PRELIMINARY DRAINAGE REPORT
for
WILLOW SPRINGS RANCH
PD Plan

Baptist Road
Monument, Colorado

December 9, 2019

Prepared for:

Polo Brown Company
514 Pike Avenue
Canon City, CO 81212
Contact: Daniel Brown
(303) 999-5533

Prepared by:

Drexel, Barrell & Co.
3 South 7th Street
Colorado Springs, CO 80905
Contact: Tim McConnell, P.E.
(719) 260-0887

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APPENDICES

PRELIMINARY DRAINAGE REPORT
for
WILLOW SPRINGS RANCH

1.0 DRAINAGE PLAN STATEMENTS

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 Town/City/County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by negligent acts, errors, or omissions on my part in preparing this report.

_____ _____
Tim D. McConnell, P.E. #33797 Date
For and on behalf of Drexel, Barrell & Co.

DEVELOPER'S STATEMENT

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

Polo Brown Company

By: _____ _____
Daniel Brown Date

TITLE: Managing Member

ADDRESS: 514 Pike Avenue
Canon City, CO 81212

TOWN OF MONUMENT
Filed in accordance with Section 17.45 of the Zoning Ordinance for the Town of Monument, and Section 16.12.060 of the Subdivision Code for the Town of Monument, revised February, 2007.

_____ _____
Director of Development Services Date

CONDITIONS:

PRELIMINARY DRAINAGE REPORT
for
WILLOW SPRINGS RANCH

2.0 PURPOSE

The purpose of this Preliminary Drainage Report is to identify the existing and proposed runoff patterns and drainage facilities required for Willow Springs Ranch, and to present the ability to safely pass developed runoff to historic downstream facilities.

3.0 GENERAL SITE DESCRIPTION

Location

Willow Springs Ranch is currently located in El Paso County, Colorado, within portions of the Southeast Quarter of Section 22, the West Half of Section 26 and the East Half of Section 27, Township 11 South, Range 67 West of the 6th P.M., northeast of Baptist Road and Forest Lakes Drive. The property is currently in the Town of Monument.

Proposed Development

Willow Springs Ranch is approximately 219 acres in size that straddles portions of both sides of Monument and Teachout Creeks. The development is proposed to consist of approximately 400 single-family and/or attached single-family residential units, numerous open space tracts, roads, parks, detention facilities and other improvements. Several barns and outbuildings currently occupy portions of the northern half of the property that will be removed as the development progresses. Prebles Meadow Jumping Mouse habitat covers much of the site along the stream corridor. The habitat will be left mostly intact, with some minor development in areas and enhancement in others.

Soils

According to the Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the following soils are found on the project site:

Soil	Hydrologic Soil Group	Percent of site
Tomah-Crowfoot loamy sands	B	56.9%
Pring coarse sandy loam	B	31.1%
Jarre-Tecolote complex	B	6.8%
Alamosa loam	D	1.9%
Ustic Torrifluvents	B	1.8%
Tomah-Crowfoot complex	B	1.5%

Runoff coefficients corresponding to groups A and B were used for the purposes of the site drainage analysis. See appendix for Soils map.

Climate

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation ranges from 12 to 14 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panels 08041CO278G and 08041CO286G (December 7, 2018, portions of the site lie within the designated 100-year floodplain along Monument Creek and Teachout Creek. No residential development is proposed within the existing 100-year floodplain.

4.0 DRAINAGE CRITERIA

The drainage analysis has been prepared in accordance with the current City of Colorado Springs Drainage Criteria Manual. Calculations were performed to determine runoff quantities during the 5 year and 100 year frequency storms for historic and developed conditions using the Rational Method as required for basins containing less than 100 acres.

In addition, Inlet Capacity Charts from the City of Colorado Springs Drainage Criteria Manual, and the following Urban Drainage and Flood Control District (UDFCD) provided spreadsheets, UD-BMP v.3.05 IRF and UD-Detention v3.07 were used for design of the detention facilities and associated storm sewer infrastructure.

Hydraulic grade line calculations utilizing UD-Sewer 2009 1.4.0 are included in the appendix. Plan and profiles of the storm system depicting the HGL will be provided at the construction document stage.

5.0 EXISTING CONDITIONS

The existing terrain generally slopes from north to south at grades of approximately 1% to 10%+ in its current condition. Native and non-native grasses and vegetation cover the area to be developed. Cottonwood trees, willows and other riparian vegetation line many of the creek bottom areas.

The Rational Method was used to determine existing conditions runoff quantities for the 5- and 100-year storm recurrence intervals.

Rational Method Runoff Summary

BASIN	AREA (AC)	% IMPERV	Q5 (cfs)	Q100 (cfs)
1	0.85	0%	0.4	2.1

2	1.70	0%	1.2	6.5
3	1.25	0%	0.8	4.2
4	17.98	0%	7.7	43.1
5	48.66	1%	17.3	94.1
6	10.24	4%	4.7	23.1
7	0.61	0%	0.4	2.1
8	18.77	0%	8.3	46.6
9	21.21	0%	8.4	46.9
10	11.71	0%	7.4	41.5
11	15.08	0%	8.1	45.3
12	37.83	0%	18.4	102.9
13	0.41	0%	0.3	1.7
14	6.03	0%	2.8	15.8
15	26.67	0%	11.2	62.7
OS1	0.75	8%	0.5	2.1
OS2	9.55	0%	4.6	25.7
OS3	2.81	53%	7.4	17.1
OS4	9.31	52%	19.9	46.2

6.0 DEVELOPED CONDITIONS

Grading of the site for the developed condition was designed to minimize import/export for the site and producing a cost effective drainage system while maintaining native areas as much as possible. Only minor offsite flows contribute to the on-site basins. See Proposed Drainage Conditions Map in the appendix.

The Rational Method was used to determine proposed conditions runoff quantities for the 5- and 100-year storm recurrence intervals.

Rational Method Runoff Summary

BASIN	AREA (AC)	% IMPERV	Q5 (cfs)	Q100 (cfs)
1	1.00	0%	0.5	2.9
2	2.42	42%	4.2	11.3
3	1.21	65%	2.5	5.5
4	3.61	65%	6.4	14.4
5	4.10	65%	7.3	16.2
6	3.61	65%	7.3	16.2
7	3.12	65%	6.3	14.1
8	2.86	65%	5.7	12.6

9	2.86	65%	5.8	13.0
10	4.82	47%	7.5	19.6
11	4.13	65%	8.3	18.5
12	3.52	65%	7.4	16.6
13	3.67	65%	7.6	16.8
OS1	0.75	8%	0.5	2.1
14	1.91	65%	3.4	7.6
15	3.80	65%	7.2	16.0
16	3.21	65%	7.0	15.7
17	1.69	65%	3.5	7.7
18	2.72	65%	6.5	14.5
19	0.60	65%	1.3	2.9
20	2.33	65%	4.8	10.7
21	2.66	65%	5.6	12.6
OS2	9.55	0%	4.6	25.7
22	6.33	52%	10.4	25.8
23	3.30	65%	7.6	16.9
24	2.43	65%	5.0	11.2
25	5.53	65%	12.2	27.3
26	2.36	65%	4.8	10.7
27	11.28	42%	14.5	39.2
28	0.91	100%	4.2	7.5

7.0 WATER QUALITY DETENTION FACILITIES

Water Quality Detention Facility No. 1 (North)

Water Quality/Detention Facility No. 1 (North) is proposed to be a private full-spectrum Extended Detention Basin (EDB). UD-Detention v3.07 calculations are provided in the appendix. Based on a watershed area of 57.18 acres, with an effective site imperviousness of 62.7%, the required pond volume for 100-yr detention (including WQCV and EURV) is 6.32 acre-ft.

Water Quality Detention Facility No. 2 (West)

Water Quality/Detention Facility No. 2 (West) is proposed to be a private full-spectrum Extended Detention Basin (EDB). UD-Detention v3.07 calculations are provided in the appendix. Based on a watershed area of 21.61 acres, with an effective site imperviousness of 32.5%, the required pond volume for 100-yr detention (including WQCV and EURV) is 1.50 acre-ft.

Water Quality Detention Facility No. 3 (Sorth)

Water Quality/Detention Facility No. 3 (South) is proposed to be a private full-spectrum Extended Detention Basin (EDB). UD-Detention v3.07 calculations are provided in the appendix. Based on a watershed area of 20.08 acres, with an effective site imperviousness of 59.3%, the required pond volume for 100-yr detention (including WQCV and EURV) is 1.98 acre-ft.

The forebay, dissipator, trickle channel, spillway and outlet structure with micropool for each pond will be designed with the final drainage report and plat prepared for each filing. The pond will release the 100-year flow at 90% of the pre-developed 100-year runoff rate and the WQCV in 40 hours, in accordance with drainage criteria. The ponds will be owned and maintained by the Willow Springs Metropolitan District.

8.0 DRAINAGE FEES

Willow Springs Ranch is located within the Teachout Creek, Monument Rock and Beaver Creek drainage basins. The drainage fees established for platting property within this basin as of December 2019 are as follows:

Teachout Creek:	$5,044 per impervious acre
Monument Rock:	$7,953 per impervious acre
Beaver Creek:	$10,970 per impervious acre

Fees will be due at building permit, based upon the final drainage report and plat prepared for each filing. Reimbursements for on-site detention facilities will also be determined at the time of final drainage report and plat preparation for each filing as allowed by Town code.

9.0 CONSTRUCTION COST ESTIMATE

Detailed construction cost estimates will be prepared at the time of final drainage report and plat preparation for each filing within the development.

10.0 SUMMARY

The findings of this report are in general conformance with the City of Colorado Springs/El Paso County DCM Volumes 1 & 2, and as such, all site runoff, storm drains and appurtenances proposed by the development of Willow Springs Ranch will not adversely affect the surrounding or downstream developments. The proposed drainage system will safely route developed flows to the proposed on-site full-spectrum water quality/detention facilities where flows will be released at or below historical rates.

