

# Final Drainage Report

For: Ms. Phyllis Didleau

## Forest Heights Estates

**Project No. 2019.012**

**October, 2023**

PCD File No: MS206

Prepared for:

**Phyllis Didleau**

8250 Forest Heights Drive  
Colorado Springs, CO 80908  
719-440-1949

**Prepared by:**

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## APPENDIX

- Exhibit 1: General Location Maps
- Exhibit 2: FEMA FIRM Map
- Exhibit 3: SCS Soils Map and Data
- Exhibit 4: Charts and Tables
- Exhibit 5: Kettle Creek Drainage Basin Planning Study Exhibits
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- Exhibit 12: Discussion Summaries and Meeting Minutes with El Paso County
- Exhibit 13: Photos
- Exhibit 14: Maintenance Agreement
- Exhibit 15: Historic/ Developed Drainage Conditions Map

**CERTIFICATIONS AND APPROVALS**

**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 drainage 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 omission on my part in preparation this report

Signature *Kenneth C. Harrison - P.E.*  
(Kenneth C. Harrison, P.E.)

Registered Professional Engineer of Colorado No. 23635

Seal



**Owner's Statement**

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

*Phyllis Didleau* *Sept. 29, 2023*  
(Signature)

\_\_\_\_\_  
(Phyllis Didleau)

Address: 8250 Forest Heights Drive  
Colorado Springs, CO 80908

**El Paso County**

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

Josh Palmer  
El Paso County Engineer

\_\_\_\_\_  
(Signature) (Joshua Palmer)

Date: \_\_\_\_\_

## I. REPORT PURPOSE

The purpose of this study is to evaluate the drainage characteristics for the historic and the developed conditions of the **Didleau Subdivision Filing 1** (the site) in accordance with **El Paso County** criteria. The subdivision subdivides the **Didleau** tract into three (3) lots for single family residences. This analysis will demonstrate that there is only a negligible increase in runoff with the development of the site.

## II. GENERAL DESCRIPTION

### Location

The site is a portion of the southwest quarter of Section 9, Township 12 South, Range 65 West of the 6<sup>th</sup> Principal Meridian, El Paso County, Colorado (*Exhibit 1, Appendix*).

The current tract consists of approximately 32.59 acres with 5.11 acres located north of Forest Heights Circle and 27.48 acres located south of Forest Heights Circle. It is proposed to subdivide the tract into 3 lots. The sizes of the lots are:

- Lot 1: 5.0 acres north of Forest Heights Circle
- Lot 2: 5.183 acres south of Forest Heights Circle
- Lot 3: 7.686 acres south of Forest Heights Circle
- Lot 4: 12.108 acres south of Forest Heights Circle
- Tract A: 0.598 acres of the existing 60-foot-wide roadway right of way beginning at the easterly right of way line of Herring Road extending easterly for approximately 434-feet.
- Tract B: 2.093 acres from approximately 950 feet east of Herring Road to the existing cul-de-sac at the easterly end of Forest Heights Road.
- The roadway is also designed with two (2) areas to accommodate fire trucks.

There is a 40-foot-wide easement where three (3) gas lines are located and run north and south. Two (2) carry natural gas are owned and managed by Kinder Morgan. The third line carries liquid petroleum and is owned by Magellan. Contact information is on “flags” located directly over the lines. It is recommended that the contractor notify the companies 72 hours in advance of construction.

## III. DESIGN CRITERIA AND METHODOLOGY

The hydrologic and hydraulic characteristics for both the historic and developed conditions of the site were evaluated using the following resources;

- **Design Manuals**
  - ***El Paso County Drainage Criteria Manual, Volume I.***  
The charts and graphs used from this manual are reproduced in *Exhibit 4 of the Appendix*.
  - ***City of Colorado Springs Drainage Criteria Manual applicable charts and nomographs were included.***  
The charts and graphs used from this manual are reproduced in *Exhibit 4 of the Appendix*.
  - **Soil Survey of El Paso County Area, Colorado United States Department of Agriculture, Soil Conservation Service**  
(See *Appendix, Exhibit 3*)

- **Flood Insurance Rate Map, Federal Emergency Management Agency**  
(See Appendix, Exhibit 2)
- **Kettle Creek Drainage Basin Planning Study**  
(See Appendix, Exhibit 5)
- **Design storms**
  - Minor storm: 5-year  
This storm was used to size drainage facilities that cross under Forest Heights Circle.
  - Major storm: 100-year  
This storm was used to evaluate overland flow through the subdivision as it pertains to impacts on existing residences and the existing roadway when overtopped.
- **Drainage Areas**
  - Areas for the offsite and onsite sub basins were determined from topographic mapping from the El Paso County GIS department. This mapping was used as the base for the Drainage Map included in a map pocket (*Exhibit 11, Appendix*) at the back of this report.
- **Runoff Methods**
  - **Rational Method**  
This method is used to determine runoff quantities for sub basins with less than 100 acres. Intensity-Duration-Frequency (IDF) curves were obtained from the EPC Drainage Criteria Manual (DCM) (*Appendix, Exhibit 4*).
- **Culvert Evaluation**  
Sizing
  - The criteria in Table 6-1 of the Drainage Criteria Manual Chapter 6 were used as the criteria by which each culvert was evaluated.
  - The 100-year storm was used to evaluate the over topping and/or overflow conditions at the three (3) culverts under Forest Heights Drive as well as impacts on the existing structures within the vicinity of the existing swales discussed in this report.
- **Drainage Swale and Borrow Ditch Evaluation**
  - Onsite and offsite drainage swales and the borrow ditches on north side of Forest Heights Drive were evaluated for erosion potential and depth of flow.
  - The assumptions that were made in the evaluation of the culverts are described in the pertinent sections of the report.
  - The Froude Number was calculated to determine the state of flow, subcritical vs. supercritical. Supercritical flow only became an issue when excessive velocities were calculated for either the minor or major storm events.

- **Detention/ Water Quality**
  - The detention/ water quality pond requirements are addressed in Section XII.
- **Erosion control**
  - Erosion issues were identified and evaluated based on the estimated velocities in the existing swales.

**IV. EXISTING REPORTS, MAPPING AND INFORMATION**

- The project is located in the upper reaches of the **Kettle Creek Drainage Basin** (*Appendix, Exhibit 5*).
- No drainage reports have been prepared for any of the tracts that surround the site.

**V. FEMA FLOODPLAIN**

The project is within Zone X as shown on the Flood Rate Insurance Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0320G, and dated December 7, 2018. (*Appendix, Exhibit 2*). New construction within this zone is subject to minimal flooding hazards.

**VI. HYDROLOGIC SOILS INFORMATION**

The hydrologic soils groups were obtained from the USDA National Resource Conservation Service website for soils types in El Paso County, Colorado (***Appendix, Exhibit 3***). The soils are identified as follows:

- Elbeth sandy loam (SCS No. 26)
- Kettle Gravelly Loam (SCS No. 40)

The soils and their detailed characteristics are described in ***Exhibit 3, Appendix***. The hydraulic soils group is classified within the B hydrologic group.

**VII. OFFSITE DRAINAGE CONDITIONS**

Topographic mapping was obtained from El Paso County GIS Department. The site drains from northeast to southwest through the site. There are five (5) defined drainageways that enter and exit the site. All of the drainageways discharge into the Burgess River which discharges into Kettle Creek. The vegetation is characterized by highland grasses and Ponderosa Pine trees. The areas are typically developed as rural large-acre single-family residential tracts with only a small portion of each tract mowed around the residences. The majority of the roads that provide access to these tracts are two lane rural gravel roads with borrow ditches.

**VIII. EXISTING/ PROPOSED CONDITIONS CHARACTERISTICS**

**1.0 General**

The proposed hydrologic conditions for this site are nearly identical as the existing conditions except for the construction of single-family residential structures. As a result, both the existing and developed conditions are discussed in this section.

The site is primarily hilly with natural drainage ways. The site, both north and south of Forest Heights Drive, slope from the northeast to the southwest with an average slope of 4.5%. The drainage ways cross Forest Heights Drive via culverts at three (3) locations. The existing Corrugated Metal Pipes (CMPs) will be replaced by Reinforced Concrete Pipe

(RCP) culverts. The size of the proposed pipes will be further described within this section.

The site is vegetated with medium height prairie grasses, small bushes, and Ponderosa Pines. A portion of the site was burned by the Black Forest fire in 2013. There are only negligible signs of erosion except for a small amount in the borrow ditches along both sides of Forest Heights Circle. A significant amount of ash has silted the existing culverts.

The subdivision is located in northerly end of El Paso County in the upper reaches of Kettle Creek (**Exhibit 5, Appendix**).

### **1.1 Forest Heights Drive**

Forest Heights Drive serves as the primary access for the subdivision. The road was initially built in the 1970's. Minimal maintenance has been accomplished since then. The proposed construction will be accomplished according to the El Paso County criteria. The proposed private road is to be a graveled two-lane road with borrow ditches on either side along with three (3) culvert crossings. The road extends approximately 2,450-feet east of the Herring Drive intersection. Forest Heights Circle is currently privately owned and maintained. The improvements are to extend from the Herring Drive intersection to approximately 2400 feet east to an existing cul-de-sac.

The road has a "right-of-way" width of 60 feet with a small portion of only 30-feet wide adjacent to and south of the Yonce lot. The road is currently maintained by Jon and Phyllis Ditleau. Future maintenance will be through a maintenance association" will be established and executed by the majority of the homeowners (Exhibit 14, Appendix)

The road crosses three (3) drainage ways, all of which will be discussed in subsequent sections of this report. The approximate locations of the crossings are shown on the drainage plan included in *Exhibit 15, Appendix* at the back of the report.

The erosion and subsequent sedimentation within the project are minimal and only occurs during large storm events. The majority of the erosion and sedimentation has occurred in sections of the existing roadside borrow ditches along each side of Forest Heights Circle. To help minimize erosion and sedimentation during construction, BMPs are recommended. The types and locations of the BMPS are indicated on the Grading and Erosion Control Plan.

### **1.3 Swales**

The site is drained by five (5) natural swales, three (3) of which cross Forest Heights Circle via existing 18-inch CMP culverts. In proposed conditions, the existing CMP culverts at Culverts 1 & 2 will be replaced with a 24" RCP at each culvert location. Culvert 3 will be replaced with an 18" RCP. The water is then carried in a southwest direction. All of the swales, with the exception of the borrow ditches along Forest Heights Circle, are characterized as follows:

- The drainage-ways cross the site in a northeast to southwest direction. They are characterized by large natural cross sections with large bottom widths and gentle side slopes.
- Seasonally wet areas are located in and along low areas and at locations where seasonal ground water comes to the surface. The approximate location of these areas is shown on the Grading and Erosion Control Plan. Drainage easements are shown on the plat along the locations of the swales.
- The upper reaches of the Burgess River, noted as Swale 1, crosses at the most

- easterly end of Forest Heights Circle at DP1.
- All of the drainage ways are well established and stable with natural vegetation and only a negligible amount of erosion as shown in the pictures.
  - All swales were evaluated for Developed Conditions.

### **1.4 Culverts**

There are three (3) Corrugated Metal Pipe (CMP) culverts that are to be replaced with Reinforced Concrete Pipe (RCP) culverts routes the water under Forest Heights Circle. All three (3) culverts were evaluated based on inlet control with a free outfall and no sediment. Each culvert is discussed under the applicable Design Point (DP) numbers included in the following sections. As explained above, the sediment in the existing culverts consist of a significant amount of ash and silt. The proposed culverts cross under Forest Heights Circle at stations: 1+70, 12+32, and 22+55 feet east of the Herring Road intersection. The proposed culvert locations and profiles can be found on the submitted Roadway Construction Set. Once under Forest Heights Circle the water is routed in a southwesterly direction in natural drainage swales with the same characteristics as described above. All of the swales are stable with only negligible signs of erosion. The depth of flow for water overtopping the road has been evaluated in accordance with DCMV1, Chapter 6.

### **2.0 Design Points**

The Design Points (DP) shown on the Drainage Map were located where natural drainage ways cross Forest Heights Circle, swale intersections, and any other point of interest.

#### **2.1 Design Point 1**

Runoff from Sub basin A (17.4 Acres) is collected via a natural swale. In existing conditions, the water is routed to an existing 18" CMP culvert (Culvert 1) which discharges into a natural broad swale. This culvert is approximately 75% full of ash from the 2013 fire and negligible amount of sediment from upstream. It is recommended that this culvert be replaced with a 24" RCP culvert attached to concrete headwall at the downstream side of Forest Heights Circle. Both Swales 1 and 2 are heavily vegetated and only show a negligible amount of erosion (photo 2, 6). Special precaution will be needed in constructing the road in the vicinity of the culvert. There is an apparent "Riparian Wetland" area found both upstream and downstream of the culvert. Approximate boundaries are indicated on the Drainage Plan. Accurate identification and boundaries of the wetland areas are beyond the scope of this report.

**Swale 1** has the following:

#### **Physical Characteristics:**

- Average slope: 4.5 %
- Bottom width: varies from 50 feet to 75 feet
- Average side slopes: varies from 15 to 1.
- Typical vegetation: Highland grasses, bushes and Ponderosa Pines trees.

#### **Hydrologic/ hydraulic characteristics:**

- Design flow: Q5 = 3.7 cfs, Q100 =24.0 cfs
- Depth of Flow: 5 year = 0.1 feet, 100 year = 0.2 feet
- Velocity: 5 year = 1.2 fps, 100 year = 2.7 fps
- Froude #: 5 year = 0.91 Subcritical, 100 year = 1.16 supercritical.



Discussion:

Swale 1 collects the water in sub basin A and directs it to the proposed 24" RCP culvert under the private road at DP1. From DP1, this runoff is routed to DP7 where it combines with runoff from sub-basin F and G. The swale from DP2 to DP7 is noted as Swale 2 on the drainage plan. The existing swale is very stable with significant vegetation.

**Existing Culvert 1** has the following:

Physical characteristics:

- Size: 18"
- Material: Corrugated Metal Pipe
- Slope: Unknown
- End Sections: None

Hydrologic/ hydraulic characteristics:

- Existing Design flow: Q5 = 3.4 cfs, Q100 = 23.6 cfs
- Headwater required to pass (for clean pipe): 5 year = 12.8", 100 year = greater than 7.5 feet (significant roadway overtopping occurs) Based on conversations with the residents, roadway overtopping has infrequently occurred with larger storm events.

Discussion:

The existing culvert has minimal capacity due to sedimentation and the poor end conditions. Overtopping of the roadway is anticipated even with possibly the minor storm event. The downstream end (photo 5) controls the amount of water that the culvert can accommodate. The end is buried with approximately 75% of sediment where wetlands have been established. Sediment removal in the bottom of the existing swale is not recommended since this would require excavating the existing wetland areas for a significant distance downstream.

**Proposed Culvert 1** has the following:

Physical characteristics:

- Size: 24"
- Material: Reinforced Concrete Pipe
- Slope: 5.4%
- End Sections:
  - Upstream: 24" RCP Flared End Section (FES)
  - Downstream: Concrete Headwall/Level Spreader

Hydrologic/ hydraulic characteristics:

- Proposed Design flow: Q5 = 3.7 cfs, Q100 = 24.0 cfs
- Invert Elevation: 7579.5 feet
- Crown Elevation: 7583.0 feet
- Max Pipe Flow: 24.0 cfs
- No Roadway Overtopping in the 5-year event
- No Roadway Overtopping in 100-year event

**2.2 Design Point 2**

Runoff from Sub basin B (20.8 Acres) is collected via a natural swale, Swales 3, 3a, and 3b, and passes under Forest Heights Circle at DP4 (photos 17, 18, 19). The water passes under Forest Heights Circle via an 18" CMP, Culvert 2 (photos 21 and 24) in existing conditions. This culvert will be replaced with a 24" RCP. There are no wetlands draining to Design Point 2 according to the US Fish and Wildlife National Wetlands Inventory.

**Swales 3, 3a, 3b** have the following:

Average physical characteristics:

- Average slope: 4.6 %
- Bottom width: varies from 20 feet to 40 feet
- Average side slopes: 10 to 1.
- Typical vegetation: meadow with high grass, bushes, with a few Ponderosa Pines.

Hydrologic/ hydraulic characteristics:

- Design flow: Q5 = 4.6 cfs, Q100 = 29.5 cfs
- Depth of Flow: 5 year = 0.1 feet, 100 year = 0.3 feet
- Velocity: 5 year = 1.8 fps, 100 year = 3.7 fps
- Froude #: 5 year = 1.04 Supercritical, 100 year = 1.26 Supercritical

Discussion:

Swale 3a and 3b join together at approximately 300 feet upstream of the culvert (Culvert 2). The vegetation along the entire length of Swale 3 is well established with only a minimal amount of erosion.

**Existing Culvert 2** has the following:

Physical characteristics:

- Size: 18"
- Material: Corrugated Metal
- Slope: Undetermined
- Condition: ends are crushed, heavy sediment, dense grass and weed growth at both the upstream and downstream ends.
- End Sections: no end sections are present.

Hydrologic/ hydraulic characteristics:

- Existing flow: Q5 = 4.4 cfs, Q100 = 29.1 cfs
- Headwater for clean pipe: 5 year = 15.3" (meets criteria), 100 year = >9ft (does not meet criteria, significant road overtopping occurs, no buildings are in danger of being inundated)

Discussion:

The existing culvert has minimal capacity due to the amount of sediment and poor end conditions. Overtopping of the roadway is anticipated even with minor storm events. The downstream end controls the amount of water that the culvert can accommodate. The end is buried approximately 75% in the sediment where grass and weeds have choked the exit conditions.

**Proposed Culvert 2** has the following:

Physical characteristics:

- Size: 24"
- Material: Reinforced Concrete
- Slope: 3.2%
- End Sections: 24" RCP Flared End Sections (FES) on upstream & downstream.
- Type M Void Filled Riprap on downstream portion.

Hydrologic/ hydraulic characteristics:

- Proposed Design flow: Q5 = 4.6 cfs, Q100 = 29.5 cfs
- Invert Elevation: 7548.4 feet
- Roadway Crown Elevation: 7553.99 feet
- Max Pipe Flow: 29.9 cfs
- No Roadway Overtopping in 5-year event

- No Roadway Overtopping in 100-year event

### **2.3 Design Point 3**

Runoff from Sub basin C, D, and overflow flow from Culvert 2 is collected by the roadside Swales 15 &16. Runoff from Sub basin E (2.3 acres) is routed to DP3 via a natural swale. The cumulative water (Q5: 5.9 cfs, Q100: 33.7 cfs) passes under Forest Heights Circle via an 18" corrugated culvert (Culvert 3) (photo 41, 43). The existing culvert is to be replaced by a proposed 18" RCP culvert.

From DP3 the runoff is routed in a broadly defined swale, Swale 8, south of Forest Heights Road in a southwesterly direction. The swale is characterized by a wide bottom with very gradual side slopes. The area which Swale 8 is located in is an extensive seasonal wet area. No erosion and sedimentation has been noted along the entire length of Swale 8. These flows continue to DP5 located within the southern portion of Sub-basin I.

**Swale 8** has the following:

Physical characteristics:

- Average slope: 3.3 %
- Bottom width: average of 35 feet.
- Average side slopes: varies from 30 to 1.
- Typical vegetation: regularly mowed and maintained

Should be DP4 per plan. Please verify that labeling in the narrative matches the drainage plan for all design points

Hydrologic/ hydraulic characteristics:

- Design flow: Q5 = 8.7 cfs, Q100 = 43.8 cfs
- Depth of Flow: 5 year = 0.1 feet, 100 year = 0.3 feet
- Velocity: 5 year = 1.8 fps, 100 year = 3.1 fps
- Froude #: 5 year = 0.91 Subcritical, 100 year = 1.06 super critical

Discussion:

- There are no proposed change of imperviousness within Sub-basin I as this sub-basin contains offsite property.

**Swale 6** has the following:

Physical characteristics:

- Average slope: 6.0 %
- Bottom width: varies from 20 feet to 30 feet
- Average side slopes: varies from 10 to 1.
- Typical vegetation: meadow with high grass and Ponderosa Pine trees

Hydrologic/ hydraulic characteristics:

- Proposed Design flow: Q5 = 4.1 cfs, Q100 = 20.3 cfs
- Depth of Flow: 5 year = 0.1 feet, 100 year = 0.2 feet
- Velocity: 5 year = 1.9 fps, 100 year = 3.5 fps
- Froude #: 5 year = 1.18 Supercritical, 100 year = 1.37 super critical

**Existing Culvert 3** has the following:

Physical characteristics:

- Size:18"
- Material: Corrugated Metal Pipe

- Slope: Undetermined
- Condition: silted to about 80%.
- End Sections: none

Hydrologic/ hydraulic characteristics:

- Design flow: Q5 = 5.9 cfs, Q100 = 28.7 cfs (includes runoff from Sub basin D & E)
- Depth required to pass: 5 year = 16.7" (meets El Paso County criteria), 100 year =>9 ft. (does not meets El Paso County criteria except that no buildings will be inundated).

Discussion:

- The existing culvert is approximately 80% full of silt and ash from the 2013 fire and only passes a portion of the minor storm event. It is expected that the roadway will be overtopped during the majority of the minor storm events and well as all of the major storm events. There are no structures downstream that are in danger of being flooded.

**Proposed Culvert 3** has the following:

Physical characteristics:

- Size: 18"
- Material: Reinforced Concrete Pipe
- Slope: 1.0%
- End Sections: 18" RCP Flared End Sections (FES) on upstream and downstream.
- Type VL Riprap on downstream.

Hydrologic/ hydraulic characteristics:

- Design flow: Q5 = 5.9 cfs, Q100 = 28.7 cfs (includes runoff from Sub basin C)
- Invert Elevation: 7515.50 feet
- Max Ponding Elevation: 7518.2 feet
- Max Depth: 2.7 feet
- Pipe Flow: Q5 = 5.9 cfs, Q100 = 13.0 cfs
- Roadway Overtopping: Q5 = 0 cfs, Q100 = 15.7 cfs
- Max Depth Above Road Crown: >0.1 feet

C, D, & E are conveyed to culvert 3

DP3 above indicates flows of 33.7 cfs. Revise accordingly so that there is no discrepancy

Discussion: The roadway is overtopped in the 100-year event as currently happens in the existing condition. All culvert pipe flows and overtop flows continue south downstream in the existing natural swale.

**2.5 Design Point 4**

Once the water passes under Forest Heights Drive via Culvert 3 at DP4, the water is routed to a private 18" CMP located under an existing **private** paved residential driveway located south of the Forest Heights' subdivision. This driveway is **not located** in the proposed subdivision. The upstream invert of the **private** 18" culvert is significantly higher than the elevation of the upstream swale. This creates the remote possibility of upstream ponding. No hydrologic and/ or hydraulic information regarding the design and placement of this culvert could be obtained. However, based on discussions with the current residents, this upstream ponding condition has never been observed. Since the increase in runoff, as a result development is minimal, it is safe to assume that only negligible changes to the hydrologic and hydraulic conditions will occur and that any increase in the flows will not adversely affect the existing hydraulic properties of the existing private

driveway culvert.

**Culvert at Design Point 4 (privately owned and adjacent to the project site under a paved driveway. The project site has several structures. The culvert has the following:**  
**Hydrologic/ hydraulic characteristics:**

- Existing Design Flow: Q5 = 7.1 cfs, Q100 = 1.6 cfs
- Design flow: Q5 = 8.7 cfs, Q100 = 2.2 cfs
- Point 3 which includes Sub-basins: C,D,E
- Runoff from Sub basin I flows southerly via Swale 8 to the ponding area located upstream of the culvert at Design Point 4.

review 3 comment: if the sites developed flows are conveyed and adversely impact this culvert them it must be analyzed/upgraded accordingly.  
 Review 4: unresolved. flows have increased because of this developments flows and the increase shall be mitigated. Identify the ponding depth of the flow within this ponding area just upstream of this culvert. Identify whether the flow will over top the culvert/driveway or whether the total flow is contained within this area? please analyze and address.

As stated above, an evaluation of culvert at offsite Design Point 4 is beyond the scope of this report. Flows at this location are negligibly affected with increases in discharges of Q5 = 1.6 cfs and Q100 = 2.2 cfs. The drainage area is considerably larger than the total area of the proposed subdivision. Also, a substantial amount of man hours would be required to evaluate the existing "ponding area" located upstream of Design Point 4.

**2.6 Design Point 5**

DP5 is located at an existing culvert that crosses Herring Road. DP6 contains flows from Swales 4 & 8. This runoff flows into a "natural ponding area" next to Herring Road. These flows are conveyed by an existing 36" CMP to the west across Herring Road. The ponding area is poorly defined and only seasonally wet. In order to evaluate the ponding area would require significant additional topo of the additional drainage area contributing and manpower in order to develop a reasonably accurate for design flow, ponding depth, discharge rates, etc. Due to the minimal increase in storm water flow (Appendix, Exhibit 4) it is safe to conclude the increase would not have any detrimental effect on downstream property owners and drainage facilities.

DP5

**Swale 4** has the following:

**Physical characteristics:**

- Average slope: 3.3 %
- Bottom width: average of 85 feet.
- Average side slopes: varies from 3 to 1.
- Typical vegetation: regularly mowed and maintained.

**Hydrologic/ hydraulic characteristics:**

- Design flow: Q5 = 10.2 cfs, Q100 = 64.2 cfs
- Depth of Flow: 5 year = 0.1 feet, 100 year = 0.2 feet
- Velocity: 5 year = 1.4 fps, 100 year = 2.9 fps
- Froude #: 5 year = 0.87 Subcritical, 100 year = 1.06 super critical

**Swale 8** has the following:

**Physical characteristics:**

- Average slope: 3.3 %
- Bottom width: average of 35 feet.
- Average side slopes: varies from 3.0 to 1.
- Typical vegetation: regularly mowed and maintained.

**Hydrologic/ hydraulic characteristics:**

swale 8 on page 11 indicates 30 to 1 slope. revise so that they are consistent

Review 3 comment: Staffs concern is the adequacy of the ditch and culvert along Herring Road that is receiving the developed flows from this development. Please analyze the downstream facilities, identify any improvements, and provide a comparison of the existing and proposed flows at DP 10 and 11 to prove that the developments effects are minimal and the downstream facilities are adequate.

Review 4: Unresolved. Analysis of the culvert and downstream is required as flows are increasing developed flows must be conveyed to a suitable outfall (refer to ECM 3.2.4)

Swale 8 above on page 11 indicates 43.8 cfs Revise so that they are consistent.

Flow: Q5 = 8.7 cfs, Q100 = 48.0 cfs  
Flow: 5 year = 0.1 feet, 100 year = 0.3 feet  
Velocity: 5 year = 1.8 fps, 100 year = 3.1 fps  
Froude #: 5 year = 0.91 Subcritical, 100 year = 1.06 super critical

existing condition the total flows at Design Point 5 are Q5 = 16.8 cfs and Q100 = 104.2 cfs. The developed Design flows at Design Point 5 are Q5 = 18.9 cfs, Q100 = 107.2 cfs. This represents negligible increases of 2.1 cfs in the 5-year event and 3.0 cfs in the 100-year event. Analysis of this ponding area is beyond the scope of this study since any increase in runoff will only have a negligible effect on the existing ponding area as well as any existing culverts. It was also deemed that the hydraulic and hydrologic conditions created would only have a minimal effect on the existing conditions at DP5.

Runoff from Sub basin A, F, G (46.0 acres) is collected via a natural swale, Swale 12, and is routed to DP7. The swale is also noted as the upper portion of the Burgess River. The characteristics that are listed below were obtained from measurements taken from topographic data provided by El Paso County for the portion of the Burgess River located in Sub basin G. This section of the Burgess River is characterized by large bottom widths, gradual side slopes, relatively steep slopes, and established wetlands. These flows continue offsite as in existing conditions with negligible impacts to the downstream neighbors.

**Swale 12** has the following:

Physical characteristics:

- Average slope: 6.1%
- Bottom width: 40 feet
- Average side slopes: 15 to 1.
- Typical vegetation: meadow with well-established high grass, wetland plant species, and a few Ponderosa Pine trees

Hydrologic characteristics:

- Design flow: Q5 = 9.8 cfs, Q100 = 63.3 cfs
- Depth of Flow: 5 year = 0.1 feet, 100 year = 0.3 feet
- Velocity: 5 year = 2.2 fps, 100 year = 4.9 fps
- Froude #: 5 year = 1.2 Supercritical, 100 year = 1.7 Supercritical,
- BMPs: as shown on the Grading and Erosion Control Plan

Discussion: The total existing condition flows at Design Point 6 are Q5 = 8.9 cfs and Q100 = 62.1 cfs. The developed Design flows at Design Point 6 are Q5 = 9.8 cfs, Q100 = 63.3 cfs. This represents negligible increases of 0.9 cfs in the 5-year event and 1.2 cfs in the 100-year event.

**2.8 Design Point 7**

Runoff from Sub basin J (3.4 acres) is collected via Swale 11. Water in this swale exits the project site at DP7. The upper end of the swale begins approximately at the southerly property line of Lot 3. These flows continue offsite as in existing conditions with negligible impacts to the downstream neighbors.

Analysis for DP 6 is missing. Please provide.

**Swale 11** has the following:

Physical characteristics:

- Average slope: 3.1%
- Bottom width: average of 60 feet.
- Average side slopes: varies from 15 to 1.
- Typical vegetation: regularly mowed and maintained.

Hydrologic/ hydraulic characteristics:

- Design flow: Q5 = 1.0 cfs, Q100 = 7.1 cfs
- Depth of Flow: 5 year = Neg, 100 year = 0.1 feet
- Velocity: 5 year = 0.6 fps, 100 year = 1.4 fps
- Froude #: 5 year = 0.7 Subcritical, 100 year = 0.86 subcritical

Discussion: The total existing condition flows at Design Point 7 are Q5 = 1.0 cfs and Q100 = 7.1 cfs. The developed condition Design flows at Design Point 7 are the same as existing with no increase in the 5-year event or the 100-year event.

### **3.0 Roadside Swales**

The following hydraulic and hydrologic analyses are based on the following conditions and assumptions:

- The areas of the sub basins contributing runoff to the roadside borrow ditches were estimated. Typically, not all of the runoff from sub basins enters the swales adjacent to the road. Some of the water is routed directly to the culvert via existing swales located within the sub basin. It was assumed there would be no backwater due to limited culvert capacity. However, without further field information and culvert analysis, this condition is not possible to accurately determine. Included in the drainage areas is one-half of the gravel roadway.
- The developed flows from the 5-year and 100-year storms were determined based on the percentage of the area assumed to be contributing to the runoff. All flows are based on the developed conditions.
- 5 minutes was used for the Time of Concentration for all swales.
- The slopes of the swales were obtained from the roadway construction plans.
- The physical characteristics of the swales are based on the typical section indicated on the construction plans.
- Types of flow, sub critical and supercritical, were determined for each swale.
- Recommended BMPs were determined from the estimated velocity and not from flow type.
- BMPs: types and locations are shown on the Grading and Erosion Control Plan

### **3.1 Swale 13**

- Location: Roadside Swale 13 is located along station 17+50 on the north side of Forest Heights Drive between DP 3 & DP4. Flow is directed from the east to the west.
- Drainage Area: 0.41 acres
- Design flow: Q100 = 5.7 cfs
- Slope: 6.7%
- Depth of Flow: 100 year = 0.84 feet
- Velocity: 100 year = 2.3 fps
- Froude #: 100 year: supercritical
- BMPs: as shown on the Grading and Erosion Control Plan

DP1 & DP2 on the plan. Please verify that labeling in the narrative matches the drainage plan

### **3.2 Swale 14**

- Location: Roadside Swale 14 is located along station 14+50 on the north side of Forest Heights Drive from DP 3 to DP4. Flow is directed from the west to the east. Runoff from a small section of Sub basin B is handled by this swale.
- Drainage Area: 0.4 acres
- Design flow: Q100 = 0.1 cfs
- Slope: 1.0%
- Depth of Flow: 100 year = 0.2 feet
- Velocity: 100 year = 0.8 fps
- Froude #: 100 year: subcritical
- BMPs: as shown on the Grading and Erosion Control Plan

DP1 & DP2

### **3.3 Swale 15**

- Location: Roadside Swale 15 is located along station 4+50 on the north side of Forest Heights Drive from just west of DP2 to culvert 3. It collects water from a portion of Sub basin D. There is no swale along the south side of Forest Heights Drive since all of the water flows overland to the south away from the road.
- Drainage Area: <0.1 acres
- Design flow: Q100 = 10.7 cfs
- Slope: 4.4%
- Depth of Flow: 100 year = 0.8 feet
- Velocity: 100 year = 4.7 fps
- Froude 100 year = Supercritical
- BMPs: 4 Ditch Check Structures installed every 135 feet from Sta 4+50 to 9+25
- BMPs: as shown on the Grading and Erosion Control Plan

DP2

### **3.4 Swale 16**

- Location: Roadside Swale 16 is located along station 2+25 on the north side of Forest Heights Drive from just west of DP6 to culvert 3. It collects water from a portion of Sub basin D. There is no swale along the south side of Forest Heights Drive since all of the water flows overland to the south away from the road.
- Drainage Area: 5.1 acres
- Design flow: Q100 = 15.7 cfs
- Slope: 4.4%
- Depth of Flow: 100 year = 1.1 feet
- Velocity: 100 year = 3.8 fps
- Froude #: 100 year = Sub critical.
- BMPs: as shown on the Grading and Erosion Control Plan

## **IX. REPRESENTATIVE DEVELOPED CONDITIONS CHARACTERISTICS**

### **General Overview**

The developed conditions were evaluated based on the following conservative assumptions. The assumptions are representative of the type of “development” that has historically occurred within the adjacent areas.



### **Area**

A hypothetical area of 1.5 acres was used to determine average runoff coefficients for the developed conditions of an individual lot. The improvements to each lot would typically include a residence, landscaping, and a gravel driveway.

### **Composite Runoff Coefficient (representative)**

Area of proposed development: 1.5 acres; C5 = 0.08 C100 = 0.35

- Roof area: 2800 sf; C5 = 0.73 C100 = 0.81
- Lawn: 0.5 acres; C5 = 0.12 C100 = 0.39
- Gravel Drive: 4,000 sf; C5 = 0.59 C100 = 0.70
- Composite "C"; C5 = 0.16 C100 = 0.41

### **Time of Concentration**

Design runoff is determined using the longest time of concentration. It was expected that even for the "developed" conditions of the project, the controlling time of concentration would be the same as for the existing conditions. The following summarizes the negligible impact that the "developed" conditions have on the total runoff at the individual Design Points (Exhibit 9) as well as the negligible impact on the hydraulic parameters of each culvert (Exhibit 9, Table 4).

## **X. COMPARISON BETWEEN EXISTING AND DEVELOPED RUNOFF**

All recommended drainage facilities were designed based on developed conditions. Since there are only negligible increases in the design flows (see Exhibit 9, Tables 1, 2, and 3), subsequent changes to all of the hydraulic characteristics; velocity, Froude number, depth, etc.; are minimal.

### **Subdivision Discharge (at structure #4 under private driveway)**

"Developed" Discharge: 5 year = 20.8 cfs, 100 year = 124.5 cfs

Negligible changes to hydrologic conditions

#### **Sub Basin B**

- Existing Discharge: 5 year = 4.4 cfs, 100 year = 29.1 cfs
- "Developed" Discharge: 5 year = 4.6 cfs, 100 year = 29.5 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin C**

- Existing Discharge: 5 year = 1.4 cfs, 100 year = 7.9 cfs
- "Developed" Discharge: 5 year = 1.8 cfs, 100 year = 8.4 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin D**

- Existing Discharge: 5 year = 2.3 cfs, 100 year = 14.3 cfs
- "Developed" Discharge: 5 year = 2.7 cfs, 100 year = 14.8 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin E**

- Existing Discharge: 5 year = 1.0 cfs, 100 year = 4.9 cfs
- "Developed" Discharge: 5 year = 1.4 cfs, 100 year = 5.5 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin D & E**

- Existing Discharge: 5 year = 3.3 cfs, 100 year = 19.2 cfs
- “Developed” Discharge: 5 year = 3.4 cfs, 100 year = 20.3 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin F**

- Existing Discharge: 5 year = 2.8 cfs, 100 year = 20.7 cfs
- “Developed” Discharge: 5 year = 3.1 cfs, 100 year = 21.1 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin G**

- Existing Discharge: 5 year = 2.7 cfs, 100 year = 17.8 cfs
- “Developed” Discharge: 5 year = 3.0 cfs, 100 year = 18.2 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin H**

- Existing Discharge: 5 year = 5.3 cfs, 100 year = 34.3 cfs
- “Developed” Discharge: 5 year = 5.6 cfs, 100 year = 34.7 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin I**

- Existing Discharge: 5 year = 2.4 cfs, 100 year = 13.7 cfs
- “Developed” Discharge: 5 year = 2.8 cfs, 100 year = 14.3 cfs
- Negligible changes to hydrologic conditions

#### **Sub Basin J**

- Existing Discharge: 5 year = 1.0 cfs, 100 year = 7.1 cfs
- “Developed” Discharge: 5 year = 1.0 cfs, 100 year = 7.1 cfs It is assumed that there will be no development in “J”

### **XI. PROPOSED DRAINAGE IMPROVEMENTS**

The following drainage improvements are recommended:

- Grade the cross section of Forest Heights Circle to the revised typical section approved by El Paso County for this project (**Exhibit 4, Appendix**)
- Replace all of the culverts with 18” & 24” RCP culverts at a minimum slope of 1%. These culverts shall have the specified Flared End Sections, headwalls, and riprap pads as specified in the design point characteristics. The existing culverts are in very poor shape. Both ends are about 75% full of sediment. The ends of the culvert should be installed in accordance with El Paso County standards (**Exhibit 4, Appendix**).
- Locate the inverts for both ends of the culverts at or slightly above the flowline of the upstream and downstream swales. The culvert should be installed at a sufficient slope to allow for a cleansing velocity to develop.
- It is expected that riprap aprons at the downstream ends of Culverts 2 & 3 will be required. Culvert 1 will require a concrete headwall to mitigate erosive conditions. These culverts will experience full pipe flow during the 100-year event with high velocities greater than 7 feet per second. Riprap calculations can be found in the Appendix.

- In downstream natural swales, there is currently a substantial amount of vegetation typical in seasonally wet areas. No mitigation is necessary for these areas.
- Minimize any grading in the areas immediately upstream and downstream of the culverts to protect the existing “seasonally wet areas”. The areas occupied by “wetlands” are very stable. Disturbing the areas with grading would only increase the erosion potential.
- Install erosion control facilities as noted on the Grading and Erosion Control plan.
- Driveway culverts have purposely not been shown since the final locations will be determined during or after construction.

## **XII. DETENTION AND WATER QUALITY**

Since the runoff exits the “development” in numerous locations, installation of a detention water quality pond is not practical. Also, the proposed development only consists to 3 residential lots each with an estimate area of potential disturbance of less than an acre. It is anticipated the area to be disturbed with the addition of one (1) residence is as follows;

- Roof area: 2800 sf
- Lawn: 0.75 acres; 32,670 sf
- Gravel Drive: 4,000 sf
- Total Area to be disturbed = 39,470 sf or 0.9 acres

El Paso County Engineering Criteria Manual, Appendix I, contains the policies and procedures for Stormwater Quality. **Section I.7.1.B** provides for exclusions to the requirements to provide Post Construction Stormwater Quality facilities. All areas of the Forest Heights project qualify for the allowed exemptions. No water quality or detention facilities are required for this site as discussed below.

The project consists of 5-acre and larger single-family residential lots and a private gravel road with a 60 foot right of way (Forest Heights Drive). There are no activities or improvements that require permanent water quality facilities for this project based on the exclusions found in **Section I.7.1.5.B.2, Section I.7.1.5.B.3 and Section I.7.1.5.B.5.**

According to **Section I.7.1.B.5,**

*“A single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling and having a total lot impervious area of less than 10 percent is excluded.”*

The total area of the site is 32.59 acres (includes Lots 1 through 4 and the tracts along Forest Heights Road). Of the total 32.59 acres are comprised of lots varying in size from 5.0 acres to 20.17 acres residential lots and the remaining 2.691 acres is right-of-way along Forest Heights Drive. The total proposed disturbance to construct/ improve the road will be 3.4 acres which is also indicated on page 2 of the ESQCP. The total lot imperviousness for rural residential lots is less than 10%.

**Section I.7.1.B.2** of the ECM provides exclusion for Roadway Redevelopment as follows:

*“Redevelopment sites for existing roadways, when 1 of the following criteria is met: 1) The site adds less than 1 acre of paved area per mile of roadway to an existing roadway, or 2) The site does not add more than 8.25 feet of paved width at any location to the existing roadway”.*

The project involves adding new gravel surface to the existing Forest Heights Drive roadway to meet El Paso requirements. No asphalt pavement will be added to the roadway (criteria 1). The total area of disturbance for adding the gravel is 0.74 acres (criteria 1). The roadway width will be expanded from an average of 20' wide to a consistent 24' width of the travel way with 1' shoulders (criteria 2).

Also, **Section I.7.1.B.3** excludes Existing Roadway Areas.

*“For redevelopment sites for existing roadways, only the area of the existing roadway is excluded from the requirements of an applicable development site when the site does not increase the width by 2 times or more, on average, of the original roadway area. The entire site is not excluded from being considered an applicable development site for this exclusion. The area of the site that is part of the added new roadway area is still an applicable development site”.*

Again, the project will add new gravel surface to Forest Heights Drive up to 0.74 acres in area. The roadway width will be expanded from an average of 20' wide to a consistent 24' width of the travel way with 1' shoulders.

Storm Detention is not required for this site since the resulting flow increases from development is found to negligible and inconsequential as shown in the above sections. The comparison between existing flow and developed is shown on the Drainage Plan and in the applicable section summarized in Section 10 of the

### XIII. EROSION CONTROL

It is recommended that the following erosion control measures be implemented for Forest Heights Circle improvements and with the construction of the new residences:

- Permanent Seeding (PS) and Mulching (MU) on all disturbed areas
- Ditch Check Structures (See Detail in Appendix I)

Erosion control facilities are recommended to minimize erosion on both sides of Forest Heights Circle as well as along the driveways accessing the new residences. The erosion control facilities are shown on the Grading and Erosion Control Plan. It is recommended that the following:

- Sediment Control Logs (SCLs)
- Silt Fencing (SF)
- Erosion Control Blanket (ECB)
- Vehicle Tracking Control (VTC)
- Stabilized Staging Area (SSA)
- Stockpile Protection (SP)

### XIV. FOUR STEP PROCESS

The El Paso County Engineering Criteria Manual (**Appendix I, Section I.7.2**) recommends the consideration of a “Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long term source controls”.

Review 3: section 10 provides the comparison of the basin flows. It does not provide the cumulative flows at the design points (10,11,12, & 15) leaving the site. Please address the above comment. The downstream must be adequate/capable of receiving the sites developed flows without any negative impacts.

Review 4: please see comments above regarding design points 4 & 5. Design point 6 analysis is missing. The downstream must be adequate/capable of receiving the sites developed flows without any negative impacts. Please analyze.

It is determined in the section above that this project is exempt from the requirements of **Section I.7.1** to provide Post Construction Stormwater Management Facilities with Water Quality Capture Volume (WQCV). However, aspects of the Four Step Process are considered and implemented in the Forest Heights project as discussed below.

**Step 1: Reduce runoff by disconnecting impervious area, eliminating "unnecessary" impervious area and encouraging infiltration into soils that are suitable.**

The impervious areas for the project include roofs, concrete patios and sidewalks, and the possibility of asphalt driveways. All runoff from the impervious areas drains onto open grassed surfaces. All downspouts for each residence are planned to discharge either within landscaped areas or natural areas. The majority of the site will remain in its existing natural condition.

**Step 2: Treat and slowly release the WQCV.**

This project meets the exemptions or providing Post Construction Stormwater Management Facilities including facilities with Water Quality Capture Volume (WQCV) such as a Full Spectrum Detention Pond and therefore does not have the slow release WQCV component.

**Step 3: Stabilize stream channels.**

All existing swales will remain heavily vegetated with the existing natural grasses. All of the onsite swales are "U" shaped with wide bottoms widths and gentle side slopes. Based on visual observations the swales are very stable with only negligible indications of erosion. The vegetation for each swale includes medium height prairie grasses that are periodically mowed. It is not anticipated that any of the swales will be modified in the future. No building will be permitted in an area that impedes the existing flow of water. It can be safely assumed that the negligible increase in flow as a result of development will have minimal negative impacts on the existing onsite swales.

**Step 4: Implement source controls.**

The rural residential site is not anticipated to contain storage of potentially harmful substances or use of potentially harmful substances. No Site Specific or Other Source Control BMP's are required.

## **XV. CONSTRUCTION COST ESTIMATE (DRAINAGE IMPROVEMENTS)**

Item #	Item Description	Approx Quant	Units	Unit Price	Total Cost
1	Remove Existing 18" CMP	150	LF	\$25	\$3,750
2	Install 18" RCP	38.1	LF	\$76	\$2,896
3	Install 18" CMP Flared End Section	6	EA	\$456	\$2,736
4	Install 24" RCP	121.3	LF	\$121	\$14,714
5	Install 24" RCP Flared End Section	3	EA	\$728	\$2,183
6	Install Riprap Pads	34.1	TONS	\$115	\$3,922
7	Install Concrete Headwall (for 24" RCP)	1	EA	\$1,000	\$1,000
8	Install Ditch Check Structures	29.5	TONS	\$115	\$3,393
Sub Total					\$34,593
Contingency (10%)					\$3,459
Grand Total					\$38,052

**XVI. DRAINAGE FEE CALCULATIONS**

The drainage fee was determined based on a total of 32.59 acres with the development of 4 lots of greater 5 acres each. The site is located in the Kettle Creek Drainage Basin which has the following fees per each impervious acre (*Exhibit 4, Appendix*):

2020 Drainage Fee per impervious acre	\$ 10,305
<u>2020 Bridge Fee per impervious</u>	<u>\$ 0</u>
2020 Total Fees per impervious acre	\$ 10,305

Total Project Area = 32.59 acres  
 % Impervious = 7% per El Paso County for 5 acre lots  
 Impervious Area = 2.281 acres  
 Fee reduction for 5-acre lots = 25%  
 Total Impervious area = 1.711 acres

Total Fees = \$17,632

The Drainage Fees are to be paid prior to the recording of the plat.

**XVII. SUMMARY**

The report addresses the hydrologic and hydraulic parameters for both the existing and developed conditions for the entire site. It has been demonstrated that there will be insignificant increases in the runoff for the developed conditions. The three (3) existing culverts under Forest Heights Circle were evaluated on a limited basis to determine the anticipated hydraulic conditions.

It has been demonstrated that the existing 18" culverts do not have sufficient capacity due to the sedimentation and vegetative growth inside and around the ends of each culvert. It is recommended that these culverts be replaced with the previously mentioned 18 & 24-inch RCP culverts and the inverts set at elevations for the culvert can develop self-cleansing velocities. It has been discussed that extra care be exercised while grading the immediate areas upstream and downstream of the culverts where seasonally wet areas are located. Riprap erosion protection is required at the downstream ends of the culverts.

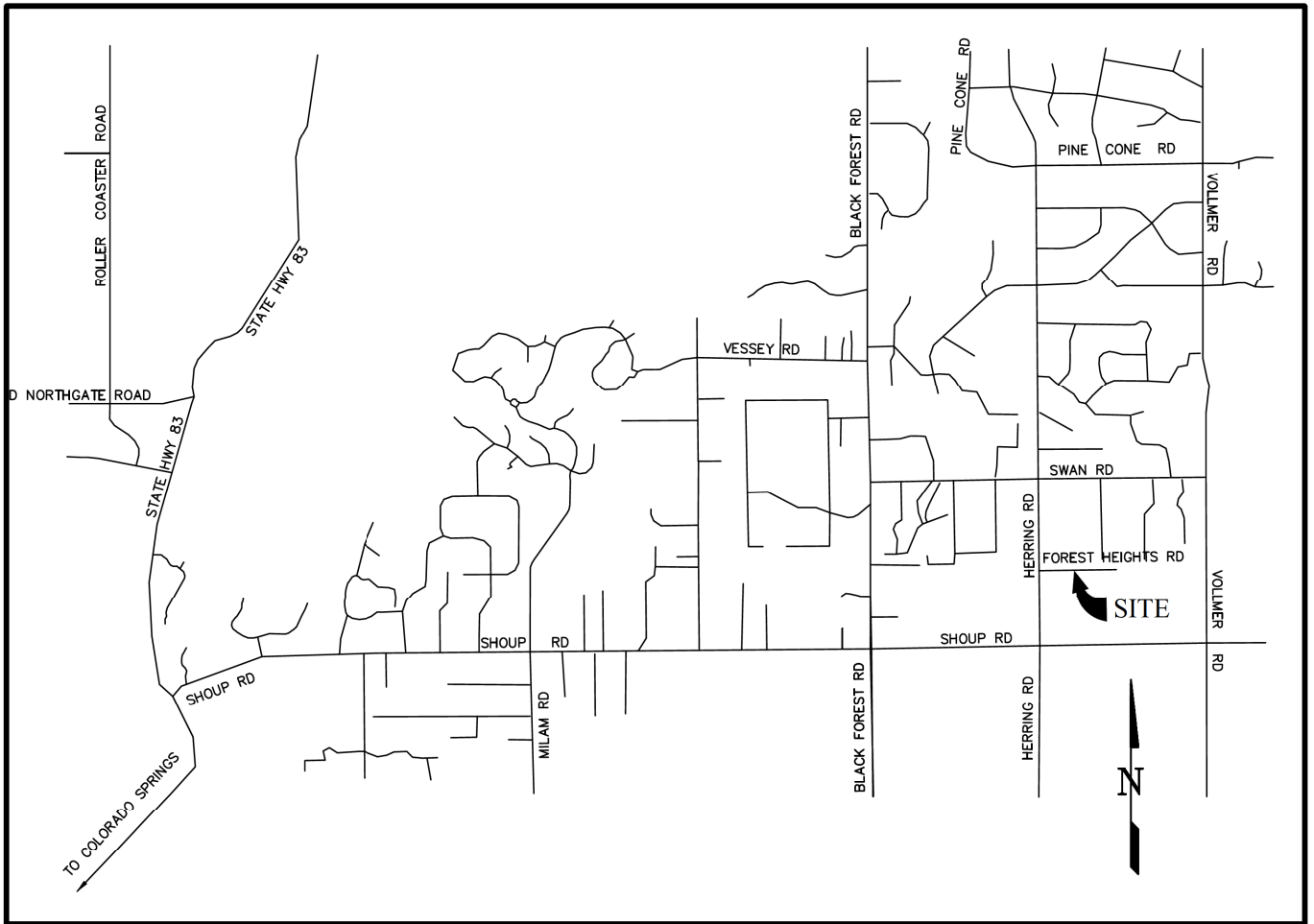
Specific types and dimensions are shown in Exhibit 8, Appendix. The insignificant increase associated with developed flows will not adversely affect the downstream nor the surrounding properties.

## **APPENDIX**

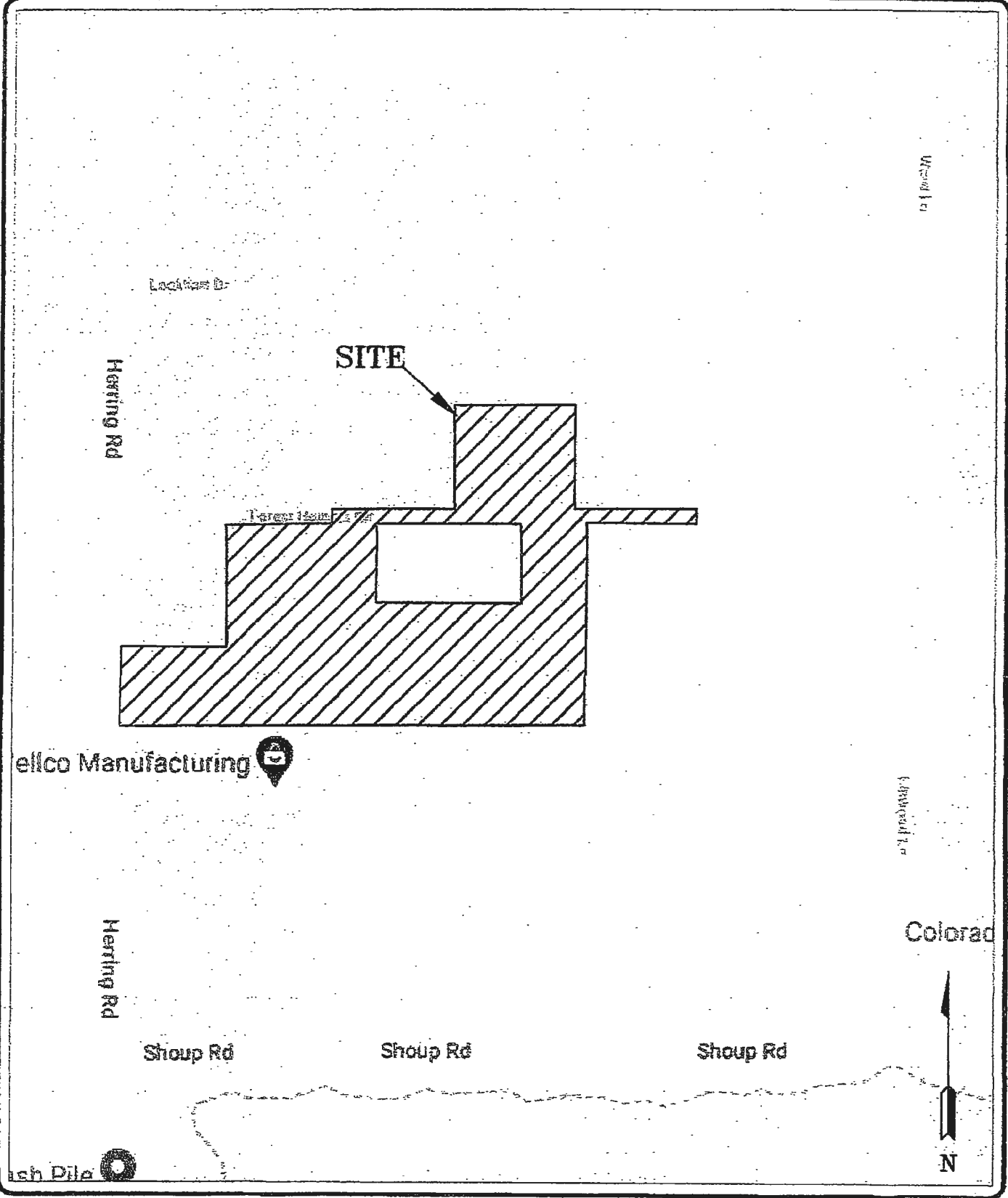



Forest Heights Estates  
Final Drainage Report, July 2023

Exhibit 1:  
General Location Map



**VICINITY MAP**  
**NOT TO SCALE**

**ENTECH**  
ENGINEERING, INC.  
565 ELKTON DRIVE  
COLORADO SPRINGS, CO. 80907 719.531.0399

VICINITY MAP  
DIDLEAU SUBDIVISION  
HERRING ROAD & FOREST HEIGHTS CIRCLE  
EL PASO COUNTY, CO.  
FOR: LDC, INC.

