I-70 Mountain Corridor PEIS Wetlands and Other Waters of the U.S. Technical Report

August 2010

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Section 1. Purpose of the Report

This I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS) *Wetlands and Other Waters of the U.S. Technical Report* (CDOT, August 2010) supports the information contained in **Chapter 3, Section 3 : Wetlands and Other Waters of the U.S**., of the *I-70 Mountain Corridor PEIS* (CDOT, 2010). This technical report identifies:

- Methods used to identify wetlands and other waters of the U.S. and determine potential impacts of alternatives.
- Coordination with local, state, and federal agencies.
- Description of wetlands and other waters of the U.S. in the Corridor.
- Consequences of the Action Alternatives evaluated in the I-70 Mountain Corridor PEIS
- Considerations for Tier 2 Processes.
- Proposed mitigation strategies for impacts to wetlands and other waters of the U.S.

Wetlands and waters of the U.S. are part of the larger biological community for the Corridor, and have direct correlations to riparian areas, water quality, and aquatic and other biological resources.

1.1 Regulatory Background

Because this is a joint project between state and federal agencies, there are several sets of regulations to consider regarding wetlands and other waters of the U.S. The following section provides a summary of regulations that define wetlands as a resource and how impacts are permitted.

Wetlands and other waters of the U.S. are regulated through a permit process administered by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. The U.S. Army Corps of Engineers jurisdiction is limited to those wetlands considered waters of the U.S., as defined in 33 Code of Federal Regulations (CFR) Part 328.3. On June 5, 2007, the EPA and USACE issued agency guidance, effective immediately, regarding jurisdiction of the Clean Water Act following the U.S. Supreme Court's consolidated ruling in *Rapanos v. United States* and *Carabel v. United States* decisions (June, 2006), commonly referred to as *Rapanos*. The guidance has been issued to ensure that jurisdictional determinations under the Clean Water Act (CWA) are consistent with the *Rapanos* decision and provide efficient protection for the nation's water resources.

Jurisdictional waters of the U.S. include traditional navigable waters, their tributaries, and adjacent wetlands. The *Rapanos* guidance states further that jurisdiction will be extended on a case-by-case basis to non-navigable waters, their tributaries, and adjacent wetlands based on their nexus to traditional navigable waters. For the purpose of establishing a significant nexus, the following standard applies:

- A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by all wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical and biological integrity of downstream traditional navigable waters (EPA, December 2008).

For regulatory purposes under Section 404 of the Clean Water Act, wetlands are defined as:

> *Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and that, under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (Environmental Protection Agency 40 CFR 230.2 and CE 33 CFR 328.3).*

Section 404 of the Clean Water Act restricts the U.S. Army Corps of Engineers to permitting only those projects that are the Least Environmentally Damaging Practicable Alternative, referred to as the LEDPA. A definition of this is: a selection process by which the full range of National Environmental Policy Act alternatives and impacts are considered for practicability and adverse environmental impacts.

Executive Order 11990, Protection of Wetlands, requires that federal agencies "…take action to minimize the destruction, loss, or degradation of wetlands…" Executive Order 11990 extends protection to most wetlands, and is not limited to wetlands that fall under the jurisdiction of the U.S. Army Corps of Engineers. Federal Highway Administration Regulations at CFR 23 Sections 771 and 777, guidance provided in Technical Advisory T6640.8A (Section V.G.12), and DOT Order 5660.1a, direct that impacts on wetlands be avoided wherever possible and minimized to the extent practicable during transportation construction projects.

Among the wetlands found in the Corridor, fens are considered especially sensitive due to their rarity and the difficulty in reestablishing damaged or destroyed fen complexes. Fens are distinguished from other wetlands and uplands by thickness of peat, or partially decayed organic matter, hydrologic regime, and vegetation composition (Bedford and Godwin, 2003). Fens are recognized as irreplaceable resources in the Southern Rocky Mountain Region due to the functional and biological values they provide, which include water quality improvement, flood attenuation, and providing habitat for unique plants and animals. The Mountain-Prairie Region of the USFWS has implemented a Regional Policy on the Protection of Fens (1999), which states that mitigation goal for fens is no loss of existing habitat value and that every reasonable effort should be made to avoid impacting that habitat type as on-site or in-kind replacement of fens is not thought to be possible.

Other waters of the U.S., also included in this discussion, are classified either as channel/riverine, navigable waters and their tributaries, or as water storage features. Other waters of the U.S. exist as open waters of each stream system that occurs along the Corridor, as well as some ponds and lakes.

Section 2. Background and Methodology

The Tier 1 analysis provided in this document is designed to provide enough data to make an informed comparison of the Action Alternatives being considered. For wetlands and other water of the U.S., existing environmental data was collected from available sources and limited field observations were made to confirm the legitimacy of the data. Although wetland delineations were not performed in the Corridor, available resources provide the general locations of wetlands and other waters of the U.S. The following section provides a summary of Tier 1 methodologies employed. Tier 2 processes, including wetland delineations, functional assessments, and Section 404 permitting are discussed in **Section 6: Tier 2 Considerations**.

For the purposes of this technical report, the three principal data categories identified for this resource are:

- **General Wetlands –** These include wetland classifications that follow Cowardin et al. (1979) of palustrine emergent, palustrine scrub-shrub, palustrine forested, and palustrine aquatic bed. These were analyzed as one category.
- **Fens –** These are distinguished from other wetlands and uplands by thickness of peat, hydrologic regime, and vegetation composition (Bedford and Godwin, 2003).
- **Other Waters of the U.S. –** These include all "open waters" such as riverine (year-round flow), intermittent or seasonal tributaries, and water storage features (ponds or lakes). These were analyzed as one category.

Between 2001 and 2004, the Colorado Department of Transportation (CDOT) mapped wetlands and other waters of the U.S. within a 2,000-foot-wide corridor along both sides of I-70 using color infrared aerial photography, National Wetland Inventory maps developed in the 1980s, and field reconnaissance. The project area centers on I-70, and mapping was conducted using interpretation of geo-referenced, ortho-rectified, false-color infrared aerial photographs. Additional digitized, high-resolution, low-altitude, geo-referenced, ortho-rectified black-and-white or true color aerial photography was used to assist mapping. Areas of interest were determined by watershed basin and are discussed below.

The assessment area for fens included a 200-foot buffer along both sides of the I-70 highway. Identification and delineation of possible fens was based on landscape context and color signature in aerial imagery compared to the signature of known fens in the area (Tiner, 1999). Sites were field verified during September and October of 2009. The methodology and results of this field survey is documented in greater detail in the *Wetlands Surveys and Findings Assessment within and near the Maximum Footprint for the Proposed Colorado I-70 Corridor Improvement Project, Tier 1* (Cooper, 2009), in **Appendix A**.

Even though the date of the wetland mapping is 7 to 8 years old, it is still considered valid because the more recent aerial mapping and field verification completed for fens did not identify major issues or changes needed with this mapping. The wetland mapping is considered to represent a justifiable basis for analysis of impacts associated with the Action Alternatives in a Tier 1 document.

Wetlands provide a wide variety of economically and ecologically important functions. Wetlands in the Corridor provide water quality improvement, groundwater recharge/discharge, bank stabilization, flood protection, food chain support, fish and wildlife habitat, rare species habitat, education and research opportunities, and recreational opportunities. The Functional Assessment of Colorado Wetlands (FACWet) is a wetland assessment technique that can be used when performing wetland delineations. Wetland delineations were not conducted during Tier 1 analysis, no functional assessment was performed. Wetlands in the Corridor will be delineated and a functional assessment performed during Tier 2 processes.

Impacts to wetlands, fens and other waters of the U.S. were determined through a Geographic Information Systems overlay process in which the impact footprint was superimposed onto each of the above-mentioned resources within the Corridor. Impacts were quantified for the whole Corridor for each resource. In determining potential impacts to wetlands, fens and other waters of the U.S. from the Action Alternatives, direct and indirect impacts were included.

The Colorado Department of Transportation has a policy of mitigating impacts to all affected wetlands, including non-jurisdictional wetlands. While wetlands not connected by surface water to waters of the U.S. were mapped as isolated waters/wetlands, CDOT took the most conservative approach possible by classifying all mapped areas as jurisdictional under the Clean Water Act Section 404. The U.S. Army Corps of Engineers concurred with this approach for Tier 1. Separating jurisdictional and non-jurisdictional wetland impacts will occur in Tier 2 processes, where issues of permitting for a specific alternative will be addressed.

2.1 Agency Coordination

Coordination with the U.S. Army Corps of Engineers occurred throughout the analysis of wetlands and other waters of the U.S. in this Corridor. Specific resource meetings were held with the U.S. Army Corps of Engineers, and comments were provided to the project team throughout development of the *I-70 Mountain Corridor PEIS* (CDOT, 2010). A major change since the previous wetlands analysis has been the U.S. Supreme Court's consolidated ruling in *Rapanos v. United States* and *Carabel v. United States* decisions (June, 2006), commonly referred to as *Rapanos*. This decision affects issues of agency jurisdiction over wetlands and other waters of the U.S. However, this decision does not affect Tier 1 analysis because all wetlands and other waters of the U.S. located in the project area are considered jurisdictional. A meeting was held on December 17, 2008, which resulted in U.S. Army Corps of Engineers concurrence with the approach of considering all wetlands and other waters of the U.S. jurisdictional during Tier 1 analysis. Meeting notes can be found in **Appendix B** of this Technical Report. There are no changes in the standards or the methodology used in this analysis since meeting with the U.S. Army Corps of Engineers.

The U.S. Army Corps of Engineers was involved throughout the alternatives development and screening process. Most recently, the U.S. Army Corps of Engineers was an active participant in the I-70 Collaborative Effort Committee, which identified the I-70 PEIS Preferred Alternative. The Environmental Protection Agency, which has a regulatory role in the Section 404 permitting process as well, was involved throughout the alternatives development and screening process.

The Colorado Department of Transportation initiated a Stream and Wetland Ecological Enhancement Program (SWEEP) as a streamlining program to identify and address environmental issues related to wetlands, streams, and fisheries in the Corridor. The SWEEP team included representatives from federal and state agencies, watershed associations, Clear Creek County, and special interest groups (see **Chapter 6, Public and Agency Involvement**, from the *I-70 Mountain Corridor PEIS* [CDOT, 2010] for more information). Clear Creek, from the Eisenhower-Johnson Memorial Tunnels downstream to Floyd Hill at the intersection of US 6 and I-70, was selected to identify areas where aquatic habitats could be improved in conjunction with Action Alternatives, more specifically at the Tier 2 level.

Section 3. Descriptions of Alternatives

This section summarizes the alternatives considered in the I-70 Mountain Corridor PEIS. A more complete description of these alternatives is available in **Chapter 2** of the PEIS and in the *I-70 Mountain Corridor PEIS Alternatives Screening and Development Technical Report* (CDOT, August 2010).

3.1 Minimal Action Alternative

The Minimal Action Alternative provides a range of local transportation improvements along the Corridor without providing major highway capacity widening or dedicated transit components. The Minimal Action Alternative includes elements of the Transportation System Management family and the Localized Highway Improvements family, including: transportation management, interchange modifications, curve safety modifications, and auxiliary lanes. These elements are also incorporated into the other Action Alternative Packages.

3.2 Transit Alternatives

Four Transit alternatives are considered in the PEIS as a reasonable range representing the Fixed Guideway and Rubber Tire Transit families:

- Rail with Intermountain Connection Alternative
- Advanced Guideway System Alternative
- Dual-Mode Bus in Guideway Alternative
- Diesel Bus in Guideway Alternative

3.2.1 Rail with Intermountain Connection

The Rail with Intermountain Connection Alternative would provide rail transit service between the Eagle County Regional Airport and C-470. Between Vail and C-470 the rail would be primarily at-grade running adjacent to the I-70 highway. The segment between Vail and the Eagle Count Airport would be constructed within the existing Union Pacific Railroad right-of-way. A new Vail Transportation Center, including new track, would be constructed between Vail and Minturn to complete the connection between the diesel and electric trains. This alternative also includes auxiliary lane improvements at eastbound Eisenhower-Johnson Memorial Tunnels to Herman Gulch and westbound Downieville to Empire and the other Minimal Action Alternative elements except for curve safety modifications at Dowd Canyon, buses in mixed traffic and other auxiliary lane improvements.

3.2.2 Advanced Guideway System

The Advanced Guideway System Alternative would provide transit service between the Eagle County Regional Airport and C-470 with a 24-foot-wide, 118 mile, fully elevated system. The Advanced Guideway System Alternative would use a new technology that provides higher speeds than the other Fixed Guideway Transit technologies studied for the PEIS. Any Advanced Guideway System would require additional research and review before it could be implemented in the Corridor. Although the Federal Transit Administration-researched urban magnetic levitation system is considered in the PEIS, the actual technology would be developed in a Tier 2 process. This alternative includes the same Minimal Action elements as described previously for the Rail with Intermountain Connection Alternative.

3.2.3 Dual-mode Bus in Guideway

This alternative includes a guideway located in the median of the I-70 highway with dual-mode buses providing transit service between the Eagle County Regional Airport and C-470. This guideway would be 24 feet wide with 3 foot high guiding barriers and would accommodate bidirectional travel. The barriers direct the movement of the bus and separate the guideway from general purpose traffic lanes. While traveling in the guideway, buses would use guidewheels to provide steering control, thus permitting a narrow guideway and providing safer operations. The buses use electric power in the guideway and diesel power when traveling outside the guideway in general purpose lanes. This alternative includes the same Minimal Action Alternative elements as described previously for the Rail with Intermountain Connection Alternative.

3.2.4 Diesel Bus in Guideway

This includes the components of the Dual-mode Bus in Guideway Alternative except that the buses use diesel power at all times.

3.3 Highway Alternatives

Three Highway alternatives are advanced for consideration in the PEIS as a reasonable range and representative of the Highway improvements, including Six-Lane Highway 55 mph, Six-Lane Highway 65 mph, and Reversible/HOV/HOT Lanes. The Highway alternatives considered both 55 and 65 mph design speeds to 1) establish corridor consistency and 2) address deficient areas within the Corridor. The 55 mph design speed establishes a consistent design speed throughout the Corridor, which currently does not exist. The 65 mph design speed further improves mobility and addresses safety deficiencies in key locations such as Dowd Canyon and the Twin Tunnels. Both the 55 mph and the 65 mph design speed options are augmented by curve safety improvements, but the 65 mph design speed constructs tunnels in two of the locations: Dowd Canyon and Floyd Hill/Hidden Valley.

3.3.1 Six-Lane Highway 55 mph Alternative

This alternative includes six-lane highway widening in two locations: Dowd Canyon and the Eisenhower-Johnson Memorial Tunnels to Floyd Hill. This alternative includes auxiliary lane improvements at eastbound Avon to Post Boulevard, both directions on the west side of Vail Pass, eastbound Frisco to Silverthorne and westbound Morrison to Chief Hosa, and the Minimal Action Alternative elements except for buses in mixed traffic and other auxiliary lane improvements.

3.3.2 Six-Lane Highway 65 mph Alternative

This alternative is similar to the Six-Lane Highway 55 mph Alternative; it includes the same six-lane widening and all of the Minimal Action Alternative elements except the curve safety modification at Dowd Canyon. The higher design speed of 65 mph alternatives requires the curve safety modifications near Floyd Hill and Fall River Road to be replaced with tunnels.

3.3.3 Reversible Lanes Alternative

This alternative is a reversible lane facility accommodating high occupancy vehicles and high occupancy toll lanes. It changes traffic flow directions as needed to accommodate peak traffic demands. It includes two additional reversible traffic lanes from the west side of the Eisenhower-Johnson Memorial Tunnels to just east of Floyd Hill. From the Eisenhower-Johnson Memorial Tunnels to US 6, two lanes are built with one lane continuing to US 6 and the other lane to the east side of Floyd Hill. This alternative includes one additional lane in each direction at Dowd Canyon. This alternative includes the same Minimal Action Alternative Elements as the Six-Lane Highway 55 mph Alternative.

3.4 Combination Alternatives

Twelve Combination alternatives, combining Highway and Transit alternatives are considered in the PEIS. Four of these alternatives involve the buildout of highway and transit components simultaneously. Eight alternatives include preservation options, the intent of which is to include, or not preclude, space for future modes in the I-70 Mountain Corridor. The Combination alternatives all include the Six-Lane Highway 55 mph Alternative for highway components.

Combination Rail and Intermountain Connection and Six-Lane Highway Alternative—This alternative includes the 55 mph six-lane highway widening between Floyd Hill and Eisenhower-Johnson Memorial Tunnels, the Rail and Intermountain Connection transit components, and most of the components of the Minimal Action Alternative. The exception is that only one of the Minimal Action auxiliary lane improvements (from Morrison to Chief Hosa westbound) is included.

Combination Advanced Guideway System and Six-Lane Highway Alternative—This alternative includes the 55 mph six-lane highway widening between Floyd Hill and Eisenhower-Johnson Memorial Tunnels and the Advanced Guideway System transit components. It includes the same Minimal Action Alternative elements as the Combination Rail and Intermountain Connection and Six-Lane Highway Alternative.

Combination Bus in Guideway (Dual-Mode) and Six-Lane Highway Alternative—This alternative the 55 mph six-lane highway widening between Floyd Hill and Eisenhower-Johnson Memorial Tunnels and the dual-mode bus in guideway transit components. It includes the same Minimal Action Alternative elements as the Combination Rail and Intermountain Connection and Six-Lane Highway Alternative.

Combination Bus in Guideway (Diesel) and Six-Lane Highway Alternative—This alternative includes the 55 mph six-lane highway widening between Floyd Hill and Eisenhower-Johnson Memorial Tunnels and the diesel bus in guideway transit components. It includes the same Minimal Action Alternative elements as the Combination Rail and Intermountain Connection and Six-Lane Highway Alternative.

Combination Rail & Intermountain Connection and Preservation of Six-Lane Highway Alternative—This alternative includes the Rail and Intermountain Connection Alternative and preserves space to construct the Six-Lane Highway 55 mph at a later point.

Combination Advanced Guideway System and Preservation of Six-Lane Highway Alternative— This alternative includes the Advanced Guideway System and preserves space to construct the Six-Lane Highway 55 mph at a later point.

Combination Bus in Guideway (Dual-Mode) and Preservation of Six-Lane Highway Alternative— This alternative includes the Combination Bus in Guideway (Dual-Mode) Alterative and preserves space to construct the Six-Lane Highway 55 mph at a later point.

Combination Bus in Guideway (Diesel) and Preservation of Six-Lane Highway Alternative—This alternative includes the Bus in Guideway (Diesel) Alternative and preserves space to construct the Six-Lane Highway 55 mph at a later point.

Combination Preservation of Rail and Intermountain Connection and Six-Lane Highway Alternative—This alternative includes the Six-Lane 55 mph Highway Alternative and also preserves space to construct the Rail and Intermountain Connection at a later point.

Combination Preservation of Advanced Guideway System and Six-Lane Highway Alternative— This alternative includes the Six-Lane 55 mph Highway Alternative and also preserves space to construct the Advanced Guideway System at a later point.

Combination Preservation of Bus in Guideway (Dual-Mode) and Six-Lane Highway Alternative— This alternative includes the Six-Lane Highway Alternative and also preserves space to construct the Bus in Guideway (Dual-Mode) at a later point.

Combination Preservation of Bus in Guideway (Diesel) and Six-Lane Highway Alternative—This alternative includes the Six-Lane Highway Alternative and also preserves space to construct the Bus in Guideway (Diesel) at a later point.

3.5 Preferred Alternative—Minimum and Maximum Programs

The Preferred Alternative provides for a range of improvements. Both the Minimum and the Maximum Programs include the Advanced Guideway System Alternative. The primary variation between the Minimum and Maximum Programs is the extent of the highway widening between the Twin Tunnels and the Eisenhower-Johnson Memorial Tunnels. The Maximum Program includes six-lane widening between these points (the Twin Tunnels and the Eisenhower-Johnson Memorial Tunnels), depending on certain events and triggers and a recommended adaptive management strategy.

3.6 No Action Alternative

The No Action Alternative provides for ongoing highway maintenance and improvements with committed funding sources highly likely to be implemented by the 2035 planning horizon. The projected highway maintenance and improvements are committed whether or not any other improvements are constructed with the I-70 Mountain Corridor project. Specific improvements under the No Action Alternative include highway projects, park and ride facilities, tunnel enhancements, and general maintenance activities.

Section 4. Affected Environment

Map 1 through **Map 14** shows the locations of mapped wetlands and other waters of the U.S. in the Corridor. Existing wetland types, general geographic locations, and acreage quantities for each sub-basin, working from west to east, are discussed below.

4.1 Colorado River Sub-basin

The wetlands mapping effort did not include areas west of Dotsero, and therefore no acreage calculations are available for the Colorado River sub-basin. Wetlands in the Colorado River sub-basin are limited because of the dry climate, steep river gradient and narrow canyons with steep slopes. Some seeps occur in this area on the side slopes above the Colorado River and support wetlands. Other wetlands occur where the Colorado River floodplain is relatively wide and water velocities are slow.

4.2 Eagle River Sub-basin

Existing wetlands and other waters of the U.S. within the Eagle River sub-basin are summarized in **Table 1**. The Eagle River sub-basin includes:

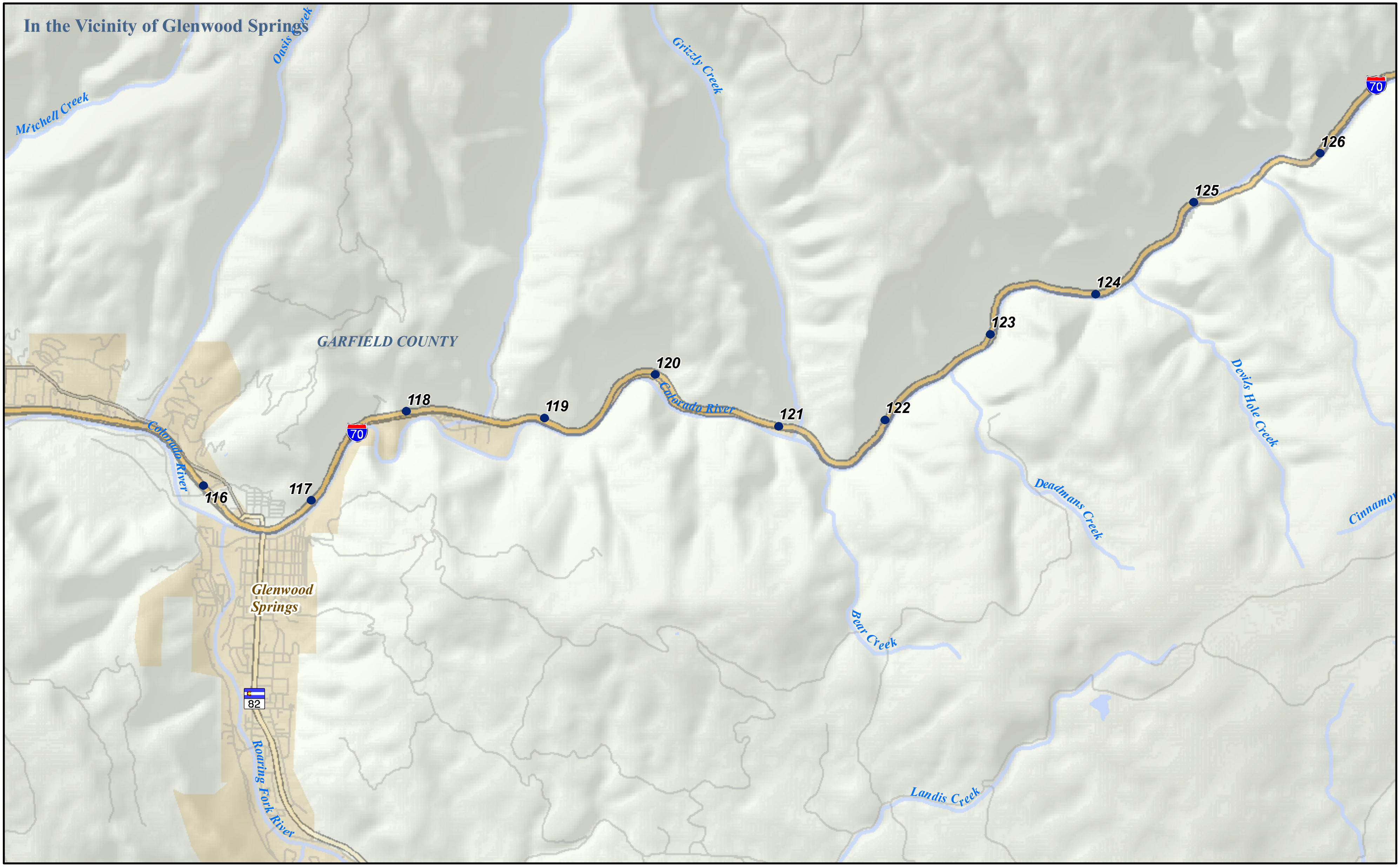
- **Eagle River -** The lower section of the Eagle River flows through a narrow channel with only sporadic areas of lower terraces, resulting in relatively few wetland areas. This area is relatively arid, and few adjacent streams or tributaries occur that contain wetlands. Relatively large wetland complexes begin to develop near Gypsum, and a valued wetland-riparian complex occurs on the wide floodplain between Gypsum and Eagle, between mileposts (mp) 137 and 146.

  The Eagle River segment of the Corridor from the town of Eagle to Wolcott Junction (SH 131) (mp 146 to mp 156) contains alternating areas of dispersed to well-developed wetlands along the river-channel margins on the lower terraces where the floodplain is relatively wide. The upper section of the Eagle River from Wolcott Junction to Dowd Canyon is greatly incised, resulting in relatively few wetland areas. The Eagle River flows through a relatively arid area west of Wolcott to Edwards (mp 156 to mp 162), and few tributaries or valley slope springs contribute to the wetlands in this section of the Corridor.

Table 1. Existing Project Area Wetlands and Other Waters of the U.S. in the Eagle River Sub-basin

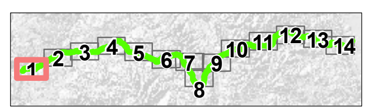
Resource Type	Acres
General Wetlands	848.6
Fens	4.3
Other Waters of the U.S.	800.87

- **Gore Creek -** Golf course development in parts of the floodplain and general residential and commercial development extensively modified wetlands in the Vail Valley. However, wetlands remain along Gore Creek (mp 171 to mp 182), and several ponds occur within the floodplain, coexisting with the golf course. The Gore Creek channel from its confluence with the Eagle River upstream to eastern Vail has low sinuosity (bends or curves in the stream), low gradient, an entrenched channel, predominantly of cobble, and narrow floodplain. Gore Creek experienced localized channel disturbance related to the construction and operation of the I-70 highway and development within the town of Vail. Gore Creek stream discharge is augmented by an estimated 500 acre-feet per year from the Eagle River for snowmaking.
- **Black Gore Creek -** The Black Gore Creek channel has low sinuosity, is narrow, and is confined. The streambed is steep, 4 percent to 10 percent slope, with cascading step pools and substrate consisting predominantly of bedrock, boulders, and cobble. This section includes the Black Lakes Reservoirs and an extensive complex of wetlands along Black Gore Creek in the valley bottom and on the lateral drainages and valley slopes (mp 182 to mp 190).



Legend

- Mileposts
- Limited Access Highways
- Major Highways
- Highways
- Lakes
- County Boundary
- Urban Areas
- Streams
- Fen Locations
- General Wetlands
- Channel / Waterbody



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Scale - 1:63,360
or 1" = 1 Miles

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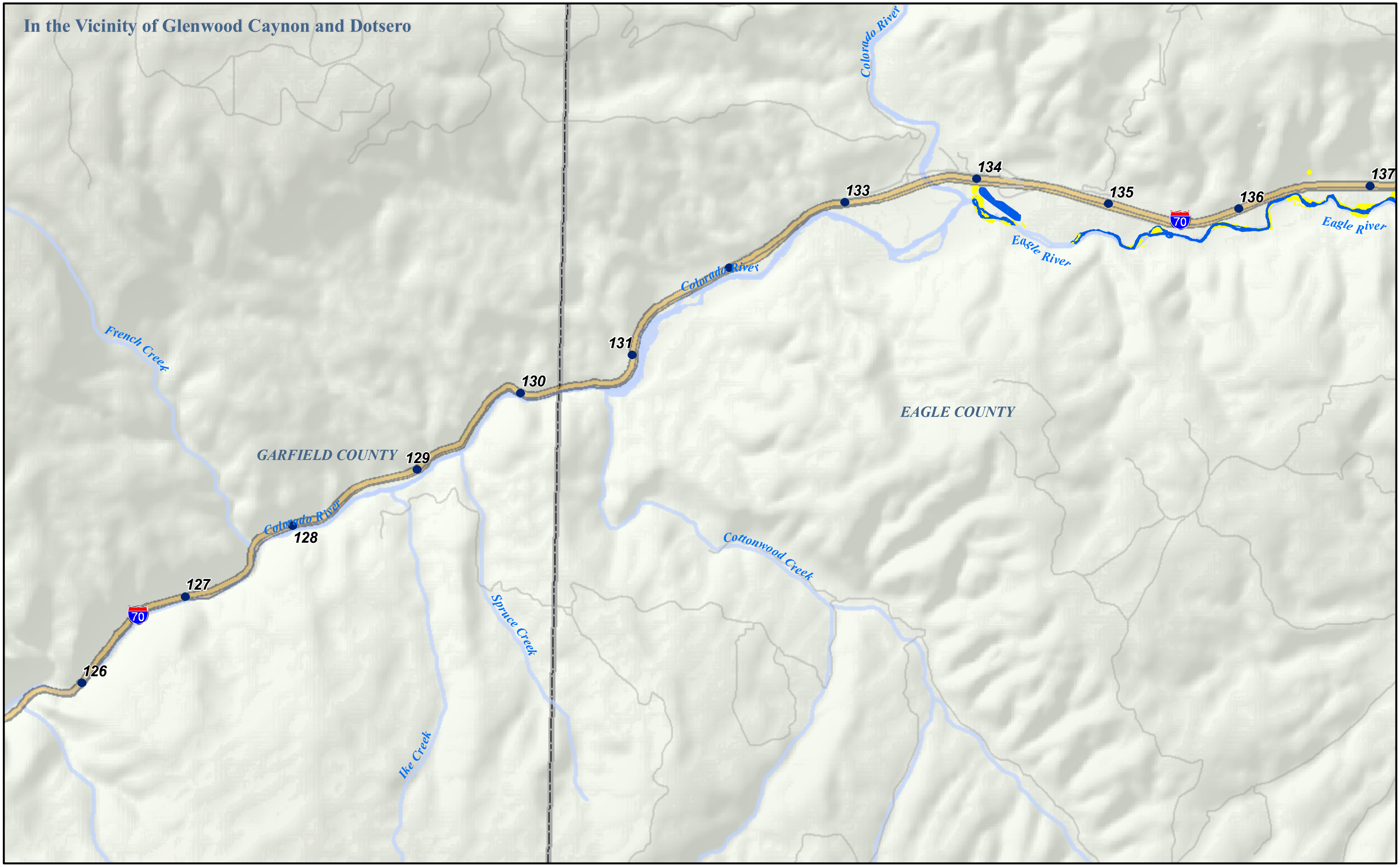
Wetlands

Map 1 of 14



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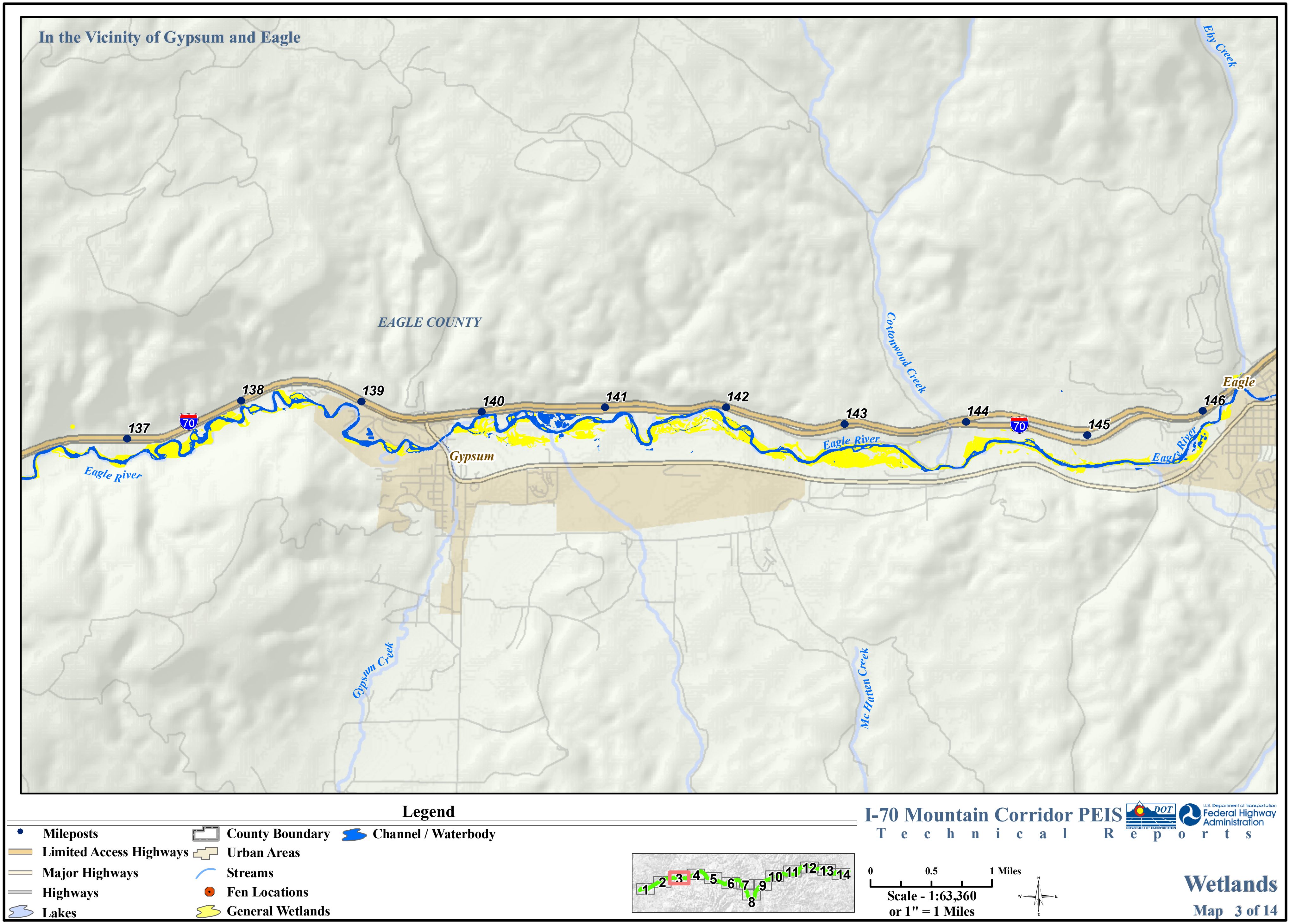
Wetlands