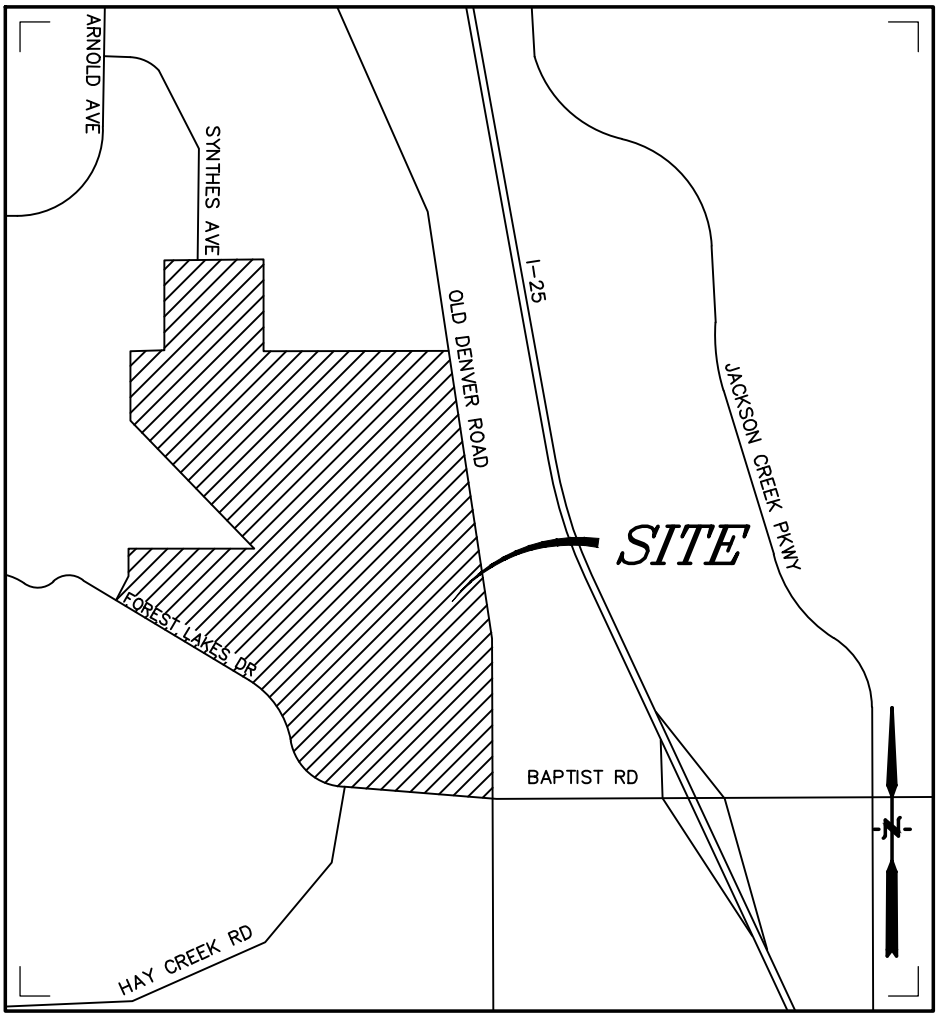
11.0 REFERENCES

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs Drainage Criteria Manual Volumes 1 & 2, May 2014 as amended.

2. Urban Storm Drainage Criteria Manuals, Urban Drainage and Flood Control District. June 2001, Revised April 2008.

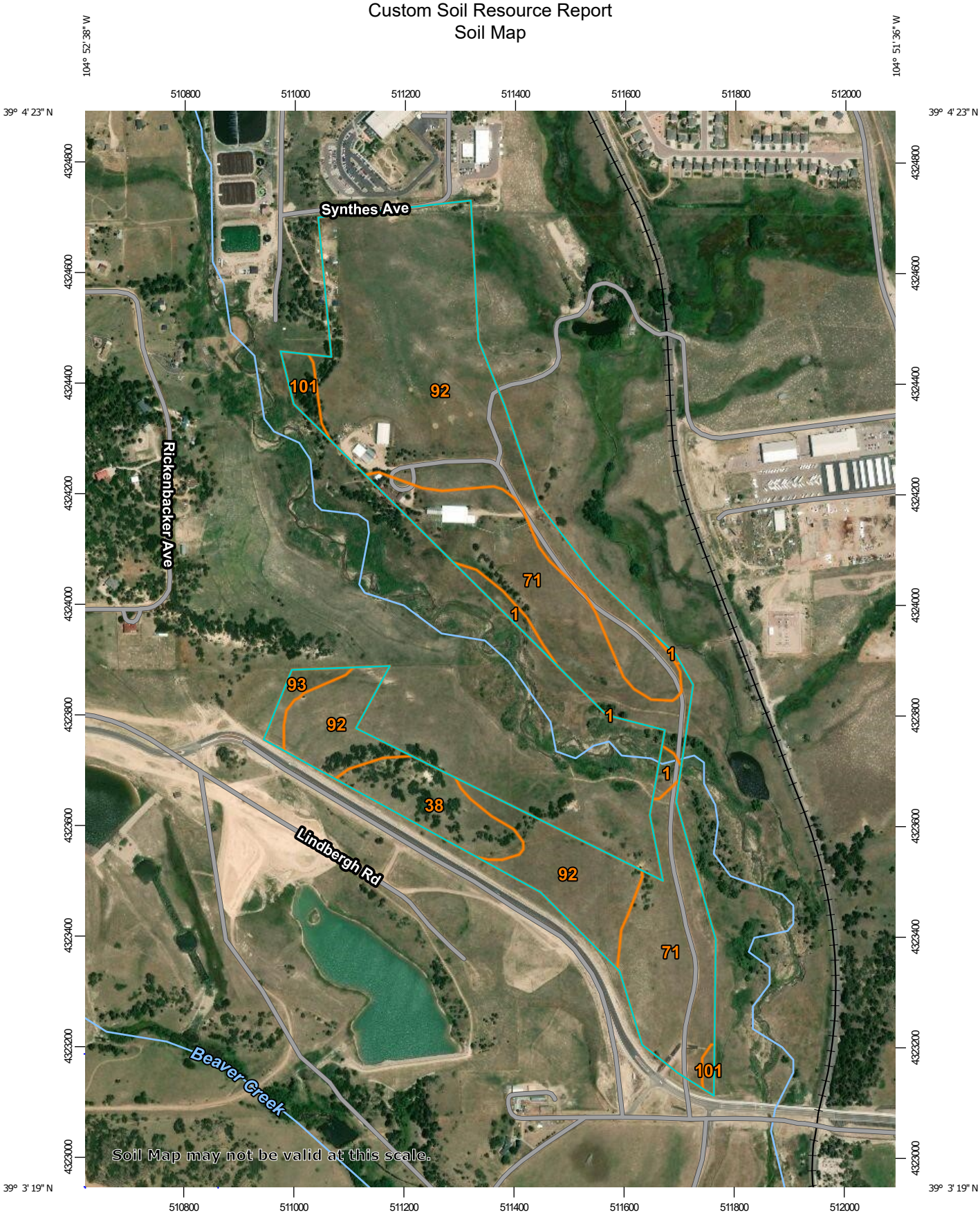
APPENDIX



Vicinity Map
Not to scale

	WILLOW SPRINGS RANCH MONUMENT, CO VICINITY MAP	Drexel, Barrell & Co. Engineers • Surveyors
		DATE:
		JOB NO: 20876-05CSCV
		DWG. NO. VMAP
		SHEET 1 OF 1

Custom Soil Resource Report
Soil Map



Map Scale: 1:9,490 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 450 900 1800 2700

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 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Jul 4, 2010—Oct 16, 2017

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
1	Alamosa loam, 1 to 3 percent slopes	1.9	1.9%
38	Jarre-Tecolote complex, 8 to 65 percent slopes	7.1	6.8%
71	Pring coarse sandy loam, 3 to 8 percent slopes	32.2	31.1%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	58.8	56.9%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	1.5	1.5%
101	Ustic Torrifluvents, loamy	1.9	1.8%
Totals for Area of Interest		**103.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it

was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

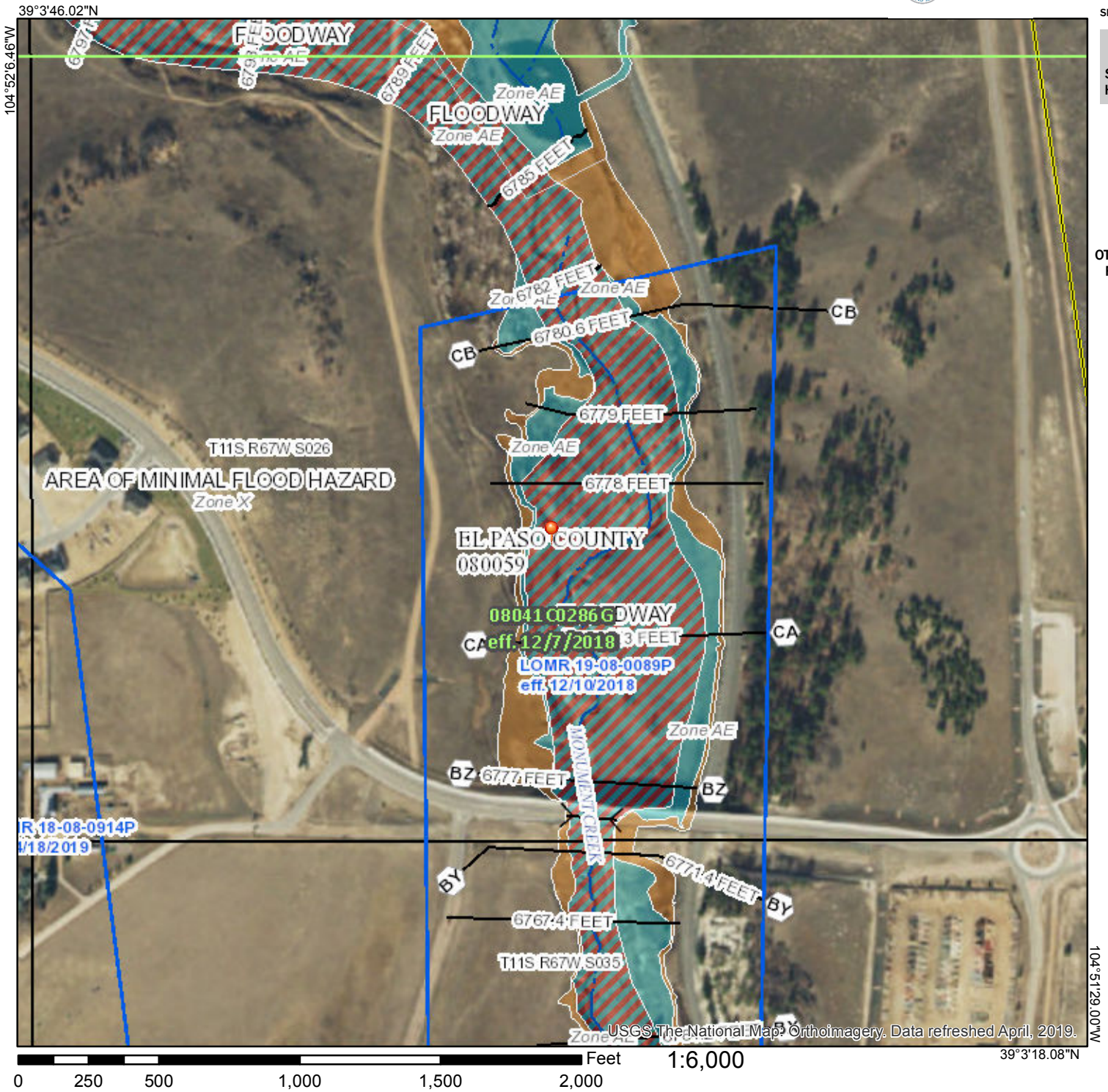
An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

