5.7 GEOLOGY, SOILS, AND PALEONTOLOGICAL RESOURCES

This section describes the geology, soils, and paleontological resources along the project alignment and assesses potential impacts related to project construction and operation activities.

This analysis reviews state and local resources characterizing geologic units and soils in the project area, including databases maintained by the following agencies:

- U.S. Geological Survey (USGS)
- NRCS
- California Geological Survey (CGS)
- University of California Museum of Paleontology (UCMP)
- Paleo Biology Database (PBDB)
- General Plans, including seismic hazard maps for the City of Alturas and the Counties of Modoc, Lassen, and Sierra

5.7.1 Environmental Setting

5.7.1.1 Regional and Local Geologic Setting

The project alignment extends 193.9 miles across portions of Modoc, Lassen, and Sierra Counties within the State of California. The alignment extends through portions of the Modoc Plateau Geomorphic Province and portions of the northwest Basin and Range Province, where it borders the northeastern portion of the Sierra Nevada Province. The Basin and Range Province is characterized by interior drainage with lakes and playas, and the typical horst and graben structure. The northern Basin and Range Province includes the Honey Lake Basin (CGS 2002). The Modoc Plateau is a volcanic table land approximately 4,000 to 6,000 feet above mean sea level. The plateau consists of a thick accumulation of lava flows and tuff beds along with many small volcanic cones. The plateau is cut by many north-south faults and is bound by the Cascade Range on the west and the Basin and Range on the east and south (CGS 2002).

The local physiographic setting includes basaltic and andesitic mountains and flows, which comprise the southern end of a series of tertiary and quaternary flows of the Cascade Mountain Range and the northern end of the Sierra Nevada Range (NRCS 2004). Sedimentary deposits along the project alignment are largely lake and associated basin-margin deposits. The geology of the area primarily consists of Tertiary and Quaternary volcanic rocks as well as Mesozoic granite and Quaternary sedimentary deposits.

5.7.1.2 Seismicity

Alquist-Priolo earthquake fault zones are areas of the state where surface rupture of a fault could damage structures in the vicinity. Both Lassen and Modoc Counties contain Alquist-Priolo earthquake fault zones. Segments of the project alignment are located in seismically active areas of these counties, with numerous Holocene (including "latest Quaternary") faults that have been identified as potential seismic sources (Figure 5.7-1). Holocene faults are considered to have been active within the past 11,000 to 15,000 years, approximately. There are also numerous older Quaternary and pre-Quaternary faults along the alignment, though these are not regarded as potential seismic sources by CGS or USGS. Active faults that have a relatively high potential for surface rupture along, across, or near the alignment include the Honey Lake Fault Zone, the Upper Long Valley Fault Zone, the Fort Sage Fault, the Warm Springs Valley Fault Zone, and the Surprise Valley Fault, as well as multiple unnamed faults.

Honey Lake Fault Zone. The Honey Lake Fault forms a 50-kilometer-long zone of landforms typical of active strike-slip faults with a slip rate estimated between 1.0 and 5.0 millimeters per year (Adams et. al 2017; Willis and Borchardt 1993). The Honey Lake Fault Zone is primarily composed of northwest-striking, right lateral, dextral strike-slip strands characterized by geomorphic evidence indicative of Holocene displacement (Adams et. al 2017). A fault exposure in Holocene alluvium shows evidence of late Holocene surface-faulting earthquakes (Willis and Borchardt 1993).

The Upper Long Valley Fault Zone. The Long Valley Fault Zone is cut by dozens of major north-northwest trending faults and down-faulted blocks (USGS 2020).

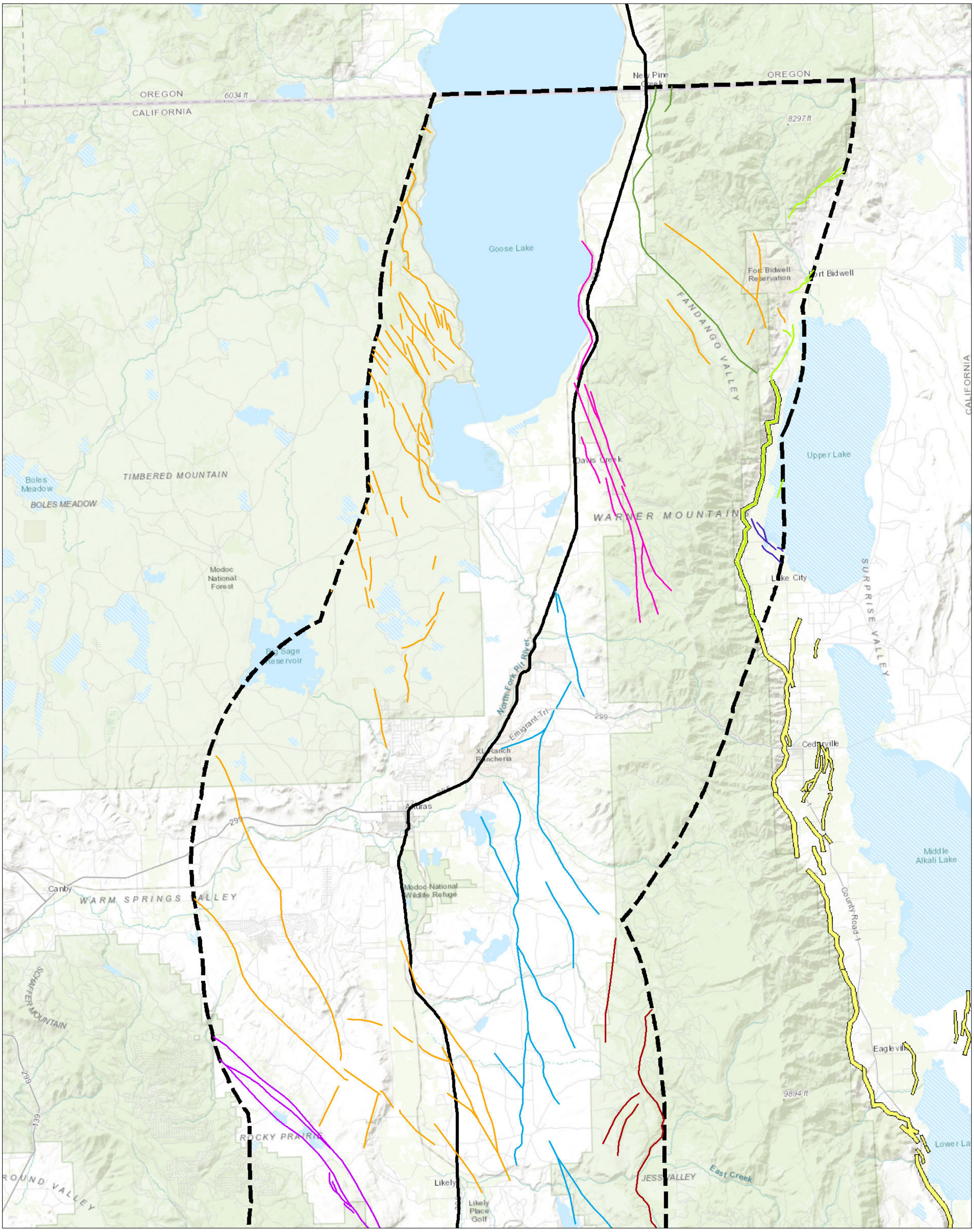
The Fort Sage Fault. The Fort Sage Fault is a high-angle, normal fault along the western side of the Fort Sage Mountains. It extends obliquely between the Honey Lake and Warm Springs Valley Fault Zones. The most recent historic earthquake was the 1950 ML 5.6 Fort Sage Mountain earthquake, which ruptured nearly the full extent of the approximately 8-kilometer-long Fort Sage Fault (Gianella 1957; Sawyer et al. 2013).