DRAWN: LLL	DATE: 2/28/20	CHECKED:	DATE:
---------------	------------------	----------	-------

JOB NO.:  
192115

FIG NO.:  
1



EL PASO COUNTY

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

ONE TOWNSHIP

ASSESSOR



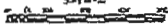
El Paso County Colorado



Rectangular Survey of One Section



December 22, 2017

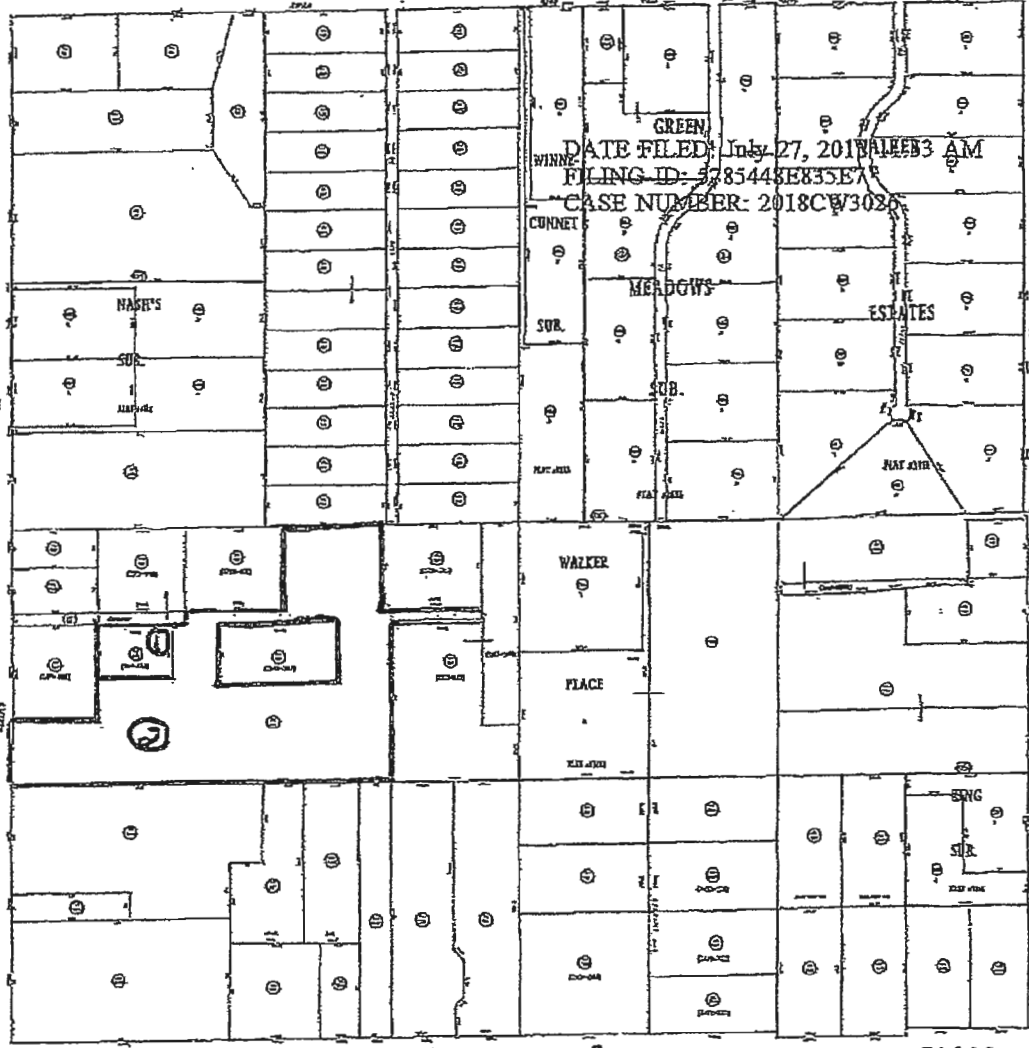


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ADJOINING 52010



ADJOINING 52020

ADJOINING 52010

ADJOINING 52060

52090

- ① Parcel 1
- ② Parcel 2

DATE FILED: July 27, 2018 11:53 AM  
 FILING ID: 20180727115357  
 CASE NUMBER: 2018CW3026

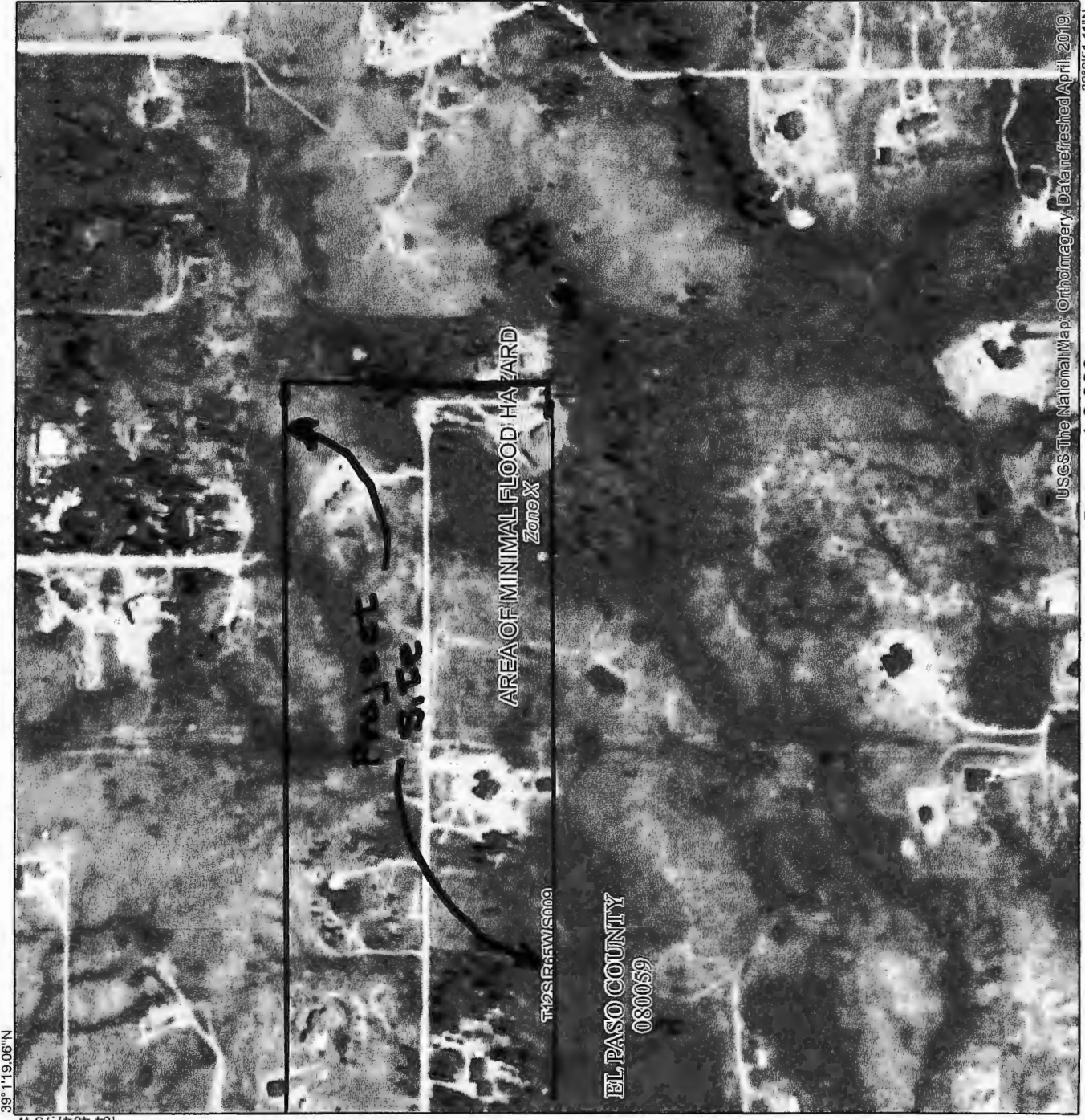
Exhibit 2:  
FEMA FIRM Map

# National Flood Hazard Layer FIRMette



FEMA

39°11'19.06"N



USGS The National Map, Orthorectified, Data refreshed April, 2019.



## 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

- 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**

- Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**OTHER AREAS**

**GENERAL STRUCTURES**

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

- 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
- 17.5 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 11/14/2019 at 3:46:08 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 undetermined areas cannot be used for regulatory purposes.

104°40'10.29"W

39°05'11.11"N

Exhibit 3:  
SCS Soils Map and Data



United States  
Department of  
Agriculture

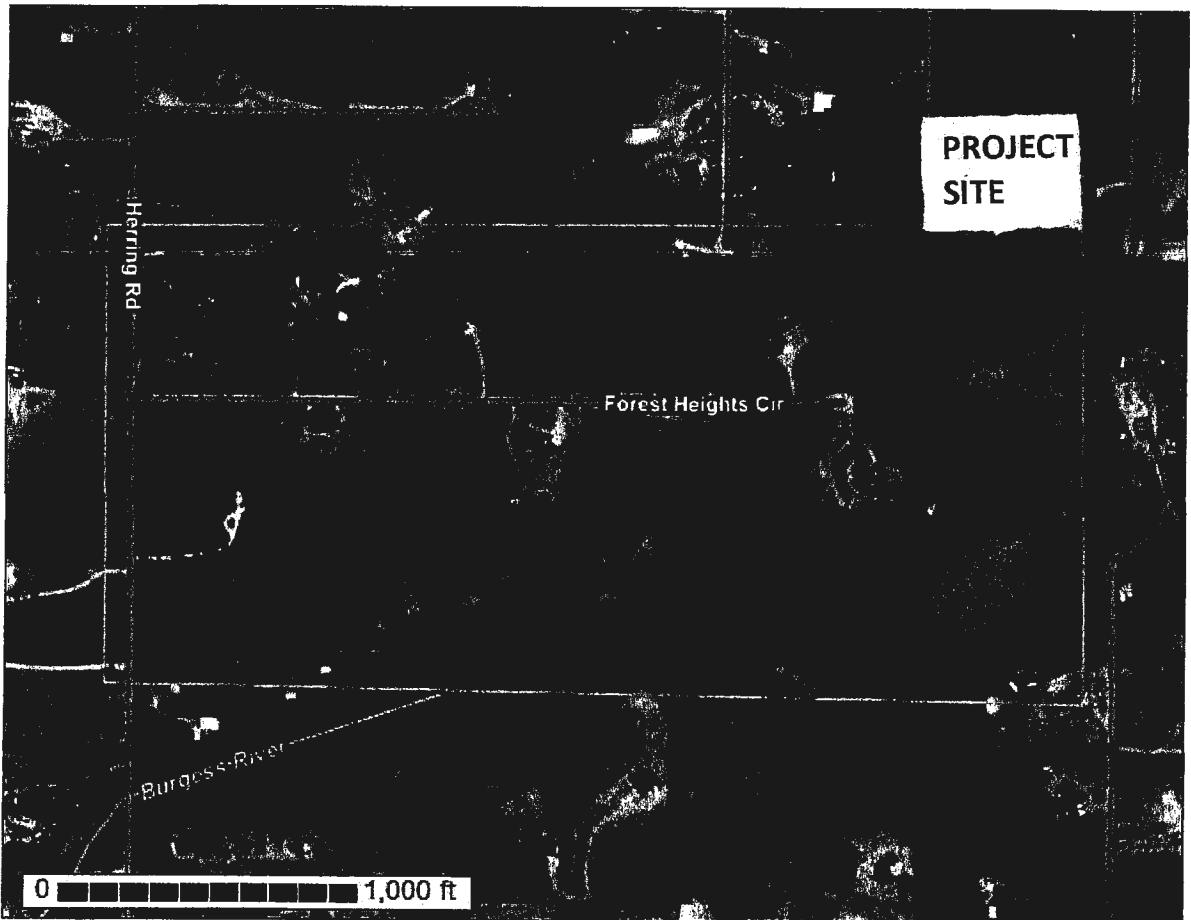
**NRCS**

Natural  
Resources  
Conservation  
Service

A product of the National  
Cooperative Soil Survey,  
a joint effort of the United  
States Department of  
Agriculture and other  
Federal agencies, State  
agencies including the  
Agricultural Experiment  
Stations, and local  
participants

# Custom Soil Resource Report for El Paso County Area, Colorado

## Didleau Subdivision, El Paso County



November 11, 2019





United States  
Department of  
Agriculture

**NRCS**

Natural  
Resources  
Conservation  
Service

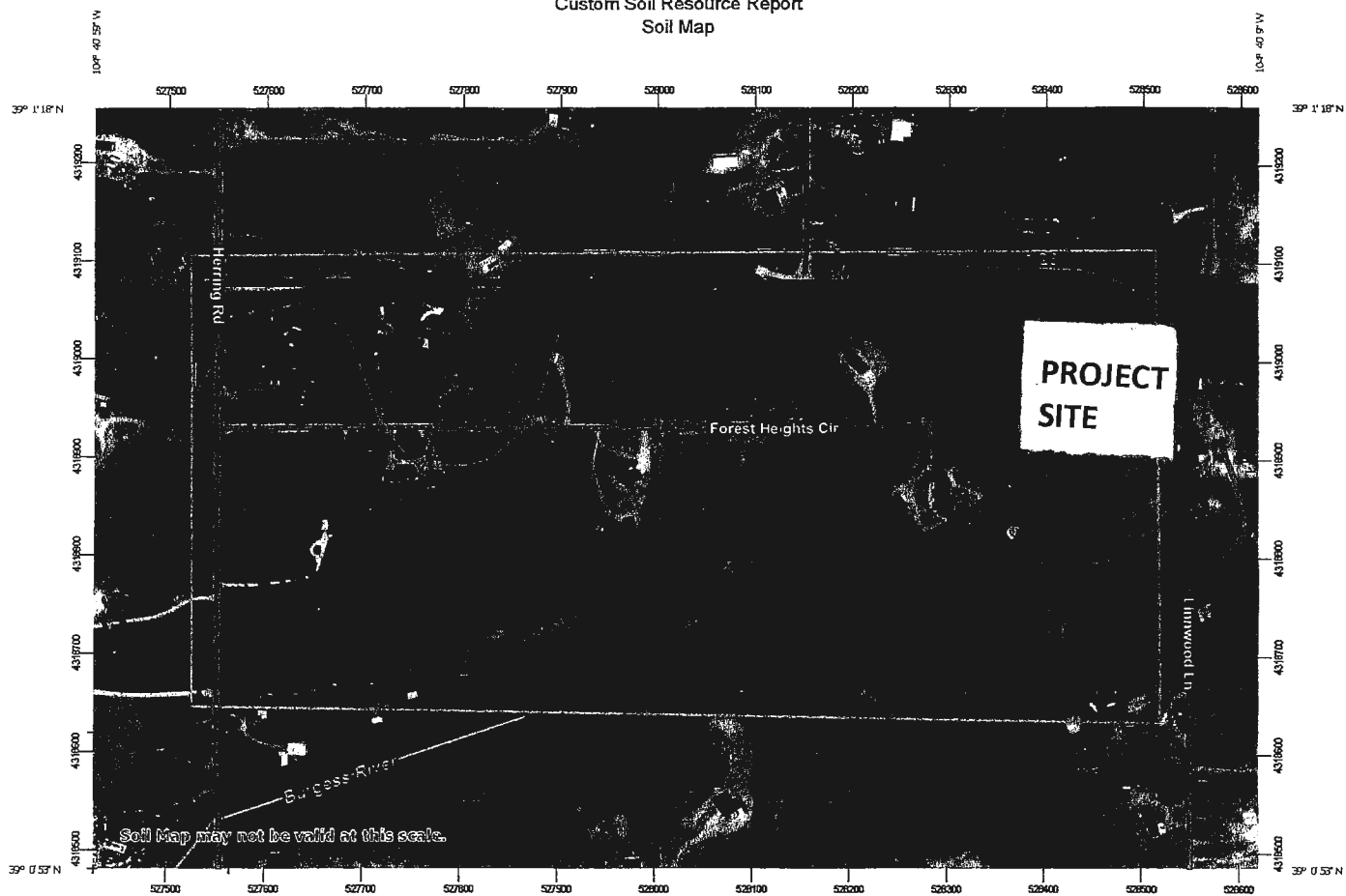
A product of the National  
Cooperative Soil Survey,  
a joint effort of the United  
States Department of  
Agriculture and other  
Federal agencies, State  
agencies including the  
Agricultural Experiment  
Stations, and local  
participants

# Custom Soil Resource Report for **El Paso County Area, Colorado**

## Didleau Subdivision, El Paso County

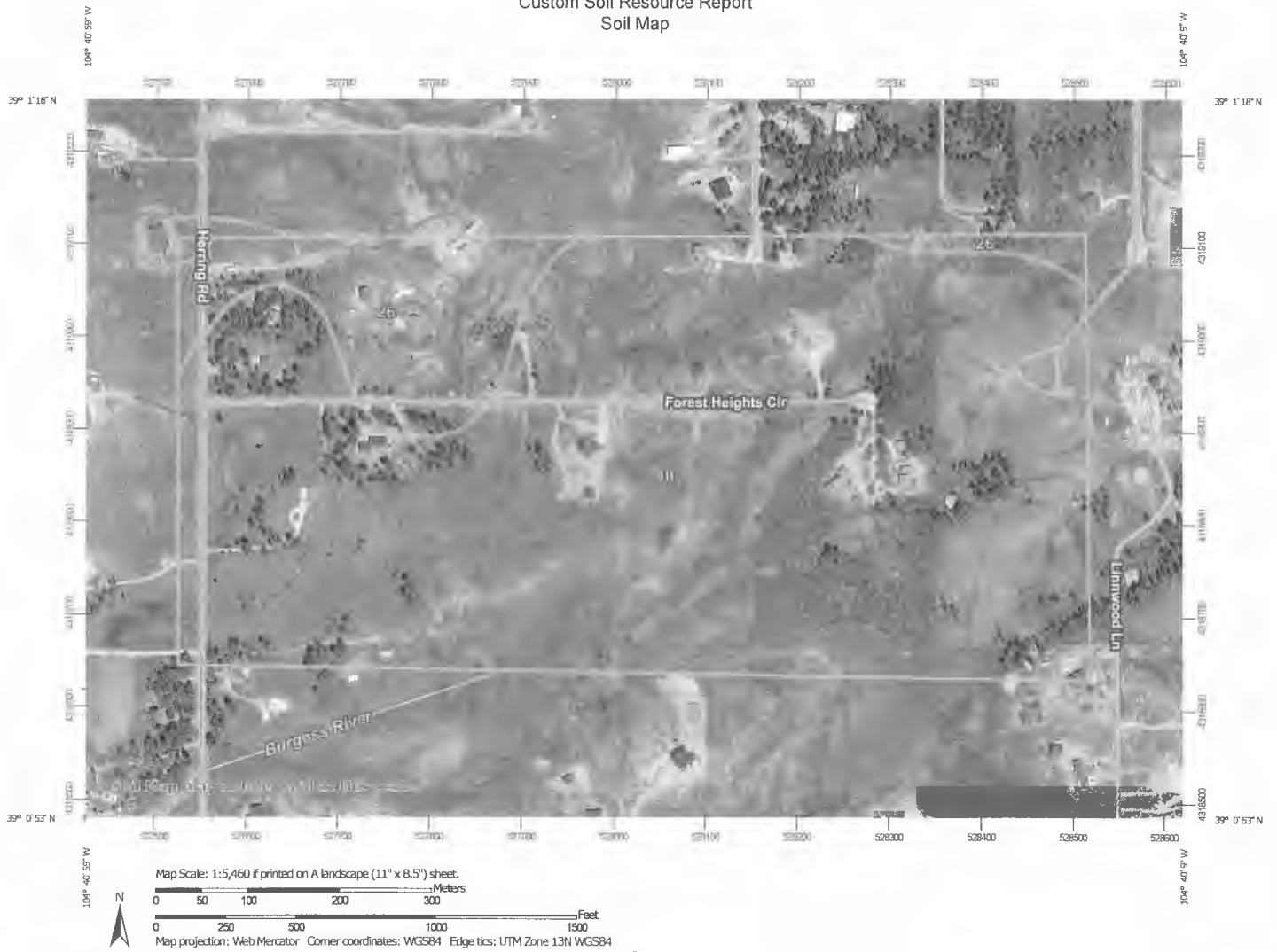


Custom Soil Resource Report  
Soil Map



Map Scale: 1:5,460 if printed on A landscape (11" x 8.5") sheet.  
0 50 100 200 300 Meters  
0 250 500 1000 1500 Feet  
Map projection: Web Mercator Corner coordinates: WGS84 Edge ticks: UTM Zone 13N WGS84

Custom Soil Resource Report  
Soil Map



## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
26	Elbeth sandy loam, 8 to 15 percent slopes	14.5	12.5%
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	101.2	87.5%
<b>Totals for Area of Interest</b>		<b>115.7</b>	<b>100.0%</b>

## 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,

## Custom Soil Resource Report

onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

## El Paso County Area, Colorado

### 26—Elbeth sandy loam, 8 to 15 percent slopes

#### Map Unit Setting

*National map unit symbol:* 367y  
*Elevation:* 7,300 to 7,600 feet  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

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

#### Description of Elbeth

##### Setting

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

##### Typical profile

*A - 0 to 3 inches:* sandy loam  
*E - 3 to 23 inches:* loamy sand  
*Bt - 23 to 68 inches:* sandy clay loam  
*C - 68 to 74 inches:* sandy clay loam

##### Properties and qualities

*Slope:* 8 to 15 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 7.1 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* B  
*Hydric soil rating:* No

#### Minor Components

##### Other soils

*Percent of map unit:*  
*Hydric soil rating:* No

##### Pleasant

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

## 40—Kettle gravelly loamy sand, 3 to 8 percent slopes

### Map Unit Setting

*National map unit symbol:* 368g

*Elevation:* 7,000 to 7,700 feet

*Farmland classification:* Not prime farmland

### Map Unit Composition

*Kettle and similar soils:* 85 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Kettle

#### Setting

*Landform:* Hills

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Sandy alluvium derived from arkose

#### Typical profile

*E - 0 to 16 inches:* gravelly loamy sand

*Bt - 16 to 40 inches:* gravelly sandy loam

*C - 40 to 60 inches:* extremely gravelly loamy sand

#### Properties and qualities

*Slope:* 3 to 8 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 (2.00 to 6.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Low (about 3.4 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* B

*Hydric soil rating:* No

### Minor Components

#### Pleasant

*Percent of map unit:*

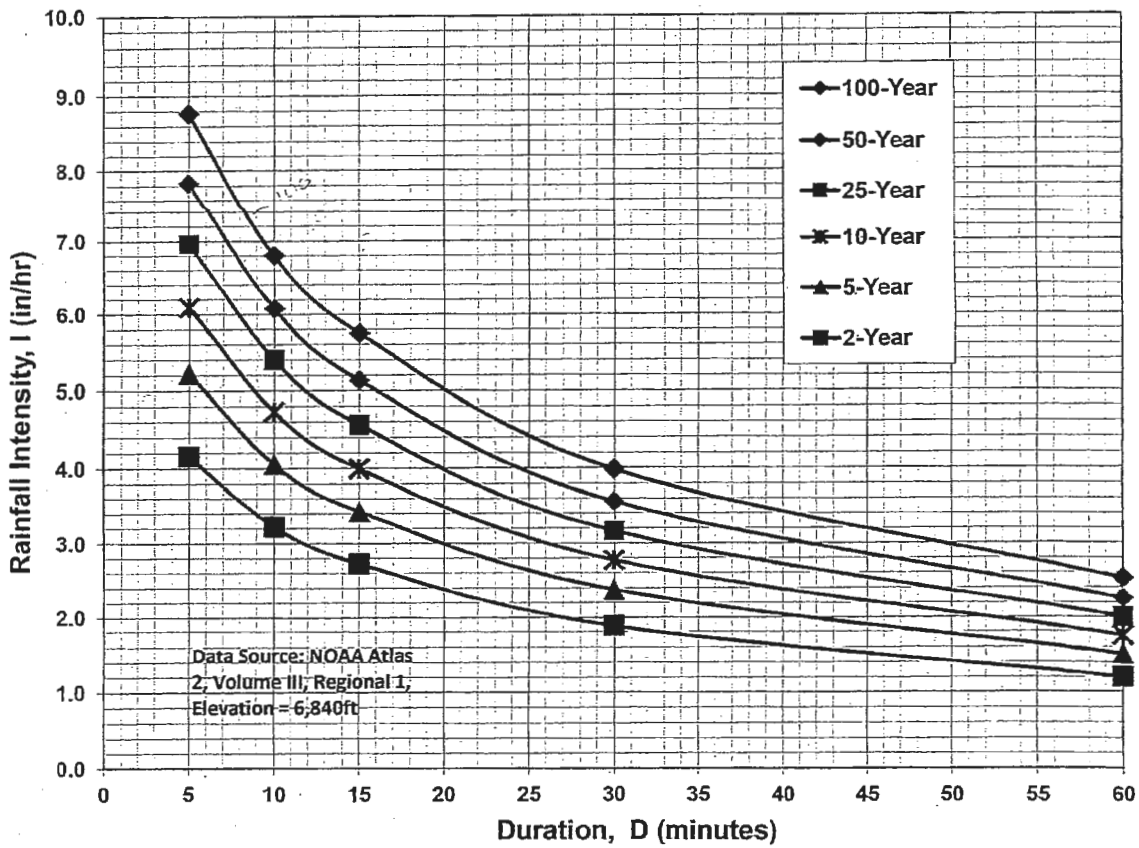
*Landform:* Depressions

*Hydric soil rating:* Yes

Exhibit 4:  
Charts and Tables



Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



**IDF Equations**

$$I_{100} = -2.52 \ln(D) + 12.735$$

$$I_{50} = -2.25 \ln(D) + 11.375$$

$$I_{25} = -2.00 \ln(D) + 10.111$$

$$I_{10} = -1.75 \ln(D) + 8.847$$

$$I_5 = -1.50 \ln(D) + 7.583$$

$$I_2 = -1.19 \ln(D) + 6.035$$

Note: Values calculated by equations may not precisely duplicate values read from figure.

**Table 6-6. Runoff Coefficients for Rational Method**  
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
<b>Business</b>													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
<b>Residential</b>													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
<b>Industrial</b>													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
<b>Parks and Cemeteries</b>													
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
<b>Undeveloped Areas</b>													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
<b>Streets</b>													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
<b>Drive and Walks</b>													
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

### 3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration ( $t_c$ ) consists of an initial time or overland flow time ( $t_i$ ) plus the travel time ( $t_t$ ) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time ( $t_i$ ) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion ( $t_t$ ) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

**Table 6-7. Conveyance Coefficient,  $C_v$** 

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

\*For buried riprap, select  $C_v$  value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration ( $t_c$ ) is then the sum of the overland flow time ( $t_i$ ) and the travel time ( $t_r$ ) per Equation 6-7.

### 3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \quad (\text{Eq. 6-10})$$

Where:

$t_c$  = maximum time of concentration at the first design point in an urban watershed (min)

$L$  = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional “calibration” of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

### 3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Centerline Grade (Min.-Max.)	1-5%	1-5%	1-5%	1-5%	1-6%
Intersection Grades (Min.-Max.)	1-2%	1-2%	1-3%	1-3%	1-4%
<sup>1</sup> Assumes 4% superelevation, 6% for 70 MPH design speeds					
<sup>2</sup> Pavement width in each direction for divided roadways					

**Table 2-5. Roadway Design Standards for Rural Collectors and Locals**

Criteria	Collectors		Local	
	Major	Minor	Local	Gravel
Design Speed / Posted Speed (MPH)	50 / 45	40 / 35	30 / 30	50/45
Clear Zone	20'	14'	7'	12'
Minimum Centerline Curve Radius	930 <sup>2</sup>	565'	300'	As Approved
Number of Through Lanes	2	2	2	2
Lane Width	12'	12'	12'	12'
Right of Way	90'	80'	70 <sup>3</sup>	70 <sup>3</sup>
Paved Width	32'	32'	28'	n/a
Median Width	n/a	n/a	n/a	n/a
Outside Shoulder Width (paved/gravel)	8'(4'/4')	6'(4'/2')	4'(2'/2')	4'(0'/4')
Inside Shoulder Width (paved/gravel)	n/a	n/a	n/a	n/a
Design ADT	3,000	1,500	750	200
Design Vehicle	WB-67	WB-67	WB-50	WB-50
Access Permitted	No	Yes	Yes	Yes
Access Spacing	n/a	Frontage	Frontage	Frontage
Intersection Spacing	¼ mile	660'	330'	330'
Parking Permitted	No	Yes	Yes	No
Minimum Flowline Grade	1%	1%	1%	1%
Centerline Grade (Min.-Max.)	1-8% <sup>1</sup>	1-8% <sup>1</sup>	1-8% <sup>1</sup>	1-8%
Intersection Grades (Min.-Max.)	1-4%	1-4%	1-4%	1-4%
<sup>1</sup> 10% maximum grade permitted at the discretion of the ECM Administrator				
<sup>2</sup> Assumes 4% superelevation, 6% for 70 MPH design speeds				
<sup>3</sup> 60-foot right-of-way plus two 5-foot Public Improvements Easements granted to El Paso County				

$$t_c = t_i + t_t \quad (\text{Eq. 6-7})$$

Where:

$t_c$  = time of concentration (min)

$t_i$  = overland (initial) flow time (min)

$t_t$  = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

### 3.2.1 Overland (Initial) Flow Time

The overland flow time,  $t_i$ , may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

$t_i$  = overland (initial) flow time (min)

$C_5$  = runoff coefficient for 5-year frequency (see Table 6-6)

$L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)

$S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

$V$  = velocity (ft/s)

$C_v$  = conveyance coefficient (from Table 6-7)

$S_w$  = watercourse slope (ft/ft)

Exhibit 5:

Kettle Creek Drainage Basin Planning Study Exhibits



**LEGEND**

- CITY LIMITS
- SANITARY SEWER
- STORM
- ▨ PRE-1970'S
- ▩ PRE-1970'S
- 1970'S
- ① 1970'S

Basin Number	Basin Name
1	South Creek
2	North Creek
3	East Creek
4	West Creek
5	Northwest Creek
6	Northwest Creek
7	Northwest Creek
8	Northwest Creek
9	Northwest Creek
10	Northwest Creek
11	Northwest Creek
12	Northwest Creek
13	Northwest Creek
14	Northwest Creek
15	Northwest Creek
16	Northwest Creek
17	Northwest Creek
18	Northwest Creek
19	Northwest Creek
20	Northwest Creek
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26	Northwest Creek
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35	Northwest Creek
36	Northwest Creek
37	Northwest Creek
38	Northwest Creek
39	Northwest Creek
40	Northwest Creek
41	Northwest Creek
42	Northwest Creek
43	Northwest Creek
44	Northwest Creek

Basin Number	Basin Name
25	Northwest Creek
26	Northwest Creek
27	Northwest Creek
28	Northwest Creek
29	Northwest Creek
30	Northwest Creek
31	Northwest Creek
32	Northwest Creek
33	Northwest Creek
34	Northwest Creek
35	Northwest Creek
36	Northwest Creek
37	Northwest Creek
38	Northwest Creek
39	Northwest Creek
40	Northwest Creek
41	Northwest Creek
42	Northwest Creek
43	Northwest Creek
44	Northwest Creek

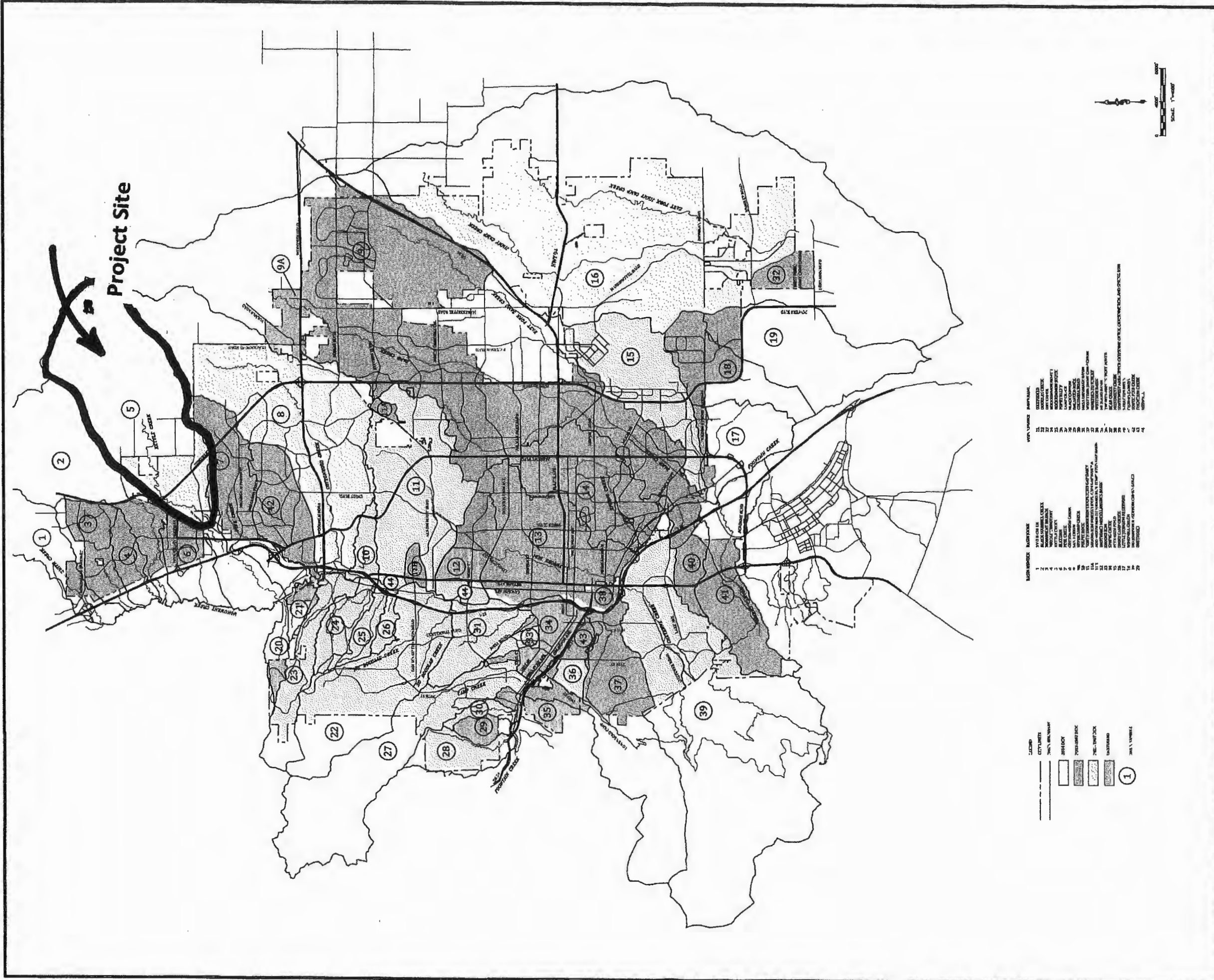


# DRAINAGE BASIN PLANNING STUDY INVENTORY

CITY OF COLORADO SPRINGS, COLORADO

**Kiowa**  
Engineering Corporation  
1674 South 21st Street  
Colorado Springs, Colorado 80904  
719/520-9342

Project No.	1000000000
Scale	AS SHOWN
Date	10/1/00
Drawn by	JKW
Checked by	JKW
Approved by	JKW



**LEGEND**

City Limits	City Limits
Manitou Creek	Manitou Creek
Shiloh	Shiloh
Post-1997 Flood	Post-1997 Flood
Pre-1997 Flood	Pre-1997 Flood
Watermain	Watermain
Sanitary Sewer	Sanitary Sewer

**BASED ON THE FOLLOWING:**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
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**STUDY CATEGORIES:**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
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Project No.	17202
Date	7/27/17
Drawn By	BNV
Checked By	JAC
Reviewed By	BNV
Drawn	















## DRAINAGE BASIN PLANNING STUDY INVENTORY

CITY OF COLORADO SPRINGS, COLORADO

**Kiowa**  
Engineering Corporation  
1804 South 21st Street  
Colorado Springs, Colorado 80901  
(719) 590-7362



# LEGEND

-  SUBBASIN ID  
CURVE NUMBER
-  BASIN BOUNDARY
-  SUBBASIN BOUNDARY
-  RESIDENTIAL (RURAL 5 ACRES)
-  RESIDENTIAL (RURAL 2.5 ACRES)
-  RESIDENTIAL (2 LOTS PER ACRE)
-  RESIDENTIAL (2-4 LOTS PER ACRE)
-  COMMERCIAL (OFFICE SPACE)
-  COMMERCIAL (RETAIL SPACE)
-  SCHOOL
-  OPEN SPACE
-  ASPHALT PAVED ROAD AREA
-  SPECIAL USES
-  MAJOR TRIBUTARY

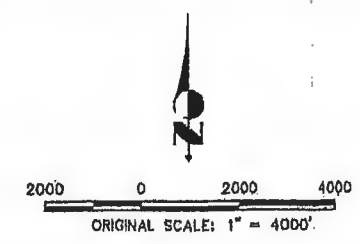
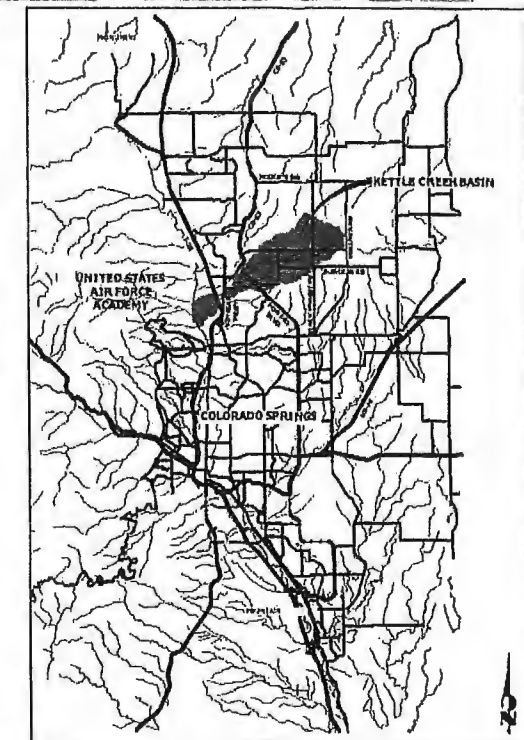
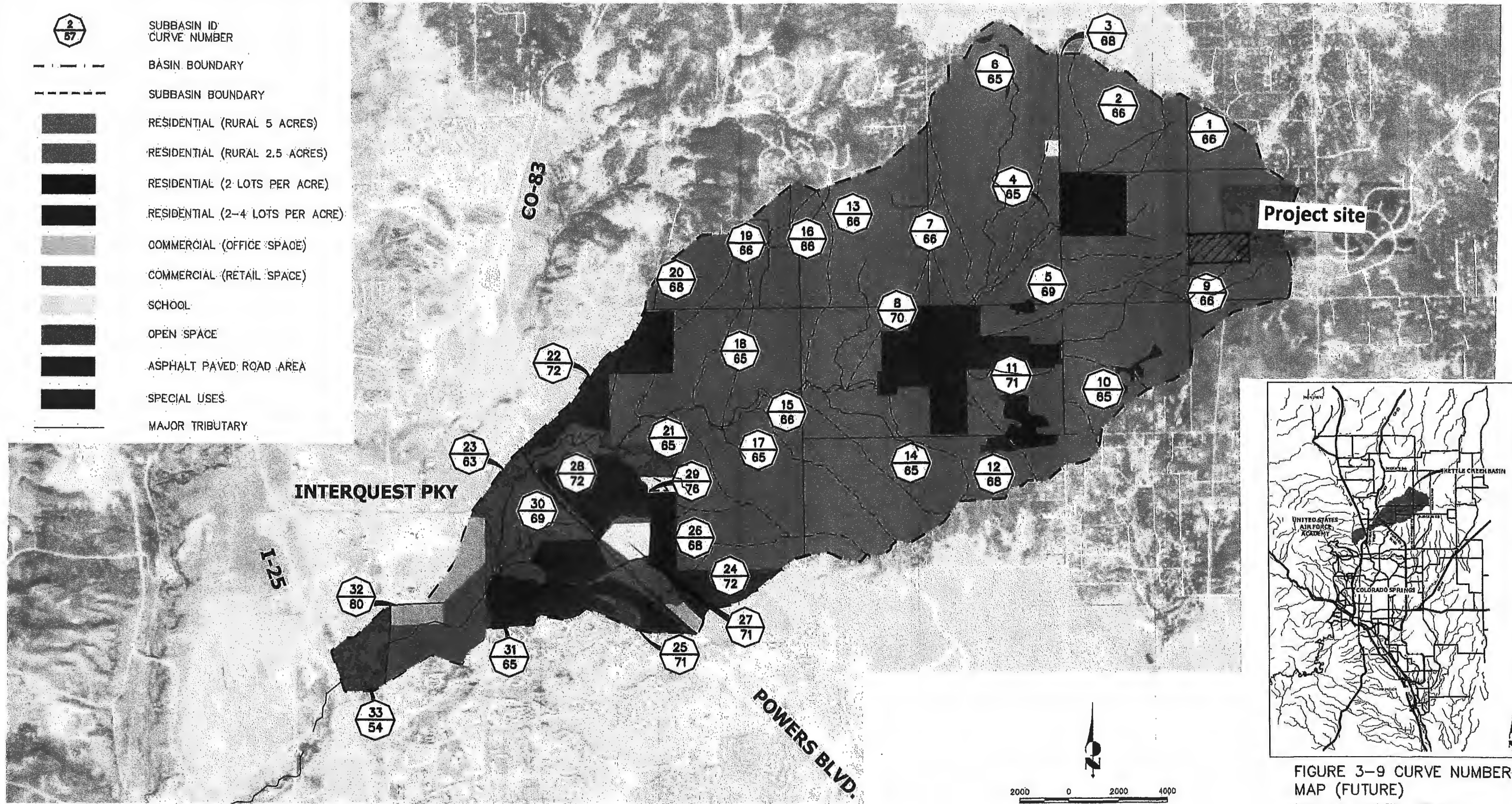









FIGURE 3-9 CURVE NUMBER MAP (FUTURE)  
 KETTLE CREEK DBPS  
 JOB NO. 25100.00  
 MAY 2015

# LEGEND

-  SUBBASIN ID
-  100-YEAR 24-HOUR FLOWS (CFS)
-  5-YEAR 24-HOUR FLOWS (CFS)
-  BASIN BOUNDARY
-  SUBBASIN BOUNDARY
-  MAJOR TRIBUTARY
-  JUNCTION

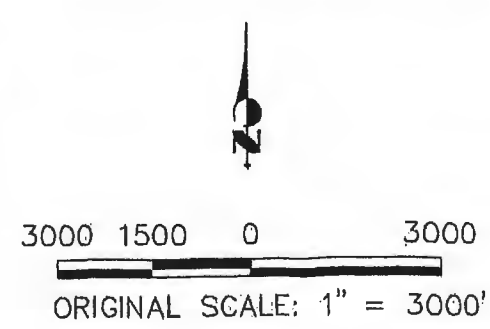
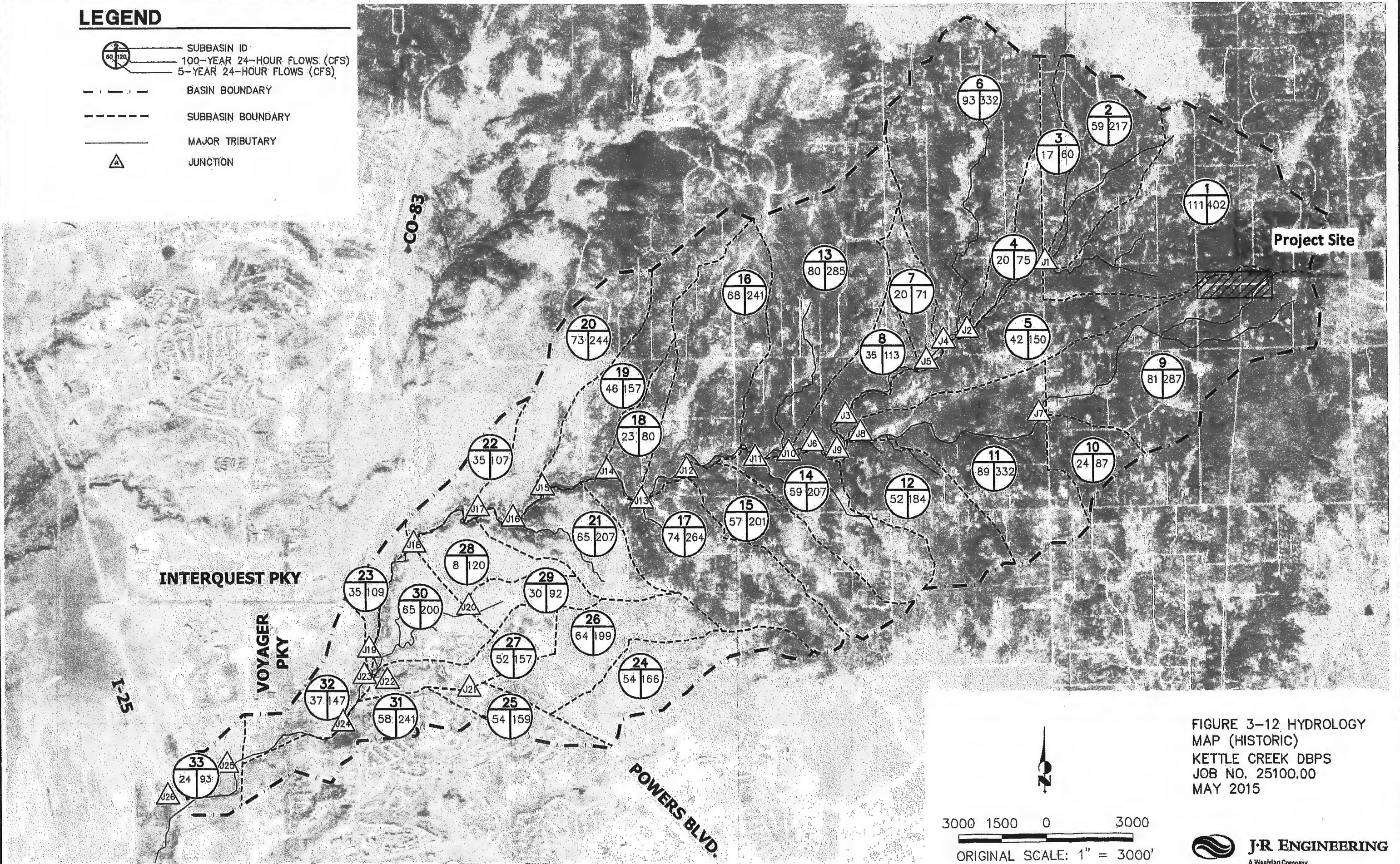









FIGURE 3-12 HYDROLOGY MAP (HISTORIC)  
KETTLE CREEK DBPS  
JOB NO. 25100.00  
MAY 2015

# LEGEND

-  SUBBASIN ID
-  100-YEAR 24-HOUR FLOWS (CFS)
-  5-YEAR 24-HOUR FLOWS (CFS)
-  BASIN BOUNDARY
-  SUBBASIN BOUNDARY
-  MAJOR TRIBUTARY
-  JUNCTION

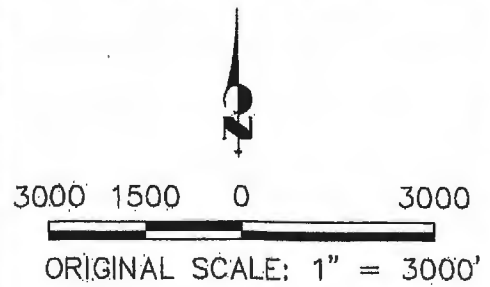
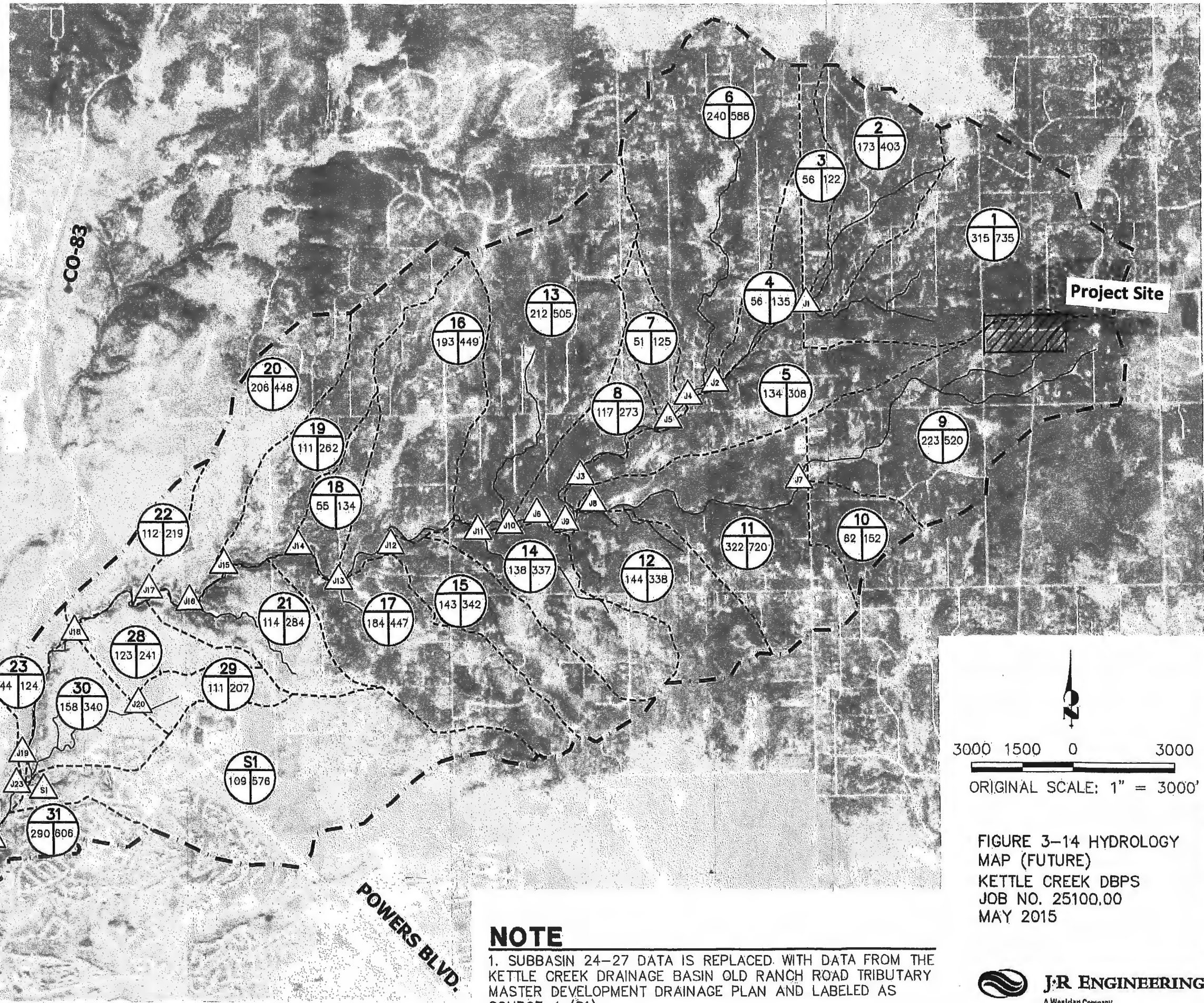


FIGURE 3-14 HYDROLOGY MAP (FUTURE)  
KETTLE CREEK DBPS  
JOB NO. 25100.00  
MAY 2015

## NOTE

1. SUBBASIN 24-27 DATA IS REPLACED WITH DATA FROM THE KETTLE CREEK DRAINAGE BASIN OLD RANCH ROAD TRIBUTARY MASTER DEVELOPMENT DRAINAGE PLAN AND LABELED AS SOURCE-1 (S1).



