

STATE OF COLORADO

DEPARTMENT OF TRANSPORTATION

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DATE: September 10, 2008

TO: Chuck Attardo

FROM: Steven M. Wallace

SUBJECT: Paleontological assessment for the North Meadows Extension project, Alternatives 6 (Castlegate) and 7 (Atrium)

INTRODUCTION

The North Meadows Extension Environmental Assessment (EA) includes two proposed alternative alignments for study. The proposed Alternative 6 (Castlegate) alignment begins south of State Highway 85, at a point in the SW¹/₄ NW¹/₄ SE¹/₄ of section 28, T7S, R67W, heads generally north and northeasterly across the NE¹/₄ of section 28, T7S, R67W, E¹/₂ SE¹/₄ SE¹/₄ of section 21, T7S, R67W, and S¹/₂ SW¹/₄ and NW¹/₄ SW¹/₄ SE¹/₄ of section 22, T7S, R67W, and intersects the Interstate Highway 25 alignment at a point in the NE¹/₄ NW¹/₄ SW¹/₄ SE¹/₄ of section 22, T7S, R67W, all in Douglas County. The proposed Alternative 7 (Atrium) alignment begins at the same point as the proposed Alternative 6 alignment, heads generally north, southeasterly, and then northeasterly across the S¹/₂ NE¹/₄ of section 28, T7S, R67W, NW¹/₄ of section 27, T7S, R68W, E¹/₂ SE¹/₄ SW¹/₄ and NW¹/₄ SW¹/₄ SE¹/₄ of section 22, T7S, R67W, all in Douglas County, and intersects the I-25 alignment at the same point as the proposed Alternative 6 alignment. I considered a corridor 300 feet wide on either side of each proposed alternative alignment's centerline. The two 600-foot wide corridors will be termed the "EA study corridors" in this paleontological assessment report.

GEOLOGY AND PALEONTOLOGY

The geologic units mapped (Morgan *et al.* 2005; Thorson 2005) within the EA study corridors' limits are, from youngest to oldest:

<u>Unit</u>	<u>Age</u>
informal "alluvium one"	late Holocene
unnamed stream-channel, flood-plain, and terrace alluvium, undivided	Holocene and late Pleistocene
unnamed sheetwash deposits	Holocene to late Pleistocene
informal "alluvium two"	early Holocene and late Pleistocene
informal "alluvial fan deposit two"	early Holocene to late-middle Pleistocene

informal “alluvium three”
Dawson Formation, informal “facies unit four”

late middle Pleistocene
early Paleocene

Morgan *et al.*'s (2005:7) “**alluvium one**” is composed of dark yellow, brownish gray to dark brown, poorly to moderately sorted, poorly consolidated clay, silt, sand, gravel and sparse boulders; it commonly includes organic-rich layers interbedded with sand and gravel lenses. This unit was deposited as river terraces above the currently active flood plain or as non-terrace-forming alluvium in valleys. This unit, in general, is lithologically and chronologically equivalent to deposits mapped (Scott and Wobus 1973; Scott 1963) as Piney Creek Alluvium in the Colorado Springs area and Piney Creek Alluvium and post-Piney Creek alluvium in the Kassler 7.5' quadrangle immediately west of the Sedalia 7.5' quadrangle. The “alluvium one” unit can produce prehistoric bone, shell, and/or plant material, but because the sediments are less than 10,000 radiocarbon years old, any material found could be in an archaeological context and should be evaluated first by a qualified archaeologist.

Lithologically and genetically, Morgan *et al.*'s (2005:7-8) “**alluvium two**” is almost identical to their “alluvium one”, but its deposition in higher terraces than “alluvium one” indicates it is older than their “alluvium one.” This unit, in general, is lithologically and chronologically equivalent to deposits mapped (Scott and Wobus 1973; Scott 1963) as the Broadway Alluvium in the Colorado Springs area and in the Kassler 7.5' quadrangle immediately west of the Sedalia 7.5' quadrangle. The Broadway Alluvium has produced mammoth, bison, horse, camel, jackrabbit, and white-tailed prairie dog specimens in the Denver and Greeley areas (Hunt 1954; G. R. Scott, personal communication, 1985; unpublished UCM and CDOT fossil locality data).

Lithologically and genetically, Morgan *et al.*'s (2005:7-8) “**alluvium three**” is almost identical to their “alluvium one” and “alluvium two”, but its deposition in higher terraces than “alluvium one” and “alluvium two” indicates it is older than either. This unit, in general, is lithologically and chronologically equivalent to deposits mapped (Scott and Wobus 1973; Scott 1963) as the Louviers Alluvium in the Colorado Springs area and in the Kassler 7.5' quadrangle immediately west of the Sedalia 7.5' quadrangle.

