5.7 Paleontological Resources

This section discusses the paleontological resources in the study area and explains why they are important to the project. The impacts of the project alternatives on these resources also are evaluated and proposed mitigation measures are discussed to offset any potential adverse effects.

Since the Supplemental Draft EIS was published in August 2014, additional analyses and content review have been performed for many of the resources discussed in this document. These updates, along with changes resulting from the comments received on the Supplemental Draft EIS, have been incorporated into this Final EIS. In this section, the updates include the following items:

- Revisions to figures and text were made to reflect an updated APE.
- The 2010 revisions to the Bureau of Land Management's Potential Fossil Yield Classification System and the Society of Vertebrate Paleontology guidelines were incorporated into the paleontological analysis.

5.7.1 What are paleontological resources and why are they important to this project?

Paleontological resources are the fossilized remains or traces of plant and animal life, or other organisms, which offer insight into understanding the history of life on Earth. These resources differ from archaeological resources, which are focused on past human life and activities. Paleontological resources can include physical remains—such as bones, teeth, shells, and leaves—and trace remains—such as footprints. Paleontological resources are important because they can be used to document the presence and evolutionary history of now-extinct organisms, to expand knowledge of the life cycle of those organisms, and to understand the environment and geographic region in which they lived.

5.7.2 What study area and evaluation process were used to analyze paleontological resources?

The study area for paleontological resources is the same as the APE for historic resources. An APE boundary was developed cooperatively among consulting parties, as described in Section 5.6, Historic Preservation. **Exhibit 5.7-1** reflects the agreed-upon APE.

Exhibit 5.7-1 Paleontological Resources Study Area

The methodology for identifying paleontological resources and analyzing impacts follows the Bureau of Land Management's Potential Fossil Yield Classification System and the Society of Vertebrate Paleontology guidelines (1995, revised 2010).

The analysis process has three main objectives: (1) to identify and generally describe fossil locations known to exist in the APE; (2) to identify sub-areas where fossils are likely to be found; and (3) to classify all sub-areas according to their probable significance to paleontological investigations.

The first objective, identifying and generally describing fossil locations known to exist in the APE, is completed by investigating published literature on the known paleontology and geology of the APE and examining museum collections and databases, along with associated unpublished records documenting previous finds.

The second objective, identifying sub-areas where fossils are likely to be found, is achieved through the use of geologic maps, which provide a link between the geographic positions of known fossil localities (where fossils have been found previously) and the predicted likelihood of future finds in other areas.

The third objective, classifying these sub-areas and determining their significance, required evaluation of two geologic maps (Moore et al, 2001; Tweto, 1979) to delineate and classify two sub-areas within the APE. The first sub-area consists of sedimentary deposits that are less than 10,000 years old—classified as originating from "recent" or Holocene time. These deposits are less likely to contain fossils of paleontological interest and generally can be excluded as having little significance.

The remaining sediments and sedimentary rocks (10,000 years or older) may vary considerably in fossil content, but the likelihood of finding fossils correlates closely with the area of surface exposure of specific geologic units, and with the geographic concentration of previous finds in the units.

5.7.3 What are the areas of interest for paleontological resources that are being analyzed and what are their existing conditions?

There are nine geologic units or layers underlying the APE. They vary by taxonomic affinity, significance, and density across their distribution (Lindvall 1979, 1980, 1983). **Exhibit 5.7-2** shows the locations of the geologic units within the APE.

The paleontological potentials of these units or layers were evaluated using the Potential Fossil Yield Classification System from the Bureau of Land Management. This system uses resource assessment criteria with rankings from Class 1, Very Low, to Class 5, Very High. The criteria rankings for geologic units that are present in the APE are summarized in **Exhibit 5.7-3**.

Potential Fossil Yield Classification System

Class 1—Very Low

Geologic units that are not likely to contain recognizable fossil remains

Class 2—Low

Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant non-vertebrate fossils

Class 3—Moderate or Unknown

Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential

Class 4—High

Geologic units containing a high occurrence of significant fossils

Class 5—Very High

Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of human-caused adverse impacts or natural degradation

Taxonomic affinity

Characteristics used to classify geologic units as similar.

