Aquatic Resources Delineation Report

Bridge M-22-U

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Executive Summary

Stanley Consultants, Inc. (Stanley) has prepared an aquatic resources delineation for the proposed replacement of a bridge structure on U.S. Highway (US) 350 about 3 miles southwest of La Junta, Colorado, known as the M-22-U Bridge Replacement Project (Project). The purpose of the delineation is to identify any wetlands and potential waters of the U.S. (WOTUS) with the potential to be impacted by Project activities. The delineation was conducted in accordance with the 1987 Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) and the Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0) (U.S. Army Corps of Engineers [USACE] 2010).

This delineation reports on the finding at the CDOT bridge M-22-U survey area (11.2 acres), where the OHWM for an intermittent drainage (R4SB5Cx: 0.33 acres and 1,310 linear ft) was identified. The drainage is known as the Otero Canal (or called the Otero Irrigation Ditch by the Otero Ditch Company that manages this feature), an irrigation canal excavated in uplands that is supplied with water from the Arkansas River. No wetlands were identified in the survey area.

The delineation findings presented in this report will be used to assess potential Project impacts to surface water resources. The findings may be used to develop Project designs that minimize or avoid impacts to surface waters or, if impacts to surface waters are unavoidable, to understand the total anticipated impacts that would need to be approved or permitted by the USACE. Depending on the level of impacts, the Project would likely require permitting under the Nationwide Permit (NWP) program or through an Individual Permit (IP). The NWP program is available for projects with relatively minor impacts (the exact nature of the impacts and acreage thresholds depend on the applicable NWP), while IPs are required for projects with larger impacts and can involve a lengthy permitting process.

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Acronyms and Abbreviations

CDOT	Colorado Department of Transportation
CO	Colorado State Highways
CWA	Clean Water Act
MP	Mile Post
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
NWP	Nationwide Permit
NWPL	National Wetland Plant List
OHWM	ordinary high water mark
PSS	palustrine scrub-shrub
ROW	right-of-way
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WOTUS	Waters of the United States

1. Introduction

On behalf of Colorado Department of Transportation (CDOT), Stanley Consultants, Inc. (Stanley) has prepared an aquatic resources delineation for the proposed replacement of a bridge structure on U.S. Highway (US) 350 about 3 miles southwest of La Junta, Colorado, known as the M-22-U Bridge Replacement Project (Project). The purpose of the delineation is to identify any potential waters of the U.S. (WOTUS) and/or wetlands, present within the area of potential Project impacts.

The presence of wetlands and other waters were assessed within the vicinity of the proposed Project construction. The boundaries of potential WOTUS were then delineated to determine the extent of waters subject to regulation under the Clean Water Act within the area of potential Project impacts. The purpose of this delineation report is to facilitate efforts to:

- Avoid or minimize impacts to aquatic resources during the design process.
- Document aquatic resource boundary determinations for review by regulatory authorities.

Field investigations were conducted on August 26, 2020, by wetland biologists for Stanley Consultants, Inc.

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2. Location and Project Description

2.1 Location

The surveyed Potential Impact Area (PIA) is based on the area of potential Project-related impacts per communications with Project engineers and is approximately 11.2 acres. The PIA includes the CDOT right-of-way (ROW), along with an expanded limit of disturbance to account for a possible detour or other work. The existing concrete-on-I-beam bridge is located approximately 3 miles southwest of La Junta (37.954765/-103.589936), in Section 17, Township 24S, Range 55W (6th Principal Base and Meridian). A map of the PIA is located in the Aquatic Resources Delineation Map in Appendix A.

2.2 Purpose and Need

The concrete on I-beam bridge (Structure M-22-U) was built in 1935 on US 350 which is a key north-south corridor connecting residents and tourists from La Junta, Colorado and the Arkansas River Valley to Trinidad and the Rocky Mountains. The structure is in poor condition, requiring frequent inspection and repair from issues such as cracking and spalling of the abutments and deterioration of the decks with extensive cracking, efflorescence, and exposed aggregate. This bridge is well past its replacement life and is not up to current construction and safety standards and must be replaced to prevent potential failure.

2.3 Project Description

The CDOT Region 2 Bridge Bundle Design Build Project consists of the replacement of a total of nineteen (19) structures bundled together as a single design-build project. These structures are rural bridges on essential highway corridors (US 350, US 24, Colorado State Highway [CO] 239 and CO 9) in southeastern and central Colorado. These key corridors provide rural mobility, intra- and interstate commerce, movement of agricultural products and supplies, and access to tourist destinations. The design build project has two funding sources; Bridge M-22-U will be jointly funded by the USDOT FHWA Competitive Highway Bridge Program grant and the Colorado Bridge Enterprise (Project No. 23558).

Bridge M-22-U is located on US 350 at milepost 69.817, approximately 3 miles southwest of La Junta, Colorado. This structure is a concrete on I-beam bridge (single span 33 feet [ft] wide, 44 ft long) structure that crosses over an historic irrigation canal, the Otero Canal (most recently renamed the Otero Irrigation Ditch by the Otero Ditch Company that manages this feature). The Project will replace this bridge with a similarly sized concrete and steel bridge, or a concrete box culvert. The size of the new crossing will be coordinated with the State Historic Preservation Office and the Otero Ditch Company.

As stated by the CDOT grant application, the roadway shall not be closed for construction. Two other alternatives were investigated:

Alternative 1: Phasing the constructions to keep one lane open. This alternative would be required to meet all typical CDOT roadway phased construction criteria. The width of the proposed structure is contingent upon the girder type and width, which would vary for the alternative described below.

Alternative 2: Building a two-lane shoofly on one side of the existing bridge with a temporary pipe placed for drainage. The irrigation ditch currently runs parallel to US 350 on both sides. A shoofly would have temporary impacts to the irrigation canal.

Alternative 1 was identified as a preferred traffic alternative for this structure. More information on traffic detour options can be found in the Traffic Design Memorandum for this structure. Once the bridge is complete and ready for use, any disturbed areas will be restored to original contours and reseeded.

