FINAL DRAINAGE REPORT FOR
BLUE SPRINGS MEADOW
EL PASO COUNTY, COLORADO

PCD FILE NO:
SF???

AUGUST 2026

Prepared For:

Prepared for:
2 BROTHERS PROPERTIES LLC
5625 E Pikes Peak Ave
Colorado Springs, CO 80916
Adam & Baruch Rhea

Prepared By:
TERRA NOVA ENGINEERING, INC.
721 S. 23rd St.
Colorado Springs, CO 80904
Contact: Quentin Armijo

Job No. 2625.00

FINAL DRAINAGE REPORT FOR
BLUE SPRINGS MEADOW
EL PASO COUNTY, COLORADO

TABLE OF CONTENTS

REQUIRED MAPS AND DRAWINGS

FINAL DRAINAGE REPORT FOR
BLUE SPRINGS MEADOW
EL PASO COUNTY, COLORADO

DESIGN ENGINEER'S STATEMENT:

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

_____ _____

Quentin Armijo, P.E. 37170 Date
On behalf of Terra Nova Engineering, Inc.

OWNER/DEVELOPER'S STATEMENT:

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

_____ _____

Authorized Signature Date

Adam Or Baruch Rhea, Property Owners
Printed Name, Title

2 Brothers Properties LLC
Business Name

5625 E Pikes Peak Ave Colorado Springs, CO 80916
Address

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 J. Palmer, P.E. Date
County Engineer / ECM Administrator
Conditions:

FINAL DRAINAGE REPORT FOR
BLUE SPRINGS MEADOW
EL PASO COUNTY, COLORADO

INTRODUCTION

PURPOSE

The purpose of this Final Drainage Report is to identify and analyze the proposed drainage patterns, determine proposed runoff quantities, size drainage structures for conveyance of developed runoff based upon the overall development of single-family homes along with all the supporting infrastructure, while following the guidelines of the 4-step process.

PROJECT CHARACTERISTICS

Blue Springs Meadow is an analysis of approximately 38.30 acres to be developed with roughly 2.67 acres of grading disturbance. The Blue Springs Meadows site is proposed to have 7-5 acre proposed single-family large lots. The development consists of grading in a private Local Rural Road with a roadside ditch and installing triple 24" culverts & a swale to route offsite and onsite runoff to it's historic path offsite.

The site is located in a portion of NE 1/4 & SW1/4 Section 8 Township 12 Range 63 West of the Sixth Principal Meridian, El Paso County, Colorado. The site is bounded on the north by private Road Elliot View and RR-5 large lots, to the east by RR-5 large lots, to the south by A-35 large lots and on the west by RR-5 and A-35 large lots. The site lies with in the Upper Bracket Creek Drainage Basin and the receiving water downstream is Black Squirrel Creek to Chico Creek and ultimately the Arkansas River (See vicinity map in Appendix A).

Hydrologic Groups "A" (8 Blakeland loamy sand & 85 Truckton loamy sand) and "B" (11 Bresser sandy loam), as determined by the "Soil Survey of El Paso County Area," prepared by the Soil Conservation Service. The hydrologic soil group "A" was used to represent the soil types and determine the onsite basin overland flow (See map in appendix B).

Based upon a site visit and RMG Engineers' description, the study area consists of undeveloped prairie land that has existing vegetation consisting of tall native grasses, weeds, cattails, & other

prairie type vegetation with good to excellent coverage of 75% to 90%. The site slopes from the northwest to the southeast and southwest to the northeast with slopes ranging from 2% to 10%. The site has an existing runoff coefficient of C5=0.15 and C100=0.20 and an average developed runoff coefficient of C5=0.20 and C100=0.29.

There are no existing on-site improvements.

The site has not been previously analyzed in any studies.

As-built field survey data and LIDAR contours are the basis for the design of the drainage basins.

FLOODPLAIN STATEMENT

No portion of this site is within a designated Zone A F.E.M.A. floodplain, as determined by Flood Insurance Rate Map No. 08041C0375 G dated December 7, 2018 (See map in appendix C).

HYDROLOGIC ANALYSIS

The Drainage Criteria Manual El Paso County (DCMEPC), dated January 2015 was the resource used in this analysis. Runoff was calculated using the Rational Method for developed conditions (see appendix). The DCM EPC Update includes the City of Colorado Spring's DCM Chapter 6. Runoff coefficients were calculated using weighted impervious values for each specific basin.

EXISTING CONDITIONS

In the existing condition offsite and onsite runoff sheet flows northwest and southeast overland to the existing into low lying areas on the east and east side of the site. Below is a description of the existing condition’s Design Points, Basins and site runoff. See the Existing Drainage Map in the appendix for a visual representation of the below Basin descriptions.

There are 6 offsite basins that drain existing runoff onto the site from the north, west and south through overland flow, ditches, low lying areas, and culverts. All of the offsite area consists of either A-35 or RR-5 large lots with single family homes, barns and open prairies, while the onsite basins consist of undeveloped open space prairie.

At Design Point EX1 an 18" CMP culvert and a low point in the private gravel Elliot View routes runoff from the upstream property (Basin OS-1). The runoff (Q_5 = 19.8 cfs, Q_{100} = 42.1 cfs) from Basin OS-1's 52.71 acres sheet flows overland to low-lying areas and roadside ditches that route the runoff to the 18" culvert. It is then routed through the culvert and over tops the road from the north side to the south side.

Design Point EX2 consists of low spot in the south ditch line of the private gravel Elliot View. Offsite Basin OS-2's 1.7 acres consists of roadside ditch and gravel roadway. The ditch routes the flow (Q_5 = 1.7 cfs, Q_{100} = 3.1 cfs) east to outlet of Design Point 1's 18" culvert.

Design Point EX3 consists of a low-lying channel. The flows at Design Point EX3 are from Design Point EX1 & EX2 and offsite Basins OS-3's 31.45 acres & onsite Basin EXA's 1.70 acres. Runoff from Basin OS-3 (Q_5 = 20.0 cfs, Q_{100} = 41.1 cfs) is routed northeast and contained by a natural berm from entering the Elliot View south ditch. It is routed onto Basin EXA. Runoff from Basin EXA (Q_5 = 0.7 cfs, Q_{100} = 1.5 cfs) is also routed northeast and contained by the natural berm. The flow from both berms sheet flows east to Design Point EX3. The combined runoff (Q_5 = 31.6 cfs, Q_{100} = 76.1 cfs) from the 2 Design points and 2 Basins is routed south in the existing low-lying channel to Design Point EX4.

Design Point EX4 consists of an existing stock pond along the middle of the eastern property line. The runoff from Design Point EX3 offsite Basins OS-4's 0.45 acres & OS-5's 2.60 acres and onsite Basins EXB's 28.82 acres & EXC's 1.5 acres is routed east to Desing Point EX4. Runoff from Basin OS-4 (Q_5 = 0.2 cfs, Q_{100} = 0.5 cfs) and OS-5 (Q_5 = 1.8 cfs, Q_{100} = 3.8 cfs) is routed east onto Basin EXB. Runoff from Basin EXC (Q_5 = 0.7 cfs, Q_{100} = 1.5 cfs) sheet flows east to an existing stock pond where it overtops onto Basin EXB. Runoff (Q_5 = 11.7 cfs, Q_{100} = 26.3 cfs) combines with the other 3 basins and is routed east to Desing Point EX4. The combined flow (Q_5 = 40.8 cfs, Q_{100} = 96.6 cfs) at Desing Point EX4 enters the stock pond and overtops the berm and continues east in the channel.

Design Point EX5 consists of a point at the middle of the east property line right behind Design Point EX4. Runoff (Q_5 = 23.9 cfs, Q_{100} = 51.3 cfs) from Basin OS-6's 48.87 acres sheet flows to low-lying areas and is directed north east onto basin EXD. The runoff (Q_5 = 2.3 cfs, Q_{100} = 5.2 cfs) from Basin

EXD's 6.02 acres is combined with Basin OS-6. The combined runoff (Q_5 = 24.9 cfs, Q_{100} = 53.6 cfs) of the 2 basins is directed to the east property line.

Design Point EX6 consists of the eastern property line where the onsite flow and tributary offsite flow leave the site. The combined flow (Q_5 = 60.1 cfs, Q_{100} = 138.3 cfs) of Desing Point EX4 and EX5 continues east in the channel offsite.

Basin E is small area at the south east corner of the site. Runoff (Q_5 = 0.1 cfs, Q_{100} = 0.3 cfs) from Basin E's 0.25 acres sheet flows offsite to the east.

PROPOSED FUTURE FINAL CONDITIONS

The proposed basin descriptions below are for the Blue Springs Meadow development in the proposed condition based upon the private road and 7 large 5-acre plus lots. The assumption is that 7 lots will each have some impervious area consisting of gravel drives, single family homes and some barns with a most of the lot remaining open space prairie. As mentioned above there are 6 offsite basins that drain existing runoff onto the site from the north, west and south through overland flow, ditches, low lying areas, and culverts. All of the offsite area consists of either A-35 or RR-5 large lots with single family homes, barns and open prairies, while the onsite basins consist of undeveloped open space prairie. See the Proposed FDR Drainage Map in the appendix for a visual representation of the below Basin descriptions.

At Design Point 1 an 18" CMP culvert and a low point in the private gravel Elliot View routes runoff from the upstream property (Basin OS-1). The runoff (Q_5 = 19.8 cfs, Q_{100} = 42.1 cfs) from Basin OS-1's 52.71 acres sheet flows overland to low-lying areas and roadside ditches that route the runoff to the 18" culvert. It is then routed through the culvert and over tops the road from the north side to the south side.

Design Point 2 consists of low spot in the south ditch line of the private gravel Elliot View. Offsite Basin OS-2A's 0.37 acres consists of roadside ditch and gravel roadway. The ditch routes the flow (Q_5 = 0.7 cfs, Q_{100} = 1.3 cfs) the south side ditch of Elliot View and to outlet of Design Point 1's 18" culvert. The combined flow (Q_5 = 20.1 cfs, Q_{100} = 42.7cfs) of Design Point 1 and Basin OS-2A is

routed south via the existing low-lying channel.

Design Point 3A consists of a private road side ditch along the westside of the proposed private rural road Blue Springs Meadow Way on the north side. The flows at Design Point 3A are from offsite Basins OS-2B's 1.33 acres & OS-3's 31.45 acres and onsite Basin A's 6.96 acres. Runoff from Basin OS-3 (Q_5 = 20.0 cfs, Q_{100} = 41.1 cfs) is routed northeast and contained by a natural berm from entering the Elliot View south ditch. It is routed onto Basin A. Runoff from Basins OS-2B (Q_5 = 1.6 cfs, Q_{100} = 3.0 cfs) consists of roadside ditch and gravel roadway that is routed east to the proposed Blue Springs Meadow Way west ditch. Runoff from Basin A (Q_5 = 3.2 cfs, Q_{100} = 6.7 cfs) is also routed east to the ditch. The combined runoff (Q_5 = 20.7 cfs, Q_{100} = 42.5 cfs) is routed in the 5' wide, 2' deep trapezoidal section with 6:1 side slopes south to Design Point 3C.

Design Point 3B consists of a private road side ditch along the westside of the proposed private rural road Blue Springs Meadow Way on the south side. The flows at Design Point 3B are from offsite Basins OS-4s 0.45 acres and onsite Basin C's 8.13 acres. Runoff from Basin OS-4 (Q_5 = 0.2 cfs, Q_{100} = 0.5 cfs) is routed east onto Basin C. Runoff from Basin C (Q_5 = 5.2 cfs, Q_{100} = 10.6 cfs) is also routed east to the ditch. The combined runoff (Q_5 = 5.7 cfs, Q_{100} = 11.7 cfs) is routed in the 5' wide, 2' deep trapezoidal swale with 6:1 side slopes north to Design Point 3C.

Design Point 3C is a low point in middle of the private road side ditch along the westside of the proposed private rural road Blue Springs Meadow Way. The flows at Design Point 3C are from Design Points 3A & 3B. The combined runoff (Q_5 = 25.3 cfs, Q_{100} = 51.8 cfs) is routed east under the roadway via triple 24" RCP culverts. A 10' wide trapezoidal, 1.8' deep swale with 4:1 side slopes routes the flow east to Design Point 3D.

Design Point 3D is a low-lying channel that flows north to south through Lots 6 & 7. The flows at Design Point 3D are from the swale at Design Point 3C and Basin B1's 3.92 acres. Runoff (Q_5 = 2.3 cfs, Q_{100} = 4.6 cfs) from Basin B1 sheet flow east to the existing channel. The combined runoff (Q_5 = 44.0 cfs, Q_{100} = 91.6 cfs) is routed south to Design Point 4 via the existing channel. 5 cross sections of the channel were analyzed for the channel. The results and proposed requirements to keep Lots 6 & 7 building pads safe are discussed below in the Hydraulics section of the report.

Design Point 4 consists of an existing stock pond along the middle of the eastern property line. The runoff from Design Point 3D, offsite Basins OS-5's 2.60 acres and onsite Basins B2's 13.01 acres is routed east Desing Point 4. Runoff from Basin OS-5 (Q_5 = 1.8 cfs, Q_{100} = 3.8 cfs) is routed east onto Basin B2. Runoff from Basin B2 (Q_5 = 8.3 cfs, Q_{100} = 17.0 cfs) sheet flows east to low lying areas and to the existing stock pond. The combined flow (Q_5 = 49.8 cfs, Q_{100} = 103.5 cfs) at Desing Point 4 enters the stock pond and overtops the berm and continues east in the channel as it historically has.

Design Point 5 consists of a point at the middle of the east property line right behind Design Point 4. As in the existing condition runoff (Q_5 = 23.9 cfs, Q_{100} = 51.3 cfs) from Basin OS-6's 48.87 acres sheet flows to low-lying areas and is directed north east onto basin D. The runoff (Q_5 = 2.3 cfs, Q_{100} = 5.2 cfs) from Basin D's 6.02 acres is combined with Basin OS-6. The combined runoff (Q_5 = 24.9 cfs, Q_{100} = 53.6 cfs) of the 2 basins is directed to the east property line.

Design Point 6 consists of the eastern property line where the onsite flow and tributary offsite flow leave the site. The combined flow (Q_5 = 60.1 cfs, Q_{100} = 138.3 cfs) of Desing Point 4 and 5 continues east in the channel offsite.

Basin E does not change in the propose condition from existing condition. The small area at the south east corner of the site remains undeveloped. Runoff (Q_5 = 0.1 cfs, Q_{100} = 0.3 cfs) from Basin E's 0.25 acres sheet flows offsite to the east.

To protect receiving water and as part of the "four step process to minimize adverse impacts of urbanization" this site was analyzed in the following manner:

1. Reduce Runoff- The proposed impervious areas on the site are surrounded by existing well established open space prairie. This will reduce the volume of runoff using infiltration.
2. Stabilize Drainageways- There is an existing drainageways onsite. The channel is a low-lying area that only sees flow in significant rain fall events. It has well established vegetation and shows no signs of erosion or deterioration and is stable.
3. Provide Water Quality Capture Volume (WQCV)- Large Lot Single-Family Site is exempted as long as the site is a single-residential lot or agricultural zoned land, $\geq$ 2.5 acres per dwelling

and total lot impervious area < 10 percent. Out impervious area is 9.14%

4. Consider Need for Industrial and Commercial BMPs- The proposed development is single family site; therefore, no Industrial and Commercial BMPs have been proposed.

HYDRAULIC ANALYSIS

As mentioned above there is an existing low-lying area that acts as channel in major precipitation events along the west side of the site that runs from north to south. There are also a road side 5' wide, 2' deep trapezoidal ditch with 6:1 side slopes and a 10' wide trapezoidal, 1.8' deep swale with 4:1 side slopes.

For the existing channel 5 cross sections were analyzed using the proposed design flows in HawsEDC Irregular Channel Manning Uniform Flow Calculator. The 100-year high water elevations were mapped on the site and then a 1' freeboard was also mapped and placed in a drainage easement/no build area. For results see appendix E Hydraulic Calculations and the Proposed Drainage Map in Appendix F.

The Blue Springs Meadow private road has a roadside side ditch along the west side. The 5' wide, 2' deep trapezoidal ditch with 6:1 side slopes routes the 100-year flow of 42.5 cfs from Design point 3A and provides 1' of freeboard.

