From: Kevin Peterson <[redacted]>
Sent: Friday, December 12, 2025 10:32 AM
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Cc: Fischer, Steven M CIV USCG D13 (USA) <Steven.M.Fischer3@uscg.mil>
Subject: [Non-DoD Source] I-5 White Paper

Dear Readers,

Planners and designers discover options and share these with stakeholders. With this knowledge stakeholders are best able to make informed decisions. After 40+ years planning and designing complex transportation I know informed decisions are best when exclusive of bias or preconceived ideas. Large projects impacting cities require juggling many, almost innumerable, choices and consequences for which planners and designers draw upon their skills to identify and share with stakeholders. We often call this ‘fit for purpose’. For the I-5 bridge were decision makers informed of alternatives?

With respect to the I-5 Columbia River bridge, it’s my opinion that key aspects that should be known to all have been superficially considered. This ‘white paper’ provides policymakers and/or impacted communities with two

alternatives that were not studied. With a thousand projects under my belt, at least a hundred having comparable scope, what I observed regarding the concept stakeholders have been offered by the IBRP office is summarized as follows:

1. **Inadequate Capacity**
   Over the next few decades mobility needs call for a minimum of six lanes. Portland's desire to not add traffic downtown means three to four lanes south of the project area is sensible. Local needs serving urban activities on both shores call for two or three lanes.

2. **Adherence to Standards**
   Most DOT design manuals require a collector-distributor (CD) to be considered if urban interchanges are more frequent than one mile separation. Five interchanges exist in 2.7 miles. The project office failed to consider this fundamental aspect of urban freeways as part of early alternative investigation. This concern was subsequently not part of project planning.

3. **Transit Understanding**
   Four trains per hour means existing riders on the Yellow Line need every seat on any train during the peak commute hour. However, if current users south of the Expo Station are required to stand, LRT can only add 500 Clark County customers in the peak commute hour. This means all riders south of the Expo Station will be forced to stand for the 50-minute 14mph journey. This is not high-capacity transit nor is this plan respectful of transit users. Is the 2-billion dollar 'plan' meant to <u>further reduce LRT desirability by showing how ineffective expensive LRT is</u>? BRT, at a fraction of the price, allows all riders a seat for a 30-minute journey. BRT can grow the transit mode share, now 3% to 4%, to between 8% and 10%. LRT cannot grow transit until four car trains run in a dedicated ROW which requires a 20+ billion-dollar investment to underground LRT in Portland and largely eliminate mixed traffic operation in the Yellow Line ROW. Policy makers should do what's best to make transit both efficient and easy to use.

4. **Poor Urban Integration**
   Fort Vancouver and Downtown Vancouver should not be separated. Hayden Island should not be split East/West. Alternatives that link urban areas; not separate them as the IBRP proposes have not been seriously considered. Also, the primary goal of the project should be to reduce the number of urban blocks required for I-5. Compared with what the IBRP proposes, this paper suggests the number of urban blocks required by the freeway can be reduced by a dozen. Urban shores on both sides of the Columbia River are too precious to not optimize as desirable places to live and work.

5. **Navigation Clearance**
   How much wealth has been invested to assure a 144' navigation clearance for the 300+ mile navigation from I-205 to Lewiston, Idaho? To reduce this to 116' is not correct if alternatives exist that maintain the 144' or meet the current 178' clearance.

It's only when engineers and planners bring informed understanding of choices to the decision-making table can proper decisions result. For the engineers and planners of the IBRP to not do this, essentially focused on one functional and locational solution, does not bring informed understanding of basic alternatives.

Please review the attached DRAFT 'White Paper'. This document presents a rough understanding of how an immersed tunnel or high-level bridge might be integrated into the urban context and address the five concerns by providing better solutions.

Once feedback has been gathered, ideally before the first week in January, the document will be finalized taking into consideration this feedback. A final paper will be published at the end of January. Please share your thoughts.

Allow me to have a couple of disclaimers:

1. What you will read is largely a compilation of input from many people and sources who generally dislike what's currently proposed. The IBRP project office has not interacted with me in a positive or proactive sense. This is unfortunate as much knowledge resides with the hundreds of planners and engineers who have worked for over a decade on the project. Having worked on a hundred similar projects with large staff involvement, the IBRP office is the least communicative as measured in professional courtesy or engagement. Normally, if a concern is brought regarding 'fit for purpose', project managements are keen to what, if any, input might make the project better. This is especially important if the project is controversial.

2. No one person or planning/design discipline can accomplish a project of this scope and complexity. Please do not read this paper as an inspiration from a designer – it is not. I have been called upon many times to meet with project leaders or communities to seek better solutions. This requires listening and reflecting on what I hear with a physical solution, a concept that represents a solution to the concern. I often call what I do that of a highly skilled 'graphic scribe', listen and 'write down' a design responsive to what's said. A thousand experiences allow quick physical understanding of a concern. As you read this, please know that thousands of real-life planning and design experiences, working with world class engineers and planners, were sourced for this 'white paper'. Also know that scores of concerned people have shared concerns that are included in this study. These range from poor urban integration to functional inadequacy.

3. Possible integration north of Evergreen Boulevard for the two alignments are not presented. I have only heard a few ideas for this area and do not wish to share possible solutions without first hearing from local authorities or impacted users. I can say that less costly and less impactful solutions are likely.

4. Many sketches and drawings are notional and/or conceptual. When your feedback these will be revised and, hopefully, be easier to understand.

What have we missed? How can this project be done better? This is where your input and feedback are important.

Thank you in advance for taking the time to consider what's in the 'White Paper'. Your input and comments will be reflected in the final 'White Paper'. Do not hesitate to call if you have questions. Leave a message and I'll get back to you!

Thanks,

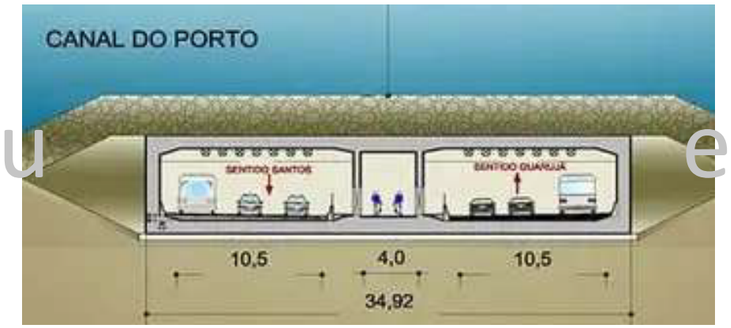
Kevin Peterson
[redacted]

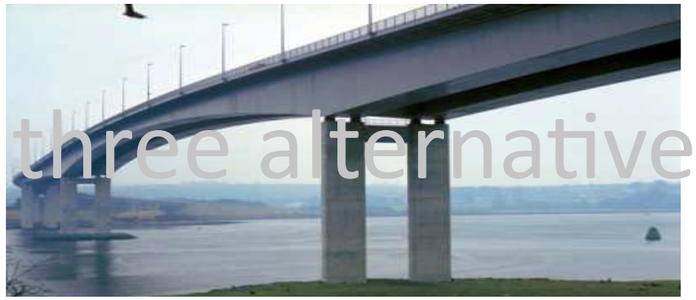
White Paper

Columbia River I-5 Bridge

Two Alternatives Not Considered by the IBR offering Significant Benefit

Cover page will inclu e three alternatives.





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5. **Immersed Tunnel Cross Section**
6. **Immersed Tunnel Urban Integration Vancouver**
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29. **Comparative Matrix of Alternatives**

Why this White Paper?

Proper infrastructure responds to the purpose for which the public investment is made. In the case of the I-5 Columbia River bridge concern that the currently proposed design inadequately satisfies mobility needs, the primary purpose of the investment. Concern exists the freeway is too intrusive to fit within the urban context of Vancouver and Hayden Island. An overarching goal for responsive infrastructure is the best possible 'fit for purpose'. This goal guides this white paper.

Four major 'Fit for Purpose' concerns are:

1. inadequate navigation clearance,

2. inadequate vehicular capacity, especially local mobility connecting urban activities on both shores of the Columbia River,

3. extraordinarily expensive LRT transit with very limited capacity, and

4. very intrusive and disruptive freeway impacts in urban communities.

In an attempt to judge the desirability of the current proposal, we asked the important question 'are better solutions possible'. This question can only be answered if alternatives are considered, studied, and shared. This 'white paper' considers two alternatives offering significant advantages with respect to how the project can better satisfy the four concerns. We know the two alternatives have many variations. We felt our effort should assume one layout and test this for potential 'fatal flaws'. Please know that what's presented is likely not the best 'fit'. A thorough 'Type, Size, and Location' study is highly recommended to establish the best possible 'Fit for Purpose'. The following brief statements encapsulate our objectives when addressing the four concerns:

1. Inadequate River Navigation Clearance

Choices are (1) achieving a navigation clearance equal to the existing I-5 lift bridges and downriver navigation, or (2) a high level bridge honoring navigation channel clearances between I-205 and Lewiston, Idaho. We are very concerned that simply paying off a few temporal industries is woefully short sighted. To accept a height disrespecting existing and, more importantly, future navigation related need is to compromise future marine activities from I-205 to Lewiston, Idaho. One needs only to look back 80 years when a national emergency resulted in over 40 aircraft carriers built upriver of the bridge at Fort Vancouver to realize future needs may require more than paying off four private companies. We recognize any request to compromise the I-205 144' clearance is a request to compromise a couple hundred miles of navigation investment. If alternative exist to what is currently proposed, they need to be considered. We set an objective that the bridge alternative should consider a navigation channel height equal to the I-205 bridge clearance.

2. Inadequate Vehicular Capacity, Especially Local Mobility Connecting Urban Activities on Both Shores of the Columbia River

Nearly half of traffic movements in the I-5 corridor at the Columbia River are within the urban fabric of both shores. This resulted in five interchanges in 2.7 miles. Freeway design standards state urban interchanges should not be closer than one mile. One mile spacing can accommodate merging traffic and avoid congestion caused delay. The IBR proposes to mitigate this with weaving ramps, small auxiliary lanes, and less than ideal roadway geometry. Three lanes in each direction is proposed by the IBRP with one auxiliary lane. The result is inadequate capacity for both local and interstate needs. Compounding this concern is downtown Portland's desires not to add additional traffic in already congested downtown Portland. To this end we asked is it possible to use the two existing I-5 bridges to satisfy local mobility needs, acting as a collector-distributor (CD) function, and only build a new crossing meeting interstate needs consistent with Portland's desire to cap I-5 capacity at three or four lanes. Alternatives consider adaptive use of the existing bridges for the collector/distributor role. Alternatives consider a three or four lane 'express' freeway on a new bridge or immersed tunnel.

3. Extraordinarily Expensive Transit with Very Limited Capacity,

The IBR project includes extension of the two-car Light Rail Transit (LRT) train of the Yellow Line. Allowing for minor growth in the existing Yellow line and a train frequency of four trains per hour, as currently proposed, LRT offers very little limited capacity across the Columbia River. This is a maximum capacity of +/- 400 to 500 Portland bound riders during the peak hour with a travel time of 60 to 70 minutes. This is a reasonable maximum capacity until downtown Portland undergrounds rail transit and the Yellow Line is improved to minimize mixed traffic operations. With Clark County ridership filling all 135 seats in a train, the result is peak commute riders south of the Expo station must stand! What's proposed is not mass transit. Spending two billion tax dollars to move what 4 to 6 busses can accomplish is, well, silly. Bus Rapid Transit (BRT) is the only reasonable transit investment. For the two alternatives, the question of 'fit for purpose' is how best to integrate BRT into the project. Preserving LRT alignment ROW for the future is also important. Rail transit will be viable when TriMet can operate a four-car train with frequent headways. A four-car train requires major changes, including undergrounding LRT in downtown Portland and a new alignment in north Portland. LRT capacity improvements are decades away further confirming better transit service is provided with BRT. Only BRT can grow ridership with the capacity needed to make future LRT operations viable. LRT alone does not provide for transit growth or mode shift, LRT requires BRT to meet transit utilization goals with future transit growth. BRT technology can accommodate 5,000 to 7,000 Clark County commuters in the peak hour and is the only transit solution able to grow transit mode share to 8% to 10% of river crossings. In the next four to five decades. Alternatives shall consider one lane in each direction of the CD for BRT use with stations serving Hayden Island and downtown Vancouver.

4. Very Intrusive Freeway Impacts on Urban Environments

Does an alignment exist that does not expand the freeway footprint and, ideally, reduce the footprint preserving precious urban land for urban uses? Can alternatives mitigate objectionable urban impacts like noise and quality of life? This question is addressed in the alternative study. To our surprise, the result the Immersed Tunnel Alternative requires +/- 21 urban blocks (280' x 280' block dimension) , A high Level Bridge requires +/- 21 urban blocks, and the IBRP layout requires +/- 33 urban blocks. Also, objectionable urban impacts are greatly reduced using a straight alignment. An Immersed Tunnel significantly reduces visual impacts and creates significant park opportunities. Historic freeway barriers are also reduced with High Level Bridge and Immersed Tunnel Alternatives.

Summary

Please understand the two alternatives consider the four concerns with respect to a high level bridge and immersed tunnel. The study goes as far as to identify one possible layout for each alternative . This is done to establish that both alternatives avoid 'fatal flaws'. We know that both alternatives will likely be refined and improved with additional study, as is expected in a Type, Size, and Location Study. We have prepared this 'white paper' assuming reasonably conservative 'fit for purpose' solutions. Information is not simply directed to navigation betterment as any urban project of this complexity involves almost innumerable choices and decisions. We

Mobility Basics

The I-5 corridor at the Columbia River is multi-modal . Cars, Vans, and trucks, (CVT) use the corridor. Buses and, to the south, LRT provides public transit. Air navigation needs above I-5 and river navigation needs constrain the corridor vertically. All this within a unique, vibrant, and growing urban context with an historic tie to the Columbia River. This white paper presents a unique challenge when planning a freeway and bridge. Presently, nearly 6,000 vehicles use this corridor in the peak direction during the rush hour with RTC predictions in 2005 suggesting this number will double this century. However, predictions for future mobility have been inconsistent and greatly varied. This white paper assumes I-5 should expect nominal mobility growth of 40% in the next three to five decades. With a bridge or immersed tunnel designed to last 150 to 200 years, this growth assumption may be too little. Let's explore what this means.

Mobility goals and objectives for this white paper include:

Basics:

Almost 6,000 vehicles presently cross the Columbia River on I-5 in the peak direction during the peak commute hour. With an average of 1.3 people per vehicle, this represents between 7,500 and 8,000 people per hour per direction presently moving across the river.

An investment able to serve 40% mobility growth.

Three decades from now, 40% growth means 10,000 to 11,000 people crossing the river to or from Portland in the peak hour. If these people are accommodated in cars, vans, and trucks then about 8,000 to 9,000 CVT peak hour movements need to be accommodated. At a flow of 1,600 to 1,800 vehicles per lane per hour, an approximation of freeway capacity within an urban area, a need for 5 to 6 lanes in each direction is suggested. Let's assume BRT reduces this demand by one lane until high capacity LRT is introduced, possibly in three to four decades. Let's further assume frequent dependable BRT operations likely requires one lane, possibly shared with HOV vehicles near term. For the purpose of this alternatives study, with assumes half of river crossing movements are local, three CD lanes plus 3 express lanes in each direction are assumed.