2.4 Directions to the Site

The PIA is accessible from Pueblo, Colorado, by taking the I-25 N exit towards Colorado Springs. At the interchange with US 50 and I-25, take US 50 E towards La Junta, Colorado. Travel east on US 50 for 64 miles until US 50 intersects with US 350 in La Junta. Turn right to travel south for 3.5 miles until reaching Structure M-22-U. Parking is available south of the bridge near the intersection with US 350 and County Road Y.

3. Methods

3.1 Regulatory Context

Section 404 of the Clean Water Act (CWA) regulates the discharge of dredged or fill material into WOTUS and is administered by the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA). The definition of WOTUS has been in flux in recent years, with the latest definition published by the EPA in the Navigable Waters Protection Rule, which went into effect on June 22, 2020, in 49 states. Due to an injunction issued by a federal court in Colorado, the Navigable Waters Protection Rule has not gone into effect in Colorado, and instead the state remains under the post-*Rapanos v. United States* (Rapanos) guidance (USACE and EPA 2008). The potential for WOTUS within the PIA therefore will be evaluated per the definition in the the Rapanos guidance. Since the WOTUS definition under Rapanos is more expansive than the Navigable Waters Protection Rule, assessing the PIA under Rapanos ensures that no additional revaluation is likely to be required in the event CWA applicability changes in Colorado during the period of Project construction.

The Rapanos guidance defines WOTUS as traditional navigable waters (TNWs), relatively permanent waters, and their adjacent wetlands.[1] Additionally, the Rapanos guidance includes all tributaries with a bed and bank or ordinary highwater mark (OHWM) that have a significant nexus to a Traditionally Navigable Water, as well as wetlands, ponds, impoundments, and lakes located adjacent to said tributaries. Under Section 404 of the

[1] Adjacent is defined as “bordering, contiguous, or neighboring” in the Rapanos guidance.

CWA, the OHWM defines the lateral extent of federal jurisdiction in non-tidal WOTUS (absent adjacent wetlands) (33 U.S.C. 1251). Per the regional guidance developed by the Corps (Mersel and Lichvar 2014), OHWM in Colorado is considered to be the "physical and biological signature established and maintained at the boundaries of the active channel." Mersel and Lichvar (2014) state the OHWM identification in non-perennial streams is based on three primary physical or biological indicators—topographic break in slope, change in sediment characteristics, and change in vegetation characteristics.

3.2 Wetland Delineation

All wetland delineations were conducted in accordance with the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) and the Regional Supplement to the *Corps of Engineers Wetlands Delineation Manual: Great Plains Region (Version 2.0)* (USACE 2010). Survey areas were assessed by the Project team to determine the presence or absence of wetland features. Locations that contained some potential as a wetland based on surface conditions such as the presence of dominant hydrophytic vegetation or surface hydrology were investigated more closely with a sampling point containing a soil pit, a delineation field form, and photo documentation.

Sources of information used in this Aquatic Resources investigation could include:

- Web Soil Survey – See Appendix B, Custom Soil Resource Report.
- Aerial photography of the PIA from the National Agriculture Imagery Program (NAIP) taken in 2017, and from aerial drone photography collected by Stanley.
- National Wetland Plant List, version 3.4 (USACE 2018)
- Munsell Soil-Color Charts (Munsell Color 2009)
- National Wetland Inventory (NWI) Map – See Appendix B, NWI Mapping)

3.3 Non-Wetland Waters Delineation

Delineations of non-wetland waters were conducted using the *Updated Datasheet for the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States* (Curtis and Lichvar 2010). The project specific PIA was examined for any potential OHWM supporting features, such as root exposure, water staining, silt deposits, litter removal, etc. (Mersel and Lichvar 2014, USACE 2005), that might provide information interpreting recent flow levels (e.g., drift/wrack deposits or headcutting) or that might eliminate or reinforce potential OHWM locations. Stanley also examined aerial photography and hydrologic data to support the Section 404 CWA assessment. The boundaries of any non-wetland water features were identified by the OHWM indicators and recorded using a Trimble sub-meter GPS antenna connected to a tablet or smart phone.

4. Existing Conditions

4.1 Topography

The PIA is located in the eastern plains of Colorado including the Purgatoire River Valley and the Arkansas River Valley to the north. To the west is the foothills of the Front Range of the Rocky Mountains, and to the south and east is the Purgatoire River Valley. The elevation at the site is approximately 4,230±5 ft above sea level. Land use in the area is agricultural and rural residential, with the high-density residential area of La Junta, Colorado, starting approximately 2 miles to the northeast. The highway and bridge structure were constructed in 1935, with fill being built up for the roadway with a gap where the Otero Canal flows, and the bridge was constructed across the canal.

4.2 Climate

The PIA (as measured from La Junta, Colorado, the closest station with complete data) has an average maximum temperature of 69.4° F and average minimum temperature of 39.1° F. The average annual precipitation is 11.5 inches, with an average snowfall of 20.7 inches (CCC 2020a). Normal monthly precipitation average for August is 1.6 inches, but during this past August (when field investigations were conducted) the rainfall was measured at 0.38 inches, which is below normal (CCC 2020b).

4.3 NWI Mapping

National Wetlands Inventory (NWI) data indicated that no wetlands exist within the PIA, only one water classified as riverine (see Appendix B, Supporting Maps, NWI Mapping).

4.4 Plant Communities

The plant communities in the PIA consisted of irrigation ditch edges and disturbed roadway edges (See Appendix C for the full plant list of species recorded). The irrigation ditch edges include a mix of upland and riparian bank species such as wild ryes (*Elymus* spp.), sunflower (*Helianthus annuus*, FACU), great ragweed (*Ambrosia trifida*, FAC), curlytop knotweed (*Polygonum lapathifolium*, OBL), sedges (*Carex* spp.) and in places narrow-leaf willow (*Salix exigua*, FACW). Roadways were not extensively sampled but contained some of the same upland grass species found in the sample areas, along with other species likely seeded by CDOT or blown in from other upland areas.

