

FINAL DRAINAGE LETTER AND PLAN

**EQUIPMENT RESOURCES
7340 UTAH LANE
EL PASO COUNTY, COLORADO**

JANUARY, 2019

Prepared for:

*T-P Enterprises Inc.
5055 E 39th Avenue
Denver CO 80207*

Prepared by:

*Core Engineering Group, LLC
15004 1st Avenue S.
Burnsville, MN 55306*

Project No. 315.003



CORE

ENGINEERING GROUP

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El Paso County Development Services
Engineering Division
2880 International Circle, Suite 110
Colorado Springs, CO. 80910

RE: Equipment Resources
7340 Utah Lane
El Paso County, Colorado

Dear Representative:

In accordance with the requirements of the El Paso County Development Code, a final drainage letter has been prepared for Equipment Resources, an existing development located at 7340 Utah Lane. The purpose of this letter is to support the approval of the use variance for this property

This report has been prepared under the current El Paso County Drainage Criteria.

Seven (7) complete copies of the drainage report and plan are hereby transmitted for your review and approval. If there are any questions or comments concerning this report, please contact the undersigned.

Sincerely,

Richard L. Schindler, P.E. #33997

Date

cc: file, client

ENGINEER'S STATEMENT

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

Richard L. Schindler, P.E. #33997
For and on Behalf of Core Engineering Group, LLC

Date

OWNER'S STATEMENT

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

T-P Enterprises Inc.

Business Name

Date

By

Title
5055 E. 39th Avenue
Address
Denver, CO 80207

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, this development is not located within a designated floodplain as shown on Flood Insurance Rate Map Panel No. 08041C0529 G, effected December 7, 2018. (See Appendix A, FEMA FIRMette Exhibit)

Richard L. Schindler, #33997

Date

EL PASO COUNTY

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volume 1 and 2, and the Engineering Criteria Manual, as amended.

County Engineer/ECM Administrator

Date

1.0 INTRODUCTION

Property Location

Equipment Resources is located at 7340 Utah Lane, El Paso County, Colorado, adjacent to and west of Utah Lane and approximately 0.2 miles south of East Woodmen Road, between Powers Boulevard and Marksheffel Road. The property is located in a portion of the north one-half of Section 8, Township 13 South, Range 65 West of the 6th Principal Meridian in the County of El Paso, State of Colorado. See **Appendix A** for vicinity map.

Property Description

Equipment Resources, located at 7340 Utah Lane contains 4.92 acres and is adjacent to Utah Lane. Storm water is directed westerly and southerly with moderate slopes to 2-existing water quality and sedimentation swales, runoff then continues in a southerly direction.

Currently the site contains an existing structure with gravel parking and a storage yard for the contractor's equipment. No additional construction is anticipated at this time.

Existing soils in the area consist mostly of the Blakeland Complex, a deep and somewhat excessively drained soil. Permeability of the soil is rapid, which gives it a Hydrologic Group 'A' rating. Other characteristics of this soil, is slow surface runoff and the hazard of erosion is moderate.

According to the current FEMA Flood Insurance Rate Map (FIRM) number 08041C0529 G, effective December 7, 2018 shows that this site is not located within 100 year FEMA floodplain. See **Appendix A** for FEMA FIRMette Flood Map.

Purpose and Scope

The purpose of this report is to support the use variance request for this property. This report confirms and verifies the findings and conclusions from the previously approved drainage reports. In addition to the existing 2-Grass Swale Sedimentation Swales, 2-Porous Landscape Detention facilities will be constructed. No other construction is planned for this site.

2.0 DRAINAGE DESIGN CRITERIA

The supporting drainage design and calculations were performed in accordance with the City of Colorado Springs and El Paso County "Drainage Criteria Manual (DCM)", dated November, 1991, the El Paso County "Engineering Criteria Manual", and the UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3.

The Rational Method as outlined in Section 6.3.0 of the May 2014 "Drainage Criteria Manual" and in Section 3.2.8.F of the El Paso County "Engineering Criteria Manual" was used for basins less than 130 acres to determine the rainfall and runoff conditions for the proposed development of the site. The runoff rates for the 5-year initial storm and 100-year major design storm were calculated.

3.0 EXISTING HYDROLOGICAL CONDITIONS

The property is located within the "Cottonwood Creek DBPS" (FOMO 2200) a studied drainage basin. The site is currently developed with an existing building, ground cover consists of native grasses and a gravel parking lot, this parking lot is located on the eastern portion of the site. There is also an existing stock pond on the site along the drainageway. No grading, construction or development is proposed near the existing drainageway on the western side of the site.

The previous approved drainage report and plan was prepared by using drainage criteria that was in effect in 2008, this report updates that criteria and conforms to the current Drainage Criteria Manuals.

Basin OS-1

Basin OS-1 is the west half of Utah Lane (graveled private drive), runoff is directed southerly to an existing 18" CMP that conveys runoff under the entrance to this property. The total flow from this 0.40 acre basin is 1.1cfs for the 5-year event and 2.2cfs for the 100-year storm event.

Basin OS-2

Basin OS-2 is located north of this site and flows from a portion of the existing animal hospital are directed southerly overland onto this property as shown on the attached final drainage plan. The total flow from this 0.81 acre basin is 2.2cfs for the 5-year event and 4.4cfs for the 100-year storm event.

Basin A1

Basin A1 is located on the easterly edge of and contains the existing building and gravel parking lot, runoff is directed overland westerly and southerly to the 2 existing Grass Swale Sedimentation Facilities as shown on the attached final drainage plan. The total flow from this 1.46 acre basin is 2.8cfs for the 5-year event and 6.4cfs for the 100-year storm event. This basin will require 2 proposed Porous Landscape Detention facilities to provide water quality for the impervious area (roof and concrete pads), the locations are shown on the attached final Drainage Plan. The PLD's will be discussed in greater detail in the water quality section of this report.

Basin A2

Basin A2 is used for a storage yard and is located on the westerly portion of this site, runoff is directed westerly overland to the existing drainageway that flows in a southerly direction, as shown on the attached final drainage plan. The total flow from this 3.46 acre basin is 4.2cfs for the 5-year event and 11.7cfs for the 100-year storm event.

Basin A

Basin A is the combined flow from basins A1 and A2 and is directed to the previously mentioned drainageway that flows in a southerly direction, as shown on the attached final drainage plan. The total flow from this 4.92 acre basin is 6.7cfs for the 5-year event and 17.6cfs for the 100-year storm event.

Design Point 1

Design Point 1 (DP-1) is located on the south edge of the property at the existing drainageway as shown on the attached final drainage plan, and is the combined runoff from basins A and OS-2. The total flow generated at this 5.73 acre design point is 7.9cfs for the 5-year event and 19.5cfs for the 100-year storm event.

4.0 DEVELOPED HYDROLOGICAL CONDITIONS

The proposed conditions for this development consist of constructing 2- Porous Landscape Detention Facilities, grass swale, and underground PVC storm pipes that convey roof and concrete surface flow to the PLD, the locations are shown on the attached final drainage plan. No other construction is planned for this site.

5.0 PROPOSED IMPROVEMENTS

No improvements are proposed for this site.

