Discipline Report
Noise

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Magnolia Bridge Replacement

City of Seattle

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Executive Summary

The purpose of the Magnolia Bridge Replacement Project is to replace the existing Magnolia Bridge structure, approaches, and related arterial connections with facilities that maintain convenient and reliable vehicular and non-motorized access between the Magnolia community and the rest of the City of Seattle. A traffic noise study was conducted for this project in accordance with Federal Highway Administration (FHWA) guidelines and State of Washington regulations. This noise study evaluated and compared the contribution of four design alternatives (including the No Build Alternative) to environmental noise in the design year (2030).

Nineteen noise sensitive receptors were selected to represent 55 residences and recreational sites in the study area that could experience noise impacts with the proposed project. (No commercial or industrial noise receptors were evaluated for this study.) To evaluate the sound environment, potentially affected receptors in the study area were grouped into four noise-affected communities. The members of a noise-affected community have common noise-related features, usually elevation, distance from dominant noise sources, and proximity to existing natural and/or man-made barriers.

The following communities were evaluated:

- Community A: Thorndyke Park users and residences along Thorndyke Avenue West north of West Hayes Street and south of West Plymouth Street.
- Community B: Residents along or near West Galer Street, and the currently undeveloped parcel known as the Upper Smith Cove Acquisition Area. The noise analysis identified Community B as the only “impacted community” in the study area.
- Community C: Residents on the western bluff overlooking Magnolia Bridge.
- Community D: The common-use area near the marina, the Lower Smith Cove Acquisition Area, Smith Cove Park, and the Terminal 91 Bicycle Path.

The noise environment for each receptor within the four communities was measured and modeled. Prospective noise impacts were determined, and mitigation measures were evaluated for the sites where impacts were predicted. Throughout the proposed study area, traffic noise levels in the design year are predicted to be from 1 to 7 decibels higher than existing conditions.

Of the 19 modeled receptors, five in Community B adjacent to West Galer Street are predicted to experience noise impacts in the design year. Traffic along West Galer Street is the dominant noise source for the affected receptors. Noise impacts to Community B receptors are predicted under all proposed alternatives, including the No Build Alternative. No other noise impacts are predicted.

All six noise impact mitigation measures approved by FHWA and the Washington State Department of Transportation (WSDOT) were investigated as solutions for the five receptors predicted to experience impacts. The results of the mitigation analysis are as follows:

- *Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development, which would be adversely affected by traffic noise*: This mitigation measure does not apply to this project because there is no available property in the affected community that could provide enough buffer space to provide the minimum required noise reduction.
- *Noise insulation of public use or nonprofit institutional structures*: This mitigation measure does not apply to this project because all of the affected receptors are residential.
- *Horizontal or vertical realignment of the highway*: This mitigation measure is infeasible for this project. The alignments studied are considered the best alignments at this point for meeting the project's purpose and need and are intended to represent the likely range of potential impacts associated with the different alternatives.
- *Land acquisition for noise buffers or barriers*: This mitigation measure is infeasible for this project. The proposed roadways are bordered by residential properties, which would be unreasonably expensive to acquire for the purpose of noise mitigation.
- *Noise barriers*: This mitigation measure is infeasible for this project. The receptors predicted to experience impacts are structures in the first and second rows of houses along West Galer Street as it transitions into the Magnolia Bridge. The predicted impacts for this project originate with traffic from West Galer Street, not from the Magnolia Bridge. A noise wall at this point on West Galer Street is infeasible due to inadequate right-of-way to build the barrier; interference with access to driveways and the intersections at Magnolia Way West, Thorndyke Avenue West, and 28th Avenue West; and safety considerations of line-of-sight at the same intersections.
- *Traffic management measures*: Restricting vehicle types and lowering speed limits within the study area could worsen congestion on other routes to and from the area, rendering these measures infeasible. Land use controls and zoning would not apply to existing property. A transportation system management plan to encourage the use of carpools, public transit, and shuttle buses would reduce vehicle trips and, subsequently, traffic noise. This last option is considered the only feasible mitigation measure to minimize the project's operational noise; however, alterations to the regional transportation plan would neither be implemented nor funded by this project.

To summarize, only residences adjacent to West Galer Street would experience noise impacts under any of the proposed alternatives. All of the affected residences would experience similar impacts under all of the alternatives, including the No Build Alternative. None of the traffic noise mitigation measures recognized by FHWA and WSDOT would be effective in reducing the traffic noise levels at the affected locations. Therefore, no traffic noise mitigation can be recommended for this project.

Purpose and Need

Purpose

The purpose of this project is to replace the existing Magnolia Bridge structure, approaches, and related arterial connections with facilities that maintain convenient and reliable vehicular and non-motorized access between the Magnolia community and the rest of the City of Seattle. The bridge provides an important link to the Magnolia community in Seattle (see Figures 1and 2). Because the existing bridge provides the only public vehicular access to the land between North Bay, also referred to as Terminal 91, Smith Cove Park, Elliott Bay Marina, and U.S. Navy property, the project purpose also includes maintenance of access to these areas.

Need

Structural Deficiencies

The City of Seattle has identified the Magnolia Bridge as an important bridge that should remain standing following a “design” seismic event (an earthquake with a peak ground acceleration of 0.3g that is anticipated to happen every 475 years and may measure 7.5 on the Richter scale). Even with the repairs completed following the February 2001 earthquake, the existing bridge is susceptible to severe damage and collapse from an earthquake that is less severe than the “design” seismic event.

The original bridge was constructed in 1929 and has been modified, strengthened, and repaired several times. The west end of the bridge was damaged by a landslide in 1997, requiring repair and replacement of bridge columns and bracing, the construction of six additional supports, and construction of a retaining wall north of the bridge to stabilize the bluff from further landslides. Repairs after the 2001 earthquake included replacement of column bracing at 27 of the 81 bridge supports. A partial seismic retrofit of the single-span bridge structure over 15th Avenue West was completed in 2001. The other spans were not upgraded.

Inspections of the bridge conclude that the concrete structure is showing signs of deterioration. The concrete is cracking and spalling at many locations, apparently related to corrosion of the reinforcing steel. The bridge requires constant maintenance in order to maintain its load capacity, but there does not appear to be any immediate load capacity problem. The existing foundations have insufficient capacity to handle the lateral load and uplift forces that would be generated by a “design” seismic event. The existing foundations do not extend below the soils that could liquefy during a “design” seismic event. If the soils were to liquefy, the foundations would lose their vertical load-carrying ability and the structure would collapse.

System Linkage

There are three roadway connections linking the Magnolia community, with more than 20,000 residents, to the rest of Seattle. As the southernmost of the three connections, the Magnolia Bridge is the most direct route for much of south and west Magnolia to downtown Seattle and the regional freeway system.

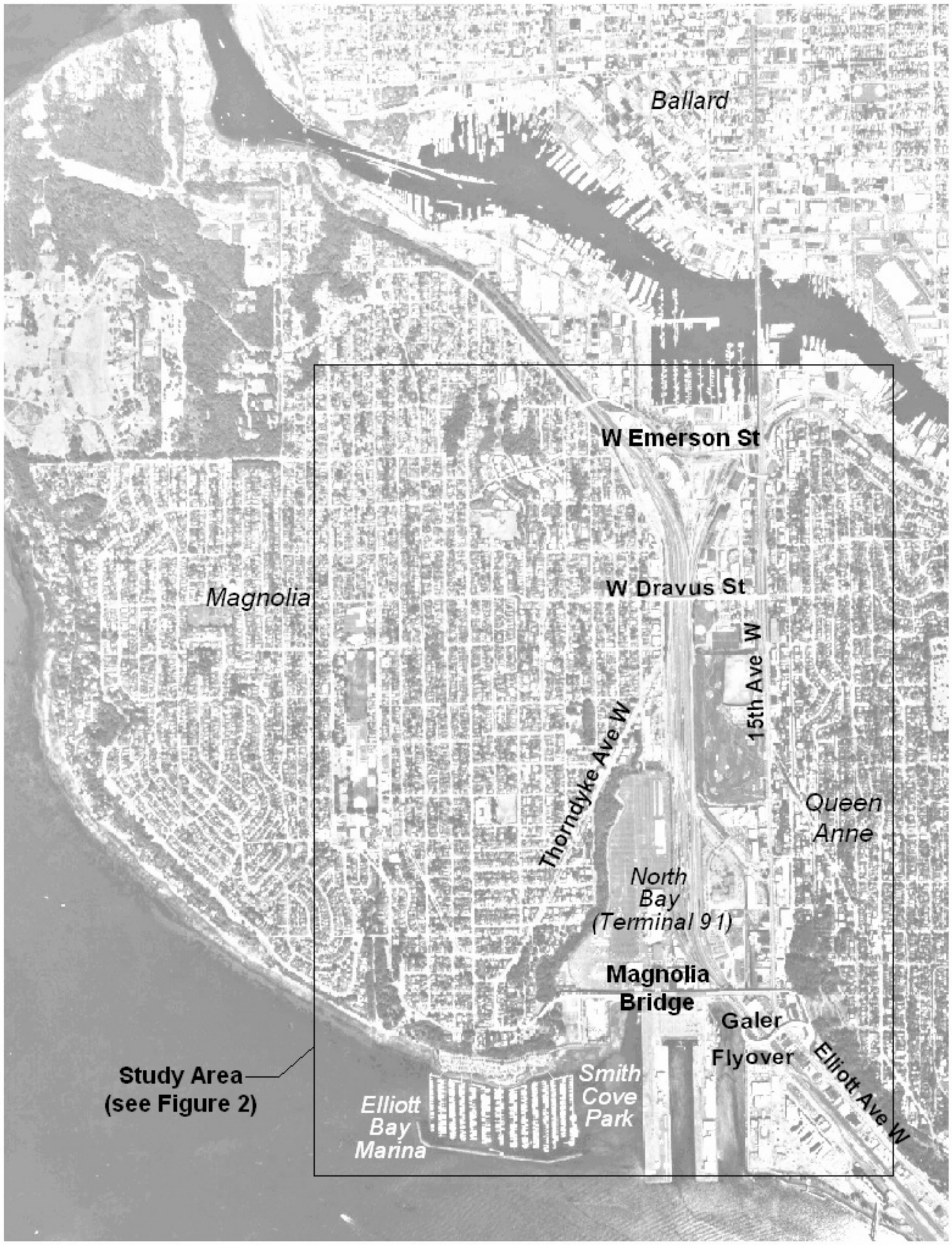


Figure 1
Vicinity Map

In meetings with the public and the Seattle Fire Department, the importance of this route for emergency services has been emphasized. The loss of use of this bridge in 1997 and again in 2001 demonstrated to the City that the remaining two bridges do not provide acceptable operation. During the bridge closure following the February 2001 earthquake, the City addressed community concerns about reduced emergency response time to medical facilities outside of Magnolia by stationing paramedics at Fire Station 41 (2416 34th Avenue West) 24 hours a day.

