Chapter 4
Alternatives Analysis

This chapter compares the Sound Transit Link Light Rail Operations and Maintenance Satellite Facility (OMSF) alternatives and their effectiveness in addressing the proposed project's goals and objectives. This evaluation takes into account differences in the alternative locations and facility designs described in Chapter 2, Alternatives Considered, and potential effects on the environment, including the ability to avoid or mitigate environmental impacts described in Chapter 3, Affected Environment and Environmental Consequences.

4.1 Effectiveness at Meeting the Goals and Objectives

Chapter 1, Purpose and Need for the Project, applies goals and objectives that form the basis for the evaluation of alternatives presented in this chapter. These goals and objectives uphold Sound Transit's legislative mandate to meet public transportation and mobility needs for high-capacity transit infrastructure while also being a responsible steward of the environment and being considerate of affected jurisdictions and the public while planning a fiscally responsible project. These goals and objectives include the following.

- **Transportation Goal.** Facilitate operation of the expanded regional Link light rail system.
    - Locate a facility to provide efficient and reliable light rail service.
- **Environment Goal.** Preserve environmental quality.
    - Minimize potential adverse impacts on the natural and built environment.
- **Financial Goal.** Achieve financial feasibility.
    - Build, operate, and maintain a facility that minimizes capital, construction, and annual system operating costs.

4.1.1 Transportation Goal: Facilitate Operation of the Expanded Regional Link Light Rail System

4.1.1.1 No Build Alternative

Under the No Build Alternative, an OMSF would not be built, and light rail service would rely on the Forest Street OMF, which lacks the capacity to maintain and operate a light rail fleet at planned service levels under *Sound Transit 2: A Mass Transit Guide, The Regional Transit System Plan for Central Puget Sound* (ST2). The Forest Street OMF would be expected to serve the entire Link light rail system including the existing Central Link, and ST2 extensions to Bellevue and Redmond, Lynnwood, and Kent/Des Moines. The East Link storage track would be built to provide overnight storage and morning deployment of up to 16 light rail vehicles (LRVs), but would not provide maintenance functions.

The No Build Alternative does not meet the goal of facilitating operation of the expanded light rail system and locating a facility to provide efficient and reliable light rail service. Based on a fleet constrained to 104 LRVs operating principally from one location (Forest Street OMF), light rail service would include fewer train cars, longer headways between trains, and decreased passenger capacity. Without the addition of an OMSF, the light rail system would operate using three-car trains at 11-minute headways during peak periods, which would reduce the system's passenger capacity by more than 40% compared to the build alternatives. The lower level of service across the entire system would not meet projected demand and could result in passenger overcrowding on trains and station platforms. To establish full morning service on the Eastside, it is likely some trains would need to be deployed from the Forest Street OMF and turn back at the Northgate Station to reach the east line, creating operational disruptions and inefficiency.

Under the No Build Alternative, the 4-hour nightly inspection and maintenance window (1:00 a.m. to 5:00 a.m.), when all trains must be off the system, could not be maintained and the time allotted to deploy trains serving the 6:00 a.m. to 10:00 a.m. morning peak period would be exceeded. If all vehicles were stored on a single site, a system failure during the morning deployment could result in the entire fleet being trapped and unable to begin service.

