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8/23/09

Mr. David K. Baker
Army Corp of Engineers
Asheville Regulatory Office
151 Patton Ave. Room 208
Asheville, TN 28801-5006

RE: Corps Action ID No. SAW-2009-1346, TIP Project No. A-9 B&C

Dear Mr. Baker:

Enclosed please find my comments regarding the US74 Relocation from Robbinsville to Stecoah, North Carolina also referred to as Sections A-9 B and C of Corridor K. These comments were originally submitted to NCDOT in 2008 in response to comments on the DEIS. My comments are based upon my reviews of the 1984 Final Environmental Impact Statement (1984 FEIS), the 2008 DEIS (Draft (supplemental) Final Environmental Impact Statement), several internal NCDOT memos, and a brief literature review. I am a concerned private citizen and I am not paid for this work. Please use these comments in your evaluation of this project, as they constitute a detailed description of the geologic hazards as they relate to water quality. In the bullets below I will summarize briefly my main concerns.

- It appears that NCDOT's analysis of geologic hazards including potential for acid-drainage and slope failure is largely absent. Both of these issues have strong potential for disrupting stream and ground water quality, as described in detail below. Despite several (NCDOT) internal memorandums in the late 1990s suggesting an intensive campaign of exploratory drilling was necessary to evaluate the subsurface geology with regards to acid drainage potential and orientation of bedding/cleavage planes with respect to the roadbed, no results of drilling were presented in the FEIS or DEIS, nor was a basic geologic map included. The DEIS does state that NCDOT drilled a number of borings but since no results are presented in the DEIS, this suggests that the basic information necessary to analyze impacts to water quality is not yet available or has not been analyzed.
- Despite indication that the roadbed will probably encounter acid-producing rocks in some locations, no mediation plan was presented to moderate either the acute effects during construction or the chronic effects following completion of the road. In fact, the potential for encountering acid-producing rocks was mentioned only once in the DEIS on page 4-29. This level of deficiency is not appropriate for a project of this scale with the potential to affect high quality headwater streams, numerous high-quality streams (some of which are trout streams) and residential ground water supplies.
- There is a large potential for the roadbed to encounter the potentiometric surface (water table) during construction of the tunnels, or in roadcuts if the tunnels are eliminated from the design. NCDOT did not discuss any potential meditative activities with regards to changes in stream or residential water supply quality or quantity.
- The rocks are near vertically-oriented in this area and as such will be very subject to slope failures during and after construction. The 1990s-era internal memos strongly recommended angled drilling methods to adequately examine the chemistry and stability of the rocks that will be encountered. Such drilling methods are very expensive, and the 2008 DEIS shows no evidence that such methods were used.

Together, the lack of effort put forth by NCDOT in evaluating these hazards suggests that they are simply not prepared to mediate the significant impacts to ground and surface water quality that would be a result of initiation of this project. I am shocked that a basic geologic map is absent. I hope that your organization will exercise the oversight necessary to ensure this project is completed without significant and long-term impacts to water quality and overall environmental degradation. In my opinion, the best way to ensure this occurs is for NCDOT to improve the existing 2-lane corridor, an option which is not under consideration in the DEIS. It does seem clear that the 4 very similar options examined in the DEIS are not the "least environmentally damaging" alternatives.

Thank you for your consideration of these comments.

DETAILED COMMENTS submitted to NCDOT during comment period for the 2008 DFEIS

I have a PhD, MS, and BS in Geology and am currently employed as a research scientist. My specialty is in hydrology, geochemistry, and contaminant transport. I am concerned that the Draft Final EIS (DEIS) referenced above is deficient in all areas of geologic investigation. The DEIS therefore does not provide sufficient information to determine either potential hazards associated with road construction, or potential mitigations that might be proffered before, during, and after construction. It therefore does not meet the obligations implied by and required by the EIS process.

