Engr.

Engineering Th 6
Chris

VandenBerghe, Alissa (Consultant)

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.

James R. Struthers, C.E.G
Assistant Chief Foundation Engineer
Special Projects Manager
WSDOT Engineering and Environmental Programs
(360) 791-2847

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.

Gordon T. Clark, PE
Chief Engineer - Consultant
Alaskan Way Viaduct and Seawall Replacement Project
Parsons Brinckerhoff

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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....

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

VandenBerghe, Alissa (Consultant)

From: Van Ness, Kristy (Consultant)
Sent: Friday, January 30, 2009 2:24 PM
To: White, John; Preedy, Matt; Greco, Theresa
Cc: Lenz, KaDeena (Consultant)
Subject: FW: Media Contact 1/30, Viaduct
Attachments: FW: AWV MEDIA: Env questions re: bored tunnel, teiephone interview requested.

I checked in with David Mattern last week prior to Matt's interview with a UW student, and he said the bored tunnel would be built to a 1,000 year earthquake standard. Attached is the verbiage that I worked on with Matt and David. Just want to make sure we're all on the same page!

From: Lenz, KaDeena (Consultant)
Sent: Friday, January 30, 2009 2:16 PM
To: WSDOT MediaContacts
Cc: Paananen, Ron; White, John; Preedy, Matt; Greco, Theresa; Brown, Lloyd; Tobin, Victoria; Grotefendt, Amy (Consultant); Van Ness, Kristy (Consultant)
Subject: Media Contact 1/30, Viaduct

KOMO Radio

Travis Mayfield of KOMO Radio taped an interview with John White, Viaduct Program Director, on the safety of bored tunnels in an earthquake. Mayfield asked why tunnels are safer than viaducts. White explained that in an earthquake, waves amplify at the surface. This translates into sway for elevated structures. The bored tunnel that we are looking at for Seattle would be built in glacial soils and to a 2,500-year earthquake standard. In the event of an earthquake, the tunnel would move gently with the soil. He explained that tunnel experts agree that tunnels are a safer place to be in an earthquake than elevated structures. White went on to describe several bored tunnels that have been through earthquakes - BNSF and Mt. Baker tunnels in Seattle and BART in San Francisco - and opened shortly after with little to no damage. He also further described the 2,500-year earthquake and how that translates or doesn't translate to the Richter scale. It's not certain whether he'll run a story.

From: White, John
Sent: Friday, February 20, 2009 7:28 PM
To: Reilly, John; 'harveyparker@compuserve.com'
Cc: Paananen, Ron
Subject: Re: Tunnel System

Thanks Harvey and John, we have more than enough to fill in the details needed for this response.

Have a great weekend,

John

From: John Reilly
To: Harvey W. Parker
Cc: harveyparker@compuserve.com ; White, John; Paananen, Ron
Sent: Fri Feb 20 18:07:11 2009
Subject: Re: Tunnel System

Dear all:

Harvey's points are good but I think simple answers to the key points of the letter is best here. We can discuss Monday.

Regards, John Reilly
Web: www.JohnReilly.us
Email: JJReils@ATTGlobal.net
Cell. +1-508-904-3434

> ----- Original Message -----
> **From:** Harvey W. Parker
> **To:** John Reilly
> **Cc:** harveyparker@compuserve.com ; White, John ; Ron Paananen
> **Sent:** Friday, February 20, 2009 8:51 PM
> **Subject:** Re: Tunnel System
>
> I agree with both Ron and John. Here are some other words. Maybe John Reilly can check some of the facts for me and suggest whether I am on the right track or not. Surely this is too much but one can just cut it down to what makes sense for a response.
> ---
> "WSDOT took many precautions before deciding on the single large tunnel. Of course, WSDOT carefully evaluated the cost, schedule, and the risks associated with both smaller twin tunnels and the larger single tunnel. The overall cost and schedule of a single large tunnel were significantly less for the single large tunnel. The savings would be about $1/2 Billion or more and the schedule is expected to be _____ years shorter This is because of many reasons. The size of any tunnel bore must be large enough to accommodate the full width and height of the traffic lanes plus all ventilation, fire and life safety, and auxiliary equipment. Smaller tunnels have a sharp curvature which restricts available height for trucks and for ventilation ducts etc. The twin tunnel scheme could not work with 36-ft-diameter tunnels but rather would require at least 43-ft-diameter tunnels. Moreover, there would be more complex and more expensive right-of-way acquisition and there would have to be larger and

more complex and more expensive ventilation structures for the twin tunnel scheme. Usually tunnels are spaced about 1 diameter apart so the overall width of the construction zone would be about 150 ft or more if each tube went below a different street.

