

SPRINGS AT WATERVIEW  
DRAINAGE LETTER  
EL PASO COUNTY, COLORADO

February 2020

PREPARED FOR:

**SWV, LLC**

31 N. Tejon, Suite 500  
Colorado Springs, CO 80903

PREPARED BY:

*Dakota Springs Engineering*

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PROJECT NO.16-01

PCD No. SP-16-005  
PCD No. SF-16-017

CERTIFICATIONS

**Design Engineer's Statement:**

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

\_\_\_\_\_  
Charles K. Cothorn, P.E. #24997

Seal

**Owner/Developer's Statement:**

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

By (signature): \_\_\_\_\_

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

Title: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

**El Paso County:**

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

\_\_\_\_\_  
Jennifer Irvine, P.E.,  
County Engineer / ECM Administrator

\_\_\_\_\_  
Date

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## **1.0 INTRODUCTION**

This report is an amendment to the Preliminary & Final Drainage report prepared by Dakota Springs Engineering and approved October 16, 2018.

### ***Purpose***

The purpose of this report is to present revisions to the preliminary and final drainage improvements associated with the construction of Springs at Waterview. Revisions are associated with previously proposed conveyance of storm flows, specifically construction of open channels in place of some of the previously proposed storm sewer pipe along Grinnell Boulevard and the main trunk line storm sewer that primarily conveys offsite flows through the property; some of the storm sewer has been downsized. No changes have been made concerning onsite or offsite hydrology or acceptance of offsite storm water through the site.

## **2.0 General Location and Description**

### ***Location***

Springs at Waterview is a planned 85-unit multi-family residential development within the north half of the northeast quarter of Section 7, Township 15 South, Range 65 West of the 6<sup>th</sup> Principal Meridian, in El Paso County, Colorado. It is located south of Goldfield Drive, east of Grinnell Boulevard, north of Bradley Road and west of Painted Sky at Waterview Filing No. 1. This portion of the Waterview development is in the Windmill Gulch Drainage Basin. Refer to Vicinity map, Appendix A Figure 1.

### ***Description of Property***

The proposed site encompasses 15.68 acres. The topography of the site and surrounding area is typical of a high desert; short prairie grass and weeds with slopes generally ranging from 1% to 9%. The area generally drains to the west.

The site is comprised of several different soil types. From the Soil Survey of El Paso County, the site falls into the following soil types:

1. "3" Ascalon sandy loam, 3 to 9 percent slopes.
2. "8" Blakeland loamy sand, 1 to 9 percent slopes.
3. "97" Truckton sandy loam, 3 to 9 percent slopes.

The Blakeland and Truckton soils are classified at Hydrological Group A and the Ascalon soil is classified as Hydrological Group B. Note: "#" indicates Soil Conservation Survey soil classification number. Hydrologic Soil Group B was used in the preparation of this report. See Appendix A Figure 2: Soils Data.

## **3.0 Drainage Basins and Sub-Basins**

### ***Major Basin Description***

Springs at Waterview residential development is located within the Windmill Gulch Drainage Basin. This report complies with the Windmill Gulch Drainage Basin Planning Study (DBPS) by Wilson and Company, the Master Development Drainage Plan for Waterview by Merrick and Company, the Preliminary Drainage Report for Waterview Phase II, also by Merrick and Company and Painted Sky at Waterview Filing 1 and 2 Final Drainage Report by Merrick and Company and the Approved Springs at Waterview PDR/FDR. All developed runoff will meet El Paso County standards for discharge rates.

### ***Floodplains***

The Flood Insurance Rate Map (FIRM No. 08041C0764-G dated 12/7/2018) indicates that there is no floodplain in the vicinity of the proposed site. See Appendix A Figure 3: FIRM Panel

## **4.0 DRAINAGE BASINS**

### ***Existing Drainage Analysis***

Please refer to the Preliminary and Final Drainage Report for Springs at Waterview, Approved on October 16, 2018, for existing drainage analysis.

### ***Proposed Drainage Analysis***

Please refer to the Preliminary and Final Drainage Report for Springs at Waterview, Approved on October 16, 2018, for proposed drainage analysis.

### ***Proposed Storm System***

The proposed storm water conveyance system presented in the approved Preliminary and Final Drainage Report of Springs at Waterview remains unchanged except for the following exceptions:

1. The Main Trunk Line Storm Sewer has been downsized on the western end
2. And the Storm Sewer that parallels Grinnell Boulevard have been replaced with open channel
3. Other minor changes are reflected on the eastern end of the main trunk line primarily related to final slopes and manhole location.

The proposed revision to the Main Trunk Line storm sewer is a reduction in the last leg of the pipe to 48-inch and a 45 degree bend in the pipe just before discharge to the channel per El Paso County Standards; an effort to reduce turbulence in the channel at junctions with storm sewer pipe. In addition, the eastern end of the storm sewer was modified to reduce disturbance of Escanaba Drive and an addition of a manhole and changes to related pipe slopes. Location of the additional manhole located just east of the western curb of Escanaba Drive was reviewed and approved by El Paso County field staff. StormCAD analysis and hydraulic grade line calculations are in Appendix C of this letter.

The proposed revision to the system parallel to Grinnell Boulevard is to replace the storm pipe with open channels. These channels will convey the developed runoff to the existing 72-inch RCP culvert

under Grinnell Blvd. Hydraulic computations for the proposed channels are contained in Appendix A of this letter.

The hydraulic analysis contained in Appendix A of the report divides the system parallel to Grinnell Blvd into three reaches, North Reach, South Reach and East Reach. The North Reach is the channel that runs between Goldfield Dr. and the 72-inch RCP culvert that crosses under Grinnell Boulevard. This reach flows southerly. The South Reach is the channel that runs northerly parallel to Grinnell Boulevard between Bradley Road and the 72-inch RCP culvert under Grinnell Boulevard. The East Reach is a short section of channel between the outfall of the storm drain running east-west through the development and the South Reach. This reach flows northwesterly and has its confluence with the South Reach approximately 115 feet south of the 72-inch RCP culvert under Grinnell Boulevard.

There is a section (section 100) in the south channel where the hydraulic computations show a velocity in excess of 5.0 fps (6.71 fps). This section is just downstream of the confluence with the east channel. Current and proposed design calls for rip rap lining of the channel in this area.

There is a section (section 200) in the north channel where the hydraulic computations show a velocity in excess of 5.0 fps (5.91 fps). This section is approximately 100 feet upstream of the 72-inch RCP culvert under Grinnell Boulevard. The existing design does not call for riprap lining in this area. The design will be revised to show the necessary riprap lining of the channel in this area. The extents of the additional riprap will be downstream to the currently designed rip rap lining and 25 feet upstream of the section.

#### Culvert Ponding and Grinnell Boulevard Inundation

The HEC RAS model (Appendix A) was modified to include the 72-inch RCP under Grinnell Boulevard as requested. The results indicated an inlet control condition. The results of the model did not provide the most accurate assessment of the culvert operation and assessment of the open channel hydraulic and ponding condition so a second model, HY-8, was used to provide more analysis of the operation of the existing 72-inch culvert, particularly in relationship to Grinnell Boulevard. The results of the HY-8 analysis can be found in Appendix B.

The approved Preliminary and Final Drainage Report recognizes the existing condition inundation of Grinnell Boulevard and provides a description and approximate inundation limits with the approved design. This letter redefines the inundation limits based on the proposed open channel hydraulics versus the approved pipe hydraulics. The calculated 100-year design storm total flow at the 72-inch RCP as approved in the Preliminary and Final Drainage Report is 239.1 cfs. Based on the approved design flow, assumed entrance losses and associated inlet control at the existing 72-inch RCP the ponding elevation for the 100-year design storm is calculated to be 5865.03 or approximately 9.0 ft. The ponding depth is translated to (backs up into) both the north and south proposed channels as shown on the HEC RAS cross sections in Appendix A.

The calculated ponding depth confirms the existing observed inundation of Grinnell Boulevard and indicates the potential for overtopping the road during the 100-year event. An HY-8 Analysis was performed to estimate, based on broad crested weir assumptions, the portion of the 100-year design storm that would continue to be conveyed through the 72-inch RCP and what portion of the 100-year storm that may overtop Grinnell Boulevard. The anticipated 100-year design storm ponding elevation with overtopping based on the HY-8 analysis would be 5862.24 (low point in the road profile is 5861.97). The HY-8 analysis provided in Appendix B indicates that 210.65 cfs of the 239.1 cfs would be

conveyed through the 72-inch RCP to the west side of Grinnell Boulevard as anticipated. This ponding elevation of 3.24-inches at the lowest point of the centerline of Grinnell Boulevard.

The overtopping of this proposed redesign does not meet the cross flow in Arterial road with roadside ditch per DCM Table 6-1. The criteria for major storm is that flow shall not encroach upon the road shoulder. Therefore the proposed design does not meet the criteria.

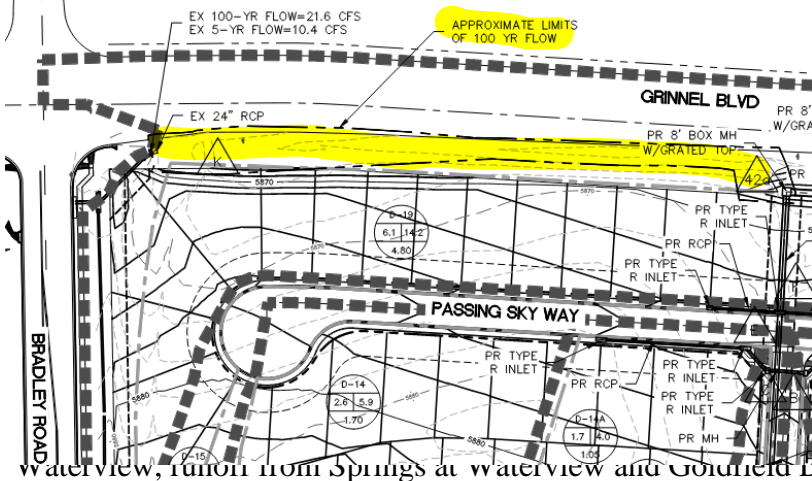
The ponding elevation of 72-inch RCP.

The approved FDR's analysis showed the 100yr flow stays within the shoulder with no overtopping of Grinnell Blvd.

Review of the 100-year design storm hydrology from the approved Preliminary and Final Drainage Report indicates that the calculated 100-year design flow from the Bradley Road storm sewer is 21.6 cfs. The following 3 Design Basins include a portion of Grinnell Boulevard:

Basin	100-Year Design Flow (CFS)
D-19	14.2 cfs
D-18	9.2 cfs
D-17	7.1 cfs
	30.5 cfs

Assuming that 50% of the Basin flows that include Grinnell Boulevard are generated by the paved surface of Grinnell Boulevard the estimated flow from the Public right-of-ways of Bradley Road and Grinnell Boulevard would be approximately 36.85 cfs ( $30.5 \text{ cfs} \times 0.5 + 21.6 \text{ cfs} = 36.85 \text{ cfs}$ ). This total flow is in excess of the calculated flow overtopping Grinnell Boulevard of 28.02 cfs. If 100-year public right-of-way flows are reduced along with the potential for



eliminary and Final Drainage Report; the improvement of Grinnell Boulevard is the improvement of widening to four lanes and public r.o.w.'s of Grinnell Boulevard and although public r.o.w., was always anticipated Sky development flows. The future stormwater stream to the west side of Grinnell Boulevard and 2 conveyed through Springs at Waterview, runoff from Springs at Waterview and Goldenfield Drive runoff would continue to be conveyed through the existing 72-inch RCP to the west side of Grinnell Boulevard as anticipated.

## 5.0 DRAINAGE FEES, COST ESTIMATE & MAINTENANCE

There are no additional fees required for this development as a result of the amendments to the approved Preliminary and Final Drainage Report for Springs at Waterview, presented in this Drainage Letter. Those portions of the approved drainage report that established fees for this development remain unchanged. The amendment only addresses changes in conveyance along Grinnell Blvd.

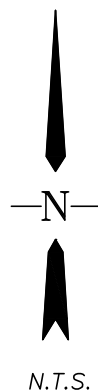
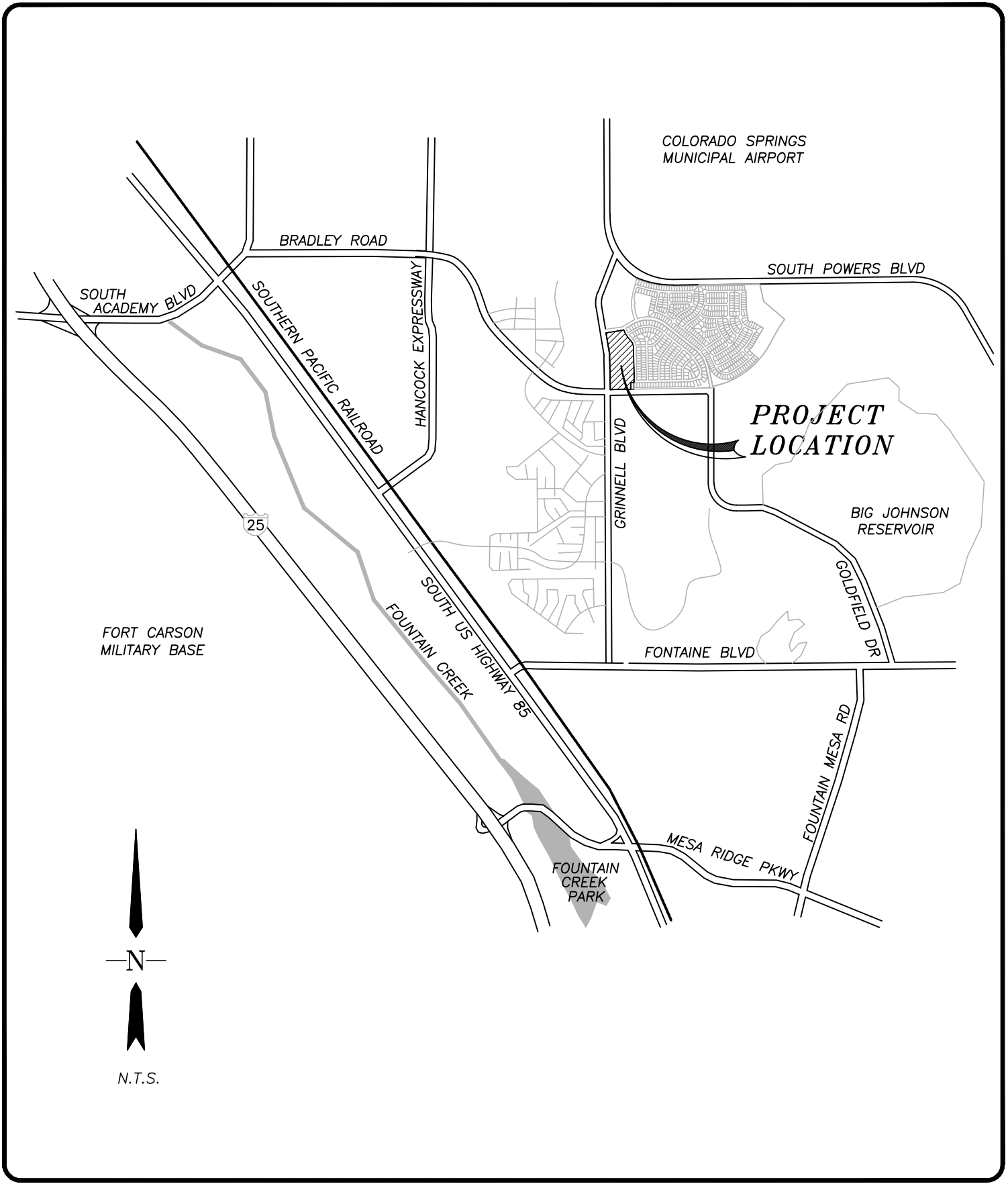
Add cost estimate for the proposed amendment and summarize the difference in cost from the approved design.

## **6.0 REFERENCE MATERIALS**

1. “City of Colorado Springs/El Paso County Drainage Criteria Manual” May 2014.
2. “Windmill Gulch Drainage Basin Planning Study”, Wilson and Company, February 1992.
3. Master Development Drainage Plan for Waterview, May 2006. Prepared by Merrick & Co.
4. Preliminary Drainage Report for Waterview Phase II, January 2007. Prepared by Merrick & Co.
5. Final Drainage Report for Painted Sky at Waterview Filings 1 and 2, January 2007. Prepared by Merrick & Co.
6. Soils Survey of El Paso County Area, Natural Resources Conservation Services of Colorado.
7. Flood Insurance Rate Study for El Paso County, Colorado and Incorporated Areas. Federal Emergency Management Agency, Revised March 17, 1997.
8. “City of Colorado Springs/El Paso County Drainage Criteria Manual, Volume 2: Stormwater Quality Policies, Procedures and Best Management Practices” May 2014.
9. Springs at Waterview Preliminary and Final Drainage Report, October 2018, Prepared by Dakota Springs Engineering.



**Figure 1: Vicinity Map**



**THE SPRINGS AT WATERVIEW  
VICINITY MAP**

**DSE** Dakota Springs  
Engineering

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**EXHIBIT**

PROJECT NO. 0001-02-16-01

## Figure 2: Soils Data

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



# Preface

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Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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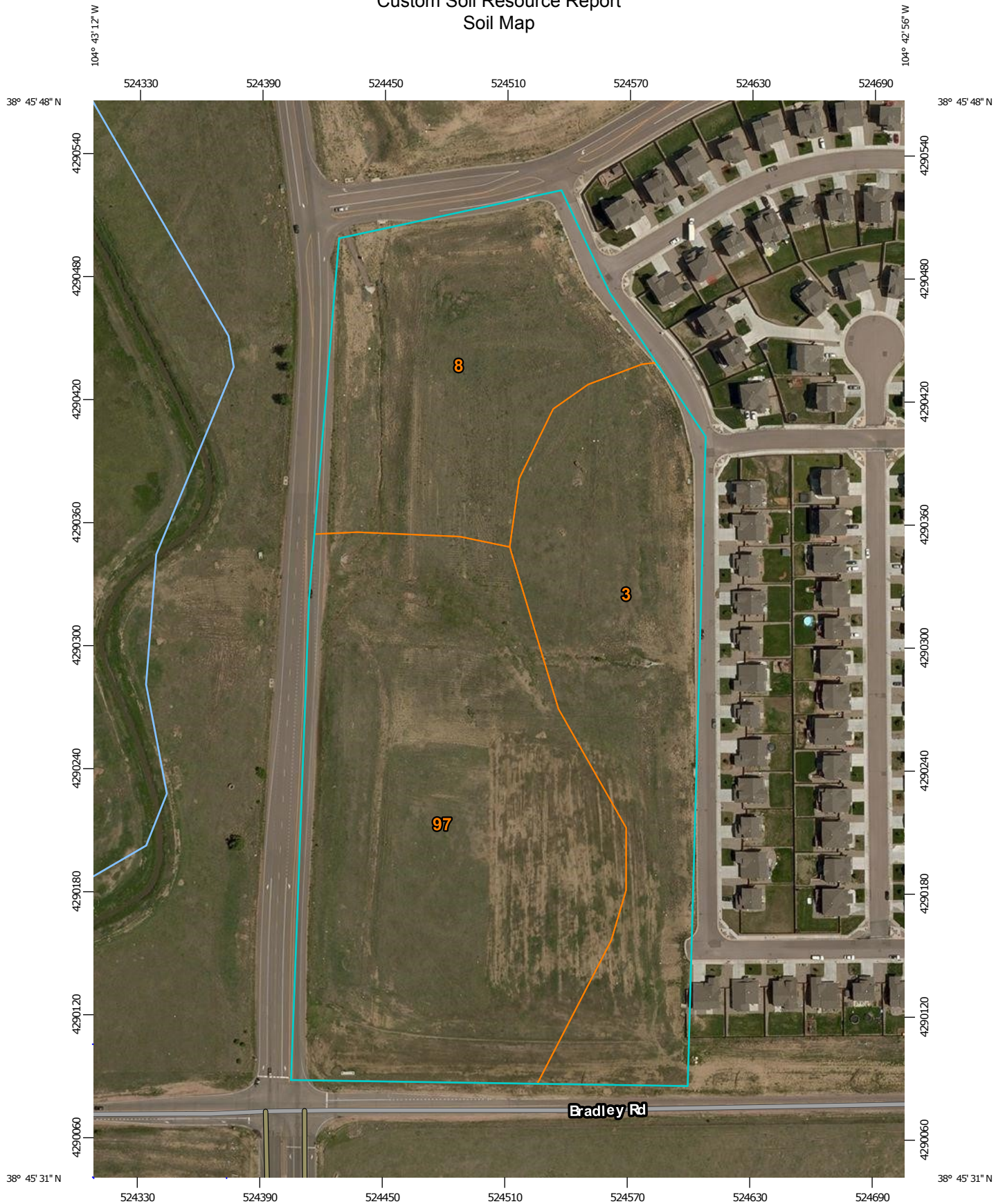
# Soil Map

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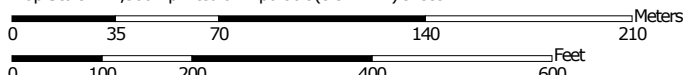
The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



# Custom Soil Resource Report Soil Map




Map Scale: 1:2,560 if printed on A portrait (8.5" x 11") sheet.




