



# West Seattle and Ballard

## Link Extensions

<b>To:</b>	Stephen Mak, Sound Transit
<b>From:</b>	HNTB
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<b>Date:</b>	January 24, 2023
<b>Re:</b>	Ballard Extension Further Studies: Downtown Concepts

## INTRODUCTION

On July 28th, 2022, the Sound Transit Board requested further studies and public engagement in some areas to inform potential additional future Board action to confirm or modify the Draft Environmental Impact Statement (EIS) Preferred Alternative for the Ballard Link Extension.<sup>1</sup> This memo focuses on the results of the further studies requested for the Downtown segment of the Ballard Link Extension.

## Board Direction

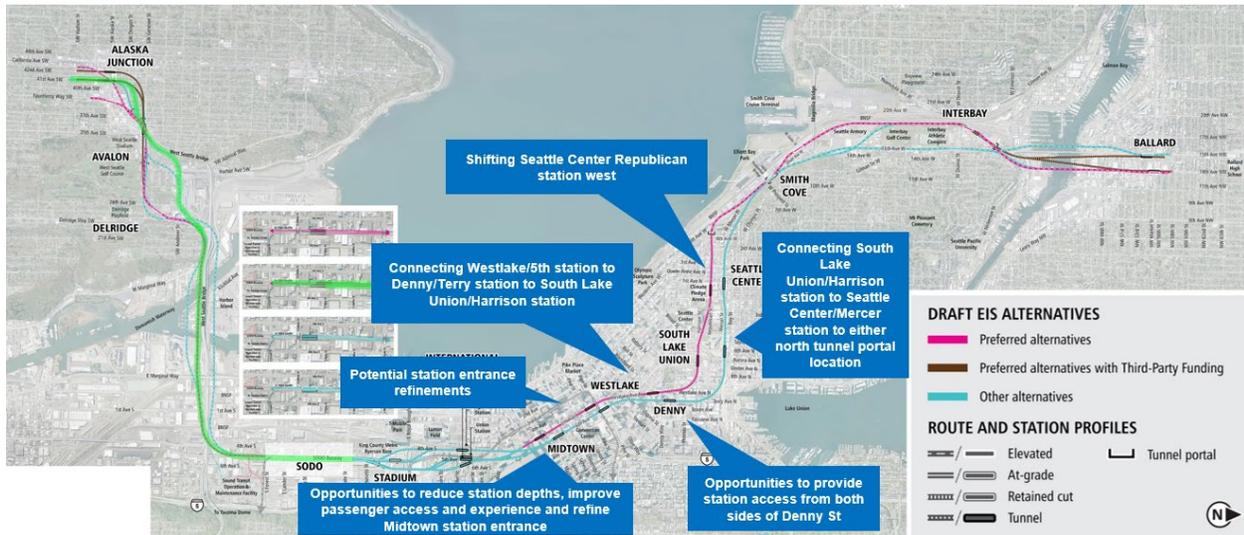
Board Motion M2022-57 directed further study of the following in the Downtown segment (Figure 1):

- Explore opportunities to reduce station depths, and to improve passenger access and experience, at all depths under consideration for the Midtown station, and refinements to the Midtown station entrance.
- Explore connecting Westlake/5th Avenue station (*Draft EIS Preferred 5th Avenue/Harrison Street Alternative [DT-1]*) to Denny/Terry station (*Draft EIS 6th Avenue/Mercer Street Alternative [DT-2]*) to South Lake Union/Harrison station (DT-1).
- Explore opportunities to provide station access from both sides of Denny Street to the Denny/Terry station (DT-2).
- Explore connecting South Lake Union/Harrison station (DT-1) to Seattle Center/Mercer station (DT-2) to either of the two north tunnel portal locations.
- Explore shifting Seattle Center Republican station west.
- Explore potential station entrance refinements at Midtown and Denny stations (shifting entrances into public right-of-way [ROW]) and Westlake (consolidating station entrances).

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<sup>1</sup> West Seattle and Ballard Link Extensions Draft Environmental Impact Statement, January 2022, Sound Transit, <https://www.soundtransit.org/get-to-know-us/documents-reports/west-seattle-ballard-link-extensions-draft-environmental-impact-0>

Figure 1 Ballard Link Extension Further Studies – Downtown



## Further Studies Concepts

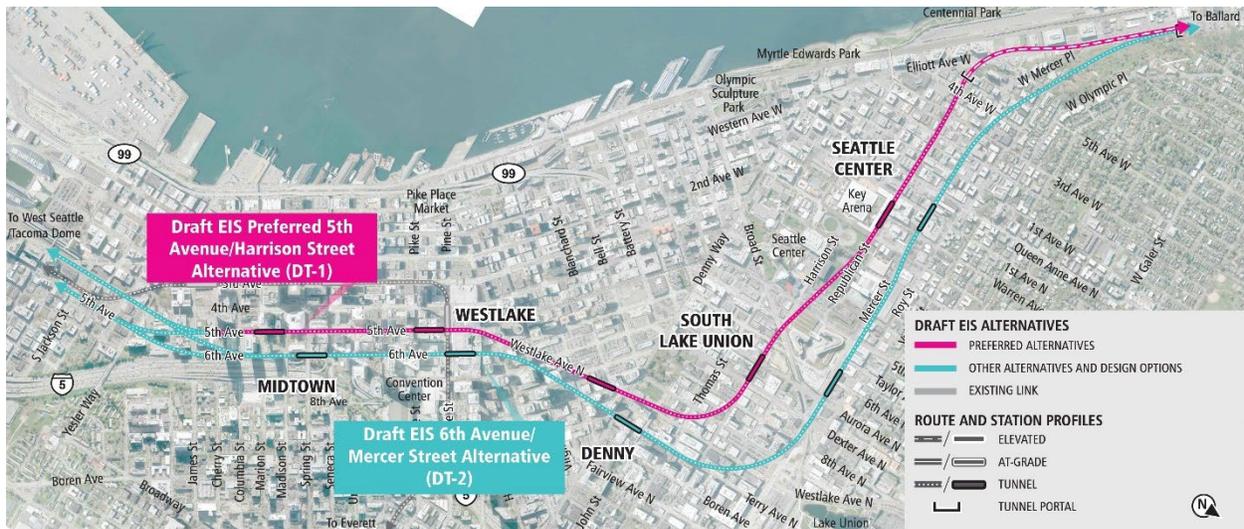
Based on the Board direction and community input, the project team developed the following concepts for further study:

1. South Lake Union: Mix-and-Match
2. Denny Station: Entrance on Both Sides of Denny Way
3. Seattle Center: Mix-and-Match
4. Seattle Center: Republican West
5. Midtown Station Depths
6. Station Entrance Refinements
  - o Midtown Station (DT-1): Columbia Street ROW
  - o Midtown Station (DT-1): 4th Avenue ROW
  - o Denny Station (DT-1): Lenora Street ROW
  - o Denny Station (DT-1): 8th Avenue ROW
  - o Westlake Station (DT-1): Entrance Consolidation

Figure 2 shows a map of the Draft EIS Alternatives in the Downtown Segment.

The concepts listed above were studied as stand-alone refinements to the Preferred Alternative. Some of the concepts may be combined, which may have additional implications for the full Ballard Link Extension alignment. More details on the systemwide implications of various combinations can be found in the *Systemwide Further Studies* memo.

Figure 2 Draft EIS Alternatives for Downtown Segment



## Summary

Figure 3 summarizes the key results from each of the further studies. More details about these results can be found in the body of this memo. Costs are shown as a change from the Sound Transit 3 Plan as represented in the realigned financial plan.

Figure 3 Summary of Downtown Further Study Results

Concept	Study Focus	Key Results (compared to DT-1)	Cost change from realigned financial plan (in \$2019)
<b>South Lake Union: Mix-and-Match</b>	Assess feasibility of mix-and-match alignment	<p>It is possible to construct this alignment, with these implications:</p> <ul style="list-style-type: none"> <li>• It is possible to construct this alignment, with these implications:</li> <li>• Transfers from buses and streetcar on Westlake would be one block further and on a steep hill. Denny Station would be 25 feet deeper (to 120 to 125 feet deep) than station in DT-1</li> <li>• Construction effects include:</li> <li>• Additional cut-and-cover construction along Harrison Street at 8th Avenue, resulting in one additional multi-family displacement</li> <li>• Avoids construction disruption to businesses along Westlake Avenue as well as impacts to vehicular traffic and streetcar operations.</li> <li>• Relocation of underground telecommunications utilities associated with H5 data center would be required</li> <li>• Minimum of one year of overall project delay. Multiple construction and schedule risks, including construction adjacent to a future development, crossover construction in a mined cavern, and increased schedule risk associated with third party utility relocation</li> <li>• Results in 12 additional residential and 12 fewer business displacements</li> <li>• Meets track design requirements for operational resilience and schedule recovery</li> </ul>	<b>+\$202 million</b>
<b>Denny Station: Entrance on Both Sides of Denny Way</b>	Explore opportunities to provide station access from both sides of Denny Way, improving passenger experience and eliminating the need for passengers to cross Denny Way	<p>It is possible to provide station access on both sides of Denny Way, with these implications:</p> <ul style="list-style-type: none"> <li>• Shortens walk for passengers transferring to transit lines on Westlake Avenue and eliminates need for passengers to cross Denny Way</li> <li>• Narrows Terry Avenue, reducing local vehicular access but increasing space for people in public realm. Traffic effects are negligible</li> <li>• Reduces property acquisition and relocation of private property infrastructure</li> <li>• Results in no change in displacements compared with South Lake Union Mix-and-Match concept</li> </ul>	<b>+\$188 million</b> (with South Lake Union Mix-and-Match)

