MASTER DEVELOPMENT
DRAINAGE PLAN
FOR
ESTEBAN RODRIGUEZ SUBDIVISION SKETCH PLAN,
EL PASO COUNTY, COLORADO

July 2023

Prepared For:

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PCD File No.: XXXX

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

____________________________________ ______________________

Bryan T. Law, Colorado P.E. # 25043 Date
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage plan.

Business Name: William Guman & Associates, Ltd.

By: ______________________________
William Guman
Title: Owner
Address: 731 North Weber Street
Colorado Springs, CO 80903

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 Engineering Criteria Manual, as amended.

____________________________________ ______________________

Joshua Palmer, P.E. Date
County Engineer/ ECM Administrator

Conditions:

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PURPOSE

This document is the Master Development Drainage Plan (MDDP) for the proposed Esteban Rodriguez Subdivision Sketch Plan. The purpose of this drainage plan is to:

1. Identify on-site and off-site drainage patterns.
2. Recommend preliminary stormwater facilities to collect and convey storm runoff from the proposed development to appropriate discharge and/or detention locations.
3. Recommend preliminary water quality and detention facilities to control discharge release rates to below historic rates.
4. Demonstrate compliance with drainage basin planning studies and master plans.

The drainage improvements proposed in this report are preliminary to support the in nature to support the Esteban Rodriguez Subdivision Sketch Plan. Future Preliminary and Final Drainage Reports will be required as development and platting progresses.

GENERAL LOCATION AND DESCRIPTION

Location

The proposed Esteban Rodriguez Subdivision development is located within the west half of Section 2, the southwest quarter of the southeast quarter of the east half of Section 2, and the north half of the north half of Section 11, Township 13 South, Range 64 West of the Sixth Principal Meridian, El Paso County, Colorado. The site is bound by existing large acre Cowboy Ranch VW developments to the east, existing Judge Orr Road to the north, vacant land owned by Gorilla Capital Co. to the west, and by the existing Sagecreek North development and 7360 Falcon Grassy Hts. to the south. A vicinity map is presented in Appendix A.

Description of Property

The proposed Esteban Rodriguez Subdivision development contains approximately 496 acres and per the “Esteban Rodriguez Subdivision Sketch Plan” will be comprised of 2.5-acre single-family lots, 5-acre single-family lots, commercial areas, neighborhood park areas, and detention pond areas. See Appendix E for the Esteban Rodriguez Subdivision Sketch Plan. The site is currently unoccupied and undeveloped. The existing ground cover is sparse short and mixed grass prairie vegetation and natural drainageways.

Per a NRCS web soil survey of the area, the site is made up of Hydrologic Group A and D soils. Type A soils are typically deep well-drained to excessively drained sands that have a high infiltration rate when thoroughly wet. Type D soils are typically clays and soils with a high water table that have a very slow infiltration rate. Most of the developable area of the site has Type A soils. The Type D soils are located mostly within the undevelopable floodplain area. A NRCS soil survey map is presented in Appendix A.

Floodplain Statement

Based on the FEMA FIRM numbers 08041C0559G, dated December 7, 2018, the site lies within Zone A and Zone X. Zone A is defined as area within the Special Flood Hazard Area (SFHA) with no base flood elevations determined. Zone X is defined as area outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The floodplains throughout the site shall be considered no-build areas and all proposed development within the site will occur in Zone X. The FIRM panels are presented in Appendix A.

Environmental

The "Wetland, Wildlife and Natural Features Report for Esteban Rodriguez Subdivision in El Paso County, Colorado" by ECOS dated June 19, 2023 describes the existing environmental features of the site. No critical habitat, wildlife refuges, or hatcheries are found in the vicinity of the site. The site does have existing wetland and riparian habitats located within the drainageway. In compliance with the environmental report, these areas will not be impacted by development and will be left intact. Road corridors that must cut through these wetland and riparian areas shall be minimized and will be analyzed farther in the Preliminary and then Final Drainage Report. See Appendix E for excerpts of the afore mentioned environmental report.

MAJOR DRAINAGE BASINS AND SUB-BASINS

Major Basin Descriptions

Gieck Ranch

A portion of the site lies within the Gieck Ranch Drainage Basin. The "Gieck Ranch Drainage Basin Planning Study" by Drexel, Barrel dated October, 2007 and updated in February 2010 has not been approved by El Paso County as of the date of this report. The Gieck Ranch Drainage Basin covers approximately 22 square miles beginning approximately 5 miles northeast of the Town of Falcon and extends approximately 15 miles to the southeast. The Gieck Ranch Drainage Bain is tributary to Black Squirrel Creek, which drains south to its confluence with the Arkansas River near Pueblo, Colorado. In general, the Gieck Ranch Drainage Basin flows from west to east across the proposed site.

As described in the report, a portion of the west fork of the Gieck Ranch drainageway flows from west to east across the proposed site. The specific channel reaches are WF-R7a, WF-R7b, and WF-R8a. The proposed improvements described within that report are described as vegetation augmentation and selective stabilization along these reaches. The report proposes several grade control structures as well as the removal of the existing stock pond located within the channel near the east site boundary. Excerpts of the Gieck Ranch DBPS are shown in Appendix E for information only. The proposed development does not intend to change peak flows in the existing drainageways. Due to a proposed residential collector crossing the existing drainageway in two locations, it is anticipated that a LOMR will be required in the future to analyze the impacts in this area. Future reports will analyze the proposed Esteban Rodriguez Subdivision drainage infrastructure and determine what is needed for the development.

Haegler Ranch
A portion of the site also lies within the Haegler Ranch Drainage Basin. The “Haegler Ranch Basin Drainage Basin Planning Study” by URS Corporation dated May, 2009 describes the characteristics of the Haegler Ranch basin. The Haegler Ranch Drainage Basin covers approximately 17 square miles located in the central portion of El Paso County. The Haegler Ranch Drainage Bain is tributary to Ellicott Consolidated Drainage Basin unnamed tributary, which is tributary to Black Squirrel Creek. In general, the Haegler Ranch Drainage Basin flows from north to south to the west of the proposed site.

As described in the report, a portion of the main stem flows north to south to the west of the proposed site. The specific channel reaches adjacent to the proposed site are MS-5 and MS-6. The proposed improvements described within the Haegler Ranch DPBS suggest sub-regional detention facilities as the selected design alternative. None of the Haegler Ranch drainageway floodplains are located on-site, and there will therefore be no impacts due to the proposed development. The proposed development does not intend to change peak flows in the existing drainageways. Excerpts of the Haegler Ranch DBPS are shown in Appendix E. Future reports will analyze the proposed Esteban Rodriguez Subdivision drainage infrastructure and determine what is needed for the development.

ESTEBAN RODRIGUEZ SUBDIVISION BASINS AND SUB-BASINS

Existing Sub-basin Drainage

Future reports will analyze existing flowrates for the Esteban Rodriguez Subdivision development. The existing basin delineation for Esteban Rodriguez Subdivision as shown on the map within Appendix F is as follows:

Basin OS1 is approximately 1.56 acres and is comprised of undeveloped areas to the west of the project site. Flow will follow the historic path overland from the northwest to the southeast where it will enter Basin EXA and follow the drainage patterns of that basin.

Basin OS2 is approximately 18.31 acres and is comprised of undeveloped areas to the west of the project site. Flow will follow the historic path overland from the southwest to the northeast where it will enter Basin EXA and follow the drainage patterns of that basin.

Existing Basin EXA is approximately 184.37 acres and in the existing condition is comprised of undeveloped land and part of the FEMA floodplain for Gieck Ranch West Tributary. Historically runoff from this basin flows from northwest and southwest to the drainageway in the middle where the flows enter the existing drainageway at DP1. Flows then continue flowing east within the existing drainageway.

Existing Basin EXB is approximately 32.18 acres and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from northwest to the southeast where the flows follow the existing path flowing to the southeast off-site at DP2. Flows then continue flowing southeast and enter the existing drainageway.

Existing Basin EXC is approximately 26.55 acres and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from south to the north where the flows follow the existing path flowing to the northeast off-site at DP3. Flows then continue flowing northeast and enter the existing drainageway.

Existing Basin EXD is approximately 48.20 acres and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from north to the south where the flows follow the existing path flowing to the southwest off-site at DP4. Flows then continue flowing south and enter the existing Haegler Ranch drainageway.

Existing Basin EXE is approximately 152.90 acres and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from north to the south where the flows follow the existing path flowing to the southwest off-site at DP5. Flows then continue flowing south following the historic path within the Haegler Ranch drainage basin.

Existing Basin EXF is approximately 50.21 acres and in the existing condition is comprised of undeveloped land. Historically runoff from this basin flows from north to the south where the flows follow the existing path flowing to the southwest off-site at DP6. Flows then continue flowing south following the historic path within the Haegler Ranch drainage basin.

A summary of existing basin parameters is presented in Appendix B.

Proposed Drainage Conveyance

In general, developed flows are collected in proposed roadside swales, which convey water to the proposed detention areas. Proposed residential collectors with 60’ right-of-ways are used throughout the site and are per the typical El Paso County section. Proposed swales will be designed per the typical county rural roadside ditch section and designed to ensure they are stable and have required capacity to satisfy criteria. A swale is considered stable with a velocity of 5 ft/s or less. To ensure capacity, swales will have a minimum of 1 ft. of freeboard over the water surface for flows anticipated in a 100-year storm event. In addition to the swales, a few proposed culverts also convey flows under proposed roadways. Culverts under paved roads will be sized to not overtop the roadways with flows from a 100-year storm event. The inlets and outlets of the proposed culverts will be protected with riprap to limit potential erosion. More detailed analysis shall be provided in the future Final Drainage Report.

Proposed Sub-basin Drainage

Future reports will analyze proposed flowrates for the Esteban Rodriguez Subdivision development. The proposed basin delineation for Esteban Rodriguez Subdivision as shown on the map within Appendix F is as follows:

Basin OS1 is approximately 1.56 acres and is comprised of undeveloped areas to the west of the project site. This basin is off-site and therefore no work is proposed in this area. Flow will follow the historic path overland from the northwest to the southeast where it will enter Basin A and follow the drainage patterns of that basin.

Basin A is approximately 15.50 acres and in the proposed condition is comprised of Parcel A and Parcel B, which both have a commercial land use. Runoff from this basin will be collected in a proposed swale that runs west to east along the south-side of the parcels. The proposed swale will convey the basin flows east towards Pond 1 at DP1. The flows will be treated within the on-site full-spectrum Extended Detention Basin (EDB) and then released to the proposed swale along the residential collector. Flows will ultimately follow the proposed conveyance to the existing Gieck Ranch West Tributary drainageway then continue flowing east.

Basin B is approximately 4.12 acres and in the proposed condition is comprised of Parcel G, which has a commercial land use. Runoff from this basin will be collected in a proposed swale that runs west to east along the south-side of the parcel. The proposed swale will convey the basin flows east towards Pond 2 at DP2. The flows will be treated within the full-spectrum EDB and then released to the existing drainage paths to the east of the site. Flows will ultimately follow the historic conveyance to the existing Gieck Ranch West Tributary drainageway then continue flowing east.

Basin C is approximately 65.60 acres and in the proposed condition is comprised of Parcel C, part of D, and part of Parcel F that all have a land use of large single-family lots. Also within this basin is proposed residential collector roadways. Runoff from this basin will be collected in proposed roadside swales that run along the proposed residential collectors. Runoff from all sides of the collectors shall be captured by the proposed swales and culverts that lead southeast to Pond 3 at DP3. The flows will be treated within the EDB then released to the existing Gieck Ranch West Tributary drainageway. Flows will then continue flowing east.

Basin D is approximately 11.85 acres and in the proposed condition is comprised of Parcel H, which has a land use of large single-family lots. Runoff from this basin will flow southeast overland towards the existing drainageway at DP4. Runoff from this basin does not include any proposed roadway flows and therefore follows the historic drainage pattern flowing to the existing drainageway undetained or treated. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure.

Basin E1 is approximately 29.34 acres and is the boundary of one of the existing floodplains that crosses the site. A proposed residential collector crosses the floodplain and is also the boundary of the basin. In the proposed condition, this basin will remain undeveloped as floodplains are no-build areas. Flows will follow the historic drainage pattern from west to east.

Basin E2 is approximately 6.01 acres and is the boundary of one of the existing floodplains that crosses the site. Two proposed residential collectors cross the floodplain and are also the boundary of the basin. In the proposed condition, this basin will remain undeveloped as floodplains are no-build areas. Flows will follow the historic drainage pattern from west to east.

Basin E3 is approximately 4.53 acres and is the boundary of one of the existing floodplains that crosses the site. A proposed residential collector crosses the floodplain and is also the boundary of the basin. In the proposed condition, this basin will remain undeveloped as floodplains are no-build areas. Flows will follow the historic drainage pattern from west to east.

Basin OS2 is approximately 18.31 acres and is comprised of undeveloped areas to the west of the project site. This basin is off-site and therefore no work is proposed in this area. Flow will follow the historic path overland from the southwest to the northeast where it will enter Basin F and follow the drainage patterns of that basin.

Basin F is approximately 81.30 acres and in the proposed condition is comprised of part of Parcel I, part of K, part of M, part of N, and part of O that all have a land use of large single-family lots. Also within this basin is Parcel J, which has a land use of park, and proposed residential collector roadways. Runoff from this basin will be collected in proposed roadside swales that run along the proposed residential collectors. Runoff from all sides of the collectors shall be captured by the proposed swales and culverts that lead northeast to Pond 4 at DP5. The flows will be treated within the EDB then released to the existing Gieck Ranch West Tributary drainageway. Flows will then continue flowing east.

Basin G is approximately 21.88 acres and in the proposed condition is comprised of part of Parcel L, which has a land use of large single-family lots. Runoff from this basin will flow northeast overland towards the existing drainageway at DP6. Runoff from this basin does not include any proposed roadway flows and therefore follows the historic drainage pattern flowing to the existing drainageway undetained or treated. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure.

Basin H is approximately 34.56 acres and in the proposed condition is comprised of part of Parcel M, which has a land use of large single-family lots, Parcel T, which has a land use of detention pond and a proposed residential collector roadway. Runoff from this basin will be collected in proposed roadside swales that run north to south along the proposed residential collector. Runoff from the east and west side of the collector shall be captured by the proposed swales and culvert that lead southwest to Pond 5 at DP7. The flows will be treated within the EDB then released to the west off-site. Flows will ultimately enter the existing Haegler Ranch drainageway and then continue flowing south.

Basin I is approximately 185.68 acres and in the proposed condition is comprised of part of Parcel N, part of O, P, and R that all have a land use of large single-family lots. Also within this basin is Parcel S, which has a land use of detention pond, and proposed residential collector roadways. Runoff from this basin will be collected in proposed roadside swales that run along the proposed residential collectors. Runoff from all sides of the collectors shall be captured by the proposed swales and culverts that lead southeast to Pond 6 at DP8. The flows will be treated within the EDB then released off-site to the south along the existing Slocum Road adjacent to the existing Sagecreek North development.

Basin J is approximately 31.07 acres and in the proposed condition is comprised of Parcel Q, which has a land use of large single-family lots. Runoff from this basin will flow south overland towards the site boundary at DP9. Runoff from this basin does not include any proposed roadway flows and therefore follows the historic drainage pattern flowing off-site undetained or treated. This in accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure.

A summary of proposed basin parameters is presented in Appendix B.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the “City of Colorado Spring/El Paso County Drainage Criteria Manual” Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the “Urban Storm Drainage Criteria Manual” Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the “Colorado Springs Drainage Criteria Manual (CCSDCM)”, dated May 2014, as adopted by El Paso County, as well as the July 2019 El Paso County Engineering Criteria Manual update.

Hydrologic Criteria

All hydrologic data was obtained from the “El Paso Drainage Criteria Manual" Volumes 1 and 2, and the “Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual” Volumes 1, 2, and 3. Future reports shall analyze the existing and proposed flows for the Esteban Rodriguez Subdivision development.

Mile High Flood District’s MHFD-Detention, Version 4.06 workbook was used for preliminary pond sizing. Required detention volumes were designed per USDCM and CCS/EPCDCM. Preliminary pond sizing spreadsheets are presented in Appendix D.

Hydraulic Criteria

For the purposes of the Esteban Rodriguez Subdivision Sketch Plan, no hydraulic analysis was performed. In future Preliminary and Final Drainage Reports, proposed culverts and roadside ditches shall be designed to conform to requirements set in the EPC DCM.

DRAINAGE FACILITY DESIGN

General Concept

The proposed stormwater conveyance system was designed to convey the developed Esteban Rodriguez Subdivision flows to one of six full-spectrum EDBs via roadside ditches and roadway culverts. Pond 1 is located within Parcel B, which has a commercial land use, and will detain the developed flows on-site. Pond 2 is located within Parcel G, which has a commercial land use, and will detain the developed flows on-site. Pond 3 is located within Parcel F that has a large single – family lot land use, and will detain the developed flows on-site. Pond 4 is located within Parcel K, which has a large single-family lot land use, and will detain the developed flows on-site. Pond 5 is located in Parcel T, which has a detention pond land use, and will detain the developed flows within this parcel. Pond 6 is located within Parcel S, which has a detention pond land use, and will detain the developed flows within this parcel. All proposed full-spectrum EDBs will be designed to release flows at less than historic to minimize adverse impacts downstream. Due to this, there are no drainage problems anticipated downstream of the Esteban Rodriguez Subdivision development. The EDBs will outfall at various points of the existing drainageway and all proposed work shall stay out of the floodplain.

In accordance with Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedure, developed basins with large lot single-family sites with a maximum of 10% impervious area shall be allowed to release runoff without a downstream water quality feature. In accordance with Section I.7.1.B.7, sites with land disturbance to undeveloped land that will remain undeveloped shall also be excluded from releasing to a downstream water quality feature. See highlighted areas in the drainage map presented in Appendix F.

SUMMARY

The proposed development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements, including ditches, culverts, detention ponds and drainage channel improvements. The proposed development will not adversely affect the offsite major drainageways or surrounding development. This report meets the latest El Paso County Drainage Criteria requirements for this site.

REFERENCES:

1. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. Esteban Rodriguez Subdivision Sketch Plan, William Guman & Associates, Ltd., April 2023.

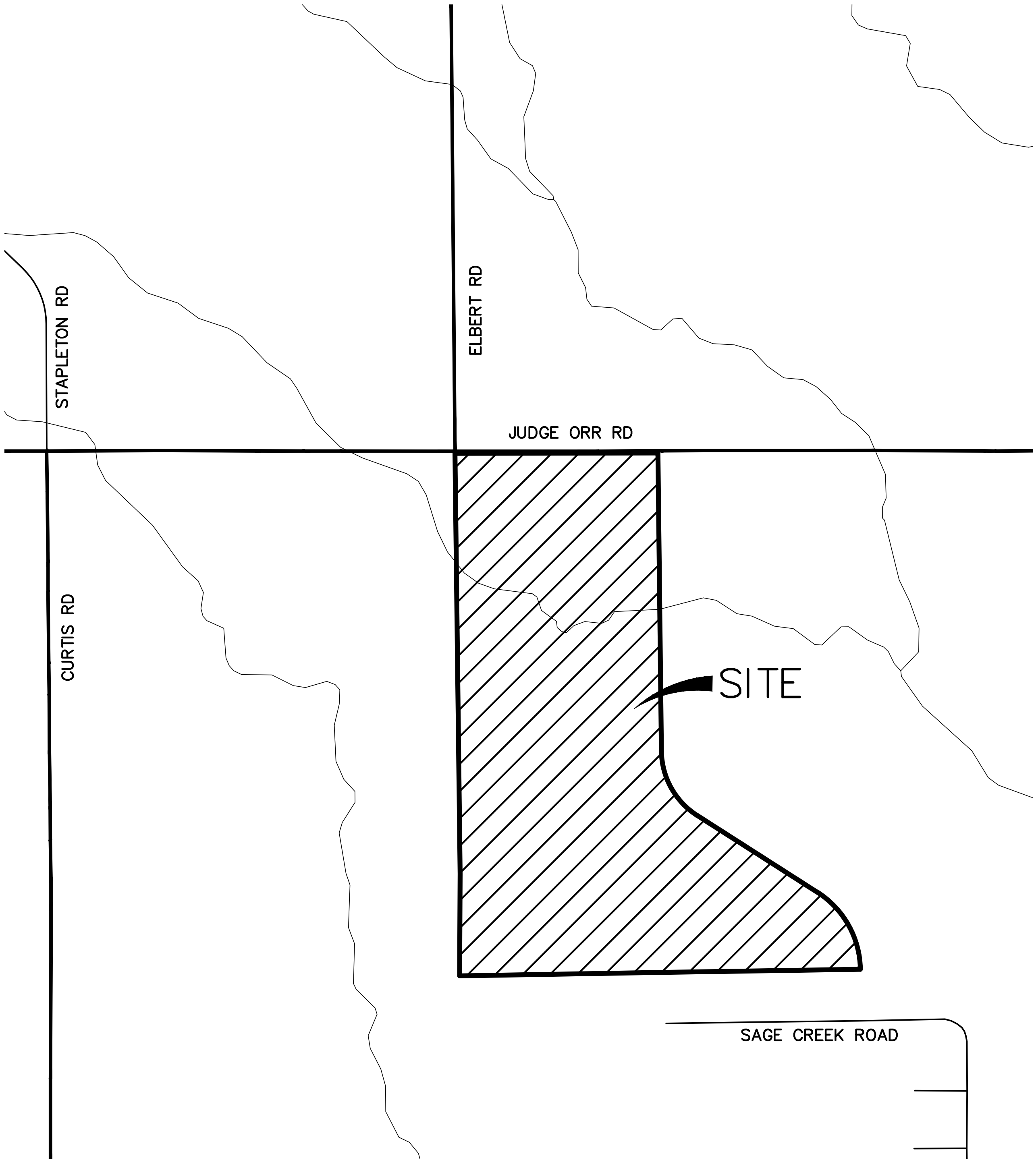
4. Wetland, Wildlife and Natural Features Report for Esteban Rodriguez Subdivision in El Paso County, Colorado, ECOS, June 2023.

5. Gieck Ranch Drainage Basin Planning Study, Drexel, Barrell & Co., October 2007 and revised in February 2010.

6. Haegler Ranch Basin Drainage Basin Planning Study, URS Corporation, May 2009.

APPENDIX A

FIGURES AND EXHIBITS



VICINITY MAP
ESTEBAN RODRIGUEZ SUBDIVISION–
SKETCH PLAN
JOB NO. 25277.00
07/11/2023
SHEET 1 OF 1

2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

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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, N/NGS12
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, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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.

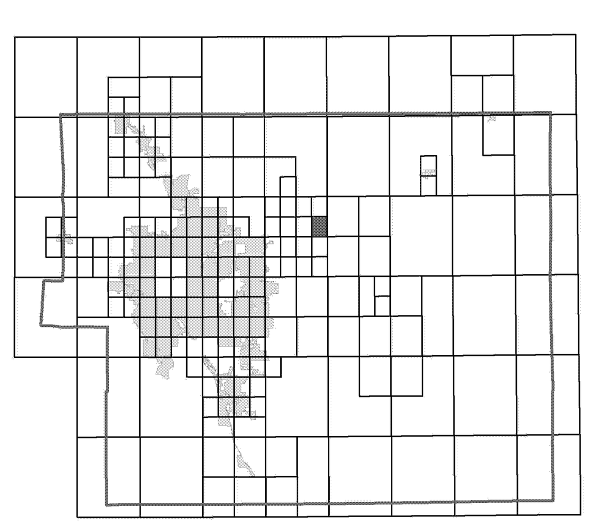
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this 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/nfip.

El Paso County Vertical Datum Offset Table

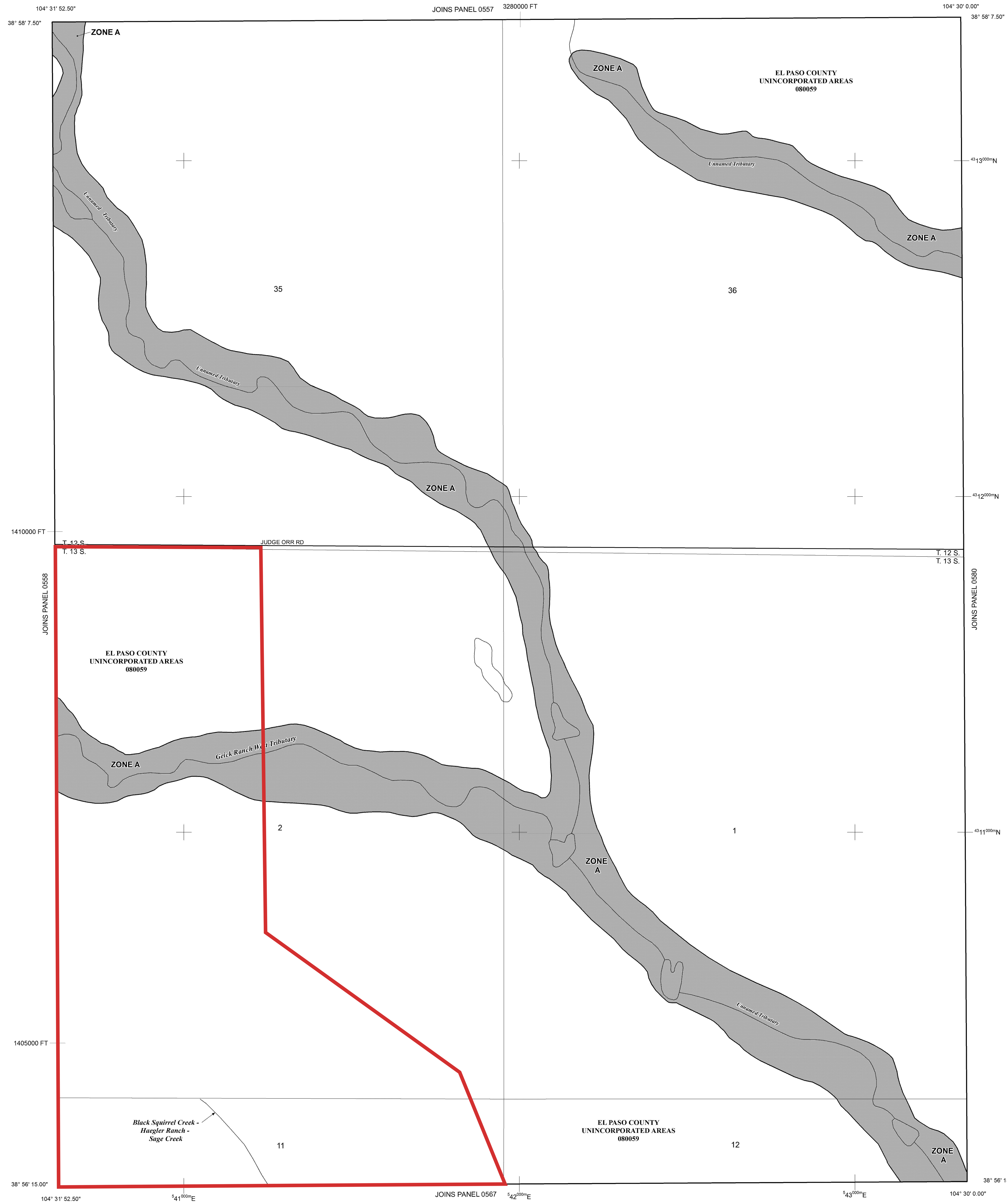
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

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.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST, AND TOWNSHIP 13 SOUTH, RANGE 64 WEST.

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 equaled 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)	Base Flood Elevation value where uniform within zone; elevation in feet*

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

A——A	Cross section line
23- - - - -23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 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.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

NFIP

PANEL 0559G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 559 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

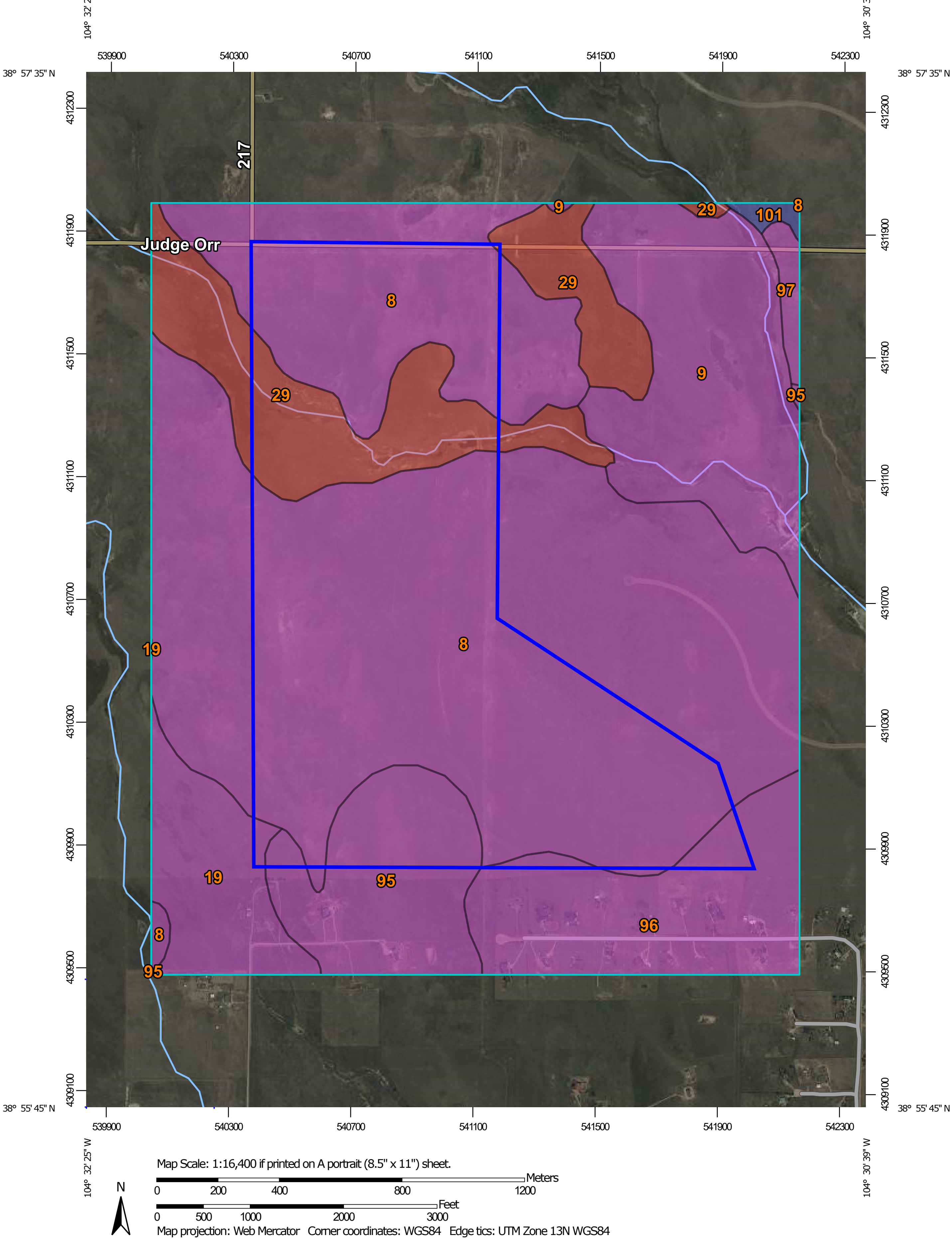
COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0559	G

Notice to User: The **Map Number** shown below should be used when placing map orders: the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0559G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency


104° 32' 25" W
104° 30' 39" W
38° 57' 35" N
38° 55' 45" N
539900
540300
540700
541100
541500
541900
542300
4312300
4311900
4311500
4311100
4310700
4310300
4309900
4309500
4309100
217
Judge Orr
8
9
19
29
95
96
97
101
Map Scale: 1:16,400 if printed on A portrait (8.5" x 11") sheet.
Meters
0
200
400
800
1200
Feet
0
500
1000
2000
3000
N
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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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.