6.0 GRADING AND EROSION CONTROL

No grading or erosion control is proposed for this site.

7.0 WATER QUALITY CONTROL

Water quality for the impervious areas will be provided by 2 Porous Landscape Detention facilities; locations of these facilities are shown on the attached final drainage plan and noted as PLD #1 and PLD #2.

PLD #1 is located on the North side and collects flow from the North half of the roof. Roof flow is directed to several downspouts and routed north-northwesterly to a grass swale that flows westerly to PLD #1. The contributing area to this PLD is 3,960 square feet, and it requires a capture volume of 132 cubic feet, the minimum flat surface area is 79 square feet, the flat surface is 5' wide and 16' long, which gives an actual flat area of 80 square feet. Side slopes are 4:1 and a depth of 8.1" and gives an actual volume of 132.3 cubic feet. The outlet weir for additional runoff was designed for a 100 year flow of 5.0cfs, this weir has bottom length of 6.0', weir depth of 0.5', 4:1 side slope, flow depth to convey 5.0cfs is 0.34'.

PLD #2 is located on the South side and collects flow from the South half of the roof and the existing concrete pads. Roof flow is directed southerly to several downspouts and routed across the existing concrete pads to proposed 8" area inlets. These inlets will convey hard surface runoff southerly via 8" PVC storm laterals to an 8" PVC storm pipe that will route runoff westerly to PLD #2. The contributing area to this PLD is 4,665 square feet, and it requires a capture volume of 155.5 cubic feet, the minimum flat surface area is 93 square feet, the flat surface is 5' wide and 19' long, which gives an actual flat area of 95 square feet. Side slopes are 4:1 and a depth of 9" which gives an actual volume of 157.8 cubic feet. The outlet weir for additional runoff was designed for a 100 year flow of 5.6cfs, this weir has bottom length of 8.0', weir depth of 0.5', 4:1 side slope, flow depth to convey 5.6cfs is 0.35'.

Water Quality Maintenance Recommendations:

<u>Required Action</u>	<u>Frequency</u>
Lawn mowing and lawn care	Routine, as needed
Debris and litter removal	Routine, as needed by inspection
Sediment removal	Routine, as needed by inspection
Landscaping removal and Replacement	5-10 years, or as needed by, inspection
Inspections	Routine, annual inspection is suggested

8.0 FACILITIES

There are no planned major drainage facilities for this area.

9.0 DRAINAGE AND BRIDGE FEES

The site is located in the Cottonwood Creek Drainage Basin. There is no platting action proposed for this site, therefore no Drainage Fees are due.

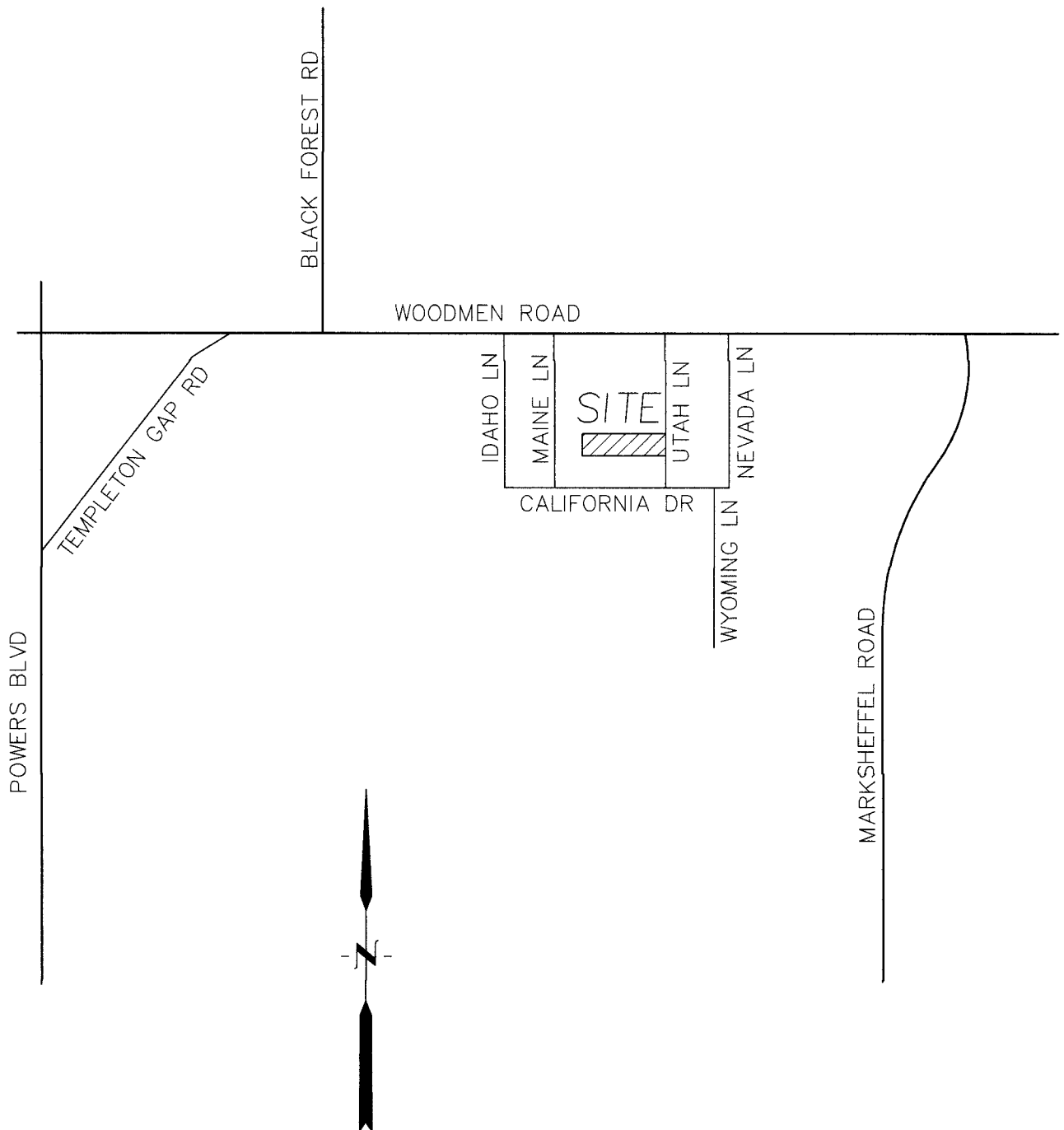
10.0 CONCLUSIONS

This drainage report has been prepared in compliance with the City of Colorado Springs/El Paso County Drainage Criteria Manual and the drainage studies for surrounding developments. No development improvements will be constructed for this site and will not generate an increase in runoff, and should not adversely affect downstream properties. The purpose of this report is to accompany the approval of the use variance for this property. This final drainage letter is in general conformance with the previously approved final drainage reports prepared by Core Engineering and WestWorks Engineering.

11.0 REFERENCES

1. City of Colorado Springs/El Paso County Drainage Criteria Manual, Vol. 1 & 2.
2. Soil Survey of El Paso County Area, Colorado by USDA, SCS.
3. The UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3.
4. Final Drainage Report for 7340 Utah Lane prepared by WestWorks Engineering, Dated 7/16/2004.
5. Final Drainage Report for Equipment Resources at 7340 Utah Lane, prepared by Core Engineering, dated 1/27/2009.

APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP



**CORE
ENGINEERING GROUP**

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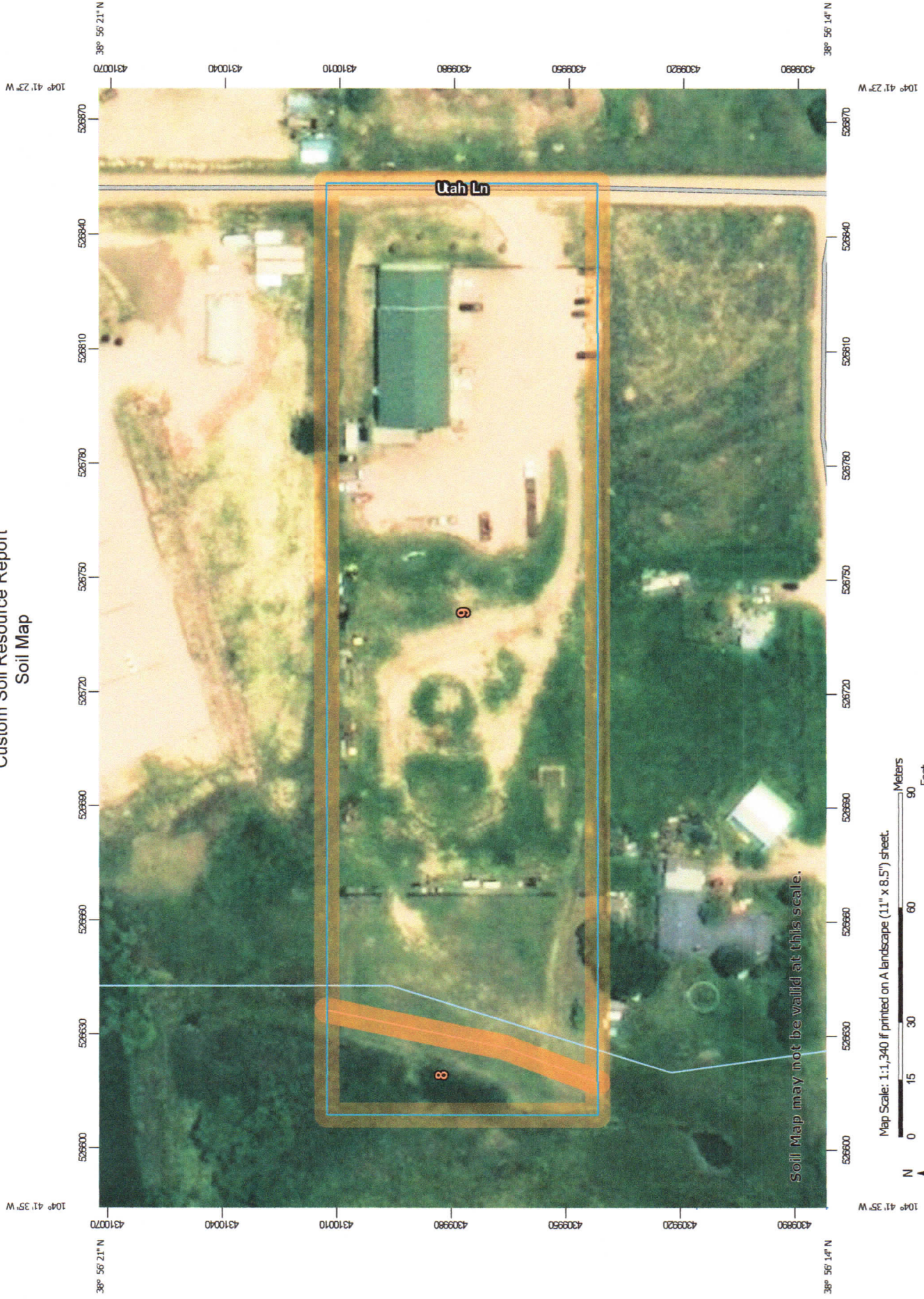
**VICINITY MAP
EQUIPMENT RESOURCES
7340 UTAH LANE**

SCALE:
NTS

DATE:
JANUARY 2019

FIGURE NO.
1

Custom Soil Resource Report Soil Map





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
- Water Features


Streams and Canals
- Transportation


Rails


Interstate Highways

US Routes


Major Roads


Local Roads
- Background


Aerial Photography
- Soils

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other
- Special Line Features



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 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jun 7, 2016—Aug 17, 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.

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

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

Map Unit Composition

Blakeland and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Custom Soil Resource Report

Pleasant

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

9—Blakeland-Fluvaquentic Haplaquolls

Map Unit Setting

National map unit symbol: 36b6
Elevation: 3,500 to 5,800 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 60 percent
Fluvaquentic haplaquolls and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, tal
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose and/or eolian deposits
derived from arkose

Typical profile

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

Properties and qualities

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

Interpretive groups

Land capability classification (irrigated): 3e

Custom Soil Resource Report

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Description of Fluvaquentic Haplaquolls

Setting

Landform: Swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: variable

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

National Flood Hazard Layer FIRMette



38°56'33.64"N



0 250 500 1,000 1,500 2,000 Feet
1:6,000

USGS The National Map: Orthoimagery. Data refreshed October 2017

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, AP
- Regulatory Floodway

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 OF FLOOD HAZARD

- NO SCREEN
- Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone I

OTHER AREAS

GENERAL STRUCTURES

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

Cross Sections with 1% Annual Chance Water Surface Elevation

Coastal Transect

Base Flood Elevation Line (BFE)

Limit of Study

Jurisdiction Boundary

Coastal Transect Baseline

Profile Baseline

Hydrographic Feature

OTHER FEATURES

Digital Data Available

No Digital Data Available

Unmapped

MAP PANELS

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 1/25/2019 at 4:59:33 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 unmapped areas cannot be used for regulatory purposes.

APPENDIX B – HYDROLOGY & HYDRAULIC CALCULATIONS

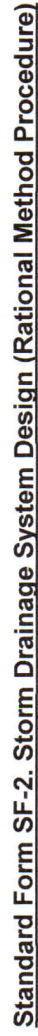


Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January 24, 2019
Checked By: Leonard Beasley

Job No: 315.003
Project: Equipment Resources, 7340 Utah Lane
Design Storm: **5 - Year Event**

[illegible]

Job No: 315.003

Project: Equipment Resources, 7340 Utah Lane

Design Storm: 100 - Year Event

[illegible]



Calculated By: Leonard Beasley
Date: January 24, 2019
Checked By: Leonard Beasley

Project: Equipment Resources, 7340 Utah Lane

[illegible]

Preliminary Drainage Plan

CURRENT CONDITIONS COEFFICIENT "C" CALCULATIONS

[illegible]

