WSDOT

SR 520 Bridge Replacement and HOV Program

SR 520/I-5 Express Lanes Connection Project

City of Seattle Major Public Project Construction Noise Variance Application SR 520/I-5 Express Lanes Connection Project

Prepared for

Washington State Department of Transportation

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Acronyms and Abbreviations

ANSI	American National Standards Institute
dB	Decibels
dBA	A-weighted decibels
HOV	High-occupancy vehicle
Hz	Hertz
INM	Independent Noise Monitor
L_1	Sound level exceeded for 1 percent of the measurement duration (i.e., 36 seconds per hour)
L_{eq}	Equivalent sound level
L_{max}	Maximum noise level
MPPCNV	Major Public Project Construction Noise Variance
NMMP	Noise Management and Mitigation Plan
RCW	Code of Washington
SDCI	Seattle Department of Construction and Inspections
SMC	Seattle Municipal Code
SR	State Route
WABS	West Approach Bridge South
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

Introduction

The Washington State Department of Transportation (WSDOT) is submitting this application to the Seattle Department of Construction and Inspections (SDCI) to request a Major Public Project Construction Noise Variance (MPPCNV) for the SR 520/I-5 Express Lanes Connection Project (SR 520/I-5 Project) per the Noise Control Ordinance (Seattle Municipal Code, Chapter 25.08 [SMC 25.08]) and City of Seattle's Director's Rule 3-2009. This noise variance will cover activities occurring as part of the SR 520 SR 520/I-5 Project.

The main elements of the project include:

- A new, reversible transit/HOV ramp between SR 520 and the I-5 express lanes
- Restriped I-5 express lanes that retain the four existing lanes while adding a reversible transit/HOV lane between the I-5 / SR 520 interchange and Mercer Street
- A modified, reversible ramp between the I-5 express lanes and Mercer Street

WSDOT requests a three-year nighttime noise variance for the proposed SR 520/I-5 Project to allow necessary construction work activities to occur during nighttime hours (between 10 p.m. and 7 a.m. on weekdays and between 10 p.m. and. 9 a.m. on weekends and legal holidays). As part of the MPPCNV for the SR 520/I-5 Project, this application proposes nighttime construction noise limits for noise-sensitive receivers near construction sites.

WSDOT requests an MPPCNV pursuant to SMC 25.08.590 (Granting of Variance) and SMC 25.08.655 (MPPCNV) to allow construction noise generated on site to exceed the sound level limit as specified in SMC 25.08.410 and as modified by 25.08.420 and 25.08.425.

Completion of all construction activities during only daytime hours would be unreasonable in light of public and worker safety. It would require multiple significant closures of SR 520 and I-5, which would result in:

- Extensive delays to the traveling public.
- Increased traffic volumes on city streets and nearby highways.
- A potential increase in the number of accidents in the project work zone.

Completion of all construction activities during only daytime hours would substantially extend the construction period and increase the economic cost to taxpayers. Increased direct project costs are estimated to be between $2.6 and $9.4 million. Added indirect costs (associated with daytime traffic impacts) to the delivery of people, goods and services in the region are estimated to result in an economic impact to the region between $90 and $280 million.

Key Takeaway

Limiting construction activities to daytime only hours would result in:

- $2.6 to $9.4 million in increased project costs
- between $90 and $280 million dollars in regional economic impact

WSDOT has developed expected construction activities and an estimated schedule for the SR 520/I-5 Project. The analysis demonstrates that means and methods are available to meet the noise limits requested in this noise variance application and noise management and mitigation plan. Construction activities and equipment used may not be specifically identical but are likely to be similar to those identified by WSDOT in the Proposed Construction Activities section.

This noise variance application includes the following:

- A Noise Management and Mitigation Plan to demonstrate that means and methods are available to meet the proposed noise limits.
- A description of the proposed construction activities and staging areas including a description of the noisiest proposed activities.
- Existing baseline sound levels at noise-sensitive land uses within the project areas.
- Proposed sound-level limits for nighttime construction activities that would be unreasonable to limit to daytime construction in light of public and worker safety or render the project economically or functionally unreasonable.
- Calculated sound levels that may be expected at noise-sensitive land uses during the noisiest nighttime construction activities.
- Proposed noise-mitigation measures.
- Provisions for compliance tracking and actions taken to resolve public complaints.

WSDOT is working with SDCI to meet the 90-day permit processing timeline for WSDOT projects on a state highway as outlined in Revised Code of Washington (RCW) 47.01.485. The legislative intent behind this law is to expand the opportunities for streamlining the delivery of essential transportation projects while maintaining natural resource protection. This requirement became effective when Governor Inslee signed 2ESSB 5994 into law on July 6, 2015. The following section was added to RCW 47.01.485:

> *(1) To the greatest extent practicable, a city, town, code city, or county must make a final determination on all permits required for a project on a state highway as defined in RCW 46.04.560 no later than 90 days after the department (WSDOT) submits a complete permit application for a project with an estimated cost of less than $500 million.*

This project would meet the requirements of RCW 47.01.485 as it would cost less than $500 million.

Project Descriptions and Proposed Construction Activities

SR 520/I-5 Project Overview and Project Site Description

For the next SR 520 program phase, WSDOT is proposing new transit and HOV features in connecting to the I-5 express lanes. The main elements of the project include:

- A new, reversible transit/HOV ramp between SR 520 and the I-5 express lanes
- Restriped I-5 express lanes that retain the four existing lanes while adding a reversible transit/HOV lane between the I-5 / SR 520 interchange and Mercer Street
- A modified, reversible ramp between the I-5 express lanes and Mercer Street

The reversible transit and HOV ramps will initially open to transit only until the new Portage Bay Bridge is completed.

The new Mercer Street transit and HOV ramp connection would eliminate the need for transit and HOV northbound traffic from Mercer Street to weave across four lanes of traffic to access SR 520. Currently, the existing northbound on-ramp from Mercer Street operates only during peak PM hours and enters the I-5 express lanes on the right (or east) side. Northbound traffic from Mercer Street trying to access SR 520 would have to weave through four lanes of traffic to access the left (or west) side off-ramp to SR 520. The new reversible ramp from Mercer Street would eliminate this weave for HOV and transit traffic by accessing I-5 from the left (or west) side. Northbound transit traffic could then access the ramp to SR 520 (which exits the I-5 express lanes on the left [or west] side) without having to weave through four lanes of traffic.

The addition of the features above will allow for direct HOV access and transit service from SR 520 to South Lake Union, which has grown to be an important business and high-tech district for the region. The Mercer Street ramp would have a reversible lane control system with swing gates. It would be illuminated with overhead lights and have signage alerting drivers about the status of the ramp.

In addition to the creation of the dedicated lane and the reversible HOV/transit ramp to/from Mercer Street to the I-5 express lanes, WSDOT has also made the following features along I-5:

- *Stormwater Treatment.* The work along I-5 would disturb surfaces in multiple threshold discharge areas (TDAs). The treatment swale would be located in the I-5 and SR 520 interchange, in the landscaped median between the I-5 Southbound Lanes and the Reversible Express Lanes. Discharge from this swale would be into Lake Union through a closed stormwater system that discharges through an existing outfall pipe at the western terminus of East Allison Street.
- *Retaining Walls.* The retaining walls required for the reversible ramp from I-5 to SR 520 were previously analyzed in the FEIS. However, two of the walls would be constructed about 2 feet higher than previously analyzed. At the newly-proposed Mercer Street ramp, new retaining walls would be required, which would be an extension of the existing walls to accommodate the new ramp.
- *Sign Structure.* A new cantilever sign structure would be constructed and span the I-5 to SR 520 reversible ramp. The sign gantry would communicate to drivers whether the lanes are open to traffic with a red x (to indicate that traffic is currently closed in that direction) or a green arrow (to indicate that traffic is open in that direction).

The proposed design refinements to allow for the construction of the auxiliary lane and transit connection from Mercer Street would shift the limits of construction previously considered in the 2011 FEIS to the south along I-5 to the Mercer/I-5 interchange. Construction of these design elements is expected to last approximately 2.5 to 3 years.

The area of potential nighttime construction work for the SR 520/I-5 Project is shown in Exhibit 1 and includes WSDOT-owned property under I-5 near the Ship Canal Bridge for staging equipment and materials for the project. Construction of this phase of the I-5 to Lake Washington Project (one of the "Rest of the West" projects) is scheduled to begin in 2020. More detailed maps are included in Attachment 2.

Land uses and zoning classifications are residential, commercial and industrial near the project area (Exhibit 2).

EXHIBIT 1. SR 520/I-5 PROJECT AREA

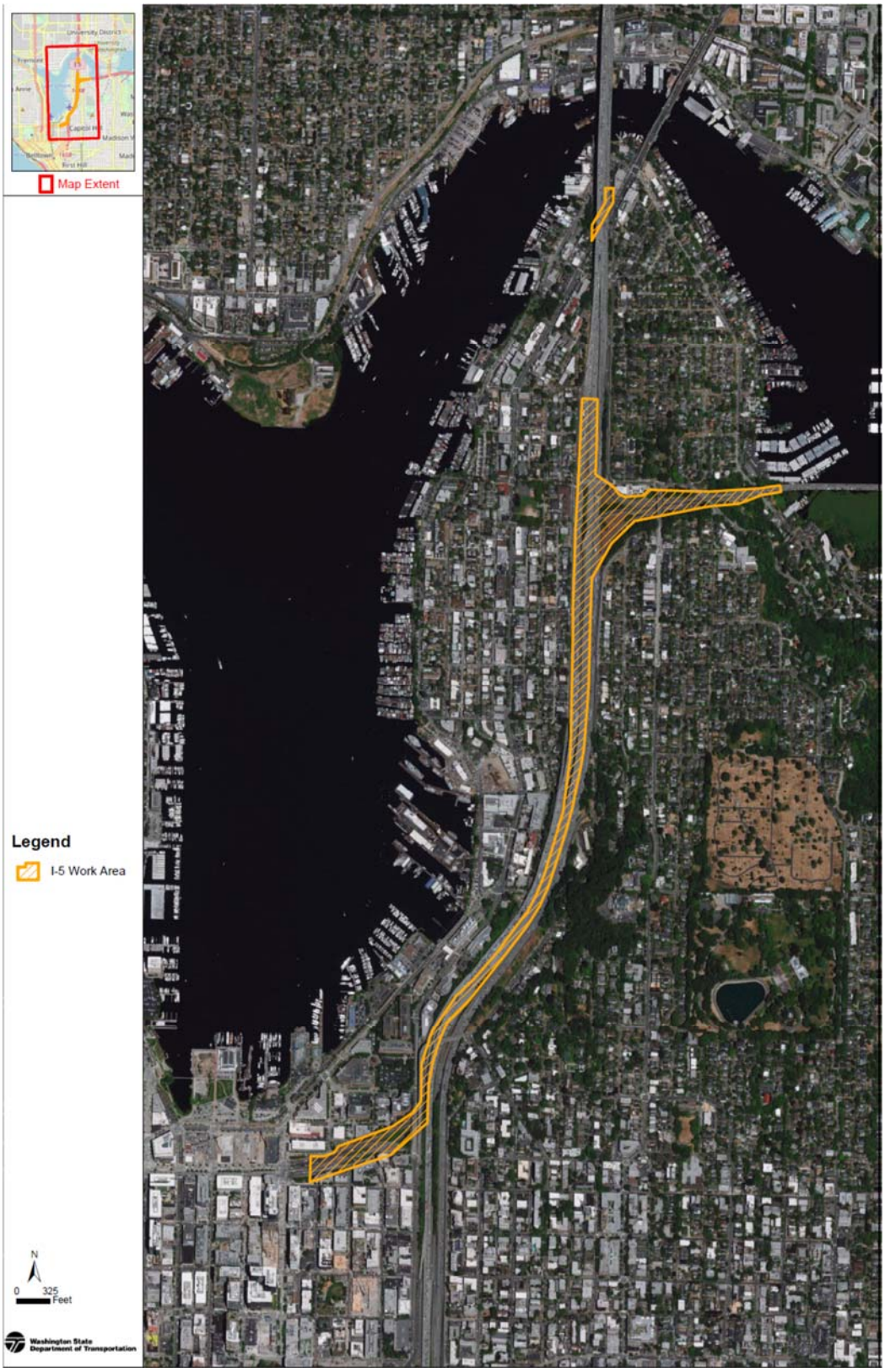
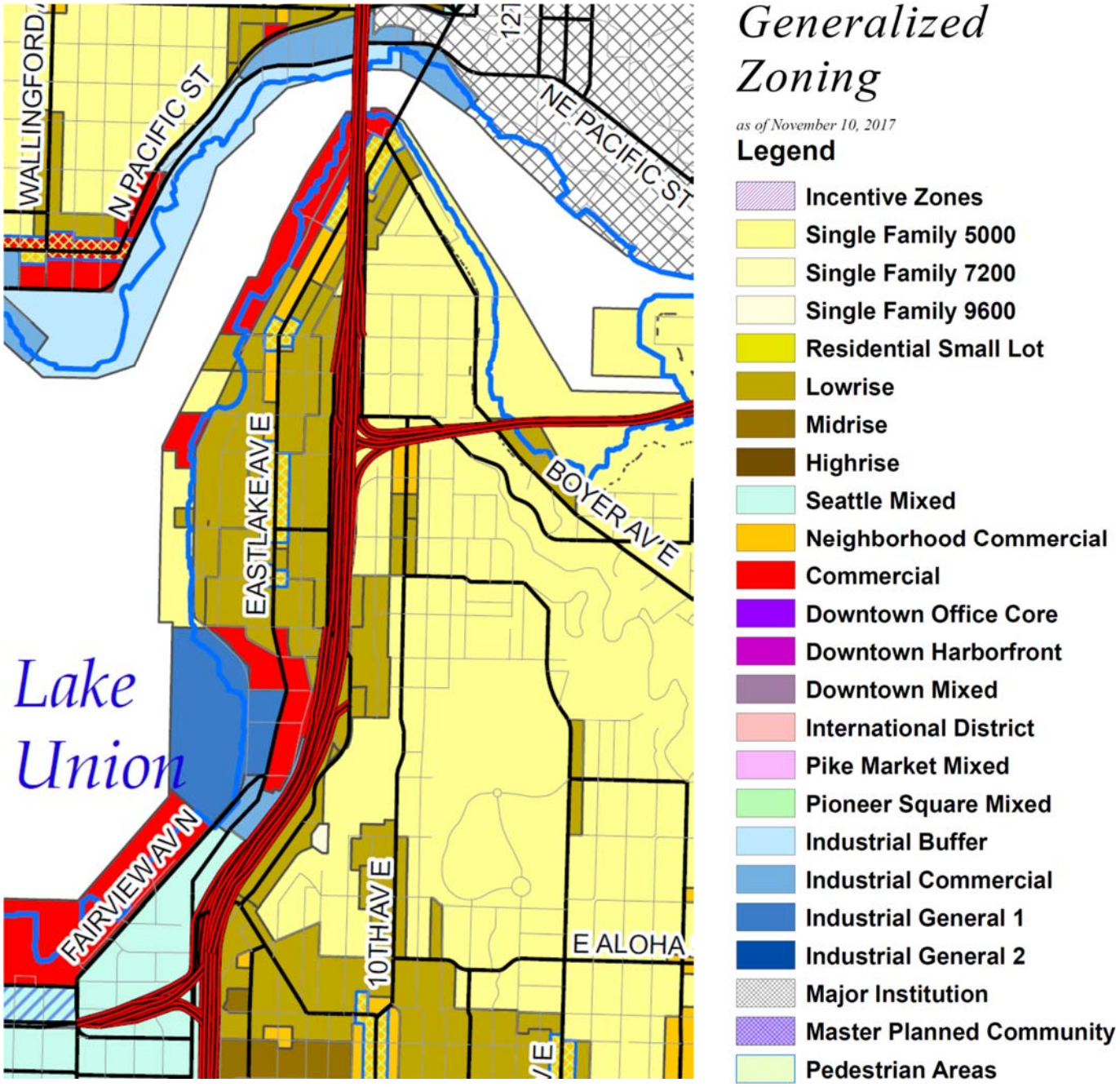