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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	759.5	57.4%
9	Blakeland-Fluvaquentic Haplaquolls	A	145.9	11.0%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	63.8	4.8%
29	Fluvaquentic Haplaquolls, nearly level	D	139.2	10.5%
95	Truckton loamy sand, 1 to 9 percent slopes	A	89.4	6.8%
96	Truckton sandy loam, 0 to 3 percent slopes	A	113.3	8.6%
97	Truckton sandy loam, 3 to 9 percent slopes	A	8.3	0.6%
101	Ustic Torrifluvents, loamy	B	3.8	0.3%
Totals for Area of Interest			**1,323.3**	**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

APPENDIX B

HYDROLOGIC CALCULATIONS

EXISTING COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County

Project Name:
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 7/6/23

Basin ID	Total Area (ac)	Hardscape (100% Impervious)				Undeveloped (0% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
EXA	181.37	0.90	0.96	0.00	0.0%	0.08	0.35	181.37	0.0%	0.08	0.35	0.0%
EXB	32.18	0.90	0.96	0.00	0.0%	0.08	0.35	32.18	0.0%	0.08	0.35	0.0%
EXC	26.55	0.90	0.96	0.00	0.0%	0.08	0.35	26.55	0.0%	0.08	0.35	0.0%
EXD	48.20	0.90	0.96	0.00	0.0%	0.08	0.35	48.20	0.0%	0.08	0.35	0.0%
EXE	152.90	0.90	0.96	0.00	0.0%	0.08	0.35	152.90	0.0%	0.08	0.35	0.0%
EXF	50.21	0.90	0.96	0.00	0.0%	0.08	0.35	50.21	0.0%	0.08	0.35	0.0%
OS1	26.55	0.90	0.96	0.00	0.0%	0.08	0.35	26.55	0.0%	0.08	0.35	0.0%
OS2	4.89	0.90	0.96	0.00	0.0%	0.08	0.35	4.89	0.0%	0.08	0.35	0.0%
Total On-Site	491.41											0.0%

PROPOSED COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Esteban Rodriguez Subdivision
Location: El Paso County

Project Name:
Project No.: 25277.00
Calculated By: GAG
Checked By:
Date: 7/5/23

Basin ID	Total Area (ac)	Hardscape (100% Impervious)				Undeveloped (0% Impervious)				Single-Family (2.5-5 acre) (10% Impervious)				Commercial (95% Impervious)				Park (7% Impervious)				Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A	15.50	0.90	0.96	0.23	1.5%	0.08	0.35	0.30	0.0%	0.16	0.41	0.00	0.0%	0.81	0.88	14.97	91.8%	0.12	0.39	0.00	0.0%	0.80	0.87	93.2%
B	4.12	0.90	0.96	0.16	3.9%	0.08	0.35	0.21	0.0%	0.16	0.41	0.00	0.0%	0.81	0.88	3.75	86.5%	0.12	0.39	0.00	0.0%	0.78	0.86	90.4%
C	65.60	0.90	0.96	3.80	5.8%	0.08	0.35	4.99	0.0%	0.16	0.41	56.81	8.7%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.20	0.44	14.5%
D	11.85	0.90	0.96	0.00	0.0%	0.08	0.35	0.00	0.0%	0.16	0.41	11.85	10.0%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.16	0.41	10.0%
E1	29.34	0.90	0.96	0.00	0.0%	0.08	0.35	29.34	0.0%	0.16	0.41	0.00	0.0%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.08	0.35	0.0%
E2	6.01	0.90	0.96	0.00	0.0%	0.08	0.35	6.01	0.0%	0.16	0.41	0.00	0.0%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.08	0.35	0.0%
E3	4.53	0.90	0.96	0.00	0.0%	0.08	0.35	4.53	0.0%	0.16	0.41	0.00	0.0%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.08	0.35	0.0%
F	81.30	0.90	0.96	3.14	3.9%	0.08	0.35	4.12	0.0%	0.16	0.41	65.50	8.1%	0.81	0.88	0.00	0.0%	0.12	0.39	8.54	0.7%	0.18	0.43	12.7%
G	21.88	0.90	0.96	0.00	0.0%	0.08	0.35	0.00	0.0%	0.16	0.41	21.88	10.0%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.16	0.41	10.0%
H	34.56	0.90	0.96	1.73	5.0%	0.08	0.35	2.27	0.0%	0.16	0.41	30.56	8.8%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.19	0.43	13.8%
I	185.68	0.90	0.96	3.88	2.1%	0.08	0.35	5.09	0.0%	0.16	0.41	176.71	9.5%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.17	0.42	11.6%
J	31.07	0.90	0.96	0.00	0.0%	0.08	0.35	0.00	0.0%	0.16	0.41	31.07	10.0%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.16	0.41	10.0%
OS1	1.56	0.90	0.96	0.00	0.0%	0.08	0.35	1.56	0.0%	0.16	0.41	0.00	0.0%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.08	0.35	0.0%
OS2	18.31	0.90	0.96	0.00	0.0%	0.08	0.35	18.31	0.0%	0.16	0.41	0.00	0.0%	0.81	0.88	0.00	0.0%	0.12	0.39	0.00	0.0%	0.08	0.35	0.0%
Total On-Site	491.44																							14.4%
Total Pond 1	17.06																							84.7%
Total Pond 2	4.12																							90.4%
Total Pond 3	65.60																							14.5%
Total Pond 4	99.61																							10.3%
Total Pond 5	34.56																							13.8%
Total Pond 6	185.68																							11.6%

APPENDIX C

HYDRAULIC CALCULATIONS

(N/A)

APPENDIX D

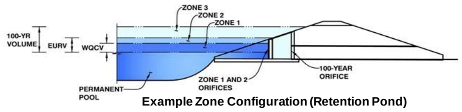
WATER QUALITY AND DETENTION CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	17.06	acres
Watershed Length =	2,400	ft
Watershed Length to Centroid =	1,230	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	85.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.515	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.940	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.397	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.805	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.134	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.504	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.866	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.279	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	4.200	acre-feet		inches
Approximate 2-yr Detention Volume =	1.277	acre-feet		
Approximate 5-yr Detention Volume =	1.658	acre-feet		
Approximate 10-yr Detention Volume =	1.973	acre-feet		
Approximate 25-yr Detention Volume =	2.335	acre-feet		
Approximate 50-yr Detention Volume =	2.545	acre-feet		
Approximate 100-yr Detention Volume =	2.733	acre-feet		

Define Zones and Basin Geometry

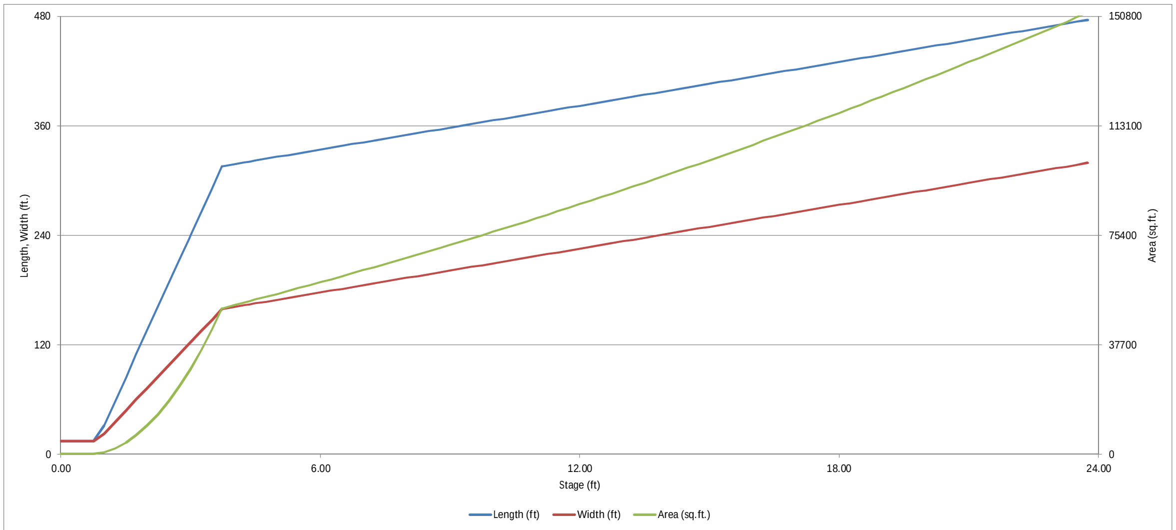
Zone 1 Volume (WQCV) =	0.515	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.425	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.794	acre-feet
Total Detention Basin Volume =	2.733	acre-feet
Initial Surcharge Volume (ISV) =	67	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	204	ft^2
Surcharge Volume Length (L_{ISV}) =	14.3	ft
Surcharge Volume Width (W_{ISV}) =	14.3	ft
Depth of Basin Floor (H_{FLOOR}) =	2.90	ft
Length of Basin Floor (L_{FLOOR}) =	315.9	ft
Width of Basin Floor (W_{FLOOR}) =	159.3	ft
Area of Basin Floor (A_{FLOOR}) =	50,312	ft^2
Volume of Basin Floor (V_{FLOOR}) =	51,928	ft^3
Depth of Main Basin (H_{MAIN}) =	1.27	ft
Length of Main Basin (L_{MAIN}) =	326.0	ft
Width of Main Basin (W_{MAIN}) =	169.4	ft
Area of Main Basin (A_{MAIN}) =	55,243	ft^2
Volume of Main Basin (V_{MAIN}) =	67,003	ft^3
Calculated Total Basin Volume (V_{total}) =	2.734	acre-feet

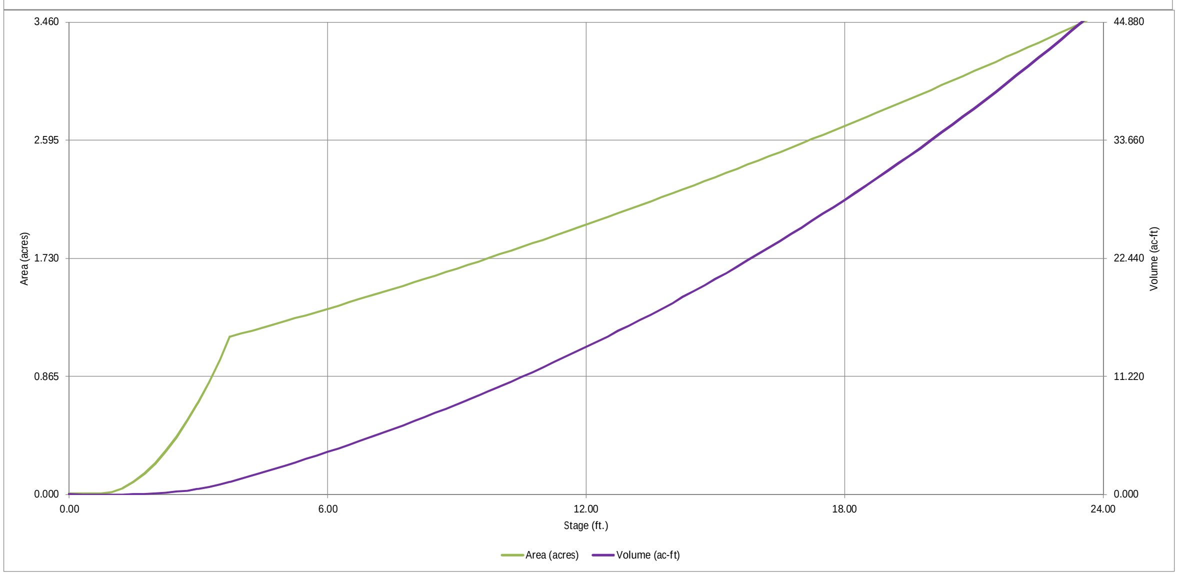
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		14.3	14.3	204		0.005		
ISV	0.33		14.3	14.3	204		0.005	67	0.002
	0.50		14.3	14.3	204		0.005	102	0.002
	0.75		14.3	14.3	204		0.005	153	0.004
	1.00		32.0	22.8	728		0.017	244	0.006
	1.25		58.0	35.3	2,045		0.047	577	0.013
	1.50		84.0	47.8	4,011		0.092	1,321	0.030
	1.75		110.0	60.3	6,628		0.152	2,637	0.061
	2.00		136.0	72.8	9,895		0.227	4,689	0.108
	2.25		162.0	85.3	13,811		0.317	7,638	0.175
	2.50		188.0	97.8	18,378		0.422	11,649	0.267
	2.75		214.0	110.3	23,595		0.542	16,882	0.388
Zone 1 (WQCV)	2.97		236.8	121.3	28,723		0.659	22,627	0.519
	3.00		240.0	122.8	29,461		0.676	23,500	0.539
	3.25		266.0	135.3	35,978		0.826	31,666	0.727
	3.50		292.0	147.8	43,145		0.990	41,543	0.954
Floor	3.73		315.9	159.3	50,312		1.155	52,280	1.200
	3.75		316.0	159.4	50,388		1.157	53,287	1.223
	4.00		318.0	161.4	51,343		1.179	66,003	1.515
	4.25		320.0	163.4	52,306		1.201	78,959	1.813
Zone 2 (EURV)	4.36		320.9	164.3	52,732		1.211	84,737	1.945
	4.50		322.0	165.4	53,277		1.223	92,157	2.116
	4.75		324.0	167.4	54,256		1.246	105,599	2.424
Zone 3 (100-year)	5.00		326.0	169.4	55,243		1.268	119,286	2.738
	5.25		328.0	171.4	56,238		1.291	133,221	3.058
	5.50		330.0	173.4	57,241		1.314	147,405	3.384
	5.75		332.0	175.4	58,252		1.337	161,842	3.715
	6.00		334.0	177.4	59,271		1.361	176,532	4.053
	6.25		336.0	179.4	60,298		1.384	191,478	4.396
	6.50		338.0	181.4	61,333		1.408	206,681	4.745
	6.75		340.0	183.4	62,376		1.432	222,145	5.100
	7.00		342.0	185.4	63,427		1.456	237,870	5.461
	7.25		344.0	187.4	64,485		1.480	253,859	5.828
	7.50		346.0	189.4	65,552		1.505	270,113	6.201
	7.75		348.0	191.4	66,627		1.530	286,636	6.580
	8.00		350.0	193.4	67,710		1.554	303,428	6.966
	8.25		352.0	195.4	68,801		1.579	320,491	7.357
	8.50		354.0	197.4	69,900		1.605	337,829	7.755
	8.75		356.0	199.4	71,007		1.630	355,442	8.160
	9.00		358.0	201.4	72,122		1.656	373,333	8.571
	9.25		360.0	203.4	73,245		1.681	391,504	8.988
	9.50		362.0	205.4	74,376		1.707	409,956	9.411
	9.75		364.0	207.4	75,515		1.734	428,693	9.841
	10.00		366.0	209.4	76,662		1.760	447,714	10.278
	10.25		368.0	211.4	77,817		1.786	467,024	10.721
	10.50		370.0	213.4	78,980		1.813	486,624	11.171
	10.75		372.0	215.4	80,151		1.840	506,515	11.628
	11.00		374.0	217.4	81,330		1.867	526,700	12.091
	11.25		376.0	219.4	82,517		1.894	547,180	12.562
	11.50		378.0	221.4	83,712		1.922	567,959	13.039
	11.75		380.0	223.4	84,915		1.949	589,037	13.522
	12.00		382.0	225.4	86,125		1.977	610,417	14.013
	12.25		384.0	227.4	87,344		2.005	632,100	14.511
	12.50		386.0	229.4	88,571		2.033	654,089	15.016
	12.75		388.0	231.4	89,806		2.062	676,386	15.528
	13.00		390.0	233.4	91,049		2.090	698,993	16.047
	13.25		392.0	235.4	92,300		2.119	721,912	16.573
	13.50		394.0	237.4	93,559		2.148	745,144	17.106
	13.75		396.0	239.4	94,826		2.177	768,692	17.647
	14.00		398.0	241.4	96,101		2.206	792,558	18.195
	14.25		400.0	243.4	97,384		2.236	816,743	18.750
	14.50		402.0	245.4	98,675		2.265	841,250	19.312
	14.75		404.0	247.4	99,974		2.295	866,081	19.882
	15.00		406.0	249.4	101,281		2.325	891,238	20.460
	15.25		408.0	251.4	102,596		2.355	916,723	21.045
	15.50		410.0	253.4	103,919		2.386	942,537	21.638
	15.75		412.0	255.4	105,250		2.416	968,683	22.238
	16.00		414.0	257.4	106,589		2.447	995,162	22.846
	16.25		416.0	259.4	107,936		2.478	1,021,978	23.461
	16.50		418.0	261.4	109,291		2.509	1,049,131	24.085
	16.75		420.0	263.4	110,654		2.540	1,076,624	24.716
	17.00		422.0	265.4	112,024		2.572	1,104,458	25.355
	17.25		424.0	267.4	113,403		2.603	1,132,636	26.002
	17.50		426.0	269.4	114,790		2.635	1,161,161	26.657
	17.75		428.0	271.4	116,185		2.667	1,190,032	27.319
	18.00		430.0	273.4	117,588		2.699	1,219,254	27.990
	18.25		432.0	275.4	118,999		2.732	1,248,827	28.669
	18.50		434.0	277.4	120,418		2.764	1,278,754	29.356
	18.75		436.0	279.4	121,845		2.797	1,309,037	30.051
	19.00		438.0	281.4	123,280		2.830	1,339,677	30.755
	19.25		440.0	283.4	124,723		2.863	1,370,678	31.466
	19.50		442.0	285.4	126,174		2.897	1,402,040	32.186
	19.75		444.0	287.4	127,633		2.930	1,433,765	32.915
	20.00		446.0	289.4	129,100		2.964	1,465,857	33.651
	20.25		448.0	291.4	130,575		2.998	1,498,316	34.397
	20.50		450.0	293.4	132,058		3.032	1,531,145	35.150
	20.75		452.0	295.4	133,549		3.066	1,564,345	35.912
	21.00		454.0	297.4	135,048		3.100	1,597,920	36.683
	21.25		456.0	299.4	136,555		3.135	1,631,870	37.463
	21.50		458.0	301.4	138,070		3.170	1,666,198	38.251
	21.75		460.0	303.4	139,593		3.205	1,700,905	39.047
	22.00		462.0	305.4	141,123		3.240	1,735,995	39.853
	22.25		464.0	307.4	142,662		3.275	1,771,468	40.667
	22.50		466.0	309.4	144,209		3.311	1,807,327	41.491
	22.75		468.0	311.4	145,764		3.346	1,843,573	42.323
	23.00		470.0	313.4	147,327		3.382	1,880,209	43.164
	23.25		472.0	315.4	148,898		3.418	1,917,237	44.014
	23.50		474.0	317.4	150,477		3.454	1,954,659	44.873
	23.75		476.0	319.4	152,064		3.491	1,992,477	45.741

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



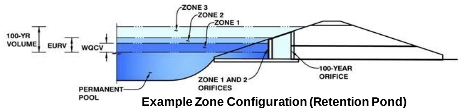


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision

Basin ID: Pond 2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB			
Watershed Area =	4.12	acres		
Watershed Length =	575	ft		
Watershed Length to Centroid =	285	ft		
Watershed Slope =	0.032	ft/ft		
Watershed Imperviousness =	91.00%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.141	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.511	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.340	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.438	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.517	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.602	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.686	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.779	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.989	acre-feet		inches
Approximate 2-yr Detention Volume =	0.338	acre-feet		
Approximate 5-yr Detention Volume =	0.437	acre-feet		
Approximate 10-yr Detention Volume =	0.519	acre-feet		
Approximate 25-yr Detention Volume =	0.611	acre-feet		
Approximate 50-yr Detention Volume =	0.665	acre-feet		
Approximate 100-yr Detention Volume =	0.711	acre-feet		

Define Zones and Basin Geometry

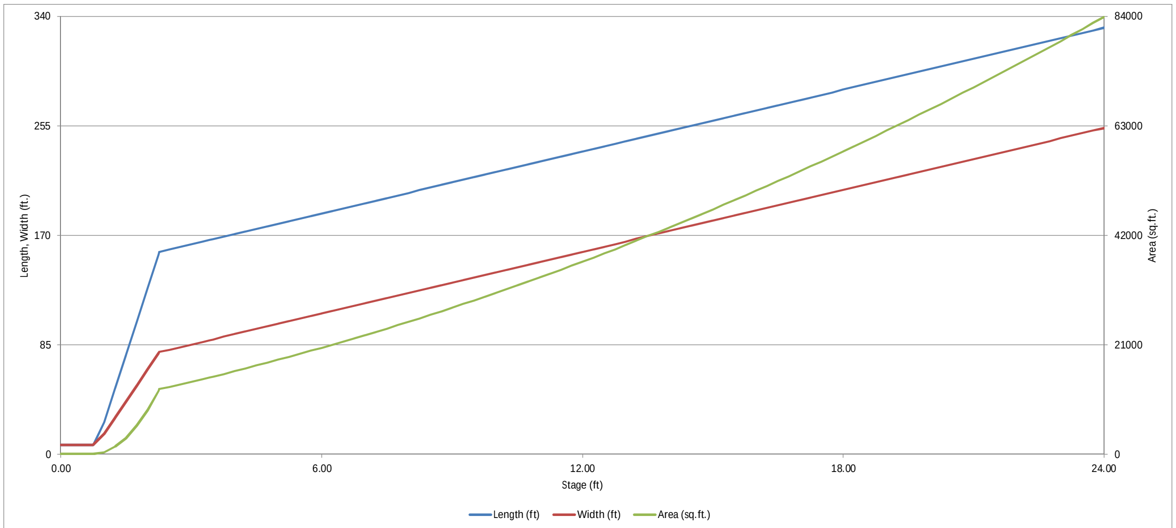
Zone 1 Volume (WQCV) =	0.141	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.370	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.200	acre-feet
Total Detention Basin Volume =	0.711	acre-feet
Initial Surcharge Volume (ISV) =	18	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	4.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	56	ft^2
Surcharge Volume Length (L_{ISV}) =	7.5	ft
Surcharge Volume Width (W_{ISV}) =	7.5	ft
Depth of Basin Floor (H_{FLOOR}) =	1.44	ft
Length of Basin Floor (L_{FLOOR}) =	157.2	ft
Width of Basin Floor (W_{FLOOR}) =	79.5	ft
Area of Basin Floor (A_{FLOOR}) =	12,494	ft^2
Volume of Basin Floor (V_{FLOOR}) =	6,425	ft^3
Depth of Main Basin (H_{MAIN}) =	1.73	ft
Length of Main Basin (L_{MAIN}) =	171.1	ft
Width of Main Basin (W_{MAIN}) =	93.3	ft
Area of Main Basin (A_{MAIN}) =	15,962	ft^2
Volume of Main Basin (V_{MAIN}) =	24,553	ft^3
Calculated Total Basin Volume (V_{total}) =	0.712	acre-feet

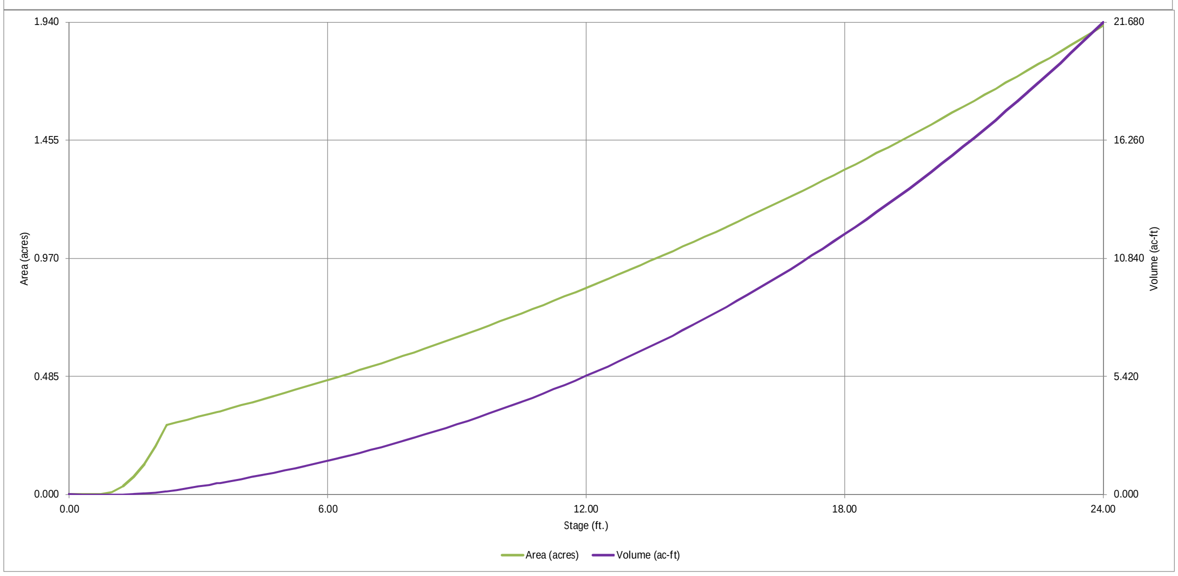
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		7.5	7.5	56		0.001		
ISV	0.33		7.5	7.5	56		0.001	18	0.000
	0.50		7.5	7.5	56		0.001	28	0.001
	0.75		7.5	7.5	56		0.001	42	0.001
	1.00		25.1	16.0	402		0.009	81	0.002
	1.25		51.1	28.5	1,456		0.033	300	0.007
	1.50		77.1	41.0	3,161		0.073	863	0.020
	1.75		103.1	53.5	5,515		0.127	1,934	0.044
	2.00		129.1	66.0	8,519		0.196	3,675	0.084
Zone 1 (WQCV)	2.25		155.1	78.5	12,174		0.279	6,248	0.143
Floor	2.27		157.2	79.5	12,494		0.287	6,495	0.149
	2.50		159.1	81.3	12,933		0.297	9,419	0.216
	2.75		161.1	83.3	13,418		0.308	12,712	0.292
	3.00		163.1	85.3	13,911		0.319	16,128	0.370
	3.25		165.1	87.3	14,412		0.331	19,668	0.452
Zone 2 (EURV)	3.43		166.5	88.7	14,777		0.339	22,295	0.512
	3.50		167.1	89.3	14,920		0.343	23,335	0.536
	3.75		169.1	91.3	15,437		0.354	27,129	0.623
Zone 3 (100-year)	4.00		171.1	93.3	15,962		0.366	31,054	0.713
	4.25		173.1	95.3	16,495		0.379	35,111	0.806
	4.50		175.1	97.3	17,035		0.391	39,302	0.902
	4.75		177.1	99.3	17,584		0.404	43,629	1.002
	5.00		179.1	101.3	18,141		0.416	48,095	1.104
	5.25		181.1	103.3	18,706		0.429	52,700	1.210
	5.50		183.1	105.3	19,278		0.443	57,448	1.319
	5.75		185.1	107.3	19,859		0.456	62,340	1.431
	6.00		187.1	109.3	20,448		0.469	67,378	1.547
	6.25		189.1	111.3	21,045		0.483	72,565	1.666
	6.50		191.1	113.3	21,649		0.497	77,901	1.788
	6.75		193.1	115.3	22,262		0.511	83,390	1.914
	7.00		195.1	117.3	22,883		0.525	89,033	2.044
	7.25		197.1	119.3	23,512		0.540	94,832	2.177
	7.50		199.1	121.3	24,148		0.554	100,789	2.314
	7.75		201.1	123.3	24,793		0.569	106,907	2.454
	8.00		203.1	125.3	25,446		0.584	113,186	2.598
	8.25		205.1	127.3	26,107		0.599	119,630	2.746
	8.50		207.1	129.3	26,775		0.615	126,240	2.898
	8.75		209.1	131.3	27,452		0.630	133,019	3.054
	9.00		211.1	133.3	28,137		0.646	139,967	3.213
	9.25		213.1	135.3	28,830		0.662	147,088	3.377
	9.50		215.1	137.3	29,530		0.678	154,382	3.544
	9.75		217.1	139.3	30,239		0.694	161,853	3.716
	10.00		219.1	141.3	30,956		0.711	169,503	3.891
	10.25		221.1	143.3	31,681		0.727	177,332	4.071
	10.50		223.1	145.3	32,413		0.744	185,344	4.255
	10.75		225.1	147.3	33,154		0.761	193,539	4.443
	11.00		227.1	149.3	33,903		0.778	201,921	4.635
	11.25		229.1	151.3	34,660		0.796	210,491	4.832
	11.50		231.1	153.3	35,424		0.813	219,252	5.033
	11.75		233.1	155.3	36,197		0.831	228,204	5.239
	12.00		235.1	157.3	36,978		0.849	237,351	5.449
	12.25		237.1	159.3	37,767		0.867	246,694	5.663
	12.50		239.1	161.3	38,563		0.885	256,235	5.882
	12.75		241.1	163.3	39,368		0.904	265,976	6.106
	13.00		243.1	165.3	40,181		0.922	275,919	6.334
	13.25		245.1	167.3	41,001		0.941	286,067	6.567
	13.50		247.1	169.3	41,830		0.960	296,421	6.805
	13.75		249.1	171.3	42,667		0.979	306,983	7.047
	14.00		251.1	173.3	43,512		0.999	317,755	7.295
	14.25		253.1	175.3	44,364		1.018	328,739	7.547
	14.50		255.1	177.3	45,225		1.038	339,938	7.804
	14.75		257.1	179.3	46,094		1.058	351,353	8.066
	15.00		259.1	181.3	46,971		1.078	362,985	8.333
	15.25		261.1	183.3	47,855		1.099	374,839	8.605
	15.50		263.1	185.3	48,748		1.119	386,914	8.882
	15.75		265.1	187.3	49,649		1.140	399,213	9.165
	16.00		267.1	189.3	50,558		1.161	411,739	9.452
	16.25		269.1	191.3	51,474		1.182	424,493	9.745
	16.50		271.1	193.3	52,399		1.203	437,477	10.043
	16.75		273.1	195.3	53,332		1.224	450,693	10.346
	17.00		275.1	197.3	54,273		1.246	464,144	10.655
	17.25		277.1	199.3	55,221		1.268	477,830	10.969
	17.50		279.1	201.3	56,178		1.290	491,755	11.289
	17.75		281.1	203.3	57,143		1.312	505,920	11.614
	18.00		283.1	205.3	58,116		1.334	520,327	11.945
	18.25		285.1	207.3	59,096		1.357	534,979	12.281
	18.50		287.1	209.3	60,085		1.379	549,876	12.623
	18.75		289.1	211.3	61,082		1.402	565,022	12.971
	19.00		291.1	213.3	62,087		1.425	580,418	13.325
	19.25		293.1	215.3	63,099		1.449	596,066	13.684
	19.50		295.1	217.3	64,120		1.472	611,968	14.049
	19.75		297.1	219.3	65,149		1.496	628,127	14.420
	20.00		299.1	221.3	66,186		1.519	644,543	14.797
	20.25		301.1	223.3	67,230		1.543	661,220	15.180
	20.50		303.1	225.3	68,283		1.568	678,159	15.568
	20.75		305.1	227.3	69,344		1.592	695,362	15.963
	21.00		307.1	229.3	70,413		1.616	712,832	16.364
	21.25		309.1	231.3	71,489		1.641	730,569	16.772
	21.50		311.1	233.3	72,574		1.666	748,577	17.185
	21.75		313.1	235.3	73,667		1.691	766,857	17.605
	22.00		315.1	237.3	74,768		1.716	785,411	18.031
	22.25		317.1	239.3	75,876		1.742	804,242	18.463
	22.50		319.1	241.3	76,993		1.768	823,350	18.902
	22.75		321.1	243.3	78,118		1.793	842,739	19.347
	23.00		323.1	245.3	79,251		1.819	862,410	19.798
	23.25		325.1	247.3	80,391		1.846	882,365	20.256
	23.50		327.1	249.3	81,540		1.872	902,606	20.721
	23.75		329.1	251.3	82,697		1.898	923,136	21.192
	24.00		331.1	253.3	83,862		1.925	943,955	21.670

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



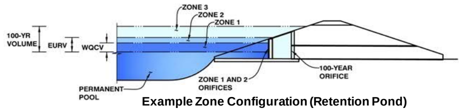


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision

Basin ID: Pond 3



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB			
Watershed Area =	65.60	acres		
Watershed Length =	2,700	ft		
Watershed Length to Centroid =	1,080	ft		
Watershed Slope =	0.035	ft/ft		
Watershed Imperviousness =	15.00%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

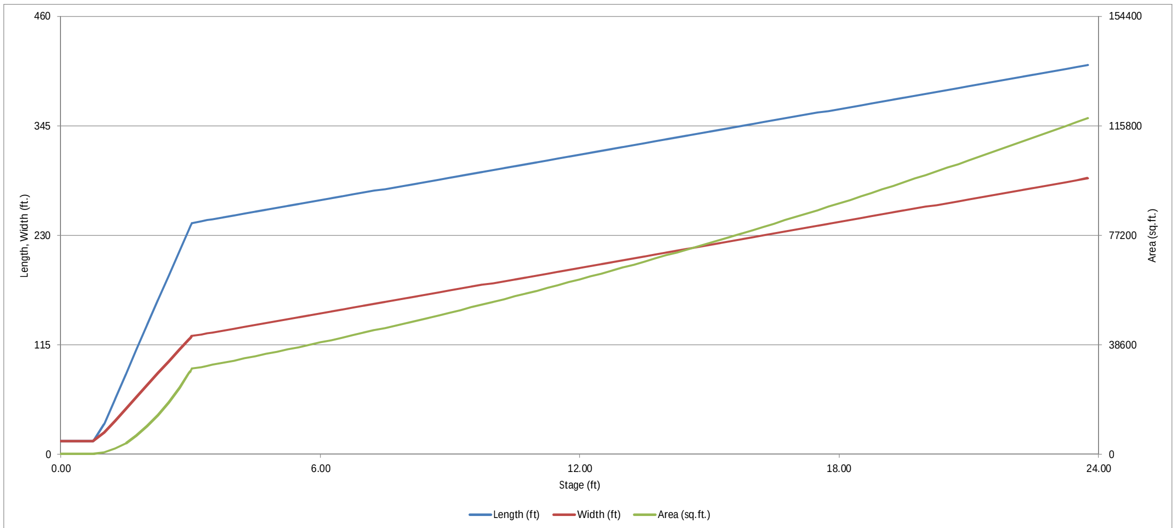
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.510	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.810	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.471	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.715	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.933	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.890	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.817	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.097	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	6.909	acre-feet		inches
Approximate 2-yr Detention Volume =	0.494	acre-feet		
Approximate 5-yr Detention Volume =	0.671	acre-feet		
Approximate 10-yr Detention Volume =	0.866	acre-feet		
Approximate 25-yr Detention Volume =	1.143	acre-feet		
Approximate 50-yr Detention Volume =	1.432	acre-feet		
Approximate 100-yr Detention Volume =	2.055	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.510	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.300	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.245	acre-feet
Total Detention Basin Volume =	2.055	acre-feet
Initial Surcharge Volume (ISV) =	67	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	202	ft^2
Surcharge Volume Length (L_{ISV}) =	14.2	ft
Surcharge Volume Width (W_{ISV}) =	14.2	ft
Depth of Basin Floor (H_{FLOOR}) =	2.20	ft
Length of Basin Floor (L_{FLOOR}) =	243.0	ft
Width of Basin Floor (W_{FLOOR}) =	124.2	ft
Area of Basin Floor (A_{FLOOR}) =	30,185	ft^2
Volume of Basin Floor (V_{FLOOR}) =	24,094	ft^3
Depth of Main Basin (H_{MAIN}) =	1.97	ft
Length of Main Basin (L_{MAIN}) =	258.8	ft
Width of Main Basin (W_{MAIN}) =	140.0	ft
Area of Main Basin (A_{MAIN}) =	36,221	ft^2
Volume of Main Basin (V_{MAIN}) =	65,319	ft^3
Calculated Total Basin Volume (V_{total}) =	2.056	acre-feet

Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		14.2	14.2	202		0.005		
ISV	0.33		14.2	14.2	202		0.005	67	0.002
	0.50		14.2	14.2	202		0.005	101	0.002
	0.75		14.2	14.2	202		0.005	151	0.003
	1.00		31.9	22.7	724		0.017	242	0.006
	1.25		57.9	35.2	2,038		0.047	574	0.013
	1.50		83.9	47.7	4,003		0.092	1,315	0.030
	1.75		109.9	60.2	6,617		0.152	2,629	0.060
	2.00		135.9	72.7	9,881		0.227	4,678	0.107
	2.25		161.9	85.2	13,795		0.317	7,624	0.175
	2.50		187.9	97.7	18,359		0.421	11,630	0.267
	2.75		213.9	110.2	23,573		0.541	16,858	0.387
Zone 1 (WQCV)	2.96		235.7	120.7	28,456		0.653	22,313	0.512
	3.00		239.9	122.7	29,437		0.676	23,471	0.539
Floor	3.03		243.0	124.2	30,185		0.693	24,365	0.559
	3.25		244.8	126.0	30,834		0.708	31,077	0.713
Zone 2 (EURV)	3.39		245.9	127.1	31,251		0.717	35,423	0.813
	3.50		246.8	128.0	31,580		0.725	38,878	0.893
	3.75		248.8	130.0	32,333		0.742	46,867	1.076
	4.00		250.8	132.0	33,095		0.760	55,046	1.264
	4.25		252.8	134.0	33,864		0.777	63,415	1.456
	4.50		254.8	136.0	34,642		0.795	71,978	1.652
	4.75		256.8	138.0	35,427		0.813	80,737	1.853
Zone 3 (100-year)	5.00		258.8	140.0	36,221		0.832	89,693	2.059
	5.25		260.8	142.0	37,022		0.850	98,848	2.269
	5.50		262.8	144.0	37,832		0.868	108,204	2.484
	5.75		264.8	146.0	38,649		0.887	117,764	2.703
	6.00		266.8	148.0	39,475		0.906	127,530	2.928
	6.25		268.8	150.0	40,308		0.925	137,502	3.157
	6.50		270.8	152.0	41,150		0.945	147,684	3.390
	6.75		272.8	154.0	41,999		0.964	158,078	3.629
	7.00		274.8	156.0	42,857		0.984	168,685	3.872
	7.25		276.8	158.0	43,722		1.004	179,507	4.121
	7.50		278.8	160.0	44,596		1.024	190,546	4.374
	7.75		280.8	162.0	45,477		1.044	201,805	4.633
	8.00		282.8	164.0	46,366		1.064	213,285	4.896
	8.25		284.8	166.0	47,264		1.085	224,989	5.165
	8.50		286.8	168.0	48,169		1.106	236,918	5.439
	8.75		288.8	170.0	49,083		1.127	249,074	5.718
	9.00		290.8	172.0	50,004		1.148	261,460	6.002
	9.25		292.8	174.0	50,934		1.169	274,077	6.292
	9.50		294.8	176.0	51,871		1.191	286,928	6.587
	9.75		296.8	178.0	52,817		1.213	300,014	6.887
	10.00		298.8	180.0	53,770		1.234	313,337	7.193
	10.25		300.8	182.0	54,732		1.256	326,900	7.505
	10.50		302.8	184.0	55,701		1.279	340,704	7.821
	10.75		304.8	186.0	56,679		1.301	354,751	8.144
	11.00		306.8	188.0	57,664		1.324	369,044	8.472
	11.25		308.8	190.0	58,658		1.347	383,584	8.806
	11.50		310.8	192.0	59,659		1.370	398,373	9.145
	11.75		312.8	194.0	60,669		1.393	413,414	9.491
	12.00		314.8	196.0	61,686		1.416	428,708	9.842
	12.25		316.8	198.0	62,712		1.440	444,258	10.199
	12.50		318.8	200.0	63,745		1.463	460,065	10.562
	12.75		320.8	202.0	64,787		1.487	476,131	10.930
	13.00		322.8	204.0	65,836		1.511	492,459	11.305
	13.25		324.8	206.0	66,894		1.536	509,050	11.686
	13.50		326.8	208.0	67,959		1.560	525,906	12.073
	13.75		328.8	210.0	69,033		1.585	543,030	12.466
	14.00		330.8	212.0	70,114		1.610	560,423	12.866
	14.25		332.8	214.0	71,204		1.635	578,088	13.271
	14.50		334.8	216.0	72,301		1.660	596,026	13.683
	14.75		336.8	218.0	73,407		1.685	614,239	14.101
	15.00		338.8	220.0	74,520		1.711	632,730	14.525
	15.25		340.8	222.0	75,642		1.736	651,500	14.956
	15.50		342.8	224.0	76,771		1.762	670,551	15.394
	15.75		344.8	226.0	77,909		1.789	689,886	15.838
	16.00		346.8	228.0	79,054		1.815	709,506	16.288
	16.25		348.8	230.0	80,208		1.841	729,414	16.745
	16.50		350.8	232.0	81,369		1.868	749,611	17.209
	16.75		352.8	234.0	82,538		1.895	770,099	17.679
	17.00		354.8	236.0	83,716		1.922	790,880	18.156
	17.25		356.8	238.0	84,901		1.949	811,958	18.640
	17.50		358.8	240.0	86,095		1.976	833,332	19.131
	17.75		360.8	242.0	87,296		2.004	855,006	19.628
	18.00		362.8	244.0	88,506		2.032	876,981	20.133
	18.25		364.8	246.0	89,723		2.060	899,259	20.644
	18.50		366.8	248.0	90,949		2.088	921,843	21.163
	18.75		368.8	250.0	92,182		2.116	944,734	21.688
	19.00		370.8	252.0	93,424		2.145	967,935	22.221
	19.25		372.8	254.0	94,673		2.173	991,447	22.760
	19.50		374.8	256.0	95,931		2.202	1,015,272	23.307
	19.75		376.8	258.0	97,196		2.231	1,039,413	23.862
	20.00		378.8	260.0	98,470		2.261	1,063,871	24.423
	20.25		380.8	262.0	99,751		2.290	1,088,649	24.992
	20.50		382.8	264.0	101,041		2.320	1,113,748	25.568
	20.75		384.8	266.0	102,338		2.349	1,139,170	26.152
	21.00		386.8	268.0	103,644		2.379	1,164,917	26.743
	21.25		388.8	270.0	104,957		2.409	1,190,992	27.341
	21.50		390.8	272.0	106,279		2.440	1,217,397	27.948
	21.75		392.8	274.0	107,608		2.470	1,244,132	28.561
	22.00		394.8	276.0	108,946		2.501	1,271,201	29.183
	22.25		396.8	278.0	110,291		2.532	1,298,606	29.812
	22.50		398.8	280.0	111,645		2.563	1,326,348	30.449
	22.75		400.8	282.0	113,006		2.594	1,354,429	31.093
	23.00		402.8	284.0	114,376		2.626	1,382,851	31.746
	23.25		404.8	286.0	115,753		2.657	1,411,617	32.406
	23.50		406.8	288.0	117,139		2.689	1,440,729	33.075
	23.75		408.8	290.0	118,532		2.721	1,470,187	33.751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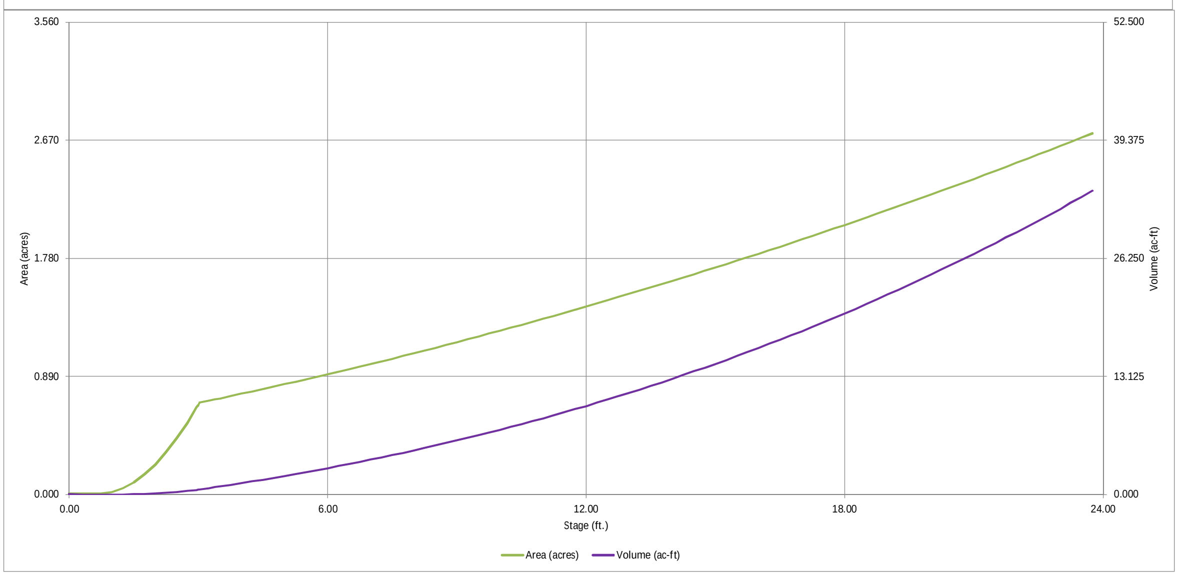
6.00
12.00
18.00
24.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)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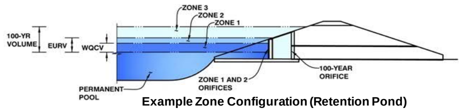
Volume (ac-ft)
0.00
6.00
12.00
18.00
24.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision

Basin ID: Pond 4



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	99.61	acres
Watershed Length =	2,575	ft
Watershed Length to Centroid =	1,300	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	11.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

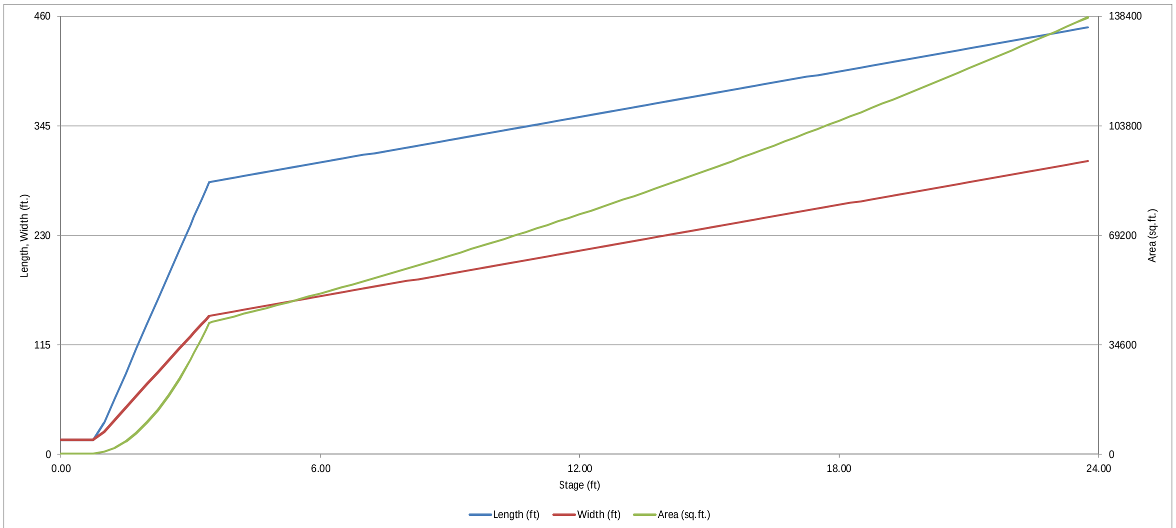
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.603	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.827	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.425	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.701	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.933	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.299	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.660	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.568	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	9.767	acre-feet		inches
Approximate 2-yr Detention Volume =	0.497	acre-feet		
Approximate 5-yr Detention Volume =	0.681	acre-feet		
Approximate 10-yr Detention Volume =	0.893	acre-feet		
Approximate 25-yr Detention Volume =	1.201	acre-feet		
Approximate 50-yr Detention Volume =	1.587	acre-feet		
Approximate 100-yr Detention Volume =	2.501	acre-feet		

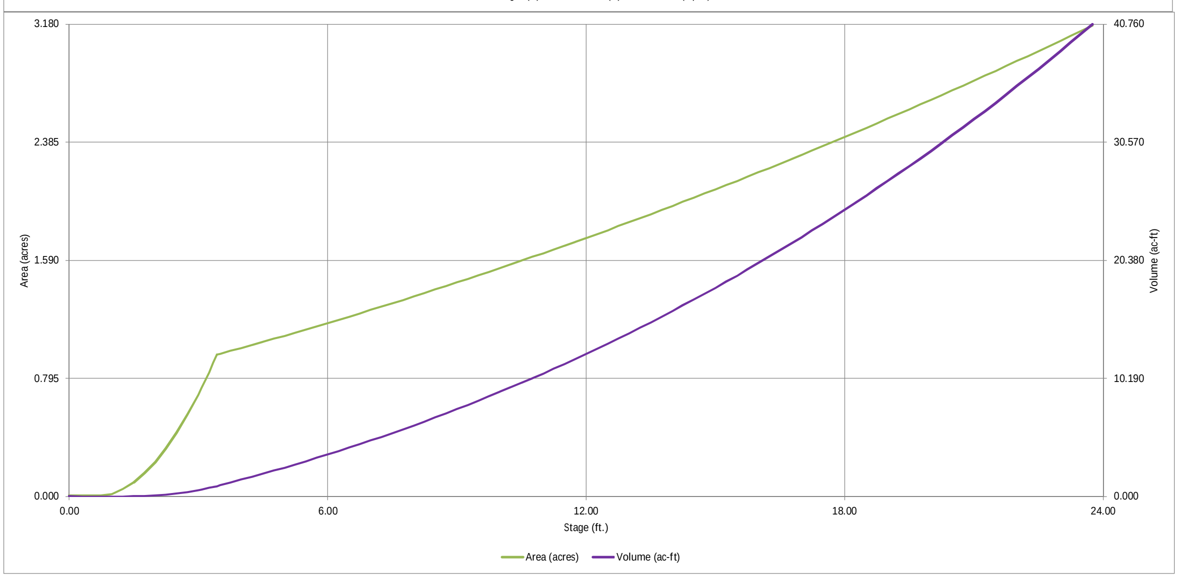
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.603	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.224	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.674	acre-feet
Total Detention Basin Volume =	2.501	acre-feet
Initial Surcharge Volume (ISV) =	79	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	239	ft^2
Surcharge Volume Length (L_{ISV}) =	15.4	ft
Surcharge Volume Width (W_{ISV}) =	15.4	ft
Depth of Basin Floor (H_{FLOOR}) =	2.60	ft
Length of Basin Floor (L_{FLOOR}) =	285.8	ft
Width of Basin Floor (W_{FLOOR}) =	145.4	ft
Area of Basin Floor (A_{FLOOR}) =	41,577	ft^2
Volume of Basin Floor (V_{FLOOR}) =	38,970	ft^3
Depth of Main Basin (H_{MAIN}) =	1.57	ft
Length of Main Basin (L_{MAIN}) =	298.4	ft
Width of Main Basin (W_{MAIN}) =	158.0	ft
Area of Main Basin (A_{MAIN}) =	47,152	ft^2
Volume of Main Basin (V_{MAIN}) =	69,606	ft^3
Calculated Total Basin Volume (V_{total}) =	2.497	acre-feet

Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		15.4	15.4	239		0.005		
ISV	0.33		15.4	15.4	239		0.005	79	0.002
	0.50		15.4	15.4	239		0.005	119	0.003
	0.75		15.4	15.4	239		0.005	179	0.004
	1.00		33.1	23.9	793		0.018	282	0.006
	1.25		59.1	36.4	2,155		0.049	637	0.015
	1.50		85.1	48.9	4,167		0.096	1,413	0.032
	1.75		111.1	61.4	6,829		0.157	2,774	0.064
	2.00		137.1	73.9	10,141		0.233	4,882	0.112
	2.25		163.1	86.4	14,102		0.324	7,899	0.181
	2.50		189.1	98.9	18,714		0.430	11,987	0.275
	2.75		215.1	111.4	23,976		0.550	17,310	0.397
	3.00		241.1	123.9	29,888		0.686	24,030	0.552
Zone 1 (WQCV)	3.08		249.4	127.9	31,917		0.733	26,501	0.608
	3.25		267.1	136.4	36,450		0.837	32,308	0.742
Zone 2 (EURV)	3.35		277.5	141.4	39,256		0.901	36,093	0.829
Floor	3.43		285.8	145.4	41,577		0.954	39,326	0.903
	3.50		286.4	146.0	41,818		0.960	42,244	0.970
	3.75		288.4	148.0	42,687		0.980	52,807	1.212
	4.00		290.4	150.0	43,564		1.000	63,589	1.460
	4.25		292.4	152.0	44,449		1.020	74,590	1.712
	4.50		294.4	154.0	45,342		1.041	85,814	1.970
	4.75		296.4	156.0	46,243		1.062	97,262	2.233
Zone 3 (100-year)	5.00		298.4	158.0	47,152		1.082	108,936	2.501
	5.25		300.4	160.0	48,068		1.103	120,838	2.774
	5.50		302.4	162.0	48,993		1.125	132,971	3.053
	5.75		304.4	164.0	49,926		1.146	145,335	3.336
	6.00		306.4	166.0	50,867		1.168	157,934	3.626
	6.25		308.4	168.0	51,816		1.190	170,770	3.920
	6.50		310.4	170.0	52,773		1.211	183,843	4.220
	6.75		312.4	172.0	53,737		1.234	197,156	4.526
	7.00		314.4	174.0	54,710		1.256	210,712	4.837
	7.25		316.4	176.0	55,691		1.278	224,512	5.154
	7.50		318.4	178.0	56,680		1.301	238,558	5.477
	7.75		320.4	180.0	57,677		1.324	252,853	5.805
	8.00		322.4	182.0	58,682		1.347	267,397	6.139
	8.25		324.4	184.0	59,694		1.370	282,194	6.478
	8.50		326.4	186.0	60,715		1.394	297,245	6.824
	8.75		328.4	188.0	61,744		1.417	312,553	7.175
	9.00		330.4	190.0	62,781		1.441	328,118	7.533
	9.25		332.4	192.0	63,826		1.465	343,944	7.896
	9.50		334.4	194.0	64,879		1.489	360,032	8.265
	9.75		336.4	196.0	65,939		1.514	376,384	8.641
	10.00		338.4	198.0	67,008		1.538	393,002	9.022
	10.25		340.4	200.0	68,085		1.563	409,888	9.410
	10.50		342.4	202.0	69,170		1.588	427,045	9.804
	10.75		344.4	204.0	70,263		1.613	444,474	10.204
	11.00		346.4	206.0	71,364		1.638	462,177	10.610
	11.25		348.4	208.0	72,472		1.664	480,157	11.023
	11.50		350.4	210.0	73,589		1.689	498,414	11.442
	11.75		352.4	212.0	74,714		1.715	516,952	11.868
	12.00		354.4	214.0	75,847		1.741	535,772	12.300
	12.25		356.4	216.0	76,988		1.767	554,876	12.738
	12.50		358.4	218.0	78,137		1.794	574,266	13.183
	12.75		360.4	220.0	79,293		1.820	593,945	13.635
	13.00		362.4	222.0	80,458		1.847	613,914	14.094
	13.25		364.4	224.0	81,631		1.874	634,175	14.559
	13.50		366.4	226.0	82,812		1.901	654,730	15.031
	13.75		368.4	228.0	84,001		1.928	675,582	15.509
	14.00		370.4	230.0	85,198		1.956	696,731	15.995
	14.25		372.4	232.0	86,403		1.984	718,181	16.487
	14.50		374.4	234.0	87,615		2.011	739,933	16.987
	14.75		376.4	236.0	88,836		2.039	761,989	17.493
	15.00		378.4	238.0	90,065		2.068	784,352	18.006
	15.25		380.4	240.0	91,302		2.096	807,023	18.527
	15.50		382.4	242.0	92,547		2.125	830,004	19.054
	15.75		384.4	244.0	93,800		2.153	853,297	19.589
	16.00		386.4	246.0	95,060		2.182	876,904	20.131
	16.25		388.4	248.0	96,329		2.211	900,827	20.680
	16.50		390.4	250.0	97,606		2.241	925,069	21.237
	16.75		392.4	252.0	98,891		2.270	949,631	21.801
	17.00		394.4	254.0	100,184		2.300	974,515	22.372
	17.25		396.4	256.0	101,485		2.330	999,724	22.950
	17.50		398.4	258.0	102,793		2.360	1,025,258	23.537
	17.75		400.4	260.0	104,110		2.390	1,051,121	24.130
	18.00		402.4	262.0	105,435		2.420	1,077,314	24.732
	18.25		404.4	264.0	106,768		2.451	1,103,839	25.341
	18.50		406.4	266.0	108,109		2.482	1,130,699	25.957
	18.75		408.4	268.0	109,458		2.513	1,157,894	26.582
	19.00		410.4	270.0	110,814		2.544	1,185,428	27.214
	19.25		412.4	272.0	112,179		2.575	1,213,302	27.854
	19.50		414.4	274.0	113,552		2.607	1,241,518	28.501
	19.75		416.4	276.0	114,933		2.638	1,270,079	29.157
	20.00		418.4	278.0	116,322		2.670	1,298,986	29.821
	20.25		420.4	280.0	117,719		2.702	1,328,241	30.492
	20.50		422.4	282.0	119,123		2.735	1,357,846	31.172
	20.75		424.4	284.0	120,536		2.767	1,387,803	31.860
	21.00		426.4	286.0	121,957		2.800	1,418,114	32.555
	21.25		428.4	288.0	123,386		2.833	1,448,782	33.259
	21.50		430.4	290.0	124,823		2.866	1,479,808	33.972
	21.75		432.4	292.0	126,268		2.899	1,511,194	34.692
	22.00		434.4	294.0	127,720		2.932	1,542,943	35.421
	22.25		436.4	296.0	129,181		2.966	1,575,055	36.158
	22.50		438.4	298.0	130,650		2.999	1,607,534	36.904
	22.75		440.4	300.0	132,127		3.033	1,640,381	37.658
	23.00		442.4	302.0	133,612		3.067	1,673,598	38.421
	23.25		444.4	304.0	135,105		3.102	1,707,187	39.192
	23.50		446.4	306.0	136,606		3.136	1,741,151	39.971
	23.75		448.4	308.0	138,114		3.171	1,775,491	40.760


460
345
230
115
0
Length, Width (ft.)
138400
103800
69200
34600
0
Area (sq.ft.)
0.00
6.00
12.00
18.00
24.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

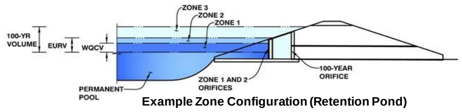

3.180
2.385
1.590
0.795
0.000
Area (acres)
40.760
30.570
20.380
10.190
0.000
Volume (ac-ft)
0.00
6.00
12.00
18.00
24.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision

Basin ID: Pond 5



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	34.56	acres
Watershed Length =	2,700	ft
Watershed Length to Centroid =	1,375	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	14.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.255	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.391	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.222	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.342	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.448	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.947	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.431	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.104	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	3.581	acre-feet		inches
Approximate 2-yr Detention Volume =	0.238	acre-feet		
Approximate 5-yr Detention Volume =	0.323	acre-feet		
Approximate 10-yr Detention Volume =	0.419	acre-feet		
Approximate 25-yr Detention Volume =	0.555	acre-feet		
Approximate 50-yr Detention Volume =	0.702	acre-feet		
Approximate 100-yr Detention Volume =	1.028	acre-feet		

Define Zones and Basin Geometry

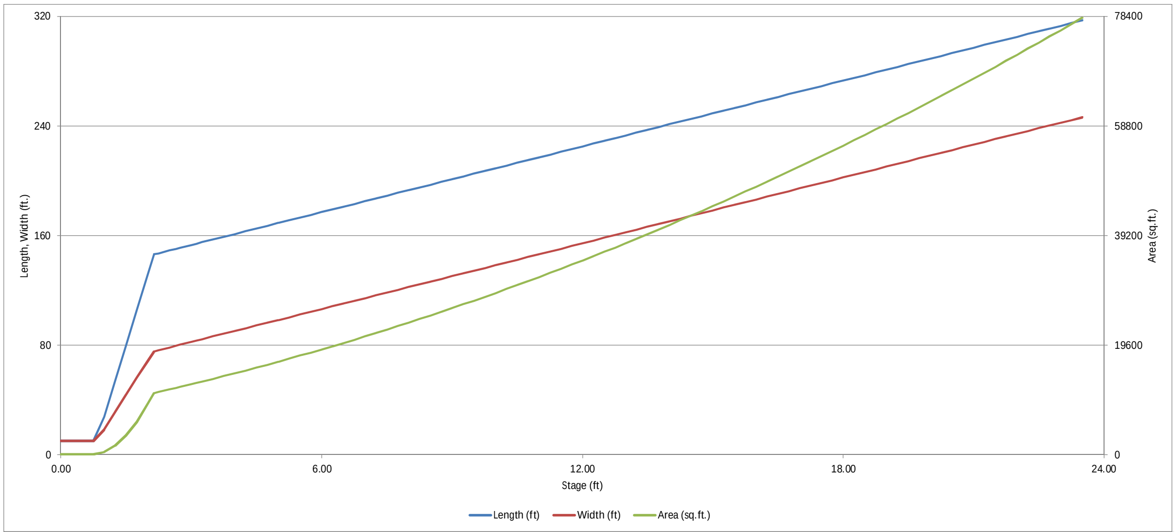
Zone 1 Volume (WQCV) =	0.255	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.136	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.638	acre-feet
Total Detention Basin Volume =	1.028	acre-feet
Initial Surcharge Volume (ISV) =	33	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	101	ft^2
Surcharge Volume Length (L_{ISV}) =	10.0	ft
Surcharge Volume Width (W_{ISV}) =	10.0	ft
Depth of Basin Floor (H_{FLOOR}) =	1.31	ft
Length of Basin Floor (L_{FLOOR}) =	146.3	ft
Width of Basin Floor (W_{FLOOR}) =	75.5	ft
Area of Basin Floor (A_{FLOOR}) =	11,050	ft^2
Volume of Basin Floor (V_{FLOOR}) =	5,330	ft^3
Depth of Main Basin (H_{MAIN}) =	2.86	ft
Length of Main Basin (L_{MAIN}) =	169.2	ft
Width of Main Basin (W_{MAIN}) =	98.4	ft
Area of Main Basin (A_{MAIN}) =	16,649	ft^2
Volume of Main Basin (V_{MAIN}) =	39,336	ft^3
Calculated Total Basin Volume (V_{total}) =	1.027	acre-feet

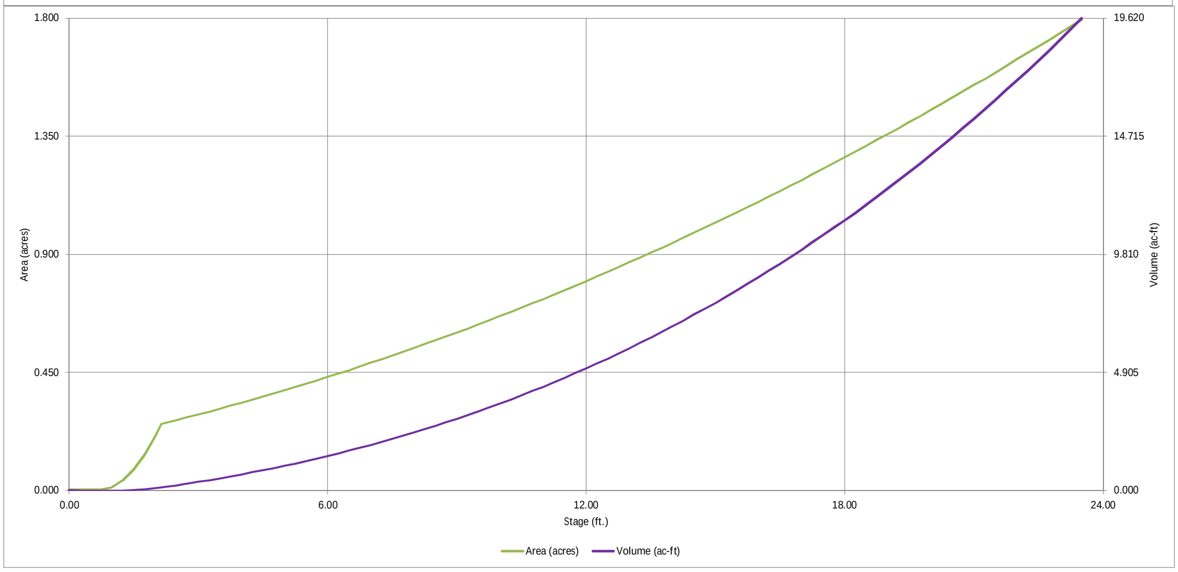
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		10.0	10.0	101		0.002		
ISV	0.33		10.0	10.0	101		0.002	33	0.001
	0.50		10.0	10.0	101		0.002	50	0.001
	0.75		10.0	10.0	101		0.002	76	0.002
	1.00		27.7	18.5	514		0.012	132	0.003
	1.25		53.7	31.0	1,667		0.038	391	0.009
	1.50		79.7	43.5	3,471		0.080	1,020	0.023
	1.75		105.7	56.0	5,924		0.136	2,180	0.050
	2.00		131.7	68.5	9,028		0.207	4,036	0.093
Floor	2.14		146.3	75.5	11,050		0.254	5,439	0.125
	2.25		147.2	76.4	11,246		0.258	6,665	0.153
	2.50		149.2	78.4	11,697		0.269	9,533	0.219
Zone 1 (WQCV)	2.64		150.3	79.5	11,953		0.274	11,188	0.257
	2.75		151.2	80.4	12,156		0.279	12,514	0.287
	3.00		153.2	82.4	12,623		0.290	15,612	0.358
Zone 2 (EURV)	3.12		154.1	83.4	12,850		0.295	17,140	0.393
	3.25		155.2	84.4	13,098		0.301	18,827	0.432
	3.50		157.2	86.4	13,582		0.312	22,162	0.509
	3.75		159.2	88.4	14,073		0.323	25,618	0.588
	4.00		161.2	90.4	14,572		0.335	29,199	0.670
	4.25		163.2	92.4	15,079		0.346	32,905	0.755
	4.50		165.2	94.4	15,594		0.358	36,739	0.843
	4.75		167.2	96.4	16,117		0.370	40,703	0.934
	5.00		169.2	98.4	16,649		0.382	44,798	1.028
Zone 3 (100-year)	5.01		169.2	98.5	16,670		0.383	44,965	1.032
	5.25		171.2	100.4	17,188		0.395	49,027	1.126
	5.50		173.2	102.4	17,735		0.407	53,393	1.226
	5.75		175.2	104.4	18,290		0.420	57,896	1.329
	6.00		177.2	106.4	18,853		0.433	62,538	1.436
	6.25		179.2	108.4	19,424		0.446	67,323	1.546
	6.50		181.2	110.4	20,003		0.459	72,251	1.659
	6.75		183.2	112.4	20,591		0.473	77,325	1.775
	7.00		185.2	114.4	21,186		0.486	82,547	1.895
	7.25		187.2	116.4	21,789		0.500	87,919	2.018
	7.50		189.2	118.4	22,400		0.514	93,442	2.145
	7.75		191.2	120.4	23,019		0.528	99,120	2.275
	8.00		193.2	122.4	23,646		0.543	104,953	2.409
	8.25		195.2	124.4	24,282		0.557	110,943	2.547
	8.50		197.2	126.4	24,925		0.572	117,094	2.688
	8.75		199.2	128.4	25,576		0.587	123,406	2.833
	9.00		201.2	130.4	26,235		0.602	129,883	2.982
	9.25		203.2	132.4	26,902		0.618	136,525	3.134
	9.50		205.2	134.4	27,577		0.633	143,334	3.291
	9.75		207.2	136.4	28,261		0.649	150,314	3.451
	10.00		209.2	138.4	28,952		0.665	157,465	3.615
	10.25		211.2	140.4	29,651		0.681	164,791	3.783
	10.50		213.2	142.4	30,358		0.697	172,291	3.955
	10.75		215.2	144.4	31,073		0.713	179,970	4.132
	11.00		217.2	146.4	31,796		0.730	187,829	4.312
	11.25		219.2	148.4	32,527		0.747	195,869	4.497
	11.50		221.2	150.4	33,267		0.764	204,093	4.685
	11.75		223.2	152.4	34,014		0.781	212,503	4.878
	12.00		225.2	154.4	34,769		0.798	221,101	5.076
	12.25		227.2	156.4	35,532		0.816	229,888	5.278
	12.50		229.2	158.4	36,303		0.833	238,867	5.484
	12.75		231.2	160.4	37,082		0.851	248,040	5.694
	13.00		233.2	162.4	37,870		0.869	257,409	5.909
	13.25		235.2	164.4	38,665		0.888	266,976	6.129
	13.50		237.2	166.4	39,468		0.906	276,742	6.353
	13.75		239.2	168.4	40,279		0.925	286,710	6.582
	14.00		241.2	170.4	41,098		0.943	296,882	6.815
	14.25		243.2	172.4	41,925		0.962	307,260	7.054
	14.50		245.2	174.4	42,761		0.982	317,846	7.297
	14.75		247.2	176.4	43,604		1.001	328,641	7.545
	15.00		249.2	178.4	44,455		1.021	339,648	7.797
	15.25		251.2	180.4	45,314		1.040	350,869	8.055
	15.50		253.2	182.4	46,181		1.060	362,306	8.317
	15.75		255.2	184.4	47,056		1.080	373,960	8.585
	16.00		257.2	186.4	47,939		1.101	385,835	8.858
	16.25		259.2	188.4	48,831		1.121	397,931	9.135
	16.50		261.2	190.4	49,730		1.142	410,251	9.418
	16.75		263.2	192.4	50,637		1.162	422,796	9.706
	17.00		265.2	194.4	51,552		1.183	435,570	9.999
	17.25		267.2	196.4	52,475		1.205	448,573	10.298
	17.50		269.2	198.4	53,406		1.226	461,808	10.602
	17.75		271.2	200.4	54,346		1.248	475,277	10.911
	18.00		273.2	202.4	55,293		1.269	488,982	11.225
	18.25		275.2	204.4	56,248		1.291	502,924	11.546
	18.50		277.2	206.4	57,211		1.313	517,106	11.871
	18.75		279.2	208.4	58,182		1.336	531,530	12.202
	19.00		281.2	210.4	59,161		1.358	546,198	12.539
	19.25		283.2	212.4	60,149		1.381	561,112	12.881
	19.50		285.2	214.4	61,144		1.404	576,273	13.229
	19.75		287.2	216.4	62,147		1.427	591,684	13.583
	20.00		289.2	218.4	63,158		1.450	607,347	13.943
	20.25		291.2	220.4	64,177		1.473	623,264	14.308
	20.50		293.2	222.4	65,204		1.497	639,436	14.679
	20.75		295.2	224.4	66,239		1.521	655,867	15.057
	21.00		297.2	226.4	67,283		1.545	672,557	15.440
	21.25		299.2	228.4	68,334		1.569	689,508	15.829
	21.50		301.2	230.4	69,393		1.593	706,724	16.224
	21.75		303.2	232.4	70,460		1.618	724,206	16.625
	22.00		305.2	234.4	71,535		1.642	741,955	17.033
	22.25		307.2	236.4	72,618		1.667	759,974	17.447
	22.50		309.2	238.4	73,710		1.692	778,265	17.866
	22.75		311.2	240.4	74,809		1.717	796,829	18.293
	23.00		313.2	242.4	75,916		1.743	815,670	18.725
	23.25		315.2	244.4	77,031		1.768	834,788	19.164
	23.50		317.2	246.4	78,154		1.794	854,186	19.609

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



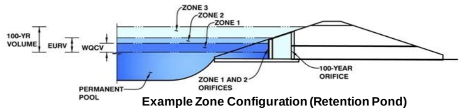


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Esteban Rodriguez Subdivision

Basin ID: Pond 6



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB			
Watershed Area =	185.68	acres		
Watershed Length =	5,580	ft		
Watershed Length to Centroid =	2,800	ft		
Watershed Slope =	0.045	ft/ft		
Watershed Imperviousness =	12.00%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.207	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.723	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.924	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.479	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.959	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.561	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	7.127	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	10.712	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	18.596	acre-feet		inches
Approximate 2-yr Detention Volume =	1.041	acre-feet		
Approximate 5-yr Detention Volume =	1.421	acre-feet		
Approximate 10-yr Detention Volume =	1.855	acre-feet		
Approximate 25-yr Detention Volume =	2.483	acre-feet		
Approximate 50-yr Detention Volume =	3.227	acre-feet		
Approximate 100-yr Detention Volume =	4.948	acre-feet		

