Section 3.6

Noise

This chapter assesses the potential noise impacts associated with implementing the alternatives under consideration. The chapter includes a description of noise and noise levels in general, regulatory standards for noise, noise sources and potential sensitive noise receptors in the maritime and industrial areas of Seattle, the methods used to assess noise and impacts from noise, and an assessment of noise impacts associated with each alternative, as well as potentially feasible noise mitigation measures where appropriate. This analysis evaluates noise conditions and potential impacts for each MIC on an area-wide cumulative basis and, and in specific areas where the alternatives consider greater degrees of change.

Under the SEPA Rules (see WAC 197-11-330, WAC 197-11-440 and WAC 197-11-794), the evaluation of the significance of potential impacts considers whether there is a reasonable likelihood of more than a moderate adverse impact on environmental quality (WAC 197-11-794). In making this assessment, the following are considered:

- The context of the proposal, including the physical setting.
- The intensity of the impact, which depends on its magnitude and duration.
- The likelihood of the impact's occurrence.
- The duration of the impact.

In many cases, regulatory thresholds are used to judge significance. If actions would meet regulatory thresholds, then the determination is typically that the level of impact is unlikely to be significant. For the purposes of this programmatic impact analysis, noise is analyzed by examining whether:

- The alternative would cause future traffic noise levels of 10 dBA or more above existing noise levels.
- After application of mitigation, the alternative fails to comply with SMC Maximum Allowable Sound Level for receivers.

3.6.1 Affected Environment

Primary & Secondary Study Areas

The study area used in the noise assessment encompasses areas where construction noise or land uses that result from implementation of the industrial and maritime strategy would have the potential to affect nearby noise-sensitive land uses. The Primary Study Area includes the full study area and subareas referenced in **Chapter 2**, as well as a Secondary Study Area that includes areas extending 500 feet from the Primary Study Area boundary. Areas within the 500-foot radius include portions of the City of Seattle, City of Tukwila, and unincorporated King County.

Data & Methods

The project team used the following data sources for this construction noise assessment:

- Highway Construction Noise Handbook (FHWA 2006)
- City of Seattle Municipal Code (SMC Chapter 25)
- State of Washington Administrative Code (Chapter 173-60 WAC)

Background

Noise is defined as excessive or undesired sound. Human sensitivity to sound depends on its intensity, frequency composition and duration. Sound waves are received by the human ear as variations in pressure through a medium such as air over time. The loudest sounds typically encountered by humans are a million times greater in pressure than faint sounds at the threshold of hearing. Because of this large scale, noise intensity is measured on a scale whose units are termed decibels (dB) which use a logarithmic scale to compress the range of pressure fluctuations to a more usable noise metric. A logarithmic loudness scale with 0 dB corresponds roughly to the threshold of human hearing and 120 dB to 140 dB corresponds to the threshold of pain.

The greater sensitivity of the human ear to certain frequencies is approximated by skewing (or weighing) the decibel scale towards those frequencies. The weighted decibel scale which best approximates the response of the human ear is known as the A- weighted scale (dBA). The A-scale deemphasizes low frequency noise, slightly emphasizes mid-high frequency noise, and slightly de-emphasizes high frequency noise.

Community noise levels are typically measured over an extended period of time to characterize a community noise environment and evaluate cumulative sound impacts. This time-varying characteristic of environmental noise is described using statistical noise descriptors. Commonly used technical noise terms used in this Chapter include:

Decibel (dB)—A logarithmic unit, which expresses the ratio of the measured sound pressure level to a standard reference level. Each increase in 10 dB equates to a tenfold increase in the magnitude of sound energy.

A-weighted Sound Level (dBA)—Sound level meters are usually equipped with weighting circuits, which filter out selected frequencies. The A-scale on a sound level meter best approximates the frequency response of the human ear.

Equivalent Noise Level (Leq)—The level of a constant sound having the same sound energy as the fluctuating levels measured over a period of time.

Ambient Noise Level—The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location (FWHA 2011).

Maximum Noise Level (Lmax)—The Lmax is the instantaneous maximum noise level measured during a measurement period of interest. This is the noise metric used when comparing a project's impacts to the City of Seattle Maximum Permissible Sound Levels.

Day-Night Average Sound Level (Ldn)—The day-night average sound level is the energy average of the A-weighted sound levels occurring during a 24-hour period, accounting for the greater sensitivity of most people to nighttime noise by weighting ("penalizing") nighttime noise levels by adding 10 dBA to noise between 10:00 p.m. and 7:00 a.m. (Seattle 2015).

Steady-state sound is typically described using the Leq descriptor. Impulse sound is sound generated over a relatively short duration period (e.g., a car horn or back-up alarm). Impulsive sound is typically characterized using the Lmax descriptor. Seattle's Noise code defines "Impulsive sound" where the peak of the sound level is less than one (1) second and short compared to the occurrence rate; the onset is abrupt; the decay rapid; and the peak value exceeds the ambient level by more than ten (10) dB(A) (Seattle 2015).

Effects of Noise on People

The effects of noise on people can be listed in three general categories:

- Subjective effects of annoyance, nuisance, and dissatisfaction
- Interference with activities such as speech, sleep, and learning
- Physiological effects such as startling and hearing loss

In most cases, environmental noise typically produces effects in the first two categories. Workers in industrial plants sometimes experience noise in the third category. There is no completely accurate way to measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction. This lack of a standard is primarily because of the wide variation in individual thresholds of annoyance and habituation to noise. Thus, an important way of determining a person's subjective reaction to a new noise is to compare it to the existing or "ambient" environment to which that person has adapted. In general, the more a new noise exceeds the previously ambient noise level, the less acceptable the new noise will be judged by listeners.

With regard to increases in A-weighted noise levels, the following relationships occur:

- People generally perceive a 10 dBA increase as a doubling of loudness and can cause an adverse response. For example, a 70 dBA sound will be perceived by an average person as twice as loud as a 60 dBA sound.
- People generally cannot detect differences of 1 dBA to 2 dBA between noise sources, but under typical listening conditions, differences of 3 dBA can be noticeable.
- A 5 dBA change would probably be perceived by most people under normal listening conditions.

Because of their logarithmic nature, decibels do not arithmetically add. For example, if two sound levels are added with one sound level being 10 dB louder than the other, the combined sound level is only 0.4 dB more than the louder sound level.

Exhibit 3.6-5 shows typical A-weighted noise levels and human response.

When distance is the only factor considered, sound levels from isolated point sources of noise typically decrease by about 6 dBA for every doubling of distance from the noise source. When the noise source is a continuous line (for example, vehicle traffic on a highway), noise levels decrease by about 3 dBA for every doubling of distance away from the source. Noise levels at receptor locations can also be affected by factors other than the distance from the noise source. For example, topographic features and physical barriers can increase or decrease noise levels by absorbing, reflecting, or scattering sound waves. Atmospheric conditions (wind speed and direction, humidity levels, and temperatures) can affect the degree to which sound is attenuated over distance. Temperature inversions and wind conditions can also diffract and focus a sound wave to a location at considerable distance from the noise source. The degree of impact also depends on the individual sensitivity of people listening and on ambient sound levels. For example, where background noise levels are high, introducing a new noise source tends to have less impact than in an environment where background noise levels are low.

Current Policy & Regulatory Frameworks

Federal Guidelines

The U.S. Department of Housing and Urban Development (HUD) promulgates noise standards (24 CFR Part 51, Subpart B) applicable to federally residential construction. These standards are widely used where federal involvement is not a factor to assess the significance of noise impacts in residential communities.

