3.16 PALEONTOLOGICAL RESOURCES

This section provides a summarized description of the existing conditions of paleontological resources within the regional study area, and anticipated impacts on these resources corresponding to each of the North I-25 alternatives. The scope of the paleontological analysis included literature and museum record searches and a field survey. The *Paleontological Resources Technical Report (Rocky Mountain Paleontology, 2008)* should be consulted for greater detail.

What's in Section 3.16?

3.16.1 Affected Environment

The Front Range foothills and adjacent eastern plains region of Colorado are well known for their geologic history and paleontologic importance. Scientists working in this area have conducted numerous studies in geology and paleontology, some of which are now considered classic works, and others that are on the cutting edge of modern paleontological and paleoenvironmental research. Many important fossil specimens, including numerous holotypes, have been collected in this region. These include the type specimens of the dinosaurs *Stegosaurus armatus, Diplodocus, Allosaurus*, and *Apatosaurus ajax*, which were collected during the late nineteenth century from historic quarries near the town of Morrison. These and many other fossils from the Front Range and eastern plains region of Colorado are now housed in museums in Colorado and throughout the United States.

3.16.2 Environmental Consequences

No-Action Alternative

There would be no impacts to paleontological resources resulting from the No-Action Alternative.

Package A

Package A would result in varying degrees of ground disturbance associated with construction. Unmitigated excavations in Pierre Shale, Fox Hills Sandstone, Laramie Formation, Denver Formation, and Pleistocene-age surficial deposits have the potential to adversely impact scientifically significant paleontological resources. Generally, the greater the amount of ground disturbance, the greater the likelihood of adverse impacts on paleontological resources in formations that are known to be fossiliferous. The potential for adverse impacts increases with the known paleontological sensitivity of each geologic formation.

Excavations for highway widening and interchange improvements are typically shallow, and mostly occur close to the existing grade. Excavations associated with rail construction are also mostly shallow in areas like the regional study area that are largely of low topographic relief. Larger and deeper excavations, such as those for building foundations at commuter bus and commuter rail stations and associated facilities, bridge abutments, underground utilities such as pipelines and powerlines, and light standards along the North I-25 corridor, have a higher potential for adverse impacts on paleontological resources.

The Denver Formation has high paleontological sensitivity, and could be impacted by construction from E-470 to US 36 (A-H4). The Pierre Shale and Laramie Formation have moderate sensitivity, and the Fox Hills Sandstone and Pleistocene-age surficial deposits have low sensitivity. These units underlie portions of the regional study area. Most previously recorded fossil localities within the regional study area are located in the Pierre Shale between Fort Collins and Loveland, especially the Hygiene Sandstone Member in the vicinity of Fossil Ridge. Construction along the existing BNSF rail-line between Fort Collins and Longmont, and along I-25 between E-470 and US 36 (A-H4), has the highest likelihood of adversely impacting paleontological resources, especially where cuts are necessary to expand highways, interchanges and rail alignments.

Package B

Package B would result in varying degrees of ground disturbance associated with construction. Unmitigated excavations in Pierre Shale, Fox Hills Sandstone, Laramie Formation, Denver Formation, and Pleistocene-age surficial deposits have the potential to adversely impact scientifically significant paleontological resources. Generally, the greater the amount of ground disturbance, the greater the likelihood of adverse impacts on paleontological resources in formations that are known to be fossiliferous. The potential for adverse impacts increases with the known paleontological sensitivity of each geologic formation.

In terms of construction-related ground disturbance and potential impacts on paleontological resources, the highway components under Package A and Package B are similar, except that under Package A structure upgrades (A-H4) are proposed to I-25 between E-470 and US 36, and under Package B (B-H4), an additional tolled express lane is proposed between E-470 and US 36 (B-H4), with upgrades to highway interchanges.

Preferred Alternative

The Preferred Alternative would result in varying degrees of ground disturbance associated with construction. Unmitigated excavations in Pierre Shale, Fox Hills Sandstone, Laramie Formation, Denver Formation, and Pleistocene-age surficial deposits have the potential to adversely impact scientifically significant paleontological resources. Generally, the greater the amount of ground disturbance, the greater the likelihood of adverse impacts on paleontological resources in formations that are known to be fossiliferous. The potential for adverse impacts increases with the known paleontological sensitivity of each geologic formation.

The highway components included in the three build alternatives would result in construction-related ground disturbance and potential impacts on paleontological resources. Generally, the higher the number of lanes and interchange improvements, the higher the potential for paleontological resource impacts, depending on the area's known paleontological sensitivity.

Transit components under Package A, Package B, and the Preferred Alternative would impact paleontological resources differently. Under Package B, transit alternatives consist of bus rapid transit service and the construction of associated infrastructure. Ground disturbance associated with the construction of commuter rail lines and facilities associated with Package A and the Preferred Alternative is anticipated to be significantly greater than that required for bus rapid transit facilities associated with Package B. It should be noted that disturbances associated with commuter rail facilities would be noticeably less under the Preferred Alternative than Package A.

