July 31, 2023

El Paso County Engineering Division
3275 Akers Dr
Colorado Springs, CO 80922

Dear El Paso County Engineering Staff:

RE: Storm Drainage Calculations for Latigo Well Site #2

This letter presents the storm drainage calculations and culvert sizing for the access road to Latigo Well Site #2 (well site). Figure 1 in Attachment A shows the proposed project site which is located on the west side of Eastonville Road, approximately 4,300 feet south of Latigo Boulevard. Attachment A also includes the proposed site plan drawing for the well site. The drainage calculations were based on the methodology outlined in the Drainage Criteria Manual County of El Paso[1] (Drainage Criteria). The 10-year and 100-year rainfall events were analyzed for the purposes of sizing the access road culvert.

HYDROLOGIC CALCULATIONS

BASIN AND SUB-BASIN CHARACTERISTICS

According to the El Paso County Drainage Basins Map,[2] the proposed well site is located near the northern portion of the Geick Ranch CHMS0400 drainage basin. Figure 2 in Attachment A shows the sub-basin (Basin 1) for the area draining to the upstream end of the proposed culvert which is approximately 10.83 acres in size.

Reports containing the hydrologic soil conditions within the vicinity of Basin 1 were downloaded from the Natural Resources Conservation Service (NRCS) Web Soil Survey[3] and are presented in Attachment B. The entire Basin 1 area consists of Stapleton sandy loam with 3 to 8 percent slopes, which is classified as Hydrologic Soil Group B.

Runoff from Basin 1 drains to the east and south at an average slope of 4.3%. The proposed well site is approximately 0.89 acres in size. The remainder of Basin 1 consists of undeveloped land with short grassland vegetation. Table 1 shows the basin characteristics including a breakdown of the percent impervious with the corresponding runoff coefficients for the 10-year and 100-year rainfall events for Hydrologic Soil Group B soils. The runoff

[1] **El Paso County, Colorado, 2018.** "Drainage Criteria Manual County of El Paso, Colorado, October 31, 2018," accessed July 11, 2023, from *https://library.municode.com/co/el_paso_county/codes/drainage_criteria_manual?nodeId=DRCRMAVO1ELPACO*

[2] **Board of County Commissioners, El Paso County, Colorado, 2005**. "Drainage Basins," accessed July 11, 2023, from *https://assets-publicworks.elpasoco.com/wp-content/uploads/Stormwater/Current_Website/Drainage-Basins.pdf*

[3] **Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture.** "Web Soil Survey," accessed July 12, 2023, from *http://websoilsurvey.nrcs.usda.gov/*

5540 TECH CENTER DRIVE
SUITE 100
COLORADO SPRINGS, CO 80919
719.227.0072

coefficients correspond to the values presented in Table 5-1 of the Drainage Criteria, a copy of which is included in Attachment C.

Table 1. Drainage Basin Characteristics

Sub-Basin ID	Area (sq-ft)	Area (ac)	Surface Description	Percent Impervious	C_{10} [(a)]	C_{100} [(b)]
Basin 1	2,024.0	0.05	Well Site: Gravel	80.0%	0.80	0.85
	353.8	0.01	Well Site: Buildings & Concrete	100.0%	0.90	0.95
	469,377.5	10.78	Pasture/Meadow	0.0%	0.25	0.35
Totals =	**471,755.2**	**10.83**	**Composite Values =**	**0.4%**	**0.25**	**0.35**

sq-ft = square feet

ac = acres

(a) C_{10} = Runoff coefficient for the 10-year rainfall event

(b) C_{100} = Runoff coefficient for the 100-year rainfall event

RUNOFF CALCULATIONS

The total runoff for the 100-year rainfall event was calculated using the Rational Method because the total area of Basin 1 is under 100 acres. The rational method uses the following equation to calculate the total runoff from a drainage basin.

$$Q = CiA$$

Where:

Q = Peak runoff rate for a storm event in cubic feet per second (cfs)
C = Composite runoff coefficient (unitless)
i = Average rainfall intensity in inches per hour (in/hr)
A = Drainage basin area in acres (ac)

The rainfall intensity was determined from the *Storm Rainfall Time Intensity – Frequency Curves* from the Drainage Criteria, a copy of which is presented in Attachment C. The rainfall intensity depends on the time of concentration in the drainage basin, which is calculated based on the longest travel path from the upstream end to the downstream end of the basin. The total travel time includes overland flow, storm sewer and/or road gutter flow and channelized flow. For Basin 1, the length of overland flow is assumed to be the maximum length for undeveloped basins of 1000 feet. The overland flow portion of the time of concentration is calculated based on the following equation.

$$T_o = 1.87(1.1-C_{100})L^{0.5}\,S^{-0.33}$$

Where:

T_o = Overland flow travel time in minutes (min)
C_{100} = Composite runoff coefficient for the 100-year event (unitless)
L = Length of overland flow in feet (ft)
S = Slope of flow path in percent

The longest flow path for Basin 1 is 1,819 feet. Assuming the maximum 1000 feet is calculated as overland flow, the overland flow time of concentration is 27.4 minutes. The remaining 819-foot flow

path length is assumed to be channelized flow. The travel time for channelized flow is based on the following velocity equation.

$$V = 1.49/n\ r^{2/3}\ s^{1/2}$$

Where:

V = Velocity of channelized flow in feet per second (ft/s)
n = Manning's coefficient (unitless)
r = Hydraulic radius of channel
r = A/P
Where:
A = Cross-sectional area
P = Wetted perimeter of channel flow in feet (ft)
s = Slope in feet per foot

The velocity of channelized flow is 3.53 ft/s, which applied over 818 feet is 232 seconds or 3.9 minutes. Therefore, the total time of concentration is 31.3 minutes. The corresponding rainfall intensities, and peak runoff rates are summarized in Table 2. The full calculations for time of concentration is presented in Attachment D.

Table 2. Peak Runoff Rates

Basin Area (ac)	C_{10}	I_{10}[(a)] (in/hr)	Q_{10}[(b)] (cfs)	C_{100}	I_{100}[(c)] (in/hr)	Q_{100}[(d)] (cfs)
10.83	0.25	2.70	7.31	0.35	4.05	15.35

(a) I_{10} = Rainfall intensity for the 10-year rainfall event in inches per hour (in/hr)
(b) Q_{10} = Peak runoff rate for the 10-year rainfall event in cubic feet per second (cfs)
(c) I_{100} = Rainfall intensity for the 100-year rainfall event in inches per hour (in/hr)
(d) Q_{100} = Peak runoff rate for the 10-year rainfall event in cubic feet per second (cfs)

CULVERT SIZING

The proposed culvert under the access road to the proposed well site was sized based on standards from the Drainage Criteria as well as the El Paso County Engineering Criteria Manual[4] (Engineering Criteria). The hydraulic calculations for the culvert were performed using HY-8 version 7.70.1.0 software developed by the Federal Highway Administration, Aquaveo LLC and Environmental Modeling Research Laboratory.