<p><b>Seattle Center: Mix-and-Match</b></p>	<p>Assess feasibility of mix-and-match alignment</p>	<p>It is possible to construct the alignment option connecting to either Prospect or Blaine portal<sup>2</sup>, with these implications:</p> <ul style="list-style-type: none"> <li>• Avoids station construction-related noise and vibration effects to NW Rooms</li> <li>• Construction effects: <ul style="list-style-type: none"> <li>○ Partial closure of Mercer Street for 3.5 years, similar to DT-2</li> <li>○ Temporary and permanent noise and vibration effects to McCaw Hall and Seattle Opera can be mitigated with standard measures</li> </ul> </li> <li>• Results in 15 additional residential and 24 additional business displacements. Avoids International Commerce and Industry Building. Avoids permanent park effects to Seattle Center</li> <li>• Meets track design requirements for operational resilience and schedule recovery</li> </ul>	<p><b>+\$214 million</b></p>
<p><b>Seattle Center: Republican West</b></p>	<p>Assess feasibility of shifting Seattle Center Republican station west</p>	<p>It is possible to construct this alignment, with these implications:</p> <ul style="list-style-type: none"> <li>• Avoids station construction-related noise and vibration effects to NW Rooms and other Seattle Center facilities</li> <li>• Adds station construction-related noise and vibration effects to SIFF Cinema Uptown</li> <li>• Temporary tunnel construction and/or permanent light rail operation ground borne noise and vibration effects to SIFF Cinema Uptown, KEXP, Vera Project, SIFF Film Center, and Seattle Repertory Theatre. Permanent effects can be mitigated</li> <li>• Results in eight additional business displacements</li> <li>• Traffic effects due to closures of Republican and north-south streets west of Seattle Center would be negligible. Additional access constraints during construction for properties west of Seattle Center due to extended cut-and-cover construction in Republican Street</li> <li>• Avoids permanent and temporary park effects to Seattle Center. Avoids adversely affecting the historic NW Rooms building</li> <li>• Meets track design requirements for operational resilience and schedule recovery</li> </ul>	<p><b>+\$61 million</b></p>

<sup>2</sup> Connection to Republican portal not practical due to operational issues

<b>Midtown Station Depths</b>	Explore opportunities to reduce station depth and improve passenger access, circulation, and experience	<ul style="list-style-type: none"><li>• Connecting to a shallower 4th Avenue Shallow Station reduces Midtown Station depth by 55 to 60 feet to be 140 feet deep</li><li>• Shifting the Midtown Station entrance into the ROW would not reduce the station depth but would allow for escalator access as opposed to elevator only access in the DEIS (does not apply when connected to CID 4th Avenue Shallow)</li></ul>	<b>N/A</b>
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Station Entrance Refinements			
<b>Midtown Station (DT-1): Columbia Street ROW</b>	Explore station entrance locations within street ROW at Midtown and Denny stations as potential cost savings opportunity	<ul style="list-style-type: none"> <li>• Results in narrower roadway on Columbia Street, but would not have substantial effect on traffic operations</li> <li>• Reduces risks associated with high rise building modification for station entrance</li> <li>• Results in seven fewer business displacements</li> <li>• Improves station access with addition of escalators instead of elevator only access in DEIS design (does not apply when connected to CID 4th Avenue Shallow)</li> <li>• Increased cost due to revised shaft configuration</li> </ul>	<b>+\$32 million</b>
<b>Midtown Station (DT-1): 4th Avenue Street ROW</b>	Explore station entrance locations within street ROW at Midtown and Denny stations as potential cost savings opportunity	<ul style="list-style-type: none"> <li>• Results in narrower roadway on 4th Avenue.</li> <li>• Reduces 4th Avenue to one lane during construction, causing substantial traffic and mobility effects. Avoids property acquisition and risk associated with high rise building modification</li> <li>• Avoids adversely affecting Bank of California Building, which is an historic resource eligible for the National Register</li> <li>• Results in one less business displacement</li> </ul>	<b>-\$22 million</b>
<b>Denny Station (DT-1): Lenora Street ROW</b>	Explore station entrance locations within street ROW at Midtown and Denny stations as potential cost savings opportunity	<ul style="list-style-type: none"> <li>• Reduces property acquisition and development risk for station entrance</li> <li>• Permanent closure of Lenora Street for half a block east of Westlake Avenue and 8th Avenue, providing potential plaza space</li> <li>• Potential relocation of telecommunication utilities on Lenora Street would introduce a cost and schedule risk</li> <li>• Results in five fewer business displacements</li> </ul>	<b>-\$18 million</b>
<b>Denny Station (DT-1): 8th Avenue ROW</b>	Explore station entrance locations within street ROW at Midtown and Denny stations as potential cost savings opportunity	<ul style="list-style-type: none"> <li>• Reduces property acquisition and development risk for station entrance.</li> <li>• 8th Avenue would be permanently narrowed to one lane and a buffered bike lane north of Westlake with minimal traffic effects</li> <li>• Results in five fewer business displacements</li> </ul>	<b>-\$64 million</b>
<b>Westlake Station (DT-1): Entrance Consolidation</b>	Explore consolidating station entrances at Westlake station	<ul style="list-style-type: none"> <li>• Improved vertical circulation redundancy and ease of transfer between all Link lines</li> <li>• Provides opportunity for integrated joint development</li> <li>• Results in four fewer business displacements</li> <li>• Eliminates 4th Avenue roadway closure</li> </ul>	<b>-\$50 million</b>

## DOWNTOWN FURTHER STUDIES RESULTS

This section describes the objective for further study, defines the concept, and presents the results for each of the Downtown further studies.

### South Lake Union: Mix-and-Match

#### Study Focus

The *South Lake Union: Mix-and-Match* concept was developed to avoid the lengthy closure of Westlake Avenue and subsequent disruption of the South Lake Union Streetcar service for the construction of Denny Station in the DT-1 alignment, while maintaining the Westlake and South Lake Union station locations in the preferred alternative.

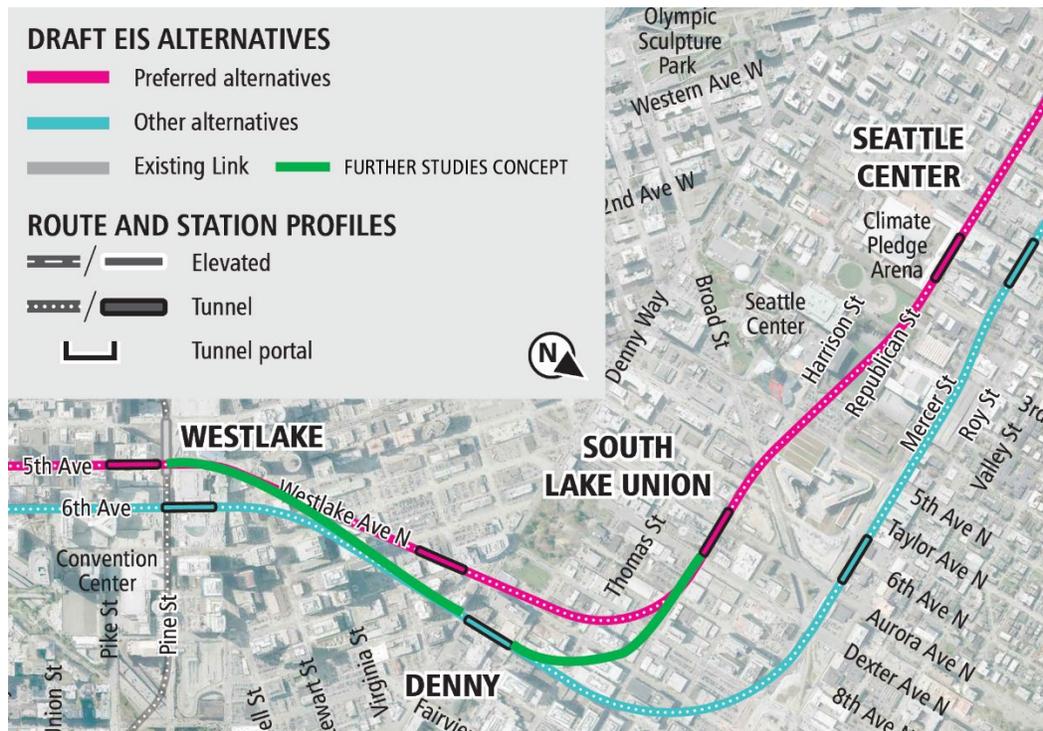
#### Definition of Concept

The *South Lake Union: Mix-and-Match* concept includes the following elements:

- Westlake Station on 5th Avenue (same as DT-1)
- Denny Station on Terry Avenue (same as DT-2)
- SLU Station on Harrison (same as DT-1)
- Shifted crossover tracks from Westlake Avenue, south of Denny Station, to Harrison Street, east of South Lake Union Station, in a sequential excavation method (SEM) cavern

Figure 4 shows a map of the concept.

**Figure 4 South Lake Union: Mix-and-Match Map**



### Study Results

This section summarizes the results of the further study of the *South Lake Union: Mix-and-Match* concept including streetcar disruption; station access and passenger experience; construction effects; property acquisitions, displacements, and environmental concerns; operations; and cost. The results in this section are expressed as comparisons to DT-1, unless otherwise noted.

#### Streetcar disruption

The *South Lake Union: Mix-and-Match* concept would not require closure of Westlake Avenue during construction and would not result in a multi-year closure of the Seattle Streetcar as described in the Draft EIS for Alternative DT-1. Also, because the station configuration on Terry Avenue would be modified with this concept, Seattle Streetcar service would not be affected during construction at the intersection of Terry Avenue and Thomas Street as described in the Draft EIS for DT-2.

#### Station access and passenger experience

The concept would have the following effects on passenger experience:

- Denny Station would be one block further uphill from north-south bus connections and the Seattle Streetcar on Westlake Avenue.
- South Lake Union Station would be 25 feet deeper (120-125 feet versus 100-feet for DT-1). This depth is similar to the DT-2 South Lake Union station location.

#### Construction effects

The concept results in the following construction effects:

- Additional construction along Harrison Street due to added cut-and-cover construction in the vicinity of Harrison Street and 8th Avenue, as well as mined construction below Harrison Street between 8th Avenue and Dexter Avenue. The effect to Dexter Avenue, including bus routes and protected bike lanes, and to Harrison Street west of Dexter Avenue, would be similar to DT-1.
- Relocation of underground telecommunications utilities located along Terry Avenue north of Denny Way associated with the H5 data center. The extent of this relocation requires further investigation and study. The additional duration of construction activities for this relocation in advance of station construction, along with associated permitting activities, would likely result in a delay of completion of the Ballard Link Extension of approximately one year. This effect would be the same with the DT-2 station location.
- Terry Avenue ROW is narrower resulting in reduced tolerances and increased risks and a longer schedule for construction. This would apply to DT-2 as well.
- Potential alterations and underpinning required for existing foundations, including the H5 data center.
- Temporary decking on Terry Avenue to maintain access during construction to a new building planned at 1001 John Street, adjacent to the north station entrance. Access to the garage for this building would be restricted temporarily during installation of temporary decking.
- Crossover is moved to mined cavern at SLU Station, with associated challenges and risks for mined construction.