The extreme deficiency of the DEIS is best illustrated by the absence of a basic geologic map showing the location of different geologic units with respect to the roadbed. This is standard practice for an EIS. Such a map would provide essential information including the specific geologic formations and their descriptions, the orientation of bedding within each particular geologic unit, the location and orientation of small- and large-scale folds and faults that offset the bedding, and the location and orientation of any local- or regional-scale joints or lineations that cross the area. This very basic level of information, that again I note is <u>entirely</u> <u>absent</u> in the DEIS, would facilitate discussion of the two very serious geologic hazards associated with the construction of the road – 1) the risk of slope failure due to movement along bedding, folds, faults, joints, and soils, and 2) the geochemistry of the rock formations and the potential for acid drainage. The discussion of these issues and the pertinent supporting information, e.g., scientific references, preliminary geologic investigations, and published maps, is entirely absent from the DEIS. These are both serious issues given what is known about the area geology and the route of the roadbed. The roadbed plan is terribly ambitious, involving a half-mile-long tunnel, a traverse through mountains of 3000-5000' elevation, steep natural slopes of up to 30%, unstable colluvial and alluvial soils, vertically-oriented rock formations, significant folds and faults, and sulfide-containing rock formations. The results of inadequate advance analyses of these geologic issues could include massive cost overruns, time extensions, landslides, stream and groundwater acidification, fish kills, loss of rural water supplies, and risks to worker safety during construction. I will discuss the two major problems in the order of 1) slope stability, and 2) acid-drainage potential.

1. Slope Stability

The problem of slope stability, in particular, was mentioned in the 1984 FEIS, e.g., "all of the alternates have the potential for serious stability problems" (FEIS, 1984). A 1995 memorandum (Acker and Reed, 1995) discusses the geologic hazards of the proposed roadbed, including a large-scale fault of up to 3000 feet of offset and a zone of deformation that is 5000 feet wide at Stecoah Gap (Brown et al., 1985). This fact is not mentioned in the 2008 DEIS. The bedding in the zone of deformation could be irregular, weathered, and would probably be subject to more slope failure than the rocks outside of the zone of

deformation. The history of landslides on NC143 near Stecoah Gap is known (Acker and Reed, 1995), but is not mentioned in the DEIS. This is particularly important given that NC143 is the approximate location of the proposed half-mile-long tunnel. In addition, the bedding planes of rocks are oriented nearly vertically (Power and Forrest, 1971; Acker and Reed, 1995), and as such, may be sensitive to failure along those bedding planes [DEIS, p 2-15]. This potential is hardly mentioned in the DEIS, rather, there is much focus on the stability of the overlying colluvium/alluvium (see below). In order to fully evaluate the hazards due to dipping rocks and the large fault gouge (i.e., weathered zone), the orientation of the bedding and any faults need to be mapped in great detail with respect to the proposed roadbed. Without a detailed preliminary investigation, road cuts may undercut geologic formations resulting in long-term instability of the rock bedding. The area is extensively forested and rock outcrops are relatively few, consequently in the past it was recommended that angled exploratory boreholes be drilled to determine the extent, orientation, and characteristics of the relevant geologic formations. In other words, it was thought that surface mapping was not sufficient to determine the specific location of the roadbed. The necessity of borehole sampling was mentioned in both Acker (1997) and Acker and Reed (1995) memorandums, but on the basis of the information presented in the 2008 DEIS, I can only assume that these exploratory boreholes were either not drilled or not analyzed. These two sources each recommended angled drilling because vertical drilling would not intersect multiple geologic formations due to the vertical orientation of the rocks (Acker and Reed, 1995; Acker, 1997). Because of the lack of relevant geologic information in the DEIS, it is impossible to judge the short- or long-term geotechnical stability of the proposed road and tunnel.

In addition to rock stability, there is the issue of soil stability which is discussed in some detail in the DEIS. Again, however, the DEIS is deficient in that the zones of colluvium (remobilized, reworked, and redeposited residuum) and alluvium (*in situ* weathered bedrock) and their relationship to the roadbed are not shown in a series of detailed, field-validated maps. This is particularly important because slope failure often occurs at the interface between colluvium and alluvium, and/or between colluvium/alluvium and underlying bedrock. This is discussed in the DEIS [DEIS p 2-15], but because it is without reference to a colluvial map showing the extent of colluvium and the interplay between topography and colluvium, the discussion does not realistically evaluate the hazards or the potential solutions. On page 2-14 it is claimed that there were preliminary geotechnical investigations, but since no results are shown, it is impossible to evaluate these claims or the proposed mitigation efforts discussed in the DEIS.