A 24-inch diameter culvert is required to convey the peak runoff rate for the 100-year event. However, two 14-inch by 23-inch elliptical reinforced concrete pipes (ERCPs) were selected instead to minimize grading impacts up and downstream of the site. The HY-8 calculations provided in Attachment D show that the proposed double ERCP culvert can convey the 100-year peak runoff rate without overtopping the access road. Rip-rap is recommended both on the upstream and downstream ends of the culvert because due to the sandy soils and the outlet velocity of 5.14 ft/s 10-year event.

[4] **El Paso County, Colorado, 2020.** "Engineering Criteria Manual County of El Paso, Colorado, October 14, 2020," accessed July 25, 2023, from *https://library.municode.com/co/el_paso_county/codes/engineering_criteria_manual_?nodeId=ENCRMACOELPACO*

CONCLUSION

The hydrologic analysis shows that approximately 15.35 cfs will drain toward the proposed culvert under the well site access road in the 100-year event. A proposed double ERCP culvert is designed to convey the entire 100-year event without overtopping Eastonville Road or the proposed well site access road. The proposed design meets the criteria outlined in the Drainage Criteria and the Engineering Criteria.

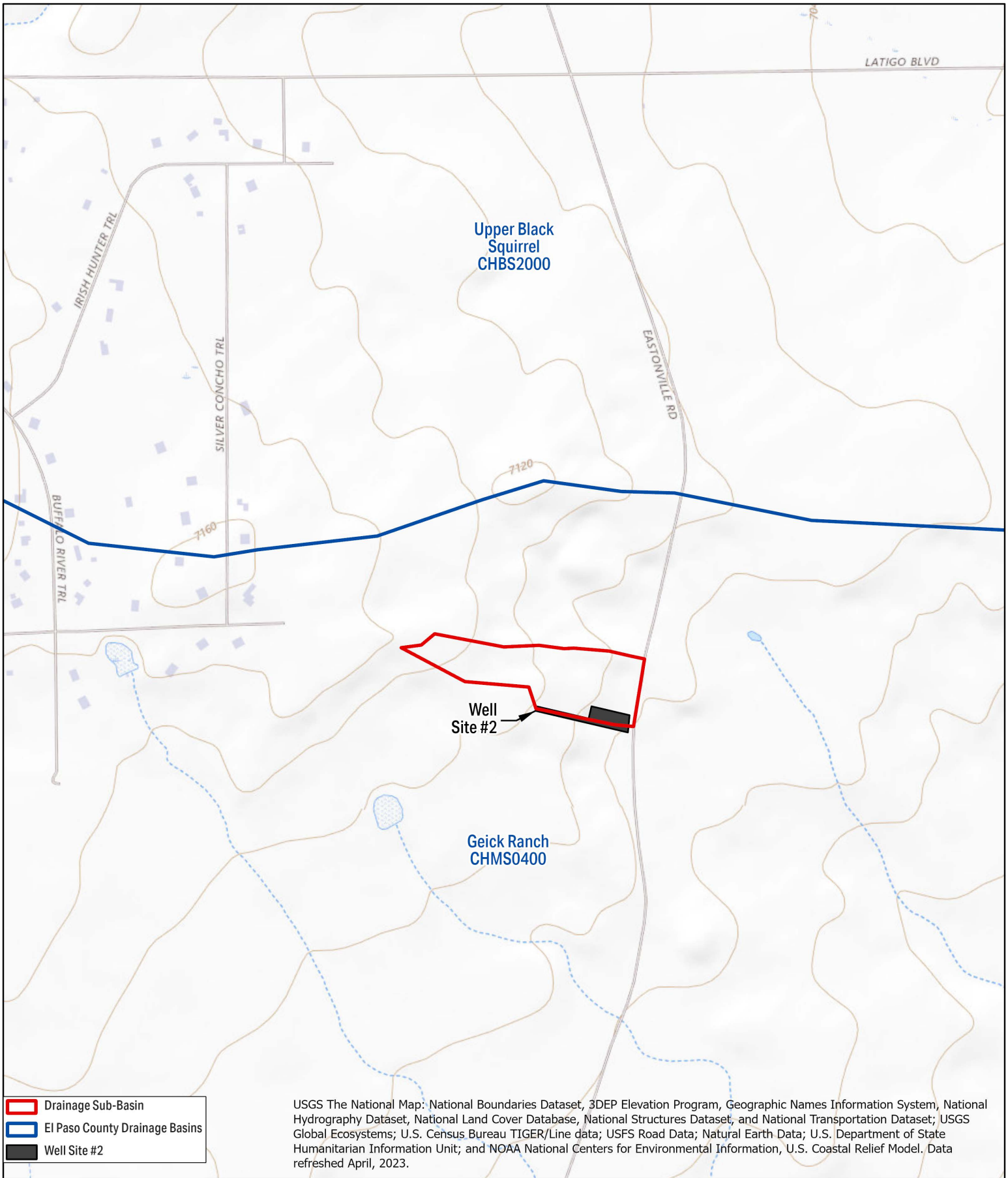
Sincerely,

Rebecca E. Norton, P.E. #40293
Project Manager

REN: ren
Attachments
cc: Project Central File W0151.22058

ATTACHMENT A

MAPS AND CIVIL SITE PLANS



USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed April, 2023.

0 400 800
FEET

Scale: 1" = 800'

N
W E
S

MERIDIAN SERVICE METROPOLITAN DISTRICT

LATIGO WELL SITE #2

FIGURE 1 - PROJECT VICINITY

RESPEC
Colorado Springs, CO
5540 Tech Center Dr., Suite 100
Colorado Springs, CO 80919
Phone: 719.227.0072
www.respec.com

EX PARCEL #: 4200000345
SEE VICINITY MAP BELOW FOR PROPERTY EXTENTS
OWNER: FALCON LATIGO LLC
MAILING ADDRESS: 5350 S ROSLYN ST STE 400 ENGLEWOOD, CO 80111
CONTACT: JIM NIKKEL
PH: 719-495 6567
EM: j.nikkel@meridianservice.org
TAX STATUS: TAXABLE
ZONING: RR-2.5
PLAT: N/A
LAND USE: VACANT LAND>100 AC
AREA: 9,004,723 SF/206.72 AC