With respect to construction risk, both the small tunnel and the large tunnel would be excavated from the safety of a protective steel shield. However, unlike the single large tunnel, the twin tunnel scheme would require connections between the tunnels, called cross passages, for fire and life safety every 600 ft or so. These would be extremely difficult, expensive and risky to construct in the anticipated soils.

The scheduled opening on 2015 would be more difficult to meet with the twin tunnel scheme. It would require purchase of 2 TBM's and coordination of the construction would be extremely difficult. Moreover, it is anticipated that construction of the structure and roadway can begin earlier and be faster and more efficient in the single tunnel making the overall schedule shorter.

It has been demonstrated in many cases that tunnels behave well in earthquakes. Both tunnel schemes would be safe in an earthquake because the movements of the soil would be small in both cases. Moreover, this 54 ft diameter single tunnel will have an approximate inside diameter of ___ ft which is much smaller (__%) than the existing Mt. Baker Ridge Tunnel which has an inside diameter of about 63 ft and which behaved extremely well during the Nisqually Earthquake.

In fact, the Mt Baker Ridge Tunnel is an excellent example of how WSDOT cares for most of the other issues you bring up in your letter. This design of this tunnel was way ahead of other tunnels and similar careful approach to the issues of drainage, fire safety, security, communications, traffic flow and control etc will be given to the new Alaskan Way tunnel. It is used every day by _____ vehicles and no concern is every voiced because it is inherently pleasant and safe. There are several double-deck tunnels around the world that have similar problems and lessons learned from these projects will be applied to the Alaskan Way tunnel project. Of course, no matter what, safety is our top priority.

Thank you for your concern. We trust that we answered your questions."

Ron, John, and John. This is just a strawman to get someone started. Maybe we should say 43 to 45 ft. It is dangerous to get it exactly to one foot and a range may be better. I may be off on some of the issues and facts so they need to be checked. If you can use any of this, ok. If not, let me know what else I can do. If you want to, you could attach one of the leaflets that are given out to drivers in Europe.....or attach some information about just how good Mt Baker Ridge really is.

Best regards,
Harvey

At 07:28 PM 2/20/2009 -0500, John Reilly wrote:

> ï»¿
> John - agree with Ron's key points, adding that the cost and risks associated with the cross passages is very significant. Additionally, to meet schedule in 2015 the twin tunnels require purchasing 2-43' dia. TBMs. A 43' TBM is maybe 75% of the cost of a 54' machine.
>
> Harvey - your comments?
>
> Regards, John Reilly
> Web: www.JohnReilly.us
> Email: JJReils@ATTGlobal.net

Cell: +1-508-904-3434

----- Original Message -----
From: White, John
To: Reilly, John ; harveyparker@compuserve.com
Sent: Friday, February 20, 2009 7:11 PM
Subject: Fw: Tunnel System

Do either of you wish to contribute any basic thoughts to this?

From: Paananen, Ron
To: White, John; Grotefendt, Amy (Consultant); Van Ness, Kristy (Consultant)
Sent: Fri Feb 20 15:10:05 2009
Subject: FW: Tunnel System

I'll let you guys expand on my two sentence answer

From: Paananen, Ron
Sent: Fri 2/20/2009 3:06 PM
To: Hammond, Paula; Dye, Dave
Subject: RE: Tunnel System

I will work with the team on a response. Our previous work on a twin bore showed that the bores would have to be 43 feet in diameter, not 36 as Mr. Still suggests. Twin bore requires cross passages every 600 feet or so between the tunnels for emergency egress. From our analyis, going from twin 43 foot tunnels to one 54 foot saved about $600 million. This was confirmed by several tunnel experts.

From: Hammond, Paula
Sent: Thu 2/19/2009 7:21 PM
To: Dye, Dave; Paananen, Ron
Subject: Fw: Tunnel System

Would one of you care to respond? Thanks
Paula

From: Nelson Still
To: Hammond, Paula
Sent: Thu Feb 19 19:14:04 2009
Subject: Fw: Tunnel System

Dear Madam,
I am forwarding this correspondence in case you did not receive the previous email.
Kind regards
Nelson R Still

--- On Mon, 2/9/09, Nelson Still <stillknotty@yahoo.com> wrote:
From: Nelson Still <stillknotty@yahoo.com>
Subject: Tunnel System
To: "Paula Hammon (DOT)" <hammonp@wsdot.wa.gov>

Date: Monday, February 9, 2009, 1:22 AM

February 8, 2009

Paula Hammond

Dear Madam.

Further to my previous letter dated 16 January 2009 regarding the building of a tunnel system to replace the Alaskan Way viaduct I wish to make some further points as follows.

1) A tunnel boring machine of 36Ê¼ diameter would be -- - 40% cheaper than the 54Ê¼ machine. The smaller machine is probably available second hand and also has a better re-sale value.

2) Even if one tunnel was closed for some reason the other tunnel could still service traffic flow north and south.