Define Zones and Basin Geometry

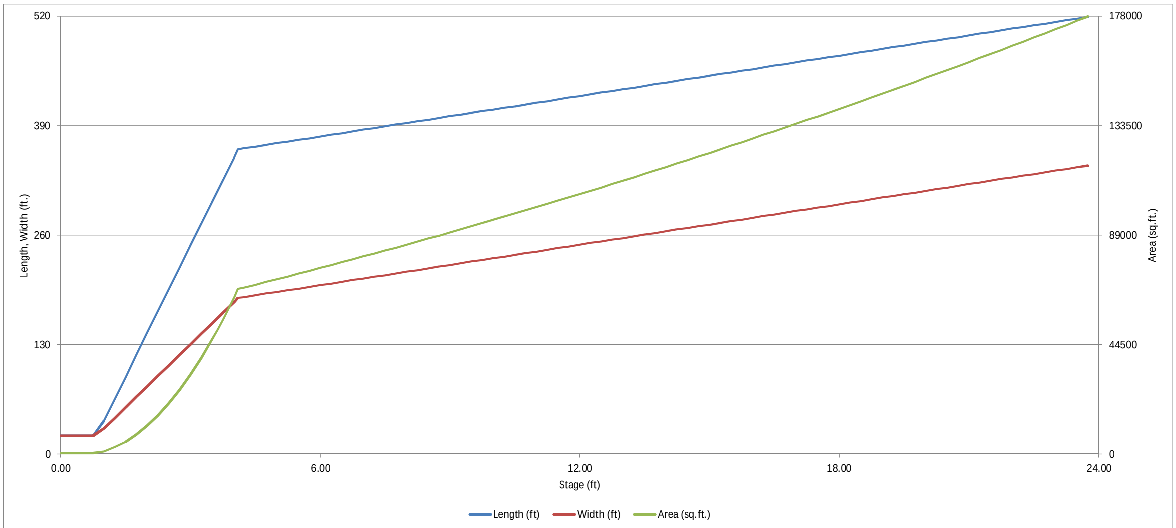
Zone 1 Volume (WQCV) =	1.207	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.515	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.225	acre-feet
Total Detention Basin Volume =	4.948	acre-feet
Initial Surcharge Volume (ISV) =	158	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.010	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{ISV}) =	478	ft^2
Surcharge Volume Length (L_{ISV}) =	21.9	ft
Surcharge Volume Width (W_{ISV}) =	21.9	ft
Depth of Basin Floor (H_{FLOOR}) =	3.27	ft
Length of Basin Floor (L_{FLOOR}) =	361.9	ft
Width of Basin Floor (W_{FLOOR}) =	185.4	ft
Area of Basin Floor (A_{FLOOR}) =	67,093	ft^2
Volume of Basin Floor (V_{FLOOR}) =	79,826	ft^3
Depth of Main Basin (H_{MAIN}) =	1.90	ft
Length of Main Basin (L_{MAIN}) =	377.1	ft
Width of Main Basin (W_{MAIN}) =	200.6	ft
Area of Main Basin (A_{MAIN}) =	75,643	ft^2
Volume of Main Basin (V_{MAIN}) =	135,518	ft^3
Calculated Total Basin Volume (V_{total}) =	4.953	acre-feet

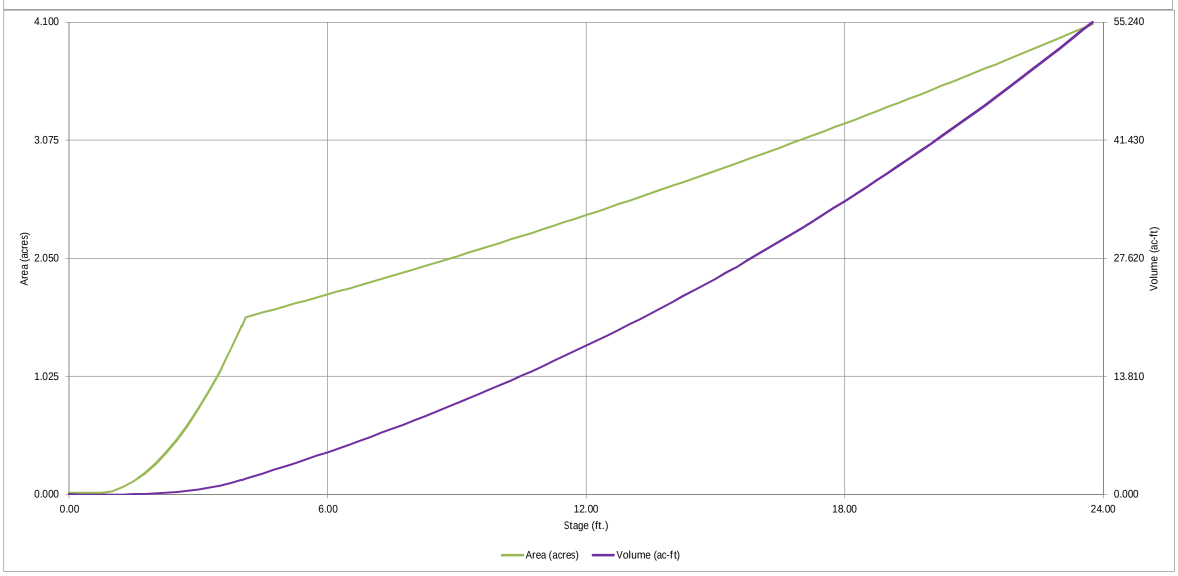
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		21.9	21.9	478		0.011		
ISV	0.33		21.9	21.9	478		0.011	158	0.004
	0.50		21.9	21.9	478		0.011	239	0.005
	0.75		21.9	21.9	478		0.011	359	0.008
	1.00		39.5	30.4	1,201		0.028	535	0.012
	1.25		65.5	42.9	2,810		0.065	1,023	0.023
	1.50		91.5	55.4	5,069		0.116	1,994	0.046
	1.75		117.5	67.9	7,978		0.183	3,612	0.083
	2.00		143.5	80.4	11,536		0.265	6,037	0.139
	2.25		169.5	92.9	15,745		0.361	9,434	0.217
	2.50		195.5	105.4	20,604		0.473	13,964	0.321
	2.75		221.5	117.9	26,113		0.599	19,790	0.454
	3.00		247.5	130.4	32,272		0.741	27,075	0.622
	3.25		273.5	142.9	39,081		0.897	35,980	0.826
	3.50		299.5	155.4	46,540		1.068	46,669	1.071
Zone 1 (WQCV)	3.63		313.1	161.9	50,675		1.163	52,987	1.216
	3.75		325.5	167.9	54,649		1.255	59,304	1.361
	4.00		351.5	180.4	63,407		1.456	74,048	1.700
Zone 2 (EURV)	4.02		353.6	181.4	64,136		1.472	75,323	1.729
Floor	4.10		361.9	185.4	67,093		1.540	80,572	1.850
	4.25		363.1	186.6	67,751		1.555	90,685	2.082
	4.50		365.1	188.6	68,855		1.581	107,761	2.474
	4.75		367.1	190.6	69,966		1.606	125,113	2.872
	5.00		369.1	192.6	71,086		1.632	142,745	3.277
	5.25		371.1	194.6	72,213		1.658	160,657	3.688
	5.50		373.1	196.6	73,348		1.684	178,852	4.106
	5.75		375.1	198.6	74,492		1.710	197,332	4.530
Zone 3 (100-year)	6.00		377.1	200.6	75,643		1.737	216,098	4.961
	6.25		379.1	202.6	76,803		1.763	235,154	5.398
	6.50		381.1	204.6	77,970		1.790	254,500	5.843
	6.75		383.1	206.6	79,146		1.817	274,140	6.293
	7.00		385.1	208.6	80,329		1.844	294,074	6.751
	7.25		387.1	210.6	81,520		1.871	314,305	7.215
	7.50		389.1	212.6	82,720		1.899	334,835	7.687
	7.75		391.1	214.6	83,927		1.927	355,665	8.165
	8.00		393.1	216.6	85,143		1.955	376,799	8.650
	8.25		395.1	218.6	86,366		1.983	398,237	9.142
	8.50		397.1	220.6	87,597		2.011	419,983	9.641
	8.75		399.1	222.6	88,837		2.039	442,037	10.148
	9.00		401.1	224.6	90,084		2.068	464,402	10.661
	9.25		403.1	226.6	91,340		2.097	487,080	11.182
	9.50		405.1	228.6	92,603		2.126	510,072	11.710
	9.75		407.1	230.6	93,875		2.155	533,382	12.245
	10.00		409.1	232.6	95,154		2.184	557,010	12.787
	10.25		411.1	234.6	96,441		2.214	580,959	13.337
	10.50		413.1	236.6	97,737		2.244	605,232	13.894
	10.75		415.1	238.6	99,040		2.274	629,829	14.459
	11.00		417.1	240.6	100,352		2.304	654,752	15.031
	11.25		419.1	242.6	101,671		2.334	680,005	15.611
	11.50		421.1	244.6	102,999		2.365	705,589	16.198
	11.75		423.1	246.6	104,334		2.395	731,505	16.793
	12.00		425.1	248.6	105,677		2.426	757,756	17.396
	12.25		427.1	250.6	107,029		2.457	784,345	18.006
	12.50		429.1	252.6	108,388		2.488	811,272	18.624
	12.75		431.1	254.6	109,756		2.520	838,539	19.250
	13.00		433.1	256.6	111,131		2.551	866,150	19.884
	13.25		435.1	258.6	112,515		2.583	894,106	20.526
	13.50		437.1	260.6	113,906		2.615	922,408	21.176
	13.75		439.1	262.6	115,305		2.647	951,059	21.833
	14.00		441.1	264.6	116,713		2.679	980,061	22.499
	14.25		443.1	266.6	118,128		2.712	1,009,416	23.173
	14.50		445.1	268.6	119,552		2.745	1,039,126	23.855
	14.75		447.1	270.6	120,983		2.777	1,069,193	24.545
	15.00		449.1	272.6	122,423		2.810	1,099,619	25.244
	15.25		451.1	274.6	123,870		2.844	1,130,405	25.951
	15.50		453.1	276.6	125,325		2.877	1,161,554	26.666
	15.75		455.1	278.6	126,789		2.911	1,193,068	27.389
	16.00		457.1	280.6	128,260		2.944	1,224,949	28.121
	16.25		459.1	282.6	129,740		2.978	1,257,199	28.861
	16.50		461.1	284.6	131,227		3.013	1,289,820	29.610
	16.75		463.1	286.6	132,723		3.047	1,322,813	30.368
	17.00		465.1	288.6	134,226		3.081	1,356,182	31.134
	17.25		467.1	290.6	135,737		3.116	1,389,927	31.908
	17.50		469.1	292.6	137,257		3.151	1,424,051	32.692
	17.75		471.1	294.6	138,784		3.186	1,458,556	33.484
	18.00		473.1	296.6	140,320		3.221	1,493,444	34.285
	18.25		475.1	298.6	141,863		3.257	1,528,717	35.095
	18.50		477.1	300.6	143,415		3.292	1,564,376	35.913
	18.75		479.1	302.6	144,974		3.328	1,600,425	36.741
	19.00		481.1	304.6	146,541		3.364	1,636,864	37.577
	19.25		483.1	306.6	148,117		3.400	1,673,696	38.423
	19.50		485.1	308.6	149,700		3.437	1,710,923	39.277
	19.75		487.1	310.6	151,292		3.473	1,748,547	40.141
	20.00		489.1	312.6	152,891		3.510	1,786,570	41.014
	20.25		491.1	314.6	154,499		3.547	1,824,993	41.896
	20.50		493.1	316.6	156,114		3.584	1,863,820	42.787
	20.75		495.1	318.6	157,737		3.621	1,903,051	43.688
	21.00		497.1	320.6	159,369		3.659	1,942,689	44.598
	21.25		499.1	322.6	161,008		3.696	1,982,736	45.517
	21.50		501.1	324.6	162,656		3.734	2,023,194	46.446
	21.75		503.1	326.6	164,311		3.772	2,064,065	47.384
	22.00		505.1	328.6	165,975		3.810	2,105,350	48.332
	22.25		507.1	330.6	167,646		3.849	2,147,053	49.290
	22.50		509.1	332.6	169,325		3.887	2,189,174	50.257
	22.75		511.1	334.6	171,013		3.926	2,231,716	51.233
	23.00		513.1	336.6	172,708		3.965	2,274,681	52.219
	23.25		515.1	338.6	174,412		4.004	2,318,071	53.216
	23.50		517.1	340.6	176,123		4.043	2,361,888	54.221
	23.75		519.1	342.6	177,843		4.083	2,406,133	55.237

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



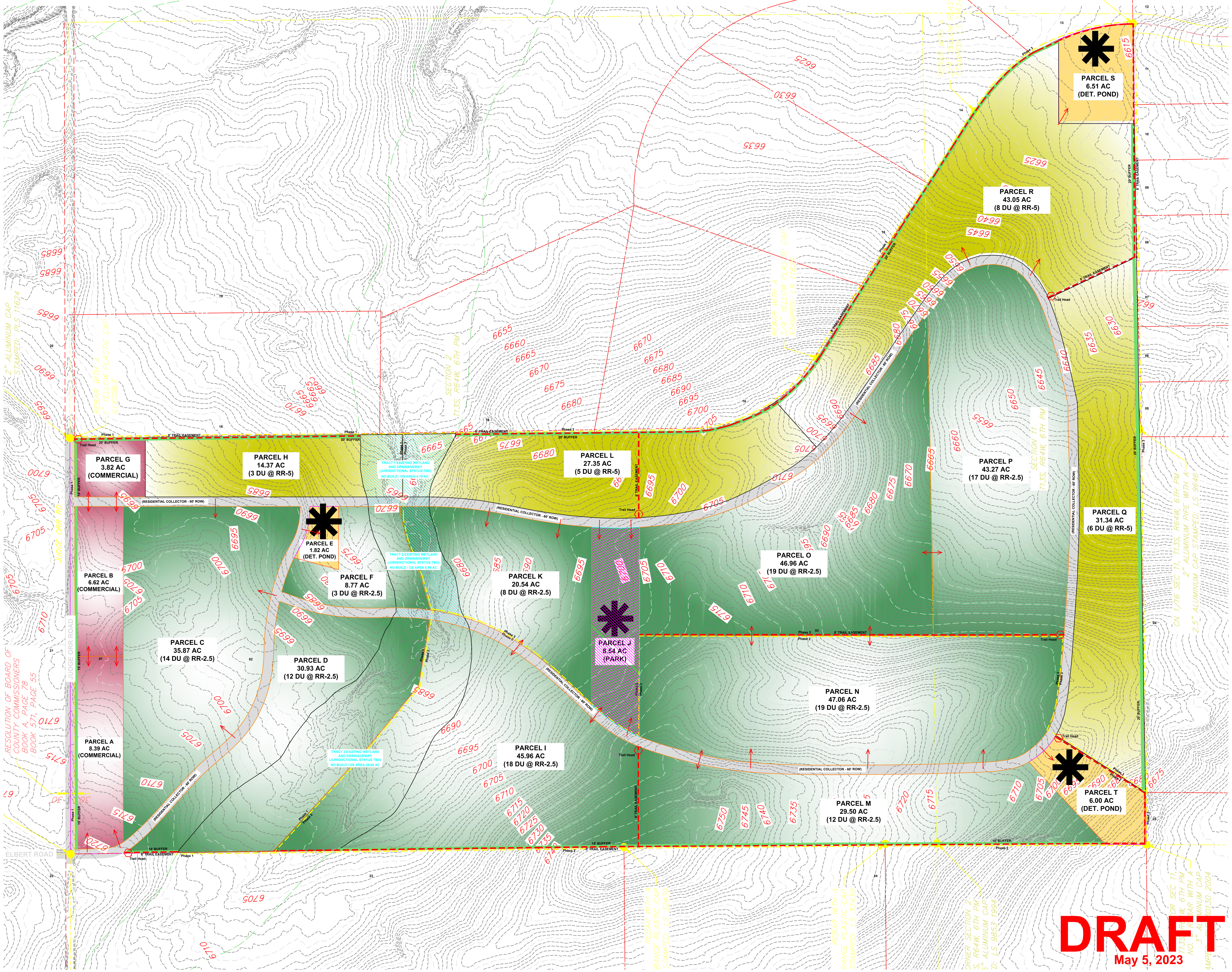


APPENDIX E

REFERENCE MATERIALS

ESTEBAN RODRIGUEZ SUBDIVISION SKETCH PLAN

EL PASO COUNTY, COLORADO



LAND USE SUMMARY TABLE:

LAND USE CATEGORY	ACREAGE	% OF SITE	MAXIMUM UNITS
LOW DENSITY RR-2.5 ZONING	308.86 ac	62.3%	122
LOW DENSITY RR-5 ZONING	116.11 ac	23%	22
COMMERCIAL CS ZONING	18.83 ac	3.8%	n.a.
OPEN SPACE PARK ZONING	8.54 ac	1.8%	n.a.
FLOODPLAIN NO-BUILD/OS	n.a.	n.a.	n.a.
DETENTION NO-BUILD	14.33 ac	2.9%	n.a.
8' TRAIL ESMT. AND TRAIL HEAD	.80 ac	1.0%	n.a.
15-20' BUFFER	n.a.	n.a.	n.a.
PROPOSED R.O.W.	28.78 ac	5.2%	n.a.
TOTAL:	496.25 ac	100%	144

A. 'FLOODPLAIN - NO BUILD' AREAS ARE INCLUDED WITHIN THE PROPOSED LOT BUT WILL BE DESIGNATED AS "NO BUILD" AREAS FOR EACH LOT WHICH ENCROACHES INTO THE FLOODPLAIN.

B. 'OPEN SPACE' AREAS INCLUDE PARK PARCEL, DETENTION PARCELS, FLOODPLAINS AND 8' TRAIL EASEMENTS.

C. 'R.O.W.' AREAS INCLUDE ALL INTERNAL STREET RIGHTS-OF-WAY, JUDGE ORR ROAD R.O.W., AND STAPLETON ROAD R.O.W.

D. 'TRAIL EASEMENT' INCLUDES A PROPOSED 8' WIDE COUNTY TRAIL EASEMENT TO PROVIDE CONNECTIVITY TO PARK AND GENERAL OPEN SPACE AREAS.

PARCEL SUMMARY

PARCEL	ACREAGE	PROPOSED USE/ZONE	MAXIMUM UNITS
A	8.34	COMMERCIAL	n.a.
B	6.62	COMMERCIAL	n.a.
C	35.87	RR-2.5	14 DU
D	30.93	RR-2.5	12 DU
E	1.82	DETENTION	n.a.
F	8.77	RR-2.5	3 DU
G	3.82	COMMERCIAL	n.a.
H	14.37	RR-5.0	3 DU
I	45.96	RR-2.5	18 DU
J	8.54	PARK	n.a.
K	20.54	RR-2.5	8 DU
L	27.35	RR-5.0	5 DU
M	29.50	RR-2.5	12 DU
N	47.06	RR-2.5	19 DU
O	46.96	RR-2.5	19 DU
P	43.27	RR-2.5	17 DU
Q	31.34	RR--5.0	6 DU
R	43.05	RR-5.0	8 DU
S	6.51	DETENTION	n.a.
T	6.00	DETENTION	n.a.

ADJACENT PROPERTY OWNERS:

KEY	NAME AND ADDRESS	KEY	NAME AND ADDRESS
01	Brent Houser Enterprises, LLC 11890 Garrett Road Peyton, CO 80831- 7685 TSN 4300000534	15	Daniel G. Carless, Jr. 1083 Prickly Pear Place Colorado Springs, CO 80921 TSN 4300000618
02	Brent Houser Enterprises, LLC 11890 Garrett Road Peyton, CO 80831-7685 TSN 4300000537	16	Walker Blount 605 Ocean Club Court Fernandina Beach, FL 32034 TSN 4300000619
03	Brent Houser Enterprises, LLC 11890 Garrett Road Peyton, CO(80831-7685 TSN 4300000538	17	Dwayne Lee Simmons 2039 N. Academy Blvd. Colorado Springs, CO 80909 TSN 4300000534
04	Jenny A Olson Trust 7360 Falcon Grassy Heights Peyton, CO 80831-7996 TSN 4300000502	18	Adam C. Moody 15365 Judge Orr Road Peyton, CO 80831 TSN 4300000528
05	Edgar E. Hall 16380 Sagecreek Road Peyton, CO 80831-7928 TSN 4311001001	19	David Fitzpatrick 15525 Judge Orr Road Peyton, CO 80831-8567 TSN 4300000569
06	James C. Costa 16440 Sagecreek Road Peyton, CO 80831-7923 TSN 4311001002	20	Andrew Townsend 16360 Judge Orr Road Peyton, CO 80831 TSN 4200000454
07	James R. Dagan 16480 Sagecreek Road Peyton, CO 80831-7923 TSN 4311001003	21	Charlotte A. Howard 3232 Muirfield Drive Colo. Springs, CO 80907-7805 TSN 4200000362
08	Lance Erickson 16520 Sagecreek Road Peyton, CO 80831-7919 TSN 4311001004	22	Jane Davis Living Trust 9060 Elbert Road Peyton, CO 80831-8319 TSN 4200000470
09	Jacob Schiferl 16520 Sagecreek Road Peyton, CO 80831-7919 TSN 4411001005	23	Gorilla Capital Co. 1342 High Street Eugene, OR 97041 TSN 4300000599
10	Daniel McCray 16640 Sagecreek Road Peyton, CO 80831-7910 TSN 4311001006	24	Gorilla Capital Co. 1342 High Street Eugene, OR 97041 TSN 4300000602
11	Laurel M. Vickers 16760 Sagecreek Road Peyton, CO 80831-7910 TSN 4311001007	25	7120 SUDIEV, LLC 7120 Falcon Grassy Heights Peyton, CO 80831-7995 TSN 4300000496
12	JWK Trust 16850 Sagecreek Road Peyton, CO 80831-7910 TSN 4312001009		
13	Nicholas Byard 7883 Morton Drive Fountain, CO 80817-1450 TSN 4300000615		
14	Jonathan David Oldja 12444 Pine Valley Circle Peyton, CO 80831-4101 TSN 4300000617		

Actual North

0' 300' 600' 900'

SCALE: 1" = 300' - 0"

William Guman & Associates, Ltd.
URBAN PLANNING | COMMUNITY DESIGN |
LANDSCAPE ARCHITECTURE
731 North Weber Street
Colorado Springs, CO 80903
(719) 633-9700
www.GumanLtd.com
bill@guman.net

PLAN NORTH:

PROJECT NAME: ESTEBAN RODRIGUEZ SUBDIVISION

PROJECT ADDRESS: JUDGE ORR ROAD
PEYTON, CO 80831

PROJECT DESCRIPTION: 496.25 ACRE SKETCH PLAN

DATE: 04/27/2023
DESIGNED: WFG
CHECKED: GEM

REVISIONS:

DATE:	BY:	DESCRIPTION:

NOTES:

PLAN SCALE: 1" = 300'0" (OR AS NOTED ON PLAN

SHEET TITLE: SKETCH PLAN

SHEET NO. SKP1.2

2 OF 3 SHEETS

FILE NO. FILE#

Wetland, Wildlife and Natural Features Report
for
Esteban Rodriguez Subdivision in El Paso County, Colorado

June 19, 2023

Prepared for:

Bill Guman, PLA, ASLA, APA
Willian Guman & Associates, Ltd.
731 North Weber Street
Colorado Springs, CO 80903

Prepared by:

ecos ecosystem services LLC

1455 Washburn Street
Erie, Colorado 80516
(p): 970-812-3267

Project Number: 2022-23-1

- The Columbine gravelly sandy loam is not hydric; however, the 1% inclusion of Fluvaquentic Haplaquolls and 1% inclusion of Pleasant soils are both hydric;
- The Fluvaquentic Haplaquolls is hydric; and the 1% inclusion of Haplaquolls soil is hydric as well;
- The Truckton loamy sand, 1 to 9 percent slopes is not hydric and none of the soils types listed as inclusion are hydric;
- The Truckton sandy loam, 0 to 3 percent slopes is not hydric; however, the 2% inclusion of Pleasant soil is hydric

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS, 1994) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in *Field Indicators of Hydric Soils in the United States* (USDA, NRCS, 2010).

3.3 Vegetation

3.3.1 Short- and Mixed-grass Prairie

The vegetation within the Site is primarily comprised of herbaceous short-grass prairie species with herbaceous wetland vegetation in the drainages and ephemeral swales flowing through the Site. Given the presence of certain mid-grass prairie species mixed throughout the shortgrass prairie, we have referred to the vegetation community as “short- and mixed-grass prairie” (refer to Figure 4, Vegetation Community Map). The dominant prairie grass species is blue grama (*Bouteloua gracilis*), with occasional little bluestem (*Schizachyrium scoparium*) and Western wheatgrass (*Pascopyrum smithii*). The other most common associative prairie species are prairie aster (*Machaeranthera tenacetifolia*), smooth brome (*Bromus inermis*), fringed sage (*Artemisia frigida*), yucca (*Yucca spp.*) and prickly pear cactus (*Opuntia* sp.). Other species include Wood’s rose (Rosa woodsii), false indigo bush (*Amorpha fruticosa*), sticky geranium (*Geranium viscosissimum*) and yarrow (Achillea millefolium). The Site is moderately grazed and there are scattered weeds, including Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), Scotch thistle (*Onopordum acanthium*), common mullein (*Verbascum thapsus*), horseweed (*Conyza canadensis*) and field bindweed (*Convolvulus arvensis*).

3.3.2 Hydrophytic Vegetation

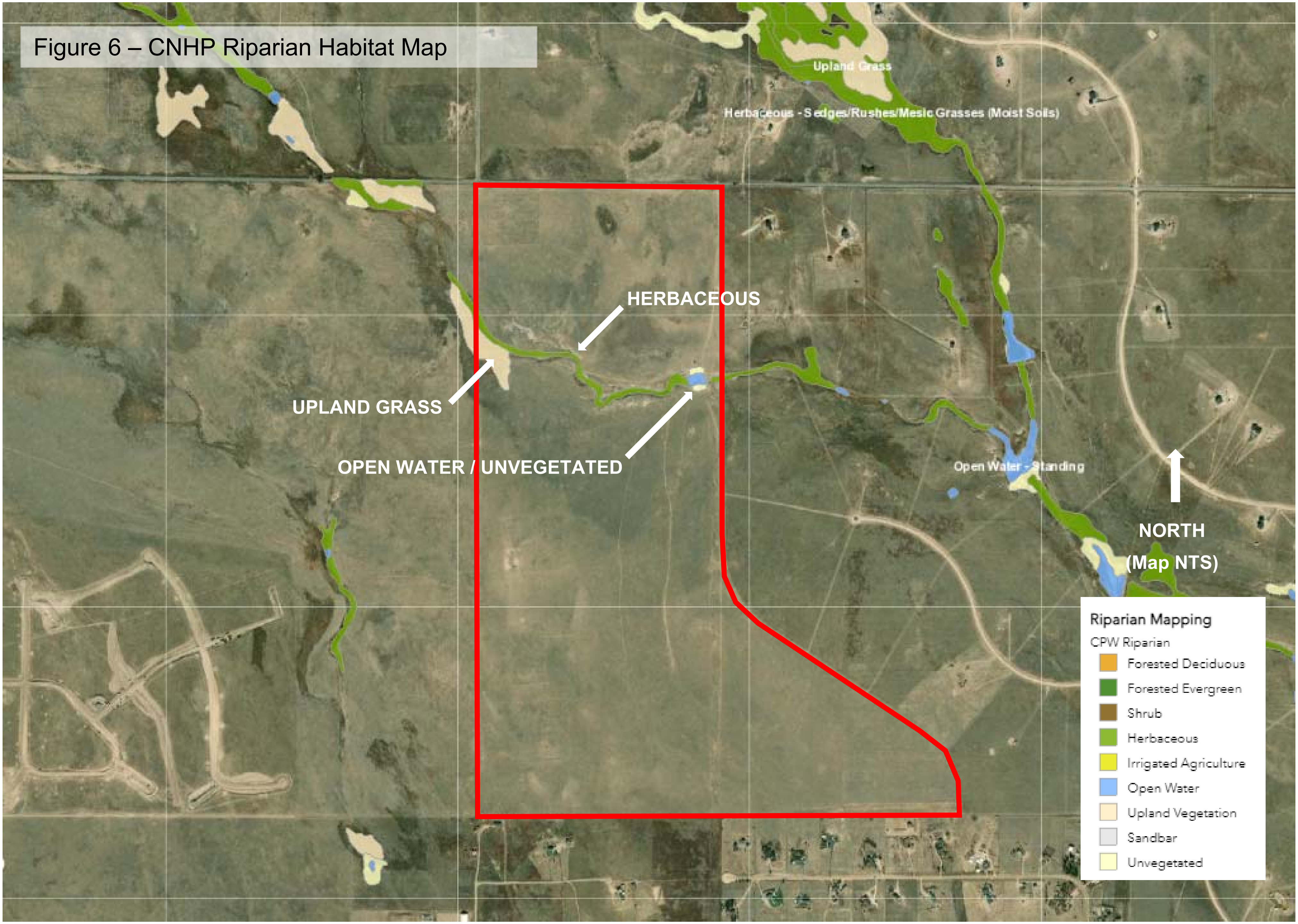
Discontinuous patches of hydrophytic vegetation (wetland vegetation) is present within the North-central ephemeral drainage where saturated (hydric) soils are present. Dominant wetland vegetation includes Nebraska sedge (*Carex nebrascensis*), common threesquare bulrush (*Schoenoplectus americanus*) and spikerush (*Eleocharis palustris*) with inclusions of Baltic rush (*Juncus balticus*), water mint (*Mentha aquatica*), narrowleaf cattail (*Typha angustifolia*) and Canada thistle (*Cirsium arvense*). Willow is notably absent. Dominant upland vegetation at the margin of the wetland boundary includes little bluestem and blue grama (*Bouteloua gracilis*), upland grasses, fringed sage and other miscellaneous upland weeds.

3.3.2 Riparian Vegetation

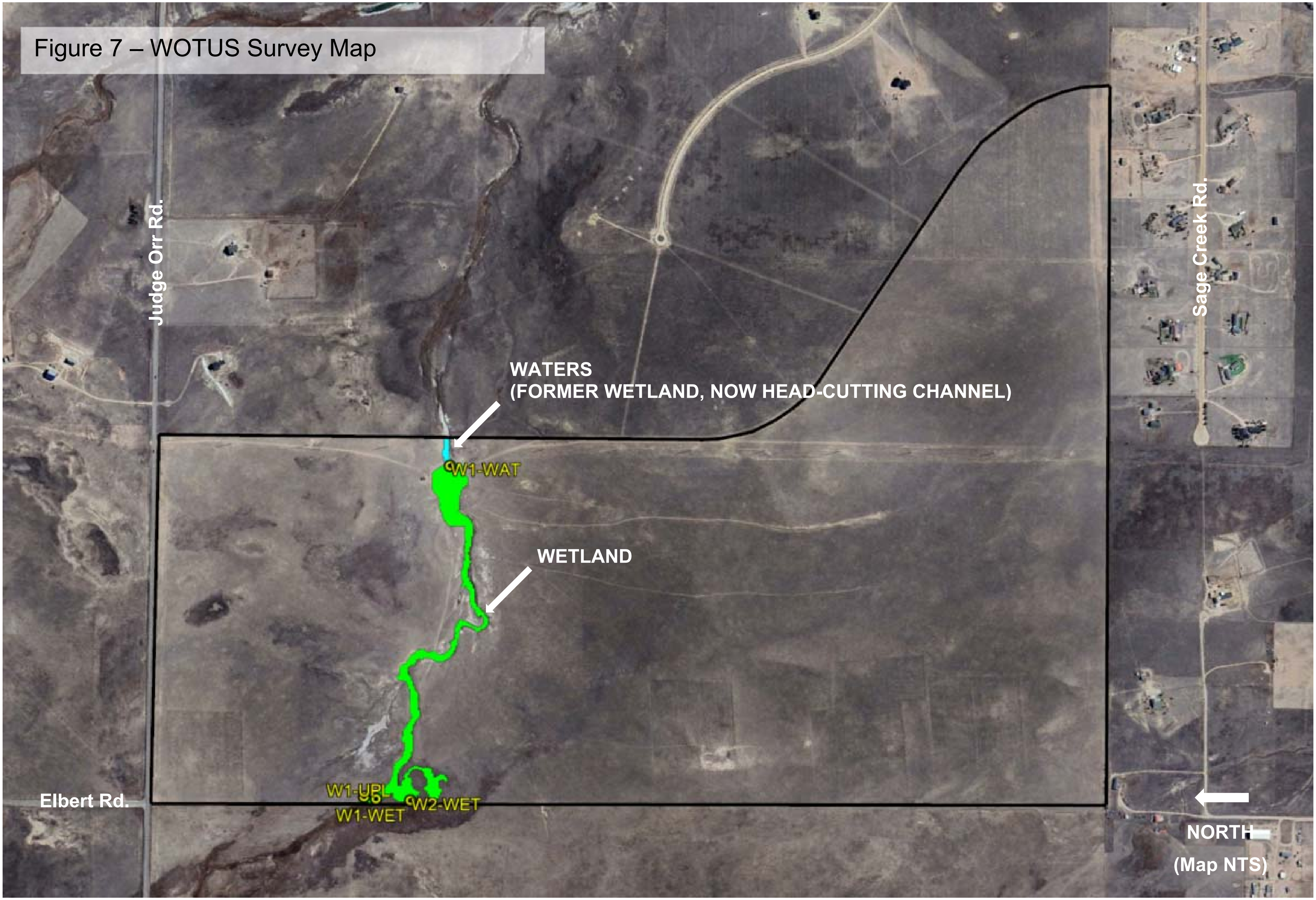
Riparian habitat within the Site is limited to one singe drainage in the North-central portion of the Site which consists of more robust short-grass prairie where moist, mesic soils are present adjacent to wetlands (described above). This North-central drainage does not support any riparian trees or shrubs.

Figure 4 – Vegetation Community Map

Source: Google Earth Aerial Image, 10/31/2022 & Ecosystem Services, LLC Site Assessment, 5/23/2023



Source: Colorado Natural Heritage Program (CNHP) Wetland Mapper



Source: Google Earth Aerial Image, 10/31/2023 & Ecosystem Services, LLC Wetland Delineation, 5/23/2023

3.5 Wildlife

The stated purpose and intent of the "El Paso County Development Standards" wildlife section is to ensure that proposed development is reviewed with consideration of the impacts to wildlife and wildlife habitat, and to implement the provisions of the Master Plan (El Paso County, 2021). The two primary vegetation types within the Site are herbaceous prairie and wetlands. ECOS has determined that the wildlife impact potential for development of this stand-alone Site is expected to be moderate to low, as the Site currently provides poor to moderate habitat for wildlife. Taken in a regional, watershed or larger landscape context, as more and more prairie is developed over time impacts to wildlife are expected to be moderate to high as wildlife run out of space and habitat.