PP EASEMENT
38,545 SF/0.88 AC

15' SIDE BLDG. SETBACK (TYP)
25' REAR SETBACK
N13° 09' 11"E 80.00'
SEE OVERALL SITE PLAN FOR EASEMENT EXTENT
FROM EX. DAWSON 30'
FUTURE PARCEL PROPERTY LINE
DISTURBED AREA TO BE RESEEDED W/EL PASO COUNTY CONSERVATION DISTRICT SHOTGUN MIX

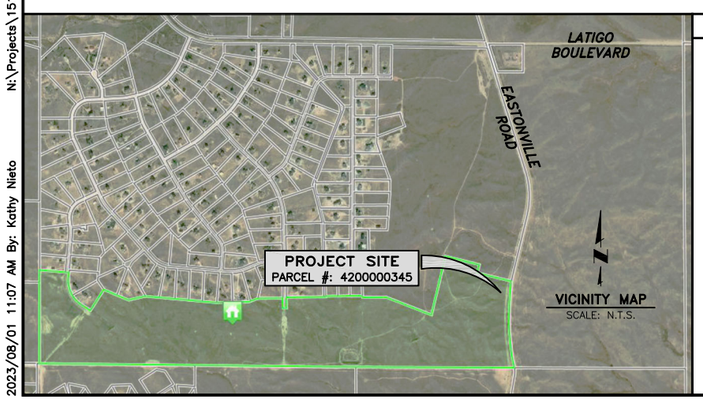
LATIGO A-2 (FUTURE)
LATIGO D-2 (FUTURE)
PP STEP-UP TRANSFORMER
PP 10'x14' METER VAULT TOP OF VAULT EL = 7063.5'
N:23124.9735
E:18871.2302
PP LATIGO LFH-2 88087-F
14.1'
9.9'
250.00'
N76° 50' 49"W
9.2'
13.3'
110.5'
S76° 50' 49"E 607.04'
15'

FUTURE 10' FENCE AND LANDSCAPE ESMT.
FUTURE 20' DRAINAGE ESMT.
FUTURE 25' PARKS EQUESTRIAN TRAIL ESMT.
EX 25' MVEA ESMT.
PP 20' RAW WATER LINE ESMT.
FUTURE 30' DEDICATED R.O.W. EASTONVILLE RD.
EX 60' EASTONVILLE RD. R.O.W.
25' FRONT SETBACK

PP SECURITY FENCE: 176 LF, 7' H BARBED WIRE CHAIN LINK. SEE DETAIL A/C3
PP DOUBLE-SWING SECURITY GATE: 12' W x 7' H BARBED WIRE CHAIN LINK. SEE DETAIL A/C3
PP PRIVATE DRIVEWAY: CLASS VI GRAVEL
PP MVEA SERVICE TRANSFORMER LOC. TBD
PP 4" RAW WATER MAIN

EX EASTONVILLE RD R.O.W./PROPERTY LINE
210.4 S.F.6" TO 9" RIP-RAP
INV = 7052.50
ACCESS POINT N: 23110.4506 E: 19073.3943
L=70.99 R=3233.52 Δ=1°15'00"
40 L.F. 2-14"X23" ERCP W/ FLARED-END SECTIONS
EASTONVILLE RD
ACCESS POINT N: 23075.6514 E: 19069.9724
INV = 7052.30
253.1 S.F.6" TO 9" RIP-RAP
EX EDGE OF GRAVEL
FUTURE EASTONVILLE RD R.O.W.

0' 15' 30'
SCALE 11x17: 1" = 30'
SCALE 24x36: 1" = 15'



LEGEND

	FUTURE R.O.W.
	FUTURE PROPERTY LINE
	FUTURE FIRE HYDRANT
	EX R.O.W.
	EX EASEMENT LINE
RAW	EX RAW WATER LINE
7385	EX CONTOURS-MAJOR
	EX CONTOURS-MINOR
7385	PP CONTOURS-MAJOR
	PP CONTOURS-MINOR
	PP EASEMENT
RAW	PP RAW WATER LINE
UGE	PP UG ELECTRIC LINE
X	PP FENCE (BARBED WIRE CHAIN LINK)
	PP VEHICLE TRAFFIC CIRCULATION PATH

APPLICANT/PLAN PREPARER:
RESPEC
CONTACT: MARIO DIPASQUALE, P.E.: 719-227-0072
mario.dispasquale@respec.com

FENCE CORNERS/GATE	
1	N: 23184.97 E: 18913.61
2	N: 23175.34 E: 18954.60
3	N: 23130.72 E: 18944.03
4	N: 23135.80 E: 18922.71
5	N: 23133.05 E: 18934.39
6	N: 23129.41 E: 18916.33
7	N: 23132.92 E: 18901.38

NOTES:
1. THE PARTIES RESPONSIBLE FOR THIS PLAN HAVE FAMILIARIZED THEMSELVES WITH ALL CURRENT ACCESSIBILITY CRITERIA AND SPECIFICATION AND THE PP PLAN REFLECTS ALL SITE ELEMENTS REQUIRED BY THE APPLICABLE ADA DESIGN STANDARDS AND GUIDELINES AS PUBLISHED BY THE UNITED STATES DEPARTMENT OF JUSTICE. APPROVAL OF THIS PLAN BY EL PASO COUNTY DOES NOT ASSURE COMPLIANCE WITH THE ADA OR ANY OTHER FEDERAL OR STATE ACCESSIBILITY LAWS OR ANY REGULATIONS OR GUIDELINES ENACTED OR PROMULGATED UNDER OR WITH RESPECT TO SUCH LAWS.
2. FEMA 100-YR FLOODPLAIN NOT WITHIN SITE BOUNDARIES.
3. UTILITY LOCATIONS SHOWN ARE APPROXIMATE AND MAY NOT BE ALL INCLUSIVE. CONTRACTOR TO VERIFY.
4. PARKING SPACES NOT INCLUDED, SEE LETTER OF INTENT.