4.5 Hydrology

The dominant hydrological feature at this site is the Otero Canal, but very little surface and sub-surface drainage flows into the canal as it is lined with debris casting excavated from the canal. The canal itself flows from the southwest to the northeast through the PIA, but it originates at a control structure on the Arkansas River just west of Fowler, Colorado, which is approximately 28 miles (direct) from M-22-U. The outlet for the canal appears to continue only another 3 miles to the east from the bridge, and then is split and eventually

ends in two different farm fields. However, it is possible that some excess flows may enter the King Arroyo, which does drain into the Arkansas River. The Arkansas River flows east then southeast to the Mississippi River and south to the Gulf of Mexico.

In the PIA, surface flows were not present as the canal was not flowing. However, the canal channel was damp and soft, as some late summer irrigation flows must have recently been moved through the canal.

4.6 Soils

Two soils were identified in the PIA (see Appendix B, Custom Soil Resource Report), Minnequa-Manvel silt loams, 1-6% slopes, dry, and Timpas silty clay loam, 1-3% slopes, and neither are considered hydric (NRCS 2020). As no wetland conditions were observed, no soil pits were investigated.

5. Aquatic Resource Results

OHWM data forms reflect the conditions as observed at the time of investigation and can be found in Appendix C. Associated photos of the sample points can be found in Appendix D. No soil sample points were taken, although an OHWM profile was conducted (Appendix C). The following subsections summarize the results of the delineation including a description of any waters delineated, justification for the boundaries, classification of the waters. Feature details are summarized in Table 1 (Aquatic Resources within the PIA).

Table 1. Aquatic Resources within the PIA

Aquatic Resource Name	Aquatic Resources Classification		Area (ac)	Length (ft)
	Cowardin	Location (Lat/Long)		
Non-Wetland Waters				
Otero Canal	R4SB5Cx	37.954837/-103.589770	0.33	1,310
		Totals	**0.33**	**1,310**

5.1 Otero Canal

The Otero Canal is an intermittent constructed drainage (0.33 acres and 1,310 linear ft) flowing through the PIA from the southwest to northeast. As the Otero Canal is a feature constructed in uplands used for agricultural irrigation, it has no watershed. Water to supply the canal is from the Arkansas River, with its upper most diversion located just west of Fowler, Colorado. Other diversions from the Arkansas River may also exist between Fowler and Manzanola, Colorado. After crossing under the M-22-U bridge, the canal appears to only be functional for another 3 miles or so before it appears to be split into one route apparently ending in a nearby farm field and the other continuing in a combination of excavated canal and eroded channel before ending in other field farther east. However, there is a chance some water from the canal, either unused or overflow, may find its way into the King Arroyo, which does flow into the Arkansas River. A more

detailed investigation on the ground and with the irrigation company would be needed to accurately determine the irrigation water's fate.

The canal channel through the PIA is a generally 9 to 10 ft wide, with steep, near vertical channel banks. The top of the banks are also steep, as over years of regular canal maintenance, canal spoils have been placed above the banks, forming a steep berm on either side of the canal. Bank vegetation is mostly along the upper part of the banks, but some of the wetland species (see above in Section 4.4 Plant Communities) persist farther down the banks where conditions are wetter due to irrigation water flows. No vegetation exists towards the bottom of the banks or in the middle of the channel because of strong flows. The OWHM was observed as a fully developed bed and bank with mud cracks, scour, debris wrack, and staining on the bridge abutments (see Appendix D: Photo Inventory). As the channel is maintained by the irrigation company, it is a fairly consistent width, though there is some widening around the bridge abutments, especially on the downstream side (see Figure 2: Aquatic Delineation Map). The channel was not flowing at the time of investigation, but the channel bottom was still damp and soft in places suggesting recent use of the canal.

6. Interstate Commerce

Federal authority to regulate waters within the United States is primarily derived from the Commerce Clause, which gives Congress the power to regulate interstate commerce. Section 404 of the Clean Water Act defines the limits of jurisdiction as encompassing navigable waters and WOTUS, including, among other water bodies, "waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce" (40 CFR § 120.2(1)(i)).

This irrigation canal feature, the Otero Canal, is believed to support instate commerce, as it supplies irrigation water to agricultural and/or ranching entities. However, whether the agricultural use of the water moved through this canal is involved in any interstate commerce, the replacement of the existing bridge with an updated structure to meet CDOT standards will not affect water flows or alter the ability of the feature to support any future interstate commerce.

7. Summary

One constructed intermittent drainage, the Otero Canal (0.33 acres and 1,310 linear ft), was identified and delineated within the PIA.

7.1 Anticipated Impacts

In the event that the selected Project design will impact any potential WOTUS delineated in this report, the impacts to these resources may need to be approved or permitted by the USACE. Depending on the level of impacts, the Project could require permitting under the Nationwide Permit (NWP) program. The NWP program is available for projects with relatively minor impacts (the exact nature of the impacts and acreage thresholds depend on the applicable NWP). Individual Permits are required for projects with larger impacts and can involve a lengthy permitting process.

7.2 Avoidance and Mitigation Measures

Measures to avoid, minimize, or mitigate for potential impacts to wetlands and other WOTUS include:

- Tailoring design to avoid or minimize impacts as much as possible given structural constraints.

- Having construction methods and equipment that can avoid or minimize temporary impacts by reducing footprint of machines used or accessing work from roadway fill or other uplands.

- Developing compensatory mitigation measures, if permanent impacts are not avoidable. These measures would be a part of the permitting process with the USACE.

- Developing a detailed and thorough construction plan which includes best management practices. An example is a Stormwater Pollution Prevention Plan that incorporates measures to protect sensitive resources from stormwater run-off, pollutants, etc., due to construction activities.

