basins OS-1 PR-A1 PR-A2

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	1,968,646	45.19	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	-	0.00	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	21,893	0.50	0.57	0.59	0.63	0.66	0.68	0.7	80%
Paved	2,145	0.05	0.89	0.9	0.92	0.94	0.95	0.96	100%
Combined	**1,992,684**	**45.75**	**0.03**	**0.09**	**0.16**	**0.26**	**0.30**	**0.35**	**1.0%**

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	OS-1	-	1,755	32	-	-	-	-	54.8
Channelized-1	Trap Ditch	2	81	4	24	40	13	2.0	0.7
Channelized-2	Trap Ditch	2	1,236	40	28	40	15	1.8	11.2
Channelized-3									
Total			3,072	76					

2 = Natural, Winding, minimal vegetation/shallow grass

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **66.7**

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)	1.04	1.28	1.50	1.71	1.93	2.15
Site Runoff (cfs)	1.28	**5.08**	10.69	19.98	26.85	**34.89**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**5.1**	-	-	-	**34.9**

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

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

Sub-Basin PR-B Runoff Calculations (DP B)

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Roofs	5688	0.13	0.71	0.73	0.75	0.78	0.8	0.81	90%
Lawns	153,211	3.52	0.02	0.08	0.15	0.25	0.30	0.35	0%
Gravel	63,106	1.45	0.57	0.59	0.63	0.66	0.68	0.7	80%
Landscaping	158,124	3.63	0.03	0.09	0.17	0.26	0.31	0.36	2%
Pasture/Meadow	977,445	22.44	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,357,574**	**31.17**	**0.05**	**0.11**	**0.18**	**0.27**	**0.32**	**0.37**	**4.3%**

1357573.673 (0)

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	1,521	74	-	-	-	-	
Initial Time	300	12	0.040	-	19.6	N/A	DCM Eq. 6-8
Shallow Channel	1,221	62	0.051	1.6	12.9	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**32.5**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.89	2.36	2.75	3.15	3.54	3.96
Runoff (cfs)	2.9	**7.9**	15.2	26.7	35.4	**45.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.9	**7.9**	15.2	26.7	35.4	**45.6**

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 PR-B1 Runoff Calculations (DP B)

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Roofs	9480	0.22	0.71	0.73	0.75	0.78	0.8	0.81	90%
Lawns	255,352	5.86	0.02	0.08	0.15	0.25	0.30	0.35	0%
Gravel	105,176	2.41	0.57	0.59	0.63	0.66	0.68	0.7	80%
Landscaping	263,540	6.05	0.03	0.09	0.17	0.26	0.31	0.36	2%
Pasture/Meadow	1,108,981	25.46	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,742,529**	**40.00**	**0.06**	**0.12**	**0.19**	**0.28**	**0.33**	**0.38**	**5.6%**

1357573.673

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	1,521	74	-	-	-	-	
Initial Time	300	12	0.040	-	19.5	N/A	DCM Eq. 6-8
Shallow Channel	1,221	62	0.051	1.6	12.9	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**32.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.90	2.37	2.76	3.16	3.55	3.97
Runoff (cfs)	4.4	**11.0**	20.5	35.2	46.5	**59.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	4.4	**11.0**	20.5	35.2	46.5	**59.6**

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 PR-C1 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Landscaping	138248.5587	3.17	0.03	0.09	0.17	0.26	0.31	0.36	2%
Pasture/Meadow	57,549	1.32	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**195,798**	**4.49**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**1.4%**

195797.7016

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	2,096	86	-	-	-	-	
Initial Time	300	10	0.033	-	21.3	N/A	DCM Eq. 6-8
Shallow Channel	1,374	60	0.044	1.5	15.7	-	DCM Eq. 6-9
Channelized	422	16	0.038	4.8	1.5	-	V-Ditch
				t_c	**38.4 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.69	2.11	2.46	2.81	3.17	3.54
Runoff (cfs)	0.2	**0.8**	1.8	3.3	4.4	**5.7**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.2	**0.8**	1.8	3.3	4.4	**5.7**

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 (DP-C1)

Includes Basins OS-2 PR-C1

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	4,897,173	112.42	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	138,249	3.17	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	-	0.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**5,035,422**	**115.60**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.1%**

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	OS-2	-	4,135	113	-	-	-	-	80.1
Channelized-1	V-Ditch	2	614	16	6	0	3	2.8	3.6
Channelized-2									
Channelized-3									
Total			4,749	129					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **83.7**

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)	0.77	0.94	1.10	1.26	1.41	1.58
Site Runoff (cfs)	1.80	**8.74**	19.12	36.32	49.03	**63.86**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**8.7**	-	-	-	**63.9**

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

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

Sub-Basin PR-C2 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Roofs	6320	0.15	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	136,454	3.13	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	145,925	3.35	0.02	0.08	0.15	0.25	0.30	0.35	0%
Landscaping	193,579	4.44	0.03	0.09	0.17	0.26	0.31	0.36	2%
Pasture/Meadow	456,563	10.48	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**938,841**	**21.55**	**0.11**	**0.16**	**0.23**	**0.32**	**0.36**	**0.41**	**12.6%**

938841.2281 0

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	1,716	84	-	-	-	-	
Initial Time	300	36	0.120	-	12.9	N/A	DCM Eq. 6-8
Shallow Channel	1,229	38	0.031	1.2	16.6	-	DCM Eq. 6-9
Channelized	187	10	0.053	3.8	0.8	-	V-Ditch
				t_c	**30.4**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.97	2.46	2.87	3.28	3.69	4.13
Runoff (cfs)	4.5	**8.5**	14.1	22.3	28.7	**36.2**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	4.5	**8.5**	14.1	22.3	28.7	**36.2**
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

Combined Sub-Basin Runoff Calculations (DP-C2)

Includes Basins OS-2 PR-C1 PR-C2

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	5,353,736	122.90	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	6,320	0.15	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	331,828	7.62	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	136,454	3.13	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	145,925	3.35	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**5,974,263**	**137.15**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**2.0%**

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	OS-2	-	4,135	113	-	-	-	-	80.1
Channelized-1	V-Ditch	2	614	16	6	0	3	2.8	3.6
Channelized-2	Trap Ditch	2	822	34	21	40	13	1.8	7.6
Channelized-3									
Total			5,571	163					

2 = Natural, Winding, minimal vegetation/shallow grass

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **91.4**

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)	0.66	0.81	0.95	1.08	1.22	1.36
Site Runoff (cfs)	3.07	**10.33**	21.11	38.62	51.67	**66.83**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**10.3**	-	-	-	**66.8**

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

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

Sub-Basin PR-D1 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		Checked by:	
Jurisdiction	**DCM**	Soil Type	**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.
Pasture/Meadow	3258	0.07	0.02	0.08	0.15	0.25	0.3	0.35	0%
Landscaping	106,417	2.44	0.03	0.09	0.17	0.26	0.31	0.36	2%
Combined	**109,675**	**2.52**	**0.03**	**0.09**	**0.17**	**0.26**	**0.31**	**0.36**	**1.9%**

109674.7669

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	1,502	49	-	-	-	-	
Initial Time	300	3	0.010	-	31.6	N/A	DCM Eq. 6-8
Shallow Channel	1,030	39	0.038	1.4	12.6	-	DCM Eq. 6-9
Channelized	172	7	0.041	1.5	1.9	-	V-Ditch
				t_c	**46.1 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			Design Volume (ft^3) 100-year	WQCV	Total
K_i (ft)	0.0000	0.0000	0		% Storage			
V_i (acre-ft)	0.000	0.000	-0.01295	EURV	0%	0	0	**0**
V_i (ft^3)	0	0	-564	WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.48	1.84	2.14	2.45	2.76	3.08
Runoff (cfs)	0.1	**0.4**	0.9	1.6	2.1	**2.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.1	**0.4**	0.9	1.6	2.1	**2.8**

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 (DP-D1)

Includes Basins OS-3 PR-D1

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	743,964	17.08	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	-	0.00	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	106,417	2.44	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	-	0.00	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	-	0.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**850,381**	**19.52**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.3%**

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	OS-3	-	1,512	75	-	-	-	-	31.7
Channelized-1	V-Ditch	2	172	7	3	0	3	2.8	1.0
Channelized-2									
Channelized-3									
Total			1,684	82					

2 = Natural, Winding, minimal vegetation/shallow grass

t_c (min) **32.7**

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)	1.88	2.35	2.74	3.13	3.53	3.94
Site Runoff (cfs)	0.78	**3.73**	8.16	15.37	20.73	**27.04**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**3.7**	-	-	-	**27.0**

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

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

Sub-Basin PR-D2 Runoff Calculations

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Landscaping	151064	3.47	0.03	0.09	0.17	0.26	0.31	0.36	2%
Roofs	2,528	0.06	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	24,308	0.56	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	1,604,773	36.84	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,782,673**	**40.92**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**1.4%**

1782672.76

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	1,856	80	-	-	-	-	
	300	20	0.067	-	16.9	N/A	DCM Eq. 6-8
Shallow Channel	1,289	52	0.040	1.4	15.3	-	DCM Eq. 6-9
Channelized	267	8	0.030	3.2	1.4	-	V-Ditch
				t_c	**33.6**	**min.**	

Storage Volume

40 -hr release time

Detention is NOT required

EURV 0.00 (in) a = 1

Water Quality is NOT required

WQCV 0.00 (in)

i (return period)	5-year	10-year	100-year			Design Volume (ft^3)		
K_i (ft)	0.0000	0.0000	0		% Storage	100-year	WQCV	Total
V_i (acre-ft)	0.000	0.000	-0.2669	EURV	0%	0	0	**0**
V_i (ft^3)	0	0	-11,626	WQCV	0%		0	**0**

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.85	2.31	2.70	3.08	3.47	3.88
Runoff (cfs)	2.2	**8.4**	17.6	32.5	43.5	**56.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.2	**8.4**	17.6	32.5	43.5	**56.6**

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

Combined Sub-Basin Runoff Calculations (DP-D2)

Includes Basins OS-5 OS-4 PR-D1 PR-D2 OS-3

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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	9,711,675	222.95	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	2,528	0.06	0.71	0.73	0.75	0.78	0.8	0.81	90%
Landscaping	257,481	5.91	0.03	0.09	0.17	0.26	0.31	0.36	2%
Gravel	24,308	0.56	0.57	0.59	0.63	0.66	0.68	0.7	80%
Lawns	-	0.00	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**9,995,992**	**229.48**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.3%**

Use another method

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	OS-4	-	5,348	175	-	-	-	-	92.4
Channelized-1	V-Ditch	2	172	7	3	0	3	2.8	1.0
Channelized-2	Trap Ditch	2	1,656	75	21	40	13	2.8	1.0
Channelized-3								1.8	15.1
Total			7,176	257					
								t_c (min)	**109.5**

2 = Natural, Winding, minimal vegetation/shallow grass

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)	0.45	0.54	0.63	0.72	0.81	0.90
Site Runoff (cfs)	2.23	**10.09**	21.90	41.45	55.90	**72.58**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**10.1**	-	-	-	**72.6**
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 PR-E Runoff Calculations (DP-E)

Job No.:	**61224**	Date:	**2/17/2025 9:18**
Project:	**168 Training Facility**	Calcs by:	**SLB**
		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.**
Landscaping	169217	3.88	0.03	0.09	0.17	0.26	0.31	0.36	2%
Roofs	2,528	0.06	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	68,041	1.56	0.57	0.59	0.63	0.66	0.68	0.7	80%
Pasture/Meadow	1,418,218	32.56	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**1,658,004**	**38.06**	**0.04**	**0.10**	**0.17**	**0.27**	**0.32**	**0.37**	**3.6%**

1658003.619 0.0001

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	1,595	70	-	-	-	-	
Initial Time	300	22	0.073	-	16.2	N/A	DCM Eq. 6-8
Shallow Channel	1,295	48	0.037	1.3	16.0	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	0
				t_c	**32.2**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.90	2.38	2.77	3.17	3.57	3.99
Runoff (cfs)	3.2	**9.3**	18.2	32.4	43.1	**55.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	3.2	**9.3**	18.2	32.4	43.1	**55.6**

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

3 Hydraulic Calculations

Swale Calculations
Culvert Calculations
Conditions at Site Outfall Locations Calculations

Channel Report

Channel C1 (North) - 5yr = 8.7 cfs

Triangular

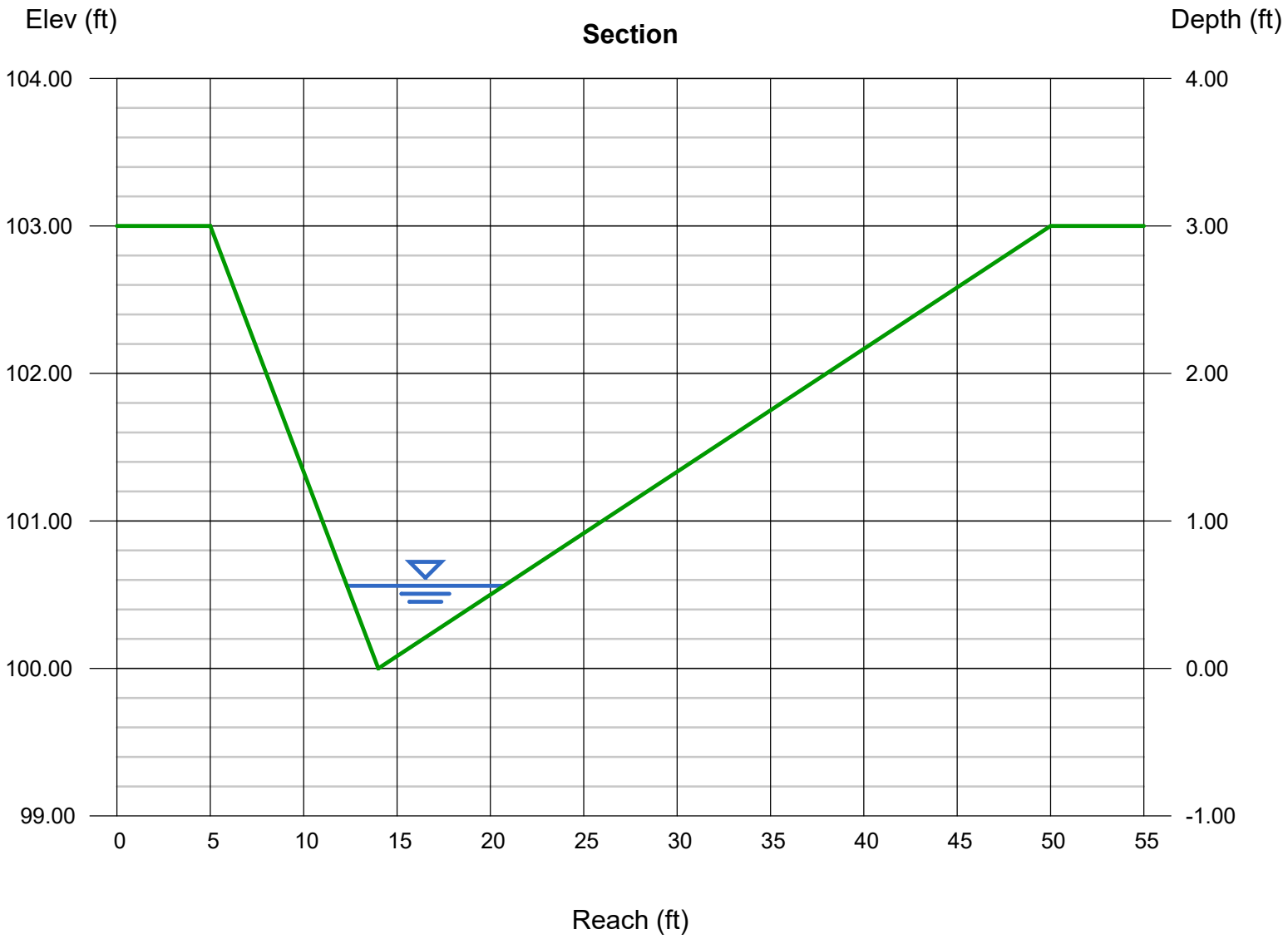
Side Slopes (z:1)	= 3.00, 12.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.70