The DEIS does state that the "rock type, degree of weathering and discontinuity properties vary considerably throughout the project study area" [DEIS p 2-14]. Therefore, both geologic maps and weathered residuum maps should be overlain onto topographic maps, because slope failures occur where roadcuts intersect colluvium, bedding, and faults unfavorably. "Unfavorably" refers to locations where roadcuts undercut bedding, faults, or colluvium as to actually promote instability. This is particularly important considering that natural slopes may be as high as 30% (Acker and Reed, 1995) and the natural orientation of the rock bedding is nearly vertical, e.g., "predominant dip angle of over 60 degrees" [DEIS, p 2-15]. There is a large tendency for slope failure to occur on bedding planes (Acker and Reed, 1995), and due to the steep orientation of native rocks, slope failure may be significant in these locations *under natural conditions* (Acker and Reed, 1995), which will be greatly exacerbated in freshly exposed outcrops and in undercut sections. Acker and Reed (1995) also note that frost wedging, which tends to degrade rock stability, is much greater on northern versus southern slopes. Note that most of the proposed section is on the northern slopes of the mountains.

Due to its high elevation (3000'-5000'), this area of the Appalachians is subject to frequent and intense rainstorms, especially hurricanes. As noted in the DEIS, rainstorms in 1994 closed off access to

Robbinsville for several days due to slope failure along roads [DEIS p 1-9]. This new road is touted as possibly improving those conditions. On the other hand, if the geologic hazards of this road are not sufficiently evaluated and mediated, it is likely to suffer from the same problems as the current roads. They may in fact be exacerbated because of the huge footprint of this road (4-lane, divided highway with cut-back slopes and areas for accumulation of debris). Since large portions of this road cross high elevation mountains in which natural slopes and geologic bedding are at steep angles, it is very likely that severe slope failure problems will repeatedly occur. This is particularly true given the ambitious tunnel project. The building of a road in most cases in the Appalachians is merely a first step in mediating the geology – the second step will involve continual and repeated maintenance. In addition, if the geologic formations are capable of producing acid drainage, as discussed below, slope failure problems will also induce stream water acidification. In addition, colluvium and alluvium are also potential contributors to acid drainage, depending on their degree of weathering. Because the geologic hazards are not adequately presented and evaluated in the 2008 DEIS, it is completely uncertain as to whether the costs associated with road construction and maintenance account for mediating these potential problems in either the short or long term.

2. Potential for Acid Drainage

The 1997 memorandum (Acker, 1997) mentions outcrops of the Ammons Formation on NC143 containing significant concentrations (several weight percent) of sulfides and graphite. This is not discussed in the 2008 DEIS to any extent. A 1997 memorandum (Acker, 1997) suggests that the proportion of acid-producing rocks in the study area might be 50%, and where the Nantahala Formation is encountered the proportion of acid-producing rocks might be 80% (Acker, 1997). Sample analysis in Acker and Reed (1995) indicate minimal acid-producing rocks, but they appear to have analyzed only 7 samples from Sections B&C. The DEIS however, fails to mention possible impacts to Water Quality from anything other than "hydrocarbon pollutants, and, in winter, probably road salt and sand". In fact, the word "acid" is only mentioned once, on page 4-29. No discussion of engineered or remedial actions (e.g., Appendix B, 2003) was associated with this one mention of the word "acid". Because no geologic maps or sample analysis is presented in the DEIS, the following discussion is based on a brief literature review. It is important to remember that the extent to which these hazards could occur is uncertain due to the lack of information in the DEIS.