Hydraflow Plan View



Project File: 315.003, 100 yr Roof Flow.stm

No. Lines: 3

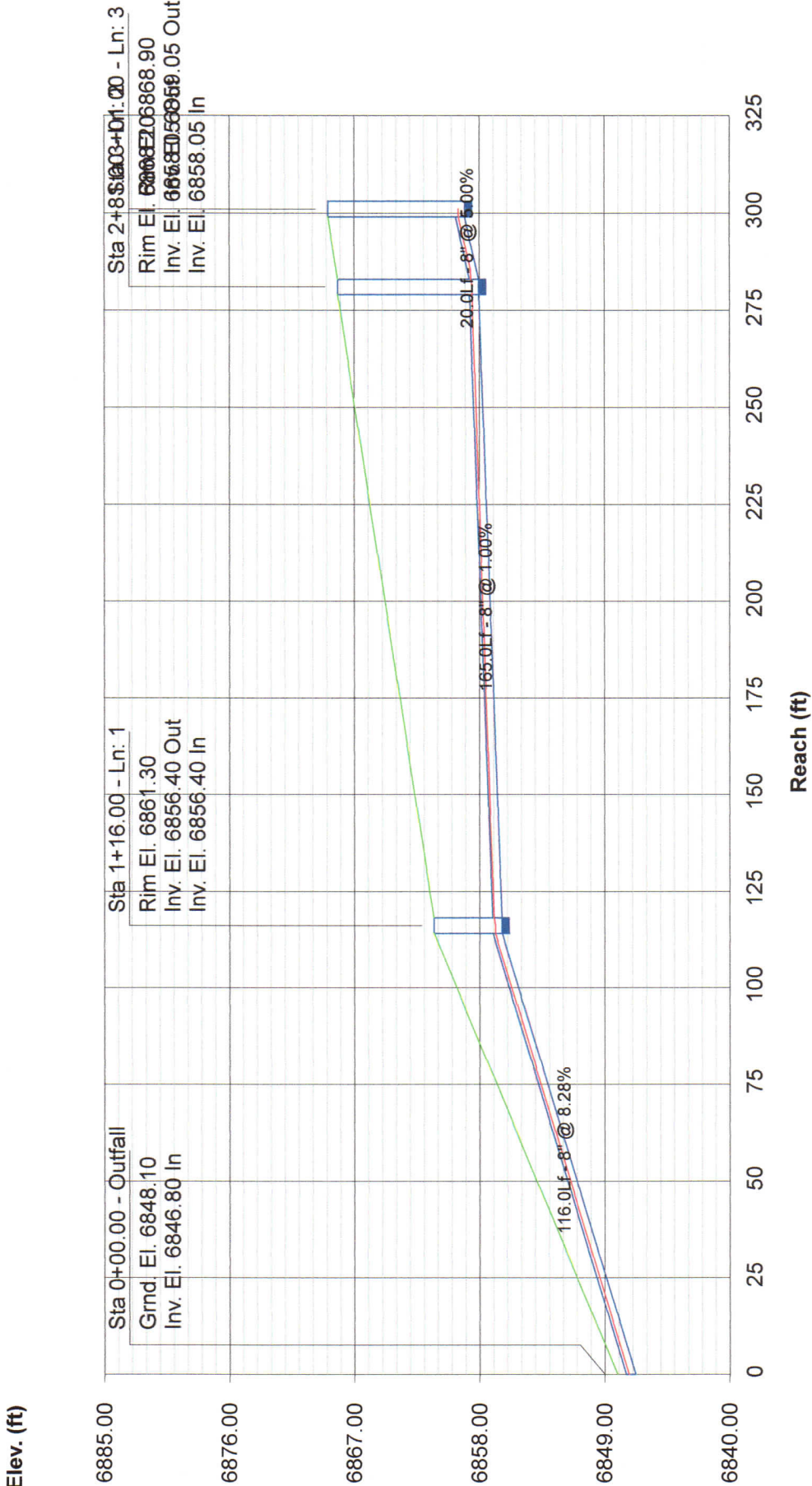
02-25-2019

Storm Sewer Summary Report

Page 1

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	L-1," PVC	1.00	8 c	116.0	6846.80	6856.40	8.276	6847.27	6856.87	n/a	6856.87	End
2	L-2, 8" PVC	1.00	8 c	165.0	6856.40	6858.05	1.000	6856.97	6858.52	n/a	6858.52	1
3	L-3, 8" PVC	1.00	8 c	20.0	6858.05	6859.05	5.000	6858.62	6859.52	n/a	6859.52 j	2
Project File: 315.003, 100 yr Roof Flow.stm							Number of lines: 3			Run Date: 02-25-2019		
NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; j - Line contains hyd. jump.												

Storm Sewer Profile



Weir Report

Hydraflow Express by Intelisolve

Tuesday, Feb 5 2019, 4:22 PM

Weir Flow for Equipment Resources, North half PLD #1, 100yr Q=5.0cfs #315.003

Trapezoidal Weir

Crest = Sharp
Bottom Length (ft) = 6.00
Total Depth (ft) = 0.50
Side Slope (z:1) = 4.00