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


### MAP LEGEND

**Area of Interest (AOI)**

 Area of Interest (AOI)




















**Soils**






 Soil Map Unit Polygons

 Soil Map Unit Lines


 Soil Map Unit Points

**Special Point Features**






-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features


**Water Features**

 Streams and Canals

**Transportation**

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

**Background**

 Aerial Photography

### MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: El Paso County Area, Colorado  
 Survey Area Data: Version 13, Sep 22, 2015

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

Date(s) aerial images were photographed: Jun 3, 2014—Jun 17, 2014

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

## Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
3	Ascalon sandy loam, 3 to 9 percent slopes	5.5	28.7%
8	Blakeland loamy sand, 1 to 9 percent slopes	4.7	24.8%
97	Truckton sandy loam, 3 to 9 percent slopes	8.9	46.5%
<b>Totals for Area of Interest</b>		<b>19.0</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

## Custom Soil Resource Report

on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

## El Paso County Area, Colorado

### 3—Ascalon sandy loam, 3 to 9 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2tlny  
*Elevation:* 3,870 to 5,960 feet  
*Mean annual precipitation:* 13 to 18 inches  
*Mean annual air temperature:* 46 to 54 degrees F  
*Frost-free period:* 95 to 155 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Ascalon and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Ascalon

##### Setting

*Landform:* Interfluves  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Wind-reworked alluvium and/or calcareous sandy eolian deposits

##### Typical profile

*Ap - 0 to 6 inches:* sandy loam  
*Bt1 - 6 to 12 inches:* sandy clay loam  
*Bt2 - 12 to 19 inches:* sandy clay loam  
*Bk1 - 19 to 35 inches:* fine sandy loam  
*Bk2 - 35 to 80 inches:* fine sandy loam

##### Properties and qualities

*Slope:* 3 to 9 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 to high  
(0.60 to 5.98 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum in profile:* 10 percent  
*Salinity, maximum in profile:* Nonsaline (0.1 to 1.9 mmhos/cm)  
*Sodium adsorption ratio, maximum in profile:* 1.0  
*Available water storage in profile:* Moderate (about 7.1 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 6e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* B  
*Ecological site:* Sandy Plains (R067BY024CO)

## Minor Components

### Olnest

*Percent of map unit:* 10 percent  
*Landform:* Interfluves  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Ecological site:* Sandy Plains (R067BY024CO)

### Vona

*Percent of map unit:* 5 percent  
*Landform:* Interfluves  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Ecological site:* Sandy Plains (R067BY024CO)

## 8—Blakeland loamy sand, 1 to 9 percent slopes

### Map Unit Setting

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

### Map Unit Composition

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

### Description of Blakeland

#### Setting

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

#### Typical profile

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

## Custom Soil Resource Report

### Properties and qualities

*Slope:* 1 to 9 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Somewhat excessively drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum in profile:* 5 percent

*Available water storage in profile:* Low (about 4.5 inches)

### Interpretive groups

*Land capability classification (irrigated):* 3e

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* A

*Ecological site:* Sandy Foothill (R049BY210CO)

### Minor Components

#### Other soils

*Percent of map unit:*

#### Pleasant

*Percent of map unit:*

*Landform:* Depressions

## 97—Truckton sandy loam, 3 to 9 percent slopes

### Map Unit Setting

*National map unit symbol:* 36bg

*Elevation:* 6,000 to 7,000 feet

*Mean annual precipitation:* 14 to 16 inches

*Mean annual air temperature:* 46 to 50 degrees F

*Frost-free period:* 125 to 145 days

*Farmland classification:* Not prime farmland

### Map Unit Composition

*Truckton and similar soils:* 80 percent

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

### Description of Truckton

#### Setting

*Landform:* Hills

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

*Down-slope shape:* Linear

*Across-slope shape:* Linear

## Custom Soil Resource Report

*Parent material:* Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

### Typical profile

*A - 0 to 8 inches:* sandy loam  
*Bt - 8 to 24 inches:* sandy loam  
*C - 24 to 60 inches:* coarse sandy loam

### Properties and qualities

*Slope:* 3 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 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 5.7 inches)

### Interpretive groups

*Land capability classification (irrigated):* 4e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* Sandy Foothill (R049BY210CO)

### Minor Components

#### Haplaquolls

*Percent of map unit:*  
*Landform:* Marshes

#### Other soils

*Percent of map unit:*

#### Pleasant

*Percent of map unit:*  
*Landform:* Depressions



# References

---

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United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

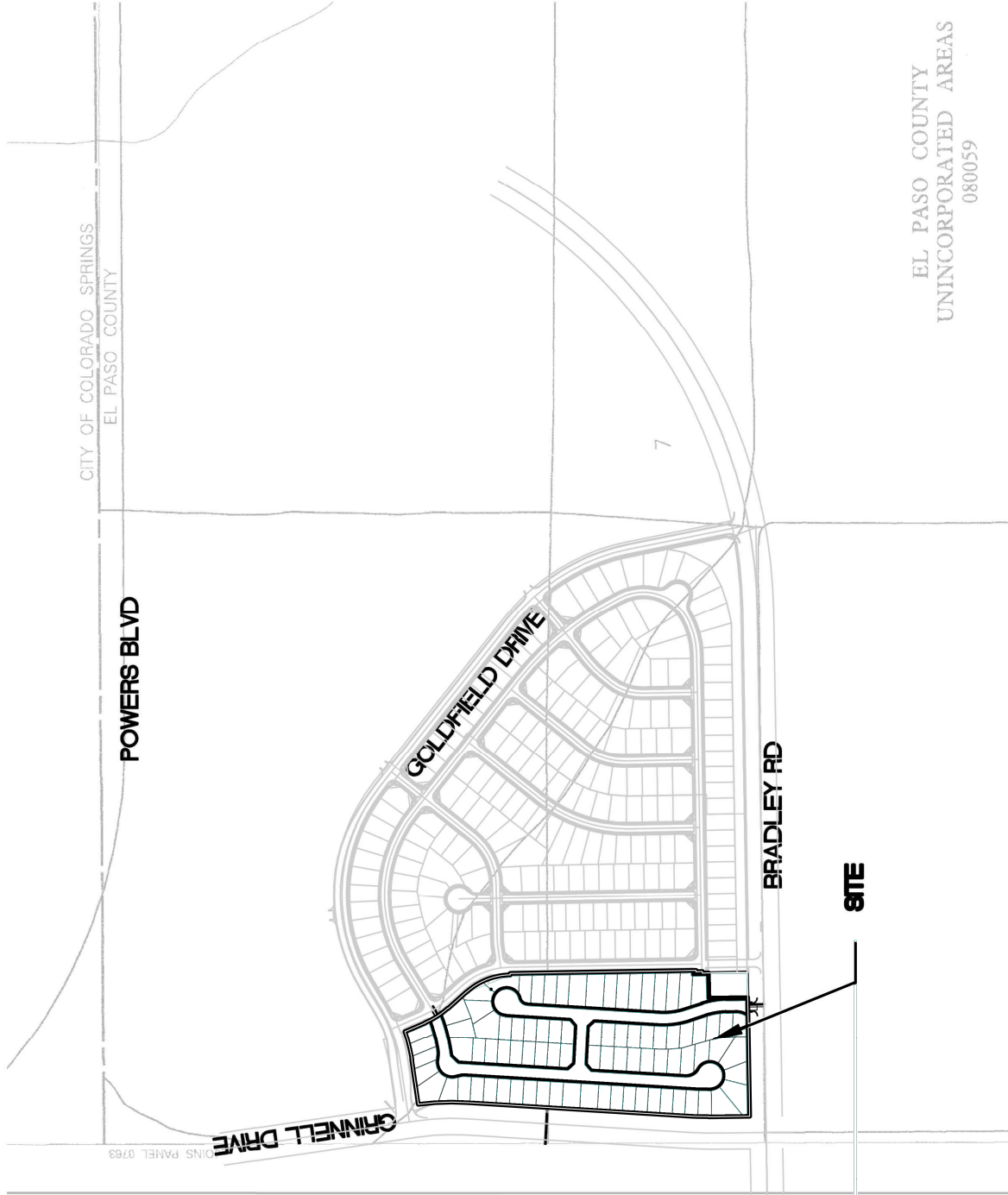
## Custom Soil Resource Report

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United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053624](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624)

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**Figure 1: FIRM Panel**



EL PASO COUNTY  
UNINCORPORATED AREAS  
080059



**NFIP** PANEL 0764G

**FIRM**  
FLOOD INSURANCE RATE MAP  
EL PASO COUNTY,  
COLORADO  
AND INCORPORATED AREAS

PANEL 764 OF 1300  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:  
COMMUNITY NUMBER 080059  
EL PASO COUNTY NUMBER 080059  
PANEL NUMBER 0764  
SUFFIX 0

MAP NUMBER 08041C0764G  
MAP REVISED DECEMBER 7, 2018  
Federal Emergency Management Agency

**NATIONAL FLOOD INSURANCE PROGRAM**

Note to User: The Map Number shown below should be used when placing map orders. The Community Number and the Panel Number are used to determine the location of the subject community.

This is an official copy of a portion of the above referenced Flood Map. It was extracted using FIRM 1.0a. This map does not reflect changes or amendments which may have been made subsequent to the date on the map. For more information on the National Flood Insurance Program, visit the FEMA Flood Map Store at www.fema.com.gov

**SE** Springs Engineering  
31 NORTH TEJON, SUITE 300  
COLORADO SPRINGS, CO 80903  
TEL: (719) 227-7388  
FAX: (719) 227-7392

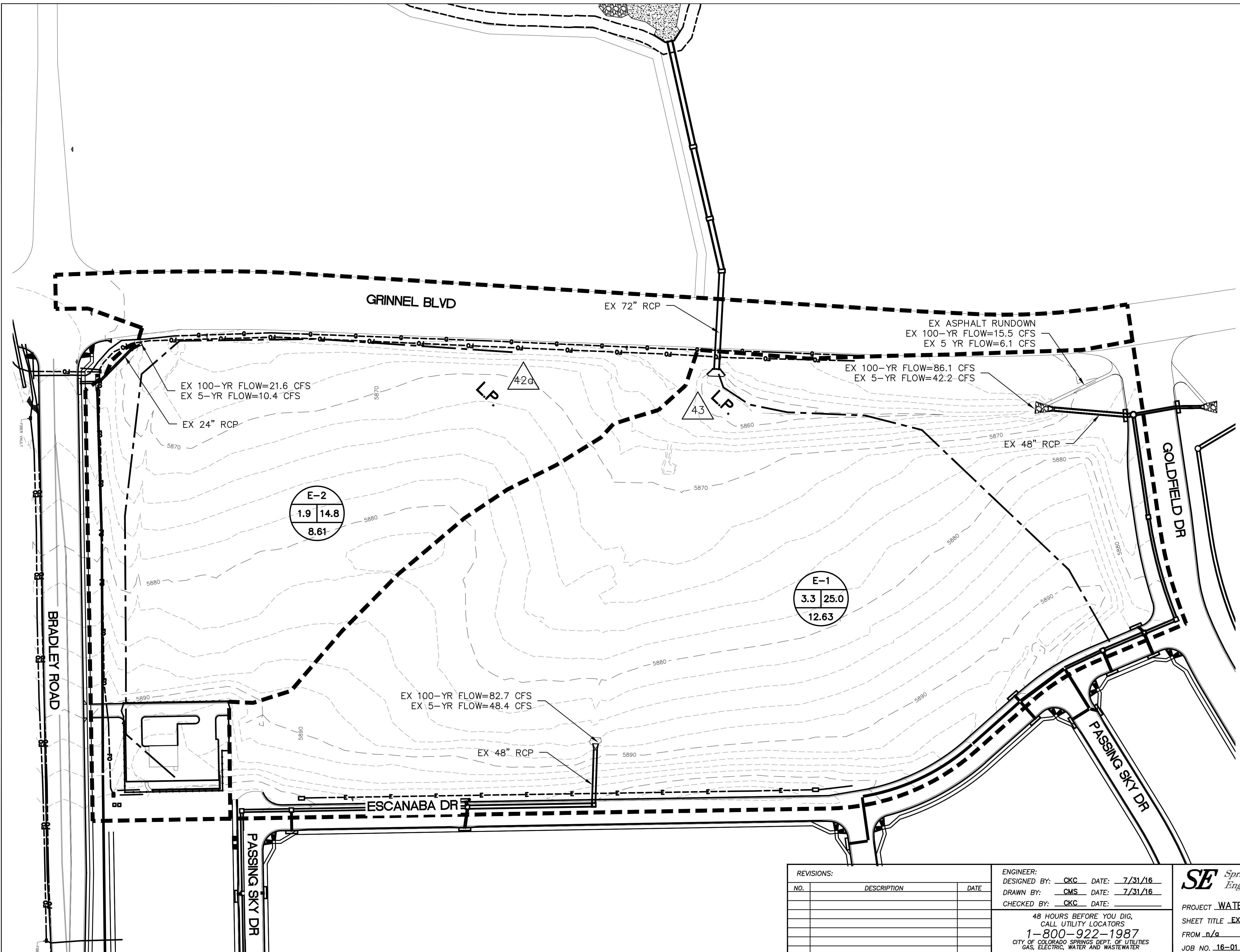
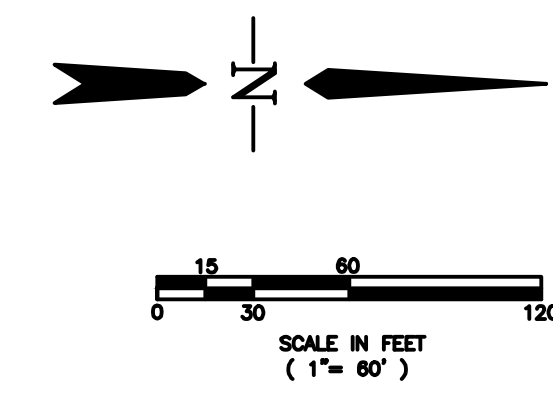
PROJECT NO. 12-005

**SPRINGS AT WATERVIEW  
PDR  
FLOOD INSURANCE RATE MAP**

**FIGURE**

**2**

**Figure 2: Existing Drainage Plan**



**LEGEND**

- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- EXISTING FLOW PATH
- EXISTING BASIN BOUNDARY
- DESIGN POINT
- BASIN LABEL

DESIGN POINT	Q (5)	Q (100)
43	44.3	112.7
42a	12.4	38.2

FIGURE 5

REVISIONS:		
NO.	DESCRIPTION	DATE

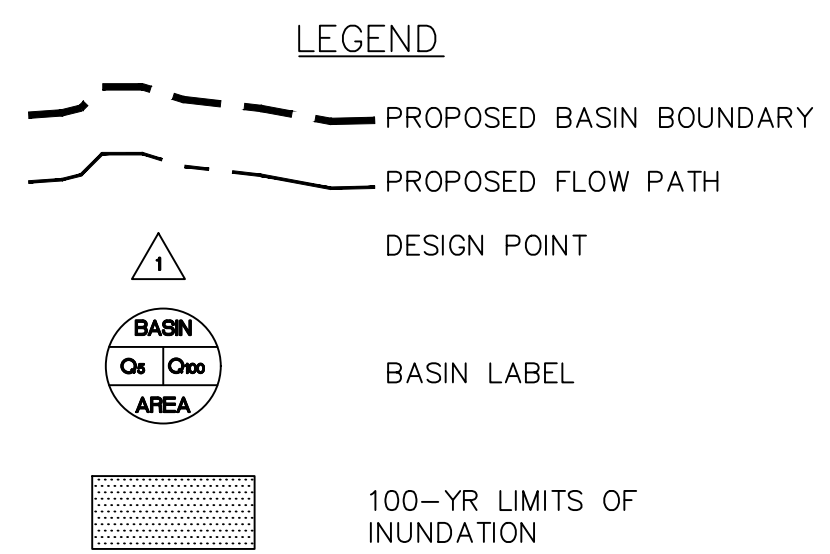
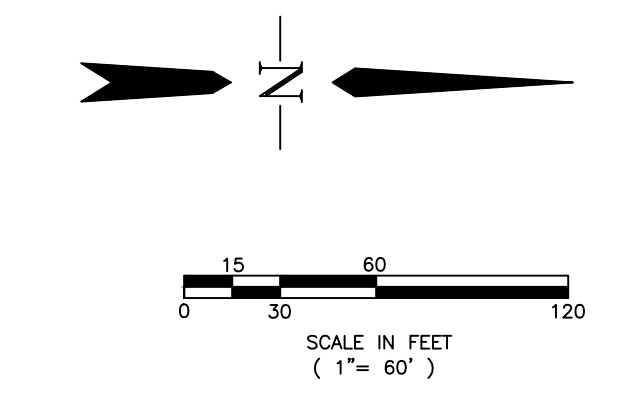
ENGINEER:  
 DESIGNED BY: CKC DATE: 7/31/16  
 DRAWN BY: CMS DATE: 7/31/16  
 CHECKED BY: CKC DATE:  

48 HOURS BEFORE YOU DIG,  
 CALL UTILITY LOCATORS  
**1-800-922-1987**  
 CITY OF COLORADO SPRINGS DEPT. OF UTILITIES  
 GAS, ELECTRIC, WATER AND WASTEWATER

**SE Springs Engineering**  
 31 N. TEJON, SUITE 315  
 COLORADO SPRINGS, CO 80903  
 P: (719) 227-7386  
 F: (719) 227-7392

PROJECT WATERVIEW SPRINGS  
 SHEET TITLE EXISTING DRAINAGE MAP  
 FROM n/a TO n/a  
 JOB NO. 16-01 SHEET 1 OF 1

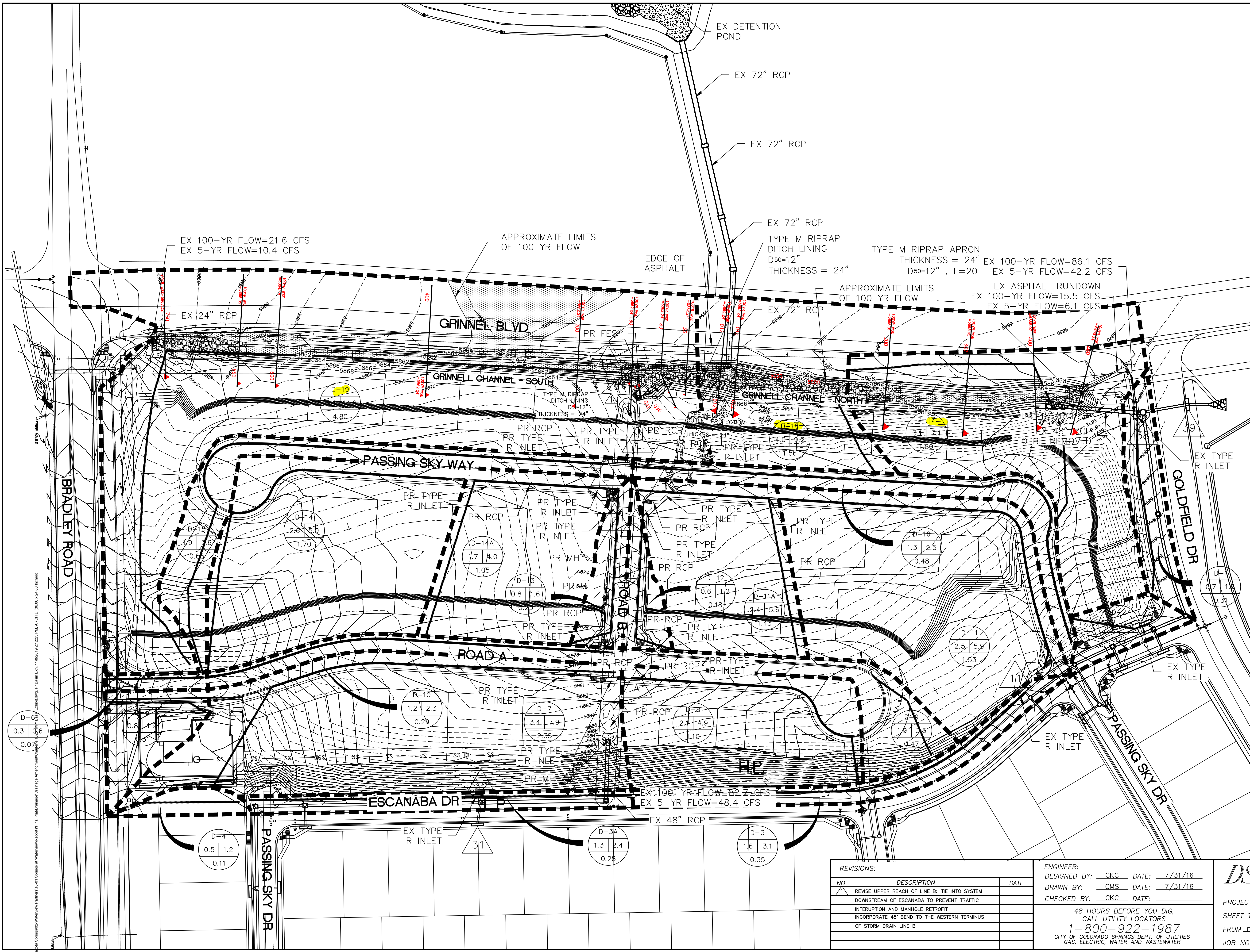
**Figure 5: Proposed Drainage Map**



DESIGN POINT	Q (5)	Q (100)
11	1.6	3.1
32	1.3	2.4
A	0.3	4.3
B	0.8	2.3
C	0.8	2.1
D	2.4	6.7
E	1.6	4.7
F	0.2	3.1
G	3.1	7.1
K	11.5	24.1
39	1.1	2.5
41	0.5	1.0
42a	11.9	26.3
43	4.0	9.2

PLEASE NOTE: VALUES INCLUDED ON THIS TABLE HAVE BEEN REFERENCED FROM THE APPROVED FINAL DRAINAGE REPORT FOR SPRINGS AT WATERVIEW, MAY 2018.