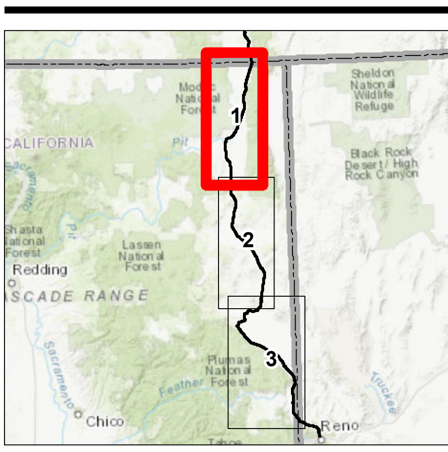
Warm Springs Valley Fault Zone. The Warm Springs Valley Fault Zone is composed of right lateral, dextral strike-slip to dextral normal faults that locally offset Holocene alluvial deposits (Sawyer et al. 1999).

The Surprise Valley Fault. The Surprise Valley Fault is an active down-to-east normal fault, delineated by geomorphic features indicative of Holocene normal faulting, bounding the Modoc Plateau (to the west) and Basin and Range (to the east) geomorphic provinces (Bryant 2000).

5.7.1.3 Ground Shaking

Ground shaking is the motion that occurs as a result of energy released during faulting. When ground shaking occurs, it can result in the damage or collapse of buildings and other structures. Ground shaking is influenced by earthquake magnitude, epicenter location, the character and duration of the ground motion, soil conditions, and depth to groundwater. Southern Lassen County along the Honey Lake Basin and extending into northeastern Sierra County is anticipated to have a moderate to high potential for ground shaking (Branum et al. 2016). The CGS's Probabilistic Seismic Hazards Assessment indicates a minimum peak horizontal acceleration of 0.1 to 0.2g (where g is the percentage of gravity) along most of the proposed route through Modoc County and into northern Lassen County, and a potential acceleration of 0.2 to 0.4g in the areas south of Susanville in Lassen County, with a 10 percent probability of earthquake occurrence in a 50-year time frame.





Alignment
10-mile Buffer
Alquist-Priolo Fault Zones

Quaternary Fault Zones
- Davis Creek fault zone
- Fitzhugh Creek fault zone
- Goose Lake graben faults
- Jess Valley fault zone
- Lake City fault zone
- Likely fault zone
- Surprise Valley fault
- Unnamed fault

0 3.5 7 Miles
1:311,750 (At Original document size of 11x17)

N

Stantec

Project Location
Prineville, OR to Reno, NV

2272020011
Prepared by CP on 2020-06-17
Technical Review by JC on 2020-06-17
Independent Review by CS on 2020-06-17

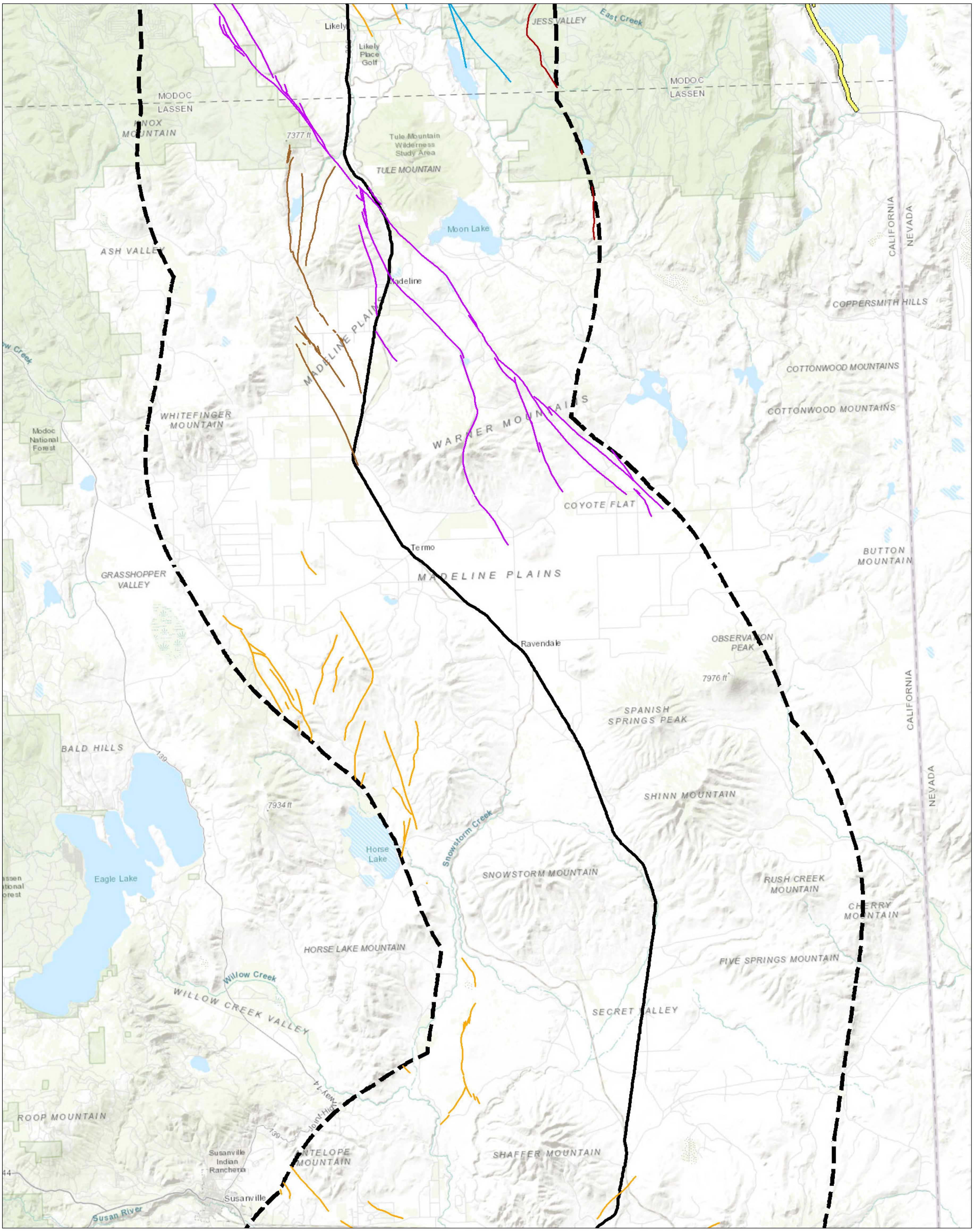
Client/Project
Zayo
Fiber Optic Line--Prineville to Reno
June 2020