The 10' wide trapezoidal, 1.8' deep swale with 4:1 side slopes at Design Point 3C routes the 100-year flow of 51.8 cfs while providing 1' of freeboard.

The manning's n values used were based upon Table 10-2 of the El Paso County Drainage Criteria Manual

FILING 1 CONSTRUCTION COST OPINION

Private Drainage Facilities Improvements, Non-Reimbursable

	Item	Quantity	Unit Price	Cost
1.	24" RCP	199 LF	$ 161/LF	$ 32,039
2.	Headwall	2 EA	$ 1,500/EA	$ 3,000

3.	Wingwall	2 EA	$ 1,500/EA	$	3,000
4.	Riprap	1 TON	$ 102/TON	$	102
5.	Swale 10W'x1.8'D	227 LF	$ 30/LF	$	6,810
			Total	**$**	**44,951**

DRAINAGE FEES BLUE SPRINGS MEADOW

This site lies within the Upper Bracket Creek Basin. There is no approved Drainage Basin Planning study on file done with fees for Upper Bracket Creek, therefore no fees will need to be paid for Upper Bracket Creek.

Total Site Acreage: 30.77 ac

Upper Bracket Creek Basin Acreage: 30.77ac

Appendix L of the Drainage Criteria Manual 1 Addendum states that for single-family 5-acre lots, an impervious percentage of 7% can be used. The combined Drainage Fees (2026) are due prior to final plat recordation.

The following calculations are based upon the 2026 Drainage & Bridge fees:

30.77 ac x 7% =2.15 Impervious acres

Upper Bracket Creek Basin Drainage Fees: $0.00 x 2.15 = **$0.00**

SUMMARY

Site runoff and storm drain and appurtenances associated with the development of the Blue Springs Meadow site will not adversely affect the surrounding and downstream developments. Terra Nova Engineering requests that this report satisfy the submittal requirements for the drainage analysis for Blue Springs Meadow. This report and findings are in general conformance with all previously approved reports for this site.

PREPARED BY:
TERRA NOVA ENGINEERING, INC.

Quentin N. Armijo, P.E.

BIBLIOGRAPHY

"City of Colorado Springs Storm Drainage Design Criteria Manual Volumes 1" Prepared by City of Colorado Springs, Revised January 2021.

"City of Colorado Springs Storm Drainage Design Criteria Manual Volumes 2" Prepared by City of Colorado Springs, Revised December 2020.

"Urban Storm Drainage Criteria Manual Volume 1" Prepared by Mile High Flood Control District, Revised August 2018.

"Urban Storm Drainage Criteria Manual Volume 2" Prepared by Mile High Flood Control District, Revised September 2017.

"Urban Storm Drainage Criteria Manual Volume 3" Prepared by Mile High Flood Control District, Revised January 2021.

USDA NRCS Web Soil Survey.

FEMA Flood Insurance Rate Map Dated December 7, 2018.

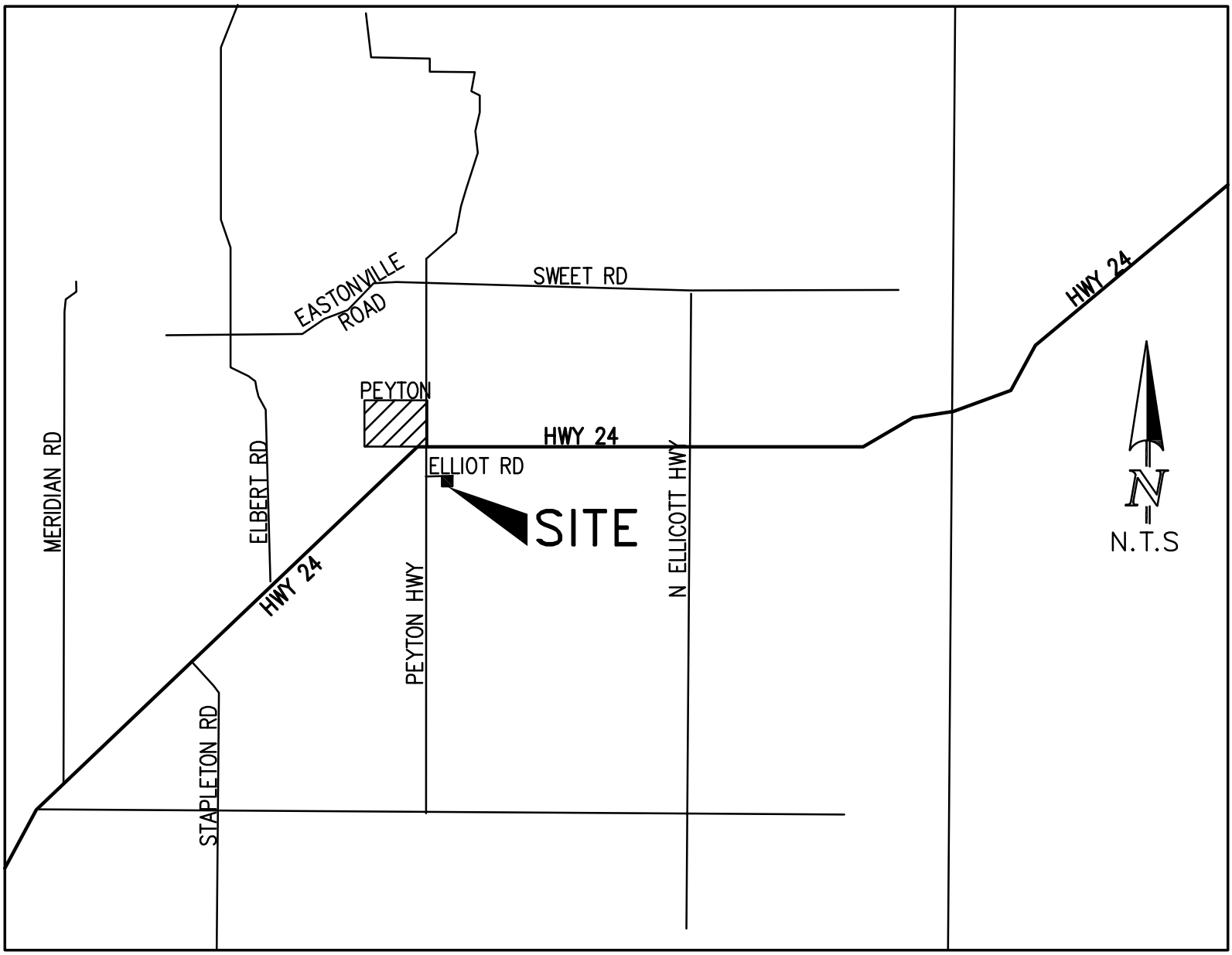
"Drainage Criteria Manual County of El Paso, Colorado Volume 1" approved October 2015 and prepared by El Paso County

"Drainage Criteria Manual County of El Paso, Colorado Volume 2" approved October 2015 and prepared by El Paso County

"Drainage Criteria Manual County of El Paso, Colorado Volume 1 update Chapter 6" approved October 2018 and prepared by El Paso County

APPENDIX

APPENDIX A
VICINTY MAP



VICINITY MAP

APPENDIX B
NRCS SOILS MAP

Soil Map—El Paso County Area, Colorado
(ELLIOT VIEW)

Map Scale: 1:3,050 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 45 90 180 270

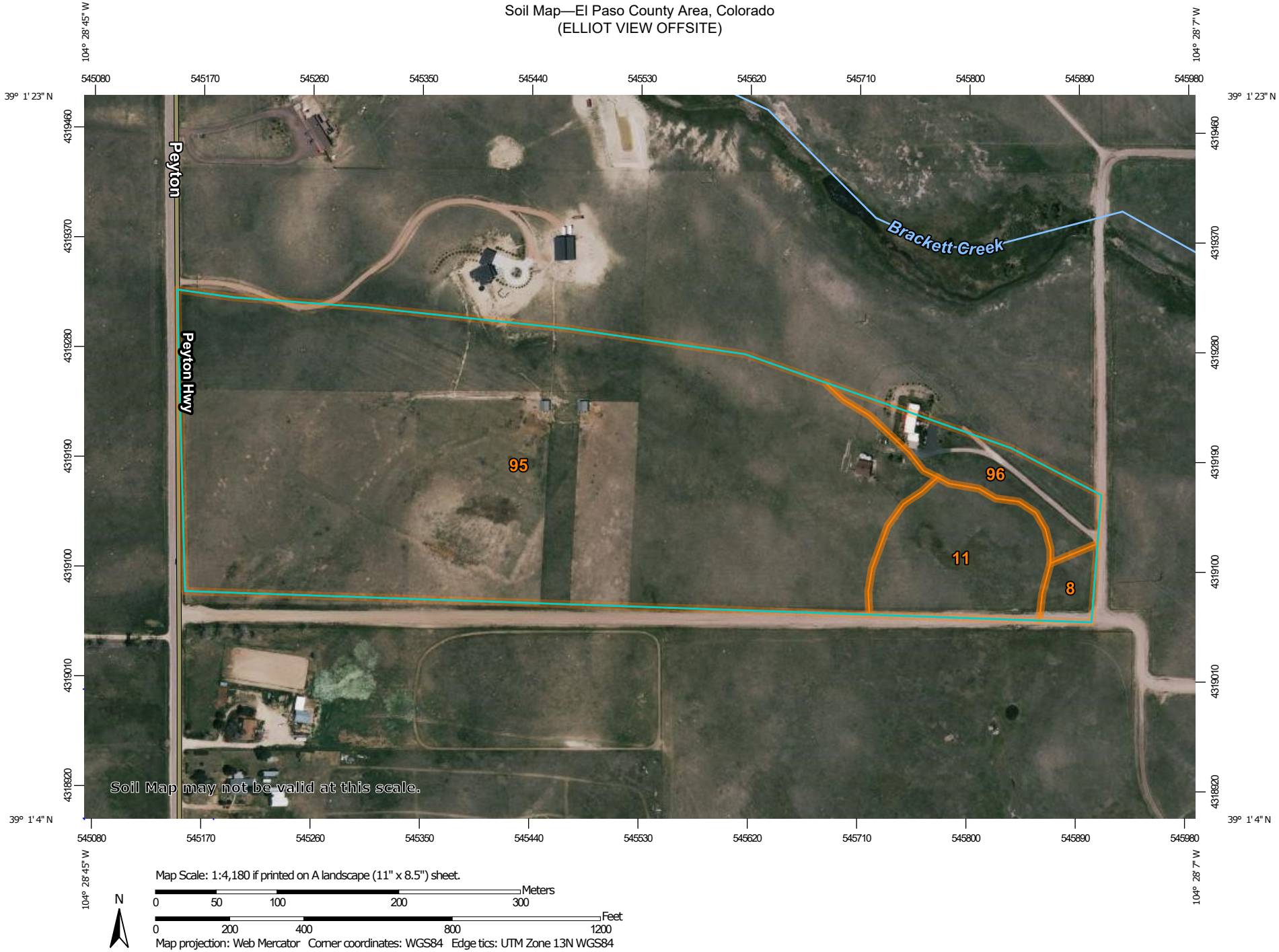
Feet
0 100 200 400 600

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	2.6	6.7%
11	Bresser sandy loam, cool, 0 to 3 percent slopes	18.6	47.2%
95	Truckton loamy sand, 1 to 9 percent slopes	18.1	46.0%
Totals for Area of Interest		**39.4**	**100.0%**

Soil Map—El Paso County Area, Colorado
(ELLIOT VIEW OFFSITE)



Map Scale: 1:4,180 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

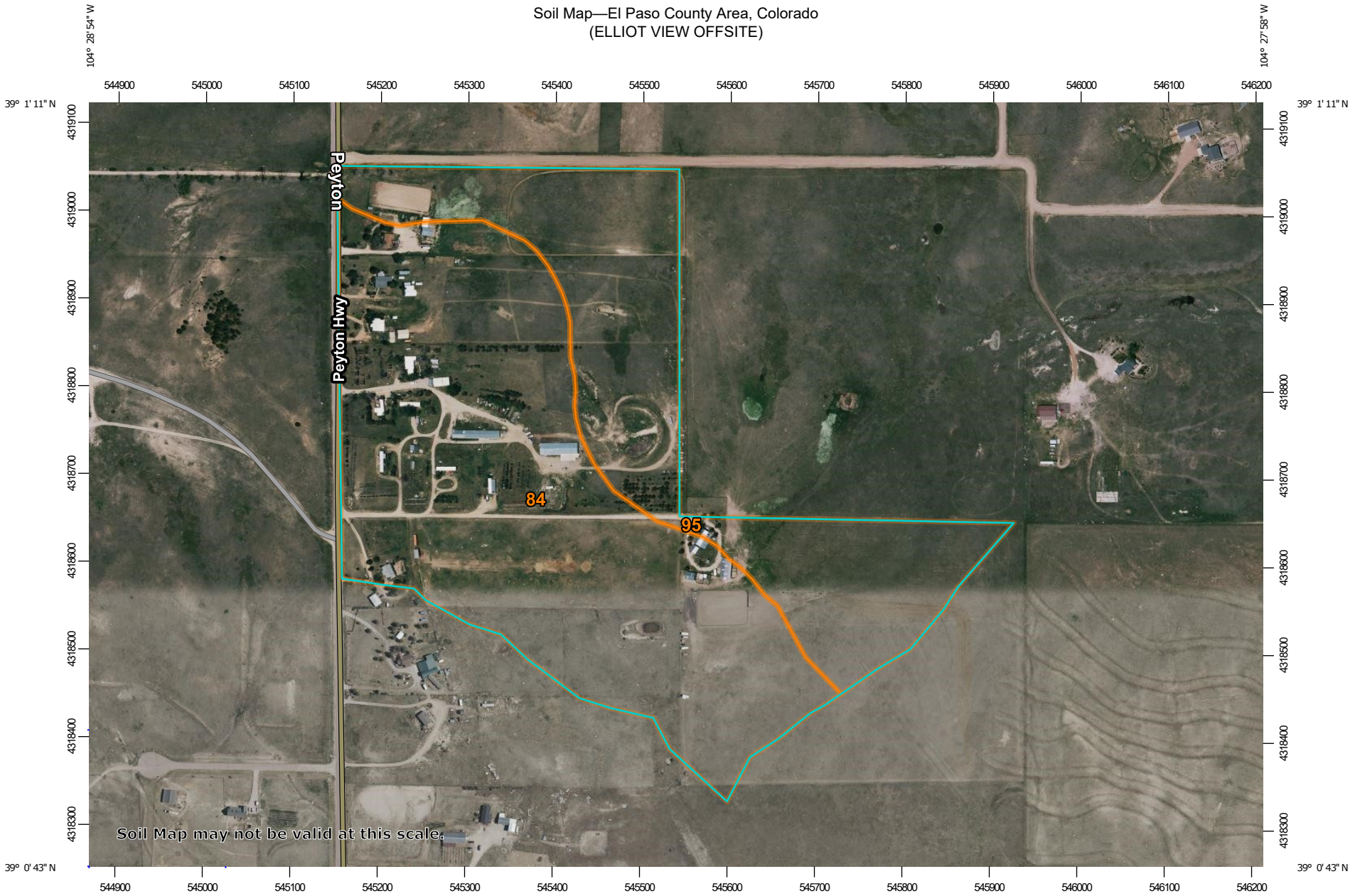
Feet: 0 200 400 800 1200

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	0.6	1.5%
11	Bresser sandy loam, cool, 0 to 3 percent slopes	3.4	8.9%
95	Truckton loamy sand, 1 to 9 percent slopes	32.2	84.1%
96	Truckton sandy loam, 0 to 3 percent slopes	2.1	5.6%
Totals for Area of Interest		**38.3**	**100.0%**

Soil Map—El Paso County Area, Colorado
(ELLIOT VIEW OFFSITE)



Map Scale: 1:6,140 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 23, Aug 29, 2025

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

Date(s) aerial images were photographed: Jun 9, 2021—Jul 28, 2024

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
84	Stapleton sandy loam, 8 to 15 percent slopes	44.9	63.6%
95	Truckton loamy sand, 1 to 9 percent slopes	25.7	36.4%
Totals for Area of Interest		**70.7**	**100.0%**

