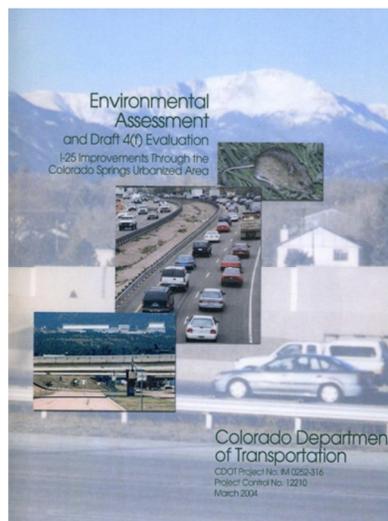




RE-EVALUATION, Mileposts 149 to 161

Interstate 25 Improvements through the Colorado Springs Area Environmental Assessment



PALEONTOLOGY TECHNICAL MEMO

April 2012

Prepared for:
CDOT Region 2

Prepared by:
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Introduction

The Colorado Department of Transportation (CDOT) has prepared this technical memorandum to update findings with regards to the paleontological resources described in the original 2004 I-25 Environmental Assessment (EA) with regard to the portion of the Proposed Action between Woodmen Road (Exit 149) in Colorado Springs and State Highway 105 in Monument (Exit 161). The purpose of the EA's Proposed Action is to relieve existing traffic congestion and address project future congestion on I-25 within the Colorado Springs Urbanized Area.

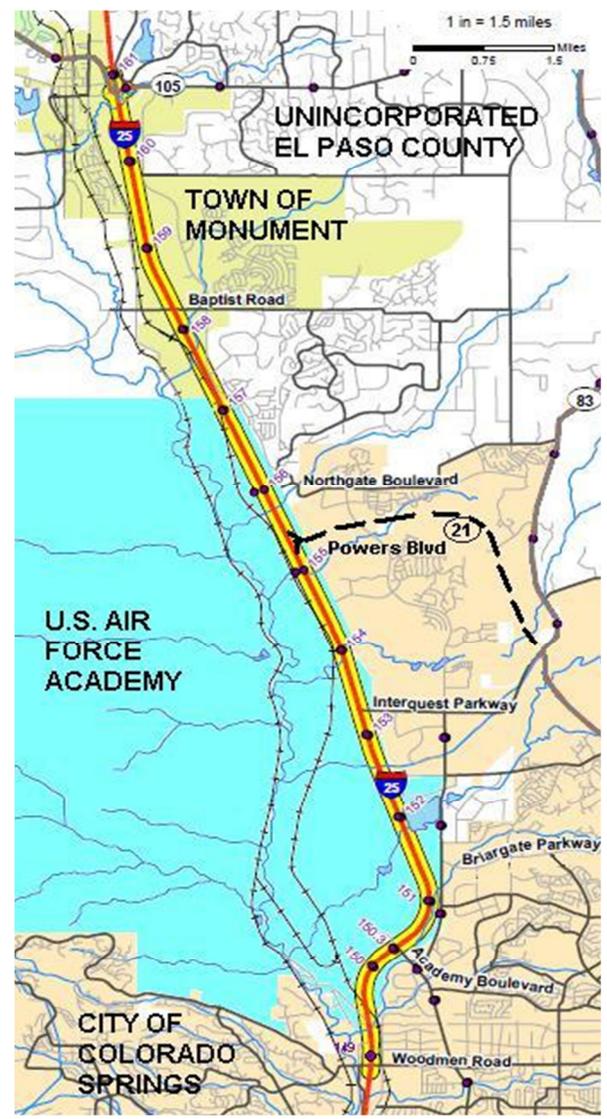
The I-25 EA originally evaluated impacts for the widening of I-25 between South Academy Boulevard (Exit 135) and SH 105, together with reconstruction of various I-25 interchanges within this corridor. Page 2-10 of the EA stated that, "Consistent with projected traffic demand in the I-25 corridor, the conceptual phasing for the Proposed Action calls for:

- (1) initially six-laning through central Colorado Springs, then
- (2) six-laning in northern El Paso County, and finally
- (3) adding HOV [High-Occupancy Vehicle] lanes through central Colorado Springs and widening to six lanes south to South Academy Boulevard."

