File No. 13926 Task 3.0PB
***Draft** Technical Memorandum*

Date:	September 28, 2001
To:	Jay Lyman, David Evans and Associates
From:	Connie Kratovil
Subject:	ODOT Contract No. 16902- I-5 Trade Corridor Study Phase II **Conceptual Engineering for Option Package 2: Express Bus Without Corridor-Wide Capacity Increase**

GENERAL FUNCTIONAL DESCRIPTION

Option Package 2 includes the operation of directional peak period express bus service between Clark County and the Expo Center/PIR MAX light rail stations. This option does not include additional corridor-wide highway capacity, but provides additional Columbia River crossing capacity via a new four-lane, joint use arterial and HOV/express bus bridge.

The key features of this option package include:

- Converts the inside (existing/planned) third northbound travel lane from Mill Plain Blvd. to 134th Street for afternoon peak period HOV use
- Results in a northbound HOV system from Going Street to 134th Street and a southbound HOV system from 134th Street to approximately Lombard Street
- Constructs a new four-lane joint use arterial and HOV/express bus bridge across the Columbia River -- serving Hayden Island and matching existing/planned HOV lanes in Oregon and Washington
- Removes the existing I-5/Hayden Island interchange and provides a new connection with Hayden Island via the new bridge
- Includes direct express bus ramps to/from the Expo/PIR transit stations
- Includes HOV specific facility treatments
- Provides truck access between Marine Drive and the new arterial/HOV facility
- Modifications to the existing interchange system between SR 14 and SR 500 to address weaving, merging, and diverging issues

Schematic drawings of Option Package 2 is shown in **Figures 2-1 and 2-2** at the end of this memo. **Figure 2-1** also depicts a typical 4-lane bridge section.

TECHNICAL DESCRIPTION OF OPTION

General Description

The general description of Option Package 2 is schematically depicted in **Figure 2-1.** It includes a new four-lane joint use arterial and HOV/express bus bridge. This bridge would supplement the existing I-5 Columbia River structures (six lanes), resulting in 10 lanes of river crossing capacity. The proposed four-

lane bridge would provide one HOV and one general purpose (GP) lane in each direction. It would have 12' shoulders on both sides and a 20' center median for a total width of 92 feet. It would be located on the west side of the existing I-5 corridor starting at Victory Boulevard and terminating just south of Evergreen Bridge.

The bridge mainline carrying the HOV lanes would begin on the north side of Victory Boulevard and have its center matching the existing I-5 centerline. It crosses over I-5, Highway 99 and Expo Road. The existing I-5 northbound on-ramp at Victory Blvd. would be widened to two lanes to accommodate the proposed northbound GP lane that would cross over I-5 and then merge with the mainline bridge at Expo Center. An exit ramp would be provided for the southbound GP lane, which would split into two lanes; one lane would go to Expo road and the other lane would merge into the existing I-5. As shown on the plan, the existing I-5 facility would be widened to accommodate the additional 2 HOV lanes, 2 GP lanes and the existing 6 lanes.

A bus access ramp is proposed at Expo Center Station to serve Vancouver southbound and northbound buses. In addition, a ramp is also provided southbound to Portland. The existing private road where the bus access is proposed would be improved and converted into a public road to improve traffic circulation.

The existing I-5 connections at Hayden Island would be eliminated to relieve congestion in this area. Instead, a split diamond interchange would be built to access Hayden Island via the new four-lane bridge. Tomahawk Island Drive would be extended thru and under I-5 and have signalized intersections at both ramps. The entrance and exit ramps at the Hayden Island Drive intersections would also be signalized to allow and control all directional traffic movements.

The four-lane bridge would cross the Columbia River with an elevation meeting the existing navigational clearance of the Interstate Bridge. It would go over the existing railroad and SR 14 interchange and touch down south of Evergreen Bridge. A northbound exit ramp would be provided to connect to SR 14 eastbound and Sixth Avenue westbound. Furthermore, a southbound on-connection from Washington Street is proposed, and a southbound off-connection with an over-crossing is designed to serve Sixth Avenue. All existing SR 14 and I-5 interchange connections would remain.

The affected area of I-5 where the proposed bridge ends would be widened on both sides to accommodate the additional lanes resulting from these improvements. While this widening would not impact the existing hospital in the historic reserve area, its road adjacent to the highway would be affected.

The proposed four-lane bridge terminates just south of Evergreen and its new lanes are designed to conform to the proposed development of the Mill Plain interchange.

Bicycle/Pedestrian Facilities

This memorandum does not include bicycle/pedestrian facilities on the proposed bridge section. The existing I-5 bridges accommodate pedestrian access. It is recommended that bicycle/pedestrian access be revisited in the future and that access be improved on the proposed or existing structures.