Centennial 303-740-9393 • Colorado Springs 719-593-2593  
Fort Collins 970-491-9888 • www.jrengineering.com

# El Paso County Drainage Basin Fees

Resolution No. 22-442

Basin Number	Receiving Waters	Year Studied	Drainage Basin Name	2023 Drainage Fee (per Impervious Acre)	2023 Bridge Fee (per Impervious Acre)
<b><u>Drainage Basins with DBPS's:</u></b>					
CHMS0200	Chico Creek	2013	Haegler Ranch	\$12,985	\$1,916
CHWS1200	Chico Creek	2001	Bennett Ranch	\$14,536	\$5,576
CHWS1400	Chico Creek	2013	Faloon	\$37,256	\$5,118
FOFO2000	Fountain Creek	2001	West Fork Jimmy Camp Creek	\$15,802	\$4,675
FOFO2600	Fountain Creek	1991*	Big Johnson / Crews Gulch	\$23,078	\$2,980
FOFO2800	Fountain Creek	1988*	Widefield	\$23,078	\$0
FOFO2900	Fountain Creek	1988*	Security	\$23,078	\$0
FOFO3000	Fountain Creek	1991*	Windmill Gulch	\$23,078	\$346
FOFO3100 / FOFO3200	Fountain Creek	1988*	Carson Street / Little Johnson	\$14,077	\$0
FOFO3400	Fountain Creek	1984*	Peterson Field	\$16,646	\$1,262
FOFO3600	Fountain Creek	1991*	Fisher's Canyon	\$23,078	\$0
FOFO4000	Fountain Creek	1996	Sand Creek	\$23,821	\$9,743
FOFO4200	Fountain Creek	1977	Spring Creek	\$11,969	\$0
FOFO4600	Fountain Creek	1984*	Southwest Area	\$23,078	\$0
FOFO4800	Fountain Creek	1991	Bear Creek	\$23,078	\$1,262
FOFO5800	Fountain Creek	1964	Camp Creek	\$2,557	\$0
FOMO1000	Monument Creek	1981	Douglas Creek	\$14,514	\$321
FOMO1200	Monument Creek	1977	Templeton Gap	\$14,900	\$346
FOMO2000	Monument Creek	1971	Pulpit Rock	\$7,653	\$0
FOMO2200	Monument Creek	1994	Cottonwood Creek / S. Pine	\$23,078	\$1,262
FOMO2400	Monument Creek	1966	Dry Creek	\$18,219	\$660
FOMO3600	Monument Creek	1989*	Black Squirrel Creek	\$10,478	\$660
FOMO3700	Monument Creek	1987*	Middle Tributary	\$19,259	\$0
FOMO3800	Monument Creek	1987*	Monument Branch	\$23,078	\$0
FOMO4000	Monument Creek	1996	Smith Creek	\$9,409	\$1,262
FOMO4200	Monument Creek	1989*	Black Forest	\$23,078	\$628
FOMO5200	Monument Creek	1993*	Dirty Woman Creek	\$23,078	\$1,262
FOMO5300	Fountain Creek	1993*	Crystal Creek	\$23,078	\$1,262
<b><u>Miscellaneous Drainage Basins: <sup>1</sup></u></b>					
CHBS0800	Chico Creek		Book Ranch	\$21,654	\$3,135
CHEC0400	Chico Creek		Upper East Chico	\$11,797	\$342
CHWS0200	Chico Creek		Telephone Exchange	\$12,962	\$304
CHWS0400	Chico Creek		Livestock Company	\$21,351	\$254
CHWS0600	Chico Creek		West Squirrel	\$11,129	\$4,619
CHWS0800	Chico Creek		Solberg Ranch	\$23,078	\$0
FOFO1200	Fountain Creek		Crooked Canyon	\$6,968	\$0
FOFO1400	Fountain Creek		Calhan Reservoir	\$5,817	\$339
FOFO1600	Fountain Creek		Sand Canyon	\$4,203	\$0
FOFO2000	Fountain Creek		Jimmy Camp Creek <sup>3</sup>	\$23,078	\$1,079
FOFO2200	Fountain Creek		Fort Carson	\$18,219	\$660
FOFO2700	Fountain Creek		West Little Johnson	\$1,521	\$0
FOFO3800	Fountain Creek		Stratton	\$11,070	\$495
FOFO5000	Fountain Creek		Midland	\$18,219	\$660
FOFO6000	Fountain Creek		Palmer Trail	\$18,219	\$660
FOFO6800	Fountain Creek		Black Canyon	\$18,219	\$660
FOMO4600	Monument Creek		Beaver Creek	\$13,797	\$0
FOMO3000	Monument Creek		Kettle Creek	\$12,463	\$0
FOMO3400	Monument Creek		Elkhorn	\$2,094	\$0
FOMO5000	Monument Creek		Monument Rock	\$10,003	\$0
FOMO5400	Monument Creek		Palmer Lake	\$15,995	\$0
FOMO5600	Monument Creek		Raspberry Mountain	\$5,380	\$0
PLPL0200	Monument Creek		Bald Mountain	\$11,465	\$0
<b><u>Interim Drainage Basins: <sup>2</sup></u></b>					
FOFO1800	Fountain Creek		Little Fountain Creek	\$2,950	\$0
FOMO4400	Monument Creek		Jackson Creek	\$9,135	\$0
FOMO4800	Monument Creek		Teachout Creek	\$6,343	\$953

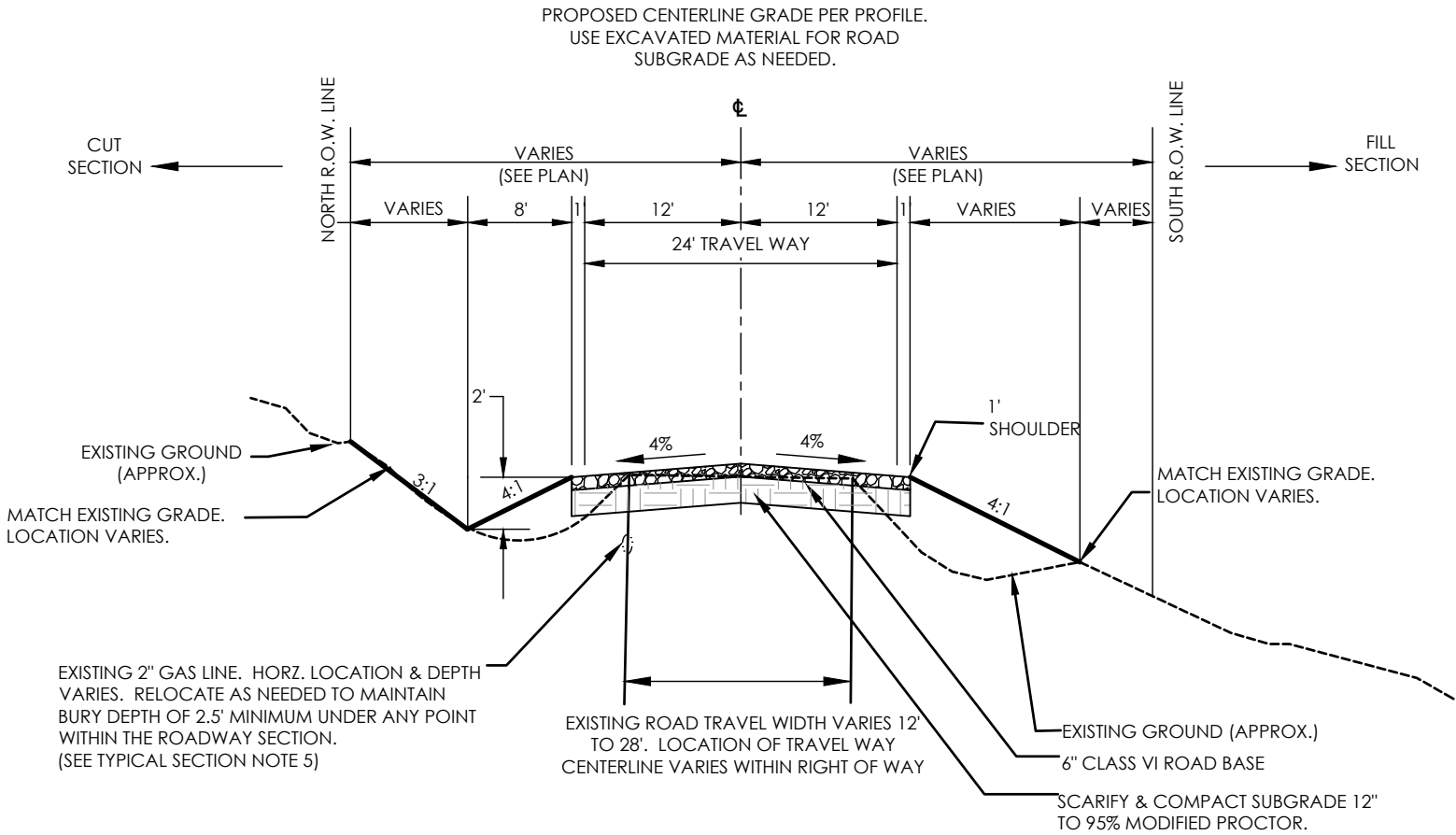
1. The miscellaneous drainage fee previous to September 1999 resolution was the average of all drainage fees for basins with Basin Planning Studies performed within the last 14 years.

2. Interim Drainage Fees are based upon draft Drainage Basin Planning Studies or the Drainage Basin Identification and Fee Estimation Report. (Best available information suitable for setting a fee.)

3. This is an interim fee and will be adjusted when a DBPS is completed. In addition to the Drainage Fee a surety in the amount of \$7,285 per impervious acre shall be provided to secure payment of additional fees in the event that the DBPS results in a fee greater than the current fee. Fees paid in excess of the future revised fee will be reimbursed. See Resolution 06-326 (9/14/06) and Resolution 16-320 (9/07/16).

Forest Heights Estates  
Final Drainage Report, July 2023

Exhibit 6:  
Typical Section



## TYPICAL PRIVATE RURAL ROADWAY SECTION RURAL GRAVEL LOCAL ROADWAY

WITH A DESIGN AND POSTED SPEED OF 20 MPH

SCALE:  
HORIZONTAL SCALE: 1" = 10'  
VERTICAL SCALE: 1" = 5'

Exhibit 7:  
Plat

# FOREST HEIGHTS ESTATES

## FINAL PLAT

PART OF THE SOUTHWEST QUARTER OF SECTION 9, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M. COUNTY OF EL PASO, STATE OF COLORADO

### KNOW ALL MEN BY THESE PRESENTS:

That Phyllis J. Didleau and Jon Didleaux, being the owners of the following described tract of land:

A Tract of land in the Southwest 1/4 of Section 9, Township 12 South, Range 65 West, of the 6th P.M. County of El Paso, State of Colorado, more specifically described as follows:  
Commencing at the West 1/4 corner of Section 9,  
Thence Along the North line of said Southwest 1/4, N89°55'03"E a distance of 1391.55 feet to the Point of Beginning of the parcel to be described hereby;  
Thence continue along said North line, N89° 55'03"E a distance of 506.51 feet to the Northwest corner of that parcel described at Book 2318, Page 387, of the records of the El Paso County Clerk and Recorder;  
Thence S00°03'25"W along the West line of said parcel a distance of 430.00 feet;  
Thence N89°55'03"E parallel to said North line, a distance of 506.81 feet to the Northmost West line of the parcel described in Book 721, Page 970 of said records;  
Thence S00°09'20"W a distance of 60.00 feet;  
Thence S89°55'03"W along the line of said parcel 459.94 feet;  
Thence S00°11'43"W along the West line of said parcel a distance of 829.47 feet;  
Thence S89°54'44"W a distance of 1941.21 feet to a point on the East Right of Way line of Herring Road;  
Thence N00°03'25"E along said East line a distance of 327.80 feet to the South line of that parcel described in Book 2371 Page 388 of said records;  
Thence N89°55'03"E along the South line of said parcel a distance of 434.00 feet;  
Thence; N00°03'25"E along the East line of said parcel a distance of 215.85 feet to the Southeast corner of that parcel described in Book 1951 at Page 432 of said records;  
Thence N89°55'03"E along the South line of said parcel a distance of 381.00 feet to the Southeast corner thereof;  
Thence N00°11'21"E along the East line of said parcel a distance of 286.00 feet to a point on the South line of that parcel described in Book 2215 Page 559 of said records;  
Thence along said South line N89°55'03"E along said South line a distance of 67.27 feet to the East line of said parcel;  
Thence N00°03'25"E along said East line a distance of 60.00 feet;  
Thence Thence N89°55'03"E a distance of 506.51 feet,  
Thence; N00°03'25"E a distance of 430.00 feet to the Point of Beginning, except that parcel described in Book 2645, Page 207.

EXCEPTION PARCEL: Book 2645, Page 207 of the records of El Paso County, Colorado  
A tract of land in the Southwest 1/4 of Section 9, Township 12 South, Range 65 West of the 6th p.m. County of El Paso, State of Colorado more particularly described as follows;  
Commencing at the West 1/4 corner of said Section 9,  
Thence along the West line of Section 9, S00°03'25"W a distance of 490.00 feet;  
Thence N89°55'03"E a distance of 1090.00 feet to the Point of Beginning of the tract described hereby;  
Thence N89°55'03"E a distance of 610.00 feet;  
Thence S00°03'25"W a distance of 325.00 feet;  
Thence S89°55'03"W a distance of 610.00 feet;  
Thence N00°03'25"E a distance of 325.00 feet to the Point of Beginning.

This description contains 34.529 acres (not including the exception parcel).

TRACT A  
Tract in Northwest quarter of the Southwest quarter of Section 9, Township 12 South, Range 65 West, of the 6th P.M. County of El Paso, State of Colorado, described as follows:  
Commencing at the West 1/4 corner of said Section 9,  
Thence along the west line of said Section 9 S00°03'25"W a distance of 430.00 feet;  
Thence N89°55'03"E 30.00 feet to a point on the West Right of Way line of Herring Road and the Point Of Beginning (P.O.B.) of the Tract described hereby;  
Thence N89°55'03"E a distance of 435.00 feet;  
Thence S01°00'46"W a distance of 60.01 feet;  
Thence S89°55'03"W a distance of 434.00 feet to a point on said West Right of Way line;  
Thence N00°03'25"E a distance of 60.00 feet to the Point Of Beginning (POB).

Tract A contains 0.598 Acres, more or less.

THE TOTAL ACREAGE OF THIS SUBDIVISION PLAT IS 32.618 ACRES.

### DEDICATION:

The undersigned, being all the owners, mortgagees, beneficiaries of deeds of trust and holders of other interests in the land described herein, have laid out, subdivided, and platted said lands into lots, tracts, and easements as shown hereon under the name and subdivision of FOREST HEIGHTS ESTATES, The utility easements shown hereon are hereby dedicated for public utilities and communication systems and other purposes as shown hereon. The entities responsible for providing the services for which the easements are established are hereby granted the perpetual right of ingress and egress from and to adjacent properties for installation, maintenance, and replacement of utility lines and related facilities.

By: \_\_\_\_\_  
Phyllis J. Didleau, Trustee  
Phyllis J. Didleau Revocable Trust

STATE OF COLORADO }  
COUNTY OF EL PASO } SS

ACKNOWLEDGED before me this \_\_\_\_\_ day of \_\_\_\_\_, 202\_\_\_ by Phyllis J. Didleau  
as Trustee of Phyllis J. Didleau Revocable Trust.

MY COMMISSION EXPIRES \_\_\_\_\_

WITNESS MY HAND AND OFFICIAL SEAL \_\_\_\_\_  
NOTARY PUBLIC

By: \_\_\_\_\_  
Jon P. Didleaux  
Owner

STATE OF COLORADO }  
COUNTY OF EL PASO } SS

ACKNOWLEDGED BEFORE ME THIS \_\_\_\_\_ DAY OF \_\_\_\_\_, 202\_\_\_ by Jon P. Didleaux.

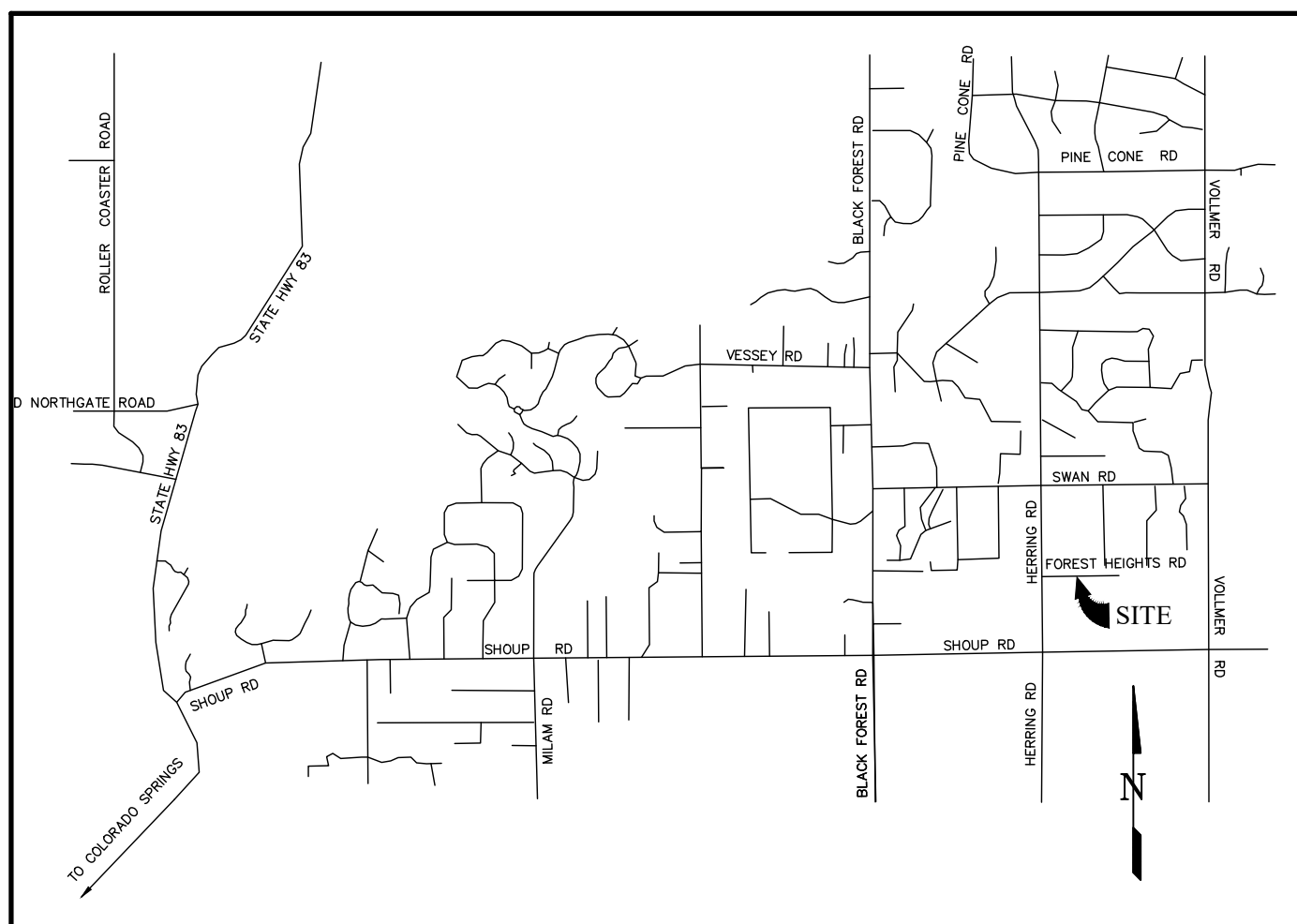
MY COMMISSION EXPIRES \_\_\_\_\_

WITNESS MY HAND AND OFFICIAL SEAL \_\_\_\_\_  
NOTARY PUBLIC

Tract A shall be utilized as a Private Road. Ownership of Tract A shall be vested with the owner of Lot 4.

Tract B shall be utilized as a Private Road. Ownership of Tract B shall be vested with the owner of Lot 1.

Maintenance of Tract A and Tract B shall be vested to the parties that are signatory and designated in the "ACCESS EASEMENT GRANT AND MAINTENANCE AGREEMENT FOR FOREST HEIGHTS CIRCLE AND RESTRICTIVE COVENANTS FOR LOTS 1, 2, 3 & 4 FOREST HEIGHTS ESTATES SUBDIVISION" and their successor and assigns.



VICINITY MAP  
NOT TO SCALE

### NOTES:

1. • - Indicates survey monument recovered as shown.  
o - Indicates set survey monument no. 4 rebar and plastic cap PLS No. 18465 set flush with ground surface.  
\* - Indicates Not a Part of this Subdivision.
2. This survey does not constitute a title search by LDC, Inc. to determine ownership or easements of record. For all information regarding easements, rights-of-way and title of record, LDC, Inc. relied upon Owner's Policy of Title Insurance issued by Stewart Title Guaranty Company, File No. 49789ECS, Policy No. 0-9301-004251616, date of policy is June 10, 2020.
3. Each individual property owner is responsible for the construction and operation of a non-evaporative wastewater disposal system approved by the El Paso County Health Department. The Health Department may require a specially designed, or "engineered," system prior to permit approval. Engineered systems may cost more to design, install and maintain than systems which are not engineered.
4. The Basis of Bearings as shown on this plat is the Observed Bearing of the line from the Center ¼ Corner of Section 9 Township 12 South, Range 65 West of the 6TH P.M. being a 3" aluminum cap PLS No. 18830, and the West ¼ corner of Section 9 Township 12 South, Range 65 West of the 6TH P.M. being a 3" aluminum cap PLS No. 9477 as monumented upon the ground, and whose positions, as observed individually, were determined utilising survey quality GPS instruments. The line as observed, and as calculated bears N89°55'03"E.
5. All structural foundations shall be located and designed by a Professional Engineer, currently registered in the State of Colorado.
6. Individual wells in the Dawson aquifer are the responsibility of each lot owner. Permits for such wells must be obtained from the Colorado Division of Water Resources. Ground water rights associated with the subdivision were decreed in Case No. 22CW3060, Water Division 2 (adjudication of water rights and plan for augmentation).  
  
The plan for augmentation was designed to allow pumping of 0.77 acre foot annually from as many as four Dawson aquifer wells in the subdivision. Applicant, its successors and assigns at the time of lot sales, shall transfer rights to underlying ground water to the initial purchaser of each lot in an amount at least sufficient to satisfy the 300 year water supply requirement of El Paso County for four lots, or 924 acre feet from the Dawson aquifer and 943 acre feet from the Laramie-Fox Hills aquifer, as well as an undivided interest in the plan for augmentation. Each subsequent sale of a lot shall convey the remaining portion of such water rights, unless a lot is further subdivided in which case the water will be equally divided; this provision is included only to be consistent with the provisions of the augmentation plan, and does not imply the future approval by El Paso County of further subdivision of any of the four lots. Such conveyance may be accomplished either by separate quit claim deed, by other appropriate deed of the water rights associated with the lot, or by specifically identifying and transferring the water rights in the warranty deed which transfers the real property to the individual lot purchaser.  
  
Water in the Denver Basin aquifers is allocated based on a 100 year aquifer life. However, for El Paso County planning purposes, water in the Denver Basin aquifers is evaluated based on a 300 year aquifer life. Applicant, and all future owners of lots in the subdivision, should be aware that the economic life of a water supply in the Dawson aquifer may be less than either 100 years or 300 years indicated due to anticipated water level declines.
7. FEDERAL EMERGENCY MANAGEMENT AGENCY, Flood Insurance Rate Map Number 08041C0320G, effective date December 7, 2018, indicates the area in the vicinity of this parcel of land to be a Zone X (area determined to be out of the 500 year flood plain).
8. ~~(12345)~~ - Indicates property address. The addresses exhibited on this plat are for informational purposes only. They are not the legal description and are subject to change.
9. Fire protection to be provided by Black Forest Fire Protection District.
10. The following reports and/or documentation have been submitted in association with the Final Plat for this subdivision and are on file at the El Paso County Planning and Community Development Department: Drainage Report; Water Resources Report; Wastewater Disposal Report; Geology and Soils Report; Development Report and Evidence.
11. All property owners are responsible for maintaining proper storm water drainage in and through their property. Public drainage easements as specifically noted on the plat shall be maintained by the individual lot owners unless otherwise indicated. Structures, fences, materials or landscaping that could impede the flow of runoff shall not be placed in drainage easements.
12. Developer shall comply with federal and state laws, regulations, ordinances, review and permit requirements, and other agency requirements, if any, of applicable agencies including, but not limited to, the Colorado Division of Wildlife, Colorado Department of Transportation, U.S. Army Corps of Engineers and/or the U.S. Fish and Wildlife Service regarding the Endangered Species Act, particularly as it relates to the listed species, if applicable.
13. Mailboxes shall be installed in accordance with all El Paso County and United States Postal Service regulations.
14. Any person who knowingly removes, alters or defaces any public land survey monument or land boundary monument or accessory commits a Class Two (2) misdemeanor pursuant to C.R.S. 18-4-508.
15. The Subdivider agrees on behalf of him/herself and any other builders, successors, and assignees that Subdivider and/or said assigns shall be required to pay Traffic Impact Fees in accordance with the El Paso County Road Impact Fee Program Resolution (Resolution No. 19-471) or any amendments thereto, at or prior to the time of Building Permit submittals. the fee obligation if not paid at final plat recording shall be documented on all salesdocuments and on plat notes plat notes to ensure that a title serch would find the fee obligation before sale of the property.
16. Forest Heights Estates subdivision as shown is Zoned RR-5.
17. No Driveway shall be established unless an Access Permit has been granted by El Paso County.
18. Individual lot purchasers are responsible for constructing driveways, including necessary drainage culverts from Forest Heights Circle per Land Development Code Sections 6.3.3.C.2 and 6.3.3.C.3. Due to their length some of the driveways will need to be specifically approved by the Black Forest Fire Rescue Protection District.

### NOTES (cont.):

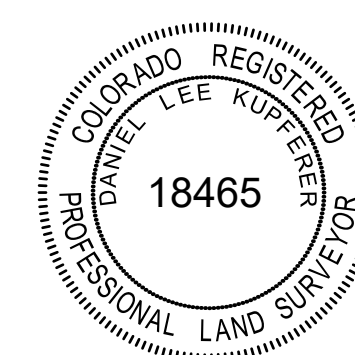
19. The area encompassed by the Forest Heights Estates subdivision has been found to be impacted by geologic hazards:  
-Seasonally high groundwater.  
-Potentially high seasonal groundwater.  
Mitigation measures and a map of the hazard area can be found in the report "Soil, Geology, and Geologic Hazard Study ,Didleau Subdivison" by Entech Engineering Inc. Dated March 10, 2020 in file MS-20-004 available at the El Paso County Planning and Community Development Department.
20. The private road as shown on this plat will not be maintained by El Paso County until, and unless the road is constructed in conformance with the El Paso County standards in effect at the date of request for dedication and maintenance.
21. Forest Heights Estates subdivision is Subject to the ACCESS EASEMENT GRANT AND MAINTENANCE AGREEMENT FOR FOREST HEIGHTS CIRCLE AND RESTRICTIVE COVENANTS FOR LOTS 1, 2, 3 & 4 FOREST HEIGHTS ESTATES SUBDIVISION as recorded under Reception No. \_\_\_\_\_ of the records of the El Paso County Clerk and Recorder
22. NO BUILD AREAS: No permanent structures shall be within No Build Areas shown hereon. Fences, driveways and portable structures may be placed within the No Build Areas. Components of onsite wastewater treatment systems may be placed within No Build Areas and outside of any drainage easements as determined by the system designer.
23. DRAINAGE EASEMENTS: Public drainage easements as specifically noted on the plat shall be maintained by the individual lot owners unless otherwise indicated. Structures, fences, materials or landscaping that could impede the flow of runoff shall not be placed in drainage easements. Components of onsite wastewater treatment systems shall not be placed in drainage easements.
24. All Property within Forest Heights Estates subdivision is subject to a Declaration of Covenants as recorded under Reception No. \_\_\_\_\_ of the records of the El Paso County Clerk and Recorder

### EASEMENTS:

Unless otherwise shown, both sides of all side lot lines and common rear lot lines are hereby platted with a ten (10) feet wide public utility and drainage easement on each side and a ten (10) feet wide public utility and drainage easement on lot lines abutting a public right-of-way and a twenty (20) feet wide public utility and drainage easement on the subdivision boundary lines. Said easements are hereby dedicated to the public for installation and maintenance of public utilities and drainage facilities as shown hereon, with the sole responsibility for maintenance being vested with the property owners.

### SURVEYOR'S CERTIFICATION:

I Daniel L. Kupferer, a duly registered Professional Land Surveyor in the State of Colorado, do hereby certify that this plat correctly represents the results of a survey made on (date of survey), by me or under my direct supervision and accurately shows the subdivision thereof and that all monuments exist as shown hereon; that mathematical closure errors are less than 1:10,000; and that said plat has been prepared in full compliance with all applicable provisions of the El Paso County Land Development Code, and that the requirements of Title 38 of the Colorado Revised Statutes, 1973 have been met to the best of my professional knowledge, belief and opinion and that it is accordance with applicable standards of practice and this is not a guaranty or warranty, either expressed or implied.



Daniel L. Kupferer  
Colorado Professional Land Surveyor No. 18465  
For and on behalf of LDC, Inc

### BOARD OF COUNTY COMMISSIONERS CERTIFICATE:

This plat of FOREST HEIGHTS ESTATES was approved for filing by the El Paso County, Colorado Board of County Commissioners on the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, subject to any notes specified hereon and any conditions included in the resolution of approval.

Chair, Board of County Commissioners \_\_\_\_\_ Date \_\_\_\_\_

### APPROVALS:

This subdivision was approved by the El Paso County Planning and Community Development Department this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ A.D.

Director, Planning and Community Development Department \_\_\_\_\_

### RECORDING:

STATE OF COLORADO }  
COUNTY OF EL PASO } SS

I hereby certify that this instrument was filed for record in my office at \_\_\_\_\_ o'clock \_\_\_\_M.

this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ A.D., and is duly recorded under

Reception No. \_\_\_\_\_ of the records of El Paso County, Colorado.

Chuck Broerman, Recorder BY: \_\_\_\_\_ Deputy \_\_\_\_\_

SURCHARGE: \_\_\_\_\_  
FEE: \_\_\_\_\_

### FEES:

Park Fee: \_\_\_\_\_  
Bridge Fee: \_\_\_\_\_  
Drainage Fee: \_\_\_\_\_  
School Fee: \_\_\_\_\_

PCD File No. MS206

NOTICE: According to Colorado law you must commence any legal action based upon any defect in this survey within three years after the first discovery of such defect. No event may only occur upon any defect in this survey within three years from the date of the certification, shown hereon.

CALL BEFORE YOU DIG ...  
811  
DIAL 811  
48 HOURS BEFORE CALLING CALL UTILITY LOCATORS FOR LOCATING AND MARKING GAS, ELECTRIC, WATER AND WASTEWATER

REVISIONS	No.	Description	Date
	1	LOT REVISIONS	02/23/2022
	2	ROAD REVISIONS	04/12/2022
	3	EPC REVIEW COMMENTS	9/28/2023

H Scale: N/A  
V Scale: N/A  
Designed By: XXX  
Drawn By: JLG  
Checked By: DLK  
Date: 5/01/2020

**Land Development Consultants, Inc.**  
PLANNING • SURVEYING  
www ldc inc com • TEL: (719) 528-6133 • FAX: (719) 528-8648  
3888 MAZELAND ROAD • COLORADO SPRINGS, CO 80909

FOREST HEIGHTS ESTATES  
FINAL PLAT.  
SW 1/4 SECTION 9, T12S, R65W, 6TH PM  
COUNTY OF EL PASO, STATE OF COLORADO

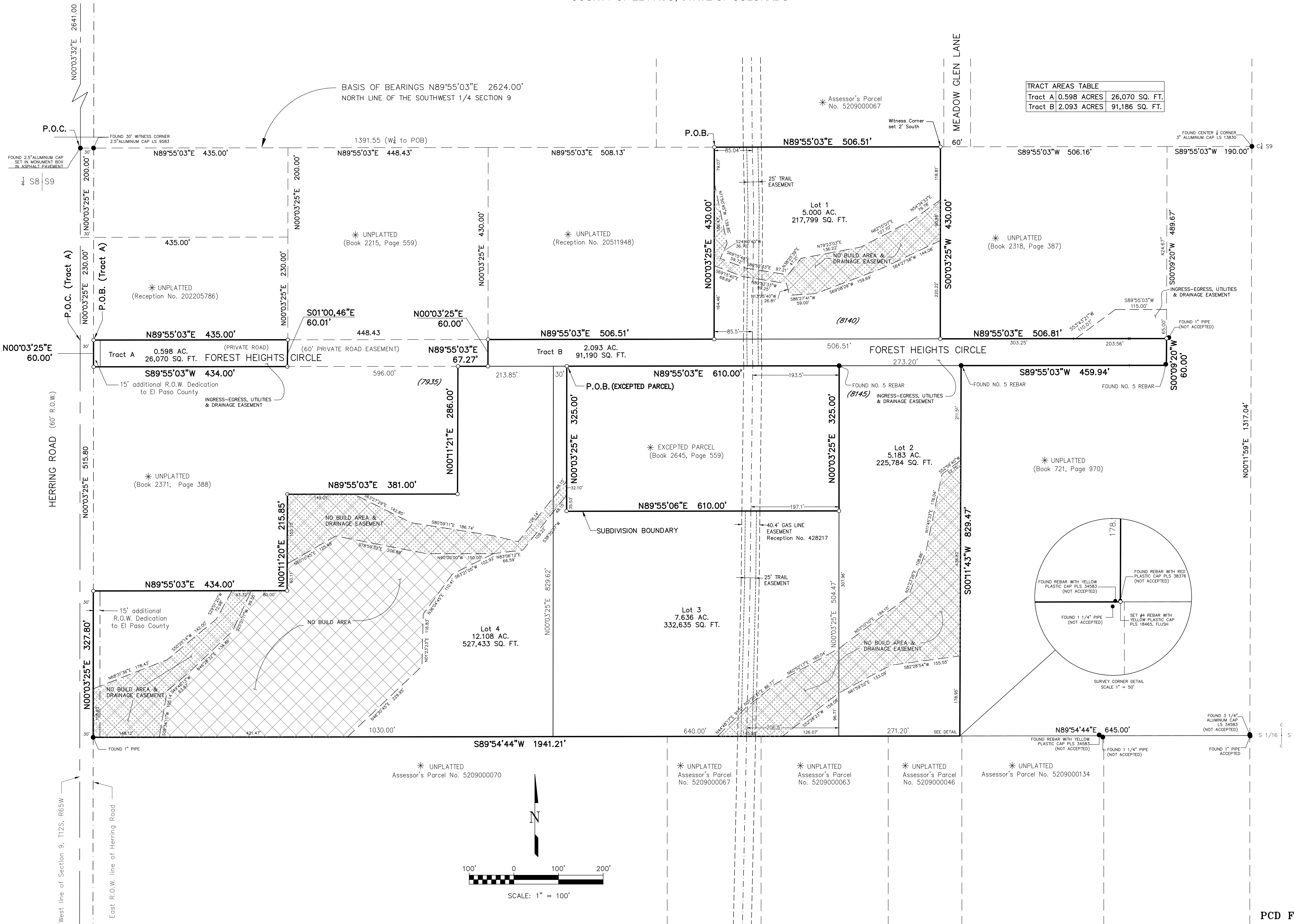
Project No.: 18070

Sheet: 1 of 2



# FOREST HEIGHTS ESTATES

FINAL PLAT  
PART OF THE SOUTHWEST QUARTER OF SECTION 9, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P.M.  
COUNTY OF EL PASO, STATE OF COLORADO



TRACT AREAS TABLE	
Tract A	0.598 ACRES 26,070 SQ. FT.
Tract B	2.093 ACRES 91,186 SQ. FT.

NOTICE: According to Colorado law you must commence any legal action based upon any error in this survey within three years after the first discovery of such defect. In no event may any action based upon any defect in this survey be commenced more than one year from the date of the certification.

CALL BEFORE YOU DIG ...  
811  
DIAL 811  
48 HOURS BEFORE CALLING CAL UTILITY LOCATORS FOR LOCATING AND MARKING GAS, ELECTRIC, WATER AND WASTEWATER

No.	Date	By	Description
1	02/23/22	DAS	LOT REVISIONS
2	04/12/22	DAS	ROAD REVISIONS
3	9/28/2023	MVE	EPC REVIEW COMMENTS

H Scale: 1"=100'  
V Scale: N/A  
Designed By: N/A  
Drawn By: JLG  
Checked By: DLK  
Date: 5/01/2020

**Land Development Consultants, Inc.**  
PLANNING • SURVEYING  
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3888 MAZELAND ROAD • COLORADO SPRINGS, CO 80909

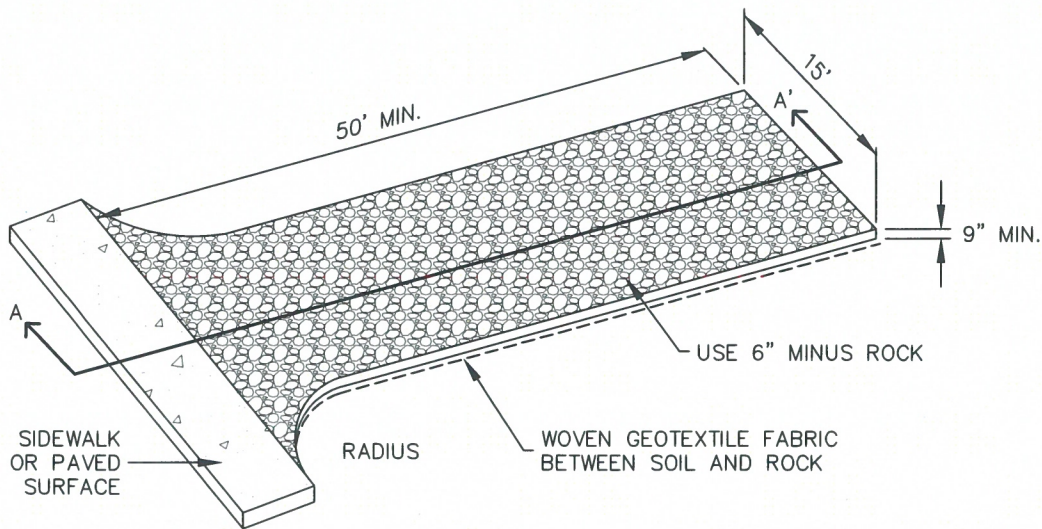
**FOREST HEIGHTS ESTATES**  
**FINAL PLAT**  
PART OF SW 1/4, SEC. 9, T12S, R65W, 6TH P.M.  
COUNTY OF EL PASO, STATE OF COLORADO

Project No.: 18070  
Sheet: 2 of 2  
PCD File No. MS206

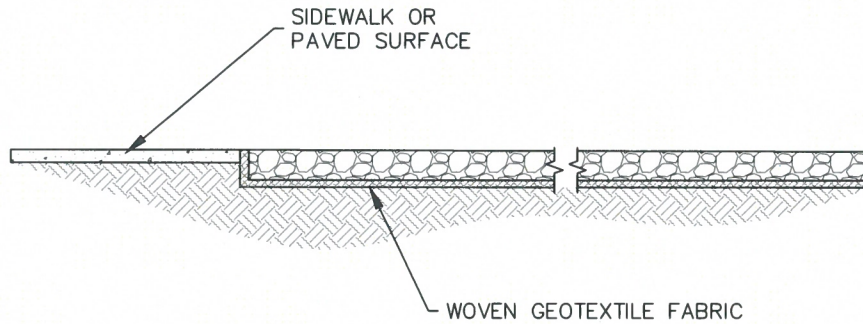
Forest Heights Estates  
Final Drainage Report, July 2023

## Exhibit 8:

### Erosion Control Facilities



### AGGREGATE VEHICLE TRACKING CONTROL



### SECTION A-A'

#### INSTALLATION NOTES

1. A STABILIZED CONSTRUCTION ENTRANCE/EXIT SHOULD BE LOCATED AT ALL POINTS WHERE VEHICLES EXIT THE CONSTRUCTION SITE TO ADJACENT ROADWAY.
2. STABILIZED CONSTRUCTION ENTRANCE/EXITS SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.
3. RADIUS MUST BE ADEQUATE FOR INTENDED CONSTRUCTION VEHICLE TURNING.
4. ROCK SHOULD CONSIST OF 6" MINUS ROCK.
5. INSTALL CONSTRUCTION FENCE ON BOTH SIDES OF VEHICLE TRACKING CONTROL PAD WHEN NEEDED OR REQUIRED BY INSPECTOR.

#### MAINTENANCE NOTES

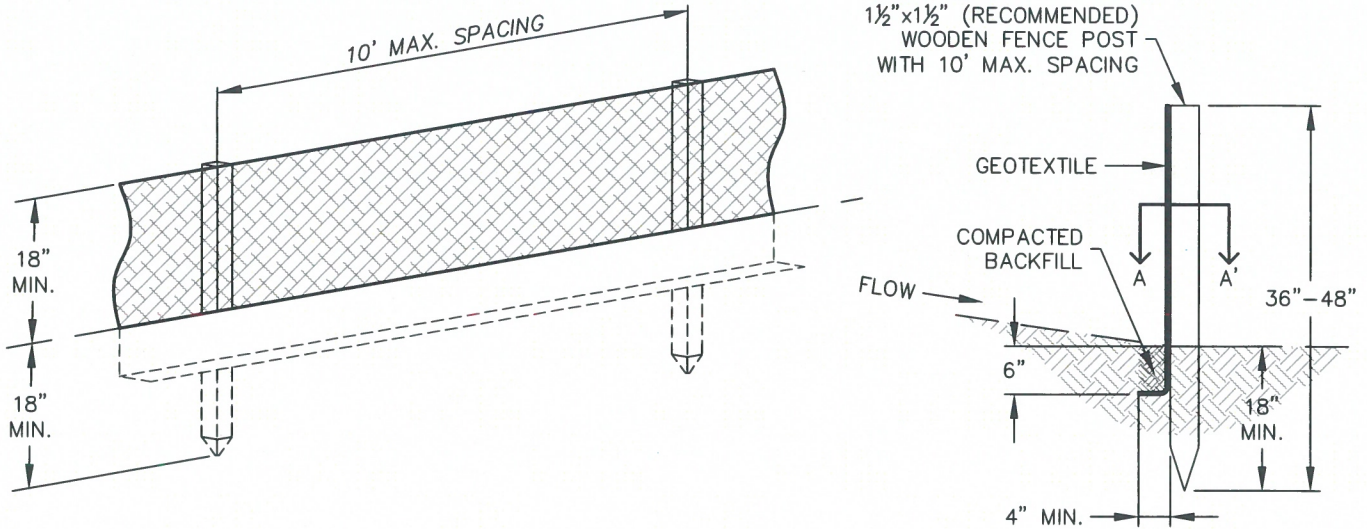
1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. SEDIMENT TRACKED ONTO THE ADJACENT ROAD SHALL BE REMOVED DAILY, BY SWEEPING OR SHOVELING, AND NEVER WASHED DOWN STORM DRAINS.
3. ROUGHEN, REPLACE AND/OR ADD ROCK AS NEEDED TO MAINTAIN CONSISTENT DEPTH AND TO PREVENT SEDIMENT TRACKING ONTO ADJACENT STREET.
4. PERMANENTLY STABILIZE AREA AFTER VEHICLE TRACKING CONTROL IS REMOVED.



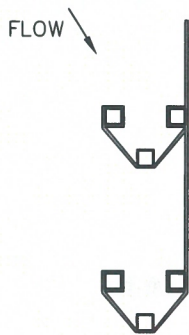
### VEHICLE TRACKING CONTROL

APPROVED:   
SWENT MANAGER

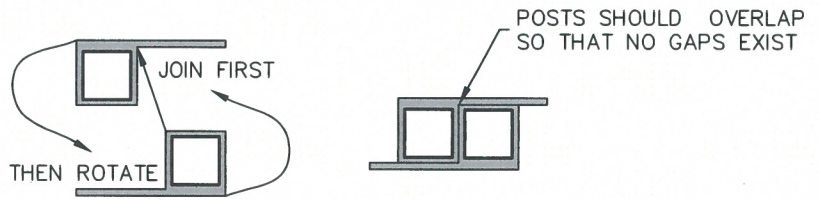
ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-VTC
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**SILT FENCE**



**J-HOOK INSTALLATION**



**SECTION A-A'**

**INSTALLATION NOTES**

1. SILT FENCE MUST BE PLACED ON A FLAT SURFACE 2'-5' AWAY FROM TOE OF THE SLOPE TO ALLOW FOR PONDING AND DEPOSITION.
2. COMPACT THE TRENCH USING A JUMPING JACK OR WHEEL ROLLING TO THE POINT THAT THE FENCE RESISTS BEING PULLED OUT OF THE GROUND BY HAND.
3. SILT FENCE SHALL BE TAUT WITH NO SAGS AFTER IT HAS BEEN ANCHORED.
4. FABRIC SHALL BE ATTACHED TO POSTS WITH 1" HEAVY DUTY STAPLES OR 1" NAILS. THESE SHOULD BE PLACED VERTICALLY DOWN THE POST, 3" APART.
5. THE PREFERRED INSTALLATION METHOD USES A TRENCHER OR SILT FENCE INSTALLATION DEVICE.
6. INSTALL SILT FENCE ALONG THE CONTOUR OF THE SLOPES OR IN A MANNER TO AVOID CREATING CONCENTRATED FLOW (SUCH AS A "J-HOOK" INSTALLATION).

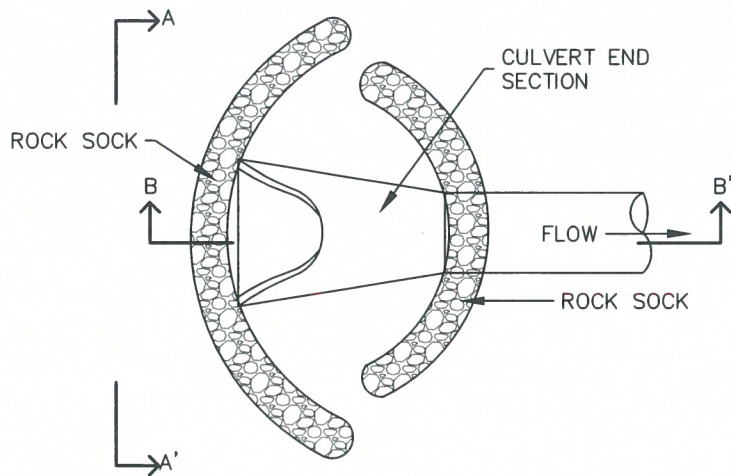
**MAINTENANCE NOTES**

1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. ACCUMULATED SEDIMENT MUST BE REMOVED WHEN THE HEIGHT REACHES 1/2 OF THE DESIGN HEIGHT OF THE SILT FENCE.
3. SILT FENCE MUST REMAIN UNTIL THE UPSTREAM DISTURBANCE AREA IS STABILIZED.
4. PERMANENTLY STABILIZE AREA AFTER SILT FENCE IS REMOVED.

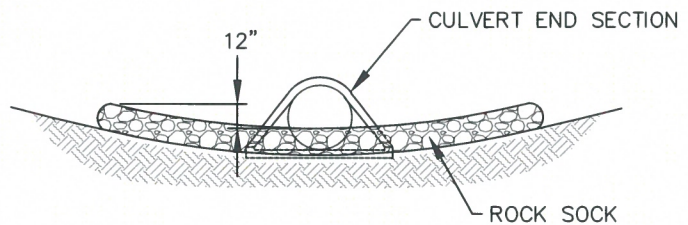


**STORMWATER  
ENTERPRISE**

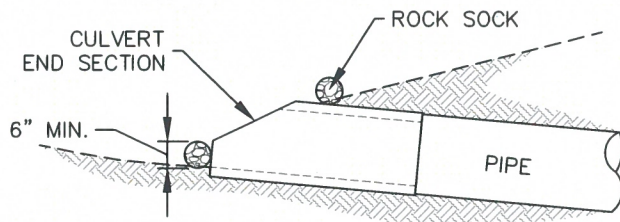
<b>SILT FENCE</b>		
APPROVED:		
SWENT MANAGER		
ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-SF



**CULVERT INLET PROTECTION PLAN**



**SECTION A-A'**



**SECTION B-B'**

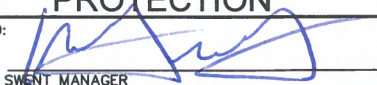
**INSTALLATION NOTES**

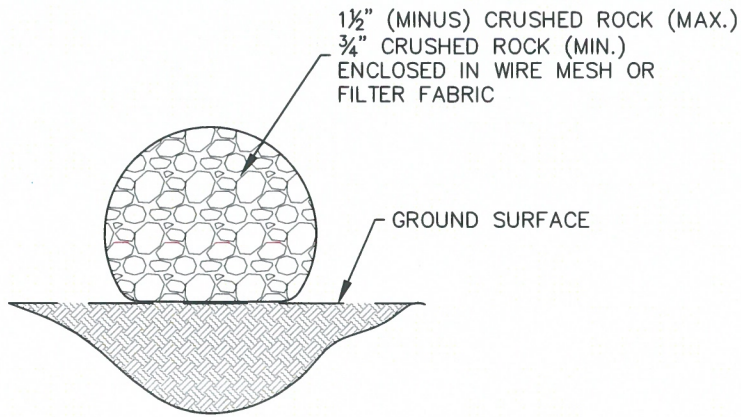
1. SEE ROCK SOCK DETAIL.

**MAINTENANCE NOTES**

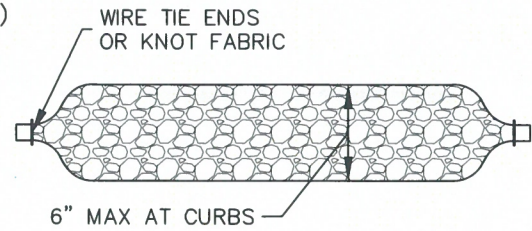
1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. ACCUMULATED SEDIMENT UPSTREAM OF THE CULVERT SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS  $\frac{1}{2}$  HEIGHT OF THE ROCK SOCK.
3. CULVERT INLET PROTECTION SHALL REMAIN UNTIL THE UPSTREAM AREA IS PERMANENTLY STABILIZED.



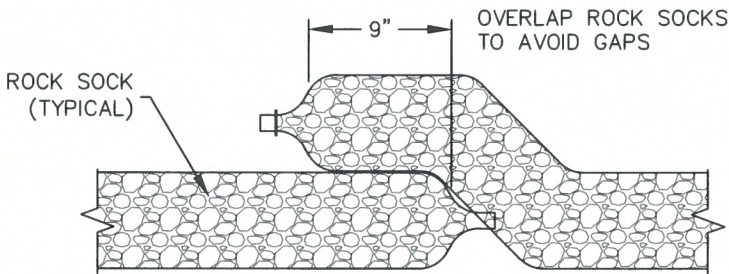
<b>CULVERT INLET PROTECTION</b>		
APPROVED: 		
SWENT MANAGER		
ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-CIP



**ROCK SOCK SECTION**



**ROCK SOCK PLAN**



**ROCK SOCK OVERLAP**

**GRADATION TABLE**

	MASS PERCENT PASSING SQUARE MESH SIEVES
	No. 4
2"	100
1 1/2"	90-100
1"	20-55
3/4"	0-15
3/8"	0-5

MATCHES SPECIFICATIONS FOR  
No. 4 COARSE AGGREGATE FOR  
CONCRETE PER AASHTO M-43.  
ALL ROCK SHALL BE FRACTURED  
FACE, ALL SIDES

**INSTALLATION NOTES**

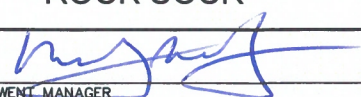
1. CRUSHED ROCK SHALL BE BETWEEN MAX. 1 1/2" (MINUS) IN SIZE WITH A FRACTURED FACE (ALL SIDES) AND SHALL COMPLY WITH GRADATION SHOWN ON THIS SHEET AND MIN. 3/4" CRUSHED ROCK.
2. WIRE MESH SHALL HAVE OPENINGS SMALLER THAN THE SMALLEST SIZE ROCK.
3. WIRE MESH SHALL BE SECURED USING 'HOG RINGS' OR WIRE TIES AT 6" CENTERS ALONG ALL JOINTS AND AT 2" CENTERS ON ENDS OF SOCKS.

**MAINTENANCE NOTES**

1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. ROCK SOCKS SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED OR DAMAGED BEYOND REPAIR.
3. ACCUMULATED SEDIMENT SHALL BE REMOVED WHEN THE DEPTH REACHES 1/2 OF THE HEIGHT OF THE ROCK SOCK.
4. ROCK SOCKS ARE TO REMAIN IN PLACE UNTIL DISTURBED AREA IS STABILIZED.
5. PERMANENTLY STABILIZE AREA AFTER ROCK SOCKS HAVE BEEN REMOVED.