Under HUD standards, noise levels within residences should not exceed a day night average sound level (Ldn) of 45 dB (typically expressed as dBA). Because interior noise levels in typical residential construction are about 20 dBA below exterior levels, HUD standards classify sites where community exterior noise levels exceed 65 dB as noise-impacted areas and require additional sound attenuation to bring interior noise levels within the 45 dB standard.

A major source of noise in urban environments is from vehicles traveling on roads. Growth or changes in land use also can lead to additional traffic, and the potential for an increase in noise. Federal aid projects—transportation facilities receiving federal funding—are subject to federal noise guidelines. Washington State Department of Transportation (WSDOT) 2020 Traffic Noise Policy and Procedures (WSDOT 2020) are consistent with those of the Federal Highway Administration (FHWA) (23 Code of Federal Regulations 772) and have been approved by FHWA for use on federal-aid projects in Washington. FHWA guidelines state that noise abatement must be considered when a noise impact affects a particular land use or Activity Category. The FHWA Activity Categories B and C noise abatement criteria (NAC) of 67 dBA apply to residences

(single- and multi-family), places of worship, schools, recreation areas, and similar land use activities. **Exhibit 3.6-1** describes WSDOT's NAC by land use category. Other developed lands (e.g., hotels/motels, offices, restaurants/bars, or other developed lands) are included in Activity Category E, with a NAC of 72 dBA. FHWA determines a noise impact to occur when predicted future traffic noise levels "approach" or exceed the established FHWA NAC for a given Activity Category. WSDOT defines "approach" as within 1 dBA of the FHWA NAC (66 dBA for Activity Categories B and C or 71 dBA for Category E).

Exhibit 3.6-1 WSDOT Noise Abatement Criteria by Land Use Category

Activity Category	Leq(h)* (dBA) at Evaluation Location	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Residential (single and multi-family units)
C	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F. Includes undeveloped land permitted for these activities.
F	—	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	—	Undeveloped lands that are not permitted

Source: WSDOT, 2020.

Washington State

The State of Washington authorized the establishment of rules to abate and control noise pollution (Revised Code of Washington 70.107). The regulations (Washington Administrative Code (WAC) 173-60-040) establish maximum permissible noise levels (termed "Environmental Designation for Noise Abatement" or EDNA), which vary depending upon the land uses of the noise source and the receiving property. The maximum permissible noise level is the decibel

level of noise generated by the project as measured at the property line of adjacent land uses; it is not the combined noise of a project and background. Maximum Permissible Environmental Noise Levels apply to a variety of activities and facilities including residences, hospitals, commercial services, storage, warehouse and distribution facilities, and industrial property, and exempts electrical substations, certain industrial installations, mobile noise sources and vehicles traveling in public right of way, as well as safety warning devices (i.e., bells). The state provisions have been adopted by most cities around the state, including the City of Seattle (SMC 25.08).

City of Seattle

Operational Noise Standards

Chapter 25.08 of the Seattle Municipal Code (SMC) establishes exterior sound level limits for specified land use zones or "districts," which vary depending on the district of sound source and the district of the receiving property (see **Exhibit 3.6-2**).

Exhibit 3.6-2 Maximum Permissible Noise Levels: Seattle Noise Control Ordinance

	EDNA Receiver of Noise (Maximum Allowable Sound Level in dBA Leq)		
EDNA Source of Noise	Residential	Commercial	Industrial
Class A Residential	55	57	60
Class B Commercial	57	60	65
Class C Industrial	60	65	70

Source: Seattle Municipal Code (SMC) 25.08.410.

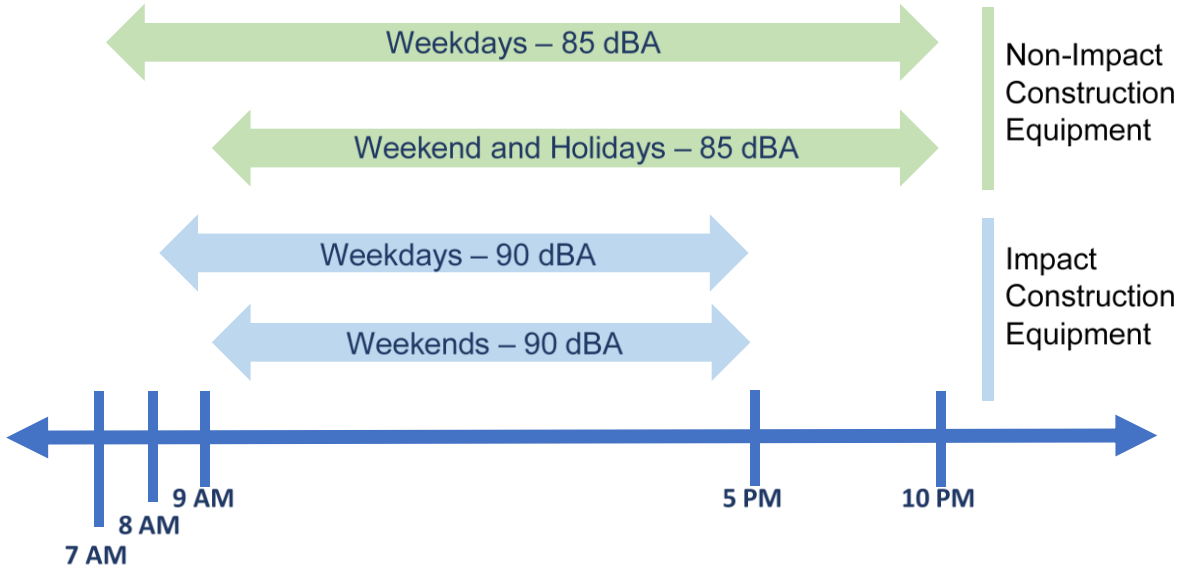
Between the hours of 10pm and 7am on weekdays and 10pm and 9am during weekends, the maximum limits for receivers within residential zones are to be reduced by 10 dBA. For noises of short duration these limits can be exceeded by a maximum of 5 dBA for 15 minutes/hour, 10 dBA for 5 minutes/hour or 15 dBA for 1.5 minutes/hour.

Construction Noise Standards

The City's Noise Control code allows the exterior sound level limits to be exceeded by certain types of construction equipment operating in many commercial districts between 7 a.m. and 10 p.m. on weekdays and between 9 a.m. and 10 p.m. on weekends and legal holidays (SMC 25.08.425; see **Exhibit 3.6-3**). The types of equipment that would usually exceed the exterior sound level limit of 60 dBA are tractors, loaders, excavators, and cranes. This equipment may exceed the applicable standard by up to 25 dBA (an 85 dBA standard) when measured at a reference distance of 50 feet. Use of impact equipment, such as a pile driver, is restricted to 8 a.m. to 5 p.m. on weekdays and 9 a.m. to 5 p.m. on weekends and holidays and limited to a

continuous noise level of 90 dBA and a maximum noise level of 99 dBA Lmax when measured at a reference distance of 50 feet.

Exhibit 3.6-3 Construction Noise Time Limits for Public Projects in Commercial Zones Under the City of Seattle Noise Ordinance



Source: City of Seattle, 2021.

Criteria for Increases in Noise Levels

As discussed in **Effects of Noise on People**, the following general relationships exist between noise levels and human perception:

- An increase in sound levels of 1- or 2-decibels is not perceptible to the average person.
- An increase in sounds levels of 3-decibels is just barely perceptible to the human ear.
- An increase in sounds levels of 5-decibels is readily perceptible to the human ear.
- An increase in sounds levels of 10-decibels is perceived as a doubling in loudness to the average person.