South and east of Denver, mammoth, horse, camel, llama, deer, bison, bighorn sheep, ground squirrel, black-tailed prairie dog, and pocket gopher remains have been recovered from the Louviers Alluvium (Scott 1962:L-28, 1963:33; Wang and Neas 1987; unpublished UCM and CDOT fossil locality data). Scott (1962:L-28) lists the following taxa recovered from the Louviers Alluvium along the South Platte River, most of which were collected at U. S. Geological Survey (USGS) fossil locality D201, about 0.9 mile north of the Arapahoe/Douglas County line:

<i>Mammuthus columbi</i> [Columbian mammoth]	<i>Camelops</i> sp. [extinct camel]
<i>Bison antiquus</i> [extinct bison/buffalo]	<i>Equus</i> sp. [horse]
several species of rodents, genus and species not identified.	

Wang and Neas (1987) described a bighorn sheep (*Ovis canadensis*) partial right horn-core found “in a gravel pit of the Cooley Gravel Company” approximately 0.9 mile north of the Arapahoe/Douglas County line, but southwest of USGS D201.

Morgan *et al.*'s (2005:7) “**stream-channel, flood-plain, and terrace alluvium, undivided**” is composed of pebble, cobble, and rare boulder gravel in a sandy silt matrix. The unit may be locally interbedded with and is commonly overlain by sandy silt and silty sand, with organic-rich sediments preserved locally. Deposits of this unit may be interbedded with fan alluvium and sheetwash deposits. Morgan *et al.* (*ibid*) do not suggest correlation of their stream-channel, flood-plain, and terrace alluvium, undivided, unit with previously described geologic units, but their assigned age (Holocene and late Pleistocene) suggests equivalence with the post-Piney Creek alluvium, Piney Creek Alluvium, and Broadway Alluvium.

Morgan *et al.*'s (2005:11) “**sheetwash deposits**” is composed of yellowish-brown, poorly sorted sandy silt, clayey silt and sand with minor amounts of pebble-sized rock fragments. This unit was transported and deposited principally by sheetflow along slopes; its sediments grade into alluvium and alluvial fan deposits and may include local loess (windblown silt and clay) pockets.

Morgan *et al.*'s (2005:12-13) “**alluvial fan deposit two**” is composed of dark yellow-gray to dark reddish-brown, poorly to moderately sorted, poorly consolidated clay, silt, sand, gravel, and boulders deposited as alluvial fans at the mouth of perennial streams. Sediments are deposited primarily by streams with significant input from sheetwash, debris flows, and hyperconcentrated flows. These deposits are lithologically similar and genetically related to “**alluvium two**” and “**alluvium three**”.

Morgan *et al.*'s (2005:20-21) **Dawson Formation, “facies unit four”** is a tan, brown, or light orange to orange arkosic conglomerate with quartz, feldspar, and occasionally granite cobbles up to eight inches in diameter. Thick-bedded to massive zones frequently contain large fluvial cross bed sets that suggest stream flow from northwest to southeast. Very fine grained sands and lenses of clay up to three feet thick are interpreted to be channel overbank deposits. “**Facies unit four**” deposits are primarily fluvial in origin, but include stream channel deposits interbedded with debris flow deposits that may represent the remnants of distributary alluvial fans.

“Facies unit four” is early Paleocene in age and lies within the Late Cretaceous and Paleocene D1 synorogenic sequence of Reynolds (2002) (Morgan *et al.* 2005: Figure 4). The D1 synorogenic sequence of Reynolds (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.

There are no previously recorded fossil localities from “**facies unit four**” of the **Dawson Formation** from within the study corridors' limits, but there are multiple Denver Museum of Nature and Science D1 plant fossil localities recorded along Interstate Highway 25 north and south of the study corridors (Table 1) and along State Highway 85 northwest of the study corridors (Table 2).

Locality number	Locality name	Highway milepost	Section	Township	Range
3209	Twelve Years and Nine Days After	180.75	11	08S	67W
3205	Twelve Years After	180.8	11	08S	67W
3629	When It Rains, It Pours	181.0	11	08S	67W
3613	Out of the Blue	181.0	11	08S	67W
3628	Another Brick Out of the Wall	181.0	11	08S	67W
3626	Pile Drive	181.0	11	08S	67W
2721	CR - Trench 102	182.1	02	08S	67W
2801	Backhoe Breaker	182.1	02	08S	67W
2763	CR - Regan's Farewell	182.1	02	08S	67W
2748	The Whenever Show	182.1	02	08S	67W
2733	Stairway to Heaven	182.1	02	08S	67W
2731	CR - Two Tarps to the Wind	182.1	02	08S	67W
2802	Subterranean Blues	182.1	02	08S	67W
2722	CR - Trench 152	182.1	02	08S	67W
2969	Last Day	182.1	02	08S	67W
2720	CR - Lizard Lounge	182.1	02	08S	67W
2716	CR - Vernon	182.1	02	08S	67W
2699	CR - Watermelon	182.1	02	08S	67W
2698	CR - National Geographic	182.1	02	08S	67W
2691	CR - Wrong Layer	182.1	02	08S	67W
2690	CR - Toad Hole	182.1	02	08S	67W
2723	CR - Leo's Dreamin'	182.1	02	08S	67W
2689	CR - Big Tree	182.1	02	08S	67W
2968	Oxidized Hill	182.1	02	08S	67W
1200	Castle Rock Roadcut	182.1	02	08S	67W
2966	Missing Hill	182.1	02	08S	67W
2967	Bulldozer Ridge	182.1	02	08S	67W
2831	Castle Rock - The Shadow	182.1	02	08S	67W
2542	Castle Rock Railroad	182.28	02	08S	67W
3301	Bowling for Sycamores	182.35	02	08S	67W
917	Wallace I-25 Lower	190.75	27	06S	67W
2342	Paleosol Garden	191.6	22	06S	67W
2339	Sick of Sycamores	191.67	22	06S	67W
2134	Happy Canyon	191.7	22	06S	67W
2343	John Smelway Quarry	191.79	22	06S	67W
2344	Shirley's Bench	191.79	22	06S	67W
2338	Meno Corner	191.94	22	06S	67W
2345	Only Seeds	191.95	22	06S	67W
3535	V for Vendetta	192.15~	14	06S	67W