**ROCK SOCK**

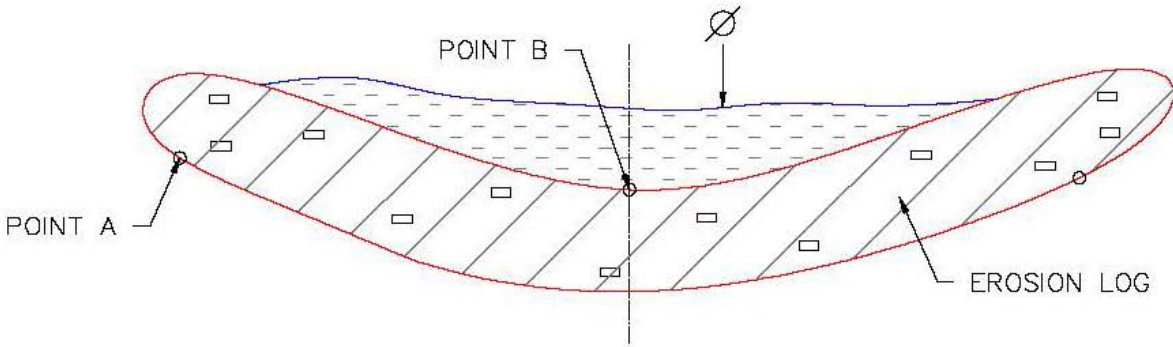
APPROVED:   
SWEMT MANAGER

ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-RS
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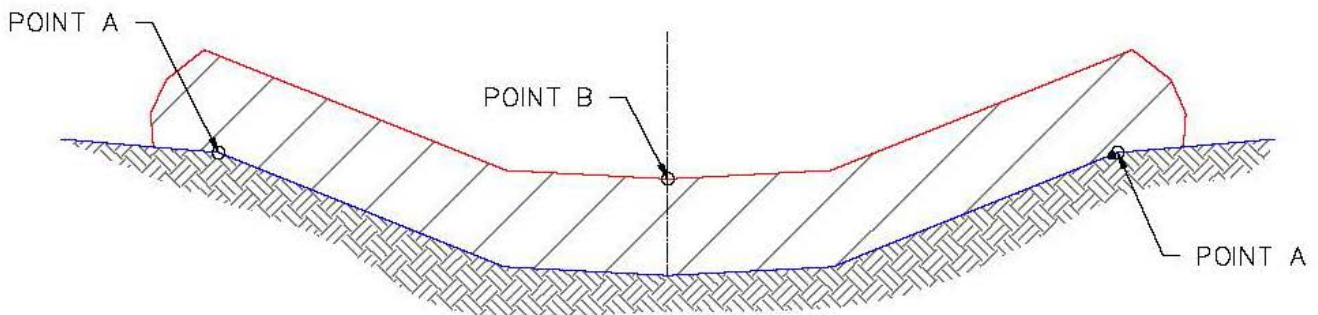


Ø REMOVE ACCUMULATED SEDIMENT WHEN IT REACHES ONE HALF OF EXPOSED LOG HEIGHT. INSPECTIONS SHALL BE PERFORMED FREQUENTLY FOR PROPER FUNCTION.

EROSION LOGS SHOULD BE KEYED IN TO PREVENT UNDER-CUTTING



PLAN VIEW



POINTS A SHALL BE HIGHER THAN POINT B

ELEVATION

EROSION LOG DETAIL DITCH INSTALLATION

NOTE: EROSION LOGS SHALL BE TIGHTLY ABUTTED WITH NO GAPS.

1/1/08

DATE APPROVED:

John A. McCarty

DEPARTMENT OF TRANSPORTATION

Erosion Log Check Dams

Standard Drawing

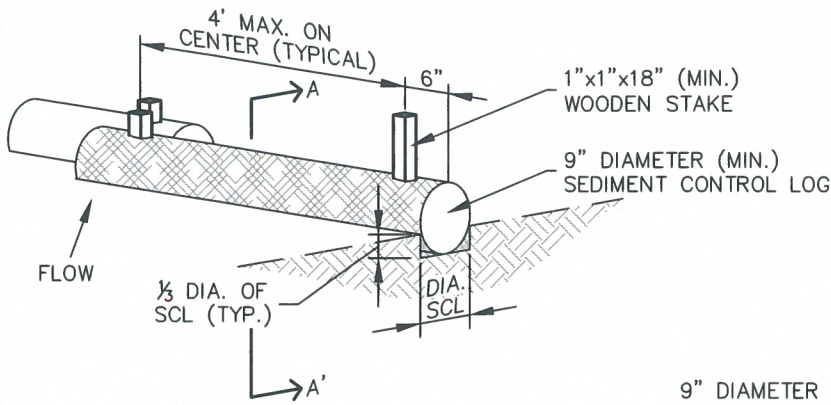
REVISION DATE:

7/17/07

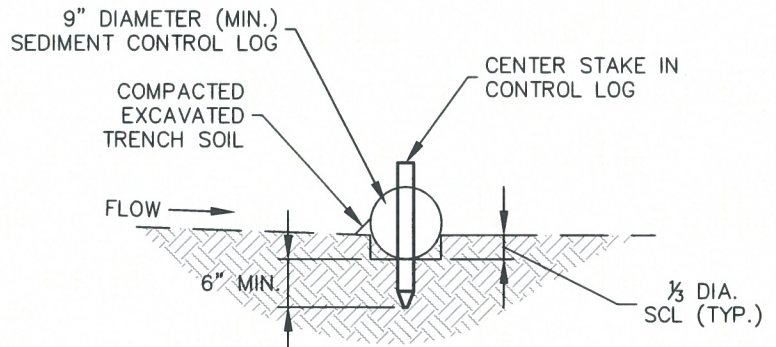
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SD\_3-85

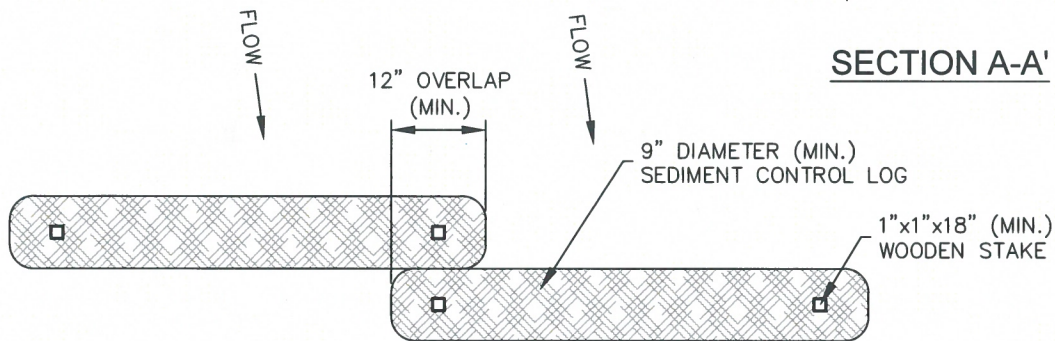




**SEDIMENT CONTROL LOG**



**SECTION A-A'**



**SEDIMENT CONTROL LOG JOINTS**

**INSTALLATION NOTES**

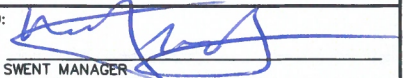
1. ALL SEDIMENT CONTROL LOGS MUST BE EMBEDDED TO  $\frac{1}{3}$  OF THE HEIGHT OF THE LOG
2. LARGER DIAMETER SEDIMENT CONTROL LOGS NEED TO BE EMBEDDED DEEPER.
3. PLACE SEDIMENT CONTROL LOG AGAINST SIDEWALK OR BACK OF CURB WHEN ADJACENT TO THESE FEATURES.
4. SEDIMENT CONTROL LOGS SHALL CONSIST OF STRAW, COMPOST, EXCELSIOR OR COCONUT FIBER, AND SHALL BE FREE FROM ANY NOXIOUS WEED SEEDS OR DEFECTS INCLUDING RIPS, HOLES AND OBVIOUS WEAR.
5. IF USING AS SLOPE PROTECTION, INSTALL SEDIMENT CONTROL LOGS ALONG THE CONTOUR.

**MAINTENANCE NOTES**

1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. ACCUMULATED SEDIMENT MUST BE REMOVED WHEN THE HEIGHT REACHES  $\frac{1}{2}$  OF THE HEIGHT OF THE SEDIMENT CONTROL LOG.
3. PERMANENTLY STABILIZE AREA AFTER SEDIMENT CONTROL LOGS HAVE BEEN REMOVED.

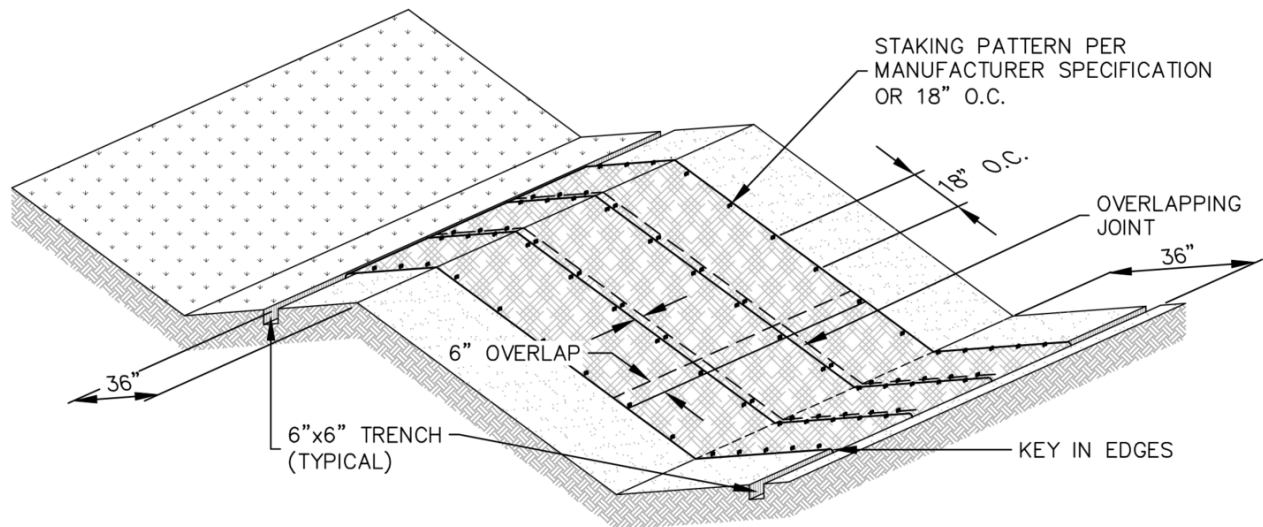


**SEDIMENT CONTROL LOGS**

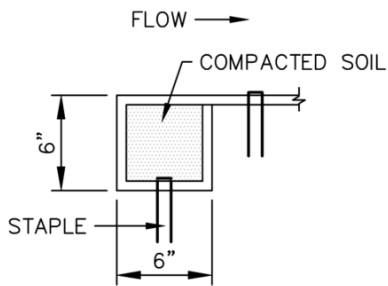
APPROVED:   
SWENT MANAGER

ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-SCL
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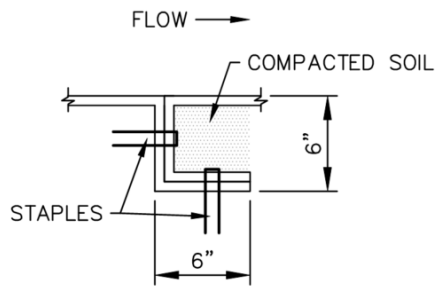




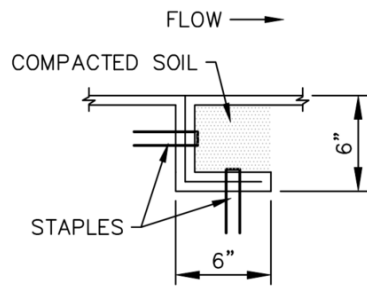
**EROSION CONTROL BLANKET**



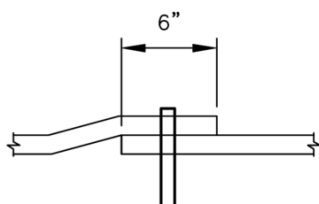
**PERIMETER ANCHOR TRENCH**



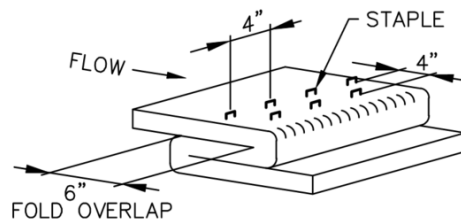
**JOINT ANCHOR TRENCH**



**INTERMEDIATE CHECK SLOT**



**OVERLAPPING JOINT**



**STAPLE CHECK**  
TO BE USED ON SLOPE EVERY 15 FEET



<p><b>STORMWATER ENTERPRISE</b></p>	<b>EROSION CONTROL BLANKET</b>	
	APPROVED: SWENT MANAGER	
ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-ECB-1

**INSTALLATION NOTES**

1. 100% NATURAL AND BIODEGRADABLE MATERIALS ARE REQUIRED FOR EROSION CONTROL BLANKETS. TRM PRODUCTS MAY BE USED WHERE APPROPRIATE AS DESIGNATED BY THE ENGINEER.
2. IN AREAS WHERE EROSION CONTROL BLANKETS ARE SHOWN ON THE PLANS, THE PERMITTEE SHALL PLACE TOPSOIL AND PERFORM FINAL GRADING, SURFACE PREPARATION, AND SEEDING AND MULCHING. SUBGRADE SHALL BE SMOOTH AND MOIST PRIOR TO EROSION CONTROL BLANKET INSTALLATION, AND THE EROSION CONTROL BLANKET SHALL BE IN FULL CONTACT WITH THE SUBGRADE. NO GAPS OR VOIDS SHALL EXIST UNDER THE BLANKET.
3. PERIMETER ANCHOR TRENCH SHALL BE USED ALONG THE OUTSIDE PERIMETER OF ALL BLANKET AREAS.
4. JOINT ANCHOR TRENCH SHALL BE USED TO JOIN ROLLS OF EROSION CONTROL BLANKETS TOGETHER (LONGITUDINALLY AND TRANSVERSELY) FOR ALL EROSION CONTROL BLANKETS.
5. INTERMEDIATE CHECK SLOT OR STAPLE CHECK SHALL BE INSTALLED EVERY 15' DOWN SLOPES. IN DRAINAGEWAYS, INSTALL CHECK SLOTS EVERY 25' PERPENDICULAR TO FLOW DIRECTION.
6. OVERLAPPING JOINT DETAIL SHALL BE USED TO JOIN ROLLS OF EROSION CONTROL BLANKETS TOGETHER FOR EROSION CONTROL BLANKETS ON SLOPES.
7. MATERIAL SPECIFICATIONS OF EROSION CONTROL BLANKETS SHALL CONFORM TO TABLE ECB-1.
8. ANY AREAS OF SEEDING AND MULCHING DISTURBED IN THE PROCESS OF INSTALLING EROSION CONTROL BLANKETS SHALL BE RESEEDED AND MULCHED.
9. STRAW EROSION CONTROL BLANKETS SHALL NOT BE USED WITHIN STREAMS AND DRAINAGE CHANNELS.
10. COMPACT ALL TRENCHES.

**MAINTENANCE NOTES**

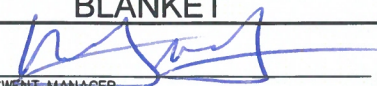
1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. EROSION CONTROL BLANKETS SHALL BE LEFT IN PLACE TO EVENTUALLY BIODEGRADE. TRM MUST BE REMOVED AT THE DISCRETION OF THE GEC INSPECTOR.
3. ANY EROSION CONTROL BLANKET PULLED OUT, TORN, OR OTHERWISE DAMAGED SHALL BE REPAIRED OR REINSTALLED. ANY SUBGRADE AREAS BELOW GEOTEXTILE THAT HAVE ERODED TO CREATE A VOID UNDER THE BLANKET, OR THAT REMAIN DEVOID OF GRASS SHALL BE REPAIRED, RESEEDED AND MULCHED AND THE EROSION CONTROL BLANKET REINSTALLED.

TABLE ECB-1, EROSION CONTROL BLANKET MATERIAL SPECIFICATIONS

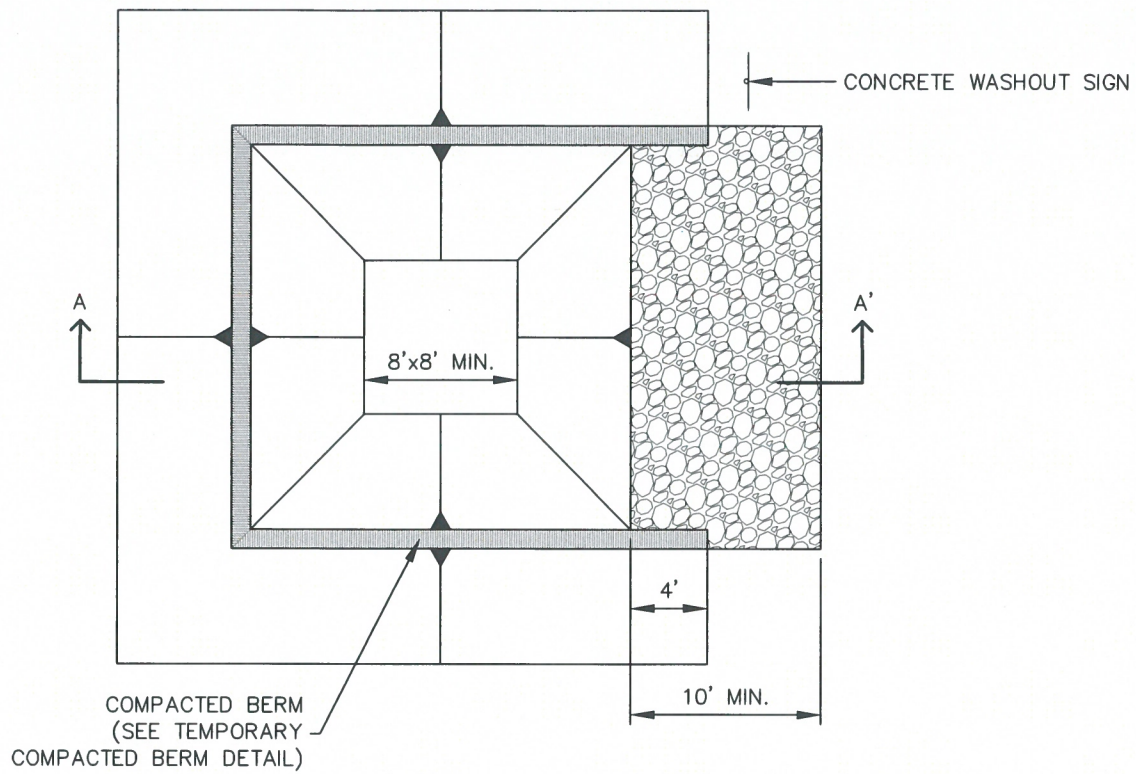
TYPE	COCONUT CONTENT	STRAW CONTENT	EXCELSIOR CONTENT	RECOMMENDED NETTING
STRAW	-	100%	-	DOUBLE/NATURAL
STRAW-COCONUT	30% MIN.	70% MAX.	-	DOUBLE/NATURAL
COCONUT	100%	-	-	DOUBLE/NATURAL
EXCELSIOR	-	-	100%	DOUBLE/NATURAL



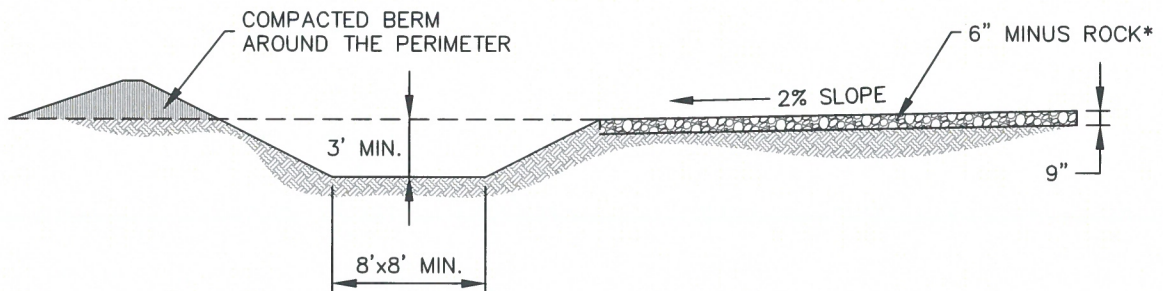
**EROSION CONTROL BLANKET**

APPROVED:   
SWENT MANAGER

ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-ECB-2
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**CONCRETE WASHOUT AREA PLAN**

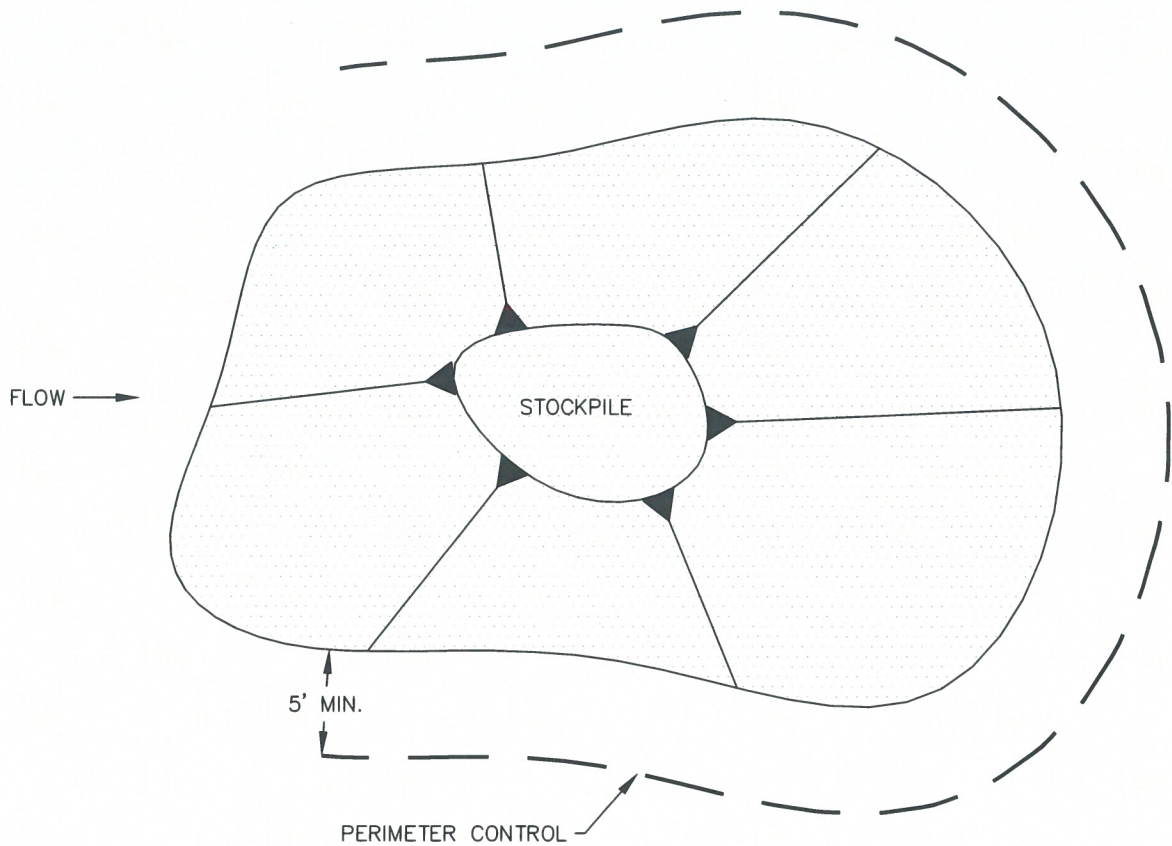


**SECTION A-A'**

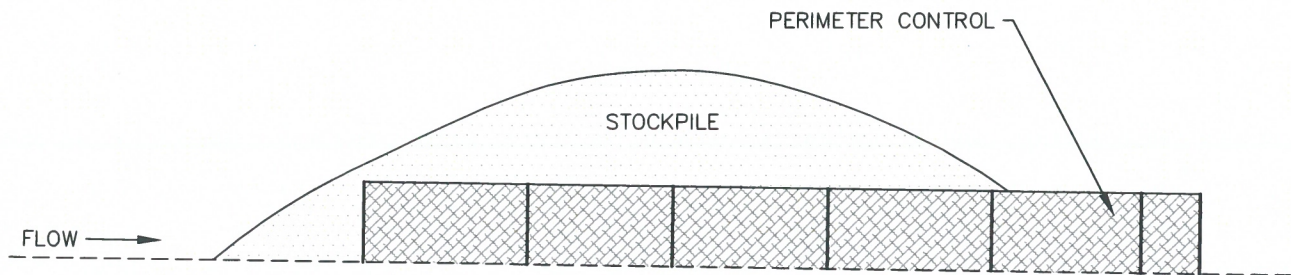
\*ROCK REQUIRED BASED ON  
SITE CONDITIONS AT THE  
DISCRETION OF THE GEC  
INSPECTOR



<b>CONCRETE WASHOUT AREA</b>		
APPROVED:		
SWENT MANAGER		
ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-CWA-1



**STOCKPILE PROTECTION PLAN**



**STOCKPILE PROTECTION ELEVATION**

**INSTALLATION NOTES**

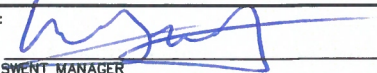
1. INSTALL PERIMETER CONTROL AROUND STOCKPILE ON DOWNGRAIDENT SIDE. PERIMETER CONTROL MUST BE SUITABLE TO SITE CONDITIONS AND INSTALLED ACCORDING TO THE RELEVANT DETAIL.
2. FOR STOCKPILES ON THE INTERIOR PORTION OF A CONSTRUCTION SITE, WHERE OTHER DOWNGRAIDENT CONTROLS INCLUDING PERIMETER CONTROL ARE IN PLACE, STOCKPILE PERIMETER CONTROLS MAY NOT BE REQUIRED.

**MAINTENANCE NOTES**

1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. IF PERIMETER CONTROLS MUST BE MOVED TO ACCESS STOCKPILE, REPLACE PERIMETER CONTROLS BY THE END OF THE WORK DAY.
3. ACCUMULATED SEDIMENT MUST BE REMOVED ACCORDING TO PERIMETER CONTROL DETAIL.



**STOCKPILE PROTECTION**

APPROVED:   
SWENT MANAGER

ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-SP
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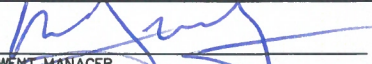
INSTALLATION NOTES

1. SEE PLAN VIEW FOR:  
-LOCATION OF CONCRETE WASHOUT AREA
2. LOCATE AT LEAST 50' AWAY FROM STATE WATERS MEASURED HORIZONTALLY.
3. AN IMPERMEABLE LINER (16 MIL. MINIMUM THICKNESS) IS REQUIRED IF CONCRETE WASH AREA IS LOCATED WITHIN 400' OF STATE WATERS OR 1000' OF WELLS OR DRINKING WATER SOURCES.
4. DO NOT LOCATE IN AREAS WHERE SHALLOW GROUNDWATER MAY BE PRESENT.
5. THE CONCRETE WASH AREA SHALL BE INSTALLED PRIOR TO CONCRETE PLACEMENT ON SITE.
6. CONCRETE WASH AREA SHALL INCLUDE A FLAT SUBSURFACE PIT THAT IS AT LEAST 8' BY 8'.
7. BERM SURROUNDING SIDES AND BACK OF CONCRETE WASH AREA SHALL HAVE A MINIMUM HEIGHT OF 2 FEET.
8. CONCRETE WASH AREA ENTRANCE SHALL BE SLOPED 2% TOWARDS THE CONCRETE WASH AREA.
9. SIGNS SHALL BE PLACED AT THE CONCRETE WASH AREA.
10. USE EXCAVATED MATERIAL FOR PERIMETER BERM CONSTRUCTION.

MAINTENANCE NOTES

1. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN CONTROL MEASURES IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.
2. THE CONCRETE WASH AREA SHALL BE REPAIRED, CLEANED, OR ENLARGED AS NECESSARY TO MAINTAIN CAPACITY FOR CONCRETE WASTE. CONCRETE MATERIALS ACCUMULATED IN THE PIT SHALL BE REMOVED ONCE THE MATERIALS HAVE REACHED A DEPTH OF  $\frac{2}{3}$  THE HEIGHT OF THE CONCRETE WASH AREA.
3. CONCRETE WASHOUT WATER, WASTED PIECES OF CONCRETE, AND ALL OTHER DEBRIS IN THE SUBSURFACE PIT SHALL BE TRANSPORTED FROM THE JOB SITE IN A WATER-TIGHT CONTAINER AND DISPOSED OF PROPERLY.
4. THE CONCRETE WASH AREA SHALL REMAIN IN PLACE UNTIL ALL CONCRETE FOR THE PROJECT IS PLACED.
5. PERMANENTLY STABILIZE AREA AFTER CONCRETE WASH AREA IS REMOVED.



<b>CONCRETE WASHOUT AREA</b>		
APPROVED: 		
SWENT MANAGER		
ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-CWA-2

## SEEDING & MULCHING

ALL SOIL TESTING, SOILS AMENDMENT AND FERTILIZER DOCUMENTATION, AND SEED LOAD AND BAG TICKETS MUST BE ADDED TO THE CSWMP.

### SOIL PREPARATION

1. IN AREAS TO BE SEEDED, THE UPPER 6 INCHES OF THE SOIL MUST NOT BE HEAVILY COMPACTED, AND SHOULD BE IN FRIABLE CONDITION. LESS THAN 85% STANDARD PROCTOR DENSITY IS ACCEPTABLE. AREAS OF COMPACTION OR GENERAL CONSTRUCTION ACTIVITY MUST BE SCARIFIED TO A DEPTH OF 6 TO 12 INCHES PRIOR TO SPREADING TOPSOIL TO BREAK UP COMPACTED LAYERS AND PROVIDE A BLENDING ZONE BETWEEN DIFFERENT SOIL LAYERS.
2. AREAS TO BE PLANTED SHALL HAVE AT LEAST 4 INCHES OF TOPSOIL SUITABLE TO SUPPORT PLANT GROWTH.
3. THE CITY RECOMMENDS THAT EXISTING AND/OR IMPORTED TOPSOIL BE TESTED TO IDENTIFY SOIL DEFICIENCIES AND ANY SOIL AMENDMENTS NECESSARY TO ADDRESS THESE DEFICIENCIES. SOIL AMENDMENTS AND/OR FERTILIZERS SHOULD BE ADDED TO CORRECT TOPSOIL DEFICIENCIES BASED ON SOIL TESTING RESULTS.
4. TOPSOIL SHALL BE PROTECTED DURING THE CONSTRUCTION PERIOD TO RETAIN ITS STRUCTURE AVOID COMPACTION, AND TO PREVENT EROSION AND CONTAMINATION. STRIPPED TOPSOIL MUST BE STORED IN AN AREA AWAY FROM MACHINERY AND CONSTRUCTION OPERATIONS, AND CARE MUST BE TAKEN TO PROTECT THE TOPSOIL AS A VALUABLE COMMODITY. TOPSOIL MUST NOT BE STRIPPED DURING UNDESIRABLE WORKING CONDITIONS (E.G. DURING WET WEATHER OR WHEN SOILS ARE SATURATED). TOPSOIL SHALL NOT BE STORED IN SWALES OR IN AREAS WITH POOR DRAINAGE.

### SEEDING

1. ALLOWABLE SEED MIXES ARE INCLUDED IN THE CITY OF COLORADO SPRINGS STORMWATER CONSTRUCTION MANUAL. ALTERNATIVE SEED MIXES ARE ACCEPTABLE IF INCLUDED IN AN APPROVED LANDSCAPING PLAN.
2. SEED SHOULD BE DRILL-SEEDED WHENEVER POSSIBLE
  - SEED DEPTH MUST BE  $\frac{1}{3}$  TO  $\frac{1}{2}$  INCHES WHEN DRILL-SEEDED IS USED
3. BROADCAST SEEDING OR HYDRO-SEEDED WITH TACKIFIER MAY BE SUBSTITUTED ON SLOPES STEEPER THAN 3:1 OR ON OTHER AREAS NOT PRACTICAL TO DRILL SEED.
  - SEEDING RATES MUST BE DOUBLED FOR BROADCAST SEEDING OR INCREASED BY 50% IF USING A BRILLION DRILL OR HYDRO-SEEDED
  - BROADCAST SEEDING MUST BE LIGHTLY HAND-RAKED INTO THE SOIL

### MULCHING

1. MULCHING SHOULD BE COMPLETED AS SOON AS PRACTICABLE AFTER SEEDING, HOWEVER PLANTED AREAS MUST BE MULCHED NO LATER THAN 14 DAYS AFTER PLANTING.
2. MULCHING REQUIREMENTS INCLUDE:
  - HAY OR STRAW MULCH
    - ONLY CERTIFIED WEED-FREE AND CERTIFIED SEED-FREE MULCH MAY BE USED. MULCH MUST BE APPLIED AT 2 TONS/ACRE AND ADEQUATELY SECURED BY CRIMPING AND/OR TACKIFIER.
    - CRIMPING MUST NOT BE USED ON SLOPES GREATER THAN 3:1 AND MULCH FIBERS MUST BE TUCKED INTO THE SOIL TO A DEPTH OF 3 TO 4 INCHES.
    - TACKIFIER MUST BE USED IN PLACE OF CRIMPING ON SLOPES STEEPER THAN 3:1.
  - HYDRAULIC MULCHING
    - HYDRAULIC MULCHING IS AN OPTION ON STEEP SLOPES OR WHERE ACCESS IS LIMITED.
    - IF HYDRO-SEEDED IS USED, MULCHING MUST BE APPLIED AS A SEPARATE, SECOND OPERATION.
    - WOOD CELLULOSE FIBERS MIXED WITH WATER MUST BE APPLIED AT A RATE OF 2,000 TO 2,500 POUNDS/ACRE, AND TACKIFIER MUST BE APPLIED AT A RATE OF 100 POUNDS/ACRE.
  - EROSION CONTROL BLANKET
    - EROSION CONTROL BLANKET MAY BE USED IN PLACE OF TRADITIONAL MULCHING METHODS.



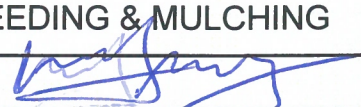
<b>SEEDING &amp; MULCHING</b>		
APPROVED: 		
SWENT MANAGER		
ISSUED: 10/7/19	REVISED: 8/19/2020	DRAWING NO. 900-SM

Exhibit 9:  
Hydrologic Calculations

**Didleau Subdivision  
FINAL DRAINAGE REPORT  
Existing Conditions  
July 25, 2023**

BASIN	TOTAL AREA (Acres)	Forest Heights Drive				DEVELOPED LOTS				NATURAL				RUNOFF COEFFICIENT	
		AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	C <sub>100</sub>	
<i>A</i>	17.40	0.20	0.59	0.70	0.00	0.38	0.57	17.20	0.08	0.35	0.09	0.35	0.35		
<i>B</i>	20.80	0.40	0.59	0.70	0.00	0.38	0.57	20.40	0.08	0.35	0.09	0.35	0.36		
<i>C</i>	3.90	0.20	0.59	0.70	0.00	0.38	0.57	3.70	0.08	0.35	0.11	0.35	0.37		
<i>D</i>	7.50	0.30	0.59	0.70	0.00	0.38	0.57	7.20	0.08	0.35	0.10	0.35	0.36		
<i>E</i>	2.30	0.20	0.59	0.70	0.00	0.38	0.57	2.10	0.08	0.35	0.12	0.35	0.38		
<i>F</i>	18.70	0.00	0.59	0.70	0.00	0.38	0.57	18.70	0.08	0.35	0.08	0.35	0.35		
<i>G</i>	9.90	0.20	0.59	0.70	0.00	0.38	0.57	9.70	0.08	0.35	0.09	0.35	0.36		
<i>H</i>	23.30	0.60	0.59	0.70	0.00	0.38	0.57	22.70	0.08	0.35	0.09	0.35	0.36		
<i>I</i>	5.70	0.30	0.59	0.70	0.00	0.38	0.57	5.40	0.08	0.35	0.11	0.35	0.37		
<i>J</i>	3.40	0.00	0.59	0.70	0.00	0.38	0.57	3.40	0.08	0.35	0.08	0.35	0.35		



**Didleau Subdivision**  
**FINAL DRAINAGE REPORT**  
**Existing Conditions**  
**July 25, 2023**

BASIN	From Area Runoff Coefficient Summary			OVERLAND				SHALLOW CHANNEL FLOW				Time of Travel (T <sub>t</sub> )				INTENSITY *			TOTAL FLOWS	
	AREA TOTAL (Acres)	C <sub>s</sub>	C <sub>100</sub>	C <sub>s</sub>	Length (ft)	Height (ft)	T <sub>c</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>t</sub> (min)	TOTAL (min)	I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>5</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)		
<b>A</b>	17.40	0.09	0.35	0.09	300	20	17.0	1100	4.5%	1.1	17.3	34.2	2.3	3.8	2.3	3.8	3.4	23.6		
<b>B</b>	20.80	0.09	0.36	0.09	200	14	13.6	1200	4.2%	1.0	19.5	33.1	2.3	3.9	2.3	3.9	4.4	29.1		
<b>C</b>	3.90	0.11	0.37	0.11	100	6	9.9	550	5.5%	1.2	7.8	17.8	3.3	5.5	3.3	5.5	1.4	7.9		
<b>D</b>	7.50	0.10	0.36	0.10	200	16	12.9	500	6.0%	1.2	6.8	19.7	3.1	5.2	3.1	5.2	2.3	14.3		
<b>E</b>	2.30	0.12	0.38	0.12	100	4	11.1	350	4.0%	1.0	5.8	17.0	3.3	5.6	3.3	5.6	1.0	4.9		
<b>F</b>	18.70	0.08	0.35	0.08	300	10	21.4	1500	4.7%	1.1	23.1	44.5	1.9	3.2	1.9	3.2	2.8	20.7		
<b>G</b>	9.90	0.09	0.36	0.09	1	0.5	0.5	1100	3.1%	0.9	20.8	21.3	3.0	5.0	3.0	5.0	2.7	17.8		
<b>H</b>	23.30	0.09	0.36	0.09	1	0.5	0.5	1600	3.1%	0.9	30.3	30.8	2.4	4.1	2.4	4.1	5.3	34.3		
<b>I</b>	5.70	0.11	0.37	0.11	1	0.1	0.8	600	3.3%	0.9	11.0	11.8	3.9	6.5	3.9	6.5	2.4	13.7		
<b>J</b>	3.40	0.08	0.35	0.08	150	10	12.1	200	6.0%	1.2	2.7	14.8	3.5	5.9	3.5	5.9	1.0	7.1		

Calculated by: Ken H

Date: 10/4/2021

Checked by: \_\_\_\_\_

**Didleau Subdivision  
Drainage Calculations  
Developed Conditions  
(Area Runoff Coefficient Summary)**

BASIN	Forest Heights Drive				DEVELOPED LOTS				NATURAL				RUNOFF COEFFICIENT		
	TOTAL AREA (Acres)	AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	C <sub>100</sub>	AREA (Acres)	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	C <sub>100</sub>	C <sub>5</sub>	C <sub>100</sub>
A	17.40	0.20	0.59	0.70	1.50	0.16	0.41	0.41	15.70	0.08	0.35	0.09	0.36	0.09	0.36
B	20.80	0.40	0.59	0.70	1.50	0.16	0.41	0.41	18.90	0.08	0.35	0.10	0.36	0.10	0.36
C	3.90	0.20	0.59	0.70	1.50	0.16	0.41	0.41	2.20	0.08	0.35	0.14	0.39	0.14	0.39
D	7.50	0.30	0.59	0.70	1.50	0.16	0.41	0.41	5.70	0.08	0.35	0.12	0.38	0.12	0.38
E	2.30	0.20	0.59	0.70	1.50	0.16	0.41	0.41	0.60	0.08	0.35	0.18	0.42	0.18	0.42
F	18.70	0.00	0.59	0.70	1.50	0.16	0.41	0.41	17.20	0.08	0.35	0.09	0.35	0.09	0.35
G	9.90	0.20	0.59	0.70	1.50	0.16	0.41	0.41	8.20	0.08	0.35	0.10	0.37	0.10	0.37
H	23.30	0.60	0.59	0.70	1.50	0.16	0.41	0.41	21.20	0.08	0.35	0.10	0.36	0.10	0.36
I	5.70	0.30	0.59	0.70	1.50	0.16	0.41	0.41	3.90	0.08	0.35	0.13	0.38	0.13	0.38
J	3.40	0.00	0.59	0.70	0.00	0.16	0.41	0.41	3.40	0.08	0.35	0.08	0.35	0.08	0.35
Rd swale 13	0.71	0.23	0.59	0.70	0.00	0.16	0.41	0.41	0.48	0.08	0.35	0.25	0.46	0.25	0.46
Rd swale 14	0.41	0.06	0.59	0.70	0.00	0.16	0.41	0.41	0.06	0.08	0.35	0.10	0.16	0.10	0.16
Rdswale 15	0.27	0.13	0.59	0.70	0.00	0.16	0.41	0.41	0.14	0.08	0.35	0.33	0.52	0.33	0.52
Rdswale 16	3.75	0.24	0.59	0.70	0.00	0.16	0.41	0.41	3.51	0.08	0.35	0.11	0.37	0.11	0.37
Rdswale 17	0.35	0.06	0.59	0.70	0.00	0.16	0.41	0.41	0.29	0.08	0.35	0.17	0.41	0.17	0.41

**Didleau Subdivision**  
**FINAL DRAINAGE REPORT**  
**Developed Conditions**  
**(Area Drainage Summary)**

BASIN	From Area Runoff Coefficient Summary		OVERLAND				SHALLOW CHANNEL FLOW				Time of Travel (T <sub>i</sub> )				INTENSITY *				TOTAL FLOWS	
	AREA TOTAL (acres)	C <sub>5</sub>	C <sub>100</sub>	C <sub>1</sub>	Length (ft)	Height (ft)	T <sub>c</sub> (min)	Length (ft)	Slope (%)	Velocity (fps)	T <sub>i</sub> (min)	TOTAL (min)	I <sub>5</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>5</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)				
A	17.40	0.09	0.36	0.09	300	20	16.8	1100	4.5%	1.1	17.3	34.1	2.3	3.8	3.7	24.0				
B	20.80	0.10	0.36	0.10	200	14	13.5	1200	4.2%	1.0	19.5	33.0	2.3	3.9	4.6	29.5				
C	3.90	0.14	0.39	0.14	100	6	9.6	550	5.5%	1.2	7.8	17.4	3.3	5.5	1.8	8.4				
D	7.50	0.12	0.38	0.12	200	16	12.6	500	6.0%	1.2	6.8	19.4	3.1	5.3	2.7	14.8				
E	2.30	0.18	0.42	0.18	100	4	10.6	350	4.0%	1.0	5.8	16.4	3.4	5.7	1.4	5.5				
F	18.70	0.09	0.35	0.09	300	10	21.3	1500	4.7%	1.1	23.1	44.4	1.9	3.2	3.1	21.1				
G	9.90	0.10	0.37	0.10	1	0.5	0.5	1100	3.1%	0.9	20.8	21.3	3.0	5.0	3.0	16.2				
H	23.30	0.10	0.36	0.10	1	0.5	0.5	1600	3.1%	0.9	30.3	30.8	2.4	4.1	5.6	34.7				
I	5.70	0.13	0.38	0.13	1	0.1	0.8	600	3.3%	0.9	11.0	11.8	3.9	6.5	2.8	14.3				
J	3.40	0.08	0.35	0.08	150	10	12.1	200	6.0%	1.2	2.7	14.8	3.5	5.9	1.0	7.1				
Rd swale 13	0.71	0.25	0.48	0.25			#DIV/0!			0.0	#DIV/0!	5.0	5.2	8.7	0.9	2.9				
Rd swale 14	0.41	0.10	0.16	0.10			#DIV/0!			0.0	#DIV/0!	5.0	5.2	8.7	0.2	0.6				
Rd swale 15	0.27	0.33	0.52	0.33			#DIV/0!			0.0	#DIV/0!	5.0	5.2	8.7	0.4	1.2				
Rd swale 16	3.75	0.11	0.37	0.11			#DIV/0!			0.0	#DIV/0!	5.0	5.2	8.7	2.2	12.1				
Rd swale 17	0.95	0.17	0.41	0.17			#DIV/0!			0.0	#DIV/0!	5.0	5.2	8.7	0.3	1.3				

Checked by:

Exhibit 10  
Hydraulic Calculations

## EXIST & PROP BASIN SUMMARY

BASIN I.D.	AREA (acres)	RUNOFF COEFFICIENTS (existing)		RUNOFF COEFFICIENTS (developed)		EXSITING RUNOFF		DEVELOPED RUNOFF	
		C5	C100	C5	C100	Q5 cfs	Q100 cfs	Q5 cfs	Q100 cfs
A	17.4	0.09	0.35	0.09	0.36	3.4	23.6	3.7	24
B	20.8	0.09	0.36	0.10	0.36	4.4	29.1	4.6	29.5
C	3.9	0.11	0.37	0.14	0.39	1.4	7.9	1.8	8.4
D	7.5	0.1	0.36	0.12	0.38	2.3	14.3	2.7	14.8
E	2.3	0.12	0.38	0.18	0.42	1	4.9	1.4	5.5
F	18.7	0.08	0.35	0.09	0.35	2	20.7	3.1	21.1
G	9.9	0.09	0.36	0.10	0.37	2.7	17.8	3	18.2
H	23.3	0.09	0.36	0.10	0.36	5.3	34.3	5.6	34.7
I	5.7	0.11	0.37	0.13	0.38	2.4	13.7	2.8	14.3
J	3.4	0.08	0.35	0.08	0.35	1	7.1	1	7.1

## EXISTING DESIGN POINT SUMMARY

DESIGN POINT	CONTRIB SUB BASINS	AREA	Q5	Q100
		(acres)	(cfs)	(cfs)
1	A	17.4	3.4	23.6
2	B	20.8	4.4	29.1
3	C,D,E	13.7	4.7	27.1
4	C,D,E,I	19.4	7.1	40.8
5	B,C,D,E,H,I	63.5	16.8	104.2
6	A,F,G	46.0	8.9	62.1
7	J	3.4	1.0	7.1

## PROPOSED DESIGN POINT SUMMARY

DESIGN POINT	CONTRIB SUB BASINS	AREA	Q5	Q100
		(acres)	(cfs)	(cfs)
1	A	17.4	3.7	24.0
2	B	20.8	4.6	29.5
3	C,D,E	13.7	5.9	28.7
4	C,D,E,I	19.4	8.7	43.0
5	B,C,D,E,H,I	63.5	18.9	107.2
6	A,F,G	46.0	9.8	63.3
7	J	3.4	1.0	7.1

# KCH Engineering Solutions

5228 Cracker Barrel Circle  
 Colorado Springs, CO 80917  
 (719) 246-4471

JOB Diploma Subdivision

SHEET NO. 1 OF \_\_\_\_\_

CALCULATED BY K. Harrison DATE 2/10/2020

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

## Developed Conditions

### A. Area

Typical area of disturbance per a 5 acres tract = 1,500sf  
 = 65,340 s.f

Typical Roof area = 2800sf

Landscaping/Lawn = 3/4acre = 32,670sf

Driveway (Gravel) = 20' x 200' = 4000sf

### B Runoff Coefficients (per 1.5 acre developed area)

	5sf	100sf	Area
Roof Area	0.73	0.81	2800sf
Landscaping/Lawn	0.12	0.39	32,670sf
Driveway (gravel)	0.59	0.70	4,000sf
Natural	0.08	0.35	25,870sf
Composite "C"	0.16	0.41	

**Design Procedure Form: Runoff Reduction**

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

**Designer:** TJW  
**Company:** MVE INC.  
**Date:** July 26, 2023  
**Project:** 61197-Forest Heights  
**Location:** Proposed Road

**SITE INFORMATION (User Input in Blue Cells)**

WQCV Rainfall Depth = 0.60 inches  
 Depth of Average Runoff Producing Storm,  $d_6$  = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA											
Area ID	North	South											
Downstream Design Point ID	None	None											
Downstream BMP Type	None	None											
DCIA (ft <sup>2</sup> )	--	--											
UIA (ft <sup>2</sup> )	32,163	32,155											
RPA (ft <sup>2</sup> )	21,609	19,941											
SPA (ft <sup>2</sup> )	--	--											
HSG A (%)	0%	0%											
HSG B (%)	100%	100%											
HSG C/D (%)	0%	0%											
Average Slope of RPA (ft/ft)	0.250	0.250											
UIA:RPA Interface Width (ft)	2405.00	2352.00											

**CALCULATED RUNOFF RESULTS**

Area ID	North	South											
UIA:RPA Area (ft <sup>2</sup> )	53,772	52,096											
L / W Ratio	0.06	0.06											
UIA / Area	0.5981	0.6172											
Runoff (in)	0.00	0.00											
Runoff (ft <sup>3</sup> )	0	0											
Runoff Reduction (ft <sup>3</sup> )	1340	1340											

**CALCULATED WQCV RESULTS**

Area ID	North	South											
WQCV (ft <sup>3</sup> )	1340	1340											
WQCV Reduction (ft <sup>3</sup> )	1340	1340											
WQCV Reduction (%)	100%	100%											
Untreated WQCV (ft <sup>3</sup> )	0	0											

**CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)**








Downstream Design Point ID	None												
DCIA (ft <sup>2</sup> )	0												
UIA (ft <sup>2</sup> )	64,318												
RPA (ft <sup>2</sup> )	41,550												
SPA (ft <sup>2</sup> )	0												
Total Area (ft <sup>2</sup> )	105,868												
Total Impervious Area (ft <sup>2</sup> )	64,318												
WQCV (ft <sup>3</sup> )	2,680												
WQCV Reduction (ft <sup>3</sup> )	2,680												
WQCV Reduction (%)	100%												
Untreated WQCV (ft <sup>3</sup> )	0												

**CALCULATED SITE RESULTS (sums results from all columns in worksheet)**

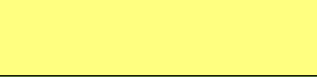


Total Area (ft <sup>2</sup> )	105,868
Total Impervious Area (ft <sup>2</sup> )	64,318
WQCV (ft <sup>3</sup> )	2,680
WQCV Reduction (ft <sup>3</sup> )	2,680
WQCV Reduction (%)	100%
Untreated WQCV (ft <sup>3</sup> )	0

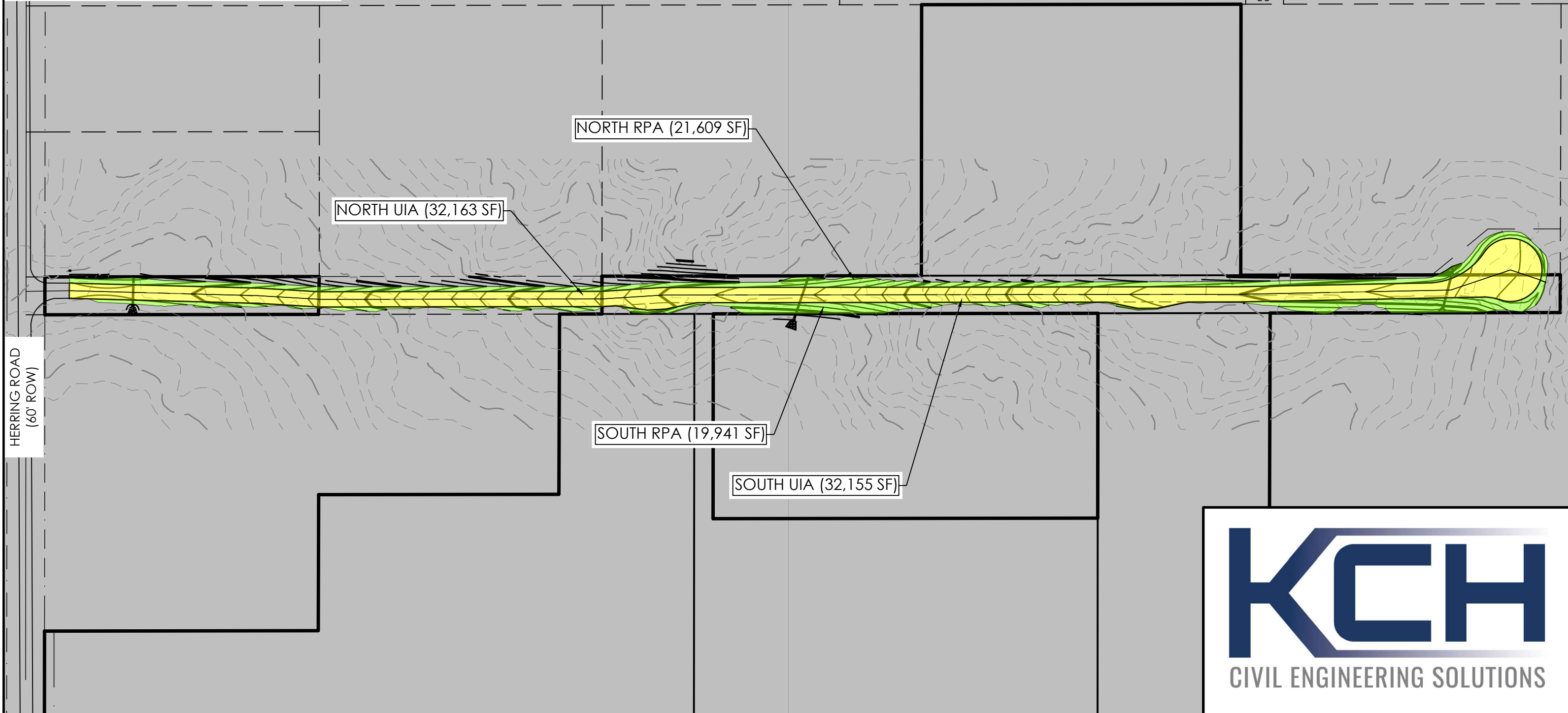


**LEGEND**

-  PROPERTY LINE
-  EASEMENT LINE
  
- EXISTING**
-  5985 INDEX CONTOUR
-  84 INTERMEDIATE CONTOUR
  
- PROPOSED**
-  5985 INDEX CONTOUR
-  84 INTERMEDIATE CONTOUR
-  AREA BOUNDARY

**SURFACE TYPES**

UNCONNECTED IMPERVIOUS AREA (UIA)	64,318 SF. TOTAL	
RECEIVING PERVIOUS AREA (RPA)	41,550 SF. TOTAL	
EXCLUDED PER ECM I.7.1.B.5		



