Cascadia Center at the Discovery Institute

Alaskan Way Replacement

Alternative Approaches

November 2006

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It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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Executive Summary

1.1 Construction Alternatives

The Alaskan Way Viaduct has reached the end of its useful life and requires replacement. The current cut and cover tunnel alternative provides sufficient capacity and represents a robust technology given the constraints of the site. However, the high costs estimates are of concern to the project stakeholders and the construction represents significant disruption to both the waterfront and to the Alaskan Way viaduct. A number of proposals are examined which will reduce these impacts:

Top down construction: Top down construction with excavation from the portals only would allow the waterfront highway, utilities and landscaping to be reinstated soon after the commencement of construction, while tunneling continues beneath. This significantly reduces the impact to waterfront businesses and tourism, and would allow early implementation of some of the waterfront park proposals in front of the Viaduct, expediting the provision of these amenities to the public.

Reduce cut and cover tunnel size to 4 lanes (two in each direction): This approach would represent a significant cost reduction to the project. Additional traffic management and demand management would be required to accommodate traffic that may chose to divert to other routes such as Alaskan Way, north-south downtown streets and I-5, or may select public transport as result of the lower tunnel capacity. These measures should form part of a city wide transport strategy.

Reduce shoulder width: A reduced shoulder would also reduce cost. A full shoulder width allows full flexibility should an incident occur, however many highways agencies have adopted reduced widths in constrained locations such as tunnels.

Bored Tunnel: A number of Tunnel Boring Machine (TBM) constructed tunnel options have been considered as an alternative to the cut and cover alternative. TBM construction significantly reduces the disruption caused at street level and can result in cheaper and faster construction. Provision of large diameter highway tunnels is not uncommon in Europe and has now been proposed for a number of highway projects around the US.

The preferred option of those considered (Option BT1) provides a stacked dual two-lane highway configuration within a single tunnel bored from west of the Seahawks stadium in the south to the Denny Way/SR99 intersection in the north. This option provides the same connectivity as the proposed scheme and by-passes the waterfront avoiding any impact on the waterfront businesses, tourism or the traffic on the viaduct. It also significantly reduces the impact on utilities and presents options for joint development, and associated funding streams, at the portals and ventilation buildings. Truck traffic is diverted around the tunnel to keep the tunnel size down and this option would require the traffic and demand management approaches described above. The seawall replacement project is decoupled from the tunnel project allowing this work to be carried out in conjunction with the waterfront masterplan work and allowing more flexibility in the form and extent of the replacement.

1.2 Funding and Procurement Alternatives

The use of Private Public Partnerships (PPP) as an alternative procurement model has the potential to create value on the delivery of the project and make better use of available funding to the benefit of this project and potentially allowing funds to be diverted to other life line projects such as the SR520 floating bridge replacement. A PPP is fundamentally about building a business to provide a public service – in this case road transportation. Value can be created by letting private teams that bring together construction, design, finance and operation & maintenance expertise to compete to deliver the most cost-effective solution that achieves the project's goals as defined by the public sector.

To deliver value the private team assumes many of the project risks that in a conventional model are retained by the public sector. The risk thus assumed is priced and backed by equity capital, providing a powerful incentive to manage those risks more successfully than historically has been the case under a public procurement model. The risk of construction cost and schedule overruns in complex infrastructure projects, for example, is real and substantial, as evidenced by a number of well-publicized projects in recent years.

One of the key benefits of a PPP model is that these liabilities have to be evaluated, incorporated and managed from project inception. A project's long-term liabilities – operation, maintenance and rehabilitation costs – have not been fully recognized nor optimized in the initial investment by traditional public procurement. Therefore, when comparing a PPP versus traditional public procurement it is important to take account of the whole life costs of the project and how they are funded.

A successful PPP model has the following goals and key features:

- **Public goal**: to provide a safe and functional transportation service
- **Private goal**: to create business that delivers that service and provides a financial return on invested capital
- **Risk transfer**: private team assumes those risks that are best managed by it (design, construction, financing, operation, maintenance and rehabilitation)
- **Risk management**: strong financial incentives to price and manage cost and schedule risks with fixed-price design-build and long-term service contracting
- **Value creation**: competition among private teams to provide an optimized solution given clear performance specifications
- **Leverage funding**: potential to obtain more favorable financial leveraging of the funding, especially if a tolling component is part of the funding mix.

To implement a PPP model and attract the attention of qualified private sector teams, the principal stakeholders have to support the goals and create a balanced blend of these ingredients. The appropriate underlying legislative framework must be put in place to give the lead contracting agency proper contracting authority. Successful models exist from past projects in the United States and other countries, providing a large body of experience and lessons learned. A public entity with the right skills, resources and knowledge of that body of experience is usually setup to champion the project and its PPP procurement.

Given the large amount of currently identified Federal, State and local funding identified for the project the most financially efficient approach for the project would be to pass these funds down to the concessionaire in the form of a regular payment mechanism such as availability payments to allow the private concessionaire to financially leverage that future cash using the optimal financial techniques available to it in the capital market. This methodology could be supplemented by other funding streams such as direct tolling and joint development opportunities.

1.3 Waterfront Development Agencies

Waterfront developments agencies and corporations have been used in many cities to coordinate the development of their waterfronts and other facilities to maximize the amenity of the project for the public. Cities such as Toronto, New York, London and Barcelona have recognized the multiplicity of agencies that are typically required to develop transportation, real estate and public amenities along a waterfront zone, they also recognized the difficulty of decision making that this entails. As a result they established single agencies to plan and construct these works. Such an agency must have the support of the mother agencies, a clear mandate, and the access to the funds necessary to complete the development.

The approach has already been successfully adopted in Seattle for earlier projects and as such, is a tried and tested approach which would allow a streamlined and coordinated approach which would bring great benefits to the Seattle waterfront.

1 Introduction

1.1 Background

The Alaskan Way Viaduct is a significant part of Seattle's transportation infrastructure providing a north south route on the west side of the downtown area. The existing structure is nearing the end of its useful life, is susceptible to damage in a significant seismic event and has been identified for replacement. The two alternatives that are being advanced through the environmental process by the Washington State Department of Transportation (WSDOT) are a replacement viaduct and a cut-and-cover tunnel. The cut and cover tunnel has been identified as the Preferred Alternative.

In addition to the viaduct, the timber structure of the existing seawall is suffering damage from a number of marine organisms and is also reaching the end of its life. The viaduct and at least a portion of the seawall's replacement are currently being addressed as one project.

In June 2006 the Washington State Governor and Legislature commissioned an expert review panel to consider both the Alaskan Way viaduct and the SR520 floating bridge replacement. Their tasks were to:

- Review the finance plan for each project.
- Review the project implementation plans.
- Report its findings and recommendation by September 1, 2006

Their key findings for the viaduct were that although the plan was generally sound:

- Some of the estimates were optimistic
- Cost ranges may be underestimated
- Price escalation may be underestimated

As a result the cost estimates for the alternatives were revised to the following:

Elevated Structure Alternative:

Core project (Likely cost) $2.82 Billion

Tunnel Alternative:

Core project (Likely cost) $4.63 Billion

The core elements included in these estimates provide for viaduct and seawall replacement along the center portion of the waterfront but exclude improvements to the north end of battery street tunnel and the portion of seawall replacement north of this zone.

The total cost ranges for each alternative are primarily a function of the choice of construction sequence and total duration of construction. Three construction sequences are considered for each project alternative, with total durations ranging from 6.5 to 10 years depending on the option as shown in Table 1.

Construction Plan	Alternative	Total Construction schedule	SR99 Impacted/Closed
Shorter Construction Plan	Tunnel	7 yrs	42 months
	Elevated	6.5 years	36 months
Intermediate Construction Plan	Tunnel	8.75	63 months
	Elevated	7.75	57 months
Longer Construction Plan	Tunnel	9.5 years	72 months
	Elevated	10 years	84 months

Table 1: Current Construction Plans

The State currently has identified committed funding[1] totaling $2.4 Billion, available through:

- 2005 Gas Tax (Partnership Funding) - $2 Billion
- Transportation 2003 Account (Nickel Funding) - $177 Million
- 2005 Federal Earmark Funds - $208 Million
- Other Funds - $19 Million

The state has also identified a number of anticipated funds which if all are realized amounts to $2.6 billion:

- Future Transportation Funding Reauthorization: $0 to 280 million
- Emergency Relief Funding: $32 to 60 million
- Water Resources Development Act (for the seawall only): $200 million
- Regional Transportation Improvement District: $800 million
- Washington State Sales Tax Rebate: $156 to 176.8 million
- Regional Tolling: $150 million
- City of Seattle Public Utilities: $0 to 400 million

Some funding sources would be available only if the Tunnel Alternative is chosen:

- Port of Seattle Capital Improvement Plan: $0 to 200 million
- Open Space Funding: $80 million
- City of Seattle Transportation Funding: $20 million

1 Per WSDOT project website: http://www.wsdot.wa.gov/Projects/Viaduct/default.htm

- City of Seattle Local Improvement District: $50 to 250 million

The expert review panel found that the finance plan and these finance sources were reasonable, although somewhat optimistic.

1.2 Schedule

The Draft EIS was circulated for public comment in 2005. As a result of extensive public comments a Supplemental Draft EIS was prepared and was released for public circulation in July 2006. It is expected that after public circulation of that document, a final decision regarding the implementation and financing plan will be made by the Governor later this year or early 2007. The Record of Decision will be reached some time in 2007, with utilities relocation commencing in 2008 and construction commencing in 2010.

1.3 Scope of Report

Arup were commissioned by the Cascadia Center at the Discovery Institute to further review alternatives for the Alaskan Way Viaduct replacement. The Discovery Institute is a strong supporter of a tunnel option which would allow opening up of Seattle best asset, its waterfront, to the public providing park amenities, currently limited, for the residents of the downtown area as well as supporting the waterfront businesses through improved tourist facilities.

The Discovery Institute has a number of concerns regarding the project:

- Already escalating costs for the tunnel may jeopardize its implementation
- Disruption during construction will severely impact downtown businesses and may close down some waterfront businesses
- The use of conventional design bid build and design build contracting may not be the most appropriate forms of procurement for the project. Public Private Partnerships allow private sector financing to be brought to the project, and through an appropriately prepared concession agreement can incentivize the concessionaire to optimize the design, construction and maintenance to reduce costs, schedule and risk.
- The large number of stakeholders involved in the project may impeded the process through not reaching consensus. The use of a Waterfront Agency responsible for the development of the tunnel, the park, and any associated waterfront development could streamline the process.

The scope of this study is therefore to;

- Explore options which reduce construction cost and disruption to the waterfront businesses
- Investigate the use of alternative contracting approaches for the project
- Provide a discussion of the benefits of the formation of a Waterfront Development Agency to plan and procure the project, based on experiences from other projects.

2 Tunnel Alternatives

2.1 Current Tunnel Option

The current tunnel alternative provides a 0.9 mile long tunnel with three lanes in each direction, with full shoulders, between portal locations at approximately South King Street in the south and Pike Street to the north. The alternative allows all vehicle types with no restrictions on truck movements. An at grade 3-lane highway connects the tunnel on the south end to the existing SR99 route at South Hanford Street, while in the north an aerial bypass connects the emerging tunnel to the Battery Street Tunnel. The current tunnel option does not provide the access to the downtown area through the Seneca and Columbia Street slips that currently exists and which would be replaced under the elevated replacement alternative.

Two tunnel options are proposed, a stacked tunnel aligned on the west side of the existing viaduct (Figure 1), and a side by side arrangement extending into the footprint of the viaduct. The stacked option appears to provide the most opportunity to minimize construction impacts on the surface street and the viaduct.

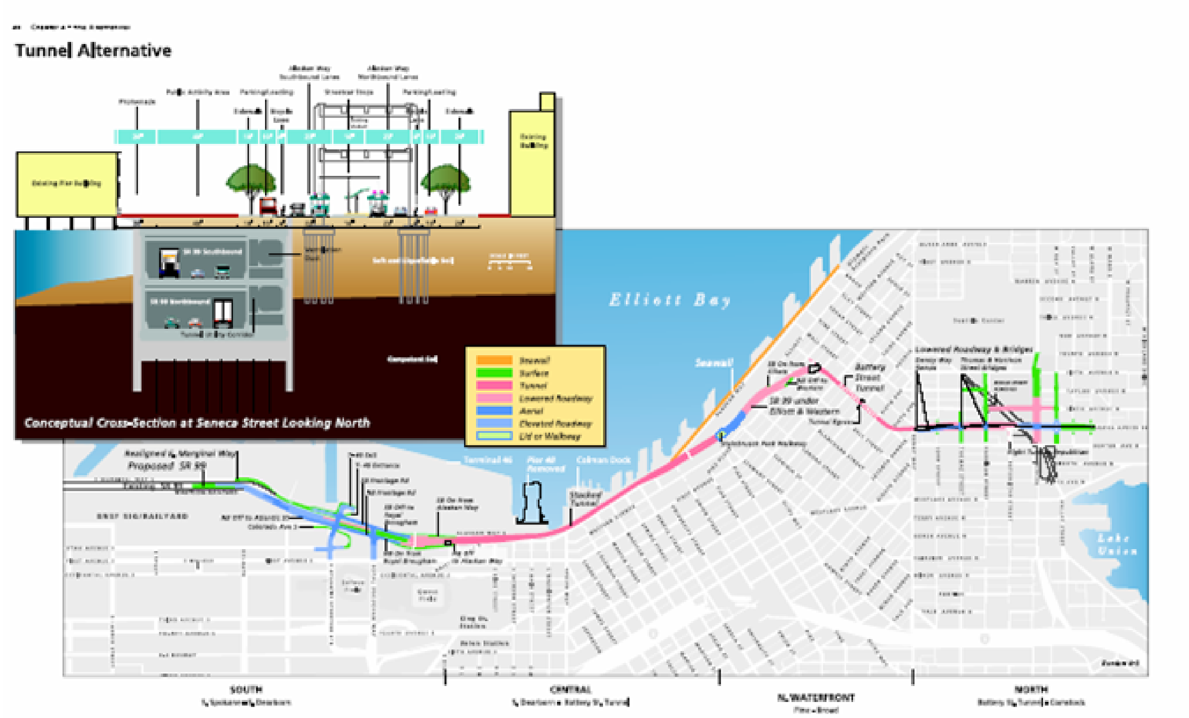

Figure 1: Stacked Tunnel Alternative for Alaskan Way Viaduct replacement (SDEIS, 2006)

The construction method proposed is a cut and cover tunnel constructed with secant piles providing support on the west side, and replacing the sea wall, and slurry walls on the east side. The excavation will be carried out using bottom up construction in an open cut with tie backs and temporary internal bracing used to support the walls prior to construction of the final structure inside the excavation.