El Paso County Area, Colorado

95—Truckton loamy sand, 1 to 9 percent slopes

Map Unit Setting

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

Map Unit Composition

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

Description of Truckton

Setting

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

Typical profile

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

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e

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

Minor Components

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

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

Urban land
Percent of map unit: 2 percent
Landscape: Uplifted piedmonts
Anthropogenic features: Streets, parking lots, sidewalks, buildings, etc. of urban land, urban or suburban anthroscape
Hydric soil rating: No

Ellicott, occasionally flooded
Percent of map unit: 1 percent
Landscape: Uplifted piedmonts
Landform: Flood plains, Drainageways
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: R067BY031CO - Sandy Bottomland
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 23, Aug 29, 2025

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

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

Map Unit Composition

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

Description of Blakeland

Setting

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

Typical profile

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

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A

Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

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

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

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 23, Aug 29, 2025

El Paso County Area, Colorado

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

Map Unit Setting

National map unit symbol: 2tlph
Landscape: Dissected plains
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: Farmland of statewide importance

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

Landscape: Dissected plains
Landform: Broad and flat 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
Landscape: Dissected plains
Landform: Broad and flat 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

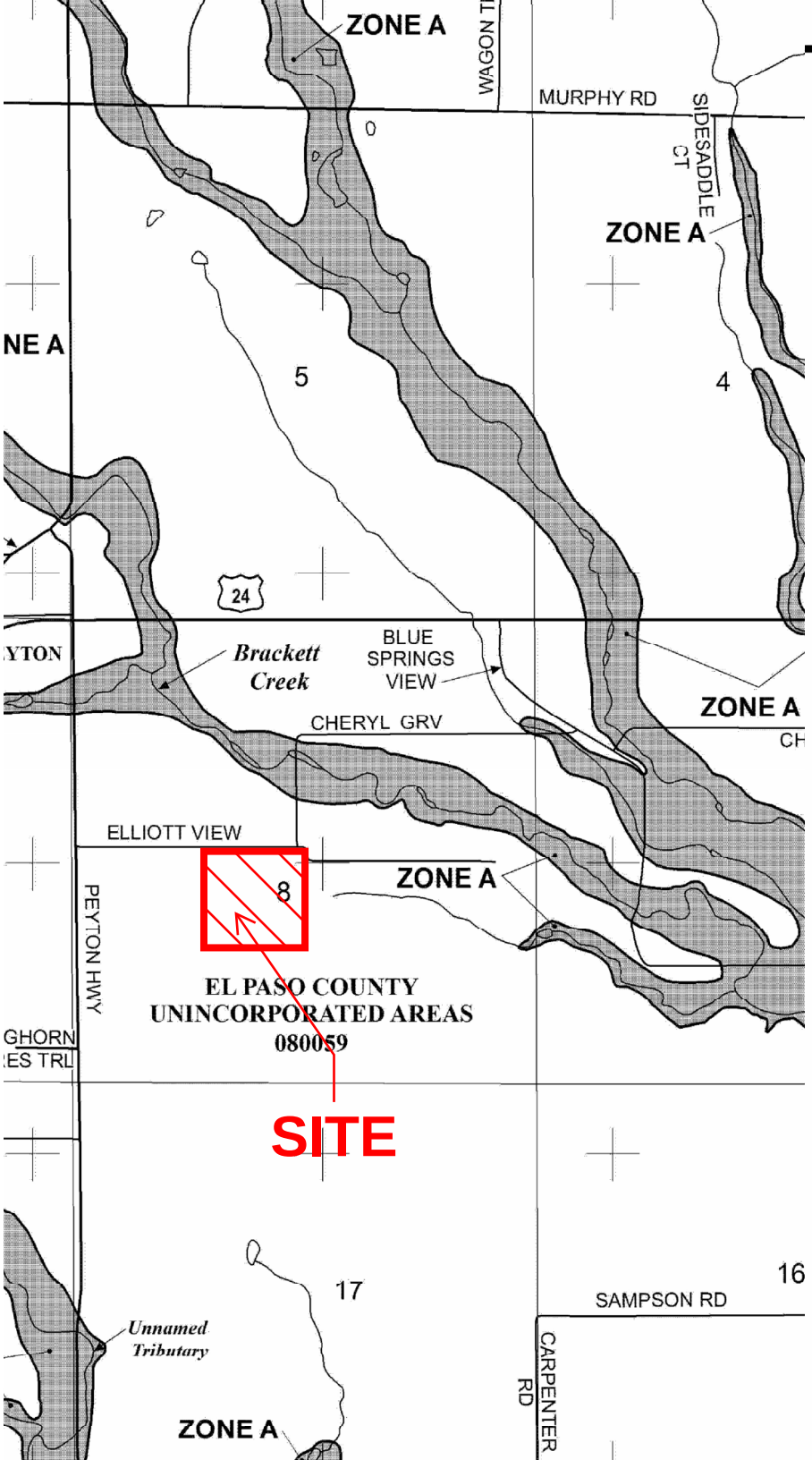
Yoder

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

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 23, Aug 29, 2025

APPENDIX C
FEMA FIRM MAP



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0375G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 375 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0375	G

Notice to User: The **Map Number** shown below should be used when placing map orders: the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0375G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

National Flood Hazard Layer FIRMette

FEMA

104°28'32"W 39°1'13"N

104°27'54"W 39°0'45"N

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

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
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/13/2026 at 5:36 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX D
HYDROLOGIC CALCULATIONS

BLUE SPRINGS MEADOW
(Area Runoff Coefficient Summary)

EXISTING CONDITIONS

		STREETS/ROOFS				*OPEN SPACE/UNDEVELOPED*				*GRAVEL STREET/YARD*				*WEIGHTED*			
BASIN	**TOTAL AREA** *(Acres)*	**% Impervious**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**% Impervious**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**% Impervious**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**% Impervious**	**C_5**	**C_{100}**	**Basin Total Impervious Area**
OS-1	52.71	90%	0.73	0.90	0.95	2%	49.86	0.15	0.20	80%	2.12	0.80	0.85	6.35%	0.19	0.24	3.35
OS-2	1.70	90%	0.00	0.90	0.95	2%	1.02	0.15	0.20	80%	0.68	0.80	0.85	33.30%	0.41	0.46	0.57
OS-3	31.45	90%	1.22	0.90	0.95	2%	28.04	0.15	0.20	80%	2.19	0.80	0.85	10.85%	0.22	0.27	3.41
OS-4	0.45	90%	0.00	0.90	0.95	2%	0.45	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
OS-5	2.60	90%	0.01	0.90	0.95	2%	2.34	0.15	0.20	80%	0.26	0.80	0.85	9.86%	0.22	0.27	0.26
OS-6	48.87	90%	0.39	0.90	0.95	2%	46.81	0.15	0.20	80%	1.68	0.80	0.85	5.37%	0.18	0.23	2.63
EXA	1.70	90%	0.00	0.90	0.95	2%	1.70	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.03
EXB	28.82	90%	0.00	0.90	0.95	2%	28.82	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.58
EXC	1.50	90%	0.00	0.90	0.95	2%	1.50	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.03
EXD	6.02	90%	0.00	0.90	0.95	2%	6.02	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.12
EXE	0.25	90%	0.00	0.90	0.95	2%	0.25	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
TOTAL AREA	**176.07**															**EX IMP. AREA AC.**	**10.98**

Calculated by: QNA
Date: 7/23/26
Checked by:

BLUE SPRINGS MEADOW
AREA DRAINAGE SUMMARY

EXISTING CONDITIONS

		WEIGHTED		*OVERLAND*				*STREET / CHANNEL FLOW*				T_t	*INTENSITY*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL** *(Acres)*	C_{10}	C_{100}	C_5	**Length** *(ft)*	**Height** *(ft)*	T_C *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	T_t *(min)*	**TOTAL** *(min)*	I_5 *(in/hr)*	I_{100} *(in/hr)*	Q_5 *(c.f.s.)*	Q_{100} *(c.f.s.)*
		** For Calcs See Runoff Summary*														
OS-1	52.71	0.19	0.24	0.15	300	9.0	21.4	2355	1.6%	2.0	19.6	41.0	2.0	3.4	19.8	42.1
OS-2	1.70	0.41	0.46	0.15	30	2.0	5.2	3265	1.6%	2.0	27.2	32.4	2.4	4.0	1.7	3.1
OS-3	31.45	0.22	0.27	0.15	300	24.0	15.5	1330	3.5%	2.7	8.2	23.7	2.8	4.8	20.0	41.1
OS-4	0.45	0.15	0.20	0.15	280	13.0	17.9					17.9	3.3	5.5	0.2	0.5
OS-5	2.60	0.22	0.27	0.15	120	3.0	14.4	490	3.5%	2.7	3.0	17.4	3.3	5.5	1.8	3.8
OS-6	48.87	0.18	0.23	0.15	300	21.0	16.2	1460	3.4%	2.7	9.0	25.2	2.7	4.6	23.9	51.3
EXA	1.70	0.15	0.20	0.15	300	8.0	22.3	740	2.6%	2.2	5.6	27.9	2.6	4.3	0.7	1.5
EXB	28.82	0.15	0.20	0.15	300	10.0	20.7	920	4.5%	3.1	4.9	25.6	2.7	4.6	11.7	26.3
EXC	1.50	0.15	0.20	0.15	300	11.0	20.0	325	7.1%	4.0	1.4	21.4	3.0	5.0	0.7	1.5
EXD	6.02	0.15	0.20	0.15	300	8.0	22.3	685	1.8%	2.0	5.7	28.0	2.6	4.3	2.3	5.2
EXE	0.25	0.15	0.20	0.15	181	3.5	19.2					19.2	3.1	5.3	0.1	0.3

Calculated by: QNA
Date: 7/23/26
Checked by:

BLUE SPRINGS MEADOW
SURFACE ROUTING SUMMARY

EXISTING CONDITIONS										
Design Point(s)	*Contributing Basins*	*Area (Acres)*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity*		*Flow*		*DP FACILITY*
						I_5	*I_{100}*	*Q_5*	*Q_{100}*	
EX1	OS-1	52.71	7.91	12.47	41.0	2.0	3.4	15.9	42.1	EX PVT 18" CMP CULVERT
EX2	OS-2	1.70	0.51	1.12	32.4	2.4	4.0	1.2	4.5	DITCH FLOWLINE
EX3	OS-1, OS-2, OS-3, & EXA	87.56	15.73	22.56	41.0	2.0	3.4	31.6	76.1	EX PVT CHANNEL
EX4	OS-1, OS-2, OS-3, EXA, EXB, & EXC	117.88	20.28	28.62	41.0	2.0	3.4	40.8	96.6	EX PVT POND
EX5	OS-6 & EXD	54.90	9.61	12.36	28.0	2.6	4.3	24.9	53.6	EX PVT CHANNEL
EX6	DP EX4 & DP EX5	172.78	29.89	40.98	41.0	2.0	3.4	60.1	138.3	EX PVT CHANNEL

Calculated by: QNA
Date: 7/23/26
Checked by:

BLUE SPRINGS MEADOW
(Area Runoff Coefficient Summary)

DEVELOPED CONDITIONS

		STREETS/ROOFS				*OPEN SPACE/UNDEVELOPED*				*GRAVEL STREET/YARD*				*WEIGHTED*			
BASIN	**TOTAL AREA** *(Acres)*	**% Impervious**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**% Impervious**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**% Impervious**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**% Impervious**	**C_5**	**C_{100}**	**Basin Total Impervious Area**
OS-1	52.71	90%	0.73	0.90	0.95	2%	49.86	0.15	0.20	80%	2.12	0.80	0.85	6.35%	0.19	0.24	3.35
OS-2A	0.37	90%	0.00	0.90	0.95	2%	0.21	0.15	0.20	80%	0.16	0.80	0.85	35.12%	0.43	0.48	0.13
OS-2B	1.33	190%	0.00	0.90	0.95	2%	0.81	0.15	0.20	80%	0.53	0.80	0.85	32.80%	0.41	0.46	0.44
OS-3	31.45	90%	1.22	0.90	0.95	2%	28.04	0.15	0.20	80%	2.19	0.80	0.85	10.85%	0.22	0.27	3.41
OS-4	0.45	90%	0.00	0.90	0.95	2%	0.45	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
OS-5	2.60	90%	0.01	0.90	0.95	2%	2.34	0.15	0.20	80%	0.26	0.80	0.85	9.86%	0.22	0.27	0.26
OS-6	48.87	90%	0.39	0.90	0.95	2%	46.81	0.15	0.20	80%	1.68	0.80	0.85	5.37%	0.18	0.23	2.63
A	6.96	90%	0.14	0.90	0.95	2%	6.45	0.15	0.20	80%	0.37	0.80	0.85	7.91%	0.20	0.25	0.55
B1	3.92	90%	0.14	0.90	0.95	2%	3.41	0.15	0.20	80%	0.37	0.80	0.85	12.49%	0.24	0.29	0.49
B2	13.01	90%	0.41	0.90	0.95	2%	11.67	0.15	0.20	80%	0.93	0.80	0.85	10.35%	0.22	0.27	1.35
C	8.13	90%	0.28	0.90	0.95	2%	7.11	0.15	0.20	80%	0.75	0.80	0.85	12.17%	0.24	0.29	0.99
D	6.02	90%	0.00	0.90	0.95	2%	6.02	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.12
E	0.25	90%	0.00	0.90	0.95	2%	0.25	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01

TOTAL AREA	**176.07**	**DP 4 IMPERVIOUS AREA =**	**3.38**	**ONSITE IMPERVIOUS AREA =**	**3.50**	**EX IMP. AREA AC.**	**13.72**
DP 4 ONSITE	**32.02**	**DP 4 TRIB ARREA =**	**32.02**	**ONSITE TRIB ARREA =**	**38.30**	**DP 4 ONSITE**	**3.38**
TOTAL ONSITE	**38.30**	**DP 4 PCNT IMPERVIOUS =**	**10.54%**	**ONSITE PCNT IMPERVIOUS =**	**9.14%**	**TOTAL ONSITE**	**3.50**

Calculated by: QNA

Date: 7/23/26

BLUE SPRINGS MEADOW
AREA DRAINAGE SUMMARY

DEVELOPED CONDITIONS

		WEIGHTED		*OVERLAND*				*STREET / CHANNEL FLOW*				T_t	*INTENSITY*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL** *(Acres)*	C_5	C_{100}	C_5	**Length** *(ft)*	**Height** *(ft)*	T_C *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	T_t *(min)*	**TOTAL** *(min)*	I_5 *(in/hr)*	I_{100} *(in/hr)*	Q_5 *(c.f.s.)*	Q_{100} *(c.f.s.)*
		** For Calcs See Runoff Summary*														
OS-1	52.71	0.19	0.24	0.15	300	9.0	21.4	2355	1.6%	2.0	19.6	41.0	2.0	3.4	19.8	42.1
OS-2A	0.37	0.43	0.48	0.15	45	2.0	7.3	175	2.3%	2.2	1.3	8.6	4.4	7.3	0.7	1.3
OS-2B	1.33	0.41	0.46	0.15	30	2.0	5.2	2200	2.1%	2.2	16.7	21.9	3.0	5.0	1.6	3.0
OS-3	31.45	0.22	0.27	0.15	300	24.0	15.5	1330	3.5%	2.7	8.2	23.7	2.8	4.8	20.0	41.1
OS-4	0.45	0.15	0.20	0.15	280	13.0	17.9					17.9	3.3	5.5	0.2	0.5
OS-5	2.60	0.22	0.27	0.15	120	3.0	14.4	490	3.5%	2.7	3.0	17.4	3.3	5.5	1.8	3.8
OS-6	48.87	0.18	0.23	0.15	300	21.0	16.2	1460	3.4%	2.7	9.0	25.2	2.7	4.6	23.9	51.3
A	6.96	0.21	0.26	0.15	300	8.0	22.3	1233	2.2%	1.8	11.4	33.7	2.3	3.9	3.3	6.9
B1	3.92	0.25	0.30	0.15	300	10.0	20.7	920	1.0%	1.5	10.2	30.9	2.4	4.1	2.4	4.8
B2	13.01	0.23	0.28	0.15	300	16.0	17.7	620	3.9%	2.0	5.2	22.9	2.9	4.8	8.7	17.7
C	8.13	0.25	0.30	0.15	300	10.0	20.7	720	4.0%	2.5	4.8	25.5	2.7	4.6	5.5	11.1
D	6.02	0.15	0.20	0.15	300	8.0	22.3	685	1.8%	2.0	5.7	28.0	2.6	4.3	2.3	5.2
E	0.25	0.15	0.20	0.15	181	3.5	19.2					19.2	3.1	5.3	0.1	0.3