PROPERTY LEGAL DESCRIPTION:
TR IN SW4 OF SEC 16 & S2 OF SEC 17-12-64 LY SLY OF THE TRAILS FIL NO 2B & NO 7 & SLY OF TRACTS CONV BY REC #206097789

EASEMENT LEGAL DESCRIPTION:
PENDING

COM File No. 2333

Colorado Springs, CO
5540 Tech Center Dr., Suite 100
Colorado Springs, CO 80919
Phone: 719.227.0072
www.respec.com

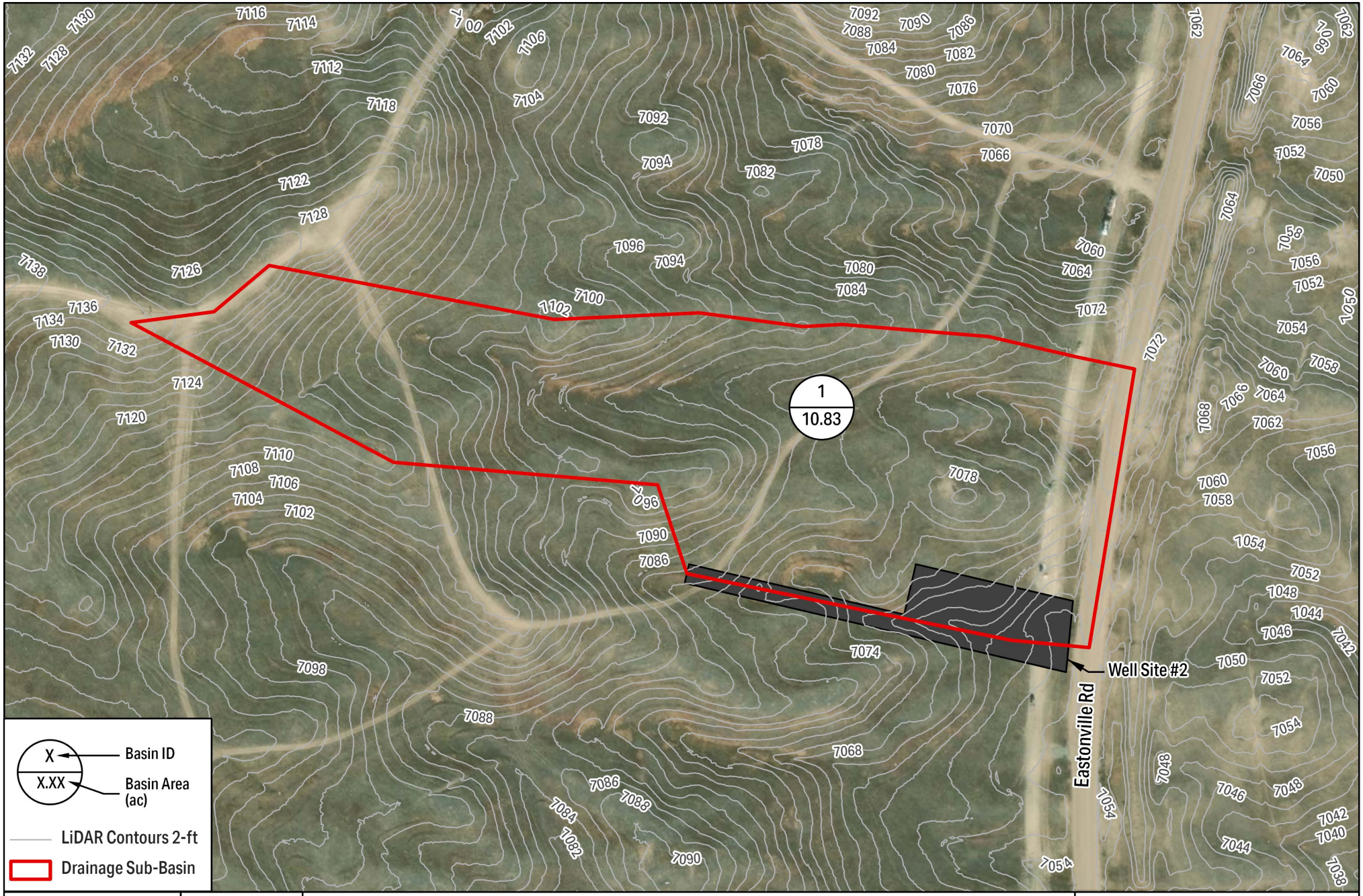
MERIDIAN SERVICE METROPOLITAN DISTRICT
LATIGO WELL SITE #2
SITE DEVELOPMENT PLAN

REVISIONS NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

FOR REVIEW

Proj.#: 15158
Date: 08/01/2023
Design: REN
Drawn: KN
Check: MLD

SHEET C2 ----OF



MERIDIAN SERVICE METROPOLITAN DISTRICT

LATIGO WELL SITE #2

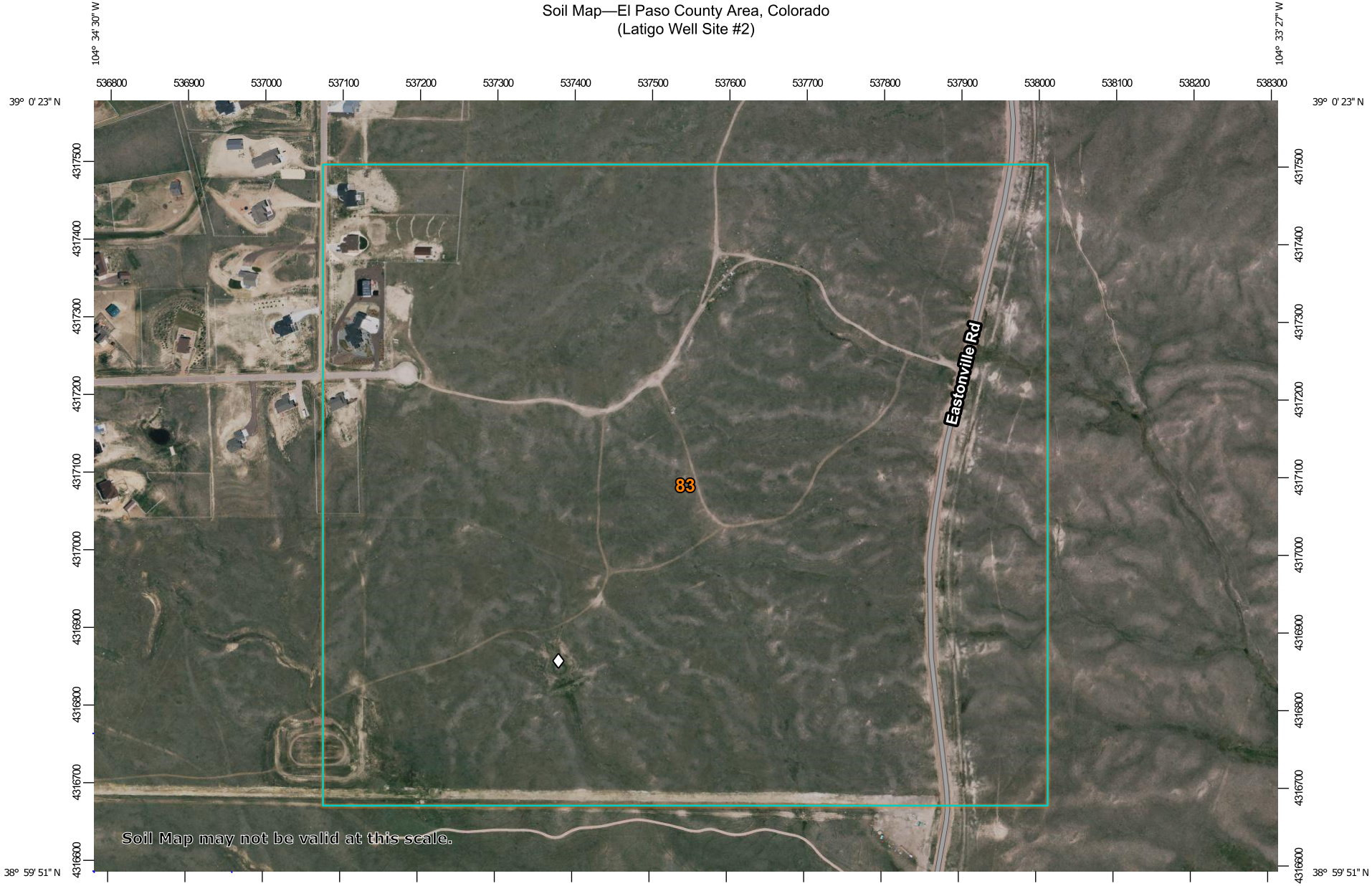
FIGURE 2 - DRAINAGE SUB-BASIN DELINEATION