8. References

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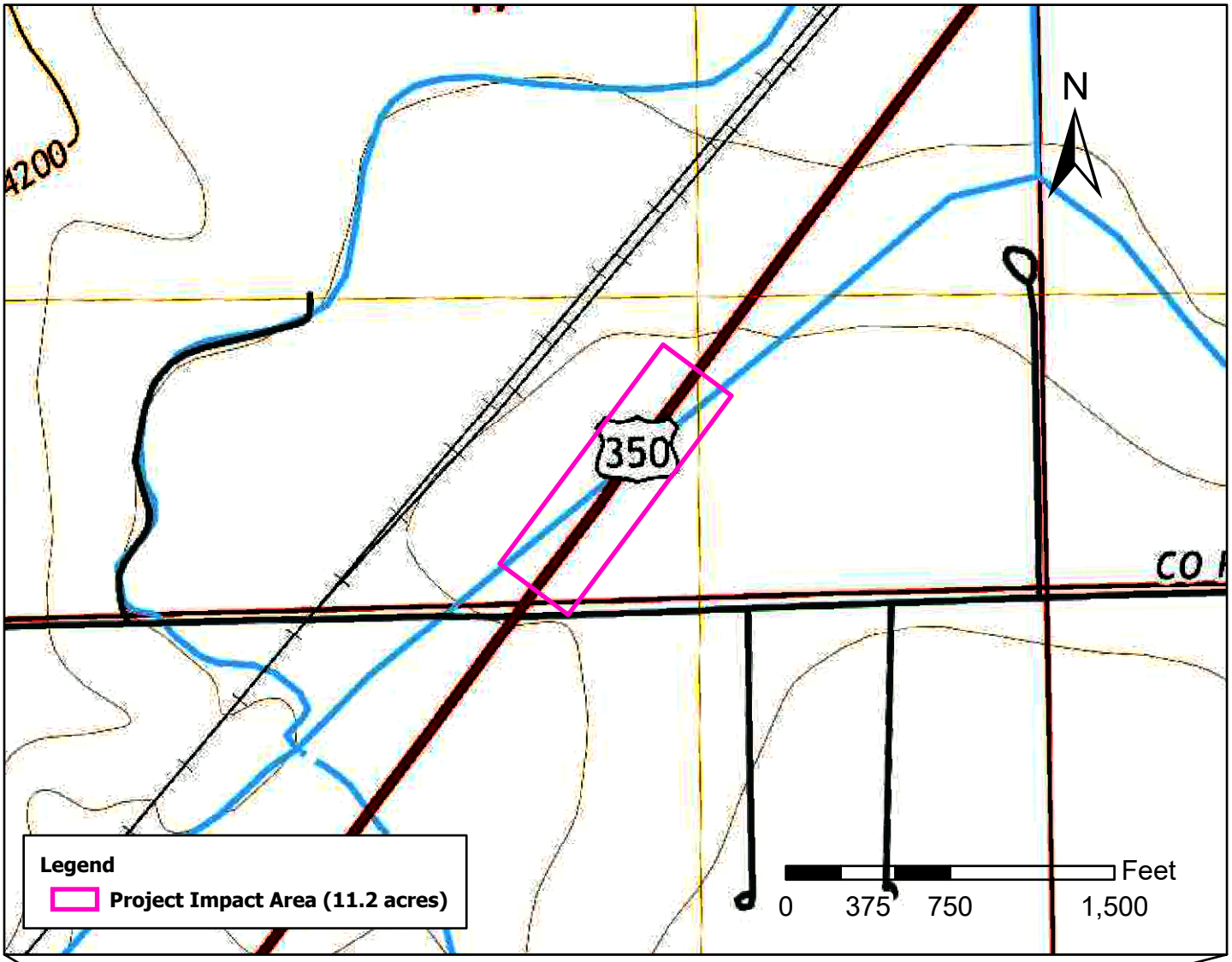
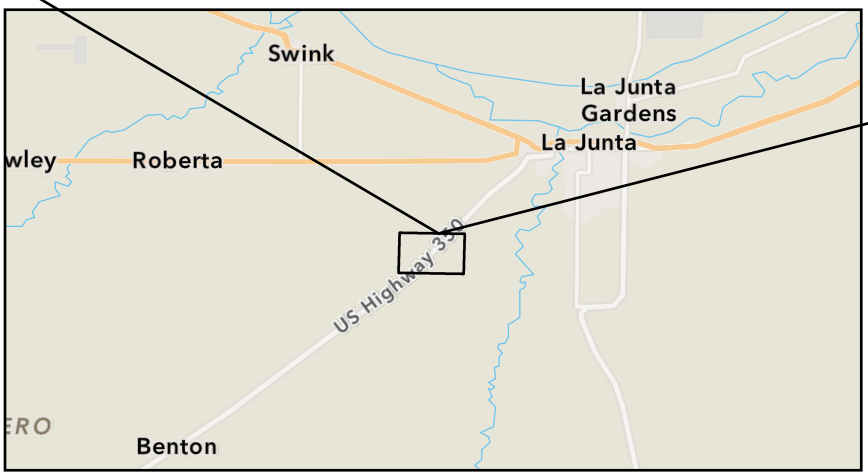
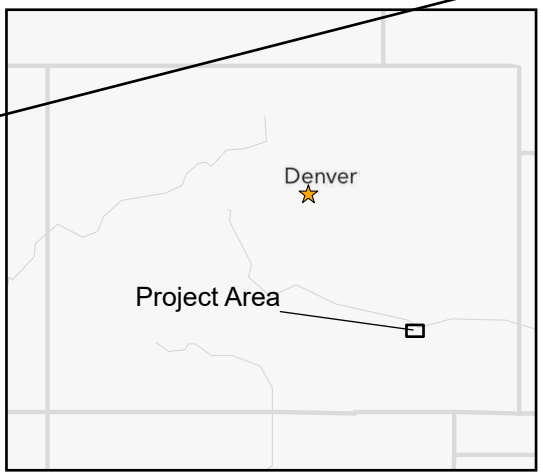
Appendix A

Aquatic Resources Delineation Maps







Colorado Department of Transportation
R2 Bridges Project - M-22-U

Figure 1
Vicinity Map

Image Source: ArcGIS Online, World Street Map, USGS TopoView
USGS Topo: La Junta, CO
S17, T24S, R55W
Bridge Lat/Long: 37.954765/-103.589936

Stanley Consultants INC.