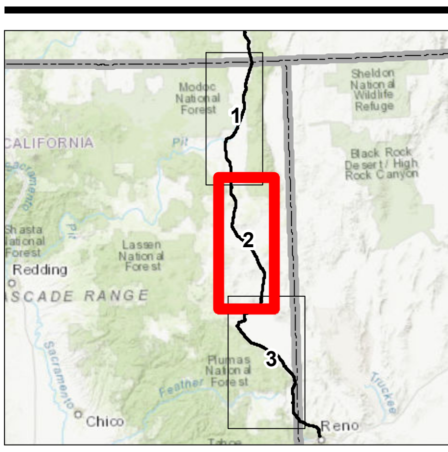
Figure No.
5.7-1-1 of 3

Title
Active Faults within 10 miles of Project Alignment

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data source: Esri 2020; USGS 2020; BLM 2020
3. Service Layer Credits: Seismic Hazards Program, California Geological Survey, California Department of Conservation Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

U:\227202011\03_data\gis_cad\gis\mxds\PEA\geology\Fig5_7_1_ZayoPEA_FaultsSeries.mxd Revised: 2020-12-04 By: jcomstock





Alignment

10-mile Buffer

Alquist-Priolo Fault Zones

Quaternary Fault Zones

Fitzhugh Creek fault

Jess Valley fault zone

Likely fault zone

Nelson Corral fault

Unnamed fault

0 3.5 7 Miles

1:311,750 (At Original document size of 11x17)

N

Stantec

Project Location

Prineville, OR to Reno, NV

227202011

Prepared by CP on 2020-06-17
Technical Review by JC on 2020-06-17
Independent Review by CS on 2020-06-17

Client/Project

Zayo
Fiber Optic Line--Prineville to Reno
June 2020

Figure No.

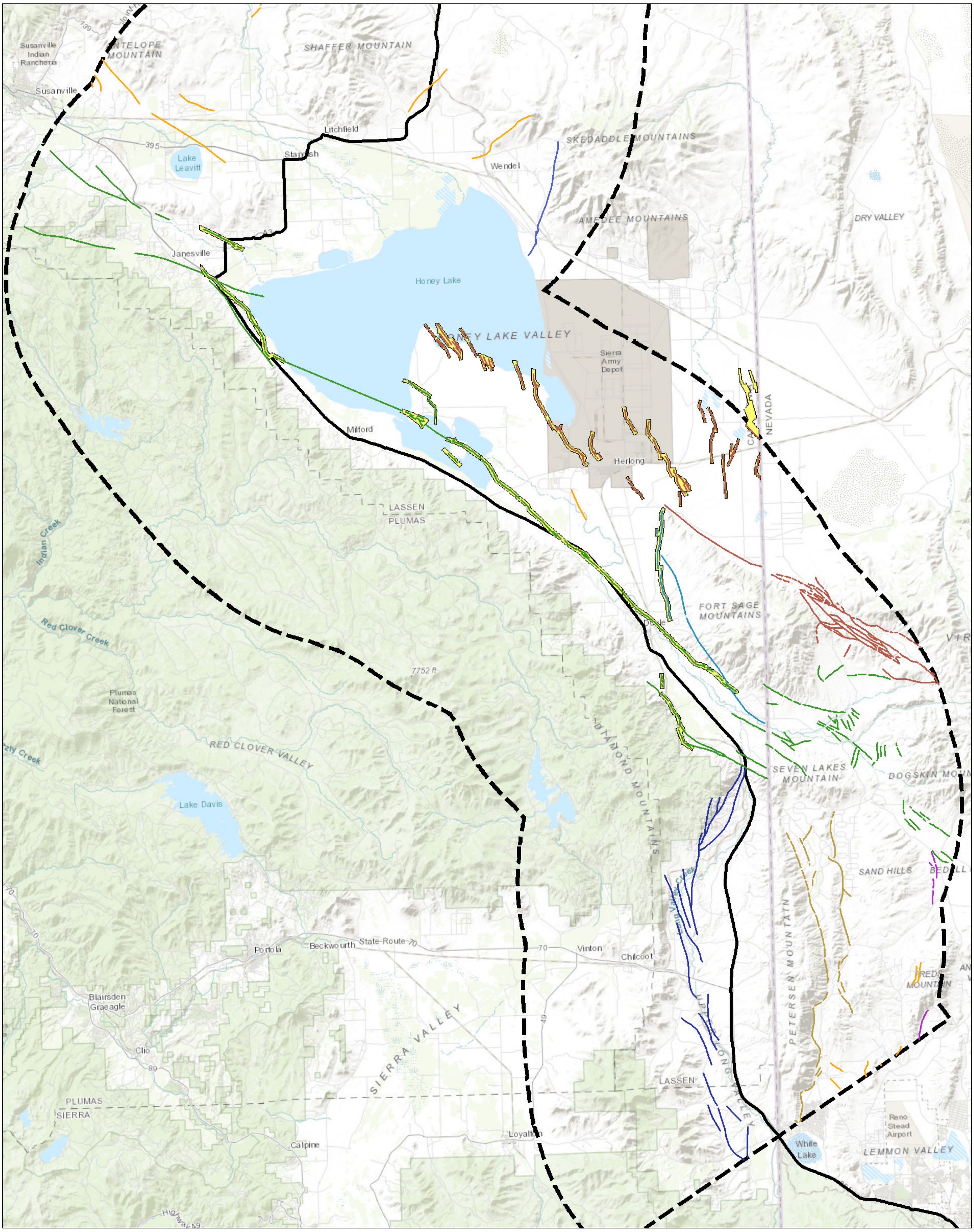
5.7-1-2 of 3

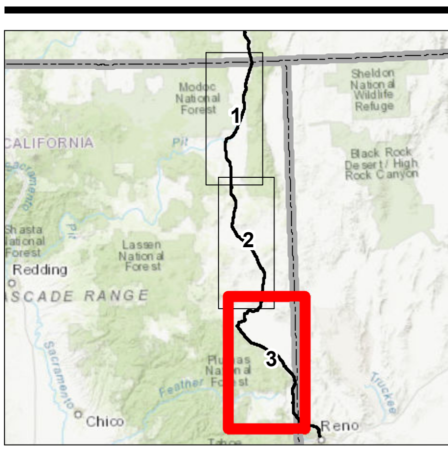
Title

Active Faults within 10 miles of Project Alignment

Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data source: Esri 2020; USGS 2020; BLM 2020
3. Service Layer Credits: Seismic Hazards Program, California Geological Survey, California Department of Conservation Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community





Alignment

10-mile Buffer

Alquist-Priolo Fault Zones

Quaternary Fault Zones

- Amedee fault
- Fort Sage fault
- Freds Mountain fault
- Honey Lake fault zone
- Petersen Mountain fault
- Upper Long Valley fault zone
- Warm Springs Valley fault zone
- Unnamed fault

0 3.5 7 Miles

1:311,750 (At Original document size of 11x17)

N

Stantec

Project Location: Prineville, OR to Reno, NV

2272020011

Prepared by CP on 2020-06-17
Technical Review by JC on 2020-06-17
Independent Review by CS on 2020-06-17

Client/Project

Zayo
Fiber Optic Line--Prineville to Reno
June 2020

Figure No.

5.7-1-3 of 3

Title

Active Faults within 10 miles of Project Alignment

Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data source: Esri 2020; USGS 2020; BLM 2020
3. Service Layer Credits: Seismic Hazards Program, California Geological Survey, California Department of Conservation
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

U:\227202001\03_data\gis_cad\gis\mxds\PEA\geology\Fig5_7_1_ZayoPEA_FaultsSeries.mxd Revised: 2020-12-04 By: jcomstock

This page intentionally left blank.