RESPEC
Colorado Springs, CO
5540 Tech Center Dr., Suite 100
Colorado Springs, CO 80919
Phone: 719.227.0072
www.respec.com

ATTACHMENT B

NRCS WEB SOIL SURVEY REPORTS

Soil Map—El Paso County Area, Colorado
(Latigo Well Site #2)



Map Scale: 1:7,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 300 600 1200 1800

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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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
83	Stapleton sandy loam, 3 to 8 percent slopes	192.0	100.0%
Totals for Area of Interest		**192.0**	**100.0%**

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Report—Physical Soil Properties

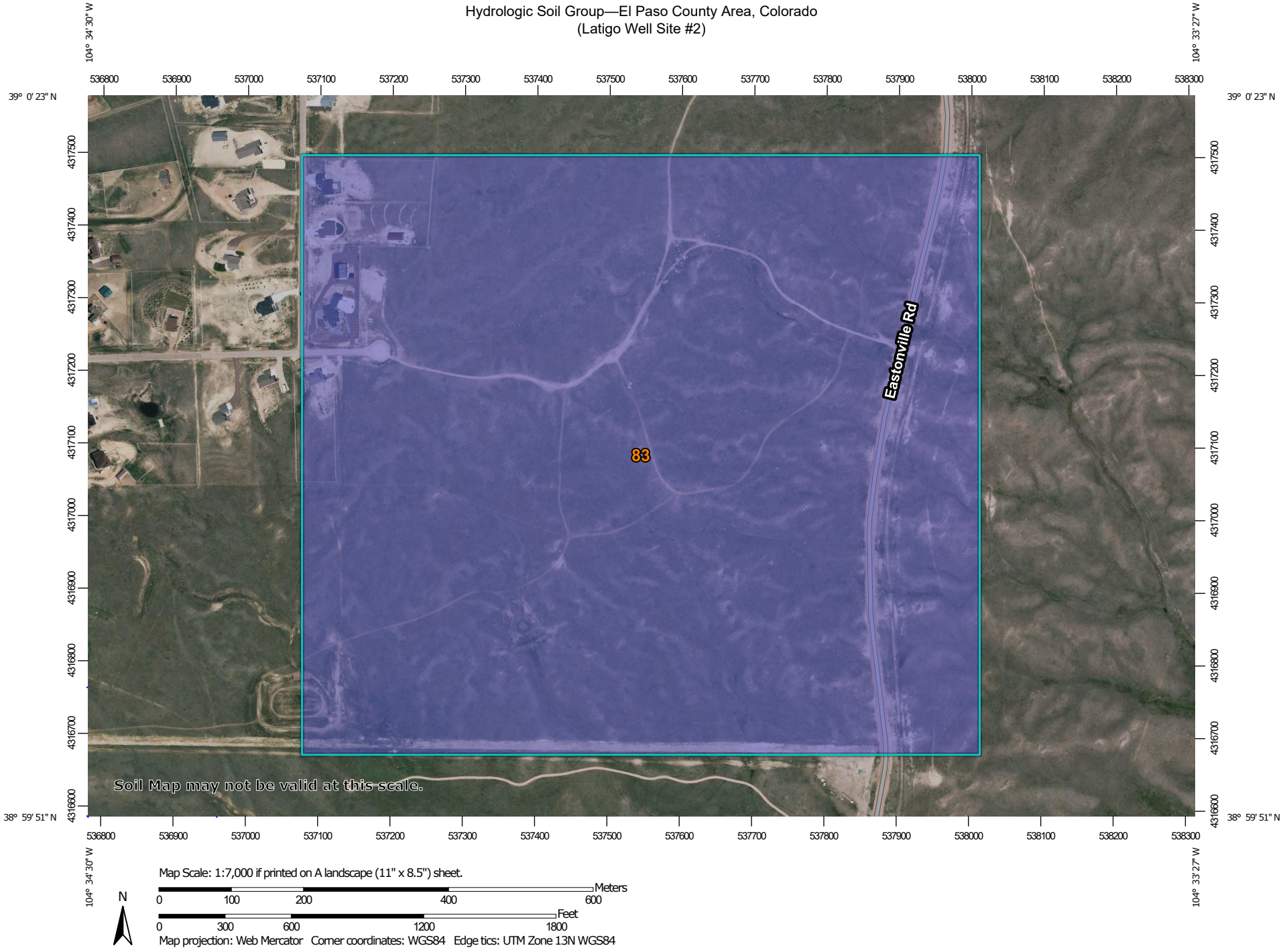
Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–El Paso County Area, Colorado														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
83—Stapleton sandy loam, 3 to 8 percent slopes														
Stapleton	0-11	-66-	-19-	10-15- 20	1.35-1.43 -1.50	14.11-28.00-42. 33	0.09-0.11-0. 13	0.0- 1.5- 2.9	2.0- 3.0- 4.0	.20	.20	2	3	86
	11-17	-67-	-19-	10-14- 18	1.35-1.43 -1.50	14.11-28.00-42. 33	0.07-0.08-0. 09	0.0- 1.5- 2.9	0.5- 1.3- 2.0	.15	.28			
	17-60	-84-	- 9-	5- 8- 10	1.35-1.48 -1.60	42.00-92.00-14 1.00	0.05-0.07-0. 09	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.15	.28			
Fluvaquentic haplaquolls	—	—	—	—	—	—	—	—	—					
Other soils	—	—	—	—	—	—	—	—	—					
Pleasant	—	—	—	—	—	—	—	—	—					