2.2 Geologic Conditions

Perhaps the largest obstacle to tunneling for the AWV project is the prevailing site geology. Two very distinct overall areas will be encountered along the AWV project. Difficult soils will be encountered from around King Street to the south and to the north . To the south these soils consist of cohesionless, loosely compacted fill material (silty sands) and other debris material (bricks, wood, etc.). The adverse geology is compounded by the high water table located only 6-8 feet below ground surface. In the saturated condition, the fill material will behave like flowing ground during tunneling. To the north of King Street, dense and stiff glacial till material rises to within the tunnel horizon and provides conditions generally favorable to tunneling from that point north. The risk associated with tunneling through this material include larger boulders, variable ground conditions and pockets of water locked into the material, which could lead to flowing ground conditions. Current tunnel projects in the Seattle area like the Sound Transit Beacon Hill Tunnel Project and the proposed Brightwater Tunnels indicate that the ground can be successfully tunneled without major disturbance and delays in the tunneling operation. All projects are using a pressurized face tunnel boring machine.

The close proximity to the water and the necessary depth of the tunnel bores to reduce the ground surface impacts (ground settlement) will require that the tunnel will have to resist water pressures in the range of 3.5-4.0 bar. Projects recently finished in the Netherlands, i.e., Groene Hard Tunnel , with extremely difficult ground conditions consisting of peat, clay and water saturated sand, 48.8-ft tunnel diameter and water pressures of 3.6bar, have shown that TBMs of the size required for AWV can successfully excavate through adverse geologic conditions.

2.3 Construction and Alignment Alternatives

2.3.1 General

In this study a number of options are explored which provide for a tunnel, and either optimize the current scheme, or adopt different technologies to reduce cost and construction disruption.

2.3.2 Cut and Cover Tunnel

The concerns that have been expressed related to the current cut and cover option are the high project cost and the disruption that will be caused to the waterfront properties through construction. While a detailed analysis of the project cost is beyond the scope of this study, the cost is strongly influenced by the construction method adopted and the size of the tunnel. Approaches which minimize the extent of these issues and can be used alone or in combination are discussed below.

2.3.2.1 Two Lane Highway with Reduced Shoulder (Option CT1)

The current scheme provides for either a single level, or stacked structural box containing three lanes in each direction, including a full shoulder, giving overall widths of approximately 140 ft and 85 ft respectively. Options that would allow the cross section to be reduced include providing two lanes instead of three in each direction. In addition to this the shoulder width could be reduced from full width to five feet or so.

Removing a lane and reducing the shoulder will reduce the width of the cut and cover tunnel options by between 22% and 30%. While costs savings are not proportional, this would represent a significant saving to the project.

The current Battery Street tunnel is a 4 lane tunnel (2 in each direction), however while this would indicate a match in capacity between the new tunnel and the Battery Tunnel it is recognized that a high proportion of the new tunnels traffic is commuter traffic from the south which, in the AM peak, leaves the SR99 at the Western slip to enter the business district. The two lane tunnel will therefore provide less capacity. This would require the in diversion of traffic on to a number of alternative routes and modes including Alaskan Way surface street, the north-south city streets and I-5, existing public transport and proposed public transport such as the Sound Transit Link service. The impacts of this diversion could be effectively managed through demand and traffic management approaches as part of a City wide traffic plan. However, an analysis of this is beyond the scope of this report.

The reduction of the shoulder width will reduce flexibility for incident recovery and maintenance, however it is an approach that has been used successfully on road tunnels elsewhere around the world.

2.3.2.2 Top down construction to reduce construction impacts (Option CT2)

The stacked approach rather than the side by side option minimizes the impacts on the existing viaduct during construction and allows traffic flows to be maintained with less disruption and is considered here.

The walls that support the cut and cover structure comprise a secant pile (west side) and slurry wall (east side) system. The west side wall will not only serve as an earth retention system during tunnel construction, but will also form the basis of the new seawall. In addition to these walls, a heavy program of ground improvement and groundwater lowering in excess of 50 ft. has been proposed. Grouting of the more permeable soil deposits (such as the water bearing beach deposits) can reduce the risk of settlement to adjacent structures. Groundwater control measures will reduce the damming effect that will occur on the east slurry wall and also reduce the potential for soil piping and critical uplift pressures which could cause construction problems before the tunnel box is completed.

The current alternative provides for open cut using bottom up techniques in which tie backs and temporary strutting are used to support the walls during excavation, with the permanent structure being constructed inside the excavation. An alternative approach would be to use the top down construction method to reduce the length of time the open cut is required and to allow early reinstatement of the surface utilities, roads and landscaping.

Referring to the stacked option, this method can be explained as follows: the west side secant wall is placed to replace the seawall, and the slurry walls are cast on the east side. An open cut of 4-6 ft deep is made between the two walls. A strut is placed across this cut and temporary decking is installed over it. At this point excavation is continued to the underside of the proposed roof slab and the tunnel roof slab is cast directly on the bottom of the excavation. This procedure can be phased along the length of the tunnel to minimize the impact on the surrounding businesses, highways and utilities. Once the roof slab is in place the temporary decking can be removed and backfilling can take place allowing reinstatement of the at-grade Alaskan Way highway, utilities and landscaping

(Figure 2).

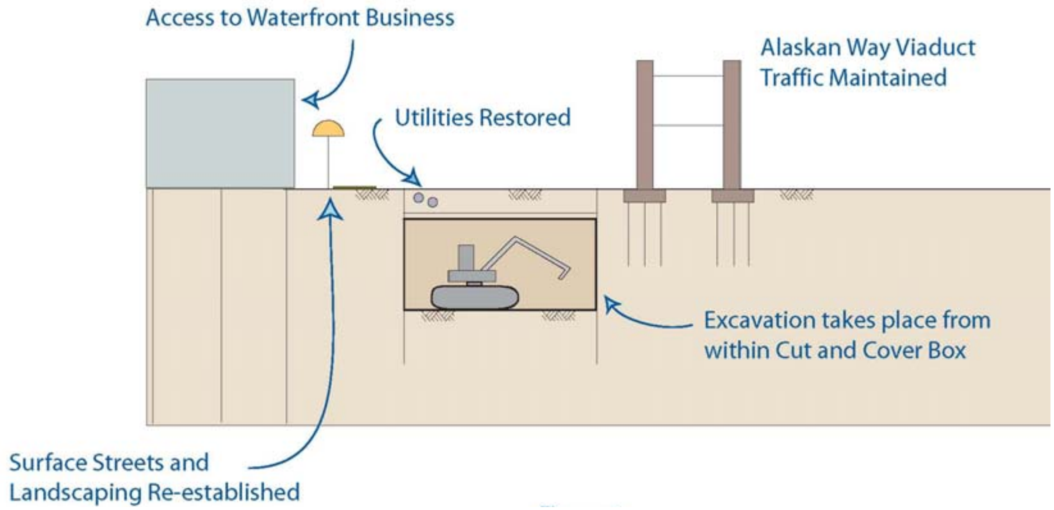

Figure 2: Cross section showing top down construction

Excavation and construction of the internal structure and installation of systems can then take place from below with access from the portals (Figure 3). This alternative would provide the minimum disturbance to the neighborhood but may increase the construction schedule. If required the schedule can be reduced by providing 'glory holes' in the roof slab along the tunnel to allow additional access points for excavation and construction. The locations of these additional work sites would be carefully coordinated to reduce community impacts.

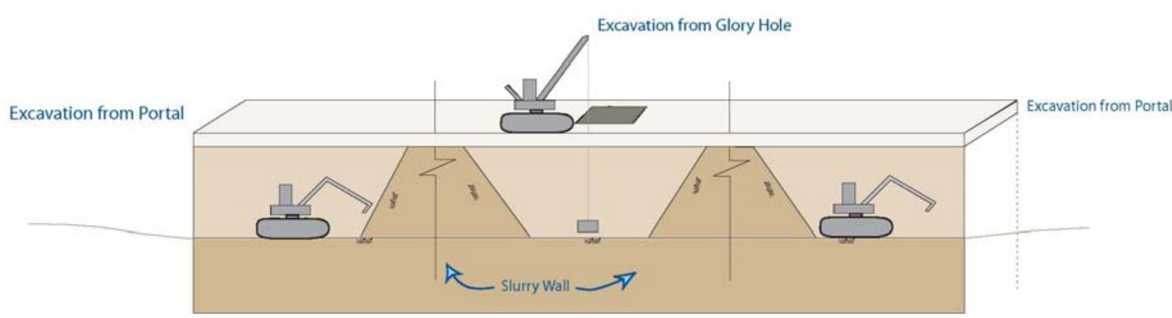

Figure 3: Longitudinal section showing access from portals and optional glory hole

An additional advantage of this method is that the tunnel roof slab struts across the top of the excavation before significant construction even begins. By effectively having the walls fixed at top and bottom, the ground movements around the excavation are minimized compared to other methods. This will be particularly important for construction immediately adjacent to the existing viaduct This also alleviates the need for several levels of internal bracing (such as would be required for bottom up construction), leaving the space open for material movement and spoil handling. Typically the exclusion of internal bracing requires a deeper slurry wall embedment.

A similar tunnel was recently completed as part of the Kallang Paya Lebar Expressway (KPE) in Singapore. KPE is to be a dual-carriageway expressway with three lanes in each direction and eight interchanges running underground for a length of 5.6 miles. The width of the tunnel is 128 ft. The tunnel also runs for 1.2 miles under a canal. Both top down and bottom up construction methods were utilized on this project by different contractors. Traffic was carried over one half of the tunnel width on a 3-lane highway minimizing the construction impact to commuters. Jet grouting of soft clays ensured the stability of the works.

This option significantly reduces the extent of the disruption to the waterfront businesses and allows early restoration of the surface street and the expediting of some of the proposed park and waterfront development.

2.3.3 Bored Tunnel Alternatives

2.3.3.1 General

A bored tunnel scheme was considered early in the design process but appears to have been eliminated early in the selection process. The reasons given for this appear to be that:

- the seawall replacement is not included
- it would cost more than twice the cost of the current tunnel option
- access is not provided to the downtown area.
- The bore size would be larger than has been used in the US before

We have considered a number of options which address some or all of these issues while also reducing disruption along the waterfront.

2.3.3.2 Tunnel Technology

In recent years TBM technology has made huge strides in producing bigger and more advanced controlled machines. There are currently machines available with diameters up to 51 ft (Figure 4), for use in excavating tunnels through difficult ground conditions similar to those likely to be encountered on the Alaskan Way project.

There is no precedent in the US for soft ground tunnels of the size proposed for this project. However, tunnels are currently being built and proposed for major three lane highway projects around the world using these state of the art tunneling machines. One such US proposal is the City of Miami port tunnel which crosses under the harbor. The project is currently in a tender stage with three consortiums proposing soft ground tunnel TBMs with diameters of up to 41ft.

Figure 4: 51-ft Diameter Earth Pressure Balance Tunnel Boring Machine.

In light of these recent advancements in TBM technology we have considered a number of tunnel configurations based on other projects around the world and considered a number of alignments that are suitable for the Alaskan Way project.

Based on our experience in tunneling projects around the world, and understanding the anticipated ground conditions in the Seattle Downtown area, the only feasible excavation method for a mined tunnel option will be by the use of a Tunnel Boring Machine (TBM) with a pressurized face. These machines minimize the risk associated with the tunneling operation (settlements due to flowing ground, collapses etc.) and make tunneling economically feasible.

Multiple alignment options have been evaluated for a bored tunnel. All options will require further evaluation in terms of construction, space requirements, and geotechnical conditions and constructability.