Map 2 of 14


In the Vicinity of Gypsum and Eagle
EAGLE COUNTY
Eby Creek
Cottonwood Creek
Eagle
Gypsum
Eagle River
Gypsum Creek
Mc Hatten Creek
70
137
138
139
140
141
142
143
144
145
146
Legend
Mileposts
Limited Access Highways
Major Highways
Highways
Lakes
County Boundary
Urban Areas
Streams
Fen Locations
General Wetlands
Channel / Waterbody
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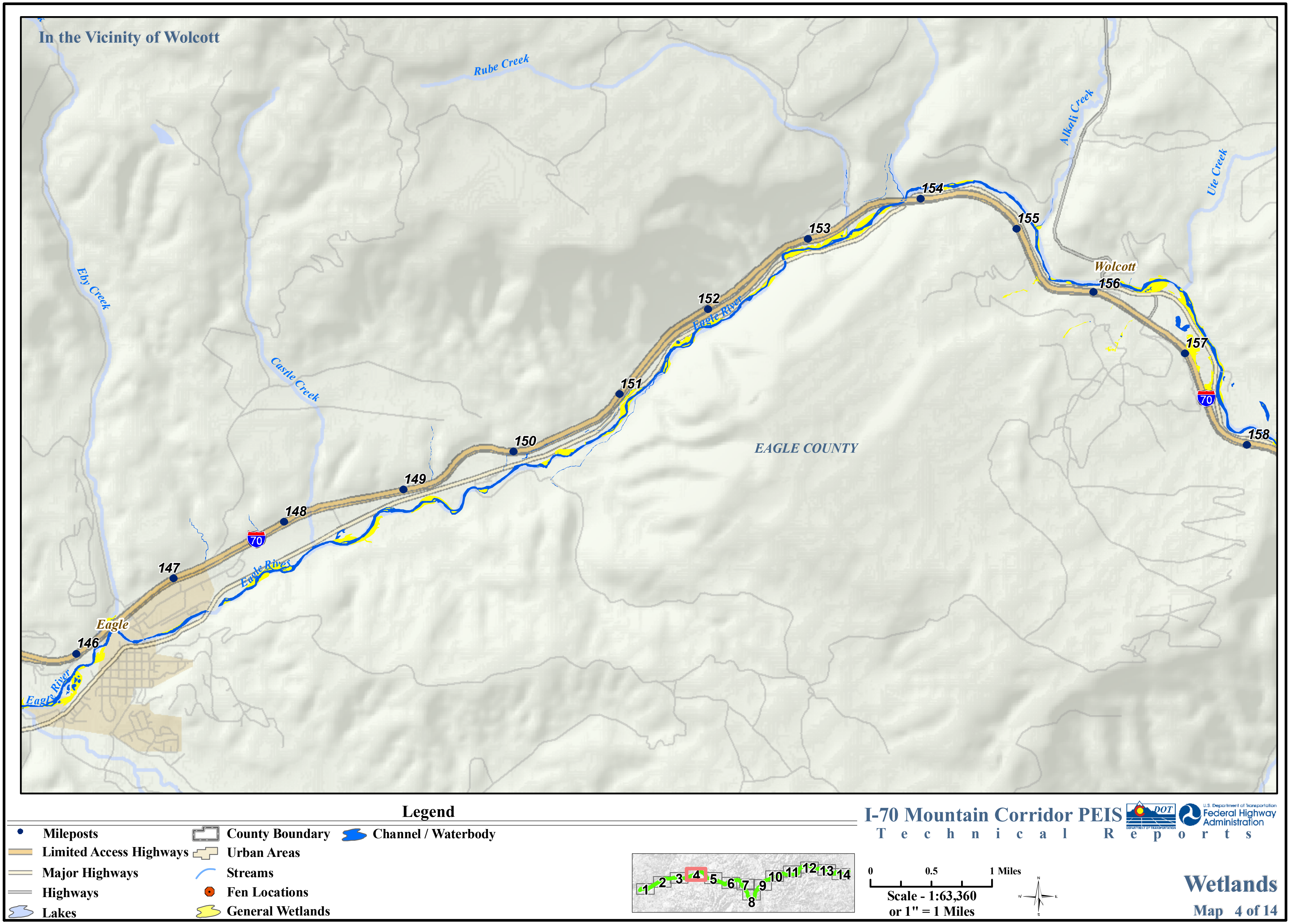

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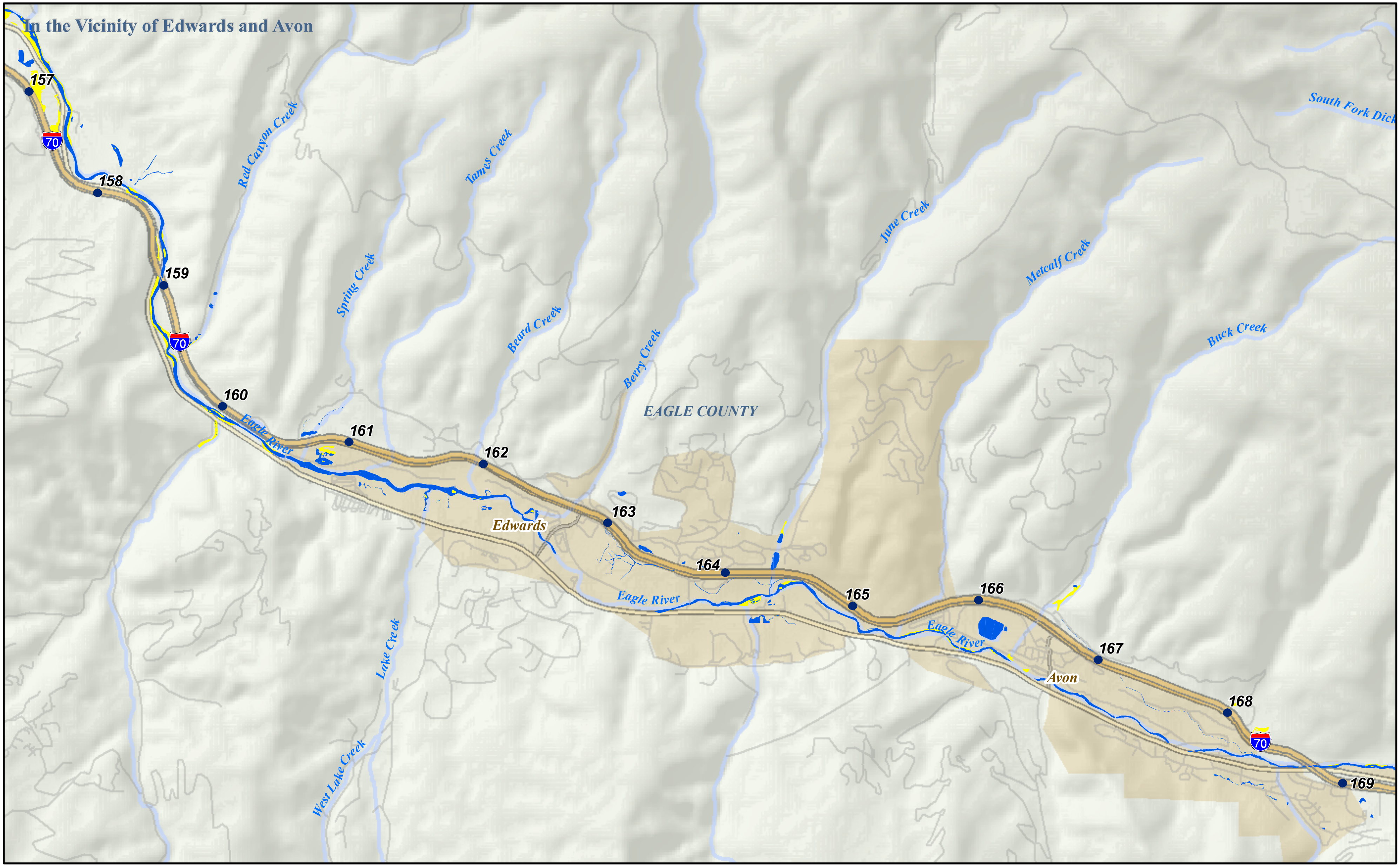

Legend

- Mileposts
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- County Boundary
- Urban Areas
- Streams
- Fen Locations
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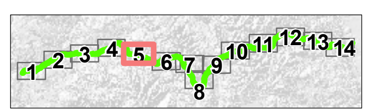
- Channel / Waterbody



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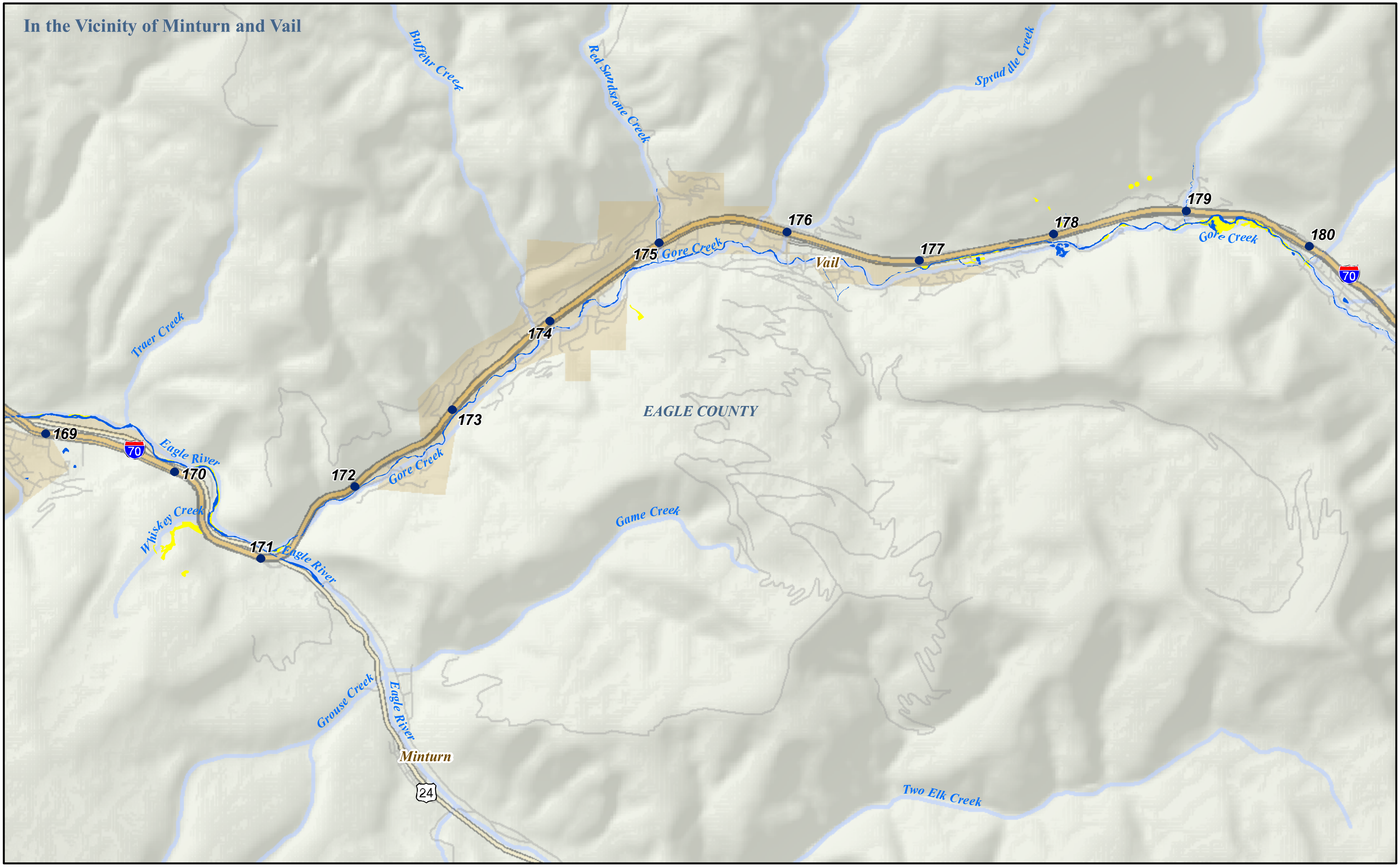
U.S. Department of Transportation Federal Highway Administration

Wetlands



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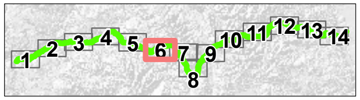

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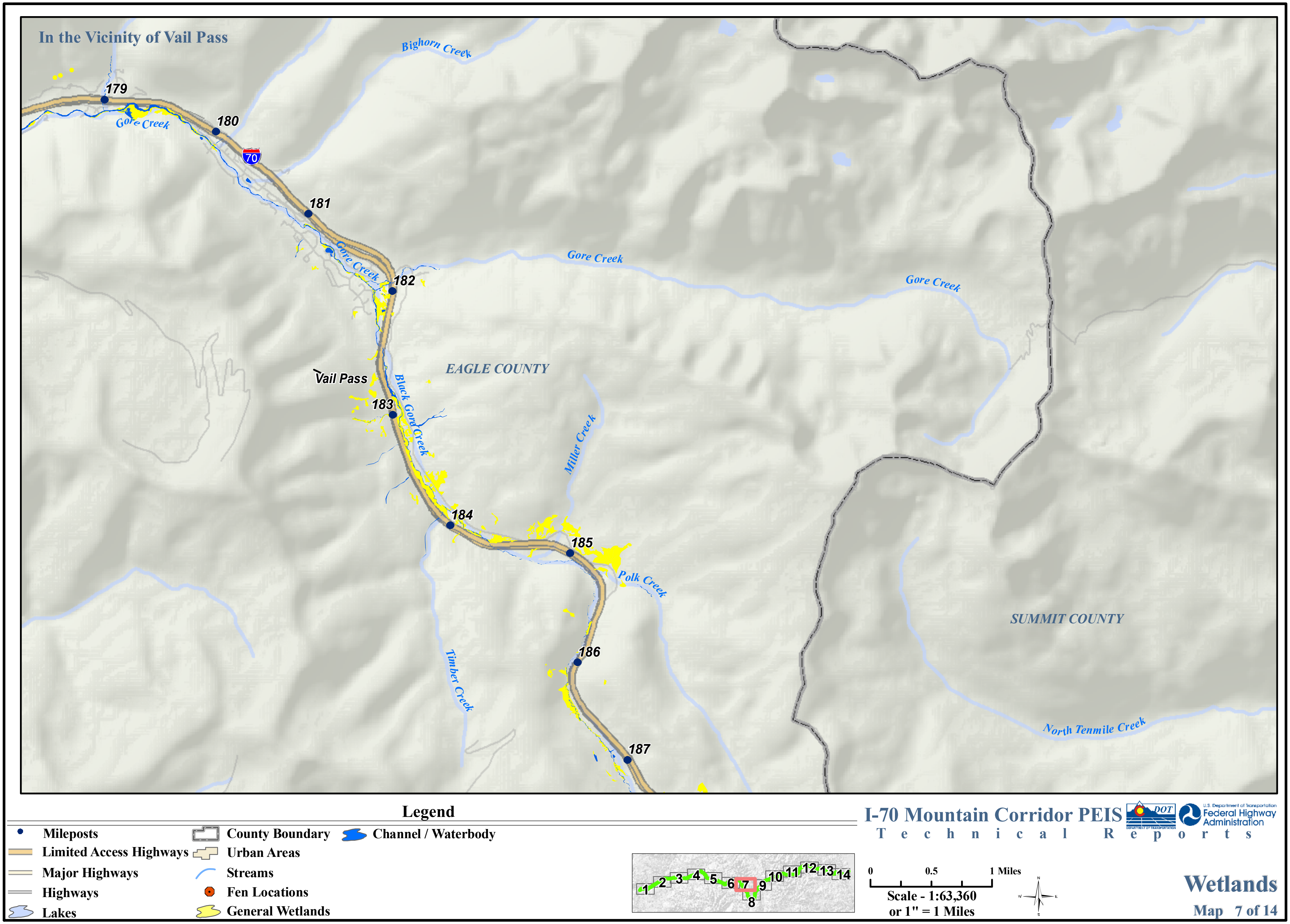
Wetlands

Map 6 of 14



In the Vicinity of Vail Pass
Bighorn Creek
179
180
181
182
183
184
185
186
187
Gore Creek
Gore Creek
Gore Creek
Gore Creek
70
Vail Pass
Black Gore Creek
EAGLE COUNTY
Miller Creek
Polk Creek
Timber Creek
SUMMIT COUNTY
North Tenmile Creek
Legend
Mileposts
Limited Access Highways
Major Highways
Highways
Lakes
County Boundary
Urban Areas
Streams
Fen Locations
General Wetlands
Channel / Waterbody
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U.S. Department of Transportation Federal Highway Administration
Wetlands
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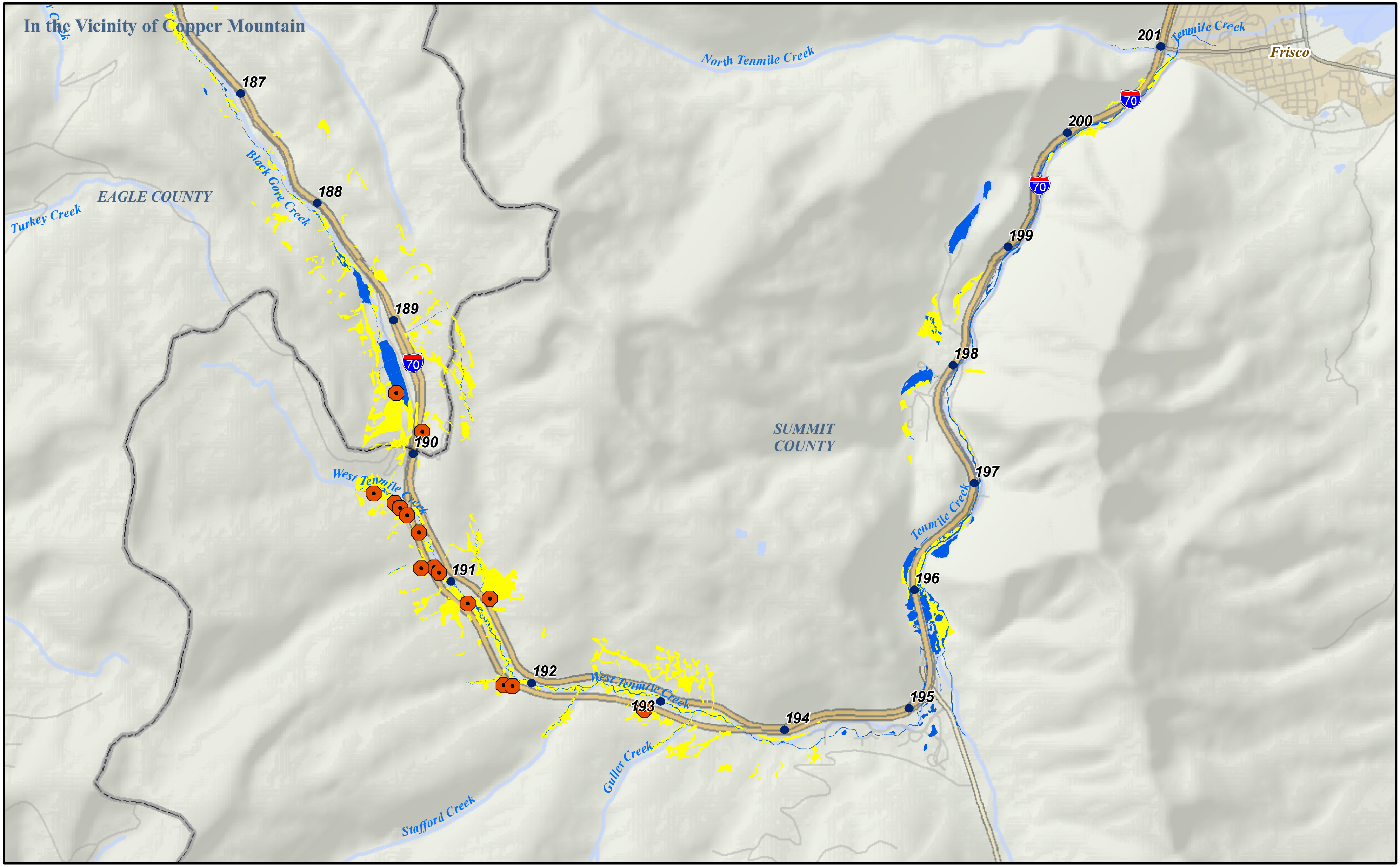

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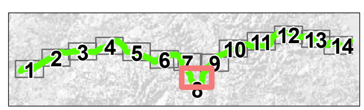
- County Boundary
- Urban Areas
- Streams
- Fen Locations
- General Wetlands
- Channel / Waterbody



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Wetlands

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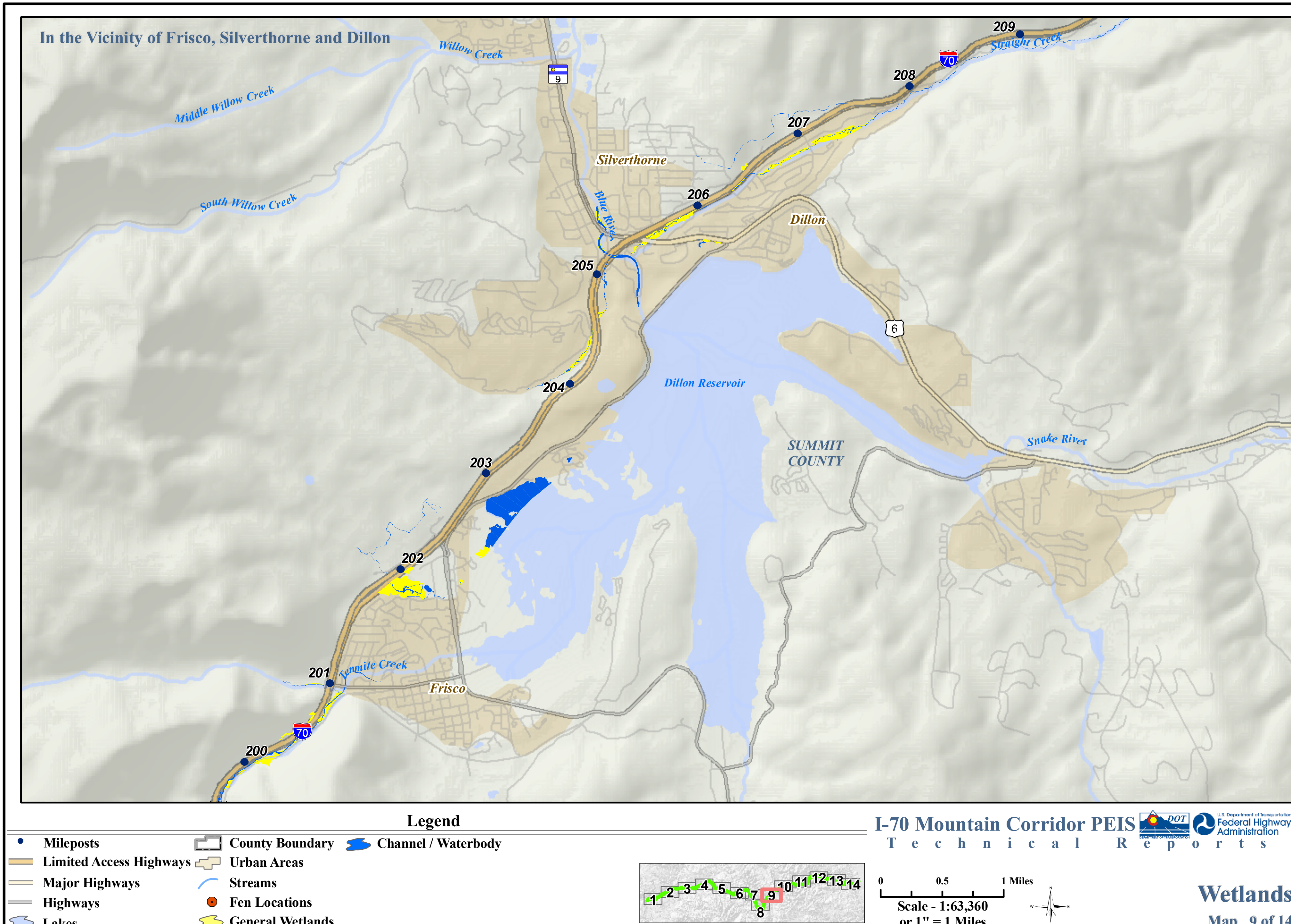

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Wetlands

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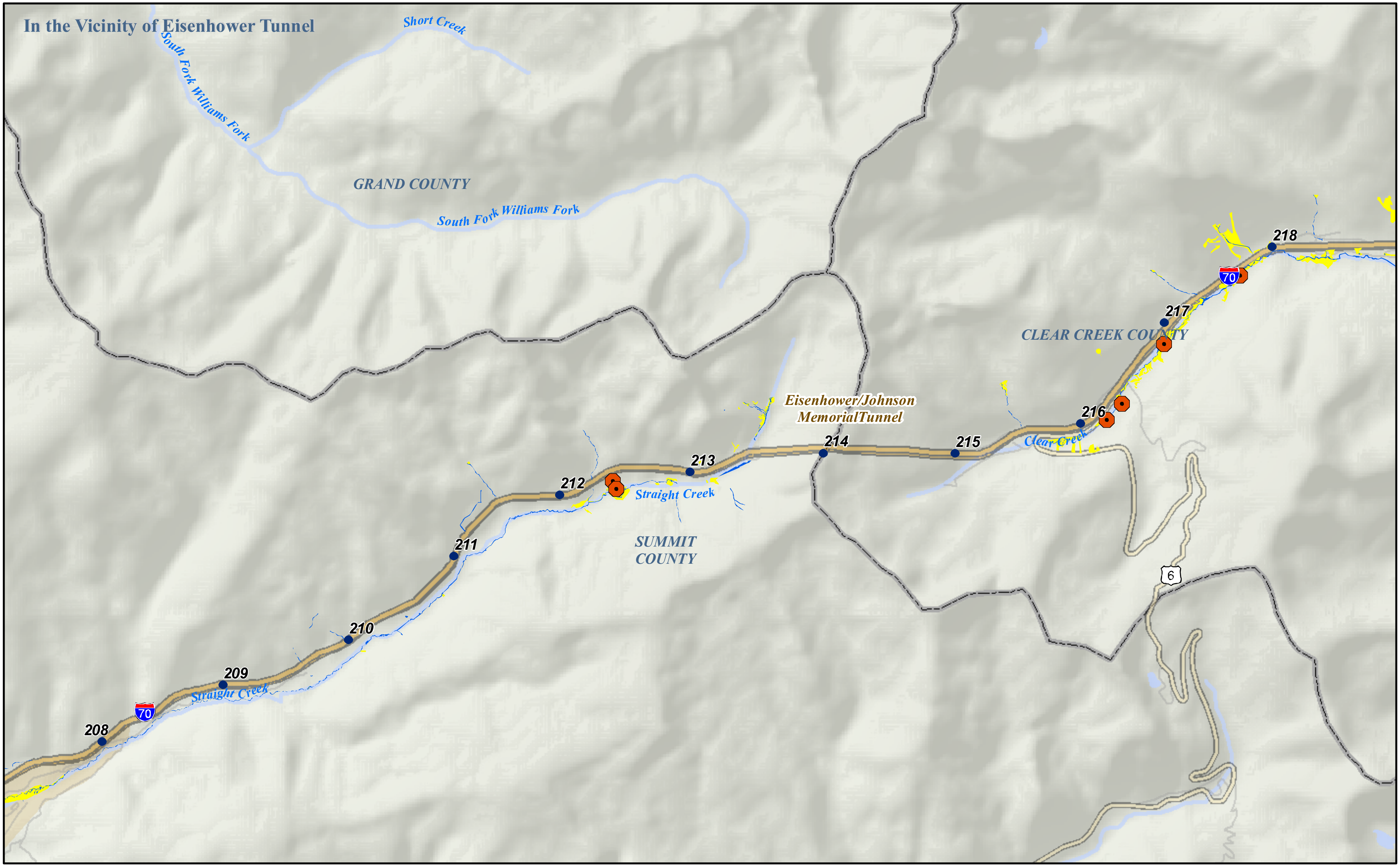

Legend

- Mileposts
- Limited Access Highways
- Major Highways
- Highways
- Lakes
- County Boundary
- Urban Areas
- Streams
- Fen Locations
- General Wetlands
- Channel / Waterbody

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Wetlands

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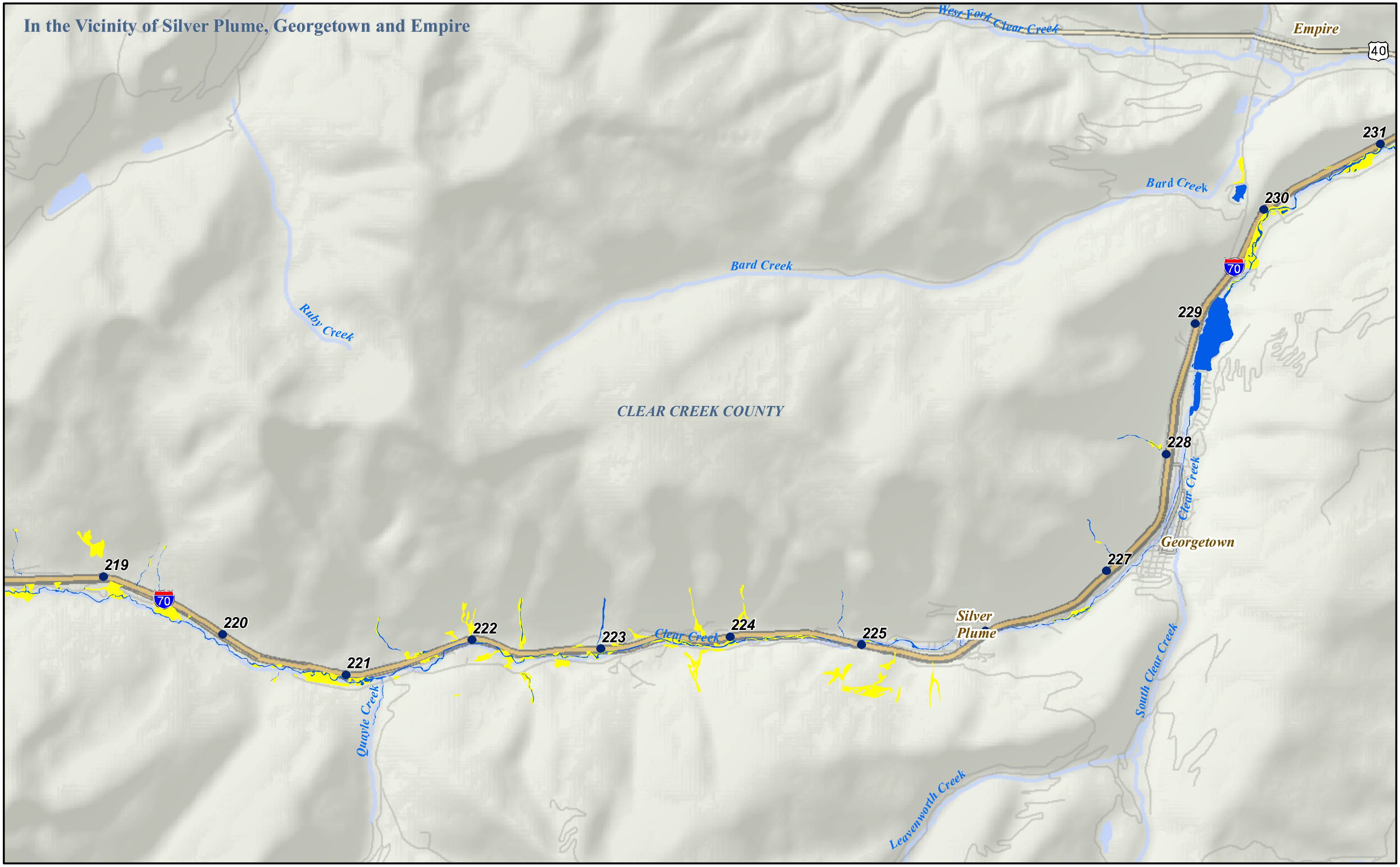

Legend

- Mileposts
- Limited Access Highways
- Major Highways
- Highways
- Lakes
- County Boundary
- Urban Areas
- Streams
- Fen Locations
- General Wetlands
- Channel / Waterbody