Data Source Information

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

Hydrologic Soil Group—El Paso County Area, Colorado
(Latigo Well Site #2)



Map Scale: 1:7,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 100 200 400 600

Feet
0 300 600 1200 1800

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

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
83	Stapleton sandy loam, 3 to 8 percent slopes	B	192.0	100.0%
Totals for Area of Interest			**192.0**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

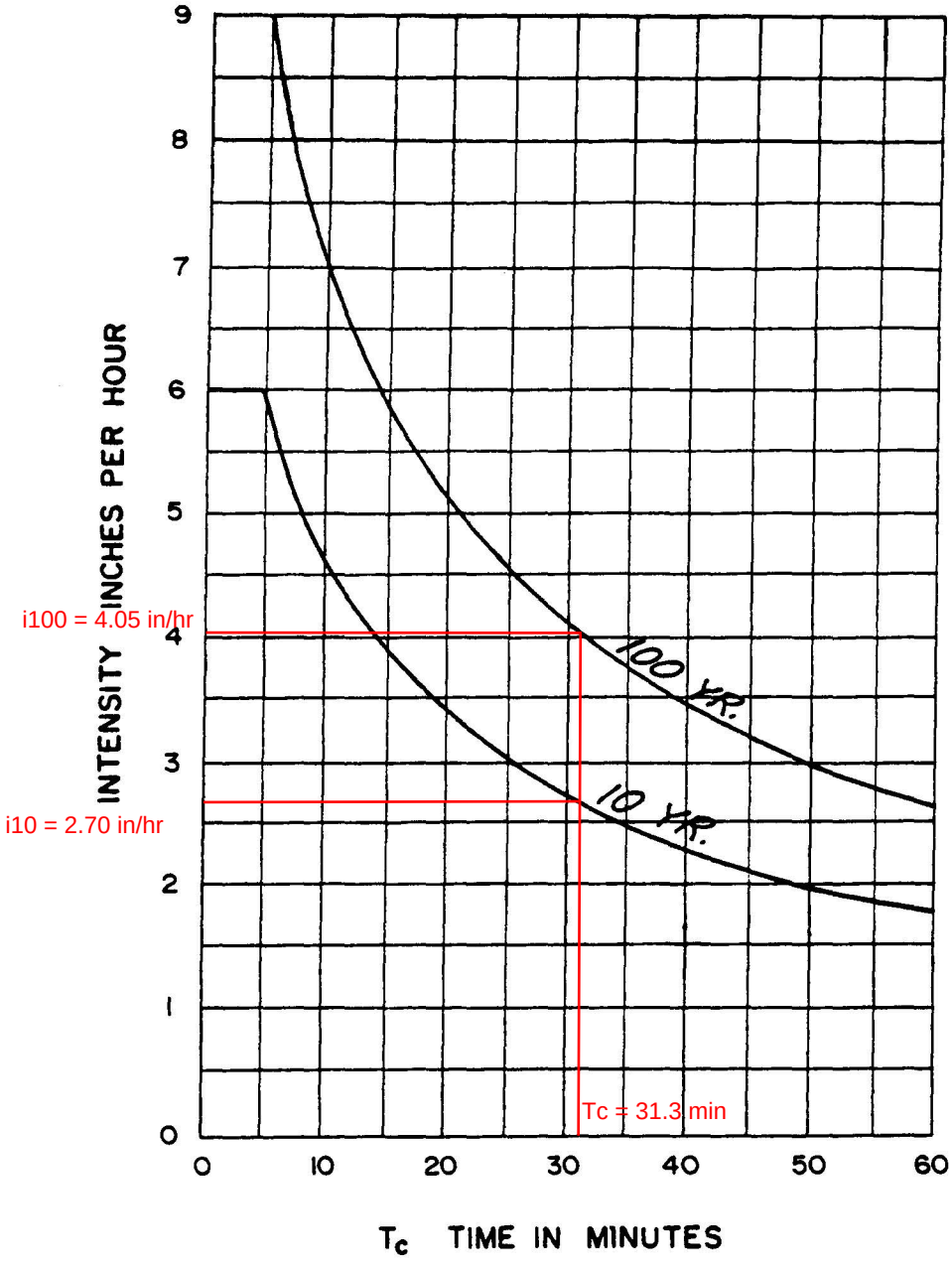
Tie-break Rule: Higher

ATTACHMENT C

EL PASO COUNTY DRAINAGE CRITERIA MANUAL EXCERPTS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY			
		10		100	
		A&B*	C&D*	A&B*	C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
⅛ Acre or less	65	0.60	0.70	0.70	0.80
¼ Acre	40	0.50	0.60	0.60	0.70
⅓ Acre	30	0.40	0.50	0.55	0.60
½ Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY			
		10		100	
		A&B*	C&D*	A&B*	C&D*
Historic Flow Analysis-Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45
*Hydrologic Soil Group					



RE: Based upon Pikes Peak area council of governments/ areawide urban runoff control manual.

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Storm Rainfall
Time Intensity-Frequency Curves

Date
OCT. 1987

Figure
5 - 1

Type of Channel and Description	Minimum	Normal	Maximum
EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033

ATTACHMENT D

HYDROLOGIC AND HYDRAULIC CALCULATIONS

RESPEC

Latigo Well Site #2

Time of Concentration

DATE: 7/13/23

PAGE: 1 / 1

Time of Concentration

Overland Flow

$$T_o = 1.87 (1.1 - C_{100}) L^{0.5} S^{-0.33}$$

$C_{100} = 0.35$

$L = 1000\ ft \rightarrow$ max length for undeveloped areas

$S = 4.3\ \%$

$$T_o = 1.87 (1.1 - 0.35) 1000^{0.5} 4.3^{-0.33} = 27.4\ min$$

Total Flow Path Length = 1819 ft

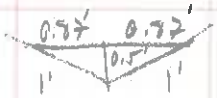
Remaining Flow Path Length = 1819 - 1000 = 819 ft