National Flood Hazard Layer FIRMette

FEMA



Feet 1:6,000

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

Legend

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

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

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

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

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

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

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

N

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

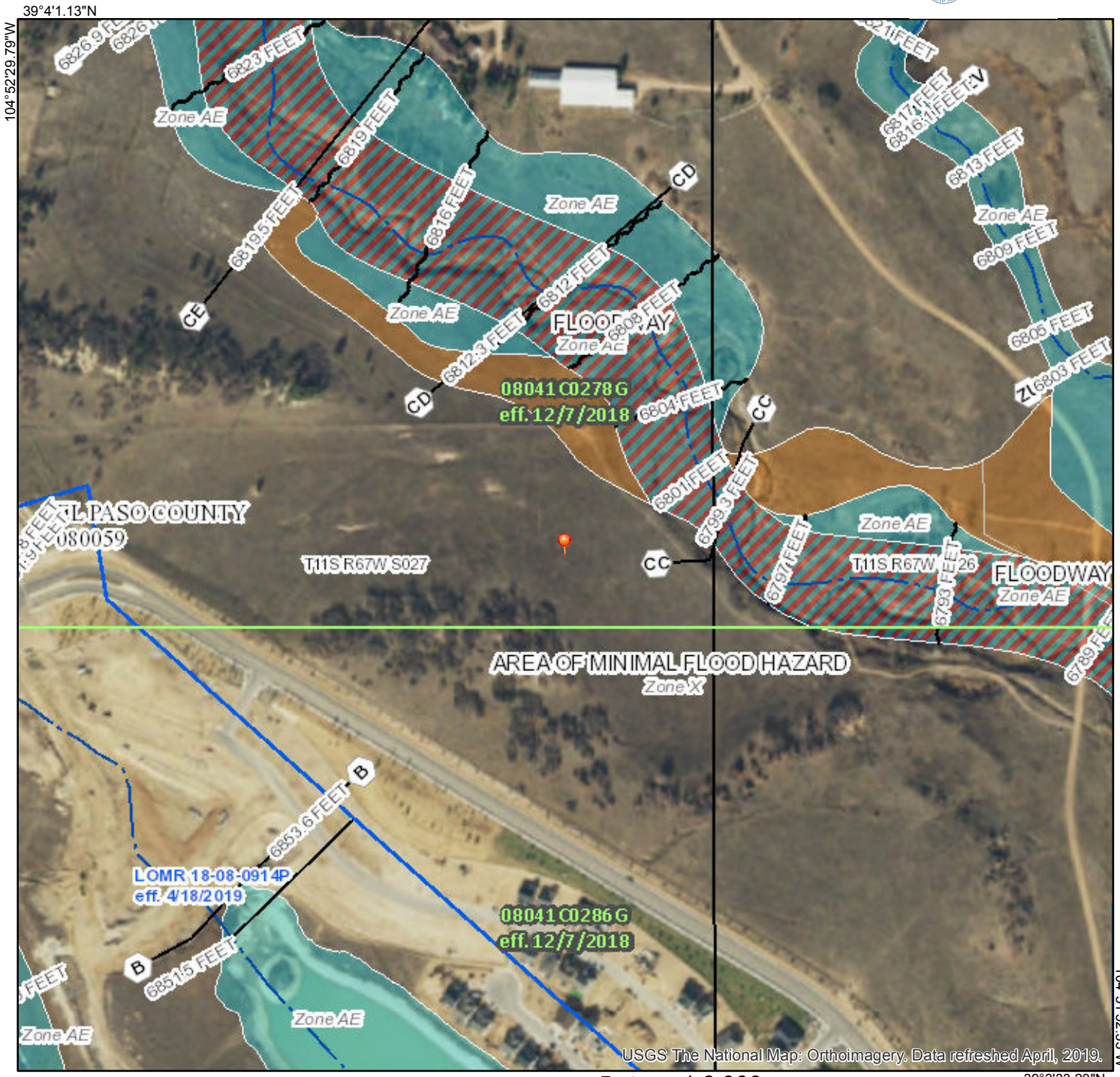
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/15/2019 at 10:03:08 AM 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.

National Flood Hazard Layer FIRMette

FEMA



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

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The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/15/2019 at 10:04:30 AM 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.

National Flood Hazard Layer FIRMette

FEMA

39°4'21.48"N

104°52'38.60"W

104°52'1.15"W

39°3'53.54"N

Feet 1:6,000

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

Legend

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

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The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/29/2019 at 3:25:05 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.

PROJECT INFORMATION							
PROJECT:	Willow Springs Ranch						
PROJECT NO:	20876-05						
DESIGN BY:	SBN					Drexel, Barrell & Co.	
REV. BY:	TDM						
AGENCY:	Town of Monument						
REPORT TYPE:	Final						
DATE:	12/9/2019						
Soil Type: B							
			C2*	C5*	C10*	C100*	% IMPERV
Pasture/Meadow				0.15		0.50	0
Roofs				0.73		0.81	90
1/8 ac residential				0.49		0.65	65
Asphalt/Sidewalk				0.90		0.96	100
*C-Values and Basin Imperviousness based on Table 5-1, City of Colorado Springs and El Paso County "Drainage Criteria Manual"							
EXISTING							
SUB-BASIN	SURFACE DESIGNATION	AREA	COMPOSITE RUNOFF COEFFICIENTS				% IMPERV
		ACRE	**C2**	**C5**	**C10**	**C100**	
1	Pasture/Meadow	0.85		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 1		0.85					
2	Pasture/Meadow	1.70		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 2		1.70					
3	Pasture/Meadow	1.25		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 3		1.25					
4	Pasture/Meadow	17.98		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 4		17.98					
5	Pasture/Meadow	48.20		0.15		0.50	0
	Roofs	0.46		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.16		0.50	1%
TOTAL 5		48.66					
6	Pasture/Meadow	9.78		0.15		0.50	0
	Roofs	0.46		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.18		0.51	4%
TOTAL 6		10.24					
7	Pasture/Meadow	0.61		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 7		0.61					
8	Pasture/Meadow	18.77		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 8		18.77					
9	Pasture/Meadow	21.21		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 9		21.21					

10	Pasture/Meadow	11.71		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 10		11.71					
11	Pasture/Meadow	15.08		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 11		15.08					
12	Pasture/Meadow	37.83		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 12		37.83					
13	Pasture/Meadow	0.41		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 13		0.41					
14	Pasture/Meadow	6.03		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 14		6.03					
15	Pasture/Meadow	26.67		0.15		0.50	0
	Roofs	0.00		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 15		26.67					
OS1	Pasture/Meadow	0.68		0.15		0.50	0
	Roofs	0.07		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.20		0.53	8%
TOTAL OS1		0.75					
OS2	Pasture/Meadow	9.52		0.15		0.50	0
	Roofs	0.03		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL OS2		9.55					
OS3	Pasture/Meadow	1.27		0.15		0.50	0
	Roofs	0.50		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	1.04		0.90		0.96	100
	WEIGHTED AVERAGE			0.53		0.73	53%
TOTAL OS3		2.81					
OS4	Pasture/Meadow	4.33		0.15		0.50	0
	Roofs	1.65		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	3.33		0.90		0.96	100
	WEIGHTED AVERAGE			0.52		0.72	52%
TOTAL OS4		9.31					
TOTAL SITE		241.42		0.17		0.51	3.0%

PROJECT INFORMATION

PROJECT:	Willow Springs Ranch
PROJECT NO:	20876-05
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	Town of Monument
REPORT TYPE:	Final
DATE:	12/9/2019

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

EXISTING TIME OF CONCENTRATION STANDARD FORM SF-2

SUB-BASIN DATA					INITIAL/OVERLAND TIME (t_i)				TRAVEL TIME (t_t)					TIME OF CONC. t_c		FINAL t_c
BASIN	DESIGN PT:	C_5	C_{100}	AREA	LENGTH	HT	SLOPE	t_i	LENGTH	HT	SLOPE	VEL.	t_t	COMP.	MINIMUM	
				Ac	Ft	FT	%	Min	Ft	FT	%	FPS	Min	t_c	t_c	Min
1		0.15	0.50	0.85	280	10	3.6	19.4	325	4	1.2	3.4	1.6	21.0	5	21.0
2		0.15	0.50	1.70	55	6	10.9	5.9	640	28	4.4	6.5	1.6	7.6	5	7.6
3		0.15	0.50	1.25	50	1	2.0	10.0	265	17	6.4	7.8	0.6	10.5	5	10.5
4		0.15	0.50	17.98	300	13	4.3	18.9	1000	26	2.6	5.0	3.3	22.2	5	22.2
5		0.16	0.50	48.66	300	5	1.7	25.8	2420	77	3.2	5.6	7.3	33.1	5	33.1
6		0.18	0.51	10.24	300	5	1.7	25.2	590	56	9.5	9.56	1.0	26.3	5	26.3
7		0.15	0.50	0.61	115	9	7.8	9.6						9.6	5	9.6
8		0.15	0.50	18.77	200	4	2.0	19.9	385	24	6.2	7.73	0.8	20.8	5	20.8
9		0.15	0.50	21.21	300	6	2.0	24.4	610	32	5.2	7.07	1.4	25.9	5	25.9
10		0.15	0.50	11.71	150	27	18.0	8.3	385	18	4.7	6.73	1.0	9.3	5	9.3
11		0.15	0.50	15.08	300	41	13.7	12.9	485	28	5.8	7.47	1.1	14.0	5	14.0
12		0.15	0.50	37.83	300	29	9.7	14.4	1205	61	5.1	7.01	2.9	17.3	5	17.3
13		0.15	0.50	0.41	65	14	21.5	5.1						5.1	5	5.1
14		0.15	0.50	6.03	300	15	5.0	18.0	290	13	4.5	6.58	0.7	18.7	5	18.7
15		0.15	0.50	26.67	300	13	4.3	18.9	1730	85	4.9	6.87	4.2	23.1	5	23.1
OS-1		0.20	0.53	0.75	105	1	1.0	17.4						17.4	5	17.4
OS-2		0.15	0.50	9.55	300	21	7.0	16.1	810	57	7.0	8.21	1.6	17.7	5	17.7
OS-3		0.53	0.73	2.81	40	1	2.5	5.0	375	15	4.0	11.70	0.5	5.5	5	5.5
OS-4		0.52	0.72	9.31	150	5	3.3	8.9	620	16	2.6	9.43	1.1	10.0	5	10.0