EXHIBIT 2. ZONING



Expected Construction Activities

The proposed SR 520/I-5 Project major construction phases and current estimated durations are as follows:

- Reversible transit/HOV ramp structure between SR 520 and the I-5 Express Lanes (spring/summer 2020 through winter/spring 2022)
  - Create access and work space
  - Shaft construction
  - Column-pier cap construction
  - Install shoring
  - Structural steel girder erection
  - Falsedeck, diaphragms, bridge deck, barrier and approach slab construction
- Retaining wall along westbound SR 520 to northbound I-5 (spring/summer 2020 through winter/spring 2022)
  - Retaining wall construction
- Mercer Street ramp configuration (fall/winter 2020 through spring/summer 2021)
  - Ramp configuration
- I-5 Express Lanes stormwater retrofit and lane reconfiguration (spring 2021 through spring 2022)
- Final lighting, signing and striping (spring 2022 to fall 2022)

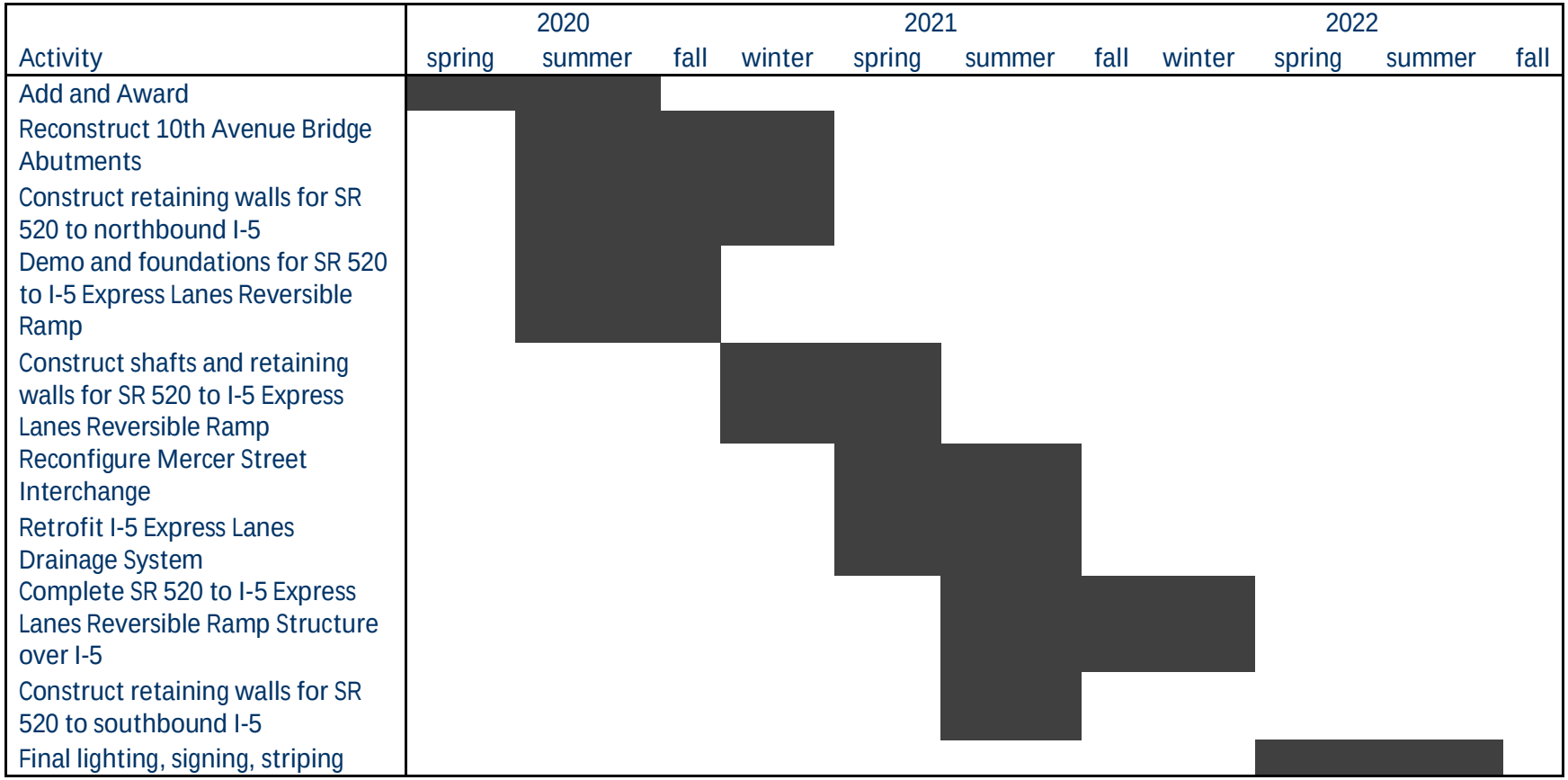
Expected nighttime construction activities, that require a noise variance, are part of some or all of the phases described above. WSDOT has developed an expected schedule in Exhibit 3. The contractor will update the list of equipment and the order and timing of activities in the updated NMMP as necessary and discussed in the section titled “Noise Management and Mitigation Plan” of this report. All construction activities noted are not expected to occur continuously on all nights for consecutive weeks and it is likely that there will be breaks in the activities.

The following are construction activities and equipment that is anticipated to be used during nighttime construction:

- Excavation, embankment and paving (dozer, excavator, trucks, grader, vibratory rollers, asphalt roller, drill rig)
- Install sheet piles/shoring (vibratory hammer, crawler crane, welder, diesel generator)
- Concrete sawing and concrete breaking (excavator with crusher, excavators with impact hammer, compressors, dump trucks, loader, debris trucks, excavators with thumb)
- Non-impact casing installation, either oscillator or vibrated casing and excavation of soil (crawler crane, welder, drill rig, vibratory hammer, concrete trucks, concrete pumps, trucks)
- Place forms, rebar and concrete (hydraulic crane, crawler crane, concrete pump, compressors, trucks, concrete trucks)
- Paving, signing, and striping (roller, concrete truck, delivery truck, dump truck, loader, street sweeper, sign and stripe trucks)

A staging area on WSDOT-owned property under I-5 near the Ship Canal Bridge for staging equipment and materials for the project.

EXHIBIT 3. ESTIMATED SCHEDULE OF SR 520/I-5 PROJECT NIGHTTIME CONSTRUCTION ACTIVITIES



All construction activities noted in Exhibit 3 are not expected to occur continuously on all nights for consecutive weeks and it is likely that there will be breaks in the activities. The SR 520/I-5 Project contractor will update the nighttime activities schedule as necessary in the updated Nighttime Management and Mitigation Plan.

SDOT Compliance with City of Seattle Criteria for a Major Public Project Construction Noise Variance

Definition of Major Public Project

SMC 25.08.168: The Definition of a Major Public Project

SMC 25.08.168 defines "major public project" as follows:

> *"Major public project" means a project for a public facility as defined in SMC Title 23, the construction of which the Administrator determines is likely to be of at least six months duration, and is likely to have a substantial impact on the public safety, health and welfare and the provision of public services, including transportation services. In making this determination the Administrator shall consider factors such as the expected size, complexity or cost of the proposed construction or reconstruction; the expected duration of the proposed construction or reconstruction; the magnitude of the expected impacts on traffic and transportation; and/or the degree of impact on the provision of public services during the proposed construction or reconstruction.*

This section contains a detailed description of how this application meets the criteria for granting a MPPCNV.

SMC 23.84A.030 "P": The Definition of Public Facility

SMC 23.84A.030 "P" defines "public facility" as follows:

> *"Public facility" means a public project or city facility.*

The proposed SR 520/I-5 Project of the SR 520 Bridge Replacement and HOV Program is a "major public project" as defined in SMC 25.08.168 and is a "public facility" as defined in SMC 23.84.030. SR 520 plays a major role in sustaining the region's economy and maintaining the ability to travel between Seattle and the Eastside. The SR 520 Bridge Replacement and HOV Program is making major enhancements to this vital urban highway. The program is improving traffic safety by replacing SR 520's aging and vulnerable bridges, while making other key highway improvements to enhance public mobility and transportation options throughout the corridor.

Work on the SR 520/I-5 Project is scheduled to commence in early 2020 with work substantially complete in fall 2022. The length of the variance requested is three years to complete substantial construction activities and allow for schedule contingency.

Criteria for Granting a Noise Variance

SMC 25.08.590.C: The Criteria for Granting a Noise Variance

SMC 25.08.590.C states:

> *A. The Administrator may grant a variance if the Administrator finds that:*
>
> *1. The noise occurring or proposed to occur does not endanger public health or safety; and*
>
> *2. The applicant demonstrates that the criteria required for the variance are met.*

This noise variance application proposes nighttime construction noise limits for noise-sensitive receivers in proximity to construction areas. In keeping with previous SDCI-granted noise variances, WSDOT proposes a 6 dBA (A-weighted decibels) increase over existing hourly averaged noise levels measured between the quietest nighttime hours of 12 a.m. to 5 a.m., at periods when no substantial nearby nighttime construction activities were underway. The proposed descriptors and noise limits for the SR 520/I-5 Project are based on WSDOT and SDCI noise variance coordination efforts, which started in 2019, and a review of other SDCI decisions on MPPCNV applications for transportation agencies such as WSDOT, Sound Transit and the Seattle Department of Transportation. Prior variances have been granted an increase of hourly average noise level limits ranging from 6 dBA up to 15 dBA over measured existing baseline noise levels.

Key Takeaway

Consistent with other SDCI-granted variances, WSDOT proposes a 6 dBA increase over existing hourly averaged noise levels measured between the quietest nighttime hours of 12 a.m. to 5 a.m.

SDCI decisions on prior noise variances range from granting an increase of 6 dBA up to 15 dBA over existing baseline noise levels (measured 12 a.m. to 5 a.m.).

Criteria for a Major Public Project Construction Noise Variance

SMC 25.08.655.A: The Criteria for an MPPCNV

The criteria for an MPPCNV are stated in SMC 25.08.655.A as follows:

> *A. The Administrator may grant a major public project construction variance to provide relief from the exterior sound level limits established by this chapter during the construction periods of major public projects. A major public project construction variance shall provide relief from the exterior sound level limits during the construction or reconstruction of a major public project only to the extent the applicant demonstrates that compliance with the levels would:*
>
> *1. Be unreasonable in light of public or worker safety or cause the applicant to violate other applicable regulations, including but not limited to regulations that reduce impacts on transportation infrastructure or natural resources; or*
>
> *2. Render the project economically or functionally unreasonable due to factors such as the financial cost of compliance or the impact of complying for the duration of the construction or reconstruction of the major public project.*

How Does This Project Meet the Criteria for an MPPCNV?