2.3.3.3 Tunnel configurations

A number of tunnel configurations have been used on highway projects around the world from double stacked single bores to twin bored solutions. Some tunnel configurations appropriate to this project are presented in Table 2. The most cost effective of these is the stacked dual two-lane tunnel as was used on the A86 in Paris as shown in Figure 5.

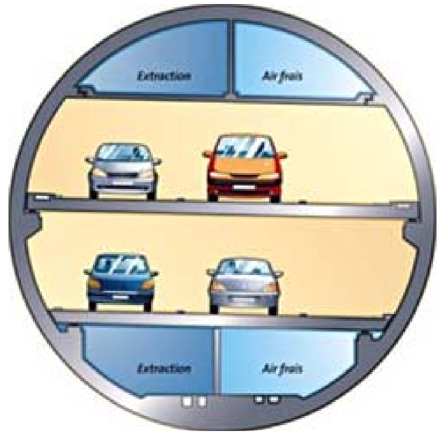

Figure 5: Typical two lane stacked tunnel section, A86 Paris.

Other configurations that have been used around the world are as follows:

Tunnel configuration	Lanes per tunnel	Traffic	Approx. Diameter	Example
Single bore	Dual 2- lanes stacked – full shoulder	Trucks diverted to I-5	34 - 38ft	A86 East Tunnel Paris
Twin bores	2 lanes – full shoulder	Trucks allowed	36 - 40ft	A86 West tunnel Paris Westerschelde Holland
Twin bores	3 lane – reduced shoulder	Trucks allowed	50 ft	M30 Madrid

Figure 2: Highway Tunnel Configurations

2.3.3.4 First Avenue - Denny Way Tunnel (Option BT 1 – Preferred TBM Option)

Of the alignments considered here the preferred option for the bored tunnel concept involves excavating a single 38-ft diameter TBM tunnel from the Seahawk Station area (between First Avenue and SR-99) just south of South King Street to the intersection of Fifth Avenue and Bell Street.

A dual two lane stacked configuration with full shoulder similar to that used on the A86 East tunnel in Paris would be adopted. As was implemented there, the tunnels would be open to car traffic only. Trucks heading north on the new at grade SR99 highway would be redirected prior to entering the tunnel via a ramp to South Royal Brougham Way where they would be directed to I-5 via another ramp at Fourth Avenue (Figure 6). Trucks heading off I-5 going west on I-90 and South Royal Brougham Way would be connected to the at-grade SR99 by a flyover which brings trucks over the at-grade highway on to the southbound lanes. This route effectively moves truck traffic into or through downtown and allows for a smaller diameter tunnel to be bored. Access to the port area is also still provided for truck traffic with this alignment option.

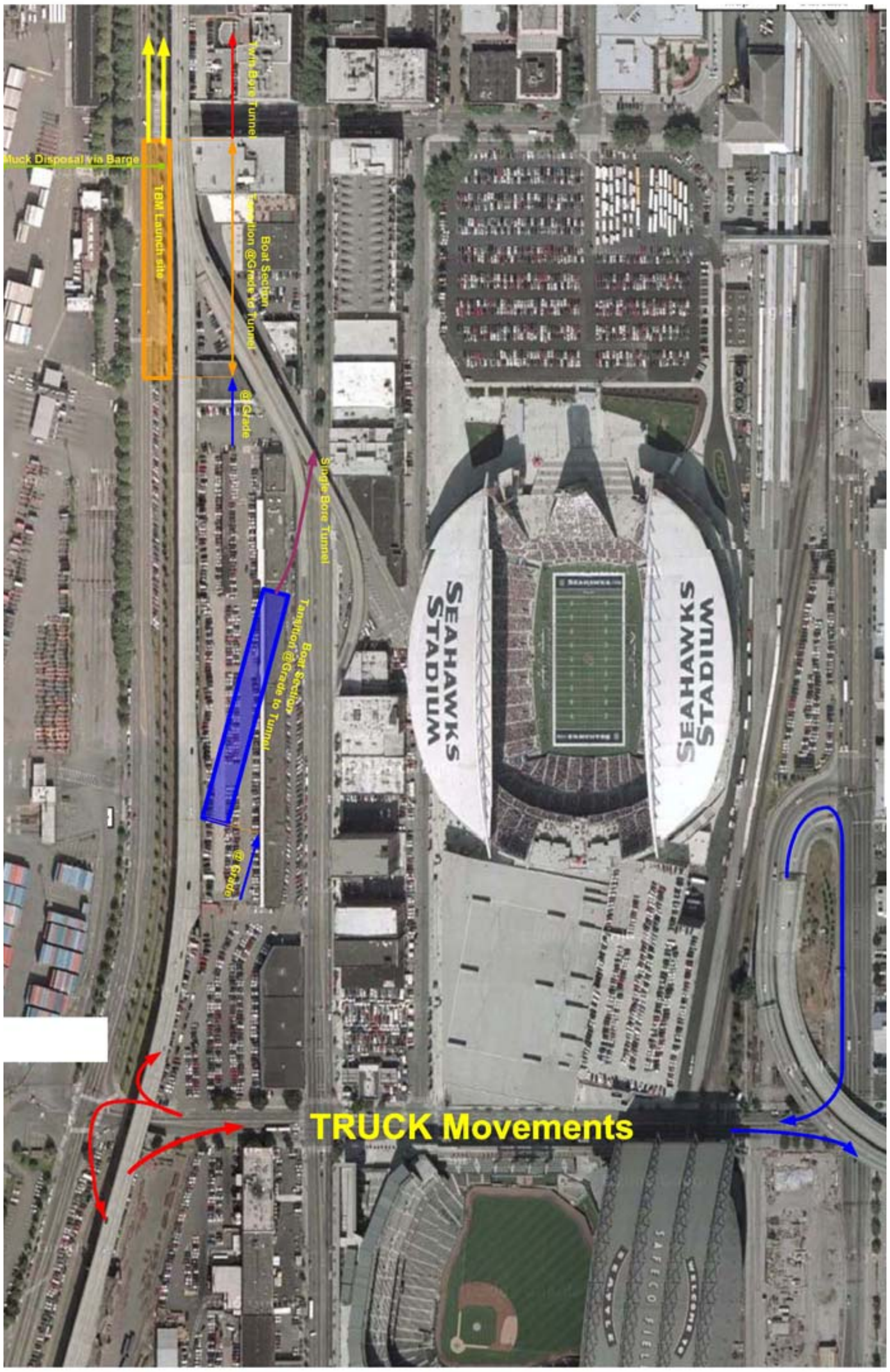

Figure 6: South Portal and Truck Routes

The TBM drive would start at the south end of the alignment (Figure 7) in a launch box located to the west of the Seahawks Stadium, turning immediately north under First Avenue. From there it would run along First Avenue, to Stewart Street, passing below the BNSF tunnels, and then turn east forming an S-shape curve to Fifth Avenue. It would then run along Fifth Avenue, to a cut and cover retrieval structure at Bell Street. One or two mid-tunnel ventilation and egress shafts are likely to be required. These could be combined with joint development depending on the site location.

The alignment for this option has been selected to avoid where possible passing beneath high rise structures, particularly near the Fifth street portal where the tunnel alignment rises to the surface.

The two large starting and receiving cut and cover structures excavated at the portals will be used to create transition structures from a side by side at grade highway configuration to a stacked configuration in the tunnel structure. These portal areas could subsequently form part of a joint development with high rise office or residential buildings constructed above to provide an additional revenue stream for the project.

This tunnel option would bypass the existing Alaskan Way Viaduct, and could be build completely offline. Only new ramps or at grade structures in the south end and a connector tunnel (box) need to be build to connect the existing I-99 to the new bored tunnel.

The tunnel would be bored as a deep tunnel with depths of at least 50-70-ft for the majority of the route to avoid any possible interaction with foundations. The tunnel grade can be steeper if necessary as only car traffic will be allowed in the tunnel. The south launch box is located close to the waterfront so that the port can be utilized during tunnel spoil removal by means of barge. This would remove construction traffic from local roads during tunnel excavation.

The currently proposed slip road configuration at the south end could be adopted, while north bound off/south bound on slips would be provided at the north portal to give access to the downtown areas.

This alignment option has the following advantages:

- Better ground conditions along First Avenue in comparison with the waterfront. Less obstructions and unknowns.
- Seawall replacement is constructed as a separate project as part of the redevelopment of the waterfront area allowing more flexibility in the form and extent of the replacement
- Traffic on the existing SR-99 structure will not be impacted while the new bypass tunnel is constructed. .The connections at the portals would be achieved with minimum disruption.
- The impact on the utilities along Alaskan Way (currently valued at $ 500m) will be significantly reduced.
- The alternative by-passes the Battery Street tunnel which is understood to be substandard and in need of substantial retrofitting.
- Minimal disturbance of the downtown area, only ventilation shaft and emergency egress shafts need to be created which may subsequently be used for joint development depending on the site selected.
- When the Bypass Tunnel is constructed, the existing viaduct can be demolished and the area can be opened up for development of public amenities.

- Detailed cost estimates and schedules for this approach have not been made at this stage however it is anticipated that this option, despite being longer, would cost less and could be constructed faster than the proposed cut and cover tunnel.
- Development over the portals and at vent building sites would provide an additional revenue stream

As this would form a significant departure from the current scheme it is anticipated that a further SDEIS would be required. As stated above the alternative provides less capacity to the proposed tunnel and therefore some redistribution of traffic to the I-5, surface street and public transport would be required. The impacts of this could be reduced through Demand and traffic management approaches.

Twin bored tunnels configurations described above could also be considered to provide for truck traffic and/or dual three lane capacity; however this would increase project cost and would require more extensive alignment studies.

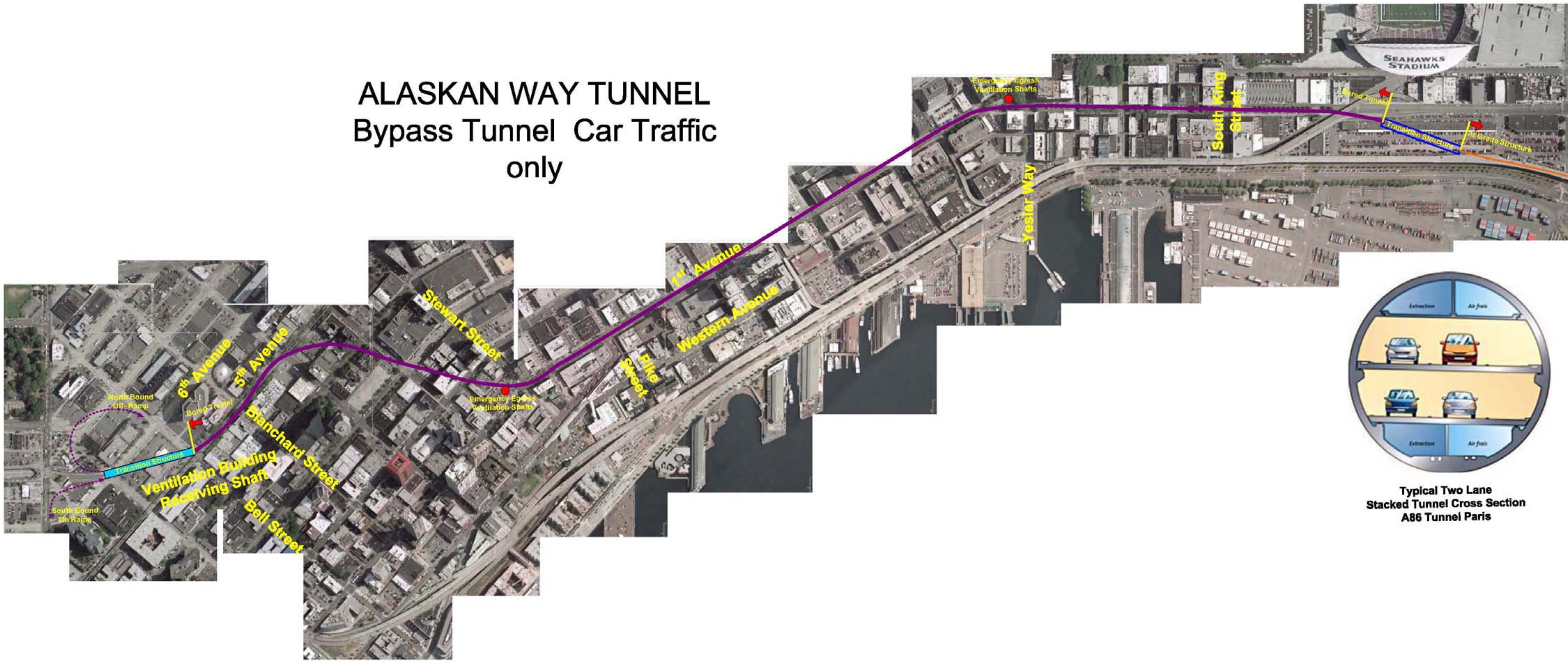

Figure 7: First Avenue - Denny Way Tunnel Alignment

2.3.3.5 Twin Bore Options

Three options have been explored which connect a southern portal near the Seahawks stadium to the Battery street tunnel in the north. These alignments are presented in Figure 7. These options provide twin bored tunnels of approximately 34 ft diameter which would allow for 2 lanes and a shoulder in each which allows for trucks, although diverting trucks as described above allows for steeper gradients and lesser tunnel ventilation needs. These options are shown in Figure 8.