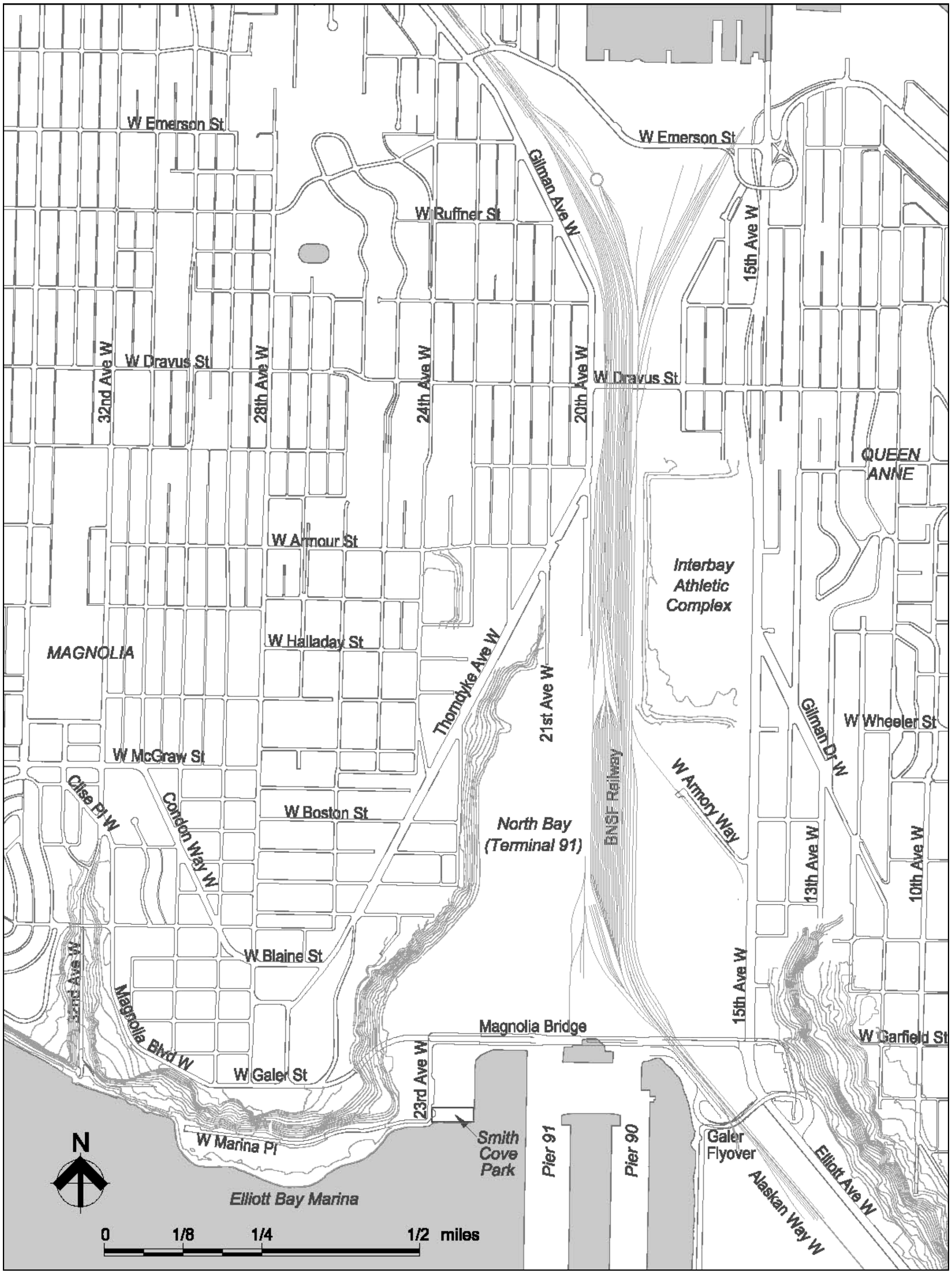


Figure 2
Study Area

Traffic Capacity

The three Magnolia community connections to the 15th Avenue West corridor are adequate for the present volume of traffic. Each of the three connections carries 30 to 35 percent of the 60,100 daily vehicle trips (2001 counts) in and out of the Magnolia community. Loss of the use of the Magnolia Bridge for several months after the February 2001 earthquake, and in 1997 following the landslide at the west end of the bridge, resulted in lengthy 15- to 30-minute delays and increased trip lengths for many of the users of the Magnolia Bridge. These users were required to use one of the two remaining bridges at West Dravus Street and West Emerson Street. Travel patterns in the Magnolia community changed substantially, resulting in negative impacts on local neighborhood streets. The increase of traffic through the West Dravus Street and West Emerson Street connections also resulted in congestion and delay for the regular users of these routes. Losing the use of any one of these three bridges would result in redirected traffic volumes that would overwhelm the capacity of the remaining two bridges.

Modal Interrelationships

The Magnolia Bridge carries three of the four local transit routes serving Magnolia and downtown Seattle destinations. The topography of the east side of Magnolia, East Hill, would make access to the 15th Avenue West corridor via the West Dravus Street Bridge a circuitous route for transit. Use of the West Emerson Street connection to 15th Avenue West would add significant distance and travel time for most trips between Magnolia and downtown Seattle.

The Magnolia Bridge has pedestrian facilities connecting the Magnolia neighborhood to Smith Cove Park and Elliott Bay Marina, as well as to 15th Avenue West/Elliott Avenue West. These facilities need to be maintained. The Elliott Bay multi-use trail connects Magnolia with downtown Seattle through Myrtle Edwards Park. The trail passes under the Magnolia Bridge along the west side of the Burlington Northern Santa Fe (BNSF) rail yard, but there are no direct connections to the bridge.

Bicycle facilities on Magnolia Bridge need to be maintained or improved. Even with the steep (about 6.3 percent) grade, bicyclists use the Magnolia Bridge in both directions. There are no bike lanes on the bridge, so cyclists use the traffic lanes and sidewalks. Once cyclists cross the bridge, they must either travel with motor vehicles on Elliott Avenue West or find a way back to the Elliott Bay Trail using local east-west streets such as the Galer Flyover.

Transportation Demand

The existing Magnolia Bridge provides automobile access for Port of Seattle North Bay (Terminal 91) to and from Elliott Avenue West/15th Avenue West. Truck access between Terminal 91 and Elliott Avenue West/15th Avenue West is accommodated via the Galer Flyover. Future planned expansion of the Amgen facility on Alaskan Way West and redevelopment of underutilized portions of North Bay and other areas of Interbay will increase demand for traffic access to the Elliott Avenue West/15th Avenue West corridor. The Port of Seattle has a master planning process under way (July 2003) for its North Bay (Terminal 91) property and the Washington National Guard property east of the BNSF Railway between West Garfield Street and West Armory Way. This area contains 82 acres available for redevelopment. There are also 20 or more acres of private property available for redevelopment east of the BNSF Railway between West Wheeler Street and West Armory Way. Redevelopment of the North Bay property will include public surface streets with connections to the replacement for the Magnolia Bridge. Forecasts of future (year 2030) traffic demand indicate that the access provided by the Galer Flyover and West Dravus Street would be inadequate. The capacity provided by the existing Magnolia Bridge or its replacement would also be needed.

Legislation

Seattle Ordinance 120957, passed in October 2002, requires that the Magnolia Bridge Replacement Study: (1) identify possible additional surface roads from Magnolia to the waterfront (avoiding 15th Avenue West and the railroad tracks); (2) obtain community input on the proposed roads; and (3) identify the cost for such roads and include it in the total cost developed in the Magnolia Bridge Replacement Study.

Description of Alternatives

An alignment study process was implemented to help identify the specific bridge replacement alternatives to be studied in the Magnolia Bridge Replacement Environmental Impact Statement (EIS). Twenty-five concepts were developed and screened against the project goals and objectives. This resulted in nine alignment alternatives, identified as A through I, that merited further analysis. These nine went through an extensive public review and comment process as well as project screening criteria and prioritization. Initially, the top four priority alternatives, A, B, D, and H, were identified to be studied in the EIS. Early on, Alternative B was eliminated because it became clear that it violated City shoreline policies and Federal Section 4(f) criteria. Upon detailed traffic analysis, Alternative H was eliminated because two key intersections are predicted to function at a level of service F and could not be mitigated. The next priority, Alternative C, was then carried forward for analysis in the EIS.

Independent of this project, a new north-south surface street will be constructed on Port of Seattle property connecting 21st Avenue West at the north end of North Bay with 23rd Avenue West near Smith Cove Park. In addition, a southbound ramp will be added to the Galer Flyover to accommodate eastbound to southbound Elliott Avenue West traffic movements. The Galer Flyover ramp has been identified as a needed improvement for expected future development of property west of the railroad tracks. Locations for new surface streets through the Port of Seattle property will be determined through the Port's master planning process for the North Bay property. The north-south surface street and ramp are assumed to exist under any Build Alternative, but they are not part of this environmental process.

Typical cross-sections and plans of the build and no Build Alternatives are located at the end of this section.

No Build Alternative

The No Build Alternative, shown in Figures 3 and 5, would maintain the existing bridge structure in place with the existing connections at the east and west ends. Long-term strategies for maintaining the existing structure would be required for the No Build Alternative. To keep the existing bridge in service for over 10 years, the following would need to be accomplished:

- An in-depth inspection of the bridge would be required to determine needed repairs and a long-term maintenance program.
- Concrete repairs would be required. These repairs could include injection of epoxy grout into cracks, repair of spalled concrete, and replacement of deficient concrete and grout.
- Preservation measures to slow corrosion of the reinforcement would be required. These measures could include a cathodic protection system.
- Any structural elements that lack the capacity to carry a tractor-trailer truck with a 20-ton gross trailer weight would need to be identified, modeled, and strengthened.

Alternative A

Alternative A would replace the existing bridge with a new structure immediately south of the existing bridge as shown in Figures 4 and 6. The alternative would construct a signalized, elevated intersection (Alternative A – Intersection) in the bridge's mid-span to provide access to the waterfront and the Port of Seattle North Bay property from both the east and west. Connections at the east and west ends of the bridge would be similar to the existing bridge.

An optional half-diamond interchange (Figure 7, Alternative A – Ramps) could be constructed in lieu of the elevated intersection to provide access to the waterfront and the Port of Seattle North Bay property to and from the east only.

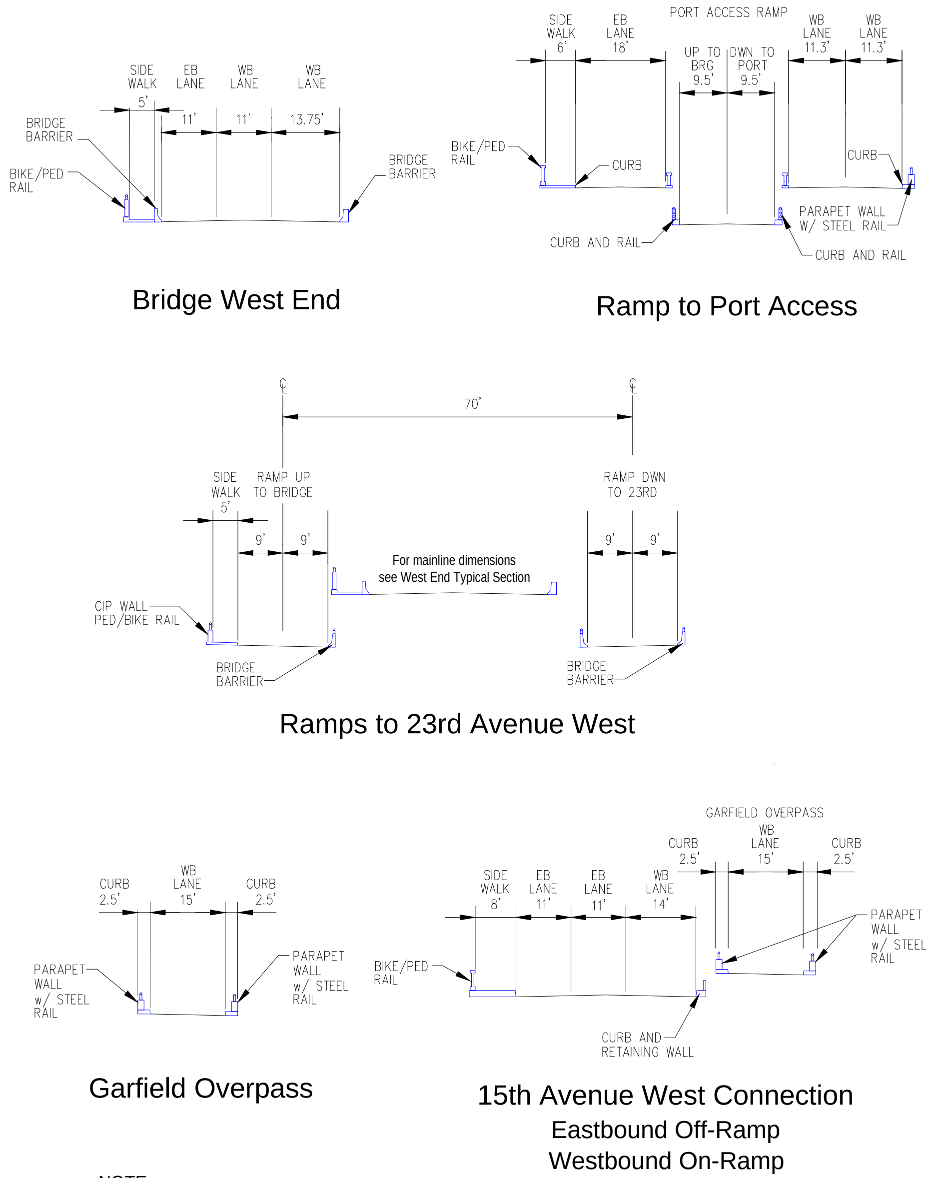
Alternative C

Alternative C would provide 2,200 feet of surface roadway within the Port of Seattle North Bay property between two structures as shown in Figures 4 and 8. The alternative alignment would descend from Magnolia Bluff on a structure running along the toe of the slope. The alignment would reach the surface while next to the bluff before turning east to an intersection with the north-south surface street. The alignment would continue east from the intersection, turning south along the west side of the BNSF rail yard. The alignment would rise on fill and structure, turning east to cross the railroad tracks and connect to 15th Avenue West.

Alternative D

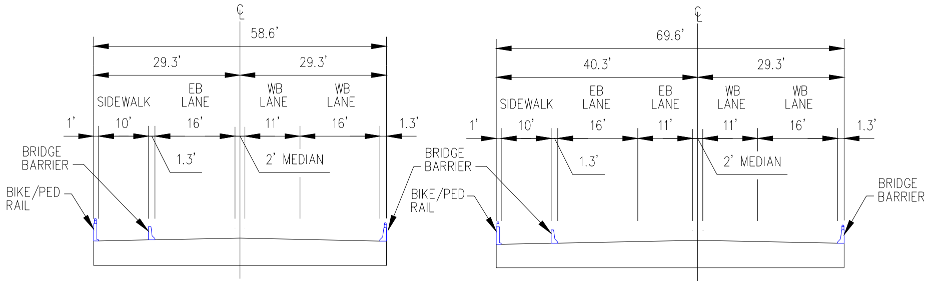
Alternative D would construct a new bridge in the form of a long arc north of the existing bridge as shown in Figures 4 and 9. Connections at the east and west ends of the bridge would be similar to the existing bridge. This alternative would construct a signalized, elevated intersection (Alternative D – Intersection) in the bridge's mid-span to provide access to the waterfront and Port of Seattle North Bay property from both the east and west.