Calculated by: QNA

Date: 7/23/26

Checked by: _____

BLUE SPRINGS MEADOW
SURFACE ROUTING SUMMARY

DEVELOPED CONDITIONS										
Design Point(s)	*Contributing Basins*	*Area (Acres)*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity*		*Flow*		*DP FACILITY*
						I_5	*I_{100}*	*Q_5*	*Q_{100}*	
1	OS-1	52.71	9.83	12.47	41.0	2.0	3.4	19.8	42.1	EX PVT 18" CMP CULVERT
2	OS-1 & OS-2A	53.07	9.99	12.64	41.0	2.0	3.4	20.1	42.7	DITCH FLOWLINE
3A	OS-3, OS-2B & A	39.75	9.04	11.03	33.7	2.3	3.9	20.9	42.7	PR PVT DITCH
3B	OS-4 & C	8.58	2.08	2.51	22.9	2.9	4.8	6.0	12.1	PR PVT DITCH
3C	DP 3A & 3B	48.32	11.11	13.53	33.7	2.3	3.9	25.6	52.4	PR PVT SWALE
3D	DP 2, DP 3C, & B1	105.32	22.08	27.35	41.0	2.0	3.4	44.4	92.3	EX PVT CHANNEL
4	DP 3D & B2	118.33	25.09	31.01	41.0	2.0	3.4	50.5	104.6	EX PVT POND
5	OS-6 & D	54.90	9.61	12.36	28.0	2.6	4.3	24.9	53.6	EX PVT CHANNEL
6	DP EX4 & DP EX5	173.22	34.70	43.37	41.0	2.0	3.4	69.8	146.3	EX PVT CHANNEL

Calculated by: QNA
Date: 7/23/26
Checked by:

APPENDIX E
HYDRAULIC CALCULATIONS

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **BLUE SPRINGS MEADOW** Location: SWALE DP 3A MIN SLOPE 1.19%

By: QNA Date: 7/23/2026

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

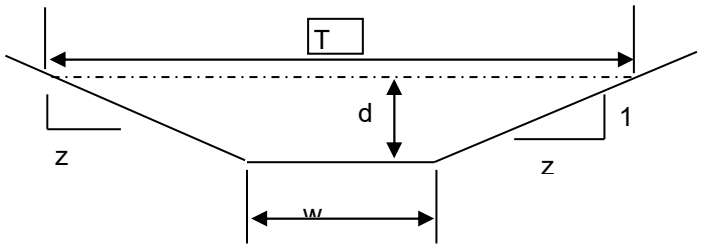
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	6
z (sideslope)=	6
b (btm width, ft)=	5
d (depth, ft)=	0.984
S (slope, ft/ft)	0.0119
n_{low} =	0.03
n_{high} =	0.03

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
0.984	10.73	16.97	0.63	3.98029726	42.7067	3.980297	42.7067	T =	16.808
								Dm =	0.638
				Sc low =	0.0154	Sc high =	0.0154		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0108	0.0200	0.0108	0.0200		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

5' W TRAPEZOIDAL, 6:1 SIDE SLOPE, 2' DEEP
DP 3A Q100=42.7 CFS, D=0.984'H, V=3.98 FPS
FREEBOARD=1.016'

Created by: Mike O'Shea

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **BLUE SPRINGS MEADOW** Location: SWALE DP 3B MIN SLOPE 1.06%

By: QNA Date: 7/23/2026

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

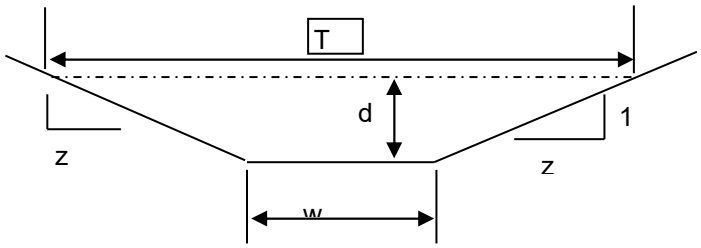
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	6
z (sideslope)=	6
b (btm width, ft)=	5
d (depth, ft)=	0.543
S (slope, ft/ft)	0.0106
n_{low} =	0.03
n_{high} =	0.03

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
0.543	4.48	11.61	0.39	2.70521097	12.1304	2.705211	12.1304	T =	11.516
								Dm =	0.389
				Sc low =	0.0181	Sc high =	0.0181		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0127	0.0236	0.0127	0.0236		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

5' W TRAPEZOIDAL, 6:1 SIDE SLOPE, 2' DEEP
DP 3B Q100=12.1CFS, D=0.543'H, V=2.705 FPS
FREEBOARD=1.457'

Created by: Mike O'Shea

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **BLUE SPRINGS MEADOW** Location: SWALE DP 3C MIN SLOPE 1.90%

By: QNA Date: 7/23/2026

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

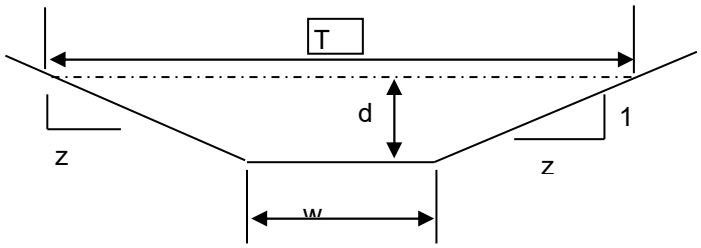
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	10
d (depth, ft)=	0.793
S (slope, ft/ft)	0.019
n_{low} =	0.03
n_{high} =	0.03

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
0.793	10.45	16.54	0.63	5.02582288	52.4967	5.025823	52.4967	T =	16.344
								Dm =	0.639
				Sc low =	0.0155	Sc high =	0.0155		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0108	0.0201	0.0108	0.0201		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

10' W TRAPEZOIDAL, 4:1 SIDE SLOPE, 1.8' DEEP
DP 3C Q100=52.4 CFS, D=0.793', V=5.026 FPS
FREEBOARD=1.007'

Created by: Mike O'Shea

Irregular Channel Manning Uniform Flow Calculator

XSECT A-A DP 2

PROPOSED CONDTION Q100=42.7

Inputs

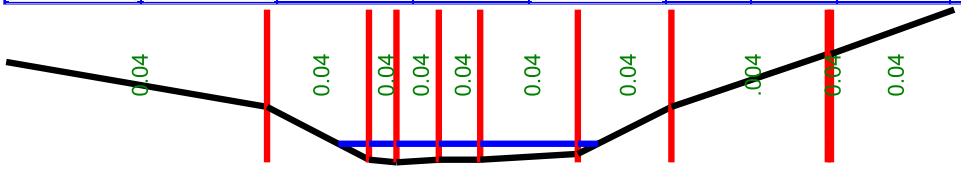
Water surface elevation	6730.302	ft
Channel slope, S	1.89	% rise/run

Results

Q ?	44.74	cfs
Velocity check	✓ OK	

Cross section points +/- (or copy/paste using the data area)

Point				Segment				Region					
Sta ft	Elevation ft	R_h, Q region boundary (Bank)	Bottom shear τ psf	n	T ft	P_w ft	A ft^2	R_h ft	Comp. n	v ft/sec	h_v ft	Fr	Q cfs
0	6731.85		0.00										
82.55	6731	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
114.8	6730	☑	0.36	0.04	9.74	9.74	1.47	0.15	0.04	1.45	0.03	0.66	2.13
123.5	6729.95	☑	0.42	0.04	8.70	8.70	2.84	0.33	0.04	2.42	0.09	0.75	6.90
136.9	6730	☑	0.36	0.04	13.40	13.40	4.38	0.33	0.04	2.42	0.09	0.75	10.62
150	6730	☑	0.36	0.04	13.10	13.10	3.96	0.30	0.04	2.30	0.08	0.74	9.09
180.9	6730.11	☑	0.23	0.04	30.90	30.90	7.63	0.25	0.04	2.01	0.06	0.71	15.34
210.5	6731	☑	0.00	0.04	6.39	6.39	0.61	0.10	0.04	1.07	0.02	0.61	0.66
260	6732	☑	0.00	.004	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
261	6732	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
300	6732.84	☐	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00



Notes

Composite n

This calculator follows HEC-RAS Reference Manual in calculating region composite n using Chow 1959, page 136, equation 6-17 (not 6-18).

Rock lining

Use the Manning Trapezoidal Channel Calculator to design rock lining. This calculator is better suited to natural sections.

Velocity check

High velocity implies that there was a large elevation drop that created such high specific energy. That energy can be lost quickly at expansions, bends, or obstructions. Verify that this is reasonable for the site.

Irregular Channel Manning Uniform Flow Calculator

XSECT B-B DP 2

PROPOSED CONDTION Q100=42.7

Inputs

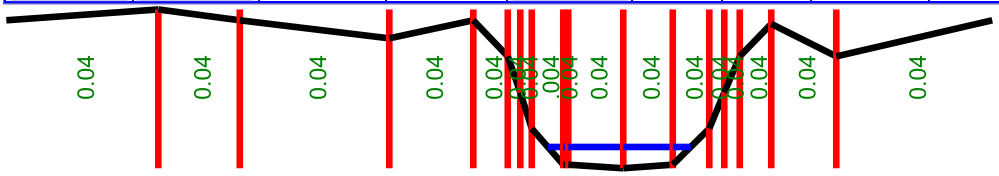
Water surface elevation	6726.49	ft
Channel slope, S	1.1	% rise/run

Results

Q ?	43.11	cfs
Velocity check	✓ OK	

Cross section points +/- (or copy/paste using the data area)

Point				Segment				Region					
Sta ft	Elevation ft	R_h, Q region boundary (Bank)	Bottom shear τ psf	n	T ft	P_w ft	A ft^2	R_h ft	Comp. n	v ft/sec	h_v ft	Fr	Q cfs
26.6	6730		0.00										
57	6730.3	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
73.3	6730	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
103.2	6729.5	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
120	6730	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
126.9	6729	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
129.4	6728	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
131.7	6727	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
138	6726	☑	0.34	.004	3.09	3.13	0.76	0.24	0.00	15.13	3.56	5.39	11.44
139	6726	☑	0.34	0.04	1.00	1.00	0.49	0.49	0.04	2.42	0.09	0.61	1.19
150	6725.9	☑	0.41	0.04	11.00	11.00	5.94	0.54	0.04	2.58	0.10	0.62	15.35
159.9	6726	☑	0.34	0.04	9.90	9.90	5.35	0.54	0.04	2.58	0.10	0.62	13.81
167.2	6727	☑	0.00	0.04	3.58	3.61	0.88	0.24	0.04	1.52	0.04	0.54	1.33
170.2	6728	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
173.3	6729	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
179.6	6729.9	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
192.6	6729	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
223.8	6730	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00



Notes

Composite n

Irregular Channel Manning Uniform Flow Calculator

XSECT C-C DP 3D

PROPOSED CONDTION Q100=92.3

Inputs

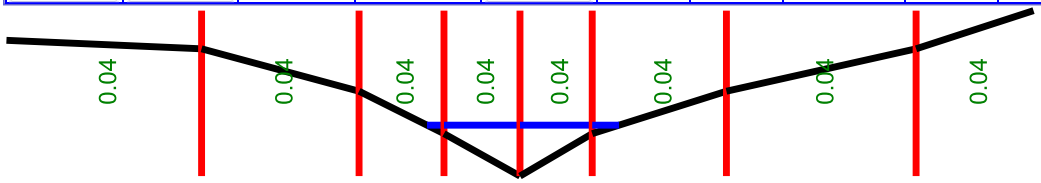
Water surface elevation	6727.2	ft
Channel slope, S	1.1	% rise/run

Results

Q ?	94.11	cfs
Velocity check	✓ OK	

Cross section points +/- (or copy/paste using the data area)

Point				Segment				Region					
Sta ft	Elevation ft	R_h, Q region boundary (Bank)	Bottom shear τ psf	n	T ft	P_w ft	A ft^2	R_h ft	Comp. n	v ft/sec	h_v ft	Fr	Q cfs
0	6729.2		0.00										
57	6729	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
103	6728	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
127.8	6727	☑	0.14	0.04	4.96	4.96	0.50	0.10	0.04	0.84	0.01	0.47	0.42
150	6726	☑	0.82	0.04	22.20	22.22	15.54	0.70	0.04	3.07	0.15	0.65	47.70
171.1	6727	☑	0.14	0.04	21.10	21.12	14.77	0.70	0.04	3.07	0.15	0.65	45.33
210.3	6728	☑	0.00	0.04	7.84	7.84	0.78	0.10	0.04	0.84	0.01	0.47	0.66
265.7	6729	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
300	6729.9	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00



Notes

Composite n

This calculator follows HEC-RAS Reference Manual in calculating region composite n using Chow 1959, page 136, equation 6-17 (not 6-18).

Rock lining

Use the Manning Trapezoidal Channel Calculator to design rock lining. This calculator is better suited to natural sections.

Velocity check

High velocity implies that there was a large elevation drop that created such high specific energy. That energy can be lost quickly at expansions, bends, or obstructions. Verify that this is reasonable for the site.

Irregular Channel Manning Uniform Flow Calculator

XSECT D-D DP 3D

PROPOSED CONDTION Q100=92.3

Inputs

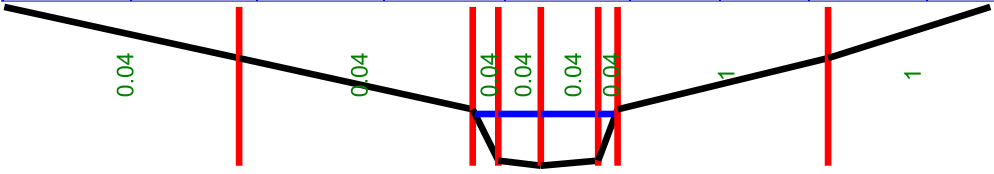
Water surface elevation	6724.91	ft
Channel slope, S	1.0	% rise/run

Results

Q ?	93.79	cfs
Velocity check	✓ OK	

Cross section points +/- (or copy/paste using the data area)

Point				Segment				Region					
Sta ft	Elevation ft	R_h, Q region boundary (Bank)	Bottom shear τ psf	n	T ft	P_w ft	A ft^2	R_h ft	Comp. n	v ft/sec	h_v ft	Fr	Q cfs
20	6727		0.00										
76.9	6726	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
133.5	6725	☑	0.00	0.04	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
139.7	6724	☑	0.57	0.04	5.64	5.71	2.57	0.45	0.04	2.18	0.07	0.57	5.59
150	6723.9	☑	0.63	0.04	10.30	10.30	9.89	0.96	0.04	3.61	0.20	0.65	35.74
163.9	6724	☑	0.57	0.04	13.90	13.90	13.34	0.96	0.04	3.61	0.20	0.65	48.24
168.6	6725	☑	0.00	0.04	4.28	4.37	1.95	0.45	0.04	2.17	0.07	0.57	4.21
219.6	6726	☑	0.00	1	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00
258.9	6727	☑	0.00	1	0.00	0.00	0.00	NaN	NaN	NaN	NaN	NaN	0.00



Notes

Composite n

This calculator follows HEC-RAS Reference Manual in calculating region composite n using Chow 1959, page 136, equation 6-17 (not 6-18).

Rock lining

Use the Manning Trapezoidal Channel Calculator to design rock lining. This calculator is better suited to natural sections.

Velocity check

High velocity implies that there was a large elevation drop that created such high specific energy. That energy can be lost quickly at expansions, bends, or obstructions. Verify that this is reasonable for the site.