Limiting SR 520/I-5 Project construction to daytime hours would be unreasonable in light of public and worker safety and would render the project economically and functionally unreasonable. Many work activities for this project cannot be completed over or adjacent to active traffic because they are too risky or dangerous to perform adjacent to or over traffic. Some activities require construction work zones to be closed off from traffic. Work zones requiring closure to live traffic will need either closures of all lanes, directional closures, or single lane closures of SR 520, I-5 and ramps during work hours to safely complete the work. These closures cannot occur during daytime due to high-traffic volumes.

Anticipated impacts of limiting construction to daytime hours

In preparation for submitting a noise variance application for the SR 520/I-5 Project, WSDOT analyzed the feasibility of conducting the construction work activities during daytime-hours only. The analysis

indicated that a restriction of construction activities to daytime hours only would result in several key factors which would render the project unreasonable in light of public and worker safety, and economically and functionally unreasonable. Below is a summary of the anticipated impacts of daytime-only construction for the SR 520/I-5 Project.

Work zone safety

WSDOT evaluated the impact of daytime and nighttime hours on public and worker safety in construction work zones. A 2010 Federal Highway Administration evaluation of work zone safety reports that the highest numbers of work zone accidents occur on urban freeways and during daytime hours, when traffic volumes are greater (*What We Know about Work Zone Fatalities*, FHWA, 2010).

Key Takeaway
The highest numbers of work zone accidents occur on urban freeways and during daytime hours, when traffic volumes are greater.

Additionally, this study found an increase in collisions considered to be more dangerous within work zones, than outside of work zones. Examples include:

- An increase in rear-end collisions associated with congestion and traffic queues within work zones.
- Work zone collisions involving larger vehicles occur at about twice the rate as in general highway collisions due to the greater number of construction vehicles present.

WSDOT reviewed the 2008 National Cooperative Highway Research Program's evaluation of nighttime and daytime work zone safety. Limited data from the report indicates that the collision rate in work zones (number of collisions per million miles traveled) is over 60 percent greater than outside of work zones (page 30, NCHRP Report 627, 2008).

Restricting SR 520/I-5 Project work to daytime hours, when traffic volumes are high, is anticipated to result in a significant increase in the expected number of collisions in and around the work zones.

Traffic operations

I-5 Mainline and Express Lanes

The I-5 mainline carries approximately 200,000 vehicles per weekday (over the Ship Canal Bridge) with most of this volume occurring between 7 a.m. and 7 p.m. The corridor operates with congestion during a significant portion of the day.

The I-5 express lanes/reversible lanes carry another 55,000 vehicles per day. The express lanes operate in the peak travel directions, which allows the overall I-5 corridor to increase the carrying capacity through the peak commutes. The I-5 express lanes operate southbound in the morning (5 to 11 a.m.) and northbound in the afternoon (11:15 a.m. to 11 p.m.). The express lanes are closed from 11 p.m. to 5 a.m. due to low use and to minimize noise at homes adjacent to the corridor.

Daytime lane closures or full closures for construction work would require this volume of traffic to use other routes. There are limited alternative north-south routes in the area (i.e. Montlake Boulevard, Aurora Avenue, or University Bridge). These alternative routes are congested as well during peak travel times.

I-5 mainline and express lanes are critical transit and freight routes. Transit uses both the mainline and express lanes to serve regional transit trips to and from downtown Seattle. I-5 is a T-1 truck freight corridor and impacts or closures that increase congestion, will also decrease the reliability and increase the cost of both the movement of persons via transit and goods via freight.

Economic considerations

WSDOT evaluated the economic effects of requiring all construction activities of the SR 520/I-5 Project to daytime hours that would otherwise exceed nighttime property-line noise limits. This restriction would affect the schedule and cost of constructing the project and have a substantial economic impact on the traveling public because of the significance of SR 520 and I-5 on the regional transportation network and local economy.

Expected SR 520/I-5 Project construction schedule and costs

WSDOT completed a schedule analysis on the effect of shifting all activities that will require total lane or directional closures from nighttime to daytime hours. This includes roadway, wall and bridge construction, and demolition operations.

Overall, limiting construction to daytime hours would have an estimated delay to project completion of approximately one year. WSDOT's analysis estimated the increased direct contract cost, as a result of limiting construction to daytime only, to WSDOT and Washington taxpayers between $2.6 and $9.4 million. This estimated increase in direct project costs accounts for the anticipated one-year extension of construction that would result in restricting construction to daytime hours.

Regional costs

The societal economic impacts to the region result in a greater financial impact than the estimated direct, project costs. Daytime closure of lanes and ramps on SR 520, the I-5 express lanes, and I-5 mainline lanes will cause delays to the traveling public, the delivery of goods and services, and hinder access by emergency vehicles.

WSDOT estimates the societal economic impact of lane closures for construction projects and captures them as Liquidated Damages (LD) in a contract to encourage contractors to maintain lane and ramp availability during peak travel periods. WSDOT may assess LDs for failure to have a lane, ramp, or roadway open to traffic, or an Intelligent Transportation System (ITS) fully operational by the specified time. The LD assessments are based on, and cannot exceed, the estimated cost to the traveling public incurred by the disruption.

WSDOT's Transportation Data, GIS, and Modeling Office (TDGMO) uses standardized methodology for calculating costs, based on roadway characteristics, hourly traffic data, and the specifics of the planned roadway or ITS disruption. To ensure uniformity, all LDs of this type for WSDOT projects statewide are calculated by engineers in the TDGMO. The methodology includes a software program called QUEWZ-98 for freeway lane closures, and specialized spreadsheet templates for various other work zone strategies. WSDOT's Budget & Financial Analysis Office is consulted annually for changes to the appropriate consumer index and their input is used to periodically update costs within the LDs templates and QUEWZ-98 program. WSDOT recently calculated LDs for I-5 for a separate project, the I-5 NB Seneca Street to SR 520 Mobility Improvements. The cost range was between $1,000 per hour for ramp closures and $20,000 per hour for I-5 express lane or mainline closures. A value of $8,000 per hour was used for each hour of single-lane closure on either the I-5 express lanes or mainline.

In total, the economic cost to the region of completing all project work during daytime hours only is estimated to be between $90 and $280 million dollars, depending on the actual required periods of facility closures, assuming the Liquidated Damages (LD) values used. The actual economic cost to the region of completing all project work during daytime hours is likely to be greater.

WSDOT Term of Proposed Variance

SMC 25.08.655.B: The Term of the Proposed Variance

SMC 25.08.655.B states:

> *B. A major public project construction variance shall set forth the period or periods during which the variance is effective, which period or periods shall be the minimum reasonably necessary in light of the standard set forth in subsection A, and the exterior sound level limits that will be in effect during the period of the variance.*

Requested Period the Variance is Effective

WSDOT requests that construction noise generated on the site be allowed to exceed the noise level limits set by Seattle Noise Control Ordinance, SMC 25.08.410, during nighttime hours (between 10 p.m. and 7 a.m. on weekdays and between 10 p.m. and. 9 a.m. on weekends and legal holidays).

The variance is requested for three years, which is the anticipated duration necessary to complete the major construction activities and allow for some flexibility for the schedule. Nighttime construction activities requiring a noise variance are expected to occur at various times throughout the project duration. Major construction is scheduled to begin in 2020, with an estimated completion date in 2022.

The contractor would be able to perform nighttime construction work if the work is performed within the SR 520/I-5 Project construction area as described below and covered by this MPPCNV or any temporary noise variances granted by SDCI. The MPPCNV is subject to review by SDCI after the first year of construction, as provided in SMC 25.08.655.D. Additional coordination with SDCI would continue throughout construction.

Construction Area and Exterior Nighttime Construction Noise-Level Limits

This noise variance application proposes nighttime construction noise limits for nighttime noise-sensitive receivers in proximity to the SR 520/I-5 Project construction area. Nighttime noise-sensitive receivers are generally properties where people are sleeping, such as a residence. The next section contains information on the characteristics of noise and sound.

The proposed descriptors and noise limits for the SR 520/I-5 Project are based on WSDOT and SDCI noise variance coordination efforts, which began in winter 2019, and a review of prior SDCI decisions on MPPCNV applications from transportation agencies such as WSDOT, Sound Transit and the Seattle Department of Transportation. In each of these cases, SDCI granted variances with an increase of average hourly noise level limits ranging from 6 dBA up to 15 dBA over measured existing baseline noise levels.

The SR 520/I-5 Project noise variance application proposes a 6 dBA increase over existing hourly average noise levels (L_{eq}) measured during the quietest part of the nighttime hours (the five-hour period from 12 a.m. to 5 a.m.) at monitors M1, M2, M4, M5 and M6 (see Exhibit 4). Monitor M3 is located directly over the I-5 lanes and will be used for monitoring purposes only. It is not representative of what residents in the area will hear with the noise variance and is not proposed to be used for nighttime noise level hourly L_{eq} limits. Noise level descriptors, such as Leq, are further defined in the Characteristics of Sound and Noise section of this application. Although these proposed noise level limits are based on measurements during only the quietest nighttime hours, the proposed limits would apply to the operation of construction equipment during all nighttime hours, from 10 p.m. to 7 a.m. on weekdays and 10 p.m.

and 9 a.m. on weekends and legal holidays. This noise variance application assumes that all equipment used for the project would meet the daytime noise level limits as described in Section 25.08.425 of the Seattle Municipal Code.

The monitoring methodology follows industry accepted practices. Continuous monitoring and recording of sound levels ranging in duration from 6 to 8 days was conducted at six sites (Exhibit 4), sites M1 to M6. Measurements were taken during March and April 2019 with calibrated Larson Davis Model 720 (Type 2) and 820 (Type 1) noise meters, which comply with American National Standards Institute S1.4 for instrument accuracy. All sound level monitoring equipment was calibrated before and after each measurement. In addition, the noise meters are calibrated annually by an accredited laboratory. Sound levels measured during the late-night hours (12 a.m. to 5 a.m.) provide the most conservative representation of the existing baseline condition. Noise measurement sites were selected based on their proximity to construction activities, with no obstructions between the monitoring location and the construction work area. Additional modeled only sites were also added to the model, sites A1 to A22, to calculate noise levels at other residential receivers.

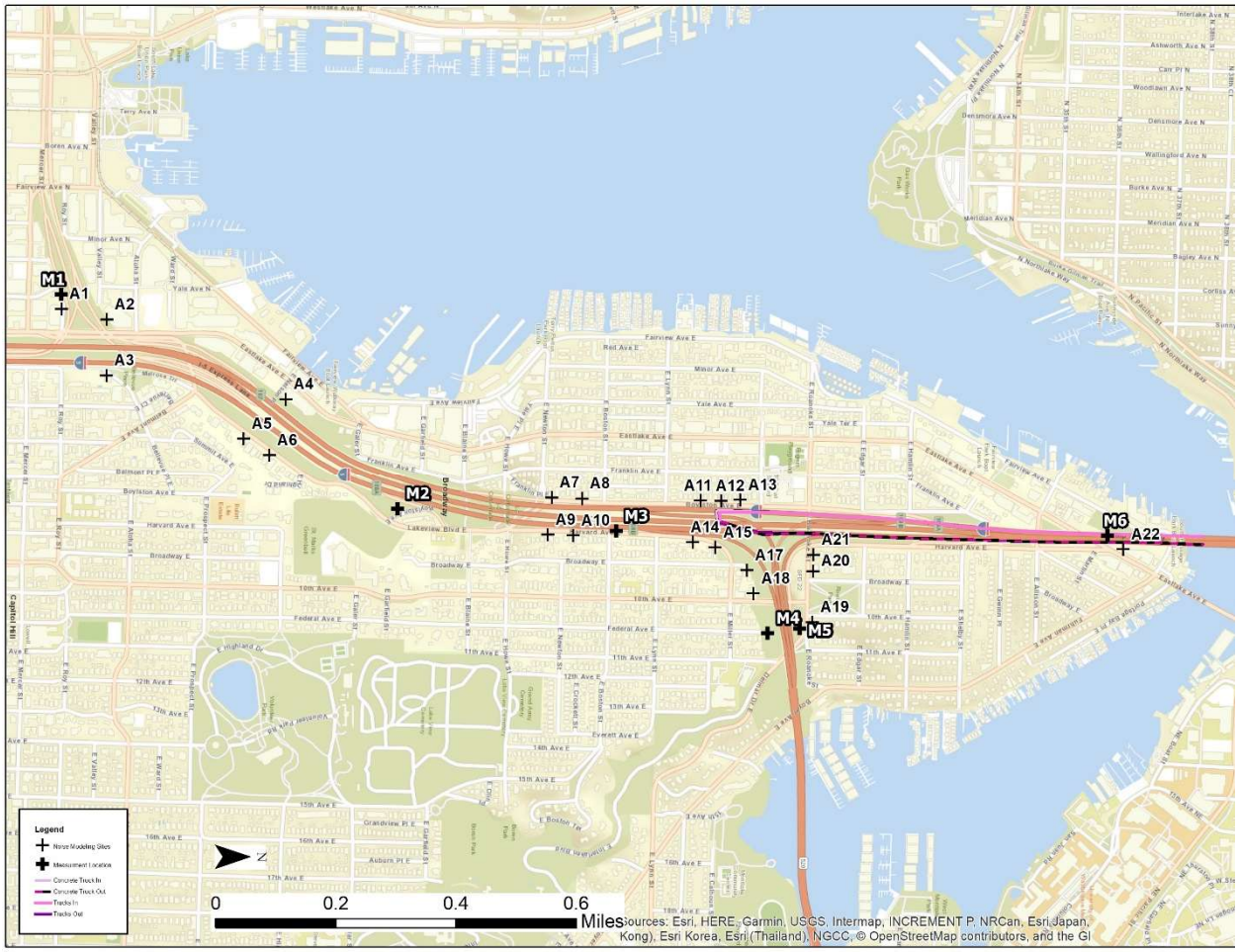
The measured existing nighttime sound levels at all monitoring locations exceed the City of Seattle nighttime noise control ordinance limits of 45 dBA (L_{eq}) for residentially zoned receivers. The existing sound levels, which are produced primarily by traffic on public roads, are not subject to the limits of the ordinance (SMC 25.08.410-425). The comparison is presented in Exhibit 5 as a baseline for evaluating potential noise impacts from proposed construction activities. Noise level descriptors are discussed in the next section titled “Characteristic of Sound and Noise”.