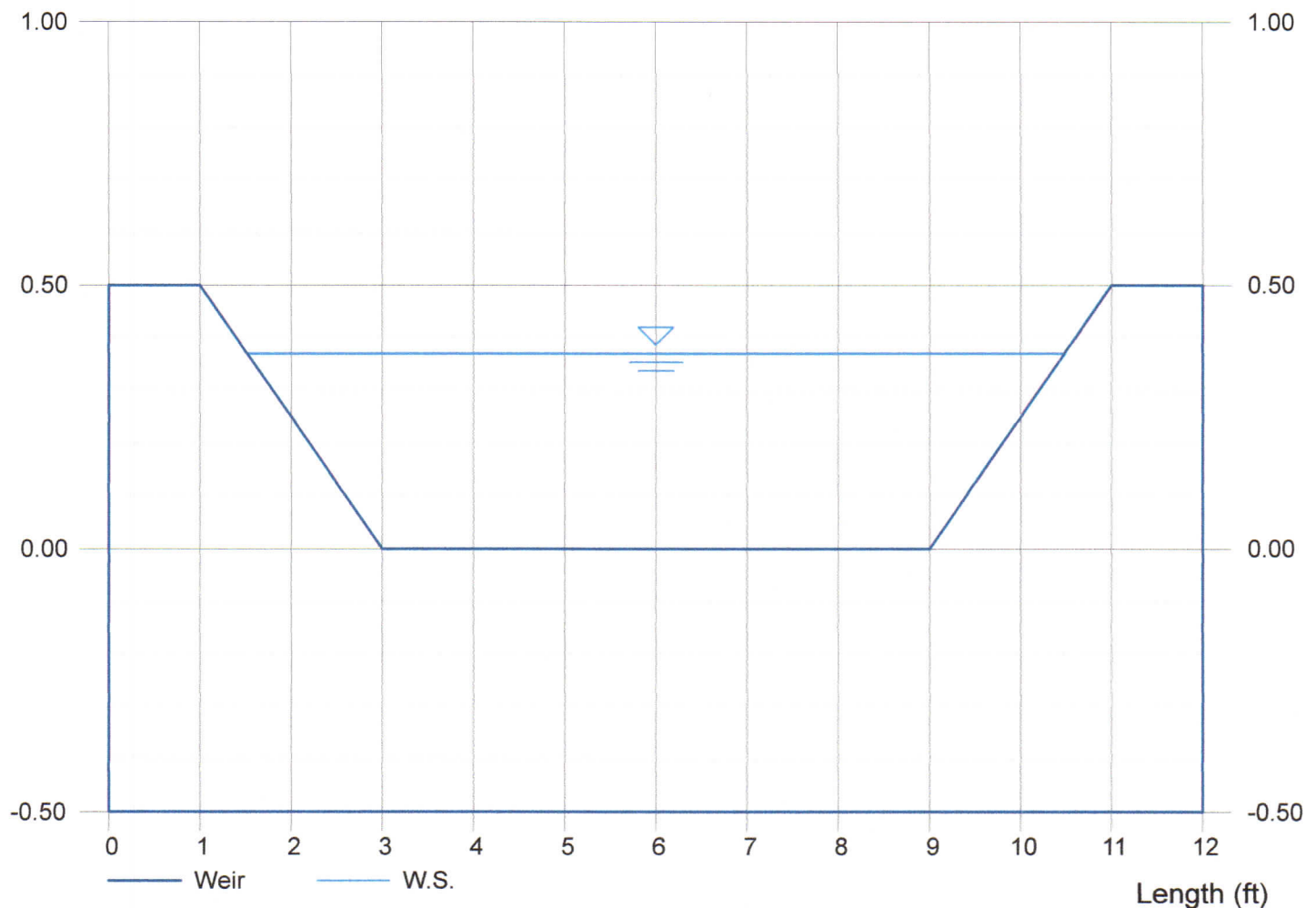
Highlighted

Depth (ft) = 0.37
Q (cfs) = 5.000
Area (sqft) = 2.77
Velocity (ft/s) = 1.81
Top Width (ft) = 8.96

Calculations

Weir Coeff. Cw = 3.10
Compute by: Known Q
Known Q (cfs) = 5.00

Depth (ft) Weir Flow for Equipment Resources, North half PLD #1, 100yr Q=5.0cfs #315.003 Depth (ft)



Weir Report

Hydraflow Express by Intelisolve

Monday, Feb 25 2019, 2:56 PM

Weir Flow for Equipment Resources, South half PLD #2, 100yr Q=6.4cfs #315.003

Trapezoidal Weir

Crest = Sharp
Bottom Length (ft) = 8.00
Total Depth (ft) = 0.50
Side Slope (z:1) = 4.00

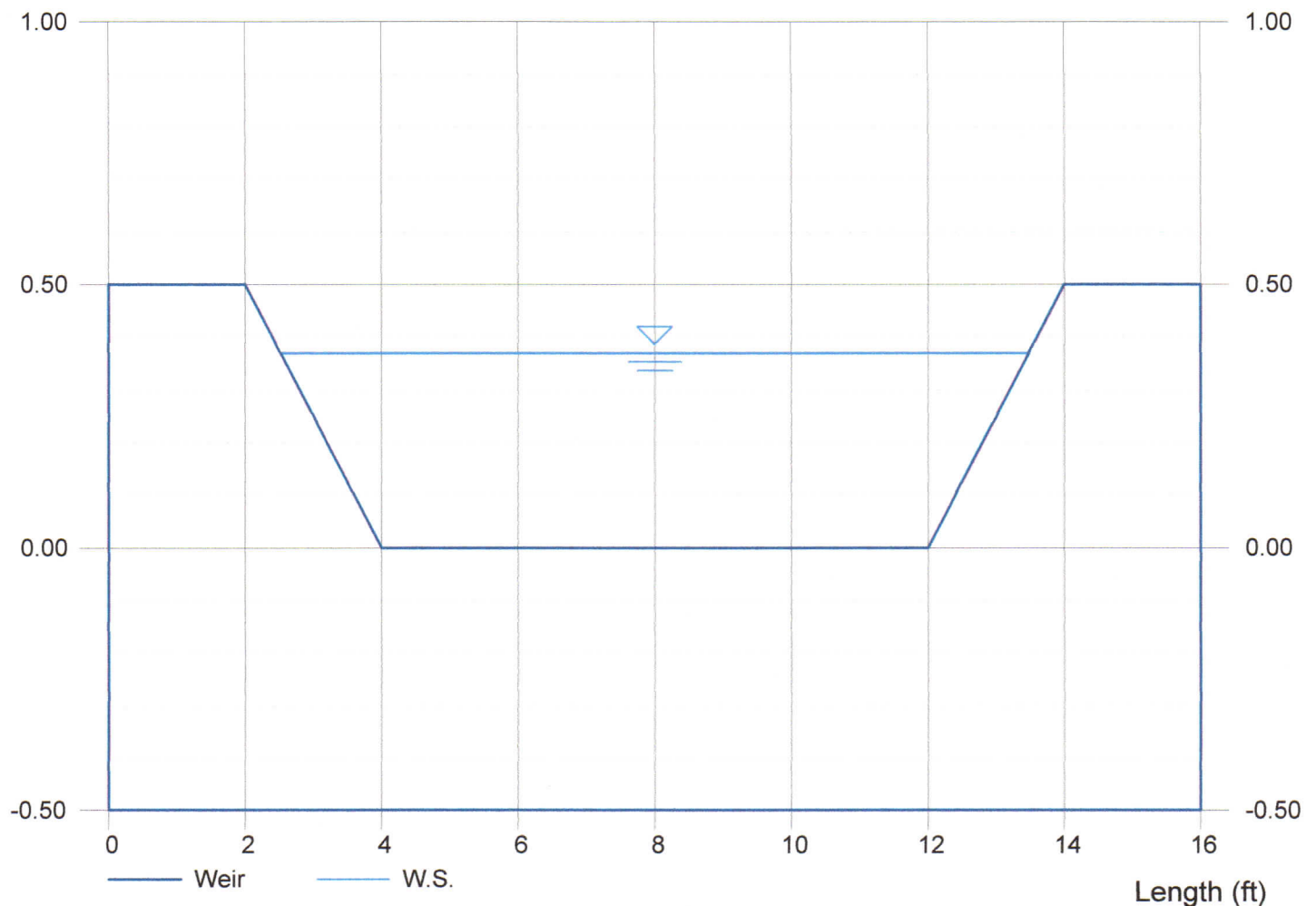
Highlighted

Depth (ft) = 0.37
Q (cfs) = 6.400
Area (sqft) = 3.51
Velocity (ft/s) = 1.82
Top Width (ft) = 10.96

Calculations

Weir Coeff. Cw = 3.10
Compute by: Known Q
Known Q (cfs) = 6.40

Depth (ft) Weir Flow for Equipment Resources, South half PLD #2, 100yr Q=6.4cfs #315.003 Depth (ft)



APPENDIX C – WATER QUALITY CALCULATIONS

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: Leonard Beasley
 Company: Core Engineering Group
 Date: January 1, 2019
 Project: Equipment Resources (N. Half) #315.003
 Location: 7340 Utah Lane, El Paso County, CO

PLD #1

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
 (100% if all paved and roofed areas upstream of rain garden)
- B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)
- C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time
 (WQCV = $0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$)
- D) Contributing Watershed Area (including rain garden area)
- E) Water Quality Capture Volume (WQCV) Design Volume
 Vol = (WQCV / 12) * Area
- F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
 (Only if a different WQCV Design Volume is desired)

