



FINAL DRAINAGE REPORT

MERIDIAN ROAD & BENT GRASS MEADOWS DRIVE

El Paso County, Colorado

PREPARED FOR:
Challenger Communities, LLC
8605 Explorer Dr., Suite 250
Colorado Springs, CO 80920

PREPARED BY:
Galloway & Company, Inc.
1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920

DATE:
November 2019



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 Drainage Criteria Manual for the City of Colorado Springs and El Paso County. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Scott Brown, PE 45900
For and on behalf of Galloway & Company, Inc.

Date

DEVELOPER'S CERTIFICATION

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

By: 
Address: Challenger Homes COMMUNITIES LLC
8605 Explorer Dr., Suite 250
Colorado Springs, CO 80920

11-15-19

Date

DEVELOPER'S CERTIFICATION

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

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

Date

Conditions:

TABLE OF CONTENTS

I.	Purpose	1
II.	General Description	1
III.	Previous Reports	1
IV.	Drainage Criteria	1
V.	Existing Drainage Conditions	2
VI.	Four Step Process	3
	1. Employ Runoff Reduction Practices	3
	2. Implement BMPs That Provide a Water Quality Capture Volume with Slow Release	3
	3. Stabilize Drainageways	3
	4. Implement Site Specific and Other Source Control BMPs	3
VII.	Proposed Drainage Conditions	3
VIII.	Proposed Channel Improvements	4
IX.	Proposed Water Quality	4
X.	Maintenance	5
XI.	Wetlands Mitigation	5
XII.	Floodplain Statement	5
XIII.	Drainage/Bridge Fees and Credits/Reimbursements	5
XIV.	Conclusion	5
XV.	References	5

Appendices:

- A. Exhibits and Figures
- B. Hydrologic Computations
- C. Hydraulic Computations
- D. Drainage Map

I. Purpose

The intent of the developer is to make improvements to the intersection at Meridian Road and Bent Grass Meadows Drive in association with the residential development of the Bent Grass Subdivision. The purpose of this Final Drainage Report is to identify drainage patterns, locate and identify tributary or downstream drainage features and facilities that are impacted by the improvements, and to identify which types of drainage facilities will be needed and where they will be located

II. General Description

The site is located in the Northwest $\frac{1}{4}$ and Southwest $\frac{1}{4}$ of Section 1, Township 13S, Range 65W, of the Sixth Principal Meridian, County of El Paso, State of Colorado. The proposed improvements are located at the intersection of Bent Grass Meadows Drive and Meridian Road, as well as the west side of Meridian Road from Bent Grass Meadows Drive to Owl Place. The proposed improvements include the construction of a right turn lane from Bent Grass Meadows Drive onto Meridian Road as well as a southbound acceleration lane from Bent Grass Meadows Drive to Owl Place. A Vicinity Map is included in Appendix A.

The existing soil type within the proposed site as determined by the NRCS Web Soil Survey for El Paso County Area consists of Columbine gravelly sandy loam which is defined as having a hydrologic soil group of A. See the soils map included in Appendix A.

III. Previous Reports

The proposed site has been included in multiple drainage studies in the past. The following is a composite list of the existing reports pertaining to this site analysis.

1. *Falcon Drainage Basin Planning Study*, by Matrix Design Group, September 2015.
2. *Master Development Drainage Plan – Bent Grass Residential Subdivision*, by Galloway & Company, May 2019.
3. *Master Development Drainage Plan and Preliminary Drainage Plan – Bent Grass Subdivision*, by Kiowa Engineering Corporation, December 2006.
4. *Final Drainage Report for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2014.
5. *Final Drainage Report Addendum for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2015.

IV. Drainage Criteria

Hydrology calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

The drainage calculations were based on the criteria manual Figure 6-5 and IDF equations to determine the intensity, and are listed in Table 1 below.

Table 1 - Precipitation Data

Return Period	One Hour Depth (in.)	Intensity (in/hr)
5-year	1.50	5.17
100-year	2.52	8.68

The rational method was used to calculate peak flows as the tributary areas are less than 100 acres. The rational method has been proven to be accurate for basins of this size and is based on the following formula:

$$Q = CIA$$

Where:

- Q = Peak Discharge (cfs)
- C = Runoff Coefficient
- I = Runoff intensity (inches/hour)
- A = Drainage area (acres)

The runoff coefficients are calculated based on land use, percent imperviousness, and design storm for each basin, as shown in the drainage criteria manual (Table 6-6). Composite percent impervious and C values were calculated using the residential, streets, roofs, and lawns coefficients found in Table 6-6 of the manual.

The 100-year event was used as the major storm event and the 5-year event was used as the minor event.

For the analysis of the existing channel adjacent to Meridian Road and the preliminary design of the proposed channel, Bentley Flowmaster was utilized. Flowmaster was used to evaluate velocity, Froude number, and channel depth. A Manning's n value of 0.035 was utilized for the channel which is appropriate for the existing native grass that comprises the channel section. The proposed channel was designed to have a maximum depth of 5' per the criteria manual and have a maximum velocity of 5 ft/s with a maximum Froude number of 0.6.

V. Existing Drainage Conditions

In the existing conditions runoff from the west half of Meridian Road near Bent Grass Meadows Drive drains directly into the roadside channel, which flows south at an average slope of 1.75%. The majority of the channel in this area is triangular in shape with a depth of approximately 3 feet. As previously stated, the existing channel was analyzed using Bentley Flowmaster. The flow rate used for the analysis was taken from the Falcon DBPS. In the DBPS this section of the channel is referred to as RMT064 which has a flow rate of 580 cfs in the existing conditions. The Flowmaster calculations, which have been included in Appendix C, show that the existing channel can only convey approximately 260 cfs in its current state. When 580 cfs is analyzed in the existing channel it produces a depth of approximately 4 feet, exceeding the channel depth by 1 foot. Relevant excerpts from the DBPS are included in Appendix A.

There are also three existing 45" x 29" elliptical RCP's that run beneath Bent Grass Meadows Drive that were analyzed with this report. The Federal Highway Administration's HY-8 program was used to analyze the culvert and design the proposed culverts in the future conditions. The calculations included in

Appendix C show that the existing culverts can convey approximately 166 cfs before flow begins to overtop Bent Grass Meadows Drive. All of the included calculations show that the culverts and channel are clearly vastly undersized and will need to be improved by El Paso County in the future to properly convey the flows outlined in the DBPS.

A historic basin map has been prepared for this area to analyze the existing basin contributing to the channel. The historic map is included in Appendix D and the basin is described below.

Basin H-1 (2.03 AC, $Q_5 = 3.2$ cfs, $Q_{100} = 7.3$ cfs): is associated with the western half of Meridian Road and the eastern half of the channel, south of Bent Grass Meadows Drive, in the existing conditions. Runoff from the basin generally flows to the southwest, into the roadside channel, where it is conveyed south.

VI. Four Step Process

The Four Step Process is used to minimize the adverse impacts of urbanization and is a vital component of developing a balanced, sustainable project. Below identifies the approach to the four-step process:

1. Employ Runoff Reduction Practices

The proposed roadway improvements use Low Impact Development (LID) practices to reduce runoff at the source. All runoff is routed through the pervious areas in the channel to promote infiltration.

2. Implement BMPs That Provide a Water Quality Capture Volume with Slow Release

This step utilizes formalized water quality capture volume to slow the release of runoff from the site. There is no water quality being proposed with the associated roadway improvements. Per Section 1.7.1.B of the El Paso County *Stormwater Quality Policy & Procedures*, since the site is less than 1 acre, is not a sensitive or high-risk site, and does not directly discharge into State Waters, it is excluded from any water quality requirements.

Address existing downstream detention/WQ.

3. Stabilize Drainageways

This step implements stabilization to the channel to accommodate developed flows while protecting infrastructure and controlling sediment loading from erosion in the drainageways. Erosion protection in the form of riprap pads at all outfall points to the channel to prevent scouring of the channel from point discharges.

Address current channel condition and stability.

4. Implement Site Specific and Other Source Control BMPs

Since this project only includes roadway work with no curb and gutter, the potential use of source control BMP's is limited. All runoff however, will be conveyed through native grass buffers and a native grass channel to promote infiltration and pollutant removal.

VII. Proposed Drainage Conditions

In the proposed conditions the historic drainage pattern will be maintained with runoff draining from Meridian Road and Bent Grass Meadows Drive directly into the roadside channel. In order to adequately determine the increase in runoff from the proposed improvements, the proposed basin, P-1, encompasses the same area as the historic basin, H-1. Basin H-1 is 48.4% impervious with peak runoff of 3.2 cfs and 7.3 cfs in the 5-year and 100-year storm events, respectively. Basin P-1 is 64.2% impervious

with peak runoff of 4.2 cfs and 8.7 cfs in the 5-year and 100-year storm events, respectively. The 1.0 cfs increase in the 5-year event and the 1.4 cfs increase in the 100-year event produced by the proposed improvements will have minimal impact on any downstream properties or infrastructure. Basin P-1 is described further below.

Basin P-1 (2.03 AC, $Q_5 = 4.2$ cfs, $Q_{100} = 8.7$ cfs): is associated with the western half of Meridian Road and the eastern half of the channel, south of Bent Grass Meadows Drive, in the proposed conditions. Runoff from the basin generally flows to the southwest, into the roadside channel, where it is conveyed south.

A proposed basin map has been prepared for this area. The proposed map is included in Appendix D.

VIII. Proposed Channel Improvements

Although the existing channel and culverts are undersized and improvements will need to be made in the future, minimal channel improvements are being proposed at this time. With the construction of the right turn lane on Bent Grass Meadows Drive, the three RCP culverts will be extended approximately 15' to span the extended width of the roadway.

In the future, El Paso County will need to improve the existing culverts and channel to adequately convey the flow outlined in the DBPS. These necessary improvements and associated calculations are described further below. A preliminary grading exhibit has been prepared showing these improvements and included in Appendix C.

Similar to the existing channel, Bentley Flowmaster was also used to design the future proposed channel section. The proposed channel was designed to have a maximum depth of 5' per the criteria manual and have a maximum velocity of 5 ft/s with a maximum Froude number of 0.6. The flow rate used for the design, 850 cfs, was taken from the future conditions in the Falcon DBPS.