These values are based on subbasin Q's, not cumulative. Include columns for the cumulative flows used in the HEC-RAS Modeling.



**REVISIONS:**

NO.	DESCRIPTION	DATE
1	REVISE UPPER REACH OF LINE B: TIE INTO SYSTEM	
2	DOWNSTREAM OF ESCANABA TO PREVENT TRAFFIC	
3	INTERRUPTION AND MANHOLE RETROFIT	
4	INCORPORATE 45' BEND TO THE WESTERN TERMINUS OF STORM DRAIN LINE B	

ENGINEER: \_\_\_\_\_  
 DESIGNED BY: CKC DATE: 7/31/16  
 DRAWN BY: CMS DATE: 7/31/16  
 CHECKED BY: CKC DATE: \_\_\_\_\_

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 GAS, ELECTRIC, WATER AND WASTEWATER

**DSE** Dakota Springs Engineering  
 31 N. TEJON, SUITE 518  
 COLORADO SPRINGS, CO 80903  
 P: (719) 227-7388  
 F: (719) 227-7392

PROJECT SPRINGS AT WATERVIEW  
 SHEET TITLE PROPOSED DRAINAGE MAP  
 FROM n/s TO n/s  
 JOB NO. 16-01 SHEET 1 OF 1

FIGURE 4

Z:\0001-Chassis Springs\02-Waterview\Partners\16-01\_Springs at Waterview\Proposed Final Plan\DWG\16-01-01.dwg, P: Bambi Esh, 11/02/2019 12:25:35 PM, ARCTID: 16-01-01 (16-01-01.rvt)



## **Appendix A: HEC-RAS Analysis of Grinnel Channel Reaches**

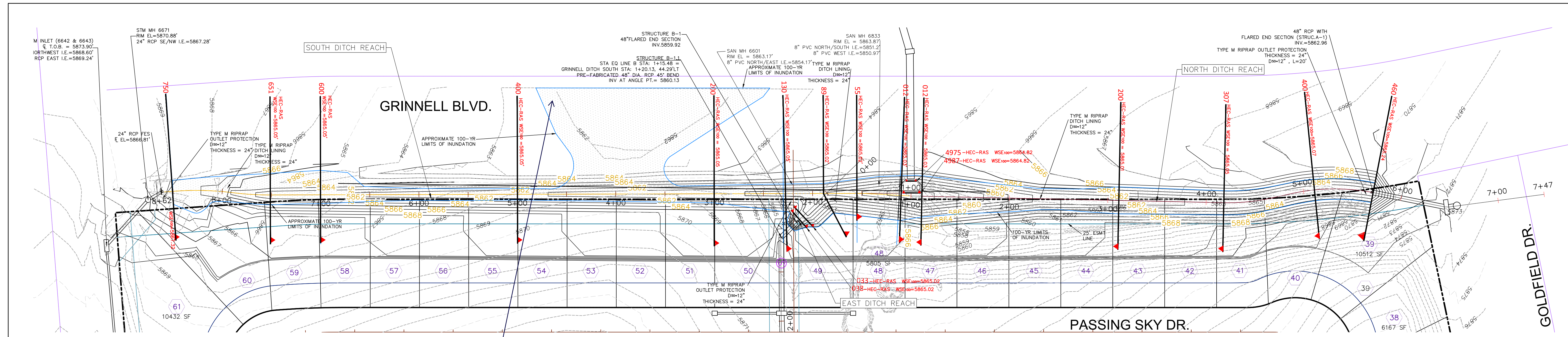
Update the narrative to identify the design storm associated with PF 1 and PF 2 or update the profile names to their respective storm events.

HEC-RAS Plan: Plan 04

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
South Ditch	South	750	PF 1	21.60	5867.00	5867.32	5867.32	5867.46	0.026768	3.04	7.11	24.51	0.99
South Ditch	South	750	PF 2	10.40	5867.00	5867.20	5867.20	5867.29	0.029971	2.41	4.31	22.81	0.98
South Ditch	South	651	PF 1	21.60	5862.41	5865.05	5863.19	5865.06	0.000049	0.69	31.43	19.83	0.10
South Ditch	South	651	PF 2	10.40	5862.41	5863.04	5862.93	5863.16	0.003955	2.80	3.71	7.78	0.72
South Ditch	South	600	PF 1	21.60	5862.15	5865.05	5862.94	5865.05	0.000040	0.62	36.65	21.34	0.07
South Ditch	South	600	PF 2	10.40	5862.15	5862.87	5862.67	5862.96	0.003787	2.36	4.41	8.28	0.57
South Ditch	South	400	PF 1	21.60	5861.16	5865.05	5861.94	5865.05	0.000006	0.40	60.91	27.34	0.04
South Ditch	South	400	PF 2	10.40	5861.16	5861.68	5861.68	5861.88	0.008140	3.61	2.88	7.12	1.00
South Ditch	South	200	PF 1	21.60	5860.16	5865.05	5860.94	5865.05	0.000007	0.26	90.89	33.24	0.02
South Ditch	South	200	PF 2	10.40	5860.16	5861.35	5860.68	5861.37	0.001010	1.15	9.06	11.15	0.22
South Ditch	South	130	PF 1	21.60	5859.81	5865.05	5860.60	5865.05	0.000005	0.24	103.27	35.43	0.02
South Ditch	South	130	PF 2	10.40	5859.81	5861.32	5860.32	5861.33	0.000386	0.81	12.90	13.08	0.14
South Ditch	North	89	PF 1	148.10	5859.58	5865.02	5861.35	5865.04	0.000122	1.27	130.74	40.35	0.10
South Ditch	North	89	PF 2	60.50	5859.58	5860.65	5860.65	5861.07	0.019697	5.17	11.71	14.14	1.00
South Ditch	North	55	PF 1	148.10	5858.16	5865.02	5860.35	5865.04	0.000065	0.94	166.17	44.78	0.08
South Ditch	North	55	PF 2	60.50	5858.16	5860.75	5859.56	5860.81	0.001385	2.05	29.51	19.11	0.29
South Ditch	North	12	PF 1	148.10	5856.67	5865.03	5858.73	5865.03	0.000022	0.74	250.42	54.90	0.05
South Ditch	North	12	PF 2	60.50	5856.67	5860.77	5857.97	5860.78	0.000106	0.93	70.47	29.52	0.09
Outlet	Outlet	4987	PF 1	239.10	5856.33	5864.82	5859.35	5865.01	20247.400000	3.52	67.92	8.00	0.21
Outlet	Outlet	4987	PF 2	111.50	5856.33	5860.59	5858.15	5860.76	25243.440000	3.27	34.09	8.00	0.28
Outlet	Outlet	4975		Culvert									
Outlet	Outlet	4870	PF 1	239.10	5855.93	5863.09	5859.51	5863.54	0.005749	5.38	44.40	6.20	0.35
Outlet	Outlet	4870	PF 2	111.50	5855.93	5859.62	5858.08	5859.99	0.006568	4.87	22.89	6.20	0.45
Outlet	Outlet	4770	PF 1	239.10	5855.00	5862.59	5858.58	5862.99	0.005001	5.08	47.07	6.20	0.33
Outlet	Outlet	4770	PF 2	111.50	5855.00	5859.10	5857.15	5859.40	0.005003	4.39	25.42	6.20	0.38
North Ditch	North	460	PF 1	101.60	5862.96	5865.24	5864.49	5865.41	0.003693	3.32	30.57	20.16	0.48
North Ditch	North	460	PF 2	48.30	5862.96	5864.39	5863.97	5864.54	0.005383	3.10	15.56	15.18	0.54
North Ditch	North	400	PF 1	101.60	5862.67	5865.07	5864.16	5865.21	0.002761	2.97	34.17	21.43	0.42

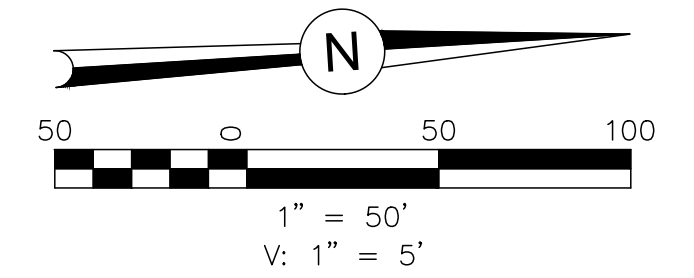
HEC-RAS Plan: Plan 04 (Continued)

River	Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
North Ditch	North	400	PF 2	48.30	5862.67	5863.80	5863.64	5864.06	0.011826	4.09	11.81	13.81	0.78
North Ditch	North	307	PF 1	101.60	5862.24	5865.05	5863.62	5865.12	0.000345	2.10	48.43	25.91	0.27
North Ditch	North	307	PF 2	48.30	5862.24	5863.44	5863.16	5863.62	0.002366	3.31	14.57	16.27	0.62
North Ditch	North	200	PF 1	101.60	5861.67	5865.01	5863.16	5865.06	0.000688	1.78	57.02	27.09	0.22
North Ditch	North	200	PF 2	48.30	5861.67	5862.65	5862.65	5863.03	0.020497	4.96	9.73	12.87	1.01
North Ditch	North	012	PF 1	101.60	5857.50	5865.03	5858.96	5865.03	0.000023	0.42	245.24	57.57	0.03
North Ditch	North	012	PF 2	48.30	5857.50	5860.80	5858.47	5860.81	0.000240	0.81	59.95	29.40	0.10
East Ditch	East	038	PF 1	130.00	5860.70	5865.02	5862.36	5865.05	0.000495	1.35	96.25	43.68	0.15
East Ditch	East	038	PF 2	53.10	5860.70	5861.72	5861.72	5862.10	0.033261	4.95	10.74	14.14	1.00
East Ditch	East	033	PF 1	130.00	5860.50	5865.02	5862.09	5865.05	0.000390	1.36	102.06	37.18	0.13
East Ditch	East	033	PF 2	53.10	5860.50	5861.54	5861.44	5861.84	0.023300	4.43	11.99	14.14	0.85



## HEC-RAS SECTION MAP

### NORTH & SOUTH REACHES



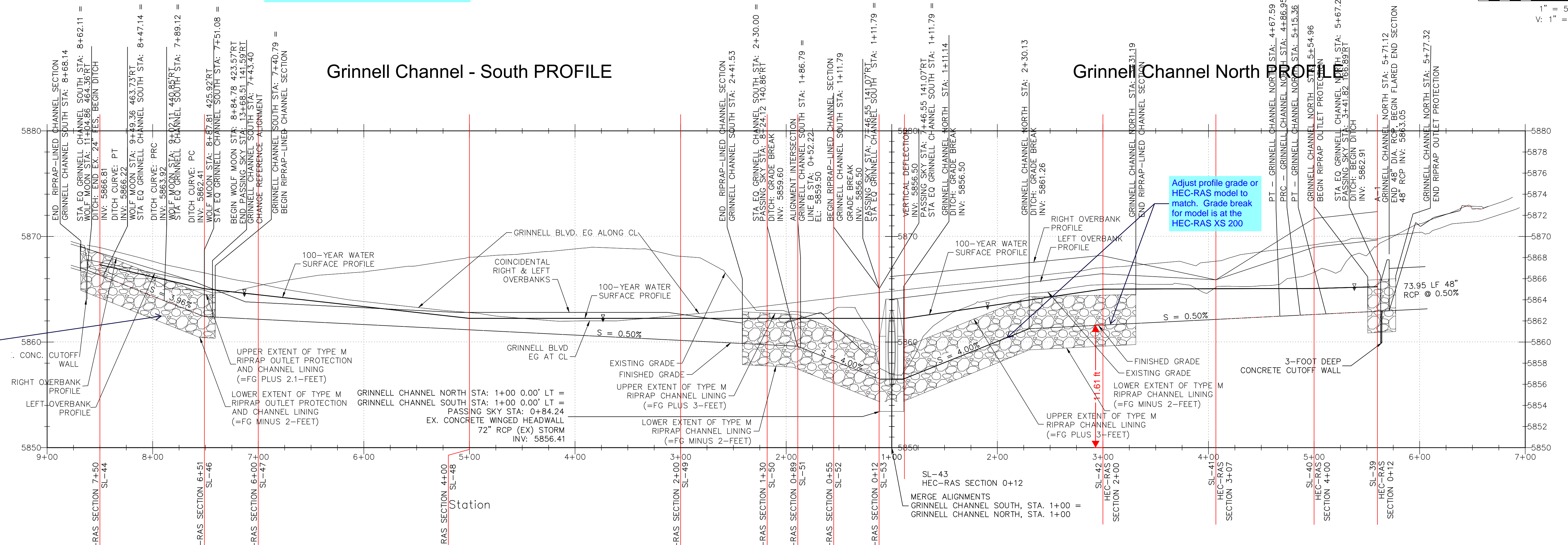
Revise ditch design to meet criteria. Per DCM Table 6-1 flow must not encroach upon road shoulder area.

Adjust profile grade or HEC-RAS model to match. Grade break for model is at the HEC-RAS XS 200

Add the riprap sizing calculations.

### Grinnell Channel - South PROFILE

### Grinnell Channel North PROFILE



REVISIONS:		
NO.	DESCRIPTION	DATE

ENGINEER: \_\_\_\_\_ DATE: 10/27/19  
DESIGNED BY: CEB DATE: 10/27/19  
DRAWN BY: CEB DATE: 10/27/19  
CHECKED BY: CC DATE: 10/27/19

48 HOURS BEFORE YOU DIG,  
CALL UTILITY LOCATORS  
**1-800-922-1987**  
CITY OF COLORADO SPRINGS, DEPT. OF UTILITIES  
GAS, ELECTRIC, WATER AND WASTEWATER