The Site provides habitat for prairie species such as pronghorn (*Antilocapra americana*), black-tailed prairie dog (*Cynomys ludovicianus*), thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*), voles (*Microtus spp.*) and jackrabbit (*Lepus townsendii*). The Site also provides foraging and breeding habitat for predators such as coyote and fox. The Site also provides good habitat for reptiles and moderate habitat for amphibians such as Woodhouse toad (*Anaxyrus woodhousii*).

The USFWS IPaC Trust Resources Report (USFWS, 2023a) (Appendix B) reports that bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*) and ferruginous hawk (*Buteo regalis*) may utilize the area. The Site provides limited tree nesting habitat for raptors; however, ferruginous hawks may also use ground nests.

The Site contains no Critical Habitat, Wildlife Refuges or Hatcheries according to the USFWS IPaC Trust Resources Report (USFWS, 2023a) (Appendix B).

The project proposes to develop most of the prairie; however, the drainages and immediately adjacent prairie would be preserved as Open Space. A noxious weed management plan will be implemented per State and County requirements to improve wildlife habitat; and a native plant re-vegetation plan for the Open Space is recommended to provide additional benefit to wildlife habitat.

4.0 FEDERAL LISTED SPECIES

A number of species that occur in El Paso County are listed as threatened and endangered (T&E) by the USFWS under the Endangered Species Act (ESA) (USFWS 2023). ECOS compiled the data regarding T&E species for the Site in Table 3 based on the Site-specific, USFWS IPaC Trust Resources Report we ran for the Project (Appendix B) and our onsite assessment. ECOS has provided our professional opinion regarding the probability that these species may occur within the Site and their probability of being impacted by the Project.

The likelihood that the Project would impact any of the species listed below is insignificant to none. Most are not expected occur in the project area and no downstream impacts are expected. The USFWS also states that there is no Critical Habitat for T&E species in the Site locations.

TABLE 3 - FEDERAL LISTED SPECIES POTENTIALLY IMPACTED BY THE PROJECT

Species	Status	Habitat Requirements and Presence	Probability of Impact by Project
FISH			
Greenback cutthroat trout (*Oncorhynchus clarki stomias*)	Threatened	Cold, clear, gravely headwater streams and mountain lakes that provide an abundant food supply of insects.	None. Suitable habitat does not exist on the Site.
Pallid sturgeon (*Scaphirhynchus albus*)	Endangered	Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.	None. The proposed project will not affect any of the listed river basins.
BIRDS			

5.0 RAPTORS AND MIGRATORY BIRDS

Raptors and most birds are protected by the Colorado Nongame Wildlife Regulations, as well as by the federal Migratory Bird Treaty Act. Additionally, eagles are protected by the Bald and Golden Eagle Protection Act (BGEPA).

5.1 COGCC Database

ECOS utilized the Colorado Oil and Gas Conservation Commissions (COGCC) GIS Online data (https://cogccmap.state.co.us/cogcc_gis_online/) (COGCC, 2023) to screen the Site for potential raptor nests. No raptor nests have been mapped within one mile of the Site (COGCC, 202). The closest raptor nests to the Site are one Golden Eagle active nest and one Ferruginous Hawk active nest, both of which are located 2.39 miles east/northeast of the eastern edge of the Site.

5.2 USFWS IPaC Data

The USFWS IPaC data for the Site indicates the probability of presence of the four bird species (refer to Appendix B) in the vicinity of the Site. The birds listed by IPaC are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in the Project location. The 1988 amendment to the Fish and Wildlife Conservation Act mandates the USFWS to “identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA. "Birds of Conservation Concern 2021 (BCC 2021)" is the most recent effort to carry out this mandate. The birds listed by IPaC include:

- Bald Eagle (*Haliaeetus leucocephalus*) - This is not a BCC but is vulnerable and warrants attention because of the BGEPA.
- Ferruginous Hawk (*Buteo regalis*) - This is a BCC only in particular Bird Conservation Regions (BCRs) including Colorado. Per the USFWS Environmental Conservation Online System data (USFWS 2022b) (https://ecos.fws.gov/ecp/species/6038), ideal habitat for Ferruginous Hawks is grassland and shrub-steppe habitat including pastures, hayland and cropland. Their nests can be found in trees and large shrubs and on roofs, utility structures and artificial platforms, or near the ground on river cutbanks, or less frequently other ground locations such as rockpiles and riverbed mounds. ECOS has observed their nests open prairie habitat in this vicinity.
- Long-eared Owl (*Asio otus*) - This is a BCC throughout its range in the continental USA and Alaska. Per the USFWS Per the Nature Serve Explorer database (Nature Serve 2022) (https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.101120/Asio_otus) this species habitat is deciduous and evergreen forests, orchards, wooded parks, farm woodlots, river woods, desert oases. Wooded areas with dense vegetation needed for roosting and nesting, open areas for hunting; therefore, it is often associated with deciduous woods near water

in West. The Site does not comprise suitable habitat for roosting and nesting for this species but may provide hunting opportunities. However, the probability of presence in the Project vicinity is limited to the 2nd week of May.

5.3 Field Assessment

The prairie, riparian corridors and wetland habitat provides ground-nesting and foraging habitat for migratory birds such as western meadowlark (*Sturnella neglecta*). No existing nest sites or prairie dog burrows for raptors, including burrowing owl were found during the Site visit.

6.0 SUMMARY OF IMPACTS

6.1 Vegetation

The vegetation within the Site is primarily comprised of herbaceous shortgrass prairie species. Given the presence of certain tallgrass prairie and non-native species mixed throughout the shortgrass prairie, we have referred to the vegetation community as “short- and mixed-grass prairie”. Wetland vegetation is comprised primarily of emergent, herbaceous, hydrophytic species in the ephemeral drainages and swales. Riparian habitat within the Site is comprised of upland grassland, herbaceous wetland species with small pockets of shallow open water. Refer to Figure 6, CNHP Riparian Habitat Map. Trees and shrubs are ~~primarily~~ absent. Refer to Figure 4, Vegetation Community Map.

The short and mixed grass prairie will be the primary vegetation/habitat type impacted by the proposed development. The proposed residential parcels are all planned to be low-density. Tthat should provide ample opportunity to preserve high quality, native habitat within private lots if building envelopes/disturbance footprints are limited. Parcel J, the only park proposed, will have no value for wildlife if isolated within a sea of housing and if completely developed for tot-lots, field sports, etc. If, however, it were to be located adjacent to the North-Central drainage floodplain and some portions of it were preserved as native habitat, this park would provide open space functions for wildlife and feel more expansive. The proposed Commercial parcels and the internal road system will have a maximum impact on short and mixed grass prairie (e.g., 100% of area beneath their footprint). The three Detention Ponds will result in the loss/impact primarily of short and mixed grass prairie. The Parcel E Detention Pond stormwater outfall will likely cause minor impacts to wetland habitat where it feeds into the North-Central drainage. Detention Pond impacts could be temporary and mitigated if prairie, riparian and wetland habitat are restored after construction.

In addition to preserving the highest value existing native vegetation on public and private open space, in order to reduce overall direct impacts from the development, proposed landscaping (private and public) should consist of native species from the same ecosystem that provide food and cover for wildlife. High, solid fences if proposed are a major impediment and impact wildlife movement through the landscape. Short, wildlife friendly fences that allow large and small species to move freely are recommended wherever fences are desired which will allow future residents to enjoy wildlife experiences in their everyday lives.

Over 80 percent of all wildlife species use riparian areas during some part of their life cycle. As such, floodplains, riparian areas including wetlands that together form linear natural corridors (i.e., greenways) should not be impacted by development and left intact. If necessary, road, trail and utility corridors (i.e., crossings) that must cut through riparian areas should be avoided or minimized to only a few locations where the riparian corridor are the narrowest and wetlands are absent. Any proposed crossings should be designed perpendicular to greenways. Greenways are ideal locations for trails that run parallel with the floodplain/riparian corridor to provide future neighborhood residents with positive natural outdoor and wildlife experiences such as bird watching (i.e., ecological benefits). The layout of the development at a sketch plan level is nebulous regarding the avoidance and minimization of impacts to greenways. During more detailed preliminary and final design, all man-made structures, including detention ponds should avoid impacting riparian areas and wetlands.

The creek channel at the downstream, eastern most end of the North-Central drainage below the stock pond was previously a wet swale. This portion of the creek is head-cutting severely, a result of recent large rainfall events. This headcut is about to completely breach and drain the stock pond and start migrating up the channel. This headcut, if left unaddressed, will completely degrade this valuable aquatic/open space resource, including all abutting wetlands and should be stabilized immediately.

Detention/water quality ponds, where required should be located adjacent to riparian areas and vegetated to the maximum extent possible utilizing native riparian and wetland vegetation in the pond bottoms; upland grasses, shrubs and trees along side-slopes, spillways and run-downs to expand riparian habitat for wildlife. Outfall structures from detention ponds with scour aprons are typically designed to extend into and impact wetlands and stream beds. These impacts can be mitigated by locating the outfall outside of riparian and/or wetland habitat then creating a riparian/wetland swale that extends to the receiving stream.

Soils in this region are very sandy and highly permeable which provides ideal conditions for implementing Low Impact Development (LID) systems and practices that mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater throughout a development rather than a waste product. LID practices such as bioretention facilities, wetland swales, rain gardens, rain barrels and permeable pavements implemented throughout the development are recommended to help improve water quality through groundwater infiltration and to reduce and delay the quantity and erosive power of stormwater discharging from traditional single point detention ponds into natural streams.

Ground disturbance /removal of vegetation and exposure of soil instigates the invasion of common and noxious weeds, one of the most detrimental processes to the quality of any kind of habitat. As such, minimization of ground disturbing

GIECK RANCH
DRAINAGE BASIN PLANNING STUDY
El Paso County, Colorado

Volume 1 – Final Report

October 1, 2007
Revised: February 10, 2010

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I. Project Description, Location and Drainage

A. Basin Description and Location

Figure 1.0 shows the location of the Gieck Ranch Drainage Basin. The basin covers a total area of 22.05 square miles within unincorporated El Paso County. The basin begins approximately five miles northeast of the Town of Falcon in El Paso County at an elevation of approximately 7,300 feet above mean sea level (msl). From this point, drainage from the basin travels approximately 15 miles to the southeast. An aerial photograph of the basin is included as Figure 1.1 which is located in Volume 2 of this report. The minimum elevation within the basin is approximately 6,100 feet above msl. Channel slope varies considerably across the basin with average channel slopes ranging from 0.5% to 5%. In general, steeper slopes are located at the northern reaches of the basin, while the flatter slopes are located at the southern reaches. The Gieck Ranch Drainage Basin is tributary to Black Squirrel Creek which drains south to its confluence with the Arkansas River near the city of Pueblo, Colorado. The area encompassing the basin is characterized by rolling range land typically associated with Colorado's semi-arid climates. Existing vegetative cover in undeveloped areas is considered fair for the purposes of this report.

While developing this Drainage Basin Planning Study it was determined that a portion of the adjacent Haegler Ranch Basin, approximately 1.4 square miles, is diverted into the Gieck Ranch Basin as shown in Figure 1.0. This diversion occurs just east and immediately upstream of the intersection of Judge Orr Road and Curtis Road. The diversion exists because no culvert was constructed to convey the runoff from the north side of Judge Orr Road to the south side when the road was originally built. Instead, runoff flows east along the northern edge of the road to a culvert located within the Gieck Basin. This condition has existed since the construction of Judge Orr Road. A stakeholder's meeting was held April, 2005 to discuss the impacts of maintaining the diversion or removing it and restoring historic flows. It was decided to maintain the diversion as is, Documentation and correspondence related to the diversion can be found in Section 1 of the Technical Addenda. In addition to the diversion, while delineating the drainage basins using LIDAR based topography, it was determined that there is an additional 1.35 square miles of area in the southeast section that drains into the Gieck Ranch Basin that was previously thought to drain into adjacent basins. The total square miles of drainage area for the Gieck Ranch Basin (22.05) includes the 1.4 square miles of drainage area diverted from the Haegler Ranch Basin and the 1.35 square miles of additional drainage area in the southeast section of the basin.

The drainage basin has been subdivided into six major sub-watersheds or drainageways. These include the Main Stem Channel (MS) and five main tributaries, the Haegler Diversion (HD), West Fork (WF), East Fork (EF), South Fork (SF), and Southeast Fork (SE). These major drainageways were determined as those existing drainageways that carry runoff from at least 100 to 160 acres. Figure 2.0 shows the locations of the six main drainageways.

There are several open water storage areas that exist within the basin. They appear to be remnants of former irrigation structures and/or stock watering ponds. They do not appear to be constructed for the purposes of flood control. For modeling purposes they were not evaluated as effective storage. Additionally, remnants of several irrigation facilities associated with former ranch lands can be found within the drainage basin. It is not apparent whether or not these irrigation structures are still used. There do not appear to be any active irrigation ditches within the basin.

B. Climate and Flood History

The region surrounding the City of Falcon is generally classified as semi-arid, with annual precipitation in the range of 14 to 16 inches. The bulk of the precipitation is received during the spring and summer months in the form of thundershowers. Most of the flood-producing storms in El Paso County occur during the summer months when thunderstorms are most intense. Available flood history for El Paso County is almost exclusively concerned with the aspects of flooding on Fountain Creek or Monument Creek urbanized areas, so there is no history of flooding in the Gieck Ranch Basin listed in the El Paso County Flood Insurance Study. However, significant flooding events resulting in damage to roadways and drainage structures have been documented in nearby basins, such as that which occurred in the Haegler Basin in 1995. This indicates that flooding and related damage within the Gieck Ranch Drainage Basin and its tributaries is possible in the future.

Table 6.4: Summary of Flows at Selected Design Points – 100-year Storm Event

Design Point ID	Design Point Location	Hydrologic Element	Accumulative Area (mi^2)	Existing Peak Flow (cfs)	Future Peak Flow (cfs)	% Difference Peak Flow	Existing Volume (ac-ft)	Future Volume (ac-ft)	% Difference Volume
1	Haegler Diversion at Eastonville Road	HD-J2	0.8	431	1060	146%	77	96	25%
2	West Fork at Eastonville Road	WF-J1	0.3	146	389	166%	29	39	33%
3	Main Channel at Eastonville Road	MS-J4	1.3	730	1233	69%	112	135	20%
4	Haegler Diversion at Highway 24	HD-J4	1.3	521	1223	135%	97	121	24%
5	West Fork at Highway 24	WF-J3	0.4	224	605	170%	49	62	26%
6	Main Channel at Highway 24	MS-J6	2.5	997	1896	90%	194	225	16%
7	East Fork at Highway 24	EF-J4	1.2	1054	1113	6%	124	126	1%
8	Main Channel at Elbert Road	MS-J7	3.0	1010	1896	88%	220	253	15%
9	East Fork at Elbert Road	EF-J6	2.1	1120	1172	5%	183	187	2%
10	West Fork at Judge Orr Road	WF-J6	1.5	1017	2213	117%	244	291	19%
11	Confluence of East Fork and Main Channel	MS-J9	5.7	1817	3068	69%	429	467	9%
12	Main Channel at Judge Orr Road	MS-J11	6.7	1968	3383	72%	487	564	16%
13	Confluence of West Fork and Main Channel	MS-J12	11.2	2732	6104	123%	805	993	23%
14	Main Channel at Falcon Highway	MS-J16	13.4	3045	6784	123%	936	1191	27%
15	Main Channel at Peyton Highway	MS-J19	15.1	3200	6946	117%	1012	1269	25%
16	Main Channel at Jones Road	MS-J20	15.6	3250	7056	117%	1040	1308	26%
17	South Fork at Jones Road	SF-J4	1.3	454	454	0%	133	133	0%
18	Confluence of South Fork and Main Channel	MS-J22	17.9	3650	7392	103%	1210	1489	23%
19	Southeast Fork at McDaniels Road	SE-J3	2.4	547	546	0%	210	210	0%
20	Main Channel at McDaniels Road	MS-J29	19.6	3791	7525	99%	1293	1597	23%
21	Total Combined Outfall	SE-J3 plus MS-J29	22.0	4326	7687	78%	1503	1807	20%

The 100-year storm event future undetained peak flow is estimated to increase by 78% over the existing peak flow while the future volume of runoff is estimated to increase by 20%.

During the hydrologic analysis it was observed that the Black Squirrel Creek lies very close to the eastern boundary of the Gieck Ranch Basin from Falcon Highway downstream to Log Road. It is possible that flow from Black Squirrel Creek could spill into the Gieck Ranch Basin during extreme storm events. The flows in Black Squirrel Creek in this area are expected to be more than 5,000 cfs for the 100-year event. If the Black Squirrel Creek were to overflow its' banks and flow into the Gieck Ranch Basin it could increase the flows shown in the above tables. Possible improvements to address this potential problem include channel improvements to increase the Black Squirrel Creek conveyance in this area or constructing berms on the east bank to prevent overflow.

Table 8.0: Structure Inventory and Evaluation Summary

Structure ID	Location	Type	Existing Condition	Percent of 100-year Flow Passing*	Adequate** Y/N?	Proposed Structure
1	Eastonville Road southeast of structure 2	18" CMP	Good	13%	N	2 - 6' x 3' CBC
2	Eastonville Road at Haegler Diversion	18" CMP	Good	3%	N	1 - 12' x 5' CBC
3	Eastonville Road northeast of structure 2	18" CMP	Good	67%	N	2 - 24" RCP
4	Eastonville Road at West Fork	36" CMP	Good	24%	N	48" x 76" ERCP
5	Eastonville Road northeast of structure 4	30" CMP	Fair	81%	N	2 - 30" CMP
6	Eastonville Road northeast of structure 5	18" CMP	Poor	100%	Y	---
7	Eastonville Road northeast of structure 6	18" CMP	Good	100%	Y	---
8	Eastonville Road northeast of structure 7	18" CMP	Good	93%	N	19" x 30" ERCP
9	Eastonville Road at Main Channel	24" CMP	Fair	2%	N	2 - 10' x 5' CBC
10	Eastonville Road at Main Channel - East Tributary	19" x 28" CMP	Good	4%	N	1 - 12' x 5' CBC
11	Eastonville Road northeast of structure 10	18" CMP	Good	100%	Y	---
12	Eastonville Road northeast of structure 11	24" x 35" CMP	Good	89%	Y	---
13	Eastonville Road at headwaters of East Fork	30" CMP	Good	24%	N	43" x 68" ERCP
14	Upstream of Hwy 24 at Haegler Diversion	2 - 36" CMP	Good	22%	N	2 - 8' x 4' CBC
15	Hwy 24 at Haegler Diversion	4' x 4' CBC	Good	34%	N.E.	---
16	Upstream of Hwy 24 northeast of structure 14	18" CI	Good	100%	N	24" CMP
17	Hwy 24 northeast of structure 15	24" RCP	Good	100%	N.E.	---
18	Upstream of Hwy 24 at West Fork	Bridge	Good	100%	Y	---
19	Hwy 24 at West Fork	Bridge	Good	100%	N.E.	---
20	Upstream of Hwy 24 northeast of structure 18	36" CMP	Good	72%	Y	---
21	Hwy 24 northeast of structure 19	24" CMP	Poor	34%	N.E.	---
22	Upstream of Hwy 24 at Main Channel	Bridge	Good	100%	Y	---
23	Hwy 24 at Main Channel	Bridge	Good	100%	N.E.	---
24	Upstream of Hwy 24 northeast of structure 22	24" CMP	Unknown	100%	Y	---
25	Hwy 24 northeast of structure 23	24" CMP	Unknown	100%	N.E.	---
26	Upstream of Hwy 24 northeast of structure 24	24" CMP	Unknown	100%	Y	---
27	Hwy 24 northeast of structure 25	24" CMP	Fair	100%	N.E.	---
28	Hwy 24 northeast of structure 27	24" CMP	Poor	99%	N.E.	---
29	Upstream of Hwy 24 at East Fork - West Tributary	24" CMP	Fair	6%	N	1 - 12' x 4' CBC
30	Hwy 24 at East Fork - West Tributary	24" CMP	Good	9%	N.E.	---
31	Upstream of Hwy 24 at East Fork - East Tributary	Bridge	Good	100%	Y	---
32	Hwy 24 at East Fork - East Tributary	Bridge	Good	100%	N.E.	---
33	Curtis Road south of Hwy 24	15" CMP	Good	6%	N	36" CMP
34	Elbert Road at East Fork	Bridge	Good	39%	N	50' Span

Table 8.0: Structure Inventory and Evaluation Summary (Cont.)

35	Elbert Road south of structure 34	24" CMP	Good	100%	Y	---
36	Elbert Road at Main Channel	2 - 48" CMP	Good	19%	N	3 - 12' x 4' CBC
37	Elbert Road south of structure 36	24" CMP	Poor	55%	Y	---
38	Judge Orr Road at West Fork	67" x 95" CMP	Good	20%	N	4 - 12' x 5' CBC
39	Judge Orr Road east of structure 38	36" CMP	Good	100%	Y	---
40	Judge Orr Road west of structure 41	24" CMP	Poor	90%	Y	---
41	Judge Orr Road at Main Channel	Bridge	Good	100%	Y	---
42	Falcon Hwy at Main Channel	Bridge	Good	57%	N	85' Span
43	Peyton Road at headwaters of South Fork	24" CMP	Fair	75%	Y	---
44	Peyton Road at Main Channel	4 - 24" RCP	Good	2%	N	5 - 12' x 7' CBC
45	Peyton Road south of structure 44	36" CMP	Poor	100%	Y	---
46	Peyton Road south of structure 45	24" CMP	Good	100%	Y	---
47	East Garrett Road west of structure 48	24" CMP	Poor	100%	Y	---
48	East Garrett Road at South Fork	48" CMP	Good	14%	N	2 - 5' x 4' CBC
49	J.D. Johnson Road at South Fork	4 - 42" RCP	Good	63%	N	2 - 12' x 4' CBC
50	J.D. Johnson Road south of structure 49	30" CMP	Fair	56%	N	36" CMP
51	J.D. Johnson Road south of structure 50	30" CMP	Fair	100%	Y	---
52	Jones Road at Main Channel	60" CMP	Fair	4%	N	6 - 12' x 7' CBC
53	J.D. Johnson Road at Jones Road	30" CMP	Fair	55%	Y	---
54	Jones Road east of J.D. Johnson Road	30" CMP	Good	73%	Y	---
55	Jones Road at South Fork	36" CMP	Good	6%	N	2 - 7' x 5' CBC
56	Jones Road east of structure 55	30" CMP	Fair	67%	Y	---
57	J.D. Johnson Road at Main Channel US of structure 58	3 - 60" RCP	Good	14%	N	85' Span
58	J.D. Johnson Road at Main Channel	30" CMP	Good	1%	N	120' Span
59	J.D. Johnson Road and Log Road	24" CMP	Fair	23%	N	2 - 6' x 3' CBC
60	Main Channel at private driveway	48" CMP (est.)	Unknown	2%	N.E.	---
61	Log Road at Main Channel	Bridge	Good	36%	N	120' Span
62	McDaniel Road at Main Channel	30" x 48" Oval CMP	Good	1%	N	120' Span
63	Log Road and McDaniels Road	24" CMP	Good	2%	N	5 - 6' x 3' CBC

* Road over-topping not included
** Allowable road over-topping included in adequacy analysis
*** Based on proposed (with selected drainage basin plan) flows
N.E. Not Evaluated, not EPCDOT responsibility

VII. Drainage Basin Plan Development

A. Selected Plan

The selected plan consists of integrating the selected alternative outlined in the previous section. This includes the construction of the small regional full spectrum detention basins and the recommended channel improvements shown on the plan and profile sheets located in the Appendices. The future conditions hydrologic and hydraulic models were updated to determine the affect of the full spectrum regional ponds on peak flows, volumes and channel velocities. Revised hydrologic and hydraulic modeling results are provided in Sections 17 and 18 of the Technical Addenda. Table 11 presents a summary of discharge rates for the selected plan incorporating the full spectrum regional detention facilities.

Table 11: Summary of Flows at Selected Design Points – Selected Plan Developed Conditions

Design Point ID	Design Point Location	Hydrologic Element	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q100 (cfs)
1	Haegler Diversion at Eastonville Road	POND HD-S1	5	25	32	338
2	West Fork at Eastonville Road	WF-J2	2	17	45	114
3	Main Channel at Eastonville Road	POND MS-S1	28	119	253	573
4	Main Channel Tributary 2 at Eastonville Road	POND MST2-S1	21	65	126	271
5	East Fork Tributary at Eastonville Road	EFT1-B1	25	46	73	134
6	East Fork at Eastonville Road	EF-B1	33	59	92	168
7	Haegler Diversion at Highway 24	HD-J4	7	33	138	429
8	West Fork at Highway 24	WF-J3	6	38	97	242
9	West Fork Tributary at Highway 24	POND WFT1-S1	1	8	24	66
10	Main Channel at Highway 24	MS-J6	49	190	391	877
11	Main Channel Tributary 3 at Highway 24	MST3-B1	1	3	7	19
12	East Fork Tributary at Highway 24	EFT1-J2	43	95	164	337
13	East Fork at Highway 24	EF-J4	160	334	564	1102
14	Main Channel at Elbert Road (Further South of)	MS-B10	1	2	6	16
15	Main Channel at Elbert Road (South of)	MS-J8	1	3	6	18
16	Main Channel at Elbert Road	MS-J7	50	193	399	896
17	East Fork at Elbert Road	EF-J6	162	344	588	1169
18	Confluence of East Fork and Main Channel	MS-J9	160	390	775	1774
19	West Fork at Judge Orr Road	POND WF-SR1	18	86	273	753
20	Main Channel at Judge Orr Road (West of)	POND WF-S3	1	2	4	11
21	Main Channel at Judge Orr Road	MS-J11	154	407	828	1920
22	Confluence of West Fork and Main Channel	MS-J12	160	500	1085	2679
23	Main Channel at Falcon Highway	MS-J16	141	494	1103	2842
24	Main Channel at Falcon Highway (East of)	MS-B20	2	7	15	38
25	South Fork at Falcon Highway	SF-B1	4	13	27	65
26	Main Channel at Peyton Highway	MS-J19	150	520	1163	3003
27	South Fork at Peyton Highway	SF-J1	18	40	70	148
28	South Fork at J.D. Johnson Road	SF-J4	51	117	212	455
29	Main Channel at Jones Road	MS-J20	154	528	1179	3054
30	South Fork at Jones Road	SF-J5	54	124	226	484
31	South Fork Tributary at Jones Road	SET1-B1	24	47	78	152
32	Main Channel at J.D. Johnson Road (North)	MS-J21	154	529	1184	3068
33	Confluence of South Fork and Main Channel	MS-J22	188	602	1341	3449
34	Main Channel at J.D. Johnson Road (South)	MS-J23	193	612	1367	3520
35	South Fork Tributary at J.D. Johnson Road	SET1-J1	38	77	131	272
36	Main Channel at Log Road (North)	MS-J25	195	616	1375	3546
37	Main Channel at Log Road (South)	MS-J26	196	618	1378	3557
38	Southeast Fork at Log Road	SE-J2	70	145	247	498
39	Main Channel at McDaniels Road	MS-J29	199	626	1395	3594
40	Southeast Fork at McDaniels Road	SE-J3	73	153	263	537
41	Total Combined Outfall	MS-J29 and SE-J3	272	779	1657	4131

Comparison to the existing conditions flows presented in Tables 6.1 through 6.4 shows that implementation of the selected plan will result in developed peak discharge rates that are slightly lower than existing discharge rates. This should reduce potential for flood damage within the basin.

B. Small Regional Detention Basins

The recommended plan includes the construction of 17 small regional detention storage basins, 15 of which would incorporate full spectrum detention. Ponds WF-SR1 and MS-SR1 exceed the contributing area size limitation for full spectrum detention. For these two ponds, the water quality control volume should be provided. Pond WFT1-S1 will only provide detention for the property located in Basin WFT1-B1 and the pond should be constructed when this property is developed. The locations of the basins shown on the plan sheets are conceptual. The final location and sizes of the basins are to be determined during final design of proposed development projects. It is possible that the location and basin size may vary from the conceptual design as long as sufficient detention storage is provided to meet required discharge rates and the excess urban runoff volumes are provided as outlined in the Urban Drainage and Flood Control District Criteria for full spectrum detention. Table 12 lists the detention basin data for the selected plan. Some areas of the drainage basin may encounter seasonal high ground water tables. Final sizing of the detention basins should be done in such a way as to minimize the need for underdrains.

C. Channel Improvements

Recommended channel improvements consist of vegetation augmentation, selective channel stabilization such as selectively armoring existing channel banks with riprap at outside channel bends and at bridge and culvert outlets, bio-engineered stabilization treatment, and low flow linings, some channelization, and construction of grade control structures. The recommended channel improvements have been selected to minimize environmental impacts and retain natural channel characteristics as much as possible since the basin is mostly undeveloped and the majority of the existing drainageways have not been disturbed at this time. There are large areas of the basin that are to remain as vacant or agricultural land based on the El Paso County 2030 Land Use Codes. Specific channel improvements to the drainageways in these areas were not recommended. It is assumed that these channels will remain in private ownership which lowers the feasibility of channel improvements that require permanent right-of-way or easements for construction and maintenance. The recommended approach for these areas is to provide as-needed improvements.

Table 12: Detention Basin Data

Basin ID	Excess Urban Runoff Volume (ac-ft)	Detention Storage Volume (ac-ft)	Discharge Rate (cfs)
HD-S1	21.4	41.0	345
HD-S2	2.4	7.0	92
WF-S1	7.3	17.0	115
WF-S2	2.7	13.8	134
WF-S3	4.3	9.0	11
WF-S4	29.7	52.0	359
WFT1-S1	2.2	9.0	70
WF-SR1	WQCV*	30.0	802
MS-S1	12.2	42.0	583
MS-S2	0.6	5.2	58
MS-S3	4.8	19.0	147
MS-S4	11.8	30.0	29
MS-S5	2.9	6.1	26
MS-SR1	WQCV*	50.0	2,900
MST2-S1	3.9	21.5	275
MST4-S1	6.4	20.0	137
MST5-S1	11.6	30.0	90

* Use Water Quality Control Volume

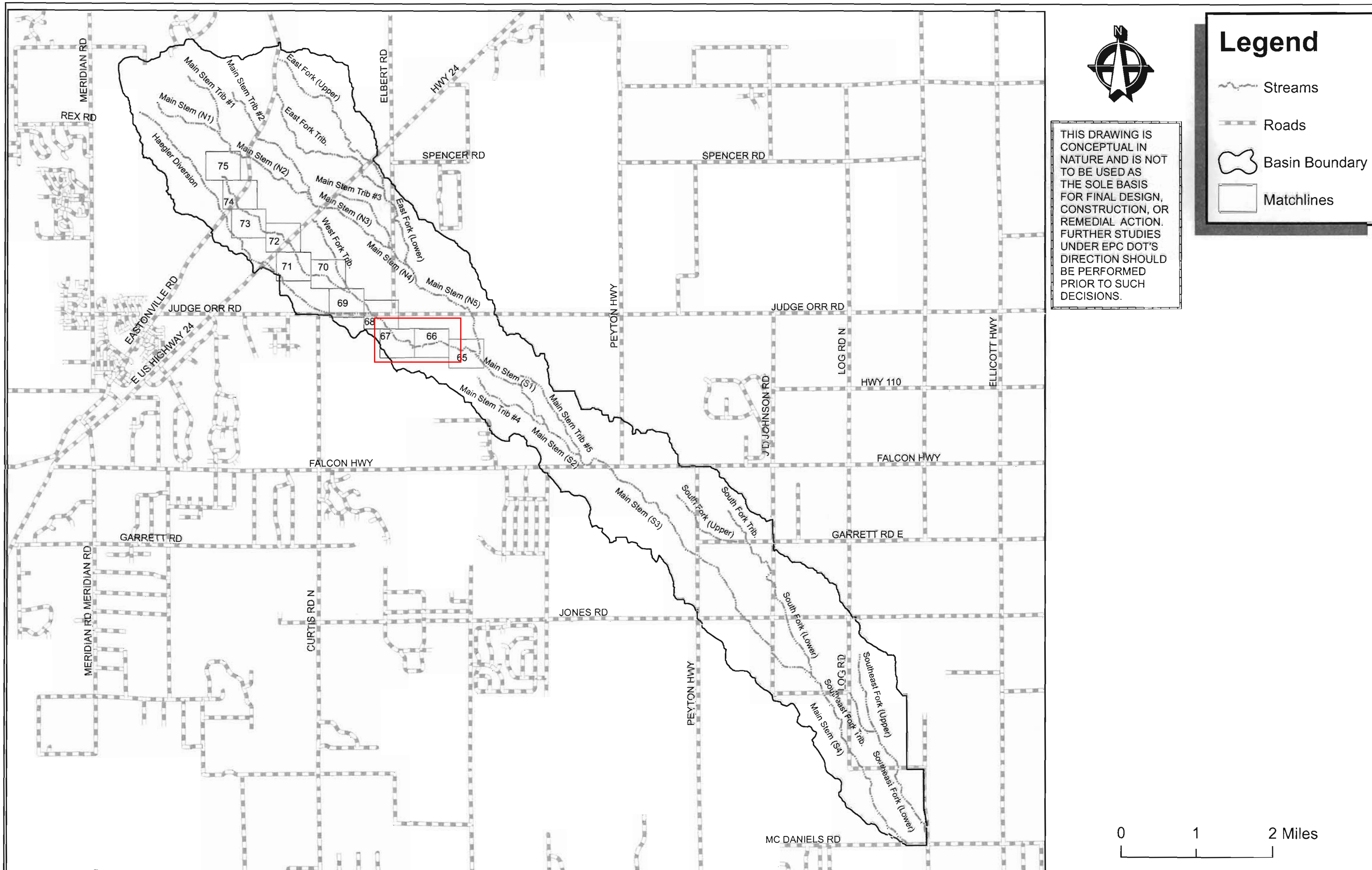
Table 13 lists the recommended approach to channel improvements on a reach by reach basis. As land development projects proceed within the drainage basin the location and specific type of selective channel improvements will need to be identified during the project design phase based on site specific conditions. There may be some overlapping of approaches between reaches. For example, some selective stabilization may be needed in reaches designated for vegetation augmentation and vice-versa. The methods outlined in the City/County Drainage Criteria Manual and the El Paso County Engineering Manual should be applied during final design analysis. Some specific channel improvements have been identified for several areas such as the Haegler Diversion channel upsizing and realignment at Judge Orr Road. These improvements are called out on the selected plan drawings.