- Additional challenges to maintain pedestrian, vehicle, and fire access to multiple adjacent properties during construction.

**Property acquisitions, displacements, and environmental concerns**

The concept would potentially result in 12 additional residential and 12 fewer business displacements. This concept is anticipated to adversely affect one additional National Register eligible historic property, Harrison Apartments, from property demolition.

**Operations**

The concept results in a shift of the crossover from Denny Station to South Lake Union Station. With this change, single tracking design criteria are met for the section north of the crossover, west of Seattle Center Station.

**Cost**

The *South Lake Union: Mix-and-Match* concept increases the cost of DT-1 by about \$202 million (Figure 5). The primary cost drivers for the concept include:

- Reduced cut-and-cover construction along Westlake Avenue reduces cost
- Additional mined construction for the crossover along Harrison Street adds cost
- Allowance for relocation of telecommunications utilities on Terry Avenue adds cost
- Avoidance of large sewer under Westlake Avenue reduces cost
- Additional property acquisition to support mined construction along Harrison Street adds cost

**Figure 5 South Lake Union: Mix-and-Match Cost Implications**

<b>Cost Category</b>	<b>Seattle Center: Mix-and-Match Cost Implications (in 2019\$ millions)</b>
<b>Construction</b>	<b>+54</b>
Reduced cut-and-cover tunnel	-98
SEM cavern for crossover	+101
Deeper Denny Station	+19
Utility relocation	+43
No streetcar mitigation	-11
<b>Property Acquisitions</b>	<b>+117</b>
<b>Professional Services</b>	<b>+26</b>
<b>Unallocated Contingency</b>	<b>+5</b>
<b>Cost delta compared to realigned financial plan</b>	<b>+202</b>

## Denny Station: Entrance on Both Sides of Denny Way

### Study Focus

The *Denny Station: Entrance on Both Sides of Denny Way* concept was developed as a refinement to the SLU Mix-and-Match concept to provide a passenger experience comparable to the DT-1 Denny Station location south of Denny Way.

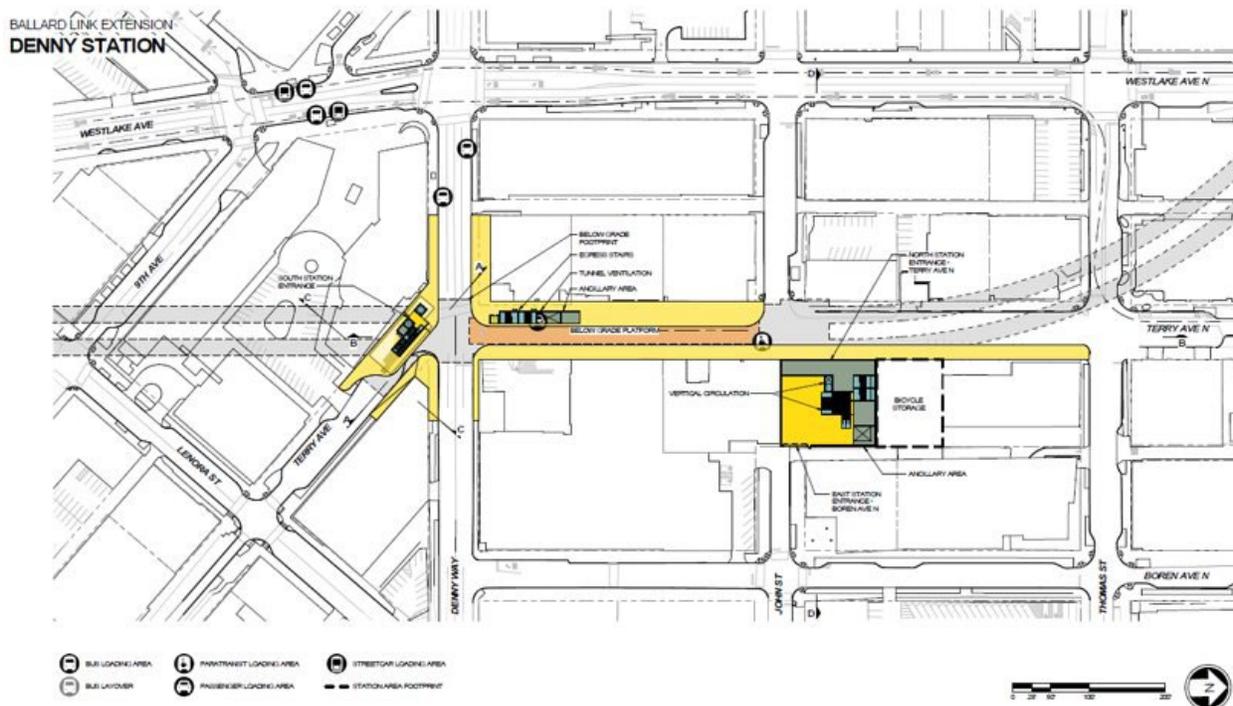
### Definition of Concept

The *Denny Station: Entrance on Both Sides of Denny Way* concept includes the following elements:

- Denny Station location from DT-2
- Rather than a south entrance on the H5 property northeast of the intersection of Denny Way and Terry Avenue, the concept has two station entrances within the street ROW on Terry Avenue both north and south of Denny Way
- Full closure of Terry Avenue south of Denny Way (cul-de-sac street end)
- Permanent reduction of Terry Avenue north of Denny Way to two lanes with parking on one side
- Widened sidewalks on Terry Avenue both north and south of Denny Way
- North station entrance shifted south from Thomas Street

A station plan of the concept can be seen in Figure 6. The concept can also be applied to the *South Lake Union: Mix-and-Match* concept.

**Figure 6 Denny Station: Entrance on Both Sides of Denny Way Station Plan**



### Study Results

This section summarizes the results of the further study of the *Denny Station: Entrance on Both Sides of Denny Way* concept including station access and passenger experience; street ROW effects; construction effects; property acquisitions, displacements, and environmental concerns; and cost. The results in this section are expressed as comparisons to DT-1, unless otherwise noted.

#### Station access and passenger experience

The *Denny Station: Entrance on Both Sides of Denny Way* concept eliminates the need for passengers to cross Denny Way to access the station from south of Denny Way.

#### Street ROW effects

The *Denny Station: Entrance on Both Sides of Denny Way* concept narrows the roadway width for a short section of Terry Avenue south of Denny Way to one lane. This is a low volume street and traffic effects would be negligible. Maintaining a single lane south of Denny Way would continue to provide emergency vehicle access.

North of Denny Way, the concept maintains the existing two-lane cross section on Terry Avenue. However, it would potentially reduce the amount of on-street parking on Terry Avenue between Denny Way and John Street, depending on the final roadway configuration.

#### Construction effects

The concept would have closures similar to those for DT-2 for station construction. Construction of the station entrance in the right of way south of Denny Way would close a section of Terry Avenue that is similar to the permanent condition (where Terry Avenue is a cul-de-sac), having similar traffic effects. Analysis of traffic with a section of Terry Avenue closed did not show an increase in travel times nor changes in nearby intersection levels of service.

#### Property acquisitions, displacements, and environmental concerns

The concept eliminates the need to acquire property from the H5 property northeast of the intersection of Denny Way and Terry Avenue, as required with DT-2, but displacements would be the same as for DT-2. The concept could potentially adversely affect one additional historic property, the National Register listed Volker William Building, due to the close proximity of the station entrance.

#### Cost

The *Denny Station: Entrance on Both Sides of Denny Way* concept, including the *South Lake Union: Mix-and-Match* concept, has the potential to increase the cost from the realigned financial plan (including DT-1) by about \$188 million (Figure 7). The primary cost drivers for the concept include:

- Reduced cut-and-cover construction along Westlake Avenue reduces cost
- Additional mined construction for the crossover along Harrison Street adds cost
- Allowance for relocation of telecommunications utilities on Terry Avenue adds cost
- Avoidance of large sewer under Westlake Avenue reduces cost
- Additional property acquisition to support mined construction along Harrison Street adds cost

- Reduced ROW cost with elimination of station entrance on H5 property compared with SLU Mix-and-Match concept
- Additional construction cost for station entrances in Terry Avenue ROW on both sides of Denny Way compared with SLU Mix-and-Match concept

**Figure 7 Denny Station: Entrance on Both Sides of Denny Way with South Lake Union Mix-and-Match Cost Implications**

Cost Category	Denny Station: Entrance on Both Sides of Denny Way with South Lake Union: Mix-and-Match Cost Implications (in 2019\$ millions)
<b>Construction</b>	<b>+65</b>
Reduced cut-and-cover tunnel	-98
SEM cavern for crossover	+101
Deeper Denny Station	+30
Utility relocation	+42
No streetcar mitigation	-11
<b>Property Acquisitions</b>	<b>+89</b>
<b>Professional Services</b>	<b>+28</b>
<b>Unallocated Contingency</b>	<b>+6</b>
<b>Cost delta compared to realigned financial plan</b>	<b>+188</b>

## Seattle Center: Mix-and-Match

### Study Focus

The *Seattle Center: Mix-and-Match* concept avoids cut-and-cover construction effects to properties on Republican Street east of 1st Avenue N associated with DT-1.

### Definition of Concept

The *Seattle Center: Mix-and-Match* concept includes the following elements:

- South Lake Union Station on Harrison (same as DT-1)
- Seattle Center Station on Mercer (same as DT-2)
- One of two route options to connect with the South Interbay Segment:

- Option A: Connect to a tunnel portal at Republican Street (SIB-1 or SIB-2). Would not include the track crossover west of Seattle Center Station below Mercer Street assumed with DT-2. This connection is not practical due to operational issues described herein.
- Option B: Connect to a tunnel portal at Prospect Street (SIB-3). Would include a track crossover west of Seattle Center Station below Mercer Street assumed with DT-2.

Figure 8 shows the concept with the Option A connection to Republican Portal. Figure 9 shows the concept with the Option B connection to Prospect Portal. The concept can also connect to any of the refined tunnel portal locations being studied in the South Interbay Segment. More information on those connections is included in the *Interbay-Smith Cove Further Studies* memo.