Highlighted

Depth (ft)	= 0.56
Q (cfs)	= 8.700
Area (sqft)	= 2.35
Velocity (ft/s)	= 3.70
Wetted Perim (ft)	= 8.51
Crit Depth, Yc (ft)	= 0.61
Top Width (ft)	= 8.40
EGL (ft)	= 0.77



Channel Report

Channel C1 (North) - 100yr = 63.9 cfs

Triangular

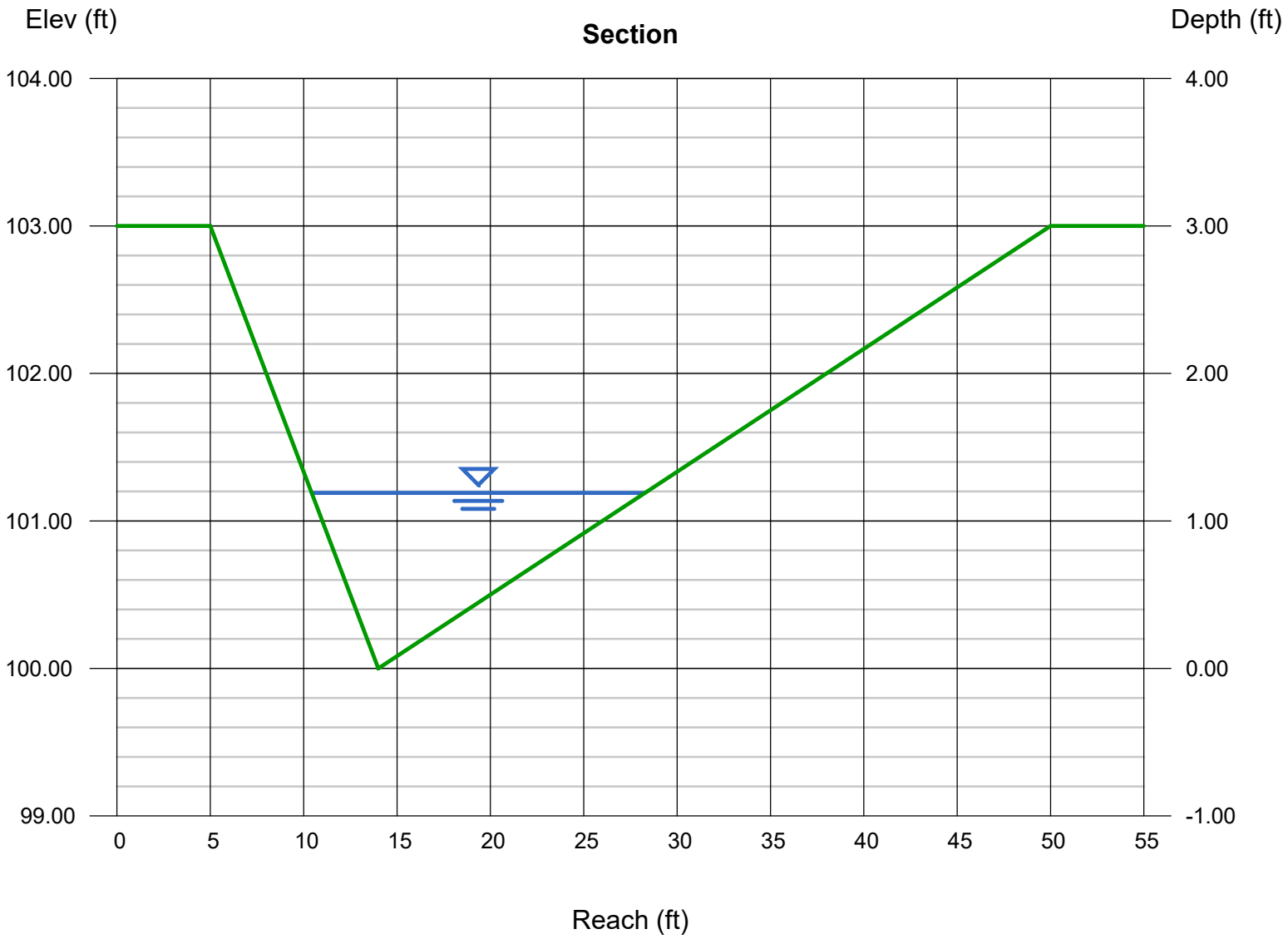
Side Slopes (z:1)	= 3.00, 12.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 63.90

Highlighted

Depth (ft)	= 1.19
Q (cfs)	= 63.90
Area (sqft)	= 10.62
Velocity (ft/s)	= 6.02
Wetted Perim (ft)	= 18.09
Crit Depth, Yc (ft)	= 1.36
Top Width (ft)	= 17.85
EGL (ft)	= 1.75



Channel Report

Channel C1 (Central) - 5yr = 8.7 cfs

Trapezoidal

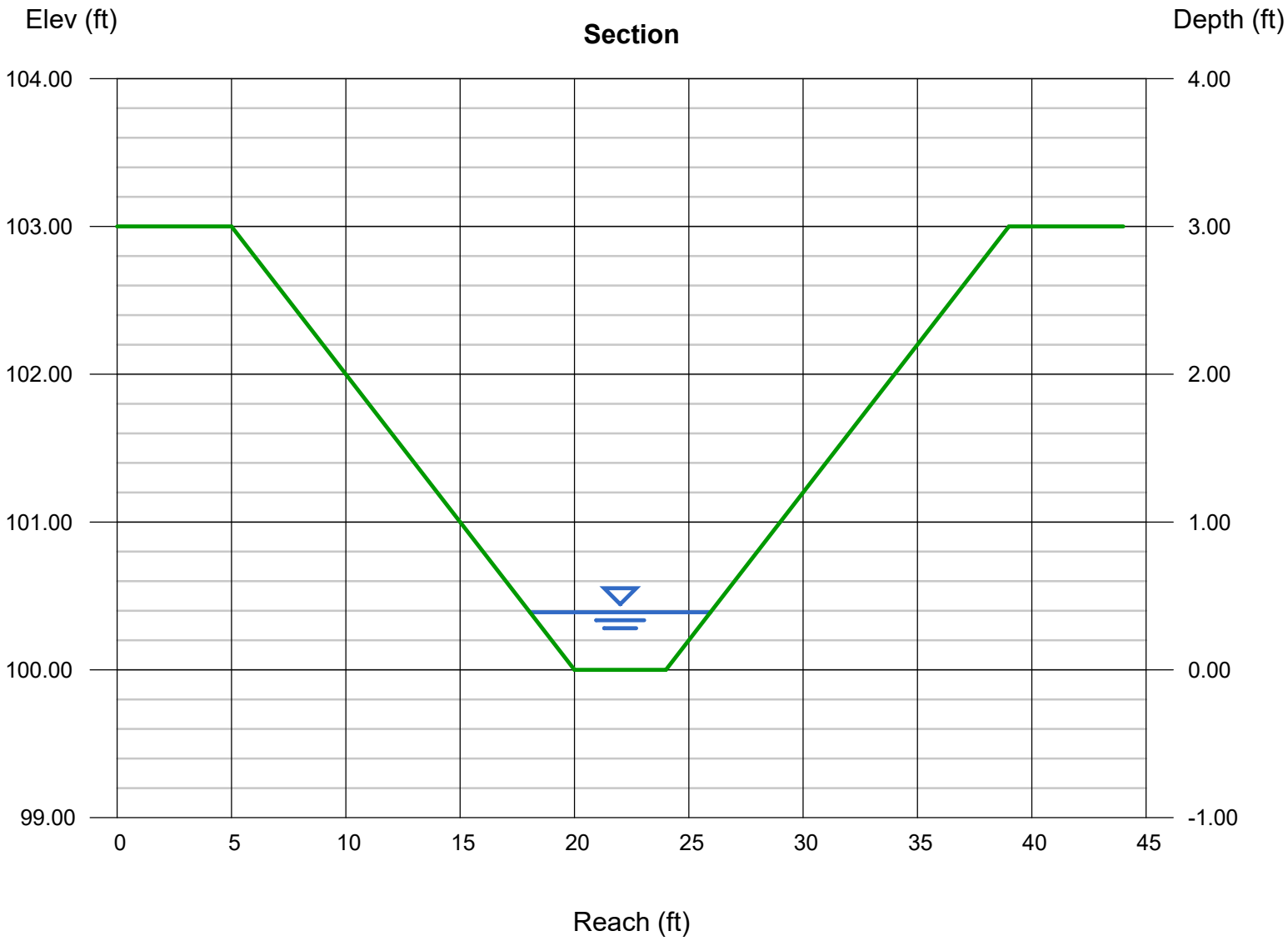
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 5.00, 5.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.70

Highlighted

Depth (ft)	= 0.39
Q (cfs)	= 8.700
Area (sqft)	= 2.32
Velocity (ft/s)	= 3.75
Wetted Perim (ft)	= 7.98
Crit Depth, Yc (ft)	= 0.44
Top Width (ft)	= 7.90
EGL (ft)	= 0.61



Channel Report

Channel C1 (Central) - 100yr = 63.9 cfs

Trapezoidal

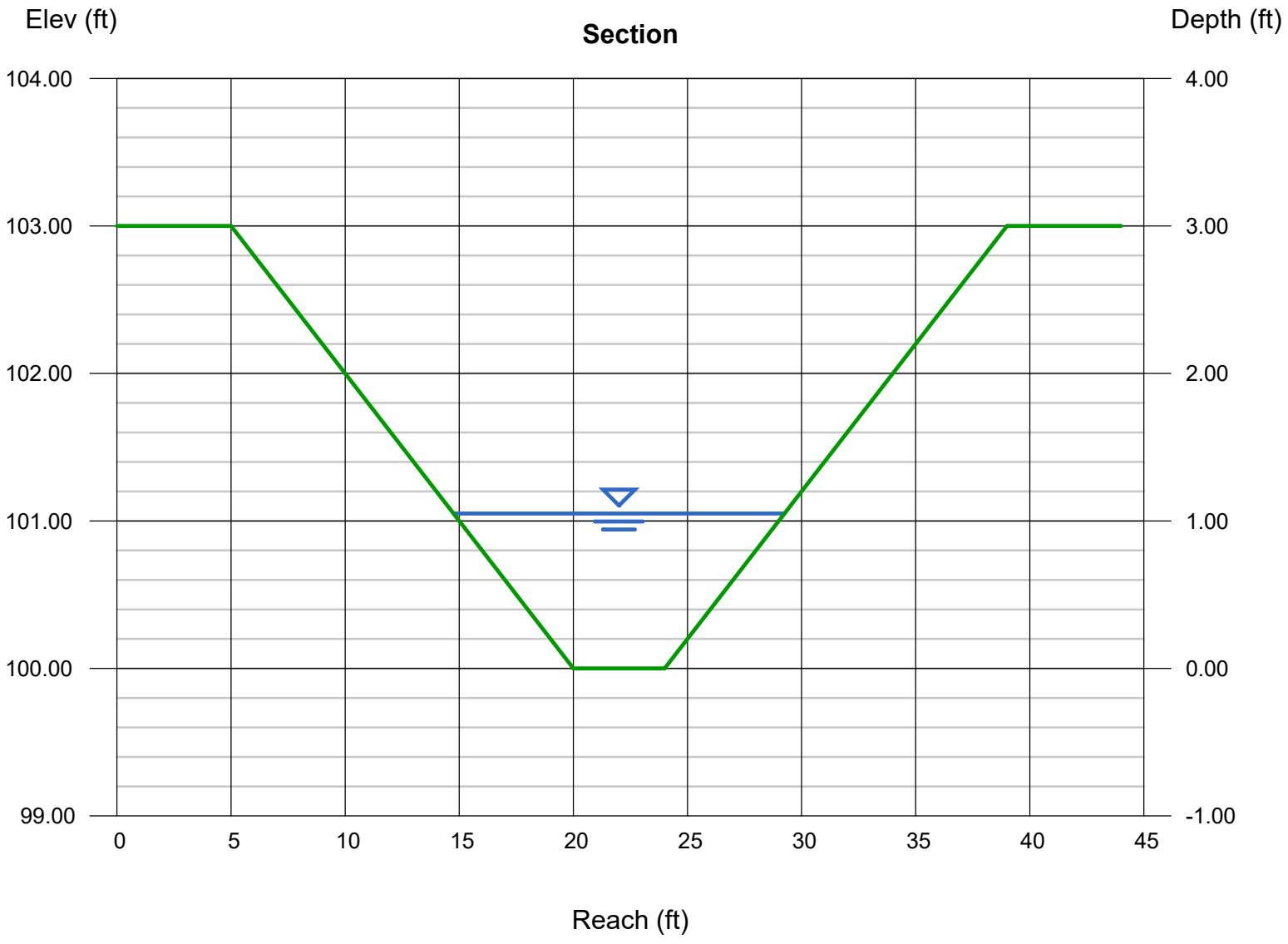
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 5.00, 5.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 63.90

Highlighted

Depth (ft)	= 1.05
Q (cfs)	= 63.90
Area (sqft)	= 9.71
Velocity (ft/s)	= 6.58
Wetted Perim (ft)	= 14.71
Crit Depth, Yc (ft)	= 1.25
Top Width (ft)	= 14.50
EGL (ft)	= 1.72