TABLE 1: Denver Museum of Nature and Science Denver/Dawson Formation D1 paleobotanical localities recorded along Interstate Highway 25 between the Plum Creek Parkway and Ridgeway Interchanges.

Locality number	Locality name	Highway milepost	Section	Township	Range
1201 ¹	Lyndon Leaves	192.33	10	07S	68W
2668	Titan Up	196.025	28	06S	68W
2669	Batten Down	196.075	21	06S	68W
2996	Lakeside Leaves	197.1	20	06S	68W

TABLE 2: Denver Museum of Nature and Science Denver/Dawson Formation D1 paleobotanical localities recorded along State Highway 85 between Interstate Highway 25 and Highway C-470.

SURVEY RESULTS

A July 10, 2008 field check of the two EA study corridors and the area between the two revealed no Holocene and/or Pleistocene geologic unit exposures that merited on-the-ground reconnaissance for paleontological resources. Within and between the EA study corridors' limits I saw a few small, coarse gritty, Dawson Arkose sandstone exposures on the southwest-facing slopes southwest of I-25 that may merit on-the-ground reconnaissance for paleontological resources if and when right-of-entry is obtained, but based on past experience, the likelihood of finding fossils at those small, coarse gritty sandstone exposures is minimal at best.

RECOMMENDATIONS

Subsurface excavation associated with any future construction project(s) permitted by approval of this EA could affect scientifically important paleontological resources in any of the Pleistocene geologic units mapped within the study corridors' limits, but, lacking subsurface data and final design plans, it is impossible at this time to determine which potentially fossiliferous Pleistocene deposits, if any, will be affected. Fossil occurrences in Colorado in Pleistocene units age-equivalent to those mapped within the study corridors' limits are sporadic; it is difficult if not impossible to predict whether or not any of these units would produce fossils in new exposures created during any future construction project(s) permitted by approval of this EA.

Furthermore, on-site construction monitoring of friable (loose, non-cemented) deposits such as those of the Pleistocene geologic units mapped within the study corridors' limits is usually feasible and cost-effective only in a closed area, such as a deep, narrow grade separation trench, where the speed of heavy mechanized earth-moving equipment is restricted. Except in a situation as noted above, it would most likely not be practical to monitor any of the late Pleistocene geologic units cropping out within the study corridor limits for paleontological resources during construction because they all are amenable to relatively rapid excavation with heavy mechanized earth-moving equipment. It is very unlikely that any scientifically important fossils other than the largest and most obviously fossil in origin (i. e., those that would be obvious to a heavy earth-moving equipment operator) would be seen during a construction monitor. Nevertheless, even if on-going monitoring of cuts into any of the Pleistocene deposits mapped within the study corridors' limits is not practical, a qualified paleontologist should check

¹ Originally recorded as University of Colorado Museum (UCM) fossil locality 92164.

out those portions of the final alignment mapped as Pleistocene in age periodically during construction because Dawson Arkose bedrock should lie at relatively shallow depths in many, if not most of those areas.

While it is not universally fossiliferous, that portion of the Dawson Formation that lies within the Late Cretaceous and Paleocene D1 synorogenic sequence of Reynolds (2002) historically has been more likely to produce fossils in new and existing exposures than any of the Pleistocene units mapped within the study corridors' limits (or age-equivalent geologic units elsewhere in Colorado). Many, if not most scientifically important D1 synorogenic sequence fossils recorded previously have been recovered from artificial cuts produced during materials pit and basement excavation and during transportation-related project construction (e. g., various CDOT construction projects and construction of Denver International Airport). Recovery of Dawson Formation fossils during construction usually is easier and more cost-effective than recovery of fossils from the younger units that crop out within the study corridor limits because the rock generally is more strongly cemented and more likely to come out of the excavation in large blocks which can be examined for fossils on spoils piles.

The D1 portion of the Dawson Formation is a paleontologically sensitive geologic unit whose regular production of scientifically important leaf fossils and more sporadic production of scientifically important vertebrate fossils has resulted in the establishment of a general CDOT policy of construction monitoring wherever significant construction impacts to the unit are proposed. A paleontological resources impacts mitigation plan for the EA corridors should include paleontological monitoring during construction if and wherever final design plans indicate there will be significant impacts to **Dawson Formation, "facies unit four"** 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 indicates that there will be significant impacts to **Dawson Formation, "facies unit four"** 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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