Exhibit 5.7-2 Geologic Units within the APE

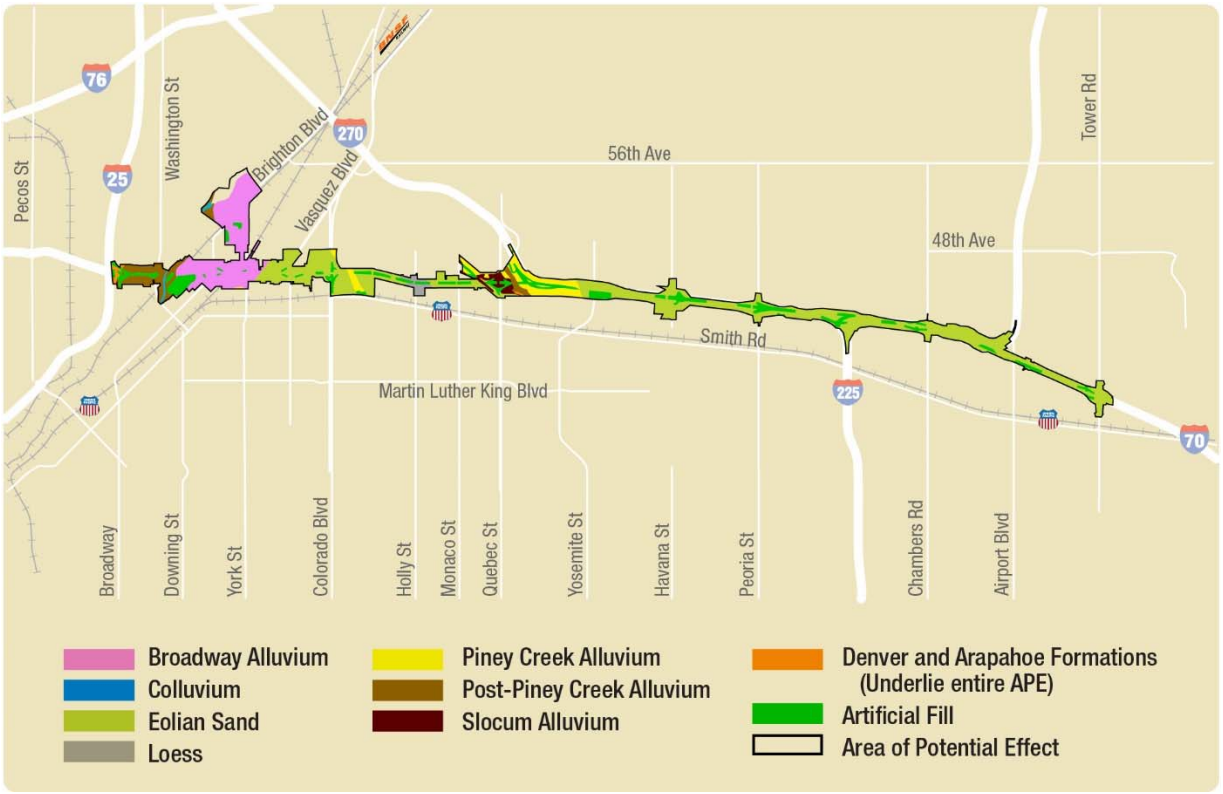

Exhibit 5.7-3 Geologic unit or layer with criteria ranking

Note: No geologic unit underlying the APE has a Class 5, Very High, or Class 3, Moderate, paleontological potential.

The depth of the Denver and Arapahoe Formations within the APE is unknown, but—based on geologic maps—it is likely not less than 10 feet below the surface (Lindvall 1979, 1980, 1983) in some areas. The geologic units or layers with low potential are all surficial deposits known to produce scattered and often poorly preserved fossil remains in the Denver area, although many of these remains are identifiable vertebrate fossils that are significant paleontological resources under Society of Vertebrate Paleontology (1995, revised 2010) guidelines.

All of the unconsolidated sedimentary deposits within the APE are relatively youthful Quaternary deposits that date back to the late Pleistocene period (between 120,000 and 11,700 years ago) and overlay the much older geologic deposits of the Late Cretaceous Arapahoe Formation and Late Cretaceous and early Paleocene Denver Formation. Within the APE, the Denver and Arapahoe Formations are the only formations that can be considered to be of high potential for the presence of significant fossil finds.

Of the Pleistocene sedimentary deposits, the Broadway Alluvium and the unnamed loess unit are noted to contain remains of Pleistocene mammals. Bison bones are reported to be commonly found in the Broadway Alluvium, as well as the occasional mammoth. The unnamed loess unit has produced a variety of small mammal fossils, as well as fossilized horse and camel remains. Many of these Pleistocene mammal fossils that are identifiable are significant paleontological resources under the guidelines of the Society of Vertebrate Paleontology (1995, revised 2010). The remaining Quaternary geological units in the APE are considered to have low paleontological potential to produce scattered fossil remains.