5.7.1.4 Liquefaction

Liquefaction occurs when groundwater is forced out of the pores of soil as it subsides. This excess water momentarily liquefies the soil, causing an almost complete loss of strength. If this layer is at the surface, its effect is much like that of quicksand for any structure located on it. If the liquefied layer is subsurface, the material above it may slide laterally depending on the confinement of the unstable mass. Liquefaction can occur as a result of strong motions in excess of 0.1g in areas of unconsolidated granular sediment and shallow groundwater. Therefore, there is a potential risk of liquefaction along the project alignment, primarily in the areas south of Susanville in Lassen County where potential ground motion acceleration is between 0.2 to 0.4g. The CGS's Seismic Hazard Zonation Program includes mapping of earthquake induced liquefaction zones. However, this program focuses on the major metropolitan areas of California and has not addressed the areas along the project alignment.

5.7.1.5 Landslides

Ground motions associated with earthquakes have the potential to trigger landslides or rockfalls along the project alignment. Seismically induced landslides are most commonly associated with earthquakes of magnitude 4.0 or more (Keefer 1984). Therefore, there is a potential risk of landslide along the project alignment, primarily in the areas south of Susanville in Lassen County where the alignment passes through Alquist-Priolo earthquake fault zones. CGS's Seismic Hazard Zonation Program includes mapping of earthquake induced landslide zones. However, this program focuses on the major metropolitan areas of California and has not addressed the areas along the project alignment.

5.7.1.6 Geologic Units

Geologic units along the project alignment primarily consist of the following USGS classification types:

- Quaternary volcanic flow rocks, unit 1 (Qv1, Cascade Volcanic Field), which include minor pyroclastic deposits.
- Tertiary (2-24 Ma) volcanic flow rocks, unit 17 (Tv17, Cascade Range), which include minor pyroclastic deposits.
- Quaternary (Pleistocene to Holocene) alluvium (Q), including alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated.
- Older Quaternary alluvium (Qoa) consisting of older alluvium, lake, playa, and terrace deposits.
- Tertiary (2-24 Ma) pyroclastic and volcanic mudflow deposits, unit 9 (Tvp9, Cascade Range).
- Plio-Pleistocene and Pliocene loosely consolidated deposits (QPOc) consisting of Pliocene and/or Pleistocene sandstone, shale, and gravel deposits; Miocene to Pleistocene.
- Mesozoic granitic rocks, unit 3 (grMZ3, Sierra Nevada) consisting of Mesozoic granite, quartz monzonite, granodiorite, and quartz diorite; Permian to Tertiary.

According to geologic maps of the Cedarville, Alturas, Eagle Lake, and Susanville 30- x 60-minute quadrangles, geologic units along the project alignment primarily consist of hard volcanic rock and unconsolidated or moderately consolidated sedimentary deposits that are largely made up of lake and associated basin-margin deposits.

Additional information regarding geologic units along the project alignment is discussed within the Paleontological Report (Appendix I) and Section 5.7.1.8, Paleontological Resources. Maps of the geologic units along the project alignment are provided as Attachment A of the Paleontological Report (Appendix I).

5.7.1.7 Soils

The project alignment generally follows US 395 through Modoc, Lassen, and Sierra Counties within the Caltrans right-of-way and Lassen County roads between the communities of Standish and Bunting. Soils along the Caltrans right-of-way have been previously graded, compacted, and completed using road base and engineered fills. Soils along the project alignment consist primarily of clay to gravelly loams, coarse sands, and silty clays (NRCS 2020) and are depicted within Appendix J.

Soils along the project alignment include soils with a low to high plasticity index (PI), or shrink-swell potential. Soils with a high shrink-swell potential, also known as expansive soils, are prone to shrinking or swelling due to changes in water content of the soil. Soils with a low shrink-swell potential are generally suitable for construction, whereas soils with a high shrink-swell potential may result in structural damage.

Primary soil types (soils that cover less than or equal to 2.5 percent of the total project area) include the following:

- **Bieber gravelly loam** (jb3t) – Alluvium derived from basic igneous rock with 0 to 9 percent slopes and a moderate to high PI.
- **Deven-Rock outcrop complex** (jb4k) – Residuum weathered from basic igneous rock comprised of very stony clay loam to clay loam with 2 to 30 percent slopes and a moderate to high PI.
- **Galeppi loamy coarse sand** (jb86) – Alluvium derived from granite with 5 to 30 percent slopes and a low PI.
- **Horsecamp-Brubeck association** (jcb4)
    - Horsecamp – Residuum weathered from volcanic rock comprised of cobbly silty clays to silty clays with 2 to 9 percent slopes and a moderate to high PI.
    - Brubeck – Colluvium derived from volcanic rock and residuum weathered from volcanic rock comprised of very cobbly clay to clay with 2 to 9 percent slopes and a moderate to high PI.

- **Loomis-Fivesprings association** (jcch)
  - Loomis – Colluvium derived from basalt over residuum weathered from basalt comprised of very cobbly loam to very gravelly clay with 5 to 9 percent slopes and a low to moderate PI.
  - Fivesprings – Colluvium derived from volcanic rock and residuum weathered from volcanic rock comprised of very cobbly loam to very gravelly clay with 9 to 30 percent slopes and a low PI.
- **Mottsville loamy coarse sand** (jcd0) and **Mottsville gravelly loamy coarse sand** (jcd2) – Alluvium derived from granite with 2 to 9 percent slopes and a low PI.
- **Ravendale silty clay** (jcgb) – Alluvium derived from volcanic rock with 0 to 2 percent slopes and a moderate to high PI.

5.7.1.8 Paleontological Resources

Paleontological resources or fossils are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. Paleontological resources include the fossils themselves, the associated organic matter, and the physical characteristics of the fossils' associated sedimentary matrix (Paleo Solutions 2020). This section summarizes the methods and results of a paleontological resource inventory and sensitivity analysis conducted by Paleo Solutions (2020) (Appendix I).

The paleontological sensitivity of geologic units identified at or near the ground surface within the project area was analyzed through a review of literature, maps, and databases. Previous paleontological finds and sediment characteristics were evaluated to determine potential paleontological sensitivity. Potential impacts to paleontological resources resulting from ground disturbing activities due to project construction were analyzed using the BLM PFYC system. The PFYC is a predictive resource management tool that classifies geologic units on their likelihood to contain paleontological resources on a scale of 1 (very low potential) to 5 (very high potential), as well as unknown potential.

A review of geologic maps of the Cedarville, Alturas, Eagle Lake, and Susanville 30 x 60-minute quadrangles (CGS 2013, 2014, 2016, 2017) and Saucedo and Wagner (1992) indicates that the project alignment is underlain by Holocene-age, very young sedimentary deposits; Holocene- to Pleistocene-age, young sedimentary deposits; Pleistocene-age, old sedimentary deposits; Pliocene-age, very old sedimentary deposits; Pleistocene- to Oligocene-age volcanic rocks; and Miocene- and Mesozoic-age plutonic rocks. Maps noting the geologic units and paleosensitivity along the project alignment are provided as Appendix A of the Paleontological Report (Appendix I).

Artificial Fill (Recent). Artificial fill is made up of recent deposits of previously disturbed sediments deposited by construction operations and is found in areas where recent construction has taken place. Color is highly variable, and sediments are mottled in appearance. These sediments are not mapped within the project area but are expected to be encountered within previously disturbed portions of the project, primarily along the Caltrans right-of-way. Any fossil resources contained within these sediments will have been removed from their original deposition locations, and therefore, lack significant stratigraphic contextual data. Therefore, these deposits are considered to have a low potential for producing significant paleontological resources (PFYC 2) based on BLM (2016) guidelines.