Most of the mobility growth is assumed to be transit with BRT assumed to achieve a 10% transit mode share in three decades.

Serve local mobility needs

A collector-distributor with a 40mph to 45mph acts much like an arterial connecting the local urban fabric. This arterial function is served with a concept consistent with better quality urban environments that include tree lined roadways, medians with trees, wide bicycle lanes, wide sidewalks. This criteria is applied on Hayden Island and between downtown Vancouver and Fort Vancouver.

Bicycle accommodation across the river is in a separate chamber for the immersed tunnel (like that on the Fraser River immersed tunnel in Vancouver BC) and for the bridge, on a 12' shoulder with double white line separation from fast moving vehicles. Pedestrian crossing for the bridge alternative is what exists today, sidewalks outboard of the trusses on the existing bridges. These outrigger sidewalks might be widened to a more acceptable width of, say, ten to 12 feet.

Preserve the historic bridges

Functionally inadequate to serve interstate freeway functions, this paper explores the notion of both historic bridges used for local mobility, preserved to function as a collector-distributor to the freeway. Seismic concerns exist and, in the past, has been a compelling reason to replace the bridges. Recent information suggests seismic concerns may not be as severe as predicted. This issue remains uncertain and therefore, is a potential FATAL FLAW. Anticipating seismic improvements for the superstructure are required, two hundred million dollars may be required to mitigate concerns. No provision for substructure mitigation is identified. This issue is simply beyond the skills and resources available to the volunteer professionals inputting to this white paper.

Grow Transit to a 10% mode share in three decades

The goal is a transit solution capable of accommodating a 10% mode share across the river in three decades. Let's assume BRT service provides seats for all users and 1,000 people in the peak hour commute to or from Portland. Let's further assume three bus routes BRT leave Clark County to the Portland metro area. Let's also assume ten minute headways for each route. This service level results in a bus service with a bus every three minutes. This suggest BRT stops have three designated bus loading areas. Local distribution by local busses, vanpools, and/or K&R suggests BRT stops are also served by up to ten local other transit/private vehicles.

Park and Ride accommodation

With BRT capable of moving many more people than LRT, Park and Ride (P&R) facilities should be encouraged for near term use. A possible exception is the Vancouver hub serving pedestrian active downtown where additional car use may not be desired. Long term, with a mature LRT system, need for P&R facilities may increase or decrease consistent with urban objectives. This informs us that P&R facilities should be accommodated such that they can easily expand or shift from transit use to local use. Station planning should place P&R facilities where they can serve both transit and commercial uses. For example, these are best located to the side of pedestrian active areas between the station and commercial activity.

For the next three decades P&R lots are assumed to serve 50% of BRT users with the peak hour, the peak hour representing 30% of morning needs. Thus suggests 1500 people or about 1300 vehicles for three BRT hubs. The white paper assumes 200 on Hayden Island and 500 at Vancouver, and 600 north of downtown Vancouver.

LRT Consideration with respect to passenger capacity, cost, and BRT relevancy

Existing Yellow Line in 2025
Link Load -

Station	Ons daily boardings	Offs daily detraining	Load Total people added to the train	Link load daily totals people in trains	Peak Hour 16% of daily link load
Expo	681	0	681	681	
Delta park	631	52	579	1260	
Kenton	366	104	262	1522	
Lombard	800	290	510	2032	
Rosa Parks	308	145	163	2195	
Killingsworth	459	296	163	2358	
Prescott	265	187	78	2436	
Overlook Park	206	110	96	2532	
Albina/Mississippi	138	92	46	2578	**412.48**
Interstate/Rose Quarter	233	870	-637	1941	
Union Station	4	447	-443	1498	
NW 5th	1	3	-2	1496	
SW 5th	2	3	-1	1495	
Pioneer Place	2	5	-3	1492	
City Hall	1	2	-1	1491	
PSU Urban Center	1	4	-3	1488	
PSU South	6	17	-11	1477	

The above spreadsheet considers how many people were on trains in early 2025 during the peak hour traveling from the Expo Station to Portland. With 15 minute headways this suggests a peak train occupancy of 100 passengers. Growth within the existing corridor needs to be considered over the next couple decades and is assumed to be 30%. This means all seats of a two car train, presently 135 seats, are accounted for. **The result is additional ridership can only be accommodated by requiring existing corridor users to stand for up to an hour.**

LRT crossing the Columbia River is a controversial issue. This page explores the reality of LRT 'Fit for Purpose'. Future utilization, travel time, and costs are also considered. LRT is compared with a BRT operation.

Please note any alternative should include eventual inclusion of light rail in the I-5 corridor. This future need will likely be required when (1) BRT ridership reaches 5,000 passengers per hour, (2) Portland undergrounds rail transit to accommodate 4-car trains, and (3) the Yellow Line is improved to reduce travel time. Three decades and a couple dozen billion dollars should be anticipated for LRT to be viable.

Data to the right compares relative costs of BRT and LRT as well as future transit enhancement utilizing BRT. LRT cost is shown at $39 per ride while BRT operates at a cost of $4 per ride.

LRT does not satisfy 'Fit for Purpose' if the investment '**purpose**' includes meaningful increase of transit utilization. An hour+ time needed to reach Portland traveling at 14mph is not viable transit.

BRT comparison with LRT

Assumes equal initial capacity and potential for growth

All data is for the peak direction in the leak hour. This is usually the morning rush hour.

	Line capacity Two car train, four trains per hour	Reserved for existing catchment	Available capacity to serve Clark Couty	Equivalent busses with all passengers seated @ 93 seats per bus	round trip travel time in minutes	Trains or busses needed
LRT	1080	536	544		90	6
BRT	Match LRT capacity		544	6	60	6

Growth Potential

LRT might operate 6 trains per hour, 10 minute headways

BRT capacity uo to 7,200 people per hour, assume four destinations and 93 riders per bus

Cost Implications over 20 years

LRT operations at $450 per hour, 1.5 billion facility investment,

BRT operations at $250 per hour, 100 million capital facility investment.

	facility cost	vehicle capital outlay**	O&M costs***	Total Cost	Cost per ride****
LRT	1,500,000,000.00	11,700,000.00	210,600,000.00	1,722,300,000.00	39
BRT*	100,000,000.00	2,340,000.00	93,600,000.00	195,940,000.00	4

* all buses replaced in ten years

** LRT @ 1.5 million per train x 6 train sets x 1.3 spares or BRT @ 150k per bus x 6 buses x2 replace in ten years x1.3 spares

*** LRT: $450 per hour, 6 trains, 12 hours per day, 325 days per year, 20 years
BRT: $200 per hour, 6 buses, 12 hours per day, 325 days per year, 20 years

**** This is if BRT mtches LRT capacity with 15 minute headways

BRT potential riders if 1.4 billion is utilized to enhance transit

	capital investment*	Riders per day**	buses***	bus cost ****	operating costs*****	20 year total investment
BRT	500,000,000.00	31,250.00	81.25	12,187,500.00	1,267,500,000.00	1,779,687,500.00

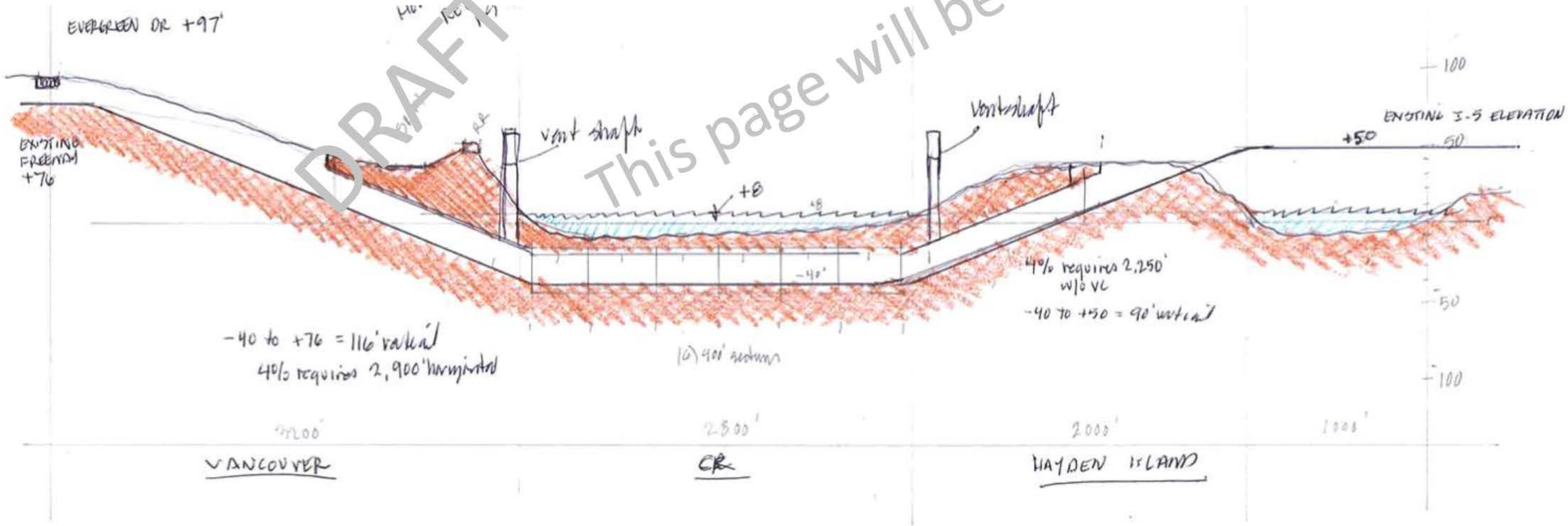
* Assumes 200 million maintenace facility, four 50 million bus hubs, 100 million roadways enhancements

** peak hour is 16% of daily total , maximize BRT use at 5,000 per peak hour

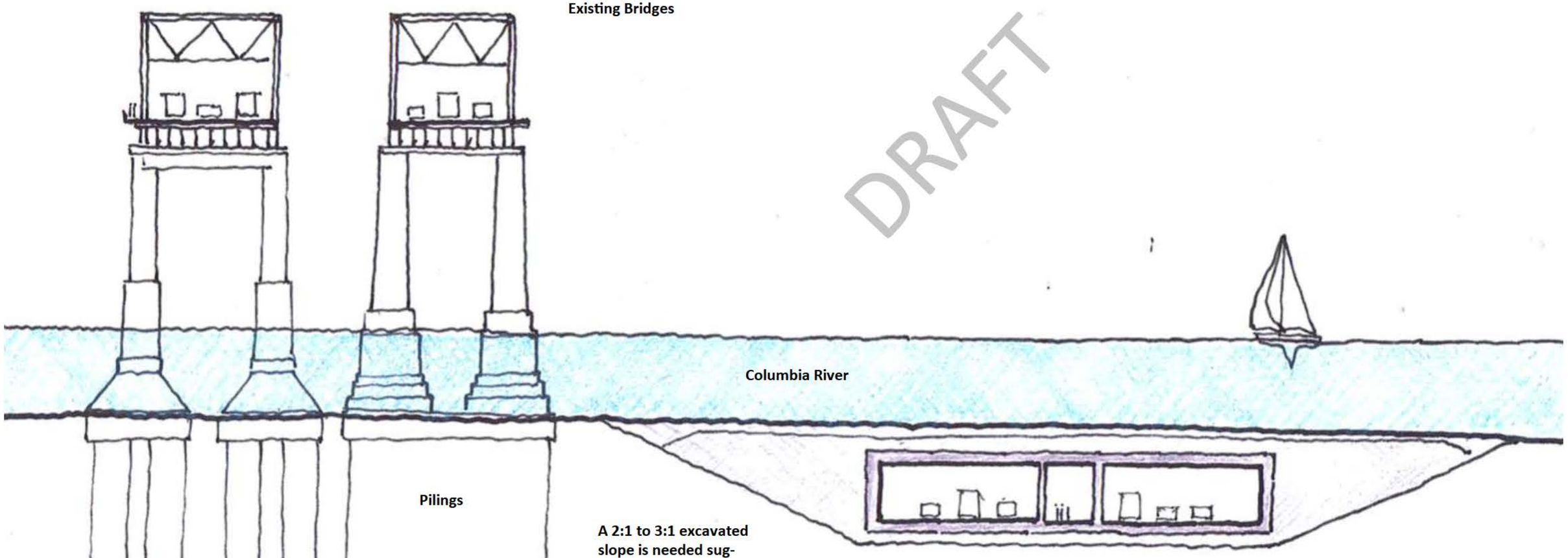
*** 5,000 p/hr, 80 p/bus, x 2 replacement, x 1.3 spares

**** $150k per bus

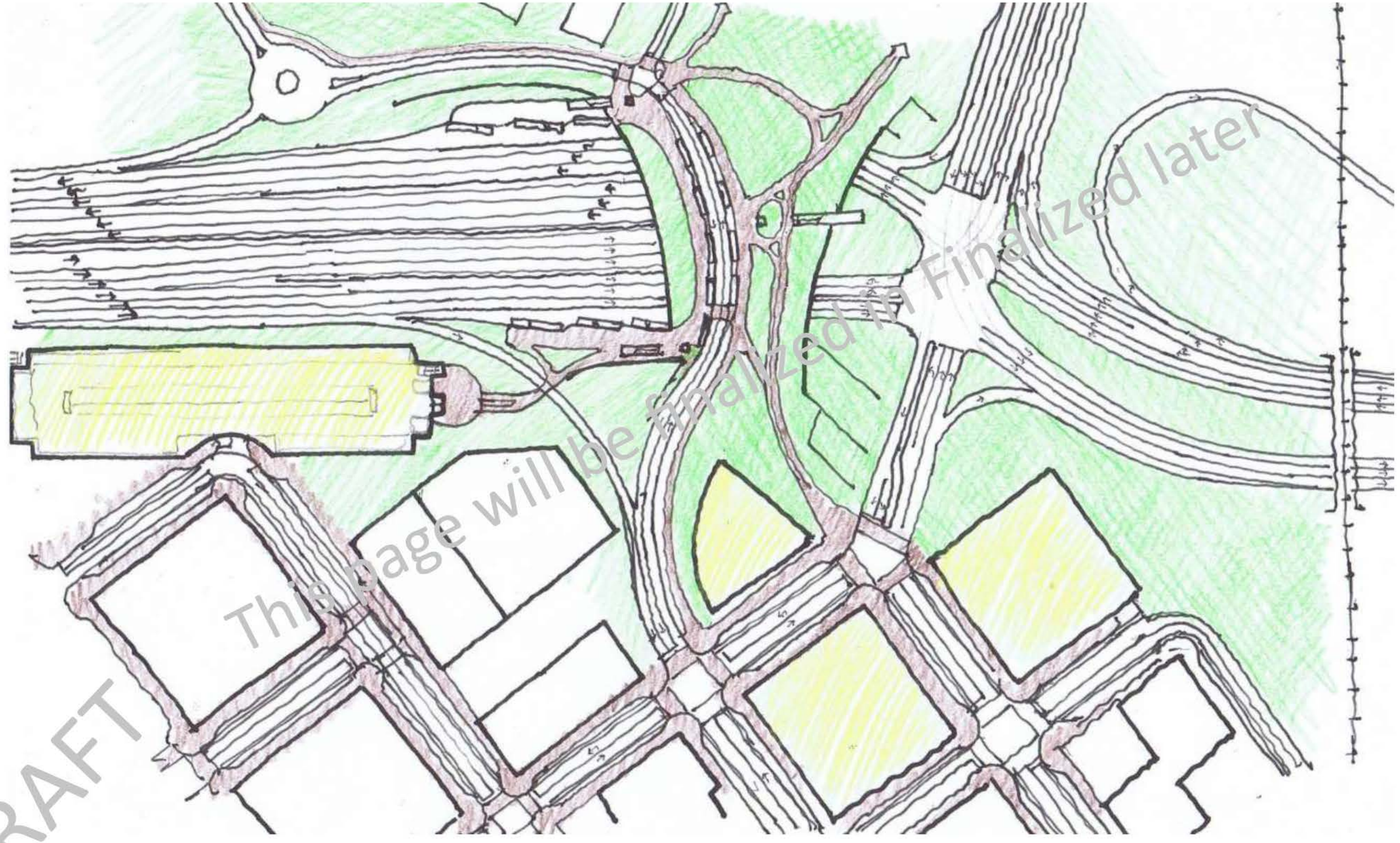
***** $200 per hour, 12 hours per day, 325 days per year, 20 years