A database search of the University of Colorado Museum and the Denver Museum of Nature and Science records revealed no previously recorded fossil localities within the project area. However, 25 previously documented localities (at least 13 within the Denver Formation) occur within approximately six miles of the project area and five previously recorded fossil localities (geological formations unknown) occur within one mile of the project area. The University of Colorado Museum has approximately 60 fossil vertebrate localities from the Denver Formation throughout the Denver Basin, but most are located win the Denver metropolitan area. Although the database search listed no recorded fossil localities within the project area, Charles B.

What are the Denver and Arapahoe Formations?

The Denver Formation overlies the Arapahoe Formation. Both are geologic formations underlying Denver, Colorado, consisting mainly of claystone, siltstone, and fine-grained sandstone with minor conglomerate beds and local lava flows. The Denver Formation ranges in thickness from 600 feet to 1,580 feet and the Arapahoe Formation is 300 feet at its maximum thickness. Each formation is known to contain plant fossils and remains of vertebrates.

What is loess?

Loess is a yellowish-brown to light-grayish-brown sandy silt. It contains large amounts of clay and silty clay with a thickness generally less than 10 feet, but locally it may be as much as 30 feet thick.

What is Broadway Alluvium?

Broadway Alluvium is sediment that was deposited during the late Wisconsinan glaciation period (85,000 to 10,000 years ago). It consists of mixed deposits of sands, clays, and occasional gravels with an average depth of 20 feet. This sedimentary deposit creates the most prominent terraces of the South Platte River.

Hunt (Hunt, 1954) shows fossil localities from Late Pleistocene Alluvium within the APE. Surficial Pleistocene deposits, such as these, are considered to have low potential.

The terrain within the APE is topographically flat with previously disturbed surface sediments. These sediments are vegetated and covered with urban development, including buildings, roadways, and railroads. The deposits directly beneath the APE consist mostly of low-potential, Pleistocene- and Holocene-aged surficial sediments. These sediments overlay the paleontologically sensitive bedrock of the Denver Formation, which occurs at varying depths.

5.7.4 How do the project alternatives affect paleontological resources?

Impacts to paleontological resources can result from the disturbance of surface and subsurface sediments. Direct effects primarily concern the potential destruction of paleontological resources and the loss of information associated with these resources.

The No-Action Alternative and the Revised Viaduct Alternative generally involve minimal deep surface disturbance, with most disturbance occurring at or just below the existing grade (with the exception of bridge pilings).

The Partial Cover Lowered Alternative will construct I-70 below grade, resulting in subsurface excavation to approximately 40 feet. The lowest grade for the Partial Cover Lowered Alternative is located between the UPRR and York Street. Subsurface geotechnical data indicate that roadway excavation in this location will primarily affect Quaternary surficial deposits and may require minor bedrock excavation.

All alternatives will require new storm drain pipes and utilities. These activities could require bedrock excavation, which has a high potential for paleontological resources. However, effects are expected to be minimal. Mitigation for these potential impacts is provided in Section 5.7.5.

5.7.5 How are the adverse effects from the project alternatives mitigated for paleontological resources?

Prior to initiating all earth-moving construction activities in rock units of high paleontological potential, an intensive preconstruction paleontological survey will be required. This will be followed by spot-checking of excavations by a qualified paleontologist until bedrock is encountered. When bedrock is encountered, continuous monitoring will be required. Upon discovery of any paleontological resources, work will cease immediately in the vicinity of the discovery, and the contractor will fence off the area to allow the paleontologist to conduct sampling or excavation of specimens by hand or with mechanized equipment. Work will not resume in the area until the paleontologist sends formal notification allowing work to resume.

Within the APE, Pleistocene and Lower Holocene-period surficial deposits—including alluvium, eolian sand, and loess—have low paleontological potential. Monitoring will not be required, but spot-checking may be conducted in certain areas at the discretion of the project or staff paleontologist. This also will help to ensure that older underlying sediments known to contain fossils are not being affected. Areas of no paleontological potential within the APE will not require mitigation. **Exhibit 5.7-4** lists the impacts and mitigations related to paleontological resources.

Exhibit 5.7-4 Summary of Paleontological Resources Impacts and Mitigations

Alternative	Impacts and/or Benefits	Mitigation Measures Applicable to All Alternatives
No-Action Alternative	Minimal deep surface disturbance	• Perform spot-checking of excavations by a qualified paleontologist in areas of high paleontological potential during all phases of construction until bedrock is reached, then perform continuous paleontological monitoring • Cease work immediately upon discovery of any paleontological resources, fence off the area, and allow the paleontologist to conduct sampling or excavation of specimens by hand or with mechanized equipment; do not resume work in the area until receiving formal notification from the paleontologist allowing work to resume
Revised Viaduct Alternative		
Partial Cover Lowered Alternative	Increased potential for encountering paleontological resources in excavated bedrock of the Denver and Arapahoe Formations	

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