The proposed channel section was designed as trapezoidal shape with a 15' bottom width, 4:1 side slopes, and 0.3% longitudinal slope. The total depth of the channel will be 6', providing 1' of freeboard for the 5' of water depth.

The Federal Highway Administration's HY-8 program was also utilized to design the proposed culverts that will run beneath Bent Grass Meadows Drive. The calculations included in Appendix C show that in order to adequately convey the 850 cfs in the future conditions, two 16'x4' concrete box culverts will need to replace the existing elliptical RCP's. In order to construct the box culverts, the channel will need to be flattened from downstream to create roughly 5' of additional clearance below the road.

IX. Proposed Water Quality

There is no water quality being proposed with the associated roadway improvements. Per Section 1.7.1.B of the El Paso County *Stormwater Quality Policy & Procedures*, since the site is less than 1 acre, is not a sensitive or high-risk site, and does not directly discharge into State Waters, it is excluded from any water quality requirements.

Describe downstream detention.
See comment letter.

X. Maintenance

The proposed channel will be a public facility. After completion of construction and upon the Board of County Commissioners acceptance the channel will be owned and maintained by El Paso County along with all drainage facilities within the public Right-of-Way.

XI. Wetlands Mitigation

No wetlands are located on site.

XII. Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map number 08041C0553G, effective December 7, 2018, the project site is located within Zone X. Zone X is areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance-flood. A copy of the FIRM Panel is included in Appendix A.

XIII. Drainage/Bridge Fees and Credits/Reimbursements

Since there is no land being platted with this development, drainage and bridge fees are not required.

XIV. Conclusion

This report for the proposed roadway improvements to Meridian Road, between Bent Grass Meadows Drive and Owl Place, has been prepared using the criteria and methods as described in the El Paso County Drainage Criteria Manual. Although the roadway improvements will result in slightly higher runoff to the roadside channel, there will be minimal impact on the downstream infrastructure. The channel was analyzed in the existing conditions and determined to be undersized. Although the channel improvements will not be made with this development, recommendations are made within this report for the future conditions of the channel. The channel will ultimately be publicly owned and maintained and shall be the responsibility of El Paso County.

XV. References

1. *City of Colorado Springs/County of El Paso Drainage Criteria Manual*, October 1991.
2. *Drainage Criteria Manual, Volume 2*, City of Colorado Springs, November 2002.
3. *Urban Storm Drainage Criteria Manual*, Urban Drainage and Flood Control District, January 2016 (with current revisions).
4. *Falcon Drainage Basin Planning Study*, by Matrix Design Group, September 2015.
5. *Master Development Drainage Plan and Preliminary Drainage Plan – Bent Grass Subdivision*, by Kiowa Engineering Corporation, December 2006.
6. *Final Drainage Report for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2014.
7. *Final Drainage Report Addendum for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2015.

APPENDIX A
Exhibits and Figures



MERIDIAN ROAD IMPROVEMENTS

MERIDIAN RD & BENT GRASS MEADOWS DR

SCALE: 1" = 1,000'

VICINITY MAP

Project No: CLH00015.20

Drawn By: BHB

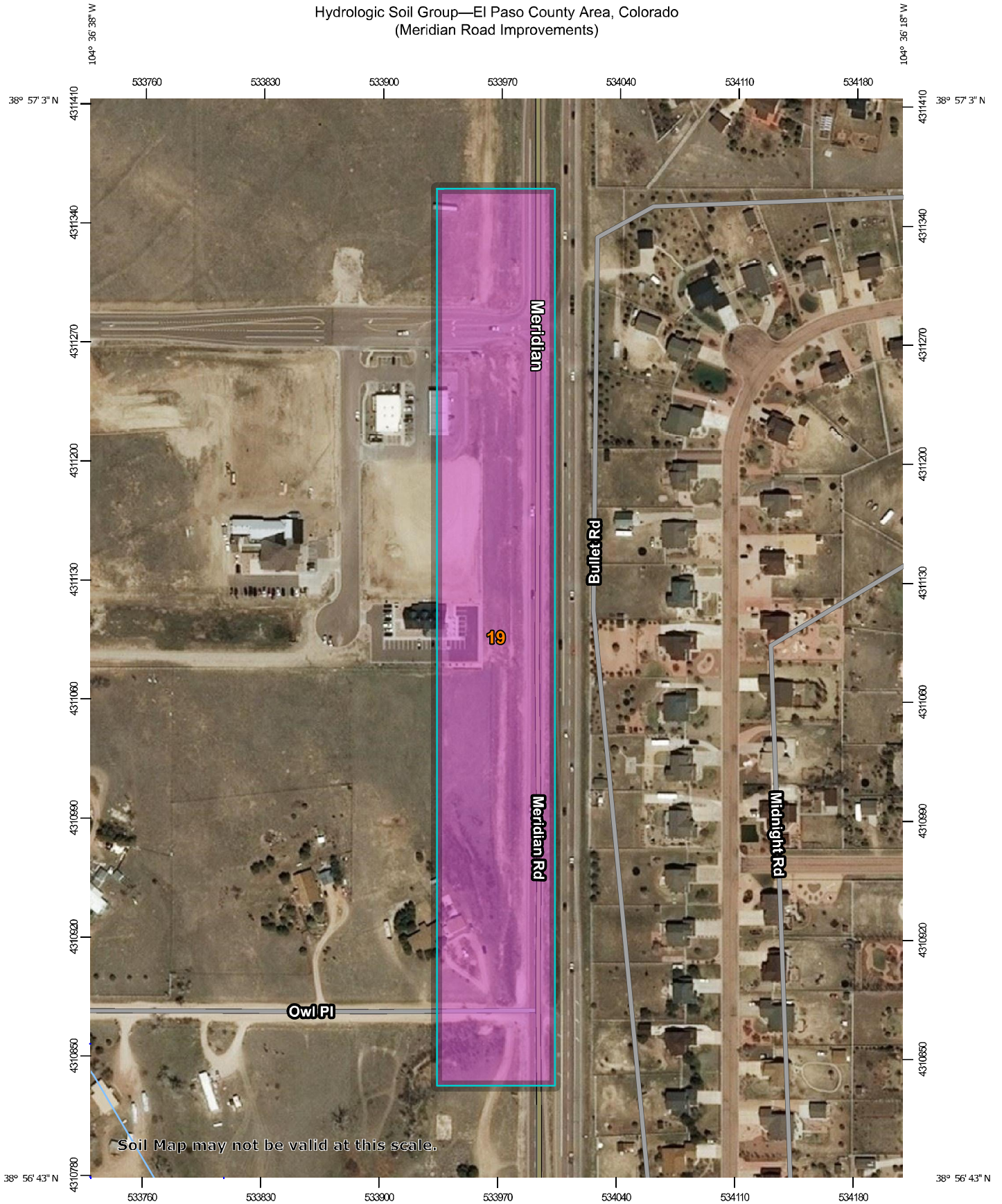
Checked By: SMB

Date: NOVEMBER 2019

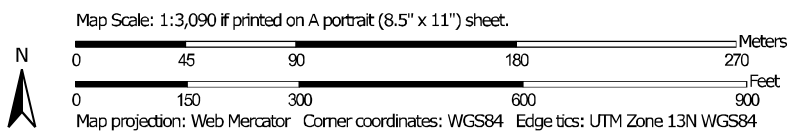


1755 Telstar Drive, Suite 107
 Colorado Springs, CO 80920
 719.900.7220 • GallowayUS.com

Hydrologic Soil Group—El Paso County Area, Colorado
(Meridian Road Improvements)



































Soil Map may not be valid at this scale.



Hydrologic Soil Group—El Paso County Area, Colorado
(Meridian Road Improvements)

MAP LEGEND

Area of Interest (AOI)	 Area of Interest (AOI)	 C
Soils		 C/D
Soil Rating Polygons		 D
 A		 Not rated or not available
 A/D		Water Features
 B		 Streams and Canals
 B/D		Transportation
 C		 Rails
 C/D		 Interstate Highways
 D		 US Routes
 Not rated or not available		 Major Roads
Soil Rating Lines		 Local Roads
 A		Background
 A/D		 Aerial Photography
 B		
 B/D		
 C		
 C/D		
 D		
 Not rated or not available		
Soil Rating Points		
 A		
 A/D		
 B		
 B/D		

MAP INFORMATION

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	9.1	100.0%
Totals for Area of Interest			9.1	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

NGS Information Services
 NOAA, NINGS12
 National Geodetic Survey
 SSMC-3, #9202
 1315 East-West Highway
 Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at <http://www.ngs.noaa.gov/>.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

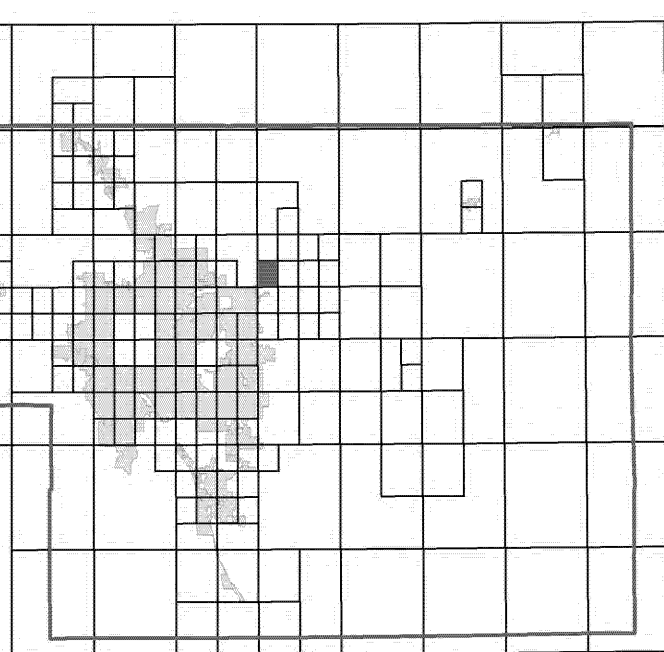
Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FIMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at <http://www.msc.fema.gov/>.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.