**DSE** *Dakota Springs Engineering*

31 N. TEJON, SUITE 518  
COLORADO SPRINGS, CO 80903  
P: (719) 227-7388  
F: (719) 227-7392

PROJECT: SPRINGS AT WATERVIEW  
SHEET TITLE: HEC-RAS EXHIBIT  
FROM: START TO: END  
JOB NO. 0102.1 SHEET 1 OF 1

HEC-RAS HEC-RAS 5.0.7 March 2019  
U.S. Army Corps of Engineers  
Hydrologic Engineering Center  
609 Second Street  
Davis, California

```
X      X  XXXXXX   XXXX       XXXX       XX       XXXX
X      X  X       X   X       X   X       X   X       X
X      X  X       X       X       X   X       X   X       X
XXXXXXXX XXXX     X       XXX  XXXX     XXXXXX     XXXX
X      X  X       X       X       X   X       X   X       X
X      X  X       X   X       X   X       X   X       X
X      X  XXXXXX   XXXX       X   X       X   X       XXXXX
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PROJECT DATA

Project Title: Channel Model2  
Project File : ChannelModel2.prj  
Run Date and Time: 1/22/2020 16:33:36

Project in English units

PLAN DATA

Plan Title: Plan 04  
Plan File : C:\LAND PROJECTS\18016 - Springs at  
Waterview\HEC-RAS\Model2\ChannelModel2.p04

Geometry Title: S@W - Ditch Analysis  
Geometry File : C:\LAND PROJECTS\18016 - Springs at  
Waterview\HEC-RAS\Model2\ChannelModel2.g04

Flow Title : Channel Flow Data2  
Flow File : C:\LAND PROJECTS\18016 - Springs at  
Waterview\HEC-RAS\Model2\ChannelModel2.f02

Plan Summary Information:

Number of:	Cross Sections =	19	Multiple Openings =	0
	Culverts =	1	Inline Structures =	0
	Bridges =	0	Lateral Structures =	0

Computational Information

Water surface calculation tolerance = 0.01  
Critical depth calculation tolerance = 0.01

Maximum number of iterations = 20  
 Maximum difference tolerance = 0.3  
 Flow tolerance factor = 0.001

Computation Options

Critical depth computed at all cross sections  
 Conveyance Calculation Method: At breaks in n values only  
 Friction Slope Method: Average Conveyance  
 Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Channel Flow Data2  
 Flow File : C:\LAND PROJECTS\18016 - Springs at  
 Waterview\HEC-RAS\Model12\ChannelModel12.f02

Flow Data (cfs)

River	Reach	RS	PF 1	PF 2
East Ditch	East	038	130	53.1
North Ditch	North	460	101.6	48.3
Outlet	Outlet	4987	239.1	111.5
South Ditch	South	750	21.6	10.4
South Ditch	North	89	148.1	60.5

Boundary Conditions

River	Reach	Profile	Upstream
Downstream			
East Ditch	East	PF 1	Normal S = 0.005
East Ditch	East	PF 2	Normal S = 0.005
North Ditch	North	PF 1	Normal S = 0.005
North Ditch	North	PF 2	Normal S = 0.005
Outlet	Outlet	PF 1	
Normal S = 0.005			
Outlet	Outlet	PF 2	
Normal S = 0.005			
South Ditch	South	PF 1	Normal S = 0.03

0.04 per plans 

South Ditch

South

PF 2

Normal S = 0.03

GEOMETRY DATA

Geometry Title: S@W - Ditch Analysis
Geometry File : C:\LAND PROJECTS\18016 - Springs at
Waterview\HEC-RAS\Model2\ChannelModel2.g04

Reach Connection Table

Table with 4 columns: River, Reach, Upstream Boundary, Downstream Boundary. Rows include East Ditch, North Ditch, Outlet, South Ditch, and South Ditch with their respective boundaries.

JUNCTION INFORMATION

Name: Ex Culv
Description: Junction of N & S Ditches at Grinnell Culvert
Energy computation Method

Table with 5 columns: River, Reach, Tributary River, Reach, Length. Rows show North Ditch and South Ditch junctions to Outlet with lengths of 12.

Name: S & E
Description:
Energy computation Method

Table with 5 columns: River, Reach, Tributary River, Reach, Length. Rows show South Ditch and East Ditch junctions to South Ditch with lengths of 41 and 36.

CROSS SECTION

RIVER: East Ditch  
 REACH: East RS: 038

INPUT

Description: East Ditch River Station 0+38

Station Elevation Data		num= 10		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	5865.01	1.53	5865	2.895864	991	6.485864	966	21.5	5860.7
25	5860.7	28.5	5860.7	43.755865	043	49.1	5865.04	505865	039

Manning's n Values		num= 3		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val
0	.045	6.48	.045	43.75	.045

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	6.48	43.75		5	5		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.05	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.03	Wt. n-Val.	0.045	0.045
W.S. Elev (ft)	5865.02	Reach Len. (ft)	5.00	5.00
5.00				
Crit W.S. (ft)	5862.36	Flow Area (sq ft)	0.23	96.02
E.G. Slope (ft/ft)	0.000495	Area (sq ft)	0.23	96.02
Q Total (cfs)	130.00	Flow (cfs)	0.02	129.98
Top Width (ft)	43.68	Top Width (ft)	6.48	37.20
Vel Total (ft/s)	1.35	Avg. Vel. (ft/s)	0.08	1.35
Max Chl Dpth (ft)	4.32	Hydr. Depth (ft)	0.04	2.58
Conv. Total (cfs)	5841.3	Conv. (cfs)	0.8	5840.5
Length Wtd. (ft)	5.00	Wetted Per. (ft)	6.49	38.40
Min Ch El (ft)	5860.70	Shear (lb/sq ft)	0.00	0.08
Alpha	1.00	Stream Power (lb/ft s)	0.00	0.10
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.01	0.09



0.01				
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.00

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5862.10	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.38	Wt. n-Val.		0.045
W.S. Elev (ft)	5861.72	Reach Len. (ft)	5.00	5.00
5.00				
Crit W.S. (ft)	5861.72	Flow Area (sq ft)		10.74
E.G. Slope (ft/ft)	0.033261	Area (sq ft)		10.74
Q Total (cfs)	53.10	Flow (cfs)		53.10
Top Width (ft)	14.14	Top Width (ft)		14.14
Vel Total (ft/s)	4.95	Avg. Vel. (ft/s)		4.95
Max Chl Dpth (ft)	1.02	Hydr. Depth (ft)		0.76
Conv. Total (cfs)	291.2	Conv. (cfs)		291.2
Length Wtd. (ft)	5.00	Wetted Per. (ft)		14.43
Min Ch El (ft)	5860.70	Shear (lb/sq ft)		1.55
Alpha	1.00	Stream Power (lb/ft s)		7.64
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		0.01
C & E Loss (ft)	0.02	Cum SA (acres)		0.00

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical

depth for the water surface and continued on with the calculations.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated

water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: East Ditch  
 REACH: East RS: 033

INPUT

Description: East Ditch River Station 0+33

Station Elevation Data		num= 9		Sta Elev		Sta Elev		Sta Elev	
81.61	5863	86.1	5864	91	5863	95.5	5860.5	100	5860.5
104.5	5860.5	119.86	5865.364	127.25	5865.051	132.91	5865.102		

Manning's n Values		num= 3		Sta n Val	
81.61	.045	91	.045	119.86	.045

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	91	119.86		33	33	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.05	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.03	Wt. n-Val.	0.045	0.045
W.S. Elev (ft)	5865.02	Reach Len. (ft)	36.00	36.00
36.00				
Crit W.S. (ft)	5862.09	Flow Area (sq ft)	14.31	87.75
E.G. Slope (ft/ft)	0.000390	Area (sq ft)	14.31	87.75
Q Total (cfs)	130.00	Flow (cfs)	10.71	119.29
Top Width (ft)	37.18	Top Width (ft)	9.39	27.79
Vel Total (ft/s)	1.27	Avg. Vel. (ft/s)	0.75	1.36
Max Chl Dpth (ft)	4.52	Hydr. Depth (ft)	1.52	3.16
Conv. Total (cfs)	6585.9	Conv. (cfs)	542.4	6043.4
Length Wtd. (ft)	36.00	Wetted Per. (ft)	11.62	29.13
Min Ch El (ft)	5860.50	Shear (lb/sq ft)	0.03	0.07

Alpha	1.07	Stream Power (lb/ft s)	0.02	0.10
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.01	0.08
0.01				
C & E Loss (ft)	0.00	Cum SA (acres)		

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5861.84	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.30	Wt. n-Val.		0.045
W.S. Elev (ft)	5861.54	Reach Len. (ft)	36.00	36.00
36.00				
Crit W.S. (ft)	5861.44	Flow Area (sq ft)		11.99
E.G. Slope (ft/ft)	0.023300	Area (sq ft)		11.99
Q Total (cfs)	53.10	Flow (cfs)		53.10
Top Width (ft)	14.14	Top Width (ft)		14.14
Vel Total (ft/s)	4.43	Avg. Vel. (ft/s)		4.43
Max Chl Dpth (ft)	1.04	Hydr. Depth (ft)		0.85
Conv. Total (cfs)	347.9	Conv. (cfs)		347.9
Length Wtd. (ft)	36.00	Wetted Per. (ft)		14.57
Min Ch El (ft)	5860.50	Shear (lb/sq ft)		1.20
Alpha	1.00	Stream Power (lb/ft s)		5.30
Frctn Loss (ft)	0.77	Cum Volume (acre-ft)		0.01
C & E Loss (ft)	0.01	Cum SA (acres)		

CROSS SECTION

RIVER: North Ditch  
 REACH: North RS: 460

INPUT

Description: North Ditch River Station 4+60

Station Elevation Data		num=		11	
Sta	Elev	Sta	Elev	Sta	Elev
26.39	5869.662	39.31	5865.36	46.55	5862.964
74.88	5870.483	80.23	5872.354	83.04	5872.585
100	5872.69			87.15	5872.634
				89.58	5872.65

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
26.39	.035	26.39	.035	80.23	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	26.39	80.23		60	60		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.41	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.17	Wt. n-Val.		0.035
W.S. Elev (ft)	5865.24	Reach Len. (ft)	60.00	60.00
60.00				
Crit W.S. (ft)	5864.49	Flow Area (sq ft)		30.57
E.G. Slope (ft/ft)	0.003693	Area (sq ft)		30.57
Q Total (cfs)	101.60	Flow (cfs)		101.60
Top Width (ft)	20.16	Top Width (ft)		20.16
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)		3.32
Max Chl Dpth (ft)	2.27	Hydr. Depth (ft)		1.52
Conv. Total (cfs)	1672.0	Conv. (cfs)		1672.0
Length Wtd. (ft)	60.00	Wetted Per. (ft)		20.91
Min Ch El (ft)	5862.96	Shear (lb/sq ft)		0.34
Alpha	1.00	Stream Power (lb/ft s)		1.12
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	0.00	1.00

0.00				
C & E Loss (ft)	0.01	Cum SA (acres)	0.01	0.33
0.00				

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5864.54	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.15	Wt. n-Val.		0.035
W.S. Elev (ft)	5864.39	Reach Len. (ft)	60.00	60.00
60.00				
Crit W.S. (ft)	5863.97	Flow Area (sq ft)		15.56
E.G. Slope (ft/ft)	0.005383	Area (sq ft)		15.56
Q Total (cfs)	48.30	Flow (cfs)		48.30
Top Width (ft)	15.18	Top Width (ft)		15.18
Vel Total (ft/s)	3.10	Avg. Vel. (ft/s)		3.10
Max Chl Dpth (ft)	1.42	Hydr. Depth (ft)		1.03
Conv. Total (cfs)	658.3	Conv. (cfs)		658.3
Length Wtd. (ft)	60.00	Wetted Per. (ft)		15.64
Min Ch El (ft)	5862.96	Shear (lb/sq ft)		0.33
Alpha	1.00	Stream Power (lb/ft s)		1.04
Frctn Loss (ft)	0.46	Cum Volume (acre-ft)		0.25
C & E Loss (ft)	0.01	Cum SA (acres)		0.18

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: North Ditch

REACH: North

RS: 400

INPUT

Description: North Ditch River Station 4+00

Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
27.56	5868.979	46.55	862.665	49.97	5862.665	53.47	5862.665	62.38	5865.624
82.18	5871.705	100	5871.972						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
27.56	.035	27.56	.035	82.18	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	27.56	82.18		86	93		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.21	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.14	Wt. n-Val.		0.035
W.S. Elev (ft)	5865.07	Reach Len. (ft)	86.00	93.00
100.00				
Crit W.S. (ft)	5864.16	Flow Area (sq ft)		34.17
E.G. Slope (ft/ft)	0.002761	Area (sq ft)		34.17
Q Total (cfs)	101.60	Flow (cfs)		101.60
Top Width (ft)	21.43	Top Width (ft)		21.43
Vel Total (ft/s)	2.97	Avg. Vel. (ft/s)		2.97
Max Chl Dpth (ft)	2.41	Hydr. Depth (ft)		1.59
Conv. Total (cfs)	1933.4	Conv. (cfs)		1933.4
Length Wtd. (ft)	93.00	Wetted Per. (ft)		22.21
Min Ch El (ft)	5862.67	Shear (lb/sq ft)		0.27
Alpha	1.00	Stream Power (lb/ft s)		0.79
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	0.00	0.95
0.00				
C & E Loss (ft)	0.02	Cum SA (acres)	0.01	0.30
0.00				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5864.06	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.26	Wt. n-Val.		0.035
W.S. Elev (ft)	5863.80	Reach Len. (ft)	86.00	93.00
100.00				
Crit W.S. (ft)	5863.64	Flow Area (sq ft)		11.81
E.G. Slope (ft/ft)	0.011826	Area (sq ft)		11.81
Q Total (cfs)	48.30	Flow (cfs)		48.30
Top Width (ft)	13.81	Top Width (ft)		13.81
Vel Total (ft/s)	4.09	Avg. Vel. (ft/s)		4.09
Max Chl Dpth (ft)	1.14	Hydr. Depth (ft)		0.86
Conv. Total (cfs)	444.2	Conv. (cfs)		444.2
Length Wtd. (ft)	93.00	Wetted Per. (ft)		14.17
Min Ch El (ft)	5862.67	Shear (lb/sq ft)		0.62
Alpha	1.00	Stream Power (lb/ft s)		2.52
Frctn Loss (ft)	0.42	Cum Volume (acre-ft)		0.23
C & E Loss (ft)	0.03	Cum SA (acres)		0.16

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: North Ditch

REACH: North

RS: 307

INPUT

Description: North Ditch Section

Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
84.5	5865.89	87.5	5864.89	90.5	5863.89	93.5	5862.89	96.5	5862.24
100	5862.24	103.5	5862.24	106.45	5862.89	109.45	5863.89	112.45	5864.89
115.45	5865.89								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
84.5	.02	87.5	.02	112.45	.02

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	87.5	112.45		107	107		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

Parameter	Value	Element	Left OB	Channel
E.G. Elev (ft)	5865.12			
Right OB				
Vel Head (ft)	0.07	Wt. n-Val.	0.020	0.020
0.020				
W.S. Elev (ft)	5865.05	Reach Len. (ft)	107.00	107.00
107.00				
Crit W.S. (ft)	5863.62	Flow Area (sq ft)	0.04	48.35
0.04				
E.G. Slope (ft/ft)	0.000345	Area (sq ft)	0.04	48.35
0.04				
Q Total (cfs)	101.60	Flow (cfs)	0.01	101.58
0.01				
Top Width (ft)	25.91	Top Width (ft)	0.48	24.95
0.48				
Vel Total (ft/s)	2.10	Avg. Vel. (ft/s)	0.25	2.10
0.25				
Max Chl Dpth (ft)	2.81	Hydr. Depth (ft)	0.08	1.94
0.08				
Conv. Total (cfs)	5470.6	Conv. (cfs)	0.5	5469.6
0.5				
Length Wtd. (ft)	107.00	Wetted Per. (ft)	0.50	25.74
0.50				
Min Ch El (ft)	5862.24	Shear (lb/sq ft)	0.00	0.04
0.00				
Alpha	1.00	Stream Power (lb/ft s)	0.00	0.08
0.00				
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)	0.00	0.86
0.00				
C & E Loss (ft)	0.01	Cum SA (acres)	0.01	0.25
0.00				



Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5863.62	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.17	Wt. n-Val.		0.020
W.S. Elev (ft)	5863.44	Reach Len. (ft)	107.00	107.00
107.00				
Crit W.S. (ft)	5863.16	Flow Area (sq ft)		14.57
E.G. Slope (ft/ft)	0.002366	Area (sq ft)		14.57
Q Total (cfs)	48.30	Flow (cfs)		48.30
Top Width (ft)	16.27	Top Width (ft)		16.27
Vel Total (ft/s)	3.31	Avg. Vel. (ft/s)		3.31
Max Chl Dpth (ft)	1.20	Hydr. Depth (ft)		0.90
Conv. Total (cfs)	993.0	Conv. (cfs)		993.0
Length Wtd. (ft)	107.00	Wetted Per. (ft)		16.59
Min Ch El (ft)	5862.24	Shear (lb/sq ft)		0.13
Alpha	1.00	Stream Power (lb/ft s)		0.43
Frctn Loss (ft)	0.56	Cum Volume (acre-ft)		0.20
C & E Loss (ft)	0.02	Cum SA (acres)		0.13

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: North Ditch  