Alaskan and Western (Option BT2)

The Alaskan and Western Option involves excavating a TBM launch box (which will be later used as the transition zone from at grade or aerial structure to tunnel structure) just west of the Alaskan Way Viaduct at South King Street. Two 36-ft. diameter tunnels will be driven north providing a bypass through the downtown area.

The launch box is again located so that the port can be utilized during tunnel spoil removal by means of barge. This removes construction traffic from local roads during boring.

The southbound bore will originate at the same launch box as the northbound bore at SR99 and South King St. and run just west of the viaduct (between the pile foundations and the seawall timbers) until approximately Pike Street where it surfaces into a transitional cut section at Pike St. and progress onto a newly constructed or retrofitted aerial flyover which is necessary to carry vehicles over the BNSF rail tracks. The flyover will follow the same route as the existing viaduct and provide ramps to Elliott Ave and Western Ave. before connecting to the Battery Street Tunnel.

The northbound bore alignment will run beside the existing viaduct footprint until it branches east at Yesler Way. At this point, it will curve east slightly and continue north beneath Western Avenue. The tunnel will be driven under the existing BNSF rail tunnel which crosses the alignment perpendicularly just north of Stewart St. This point is very near the northern portal of the rail tunnel resulting in a shallow vertical alignment making the crossing possible. The tunnel will surface into a transitional cut section at Western Ave. and Bell St. and funnel two lanes of traffic into the existing Battery Street Tunnel. Ramps will be constructed prior to entering the Battery Street Tunnel to allow traffic to access local streets. North bound off and south bound on slips will be provided here.

This alternative could provide for truck traffic and minimizes the disruption to the downtown areas. However if a replacement viaduct is provided for the connection to the Battery Street tunnel the impacts on the SR99 traffic during construction still exist.

Alaskan and First (Option BT3)

The Alaskan and First alignment runs the southbound bore just west of the viaduct footprint from South King Street north to Pike St. as described above in Option BT2.

The northbound bore will originate at the same location described above and immediately curve slightly east, boring under the buildings that are on either side of South King St. The tunnel will continue north under First Avenue until Lenora St. where it will curve back west and surface into a transitional retained cut at Western Ave and Bell St. This alignment has the advantage of being farther inland where the geologic conditions are improved.

Alaskan Way Twin Stacked tunnels (Option BT4)

The final alignment option considered is to run again just west of the viaduct, with the same origin as described in the previous options. The tunnels will begin side by side in the transitional retained cut zone then move into a vertically stacked configuration as they progress north. The southbound bore will be the shallower of the two and surface into a retained cut zone just before the BNSF rail tunnel at Pike St. The northbound bore will stay deep and curves slightly eastward, dipping under the BNSF rail tunnel and portaling in the middle of Western Ave between Blanchard and Bell Streets, where it will send traffic under the new southbound flyover and into the Battery Street Tunnel.

These options provide the following advantages:

- Trucks are provided for
- No disruption to the waterfront
- Minimal disruption to utilities
- The seawall construction is de-coupled allowing it to be carried out as part of the waterfront development.
- A shorter tunnel is provided reducing tunnel ventilation requirements

Traffic and demand management would be required as described for Option BT1. These options have the following disadvantages:

- The alignment of the northbound tunnel into the Battery Street tunnel requires a steep gradient and tight curve.
- The south bound connection to the Battery Street tunnel would require some disruption to the SR 99 traffic, although the north bound tunnel could be used to partly alleviate this.

Although twin bored tunnels are proposed for these options, a single stacked bore which restricts trucks, as described in Option TB1, could be used. A twin three-lane configuration could also be considered; however this would require a larger tunnel (approximately 50-ft) and would require a deeper alignment to contend with the poor ground conditions and to pass beneath the BNSF tracks making a satisfactory alignment difficult.

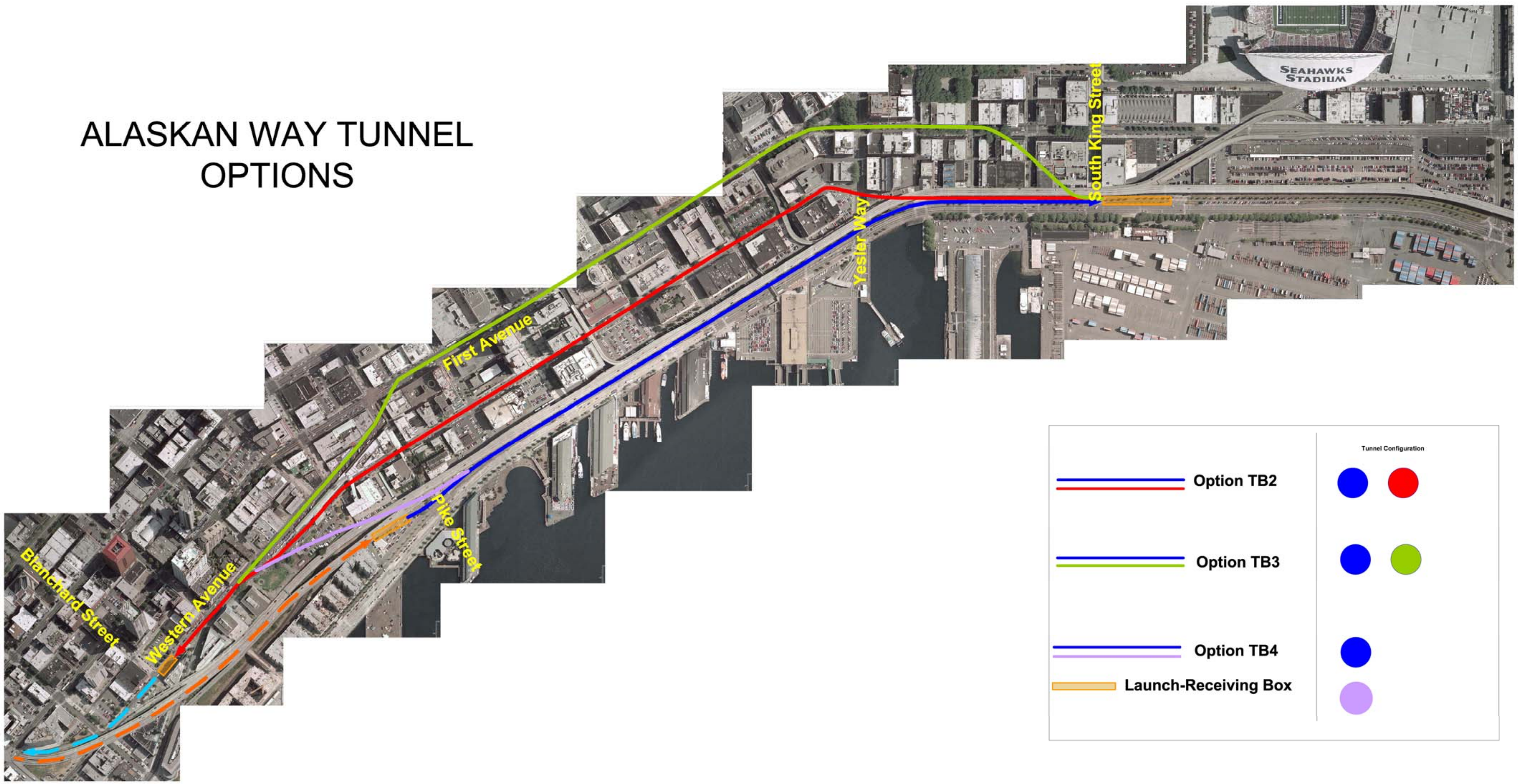

Figure 8: Twin Bore Options

2.2.4 Immersed Tube

The use of immersed tube technology was considered for the viaduct replacement. This comprises the precasting of box shaped tunnel sections, sealing the ends and floating the sections into location and then sinking them into place in a pre-excavated or dredged channel. The sections are connected together and the water evacuated from the tunnel.

If the tunnel was located along the existing Alaskan Way a significant excavation would be excavated and flooded to allow floating in of the sections. It is anticipated that while the construction of precast segments off site would remove one construction activity from the waterfront area, the disruption to the waterfront would be significantly greater than using a top down cut and cover tunnel as proposed above.

Locating an immersed tube tunnel outboard of the current pier line is likely to have significant environmental effect as a result of dredging the channel, and given the steep slope of the mudline beyond the piers it is unlikely to allow a feasible alignment. The Harbor Island shipyard located on the south end of Elliott Bay will also impede such an alignment. Without relocation of the yard, a completely new alignment would have to be developed and the overall project goals would not be satisfied.

This alternative has not been further evaluated.

2.3.4 Summary of Options

A comparison of the options discussed above with the current tunnel scheme is given in the Evaluation Matrix presented in Table 3. The stacked bored tunnel option (BT1) provides the greatest opportunity to reduce the project cost and the disruption that construction will cause at the expense of providing less capacity and requiring trucks to use alternative routes. Top down methods (CT2) provide the most effective way of minimizing impacts to the surface during construction while providing the full capacity of the current scheme.

Alaskan Way Viaduct Replacement – Tunnel Options Evaluations Matrix

Evaluation Criteria	Current Cut and Cover Tunnel (dual 3 lane - Stacked)	Two Lane Highway with Reduced Shoulder	Top down construction to reduce construction impacts (Dual 3 lane stacked)	Top down construction with Dual two lane stacked	Single Stacked Tunnel First Avenue to Denny Way Alternative (	Twin Bore Options
		Option CT1	**Option CT2**	**CT1 + CT2**	**Option BT1**	**Option BT2, 3, 4**
Disruption to waterfront	HIGH (Tunneling carried out in open cut)	HIGH (Tunneling carried out in open cut however volume reduced)	LOW (Majority of work carried out below ground)	LOW (Majority of work carried out below ground)	MINIMAL (All surface work carried out at portals)	MINIMAL (All surface work carried out at portals)
Disruption to Alaskan Way Viaduct during construction	HIGH (Significant closures to allow connections)	MODERATE (Closures required however extent minimized due to smaller tunnel)	HIGH (Significant closures to allow connections)	MODERATE (Closures required however extent minimized due to smaller tunnel)	LOW (Portal site selected to minimize impact on viaduct)	MODERATE (Impacts when connecting north end of south tunnel))
Cost	HIGH (Current Estimate $4.63 Billion)	MODERATE (Reduced volume)	MODERATE (Minimize length of impacts at surface)	MODERATE (Reduce volume and extent of impacts at surface)	LOW (Minimal utilities relocations, and traffic constraints, single longer tunnel)	LOW (Minimal utilities relocations, and traffic constraints, two tunnels)
Schedule	HIGH (7 to 9.5 years)	MODERATE (Reduced volume of excavation)	HIGH (Reduced access may increase, however balanced by independence from surface street)	MODERATE (Reduced volume of excavation)	LOW (Reduced utilities impacts and independent from surface streets)	LOW (Reduced utilities impacts and independent from surface streets)
Alignment	GOOD (Achieves alignment goals)	GOOD (Achieves alignment goals)	GOOD (Achieves alignment goals)	GOOD (Achieves alignment goals)	GOOD (Achieves alignment goals)	MODERATE (Tight radius into Battery Street Tunnel for NB tunnel)
Highway Connectivity	GOOD (Provide adequate slips)	GOOD (Provide adequate slips)	GOOD (Provide adequate slips)	GOOD (Provide adequate slips)	GOOD (Provide adequate slips)	GOOD (Provide adequate slips)
Capacity	HIGH (Designed for anticipated forecasts)	REDUCED (Requires redistribution of trips)	GOOD (Designed for anticipated forecasts)	REDUCED (Requires redistribution of trips)	REDUCED (Requires redistribution of trips)	REDUCED (Requires redistribution of trips)
Environmental Impact	HIGH (Significant amount of spoil removal/trucking)	MODERATE (Reduced volume)	HIGH (Significant amount of spoil removal – trucking along Alaskan Way reduced)	MODERATE (Reduced volume)	LOW (Substantially lower spoil removal/trucking despite longer tunnel)	LOW (Lower spoil removal/trucking)
Utility Impacts	HIGH (Open cuts extends impacts on Utilities)	HIGH (Open cuts extends impacts on Utilities)	MODERATE (Utilities replaced after roof slab cast)	MODERATE (Utilities replaced after roof slab cast)	LOW (Impacts at portals only)	LOW (Impacts at portals only)
Truck Traffic	ACCOMMODATED	ACCOMMODATED	ACCOMMODATED	ACCOMMODATED	REDIRECTED	ACCOMMODATED
Geotechnical Impacts	HIGH (Significant excavation in poor ground)	HIGH (Significant excavation in poor ground)	HIGH (Significant excavation in poor ground)	HIGH (Significant excavation in poor ground)	LOW (Majority of tunnel in competent ground)	MODERATE (Poor ground along waterfront)

Table 3: Options Evaluations Matrix

3 Alternative Funding and Procurement Models

3.1 Procurement Models

3.1.1 Traditional Model

In the procurement of large, complex public infrastructure a number of models have been put into practice. The predominant model in the United States has been and continues to be to this day the so called "Design-Bid-Build" model. In this model the main underlying risks of a project are retained by the public sector. These risks typically include: design/construction cost and schedule, O&M costs, facility damage/loss, expansion and rehabilitation costs, revenue risks (user-paid toll schemes), third-party liability, acts of God, and obsolescence.