In terms of construction disturbance, Package A would disturb 2,877 acres, Package B would disturb 2,959 acres, and the Preferred Alternative would disturb 3,224 acres. Therefore, Package A has the lowest potential for impacts on paleontological resources, followed by Package B, with the Preferred Alternative having the highest potential for paleontological impacts. All build alternatives have a higher potential for impacts on paleontological resources than the No-Action Alternative.

3.16.3 Mitigation Measures

Construction Monitoring

Continuous monitoring or spot checking during construction is recommended for the Pierre Shale, Laramie Formation, and Denver Formation (or portions thereof). Paleontological clearance with no attached mitigation stipulations is recommended for the Fox Hills Sandstone and Pleistocene-age surficial deposits.

All paleontological monitoring work will be performed by a qualified and State of Colorado-permitted paleontologist. Paleontological monitoring will include inspection of exposed rock units and microscopic examination of matrix to determine if fossils are present. This work would take place during surface disturbing activities, such as excavations for the construction of roads, railways, bridges, underpasses, and buildings. Depending upon the paleontological sensitivity of the project area based on its geology and the types and significance of potential fossils that could be present in sub-surface sedimentary deposits, monitoring will be scheduled to take place continuously or to consist of spot-checks of construction excavations. Paleontological monitors will follow earth-moving equipment and examine excavated sediments and excavation sidewalls for evidence of significant paleontological resources. At the request of the monitors, the project engineer will order temporary diversion of grading away from exposed fossils in order to permit the monitors to efficiently and professionally recover the fossil specimens and collect associated data. All efforts to avoid delays to project schedules will be made.

The final paleontological monitoring report should provide all necessary paleontological data. This includes, but is not limited to, a discussion of the results of the mitigation-monitoring plan, an evaluation and analysis of the fossils collected (including an assessment of their significance, age, and geologic context), an itemized inventory of fossils collected, a confidential appendix of locality and specimen data with locality maps and photographs, an appendix of curation agreements and other appropriate communications, and a copy of the project-specific paleontological monitoring and mitigation plan.

If any subsurface bones or other potential fossils are found by construction personnel during construction, work in the immediate area will cease immediately, and the CDOT staff paleontologist will be contacted to evaluate the significance of the find. Once salvage or other mitigation measures (including sampling) is complete, the CDOT staff paleontologist will notify the construction supervisor that paleontological clearance has been granted.

Recommendations

1. Potential adverse impacts on paleontological resources within the North I-25 Final EIS regional study area can be reduced to below the level of significance with the implementation of paleontological mitigation. **Table 3.16-1** summarizes the paleontological resource mitigation measures recommendations by geologic formation.

2. When the Preferred Alternative has been selected and the project design plans have been finalized, the CDOT paleontologist will review these documents and determine the extent and depth of ground disturbance associated with construction of the proposed transportation improvements. Based on these findings, mitigation measures will be modified, as appropriate and additional site-specific or project-specific paleontological studies may be recommended.

3. The majority of privately owned lands within the regional study area and some segments of the BNSF right-of-way were not surveyed for paleontological resources because access to these parcels was not granted. When the Preferred Alternative is selected, the CDOT paleontologist will determine which of these parcels, if any, could contain exposures of potentially fossiliferous bedrock and/or surface fossils, and should be surveyed prior to construction.

4. If any subsurface bones or other potential fossils are found anywhere within the regional study area during construction-related ground disturbance, the CDOT paleontologist will be notified immediately to assess their significance and make further recommendation.

Table 3.16-1 Summarized Paleontological Resource Mitigation Recommendations by Geologic Formation

Formation	Location	Approach
Pierre Shale, Hygiene Sandstone Member	Fossil Ridge, BNSF corridor south of Fort Collins and north of Loveland.	Monitor all excavations during construction
Pierre Shale	All locations where unit occurs within regional study area except Fossil Ridge.	Spot-check large excavations for significant fossils during construction. Immediately notify CDOT paleontologist if fossils found during construction.
Fox Hills Sandstone	All locations where unit occurs within regional study area.	Paleontological clearance with no attached mitigation stipulations recommended. Immediately notify CDOT paleontologist if fossils found during construction.
Laramie Formation	All locations where unit occurs within regional study area.	Spot-check large excavations for significant fossils during construction. Immediately notify CDOT paleontologist if fossils found during construction.
Denver Formation	All locations where unit occurs within regional study area.	Monitor all excavations during construction.
Pleistocene-age surficial deposits	All locations where unit occurs within regional study area.	Paleontological clearance with no attached mitigation stipulations recommended. Immediately notify CDOT paleontologist if fossils found during construction.