Date Exported: 11/16/2020 9:06 AM

Path: C:\Users\9666\Documents\A_WorkDocs\GIS_files\CDOT\19_Bridges\19-GIS\03-MXDs\M22U_ARDR_Fig1.aprx

Colorado Department of Transportation
R2 Bridges Project - M-22-U

Figure 2: Aquatic Delineation Map

Data Source: Stanley Consultants, Inc.
Image Source: ArcGIS Online, World Imagery

Coordinate System: NAD 1983
State Plane CO Central FIPS 0502 (US Feet)
Projection: State Plane
Datum: North American 1983
Created: November 18, 2020

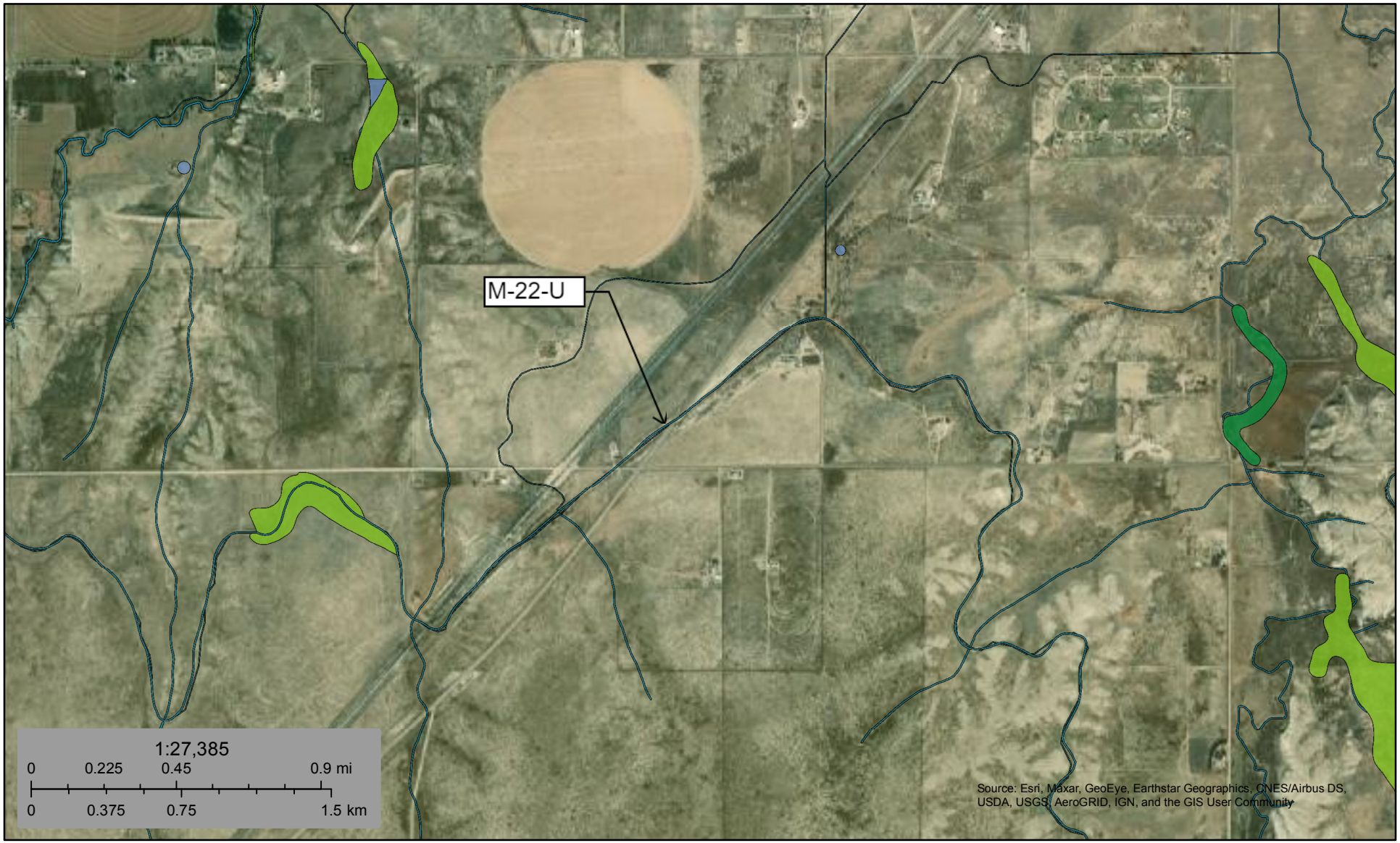
Stanley Consultants INC.