Immersed Tunnel Section at Mid-River



Immersed Tunnel Integration Vancouver Plan



Hayden Island General Plan—Immersed Tunnel

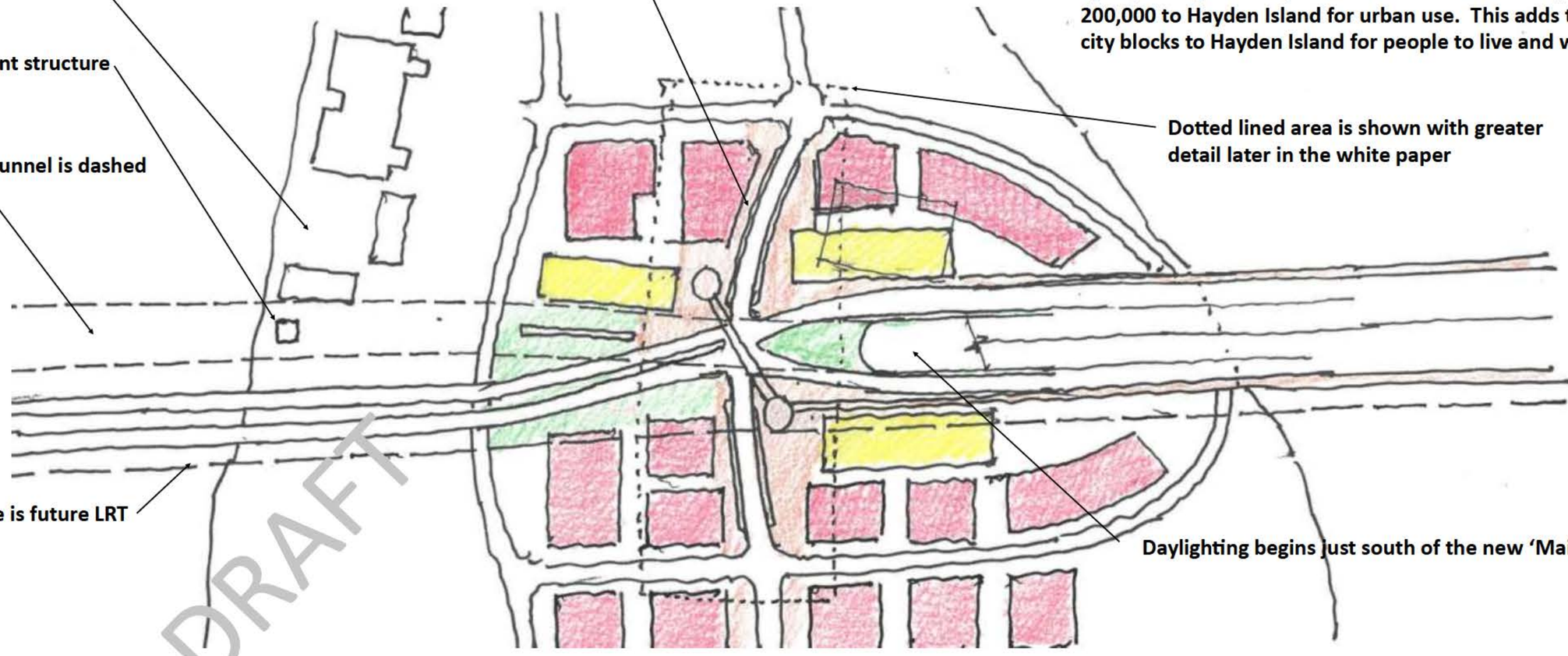
An immersed tunnel will require land and buildings on the west end of the hotel. Once the tunnel is build, possibly a two to three year duration, this property can revert to hotel use.

Hayden Island gets new 'Main Street". This is becomes central location for coming and going from the island. Developed to be urban in character utilizing wide tree lined streets and generous pedestrian provisioning, today's freeway wasteland transitions to a pedestrian hub with a pleasant urban image.

Red blocks show possible redevelopment of central Hayden Island in a more classic urban grid. The resultant footprint of I-5 on Hayden Island with an immersed tunnel and collector-distributor is +/- 800,000 to 900,000 square feet. With the existing freeway occupying +/- 1,000,000 to 1,100,000 square feet, an immersed tunnel adds +/- 200,000 to Hayden Island for urban use. This adds three city blocks to Hayden Island for people to live and work.

Possible vent structure

Immersed tunnel is dashed line area



Dotted lined area is shown with greater detail later in the white paper

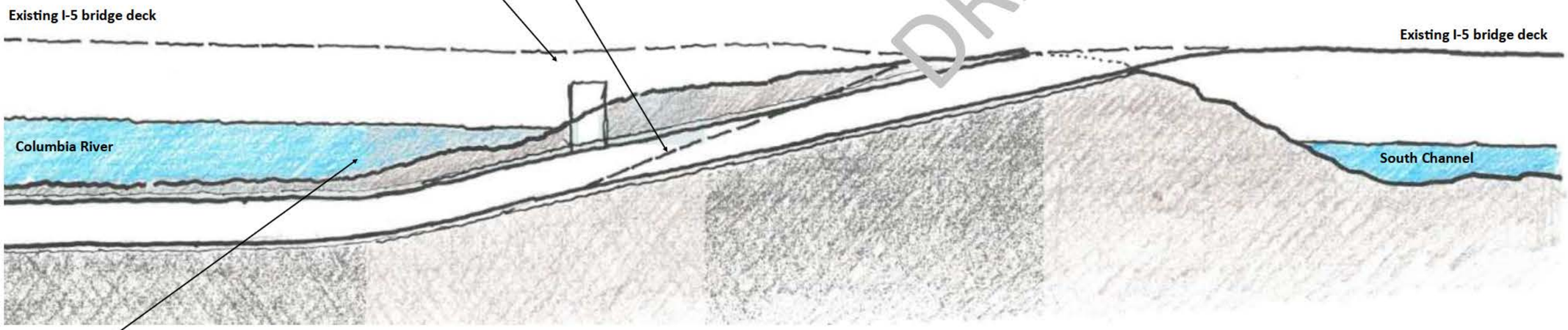
Dotted line is future LRT

Daylighting begins just south of the new 'Main Street"

Hayden Island Section—Immersed Tunnel

Bicycles using the immersed tunnel daylight in the center of Hayden Island where the grade may be 8% to 9% . This steeper transition occurs in the cut and cover portion of the tunnel.

Possible air ventilation location just inside the shore. This is where immersed tunnel sctions begin and Hayden Island cut-and-cover structures transition.



A 20' river depth is assumed 450' to 500' from shore placing the roadway elevation at –52'. The distance from the south channel bridge, elevation +51, to where the tunnel reaches –52' a distance 450' north of the north bank of Hayden island is +/- 2,465' to 2,515'. 103' vertical results in a nominal 4% to 4.1% grade. Express freeway grade.

Hayden Island Central Intersection Plan

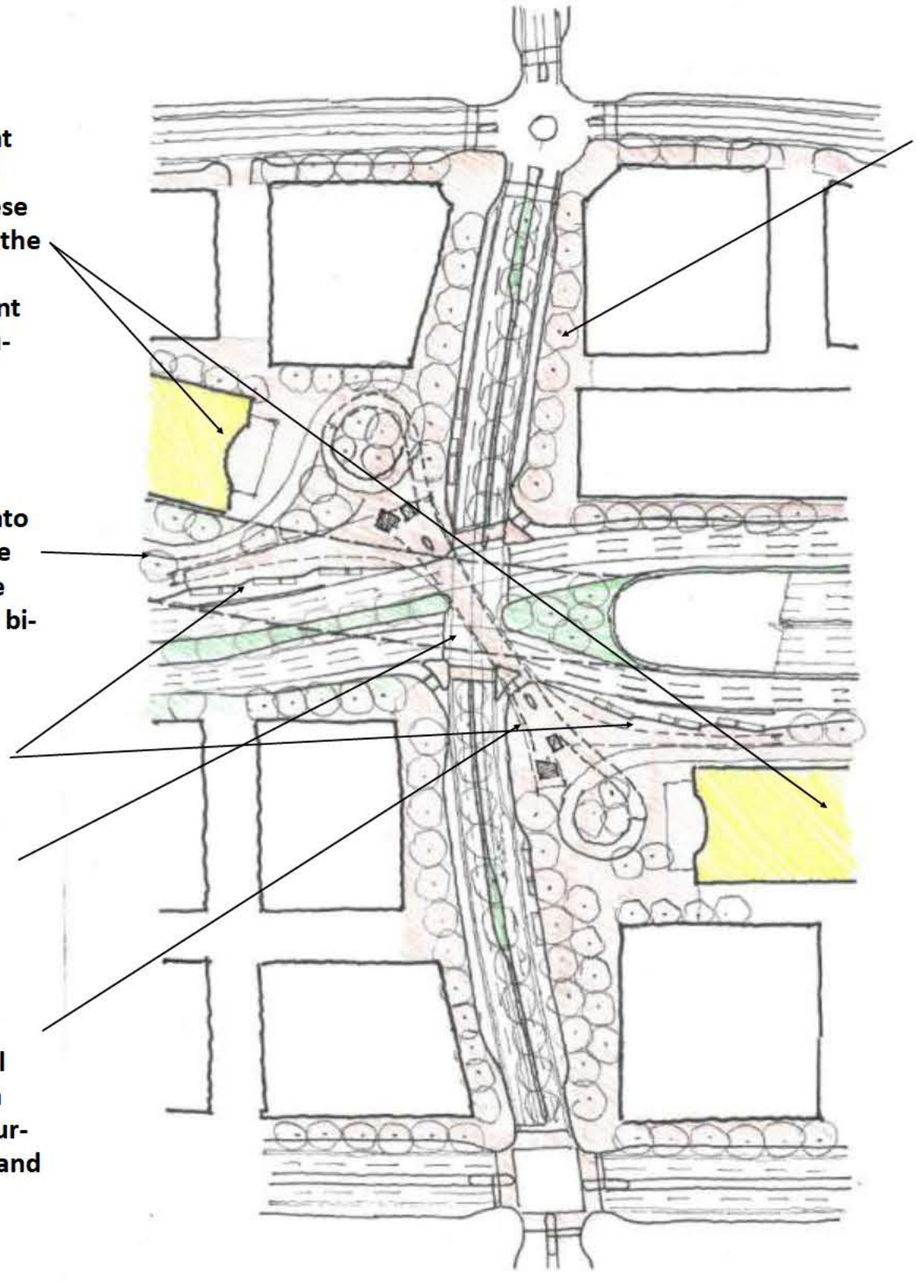
Yellow Blocks are potential Park & Ride lots. Each lot might be a surface lot or three to six floor parking structure two bays wide and between 400 and 600 foot long. Two of these facilities each can park between 140 and 1,200 cars. With the west lot reserved for future LRT and used as a surface lot, P&R initially might total 800 to 1,400 stalls. Redevelopment in the area might result in joint public/private parking solutions.

Bicycle inclusion in the immersed tunnel might daylight into a bicycle plaza just northeast of the intersection. A bicycle shop would be an ideal fit located on the south end of the P&R structure. This brings eyes to the site and celebrates bicycle usage on Hayden Island.

BRT loading areas are located just beyond the signaled intersection.

A pedestrian bridge allows an efficient four phase signal operation with priority given to CD through movement, possibly up to 50% to 70% green.

Pedestrians and bicycles move above intersection traffic. This frees the signaled intersection from long pedestrian crossing phases. The sketch suggests a deep tubular steel truss supports both the bridge deck and tentlike roof. An iconic architectural feature is recommended as this will further diminish freeway intrusion and celebrate Hayden Island as a good place to live and work.



Generous sidewalks and plazas allow this new 'Main Street' of Hayden Island to be very much a desirable tree lined boulevard. The intent is to create a pedestrian friendly place with shops lining the boulevard.