In addition, FHWA and WSDOT consider a traffic noise impact to occur if future predicted noise levels substantially exceed the existing noise levels. The WSDOT guidance indicates that a predicted future traffic noise level of 10 dBA or more above existing noise levels constitutes a substantial increase.

Current Conditions

Noise Sources in Seattle

For this analysis, the existing noise environments in the BINMIC and Greater Duwamish MIC are divided into several categories of noise sources: surface vehicle traffic; rail operations, including freight, light rail, and commuter trains; aircraft operations; commercial/industrial equipment; construction equipment and any other sources not associated with the transportation of people or goods.

Traffic Noise

Traffic noise exposure is primarily a function of the volume of vehicles per day, the speed of those vehicles, the number of those vehicles represented by medium and heavy trucks, the distribution of those vehicles during daytime and nighttime hours and the proximity of noise-sensitive receivers to the roadway. Existing traffic noise exposure adjacent to interstate highways is expected to be as high as 75 dB Ldn (FTA 2006). Bus transit can also make a meaningful contribution to roadway noise levels. Traffic noise assessment in this analysis is inclusive of bus transit, as buses are an assumed percentage of overall roadway volumes used in the calculation of roadside noise levels.

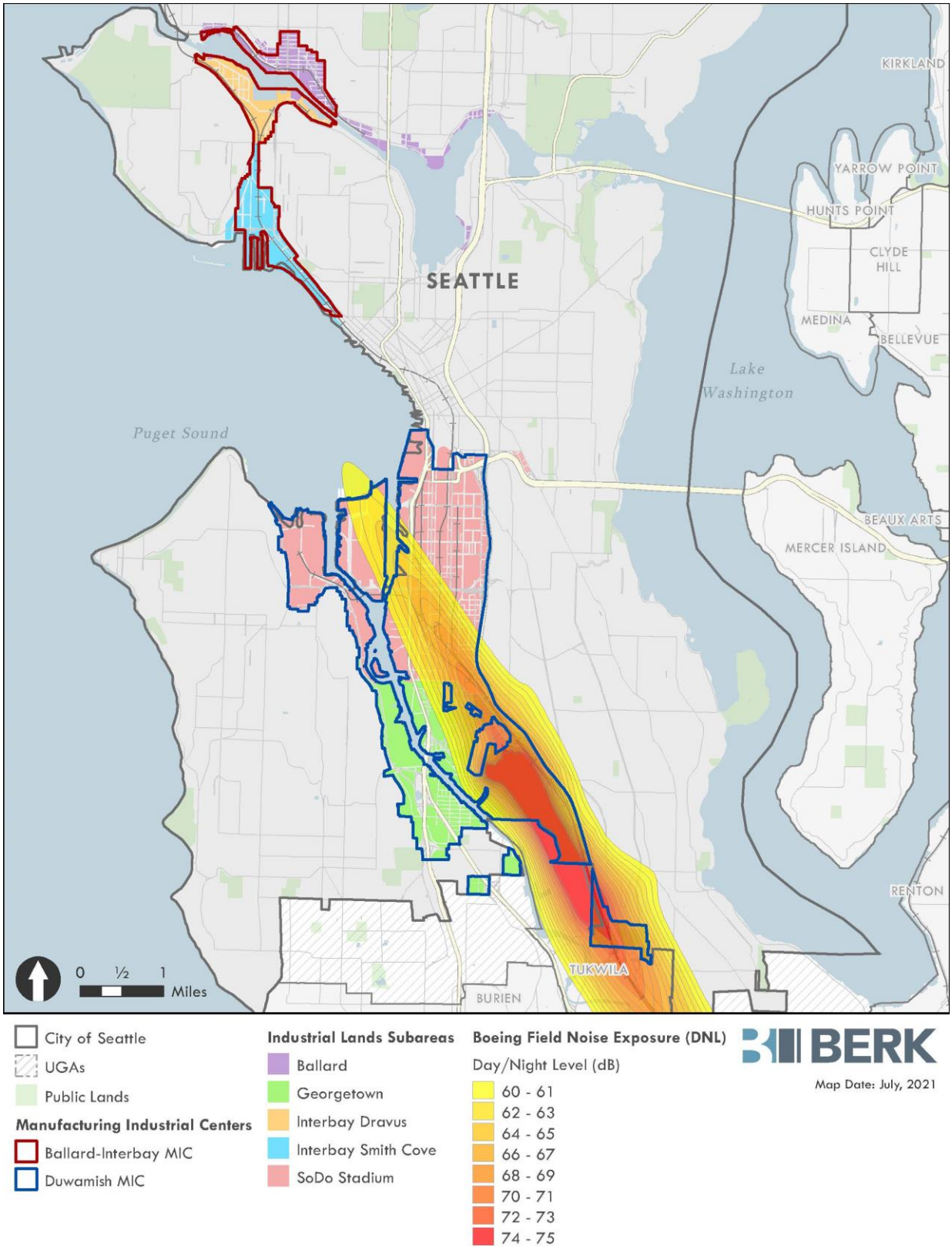
Rail Noise

MIC areas in Seattle are also affected by noise from freight and passenger rail operations. While these operations generate significant noise levels in the immediate vicinity of the railways, train operations are intermittent and area railways are widely dispersed. Commuter rail such as Sound Transit's light rail system operate with more frequency than standard gauge rail operations but electrification and lower speeds result in lower noise levels. The contribution of rail noise to the overall ambient noise environment in the Seattle MIC areas is relatively minor compared to other sources such as traffic. However, areas near train yards from assembling railcars into long trains and idling engines frequently experience high noise levels (FTA 2006).

Aircraft Noise

The King County International Airport, also known as Boeing Field, which generates approximately 500 aircraft operations a day. In addition to the numerous daily aircraft operations originating and terminating at Boeing Field, aircraft originating from other airports such as Seattle-Tacoma International Airport (Sea-Tac) frequently fly over Seattle. All of these operations contribute to the overall ambient noise environment. In general, like rail noise, the proximity of the receiver to the airport and aircraft flight path determines the noise exposure. Other contributing factors include the type of aircraft operated, altitude of the aircraft and atmospheric conditions. Atmospheric conditions may contribute to the direction of aircraft operations (flow) and affect aircraft noise propagation. **Exhibit 3.6-4** presents the noise contours for Boeing Field as of the 2010 (King County 2010).

Exhibit 3.6-4 Boeing Field Noise Exposure



Source: Herrera, 2021.

Construction Noise

Construction activities for new development and transportation improvements can create high noise levels of relatively short duration. Noise production from construction equipment varies depending on factors such as operation being performed and equipment type, model, age, and condition. Noise from heavy equipment diesel engine operations often dominates the noise environment in the vicinity of construction sites. Stationary sources such as generators, pumps and compressors may also produce a significant contribution. However, if present, operations from impact equipment (e.g., pile driving, pavement breaking) will generally produce the highest noise levels and may also produce significant vibration in the vicinity. Maximum noise exposure from typical construction equipment operations is approximately 75–100 dB (Lmax at 50 feet) with noise from heavy demolition and pile driving operations having the highest noise production.

Industry and Other Non-Transportation Noise

A wide variety of industrial and other non-transportation noise sources are located in Seattle MICs. These include manufacturing plants, marine shipping facilities, and other heavy and general industrial facilities, and others. Noise generated by these sources varies widely, but in many cases may be a significant contributor to a local noise environment.