An optional half-diamond interchange (Figure 10, Alternative D – Ramps) could be constructed in lieu of the elevated intersection to provide access to the waterfront and the Port of Seattle North Bay property to and from the east only.



NOTE:
Dimensions are approximate and obtained from construction plans and aerial photographs. The information shown has not been field verified.

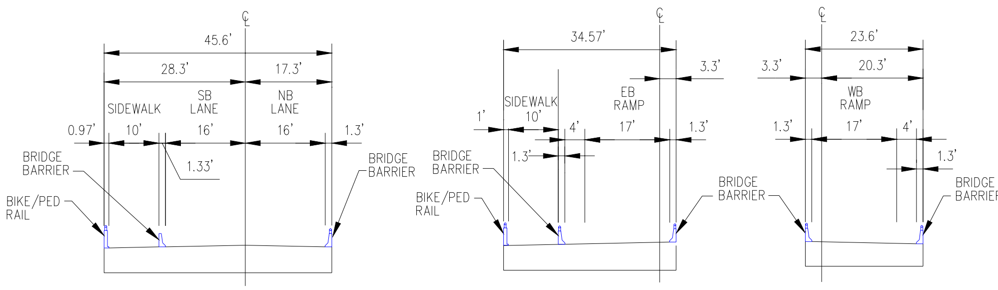
Figure 3
Typical Sections – No Build Alternative