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 6 2024

Channel D1 (North) - 5yr = 3.7 cfs

Triangular

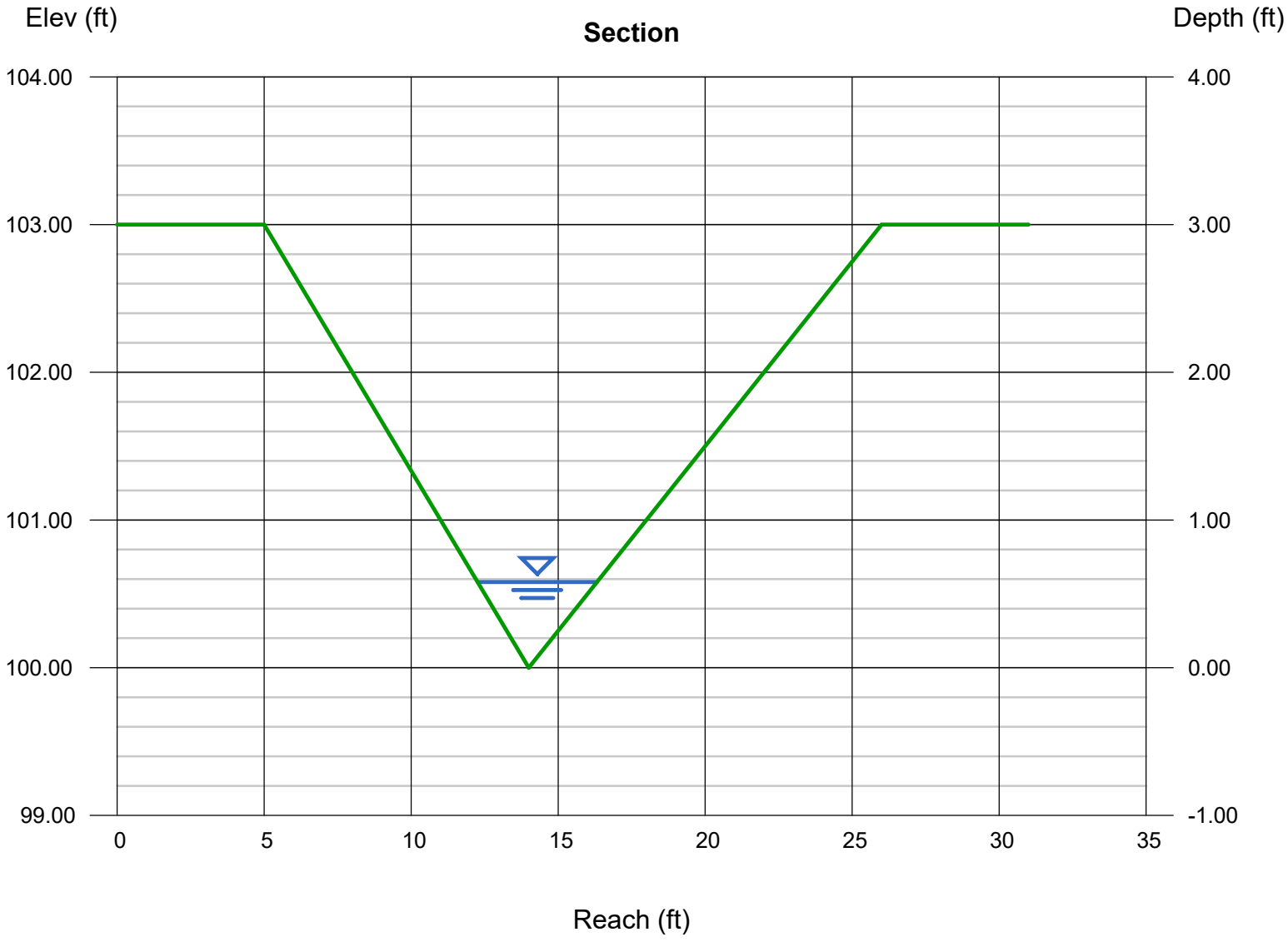
Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 3.70

Highlighted

Depth (ft)	= 0.58
Q (cfs)	= 3.700
Area (sqft)	= 1.18
Velocity (ft/s)	= 3.14
Wetted Perim (ft)	= 4.23
Crit Depth, Yc (ft)	= 0.59
Top Width (ft)	= 4.06
EGL (ft)	= 0.73



Channel Report

Channel D1 (North) - 100yr = 27.0 cfs

Triangular

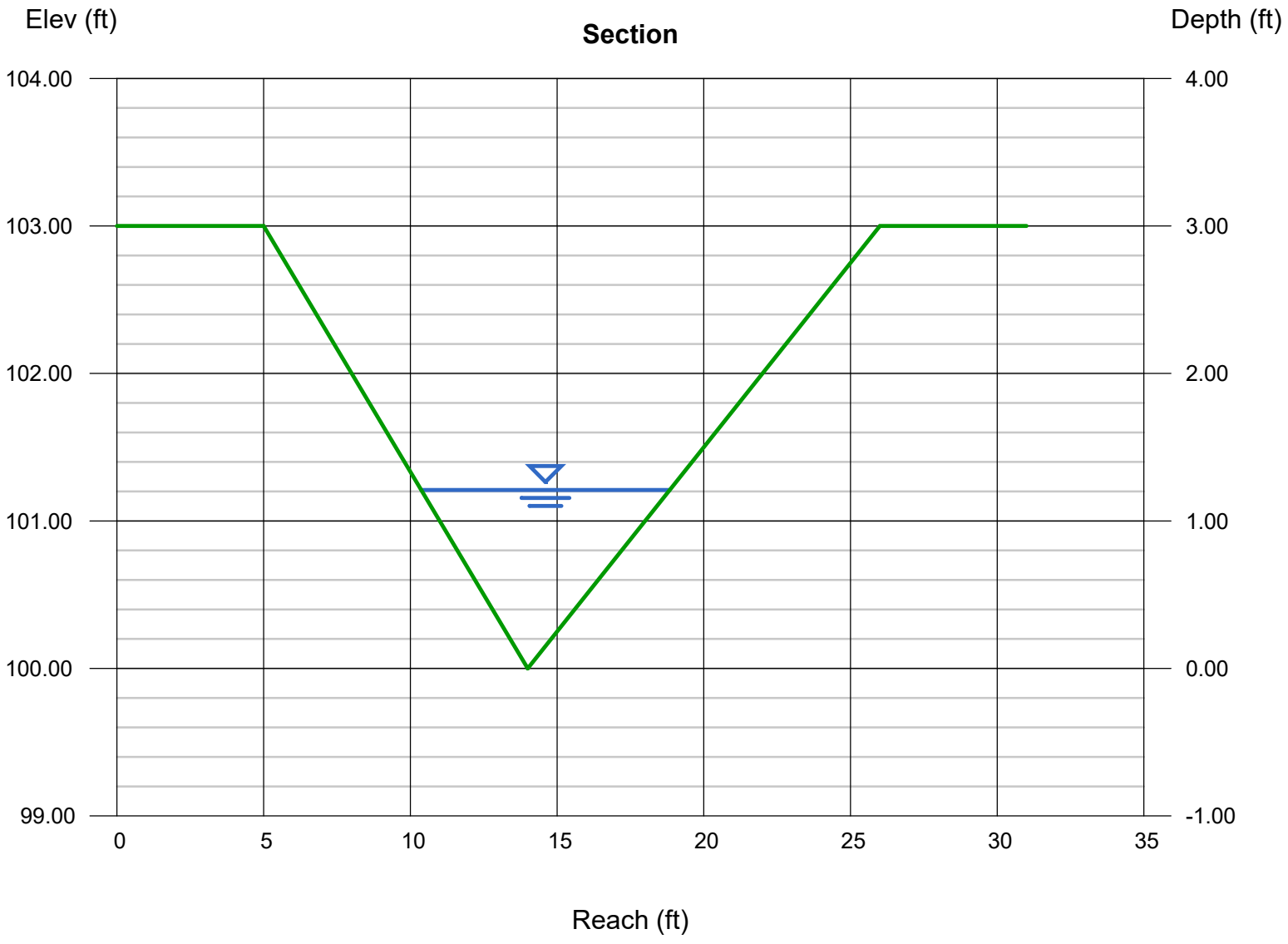
Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 27.00

Highlighted

Depth (ft)	= 1.21
Q (cfs)	= 27.00
Area (sqft)	= 5.12
Velocity (ft/s)	= 5.27
Wetted Perim (ft)	= 8.82
Crit Depth, Yc (ft)	= 1.30
Top Width (ft)	= 8.47
EGL (ft)	= 1.64



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 6 2024

Culvert A1 - 5yr

Invert Elev Dn (ft)	=	6674.50
Pipe Length (ft)	=	36.00
Slope (%)	=	2.78
Invert Elev Up (ft)	=	6675.50
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

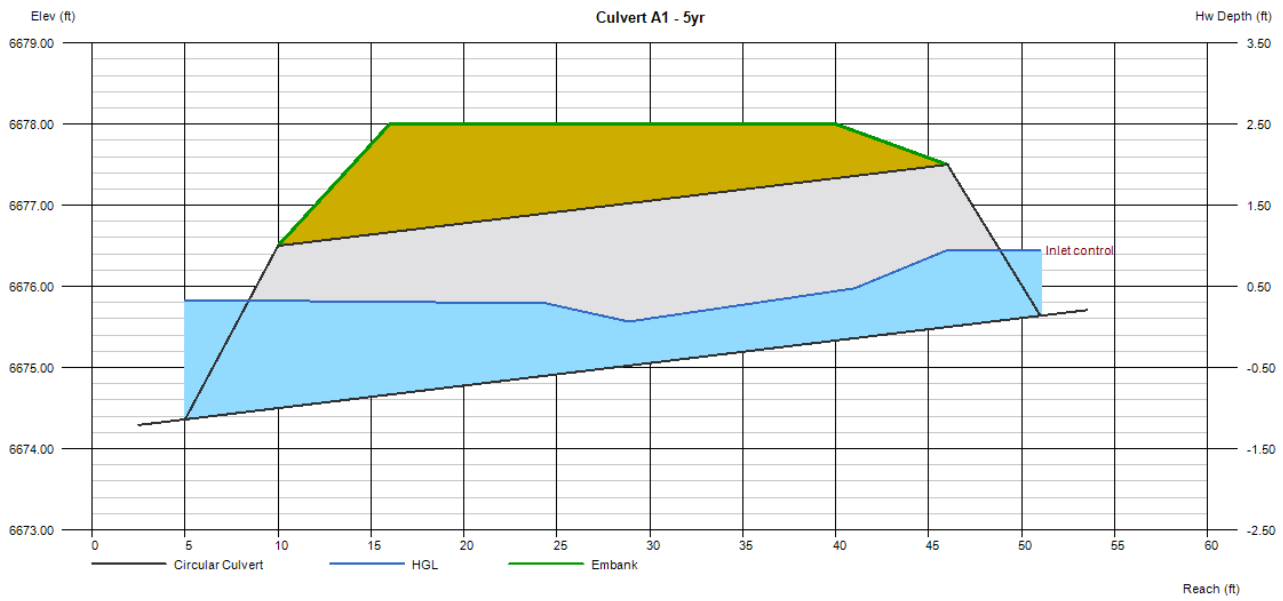
Top Elevation (ft)	=	6678.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	3.40
Qmax (cfs)	=	3.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	3.40
Qpipe (cfs)	=	3.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.54
Veloc Up (ft/s)	=	3.89
HGL Dn (ft)	=	6675.82
HGL Up (ft)	=	6676.14
Hw Elev (ft)	=	6676.45
Hw/D (ft)	=	0.47
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 6 2024

Culvert A1 - 100yr

Invert Elev Dn (ft)	=	6674.50
Pipe Length (ft)	=	36.00
Slope (%)	=	2.78
Invert Elev Up (ft)	=	6675.50
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

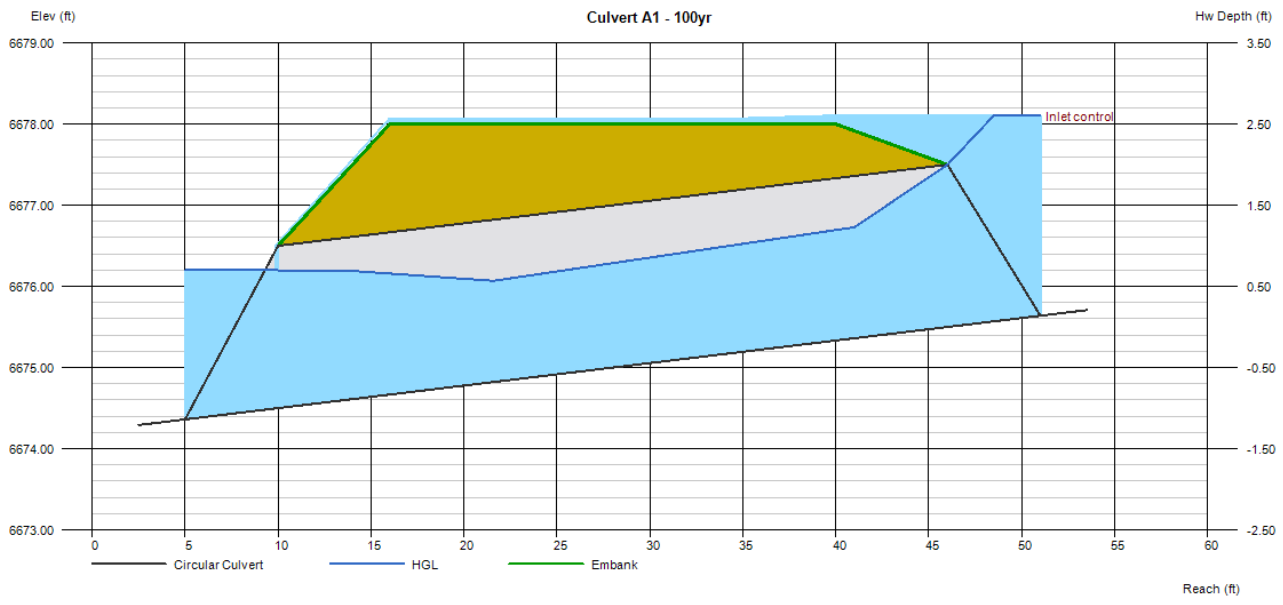
Top Elevation (ft)	=	6678.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	25.00
Qmax (cfs)	=	25.00
Tailwater Elev (ft)	=	(dc+D)/2

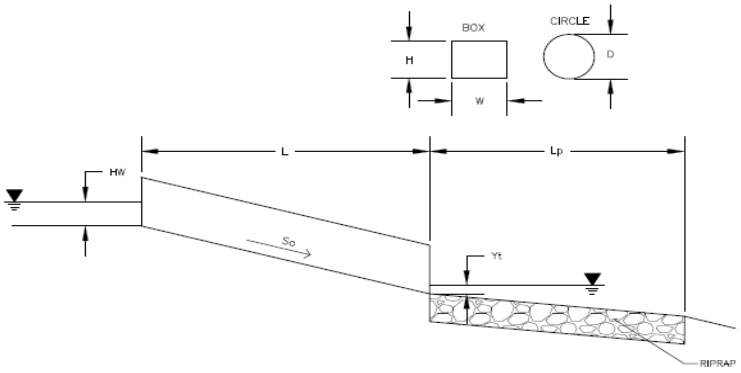
Highlighted

Qtotal (cfs)	=	25.00
Qpipe (cfs)	=	15.08
Qovertop (cfs)	=	9.92
Veloc Dn (ft/s)	=	5.30
Veloc Up (ft/s)	=	6.43
HGL Dn (ft)	=	6676.20
HGL Up (ft)	=	6676.90
Hw Elev (ft)	=	6678.11
Hw/D (ft)	=	1.30
Flow Regime	=	Inlet Control



Determination of Culvert Headwater and Outlet Protection

Project: 61224 - I68 Ranges
Basin ID: Culvert A1 - 100yr



Soil Type:
Choose One:
(•) Sandy
( ) Non-Sandy

Design Information (Input):

Design Discharge	Q =	25	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		1.5 : 1 Beveled Edge	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	6675.5	ft
Outlet Elevation **OR** Slope	Elev OUT =	6674.5	ft
Culvert Length	L =	36	ft
Manning's Roughness	n =	0.023	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.80	ft
Flow Area at Max Channel Velocity	A_t =	5.00	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.39	
Sum of All Losses Coefficients	k_s =	2.59	ft
Culvert Normal Depth	Y_n =	1.41	ft
Culvert Critical Depth	Y_c =	1.76	ft
Tailwater Depth for Design	d =	1.88	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	3.04	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	4.42	$ft^{0.5}/s$
Froude Number	Fr =	-	**Pressure flow!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	3.20	ft
Outlet Control Headwater	HW_O =	3.43	
Design Headwater Elevation	**HW =**	**6,678.93**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.71**	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	7	in
Nominal Riprap Size	d_{50} =	9	in
UDFCD Riprap Type	**Type =**	**L**	
Length of Protection	**L_p =**	**13**	**ft**
Width of Protection	**T =**	**7**	**ft**

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 6 2024

Culvert C1 - 5yr

Invert Elev Dn (ft)	=	6613.00
Pipe Length (ft)	=	36.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	6613.72
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