For comparative purposes, a list of common A-weighted noise levels is shown in **Exhibit 3.6-5**. Decibel levels and common subjective responses to that sound level are also presented in the table. The table also depicts how persons commonly describe sound level differences of 10 dB as being twice as loud or half as loud.

Exhibit 3.6-5 Typical Sound Levels

Example	dBA	Qualitative Evaluations	Times as Loud (re 70 dBA)
	140	Deafening	
Threshold of Pain	135		
Jet Engine 200 feet	125		
	120		32
Rock Band	115		
Accelerating Motorcycle a few ft. away	110		16
Noisy Urban Street/Heavy City Traffic	100	Very Loud	8
Jack Hammer at 50 feet	95		
	90		4
Heavy Truck at 50 feet	85		
	80	Moderately Loud	2
Vacuum Cleaner at 10 feet	75		

Example	dBA	Qualitative Evaluations	
Near freeway auto traffic	70		1
Business Office	60		½
	50	Quiet	¼
	45		
Quiet urban nighttime	40		⅛
Soft whisper at 5 ft.	30	Faint	
	25		
Motion picture studio	20	Very Faint	
Human breathing	10		
Threshold of human hearing	0		

Source: Herrera, 2021.

Existing Noise Levels in Seattle MIC Areas

This section presents current noise levels in the BINMIC and Greater Duwamish MIC study areas. Three methods are used to characterize existing noise levels in the Seattle MIC areas:

- A compilation of available noise data near the MICs was collected from publicly available documents to provide a sampling of noise environments near the areas of interest.
- Noise levels were measured at 8 locations in specific areas where the alternatives consider greater degrees of change and the potential for noise impacts is higher.
- A desktop survey using aerial photography, ArcGIS, and the City of Seattle Comprehensive Plan and zoning was used to determine locations of noise sensitive land uses in the MIC areas.

Existing noise levels are presented in **Exhibit 3.6-6** and **Exhibit 3.6-7** and the location of the measurements is presented in **Exhibit 3.6-8**. Measurements indicate that portions of the SODO/Stadium and Georgetown/South Park subareas exceed HUD's 65 dBA standard and would be classified as noise-impacted areas needing additional noise attenuation for residential structures.

These data show that ambient noise levels in maritime and industrial areas of the city (locations in **Exhibit 3.6-8**) are higher than other developed areas of the city. Larger traffic volumes on local roadways, rail and aircraft operations, and transit bus operations are largely responsible for this condition. Typical urban areas with low roadway volumes can regularly experience typical ambient noise levels below 50 dBA. Locations adjacent to freeways and highways can experience daytime ambient noise levels of 65–75 dBA, L50 (Caltrans 2009).

Exhibit 3.6-6 Ambient Noise Level Data at Ecology/PSCAA Seattle Monitoring Stations

	2018		2019		2020		2021	
Location	LEQ	LMax	LEQ	LMax	LEQ	LMax	LEQ	LMax
11-Beverly Park School	64.1	71.0	63.7	69.0	62.0	68.0	62.9	66.0
9-Beacon Hill	64.0	70.0	91.2	110.0	73.6	99.0	62.8	69.0
6-Hamilton Viewpoint Park	57.0	74.0	57.4	64.0	57.0	66.0	53.8	64.0
4b-Catherine Blaine School (Magnolia)	53.2	64.0	53.1	64.0	54.5	71.0	66.8	85.0

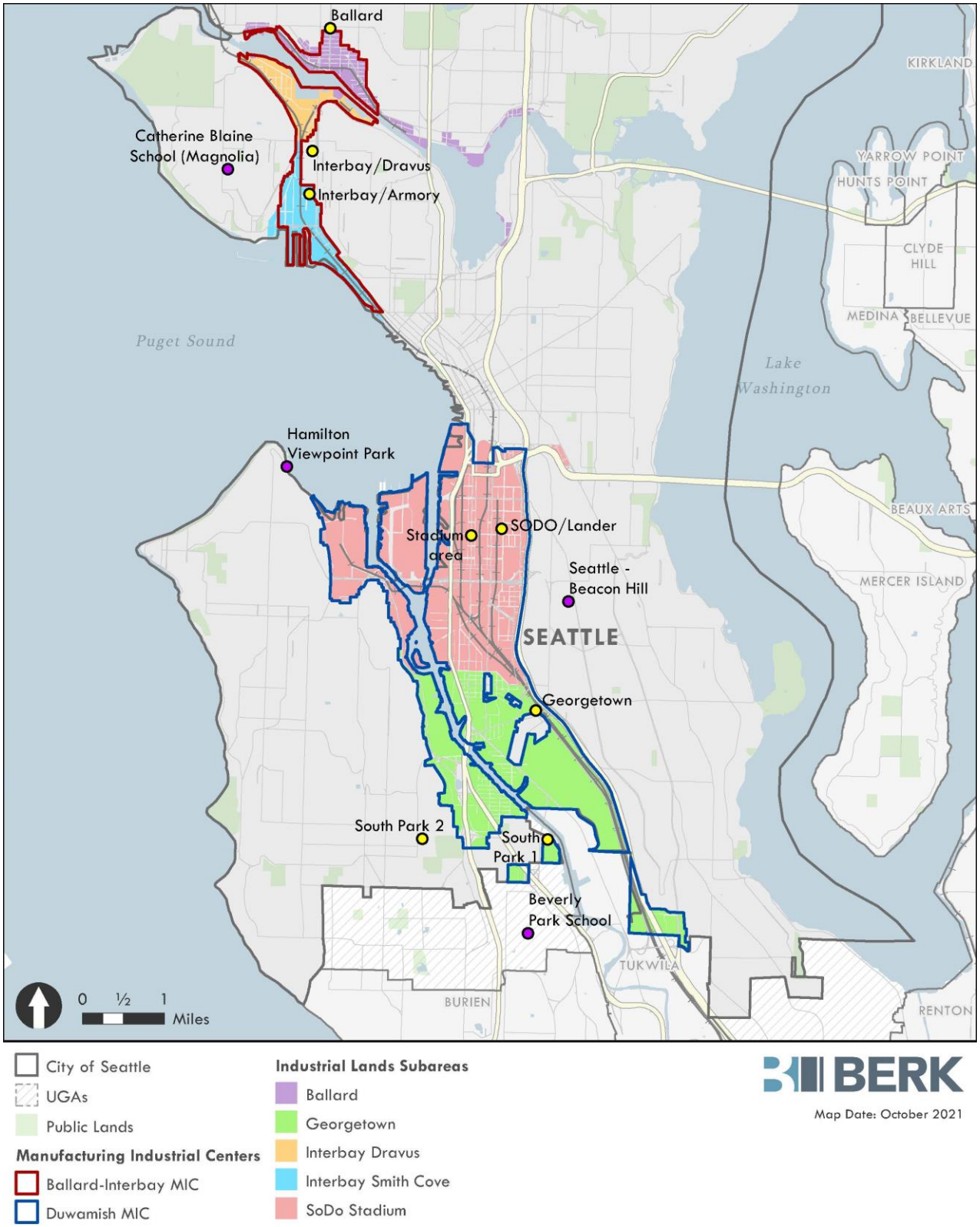
Sources: Port of Seattle, 2021 (https://www.portseattle.org/page/aircraft-noise-monitoring-system); Ramboll, 2021.

