

**Kamran M. Nemati, Ph.D., P.E.**  
**Consulting Civil Engineer**  
**P.O. Box 95233**  
**Seattle, Washington 98145-2233**

Phone: 1-206-729-6000

Email: [nemati@nemati.com](mailto:nemati@nemati.com)

April 26, 2006

**Project:** Proposed Burlington Northern/Santa Fe Second Track through Abo Canyon and Dripping Springs Ranch, LLC

**Subject:** Response to the letter from Mr. Robert J. Boileau, Assistant Vice President – Engineering Services for the BNSF Railway Company written April 6, 2006.

Mr. Boileau responded to a tunnel proposal report prepared by Kamran Nemati and Gordon Clark, dated January 10, 2006, that proposed using a tunnel to construct a second track in Abo Canyon in lieu of the open cut configuration proposed by BNSF. The tunnel alternative presented in the January report was very conceptual, but in their professional opinion should be explored further as it is their belief that a tunnel offers a reasonable and practicable alternative to the permanent impacts of an open cut. The attempt to dismiss the tunnel approach as too costly, based on experience with tunnels built 75 years ago, is not thought prudent nor responsible in light of advances in tunneling technology that have taken place in the last 10 years. In the rush to address the need for a second track, BNSF has an obligation as good citizens to eliminate all possibilities of making a tunnel concept work prior to deciding upon a design and construction approach that would have permanent negative impacts to the scenic beauty and recreational value of the canyon.

The tunnel concept obviously requires additional investigation as it was based on limited geological information available at the time of writing but merits more in depth study. Design and construction of a tunnel of the size and lengths proposed in the report

is well within the capability of current tunnel technology and could be designed to meet all of the concerns expressed in Mr. Boileau's report with the exception of cost. The tunnel alternative was not offered as a cheaper way of addressing the need for a second track – but as a way to strike a balance between form and function of the Canyon.

The response by Mr. Boileau was a thorough recitation of perceived negative aspects of tunnels based on his railroad experience. His response was quick to compare the proposed alignments with two existing BNSF tunnels. It must be pointed out that with few exceptions; the maintenance, safety, and operations issues he describes pertain to tunnels built between 1929 and 1970. The New Cascade Tunnel and Flathead Tunnel are the longest tunnels on the American continent, five times as long as the north tunnel proposed for Abo Canyon. These older tunnels were blasted out of rock in mountainous terrain that experiences heavy annual snow fall. The rail was placed on timber ties and ballast through long stretches of unlined tunnel. Because of the topography, water inflow is a major concern for these older tunnels. They are flanked by long steep grades that require a large amount of locomotive power and thus engine heat is a major concern. They are outfitted with special ventilation systems that include doors that close once the train is in the tunnel and the requirement to flush the tunnels for 30 minutes following the passing of a train. The fact that they also have substantial maintenance issues is not questioned. However, to compare these two tunnels to one that would be 20% of the length, built in a dry arid environment using modern techniques for excavation, lining, and placement of the rails is not reasonable or responsible.

The tunnel alternative proposed for the Abo Canyon is envisioned to be excavated with a tunnel boring machine, lined with precast concrete segments. More about this approach later. Continuous welded rail with direct fixation fasteners attached to an invert track slab would eliminate the maintenance concerns expressed by Mr. Boileau and significantly increase safety and reliability over the open cut proposal. Such a modern tunnel would not have the frequent delays and maintenance issues found on the current at grade option due to rock slides and animal kills. We suggest that perhaps Mr. Boileau should study some of the successes that others are experiencing with modern tunnels<sup>1</sup>,

---

<sup>1</sup> O'Reilly, Joseph "Tunnel Vision" Switzerland's AlpTransit Gotthard Tunnel," Global Logistics, January 2006.

before flatly rejecting an alternative that would preserve Abo Canyon to be enjoyed by future generations. With the tunneling option, goods can be carried through the Abo Canyon in an environmentally friendly way, while considerably increasing freight capacity. This letter addresses the points that Mr. Boileau brought up in his response to the January 10<sup>th</sup> tunnel proposal report and provides additional positive aspects of the tunneling alternative for consideration.