## SWALE SUMMARY

SWALE #	CONTRIBUTING SUBBASINS	SLOPE %	DESIGN FLOW		DEPTH OF FLOW		VELOCITY		FROUDE #	
			Q5 cfs	Q100 cfs	Q5 ft	Q100 ft	V5 fps	V100 fps	5 year	100 year
1	A	4.5	3.7	24.0	0.1	0.2	1.2	2.7	0.91	1.16
2	A,G	3.1	5.7	36.1	0.1	0.3	1.5	2.9	0.84	1.02
3	B	4.6	4.6	29.5	0.1	0.3	1.8	3.7	1.04	1.26
4	B,C,H	3.3	10.2	64.2	0.1	0.2	1.4	2.9	0.87	1.06
5	C	5.5	1.8	8.4	0.1	0.1	1.3	2.4	1.00	1.20
6	D	6.0	4.1	20.3	0.1	0.2	1.9	3.5	1.18	1.37
8	C,D,E,I	3.3	8.7	43.8	0.1	0.3	1.8	3.1	0.91	1.06
10	F	5.3	3.1	21.1	0.1	0.3	1.7	3.4	1.09	1.30
11	J	3.1	1.0	7.1	0.0	0.1	0.6	1.4	0.70	0.86
12	A,G,F	6.1	9.8	63.3	0.1	0.3	2.2	4.9	1.20	1.70
13 RD DITCH	PORTION OF SUBBASIN B	6.7	0.1	0.6	0.1	0.2	1.5	2.1	1.01	1.19
14 RD DITCH	PORTION OF SUBBASIN B	1.0	0.1	0.1	0.1	0.2	0.8	0.8	0.44	0.44
15 RD DITCH	PORTION OF SUBBASIN C	4.5	2.2	10.7	0.5	0.8	3.1	4.7	1.15	1.28
16 RD DITCH	PORTION OF SUBBASIN D	2.0	3.2	15.7	0.6	1.1	2.5	3.8	0.82	0.92

Swale  
Dove's yr

# The open channel flow calculator

Select Channel Type: Trapezoid		
Depth from Q	Select unit system: Feet(ft)	
Channel slope: .045 ft/ft	Water depth(y): 0.06 ft	Bottom width(b): 50 ft
Flow velocity: 1.236688 ft/s	LeftSlope (Z1): 15 to 1 (H:V)	RightSlope (Z2): 15 to 1 (H:V)
Flow discharge: 3.7 ft <sup>3</sup> /s	Input n value: 0.035 or select n clean, uncoated castiron: 0.014	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter: 51.77 ft	Flow area: 2.99 ft <sup>2</sup>	Top width(T): 51.76 ft
Specific energy: 0.08 ft	Froude number: 0.91	Flow status Subcritical flow
Critical depth: 0.06 ft	Critical slope: 0.038 ft/ft	Velocity head: 0.02 ft

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Contributing Basins

A 3.7 cfs      24.0 cfs



Swale 1  
100yr

## The open channel flow calculator

Select Channel Type: Trapezoid ▾			
Depth from Q ▾	Select unit system: Feet(ft) ▾		
Channel slope: .045 ft/ft	Water depth(y): 0.17 ft	Bottom width(b) 50 ft	
Flow velocity 2.66188 ft/s	LeftSlope (Z1): 15 to 1 (H:V)	RightSlope (Z2): 15 to 1 (H:V)	
Flow discharge 24 ft <sup>3</sup> /s	Input n value 0.035 or select n clean,uncoated castiron:0.014 ▾		
Calculate!	Status: Calculation finished	Reset	
Wetted perimeter 55.16 ft	Flow area 9.02 ft <sup>2</sup>	Top width(T) 55.15 ft	
Specific energy 0.28 ft	Froude number 1.16	Flow status Supercritical flow	
Critical depth 0.19 ft	Critical slope 0.0305 ft/ft	Velocity head 0.11 ft	

Swake #2  
3/5

### The open channel flow calculator

Select Channel Type: Trapezoid ▾			
Depth from Q ▾	Select unit system: Feet(ft) ▾		
Channel slope: 0.031 ft/ft	Water depth(y): 0.1 ft	Bottom width(b) 35 ft	
Flow velocity 1.474312 ft/s	LeftSlope (Z1): 25 to 1 (H:V)	RightSlope (Z2): 25 to 1 (H:V)	
Flow discharge 5.7 ft <sup>3</sup> /s	Input n value .035 or select n		
Calculate!	Status: Calculation finished	Reset	
Wetted perimeter 40.15 ft	Flow area 3.87 ft <sup>2</sup>	Top width(T) 40.15 ft	
Specific energy 0.14 ft	Froude number 0.84	Flow status Subcritical flow	
Critical depth 0.09 ft	Critical slope 0.0383 ft/ft	Velocity head 0.03 ft	

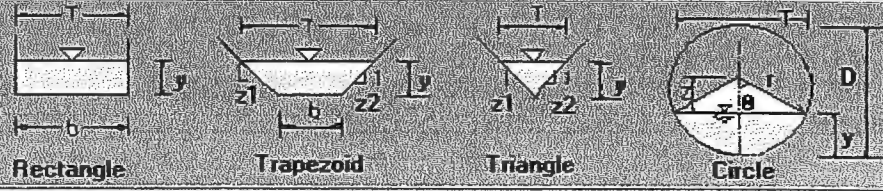
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Subsidiary

A	3.7	24.6
G	$3\frac{2}{3}$	18.2 ( $\frac{2}{3}$ )
	5.7	36.1

Swale #2  
100 ft

## The open channel flow calculator

Select Channel Type: <input type="text" value="Trapezoid"/>			
Depth from Q <input type="text" value=""/>	Select unit system: <input type="text" value="Feet(ft)"/>		
Channel slope: <input type="text" value="0.031"/> <input type="text" value="ft/ft"/>	Water depth(y): <input type="text" value="0.29"/> <input type="text" value="ft"/>	Bottom width(b) <input type="text" value="35"/> <input type="text" value="ft"/>	
Flow velocity <input type="text" value="2.899389"/> <input type="text" value="ft/s"/>	LeftSlope (Z1): <input type="text" value="25"/> to 1 (H:V)	RightSlope (Z2): <input type="text" value="25"/> <input type="text" value="to 1 (H:V)"/>	
Flow discharge <input type="text" value="36.1"/> <input type="text" value="ft^3/s"/>	Input n value <input type="text" value=".035"/> or select n		
<input type="button" value="Calculate!"/>	Status: <input type="text" value="Calculation finished"/>	<input type="button" value="Reset"/>	
Wetted perimeter <input type="text" value="49.71"/> <input type="text" value="ft"/>	Flow area <input type="text" value="12.45"/> <input type="text" value="ft^2"/>	Top width(T) <input type="text" value="49.7"/> <input type="text" value="ft"/>	
Specific energy <input type="text" value="0.42"/> <input type="text" value="ft"/>	Froude number <input type="text" value="1.02"/>	Flow status <input type="text" value="Supercritical flow"/>	
Critical depth <input type="text" value="0.3"/> <input type="text" value="ft"/>	Critical slope <input type="text" value="0.0279"/> <input type="text" value="ft/ft"/>	Velocity head <input type="text" value="0.13"/> <input type="text" value="ft"/>	

Swale 3  
5yr

## The open channel flow calculator

Select Channel Type: Trapezoid ▾			
Depth from Q ▾	Select unit system: Feet(ft) ▾		
Channel slope: .046 ft/ft	Water depth(y): 0.1 ft	Bottom width(b) 25 ft	
Flow velocity 1.806727 ft/s	LeftSlope (Z1): 10 to 1 (H:V)	RightSlope (Z2): 10 to 1 (H:V)	
Flow discharge 4.6 ft <sup>3</sup> /s	Input n value 0.035 or select n clean,uncoated castiron:0.014 ▾		
Calculate!	Status: Calculation finished	Reset	
Wetted perimeter 26.97 ft	Flow area 2.55 ft <sup>2</sup>	Top width(T) 26.96 ft	
Specific energy 0.15 ft	Froude number 1.04	Flow status Supercritical flow	
Critical depth 0.1 ft	Critical slope 0.0358 ft/ft	Velocity head 0.05 ft	

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Contributing Basins

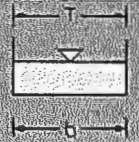
B 4.6 29.5

Swidle 3  
100 years

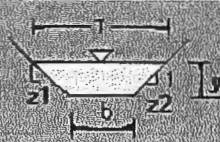
# The open channel flow calculator

Select Channel Type:

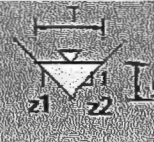
Trapezoid ▾



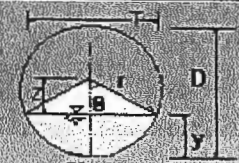
Rectangle



Trapezoid



Triangle



Circle

Depth from Q ▾

Select unit system: Feet(ft) ▾

Channel slope: .046

ft/ft

Water depth(y): 0.29

ft

Bottom width(b): 25

ft

Flow velocity: 3.658557

ft/s

LeftSlope (Z1): 10

to 1 (H:V)

RightSlope (Z2): 10

to 1 (H:V)

Flow discharge: 29.5

ft<sup>3</sup>/s

Input n value: 0.035

or select n

clean,uncoated castiron:0.014 ▾

Calculate!

Status: Calculation finished

Reset

Wetted perimeter: 30.81

ft

Flow area: 8.06

ft<sup>2</sup>

Top width(T): 30.78

ft

Specific energy: 0.5

ft

Froude number: 1.26

Flow status

Supercritical flow

Critical depth: 0.34

ft

Critical slope: 0.0259

ft/ft

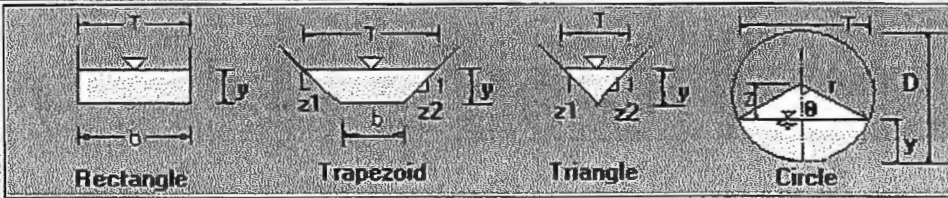
Velocity head: 0.21

ft



Sub 4  
5yr

# The open channel flow calculator

Select Channel Type: Trapezoid ▾		
Depth from Q ▾	Select unit system: Feet(ft) ▾	
Channel slope: .033 ft/ft	Water depth(y): 0.08 ft	Bottom width(b): 85 ft
Flow velocity: 1.406126 ft/s	LeftSlope (Z1): 25 to 1 (H:V)	RightSlope (Z2): 25 to 1 (H:V)
Flow discharge: 10.2 ft <sup>3</sup> /s	Input n value: .035 or select n clean,uncoated castiron:0.014 ▾	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter: 89.17 ft	Flow area: 7.25 ft <sup>2</sup>	Top width(T): 89.17 ft
Specific energy: 0.11 ft	Froude number: 0.87	Flow status Subcritical flow
Critical depth: 0.08 ft	Critical slope: 0.0381 ft/ft	Velocity head: 0.03 ft

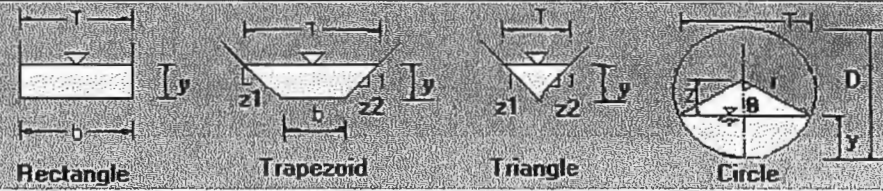
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Contributing Basins

B	4.6	29.5
H	5.6	34.7
	<u>10.2</u>	<u>64.2</u>

Swale 4  
100 yds

### The open channel flow calculator

Select Channel Type: Trapezoid ▾			
Depth from Q ▾	Select unit system: Feet(ft) ▾		
Channel slope: <input type="text" value=".033"/> <input type="text" value="ft/ft"/>	Water depth(y): <input type="text" value="0.24"/> <input type="text" value="ft"/>	Bottom width(b) <input type="text" value="85"/> <input type="text" value="ft"/>	
Flow velocity <input type="text" value="2.875619"/> <input type="text" value="ft/s"/>	LeftSlope (Z1): <input type="text" value="25"/> to 1 (H:V)	RightSlope (Z2): <input type="text" value="25"/> <input type="text" value="to 1 (H:V)"/>	
Flow discharge <input type="text" value="64.2"/> <input type="text" value="ft^3/s"/>	Input n value <input type="text" value=".035"/> or select n <input type="text" value="clean,uncoated castiron:0.014"/> ▾		
<input type="button" value="Calculate!"/>	Status: <input type="text" value="Calculation finished"/>	<input type="button" value="Reset"/>	
Wetted perimeter <input type="text" value="97.26"/> <input type="text" value="ft"/>	Flow area <input type="text" value="22.33"/> <input type="text" value="ft^2"/>	Top width(T) <input type="text" value="97.25"/> <input type="text" value="ft"/>	
Specific energy <input type="text" value="0.37"/> <input type="text" value="ft"/>	Froude number <input type="text" value="1.06"/>	Flow status <input type="text" value="Supercritical flow"/>	
Critical depth <input type="text" value="0.25"/> <input type="text" value="ft"/>	Critical slope <input type="text" value="0.0286"/> <input type="text" value="ft/ft"/>	Velocity head <input type="text" value="0.13"/> <input type="text" value="ft"/>	

Slide 5

5yr

### The open channel flow calculator

Select Channel Type: Trapezoid ▾					
Depth from Q ▾		Select unit system: Feet(ft) ▾			
Channel slope: <input type="text" value=".055"/> ft/ft	Water depth(y): <input type="text" value="0.05"/> ft	Bottom width(b) <input type="text" value="25"/> ft			
Flow velocity <input type="text" value="1.307615"/> ft/s	LeftSlope (Z1): <input type="text" value="10"/> to 1 (H:V)	RightSlope (Z2): <input type="text" value="10"/> to 1 (H:V)			
Flow discharge <input type="text" value="1.8"/> ft <sup>3</sup> /s	Input n value <input type="text" value=".035"/> or select n clean,uncoated castiron:0.014 ▾				
<input type="button" value="Calculate!"/>	Status: <input type="text" value="Calculation finished"/>	<input type="button" value="Reset"/>			
Wetted perimeter <input type="text" value="26.08"/> ft	Flow area <input type="text" value="1.38"/> ft <sup>2</sup>	Top width(T) <input type="text" value="26.08"/> ft			
Specific energy <input type="text" value="0.08"/> ft	Froude number <input type="text" value="1"/>	Flow status <input type="text" value="Critical flow"/>			
Critical depth <input type="text" value="0.06"/> ft	Critical slope <input type="text" value="0.0358"/> ft/ft	Velocity head <input type="text" value="0.03"/> ft			

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Subbsin

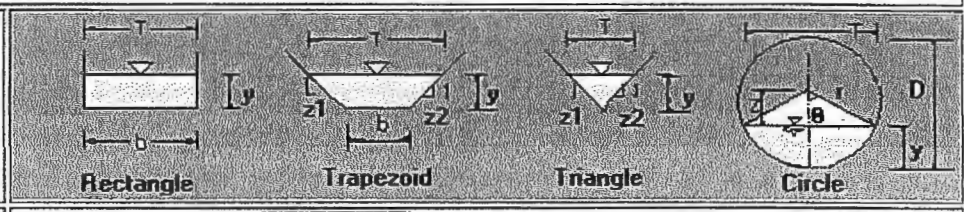
C 1.8

8.4

Swale 5  
100yr

### The open channel flow calculator

Select Channel Type:  
Trapezoid ▾



Depth from Q ▾      Select unit system: Feet(ft) ▾

Channel slope: <input type="text" value=".055"/> ft/ft	Water depth(y): <input type="text" value="0.13"/> ft	Bottom width(b) <input type="text" value="25"/> ft
Flow velocity <input type="text" value="2.412038"/> ft/s	LeftSlope (Z1): <input type="text" value="10"/> to 1 (H:V)	RightSlope (Z2): <input type="text" value="10"/> to 1 (H:V)
Flow discharge <input type="text" value="8.4"/> ft <sup>3</sup> /s	Input n value <input type="text" value=".035"/> or select n clean,uncoated castiron:0.014 ▾	
<input type="button" value="Calculate!"/>	Status: <input type="text" value="Calculation finished"/>	<input type="button" value="Reset"/>
Wetted perimeter <input type="text" value="27.66"/> ft	Flow area <input type="text" value="3.48"/> ft <sup>2</sup>	Top width(T) <input type="text" value="27.65"/> ft
Specific energy <input type="text" value="0.22"/> ft	Froude number <input type="text" value="1.2"/>	Flow status <input type="text" value="Supercritical flow"/>
Critical depth <input type="text" value="0.15"/> ft	Critical slope <input type="text" value="0.0321"/> ft/ft	Velocity head <input type="text" value="0.09"/> ft

5 weeks  
5 year

### The open channel flow calculator

Select Channel Type: Trapezoid ▾			
Depth from Q ▾	Select unit system: Feet(ft) ▾		
Channel slope: .06 ft/ft	Water depth(y): 0.08 ft	Bottom width(b) 25 ft	
Flow velocity 1.905303 ft/s	LeftSlope (Z1): 10 to 1 (H:V)	RightSlope (Z2): 10 to 1 (H:V)	
Flow discharge 4.1 ft^3/s	Input n value .035 or select n clean,uncoated castiron:0.014 ▾		
Calculate!	Status: Calculation finished	Reset	
Wetted perimeter 26.67 ft	Flow area 2.15 ft^2	Top width(T) 26.67 ft	
Specific energy 0.14 ft	Froude number 1.18	Flow status Supercritical flow	
Critical depth 0.09 ft	Critical slope 0.0398 ft/ft	Velocity head 0.06 ft	

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Subbasins

D	2.7	14.8
E	<u>1.4</u>	<u>5.5</u>
	4.1	20.3

Sheet 6  
100%

## The open channel flow calculator

Select Channel Type: Trapezoid ▾			
Depth from Q ▾	Select unit system: Feet(ft) ▾		
Channel slope: <input type="text" value=".06"/> ft/ft	Water depth(y): <input type="text" value="0.22"/> ft	Bottom width(b) <input type="text" value="25"/> ft	
Flow velocity <input type="text" value="3.467221"/> ft/s	LeftSlope (Z1): <input type="text" value="10"/> to 1 (H:V)	RightSlope (Z2): <input type="text" value="10"/> to 1 (H:V)	
Flow discharge <input type="text" value="20.3"/> ft^3/s	Input n value <input type="text" value=".035"/> or select n clean,uncoated castiron:0.014 ▾		
<input type="button" value="Calculate!"/>	Status: <input type="text" value="Calculation finished"/>	<input type="button" value="Reset"/>	
Wetted perimeter <input type="text" value="29.33"/> ft	Flow area <input type="text" value="5.85"/> ft^2	Top width(T) <input type="text" value="29.31"/> ft	
Specific energy <input type="text" value="0.4"/> ft	Froude number <input type="text" value="1.37"/>	Flow status <input type="text" value="Supercritical flow"/>	
Critical depth <input type="text" value="0.26"/> ft	Critical slope <input type="text" value="0.0284"/> ft/ft	Velocity head <input type="text" value="0.19"/> ft	

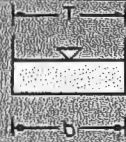
Scale 3

# The open channel flow calculator

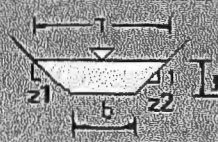
0.75

Select Channel Type:

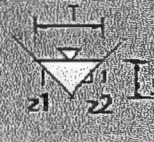
Trapezoid ▾



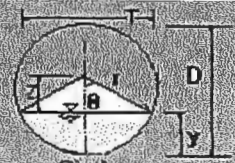
Rectangle



Trapezoid



Triangle



Circle

Depth from Q ▾

Select unit system: Feet(ft) ▾

Channel slope: .033

ft/ft

Water depth(y): 0.13

ft

Bottom width(b): 35

ft

Flow velocity: 1.759025

ft/s

Left Slope (Z1): 30

to 1 (H:V)

Right Slope (Z2): 30

to 1 (H:V)

Flow discharge: 8.7

ft<sup>3</sup>/s

Input n value: 0.035

or select n

Calculate!

Status: Calculation finished

Reset

Wetted perimeter: 42.65

ft

Flow area: 4.95

ft<sup>2</sup>

Top width(T): 42.64

ft

Specific energy: 0.18

ft

Froude number: 0.91

Flow status

Subcritical flow

Critical depth: 0.12

ft

Critical slope: 0.0347

ft/ft

Velocity head: 0.05

ft

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Basin

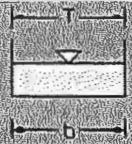
D	2.7	14.8
E	1.4	5.5
C	1.8	<del>8.1</del>
I	2.8	8.4
	<u>8.7</u>	<u>14.3</u>
		43.0

Swab 8  
100 yds

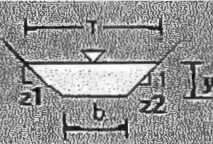
## The open channel flow calculator

Select Channel Type:

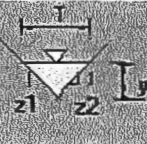
Trapezoid ▾



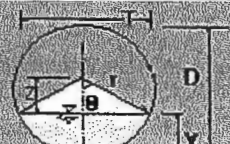
Rectangle



Trapezoid



Triangle



Circle

Depth from Q ▾

Select unit system: Feet(ft) ▾

Channel slope:   
ft/ft

Water depth(y):  ft

Bottom width(b)   
ft

Flow velocity   
ft/s

LeftSlope (Z1):  to 1 (H:V)

RightSlope (Z2):   
to 1 (H:V)

Flow discharge   
ft<sup>3</sup>/s

Input n value  or select n

Calculate!

Status:

Reset

Wetted perimeter   
ft

Flow area  ft<sup>2</sup>

Top width(T)   
ft

Specific energy   
ft

Froude number

Flow status

Critical depth   
ft

Critical slope  ft/ft

Velocity head   
ft



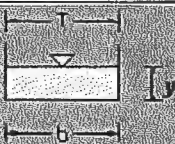
Saddle 16

5yr

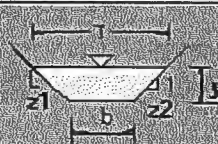
# The open channel flow calculator

Select Channel Type:

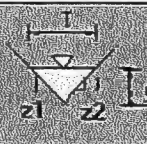
Trapezoid ▾



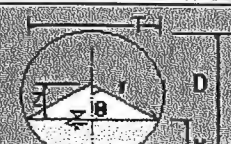
Rectangle



Trapezoid



Triangle



Circle

Depth from Q ▾

Select unit system: Feet(ft) ▾

Channel slope: .053

ft/ft

Water depth(y): 0.08 ft

Bottom width(b) 20

ft

Flow velocity 1.717663

ft/s

LeftSlope (Z1): 20 to 1 (H:V)

RightSlope (Z2): 20

to 1 (H:V)

Flow discharge 3.1

ft<sup>3</sup>/s

Input n value .035 or select n

clean,uncoated castiron:0.014 ▾

Calculate!

Status: Calculation finished

Reset

Wetted perimeter 23.34

ft

Flow area 1.8 ft<sup>2</sup>

Top width(T) 23.33

ft

Specific energy 0.13

ft

Froude number 1.09

Flow status

Supercritical flow

Critical depth 0.09

ft

Critical slope 0.0409 ft/ft

Velocity head 0.05

ft

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Basin

F 3.1 21.1

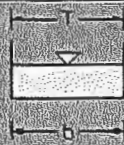
Swale 10

100yr

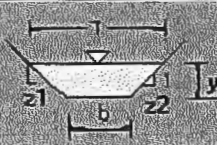
# The open channel flow calculator

Select Channel Type:

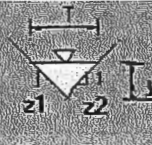
Trapezoid ▾



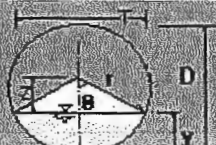
Rectangle



Trapezoid



Triangle



Circle

Depth from Q ▾

Select unit system: Feet(ft) ▾

Channel slope:   
ft/ft

Water depth(y):  ft

Bottom width(b)   
ft

Flow velocity   
ft/s

LeftSlope (Z1):  to 1 (H:V)

RightSlope (Z2):   
to 1 (H:V)

Flow discharge   
ft<sup>3</sup>/s

Input n value  or select n  
clean,uncoated castiron:0.014 ▾

Calculate!

Status:

Reset

Wetted perimeter   
ft

Flow area  ft<sup>2</sup>

Top width(T)   
ft

Specific energy   
ft

Froude number

Flow status

Critical depth   
ft

Critical slope  ft/ft

Velocity head   
ft

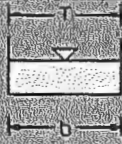
Swale 1)

5yr

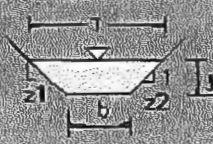
# The open channel flow calculator

Select Channel Type:

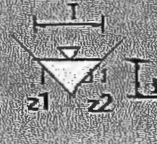
Trapezoid ▾



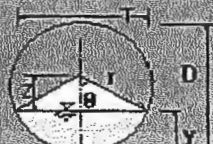
Rectangle



Trapezoid



Triangle



Circle

Depth from Q ▾

Select unit system: Feet(ft) ▾

Channel slope: .031

ft/ft

Water depth(y): 0.03

ft

Bottom width(b): 60

ft

Flow velocity: 0.636886

ft/s

LeftSlope (Z1): 15

to 1 (H:V)

RightSlope (Z2): 15

to 1 (H:V)

Flow discharge: 1.0

ft<sup>3</sup>/s

Input n value: .035

or select n

clean,uncoated castiron:0.014 ▾

Calculate!

Status: Calculation finished

Reset

Wetted perimeter: 60.78

ft

Flow area: 1.57

ft<sup>2</sup>

Top width(T): 60.78

ft

Specific energy: 0.03

ft

Froude number: 0.7

Flow status

Subcritical flow

Critical depth: 0.02

ft

Critical slope: 0.0601

ft/ft

Velocity head: 0.01

ft

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Basins

J

1.0

7.1

swale-11  
100 year

# The open channel flow calculator

Select Channel Type: Trapezoid ▾			
Depth from Q ▾	Select unit system: Feet(ft) ▾		
Channel slope: .031 ft/ft	Water depth(y): 0.08 ft	Bottom width(b): 60 ft	
Flow velocity: 1.391588 ft/s	LeftSlope (Z1): 15 to 1 (H:V)	RightSlope (Z2): 15 to 1 (H:V)	
Flow discharge: 7.1 ft^3/s	Input n value: .035 or select n clean,uncoated castiron:0.014 ▾		
Calculate!	Status: Calculation finished	Reset	
Wetted perimeter: 62.5 ft	Flow area: 5.1 ft^2	Top width(T): 62.5 ft	
Specific energy: 0.11 ft	Froude number: 0.86	Flow status: Subcritical flow	
Critical depth: 0.08 ft	Critical slope: 0.0372 ft/ft	Velocity head: 0.03 ft	

Example 13

0.45

### The open channel flow calculator

Select Channel Type: Trapezoid ▾			
Depth from Q ▾	Select unit system: Feet(ft) ▾		
Channel slope: 0.061 ft/ft	Water depth(y): 0.11 ft	Bottom width(b): 40 ft	
Flow velocity: 2.184422 ft/s	LeftSlope (Z1): 15 to 1 (H:V)	RightSlope (Z2): 15 to 1 (H:V)	
Flow discharge: 9.8 ft <sup>3</sup> /s	Input n value: 0.035 or select n		
Calculate!	Status: Calculation finished	Reset	
Wetted perimeter: 43.24 ft	Flow area: 4.49 ft <sup>2</sup>	Top width(T): 43.23 ft	
Specific energy: 0.18 ft	Froude number: 1.2	Flow status: Supercritical flow	
Critical depth: 0.12 ft	Critical slope: 0.0353 ft/ft	Velocity head: 0.07 ft	

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### Basins

A	3.7	240
F	3.1	21.1
G	3.0	18.2
	<u>9.8</u>	<u>63.3</u>

Scale 1:2

100yr

The open channel flow calculator		
Select Channel Type: Trapezoid ▾		
Depth from Q ▾	Select unit system: Feet(ft) ▾	
Channel slope: .061 ft/ft	Water depth(y): 0.29 ft	Bottom width(b): 40 ft
Flow velocity: 4.93849 ft/s	LeftSlope (Z1): 15 to 1 (H:V)	RightSlope (Z2): 15 to 1 (H:V)
Flow discharge: 63.3 ft <sup>3</sup> /s	Input n value: .030 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter: 48.69 ft	Flow area: 12.82 ft <sup>2</sup>	Top width(T): 48.67 ft
Specific energy: 0.67 ft	Froude number: 1.7	Flow status: Supercritical flow
Critical depth: 0.41 ft	Critical slope: 0.0182 ft/ft	Velocity head: 0.38 ft

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### Basins

A	3.7	24.0
F	3.1	21.1
S	3.0	18.2
	<u>9.8</u>	<u>63.3</u>

# Channel Report

## 61197-Sta 2+25 (21'L) Ditch Capacity Check 5YR

### Triangular

Side Slopes (z:1) = 4.00, 3.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 7516.97

Slope (%) = 2.00

N-Value = 0.035

### Calculations

Compute by: Known Q

Known Q (cfs) = 3.20

### Highlighted

Depth (ft) = 0.60

Q (cfs) = 3.200

Area (sqft) = 1.26

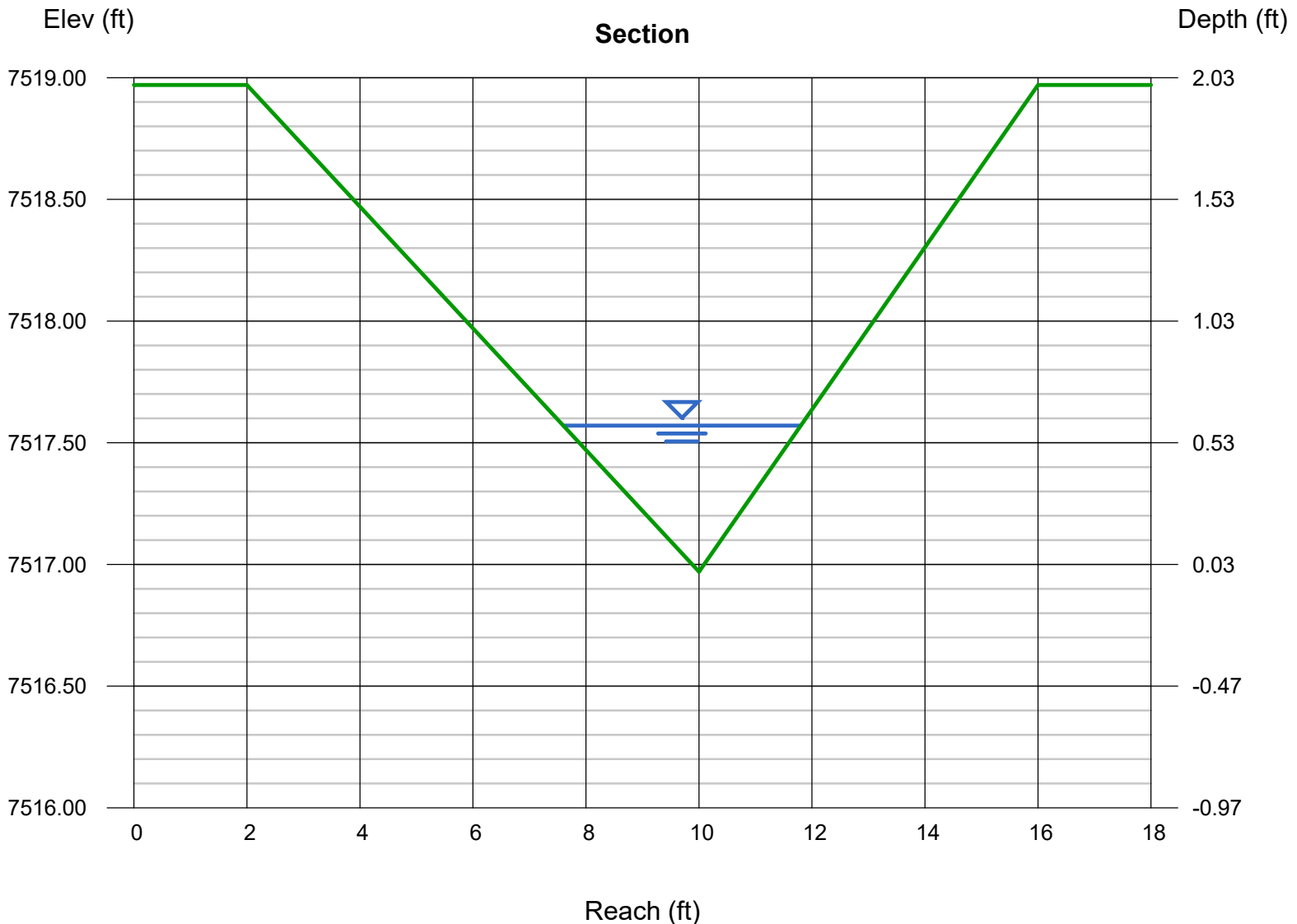
Velocity (ft/s) = 2.54

Wetted Perim (ft) = 4.37

Crit Depth, Yc (ft) = 0.56

Top Width (ft) = 4.20

EGL (ft) = 0.70



# Channel Report

## 61197-Sta 2+25 (21'L) Ditch Capacity Check

### Triangular

Side Slopes (z:1) = 4.00, 3.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 7516.97

Slope (%) = 2.00

N-Value = 0.035

### Calculations

Compute by: Known Q

Known Q (cfs) = 15.70

### Highlighted

Depth (ft) = 1.08

Q (cfs) = 15.70

Area (sqft) = 4.08

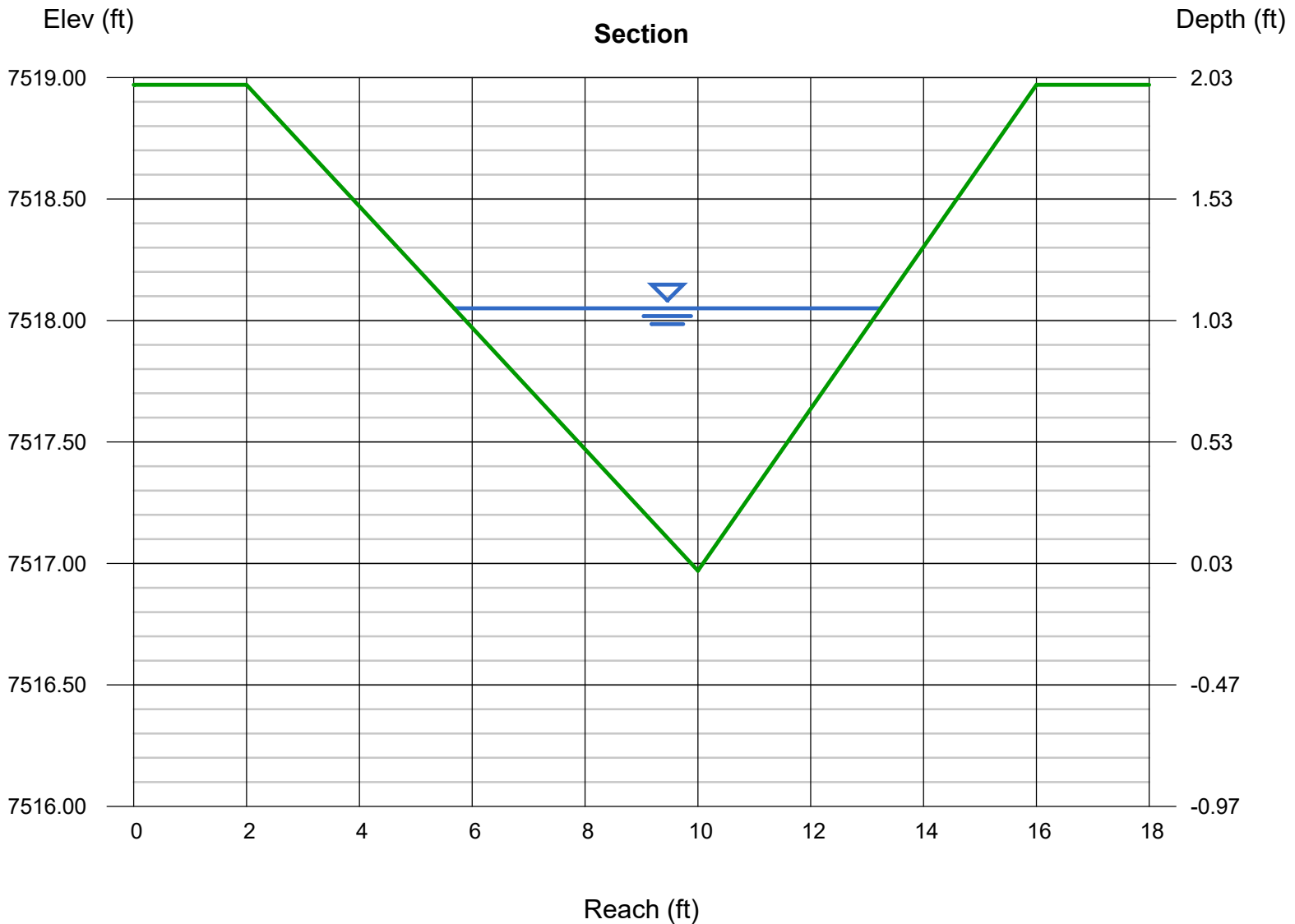
Velocity (ft/s) = 3.85

Wetted Perim (ft) = 7.87

Crit Depth,  $Y_c$  (ft) = 1.05

Top Width (ft) = 7.56

EGL (ft) = 1.31





# Channel Report

## 61197-Sta 4+50 (21'L) Velocity Check - 5YR

### Triangular

Side Slopes (z:1) = 4.00, 3.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 7526.14

Slope (%) = 4.42

N-Value = 0.035

### Calculations

Compute by: Known Q

Known Q (cfs) = 2.20

### Highlighted

Depth (ft) = 0.45

Q (cfs) = 2.200

Area (sqft) = 0.71

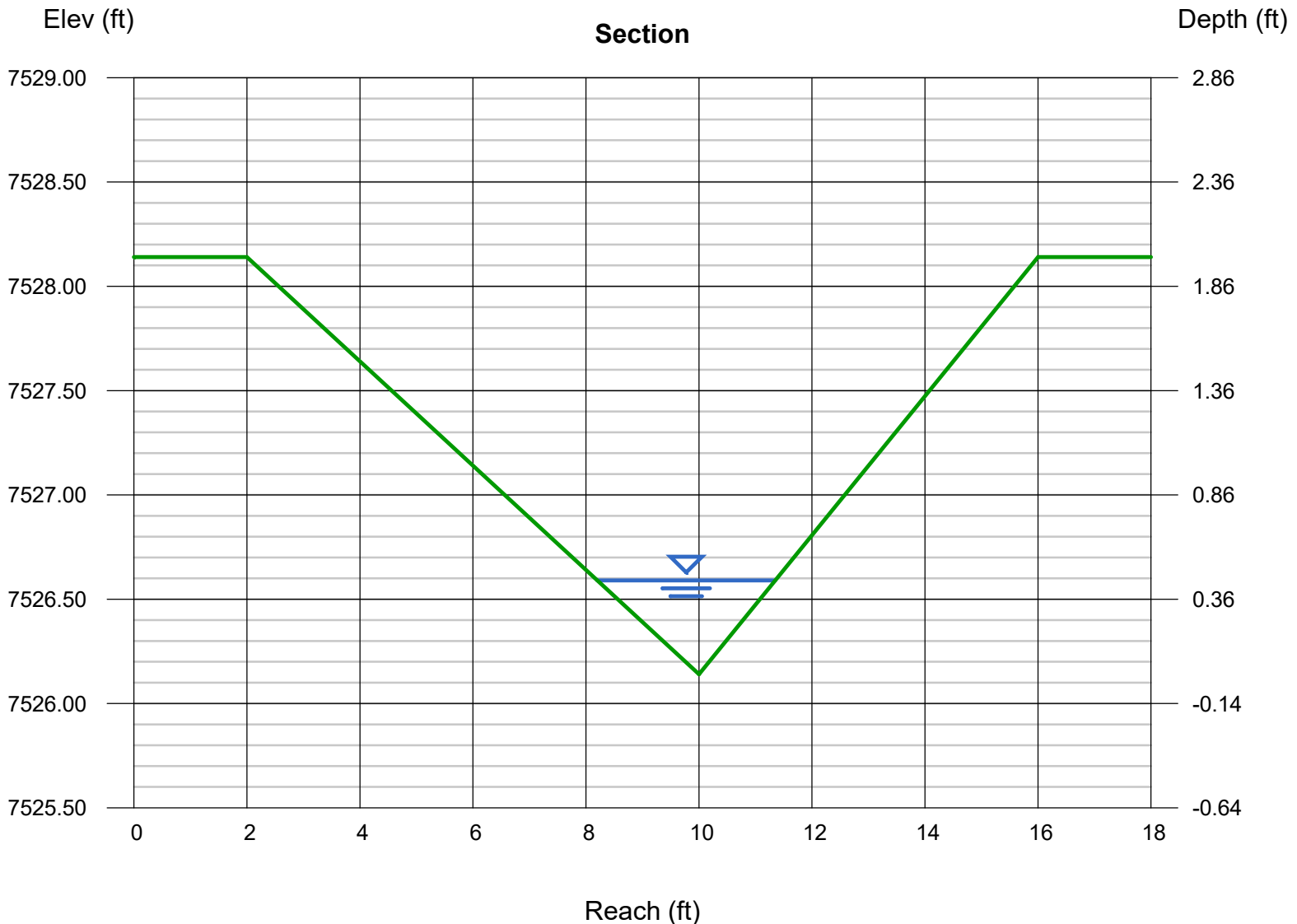
Velocity (ft/s) = 3.10

Wetted Perim (ft) = 3.28

Crit Depth,  $Y_c$  (ft) = 0.48

Top Width (ft) = 3.15

EGL (ft) = 0.60



# Channel Report

## 61197-Sta 4+50 (21'L) Velocity Check

### Triangular

Side Slopes (z:1) = 4.00, 3.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 7526.14

Slope (%) = 4.42

N-Value = 0.035

### Calculations

Compute by: Known Q

Known Q (cfs) = 10.70

### Highlighted

Depth (ft) = 0.81

Q (cfs) = 10.70

Area (sqft) = 2.30

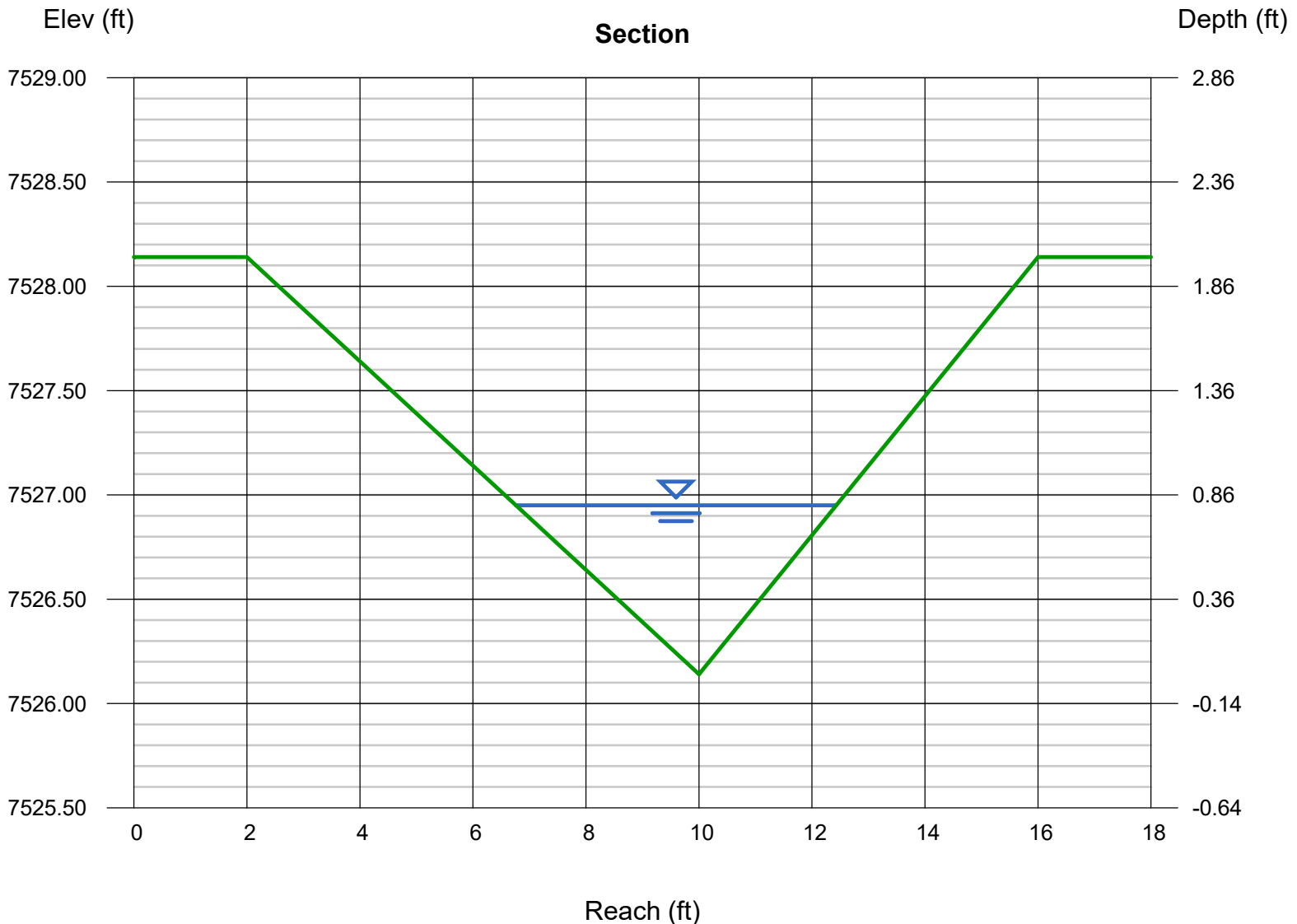
Velocity (ft/s) = 4.66

Wetted Perim (ft) = 5.90

Crit Depth, Yc (ft) = 0.90

Top Width (ft) = 5.67

EGL (ft) = 1.15



# Channel Report

## Sta 11+25 (21'L) Velocity Check-5YR

### Triangular

Side Slopes (z:1) = 4.00, 3.00  
Total Depth (ft) = 2.00

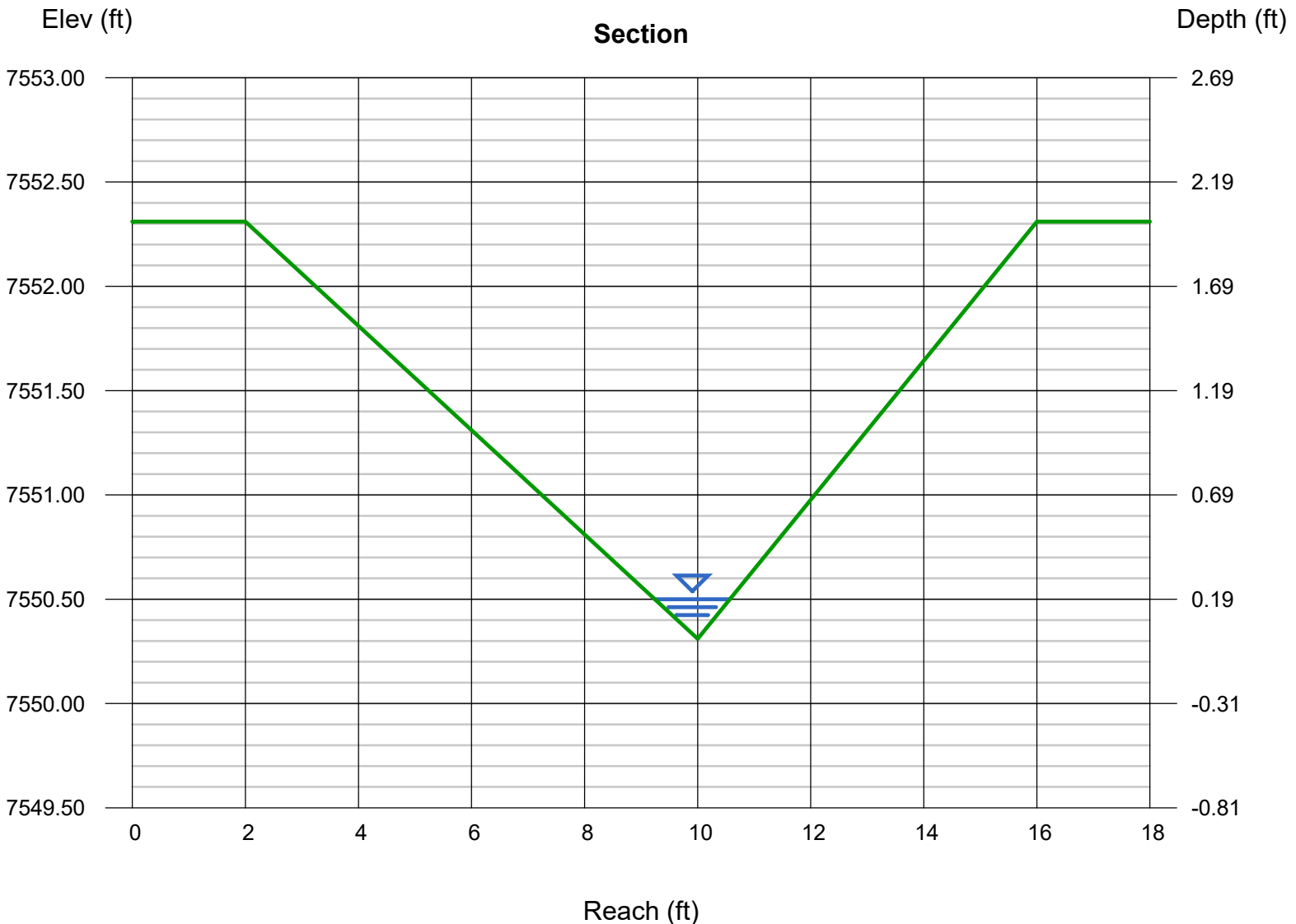
Invert Elev (ft) = 7550.31  
Slope (%) = 1.00  
N-Value = 0.035

### Calculations

Compute by: Known Q  
Known Q (cfs) = 0.10

### Highlighted

Depth (ft) = 0.19  
Q (cfs) = 0.100  
Area (sqft) = 0.13  
Velocity (ft/s) = 0.79  
Wetted Perim (ft) = 1.38  
Crit Depth, Yc (ft) = 0.14  
Top Width (ft) = 1.33  
EGL (ft) = 0.20



# Channel Report

## Sta 11+25 (21'L) Velocity Check

### Triangular

Side Slopes (z:1) = 4.00, 3.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 7550.31