The road traverses a major mountain range where the section cuts through the older units of the Murphy Syncline (Power and Forrest, 1971), a large-scale regional fold. In the section of the project that the DEIS covers, the Dean and Ammons Formations of the Great Smoky Group are mostly encountered [DEIS p3-133], of which the Hughes Gap, Hothouse, and Grassy Branch Formations are a part [DEIS p3-66] (Kish et al., 1975; Brown et al., 1985). These are described in various publications as being composed of metagraywacke, metasandstone and metasiltstone with interbeds of marble, phyllite, and argillite (Powers and Forest, 1971; Kish et al., 1975; Brown et al., 1985). These are not the sulfide- and graphite-bearing rocks of the Anakeesta Formation, which was the major source of acid-producing drainage in the proposed Northshore Road in the Great Smoky Mountains National Park. However, Acker and Reed (1995) mention that the Horse Branch Member of the Ammons Formation contains a "large component of dark gray sulfidic and graphitic (acidic) schist" (Wiener and Merschat, 1992). Acker and Reed (1995) also mention encountering pyrite and/or pyrrhotite in the Ammons Formation at concentrations up to several percent in the roadcuts of NC 143 at Stecoah Gap. They go on to mention finding argillite and phyllite near Stecoah Gap that contain more and less sulfidic concentrations. This is of concern here because graphite, pyrite, pyrrhotite, and dark, fine-grained rocks may be capable of dissolving and releasing acid and metals into area streams (and also are more subject to slope failure). Acker and Reed's (1995) geologic log of the Ammons Formation outcrop shows significant portions of

fine-grained phyllitic rocks, which may or may not contain acid-releasing components. The lack of a geologic map and exploratory boreholes again prevents the 2008 DEIS from adequately identifying or planning for mitigation of these potential hazards.

Further, the section at Stecoah Gap probably encounters the Wehutty Formation, which is described as "consisting of dark gray slates and schists" [DEIS p3-66] (FEIS, 1984; Brown et al., 1985). The tunnel area may encounter a significant fault wherein the Ammons Formation and Wehutty Formations are offset by 3000 feet (Kish et al., 1975; Brown et al., 1985; Wiener and Merschat, 1992; Acker and Reed, 1995). It is very notable that in Kish et al. (1975), the Wehutty was provisionally mapped as the Anakeesta Formation, or as an "Anakeesta-like geologic unit" since it contained several percent of sulfides. This was actually discussed in the 1984 FEIS when the unit in question was referred to as the Anakeesta. The potential for generating acid drainage from building a half-mile long tunnel through this Formation, therefore, is possibly significant, but it is not mentioned in the 2008 DEIS.

On page 4-29 of the DEIS is the only place where the potential for acid drainage is even discussed, stating that "acidic inputs are substantial concerns in all of the watersheds crossed". But no published strategies are discussed to mediate acid drainage (e.g., Appendix B, 2003), and the potential for the geology to generate acidity is also not discussed. So it is hard to reconcile that these "substantial" concerns are seriously considered in this DEIS. Although these geologic Formations may be primarily composed of relatively harmless (from a geochemical standpoint) rocks such as metasandstone, marble, and metasiltstone, it is typical that such lithologies will be interbedded with fine-grained phyllite, argillite, graphite and metagraywacke. These lithologies are the ones that promote the greatest risk for acid drainage because they contain low concentrations of metals and sulfides. The steep natural slopes of the area (up to 30%) clearly indicate that the area is underlain by fine-grained rocks. In my own personal experience, I observed that the rocks of Stecoah Gap and Cheoah bald are primarily fine-grained, dark-colored phyllites and argillites. These are the type of rocks that may have acid-producing potential.

In addition, information on the location of the water table (potentiometric surface) should be overlain upon a geologic map, a topographic map, *and* a map of the proposed road. This is particularly important because the tunnel through Stecoah Gap will be either 577' (2870 feet long) or 427' deep (1919 feet long). Undoubtedly, such a tunnel would encounter groundwater and would also have the potential to encounter (or even *create*) prominent discharge points such as springs. It should be noted that in the Appalachians, there is often an excellent correlation between structural gaps (e.g., Stecoah Gap), faults, joints, and springs. If such a discharge point were encountered, significant and costly measures might be required to divert the water. If the water constituted a major aquifer, then local residents' drinking water could be impacted. If the water were also in contact with fresh rock capable of producing acid drainage, then these problems would be greatly compounded. The DEIS does note in several places that residents' groundwater supplies may be negatively impacted by the construction of the road. However the DEIS does not provide any specifics about the potential for impacts or any resolution for the impact upon rural residents' drinking water sources. Such impacts could devastate rural communities that depend upon groundwater aquifers for their drinking water, as well as the acid balance in local streams.