Interchange Modifications

Option Package 2 includes modifications to the existing interchange system between SR 14 and SR 500 to address weaving, merging, and diverging issues. These modifications are common to all new bridge concepts developed for Option Packages 2, 3, 6, and 7. Interchange modifications to address weaving, merging, and diverging issues in Oregon are only included in Option Packages 6 and 7, which widen I-5 to include a fourth travel lane in each direction.

Conceptual interchange modifications along I-5 in Washington are functionally depicted in **Figure 2-2.** It should be noted that the final interchange configurations may change from those shown here as conceptual layouts and designs are refined. However, these functional descriptions can provide guidance to designers as they address interchange spacing and operation issues during the evaluation.

Between Mill Plain Blvd. and SR 500 in Vancouver, the proposed design reconfigures the existing interchanges to reduce the number of weaving sections on the freeway. The freeway would retain six through-lanes and add auxiliary lanes between interchanges where the space between ramps is inadequate to accommodate merges and diverges from the highway. The interchange improvements would be accomplished primarily by braiding the on/off ramps. Construction of the braided ramps would require the replacement of overpasses at 29th St. and 33rd St., and widening of the Mill Plain and McLaughlin overcrossings.

Interchanges were modified based upon the schematic design developed at a workshop held with DOT and consultant team members on June 29, 2001. The design concept included braiding most of the ramps to and from the existing interchanges. Ramps to be braided include:

Northbound

- Fourth Plain on-ramp with SR 500 off-ramp: The new diverge point for the SR 500 off-ramp would begin on the north side of the Fourth Plain overpass. The Fourth Plain on-ramp would pass over the SR 500 off-ramp, merging with the highway near the 29th Street overpass. The Fourth Plain on-ramp would also have a split to allow traffic to access I-5 northbound or SR500 eastbound. Braiding these ramps would require reconstruction of the 29th St. and 33rd St. overpasses.

Southbound

- SR 500 on-ramp with Fourth Plain off-ramp: The diverge point for the Fourth Plain off-ramp would be moved to the area between the 39th St. off-ramp and the SR 500 overpass. The new ramp would align to the west side of the SR 500 on-ramp, cross under the 39th St. on-ramp, and parallel the highway to connect to the existing interchange area. The design currently includes a connection between SR 500 and Fourth Plain Blvd. via a short weaving area. This weave takes place within the same zone that includes the SR 500-to-mainline weave and may negate the advantages of braiding the ramps. As a result, further study of this ramp configuration is recommended during subsequent alternatives analysis to determine the need for this connection and, if warranted, whether the best design solution is to braid the ramps at this location.

- Fourth Plain on-ramp with Mill Plain off-ramp: The diverge point for the Mill Plain off-ramp would be moved to approximately the same location as the existing Fourth Plain off-ramp diverge. The Mill Plain ramp would rise and cross over both the Fourth Plain on-ramp, which is left mostly unchanged from the existing configuration, and Fourth Plain Blvd. Much of this ramp would be on structure because of the need to clear Fourth Plain.

- Mill Plain on-ramp with Downtown Vancouver/SR 14 off-ramp: To mitigate an existing short weave distance between the Mill Plain on-ramp and the Downtown Vancouver/SR14 off-ramp, the off-ramp diverge point would be moved to the north edge of the Mill Plain underpass, braid over the Mill Plain on-ramp and make a connection to SR 14 via the ramp included in the design for each of the river crossing options. The Mill Plain on-ramp would offer the option, via a mid-ramp split, to go to either I-5 southbound or SR 14 eastbound.

The design also includes a connector between SR 500 westbound and the 39th St. northbound on-ramp, providing a direct connection between SR 500 and I-5 northbound.

During the I-5 HOV study completed by Parsons Brinckerhoff, it was noted that in Vancouver, I-5 functions as both a regional and local connector. To improve the performance of I-5, these two traffic types could be separated via a barrier, effectively creating a bypass system through Vancouver for regional traffic. This option would require additional widening of the freeway to accommodate all the lanes, but would eliminate the need to extensively braid the interchanges. Separation of the freeway would occur north of SR 500 and south of SR 14, although the river crossing options that include a bypass bridge could connect into the regional route. Lane configurations would likely include 2 lanes in each direction on the bypass (1 HOV and 1 general purpose) and 2 lanes on the "local" system, plus any necessary auxiliary lanes between interchanges. It is recommended that this option be revisited in future studies along with the braided ramp option shown.