West End

East End

Typical Bridge Structure



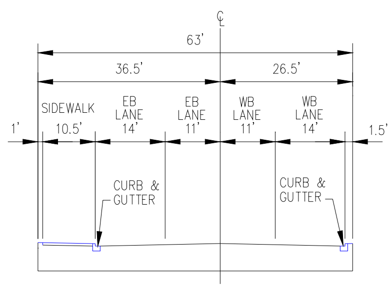
T-Ramp

Typical A & D Intersection Option

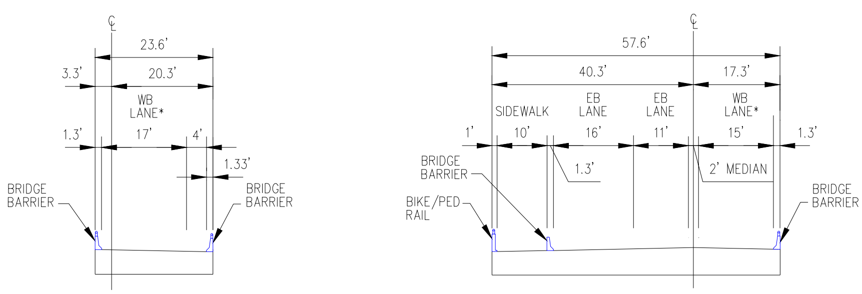
On-Ramp

Off-Ramp

Typical A & D Ramp Option



Typical Alternative C Surface Road



Garfield Overpass

* 15' Alternative C
19' Alternative D

15th Avenue West Connection
Eastbound Off-Ramp
Westbound On-Ramp

* 16' Alternative D

Figure 4
Typical Sections – Build Alternatives

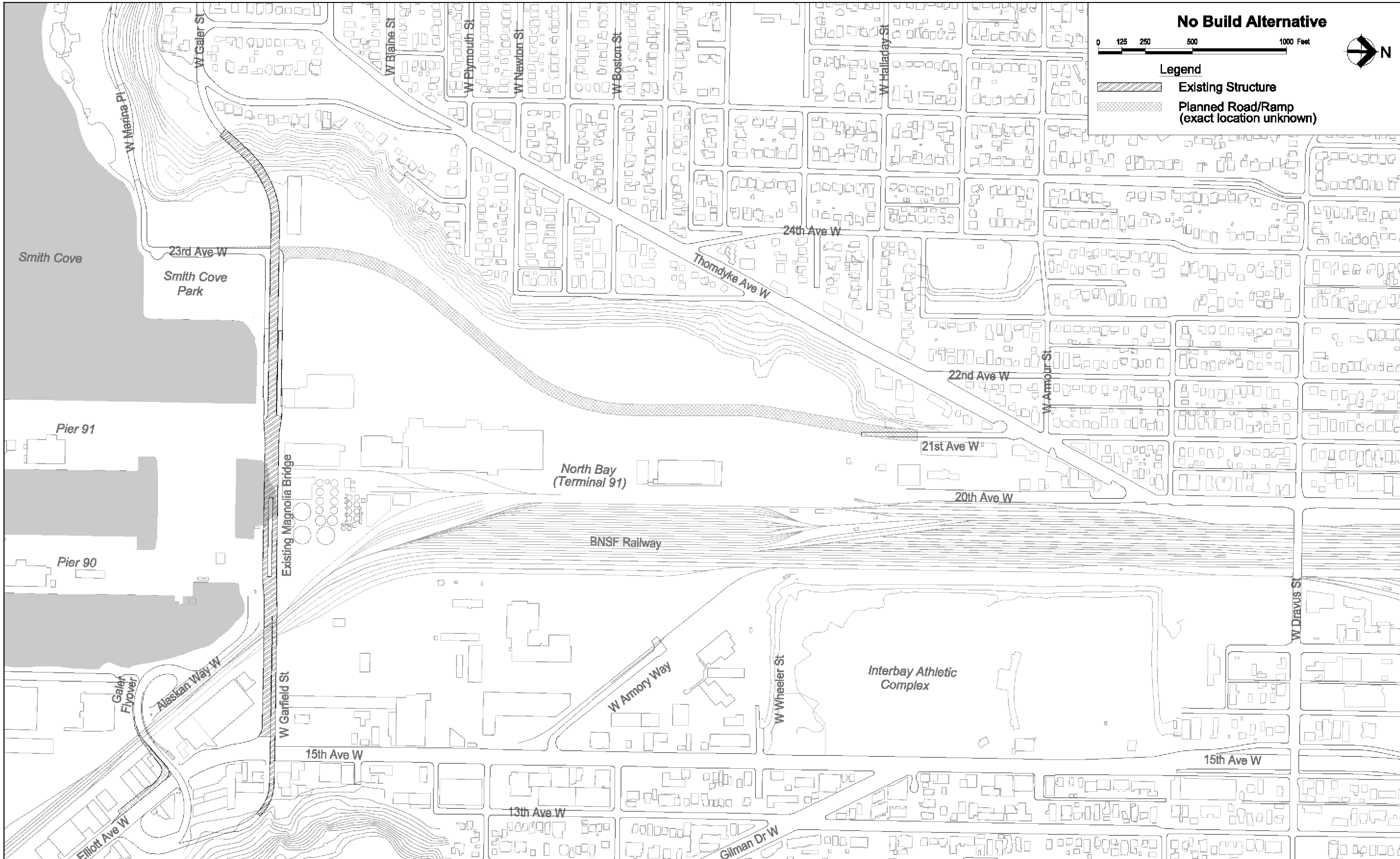


Figure 5 No Build Alternative

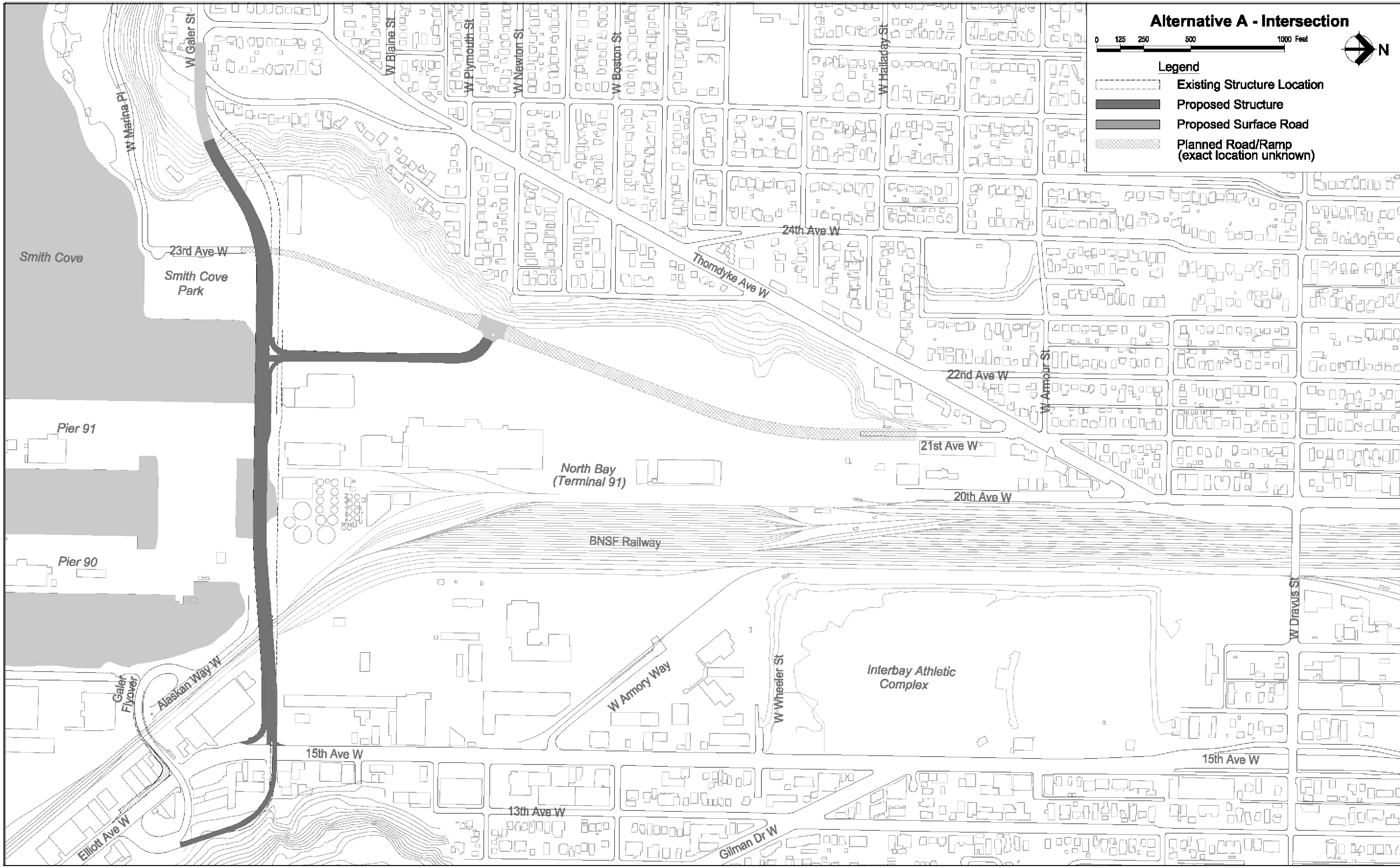


Figure 6 Alternative A - Intersection

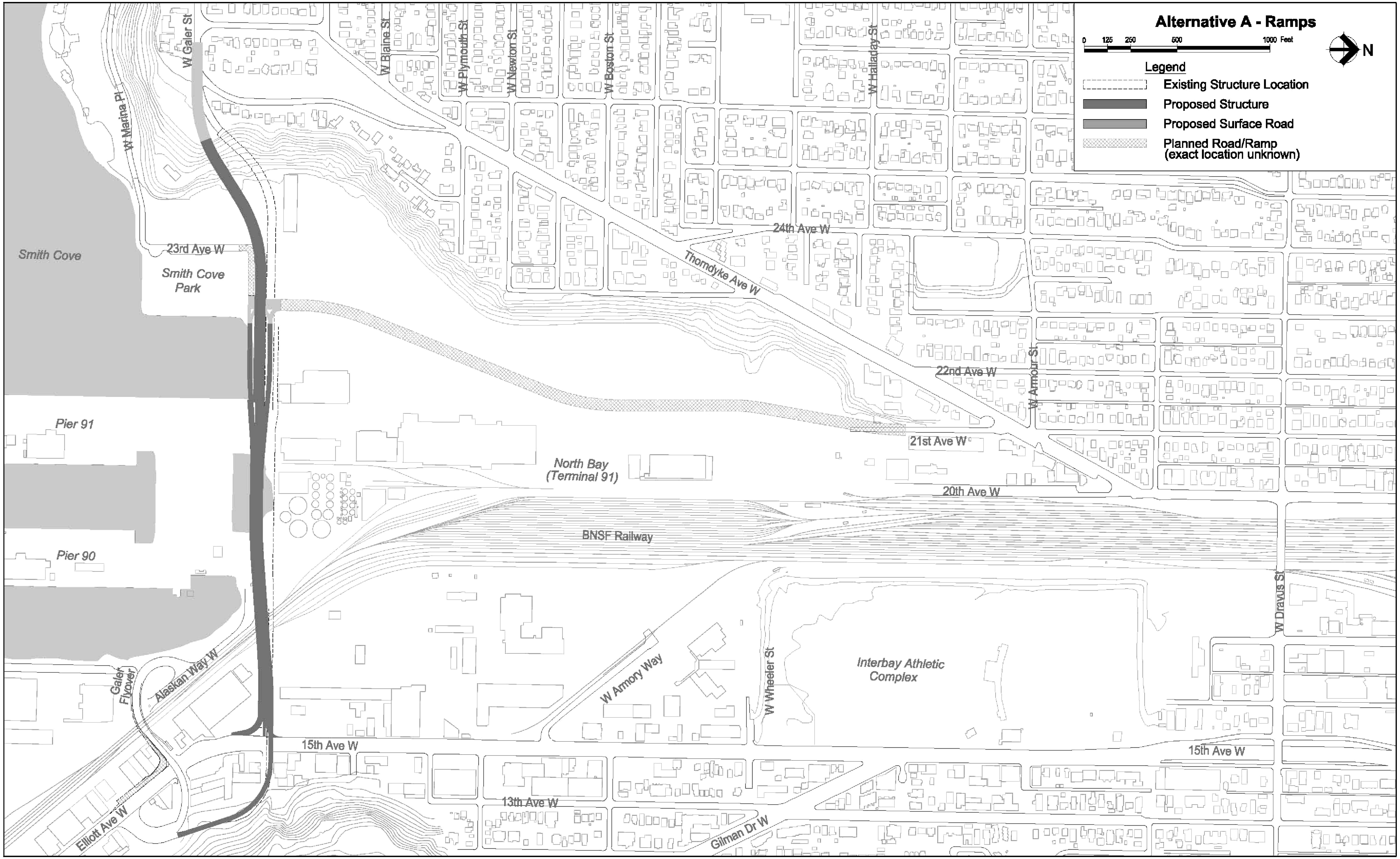


Figure 7 Alternative A - Ramps

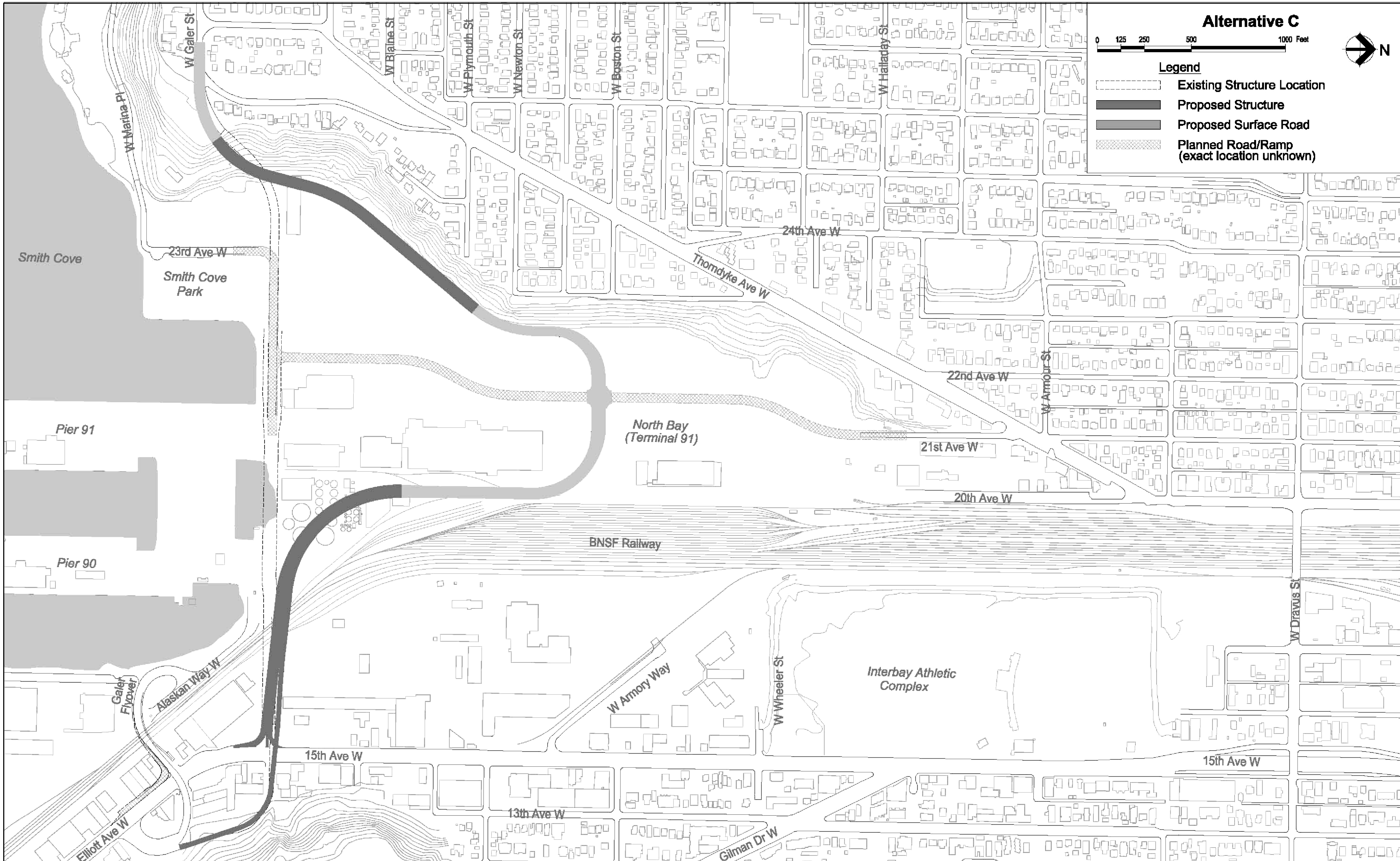


Figure 8 Alternative C

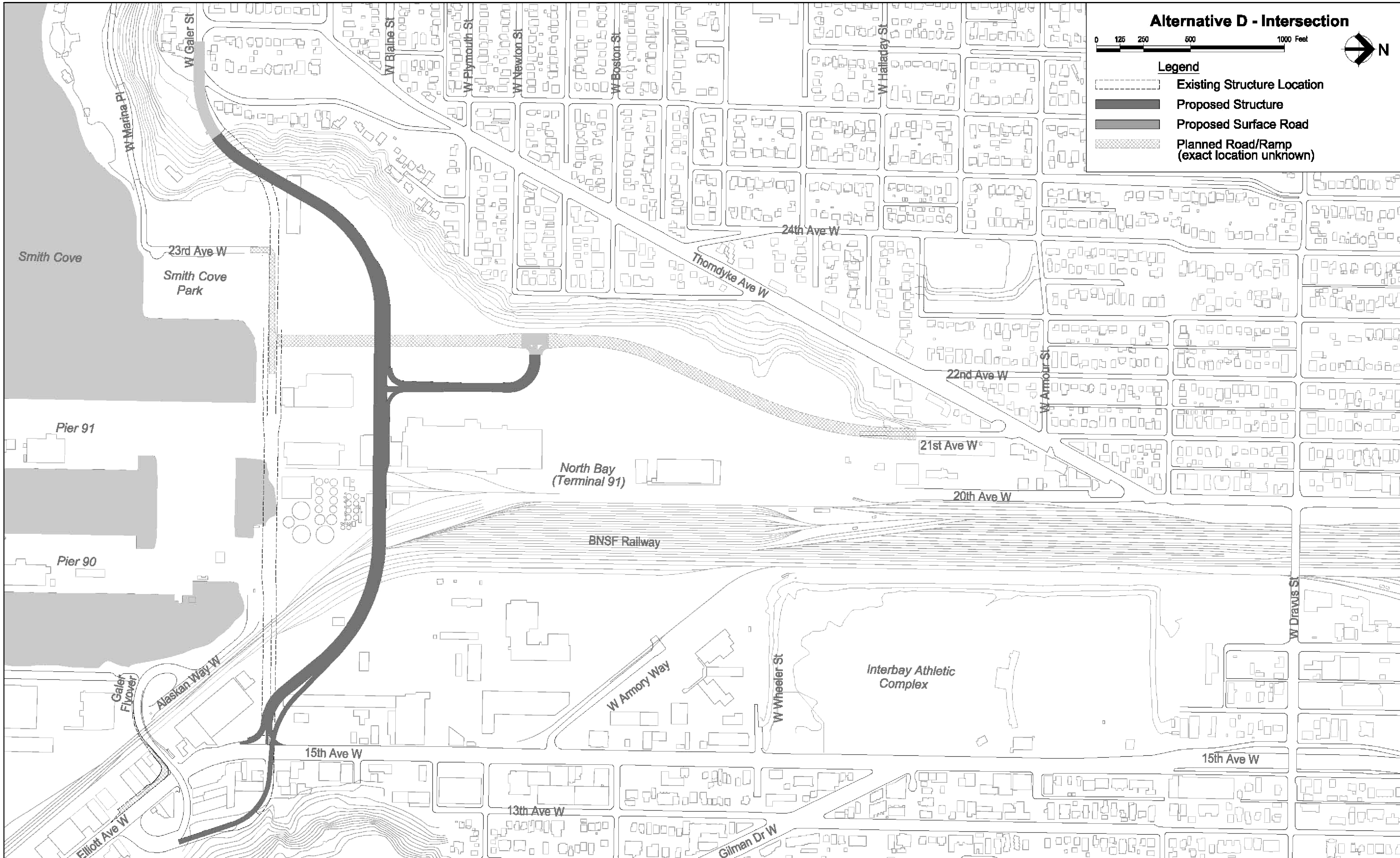


Figure 9 Alternative D - Intersection

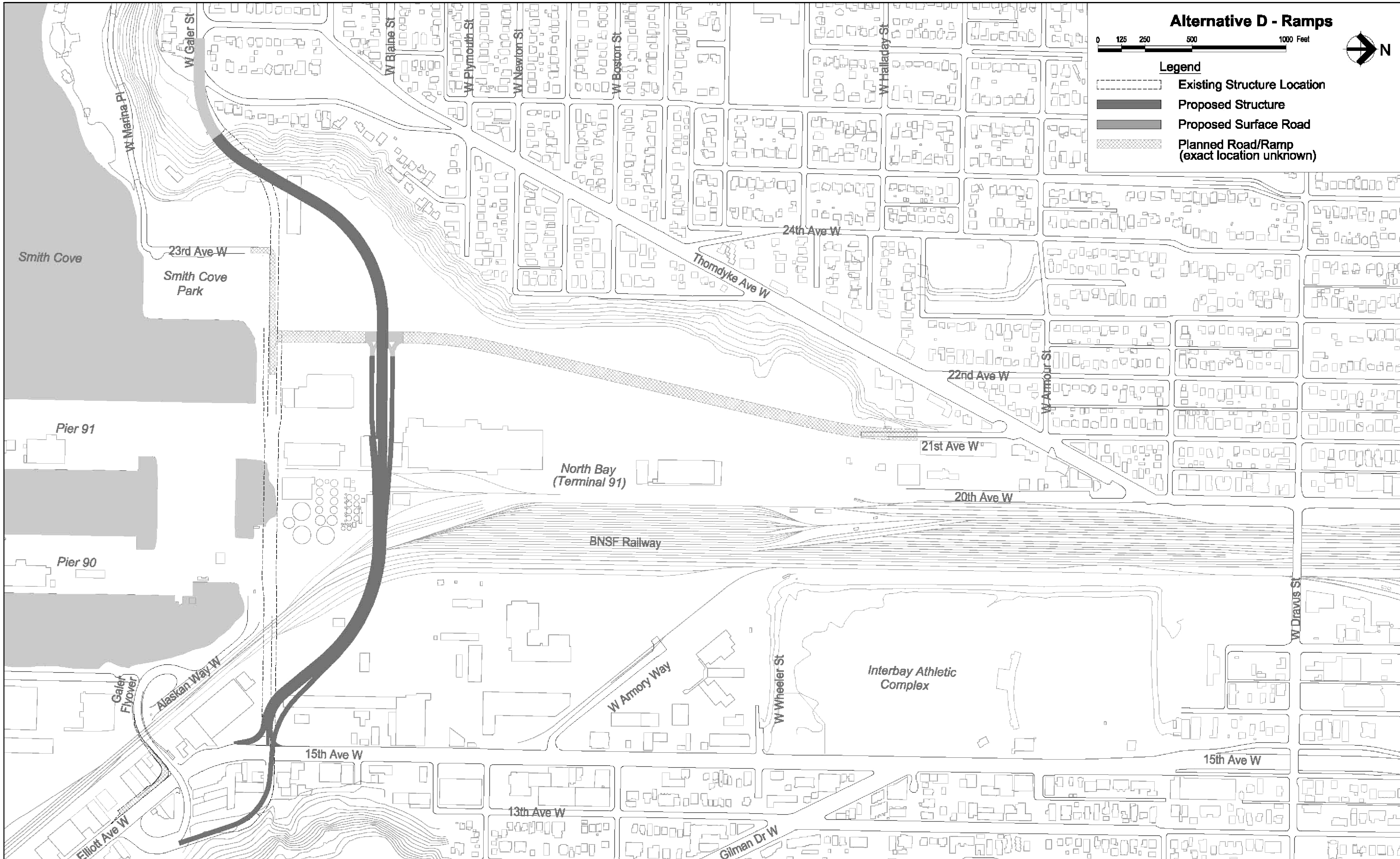


Figure 10 Alternative D - Ramps

Background and Characteristics of Noise

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 (U.S. Environmental Protection Agency 1974). Magnitude describes the physical size of sound waves in the air. The range of magnitude from the faintest to the loudest sound humans can hear is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Loudness, compared to physical sound measurement, refers to how people subjectively judge a sound. This varies from person to person. Table 1 shows noise levels of representative sounds.