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Wetlands

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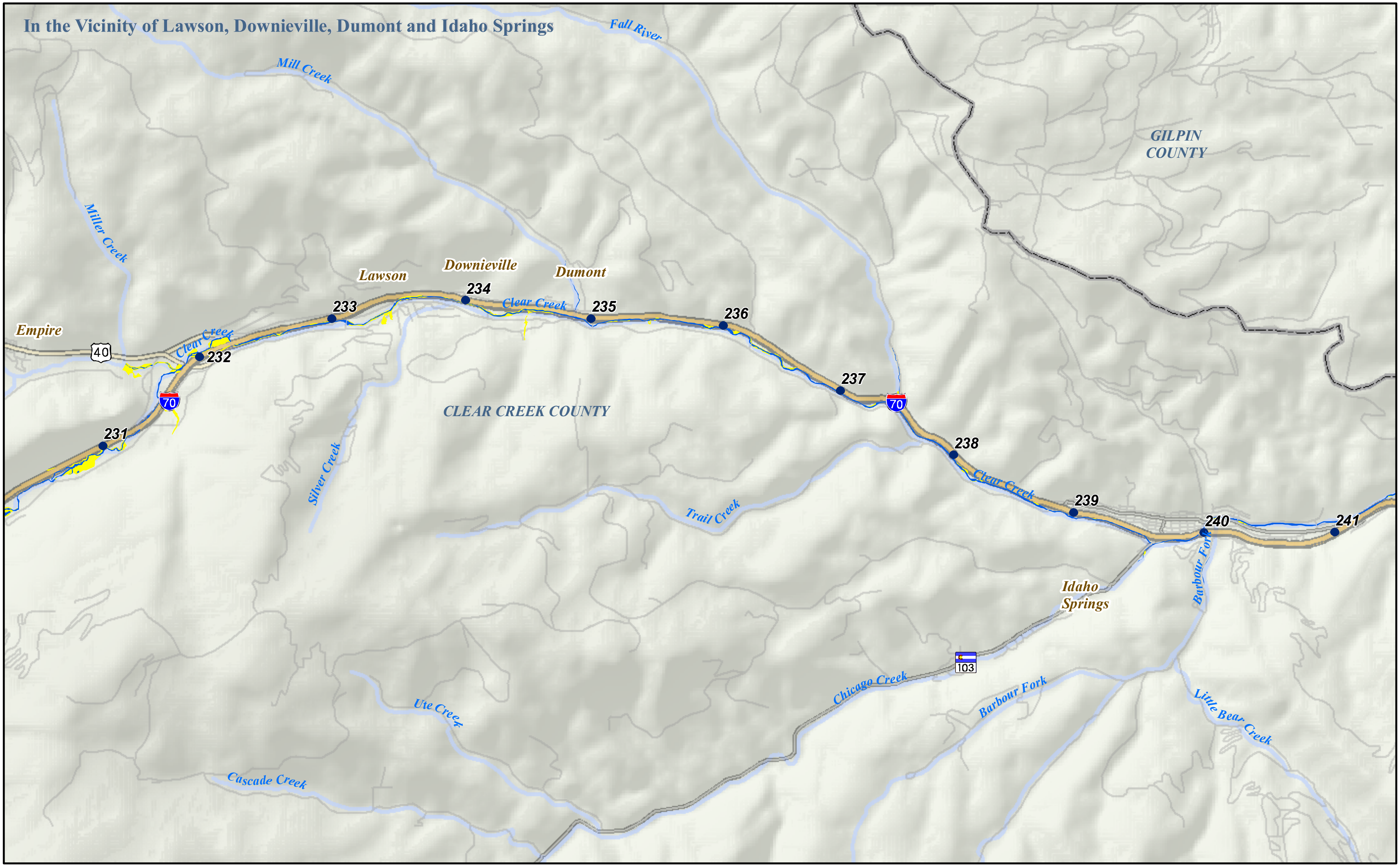
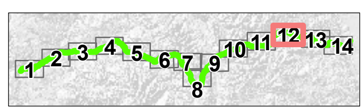


Legend

- Mileposts
- Limited Access Highways
- Major Highways
- Highways
- Lakes
- County Boundary
- Urban Areas
- Streams
- Fen Locations
- General Wetlands
- Channel / Waterbody



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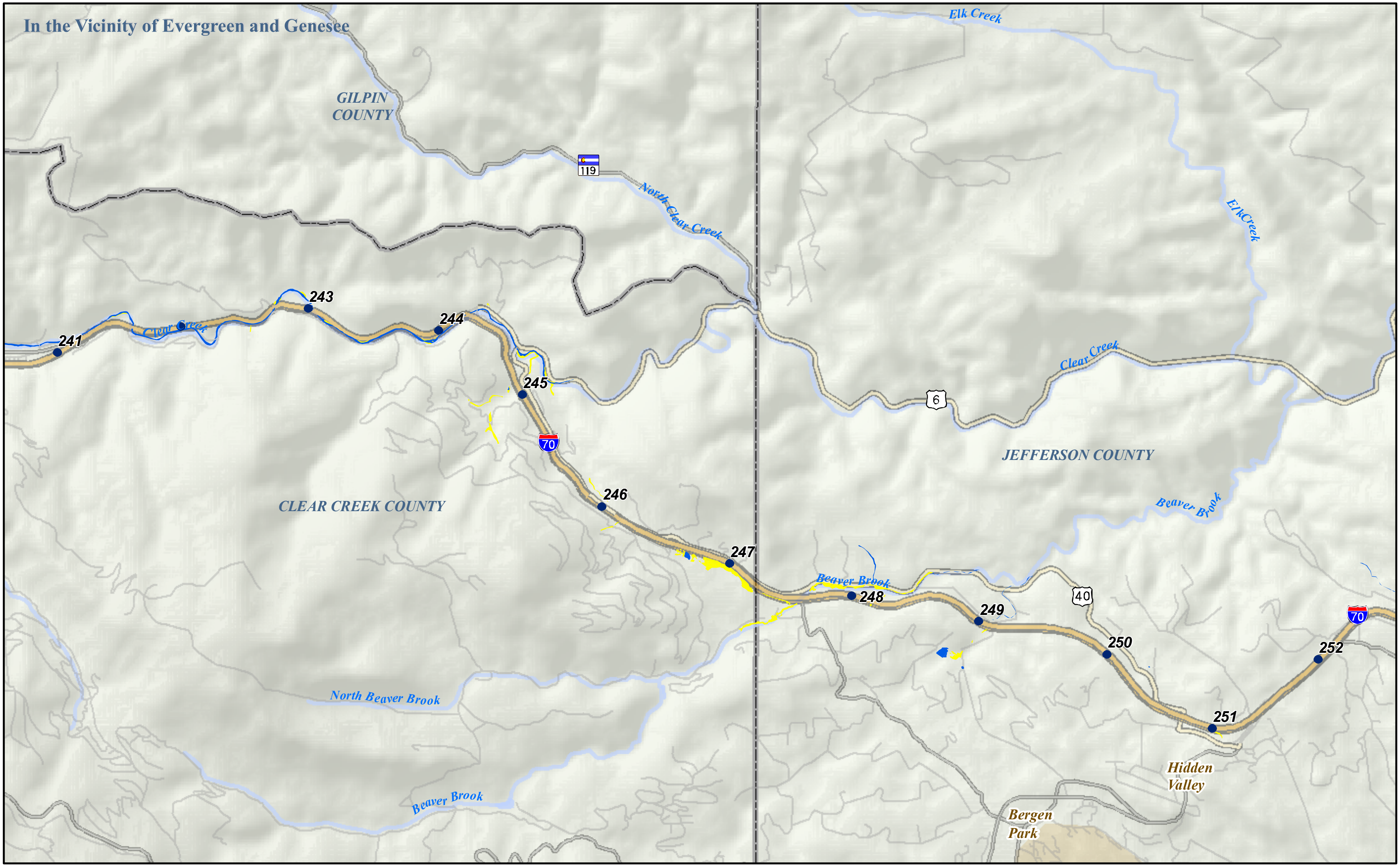
In the Vicinity of Evergreen and Genesee



Legend

- Mileposts
- Limited Access Highways
- Major Highways
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- County Boundary
- Urban Areas
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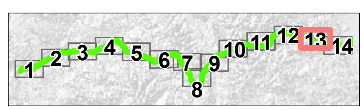
- Fen Locations
- General Wetlands
- Channel / Waterbody



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or 1" = 1 Miles

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Legend

- Mileposts
- Limited Access Highways
- Major Highways
- Highways
- Lakes
- County Boundary
- Urban Areas
- Streams
- Fen Locations
- General Wetlands
- Channel / Waterbody

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0 0.5 1 Miles

Scale - 1:63,360
or 1" = 1 Miles

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4.3 Blue River Sub-basin

Existing wetlands and other waters of the U.S. within the Blue River sub-basin are summarized in **Table 2**. The Blue River sub-basin includes:

- **West Tenmile Creek –** West Tenmile Creek has extensive areas of wetlands (mp 190 to mp 195). These wetlands are associated with the relatively broad valley bottom, lateral channels, and the relatively moderate slopes of the valley. The higher altitude produces an environment with higher moisture availability from spring runoff and summer rains, as well as a relatively short growing season with cooler temperatures. These factors combine to produce an abundance of wetlands and the necessary conditions for development of fens with deep organic layers. A preliminary examination of the organic soil horizons in this area indicates that some, but not all, of the fens are classified as fens with histosols or histic epipedons soil types. Many of the other wetland areas that were sampled do not qualify as fens. Fens are most abundant and likely to occur at the higher elevations of West Tenmile Creek, especially near the summit of Vail Pass. Areas where perennial drainages join West Tenmile Creek represent additional locations with some probability for supporting fens.
- **Tenmile Creek –** The Curtain Ponds between the I-70 highway and Tenmile Creek were restored as part of the construction work of the I-70 highway in the late 1960s (mp 195 to mp 197). This restoration of Tenmile Creek included channel realignment and placement of log drop structures and willows to improve habitat diversity. Lakes and ponds used for recreation dominate the wetlands in this section. Urban development encroached along the area near Dillon Reservoir, which is a dominant feature in this sub-basin (mp 197 to mp 205); however, wetlands are associated with the margin of the reservoir and some lateral drainages, such as Salt Lick Gulch.
- **Straight Creek –** The Straight Creek section of the Corridor is west of the Continental Divide and includes a wide zone of elevation change (mp 206 to mp 213); it extends from the Upper Montane-Subalpine ecotone into the Subalpine-Alpine ecotone. The steeper channel gradient and narrow valley bottom support fewer wetlands, yet there are some alpine willow complexes near the west portal of the Eisenhower-Johnson Memorial Tunnels. There is some potential for fens to occur in this section; however, inspected sites showed that no fens were present.

Table 2. Existing Project Area Wetlands and Other Waters of the U.S. in the Blue River Sub-basin

Resource Type	Acres
General Wetlands	494.40
Fens	3.55
Other Waters of the U.S.	250.27

4.4 Clear Creek Sub-basin

Existing wetlands and other waters of the U.S. within the Clear Creek sub-basin are summarized in **Table 3**. The Clear Creek sub-basin includes:

- **Clear Creek –** The elevation zone of Upper Clear Creek (Eisenhower-Johnson Memorial Tunnels to the town of Georgetown – mp 215 to mp 227) has an abundance of wetlands along Clear Creek, with some large areas of wetlands in lateral drainages and on moist slopes with seeps. An area near mp 231 (near the US 40/I-70 junction) has a reduced stream-channel gradient and slightly wider valley bottom that supports wetlands. The elevation gradient from Empire Junction to Floyd Hill spans the Lower Montane Zone region to the Middle Montane/Upper Montane ecotone region.

- **Mount Vernon Creek –** Several small wetlands were mapped within the Mount Vernon Creek portion of the Corridor (mp 254 to mp 259). Several small areas of cattail marshes have formed where drainage is impounded and occur in this area of the Corridor from approximately the Lookout Mountain exit to the top of Floyd Hill.

Table 3. Existing Project Area Wetlands and Other Waters of the U.S. in the Clear Creek Sub-basin

Resource Type	Acres
General Wetlands	380.63
Fens	0.92
Other Waters of the U.S.	254.80

Section 5. Environmental Consequences

This section addresses direct, indirect, and temporary impacts on wetlands, fens, and other waters of the U.S. for each Action Alternative. Impacts to wetlands, fens and other waters of the U.S. were determined through a Geographic Information System overlay process in which the impact footprint was superimposed onto each of the above-mentioned resources within the Corridor. Impacts were quantified for the whole Corridor for each resource. In determining potential effects on wetlands and other waters of the U.S. from the Action Alternatives, direct and indirect effects were included. The following text addresses impacts by alternatives on wetlands, fens, and other waters of the U.S.

5.1 Direct Impacts

All of the Action Alternatives result in impacts on wetlands and waters of the U.S., except for the No Action Alternative. The impacts on wetlands and waters of the U.S. associated with the Minimum Program of the Preferred Alternative (15.8 acres) are less than the impacts associated with all other alternatives, with the exception of the Minimal Action Alternative (14.6 acres) and Advanced Guideway System Alternative (15.4 acres), which do not meet the purpose and need of the this project. The maximum quantity of impacts on wetlands if the Maximum Program of the Preferred Alternative is fully implemented (32.3 acres) is more than the impacts associated with other Action Alternatives, except the Combination Six-Lane Highway with Rail and Intermountain Connection Alternative (36.6 acres), and the Combination Six-Lane Highway with Diesel Bus in Guideway (32.5 acres).

Table 4 provides a visual summary of direct impacts on wetlands, fens, and other waters of the U.S. by Action Alternative and resource.

All alternatives are believed to avoid impacts to fens. It is CDOT policy to avoid fens where ever practicable. This conclusion will be updated through an inventory of wetlands and fens completed in Tier 2 processes.

Table 4. Comparison of Wetlands Impacts by Resource and Alternative (Acres)

Alternative	General Wetlands	Fens	Other Waters of the U.S.	Total Impacts
No Action	0.0	0.0	0.0	0.0
Minimal Action	5.6	0.0	9.0	14.6
Rail with IMC	10.0	0.0	15.5	25.5
AGS	4.6	0.0	10.8	15.4
Dual-Mode Bus in Guideway	7.2	0.0	11.7	18.9
Six-Lane Highway (55 mph)	9.0	0.0	11.4	20.4
Six-Lane Highway (65 mph)	9.1	0.0	12.4	21.5
Reversible/HOV/HOT Lanes	10.6	0.0	13.0	23.6
Combination Six-Lane Highway with Rail and IMC	17.2	0.0	19.4	36.6
Combination Six-Lane Highway with AGS	13.3	0.0	17.4	30.7
Combination Six-Lane Highway With Diesel Bus in Guideway	14.5	0.0	18.0	32.5
Preferred Alternative[1]	6.5 - 13.3	0.0 - 0.0	9.3 - 19.0	15.8 - 32.3

[1]The Preferred Alternative is presented as a range because the adaptive management component allows it to be implemented based on future needs and associated triggers for further action. Chapter 2, Section 2.7 of the I-70 Mountain Corridor PEIS (CDOT, 2010) document describes the triggers for implementing components of the Preferred Alternative.

Key to Abbreviations/Acronyms

HOV = high occupancy vehicle HOT = high occupancy toll AGS = Advanced Guideway System

IMC = Intermountain Connection mph = miles per hour

5.2 Indirect Impacts

Indirect impacts on wetlands include erosion and sedimentation from winter sanding and effects associated with possible induced growth associated with Action Alternatives, as presented in **Chapter 3.7: Land Use and Right of Way** of the *I-70 Mountain Corridor PEIS* (CDOT, 2010). All Action Alternatives, other than No Action and Minimal Action, induce varying levels of growth in the Eagle River sub-basin. Induced growth causes additional impacts on wetlands and other waters of the U.S. due to encroachment/loss and construction impacts (erosion/sedimentation). Sedimentation is an existing problem in the Corridor, and all of the Action Alternatives could contribute to that problem during construction. However, through implementation of the mitigation strategies presented in **Section 3.19** of the I-70 Mountain Corridor PEIS (CDOT, 2010) primarily the SWEEP Memorandum of Understanding), all Action Alternatives improve the sedimentation problem throughout the Corridor.

Most indirect impacts would result from the increase in impervious surfaces caused by additional lanes or added road shoulders. The greater area of impervious surfaces would be expected to increase roadway runoff, surface flows in adjacent streams, erosion, and the creation of channels in wetlands that were previously free of channelization. New flows could contain pollutants associated with roadway runoff.

Additional sediment and erosion would be expected during and after construction until exposed fill and cut slopes could be successfully re-vegetated.

Other indirect wetland effects include the decrease or elimination of upland tree and/or shrub buffers between the Corridor and wetlands adjacent to other aquatic sites. Buffers filter pollutants before they reach wetlands, streams, and lakes as well as provide habitat for wildlife.

Because the Action Alternatives primarily follow existing transportation lines, many wetlands and other waters of the U.S. currently receive indirect impacts from general activity and maintenance practices. However, the magnitude of indirect impacts would increase with increased area of the roadway.

Importing water to accommodate increased water supply demands from induced growth increases the flow of water in waterways. This increased flow potentially destabilizes streambanks throughout the Corridor. A more detailed analysis of indirect impacts on wetlands and other waters of the U.S. will be conducted during Tier 2 processes.

Winter traction sanding operations and erosion along the Corridor have been identified as impairments to wetlands and water quality. Sediment loading in wetlands due to erosion and sanding operations degrades the natural function of wetlands and degrades water quality in rivers, creeks, streams, reservoirs, and lakes. Means to reduce the impacts of winter sanding operations to area streams are currently being implemented in the Corridor. Sediment Control Action Plans are focusing on Black Gore Creek (Upper Eagle River sub-basin) and Straight Creek (Upper Blue River sub-basin) because these systems have already been adversely affected by traction sand. A Clear Creek Sediment Control Action Plan is under development.

The Colorado Transportation Commission identified these two creeks for immediate remediation action regardless of the outcome of the *I-70 Mountain Corridor PEIS* (CDOT, 2010). The Colorado Department of Transportation has led the effort and has coordinated with the Black Gore Creek Steering Committee and the Straight Creek Cleanup Committee. This action will result in new practices to provide a beneficial effect on many of the stream systems and associated wetlands along I-70. Other measures to address winter maintenance are currently being evaluated and include sand retrieval, automated deicing systems, and solar snow storage zones (CDOT 2002a, 2002b).

5.3 Construction Impacts

Impacts associated with the footprint of the project are considered permanent because the transportation facility (such as additional traffic lanes, rail, and interchange reconstruction or transit stations) covers the given resource. Impacts associated with construction disturbance are considered temporary because this area could later be reclaimed.

In addition to causing losses of wetlands, construction of Action Alternatives has the potential to affect wetlands adjacent to and downstream from the alternatives. Changes in hydrological regime and water quality can cause changes in plant dispersal and survival, leading to plant community shifts over time and resulting in effects on an entire ecosystem’s function.

5.4 Impacts in 2050

By 2050, climate change, continued development and changing water supply demands in the Corridor could affect both groundwater and surface water levels, potentially contributing to the existing trend of loss and degradation of wetlands. As a result, the wetland acreage present at the time of construction impacts may be less than the current condition, resulting in the Action Alternatives impacting less wetland acreage than currently estimated. Because the Action Alternatives contribute to the existing trend of loss and degradation of wetlands in the Corridor, extending the timeframe for construction impacts out to 2050 allows the wetlands to exist and contribute to the biological system for additional time. This benefits the biological system in the short-term.

Section 6. Tier 2 Considerations

Tier 2 processes will include the following:

- A delineation of all wetlands to identify affected resources with greater detail including vegetative characteristics, soil properties, and hydrological sources, using approved U.S. Army Corps of Engineers methodology.
- Identification and analysis of impacts to fens for each specific project and will require in-depth field studies to identify fens. In such cases, project plans will need to be modified to avoid affecting these areas.
- Functional Assessment of wetlands within the Corridor using the Functional Assessment of Colorado Wetlands (FACWet) Methodology.
- Analysis to separate jurisdictional and non-jurisdictional wetlands for permitting the specific alternative.
- A more detailed analysis of direct and indirect impacts to wetlands and other waters of the U.S.
- Development of specific and detailed mitigation strategies and measures.
- Development of specific best management practices for each project.

Section 7. Mitigation

At the first tier, the mitigation focuses on avoidance and minimization of impacts. Impact avoidance and minimization strategies are incorporated into the development of Action Alternative alignments and design concepts. **Chapter 2: Summary and Comparison of Alternatives** of the *I-70 Mountain Corridor PEIS* (CDOT, 2010) lists efforts to avoid and minimize impacts. However, while mitigation activities avoid and minimize impacts, some impacts on Corridor wetlands and other water resources are likely.

The Colorado Department of Transportation is committed to implementing the SWEEP Memorandum of Understanding as the foundation for mitigation for aquatic resource impacts during projects along the Corridor and within its communities. The SWEEP Committee will identify and recommend appropriate mitigation strategies, including design, implementation, and monitoring to anticipate environmental impacts resulting from redevelopment of the Corridor. The SWEEP Committee will coordinate with the ALIVE (A Landscape Level Inventory of Valued Ecosystem Components) Committee to increase the permeability of the I-70 Mountain Corridor to terrestrial and aquatic species to provide and maintain long-term protection and restoration of wildlife linkage areas, improve habitat connectivity, and preserve essential ecosystem components.

Overall, mitigation strategies provide the opportunity to reduce impacts and enhance wetland environments in the Corridor. Impacts to wetlands and other waters of the U.S. will be addressed more specifically for each project evaluated in Tier 2 processes. Additionally, CDOT's policy is to mitigate all impacts on a one-to-one per acre basis, regardless of whether the wetland is jurisdictional or non-jurisdictional. Mitigation ratios will be subject to approval by the U.S. Army Corps of Engineers.

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Appendix A. Wetland Surveys and Findings Assessment Within and Near the Maximum Footprint for the Proposed Colorado I-70 Corridor Improvement Project, Tier 1 (Milepost 130 to Milepost 259)

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Wetland Surveys and Findings Assessment within and near the Maximum Footprint for the Proposed Colorado I-70 Corridor Improvement Project, Tier I

Milepost 130 to Milepost 259

Submitted to:
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December 23, 2009

This report has been reviewed and concurred upon by Steve J. Popovich, Forest Botanist, Arapaho and Roosevelt National Forests and Pawnee National Grassland, Supervisor's Office, Fort Collins, Colorado.

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Authors' Biographies

Jennifer Jones is a Research Associate with Colorado State University. She has worked on a variety of botany and wetland related projects in the Rocky Mountains and Sierra Nevada since 2001. Her relevant project experience includes vegetation mapping at Rocky Mountain and Yosemite National Parks, wetland inventories of Hinsdale and Grand Counties of Colorado with the Colorado Natural Heritage Program, and developing a long-term monitoring program for wetland resources in the Sierra Nevada Network Parks: Yosemite, Sequoia, and Kings Canyon. Projects have involved extensive vegetation sampling in wetland resources and field verification of organic soils in mountains of the western U.S. She received a B.S. in Botany from North Carolina State University, Raleigh, NC (2000). She is currently a candidate for a Master's degree in the Graduate Degree Program in Ecology at Colorado State University, Fort Collins. Her thesis research focuses on the contribution of wet meadows and fens to the regional floristic diversity of Sequoia and Kings Canyon National Parks.

Katharine Driver is a Research Associate with Colorado State University. She has worked on vegetation and wetland projects in the Rocky Mountains for 8 years. Her projects have included vegetation mapping at Great Sand Dunes National Monument and Rocky Mountain National Park with the Colorado Natural Heritage Program and developing and implementing a long-term monitoring protocol for wetlands in Rocky Mountain National park with the National Park Service Inventory and Monitoring. This work has included extensive vascular and non-vascular plant identification, vegetation classification and work with large collections of bryophytes from Colorado wetlands. She received her Bachelor's degree in Biology from Knox College, Galesburg, IL in 2001 and is currently a candidate for a Master's degree with the Graduate Degree Program in Ecology at Colorado State University, Fort Collins, CO. Her thesis research endeavors to distinguish the differences in soils, hydrology, and vegetation in fens and wet meadows of the Rocky Mountains.

David J. Cooper, Ph.D., is a Senior Research Scientist and Associate Professor in the Department of Forest, Rangeland and Watershed Stewardship, and a faculty member in the Graduate Degree Program in Ecology at Colorado State University, where he has worked for 17 years. He received his Ph.D. in Biology from the University of Colorado, Boulder in 1983. For the past 26 years his research and teaching has involved wetland and riparian ecosystems in western North America. He has expertise in the flora, vegetation, ecosystem classification, restoration, hydrology, geochemistry and geomorphology of wetlands and riparian lands. Dr. Cooper has extensive field and research experience dealing with western North America wetlands, particularly fen identification and ecology in Colorado.

Summary

Fens are recognized as an irreplaceable resource in the Southern Rocky Mountain Region due to the functional and biological values they provide. In order to protect and reduce impacts to these unique wetlands, they must be inventoried and mapped in areas that may be impacted by development. This study provides a first approximation of fen resources along the Interstate 70 corridor from Milepost 259 to 130 in Colorado. The study aims to inform managers of the potential impacts of development to fens along this section of the interstate.

Introduction

In the semi-arid, southern Rocky Mountains, water is a limiting resource and wetlands often occur as discrete features in a largely dry landscape. Wetlands are an important functional component of Rocky Mountain ecosystems, providing flood attenuation storage, aquifer discharge and recharge, carbon storage, water quality restoration, nutrient cycling, and sediment stabilization and sequester (Grimm et al. 1997, Mitsch and Gosselink 2000b, Wurster et al. 2003, Sutula et al. 2006, Harvey et al. 2007). Wetlands also provide important aesthetic values, critical habitat, landscape variability, and are economically valuable in many areas of the world. It is estimated that by the 1980's the United States had lost over half of the original 221 million acres of wetland present at the time of European settlement (Dahl 2006). Western states are reported to have lost between 50 and 90% of wetland area by this time, making the task of understanding and managing for this resource in natural areas imperative (Dahl and Johnson 1991).

Peatlands are an ecologically and economically important wetland type, and in the northern hemisphere are concentrated in relatively flat boreal regions with cold, humid climates. This wetland type covers approximately 3% of the earth surface and is a reservoir for 30% of the world's terrestrial carbon (Chadde et al. 1998, Wieder and Vitt 2006). Peatlands are characterized by perennially saturated soils maintained at low temperatures which slows decomposition causing organic matter to accumulate as peat (Moore and Bellamy 1974, Mitsch and Gosselink 2000a). Peatland type, occurrence, and extent are predominantly driven by precipitation, temperature, hydrologic source, regional lithology, and geomorphology (Bridgham et al. 1996, Wieder and Vitt 2006). The hydrologic source maintaining a peatland greatly influences water chemistry and vegetation composition. Although peatlands span a hydrologic source gradient, they are typically classified into either ombrotrophic, precipitation-fed (bog) or minerotrophic, groundwater-fed (fen) groups. Fens are further divided along a poor to rich nutrient and pH gradient.

Peatlands reach their southern extent in North America in high elevation regions of the Sierra Nevada and Rocky Mountains (Bedford and Godwin 2003). In the southern Rocky Mountains of Colorado, climate is characterized by an intercontinental pattern of warm, dry summers and long, cold winters. Due to the combined effects of climate and geomorphic features on the landscape, peatlands are concentrated at high elevations and have formed in sites of groundwater discharge (Bedford and Godwin 2003). Because of high evaporative demands and dry climate in this region compared to boreal regions, all peatlands are properly classified as fens (Cooper and Andrus 1994). Cooper and

Sanderson estimate that fens cover approximately 0.08-0.15% of the landscape in Colorado (Bedford and Godwin 2003). Fens often occur as small patch habitats, so they are not uncommon on the landscape in this region, but provide a unique habitat type that covers limited area (Johnson and Steingraeber 2003).

Forest Resource Specialists of the Arapaho and White River National Forests recognize fens as a rare and specialized resource (Popovich personal communication 2009). In addition to the functional values provided by wetland resources, fens have high biological value in this region. Fens in Colorado have been shown to make important contributions to regional diversity, often supporting unique species assemblages and sensitive relictual species whose primary distributions are in boreal regions (Cooper 1996, Chadde et al. 1998, Bedford and Godwin 2003). Some of the rarest plants on these Forests are restricted to fens, for example *Drosera rotundifolia* and *Carex diandra*. Both Forests strive to achieve full protection of fen resources, and to maintain viable populations of associated rare plants.

The goal of this study was to identify the extent of fens within the zone of proposed highway improvement or expansion along the Interstate 70 (I-70) corridor from Golden, Colorado (milepost 259) to the mouth of the Glenwood Canyon (milepost 130). No comprehensive survey of this area has been developed for wetland or fen resources. Within fens identified during this survey, we identified populations of rare plants, peat humification in the upper 40 cm, performed a qualitative assessment of dominant plant communities, assessed fen type, and site condition. This report provides a first approximation of fen resources along this stretch of highway. The study is aimed at informing resource specialists about the presence and qualitative descriptors of fens and associated rare plants to better assess potential impacts to these resources resulting from proposed development along or within the corridor.

Definitions and Classification

Wetlands

Wetlands are defined using three criteria: cover of hydrophytes, hydric soils, and soil saturation within 12 inches of the surface for sufficient time during the growing season to cause anaerobic conditions (Environmental Laboratory 1987, National Research Council 1995, Mitsch and Gosselink 2000b). The definition used often depends on the focus of a particular project or the desired standard. The definition used by the U.S. Fish and Wildlife Service, developed for the National Wetlands Inventory mapping effort is more inclusive, requiring only one of the three criteria be met for a site to be defined as a wetland (Cowardin et al. 1979). The most restrictive definition of wetlands, developed by the U.S. Army Corp. of Engineers for Section 404 of the Clean Water Act, requires that all three criteria be met for a site to be defined and regulated as a jurisdictional wetland (Environmental Laboratory 1987). For the purpose of this project, we have adopted the Corp definition as a baseline for defining and delineating fens within the assessment area.

Fens

All peatlands in the Southern Rocky Mountains are supported by ground waters (Cooper and Andrus 1994). Two general landforms have supported peatland formation in our region, as defined by their geomorphologic setting and hydrology, topogenous and soligenous (Rocchio 2005). **Topogenous or basin fens** are those peatlands formed in connection with a confined water source such as a topographic depression or lacustrine system. **Soligenous or sloping fens** are peatlands formed in relation to flowing surface or groundwater on gentle slopes or at topographic breaks.

Fens are distinguished from other wetlands and uplands by thickness of peat, hydrologic regime, and vegetation composition (Bedford and Godwin 2003). For the purpose of this study we define fens as wetlands with:

1) wetlands with histosols, soils with at least 40 cm of peat layers in the upper 80 cm of soil
2) soil saturation within the upper 12 inches of the soil surface for some time during the growing season
3) 50% or greater cover of hydrophytes ranked OBL, FACW, or FAC according to NWI and

Soils

Hydric soils are saturated for long enough during the growing season to exhibit indicators of anaerobic conditions (U.S. Department of Agriculture - Soil Conservation Service 1985). All histosols are considered hydric soils with peat accumulation being the indicator of anaerobic conditions. Histosols are organic soils with peat thickness greater than 40 cm in the upper 80 cm (USDA 2003). A histosol must have 12% to 18% organic carbon content by weight depending on the clay content of the mineral portion, with higher proportions of clay requiring higher carbon matter (Tate 1987). Organic soils are further classified into suborders based on their humification level, or the amount of decomposition. Fibric peat is relatively undecomposed, hemic peat is moderately decomposed and sapric peat or muck is highly decomposed (Ekono 1981, Andriesse 1988). The level of humification and source of peat influences bulk density and water-holding capacity of the peat body and can indicate disturbance and changes in climate and hydrology (Francez and Vasander 1995, Laiho 2006).

Hydrology

Perennially high water tables drive peat accumulation and the autogenic processes sustaining peatlands (Chadde et al. 1998). Fens are characterized by their connectivity to groundwater in our region as direct precipitation inputs are not adequate to create perennially saturated areas which would allow ombrotrophic (rain-fed) peatlands to develop. Though hydrology drives vegetation and peat accumulation in fens, this factor is very difficult to assess based on single, disparate water table measurements so vegetation and soils are often used as a proxy for understanding general hydrologic trends in a wetland. Some field indicators of wetland hydrology include drainage patterns, drift lines, sediment deposition, watermarks, and visual observation of saturated soils (Environmental Laboratory 1987). Many of these indicators are not readily apparent in the focal habitat type, so a measure of water table depth and observation of soil saturation within the rooting zone is used. Measuring water table depth in a wetland entails digging a soil pit to approximately 40 cm and allowing the water to equilibrate to obtain a water table measurement. Soil saturation is assessed by examining soils from the pit and feeling for moisture.

Vegetation

Hydrophytic vegetation includes plant species "typically adapted" to saturated soil conditions (Environmental Laboratory 1987). Jurisdictional wetlands contain >50% cover of species found predominantly in wetlands, ranked OBL, FACW or FAC (U. S. Fish and Wildlife Service 1996). Many species that occur in wetlands have been assigned a wetland indicator status value based on expert opinion and existing data (U. S. Fish and Wildlife Service 1996). These values indicate the likelihood that a given species will occur in wetlands and can be used to determine the cover of hydrophytic species.