Irregular Channel Manning Uniform Flow Calculator

XSECT E-E DP 3D

PROPOSED CONDTION Q100=92.3

Inputs

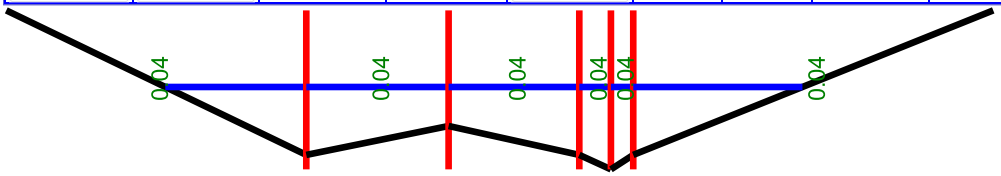
Water surface elevation	6724.47	ft
Channel slope, S	1.4	% rise/run

Results

Q ?	92.57	cfs
Velocity check	⚠ Low	

Cross section points +/- (or copy/paste using the data area)

Point				Segment				Region					
Sta ft	Elevation ft	R_h, Q region boundary (Bank)	Bottom shear τ psf	n	T ft	P_w ft	A ft^2	R_h ft	Comp. n	v ft/sec	h_v ft	Fr	Q cfs
20	6725		0.00										
84.5	6724	☑	0.41	0.04	30.31	30.32	7.12	0.23	0.04	1.67	0.04	0.61	11.92
115.1	6724.2	☑	0.24	0.04	30.60	30.60	11.32	0.37	0.04	2.27	0.08	0.66	25.65
143.2	6724	☑	0.41	0.04	28.10	28.10	10.40	0.37	0.04	2.27	0.08	0.66	23.55
150	6723.9	☑	0.50	0.04	6.80	6.80	3.54	0.52	0.04	2.84	0.13	0.69	10.05
154.8	6724	☑	0.41	0.04	4.80	4.80	2.50	0.52	0.04	2.84	0.13	0.69	7.09
232.2	6725	☑	0.00	0.04	36.38	36.38	8.55	0.23	0.04	1.67	0.04	0.61	14.31



Notes

Composite n

This calculator follows HEC-RAS Reference Manual in calculating region composite n using Chow 1959, page 136, equation 6-17 (not 6-18).

Rock lining

Use the Manning Trapezoidal Channel Calculator to design rock lining. This calculator is better suited to natural sections.

Velocity check

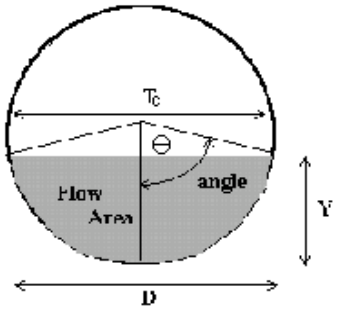
High velocity implies that there was a large elevation drop that created such high specific energy. That energy can be lost quickly at expansions, bends, or obstructions. Verify that this is reasonable for the site.

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: BLUE SPRINGS MEADOW

Pipe ID: Design Point 3C



Design Information (Input)			
Pipe Invert Slope	So =	0.0050	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	16.04	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	16.04	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	2.26	radians
Flow area	An =	2.76	sq ft
Top width	Tn =	1.54	ft
Wetted perimeter	Pn =	4.53	ft
Flow depth	Yn =	1.64	ft
Flow velocity	Vn =	5.82	fps
Discharge	Qn =	16.04	cfs
Percent of Full Flow	Flow =	100.0%	of full flow
Normal Depth Froude Number	Fr_n =	0.77	subcritical

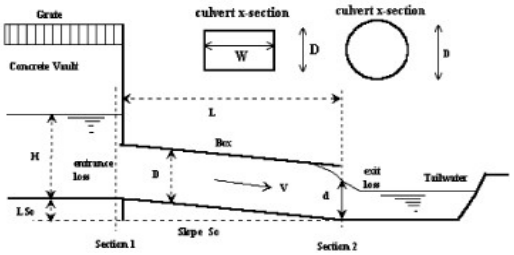
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.03	radians
Critical flow area	Ac =	2.43	sq ft
Critical top width	Tc =	1.79	ft
Critical flow depth	Yc =	1.44	ft
Critical flow velocity	Vc =	6.61	fps
Critical Depth Froude Number	Fr_c =	1.00	

CULVERT SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

MHFD-Culvert, Version 4.00 (May 2020)

Project: Waterbury Fil #1

ID: Design Point 3C



Design Information (Input):

Circular Culvert:

Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		Square Edge with Headwall	

OR:

Box Culvert:

Barrel Height (Rise) in Feet	H (Rise) =		ft
Barrel Width (Span) in Feet	W (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			

Number of Barrels	# Barrels =	3	
Inlet Elevation at Culvert Invert	Elev IN =	6732.83	ft
Outlet Elevation **OR** Slope	Elev OUT =	6732.5	ft
Culvert Length	L =	66.3	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	K_b =	0	
Exit Loss Coefficient	K_x =	1	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.50
Friction Loss Coefficient	K_f =	0.82
Sum of All Loss Coefficients	K_s =	2.32
Minimum Energy Condition Coefficient	KE_{low} =	0.0264
Orifice Inlet Condition Coefficient	C_d =	0.60

Calculations of Culvert Capacity (output):

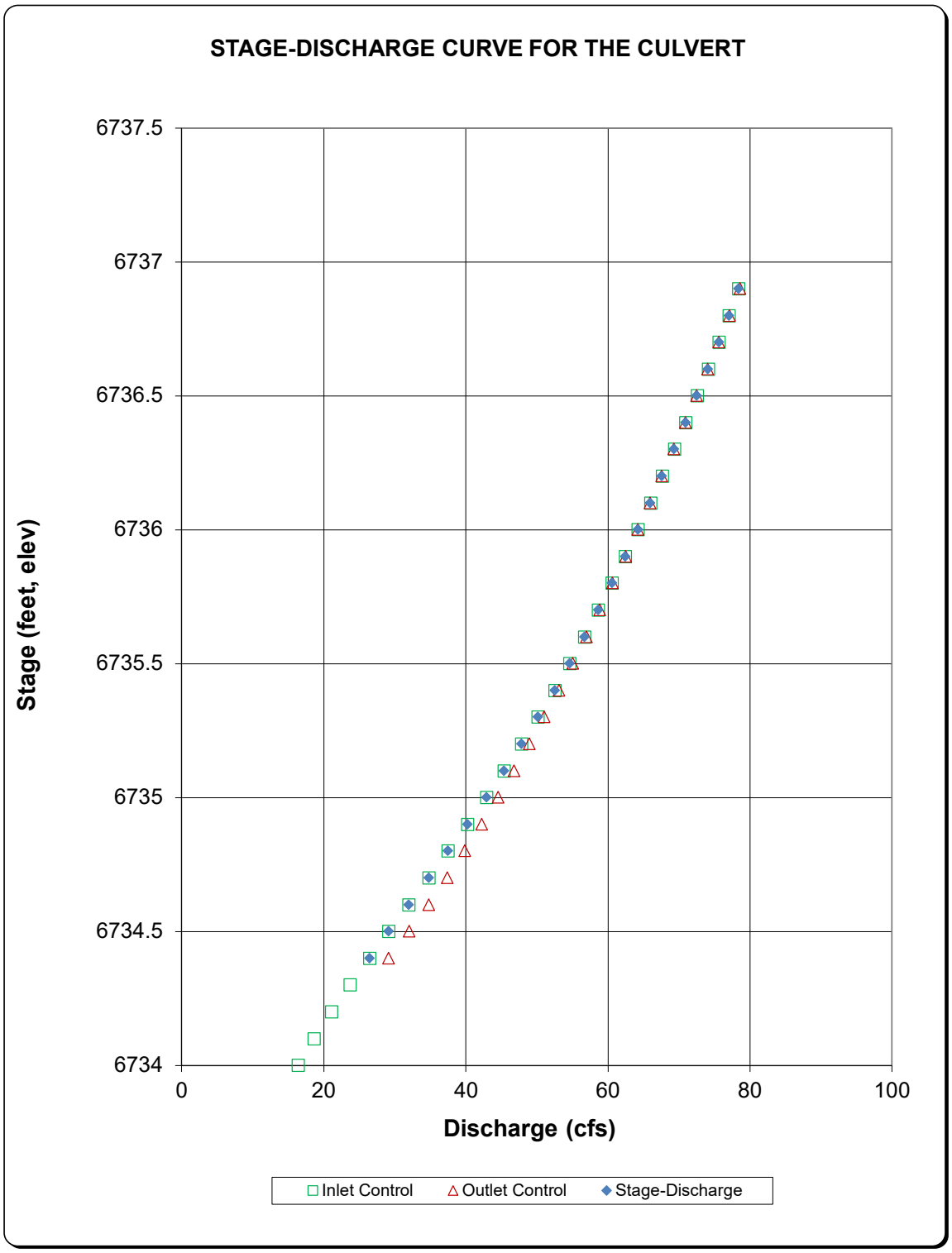
Backwater calculations required to obtain Outlet Control Flowrate when HWo < 0.75 * Culvert Rise

Headwater Surface Elevation (ft)	Tailwater Surface Elevation (ft)	Inlet Control Equation Used	Inlet Control Flowrate (cfs)	Outlet Control Flowrate (cfs)	Controlling Culvert Flowrate (cfs)	Flow Control Used
6734.00	6733.00	Regression Eqn.	16.38	#N/A	#N/A	#N/A
6734.10	6733.00	Regression Eqn.	18.66	#N/A	#N/A	#N/A
6734.20	6733.00	Regression Eqn.	21.12	#N/A	#N/A	#N/A
6734.30	6733.00	Regression Eqn.	23.73	#N/A	#N/A	#N/A
6734.40	6733.00	Regression Eqn.	26.43	29.13	**26.43**	INLET
6734.50	6733.00	Regression Eqn.	29.13	32.03	**29.13**	INLET
6734.60	6733.00	Regression Eqn.	31.95	34.79	**31.95**	INLET
6734.70	6733.00	Regression Eqn.	34.83	37.38	**34.83**	INLET
6734.80	6733.00	Regression Eqn.	37.53	39.88	**37.53**	INLET
6734.90	6733.00	Regression Eqn.	40.26	42.28	**40.26**	INLET
6735.00	6733.00	Regression Eqn.	42.93	44.61	**42.93**	INLET
6735.10	6733.00	Regression Eqn.	45.42	46.84	**45.42**	INLET
6735.20	6733.00	Regression Eqn.	47.85	49.00	**47.85**	INLET
6735.30	6733.00	Regression Eqn.	50.19	51.08	**50.19**	INLET
6735.40	6733.00	Regression Eqn.	52.53	53.12	**52.53**	INLET
6735.50	6733.00	Regression Eqn.	54.63	55.09	**54.63**	INLET
6735.60	6733.00	Regression Eqn.	56.73	57.01	**56.73**	INLET
6735.70	6733.00	Regression Eqn.	58.68	58.88	**58.68**	INLET
6735.80	6733.00	Regression Eqn.	60.63	60.71	**60.63**	INLET
6735.90	6733.00	Regression Eqn.	62.49	62.51	**62.49**	INLET
6736.00	6733.00	Regression Eqn.	64.29	64.26	**64.26**	OUTLET
6736.10	6733.00	Regression Eqn.	66.03	65.96	**65.96**	OUTLET
6736.20	6733.00	Regression Eqn.	67.71	67.64	**67.64**	OUTLET
6736.30	6733.00	Regression Eqn.	69.36	69.30	**69.30**	OUTLET
6736.40	6733.00	Regression Eqn.	70.98	70.93	**70.93**	OUTLET
6736.50	6733.00	Regression Eqn.	72.63	72.54	**72.54**	OUTLET
6736.60	6733.00	Regression Eqn.	74.13	74.10	**74.10**	OUTLET
6736.70	6733.00	Regression Eqn.	75.63	75.63	**75.63**	INLET
6736.80	6733.00	Regression Eqn.	77.04	77.14	**77.04**	INLET
6736.90	6733.00	Regression Eqn.	78.45	78.63	**78.45**	INLET
				Processing Time:	**00.17 Seconds**	

CULVERT SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

MHFD-Culvert, Version 4.00 (May 2020)

Project: Waterbury Fil #1
ID: Design Point 3C

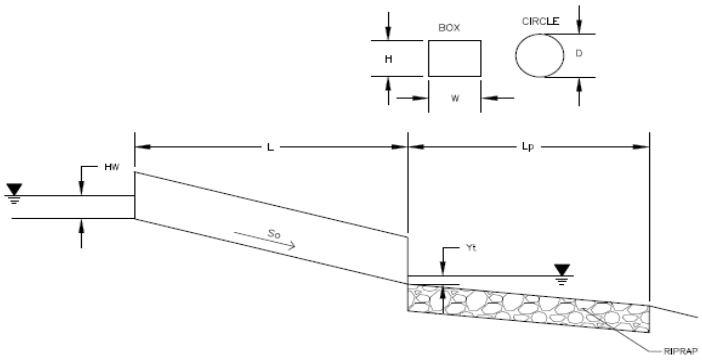


DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Waterbury Fil #1**

ID: **Design Point 3C**



Soil Type:

Choose One:

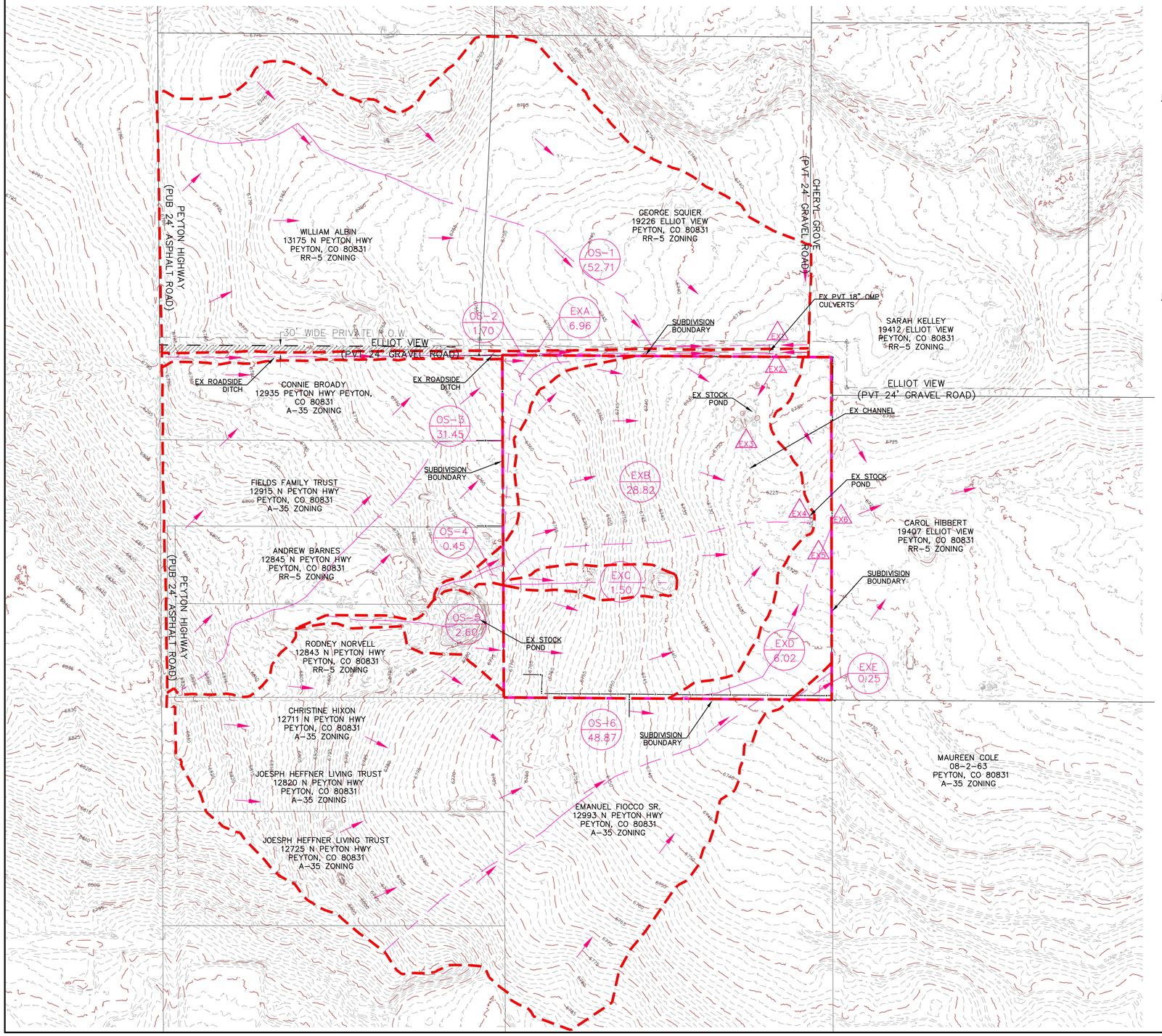
(●) Sandy

( ) Non-Sandy

Design Information:				
	Design Discharge	Q =	52.4	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =	24	inches
	Inlet Edge Type (Choose from pull-down list)		Grooved Edge Projecting	
OR:				
Box Culvert:			**OR**	
	Barrel Height (Rise) in Feet	H (Rise) =		ft
	Barrel Width (Span) in Feet	W (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	# Barrels =	3	
	Inlet Elevation	Elev IN =	6732.83	ft
	Outlet Elevation **OR** Slope	Elev OUT =	6732.5	ft
	Culvert Length	L =	66.3	ft
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =	6734	ft
	Max Allowable Channel Velocity	V =	5	ft/s
Calculated Results:				
	Culvert Cross Sectional Area Available	A =	3.14	ft^2
	Culvert Normal Depth	Y_n =	2.00	ft
	Culvert Critical Depth	Y_c =	1.51	ft
	Froude Number	Fr =	-	**Pressure flow!**
	Entrance Loss Coefficient	k_e =	0.20	
	Friction Loss Coefficient	k_f =	0.82	
	Sum of All Loss Coefficients	k_s =	2.02	ft
Headwater:				
	Inlet Control Headwater	HW_I =	2.36	ft
	Outlet Control Headwater	HW_O =	2.39	ft
	Design Headwater Elevation	**HW =**	**6735.22**	**ft**
	Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.20**	
Outlet Protection:				
	Flow/(Diameter^2.5)	Q/D^2.5 =	3.09	$ft^{0.5}/s$
	Tailwater Surface Height	Y_t =	1.50	ft
	Tailwater/Diameter	Yt/D =	0.75	
	Expansion Factor	1/(2*tan(Θ)) =	6.70	
	Flow Area at Max Channel Velocity	A_t =	10.48	ft^2
	Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	6.00	ft
	Length of Riprap Protection	**L_p =**	**7**	**ft**
	Width of Riprap Protection at Downstream End	**T =**	**8**	**ft**
	Adjusted Diameter for Supercritical Flow	Da =	-	ft
	Minimum Theoretical Riprap Size	d_{50} min=	2	in
	Nominal Riprap Size	d_{50} nominal=	6	in
	MHFD Riprap Type	**Type =**	**VL**	

APPENDIX F
DRAINAGE MAPS

BLUE SPRINGS MEADOW
EL PASO COUNTY
EXISTING DRAINAGE MAP OVERALL



COEFFICIENT SUMMARY

EXISTING CONDITIONS

BASIN	TOTAL (Acres)	STREETS/ROOFS % Impervious	STREETS/ROOFS AREA (Acres)	STREETS/ROOFS C_5	STREETS/ROOFS C_{100}	OPEN SPACE/UNDEVELOPED % Impervious	OPEN SPACE/UNDEVELOPED AREA (Acres)	OPEN SPACE/UNDEVELOPED C_5	OPEN SPACE/UNDEVELOPED C_{100}	GRAVEL STREET/YARD % Impervious	GRAVEL STREET/YARD AREA (Acres)	GRAVEL STREET/YARD C_5	GRAVEL STREET/YARD C_{100}	WEIGHTED % Impervious	WEIGHTED C_5	WEIGHTED C_{100}	Basin Total Impervious
OS-1	52.71	90%	0.73	0.90	0.95	2%	49.86	0.15	0.20	80%	2.12	0.80	0.85	6.35%	0.19	0.24	3.35
OS-2	1.70	90%	0.00	0.90	0.95	2%	1.02	0.15	0.20	80%	0.68	0.80	0.85	33.30%	0.41	0.46	0.57
OS-3	31.45	90%	1.22	0.90	0.95	2%	28.04	0.15	0.20	80%	2.19	0.80	0.85	10.85%	0.22	0.27	3.41
OS-4	0.45	90%	0.00	0.90	0.95	2%	0.45	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
OS-5	2.60	90%	0.01	0.90	0.95	2%	2.34	0.15	0.20	80%	0.26	0.80	0.85	9.86%	0.22	0.27	0.26
OS-6	48.87	90%	0.39	0.90	0.95	2%	46.81	0.15	0.20	80%	1.68	0.80	0.85	5.37%	0.18	0.23	2.63
EXA	1.70	90%	0.00	0.90	0.95	2%	1.70	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.03
EXB	28.82	90%	0.00	0.90	0.95	2%	28.82	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.58
EXC	1.50	90%	0.00	0.90	0.95	2%	1.50	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.03
EXD	6.02	90%	0.00	0.90	0.95	2%	6.02	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.12
EXE	0.25	90%	0.00	0.90	0.95	2%	0.25	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
TOTAL AREA	176.07													EX IMP. AREA AC.			10.98

DRAINAGE SUMMARY

EXISTING CONDITIONS

BASIN	AREA TOTAL (Acres)	WEIGHTED C_{10}	WEIGHTED C_{100}	OVERLAND C_5	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND T_c (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW T_t (min)	T_c TOTAL (min)	INTENSITY I_5 (in/hr)	INTENSITY I_{100} (in/hr)	TOTAL FLOWS Q_5 (c.f.s.)	TOTAL FLOWS Q_{100} (c.f.s.)
OS-1	52.71	0.19	0.24	0.15	300	9.0	21.4	2355	1.6%	2.0	19.6	41.0	2.0	3.4	19.8	42.1
OS-2	1.70	0.41	0.46	0.15	30	2.0	5.2	3265	1.6%	2.0	27.2	32.4	2.4	4.0	1.7	3.1
OS-3	31.45	0.22	0.27	0.15	300	24.0	15.5	1330	3.5%	2.7	8.2	23.7	2.8	4.8	20.0	41.1
OS-4	0.45	0.15	0.20	0.15	280	13.0	17.9					17.9	3.3	5.5	0.2	0.5
OS-5	2.60	0.22	0.27	0.15	120	3.0	14.4	490	3.5%	2.7	3.0	17.4	3.3	5.5	1.8	3.8
OS-6	48.87	0.18	0.23	0.15	300	21.0	16.2	1460	3.4%	2.7	9.0	25.2	2.7	4.6	23.9	51.3
EXA	1.70	0.15	0.20	0.15	300	8.0	22.3	740	2.6%	2.2	5.6	27.9	2.6	4.3	0.7	1.5
EXB	28.82	0.15	0.20	0.15	300	10.0	20.7	920	4.5%	3.1	4.9	25.6	2.7	4.6	11.7	26.3
EXC	1.50	0.15	0.20	0.15	300	11.0	20.0	325	7.1%	4.0	1.4	21.4	3.0	5.0	0.7	1.5
EXD	6.02	0.15	0.20	0.15	300	8.0	22.3	685	1.8%	2.0	5.7	28.0	2.6	4.3	2.3	5.2
EXE	0.25	0.15	0.20	0.15	181	3.5	19.2					19.2	3.1	5.3	0.1	0.3

DESIGN POINT SUMMARY

EXISTING CONDITIONS

Design Point(s)	Contributing Basins	Area (Acres)	Equivalent CA_5	Equivalent CA_{100}	Maximum T_c	Intensity I_5	Intensity I_{100}	Flow Q_5	Flow Q_{100}	DP FACILITY
EX1	OS-1	52.71	7.91	12.47	41.0	2.0	3.4	15.9	42.1	EX PVT 18" CMP CULVERT DITCH
EX2	OS-2	1.70	0.51	1.12	32.4	2.4	4.0	1.2	4.5	FLOWLINE EX PVT CHANNEL
EX3	OS-1, OS-2, OS-3, & EXA	87.56	15.73	22.56	41.0	2.0	3.4	31.6	76.1	EX PVT POND
EX4	OS-1, OS-2, OS-3, EXA, EXB, & EXC	117.88	20.28	28.62	41.0	2.0	3.4	40.8	96.6	EX PVT CHANNEL
EX5	OS-6 & EXD	54.90	9.61	12.36	28.0	2.6	4.3	24.9	53.6	EX PVT CHANNEL
EX6	DP EX4 & DP EX5	172.78	29.89	40.98	41.0	2.0	3.4	60.1	138.3	EX PVT CHANNEL

LEGEND

- 5' EX CONTOUR — 6735
- 1' EX CONTOUR — 6731
- EXISTING FLOW DIRECTION
- PROPERTY BOUNDARY
- EX BASIN BOUNDARY
- TIME OF CONCENTRATION
- BASIN ID — A
- ACREAGE — 0.37
- DESIGN POINT — 3
- EXISTING STORM

N

200' 0 200' 400'

SCALE: 1"=200'

NO.	REVISIONS DESCRIPTION	DATE

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
SIGNATURE HOMES
ATTN: MICHAEL ANDON
655 SOUTHPOINTE CT., SUITE 20
COLORADO SPRINGS, CO 80906
602-615-6749

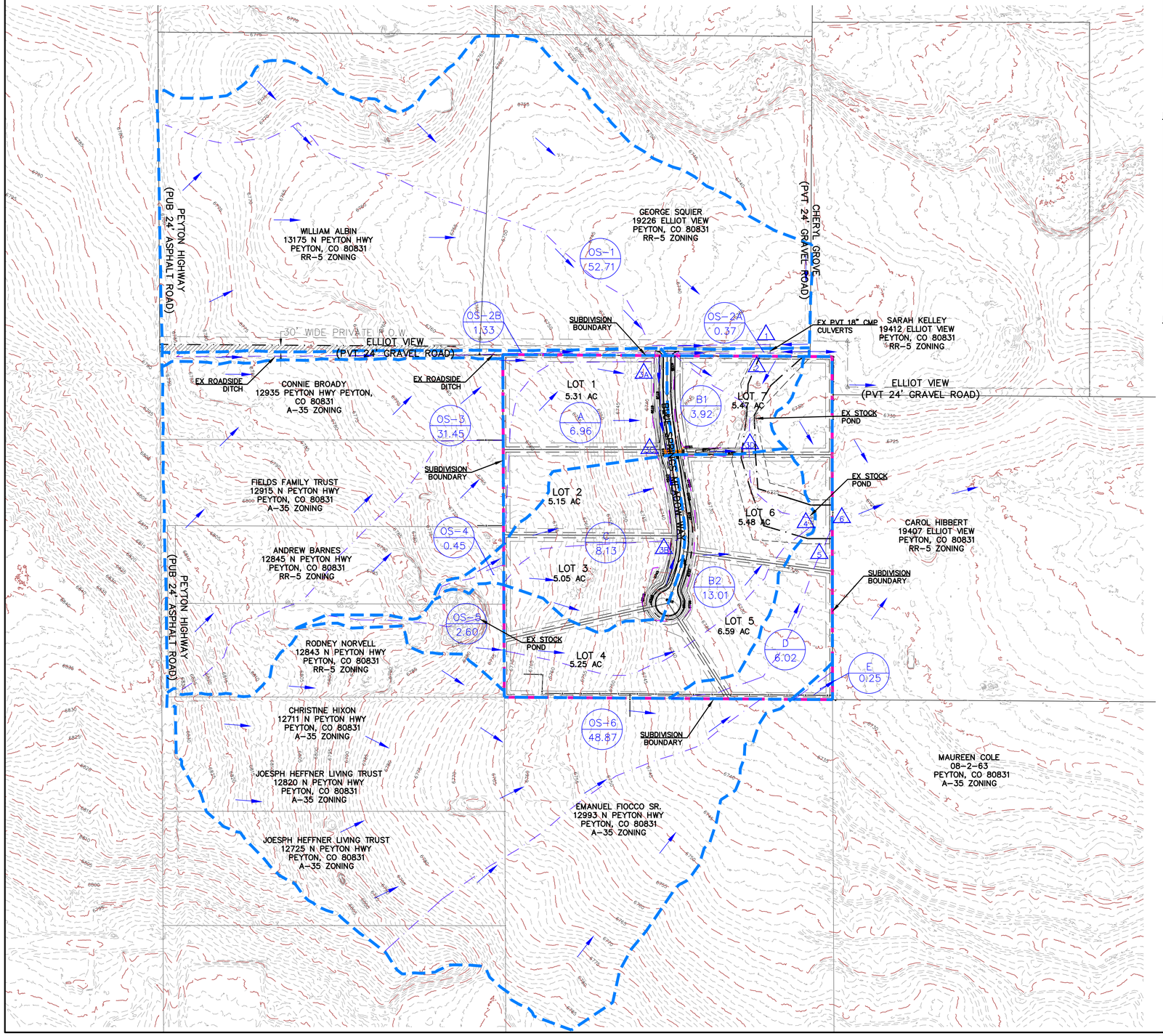
Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnsinc.com

BLUE SPRINGS MEADOW

EXISTING DRAINAGE MAP OVERALL
OFFSITE BASINS

DESIGNED BY	QNA
DRAWN BY	LD
CHECKED BY	
H-SCALE	
V-SCALE	
JOB NO.	2625.00
DATE ISSUED	8/15/26
SHEET NO.	1 OF 1

BLUE SPRINGS MEADOW
EL PASO COUNTY
PROPOSED DRAINAGE MAP OVERALL



LEGEND

- 5' EX CONTOUR — 6735
- 1' EX CONTOUR — 6731
- 5' PROP. CONTOUR — 6735
- 1' PROP. CONTOUR — 6731
- PROPOSED FLOW DIRECTION
- PROPERTY BOUNDARY
- BASIN BOUNDARY
- TIME OF CONCENTRATION
- PROPOSED STORM
- EXISTING STORM
- BASIN ID — A
- ACREAGE — 1.00
- DESIGN POINT — 3
- LIMITS OF DISTURBANCE

N

200' 0 200' 400'

SCALE: 1"=200'

COEFFICIENT SUMMARY

DEVELOPED CONDITIONS

BASIN	TOTAL (Acres)	STREETS/ROOFS % Impervious	STREETS/ROOFS AREA (Acres)	STREETS/ROOFS C_5	STREETS/ROOFS C_{100}	OPEN SPACE/UNDEVELOPED % Impervious	OPEN SPACE/UNDEVELOPED AREA (Acres)	OPEN SPACE/UNDEVELOPED C_5	OPEN SPACE/UNDEVELOPED C_{100}	GRAVEL STREET/YARD % Impervious	GRAVEL STREET/YARD AREA (Acres)	GRAVEL STREET/YARD C_5	GRAVEL STREET/YARD C_{100}	WEIGHTED % Impervious	WEIGHTED C_5	WEIGHTED C_{100}	Basin Total Imperviousness
OS-1	52.71	90%	0.73	0.90	0.95	2%	49.86	0.15	0.20	80%	2.12	0.80	0.85	6.39%	0.19	0.24	3.35
OS-2A	0.37	90%	0.00	0.90	0.95	2%	0.21	0.15	0.20	80%	0.16	0.80	0.85	35.12%	0.43	0.48	0.13
OS-2B	1.33	190%	0.00	0.90	0.95	2%	0.81	0.15	0.20	80%	0.53	0.80	0.85	32.80%	0.41	0.46	0.44
OS-3	31.45	90%	1.22	0.90	0.95	2%	28.04	0.15	0.20	80%	2.19	0.80	0.85	10.85%	0.22	0.27	3.41
OS-4	0.45	90%	0.00	0.90	0.95	2%	0.45	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
OS-5	2.60	90%	0.01	0.90	0.95	2%	2.34	0.15	0.20	80%	0.26	0.80	0.85	9.86%	0.22	0.27	0.26
OS-6	48.87	90%	0.39	0.90	0.95	2%	46.81	0.15	0.20	80%	1.68	0.80	0.85	5.37%	0.18	0.23	2.63
A	6.96	90%	0.20	0.90	0.95	2%	6.39	0.15	0.20	80%	0.37	0.80	0.85	8.73%	0.21	0.26	0.61
B1	3.92	90%	0.20	0.90	0.95	2%	3.35	0.15	0.20	80%	0.37	0.80	0.85	13.94%	0.25	0.30	0.55
B2	13.01	90%	0.61	0.90	0.95	2%	11.48	0.15	0.20	80%	0.93	0.80	0.85	11.65%	0.23	0.28	1.52
C	8.13	90%	0.40	0.90	0.95	2%	6.98	0.15	0.20	80%	0.75	0.80	0.85	13.56%	0.25	0.30	1.10
D	6.02	90%	0.00	0.90	0.95	2%	6.02	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.12
E	0.25	90%	0.00	0.90	0.95	2%	0.25	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
TOTAL AREA	176.07													EX IMP. AREA AC.			14.12