PROJECT INFORMATION

PROJECT:	Willow Springs Ranch
PROJECT NO:	20876-05
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	Town of Monument
REPORT TYPE:	Final
DATE:	12/9/2019

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

EXISTING RUNOFF 5 YR STORM P1= **1.50**

			DIRECT RUNOFF				
BASIN (S)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
1		0.85	0.15	21.0	0.13	2.94	0.4
2		1.70	0.15	7.6	0.26	4.52	1.2
3		1.25	0.15	10.5	0.19	4.02	0.8
4		17.98	0.15	22.2	2.70	2.86	7.7
5		48.66	0.16	33.1	7.57	2.29	17.3
6		10.24	0.18	26.3	1.80	2.61	4.7
7		0.61	0.15	9.6	0.09	4.17	0.4
8		18.77	0.15	20.8	2.82	2.96	8.3
9		21.21	0.15	25.9	3.18	2.63	8.4
10		11.71	0.15	9.3	1.76	4.22	7.4
11		15.08	0.15	14.0	2.26	3.58	8.1
12		37.83	0.15	17.3	5.67	3.24	18.4
13		0.41	0.15	5.1	0.06	5.07	0.3
14		6.03	0.15	18.7	0.90	3.12	2.8
15		26.67	0.15	23.1	4.00	2.80	11.2
OS1		0.75	0.20	17.4	0.15	3.22	0.5
OS2		9.55	0.15	17.7	1.45	3.20	4.6
OS3		2.81	0.53	5.5	1.49	4.98	7.4
OS4		9.31	0.52	10.0	4.85	4.11	19.9

PROJECT INFORMATION

PROJECT:	Willow Springs Ranch
PROJECT NO:	20876-05
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	Town of Monument
REPORT TYPE:	Final
DATE:	12/9/2019

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

EXISTING RUNOFF 100 YR STORM P1= **2.52**

			DIRECT RUNOFF				
BASIN (S)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
1		0.85	0.50	21.0	0.43	4.93	2.1
2		1.70	0.50	7.6	0.85	7.60	6.5
3		1.25	0.50	10.5	0.63	6.76	4.2
4		17.98	0.50	22.2	8.99	4.80	43.1
5		48.66	0.50	33.1	24.47	3.85	94.1
6		10.24	0.51	26.3	5.26	4.38	23.1
7		0.61	0.50	9.6	0.31	7.00	2.1
8		18.77	0.50	20.8	9.39	4.97	46.6
9		21.21	0.50	25.9	10.61	4.42	46.9
10		11.71	0.50	9.3	5.86	7.09	41.5
11		15.08	0.50	14.0	7.54	6.01	45.3
12		37.83	0.50	17.3	18.92	5.44	102.9
13		0.41	0.50	5.1	0.21	8.51	1.7
14		6.03	0.50	18.7	3.02	5.23	15.8
15		26.67	0.50	23.1	13.34	4.70	62.7
OS1		0.75	0.53	17.4	0.40	5.42	2.1
OS2		9.55	0.50	17.7	4.78	5.38	25.7
OS3		2.81	0.73	5.5	2.04	8.37	17.1
OS4		9.31	0.72	10.0	6.70	6.90	46.2

PROJECT INFORMATION

PROJECT:	Willow Springs Ranch
PROJECT NO:	20876-05
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	Town of Monument
REPORT TYPE:	Final
DATE:	12/9/2019
Soil Type: B	

Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Pasture/Meadow		0.15		0.50	0
1/8 ac residential		0.49		0.65	65
Asphalt/Sidewalk		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 5-1, City of Colorado Springs and El Paso County "Drainage Criteria Manual"

PROPOSED

SUB-BASIN	SURFACE DESIGNATION	AREA	COMPOSITE RUNOFF COEFFICIENTS				% IMPERV
		ACRE	**C2**	**C5**	**C10**	**C100**	
1	Pasture/Meadow	1.00		0.15		0.50	0
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL 1		1.00					
2	Pasture/Meadow	0.85		0.15		0.50	0
	1/8 ac residential	1.57		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.37		0.60	42%
TOTAL 2		2.42					
3	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	1.21		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 3		1.21					
4	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	3.61		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 4		3.61					
5	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	4.10		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 5		4.10					
6	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	3.61		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 6		3.61					
7	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	3.12		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 7		3.12					
8	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	2.86		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 8		2.86					
9	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	2.86		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 9		2.86					

10	Pasture/Meadow	1.36		0.15		0.50	0
	1/8 ac residential	3.46		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.39		0.61	47%
TOTAL 10		4.82					
11	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	4.13		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 11		4.13					
12	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	3.52		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 12		3.52					
13	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	3.67		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 13		3.67					
OS1	Pasture/Meadow	0.68		0.15		0.50	0
	Roofs	0.07		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.20		0.53	8%
TOTAL OS1		0.75					
14	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	1.91		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 14		1.91					
15	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	3.80		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 15		3.80					
16	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	3.21		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 16		3.21					
17	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	1.69		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 17		1.69					
18	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	2.72		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 18		2.72					

19	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	0.60		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 19		0.60					
20	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	2.33		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 20		2.33					
21	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	2.66		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 21		2.66					
OS2	Pasture/Meadow	9.52		0.15		0.50	0
	Roofs	0.03		0.73		0.81	90
	1/8 ac residential	0.00		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL OS2		9.55					
22	Pasture/Meadow	1.31		0.15		0.50	0
	1/8 ac residential	5.02		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.42		0.62	52%
TOTAL 22		6.33					
23	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	3.30		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 23		3.30					
24	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	2.43		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 24		2.43					
25	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	5.53		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 25		5.53					
26	Pasture/Meadow	0.00		0.15		0.50	0
	1/8 ac residential	2.36		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.49		0.65	65%
TOTAL 26		2.36					
27	Pasture/Meadow	3.93		0.15		0.50	0
	1/8 ac residential	7.35		0.49		0.65	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.37		0.60	42%
TOTAL 27		11.28					

28	Pasture/Meadow		0.00		0.15		0.50	0
	1/8 ac residential		0.00		0.49		0.65	65
	Asphalt/Sidewalk		0.91		0.90		0.96	100
	WEIGHTED AVERAGE				0.90		0.96	100%
TOTAL 28			0.91					
TOTAL SITE			102.29		0.43		0.63	53.5%

PROJECT INFORMATION

PROJECT:	Willow Springs Ranch
PROJECT NO:	20876-05
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	Town of Monument
REPORT TYPE:	Final
DATE:	12/9/2019

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

PROPOSED TIME OF CONCENTRATION STANDARD FORM SF-2

SUB-BASIN DATA					INITIAL/OVERLAND TIME (t_i)				TRAVEL TIME (t_t)					PIPE TRAVEL TIME (t_p)				TIME OF CONC. t_c		FINAL t_c
BASIN	DESIGN PT:	C_5	C_{100}	AREA	LENGTH	HT	SLOPE	t_i	LENGTH	HT	SLOPE	VEL.	t_t	LENGTH	SLOPE	VEL.	t_t	COMP.	MINIMUM	
				Ac	Ft	FT	%	Min	Ft	FT	%	FPS	Min	Ft	%	FPS	Min	t_c	t_c	Min
1	1	0.15	0.50	1.00	100	2	2.0	14.1	375	33	8.8	9.2	0.7					14.8	5	14.8
2	2	0.37	0.60	2.42	100	8	8.0	6.8	70	3	4.3	6.4	0.2					7.0	5	7.0
3	3	0.49	0.65	1.21	85	2	2.4	7.9	665	8	1.2	6.4	1.7					9.6	5	9.6
4	4	0.49	0.65	3.61	100	1	1.0	11.4	795	10	1.3	6.7	2.0					13.4	5	13.4
5	5	0.49	0.65	4.10	100	3	3.0	7.9	1540	9	0.6	4.5	5.7					13.6	5	13.6
6		0.49	0.65	3.61	100	3	3.0	7.9	775	9	1.2	6.4	2.0					9.9	5	9.9
7		0.49	0.65	3.12	100	3	3.0	7.9	715	9	1.3	6.7	1.8					9.7	5	9.7
8		0.49	0.65	2.86	100	2	2.0	9.1	575	9	1.6	7.4	1.3					10.3	5	10.3
9		0.49	0.65	2.86	100	3	3.0	7.9	800	13	1.6	7.4	1.8					9.7	5	9.7
10		0.39	0.61	4.82	100	4	4.0	8.3	975	12	1.2	6.4	2.5					10.9	5	10.9
11		0.49	0.65	4.13	100	3	3.0	7.9	875	12	1.4	6.9	2.1					10.0	5	10.0
12		0.49	0.65	3.52	100	5	5.0	6.7	745	8	1.1	6.1	2.0					8.7	5	8.7
13		0.49	0.65	3.67	100	4	4.0	7.2	765	8	1.0	5.9	2.2					9.4	5	9.4
OS1		0.20	0.53	0.75	105	1	1.0	17.4										17.4	5	17.4
14		0.49	0.65	1.91	105	2	1.9	9.4	1490	18	1.2	6.4	3.9					13.3	5	13.3
15		0.49	0.65	3.80	105	2	1.9	9.4	1040	18	1.7	7.6	2.3					11.7	5	11.7
16		0.49	0.65	3.21	100	8	8.0	5.7	795	9	1.1	6.1	2.2					7.9	5	7.9
17		0.49	0.65	1.69	100	3	3.0	7.9	570	6	1.1	6.1	1.5					9.5	5	9.5
18		0.49	0.65	2.72	30	3	10.0	2.9	1765	52	2.9	10.0	3.0					5.9	5	5.9
19		0.49	0.65	0.60	80	2	2.5	7.5	640	28	4.4	12.3	0.9					8.4	5	8.4
20		0.49	0.65	2.33	100	3	3.0	7.9	470	4	0.9	5.6	1.4					9.3	5	9.3
21		0.49	0.65	2.66	100	4	4.0	7.2	545	6	1.1	6.1	1.5					8.7	5	8.7

OS2		0.15	0.50	9.55	300	21	7	16.1	810	57	7.0	8.2	1.6					17.7	5	17.7
22		0.42	0.62	6.33	100	2	2	10.1	895	42	4.7	12.7	1.2					11.3	5	11.3
23		0.49	0.65	3.30	100	9	9	5.5	905	34	3.8	11.4	1.3					6.8	5	6.8
24		0.49	0.65	2.43	80	2	2.5	7.5	1150	40	3.5	10.9	1.8					9.3	5	9.3
25		0.49	0.65	5.53	100	8	8	5.7	935	18	1.9	8.1	1.9					7.6	5	7.6
26		0.49	0.65	2.36	80	2	2.5	7.5	785	8	1.0	5.9	2.2					9.8	5	9.8
27		0.37	0.60	11.28	125	2	1.6	13.0	1245	41	3.3	10.6	2.0					15.0	5	15.0
28		0.90	0.96	0.91	20	0.4	2	1.3	730	8	1.1	6.1	2.0					3.3	5	5.0