**Figure 8 Seattle Center: Mix-and-Match Map – Option A: Republican Portal**

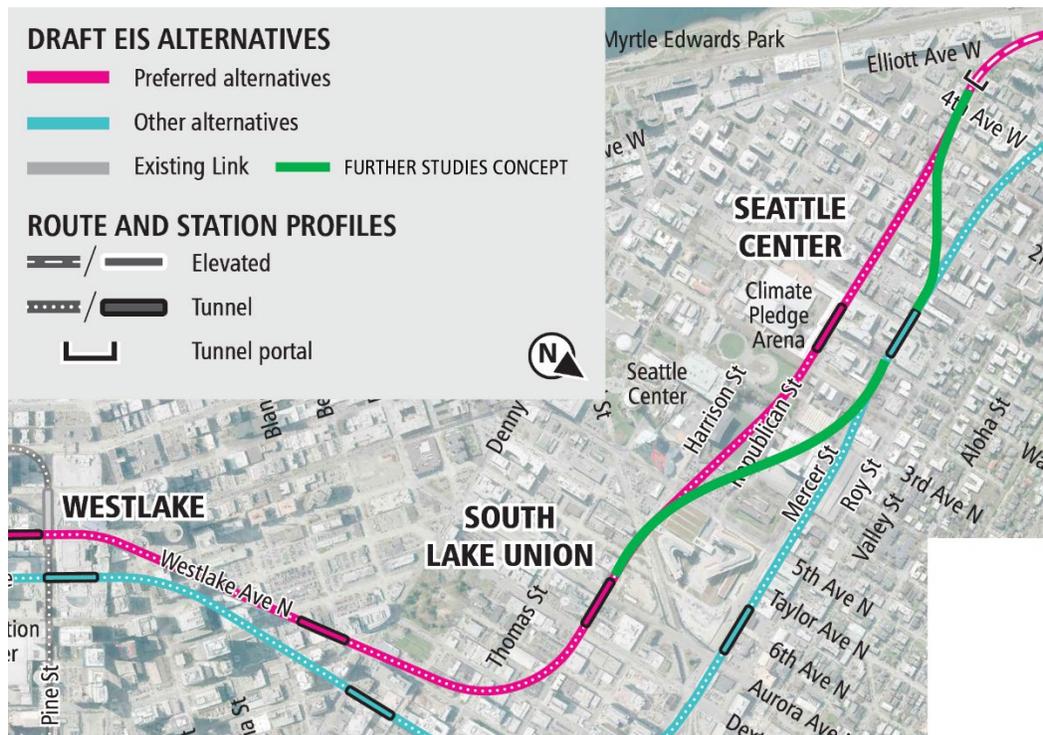
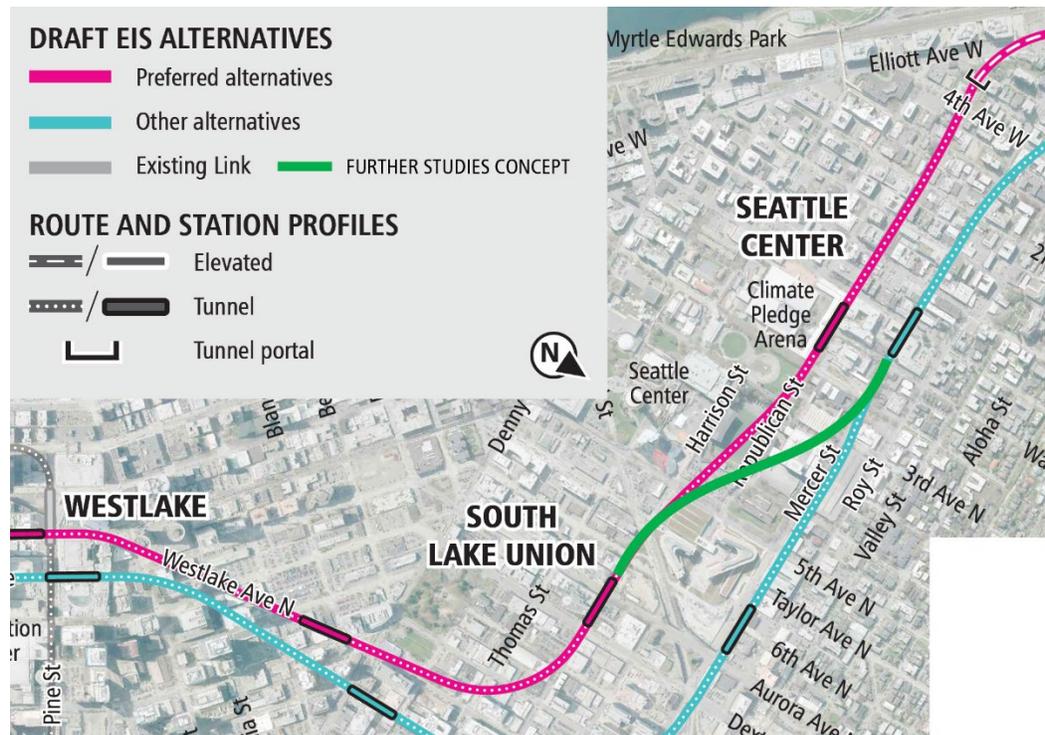


Figure 9 Seattle Center: Mix-and-Match Map – Option B: Prospect Portal



### Study Results

This section summarizes the *Seattle Center: Mix-and-Match* concept study results, including construction effects; property acquisitions, displacements, and environmental concerns; operations; and cost. The results in this section are expressed as comparisons to DT-1, unless otherwise noted.

### Construction effects

The *Seattle Center: Mix-and-Match* concept avoids the cut-and-cover construction on Republican Street east of 1st Avenue N associated with DT-1, including avoiding effects to the NW Rooms building. Instead, the following other construction effects are expected:

- Traffic effects on Mercer Street associated with the construction of DT-2 including partial roadway closures and temporary decking on Mercer Street for a period of 3.5 years. Installation of temporary decking would facilitate providing the full width of Mercer Street for traffic to maintain access through, into, and out of the surrounding neighborhood during station construction. During decking installation, Mercer Street capacity would be reduced to 2 lanes between Warren Avenue and 1st Avenue W. North-south traffic would be able to travel through intersections in the construction area, except during 3-month non-concurrent closures at the intersections of Mercer Street and 1st Avenue N, and of Queen Anne Avenue N, and 1st Avenue West. Additional traffic analysis completed during further study showed that during the 3.5 year partial closure on Mercer Street, drivers could expect an overall travel time increase of 6-8 minutes during peak hours. Transportation Demand Management (TDM) strategies, such as detour routes with targeted capacity improvements, and other shifts in travel behavior, could help limit travel time increases.

- Temporary tunnel construction and permanent light rail operation ground borne noise and vibration effects below additional buildings compared to DT-1, including McCaw Hall and Seattle Opera. All permanent effects can be mitigated with standard measures.
- Risk in tunnel construction with gap in geotechnical information. Construction may require ground improvement or dewatering.
- Constructing Seattle Center Station on Mercer using an SEM construction method would not be practical due to proximity to an existing large sewer, as well as project schedule and cost effects.

### Property acquisitions, displacements, and environmental concerns

Both options would result in additional residential and business displacements, as well as historic property effects:

- *Option A: Republican Portal* would potentially result in 15 additional residential and 16 additional business displacements. This option is anticipated to adversely affect one additional property eligible for the National Register of Historic Places (National Register) in the Downtown Segment. It avoids affecting the National Register eligible International Commerce and Industry Building but would affect two historic properties also affected by DT-2 in the Seattle Center Station area: Thurmonds Central Realty and Maxine Apartments (property demolition). It is also anticipated to adversely affect one additional National Register eligible historic property, Cape Flattery Apartments (property demolition), in the South Interbay Segment. This option would also potentially result in an additional 76 residential displacements in the South Interbay Segment.
- *Option B: Prospect Portal* would potentially result in 15 additional residential and 24 additional business displacements. This option is anticipated to adversely affect two additional National Register eligible historic properties in the Downtown Segment. It avoids affecting the National Register eligible International Commerce and Industry Building but would affect the same historic properties as DT-2 in the Seattle Center Station area: Thurmonds Central Realty, Maxine Apartments, and National Bank of Commerce – Queen Anne Branch (property demolition).

Both options would reduce park effects by avoiding permanent effects to Seattle Center similar to Alternative DT-2.

### Operations

Option A is not practical operationally, while Option B meets requirements:

- *Option A: Republican Portal* would result in additional operational constraints on the larger system by increasing the distance between track crossovers. A crossover would be located west of Republican Portal in guideway along Elliott Avenue. Sound Transit's single tracking (frequency of service that can be provided during single tracking operations) criteria would not be met. The option would also result in multiple track curves, which could lead to increased vehicle and track maintenance costs and affect passenger experience. The curves are not expected to add additional travel time because trains entering and leaving Seattle Center Station would not be traveling at full speed.
- *Option B: Prospect Portal* would decrease the distance between crossovers, with a crossover located on Mercer Street west of Seattle Center Station. Single tracking headway criteria can be met with this configuration.

**Cost**

The *Seattle Center: Mix-and-Match* concept has the potential to increase the cost from the realigned financial plan (including DT-1) by between about \$214 million (Option B), or about \$266 million (Option A) (Figure 10). The primary cost drivers for the two options include:

- *Option A: Republican Portal* - Additional property acquisition due to the shifted tunnel portal and changes in station entrances and staging areas
- *Option B: Prospect Portal* - Additional cut-and-cover construction compared with DT-1 and changes in station entrances and staging areas

**Figure 10** Seattle Center: Mix-and-Match Cost Implications

Cost Category	Seattle Center: Mix-and-Match Cost Implications (in 2019\$ millions)	
	Option A: Republican Portal	Option B: Prospect Portal
<b>Construction</b>	<b>+58</b>	<b>+126</b>
Additional cut-and-cover tunnel	+46	+114
Deeper Seattle Center Station	+12	+12
Utility relocation	+1	+1
<b>Property Acquisitions</b>	<b>+171</b>	<b>+28</b>
<b>Professional Services</b>	<b>+31</b>	<b>+47</b>
<b>Unallocated Contingency</b>	<b>+6</b>	<b>+13</b>
<b>Cost delta compared to realigned financial plan</b>	<b>+266</b>	<b>+214</b>

**Seattle Center: Republican West**

**Study Focus**

The *Seattle Center: Republican West* concept was developed to avoid cut-and-cover construction effects to properties on Republican Street east of 1st Avenue N associated with DT-1.