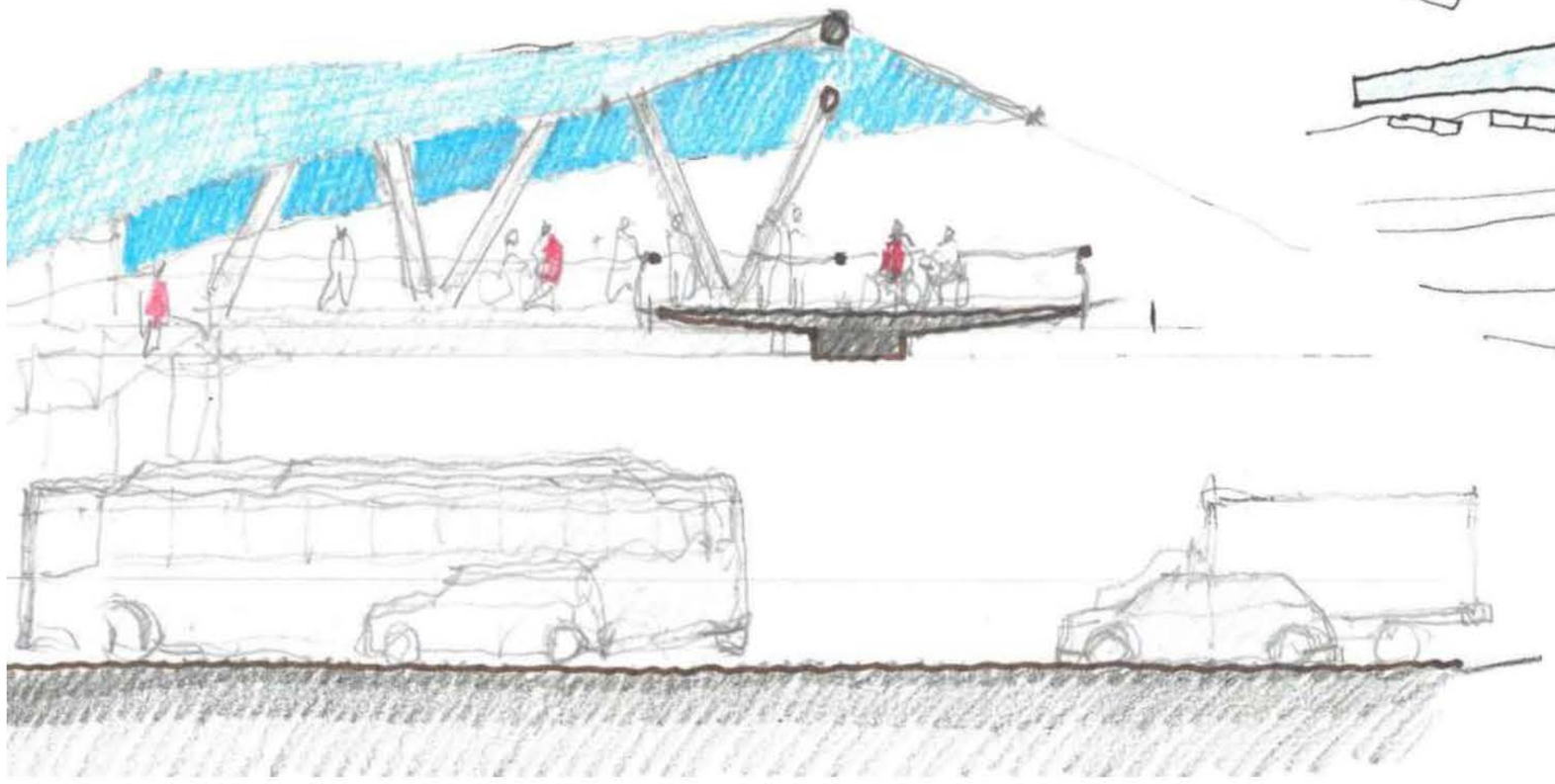
BRT activity helps activate the 'Main Street', mainly during morning and evening during commute periods. With frequent BRT headways, the Hayden Island 'Main Street' becomes a convenient place to stop and shop, used by transit, pedestrians, and motorists alike.

Freeway express lanes are under the intersection. This freeway cut section can be landscaped so as to be a landscaped element in the heart of Hayden Island. However, freeway noise will still originate from the freeway, especially SB lanes climbing at 4% grade.

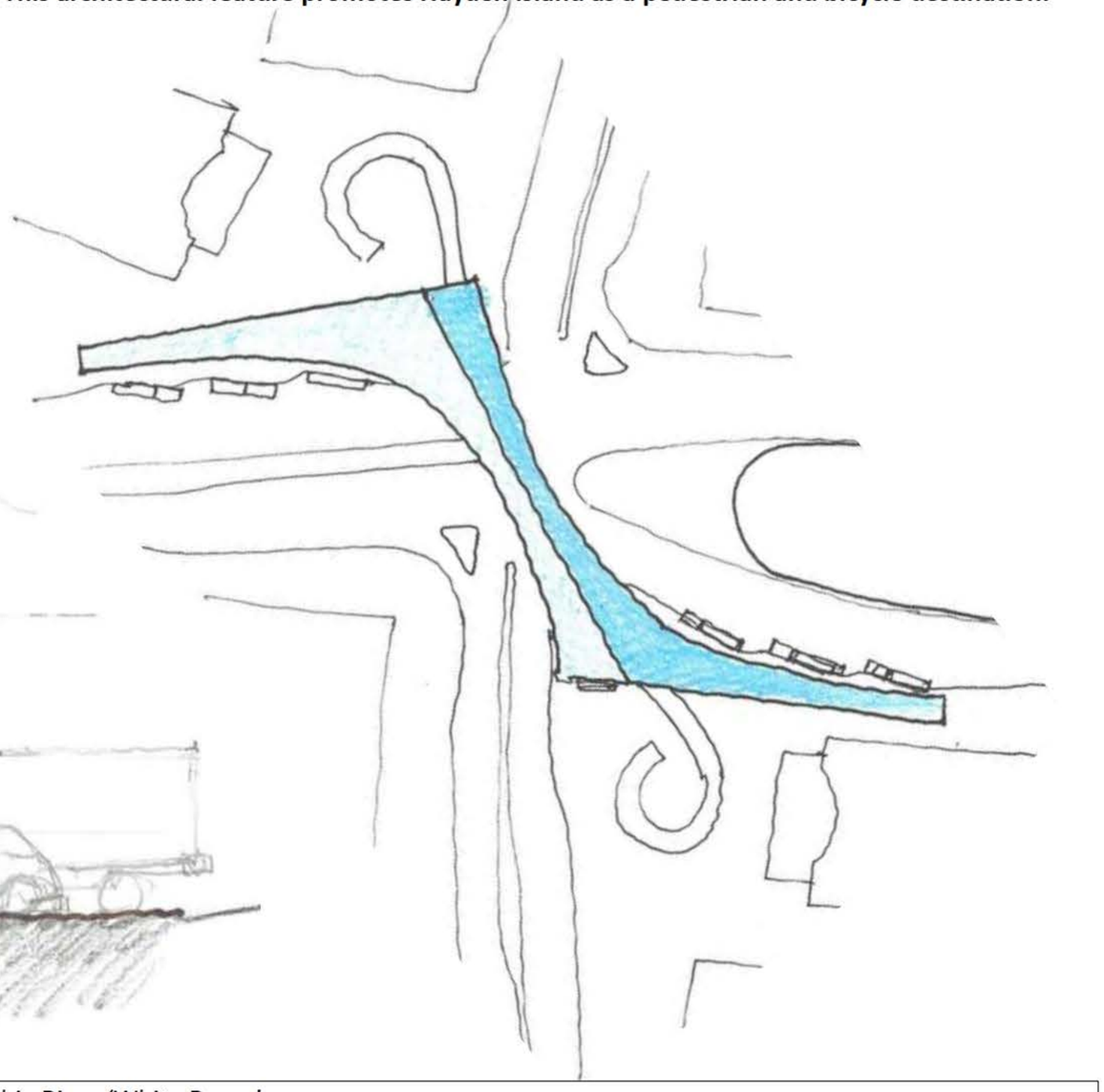
Bicycle and pedestrian lanes, as wide as 20' flank both sides of the collector-distributor and continue south across the South Channel. When bicycles reach the intersection they split east or west in bicycle lanes on streets or climb to cross the intersection using 20:1 ramps. These ramps allow most bicycles to negotiate the intersection via the overhead bridge.

Hayden Island Intersection Pedestrian Linkage - Covered Bridge

Pedestrians and bicycles move above intersection traffic. This frees the signaled intersection from long pedestrian crossing phases. The sketch suggests a deep tubular steel truss supports both the bridge deck and tentlike roof. An iconic architectural feature is recommended as this will further diminish freeway intrusion and celebrate Hayden Island as a good place to live and work.



Connecting NB and SB BRT loading areas as well as facilitating easy pedestrian crossing a covered bridge allows rain protected passage. To the right is a plan suggesting a flowing tentlike roof covering BRT loading areas and the pedestrian bridge above the intersection. This architectural feature promotes Hayden Island as a pedestrian and bicycle destination.

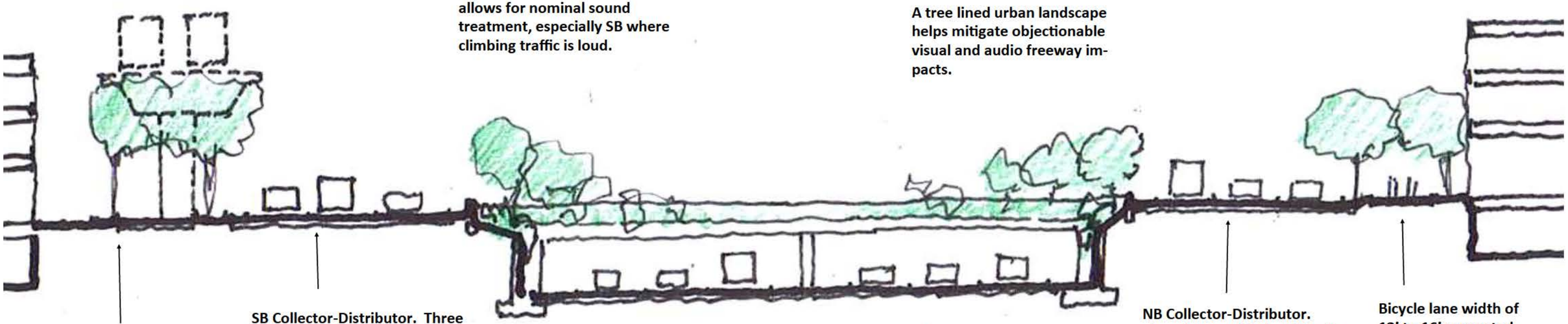


Hayden Island section at daylighting structure

Future Light Rail alignment accommodated to the west side of the SB Collector-Distributor

6’ to 10’ allowance for landscaping and retaining walls between the Express cut structure and Collector-Distributor allows for nominal sound treatment, especially SB where climbing traffic is loud.

A tree lined urban landscape helps mitigate objectionable visual and audio freeway impacts.



Bicycle lane width of 12’ to 16’ separated from the roadway by landscaping suggests a 24’ to 30’ setback for buildings.

SB Collector-Distributor. Three lanes with shoulders is a pavement width of 46’ to 52’.

Three lanes in each direction with 8’ outside shoulders and 6’ inside shoulders suggests a cut width of 114’ to 120’.

NB Collector-Distributor. Three lanes with shoulders is a pavement width of 46’ to 52’. This will widen for left and right turn lanes. This width will vary from 46’ to 70’.

Bicycle lane width of 12’ to 16’ separated from the roadway by landscaping suggests a 24’ to 30’ setback for buildings.

Transitioning from the North Portland Harbor bridge to the Immersed Tunnel will require a vertical change of +/- 70’ on Hayden Island. This suggests a cut structure nominally 20’ below the center of Hayden Island where an intersection connects the Collector-Distributor (CD) with Hayden Island. The overall width of I-5 across Hayden Island south of the CD intersection can be anticipated to be between 254’ and 302’.

N Marine View Drive/Martin Luther King Blvd Interchange Plan

Pedestrian/bicycle lanes on each shoulder of the North Portland Harbor I-5 bridge connects with paths connecting with the Expo station and east and west on N Marine Drive and Martin Luther King Blvd. No pedestrian or bicyclists are allowed in the freeway south of the interchange.

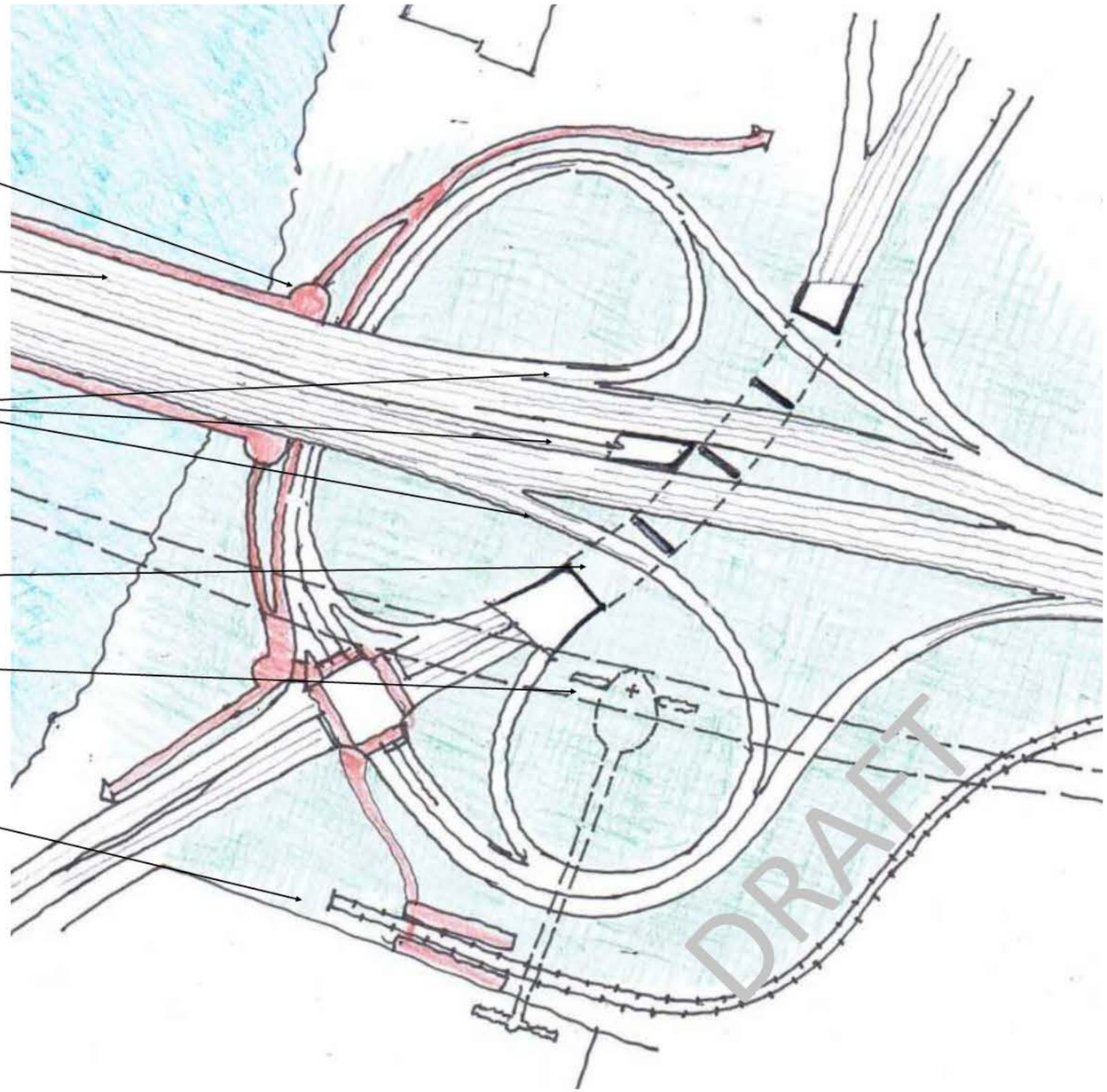
Widening the North Portland Harbor Bridge on the east allows the widened freeway to pass under the second span from the east of the existing N Marine Drive/Martin Luther King Blvd overpass.

On and off ramps on the inside lane of the freeway and on and off ramps from the shoulder eliminates **conflicting lane changes and merging on SB I-5 for those using this exit. This allows CD movements to stay in the right lane and fast moving traffic from express header lanes to not cross multiple lanes. This interchange is important access to North Portland areas near the Columbia river and PDX. Ramping on the inside lanes rising to N Marine Drive/Martin Luther King Blvd likely is a retained fill structure.**

Existing bridge at N Marine Drive/Martin Luther King Blvd is not replaced

Future LRT station. LRT alignment may be straightened to improve trip time.