 REACH: North RS: 200

INPUT

Description: North Ditch River Station 2+00

Station Elevation Data num= 8

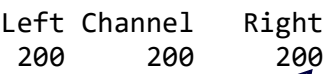
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
32.25	5866.41	46.48	5861.67	47.85	5861.665	49.99	5861.665	53.48	5861.665
72.51	5868	73.64	5868.141	100	5868.141				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
32.25	.035	32.25	.035	73.64	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	32.25	73.64		200	200		.1	.3

CROSS SECTION OUTPUT Profile #PF 1



E.G. Elev (ft)	5865.06	Element	188	Left OB	Channel
Right OB					
Vel Head (ft)	0.05	Wt. n-Val.			0.035
W.S. Elev (ft)	5865.01	Reach Len. (ft)		200.00	200.00
200.00					
Crit W.S. (ft)	5863.16	Flow Area (sq ft)			57.02
E.G. Slope (ft/ft)	0.000688	Area (sq ft)			57.02
Q Total (cfs)	101.60	Flow (cfs)			101.60
Top Width (ft)	27.09	Top Width (ft)			27.09
Vel Total (ft/s)	1.78	Avg. Vel. (ft/s)			1.78
Max Chl Dpth (ft)	3.35	Hydr. Depth (ft)			2.11
Conv. Total (cfs)	3873.5	Conv. (cfs)			3873.5
Length Wtd. (ft)	200.00	Wetted Per. (ft)			28.17
Min Ch El (ft)	5861.67	Shear (lb/sq ft)			0.09
Alpha	1.00	Stream Power (lb/ft s)			0.15
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)		0.00	0.73
C & E Loss (ft)	0.01	Cum SA (acres)		0.01	0.19

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5863.03	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.38	Wt. n-Val.		0.035
W.S. Elev (ft)	5862.65	Reach Len. (ft)	200.00	200.00
200.00				
Crit W.S. (ft)	5862.65	Flow Area (sq ft)		9.73
E.G. Slope (ft/ft)	0.020497	Area (sq ft)		9.73
Q Total (cfs)	48.30	Flow (cfs)		48.30
Top Width (ft)	12.87	Top Width (ft)		12.87
Vel Total (ft/s)	4.96	Avg. Vel. (ft/s)		4.96
Max Chl Dpth (ft)	0.98	Hydr. Depth (ft)		0.76
Conv. Total (cfs)	337.4	Conv. (cfs)		337.4
Length Wtd. (ft)	200.00	Wetted Per. (ft)		13.19
Min Ch El (ft)	5861.67	Shear (lb/sq ft)		0.94
Alpha	1.00	Stream Power (lb/ft s)		4.69
Frctn Loss (ft)	0.16	Cum Volume (acre-ft)		0.17
C & E Loss (ft)	0.11	Cum SA (acres)		0.10

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical

depth for the water surface and continued on with the calculations.

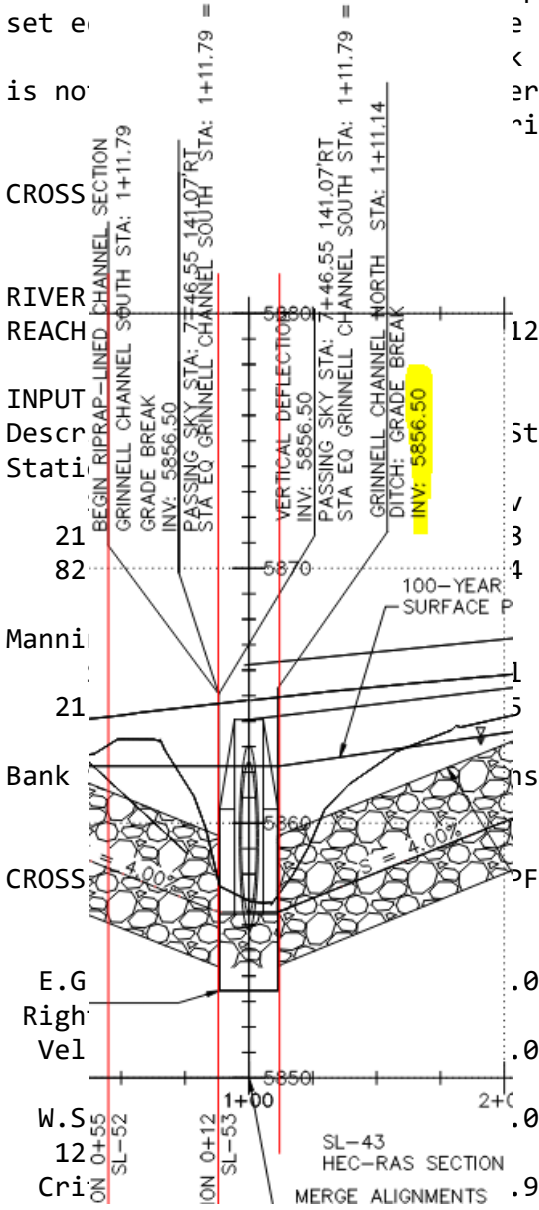
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and

previous cross section. This may indicate the need for additional cross sections.

Warning: The water surface elevation is set below critical depth. This indicates that there is no critical depth.



Bottom of channel cross section does not match the plans. Update.

Station	Elev	Station	Elev	Station	Elev
21	5857.502	50	5857.5	53.49	5857.5
82					
21	82.35				.045
Left Channel	12	Right	12	Coeff	.1
Constr.		Expan.			.3
Element		Left OB		Channel	
Wt. n-Val.		0.045		0.045	
Reach Len. (ft)		12.00		12.00	
Flow Area (sq ft)		1.65		243.59	
Area (sq ft)		1.65		243.59	
Flow (cfs)		0.17		101.43	
Top Width (ft)		3.00		54.57	
Avg. Vel. (ft/s)		0.10		0.42	
Hydr. Depth (ft)		0.55		4.46	
Conv. (cfs)		35.1		21284.8	

Length Wtd. (ft)	12.00	Wetted Per. (ft)	3.21	56.59
Min Ch El (ft)	5857.50	Shear (lb/sq ft)	0.00	0.01
Alpha	1.01	Stream Power (lb/ft s)	0.00	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.00	0.04
C & E Loss (ft)	0.02	Cum SA (acres)		

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5860.81	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.01	Wt. n-Val.		0.045
W.S. Elev (ft)	5860.80	Reach Len. (ft)	12.00	12.00
12.00				
Crit W.S. (ft)	5858.47	Flow Area (sq ft)		59.95
E.G. Slope (ft/ft)	0.000240	Area (sq ft)		59.95
Q Total (cfs)	48.30	Flow (cfs)		48.30
Top Width (ft)	29.40	Top Width (ft)		29.40
Vel Total (ft/s)	0.81	Avg. Vel. (ft/s)		0.81
Max Chl Dpth (ft)	3.29	Hydr. Depth (ft)		2.04
Conv. Total (cfs)	3116.6	Conv. (cfs)		3116.6
Length Wtd. (ft)	12.00	Wetted Per. (ft)		30.35
Min Ch El (ft)	5857.50	Shear (lb/sq ft)		0.03
Alpha	1.00	Stream Power (lb/ft s)		0.02
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)		0.01
C & E Loss (ft)	0.02	Cum SA (acres)		

CROSS SECTION

RIVER: Outlet  
 REACH: Outlet RS: 4987

INPUT

Description: Outlet Reach - Entrance to 72" RCP Section

Station Elevation Data		num=		5	
Sta	Elev	Sta	Elev	Sta	Elev
96	5866	96	5856.33	100	5856.33
				104	5856.33
				104	5866

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
96	.015	96	117	104	117

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	96	104		117	130	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.01	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.19	Wt. n-Val.		117.000
W.S. Elev (ft)	5864.82	Reach Len. (ft)	117.00	130.00
130.00				
Crit W.S. (ft)	5859.35	Flow Area (sq ft)		67.92
E.G. Slope (ft/ft)	20247.400000	Area (sq ft)		
67.92				
Q Total (cfs)	239.10	Flow (cfs)		239.10
Top Width (ft)	8.00	Top Width (ft)		8.00
Vel Total (ft/s)	3.52	Avg. Vel. (ft/s)		3.52
Max Chl Dpth (ft)	8.49	Hydr. Depth (ft)		8.49
Conv. Total (cfs)	1.7	Conv. (cfs)		1.7
Length Wtd. (ft)	130.00	Wetted Per. (ft)		24.98
Min Ch El (ft)	5856.33	Shear (lb/sq ft)		3436875.00
Alpha	1.00	Stream Power (lb/ft s)		

12099250.00			
Frctn Loss (ft)		Cum Volume (acre-ft)	0.21
C & E Loss (ft)		Cum SA (acres)	0.04

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5860.76	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.17	Wt. n-Val.		117.000
W.S. Elev (ft)	5860.59	Reach Len. (ft)	117.00	130.00
130.00				
Crit W.S. (ft)	5858.15	Flow Area (sq ft)		34.09
E.G. Slope (ft/ft)	25243.440000	Area (sq ft)		
34.09				
Q Total (cfs)	111.50	Flow (cfs)		111.50
Top Width (ft)	8.00	Top Width (ft)		8.00
Vel Total (ft/s)	3.27	Avg. Vel. (ft/s)		3.27
Max Chl Dpth (ft)	4.26	Hydr. Depth (ft)		4.26
Conv. Total (cfs)	0.7	Conv. (cfs)		0.7
Length Wtd. (ft)	130.00	Wetted Per. (ft)		16.52
Min Ch El (ft)	5856.33	Shear (lb/sq ft)		3251744.00
Alpha	1.00	Stream Power (lb/ft s)		
10634480.00				
Frctn Loss (ft)		Cum Volume (acre-ft)		0.11
C & E Loss (ft)		Cum SA (acres)		0.04

CULVERT

RIVER: Outlet  
 REACH: Outlet

RS: 4975

INPUT

Description: Entrance to Culvert Under Grinnell

Distance from Upstream XS = 25

Deck/Roadway Width = 80

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num=		2							
Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
0		5866		5864	200		5866		5864

Upstream Bridge Cross Section Data

Station Elevation Data		num=		5					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
96	5866	96	5856.33	100	5856.33	104	5856.33	104	5866

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
96	.015	96	.117	104	.117

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	96	104		.1	.3

Downstream Deck/Roadway Coordinates

num=		2							
Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
0		5866		5864	200		5866		5864

Downstream Bridge Cross Section Data

Station Elevation Data		num=		5					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
96.9	5866	96.9	5855.93	100	5855.93	103.1	5855.93	103.1	5866

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
96.9	.035	96.9	.035	103.1	.035

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	96.9	103.1		.1	.3

Upstream Embankment side slope = 1 horiz. to 1.0 vertical  
 Downstream Embankment side slope = 1 horiz. to 1.0 vertical  
 Maximum allowable submergence for weir flow = .98  
 Elevation at which weir flow begins =  
 Energy head used in spillway design =  
 Spillway height used in design =  
 Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span



Culvert #1          Circular          6  
 FHWA Chart # 1 - Concrete Pipe Culvert  
 FHWA Scale # 3 - Groove end entrance; pipe projecting from fill  
 Solution Criteria = Highest U.S. EG  
 Culvert Upstrm Dist    Length      Top n    Bottom n    Depth Blocked    Entrance Loss Coef  
 Exit Loss Coef  
                          25          80          .013      .013          0                           .5  
                          1  
 Upstream    Elevation = 5856.33  
                          Centerline Station = 100  
 Downstream Elevation = 5855.93  
                          Centerline Station = 100

CULVERT OUTPUT Profile #PF 1 Culv Group: Culvert #1

Q Culv Group (cfs)	239.10	Culv Full Len (ft)	80.00
# Barrels	1	Culv Vel US (ft/s)	8.46
Q Barrel (cfs)	239.10	Culv Vel DS (ft/s)	8.46
E.G. US. (ft)	5865.01	Culv Inv El Up (ft)	5856.33
W.S. US. (ft)	5864.82	Culv Inv El Dn (ft)	5855.93
E.G. DS (ft)	5863.54	Culv Frctn Ls (ft)	0.26
W.S. DS (ft)	5863.09	Culv Exit Loss (ft)	0.66
Delta EG (ft)	1.47	Culv Entr Loss (ft)	0.56
Delta WS (ft)	1.73	Q Weir (cfs)	
E.G. IC (ft)	5862.82	Weir Sta Lft (ft)	
E.G. OC (ft)	5865.01	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	5862.33	Weir Max Depth (ft)	
Culv WS Outlet (ft)	5861.93	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	4.24	Min El Weir Flow (ft)	5866.01

CULVERT OUTPUT Profile #PF 2 Culv Group: Culvert #1

Q Culv Group (cfs)	111.50	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	7.33
Q Barrel (cfs)	111.50	Culv Vel DS (ft/s)	6.11
E.G. US. (ft)	5860.76	Culv Inv El Up (ft)	5856.33
W.S. US. (ft)	5860.59	Culv Inv El Dn (ft)	5855.93
E.G. DS (ft)	5859.99	Culv Frctn Ls (ft)	0.14
W.S. DS (ft)	5859.62	Culv Exit Loss (ft)	0.21
Delta EG (ft)	0.77	Culv Entr Loss (ft)	0.42
Delta WS (ft)	0.97	Q Weir (cfs)	
E.G. IC (ft)	5860.34	Weir Sta Lft (ft)	
E.G. OC (ft)	5860.76	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	5859.51	Weir Max Depth (ft)	
Culv WS Outlet (ft)	5859.62	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	2.54	Weir Flow Area (sq ft)	

Culv Crt Depth (ft)                    2.85      Min El Weir Flow (ft)      5866.01

CROSS SECTION

RIVER: Outlet  
 REACH: Outlet                            RS: 4870

INPUT

Description: Grinnell 72" Cuvert Exit Section for Model Only

Station Elevation Data      num=      5  
      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev  
      96.9    5866      96.9 5855.93      100 5855.93      103.1 5855.93      103.1    5866

Manning's n Values                    num=      3  
      Sta    n Val      Sta    n Val      Sta    n Val  
      96.9    .035      96.9    .035      103.1    .035

Bank Sta: Left    Right      Lengths: Left Channel    Right      Coeff Contr.    Expan.  
                   96.9    103.1                    100      100      100                    .1                    .3

CROSS SECTION OUTPUT    Profile #PF 1

E.G. Elev (ft)	5863.54	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.45	Wt. n-Val.		0.035
W.S. Elev (ft)	5863.09	Reach Len. (ft)	100.00	100.00
100.00				
Crit W.S. (ft)	5859.51	Flow Area (sq ft)		44.40
E.G. Slope (ft/ft)	0.005749	Area (sq ft)		44.40
Q Total (cfs)	239.10	Flow (cfs)		239.10
Top Width (ft)	6.20	Top Width (ft)		6.20
Vel Total (ft/s)	5.38	Avg. Vel. (ft/s)		5.38
Max Chl Dpth (ft)	7.16	Hydr. Depth (ft)		7.16
Conv. Total (cfs)	3153.3	Conv. (cfs)		3153.3
Length Wtd. (ft)	100.00	Wetted Per. (ft)		20.52
Min Ch El (ft)	5855.93	Shear (lb/sq ft)		0.78
Alpha	1.00	Stream Power (lb/ft s)		4.18

Frctn Loss (ft)	0.54	Cum Volume (acre-ft)	0.10
C & E Loss (ft)	0.01	Cum SA (acres)	0.01

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5859.99	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.37	Wt. n-Val.		0.035
W.S. Elev (ft)	5859.62	Reach Len. (ft)	100.00	100.00
100.00				
Crit W.S. (ft)	5858.08	Flow Area (sq ft)		22.89
E.G. Slope (ft/ft)	0.006568	Area (sq ft)		22.89
Q Total (cfs)	111.50	Flow (cfs)		111.50
Top Width (ft)	6.20	Top Width (ft)		6.20
Vel Total (ft/s)	4.87	Avg. Vel. (ft/s)		4.87
Max Chl Dpth (ft)	3.69	Hydr. Depth (ft)		3.69
Conv. Total (cfs)	1375.9	Conv. (cfs)		1375.9
Length Wtd. (ft)	100.00	Wetted Per. (ft)		13.58
Min Ch El (ft)	5855.93	Shear (lb/sq ft)		0.69
Alpha	1.00	Stream Power (lb/ft s)		3.37
Frctn Loss (ft)	0.57	Cum Volume (acre-ft)		0.06
C & E Loss (ft)	0.02	Cum SA (acres)		0.01

CROSS SECTION

RIVER: Outlet  
REACH: Outlet

RS: 4770

INPUT

Description: Grinnell 72" Cuvert Exit Section for Model Only

Station Elevation Data		num= 5							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
96.9	5870	96.9	5855	100	5855	103.1	5855	103.1	5870

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
96.9	.035	96.9	.035	103.1	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	96.9	103.1		100	100	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5862.99	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.40	Wt. n-Val.		0.035
W.S. Elev (ft)	5862.59	Reach Len. (ft)		
Crit W.S. (ft)	5858.58	Flow Area (sq ft)		47.07
E.G. Slope (ft/ft)	0.005001	Area (sq ft)		47.07
Q Total (cfs)	239.10	Flow (cfs)		239.10
Top Width (ft)	6.20	Top Width (ft)		6.20
Vel Total (ft/s)	5.08	Avg. Vel. (ft/s)		5.08
Max Chl Dpth (ft)	7.59	Hydr. Depth (ft)		7.59
Conv. Total (cfs)	3381.2	Conv. (cfs)		3381.2
Length Wtd. (ft)		Wetted Per. (ft)		21.38
Min Ch El (ft)	5855.00	Shear (lb/sq ft)		0.69
Alpha	1.00	Stream Power (lb/ft s)		3.49
Frctn Loss (ft)		Cum Volume (acre-ft)		
C & E Loss (ft)		Cum SA (acres)		

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5859.40	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.30	Wt. n-Val.		0.035
W.S. Elev (ft)	5859.10	Reach Len. (ft)		
Crit W.S. (ft)	5857.15	Flow Area (sq ft)		25.42
E.G. Slope (ft/ft)	0.005003	Area (sq ft)		25.42
Q Total (cfs)	111.50	Flow (cfs)		111.50
Top Width (ft)	6.20	Top Width (ft)		6.20
Vel Total (ft/s)	4.39	Avg. Vel. (ft/s)		4.39
Max Chl Dpth (ft)	4.10	Hydr. Depth (ft)		4.10
Conv. Total (cfs)	1576.4	Conv. (cfs)		1576.4
Length Wtd. (ft)		Wetted Per. (ft)		14.40
Min Ch El (ft)	5855.00	Shear (lb/sq ft)		0.55
Alpha	1.00	Stream Power (lb/ft s)		2.42
Frctn Loss (ft)		Cum Volume (acre-ft)		
C & E Loss (ft)		Cum SA (acres)		

CROSS SECTION

RIVER: South Ditch

REACH: South

RS: 750

INPUT

Description: South Ditch River Station

Station Elevation Data

num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
60	5869	87.63	5868	89.19	5867	100	5867	109.1	5867
121.9	5868	130.9	5869	138.4	5870				

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val

60 .025 87.63 .035 130.9 .025

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
87.63	130.9	99	99	99	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5867.46	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.14	Wt. n-Val.		0.035