Structures

The new 4 lane bridge over the Columbia River is conceptualized as a concrete segmental type with a bascule moveable span over the navigation channel. The span layout could be comprised of (south bank to north bank) 260'-540'-270'-540'-540'-280'(Bascule Draw Span)-320' sections.

Currently, the existing dual bridges provide a horizontal clearance of 263 feet between the lift span piers over the main navigation channel. The lift span provides a 39-foot vertical clearance above the Columbia River Datum (also referred to as zero gage or low water) when closed, and a maximum of 178 feet when fully raised. An increased vertical clearance of 58 feet is provided at the alternate barge channel beneath the bridge's fixed 531-foot truss span. South of the 531-foot span, a vertical clearance of 72 feet is provided between piers 6 and 7 and piers 7 and 8; these spans are outside of the maintained channel limits.

The 4-lane bridge would have a 145 foot elevation over the navigation channel in the closed position. This is compared to the existing twin I-5 bridges, which have a deck elevation of 45'feet (+-) in the closed position. The 4 lane HOV bridge would function with the exiting I-5 bridges in operation. The new bridge is conceptualized to have a bascule moveable span, that when open, provides unlimited vertical clearance. The deck elevation of 145 feet was assumed based on the vertical restriction associated with Pearson Airpark. The airpark airspace height restriction is approximately 175 feet; a deck at 145 feet should allow lights, signs and trucks to pass without infringing into the airspace.

Construction Considerations

- *Superstructure Type* - The superstructure section could be a multi-cell trapezoidal concrete box girder built by the balanced cantilever method. The cross section varies in depth from maximum depths over the interior piers to 10' at midspan. A suggested depth to span ratio would be 1/20 at the piers, and 1/50 at midspan (but no less than 10 feet). The parabolic soffit resulting from the variable structure depth coupled with the sloping webs of the box girder provides a dramatic aesthetic appearance, similar to the Glenn Jackson (I-205) Columbia River Bridge.

- *Column Type* - The river pier columns could consist of two 6' by 20' shafts spaced longitudinally 24' on center. The purpose of these twin wall shafts is to provide longitudinal stability during balanced cantilever erection, and then to provide longitudinal flexibility for the large time-dependent displacements experienced by this type of bridge in the final service condition. The piers for the moveable span would be solid 20' X 120' rectangles, housing the bascule lift span drive motors. If a

vertical lift span is utilized, the bridge would most likely be two bridges with 4 towers to lift the large deck section.

- *Foundations* - The two end transition piers are on land at the riverbanks, and the remaining interior piers are all in the river. For the river piers, a footing size of approximately 36' by 36' (non-moveable piers) is required. Deep foundation elements may be either driven piles or drilled shafts. Larger diameter drilled shafts may be preferable to limit noise and vibration construction impacts.

- *Construction Procedures* - The river piers could be constructed by conventional methods using cofferdams. This features braced sheet piling walls, driven piles, underwater tremie concrete pours, and extensive pumping of the water inside the cofferdam to allow construction of the remainder of the pier footing and columns in the dry. This foundation type features footings that are founded below the river bottom. Because contractors assume significant risk with this type of foundation construction, costs are generally high for cofferdams.

  The river piers could also be constructed as water level foundations. This foundation makes use of a precast concrete lost footing form. The form has a bottom and four sides approximately 15' high. The bottom has holes for piling or in this case, large diameter drilled shafts. The drilled shafts are installed with permanent casings from the water level down below the bottom of the river. The precast footing form is lifted and placed over the top of the shaft casings and supported by hangers from the casings. Underwater tremie concrete is placed in the bottom of the form to allow pumping out the water to construct the remainder of the footing in the dry. However, in this configuration, the bottom of the footing is at a much higher elevation, requiring a smaller tremie pour due to the reduced hydrostatic head. This type of foundation is generally less costly, because contractor risk is reduced.

  Superstructure construction could be by the balanced cantilever method. The concrete superstructure may be either cast-in-place or precast, however for the 500' span range (anticipated for this crossing), cast-in-place has been more widely used and is the recommended construction type. Segments are cast in pairs using form travelers, and typically two segments are cast per one week cycle. Segment lengths may vary between 10' and 15', with shorter lengths occurring near the piers where the sections are heavier.

- *Construction Duration* - Substructure construction could be expected to take about 3 months per main river pier. Construction of the land-based piers could overlap with the construction of the river piers. Therefore substructure construction would be dependant on the actual type of bridge selected and the spans over Columbia River. Superstructure construction is dependent on the number of form travelers utilized (overhead erection equipment). With an average segment length of 12', one would calculate the number of segment pairs comprising each cantilever (½ span). Assuming a one-week cycle per segment pair, superstructure construction could be approximated with only one pair of travelers. Total construction time with mobilization and demobilization could be readily calculated once a conceptual span arrangement is determined. This schedule could be accelerated with the use of additional travelers.