Today's two-car LRT train will operate near capacity until a four-car train is introduced Adding additional ridership from BRT operations at the Expo Station may not be viable. This suggests BRT should operate between Hayden Island/Clark County without stopping at the Expo LRT station. However, local bus service at the Expo station connecting with local destinations, including Hayden Island and Vancouver, should be encouraged. Providing a easy connection with the CD lanes that can be used by busses is highly desirable.



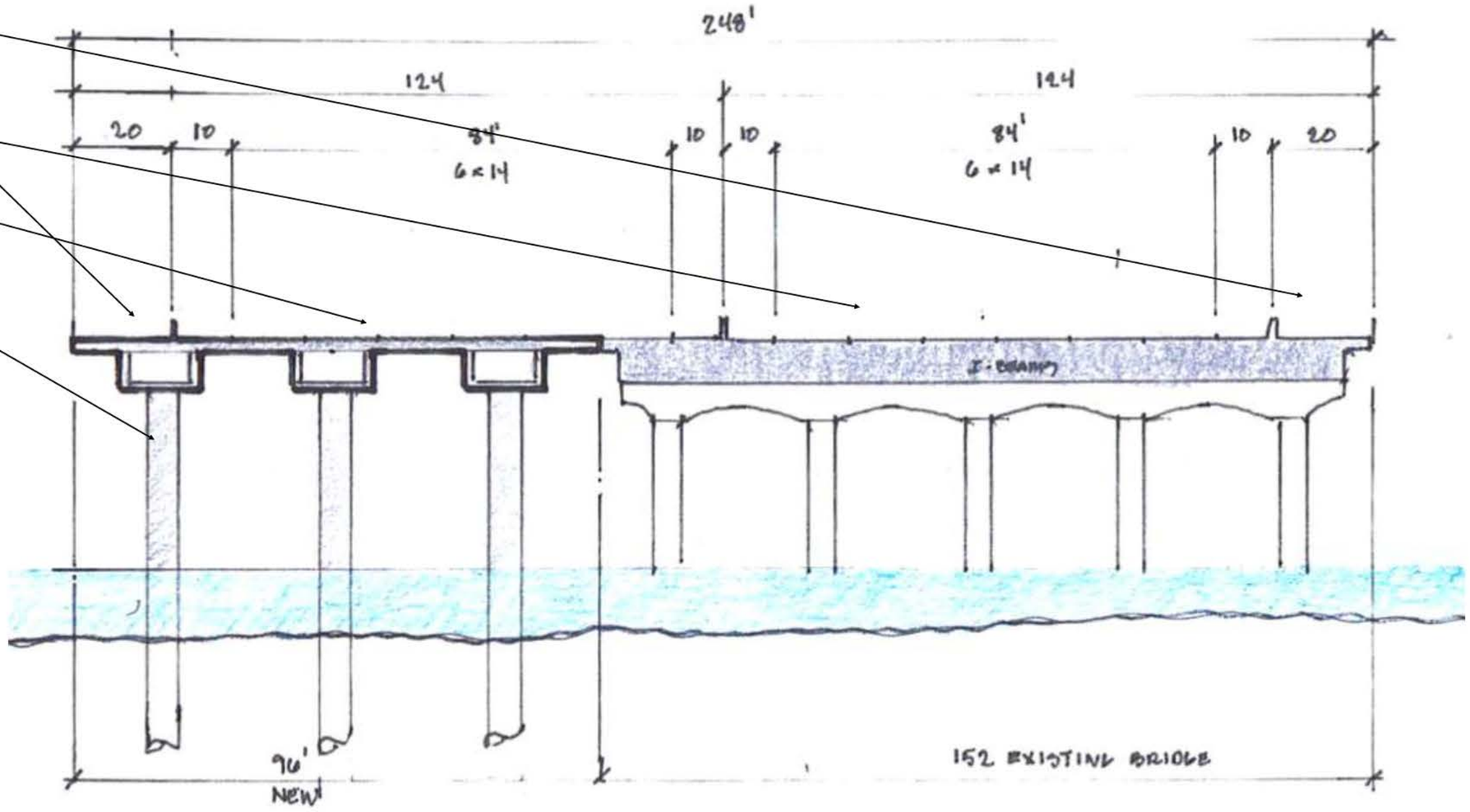
N Portland Harbor Bridge Section Looking South

20’ bicycle and pedestrian paths flank both sides of the bridge

Existing bridge

New bridge widening

Columns and piers align with existing bridge piers



High Level Bridge Alternative

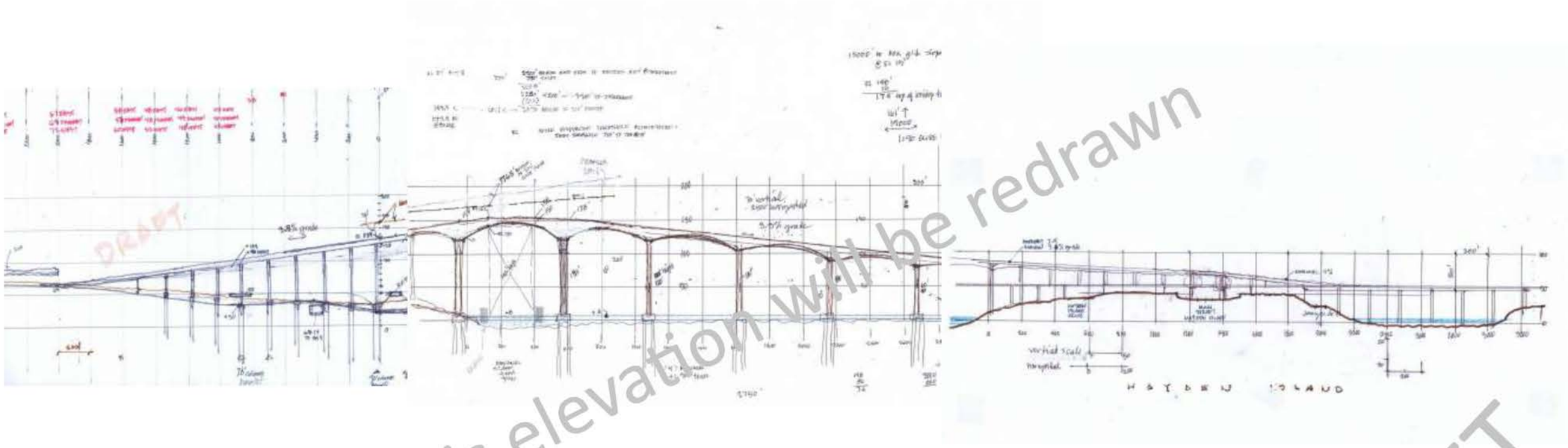
Consideration of a high level bridge involves a number of sub-alternatives or choices this 'White Paper' simply cannot consider. This is the purpose of a Type, Size, and Location study for which many skilled professionals must be engaged. Coping with this inadequacy requires making simple, conservative assumptions. These include a concrete long span segmental box structure as the structural type. Size is assumed to be three lanes in each direction with adequate shoulders to cope with stalled vehicles. Grades are assumed to be equal to or less than 4%. River clearance begets shifting the Pearson Airport runway to the east. This shift can be such that navigation clearance is the same as I-205, 144', or as high as 162'. Grades are considered with the higher navigation clearance. See page 25 for airport information.

Various bridge types may have subtle consequences on grades and clearances. For example, if the bridge deck is supported by a tensile structure, as would be the case with an extrados bridge type, the navigation clearance might increase by a few feet. If shorter spans are considered at the navigation channel, aligning with existing I-5 bridge lift structures, then the navigation clearance my increase by a few feet.

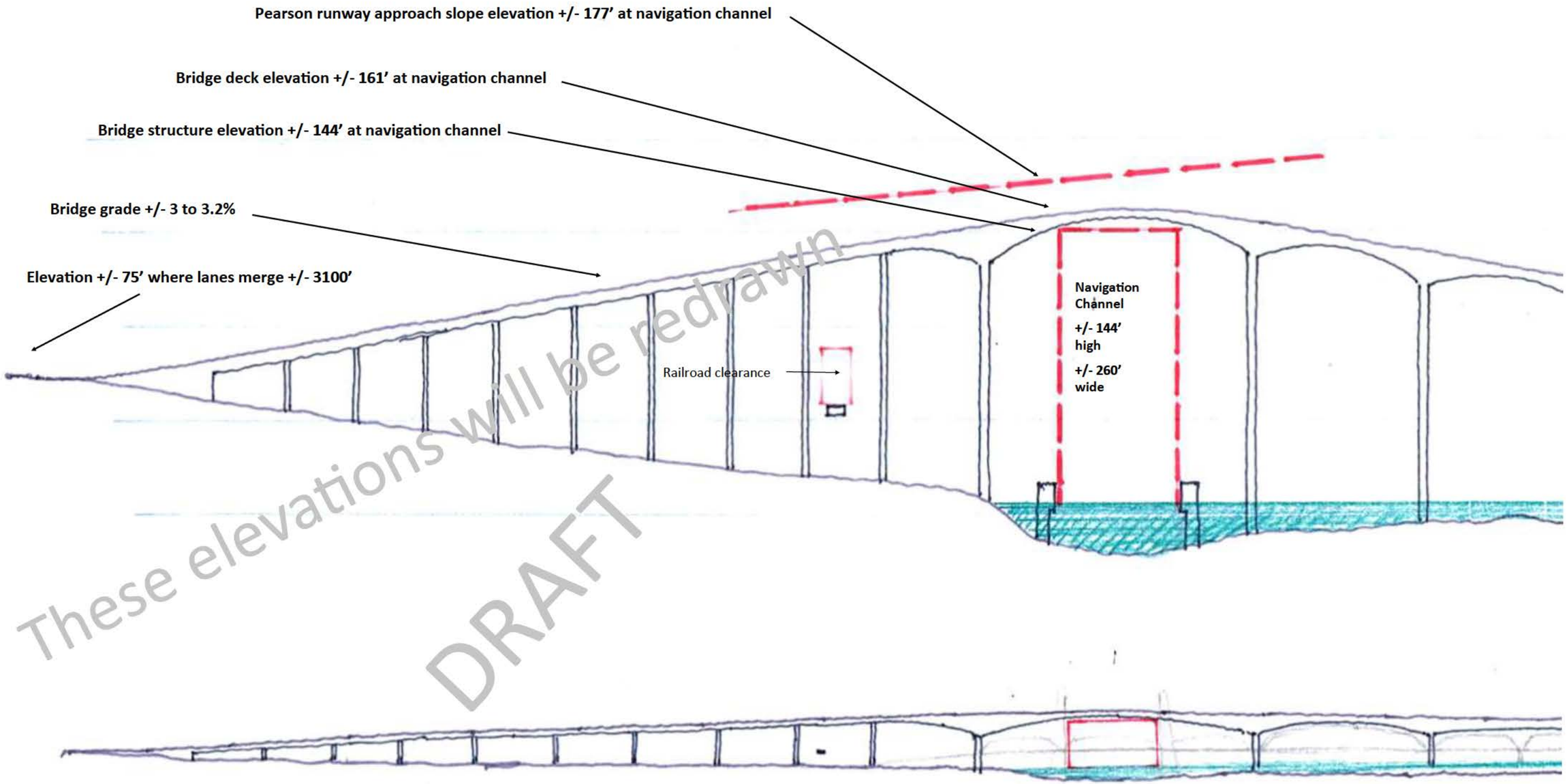
The important thing to remember is this 'White Paper' assumes a conservative structure. Other structures types, bridge widths, and optimizing the location will be required.

Photo of a bridge similar to the bridge type suggested in this White Paper

Bridge Alternative Elevation



Bridge Alternative Elevation

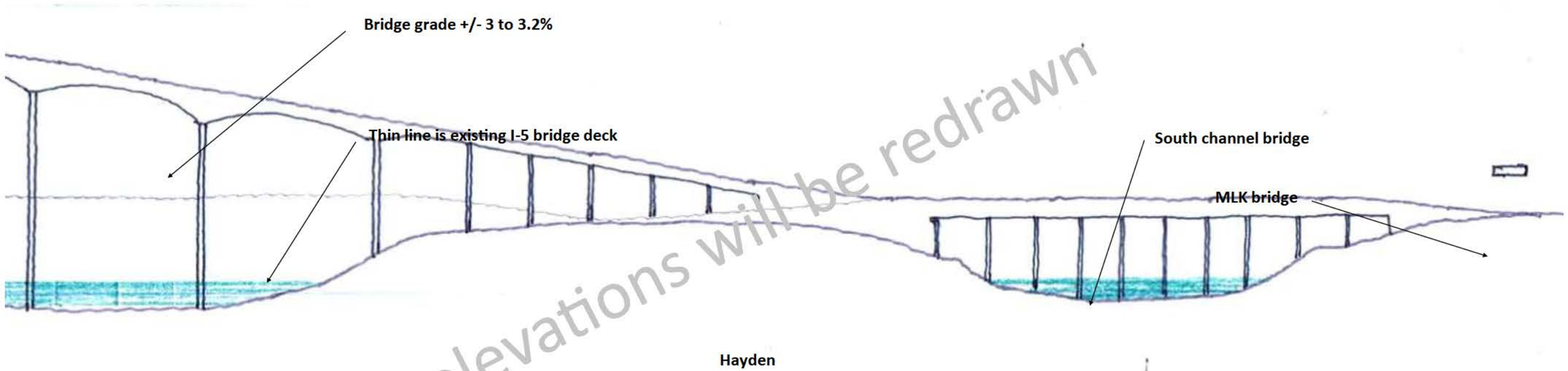


Description of structure elements. These are indicative and generally representative of bridge type structures employed for high level freeway bridges and long river spans. River columns are placed to correspond with every other in-water I-5 piers for navigation channels, river flow, and scour.

Indicative north approach structure consists of multiple 230' to 250' span precast or cast-in-place concrete structures.

Main spans over the river shown are indicative of segmental concrete hunched box girders. The main span at the navigation channel is approximately 800' to 840'. The first span south of the navigation channel is +/- 520' to 540'. See indicative

Bridge Alternative Elevation



Description of structure elements. These are indicative and generally representative of bridge type structures employed for high level freeway bridges and long river spans. River columns are placed to correspond with every other in-water I-5 piers for navigation channels, river flow, and scour.

Main spans over the river shown are indicative of segmental concrete hunched box girders. Between the +/- 530' span and Hayden Island (3) nominal 350' spans are shown.