The noise variance application also proposes a highest 1 percent maximum noise level (L_1) limit above the nighttime L_{eq} to monitor potential short-term noises. Hourly percentile sound levels, Ln, are the sound levels exceeded for “n” percent of an hour. The measured L_1 is the sound level exceeded for 1 percent of the measurement duration (i.e., 36 seconds per hour). The proposed L_1 indicator levels are 10 dBA above the proposed L_{eq} noise level limits. The proposed L_1 indicator levels would be in the range of existing maximum (L_{max}) sound levels measured during the late-night hours of 12 a.m. to 5 a.m. in the construction area, see Exhibit 6. Noise level descriptors, such as L_1 and L_{max}, are further defined in the Characteristics of Sound and Noise section of this application.

In addition to the L_{eq}, this noise variance application proposes to monitor the measured hourly L_1 sound level at all monitoring locations, including M3, as an early indicator of potential non-compliance with the L_{eq} noise limits. The L_1 has been found to be more reliable than the L_{max}, as stated in Seattle City Light’s Denny Substation Program Noise Monitoring and Mitigation Plan, February 11, 2015:

> *For the purpose of monitoring construction sound levels, the hourly L_1 has been found to be more reliable than the hourly L_{max} in tracking compliance with MPPCNV limits. As with the L_{max}, the hourly L_1 provides a representative measure of the worst-case sound levels produced by a construction activity; unlike the L_{max}, the L_1 is not susceptible to distortion by one-time, atypical events such as a tool or load being dropped, and it is more representative of sound levels produced during higher-intensity construction activities each hour.*

EXHIBIT 4. CONSTRUCTION AREA AND NOISE MEASUREMENT AND MODELED LOCATIONS



Note: Measured sites are sites M1 to M6. Modeled only sites are sites A1 to A22.

EXHIBIT 5. MEASURED HOURLY AVERAGE BASELINE NOISE LEVELS AND PROPOSED EXTERIOR NIGHTTIME NOISE LEVEL LIMITS

Measured Site	Representative Residential Receivers - Additional Modeled Only Sites	Measured 12 to 5 AM Log Hourly Average L_{eq} (dBA)	Proposed Nighttime Noise Level Hourly Average Limit L_{eq} (dBA)
M1	A1 to A3	66	72
M2	A4 to A15	68	74
M3*	Not Applicable	81*	Not Applicable
M4	A17 and A18	64	70
M5	A19 to A21	65	71
M6	A22	60	66

Measured hourly average L_{eq} noise levels between 12 a.m. and 5 a.m. exceed the City of Seattle Noise Control Ordinance.
*M3 is located directly over the I-5 lanes and will be used for L_1 monitoring purposes only. It is not representative of what residents in the area would hear and is not proposed to be used for nighttime noise level hourly L_{eq} limits.

EXHIBIT 6. MEASURED L_{MAX} NOISE LEVELS AND PROPOSED L_1 EXTERIOR NIGHTTIME INDICATOR NOISE LEVELS

Site	Representative Residential Receivers Modeled Only Sites	Measured 12 to 5 AM L_{max} range (dBA)	Proposed Nighttime Indicator Noise Level Hourly L_1 (dBA)
M1	A1 to A3	76 to 103	82
M2	A4 to A15	74 to 90	84
M3*	Not Applicable	87 to 105	Monitoring Level next to freeway closest to construction activities: 97* Does not apply to residential receivers.
M4	A17 and A18	70 to 91	80
M5	A19 to A21	74 to 103	81
M6	A22	68 to 97	76

Measured L_{max} noise levels between 12 a.m. and 5 a.m. exceed the City of Seattle Noise Control Ordinance limits.
*M3 is located directly over the I-5 lanes and will be used for L_1 monitoring purposes only. Noise measurements at M3 will be used only to manage noise-generating work and it is not a location used to establish hourly L_{eq} limits established in Exhibit 5.

Public health and safety

SDCI's decision on the Sound Transit project at 6600 Roosevelt Way NE includes the following assessment of noise levels related to public health and safety:

> *It is generally accepted that very high levels of noise have adverse physical impacts on humans including, but not limited to, hearing damage. Many standards apply to occupational exposures at high levels for prolonged periods of time. For example, the Occupational Safety and Health Act (OSHA) mandates a hearing conservation program by employers if sound levels exceed 85 dBA continuously over an 8-hour workday. If sound levels exceed 90 dBA continuously over an 8-hour workday, hearing protection is required.*

The proposed nighttime noise level hourly average L_{eq} limits are all below 75 dBA as shown in Exhibit 5. The highest 1 percent maximum L_1 indicator level would be no greater than 85 dBA for all but site M3. Site M3 is located directly over the I-5 lanes and will be used for L_1 monitoring purposes and is not representative of what residents in the area would hear.

Although the 6 dBA increases requested in this variance, and the resulting noise levels, will likely be noticed by some residents, the noise levels would not cause a danger to public health or safety as construction noise levels would not exceed 85 dBA continuously at residences (OSHA hearing conservation program).

Characteristics of Sound and Noise

Definition of Sound

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure, called sound pressure. The human response to sound depends on the magnitude of a sound as a function of its frequency and time pattern. Magnitude is a measure of the physical sound energy in the air. The range of magnitude the ear can hear, from the faintest to the loudest sound, is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Loudness refers to how people subjectively judge a sound and varies between people.

Sound is measured using the logarithmic decibel scale, so doubling the number of noise sources, such as the number of cars on a roadway, increases noise levels by 3 dBA. Therefore, when you combine two noise sources emitting 60 dBA, the combined noise level is 63 dBA, not 120 dBA. The human ear can barely perceive a 3 dBA increase, while a 5 dBA increase is about one and one-half times as loud. A 10-dBA increase appears to be a doubling in noise level to most listeners. A tenfold increase in the number of noise sources will add 10 dBA.

In addition to magnitude, humans also respond to a sound's frequency or pitch. The human ear is very effective at perceiving frequencies between 1,000 and 5,000 hertz (Hz), with less efficiency outside this range. Environmental noise is composed of many frequencies. A-weighting (dBA) of sound levels is applied electronically by a sound level meter and combines the many frequencies into one sound level that simulates how an average person hears sounds of low to moderate magnitude.

The smallest "just noticeable" increase in sound is about 3 dBA. A 6 dBA increase is clearly noticeable, and a 10 dBA increase causes a doubling of judged loudness. For example, 80 dBA is judged to be twice as loud as 70 dBA and four times as loud as 60 dBA. Exhibit 7 summarizes how increases in perceived loudness correlate with sound level increases.

EXHIBIT 7. PERCEIVED LOUDNESS INCREASES

Sound Level Increase (dBA)	Perceived Loudness Increase
0 to 2	Not noticeable
3	Just noticeable
6	Noticeable
10	Twice as loud
20	Four times as loud

Definition of Noise

Noise is unwanted or unpleasant sound. Noise is a subjective term because, as described above, sound levels are perceived differently by different people. Magnitudes of typical noise levels are presented in Exhibit 8.

EXHIBIT 8. TYPICAL NOISE LEVELS

NOISE SOURCE OR ACTIVITY		SUBJECTIVE IMPRESSION	RELATIVE LOUDNESS (human judgment of different sound levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-horsepower siren (100 feet)	130		32 times as loud
Loud rock concert near stage Jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 feet)	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)*	90		2 times as loud
Garbage disposal (2 feet) **Pneumatic drill (50 feet)**	80	**Moderately loud**	**Reference loudness**
Vacuum cleaner (10 feet) Passenger car at 65 mph (25 feet)*	70		1/2 as loud
Typical office environment	60		1/4 as loud
Light auto traffic (100 feet)*	50	Quiet	1/8 as loud
Bedroom or quiet living room Bird calls	40		1/16 as loud
Quiet library, soft whisper (15 feet)	30	Very quiet	
High quality recording studio	20		
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	

Noise Level Descriptors

Because sound levels fluctuate over time, several A-weighted sound level descriptors are used to characterize the sound.

The L_{eq} is a measure of the average noise level during a specified period of time. A one-hour period, or hourly L_{eq}, is used to measure construction noise. L_{eq} is a measure of total noise during a time period that places more emphasis on occasional high noise levels that accompany general background noise levels. For example, if you have two different sounds, and one contains twice as much energy, but lasts only half as long as the other, the two would have the same L_{eq} noise levels.

Either the total noise energy or the highest instantaneous noise level can describe short-term noise levels. L_{max} is the maximum sound level that occurs during a single event and is related to impacts on speech interference and sleep disruption.

With Ln, "n" is the percent of time that a sound level is exceeded and is used to describe the range and pattern of sound levels experienced during the measurement period. For example, the L_1 level is the noise level that is exceeded 1 percent of the time. Sound varies in the environment and people will generally find a higher, but constant, sound level more tolerable than a quiet background level interrupted by higher sound level events. For example, steady traffic noise from a highway is normally less bothersome than occasional aircraft flyovers in an otherwise quiet area if both environments have the same L_{eq}.

City of Seattle Noise Control Ordinance

The City of Seattle limits noise levels at property lines of neighboring properties (Seattle Noise Control Ordinance, SMC 25.08.410). The sound level limit depends on the land uses of both the noise source and the receiving property (Exhibit 9). The SR 520/I-5 Project area and the surrounding properties are zoned residential, residential commercial, midrise, industrial, and commercial (Exhibit 2). The City's sound level limits apply to construction activities occurring between 10 p.m. and 7 a.m. on weekdays or 10 p.m. and 9 a.m. on weekends and legal holidays. Legal holidays are defined in SMC 25.08.155 as New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and the day after, and Christmas Day. Construction activities during nighttime hours that would exceed these levels require a noise variance from the City.

EXHIBIT 9. SEATTLE NOISE CONTROL ORDINANCE – EXTERIOR SOUND LEVEL LIMITS

District of Sound Source	District of Receiving Property			
	Residential Daytime L_{eq} (dBA)	Residential Nighttime L_{eq} (dBA)	Commercial L_{eq} (dBA)	Industrial L_{eq} (dBA)
Residential	55	45	57	60
Commercial	57	47	60	65
Industrial	60	50	65	70

Nighttime hours are 10 p.m. to 7 a.m. during weekdays and 10 p.m. to 9 a.m. during weekends and legal holidays
dBA = A-weighted decibels
L_{eq} = equivalent sound level
During a measurement interval, L_{max} may exceed the exterior sound level limits shown by no more than 15 dBA.

Exceptions to the Seattle Noise Control Ordinance

Daytime noise

Noise levels shown in Exhibit 9 may be exceeded by construction equipment between 7 a.m. and 10 p.m. on weekdays and between 9 a.m. and 10 p.m. on weekends and legal holidays. Threshold levels for equipment are listed below:

> *25 A-weighted decibels (dBA) for equipment on construction sites, including but not limited to, crawlers, tractors, dozers, rotary drills and augers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, trenchers, compactors, compressors, derrick barges, tug boats, and pneumatic-powered equipment*

Daytime construction activities are allowed to exceed the noise-level limits in the Seattle Noise Control Ordinance (SMC 25.08.425) by 25 dBA (Exhibit 9). These levels should be measured from the real property of another person or at a distance of 50 feet from the equipment, whichever is greater. Construction activities for the SR 520/I-5 Project would occur in residential, commercial, and industrial districts. The daytime construction activity associated with the SR 520/I-5 Project would be limited to 80 dBA (55 dBA + 25 dBA) in residential districts and 85 dBA (60 dBA + 25 dBA) in commercial districts.

Impact type noise

In addition, the Seattle Noise Control Ordinance (SMC 25.08.425) regulates sound created by impact types of construction equipment (e.g., pavement breakers, pile drivers, jackhammers, and sandblasting tools) or those that otherwise create impulse or impact noise (as measured at the property line or 50 feet from the equipment, whichever is greater). The equipment may exceed the sound level limits (equivalent sound level [L_{eq}] described in Exhibit 9) in any 1-hour period between 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends and legal holidays. The sound level is in no event to exceed the following:

- L_{eq} = 90 dBA continuously
- L_{eq} = 93 dBA for 30 minutes
- L_{eq} = 96 dBA for 15 minutes
- L_{eq} = 99 dBA for 7.5 minutes

Sound levels in excess of L_{eq} = 99 dBA are prohibited unless authorized by variance. The standard of measurement is a 1-hour L_{eq} measured for time periods not less than 1 minute to project an hourly L_{eq}.

Proposed Nighttime Noise Level Limits

Noise level limits (Exhibit 6) were established in the previous section, WSDOT Compliance with City of Seattle Criteria for a Major Public Project Construction Noise Variance. The SR 520/I-5 Project noise variance application proposes a 6 dBA increase over existing hourly average noise levels (L_{eq}) measured during the quietest part of the nighttime hours (the five-hour period from 12 a.m. to 5 a.m.).