Table 13: Channel Improvements By Reach

Drainageway	Reach ID	Reach Length (ft)	Channel Approach
Haegler Diversion	HD-R1a	3875	Selective Stabilization
Haegler Diversion	HD-R1b	5737	Channelization
Haegler Diversion	HD-R2	2826	Vegetation Augmentation
Haegler Diversion	HD-R3	2207	Selective Stabilization
Haegler Diversion	HD-R4	5161	Vegetation Augmentation
Haegler Diversion	HD-R5	3784	Selective Stabilization
West Fork	WF-R1	1775	Channelization
West Fork	WF-R2	2281	Vegetation Augmentation
West Fork	WF-R3	3029	Selective Stabilization
West Fork	WF-R4a	1717	Vegetation Augmentation
West Fork	WF-R4b	2001	Vegetation Augmentation
West Fork	WF-R4c	1601	Selective Stabilization
West Fork	WF-R4d	1198	Selective Stabilization
West Fork	WF-R5	1200	Selective Stabilization
West Fork	WF-R6	863	Selective Stabilization
West Fork	WF-R7a	2341	Vegetation Augmentation
West Fork	WF-R7b	1594	Vegetation Augmentation
West Fork	WF-R8a	4002	Selective Stabilization
West Fork	WF-R8b	1600	Selective Stabilization
West Fork - Trib. WF1	WFT1-RI	5601	Vegetation Augmentation
Gieck Main	MS-R1	2400	Vegetation Augmentation
Gieck Main	MS-R2	2000	Selective Stabilization
Gieck Main	MS-R3	1200	Selective Stabilization
Gieck Main	MS-R4a	1278	Channelization
Gieck Main	MS-R4b	1341	Channelization
Gieck Main	MS-R5	6181	Vegetation Augmentation
Gieck Main	MS-R6	804	Selective Stabilization
Gieck Main	MS-R7a	1554	Vegetation Augmentation
Gieck Main	MS-R7b	3191	Vegetation Augmentation
Gieck Main	MS-R7c	1354	Vegetation Augmentation
Gieck Main	MS-R8a	314	Vegetation Augmentation
Gieck Main	MS-R8b	783	Selective Stabilization
Gieck Main	MS-R8c	568	Selective Stabilization
Gieck Main	MS-R11a	3376	Selective Stabilization
Gieck Main	MS-R11b	2405	Selective Stabilization
Gieck Main	MS-R12	620	Selective Stabilization
Gieck Main	MS-R13	3158	Vegetation Augmentation
Gieck Main	MS-R14	7422	Selective Stabilization
Gieck Main	MS-R15	3306	Selective Stabilization
Gieck Main	MS-R16	2294	As-needed Improvements
Gieck Main	MS-R17	542	As-needed Improvements
Gieck Main	MS-R18	5457	As-needed Improvements
Gieck Main	MS-R19	1604	As-needed Improvements
Gieck Main	MS-R20a	1197	As-needed Improvements

Table 13: Channel Improvements By Reach, cont.

Drainageway	Reach ID	Reach Length (ft)	Channel Approach
Gieck Main	MS-R20b	1227	As-needed Improvements
Gieck Main	MS-R21a	1990	As-needed Improvements
Gieck Main	MS-R21b	1584	As-needed Improvements
Gieck Main	MS-R21c	2242	As-needed Improvements
Gieck Main	MS-R22	3360	As-needed Improvements
Gieck Main	MS-R23	3268	As-needed Improvements
Gieck Main	MS-R24	1927	As-needed Improvements
Gieck Main	MS-R25a	1603	As-needed Improvements
Gieck Main	MS-R25b	1615	As-needed Improvements
Gieck Main	MS-R25c	384	As-needed Improvements
Gieck Main	MS-R26	803	As-needed Improvements
Gieck Main	MS-R27	1597	As-needed Improvements
Gieck Main	MS-R28	3599	As-needed Improvements
Gieck Main	MS-R29	797	As-needed Improvements
Gieck Main	MS-R30	2004	As-needed Improvements
Gieck Main - Sub Trib M1	MST1-R1	4799	Selective Stabilization
Gieck Main - Sub Trib M2	MST2-R1	3896	Selective Stabilization
Gieck Main - Sub Trib M2	MST2-R2	6504	Vegetation Augmentation
Gieck Main - Sub Trib M3	MST3-R1	5599	As-needed Improvements
Gieck Main - Sub Trib M4	MST4-R1	6000	Selective Stabilization
Gieck Main - Trib. M5	MST5-R1	7200	Selective Stabilization
East Fork	EF-R1	2659	As-needed Improvements
East Fork	EF-R2	2400	As-needed Improvements
East Fork	EF-R3	4800	As-needed Improvements
East Fork	EF-R4	1122	As-needed Improvements
East Fork	EF-R5	2161	As-needed Improvements
East Fork	EF-R6	1410	As-needed Improvements
East Fork	EF-R7	4876	As-needed Improvements
East Fork - Trib. EF1	EFT1-R1	3200	As-needed Improvements
East Fork - Trib. EF1	EFT1-R2a	2400	As-needed Improvements
East Fork - Trib. EF1	EFT1-R2b	4041	As-needed Improvements
East Fork - Trib. EF1	EFT1-R3	2394	As-needed Improvements
South Fork	SF-R1	2017	As-needed Improvements
South Fork	SF-R2	4120	As-needed Improvements
South Fork	SF-R3	3063	As-needed Improvements
South Fork	SF-R4	1167	As-needed Improvements
South Fork	SF-R5	2434	As-needed Improvements
South Fork	SF-R6	4799	As-needed Improvements
South Fork - Trib. SF1	SFT1-R1	2400	As-needed Improvements
Southeast Fork	SE-R1	5596	As-needed Improvements
Southeast Fork	SE-R2	2786	As-needed Improvements
Southeast Fork	SE-R3a	3209	As-needed Improvements
Southeast Fork	SE-R3b	2940	As-needed Improvements
Southeast Fork - Trib. SEF1	SET1-R1	3301	As-needed Improvements



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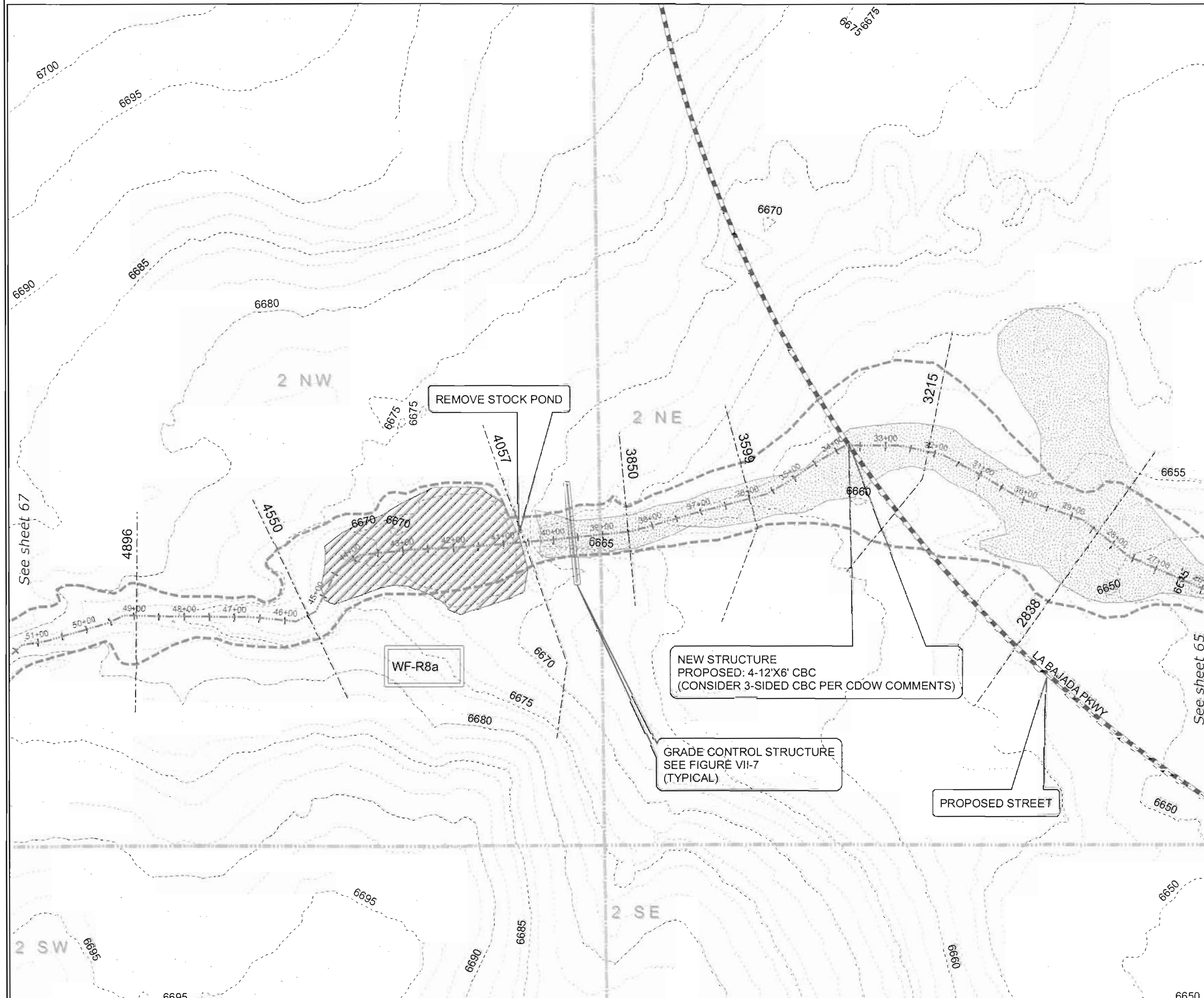
DRAWING INFO: GIECK RANCH KEY MAP WEST FORK	DATE: AUGUST 2007 SCALE: H: 1" = 6000' V:	JOB NO: C7706-1 DRAWING NO.: 6D 038	SET PL SHEET K8



Environmental Key

- Ponds
- Riparian: Good
- Riparian: Poor
- Potential Wetlands

The channel is considered dry unless shown as one of the above environmental categories.

Legend

- *Proposed Future Conditions 100-yr Flood Limits*
- Streams
- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

0 100 200 Feet

Reach	Slope (%)	Q_{100} (cfs)	V_{100} (ft/s)
WF-R8a	1.36	753	4.05

RECOMMENDED PLAN IMPROVEMENTS

Reach	
WF-R8a	Selective Stabilization

Note:
See Technical Addenda for grade control data.

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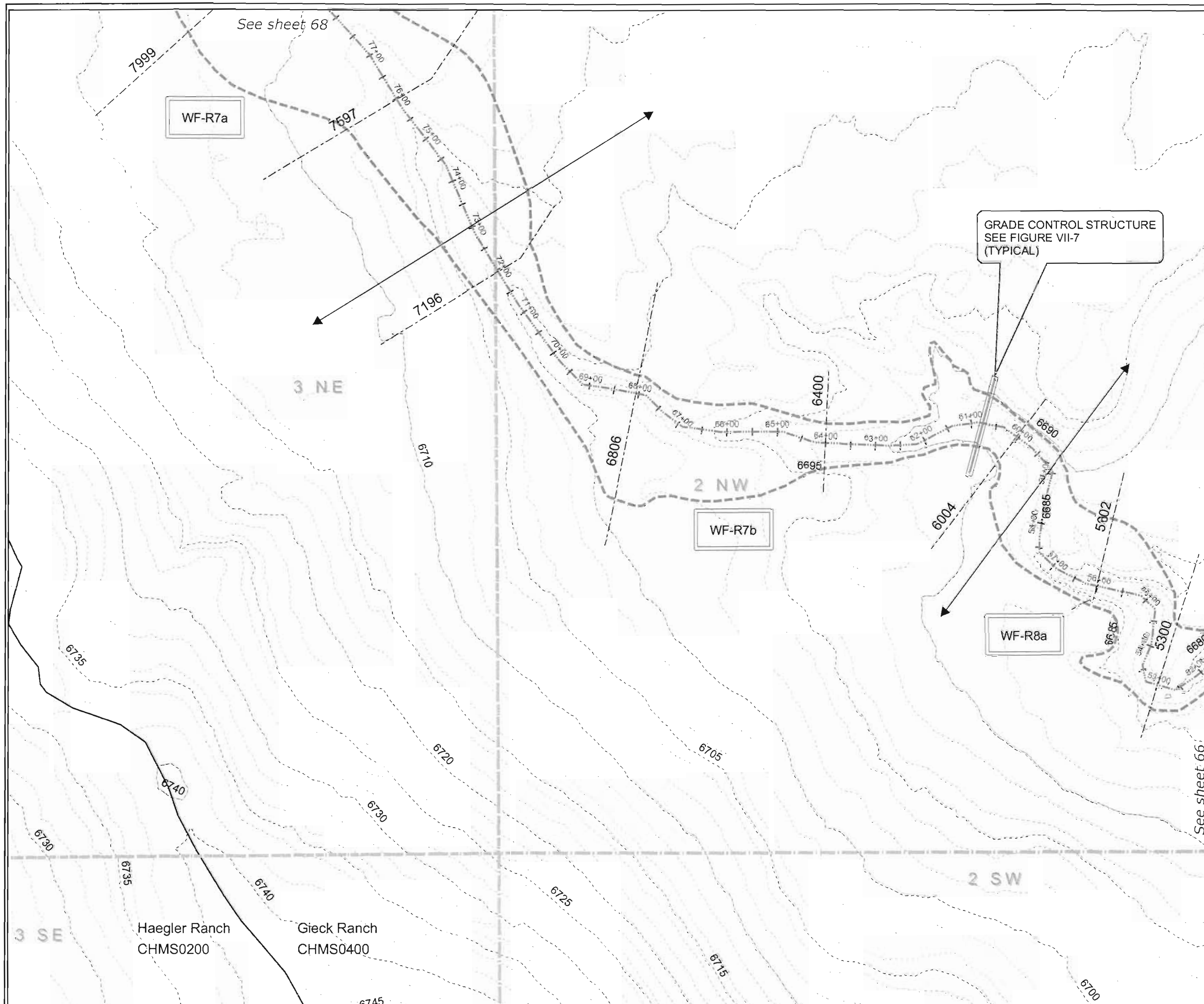
PROJECT INFO: GIECK RANCH
DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

DESIGNED BY: RJB	REVISION DESCRIPTIONS	DATE
DRAWN BY: BLF/MLM	PER EPCDOT COMMENTS	FEBRUARY 2008
CHECKED BY: RJB/TML	PER EPC FINAL REVIEW	JANUARY 2010

DRAWING INFO: GIECK RANCH DBPS
PLAN VIEW
WEST FORK #2

DATE: AUGUST 2007
SCALE: H: 1" = 200' V: NONE
JOB NO: C7706-2
DRAWING NO.: 6D 038
SET: PL
SHEET: 66



Environmental Key

- Ponds
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- Riparian: Poor
- Potential Wetlands

The channel is considered dry unless shown as one of the above environmental categories.

0 100 200 Feet

Legend

- *Proposed Future Conditions 100-yr Flood Limits*
- Streams
- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

Reach	Slope (%)	Q_{100} (cfs)	V_{100} (ft/s)
WF-R7a	1.18	753	2.19
WF-R7b	1.14	753	4.21
WF-R8a	1.36	753	4.05

RECOMMENDED PLAN IMPROVEMENTS

Reach	
WF-R7a	Vegetation Augmentation
WF-R7b	Vegetation Augmentation
WF-R8a	Selective Stabilization

Note:
See Technical Addenda for grade control data.

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DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

DESIGNED BY: RJB
DRAWN BY: BLF/MLM
CHECKED BY: RJB/TML

REVISION DESCRIPTIONS	DATE
PER EPCDOT COMMENTS	FEBRUARY 2008
PER EPC FINAL REVIEW	JANUARY 2010

DRAWING INFO: GIECK RANCH DBPS
PLAN VIEW
WEST FORK #3

DATE: AUGUST 2007
JOB NO: C7706-2
SET: PL
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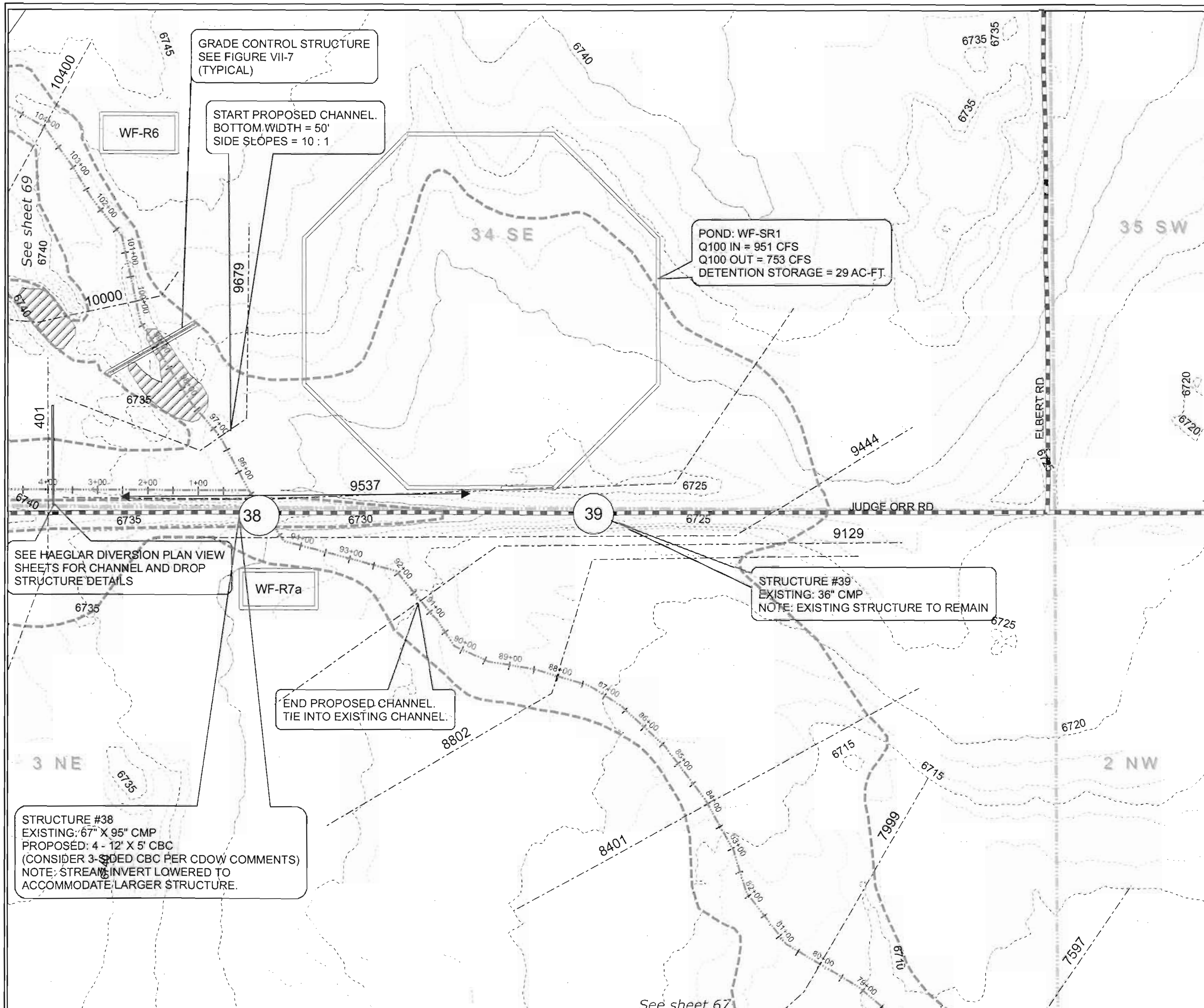

Environmental Key

- Ponds
- Riparian: Good
- Riparian: Poor
- Potential Wetlands

The channel is considered dry unless shown as one of the above environmental categories.

0 100 200 Feet

Legend

- *Proposed Future Conditions 100-yr Flood Limits*
- Streams
- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

Reach	Slope (%)	Q_{100} (cfs)	V_{100} (ft/s)
WF-R6	1.04	698	3.45
WF-R7a	1.18	753	2.19

RECOMMENDED PLAN IMPROVEMENTS

Reach	
WF-R6	Selective Stabilization
WF-R7a	Vegetation Augmentation

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DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

DESIGNED BY: RJB
DRAWN BY: BLF/MLM
CHECKED BY: RJB/TML

REVISION DESCRIPTIONS	DATE
PER EPCDOT COMMENTS	FEBRUARY 2008
PER EPC FINAL REVIEW	JANUARY 2010

DRAWING INFO: GIECK RANCH DBPS
PLAN VIEW
WEST FORK #4

DATE: AUGUST 2007
JOB NO: C7706-2
SET: PL
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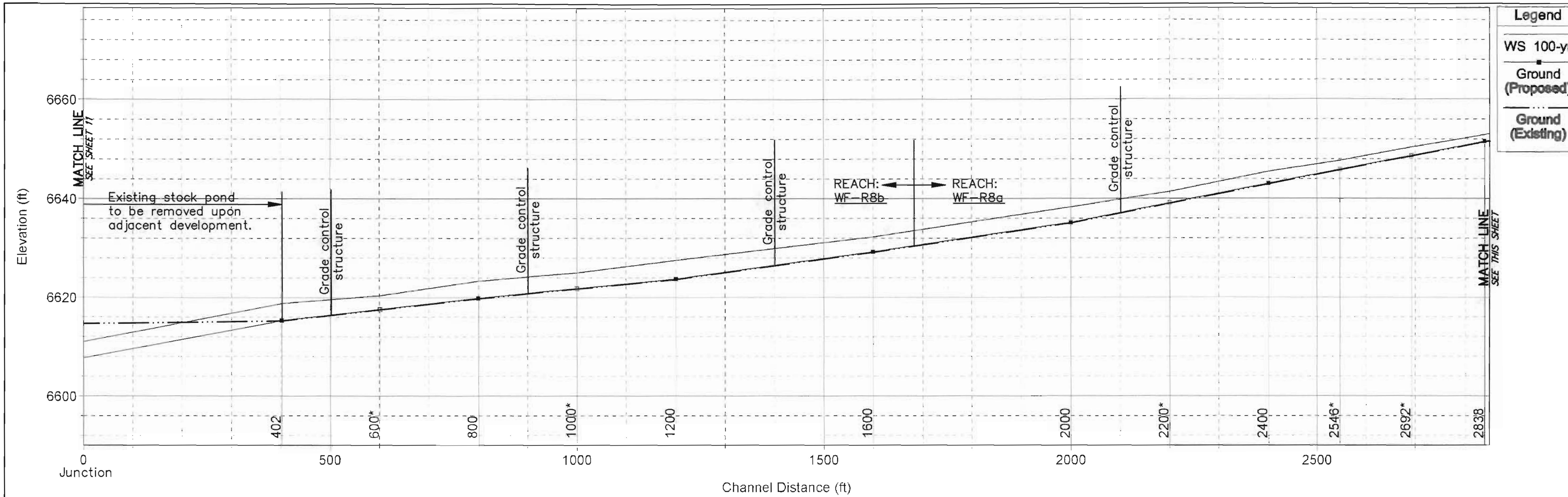

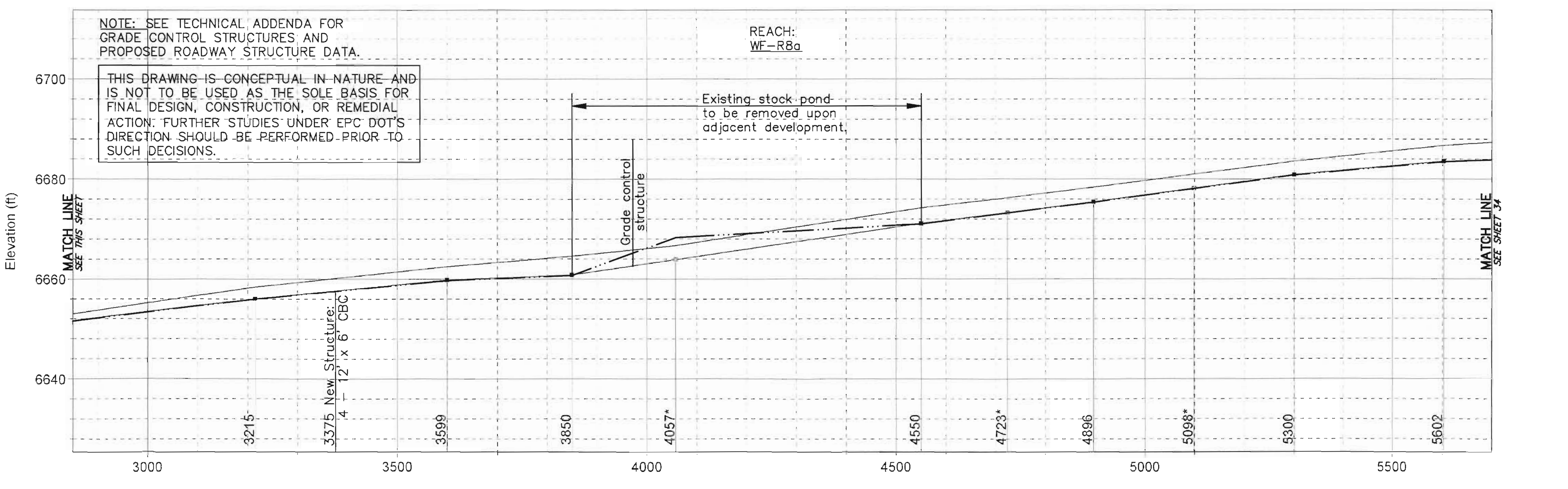

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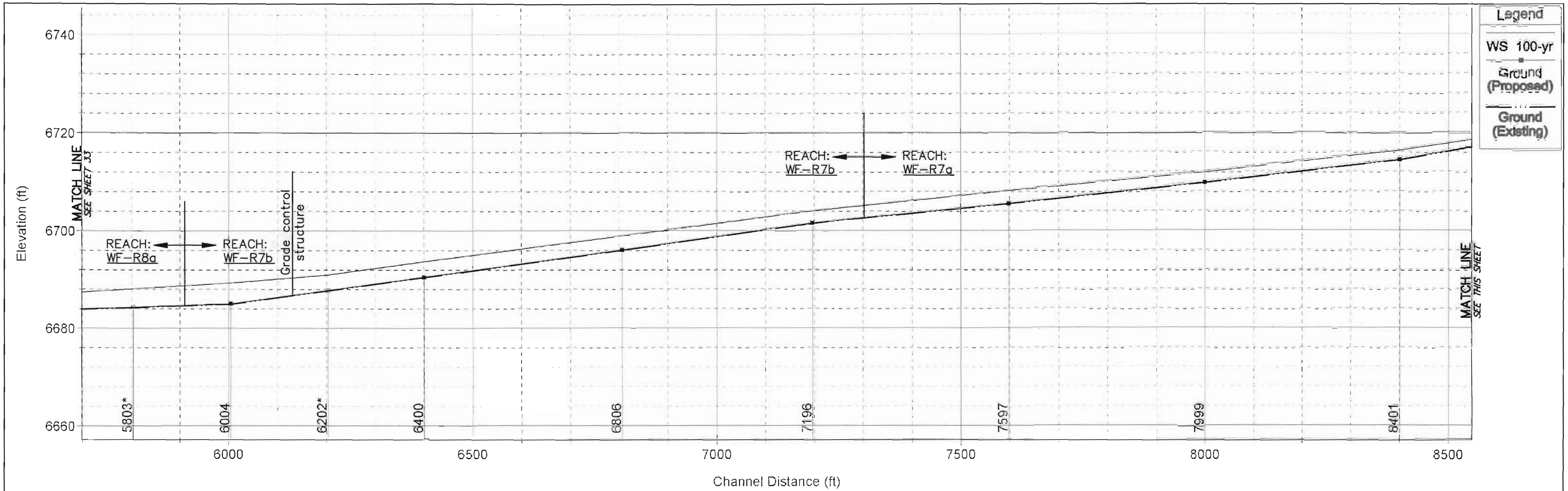

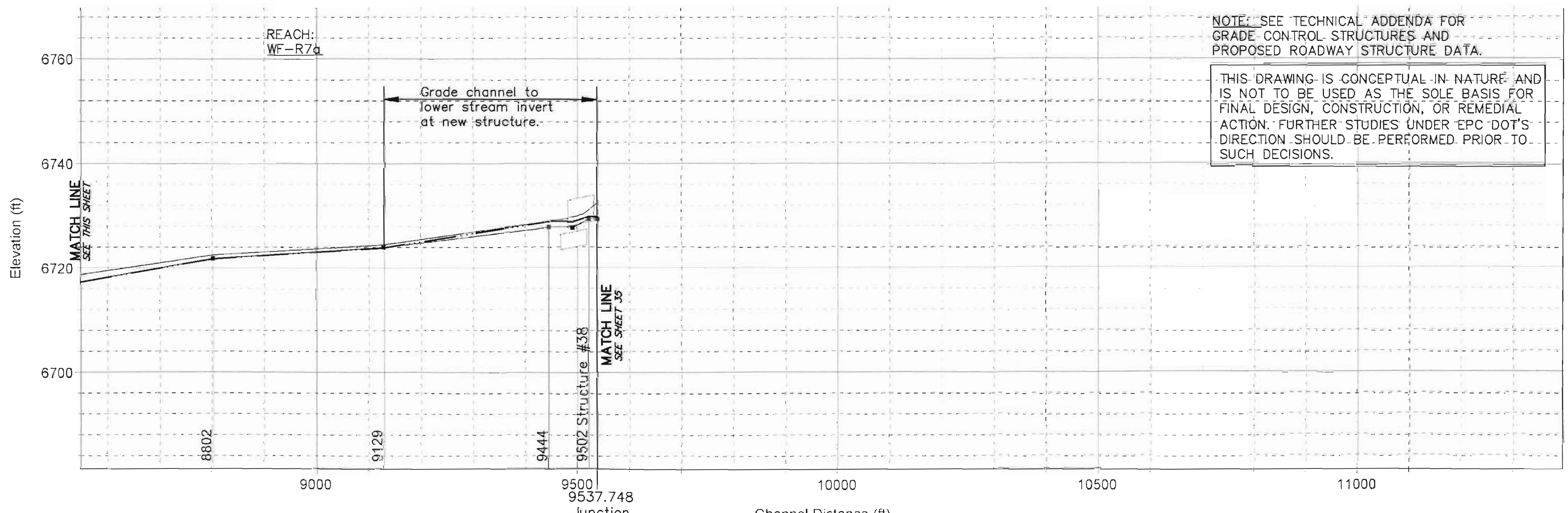

NOTE: SEE TECHNICAL ADDENDA FOR GRADE CONTROL STRUCTURES AND PROPOSED ROADWAY STRUCTURE DATA.

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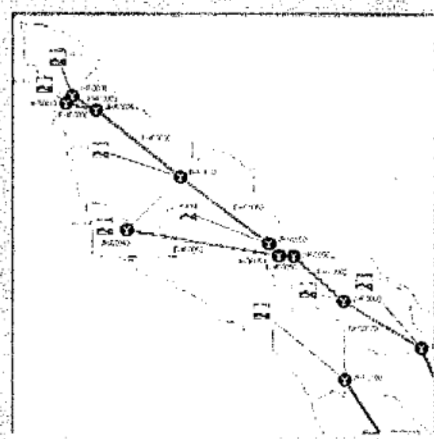
DATE: AUGUST 2007	JOB NO: C7706-2	SET: PR	SCALE: H: 1" = 200', V: 1" = 20'	DRAWING NO: 6D 038	SHEET: 34



Haegler Ranch Basin

Drainage Basin Planning Study

May 2009

URS

3.0 AREA DESCRIPTION

The Haegler Ranch (El Paso County Basin Number CHMS0200) is an unnamed tributary to Ellicott Consolidated Drainage Basin unnamed tributary, which is a tributary of Black Squirrel Creek. Haegler Ranch lies in the central portion of El Paso County. Figure 1-1 shows the location of the Haegler Ranch in respect to El Paso County, Colorado. Haegler Ranch Basin is located in Sections 29, 32 and 33 of Township 12 South Range 64 West and sections 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 22, 23, and 24 of Township 13 South, Range, 64 West and sections 18, 19, 20, 28, 29, 30, 31, 32, 33, and 34 of Township 13 South, Range 63 West and sections 2, 3, and 4 of Township 14 South, Range 63 West.

3.1. Basin Description

The Haegler Ranch flows to the southeast from north of Eastonville Road to McDaniels Road with a total of 16.6 sq mi in unincorporated El Paso County, Colorado. In 2005, approximately 14% of the basin was developed. Mucb of the existing development consists of 2- and 5-acre (ac) residential lots surrounded by open space range land used for agriculture and large parcels with homes south of U.S. Highway 24 (US 24). High-density residential developments are being planned in the northern portions of the basin.

The maximum basin elevation is approximately 7,054 ft in the headwaters and falls to approximately 6,085 ft at the downstream confluence of the basin. The basin is typified by rolling rangeland with poor vegetative cover associated with semi-arid climates.

3.2. Climate

This area of El Paso County can be described as high plains with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, while the springs and summer receive a majority of this precipitation in the form of rainfall. The average precipitation ranges from 14 to 16 in. per year. Thunderstorms are common during the summer months and are quick-moving low-pressure cells that draw moisture from the Gulf of Mexico into the region. The County has an average temperature ranging from a low of 14°F in the winter to a high of 81°F in the summer. The relative humidity ranges from 25% in the summer to 45% in the winter (SCS 1981).

3.3. Soils and Geology

Soils within the Haegler Ranch are classified according to the NRCS soil classification system. The predominant soils are in the Blakeland soil series, which consist of deep, somewhat excessively drained soils that formed in sandy alluvium and sediment on uplands. The soil series has high infiltration rates, and are extremely susceptible to wind and water erosion where poor vegetation cover exists. Figure 3-1 shows the soil distribution map for the Haegler Ranch (SCS 1981). The bedrock geology is predominately flat lying sandstone and siltstone, some of which is covered with recent alluvium.

3.4. Property Ownership and Land Use Information

Property ownership along the major drainageways within the Haegler Ranch varies from public to private. Along recent developments, drainage right-of-ways and greenbelts have been dedicated during the development of the adjacent residential and commercial land. A portion of Haegler Ranch has already been developed with 2- and 5-ac residential lots. The drainageways in the lower part of the basin remain under private ownership with no delineated drainage right-of-way or easements. A drainage easement or right-of-way must be granted to the County in order for DOT to perform any recommended improvements.

Roadway and utility easements abutting or crossing the major drainageways occur most frequently in the developed portions of the basin. The locations of roadways were obtained from the El Paso County Major Transportation Corridors Plan dated September 21, 2004 (EPC 2004). The El Paso County Rock Island Trail System runs parallel along the north side of US 24. The trail follows the abandoned Chicago and Rock Island Railroad between Falcon and Peyton, Colorado.