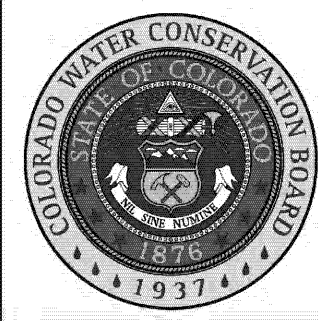
El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

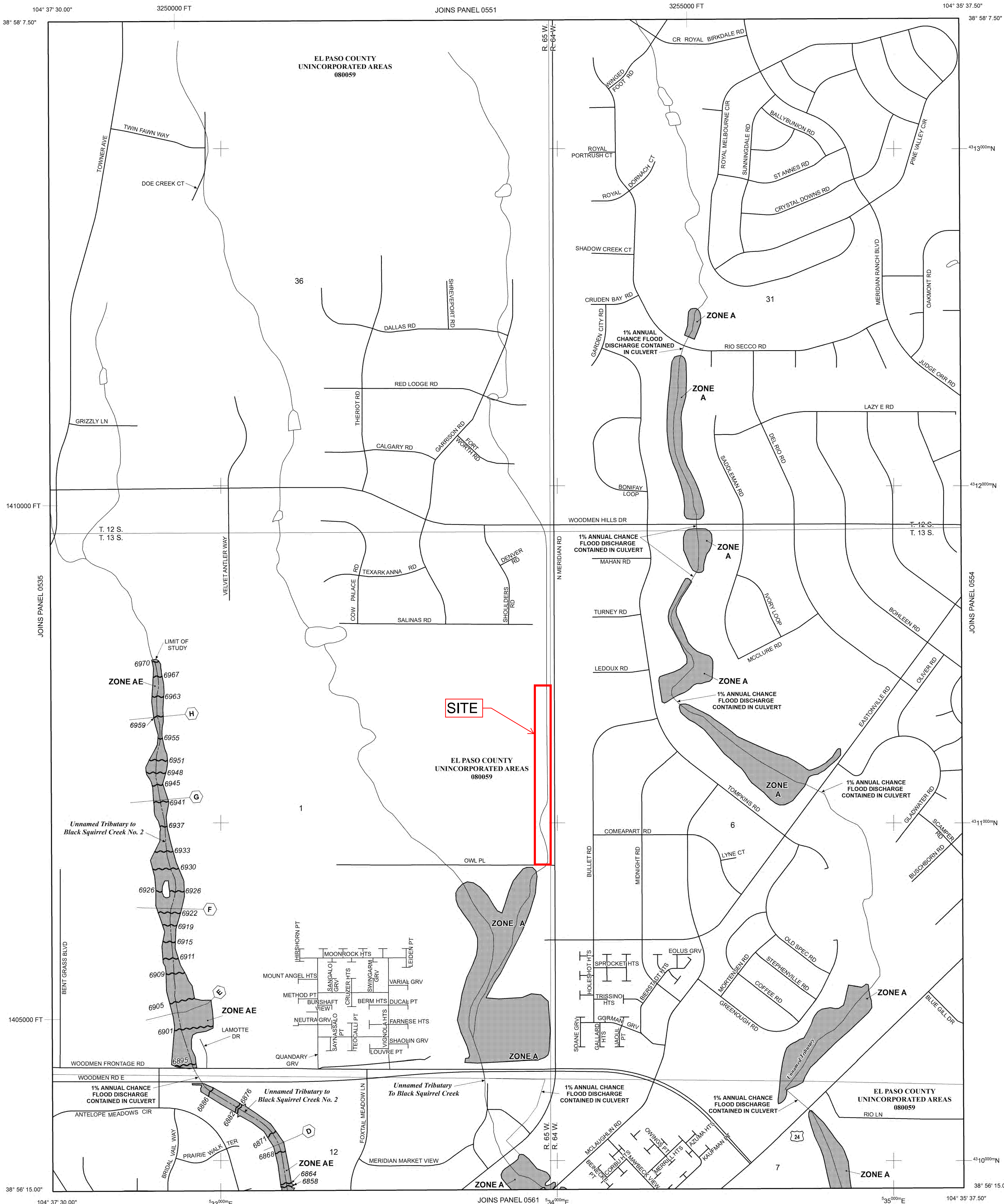
Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).



Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equalled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE
 The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS
ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS
ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 Base Flood Elevation line and value; elevation in feet* (EL 987)

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A-A Cross section line
- 23-23 Transsect line
- 97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 475000N 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT 5000-foot grid ticks; Colorado State Plane coordinate system, central zone (FIPS ZONE 0502), Lambert Conformal Conic Projection
- DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 River Mile

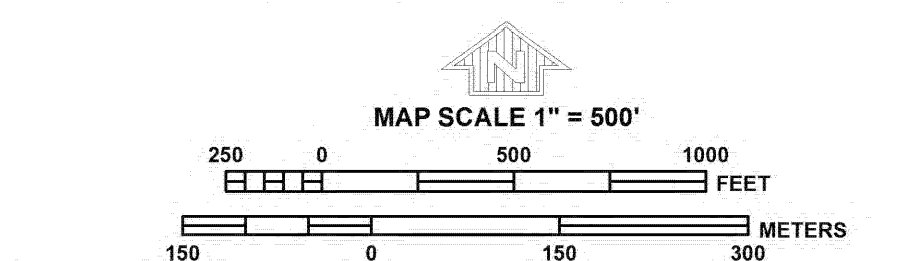
MAP REPOSITORIES
 Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
 MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
 DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



PANEL 053G

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

PANEL 553 OF 1300
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:
 COMMUNITY: EL PASO COUNTY NUMBER: 080059 PANEL: 053G SUFFIX: 0

MAP NUMBER
08041C0553G

MAP REVISED
DECEMBER 7, 2018
 Federal Emergency Management Agency

FALCON DRAINAGE BASIN PLANNING STUDY
SELECTED PLAN REPORT
FINAL - SEPTEMBER 2015

Prepared for:



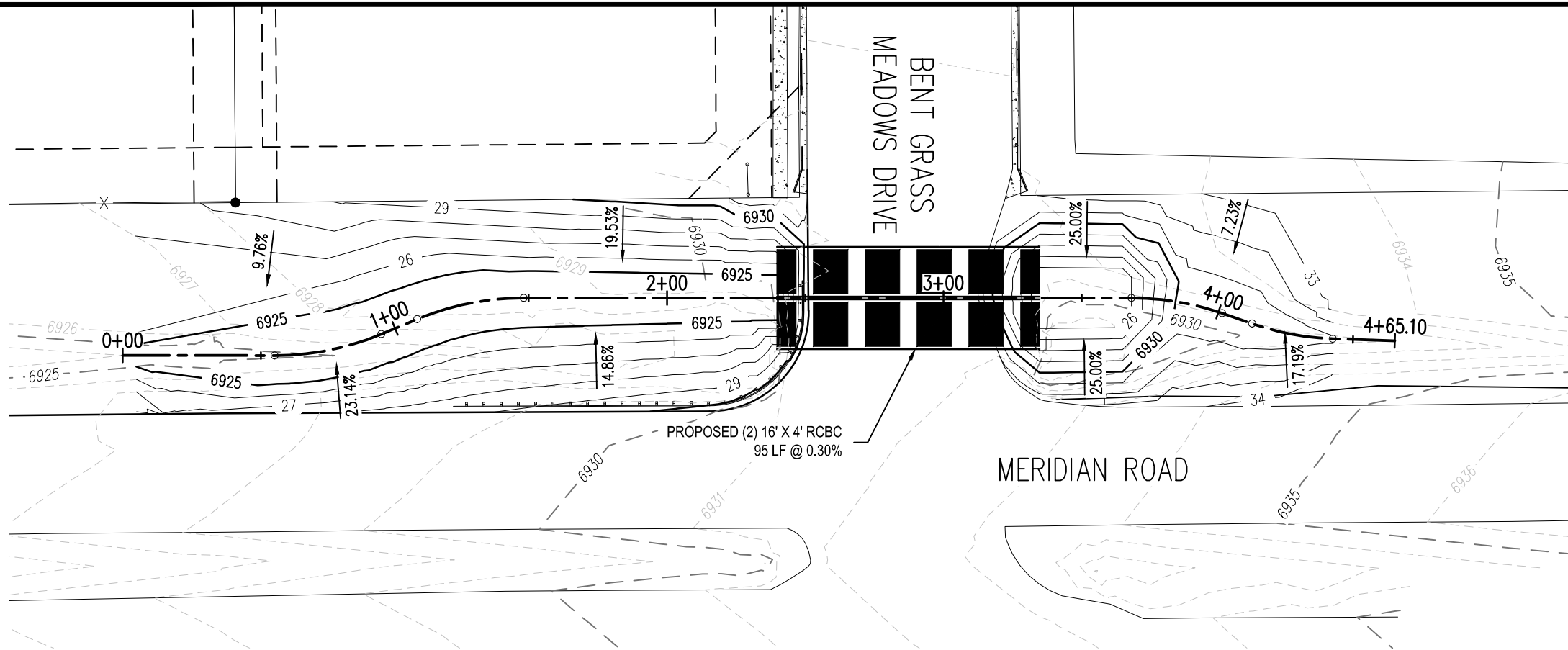
El Paso County Public Services Department
3275 Akers Drive
Colorado Springs, CO 80922

Prepared By:

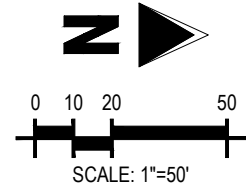


Matrix Design Group
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920

Matrix Project No. 10.122.003

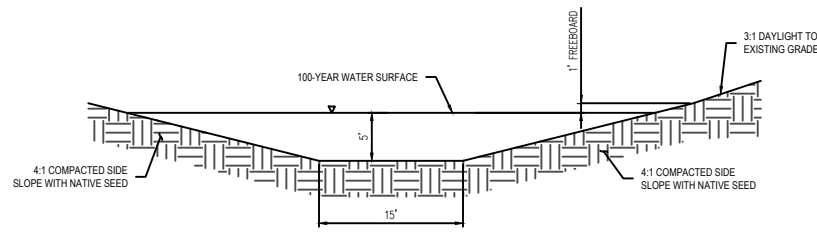


FUTURE MERIDIAN CHANNEL - PLAN
SCALE: 1"=50'