Very Young Sedimentary Deposits (Q, Qa, Qc, Qf, Qt, Ql, Qhs, Qhe, Qhds) (Holocene). Very young sedimentary deposits are Holocene-age (less than 11,000 years old) and include surficial deposits made up of variable compositions of clay, silt, sand, gravel, and larger clasts that were laid down in modern fluvial and lacustrine systems. Gravel is composed of igneous and metamorphic rocks that range from granule- to cobble-sized and that generally vary between subangular to subrounded depending on the source proximity. These surficial units are generally unconsolidated, undissected, and less topographically developed than older units. There are seven Holocene-age geologic units mapped within the project alignment: alluvium (Q, Qa), colluvium (Qc), alluvial fan (Qf), terrace deposits (Qt), lake deposits (Ql), sand deposits (Qhs), and eolian, fluvial, and lacustrine deposits (Qhe) (CGS 2013, 2014, 2016, 2017; Saucedo and Wagner 1992). Also mapped within a quarter mile buffer of the project alignment is Holocene-age dune sand (Qhds) (Saucedo and Wagner 1992). Holocene-age sediments are typically too young to contain fossilized material (SVP 2010), although they may shallowly overlie sensitive older (e.g., Pleistocene) deposits at variable depth. Therefore, Holocene-age sedimentary deposits are considered to have a low potential for producing significant paleontological resources (PFYC 2) based on BLM (2016) guidelines.

Young Sedimentary Deposits (Qa, Qf, Qd, Qol, Qlmd, Qls, Qg) (Holocene to Pleistocene). Young sedimentary deposits are Holocene- to Pleistocene-age (approximately 2.51 million years to less than 11,000 years old) and include surficial deposits made up of variable compositions of clay, silt, sand, gravel, and larger clasts that were laid down in modern and ancient fluvial and lacustrine systems. Gravel is composed of igneous and metamorphic rocks that range from granule- to cobble-sized and that generally vary between subangular to subrounded depending on the source proximity. These sediments are generally unconsolidated to weakly consolidated and are often dissected where elevated. They are moderately indurated, relatively elevated, and contrast the lower-lying Holocene-age surficial sediments.

There are six Holocene- to Pleistocene-age geologic units mapped within the project alignment, including alluvium (Qa), alluvial fan deposits (Qf), delta deposits of the Susan River (Qd), older lake deposits (Qol), near-shore and deltaic deposits of Lake Madeline (Qlmd), and landslide deposits (Qls), the latter of which are made up of displaced sections of land masses (CGS 2013, 2014, 2016, 2017; Saucedo and Wagner, 1992). Also mapped in the project vicinity within a 0.25-mile buffer is Holocene- to Pleistocene-age colluvial gravel (Qg) (CGS 2016). Holocene-age sediments are typically too young to contain fossilized material (SVP 2010), although they may shallowly overlie sensitive older (e.g., Pleistocene) deposits at variable depth.

Therefore, Holocene- to Pleistocene-age sedimentary deposits are considered to have an unknown potential for producing paleontological resources (PFYC U) based on BLM (2016) guidelines, until more subsurface data is acquired. Additionally, fossils contained within landslide deposits may lack stratigraphic context due to displacement from the original area of deposition, thereby reducing the significance of the fossils. However, the resources may retain some significance if any stratigraphic structure is preserved in the landslide masses. Therefore, Holocene- to Pleistocene-age landslide deposits (Qls) are also considered to have an unknown potential for producing paleontological resources (PFYC U) based on BLM (2016) guidelines, until more subsurface data is acquired.

Old Sedimentary Deposits (Qoa, Qof, Qpl, Qplg, Qos, Qpfd) (Pleistocene). Old sedimentary deposits are Pleistocene-age (approximately 2.51 million years to 11,000 years old) and include deposits consisting of variable compositions of clay, silt, sand, gravel, and larger clasts that were laid down in ancient terrestrial and marine environments. Gravel is composed of igneous and metamorphic rocks that range from granule to cobble-sized and that generally vary between subangular to subrounded depending on the source proximity. These deposits are moderately to well indurated and are generally characterized by their low-moderate to moderate relief and dissected surfaces. They are relatively elevated and contrast the lower-lying Holocene-age sedimentary deposits.

There are six Pleistocene-age sedimentary geologic units mapped within the project alignment: older alluvium (Qoa), older fan deposits (Qof), near-shore deposits of Lake Lahontan (Qpl), gravel deposits of Lake Lahontan (Qplg), nonmarine sedimentary rocks (Qos), and fan delta deposits of Long Creek (Qpfd) (CGS 2013, 2014, 2016, 2017; Saucedo and Wagner 1992). Numerous Ice Age taxa have been recovered from Pleistocene-age deposits throughout Lassen and Modoc Counties as well as other areas of California. Fossils recorded from Pleistocene-age sediments within the project vicinity are listed in Table 5.7-1.Therefore, Pleistocene-age sedimentary deposits are considered to have a moderate potential for producing paleontological resources (PFYC 3) based on BLM (2016) guidelines.

Very Old Sedimentary Deposits (Ps) (Pliocene). Very old sedimentary deposits are Pliocene-age (approximately 5.51 million years to 2.33 million years old) and include nonmarine sedimentary rocks (Ps) within the project area. This unit is made up of undifferentiated deposits of fluvial and lacustrine shale, sandstone, and ash (Saucedo and Wagner 1992).

Geologic units with informal names like Pliocene-age nonmarine sedimentary deposits (Ps) are not responsive to searches in the literature because they lack formal designation. However, online databases record numerous vertebrate fossils from similar Pliocene-age sedimentary sediments in Lassen and Modoc Counties. Fossils recorded from Pliocene-age sedimentary deposits within the project vicinity are listed in Table 5.7-1. Therefore, Pliocene-age nonmarine sedimentary deposits (Ps) are considered to have an unknown potential for producing paleontological resources (PFYC U) based on BLM (2016) guidelines until more lithological data is obtained.

Volcanic Rocks (Tmma, Tlma, Ttmb, Tvb, Tdrb, Tsbl, Tlrt, Tvgb, Tdgb, Tb, Ta, Tabpf, Tsht, Tvsa, Ttpw, Ttab, Trpt, Tsha, Tssa, Tsl, Tfcb, Tdct, Tesa, Tsab, Tsbu, Tvbi, Tld, Tlp, Tpvu, Tfp, Ttpf, Omv) (Pleistocene to Oligocene). Igneous rocks are crystalline or non-crystalline rocks that form through the cooling and subsequent solidification of lava or magma. Volcanic (extrusive) igneous rocks form at the Earth's surface when lava erupts and rapidly solidifies. Lava is formed by the partial melting of pre-existing plutonic rocks in the Earth's crust or mantle due to increases in temperature, changes in pressure, or changes in geochemical composition.

Extreme temperatures in the environments in which most extrusive igneous rocks form prevent the preservation of fossils (e.g., basaltic and andesitic lava flows, pyroclastic flows). However, some volcanic deposits, namely ash and tuff, can harbor significant intact paleontological resources. There are no specimens in the UCMP or PBDB specifically attributed to ash or tuff deposits within Lassen, Modoc, or Sierra Counties. However, the Pliocene-age Alturas Formation, which includes tuff and volcaniclastic sandstone deposits as well as lake clays, has produced vertebrate fossils in Modoc County (PBDB 2020; UCMP 2020). Most of the listed localities do not specify which facies of the Alturas Formation that the fossils were recovered from; however, several were reported from sandstone, volcaniclastic sandstone, and siltstone facies. Recorded specimens from the Alturas Formation are listed in Table 5.7-1.