Noise Management and Mitigation Plan

This section provides a summary of the Noise Management and Mitigation Plan (NMMP) in Attachment 1 and summarizes a noise analysis for the expected construction activities of the SR 520/I-5 Project of the SR 520 Bridge Replacement and HOV Program. This section was prepared according to the requirements of Section 25.08.655 of the Seattle Municipal Code and Director's Rule DR3-2009, both pertaining to Major Public Project Construction Noise Variances from the City of Seattle Noise Code.

WSDOT has developed expected construction activities and an estimated schedule for the SR 520/I-5 Project. The analysis in this NMMP section demonstrates that means and methods are available to meet the noise limits requested in this MPPCNV. The contractor will propose their own construction activities and schedule, and create a detailed NMMP to meet the commitments WSDOT has made in this noise variance application and the MPPCNV issued by SDCI. Construction activities and equipment used may not be specifically identical but are likely to be similar to those identified by WSDOT.

Expected Noisiest Nighttime Construction Periods

Projected nighttime major construction L_{eq} and L_1 noise levels were modeled for selected noise-sensitive receivers using SoundPLAN Version 7.4, a sophisticated three-dimensional graphics-oriented program for outdoor noise propagation. SoundPLAN calculates the L_{eq} by averaging the use of each individual piece of equipment and evenly distributes the activity over an hour. SoundPLAN calculates the L_1 using the loudest 1 percent same hour as used to calculate the L_{eq}. The L_1 results from SoundPLAN are an additional 10 dBA over the L_{eq}, which is a conservative high level estimate for the L_1. For nighttime construction noise estimates, the noisiest nighttime construction activity that would occur at the surface of each construction site and the noisiest equipment during this activity was assumed.

The noisiest major construction activities were modeled to provide a conservative estimate of noise levels. A variety of construction activities are anticipated to occur within the footprint of the SR 520/I-5 Project, potentially using the equipment outlined in Exhibit 10. Construction noise includes truck operations within the construction site and not on haul routes. Haul routes are not regulated under the Seattle Noise Control Ordinance and therefore are not included in this application.

Major construction activities that are expected to be the loudest during the project were modeled for five construction periods to estimate the anticipated highest nighttime construction noise levels.

Construction may not occur on all nights, and construction during other phases of work would generate less noise than those selected for noise modeling. The modeled levels represent the loudest nighttime construction activities that are anticipated over the construction period.

Key Takeaway

WSDOT conducted noise modeling of the loudest expected construction activities to provide a conservative estimate of nighttime noise levels.

As a result, the modeled levels represent the loudest nights that are anticipated over the construction period.

Construction may not occur on all nights, and construction during some phases of work would generate less noise than those selected for noise modeling.

EXHIBIT 10. NIGHTTIME CONSTRUCTION EQUIPMENT TYPICAL NOISE LEVELS

Equipment Type	Typical Noise Level (dBA) at 50 Feet
Asphalt roller	80
Bulldozer	82
Compressor without mitigation	81
Compressor with mitigation	71
Concrete pump	82
Concrete truck	88
Crawler crane	83
Delivery truck	88
Diesel generator	81
Drill rig	83
Dump or Debris truck	88
Excavator with crusher	96
Excavator with thumb	96
Forklift	80
Grader	85
Hydraulic crane	88
Loader	85
Street sweeper	80
Vactor Trucks	85
Vibratory roller	80
Vibratory pile installer	96
Welder	82

Source: August 2006 FHWA Construction Noise Handbook, Section 9: https://www.fhwa.dot.gov/Environment/noise/construction_noise/handbook/

The construction equipment listed in Exhibit 10 is not expected to be used all together at the same time, or on all nights. The measurements are also taken at only 50 feet from the noise source, which is much closer than residences would be to the noise. The noise levels for the five expected loudest construction periods are described in the following subsections. The construction noise modeling includes activities in staging areas that is anticipated to occur during nighttime hours for each of the evaluated construction periods. Each subsection lists the number and type of construction equipment modeled to estimate the expected highest nighttime construction noise levels. Construction during other phases of work would generate less noise than those selected for noise modeling. While other phases of work would occur at other locations within the Project Area (Exhibit 1), they would be required to meet the Proposed Nighttime Noise Level Limits at nearby residences and they would generate similar or less noise than the modeled phases of work. In addition to monitoring stations, the Independent Noise Monitor (INM) will monitor and enforce the requirements of this variance at residences near all nighttime construction activities.

WSDOT Noise Modeling Summary

SR 520/I-5 Project – Create Access and Work Space Impact Activities

Modeled nighttime exterior noise levels for the creation of access and work space are shown in Exhibit 11. The model included the construction to create access and work space and includes some limited demolition work, including impact work. These activities are expected to last 25 nights at the 10th Avenue Abutment, 5 nights at the Mercer Ramp and 15 nights in the I-5 Express lanes. These activities are expected to occur on non-consecutive nights. Equipment used for each activity was estimated to include two excavators with crusher, two excavators with impact hammers, three compressors, five dump trucks, 15 debris trucks, excavator with thumb, and a loader. Staging area activities are also included near site M6. Noise levels would be at or below the L_{eq} noise level limit (Exhibit 12). No nighttime L_{eq} exceedances are expected in this phase of construction, as modeled.

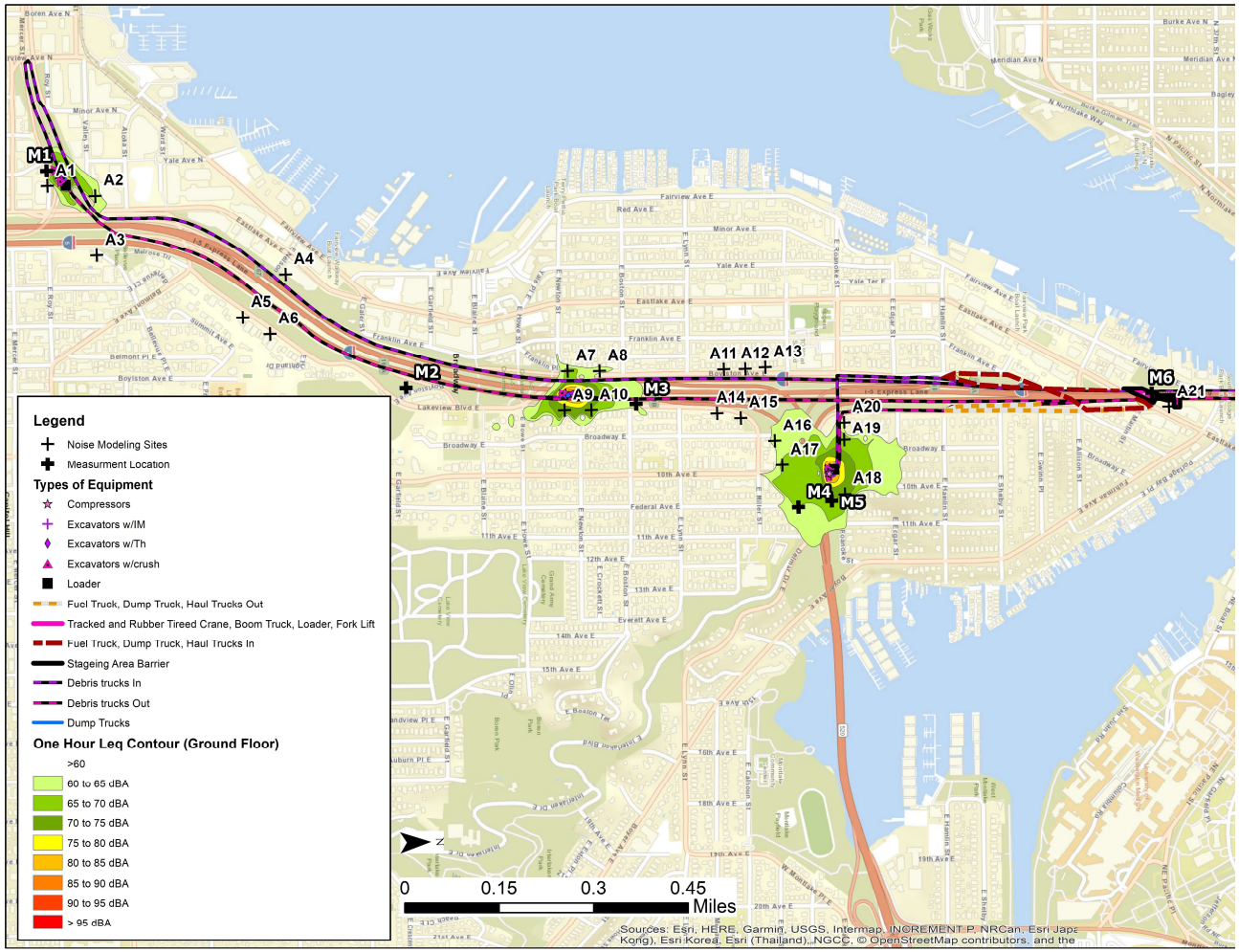
EXHIBIT 11. EXTERIOR NIGHTTIME ACCESS AND WORK SPACE NOISE LEVELS

Site	L_{eq} Modeled Noise Level (dBA)	L_{eq} Proposed Noise Level Limit (dBA)	L_1 Modeled Noise Levels (dBA)	L_1 Proposed Indicator Noise Level (dBA)
M1	53	72	63	82
A1 fourth floor (Loudest site near Mercer Ramp)	71	72	81	82
M2	51	74	61	84
M3	60	Not Applicable	70	97*
A9 (Loudest site near I-5 Express Lanes)	73	74	83	84
M4	65	70	75	80
M5	69	71	79	81
A19 (Loudest site near 10th Avenue Abutment)	71	71	81	81
M6	64	66	74	76

Note: Noise levels are hourly averages.
*M3 is located directly over the I-5 lanes and will be used for L_1 monitoring purposes only. It is not representative of what residents in the area would hear and is not proposed to be used for nighttime noise level hourly L_{eq} limits.

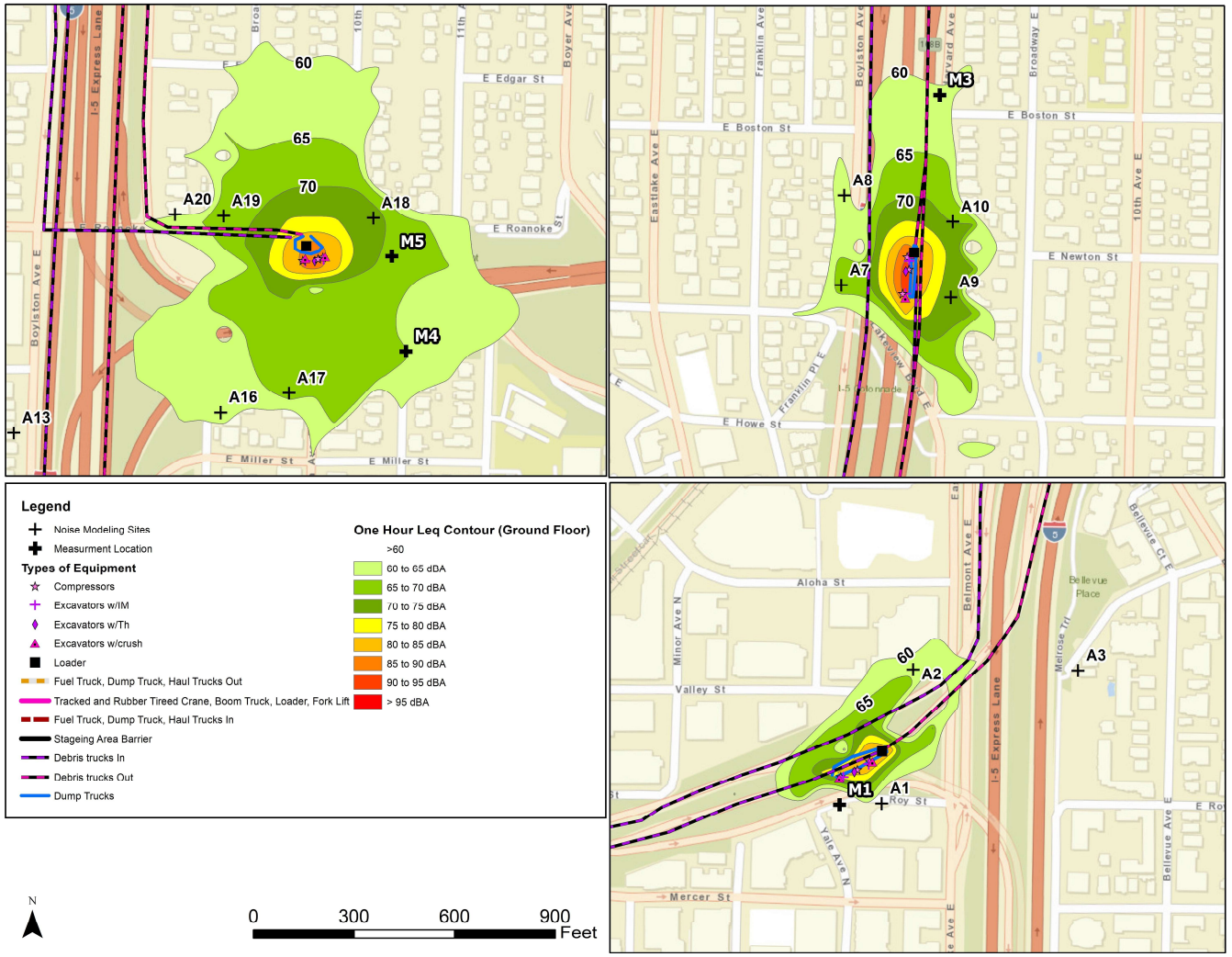
Exhibit 12 shows the noise level contours for the "Create Access and Work Space" stage of the project. Modeled equipment locations were selected to represent noise levels when equipment is located nearest noise-sensitive receivers.