4.1.1.2 Build Alternatives

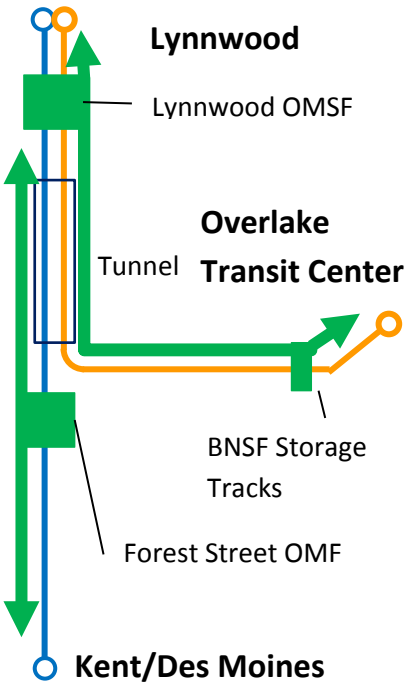
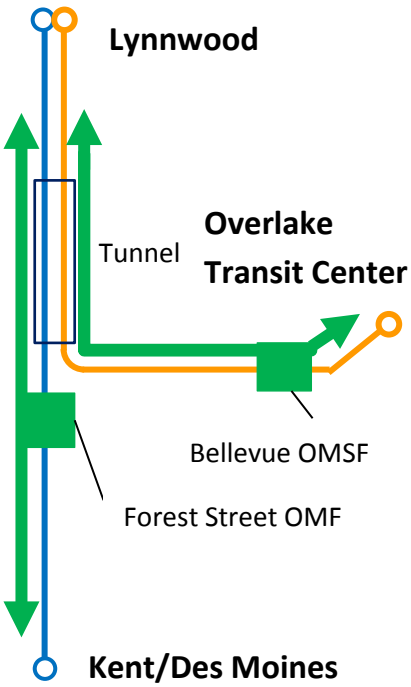
Each of the build alternatives would enable Sound Transit to support a fleet of at least 80 additional LRVs with the assumption that the Forest Street OMF would continue to provide inspection, heavy repair, and overhaul services. In combination with the Forest Street OMF, the OMSF would enable operations and maintenance of the ST2 light rail fleet needed to meet planned service levels. The OMSF would be located on either the north operating line or the east operating line to provide efficient and reliable light rail service. Locating an OMSF south of the junction where the north-south line and the north-east line meet at the International District Station (including expansion of the Forest Street OMF) would not be operationally feasible. Below is a description of the advantages and disadvantages of each build alternative in supporting the operation of the expanded regional Link light rail system. The advantages and disadvantages are focused on distinctions between alternatives related to site operations and deployment of LRVs.

Table 4-1 shows the number of LRVs planned to be stored at each of the build alternative sites. LRVs for the Lynnwood–Kent/Des Moines line would be stored at the Forest Street OMF. The Forest Street OMF would store enough LRVs to provide service for the Lynnwood–Kent/Des Moines line plus spare LRVs: it would store 20 four-car trains (80 LRVs) and 12 spare LRVs, for a total of 92 LRVs. LRVs for the Lynnwood–Overlake Transit Center line would be stored at the Lynnwood OMSF and BNSF Storage Tracks or the OMSF in Bellevue (BNSF Alternative, BNSF Modified Alternative, and SR 520 Alternative).

At the beginning of service, one or more trains from the Forest Street OMF could be deployed out of service (deadhead) northbound toward the International District/Chinatown Station. Those trains would then begin service southbound from the International District/Chinatown Station. This would provide a transfer opportunity for passengers arriving by bus or train from the north and east in the

early morning to reach points south, including SeaTac/Airport Station. The remaining Forest Street OMF trains would be deployed both northbound toward Lynnwood and southbound toward Kent/Des Moines.

Table 4-1. Fleet Storage and Deployment by Alternative

	Lynnwood Alternative, BNSF Storage Tracks			BNSF Alternative, BNSF Modified Alternative, and SR 520 Alternative		
						
	Forest Street OMF	**Lynnwood OMSF**	**BNSF Storage Tracks**	**Forest Street OMF**	**Lynnwood OMSF**	**Bellevue OMSF**
Peak service trains stored (4-car trains)	20	11	8	20	-	19
Spare LRVs stored	12	12	0	12	-	12
Total LRVs stored	92	56	32	92	-	88
Establish 4-min headway toward Downtown Seattle from the north	5:30 a.m.			5:30 a.m.		
Off-Peak headway after 6:30 p.m. for the Lynnwood – Overlake Transit Center Line	15 minutes			10 minutes		

At Overlake Transit Center, morning service would start at approximately the same time regardless of alternative. For the Lynnwood Alternative, trains beginning service at Overlake Transit Center would be deployed from the BNSF Storage Tracks, whereas under the BNSF Alternative, BNSF Modified Alternative, and SR 520 Alternative, trains would deploy from the OMSF in Bellevue.