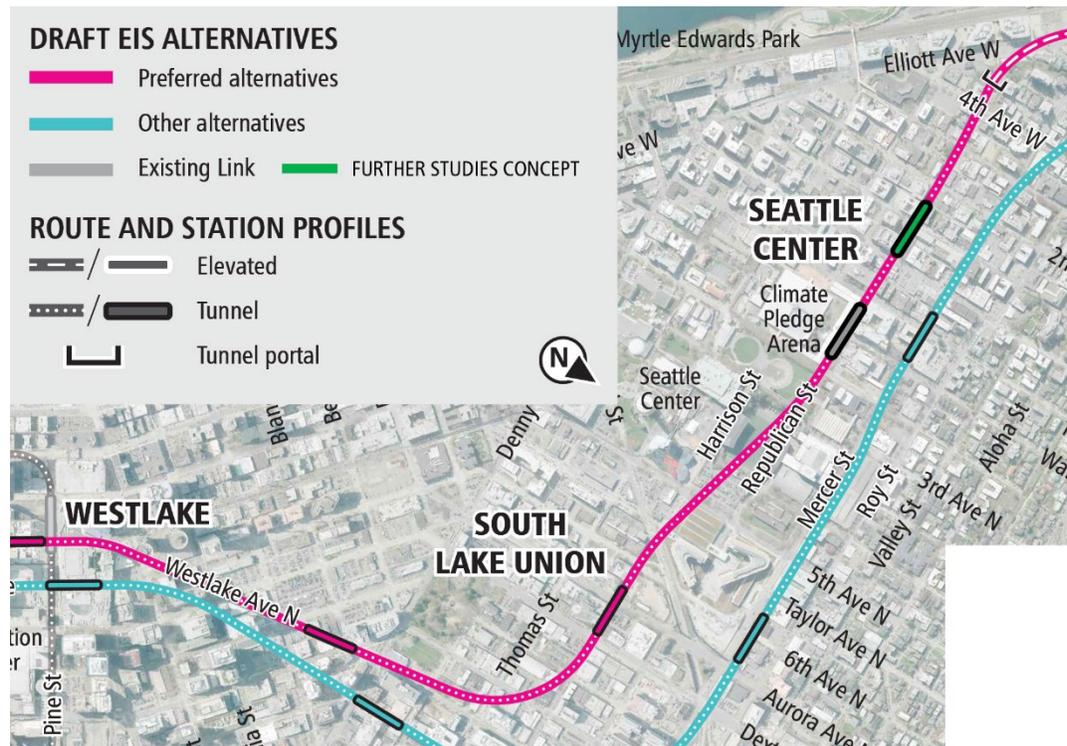
**Definition of Concept**

The *Seattle Center: Republican West* concept includes the following elements:

- Station shifted west along Republican Street from adjacent to the NW Rooms to between Queen Anne Avenue N and 1st Avenue W
- East station entrance at the same location as DT-1 west entrance

Figure 11 shows a map of the concept.

Figure 11 Seattle Center: Republican West Map



### Study Results

This section summarizes the results of the further study of the *Seattle Center: Mix-and-Match* concept concept, including construction effects; property acquisitions, displacements, and environmental concerns; operations; and cost. The results in this section are expressed as comparisons to DT-1, unless otherwise noted.

#### Construction effects

The *Seattle Center: Republican West* concept avoids cut-and-cover construction effects to properties on Republican Street east of 1st Avenue N. Instead, the following other construction effects are expected:

- Phased, partial closure of Queen Anne Avenue N at the Republican Street intersection, with potential for short periods of full closure for utility work, installation of temporary decking, excavation, and roadway restoration.
- Full closure of W Republican Street between 3rd Avenue W and Queen Anne Avenue N for up to 5 years, as well as phased closures of north-south access at 2nd Avenue W and 1st Avenue W. These closures will require pedestrian detours. Local access to properties west of Queen Anne Avenue N would be maintained, but constrained due to this closure. These closures are anticipated to have limited traffic effects to nearby streets.

It should be noted that the concept shifts the bored tunnel closer to existing Climate Pledge Arena foundation footings, but the project team has determined that this would not affect the building due to the depth of the tunnel.

**Property acquisitions, displacements, and environmental concerns**

The concept has the following potential effects to property acquisitions, displacements, and environmental concerns:

- Four additional business displacements in the Downtown Segment. It would also potentially result in four additional business displacements in the South Interbay Segment.
- Avoids both permanent and temporary park effects to Seattle Center.
- This concept is anticipated to adversely affect one less historic property in the Downtown Segment: the National Register eligible International Commerce and Industry Building (NW Rooms).
- Temporary tunnel construction and/or permanent light rail operation ground borne noise and vibration effects to SIFF Cinema Uptown, which would not be affected by DT-1. It is anticipated that there would still be tunnel construction and permanent operations effects to KEXP radio station, the Vera Project, SIFF Film Center, and Seattle Repertory Theatre. All permanent effects can be mitigated with standard measures.
- Station construction-related noise and vibration effects are anticipated for SIFF Cinema Uptown, which would not be affected by DT-1. No station construction-related effects are anticipated for KEXP radio station, the Vera Project, SIFF Film Center, Seattle Repertory Theatre.

**Operations**

With this concept, the track crossover would be shifted to the east of the Republican Portal. This location would allow for single tracking headway criteria to be met.

**Cost**

The *Seattle Center: Republican West* concept has the potential to increase the cost from the realigned financial plan (including DT-1) by about \$61 million (Figure 12). The primary cost drivers for the concept include:

- Reduced cost due to shallower Seattle Center Station
- Increased cost due to different properties required for entrances and construction staging

**Figure 12 Seattle Center: Republican West Cost Implications**

Cost Category	Seattle Center: Republican West Cost Implications (in 2019\$ millions)
<b>Construction</b>	<b>-15</b>
Additional cut-and-cover tunnel	+2
Shallower Seattle Center Station	-17
Utility relocation	+1
<b>Property Acquisitions</b>	<b>+78</b>
<b>Professional Services</b>	<b>+2</b>
<b>Unallocated Contingency</b>	<b>-2</b>

Cost delta compared to realigned financial plan	+61
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## Midtown Station Depths

### Study Focus

Community feedback received on the Draft EIS included concerns about the depths of some of the proposed stations, including Midtown Station. The project team has acknowledged these concerns and is actively exploring ways to decrease the Midtown Station depth, which is driven by the following:

- Midtown Station is adjacent to very tall high-rise buildings with deep foundations and tie backs that drive the depth of the station due to the size of the mined station cavern
- The Midtown area is on a relatively high hill terrain and there are limitations to how steep a grade light rail trains can climb from CID
- Alignments that would serve a CID Station on 4th Avenue need to cross over or under the existing Downtown Seattle Transit Tunnel (DSTT), which further drives the depth of Midtown Station

Because of these constraints, the DT-1 Midtown Station would be deep (145 to 205 feet deep depending on the CID station option). Due to limited space at the south entrance, station access would be limited to elevator only. At the north entrance, the team has developed design options that could provide escalator access to the station for the shallower station options. The deeper Midtown Station alternative would lead to substantially longer passenger access times compared to the shallower alternative. Additionally, the elevator-only configuration could limit the station's capacity to accommodate future growth in service/ridership and presents concerns regarding maintaining passenger flow during planned and unplanned maintenance of vertical circulation.

To improve passenger access, the project team investigated several opportunities to reduce the station depth and/or otherwise improve passenger circulation within the station. The platform depth for the DT-1 Midtown Station connecting to *Draft EIS 4th Avenue Shallow (CID-1a)* would be about 195-205 feet deep. This depth is driven by the fact that the alignment connecting to *4th Avenue Shallow* in CID would cross below the existing DSTT. An alignment crossing above the DSTT was explored and would result in a Midtown Station about 140-145 feet deep. There would be additional construction risks to crossing above the DSTT and additional effects in the CID segment. This alignment is described in more detail, including anticipated rough order of magnitude cost differences, in the *Ballard Extension Further Studies: Chinatown/International District Ideas* memo.

### Station Entrance Refinements

The project team identified several station locations where costs could be reduced by refining station entrances. The following locations were investigated:

- Midtown Station (DT-1): Columbia Street ROW
- Midtown Station (DT-1): 4th Avenue ROW
- Denny Station (DT-1): Lenora Street ROW

- Denny Station (DT-1): 8th Avenue ROW
- Westlake Station (DT-1): Entrance Consolidation