### **I. TUNNEL COSTS:**

The costs estimated by Mr. Boileau for the construction of the tunnel and ventilation facilities appear to be reasonable. The estimated cost of \$40 million for the five mile open cut project however, looks to be unreasonably low. A more prudent estimate would be double this amount. Still, it goes without question that building a tunnel is more expensive than an open cut. The January tunnel report proposed an alignment that greatly reduced the amount of open cut while trying to strike a balance between preserving the most scenic parts of the canyon and making use of the flats on the western end of the canyon for at-grade track. While the tunnel portals would require some excavation and slope stabilization, the work would not be substantial nor extraordinary. Crossing a fault line with the tunnel – especially an inactive fault – also does not require extraordinary measures. The Cascade and Flathead tunnels cross several faults. The amount of rock to be excavated for the tunnel as compared to the open cut is estimated to be less than 40% of that required for the open cut proposed by BNSF.

Mr. Boileau goes into great detail with regard to the specialized workers and equipment required to build a tunnel. This is both redundant and irrelevant as the means and methods result in a cost that is not being questioned. The cost of the tunnel boring machine is also part of the per-foot cost of the tunnel and is amortized into the overall job. Tunnel boring machines have been commonly used in the United States for 30 years and are available in a range of diameters suitable for the proposed tunnel. Refurbishment of a “used” machine typically takes 3 months while procurement of a new machine can take up to a year. There is a great deal of work required in advance of tunneling such as excavation of the portals and construction of the track on either side of the tunnel. This work can be done during the time it takes to procure a machine and assemble it on site.

As stated by Mr. Boileau, BNSF operates several tunnels around the United States and thus it must be assumed they have existing operating procedures for tunnels that could be easily adapted for use on the Abo Canyon Tunnel. Communication systems for use in the tunnel are readily available “off the shelf” and are comparable to the cost of systems that would be installed in an open cut alignment.

As to whether or not the operating and maintenance costs of a modern tunnel are more expensive is dependent upon several factors. Without question the maintenance and operating costs of the New Cascade and Flathead Tunnels are far greater than for a normal tunnel or open cut track section. It must be pointed out, however, that the maintenance costs of the current alignment, due to rock slides and ballast maintenance are not trivial and that the design proposed by BNSF would still require continuous attention due to the ongoing weathering and erosion of the insitu rock. Cutting back the canyon walls in an attempt to slow the erosion would reduce the amount of maintenance but would also completely reshapes the canyon, destroy wildlife habitat and replace the natural scenic beauty of weathered rock with a flat machined surface. This is a tremendous price to pay just to reduce the rock maintenance, when a tunnel could achieve both. The primary goal of the tunnel alternative is not to reduce BNSF’s one time capitol costs but to preserve Abo Canyon.

## **II. PROPOSED TUNNEL ALIGNMENTS:**

Unlike the at-grade alignment proposed by BNSF, the conceptual tunnel alignments proposed in the report are not constrained by existing topography and can utilize a degree of curvature of less than 1.5 degrees which results in less wheel and rail wear and much faster speeds (up to 60 mph). The grade is held to a uniform 1.5%. This compares to the proposed open cut alignment with 4.0 degree curves and speeds limited to 40 mph.

## **III. ENVIRONMENTAL CONCERNS:**

It was stated that water ingress into the tunnel was a major problem that caused track maintenance issues related to rotting of the wood ties and a requirement to re-tamp ballast. It is common practice in modern tunnels to use a bolted precast concrete liner

with waterproof gaskets. This system has shown to be very effective at reducing inflows to below a level of concern. Since the tunnel is on a 1.5% slope, the minor amount of water that may still enter the tunnel would simply run out via a small slot cast into the tunnel invert. The track would be placed on either concrete ties or more probably a track slab cast into the invert of the tunnel. The track would be virtually maintenance free.