Humans also respond to a sound's frequency or pitch. Environmental noise is composed of many frequencies, each occurring simultaneously at its own sound pressure level. As measured by an electronic sound level meter, frequency "weighting" combines the overall sound frequency into one sound level. The commonly used frequency weighting for environmental noise is A-weighting, or dBA, which estimates how an average person hears sounds.

Because of the logarithmic nature of the decibel scale, doubling the number of noise sources, such as the number of automobiles contributing to traffic volume, increases noise levels by 3 dBA. Thus, a noise source emitting a level of 60 dBA combined with another noise source of 60 dBA results in a combined noise level of 63 dBA, not 120 dBA.

Table 1
Noise Levels of Representative Sounds

Noise Source	Decibels	Description
Large rocket engine (nearby)	180	
Jet takeoff (nearby)	150	
Pneumatic riveter	130	
Jet takeoff (60 meters)	120	Pain threshold
Construction noise (3 meters)	110	
Subway train	100	
Heavy truck (15 meters) and Niagara Falls	90	Constant exposure above this level endangers hearing
Average factory	80	
Busy traffic	70	
Normal conversation (1 meter)	60	
Quiet office	50	Quiet
Library	40	
Soft whisper (5 meters)	30	Very quiet
Rustling leaves	20	
Normal breathing	10	Barely audible
Hearing threshold	0	

Source: Tipler 1976

Noise levels decrease with distance from the noise source. For a roadway, noise levels will decrease 3 dB over hard ground (concrete or pavement) or 4.5 dB over soft ground (grass) for every doubled distance between the source and the receptor. For a point source such as stationary construction equipment, noise levels will decrease between 6 and 7.5 dB for every doubled distance from the source.

Traffic noise levels depend on volume, speed, ratio of truck traffic to total traffic on the road, topography, vegetation, and distance from the roadway to the receptor. Generally, an increase in volume, speed, or percentage of trucks increases traffic noise levels. Vehicular noise is a combination of noises from the engine, exhaust, and tires.

Noise Descriptors

A descriptor for environmental noise is the equivalent sound level (L_{eq}). L_{eq} is defined as a sum of energy-averaged discrete samples of noise over a specific period of time. It is a measure of total noise, a summation of all sounds during a time period. As such, it places more emphasis on occasional high noise levels than accompanying general background noise levels. L_{eq} measured or predicted for a one-hour period is the hourly L_{eq} or L_{eq}(h), which is recommended by the Federal Highway Administration (FHWA) for highway noise analyses. Wherever the symbol L_{eq} is used in this report, it means the hourly L_{eq}.

Method of Evaluation

This noise study evaluates impacts and mitigation from the proposed replacement of Magnolia Bridge and improvement to the approaches and related arterial connections. The existing noise environment was characterized by measuring noise levels at receptor locations within the study area. Construction noise impacts are described based on noise levels of typical construction equipment published by the U.S. Environmental Protection Agency (EPA).

The FHWA Traffic Noise Model (TNM) computer program, Version 2.1, was used to predict future traffic noise levels at sensitive receptors. TNM computes highway traffic noise at nearby receptors and evaluates various heights of highway noise barriers. The analysis of traffic noise impacts and mitigation is consistent with FHWA, Washington State Department of Transportation (WSDOT), and City of Seattle guidance and criteria.

Traffic noise levels depend on the number of automobiles and trucks, speeds, noise emission levels of individual vehicles, and a receptor’s distance from the roadway. TNM also considers effects of intervening barriers, topography, vegetation, pavement type, grades, intersections, and atmospheric conditions. The noise model does not include noises from sources other than traffic.

Traffic Data

Traffic noise levels for the PM peak-traffic period, also referred to as the design hour, are predicted for the design year (2030) both with and without the project. Existing and future design-hour traffic volumes from the Magnolia Bridge Replacement project are based on vehicle counts and growth projections. The projected traffic volumes for the bridge with the project in 2030 (Alternatives A, C, and D) are assumed to be the same as without the project in 2030 (No Build Alternative).

The PM peak-hour volumes and speeds used in the modeling effort for Magnolia Bridge and the surrounding roadways in 2030 are outlined in the Traffic and Transportation Discipline Report.

The TNM divides all vehicles into automobiles, medium trucks, and heavy trucks. Medium trucks are defined as cargo vehicles with two axles and six wheels, and heavy trucks as cargo vehicles having three or more axles. According to vehicle classification data outlined in the Traffic and Transportation Discipline Report, the percentage of trucks on the roadways within the study area ranges from 2 to 14 percent, which includes both medium and heavy trucks.

During spot traffic counts conducted during the noise measurements, the observed vehicle mix was an average of 80 percent medium trucks and 20 percent heavy trucks. These distribution percentages of medium and heavy trucks were applied to the total classification data to determine the number of medium and large trucks for the noise modeling.

Noise Measurements

Figure 11 shows the location of noise measurements within the study area. Generally, measurements were taken at two locations along Thorndyke Avenue; two locations along West Galer Street; and two locations on the western bluff above Magnolia Bridge, at the end of West Plymouth Street and at the end of West Crockett Street at 23rd Avenue West. Noise measurements can be found in Appendix A.

Accuracy of the model was confirmed by modeling L_{eq} noise levels at the measurement sites based on actual traffic volumes counted during noise measurements, and then comparing those modeled noise levels with the corresponding measured noise levels.

Modeled results are within 2 dBA of the corresponding noise measurements, which is considered satisfactory agreement.

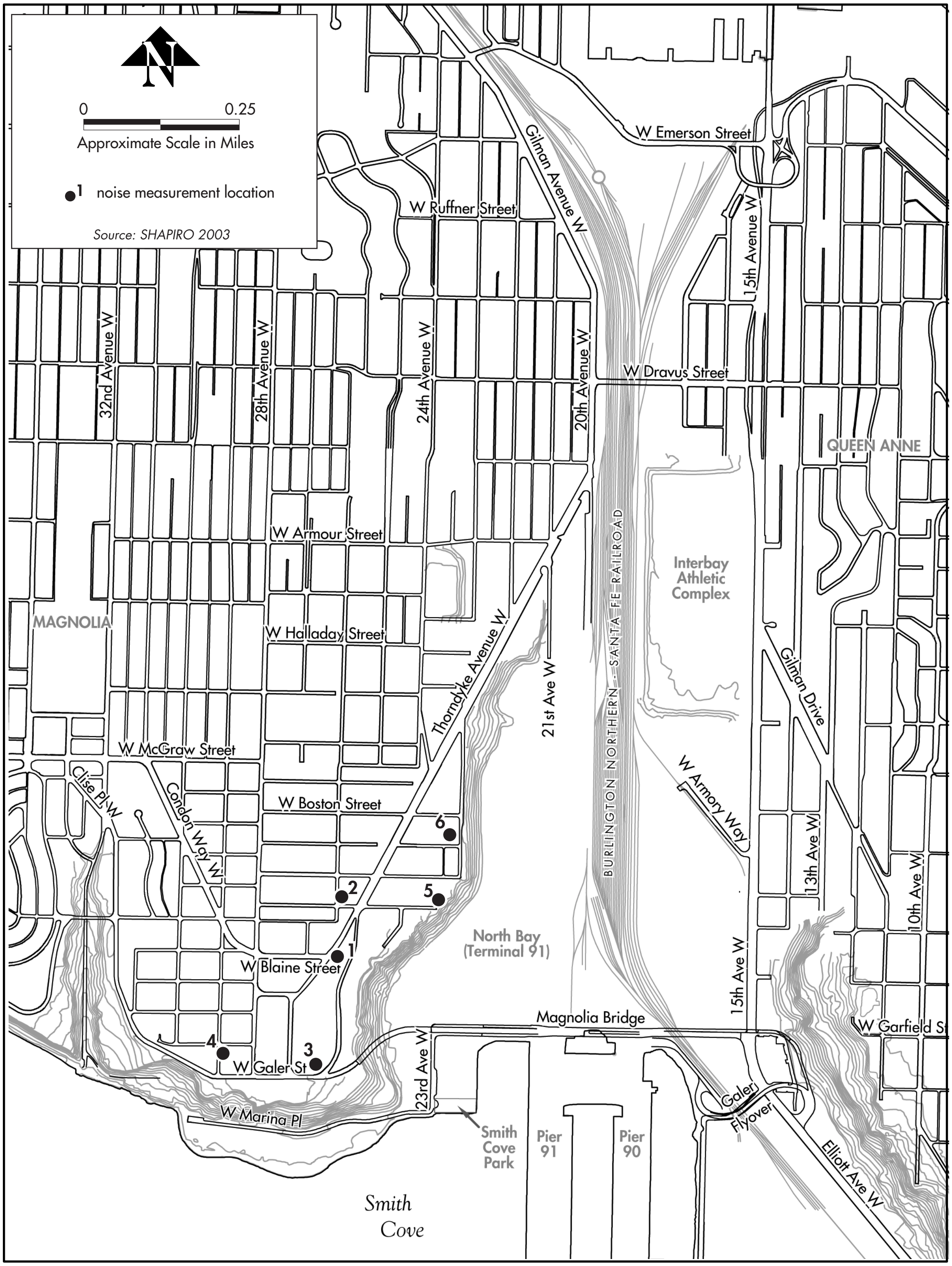


Figure 11
Noise Measurement Locations

Land Uses and Terrain

Existing Land Use

Under all of the alternatives, the bridge span is located over land designated in the City's comprehensive plan as industrial/commercial.

Single-family residential neighborhoods are located to the east and west of the project site on the upper portions of the Magnolia Bluff and Queen Anne Hill. Multifamily residential buildings are generally located on the lower portions of both hills.

Interbay, which is the lowland area between Magnolia and Queen Anne, is used for a mix of industrial and commercial businesses. BNSF railroad tracks run up the middle of the industrial area in Interbay.

The Port’s North Bay/Terminal 91 property is located west of the railroad tracks and east of the Magnolia Bluff. The Port is a major landholder in the study area. Major current uses on Port property include cold storage, fish processing, fuel distribution, and vehicle storage for the Seattle School District.

Existing Zoning

Existing land uses described above are consistent with zoning designations and the City of Seattle Comprehensive Plan. See Figure 12 for existing zoning designations in the study area.

The uphill portions of the Magnolia neighborhood are zoned Residential Single Family 5000, with lower areas zoned Lowrise 1, 2, or 3. Lowrise zoning designations allow multifamily residential development 25 to 30 feet high, with densities of one dwelling unit per 800 to 1,600 square feet of lot area.

The Port’s North Bay/Terminal 91, including properties south of the bridge along Elliott Avenue West, and BNSF Railway property are zoned General Industrial 1/45 (IG1), which allows industrial development in areas characterized as having access to waterways and rail. This zoning designation has a height limit of 45 feet.

Existing Conditions

Sources of Noise

Ambient noise levels were measured at numerous locations surrounding West Galer Street and Thorndyke Avenue West to establish accurate existing condition readings. These measurements indicate that existing noise levels in the study area range from a low of 54 dBA near the Elliott Bay Marina to a high of 68 dBA at a residence on West Galer Street east of Thorndyke Avenue West. The majority of the measured noise levels fall below the WSDOT noise abatement criterion (NAC) of 66 dBA for residences, parks, schools, churches, and similar areas (see Noise Regulations section below)

There are four principal sources of traffic noise in the study area: the Magnolia Bridge, the bridge approaches, West Galer Street, and Thorndyke Avenue West. Background noise sources include urban residential noise, such as yard tools, pets, and children at play, industrial and railyard noise from the Port of Seattle property, and aircraft flights. The effect of each of these sources on noise-sensitive receptors was evaluated individually and cumulatively.