### Midtown Station (DT-1): Columbia Street ROW

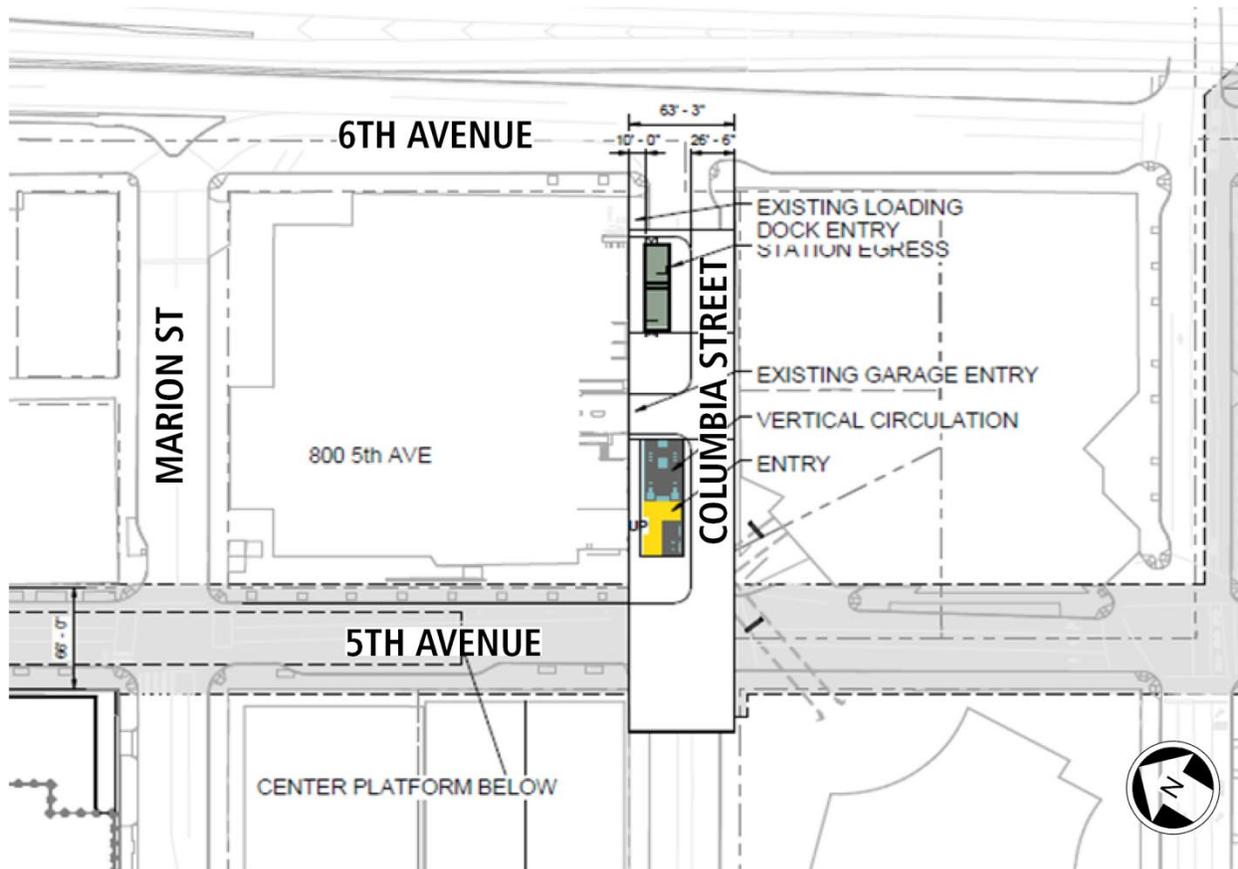
#### Study Focus

The *Midtown Station (DT-1): Columbia Street ROW* concept was developed to save property acquisition costs and reduce the acquisition, design and construction risks associated with placing a station entrance within an existing building.

#### Definition of Concept

The *Midtown Station (DT-1): Columbia Street ROW* concept shifts the south station entrance of the Midtown Station included in DT-1 from within the building northeast of the intersection of 5th Avenue and Columbia Street into the public ROW of Columbia Street, east of 5th Avenue. The station entrance would be within a widened sidewalk on the north side of Columbia Street between 5th Avenue and 6th Avenue. Figure 13 shows a station plan of the station entrance in the ROW. This concept would not be applicable to the option that connects to CID 4th Avenue Shallow.

Figure 13 Midtown Station (DT-1): Columbia Street ROW Station Plan



**Study Results**

This section summarizes how the *Midtown Station (DT-1): Columbia Street ROW* concept affects costs, as well as other implications including street ROW effects, construction effects, property acquisitions and displacements, and station access and passenger experience. The results in this section are expressed as comparisons to DT-1 (connected to shallower station options in CID), unless otherwise noted.

**Cost**

The *Midtown Station (DT-1): Columbia Street ROW* concept has the potential to increase the cost from the realigned financial plan (including DT-1) by about \$32 million (Figure 14). The primary cost drivers for the concept include:

- Reduced property acquisition cost for station entrance, offset by increased property acquisition cost for remote ventilation (this cost could potentially be further reduced with ventilation located within public ROW, which would require additional study)
- Increased cost due to revised shaft configuration

It should be noted that additional cost-savings measures such as using additional public ROW for remote ventilation could be explored in the future.

**Figure 14 Midtown Station (DT-1): Columbia Street ROW Cost Implications**

Cost Category	Midtown Station (DT-1): Columbia Street ROW Cost Implications (in 2019\$ millions)
<b>Construction</b>	<b>+36</b>
Revised shaft configuration	+24
Revised vertical circulation	+11
Utility relocation	+2
<b>Property Acquisitions</b>	<b>-20</b>
<b>Professional Services</b>	<b>+12</b>
<b>Unallocated Contingency</b>	<b>+4</b>
<b>Cost delta from realigned financial plan</b>	<b>+32</b>

**ROW effects**

The *Midtown Station (DT-1): Columbia Street ROW* concept results in a narrowing of Columbia Street between 5th Avenue and 6th Avenue from three lanes with parking on both sides to one lane and no on-street parking. The sidewalk on the north side of the street would be widened. Access to parking garages and loading docks on both sides of Columbia Street would be maintained. This is expected to have minor effects on traffic circulation.

### **Construction effects**

During construction, one lane of Columbia Street would be maintained between 5th Avenue and 6th Avenue. As with DT-1, one leg of the I-5 Reversible Express Ramp would be closed at the intersection of 5th Avenue and Columbia Street. The other leg of the I-5 Reversible Express Ramp connecting to 5th Avenue and Cherry Street would remain open. Avoidance of property acquisition for the station entrance would reduce risk associated with high rise building modification.

### **Property acquisitions and displacements**

This concept would potentially result in seven fewer business displacements.

### **Station access and passenger experience**

This concept allows for the addition of escalator access at this station entrance, providing more capacity and a more direct pathway for passenger access to the station.

## **Midtown Station (DT-1): 4th Avenue ROW**

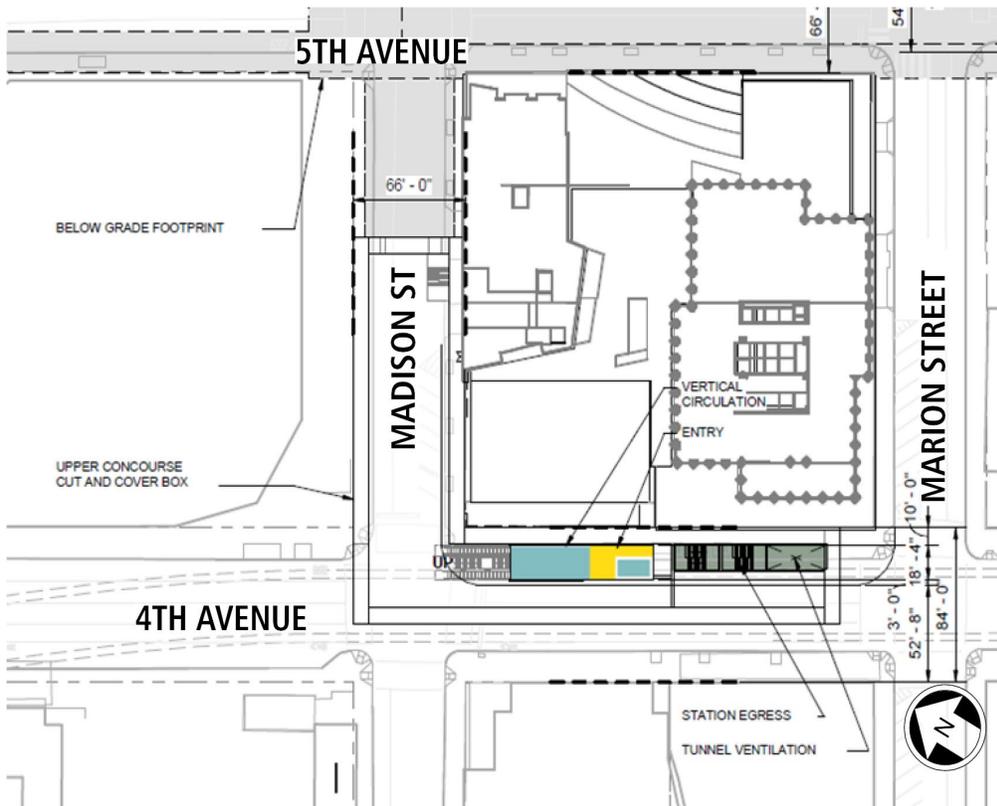
### **Study Focus**

The *Midtown Station (DT-1): 4th Avenue ROW* concept was developed to save property acquisition costs and reduce the acquisition, design and construction risks associated with placing a station entrance within an existing building.

### **Definition of Concept**

The *Midtown Station (DT-1): 4th Avenue ROW* concept shifts the DT-1 Midtown Station north station entrance from the parcel southeast of 4th Avenue and Madison Street into the public ROW of 4th Avenue south of Madison Street. The station entrance would be located in a widened sidewalk on the east side of 4th Avenue between Marion Street and Madison Street. Figure 15 shows a station plan of the station orientation.

Figure 15 Midtown Station (DT-1): 4th Avenue ROW Station Plan



### Study Results

This section summarizes the potential of the *Midtown Station (DT-1): 4th Avenue ROW* concept to reduce costs, as well as other implications including: ROW effects; construction effects; and property acquisitions, displacements, and environmental concerns. The results in this section are expressed as comparisons to DT-1 (connected to shallower station options in CID), unless otherwise noted.

### Cost

The *Midtown Station (DT-1): 4th Avenue ROW* concept has the potential to decrease the cost from the realigned financial plan (including DT-1) by about \$22 million (Figure 16). The primary cost drivers for the concept include:

- Reduced property acquisition cost
- Increased construction cost due to revised shaft configuration

Figure 16 Midtown Station (DT-1): 4th Avenue ROW Cost Implications

Cost Category	Midtown Station (DT-1): 4th Avenue ROW Cost Implications (in 2019\$ millions)
<b>Construction</b>	<b>+24</b>
Revised shaft configuration	+18
Revised vertical circulation	+5
Utility relocation	+1
<b>Property Acquisitions</b>	<b>-54</b>
<b>Professional Services</b>	<b>+5</b>
<b>Unallocated Contingency</b>	<b>+2</b>
<b>Cost delta from realigned financial plan</b>	<b>-22</b>

**Street ROW**

The *Midtown Station (DT-1): 4th Avenue ROW* concept results in a narrowing of 4th Avenue between Marion Street and Madison Street from three lanes plus a bus lane to two travel lanes (final configuration to be determined). A two-way cycle track on the west side of the street would be maintained.