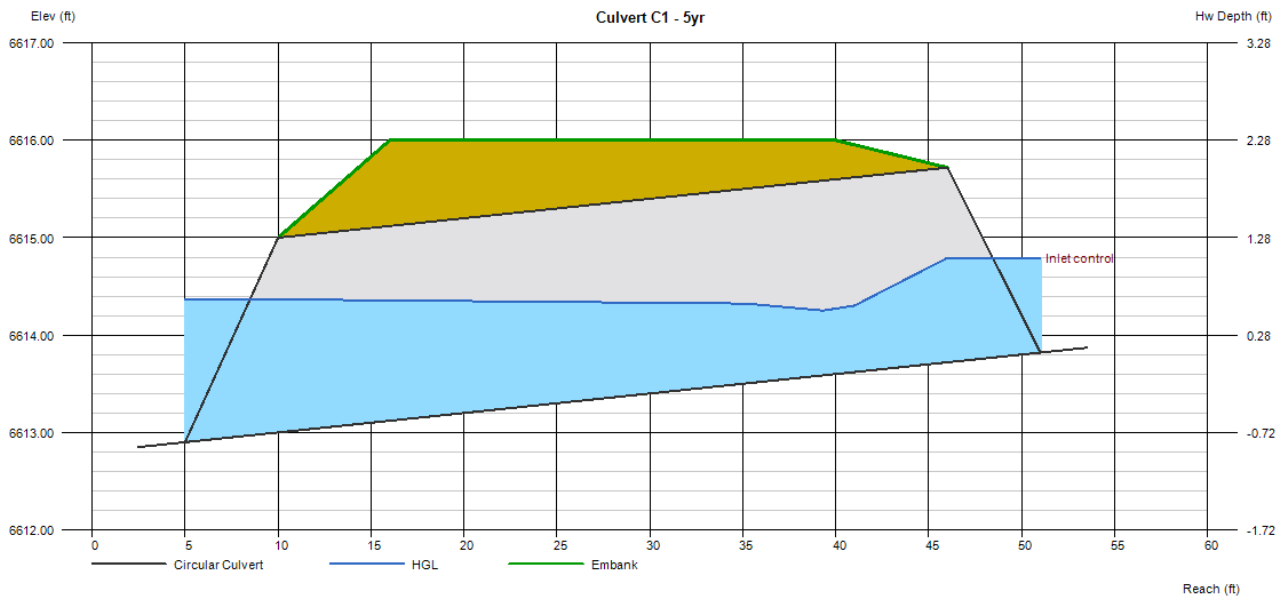
Top Elevation (ft)	=	6616.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	8.70
Qmax (cfs)	=	8.70
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	8.70
Qpipe (cfs)	=	8.70
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.90
Veloc Up (ft/s)	=	4.18
HGL Dn (ft)	=	6614.37
HGL Up (ft)	=	6614.45
Hw Elev (ft)	=	6614.79
Hw/D (ft)	=	0.54
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Dec 30 2024

Culvert C1 - 100yr

Invert Elev Dn (ft)	=	6613.00
Pipe Length (ft)	=	36.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	6613.72
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

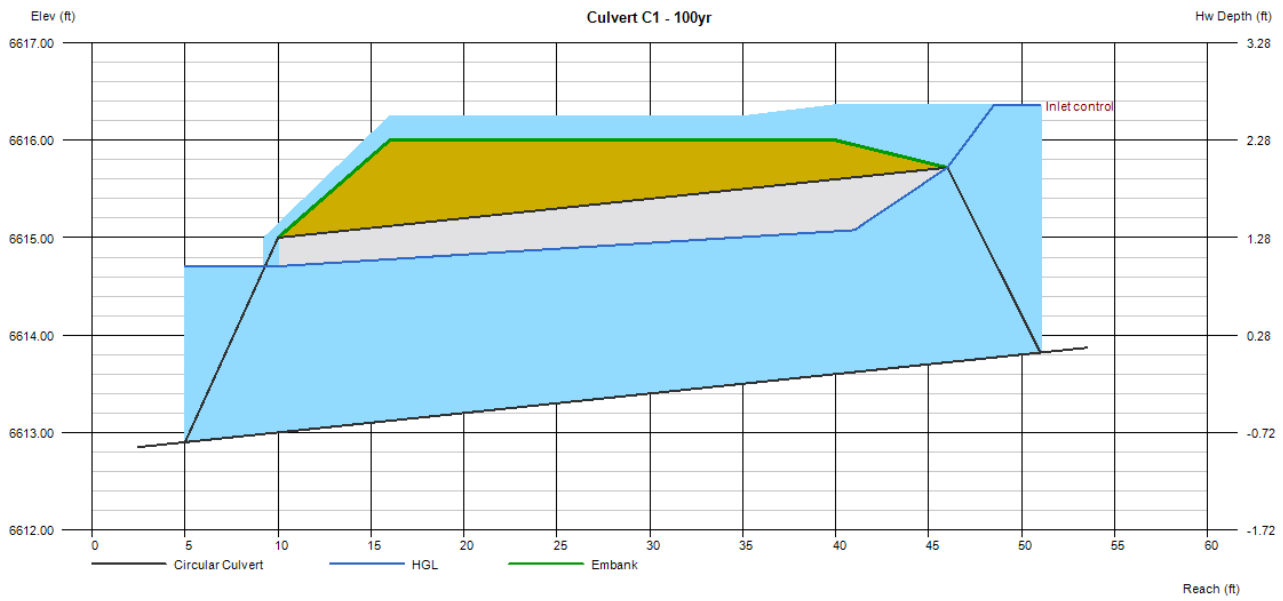
Top Elevation (ft)	=	6616.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	63.90
Qmax (cfs)	=	63.90
Tailwater Elev (ft)	=	(dc+D)/2

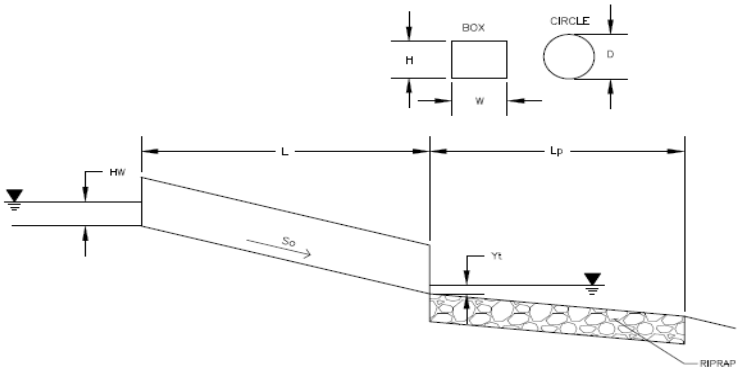
Highlighted

Qtotal (cfs)	=	63.90
Qpipe (cfs)	=	30.81
Qovertop (cfs)	=	33.09
Veloc Dn (ft/s)	=	5.39
Veloc Up (ft/s)	=	6.47
HGL Dn (ft)	=	6614.71
HGL Up (ft)	=	6615.14
Hw Elev (ft)	=	6616.36
Hw/D (ft)	=	1.32
Flow Regime	=	Inlet Control



Determination of Culvert Headwater and Outlet Protection

Project: 61224 - I68 Ranges
Basin ID: Culvert C1 - 100yr



Soil Type:
Choose One:
(•) Sandy
( ) Non-Sandy

Design Information (Input):

Design Discharge	Q =	63.9	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		1.1 : 1 Beveled Edge	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	2	
Inlet Elevation	Elev IN =	6613.72	ft
Outlet Elevation **OR** Slope	Elev OUT =	6613	ft
Culvert Length	L =	36	ft
Manning's Roughness	n =	0.023	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.80	ft
Flow Area at Max Channel Velocity	A_t =	6.39	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.39	
Sum of All Losses Coefficients	k_s =	2.59	ft
Culvert Normal Depth	Y_n =	0.69	ft
Culvert Critical Depth	Y_c =	1.89	ft
Tailwater Depth for Design	d =	1.94	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	2.04	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	5.65	$ft^{0.5}/s$
Froude Number	Fr =	-	**Pressure flow!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	4.96	ft
Outlet Control Headwater	HW_O =	5.39	
Design Headwater Elevation	**HW =**	**6,619.11**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**2.69**	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	9	in
Nominal Riprap Size	d_{50} =	12	in
UDFCD Riprap Type	**Type =**	**M**	
Length of Protection	**L_p =**	**13**	**ft**
Width of Protection	**T =**	**9**	**ft**

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 27 2024

Hesco Barrier Openings in Basin PB-E - 100yr = 0.6 cfs per 10' opening

Rectangular

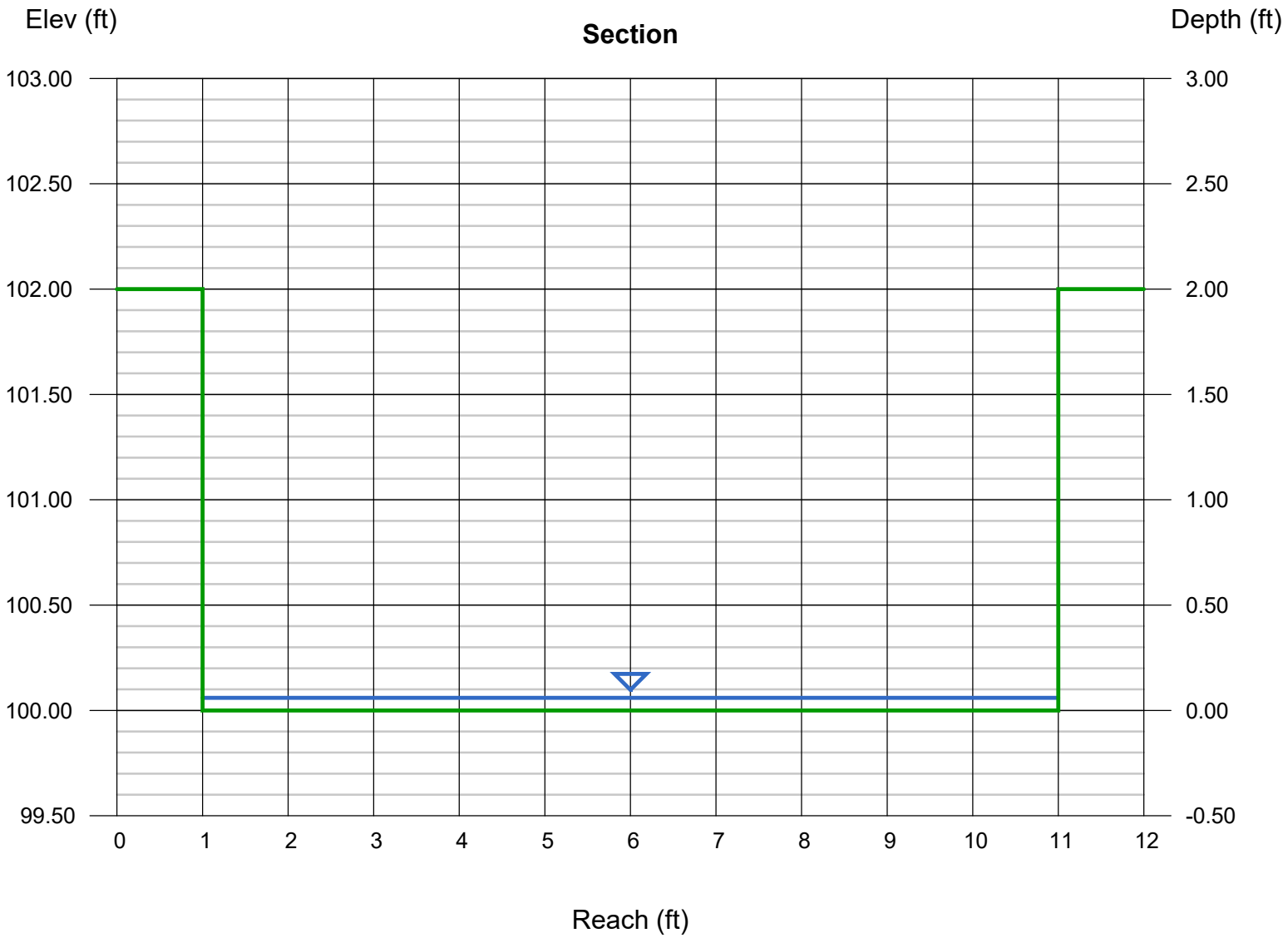
Bottom Width (ft)	= 10.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.60

Highlighted

Depth (ft)	= 0.06
Q (cfs)	= 0.600
Area (sqft)	= 0.60
Velocity (ft/s)	= 1.00
Wetted Perim (ft)	= 10.12
Crit Depth, Yc (ft)	= 0.05
Top Width (ft)	= 10.00
EGL (ft)	= 0.08



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 27 2024

Hesco Barrier Openings in Basin PB-B - 100yr = 0.9 cfs per 10' opening

Rectangular

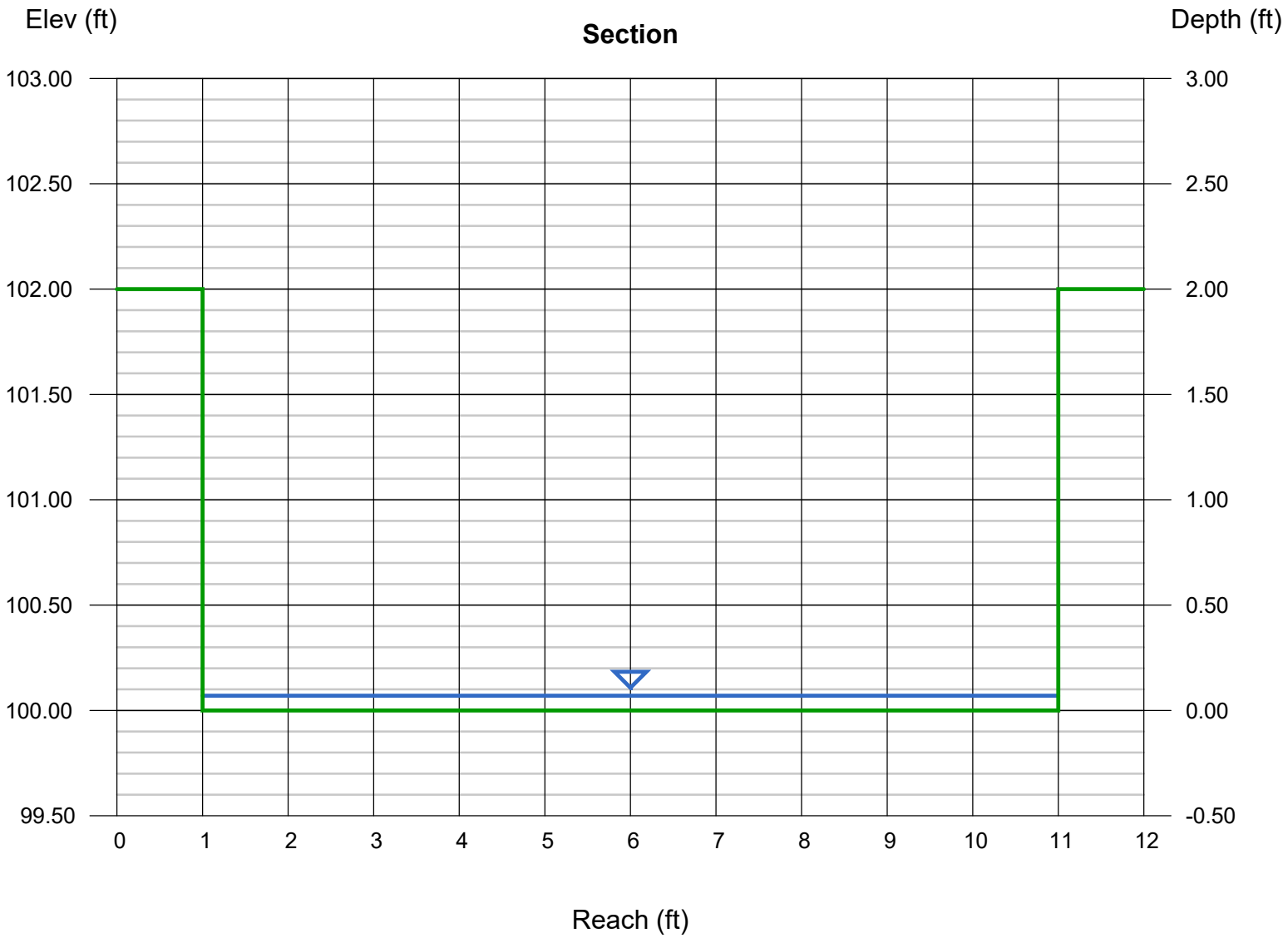
Bottom Width (ft)	= 10.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 4.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.90