EXHIBIT 12. CREATE ACCESS AND WORK SPACE



Nighttime modeled noise levels during construction of access and workspace would meet the proposed noise level limits at all residential locations.

EXHIBIT 13. CREATE ACCESS AND WORK SPACE ZOOMED



SR 520/I-5 Project – Retaining Walls Demolition Impact Activities

Modeled nighttime exterior noise levels for the demolition and replacement of existing retaining walls at the westbound SR 520 northbound I-5 on ramps are shown in Exhibit 14. The model included the construction to new retaining walls, including impact work. This activity is expected to last 72 non-consecutive nights and include excavation, demolition of the walls and installation of lagging. Equipment used for this activity was estimated to include two excavators with crusher, two excavators with impact hammers, three compressors, five dump trucks, 15 debris trucks, excavator with thumb, and a loader. Staging area activities are also included near site M6. Noise levels would be at or below the L_{eq} noise level limit (Exhibit 15). No nighttime L_{eq} exceedances are expected in this phase of construction, as modeled.

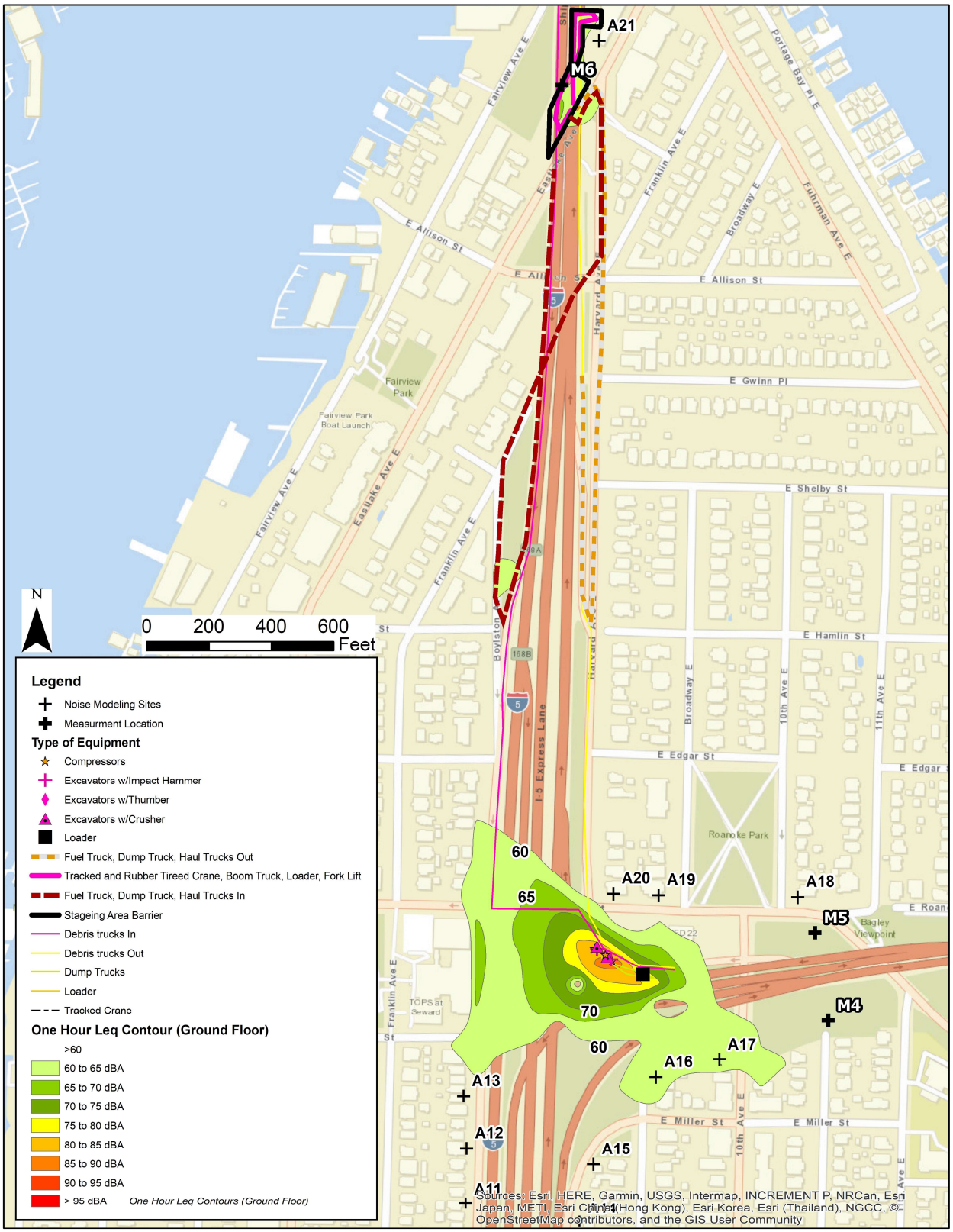
EXHIBIT 14. EXTERIOR NIGHTTIME DEMOLITION OF RETAINING WALLS NOISE LEVELS

Site	L_{eq} Modeled Noise Level (dBA)	L_{eq} Proposed Noise Level Limit (dBA)	L_1 Modeled Noise Levels (dBA)	L_1 Proposed Indicator Noise Level (dBA)
M1	No construction activity modeled nearby			
M2	No construction activity modeled nearby			
M3	No construction activity modeled nearby			
M4	53	70	63	80
M5	46	71	56	81
M6	64	66	74	76

Note: Noise levels are hourly averages.
*M3 is located directly over the I-5 lanes and will be used for L_1 monitoring purposes only. It is not representative of what residents in the area would hear and is not proposed to be used for nighttime noise level hourly L_{eq} limits.

Exhibit 15 shows the noise level contours and the areas of construction for the "Demolition of Retaining Walls" stage of the project. Modeled equipment locations were selected to represent noise levels when equipment is located nearest noise-sensitive receivers.

EXHIBIT 15. DEMOLITION OF RETAINING WALLS



SR 520/I-5 Project – Shaft Construction

Modeled exterior nighttime noise levels for the construction of the shafts for the SR 520 to I-5 express lane connection are shown in Exhibit 16. The model included the construction activities for the shaft construction at the SR 520 and I-5 Interchange. This activity would occur over a period of one month. Equipment used for this activity was estimated to include two welders, a crawler crane, a drill rig, a vibratory hammer, a concrete pump, three compressors, and eight concrete trucks and eight hauling trucks. The shafts would be constructed by vibrating a casing into the ground, then auguring out the earth, a rebar cage would then be placed in the hole, and concrete would be pumped in. Staging area activities are also included near site M6. While the equipment was modeled to be operating at the same time to represent a loudest possible condition, not all of the equipment would operate at once. Noise levels would be below the L_{eq} noise level limit. No nighttime L_{eq} exceedances are expected in this phase of construction, as modeled.

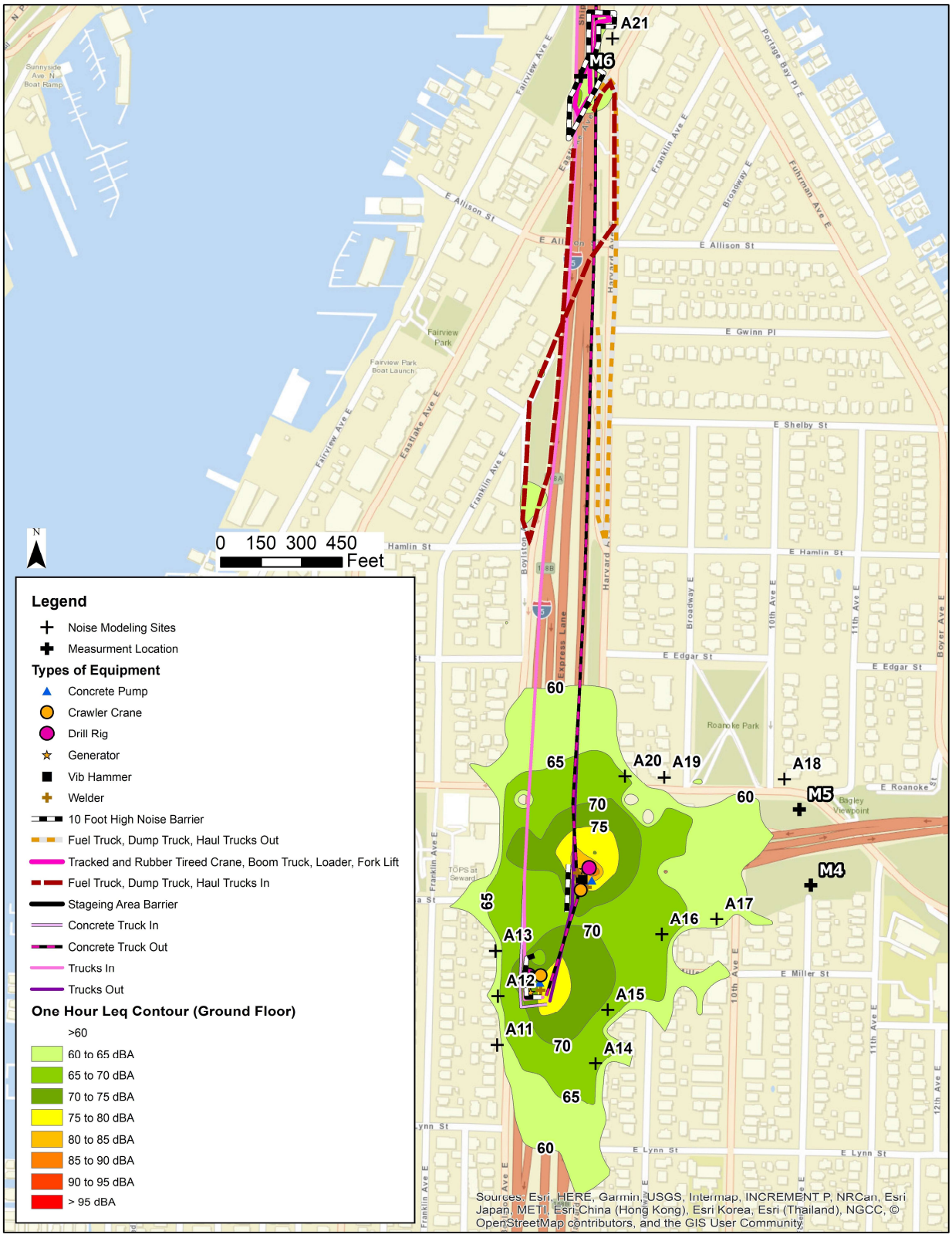
EXHIBIT 16. EXTERIOR NIGHTTIME SHAFT CONSTRUCTION

Site	L_{eq} Modeled Noise Level (dBA)	L_{eq} Proposed Noise Level Limit (dBA)	L_1 Modeled Noise Levels (dBA)	L_1 Proposed Indicator Noise Level (dBA)
M1	No construction activity modeled nearby			
M2	No construction activity modeled nearby			
M3*	56	Not Applicable	66	97*
Highest Modeled Location A13 (shaft construction)	68	74	78	80
M4	56	70	66	80
M5	59	71	69	81
M6	64	66	74	76

Note: Noise levels are hourly averages.
*M3 is located directly over the I-5 lanes and will be used for L_1 monitoring purposes only. It is not representative of what residents in the area would hear and is not proposed to be used for nighttime noise level hourly L_{eq} limits.

In Exhibit 17, modeled equipment locations and additional modeled locations were selected to represent noise levels when equipment is located nearest noise-sensitive receivers. Moveable barriers were included in the modeling to reduce noise levels for the upper floor of the residence at the corner of E. Louisa Street and Boylston Avenue E.

EXHIBIT 17. SHAFT CONSTRUCTION



SR 520/I-5 Project – Structural Steel Girder

The erection of the structural steel for the HOV flyover ramp from the I-5 Express lanes is estimated to take two months. Equipment modeled during nighttime hours was estimated to include hydraulic crane, crawler crane, concrete pump, two compressors, five concrete trucks, and two debris trucks. Staging area activities are also included near site M6. Modeled noise levels are shown in Exhibit 18. Noise levels would be below the L_{eq} noise level limit. No nighttime L_{eq} exceedances are expected in this phase of construction, as modeled.