3) The smaller bore tunnel would be structurally stronger and could withstand seismic disturbance better than the larger tunnel.. Whichever design is used a gel should be pumped into the surrounding strata for added protection from water penetration or seismic disturbance

4) The tunnels would have an incline that would allow any water (example flooding) to flow in the desired direction and then pumped out. The highest elevation would face the prevailing winds and this would allow exhaust gases in the tunnel dissipate quicker.

5) In the twin tunnel system, only the road deck would require concrete and this would be a substantial saving. The sidewalls and the headwall would only require fireproofing.

6) A good audio system and video system would be required so that drivers and passengers could be advised on any problem and what to do.

7) Drivers would have to know in the event of an evacuation that they must switch off, leave the keys in the ignition, doors unlocked and move quickly to the safety area (probably the adjacent tunnel).

8) Fire protection of the actual tunnel lining (concrete segments) must be very carefully considered. Damage control from terrorist action must also be considered.

9) Traffic flow would be both lanes going south in tunnel #1 and both lanes going north in tunnel #2. Alternatively traffic in both tunnels could have one lane going north and one lane going south which means that in the event of an emergency (example fire) the tunnel could be cleared very quickly.

10) The alternative method as described in 9) would allow traffic in one lane to do a u-turn and exit the tunnel quickly

11) Fire hoses and phones every 200 yards which could be used by drivers in an emergency.

12) The twin tunnel system would allow drivers and passengers to exit from one tunnel to the other for safety reasons. The safety of persons using the tunnels is of the utmost importance. It has to be top priority.

Sincerely,

Nelson R Still

23800 S E Tiger Mountain Road #29

Issaquah

WA 98027

Tel: 425 635 8715

BORED TUNNEL CONCEPTUAL ENGINEERING DELIVERABLES

SCOPE	TASK	LEAD	DRAFT TO CLIENT	DRAFT SUBMIT	FINAL DUE	FINAL SUBMIT
4A1a	Architectural plans, sections, elevations	Browning	5/18/2009[2]		6/30/2009	
4A1b	Civil alignment and interchange plans, profiles, sections	Rodenbough	5/18/2009[2]		6/30/2009	
4A1c	Tunnel, portal and bridge structural plans and sections	Inverso	5/18/2009[2]		6/30/2009	
4A1d	Urban design plans, sections and elevations	Dramov	5/18/2009[2]		6/30/2009	
4A1e	Existing utilities plans and typical utility sections [1]	Smith	5/18/2009[2]		6/30/2009	
4A1f	Tunnel systems schematics [1]	Hawkins	5/18/2009[2]		6/30/2009	
4A2a	Architectural themes and concepts with graphics report	Browning	4/22/2009		6/1/2009	
4A2b	Urban design concepts and themes with graphics report	Dramov	4/22/2009		6/1/2009	
4A2c	Utilities impacts report	Smith	4/22/2009		6/1/2009	
4A2d	Summary level stormwater report	Smith	4/22/2009		6/1/2009	
4A2e	Construction staging, sequence and impacts (see A3h)	Petersen	4/22/2009		6/1/2009	
4A2f	Right of way impacts	Rodenbough	4/22/2009		6/1/2009	
4A2g	Corridor operations plan	Wellander	4/22/2009		6/1/2009	
4A3a	Civil Design Criteria	Rodenbough	3/16/2009	3/9/2009	5/6/09	
4A3b	Addendum to the corridor analysis (Addendum C)	Loen	3/30/2009	3/30/2009	6/30/09	
4A3c	Geometric design matrix	Rodenbough	3/16/2009	3/9/2009	5/6/2009	
4A3d	Structural design criteria update	Soudy	3/16/2009	3/16/2009	5/6/2009	
4A3e	Tunnel systems design criteria	Hawkins	3/16/2009	3/16/2009	5/15/2009	
4A3f	Draft design approval package	Loen	5/29/2009		6/29/09	
4A3g	Draft deviations	Loen	4/10/09		6/26/09	
4A3h	Construction impacts and constructability white paper	Petersen	4/22/2009		6/1/09	
4A3i	Planning level cost estimate	Petersen	n/a		4/3/09	
4A3j	Planning level cost estimate update	Petersen	n/a		6/30/09	
	Work Products:					
4B1	Visual simulations	Mezher	n/a		6/30/09	
4B2	4D graphical support	Mezher	n/a		6/30/09	
5A1	EIS Snapshot Plan Set	Clark	5/18/2009[2]		6/30/2009	
5B1	Geotech needs and recommendations	Clark	3/9/2009	3/9/2009	6/30/2009	
5B2	Review of geotech data	Clark	5/1/2009		6/30/2009	
5B3	Coordinate geotech analysis	Clark	6/1/2009		6/30/2009	

Note: (1) Drawings are not included in Snapshot Plan Set but are included in reports
(2) Consultant Team draft due May 1