For the year 2012, CDOT has received funding to begin the second phase, meaning to widen I-25 to six lanes in northern El Paso County. The EA calls for eventually widening I-25 all the way to SH105. The 2012 project will begin north of Woodmen Road (Exit 149) and may be able to widen I-25 to the North Gate Interchange (Exit 156) or slightly beyond, perhaps to Black Squirrel Creek. Nevertheless, to be prepared for possible additional funding availability in the near future, CDOT's current EA re-evaluation effort is covering all Phase 2 improvements. Therefore, the study area for this re-evaluation extends northward all the way to Monument. See Figure 1.

The I-25 EA included a new connection with Powers Boulevard (now State Highway 21), following SH 21 eastward to just past the Powers Boulevard/Voyager Boulevard interchange. The design and analysis of this connection in the I-25 EA superseded what was proposed earlier in the North Powers Boulevard EA that was approved in 1999. The current EA re-evaluation also includes this portion of Powers Boulevard from I-25 to just east of Voyager Parkway.

Figure 1. I-25 EA Re-evaluation Project Vicinity



Summary of the 2004 EA Paleontological Resources, Impact, and Mitigation

The 2004 EA included research regarding known locations with paleontological resources within an area of potential effects along the I-25 corridor. It stated the following conclusion:

Based on review of the conceptual design for the Proposed Action, the project would not impact any known paleontological resources. However, there is always the potential for discovery of currently unknown resources during a construction project. Construction excavation may produce new exposures of the potentially fossiliferous Pierre Shale, Denver Formation, and Dawson Arkose. [I-25 EA, page 127]

Accordingly, mitigation identified in the EA focused on steps to be taken in the event that the Proposed Action resulted in discovery of any previously unknown sites.

Phase 2 of the Proposed Action now also will include the I-25/ North Powers Boulevard beyond the existing I-25 easement eastward to just east of the planned Powers Boulevard/ Voyager Parkway interchange. This segment was previously assessed and cleared as part of the North Powers Boulevard Environmental Assessment. That EA, completed in July 2007, included the following summary paragraph regarding paleontological resources:

Based on the results of on-the-ground reconnaissance for paleontological resources, it appears that construction at or above the present ground surface within the preferred alternative will have no affect [sic] on scientifically important paleontological resources. Nevertheless, the late Paleocene and early Eocene Dawson Arkose, which crops out extensively within the EA study area, has produced scientifically important plant fossils within and near the EA study area. In large areas where the Dawson Arkose is not presently exposed at the ground surface, it appears to be or is known to be buried at shallow depth. Subsurface excavation associated with this project could have an effect on scientifically important paleontological resources in the Dawson Arkose. [North Powers Boulevard EA, page 26]

Changes to the Project that Would Affect the Resource Differently

Since the EA was approved in 2004, the Baptist Road interchange was reconstructed (I-25 Exit 158), and the COSMIX project widened I-25 from South Circle Drive (Exit 138) to North Academy Boulevard (Exit 150).

As noted above, the I-25 EA Phase 2 project now includes the I-25/North Powers connection from I-25 to just east of the planned Powers/Voyager Parkway interchange.

Changes in Resources, Analysis Data, Analysis Methods or Applicable Regulations

Mr. Steven Wallace, the CDOT Paleontologist, prepared a Paleontological Assessment for this project in April 2012. That assessment is included in its entirety as an appendix to this technical memorandum. His assessment notes that since the EA was prepared nearly a decade ago, many paleontological research papers and abstracts pertinent to the reassessment corridor have been published, and that their results "reinforce CDOT's original commitment to perform monitoring of construction impacts to paleontologically sensitive geologic units within the EA corridor."