Land use information for the existing and future conditions models was obtained from El Paso County Planning Department in 2005. This information is used in the hydrologic analysis to predict runoff rates and volumes for the purposes of stormwater facility evaluation. The identification of land uses abutting the drainageways is also useful in the identification of feasible plans for stabilization and aesthetic treatment of the basin. Presented in Figure 3-2 and Figure 3-3 are the land use maps used for the evaluation of impervious land densities discussed in Section 4.0. These figures are not intended to reflect the future zoning or land use policies of the County.

3.5. Environmental Analysis

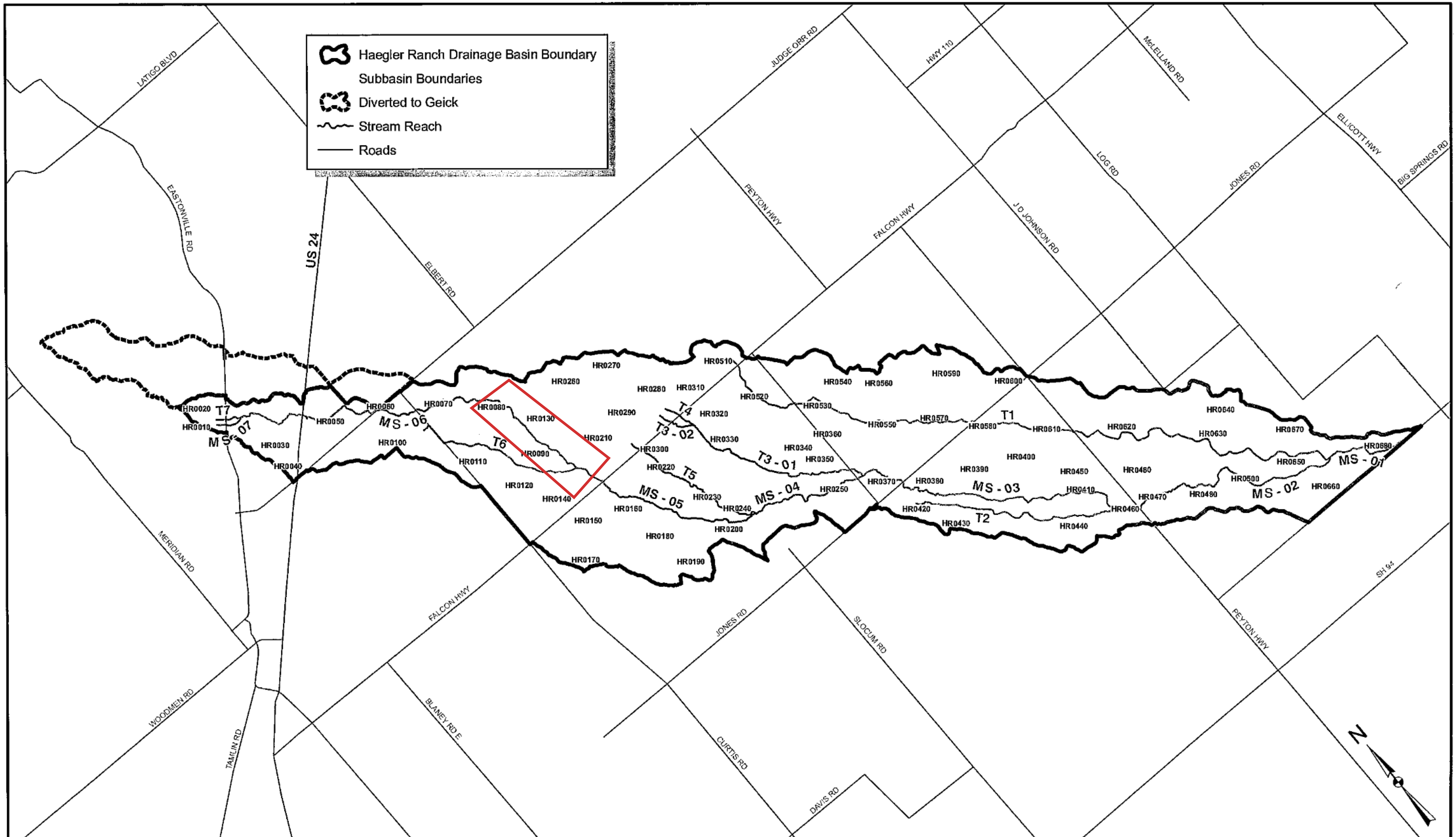
An environmental analysis was conducted for this DBPS to assess the present condition of the biological and environmental resources in the Haegler Ranch. Site visits were conducted to study these elements of the basin. Particular attention was paid to the drainageways and spring/seep areas to determine biological resources in riparian zones and wetlands.

The Haegler Ranch consists of indistinct ephemeral streams that flow after storms for a short period of time. The main stem of Haegler Ranch consists of dry natural grass swales with some poor quality riparian zones and small wetlands in the floodplains. Most of the wetlands surround stock reservoirs and are heavily grazed in some of the rangeland pastures. As a result, the wetlands and riparian drainageways have been degraded in vegetative cover and ecological value. The existing wetlands are neither large nor extensive, and are mostly discontinuous. In their present condition, the wetlands are not a significant habitat resource within the basin. Figure 3-4 and Figure 4-4 show and potential wetlands that may require further study.

Most of the open space is used for agriculture or rangeland. Drainageways have been channelized principally only at roadway crossings. These areas of concentrated flow have defined channels that tend to become indistinct as they flow downstream. Vegetation in the Haegler Ranch in the open space does not vary dramatically. Vegetation patterns generally follow tbe physiographic region of the plains dominated by a short- to mid-height prairie grass with a few shrubs and sporadic trees such as cottonwoods. Wetlands consist of rushes and sedges such as little bluestem, grama grasses, needle and thread and western wbeat grass.

Wildlife and animal species common to the open plains inhabit the basin. They consist of animals that tolerate the presence of roads and people including large and small mammals such as deer, antelope, coyotes and rodents, and several species of birds such as killdeer and red-winged blackbirds. Preliminary review indicates that the DBPS will not affect any threatened or endangered species or critical habitat.

Because of the sensitivity of wetlands, riparian areas, and wildlife to stormwater runoff, sedimentation and erosion should be evaluated and planned for in the alternatives. Wetland and riparian areas provide a habitat resource that should be preserved during the alternative development. These areas can be protected and enhanced to improve ecological value.



URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

5,000 2,500 0 5,000 Feet
1" = 5,000'

DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN

SUBBASIN DELINEATION
FIGURE 4-1

URS NO. 21711039

- Main Stem (MS-05) – This channel extends from the confluence of the main stem with Tributary 6 north of Falcon Highway in subbasin HR0140 to the confluence of the main stem with Tributary 5 in subbasin HR0200. The channel is a grass swale with one culvert crossing at Falcon Highway.
- Main Stem (MS-06) – This channel extends from the confluence of the main stem with Tributary 7, southeast of Eastonville Road in subbasin HR0030, to the confluence of the main stem with Tributary 6, just north of Falcon Highway in subbasin HR0090. The channel is a grass swale with two culvert crossings, one bridge crossing, and one overtopped roadway at Judge Orr Road.
- Main Stem (MS-07) – This channel extends from subbasin HR0010 northwest of Eastonville Road to the confluence of the main stem with Tributary 7, southeast of Eastonville Road in subbasin HR0030. The channel is a grass swale with one culvert crossing at Eastonville Road.
- Tributary 1 (T1) – This channel extends from subbasin HR0510 just north of Falcon Highway to the confluence of the main stem at subbasin HR0650. The channel is long, dominated by a grass swale with low points along the channel, and has 4 culvert crossings.
- Tributary 2 (T2) – This channel extends from subbasin HR0420 just south of Jones Road to the confluence of the main stem at subbasin HR0440 to the northwest of Peyton Highway. The channel is parallel to MS-03, and varies between a grass swale and an alluvial sand bed channel with diversion structures such as pond embankments and berms.
- Tributary 3 (T3-01) – This channel extends from subbasin HR0330 at the confluence with Tributary 4, just south of Falcon Highway, to the confluence with the main stem east of Murr Road, at subbasin HR0360. The channel is a grass swale with two culvert crossings in a large lot residential development.
- Tributary 3 (T3-02) – This channel extends from subbasin HR0290 just north of Falcon Highway to the confluence with Tributary 4, just south of Falcon Highway, in subbasin HR0300. The channel is a grass swale with one culvert crossing at Falcon Highway.
- Tributary 4 (T4) – This channel extends from subbasin HR0280 north of Falcon Highway to the confluence with Tributary 3, just south of Falcon Highway, in subbasin HR0300. The channel is a grass swale with one culvert crossing at Falcon Highway.
- Tributary 5 (T5) – This channel extends from subbasin HR0210 just north of Falcon Highway to to the confluence with the main stem in subbasin HR0230. The channel is a grass swale with one culvert crossing at Falcon Highway.
- Tributary 6 (T6) – This channel extends from subbasin HR0100 west of Curtis Road to the confluence of the main stem north of Falcon Highway in subbasin HR0120. The channel is a grass swale with one culvert crossing at Curtis Road.
- Tributary 7 (T7) – Tbis cbannel extends from subbasin HR0020 northwest of Eastonville Road to the confluence of the main stem, southeast of Eastonville Road, in subbasin HR0030. The channel is a grass swale with one culvert crossing at Eastonville Road.

5.6. Manning's Roughness Coefficients

Manning's roughness coefficients for each cross-section were estimated based on site visits and aerial photographs. Multiple Manning's roughness coefficients were used across the cross-section as necessary to accurately describe cbanges in vegetative cover between the main channel and overbank areas. The values for the Manning's roughness coefficients in the channel and the floodplains are taken from the Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains by the USGS (WSP 2339). This manual was used since the Manning's roughness coefficients can be adjusted for surface irregularities, variation in cross-sections, obstructions, vegetation, and meandering. The Manning's roughness coefficients for the channels and floodplains associated with different types of land cover are summarized in Table 5-1.

Table 5-1 Manning's Roughness Coefficients for the Haegler Ranch Drainage Basin

Land Surface Type	Manning's Roughness Coefficients
Channel	
Grass swale	0.055
Grass-lined ditch	0.032
Sand bed	0.025
Floodplain	
Grass	0.065
Trees	0.150
Light Brush	0.074
Brush	0.100
Earth	0.038
Asphalt / Concrete	0.020

Notes:
[1]Source: Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains by the USGS (WSP 2339).

5.7. Cross-sections

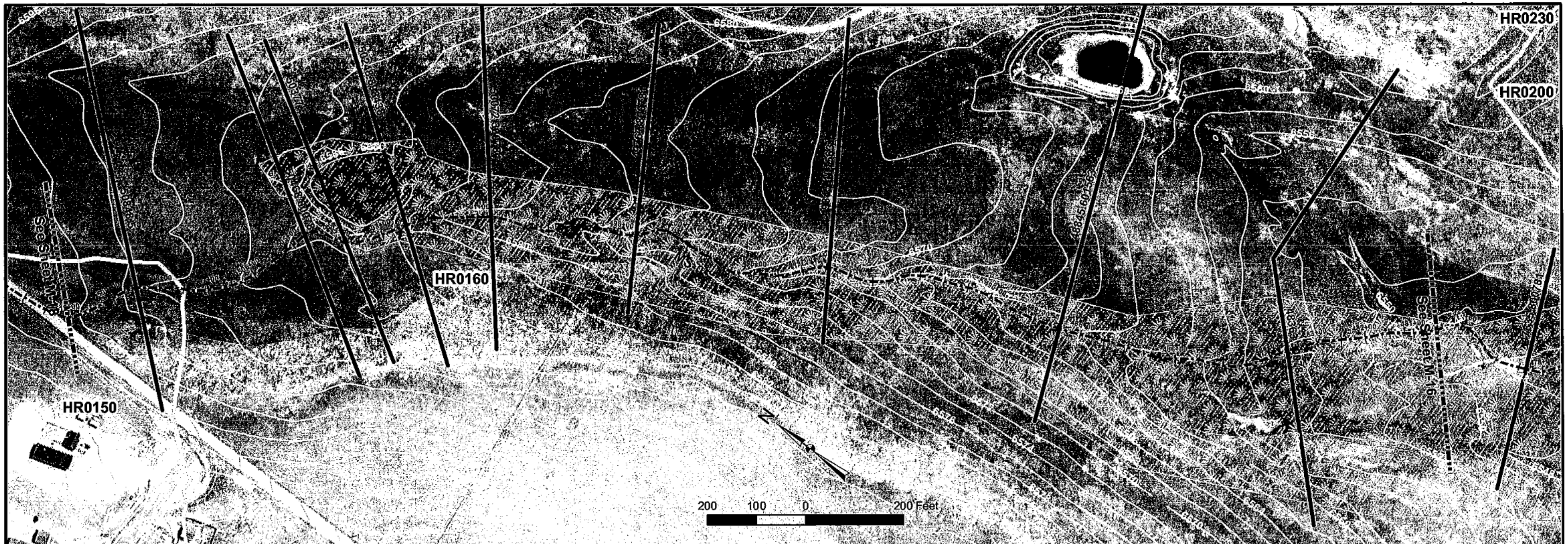
Hydraulic cross-sections were initially placed approximately 500-ft apart along reaches, and additional cross-sections were added to represent confluences, road crossings and changes in channel form. Cross-sections were automatically stationed from downstream to upstream along the reacb. Each cross-section was adjusted to extend across the entire floodplain and was placed perpendicular to the anticipated direction of flow in both the main channel and left/right overbanks. The cross-sections were bent in some locations to meet this requirement, as described in Chapter 3 of HEC-RAS Hydraulic Reference Manual (Version 3.1, November 2002).

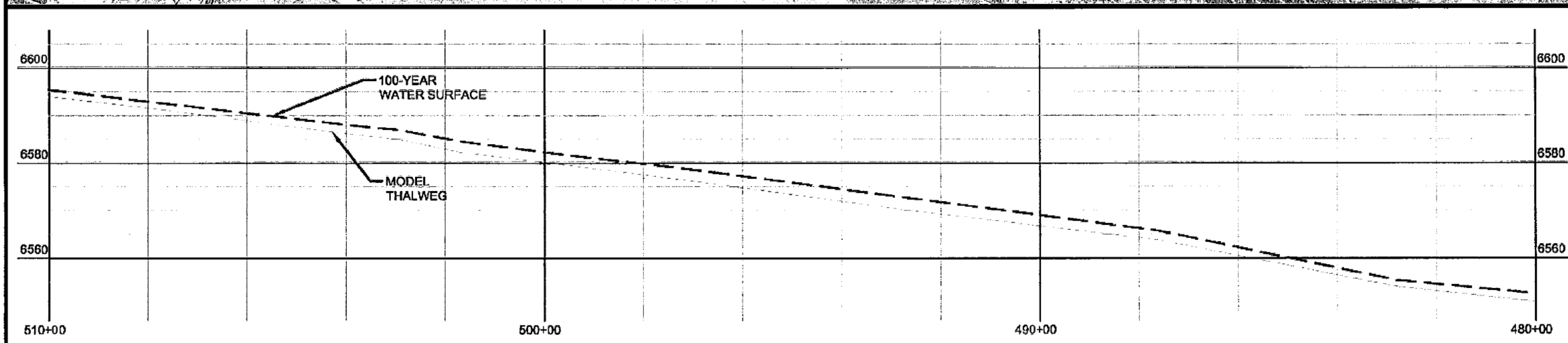
Additional cross-sections were added at structures such as bridges and culverts. At eacb structure, four cross-sections were added to the HEC-RAS model. These four cross-sections included an upstream cross-section prior to flow contraction, a cross-section at the upstream face of the structure, a cross-section at the downstream face of the structure, and a downstream cross-section where flow is fully expanded. All bridge and culvert crossings were field surveyed to determine their size, inverts, and material.

Expansion and contraction coefficients were estimated based on the ratio of expansion and contraction of the effective flow area in the floodplain occurring at cross-sections and at roadway crossings. For subcritical flow conditions and wbere tbe change in the stream cross-section was gradual, contraction and expansion coefficients of 0.1 and 0.3, respectively, were used. Wherever the change in effective

Table 5-4 Existing Conditions HEC-RAS Model

Key Location	Reach and Station	HEC-RAS Result	Recurrence Intervals			
			2-yr	5-yr	10-yr	100-yr
Main stem at US 24	MS-06 72276	Channel velocity (ft/sec)	1.1	1.63	1.98	2.92
		Water surface depth in channel (ft)	1.36	2.44	3.24	6.49
		Top width (ft)	18.23	24.85	29.7	255.62
Main stem at Judge Orr Road	MS-06 67666	Channel velocity (ft/sec)	3.33	4.09	1.76	3.48
		Water surface depth in channel (ft)	0.52	1.04	1.05	1.35
		Top width (ft)	174.53	534.34	535.52	569.34
Main stem at Falcon Highway	MS-05 52353	Channel velocity (ft/sec)	1.05	1.6	2.04	3.59
		Water surface depth in channel (ft)	1.79	3.69	4.96	5.74
		Top width (ft)	31.42	83.76	556.41	592.33
Main stem at Jones Road	MS-03 33189	Channel velocity (ft/sec)	2.45	3.7	1.27	2.51
		Water surface depth in channel (ft)	3.2	5.83	9.25	10.46
		Top width (ft)	47.98	105.51	580.28	667.17
Main stem at Peyton Highway	MS-02 18474	Channel velocity (ft/sec)	0.16	0.4	0.59	1.43
		Water surface depth in channel (ft)	4.14	4.35	4.51	5.15
		Top width (ft)	813.21	871.68	882.22	925.27
Southeast Tributary at Jones Road	T1 22297	Channel velocity (ft/sec)	0.62	1.02	1.47	3.2
		Water surface depth in channel (ft)	2.45	3.52	3.59	3.82
		Top width (ft)	197.35	345.68	351.74	372.17
Southeast Tributary at Peyton Highway	T1 16611	Channel velocity (ft/sec)	1.67	2.25	2.65	4.05
		Water surface depth in channel (ft)	0.08	0.17	0.24	0.51
		Top width (ft)	239.82	241.36	242.51	247.41
Southeast Tributary at Confluence with Main stem	T1 410	Channel velocity (ft/sec)	3.44	0.11	0.18	0.67
		Water surface depth in channel (ft)	1.69	2.01	2.01	2.01
		Top width (ft)	31.89	1169.3	1169.3	1169.3
At Confluence with Geick Basin	MS-01 82	Channel velocity (ft/sec)	2.68	3.85	19.89	17.33
		Water surface depth in channel (ft)	1.45	2.17	1.11	2.36
		Top width (ft)	75.88	255.32	60.67	262.84





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Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

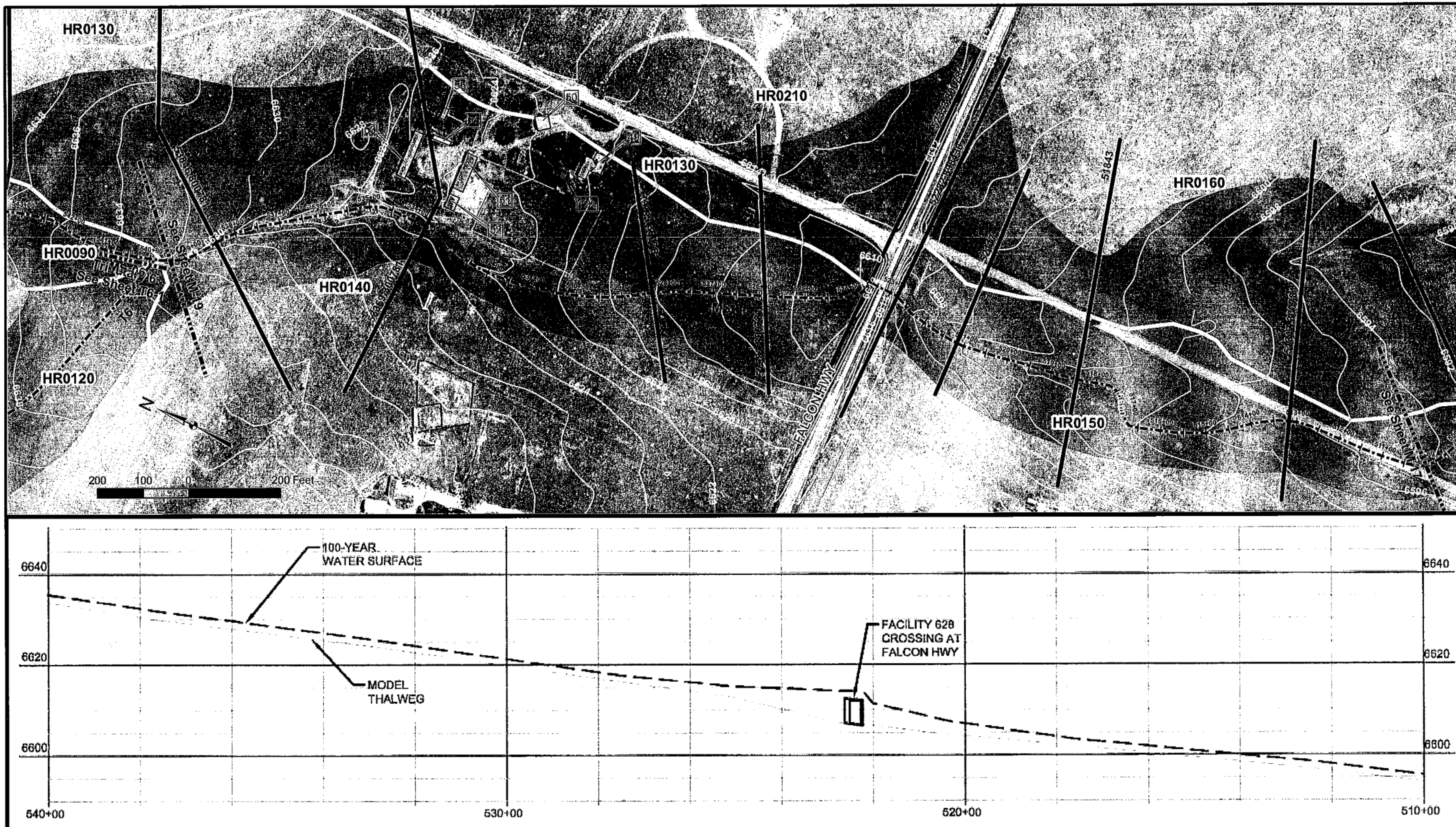
HAEGLER RANCH DRAINAGE BASIN

APPROXIMATE 100-YEAR FLOOD LIMITS

SHEET M-17

FIGURE 5-4

URS NO. 21711039



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Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

HAEGLER RANCH DRAINAGE BASIN

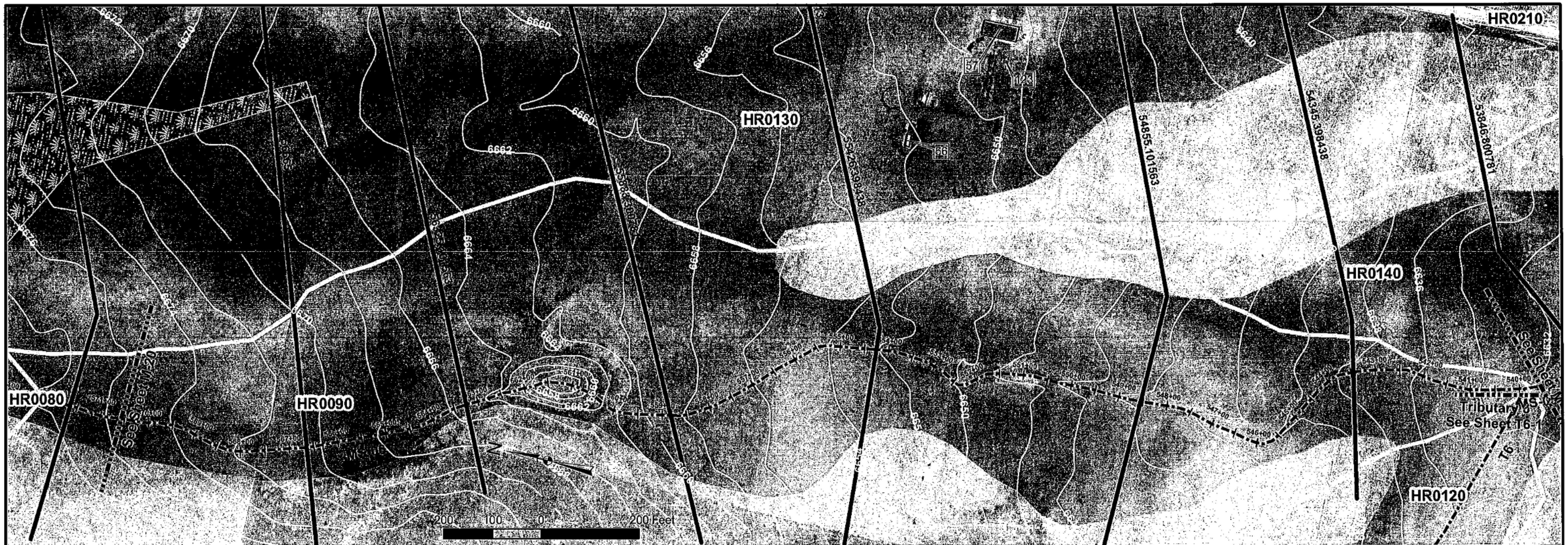
APPROXIMATE 100-YEAR FLOOD LIMITS

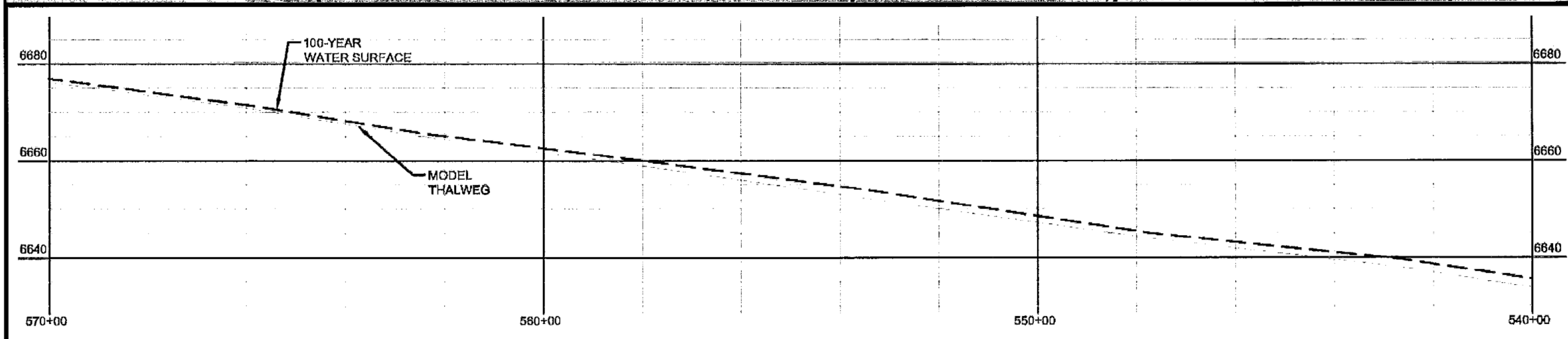
SHEET M-18

FIGURE 5-4

DATE: 05/08

URS NO. 21711039





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Potential Wetlands	Thalweg
Subbasin Boundaries	Cross Sections
Approximate 100-Year Floodplain	2' Contours

DATE: 05/08

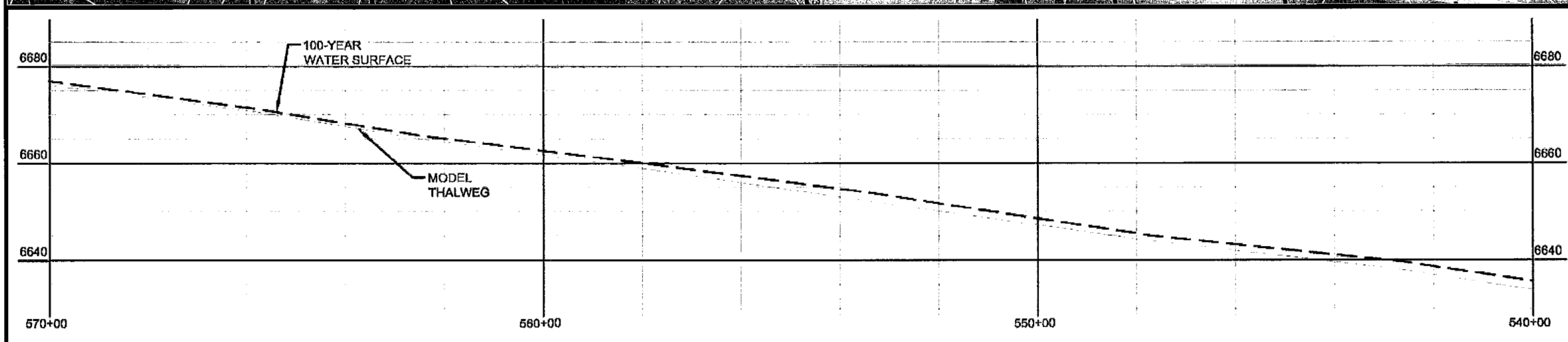
HAEGLER RANCH DRAINAGE BASIN

APPROXIMATE 100-YEAR FLOOD LIMITS

SHEET M-19

FIGURE 5-4

URS NO. 21711039



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Potential Wetlands

Subbasin Boundaries

Approximate 100-Year Floodplain

Thalweg

Cross Sections

2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN

APPROXIMATE 100-YEAR FLOOD LIMITS

SHEET M-19A

FIGURE 5-4

URS NO. 21711039

Table 6-8 Subregional Detention Pond Summary

Pond	Size (AF)	Peak Inflow (cfs)		Peak Outflow (cfs)	
		2-yr	100-yr	2-yr	100-yr
SR-01	10	100	320	8	90
SR-02	5	14	300	3	250
SR-03	16	210	640	29	530
SR-04	25	200	1120	33	740
SR-05	24	76	570	9	250
SR-06	9	14	180	1	20
SR-07	5	6	140	1	88
SR-08	5	23	240	15	210
SR-09	20	50	430	3	66
SR-10	23	85	860	23	600
SR-11	2	3	70	1	61
SR-12	9	19	140	1	35
SR-13	3	12	120	6	110

Subregional ponds have been sized using the hydrograph routing method described above. In this alternative, all proposed channels and culverts are sized for the existing 100-year peak flow rates, except within proposed developments where it is necessary to provide conveyance for developed flow rates. Flood impacts for the 100-year peak flow downstream of the subregional, full spectrum detention ponds will not increase.

6.3.2.1. Channels

In this alternative, only channel improvements through proposed developments are included, unless an area is undersized for existing conditions. Existing deficiencies are the responsibility of the current land owner or the County, and not the developer, and corrective measures for existing deficiencies are not included in the cost estimates. Proposed channel improvements along the corresponding reaches are summarized in Table 6-9.

Table 6-9 Channel Design for Subregional Detention Alternative

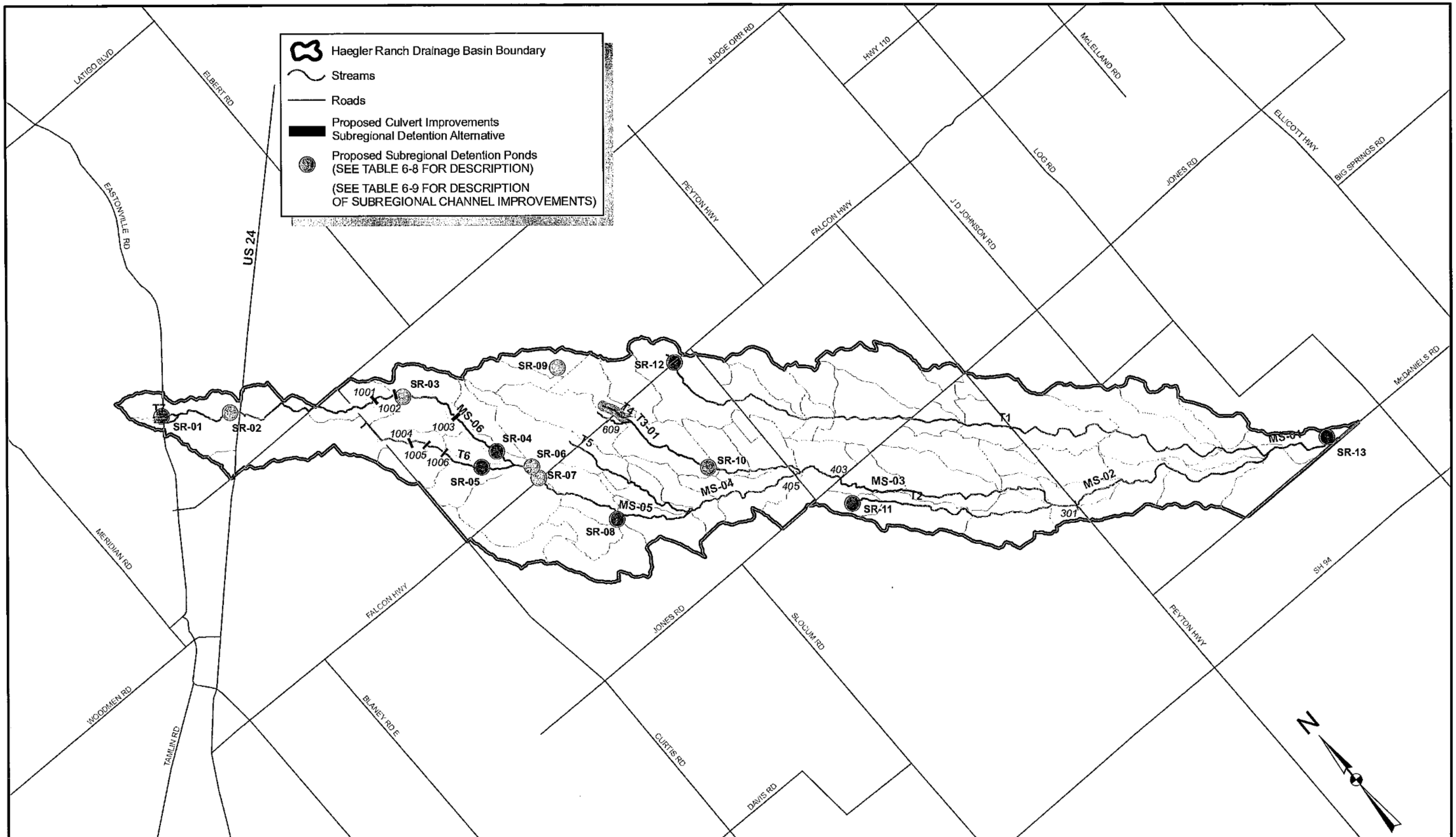
Channel	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Material
Main Stem (MS-05)	1460	1680	2000	1560	Grass
Main Stem (MS-06)	660	530	600	3120	Grass
Main Stem (MS-06)	720	970	1000	4535	Grass
Main Stem (MS-06)	750	740	800	3190	Grass
Tributary 3 (T3-01)	600	600	600	5000	Grass
Tributary 3 (T3-02)	220	500	500	420	Grass
Tributary 4 (T4)	220	500	500	940	Grass
Tributary 6 (T6)	200	440	500	4280	Grass
Tributary 6 (T6)	240	250	300	1400	Grass

6.3.2.2. Culverts

As with the channels, only the culverts through proposed developments will be effected unless an area is undersized for existing conditions. Any existing deficiencies in the roadway culverts are the responsibility of the County and not the developer, and required culvert improvements are not included in the cost estimates for the alternative. Proposed culvert improvements are summarized in Table 6-10.