The majority of volcanic rocks within the project area are considered to have very low to low potential for producing significant paleontological resources (PFYC 2 to 1) based on BLM (2016) guidelines. However, the Pliocene- to Miocene-age Alturas Formation (Ta) and the unnamed and undifferentiated Oligocene- to Miocene-age rhyolite tuff and sedimentary rocks (Omv) are considered to have an unknown potential for producing paleontological resources (PFYC U) based on BLM (2016) guidelines.

Plutonic Rocks (Tovi, Kgd, KJgr) (Miocene and Mesozoic). Igneous rocks are crystalline or non-crystalline rocks that form through the cooling and subsequent solidification of lava (volcanic) or magma (plutonic). Intrusive (plutonic) igneous rocks form below the Earth's surface. Magma is formed by the partial melting of pre-existing plutonic rocks in the Earth's crust or mantle due to increases in temperature, changes in pressure, or changes in geochemical composition. Three plutonic geologic units are mapped within the project alignment, including Miocene-age hypabyssal intrusions (Tovi), Cretaceous-age hornblende-biotite granodiorite (Kgd), and Mesozoic-age granite and granodiorite (KJgr) (CGS 2013, 2017; Saucedo and Wagner 1992).

Extreme temperatures and the environments in which these intrusive igneous rocks form prevent the preservation of fossils. Therefore, plutonic rocks are considered to have a very low potential for producing significant paleontological resources (PFYC 1) based on BLM (2016) guidelines.

Table 5.7-1. Paleontological Literature and Record Search Results

Institutional Locality Number/Name	Geologic Unit	Taxon	Common Name	Location	Source
Not Reported	Pleistocene-age sedimentary deposits	*Gila bicolor*	blue chub	Lassen County	UCMP 2020; PBDB 2020
		Gila coerulea	blue chub		
		Acrocheilus	chiselmouth		
		Ptychocheilus	cyprinid fish		
		Lavinia	cyprinid fish		
		Chasmistes	ray-finned fish		
		Oncorhyncus	Pacific salmon/trout		
		Peromyscus	deer mouse		
		Sigmodon medius	cotton rat		
		Ammospermophilus	antelope squirrel		
		Lepus	hare/jackrabbit		

Institutional Locality Number/Name	Geologic Unit	Taxon	Common Name	Location	Source
		Sylvilagus	cotton rabbit		
		Canis	dog		
		Canis latrans	coyote		
		Equus	horse		
		Camelops	camel		
		Sphenophalos	pronghorn		
		Bison latifrons	bison		
		Smilodon	sabre-tooth cat		
		Mammut pacificus	mastodon		
		Mammuthus	mammoth		
UCMP V5037, V6037, V6613, V6629	Pleistocene-age sedimentary deposits	*Equus*	horse	Modoc County	UCMP 2020; PBDB 2020
		Symbos	musk oxen		
		Bison	bison		
		Camelidae	camel		
		Proboscidean	elephant		
Not Reported	Pleistocene-age sedimentary deposits	*Mammuthus*	mammoth	Southern and Central California	Jahns 1954; Jefferson 1991
		Mammut	mastodon		
		Camelidae	camel		
		Equidae	horse		
		Bison	bison		
		Megatherium	giant ground sloth		
		Tayassuidae	peccary		
		Acinonyx	cheetah		
		Panthera	lion		
		Smilodon	saber-tooth cat		
		Hydrochoerus	capybara		
		Canis dirus	dire wolf		
		Rodentia	rodent		
Not Reported	Pliocene-age sedimentary deposits	*Anas*	dabbling duck	Modoc County	UCMP 2020; PBDB 2020
		Gila coerulea	blue chub		
		Oncorhyncus	Pacific salmon/trout		
		Acrocheilus	chiselmouth		
		Ptychocheilus	cyprinid fish		
		Chasmistes	ray-finned fish		
		Catostomus	common sucker		

Institutional Locality Number/Name	Geologic Unit	Taxon	Common Name	Location	Source
		Cottus	sculpin		
		Felis	small cat		
		Hypolagus	rabbit		
		Plesippus	extinct horse		
		Titanotylopus	camel		
		Hemiauchenia	camel		
		Odocoileus lucasi	American mountain deer		
UCMP V95026, V95027, V95028, V95029, V95030, V95031, V95032, V95033, V95038	Alturas Formation (Pliocene-age)	*Rana*	pond frog	Lassen County	UCMP 2020; PBDB 2020
		Sceloporus	spiny lizard		
		Aves	bird		
		Anas	dabbling duck		
		Cyprinidae	carp/minnow		
		Gila coerulea	blue chub		
		Oncorhyncus	Pacific salmon/trout		
		Acrocheilus	chiselmouth		
		Ptychocheilus	cyprinid fish		
		Chasmistes	ray-finned fish		
		Catostomus	common sucker		
		Peromyscus	deer mouse		
		Cryptotis	small-eared shrew		
		Mimomys sawrockensis	mouse		

5.7.2 Regulatory Setting

5.7.2.1 Federal

Clean Water Act Section 402p. The CWA was amended in 1987 to include Section 402p. This amendment created a framework for regulating municipal and industrial stormwater discharges under the National Pollutant Discharge Elimination Service (NPDES) program. SWRCB is responsible for implementing the NPDES program. Pursuant to the state's Porter-Cologne Act, it delegates implementation responsibility to California's nine RWQCBs. Both the Central Valley and the Lahontan RWQCBs have jurisdiction along areas of the project alignment. The Central Valley RWQCB has jurisdiction along the northern extent from the Oregon–California border to the northern portion of Lassen County. The Lahontan RWQCB has jurisdiction along the remaining extent through Lassen County to the Nevada–California border.

Under the NPDES Phase II Rule, any construction project disturbing greater than or equal to 1.0 acre must obtain coverage under the state's Construction General Permit (CGP) for stormwater discharges associated with construction activity. The purpose of the Phase II Rule is to avoid or mitigate the effects of construction activities, including earthwork, on surface waters. CGP applicants are required to file a Notice of Intent to Discharge Stormwater with the regulating RWQCB and to prepare a SWPPP stipulating BMPs that would be implemented to avoid adverse effects on water quality.

Federal Land Policy and Management Act (FLPMA) (43 USC 1701). Federal law, including the Federal Land Policy and Management Act (FLPMA) of 1976 (43 USC 1701), includes objectives such as the evaluation, management, protection, and location of fossils on BLM-managed lands, defines fossils, and lays out penalties for the destruction of significant fossils. Also, NEPA requires the preservation of "historic, cultural, and natural aspects of our national heritage." Most recently, the Omnibus Public Lands Act refines NEPA and FLPMA guidelines and strictures and outlines minimum punishments for removal or destruction of fossils from federal and public lands.