$I_a = 100.0$ %

$i = 1.000$

WQCV = 0.40 watershed inches

Area = 3,960 sq ft

$V_{WQCV} = 132.0$ cu ft

$d_s =$ in

$V_{WQCV \text{ OTHER}} =$ cu ft

$V_{WQCV \text{ USER}} =$ cu ft

2. Basin Geometry

- A) WQCV Depth (12-inch maximum)
- B) Rain Garden Side Slopes ($Z = 4$ min., horiz. dist per unit vertical)
 (Use "0" if rain garden has vertical walls)
- C) Minimum Flat Surface Area
- D) Actual Flat Surface Area
- E) Area at Design Depth (Top Surface Area)
- F) Rain Garden Total Volume
 ($V_T = ((A_{Top} + A_{Actual}) / 2) * \text{Depth}$)

$D_{WQCV} = 8.1$ in

$Z = 4.00$ ft / ft

$A_{Min} = 79$ sq ft

$A_{Actual} = 80$ sq ft

$A_{Top} = 312$ sq ft

$V_T = 132.3$ cu ft

3. Growing Media

- Choose One _____
- ☒ 18" Rain Garden Growing Media
- ☐ Other (Explain):

4. Underdrain System

- A) Are underdrains provided?
- B) Underdrain system orifice diameter for 12 hour drain time
- i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice
- ii) Volume to Drain in 12 Hours
- iii) Orifice Diameter, 3/8" Minimum

- Choose One _____
- ☐ YES
- ☒ NO

$y = \text{N/A}$ ft

$Vol_{12} = \text{N/A}$ cu ft

$D_o = \text{N/A}$ in

Design Procedure Form: Rain Garden (RG)

Sheet 2 of 2

Designer: Leonard Beasley
 Company: Core Engineering Group
 Date: January 1, 2019
 Project: Equipment Resources (N. Half) #315.003
 Location: 7340 Utah Lane, El Paso County, CO

PLD #1

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One
☐ YES
☒ NO

6. Inlet / Outlet Control

A) Inlet Control

Choose One
☒ Sheet Flow- No Energy Dissipation Required
☐ Concentrated Flow- Energy Dissipation Provided

7. Vegetation

Choose One
☐ Seed (Plan for frequent weed control)
☐ Plantings
☒ Sand Grown or Other High Infiltration Sod

8. Irrigation

A) Will the rain garden be irrigated?

Choose One
☐ YES
☐ NO

Notes:

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

Designer: Leonard Beasley
 Company: Core Engineering Group
 Date: January 23, 2019
 Project: Equipment Resources (S. Half) #315.003
 Location: 7340 Utah Lane, El Paso County, CO

PLD #2

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)</p> <p>C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV = $0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$)</p> <p>D) Contributing Watershed Area (including rain garden area)</p> <p>E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area</p> <p>F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p>	<p>$I_a = 100.0$ %</p> <p>$i = 1.000$</p> <p>WQCV = 0.40 watershed inches</p> <p>Area = 4,665 sq ft</p> <p>$V_{WQCV} = 155.5$ cu ft</p> <p>$d_6 =$ in</p> <p>$V_{WQCV \text{ OTHER}} =$ cu ft</p> <p>$V_{WQCV \text{ USER}} =$ cu ft</p>
<p>2. Basin Geometry</p> <p>A) WQCV Depth (12-inch maximum)</p> <p>B) Rain Garden Side Slopes ($Z = 4$ min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)</p> <p>C) Minimum Flat Surface Area</p> <p>D) Actual Flat Surface Area</p> <p>E) Area at Design Depth (Top Surface Area)</p> <p>F) Rain Garden Total Volume ($V_T = ((A_{Top} + A_{Actual}) / 2) * \text{Depth}$)</p>	<p>$D_{WQCV} = 9.0$ in</p> <p>$Z = 4.00$ ft / ft</p> <p>$A_{Min} = 93$ sq ft</p> <p>$A_{Actual} = 95$ sq ft</p> <p>$A_{Top} = 326$ sq ft</p> <p>$V_T = 157.8$ cu ft</p>
<p>3. Growing Media</p>	<p>Choose One _____</p> <p><input checked="" type="radio"/> 18" Rain Garden Growing Media</p> <p><input type="radio"/> Other (Explain): _____</p>
<p>4. Underdrain System</p> <p>A) Are underdrains provided?</p> <p>B) Underdrain system orifice diameter for 12 hour drain time</p> <p>i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice</p> <p>ii) Volume to Drain in 12 Hours</p> <p>iii) Orifice Diameter, 3/8" Minimum</p>	<p>Choose One _____</p> <p><input checked="" type="radio"/> YES</p> <p><input type="radio"/> NO</p> <p>$y =$ ft</p> <p>$Vol_{12} =$ cu ft</p> <p>$D_o =$ in</p>

Design Procedure Form: Rain Garden (RG)

Sheet 2 of 2

Designer: Leonard Beasley
 Company: Core Engineering Group
 Date: January 23, 2019
 Project: Equipment Resources (S. Half) #315.003
 Location: 7340 Utah Lane, El Paso County, CO

PLD #2

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One
☐ YES
☒ NO

6. Inlet / Outlet Control

A) Inlet Control

Choose One
☒ Sheet Flow- No Energy Dissipation Required
☐ Concentrated Flow- Energy Dissipation Provided

7. Vegetation

Choose One
☐ Seed (Plan for frequent weed control)
☐ Plantings
☒ Sand Grown or Other High Infiltration Sod