Appendix B

Supporting Maps and Documents

U.S. Fish and Wildlife Service
National Wetlands Inventory

CDOT R2 Bridges Project: M-22-U



November 23, 2020

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Otero County, Colorado

November 23, 2020

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

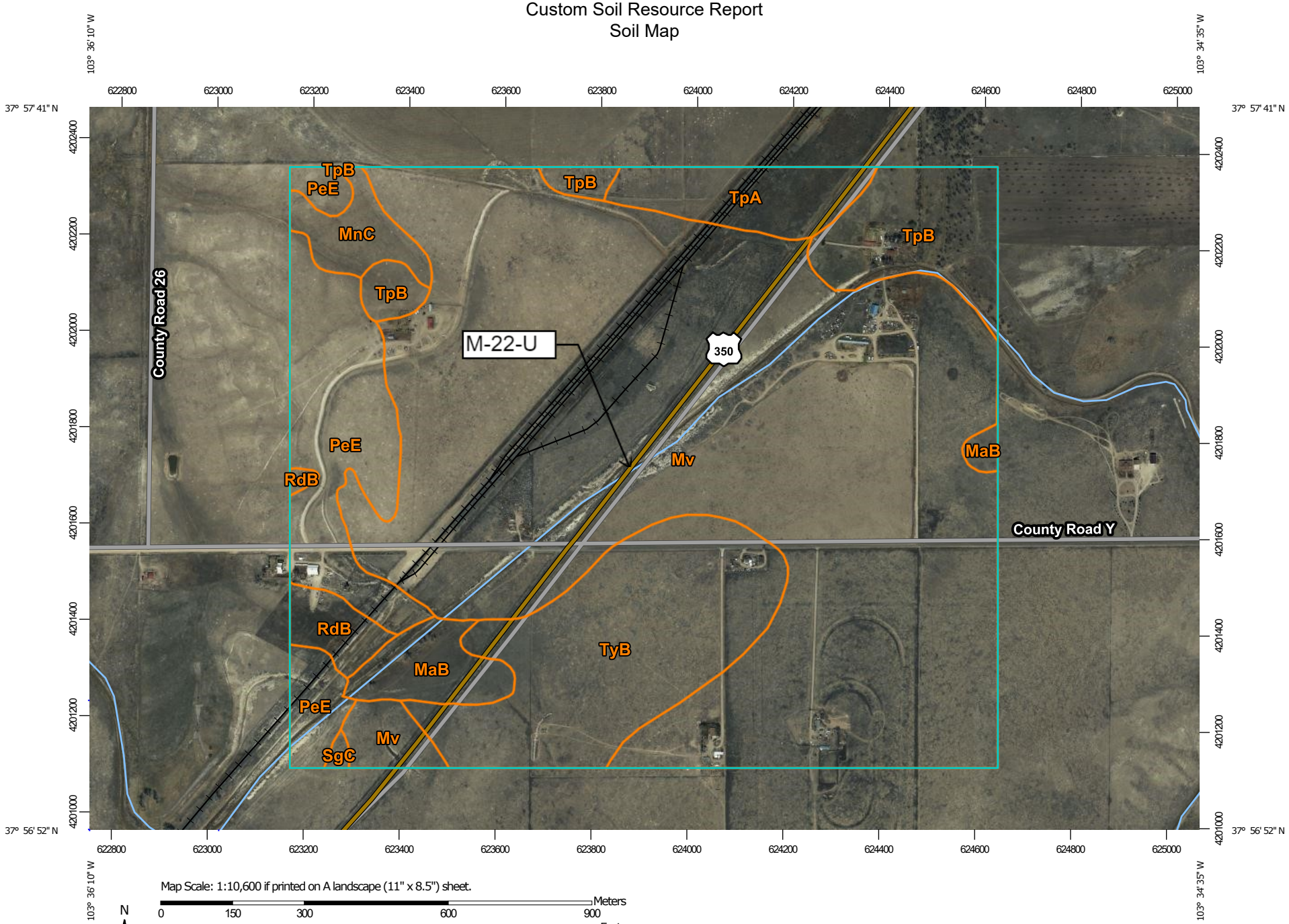
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Otero County, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Mar 31, 2020—Apr 7, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
MaB	Manvel silt loam, dry, 0 to 2 percent slopes	11.8	2.6%
MnC	Minnequa silty clay loam, 0 to 5 percent slopes	8.4	1.8%
Mv	Minnequa-Manvel silt loams, 1 to 6 percent slopes, dry	289.9	63.4%
PeE	Penrose channery loam, 1 to 15 percent slopes	41.6	9.1%
RdB	Rocky Ford silty clay loam, 1 to 3 percent slopes	6.5	1.4%
SgC	Shingle loam, 1 to 9 percent slopes	0.7	0.1%
TpA	Timpas silty clay loam, 0 to 1 percent slopes	15.0	3.3%
TpB	Timpas silty clay loam, 1 to 3 percent slopes	26.7	5.8%
TyB	Tyrone silty clay loam, 0 to 3 percent slopes	56.4	12.3%
Totals for Area of Interest		**457.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They

generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

Otero County, Colorado

MaB—Manvel silt loam, dry, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2rgqh
Elevation: 3,700 to 6,400 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Manvel, dry, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manvel, Dry

Setting

Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess

Typical profile

A - 0 to 7 inches: silt loam
Bk1 - 7 to 25 inches: silt loam
Bk2 - 25 to 49 inches: silt loam
Bk3 - 49 to 79 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Very slightly saline (2.0 to 3.9 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Very high (about 12.7 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: B
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Minor Components

Wilid, dry

Percent of map unit: 5 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Minnequa, dry

Percent of map unit: 5 percent
Landform: Pediments, ridges
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear, convex
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

MnC—Minnequa silty clay loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2rgr4
Elevation: 3,800 to 5,200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Minnequa

Setting

Landform: Strath terraces, paleoterraces
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium from irrigation water over alluvium over residuum weathered from limestone and shale

Typical profile

Ap1 - 0 to 6 inches: silty clay loam
Ap2 - 6 to 14 inches: silty clay loam
Bw - 14 to 25 inches: loam

Bk - 25 to 32 inches: loam
Cr - 32 to 79 inches: bedrock

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Nonsaline to slightly saline (0.1 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: C
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Minor Components

Rocky ford

Percent of map unit: 5 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Penrose

Percent of map unit: 5 percent
Landform: Scarps
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R069XY058CO - Limestone Breaks LRU's A & B
Hydric soil rating: No

Timpas

Percent of map unit: 5 percent
Landform: Strath terraces, paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Mv—Minnequa-Manvel silt loams, 1 to 6 percent slopes, dry

Map Unit Setting

National map unit symbol: 2rgqm
Elevation: 4,000 to 6,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Minnequa, dry, and similar soils: 55 percent
Manvel, dry, and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Minnequa, Dry

Setting

Landform: Pediments, ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear, convex
Parent material: Slope alluvium and/or residuum weathered from limestone and shale

Typical profile

A - 0 to 6 inches: silt loam
Bw - 6 to 17 inches: silt loam
Bk - 17 to 35 inches: silty clay loam
Cr - 35 to 60 inches: bedrock