Slope (%) = 1.00

N-Value = 0.035

### Calculations

Compute by: Known Q

Known Q (cfs) = 0.10

### Highlighted

Depth (ft) = 0.19

Q (cfs) = 0.100

Area (sqft) = 0.13

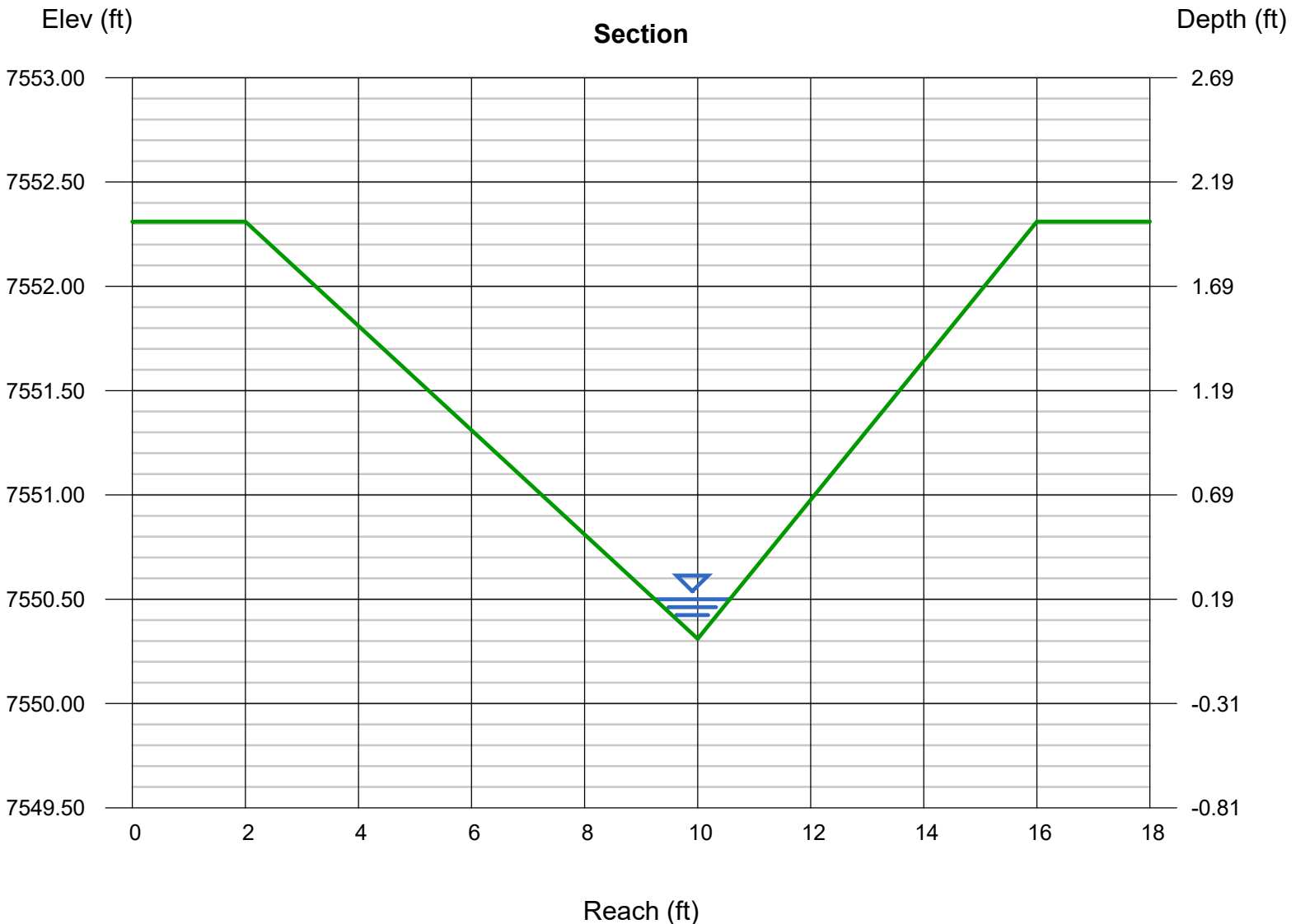
Velocity (ft/s) = 0.79

Wetted Perim (ft) = 1.38

Crit Depth, Yc (ft) = 0.14

Top Width (ft) = 1.33

EGL (ft) = 0.20



# Channel Report

## 61197-Sta 14+50 (21'L) Velocity Check-5YR

### Triangular

Side Slopes (z:1) = 4.00, 7.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 7561.84

Slope (%) = 6.70

N-Value = 0.035

### Calculations

Compute by: Known Q

Known Q (cfs) = 0.10

### Highlighted

Depth (ft) = 0.11

Q (cfs) = 0.100

Area (sqft) = 0.07

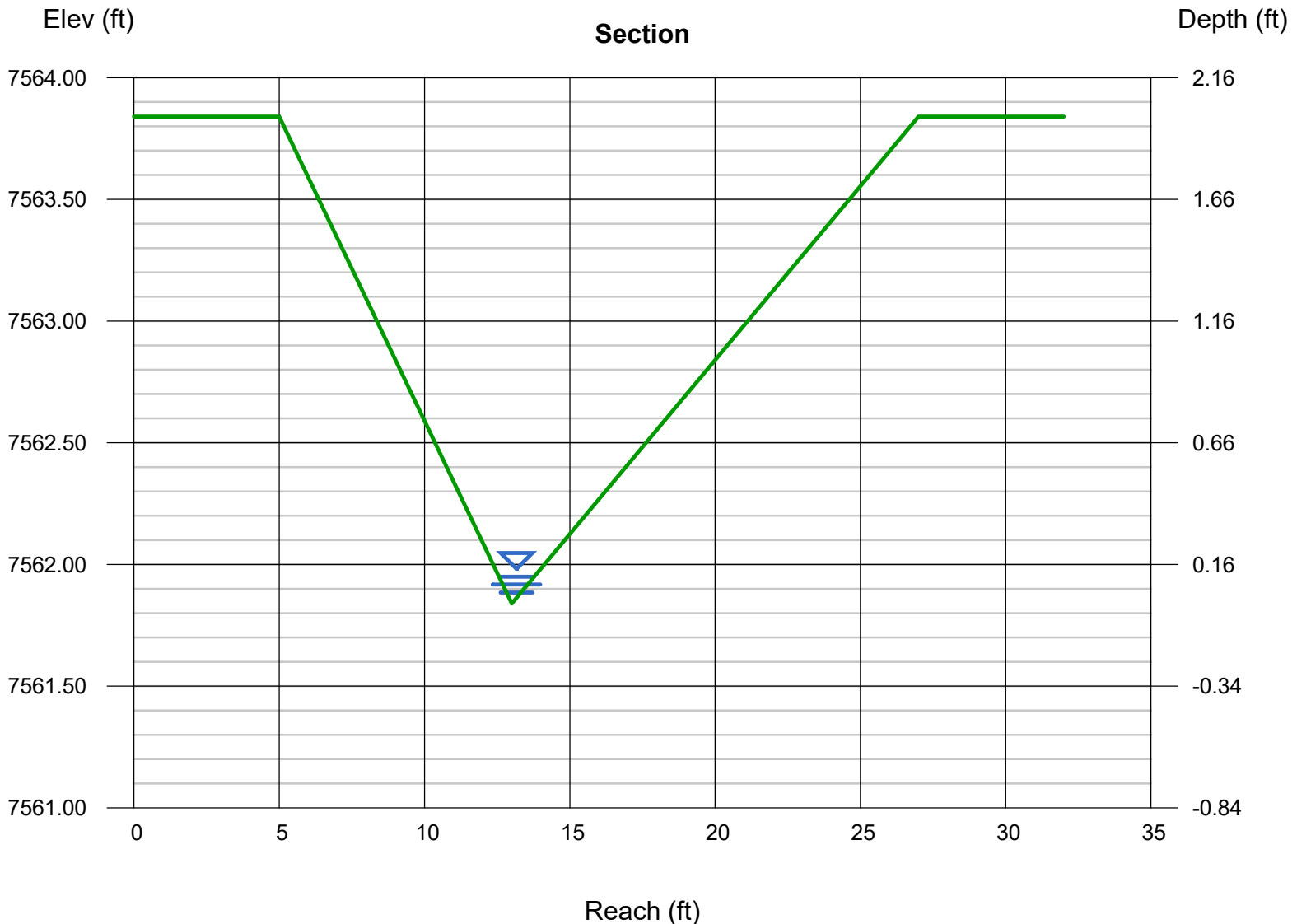
Velocity (ft/s) = 1.50

Wetted Perim (ft) = 1.23

Crit Depth, Yc (ft) = 0.12

Top Width (ft) = 1.21

EGL (ft) = 0.15



# Channel Report

## 61197-Sta 14+50 (21'L) Velocity Check

### Triangular

Side Slopes (z:1) = 4.00, 7.00

Total Depth (ft) = 2.00

Invert Elev (ft) = 7561.84

Slope (%) = 6.70

N-Value = 0.035

### Calculations

Compute by: Known Q

Known Q (cfs) = 0.60

### Highlighted

Depth (ft) = 0.22

Q (cfs) = 0.600

Area (sqft) = 0.27

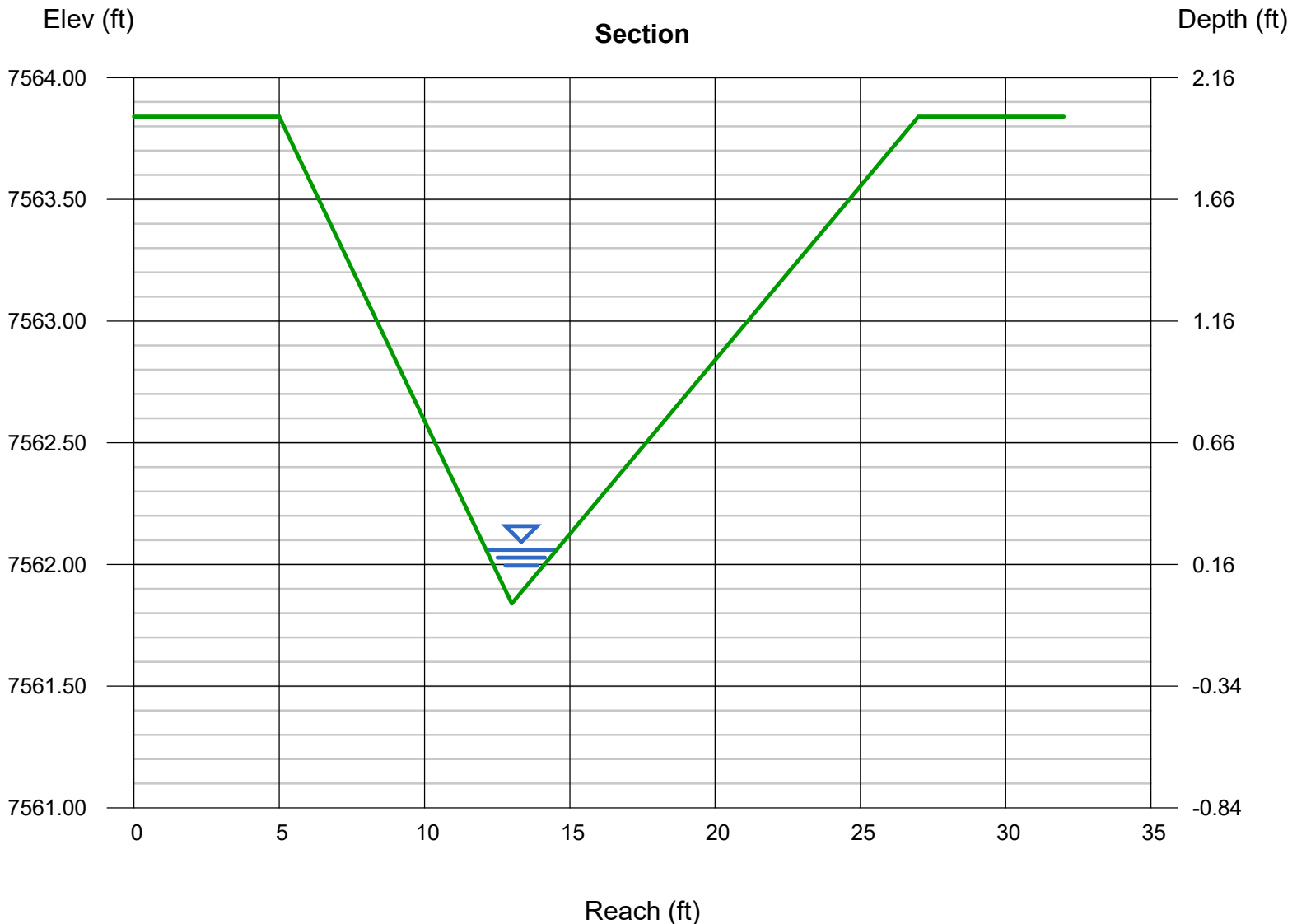
Velocity (ft/s) = 2.25

Wetted Perim (ft) = 2.46

Crit Depth,  $Y_c$  (ft) = 0.24

Top Width (ft) = 2.42

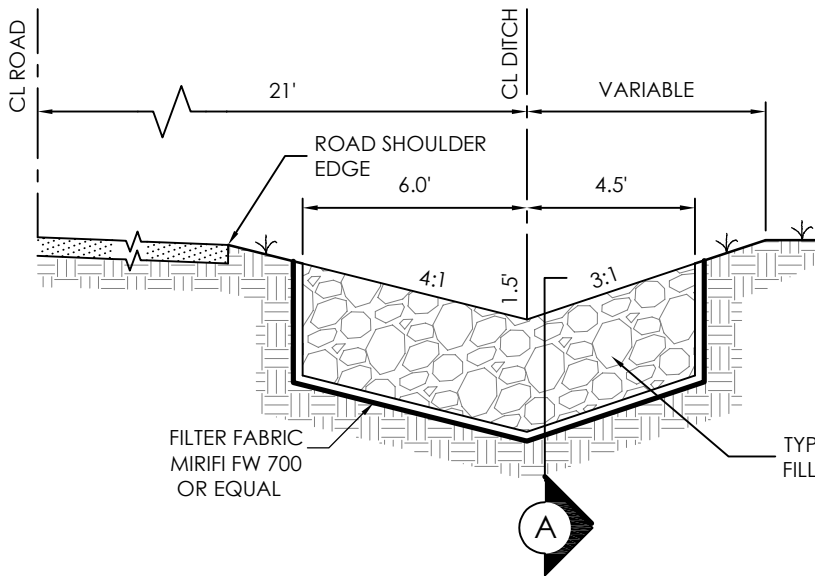
EGL (ft) = 0.30





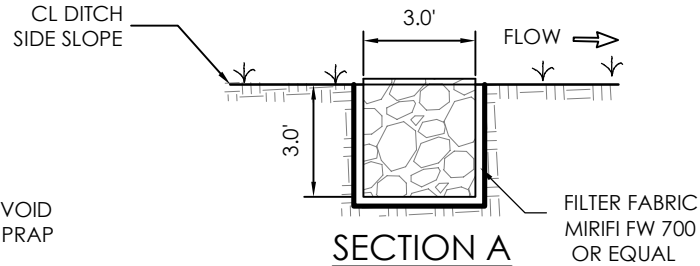






**NOTE:**

ALTERNATE TREATMENT IS INSTALLATION OF NORTH AMERICAN GREEN VMAX3 SC250 OR APPROVED ALTERNATE IN PLACE OF RIPRAP.



## DITCH CHECK STRUCTURE DETAIL

NTS

DCS

VOID-FILLED RIPRAP AND GRADATION			
RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	D50 (INCHES)
TYPE VL	70-100	12	6
	50-70	9	
	35-50	6	
	2-10	2	
TYPE M	70-100	15	9
	50-70	12	
	35-50	9	
	2-10	3	

MIX REQUIREMENTS FOR TYPE VL VOID-FILLED RIPRAP (D50 = 6 - INCH)		
APPROPRIATE PROPORTIONS (BY VOLUME)	MATERIAL TYPE	MATERIAL DESCRIPTION
6 PARTS	RIPRAP	D50 = 6 INCH (TYPE VL)
1 PART	VOID-FILL MATERIAL	VTC (VEHICLE TRACKING CONTROL) ROCK (CRUSHED ROCK WITH 100% PASSING 4-INCH SIEVE, 50-70% PASSING 3-INCH SIEVE, 0-10% PASSING 2-INCH SIEVE)
1 PART	VOID-FILL	4-INCH MINUS PIT RUN SURGE (ROUND RIVER ROCK AND SAND, WELL GRADED, 90-100% PASSING 4-INCH SIEVE, 70-80% PASSING 1½-INCH SIEVE, 40-60% PASSING ¾-INCH SIEVE, 10-30% PASSING #16 SIEVE)
1 PART	VOID-FILL MATERIAL	TYPE II BEDDING (CRUSHED ROCK WITH 100% PASSING 3-INCH SIEVE, 20-90% PASSING ¾-INCH SIEVE, 0-20% PASSING #4 SIEVE, 0-3% PASSING #200 SIEVE)
½ TO 1 PART	VOID-FILL MATERIAL	NATIVE TOPSOIL

## EXISTING CULVERT SUMMARY

CULVERT #	SIZE	MATERIAL	CONTRIBUTING SUBBASINS	5 YEAR		100 YEAR		CONDITION
				Q (cfs)	HEADWATER REQUIRED	Q (cfs)	HEADWATER REQUIRED	
1	18"	CMP	A	3.7	12.8"	24.0	> 7.5 FT	75% SILTED, ROADWAY OVERTOPPING WITH 100 YR
2	18"	CMP	B	4.6	15.3"	29.5	> 9 FT	75% SILTED, ROADWAY OVERTOPPING WITH 100 YR
3	18"	CMP	C, D, E	5.9	16.7"	28.7	> 9 FT	75% SILTED, ROADWAY OVERTOPPING WITH 100 YR

## PROPOSED CULVERT SUMMARY

CULVERT #	SIZE	MATERIAL	CONTRIBUTING SUBBASINS	5 YEAR			100 YEAR		
				Q5	QPIPE	QOVERFLOW	Q100	QPIPE	QOVERFLOW
1	24"	RCP	A	3.7	3.7	N/A	24.0	24.0	0.0
2	24"	RCP	B	4.6	4.6	N/A	29.5	29.5	0.0
3	18"	RCP	C, D, E	5.9	5.9	N/A	28.7	13.0	15.7

# Culvert Report

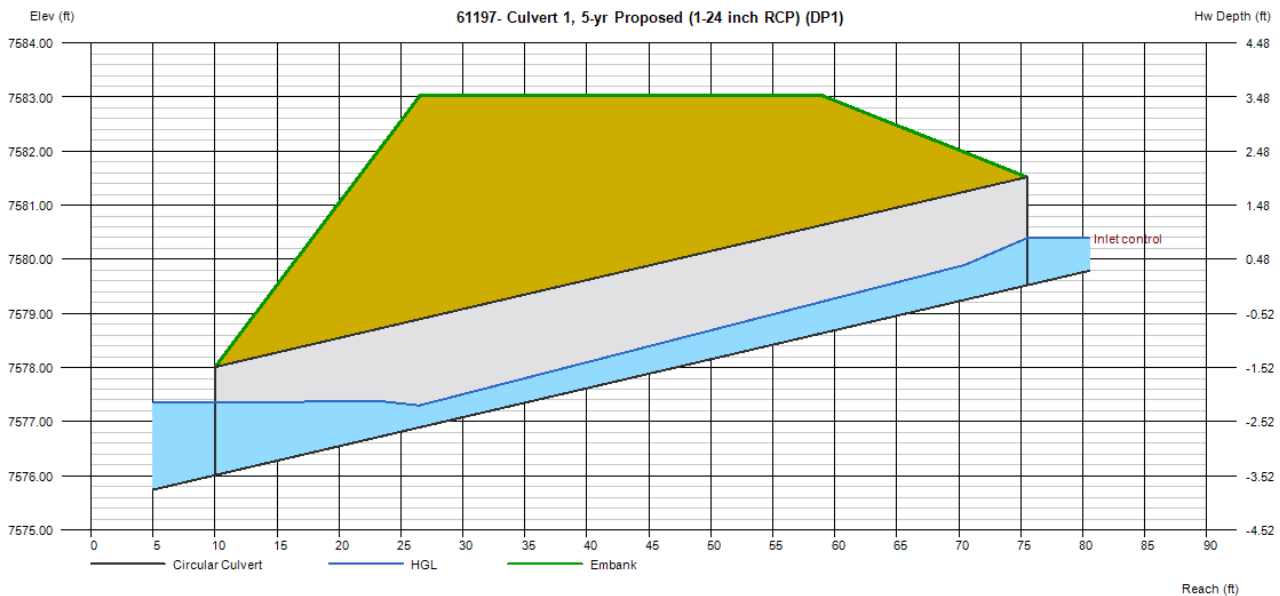
## 61197- Culvert 1, 5-yr Proposed (1-24 inch RCP) (DP1)

Invert Elev Dn (ft)	= 7576.01
Pipe Length (ft)	= 65.50
Slope (%)	= 5.36
Invert Elev Up (ft)	= 7579.52
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.011
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

<b>Embankment</b>	
Top Elevation (ft)	= 7583.03
Top Width (ft)	= 32.40
Crest Width (ft)	= 100.00

<b>Calculations</b>	
Qmin (cfs)	= 3.70
Qmax (cfs)	= 3.70
Tailwater Elev (ft)	= (dc+D)/2

<b>Highlighted</b>	
Qtotal (cfs)	= 3.70
Qpipe (cfs)	= 3.70
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.66
Veloc Up (ft/s)	= 3.98
HGL Dn (ft)	= 7577.35
HGL Up (ft)	= 7580.19
Hw Elev (ft)	= 7580.39
Hw/D (ft)	= 0.44
Flow Regime	= Inlet Control



# Culvert Report

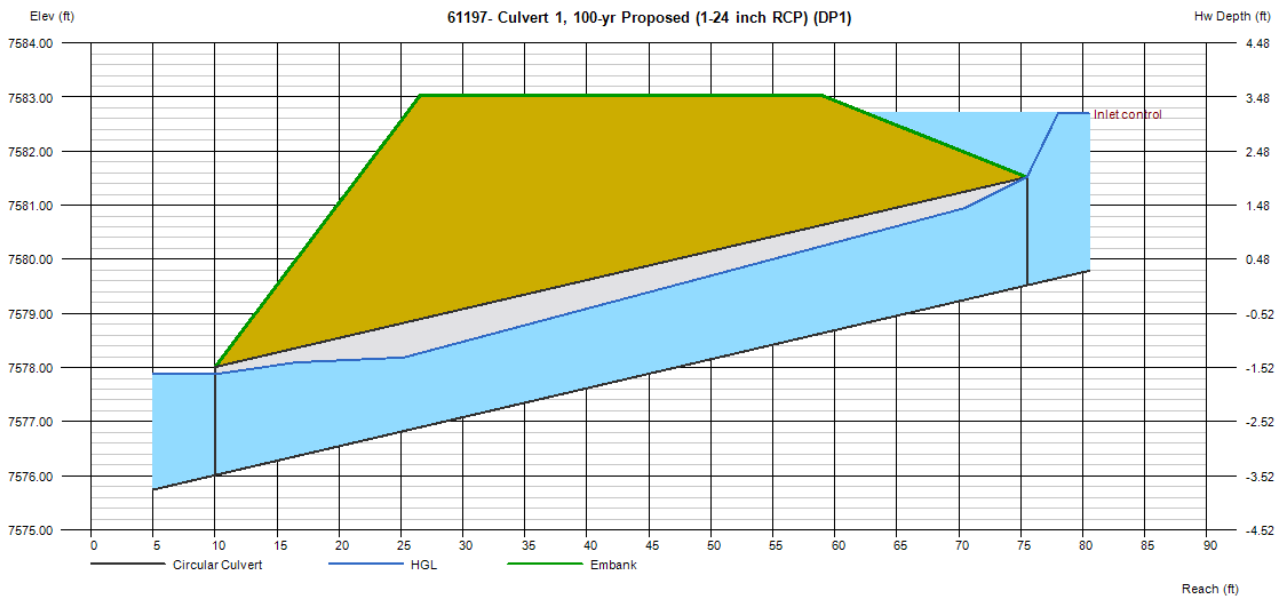
## 61197- Culvert 1, 100-yr Proposed (1-24 inch RCP) (DP1)

Invert Elev Dn (ft)	= 7576.01
Pipe Length (ft)	= 65.50
Slope (%)	= 5.36
Invert Elev Up (ft)	= 7579.52
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.011
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

<b>Embankment</b>	
Top Elevation (ft)	= 7583.03
Top Width (ft)	= 32.40
Crest Width (ft)	= 100.00

<b>Calculations</b>	
Qmin (cfs)	= 24.00
Qmax (cfs)	= 24.00
Tailwater Elev (ft)	= (dc+D)/2

<b>Highlighted</b>	
Qtotal (cfs)	= 24.00
Qpipe (cfs)	= 24.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 7.86
Veloc Up (ft/s)	= 8.29
HGL Dn (ft)	= 7577.88
HGL Up (ft)	= 7581.25
Hw Elev (ft)	= 7582.70
Hw/D (ft)	= 1.59
Flow Regime	= Inlet Control



# Culvert Report

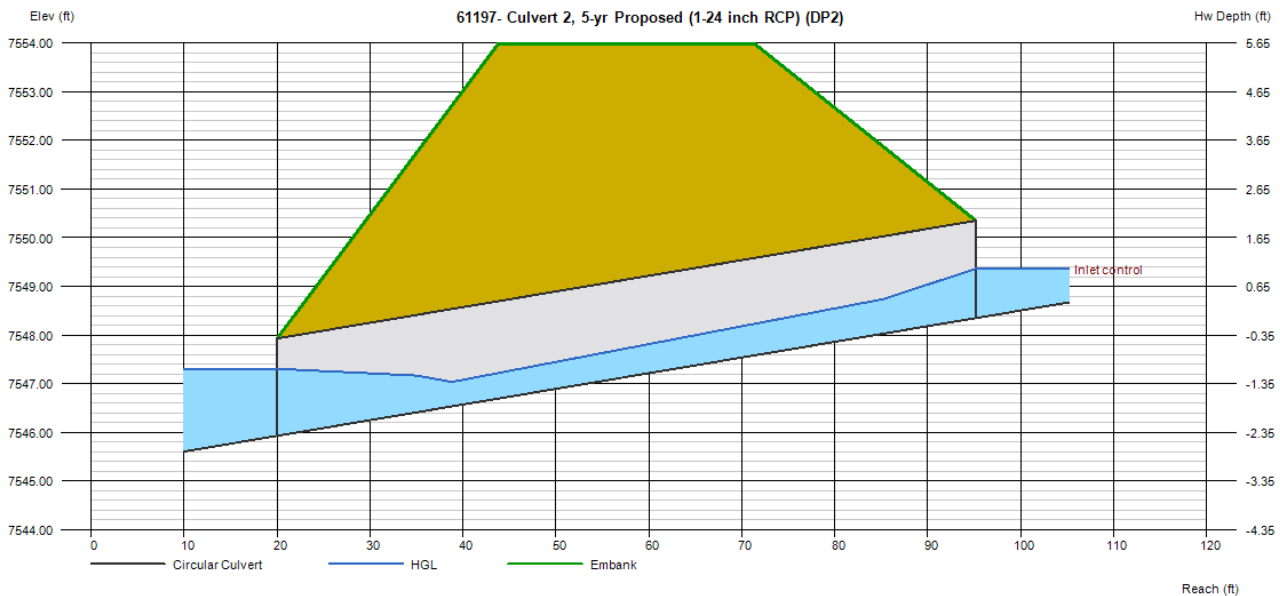
## 61197- Culvert 2, 5-yr Proposed (1-24 inch RCP) (DP2)

Invert Elev Dn (ft)	= 7545.93
Pipe Length (ft)	= 75.17
Slope (%)	= 3.22
Invert Elev Up (ft)	= 7548.35
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.011
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

<b>Embankment</b>	
Top Elevation (ft)	= 7553.99
Top Width (ft)	= 27.50
Crest Width (ft)	= 100.00

<b>Calculations</b>	
Qmin (cfs)	= 4.60
Qmax (cfs)	= 4.60
Tailwater Elev (ft)	= (dc+D)/2

<b>Highlighted</b>	
Qtotal (cfs)	= 4.60
Qpipe (cfs)	= 4.60
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.99
Veloc Up (ft/s)	= 4.25
HGL Dn (ft)	= 7547.31
HGL Up (ft)	= 7549.10
Hw Elev (ft)	= 7549.36
Hw/D (ft)	= 0.51
Flow Regime	= Inlet Control



# Culvert Report

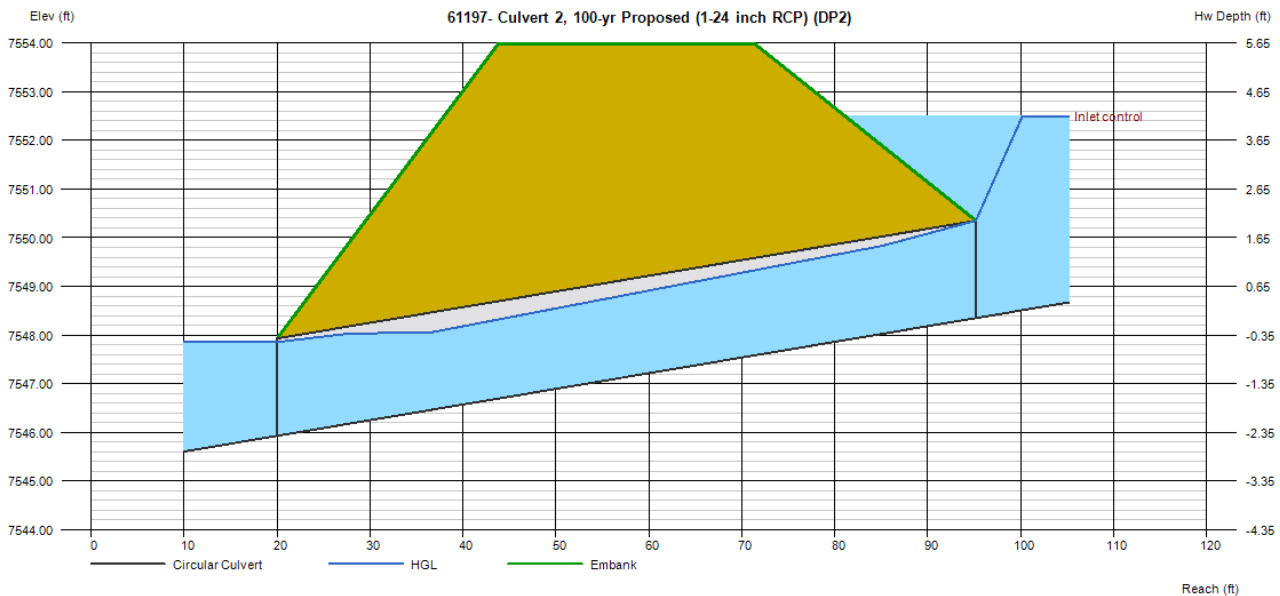
## 61197- Culvert 2, 100-yr Proposed (1-24 inch RCP) (DP2)

Invert Elev Dn (ft)	= 7545.93
Pipe Length (ft)	= 75.17
Slope (%)	= 3.22
Invert Elev Up (ft)	= 7548.35
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.011
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

<b>Embankment</b>	
Top Elevation (ft)	= 7553.99
Top Width (ft)	= 27.50
Crest Width (ft)	= 100.00

<b>Calculations</b>	
Qmin (cfs)	= 29.50
Qmax (cfs)	= 29.50
Tailwater Elev (ft)	= (dc+D)/2

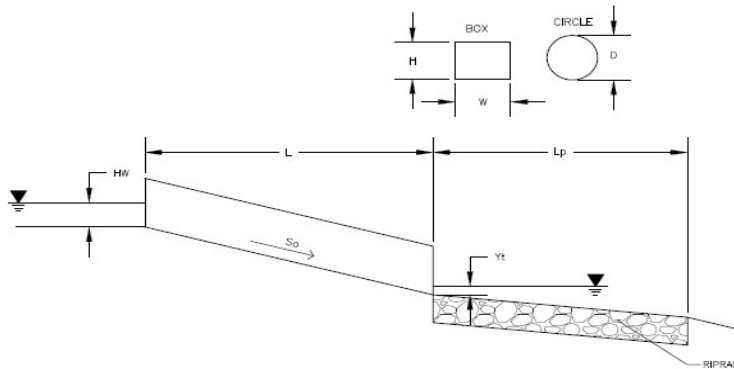
<b>Highlighted</b>	
Qtotal (cfs)	= 29.50
Qpipe (cfs)	= 29.50
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 9.50
Veloc Up (ft/s)	= 9.71
HGL Dn (ft)	= 7547.86
HGL Up (ft)	= 7550.20
Hw Elev (ft)	= 7552.49
Hw/D (ft)	= 2.07
Flow Regime	= Inlet Control



## Determination of Culvert Headwater and Outlet Protection

Project: **61197-Forest Heights Estates**

Basin ID: **Culvert 2 Riprap**



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

**Supercritical Flow! Using Da to calculate protection type.**

**Design Information (Input):**

<p>Design Discharge</p> <p><b>Circular Culvert:</b>          Barrel Diameter in Inches          Inlet Edge Type (Choose from pull-down list)</p> <p><b>Box Culvert:</b>          Barrel Height (Rise) in Feet          Barrel Width (Span) in Feet          Inlet Edge Type (Choose from pull-down list)</p> <p>Number of Barrels          Inlet Elevation          Outlet Elevation <b>OR</b> Slope          Culvert Length          Manning's Roughness          Bend Loss Coefficient          Exit Loss Coefficient          Tailwater Surface Elevation          Max Allowable Channel Velocity</p>	<p>Q = <input type="text" value="29.5"/> cfs</p> <p>D = <input type="text" value="24"/> inches</p> <p>Grooved End Projection <input type="text" value=""/></p> <p style="text-align: center;"><b>OR</b></p> <p>Height (Rise) = <input type="text" value=""/> ft          Width (Span) = <input type="text" value=""/> ft</p> <p>Square Edge w/ 90-15 Deg. Headwall <input type="text" value=""/></p> <p>No = <input type="text" value="1"/></p> <p>Elev IN = <input type="text" value="7548.35"/> ft          Elev OUT = <input type="text" value="7545.93"/> ft          L = <input type="text" value="75.2"/> ft          n = <input type="text" value="0.011"/></p> <p>k<sub>b</sub> = <input type="text" value="0"/></p> <p>k<sub>x</sub> = <input type="text" value="1"/></p> <p>Elev Y<sub>t</sub> = <input type="text" value=""/> ft          V = <input type="text" value="5"/> ft/s</p>
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**Required Protection (Output):**

<p>Tailwater Surface Height          Flow Area at Max Channel Velocity          Culvert Cross Sectional Area Available          Entrance Loss Coefficient          Friction Loss Coefficient          Sum of All Losses Coefficients          Culvert Normal Depth          Culvert Critical Depth</p> <p>Tailwater Depth for Design          Adjusted Diameter <b>OR</b> Adjusted Rise          Expansion Factor          Flow/Diameter<sup>2.5</sup> <b>OR</b> Flow/(Span * Rise<sup>1.5</sup>)          Froude Number          Tailwater/Adjusted Diameter <b>OR</b> Tailwater/Adjusted Rise</p> <p>Inlet Control Headwater          Outlet Control Headwater  <b>Design Headwater Elevation</b>  <b>Headwater/Diameter <b>OR</b> Headwater/Rise Ratio</b></p> <p>Minimum Theoretical Riprap Size          Nominal Riprap Size  <b>UDFCD Riprap Type</b>  <b>Length of Protection</b>  <b>Width of Protection</b></p>	<p>Y<sub>t</sub> = <input type="text" value="0.80"/> ft</p> <p>A<sub>t</sub> = <input type="text" value="5.90"/> ft<sup>2</sup></p> <p>A = <input type="text" value="3.14"/> ft<sup>2</sup></p> <p>k<sub>e</sub> = <input type="text" value="0.20"/></p> <p>k<sub>f</sub> = <input type="text" value="0.66"/></p> <p>k<sub>s</sub> = <input type="text" value="1.86"/> ft</p> <p>Y<sub>n</sub> = <input type="text" value="1.13"/> ft</p> <p>Y<sub>c</sub> = <input type="text" value="1.85"/> ft</p> <p>d = <input type="text" value="1.93"/> ft</p> <p>D<sub>a</sub> = <input type="text" value="1.57"/> ft</p> <p>1/(2*tan(θ)) = <input type="text" value="3.36"/></p> <p>Q/D<sup>2.5</sup> = <input type="text" value="5.21"/> ft<sup>0.5</sup>/s</p> <p>Fr = <input type="text" value="2.95"/> <b>Supercritical!</b></p> <p>Y<sub>t</sub>/D = <input type="text" value="0.51"/></p> <p>HW<sub>i</sub> = <input type="text" value="4.15"/> ft</p> <p>HW<sub>o</sub> = <input type="text" value="2.06"/> ft</p> <p>HW = <input type="text" value="7,552.50"/> ft</p> <p>HW/D = <input type="text" value="2.07"/> <b>HW/D &gt; 1.5!</b></p> <p>d<sub>50</sub> = <input type="text" value="9"/> in</p> <p>d<sub>50</sub> = <input type="text" value="12"/> in</p> <p>Type = <input type="text" value="M"/></p> <p>L<sub>p</sub> = <input type="text" value="19"/> ft</p> <p>T = <input type="text" value="8"/> ft</p>
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# Culvert Report

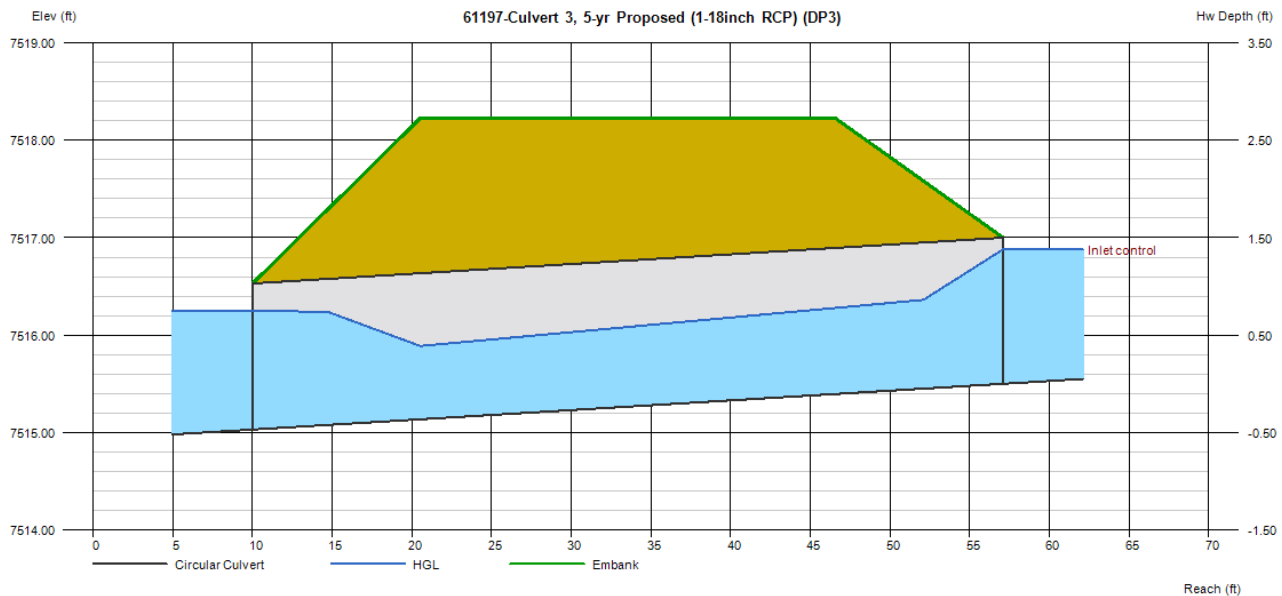
## 61197-Culvert 3, 5-yr Proposed (1-18inch RCP) (DP3)

Invert Elev Dn (ft)	= 7515.03
Pipe Length (ft)	= 47.10
Slope (%)	= 1.00
Invert Elev Up (ft)	= 7515.50
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.011
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

<b>Embankment</b>	
Top Elevation (ft)	= 7518.23
Top Width (ft)	= 26.00
Crest Width (ft)	= 275.00

<b>Calculations</b>	
Qmin (cfs)	= 5.90
Qmax (cfs)	= 5.90
Tailwater Elev (ft)	= (dc+D)/2

<b>Highlighted</b>	
Qtotal (cfs)	= 5.90
Qpipe (cfs)	= 5.90
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.84
Veloc Up (ft/s)	= 5.08
HGL Dn (ft)	= 7516.25
HGL Up (ft)	= 7516.44
Hw Elev (ft)	= 7516.88
Hw/D (ft)	= 0.92
Flow Regime	= Inlet Control





# Culvert Report

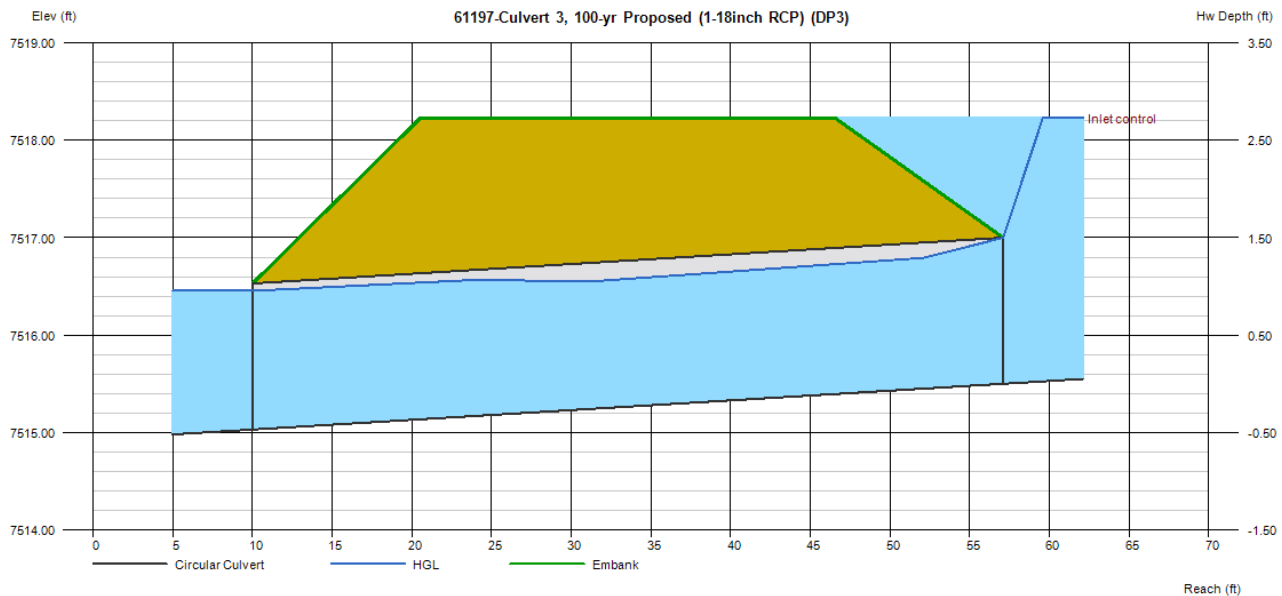
## 61197-Culvert 3, 100-yr Proposed (1-18inch RCP) (DP3)

Invert Elev Dn (ft)	= 7515.03
Pipe Length (ft)	= 47.10
Slope (%)	= 1.00
Invert Elev Up (ft)	= 7515.50
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.011
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

<b>Embankment</b>	
Top Elevation (ft)	= 7518.23
Top Width (ft)	= 26.00
Crest Width (ft)	= 275.00

<b>Calculations</b>	
Qmin (cfs)	= 28.70
Qmax (cfs)	= 28.70
Tailwater Elev (ft)	= (dc+D)/2

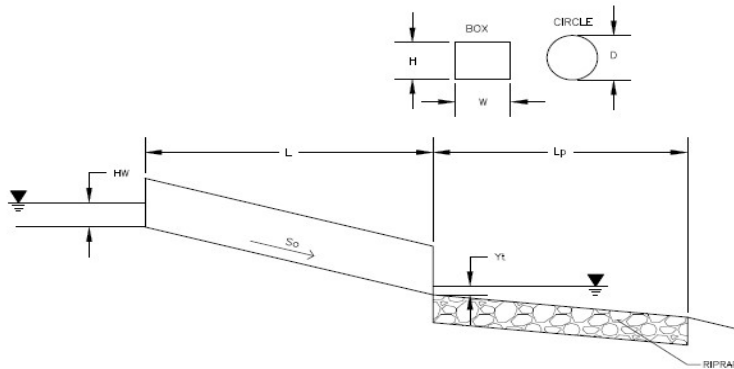
<b>Highlighted</b>	
Qtotal (cfs)	= 28.70
Qpipe (cfs)	= 12.96
Qovertop (cfs)	= 15.74
Veloc Dn (ft/s)	= 7.48
Veloc Up (ft/s)	= 7.73
HGL Dn (ft)	= 7516.45
HGL Up (ft)	= 7516.85
Hw Elev (ft)	= 7518.23
Hw/D (ft)	= 1.82
Flow Regime	= Inlet Control



## Determination of Culvert Headwater and Outlet Protection

Project: **61197-Forest Heights Estates**

Basin ID: **Culvert 3 Riprap**



**Soil Type:**

Choose One:

- Sandy  
 Non-Sandy

**Supercritical Flow! Using Da to calculate protection type.**

**Design Information (Input):**

<p>Design Discharge</p> <p><b>Circular Culvert:</b>          Barrel Diameter in Inches          Inlet Edge Type (Choose from pull-down list)</p> <p><b>Box Culvert:</b>          Barrel Height (Rise) in Feet          Barrel Width (Span) in Feet          Inlet Edge Type (Choose from pull-down list)</p> <p>Number of Barrels          Inlet Elevation          Outlet Elevation <b>OR</b> Slope          Culvert Length          Manning's Roughness          Bend Loss Coefficient          Exit Loss Coefficient          Tailwater Surface Elevation          Max Allowable Channel Velocity</p>	<p>Q = <input style="width: 50px;" type="text" value="12.9"/> cfs</p> <p>D = <input style="width: 50px;" type="text" value="18"/> inches</p> <p>Grooved End Projection <input type="button" value="v"/></p> <p style="text-align: center;"><b>OR</b></p> <p>Height (Rise) = <input style="width: 50px;" type="text"/> ft</p> <p>Width (Span) = <input style="width: 50px;" type="text"/> ft</p> <p>Square Edge w/ 90-15 Deg. Headwall <input type="button" value="v"/></p> <p>No = <input style="width: 50px;" type="text" value="1"/></p> <p>Elev IN = <input style="width: 50px;" type="text" value="7515.5"/> ft</p> <p>Elev OUT = <input style="width: 50px;" type="text" value="7514.94"/> ft</p> <p>L = <input style="width: 50px;" type="text" value="46.7"/> ft</p> <p>n = <input style="width: 50px;" type="text" value="0.011"/></p> <p>k<sub>b</sub> = <input style="width: 50px;" type="text" value="0"/></p> <p>k<sub>x</sub> = <input style="width: 50px;" type="text" value="1"/></p> <p>Elev Y<sub>t</sub> = <input style="width: 50px;" type="text"/> ft</p> <p>V = <input style="width: 50px;" type="text" value="5"/> ft/s</p>
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**Required Protection (Output):**

<p>Tailwater Surface Height</p> <p>Flow Area at Max Channel Velocity</p> <p>Culvert Cross Sectional Area Available</p> <p>Entrance Loss Coefficient</p> <p>Friction Loss Coefficient</p> <p>Sum of All Losses Coefficients</p> <p>Culvert Normal Depth</p> <p>Culvert Critical Depth</p> <p>Tailwater Depth for Design</p> <p>Adjusted Diameter <b>OR</b> Adjusted Rise</p> <p>Expansion Factor</p> <p>Flow/Diameter<sup>2.5</sup> <b>OR</b> Flow/(Span * Rise<sup>1.5</sup>)</p> <p>Froude Number</p> <p>Tailwater/Adjusted Diameter <b>OR</b> Tailwater/Adjusted Rise</p> <p>Inlet Control Headwater</p> <p>Outlet Control Headwater</p> <p><b>Design Headwater Elevation</b></p> <p><b>Headwater/Diameter <b>OR</b> Headwater/Rise Ratio</b></p> <p>Minimum Theoretical Riprap Size</p> <p>Nominal Riprap Size</p> <p><b>UDFCD Riprap Type</b></p> <p><b>Length of Protection</b></p> <p><b>Width of Protection</b></p>	<p>Y<sub>t</sub> = <input style="width: 50px;" type="text" value="0.60"/> ft</p> <p>A<sub>t</sub> = <input style="width: 50px;" type="text" value="2.58"/> ft<sup>2</sup></p> <p>A = <input style="width: 50px;" type="text" value="1.77"/> ft<sup>2</sup></p> <p>k<sub>e</sub> = <input style="width: 50px;" type="text" value="0.20"/></p> <p>k<sub>f</sub> = <input style="width: 50px;" type="text" value="0.61"/></p> <p>k<sub>s</sub> = <input style="width: 50px;" type="text" value="1.81"/> ft</p> <p>Y<sub>n</sub> = <input style="width: 50px;" type="text" value="1.16"/> ft</p> <p>Y<sub>c</sub> = <input style="width: 50px;" type="text" value="1.35"/> ft</p> <p>d = <input style="width: 50px;" type="text" value="1.42"/> ft</p> <p>D<sub>a</sub> = <input style="width: 50px;" type="text" value="1.33"/> ft</p> <p>1/(2*tan(θ)) = <input style="width: 50px;" type="text" value="3.32"/></p> <p>Q/D<sup>2.5</sup> = <input style="width: 50px;" type="text" value="4.68"/> ft<sup>0.5</sup>/s</p> <p>Fr = <input style="width: 50px;" type="text" value="1.43"/> <b>Supercritical!</b></p> <p>Y<sub>t</sub>/D = <input style="width: 50px;" type="text" value="0.45"/></p> <p>HW<sub>i</sub> = <input style="width: 50px;" type="text" value="2.71"/> ft</p> <p>HW<sub>o</sub> = <input style="width: 50px;" type="text" value="2.36"/> ft</p> <p><b>HW = 7,518.21 ft</b></p> <p><b>HW/D = 1.81 <b>HW/D &gt; 1.5!</b></b></p> <p>d<sub>50</sub> = <input style="width: 50px;" type="text" value="6"/> in</p> <p>d<sub>50</sub> = <input style="width: 50px;" type="text" value="6"/> in</p> <p><b>Type = L</b></p> <p>L<sub>p</sub> = <input style="width: 50px;" type="text" value="10"/> ft</p> <p>T = <input style="width: 50px;" type="text" value="5"/> ft</p>
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Forest Heights Estates  
Final Drainage Report, July 2023

Exhibit 11:  
Entech Engineering Report

March 10, 2020

Land Development Consultants, Inc.  
3898 Maizeland Road  
Colorado Springs, CO 80909



**ENTECH**  
ENGINEERING, INC.

505 ELKTON DRIVE  
COLORADO SPRINGS, CO 80907  
PHONE (719) 531-5599  
FAX (719) 531-5238

Attn: Daniel Kupferer

Re: Soil, Geology, and Geologic Hazard Study  
Didleau Subdivision  
Herring Road & Forest Heights Circle  
Parcel Nos. 52090-00-050 & 52090-00-120  
El Paso County, Colorado

Dear Mr. Kupferer:

### **GENERAL SITE CONDITIONS AND PROJECT DESCRIPTION**

The site is located in a portion of the SW $\frac{1}{4}$  of Section 9, Township 12 South, Range 65 West of the 6<sup>th</sup> Principal Meridian in El Paso County, Colorado. The site is located approximately 4 miles northeast of Colorado Springs city limits, northeast of Shoup Road and Herring Road in El Paso County, Colorado. The location of the site is as shown on the Vicinity Map, Figure 1.

The topography of the site is gradually sloping generally to the southwest with moderate slopes along the ridge that bisects the site. Burgess Creek is located in the eastern portion of the site and flows in a southwesterly direction. A minor drainage is located in the western portion of the property. Water was not observed in the drainages at the time of this investigation. The site boundaries are indicated on the USGS Map, Figure 2. Previous land uses have included undeveloped and a rural residential development. The site is located within the Black Forest burn scar. The site contains primarily field grasses and weeds with scattered areas of ponderosa pines in the western portion of the site and around the existing house located on Lot 2. Site photographs, taken January 30, 2020, are included in Appendix A.

Total acreage involved in the proposed subdivision is 32.25-acres. Four rural residential lots are proposed as part of the replat. The proposed lot sizes range from approximately 5-acres to 15-acres. The existing house located on Lot 2 will remain. The new lots will be serviced by individual wells and on-site wastewater treatment systems. The Site Plan with the proposed replat is presented in Figure 3.

### **LAND USE AND ENGINEERING GEOLOGY**

This site was found to be suitable for the proposed development. Areas were encountered where the geologic conditions will impose some constraints on development and land use. These include areas of potentially seasonal shallow and seasonal shallow groundwater. Based on the proposed development plan, it appears that these areas will have some minor impacts on the development. These conditions will be discussed in greater detail in the report.

In general, it is our opinion that the development can be achieved if the observed geologic conditions on site are either avoided or properly mitigated. All recommendations are subject to the limitations discussed in the report.

Land Development Consultants, Inc.  
Soils, Geology, and Geologic Hazard Study  
Didleau Subdivision  
Herring Road & Forest Heights Circle  
Parcel Nos. 52090-00-050 & 52090-00-120  
El Paso County, Colorado

## SCOPE OF THE REPORT

The scope of the report will include the following:

- A general geologic analysis utilizing published geologic data. Detailed site-specific mapping will be conducted to obtain general information in respect to major geographic and geologic features, geologic descriptions and their effects on the development of the property.

## FIELD INVESTIGATION

Our field investigation consisted of the preparation of a geologic map of any bedrock features and significant surficial deposits. The Natural Resource Conservation Service (NRCS), previously the Soil Conservation Service (SCS) survey was also reviewed to evaluate the site. The position of mappable units within the subject property are shown on the Geologic Map. Our mapping procedures involved both field reconnaissance and measurements, and aerial photo reconnaissance and interpretation. The same mapping procedures have also been utilized to produce the Geology/Engineering Geology Map which identified pertinent geologic conditions affecting development. The field mapping was performed by personnel of Entech Engineering, Inc. on January 3 and 30, 2020.