For trains headed toward downtown Seattle from the north, the morning peak period headway would be established about the same time, regardless of alternative. The first trains serving the SeaTac/Airport Station would also arrive about the same time in the morning, regardless of alternative.

Lynnwood Alternative

The Lynnwood Alternative would store enough LRVs for the peak service requirement for the Lynnwood–Overlake Transit Center line plus spares. The Lynnwood OMSF would store 11 four-car trains (44 LRVs) and 12 spare LRVs, for a total of 56 LRVs. The BNSF Storage Tracks would store eight four-car trains for a total of 32 LRVs.

All service trains at the Lynnwood OMSF would be deployed first toward the north (deadhead) to reach the Lynnwood Transit Center, and then turn back to begin service toward the south. All service trains at the BNSF Storage Tracks would be deployed first toward the east to reach Overlake Transit Center, and then head west toward downtown Seattle and then north to Lynnwood.

Advantages

- **Earlier Lynnwood Service.** Because LRVs would be stored very close to the terminus of the system in Lynnwood and deployed first toward the station at the Lynnwood Transit Center, this alternative would allow service to begin in Lynnwood for the Lynnwood–Overlake Transit Center line about 30 minutes earlier than the BNSF Alternative, BNSF Modified Alternative, and SR 520 Alternative.

Disadvantages

- **Reduced Evening Headways.** For the Lynnwood–Overlake Transit Center line, the evening headway would need to be reduced to 15 minutes after 6:30 p.m., in order to bring trains back to the Lynnwood OMSF to facilitate daily inspections and preparation for the next morning's deployment. The time needed to complete these functions at the BNSF Storage Tracks would require that these vehicles be removed from service earlier in the evening, resulting in longer headways after 6:30 p.m. This headway would not meet Sound Transit's planned off-peak headway of 10 minutes until 10:00 p.m. as shown in Section 3.1, Transportation (Table 3.1-1).
- **Vehicle Rotation Inefficiency.** Because the BNSF Storage Tracks would only accommodate daily vehicle inspections and cleaning, special consideration would need to be given to rotate LRVs to the Forest Street OMF or Lynnwood OMSF for other scheduled or unscheduled maintenance, inspection and washing. This could introduce inefficiency in the system.

- **Tunnel Restrictions.** The tunnel between downtown and Northgate has special operating restrictions near scientific research buildings on the University of Washington (UW) campus related to electromagnetic interference and vibration. These restrictions could disrupt deployment and recovery of trains to the Lynnwood OMSF, especially a disabled train. Also, there would be no pocket track between International District/Chinatown Station and Northgate Station to temporarily store a disabled train.
- **Overburden of Forest Street OMF.** Some disabled trains would not be taken to the Lynnwood OMSF, potentially causing the Forest Street OMF to become overburdened with unscheduled maintenance activities. For example, wheel defects would cause vibration and could not be moved through the tunnel underneath the UW campus. If the defect was detected south or east of UW Station, the train would need to be moved to the Forest Street OMF. Additionally, disabled trains on the eastside would not likely be taken all the way to the Lynnwood OMSF, but rather they would be taken to the Forest Street OMF because of its proximity.
- **Service Disruption from Mainline Turnback Track.** Movements from the eastside to the Forest Street OMF would require a turnback on the mainline tracks north of the merge point, causing service disruption along the highest-ridership segments in the system. If the disruption occurred during the peak period, the peak headway could not be maintained, causing trains and platforms to become overloaded and potentially resulting in crowds that exceed the fire/life safety design of the stations.
- **Evening Irregular Train Spacing.** After 6:30 p.m., the Lynnwood–Overlake Transit Center line would operate with a different headway (15-minute headway) than the Lynnwood–Kent/Des Moines line (10-minute headway) until 10:00 p.m. Because these lines merge together at International District/Chinatown Station, the uneven headways would create irregular spacing between trains along the shared tracks after 6:30 p.m. This could result in operational disadvantages, such as the arrival of two consecutive trains from the same line, or trains from the two lines arriving at the merge point at the same time.