Vegetation can also be an important tool in classifying wetlands (Tiner 1993). Species and communities in fens are often indicative of hydrologic regime, groundwater nutrients and pH. Poor fens have vegetation most similar to bogs due to similar pH and nutrients. They are often dominated by species in the family Cyperaceae that do not occur on calcareous substrates, as well as species of *Sphagnum* and ericaceous shrubs (Bedford and Godwin 2003). Transitional to rich fens are more often dominated by species of Cyperaceae, a rich flora of herbaceous dicots, and true or 'brown mosses' (Wheeler and Proctor 2000). Fens of the southern Rocky Mountains are often dominated by species in the genus *Carex* which can comprise up to 100% of the cover (Rocchio 2005). Species of *Eleocharis* and *Kobresia* can have high cover. Many of these species are important in peat accumulation due to their clonal growth and development of extensive below-ground biomass. Common graminoids in the Cyperaceae family in southern Rocky Mountain fens include water sedge (*Carex aquatilis*), beaked sedge (*C. utriculata*) and analogue sedge (*C. simulata*). Shrubs may also be important constituents of fens in our region, including resin birch (*Betula glandulosa*), diamondleaf willow (*Salix planifolia*) and Wolf's willow (*S. wolfii*) (Cooper 1990). Cover of herbaceous dicots is variable in regional fens. Herbaceous dicots encountered in fens include elephanthead lousewort (*Pedicularis groenlandica*), white marsh marigold (*Caltha leptosepala*), largeleaf avens (*Geum macrophyllum*), American speedwell (*Veronica americana*), alpine meadow-rue (*Thalictrum alpinum*), alpine leafybract aster (*Symphyotrichum foliaceum* var. *foliaceum*), western mountain aster (*Symphyotrichum spathulatum* var. *spathulatum*), American bistort (*Polygonum bistortoides*), alpine bistort (*P. viviparum*) and redpod stonecrop (*Rhodiola rhodantha*) (Rocchio 2005).

Classification

Fens are commonly classified along a poor-to-rich gradient based on combined groundwater pH, nutrient concentrations, and vegetation composition (Chee and Vitt 1989, Bridgham et al. 1996, Hajek et al. 2006). These classes can be generic and not all fens fit clearly into a well-defined classification system (Cooper and Andrus 1994, Bridgham et al. 1996). Vegetation composition is often driven by nutrient availability and pH of groundwater and is an important component of classification along this poor to rich gradient. **Poor fens** are similar to bogs, being low in nutrient availability, with pH levels below 6.5 (Bridgham et al. 1996). Poor fens tend to be associated with granitic or metamorphic rock which provides few available nutrients to passing groundwater (Cooper and Andrus 1994). Transitional fens are the most common fen type in our region due to predominantly igneous and metamorphic bedrock (Cooper 1991a, Cooper and Andrus 1994, Cooper 1996). **Transitional fens** are typified by acid to circumneutral pH (5.3-7.1) and low to moderate base ion concentrations (Mg^{2+} 4.3 – 11.0, Na^{+} 7.0) (Zoltai and Johnson 1985, Comeau and Bellamy 1986, Chee and Vitt 1989). Areas of carbonate containing rocks may support **rich** and **extreme rich fens** due to increased cation concentrations and pH levels provided by bedrock (Cooper and Andrus 1994, Cooper 1996). Rich fens are characterized by pH levels that are slightly to moderately alkaline (5.0 – 7.5) with moderate cation concentrations (Ca^{2+} 3.6-75.0, Mg^{2+} 2.8-19.8), while extreme rich fens are often more alkaline (pH 6.8 – 8.6) with high cation concentrations (Ca^{2+} 31.0-120.0, Mg^{2+}10.0-44.0, Na^{+} 7.0-32.0) (Schwintzer 1978, Slack et al. 1980, Glaser et al. 1981, Karlin and Bliss 1984, Cooper 1991b). These sites often support a rich and unique flora in our region (Cooper 1996, Bedford and Godwin 2003).

Site Description

The Southern Rocky Mountains of Colorado include over 30 smaller mountains ranges, and contain the highest peaks in Rockies. I-70 traverses two major mountain passes within the assessment area, Vail Pass at 10,622 ft and the Eisenhower/Johnson Tunnel at 11,112 ft. Due to temperature and precipitation, fens along the study corridor are concentrated in high elevation areas.

Climate

Climate of the study area is typical of the region, having an intercontinental pattern of moderate, dry summers, and cold winters. The majority of precipitation falls in the form of snow at higher elevations. Prevailing westerly winds and north to south orientation of ranges create a moisture gradient from west to east across ranges in this portion of the Rockies.

Geology

Geology of the study area is predominantly Early to Middle Proterozoic gneiss and granitic rocks (Tweto 1979). Areas along Tenmile Creek consist of glacial deposits of the Quaternary Age. Large blocks near Vail Pass consist of Permian and Pennsylvanian sandstones. A few patches of shale persist along the Blue River near the Dillon Reservoir where I-70 passes through Silverthorne (Tweto 1979).

Vegetation

The survey area consists of three of the four ecological zones in the Southern Rocky Mountain Region, lower montane/foothill, upper montane, and subalpine (Marr 1967). Fens are typically found in the upper montane and subalpine zones. The lower montane/foothill zone occurs below 2300 m, consisting of *Pinus ponderosa* and *Pseudotsuga menziesii* forests, grasslands, woodlands, sagebrush shrublands, and variable size stream corridors. Stream communities are dominated by *Populus angustifolia* along lower reaches of the corridor.

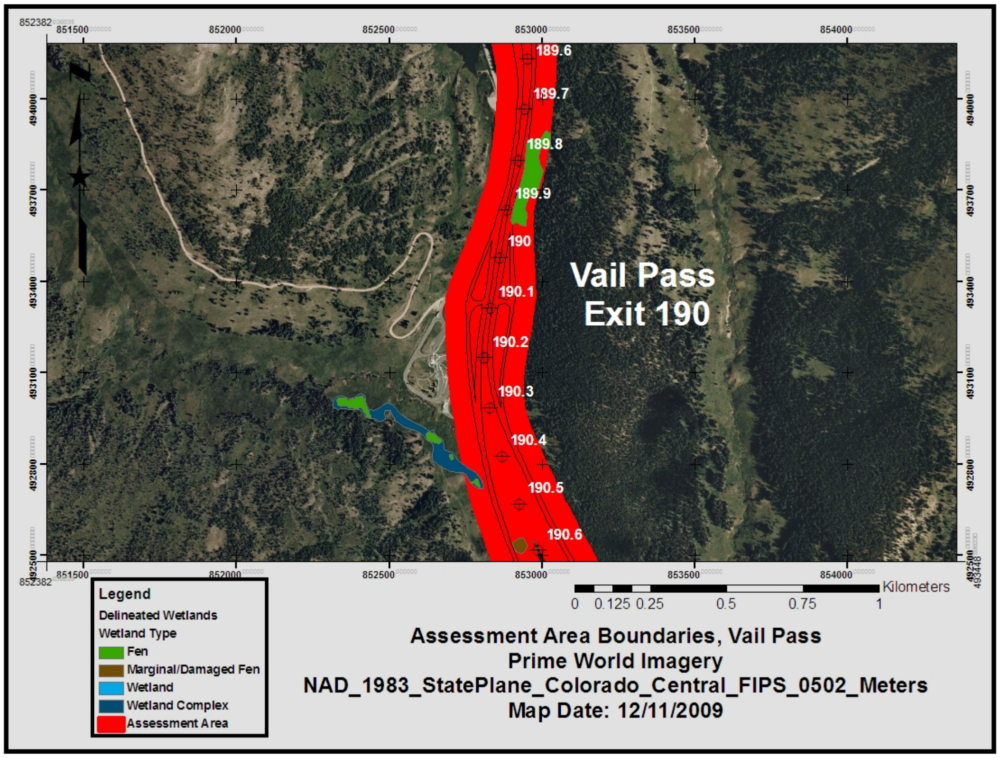
The Upper Montane zone consists of mixed coniferous and aspen forests, montane grasslands, sagebrush shrublands, riparian woodlands and shrublands, lakes and streams of high-moderate gradient (Marr 1967). It occurs between approximately 2300 and 2800 m. Riparian areas are populated by *Picea engelmannii*, *Abies lasiocarpa*, and *Populus tremuloides* on the overstory with *Alnus incana* and *Salix* spp. often creating dense thickets along stream edges and low gradient floodplains.

The subalpine zone occurs between 2800 and 3500 m and is characterized by *Picea engelmannii*, *Abies lasiocarpa* and *Pinus contorta* forests, aspen glens, and high gradient streams (Marr 1967). Riparian reaches in this zone are similar to Upper Montane Riparian systems of mixed conifers, aspen, *Salix*, and *Alnus*.

Methods

The assessment area included a 200 ft buffer from the outermost edge of pavement of the east and westbound lanes along I-70 from mile 259 near Golden to mile 130 near the mouth of Glenwood Canyon, a distance of approximately 129 miles. The buffer was determined by the proposed alternatives for highway development or expansion along the corridor and the subsequent maximum footprint relating to these alternatives. Proposed alternatives were developed and provided by J.F. Sato. The buffer was created by combining shapefile layers of all proposed alternatives with the current edge of pavement including on and off-ramps in ArcMap 9.3. This combined layer was then buffered by 200 feet to provide a layer of all possible impact areas along the target corridor (Figure 1). The total assessment area included this buffer along both the eastbound and westbound lanes plus all land area in the median. If a fen within the assessment area extended beyond the buffer, the survey continued beyond the assessment area to determine the extent of the fen. The buffer was used to both frame the study extent and identify possible fen habitat prior to field survey (ESRI 2008).

Figure 1. Assessment area near Vail Pass



Existing shapefiles for wetland habitat and possible fens identified in a previous survey were used as baseline imagery for preliminary identification of fens along the corridor (Murphy 2003). During August, 2009, 13 potential fens within the proposed impact zone identified by J.F. Sato based on this previous survey, were surveyed by David Cooper. This preliminary investigation found that only one of the 13 sites was a fen based on the criteria described in earlier. All other sites were found to be either mineral soil wetlands, riparian, or upland. Due to inaccuracies in this baseline data, stakeholders decided that all possible fens should be verified by field survey. The entire extent, 200 ft buffer along the 129 mile corridor, was examined by Jennifer Jones in September 2009 using stereoscope analysis of pairs of natural color aerial photographs from September, 2001, for the White River National Forest (scale approximately 1:15,840) and from 2000 for the Arapahoe National Forest (scale approximately 1:16,000) provided by the U.S. Forest Service (Graber et al. 1993, Wilen and Bates 1995). Identification and delineation of possible fens was based on landscape context and color signature in aerial imagery compared to the signature of known fens in the area (Tiner 1999). Target sample areas identified using aerial imagery were compared to and identified in baseline data layers and Prime World 2D imagery in ArcMap 9.3 to generate spatial reference. Sites were identified in ArcMap 9.3 as polygons in the baseline shapefile and target points were created using the "feature to point" function in ArcMap 9.3 to direct field sampling in target sites. Sites that were not identified as possible fens based aerial imagery review, but were indicated as possible fens in baseline imagery were retained in the target frame and investigated for the presence of fens.

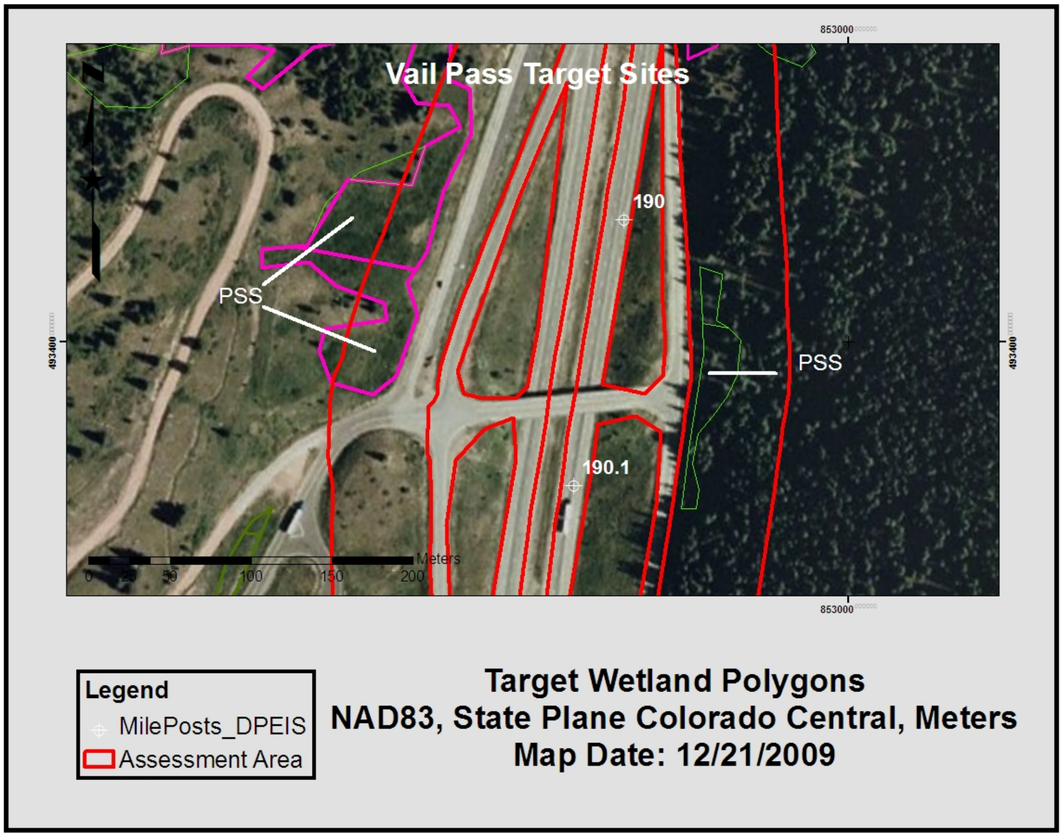
Many fens occur as inclusions within wetland complexes, and some fens may be smaller than 30 ft X 30 ft. When no minimum mapping unit is designated, field verification is essential to capture all sites that will not be visible in aerial imagery. Sites were field verified during September and October of 2009 by Jennifer Jones. Surveys was prioritized based on phenology and elevation, with sites at greater elevations and those that contained areas of high probability of including fen habitat being assigned highest priority. Due to the late timing of initial field surveys, not all sites targeted for field surveys were visited. Sites that were not surveyed during 2009 were included in shapefile (I70_site verification_2009_Jones) with confidence levels pertaining to the likelihood of the site containing fen habitat. This shapefile has been provided to J.F.Sato separately.

Our survey typically involved parking along the highway in a target area, navigating to the stream corridor or target point using a GPS unit (Garmin, eTrex Vista H) with uploaded points, and then investigating surrounding areas for fens. If an area was suspected to support a fen, its vegetation, hydrology, and soils were then assessed.

Once fens were identified and validated, the fen edge was walked using the tracking function in the GPS unit to provide a file of the site's approximate boundaries. Tracks were transferred into ArcMap 9.3 in the form of a polygon shapefile (I70_fen delineation_2009_Jones) and compared with aerial imagery to create approximate boundaries for each fen. This shapefile has been provided to J.F.Sato separately. This provided a spatially explicit frame for comparison to highway expansion alternatives. All sites were assigned a vegetation type based on NatureServe ecological associations or recognized species (NatureServe 2009). Sites that were assessed during field surveys that did not meet fen criteria, but were wetlands, were assigned a wetland type (example, PSS, palustrine scrub-shrub) based on the Cowardin Classification System (Cowardin et al. 1979). The status of these sites was addressed in an additional shapefile (I70_site verification_2009_Jones)(Figure 2) (Murphy 2003).

Attachment 1 contains a list of target plants for fens identified through fieldwork.

Figure 2. Site verification, Vail Pass. Pink sites were indicated as possible fens, green sites were otherwise identified based on their Cowardin class. Both sites in this image were surveyed and identified as palustrine scrub-shrub wetlands (PSS).



Vegetation Assessment

Vascular Plants

A list of plants that the United States Forest Service (USFS) considers to be Endangered, Threatened, Forest Service Region 2 Sensitive, or of local concern was provided by Steve Popovich, Forest Botanist, Arapaho and Roosevelt National Forests and Pawnee National Grassland, Fort Collins, Colorado. The target list is provided as an attachment to this document (I-70_target species, attachment 1). Prior to field sampling, all suggested sensitive species were investigated on available databases and viewed at the Colorado State University herbarium to ensure surveyor familiarity with each (U.S. Department of Agriculture 2009).

Vascular plants were surveyed during October and November of 2009 at field identified fen sites within the assessment area by Jennifer Jones. Vascular plants were surveyed using a visual grid search throughout the identified fen area. All vegetation types within the fen were thoroughly searched and noted. At each identified fen data collected included common and dominant species, plant cover values, general site description, landscape context, and condition. Special attention was used in searching for species present on the USFS target list (attachment 1). Cover classes used for targeted and associated species follow classes used in Heritage Program methodology (Table 1)(NatureServe 2002).

Table 1. Natural Heritage Methodology cover classes.

T 0-1%	5 >45-55%
P >1-5%	6 >55-65%
1 >5-15%	7 >65-75%
2 >15-25%	8 >75-85%
3 >25-35%	9 >85-95%
4 >35-45%	10 >95%

Species that could not be identified in the field were collected and identified using the appropriate resource, Colorado Flora: Eastern and Western Slope, Flora of North America, Intermountain Flora, and/or Field Guide to Intermountain Sedges (Cronquist 1972, Hurd 1998, Weber and Wittmann 2001b, a, Ball et al. 2009). Nomenclature used for reporting in this study follows PLANTS database (U.S. Department of Agriculture 2009). One specimen was verified by Jennifer Ackerfield, Collections Manager of the Colorado State University Herbarium. Two specimens, *Kobresia simpliciuscula* and *Carex leptalea*, will be accessioned (collection numbers I70_001 and I70_002 collected by J. Jones) at the herbaria of Colorado State University, Fort Collins and the University of Colorado, Boulder.

An Element Occurrence Record (EOR) was created for each fen based on the most recent Plant and Natural Community Field forms and data dictionaries provided by the Colorado Natural Heritage Program (CNHP)(NatureServe 2002). An EOR was also created for each species encountered that was indicated by the USFS to be endangered, threatened, rare, or otherwise considered sensitive or of local concern. All EOR's and maps of fens and sensitive species are provided as an appendix to this document. These documents contain site details and other information not included in this narrative (Appendix 1).

Non-vascular plants

Bryophytes were sampled in identified fens in the survey area on October 10 and 11, 2009 by Katharine Driver. Bryophytes were sampled and collected using visual searches on grid patterns throughout the identified fen areas. All vegetation types within each fen were thoroughly examined for the presence of bryophyte species. Each species was assigned a cover class based on classes suggested by the Natural Heritage Program methodology (NatureServe 2002). Vouchers specimens of each known and unknown species of mosses were collected to for identification and verification purposes. Unknown specimens were sent to Dr. William A. Weber at the University of Colorado, Boulder for identification and have been accessioned in the University of Colorado herbarium.

Soils

Soils were assessed in a soil pit dug in the upper 40 cm at sites where the vegetation and hydrology indicated a possible fen was present. If organic soils were not evident throughout the upper 40 cm, an auger was used to extract soils to 80 cm depth. The size and variability of surface features in each fen affected the number of soil pits dug. In small sites, soils were assessed in the middle of the site. In larger fens, multiple pits were dug in areas of variable vegetation and hydrology. In the majority of sites with 40 cm of organic soil in the upper 80 cm, organic matter content was estimated in the field using several indicators. Field indicators included soil texture, organic matter either visible or decomposed that disintegrates when rubbed between fingers, low color value, very low bulk density, limited mineral sediment, distinct odor, and high water holding capacity. Soil pits of organic matter often can be extracted in one cohesive unit. The majority of fens surveyed for this study had what we considered to be obvious histosols in the upper 40 cm meaning well defined peat at least 40 cm thick. Three soil samples were extracted at 40 cm to validated observer ability to identify organic soils in the field.

The loss-on-ignition method was employed to determine organic matter content of the three soil samples (Schumacher 2002). This method entails burning soil samples between 350ºC and 440ºC for approximately 12 hours which removes organic matter allowing the calculation of organic matter loss. One site surveyed had soils that were difficult to assess in the field. This site was retained in the frame as a possible fen, but was not assessed further due to its landscape context. This site is situated on the southern side of Clear Creek with a very low likelihood that it would be impacted by any of the possible highway expansion alternatives.

Condition Assessment

Resource management and assessment programs have adopted standardized methodologies to assess and rank ecological plant and community occurrences. The methodology used is often driven by the focus of the project and monetary and time constraints. Quantitative methods can often be time consuming and require some level of training, but can provide a rigorous, standardized method by which to rank ecological and functional integrity of focal habitats. Though qualitative methods are characteristically less rigorous, they can provide an approximation of site viability and conservation status. Due to time constraints and other focal products of this study, we employed a rapid assessment methodology developed by the Natural Heritage Network to rank element occurrences. Ranks provide an assessment of estimated viability based on condition, size, and landscape context of the occurrence (NatureServe 2002). Fens in this region may occur as small stands, so size is addressed only if size has been impacted by hydrologic alterations or other disturbances. Each identified fen in the assessment area has been ranked using Heritage Methodology and regional, standardized specifications (Table 2) (Rondeau 2001). Element Occurrence records will be submitted to the Colorado Natural Heritage program office in Fort Collins, CO.

Table 2. Basic Element Occurrence Ranks

EO	Rank Description
A	excellent estimated viability
B	good estimated viability
C	fair estimated viability
D	poor estimated viability
E	verified extant (viability not assessed)
H	historical
F	failed to find
X	extirpated

Classification Assessment

Sites that were assessed during field surveys and that met fen criteria were assigned a fen type (e.g., rich fen, transitional fen etc.). Vegetation and species associated with a certain fen type were used as the main indicators of a given fen type. Due to the time of surveys and snow events, pH values may not be reliable for some of the fens. Ground water dissolved ion concentrations were not measured.

Results

Fens

We detected and surveyed 12 fens and wetland complexes that include fens within the assessment area. Though aerial imagery provides a useful tool to direct field sampling, the majority of sites were found during field surveys, being too small to identify in the aerial imagery used. Fen resources are concentrated at high elevations near Vail Pass and on both sides of the Eisenhower/Johnson Memorial Tunnels (Figures, 3, 4 and 5).

Figure 3. Fen concentrations within the assessment area, Vail Pass Area

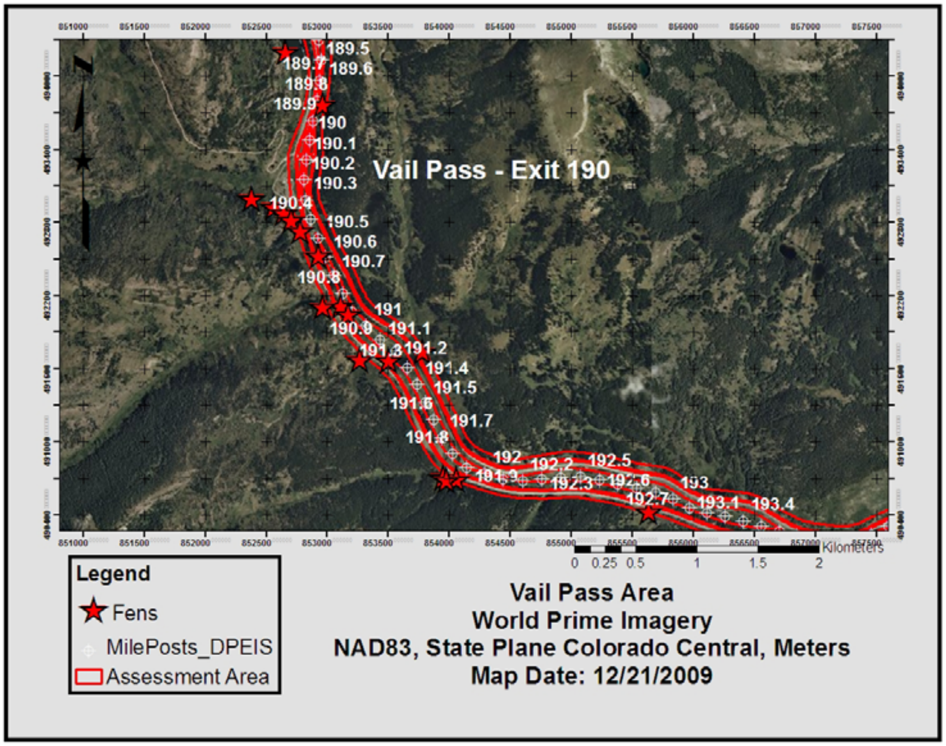


Figure 4. Fen concentrations within the assessment area, West of the Eisenhower Tunnel

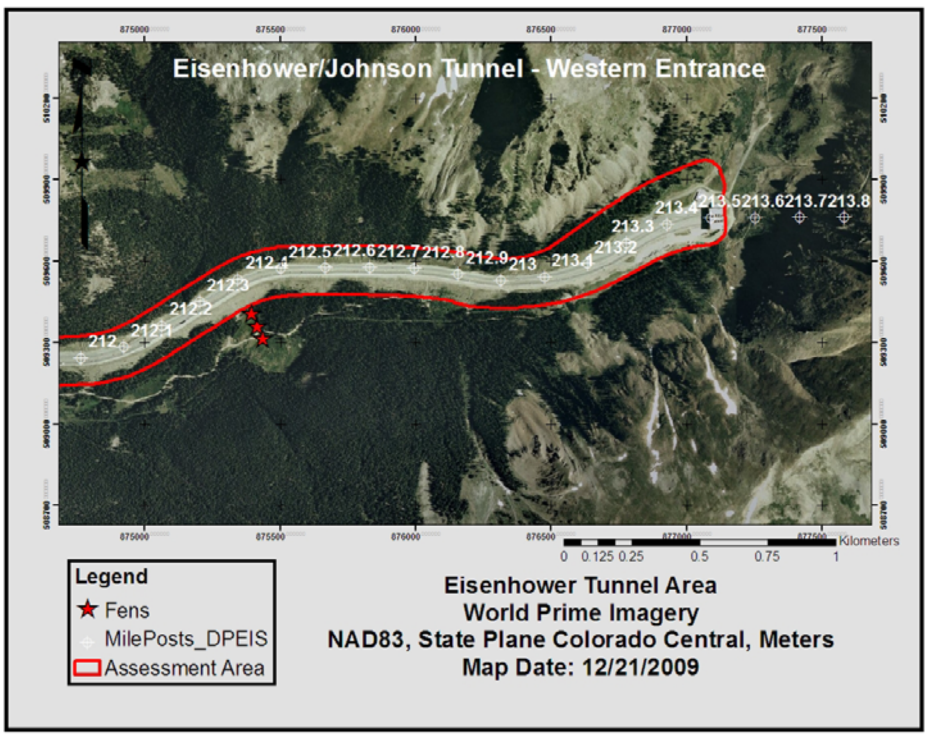
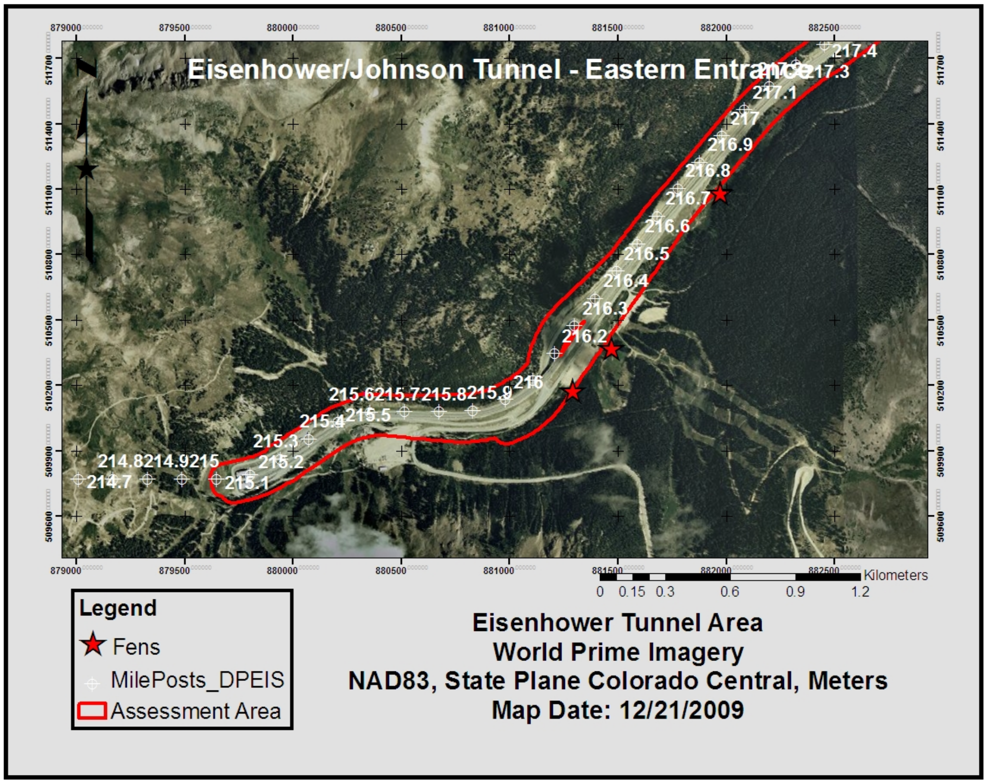


Figure 5. Fen concentrations within the assessment area, East of the Eisenhower Tunnel



Vascular Plants

Within the 12 surveyed fens, we found 8 different natural community occurrences (Table #). All but one of the 8 communities is considered apparently secure to secure at the global level and vulnerable to secure at the state level. Two vascular plant species indicated as rare, threatened, or endangered in the State of Colorado by the USFS were found in the survey area, *Carex leptalea* and *Kobresia simpliciuscula*. Two vascular plants and one bryophyte considered locally significant were also found, *Thalictrum alpinum*, *Eriophorum angustifolium*, and *Tomentypnum nitans*.

***Kobresia simpliciuscula - Trichophorum pumilum* Saturated Herbaceous Vegetation (G2/S2)**

Kobresia simpliciuscula was treated as part of a Natural Community Occurrence for the purpose of this study. The southern extent of the contiguous range of *Kobresia simpliciuscula* is in the northern Rockies with a few disjunct populations in the central Rockies (Cooper 1996, Lesica and Steele 1996, Decker et al. 2006). It is a globally secure species, but rare in Colorado due to limited habitat. A 2006 Technical Conservation Assessment of the species documented 27 occurrences in Colorado. In concordance with other fen populations of this species in Colorado, it is acknowledged as an indicator of extreme rich fen conditions, with pH values from 7.6 to 8.3 (Cooper 1996). Because *Trichophorum pumilum* was not detected at the site, the occurrence may not be comparable to the *Kobresia simpliciuscula* - *Trichophorum pumilum* Saturated Herbaceous Vegetation found in extreme rich fens in this region and may need to be considered as a plant occurrence of *Kobresia simpliciuscula* (G5/S2) or classified at the Alliance level to the *Kobresia myosuroides - (Kobresia simpliciuscula)* Saturated Herbaceous Alliance (NatureServe 2009). Further surveys of this site have been suggested because of the likelihood that other unique and rare species may be present and were not detected due to the late time of survey.

***Carex leptalea* (G5/S1)**

Carex leptalea was found in a small benched fen east of Loveland ski area. This species is globally secure, but considered critically imperiled in the state of Colorado have only 5 known populations prior to the detection of this population (Gage and Cooper 2006, NatureServe 2009).

***Thalictrum alpinum* (G5/SN)**

Thalictrum alpinum is a globally secure species that has not been assigned a conservation status rank in the state of Colorado. The species is not tracked by the Colorado Natural Heritage Program. *Thalictrum alpinum* was targeted as a species of local concern due to its association with rich and extreme rich fens in some areas of the state (Cooper 1996). The species was found to be ubiquitous throughout the survey area both in fens and in interstitial mesic areas at low to moderate cover. In fens, the species occurred predominantly on hummocks and drier areas. Outside of fens, the species was found under low stature *Salix* sp. in mesic meadows, along stream banks, and in small meadows openings. The highest elevation occurrence was on Vail Pass at approximately 3230 m and the lowest occurrence was observed at approximately 3015 m near milepost 193.5 in the median along Tenmile Creek. Commonly associated species include *Salix wolfii*, *Polygonum viviparum*, and *Carex aquatilis*.

***Eriophorum angustifolium* (G5/SN)**

Eriophorum angustifolium is a globally secure species that has not been assigned a conservation status in Colorado. The species is not tracked by the Colorado Natural Heritage Program. The species was found in four fens (I-70_F11, I-70_F2, I-70F4, and I-70_F12) in the survey with moderate cover in open peat flats that are inundated for most of the summer. Commonly associated species in these areas include *Eleocharis quinqueflora* and *Sanionia uncinata*.

Tomentypnum nitans

Tomentypnum nitens was targeted as a species of local concern due to its association with rich and extreme rich fens in some areas of the state (Cooper 1996). It was found in low to moderate cover in all but two of the identified fen sites (not found in I-70_F8 and I-70_F11).

Soils

Soils were analyzed from four surveyed fens (I-70_F2, I-70_F3, I-70_F5 and I-70_F8) to verify the ability of surveyors in the field identification of organic soils. Soils were collected between 35 and 40 cm from the surface. All four sites were determined to have organic soils (Table 3).

Table 3. Organic carbon content by weight for 4 surveyed fens

site id	percent organic carbon content by weight at 40 cm
I-70_F2	84.58
I-70_F3	65.84
I-70_F5	77.30
I-70_F8	79.20
I-70_F8	54.92

Natural Community Element Occurrences

Eleocharis quinqueflora Herbaceous Vegetation (Few-flower Spikerush Herbaceous Vegetation)
Black Lake
Mile Post 190, South Side of Highway
Polygon ID I-70_F1

Description: The occurrence is a small, sloping fen with homogeneous vegetation and hydrology throughout. This site is unique because of its soils and perennial, groundwater-fed hydrology, though it does not support any sensitive species or communities. Surrounding wetlands are dominated by a *Salix planifolia* with an understory of *Carex aquatilis* in wet areas and herbaceous dicots in drier areas. Uplands consist of open *Picea engelmannii* with mixed *Vaccinium* sp. and herbaceous dicots. Surface geology in the area consists of Pennsylvanian sandstone. The entire wetland is situated outside of the assessment area, but was evident in both aerial imagery and from the highway to support a fen and was also easily accessible, so was included in the survey.