Highlighted

Depth (ft)	= 0.07
Q (cfs)	= 0.900
Area (sqft)	= 0.70
Velocity (ft/s)	= 1.29
Wetted Perim (ft)	= 10.14
Crit Depth, Yc (ft)	= 0.07
Top Width (ft)	= 10.00
EGL (ft)	= 0.10



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 27 2024

Hesco Barrier Openings at DP-C2 - 100yr = 62.1 cfs in 20' Channel

Trapezoidal

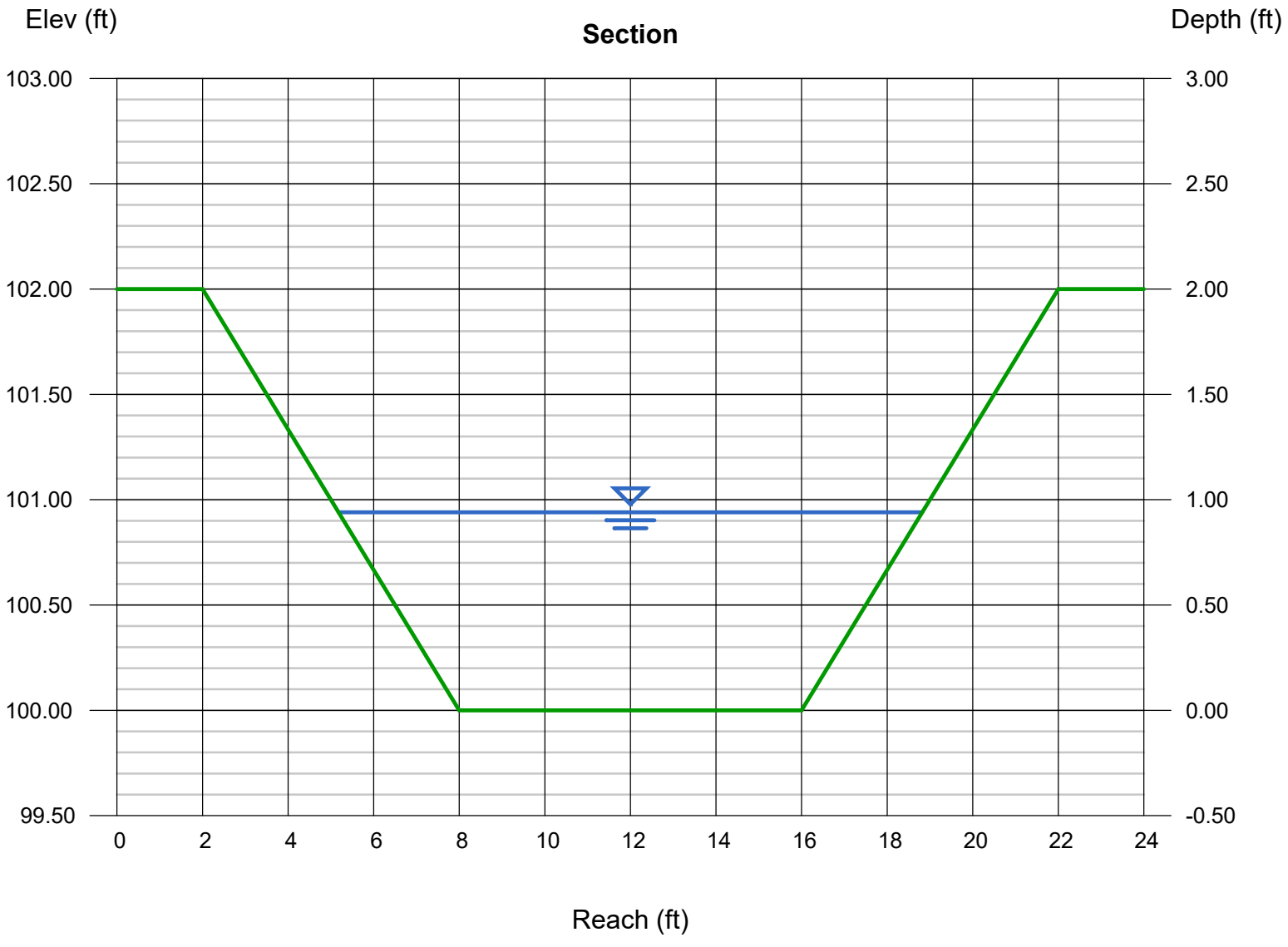
Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 62.10

Highlighted

Depth (ft)	= 0.94
Q (cfs)	= 62.10
Area (sqft)	= 10.17
Velocity (ft/s)	= 6.11
Wetted Perim (ft)	= 13.95
Crit Depth, Yc (ft)	= 1.08
Top Width (ft)	= 13.64
EGL (ft)	= 1.52



61224

CHANNEL LINING & HESCO BARRIERS

TJW - 12/27/24

TABLE 10-6

RIPRAP REQUIREMENTS FOR CHANNEL LININGS **

$VS^{0.17}/(S_s-1)^{0.66}$* (ft^{1}/2/sec)	Rock Type ***
1.4 to 3.2	VL
3.3 to 3.9	L
4.0 to 4.5	M
4.6 to 5.5	H
5.6 to 6.4	VH

* where:

V = mean channel flow velocity, in fps;

S = longitudinal channel slope, in feet per foot (ft/ft); and

S_s = specific gravity of stone (minimum S_s = 2.50)

** Table valid only for Froude number of 0.8 or less and side slopes no steeper than 2h:1v.

*** Type VL and L riprap may be buried after placement to reduce vandalism.

$V = 6.11$

$S = .03$

$S_s = 2.50$

$$\frac{6.11 \cdot .03^{0.17}}{(2.5-1)^{0.66}} = \frac{6.11 \cdot 0.55}{1.307} = \frac{3.361}{1.307} = \underline{2.571}$$

USE TYPE VL RIPRAP

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 6 2024

Design Point A2 - 100yr = 34.9cfs

Trapezoidal

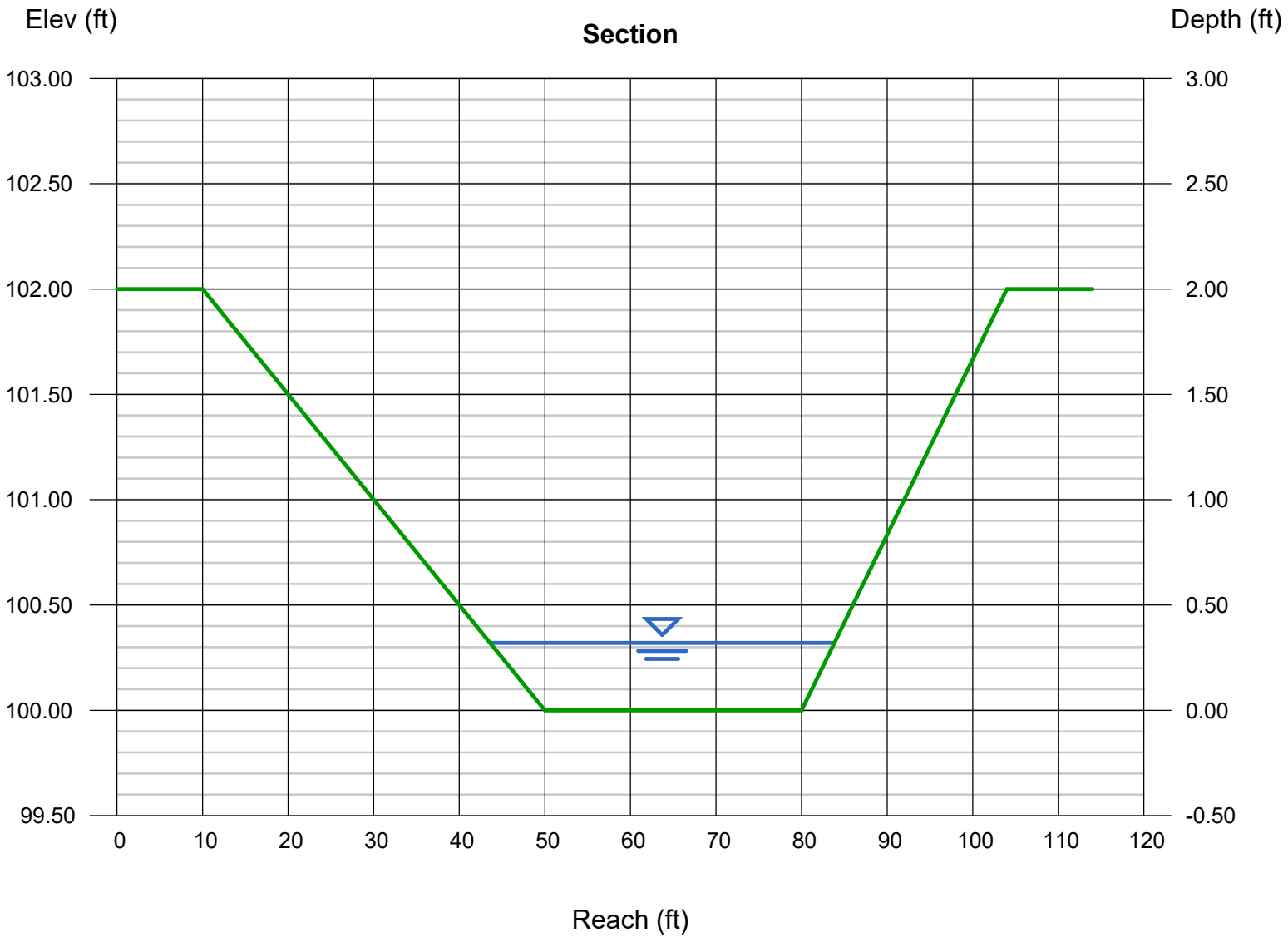
Bottom Width (ft)	= 30.00
Side Slopes (z:1)	= 20.00, 12.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 34.90

Highlighted

Depth (ft)	= 0.32
Q (cfs)	= 34.90
Area (sqft)	= 11.24
Velocity (ft/s)	= 3.11
Wetted Perim (ft)	= 40.26
Crit Depth, Yc (ft)	= 0.33
Top Width (ft)	= 40.24
EGL (ft)	= 0.47



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 6 2024

Design Point C2 - 100yr = 62.1cfs

Trapezoidal

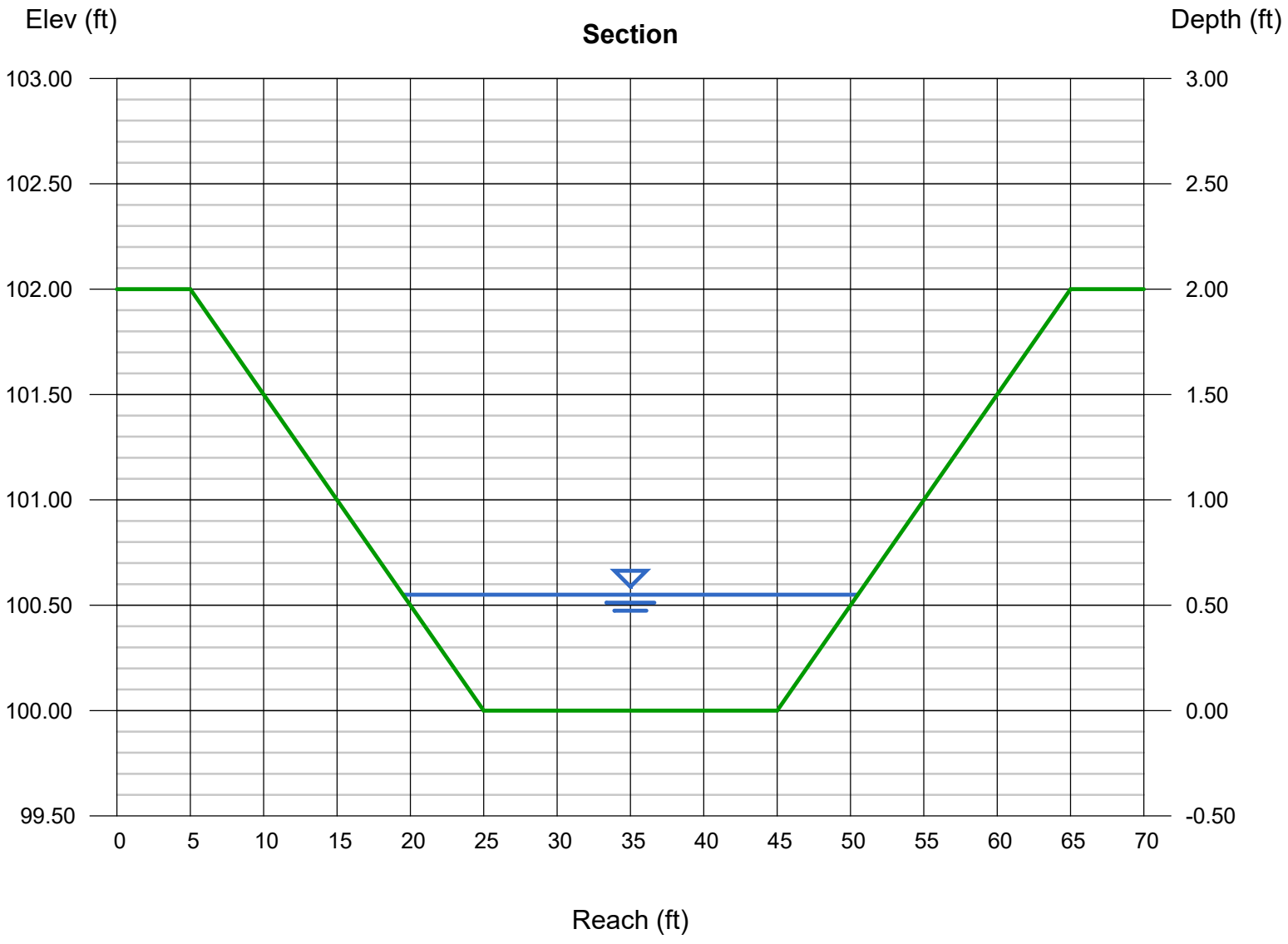
Bottom Width (ft)	= 20.00
Side Slopes (z:1)	= 10.00, 10.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 62.10

Highlighted

Depth (ft)	= 0.55
Q (cfs)	= 62.10
Area (sqft)	= 14.02
Velocity (ft/s)	= 4.43
Wetted Perim (ft)	= 31.05
Crit Depth, Yc (ft)	= 0.61
Top Width (ft)	= 31.00
EGL (ft)	= 0.85