Assume open channel

$$V = \frac{1.49}{n} r^{2/3} S^{1/2}$$

$n = 0.030$ for grass

$r = \frac{A}{P}$ $\quad A = 0.87' \times 0.5' = 0.44 ft^2$



$P = 2'$

$$r = \frac{0.44}{2} = 0.22$$

$S = 0.043\ ft/ft$

$$V = \frac{1.49}{0.030} (0.22)^{2/3} (0.043)^{1/2} = 3.53\ ft/sec$$

$$T_{channel} = \frac{819\ ft}{3.53\ ft/s} = \frac{232\ sec}{60\ min/sec} = 3.9\ min$$

$$T_c = T_{channel} + T_o = 3.9\ min + 27.4\ min = \boxed{31.3\ min}$$

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 7.31 cfs

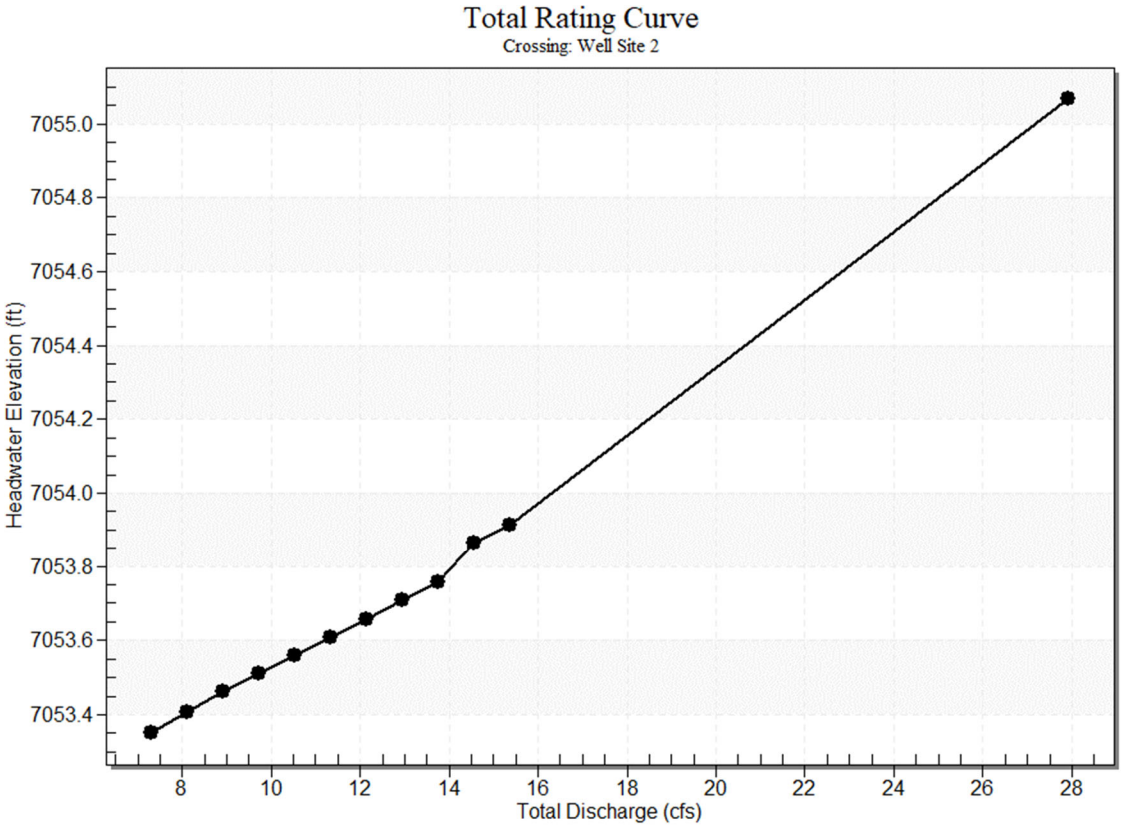
Design Flow: 15.35 cfs

Maximum Flow: 15.35 cfs

Table 1 - Summary of Culvert Flows at Crossing: Well Site 2

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
7053.35	7.31	7.31	0.00	1
7053.41	8.11	8.11	0.00	1
7053.46	8.92	8.92	0.00	1
7053.51	9.72	9.72	0.00	1
7053.56	10.53	10.53	0.00	1
7053.61	11.33	11.33	0.00	1
7053.66	12.13	12.13	0.00	1
7053.71	12.94	12.94	0.00	1
7053.76	13.74	13.74	0.00	1
7053.86	14.55	14.55	0.00	1
7053.91	15.35	15.35	0.00	1
7055.00	25.57	25.57	0.00	Overtopping

Rating Curve Plot for Crossing: Well Site 2



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
7.31 cfs	7.31 cfs	7053.35	0.85	0.679	1-JS1t	0.55	0.60	0.76	0.76	3.01	1.61
8.11 cfs	8.11 cfs	7053.41	0.91	0.737	1-JS1t	0.59	0.63	0.79	0.79	3.20	1.65
8.92 cfs	8.92 cfs	7053.46	0.96	0.797	1-JS1t	0.63	0.66	0.82	0.82	3.38	1.69
9.72 cfs	9.72 cfs	7053.51	1.01	0.858	1-JS1t	0.66	0.70	0.84	0.84	3.56	1.72

10.53 cfs	10.53 cfs	7053.56	1.06	0.921	1-JS1t	0.70	0.73	0.87	0.87	3.74	1.76
11.33 cfs	11.33 cfs	7053.61	1.11	0.985	1-JS1t	0.73	0.76	0.89	0.89	3.91	1.79
12.13 cfs	12.13 cfs	7053.66	1.16	1.051	1-JS1t	0.76	0.79	0.92	0.92	4.08	1.82
12.94 cfs	12.94 cfs	7053.71	1.21	1.119	5-S2n	0.80	0.81	0.80	0.94	5.03	1.85
13.74 cfs	13.74 cfs	7053.76	1.26	1.190	5-S2n	0.83	0.84	0.83	0.96	5.09	1.88
14.55 cfs	14.55 cfs	7053.86	1.31	1.365	7-M1t	0.87	0.87	0.98	0.98	4.58	1.91
15.35 cfs	15.35 cfs	7053.91	1.37	1.412	7-M1t	0.91	0.89	1.00	1.00	4.75	1.93