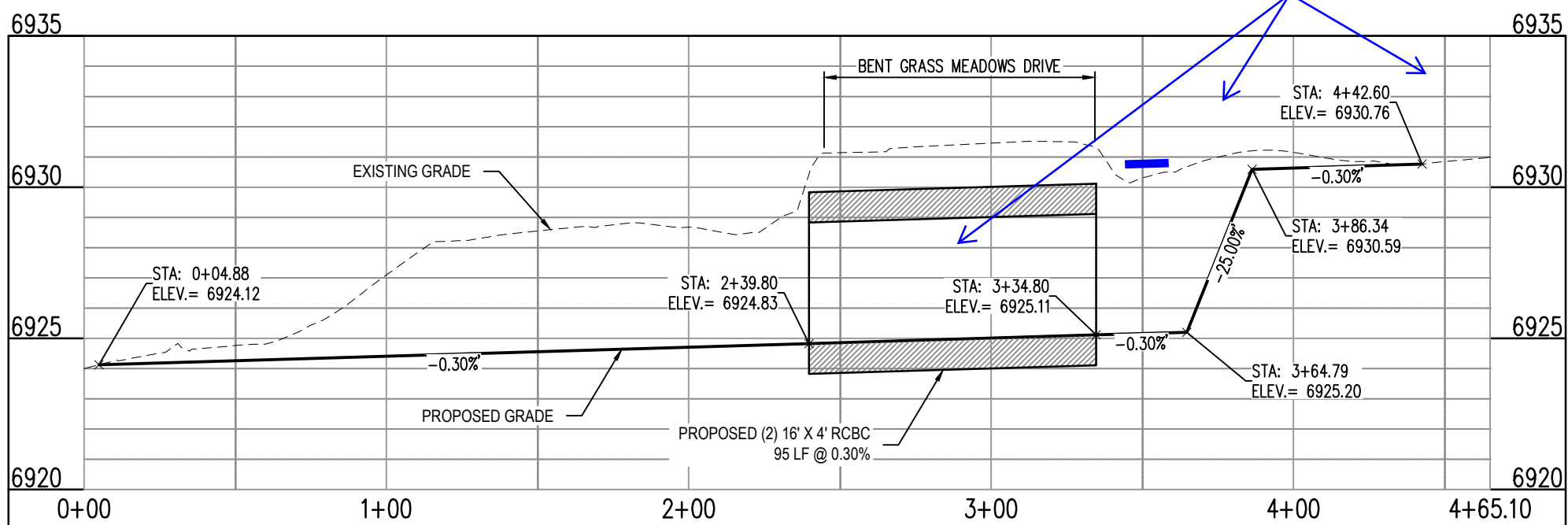
LEGEND

- - - 6485 - - -	EXISTING MAJOR CONTOUR
- - - 6483 - - -	EXISTING MINOR CONTOUR
— 6485 —	PROPOSED MAJOR CONTOUR
— 6483 —	PROPOSED MINOR CONTOUR



ROADSIDE CHANNEL FUTURE SECTION
SCALE: 1"=20'

show HGL/headwater elev.



FUTURE MERIDIAN CHANNEL - PROFILE
SCALE: 1"=50' HORIZONTAL, 1"=5' VERTICAL

Project No:	CLH15.20
Drawn By:	BHB
Checked By:	SMB
Date:	11/15/19

APPENDIX B
Hydrologic Computations

COMPOSITE % IMPERVIOUS CALCULATIONS: PROPOSED

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 11/12/19

1	2	3	4	5	6	7	8	9	10	11	12
Basin ID	Total Area (ac)	Paved/Gravel Roads			Lawns/Undeveloped			Roofs			Basins Total
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	Weighted % Imp.
H-1	2.03	100	0.96	47.3	2	1.07	1.1	90	0.00	0.0	48.4
P-1	2.03	100	1.29	63.5	2	0.74	0.7	90	0.00	0.0	64.2

NOTES:

% Impervious values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS: PROPOSED

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 11/12/19

1	2	3	4	5	6	7	8	9	10	11	12	13
Basin ID	Total Area (ac)	Paved/Gravel Roads			Lawns/Undeveloped			Roofs			Composite C ₅	Composite C ₁₀₀
		C ₅	C ₁₀₀	Area (ac)	C ₅	C ₁₀₀	Area (ac)	C ₅	C ₁₀₀	Area (ac)		
H-1	2.03	0.90	0.96	0.96	0.09	0.36	1.07	0.73	0.81	0.00	0.47	0.64
P-1	2.03	0.90	0.96	1.29	0.09	0.36	0.74	0.73	0.81	0.00	0.60	0.74

NOTES:

*C values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1, CH. 6 (Referencing UDFCD 2001)
 Coefficients use HSG A&B soils - Refer to "Appendix A: Exhibits and Figures" for soil map*

STANDARD FORM SF-2: PROPOSED TIME OF CONCENTRATION

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 11/12/19

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					T _c CHECK			FINAL
DATA						(T _i)			(T _t)					(URBANIZED BASINS)			
BASIN ID	D.A. (AC)	Hydrologic Soils Group	Impervious (%)	C ₅	C ₁₀₀	L (FT)	S (%)	T _i (MIN)	L (FT)	S (%)	C _v	VEL. (FPS)	T _t (MIN)	COMP. T _c (MIN)	TOTAL LENGTH(FT)	Urbanized T _c (MIN)	T _c (MIN)
H-1	2.03	A	48.4	0.47	0.64	100	6.0	6.4	1230	1.7	15	2.0	10.48	16.8	1330.0	17.4	16.8
P-1	2.03	A	64.2	0.60	0.74	100	6.0	5.0	1230	1.7	15	2.0	10.48	15.5	1330.0	17.4	15.5

NOTES:

$T_i = (0.395 * (1.1 - C_5) * (L)^{0.5}) / ((S)^{0.33})$, S in ft/ft

$T_t = L / 60V$ (Velocity From Fig. 501)

Velocity $V = C_v * S^{0.5}$, S in ft/ft

T_c Check = 10+L/180

For Urbanized basins a minimum T_c of 5.0 minutes is required.

For non-urbanized basins a minimum T_c of 10.0 minutes is required

**STANDARD FORM SF-3: PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs
Design Storm: 5-Year

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 11/12/19

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE		TRAVEL TIME			REMARKS	
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)		Tt (min)
	H1A							850.0				850.0									Flow from Falcon DBPS
	H-1	2.03	0.47	16.8	0.95	3.35	3.2														Historic flow into channel from Meridian Road and Bent Grass Meadows Dr.
	P-1	2.03	0.60	15.5	1.22	3.47	4.2														Proposed flow into channel from Meridian Road and Bent Grass Meadows Dr.

**STANDARD FORM SF-3: PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs
Design Storm: 100-Year

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 11/12/19

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
	H1A						850.0				850.0										Flow from Falcon DBPS
		H-1	2.03	0.64	16.8	1.30	5.62	7.3													Historic flow into channel from Meridian Road and Bent Grass Meadows Dr.
		P-1	2.03	0.74	15.5	1.50	5.82	8.7													Proposed flow into channel from Meridian Road and Bent Grass Meadows Dr.

APPENDIX C
Hydraulic Computations

Existing Channel Capacity

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035
Channel Slope	1.75 %
Normal Depth	3.00 ft
Left Side Slope	4.00 ft/ft (H:V)
Right Side Slope	4.00 ft/ft (H:V)

Results

Discharge	259.64	ft ³ /s
Flow Area	36.00	ft ²
Wetted Perimeter	24.74	ft
Hydraulic Radius	1.46	ft
Top Width	24.00	ft
Critical Depth	3.05	ft
Critical Slope	0.01616	ft/ft
Velocity	7.21	ft/s
Velocity Head	0.81	ft
Specific Energy	3.81	ft
Froude Number	1.04	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.00	ft
Critical Depth	3.05	ft
Channel Slope	1.75	%
Critical Slope	0.01616	ft/ft

Existing Channel - DBPS Flow

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	1.75 %
Left Side Slope	4.00 ft/ft (H:V)
Right Side Slope	4.00 ft/ft (H:V)
Discharge	580.00 ft ³ /s

Results

Normal Depth	4.06 ft
Flow Area	65.78 ft ²
Wetted Perimeter	33.44 ft
Hydraulic Radius	1.97 ft
Top Width	32.44 ft
Critical Depth	4.20 ft
Critical Slope	0.01451 ft/ft
Velocity	8.82 ft/s
Velocity Head	1.21 ft
Specific Energy	5.26 ft
Froude Number	1.09
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.06 ft
Critical Depth	4.20 ft
Channel Slope	1.75 %
Critical Slope	0.01451 ft/ft

Bent Grass & Meridian Proposed Channel

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	0.30 %
Left Side Slope	4.00 ft/ft (H:V)
Right Side Slope	4.00 ft/ft (H:V)
Bottom Width	15.00 ft
Discharge	850.00 ft ³ /s

Results

Normal Depth	4.95 ft
Flow Area	172.40 ft ²
Wetted Perimeter	55.84 ft
Hydraulic Radius	3.09 ft
Top Width	54.62 ft
Critical Depth	3.43 ft
Critical Slope	0.01384 ft/ft
Velocity	4.93 ft/s
Velocity Head	0.38 ft
Specific Energy	5.33 ft
Froude Number	0.49
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.95 ft
Critical Depth	3.43 ft
Channel Slope	0.30 %
Critical Slope	0.01384 ft/ft

Existing Culvert Analysis

HY-8 Culvert Analysis Report

Crossing Discharge Data

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

Minimum Flow: 0 cfs

Design Flow: 850 cfs

Maximum Flow: 850 cfs

Table 1 - Summary of Culvert Flows at Crossing: Bent Grass & Meridian Existing

Headwater Elevation (ft)	Total Discharge (cfs)	Existing Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6928.05	0.00	0.00	0.00	1
6930.20	85.00	85.00	0.00	1
6931.94	170.00	167.78	2.11	11
6932.35	255.00	182.24	72.54	5
6932.62	340.00	191.34	148.59	5
6932.85	425.00	198.73	226.00	4
6933.06	510.00	205.16	304.66	4
6933.26	595.00	210.91	383.97	4
6933.44	680.00	216.15	463.77	4
6933.61	765.00	220.96	543.59	3
6933.78	850.00	225.50	624.27	3
6931.90	166.14	166.14	0.00	Overtopping