BNSF Alternative, BNSF Modified Alternative, and SR 520 Alternative

The BNSF Alternative, BNSF Modified Alternative, and SR 520 Alternative would operate similarly because in all cases the OMSF would be located in the Bel-Red area of Bellevue along the East Link extension. The OMSF in Bellevue would store enough LRVs to provide service for the Lynnwood–Overlake Transit Center line plus spares. It would store 19 four-car trains (76 LRVs) and 12 spare LRVs, for a total of 88 LRVs. All service trains at the OMSF in Bellevue would be deployed first toward the east to reach the Overlake Transit Center, and then would turn back, heading west toward downtown Seattle and Lynnwood.

Advantages

- **Ability to Maintain Off-Peak Headways.** Off-peak 10-minute headways could be maintained on both operating lines until 10:00 p.m. as planned.

- **Limited Service Disruptions.** If the Interstate 90 (I-90) floating bridge is closed, full service could be maintained between Mercer Island and the Overlake Transit Center. If there is a disruption on the line between Lynnwood and Kent/Des Moines, limiting the ability to access the tunnel, full service could be maintained between the Rainier Station and the Overlake Transit Center.
- **No Mainline Turnback Track.** For any recovery of a disabled train to the Bellevue OMSF or Forest Street OMF, there would not be a turnback north of the merge point, and there would not be a service disruption in the highest ridership segments of the system with the most frequent combined headway.

Disadvantages

- **East Link Operating Speed.** The SR 520 Alternative lead track connection to the East Link mainline would reduce the operating speed through this portion of the mainline. Modifications to the profile and geometry of this portion of the East Link mainline would be required to accommodate the lead track connection, and would result in a reduction in operating speed on the mainline.

4.1.2 Environmental Goal: Preserve Environmental Quality

4.1.2.1 No Build Alternative

The No Build Alternative supports the goal of preserving environmental quality by minimizing potential adverse impacts on the natural and built environment; however, beneficial impacts of the proposed project would not be realized. To address future population and employment growth, regional, state, and local land use and transportation plans include a goal of improving transit accessibility and encouraging transit use. In addition, economic development plans call for reducing congestion to increase the mobility of goods and services. Enabling planned service levels on light rail system extensions under ST2 would increase transit accessibility and reduce congestion, thereby reducing overall vehicle emissions and improving freight mobility. The No Build Alternative would not support planned service levels and would limit the light rail system's ability to support these changes.

4.1.2.2 Build Alternatives

Impacts concerning transportation; social, community facilities, and neighborhoods; visual and aesthetic resources; air quality and greenhouse gases; energy; hazardous materials; electromagnetic fields; geology and soils; utilities; and historic and archaeological resources would be similar among the build alternatives and would not differentiate them from one another. Although noise impacts would vary among alternatives, they could also be fully mitigated. The types of impacts relative to each resource area that differentiate the alternatives are summarized in Table 4-2.

Table 4-2. Differentiating Characteristics and Impacts of the Build Alternatives

Differentiating Characteristic	Lynnwood Alternative	BNSF Alternative	BNSF Modified Alternative	SR 520 Alternative
Capital Costs (2013 dollars)				
Million dollars	$350–$355	$345	$415	$385
Operations				
Requires off-site storage tracks	Yes	No	No	No
Annual Facility Operating Costs (constant dollars)				
Million dollars	$66	$63	$63	$63
Acquisitions, Displacements, and Relocations				
Number of parcels acquired	14–15	6	14	13
Number of existing land uses displaced	11–14	14	25	101
Land Use				
Consistent with zoning / comprehensive plan designations	No; would require comp. plan, zoning change and a CUP	No; would require a CUP	No; would require a CUP	No; would require a CUP
Surplus land available for redevelopment	9–13 acres	4 acres	8 acres	0 acres
Economics				
Loss of annual property tax revenue (2012)	$413,100–$450,400	$464,200	$572,400	$630,500
Noise and Vibration				
Affected sensitive receptors and adjacent land uses (number after mitigation)	2 homes (None)	None	None	None
Ecosystems and Water Resources				
Aquatic impacts	≤ 0.1 acre of stream buffer	0 acres of stream buffer	0 acres of stream buffer	Piping approx. 700 feet of Goff Creek and 0.64 acre of stream buffer
Vegetation and wildlife impacts (vegetation removal)	11–12 acres	3 acres	6 acres	2 acres
Wetland impacts (direct)	1.98–2.18 acres	0.07 acre	0.6 acre	0.39 acre
Wetland buffer impacts	1.79 acres	0.25 acre	1.33 acres	0.29 acre
Groundwater and stream baseflow impacts	No	No	No	Yes
Public Services				
Number of direct impacts on essential public facilities	1	0	1	0
Parklands and Open Space				
Number of temporary impacts on park resources	1	0	0	0