Two test borings and two test pits were excavated on the site to determine general suitability for the use of on-site wastewater treatment systems and general soil characteristics. The location of the test pit is indicated on the Site Plan/Test Pit Location Map, Figure 3. The Test Pit Log is presented in Appendix B. Results of this testing will be discussed later in this report.

Laboratory testing was also performed on some of the soils to classify and determine the soils engineering characteristics. Laboratory tests included grain-size analysis, ASTM D-422, and Atterberg Limits, ASTM D-4318. Results of the laboratory testing are included in Appendix C. A Summary of Laboratory Test Results is presented in Table 1.

## SOIL AND GEOLOGIC CONDITIONS

### Soil Survey

The Natural Resource Conservation Service (NRCS) (Reference 1, Figure 4), previously the Soil Conservation Service (Reference 2) has mapped two soil types on the site. Complete descriptions of the soil types are presented in Appendix D. In general, the soils consist of sandy loam to gravelly loamy sand. The soils are described as follows:

<u>Type</u>	<u>Description</u>
26	Elbeth Sandy Loam, 8 – 15% Slopes
40	Kettle Gravelly Loamy Sand, 3 – 8% Slopes

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The soils have been described to have moderate to rapid permeabilities. The soils are described as well suited for use as homesites. Possible hazards with soils erosion are present on the site. The erosion potential can be controlled with vegetation. The soils have been described to have moderate erosion hazards (Reference 2).

### Soils

The soils encountered in the test borings and test pits consisted of silty sand to very clayey sand overlying weathered to formational silty sandstone and very sandy claystone. Bedrock was encountered at depths ranging from 2 to 6 feet. The upper sands were encountered at loose to dense states and moderate moisture conditions, and the sandstone was encountered at very dense states and moderate moisture conditions. The claystone was encountered at hard consistencies and moderate moisture conditions. The samples of sand tested had approximately 12 to 38 percent of the soil size particles passing the No. 200 sieve. FHA Swell Testing on a sample of the very clayey sand resulted in an expansion pressure of 1640 psf, which indicates a moderate expansion potential. The samples of sandstone tested had 10 to 22 percent of the soil size particles passing the No. 200 sieve. The samples of claystone tested had 54 to 59 percent of the soil size particles passing the No. 200 sieve. FHA Swell Testing on a sample of the claystone resulted in an expansion pressure of 730 psf, which indicates a low to moderate expansion potential. Highly expansive claystone and siltstone lenses are commonly interbedded in the Dawson Formation.

### Groundwater

Groundwater or signs of seasonally occurring water were not encountered in the test borings or test pits, which were drilled to 20 feet and excavated to 6 to 7 feet. It is anticipated groundwater will not affect shallow foundations on the majority of the site. Areas of potentially seasonal shallow and seasonal shallow groundwater have been mapped in drainages on the site that are discussed in the following sections. Fluctuations in groundwater conditions may occur due to variations in rainfall or other factors not readily apparent at this time. Isolated sand layers within the soil profile can carry water in the subsurface. Contractors should be cognizant of the potential for the occurrence of subsurface water features during construction.

### Geology

Approximately 12 miles west of the site is a major structural feature known as the Rampart Range Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within a large structural feature known as the Denver Basin. Bedrock in the area is typically gently dipping in a northerly direction (Reference 3). The bedrock underlying the site consists of the Dawson Formation of Cretaceous Age. The Dawson Formation typically consists of coarse-grained arkosic sandstone with interbedded layers claystone or siltstone.

The geology of the site was evaluated using the *Geologic Map of the Black Forest*, by Thorson in 2003, (Reference 4, Figure 5). The Geology Map for the site is presented in Figure 6. Four mappable units were identified on this site which is described as follows:

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- Qaf Artificial Fill of Holocene Age:** These consist of man-made fill deposits associated with a gas pipeline that bisects the site in portions of Lot 1 and Lot 2. Fill piles consisting of logs and branches are located across the site.
- Qal Recent Alluvium of Holocene Age:** These are recent deposits that have been deposited in the drainages that exist on-site. These materials consist of silty to clayey sands. Some of these alluviums can contain highly organic soils.
- Qau Alluvium, Undivided of Holocene and Pleistocene Age:** These are sheetwash and stream deposited alluvium that exists in the western portion of the site associated with alluvial-filled valley heads. These materials typically consist of silty to clayey sands and gravel.
- Qc/Tkd Colluvium of Quaternary Age overlying Dawson Formation of Tertiary to Cretaceous Age:** The materials consist of colluvial or residual soils overlying the bedrock materials on-site. The colluvial soils were deposited by the action of sheetwash and gravity. The residual soils were derived from the in-situ weathering of the bedrock on site. These materials typically consist of silty to clayey sand with potential areas of sandy clays. The bedrock consists of the Dawson Formation. The Dawson Formation typically consists of coarse-grained, arkosic sandstone with interbedded lenses of fine-grained sandstone, siltstone and claystone.

The soils listed above were mapped from site-specific mapping, the *Geologic Map of the Black Forest Quadrangle* distributed by the Colorado Geologic Survey in 2003 (Reference 4, Figure 5), the *Geologic Map of the Colorado Springs-Castle Rock Area*, distributed by the US Geological Survey in 1979 (Reference 5), and the *Geologic Map of the Pueblo 1° x 2° Quadrangle*, distributed by the US Geological Survey in 1978 (Reference 6). The test borings and test pits were used in evaluating the site and is included in Appendix B. The Geology Map prepared for the site is presented in Figure 6.

## ENGINEERING GEOLOGIC HAZARDS

Mapping has been performed on this site to identify areas where various geologic conditions exist of which developers should be cognizant during the planning, design and construction stages where new construction is proposed. The engineering geologic hazards identified on this site include potentially seasonal shallow and seasonally shallow groundwater areas. These hazards and recommended mitigation techniques are discussed as follows:

### Expansive Soils

Expansive soils were encountered in Test Boring No. 2 located on Lot 3. These occurrences are typically sporadic; therefore, none have been indicated on the maps. Highly expansive claystone and siltstone are commonly interbedded in the sandstone of the Dawson Formation. These clays, if encountered beneath foundations, can cause differential movement in the structure foundation.

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Mitigation: Should expansive soils be encountered beneath the foundation; mitigation will be necessary. Mitigation of expansive soils will require special foundation design. Overexcavation and replacement with non-expansive soils at a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation, which is common in the area. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements.

#### Potentially Seasonal Shallow and Seasonal Shallow Groundwater Area

The site is not mapped within any floodplains according to the FEMA Map No. 08041CO320G, dated December 7, 2018 (Figure 7, Reference 7). Areas of potentially seasonal shallow and seasonal shallow groundwater were observed on the site (Figure 6). In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and frost heave potential. These areas lie within low-lying areas and along the drainages in the eastern and western portions of the site. The seasonal shallow groundwater area is located along Burgess Creek located along the eastern portion of the site on Lot 4. The potentially seasonal shallow groundwater area is located in the western portion of the site on Lot 2. Water was not observed in any of the drainages at the time of our site investigation. These areas can likely be avoided or properly mitigated by development. The potential exists for high groundwater levels during high moisture periods and should structures encroach on these areas the following precautions should be followed.

Mitigation: Foundations must have a minimum 30-inch depth for frost protection. In areas where high subsurface moisture conditions are anticipated periodically, subsurface perimeter drains are recommended to help prevent the intrusion of water into areas below grade. Typical drain details are presented in Figure 8. Any grading in these areas should be done to direct surface flow around construction to avoid areas of ponded water. All organic material would be completely removed prior to any fill placement. **Specific drainage studies are beyond the scope of this report.**

#### **RELEVANCE OF GEOLOGIC CONDITIONS TO LAND USE PLANNING**

The proposed development will be rural-residential utilizing individual on-site wastewater treatment systems and water wells. Total acreage involved in the proposed subdivision is 32.25-acres. Four rural residential lots are proposed as part of the replat. The proposed lot sizes range from approximately 5-acres to 15-acres. The existing house located on Lot 2 will remain. The house on Lot 2 has an existing water well and on-site wastewater treatment system. The new lots will be serviced by an individual wells and on-site wastewater treatment systems. The existing geologic and engineering geologic conditions will impose minor constraints on development and construction. The geologic conditions on the site include potentially seasonal shallow and shallow groundwater areas, which can be satisfactorily mitigated through avoidance or proper engineering design and construction practices.

The upper granular soils encountered in the test borings and test pits on the site were encountered at loose to dense states, the sandstone was encountered at very dense states, and the claystone at hard consistencies. Highly expansive claystone and siltstone are



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El Paso County, Colorado

commonly interbedded in the sandstone of the Dawson Formation. Mitigation of expansive soils will require special foundation design. Overexcavation and replacement with non-expansive soils at a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557 is a suitable mitigation, which is common in the area. Floor slabs on expansive soils should be expected to experience movement. Overexcavation and replacement has been successful in minimizing slab movements. These soils will not prohibit development.

Areas of potentially seasonal shallow and seasonal shallow groundwater were observed on the site (Figure 6). In these areas, we would anticipate the potential for periodically high subsurface moisture conditions and frost heave potential. These areas lie within low-lying areas and along the minor drainage in the western portion of the site, and Burgess Creek in the eastern portion of the site. These areas can likely be avoided or properly mitigated by development. The potential exists for high groundwater levels during high moisture periods and should structures encroach on these areas. Subsurface perimeter drains are recommended should structures encroach on this area. Typical drain details are presented in Figure 8. Septic systems are not recommended in these areas due to the potential for shallow groundwater. Any grading in these areas should be done to direct surface flow around construction to avoid areas of ponded water. All organic material should be completely removed prior to any fill placement. Specific drainage studies are beyond the scope of this report. The site is not mapped within any floodplains according to the FEMA Map No. 80841C0320G (Figure 7, Reference 7).

In summary, the granular soils will likely provide suitable support for shallow foundations. The geologic conditions encountered on site can be mitigated with avoidance or proper engineering and construction practices.

## **ECONOMIC MINERAL RESOURCES**

Some of the sandy materials on-site could be considered a low-grade sand resource. According to the *El Paso County Aggregate Resource Evaluation Map* (Reference 8), of the area of the site is not mapped with any potential aggregate resources. According to the *Atlas of Sand, Gravel and Quarry Aggregate Resources, Colorado Front Range Counties* distributed by the Colorado Geological Survey (Reference 9), the site is not mapped with any resources. According to the *Evaluation of Mineral and Mineral Fuel Potential* (Reference 10), the area of the site has been mapped as "little or no potential" for industrial minerals.

According to the *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands* (Reference 10), the site is mapped within the Denver Basin Coal Region. However, the area of the site has been mapped as "Poor" for coal resources. No active or inactive mines have been mapped in the area of the site. No metallic mineral resources have been mapped on the site (Reference 10).

The site has been mapped as "Fair" for oil and gas resources (Reference 10). No oil or gas fields have been discovered in the area of the site. The sedimentary rocks in the area may lack the geologic structure for trapping oil or gas; therefore, it may not be considered a significant resource. Hydraulic fracturing is a new method that is being used to extract oil and gas from

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Soils, Geology, and Geologic Hazard Study  
Didleau Subdivision  
Herring Road & Forest Heights Circle  
Parcel Nos. 52090-00-050 & 52090-00-120  
El Paso County, Colorado

rocks. It utilizes pressurized fluid to extract oil and gas from rocks that would not normally be productive. The area of the site has not been explored to determine if the rocks underlying the site would be commercially viable utilizing hydraulic fracturing. The practice of hydraulic fracturing has come under review due to concerns about environmental impacts, health and safety.

## **EROSION CONTROL**

The soil types observed on the site are mildly to highly susceptible to wind erosion, and moderately to highly susceptible to water erosion. A minor wind erosion and dust problem may be created for a short time during and immediately after construction. Should the problem be considered severe enough during this time, watering of the cut areas or the use of chemical palliative may be required to control dust. However, once construction has been completed and vegetation re-established, the potential for wind erosion should be considerably reduced.

With regard to water erosion, loosely compacted soils will be the most susceptible to water erosion, residually weathered soils and weathered bedrock materials become increasingly less susceptible to water erosion. For the typical soils observed on site, allowable velocities or unvegetated and unlined earth channels would be on the order of 3 to 4 feet/second, depending upon the sediment load carried by the water. Permissible velocities may be increased through the use of vegetation to something on the order of 4 to 7 feet/second, depending upon the type of vegetation established. Should the anticipated velocities exceed these values, some form of channel lining material may be required to reduce erosion potential. These might consist of some of the synthetic channel lining materials on the market or conventional riprap. In cases where ditch-lining materials are still insufficient to control erosion, small check dams or sediment traps may be required. The check dams will serve to reduce flow velocities, as well as provide small traps for containing sediment. The determination of the amount, location and placement of ditch linings, check dams and of the special erosion control features should be performed by or in conjunction with the drainage engineer who is more familiar with the flow quantities and velocities.

Cut and fill slope areas will be subjected primarily to sheetwash and rill erosion. Unchecked rill erosion can eventually lead to concentrated flows of water and gully erosion. The best means to combat this type of erosion is, where possible, the adequate re-vegetation of cut and fill slopes. Cut and fill slopes having gradients more than three (3) horizontal to one (1) vertical become increasingly more difficult to revegetate successfully. Therefore, recommendations pertaining to the vegetation of the cut and fill slopes may require input from a qualified landscape architect and/or the Soil Conservation Service.

## **CLOSURE**

It is our opinion that the existing geologic engineering and geologic conditions will impose some minor constraints on development and construction of the site. The majority of these conditions can be avoided by construction. Others can be mitigated through proper engineering design and construction practices. The proposed development and use are consistent with anticipated geologic and engineering geologic conditions.

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El Paso County, Colorado

It should be pointed out that because of the nature of data obtained by random sampling of such variable and non-homogeneous materials as soil and rock, it is important that we be informed of any differences observed between surface and subsurface conditions encountered in construction and those assumed in the body of this report. Individual investigations for new building sites and septic systems will be required prior to construction. Construction and design personnel should be made familiar with the contents of this report. Reporting such discrepancies to Entech Engineering, Inc. soon after they are discovered would be greatly appreciated and could possibly help avoid construction and development problems.

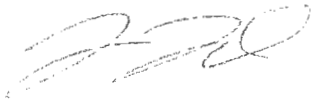
This report has been prepared for Land Development Consultants, Inc., for application to the proposed project in accordance with generally accepted geologic soil and engineering practices. No other warranty expressed or implied is made.

We trust that this report has provided you with all the information that you required. Should you require additional information, please do not hesitate to contact Entech Engineering, Inc.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Reviewed by:

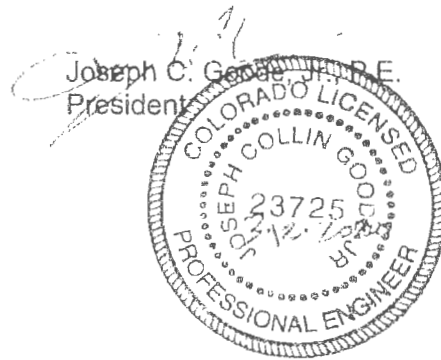


Logan L. Langford, P.G.  
Geologist

LLL/III

Encl.

Entech Job No. 192115  
AAprojects/2019/192115 sg&ghs



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Herring Road & Forest Heights Circle  
Parcel Nos. 52090-00-050 & 52090-00-120  
El Paso County, Colorado

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3. Scott, Glen R.; Taylor Richard B.; Epis, Rudy C; and Wobus, Reinhard A. 1978. *Geologic Structure Map of the Pueblo 1° x 2° Quadrangle, South-Central Colorado*. Sheet 2. U.S. Geologic Survey. Map I-1022, Sheet 2.
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6. Scott, Glen R.; Taylor Richard B.; Epis, Rudy C; and Wobus, Reinhard A. 1978. *Geologic Structure Map of the Pueblo 1° x 2° Quadrangle, South-Central Colorado*. Sheet 2. U.S. Geologic Survey. Map I-1022.
7. Federal Emergency Management Agency. December 7, 2018. *Flood Insurance Rate Maps for the City of Colorado Springs, Colorado*. Map Number 08041CO320G
8. El Paso County Planning Development. December 1995. *El Paso County Aggregate Resource Evaluation Maps*.
9. Schwochow, S.D.; Shroba, R.R. and Wicklein, P.C. 1974. *Atlas of Sand, Gravel, and Quarry Aggregate Resources, Colorado Front Range Counties*. Colorado Geological Survey. Special Publication 5-B.
10. Keller, John W.; TerBest, Harry and Garrison, Rachel E. 2003. *Evaluation of Mineral and Mineral Fuel Potential of El Paso County State Mineral Lands Administered by the Colorado State Land Board*. Colorado Geological Survey. Open-File Report 03-07.

## TABLES

**TABLE 4**  
**SUMMARY OF LABORATORY TEST RESULTS**

CLIENT LDC, INC.  
 PROJECT DIDLEAU SUBDIVISION  
 JOB NO. 192115

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	1	2-3			12.2						SM	SAND, SILTY
1	2	2-3			38.4				1640		SC	SAND, VERY CLAYEY
1	TP-2	2-3			14.9						SM	SAND, SILTY
2	TP-1	5-6			9.6						SM	SANDSTONE, SILTY
2	1	15			22.2						SM	SANDSTONE, SILTY
3	2	10			59.3				730		CL	CLAYSTONE, VERY SANDY
3	2	5			54.2						CL	CLAYSTONE, VERY SANDY

**Table 2: Summary Tactile Test Pit Results**

Test Pit No.	USDA Soil Type	LTAR Value	Depth to Redrock (ft.)	Depth to Seasonally Occurring Groundwater (ft.)
1	3A*	0.30*	3*	N/A
2	3A*	0.30*	2*	N/A

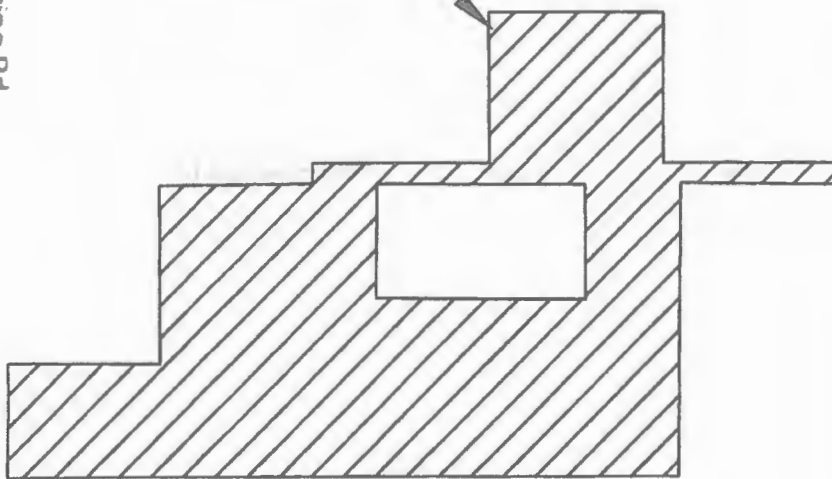
\*- Conditions that will require an engineered OWTS

## FIGURES



Herring Rd

SITE



elco Manufacturing



Herring Rd

Shoup Rd

Shoup Rd

Shoup Rd

Colorado



ish Pile



**ENTECH**  
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505 ELKTON DRIVE  
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VICINITY MAP  
 DITLEAU SUBDIVISION  
 HERRING ROAD & FOREST HEIGHTS CIRCLE  
 EL PASO COUNTY, CO.  
 FOR: LDC, INC.

DRAWN:  
 LLL

DATE:  
 2/28/20

CHECKED:

DATE:

JOB NO.:  
 192115

FIG NO.:

1



**ENTECH**  
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USGS MAP  
DIDLEAU SUBDIVISION  
HERRING ROAD & FOREST HEIGHTS CIRCLE  
PASO COUNTY, CO.  
FOR: LDC, INC.

DRAWN:  
LLL

DATE:  
2/28/20

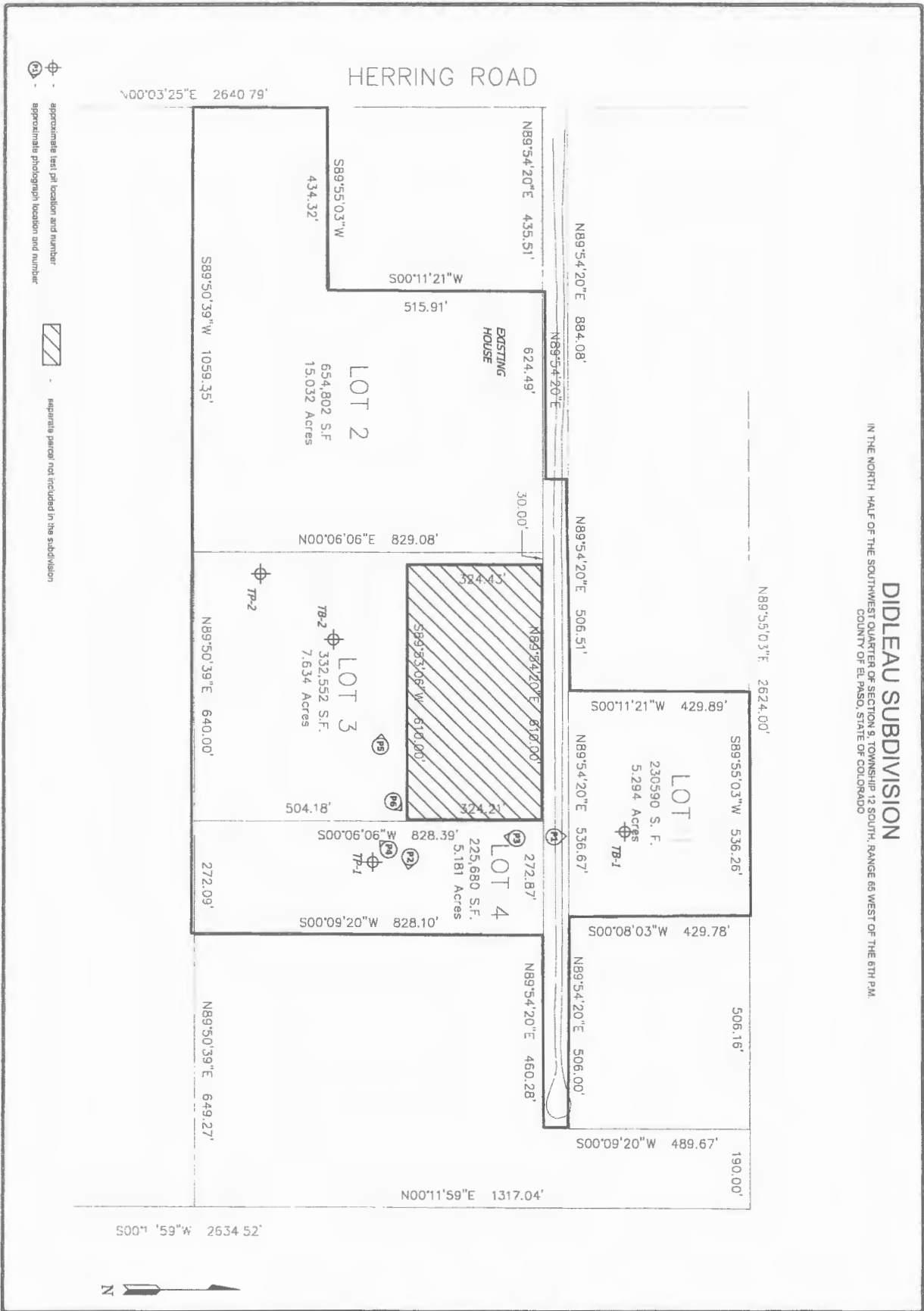
CHECKED:

DATE:

JOB NO.:  
192115

FIG NO.:  
2

**DIDLEAU SUBDIVISION**  
 IN THE NORTH HALF OF THE SOUTHWEST QUARTER OF SECTION 9, TOWNSHIP 12 SOUTH, RANGE 66 WEST OF THE 6TH PM.  
 COUNTY OF EL PASO, STATE OF COLORADO



DATE	BY	REVISION
2/28/20	AS	1
3/11/20	AS	2
3/11/20	AS	3

**SITE PLAN/TESTING LOCATION MAP**  
**DIDLEAU SUBDIVISION**  
**HERRING ROAD & FOREST HEIGHTS**  
**CIRCLECOLORADO SPRINGS, CO.**  
**FOR: LDC, INC.**



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REVISION	BY



SEPERATE PARCEL NOT INCLUDED IN THE SUBDIVISION



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SOIL SURVEY MAP  
 DIDLEAU SUBDIVISION  
 HERRING ROAD & FOREST HEIGHTS CIRCLE  
 EL PASO COUNTY, CO.  
 FOR: LDC, INC.

DRAWN:  
 LLL

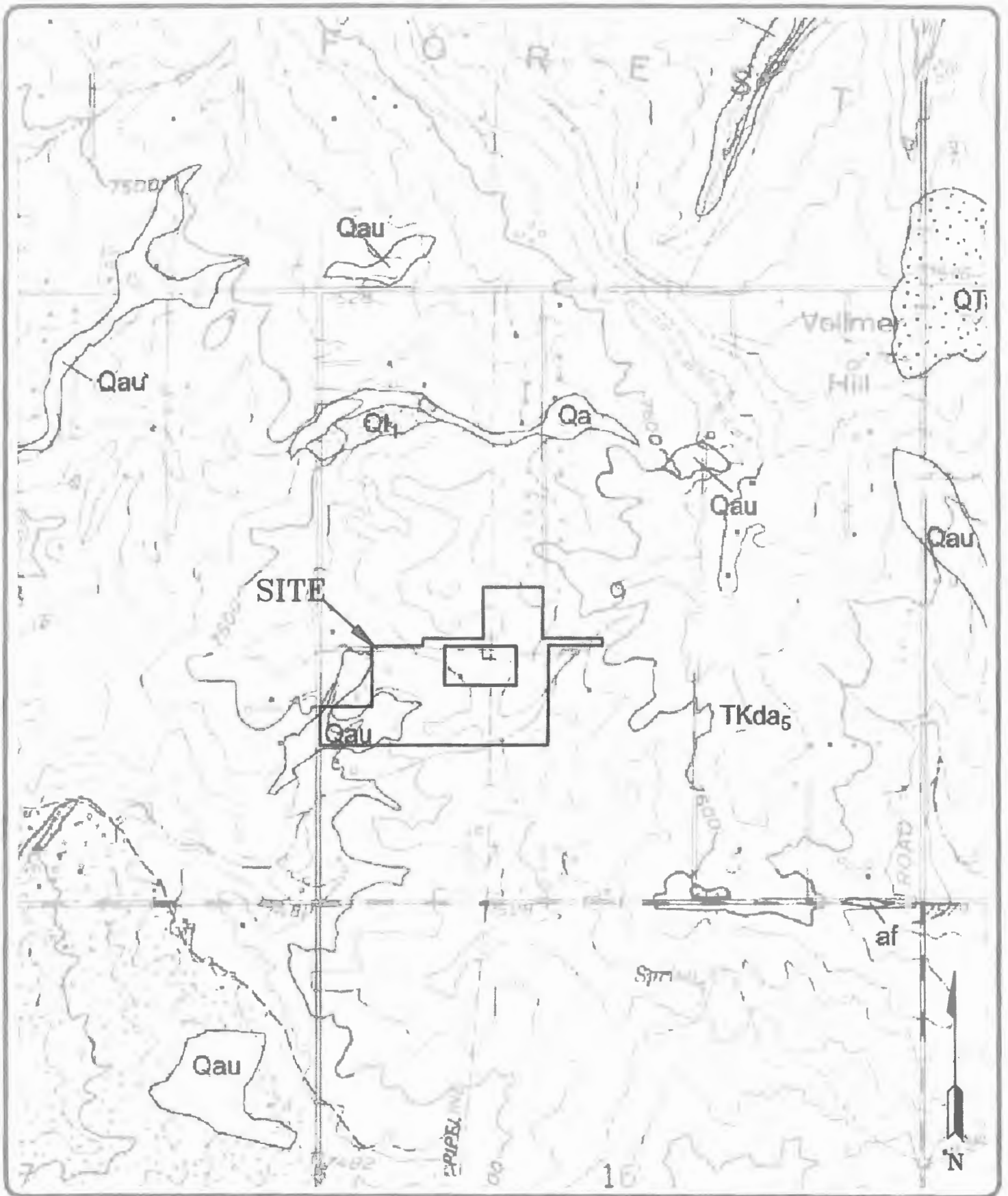
DATE:  
 2/28/20

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DATE:

JOB NO.:  
 192115

FIG NO.:  
 4



**ENTECH**  
ENGINEERING, INC.  
305 ELKTON DRIVE  
COLORADO SPRINGS, CO. 80907 (719) 331-3399

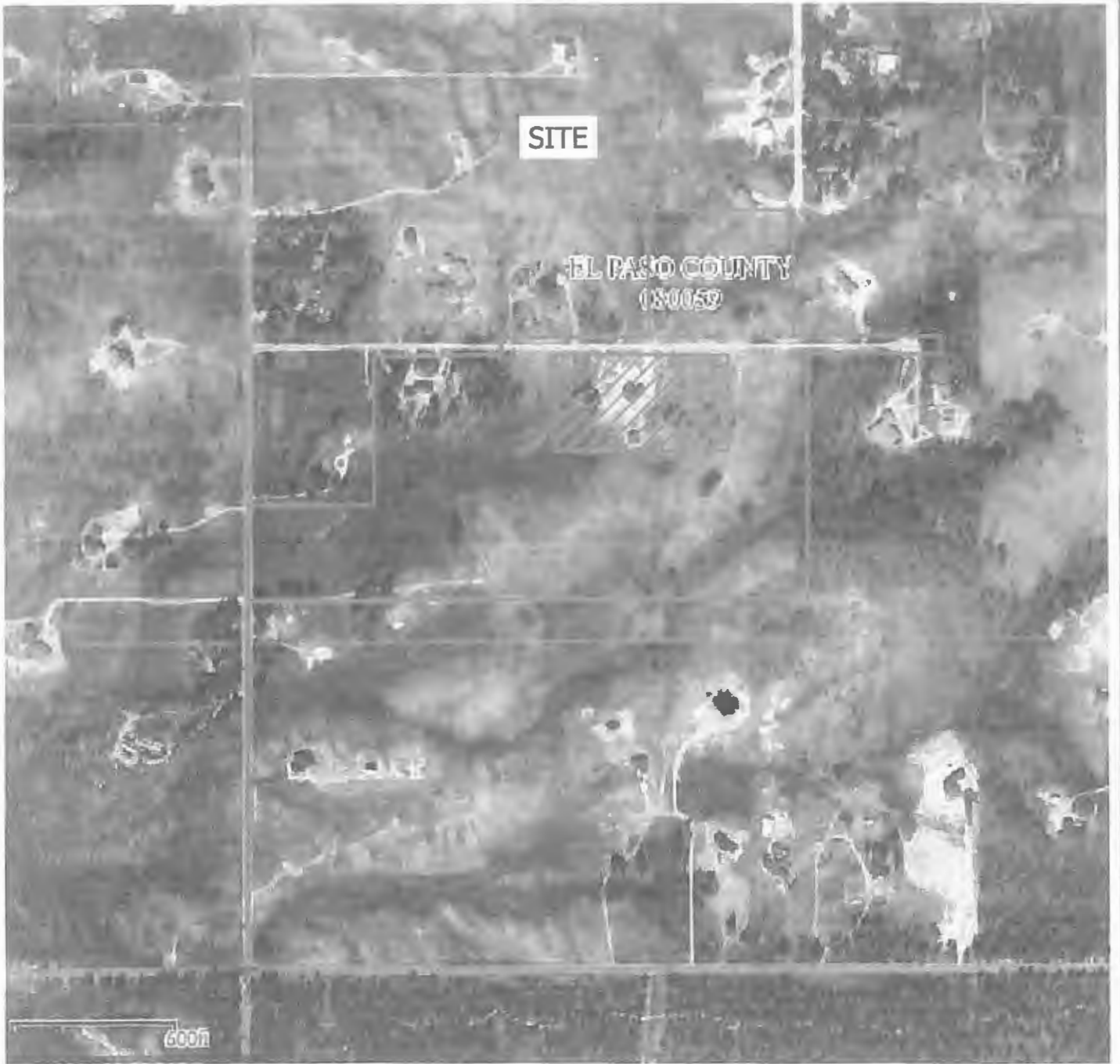
BLACK FOREST QUADRANGLE GEOLOGIC MAP  
DIDLEAU SUBDIVISION  
HERRING ROAD & FOREST HEIGHTS CIRCLE  
EL PASO COUNTY, CO.  
FOR: LDC, INC.

DRAWN: LLL	DATE: 2/28/20	CHECKED:	DATE:
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JOB NO.:  
192115

FIG NO.:  
5





SEPERATE PARCEL NOT INCLUDED IN THE SUBDIVISION



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**ENGINEERING, INC.**  
 525 ELKTON DRIVE  
 COLORADO SPRINGS, CO. 80907 (719) 531-5599

FEMA FLOODPLAIN MAP  
 DIDLEAU SUBDIVISION  
 HERRING ROAD & FOREST HEIGHTS CIRCLE  
 EL PASO COUNTY, CO.  
 FOR: LDC, INC.

DRAWN:  
**LLL**

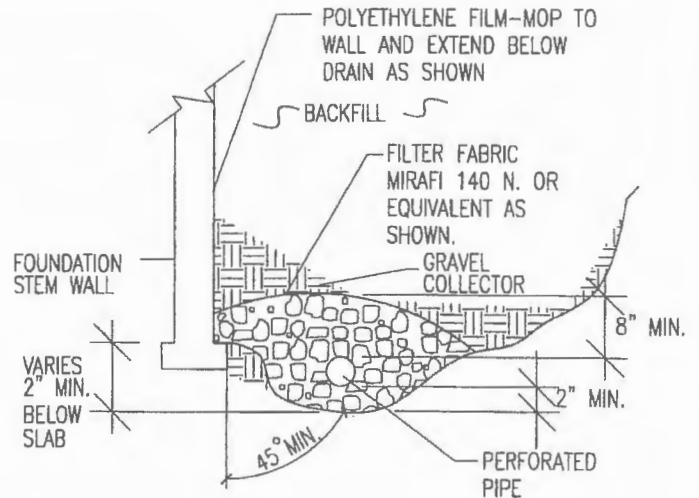
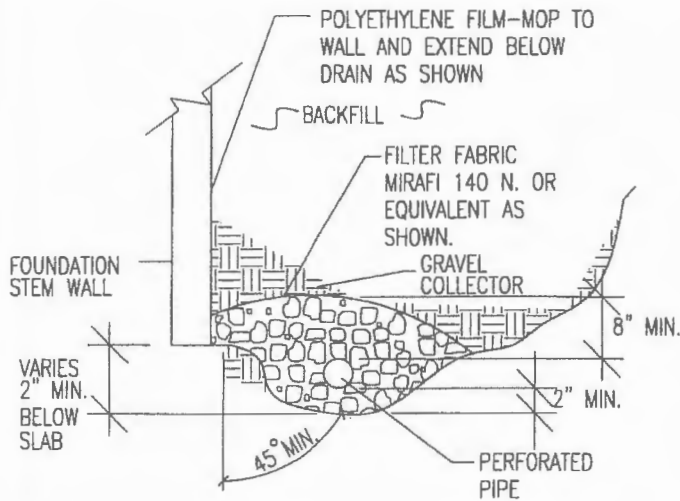
DATE:  
**2/28/20**

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DATE:

JOB NO.:  
**192115**

FIG NO.:  
**7**



NOTES:

-GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS-85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

-PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4-INCH DIAMETER IS MOST OFTEN USED.

-ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON-PERFORATED PIPE.

-FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

-MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

-DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUTFALL IS NOT AVAILABLE.



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*PERIMETER DRAIN DETAIL*

DRAWN:

DATE:

DESIGNED:

CHECKED:

DS

LLL

JOB NO.:

192125

FIG NO.:

8



## **APPENDIX A: Photographs**



**Looking north towards  
Lot 1 in the eastern  
portion of the site.**

January 30, 2020



**Looking north from the  
central portion of Lot  
2.**

January 30, 2020



**Looking south from  
the northern portion of  
Lot 4.**

January 30, 2020



**Looking south towards  
one of the stockpiles  
of cut trees.**

January 30, 2020



**Looking northeast  
towards stockpile of  
trees on Lot 3.**

January 30, 2020



**Looking north from the  
eastern portion of Lot  
3.**

January 30, 2020

## **APPENDIX B: Test Boring and Test Pit Logs**

TEST BORING NO. 1  
 DATE DRILLED 1/3/2020  
 Job # 192115

TEST BORING NO. 2  
 DATE DRILLED 1/3/2020  
 CLIENT LDC, INC.  
 LOCATION DIDLEAU SUBDIVISION

REMARKS

REMARKS

DRY TO 17.5', 1/6/20

SAND, SILTY, FINE TO COARSE  
 GRAINED, BROWN, VERY DENSE  
 TO DENSE, MOIST

SANDSTONE, SILTY, FINE TO  
 COARSE GRAINED, BROWN,  
 VERY DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			50	5.6	1
			42	10.8	1
10			50 10"	12.5	2
15			50 9"	11.7	2
20			50 7"	11.5	2

DRY TO 18.5', 1/6/20

SAND, VERY CLAYEY, FINE TO  
 MEDIUM GRAINED, BROWN,  
 LOOSE, MOIST

CLAYSTONE, VERY SANDY,  
 BROWN, HARD, MOIST

SANDSTONE, SILTY, FINE TO  
 COARSE GRAINED, BROWN,  
 VERY DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			7	23.1	1
			50 11"	12.7	1 3
10			50 6"	15.2	3
15			50 5"	6.9	2
20			50 6"	15.8	2



**ENTECH  
 ENGINEERING, INC.**

505 ELKTON DRIVE  
 COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN: DATE: CHECKED: *[Signature]* DATE: 1/17/20

JOB NO.  
 192115

FIG NO.  
 B-1

TEST PIT NO. 1  
 DATE EXCAVATED 4/23/2019  
 Job # 192115

TEST PIT NO. 2  
 DATE EXCAVATED 4/23/2019  
 CLIENT LDC, INC.  
 LOCATION DIDLEAU SUBDIVISION

REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type
topsoil sandy loam, brown	1			gr	m	2	topsoil sandy loam, brown	1			gr	m	2
gravelly sandy loam, fine to coarse grained, light brown	2			gr	m	2	gravelly sandy loam, fine to coarse grained, light brown	2			gr	m	2
weathered to formational silty sandstone, fine to coarse grained, tan	3			ma		3A	weathered to formational silty sandstone, fine to coarse grained, tan	3			ma		3A
	4							4					
	5							5					
	6							6					
	7							7					
	8							8					
	9							9					
	10							10					

Soil Structure Shape  
 granular - gr  
 platy - pl  
 blocky - bl  
 prismatic - pr  
 single grain - sg  
 massive - ma

Soil Structure Grade  
 weak - w  
 moderate - m  
 strong - s  
 loose - l



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505 ELKTON DRIVE  
 COLORADO SPRINGS, COLORADO 80907

TEST PIT LOG

DRAWN:

DATE:

CHECKED:  
 LLL

DATE:  
 2/25/20

JOB NO.:

192115

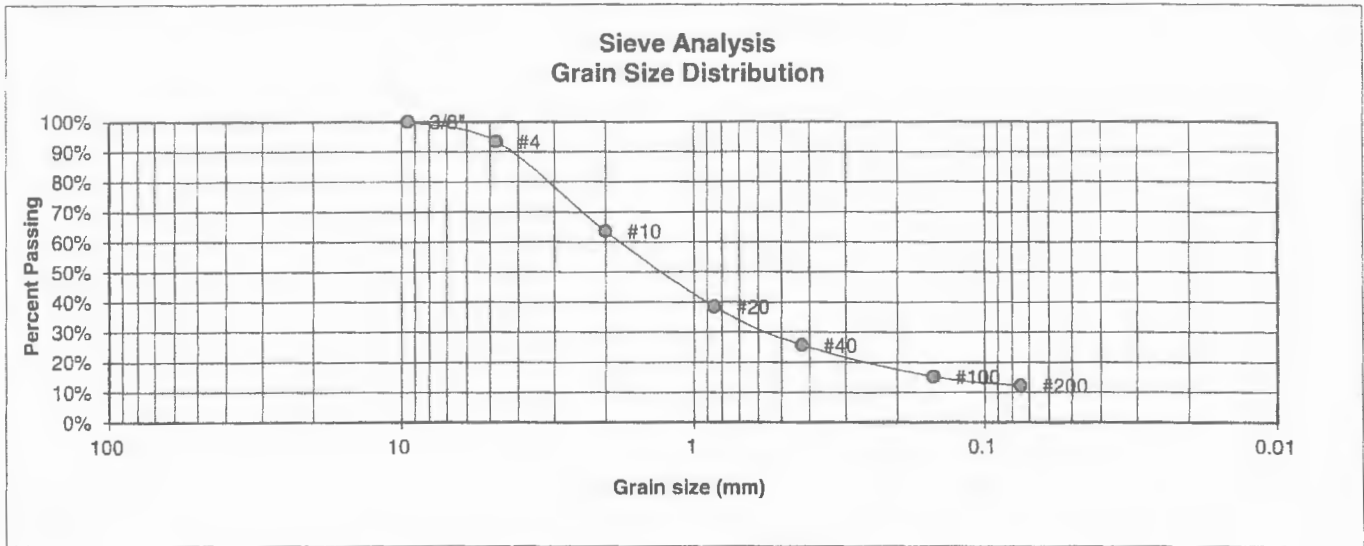
FIG NO.:

B-2

## **APPENDIX C: Laboratory Test Results**



<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	LDC, INC.
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	DIDLEAU SUBDIVISION
<u>TEST BORING #</u>	1	<u>JOB NO.</u>	192115
<u>DEPTH (FT)</u>	2-3	<u>TEST BY</u>	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	93.4%
10	63.6%
20	38.4%
40	25.6%
100	15.1%
200	12.2%

Atterberg Limits  
 Plastic Limit  
 Liquid Limit  
 Plastic Index

Swell  
 Moisture at start  
 Moisture at finish  
 Moisture increase  
 Initial dry density (pcf)  
 Swell (psf)



**ENTECH  
ENGINEERING, INC.**

505 ELKTON DRIVE  
COLORADO SPRINGS, COLORADO 80907

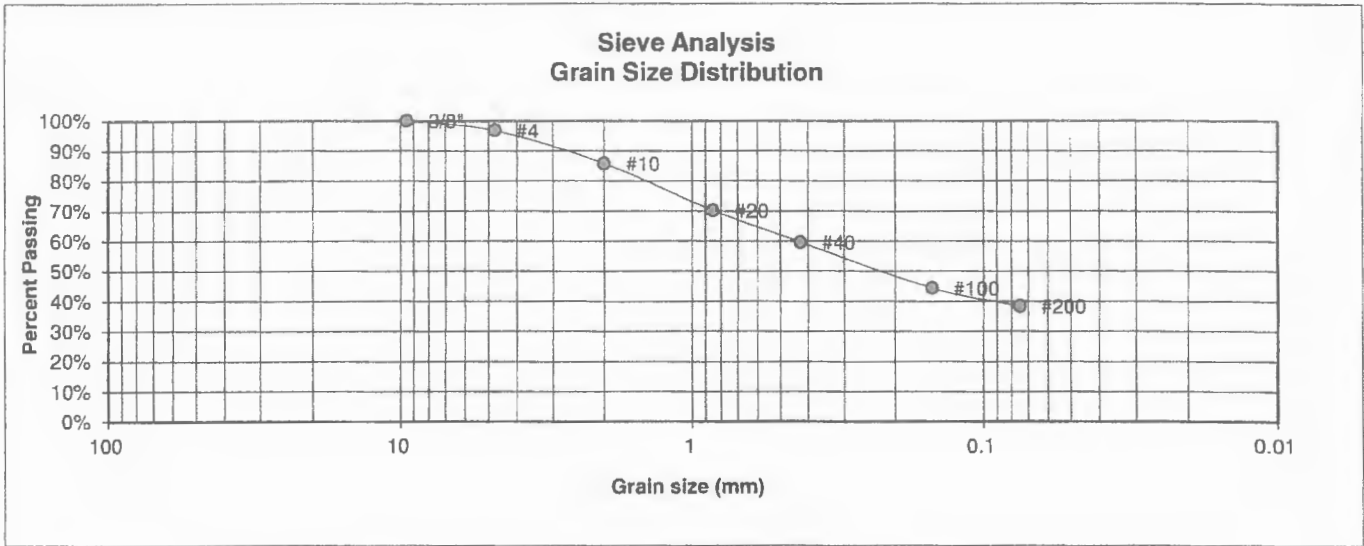
**LABORATORY TEST  
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		<i>h</i>	1/17/20

JOB NO.:  
192115

FIG NO.:  
6-1

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	LDC, INC.
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	DIDLEAU SUBDIVISION
<u>TEST BORING #</u>	2	<u>JOB NO.</u>	192115
<u>DEPTH (FT)</u>	2-3	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.8%
10	85.8%
20	70.2%
40	59.7%
100	44.3%
200	38.4%

Atterberg Limits  
 Plastic Limit  
 Liquid Limit  
 Plastic Index

Swell

Moisture at start	13.8%
Moisture at finish	25.6%
Moisture increase	11.8%
Initial dry density (pcf)	95
Swell (psf)	1640



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505 ELKTON DRIVE  
COLORADO SPRINGS, COLORADO 80907

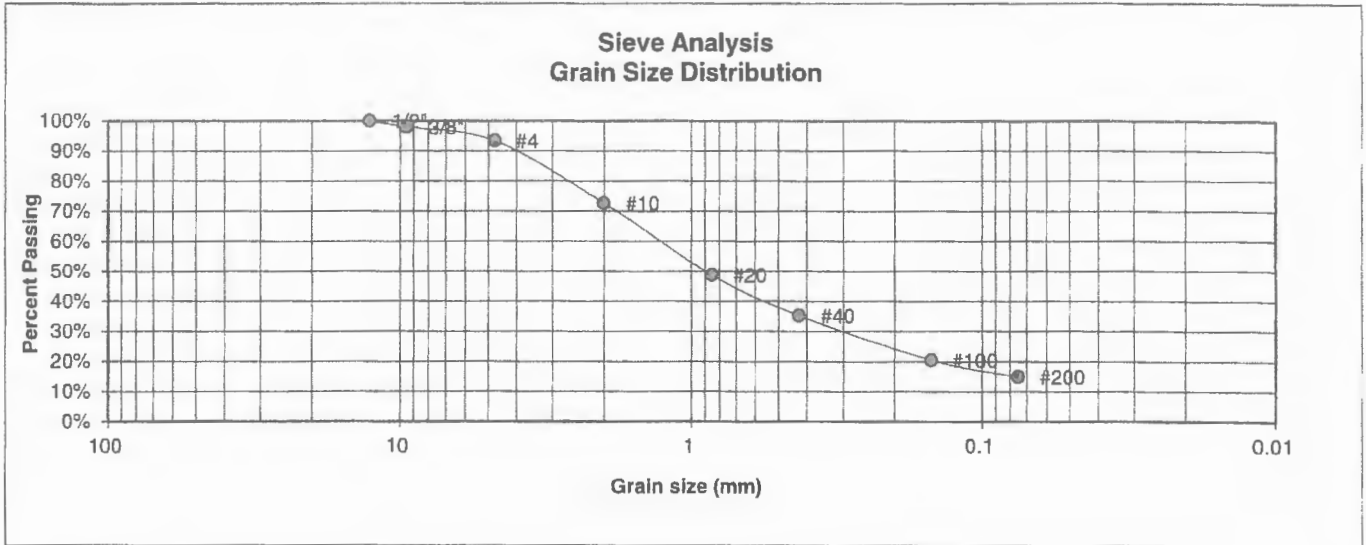
**LABORATORY TEST  
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u>	<u>DATE:</u>
		<i>BL</i>	1/17/20

JOB NO  
192115

FIG NO..  
L-2

UNIFIED CLASSIFICATION	SM	CLIENT	LDC, INC.
SOIL TYPE #	1	PROJECT	DIDLEAU SUBDIVISION
TEST BORING #	TP-2	JOB NO.	192115
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.9%
4	93.3%
10	72.7%
20	48.7%
40	35.2%
100	20.5%
200	14.9%

Atterberg  
Limits  
Plastic Limit  
Liquid Limit  
Plastic Index

Swell  
Moisture at start  
Moisture at finish  
Moisture increase  
Initial dry density (pcf)  
Swell (psf)



**ENTECH  
ENGINEERING, INC.**

505 ELKTON DRIVE  
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST  
RESULTS**

DRAWN

DATE:

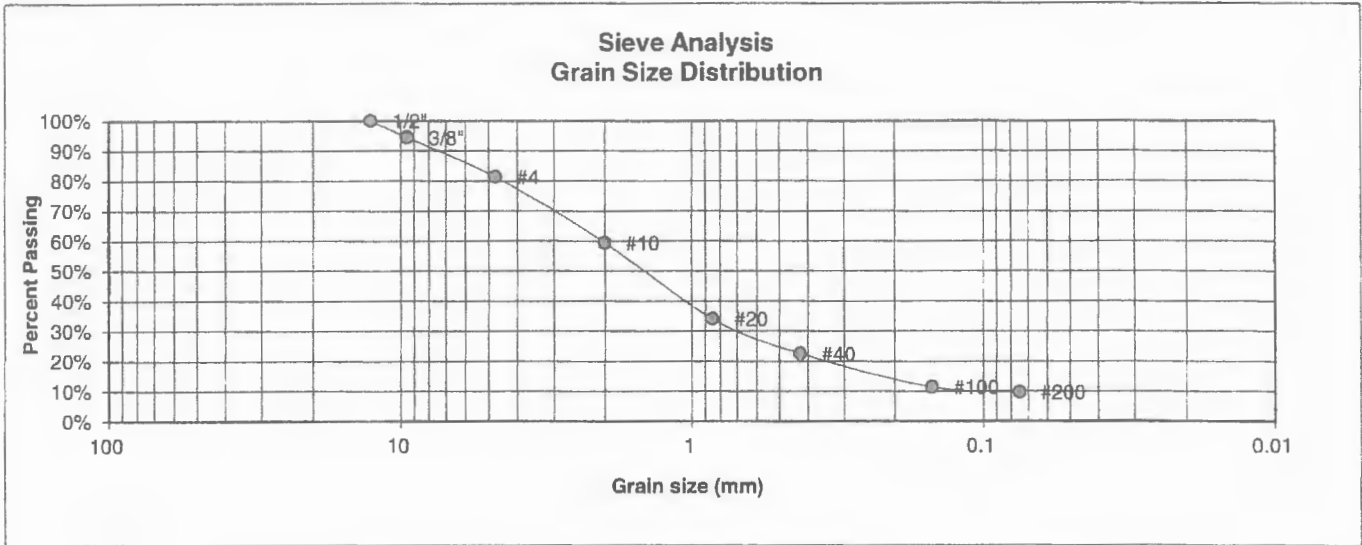
CHECKED:  
LLL

DATE:  
1/17/20

JOB NO.:  
192115

FIG NO.:  
C-3

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	LDC, INC.
<u>SOIL TYPE #</u>	2	<u>PROJECT</u>	DIDLEAU SUBDIVISION
<u>TEST BORING #</u>	TP-1	<u>JOB NO.</u>	192115
<u>DEPTH (FT)</u>	5-6	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	94.5%
4	81.3%
10	59.5%
20	34.1%
40	22.5%
100	11.4%
200	9.6%

Atterberg Limits  
 Plastic Limit  
 Liquid Limit  
 Plastic Index

Swell  
 Moisture at start  
 Moisture at finish  
 Moisture increase  
 Initial dry density (pcf)  
 Swell (psf)



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ENGINEERING, INC.**

505 ELKTON DRIVE  
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST  
RESULTS**

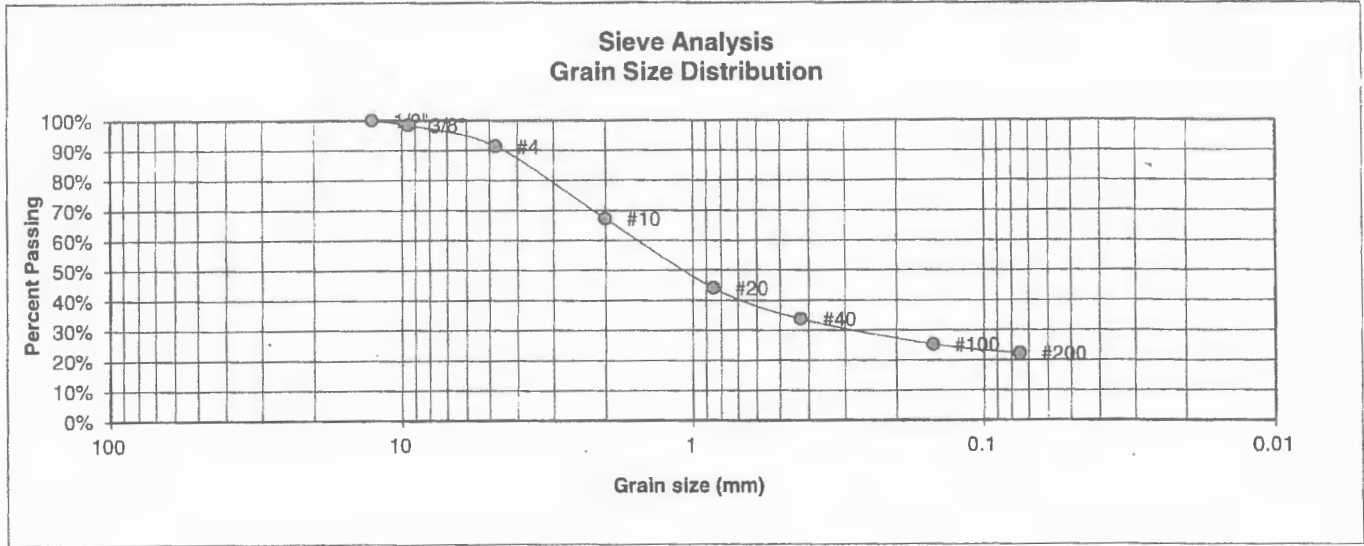
<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> LLL	<u>DATE:</u> V17/20
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JOB NO.:  
192115