Rating Curve Plot for Crossing: Bent Grass & Meridian Existing

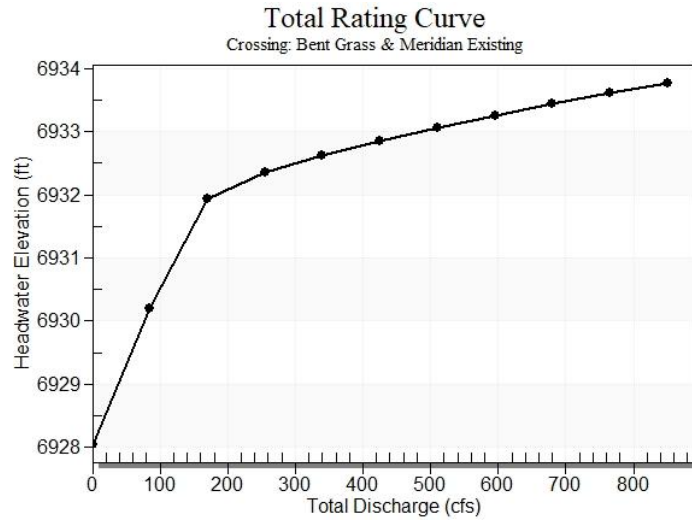


Table 2 - Culvert Summary Table: Existing Culvert

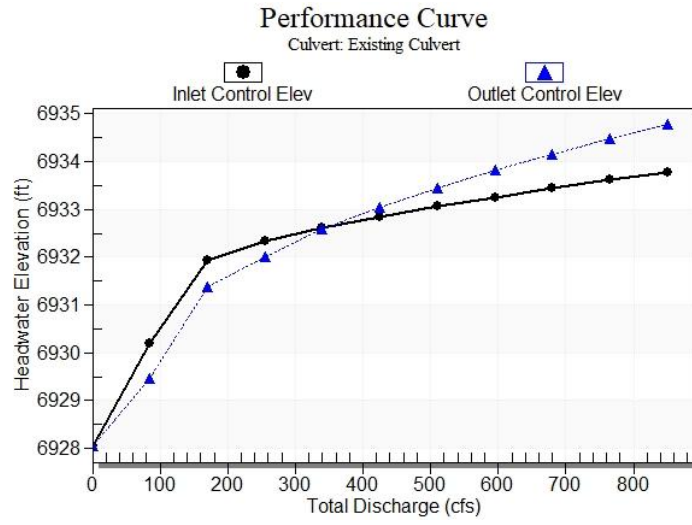
Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	6928.05	0.000	0.000	0-NF	0.000	0.000	0.710	0.000	0.000	0.000
85.00	85.00	6930.20	2.148	1.427	1-S2n	1.171	1.425	1.171	0.914	7.716	4.985
170.00	167.78	6931.94	3.893	3.342	5-S2n	1.825	2.027	1.883	1.345	8.849	6.204
255.00	182.24	6932.35	4.298	3.961	3-M2t	2.417	2.099	2.386	1.676	8.209	7.012
340.00	191.34	6932.62	4.571	4.551	4-FFf	2.417	2.137	2.417	1.953	8.597	7.630
425.00	198.73	6932.85	4.804	4.998	4-FFf	2.417	2.167	2.417	2.196	8.929	8.137
510.00	205.16	6933.06	5.014	5.400	4-FFf	2.417	2.187	2.417	2.414	9.218	8.570
595.00	210.91	6933.26	5.208	5.769	4-FFf	2.417	2.206	2.417	2.613	9.476	8.949
680.00	216.15	6933.44	5.390	6.111	4-FFf	2.417	2.219	2.417	2.796	9.712	9.288
765.00	220.96	6933.61	5.561	6.432	4-FFf	2.417	2.230	2.417	2.967	9.928	9.595
850.00	225.50	6933.78	5.727	6.736	4-FFf	2.417	2.245	2.417	3.128	10.132	9.877

Straight Culvert

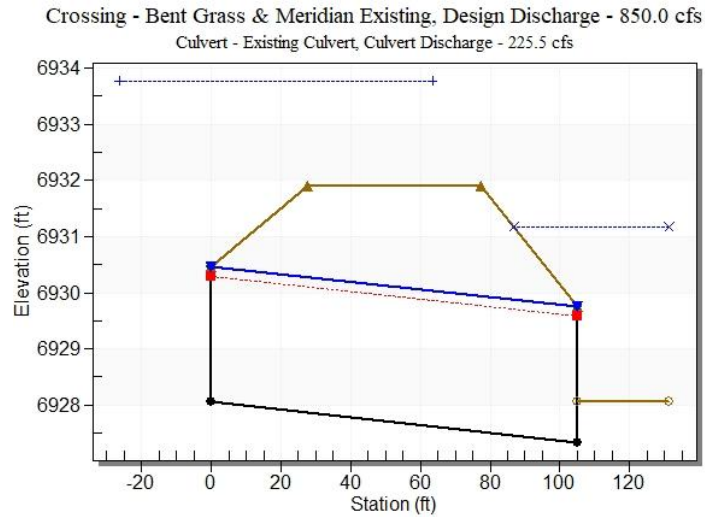
Inlet Elevation (invert): 6928.05 ft, Outlet Elevation (invert): 6927.34 ft

Culvert Length: 105.00 ft, Culvert Slope: 0.0068

Culvert Performance Curve Plot: Existing Culvert



Water Surface Profile Plot for Culvert: Existing Culvert



Site Data - Existing Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6928.05 ft

Outlet Station: 105.00 ft

Outlet Elevation: 6927.34 ft

Number of Barrels: 3

Culvert Data Summary - Existing Culvert

Barrel Shape: Elliptical

Barrel Span: 45.00 in

Barrel Rise: 29.00 in

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Bent Grass & Meridian Existing)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	6928.05	0.00	0.00	0.00	0.00
85.00	6928.96	0.91	4.99	1.14	1.00
170.00	6929.39	1.34	6.20	1.68	1.06
255.00	6929.73	1.68	7.01	2.09	1.09
340.00	6930.00	1.95	7.63	2.44	1.11
425.00	6930.25	2.20	8.14	2.74	1.13
510.00	6930.46	2.41	8.57	3.01	1.15
595.00	6930.66	2.61	8.95	3.26	1.16
680.00	6930.85	2.80	9.29	3.49	1.17
765.00	6931.02	2.97	9.59	3.70	1.18
850.00	6931.18	3.13	9.88	3.90	1.19

Tailwater Channel Data - Bent Grass & Meridian Existing

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 15.00 ft

Side Slope (H:V): 4.00 (4:1)

Channel Slope: 0.0200

Channel Manning's n: 0.0350

Channel Invert Elevation: 6928.05 ft

Roadway Data for Crossing: Bent Grass & Meridian Existing

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 6931.90 ft

Roadway Surface: Paved

Roadway Top Width: 50.00 ft

Proposed Culvert Analysis

HY-8 Culvert Analysis Report

Crossing Discharge Data

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

Minimum Flow: 0 cfs

Design Flow: 850 cfs

Maximum Flow: 850 cfs

Table 1 - Summary of Culvert Flows at Crossing: Bent Grass & Meridian Proposed

Headwater Elevation (ft)	Total Discharge (cfs)	Proposed Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6925.11	0.00	0.00	0.00	1
6926.47	85.00	85.00	0.00	1
6927.22	170.00	170.00	0.00	1
6927.80	255.00	255.00	0.00	1
6928.30	340.00	340.00	0.00	1
6928.73	425.00	425.00	0.00	1
6929.13	510.00	510.00	0.00	1
6929.56	595.00	595.00	0.00	1
6930.01	680.00	680.00	0.00	1
6930.46	765.00	765.00	0.00	1
6930.91	850.00	850.00	0.00	1
6931.50	957.61	957.61	0.00	Overtopping