Three reported findings of direct relevance to the I-25 EA re-evaluation area (mileposts 149 to 161) are noted below. In their descriptions, the acronym DMNH means Denver Museum of Natural History is followed by the site's identification number in the museum's records.

- About 25 miles north of the I-25 re-evaluation area, an important discovery of early Paleocene (i.e., about 63.8 million years old) tropical rainforest flora was made in Castle Rock (DMNH 1200). More species diversity was found at this site than at similar U.S. sites of the same geologic age, which is an important scientific finding necessitating some adjustment of previous theories about that time period.
- A rainforest-type site known as the Scotty's Palm locality (DMNH 1204) was discovered and quarried in 1992-3 and was further quarried in 2002 west of I-25 near the North Gate of the U.S. Air Force Academy (I-25 Exit 156).
- Moderately abundant leaf fossils were found on the eastern side of I-25 (west of Voyager Parkway) in 1995 (DMNH 1651). This location is in the general vicinity of the planned I-25/North Powers Boulevard connection.

The important finding in Castle Rock shed new light on the meaning of the previous finds in the I-25 and North Powers Boulevard EA study areas. As a result, the potential for encountering scientifically important paleontological resources in the Dawson Arkose Formation now appears to be greater than was anticipated in the I-25 EA. The inclusion of the I-25/ North Powers Boulevard connection (to just east of Voyager Parkway) in the I-25 EA re-evaluation area makes the Voyager Parkway site relevant to I-25 Phase 2 improvements.

It should be noted that the I-25 EA revised the configuration of the proposed I-25/ Powers Boulevard connection based on input from the U.S. Air Force Academy with regard to visual impacts to their historic (50 year old) cultural landscape. With the new design in the 2004 I-25 EA, keeping all ramps at or below existing grade requires rock cuts east of I-25, in a potentially fossiliferous Dawson Arkose outcrop.

Changes in Proposed Mitigation

As recommended by the CDOT Paleontologist, a paleontological mitigation plan for the reevaluation corridor will include paleontological monitoring during construction if and wherever final design plans indicate there will be significant impacts to Dawson Formation outcrop. Paleontological monitoring will also be undertaken where this unit may be present at relatively shallow depths in areas mapped as Pleistocene deposits.

If the CDOT Paleontologist's examination of final plan, profile, and cross-section sheets (and any subsurface geologic data that might be part of any final plan set for any future construction project permitted by approval of this EA reevaluation) indicates that there will be significant impacts to Dawson Formation outcrop, CDOT will write a revision of Subsection 107.23 of the Standard Specifications (Archaeological and Paleontological Discoveries) identifying the paleontological monitoring corridor(s) for attachment to the construction project specifications.

Conclusion

As the result of the discovery of the rainforest fossils discovery in Castle Rock the potential for encountering scientifically important paleontological resources within the re-evaluation area now appears to be greater than was anticipated in the I-25 EA. The discovery reinforces CDOT's previously identified approach that vigilance will be needed, especially where construction encounters outcrops of the Dawson Arkose Formation, to protect any important resources that may be encountered.

Summary of Previously and Currently Identified Paleontological Impacts and Mitigation