Table 6-10 Culvert Design for Subregional Detention Alternative

Facility Number	Road Crossing	Channel	Proposed 100-yr Flow (cfs)	Deficiency	Necessary Facility for Proposed 100-year Flow
301	Peyton Highway	Main Stem (MS-02)	3,370	Overtops	9-6'X6' RCBs
403	Jones Road	Main Stem (MS-03)	2,970	Overtops	8-6'X6' RCBs
405	Murr Road	Main Stem (MS-04)	2,870	Overtops	8-6'X6' RCBs
609	Falcon Highway	Tributary 3 (T3-02)	460	Overtops	2-6'X6' RCBs
1001	Future Pastura Street	Main Stem (MS-06)	930	Future Road	3-6'X6' RCBs
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	930	Future Road	3-6'X6' RCBs
1003	Future Arroyo Hondo Blvd. S.	Main Stem (MS-06)	1500	Future Road	4-6'X6' RCBs
1004	Future Pastura Street	Tributary 6 (T6)	440	Future Road	2-66" RCPs
1005	Future El Vado Road	Tributary 6 (T6)	440	Future Road	2-66" RCPs
1006	Future Socorro Trail	Tributary 6 (T6)	440	Future Road	2-66" RCPs



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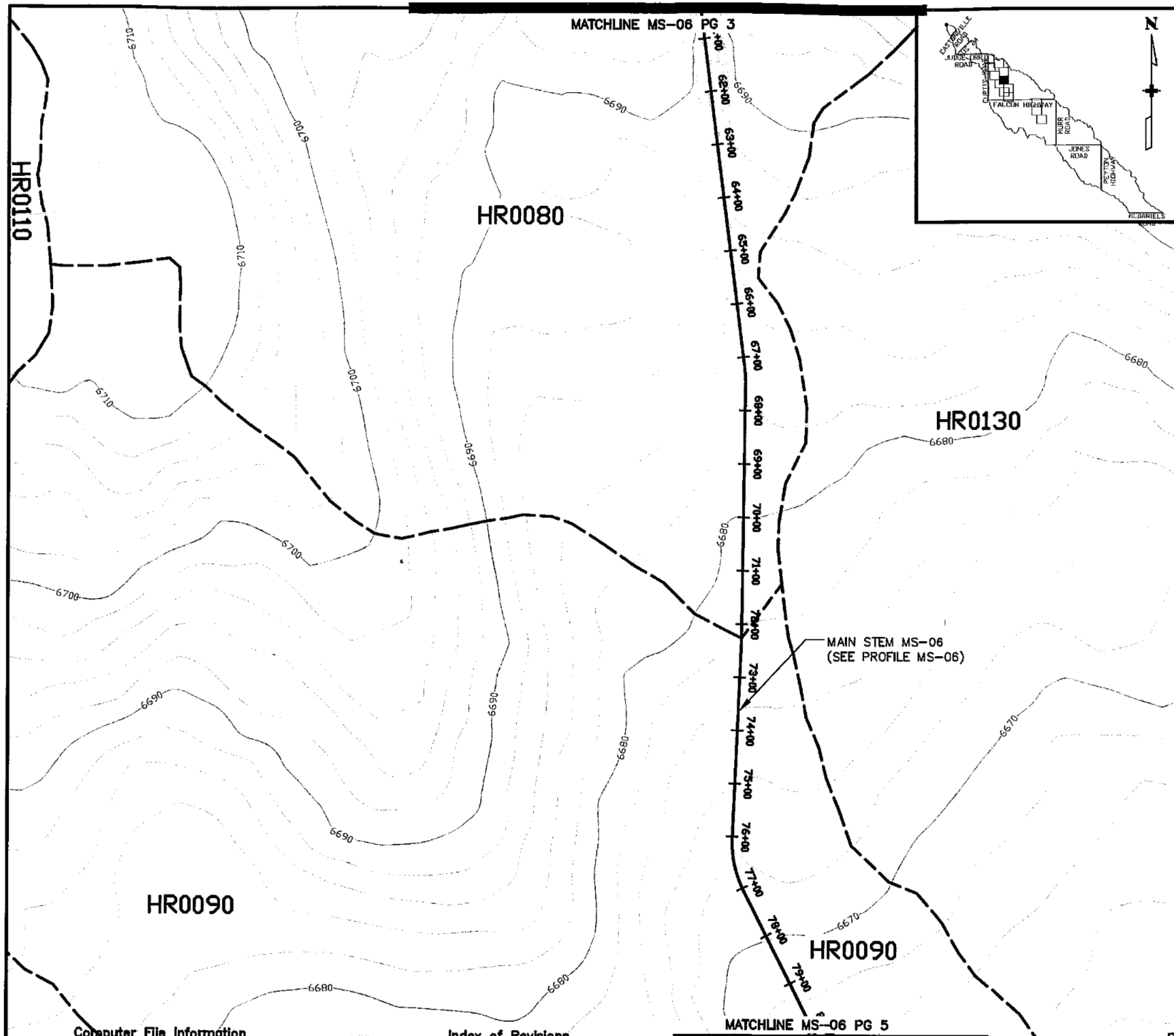
5,000 2,500 0 5,000 Feet
1" = 5,000'

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
SUBREGIONAL DETENTION ALTERNATIVES
FIGURE 6-2

URS NO. 21711039



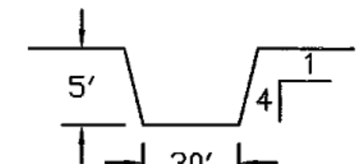
LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

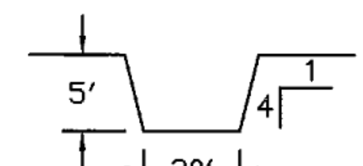
CHANNEL: MAIN STEM (MS-06)
BASIN: HR0080



STA: 31+34 TO STA: 74+61

Q: 1000 CFS

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0090



STA: 74+61 TO STA: 103+62

Q: 800 CFS

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Acad. Ver. 2006 Scale: 1"=200'	Units: Feet		Checked by: JAJ

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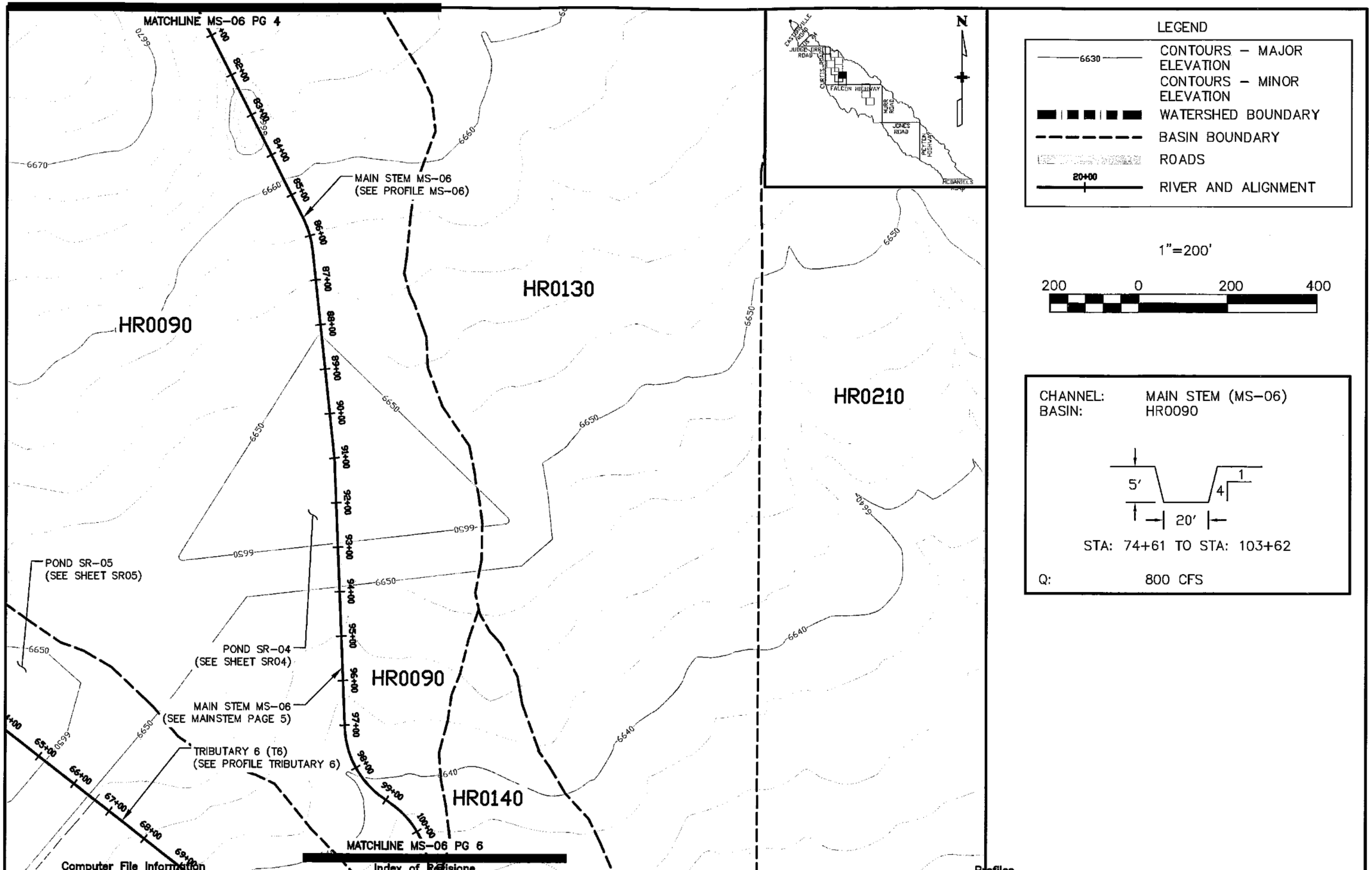
Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 4



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Index of Revisions

Profiles

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Detailed by:	DRM
Checked by:	JAJ

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 5

MS-06 HR0080

SLOPE = 0.60%

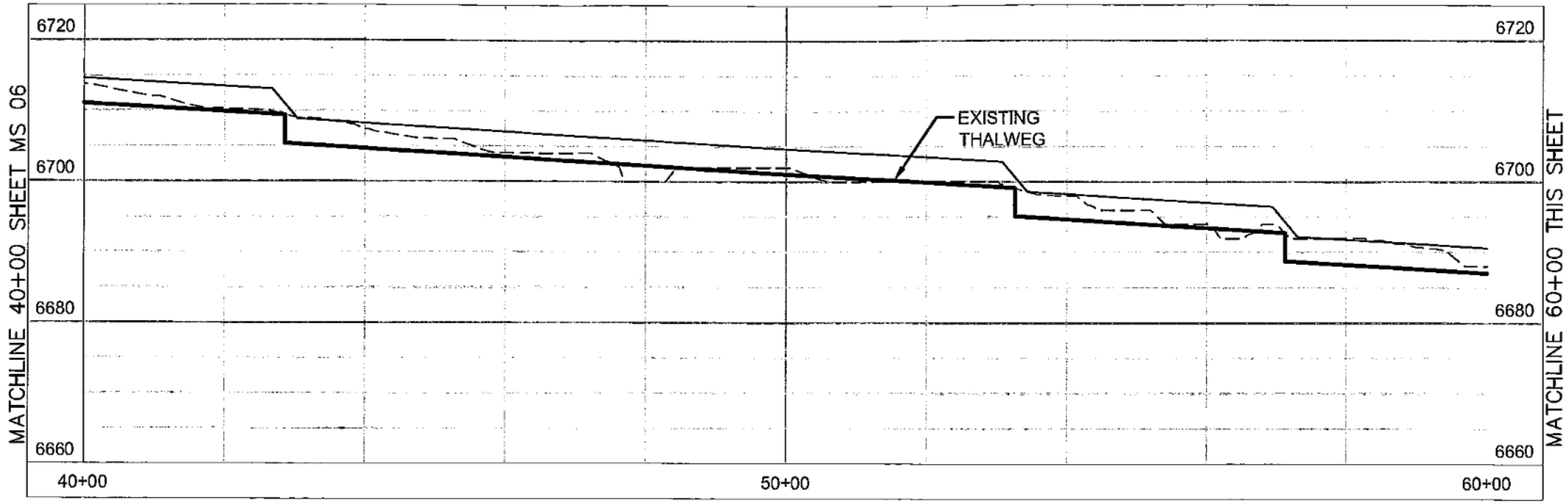
(7) 4' DROPS

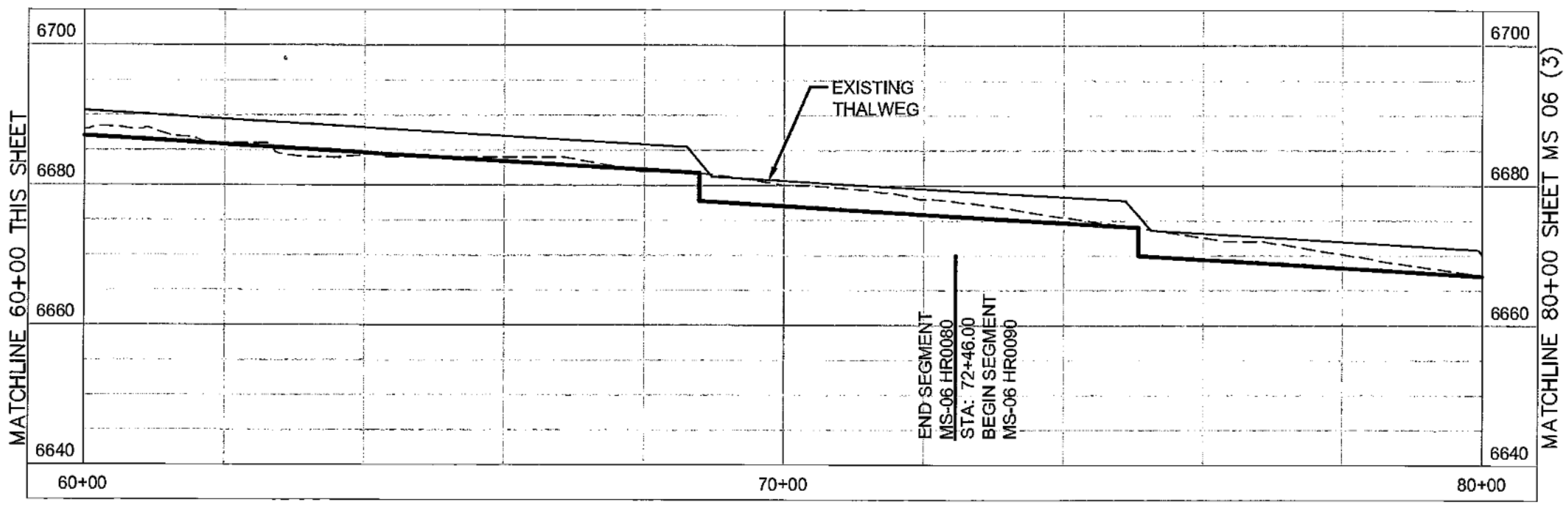
MS-06 HR0090

SLOPE = 0.60%

(8) 4' DROPS

PROFILE MAIN STEM (MS-06 & MS-05)





LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information	Index of Revisions				Profiles			
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Drawing File Name: MAINSTEM PROFILES_PROPOSED.DWG				Detailed by: DRM			
Acad. Ver. 2006 Scale: 1"=20' Units: Feet				Checked by:			Sheet Number MS06 (2)

MS-06 HR0090

SLOPE = 0.60%

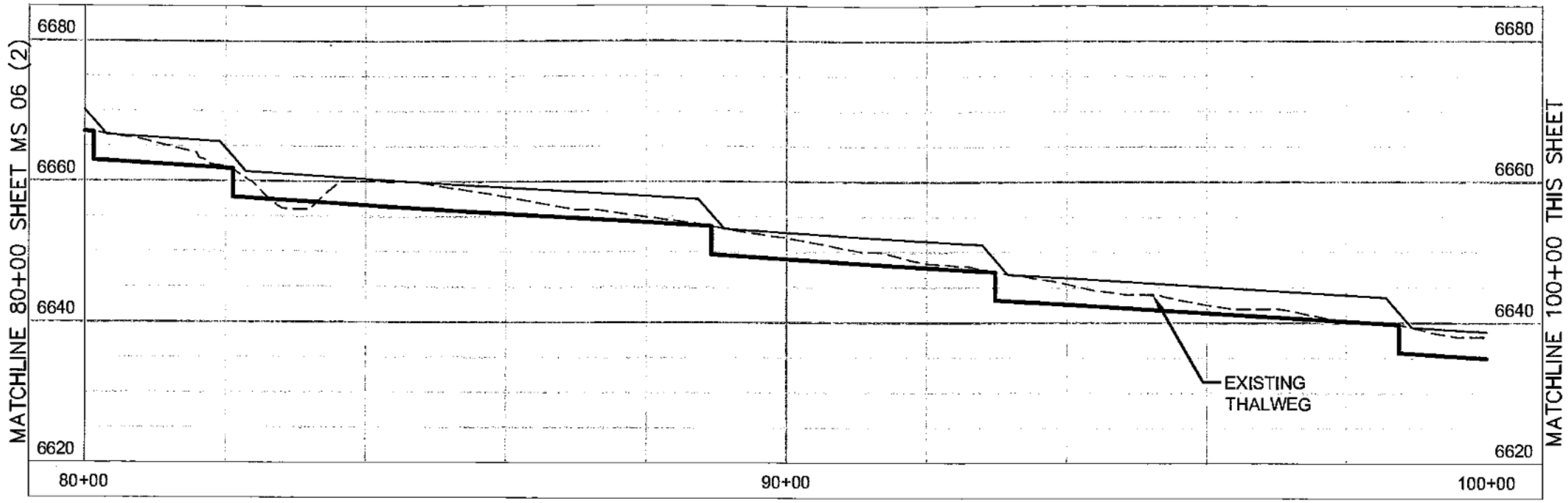
(8) 4' DROPS

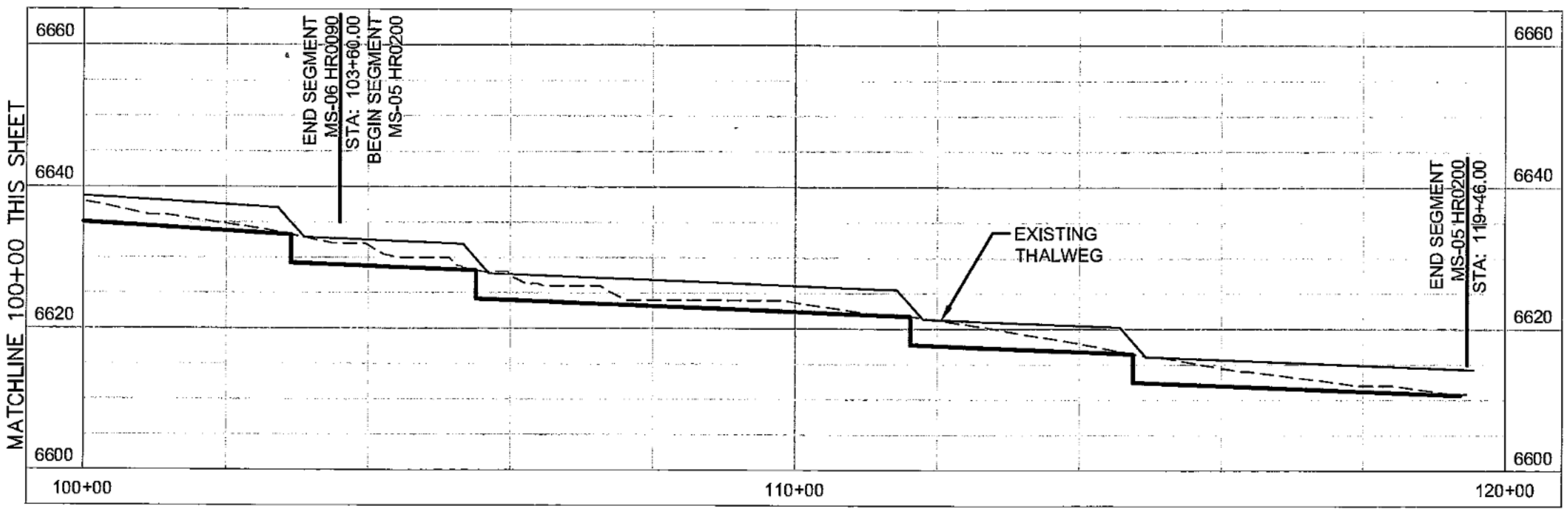
MS-05 HR0200

SLOPE = 0.40%

(4) 4' DROPS

PROFILE MAIN STEM (MS-06 & MS-05)





LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

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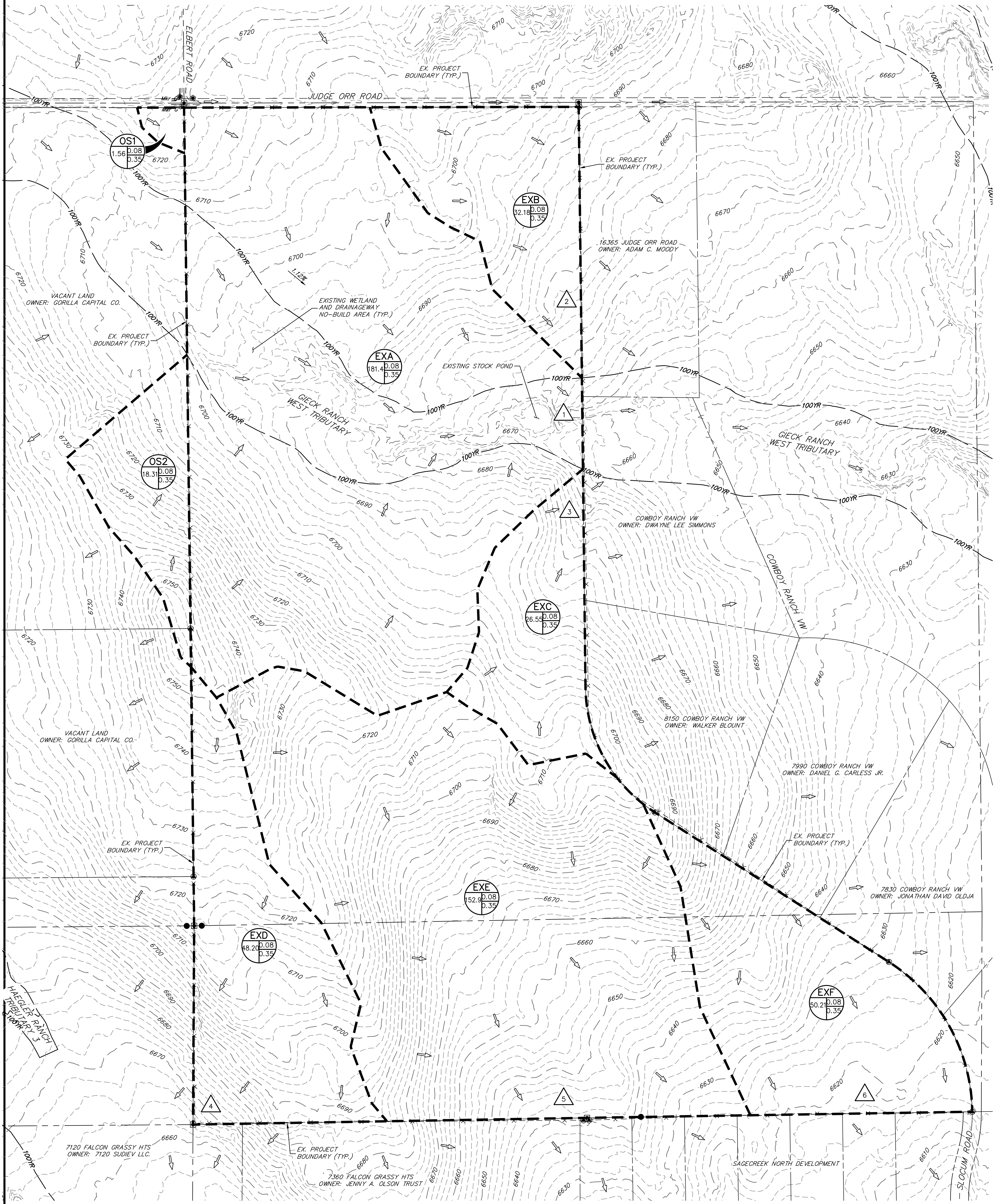
Detailed by: DRM			
Checked by:			Sheet Number MS06 & MS05 (3)

APPENDIX F

DRAINAGE MAPS

ESTEBAN RODRIGUEZ SUBDIVISION-SKETCH PLAN
EXISTING DRAINAGE MAP



LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
CURB & GUTTER		
FEMA FLOODPLAIN	100YR	100YR
SUB-BASIN DRAINAGE AREA		

BASIN TAG: BASIN ID #; AREA [AC] #.#; C_{100} #; C_5 #

DESIGN POINT DESIGNATION (1)

FLOW DIRECTION (EXISTING)   FLOW DIRECTION (PROPOSED)

N

300 150 0 300 600

ORIGINAL SCALE: 1" = 300'

EXISTING DRAINAGE MAP
ESTEBAN RODRIGUEZ SUBDIVISION-SKETCH PLAN
JOB NO. 25277.00
07/10/2023
SHEET 1 OF 1

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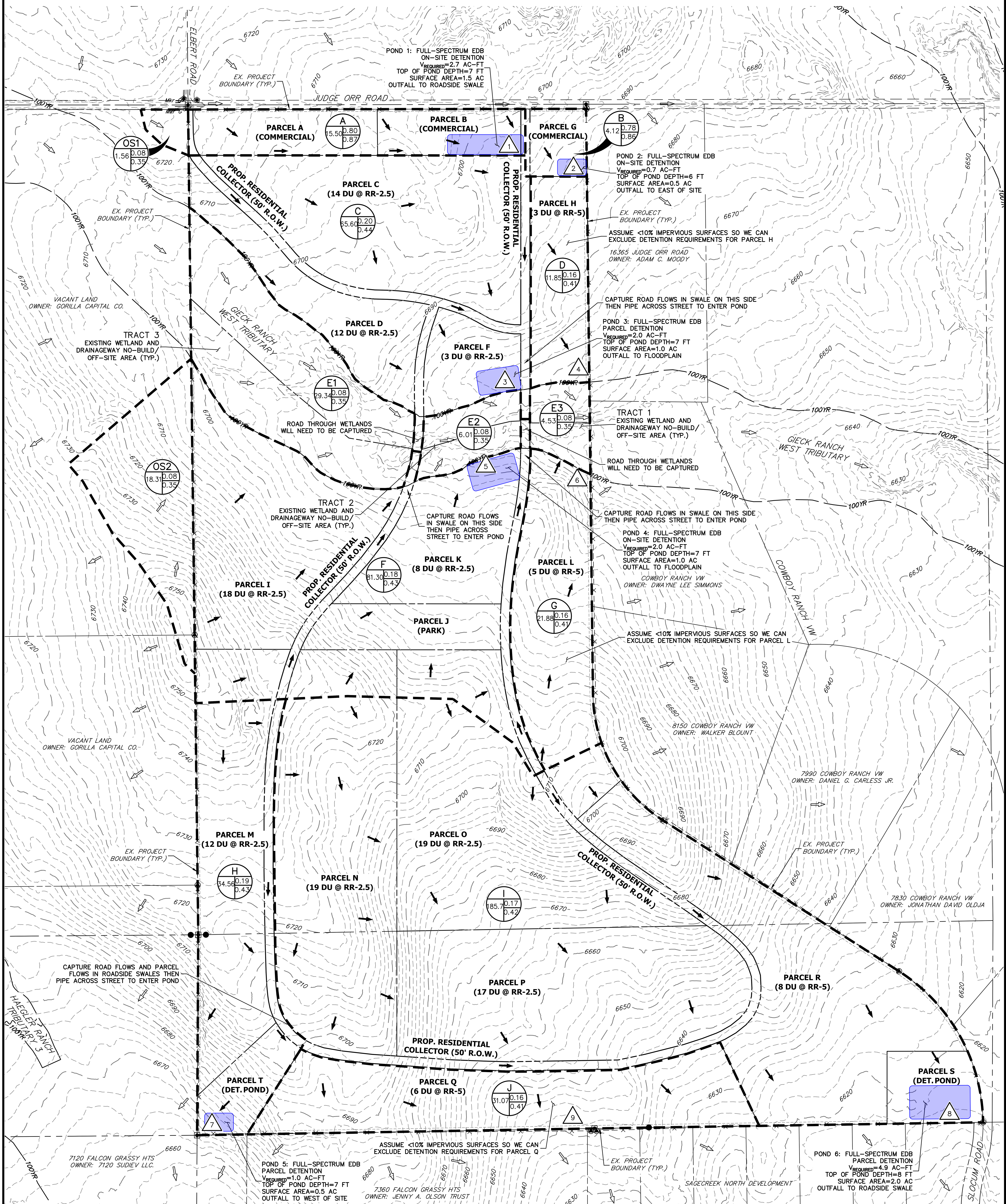
ESTEBAN RODRIGUEZ SUBDIVISION-SKETCH PLAN
PROPOSED DRAINAGE MAP



LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
CURB & GUTTER		
FEMA FLOODPLAIN	100YR	100YR
SUB-BASIN DRAINAGE AREA		

BASIN TAG: BASIN ID, AREA [AC], C_{100}, C_5

DESIGN POINT DESIGNATION

FLOW DIRECTION (EXISTING) FLOW DIRECTION (PROPOSED)

300 150 0 300 600
ORIGINAL SCALE: 1" = 300'

PROPOSED DRAINAGE MAP
ESTEBAN RODRIGUEZ SUBDIVISION-SKETCH PLAN
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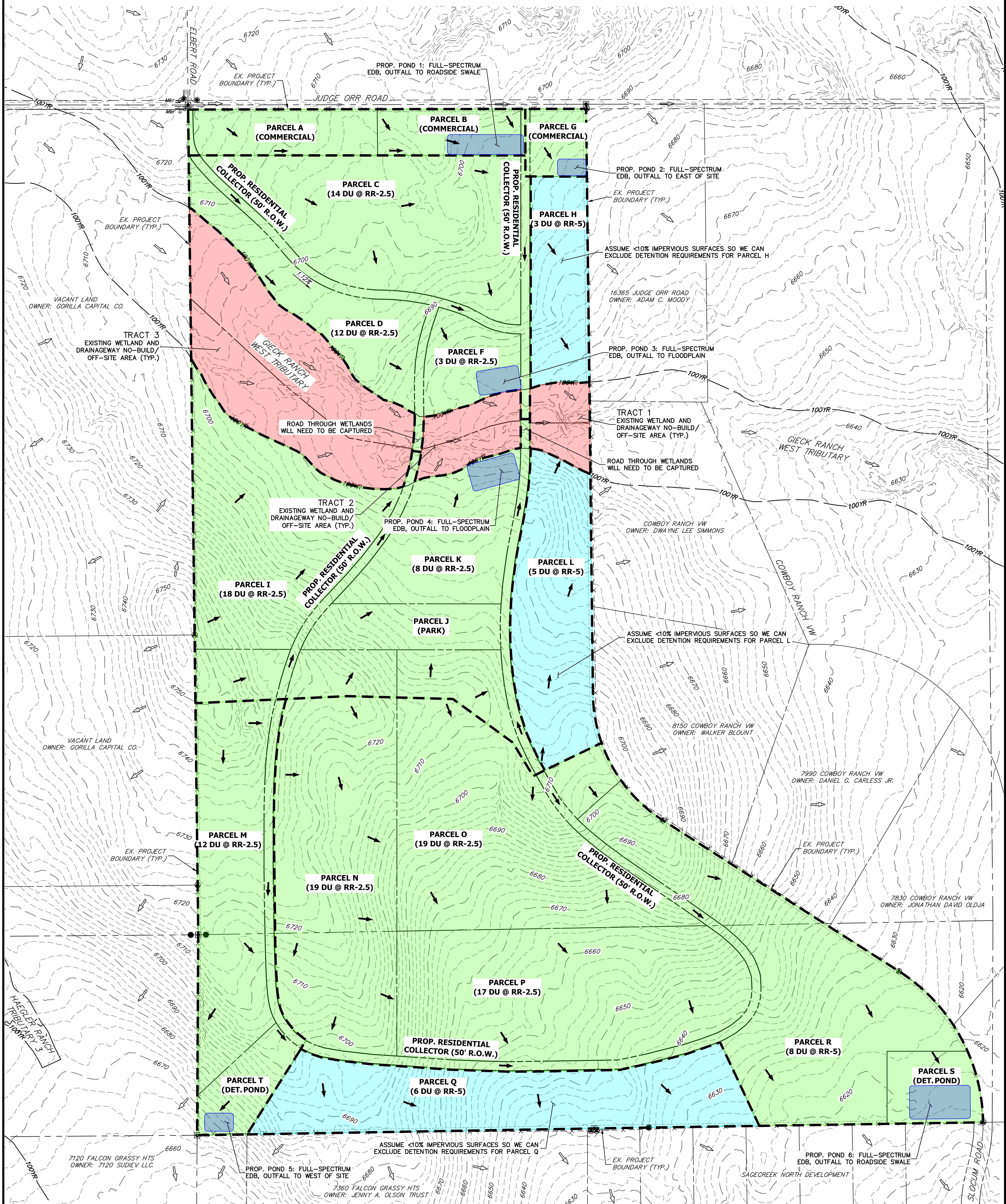
ESTEBAN RODRIGUEZ SUBDIVISION-SKETCH PLAN
PROPOSED WATER QUALITY MAP



LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
CURB & GUTTER		
SUB-BASIN DRAINAGE AREA		
	FLOW DIRECTION (EXISTING)	FLOW DIRECTION (PROPOSED)
FEMA FLOODPLAIN	100YR	100YR

- LARGE-LOT SINGLE FAMILY DEVELOPMENT UNDETAINED AREA
- EXISTING FLOODPLAIN NO PROPOSED BUILD UNDETAINED AREA
- DETAINED AND TREATED AREAS WITHIN PROPOSED EDB'S
- APPROXIMATE EDB FOR DETENTION AND WATER QUALITY

N

300 150 0 300 600

ORIGINAL SCALE: 1" = 300'

PROPOSED WATER QUALITY MAP
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