

## VandenBerghe, Alissa (Consultant)

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**From:** Struthers, James  
**Sent:** Tuesday, January 27, 2009 11:10 AM  
**To:** Williamson, Alec  
**Subject:** FW: The South End of the Tunnel  
**Follow Up Flag:** Follow up  
**Flag Status:** Red

I concur with Gordon that a top-down would be the least-risk approach. It should be noted that depressurization of the excavation base (groundwater control) will be required even with a water-tight wall system. A groundwater recharge system will likely be required in order to avoid excessive settlement of adjacent soils. Because the cut and cover tunnel would be very close to existing buildings/structures, the recharge system would need to inject through the tunnel walls. This type of setup is not typical but is thought to be feasible by dewatering specialists to whom I have recently spoken.

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**From:** Clark, Gordon T. (Consultant)  
**Sent:** Tuesday, January 27, 2009 11:03 AM  
**To:** Williamson, Alec; Rigsby, Mike (Consultant); Preedy, Matt; White, John; Conte, Rick (Consultant)  
**Cc:** Struthers, James  
**Subject:** RE: The South End of the Tunnel

Alec,

We discussed this with Lee several days ago and I think came to the same conclusion – that is we need to do a top down approach. I agree with Lee that boring the first 600 feet is not the way to go. I do not think hand mining is a reasonable approach given the ground conditions, obstructions, and need to support utilities in place. We also discussed the potential to modify the ground with jet grout but this does not address the tiebacks and still leaves the TBM starting on a curve in a mixed face condition. We are studying the opportunity to lower the alignment and it appears we can come down about 10 feet but lowering more than this does not look promising at this point.

A few thoughts on the top-down approach... this would involve building a secant pile wall on either side of First Ave from approximately the RR way ramps to King Street or about 750 feet. The walls would be topped with a slab at grade such that traffic could be restored and the excavation performed beneath the slab. The walls would range from 70 to 130 feet deep which will be a challenge but is thought feasible. Use of the oscillator type machine would be recommended to be able to cut through any timbers, tiebacks, or other obstructions. Constructing the walls would take 3 to 6 months depending on the number of drill rigs mobilized for the effort. During this time relocation of some utilities could be accomplished. It is thought than many of the utilities – such as electrical transmission and distribution – could be suspended in place from the top slab. It is thought that constructing the walls could be done while one lane of traffic is maintained in each direction. This would be followed by a closure of First Avenue for approximately 1 month to cast the top slab. Once this initial work is completed the surface would be restored to normal function.

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**From:** Williamson, Alec  
**Sent:** Monday, January 26, 2009 12:56 PM  
**To:** Clark, Gordon T. (Consultant); Rigsby, Mike (Consultant); Preedy, Matt; White, John  
**Subject:** FW: The South End of the Tunnel

[Thoughts from Lee Abramson on the south portal...](#)

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**From:** Abramson, Lee (Consultant)  
**Sent:** Friday, January 23, 2009 11:16 AM  
**To:** Struthers, James  
**Cc:** Robison, Jim (Consultant); Jarnagan, Harry (Consultant); Nykamp, Monique (Consultant); Williamson, Alec  
**Subject:** The South End of the Tunnel

Jim:

I gave some additional thought to our discussions yesterday and offer the following:

1. Using a closed-face TBM to bore the first 600 feet of the tunnel will be exceedingly risky, difficult and expensive. Reasons for this include:

- Loose, wet sand with high amounts of lumber and wood pieces in the upper half of the bore and above
- Mixed face conditions with the above and glacial soils below
- Tiebacks remnant from previous building excavations and shoring
- Deep pile bridge foundations under the Railroad Way structure
- Shallow ground cover above the tunnel
- Dense utilities
- Seattle Area Ways
- Initiating tunneling (learning curve) in these conditions
- Curvature of alignment
- Potential adverse impacts on adjacent buildings
- Probable clogging of the TBM and support equipment
- Dangerous working conditions out ahead of the TBM cutting head
- Significant ground improvement (grouting, etc.) requirements
- Etc.

2. Initially, I see four alternative ways to tunnel this portion of the project including:

- **"Top-Down" cut and cover with decking over 1st Ave.** This would require excessive and difficult utility relocations in 1st Ave, disruptions to traffic, structural underpinning of adjacent buildings, ground improvement, etc. However, the cost of this type of construction could be somewhat less than bored tunnel and less risky.
- **Hand mining the first 600 feet.** This could be done with some combination of ground improvement and excavation support consisting of steel sets, spiling, lagging, breasting the face, etc. This part of the tunnel would need to be larger to accommodate installation of the TBM from within the starter tunnel. Hand mining

might seem more difficult and expensive than boring but not really that much given the issues and significant difficulties anticipated above. This would be less risky than trying to bore through but might take a little longer schedule wise.

- **Tunnel jacking.** This involves prefabricating a concrete tunnel box in the access pit and then jacking it forward with a series of large hydraulic jacks. Typically, these boxes are about 300 feet long so two would be needed. A cutting shield is placed on the front of the first box. This would require additional ground improvement. The improved ground could be excavated with hydraulic spades or road headers. This type of tunneling would probably take the longest to carry out.
- **Lower the vertical tunnel profile.** I'm inclined to think this would cost just as much as hand mining or jacking but would be very disruptive to the presently accepted designs and assumptions to the south. This would also increase the length of bored tunneling and the depth and volume of the access pit excavation.

3. In all of these scenarios, the TBM would be assembled, skidded and started further down the alignment and more room for full assembly of the TBM trailing gear would be provided.

I think **top-down** would be the way to go if you can tolerate the utility and traffic issues. If not, **hand mining** would be my first choice although it might have higher cost and schedule impacts.

**I do not recommend boring the first 600 feet of the tunnel.** That would be a very, very bad way to start the tunneling off.

This is just a first cut. Please let me know if you would like me to evaluate these or other options further.

Thanks.

Lee