An important and often overlooked characteristic of publicly owned, financed and operated projects is that in effect there is no (financial) equity in the project. What is meant by this is not only the fact that most if not all such projects are essentially 100% debt financed, but also that there is limited incentive to manage all or even most project risks because there is no equity capital at stake. This is particularly true with regards to cost overruns during initial construction as well as long-term liabilities (O&M, rehabilitation and obsolescence costs).

While historically this model has served us reasonably well in so far as the infrastructure has been developed, it is becoming increasingly apparent that the hurdles are getting higher:

- Traditional funding sources insufficient to build new or replace/expand existing infrastructure
- Project delivery methods have proved to be inadequate to manage cost and schedule risks, especially with regards to large, complex projects
- Incentives not in place to manage life-cycle goals and risks.

3.1.2 Public Private Partnership Models

In contrast to the traditional model described above and its forward-looking challenges, alternative models have been developed in various countries and other States to attempt to address these issues. The fundamental point about Public Private Partnerships (PPP) is that they aim to engage the private sector to create a successful operating business around the delivery of a service (i.e. road transportation) through an appropriate risk and responsibility sharing arrangement. PPPs are not about financing, they are about building businesses that create value for their customer's money.

A PPP model cannot create funding out of thin air. If properly designed, however it can create value by delivering the same service at a lower total cost:

- Recognition and management of development and operating risks – equity capital has the incentives to manage these risks
- Innovation in the design, construction and operation of the project/service – public sector defines the performance goals with clear service specifications and allows the private sector partner to develop cost effective solutions to deliver the project/service

In the PPP context the public sector works from the perspective of its policy goals – economic development, safety of the traveling public, etc – to define a process that allocates risk. The risk allocation usually contains positive feedback loops that incentivize the public sector to ensure that value is being created and delivered to the users. They are also designed to incentivize the private sector to perform its duties thereof.

In the broadest terms, the degree of risk transfer in any given context or project will be a function of the respective abilities of the public and private sectors to manage them. The private sector's interest in assuming some of these risks is commensurate with its ability to manage them and generate a financial return by providing the services which these risks are associated with. For example, private parties are generally willing and able to assume the design, construction and operation risks associated with highways. In the case of projects funded with user-paid tolls (i.e., toll roads), they are also willing and able to assume future traffic and tariff risks. Where the projects are funded with public monies (upfront and/or future payment streams), they are willing and able to assume the public sector counterparty risk.

The decision of which model to use will therefore be based on consideration of:

- The legal and political context allowing a given allocation of responsibilities and degree of risk transfer
- The relative abilities of the public and private sector in that context to perform on the corresponding responsibilities and manage the risks
- The specific project risks and their relative importance.

3.1.3 Summary of Procurement Models

The various models and their key features can be summarized as follows. The models are listed in order of increasing level of risk transfer to the private sector.

Design-Bid-Build ("DBB")

- Public sector plans and designs project, private bidding for construction, public ownership (i.e., operates and maintains the project)
- Initial investment and O&M costs paid by user-paid tolls/fees, taxes, or a combination of these two
- Predominant model in the United States
- Model currently being pursued by principal stakeholders of Alaskan Way Viaduct project

Build-Transfers ("BT")

- Turnkey delivery by private sector providing design, construction, and construction financing resulting in public ownership
- Public permanent financing and public operation
- This model is currently being used for the Tacoma Narrows Bridge project

Build-Lease ("BL")

- Similar to BT, but uses lease form for private financing and transfer to public sector, public operation during lease term

Design-Build-Operate ("DBO")

- Private sector designs, builds and operates facility for the long term

- Public sector provides construction and permanent financing through tax exempt financing

Build-Transfer-Operate ("BTO", also known as "DBFO")

- Private sector design, builds and generally finances the facility
- Private party transfers title to public sector at construction completion and then contracts to operate facility
- Investment is recovered over time through user-paid tolls/fees, publicly funded revenue stream, or a combination of these two
- Operating agreement sets responsibility of private sector to perform services and of public sector to oversee such performance
- Currently being used for the SR125 Toll Road in San Diego, California and other projects in Texas and Virginia

Build-Operate-Transfer ("BOT")

- Variation of BTO where title passes back to public sector at end of long-term concession period
- Also used for rehabilitation and expansion of existing facilities (eg, recent sale of Chicago Skyway and Indiana Toll Road long-term leases to private sector)

Build-Own-Operate-Transfer ("BOOT")

- No operating relationship with public sector, transfer at the end of useful life to public sector

Build-Own-Operate ("BOO")

- Essentially Private

Design-Bid-Build, Build-Transfer and Build-Lease arrangements are generally based on Service and Management type contracts. To qualify for the label "Public Private Partnership" (PPP), in our view, there has to be a greater degree of private sector participation (i.e., greater risk transfer to it). In the context of this paper we consider Design-Build-Operate, Build-Transfer-Operate and Build-Operate-Transfer models to be PPPs. These models are generally based on Franchise and Concession type contracts. Beyond that the models can be more rightly characterized as Divestitures or full privatizations.

3.2 Public Private Partnerships

The Public Private Partnership (PPP) model has been used in Europe, Australia, Asia and some Latin American countries for over 15 years. It is becoming more popular in Canada and some States in the US such as Illinois, Virginia, Texas and California. In its broadest sense a PPP is the creation of a private business that delivers a public service, in this case vehicular transportation. The main drivers to date for the use of PPP's have been:

- Inability to publicly finance project costs – initial and life-cycle – with available funding sources
- Long cycle from identification of need to operation due to sequential nature of traditional model

- History of unanticipated cost overruns and extended schedules, particularly for major projects
- Lack of experience and resources to develop projects, especially large and/or complex ones
- Prioritization of public funds away from maintenance during operation, leading to shortened useful life of the assets, reduced performance, and greater costs to users.

Different PPP flavors have been developed to address these issues to varying degrees and to suit the circumstances of a given project. The record is that PPP's are better able to mitigate project risks and provide better value for the public sector and users, provided that the model is tailored to the project and its legal and political context.

3.2.1.1 Principal Benefits

It is of critical importance when comparing the procurement of a project under a 'traditional' versus a PPP model that the life-cycle costs and benefits be included in the evaluation. Generally speaking, while there are substantial benefits at the front end of a project in a PPP model, the main benefit is ultimately that the public will receive an equal or better service at a lower total cost. By total cost what is meant is the sum of initial costs including the risk of cost overruns and the cost to operate, maintain and rehabilitate the facilities that provide the service.

The benefits typically reported of PPP's are:

- Capital markets have the ability to generate larger financing quantum from available funding sources than traditional public finance
- Shortened development cycle due to financing advantages and fast-tracking of design-build
- Most sources of cost and schedule risk passed down to private party (i.e., the public-sector Owner has significant protection against cost and schedule overruns)
- Ability to select key project/service delivery management expertise among competing private parties, especially for large, complex projects that the public-sector Owner may have limited experience
- Greater opportunity for value creation given design-build arrangement and consideration of life-cycle trade offs between initial and ongoing O&M costs
- Public-sector Owner conducts performance oversight at all stages
- Whole-life costs and associated risks recognized and funded upfront.

3.2.1.2 PPP Funding

In this context it is critical to differentiate between "funding" and "financing". The Owner provides a revenue stream directly or, in the case of user-paid tolls, indirectly (i.e., the funding). The private party provides risk capital in the form of an equity investment plus debt sources (i.e., the financing). The funding flows to the private party to pay for project costs (design & construction, operation & maintenance, and debt service costs) and provide a reasonable rate of return to it.

The funding flow may be structured as a payment mechanism which would include a combination of the following:

- Publicly funded payment stream:

- (1) In some cases direct payments during construction for all or part of the initial capital investment ("capital payments")
- (2) Direct payments during operation, usually tied to some performance measure such as availability, safety, etc. or to traffic volumes ("shadow tolls")

- User-paid toll stream:
  - (3) Tolls that can flow either to the Owner or directly to the private party in which case the traffic risk is passed down to it.

The first two forms of payment are typical for projects in which user-paid tolls are either not feasible for economic or political reasons, or when user-paid tolls alone are insufficient to pay for the project. For example, in Canada most highway PPP projects are being undertaken with a combination of capital and availability payments[2]. Some projects in the US are being developed in this manner, for example, the Port of Miami Tunnel project.

The money to fund the forms of payment (1) and (2) must come from public sources. In the case of the Alaskan Way Viaduct replacement project, the funding sources that support the current identified funding, i.e., gas tax, federal earmark, and other sources described above, would have to be used to fund them. The most efficient use of them would be to pass down the share of future annual revenue from the gas tax that has already been allocated to the Alaskan Way Viaduct project, for example, to fund an availability payment mechanism spread over the term of the concession period. This would allow the private concessionaire to financially leverage that future cash flow using the optimal financial techniques available to it in the capital market of its choice.

In some projects the third form of payment, user-paid tolls, can be designed to fully fund the project. These are typically, but not always, green-field road projects with a strong traffic demand rationale and average capital investment requirements (i.e., access-controlled highways with conventional features). An example would be the SR-125 project currently under construction in San Diego, California.

Complex projects with unusually high capital investment requirements, such as the Alaskan Way Viaduct replacement project, are typically not good candidates to be fully-funded by user-paid tolls. Nevertheless, the SR-99 corridor has some of the traffic characteristics that make it a compelling case for a concession, even if that revenue cannot reasonably be expected to fully fund the project.

Hybrid structures using a combination of these three payment sources are also seen in the market. As noted earlier, the Golden Ears Bridge project in Vancouver is currently under development based on a hybrid of capital and availability payments funded by the regional transportation agency and user-paid tolls.

3.2.1.3 PPP Financing

Under a properly designed and applied model, the key financing skill brought by the private party is its ability to generate a larger quantum to pay for initial total project cost than can be generated by a traditional model. The above sources of revenue carry different types and degrees of risk from the perspective of the private party providing the financing, hence they will result in different financial structures and target rates of return. In order to maximize this value creation the PPP market will look for:

- A strong overall legal framework

2 An exception is Route 407 in Toronto which uses tolls.

- Clear and rational allocation of risks
- Balanced upside/downside risk profile
- Robust lender rights

The appetite of potential private parties to finance a project such as the Alaskan Way Viaduct replacement will depend whether the public agencies responsible for the project can design a structure that addresses these issues in a balanced manner. The public agencies have a duty to get best value for public monies and to maximize the social and economic benefits of the project. The private party's interest is to generate a return on invested capital. These goals can be complementary with an equitable distribution of risk and incentive mechanisms that support each others' goals. There are examples of projects where this has been achieved with different formulas that are tailored to their circumstances. Likewise, there have been sufficient projects implemented that the "lessons learned" help to achieve this balance.

3.2.1.4 Whole-life Costing and Financing of PPP's

A significant aspect of a PPP procurement that must not be overlooked is that the concessionaire assumes most of the long-term liabilities that are normally not priced during the conventional public development process. To make an apples-to-apples comparison of procurement models, the public agency's future liabilities in a traditional design-bid-build model must also be accounted for. These would include:

- Operations costs
- Routine and Major Maintenance costs
- Insurance (or if not insured the actuarial value of third-party liabilities)
- Replacement capital expenditures.

As would be expected, these costs are very significant for a highway project and especially so for one of greater than average complexity such as a long tunnel. Typically in a PPP model not only are these future liabilities priced into the financing, but their funding is locked into the project. A common public perception regarding gas tax revenue is the lack of confidence that these monies are being fully reinvested in transportation and/or that the most efficient use is not being made. This legitimate concern can be mitigated if the procurement model is well designed and it is properly communicated to the public.

In this regard, the key benefit to the public is that their dollars, be them gas tax dollars or user-paid tolls, are reinvested into the road to maintain the level of service that they expect. These benefits are felt, among other things, in reduced congestion due to improved incident response and traffic management, improved riding surface quality, and faster repairs to features such as safety barriers, etc.

3.2.1.5 DBFO Model

A common form of PPP for road projects is the Design-Build-Finance-Operate model (DBFO; similar to BTO and BOT models described above). Although there are other 'intermediate' models, the DBFO model in most circumstances fully captures the potential benefits of private participation in public infrastructure.

A DBFO model creates a long-term concession contract between the public agency (the Owner) that owns the right-of-way and the assets, and a stand-alone private company (the Concessionaire) that delivers the services.

The essence of the DBFO model is that the Concessionaire commits to finance the design, construction, operation and maintenance of the assets for a long period of time, usually fixed, in exchange for a revenue stream over that period of time. The revenue stream provides the Concessionaire with a source of funds to service debt, pay for operation and maintenance, and generate a return on its equity investment. The Owner retains clear rights with respect to design and construction standards, quality, and operations and maintenance performance. At the end of the concession period the Concessionaire hands back control of the assets, usually with requirements to meet remaining useful life criteria.

The main criteria used by private entities for judging the value of the Concession rights include:

- Revenue stream – in the case of direct payments the credit-worthiness of the counterparty, in the case of traffic dependent revenue (tolls) the fundamentals of the transportation problem
- Concession Contract – robustness of risk transfer, clarity of roles and performance standards, lender/bondholder protection provisions, and commercial viability
- Technical (design, construction, O&M) – degree of risk and its ability to manage them
- Political – likelihood of material changes in law and/or political support.