- *Noise from the Magnolia Bridge*: Traffic on the Magnolia Bridge produces a low-level but nearly constant noise that can be heard at houses on the Magnolia Bluff west of and above the existing bridge. The average traffic noise level on the bluff was calculated to be 60 dBA. This is 6 dBA below the NAC. North of West Plymouth Street, noise from the bridge falls to 54 dBA and lower. Noise from the bridge is also audible at the Elliott Bay Marina and Smith Cove Park. The traffic noise level in this area is 54 dBA and lower.
- *Approaches to the Magnolia Bridge*: The southernmost houses on the Magnolia Bluff (except Receptor 10, which receives most of its noise from West Galer Street) receive most of their traffic noise from the bridge approaches. The highest existing noise level from the approaches was 61 dBA, 5 dBA below the WSDOT NAC.
- *Noise from West Galer Street*: Traffic volumes on West Galer Street are high, and the street is at grade with the adjacent houses, which are in most cases less than 50 feet from the curb. As a result, traffic noise is much higher at the receptors along West Galer Street than for any other community in the study area: an average of 67 dBA in the houses nearest the street. This slightly exceeds the WSDOT NAC.
- *Noise from Thorndyke Avenue West*: Traffic volumes on Thorndyke Avenue West are lower than on West Galer Street, so the existing noise levels at Thorndyke Park and nearby houses are below the WSDOT NAC: an average of 60 dBA.
- *Background Noise*: During noise measurements, aircraft overflights were observed, which added perceptibly to background noise levels. Helicopters, small private airplanes, jetliners, and military jets were noted to add from 3 to 5 dBA to the noise environment. Railway noise is also generated through the center of the study area; however, given the distance of the rail network to the residential neighborhoods and the intermittent timing of the trains, modeling of the rail network was not considered for this project. At the edge of the Magnolia Bluff north of West Plymouth Street, where traffic noise from the Magnolia Bridge is a maximum of 54 dBA, noise measurement showed that the noise contributed by the railyard and Port of Seattle industrial activity was 3 to 6 dBA. Incidental residential noise and traffic noise from minor surface streets were so low in the study area as to be insignificant to the noise measurement process.

Noise Sensitive Receptors

There are 55 potentially affected noise receptors in the study area. Figure 13 shows the location of the representative receptors used in modeling. Most of the modeled sites act as representative receptors for multiple locations, or “communities,” within a given area. The members of a noise-affected community have common noise-related features, usually elevation, distance from dominant noise sources, and proximity to existing natural and/or man-made barriers. Noise-affected communities that are predicted to experience project-related operational noise levels above the NAC are called “impacted communities.” The communities for this project can be summarized as follows:

- Community A: Receptors 1 and 2 represent 11 residences and Thorndyke Park users along Thorndyke Avenue West north of West Hayes Street and south of West Plymouth Street. This community receives most of its noise from traffic on Thorndyke Avenue West, an average of 61 dBA.
- Community B: Receptors 3 to 10 represent residents along or near West Galer Street and the currently undeveloped parcel known as the Upper Smith Cove Acquisition Area. Receptor 3 represents two houses and the Upper Smith Cove Acquisition Area; Receptor 4 three houses and the Upper Smith Cove Acquisition Area; Receptor 5 two houses; Receptor 6 two houses; Receptor 7 three houses; Receptor 8 four houses; and Receptor 9 four houses. Receptor 10 represents itself as the residence on the Magnolia Bluff closest to West Galer Street. This community receives most of its noise from traffic on West Galer Street. The noise analysis identified Community B as the only impacted community in the study area, with an average noise level of 67 dBA.
- Community C: Receptors 11 through 18 represent residents on the western bluff overlooking Magnolia Bridge. Receptors 11 through 16 represent one house each, averaging 60 dBA. Receptor 17, at 54 dBA, represents nine houses north of West Hayes Street and south of West Newton Street, and Receptor 18, at 53 dBA, represents eight houses north of West Newton Street. This community receives most of its noise from the Magnolia Bridge and the Port of Seattle/Terminal 91 industrial area and would be uniquely affected by the expansion of the Magnolia Bridge into the Port area under Alternatives C and D.
- Community D: Receptor 19 represents Smith Cove Park, the common-use area near the Elliott Bay Marina, the Lower Smith Cove Acquisition Area, and the Terminal 91 Bicycle Path. It receives most of its noise, 54 dBA and below, from traffic on the Magnolia Bridge.

Recreational Uses in the Study Area

See Figure 14 for the locations of existing recreational uses in the study area.

Thorndyke Park (Receptor 1), bounded by Thorndyke Avenue West on the west, Magnolia Way West on the east, and north of West Hayes Street, is subjected to noise primarily from Thorndyke Avenue West and secondarily from the Magnolia Bridge. The traffic noise model showed that noise from the Magnolia Bridge was minimal at this location because it was blocked by the Magnolia Bluff and the rows of houses between the park and the bluff.

The Upper Smith Cove Acquisition Area is an undeveloped area adjacent to West Galer Street, immediately south of the western approach to the Magnolia Bridge, with a view of Elliott Bay. It is a potential future park site. Because it is currently not an area of frequent human use, it cannot be quantitatively evaluated for noise impacts, but it would be correct to assume that noise levels at this location will be roughly equivalent to those at Receptors 3 and 4. A follow-up traffic noise impact and mitigation study could be conducted when final plans for development of the site are available.

Smith Cove Park is a small park at 23rd Avenue West and West Marina Place on the shore northeast of the marina. It features park benches, picnic tables, a sundial monument, and a view of Elliott Bay and Terminal 91. Receptor 19 represents the park, although it lies farther away from all proposed Magnolia Bridge alignments. At this distance, traffic noise from the Magnolia Bridge, even under free-flow peak traffic conditions, is nearly inaudible. Project-related noise levels at Smith Cove Park would be lower than at the marina.

The Lower Smith Cove Acquisition Area extends north of West Marina Place to under the Magnolia Bridge, west of 23rd Avenue West, and east of the Magnolia Bluff. It is another undeveloped potential park site currently not an area of human use. It extends as far south of the bridge as Smith Cove Park, and traffic noise from the Magnolia Bridge is similarly low in volume. The shielding effect of the bridge deck creates a “noise shadow” beneath the bridge. At this point, vehicles on the bridge are more palpable than audible, as vibration from the bridge is more noticeable than the muffled traffic noise. As with the Upper Smith Cove Acquisition Area, a follow-up traffic noise impact and mitigation study could be conducted when final plans for development of the site are available.

The Terminal 91 Bicycle Path is located at the northern, eastern, and western perimeter of the Port of Seattle North Bay/Terminal 91 property. It is paved with asphalt and concrete, about 6 to 12 feet wide, which functions as a transportation corridor for bicyclists, runners, and walkers. No recreational amenities are located along the trail. The western leg of the trail lies at the foot of the Magnolia Bluff. The eastern leg passes between Terminal 91 and the BNSF Railway yard. The dominant noise source is Terminal 91 and the railway yard. Traffic noise from the Magnolia Bridge is inaudible in this location because of high background noise from idling trucks, rail yard operations, and pumping stations.

Other Parks and Recreation Land

Seattle Parks and Recreation owns a number of parcels in the project vicinity. These parcels are undeveloped park property located on steep slopes or in the water, including:

- Ten parcels totaling 2.75 acres along the eastern bluff of Magnolia. The parcels, along with privately owned land, make up the greenbelt along the Magnolia hillside.
- Twenty parcels on Queen Anne Hill east of the eastern Magnolia Bridge ramp. The greenbelt on the hill comprises these Seattle Parks and Recreation-owned parcels and city right-of-way. Land adjacent to the eastern bridge ramp is under Seattle Department of Transportation jurisdiction and includes the portion of the hillside recently secured to prevent landslides.
- Tidelands south of Smith Cove Park at North Bay/Terminal 91. These city-owned lands are approximately 440 feet wide and extend approximately 1,500 feet into Elliott Bay. They provide fish and wildlife habitat. No other facilities or amenities are associated with the tideland parcel.

None of these parcels are areas of frequent human use, and this condition is not expected to change throughout the life of the project.