**Construction**

During construction, 4th Avenue and Madison Street would be narrowed to one lane (with a temporary removal of the two-way cycle track). This would be a change from DT-1, where only one lane of 4th Avenue would be closed during construction. On Madison Street for DT-1, either one lane would be closed, or a full closure would be required, depending on the alternative in the CID Segment. This construction scenario would result in substantial traffic effects, including effects to transit service along 4th Avenue and Madison Street. Avoidance of property acquisition for the station entrance would reduce the risk associated with high rise building modification.

**Property acquisitions, displacements, and environmental concerns**

This concept would potentially result in one less business displacement. This concept is anticipated to adversely affect *one less* historic *property*. The concept is anticipated to avoid adversely affecting the Bank of California Building, which is an historic resource eligible for the National Register.

**Denny Station (DT-1): Lenora Street ROW**

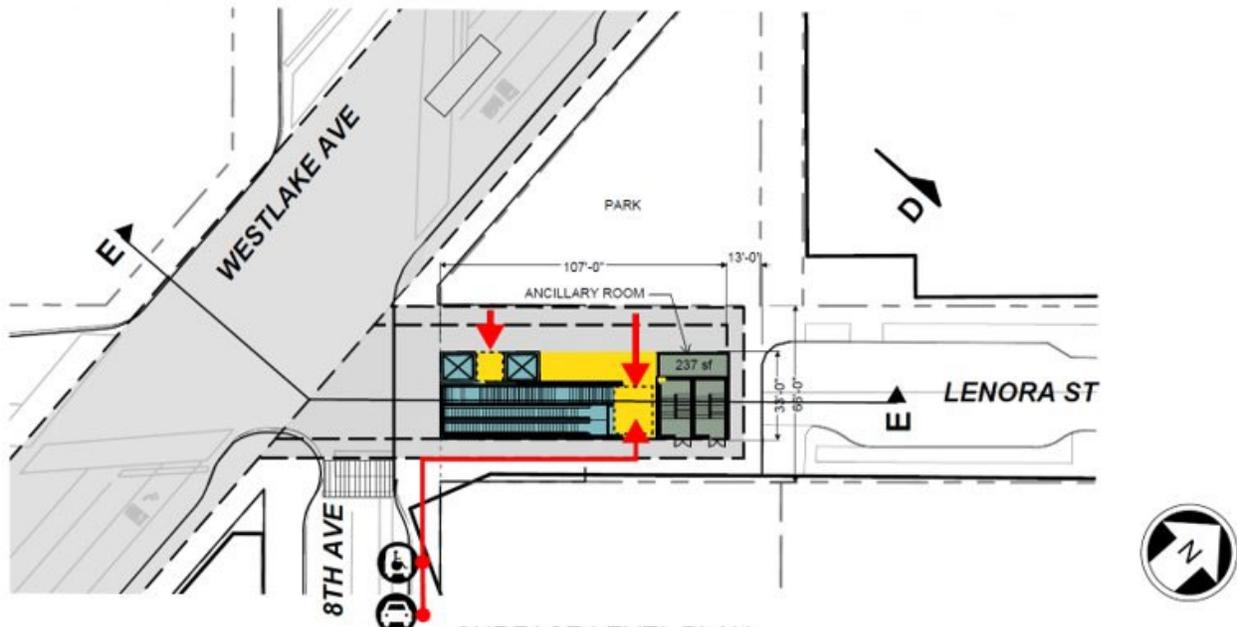
**Study Focus**

The *Denny Station (DT-1): Lenora Street ROW* concept was developed to save property acquisition costs.

## Definition of Concept

The *Denny Station (DT-1): Lenora Street ROW* concept shifts the south station entrance of the DT-1 Denny Station location from the parcel at the northwest corner of Westlake Avenue and 8th Avenue, into the public ROW of Lenora Street east of Westlake Avenue. Lenora Street east of Westlake Avenue and 8th Avenue would be permanently closed for about half a block with the station entrance located in a widened sidewalk and plaza. Figure 17 shows a station plan of the concept.

**Figure 17 Denny Station (DT-1): Lenora Street ROW Station Plan**



## Study Results

This section summarizes how the *Denny Station (DT-1): Lenora Street ROW* concept reduces costs, as well as other implications including ROW effects and construction effects. The results in this section are expressed as comparisons to DT-1, unless otherwise noted.

### Cost

The *Denny Station (DT-1): Lenora Street ROW* concept has the potential to decrease the cost from the realigned financial plan (including DT-1) by about \$18 million (Figure 18). The primary cost drivers for the concept include:

- Reduced property acquisition cost
- Increased cost for utility relocation

**Figure 18 Denny Station (DT-1): Lenora Street ROW Cost Implications**

<b>Cost Category</b>	<b>Denny Station (DT-1): Lenora Street ROW Cost Implications (in 2019\$ millions)</b>
<b>Construction</b>	<b>+22</b>
Revised vertical circulation	-8
Utility relocation	+30
<b>Property Acquisitions</b>	<b>-47</b>
<b>Professional Services</b>	<b>+5</b>
<b>Unallocated Contingency</b>	<b>+2</b>
<b>Cost delta compared to realigned financial plan</b>	<b>-18</b>

**Street ROW effects**

The *Denny Station (DT-1): Lenora Street ROW* concept results in the following effects to the street ROW:

- Permanent closure of Lenora Street for half a block east of Westlake Avenue and 8th Avenue. The eastern half of the block would remain open between the alley and 9th Avenue. This would maintain vehicle access to local properties in the block of Lenora Street between 8th Avenue and 9th Avenue. This is a low volume street and traffic effects would be negligible. Emergency vehicle access could be maintained and designed through the plaza and station entrance area, if needed.
- The closure of the street would provide space for a plaza in the public ROW around the station, which could be integrated with the nearby park.
- Traffic analysis showed that the closure of Lenora Street at Westlake Avenue could reduce overall intersection delay in the AM peak hour.

**Construction effects**

A substantial amount of fiber optic lines in the ground underneath Lenora Street would likely need to be relocated to construct an entrance in this location. This would introduce a potential cost and schedule risk to the project.

**Property acquisitions and displacements**

This concept would potentially result in five fewer business displacements.

**Denny Station (DT-1): 8th Avenue ROW**

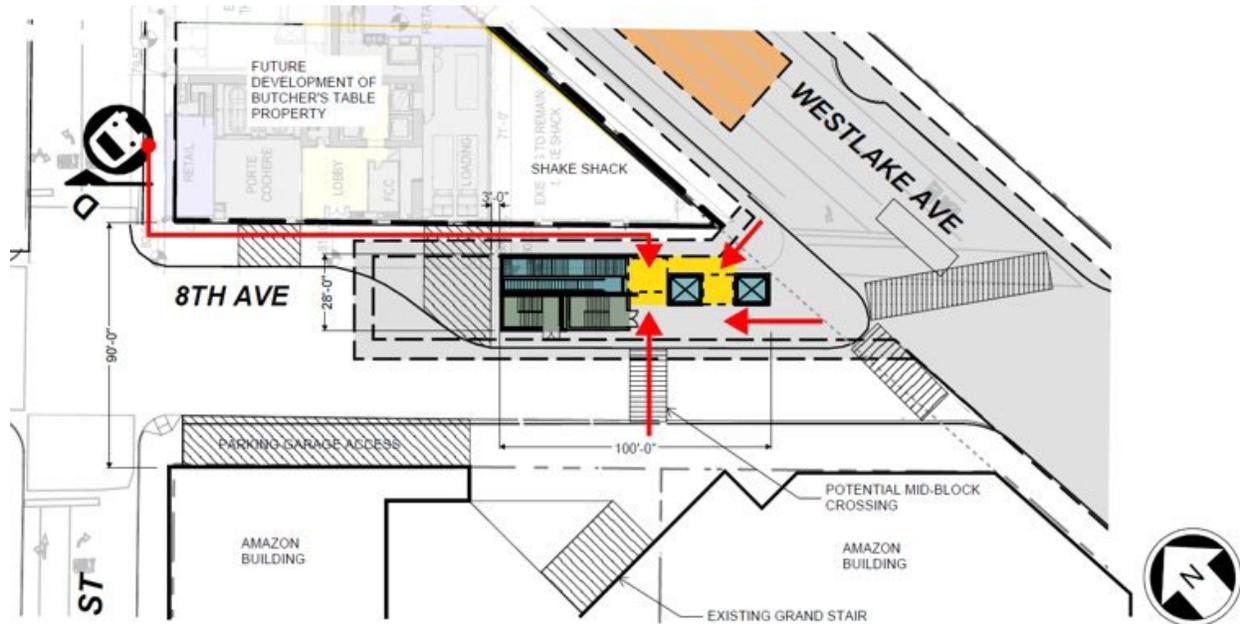
**Study Focus**

The *Denny Station (DT-1): 8th Avenue ROW* concept was investigated to save property acquisition costs.

## Definition of Concept

The concept would shift the south station entrance of DT-1 Denny Station from the parcel west of NW corner of Westlake and 8th into the public ROW. The station entrance would be located in a widened sidewalk on the east side of 8th Avenue. Figure 19 shows a station plan of the concept.

**Figure 19 Denny Station (DT-1): 8th Avenue ROW Station Plan**



## Study Results

This section summarizes how the *Denny Station (DT-1): 8th Avenue ROW* concept reduces costs, as well as other implications such as street ROW effects and property acquisitions and displacements. The results in this section are expressed as comparisons to DT-1, unless otherwise noted.

### Cost

The *Denny Station (DT-1): 8th Avenue ROW* concept has the potential to decrease the cost from the realigned financial plan (including DT-1) by about \$64 million (Figure 20). The primary cost drivers for the concept include:

- Reduced property acquisition cost
- Reduced cost due to revised vertical circulation

**Figure 20 Denny Station (DT-1): 8th Avenue ROW Cost Implications**

<b>Cost Category</b>	<b>Denny Station (DT-1): 8th Avenue ROW Cost Implications (in 2019\$ millions)</b>
<b>Construction</b>	<b>-9</b>
Revised vertical circulation	-10
Utility relocation	+1
<b>Property Acquisitions</b>	<b>-47</b>
<b>Professional Services</b>	<b>-6</b>
<b>Unallocated Contingency</b>	<b>-1</b>
<b>Cost delta compared to realigned financial plan</b>	<b>-64</b>

**Street ROW effects**

The *Denny Station (DT-1): 8th Avenue ROW* concept results in the following effects to the street ROW:

- North of Westlake Avenue, 8th Avenue would be narrowed for about half a block from three lanes plus a buffered bike lane to one lane and a buffered bike lane. This is a low volume street and traffic effects would be negligible. Access to adjacent properties in this block of 8th Avenue would be maintained.
- The narrowing of the ROW would shorten the intersection distance for pedestrians crossing across 8th Avenue.