Rating Curve Plot for Crossing: Bent Grass & Meridian Existing Proposed

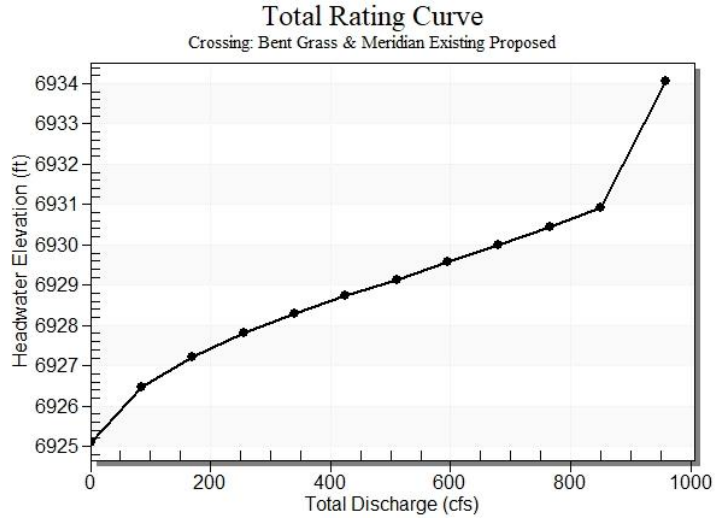


Table 2 - Culvert Summary Table: Proposed Culvert

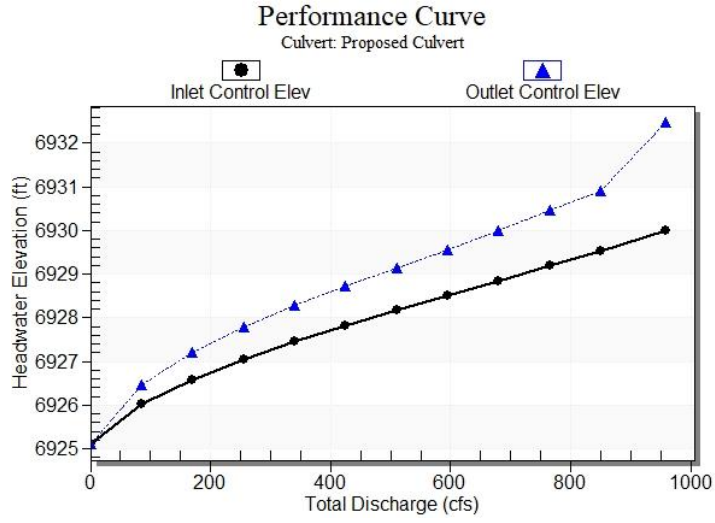
Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	6925.11	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
85.00	85.00	6926.47	0.924	1.360	1-S1t	0.602	0.603	1.545	1.545	1.719	2.597
170.00	170.00	6927.22	1.467	2.112	1-S1t	0.927	0.957	2.233	2.233	2.379	3.181
255.00	255.00	6927.80	1.922	2.694	1-S1t	1.197	1.254	2.751	2.751	2.897	3.565
340.00	340.00	6928.30	2.339	3.188	1-S1t	1.438	1.519	3.179	3.179	3.342	3.859
425.00	425.00	6928.73	2.719	3.625	1-S1t	1.659	1.763	3.550	3.550	3.741	4.100
510.00	510.00	6929.13	3.072	4.023	1-S1t	1.867	1.991	3.880	3.880	4.107	4.306
595.00	595.00	6929.56	3.410	4.453	1-S1f	2.065	2.206	4.000	4.180	4.648	4.487
680.00	680.00	6930.01	3.742	4.899	4-FFf	2.255	2.412	4.000	4.456	5.313	4.649
765.00	765.00	6930.46	4.077	5.347	4-FFf	2.437	2.608	4.000	4.712	5.977	4.796
850.00	850.00	6930.91	4.422	5.802	4-FFf	2.614	2.798	4.000	4.953	6.641	4.930

Straight Culvert

Inlet Elevation (invert): 6925.11 ft, Outlet Elevation (invert): 6924.83 ft

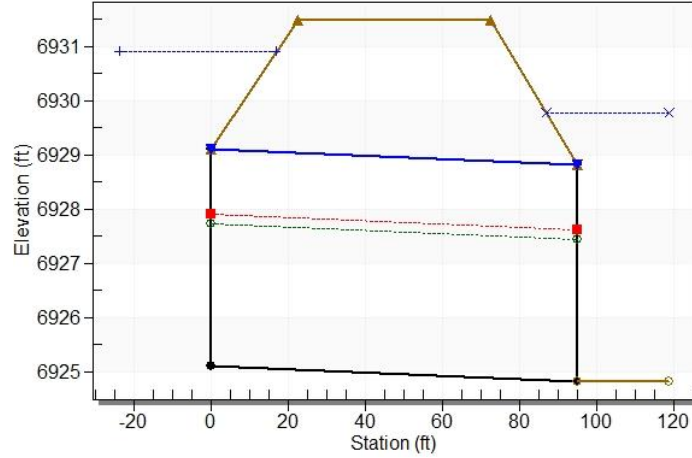
Culvert Length: 95.00 ft, Culvert Slope: 0.0029

Culvert Performance Curve Plot: Proposed Culvert



Water Surface Profile Plot for Culvert: Proposed Culvert

Crossing - Bent Grass & Meridian Existing Proposed, Design Discharge - 850.0 cfs
Culvert - Proposed Culvert, Culvert Discharge - 850.0 cfs



Site Data - Proposed Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6925.11 ft

Outlet Station: 95.00 ft

Outlet Elevation: 6924.83 ft

Number of Barrels: 2

Culvert Data Summary - Proposed Culvert

Barrel Shape: Concrete Box

Barrel Span: 16.00 ft

Barrel Rise: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Downstream Channel Rating Curve - Crossing: Bent Grass & Meridian Proposed

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	6924.83	0.00	0.00	0.00	0.00
85.00	6926.38	1.55	2.60	0.29	0.42
170.00	6927.06	2.23	3.18	0.42	0.44
255.00	6927.58	2.75	3.56	0.51	0.45
340.00	6928.01	3.18	3.86	0.60	0.46
425.00	6928.38	3.55	4.10	0.66	0.47
510.00	6928.71	3.88	4.31	0.73	0.47
595.00	6929.01	4.18	4.49	0.78	0.48
680.00	6929.29	4.46	4.65	0.83	0.48
765.00	6929.54	4.71	4.80	0.88	0.49
850.00	6929.78	4.95	4.93	0.93	0.49

Tailwater Channel Data - Bent Grass & Meridian Proposed

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 15.00 ft

Side Slope (H:V): 4.00 (4:1)

Channel Slope: 0.0030

Channel Manning's n: 0.0350

Channel Invert Elevation: 6924.83 ft

Roadway Data for Crossing: Bent Grass & Meridian Proposed

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 6931.50 ft

Roadway Surface: Paved

Roadway Top Width: 50.00 ft

APPENDIX D
Drainage Maps

NOT FOR
CONSTRUCTION

COPYRIGHT
THESE PLANS ARE AN INSTRUMENT OF SERVICE
AND ARE THE PROPERTY OF GALLOWAY, AND MAY
NOT BE DUPLICATED, DISCLOSED, OR REPRODUCED
WITHOUT THE WRITTEN CONSENT OF GALLOWAY.
COPYRIGHTS AND INFRINGEMENTS WILL BE
ENFORCED AND PROSECUTED.