3.3 Funding Mechanisms

The purpose of the funding mechanism is to provide the funds to pay back the initial investment, the operating costs, additional investments to sustain the facility, debt service, and the financial return to the equity investors. In the context of PPPs, the funding or payment mechanism has another important role which is to provide the feedback loop that links service specification (defined by the public sector) and the outcome (delivered by the private sector). The payment mechanism should incentivize the delivery of the desired level of service (quality and quantity).

In PPP highway projects a number of funding or payment mechanisms have been used. These include:

- **Capital payments** – these are upfront direct payments made by the public-sector Owner to the Concessionaire, usually against progress during construction
- **Availability payments** – this is a stream of future, periodic payments made by the public-sector Owner to the Concessionaire on the basis of a precisely defined measure of road availability to the users (i.e., it is a measure of the key performance metric of relevance to users of the road)
- **Other performance payments** – similar to availability payments except that they are based on other performance metrics such as safety record, incident response time, measures of congestion, etc.
- **Shadow tolls** – this is a stream of future, periodic payments made by the public-sector Owner to the Concessionaire on the basis of traffic counts and a contractually agreed tariff structure over time
- **User-paid tolls** – this is a stream of future, periodic payments that usually flow directly from the users of the road to the Concessionaire on the basis of traffic volume. The tariff structure can be contractually agreed between the public-sector Owner and the

Concessionaire upfront, or the Concessionaire is given a significant degree of freedom in setting tariffs

- **Other revenue generators** – these would include land development along the corridor, cost-sharing of added features with other private sector partners, and secondary related revenue generators such as rest areas, gas stations, etc.

Note that of the above funding mechanisms only one involves user-paid tolls. Most PPP projects rely either on a single payment mechanism or a combination of some of the above. We do not know of any project that relies on all of the above.

The main characteristics of each one is discussed as follows and the key factors and circumstances when each is used.

3.3.1 Key Issues

The main factors that, generally speaking, influence which payment mechanism is used can be summarized as follows:

- **Political and legal** – in many regions user-paid tolls have proved to be politically challenging to implement due to history and expectations of users and taxpayers in general. Most PPP projects in Canada and the UK, for example, are availability or shadow toll schemes with some measure of capital payments as well. Most PPP projects in Australia, Chile and Spain on the other hand are based on user-paid tolls. In the United States the few PPP projects in the market have been based on user-paid tolls[3], with the exception of the Port of Miami Tunnel project that is currently being bid by Florida Department of Transportation which will be based on an availability payment scheme.
- **Economics** – if the project stands up on its own with user-paid tolls alone as the funding mechanism then usually that becomes the preferred mechanism. It is not unusual for very large, complex projects that have a high initial cost to require direct public funding of some one or more of the forms described above. In such cases the traffic will typically not bear sufficiently high tariffs to generate enough revenue to fund it.
- **Participants** – the public and private sector participants in the relevant market for the PPP project have to have the experience, resources (technical and financial), and ability to assume the risks associated with each funding mechanism. For example, the contracting authority (public) has to have the legal mandate to enter into a long-term contract with a private party that commits it to upfront (capital) and/or future (availability, performance or shadow) payments to the private party. The private sector has to have access to equity and debt markets to finance the project.

3.3.2 Capital Payments

These are payments usually made during construction by the public-sector Owner to the Concessionaire. The payments can be made directly at project inception in a lump sum or, more usually, against progress during construction.

Capital payments are used typically when:

3 It is interesting to note that historically the pre-war Turnpikes in many States in the East Coast were privately developed projects financed with user-paid tolls. After the II World War the United States shifted most highway procurement to a public model funded with the gas tax.

- The project has a relatively high initial cost (say, per lane-mile of road) and the future payment streams are projected to be insufficient to finance the investment
- Substantial upfront funding (lump sum) has been provided to the contracting authority by another public-sector entity and such funding would be otherwise lost and cannot be converted to a future stream of periodic payments (eg, a Federal earmark)
- In some cases the traditional (public) tax-exempt financing can generate a greater quantum than the private sector financing for the same future revenue stream
- The project has an unusually high technical risk profile which the private sector participants are not willing to finance themselves (eg, the project requires use of construction techniques in situations without a track record).

In most cases the risk of this payment mechanism, from the private sector's perspective, is considered to be low because the funding has been secured upfront by the contracting authority. We also note that when capital payments are used they typically represent a substantial percentage, but well below all, of the initial cost

3.3.3 Availability and Other Performance Payments

This is a stream of future, periodic payments made by the public-sector Owner to the Concessionaire on the basis of a precisely defined measure of road availability to the users. Other performance measures can be used, such as safety performance. Such measures are introduced when specific incentives are desirable. The payment mechanism is carefully defined in the Concession contract.

In practice availability payment schemes tend to provide a highly uniform, periodic, and relatively low risk revenue stream. All else being equal, projects funded with availability payments tend to be priced at relatively lower rates of return than tolling schemes.

When other performance measures are used they tend to be additional to and of a smaller relative magnitude than the availability measure. The former tend to be somewhat more variable than the latter.

The contracting authority will typically fund this payment mechanism with future tax revenue, either by earmarking specific tax revenue sources (i.e., creating a secured tax revenue stream) or from its general fund revenue (i.e., using its full faith and credit). In either case it is crucial that the contracting authority (public) have proper legal authority to enter into long-term contracts. If a secured tax revenue stream is not used, then it is important that the contracting authority is highly rated by the credit rating agencies.

Under these conditions, the risk of this payment stream is therefore generally considered to be low. From the private party's perspective there is also the technical risk of not meeting the availability performance requirements set out in the contract during the operation of the project. In most cases in practice this risk is also considered low.

This mechanism is typically used when user-paid tolls are not feasible either because of political/legal reasons or because the economics of the project are such that such tolls alone do not support it.

3.3.4 Shadow Tolls

The funding source(s) for a shadow toll is very similar to that of an Availability Payment scheme. Its main features are:

- The Concessionaire is exposed to traffic risk

- The traffic risk is tempered by the fact that changes in tariffs are not felt by the users, hence demand is not a function of pricing

As a consequence the payment mechanism is riskier than an availability scheme. Many private sector participants are indeed attracted to being exposed to long term traffic risk in prime transportation markets with limited alternatives/capacity.

3.3.5 User-paid Tolls

When the users of the road pay tolls pricing of the service can act as the market clearing mechanism between demand and supply. This is particularly true with more 'sophisticated' tolling schemes where pricing is dependent on time-of-day, congestion levels, etc. More generally, user-paid tolls more closely assign the costs of providing the transportation infrastructure to those who use it. Through differentiated pricing it can also more closely discriminate between the classes of users who cause the most wear and tear (eg, passenger vehicles versus heavy trucks which cause most deterioration of pavements). These important features make user-paid tolls the most efficient funding mechanism for roads from a strictly economics point of view.

It is recognized on the other hand that user-paid tolls are challenging to implement in regions where there is little or no history of tolling and where the traveling public is of the understanding that taxes do (or should, depending on one's point of view) fund the transportation infrastructure.

Another historic consideration has been that of the mechanism to collect the toll. Manual (cash) toll collection is clearly cumbersome and tends to add to congestion. It is more amenable for inter-city routes where tolls can be collected at relatively larger intervals and/or where the added time to a trip is relatively small percentage wise.

Today however the mechanics of toll collection is effectively no longer an issue. With the advent of fully automated electronic transactions using transponders and optical verification systems it is possible to collect tolls without affecting traffic flows at all. Open road (aka free-flow) tolling systems have been successfully implemented in several urban highways around the world[4]. The technology and payment mechanism systems have been proven to work with a high degree of confidence for both the users as wells as the toll operator.

Of all the payment mechanisms considered here, user-paid tolls that are fully passed through to the Concessionaire would be riskier. However, as commented in the previous section, markets such as Seattle and corridors such as the SR-99 corridor represent the type of traffic revenue risk that private sector participants in PPP/DBFO procurements are very attracted to:

- In the long term traffic revenue tends to increase at the rate of GDP growth
- O&M costs however tend to increase at the rate of CPI
- The long term growth of the net difference between revenue and operating cost results in a large and growing 'wedge' that can provide attractive returns to patient equity investors

4 Examples of full-blown open road toll systems include: Highway 407 in Toronto, Cross-Israel Highway, and the four urban highway concessions in the city of Santiago, Chile. Electronic tolling with barrier/gate control has been implemented even more widely. Hybrid systems have been used or are being constructed in a number of other projects such as the Pocahontas Parkway in Virginia, SR125 in California, Chicago Skyway, and a number of other publicly-owned and operated highways, bridges and tunnels in the United States and elsewhere.

- The debt markets are able to structure and price that pattern of project cash-flows[5].

While many PPP/DBFO projects around the world have been successfully structured without any user-paid tolls[6], if they are politically and legally feasible in the current market their inclusion would result in a more attractive project. More broadly speaking on the other hand it is important to note that, all else being equal and regardless of who holds the traffic risk (the public or private sector) in a given PPP/DBFO project, user-paid tolling is the most economically efficient funding mechanism.

3.4 Funding Sources

3.4.1 General

A number of funding sources, alone or in combination, may generate additional project funding for the "Core" project of the Tunnel Alternative. The current finance plan has identified $2.4 billion of secured funding and up to $2.6 billion of anticipated funding. It is not clear how much of the anticipated funding will eventually be secured, and therefore to provide examples of alternative funding sources we have assumed a shortfall for the tunnel option of between $300 million and $500 million. Although large, these figures are not unachievable, and the adoption of these approaches may not only make the tunnel more affordable, but may allow funds to be freed up for other critical projects such as the SR 520 floating bridge replacement. The sources discussed in this section are therefore additional to those already identified by the State.

In order to simplify the analysis, the discussion that follows considers the incremental funding needed to close the gap primarily from the perspective of a traditional public-finance, design-bid-build model for the "Core" project. The legal and/or political feasibility of implementation of each option is treated in a cursory manner.

It is important to recognize that alternative methods of project implementation such as a Public Private Partnership (PPP) require an analysis of the funding sources as a whole. Under the right conditions the private party responsible for arranging the financing in a PPP will use capital market financial structures not available in public financing. The present value of a given stream of future cash-flows (revenues) thus generated can potentially be larger than in a conventional public-finance, design-bid-build model.

Because of these differences, a separate analysis would be required to size-up the funding gap under a PPP model. The payment mechanism could then be designed in relation to what would be attractive to the market. Likewise, the analysis would also extend to the legal and contractual framework and the level of political support. This is discussed in more detail in the next chapter.

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5 Traditional public infrastructure municipal bond financing is tax advantaged, however, it tends to be structured based on conservative traffic forecasts for 30 year or less horizons. Debt financing for PPP/DBFO projects in this context tend to be highly structured in terms of amortization structure, is based on longer horizons and thus better captures the long-term revenue-cost wedge, and takes advantage of depreciation to at least partially offset the tax advantage of municipal bonds.

6 With the exception of Highway 407 in Toronto, all Canadian PPP road projects in recent years have been and continue to be procured as availability and performance based payment schemes, with additional capital payment schemes in some cases, which are fully funded by the public contracting authority. This is the case with the Sea-to-Sky highway in Vancouver, the Okanagan Lake Bridge in Kelowna, the Edmonton Ring Road and the Stoney Trail Highway in Calgary.

3.4.2 Real Estate Development

A possible source to raise funds from existing City-owned land is either ground leases or outright sale of parcels. The parcels could be within the right of way, in which case only ground leases would probably be feasible, or elsewhere in the City.

A high-level analysis of the revenue that could potentially be generated by ground leasing of City parcels in the downtown business district indicates that is likely not a feasible option in terms of generating, on its own, enough funding to close the funding gap assumed. The main constraint is that the quantum of development would be larger than can be accommodated on current City-owned parcels and/or be absorbed by the real estate market. A full account of this is not therefore presented here. However, it is recognized that some level of funding could be generated and that, in the context of a PPP model, it could provide business opportunities on the margin.

3.4.3 User-paid Tolling

Although tolling is used only for the ferry system in Washington State at the moment, it is being considered for future and some existing highway projects. WSDOT has commissioned several tolling feasibility studies for the road network in the Puget Sound area. The impetus of these studies is the forecast of large investments required for congestion relief and expansion of existing infrastructure (e.g., SR520 widening).

Some of the key ingredients for tolling to provide substantial funding for construction of SR99 are, in our view, the following:

- Setting of toll rates to maximize revenue
- Toll rates scheduled to escalate over time according to GDP growth or regional CPI
- Use of electronic tolling collection (“ETC”; aka “open road” or “free flow” tolling)
- Implementing policies to promote widespread adoption of ETC among drivers.

We would envision three basic alternatives for implementation of tolls to benefit the Alaskan Way Viaduct replacement project, in order of increasing revenue creation potential:

- Tolling of SR-99 alone:
  - (1) Create HOV/HOT lane in each direction
  - (2) Toll all traffic lanes
- Network tolling strategy:
  - (3) Toll SR-99 and I-5

It is outside the scope of this level of analysis to evaluate alternatives (1) and (3). On the other hand, they represent viable scenarios that we recommend should be studied at the appropriate level of detail, at least from a feasibility standpoint. HOV/HOT lanes are easier to implement than tolling all lanes of a facility because a ‘free’ alternative is maintained on the facility. In many jurisdictions political support for HOV/HOT lanes has proven to be more feasible than tolling all existing lanes of a facility. Alternative (3) is essentially a network strategy that offers the greatest opportunities to comprehensively manage congestion and generate substantial revenue.