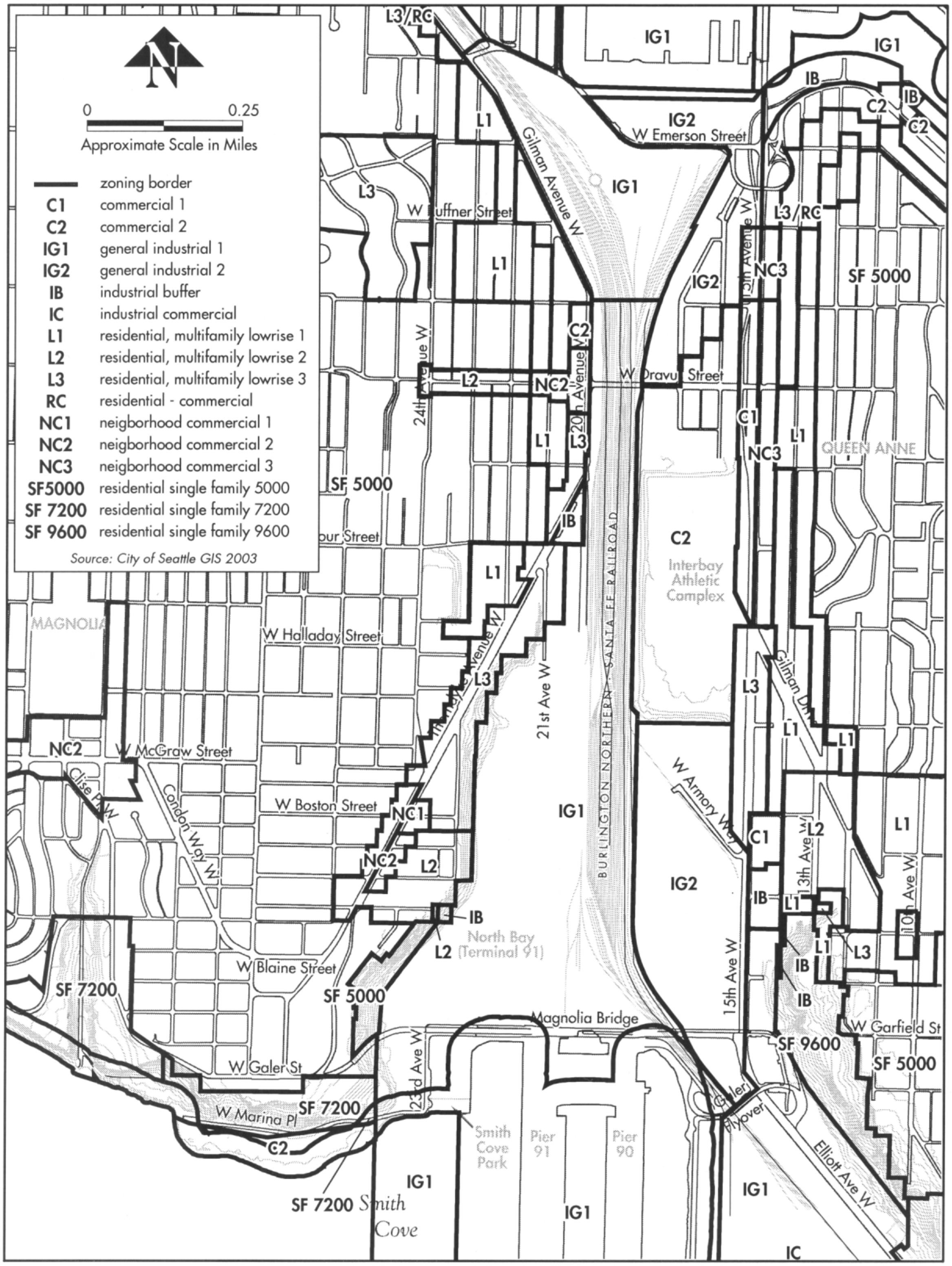


Figure 12
Zoning

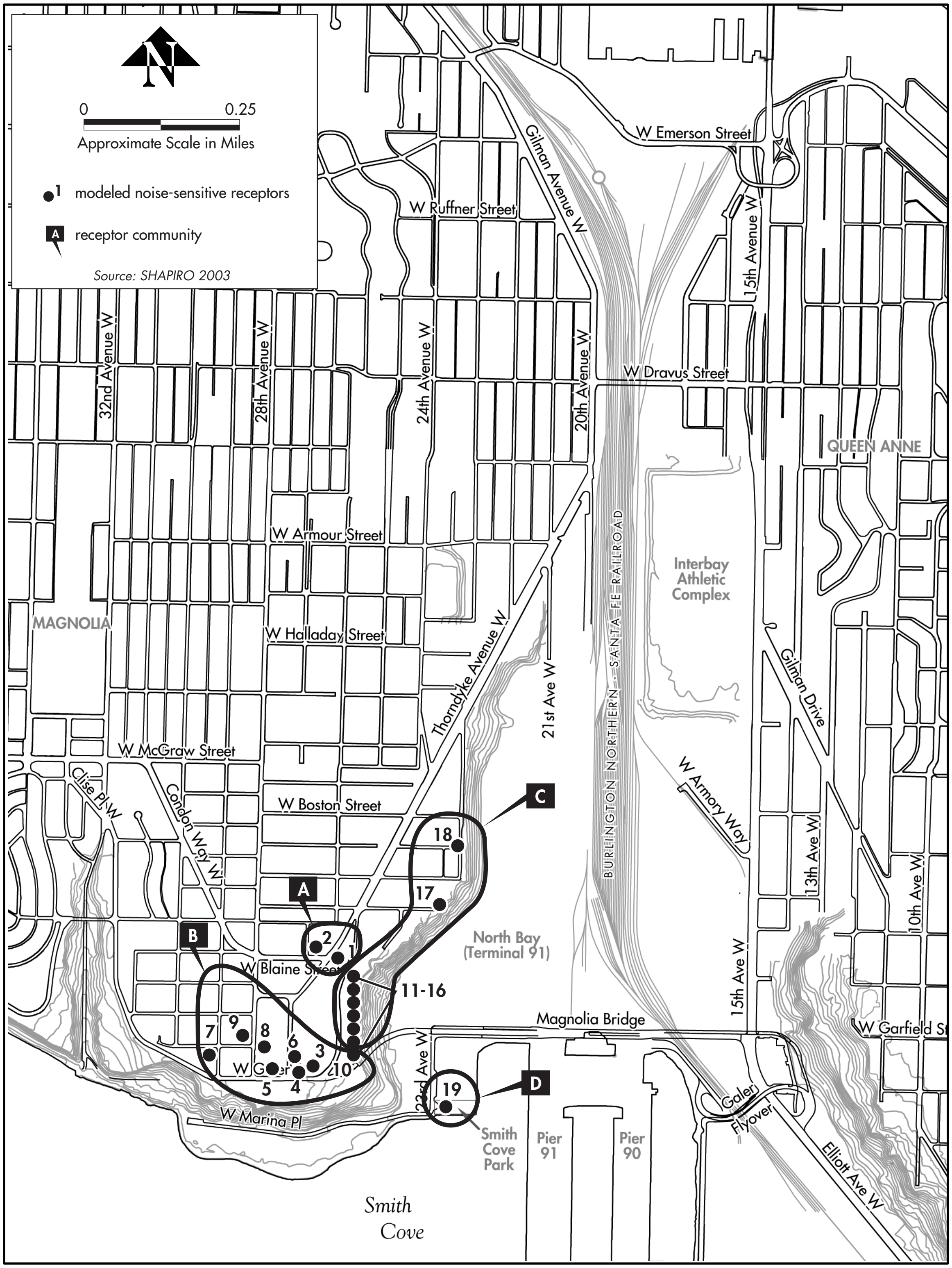


Figure 13
Modeled Sensitive Receptors

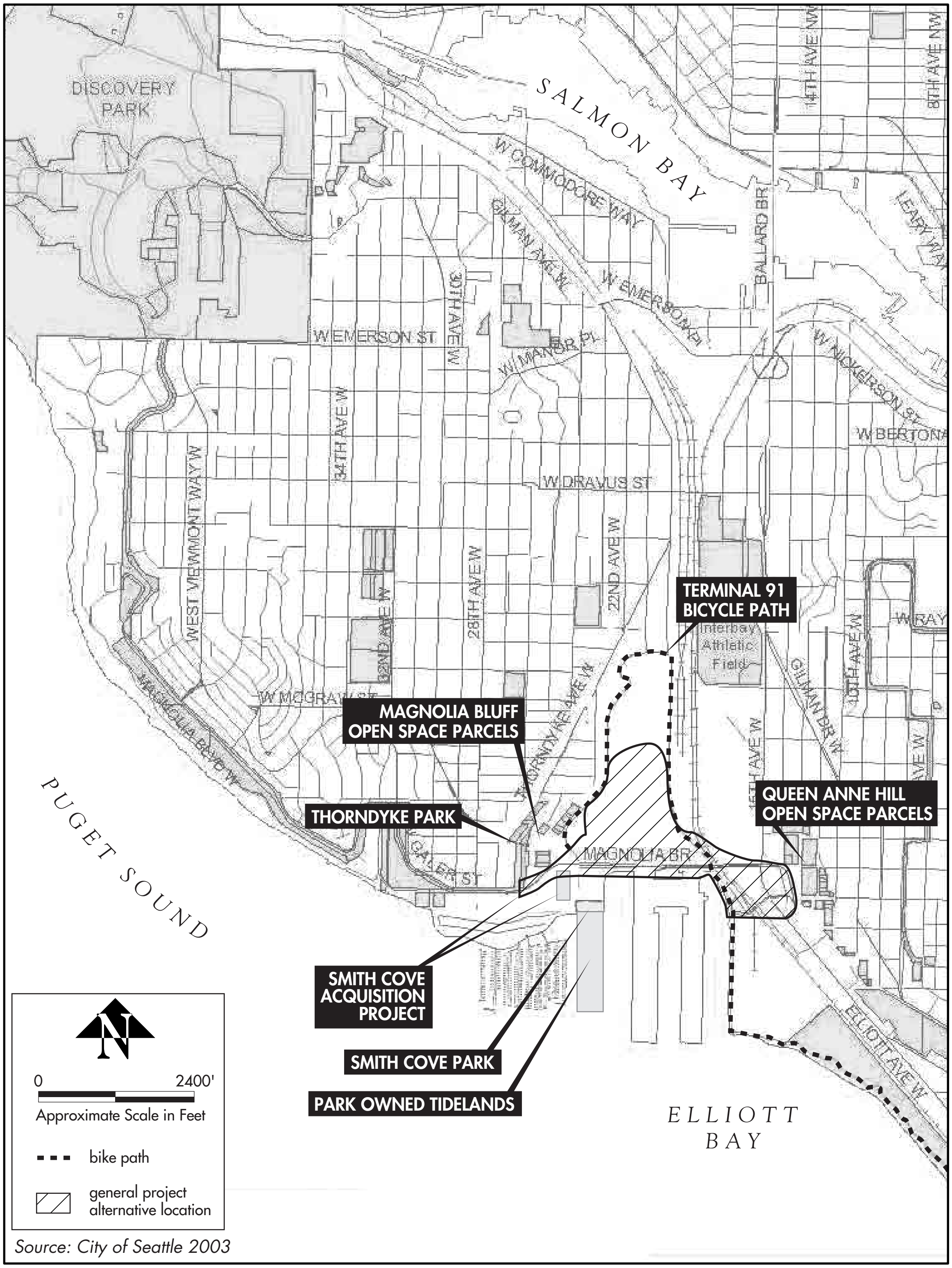


Figure 14
Park, Recreation, and Bike Facilities

Studies and Coordination

The National Environmental Policy Act (NEPA) of 1969 as amended (42 USC 4321) requires that all actions sponsored, funded, permitted, or approved by federal agencies undergo planning to ensure that environmental considerations such as noise impacts are given due weight in project decision-making. In addition, the State Environmental Policy Act (SEPA) mandates a similar procedure for state and local actions. The federal Noise Control Act of 1972 (42 USC 4901 *et seq.*) authorized the establishment of federal noise emission standards. Companion legislation (23 USC 109(i)) directs the Secretary of Transportation to develop and implement traffic noise standards for highway projects.

The Magnolia Bridge Replacement Project is classified as a Type 1 project because it proposes "the construction of a highway at a new location or the physical alteration of an existing highway, which significantly changes either the horizontal or vertical alignment or increases the number of traffic through-lanes" (FHWA - 23 CFR 772.5h; WSDOT 2004a). This noise study has been prepared to assist FHWA in meeting the requirements for a traffic noise abatement analysis for a Type 1 highway project as defined by FHWA and WSDOT.

This study includes descriptions of the methodology used to conduct the analysis, the affected environment and existing noise levels, predicted future noise levels under each alternative, and an analysis of the reasonableness and feasibleness of potential noise mitigation measures.

Studies

According to an EPA study, average noise levels in an urban environment are not hazardous to human hearing (EPA 1974). Urban noise would be more appropriately classified as an annoyance resulting in interference with activity, particularly speech communication. Because most buildings offer effective noise shielding for their occupants, this discipline report focuses on annoyance and interference with exterior activities resulting from operational noise associated with the project alternatives.

Noise Regulations

Federal and State

Applicable noise regulations and agency guidelines provide a basis for defining and evaluating noise impacts and mitigation for the proposed project. WSDOT and FHWA establish noise regulations and guidelines for federally funded roadway projects in Washington. Noise regulations and guidelines specify ambient or outdoor noise levels.

WSDOT has adopted the FHWA two-part test to evaluate traffic noise impacts (23 CFR §772). According to guidelines, traffic noise impacts occur when:

- predicted traffic noise levels approach or exceed the noise abatement criteria in Table 2, or
- predicted traffic noise levels substantially exceed the existing noise levels.

WSDOT defines “approach” to be 1 dBA below the FHWA noise abatement criteria. WSDOT also defines “substantially exceed” as a 15 dBA or greater increase over existing noise levels (WSDOT 2001). Noise levels in this study are not predicted to substantially exceed existing conditions at any location in the study area.

Table 2
Noise Abatement Criteria

Activity Category	L_{eq} in dBA	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)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Note: Noise generated by construction or maintenance during daytime hours is not subject to any state or federal regulations during daytime hours.

Source: 23 CFR Part 772.

The FHWA noise abatement criteria are noise standards that specify exterior noise levels for various land activity categories, as presented in Table 2. For residences, parks, schools, churches, and similar areas, the NAC is 67 dBA. Because approach is defined to be within 1 dBA, traffic noise impacts at residences (in the state of Washington) would occur if predicted noise levels are 66 dBA or higher.

City of Seattle

Construction noise is subject to local regulations within the City of Seattle. Noise from construction equipment (as measured from the real property of another person or at a distance of 50 feet, whichever is greater) may exceed the maximum permissible sound level by up to 25 dBA Leq, depending on the type of equipment, between the hours of 7 a.m. and 10 p.m. on weekdays and 9 a.m. and 10 p.m. on weekends. Noise from impact-type construction equipment, such as pile drivers and jackhammers, may not exceed 90 dBA Leq when operated continuously. Noise levels above 99 dBA Leq are prohibited (SMC 25.08.425).

Data Sources

The following data sources were used for the TNM:

- Traffic numbers used to model the existing, future no-build, and proposed alignment noise levels were provided by HNTB Engineers (see Appendix B for traffic volume data input in the TNM).

- FHWA regulations and guidance were used as a reference for proper site selection, measurement procedures, analysis techniques, and determination of impacts (WSDOT 2004a).
- WSDOT (2004b) Environmental Procedures Manual was used as a reference for preparing this noise discipline report.
- City of Seattle Construction Noise Regulations (SMC 25.08.425) were also consulted.

Major Assumptions

Key assumptions used for the TNM include:

- TNM default values of 50 percent relative humidity, 20°C temperature, and average pavement type were used.
- The height above ground for all receptors was 1.5 meters (approximately 5 feet), which corresponds to ear height.
- The ground surface for the overall study area was assumed to be pavement.

Table 3 compares existing noise levels to the predicted design hour L_{eq} noise levels at 19 receptors in the study area for all alternatives under consideration. The results of this analysis are summarized below.

No Build Alternative

Compared with existing noise measurements, noise levels in 2030 could increase by 1 to 4 dBA at all receptors analyzed (Table 3). Noise levels are predicted to increase by 3 to 4 dBA at residences along West Galer Street (Community B) immediately west of the Magnolia Bridge and by 3 to 5 dBA at residences along Thorndyke Avenue West (Community A) north of the three-way stop with West Blaine Street. At Smith Cove Park (Community D, Receptor 19) south of the bridge, traffic noise is predicted to increase by 1 dBA.

The increase in traffic noise would result from the growth in traffic volumes through 2030 on Magnolia Bridge and surrounding streets, primarily West Galer Street. Noise levels equal or exceed the NAC at five receptor locations (Community B, Receptors 3, 4, 5, 6, and 10) along the existing West Galer Street alignment. The projected increase in traffic volumes by 2030 would increase noise levels at these receptor locations and others within the study area. Under the No Build Alternative, noise levels in 2030 would exceed the NAC by 3 to 4 dBA at five locations in Community B: Receptors 3, 4, 5, 6, and 10 (Table 3).

Alternative A

Alternative A has a similar alignment to the existing Magnolia Bridge and was modeled with the same traffic volumes as the No Build Alternative 2030 prediction. Thus, the predicted noise levels under Alternative A are similar to those predicted for the No Build Alternative in 2030. Compared to existing conditions, noise levels in 2030 are predicted to increase by 2 to 4 dBA at all receptors analyzed.

Areas along the westernmost end of Magnolia Bridge and those closest to West Galer Street (Community B, Receptors 3, 4, 5, 6, and 10) would experience a noise increase of 3 to 4 dBA, which would exceed the NAC (Table 3). These areas, however, are expected to experience a nearly inaudible difference in noise levels over existing conditions.

The shift of the bridge to the south under Alternative A provides a slight reduction in noise levels compared to the No Build Alternative for the residences on the western bluff above the bridge (Community C). The reduction would be less than 1 dBA, which is not an audible difference. Traffic noise at Smith Cove Park (Community D Receptor 19) could increase by 2 dBA over existing conditions but would not exceed the NAC.

Noise levels would exceed the NAC by 3 to 4 dBA at the same locations as described under the No Build Alternative (Table 3). All of the affected sites would receive most of their noise from West Galer Street. Alternative A would not create noise impacts that do not already exist or that would not occur with the No Build Alternative. Therefore, no significant noise consequences would be incurred by building this alternative compared to taking no action.