W.S. Elev (ft)	5867.32	Reach Len. (ft)	99.00	99.00
99.00				
Crit W.S. (ft)	5867.32	Flow Area (sq ft)		7.11
E.G. Slope (ft/ft)	0.026768	Area (sq ft)		7.11
Q Total (cfs)	21.60	Flow (cfs)		21.60
Top Width (ft)	24.51	Top Width (ft)		24.51
Vel Total (ft/s)	3.04	Avg. Vel. (ft/s)		3.04
Max Chl Dpth (ft)	0.32	Hydr. Depth (ft)		0.29
Conv. Total (cfs)	132.0	Conv. (cfs)		132.0
Length Wtd. (ft)	99.00	Wetted Per. (ft)		24.62
Min Ch El (ft)	5867.00	Shear (lb/sq ft)		0.48
Alpha	1.00	Stream Power (lb/ft s)		1.47
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.08	0.77
0.08				
C & E Loss (ft)	0.04	Cum SA (acres)	0.06	0.25
0.06				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical

depth for the water surface and continued on with the calculations.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate

the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5867.29	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.09	Wt. n-Val.		0.035
W.S. Elev (ft)	5867.20	Reach Len. (ft)	99.00	99.00
99.00				
Crit W.S. (ft)	5867.20	Flow Area (sq ft)		4.31
E.G. Slope (ft/ft)	0.029971	Area (sq ft)		4.31
Q Total (cfs)	10.40	Flow (cfs)		10.40
Top Width (ft)	22.81	Top Width (ft)		22.81
Vel Total (ft/s)	2.41	Avg. Vel. (ft/s)		2.41
Max Chl Dpth (ft)	0.20	Hydr. Depth (ft)		0.19
Conv. Total (cfs)	60.1	Conv. (cfs)		60.1
Length Wtd. (ft)	99.00	Wetted Per. (ft)		22.87
Min Ch El (ft)	5867.00	Shear (lb/sq ft)		0.35
Alpha	1.00	Stream Power (lb/ft s)		0.85
Frctn Loss (ft)	0.84	Cum Volume (acre-ft)		0.09
C & E Loss (ft)	0.00	Cum SA (acres)		0.14

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical

depth for the water surface and continued on with the calculations.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate

the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: South Ditch  
 REACH: South RS: 651

INPUT

Description: South Ditch River Station Grade Break

Station Elevation Data		num= 13		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
84.23	5867	87.23	5866	90.23	5865	93.23	5864	96.23	5863
98	5862.41	100	5862.41	102	5862.41	103.77	5863	106.77	5864
109.77	5865	112.77	5866	115.77	5867				

Manning's n Values		num= 3		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val
84.23	.02	87.23	.02	112.77	.02

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	87.23	112.77		51	51		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.06	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.01	Wt. n-Val.		0.020
W.S. Elev (ft)	5865.05	Reach Len. (ft)	51.00	51.00
51.00				
Crit W.S. (ft)	5863.19	Flow Area (sq ft)		31.43
E.G. Slope (ft/ft)	0.000049	Area (sq ft)		31.43
Q Total (cfs)	21.60	Flow (cfs)		21.60
Top Width (ft)	19.83	Top Width (ft)		19.83
Vel Total (ft/s)	0.69	Avg. Vel. (ft/s)		0.69
Max Chl Dpth (ft)	2.64	Hydr. Depth (ft)		1.58
Conv. Total (cfs)	3085.7	Conv. (cfs)		3085.7



Length Wtd. (ft)	51.00	Wetted Per. (ft)		20.68
Min Ch El (ft)	5862.41	Shear (lb/sq ft)		0.00
Alpha	1.00	Stream Power (lb/ft s)		0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.08	0.72
0.08				
C & E Loss (ft)	0.00	Cum SA (acres)	0.06	0.20
0.06				

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5863.16	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.12	Wt. n-Val.		0.020
W.S. Elev (ft)	5863.04	Reach Len. (ft)	51.00	51.00
51.00				
Crit W.S. (ft)	5862.93	Flow Area (sq ft)		3.71
E.G. Slope (ft/ft)	0.003955	Area (sq ft)		3.71
Q Total (cfs)	10.40	Flow (cfs)		10.40
Top Width (ft)	7.78	Top Width (ft)		7.78
Vel Total (ft/s)	2.80	Avg. Vel. (ft/s)		2.80
Max Chl Dpth (ft)	0.63	Hydr. Depth (ft)		0.48
Conv. Total (cfs)	165.4	Conv. (cfs)		165.4
Length Wtd. (ft)	51.00	Wetted Per. (ft)		7.98
Min Ch El (ft)	5862.41	Shear (lb/sq ft)		0.11
Alpha	1.00	Stream Power (lb/ft s)		0.32
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)		0.08
C & E Loss (ft)	0.01	Cum SA (acres)		0.11

CROSS SECTION

RIVER: South Ditch  
 REACH: South RS: 600

INPUT

Description: South Ditch River Station 6+00

Station Elevation Data		num= 12							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
86.47	5866	89.47	5865	92.47	5864	95.47	5863	98	5862.15
100	5862.15	102	5862.15	104.53	5863	107.53	5864	110.53	5865
113.53	5866	116.53	5867						

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
86.47	.025	92.47	.025	107.53	.025

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	92.47	107.53		200	200		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

			Left OB	Channel
E.G. Elev (ft)	5865.05	Element		
Right OB				
Vel Head (ft)	0.01	Wt. n-Val.	0.025	0.025
0.025				
W.S. Elev (ft)	5865.05	Reach Len. (ft)	200.00	200.00
200.00				
Crit W.S. (ft)	5862.94	Flow Area (sq ft)	1.64	33.37
1.64				
E.G. Slope (ft/ft)	0.000040	Area (sq ft)	1.64	33.37
1.64				
Q Total (cfs)	21.60	Flow (cfs)	0.39	20.82
0.39				
Top Width (ft)	21.34	Top Width (ft)	3.14	15.06
3.14				
Vel Total (ft/s)	0.59	Avg. Vel. (ft/s)	0.24	0.62
0.24				
Max Chl Dpth (ft)	2.90	Hydr. Depth (ft)	0.52	2.22
0.52				
Conv. Total (cfs)	3406.4	Conv. (cfs)	61.2	3284.0
61.2				
Length Wtd. (ft)	200.00	Wetted Per. (ft)	3.31	15.66
3.31				
Min Ch El (ft)	5862.15	Shear (lb/sq ft)	0.00	0.01
0.00				
Alpha	1.09	Stream Power (lb/ft s)	0.00	0.00
0.00				

Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.08	0.69
0.08				
C & E Loss (ft)	0.00	Cum SA (acres)	0.06	0.18
0.06				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5862.96	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.09	Wt. n-Val.		0.025
W.S. Elev (ft)	5862.87	Reach Len. (ft)	200.00	200.00
200.00				
Crit W.S. (ft)	5862.67	Flow Area (sq ft)		4.41
E.G. Slope (ft/ft)	0.003787	Area (sq ft)		4.41
Q Total (cfs)	10.40	Flow (cfs)		10.40
Top Width (ft)	8.28	Top Width (ft)		8.28
Vel Total (ft/s)	2.36	Avg. Vel. (ft/s)		2.36
Max Chl Dpth (ft)	0.72	Hydr. Depth (ft)		0.53
Conv. Total (cfs)	169.0	Conv. (cfs)		169.0
Length Wtd. (ft)	200.00	Wetted Per. (ft)		8.51
Min Ch El (ft)	5862.15	Shear (lb/sq ft)		0.12
Alpha	1.00	Stream Power (lb/ft s)		0.29
Frctn Loss (ft)	1.07	Cum Volume (acre-ft)		0.07
C & E Loss (ft)	0.01	Cum SA (acres)		0.10

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: South Ditch  
 REACH: South RS: 400

INPUT

Description: South Ditch River Station 4+00

Station Elevation Data		num=		13							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
83.47	5866	86.47	5865	89.47	5864	92.47	5863	95.47	5862		
98	5861.16	100	5861.16	102	5861.16	104.53	5862	107.53	5863		
110.53	5864	113.53	5865	116.53	5866						

Manning's n Values		num=		3					
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
83.47	.02	92.47	.02	107.53	.02				

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	92.47	107.53		200	200		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

		Element	Left OB	Channel
E.G. Elev (ft)	5865.05			
Right OB				
Vel Head (ft)	0.00	Wt. n-Val.	0.020	0.020
0.020				
W.S. Elev (ft)	5865.05	Reach Len. (ft)	200.00	200.00
200.00				
Crit W.S. (ft)	5861.94	Flow Area (sq ft)	6.28	48.36
6.28				
E.G. Slope (ft/ft)	0.000006	Area (sq ft)	6.28	48.36
6.28				
Q Total (cfs)	21.60	Flow (cfs)	1.16	19.29
1.16				
Top Width (ft)	27.34	Top Width (ft)	6.14	15.06
6.14				
Vel Total (ft/s)	0.35	Avg. Vel. (ft/s)	0.18	0.40
0.18				
Max Chl Dpth (ft)	3.89	Hydr. Depth (ft)	1.02	3.21
1.02				
Conv. Total (cfs)	8533.8	Conv. (cfs)	457.2	7619.4
457.2				
Length Wtd. (ft)	200.00	Wetted Per. (ft)	6.47	15.66
6.47				

Min Ch El (ft) 0.00	5861.16	Shear (lb/sq ft)	0.00	0.00
Alpha 0.00	1.16	Stream Power (lb/ft s)	0.00	0.00
Frctn Loss (ft) 0.06	0.00	Cum Volume (acre-ft)	0.06	0.50
C & E Loss (ft) 0.04	0.00	Cum SA (acres)	0.04	0.11

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft) Right OB	5861.88	Element	Left OB	Channel
Vel Head (ft)	0.20	Wt. n-Val.		0.020
W.S. Elev (ft) 200.00	5861.68	Reach Len. (ft)	200.00	200.00
Crit W.S. (ft)	5861.68	Flow Area (sq ft)		2.88
E.G. Slope (ft/ft)	0.008140	Area (sq ft)		2.88
Q Total (cfs)	10.40	Flow (cfs)		10.40
Top Width (ft)	7.12	Top Width (ft)		7.12
Vel Total (ft/s)	3.61	Avg. Vel. (ft/s)		3.61
Max Chl Dpth (ft)	0.52	Hydr. Depth (ft)		0.40
Conv. Total (cfs)	115.3	Conv. (cfs)		115.3
Length Wtd. (ft)	200.00	Wetted Per. (ft)		7.29
Min Ch El (ft)	5861.16	Shear (lb/sq ft)		0.20
Alpha	1.00	Stream Power (lb/ft s)		0.73
Frctn Loss (ft)	0.44	Cum Volume (acre-ft)		0.06
C & E Loss (ft)	0.05	Cum SA (acres)		0.06

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated

water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: South Ditch

REACH: South RS: 200

INPUT

Description: South Ditch River Station

Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
80.57	5866	83.57	5865	86.57	5864	89.57	5863	92.57	5862
95.47	5861	98	5860.16	100	5860.16	102	5860.16	104.53	5861
107.53	5862	110.53	5863	113.53	5864	116.53	5865	119.53	5866

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
80.57	.035	89.57	.035	110.53	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	89.57	110.53		70	70		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.05	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.00	Wt. n-Val.	0.035	0.035
0.035				
W.S. Elev (ft)	5865.05	Reach Len. (ft)	70.00	70.00
70.00				
Crit W.S. (ft)	5860.94	Flow Area (sq ft)	6.28	78.34
6.28				
E.G. Slope (ft/ft)	0.000007	Area (sq ft)	6.28	78.34
6.28				
Q Total (cfs)	21.60	Flow (cfs)	0.68	20.24
0.68				
Top Width (ft)	33.24	Top Width (ft)	6.14	20.96
6.14				
Vel Total (ft/s)	0.24	Avg. Vel. (ft/s)	0.11	0.26
0.11				
Max Chl Dpth (ft)	4.89	Hydr. Depth (ft)	1.02	3.74

1.02				
Conv. Total (cfs)	8304.5	Conv. (cfs)	261.3	7782.0
261.3				
Length Wtd. (ft)	70.00	Wetted Per. (ft)	6.47	21.89
6.47				
Min Ch El (ft)	5860.16	Shear (lb/sq ft)	0.00	0.00
0.00				
Alpha	1.12	Stream Power (lb/ft s)	0.00	0.00
0.00				
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.03	0.21
0.03				
C & E Loss (ft)	0.00	Cum SA (acres)	0.01	0.03
0.01				

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5861.37	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.02	Wt. n-Val.		0.035
W.S. Elev (ft)	5861.35	Reach Len. (ft)	70.00	70.00
70.00				
Crit W.S. (ft)	5860.68	Flow Area (sq ft)		9.06
E.G. Slope (ft/ft)	0.001010	Area (sq ft)		9.06
Q Total (cfs)	10.40	Flow (cfs)		10.40
Top Width (ft)	11.15	Top Width (ft)		11.15
Vel Total (ft/s)	1.15	Avg. Vel. (ft/s)		1.15
Max Chl Dpth (ft)	1.19	Hydr. Depth (ft)		0.81
Conv. Total (cfs)	327.2	Conv. (cfs)		327.2
Length Wtd. (ft)	70.00	Wetted Per. (ft)		11.53
Min Ch El (ft)	5860.16	Shear (lb/sq ft)		0.05
Alpha	1.00	Stream Power (lb/ft s)		0.06
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)		0.03
C & E Loss (ft)	0.00	Cum SA (acres)		0.02

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: South Ditch  
 REACH: South RS: 130

INPUT

Description: South Channel River Station Above confluence with East Channel

Station Elevation Data		num= 17		Sta		Elev		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
79.42	5866	82.42	5865	85.42	5864	88.42	5863	91.42	5862		
94.42	5861	97.42	5860	98	5859.81	100	5859.81	102	5859.81		
102.58	5860	105.58	5861	108.58	5862	111.58	5863	114.58	5864		
117.58	5865	120.58	5866								

Manning's n Values		num= 3		Sta		n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
79.42	.035	91.42	.035	108.58	.035		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	91.42	108.58		41	41	50		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.05	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.00	Wt. n-Val.	0.035	0.035
0.035				
W.S. Elev (ft)	5865.05	Reach Len. (ft)	41.00	41.00
41.00				
Crit W.S. (ft)	5860.60	Flow Area (sq ft)	13.91	75.45
13.91				
E.G. Slope (ft/ft)	0.000005	Area (sq ft)	13.91	75.45
13.91				
Q Total (cfs)	21.60	Flow (cfs)	1.65	18.30
1.65				
Top Width (ft)	35.43	Top Width (ft)	9.14	17.16
9.14				
Vel Total (ft/s)	0.21	Avg. Vel. (ft/s)	0.12	0.24
0.12				
Max Chl Dpth (ft)	5.24	Hydr. Depth (ft)	1.52	4.40
1.52				
Conv. Total (cfs)	9877.2	Conv. (cfs)	754.7	8367.7



754.7				
Length Wtd. (ft)	41.00	Wetted Per. (ft)	9.63	17.87
9.63				
Min Ch El (ft)	5859.81	Shear (lb/sq ft)	0.00	0.00
0.00				
Alpha	1.19	Stream Power (lb/ft s)	0.00	0.00
0.00				
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.01	0.08
0.01				
C & E Loss (ft)	0.00	Cum SA (acres)		

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5861.33	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.01	Wt. n-Val.		0.035
W.S. Elev (ft)	5861.32	Reach Len. (ft)	41.00	41.00
41.00				
Crit W.S. (ft)	5860.32	Flow Area (sq ft)		12.90
E.G. Slope (ft/ft)	0.000386	Area (sq ft)		12.90
Q Total (cfs)	10.40	Flow (cfs)		10.40
Top Width (ft)	13.08	Top Width (ft)		13.08
Vel Total (ft/s)	0.81	Avg. Vel. (ft/s)		0.81
Max Chl Dpth (ft)	1.51	Hydr. Depth (ft)		0.99
Conv. Total (cfs)	529.6	Conv. (cfs)		529.6
Length Wtd. (ft)	41.00	Wetted Per. (ft)		13.56
Min Ch El (ft)	5859.81	Shear (lb/sq ft)		0.02
Alpha	1.00	Stream Power (lb/ft s)		0.02
Frctn Loss (ft)	0.22	Cum Volume (acre-ft)		0.01
C & E Loss (ft)	0.04	Cum SA (acres)		

CROSS SECTION

RIVER: South Ditch

REACH: North

RS: 89

INPUT

Description: Confluence Section South Ditch with East Ditch

Station Elevation Data		num=		17					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
78.76	5866	81.76	5865	84.76	5864	87.76	5863	90.76	5862
93.76	5861	96.76	5860	98	5859.58	100	5859.58	105.75	5859.58
107	5860	110	5861	113	5862	116	5863	119	5864
122	5865	125	5866						

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
78.76	.035	90.76	.035	113	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	90.76	113		34	34		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.04	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.02	Wt. n-Val.	0.035	0.035
0.035				
W.S. Elev (ft)	5865.02	Reach Len. (ft)	34.00	34.00
28.00				
Crit W.S. (ft)	5861.35	Flow Area (sq ft)	13.67	103.40
13.67				
E.G. Slope (ft/ft)	0.000122	Area (sq ft)	13.67	103.40
13.67				
Q Total (cfs)	148.10	Flow (cfs)	8.14	131.83
8.14				
Top Width (ft)	40.35	Top Width (ft)	9.06	22.24
9.06				
Vel Total (ft/s)	1.13	Avg. Vel. (ft/s)	0.60	1.27
0.60				
Max Chl Dpth (ft)	5.44	Hydr. Depth (ft)	1.51	4.65
1.51				