For alternative (2) above, i.e., tolling of all traffic lanes, we can make a rough estimate of what toll rate would need to be charged to close the funding gap. The basis is the actual and projected traffic volumes presented in the June 2002 "SR-99 Alaskan Way Viaduct Project – Toll Feasibility Study", conducted for WSDOT and the City of Seattle. A number of important caveats must be noted regarding the use of that study for this analysis:

- The study estimated a diversion of traffic of a tolled facility compared to a non-tolled facility of 13-17%
- It has been noted by others that the study's traffic model likely overstated the capacity of alternative routes, hence *underestimated* the willingness to pay of SR-99 drivers
- The focus of the study was to determine the economically efficient toll rate, not the revenue maximizing rate; the study noted that was outside its scope
- The previous points notwithstanding, the study was based on assumptions of toll rate per mile and per trip for a 4-mile section of SR-99--significantly less than assumed in the present analysis; a deeper analysis of demand elasticity would be required to have confidence in the rough estimates presented herein
- The study did not consider tolling of off-peak traffic, whereas the present analysis considers peak/non-peak tolling at all hours.

In the present analysis assumptions with regards to use of electronic toll collection (ETC), peak/non-peak differentiated toll rates, and growth rates for traffic and toll rates are consistent with the June 2002 study, except that we assume a larger rate of toll rate increase. The June 2002 study assumed an average annual rate of increase of tolls of slightly less than 1%, whereas for this analysis we assume a rate closer to long-term CPI of 2%. The revenue estimates deduct the operating cost of the ETC system, which is assumed at $0.12 per transaction. No other operating costs are deducted from the estimated toll revenue. Finally, we note that the June 2002 study did not explicitly state the financial assumptions used to calculate the toll revenue financing potential[7].

3.4.3.1 Estimated Value of Tolling – Traditional Procurement Model

To calculate the financing potential in the context of a traditional procurement model, we assume that 30-year tax-exempt bonds backed with toll revenue (net of ETC operating cost) with an interest rate of 7%. A detailed financial analysis that takes account of the tax-exempt and municipal bond market's view of traffic risk is beyond the scope of this analysis. The underlying assumption is that the traffic risk would be borne by WSDOT and that it would collect the tolls. Generally this results in conservative underwriting in this type of financing. The figures below must therefore be used with caution. Nevertheless, it provides an order of magnitude analysis of the value of tolling in the context of the funding gap discussed above.

Based on the assumptions above and using the traffic forecasts for the improved facility[8], we estimate the required toll rates and financing potential as follows.

7 The study stated that "Each $1 million in annual toll revenue, net of any operating costs, could leverage approx. $7-10 million of capital investment, plus another $1-2 million toward a few years of capitalized debt service costs during construction, via the sale of municipal revenue bonds or similar debt instruments" (page 6). The assumptions made herein imply a slightly greater leveraging of the estimated revenue, possibly due to a lower interest rate assumption and/or longer amortization of the debt. Since the financing assumptions in that study are not provided we cannot comment further.

8 The improved facility, which results in marginally improved operating characteristics and traffic capacity compared to the existing, is labeled "Alternative D" in the June 2002 tolling study. The report indicates that traffic volumes increase by approximately 8% for the improved facility compared to the existing facility, regardless of tolling scenario and forecast year.

Table 4: Estimate of Required Toll Rate to close Funding Gap (*based on un-modified traffic forecasts in June 2002 "SR-99 Alaskan Way Viaduct Project – Toll Feasibility Study"*)

Funding Gap = Financing Potential	Required Toll Rate[9] per trip	Estimated Year 1 Net Toll Revenue
Case (A) $300 Million	$1.30 peak [10] $0.65 non-peak	$19 Million
Case (B) $500 Million	$2.10 peak $1.05 non-peak	$32.5 Million

Comparing the above toll rates with other toll roads in the United States it can be seen that these are at the upper end in terms of rate per mile, but well within the range for rate per trip[11]. The study does not state what the savings in travel time is for a driver choosing a tolled SR-99 over a 'free' alternative route (either I-5 or surface streets), but presumably it would be substantial.

Finally, we note that if the project were to be procured with a DBFO model ("Design-Build-Finance-Operate"), it is very likely that the toll revenue could be leveraged up at more aggressive ratios. Given the history of traffic volumes of SR-99 and the characteristics of the corridor the most likely, but not the only, scenario[12] is that the private concessionaire would take the traffic risk and collect the tolls. On this basis the concessionaire can issue debt with longer and/or structured amortization schedules, it can make use of various financial instruments, and it can take advantage of depreciation expense for tax purposes. This is discussed in more detail below.

3.4.3.2 Estimated Value of Tolling – DBFO Procurement Model

As follows we make a very rough estimate of the financing potential that could be leveraged from a user-paid toll in the context of a DBFO model that addresses these issues in an equitable distribution of risks attractive to the market. Such an estimate carries substantial caveats given the range of unknowns for application of a DBFO model, not least the legal and political context for an implementation. Nevertheless, it serves to

9 The effect of trucks/commercial vehicles is not considered explicitly. The toll rate given can be considered an average over the two.

10 Consistent with the June 2002 tolling study, the AM and PM week-day peak periods add to 7 hours per day. The weekend is considered off-peak.

11 See pages 33 to 37 of the June 2002 "SR-99 Alaskan Way Viaduct Project – Toll Feasibility Study" where the toll rates for several roads in the US are given. The range is $0.02 to $0.50 per mile depending on the facility and peak/non-peak period. The range of toll rate per trip for those roads is $0.25 to $5.50. Note however that the lower end of the range of per-mile rates is for the most part for highways used heavily by inter-city, long distance trips. More generally in the U.S. the toll rates most publicly owned and operated toll roads have not increased to maintain purchasing parity. In other words, toll rates have increased at a slower pace than income per capita. From a congestion management and revenue standpoint this is obviously an undesirable trend that would need to be addressed in the context of this discussion. The June 2002 tolling report for SR-99 makes recommendations to that effect.

12 An alternative scenario would be for the public agency to collect the tolls and retain the traffic risk. The payments to the private concessionaire in a DBFO model would be based on a performance measure, such as availability, safety, or a combination. While this model has seen application around the world, generally speaking it is less attractive to the DBFO market for a number of reasons. An example of this alternative scenario is the Golden Ears Bridge project in Vancouver, British Columbia that is currently being developed by TransLink.

make a comparison of the *potential* for value creation relative to the use of toll revenue in a traditional design-bid-build model.

In addition to the assumptions above regarding use of past tolling studies for SR-99, the basic assumptions for this estimate are:

- Operating costs estimated at 40% of toll revenue
- Financing potential calculated as a multiple of Year 1 EBITDA – use a range of 30x to 40x[13]
- Toll revenue would be supplemented with a publicly funded payment mechanism.

We calculate the level of tolls that would be required to generate a given financing quantum (i.e., $300 million and $500 million funding gap). While this approach ignores the expected benefit of the private concessionaire capitalizing the entire revenue stream (toll revenue + publicly funded payments), it serves to illustrate the expected additional benefit over and above the project's secured funding sources.

As can be seen by comparing Tables 4 and 5, using a DBFO model to raise a given amount of money would result in toll rates that are potentially 25% to 40% less than those in a traditional publicly financed design-bid-build model. Conversely, for the same toll rate the DBFO model would potentially raise a financing quantum that is 25% to 40% larger.

Table 5: Estimate of Required Toll Rate under a DBFO model (*use solely to compare with public financing potential of tolls as presented in Table 3 above*)

Financing Potential from Toll Revenue only	Required peak-hour Toll Rate per trip[14]	
	@ 40xEBITDA	@ 30xEBITDA
Case (A) $300 Million	$0.80	$1.00
Case (B) $500 Million	$1.30	$1.70

As previously stated, a comprehensive analysis of the financing for an SR-99 DBFO procurement would have to assess the robustness and potential upside of future toll revenue, the elasticity of demand in the corridor for the range of toll rates considered, and the overall risk distribution. The above calculation is for illustration purposes only of the *relative* value of a DBFO versus traditional model.

13 EBITDA = net earnings before interest, taxes, depreciation and amortization. These financing multiples have been seen in recent transactions such as the long-term leases of the Chicago Skyway and the Indiana Toll Road. The industry's assessment is that these transactions had optimal risk allocation structures and the market's assessment of the projects' future toll revenue upside is positive. Hence they were able to command significant premiums compared to a corporate bond issue, for example. An EBITDA multiple range of 30x to 40x must is the top end that the market can bear. Therefore these multiples must be used with caution and only to estimate an order of magnitude. Every project is unique in this respect and a proper, case-specific valuation of the expected cash flows would have to be carried out to make a robust estimate of the true financing potential.
14 Assume non-peak toll rate is half of peak hour rate.

3.4.4 Utilities

There are a number of major utilities route which run along and cross the corridor. These will need to be relocated prior to construction. Funding from relocation of existing utilities has already been identified by the City and the funding gap discussed here is net of that contribution to offsetting of costs. Additional funding can be derived from this through rental of space to convey future utilities. Analysis of this option is beyond the scope of this paper. However, our assessment is that such contributions will be relatively marginal.

3.4.5 Taxes and Assessments

Generally speaking the voters in Seattle have historically supported incremental property taxes to support infrastructure improvement bonds for new services, parks, schools, roads, etc.

3.4.5.1 Local Improvement Districts (LIDs)

The removal of the viaduct and its replacement with a tunnel will increase the value of existing properties along the corridor. Mechanisms such as LIDs allow additional revenues to be raised from assessments imposed upon real property which has increased in market value as a result of public improvements. This is a possible funding mechanism for this project. One or more local improvement districts could be formed by the City of Seattle. Financing would be obtained in advance of completion of the project by issuance of LID Bond Anticipation Notes. LID Bonds would be issued when assessments against benefited properties are imposed upon completion of the Project. Bond proceeds would be used to retire the Bond Anticipation Notes, and to pay a portion of the Project costs. Debt service on the bonds would be paid from annual assessment installments paid by property owners. We understand that determining the amount of funding that could be generated from LID assessments is the subject of an ongoing study commissioned by the City. We have not attempted to determine that amount.

3.4.5.2 Increased Tax Base

The redevelopment that is likely to occur around the viaduct if the tunnel alternative is implemented is expected to generate more revenue in property and business taxes. This additional tax revenue would flow to the City's general fund unless a Tax Increment Financing mechanism is used (see next section). It is an open question outside the scope of this paper whether the City could issue debt on the expectation of higher tax base and revenue.

3.4.5.3 Tax Increment Financing

Tax increment financing is not likely to be a viable tool in Washington State in the near future. Washington court rulings based on provisions of the State Constitution for funding schools from property taxes, combined with severe limitations on annual levy increases imposed by Initiative 747, which make it extremely difficult at present to raise significant revenues from any form of tax increment financing.

3.5 Contract Approaches

It is of prime importance that the contractual framework for a PPP/DBFO procurement model establish a clear and equitable risk allocation among the parties that supports the project goals, assigns risks to the parties best able to manage those risks, and creates clear mechanisms to measure and enforce contract performance. A considerable body of experience has been developed over the last 15+ years with regards to the more efficient and successful forms of contract to achieve these goals. Any project being considered for a PPP/DBFO procurement should use as its starting point this body of knowledge and tailor it to the specifics of the project, the legal and political context, and the abilities of the project participants.

The form of contract that would be used in a PPP/DBFO procurement model is that of a Concession Agreement. Some of the key general features of a Concession Agreement are:

- Long-term contract for provision of services by the private party – in the United States 50 to 99 year terms are typically seen[15]
- Risk allocation – clearly enumerated and defined to create certainty within the agreement and for the Concessionaire to be able to pass down some of its risks to other parties/vendors it subcontracts with
- Scope, quantity and quality of the services– must be clearly defined and be based on a performance specification[16]
- Payment mechanism – to be designed to provide a feedback loop vis a vis the provision of the services
- Public sector oversight/monitoring – to be geared to periodically verify performance
- Asset definition – clearly defined scope and responsibility with regards to the physical assets (maintenance requirements, condition at hand-back, etc)
- Other contractual provisions – dispute resolution process, rights of other parties such as debt providers, independent oversight/review, etc.

In our experience the optimum approach to defining a Concession Agreement is based on:

- Start with a market-proven structure that most closely resembles the goals for the project and given the legal and political context
- Contracting authority (ie, the public sector) to tailor that structure as appropriate during the feasibility stage to the point that broad principles are sufficiently defined to address the public sectors' goals while at the same time test the market's appetite for that tailored structure
- During the bid phase the private sector bidding consortia enter into an iterative process of review and comment with the contracting authority to further tailor the contract while preserving the public and competitive nature of the bidding process – allowing some degree of negotiation of key terms of the agreement will generally result in lower risk of the agreement being disputed or re-negotiated post award, and it signals to potential bidders that the project will most likely be attractive to the market at the end of the bid phase

Bidding costs for a PPP/DBFO proposal are relatively high compared to a traditional procurement. It is critical that in order to attract sufficient conforming bids to ensure competitive pricing the public sector must signal a reasonable willingness to incorporate

15 In other countries it is more common to see concession terms of 30 to 40 years. The United State's economic stability and depth of capital markets allows longer terms that to a significant extent make the projects more attractive to the private sector thus optimizing their valuation.