PROJECT INFORMATION

PROJECT:	Willow Springs Ranch
PROJECT NO:	20876-05
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	Town of Monument
REPORT TYPE:	Final
DATE:	12/9/2019

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

PROPOSED RUNOFF 5 YR STORM P1= **1.50**

BASIN (S)	DESIGN POINT	AREA (AC)	DIRECT RUNOFF RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
1	1	1.00	0.15	14.8	0.15	3.49	0.5
2	2	2.42	0.37	7.0	0.90	4.64	4.2
3	3	1.21	0.49	9.6	0.59	4.16	2.5
4	4	3.61	0.49	13.4	1.77	3.64	6.4
5	5	4.10	0.49	13.6	2.01	3.62	7.3
6		3.61	0.49	9.9	1.77	4.11	7.3
7		3.12	0.49	9.7	1.53	4.15	6.3
8		2.86	0.49	10.3	1.40	4.05	5.7
9		2.86	0.49	9.7	1.40	4.15	5.8
10		4.82	0.39	10.9	1.90	3.97	7.5
11		4.13	0.49	10.0	2.02	4.10	8.3
12		3.52	0.49	8.7	1.72	4.32	7.4
13		3.67	0.49	9.4	1.80	4.20	7.6
OS1		0.75	0.20	17.4	0.15	3.22	0.5
14		1.91	0.49	13.3	0.94	3.65	3.4
15		3.80	0.49	11.7	1.86	3.86	7.2
16		3.21	0.49	7.9	1.57	4.47	7.0
17		1.69	0.49	9.5	0.83	4.19	3.5
18		2.72	0.49	5.9	1.33	4.89	6.5
19		0.60	0.49	8.4	0.29	4.37	1.3
20		2.33	0.49	9.3	1.14	4.21	4.8
21		2.66	0.49	8.7	1.30	4.32	5.6
OS2		9.55	0.15	17.7	1.45	3.20	4.6
22		6.33	0.42	11.3	2.66	3.91	10.4
23		3.30	0.49	6.8	1.62	4.68	7.6
24		2.43	0.49	9.3	1.19	4.22	5.0
25		5.53	0.49	7.6	2.71	4.51	12.2
26		2.36	0.49	9.8	1.16	4.14	4.8
27		11.28	0.37	15.0	4.19	3.46	14.5
28		0.91	0.90	5.0	0.82	5.10	4.2

PROJECT INFORMATION

PROJECT:	Willow Springs Ranch
PROJECT NO:	20876-05
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	Town of Monument
REPORT TYPE:	Final
DATE:	12/9/2019

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

PROPOSED RUNOFF 100 YR STORM P1= 2.52

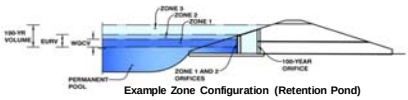
BASIN (S)	DESIGN POINT	AREA (AC)	DIRECT RUNOFF RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
1	1	1.00	0.50	14.8	0.50	5.86	2.9
2	2	2.42	0.60	7.0	1.45	7.80	11.3
3	3	1.21	0.65	9.6	0.79	6.99	5.5
4	4	3.61	0.65	13.4	2.35	6.12	14.4
5	5	4.10	0.65	13.6	2.67	6.08	16.2
6		3.61	0.65	9.9	2.35	6.91	16.2
7		3.12	0.65	9.7	2.03	6.97	14.1
8		2.86	0.65	10.3	1.86	6.80	12.6
9		2.86	0.65	9.7	1.86	6.97	13.0
10		4.82	0.61	10.9	2.93	6.68	19.6
11		4.13	0.65	10.0	2.68	6.89	18.5
12		3.52	0.65	8.7	2.29	7.25	16.6
13		3.67	0.65	9.4	2.39	7.06	16.8
OS1		0.75	0.53	17.4	0.40	5.42	2.1
14		1.91	0.65	13.3	1.24	6.14	7.6
15		3.80	0.65	11.7	2.47	6.48	16.0
16		3.21	0.65	7.9	2.09	7.51	15.7
17		1.69	0.65	9.5	1.10	7.04	7.7
18		2.72	0.65	5.9	1.77	8.22	14.5
19		0.60	0.65	8.4	0.39	7.35	2.9
20		2.33	0.65	9.3	1.51	7.07	10.7
21		2.66	0.65	8.7	1.73	7.26	12.6
OS2		9.55	0.50	17.7	4.78	5.38	25.7
22		6.33	0.62	11.3	3.92	6.58	25.8
23		3.30	0.65	6.8	2.15	7.87	16.9
24		2.43	0.65	9.3	1.58	7.09	11.2
25		5.53	0.65	7.6	3.59	7.58	27.3
26		2.36	0.65	9.8	1.53	6.96	10.7
27		11.28	0.60	15.0	6.74	5.82	39.2
28		0.91	0.96	5.0	0.87	8.58	7.5

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: WILLOW SPRINGS RANCH

Basin ID: POND 1 - NORTH



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	57.18	acres		
Watershed Length =	2,000	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	62.70%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	1.170	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	3.903	acre-feet		
2-yr Runoff Volume (P1 = 0.89 in.) =	2.409	acre-feet	0.89	inches
5-yr Runoff Volume (P1 = 1.19 in.) =	3.423	acre-feet	1.19	inches
10-yr Runoff Volume (P1 = 1.45 in.) =	4.625	acre-feet	1.45	inches
25-yr Runoff Volume (P1 = 1.84 in.) =	6.681	acre-feet	1.84	inches
50-yr Runoff Volume (P1 = 2.17 in.) =	8.172	acre-feet	2.17	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	10.024	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.4 in.) =	14.498	acre-feet	3.40	inches
Approximate 2-yr Detention Volume =	2.257	acre-feet		
Approximate 5-yr Detention Volume =	3.217	acre-feet		
Approximate 10-yr Detention Volume =	4.303	acre-feet		
Approximate 25-yr Detention Volume =	5.156	acre-feet		
Approximate 50-yr Detention Volume =	5.631	acre-feet		
Approximate 100-yr Detention Volume =	6.315	acre-feet		

Stage-Storage Calculation

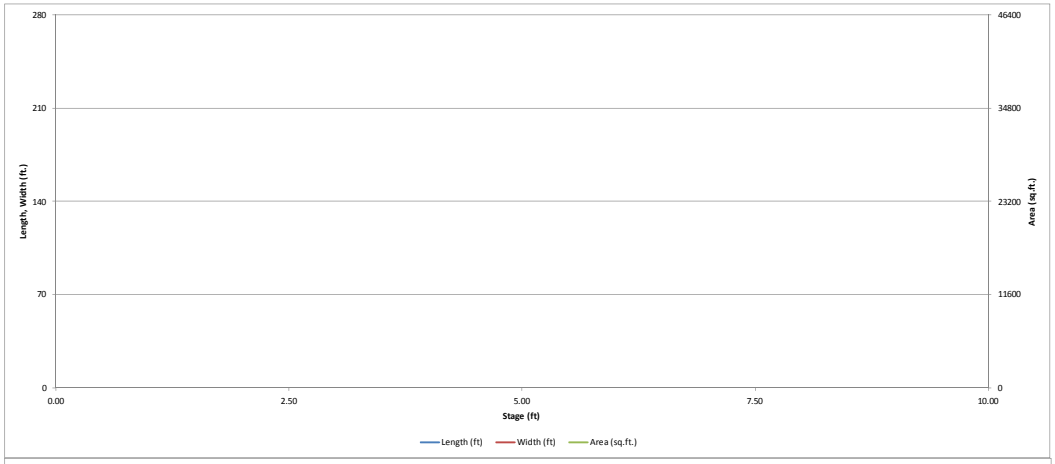
Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	153	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		
Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

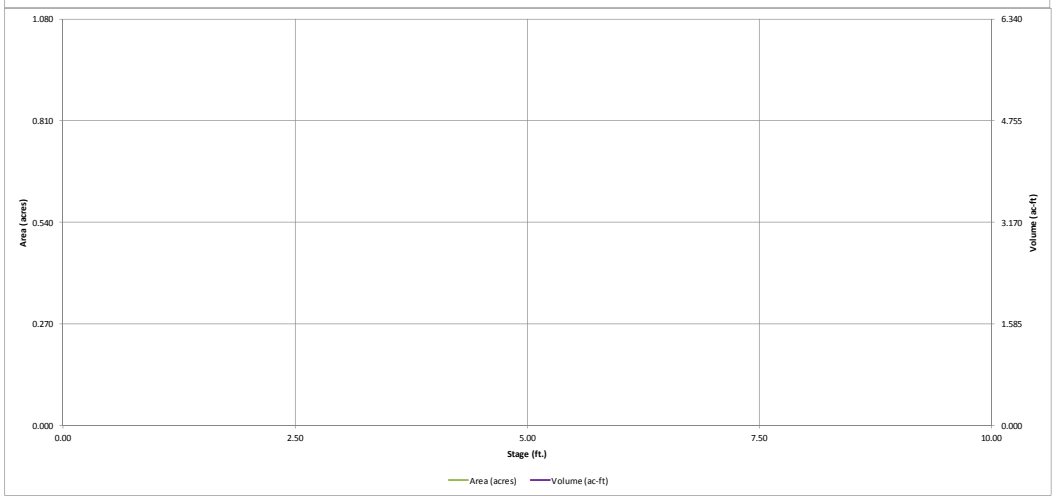
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



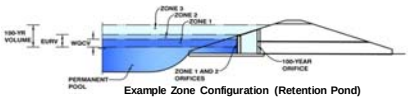


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: WILLOW SPRINGS RANCH

Basin ID: POND 2 - WEST



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	21.61	acres		
Watershed Length =	1,200	ft		
Watershed Slope =	0.050	ft/ft		
Watershed Imperviousness =	32.50%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.286	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.725	acre-feet		
2-yr Runoff Volume (P1 = 0.89 in.) =	0.420	acre-feet	0.89	inches
5-yr Runoff Volume (P1 = 1.19 in.) =	0.629	acre-feet	1.19	inches
10-yr Runoff Volume (P1 = 1.45 in.) =	0.982	acre-feet	1.45	inches
25-yr Runoff Volume (P1 = 1.84 in.) =	1.768	acre-feet	1.84	inches
50-yr Runoff Volume (P1 = 2.17 in.) =	2.324	acre-feet	2.17	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	3.035	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.4 in.) =	4.680	acre-feet	3.40	inches
Approximate 2-yr Detention Volume =	0.392	acre-feet		
Approximate 5-yr Detention Volume =	0.590	acre-feet		
Approximate 10-yr Detention Volume =	0.883	acre-feet		
Approximate 25-yr Detention Volume =	1.125	acre-feet		
Approximate 50-yr Detention Volume =	1.241	acre-feet		
Approximate 100-yr Detention Volume =	1.503	acre-feet		