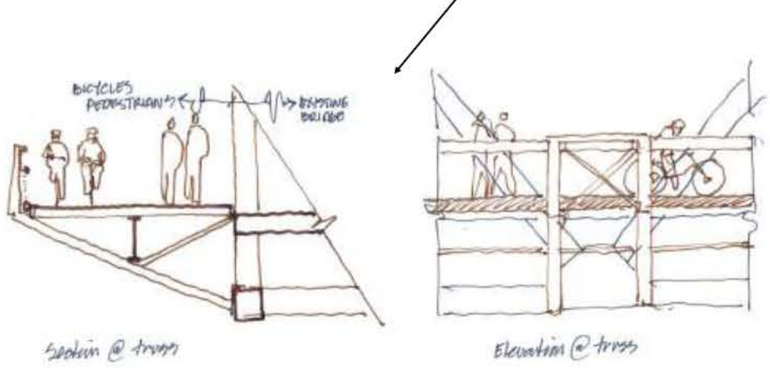
Indicative south approach structure consists of multiple 230' to 250' span precast or cast-in-place concrete structures.

South channel bridge widening likely consists of precast concrete girders with spans equal to the existing bridge.

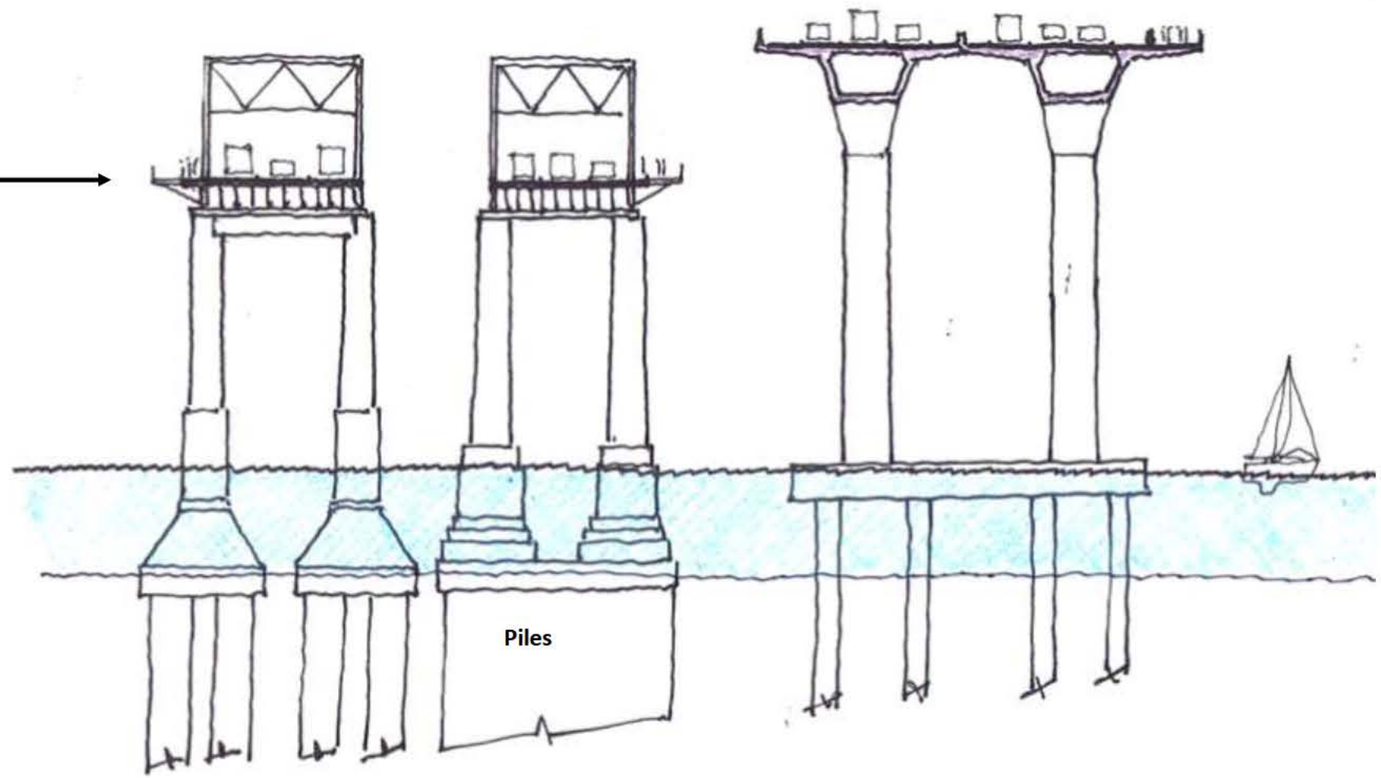
Bridge Alternative Section at Mid-River

Existing I-5 Bridges repurposed as a Collector-distributor. Note sidewalks are widened to be 10’ to 12’. If this is done then the high level bridge need not have a bicycle lane. Accommodating bicycles on the CD bridge is preferable to the high level bridge where noise and wind will be much more objectionable.

High level I-5 ‘Express’ bridge. Note the inclusion of bicycle lanes on the east side of the bridge deck.



Widen Walkways on both bridges

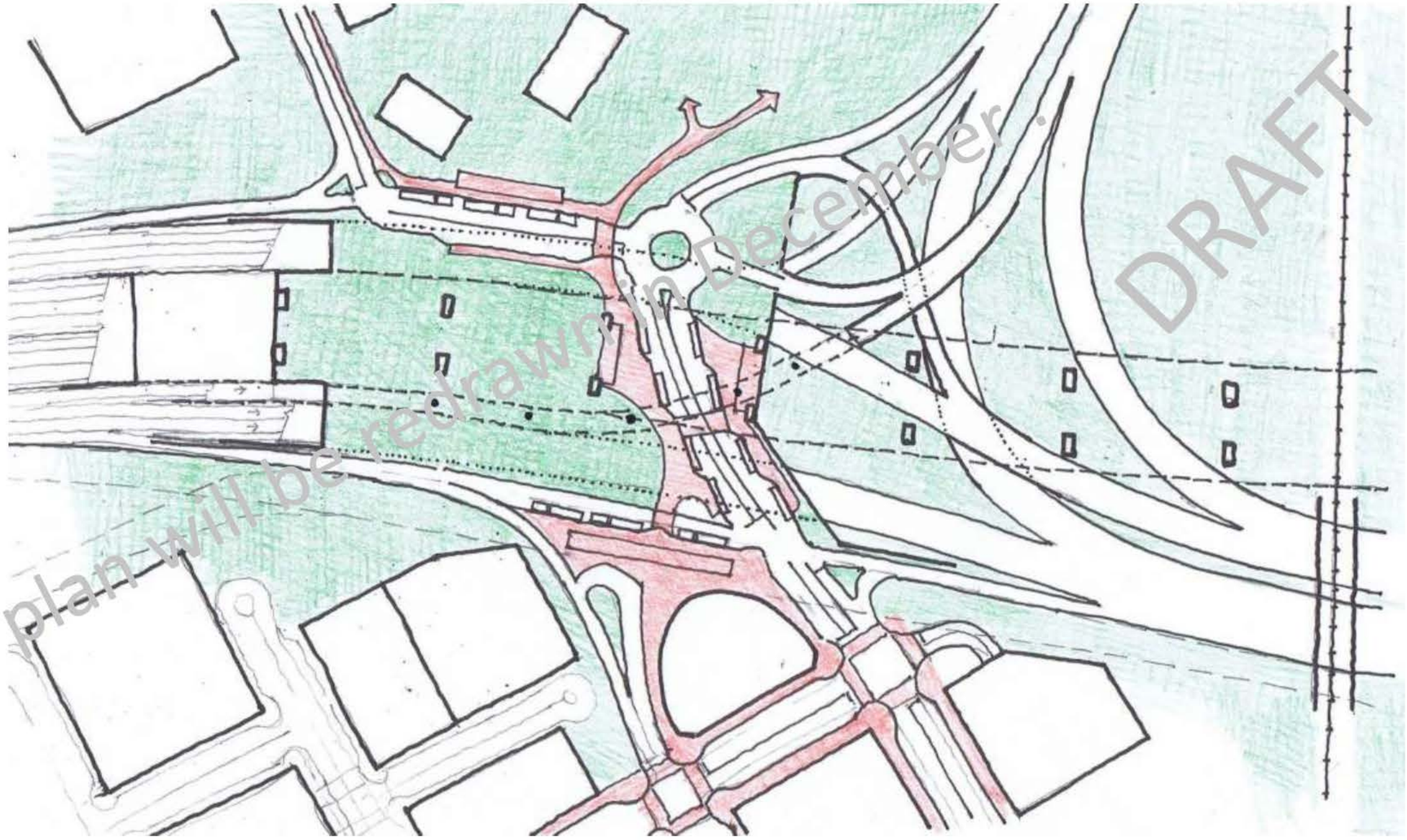


Bridge Alternative Plan at Vancouver

Evergreen Blvd. Keeping grades to 4% suggests a merging of CD and Express lanes just south of this location. However, merging will continue north and require modifications that are not included in this 'White Paper'. A preliminary look at this issue suggests changes to the two interchanges to the north but likely do not involve new structures.

Contrasted with the IBRP proposed alternative, downtown Vancouver benefits with five additional city blocks added to the urban context. Also, flanking CD lanes help shield noise from the high level bridge from the Fort Vancouver park and downtown Vancouver business district.

Closer Look at Vancouver Lid/BRT Hub for the Bridge Alternative

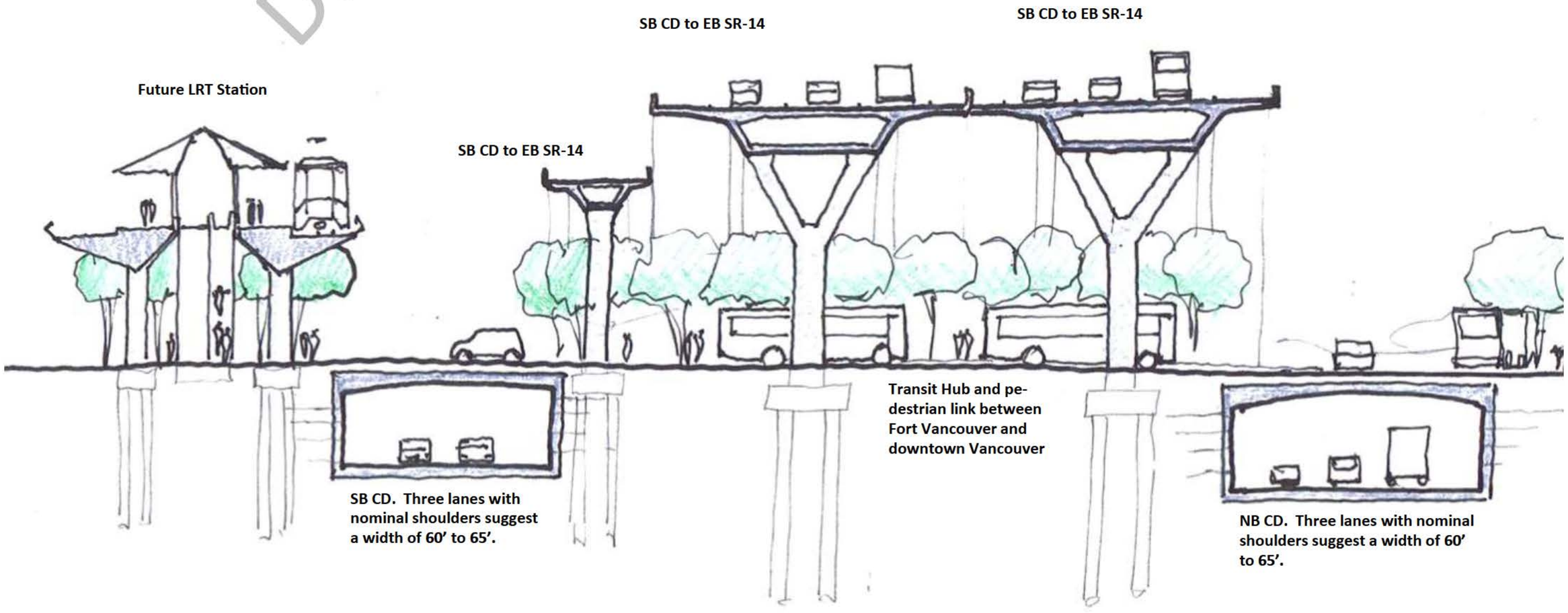


Shown on this page is a lid between 450' and 550' long placed over both CD roadways. This lid connects downtown Vancouver with Fort Vancouver in a park like setting. On the lid a BRT hub is suggested. This transit hub includes local busses and shuttles able to quickly connect transit users with downtown Vancouver and surrounding urban areas.

Future LRT just west of the SB CD lanes advantages the existing transit hub.

This drawing will be revised to include a park-and-ride with 400 to 600 parking stalls.

Bridge Alternative Section at the Vancouver Lid



Pears Airport Runway Background Information

200’ beyond the runway threshold a 20:1 ‘glide slope’ is required. This glide slope extends beyond the I-5 corridor. Curiously, the existing displaced threshold results in an 11:1 glide slope with the towers of the existing I-5 lift structure. This is most curious in that the airport authority shifted the runway west to accommodate the blue roofed building.

Pearson Airport. Note the runway is 2,500’ long with a nominal 770’ displaced threshold on the east (runway 28). This displaced threshold was done to allow the building with the blue roof.

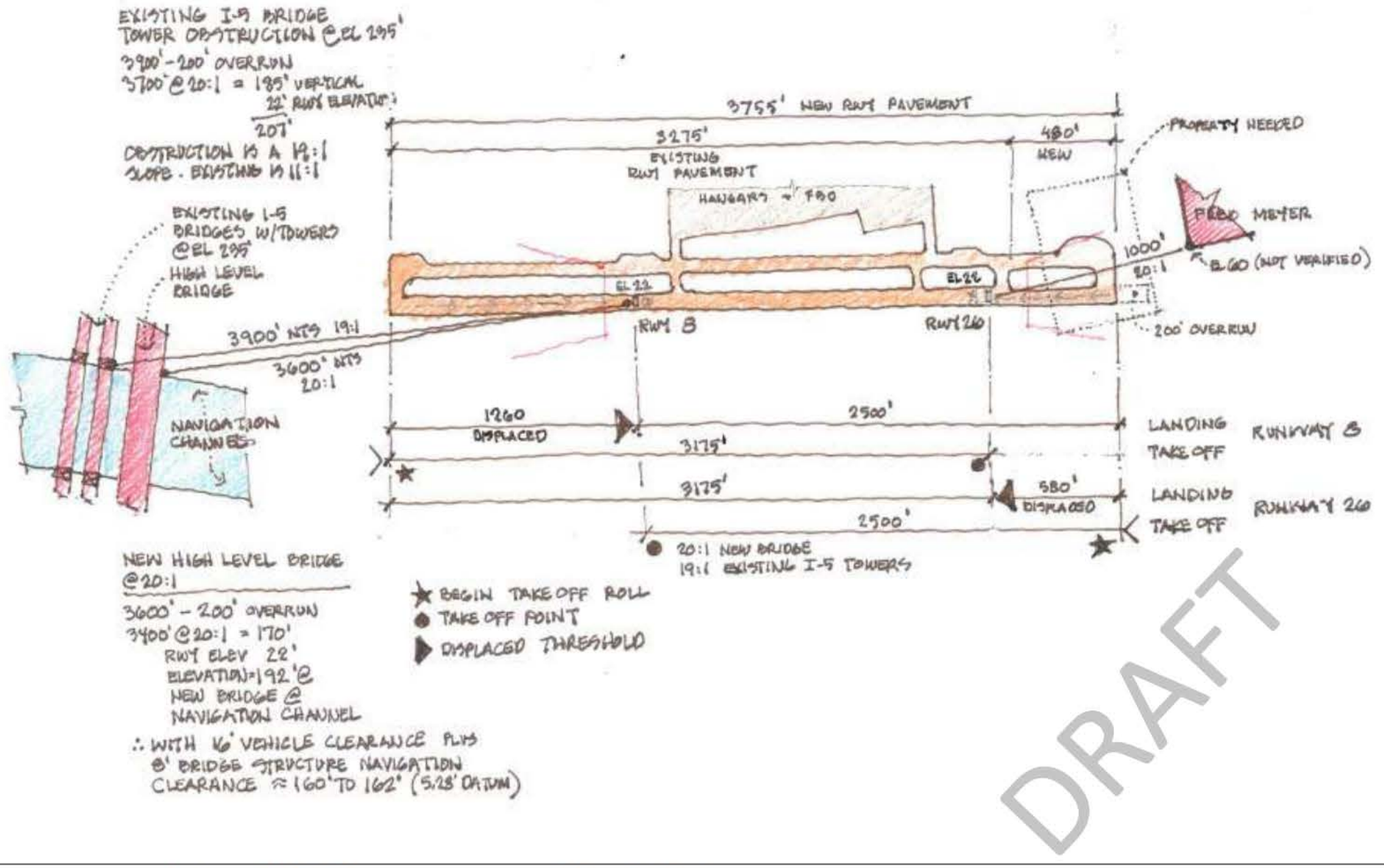
Building with the blue roof

Columbia River navigation channel

The roof of the Fred Meyer building governs where the runway threshold can be shifted to the east. Shifting the runway to the east allows greater clearance at the navigation channel.