EA 2004 – No-Action Alternative	EA 2004 – Impacts of Proposed Action	EA 2004 - Mitigation	2012 – What Has Changed	Re-evaluation 2012 – Impacts of No Action	Re-evaluation 2012 – Impacts of Proposed Action	Re-evaluation 2012 – Mitigation
<p>The No Action Alternative would have no impacts to known paleontological sites.</p>	<p>Based on the current Concept Design, there will not be any known impacts to paleontological resources.</p>	<p>Once project design plans are finalized, CDOT will have a qualified Paleontologist examine them to determine if monitoring during construction is necessary.</p>	<p>An important tropical rainforest fossil discovery 25 miles north of the project area has shed new light on previous fossil discoveries in the I-25 EA re-evaluation area. The potential for encountering scientifically important fossils in any impacted outcroppings of the Dawson Arkose now appears to be greater than was previously anticipated.</p>	<p>No change. The No Action Alternative would have no impacts to <u>known paleontological sites</u>.</p>	<p>No change. The Proposed Action would have no impacts to <u>known paleontological sites</u>. However, see below for important additional information.</p>	<p>No mitigation is necessary.</p>
<p>The No Action Alternative would have no impacts to paleontological sites that have not yet been discovered.</p>	<p>The Proposed Action has the potential to impact paleontological resources that have not yet been discovered.</p>	<p>If any sub-surface bones or other possible fossils are found anywhere within the survey corridor during construction, the CDOT staff Paleontologist will be notified immediately to assess their significance and make further recommendations.</p>	<p>The potential for encountering scientifically important fossils in any impacted outcroppings of the Dawson Arkose now appears to be greater than was previously anticipated.</p>	<p>No change. The No Action Alternative would have no impacts to <u>paleontological sites that have not yet been discovered</u>.</p>	<p>No change. The Proposed Action has the potential to impact <u>paleontological sites that have not yet been discovered</u>. In particular, this could be an issue in the general vicinity of the I-25/ Northgate and North Powers Boulevard interchange complex.</p>	<p>CDOT will prepare a paleontological mitigation plan for the reevaluation corridor, to include paleontological monitoring during construction if and wherever final design plans indicate there will be substantial impacts to Dawson Formation outcrop. If substantial impacts are anticipated, the CDOT Paleontologist will write a revision of Subsection 107.23 of the Standard Specifications for attachment to the contractor's project specifications.</p>

APPENDIX

**APRIL 2012 PALEOLOGICAL ASSESSMENT
BY STEVEN WALLACE, CDOT PALEONTOLOGIST**

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DATE: April 20, 2012

TO: Rob Frei

FROM: Steven M. Wallace

SUBJECT: Paleontological assessment for project IM C040-029, I 25 North – Design Build Procurement

I have prepared this technical memorandum to update findings described in the original 2004 I-25 Environmental Assessment (EA) with regard to the portion of the Proposed Action between Woodmen Road (Exit 149) in Colorado Springs and State Highway 105 in Monument (Exit 161). The original technical report (Murphey 2002) for Interstate Highway 25 between Widefield (milepost 131.8) and Monument (milepost 161.8) was submitted to CDOT on September 28, 2002. Many paleontological research papers and abstracts pertinent to the reassessment corridor (mileposts 149-161 on I-25) have been published in the interim, with results that reinforce CDOT's original commitment to perform monitoring of construction impacts to paleontologically sensitive geologic units within the EA corridor. Because the current reassessment footprint also includes the portion of the future Powers Boulevard (State Highway 21) corridor from I-25 to just east of Voyager Boulevard, this memorandum includes data from the November 3, 1995 paleontological assessment memo for project STM M240-014, Powers Boulevard Extension – North, not considered in the 2002 technical report.

In his 2002 technical report, Murphey recommended the following:

“Paleontologic clearance is recommended for all areas within the survey corridor except where the Pierre, Laramie and Dawson formations are present. Because of the known paleontological sensitivity of these units in combination with the results of this study, continuous or spot check monitoring¹ of all areas where they will be significantly impacted by construction excavations is recommended. When the project design plans are finalized, the CDOT staff paleontologist should examine them in order to estimate the impact to these formations, and the scope of paleontological monitoring work, if any, which is required.”

¹Murphey (2002:Table 2) recommended *continuous* monitoring of construction impacts to Dawson Formation outcrop.