BENT GRASS MEADOW DRIVE & MERIDIAN ROAD
ROADWAY IMPROVEMENTS
DRAINAGE PLAN

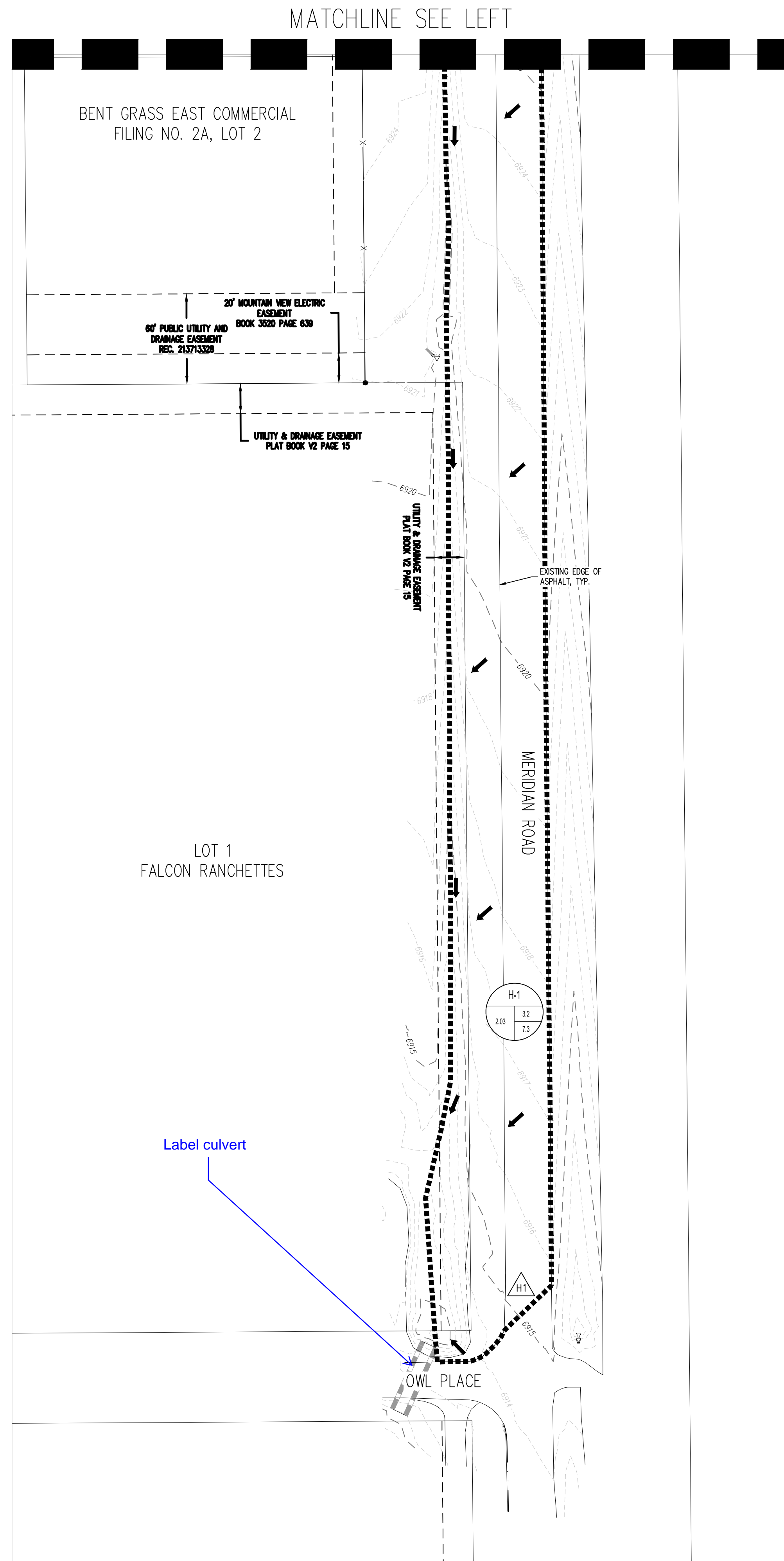
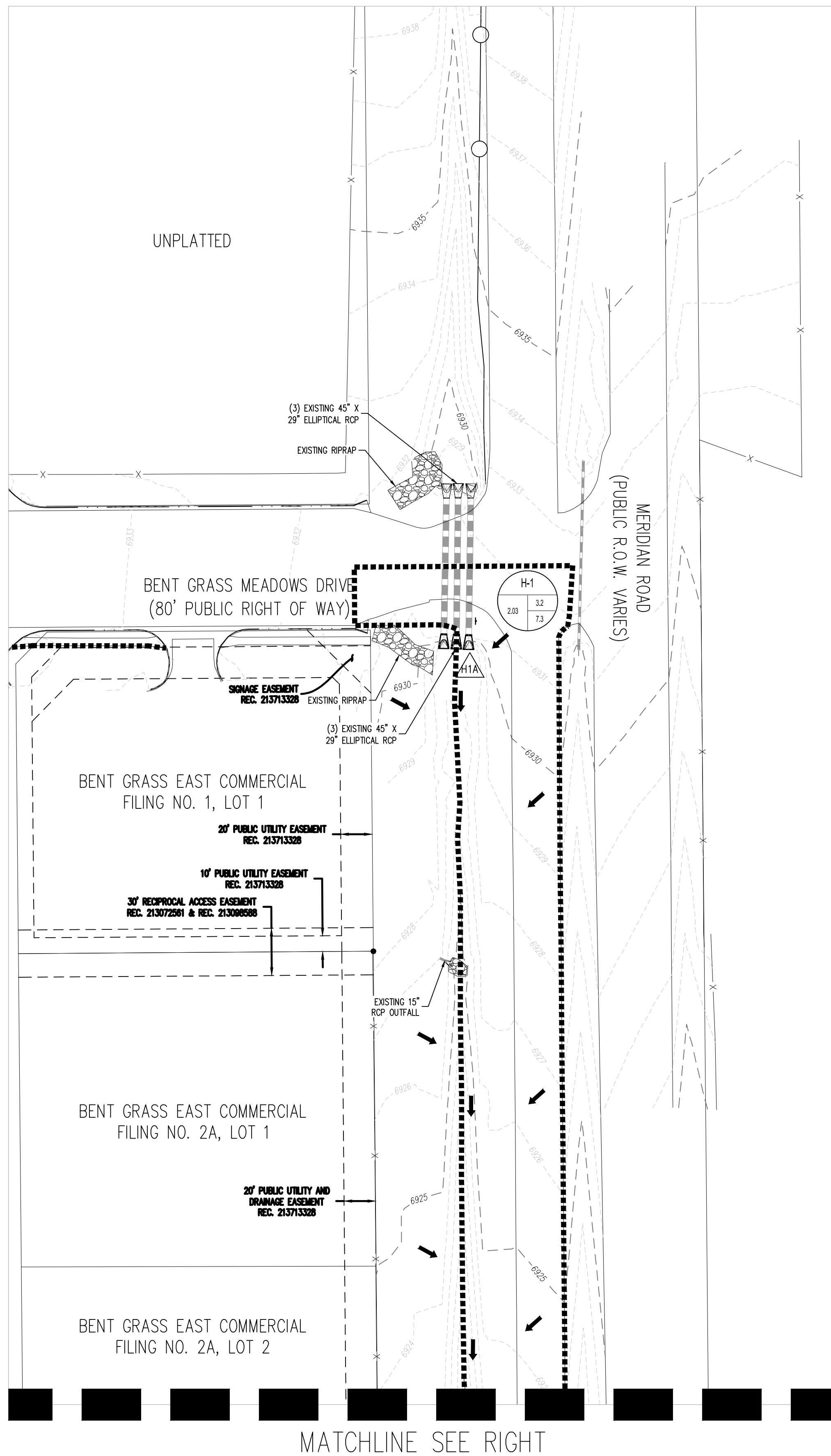
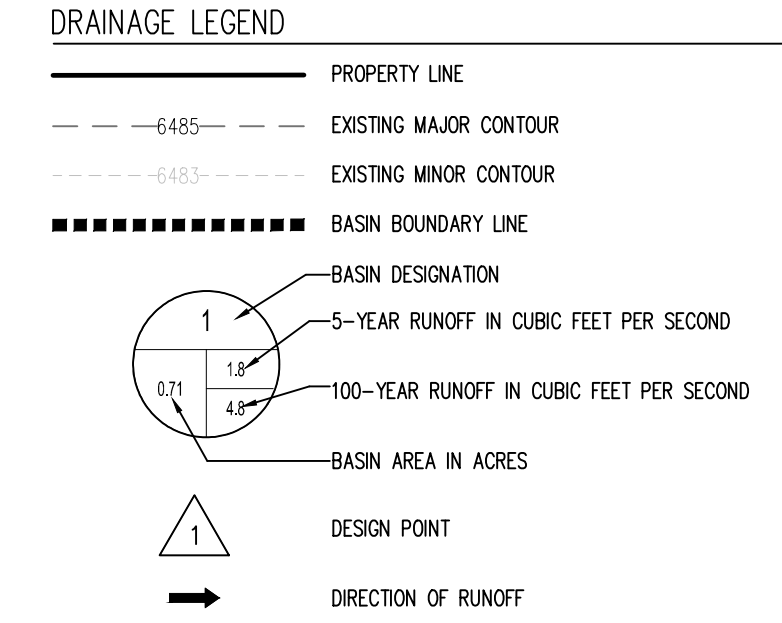
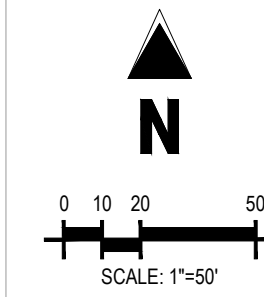
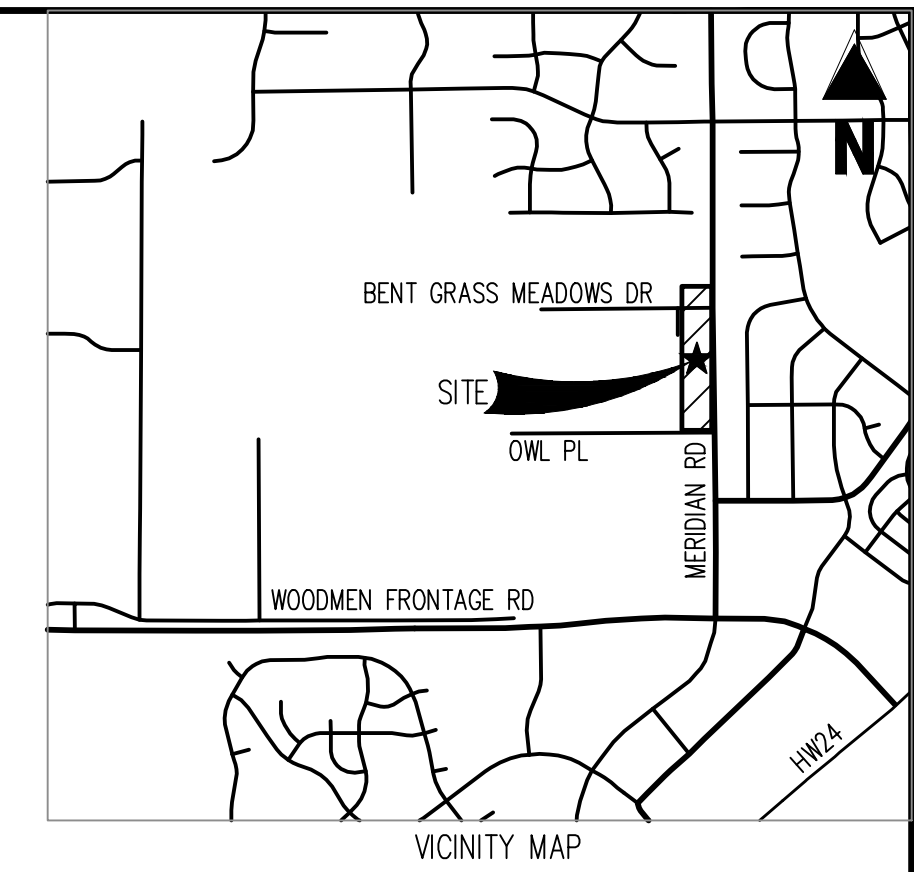
BENT GRASS MEADOWS DRIVE & MERIDIAN ROAD
COLORADO SPRINGS, COLORADO

#	Date	Issue / Description	Init.

Project No:	CLH15.20
Drawn By:	BHB
Checked By:	SMB
Date:	NOVEMBER 2019

HISTORIC DRAINAGE MAP

DR-1



C:\Users\james\Documents\Projects\Bent Grass Meadow Drive & Meridian Road\Drawings\Bent Grass Meadow Drive & Meridian Road\DR-1.dwg, 11/15/2019

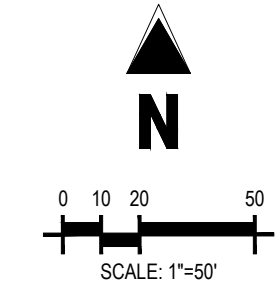
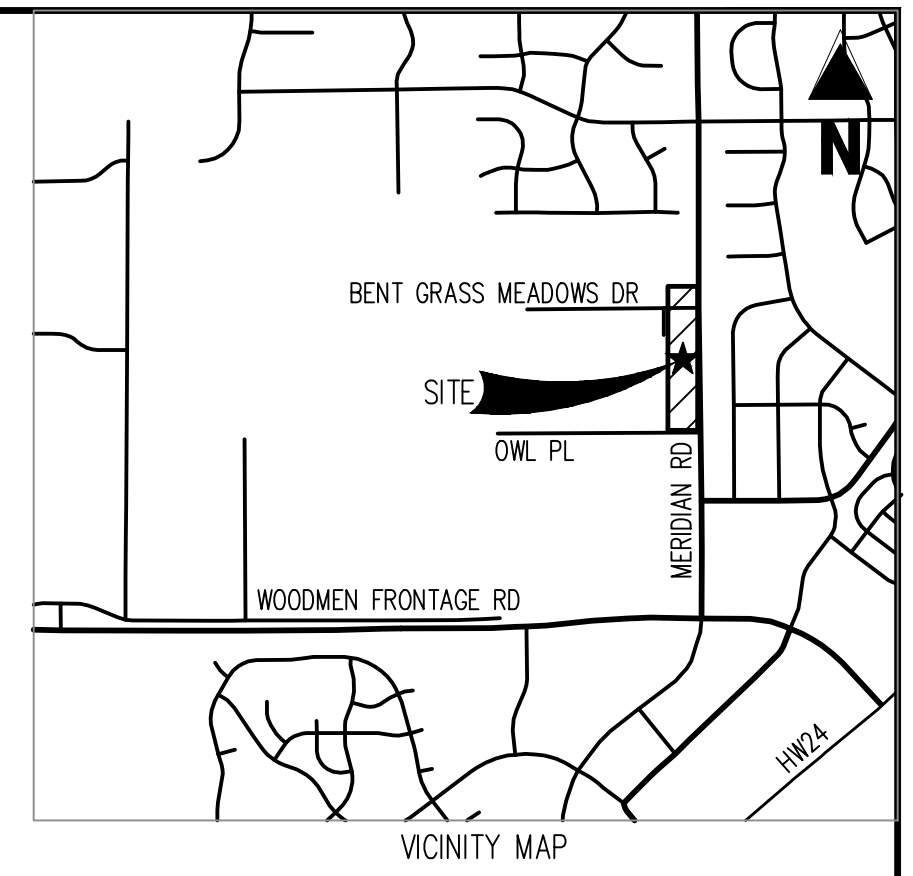
NOT FOR CONSTRUCTION

COPYRIGHT
 THESE PLANS ARE AN INSTRUMENT OF SERVICE AND ARE THE PROPERTY OF GALLOWAY, AND MAY NOT BE DUPLICATED, DISCLOSED, OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF GALLOWAY. COPYRIGHTS AND INFRINGEMENTS WILL BE ENFORCED AND PROSECUTED.