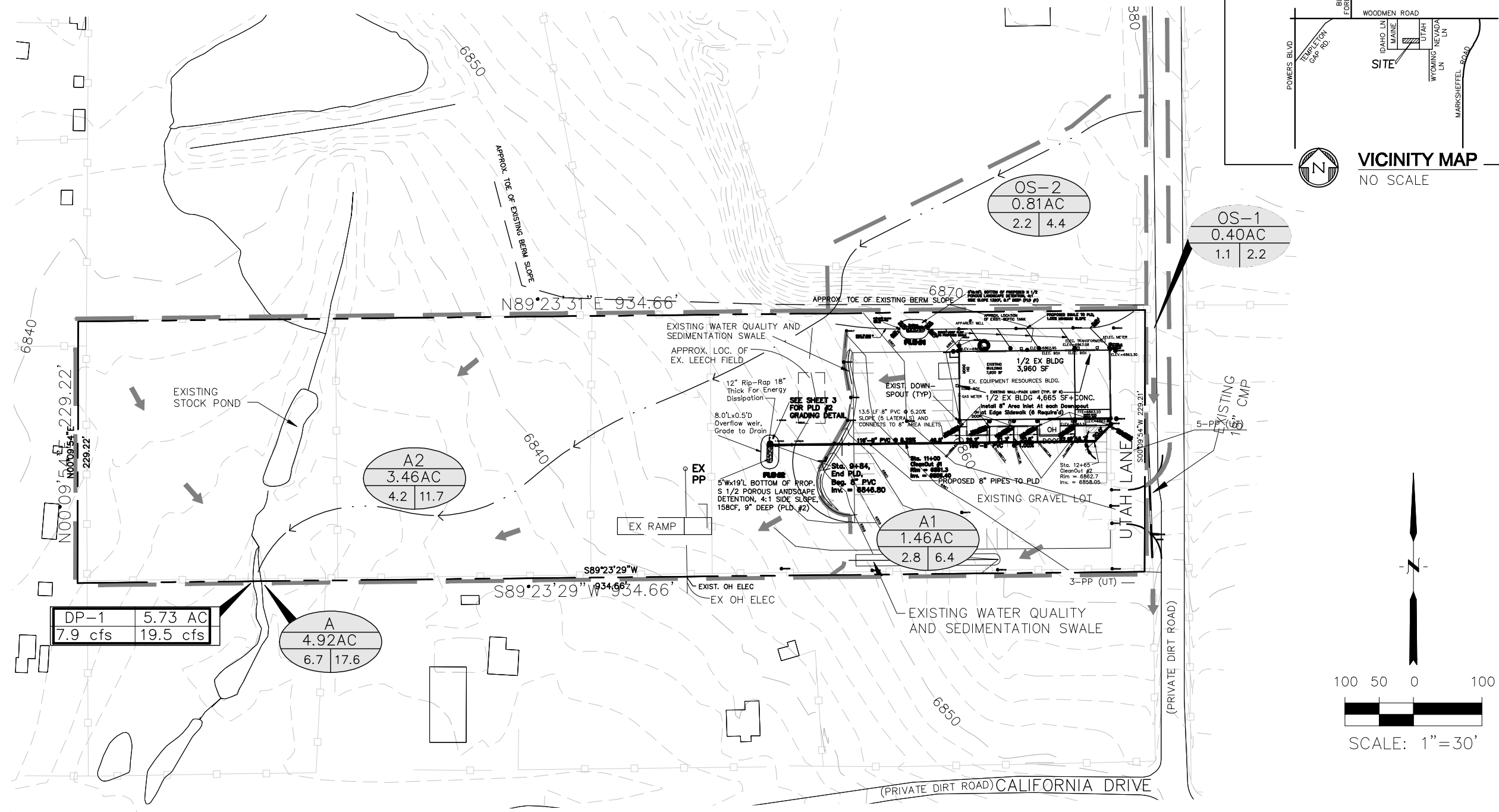
8. Irrigation

A) Will the rain garden be irrigated?

Choose One
☐ YES
☐ NO

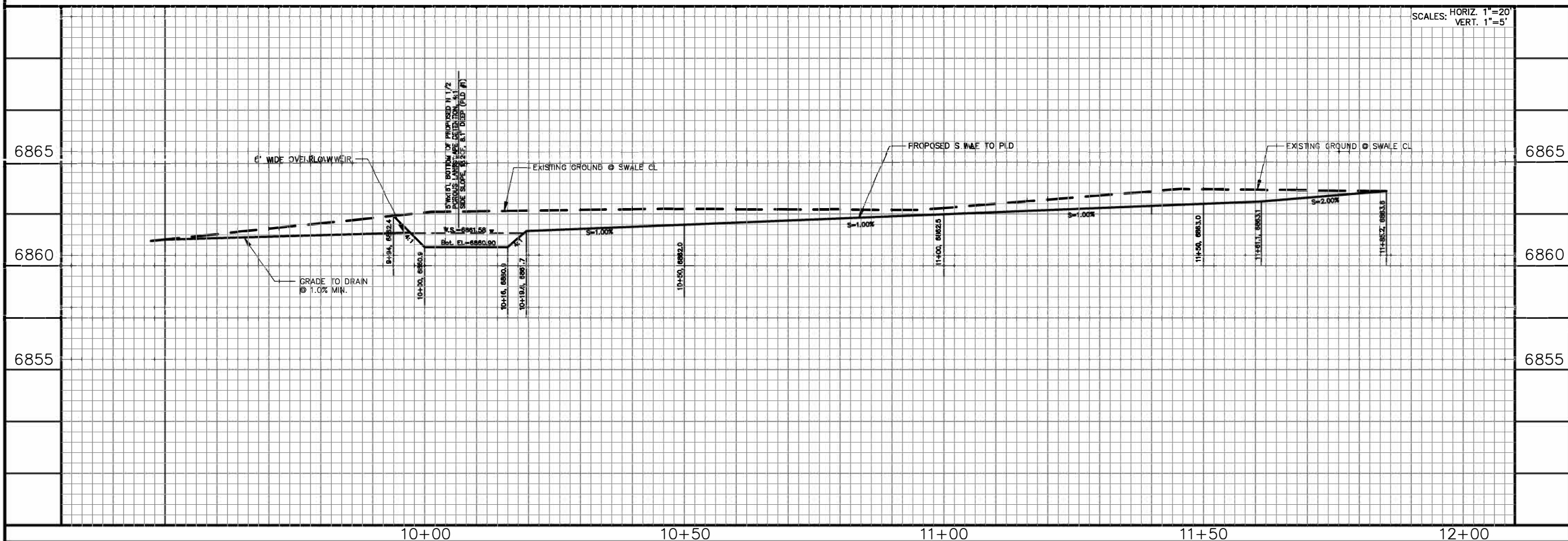
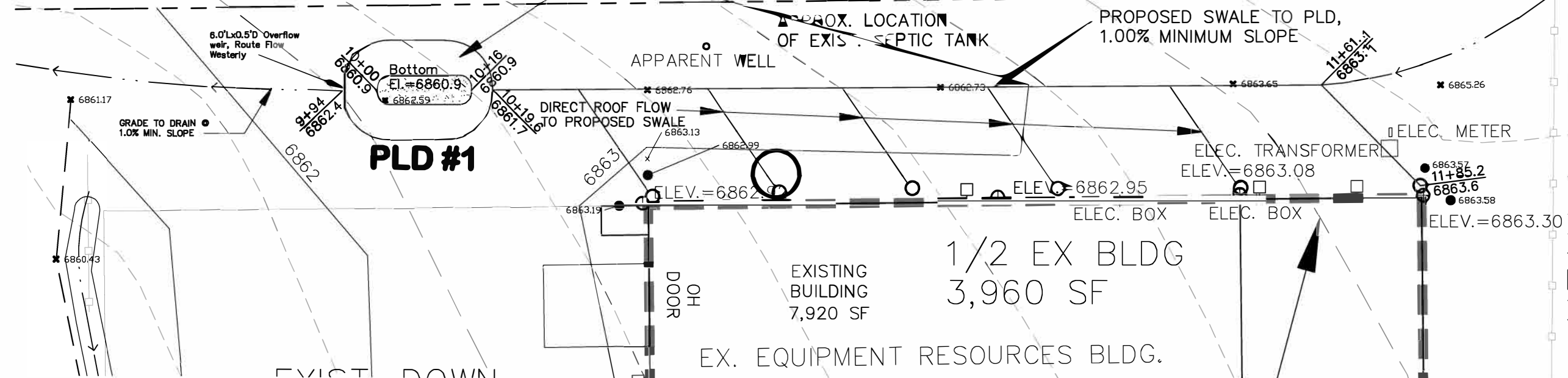
Notes:

APPENDIX D – DRAINAGE MAP, STORM P&P, PLD #1 & #2





5'Wx16'L BOTTOM OF PROPOSED N 1/2
POROUS LANDSCAPE DETENTION, 4:1
SIDE SLOPE 132CF, 8.1" DEEP (PLD #1)



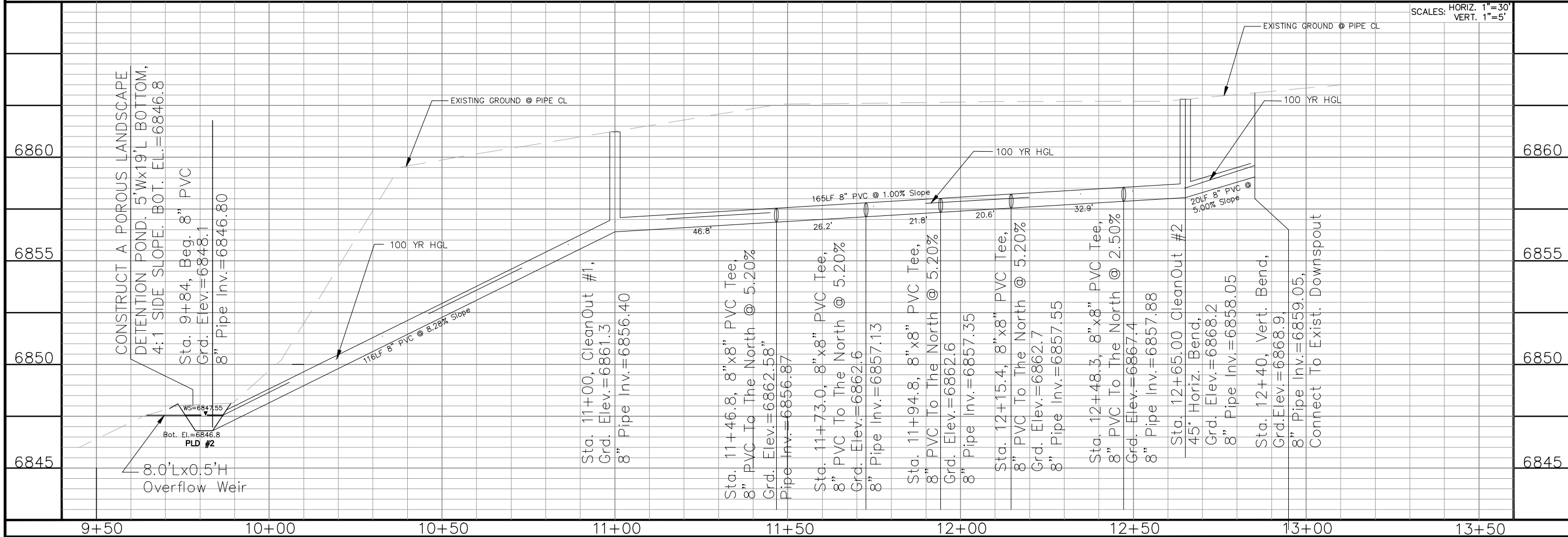
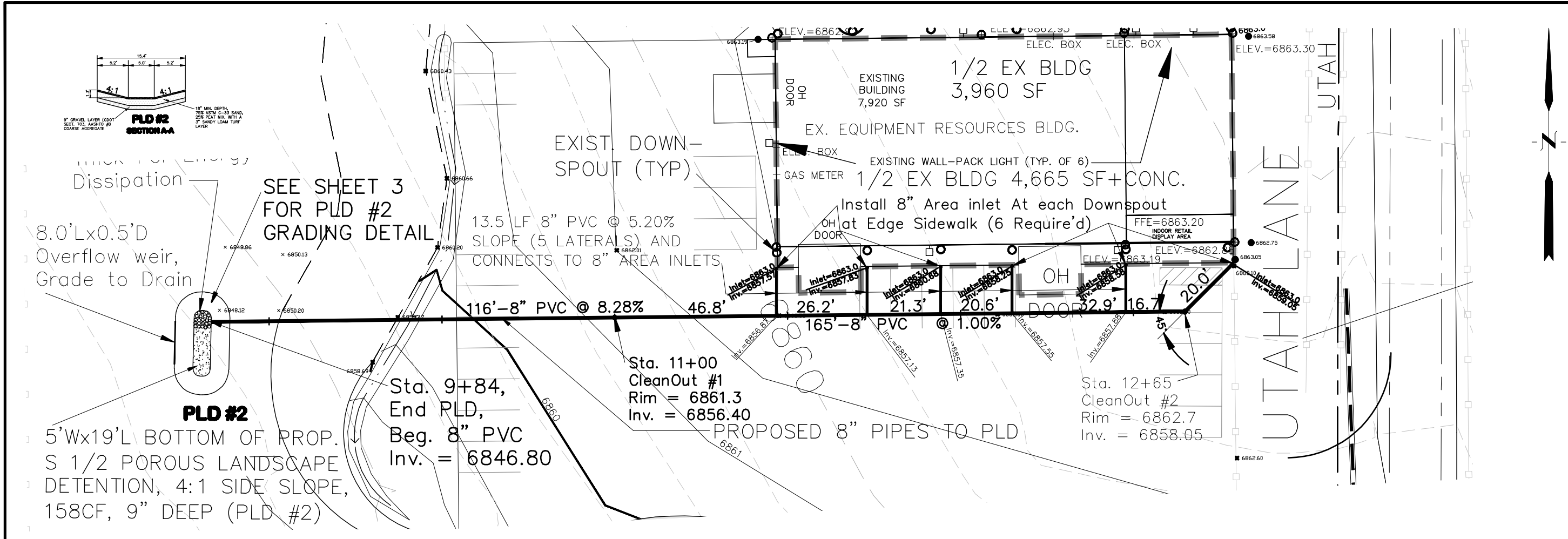
PLAN AND PROFILE
SURFACE SWALE to PLD #1
7340 UTAH LANE
EL PASO COUNTY, COLORADO

DATE:
FEB. 2019

PROJECT NO.
315.003

SHEET NUMBER
3 of 5

TOTAL SHEETS:



CORE ENGINEERING GROUP 15004 1st AVENUE SOUTH BURNSVILLE, MN 55306 PH: 719.570.1100 FAX: 719.570.1106 EMAIL: RICH@coreg1.com	
DATE: _____	
DESCRIPTION: _____	
NO. _____	
PROJECT: EQUIPMENT RESOURCES 7340 UTAH LANE EL PASO COUNTY, COLORADO	PREPARED FOR: T-P ENTERPRISES, INC. 5055 E. 39th AVENUE DENVER, COLORADO 80207 CONTACT: DATE FORKRELL
DRAWN: LAB DESIGNED: LAB CHECKED: RLS	
PLAN AND PROFILE 8" STORM PIPE TO PLD #2 7340 UTAH LANE EL PASO COUNTY, COLORADO	
DATE: FEB. 2019	
PROJECT NO. 315.003	
SHEET NUMBER 4 of 5	
TOTAL SHEETS: _____	