Of the three paleontologically sensitive geologic units cited above, only the Dawson Formation crops out (Thorson et al. 2001; Thorson and Madole 2002) within the reevaluation corridors. The Dawson Formation (aka Dawson Arkose) is a highly lithologically variable unit, including quartzose sandstone, arkosic sandstone, olive-gray and variegated (multicolored) claystone, and conglomerate (Maberry and Lindvall 1977). The Denver Formation is another lithologically variable unit composed chiefly of sandstone and claystone, and containing weathered andesitic (volcanic) rock fragments (ibid). The lateral and vertical lithologic variability within these two closely-related geologic units has resulted in a long, complex, and often confusing history of nomenclature. Recent study of these units has resulted in the conclusion that these two units combined represent two major pulses of uplift along the Front Range in the area between Denver, Colorado Springs, and Limon, an area known as the Denver Basin. These two pulses have been provisionally designated as the D1 and D2 synorogenic sequences (Raynolds 2002). Paleontological and stratigraphic evidence indicates that strata within the reevaluation corridors that have been historically allocated to the Dawson Formation represent deposition that was part of the Late Cretaceous to early Paleocene D1 orogenic sequence of Raynolds (2002).

Of particular concern paleontologically is the potential for impacts to outcrops of the Late Cretaceous to early Paleocene D1 synorogenic sequence of Raynolds (2002). The D1 synorogenic sequence of Raynolds (2002) has produced Late Cretaceous leaves, dinosaur remains, and very rarely, mammal teeth, as well as early Paleocene leaves and mammal, reptile, and amphibian bones and teeth in the Denver Basin (Cannon 1906; Brown 1962; Middleton 1983; Carpenter and Young 2002; Johnson et al. 2003; Hutchison and Holroyd 2003; Eberle 2003; Middleton and Dewar 2004). I am aware of only two published invertebrate fossil occurrences in the D1 synorogenic sequence (Cross 1889:131; Cannon 1893:261; Brown 1943:79), but a third one has been recorded adjacent to State Highway 86 east of Kiowa, at University of Colorado Museum (UCM) fossil locality 91278. The published invertebrate fauna consists of a few, poorly preserved fresh-water snails; the UCM 91278 fauna includes unidentified fresh-water snails and clams (unpublished UCM and CDOT fossil locality data).

Of most critical concern is the potential for impacting Dawson Formation outcrop that could contain an early Paleocene tropical rainforest flora first published by Johnson and Ellis (2002). The 63.8 million year old Castle Rock Rainforest paleoflora from DMNH2 fossil locality 1200, Castle Rock Roadcut, and subsequently recorded quarry excavation localities within the limits of the originally recorded locality, is extremely taxonomically diverse³, with leaves showing morphological features similar to those of leaves in modern tropical rainforests. Prior to the initial publication of the Castle Rock Rainforest paleoflora (ibid), all known Paleocene paleofloras in the Western Interior of North America were species-poor, a feature generally attributed to the lingering aftereffects of the Cretaceous-Tertiary (K-T) megaextinction event that marked the last occurrence of the non-avian dinosaurs and many marine groups including mosasaurs, plesiosaurs, ammonites, inoceramid clams, and the majority of the Late Cretaceous marine microfauna and microflora.

The diversity of the Castle Rock Rainforest paleoflora is even more remarkable because it grew less than two million years after the K-T megaextinction event, an event marked by the

² DMNH = Denver Museum of Natural History, now the Denver Museum of Nature and Science

³The most recent unpublished estimates indicate the presence of over 100 species.

extinction of more than 60 percent of forest tree species in the Western Interior of North America. Most Paleocene leaf sites from the Western Interior contain no more than 20 species. Prior to the discovery and analysis of the Castle Rock Rainforest and associated plant fossil localities along the Rocky Mountain front in Colorado, it was thought that it took about 10 million years for ecosystems to recover from the cataclysmic K-T bolide impact. The Castle Rock flora raises significant questions about K-T boundary recovery and the origin of tropical rainforests in general (Raynolds et al. 2007:7-8).