DRAINAGE SUMMARY

DEVELOPED CONDITIONS

BASIN	AREA TOTAL (Acres)	WEIGHTED C_5	WEIGHTED C_{100}	OVERLAND C_5	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND T_c (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW T_t (min)	T_c TOTAL (min)	INTENSITY I_5 (in/hr)	INTENSITY I_{100} (in/hr)	TOTAL FLOWS Q_5 (c.f.s.)	TOTAL FLOWS Q_{100} (c.f.s.)
OS-1	52.71	0.19	0.24	0.15	300	9.0	21.4	2355	1.6%	2.0	19.6	41.0	2.0	3.4	19.8	42.1
OS-2A	0.37	0.43	0.48	0.15	45	2.0	7.3	175	2.3%	2.2	1.3	8.6	4.4	7.3	0.7	1.3
OS-2B	1.33	0.41	0.46	0.15	30	2.0	5.2	2200	2.1%	2.2	16.7	21.9	3.0	5.0	1.6	3.0
OS-3	31.45	0.22	0.27	0.15	300	24.0	15.5	1330	3.5%	2.7	8.2	23.7	2.8	4.8	20.0	41.1
OS-4	0.45	0.15	0.20	0.15	280	13.0	17.9					17.9	3.3	5.5	0.2	0.5
OS-5	2.60	0.22	0.27	0.15	120	3.0	14.4	490	3.5%	2.7	3.0	17.4	3.3	5.5	1.8	3.8
OS-6	48.87	0.18	0.23	0.15	300	21.0	16.2	1460	3.4%	2.7	9.0	25.2	2.7	4.6	23.9	51.3
A	6.96	0.21	0.26	0.15	300	8.0	22.3	1233	2.2%	1.8	11.4	33.7	2.3	3.9	3.3	6.9
B1	3.92	0.25	0.30	0.15	300	10.0	20.7	920	1.0%	1.5	10.2	30.9	2.4	4.1	2.4	4.8
B2	13.01	0.23	0.28	0.15	300	16.0	17.7	620	3.9%	2.0	5.2	22.9	2.9	4.8	8.7	17.7
C	8.13	0.25	0.30	0.15	300	10.0	20.7	720	4.0%	2.5	4.8	25.5	2.7	4.6	5.5	11.1
D	6.02	0.15	0.20	0.15	300	8.0	22.3	685	1.8%	2.0	5.7	28.0	2.6	4.3	2.3	5.2
E	0.25	0.15	0.20	0.15	181	3.5	19.2					19.2	3.1	5.3	0.1	0.3

DESIGN POINT SUMMARY

DEVELOPED CONDITIONS

Design Point(s)	Contributing Basins	Area (Acres)	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity I_5	Intensity I_{100}	Flow Q_5	Flow Q_{100}	DP FACILITY
1	OS-1	52.71	9.83	12.47	41.0	2.0	3.4	19.8	42.1	EX PVT 18" CMP CULVERT DITCH FLOWLINE
2	OS-1 & OS-2A	53.07	9.99	12.64	41.0	2.0	3.4	20.1	42.7	PR PVT DITCH
3A	OS-3, OS-2B & A	39.75	9.04	11.03	33.7	2.3	3.9	20.9	42.7	PR PVT DITCH
3B	OS-4 & C	8.58	2.08	2.51	22.9	2.9	4.8	6.0	12.1	PR PVT DITCH
3C	DP 3A & 3B	48.32	11.11	13.53	33.7	2.3	3.9	25.6	52.4	PR PVT SWALE
3D	DP 2, DP 3C, & B1	105.32	22.08	27.35	41.0	2.0	3.4	44.4	92.3	EX PVT CHANNEL
4	DP 3D & B2	118.33	25.09	31.01	41.0	2.0	3.4	50.5	104.6	EX PVT POND
5	OS-6 & D	54.90	9.61	12.36	28.0	2.6	4.3	24.9	53.6	EX PVT CHANNEL
6	DP EX4 & DP EX5	173.22	34.70	43.37	41.0	2.0	3.4	69.8	146.3	EX PVT CHANNEL

REVISIONS

NO.	DESCRIPTION	DATE

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
SIGNATURE HOMES
ATTN: MICHAEL ANDON
2155 SOUTHPOINTE CT., SUITE 200
COLORADO SPRINGS, CO 80906
602-615-9749

Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnsinc.com

BLUE SPRINGS MEADOW

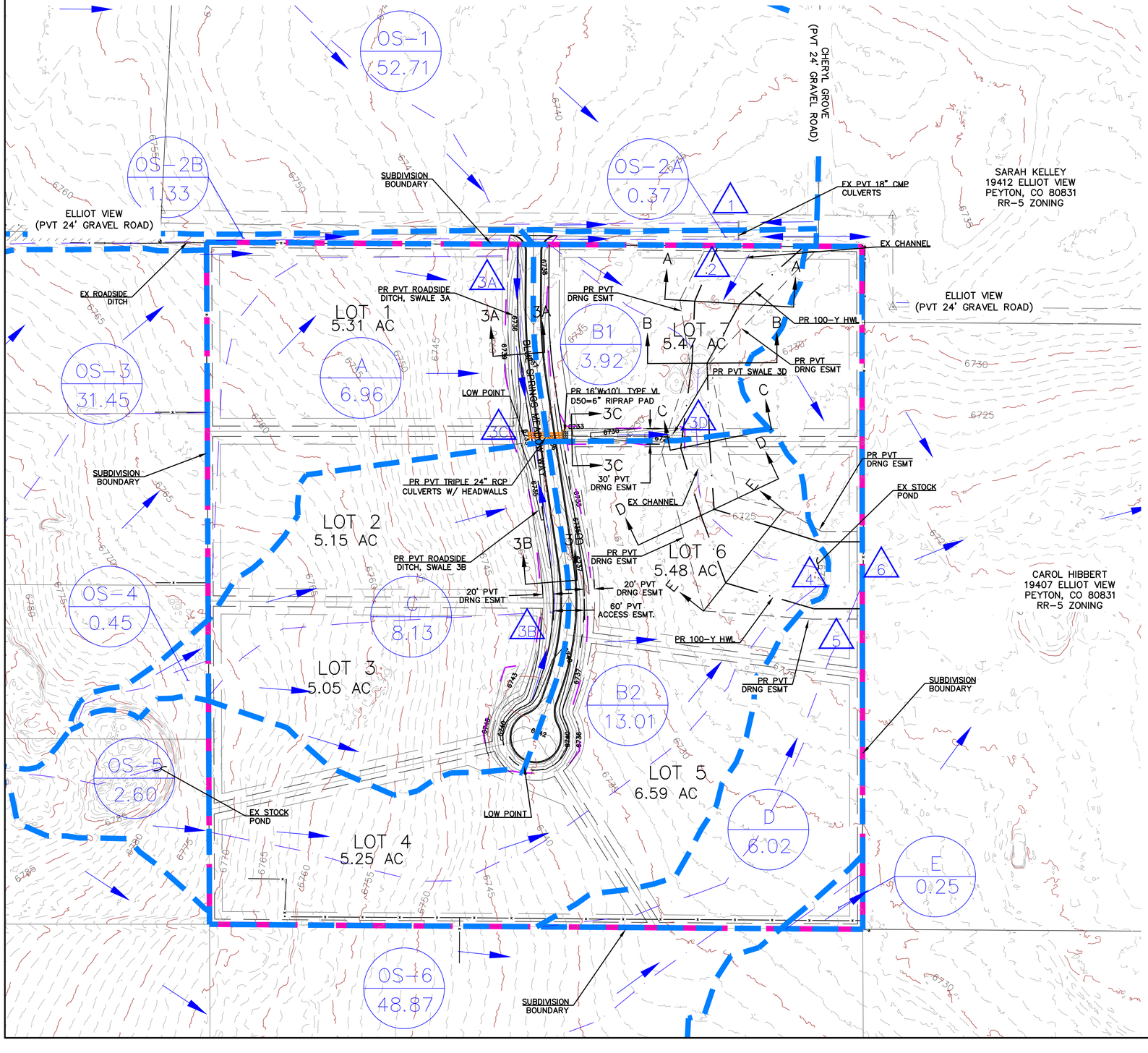
PROPOSED DRAINAGE MAP OVERALL
OFFSITE BASINS

DESIGNED BY	QNA
DRAWN BY	QNA
CHECKED BY	
H-SCALE	
V-SCALE	
JOB NO.	2625.00
DATE ISSUED	8/15/26
SHEET NO.	1 OF 2

BLUE SPRINGS MEADOW

EL PASO COUNTY

PROPOSED DRAINAGE MAP ONSITE



COEFFICIENT SUMMARY

DEVELOPED CONDITIONS

BASIN	TOTAL (Acres)	STREETS/ROOFS % Impervious	STREETS/ROOFS AREA (Acres)	STREETS/ROOFS C_5	STREETS/ROOFS C_{100}	OPEN SPACE/UNDEVELOPED % Impervious	OPEN SPACE/UNDEVELOPED AREA (Acres)	OPEN SPACE/UNDEVELOPED C_5	OPEN SPACE/UNDEVELOPED C_{100}	GRAVEL STREET/YARD % Impervious	GRAVEL STREET/YARD AREA (Acres)	GRAVEL STREET/YARD C_5	GRAVEL STREET/YARD C_{100}	WEIGHTED % Impervious	WEIGHTED C_5	WEIGHTED C_{100}	Basin Total Imperviousness
OS-1	52.71	90%	0.73	0.90	0.95	2%	49.86	0.15	0.20	80%	2.12	0.80	0.85	6.39%	0.19	0.24	3.35
OS-2A	0.37	90%	0.00	0.90	0.95	2%	0.21	0.15	0.20	80%	0.16	0.80	0.85	35.12%	0.43	0.48	0.13
OS-2B	1.33	190%	0.00	0.90	0.95	2%	0.81	0.15	0.20	80%	0.53	0.80	0.85	32.80%	0.41	0.46	0.44
OS-3	31.45	90%	1.22	0.90	0.95	2%	28.04	0.15	0.20	80%	2.19	0.80	0.85	10.85%	0.22	0.27	3.41
OS-4	0.45	90%	0.00	0.90	0.95	2%	0.45	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
OS-5	2.60	90%	0.01	0.90	0.95	2%	2.34	0.15	0.20	80%	0.26	0.80	0.85	9.86%	0.22	0.27	0.26
OS-6	48.87	90%	0.39	0.90	0.95	2%	46.81	0.15	0.20	80%	1.68	0.80	0.85	5.37%	0.18	0.23	2.63
A	6.96	90%	0.20	0.90	0.95	2%	6.39	0.15	0.20	80%	0.37	0.80	0.85	8.73%	0.21	0.26	0.61
B1	3.92	90%	0.20	0.90	0.95	2%	3.35	0.15	0.20	80%	0.37	0.80	0.85	13.94%	0.25	0.30	0.55
B2	13.01	90%	0.61	0.90	0.95	2%	11.48	0.15	0.20	80%	0.93	0.80	0.85	11.65%	0.23	0.28	1.52
C	8.13	90%	0.40	0.90	0.95	2%	6.98	0.15	0.20	80%	0.75	0.80	0.85	13.56%	0.25	0.30	1.10
D	6.02	90%	0.00	0.90	0.95	2%	6.02	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.12
E	0.25	90%	0.00	0.90	0.95	2%	0.25	0.15	0.20	80%	0.00	0.80	0.85	2.00%	0.15	0.20	0.01
TOTAL AREA	176.07													EX IMP. AREA AC.			14.12

DRAINAGE SUMMARY

DEVELOPED CONDITIONS

BASIN	AREA TOTAL (Acres)	WEIGHTED C_5	WEIGHTED C_{100}	OVERLAND C_5	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND T_c (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW T_t (min)	T_c TOTAL (min)	INTENSITY I_5 (in/hr)	INTENSITY I_{100} (in/hr)	TOTAL FLOWS Q_5 (c.f.s.)	TOTAL FLOWS Q_{100} (c.f.s.)
OS-1	52.71	0.19	0.24	0.15	300	9.0	21.4	2355	1.6%	2.0	19.6	41.0	2.0	3.4	19.8	42.1
OS-2A	0.37	0.43	0.48	0.15	45	2.0	7.3	175	2.3%	2.2	1.3	8.6	4.4	7.3	0.7	1.3
OS-2B	1.33	0.41	0.46	0.15	30	2.0	5.2	2200	2.1%	2.2	16.7	21.9	3.0	5.0	1.6	3.0
OS-3	31.45	0.22	0.27	0.15	300	24.0	15.5	1330	3.5%	2.7	8.2	23.7	2.8	4.8	20.0	41.1
OS-4	0.45	0.15	0.20	0.15	280	13.0	17.9					17.9	3.3	5.5	0.2	0.5
OS-5	2.60	0.22	0.27	0.15	120	3.0	14.4	490	3.5%	2.7	3.0	17.4	3.3	5.5	1.8	3.8
OS-6	48.87	0.18	0.23	0.15	300	21.0	16.2	1460	3.4%	2.7	9.0	25.2	2.7	4.6	23.9	51.3
A	6.96	0.21	0.26	0.15	300	8.0	22.3	1233	2.2%	1.8	11.4	33.7	2.3	3.9	3.3	6.9
B1	3.92	0.25	0.30	0.15	300	10.0	20.7	920	1.0%	1.5	10.2	30.9	2.4	4.1	2.4	4.8
B2	13.01	0.23	0.28	0.15	300	16.0	17.7	620	3.9%	2.0	5.2	22.9	2.9	4.8	8.7	17.7
C	8.13	0.25	0.30	0.15	300	10.0	20.7	720	4.0%	2.5	4.8	25.5	2.7	4.6	5.5	11.1
D	6.02	0.15	0.20	0.15	300	8.0	22.3	685	1.8%	2.0	5.7	28.0	2.6	4.3	2.3	5.2
E	0.25	0.15	0.20	0.15	181	3.5	19.2					19.2	3.1	5.3	0.1	0.3

DESIGN POINT SUMMARY

DEVELOPED CONDITIONS

Design Point(s)	Contributing Basins	Area (Acres)	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity I_5	Intensity I_{100}	Flow Q_5	Flow Q_{100}	DP FACILITY
1	OS-1	52.71	9.83	12.47	41.0	2.0	3.4	19.8	42.1	EX PVT 18" CMP CULVERT
2	OS-1 & OS-2A	53.07	9.99	12.64	41.0	2.0	3.4	20.1	42.7	DITCH FLOWLINE
3A	OS-3, OS-2B & A	39.75	9.04	11.03	33.7	2.3	3.9	20.9	42.7	PR PVT DITCH
3B	OS-4 & C	8.58	2.08	2.51	22.9	2.9	4.8	6.0	12.1	PR PVT DITCH
3C	DP 3A & 3B	48.32	11.11	13.53	33.7	2.3	3.9	25.6	52.4	PR PVT SWALE
3D	DP 2, DP 3C, & B1	105.32	22.08	27.35	41.0	2.0	3.4	44.4	92.3	EX PVT CHANNEL
4	DP 3D & B2	118.33	25.09	31.01	41.0	2.0	3.4	50.5	104.6	EX PVT POND
5	OS-6 & D	54.90	9.61	12.36	28.0	2.6	4.3	24.9	53.6	EX PVT CHANNEL
6	DP EX4 & DP EX5	173.22	34.70	43.37	41.0	2.0	3.4	69.8	146.3	EX PVT CHANNEL

LEGEND

- 5' EX CONTOUR — 6735
- 1' EX CONTOUR — 6731
- 5' PROP. CONTOUR — 6735
- 1' PROP. CONTOUR — 6731
- PROPOSED FLOW DIRECTION
- PROPERTY BOUNDARY
- BASIN BOUNDARY
- TIME OF CONCENTRATION
- PROPOSED STORM
- EXISTING STORM
- BASIN ID / ACREAGE — A / 1.00
- DESIGN POINT — 3
- LIMITS OF DISTURBANCE

N

100' 0 100' 200'

SCALE: 1"=100'

REVISIONS

NO.	DESCRIPTION	DATE

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
SIGNATURE HOMES
ATTN: MICHAEL ANDON
2155 SOUTHPOINTE CT., SUTIE 200
COLORADO SPRINGS, CO 80906
602-615-9749

Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tneinc.com

BLUE SPRINGS MEADOW

PROPOSED DRAINAGE MAP ONSITE
ONSITE BASINS

DESIGNED BY	QNA
DRAWN BY	QNA
CHECKED BY	
H-SCALE	
V-SCALE	
JOB NO.	2625.00
DATE ISSUED	8/15/26
SHEET NO.	2 OF 2

APPENDIX G
OPERATIONS AND MAINTENA NCE

Blue Springs Meadow
Operations and Maintenance Manual
Extended Detention Basin, Diversion Swale E-E & Grass Buffers

County Job No. PUDSP-21-005 & SF237

Extended detention basins have low to moderate maintenance requirements. Routine and non-routine maintenance is necessary to assure performance, enhance aesthetics, and protect structural integrity. Dry basins can result in nuisance complaints if not properly designed or maintained. Bio-degradable pesticides may be required to limit insect problems. Frequent debris removal and grass-mowing can reduce aesthetic complaints. If a shallow wetland or marshy area is included, mosquito breeding and nuisance odors could occur if the water becomes stagnant.