Natural Communities: *Eleocharis quinqueflora* Herbaceous Vegetation (Few-flower Spikerush Herbaceous Vegetation)

Vascular Plants: The area is dominated by *Eleocharis quinqueflora* and *Carex aquatilis* forming an open herbaceous layer on seasonally inundated peat soils. There are a few hummocks with more diverse and dense vegetation supporting *Thalictrum alpinum, Tomentypnum nitens*, *Caltha leptosepala*, and *Pedicularis groenlandica*. *Carex microglochin* is present in trace amounts. *Salix planifolia* is dominant in surrounding shrublands and in small patches at the site. *Muhlenbergia filiformis* is present in high cover along the northern drier edge.

Bryophytes: *Sanionia uncinata* is present in high cover throughout in these low-lying areas. *Tomentypnum nitens* is also common in slightly elevation areas.

Condition and Ranking: B, good estimated viability

Condition – A – Occurrence appears to be stable and healthy. There is no evidence of altered hydrology or use impacts. No exotic species were observed.

Landscape Context – A – The occurrence is situated along the western slope of the headwaters of Black Gore Creek just below Vail Pass. The fen is fed by snowmelt from the Shrine Mountain area near the northern end of the Sawatch Range. There are few disturbances in the landscape surrounding the site aside from minimal recreational use.

Size – D – The area of fen is approximately 0.15 hectare. The site may have been reduced in size when the adjacent reservoir was flooded. Though the site is small, size is not weighed as heavily for fen ranking because small patches are common.

Fen Type Classification: Transitional Fen

Eleocharis quinqueflora and *Carex aquatilis* are common dominants of many natural wetland communities at this elevation in this region. The species are not associated with any particular fen type. *Tomentypnum nitens, Thalictrum alpinum*, *Carex microglochin* have been associated with rich and extreme rich fens (Chee and Vitt 1989, Cooper 1996, Hajek et al. 2006). This type of fen is difficult to classify without data about pH and cation concentrations, but may be considered a transitional fen for the purpose of this study based on species composition and upslope bedrock composition.

Figure 6. Map of fen at Black Lake, USGS 7.5' Quadrangle basemap

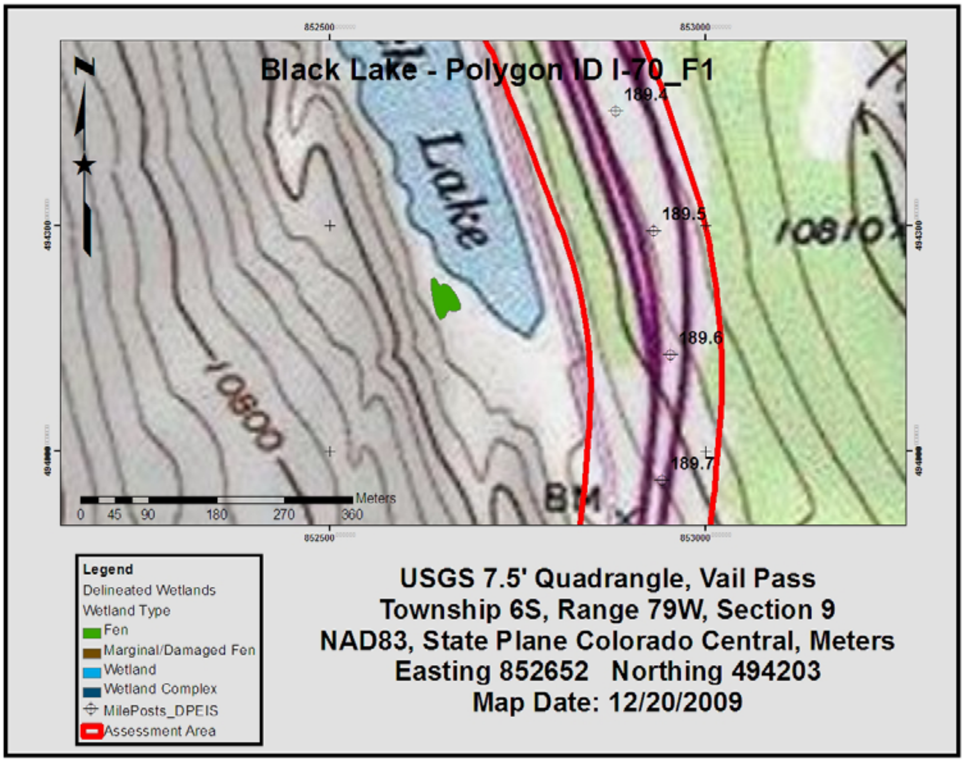
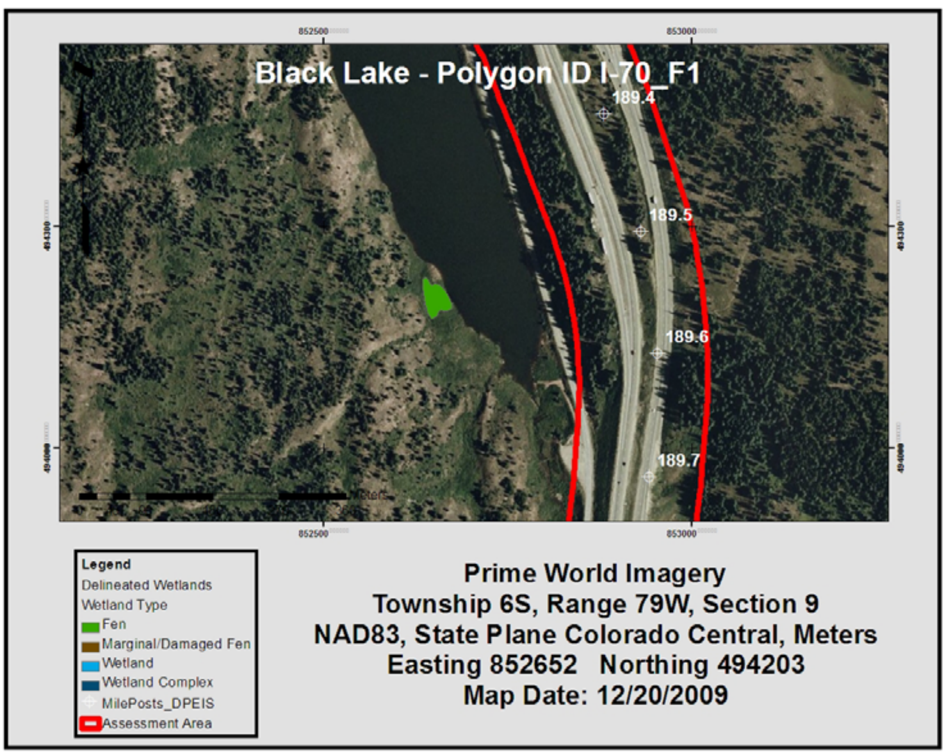


Figure 7. Map of fen at Black Lake, World Prime Imagery basemap



Kobresia simpliciuscula - Trichophorum pumilum Saturated Herbaceous Vegetation

West Tenmile Creek at Vail Pass
Mile Post 190, South Side of Highway
Polygon ID I-70_F2

Description: Occurrence is located on the southern side of West Tenmile Creek, near its confluence with Tenmile Creek near Vail Pass. This occurrence is part of a large wetland complex that supports a number of small fens just to the south of West Tenmile Creek before it meets Tenmile Creek. The assessment area is approximately 20,500 m^2. Fens cover approximately 35% of this area. The survey area is part of a much larger wetland complex, and was delineated due to its importance to hydrologic connectivity between the fen patches. The occurrence is situated at the northwestern end of the complex, fed by groundwater from the Shrine and Sloane Mountain area near the northern end of the Sawatch Range. Surface geology in the area consists of Quaternary glacial drift. Surface geology above the site consists of Pennsylvanian and Permian sandstones.

Natural Communities: *Kobresia simpliciuscula* - *Trichophorum pumilum* Saturated Herbaceous Vegetation (Simple Bog Sedge - Rolland's Leafless-bulrush Saturated Herbaceous Vegetation)

Vascular Plants: The fen is dominated by species in the Cyperaceae family with <0.5 m stature, shrubs are common throughout, with moderate cover on hummocks and along strings. Patterning is evident in some areas with moderate sized inclusions of open peat with sparse vegetation, between densely vegetated hummocks. Inundated areas are dominated by *Eleocharis quinqueflora*, *Eriophorum angustifolium*, and *Carex microglochin*. Hummocks are densely vegetated with moderate to high cover of *Kobresia simpliciuscula*. Other grasses and sedges present include *Carex aquatilis, Carex capillaris*, *Deschampsia caespitosa, Carex nova*, and *Carex norvegica*. Herbaceous dicots present include *Thalictrum alpinum, Pedicularis groenlandica, Swertia perennis, Conioselinum scopulorum*, and *Caltha leptosepala*. Shrubs common throughout the site on hummocks and drier edges include *Dasiphora fruticosa* ssp. *floribunda, Betula glandulosa, Salix planifolia*, and *Salix wolfii*.

Bryophytes: Common mosses include *Sanionia uncinata* and *Tomentypnum nitens*, and *Aulacomnium palustre*. Other mosses present include *Climacium dendroides, Bryum pseudotriquetrum*, and *Campylium stellatum*.

Site Name	Species	Cover Class
190S	*Brachythecium erythrorrhizon* Schimp.	P
190S	*Plagiomnium ellipticum* Brid. T. Kop	P
190S	*Oncophorus virens* (Hedw.) Brid.	P
190S	*Tomentypnum nitens* (Hedw.) Loeske	3
190S	*Aulacomnium palustre* (Hedw.) Schwagr.	3
190S	*Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb	P

190S	*Sanionia uncinata* (Hedw.) Loeske	2
190S	*Campylium hispidulum* (Brid.) Mitt.	P
190S	*Aulacomnium palustre* (Hedw.) Schwagr. (immature)	T
190S	*Climacium dendroides* (Hedw.) F. Weber & D. Mohr	P
190S	*Campylium stellatum* (Hedw.) C.E.O. Jensen	P

Condition and Ranking: A, excellent estimated viability

Condition – A – Upper reaches of the wetland complex are intact and properly functioning. The occurrence appears to be unaltered by recreational use. Lower reaches near the road exhibit more use including trails and have variable hydrology throughout.

Landscape Context – B – The surrounding watershed is divided by trails and roads. The area immediately above the site is comparatively undisturbed. I-70 has truncated the southeastern edge of the wetland complex and may be impacting the site by dewatering lower reaches. The focal habitat is situated well above this area and does not appear to be drying.

Size – B –The uppermost section of fen is approximately 0.4 hectare. The larger wetland complex is much greater than the 2 hectare indicated on the map and creates a moderate buffer for the occurrence.

Fen Type Classification: Extreme Rich Fen

In Colorado, *Kobresia simpliciuscula* is found in wet alpine sites or at lower elevations in rich and extreme rich fens (Cooper 1996). The groundwater pH at this site was measured at 7.2, within the range often indicated for rich and extreme rich fens. This value was measured after several snowfalls, and may be considered a low estimate of the groundwater pH due to snowmelt water diluting the concentrations of ions in the water being measured. Other species occurring at this site commonly found in rich and extreme rich fens include *Tomentypnum nitens*, *Campylium stellatum*, *Carex microglochin*, and *Thalictrum alpinum* (Chee and Vitt 1989, Cooper and Andrus 1994, Cooper 1996, Johnson and Steingraeber 2003, Hajek et al. 2006). *Trichophorum pumilum*, and *Triglochin* sp. which are found in South Park fens dominated by *Kobresia simpliciuscula* were not observed, but may have been overlooked due to the late time of survey.

Figure 8. Map of fen at West Tenmile Creek at Vail Pass, USGS 7.5' Quadrangle basemap

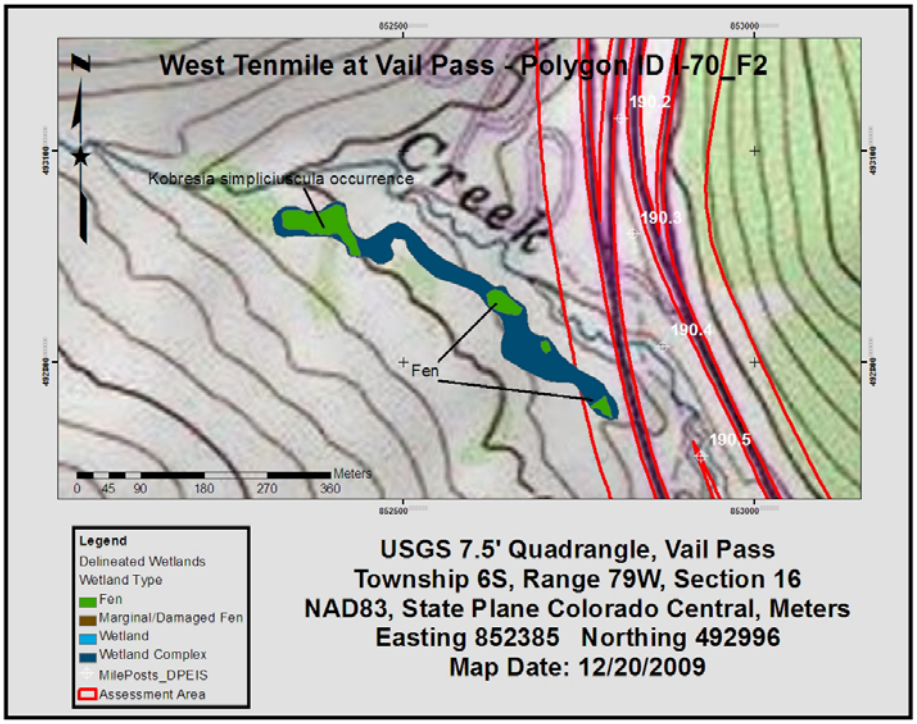
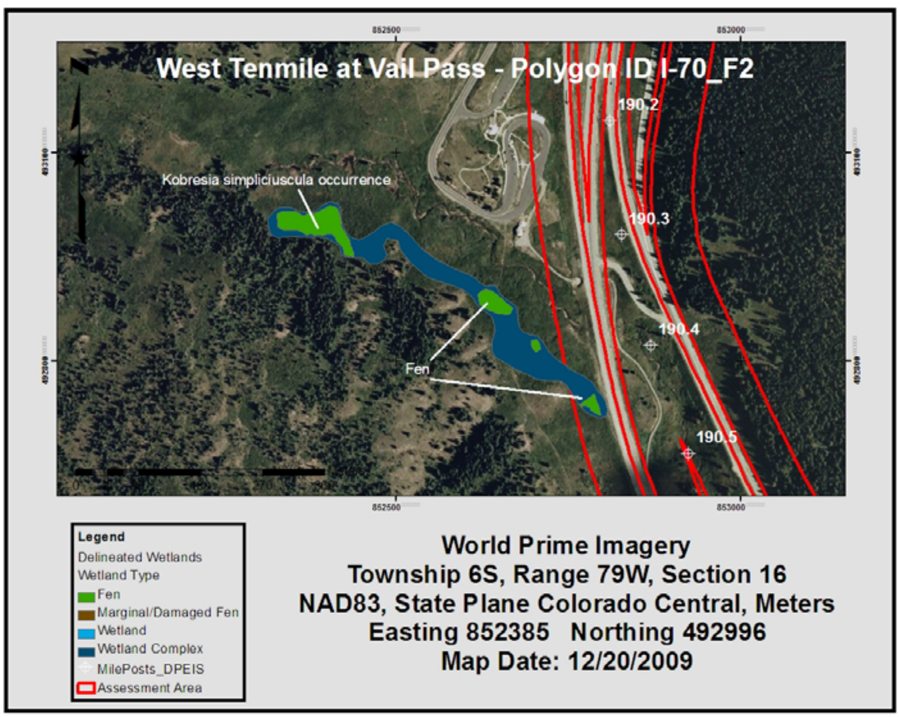


Figure 9. Map of fen at West Tenmile Creek at Vail Pass, World Prime Imagery basemap



Salix planifolia/Carex aquatilis Shrubland (Planeleaf Willow/Aquatic Sedge)
Carex aquatilis Herbaceous Vegetation(Aquatic Sedge Herbaceous Vegetation)
Eleocharis quinqueflora Herbaceous Vegetation (Few-flower Spikerush Herbaceous Vegetation)
Westbound Onramp at Vail Pass
Mile Post 190, North Side of Highway
Polygon ID I-70_F3

Description: The occurrence is a large fen complex containing several vegetation types and hydrologic regimes including moss-dominated seeps, sedge and shrub-dominated wetlands. There are a few mineral soil inclusions dominated by taller (1-2m) *Salix planifolia* and grasses and sedges, but the majority of the site is fen. Though none of the vegetation types are dominated by sensitive species or communities, the large area of histosol and site proximity to I-70 make this wetland unique. Surface geology in the area consists of Pennsylvanian sandstones and Quaternary glacial drift.

Natural Communities: *Salix planifolia* / *Carex aquatilis* Shrubland (Planeleaf Willow / Aquatic Sedge Shrubland), *Carex aquatilis* Herbaceous Vegetation(Aquatic Sedge Herbaceous Vegetation), and *Eleocharis quinqueflora* Herbaceous Vegetation (Few-flower Spikerush Herbaceous Vegetation)

Vascular Plants: Dominant and common species across all vegetation types include *Carex aquatilis*, *Salix planifolia*, and *Eleocharis quinqueflora*. Other common Cyperaceae species include *Carex norvegica*, *Carex utriculata*, and *Carex capillaris*. A small patch of *Carex saxitillis* and a few patches of *Carex microglochin* are present at the southern end of the site. Herbaceous dicots present include *Polygonum viviparum*, *Rhodiola rhodantha*, *Pedicularis groenlandica*, *Caltha leptosepala*, *Swertia perennis*, *Packera crocata* and *Thalictrum alpinum*.

Bryophytes: Dominant mosses include *Tomentypnum nitens* and *Sanionia uncinata*. Common mosses include *Campylium stellatum*, *Bryum pseudotriquetrum*, *Philonotis fontana* var. *americana*, and *Aulacomnium palustre*.

Site Name	Species	Cover Class
190N	*Philonotis fontana* (Hedw.) Brid. var. americana (Dism.) Flow.	P
190N	*Polytrichum longisetum* Brid.	P
190N	*Aulacomnium palustre* (Hedw.) Schwagr.	P
190N	*Brachythecium erythrorrhizon* Schimp.	P
190N	*Tomentypnum nitens* (Hedw.) Loeske	3
190N	*Sanionia uncinata* (Hedw.) Loeske	3
190N	*Campylium stellatum* (Hedw.) C.E.O. Jensen	P
190N	*Aulacomnium palustre* (Hedw.) Schwagr.	P
190N	*Pellia neesiana* (Gottsche) Limpr.	P
190N	*Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb	P

190N	*Plagiomnium ellipticum* Brid. T. Kop	P
190N	*Climacium dendroides* (Hedw.) F. Weber & D. Mohr	P

Condition and Ranking: B, good estimated viability

Condition – B – Fen is located immediately adjacent to highway 70 and appears to have been truncated along the western side by the highway. Hydrology originates along the eastern slope and disturbance is limited above this area except for a trail along Corral Creek that leads to Uneva Peak in the Eagles Nest Wilderness. No trails or exotic species were observed in the site.

Landscape Context – B – Though adjacent to the highway, upslope areas exhibit little to no disturbance.

Size – A – The site is approximately 1.6 hectare, which is considered very large for a fen in this region (Rocchio 2005).

Fen Type Classification: Intermediate Rich Fen

This site supports multiple, common natural communities that are not associated with any particular fen type. Some of the dominant species including *Carex aquatilis*, *Salix planifolia*, and *Eleocharis quinqueflora* are common in many fen types along the poor to rich gradient and do not indicate a specific fen type. A few species that are often associated with rich fens, *Tomentypnum nitens*, *Campylium stellatum*, *Thalictrum alpinum*, and *Carex microglochin* are present (Chee and Vitt 1989, Cooper and Andrus 1994, Cooper 1996, Johnson and Steingraeber 2003, Hajek et al. 2006). Based on the presence of these species and composition of surrouding bedrock, the site is likely a transitional to rich fen. Due to snowmelt at the time of survey, pH values are unreliable and were not used in this assessment.

Figure 10. Map of fen at the Westbound Onramp at Vail Pass, USGS 7.5' Quadrangle basemap

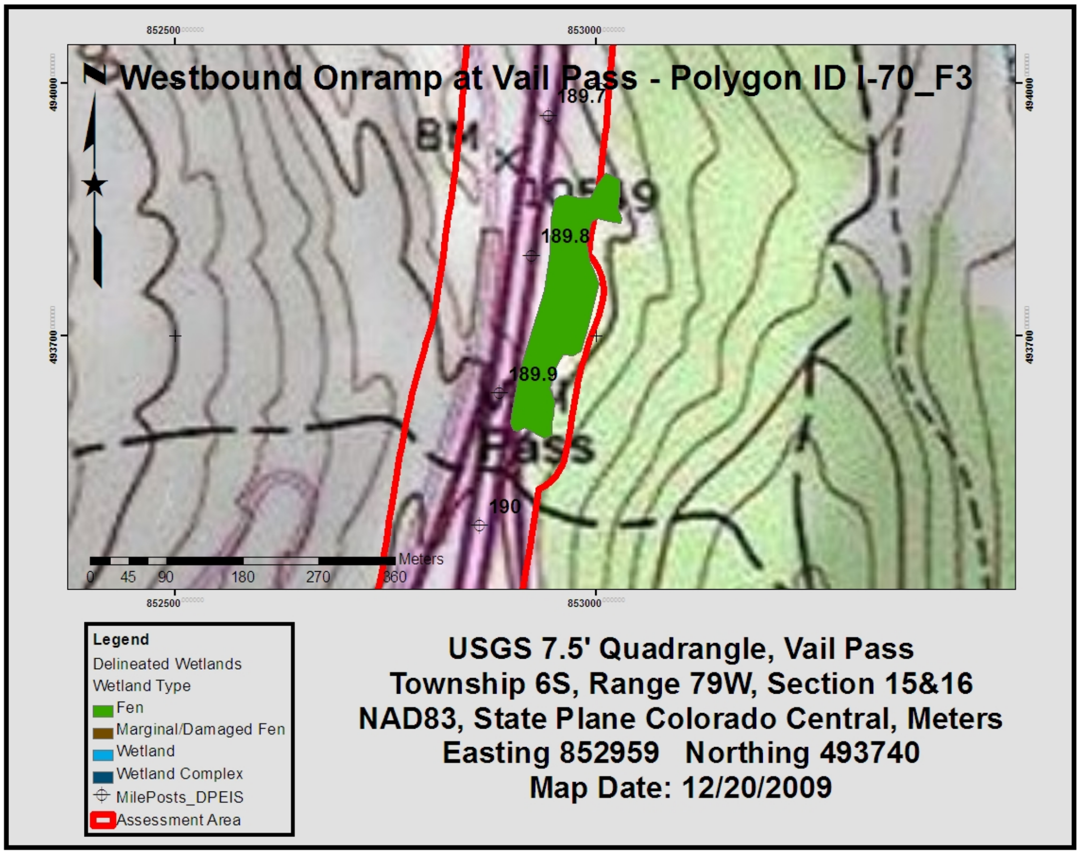
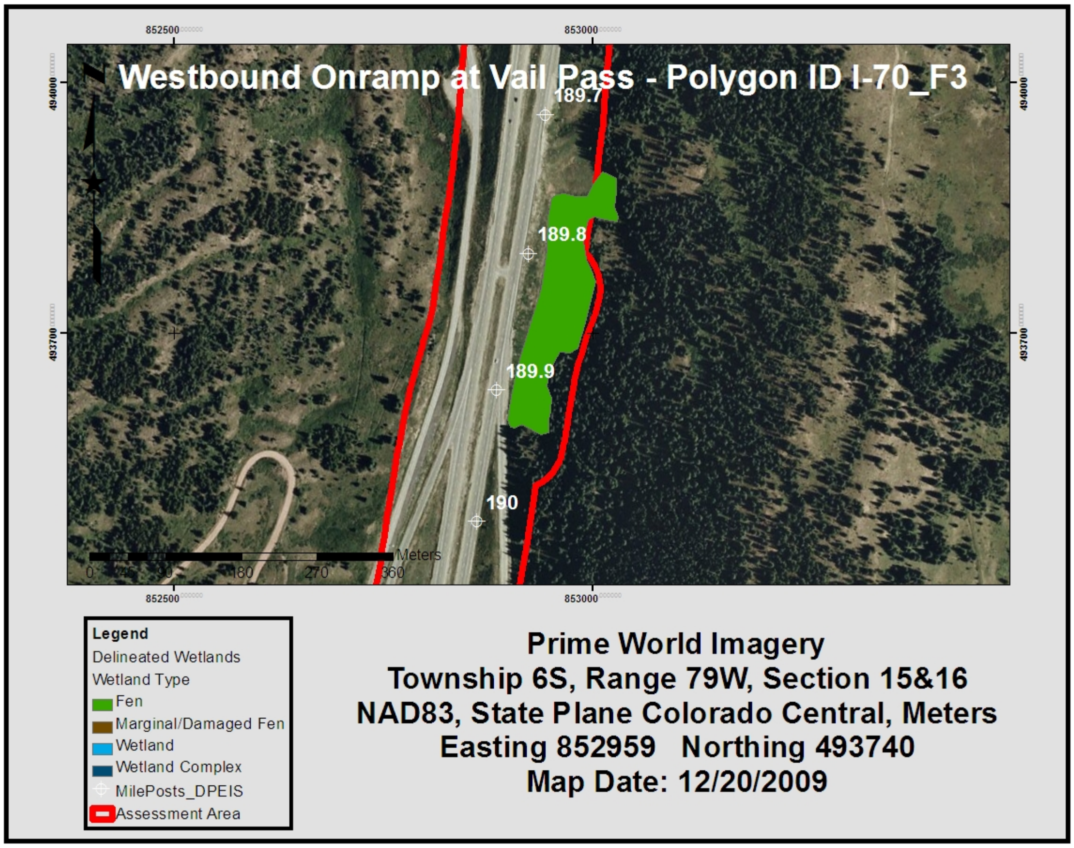


Figure 11. Map of fen at the Westbound Onramp at Vail Pass, World Prime Imagery basemap



***Salix wolfii* / *Carex aquatilis* Shrubland (Wolf's Willow / Aquatic Sedge Shrubland)**
Wilder Gulch at Tenmile Creek
Mile Post 190.8, South Side of Highway
Polygon ID I-70_F4

Description: Occurrence is situated at the toeslope of Ptarmigan Hill, along a series of seeps on the southern slope of Wilder Gulch. Occurrence consists of a series of fens within a larger wetland complex. Surrounding uplands consist of sparse *Picea engelmannii* forests and dry to wet meadows. Mineral soil areas on the south side of the road and in the median are dominated by *Salix* sp., predominantly *Salix wolfii* with an understory of herbaceous dicots and plants in the *Cyperaceae* and *Poaceae* families. *Betula glandulosa* is also common in the shrub strata. Surface geology above the site consists of Pennsylvanian and Permian sandstones.

Natural Communities: *Salix wolfii* / *Carex aquatilis* Shrubland (Wolf's Willow / Aquatic Sedge Shrubland)

Vascular Plants: The upper patch is a small spring with standing water and is dominated by *Eriophorum angustifolium* and *Eleocharis quinqueflora*. Other species present include *Carex aquatilis*, *Thalictrum alpinum*, and *Salix wolfii*. Middle and lower patches are dominated by *Salix wolfii* and *Carex aquatilis* with a mixed herbaceous dicots and bryophyte dominated understory. Common mesic herbaceous dicots include *Polygonum viviparum, Aster foliaceus*, and Geum macrophyllum. Common mosses include *Helodium blandowii*, *Tomentypnum nitens*, *Sanionia uncinata*, *Climacium dendroides* and *Aulacomnium palustre*. Drier portions of the complex are also dominated by *Salix* sp., with mesic herbaceous dicots being more dominant in the understory.

Bryophytes: Hummocks of *Philonotis fontana* are found on creek side seeps. *Tomentypnum nitens* and *Sanionia uncinata* are dominant in the larger wetland complex. *Helodium blandowii* is common throughout as well forming hummocks at the base of Salix.

Site Name	Species	Cover Class
190.8S	*Philonotis fontana* (Hedw.) Brid. var. americana (Dism.) Flow.	1
190.8S	*Plagiomnium ellipticum* Brid. T. Kop	P
190.8S	*Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb	P
190.8S	*Campylium stellatum* (Hedw.) C.E.O. Jensen	P
190.8S	*Aulacomnium palustre* (Hedw.) Schwagr.	P
190.8S	*Helodium blandowii* (F. Weber & D. Mohr) Warnst.	2
190.8S	*Marchantia polymorpha* L.	T
190.8S	*Tomentypnum nitens* (Hedw.) Loeske	2
190.8S	*Sanionia uncinata* (Hedw.) Loeske	2
190.8S	*Dicranum rhabdocarpum* Sull.	P
190.8S	*Pellia neesiana (*Gottsche) Limpr.	P
190.8S	*Climacium dendroides* (Hedw.) F. Weber & D. Mohr	P
190.8S	*Brachythecium erythrorrhizon* Schimp.	P

Condition and Ranking: A, excellent estimated viability

Condition – A – Occurrence along the south side of the highway appears stable and healthy. The small fen in the median is likely impacted by road maintenance activities, but appears to be functioning properly.

Landscape Context – A – Upper reaches of site do not exhibit impacts from recreational use or proximity to road. Site may have extended below the highway prior to construction evidenced by a few small patches of histosols and peat accumulation below the highway in the median.

Size – B – The area of fen is approximately 0.2 hectare. Fen soils are not consistent, occurring in small patches throughout a larger, mineral soil shrub-dominated wetland.

Fen Type Classification: Transitional Fen

Salix wolfii and *Carex aquatilis* are common dominants of many natural wetland communities at this elevation in this region. The species are not associated with any particular fen type. *Tomentypnum nitens* and *Campylium stellatum* were the only species that have been associated with a particular fen type (Chee and Vitt 1989, Cooper and Andrus 1994). This type of fen is difficult to classify, but may be considered a transitional fen for the purpose of this study based on species and upslope bedrock composition.

Figure 12. Map of fen at Wilder Gulch at Tenmile Creek, USGS 7.5' Quadrangle basemap

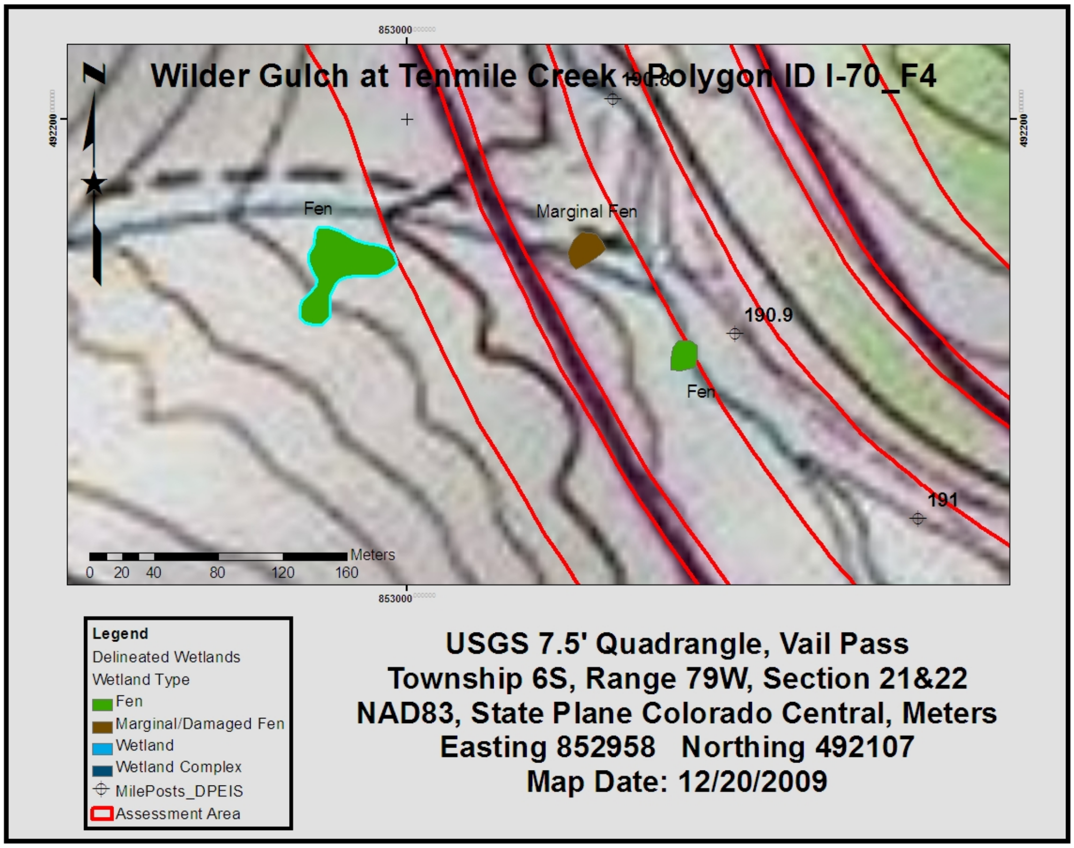
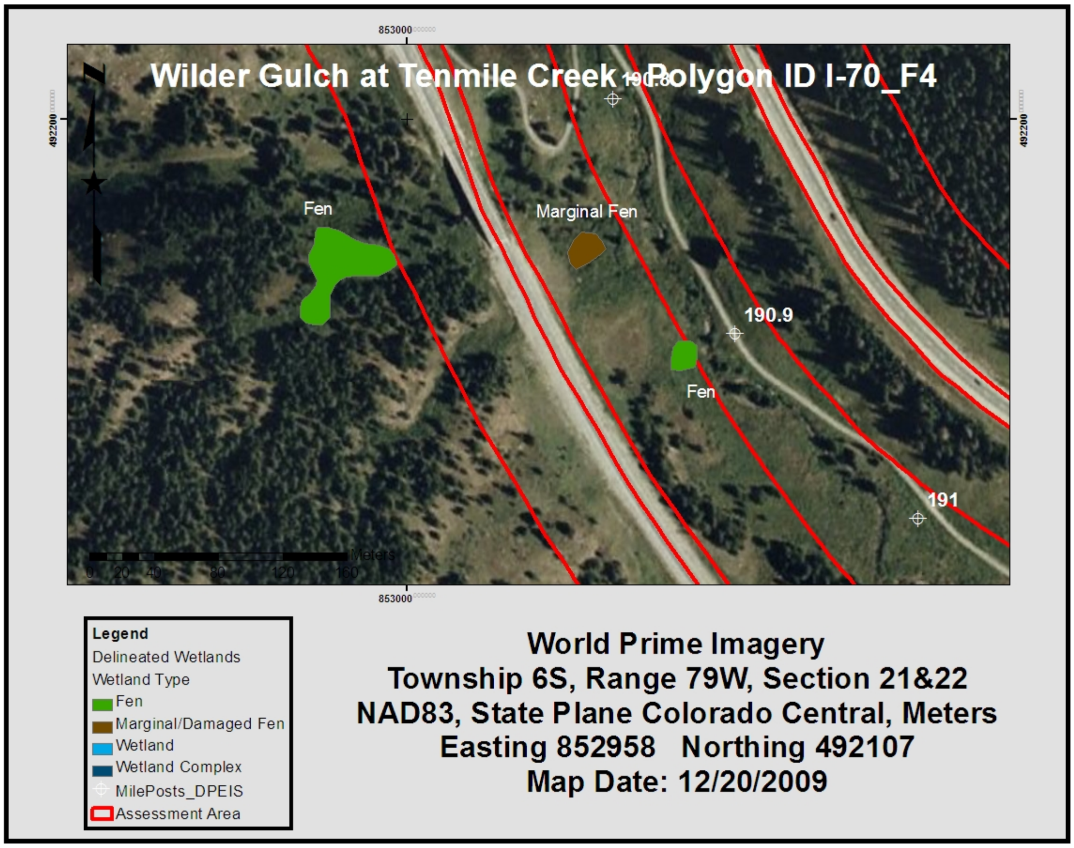


Figure 13. Map of fen at Wilder Gulch at Tenmile Creek, World Prime Imagery basemap



Juncus balticus Herbaceous Vegetation
Betula glandulosa/Herbaceous dicots-Mesic Graminoids
Salix wolfii / _Carex aquatilis_ Shrubland
Eastbound I-70 at milemarker 191
Mile Post 191, South Side and Median of Highway
Polygon ID I-70_F5

Description: The surveyed area consists predominantly of a mineral soil, shrub-dominated subalpine willow carr. The main area of fen soils is located in the median on the northeast side of the eastbound lane. The large wetland complex on the south side of the road supports a few small patches of histosols along seepage areas, but very little fen habitat. Surrounding uplands consist of mature *Picea engelmannii* and *Abies lasiocarpa* forests. Surrounding wetland complex consists of mixed *Salix* and *Betula glandulosa* with mixed herbaceous dicots, sedges, and grasses in the understory. Surface geology in the area is composed of Quaternary glacial drift. Surface geology above the site consists of Pennsylvanian and Permian sandstones. pH is approximately 7.3 in the largest area of fen.