**Property acquisitions and displacements**

This concept would potentially result in five fewer business displacements.

**Westlake Station (DT-1): Entrance Consolidation**

**Study Focus**

The Westlake Station Entrance Consolidation concept was investigated to save property acquisition costs.

**Definition of Concept**

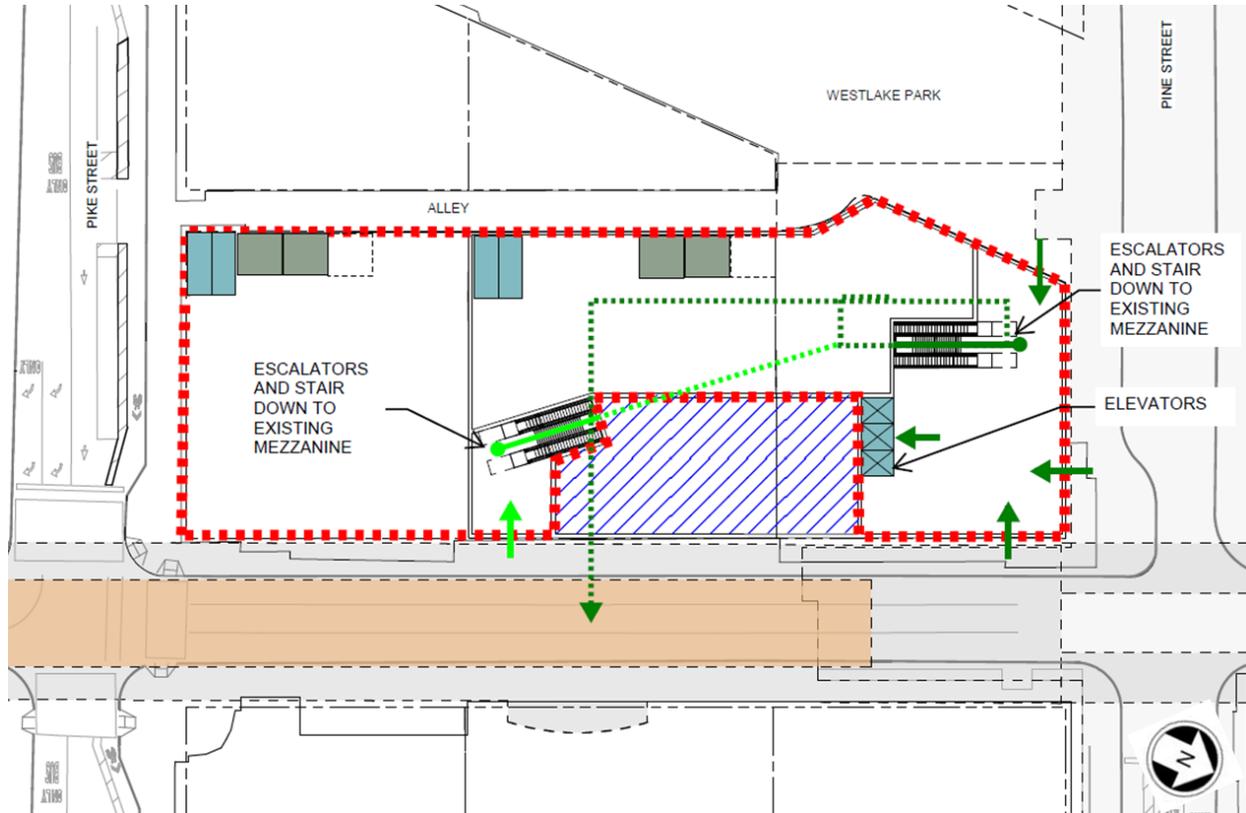
The Westlake Station Entrance Consolidation concept would include the following elements:

- Removal of the proposed south station entrance and parcel acquisition at the southwest corner of 5th Avenue and Pike Street.
- Removal of the proposed west station entrance and parcel acquisition at the northeast corner of 4th Avenue and Pine Street.
- Consolidation of entrances and vertical conveyances in a single larger headhouse

- Expansion of the footprint of the proposed north station entrance in the southwest corner of 5th Avenue and Pine Street

Figure 21 shows a station plan of the concept.

**Figure 21 Westlake Station Entrance Consolidation Station Plan**



### Study Results

This section summarizes how the *Westlake Station Entrance Consolidation* concept reduces costs, as well as other implications including station access and passenger experience, property acquisitions and displacements, development potential, and construction. The results in this section are expressed as comparisons to DT-1, unless otherwise noted.

### Cost

The *Westlake Station Entrance Consolidation* concept has the potential to decrease the cost from the realigned financial plan (including DT-1) by about \$50 million (Figure 22). The primary cost drivers for the concept include:

- Reduced property acquisition cost, including avoiding purchase of property for the south station entrance and the west station entrance.
- Reduced overall number of elevators and escalators

**Figure 22 Westlake Station (DT-1): Entrance Consolidation Cost Implications**

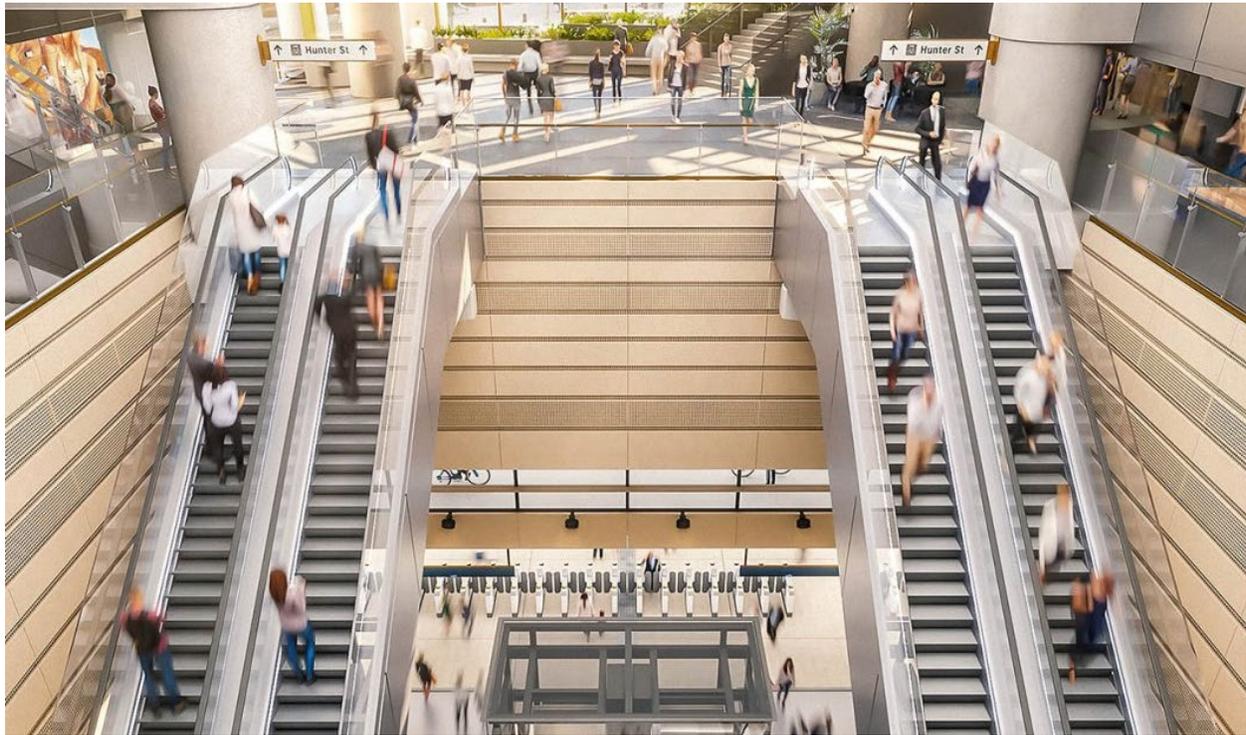
<b>Cost Category</b>	<b>Westlake Station (DT-1): Entrance Consolidation Cost Implications (in 2019\$ millions)</b>
<b>Construction</b>	<b>-1</b>
Consolidated expanded headhouse	+47
Reduced number of elevators/escalators	-48
<b>Property Acquisitions</b>	<b>-47</b>
<b>Professional Services</b>	<b>-3</b>
<b>Unallocated Contingency</b>	<b>0</b>
<b>Cost delta compared to realigned financial plan</b>	<b>-50</b>

**Station access and passenger experience**

The single consolidated entrance/headhouse provides the following opportunities for passenger experience:

- Improved redundancy of vertical circulation at a high-volume station by concentrating escalators and elevators in a single location. This redundancy not only provides additional capacity but helps maintain reliable passenger pathways during planned and unplanned maintenance. Figure 23 shows an image of redundant elevators at Martin Place Station in Sydney, Australia.
- Single entrance/headhouse provides a highly legible access point to all Link lines serving the Westlake Station (1-, 2-, and 3-Lines). The single entrance/headhouse concept would require transfers to and from the existing Westlake Station southbound platform to take place via the existing mezzanine.

Figure 23 Redundant Escalators at Martin Place Station



Source: Sydney Metro

### ***Property acquisitions and displacements***

This concept would potentially result in four fewer business displacements.

### ***Development potential***

Because the *Westlake Station Entrance Consolidation* concept consolidates station entrances on a single large site, an integrated joint development approach would be warranted to realize full site development potential.

### ***Construction***

During station construction, DT-1 anticipates partial closure of 5th Avenue between Pike Street and Union Street, partial closure of Pike Street between 4th Avenue and 5th Avenue, full closure of 4th Avenue between Pine Street and Olive Street, and full closure of Pine Street between 4th Avenue and 5th Avenue. With this concept, the partial closure of 5th Avenue would no longer be needed between Pike Street and Union Street, but would be shifted one block to the north, between Pine Street and Pike Street. In addition, the full closure of 4th Avenue between Pine Street and Olive Street would no longer be needed. Temporary effects to Westlake Park would also be avoided with this concept. The larger consolidated construction staging area would also reduce construction risk.