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Dec 6 2024

Design Point D2 - 100yr = 67.2cfs

Trapezoidal

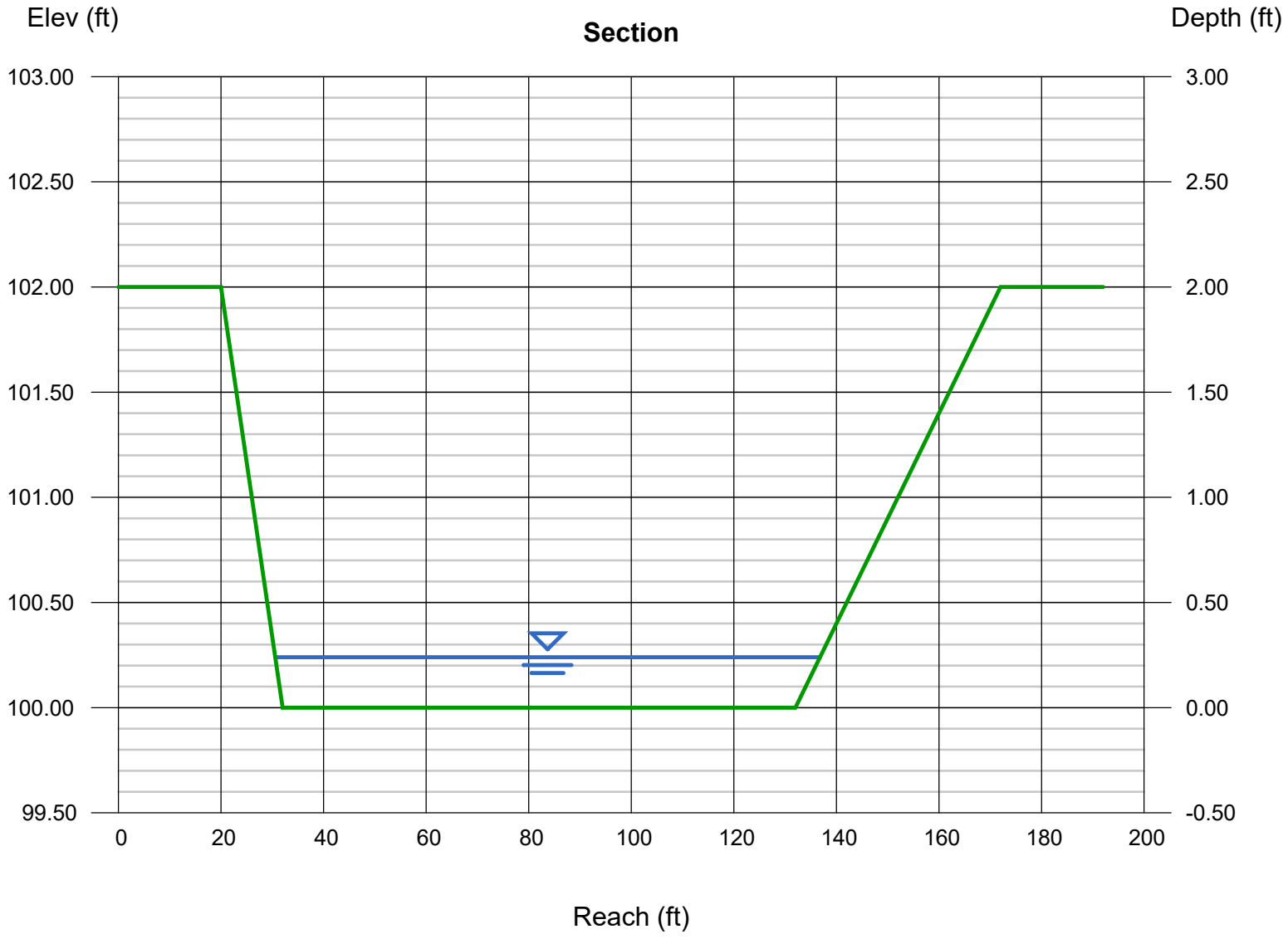
Bottom Width (ft)	= 100.00
Side Slopes (z:1)	= 6.00, 20.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 3.00
N-Value	= 0.034

Calculations

Compute by:	Known Q
Known Q (cfs)	= 67.20

Highlighted

Depth (ft)	= 0.24
Q (cfs)	= 67.20
Area (sqft)	= 24.75
Velocity (ft/s)	= 2.72
Wetted Perim (ft)	= 106.27
Crit Depth, Yc (ft)	= 0.24
Top Width (ft)	= 106.24
EGL (ft)	= 0.35



El Paso County Conservation District

5610 Industrial Pl #100
Colorado Springs, CO 80916

719-600-4706

districtmanager@epccd.org

https://epccd.org

The El Paso County Conservation District serves landowners, land users, and partners to champion the responsible management and conservation of our finite natural resources.

To Whom It May Concern,

The El Paso County Conservation District (EPCCD) Board of Supervisors recommendations are as follows:

Ground Disturbance: If the ground is disturbed, it should be mulched or revegetated within **45 days of disturbance**. It is generally important that some type of native grass should be planted for the protection of natural resources, erosion control, native vegetation preservation, sedimentation prevention, habitat protection, stormwater management, and soil health. Please make sure the "native" grasses and plants already in place are in fact native to the area. The EPCCD store inventory generally includes both our Shotgun Native Grass Seed Mix as well as the El Paso Low Grow Grass Seed Mix; these are our recommendations should grass seed need to be implemented.

- Our **Shotgun Native Grass Seed Mix** is formulated specifically for the Pikes Peak Front Range by our NRCS District Conservationist and Rangeland Management partners. It is drought-tolerant and includes: about 20% each of Big Bluestem Native and Wheatgrass, Western Native, and about 10% each of Grama, Sideoats Native, Green Needlegrass Native, Little Bluestem Native, Prairie Sandreed Native, Switchgrass Native, and Yellow Indiangrass Native.
- The **El Paso Low Grow Grass Seed Mix** is a great drought-tolerant and low-grow grass seed mix designed for the Pikes Peak Front Range; it includes: about 24% Western Wheatgrass, about 20% Blue Grama, Native, about 18% Buffalograss, about 13% Sideoats Grama, about 6% Green Needlegrass, and about 1.5% Sand Dropseed.

More information about these grass seed mixes, as well as clover, cover crop, and wildflower seeds, and many waterwise/Coloradoscape plants, is available on our website at https://epccd.org/

Integrated Noxious Weed Management: Early intervention and integrated control measures are generally important, especially in areas where the ground is disturbed or undergoing development for: preservation of native vegetation, protection of land and soil, fire risk reduction, maintenance of water quality, cost savings, and long-term health and sustainability. An integrated noxious weed control plan typically includes a combination of prevention, mechanical, biological, and/or chemical control, and ongoing assessment and monitoring. It is a proactive approach to address the threat posed by invasive weeds and protect the ecological and economic health of the region. If there is no integrated noxious weed control plan in place, we recommend a weed program be reviewed and approved by the NRCS, Colorado Department of Agriculture, Colorado State University Extension - El Paso County, El Paso County Environmental Services Department, or a qualified weed management professional *prior* to the land use authority approval.

If you have any questions regarding these remarks please call us at 719-600-4706 or email districtmanager@epccd.org

Thank you,

Kenneth Barker

Kenneth Barker, Board President
El Paso County Conservation District

Table 2. Permissible Shear and Velocity for Selected Lining Materials[1]

Boundary Category	Boundary Type	Permissible Shear Stress (lb/sq ft)	Permissible Velocity (ft/sec)	Citation(s)
Soils	Fine colloidal sand	0.02 - 0.03	1.5	A
	Sandy loam (noncolloidal)	0.03 - 0.04	1.75	A
	Alluvial silt (noncolloidal)	0.045 - 0.05	2	A
	Silty loam (noncolloidal)	0.045 - 0.05	1.75 – 2.25	A
	Firm loam	0.075	2.5	A
	Fine gravels	0.075	2.5	A
	Stiff clay	0.26	3 – 4.5	A, F
	Alluvial silt (colloidal)	0.26	3.75	A
	Graded loam to cobbles	0.38	3.75	A
	Graded silts to cobbles	0.43	4	A
	Shales and hardpan	0.67	6	A
Gravel/Cobble	1-in.	0.33	2.5 – 5	A
	2-in.	0.67	3 – 6	A
	6-in.	2.0	4 – 7.5	A
	12-in.	4.0	5.5 – 12	A
Vegetation	Class A turf	3.7	6 – 8	E, N
	Class B turf	2.1	4 - 7	E, N
	Class C turf	1.0	3.5	E, N
	Long native grasses	1.2 – 1.7	4 – 6	G, H, L, N
	Short native and bunch grass	0.7 - 0.95	3 – 4	G, H, L, N
	Reed plantings	0.1-0.6	N/A	E, N
	Hardwood tree plantings	0.41-2.5	N/A	E, N
Temporary Degradable RECPs	Jute net	0.45	1 – 2.5	E, H, M
	Straw with net	1.5 – 1.65	1 – 3	E, H, M
	Coconut fiber with net	2.25	3 – 4	E, M
	Fiberglass roving	2.00	2.5 – 7	E, H, M
Non-Degradable RECPs	Unvegetated	3.00	5 – 7	E, G, M
	Partially established	4.0-6.0	7.5 – 15	E, G, M
	Fully vegetated	8.00	8 – 21	F, L, M
Riprap	6 – in. d_{50}	2.5	5 – 10	H
	9 – in. d_{50}	3.8	7 – 11	H
	12 – in. d_{50}	5.1	10 – 13	H
	18 – in. d_{50}	7.6	12 – 16	H
	24 – in. d_{50}	10.1	14 – 18	E
Soil Bioengineering	Wattles	0.2 – 1.0	3	C, I, J, N
	Reed fascine	0.6-1.25	5	E
	Coir roll	3 - 5	8	E, M, N
	Vegetated coir mat	4 - 8	9.5	E, M, N
	Live brush mattress (initial)	0.4 – 4.1	4	B, E, I
	Live brush mattress (grown)	3.90-8.2	12	B, C, E, I, N
	Brush layering (initial/grown)	0.4 – 6.25	12	E, I, N
	Live fascine	1.25-3.10	6 – 8	C, E, I, J
	Live willow stakes	2.10-3.10	3 – 10	E, N, O
Hard Surfacing	Gabions	10	14 – 19	D
	Concrete	12.5	>18	H

[1] Ranges of values generally reflect multiple sources of data or different testing conditions.

A. Chang, H.H. (1988).
B. Florineth. (1982)
C. Gerstgraser, C. (1998).
D. Goff, K. (1999).
E. Gray, D.H., and Sotir, R.B. (1996).
F. Julien, P.Y. (1995).
G. Kouwen, N.; Li, R. M.; and Simons, D.B., (1980).
H. Norman, J. N. (1975).
I. Schiechtl, H. M. and R. Stern. (1996).
J. Schoklitsch, A. (1937).
K. Sprague, C.J. (1999).
L. Temple, D.M. (1980).
M. TXDOT (1999)
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USACE TR EL 97-8

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Plant Fact Sheet

WESTERN WHEATGRASS

Pascopyrum smithii (Rydb.) A. Love

Plant Symbol = PASM

Contributed by: USDA NRCS Plant Materials Program

Robert H. Mohlenbrock
USDA NRCS 1989.
Midwestern Wetland Flora
@ USDA NRCS PLANTS

Alternate Names
Agropyron smithii Rydb.

Uses
Erosion control: Western wheatgrass is an excellent erosion control plant because of its spreading rhizomes. It is widely used in seed mixtures for range seeding, revegetation of saline and alkaline areas, and in critical areas for erosion control in the central and northern Great Plains region. This grass protected watershed dams in Kansas from damage when they were overtopped during a 14-inch rainfall event.

Reclamation: Western wheatgrass is frequently used in the northern Great Plains for surface mine revegetation. Because of its strong rhizomes and adaptation to a variety of soils, it performs well as part of a reclamation mixture.

Livestock: Forage quality is high for pasture or range seedings.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
Pascopyrum smithii (Rydb.) A. Love, western wheatgrass, is perhaps one of the best known and most commonly used native grasses. It is a long-lived, cool season species that has coarse blue- green leaves with prominent veins. Because of this bluish appearance it has sometimes been called bluestem wheatgrass or bluejoint. It is a sod former with very strong, spreading rhizomes. Stems arise singly or in clusters of a few and reach heights of 1 to 3 feet. The sheaths are hairy and the purplish auricles typically clasp the stem. The seed spike is erect and about 2 to 6 inches long.

Adaptation and Distribution
Western wheatgrass is adapted to fine and very fine soils and is replaced by thickspike wheatgrass on coarser soils. Although it is able to grow on a wide variety of soils it prefers the heavier but well drained soils. It requires moderate to high soil moisture content and is most common in the 10 to 14 inch annual precipitation zones. Above 20 inches per year it behaves as an increaser on rangelands, below 20 inches it is a decreaser. Its elevational range is 1,000 to 9,000 feet.

Western wheatgrass tolerates saline and saline-sodic soils, poor drainage and moderately severe drought. It will tolerate spring flooding, high water tables, and considerable silt deposition. It is very cold hardy and can grow in partial shade. It is grazing resistant and can survive fires if in the dormant stage; recovery from fire, however, is slow.

Western wheatgrass grows in association with many species, the more common being blue grama, buffalograss, needlegrasses, bluebunch wheatgrass, rough fescue, Idaho fescue, and prairie junegrass. It begins growth about 2 to 3 weeks before blue grama

and does not mature until much later in the growing season.

Western wheatgrass performs poorly in the East and is not recommended for any use in the region.

Western wheatgrass is distributed throughout the west and midwest portions of the United States. For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment
Seed of western wheatgrass should be planted 1/2 to 1 inch deep in fine to medium soil. Seeding rates should be 5 to 15 pounds PLS per acre drilled or 20 to 25 PLS per row foot. If seed is broadcast or used on harsh sites, the rate should be doubled. This species should be seeded in early spring, late fall or in the period of late summer, early fall. It can be sodded.

Seedling vigor is fair and stands may be slow to establish. It has stronger rooting abilities than does thickspike wheatgrass but spreads more slowly and may take several years to become firmly established. Once established, it is very hardy and enduring. It is moderately compatible with other species and is moderately aggressive.

Management
Western wheatgrass greens up in March or early April and matures in August. If moisture is adequate, it will make fair summer or fall regrowth. If nitrogen is applied it will compete with warm season grasses.

Western wheatgrass is moderately palatable to elk and cattle all year although this quality diminishes in late summer. It is palatable to deer only in spring. It is preferred by cattle more than by sheep. It can be grazed if 50 to 60 percent of the annual growth is allowed to remain (3 or 4 inch stubble). Rest rotation of western wheatgrass is advised. In areas where it is dense, it makes an excellent hay as well as pasture.

Irrigation will improve western wheatgrass stands and aid establishment. Weed control and fertilization will also help. Pitting, chiseling, disking, and interseeding can be used to stimulate stands of western wheatgrass.

Pests and Potential Problems
The primary pests to western wheatgrass are grasshoppers, ergot, and stem and leaf rusts.