Exhibit 3.6-7 Sound Level Measurements (dBA) in the Seattle MIC Areas (2021)

	2021		
Location	24-Hour Day-Night Ldn	Hourly Leq Range—Daytime Hours	Hourly Leq Range—Nighttime Hours
Ballard	62.5	55.6–66.7	47.4–60.2
Interbay/Dravus	58.8	51.6–57.1	50.4–53.6
Interbay/Armory	58.5	52.1–56.7	50.6–52.3
Stadium	69.2	61.5–69.0	55.7–68.0
Georgetown	68.1	62.8–67.6	55.2–66.0
South Park 1	60.5	53.9–59.9	51.0–56.3
SODO/Lander	67.8 [a]	57.4–72.2 [a]	53.1–61.2
South Park 2	59.5	53.9–63.7	44.5–54.1

[a] At SODO/Lander location, sound levels during daytime hours between 7 a.m. and 2 p.m. were influenced by interference of a generator operating nearby. As estimate of the 24-hour Ldn sound level during this time period is approximately 65 dBA, approximately 3 dBA lower than presented in this table.
All measurements collected between August 23 and August 27, 2021.
Source: Ramboll, 2021.

Exhibit 3.6-8 Noise Monitoring Locations



Source: Herrera, 2021.

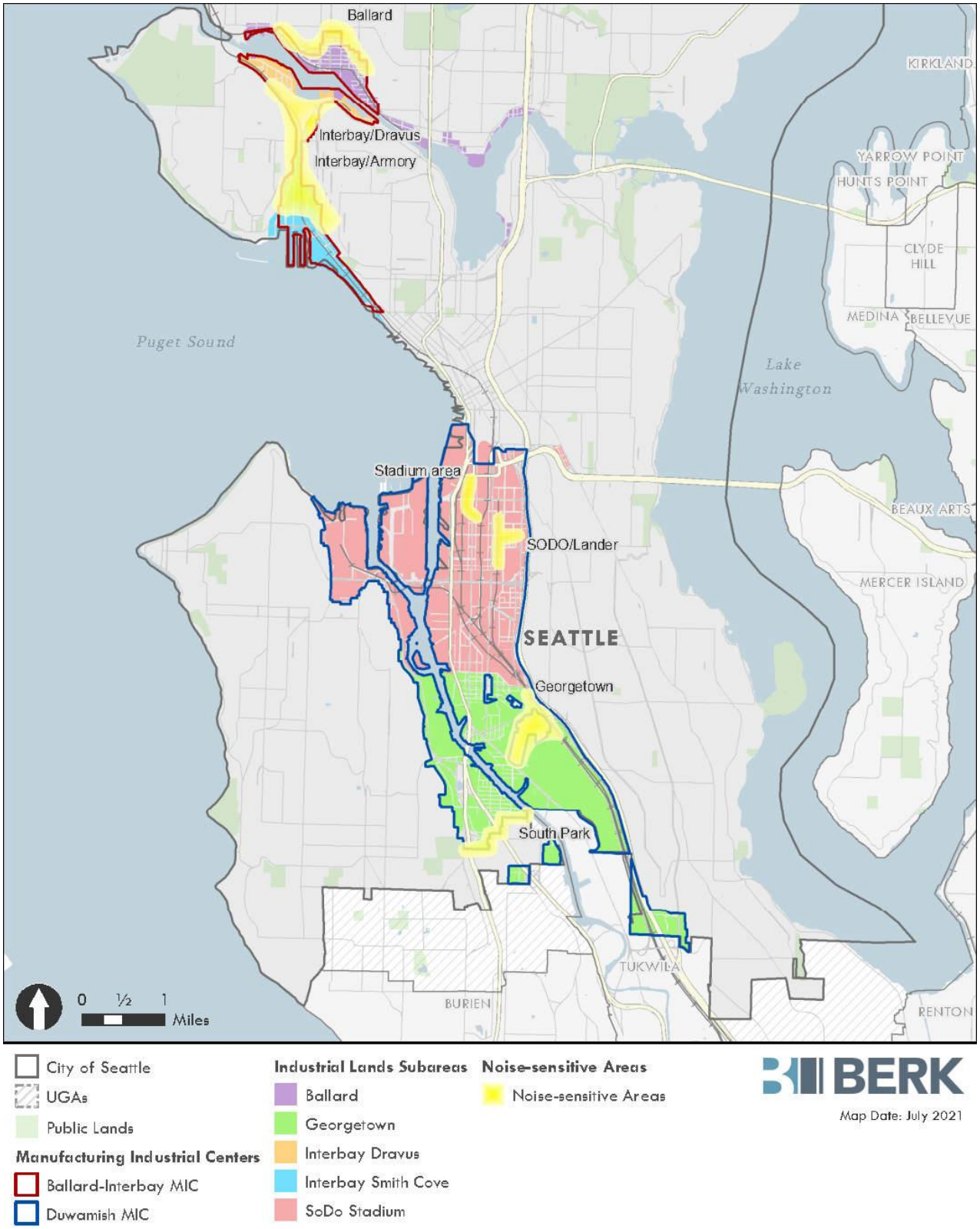
Noise-Sensitive Receptors

Noise-sensitive land uses are generally defined as locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Noise-sensitive land uses typically include residences, hospitals, schools, transient lodging, libraries, and certain types of recreational uses such as parks. Noise-sensitive residential receivers are found adjacent to many of the MIC areas. Residential areas of the Georgetown neighborhood occur within and surrounded by industrial land uses of the Greater Duwamish MIC.

Exhibit 3.6-9 shows the locations of the noise sensitive areas used in the analysis. The locations were selected because they are associated with areas of future land uses under one or more of the alternatives under consideration during Scoping, and would include a higher density of office workers, live/work uses, or in some cases, mixed-uses that may support residential and open space areas.

1. Ballard: 5007 14th Avenue Northwest. This site is also close to the future Sound Transit light rail station.
2. Interbay/Dravus: 3425 16th Avenue West. This is also close to a future Sound Transit light rail station, a BNSF rail yard, and facilities.
3. Interbay/Armory site: 1561 W Armory Way. This is a site that is close to the BNSF rail yard.
4. Stadium area: 1730 1st Avenue South
5. Georgetown: 5707 Airport Way South
6. South Park 1: 8620 16th Avenue South. An area close to the King County airport
7. SODO/Lander: 2437 6th Avenue South. An existing light rail station.
8. South Park 2: 8100 8th Avenue South. An area in proximity to SR 99 and SR 509.

Exhibit 3.6-9 Location of Potential Noise Sensitive Areas



Source: Herrera, 2021.

3.6.2 Impacts

Impacts Common to All Alternatives

Ballard

Noise Sensitive Receivers

In the Ballard Subarea portion of the BINMIC, existing sensitive receivers potentially impacted by noise include residences and schools primarily adjacent to the north and east sides of the Ballard Subarea but also at scattered locations within the subarea.

Recreation sites and facilities in and adjacent to this subarea include: a boat ramp, wading pool, outdoor sports courts, play areas, sports fields, the Burke-Gilman multi-use trail, and Fremont Canal Park. As urban recreation facilities they are only moderately noise sensitive, and the likeliest adverse impacts would result from noise from nearby construction activities.

Construction

Construction activities associated with development or redevelopment of industrial, commercial, and residential land uses would result in temporary, localized increases in noise that could affect nearby sensitive receivers.