Lynnwood Alternative

The Lynnwood Alternative site is currently zoned for Light Industrial and Business/Technical Park uses. Development of the OMSF is not explicitly addressed in the City's land use code and would require a Conditional Use Permit approval from the City of Lynnwood, and an amendment to the City's official zoning map. This is the only build alternative that has the potential to affect existing residential uses (the neighborhood west of the Lynnwood Alternative site) due to the increase in noise. However, the increase in noise would be fully mitigated. The Lynnwood Alternative would also result in the greatest impacts on ecosystem resources including vegetation, wetlands, and wildlife habitat. The Lynnwood Alternative would also require temporary closure and detour of the Interurban Trail while the elevated lead track is constructed. This alternative would occupy land owned by the Edmonds School District that is planned for the district support center, which would include administrative offices and school bus storage and maintenance facilities. The proposed maximum building height of the OMSF would be approximately 32 feet, consistent with the low profile of the buildings in the surrounding area and, therefore, does not represent a substantial visual change. Additionally, screening fences and landscape elements would be incorporated into the design.

BNSF Alternative

The BNSF Alternative would require relocating existing industrial and commercial uses. The BNSF Alternative site is in the Bel-Red area zoned for mixed use, office, and residential uses. The City's land use code would allow an OMSF with a Conditional Use Permit approval from the City of Bellevue. The Bel-Red Corridor no longer includes industrially zoned land, but relocation of displaced businesses could occur on industrially zoned land elsewhere in Bellevue. The OMSF is consistent and compatible with existing uses and would not result in substantial changes to the visual environment because the building mass, size, and use are typical of the surrounding area. However, the OMSF would be inconsistent with the Bel-Red land use plans and zoning designations in this location, which anticipate a transition over time from the current industrial character to a transit-oriented, higher density mixed-use development pattern of retail, office, and residential uses near the East Link 120th Avenue Station.

BNSF Modified Alternative

The BNSF Modified Alternative site has the same zoning designations as the BNSF Alternative on the east side of BNSF corridor. Properties west of the rail corridor are zoned for medical office uses. The land use approval process would be the same as the BNSF Alternative, and the BNSF Modified Alternative would result in nearly identical impacts as BNSF Alternative except that it would also require the acquisition and relocation of the Bellevue Public Safety Training Center. The OMSF is consistent with existing uses and would not result in substantial changes to the visual environment because the building mass, size, and use are typical of the surrounding area. However, the OMSF would be inconsistent with the Bel-Red land use plans and zoning designations in this location. Compared to the BNSF Alternative, the BNSF Modified Alternative is configured to be farther away

from the East Link 120th Avenue Station. The OMSF configuration would better accommodate future mixed-use development, consistent with land use plans nearest to the light rail station.

SR 520 Alternative

The SR 520 Alternative site is currently zoned for commercial uses and development of the OMSF would require a similar Conditional Use Permit approval as the BNSF Alternative or BNSF Modified Alternative. However, the SR 520 Alternative site is located furthest away from the future East Link stations, outside of Bel-Red land use designations for mixed-use, transit-oriented development. The SR 520 Alternative would require the greatest number of commercial business displacements. Based on the City of Bellevue's noise ordinance, there is potential for noise impacts on neighboring commercial businesses, but these impacts would be mitigated. The SR 520 Alternative would also have the greatest aquatic resource impacts related to piping portions of Goff Creek that are currently daylighted through the site. Modifications to the Goff Creek channel would require mitigation and may affect shallow groundwater to the degree that it would affect the amount of baseflow entering the creek. The OMSF would not result in substantial changes to the visual environment because the building mass, size, and use are typical of the surrounding area. Views from the Bridle Trails neighborhood north of the site are blocked by existing vegetation and landforms.