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

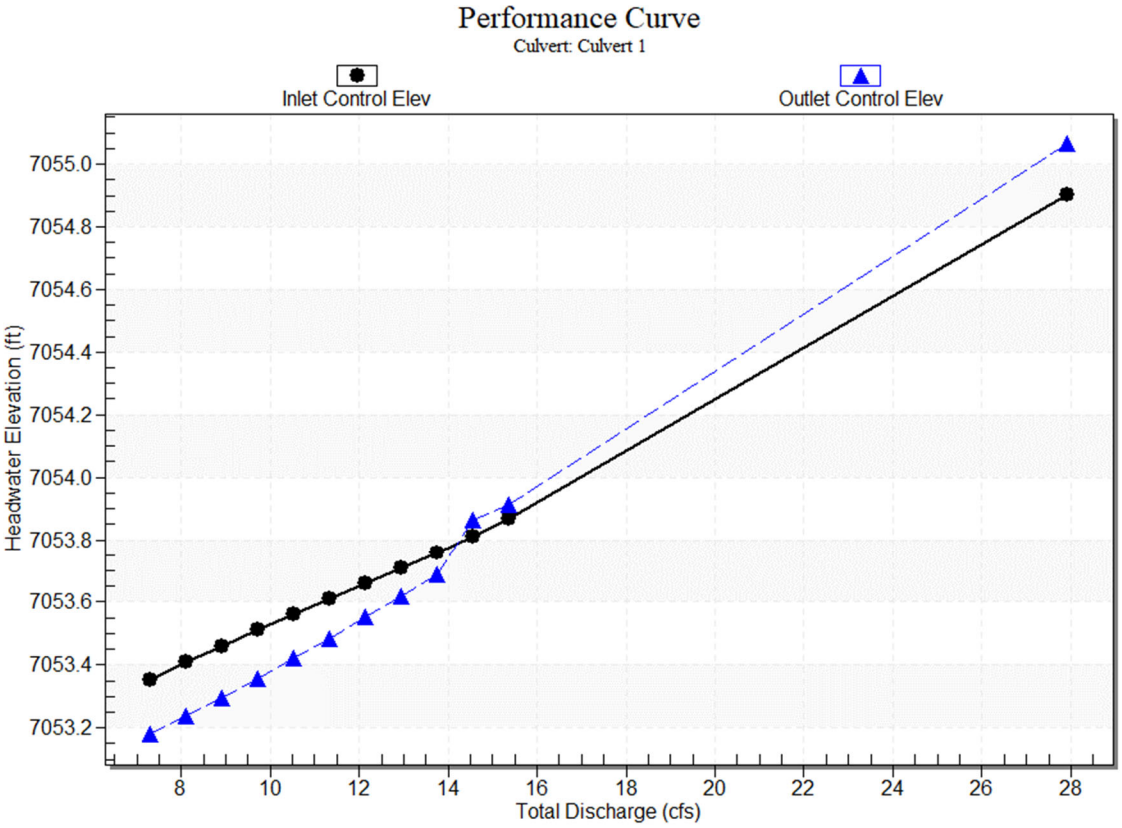
Inlet Elevation (invert): 7052.50 ft,

Outlet Elevation (invert): 7052.30 ft

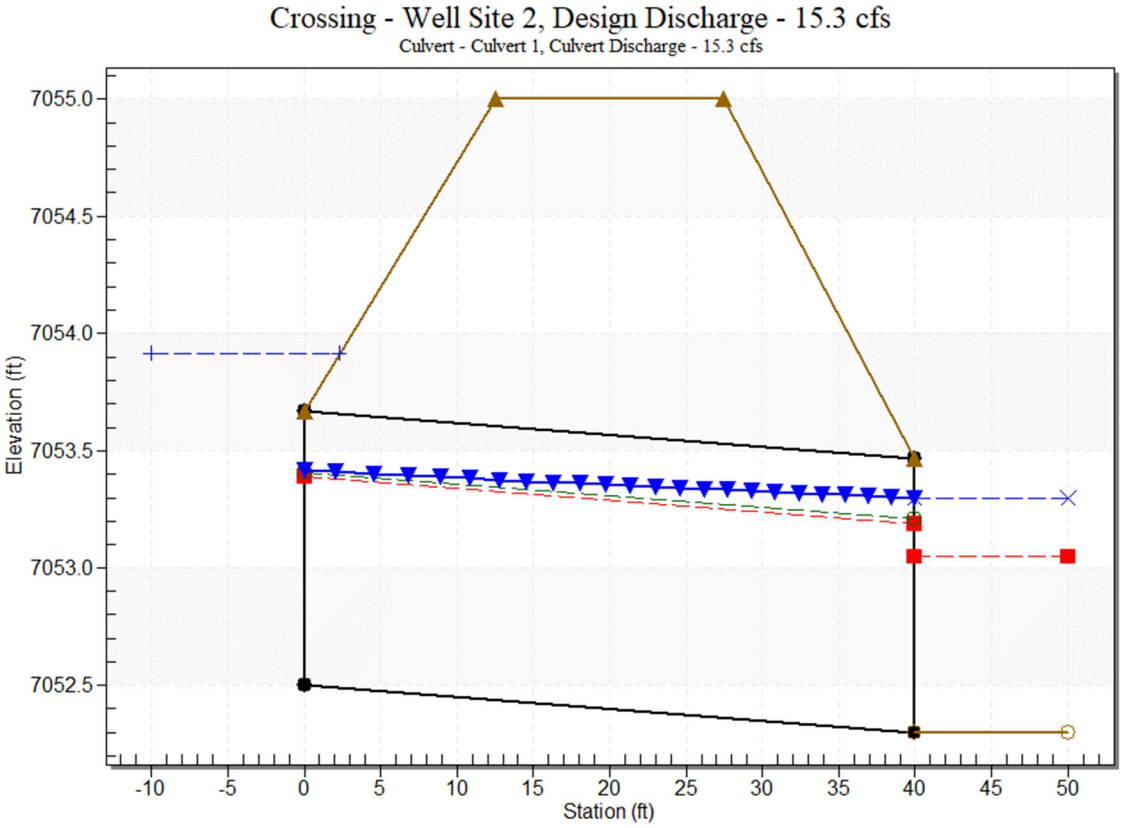
Culvert Length: 40.00 ft,

Culvert Slope: 0.0050

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 7052.50 ft

Outlet Station: 40.00 ft

Outlet Elevation: 7052.30 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 1

Barrel Shape: Elliptical

Barrel Span: 23.00 in

Barrel Rise: 14.00 in

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Grooved Edge Projecting (Ke=0.2)

Inlet Depression: None

Tailwater Data for Crossing: Well Site 2

Table 3 - Downstream Channel Rating Curve (Crossing: Well Site 2)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
7.31	7053.06	0.76	1.61	0.18	0.46
8.11	7053.09	0.79	1.65	0.19	0.46
8.92	7053.12	0.82	1.69	0.20	0.47
9.72	7053.14	0.84	1.72	0.21	0.47
10.53	7053.17	0.87	1.76	0.21	0.47
11.33	7053.19	0.89	1.79	0.22	0.47
12.13	7053.22	0.92	1.82	0.22	0.47
12.94	7053.24	0.94	1.85	0.23	0.48
13.74	7053.26	0.96	1.88	0.23	0.48
14.55	7053.28	0.98	1.91	0.24	0.48
15.35	7053.30	1.00	1.93	0.24	0.48

Tailwater Channel Data - Well Site 2

Tailwater Channel Option: Irregular Channel

Channel Slope: Irregular Channel

User Defined Channel Cross-Section

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	7054.00	0.0300
2	22.00	7052.30	0.0300
3	27.00	7054.00	0.0000

Roadway Data for Crossing: Well Site 2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 7055.00 ft

Roadway Surface: Gravel

Roadway Top Width: 15.00 ft