16 Performance specifications, as opposed to prescriptive specifications, are very important in order to allow an appropriate degree of innovation in the delivery of the services. While the burden of demonstrating performance metrics are being achieved by definition falls on the provider of the services, the performance goals and the means to measure them must be clearly defined.

valid feedback from the bidders that is consistent with its ultimate policy goals (within the applicable legal context). By extension it is also critical that the contracting authority have the standing to set the terms and enter into the applicable commitments, and that the legal/political constraints that it must operate within be communicated clearly.

3.6 Project Management Approaches

In order to implement a PPP model, the lead agency in charge of the project would organize a team that brings together the relevant experience and is empowered to implement it. There is a deep body of knowledge from past projects in the United States and other countries that is directly relevant for the Alaskan Way Viaduct project. From these projects the lessons learned can be effectively applied to maximize outcomes. The PPP agency team would then champion the project and the process. It would steer the PPP model through feasibility, bid preparation, award, and oversight during construction and operation.

The optimal approach is for this team to oversee the project through its full life cycle. The team should also be able to undertake certain tasks that might normally be done by other agencies. Examples would be right of way acquisition, negotiation with third parties such as utilities, engineering design review, and oversight during construction.

Some of the key ingredients that that the PPP agency team would work to define are:

- Models of contracts
- Risk transfer mechanisms
- Funding sources, revenue stream(s) and payment mechanism(s)
- Approaches to creating incentives
- Output/performance specifications
- Third-party agreements (utility owners, port authority, etc)
- Oversight procedures and arrangements
- Compensation mechanisms.
- The skills that the PPP agency team would have to bring together to design and implement a PPP model are: Management team with past PPP project experience
- Financial, legal and technical advisors with past PPP project experience
- Contract experts with concession, design-build and O&M contract experience
- During later stages, engineering staff to develop output/performance specifications, conduct design reviews, construction oversight, etc.

3.7 Indicative Implementation Schedule

The schedule for implementation of a PPP model will depend primarily on the ability of the principal stakeholders to create the political and legal/legislative context that would allow the project to be procured this way. Provided that the lead agency responsible for the project supports the concept it is possible to advance a detailed feasibility with the above team, both as part of the process of building wider stakeholder support for the PPP model approach as well as advancing to the preparation of bid conditions and bringing the project to market.

From the starting point of having lead agency buy-in, a reasonably likely schedule can be summarized as follows:

- Detailed feasibility: 9 months
- Stakeholder support: in parallel with feasibility study but could take longer
- Environmental process: could be completed in parallel with the feasibility study (note that when the RFQ or, at the latest, the RFP is released it is of prime importance that the environmental permits be firmly in place)
- Pre-bid engineering planning and design: see comments below regarding level of design to be undertaken by the public agency as part of a PPP model and its timing
- Bid documentation preparation: 4 months
- Bid process (RFQ, RFP, Bid Submittal and Preferred Proponent selection): 10 months
- Financial Close and Notice to Proceed: additional 4 months after Preferred Proponent selection.

Note that during the detailed feasibility and bid document preparation stages (approx. one year) the planning and engineering design that is part of the environmental process can and should be continued to define what are the key parameters of the project that the public seeks (traffic capacity, alignment, performance-based operational and safety features, design features required as part of environmental mitigations, etc). Typically however the engineering design would be developed to no more than a 15-30% level, depending on the size and complexity of the project. The intent is that the project be sufficiently defined to allow bidding teams to understand the public goals, while leaving sufficient scope for innovation in terms of design and construction methods, etc.

Depending on the timing of the completion of the environmental process vis a vis the development of the PPP detailed feasibility study and the bid document preparation, it is conceivable that the pre-bid planning and design activities undertaken by the public sector could be completed in parallel. This would allow the components of the schedule above to occur consecutively without adding time to it.

The above caveats regarding wider stakeholder support and completion of the environmental process not withstanding, the above timeline suggests a total time frame from the decision to undertake the detailed feasibility of the PPP model to Notice to Proceed of approximately 27 months. Given the above caveats, a less optimistic case would allow 36 months to get to the Notice to Proceed. Since final engineering design would be undertaken by the design-build team after the Notice to Proceed, construction would start approximately 10 months after that.

Assuming that the environmental process can be completed concurrently with the bid document preparation stage, the total time frame from completion of the environmental process to start of construction can be estimated as 33 to 42 months.

Finally, we note the following comparative time line with a conventional procurement model (design-bid-build):

- Complete environmental process: before final engineering can be started the environmental process must be completed

- Final (detailed) engineering planning and design: 24-30 months
- Bid documentation preparation: 6 months
- Bid process (RFQ, RFP, Bid Submittal and Preferred Proponent selection): 6 months
- Start of Construction: additional 3 months after Preferred Proponent selection.

The above schedule for comparative purposes suggests a time frame from completion of the environmental process to start of construction can be estimated as 39 to 45 months.

This rough comparison of schedules suggests that there is an opportunity to modestly shorten the procurement cycle. The improvement would be primarily a function of the ability of the lead agency and the interested stakeholders to gain sufficient political and legal/legislative support for a PPP model.

4 Project Organization

4.1 Background

The project currently has several key stakeholders with differing views on what constitutes the success of the project. The formation of a single development agency which combines members of these various stakeholders would provide a single entity through which the SR99 replacement, Alaskan Way, seawall replacement and the waterfront development could be planned and implemented. Supporters of this agency may include: WSDOT, City of Seattle, Port of Seattle, State of Washington. The process and legal issues associated with the formation of such an agency are beyond the scope of this study, however a number of examples of this approach are provided below.

4.2 Case Histories

4.2.1 Background

The approach of a consolidated development agency has been successfully adopted on a number of major developments in Seattle including the Seahawks Stadium, the Pike Street Redevelopment and the Seattle Arts Museum and is therefore supported by state legislation. However, this model requires the redistribution of Authority between agencies which can create an obstacle to their implementation. Other projects that have been approached in this way are described.

4.2.2 Hudson River Park Trust

Hudson River Park Trust is a partnership between New York State and City charged with the design, construction and operation of the five-mile Hudson River Park.

As a public benefit corporation, the Trust is governed by a thirteen-member Board of Directors. They employ a focused, diverse staff with experience in parks, design, finance, public policy, operations and maintenance. They are governed by the Hudson River Park Act, a 1998 law that established both the park and its governing requirements.

One special aspect of the Trust is its fifty-member Advisory Council which plays an integral role in the park planning process. The Advisory Council is comprised of elected officials and representatives from the business, environmental and civic communities.

4.2.3 Toronto

The revitalization of Toronto's waterfront provides the city, the province and the country with an excellent opportunity to ensure that Toronto remains among the best places in the world to live, work and visit. Revitalization is a significant key to future prosperity and Canada's much envied standard of living.

Following the release of the Toronto Waterfront Revitalization Task Force's report in March 2000, the Government of Canada, the Province of Ontario, and the City of Toronto jointly announced their support for the creation of the Toronto Waterfront Revitalization Corporation (TWRC) to oversee and lead waterfront renewal.

The development of successful waterfront projects in other cities such as London, New York, and Barcelona, has shown that a separate corporation with a strong mandate to coordinate and oversee an integrated strategy is crucial to making waterfront revitalization a reality. TWRC was formally established in the fall of 2001 and was up and running in February 2002.

Mission

To put Toronto at the forefront of global cities in the 21st century by transforming the waterfront into beautiful, sustainable new communities, parks and public spaces, fostering economic growth in knowledge-based, creative industries and ultimately: re-defining how the city, province and country are perceived by the world.

Vision

Working with the community and public and private sector partners, the Corporation will create waterfront parks, public spaces, cultural institutions and diverse and sustainable commercial and residential communities. The corporation will strive to ensure that Toronto becomes the city where the world desires to live.

Governance

TWRC is governed by a 11-member Board of Directors, including the chair, appointed by the federal and provincial governments and the City of Toronto. Corporate authorities and accountabilities are set out in Bill 151.

Overall Corporate Objectives

Develop accessible new waterfront communities that offer a high quality of life for residents and visitors alike

Attract innovative, knowledge-based industries to the Portlands

Engage the community as an active partner in revitalization

Develop strategic partnerships to attract private sector investment

4.2.4 London Docklands development Corporation

The LDDC was an urban development corporation, the second to be established by the then Secretary of State for the Environment, Michael Heseltine, under s.136 of the Local Government, Planning and Land Act 1980. Its object was to secure the regeneration of the London Docklands Urban Development Area (UDA) comprising 8½ square miles of East London in the Boroughs of Tower Hamlets, Newham and Southwark. This was a response to a huge decline in the economy of the area brought about by the progressive closure of the 1960s onwards.

LDDC was wholly financed by grant from the Government and the income generated by the disposal of land for housing, industrial and commercial development.

Aims and powers

Although its influence in the area was undoubtedly very strong, LDDC's powers were in practice limited:

It had powers to acquire land by agreement or compulsory purchase and, in the case of the large amount of land in the public sector, there were powers for it to be vested in the Corporation by the Secretary of State. This ensured a supply of land for development.

It took over from the London Boroughs their planning (but not their plan making) powers. This was response to the Government's perception that the Boroughs had been too restrictive in exercising their development control and other powers because their plans for the area were outmoded and inappropriate.

It had powers, and the resources, to provide new (or refurbish the existing) infrastructure.

Apart from planning all other public services (housing, education, health etc) remained firmly in the hands of the Boroughs and other public agencies although the Corporation could and did provide funds for their development and improvement. The Corporation's lack of remit in this respect was often misunderstood by those who felt the LDDC should do more to revitalize these services for the benefit of local people.

The Task

THE 1980 Act requires an urban development corporation "to secure the regeneration of its area, by bringing land and buildings into effective use, encouraging the development of existing and new industry and commerce, creating an attractive environment and ensuring that housing and social facilities are available to encourage people to live and work in the area".

Shadwell Basin, 1998

Against such a brief the task facing the Corporation in 1981 was daunting. A Regeneration Research Report published in 1997 by the Department of the Environment, Transport and the Regions (DETR) analyzed the problems of the Docklands as follows:

The area experienced catastrophic job losses over a short period of time, as the Docks closed. Between 1978 and 1983, over 12,000 jobs were lost. The skills of the local population, directed at blue collar work, were inappropriate for many of the growth areas of the London economy.

A high proportion of land was held by public bodies who had neither the will nor the capital to make it available for redevelopment. Relatively little land was in private holdings. Thus the supply of land was constrained by a pattern of ownership which was not market sensitive.

The extent of dereliction in parts of Docklands was so severe that the costs of development would be very high and uncertain, lowering the attractiveness of the area to investors. External intervention was needed to meet extra-ordinary land reclamation costs and to improve developer confidence more generally.

Many development sites were poorly served by the local infrastructure - the provision of which would be essential for these sites to be developed. Poor strategic links between Docklands and the rest of London, the country and internationally, would have created additional costs for employers thus depressing the potential returns on investment.

Western Dock, Wapping, 1981

The market alone was unlikely to provide the environmental improvements (including landscaping, refurbishment of the dock estate or restoration of prominent landmarks) or the provision of infrastructure and amenities that were essential if Docklands was to cast off its run-down image and become an attractive place in which to live and conduct business.

There were certain gaps in available information that were hindering the operation of markets - for example, the almost complete absence of private house-building in the area for years meant that housing developers had no idea on the potential return for new-build, thus magnifying the risk to developers and deterring investment.

This combination of factors made it difficult for the market, without external intervention, to reverse the steep cycle of decline experienced by Docklands before the establishment of LDDC.

Achievements

Western Dock, Wapping, 1998

THE Corporation was at work for 17 years. In its final Annual Report in 1998 it headlined its achievements as follows:

- £1.86 billion in public sector investment
- £7.7 billion in private sector investment
- 1,066 acres of land sold for redevelopment
- 144 km of new and improved roads
- the construction of the Docklands Light Railway
- 25 million sq feet of commercial /industrial floorspace built
- 1,884 acres of derelict land reclaimed
- 24,046 new homes built
- 2,700 businesses trading
- contributions to 5 new health centers and the redevelopment of 6 more
- funding towards 11 new primary schools, 2 secondary schools, 3 post-16 colleges and 9 vocational training centers
- 94 awards for architecture, conservation and landscaping
- 85,000 now at work in London Docklands

4.3 Waterfront Development Corporation – Success factors

From the foregoing examples several key success factor may be identified. They are:

- City, State and Federal government support
- Strong charismatic leader, committed to the development's success.
- Local participation by businesses.
- Community participation
- Clear and simple objectives
- Sufficient funding to allow continuous operation of the corporation to achieve the objectives
- Team with experience in all mother agencies, financial, public relations, technical and legal.

If these factors can be incorporated into the establishment of a Seattle Waterfront Agency this model provides a proven methodology for the streamline planning and implementation of a coordinated waterfront amenity and infrastructure for the City of Seattle.