Conversely, associated research (Barclay et al. 2003) has demonstrated that species diversity is much lower in roughly time-equivalent early Paleocene localities east of and away from the Rocky Mountain front. On-going research is demonstrating a pattern of vegetational zoning related to the position of the Rocky Mountain front (Raynolds et al. 2007:8). Analysis of early Paleocene paleofloras (Johnson et al. 2004) along the Rocky Mountain front⁴ show a mean annual temperature (MAT) range of 17.5-24.6 degrees C and a mean annual precipitation (MAP) range of 157-256 centimeters/year between the vicinity of Kiowa and the Rocky Mountain front. Collectively, they support the concept of a relatively narrow band of rainforest vegetation growing along the eastern margin of the Rocky Mountain front from shortly after the K-T boundary megaextinction event at 65.51 Ma⁵ until at least 63.8 Ma, when the fossil record is interrupted locally.

One of the Castle Rock Rainforest-type localities cited in Johnson et al. (2004) is the Scotty's Palm locality (DMNH 1204) recorded on U. S. Air Force Academy property west of the North U. S. Air Force Academy exit (Exit 156) on I-25. This locality was discovered and extensively quarried in 1992-1993 and again in 2002. Preliminary examination of the 1992-1993 collection documented 68 species of plants. The high species diversity, large leaf size, a leaf margin percentage indicating a MAT of 22 degrees C, and an abundance of fossil palm material supports a tropical rainforest origin for this paleoflora. This paleoflora is believed to date from within 300,000 years of the K-T megaextinction event (Reynolds et al. 2002), making it the oldest of the rainforest paleoflora localities identified to date in the Denver Basin. Its occurrence that soon after the K-T boundary event supports the concept that floral recovery from the boundary event was even more rapid along the Rocky Mountain front than suggested by the younger Castle Rock, Chopping at the Gap, Baptist Road (DMNH 2177), and Sick of Sycamore localities analyzed in Johnson et al. (2004).

Identified in the November 3, 1995 paleontological assessment memo for project STM M240-014, Powers Boulevard Extension – North, and identified but not discussed in the Murphey (2002:Table 1) technical report is DMNH fossil locality 1651, CDOT Monument Creek. I located and recorded this locality about 150 meters west of a north-south dirt road proposed as the future alignment of Voyager Parkway, making its identification pertinent to this reevaluation. Leaf fossils were moderately abundant. Most of the leaves I observed preserved only first- and second-order venation, making their identification to a taxonomically useful level problematic, but I did find occasional specimens with finer, third- and fourth-order venation preserved. At that time, I considered DMNH 1651 to have further research potential and to be scientifically

⁴Paleofloras analyzed include those from the Castle Rock (DMNH 1200), Chopping at the Gap (DMNH 2687), and Sick of Sycamore (DMNH 2339) localities, whose excavations and analyses CDOT financially supported.

⁵Ma = million years ago

significant. The potential for it being another rainforest locality, probably younger than Scotty's Palm locality given its location, only adds to its perceived scientific significance.

Given the proven paleontological potential of the Dawson Formation in the vicinity of the reevaluation corridors, I believe a paleontological mitigation plan for the reevaluation corridors should include paleontological monitoring during construction if and wherever final design plans indicate there will be significant impacts to Dawson Formation outcrop. Paleontological monitoring is also recommended where this unit may be present at relatively shallow depths in areas mapped as Pleistocene deposits. If my examination of final plan, profile, and cross-section sheets and any subsurface geologic data that might be part of any final plan set(s) for any future construction project(s) permitted by approval of this EA reevaluation indicates that there will be significant impacts to Dawson Formation outcrop, I will write a revision of Subsection 107.23 of the Standard Specifications (Archaeological and Paleontological Discoveries) identifying the paleontological monitoring corridor(s) for attachment to the construction project(s) specifications.

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SMW:smw
cc: CF, Wallace