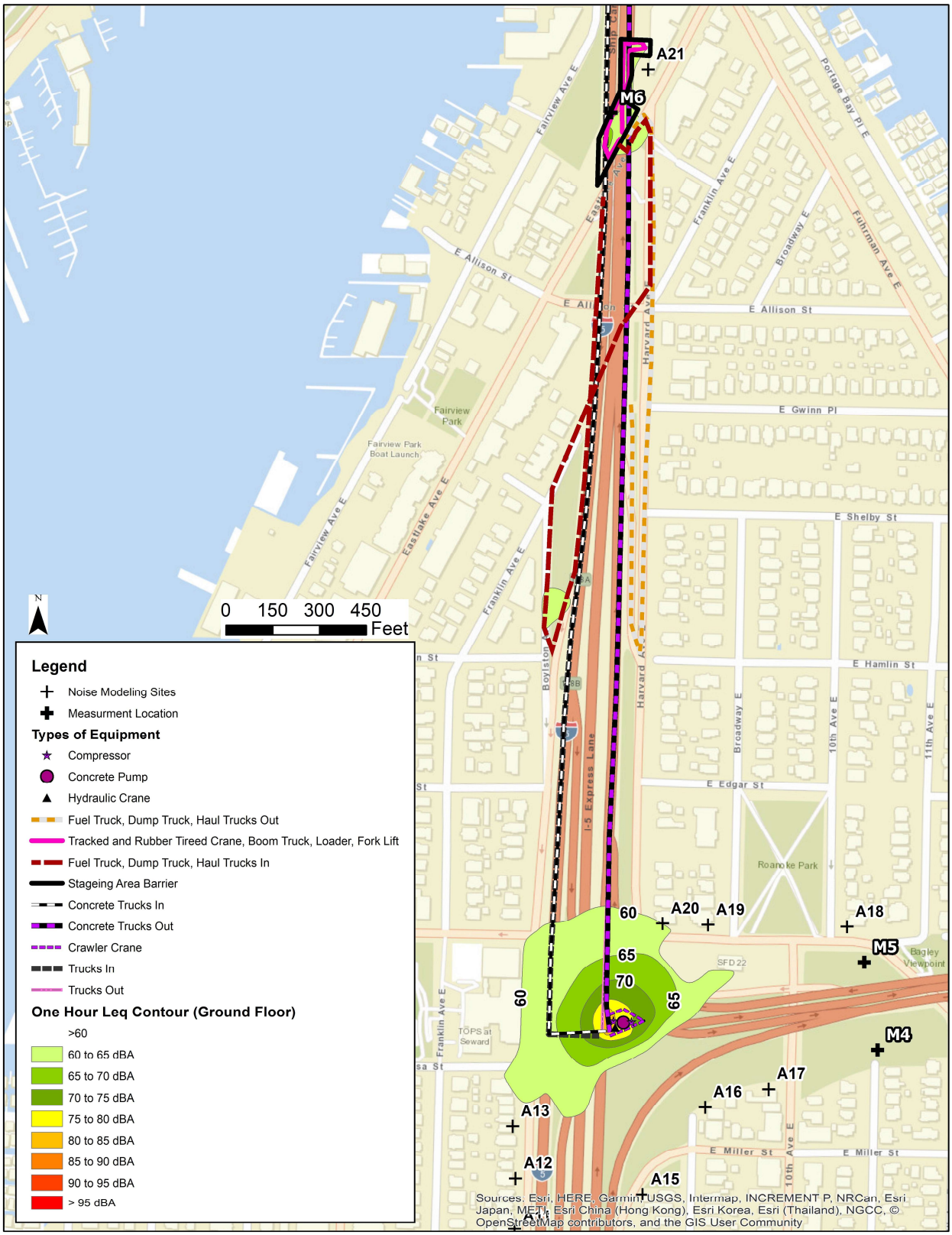
EXHIBIT 18. EXTERIOR NIGHTTIME STRUCTURAL STEEL GIRDER ERECTION

Site	L_{eq} Modeled Noise Level (dBA)	L_{eq} Proposed Noise Level Limit (dBA)	L_1 Modeled Noise Levels (dBA)	L_1 Indicator Noise Level (dBA)
M1	No construction activity modeled nearby			
M2	No construction activity modeled nearby			
M3	No construction activity modeled nearby			
M4	46	70	56	80
M5	48	71	58	81
Highest Modeled Location A20 (near site M5)	60	71	70	81
M6	64	66	74	76

Note: Noise levels are hourly averages.

Exhibit 19 shows the noise level contours and construction activities locations for the structural steel and girder erection.

EXHIBIT 19. STRUCTURAL STEEL GIRDER



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SR 520/I-5 Project – Retaining Wall Construction

Retaining wall construction on the I-5 interchange and 10th Avenue Abutment, the Mercer Ramp and in the I-5 Express lanes. Equipment modeled during nighttime hours include a crawler crane, hydraulic crane, concrete pump, two compressors, five concrete trucks, and two haul trucks. Retaining wall construction in along these areas would be for shorter durations and have similar noise levels as the work modeled in the I-5 interchange and Mercer Ramp areas. Noise levels would be above the L_{eq} noise level limit (Exhibit 20) at location A2. Staging area activities are also included near site M6. No nighttime L_{eq} exceedances are expected in this phase of construction in other locations, as modeled.

However, there is no nighttime use at Site A2. If nighttime use does occur at location A2, additional mitigation would be needed to meet the proposed nighttime noise level limits for this phase of construction near site A2.

EXHIBIT 20. EXTERIOR NIGHTTIME RETAINING WALL CONSTRUCTION

Site	L_{eq} Modeled Noise Level (dBA)	L_{eq} Proposed Noise Level Limit (dBA)	L_1 Modeled Noise Levels (dBA)	L_1 Proposed Indicator Noise Level (dBA)
M1	45	72	55	82
A1 fourth floor (Loudest site near M1)	71	72	81	82
M2	50	74	60	84
M3	43	Not Applicable	53	97*
A9 (Loudest site near M3)	45	74	55	84
M4	60	70	70	80
M5	59	71	69	81
A19 (Loudest site near M5)	67	71	77	81
M6	64	66	74	76

Note: Noise levels are hourly averages.
*M3 is located directly over the I-5 lanes and will be used for L_1 monitoring purposes only. It is not representative of what residents in the area would hear and is not proposed to be used for nighttime noise level hourly L_{eq} limits.

Noise contours are shown in Exhibit 21 and Exhibit 22**.** Modeled equipment locations were selected to represent noise levels when equipment is located nearest noise-sensitive receivers.

EXHIBIT 21. RETAINING WALL CONSTRUCTION NOISE LEVEL CONTOURS

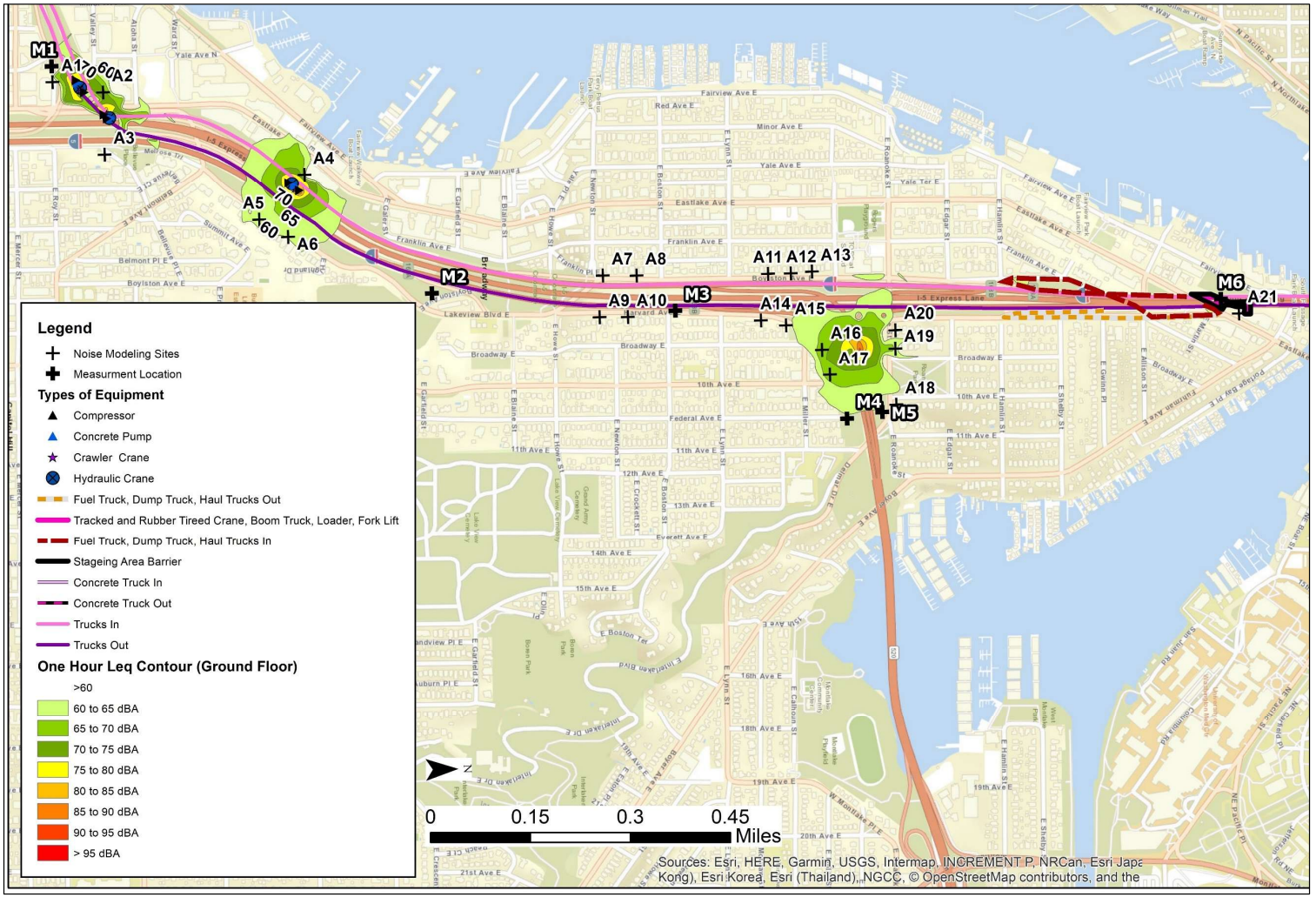
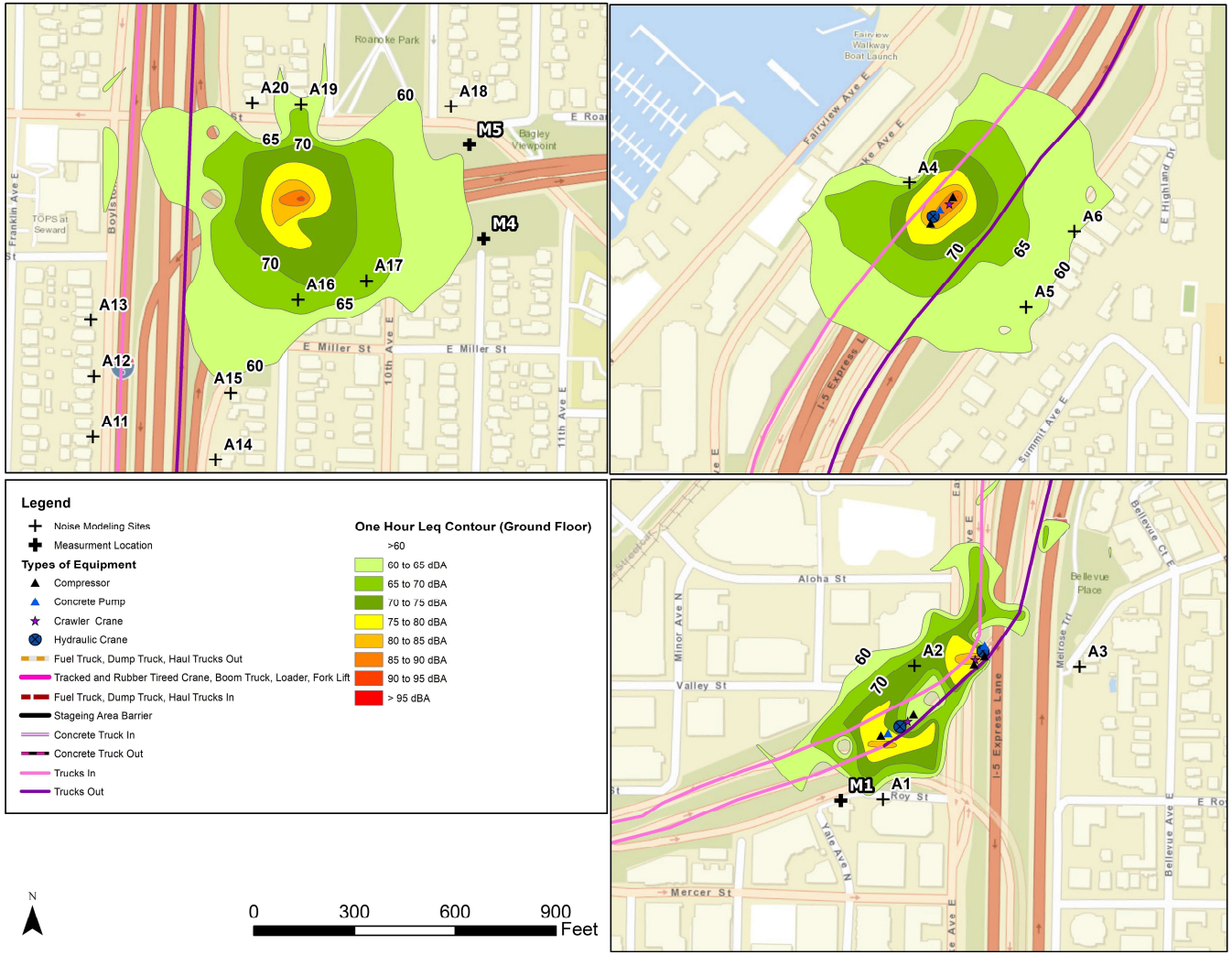