ROW IMPACTS

Four Lane Bridge (Victory to Mill Plain)

The proposed four-lane bridge would require about 17 acres of new right of way acquisition, comprised of approximately 60% commercial lands and 40% open or undeveloped lands. The affected commercial land primarily includes parking areas and few buildings, while the majority of the open land is classified as wetland or existing private roads.

Interchange Modifications (Mill Plain to SR-500)

Approximately 2.9. acres would be required as a result of ramps along I-5 and broken down as follows:

Open Land 0.6 Acres

Residential 2.3 Acres (with **26** residential displacements)

COSTS

All estimates are based on 2001 unit costs: These estimates do NOT include the cost to purchase any businesses on Hayden Island. Commercial land value has been included in this estimate.

Four Lane Bridge (Victory to Mill Plain)	
Right of Way	$ 14,564,061
Utility Relocations	4,500,000
Excavation	546,714
Surfacing	2,618,837
Roadside Development	3,722,500
Traffic Services	3,181,800
Structures	307,309,468
Mobilization	25,750,346
Contingencies	111,241,493
Engineering and Administration	114,717,789
Total	$588,153,007

Interchange Modifications (Mill Plain to SR-500)	
Right of Way	$ 8,701,589
Utility Relocations	6,150,000
Excavation	2,926,560
Surfacing	6,248,970
Roadside Development	4,100,000
Traffic Services	1,481,375
Structures	26,639,112
Mobilization	3,803,681
Contingencies	16,431,903
Engineering and Administration	16,945,400
Total	$93,428,591

FIGURES

Note to reviewers: Figure 2-1 would be similar to figure 5-1 of the graphics package.
Figure 2-2 would be similar to figure 4-6 of the graphics package.

I-5 Transportation and Trade corridor Partnership
Draft Costs by Option Package
October 16, 2001

Costs by Option Package	Unique Costs	Park and Ride Lots	Baseline Road Costs	Baseline Transit Costs	Rose Quarter Widening	Delta Park to Lombard	Vancouver Interchange Modifications	Add North Ramps to Columbia	No Bridge - Access to Hayden island through Marine Drive	LRT only Columbia River Bridge	4-lane supplemental Bridge	6-lane supplemental Bridge	10-lane supplemental Bridge	4-lane supplemental Tunnel	Total
Baseline					$300	$41	$93								$434
West Arterial	$947				$300	$41	$93								$1,381
3 Lanes (with a 4-lane Bridge)		$52			$300	$41	$93				$596				$1,083
Add a 4th Lane (with 6 lane bridge)	$465	$52			$300							$940			$1,757
Add a 4th Lane (with 10 lane bridge)	$465	$52			$300								$1,117		$1,933
Add a 4th Lane (with 4 lane tunnel)	$465	$52			$300									$807	$1,624
Light Rail Loop/3 lane [1, 2]	$1,082				$300	$41	$93			$140	$596				$2,252
Light Rail Loop/add a 4th lane [1,2]	$1,546				$300					$140		$940			$2,926

notes: 1. Assume separate LRT bridge
2. Park and Ride facilities inclused in "Unique costs"

I-5 Transportation and Trade corridor Partnership
Draft Costs by Decision Point
October 16, 2001

Costs by Decision Point	Unique Costs	Park and Ride	Baseline Road Costs	Baseline Transit Costs	Rose Quarter Widening	Delta Park to Lombard	Vancouver Interchange Modifications	Add North Ramps to Columbia	No Bridge - Access to Hayden island through Marine Drive	Total
Baseline					$300	$41	$93	$111	$76	$621
West Arterial	$947									$947
3 Lanes (with a 4-lane Bridge)	$596	$52			$300	$41	$93	$111		$1,193
Add a 4th Lane (with 6 lane bridge)	$1,405	$52			$300					$1,757
Light Rail Loop [1]	$1,222									$1,222
Express Bus - Short [2]	$199	$52				$41				$292
Express Bus- long [3]	$351	$52								$403
LRT only Columbia River Bridge	$140									$140
4-lane Supplemental Bridge (Victory to Mill Plain)	$596									$596
6-lane Supplemental Bridge (Victory to Mill Plain)	$940									$940
10-lane Supplemental Bridge (Victory to Mill Plain)	$1,117									$1,117
4-lane Supplemental Tunnel (Victory to Mill Plain)	$807									$807

Notes: 1. Park and Ride facilities included in "Unique costs"
2. Assume cost is 1/3 of 3-lane option
3. Assume cost is 1/4 of 4-lane option