Use of a bolted and gasketed tunnel liner would also eliminate the concern of drainage into the tunnel having the effect of lowering the surrounding water table or draining of perched aquifers as the amount of water that did leak into the tunnel would be insignificant.

The drill and blast operation planned by BNSF for the open cut alignment will require upwards of 30 million gallons of water. In contrast, the water required to cool the cutter head of the tunnel boring machine during excavation is re-circulated and does not require the inflow of fresh water. Water is a major environmental concern for the drill and shoot excavation but not for the bored tunnel.

#### **IV. TUNNEL VENTILATION:**

If the proposed north tunnel alignment were built, with a length of approximately 7,500 feet, a passive ventilation system may be adequate. This could be achieved with the simple piston action of the train itself flushing out the air and drawing fresh air into the tunnel. This will require further study. If the longer south tunnel alignment were built, at 18,000+ feet, some form of active ventilation would probably be required. In the worst case a 10-12 foot diameter shaft at the mid point of the tunnel would be outfitted with a simple axial fan. Mr. Boileau's discussion of ventilation challenges in the Cascade and Flathead Tunnels are not relevant to the unique systems required for these record length tunnels (5 times longer than the proposed north tunnel) that are flanked by long steep grades.

#### **V. BURDENS ON OPERATIONS AND MAINTENANCE:**

As previously stated, many of the points that Mr. Boileau mentions in his letter are valid for old tunnels, but not necessarily true for modern tunnels.

### **SAFETY**

Because of the relatively short length of the tunnel and flat grades leading up to the tunnel as compared to the New Cascade or Flathead Tunnels, the chances of the locomotives overheating is not a big issue. Further study and CFD modeling would be required as part of the normal design process. This is not thought to be a major issue. It is unlikely that the north tunnel alignment would have problems with the buildup of combustion by-products or brake dust. Further study would be required to determine appropriate mitigation for these issues if the south tunnel were selected.

Use of continuous welded rail with direct fixation fasteners attached to a concrete track slab will provide a much safer and problem free rail solution compared to that currently in use by BNSF in Abo Canyon. Similar modern systems such as the one described have shown to have far fewer problems with misaligned, loose, or broken rails that can result in train derailment. In short, a modern tunnel would greatly improve train safety.

### **SCHEDULING**

The two proposed tunnel options are 1.4 miles (north alignment) and 3.5 miles (south alignment) in length. If it were shown that tunnel ventilation were required, the time to flush heat and contaminants from the tunnel would be far less than the existing headways of trains operating on the single track and not an issue when two tracks are taken into consideration. Because of the superior alignment achieved with a tunnel that allows greater train speeds, the throughput of the tunnel would be greater than an open cut and allow for an improved schedule over the open cut track alignment.

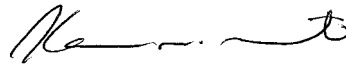
### **EMERGENCY PLANNING**

Mr. Boileau refers to a hazardous chemicals accident in Baltimore. While we cannot rule out that such an accident could occur inside the tunnel, a sound and well-practiced emergency plan should be in place to deal with such extremely rare catastrophes. The possibility of such an event has certainly not stopped BNSF from operating trains through the New Cascade and Flathead Tunnels.

**CONCLUSION:**

BNSF should not use cost as the sole deciding factor in selecting an alignment. Environmental damage must be taken into account. It is not realistic or responsible to compare the proposed tunnel with a tunnel 5 times as long and over 75 years old. BNSF should accept tunneling as a reasonable and practicable alternative that creates a superior alignment with increased capacity while preserving the scenic beauty and recreational value of the canyon. Tunneling is a viable alternative that strikes the right balance. We would be more than willing to meet with BNSF to discuss the benefits of our tunnel proposal further.

Sincerely yours,



Kamran M. Nemati, Ph.D., P.E.

Washington P.E. Number 22031

And



Gordon Clark, P.E.

Washington P.E. Number 35051