Construction activities most likely to lead to increased noise involve excavation and related site preparation, and construction of foundation and building structure and exterior. These activities typically involve the use of heavy on-site equipment. Construction is also typically associated with a temporary increase in truck traffic as material is brought to and from the construction site. As indicated earlier in this section construction activities typically generate noise levels of 75–100 dB (Lmax at 50 feet) with noise from heavy demolition and pile driving operations typically having the highest noise production.

As described earlier in this section, the City's Noise Control regulations (SMC 25.08) would serve to limit noise impacts from construction by restricting the times when construction activity can exceed standard noise limitations.

Vibration is a distinct noise-related effect resulting from some construction activities, such as pile-driving, that can adversely affect the integrity of nearby structures and cause annoyance to nearby residents and other sensitive receptors. The City has not adopted quantitative standards limiting vibration. Potential vibration impacts, where anticipated, would be assessed in project-specific environmental review documents.

Noise from Stationary Operations

Industrial activities include manufacturing plants, marine shipping facilities, and other heavy and general industrial facilities and other stationary activities and land uses that generate noise. These facilities could use outdoor loading docks and outdoor material storage areas that, unless properly designed and controlled, could also generate of noise in the surrounding community. Noise generated by these sources varies widely and are often periodic but can exceed 80 dBA close to the source for some activities (**Exhibit 3.6-5**) and can be a substantial contributor to localized levels of noise. Depending on location, new residential uses within the Ballard Subarea could experience noise impacts from stationary industrial operations. Such uses would be subject to the noise limits of SMC Chapter 25.08.

Traffic Noise

Under all alternatives, traffic volumes on roads in and near the Ballard Subarea are expected to increase due to expected development and associated population increase in the overall Seattle area. Roadways in the study area are expected to experience a relatively high volume of light and heavy trucks. **Exhibit 3.6-10** shows PM peak hour volumes for all alternatives at roadways adjacent to monitoring locations.

Exhibit 3.6-10 PM Peak Hour Traffic Volumes for Existing Conditions and All Alternatives

Geographic Area	Adjacent Model Roadway	PM Peak Hour Volume											
		2019 Existing		2042 No Action		2044 Alt. 2		2044 Alt. 3		2044 Alt. 4		2044 Pref. Alt.	
		NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
Ballard	14th Ave NW	110	110	110	100	110	100	140	130	160	160	130	120
Interbay/Dravus	W Dravus St	1,180	1,220	1,150	1,210	1,240	1,230	1,390	1,260	1,410	1,260	1,290	1,240
Interbay/Armory	15th Ave NW	1,610	1,210	1,670	1,280	1,690	1,280	1,670	1,270	1,680	1,270	1,680	1,280
Stadium	1st Ave S	1,140	2,230	970	2,230	1,000	2,220	1,020	2,180	1,020	2,170	1,000	2,190
Georgetown	Airport Way S	510	1,580	760	1,590	780	1,600	820	1,620	830	1,650	810	1,600
South Park 1	14th Ave S	470	1,140	610	1,160	620	1,210	680	1,280	690	1,240	620	1,190
SODO/Lander	6th Ave S	250	320	230	720	230	720	230	700	250	720	240	720
South Park 2	8th Ave S	280	350	290	340	310	350	310	360	300	340	310	350

Source: Fehr and Peers, 2022~~1~~.

These increased volumes would lead to very slight increases in roadway noise, if any. **Exhibit 3.6-11** shows estimated increases in modeled total noise exposure for all geographic areas for existing conditions, no action, and alternatives at the locations shown in **Exhibit 3.6-8**, above.

Exhibit 3.6-11 Increase in dBA Over Existing Conditions, All Alternatives

Geographic Area	Existing 24-Hour Day-Night Ldn	Increase in dBA—PM Peak Hour Volume									
		2042 No Action		2044 Alt. 2		2044 Alt. 3		2044 Alt. 4		2044 Pref. Alt.	
		NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
Ballard	62.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0
Interbay/Dravus	59	0.0	0.0	1.0	0.0	2.0	0.0	2.0	0.0	1.0	0.0
Interbay/Armory	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stadium	69	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Georgetown	68.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Park 1	60.5	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
SODO/Lander	67.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Park 2	59.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Fehr and Peers, 2022~~1~~; Herrera, 2022~~1~~.

Anticipated increases in traffic within the Ballard Subarea would be insufficient (less than 3 dBA) to generate noticeable increases in roadway noise compared to the existing condition. In addition, over the next several decades technology of vehicles, both car and truck, is likely to reduce average vehicle noise. The result of expected limited increases coupled with likely technology changes would be that existing noise-sensitive land uses adjacent to the Ballard Subarea are unlikely to be adversely affected under any of the alternatives. Roadway noise could, however, adversely impact residents of new residential development anticipated within the subarea, especially under alternatives 3 and 4 if the new residential development occurs adjacent to major arterials.

Land Use Compatibility

Land use compatibility issues can arise when noise-sensitive uses, especially residences, are located near to industrial activities or heavily travelled roadways that generate high levels of noise. A common exterior noise standard for residences is 65 Ldn noise level, because exterior noise at that level can be reduced to an interior level of 45 dBA Ldn (the accepted maximum interior noise level for residential uses) using standard construction techniques. In the Ballard Subarea, land use compatibility impacts contributed to by subarea noise could occur in residential areas adjacent to the periphery of the subarea or in new residential and associated uses anticipated to be developed in the northern portion of the subarea (**Exhibit 3.6-9**).

Interbay Dravus

Noise Sensitive Receivers

In the vicinity of the Interbay Dravus Subarea, existing sensitive receivers potentially impacted by noise include residences and schools located primarily on the flanking hillsides to the east and west of the subarea, but also including multi-family residences and outdoor recreation facilities on the valley floor adjacent to the subarea boundary.

Recreation sites and facilities in and adjacent to this subarea include: Interbay Athletic Fields and Interbay Golf Course and the Ship Canal multi-use trail. As urban recreation facilities they are only moderately noise sensitive, and the likeliest adverse impacts would result from noise from nearby construction activities.

Construction

Construction noise impacts would be similar to those described for the Ballard Subarea. However, much of this subarea is underlain by fill, and special foundation construction (for example, over-excavation, pile-driving) may be necessary for some development leading to comparatively greater levels and/or durations of some construction noise.

Noise from Stationary Operations

Noise impacts from stationary sources would be similar to those described for the Ballard Subarea. However, historically, rail operations at the Balmer Yard (previously the Interbay Yard) have generated noticeable periodic noise. Depending on location, new residential uses within the Interbay Dravus Subarea could experience noise impacts from stationary industrial operations.

Traffic Noise

In the Interbay Dravus Subarea, impacts from traffic noise would be similar to those described for the Ballard Subarea.

Land Use Compatibility

Land use compatibility issues in the Interbay Dravus Subarea would be similar to those described for the Ballard Subarea. In the Interbay Dravus Subarea, land use compatibility impacts could occur in residential areas adjacent to the periphery of the subarea or in new residential and associated uses anticipated to be developed within the subarea (**Exhibit 3.6-9**).

Interbay Smith Cove

Noise Sensitive Receivers

In the vicinity of the Interbay Smith Cove Subarea, existing sensitive receivers potentially impacted by noise include residences and schools located primarily on the flanking hillsides to the east and west of the subarea, but also including multi-family residences and outdoor recreation facilities on the valley floor adjacent to the subarea boundary.

Recreation sites and facilities in and adjacent to this subarea include: sports fields, the Elliott Bay multi-use trail, and Smith Cove and Elliott Bay parks. As urban recreation facilities they are only moderately noise sensitive, and the likeliest adverse impacts would result from noise from nearby construction activities.