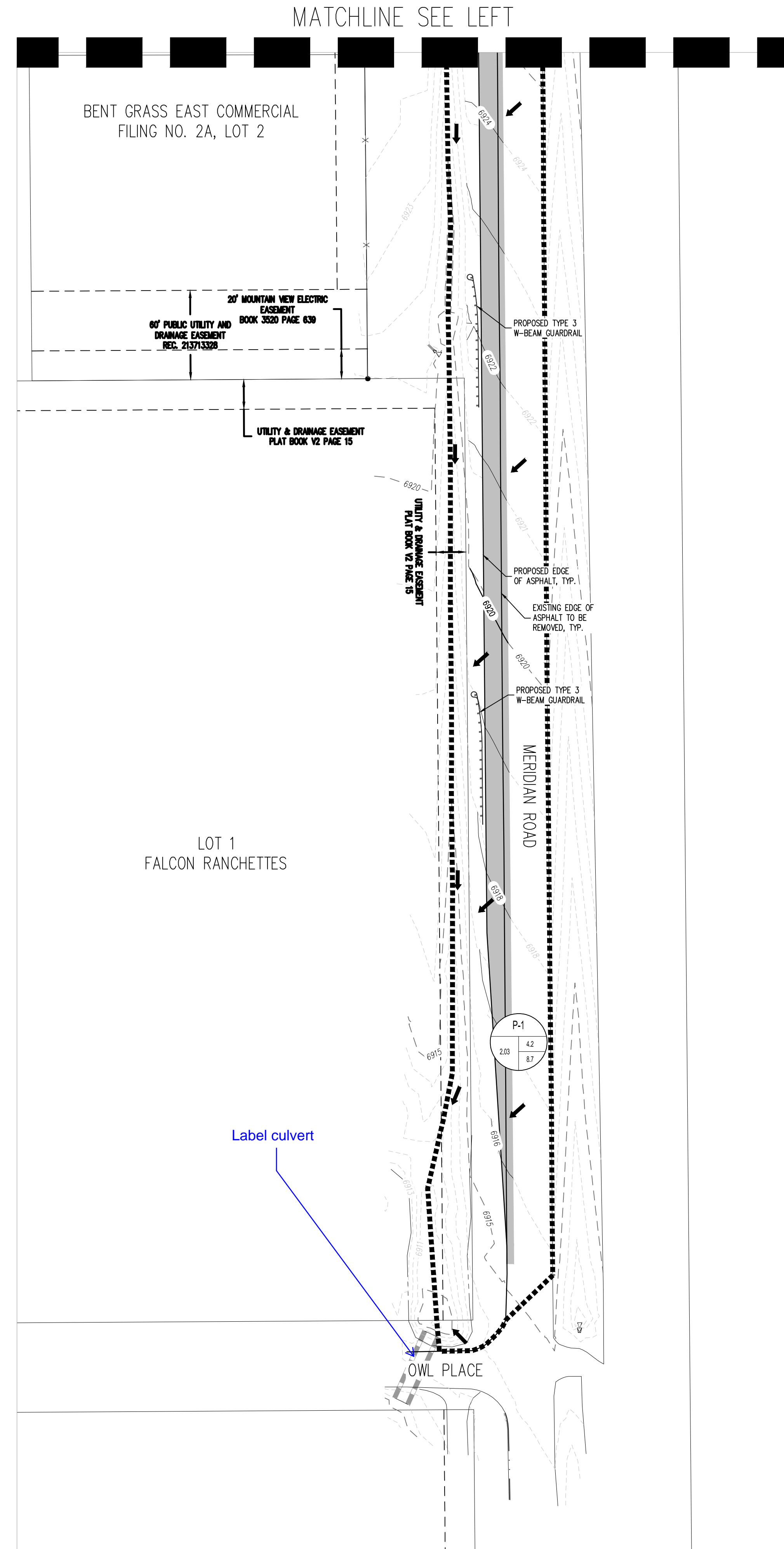
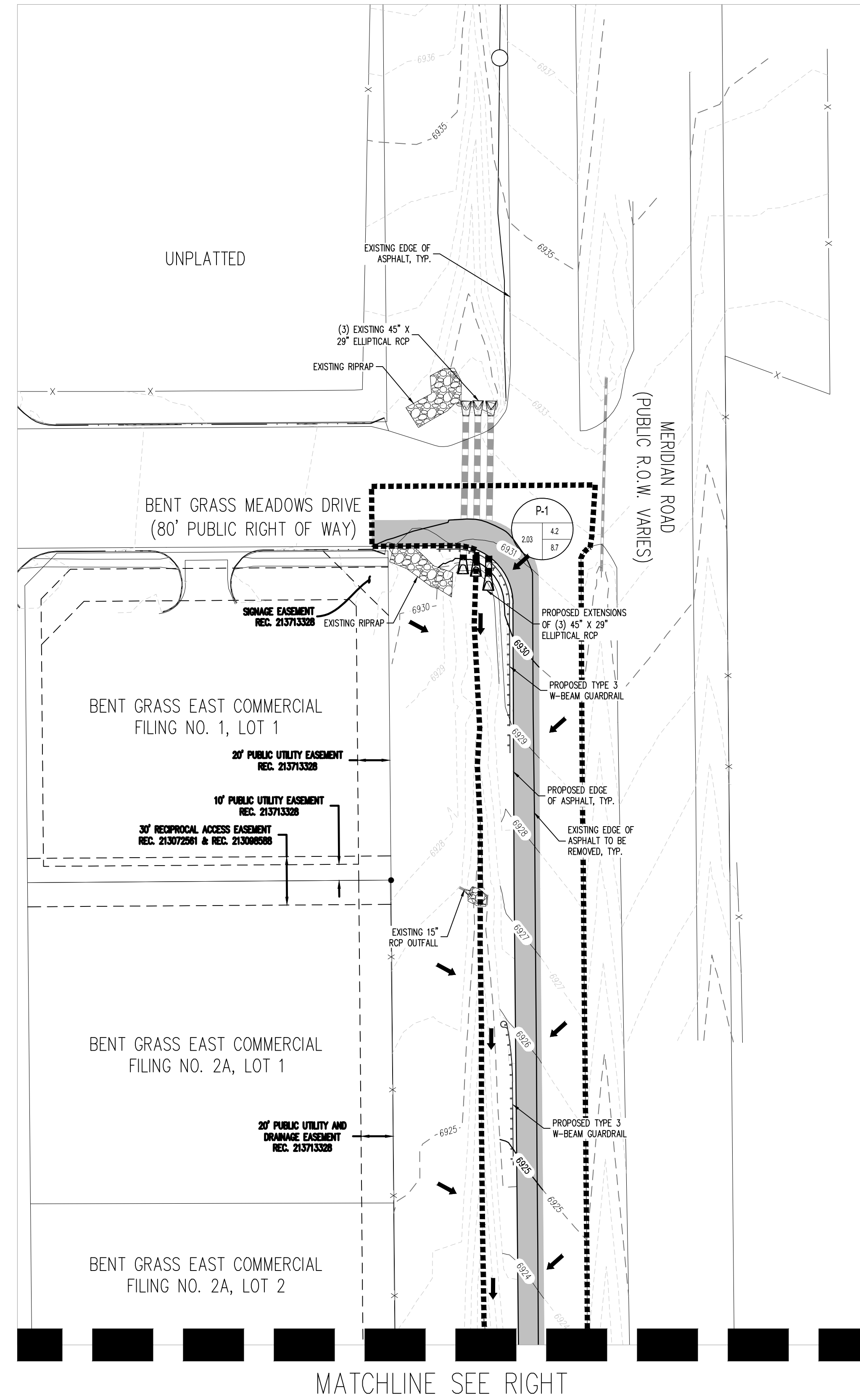


BENT GRASS MEADOW DRIVE & MERIDIAN ROAD ROADWAY IMPROVEMENTS DRAINAGE PLAN

BENT GRASS MEADOWS DRIVE & MERIDIAN ROAD
 COLORADO SPRINGS, COLORADO



- DRAINAGE LEGEND**
- PROPERTY LINE
 - 6485 --- EXISTING MAJOR CONTOUR
 - 6483 --- EXISTING MINOR CONTOUR
 - - - - - 6485 - - - - - PROPOSED MAJOR CONTOUR
 - - - - - 6483 - - - - - PROPOSED MINOR CONTOUR
 - - - - - BASIN BOUNDARY LINE
 - BASIN DESIGNATION
 - 1 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
 - 1 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
 - BASIN AREA IN ACRES
 - △ DESIGN POINT
 - DIRECTION OF RUNOFF
 - ▬ PROPOSED ASPHALT



#	Date	Issue / Description	Init.

Project No: CLH15.20
 Drawn By: BHB
 Checked By: SMB
 Date: NOVEMBER 2019

PROPOSED DRAINAGE MAP