Cultivars, Improved, and Selected Materials (and area of origin)
'Ariba' western wheatgrass was released for dry land hay production, grazing, and conservation seedings in the western part of the Central Plains and in the southwestern United States. 'Flintlock' is a broad-based cultivar. It is recommended for conservation seeding, dry land hay production, and grazing in the Central Plains. 'Barton' is a strongly rhizomatous, leafy ecotype, intermediate in growth between northern and southern types. 'Barton' is relatively disease free and high in forage and seed production. 'Rosana' is a northern type western wheatgrass. Plants are blue-green, leafy, with moderately fine stems. Rhizomes produce a tight sod. 'Rosana' is recommended for reseeding depleted range lands and the reclamation of disturbed lands in the Northern Great Plains. 'Rodan' northern type western wheatgrass is moderately rhizomatous and forms a dense blue-green sward. Leaves are thinner and less heavily veined than other western wheatgrasses. Western wheatgrass seed is available at most farm seed stores.

Prepared By & Species Coordinator:
USDA NRCS Plant Materials Program

Edited: 05Feb2002 JLK; 060802 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

USDA NRCS
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Natural Resources Conservation Service

Plant Fact Sheet

BLUE GRAMA

Bouteloua gracilis (Willd. ex Kunth.) Lag. ex Griffiths

Plant Symbol = BOGR2

Contributed by: USDA NRCS Plant Materials Program

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Uses

Livestock: In southern states, blue grama grows as a bunchgrass; in northern states or areas of heavy grazing pressure, it is a sod former.

Erosion control: Blue grama is suitable for mixtures of grasses used in erosion control, low maintenance turf plantings, and surface mine revegetation.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description

Bouteloua gracilis, blue grama, is a major warm season grass found throughout the Great Plains. The plant is fairly short, reaching 10 to 20 inches with narrow basal leaves of 3 to 6 inches. Blue grama grows in definite bunches and reproduces by tillering and by seed. Mature seed heads are curved, resembling a human eyebrow. Blue grama can be found growing in association with buffalograss, western wheatgrass, needlegrasses and in some areas the bluegrasses.

Adaptation and Distribution

Blue grama demonstrates good drought, fair salinity, and moderate alkalinity tolerances. In its dormant state, it will also tolerate burning. Blue grama will not tolerate dense shade, flooding, a high water table, or acid soils.

Blue grama is distributed throughout the western United States. For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment

As with all native grasses, proper ground preparation is one of the most important considerations. The seedbed should be firm but not solid; cultivation to kill the roots of cool-season grasses is essential. Planting may be done by either drilling or broadcasting, with the seed being sown no more than 1/4 to 1/2 inches deep at a rate of 1 to 3 pounds PLS/acre. Seeding in late spring is recommended in the Great Plains; earlier seeding is recommended in areas further south. In the Southwest, seeding should be done during the period from June 15 to July 15. Mulching and irrigation is recommended on harsh sites. Soil tests should be made to test the soils for deficiencies. Blue grama will tolerate low-nutrient soils better than acidic conditions. Planting should be done by a native grass seed drill. In western areas plant blue grama in a sorghum cover crop, stubble, or in with the crop itself.

Management

Once the grass is established, it is very palatable to livestock all year long. Since growing points are at or near the ground surface, the grass withstands fairly close grazing. For best yields, defer grazing during the growing season every 2 to 3 years. Blue grama cures well on stem, making it a good grass for grazing during the dormant season. Renovation of sodbound stands is also recommended. Weeds can be controlled by use of herbicides, mowing or controlled grazing.

Pests and Potential Problems

There are no known serious pests of blue grama grass.

Cultivars, Improved, and Selected Materials (and area of origin)

Improved materials include the cultivars ‘Lovington’ (NM), ‘Hachita’ (NM), and ‘Alma’ (NM) and the selected class release Bad River Ecotype (SD). Seeds are available at most commercial seed sources.

Prepared By & Species Coordinator:

USDA NRCS Plant Materials Program

Edited: 01Feb2002 JLK; 31may06jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

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United States Department of Agriculture
Natural Resources Conservation Service

Plant Fact Sheet

BUFFALOGRASS
Buchloe dactyloides (Nutt.) Engelm.

Plant Symbol = BUDA

Contributed by: USDA NRCS Plant Materials Program

Hitchcock 1950
Manual of the Grasses of the U.S.

Alternate Names
Bouteloua dactyloides (Nutt.) J.T. Columbus

Uses
Erosion control: Buffalograss can be used on areas that do not receive a lot of rain but are affected by wind erosion, such as roadside cuts.

Recreation and beautification: This grass can be used in parks and on school grounds, golf course roughs, and open lawns.

Livestock: This is an important pasture grass for native and introduced animals.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
Buchloe dactyloides (Nutt.) Engelm., buffalograss, is a perennial, native, low-growing, warm-season grass. Leaf blades are 10 to12 inches long, but they fall over and give the turf a short appearance. Staminate plants have 2 to 3 flag-like, one-sided spikes on a seedstalk 4 to 6 inches long. Spikelets, usually 10, are 1/8 inch long in two rows on one side of the rachis. Pistillate spikelets are in a short spike or head and included in the inflated sheaths of the upper leaves. Both male and female plants have stolons from several inches to several feet in length, internodes 2 to 3 inches long, and nodes with tufts on short leaves.

Adaptation and Distribution
This grass occurs naturally and grows best on clay loam to clay soils. It requires little mowing to achieve a uniform appearance. It has a low fertility requirement and it often will maintain good density without supplemental fertilization. Buffalograss is well suited for sites with 10 to 25 inches of annual precipitation. It is not adapted to shaded sites.

Buffalograss is distributed throughout the Midwest. For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment
Buffalograss is propagated by seed and vegetatively. Establishment can be accomplished by seeding, solid sodding, or sprigging rooted and unrooted plugs. If seeds are used, drill at 1/2 inch deep and provide firm contact between the seed and moist soil. The seed may also be broadcast. When broadcasting seed, harrow or rake the area in two directions immediately after seeding to work the seeds into the soil. Broadcast seed must be covered with soil for the seeding to be successful. With any method, the soil must be firmed against the seed. Seedlings begin to appear 14 to 21 days after planting when moisture is available for germination. The amount of seed needed to ensure a stand at the end of the first year will depend on the method of seeding, the quality of seedbed preparation, the availability of water for

establishment, and certain climatic uncertainties. All planting should be delayed until the danger of frost has past. The time of planting depends upon the latitude of the location, and may extend to August 1 in lower latitudes.

Buffalograss can be established from pieces of sod or sod plugs. Sod should be planted on a well prepared seedbed in 18-inch rows. Sod should be spaced from 6 inches to 2 feet apart; plugs should be planted on 12 to 24 inch centers depending on how quickly a complete cover is desired. When planting, dig a hole deep enough to set a plant in with the grass blades above the ground. Pack soil around the sod making sure not to cover with soil because the plant will die. Once planted, the sod should be watered for about 3 weeks to ensure root establishment.

Sprigs should be planted into soil that has been tilled to a depth of 4 to 6 inches. Sprigging rate should be approximately 240 bushels of sprigs per acre, planted to a depth of 1 inch or less. A planted site should be rolled to ensure good sprig-soil contact and irrigated within 3 hours after planting. Newly planted areas will also require irrigation for several weeks to maintain a moist environment for root establishment.

Proper seedbed preparation for planting a home lawn is essential. Buffalograss will grow on heavy and compacted soils, but it is easier to start and maintain on good loam soils. Heavy soils may be improved by applying good quality organic matter such as peat moss, aged manure, or compost. Applying a phosphorus fertilizer stimulates seedling root growth, even on soils testing high in phosphorus. Work the soil to a depth of 4 to 6 inches. This may require plowing, discing, or tilling. The seedbed should be uniform, friable, and well-packed. Use tillage methods to control any weeds that may develop before seeding.

Management

Buffalograss is only recommended for low maintenance and low use turfgrass areas. Mowing height and frequency depend on grass use, amount of irrigation, and time of year. Care must be taken when mowing not to cut shorter than 2 to 3 inches to avoid other grasses from out-competing the buffalograss. Buffalograss responds well to light applications of nitrogen. Over- fertilization will promote undesirable grasses within the planted area. Buffalograss is excellent for people who want a large, attractive lawn during the summer with a minimum of work involved. Other advantages of buffalograss for lawns is that it withstands heavy usage and has good drought tolerance. However, potential lawn growers should note that buffalograss is a warm-season grass, it turns brown with fall's first freezing weather, and will not green-up until warm weather returns; it will be brown and unattractive when the neighbor's Kentucky Bluegrass is brilliant green. During extended dry periods in the summer months, buffalograss will go brown and become dormant if no supplemental water is provided. Because of aggressive runners, buffalograss can require edging along walks, driveway, and flower beds.

Pests and Potential Problems

Buffalograss has no serious pests.

Cultivars, Improved, and Selected Materials (and area of origin)

'Bison', 'Plains', 'Texoka', and 'Topgun' (cultivars); Bismarck Ecotype (selected class release). Seeds are available at most Midwestern commercial seed sources. Sod, sod plugs, and sprigs can be obtained from sod farms.

Prepared By & Species Coordinator:

USDA NRCS Plant Materials Program

Edited: 01Feb2002 JLK; 31may06jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

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United States Department of Agriculture
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Plant Fact Sheet

SIDEOATS GRAMA
Bouteloua curtipendula
(Michx.) Torr.

Plant Symbol = BOCU

Contributed by: USDA NRCS Plant Materials Program

Uses

Erosion Control: This grass is adapted to most soil conditions. Successful seedings are obtained in rocky, stony, or shallow soils. It is a fair to good erosion control plant when mixed with the other plants naturally associated with it.

Grazing: This is one of the most important range grasses. Although not as palatable as some of the smaller gramas, e.g. blue grama, it is more palatable than many of the other grass species. It produces a much greater volume of forage than blue grama, and this tends to make up for its slightly lower palatability. It remains green later in the fall and usually begins growth in the spring before other gramas. It cures well, and maintains a fairly high feeding value throughout the year.

Wildlife: Furnishes some forage for deer and antelope when green. Elk use this plant throughout the year.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values). It is considered threatened in several states.

Description

Bouteloua curtipendula, sideoats grama, is a medium-size perennial bunchgrass, 15 to 30 inches tall or occasionally taller. This is the largest and most coarse of the grama grasses. It has a bluish-green color, sometimes with a purplish cast (especially in the spring), and cures to a reddish-brown or straw color. Leaves are coarser than other species of gramas, straight, comparatively stiff, and mostly basal. Ten to thirty small, non-comb-like spikes are borne mostly along one side of each central seed stalk. These spikes drop when mature, leaving a long zigzag stalk.

Adaptation and Distribution

Sideoats grama is found on rocky open slopes, woodlands, and forest openings up to an elevation of about 7,000 feet.

Sideoats grama is distributed throughout most of the United States. For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment

Seeding of improved strains of this grass is accomplished by drilling in firm, weed-free seedbeds at the rate of 2-1/2 to 5 pounds (or more) pure live seed per acre. Protect from grazing from date of seeding through the second growing season. Seedings should be delayed until good soil moisture is present.

Management

Sideoats grama is not as resistant to grazing as blue grama because of its taller growth habit, but sideoats grama stays green longer and can be grazed for a longer period. Reduced forage production, carrying capacity, and loss in cattle weight is a direct result of overgrazing. Sideoats grama is a normal component of a large number of range sites. The grass lengthens

the grazing season and increases forage production, in addition to providing variety in the feed. Sideoats grama will return to most ranges under good management. Practices that will bring the grass back include proper grazing use, planned grazing systems, and brush control.

Pests and Potential Problems
There are no serious pests of sideoats grama.

Cultivars, Improved, and Selected Materials (and area of origin)
Released cultivars include'Butte' (NE), 'El Reno' (OK), 'Haskell' (TX), 'Niner' (NM), 'Premier' (Mexico), 'Trailway' (NE), and 'Vaughn' (NM); informal releases include Killdeer (ND) and Pierre (SD); and source identified releases include Northern Iowa Germplasm, Central Iowa Germplasm, Southern Iowa Germplasm (all from IA). Seeds are available at most western commercial seed sources.

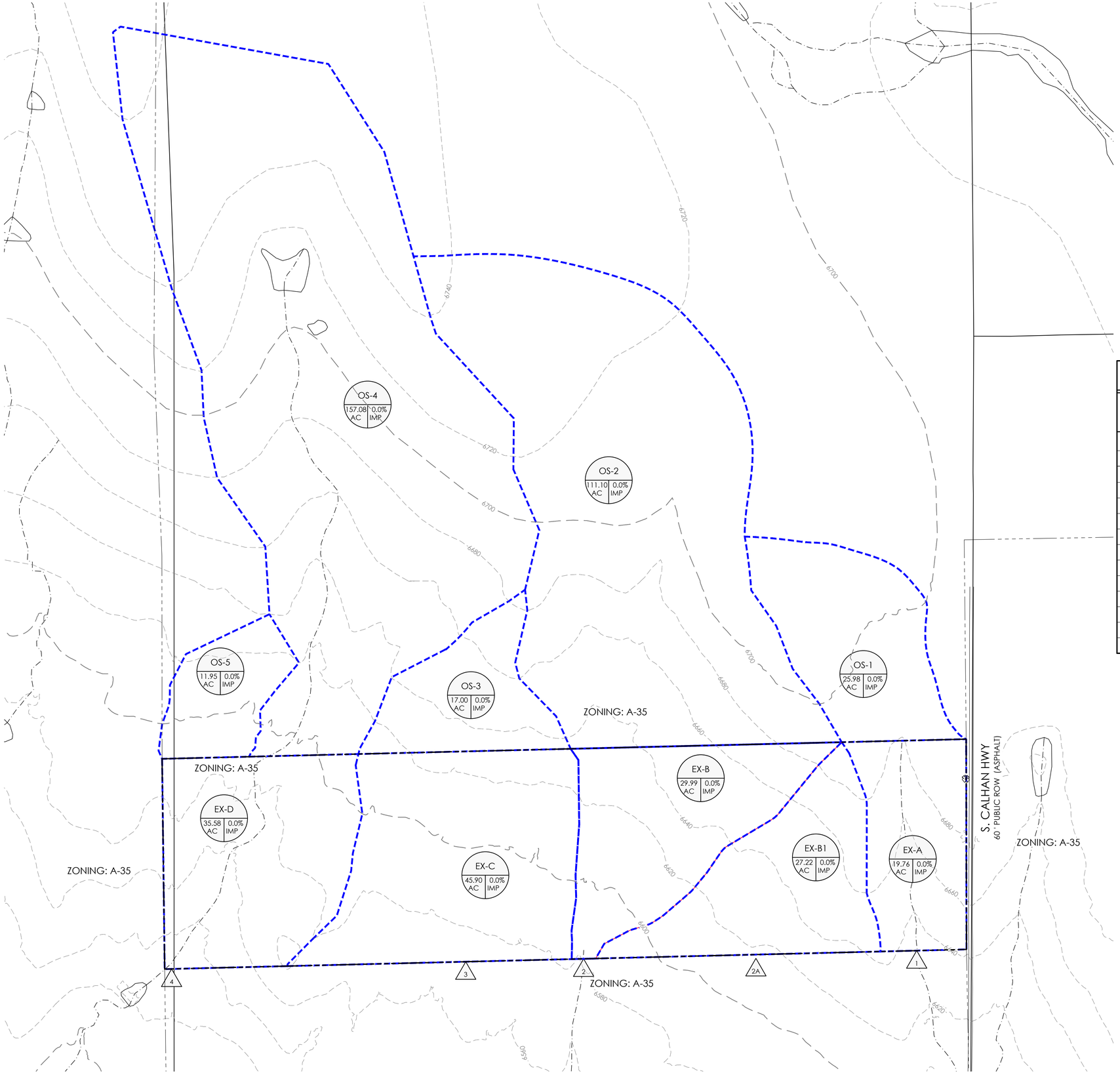
Prepared By & Species Coordinator:
USDA NRCS Plant Materials Program