Construction

Construction noise impacts would be similar to those described for the Ballard Subarea. However, much of this subarea is underlain by fill, and special foundation construction (for example, over-excavation, pile-driving) may be necessary for some development leading to comparatively greater levels and/or durations of some construction noise.

Noise from Stationary Operations

Noise impacts from stationary sources would be similar to those described for the Ballard Subarea. However, historically, rail operations at the Balmer Yard (previously the Interbay Yard) have generated noticeable periodic noise. Depending on location, new residential uses within the Interbay Smith Cove Subarea could experience noise impacts from stationary industrial operations.

Traffic Noise

In the Interbay Smith Cove Subarea, impacts from traffic noise would be similar to those described for the Ballard Subarea.

Land Use Compatibility

Land use compatibility issues in the Interbay Smith Cove Subarea would be similar to those described for the Ballard Subarea. In the Interbay Smith Cove Subarea, land use compatibility impacts could occur in residential areas adjacent to the periphery of the subarea or in new residential and associated uses anticipated to be developed within the subarea (**Exhibit 3.6-9**)

SODO/Stadium

Noise Sensitive Receivers

In the SODO/Stadium Subarea portion of the Greater Duwamish MIC, existing sensitive receivers potentially impacted by noise include residences just west of the subarea in West Seattle and residences adjacent to the north periphery of the subarea. The noise environment of the primarily residential Beacon Hill area east of the subarea is dominated by noise from Interstate-5, and this area is unlikely to be affected substantially by noise from subarea development.

Recreation sites and facilities in and adjacent to this subarea include: a community center, the West Seattle Bridge and Duwamish River multi-use trails, and the West Duwamish Greenbelt and Puget Park adjacent to the west side of the subarea. As urban recreation facilities they are only moderately noise sensitive, and the likeliest adverse impacts would result from noise from nearby construction activities.

Construction

Construction noise impacts would be similar to those described for the Ballard Subarea. As in the Interbay subarea, much of the SODO/Stadium Subarea is underlain by fill, and special foundation construction (for example, over-excavation, pile-driving) may be necessary for some development resulting in comparatively greater levels and/or durations of some construction noise.

Noise from Stationary Operations

In the SODO/Stadium Subarea, noise impacts from stationary sources would be similar to those described for the Ballard Subarea. Rail operations at the Argo Yard in the southeast portion of the subarea periodically generate high frequency and impulsive noise. Depending on location, new residential uses within SODO/Stadium Subarea could experience noise impacts from stationary industrial operations.

Traffic Noise

In the SODO/Stadium Subarea, impacts from traffic noise would be similar to those described for the Ballard Subarea.

Land Use Compatibility

Land use compatibility issues in the SODO/Stadium Subarea would be similar to those described for the Ballard Subarea. In the SODO/Stadium Subarea, land use compatibility impacts could occur in residential areas adjacent to the periphery of the subarea or in new residential and associated uses anticipated to be developed primarily in the vicinities of the stadiums and the SODO light rail station (**Exhibit 3.6-9**). Noise monitoring at locations within the subarea suggests that much of the subarea currently experiences noise levels above 65

dBA (Ldn) and new residential and associated noise sensitive development could be significantly adversely impacted by noise.

Georgetown/South Park

Noise Sensitive Receivers

In the Georgetown/South Park Subarea, existing sensitive receivers potentially impacted by noise include residences just west of the subarea in Delridge. The noise environment of the primarily residential Beacon Hill area east of the subarea is dominated by noise from Interstate-5 and Boeing Field (**Exhibit 3.6-4**), and this area is unlikely to be affected substantially by noise from subarea development.

Recreation sites and facilities in and adjacent to this subarea include: a hand launch site on the Duwamish River, a wading pool, a community center, outdoor sports courts, play areas, the Duwamish River and S Henderson Street multi-use trails, and the Duwamish Greenbelt and Puget Park adjacent to the west side of the subarea and Westcrest Park on the southeast. As urban recreation facilities they are only moderately noise sensitive, and the likeliest adverse impacts would result from noise from nearby construction activities.

Construction

Construction noise impacts would be similar to those described for the Ballard Subarea. Portions of the Georgetown/South Park Subarea are underlain by fill, and special foundation construction (for example, over-excavation, pile-driving) may be necessary for some development resulting in comparatively greater levels and/or durations of some construction noise.

Noise from Stationary Operations

In the Georgetown/South Park Subarea, noise impacts from stationary sources would be similar to those described for the Ballard Subarea. Depending on location, new residential uses within the Georgetown/South Park Subarea could experience noise impacts from stationary industrial operations.

Traffic and Aircraft Noise

In the Georgetown/South Park Subarea, impacts from traffic noise would be similar to those described for the Ballard Subarea. As shown in **Exhibit 3.6-4**, parts of the Georgetown portion of the subarea are within the Boeing Field Noise Exposure area. Areas of proposed Urban Industrial land within Georgetown lie within the exposure area, and new residential uses could experience relatively high levels of aircraft noise.

Land Use Compatibility

Land use compatibility issues in the Georgetown/South Park Subarea would be similar to those described for the Ballard Subarea. In the Georgetown/South Park Subarea, land use compatibility impacts could occur in residential areas adjacent to the periphery of the subarea or in new residential and associated uses anticipated to be developed primarily northwest of the north end of Boeing Field and in South Park (**Exhibit 3.6-9**). Noise monitoring at locations within the subarea suggests that the area northwest of Boeing Field may currently experience noise levels at or above 65 dBA (Ldn) and new residential and associated noise sensitive development in that area could be significantly adversely impacted by noise.

Other Industrial Zoned Lands

Other industrial lands include areas within the Ballard Subarea, but outside of the BINMIC, along the north side of the Ship Canal from the east end of the Ballard Subarea to about the Interstate-5 bridge and a confined area along the southeast shore of Lake Union. Also, other industrial lands include two small areas within the SODO/Stadium neighborhoods, but outside of the Greater Duwamish MIC, located north and east of the north end of SODO/Stadium Subarea. The other industrial lands in the Ballard Subarea are adjacent to residential areas to the north and east and noise impacts would be similar to those described for Ballard Subarea and unlikely to be significant. The other industrial lands within the SODO/Stadium Subarea are located adjacent to primarily commercial land uses which would not be noise sensitive and adverse noise impacts would be minimal.

Recreation sites and facilities in and adjacent to these other industrial lands include Gasworks Park at the north end of Lake Union. This is an urban recreation facility that is only moderately noise sensitive, and the likeliest adverse impact would result from noise from nearby construction activities.

Equity & Environmental Justice Considerations

Construction and increased activity under any of the alternatives has the potential to exacerbate residents' and workers' exposure to increased noise. Within the study area, the City has identified the SODO/Stadium and Georgetown/South Park subareas as having a Higher Disadvantage ranking in its Racial and Social Equity Index (City of Seattle 2017), and noise impacts to residents in those subareas may disproportionately affect low-income and minority communities.

Actual noise exposure is highly dependent on location, and in developing zoning boundaries to implement the selected industrial and maritime strategy, limiting proximity of new residential and associated development to high noise sources would limit exposure to excessive noise. In addition, noise reduction measures can be mandated for construction activities and adequate noise reduction measures also mandated for new residential construction, irrespective of market value, in high noise environments within industrial areas. These measures are addressed below under **Section 3.6.3**.