Pearson Runway Shift East

Shifting the Pearson airport runway to the east by +/- 480' allows greater clearances at I-5. Existing I-5 bridge towers have a 19:1 glide slope, much improved with respect to the existing 11:1 glide slope. FAA Part 77 specified a20:1 glide slope starting 200' beyond the end of the runway. Holding to 20:1 for the new express bridge results in the bottom of the glide slope at elevation +192' at the navigation channel. Allowing 16' for vehicles and eight feet for bridge structure suggest the top pf the navigation channel is elevation +168'. The navigation channel is elevation 5.28' resulting in a potential navigation clearance of 162 'to 163'. Existing I-5 bridges have a navigation clearance of 178' suggesting the navigation clearance is reduced by +/- 16' to 17'. The result is I-5 clearances exceed upriver clearances that are a minimum of 144'. The proposed IBR bridge clearance is 116', a 28' reduction in upriver navigation clearance. Any bridge looks to reduce navigation clearance between I-5 and I-205 from today's 178' to either 162' or 116'.

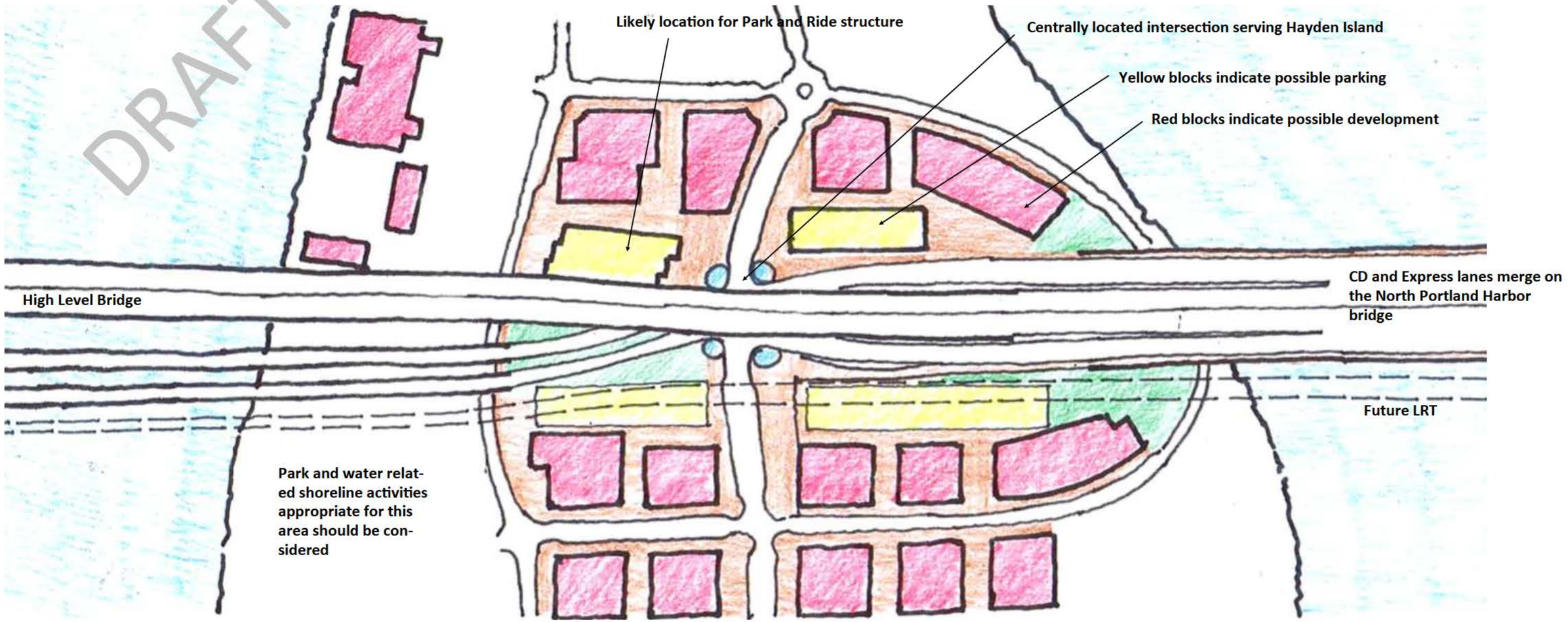


Shifting the runway to the east is limited by the height of the Fred Meyers roof and a 200' overrun beyond the end of the runway. Shifting east requires a detailed analysis of distances and elevations to assure a 20:1 glide slope is achieved.

From a pilot's perspective, shifting the runway comes very close to meeting FAA Part 77 20:1 glide slopes. This is a great improvement compared with the existing 11:1 glide slope obstruction.

Landing on runway 26, with a +/- 580' displaced threshold, has +/-3,175 of runway to come to a stop. Landing on runway 8, with a displaced threshold of 1,260' has 2,500' of runway to come to a stop.

Hayden Island General Plan Bridge Alternative

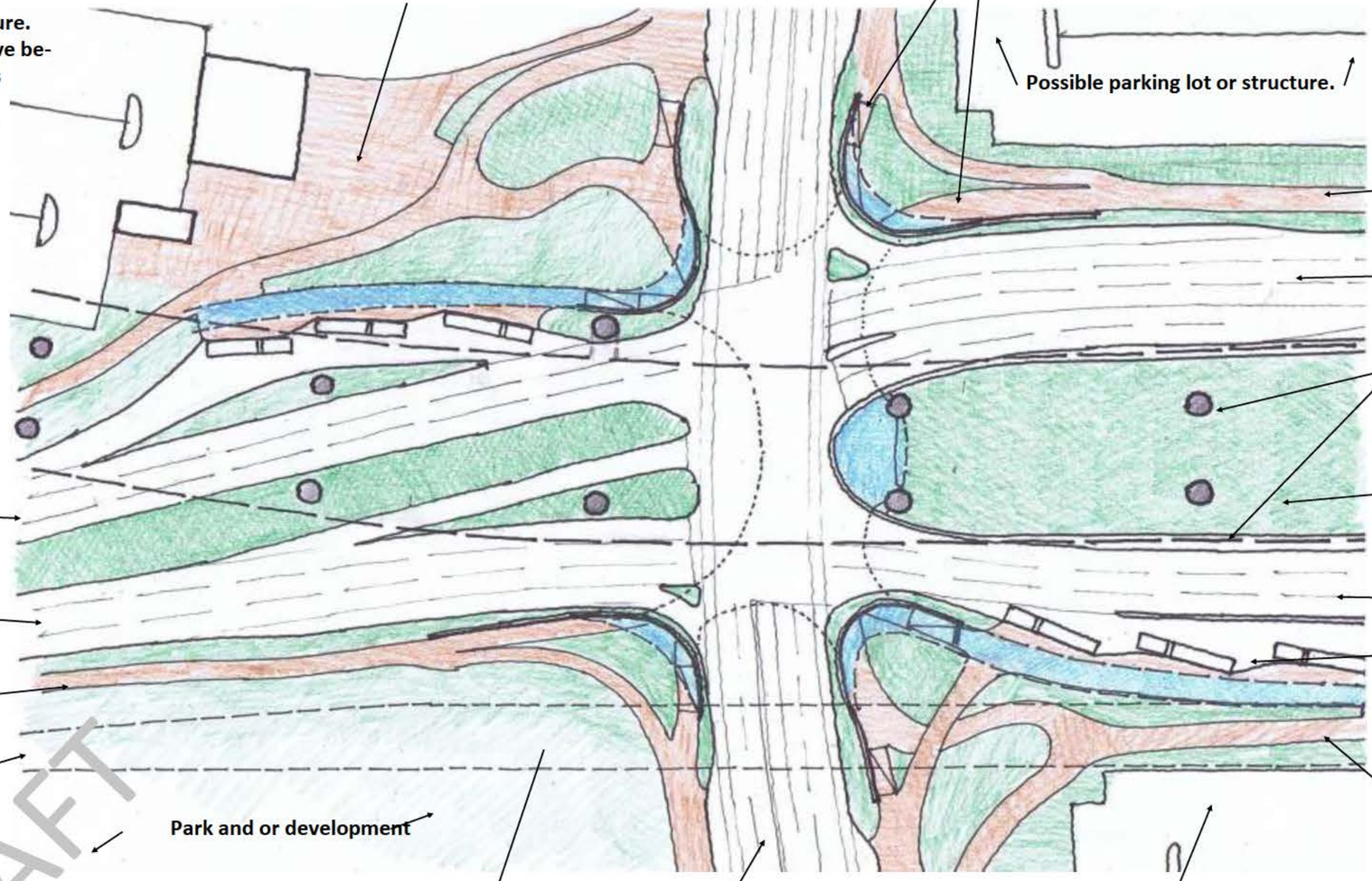


I-5 has separated Hayden Island into east and west portions for a century. The bridge alternative considers how this separation might be mitigated and opportunities for new development might happen.

The CD is provided with a signaled at-grade intersection to serve movements to and from Hayden Island. This central intersection is where a BRT transit hub is located. A linear tree lined east west new 'main street' within a pedestrian plaza is considered to provide and urban setting. A pedestrian 'underpass' facilitating easy access to and from the BRT hub is also included. The 'underpass' eliminates pedestrian phases at the intersection to better CD movements. A bridge alternative can be improved in a manner that enhances the livability of Hayden Island.

Evolving urban viability is important. Hayden Island is a rare and unique setting that can evolve to be a celebrated place for people to live and work. The 'white paper' shows a traditional urban arrangement of walkable streets and multistoried buildings that take on a classical urban setting, much like Parisian blocks near the Seine River, where wide tree shaded sidewalks allow outdoor dining, bicycle paths are found on all streets, shops and businesses are at street level and, people reside in upper floors. Served by BRT and easy access to other areas of the metropolitan area, Hayden Island should consider the I-5 bridge changes as an opportunity to shape the community into a viable place of pride.

Hayden Island Bridge Alternative—Interchange Ground Level Plan



Possible bicycle plaza and shop brings bicycle services and exposure to commuters. Hayden Island can greatly encourage bicycle use, providing rental and services, where transit users can best advantage.

20:1 ramps and stairs lead pedestrians to the 'underpass'. This occurs at all four corners of the intersection in landscaped plazas open to daylight.

Possible Park & Ride structure. Two or three levels can serve between 300 and 600 vehicles

Possible parking lot or structure.

BRT stop. Blue represents shelter integrated with the intersection 'underpass'. Three 60' articulated bus loading areas shown.

Bicycle lane to North Portland harbor bridge

Bicycle lane to existing I-5 NB CD bridge across the Columbia River.

NB CD

Dashed line is edge of I-5 Express structure above. Round circles are possible column locations

NB CD lanes

Landscaping

SB CD lanes

SB CD

Bicycle lane to existing I-5 SB CD bridge across the Columbia River.

BRT stop. Blue represents shelter integrated with the intersection 'underpass'. Three 60' articulated bus loading areas shown.

Future LRT location

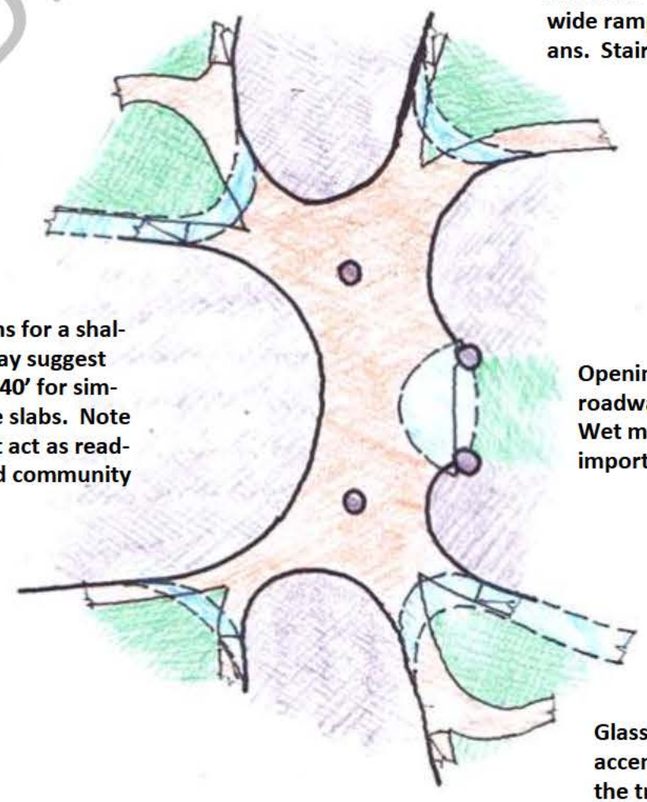
Park and or development

Bicycle lane to North Portland harbor bridge

New tree lined street serving Hayden Island. Short term street parking provides kiss & ride and shuttle connection. Hayden Island is a size and density ideal for a circulator connecting the BRT hub with island residents.

Possible Park & Ride lot or development

Hayden Island Pedestrian Underpass



Structural implications for a shallow pedestrian subway suggest clear spans less than 40' for simple two way concrete slabs. Note the two columns that act as reader boards for BRT and community information

Access to the 'underpass' is from each intersection corner. 20:1 wide ramps, 12' to 16' wide, allow use by bicycles and pedestrians. Stairs provide convenient access for most users.