EXHIBIT 22. RETAINING WALL CONSTRUCTION NOISE LEVEL CONTOURS ZOOMED



Proposed Noise Mitigation Measures

Required Minimum Mitigation Measures

The contractor will perform the following minimum mitigation measures to minimize nighttime construction noise, except in the case of emergency, as defined by the Seattle Noise Control Ordinance (SMC 25.08.110), whenever the contractors work between 10 p.m. and 7 a.m. Monday through Friday, or between 10 p.m. and 9 a.m. Saturday through Sunday and legal holidays, and exceeds the local ordinance noise levels:

- The contractor will meet the noise level limits established in the noise variance.
- The contractor will use broadband or strobe backup warning devices, or use backup observers in lieu of backup warning devices for all equipment, in compliance with Washington Administration Code, Sections 296-155-610 and 296-155-615. For dump trucks, if the surrounding noise level is so loud that broadband or strobe backup warning devices are not effective, then an observer must be used (WAC 296-155-610). This condition will apply to activity conducted between 10 p.m. and 7 a.m., Monday through Friday, and between 10 p.m. and 9 a.m. on Saturday, Sunday, and legal holidays. No pure-tone backup warning devices will be used after 10 p.m. and before 7 a.m. weekdays or 9 a.m. weekends and legal holidays.
- Except as described below, there will be no impact work, such as auger shaking, jack hammering and impact pile driving, during nighttime hours from 10 p.m. to 7 a.m. on weekdays and 10 p.m. to 9 a.m. on weekends and legal holidays. Nighttime impact work will be conducted within the noise level limits established in the variance.
    - There will be impact work for the creation of access and work space. These activities are expected to occur on up to 25 non-consecutive nights at the 10th Avenue Abutment, 5 non-consecutive nights at the Mercer Ramp and 15 non-consecutive nights in the I-5 Express lanes. This work was modeled and shown in Exhibit 12.
    - There will be impact work for the demolition of the existing retaining wall at the westbound SR 520 northbound I-5 on ramps. This work is expected to occur on 72 non-consecutive nights. This work was modeled and shown in Exhibit 15.
    - Additional notifications will be sent to residences within 300 feet of any nighttime impact work. Notices will be sent with a minimum of 3 days prior to the start of nighttime impact work.
- The contractor will securely fasten truck tailgates.
- The contractor will use sand, rubber or plastic lined truck beds for all haul-trucks to reduce noise, unless an exception is approved by WSDOT.
- The contractor will not use compression brakes.
- The contractor will not leave equipment to idle for longer than five minutes.
- The contractor will use temporary noise mitigation shields, enclose, or use low noise-generating stationary equipment, such as light plants, generators, pumps, and air compressors near residences where practical.

Additional Noise-Control Measures

The contractor will submit to WSDOT an updated NMMP if necessary to reflect changes to their specific construction means and methods and will detail the additional mitigation measures needed to meet the noise level limits established in the noise variance. If the contractor updates the NMMP, once WSDOT has reviewed and accepted the NMMP, the contractor will submit it to SDCI. Additional mitigation measures that the contractor could also use as necessary are listed below:

- Equip nighttime surface equipment with high-grade engine-exhaust silencers and engine-casing sound insulation.
- Use electric welders powered from utility main lines instead of gas, diesel, or internal combustion generators/welders.
- Use critical or double mufflers where practicable on machinery for off-road use, such as cranes.
- Use noise blankets, skirts, or other available means for mobile equipment to mitigate noise that does not unreasonably interfere with the operation of the engine.
- Use temporary mobile noise barriers in the immediate vicinity of loud activities nearby residences.
- Provide earplugs and white noise machines to residents near the project area.
- Install temporary sound dampening drapes for residents.
- Provide hotel rooms for residents during high impact or extremely noisy operations.

Compliance Monitoring and Reporting

Director's Rule 3-2009, Section C.2, requires that WSDOT provide for an onsite inspector to serve as an Independent Noise Monitor (INM). The INM may be an individual, firm, or contracted staff member within SDCI who is independent from the contractor and who will oversee the monitoring of sound levels from construction covered by the MPPCNV and report directly to the SDCI Coordinator for Noise Abatement. WSDOT plans to dedicate the resources needed to have a WSDOT-trained inspector on-site to perform the duties of the INM.

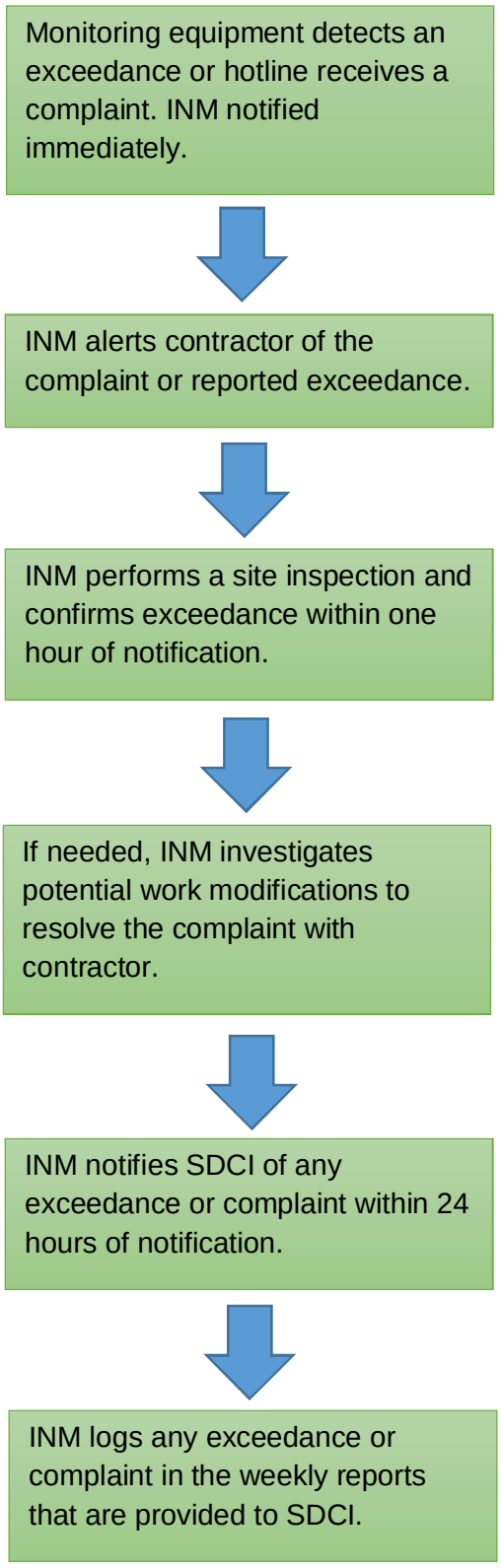
The contractor will create a Noise Monitoring Plan. The contractor will take noise measurements continuously during nighttime hours using automated noise monitoring equipment that is consistent with the American National Standards Institute Standards to Type 1 and that allows for remote access to real time results available to SDCI, WSDOT, and the contractor. The noise monitoring equipment will have the capability to log continuous L_{eq} and L_1 sound levels and to initiate a recording of audio files when the L_{eq} or L_1 sound-level thresholds are exceeded. Sound level thresholds will be set at 3 dBA below the MPPCNV nighttime L_{eq} noise levels limits and at the L_1 indicator level. The Noise Monitoring Plan will identify the type and location of monitoring equipment. There will be a minimum of two noise monitoring stations placed at or near the residences affected by the construction when construction is occurring during nighttime hours. Generally, a monitor will be placed at the six monitoring locations (sites M1, M2, M3, M4, M5 and M6) when construction is occurring within 300 feet or moved to a comparable location along the I-5 right of way near the residential receiver closest to the area of active nighttime construction.

If the monitoring equipment detects an exceedance of the MPPCNV nighttime noise level limits or indicator levels, or if a caller to the hotline has a noise-related complaint and requests additional information, the INM will be notified. The INM will be on-site during all periods of scheduled night work. If the INM receives a complaint call during nighttime work hours, the INM will notify the contractor and other WSDOT inspection staff on the job, perform a site inspection within 60 minutes of receiving the complaint, conduct short-term noise measurements (minimum 15 minutes per location) while on-site to confirm whether an exceedance of the MPPCNV sound-level limits is occurring, and investigate potential work modifications to resolve the complaint. INM's regular duties include, but are not limited to:

- Coordinating with WSDOT and contractor's night time crews about planned work operations.
- Coordinating with WSDOT Communications Team and Ombudsman on any updates or concerns from neighborhood and residents.
- Coordinating with SDCI on any questions or concerns from the City regarding project noise.
- Conducting nightly verification of fixed noise monitoring stations with hand held noise monitor to validate noise monitoring results from the fixed locations.
- Conducting regular spot-check noise monitoring at various locations of the project site with hand held monitor.
- Addressing noise exceedances and monitoring alarms in the field.

The Noise Monitoring Plan will also include a provision to generate weekly and annual reports that are required as part of Director's Rule 3-2009. The INM will provide the reports to SDCI and will include any monitored L_{eq} exceedances, noise complaints logged in the program database, and work modifications completed to resolve complaints. The reporting structure for noncompliance or a noise complaint is detailed in Exhibit 23. The weekly reports will be publicly available.

EXHIBIT 23. REPORTING STRUCTURE FOR NON-COMPLIANCE



Public Outreach and Community Involvement

WSDOT believes public involvement is essential to a project's development and has implemented a comprehensive and ongoing public involvement program for the SR 520 Bridge Replacement and HOV Program. During construction of the SR 520/I-5 Project, WSDOT's communications team, in coordination with the City of Seattle and the selected contractor, will provide up-to-date information on construction activities and construction noise to neighbors and stakeholders.

WSDOT's approach to construction communications and descriptions of the various communications tools and activities are included below. WSDOT will keep the public informed of construction activities, promote two-way communication with the community, and work to minimize construction impacts.

The key elements of the SR 520/I-5 Project communications plan are outlined below.

Written Materials

WSDOT uses a variety of written materials to provide advance notification and keep people informed of construction activities. All written materials have program contact information, including the email address, website, and the 24-hour live telephone construction hotline number. Examples of these types of materials include:

- Fact sheets to provide background information for the type of work occurring.
- Fliers which are often delivered door-to-door when there are localized construction impacts.
- Mailers which are sent to neighbors in compliance with permitting requirements.

In-person Public Engagement Activities

WSDOT provides a wide range of opportunities for community members to connect face-to-face with SR 520 Program staff. These opportunities provide an additional opportunity for the public to voice questions and concerns regarding the SR 520 Program.

Recent in-person events and meetings

- In preparation for the SR 520/I-5 Project nighttime noise application, WSDOT hosted a public meeting on 5/29/19 to provide an opportunity for community members to learn about the application process and share concerns about construction noise for the SR 520/I-5 Project. The notification area for the public meeting is shown in Attachment 2.

Planned and ongoing in-person events and meetings

- Pre-construction outreach with the future project contractor prior to the beginning of major construction activities.
- Regular public construction meetings provide timely updates on construction progress and upcoming activities throughout SR 520/I-5 Project construction.
- SR 520 Program briefings provided to community groups as requested.

Online and Electronic Communications

WSDOT uses a combination of the following online and electronic communications to keep community members informed of upcoming and ongoing construction activities:

- WSDOT maintains an electronic mailing list, and regular e-mail updates are sent to provide status updates and information on current activities.
- The project website is updated regularly and provides the latest design and construction information.
- WSDOT collaborates with other agencies and organizations to provide information in their respective e-mail updates or websites.
- SR 520 social media accounts are maintained on Twitter, Flickr, and YouTube.
- A 24-hour live telephone construction hotline will be maintained for the SR 520/I-5 Project. Real-time responses to immediate concerns and updates of the project status and current construction activities and impacts will be provided.
- During business hours, community members may contact the SR 520 Program Information Line for non-urgent, general project information.
- Detailed responses will be provided to emails received via the project e-mail address.
- Highway advisory radio, variable message signs, active traffic management signs, and project identification signs will be used as needed.

Media Relations and Social Media

WSDOT is able to reach a wide range of public located along the SR 520 corridor through the following means of mass communication:

- Community blogs and newspapers
- Regional print and broadcast media outlets
- Regular use of Twitter and Flickr social media accounts

Conclusion

WSDOT is completing the application process for a nighttime noise variance because construction crews will need to work at night within the City of Seattle limits during the SR 520/I-5 Project. Nighttime construction work is necessary to avoid disrupting weekday traffic and to provide a safe environment for construction crews and the traveling public. Since nighttime work will be required, WSDOT would receive this variance from SDCI to set limits for the noise levels of nighttime construction activities.

The noise limits proposed in this noise variance application for the SR 520/I-5 Project are based on WSDOT and SDCI noise variance coordination efforts which started in fall 2016 and a review of prior SDCI decisions on MPPCNV applications, tailored specifically for major public construction projects, from transportation agencies including WSDOT, Sound Transit and the Seattle Department of Transportation. By applying for a nighttime noise variance, WSDOT is complying with City of Seattle noise code for major public projects.

The SR 520 program is enhancing safety by replacing the highway's aging bridges and keeping the region moving with vital highway and transit facility improvements throughout the corridor. WSDOT understands that constructing this project in a dense, urban environment has an effect on those who live, work, travel, and play in the area. This variance requires WSDOT to implement nighttime noise limits, requires our contractor to implement noise-control measures, and ensures appropriate monitoring and enforcement of our nighttime construction activities, while also ensuring the safety of the public and our crews.