2 BROTHERS PROPERTIES LLC
Contact Person ADAM & BARUCH RHEA
Phone: NA
Email: NA
Mailing Address: 5625 E Pikes Peak Avenue Colorado Springs, CO 80916

1. Blue Springs Meadow Swale 3C &

Swale 3C- This Swale will be built in 2026. The final drainage report for Blue Springs Meadow covers the drainage calculations for this swale.

2. Access

The Swale 3C can be accessed from the end of Blue Springs Meadow Way private access easement

3. Inspections

Inspection and Frequency

· Annually inspect the swale to ensure that the swale continues to function as initially intended. The annual inspection should evaluate the triple culverts, headwalls, and downstream channel. A site survey will be the best indication of excessive sediment buildup and degradation of the swale. In addition, an inspection of the vegetation on the berm and inside the swale area. Any bare areas should be noted and repaired using native grasses. Any sloughing or erosion of the embankment should be noted and repaired. Items to record will include any items inspected and the mowing frequency of the vegetation on the facility.

· Just before annual storm seasons (that is, April and May) and following significant rainfall events, inspect for litter and debris that may build up.

· A baseline survey should be performed at the time of construction and comparison surveys conducted every ten to twenty years after to monitor overall performance of the pond. Results of

inspections should be recorded and kept at a central location for review and recording by the district.

Inspection Personnel

A qualified engineer, surveyor, or certified storm water inspector should conduct inspections of the facility.

4.0 Operations

No specific operating instructions are required.

5.0 Maintenance

Maintenance of the Swales (Diversion Swale) shall be in accordance with the guidelines included in Table RPA-1, below.

Table RPA-1

Required Action	Maintenance Objective	Frequency of Action
Inspection	Check for sediment accumulation and rill and gully development. Inspect vegetation for uniform coverage.	Routine – at least twice annually for uniform cover and traffic impacts.
Debris and litter removal	Remove litter and debris to prevent rill and gully development from preferential flow paths around accumulated debris, enhance aesthetics, and prevent floatables from being washed offsite.	Routine This should be done as needed based on inspection, but no less than two times per year.
Aeration	Aeration is done by punching holes in the ground using an aerator with hollow punches that pull the soil cores or "plugs" from the ground. Holes should be at least 2 inches deep and no more than 4 inches apart.	Routine – Should be performed at least once per year when the ground is not frozen.
Mowing	When starting from seed, mow native/drought-tolerant grasses only when required to deter weeds during the first three years. Following this period mowing of	Routine – Mowing of manicured grasses may vary from as frequently as weekly during the summer, to no mowing during the winter.

	native/drought tolerant grass may stop or be reduced to maintain a length of no less than six inches.	
Added Fertilizer, Herbicide, and Pesticide Application	Use the minimum amount of biodegradable nontoxic fertilizers and herbicides needed to establish and maintain dense vegetation cover that is reasonably free of weeds. Fertilizer application may be significantly reduced or eliminated by the use of mulch-mowers, as opposed to bagging and removing clippings. To keep clippings out of receiving waters, maintain a 25-foot buffer adjacent to open water areas where clippings are bagged. Hand-pull the weeds in areas with limited weed problems.	Nonroutine – Frequency of fertilizer, herbicide, and pesticide application should be on an as-needed basis only and should decrease following establishment of vegetation.
Sediment removal	For Grass Buffers: Using a shovel, remove sediment at the interface between the impervious area and buffer For Grass Swales: Remove accumulated sediment near culverts and in channels to maintain flow capacity. Spot replace the grass areas as necessary.	Nonroutine – Remove sediment as needed based on inspection. Frequency depends on site-specific conditions. For planning purposes, it can be estimated that 3 to 10% of the swale length or buffer interface length will require sediment removal on an annual basis. Reseed and/or patch damage areas in buffer, sideslopes and/or channel to maintain healthy vegetative cover. Over time, and depending on pollutant load, portion of butter/sale may need to be rehabilitated due to sediment deposition. Periodic sediment removal will reduce the frequency of revegetation required. Expect turf replacement for the buffer

		interface area every 10 to 20 years.
Irrigation Schedule and Maintenance	Check for broken sprinkler heads and repair them, as needed. Do not overwater. Signs of overwatering and/or broken sprinkler heads may include soggy areas and unevenly distributed areas of lush growth. Completely drain and blowout the irrigation system before the first winter freeze each year. Upon reactivation of the irrigation system in the spring, inspect all components and replace damaged parts, as needed.	Adjust irrigation schedules throughout the growing season to provide the proper irrigation application rate to maintain healthy vegetation. Less irrigation is typically needed in early summer and fall, with more irrigation needed during July and August. Native grass should not require irrigation after establishment, except during prolonged dry periods when supplemental, temporary irrigation may aid in maintaining healthy vegetation cover.

Operations and Maintenance Manual
Open Drainage Channel Inspections and Maintenance (O&M)

County Job No. PCF SF???

Routine maintenance of the open drainage channel system consists of litter and debris pickup, vegetation management, erosion control, and sediment removal when necessary. Removal of excessive shrubs and trees is required to ensure that the channel will flow in conformance with the original design. Mowing and vegetation management shall be performed with care to ensure that soils remain stable and not to cause erosion. Noxious weed management shall be performed as necessary and as required under project approval conditions. All dead trees and trees growing in the flowline of a structure such as a bridge or culvert shall be removed.

Removal of sediment shall be performed with the use of equipment such as a skid steer, backhoe, and front-end loader. The removed materials shall be hauled to an acceptable landfill site unless otherwise legally permitted to be utilized elsewhere. Materials are not to be stored onsite. Equipment shall utilize the designated access roads and shall not be used in a manner to cause damage to adjacent vegetated and stable areas to the extent possible. If drainage channels contain wetlands many activities, including maintenance, may be subject to regulation and permitting.

Erosion control and restoration work such as side slope reconstruction, revegetation, riprap installation, and other stabilization methods will require the use of heavy equipment.

Maintaining altered watercourses is a minimum requirement of the National Flood Insurance Program (NFIP). In fact, failure to maintain such watercourses may result in a revision to the community's Flood Insurance Rate Map (FIRM). If a stream is altered after the community's FIRM is published, the NFIP requires the community to ensure that the channel's carrying capacity is not adversely altered. This is required in 44 CFR 60.3(b)(7) of the Federal Emergency Management Agency's (FEMA's) NFIP regulations.

Table 1 – General Channel Maintenance Guidelines

Activity	Maintenance Action	Frequency of Action
Mowing, vegetation management, and lawn care	Occasional mowing to limit unwanted vegetation on areas outside of the bottom of the channel and the banks. Maintain irrigated turf grass as 2 to 4 inches tall and non-irrigated native turf grasses at 4 to 6. Vegetation along the channel banks and in the bottom of the channel shall be left uncut and allowed to grow.	Routine – depending on aesthetic requirements.
Debris and litter removal	Remove debris and litter from the entire channel to improve flow characteristics and aesthetics. Dispose of as appropriate.	Routine – including annual, pre-storm season (April and May) and following significant rainfall events.
Erosion and sediment control	Repair and revegetate eroded areas in the channel.	Non-routine –as necessary based on inspection.
Structural	Repair inflow structures, low flow channel linings, and energy dissipation structures as needed.	Non-routine – repair as needed based on regular inspections.
Inspections	Inspect channel to ensure continued function as initially intended. Check for erosion, slumping, excessive sedimentation, overgrowth, embankment and inflow integrity, and damage to any structural elements. Report any illicit discharge immediately.	Routine – annual inspection of hydraulic and structural facilities. Also check for obvious problems during routine maintenance visits.
Nuisance control	Address odor, insects, and other issues associated with stagnant or standing water.	Non-routine –as necessary per inspection or complaint.
Sediment removal	Remove accumulated sediment from the channel bottom.	Non-routine –as necessary per inspection.

Routine Maintenance Activities

The majority of this work consists of scheduled mowing, litter and debris pickups for the drainage channel during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items typically do not require any prior correspondence with EPC, however, completed inspection and maintenance forms shall be retained and submitted to EPC for each inspection and maintenance upon request. The Routine Maintenance Activities are summarized below, and further described in the following sections.

Table 2 – Summary of Routine Maintenance Activities

Activity	Maintenance Action	Look for:	Minimum Frequency
Mowing	2”-4” irrigated grass height; 4-6” natural grass height on areas outside of the bottom of the channel and the banks	Excessive grass height/aesthetics	Routine – twice annually
Litter / Debris Removal	Remove and dispose of litter and debris	Litter / debris in drainage channel	Routine – twice annually

Woody growth control / weed removal	Treat w/herbicide or hand pull	Noxious weeds, undesirable vegetation	Routine – minimum twice annually

Properly dispose of litter and debris materials at an approved landfill or recycling facility. It should be noted that major debris removal may require other regulatory permits prior to completing the work.

Noxious weeds and other unwanted vegetation must be treated as needed throughout the drainage channel. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the County Environmental Division is recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer's recommendations.

Minor Maintenance Activities

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items may require prior approval from EPC depending on the scope of work. Completed inspection and maintenance forms shall be retained for each inspection and maintenance period. In the event that the drainage channel needs to be dewatered, care should be given to ensure sediment, filter material and other pollutants are not discharged. The appropriate permits shall be obtained prior to any dewatering activity.

Table 3 – Summary of Minor Maintenance Activities

Activity	Maintenance Action	Look for:	Minimum Frequency
Sediment/Pollutant Removal	Remove and dispose of accumulated sediment from the channel bottom.	Minor sediment and pollution build-up in channel bottom; potential decrease in channel flow rate	Non-routine – as needed based on inspection.
Erosion Repair	Repair eroded areas and revegetate; address cause.	Rills/gullies on sides of channel	Non-routine – as needed, based on inspection.

Major Maintenance Activities

This work consists of larger maintenance/operational problems and failures within the stormwater drainage facilities. This work will likely require approval from EPC Engineering to ensure the proper maintenance is performed. This work requires that Engineering Staff review the original design and construction drawings to assess the situation and necessary maintenance activities. This work may also require more specialized maintenance equipment, design plans/details, surveying, and assistance through private contractors and consultants. In the event that the drainage channel needs to be dewatered, care should be given to ensure sediment, filter material and other pollutants are not discharged. The appropriate permits shall be obtained prior to any dewatering activity.

Table 4 – Summary of Major Maintenance Activities

Activity	Maintenance Action	Look for:	Minimum Frequency
Major Sediment / Pollutant Removal	Remove and dispose of sediment. Repair vegetation as necessary	Large quantities of sediment in the channel and reduced conveyance rate/capacity	Non-routine –as necessary based on inspection.
Major Erosion Repair	Repair erosion – find cause of problem and address to avoid future erosion	Severe erosion including gullies, excessive soil displacement, unusual areas of settlement, holes	Non-routine –as necessary based on inspection.
Structural Repair	Structural repair to restore portions of the channel to its original design	Deterioration and/or damage to structural components – broken concrete, damaged pipe, drop/check structures or dissipators	Non-routine –as necessary based on inspection.
Drainage Channel Rebuild	Contact EPC Engineering	Overall channel failure	Non-routine –as needed due to complete failure of drainage channel

Inspection Procedures

Periodic inspections of drainage channels and associated stormwater control measures in developed areas are needed in every community to prevent the accumulation of debris deposited by storms, dumping, or natural processes. Inspections must be conducted at least once each year and after each storm that could adversely impact the drainage system. Inspections are also needed in response to citizen complaints.

Conduct annual visual inspections during the dry season to determine if there are problem inlets where sediment/trash or other pollutants accumulate. Inspection and maintenance records should be used to determine problem areas that may need to be checked more often. Appropriate action must be taken after an inspection identifies the need for maintenance or cleaning.

The attached form includes the typical information necessary for and during an inspection. Similar forms or electronic record keeping may be utilized if all relevant information is recorded. The entity responsible for channel maintenance is required to submit the periodic inspection reports upon request by County Staff. Inspections involving decisions about structural issues shall be signed by a licensed professional engineer.

Inspections of inflow structures including detention spillways and water quality outlet pipes discharging to the channel shall be coordinated with channel inspections.

Illicit discharges such as dumping of home goods or garbage, appliances, yard wastes, paint spills, abandoned oil containers and other pollutants shall be immediately reported to EPC Staff and other agencies as appropriate. Reference El Paso County Ordinance No. 07-01, as amended. EPC recommends that the responsible entity encourage public reporting of improper waste disposal by

posting “No Dumping” signs, neighborhood notices, and/or social media when available, with contact information to report violations.

Wetlands

If drainage channels contain wetlands many activities, including maintenance, may be subject to regulation and permitting. The responsible maintenance entity shall maintain wetlands vegetation as appropriate and in consultation with the proper authorities including the U.S. Army Corps of Engineers when applicable. The responsible maintenance entity shall ensure proper training / licensing of contractors and staff to minimize the potential for damages to the wetlands.

All applicable safety and environmental considerations with regards to the application of any pesticides or herbicides shall be verified. It is also strongly encouraged that the responsible entity employ or consult a wetlands specialist or certified arborist with the ability to identify invasive/exotic species. Due to the sensitive nature of using chemicals near water bodies, a written Quality Assurance/Quality Control (QA/QC) plan shall be implemented.

Employees shall be trained in accordance with any local, state, and federal regulations and laws prior to any application of chemicals. A copy of the QA/QC plan must be submitted to the County Environmental Division prior to any chemical applications. In addition to the QA/QC plan, copies of the Safety Data Sheets (SDS) for all the chemicals being used shall be provided upon request.

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with amendments in 1972.

Section 404 - establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. CWA Section 404(b)(1) Guidelines – U.S. Environmental Protection Agency (EPA) (Although they are called “guidelines,” these criteria are established in regulations (40 CFR Part 230) and are legally binding.)
https://www.epa.gov/cwa-404/clean-water-laws-regulations-and-executive-orders-related-section-404

Open Drainage Channel Inspection Report Form

Date: _____ Inspector: _____

Type of inspection: Post-Storm _____ Complaint _____ Routine _____

Location: (Identify stream or basin name, downstream and upstream streets or reference points, and location of problem. Provide sketch as needed.)

_____

_____

_____

Type of problem: Litter ___ Minor ___ Obstruction ___ Structural ___ Illicit Discharge** ___

Recommended maintenance: _____

_____

_____

Is equipment needed? _____ If so, list equipment needed: _____

_____

Date: _____ Offsite Right of entry needed? _____

Work order description: _____

_____

_____

_____

_____

State permit(s) needed? _____ Work order number: _____

Date: Crew chief: _____

Maintenance performed: _____

_____

_____

_____

Inspected by: _____

Use other side for additional recommendations for this site.

****Report illicit discharges to the County and appropriate agencies.**