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 45 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (0.1 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 8.0
Available water capacity: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Forage suitability group: Loamy (G069XW017CO)
Other vegetative classification: Loamy (G069XW017CO)
Hydric soil rating: No

Description of Manvel, Dry

Setting

Landform: Fans, interfluves
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Alluvium derived from limestone and shale

Typical profile

A - 0 to 7 inches: silt loam
Bk1 - 7 to 25 inches: silt loam
Bk2 - 25 to 49 inches: silt loam
Bk3 - 49 to 79 inches: silt loam

Properties and qualities

Slope: 1 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Nonsaline to moderately saline (1.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Forage suitability group: Loamy, Limy (G069XW022CO)
Other vegetative classification: Loamy Plains #6 (069XY006CO_2), Loamy, Limy (G069XW022CO)
Hydric soil rating: No

Minor Components

Manvel, deep, dry

Percent of map unit: 10 percent
Landform: Fans, interfluves
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex

Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Other vegetative classification: Loamy Plains #6 (069XY006CO_2), Loamy, Limy (G069XW022CO)
Hydric soil rating: No

Penrose

Percent of map unit: 5 percent
Landform: Hogbacks, hills, scarps
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R069XY058CO - Limestone Breaks LRU's A & B
Other vegetative classification: Limestone Breaks #58 (069XY058CO_2), Not Suited (G069XW000CO)
Hydric soil rating: No

PeE—Penrose channery loam, 1 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2rgr9
Elevation: 3,800 to 6,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 125 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Penrose and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Penrose

Setting

Landform: Hogbacks, hills, scarps
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Slope alluvium over residuum weathered from limestone

Typical profile

A - 0 to 4 inches: channery loam
C - 4 to 15 inches: channery loam
R - 15 to 79 inches: bedrock

Properties and qualities

Slope: 1 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock

Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 70 percent
Maximum salinity: Nonsaline (0.1 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R069XY058CO - Limestone Breaks LRU's A & B
Forage suitability group: Not Suited (G069XW000CO)
Other vegetative classification: Not Suited (G069XW000CO)
Hydric soil rating: No

Minor Components

Rock outcrop

Percent of map unit: 10 percent
Hydric soil rating: No

Minnequa

Percent of map unit: 5 percent
Landform: Interfluves, ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Linear
Across-slope shape: Linear, convex
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Other vegetative classification: Loamy (G069XW017CO)
Hydric soil rating: No

Manvel

Percent of map unit: 5 percent
Landform: Fans, interfluves
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Other vegetative classification: Loamy, Limy (G069XW022CO)
Hydric soil rating: No

RdB—Rocky Ford silty clay loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2rgqz
Elevation: 3,800 to 5,200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Rocky Ford

Setting

Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium from irrigation water over silty alluvium

Typical profile

Ap1 - 0 to 10 inches: clay loam
Ap2 - 10 to 19 inches: clay loam
Bk1 - 19 to 34 inches: silt loam
Bk2 - 34 to 46 inches: loam
Bk3 - 46 to 79 inches: sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.5 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water capacity: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 2c
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: C

Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Forage suitability group: Not Suited (G069XW000CO)
Other vegetative classification: Not Suited (G069XW000CO)
Hydric soil rating: No

Minor Components

Numa

Percent of map unit: 5 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Other vegetative classification: Not Suited (G069XW000CO)
Hydric soil rating: No

Timpas

Percent of map unit: 5 percent
Landform: Strath terraces, paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Other vegetative classification: Not Suited (G069XW000CO)
Hydric soil rating: No

Manvel

Percent of map unit: 5 percent
Landform: Interfluves, fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Other vegetative classification: Not Suited (G069XW000CO)
Hydric soil rating: No

SgC—Shingle loam, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2w4pt
Elevation: 3,940 to 5,250 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Shingle and similar soils: 90 percent

Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Shingle

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from shale

Typical profile

A - 0 to 2 inches: loam
Bw - 2 to 7 inches: loam
Cy - 7 to 12 inches: clay loam
Cr - 12 to 79 inches: bedrock

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: 8 to 16 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Very slightly saline (2.0 to 3.9 mmhos/cm)
Available water capacity: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R069XY046CO - Shaly Plains LRU's A & B
Hydric soil rating: No

Minor Components

Minnequa

Percent of map unit: 10 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

TpA—Timpas silty clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2rgr2
Elevation: 3,800 to 5,200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Timpas

Setting

Landform: Strath terraces, paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium from irrigation water over silty alluvium over residuum weathered from limestone and shale

Typical profile

Ap1 - 0 to 6 inches: silty clay loam
Ap2 - 6 to 12 inches: silty clay loam
Bk - 12 to 24 inches: silty clay loam
Bky - 24 to 33 inches: silt loam
BCky - 33 to 48 inches: silt loam
Cr - 48 to 79 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 39 to 59 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Nonsaline to slightly saline (1.5 to 6.0 mmhos/cm)
Sodium adsorption ratio, maximum: 6.0
Available water capacity: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2s

Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: C
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Minor Components

Rocky ford
Percent of map unit: 5 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Minnequa
Percent of map unit: 5 percent
Landform: Strath terraces, paleoterraces
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Numa
Percent of map unit: 5 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

TpB—Timpas silty clay loam, 1 to 3 percent slopes

Map Unit Setting
National map unit symbol: 2rgr3
Elevation: 3,800 to 5,200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Timpas and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Timpas

Setting

Landform: Strath terraces, paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium from irrigation water over silty alluvium over residuum weathered from limestone and shale

Typical profile

Ap1 - 0 to 6 inches: silty clay loam
Ap2 - 6 to 12 inches: silty clay loam
Bk - 12 to 24 inches: silty clay loam
Bky - 24 to 33 inches: silt loam
BCky - 33 to 48 inches: silt loam
Cr - 48 to 79 inches: bedrock