Paleontological Resources Preservation Act (PRPA). Paleontological Resources Preservation, Title VI, Subtitle D in the Omnibus Public Lands Act of 2009, Public Law 111-011 Purpose: The Secretaries of Interior and Agriculture shall manage and protect paleontological resources on federal land using scientific principles and expertise. With the passage of the PRPA, Congress officially recognizes the importance of paleontological resources on federal lands (U.S. Department of the Interior, USDA) by declaring that fossils from federal lands are federal property that must be preserved and protected using scientific principles and expertise. The PRPA provides the following:

- Uniform definitions for "paleontological resources" and "casual collecting"
- Uniform minimum requirements for paleontological resource use permit issuance (terms, conditions, and qualifications of applicants)
- Uniform criminal and civil penalties for illegal sale, transport, theft, and vandalism of fossils from federal lands
- Uniform requirements for curation of federal fossils in approved repositories

Code of Federal Regulations, Title 43. Under Title 43, CFR Section 8365.1-5, the collection of scientific and paleontological resources, including vertebrate fossils, on federal land is prohibited. The collection of a "reasonable amount" of common invertebrate or plant fossils for non-commercial purposes is permissible (43 CFR 8365.1-5).

5.7.2.2 State

Alquist-Priolo Earthquake Fault Zoning Act. In 1972, the State of California passed the Alquist-Priolo (AP) Geologic Hazards Zone Act (renamed the Alquist-Priolo Earthquake Fault Zoning Act in 1994).The act limits the hazards of fault surface rupture to occupied structures and prohibits the development of new structures intended for human occupancy from being located across the trace of an active fault. AP earthquake fault zones are areas designated along faults that are "sufficiently active and well defined."

Fault Evaluation Reports and maps for AP earthquake fault zones summarize data on fault location, age of activity, orientation, and probable magnitude of displacement.

Seismic Hazard Mapping Act. In 1990, the State of California passed the Seismic Hazards Mapping Act. This law was codified in the PRC as Division 2, Chapter 7.8A. It addresses non-surface fault rupture earthquake hazards, including liquefaction, ground shaking, and seismically induced landslides. Under the Seismic Hazard Mapping Act, these hazards are identified and mapped to assist local governments in land use planning.

California Environmental Quality Act. The procedures, types of activities, persons, and public agencies required to comply with CEQA are defined in the CEQA Guidelines as amended on March 18, 2010 (Title 14, CCR Section 15000 et seq.) and further amended January 4, 2013, and December 28, 2018. (CEQA Guidelines Appendix G, Section VII).

State of California Public Resources Code. PRC Chapter 1.7, Sections 5097 and 30244, includes additional state-level requirements for the assessment and management of paleontological resources. These statutes require reasonable mitigation of adverse impacts to paleontological resources resulting from the development on state lands, and define the excavation, destruction, or removal of paleontological "sites" or "features" from public lands without the express permission of the jurisdictional agency as a misdemeanor. As used in Section 5097, "state lands" refers to lands owned by or under the jurisdiction of the state or any state agency. "Public lands" is defined as lands owned by or under the jurisdiction of the state, or any city, county, district, authority, public corporation, or any agency thereof.

5.7.2.3 Local

Per Section 65302 (g) of the California Government Code, the Safety Element of a General Plan shall include policies and implementation measures designed to protect the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides; subsidence and other geologic hazards known to the legislative body; flooding; and wildland and urban fires. The safety element shall include mapping of known seismic and other geologic hazards.

Modoc County General Plan, Safety Element. The Safety Element of the Modoc County General Plan (Modoc County 1988, as amended) includes components related to geologic and seismic hazards. Modoc County lies in the lowest rated area in the State of California for earthquake activity. There are no recorded epicenters in the area. Modoc County does, however, adhere to the most recent accepted building standards for earthquakes. Policies including restrictions to new development on slopes of more than 30 percent or on land which has been identified as environmentally unsound to support development are implemented to support the goal of protecting the public health and safety though limitation of development in hazardous areas.

Lassen County General Plan Safety and Seismic Safety Element. The Safety and Seismic Safety Element of the Lassen County General Plan (Lassen County 1999, as amended) contains a number of goals, policies, and implementation measures designed to add safety considerations to the active planning process in order to reduce loss of life, injuries, damage to property, socio-economic dislocation from fire, seismic hazards, and other possible seismic disasters. It addresses hazards related to seismic earth shaking, surface rupture, and seiches, as well as unstable slopes and soils, mudslides, landslides, subsidence, volcanism and erosion among other topics.

Sierra County General Plan Safety Element. The Safety Element of the Sierra County General Plan (Sierra County 1996, as amended) contains a number of goals, policies, and implementation measures designed to maintain a high level of safety for people and property by limiting the exposure of its residents to safety hazards including seismic and geologic hazards, flooding, and fire. It addresses geologic hazards including seismicity, mine shafts, avalanche hazards, and evacuation routes.

City of Alturas General Plan. The Safety Element of the City of Alturas General Plan includes components related to geologic and seismic hazards. Alturas lies in the lowest rated area in the State of California for earthquake activity. There are no recorded epicenters in the area. However, Alturas does adhere to the most recent accepted building standards for earthquakes. The goals, policies, and implementation measures reflect that of Modoc County. Policies, including restrictions to new development on slopes of more than 30 percent or on land, which has been identified as environmentally unsound to support development, are implemented to support the goal of protecting the public health and safety though limitation of development in hazardous areas.

5.7.3 Impact Questions

Would the project:	Potentially Significant Impact	Less-than-Significant Impact with Mitigation Incorporated	Less-than-Significant Impact	No Impact
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☒	☐
ii) Strong seismic ground shaking?	☐	☐	☒	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
iv) Landslides?	☐	☐	☒	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐

Would the project:	Potentially Significant Impact	Less-than-Significant Impact with Mitigation Incorporated	Less-than-Significant Impact	No Impact
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?	☐	☐	☒	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste-water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐

5.7.4 Impact Analysis

Impacts on geology, soils, and paleontological resources that could result from the construction and operation of the project were evaluated based on general locations and proposed construction activities. Geologic and seismic hazards that could potentially result from installation of the proposed underground fiber optic network, and that could expose people to injury and infrastructure to damage, were considered in terms of adverse impacts on public safety.

a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:

i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

Less Than Significant Impact. Topographic maps of the Honey Lake Basin in southern Lassen County show active faults that have a relatively high potential for surface rupture. Topographic maps of eastern Modoc County identify the Surprise Valley Fault as an active fault trace extending parallel along the northern portion of the project alignment. The Surprise Valley fault runs within 10 miles of the project alignment near Goose Lake. Additional late Quaternary faults identified along the project alignment include the Likely Fault Zone in southern Modoc County and northern Lassen County, the Nelson Corral Fault in northern Lassen County, the Fitzhugh Creek and the Davis Creek Fault Zones at the southern edge of Goose Lake, and the Goose Lake graben faults.

With the exception of the active fault areas described above, the majority of the project alignment would be located outside of Alquist-Priolo earthquake fault zones. Furthermore, both the Modoc County and the City of Alturas General Plans state that they are within the lowest rated area in the State of California for earthquake activity and that there are no recorded epicenters in their respective planning areas.

Known faults located along the project alignment have the potential to rupture at any time. However, because project infrastructure primarily consists of underground fiber optic cable and unmanned ancillary equipment, any surface fault rupture or seismic-related ground failure would not expose people or structures present to potential substantial adverse effects as a result of the project, or increase the risk of loss, injury or death as a result of surface fault rupture. Under this criterion, the impact is less than significant.

ii) Strong seismic ground shaking?