Stage-Storage Calculation

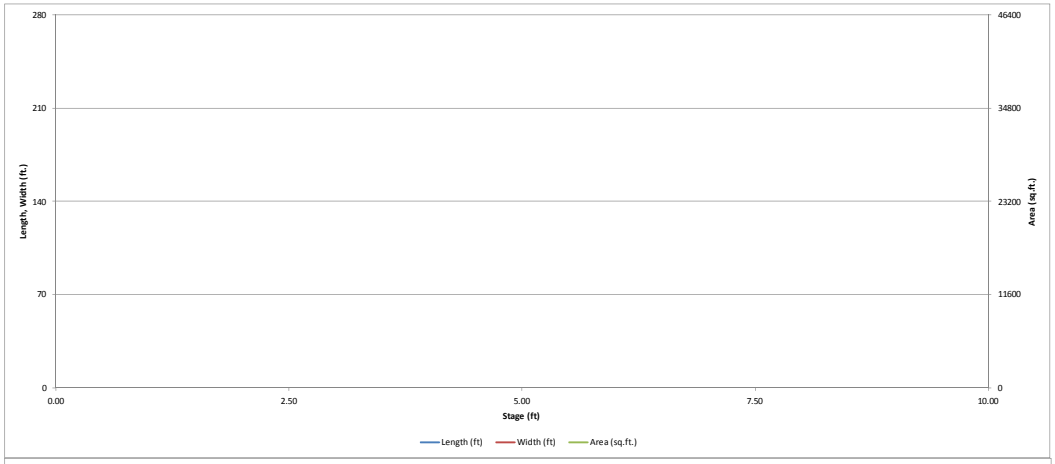
Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	37	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		
Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

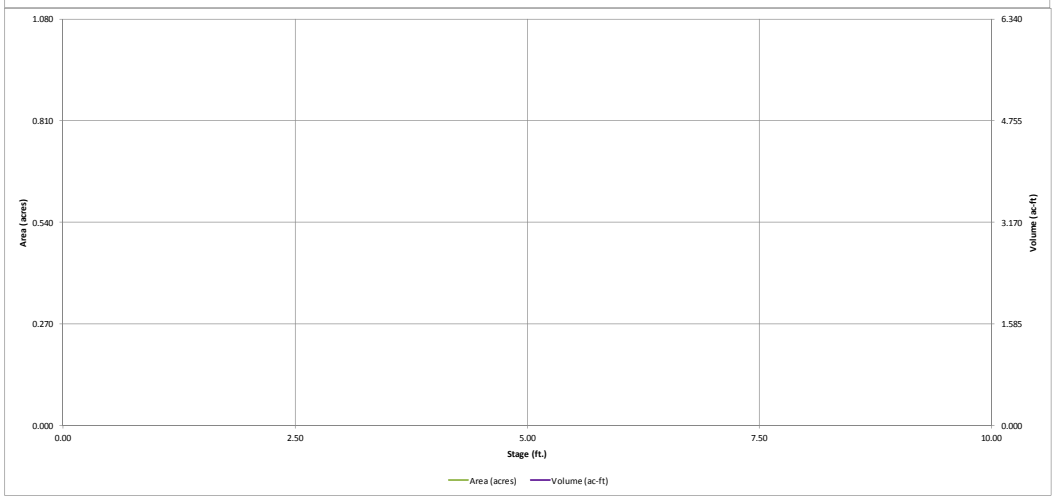
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



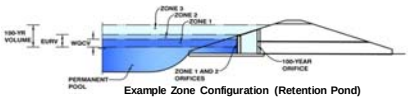


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: WILLOW SPRINGS RANCH

Basin ID: POND 3 - SOUTH



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	20.08	acres		
Watershed Length =	1,600	ft		
Watershed Slope =	0.050	ft/ft		
Watershed Imperviousness =	53.90%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.363	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.164	acre-feet		
2-yr Runoff Volume (P1 = 0.89 in.) =	0.708	acre-feet	0.89	inches
5-yr Runoff Volume (P1 = 1.19 in.) =	1.018	acre-feet	1.19	inches
10-yr Runoff Volume (P1 = 1.45 in.) =	1.417	acre-feet	1.45	inches
25-yr Runoff Volume (P1 = 1.84 in.) =	2.141	acre-feet	1.84	inches
50-yr Runoff Volume (P1 = 2.17 in.) =	2.663	acre-feet	2.17	inches
100-yr Runoff Volume (P1 = 2.51 in.) =	3.316	acre-feet	2.51	inches
500-yr Runoff Volume (P1 = 3.4 in.) =	4.875	acre-feet	3.40	inches
Approximate 2-yr Detention Volume =	0.663	acre-feet		
Approximate 5-yr Detention Volume =	0.957	acre-feet		
Approximate 10-yr Detention Volume =	1.308	acre-feet		
Approximate 25-yr Detention Volume =	1.581	acre-feet		
Approximate 50-yr Detention Volume =	1.730	acre-feet		
Approximate 100-yr Detention Volume =	1.977	acre-feet		

Stage-Storage Calculation

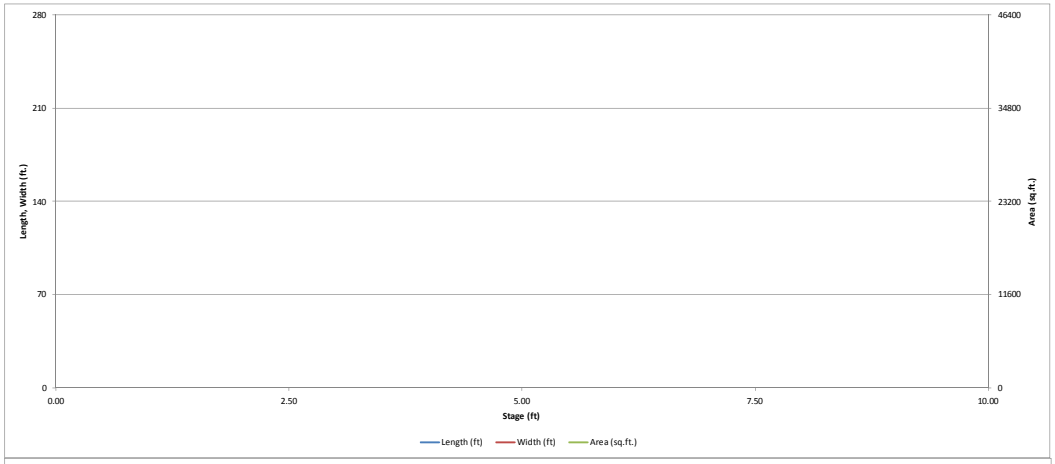
Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	47	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		
Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

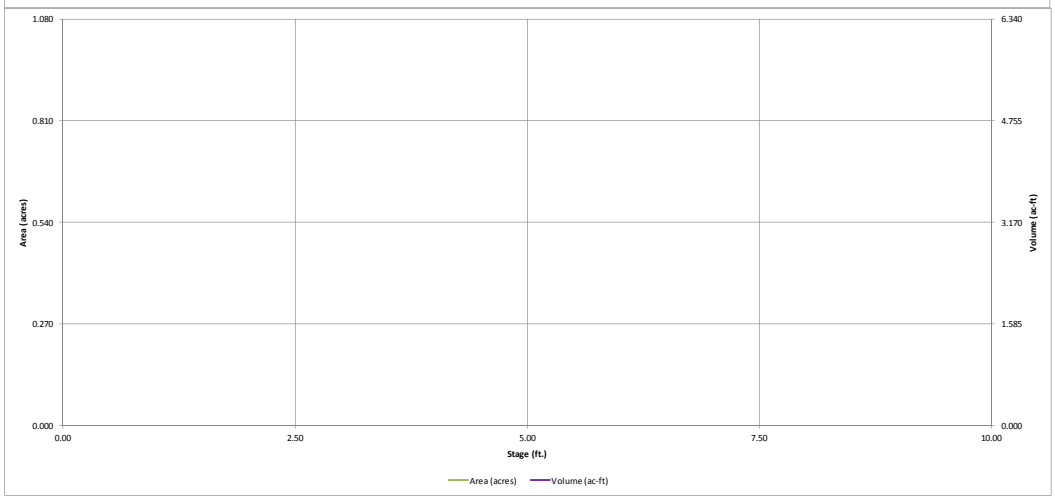
Depth Increment = ft

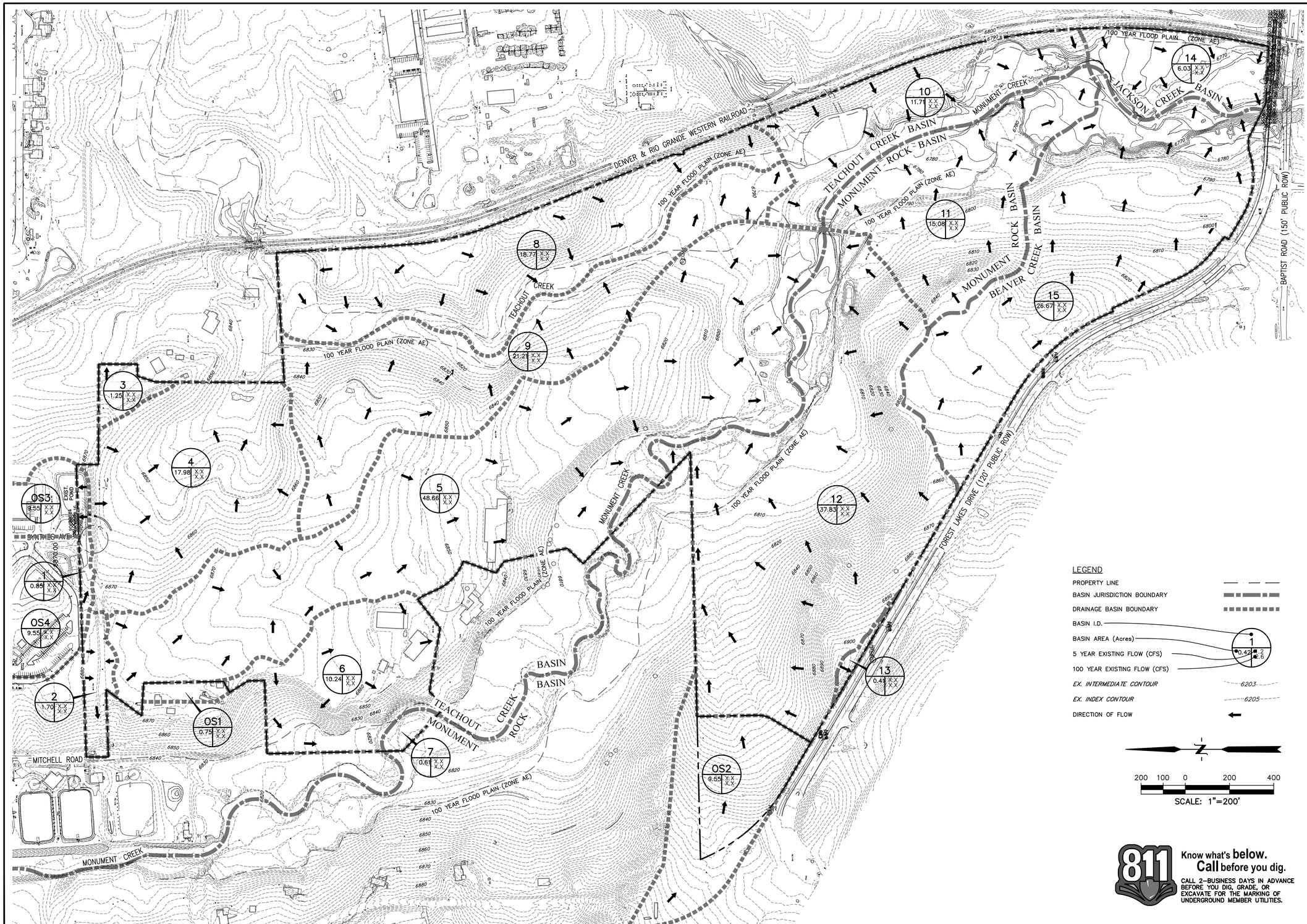
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)