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: 39 to 59 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Nonsaline to slightly saline (1.5 to 6.0 mmhos/cm)
Sodium adsorption ratio, maximum: 6.0
Available water capacity: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: C
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Minor Components

Minnequa

Percent of map unit: 5 percent
Landform: Strath terraces, paleoterraces
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Rocky ford

Percent of map unit: 5 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Numa

Percent of map unit: 5 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

TyB—Tyrone silty clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2w4q0
Elevation: 3,940 to 5,250 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Tyrone and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tyrone

Setting

Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous pre-bull lake alluvium derived from limestone

Typical profile

A - 0 to 4 inches: silty clay loam
Btn1 - 4 to 18 inches: clay loam
Btn2 - 18 to 25 inches: clay loam
C - 25 to 79 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 2 to 6 inches to natric
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 18.0
Available water capacity: Very low (about 0.7 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: C
Ecological site: R069XY047CO - Alkaline Plains LRU's A & B
Hydric soil rating: No

Minor Components

Manvel

Percent of map unit: 5 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

Minnequa

Percent of map unit: 5 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R069XY006CO - Loamy Plains, LRU's A & B 10-14 Inches, P.Z.
Hydric soil rating: No

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Appendix C

Ordinary Highwater Mark Data Sheets

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project:	**Date:**	**Time:**
Project Number:	**Town:**	**State:**
Stream:	**Photo begin file#:**	**Photo end file#:**
Investigator(s):		

Y ☐ / N ☐ Do normal circumstances exist on the site?	**Location Details:**
Y ☐ / N ☐ Is the site significantly disturbed?	**Projection:** **Datum:** **Coordinates:**

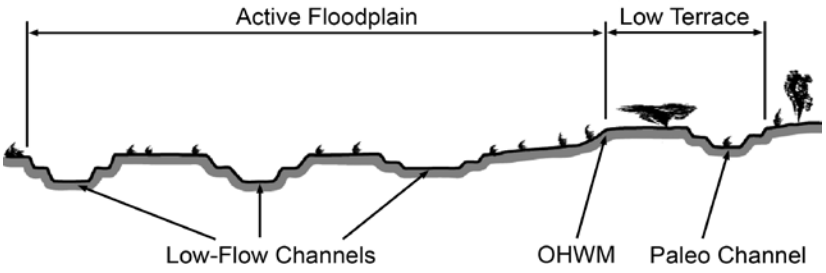
Potential anthropogenic influences on the channel system:

Brief site description:

Checklist of resources (if available):

- ☐ Aerial photography
  Dates:
- ☐ Topographic maps
- ☐ Geologic maps
- ☐ Vegetation maps
- ☐ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☐ Global positioning system (GPS)
- ☐ Other studies
- ☐ Stream gage data
  Gage number:
  Period of record:
- ☐ History of recent effective discharges
- ☐ Results of flood frequency analysis
- ☐ Most recent shift-adjusted rating
- ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units



Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☐ Mapping on aerial photograph
   - ☐ Digitized on computer
   - ☐ GPS
   - ☐ Other:

Project ID: **Cross section ID:** **Date:** **Time:**

Cross section drawing:

OHWM

GPS point: _____

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☐ Break in bank slope
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____% Shrub: _____% Herb: _____%

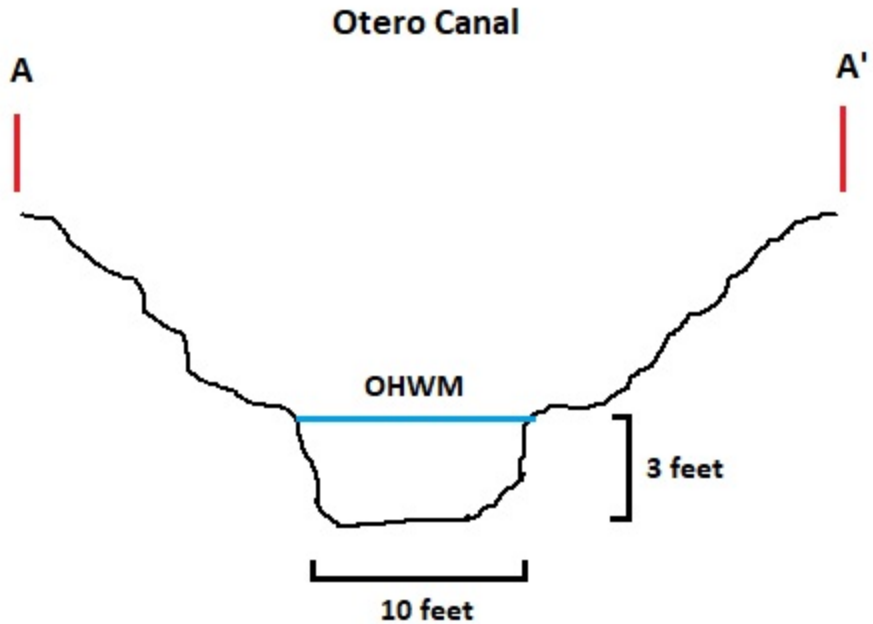
Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:


Otero Canal
A
A'
OHWM
3 feet
10 feet

Appendix D

Photo Inventory

Photo 1.
Otero Canal, looking east and downstream towards the bridge abutments, at cross section A. OHWM can be seen on the abutment as staining, and starting below the overgrown bankside vegetation.

Photo 2.
Otero Canal, looking southwest and upstream away from the bridge, from cross section A. OHWM can be seen starting below the overgrown bankside vegetation.

Photo 3.
Otero Canal, looking southwest towards the bridge (in the far distance). Bank sides less steep in places along this section of the canal.

Photo 4.
Otero Canal, looking southwest from the bridge at entire upstream section of the canal. Note the high canal sediment castings lining the tops of the banks from years of maintenance of the canal.

Photo 5.
Otero Canal, looking northeast and upstream of bridge. Upper top of the banks on east side (photo right) are steep and very tall.

Appendix E

Signed Property Access Letter

(not included; needs to be obtained prior to permitting efforts)