Natural Communities: *Juncus balticus* Herbaceous Vegetation, *Betula glandulosa*/Mesic Forbs-Mesic Graminoids, and *Salix wolfii* / *Carex aquatilis* Shrubland
Vascular Plants: The largest fen patch in the median is dominated by *Juncus balticus*. Other common species include *Salix wolfii* and *Carex aquatilis*. The large wetland complex on the south side of the highway is dominated by a *Salix wolfii*, herbaceous dicot, sedge, and grass community.

Bryophytes: Mosses are dominated by *Tomentypnum nitens* and *Sanionia uncinata*. Because of hydrologic variability, moss richness is high.

Site Name	Species	Cover Class
191M	*Drepanocladus aduncus* (Hedw.) Warnst.	P
191M	*Brachythecium rivulare* Schimp.	P
191M	*Timmia austriaca* (Hedw.)	P
191M	*Philonotis fontana* (Hedw.) Brid. var. americana (Dism.) Flow.	P
191M	*Sanionia uncinata* (Hedw.) Loeske	1
191M	*Climacium dendroides* (Hedw.) F. Weber & D. Mohr	P
191M	*Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb	P
191M	*Plagiomnium ellipticum* Brid. T. Kop	P
191M	*Brachythecium erythrorrhizon* Schimp.	P
191M	*Aulacomnium palustre* (Hedw.) Schwagr.	P
191M	*Tomentypnum nitens* (Hedw.) Loeske	1
191M	*Marchantia polymorpha* L.	T
191M	*Amblystegium riparium* (Hedw.) Warsnt.	P
191M	*Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb	P
191M	*Tortula norvegica* (F. Weber) Wahlenb. ex Lindb.	T
191M	*Campylium stellatum* (Hedw.) C.E.O. Jensen	P
191M	*Lophozia* sp. (Dumort.) Dumort. (subgenus Dilophozia)	T

Condition and Ranking: C, fair estimated viability

Condition – B – The high cover of *Juncus balticus* at this site may reflect an impacted hydrologic regime (Cooper 1990). No exotic species were observed within the fen area. The road shoulder area is dominated by *Bromus inermis*.

Landscape Context – C – Site may be impacted by proximity to highway and highway maintenance provisions, salting and gravel. The two surveyed areas on each side of the eastbound lane were likely connected prior to road construction.

Size – D – The small area of fens soils is approximately 0.12 hectare. The larger wetland complex on the south side of the road covers an area greater than 3.5 hectare. The defined assessment area for this survey included only 200ft off the the edge of pavement. It is highly likely that upper reaches of the wetland complex on the south side of the highway support fen soils and vegetation, those areas were not surveyed during this study.

Fen Type Classification: Transitional Fen

Juncus balticus, *Betula glandulosa*, *Salix wolfii* and *Carex aquatilis* are common dominants of many natural wetland communities at this elevation in this region. The species are not associated with any particular fen type. *Tomentypnum nitens* was the only species that has been associated with a particular fen type (Chee and Vitt 1989). Groundwater pH of the upper patch was meaured at 7.3, within the range of transitional to extreme rich fens. This type of fen is difficult to classify, but may be considered a transitional fen for the purpose of this study based on species and upslope bedrock composition.

Figure 14. Map of fen at Wilder Gulch at Tenmile Creek, USGS 7.5' Quadrangle basemap

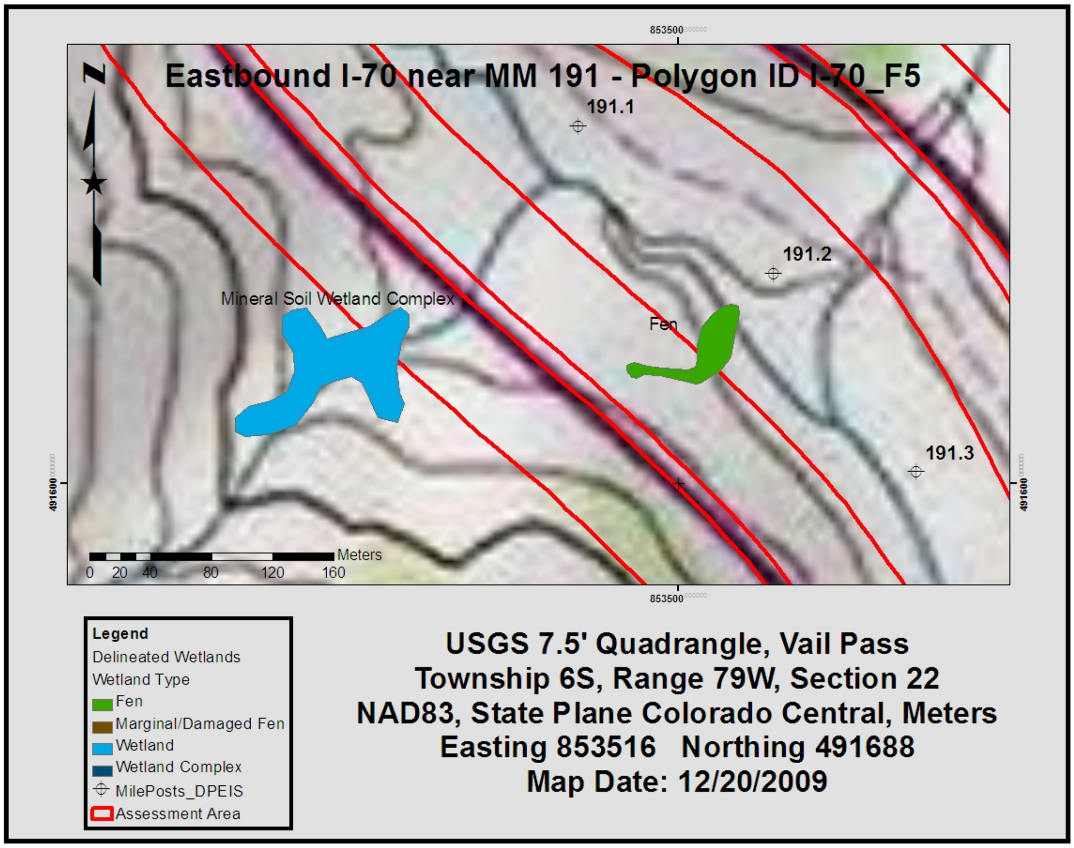
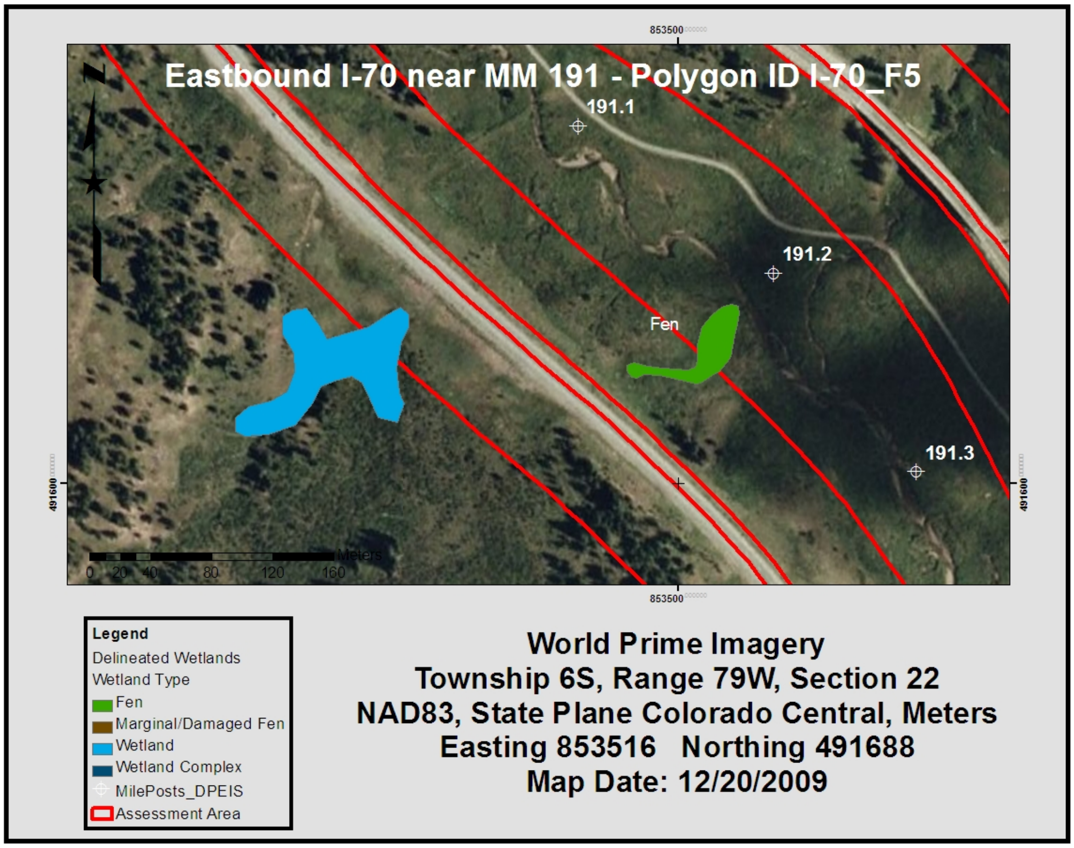


Figure 15. Map of fen at Wilder Gulch at Tenmile Creek, World Prime Imagery basemap



Salix wolfii / _Carex aquatilis_ Shrubland (Wolf's Willow / Aquatic Sedge Shrubland)
Vail Pass at Corral Creek
Mile Post 191, North Side of Highway
Polygon ID I-70_F6

Description: Occurrence is situated along the eastern slope of Corral Creek at the base of a large wetland complex. Complex is fed by snowmelt from the southernmost peaks of the Gore Range. The occurrence is a small, sloping fen at the base of a large mineral soil, shrub-dominated wetland complex. Vegetation and hydrology is consistent throughout the fen. The larger wetland complex is dominated by *Salix* sp. with herbaceous dicots, sedges, and grasses in the understory. Hydrology is variable throughout, wetter areas being dominated by *Carex aquatilis* and drier areas by more dense *Salix* cover and herbaceous dicots. Surrounding uplands are dominated by mature, mixed *Picea engelmannii* and *Abies lasiocarpa* forest and dry subalpine meadows. Surface geology in the wetland complex consists of Quaternary glacial drift. Surface geology above the site consists of Pennsylvanian and Permian sandstones.

Natural Communities: *Salix wolfii* / *Carex aquatilis* Shrubland (Wolf's Willow / Aquatic Sedge Shrubland)

Vascular Plants: Dominant and common species across the larger wetland complex are *Carex aquatilis*, *Salix wolfii* and *Dasiphora fruticosa*. In the fen area herbaceous dicots are less abundant, while sedges and mosses are present in high cover. Other sedges species present include *Carex norvegica* and *Carex capillaris*. Herbaceous dicots present include *Polygonum viviparum*, *Rhodiola rhodantha*, *Pedicularis groenlandica*, *Caltha leptosepala*, *Swertia perennis*, *Conioselinum scopulorum*, and *Thalictrum alpinum*.

Bryophytes: Common bryophytes include *Tomentypnum nitens*, *Sanionia uncinata*, and *Aulacomnium palustre*.

Site Name	**Species**	**Cover Class**
191N	*Sanionia uncinata* (Hedw.) Loeske	2
191N	*Tomentypnum nitens* (Hedw.) Loeske	2
191N	*Aulacomnium palustre* (Hedw.) Schwagr.	P
191N	*Plagiomnium ellipticum* Brid. T. Kop	P

Condition and Ranking: B, good estimated viability

Condition – B – The occurrence appears to be functioning with intact hydrology. No exotic species were observed. Development below the fen may impact hydrology by channeling water away from the site.

Landscape Context – A – Landscape connectivity appears to be enact. There is no evidence of hydrologic alterations above the site.

Size – D – Extent of fen may have been reduced by construction of adjacent parking area, bridge, and highway. The larger wetland complex is approximately 5 acres in size, with more extensive wetland areas separated from the immediate wetland complex by patches of forested uplands. The fen is very small, less than 0.04 hectares.

Fen Type Classification: Transitional Fen

Carex aquatilis and *Salix wolfii* are common dominants of many natural wetland communities at this elevation in this region. The species are not associated with any particular fen type. *Thalictrum alpinum* and *Tomentypnum nitens* are present in low cover, both have been associated with rich and extreme rich fens in our region (Chee and Vitt 1989, Cooper 1996). This type of fen is difficult to classify, but may be considered a transitional fen for the purpose of this study based on species and upslope bedrock composition.

Figure 16. Map of fen at Vail Pass at Corral Creek, USGS 7.5' Quadrangle basemap

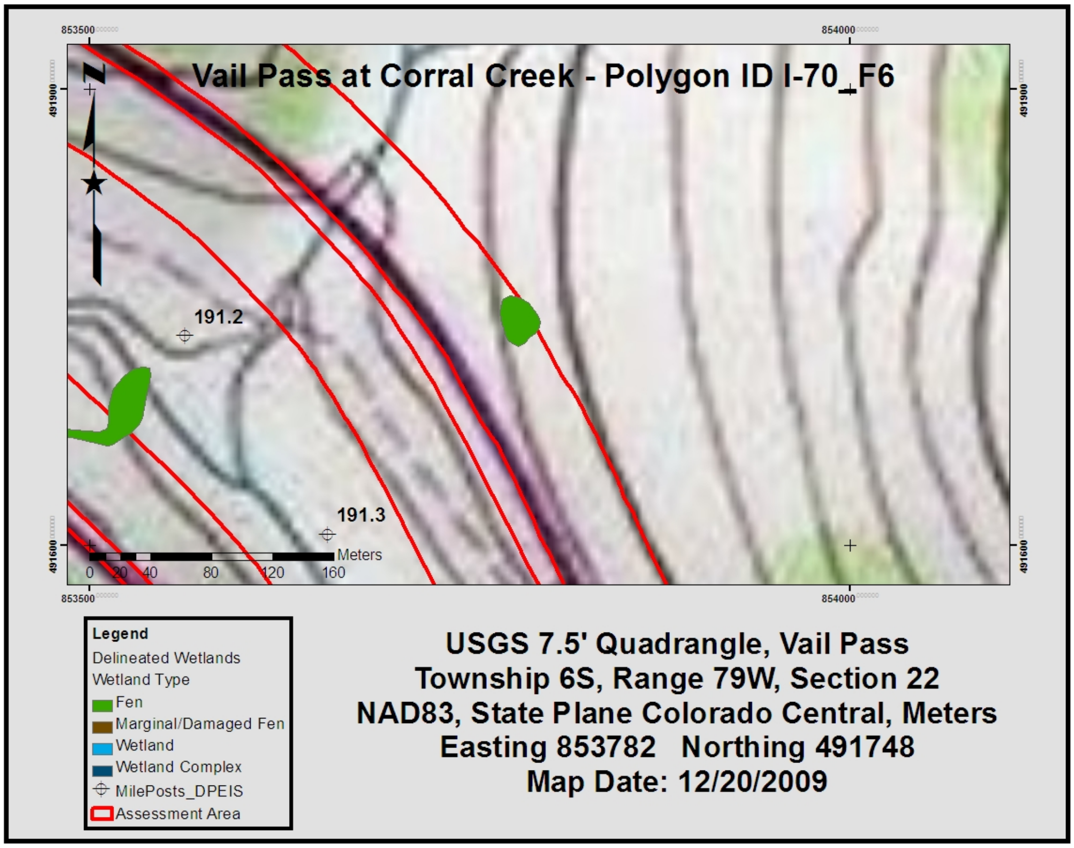
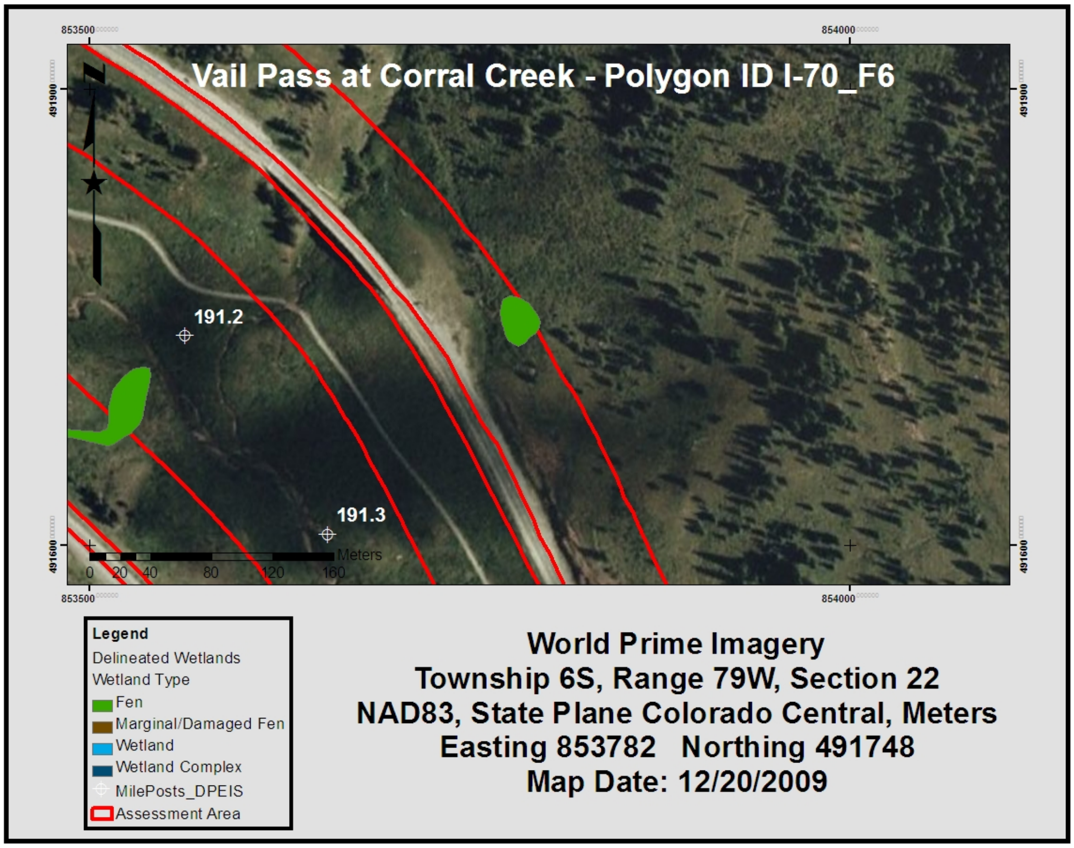


Figure 17. Map of fen at Vail Pass at Corral Creek, World Prime Imagery basemap



Carex aquatilis Herbaceous Vegetation (Aquatic Sedge Herbaceous Vegetation)
Eleocharis quinqueflora Herbaceous Vegetation (Few-flower Spikerush Herbaceous Vegetation)
Eastbound I-70 at Smith Gulch
Mile Post 192, South Side of Highway
Polygon ID I-70_F7

Description: Occurrence is situated at the base of a small drainage adjacent to Smith Gulch at the toe of Ptarmigan Ridge where it meets Tenmile Creek. Site consists of a large wetland complex that slopes northwest toward the drainage. The majority of the wetland is seasonally saturated with mineral soil. Surveyed area consists of two small areas of histosols in a larger shrub-dominated subalpine wetland. Surrounding uplands consist of mature *Picea engelmannii* and *Abies lasiocarpa* forests. Surrounding wetland complex consists of mixed *Salix* and *Betula glandulosa* with mixed herbaceous dicots, sedges, and grasses in the understory. Surface geology in the area consists of Quaternary glacial drift. Surface geology above the site consists of Pennsylvanian and Permian sandstones. Groundwater pH was measured at 7.7.

Natural Communities: *Carex aquatilis* Herbaceous Vegetation, *Eleocharis quinqueflora* Herbaceous Vegetation

Vascular Plants: Both fen patches are dominated by sedges with *Carex aquatilis* being the most common species in the western patch and *Eleocharis quinqueflora* being most common in the eastern patch. Other species present in the western patch include *Carex capillaris*, *Carex gynocrates*, *Eleocharis quinqueflora*, *Carex norvegica*, *Thalictrum alpinum*, *Pedicularis groenlandica*, *Polygonum viviparum*, and *Carex aurea*. Other species present in the eastern patch include *Carex gynocrates*, *Thalictrum alpinum*, *Polygonum viviparum*, *Juncus triglumis*, and *Deschampsia caespitosa*. *Salix wolfii* and *Salix planifolia* dominate along the edges of both sites.

Bryophytes: Dominant bryophytes at site include *Sanionia uncinata* and *Tomentypnum nitens.*

Site Name	Species	Cover Class
192S	*Sanionia uncinata* (Hedw.) Loeske	3
192S	*Aulacomnium palustre* (Hedw.) Schwagr.	P
192S	*Pellia neesiana* (Gottsche) Limpr.	T
192S	*Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb	P
192S	*Plagiomnium ellipticum* Brid. T. Kop	P
192S	*Philonotis fontana* (Hedw.) Brid. var. americana (Dism.) Flow.	P
192S	*Warnstorfia exannulata* (Schimp.) Loeske	P
192S	*Tomentypnum nitens* (Hedw.) Loeske	3

Condition and Ranking: B good estimated viability

Condition – B – Small fen patches appear to be stable and healthy. The larger wetland complex has numerous game trails throughout, extensive gopher activity, and areas of unvegetated soil. Lower reaches have been impacted by road construction, constraining and channeling flow.

Landscape Context – B – Surrounding uplands are relatively undisturbed. The site is immediately adjacent to the highway and lower reaches may be impacted by altered hydrologic regime.

Size – D – The area of fen is only about 0.02 hectare, while the larger 1.6 hectare wetland complex. Only the two small fen areas closest to the highway were surveyed. The site may support more area of fen soils upslope of these sites.

Fen Type Classification: Transitional Fen

Eleocharis quinqueflora and *Carex aquatilis* are common dominants of many natural wetland communities at this elevation in this region. The species are not associated with any particular fen type. *Tomentypnum nitens, Thalictrum alpinum, Carex gynocrates* have been associated with rich and extreme rich fens (Chee and Vitt 1989, Cooper 1996, Hajek et al. 2006). Groundwater pH of both patches was approximately 7.7, within the range of transitional to extreme rich fens. This type of fen is difficult to classify, but may be considered a transitional fen for the purpose of this study based on species composition and upslope bedrock composition.

Figure 18. Map of fen at Eastbound I-70 at Smith Gulch, USGS 7.5' Quadrangle basemap

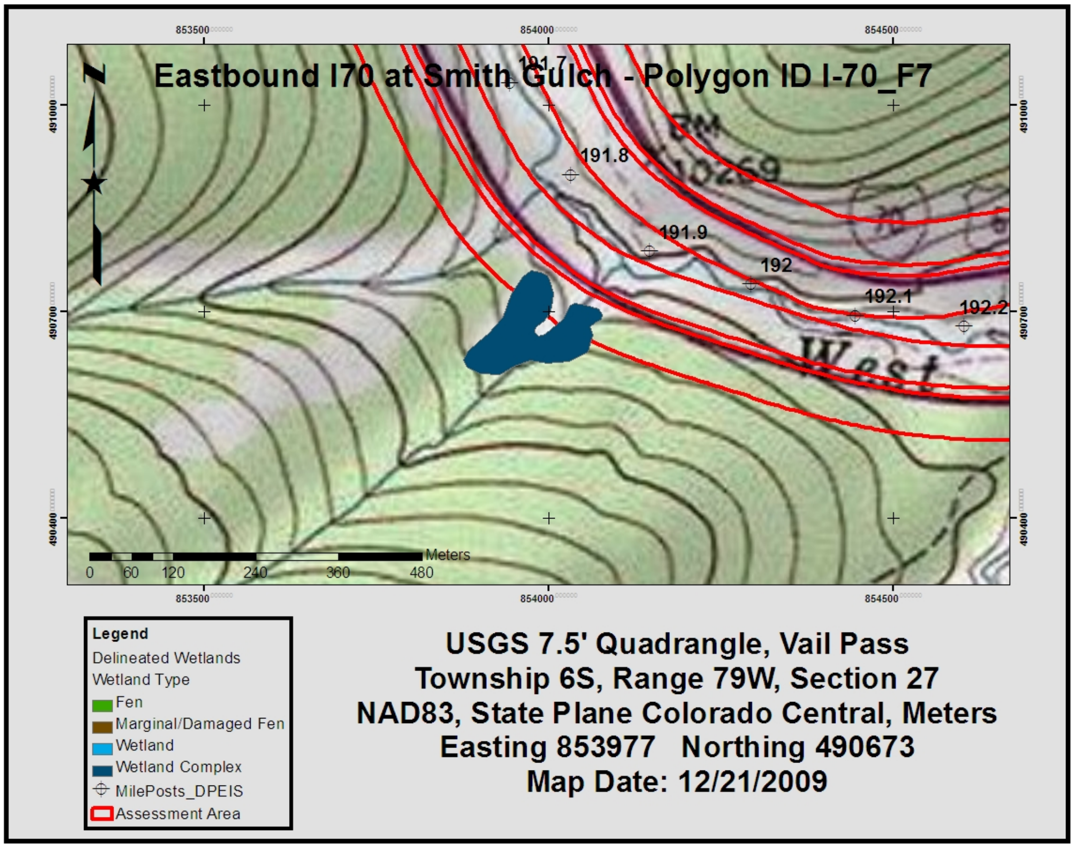
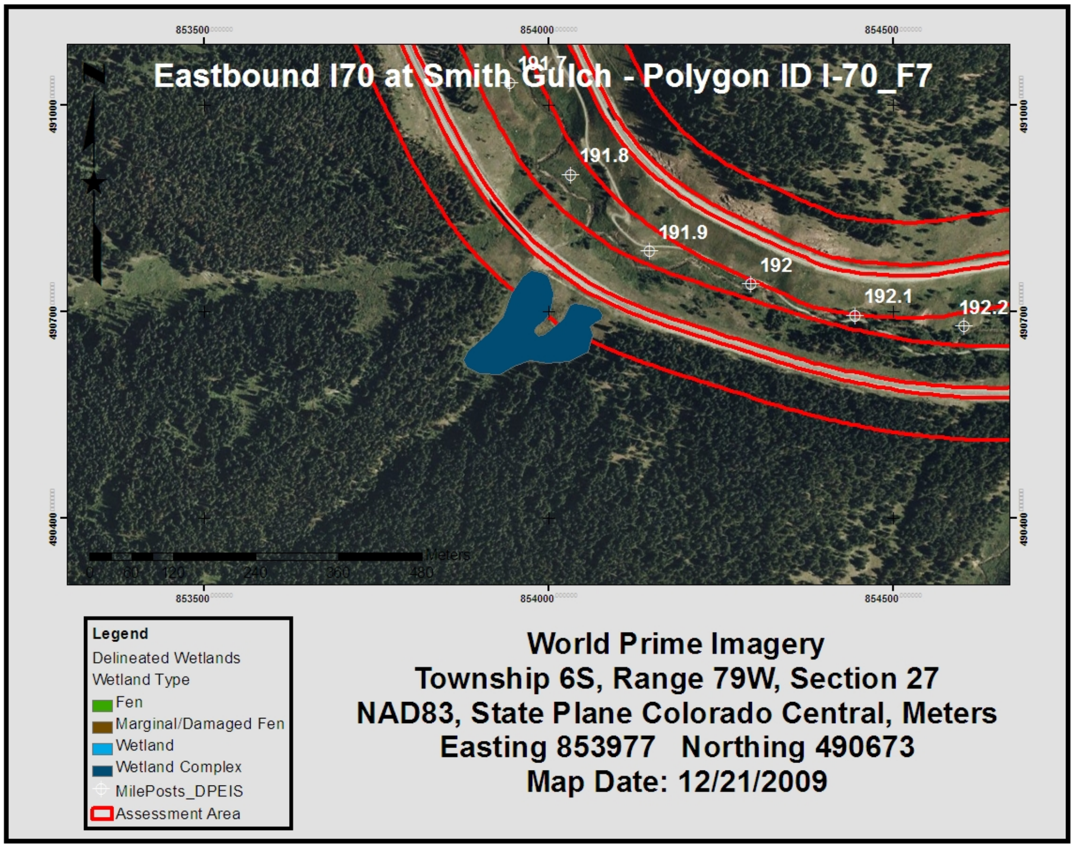


Figure 19. Map of fen at Eastbound I-70 at Smith Gulch, World Prime Imagery basemap



Carex utriculata Herbaceous Vegetation (Northwest Territory Sedge Herbaceous Vegetation)
Eastbound I-70 at Milepost 193
Mile Post 193, South Side of Highway
Polygon ID I-70_F8

Description: Occurrence is situated immediately adjacent to I-70 at the base of the ridge between Guller and Stafford Creeks, just above Tenmile Creek. The site has been heavily impacted by the adjacent road. Up to 50 cm of sloughing peat is evident along the road edge. Other areas have extensive mineral deposition (gravel) in surface layers. The area is heavily used as a wallow. Wallow area appears to be all fine-textured mineral soil. Hydrology has been heavily altered by adjacent highway and site is not in proper functioning condition. Surrounding uplands are dominated by mixed *Picea engelmannii* and *Abies lasiocarpa* mature forest with an understory of *Vacciunium* sp., and dry to wet subalpine meadows. Just south of the area with organic soils is an open dry to mesic meadow dominated by forbs and graminoids with patches of *Dasiphora fruticosa* ssp. *floribunda*. Surface geology in the area consists of Pennsylvanian and Permian sandstones. Surface geology just downstream and along Tenmile Creek consists of Quaternary glacial drift.

Natural Communities: *Carex utriculata* Herbaceous Vegetation (Northwest Territory Sedge Herbaceous Vegetation)

Vascular Plants: Site is species poor. *Carex utriculata* is dominant in most areas with few mesice herbaceous dicots, Other species present in low cover include *Carex buxbaumii*, *Geum macrophyllum*, *Pleum pratense*, *Dasiphora fruticosa* ssp. *floribunda*, and *Juncus balticus*. The large wallow has no vegetation, consisting of bare, mineral soil.

Bryophytes: There are very few mosses at this site.

Site Name	Species	Cover Class
193S	*Polytrichum longisetum* Brid.	P
193S	*Dicranella* sp. (Mull. Hal.) Schimp.	P
193S	*Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb	P

Condition and Ranking: D, poor estimated viability

Condition – D – Previous hydrologic regime appears to have been dominated by groundwater from the southwest. Water is now drained across the site from the west due to constriction of flow from the road. Vegetation types are patchy and disjunct and soils are highly variable throughout. Multiple exotic, weedy species area present including *Phleum pratense* and *Bromus inermis*.

Landscape Context – C – Site and surrounding landscape is heavily disturbed to the north. Surrounding lands to the south are relatively undisturbed.

Size – D – Extent of fen appears to have been reduced due to impacts from adjacent highway. Pre-highway aerials may aid in elucidating the former extent of fen soils and how the highway has impacted hydrology, soils, and vegetation.