LEGEND

PROPERTY LINE

BASIN JURISDICTION BOUNDARY

DRAINAGE BASIN BOUNDARY

BASIN I.D.

BASIN AREA (Acres)

5 YEAR EXISTING FLOW (CFS)

100 YEAR EXISTING FLOW (CFS)

EX. INTERMEDIATE CONTOUR 6203

EX. INDEX CONTOUR 6205

DIRECTION OF FLOW

200 100 0 200 400

SCALE: 1"=200'

811 Know what's **below.** **Call** before you dig.

CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

PREPARED BY:

DREXEL, BARRELL & CO.
Engineers • Surveyors
3 SOUTH 7TH STREET
COLORADO SPGS, COLORADO 80905
CONTACT: TIM D. McCONNELL, P.E.
(719)260-0887
BOULDER • COLORADO SPRINGS • GREELEY

CLIENT:

POLO BROWN COMPANY
514 PIKE AVENUE
CANON CITY, COLORADO 801212
(303) 999-5533

PRELIMINARY/FINAL PD SITE PLAN

WILLOW SPRINGS RANCH

BAPTIST ROAD & FOREST LAKES DRIVE
MONUMENT, COLORADO

ISSUE	DATE
INITIAL ISSUE	11-18-19
LATEST ISSUE	

DESIGNED BY:	XXX
DRAWN BY:	XXX
CHECKED BY:	XXX
FILE NAME:	20876-05DRN-1

DRAWING SCALE:
HORIZONTAL: X" = XX"
VERTICAL: X" = XX"

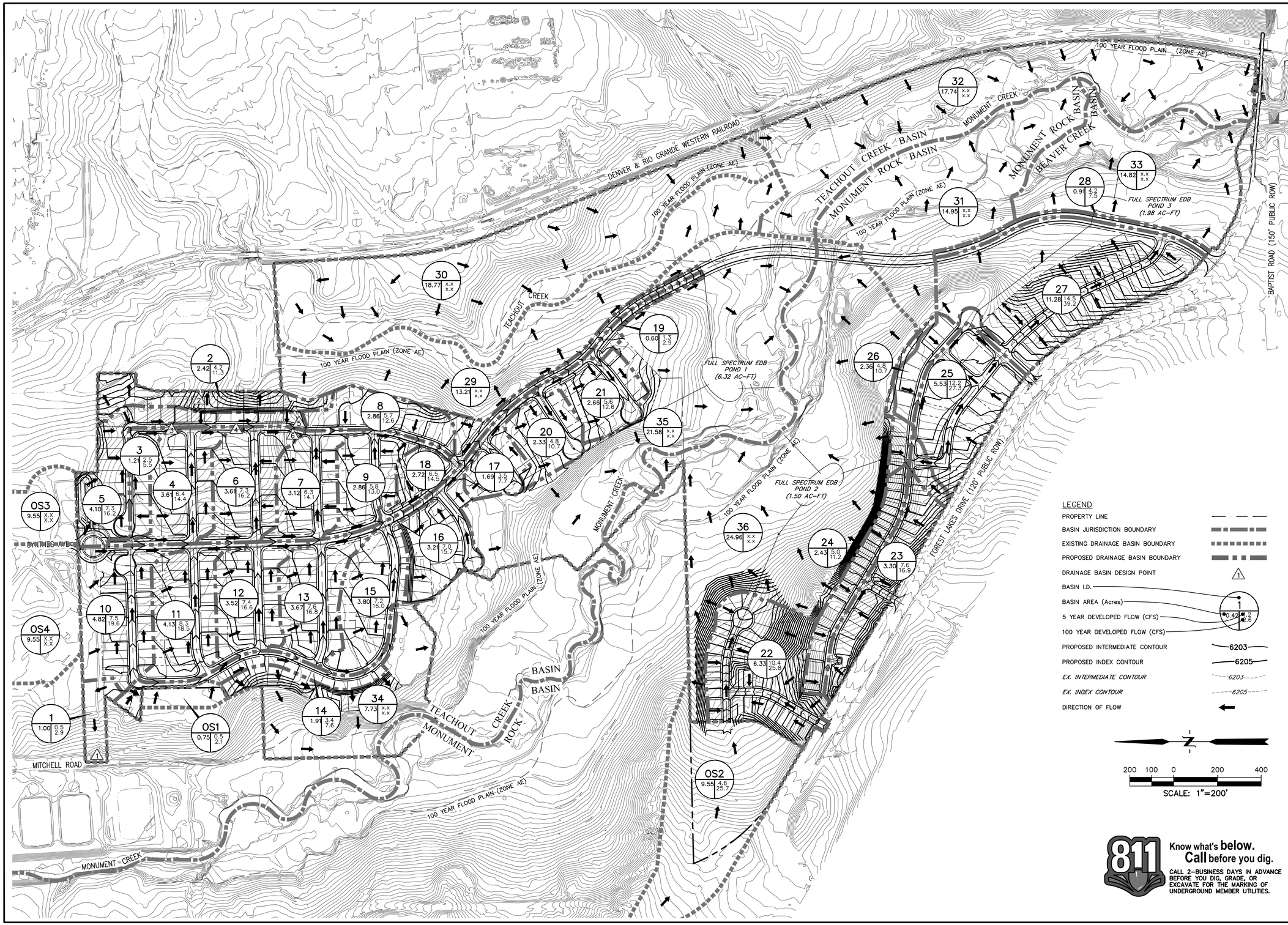
EXISTING CONDITIONS DRAINAGE PLAN

PROJECT NO. 20876-05CSCV

DRAWING NO.

DR-1

SHEET: 1 OF



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WILLOW SPRINGS RANCH

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MONUMENT, COLORADO

ISSUE	DATE
INITIAL ISSUE	11-18-19
LATEST ISSUE	

DESIGNED BY:	XXX
DRAWN BY:	XXX
CHECKED BY:	XXX
FILE NAME:	20876-05DRN-2

DRAWING SCALE:
HORIZONTAL: X" = XX"
VERTICAL: X" = XX"

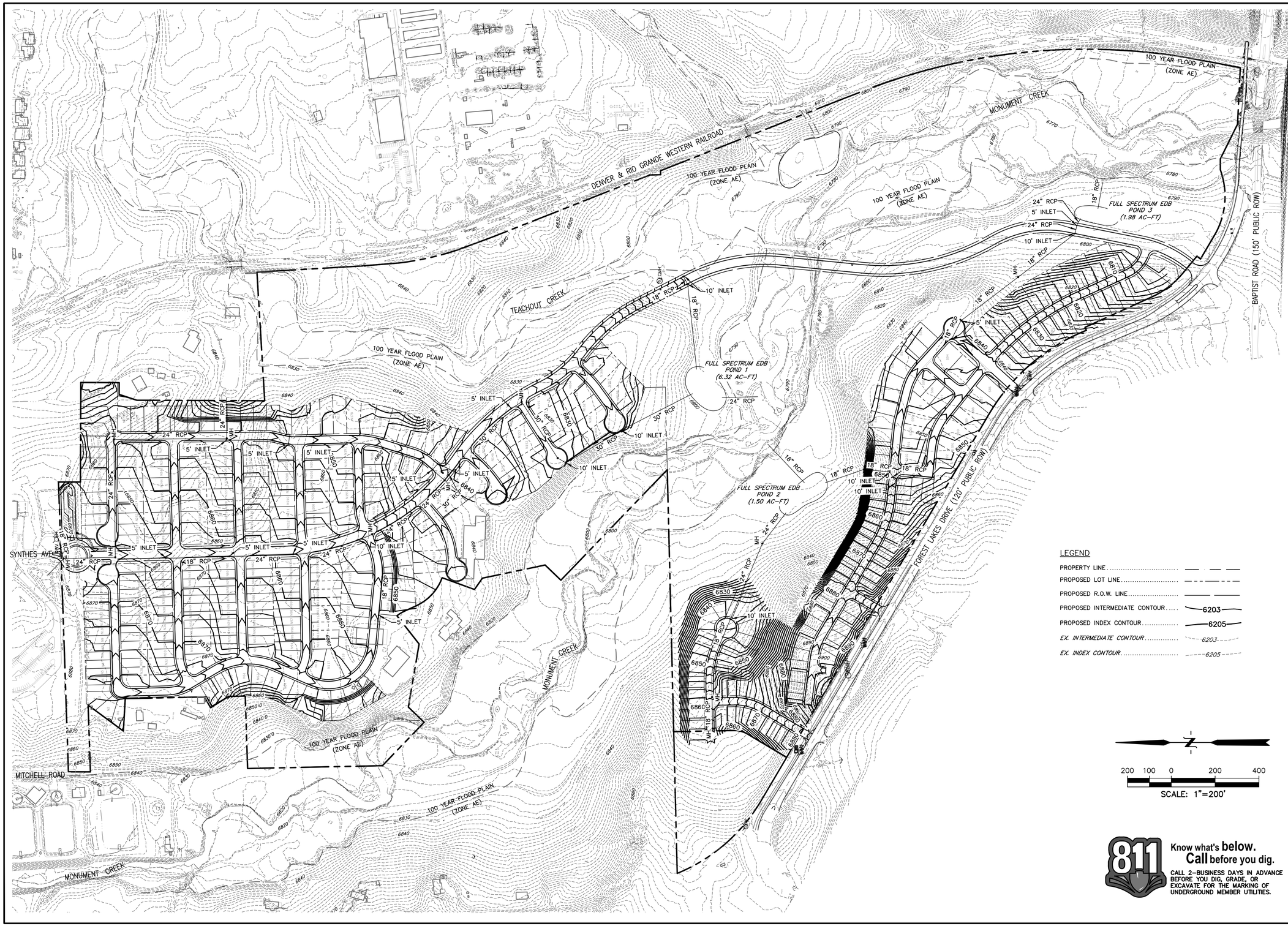
PROPOSED CONDITIONS DRAINAGE PLAN

PROJECT NO. 20876-05CSCV

DRAWING NO.