4.1.3 Financial Goal: Achieve Financial Feasibility

4.1.3.1 No Build Alternative

Under the No Build Alternative, there would be no capital cost or operating cost because the proposed project would not be implemented. Without expanded operations and maintenance capacity, there could be an effect on the competitiveness of the ST2 Link light rail extensions for federal grant funding.

4.1.3.2 Build Alternatives

All build alternatives are financially feasible and could be developed and supported by ST2 tax revenue. Capital costs of the proposed project (including property acquisition, relocation, construction, and design/permitting/administrative costs) are estimated to range from $345 million (BNSF Alternative) to $415 million (BNSF Modified Alternative), as described in Chapter 2, Section 2.9, Funding and Estimated Project Costs and as shown in Table 4-3. The Lynnwood Alternative would have the lowest property and relocation costs, but the second highest construction costs. This is due to costs to design and construct two separate facilities and the length of elevated lead track. The BNSF Alternative would have the second lowest property and relocation costs and the lowest design and construction costs. This is due to the relatively flat site topography and limited number of properties and businesses that would be displaced. The BNSF Modified Alternative would have the highest capital costs, due to higher property and relocation costs and the structural complexity of this alternative (e.g., need for earthwork and retaining walls and elevated track work spanning the Eastside Rail Corridor). The SR 520 Alternative would have the second highest property and

relocation costs due to the large number of businesses that would be displaced, but the second lowest costs for design and construction.

Table 4-3. Estimated Capital and Operating Costs of the Build Alternatives

Alternative	Real Estate and Relocation (million dollars)[a]	Final Design and Construction (million dollars)[a,b]	Total Capital Cost (million dollars)[a]	Annual Operating Cost (million dollars)[c]
Lynnwood Alternative				
Design Option C1	$45	$305	$350	$66
Design Option C2	$40	$310	$350	$66
Design Option C3	$50	$305	$355	$66
BNSF Alternative	$80	$265	$345	$63
BNSF Modified Alternative	$100	$315	$415	$63
SR 520 Alternative	$95	$290	$385	$63

[a] 2013 dollars.

[b] Includes professional services and unallocated contingency.

[c] Annual labor cost in constant dollars to operate the facility.

Annual OMSF operating costs (i.e., facility maintenance and labor costs) are estimated to range between $63 million (BNSF Alternative, BNSF Modified Alternative, and SR 520 Alternative) and $66 million (Lynnwood Alternative). The increased annual operating costs for the Lynnwood Alternative relate directly to the need for a separate storage track facility in Bellevue. The added annual operating costs are primarily labor costs driven by the additional staff needed to operate and maintain the two separate facilities under the Lynnwood Alternative.

4.2 Commitment of Resources

If built, the proposed project would have irreversible and irretrievable commitments of property and natural resources. Private properties with industrial and commercial uses would be converted to transit use. The conversion of lands to light rail use would change the character of the Lynnwood Alternative site. The proposed project would affect wetlands, wildlife habitat, and aquatic resources to varying degrees, depending on the alternative selected and built. Mitigation measures would be implemented, but some of these resources would be irretrievably altered. Construction of the proposed project would also require the irretrievable commitment of resources such as fuel and construction materials (e.g., aggregate for concrete, wood for forms and frames, and steel for rebar and rails).

4.3 Areas of Controversy and Issues to be Resolved

The following are known areas of controversy and issues to be resolved.

- Determining whether the Edmonds School District could and would develop the portion of the Lynnwood Alternative site not needed for the OMSF to accommodate some functions of the planned district support center.
- Resolving conflicts related to locating the proposed project within areas envisioned for transit-oriented development within the City of Bellevue's Bel-Red Corridor under the BNSF Alternative and BNSF Modified Alternative.