The preparers of this DEIS should refer to the Northshore Road EIS for guidance on the needs of an EIS in the Appalachian Mountains. The area in question here is just as sensitive as that of the Northshore Road in terms of its geology and environment. Cheoah Bald is a national treasure. Two major trail systems run through these mountains, the Bartram and Appalachian trails. The proposed road will impact the views and scenery from these areas. The lack of consideration given the imposing geologic issues associated with construction of the road and the associated half-mile-long tunnel in this DEIS is truly

surprising. This road, unfortunately, has the potential to become a boondoggle unless the geology of the area is considered and adequately mediated.

Finally, the project is very narrowly defined as to include only the B and C sections. This excludes the section through the Snowbird Mountains southwest of Robbinsville US74 to the connection with US129, referred to as the A section. But the B-C sections are nearly useless from a transportation standpoint without completion of the A section. Construction of the B-C sections will later be used as support for construction of the A section, just as construction of the NC-28 section east of Stecoah (Section D) is used in the current DEIS to force the construction of the B-C portions. On page S-3 of the DEIS, it is stated that "[the Improve Existing Alternative] would not connect to the D section of the A-9 project, which has been completed; therefore, it is not consistent with current transportation plans". The risk of exposing pyrite- and pyrrhotite-containing rocks in Section A is huge because the road runs through the Nantahala and Brasstown Formations. The Nantahala Formation and Brasstown Formations of the Hiwassee Group (Brown et al., 1985; Aylor, 1991; Tull et al., 1991) immediately overlie the Great Smoky Group, of which the Dean and Ammons are members. The Nantahala and Brasstown Formations have significant potential for producing acid drainage and may contain sulfides up to several weight % (Kish et al., 1975; Aylor, 1991; Tull et al., 1991). Further, the A section also has a very large tunnel, again through potential acid-producing formations. It is disingenuous to exclude consideration of the A section in order to minimize risk in the B-C sections, particularly when they are all necessary to produce the final finished product. As discussed on p1-8 of the DEIS, "The decision to postpone reevaluation of Section A based on environmental and budget concerns". More detail is provided on p1-14, "In 1998, the decision was made to re-evaluate A-9 A and A-9 B&C as two separate studies so that environmental studies for the B&C sections could move forward." This was due to "potential impacts to historic resources, fragmentation of wetlands and undisturbed forest habitat, impacts to surface waters, trout habitat loss, and the presence of anakista (sulfide-bearing) rock" [DEIS p1-14]. Please note that "anakista" is both misspelled and mis-interpreted. The correct spelling is "Anakeesta", and it is a specific geologic Formation. It does not mean that all sulfide-bearing rock is of the Anakeesta Formation, or that only the Anakeesta Formation is capable of producing acid drainage. These misspellings and misstatements certainly suggest that the writers of the DEIS are not knowledgeable regarding geology and are apparently not qualified to evaluate the geologic hazards associated with construction of this section of the road.

Overall, I question the need for such a road. If the development is "largely confined to valleys" [p1-10], the "promotion of Graham County as an eco-tourism destination" is the primary development trend in the area [p S-6], and "Appalachian Trail users would see glimpses of the highway from numerous locations north and south of Stecoah Gap and at least five viewpoints would have unobstructed views of the project. Visual impacts to the trail would be greater during the leaf-off season" [pS-11], it seems the road works against ongoing and future trends for commercial development in the area.

The risks of initiating construction in such challenging geology and topography are huge, in terms of cost overruns, worker safety, water supply, and slope failure. Such construction should only proceed once the best available information is compiled and reviewed to determine the cost and feasibility for construction and long-term stability. Unfortunately, this DEIS does not present the best available geologic information and therefore does not adequately evaluate or mediate the geologic hazards.

Sincerely,

Melanie A. Mayes, PhD

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Appendix B. Proposed plan for handling acid-producing rock. 2003. Draft Environmental Impact Statement and Draft Section 4(f) Evaluation, Appalachian Development Highway System Corridor K (Relocated US 64). FHWA-TN-EIS-03-01-D.

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