DR-2

SHEET#### OF 3



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PRELIMINARY/FINAL PD SITE PLAN

WILLOW SPRINGS RANCH

BAPTIST ROAD & FOREST LAKES DRIVE
MONUMENT, COLORADO

ISSUE	DATE
INITIAL ISSUE	11-18-19
LATEST ISSUE	

DESIGNED BY:	TDM
DRAWN BY:	GES
CHECKED BY:	TDM
FILE NAME:	20876-05GD1

DRAWING SCALE:
HORIZONTAL: 1" = 200'
VERTICAL: N/A

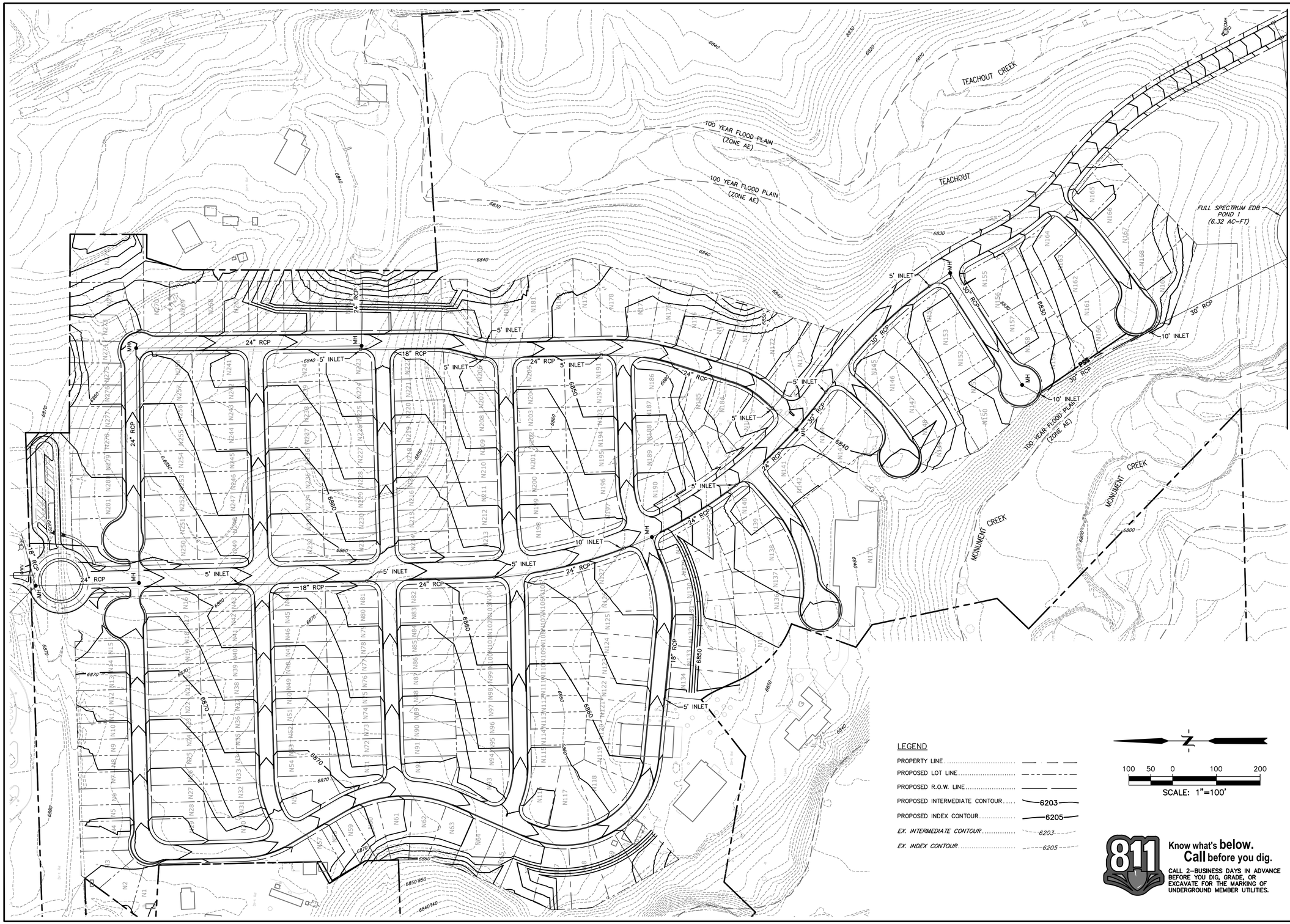
OVERALL PRELIMINARY GRADING PLAN

PROJECT NO. 20876-05CSCV

DRAWING NO.

GD-1

SHEET: 1 OF 3



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PRELIMINARY/FINAL PD SITE PLAN

WILLOW SPRINGS RANCH

BAPTIST ROAD & FOREST LAKES DRIVE
MONUMENT, COLORADO

ISSUE	DATE
INITIAL ISSUE	11-18-19
LATEST ISSUE	

DESIGNED BY:	TDM
DRAWN BY:	GES
CHECKED BY:	TDM
FILE NAME:	20876-05GD1

DRAWING SCALE:
HORIZONTAL: 1" = 100"
VERTICAL: N/A

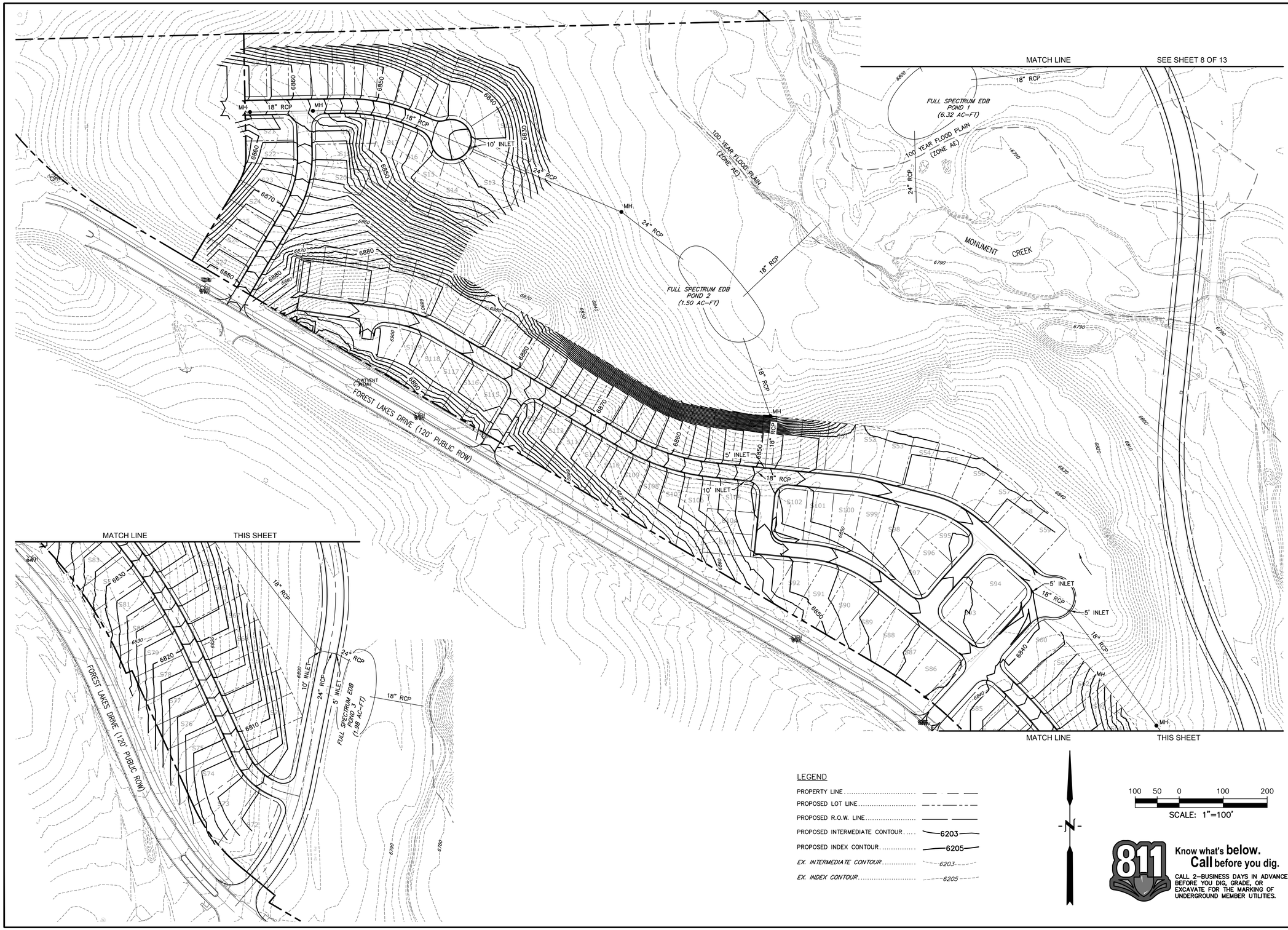
PRELIMINARY GRADING PLAN

PROJECT NO. 20876-05CSCV

DRAWING NO.

GD-2

SHEET: 2 OF 3



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MONUMENT, COLORADO

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INITIAL ISSUE	11-18-19
LATEST ISSUE	

DESIGNED BY:	TDM
DRAWN BY:	GES
CHECKED BY:	TDM
FILE NAME:	20876-05GD1

DRAWING SCALE:
HORIZONTAL: 1" = 100"
VERTICAL: N/A

PRELIMINARY GRADING PLAN

PROJECT NO. 20876-05CSCV

DRAWING NO.

GD-3

SHEET: 3 OF 3