FIG NO.:  
C-4

UNIFIED CLASSIFICATION SM  
SOIL TYPE # 2  
TEST BORING # 1  
DEPTH (FT) 15

CLIENT LDC, INC.  
PROJECT DIDLEAU SUBDIVISION  
JOB NO. 192115  
TEST BY BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.4%
4	91.4%
10	67.2%
20	44.1%
40	33.8%
100	25.2%
200	22.2%

Atterberg Limits  
 Plastic Limit  
 Liquid Limit  
 Plastic Index

Swell  
 Moisture at start  
 Moisture at finish  
 Moisture increase  
 Initial dry density (pcf)  
 Swell (psf)



**ENTECH**  
**ENGINEERING, INC.**

505 ELKTON DRIVE  
 COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST  
 RESULTS**

DRAWN:

DATE:

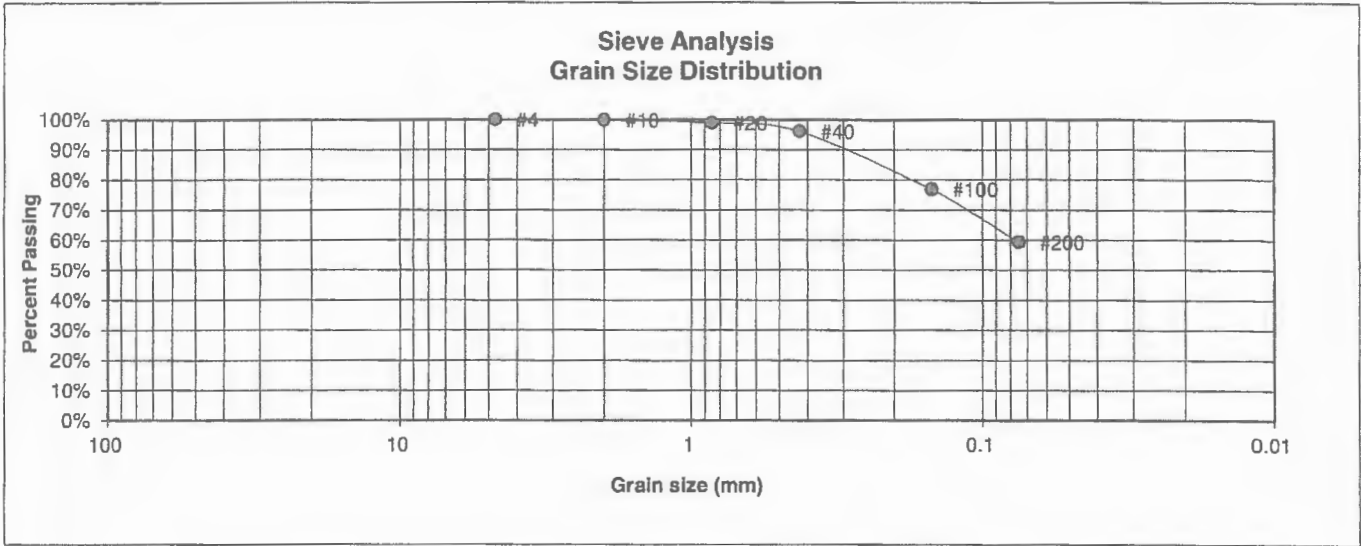
CHECKED: *h*

DATE: 1/17/20

JOB NO.:  
 192115

FIG NO.:  
 C-5

<u>UNIFIED CLASSIFICATION</u>	CL	<u>CLIENT</u>	LDC, INC.
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	DIDLEAU SUBDIVISION
<u>TEST BORING #</u>	2	<u>JOB NO.</u>	192115
<u>DEPTH (FT)</u>	10	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.8%
20	98.9%
40	96.1%
100	76.9%
200	59.3%

Atterberg Limits  
 Plastic Limit  
 Liquid Limit  
 Plastic Index

Swell

Moisture at start	16.1%
Moisture at finish	20.4%
Moisture increase	4.3%
Initial dry density (pcf)	104
Swell (psf)	730



**ENTECH  
ENGINEERING, INC.**

505 ELKTON DRIVE  
COLORADO SPRINGS, COLORADO 80907

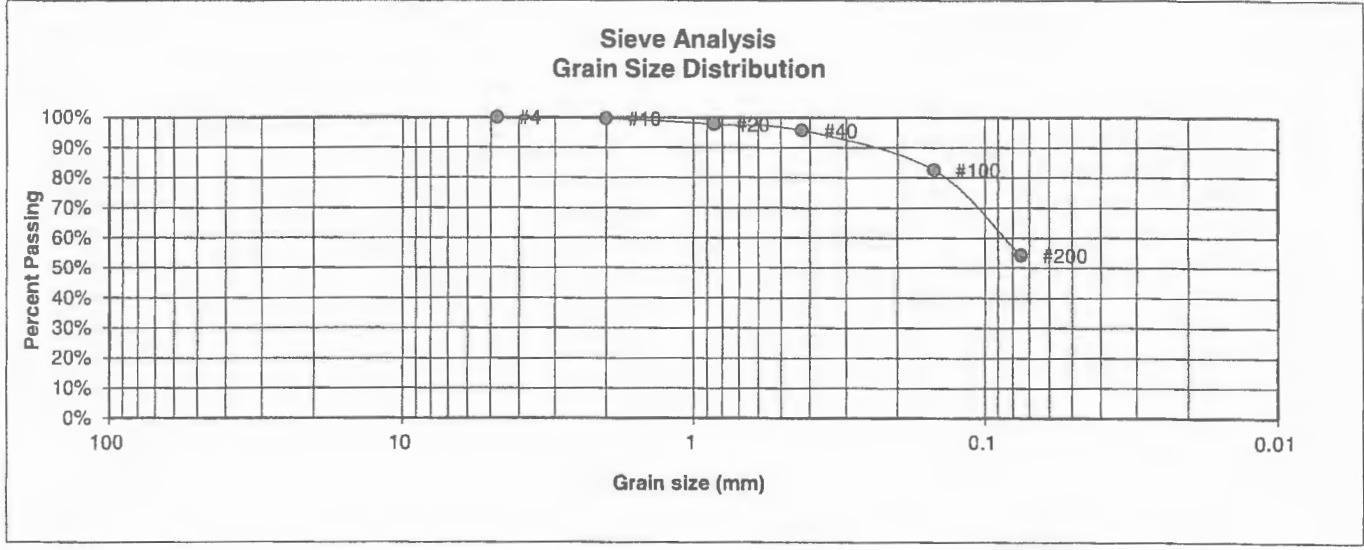
**LABORATORY TEST  
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u>	<u>DATE:</u>
			A 1/17/20

JOB NO.:  
192115

FIG NO.:  
C-6

UNIFIED CLASSIFICATION	CL	CLIENT	LDC, INC.
SOIL TYPE #	3	PROJECT	DIDLEAU SUBDIVISION
TEST BORING #	2	JOB NO.	192115
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.6%
20	97.7%
40	95.7%
100	82.6%
200	54.2%

Atterberg Limits  
 Plastic Limit  
 Liquid Limit  
 Plastic Index

Swell  
 Moisture at start  
 Moisture at finish  
 Moisture increase  
 Initial dry density (pcf)  
 Swell (psf)



**ENTECH  
ENGINEERING, INC.**  
 505 ELKTON DRIVE  
 COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST  
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		A	1/17/20

JOB NO.:  
192115  
  
 FIG NO.:  
C-7

## **APPENDIX D: Soil Survey Descriptions**



## El Paso County Area, Colorado

### 26—Elbeth sandy loam, 8 to 15 percent slopes

#### Map Unit Setting

*National map unit symbol:* 367y

*Elevation:* 7,300 to 7,600 feet

*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Elbeth and similar soils:* 85 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Elbeth

##### Setting

*Landform:* Hills

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Alluvium derived from arkose

##### Typical profile

*A - 0 to 3 inches:* sandy loam

*E - 3 to 23 inches:* loamy sand

*Bt - 23 to 68 inches:* sandy clay loam

*C - 68 to 74 inches:* sandy clay loam

##### Properties and qualities

*Slope:* 8 to 15 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):*

Moderately high (0.20 to 0.60 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Moderate (about 7.1 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* B

*Hydric soil rating:* No

#### Minor Components

##### Other soils

*Percent of map unit:*

*Hydric soil rating:* No

**Pleasant**

*Percent of map unit:*

*Landform:* Depressions

*Hydric soil rating:* Yes

**Data Source Information**

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 17, Sep 13, 2019

## El Paso County Area, Colorado

### 40—Kettle gravelly loamy sand, 3 to 8 percent slopes

#### Map Unit Setting

*National map unit symbol:* 368g  
*Elevation:* 7,000 to 7,700 feet  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

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

#### Description of Kettle

##### Setting

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

##### Typical profile

*E - 0 to 16 inches:* gravelly loamy sand  
*Bt - 16 to 40 inches:* gravelly sandy loam  
*C - 40 to 60 inches:* extremely gravelly loamy sand

##### Properties and qualities

*Slope:* 3 to 8 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  
(2.00 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Low (about 3.4 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* B  
*Hydric soil rating:* No

#### Minor Components

##### Pleasant

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

Map Unit Description: Kettle gravelly loamy sand, 3 to 6 percent slopes--El Paso County Area,  
Colorado

---

**Other soils**

*Percent of map unit:*

*Hydric soil rating:* No

**Data Source Information**

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 17, Sep 13, 2019

Exhibit 12:  
Discussion Summaries



**Black Forest Fire Rescue Protection District**  
11445 Teachout Road  
Colorado Springs, Colorado 80908  
Ph-719.495.4300  
Fax 719.495.7504  
Web- [www.bffire.org](http://www.bffire.org)

*"Always Ready, Always Forward, Always Learning."*

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## *Office of the Fire Marshal*

Thursday, August 27, 2020

Dear Ms. Didleau

Thank you for reaching out to me regarding your future road needs for the Forest Heights Estates sub-division. Per our current code Black Forest Fire Rescue is requiring the following Fire Access to your sub.

1. **403.3 Fire apparatus access road. (2006 WUI code)**When required, fire apparatus access roads shall be all-weather roads with a minimum width of 20 feet (6096 mm) and a clear height of 13 feet 6 inches (4115 mm); shall be designed to accommodate the loads (75,000lbs) and turning radii for fire apparatus; and have a gradient negotiable by the specific fire apparatus normally used at that location within the jurisdiction. Dead-end roads in excess of 150 feet (45 720 mm) in length shall be provided with turnarounds as approved by the code official. An all-weather road surface shall be any surface material acceptable to the code official that would normally allow the passage of emergency service vehicle.
2. Per 2015 IFC (amended), sec D103.4. Requirements for Dead-End Fire Apparatus Access Roads we are requiring a minimum of an 80-foot diameter cul-de-sac with curb and gutter or a 100-foot diameter cul-de-sac without curb and gutter.
3. As the road length is approximately 2200 ft to cul-de-sac, we will require a minimum of two turnouts along the main access roadway for emergency vehicle turnarounds. These turnouts should be spaced and located for maximum efficiency and shall be no less than 30 ft in length and 10 ft deep.

As you begin development of your project please be advised that your project, if 5 or more homes, will require a firefighting water supply source which is generally a water cistern located with the project and accessible to all fire apparatus or departments working in our district. This information is found in the NFPA sec 1142 (Standard on Water Supplies for suburban and Rural Fire Fighting) chapters 7 & 8. I will be happy to sit down and go over these requirements with you as you progress in your project.

Thank you,

A handwritten signature in black ink that reads "James Rebitski".

James Rebitski  
Deputy Fire Chief

*"Serving the citizens of Black Forest since 1945"*

Exhibit 13:

Photos



Figure 1: Upstream End of Culvert #1

Figure 2: Facing Downstream of Culvert #1



Figure 4: Facing NE from Wetland Area



Figure 3: Wetlands upstream of Culvert 1



Figure 5: Downstream End of Culvert 1





Figure 6: Facing downstream of Culvert 1



Figure 9: Facing west along southerly edge of road



Figure 7: 8250 Forest Heights Circle



Figure 10: Facing south along property line



Figure 8: Facing west along northerly edge of road



Figure 11: First Residence off of cul-de-sac



Figure 12: Facing NE to Swale 3



Figure 15: Facing SW of Prop Corner



Figure 13: Wetland Area along east fork of Swale 3



Figure 16: Facing north along gas line easement

2



Figure 14: Facing south along prop line



Figure 17: Wetland area in Swale 3



Figure 20: Facing SW along Swale 3



Figure 18: Facing SW at upper end of wetland area



Figure 21: Upstream end of Culvert 2



Figure 19: facing NE along w. branch of swale 3



Figure 22: Facing NE of Culvert 2



Figure 23: Facing SW along PL



Figure 26: Facing east along northerly edge



Figure 24: Downstream end of Culvert 2



Figure 27: 7960 Forest Heights Circle



Figure 25: west along southerly edge



2

Figure 28: Facing south along PL



Figure 29: Top of high point facing west



Figure 30: Facing NE along Swale 5

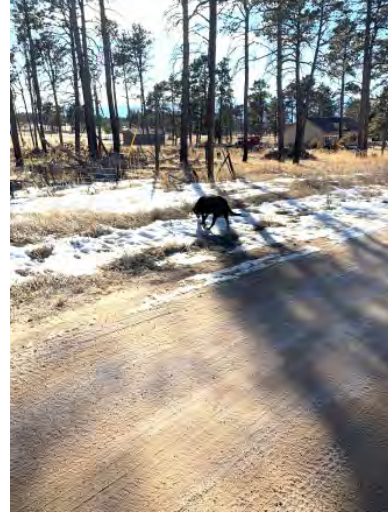


Figure 31: Facing SW along Swale 6



Figure 32: Water routed in northern borrow ditch



Figure 33: Facing west along north side

Figure 34: photo omitted



Figure 35: Facing west along S edge



Figure 36: 7940 Forest Heights Circle



Figure 37: Asphalt drive 7940 FHC



Figure 38: Facing west along northern edge



Figure 39: Facing west along southerly edge



Figure 40: wetland area east of culvert 3



Figure 43:Downstream end of Culvert 3



Figure 41: Upstream end Culvert 3



Figure 44: Facing downstream of Culvert 3



Figure 42:Facing north of Culvert 3



Figure 45: Herring Road Intersection



Figure 46: Facing east of intersection



Figure 49: Facing SW at Herring Rd Crossing



Figure 47: Facing south to culvert under Herring



Figure 50: Facing west from High pnt 1 east of Herring



Figure 48: 18" CMP under Drive





Figure 51: Facing east from first HP



Figure 52: Facing downstream of culvert 2



Figure 53: Facing west of 2nd HP



Figure 54: Facing west from 2nd HP



Figure 55: culvert under Herring



Figure 56: Culvert under Herring

Forest Heights Estates  
Final Drainage Report, July 2023

Exhibit 14:  
Maintenance Agreement

**ACCESS EASEMENT GRANT AND MAINTENANCE  
AGREEMENT  
FOR FOREST HEIGHTS CIRCLE  
AND  
RESTRICTIVE COVENANTS FOR  
LOTS 1, 2, 3 & 4  
FOREST HEIGHTS ESTATES SUBDIVISION**

This Access Easement Grant and Maintenance Agreement For Forest Heights Circle and Restrictive Covenants for Forest Heights Estates Subdivision, dated for reference this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, (Agreement) is made among Phyllis J Didleau Revocable Trust, Jon P. Didleaux, Leilani A Ritchie, Charles F. Bauer and Shirley L. Bauer, and Frederick J. Yonce (each individually an “Owner” and collectively the “Owners”).

**RECITALS:**

- A. Phyllis J Didleau Revocable Trust and Jon P Didleaux are the owner of the real property situated in the County of El Paso, State of Colorado described on Exhibit A (Assessor Parcel # 5209000121).
- B. Phyllis J Didleau Revocable Trust is the owner of the real property situated in El Paso County State of Colorado described on Exhibit A-1 (Assessor Parcel 5209000081)
- C. Phyllis J Didleau Revocable Trust and Jon Didleaux are the owners of real property situated in the County of El Paso, State of Colorado described on Exhibit B (Assessor Parcel # 5209000120).
- D. Phyllis J Didleau Revocable Trust and Jon P Didleaux are the owners of the real property situated in the County of El Paso, State of Colorado described on Exhibit C (Assessor Parcel # 5209000050).
- E. Leilani A Ritchie is the owner of the real estate situated in the County of El Paso, State of Colorado described on Exhibit D (Assessor Parcel # 5209000103).
- F. Charles, F. Bauer and Shirley L Bauer are the owners of the real property situated in the County of El Paso, State of Colorado described on Exhibit E (Assessor Parcel # 5209000100).

- G. Frederick J. Yonce is the owner of the real property situated in the County of El Paso, State of Colorado described on Exhibit F (Assessor Parcel # 5209000119).
- H. Judith P. Von Ahlefeldt is the owner of the real property situated in the County of El Paso, State of Colorado described on Exhibit G (Assessor Parcel # 5209000108).
- I. Phyllis J Didleau Revocable Trust, Jon P. Didleaux (a/k/a Jon Didleaux) and Frederick J. Yonce, (collectively referred to herein as "Grantors") wish to grant an access easement to the Owners across the property described in Exhibits A, A-1, B, and F and to establish and provide for the maintenance of a private right of way and road within the access easement for the use and benefit of all Owners and Judith P. Von Ahlefeldt.
- J. The access easement within which the private right of way and road is located is legally described in Exhibit H (the "Private Road Land").
- K. The Owners understand that El Paso County does not maintain private roads such as the one subject to this Agreement.
- L. The Owners wish to provide for and set forth their understandings and agreement with respect to use and maintenance of the private road and improvements thereon.
- M. Phyllis J Didleau Revocable Trust and Jon P. Didleaux have submitted an application to subdivide the property described in Exhibits A and B with El Paso County and desire to have this Agreement meet the requirements of El Paso County for County approval of such subdivision.
- N. This Agreement shall become fully in force, as to all Owners who have signed, upon the recording of the Final Plat of Forest Heights Estates Subdivision in the real estate records of El Paso County, Colorado.

**NOW THEREFORE**, in consideration of the sum of Ten Dollars (\$10.00) and other valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the following grants, agreement, covenants, declaration and restrictions are made:

#### **PRIVATE ROAD – FOREST HEIGHTS CIRCLE**

1. Grant of Easement. Each of the Grantors hereby grants to each Owner and to Judith P. Von Ahlefeldt and their successors and assigns, a nonexclusive easement for access, utilities and drainage for the benefit of each such landowner's respective parcel described above across the Private Road Land.
2. Use of the Owners' Real Estate. Use of the Private Road Land by the Owners is not confined to the present configuration of their respective properties, and the Owners or their successors may subdivide, reconfigure, construct improvements on or otherwise modify or use their property. However, the Owners agree to construct no fences or place any other obstructions on their respective properties in a manner which would prevent, or reasonably impede, vehicle or personnel travel, utility access or drainage across the Private Road Land. Otherwise, the respective Owners

each shall have full use and occupancy of their respective real estate which is subject to the easement set forth above.

3. Construction of the Private Road. After recording of the Final Plat submitted by Phyllis J Didleau Revocable Trust and Jon Didleaux, without cost to the other Owners, Phyllis J Didleau Revocable Trust and Jon Didleaux shall improve the road to meet the standards required by the County approval of the Final Plat and shall provide maintenance of the road until such improvements are substantially complete.
4. Maintenance of the Private Road. Following construction of the Private Road, as a general standard, the Owners agree that they shall provide maintenance sufficient to provide reasonable access for emergency vehicles and in no event less than has traditionally been the maintenance level of this access prior to the subdivision. The Owners may by majority vote adopt (and modify) specific standards for maintenance from time to time. The Owners of each residence shall collectively have one vote regardless of the number of Owners of that residence. The Owners agree to share the cost and expense of maintaining the improvements on the Private Road Land in good operating condition and to share equally the cost and expense of affecting any repair to said Improvements accruing from and after the date of this Agreement. For purposes of this cost sharing, each Owner shall pay a share for each residential dwelling unit on such Owner's real estate, including a dwelling unit under construction and a "mother-in-law" unit. For example, if there are seven parcels of real estate, and five residences (whether occupied or not), each Owner with a residence on such Owner's property shall pay one fifth (1/5<sup>th</sup>) of the cost of maintaining the improvements for each such residence on such Owner's property.
5. Maintenance Process. The Owners appoint Jon P. Didleaux and Frederick J. Yonce as Co-Administrators for maintenance of the road under this Agreement. Whenever in the opinion of the Administrators the road requires such maintenance, on behalf of the Owners, the Administrators shall order and arrange for sufficient maintenance meet the standard above and to enable the Owners and emergency vehicles to use the roadway. Such maintenance shall include snow removal, grading, re-gravelling, cleaning culverts, weed treatment, tree and debris removal, and any other maintenance generally desired by Owners. The Administrators shall annually no later than September 30 submit to the Owners a budget for the succeeding 12 months. If the budget is approved by the majority of the Owners, each Owner shall by December 1 pay such Owner's share of the amount set forth in the budget into a fund run by the Administrators. The budget shall include a reasonable amount to build up a reserve to prevent the need for large expenditures in any one year. The Administrators shall use the fund to pay for maintenance to meet the standards above and any which may be adopted by the Owners. To the extent any Owner fails to pay such Owner's proportionate share of the adopted budget, the Administrators, on behalf of all the Owners, shall have a lien on each such Owner's respective real estate as set forth above until such Owner's share is paid in full with interest accruing on any unpaid amount at the rate of 10% per annum simple interest and

the Administrators shall be entitled to recover the costs of enforcing such lien and collecting such amount, including reasonable legal fees, expert witness fees and costs. The Administrators may refuse to order such maintenance until there is, in the Administrators' opinion, sufficient commitment or actual payment to pay for such maintenance. Each Owner's share shall be the proportion that the number of dwelling units (including dwelling units under construction) on such Owner's real estate above bears to the total number of dwelling units on the real estate above of all Owners. Owners of the real estate with 60% of the dwelling units accessing by the road may change who are the Co-Administrators. Administrators shall serve without compensation unless otherwise determined by Owners of the real estate with 60% of the dwelling units on the real estate of All Owners.

## **RESTRICTIVE COVENANTS FOR LOTS 1, 2, 3 & 4 TO PRESERVE THE RURAL/RESIDENTIAL CHARACTER OF FOREST HEIGHTS ESTATES**

6. Property Uses. Lots 1, 2, 3 and 4 in Forest Heights Estates Subdivision shall be used exclusively for private residential purposes. No dwelling erected or maintained within the Subdivision shall be used or occupied for any purpose other than for a single-family dwelling. The construction of separate guest quarters and "mother-in-law" quarters may be allowed on a Lot on a case-by-case basis if approved by the appropriate zoning authority, subject to any conditions in such approvals.
7. Construction Type. All construction on Lots 1, 2, 3 and 4 of Forest Heights Estates Subdivision shall be new.
8. Substantial Completion. A Structure shall not be occupied in the course of original construction until substantially completed and approved for occupancy by the appropriate governmental authorities.
9. Dwelling Area Requirements. No dwelling Structure shall be constructed unless the ground floor area, or footprint area, of the main Structure, exclusive of open porches, basements and garages, is more than 1,500 square feet.
10. Enforcement. Each Owner of a Lot in Forest Heights Estates Subdivision shall have the right to enforce these Covenants To Preserve The Rural/Residential Character Of Forest Heights Estates and no other persons shall gain any legal or equitable rights to enforce these Restrictive Covenants.

## **BINDING AGREEMENT**

11. Agreement Runs With the Land. This Agreement shall be binding upon the undersigned Owners, and their respective successors, assigns, and personal representatives. This Agreement may not be revoked without the written unanimous consent of the affected Owners. This Agreement shall be recorded in the land records of the Office of the Clerk and Recorder of El Paso County, Colorado, and

shall be a covenant running with the lands of the Owners as those lands are described herein above, and shall be enforceable by the Owners' successors and assigns and personal representatives. Any persons or other entities who acquire title to the Owners' property hereinabove described, whether by purchase or otherwise, shall be subject to the provisions of this Agreement to the same extent as if such parties had been signatory to this Agreement. This Agreement may be executed in multiple counterparts, each of which shall constitute an original and all of which shall constitute one document.

12. Effectiveness. This Agreement shall be effective as to each signatory hereto, on the later of the (a) date on which they sign or the (b) date this Agreement is recorded in the real estate records of El Paso County after County approval of the Final Plat of Forest Heights Estates.

**OWNERS:**

Phyllis J Didleau Revocable Trust

By: \_\_\_\_\_  
Phyllis Didleau, Trustee

STATE OF COLORADO )  
 ) ss.  
COUNTY OF EL PASO )

This instrument was acknowledged before me on \_\_\_\_\_, by Phyllis Didleau as Trustee of the Phyllis J Didleau Revocable Trust and by Jon P. Didleaux (a/k/a Jon Didleaux).

[Seal] \_\_\_\_\_  
\_\_\_\_\_, Notary Public  
My commission expires: \_\_\_\_\_

By: \_\_\_\_\_  
Jon P. Didleaux (a/k/a Jon Didleaux)

STATE OF COLORADO )  
 ) ss.  
COUNTY OF EL PASO )

This instrument was acknowledged before me on \_\_\_\_\_, by Jon P. Didleaux (a/k/a Jon Didleaux).

[Seal] \_\_\_\_\_  
\_\_\_\_\_, Notary Public  
My commission expires: \_\_\_\_\_

\_\_\_\_\_  
Leilani A Ritchie

STATE OF COLORADO )  
 ) ss.  
COUNTY OF EL PASO )

This instrument was acknowledged before me on \_\_\_\_\_, by Leilani A Ritchie.

[Seal]

\_\_\_\_\_  
\_\_\_\_\_, Notary Public  
My commission expires: \_\_\_\_\_

\_\_\_\_\_  
Charles, F. Bauer

\_\_\_\_\_  
Shirley L Bauer

STATE OF COLORADO )  
 ) ss.  
COUNTY OF EL PASO )

This instrument was acknowledged before me on \_\_\_\_\_, by Charles, F. Bauer and Shirley L Bauer.

[Seal]

\_\_\_\_\_  
\_\_\_\_\_, Notary Public  
My commission expires: \_\_\_\_\_

\_\_\_\_\_  
Frederick J. Yonce

STATE OF COLORADO )  
 ) ss.  
COUNTY OF EL PASO )

This instrument was acknowledged before me on \_\_\_\_\_, by Frederick J. Yonce.

[Seal]

\_\_\_\_\_  
\_\_\_\_\_, Notary Public  
My commission expires: \_\_\_\_\_



**EXHIBIT A (Assessor Parcel# 5209000121)**

**Tract in Northwest quarter of the Southwest quarter of Section 9, Township 12 South, Range 65 West, County of El Paso, State of Colorado, described as follows:  
Commencing at the Northwest corner of said Northwest quarter of the Southwest quarter;  
Thence Southerly on Westerly line 430.0 feet, angling left  $90^{\circ} 13'$  Easterly 30.0 feet for point of beginning;  
Thence continuing Easterly on same course 435.0 feet, angling right Southerly 60.0 feet, angling right 434.0 feet;  
Thence angling right Northerly 60.0 feet to point of beginning.**

**A TRACT OF LAND IN THE NORTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 9, TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6<sup>TH</sup> P.M., SITUATE IN EL PASO COUNTY, COLORADO, AND DESCRIBED AS FOLLOWS:**

**COMMENCING AT THE WEST QUARTER CORNER OF SAID SECTION 9; THENCE NORTH 89 DEGREES 47 MINUTES EAST ON THE EAST-WEST CENTERLINE THEREOF FOR 1926.45 FEET TO THE POINT OF BEGINNING OF THE TRACT DESCRIBED HEREBY; THENCE (1) CONTINUE NORTH 89 DEGREES 47 MINUTES EAST ON SAID EAST-WEST CENTERLINE FOR 506.16 FEET TO THE NORTHWEST CORNER OF THAT TRACT DESCRIBED IN DEED RECORDED IN BOOK 1500 AT PAGE 633 OF THE RECORDS OF SAID COUNTY; (2) SOUTH 0 DEGREES 06 MINUTES 04 SECONDS WEST ON THE WEST LINE THEREOF FOR 430.0 FEET; (3) SOUTH 89 DEGREES 47 MINUTES WEST PARALLEL WITH SAID EAST-WEST CENTERLINE FOR 505.40 FEET; (4) NORTH PARALLEL WITH THE WEST LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 9 FOR 430.0 FEET TO THE POINT OF BEGINNING; TOGETHER WITH A NON-EXCLUSIVE RIGHT OF WAY FOR EGRESS AND INGRESS OVER A TRACT OF LAND 33 FEET WIDE, THE CENTER LINE OF WHICH IS DESCRIBED AS FOLLOWS: BEGINNING AT A POINT LOCATED  $446 \frac{1}{2}$  FEET SOUTH OF THE NORTH LINE OF SAID SOUTHWEST QUARTER OF SECTION 9 ON THE WEST SIDE OF SAID SECTION; THENCE EAST PARALLEL WITH THE NORTH LINE OF SAID SOUTHWEST QUARTER OF SECTION 9 TO THE EAST LINE OF THE LAND DESCRIBED IN DEED RECORDED IN BOOK 1500 AT PAGE 633, COUNTY OF EL PASO, STATE OF COLORADO.**

**EXHIBIT B (Assessor Parcel# 5209000120)**

**Tract of land in Section 9, Township 12 South, Range 65 West, County of El Paso, State of Colorado, described as follows: Commencing at the West corner of East/West center line of subdivision Section 9;**

**Thence Easterly 1419.94 feet for point of beginning;**

**Thence continuing on same Easterly course 540.0 feet m/l to tract described at Book 2318, Page 387, Southerly along the West boundary of subdivision tract 430.0 feet, Easterly along South line of same tract 505.40 feet;**

**Thence Southerly 60.0 feet m/l to tract described in Book 721, Page 970;**

**Thence Westerly along North line 460.74 feet, Southerly along West line of same subdivision tract 829.87 feet, Westerly at R/A 1969.86 feet to a point on the East line of Herring Road;**

**Thence Northerly along that East line 320.0 feet to the South line of tract described in Book 2371, Page 388;**

**Thence Easterly on subdivision South line 434.0 feet, Northerly on East line of same subdivision tract 230.0 feet to Southwest corner of tract described in Book 1951, Page 432, Easterly on South line of said tract 381.0 feet, Northerly on East line of same tract 286.0 feet, Easterly at R/A 67.43 feet, Northerly at r/a 60 feet to Southeast corner of tract described in Book 2215, Page 559, Easterly at r/a 506.51 feet m/l;**

**Thence Northerly 430.0 feet to point of beginning, except tract described in Book 2645, Page 207.**

**EXHIBIT C (Assessor Parcel# 5209000050)**

**THAT PORTION OF THE NORTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 9  
TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH P M , DESCRIBED AS FOLLOWS:**

**FROM THE NORTHWEST CORNER OF THE NORTHWEST QUARTER OF THE SOUTHWEST QUARTER OF  
SAID SECTION 9, RUN SOUTH ON THE WEST LINE THEREOF, 490.0 FEET; THENCE EAST  
PARALLEL TO THE NORTH LINE OF SAID NORTHWEST QUARTER OF THE SOUTHWEST QUARTER,  
A DISTANCE OF 464 FEET TO THE POINT OF BEGINNING OF THE TRACT TO BE DESCRIBED  
HEREBY; THENCE CONTINUE ON SAID PARALLEL LINE EAST, A DISTANCE OF 381.0 FEET,  
THENCE SOUTH PARALLEL TO THE WEST LINE OF SAID NORTHWEST QUARTER OF THE  
SOUTHWEST QUARTER, A DISTANCE OF 286.0 FEET; THENCE WEST PARALLEL WITH THE  
FIRST COURSE, A DISTANCE OF 381 0 FEET; THENCE NORTH PARALLEL WITH THE SECOND  
COURSE, 286.0 FEET TO THE POINT OP BEGINNING, COUNTY OF EL PASO, STATE OP  
COLORADO**

**EXHIBIT D** (Assessor Parcel# 5209000103)

A tract of land in the North half of the Southwest quarter of Section 9, Township 12 South, Range 65 West of the 6th P.M. described as follows: Commencing at the West quarter corner of said Section 9, thence North 89 degrees 47 minutes East on the East-West center line thereof for 913.43 feet to the Point of Beginning of the tract hereby described; thence (1) continuing North 89 degrees 47 minutes East for 506.51 feet along said line; (2) South for 430.0 feet; (3) South 89 degrees 47 minutes West for 506.51 feet; (4) North for 430.0 feet to the Point of Beginning, in El Paso County, Colorado. Together with a tract of land in the North half of the Southwest quarter of Section 9, Township 12 South, Range 65 West of the 6th P.M. El Paso County, Colorado, described as follows: A non-exclusive easement for ingress and egress being 60 feet in width, 30 feet on each side of the following described center line; beginning at a point on the West line of said Section 9 that lies 460 feet south from the West quarter corner of said Section 9; thence North 89 degrees 47 minutes East, parallel with the North line of said Southwest quarter a distance of 1,419.94 feet, County of El Paso, State of Colorado.

**EXHIBIT E (Assessor Parcel# 5209000100)**

A tract of Land in the North half of the Southwest Quarter of Section 9, Township 12 South, Range 65 West of the 6th P.M., County of El Paso, State of Colorado, described as follows:

Commencing at the West quarter corner of said Section 9; thence Southerly on the West line thereof for 490 feet; thence angle left 90 degrees 13 minutes Easterly parallel with the North line of said Southwest quarter of Section 9 for 1090 feet to the point of beginning of the tract to be described hereby; thence (1) continue Easterly 610 feet; (2) angle right 90 degrees 13 minutes Southerly parallel to said West line for 325 feet; (3) angle right 89 degrees 47 minutes Westerly parallel to said North line for 610 feet; (4) angle right 90 degrees 13 minutes Northerly parallel to said West line for 325 feet to the point of beginning; TOGETHER with a right of way for ingress and egress over a strip of land 60 feet in width, being 30 feet on each side of the following described center line; beginning at a point on the West line of Section 9, Township 12 South, Range aforesaid that is 460 feet Southerly from the West quarter corner of said Section 9; thence angle left 90 degrees 13 minutes Easterly parallel with the aforesaid North line for 1700 feet.

**EXHIBIT F (Assessor Parcel# 5209000119)**

**That portion of the Northwest quarter of the Southwest quarter of Section 9 in Township 12 South, Range 65 West of the 6<sup>th</sup> P.M., described as follows: Commencing at the Northwest corner of said Northwest quarter of the Southwest quarter of Section 9; thence Southerly on the Westerly line thereof a distance of 430 feet; thence angle left 90 degrees 13 minutes on a line parallel with the North line of said Northwest quarter of the Southwest quarter a distance of 465 feet to the Southeast corner of a tract described in Book 1501 at page 299 under Reception No. 962187 of the records of El Paso County, Colorado and the point of beginning of the tract to be described hereby; thence Northerly on the Easterly line of said tract described in Book 1501 at page 299 a distance of 430 feet to the North line of said Northwest quarter of the Southwest quarter of Section 9; thence Easterly on said Northerly line a distance of 448.43 feet to a point; thence angle right 90 degrees 13 minutes Southerly a distance of 430 feet; thence angle right 89 degrees 47 minutes Westerly a distance of 448.43 feet to the point of beginning.**

**Together with a non-exclusive right of way for ingress and egress over a tract of land 60 feet wide, being 30 feet on either side of a centerline which is described as follows: Beginning at a point on the West line of the Southwest corner of section 9 in Township 12 South, Range 65 West of the 6<sup>th</sup> P.M., that is 460 feet Southerly thereon from the Northwest corner of said Southwest quarter; thence Easterly parallel with the North line of said Southwest quarter a distance of 913.43 feet.**

**EXHIBIT G** (Assessor Parcel# 5209000108)

A tract of land located in the NE1/4 of the SW1/4 of Section 9, Township 12 South, Range 65 West more particularly described as follows:

Commencing at the W1/4 of said Section 9, thence south along the west section line of said Section 9 a distance of 490.00 feet; thence N 89°47'00" E parallel with the east-west center line of said Section 9, a distance of 1971.00 feet to the **Point of Beginning**:

Thence continuing N 89°47'00" E a distance of 460.74 feet;

Thence N 00°06'04" E a distance of 490.00 feet to the intersection of said east-west center line;

Thence continuing N 89°47'00" E along said east-west center line a distance of 190.00 feet;

Thence S 00°06'04" W a distance of 1320.00 feet;

Thence S 89°45'20" W a distance of 649.27 feet;

Thence northerly a distance of 829.87 feet to the **Point of Beginning**.



**EXHIBIT H** (Private Road Land)

A tract of located in the SW1/4 of Section 9, Township 12 South, Range 65 West of the 6<sup>th</sup> P.M. being over and across a portion of the properties described in Exhibits A, A-1, B and F, to be known as Forest Heights Circle and shown as 15' additional R.O.W. Dedication to El Paso County, Tract A, 60' Private Road Easement, Tract B and Ingress-Egress, Utilities & Drainage Easement on the plat of Forest Heights Estates, more particularly described as follows:

Commencing at the NW corner of said SW1/4; Thence S 00°03'25" W a distance of 430.00 feet along the west line of said SW1/4; Thence N 89°55'03" E a distance of 30.00 feet to the **Point of Beginning**:

Thence N 89°55'03" E a distance of 2199.70 feet;

Thence N 53°43'21" E a distance of 110.07 feet;

Thence N 89°55'03" E a distance of 115.00 feet;

Thence S 00°09'20" W a distance of 125.00 feet;

Thence S 89°55'03" W a distance of 2403.55 feet;

Thence N 00°03'25" E a distance of 60.00 feet to the **Point of Beginning**.

Exhibit 15  
Drainage Map

**EXISTING DESIGN POINT SUMMARY**

DESIGN POINT	CONTRIB SUB BASINS	AREA (acres)	Q5 (cfs)	Q100 (cfs)
1	A	17.4	3.4	23.6
2	B	20.8	4.4	29.1
3	C,D,E	13.7	4.7	27.1
4	C,D,E,I	19.4	7.1	40.8
5	B,C,D,E,H,I	63.5	16.8	104.2
6	A,F,G	46.0	8.9	62.1
7	J	3.4	1.0	7.1

**SWALE SUMMARY**

SWALE #	CONTRIBUTING SUBBASINS	SLOPE %	DESIGN FLOW		DEPTH OF FLOW		VELOCITY		FROUDE #	
			Q5 cfs	Q100 cfs	Q5 ft	Q100 ft	V5 fps	V100 fps	5 year	100 year
1	A	4.5	3.7	24.0	0.1	0.2	1.2	2.7	0.91	1.16
2	A,G	3.1	5.7	36.1	0.1	0.3	1.5	2.9	0.84	1.02
3	B	4.6	4.6	29.5	0.1	0.3	1.8	3.7	1.04	1.26
4	B,C,H	3.3	10.2	64.2	0.1	0.2	1.4	2.9	0.87	1.06
5	C	5.5	1.8	8.4	0.1	0.1	1.3	2.4	1.00	1.20
6	D	6.0	4.1	20.3	0.1	0.2	1.9	3.5	1.18	1.37
8	C,D,E,I	3.3	8.7	43.8	0.1	0.3	1.8	3.1	0.91	1.06
10	F	5.3	3.1	21.1	0.1	0.3	1.7	3.4	1.09	1.30
11	J	3.1	1.0	7.1	0.0	0.1	0.6	1.4	0.70	0.86
12	A,G,F	6.1	9.8	63.3	0.1	0.3	2.2	4.9	1.20	1.70
13 RD DITCH	PORTION OF SUBBASIN B	6.7	0.1	0.6	0.1	0.2	1.5	2.1	1.01	1.19
14 RD DITCH	PORTION OF SUBBASIN B	1.0	0.1	0.1	0.1	0.2	0.8	0.8	0.44	0.44
15 RD DITCH	PORTION OF SUBBASIN C	4.5	2.2	10.7	0.5	0.8	3.1	4.7	1.15	1.28
16 RD DITCH	PORTION OF SUBBASIN D	2.0	3.2	15.7	0.6	1.1	2.5	3.8	0.82	0.92

**EXIST & PROP BASIN SUMMARY**

BASIN I.D.	AREA (acres)	RUNOFF COEFFICIENTS (existing)		RUNOFF COEFFICIENTS (developed)		EXISTING RUNOFF		DEVELOPED RUNOFF	
		C5	C100	C5	C100	Q5 cfs	Q100 cfs	Q5 cfs	Q100 cfs
A	17.4	0.09	0.35	0.09	0.36	3.4	23.6	3.7	24
B	20.8	0.09	0.36	0.10	0.36	4.4	29.1	4.6	29.5
C	3.9	0.11	0.37	0.14	0.39	1.4	7.9	1.8	8.4
D	7.5	0.1	0.36	0.12	0.38	2.3	14.3	2.7	14.8
E	2.3	0.12	0.38	0.18	0.42	1	4.9	1.4	5.5
F	18.7	0.08	0.35	0.09	0.35	2	20.7	3.1	21.1
G	9.9	0.09	0.36	0.10	0.37	2.7	17.8	3	18.2
H	23.3	0.09	0.36	0.10	0.36	5.3	34.3	5.6	34.7
I	5.7	0.11	0.37	0.13	0.38	2.4	13.7	2.8	14.3
J	3.4	0.08	0.35	0.08	0.35	1	7.1	1	7.1

**EXISTING CULVERT SUMMARY**

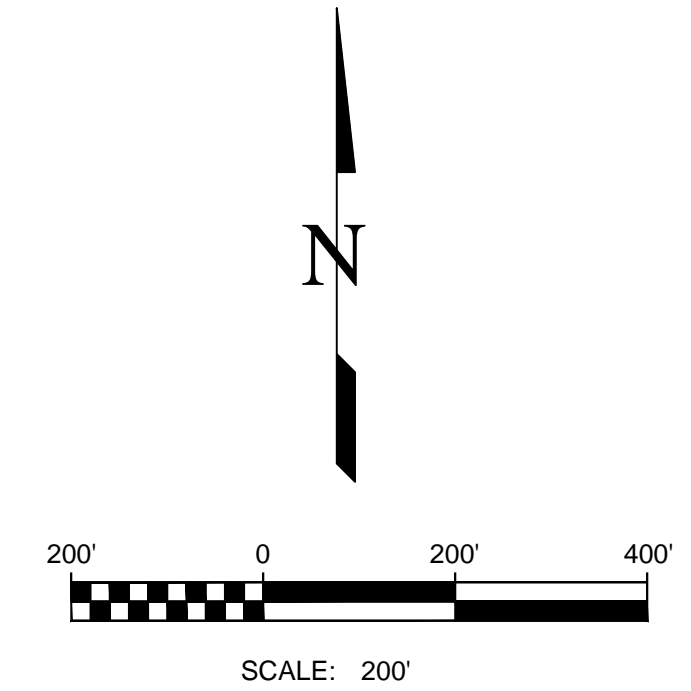
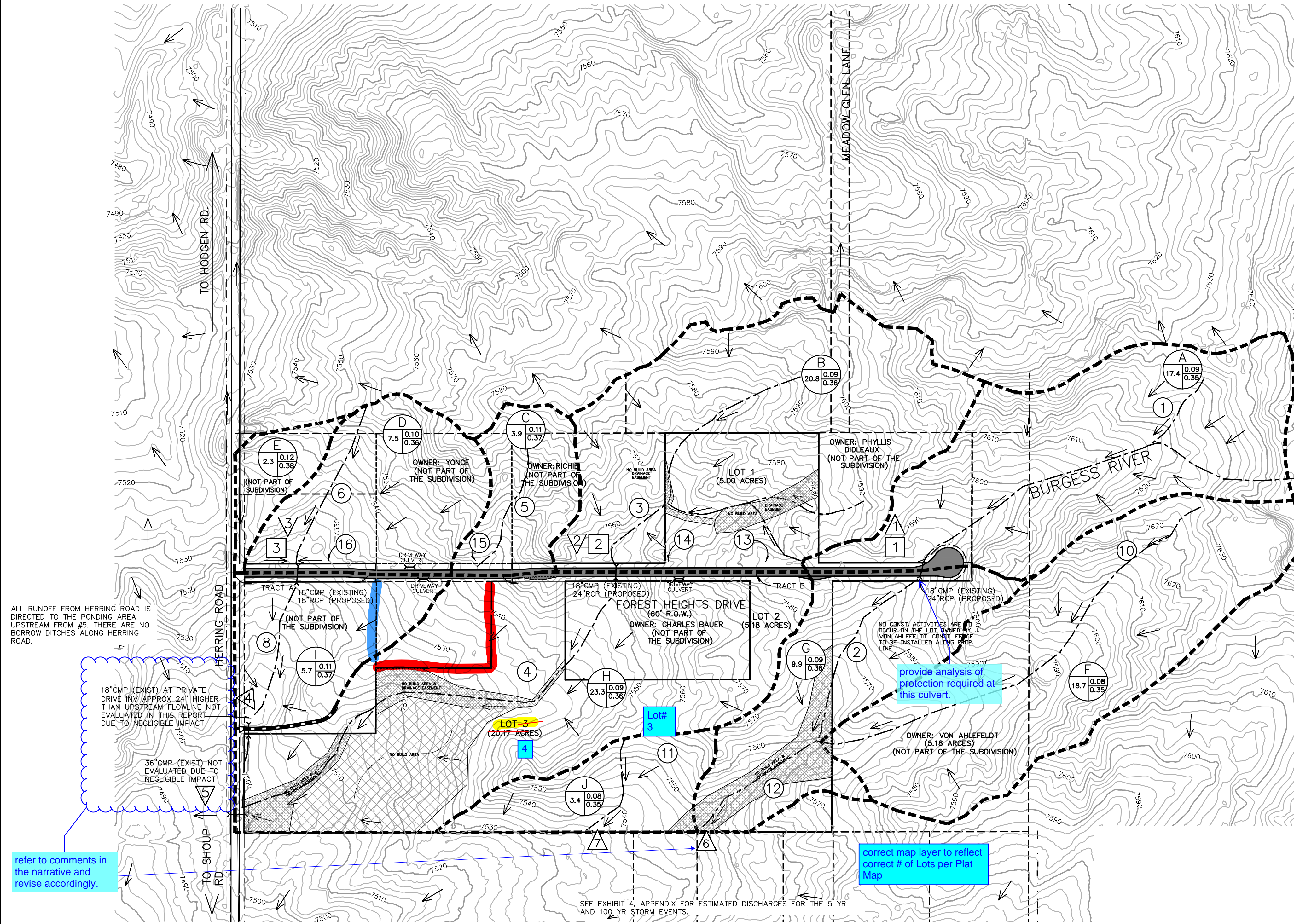
CULVERT #	SIZE	MATERIAL	CONTRIBUTING SUBBASINS	5 YEAR		100 YEAR		CONDITION
				Q5 (cfs)	HEADWATER REQUIRED (ft)	Q100 (cfs)	HEADWATER REQUIRED (ft)	
1	18"	CMP	A	3.7	12.8"	24.0	> 7.5 FT	75% SILTED, ROADWAY OVERTOPPING WITH 100 YR
2	18"	CMP	B	4.6	15.3"	29.5	> 9 FT	75% SILTED, ROADWAY OVERTOPPING WITH 100 YR
3	18"	CMP	C, D, E	5.9	16.7"	28.7	> 9 FT	75% SILTED, ROADWAY OVERTOPPING WITH 100 YR

**PROPOSED CULVERT SUMMARY**

CULVERT #	SIZE	MATERIAL	CONTRIBUTING SUBBASINS	5 YEAR			100 YEAR		
				Q5	QPIPE	QOVERFLOW	Q100	QPIPE	QOVERFLOW
1	24"	RCP	A	3.7	3.7	N/A	24.0	24.0	0.0
2	24"	RCP	B	4.6	4.6	N/A	29.5	29.5	0.0
3	18"	RCP	C, D, E	5.9	5.9	N/A	28.7	13.0	15.7

**PROPOSED DESIGN POINT SUMMARY**

DESIGN POINT	CONTRIB SUB BASINS	AREA (acres)	Q5 (cfs)	Q100 (cfs)
1	A	17.4	3.7	24.0
2	B	20.8	4.6	29.5
3	C,D,E	13.7	5.9	28.7
4	C,D,E,I	19.4	8.7	43.0
5	B,C,D,E,H,I	63.5	18.9	107.2
6	A,F,G	46.0	9.8	63.3
7	J	3.4	1.0	7.1



**LEGEND:**

- ← - DIRECTION OF FLOW
- - - - - PROJECT BOUNDARY
- - - - - FLOWLINE NATURAL SWALE
- - - - - SUBBASIN BOUNDARY
- ⊙ - DESIGN POINT
- ⊗ - SWALE NUMBER
- ⊗ - SUBDIVISION I.D.
- ⊗ - 5 YR. RUNOFF COEFFICIENT
- ⊗ - 100 YR. RUNOFF COEFFICIENT
- ⊗ - AREA (ARCES)
- ⊗ - CULVERT
- ⊗ - CULVERT NUMBER
- - - - - INDEX CONTOURS
- - - - - INTERMEDIATE CONTOURS
- - - - - EXISTING RESIDENCE (APPROX.)
- - - - - PROPOSED RESIDENCE
- - - - - NO BUILD AREA
- - - - - DRAINAGE EASEMENT
- - - - - EXISTING LOT LINES
- - - - - PROPOSED LOT LINE
- - - - - SUBDIVISION BOUNDARY
- - - - - EXISTING ROAD (GRAVEL)
- - - - - EXISTING ROAD (ASPHALT)
- - - - - PROPOSED ROAD (GRAVEL)
- - - - - ROADSIDE DITCHES

**NOTES:**

1. NO NEW CONSTRUCTION; BUILDINGS, BARNES, FENCES, DRIVEWAYS, AND/OR LANDSCAPING, SHALL BE INSTALLED IN ANY EXISTING DRAINAGEWAY AND/OR SWALE SO AS TO IMPEDE THE FLOW OF STORM WATER RUNOFF.
2. PROPOSED TOPOGRAPHIC DATA IS NOT SHOWN DUE TO MINIMAL CHANGES TO EXISTING GRADE. NO OVERLOT GRADING IS PROPOSED.
3. RUNOFF COEFFICIENTS FOR BOTH THE 5 YR & 100 YR CONDITIONS ARE INDICATED IN THE ABOVE BASIN SUMMARY TABLES.
4. SEE THE "GRADING & EROSION CONTROL PLAN" FOR RECOMMENDED CONTROL MEASURES.
5. ALL DRIVEWAY CULVERTS ARE TO BE REMOVED AND REPLACED AS DEEMED NECESSARY DURING CONSTRUCTION. EXISTING DRIVEWAY CULVERTS ARE SHOWN AT APPROPRIATE LOCATIONS. FINAL LOCATION WILL BE DETERMINED DURING CONSTRUCTION.
6. ONLY ONE DRAINAGE MAP HAS BEEN INCLUDED IN THIS REPORT SINCE ANY AND ALL IMPROVEMENTS DO NOT NEGATIVELY IMPACT THE FLOW RATE, FLOW REGIME, FLOW VELOCITY, EROSION CONDITIONS, ETC.
7. ALL PROPOSED DRIVEWAY CULVERTS ARE TO INCLUDE 18" CMP FLARED END SECTIONS.

**NOT FOR CONSTRUCTION!**  
 THESE PLANS ARE INTENDED FOR SUBMITTAL, REVIEW AND PLANNING PURPOSES ONLY AND SHOULD NOT BE USED ON SITE FOR CONSTRUCTION OR LAYOUT.  
**CALL BEFORE YOU DIG ...**  
 811  
**DIAL 811**  
 48 HOURS BEFORE YOU DIG. CALL UTILITY LOCATORS FOR LOCATING AND MARKING GAS, ELECTRIC, WATER AND WASTEWATER.

**REVISIONS**

No.	Description	Date
1	REV PER COUNTY COMMENTS	10/15/21
2	LOT REVISIONS	02/16/22
3	ROAD REVISIONS	04/12/22
4	MAP REVISIONS	10/2/23

H Scale: 1" = 200'  
 V Scale:  
 Designed By: KH  
 Drawn By: TLC  
 Checked By: KH  
 Date: 07/16/22



**DRAINAGE MAP**  
**DIDLEAU SUBDIVISION**  
 FOREST HEIGHT ESTATES

Project Number: 18070  
 Sheet: 1 of 1