Fen Type Classification: Undetermined

Carex utriculata is a common dominant of many natural wetland communities at this elevation in this region. None of the species present are associated with any particular fen type. There was no water at the time of the survey to allow a pH reading.

Figure 20. Map of fen at Eastbound I-70 at Milepost 193, USGS 7.5' Quadrangle basemap

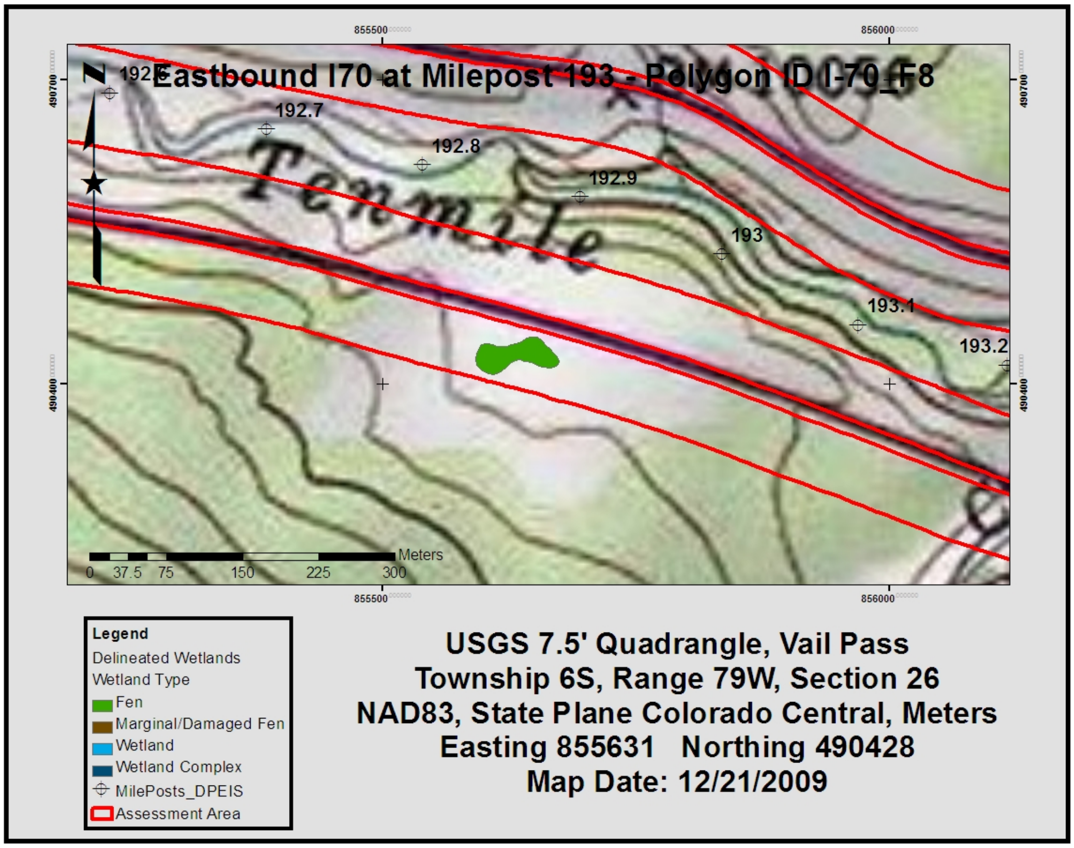
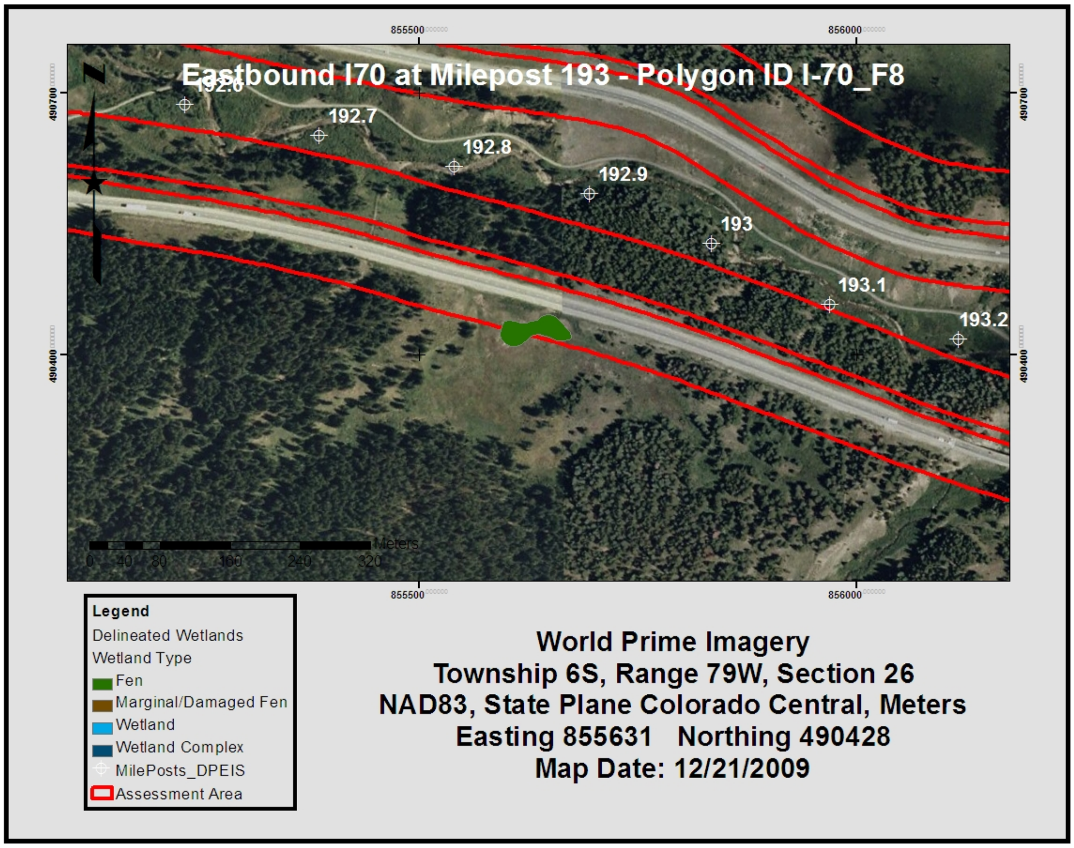


Figure 21. Map of fen at Eastbound I-70 at Milepost 193, World Prime Imagery basemap



Eleocharis quinqueflora Herbaceous Vegetation (Few-flower Spikerush Herbaceous Vegetation)
Upper Straight Creek West of Eisenhower Tunnel
Mile Post 212.5, South Side of Highway
Polygon ID I-70_F9

Description: Occurrence is part of a large wetland complex along the northern side of Straight Creek situated at the toeslope of Coon Hill in the Williams Fork Mountains. Groundwater and snowmelt originates on Coon Hill and is disconnect by I-70. The occurrence consists of two small fens along the edge of a large wetland complex with both groundwater and riparian hydrology. Surrounding uplands are dominated by mixed coniferous forests of *Picea engelmannii*, *Pinus contorta*, and *Abies lasiocarpa* with mixed herbaceous dicots and *Vaccinium* sp. in the understory. Lower reaches of the wetland complex, are hydrologically connected to Straight Creek. These areas are dominated by *Salix planifolia* with herbaceous dicots, sedges, and grasses in the understory. Old beaver dams are present throughout the area, there was no current beaver activity observed.

Natural Communities: *Eleocharis quinqueflora* Herbaceous Vegetation (Few-flower Spikerush Herbaceous Vegetation)
Vascular Plants: The upper patch is species poor, dominated by *Eleocharis quinqueflora* with sparse *Carex utriculata* and *Carex aquatilis*. Edges and small hummocks support *Salix planifolia*, *Dasiphora fruticosa* ssp. *floribunda*, and low cover of mixed herbaceous dicots. The fen patch below the maintenance road is drier and supports more dense and diverse vegetation. *Carex aquatilis* is the most common species with *Eleocharis quinqueflora* being present throughout. Additional species common throughout the lower patch include *Salix planifolia* and *Frageria virginiana*. Other species present include *Caltha leptosepala*, *Carex dioica* (*gynocrates*), *Pedicularis groenlandica*, *Polygonum viviparum*, and *Agrostis humilis*.

Bryophytes: *Sanionia uncinata* is common throughout inundated areas. *Helodium blandowii* is dominant on hummocks and drier edges.

Site Name	**Species**	**Cover Class**
212.5	*Plagiomnium ellipticum* Brid. T. Kop	P
212.5	*Helodium blandowii* (F. Weber & D. Mohr) Warnst.	1
212.5	*Campylium stellatum* (Hedw.) C.E.O. Jensen	P
212.5	*Aulacomnium palustre* (Hedw.) Schwagr.	P
212.5	*Scapania irrigua* (Nees) Gottsche Lindenb. & Nees	P
212.5	*Tomentypnum nitens* (Hedw.) Loeske	2
212.5	*Bryum pseudotriquetrum* (Hedw.) G. Gaertn., B. Mey. & Scherb	P
212.5	*Sanionia uncinata* (Hedw.) Loeske	1

Condition and Ranking: C, fair estimated viability

Condition – B – Despite proximity to I-70 and highway maintenance activities (plowing, gravel, and salting) the two fen patches appear to be functioning properly with intact hydrology. No exotic species were observed.

Landscape Context – C – The surrounding landscape has been altered heavily by I-70 and the forest service road along Straight Creek. Construction of a sediment retention pond at the north end of the site likely helps control amounts of $MgCl_2$ and sediment entering the site from highway maintenance. The northern edge of the upper fen patch appears to have been buried by sediment from the highway. Soils in this section consist of mineral layers over consistent peat in the upper 40cm. *Pinus contorta* in the area have experienced considerable loss due to *Dendroctonus ponderosae* (Mountain Pine Beetle) infestations. The site is dissected in the middle by a service road.

Size – D – The fen area is very small, approximately 0.13 hectare. The portion of the wetland complex that is hydrologically connected to the small fen patches is approximately 1.7 acres. The larger wetland complex is approximately 5 acres in size.

Fen Type Classification: Transitional Fen

Eleocharis quinqueflora and *Carex aquatilis* are common dominants of many natural wetland communities at this elevation in this region. The species are not associated with any particular fen type. *Tomentypnum nitens* was the only species that has been associated with a particular fen type (Chee and Vitt 1989). Groundwater pH of the upper patch was meaured at 7.2, within the range of transitional to extreme rich fens. This type of fen is difficult to classify, but may be considered a transitional fen for the purpose of this study based on species and upslope bedrock composition.

Figure 22. Map of fen west of the Eisenhower Tunnel along Straight Creek, USGS 7.5' Quadrangle basemap

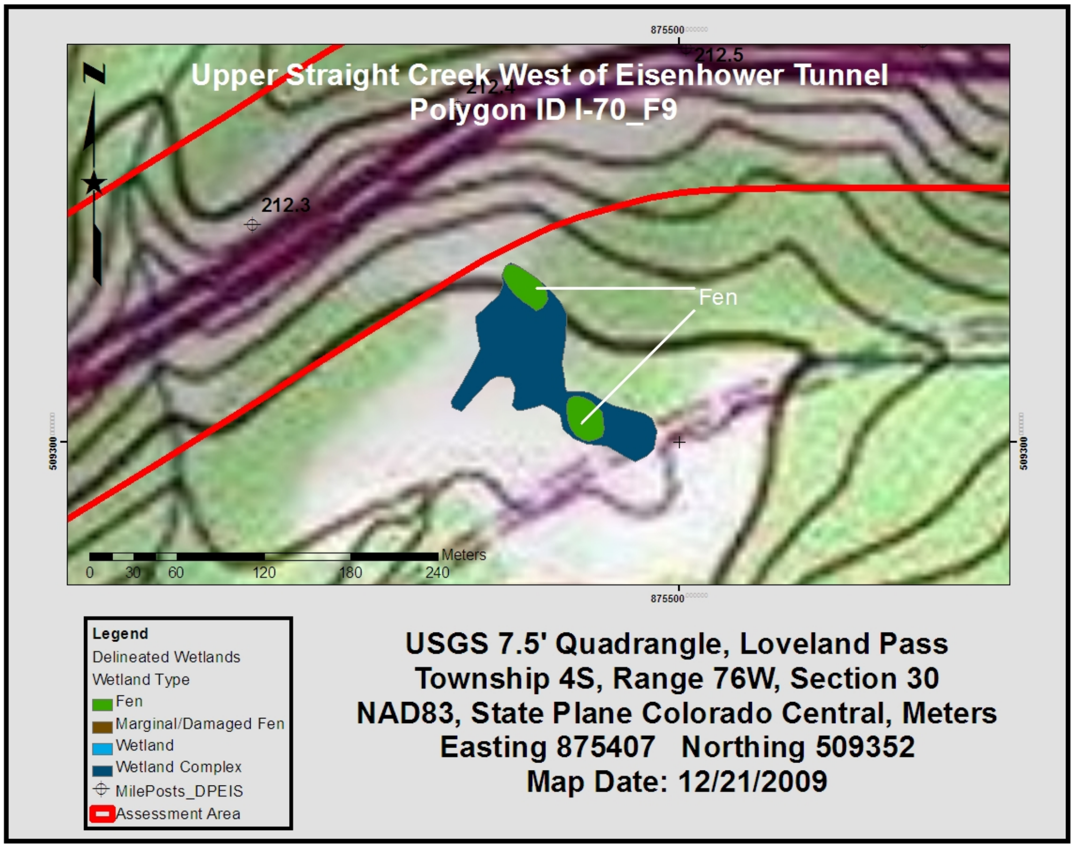
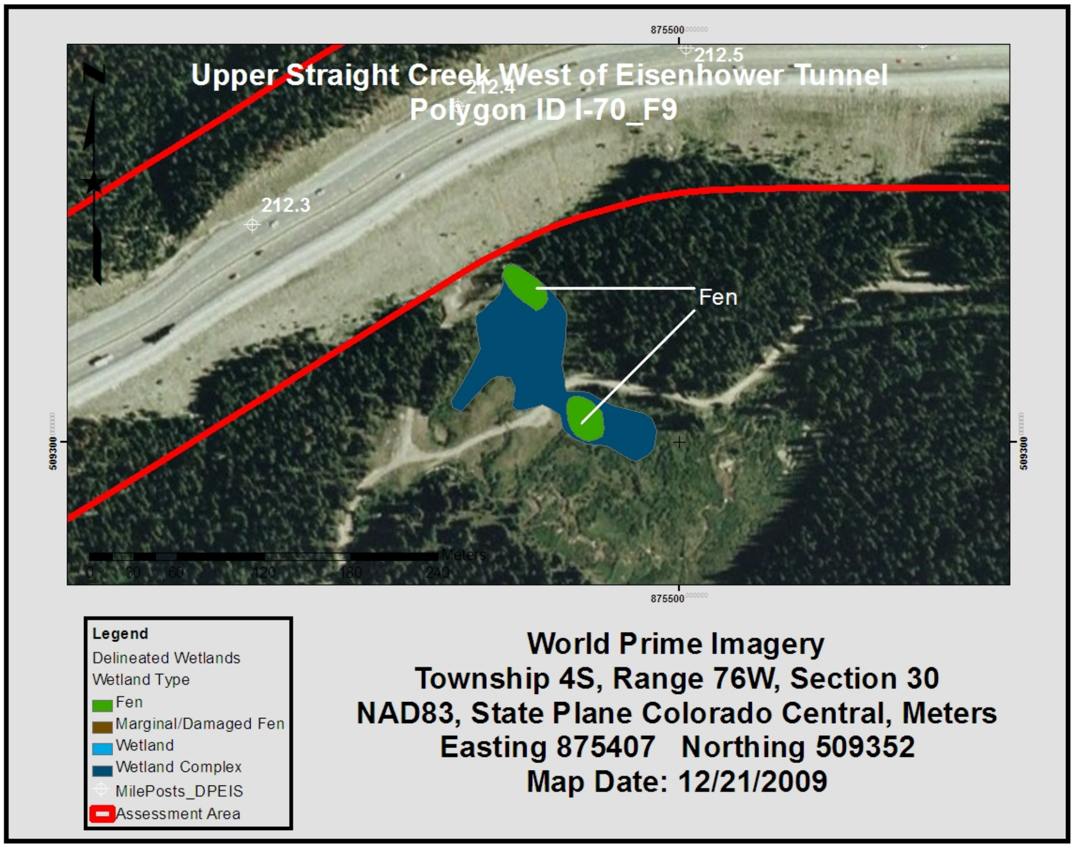


Figure 23. Map of fen west of the Eisenhower Tunnel along Straight Creek, World Prime Imagery basemap



Carex aquatilis **Herbaceous Vegetation (Aquatic Sedge Herbaceous Vegetation)**
Lower Loveland Ski Area
Mile Post 216S1, South Side of Highway
Polygon ID I-70_F10

Description: The occurrence is situated along the northwest toeslope of Mount Sniktau, where it meets Clear Creek. The fen is located immediately adjacent to Clear Creek in the Loveland Valley portion of Loveland Ski area. Site is fed by a small spring complex just above Clear Creek at the southern end of the fen. Peat depth exceeds 80 cm of H4 peat. Soils were saturated throughout. Surrounding uplands are dominated by a mixed *Picea engelmannii* and *Abies lasiocarpa* mature forest system with *Vaccinium* sp. in the understory. Site is bordered to the north and west by a parking area for Loveland Ski Area. Clear Creek is dominated by dense *Betula glandulosa* and *Salix* sp. Surface geology along Clear Creek consists of Quaternary glacial drift. Southeastern slopes above the site consist of Proterozoic granites and gneiss.

Natural Communities: *Carex aquatilis* Herbaceous Vegetation (Aquatic Sedge Herbaceous Vegetation)

Vascular Plants: The area of fen soils is dominated by sedges and grasses with <0.5 m stature. Surrounding mineral soil wetlands are dominated by taller (1-2m) *Betula glandulosa* and *Salix* sp. Some patterning is present with small inclusions of open, peat pools between densely vegetated hummocks. Inundated areas are dominated by *Eleocharis quinqueflora* and *Warnstorfia exannulata*. Hummocks are more diverse and densely vegetated with *Carex aquatilis*, *Carex dioica* (*gynocrates*), *Thalictrum alpinum*, *Caltha leptosepala*, and *Tomentypnum nitens* all common. Other sedges and grasses present include *Deschampisa caespitosa*, *Calamagrostis canadensis*, *Carex aurea*, *Agrostis humilis*, and *Carex norvegica*. Herbaceous dicots present include *Polygonum viviparum*, *Rhodiola rhodantha*, *Pedicularis groenlandica*, and *Viola macloskeyi*. Shrubs are somewhat stunted throughout with *Salix planifolia* and *Betula glandulosa* being most common.

Bryophytes: The dominant moss throughout site is *Tomentypnum nitens.*

Site Name	Species	Cover Class
216S1	*Campylium stellatum* (Hedw.) C.E.O. Jensen	P
216S1	*Warnstorfia exannulata* (Schimp.) Loeske	P
216S1	*Lophozia* sp. (Dumort.) Dumort. (subgenus Dilophozia)	P
216S1	*Tomentypnum nitens* (Hedw.) Loeske	3
216S1	*Campylium stellatum* (Hedw.) C.E.O. Jensen	P
216S1	*Aulacomnium palustre* (Hedw.) Schwagr.	P

Condition and Ranking: B, good estimated viability

Condition – B – Snow plowing from adjacent parking lot may impact the site by adding gravel. There were no evident disturbances within the site and no exotic species were observed.

Landscape Context – B – Though site is immediately adjacent to a ski area, the hydrology appears to be intact. The site was saturated throughout in November. Recreational uses and parking lot maintenance may impact the site. The area does not appear to be part of the skied or maintained skiing area. There is some gravel on the surface adjacent to the parking lot that may result from plowing during the ski season. Plow piles may need to be moved to other areas to avoid filling the creek or burying the fen with gravel each winter.

Size – D – It is unlikely that fen extent was altered due to parking lot construction based on observed hydrologic source, current extent, and adjoining fluvial system. The fen is very small, but appears to be stable and functioning properly.

Fen Type Classification: Transitional Fen

Carex aquatilis is a common dominant of many natural wetland communities in this region. The species is not associated with any particular fen type. A few species that are often associated with rich fens, *Tomentypnum nitens*, *Campylium stellatum*, and *Thalictrum alpinum* are present (Chee and Vitt 1989, Cooper and Andrus 1994, Cooper 1996). Grounwater pH at the site was measured at 6.2 Due to recent rain and snowmelt at the time of survey, pH values may be considered a low estimate. This type of fen is difficult to determine, but may be considered a transitional fen for the purpose of this study.

Figure 24. Map of fen at Lower Loveland Ski Area, USGS 7.5' Quadrangle basemap

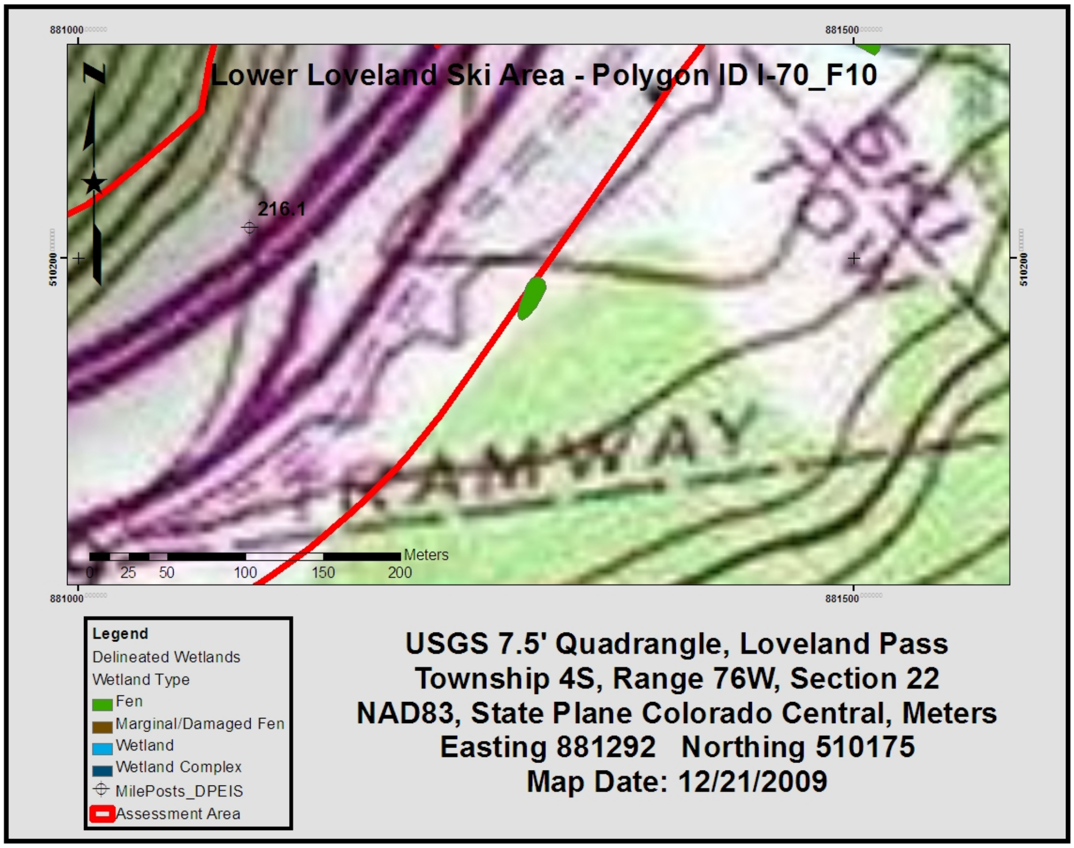
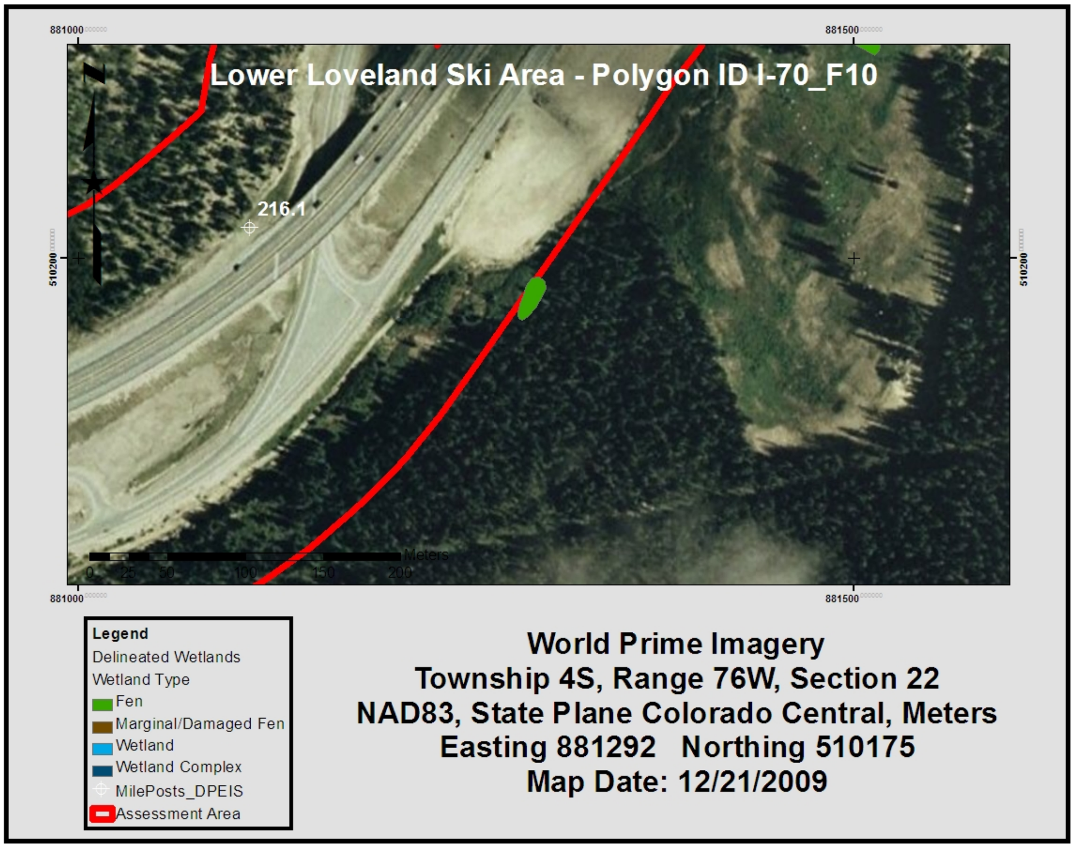


Figure 25. Map of fen at Lower Loveland Ski Area, World Prime Imagery basemap



Carex aquatilis Herbaceous Vegetation (Aquatic Sedge Herbaceous Vegetation)
Lower Loveland Ski Area
Mile Post 216S2, South Side of Highway
Polygon ID I-70_F11

Description: The occurrence is a moderate sized fen situated along the northwest toeslope of Mount Sniktau. The fen is located just above Clear Creek in Loveland Valley, part of Loveland Ski Area. The site is bordered to the northeast by a small, conveyor belt ski lift and to the southwest by a chairlift, chair 7. Clear Creek runs along the northwest side of the occurrence. Surrounding uplands are dominated by a mixed *Picea engelmannii* and *Abies lasiocarpa* mature forest system with *Vaccinium* sp. in the understory. The maintained ski slope surrounding the fen has variable hydrology throughout with multiple seep areas. Surrounding meadows are dominated by mixed *Salix* sp. and dry to wet graminoid dominated meadow openings. Groundwater had a pH of approximately 6.5. Peat depth exceeds 40cm of H2, fibric peat. Soils were inundated to saturated throughout. Surface geology along Clear Creek consists of Quaternary glacial drift. Southeastern slopes above the site consist of Proterozoic granites and gneiss.

Natural Communities: *Carex aquatilis* Herbaceous Vegetation (Aquatic Sedge Herbaceous Vegetation)

Vascular Plants: Occurrence has variable vegetation and hydrology throughout, with *Carex aquatilis* common to dominant in all areas. The area of fen soils is predominantly graminoid dominated with <.5 m stature. Some patterning is evident at lower reaches of the site with moderate sized inclusions of open peat areas of sparse vegetation, between densely vegetated hummocks. Inundated areas are dominated by Eleocharis quinqueflora and *Eriophorum angustifolium* at lower reaches of the fen. Hummocks and other areas are densely vegetated with *Carex aquatilis*. Other graminoids present include *Carex utriculata*, *Calamagrostis canadensis,* and *Juncus triglumis*. Forbs present include *Thalictrum alpinum* and *Pedicularis groenlandica*. *Salix planifolia* is present throughout on small hummocked areas and along drier edges. The site is species poor compared to other fens surveyed.

Bryophytes: Patterning is evident throughout fen and area has low bryophyte cover. Common mosses include *Climacium dendroides* and *Sanionia uncinata*.

Site Name	Species	Cover Class
216S2	*Warnstorfia exannulata* (Schimp.) Loeske	P
216S2	*Sanionia uncinata* (Hedw.) Loeske	1
216S2	*Climacium dendroides* (Hedw.) F. Weber & D. Mohr	1
216S2	*Aulacomnium palustre* (Hedw.) Schwagr.	P

Condition and Ranking: C, fair estimated viability

Condition – B – It is very likely that fen extent has been altered due to ski area and lift maintenance and other recreational and mountain operations activities on the All Smiles ski run. These activities may cause compression of the peat body and alter hydrology. Snowmaking and grooming activities are constant throughout the winter months. The new conveyor belt lift may also be impacting hydrology.

Landscape Context – C – The surrounding landscape is heavily impacted by recreational uses.

Size – C – It is very likely that fen extent and hydrology has been altered due to ski area construction and maintenance. The area of fens soils is moderate in size, 0.2 hectare, part of a much larger wetland complex.

Fen Type Classification: Transitional Fen

Carex aquatilis is a common dominant of many natural wetland communities in this region. The species is not associated with any particular fen type. *Thalictrum alpinum* is present in low cover and has been associated with rich fens in our region (Cooper 1996). Grounwater pH at the site was measured at 6.5 a value associated with both poor and transitional rich fens. This type of fen is difficult to determine, but may be considered a transitional fen for the purpose of this study.

Figure 26. Map of fen at Lower Loveland Ski Area, USGS 7.5' Quadrangle basemap

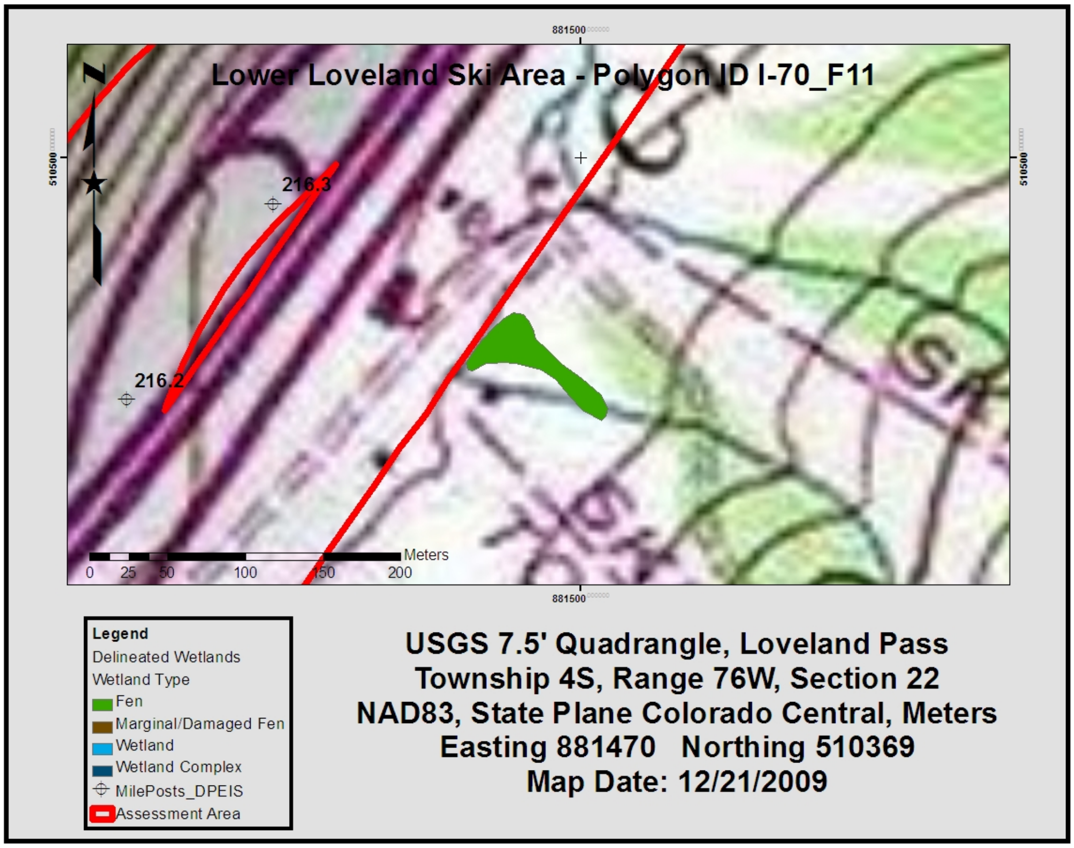
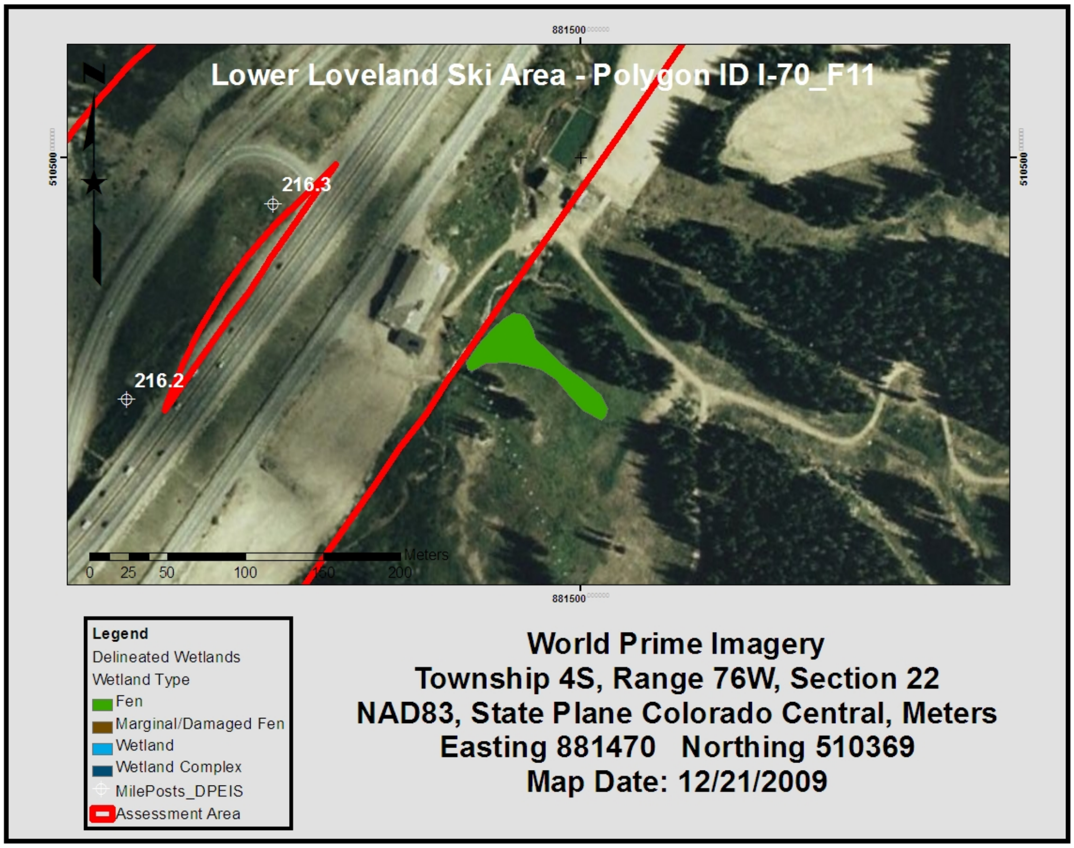


Figure 27. Map of fen at Lower Loveland Ski Area, World Prime Imagery basemap



Plant Element Occurrences

Carex leptalea, Bristlystalked sedge
Upper Clear Creek, East of Loveland Ski Area
Mile Post 217, South Side of Highway
Polygon ID I-70_F12

Site Description: The *Carex leptalea* population occurs in a small fen along the northwest toeslope of Mount Sniktau, where it meets Clear Creek. The site occurs in a shrub-dominated wetland mosaic along the southeast bank of Clear Creek. Immediate surrounding wetlands are dominated by *Betula glandulosa* and *Salix planifolia* with an understory of herbaceous dicots, sedges, and grasses. Uplands to the south and east are dominated by mixed *Picea engelmannii* and *Abies lasiocarpa* forest. Riparian habitat along Clear Creek consists of mixed *Salix* sp. with herbaceous dicots and graminoids. Hydrology appears to be intact with little disturbance along adjacent slopes. Peat humification is fibric (H3), groundwater pH at the site is approximately 6.5. Surface geology along Clear Creek consists of Quaternary glacial drift. Southeastern slopes above the site consist of Proterozoic granites and gneiss.