Opening the 'underpass' to the landscaped area between CD roadways allows daylight to reach into the pedestrian space. Wet months suggests glass canopy use. Architectural design is important.

Glass canopy can easily be extended to shelter BRT users and accentuate the path to and from the 'underpass'. Landscaping the transition between ground level and 'underpass' portal.

A pedestrian environment open to daylight with a flowing form is a creative and unique space. Open lines of sight enhance security. This is a pedestrian setting from Ottawa.

A pedestrian environment respectful of users in a beautiful well lite space is inviting. Art and creative design play a big role creating a space people desire to use. This is a pedestrian subway in Phoenix.

N Marine View Drive/Martin Luther King Blvd Interchange Plan

Pedestrian/bicycle lanes on each shoulder of the North Portland Harbor I-5 bridge connects with paths connecting with the Expo station and east and west on N Marine Drive and Martin Luther King Blvd. No pedestrian or bicyclists are allowed in the freeway south of the interchange.

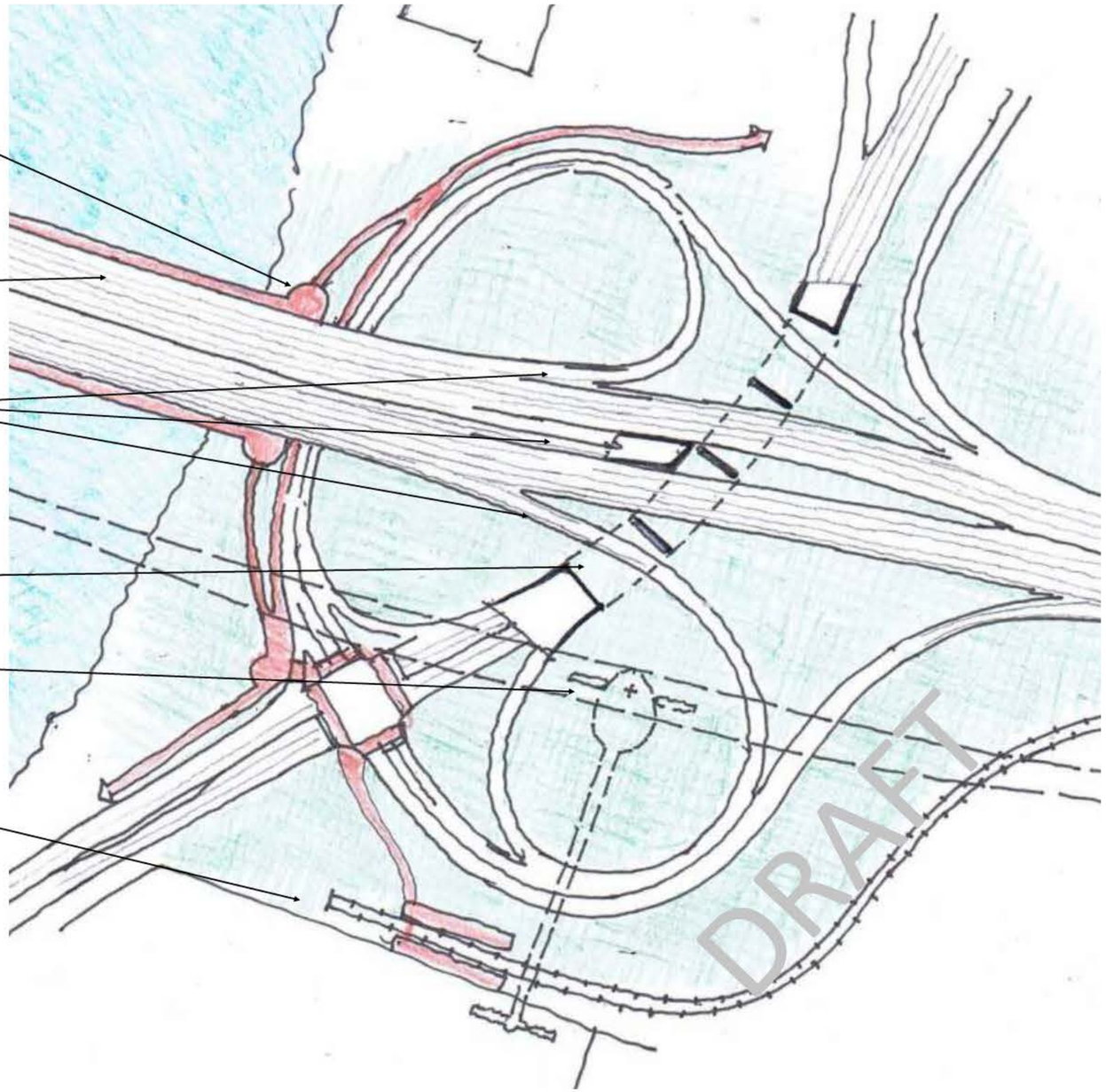
Widening the North Portland Harbor Bridge on the east allows the widened freeway to pass under the second span from the east of the existing N Marine Drive/Martin Luther King Blvd overpass.

On and off ramps on the inside lane of the freeway and on and off ramps from the shoulder eliminates conflicting lane changes and merging on SB I-5 for those using this exit. This allows CD movements to stay in the right lane and fast moving traffic from express header lanes to not cross multiple lanes. This interchange is important access to North Portland areas near the Columbia river and PDX. Ramping on the inside lanes rising to N Marine Drive/Martin Luther King Blvd likely is a retained fill structure.

Existing bridge at N Marine Drive/Martin Luther King Blvd is not replaced

Future LRT station. LRT alignment may be straightened to improve trip time.

Today's two-car LRT train will operate near capacity until a four-car train is introduced Adding additional ridership from BRT operations at the Expo Station may not be viable. This suggests BRT should operate between Hayden Island/Clark County without stopping at the Expo LRT station. However, local bus service at the Expo station connecting with local destinations, including Hayden Island and Vancouver, should be encouraged. Providing a easy connection with the CD lanes that can be used by busses is highly desirable.



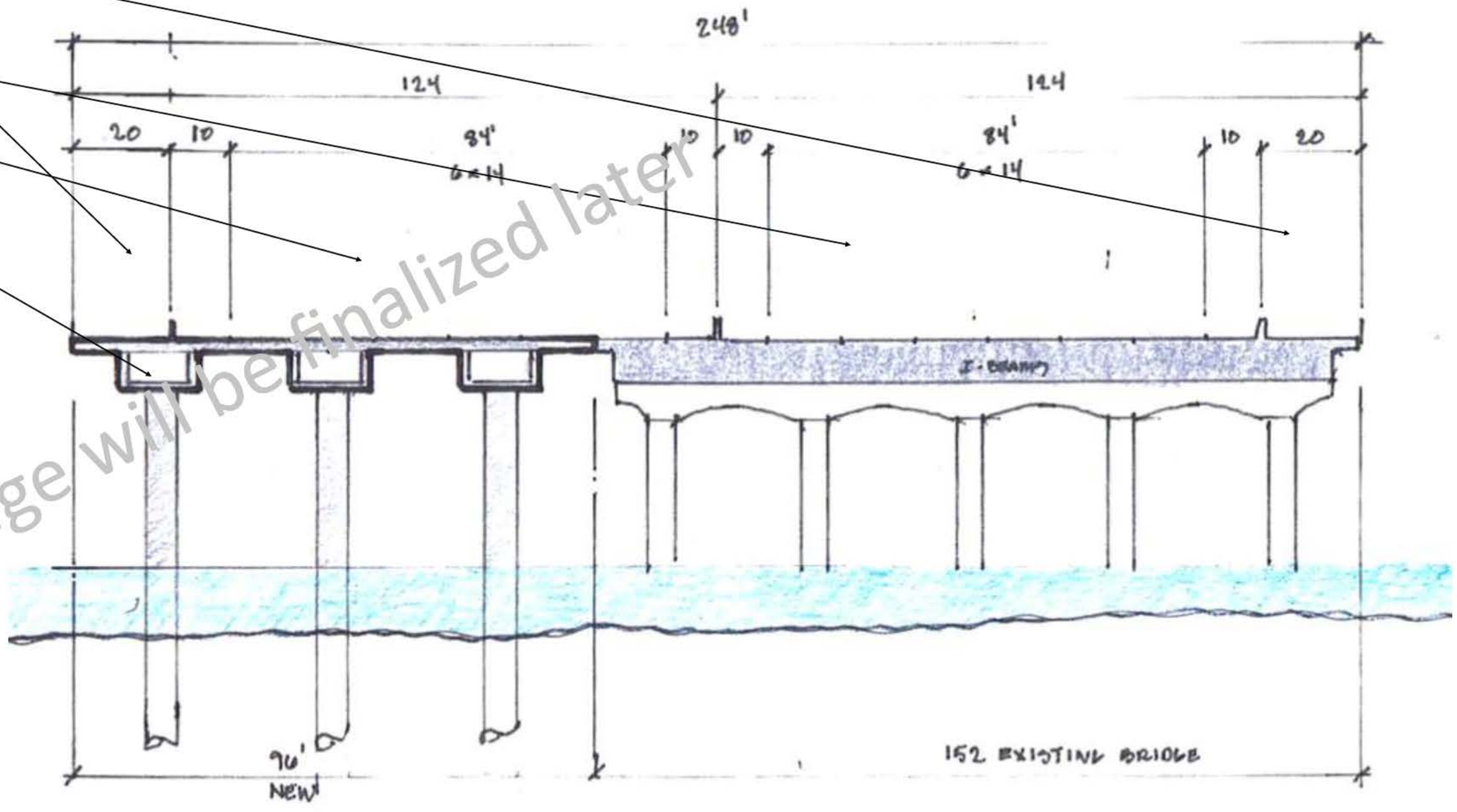
N Portland Harbor Bridge Section Looking South

20’ bicycle and pedestrian paths flank both sides of the bridge

Existing bridge

New bridge widening

Columns and piers align with existing bridge piers



Let's Compare the Immersed Tunnel, High Level Bridge, and IBR Proposal

Basic consequences for the three alternatives are shared on this 'Comparison of Alternatives' matrix. Please note that this is a comparison using IBRP materials, the product of many decades of planning and design, with two alternatives created by volunteer professionals over a three month period.

Only basic attributes can be compared as data used for the immersed tunnel and high level bridge alternatives have not been explored consistent with a traditional Type, Size, and Location study. A T,S&L study normally precedes detailed planning and design but does require sufficient transportation planning, structural engineering, and urban design to properly evaluate basic consequences of bridge type, bridge size, and location. In the case of the Columbia River a T,S&L study requires careful consideration of interchanges as five interchanges are currently located in a 2.8 mile freeway that includes the Columbia River bridge.

Both the immersed tunnel and high level bridge provide significant comparative benefit when compared with he IBRP design to warrant future consideration.

Comparison of Alternatives
I-5 at the Columbia River
Three choices are included.
The IBRP proposed bridge with a 116' navigation clearance, an immersed tunnel with 178' navigation clearance, and a bridge with 144' navigation clearance
Note that non-IBRP alternatives assume retaining the two I-5 bridges functioning as a collector-distributor

attributes	IBRP 116' Bridge	Immersed Tunnel	High Level Bridge
Navigation Clearance	**116'**	**178'**	**144' to 160'**
Satisfy FAA airspace part 77 requirements	**Y**	**Y**	**Y**
Mobility Comparison *			
Interstate lanes	**3**	**3 or 4**	**3 tor 4**
Local lanes	**1****	**3**	**3**
City blocks needed for the freeway***	**35 to 40**	**27 to 32**	**28 to 33**
Vancouver blocks gained with IBR as the baseline	-	plus **5 to 6**	plus **4 to 5**
Hayden Island blocks gained with IBRas the baseline	-	plus **2**	plus **2**
Vancouver/Fort Vancouver pedestrain connection rating *0 is existing, 10 is pedestrain connection free of road barrier*	**1**	**6**	**6**
East/West Hayden Island pedestrian linkage rating *0 is existing, 10 is pedestrain connection free of road barrier*	**2**	**7**	**6**
Transit			
BRT and LRT**** part of the project	**Y**	-	-
BRT more than adequate	**Y**	**Y**	**Y**
Future LRT line preserved	**Y**	**Y*****	**Y*****
Cost (in Billions)	**8 to 10**	**4 to 7**	**3 to 6**

* Vehicle lanes needed with 40% growth. One CD lane prioritize for transit
** Requires merging onto the interstate freeway
*** These are 200' X 200' equivalent city blocks with 80' streets. Detailed planning will determine actual numbers.
**** Extending the Yellow Line LRT into Clark County is a two-car train with a 15 minute headway operating in mixed traffic.
***** LRT capacity of more than +/- 4,000 people per hour requires a four-car train operating in mostly dedicated ROW. .
This requires $20+ billion investment to underground LRT in the Portland CBD and mitigate slow mixed-traffic operations.
Until downtown Portland and the Yellow line are improved, BRT can serve the communities of the
Portland Metro area transporting more than 5,000 transit users an hour to and from Clark County

Summary statement

Key points shared in this White paper are:

Inadequate Capacity

Mobility need across the Columbia River calls for a minimum of six lanes. This is tempered by Portland's desire to not add traffic downtown. This suggests through movements limited to three or four lanes south of the project area. Local mobility serving local urban activities on both shores is a need of two or three lanes. Using the two existing bridges as a collector-distributor serving local mobility needs is self-evident.

Adherence to Standards

Most DOT design manuals require a Collector-Distributor be considered if urban interchanges are more frequent than a one mile spacing. Five interchanges presently exist in 2.7 miles. The project office failed to appropriately consider a Collector-Distributor as part of alternatives study.

Transit Understanding

Existing link loading on the Yellow Line has the capacity to serve 500 commuters leaving Clark County to Portland in the peak hour with the four trains per hour proposed. 500 passengers in the peak hour means all riders south of the Expo Station must stand in the train for a 50-minute journey. This is not high-capacity transit. What's proposed is undercapacity and, unfortunately, may well represent a 2-billion-dollar investment further eroding transit's desirability and ability to grow mode share. BRT, at a fraction of LRT price, allows all riders a seat for a 30-minute journey. BRT can grow transit mode share; LRT cannot until four car trains run in a dedicated ROW which requires a 20+ billion-dollar investment to underground LRT in Portland and largely eliminate mixed traffic operation in the ROW. The only viable high capacity transit mode at this time is BRT. This will change when LRT improvements in downtown Portland, likely undergrounding the line, and mixed traffic operations of the Yellow Line are largely eliminated.

Poor Urban Integration

Fort Vancouver and Downtown Vancouver should not be separated. Hayden Island should not be split East/West. Any solution should link urban areas; not separate them as the IBRP proposes. Also, urban blocks required by I-5 should be reduced. Six to ten FEWER city blocks are required by the two alternatives shared in this 'white paper'. Urban shores on both sides of the Columbia River are too precious to not optimize as desirable urban places to live and work.

Navigation Clearance

How much public wealth has been invested to assure navigation vertical clearance of 144' for the 300+ miles between I-205 to Lewiston, Idaho? To reduce this to 116' is not consistent with the public wealth invested in the navigation channel. Alternatives exist, at less cost, that maintain the 144' or meet the current 178' clearance.