Less Than Significant Impact. Southern Lassen County along the Honey Lake Basin and extending into northeastern Sierra County is anticipated to have a moderate to high potential for ground shaking. The extent of the alignment that runs through these areas would be subject to the effects of strong seismic ground shaking. Construction activities would not substantially increase risks of seismic hazard exposure over typical seismic hazard risks throughout the area. In addition, the project would be belowground and unmanned. Thus, the project would not directly or indirectly cause potential substantial adverse effects involving strong seismic ground shaking including the risk of loss, injury, or death. Under this criterion, the impact is less than significant.

iii) Seismic-related ground failure, including liquefaction?

Less Than Significant Impact. Soils along the project alignment include expansive soils with a low to high shrink-swell potential, which could result in damage to concrete foundations associated with the regeneration huts. However, all aboveground structures would be built in accordance with the California Building Code, and all construction activities would be conducted according to applicable grading codes and best practices associated with compaction and treatment of soils. In addition, no habitable structures are included as part of the project, and therefore, there would be no increased risk of loss, injury, or death associated with seismic-related ground failure or liquefaction as a result of project construction or operations. Under this criterion, the impact is less than significant.

iv) Landslides?

Less Than Significant Impact. The fiber optic conduit is proposed to be installed approximately 36 to 42 inches below ground surface and generally within the Caltrans right-of-way and existing roadways. Therefore, the risk of localized ground failure due to preexisting geologic conditions has been previously accounted for and reduced through grading, compaction, and use of road base and engineered fills. In addition, any seismic-related ground failure, including landslides, would not expose people or structures to potentially substantial adverse effects because the project would be underground and monitored remotely. Thus, the project would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death, involving landslides. Under this criterion, the impact is less than significant.

b) Result in substantial soil erosion or the loss of topsoil?

Less Than Significant Impact. Project construction would involve ground-disturbing activities such as vegetation clearing, minor grading, trenching, plowing, and directional drilling. These activities would have the potential to exacerbate erosion or contribute to the loss of topsoil if soil were improperly contained during trenching or drilling, or if the construction contractor failed to adequately isolate and reapply topsoil during backfilling of excavations.

However, because the extent of earth-moving activities would be limited, and most of the project area is relatively flat, substantial erosion or loss of topsoil is not expected to occur. In addition, Zayo would obtain coverage under the SWRCB General Permit for Storm Water Discharges Associated with Construction Activity because project activities would result in ground disturbance of more than 1 acre. As a result, Zayo would prepare and implement an SWPPP to prevent construction-related erosion, sediment runoff, and discharge of pollutants into waterways or onto neighboring properties (APM HYDRO-1; see Section 5.10, Hydrology and Water Quality). The SWPPP would require implementation of temporary erosion control measures to control erosion from disturbed areas, sedimentation control measures, and post-construction restoration and sediment stabilization measures. As such, implementation of APM HYDRO-1 would further reduce any impacts associated with soil erosion or loss of topsoil, and impacts under this criterion would remain less than significant.

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Less Than Significant Impact. The fiber optic conduit is proposed to be installed approximately 36 to 42 inches below ground surface and generally within the Caltrans right-of-way and existing roadways. Additionally, no areas along the alignment have been evaluated for liquefaction or landslides. Therefore, the risk of soil instability, landslide, lateral spreading, subsidence, liquefaction, or collapse resulting from the project has previously been accounted for and is considered low. Under this criterion, the impact is less than significant.

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?

Less Than Significant Impact. Soils along the project alignment include expansive soils with a low to high shrink-swell potential, which could result in damage to concrete foundations associated with the regeneration huts. However, all aboveground structures would be built in accordance with the California Building Code, and all construction activities would be conducted according to applicable grading codes and best practices associated with compaction and treatment of soils. In addition, no habitable structures are included as part of the project, and therefore, there would be no direct or indirect risks to life or property as a result of project construction or operations. Under this criterion, the impact is less than significant.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste-water disposal systems where sewers are not available for the disposal of waste water?

No Impact. No septic tanks or alternative waste-water disposal systems are proposed as part of the project. Therefore, no impacts would occur.

f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Less than Significant Impact. A paleontological evaluation and inventory of the project area analyzed existing paleontological data to determine sensitivity (Paleo Solutions 2020). Components of the analysis included a review of geologic maps, literature, and online databases. Reviews of literature and online databases yielded numerous vertebrate fossils recorded from sediments similar to those that occur within the project vicinity. Additionally, numerous geologic units with unknown (PFYC U) and moderate paleontological potential (PFYC 3) are encountered within 0.25 mile of the project alignment. Ground disturbing activities that impact these areas may encounter important paleontological resources if the sediments are conducive to fossilization. Surface grading or shallow excavations in sedimentary geologic units with low paleontological potential (PFYC 2) are unlikely to uncover significant fossil vertebrate remains since these units are either too young or not conducive to fossilization. Excavations entirely within volcanic and plutonic rocks with very low paleontological potential (PFYC 1) or very low to low potential (PFYC 2 to 1) are unlikely to encounter any fossil resources because of the environments in which these rocks form.

In areas of unknown or moderate paleontological potential (PFYC U and 3), construction-related ground disturbing activities have the potential to result in significant adverse direct impacts to paleontological resources. However, the proposed alignment would be located within existing roadway right-of-way that have been previously graded, compacted, and backfilled. Surface grading or shallow excavations entirely within artificial fill or previously disturbed sediments are unlikely to uncover significant fossil vertebrate remains since any recovered resources would lack stratigraphic context. However, these deposits may shallowly overlie older sedimentary deposits. Implementation of APM PALEO-1 and APM PALEO-2 would lessen the potential impact. Therefore, the risk of directly or indirectly destroying a unique paleontological resource or site or unique geologic feature is anticipated to be less than significant.

5.7.5 Draft Applicant Proposed Measures

Applicant Proposed Measures

APM PALEO-1: Paleontological Mitigation Plan

Prior to construction, a Paleontological Mitigation Plan (PMP) should be prepared. It should provide detailed recommended monitoring locations; a description of a worker training program; detailed procedures for monitoring, fossil recovery, laboratory analysis, and museum curation; and notification procedures in the event of a fossil discovery by a paleontological monitor or other project personnel. Any subsurface bones or potential fossils that are unearthed during construction should be evaluated by a professional paleontologist as described in the PMP.

APM PALEO-2: Paleontological Resource Monitoring

Construction excavations which disturb geologic units with moderate paleontological potential (Potential Fossil Yield Classification [PFYC] 3) should be monitored by a professional paleontologist in conjunction with worker environmental training to reduce potential adverse impacts on scientifically important paleontological resources to a less than significant level. The timing and frequency (e.g., part-time vs. full-time) of monitoring should be determined by the professional paleontologist based on initial field observations and excavation activities. Additionally, excavations which disturb geologic units with unknown paleontological potential (PFYC U) should be initially monitored in order to inspect for the presence of sensitive sediments and any resources that may be harbored within. In the event that a highly fossiliferous facies are encountered, full time monitoring should occur until excavations within that facies are complete. Worker environmental training of construction personnel is recommended for excavations impacting sedimentary geologic units with low paleontological potential (PFYC 2). No additional measures are recommended for excavations impacting volcanic and plutonic rock units with very low paleontological potential (PFYC 1) or very low to low potential (PFYC 2 to 1). As summary of the recommended monitoring procedures for each of the mile posts is provided in Appendix B.

APM HYDRO-1: Prepare and Implement a Storm Water Pollution Prevention Plan (SWPPP)

See Section 5.10, Hydrology and Water Quality.