Vascular Plants: *Carex leptalea* is found predominantly on hummocks. *Carex aquatilis* and bryophytes including *Tomentypnum nitens*, *Sanionia uncinata*, *Campylium stellatum*, *Bryum pseudotriquetrum*, and *Polytrichum longisetum* are also common on hummocks. Open peat flats, inundated through much of the summer, are dominated by *Eriophorum angustifolium* with low cover of *Eleocharis quinqueflora*. Shrubs species present at the site include *Betula glandulosa*, *Dasiphora fruticosa* ssp. *floribunda*, and *Salix planifolia*. Herbaceous dicots present at the site include *Thalictrum alpinum*, *Conioselinum scopulorum*, *Clementsia rhodantha*, *Clatha leptosepala*, and *Swertia perennis*. Other sedge and grasse species present include *Carex nova*, *Carex capillaris*, *Carex dioica*, *Deschampsia caespitosa*, and *Luzula parviflora*.

Bryophytes: Open peat flats are dominated by *Warnstorfia exannulata.* Hummocks are dominated by *Tomentypnum nitens*, *Sanionia uncinata*, and *Bryum pseudotriquetrum*.

Species	**Cover Class**
Dicranum rhabdocarpum Sull.	P
Campylium stellatum (Hedw.) C.E.O. Jensen	P
Polytrichum longisetum Brid.	P
Limprichtia revolvens (Sw.) Loeske	P
Tomentypnum nitens (Hedw.) Loeske	3
Bryum pseudotriquetrum (Hedw.) G. Gaertn., B. Mey. & Scherb	1
Sanionia uncinata (Hedw.) Loeske	2
Warnstorfia exannulata (Schimp.) Loeske	P

Condition and Ranking: B, good estimated viability

Condition – B – Hydrology at the site is intact, originating along the north-facing, toeslope. There is evidence of OHV use at the western edge of the fen, where the soil surface was disturbed and vegetation removed.

Landscape Context – A – The watershed upslope of the site is intact, with little or no disturbances. The site is benched well above Clear Creek and far enough away from Loveland Ski area to be impacted by its operations. The local watershed may be impacted by salting on Highway 6, well above the occurrence.

Size – D – Fen size is determined by topography and hydrologic processes. Fens often occur as small patch habitats in this region. The occurrence covers approximately 0.06 hectare and the fen area extends only slightly beyond that. Despite its small size, the site appears to be stable and functioning.

Fen Type Classification: Intermediate Rich Fen

In this region, *Carex leptalea* is found in sedge and grass-dominated transitional to rich fens and tree to shrub-dominated springs and small stream habitats (Gage and Cooper 2006). Though a pH of 6.5 is at the low end of the spectrum for transitional rich fens, multiple species found on the site are often associated with transitional to rich fen habitats. Other species occurring at this site commonly found in rich fens include *Tomentypnum nitens*, *Campylium stellatum, and Thalictrum alpinum* (Chee and Vitt 1989, Cooper and Andrus 1994, Cooper 1996, Johnson and Steingraeber 2003, Hajek et al. 2006).

Figure 28. Fen at Upper Clear Creek, East of Loveland Ski Area, USGS 7.5' Quadrangle basemap

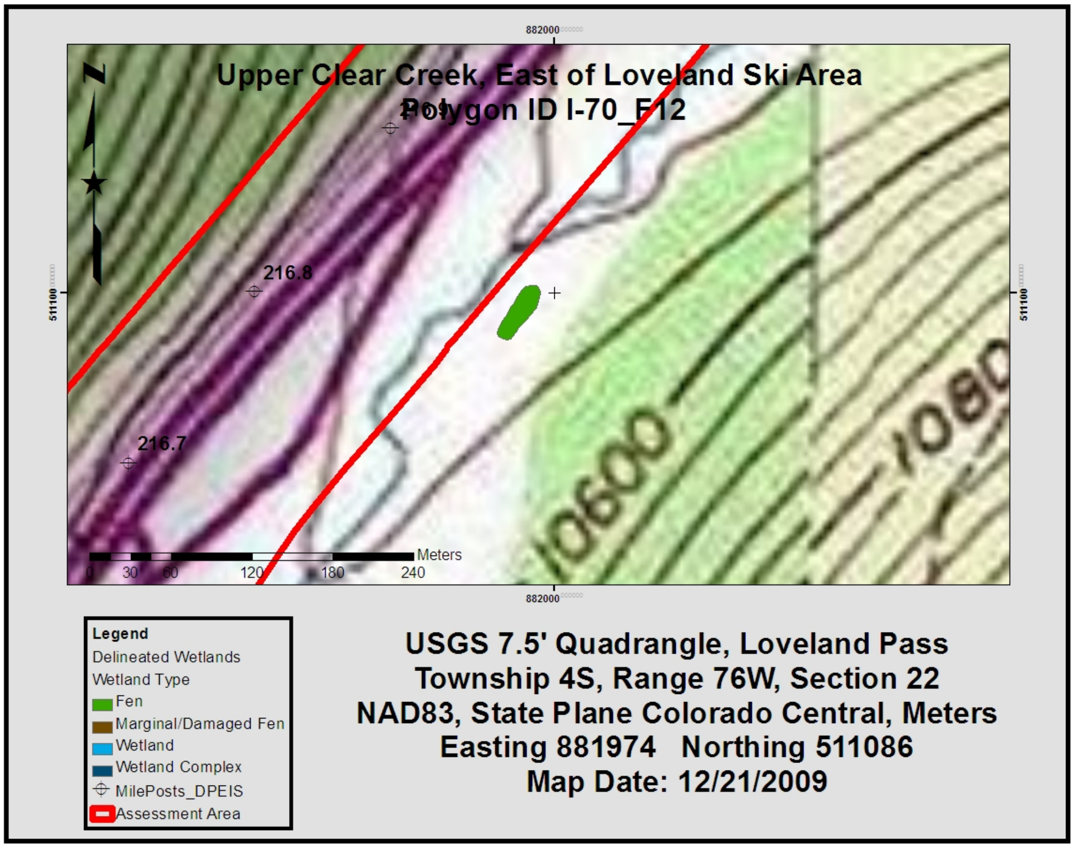
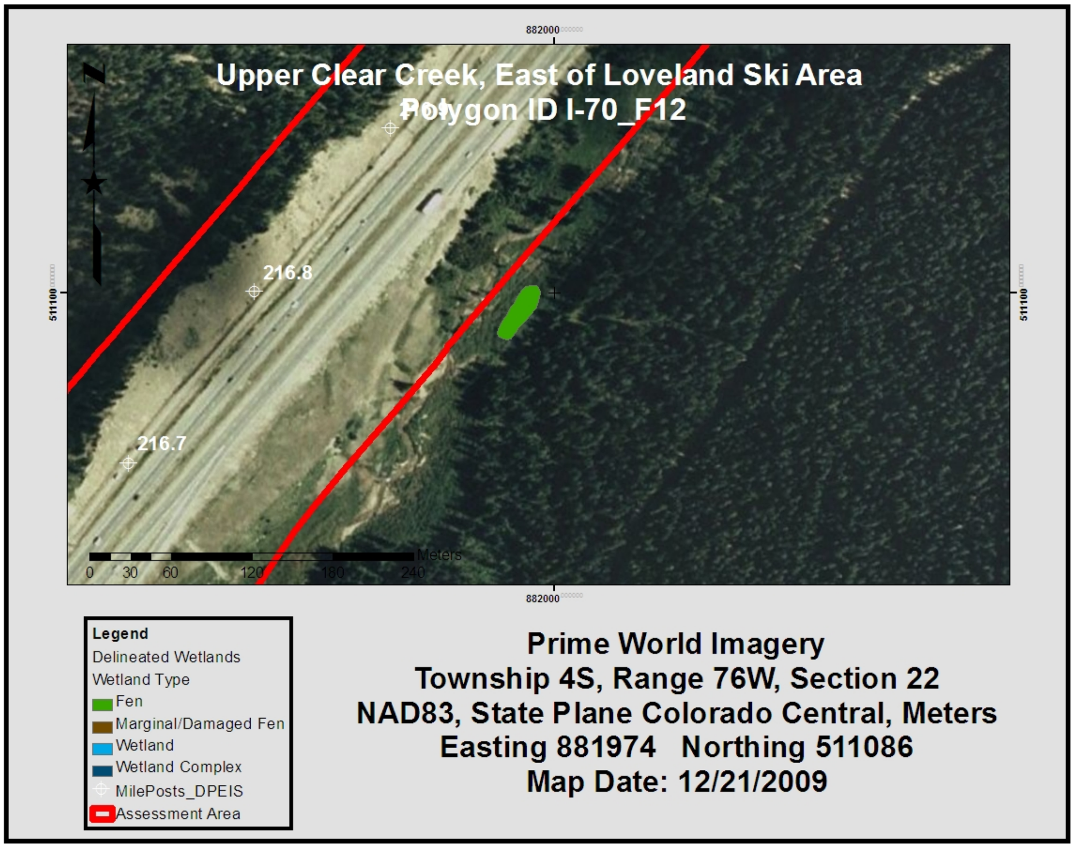


Figure 29. Fen at Upper Clear Creek, East of Loveland Ski Area, Prime Imagery basemap



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Attachment 1
Target Plant List for Fens

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Attachment - Target Species List for I-70 Fen Survey - Provided by Steve Popovich, Forest Botanist, Arapaho and Roosevelt National Forests and Pawnee National Grassland, Fort Collins, Colorado														
Scientific Name	**Common Name**	**Family**	**Category**	**National Wetland Indicator Status**	**Regional Wetland Indicator Status (Region 8)**	**Status**	**Taxon encountered**	**Suitable habitat present**	**Taxon adequately surveyed**	**Threat to known site(s) from existing corridor**	**Threat to known site(s) if corridor widened**	**Likelihood taxon is present in assessment area (high, mod, low)**	**Likelihood taxon was missed (high, mod, low)**	**Additional survey recommended**
Asplenium septentrionale	forked spleenwort	Aspleniaceae	Fern	Not available	Not available	SS, ROMO	N	N	Y	N	N	L	L	N
Aster alpinus var. vierhapperi	Vierhapper's aster	Asteraceae	Dicot	Not available	Not available	SS	N	N	Y	N	N	L	L	N
Astragalus leptaleus	park milkvetch	Fabaceae	Dicot	OBL?	NI	SS	N	Y	N-P	N	UNK	M	M	Y
Botrychium "furcatum"	forkleaved moonwort	Ophioglossaceae	Fern	Not available	Not available	SS, ROMO	N	N	Y	N	N	L	L	N
Botrychium "redbank"	"Redbank" moonwort	Ophioglossaceae	Fern	Not available	Not available	LOC	N	Y	N-P	N	UNK	M	M	Y
Botrychium ascendens	trianlgleobe moonwort	Ophioglossaceae	Fern	Not available	Not available	SS	N	N	Y	N	N	L	L	N
Botrychium campestre	Iowa moonwort	Ophioglossaceae	Fern	Not available	Not available	SS	N	N	Y	N	N	L	L	N
Botrychium echo	reflected grapefern	Ophioglossaceae	Fern	Not available	Not available	LOC, ROMO	N	N	Y	N	N	L	L	N
Botrychium hesperium	western moonwort	Ophioglossaceae	Fern	Not available	Not available	LOC, ROMO	N	N	Y	N	N	L	L	N
Botrychium lanceolatum	lanceleaf grapefern	Ophioglossaceae	Fern	FAC, FACW	FACW	LOC	N	N	Y	N	N	L	L	N
Botrychium lineare	narrowleaf grapefern	Ophioglossaceae	Fern	Not available	Not available	SS	N	N	Y	N	N	L	L	N
Botrychium lunaria	common moonwort	Ophioglossaceae	Fern	FAC, FACW	FACW	LOC	N	Y	N-P	N	UNK	M	M	Y
Botrychium minganense	Mingan moonwort	Ophioglossaceae	Fern	Not available	Not available	LOC	N	Y	N-P	N	UNK	M	M	Y
Botrychium multifidum	leathery grapefern	Ophioglossaceae	Fern	FACU, FAC	FACU	LOC	N	Y	Y	N	N	L	L	N
Botrychium paradoxum	peculiar moonwort	Ophioglossaceae	Fern	Not available	Not available	SS	N	Y	N-P	N	UNK	M	M	Y
Botrychium pinnatum	northern moonwort	Ophioglossaceae	Fern	Not available	Not available	LOC	N	Y	N-P	N	UNK	M	M	Y
Botrychium simplex	little grapefern	Ophioglossaceae	Fern	FACU, FAC	FACU	LOC	N	Y	N-P	N	UNK	M	M	Y
Botrychium spathulatum	spathulate botrychium	Ophioglossaceae	Fern	Not available	Not available	LOC	N	Y	N-P	N	UNK	M	M	Y
Botrychium virginianum	rattlesnake fern	Ophioglossaceae	Fern	FACU	FACU	LOC	N	Y	N-P	N	UNK	M	M	Y
Carex diandra	lesser panicled sedge	Cyperaceae	Monocot	OBL	OBL	SS	N	Y	N-H	N	UNK	M	M	Y
Carex lasiocarpa	woollyfruit sedge	Cyperaceae	Monocot	OBL	NI	LOC	N	N	Y	N	N	L	L	N
Carex leptalea	bristlystalked sedge	Cyperaceae	Monocot	OBL	OBL	LOC	Y	Y	N-H	N	N	H	M	Y
Carex limosa	mud sedge	Cyperaceae	Monocot	OBL	OBL	LOC	N	N	Y	N	N	L	L	N
Carex livida	livid sedge	Cyperaceae	Monocot	OBL	Not available	SS	N	N	Y	N	N	L	L	N
Chrysosplenium tetrandrum	northern golden saxifrage	Saxifragaceae	Dicot	OBL	OBL	LOC	N	Y	N-H	N	UNK	M	M	Y
Comarum palustre	purple marshlocks	Rosaceae	Dicot	Not available	Not available	LOC	N	Y	Y	N	N	L	L	N
Cornus canadensis	bunchberry dogwood	Cornaceae	Dicot	FACU, FAC	FAC	LOC	N	Y	Y	N	N	L	L	N
Cypripedium fasciculatum	clustered lady's slipper	Orchidaceae	Monocot	FACU, FAC	FACU	LOC	N	Y	Y	N	N	L	L	N
Cypripedium parviflorum	lesser yellow lady's slipper	Orchidaceae	Monocot	Not available	Not available	SS	N	Y	Y	N	N	L	L	N
Cystopteris montana	mountain bladderfern	Dryopteridaceae	Fern	FAC, FAC+	FAC+	LOC	N	N	Y	N	N	L	L	N
Drosera anglica	English sundew	Droseraceae	Dicot	OBL	Not available	SS	N	N	Y	N	N	L	L	N
Drosera rotundifolia	roundleaf sundew	Droseraceae	Dicot	OBL	OBL	SS	N	N	Y	N	N	L	L	N
Eleocharis elliptica	elliptic spikerush	Cyperaceae	Monocot	Not available	Not available	LOC	N	N	Y	N	N	L	L	N
Eriophorum altaicum var. neogaeum	whitebristle cottongrass	Cyperaceae	Monocot	Not available	Not available	SS	N	Y	Y	N	N	L	L	N
Eriophorum angustifolium	tall cottongrass	Cyperaceae	Monocot	OBL	OBL	LOC	Y	Y	Y	N	N	H	L	N
Eriophorum chamissonis	Chamisso's cottongrass	Cyperaceae	Monocot	OBL	OBL	SS	N	Y	Y	N	N	L	L	N
Eriophorum gracile	slender cottongrass	Cyperaceae	Monocot	OBL	OBL	SS	N	Y	Y	N	N	L	L	N
Goodyera repens	lesser rattlesnake plantain	Orchidaceae	Monocot	UPL, FACW	UPL	LOC	N	Y	Y	N	N	L	L	N
Kobresia simpliciuscula	simple bog sedge	Cyperaceae	Monocot	FAC, FACW	FACW	SS	Y	Y	N-H	N	UNK	H	M	Y
Lilium philadelphicum	wood lily	Liliaceae	Monocot	FACU-, FACW+	FACU	LOC	N	Y	Y	N	N	L	L	N
Listera borealis	northern twayblade	Orchidaceae	Monocot	FACU, FACW	FACU	LOC	N	Y	N-H	N	UNK	L	L	Y
Listera convallarioides	broadlipped twayblade	Orchidaceae	Monocot	FACU, FACW	FACW	LOC	N	Y	N-H	N	UNK	L	L	Y
Listera cordata	heartleaf twayblade	Orchidaceae	Monocot	FACU, FACW+	FACU	LOC	N	Y	N-H	N	UNK	L	L	Y
Lomatogonium rotatum	marsh felwort	Gentianaceae	Dicot	OBL	OBL	LOC	N	Y	N-H	N	UNK	M	M	Y
Luzula subcapitata	Colorado woodrush	Juncaceae	Monocot	OBL	OBL	LOC, ROMO	N	Y	N-H	N	UNK	M	M	Y
Lycopodium annotinum	stiff clubmoss	Lycopodiaceae	Lycopod	FACU, FAC	FACU	LOC	N	Y	N-H	N	UNK	L	L	Y
Mimulus gemmiparus	Rocky Mountain monkeyflower	Scrophulariaceae	Dicot	Not available	Not available	SS, ROMO	N	Y	N-H	N	UNK	L	L	Y
Papaver radicatum ssp. kluanense	rooted poppy	Papaveraceae	Dicot	Not available	Not available	LOC, ROMO	N	N	Y	N	N	L	L	N
Parnassia kotzebuei	Kotzebue's grass of Parnassus	Saxifragaceae	Dicot	FACW, OBL	OBL	LOC, ROMO	N	Y	N-H	N	UNK	L	L	Y
Petasites frigidus var. sagittatus	arrowleaf sweet coltsfoot	Asteraceae	Dicot	Not available	Not available	LOC	N	Y	N-H	N	UNK	L	L	Y
Polypodium hesperium	western polypody	Polypodiaceae	Fern	Not available	Not available	LOC, ROMO	N	Y	Y	N	N	L	L	N
Primula egaliksensis	Greenland primrose	Primulaceae	Dicot	FACW	FACW	LOC	N	N	N-H	N	N	L	L	N
Primula incana	silvery primrose	Primulaceae	Dicot	FACW, OBL	FACW	LOC	N	N	N-H	N	N	L	L	N
Ptilagrostis porteri	Porter's false needlegrass	Poaceae	Monocot	Not available	Not available	LOC	N	Y	N-H	N	UNK	M	M	Y
Pyrola picta	whiteveined wintergreen	Pyrolaceae	Dicot	Not available	Not available	LOC, ROMO	N	N	Y	N	N	L	L	N
Rubus arcticus ssp. acaulis	dwarf raspberry	Rosaceae	Dicot	Not available	Not available	SS	N	Y	N-H	N	UNK	L	L	Y
Salix candida	sageleaf willow	Salicaceae	Dicot	OBL	OBL	SS	N	Y	N-H	N	UNK	L	L	Y
Salix myrtillifolia	blueberry willow	Salicaceae	Dicot	FACW, FACW+	NI	SS	N	N	Y	N	N	L	L	N
Salix serissima	autumn willow	Salicaceae	Dicot	OBL	NI	SS, ROMO	N	Y	N-H	N	UNK	L	L	Y
Selaginella selaginoides	club spikemoss	Selaginellaceae	Lycopod	FACU, OBL	OBL	SS	N	Y	N-H	N	UNK	L	L	Y
Sisyrinchium pallidum	pale blue-eyed grass	Iridaceae	Monocot	Not available	Not available	LOC, ROMO	N	Y	N-H	N	UNK	M	M	Y
Sphagnum angustifolium	sphagnum	Sphagnaceae	Moss	Not available	Not available	SS	N	Y	N-H	N	UNK	L	L	Y
Sphagnum balticum	Baltic sphagnum	Sphagnaceae	Moss	Not available	Not available	SS	N	Y	N-H	N	UNK	L	L	Y
Sphagnum contortum	contorted sphagnum	Sphagnaceae	Moss	Not available	Not available	LOC	N	Y	N-H	N	UNK	L	L	Y
Thalictrum alpinum	alpine meadow-rue	Ranunculaceae	Dicot	FACU, FACW-	FAC	LOC	Y	Y	N	Y	UNK	H	H	Y
Utricularia minor	lesser bladderwort	Lentibulariaceae	Dicot	OBL	OBL	SS	N	N	Y	N	N	L	L	N
Viola selkirkii	Selkirk's violet	Violaceae	Dicot	Not available	Not available	SS, ROMO	N	N	Y	N	N	L	L	N

Attachment - Target Species List for I-70 Fen Survey, continued - Habitat Description	
Scientific Name	**USFS Habitat or Flora of North America Habita Description**
Asplenium septentrionale	cliffs of various substrates; 700--2900 m
Aster alpinus var. vierhapperi	typically occupying alpine tundra, slopes and saddles of the high mountains
Astragalus leptaleus	typically grows in sedge-grass meadows, swales and hummocks, and among streamside willows
Botrychium "furcatum"	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium "redbank"	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium ascendens	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium campestre	extremely inconspicuous in prairies, dunes, grassy railroad sidings, and fields over limestone; 50--1200 m
Botrychium echo	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium hesperium	gneiss outcrops and cliffs, decomposed gneiss and organic soil slope, small forest openings, road cuts, and open subalpine meadows
Botrychium lanceolatum	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium lineare	aspen groves, town sites, canal berm, gravel roadsides
Botrychium lunaria	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium minganense	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium multifidum	moist mountain meadows, riparian cooridors
Botrychium paradoxum	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium pinnatum	natural openings and meadows, often moist
Botrychium simplex	mossy and grass-herb-willow riparian corridors
Botrychium spathulatum	gravelly soils near roads and trails, rocky hillsides, grassy slopes, and meadows
Botrychium virginianum	moist woodlands, thickets, and meadows
Carex diandra	swampy, marshy, or boggy areas, including features such as wet meadows, fens, muskegs, floating mats, and shores of lakes and ponds
Carex lasiocarpa	sedge meadows, fens, bogs, lakeshores, stream banks, usually in very wet sites and sometimes forming floating mats; 0–1300 m
Carex leptalea	graminoid-dominated transitional rich and rich fens, and shrub or tree-dominated wetlands associated with springs or small streams
Carex limosa	typically occurs in montane or subalpine peatlands, often as part of a floating mat community adjacent to an open water system
Carex livida	montane and subalpine fens, including those formed in depressions such as small kettle basins on toeslope or alluvial fans
Chrysosplenium tetrandrum	occurs in seeps, rock crevices, wet banks, and other open, wet places at lower to mid-elevations
Comarum palustre	upper montane subapline fens and wet meadows
Cornus canadensis	wooded sites, moist forests
Cypripedium fasciculatum	open to densly shaded Pinus contorta forest, less frequently in spruce-fir foret
Cypripedium parviflorum	aspen groves and ponderosa pine/Douglas fir forests
Cystopteris montana	moist rich soil in spruce-fir forest
Drosera anglica	floating peat mats and on margins of acidic ponds and poor to rich fens
Drosera rotundifolia	floating peat mats and on margins of acidic ponds and fens
Eleocharis elliptica	very wet, calcareous (or brackish) shores, pool margins, fens, meadows, prairies
Eriophorum altaicum var. neoga	fens, wet meadows, pond edges
Eriophorum angustifolium	fens, wet meadows, pond edges
Eriophorum chamissonis	fens, wet meadows, pond edges
Eriophorum gracile	fens, wet meadows, pond edges
Goodyera repens	shady, moist, coniferous or mixed woods, on mossy or humus-covered ground, sometimes in bogs or cedar swamps
Kobresia simpliciuscula	mesic to wet tundra, in shallow wetlands of glacial cirques, and in rich or extreme rich fens
Lilium philadelphicum	tallgrass prairies, open woods, thickets, roadsides, powerlines, balds, barrens, dunes, and heathlands, w mountain meadows
Listera borealis	seeps, springs, streamsides in cold air drainages, ususally in moist spruce-fir forests
Listera convallarioides	seeps, springs, streamsides in cold air drainages, ususally in moist spruce-fir forests
Listera cordata	seeps, springs, streamsides in cold air drainages, ususally in moist spruce-fir forests
Lomatogonium rotatum	subalpine fens and wet meadows
Luzula subcapitata	subalpine and alpine fens
Lycopodium annotinum	Swampy or moist coniferous forests, mountain forests, and exposed grassy or rocky sites
Mimulus gemmiparus	granitic seeps, slopes, and alluvium in open sites, within spruce-fir and aspen forests
Papaver radicatum ssp. kluanens	dry, rocky alpine ridges
Parnassia kotzebuei	wet rocky ledges, streamlets, moss mats
Petasites frigidus var. sagittatus	cold wetlands: edges of fens willow carrs, and wet sedge meadows, bogs, marshes
Polypodium hesperium	spruce-fir forest
Primula egaliksensis	montane and subalpine fens
Primula incana	montane and subalpine fens
Ptilagrostis porteri	montane and subalpine fens and willow carrs
Pyrola picta	dry, coniferous forests
Rubus arcticus ssp. acaulis	montane and sub-alpine, at elevations between approximately 2,130 and 2,970 m
Salix candida	cold, often calcareous bogs and fens, swamps, lakeshores, and stream banks at low to mid-elevations
Salix myrtillifolia	fens and muskegs, small stream- and riverbanks, and boreal and subalpine black spruce lowlands, plants considered calciphiles
Salix serissima	cold, often calcareous bogs and fens, swamps, lakeshores, sandy habitats, and stream banks at low to mid-elevations
Selaginella selaginoides	mossy areas
Sisyrinchium pallidum	wetlands, fens, riparian corridors, and meadows
Sphagnum angustifolium	ombrotrophic to rich fens, open mires, sedge fens and muskeg, as carpets, floating mats, low hummocks and hummock sides
Sphagnum balticum	abundant in hollows and floating mats in raised bogs and poor fens; low to high elevations
Sphagnum contortum	very minerotrophic, sometimes found in slightly basic mires; intolerant of shade; low to moderate elevations
Thalictrum alpinum	wet meadows, damp rocky ledges and slopes, and cold (often calcareous) bogs in willow-sedge, lodgepole pine, and spruce-fir; 0-3800 m
Utricularia minor	aquatic species, bogs pools, shallow water, inundated mudflats
Viola selkirkii	moist, shaded ravines and cold boreal and hardwood forest habitats throughout its North American distribution

	Attachment - Target Species List for I-70 Fen Survey, continued - Nonvascular and Other	
	Scientific Name	Common Name
Amphibians	*Bufo boreas*	Boreal Toad
Lichens	*Brachythecium ferruginascens*	
	Bryum alpinum	alpine bryum moss
Mosses	*Andreaea heinemannii*	Heinemann's andreaea moss
	Andreaea rupestris	andreaea moss
	Aulacomnium palustre	aulacomnium moss
	Campylopus schimperi	Schimper's campylopus moss
	Grimmia mollis	grimmia dry rock moss
	Grimmia teretinervis	grimmia dry rock moss
	Hylocmiastrum pyrenaicum	hylocomiastrum moss
	Hylocmiastrum alaskanum	hylocomiastrum moss
	Leptopterigynandrum austro-alpinu	alpine leptopterigynandrum moss
	Mnium blyttii	Blytt's calcareous moss
	Oreas martiana	oreas moss
	Plagiothecium cavifolium	plagiothecium moss
	Pleurozium schreberi	Schreber's big red stem moss
	Pohlia tundrae	tundra pohlia moss
	Rhytidium rugosum	rhytidium moss
	Roellia roellii	Roell's moss
	Sphagnum contortum	contorted sphagnum
	Sphagnum angustifolium	sphagnum
	Sphagnum balticum	Baltic sphagnum
Liverworts	*Nardia geoscyphus*	
	Gymnomitrion corallioides	

Attachment - Target Species List for I-70 Fen Survey, continued - Key	
Y	Yes
N	No
Unk	Unknown
E	Listed Endangered
T	Listed Threatened
SS	Region 2 USFS Sensitive
LOC	USFS Local Concern
ROMO	tracked by Rocky Mtn National Park
N-P	Not adequately surveyed due to too late in season phenologically
N-H	Not adequately surveyed because some but not all suitable habitat was surveyed (see report - some areas need initial or additional surveys)
L	Low
M	Medium
H	High

Note: If both suitable habitat and plants were not present, and all areas were surveyed, then impacts to plant is "no impact based on abs

Indicator Code	Wetland Type	Comment
OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List.
NA	No agreement	The regional panel was not able to reach a unanimous decision on this species.
NI	No indicator	Insufficient information was available to determine an indicator status.
NO	No occurrence	The species does not occur in that region.

Appendix B. Meeting Notes

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US Army Corps of Engineers, EPA, FHWA and CDOT, Coordination Meeting, December 17, 2008 – Summary of topics:

- Wetland jurisdictional determination (JD) –
- Tim Carey, USACE, indicated that the team does not need to make a wetland JD at the Tier I level, and that since no permit is sought at a Tier I level, CDOT would only need to make a JD in the future, if mitigation is not planned for impacts to all wetlands. It is CDOT's policy to mitigate all impacts on a one to one basis, regardless of whether the wetland is jurisdictional or non-jurisdictional.
- Least Environmental Damaging Practical Alternative (LEDPA) –
- The determination of the LEDPA is required at Tier 1. The mapping of wetlands in the Draft PEIS is adequate for determining the LEDPA in the Final PEIS. UAEC concurs with CDOT's approach of assuming all wetlands are jurisdictional in the determination of the LEDPA.
- The Collaborative Effort's Consensus Recommendation (CR) –
- The CR will be compared with the 21 alternatives from the Draft PEIS and all impacts will be disclosed in the Final PEIS. Since the future needs weren't known the team would assume a worst - case scenario for impacts assessment (Combination Six-lane highway with AGS). Both the 55 mph and the 65 mph will be include in the analysis. Tim Carey and Sarah Fowler, EPA, agreed with this approach for the PEIS.
- USACE Guidance –
- Tim Carey stated that the USACE Guidance is still applicable, however, the recent changes to the guidance for jurisdiction, do not affect the PEIS, since all wetlands are being considered as jurisdictional.
- Technical Report -
- A wetlands technical report will be prepared with a determination of the LEDPA, based on the comparison of CR with the alternatives in the Draft PEIS. This report will be provided to the EPA and USACE.

  Action Items:

  Assess impacts of CR and compare to alternatives in Draft PEIS, and prepare technical report for February 11 EPB meeting