Impacts of Alternative 1 No Action

Based primarily on the expected increase in employment over the planning period, which is the lowest among the alternatives, the amount of construction and extent of new development would be less than other alternatives. Noise from stationary sources, which is typically dominated by heavy industrial exterior operations, would probably not increase substantially. As discussed above, expected traffic increases (see **Exhibit 3.6-10**) would be insufficient (less than 3dBA) to be noticeable (see **Exhibit 3.6-11**). Construction noise could adversely impact nearby locations, but impacts would be temporary and limited by the City's timing restrictions on construction activities. Overall, noise impacts should not be significant.

Impacts of Alternative 2

Based on the expected increase in employment and traffic over the planning period, noise increases would be similar to Alternative 1 in most locations, with minor increases in the Interbay Dravus Subarea; and similar to the other alternatives in most locations, but with less increase than Alternative 4 in the Interbay Dravus Subarea.

Impacts of Alternative 3

Based on the expected increase in employment and traffic over the planning period, noise increases would be similar to alternatives 1 and 2 in most locations, but slightly greater in the Interbay Dravus Subarea and portions of South Park; and similar to Alternative 4 but less than portions of South Park. Alternative 3 would include an expansion of housing allowances, which would expose new residents to potential noise impacts that could be significant without mitigation. Locations of new housing where residents would be particularly susceptible to adverse noise impacts include locations in proximity to one or more of the following: Interstate-5, active heavy or light rail lines, Boeing Field and its approach paths, and major activity centers. Locations having these characteristics occur in Interbay (heavy rail and future light rail); Stadium (Interstate-5, heavy and light rail, major activity center); SODO (Interstate-5, heavy and light rail); and Georgetown (Interstate-5, heavy rail, Boeing Field). In Georgetown, where the triangular area bounded by Corson Avenue S, Carleton Avenue S, and I-5 would be removed from the MIC and placed into a mixed-use zone and in the areas to be designated as Urban Industrial, existing or new residents may experience greater noise impacts resulting from nearby industrial and transportation activities, including the WSDOT Corson facility on Corson Avenue S. Some of these locations experience high existing ambient noise levels (Leq) up to about 69 dBA (**Exhibit 3.6-7** Permissible EDNA levels are 60 dBA for residential receivers and up to 70 dBA for industrial receivers (SMC 25.08.410). However, some noise sources, for example rail and plane noise, are periodic and/or infrequent, and their contribution to hourly or daily noise metrics may not capture the extent to which their noise adversely affects noise-sensitive receptors.

Impacts of Alternative 4

Based on the expected increase in employment and traffic over the planning period, noise increases would be greater than alternatives 1 and 2 in the Ballard and Interbay Dravus subareas and less than some portions of South Park, but similar at all other locations. Alternative 4 would be similar to Alternative 3 in most locations, but greater in the Ballard Subarea and in Georgetown where the triangular area bounded by Corson Avenue S, Carleton Avenue S, and I-5 would be removed from the MIC and placed into a mixed-use zone and in the areas to be designated as Urban Industrial. Alternative 4 impacts would likely be ~~and~~ less than Alternative 3 impacts in portions of South Park. Alternative 4 would include the largest expansion of housing allowances among the alternatives, which would expose the greatest number of new residents to potential noise impacts, the nature of which is discussed above under Alternative 3.

Impacts of the Preferred Alternative

Based on the expected increase in employment and traffic over the planning period, noise increases overall would be similar or slightly greater than alternatives 1 and 2, and lower than alternatives 3 and 4. This pattern holds true for all locations, except SODO/Stadium and South Park and Georgetown where employment growth would be less than alternatives 2, 3, and 4 but still greater than Alternative 1 No Action. With the more concentrated amount of new housing in two new areas outside the MICs to mixed use zoning in west Ballard and Judkins Park, more housing would result with the Preferred Alternative compared to the Draft EIS alternatives in those locations, though total increases in industry supported housing and mixed use housing are below Alternative 4. However, because new housing would be targeted to reduce conflicts with existing and proposed industrial uses, noise impacts for these residents under the Preferred Alternative are expected to be less than alternatives 3 and 4. The Preferred Alternative would also remove focused land from the MIC in Georgetown and South Park as with the other alternatives, but also alter the zoning approach for the proposed mixed use zone in central Georgetown, and include more UI zoning around Georgetown. As a result, existing or new residents in these areas under the Preferred Alternative would likely experience less noise impacts resulting from nearby industrial and transportation activities, including the WSDOT Corson facility on Corson Avenue S, than under alternatives 3 and 4.

3.6.3 Mitigation Measures

Incorporated Plan Features

The recommendations of the Industrial and Maritime Strategy include the following features that relate to noise attenuation:

- Inclusion of circulation routes for non-motorized travel would reduce motorized traffic and associated noise.

- Incentivizing the use of transit and discouraging the use of single-occupancy vehicles would reduce overall traffic volumes and associated noise.
- Inclusion of green open spaces within Urban Industrial and Industry and Innovation districts would create greater separation between uses and decrease exterior noise levels.

Regulations & Commitments

City noise regulations establish exterior sound level limits for various land use zones with the limits varying depending on the source zone and the receiving zone (**Exhibit 3.6-2**). These limits are intended to result in acceptably low interior noise levels for residences and other sensitive noise receptors. City noise regulations also address construction noise, limiting the times during the day when construction noise, both impact and non-impact, can exceed exterior noise limits (**Exhibit 3.6-3**).

Other Potential Mitigation Measures

Zoning land use criteria or boundaries could be established, while meeting other planning goals, to limit the proximity of new residential development to known or anticipated sources of high noise levels.

To limit the impacts of temporary construction noise, in addition to restrictions on the hours of construction other mitigation that could be applied includes:

- installing barriers to shield noise sensitive receptors and enclosing stationary work
- selecting haul routes to avoid noise sensitive areas
- using alternative methods to pile-driving (e.g., hydraulic or vibration pile insertion or auguring/drilling holes for piles)
- using fully baffled compressors, or preferably electric compressors
- using fully mufflered construction equipment

Under alternatives 3 and 4 and the Preferred Alternative, which would allow the development of new residential, the City could impose greater noise reduction standards in residential buildings where exterior noise levels greater than 65 dBA are likely to occur or where other uses occupying the same structure would likely contribute to excessive noise levels (above 45 dBA) within residences. These standards could include:

- installation of acoustically rated windows and doors that include high quality elastomeric caulking, multiple sashes, multiple panes, increased glass thickness, and increased airspace between glass panes
- installation of additional wall and attic/roof insulation
- installation of dampers and baffles on exterior vents, flues, and chimneys

Noise from tire-pavement interactions is the dominant contributor to roadway noise. A long-term mitigation program to reduce noise in noise-sensitive areas within the study area would

be to install noise reducing pavement on major arterials and roadways that experience relatively high traffic volumes and speeds.

The City and partner agencies could also improve coordination and improve the user experience for community members registering complaints or requesting information about enforcement related to noise from sites or businesses.

3.6.4 Significant Unavoidable Adverse Impacts

Under the studied alternatives, increased employment growth could result in increased traffic volumes, though the resulting noise increases are not anticipated to exceed 3dBA, the threshold of change that is perceptible. The location of noise sensitive receivers like residential uses near industrial or traffic noise sources could occur under all alternatives, particularly alternatives 3 and 4 and the Preferred Alternative. Implementation of residential noise mitigation described in the preceding subsection should adequately reduce noise experienced by noise sensitive receivers. With the application of mitigation measures described above, no significant unavoidable adverse noise impacts would occur under any of the alternatives.