Conv. Total (cfs)	13423.3	Conv. (cfs)	737.4	11948.4
737.4				
Length Wtd. (ft)	33.79	Wetted Per. (ft)	9.55	23.03
9.55				
Min Ch El (ft)	5859.58	Shear (lb/sq ft)	0.01	0.03
0.01				
Alpha	1.16	Stream Power (lb/ft s)	0.01	0.04

0.01				
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.05	0.28
0.04				
C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.05
0.02				

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5861.07	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.42	Wt. n-Val.		0.035
W.S. Elev (ft)	5860.65	Reach Len. (ft)	34.00	34.00
28.00				
Crit W.S. (ft)	5860.65	Flow Area (sq ft)		11.71
E.G. Slope (ft/ft)	0.019697	Area (sq ft)		11.71
Q Total (cfs)	60.50	Flow (cfs)		60.50
Top Width (ft)	14.14	Top Width (ft)		14.14
Vel Total (ft/s)	5.17	Avg. Vel. (ft/s)		5.17
Max Chl Dpth (ft)	1.07	Hydr. Depth (ft)		0.83
Conv. Total (cfs)	431.1	Conv. (cfs)		431.1
Length Wtd. (ft)	34.00	Wetted Per. (ft)		14.49
Min Ch El (ft)	5859.58	Shear (lb/sq ft)		0.99
Alpha	1.00	Stream Power (lb/ft s)		5.13
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	0.00	0.07
0.00				
C & E Loss (ft)	0.10	Cum SA (acres)	0.00	0.03
0.00				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical

depth for the water surface and continued on with the calculations.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: South Ditch  
 REACH: North RS: 55

INPUT

Description: South Ditch River Station (1st Section Below Confluence)

Station Elevation Data		num= 19									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
74.68	5866	77.68	5865	80.68	5864	83.68	5863	86.68	5862		
89.68	5861	92.68	5860	95.68	5859	98	5858.16	100	5858.16		
102	5858.16	104.32	5859	107.32	5860	110.32	5861	113.32	5862		
116.32	5863	119.32	5864	122.32	5865	125.32	5866				

Manning's n Values		num= 3			
Sta	n Val	Sta	n Val	Sta	n Val
74.68	.035	83.68	.035	116.32	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	83.68	116.32		43	43		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.04	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.01	Wt. n-Val.	0.035	0.035
0.035				
W.S. Elev (ft)	5865.02	Reach Len. (ft)	43.00	43.00
43.00				
Crit W.S. (ft)	5860.35	Flow Area (sq ft)	6.14	153.90
6.14				
E.G. Slope (ft/ft)	0.000065	Area (sq ft)	6.14	153.90
6.14				
Q Total (cfs)	148.10	Flow (cfs)	2.05	144.00
2.05				
Top Width (ft)	44.78	Top Width (ft)	6.07	32.64
6.07				
Vel Total (ft/s)	0.89	Avg. Vel. (ft/s)	0.33	0.94
0.33				
Max Chl Dpth (ft)	6.86	Hydr. Depth (ft)	1.01	4.71
1.01				
Conv. Total (cfs)	18304.1	Conv. (cfs)	253.5	17797.1

253.5				
Length Wtd. (ft)	43.00	Wetted Per. (ft)	6.40	34.23
6.40				
Min Ch El (ft)	5858.16	Shear (lb/sq ft)	0.00	0.02
0.00				
Alpha	1.08	Stream Power (lb/ft s)	0.00	0.02
0.00				
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.04	0.17
0.04				
C & E Loss (ft)	0.00	Cum SA (acres)	0.01	0.03
0.01				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5860.81	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.07	Wt. n-Val.		0.035
W.S. Elev (ft)	5860.75	Reach Len. (ft)	43.00	43.00
43.00				
Crit W.S. (ft)	5859.56	Flow Area (sq ft)		29.51
E.G. Slope (ft/ft)	0.001385	Area (sq ft)		29.51
Q Total (cfs)	60.50	Flow (cfs)		60.50
Top Width (ft)	19.11	Top Width (ft)		19.11
Vel Total (ft/s)	2.05	Avg. Vel. (ft/s)		2.05
Max Chl Dpth (ft)	2.58	Hydr. Depth (ft)		1.54
Conv. Total (cfs)	1625.7	Conv. (cfs)		1625.7
Length Wtd. (ft)	43.00	Wetted Per. (ft)		19.97
Min Ch El (ft)	5858.16	Shear (lb/sq ft)		0.13
Alpha	1.00	Stream Power (lb/ft s)		0.26
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.00	0.06
0.00				
C & E Loss (ft)	0.02	Cum SA (acres)	0.00	0.02

0.00

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: South Ditch  
REACH: North RS: 12

INPUT

Description: South Ditch River Station  
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
72.55	5865	75.55	5864	78.55	5863	81.55	5862	84.55	5861
87.55	5860	90.55	5859	93.55	5858	96.55	5857	98	5856.67
100	5856.67	102	5856.67	103.45	5857	106.45	5858	109.45	5859
112.45	5860	115.45	5861	118.45	5862	121.45	5863	124.45	5864
127.45	5865								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
72.55	.035	90.55	.035	109.45	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	90.55	109.45		12	12		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5865.03	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.01	Wt. n-Val.	0.035	0.035
0.035				
W.S. Elev (ft)	5865.03	Reach Len. (ft)	12.00	12.00
12.00				
Crit W.S. (ft)	5858.73	Flow Area (sq ft)	54.47	141.49
54.47				
E.G. Slope (ft/ft)	0.000022	Area (sq ft)	54.47	141.49
54.47				
Q Total (cfs)	148.10	Flow (cfs)	21.77	104.57
21.77				
Top Width (ft)	54.90	Top Width (ft)	18.00	18.90
18.00				
Vel Total (ft/s)	0.59	Avg. Vel. (ft/s)	0.40	0.74
0.40				

Max Chl Dpth (ft)	8.36	Hydr. Depth (ft)	3.03	7.49
3.03				
Conv. Total (cfs)	31751.4	Conv. (cfs)	4666.3	22418.8
4666.3				
Length Wtd. (ft)	12.00	Wetted Per. (ft)	19.00	19.62
19.00				
Min Ch El (ft)	5856.67	Shear (lb/sq ft)	0.00	0.01
0.00				
Alpha	1.24	Stream Power (lb/ft s)	0.00	0.01
0.00				
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.01	0.03
0.01				
C & E Loss (ft)	0.02	Cum SA (acres)		

Warning: The cross-section end points had to be extended vertically for the computed water surface.

CROSS SECTION OUTPUT Profile #PF 2

E.G. Elev (ft)	5860.78	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.01	Wt. n-Val.	0.035	0.035
0.035				
W.S. Elev (ft)	5860.77	Reach Len. (ft)	12.00	12.00
12.00				
Crit W.S. (ft)	5857.97	Flow Area (sq ft)	4.70	61.06
4.70				
E.G. Slope (ft/ft)	0.000106	Area (sq ft)	4.70	61.06
4.70				
Q Total (cfs)	60.50	Flow (cfs)	1.83	56.84
1.83				
Top Width (ft)	29.52	Top Width (ft)	5.31	18.90
5.31				
Vel Total (ft/s)	0.86	Avg. Vel. (ft/s)	0.39	0.93
0.39				
Max Chl Dpth (ft)	4.10	Hydr. Depth (ft)	0.89	3.23
0.89				
Conv. Total (cfs)	5880.7	Conv. (cfs)	177.7	5525.3
177.7				
Length Wtd. (ft)	12.00	Wetted Per. (ft)	5.60	19.62
5.60				
Min Ch El (ft)	5856.67	Shear (lb/sq ft)	0.01	0.02
0.01				
Alpha	1.12	Stream Power (lb/ft s)	0.00	0.02
0.00				
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.00	0.01

0.00  
 C & E Loss (ft)                      0.02      Cum SA (acres)

SUMMARY OF MANNING'S N VALUES

River:East Ditch

Reach	River Sta.	n1	n2	n3
East	038	.045	.045	.045
East	033	.045	.045	.045

River:North Ditch

Reach	River Sta.	n1	n2	n3
North	460	.035	.035	.035
North	400	.035	.035	.035
North	307	.02	.02	.02
North	200	.035	.035	.035
North	012	.045	.045	.045

River:Outlet

Reach	River Sta.	n1	n2	n3
Outlet	4987	.015	117	117
Outlet	4975	Culvert		
Outlet	4870	.035	.035	.035
Outlet	4770	.035	.035	.035

River:South Ditch

Reach	River Sta.	n1	n2	n3
South	750	.025	.035	.025
South	651	.02	.02	.02
South	600	.025	.025	.025
South	400	.02	.02	.02
South	200	.035	.035	.035
South	130	.035	.035	.035
North	89	.035	.035	.035



North	55	.035	.035	.035
North	12	.035	.035	.035

SUMMARY OF REACH LENGTHS

River: East Ditch

Reach	River Sta.	Left	Channel	Right
East	038	5	5	5
East	033	33	33	33

River: North Ditch

Reach	River Sta.	Left	Channel	Right
North	460	60	60	60
North	400	86	93	100
North	307	107	107	107
North	200	200	200	200
North	012	12	12	12

River: Outlet

Reach	River Sta.	Left	Channel	Right
Outlet	4987	117	130	130
Outlet	4975	Culvert		
Outlet	4870	100	100	100
Outlet	4770	100	100	100

River: South Ditch

Reach	River Sta.	Left	Channel	Right
South	750	99	99	99
South	651	51	51	51
South	600	200	200	200
South	400	200	200	200
South	200	70	70	70
South	130	41	41	50
North	89	34	34	28
North	55	43	43	43
North	12	12	12	12

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: East Ditch

Reach	River Sta.	Contr.	Expan.
East	038	.1	.3
East	033	.1	.3

River: North Ditch

Reach	River Sta.	Contr.	Expan.
North	460	.1	.3
North	400	.1	.3
North	307	.1	.3
North	200	.1	.3
North	012	.1	.3

River: Outlet

Reach	River Sta.	Contr.	Expan.
Outlet	4987	.1	.3
Outlet	4975	Culvert	
Outlet	4870	.1	.3
Outlet	4770	.1	.3

River: South Ditch

Reach	River Sta.	Contr.	Expan.
South	750	.1	.3
South	651	.1	.3
South	600	.1	.3
South	400	.1	.3
South	200	.1	.3
South	130	.1	.3
North	89	.1	.3
North	55	.1	.3
North	12	.1	.3

## **Appendix B: HY-8 Analysis of Grinnell Culvert**

# HY-8 Culvert Analysis Report

## Crossing Discharge Data

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

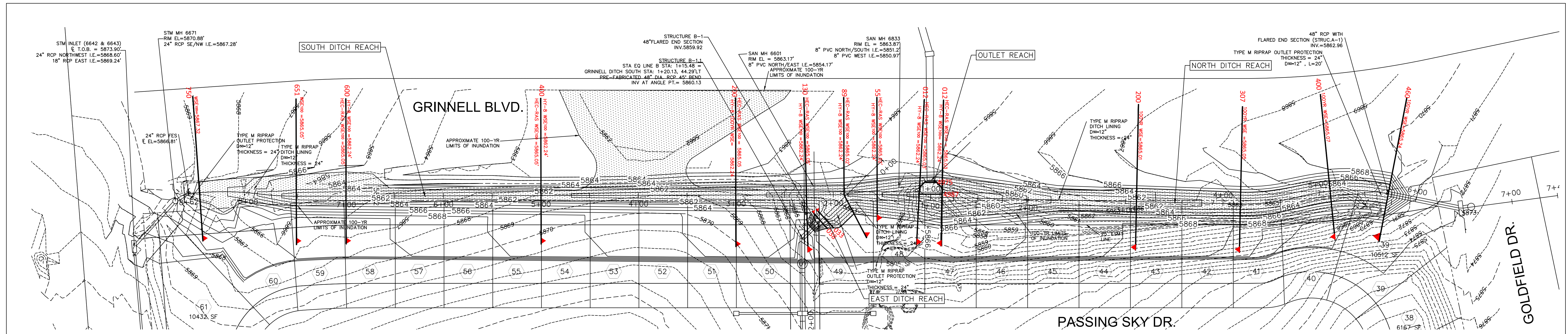
Minimum Flow: 111 cfs

Design Flow: 239.1 cfs

Maximum Flow: 250 cfs

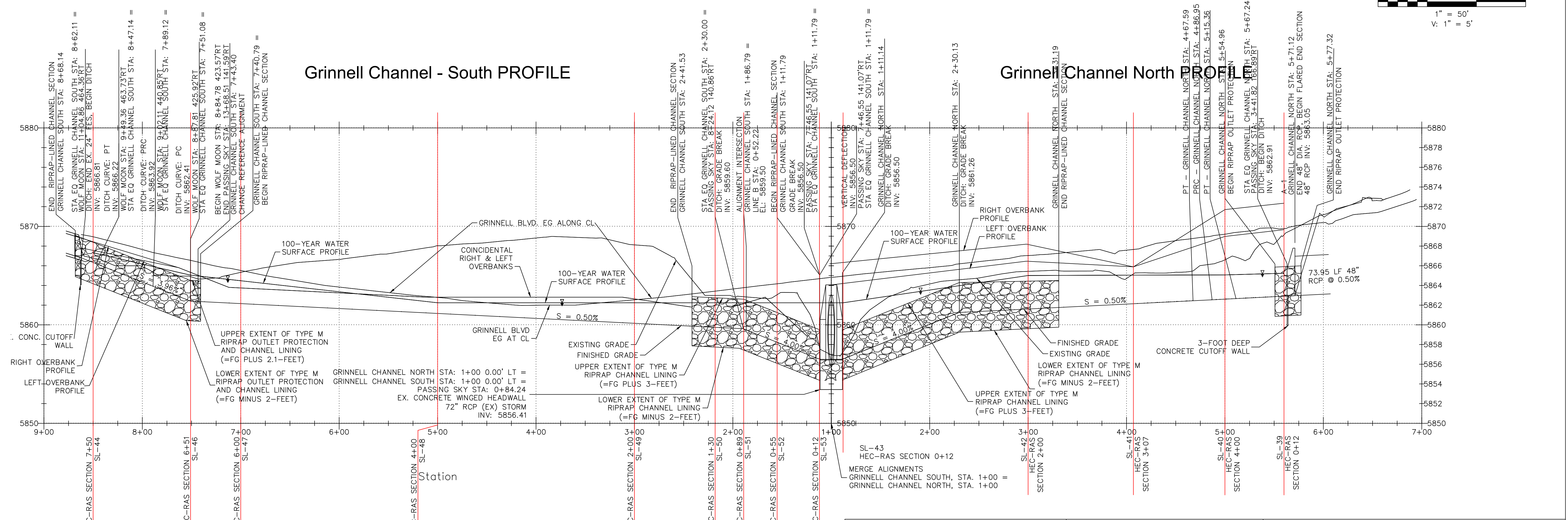
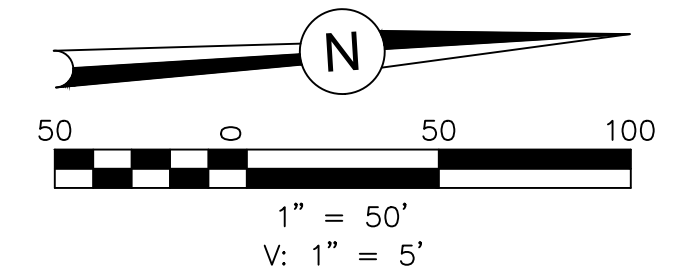
**Table 1 - Summary of Culvert Flows at Crossing: ex. 72**

Headwater Elevation (ft)	Total Discharge (cfs)	ex.72 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5860.13	111.00	111.00	0.00	1
5860.44	124.90	124.90	0.00	1
5860.74	138.80	138.80	0.00	1
5861.03	152.70	152.70	0.00	1
5861.31	166.60	166.60	0.00	1
5861.60	180.50	180.50	0.00	1
5861.89	194.40	194.40	0.00	1
5862.07	208.30	203.11	4.90	13
5862.16	222.20	207.10	14.84	8
<b>5862.24</b>	<b>239.10</b>	<b>210.65</b>	<b>28.02</b>	<b>6</b>
5862.28	250.00	212.63	37.00	5
5861.97	198.27	198.27	0.00	Overtopping



## HY-8 APPENDED HEC-RAS SECTION MAP

### NORTH & SOUTH REACHES



REVISIONS:		
NO.	DESCRIPTION	DATE

ENGINEER: \_\_\_\_\_  
 DESIGNED BY: CEB DATE: 3/11/20  
 DRAWN BY: CEB DATE: 3/11/20  
 CHECKED BY: CC DATE: 3/11/20

48 HOURS BEFORE YOU DIG,  
 CALL UTILITY LOCATORS  
 1-800-922-1987  
 CITY OF COLORADO SPRINGS DEPT. OF UTILITIES  
 GAS, ELECTRIC, WATER AND WASTEWATER

**DSE** *Dakota Springs Engineering*

31 N. TEJON, SUITE 518  
 COLORADO SPRINGS, CO 80903  
 P: (719) 227-7388  
 F: (719) 227-7392

PROJECT SPRINGS AT WATERVIEW

SHEET TITLE HY8-APPENDED HEC-RAS EXHIBIT

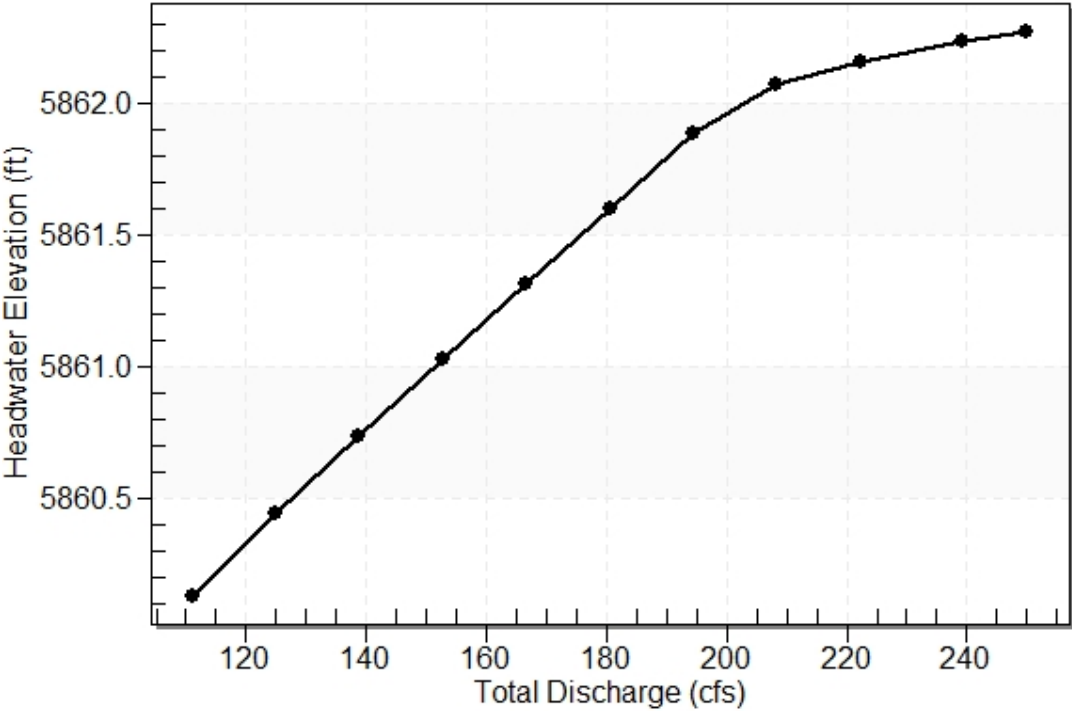
FROM START \_\_\_\_\_ TO END \_\_\_\_\_

JOB NO. 0102.1 SHEET 1 OF 1

Rating Curve Plot for Crossing: ex. 72

### Total Rating Curve

Crossing: ex. 72



**Table 2 - Culvert Summary Table: ex.72**

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
111.00	111.00	5860.13	4.102	0.078	1-S2n	0.000	0.000	1.816	0.784	15.374	47.193
124.90	124.90	5860.44	4.412	0.197	1-S2n	0.000	0.000	1.933	0.851	15.868	48.904
138.80	138.80	5860.74	4.709	0.330	1-S2n	0.000	0.000	2.045	0.917	16.316	50.451
152.70	152.70	5861.03	4.999	0.477	1-S2n	0.000	0.000	2.154	0.981	16.724	51.873
166.60	166.60	5861.31	5.284	0.638	1-S2n	0.000	0.000	2.260	1.044	17.101	53.172
180.50	180.50	5861.60	5.570	0.814	1-S2n	0.000	0.000	2.363	1.106	17.449	54.378
194.40	194.40	5861.89	5.859	1.003	1-S2n	0.000	0.000	2.464	1.168	17.772	55.500
208.30	203.11	5862.07	6.043	1.129	5-S2n	0.000	0.000	2.526	1.228	17.966	56.548
222.20	207.10	5862.16	6.128	1.188	5-S2n	0.000	0.000	2.554	1.288	18.053	57.523
239.10	210.65	5862.24	6.205	1.242	5-S2n	0.000	0.000	2.579	1.359	18.127	58.638
250.00	212.63	5862.28	6.248	1.272	5-S2n	0.000	0.000	2.593	1.405	18.167	59.315

\*\*\*\*\*

Single Broken-back Culvert

Inlet Elevation (invert): 5856.03 ft,

Break Elevation (invert): 5853.46 ft,

Culvert Length: 443.07 ft,

Upper Culvert Section Slope: 0.0198

Steep Culvert Section Slope: 0.0176

\*\*\*\*\*

**Site Data - ex.72**

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5856.03 ft

Break Station: 129.50 ft

Break Elevation: 5853.46 ft

Outlet Station: 443.00 ft

Outlet Elevation: 5847.95 ft

Number of Barrels: 1

Does not meet criteria for overtopping. Revise design.

**Culvert Data Summary - ex.72**

Barrel Shape: Circular

Barrel Diameter: 6.00 ft

Upper Section Material: Concrete

Lower Section Material:

Embedment: 0.00 in

Upper Section Manning's n: 0.0130

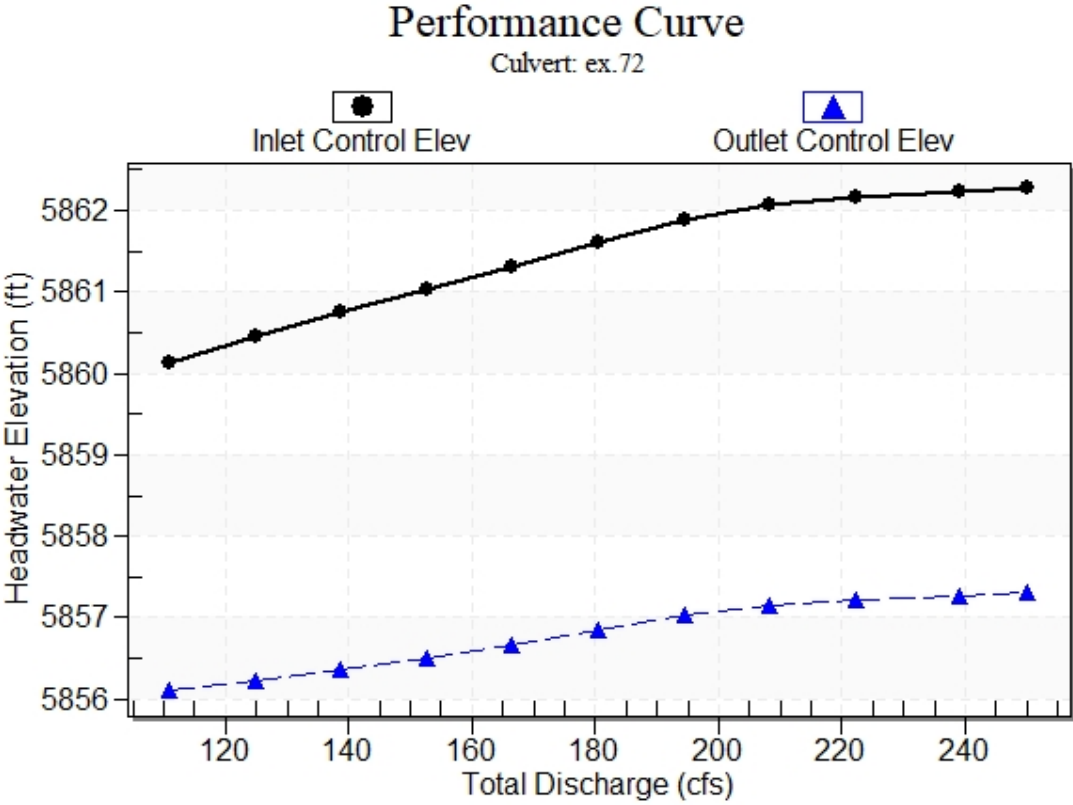
Lower Section Manning's n: 0.0130

Culvert Type: Single Broken-back

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Culvert Performance Curve Plot: ex.72

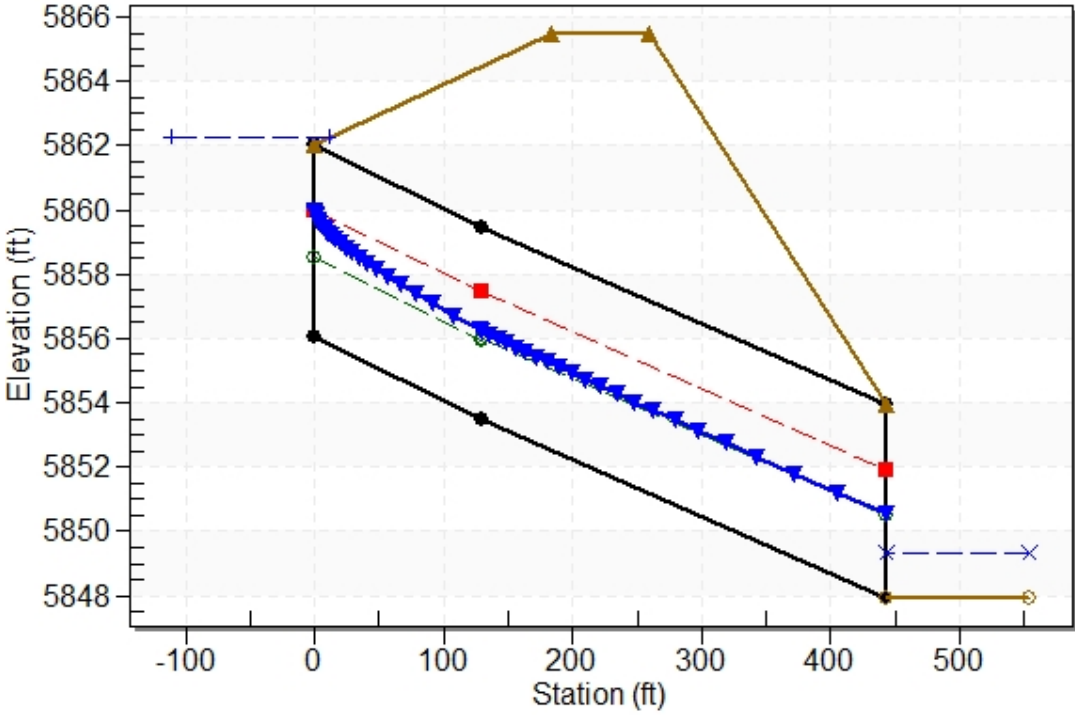




**Water Surface Profile Plot for Culvert: ex.72**

**Crossing - ex. 72, Design Discharge - 239.1 cfs**

Culvert - ex.72, Culvert Discharge - 210.6 cfs



**Table 3 - Downstream Channel Rating Curve (Crossing: ex. 72)**

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
111.00	5848.73	0.78	47.19	107.63	9.39
124.90	5848.80	0.85	48.90	116.87	9.34
138.80	5848.87	0.92	50.45	125.90	9.28
152.70	5848.93	0.98	51.87	134.71	9.23
166.60	5848.99	1.04	53.17	143.38	9.17
180.50	5849.06	1.11	54.38	151.89	9.11
194.40	5849.12	1.17	55.50	160.28	9.05
208.30	5849.18	1.23	56.55	168.56	8.99
222.20	5849.24	1.29	57.52	176.76	8.93
239.10	5849.31	1.36	58.64	186.59	8.86
250.00	5849.35	1.40	59.31	192.87	8.82

**Tailwater Channel Data - ex. 72**

Tailwater Channel Option: Rectangular Channel

Bottom Width: 3.00 ft

Channel Slope: 2.2000

Channel Manning's n: 0.0300

Channel Invert Elevation: 5847.95 ft

**Roadway Data for Crossing: ex. 72**

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	5865.50
1	25.00	5865.00
2	85.58	5864.00
3	175.00	5863.00
4	279.87	5862.00
5	285.34	5861.97
6	339.25	5862.00
7	446.09	5863.00
8	528.77	5864.00
9	617.11	5865.00
10	719.68	5866.00

Roadway Surface: Paved

Roadway Top Width: 75.00 ft

## **Appendix C: StormCAD Analysis of Main Trunk Line Storm Sewer**

\*\*\*\*\*  
Project Description  
\*\*\*\*\*

File Name ..... 0102-2 - Storm[20200213].SPF

\*\*\*\*\*  
Analysis Options  
\*\*\*\*\*

Flow Units ..... cfs  
Link Routing Method ..... Kinematic Wave  
Storage Node Exfiltration.. None  
Starting Date ..... MAR-28-2019 00:00:00  
Ending Date ..... MAR-29-2019 00:00:00  
Report Time Step ..... 00:05:00

\*\*\*\*\*  
Element Count  
\*\*\*\*\*

Number of subbasins ..... 0  
Number of nodes ..... 37  
Number of links ..... 36

\*\*\*\*\*  
Node Summary  
\*\*\*\*\*

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft <sup>2</sup>	External Inflow
A-1	JUNCTION	5862.96	5868.96	0.00	
A-2	JUNCTION	5863.35	5872.83	0.00	
B-1.1	JUNCTION	5860.14	5867.48	0.00	
B-2	JUNCTION	5861.25	5872.94	0.00	
B-3	JUNCTION	5865.59	5872.54	0.00	
B-4	JUNCTION	5869.04	5880.27	0.00	
B-5	JUNCTION	5869.53	5880.07	0.00	
B-6	JUNCTION	5878.05	5893.27	0.00	
B-7	JUNCTION	5887.07	5899.57	0.00	Yes
C-1	JUNCTION	5868.79	5872.50	0.00	Yes
D-1	JUNCTION	5868.79	5872.50	0.00	Yes