Edited: 01Feb2002 JLK: 31may06jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

4 Report Maps

Existing Drainage Map (Map Pocket)
Proposed Drainage Map (Map Pocket)



LEGEND

- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

EXISTING

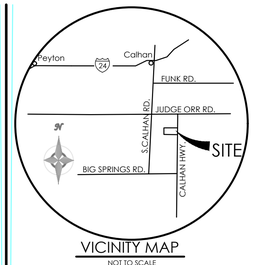
- 5985 INDEX CONTOUR
- 84 INTERMEDIATE CONTOUR

PROPOSED

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

EXISTING DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
	OS-1	25.98	54.8	3.3	24.1	RATIONAL
	OS-2	111.10	80.1	9.0	65.6	RATIONAL
	OS-3	17.00	31.7	3.3	23.9	RATIONAL
	OS-4	157.08	92.4	10.0	73.0	RATIONAL
	OS-5	11.95	27.3	2.5	18.4	RATIONAL
	EX-A	19.76	31.2	3.8	28.1	RATIONAL
DP-1	OS-1, EX-A	45.75	66.1	4.7	34.8	RATIONAL
	EX-B	29.99	35.0	5.4	39.6	RATIONAL
DP-2	OS-2, EX-B	166.18	88.3	9.7	71.3	RATIONAL
	EX-C	45.90	31.9	8.8	64.4	RATIONAL
DP-2A	EX-B1	27.22	30.4	5.4	39.4	RATIONAL
DP-3	OS-3, EX-C	65.05	40.4	10.2	75.2	RATIONAL
	EX-D	35.58	34.2	6.5	47.7	RATIONAL
DP-4	OS-4&5, EX-D	204.61	104.3	10.0	73.3	RATIONAL



VICINITY MAP
NOT TO SCALE

BENCHMARK

N

50 0 100 300 600
1" = 300' 1:3,600

MVE, INC.
ENGINEERS' SURVEYORS
19003 lelaray street, suite 200 colorado springs co 80909 719.635.5736

REVISIONS

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

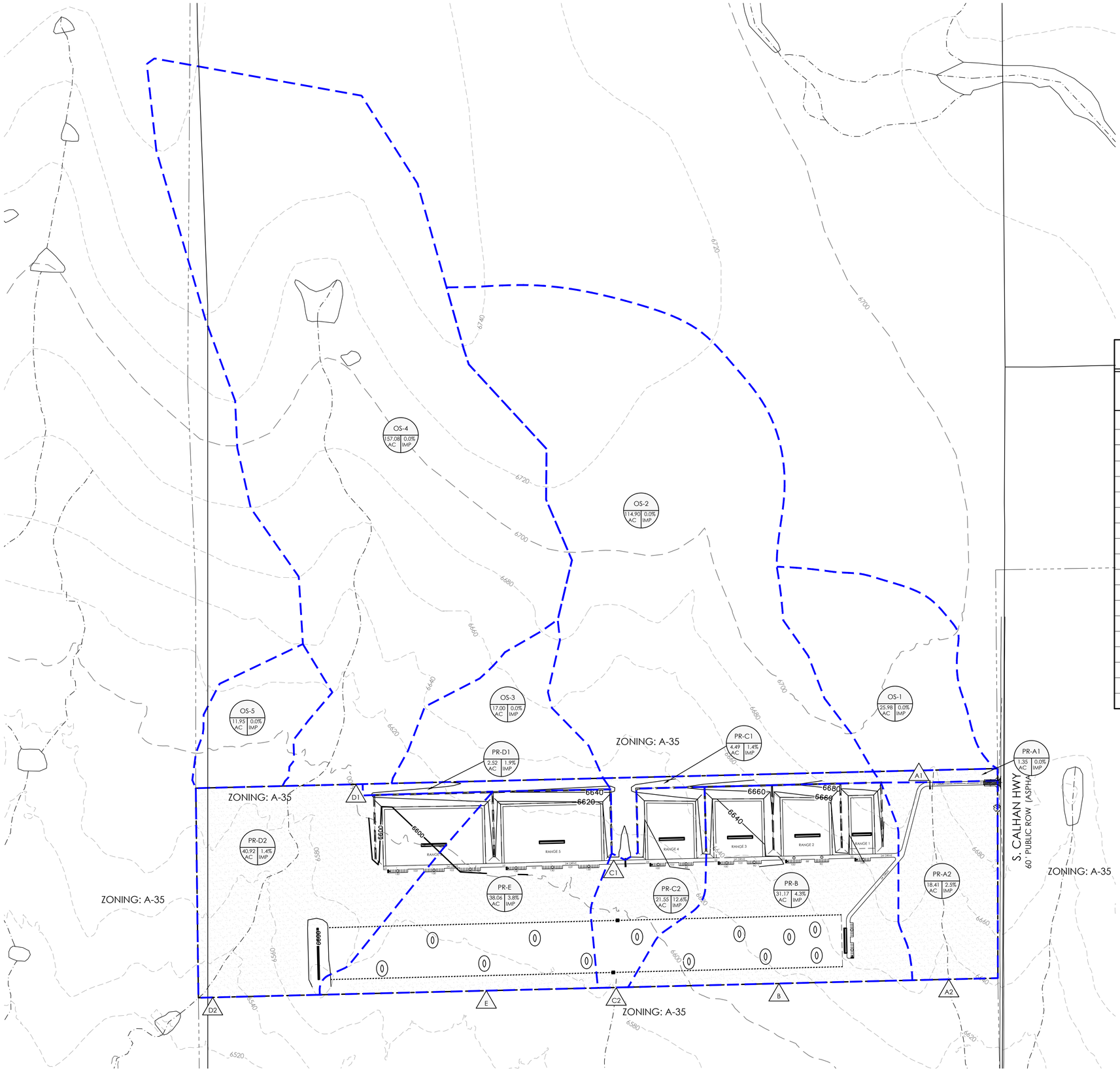
+158 Acre Parcel
168 Training Facility

DRAINAGE REPORT

EX OVERALL MAP

MVE PROJECT 61224
MVE DRAWING EXDRAIN MAP

fEBRUARY 14, 2025
SHEET 1 OF 3



LEGEND

- PROPERTY LINE
- EASEMENT LINE
- LOT LINE

EXISTING

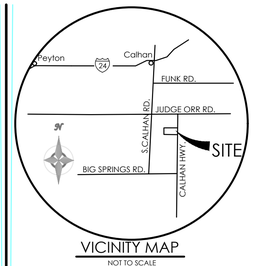
- 5985 INDEX CONTOUR
- 84 INTERMEDIATE CONTOUR

PROPOSED

- 5985 INDEX CONTOUR
- 84 INTERMEDIATE CONTOUR
- BASIN BOUNDARY
- Q = 19.0 cfs, Q = 60.0 cfs FLOW AMOUNTS
- A1 | 1.0 AC | 50% IMP — SLOPE DIRECTION AND GRADE; BASIN LABEL, AREA IN ACRES, PERCENT IMPERVIOUS
- 1 DESIGN POINT
- TIME OF CONCENTRATION
- FLOW DIRECTION

PROPOSED DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
	OS-1	25.98	54.8	3.3	24.1	RATIONAL
	OS-2	111.10	80.1	9.0	65.6	RATIONAL
	OS-3	17.00	31.7	3.3	23.9	RATIONAL
	OS-4	157.08	92.4	10.0	73.0	RATIONAL
	OS-5	11.95	27.3	2.5	18.4	RATIONAL
	PR-A1	1.35	6.9	0.5	3.7	RATIONAL
DP-A1	OS-1, PR-A1	27.33	55.5	3.4	25.0	RATIONAL
	PR-A2	18.41	28.9	4.5	28.3	RATIONAL
DP-A2	OS-1, PR-A1&2	45.75	66.7	5.1	34.9	RATIONAL
DP-B	PR-B	31.17	32.5	7.9	45.6	RATIONAL
	PR-C1	4.49	38.4	0.8	5.7	RATIONAL
DP-C1	OS-2, PR-C1	115.60	83.7	8.7	63.9	RATIONAL
	PR-C2	21.55	30.4	8.5	36.2	RATIONAL
DP-C2	OS-2, PR-C1&2	129.69	91.4	10.3	66.8	RATIONAL
	PR-D1	2.52	46.1	0.4	2.8	RATIONAL
DP-D1	OS-3, PR-D1	19.52	32.7	3.7	27.0	RATIONAL
	PR-D2	40.92	33.6	8.4	56.6	RATIONAL
DP-D2	OS-4&5, D1&2	212.47	109.5	10.1	72.6	RATIONAL
DP-E	PR-E	36.66	32.2	9.3	55.6	RATIONAL



VICINITY MAP
NOT TO SCALE

BENCHMARK

N

50 0 100 300 600

1" = 300' 1:3,600

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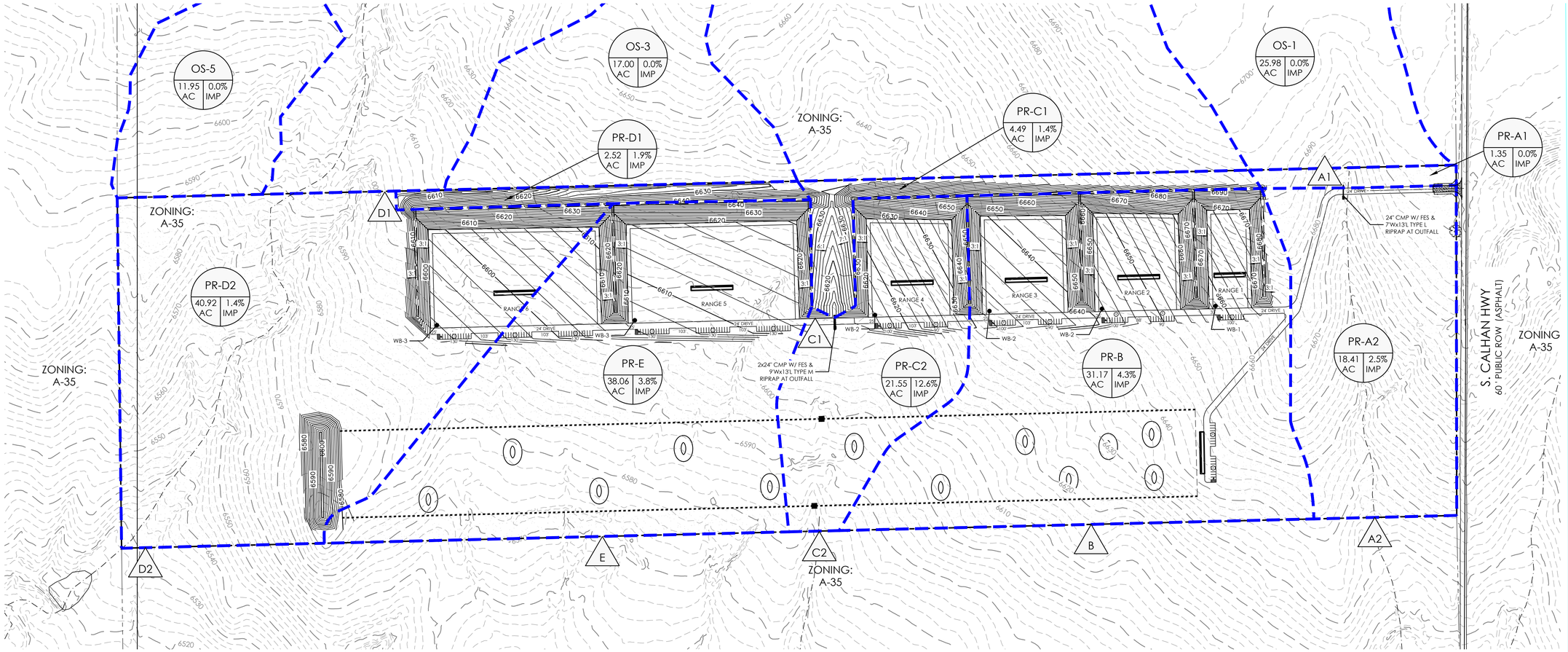
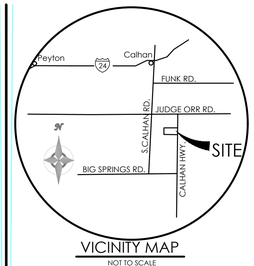
DRAINAGE REPORT

OVERALL DRAINAGE MAP

MVE PROJECT 61224
MVE DRAWING PRDRAIN MAP

FEBRUARY 14, 2025
SHEET 2 OF 3





BENCHMARK

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 — FLOW AMOUNTS
- SLOPE DIRECTION AND GRADE
- A1 / 1.0 AC / 50% IMP — BASIN LABEL: AREA IN ACRES, PERCENT IMPERVIOUS
- 1 — DESIGN POINT
- TIME OF CONCENTRATION
- FLOW DIRECTION

PROPOSED DRAINAGE SUMMARY TABLE

DESIGN POINTS	INCLUDED BASINS	AREA (AC)	Tc (MIN.)	RUNOFF Q5 (CFS)	RUNOFF Q100 (CFS)	METHOD
	OS-1	25.98	54.8	3.3	24.1	RATIONAL
	OS-2	111.10	80.1	9.0	65.6	RATIONAL
	OS-3	17.00	31.7	3.3	23.9	RATIONAL
	OS-4	157.08	92.4	10.0	73.0	RATIONAL
	OS-5	11.95	27.3	2.5	18.4	RATIONAL
	PR-A1	1.35	6.9	0.5	3.7	RATIONAL
DP-A1	OS-1, PR-A1	27.33	55.5	3.4	25.0	RATIONAL
	PR-A2	18.41	28.9	4.5	28.3	RATIONAL
DP-A2	OS-1, PR-A1&2	45.75	66.7	5.1	34.9	RATIONAL
DP-B	PR-B	31.17	32.5	7.9	45.6	RATIONAL
	PR-C1	4.49	38.4	0.8	5.7	RATIONAL
DP-C1	OS-2, PR-C1	115.60	83.7	8.7	63.9	RATIONAL
	PR-C2	21.55	30.4	8.5	36.2	RATIONAL
DP-C2	OS-2, PR-C1&2	129.69	91.4	10.3	66.8	RATIONAL
	PR-D1	2.52	46.1	0.4	2.8	RATIONAL
DP-D1	OS-3, PR-D1	19.52	32.7	3.7	27.0	RATIONAL
	PR-D2	40.92	33.6	8.4	56.6	RATIONAL
DP-D2	OS-4&5, D1&2	212.47	109.5	10.1	72.6	RATIONAL
DP-E	PR-E	36.66	32.2	9.3	55.6	RATIONAL

WATER BASIN SUMMARY TABLE FOR WATER QUALITY

WB	RANGE	AREA(SF)	UPSTREAM DRAINAGE AREA
1	1	28'x56'=1568 SF	2.7 ACRES
2	2,3,4	36'x72'=2592 SF	4.5 ACRES
3	5,6	50'x100'=5000 SF	7.9 ACRES

REFERENCE THE TEMPORARY SEDIMENT BASIN DETAILS ON THE GRADING & EROSION CONTROL PLAN DETAILS.

MVE, INC. ENGINEERS / SURVEYORS
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REVISIONS

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

+158 Acre Parcel
168 Training Facility

DRAINAGE REPORT

ONSITE DRAINAGE MAP

MVE PROJECT 61224
MVE DRAWING PRDRAIN MAP

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