Ditch-Int	JUNCTION	5859.50	5865.50	0.00	Yes
E-1	JUNCTION	5868.12	5872.78	0.00	Yes
E-2	JUNCTION	5868.81	5872.32	0.00	Yes
E-3	JUNCTION	5870.00	5873.70	0.00	Yes
EX-FES1	JUNCTION	5866.81	5870.88	0.00	
F-1	JUNCTION	5867.40	5872.73	0.00	Yes
F-2	JUNCTION	5868.09	5872.10	0.00	Yes
F-3	JUNCTION	5869.79	5873.50	0.00	Yes
G-1	JUNCTION	5876.86	5880.56	0.00	Yes
H-1	JUNCTION	5876.33	5880.04	0.00	Yes
I-1	JUNCTION	5877.49	5881.20	0.00	Yes
J-1	JUNCTION	5876.81	5880.52	0.00	Yes
K-1	JUNCTION	5880.27	5887.38	0.00	
Null Structure	JUNCTION	5855.88	5861.88	0.00	
SDMH 6015 (EX)	JUNCTION	5886.78	5893.78	0.00	
SDMH 6472 (EX)	JUNCTION	5873.99	5878.89	0.00	
STR.B-1	JUNCTION	5859.82	5865.82	0.00	
Structure - (16)	JUNCTION	5915.43	5918.69	0.00	
Structure - (17)	JUNCTION	5913.66	5918.10	0.00	
Structure - (21)	JUNCTION	5868.60	5873.90	0.00	
Structure - (22)	JUNCTION	5867.28	5870.88	0.00	
Structure - (29)	JUNCTION	5851.80	5862.48	0.00	
Structure - (30)	JUNCTION	5850.34	5858.52	0.00	
Structure - (31)	JUNCTION	5848.75	5856.93	0.00	
Structure - (60)	JUNCTION	5867.16	5872.58	0.00	
EX-FES2	OUTFALL	5848.03	5854.03	0.00	

\*\*\*\*\*  
Link Summary  
\*\*\*\*\*

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
48FES-TO-TRAPCHANNELB-1.1		STR.B-1	CONDUIT	29.5	1.0707	0.0130
Ditch-A	A-1	Null Structure	CHANNEL	460.0	1.4250	0.0320
Ditch-both	Ditch-Int	Null Structure	CHANNEL	86.8	3.5599	0.0350
Ditch-Grinnell	EX-FES1	Ditch-Int	CHANNEL	630.1	1.1601	0.0320
Link-05	STR.B-1	Ditch-Int	CHANNEL	34.0	0.9412	0.0350
Pipe - (11)	Structure - (16)	Structure - (17)	CONDUIT	26.2	1.7959	0.0130
Pipe - (12)	Structure - (17)	SDMH 6015 (EX)	CONDUIT	516.1	5.2079	0.0130
Pipe - (13)	SDMH 6015 (EX)	K-1	CONDUIT	156.1	2.1592	0.0130
Pipe - (14)	K-1	SDMH 6472 (EX)	CONDUIT	150.4	4.1742	0.0130

Pipe - (15)	SDMH 6472 (EX)	Structure - (21)	CONDUIT	212.3	2.2376	0.0130
Pipe - (16)	Structure - (21)	Structure - (22)	CONDUIT	62.9	0.2000	0.0130
Pipe - (17)	Structure - (22)	EX-FES1	CONDUIT	15.4	3.0499	0.0130
Pipe - (21)	Null Structure	Structure - (29)	CONDUIT	129.5	0.5000	0.0130
Pipe - (22)	Structure - (29)	Structure - (30)	CONDUIT	71.4	0.5000	0.0130
Pipe - (23)	Structure - (30)	Structure - (31)	CONDUIT	97.5	0.5000	0.0130
Pipe - (24)	Structure - (31)	EX-FES2	CONDUIT	143.4	0.5000	0.0130
Pipe - (25)	A-2	A-1	CONDUIT	76.1	0.5000	0.0130
Pipe - (26)	B-7	B-6	CONDUIT	43.2	0.7234	0.0130
Pipe - (27)	B-6	B-5	CONDUIT	124.0	6.6256	0.0130
Pipe - (28)	B-5	B-4	CONDUIT	33.5	0.5742	0.0130
Pipe - (29)	B-4	B-3	CONDUIT	185.2	1.7032	0.0130
Pipe - (30)	B-3	B-2	CONDUIT	58.8	1.2635	0.0130
Pipe - (31)	B-2	B-1.1	CONDUIT	77.3	1.4415	0.0130
Pipe - (33)	C-1	B-2	CONDUIT	72.5	1.9953	0.0130
Pipe - (34)	D-1	B-2	CONDUIT	68.1	2.1325	0.0130
Pipe - (35)	E-3	E-2	CONDUIT	137.8	0.6401	0.0130
Pipe - (36)	E-2	E-1	CONDUIT	31.6	1.2508	0.0130
Pipe - (37)	E-1	B-3	CONDUIT	30.2	4.2565	0.0130
Pipe - (38)	F-3	F-2	CONDUIT	137.4	0.6220	0.0130
Pipe - (39)	F-2	F-1	CONDUIT	31.5	1.2426	0.0130
Pipe - (40)	F-1	B-3	CONDUIT	8.2	6.8868	0.0130
Pipe - (41)	G-1	B-4	CONDUIT	51.1	9.8202	0.0130
Pipe - (42)	H-1	B-4	CONDUIT	29.3	15.3474	0.0130
Pipe - (43)	I-1	B-5	CONDUIT	72.5	7.1194	0.0130
Pipe - (44)	J-1	B-5	CONDUIT	67.5	6.6293	0.0130
Pipe - (46)	Structure - (60)	A-2	CONDUIT	10.6	0.5000	0.0130

\*\*\*\*\*  
Cross Section Summary  
\*\*\*\*\*

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
48FES-TO-TRAPCHANNEL	CIRCULAR	4.00	4.00	1	12.57	1.00	148.64
Ditch-A	TRAPEZOIDAL	5.00	37.00	1	110.00	2.85	1225.18
Ditch-both	TRAPEZOIDAL	5.00	34.00	1	95.00	2.67	1463.49
Ditch-Grinnell	TRAPEZOIDAL	3.50	11.00	1	26.25	1.89	200.60
Link-05	TRAPEZOIDAL	6.00	43.00	1	150.00	3.34	1379.76
Pipe - (11)	CIRCULAR	1.50	1.50	1	1.77	0.38	14.08
Pipe - (12)	CIRCULAR	1.50	1.50	1	1.77	0.38	23.97
Pipe - (13)	CIRCULAR	1.50	1.50	1	1.77	0.38	15.44
Pipe - (14)	CIRCULAR	1.50	1.50	1	1.77	0.38	21.46
Pipe - (15)	CIRCULAR	1.50	1.50	1	1.77	0.38	15.71
Pipe - (16)	CIRCULAR	2.00	2.00	1	3.14	0.50	10.12
Pipe - (17)	CIRCULAR	2.00	2.00	1	3.14	0.50	39.51
Pipe - (21)	CIRCULAR	6.00	6.00	1	28.27	1.50	299.47
Pipe - (22)	CIRCULAR	6.00	6.00	1	28.27	1.50	299.47
Pipe - (23)	CIRCULAR	6.00	6.00	1	28.27	1.50	299.47
Pipe - (24)	CIRCULAR	6.00	6.00	1	28.27	1.50	299.47
Pipe - (25)	CIRCULAR	4.00	4.00	1	12.57	1.00	101.57
Pipe - (26)	CIRCULAR	4.00	4.00	1	12.57	1.00	122.18
Pipe - (27)	CIRCULAR	4.00	4.00	1	12.57	1.00	369.74
Pipe - (28)	CIRCULAR	4.00	4.00	1	12.57	1.00	108.85
Pipe - (29)	CIRCULAR	4.00	4.00	1	12.57	1.00	187.46
Pipe - (30)	CIRCULAR	4.00	4.00	1	12.57	1.00	161.46
Pipe - (31)	CIRCULAR	4.00	4.00	1	12.57	1.00	172.46
Pipe - (33)	CIRCULAR	1.50	1.50	1	1.77	0.38	14.84
Pipe - (34)	CIRCULAR	1.50	1.50	1	1.77	0.38	15.34
Pipe - (35)	CIRCULAR	1.50	1.50	1	1.77	0.38	8.40
Pipe - (36)	CIRCULAR	1.50	1.50	1	1.77	0.38	11.75
Pipe - (37)	CIRCULAR	1.50	1.50	1	1.77	0.38	21.67
Pipe - (38)	CIRCULAR	1.50	1.50	1	1.77	0.38	8.28
Pipe - (39)	CIRCULAR	1.50	1.50	1	1.77	0.38	11.71
Pipe - (40)	CIRCULAR	1.50	1.50	1	1.77	0.38	27.57
Pipe - (41)	CIRCULAR	1.50	1.50	1	1.77	0.38	32.92
Pipe - (42)	CIRCULAR	1.50	1.50	1	1.77	0.38	41.15
Pipe - (43)	CIRCULAR	1.50	1.50	1	1.77	0.38	28.03
Pipe - (44)	CIRCULAR	1.50	1.50	1	1.77	0.38	27.05
Pipe - (46)	CIRCULAR	4.00	4.00	1	12.57	1.00	101.57

\*\*\*\*\*  
Transect Summary  
\*\*\*\*\*

Transect Grinnell Channel North  
Area:

0.0076	0.0157	0.0244	0.0335	0.0432
0.0533	0.0640	0.0751	0.0868	0.0989
0.1116	0.1248	0.1385	0.1527	0.1674
0.1826	0.1983	0.2145	0.2312	0.2484
0.2661	0.2844	0.3031	0.3224	0.3421
0.3624	0.3831	0.4044	0.4261	0.4484
0.4712	0.4945	0.5183	0.5426	0.5674
0.5927	0.6185	0.6448	0.6716	0.6989
0.7268	0.7551	0.7840	0.8133	0.8432

Hrad:	0.8735	0.9044	0.9357	0.9676	1.0000
	0.0328	0.0635	0.0924	0.1200	0.1463
	0.1716	0.1960	0.2196	0.2426	0.2650
	0.2869	0.3084	0.3294	0.3501	0.3705
	0.3906	0.4105	0.4301	0.4495	0.4687
	0.4877	0.5066	0.5253	0.5439	0.5623
	0.5807	0.5989	0.6170	0.6351	0.6530
	0.6709	0.6887	0.7064	0.7240	0.7416
	0.7592	0.7766	0.7941	0.8114	0.8288
	0.8461	0.8633	0.8805	0.8977	0.9148
	0.9319	0.9490	0.9660	0.9830	1.0000
Width:	0.2413	0.2568	0.2723	0.2877	0.3032
	0.3187	0.3342	0.3497	0.3652	0.3806
	0.3961	0.4116	0.4271	0.4426	0.4581
	0.4735	0.4890	0.5045	0.5200	0.5355
	0.5510	0.5665	0.5819	0.5974	0.6129
	0.6284	0.6439	0.6594	0.6748	0.6903
	0.7058	0.7213	0.7368	0.7523	0.7677
	0.7832	0.7987	0.8142	0.8297	0.8452
	0.8606	0.8761	0.8916	0.9071	0.9226
	0.9381	0.9535	0.9690	0.9845	1.0000

Transect grinnell channel south  
Area:

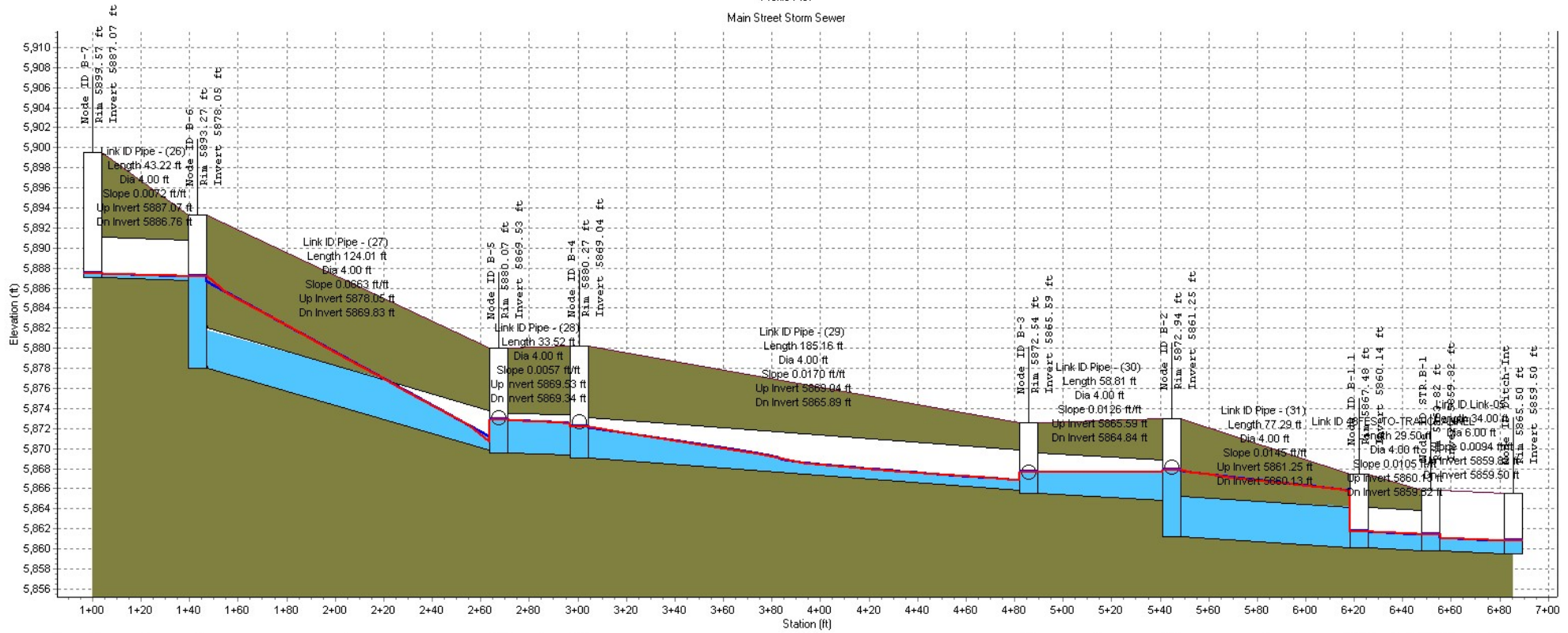
	0.0053	0.0112	0.0177	0.0248	0.0325
	0.0408	0.0497	0.0592	0.0693	0.0800
	0.0913	0.1032	0.1157	0.1288	0.1425
	0.1568	0.1717	0.1872	0.2033	0.2200
	0.2373	0.2552	0.2737	0.2928	0.3125
	0.3328	0.3537	0.3752	0.3973	0.4200
	0.4433	0.4672	0.4917	0.5168	0.5425
	0.5688	0.5957	0.6232	0.6513	0.6800
	0.7093	0.7392	0.7697	0.8008	0.8325
	0.8648	0.8977	0.9312	0.9653	1.0000
Hrad:	0.0345	0.0655	0.0940	0.1206	0.1458
	0.1699	0.1931	0.2155	0.2374	0.2587
	0.2796	0.3002	0.3205	0.3405	0.3602
	0.3798	0.3992	0.4184	0.4375	0.4565
	0.4754	0.4941	0.5128	0.5314	0.5499
	0.5684	0.5868	0.6051	0.6234	0.6416
	0.6598	0.6779	0.6960	0.7141	0.7322
	0.7502	0.7682	0.7861	0.8040	0.8219
	0.8398	0.8577	0.8755	0.8934	0.9112
	0.9290	0.9467	0.9645	0.9823	1.0000
Width:	0.1600	0.1771	0.1943	0.2114	0.2286
	0.2457	0.2629	0.2800	0.2971	0.3143
	0.3314	0.3486	0.3657	0.3829	0.4000
	0.4171	0.4343	0.4514	0.4686	0.4857
	0.5029	0.5200	0.5371	0.5543	0.5714
	0.5886	0.6057	0.6229	0.6400	0.6571
	0.6743	0.6914	0.7086	0.7257	0.7429
	0.7600	0.7771	0.7943	0.8114	0.8286
	0.8457	0.8629	0.8800	0.8971	0.9143
	0.9314	0.9486	0.9657	0.9829	1.0000

	Volume acre-ft	Volume Mgallons
Flow Routing Continuity		
External Inflow .....	144.416	47.060
External Outflow .....	144.258	47.009
Initial Stored Volume ....	0.000	0.000
Final Stored Volume .....	0.158	0.051
Continuity Error (%) .....	0.000	

Node Depth Summary

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time
				days hh:mm			hh:mm:ss
A-1	0.00	0.00	5862.96	0 00:00	0	0	0:00:00
A-2	3.77	3.77	5867.11	0 00:00	0	0	0:00:00
B-1.1	1.62	1.66	5861.80	0 00:01	0	0	0:00:00
B-2	6.59	6.62	5867.87	0 00:01	0	0	0:00:00
B-3	2.07	2.07	5867.66	0 00:02	0	0	0:00:00
B-4	3.13	3.15	5872.19	0 00:01	0	0	0:00:00
B-5	3.36	3.39	5872.92	0 00:01	0	0	0:00:00
B-6	9.09	9.12	5887.17	0 00:01	0	0	0:00:00
B-7	0.40	0.40	5887.47	0 00:00	0	0	0:00:00
C-1	0.42	0.42	5869.21	0 00:00	0	0	0:00:00

Profile Plot  
Main Street Storm Sewer



Node ID:	B-7	B-6		B-5	B-4		B-3	B-2		B-1.1	STR-B-1	Ditch-Int
Rim (ft):	5899.57	5893.27		5880.07	5880.27		5872.54	5872.94		5867.48	5863.82	5865.50
Invert (ft):	5887.07	5878.05		5869.53	5869.04		5865.59	5861.25		5860.14	5859.82	5859.50
Min Pipe Cover (ft):	8.50	2.52		6.24	6.93		2.65	4.10		3.35	0.00	0.00
Max HGL (ft):	5887.47	5887.17		5872.92	5872.19		5867.66	5867.87		5861.80	5861.48	5860.81
Link ID:	Pipe - (26)	Pipe - (27)		Pipe - (28)		Pipe - (29)	Pipe - (30)	Pipe - (31)		48FE3-TO-TRAPCHAN	Link-05	
Length (ft):	43.22	124.01		33.52		185.16	58.81	77.29		29.50	34.00	
Dia (ft):	4.00	4.00		4.00		4.00	4.00	4.00		4.00	6.00	
Slope (ft/ft):	0.0072	0.0663		0.0057		0.0170	0.0126	0.0145		0.0105	0.0094	
Up Invert (ft):	5887.07	5878.05		5869.53	5869.04	5869.04	5865.59	5861.25		5860.13	5859.82	
Dn Invert (ft):	5886.76	5869.83		5869.34	5865.89	5865.89	5864.84	5860.13		5859.82	5859.50	
Max Q (cfs):	2.76	2.63		16.54		22.60	47.28	53.62		53.54	52.97	
Max Vel (ft/s):	4.14	8.93		6.25		10.41	11.21	12.15		10.85	3.91	
Max Depth (ft):	0.39	0.23		1.01		0.90	1.45	1.49		1.62	1.24	

Node ID:	Null Structure	Ditch-Int	STR.B-1	B-1.1	B-2	B-3	B-4	B-5	B-6	B-7
Rim (ft):	0.00	5865.50	5863.82	5864.13	5872.94	5872.54	5880.27	5880.07	5893.27	5899.57
Invert (ft):	5855.88	5859.50	5859.82	5860.14	5861.25	5865.59	5869.04	5869.53	5878.05	5887.07
Min Pipe Cover (ft):	0.00	0.00	0.00	0.00	4.10	2.65	6.93	6.24	2.52	8.50
Max HGL (ft):	5857.91	5860.79	5861.44	5861.76	5867.87	5867.66	5872.19	5872.92	5886.76	5887.07
Link ID:	Ditch-both	Link-05	48FES-TO-...	Pipe - (31)	Pipe - (30)	Pipe - (29)	Pipe - (28)	Pipe - (27)	Pipe - (26)	
Length (ft):	86.80	34.00	29.50	77.29	58.81	185.16	33.52	124.01	43.22	
Dia (in):	60.00	72.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	
Slope (ft/ft):	0.0356	0.0094	0.0105	0.0145	0.0126	0.0170	0.0057	0.0663	0.0072	
Up Invert (ft):	5859.50	5859.82	5860.13	5861.25	5865.59	5869.04	5869.53	5878.05	5887.07	
Dn Invert (ft):	5856.41	5859.50	5859.82	5860.13	5864.84	5865.89	5869.34	5869.83	5886.76	
Max Q (cfs):	73.97	50.42	51.20	51.30	44.84	20.12	14.63	0.00	0.00	
Max Vel (ft/s):	7.22	3.86	10.72	12.02	11.05	10.15	6.08	0.00	0.00	
Max Depth (ft):	1.27	1.21	1.58	1.46	1.40	0.85	0.93	0.00	0.00	



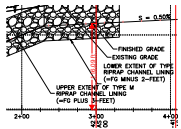
# Drng\_v4.pdf Markup Summary

dsdlaforce (19)



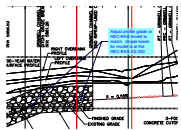
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**Author:** dsdlaforce  
**Date:** 4/10/2020 8:10:51 AM  
**Status:**  
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**Space:**

0.04 per plans



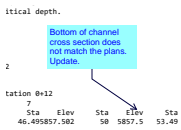
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11.61 ft



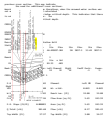
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**Date:** 4/10/2020 8:20:19 AM  
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Adjust profile grade or HEC-RAS model to match.  
Grade break for model is at the HEC-RAS XS 200

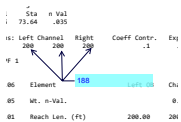


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Bottom of channel cross section does not match the plans. Update.

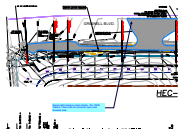


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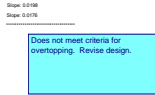
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188



**Subject:** Callout  
**Page Label:** 36  
**Author:** dsdlaforce  
**Date:** 4/10/2020 9:31:32 AM  
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Revise ditch design to meet criteria. Per DCM Table 6-1 flow must not encroach upon road shoulder area.



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**Author:** dsdlaforce  
**Date:** 4/10/2020 9:35:38 AM  
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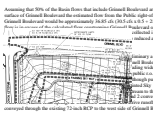
Does not meet criteria for overtopping. Revise design.



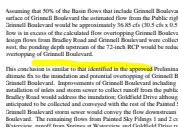
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The overtopping of this proposed redesign does not meet the cross flow in Arterial road with roadside ditch per DCM Table 6-1. The criteria for major storm is that flow shall not encroach upon the road shoulder. Therefore the proposed design does not meet the criteria.

The approved FDR's analysis showed the 100yr flow stays within the shoulder with no overtopping of Grinnell Blvd.



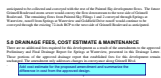
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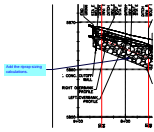
approximately 36  
 lated flow overtop  
 road and Grinnell E  
 eam of the 72-incl  
 eard.

**Subject:** Highlight  
**Page Label:** 7  
**Author:** dsdlaforce  
**Date:** 4/15/2020 1:08:48 PM  
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**Subject:** Text Box  
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Add cost estimate for the proposed amendment and summarize the difference in cost from the approved design.



**Subject:** Callout  
**Page Label:** 36  
**Author:** dsdlaforce  
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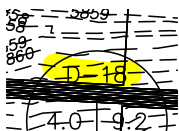
Add the riprap sizing calculations.



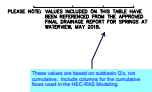
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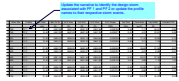


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These values are based on subbasin Q's, not cumulative. Include columns for the cumulative flows used in the HEC-RAS Modeling.



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**Page Label:** 34  
**Author:** dsdlaforce  
**Date:** 4/9/2020 3:49:16 PM  
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Update the narrative to identify the design storm associated with PF 1 and PF 2 or update the profile names to their respective storm events.