Table 3
Predicted Design-Year Leq Traffic Noise Levels (in dBA)

Receptor Number	Description of Receptor Location	Community	Number of Residences	Source of Noise[1]	WSDOT NAC	Existing Conditions	2030 No Action	Distance to Receptor (feet)	Alt. A	Distance to Receptor (feet)[3]	Alt. C	Distance to Receptor (feet)	Alt. D	Distance to Receptor (feet)
1	Thorndyke Park north of W Blaine St (first row from Thorndyke Ave W)	A	N/A	Thorndyke	66	62	65	40	65	40	65	40	65	40
2	Second row receptor west from Thorndyke Ave W, north of W Blaine St	A	11	Thorndyke	66	61	65	72	65	72	65	72	65	72
3	W Galer St and Magnolia Bridge (first row from W Galer St, second row from the western bluff)	B	2	Galer	66	**66**	**70**	55	**70**	55	**70**	55	**68**	55
4	First row from W Galer St, east of Thorndyke Ave W	B	3	Galer	66	**68**	**71**	50	**71**	50	**71**	50	**70**	50
5	First row from W Galer St, east of 28th Ave W	B	2	Galer	66	**67**	**70**	55	**70**	55	**70**	55	**70**	55
6	Second row from W Galer St, east of Thorndyke Ave W	B	2	Galer	66	**67**	**70**	82	**70**	82	**70**	82	**69**	82
7	Second row from W Galer St, west of 28th Ave W	B	3	Galer	66	58	61	120	62	120	61	120	62	120
8	Third row from W Galer St, east of 28th Ave W	B	4	Galer	66	62	65	330	65	330	65	330	65	330
9	Third row from W Galer St, west of 28th Ave W	B	4	Galer	66	60	63	275	63	275	63	275	63	275
10	First house on western bluff of Magnolia (first row from W Galer St)	B	1	Galer	66	**67**	**70**	30	**71**	30	**69**	30	**67**	30
11	Second house on western bluff of Magnolia	C	1	Approach	66	61	65	35	65	111	64	78	62	80
12	Third house on western bluff of Magnolia	C	1	Approach	66	60	63	70	63	163	63	123	61	128
13	Fourth house on western bluff of Magnolia	C	1	Approach	66	59	62	108	62	205	62	163	60	170
14	Fifth house on western bluff of Magnolia	C	1	Bridge	66	58	61	147	61	253	61	205	59	211
15	Sixth house on western bluff of Magnolia	C	1	Bridge	66	58	61	164	61	311	61	219	60	212
16	Seventh house on western bluff of Magnolia	C	1	Bridge	66	57	60	192	60	357	60	240	59	242
17	Multi-family residence at eastern end of W Plymouth St	C	9	Bridge	66	54	57	>500	57	>500	61	142	60	>500
18	Single-family residence at W Crockett St and 23rd Ave W	C	8	Bridge	66	53	56	>500	56	>500	57	241	57	>500

Receptor Number	Description of Receptor Location	Community	Number of Residences	Source of Noise[1]	WSDOT NAC	Existing Conditions	2030 No Action	Distance to Receptor (feet)	Alt. A	Distance to Receptor (feet)[3]	Alt. C	Distance to Receptor (feet)	Alt. D	Distance to Receptor (feet)
19	Smith Cove Park, Elliott Bay Marina access area, Smith Cove Acquisition Area (Lower)	D	N/A	Bridge	66[2]	54	55	>500	56	>500	56	>500	55	>500

Bold = Noise level equals or exceeds the Noise Abatement Criteria (NAC) of 66 dBA.

Notes: 1. “Source of Noise” is the source of traffic noise most significant to each noise receptor. “Thorndyke” refers to Thorndyke Avenue West, “Galer” to West Galer Street, “Bridge” is the Magnolia Bridge, and “Approach” refers to the Magnolia Bridge approaches or transition from the bridge to West Galer Street.

2. Two NAC levels apply to Community D: the Residential NAC of 66 dBA applies to Smith Cove Park and the Lower Smith Cove Acquisition Are if it is developed for use as a public park; the Commercial NAC of 71 dBA applies to the Elliott Bay Marina and to the Lower Smith Cove Acquisition Area while it remains undeveloped. To preserve the public interest, the more restrictive Residential NAC is used for the table.

3. “Distance to Receptor” is the shortest straight-line distance from the property line of each receptor to the Source of Noise as presented in column 5 of the table. For many of the receptors analyzed this distance is different for the various alternative bridge designs. This distance is one of the most critical factors in comparing traffic noise levels between alternatives.

Alternative C

Alternative C was modeled with the same traffic volumes as the No Build Alternative and Alternative A. For this option, the Magnolia Bridge would extend farther north and west than the other alternatives. Receptors 17 and 18 (Community C) represent residences along the western bluff above Magnolia Bridge at the closest approach of the bridge as proposed in Alternative C. Traffic noise increases at these sites are predicted to be the largest in the study area, 4 to 7 dBA over existing conditions, because of the proximity of the new bridge. The predicted noise levels of 57 and 61 dBA at Receptors 18 and 17, respectively, would be perceptible but well below the NAC. Noise levels at other receptors in Community C are predicted to increase by 3 to 4 dBA.

Under Alternative C, noise would increase by 3 to 4 dBA at residences along West Galer Street (Community B) and by 3 to 5 dBA along Thorndyke Avenue West north of West Blaine Street (Community A). These increases would be similar to those resulting from the No Build Alternative and Alternative A. At Smith Cove Park (Community D), noise levels are predicted to rise by 2 dBA but would be below the NAC.

Noise levels would exceed the NAC by 2 to 4 dBA at the same locations as described under the No Build Alternative and Alternative A (Table 3), with West Galer Street as the dominant noise source. Alternative C would not create noise impacts that do not already exist or that would not occur with the No Build Alternative. Therefore, no significant noise consequences would be incurred by building this alternative compared to taking no action.

Alternative D

Alternative D was modeled with the same traffic volumes as the No Build Alternative and Alternatives A and C. Traffic noise is predicted to increase by 1 to 6 dBA throughout the study area. For this alternative, Magnolia Bridge would extend farther north than the No Build Alternative and Alternative A but not as far north as Alternative C. Therefore, similar to Alternative C, the highest increases in noise levels in 2030 are predicted to be 4 to 6 dBA at the residences on the western bluff above Magnolia Bridge (Community C) north of West Blaine Street, represented by Receptors 17 and 18. As in the other alternatives, noise levels would increase by 3 to 5 dBA along Thorndyke Avenue West north of West Blaine Street (Community A). Residences in Community C south of West Blaine Street would experience noise increases of 2 to 3 dBA. Noise is predicted to increase by 1 to 4 dBA at the residences along West Galer Street (Community B).

Noise levels would equal or exceed the NAC by 1 to 4 dBA at the same locations as described under the No Build Alternative and Alternatives A and C (Table 3). These impact sites would receive most of their noise from West Galer Street. Alternative D would not create noise impacts that do not already exist or that would not occur with the No Build Alternative. Therefore, no significant noise consequences would be incurred by building this alternative compared to taking no action.

General Discussion of Mitigation Measures

Noise can be controlled at three locations: (1) at the source, such as with mufflers and quieter engines; (2) along the noise path, with barriers; and (3) at the receptor, with insulation. Noise abatement is necessary only where frequent human use occurs and where a lower noise level would have benefits (U.S. Department of Transportation 1982).

FHWA provides guidance for including mitigation recommendations in traffic noise studies (USDOT 1995). FHWA recognizes six noise mitigation measures, which can be used with interstate construction funds:

1) Traffic management measures (e.g., traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive land designations).
2) Alteration of horizontal and vertical alignments.
3) Acquisition of property rights (either in fee or lesser interest) for construction of noise barriers.
4) Construction of noise barriers (including landscaping for aesthetic purposes) whether within or outside the highway right-of-way. Interstate construction funds may not be used for landscaping.
5) Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely affected by traffic noise. This measure may be included in Type I projects only.
6) Noise insulation of public use or nonprofit institutional structures.

Only those mitigation measures that might be considered for implementation should be recommended as feasible in the noise study (USDOT 1995). For instance buffer zones, the fifth method in the above list, would clearly be infeasible for urban projects in which all of the property that might be affected by traffic noise is already developed before the project starts. Alteration of vertical and horizontal alignments is also rarely shown to be feasible, since such redesigns can seldom be shown to fit the needs of the project. Noise insulation of buildings would not be considered for this project because there are no structures in the impacted community that would qualify for this method.

WSDOT requires that at least four of these six mitigation measures be considered for Washington State-funded roadway projects:

1) Traffic management measures (e.g., traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, and modified speed limits).
2) Change of alignment either vertical or horizontal.
3) Construction of noise barriers.

4) Acquisition of property. Because WSDOT does not specify whether the property acquisition is intended for the third mitigation method in the FHWA list above (construction of barriers) or for the fifth (buffer zones), both are usually considered for WSDOT projects.

In the case where traffic noise analysis predicts severe noise impacts, other mitigation measures may be considered for WSDOT projects. No severe noise impacts are predicted for this project.

If a mitigation measure is to be recommended for a project, it must be shown to be feasible and reasonable. A mitigation method is feasible if it would be effective in reducing noise levels by a factor predetermined by WSDOT (see the discussion of noise barrier feasibility below). If the mitigation method can be shown to be feasible, it must be evaluated for reasonableness, which is a cost-effectiveness determination (WSDOT 2004b; Appendix C).

All mitigation measures were evaluated as required by FHWA and WSDOT for their potential to reduce noise impacts from the proposed project. The results of the evaluation are summarized below for each of the proposed alternatives.

Mitigation for the No Build Alternative

No mitigation would be required under the No Build Alternative.

Mitigation for Alternatives A, C, and D

Under Alternatives A, C, and D noise impacts are predicted to occur in the same locations from the same source; therefore, the analysis of mitigation measures is the same for all three build alternatives. Under Alternatives A, C, and D, noise levels at Receptors 3, 4, 5, 6, and 10 (Community B) are predicted to exceed the NAC. Mitigation measures for the other communities were not evaluated because no noise impacts would occur in those areas.

Traffic Management Measures

These measures include time restrictions or traffic-control devices and signs that prohibit certain vehicle types (such as heavy trucks), modified speed limits, and exclusive land designations. Noise impacts could be reduced by land use controls throughout the study area. The City of Seattle could implement land use plans and zoning that would restrict future land uses in the study area to those that are compatible with road noise.

Restricting vehicle types and lowering speed limits within the study area could worsen congestion on other routes to and from the area, rendering these measures infeasible. Land use controls and zoning would not apply to developed property. A transportation system management plan to encourage the use of carpools, public transit, and shuttle buses would reduce vehicle trips and, subsequently, traffic noise. This last option is considered the only feasible mitigation measure to minimize the project's operational noise; however, alterations to the regional transportation plan would neither be implemented nor funded by this project.

Realigning the Roadway

Roadway designs can sometimes be modified to minimize noise impacts by providing the maximum possible distance between traffic and receptors. Feasible roadway shifts for this purpose are usually horizontal, but a change in elevation, especially if the roadway can be moved below ground level, can also be effective. This method of mitigation is usually rendered infeasible because it conflicts with the optimum design for traffic flow and safety considerations. It is also usually unreasonable from the cost-benefit standpoint, particularly for vertical alignment changes.

This mitigation measure was found to be infeasible for this project. An alignment study process identified the specific bridge replacement alternatives to be studied in the Magnolia Bridge Replacement Environmental Impact Statement (EIS). Twenty-five concepts were developed and screened against the project goals and objectives. The alignments considered in this study have been determined by the project design team to be the only options capable of meeting the project's purpose and need.

Noise Barriers

Noise barriers include noise walls, berms, and buildings that are not sensitive to noise. The effectiveness of a noise barrier is determined by its height and length and by the topography of the project site. To be effective, the barrier must block the line of sight between the highest point of a noise source, such as a truck's exhaust stack, and the highest part of a receptor. It must be long enough to prevent sounds from passing around the ends, have no openings, such as driveway connections or intersections with other streets, and be dense enough so that noise would not be transmitted through it (Barry and Reagan 1978).

WSDOT evaluates many factors to determine whether barriers would be feasible and reasonable. The evaluation consists of engineering feasibility of whether barriers could be built in a location to achieve a noise reduction of at least 5 dBA to the row of houses closest to the roadway, with one receptor having at least a 7-dBA reduction. Determination of reasonableness includes the number of sensitive receptors that benefit; cost-effectiveness of the barriers; and concerns such as the desires of nearby residents, aesthetics, and safety. One critical WSDOT test for reasonableness is to divide the total estimated cost of a proposed barrier by the number of sensitive receptors that would benefit with at least a 3-dB noise reduction from the barrier (a measure of cost-effectiveness). A base of $22,600 is allowed per household if the design year traffic noise level is 66 dBA. However, as the predicted future noise level increases, it is reasonable to carry out more costly measures. For each decibel increase resulting from the proposed project in the design year, an additional $2,200 is allowed per household. For example, if the design year noise level is 69 dBA, then $29,200 would be allowed. If the result of that computation is less than the allowed cost per household, construction of the barrier is considered cost-effective. Other reasonableness considerations are derived through public meetings and public review of the Environmental Impact Statement (WSDOT 2004a).

This mitigation measure was found to be infeasible for this project. The receptors predicted to experience impacts under Alternative A are first and second row structures along West Galer Street as it transitions into the Magnolia Bridge. Table 3 shows that the predicted impacts for this project originate with traffic from West

Galer Street, not from the Magnolia Bridge. A noise wall on West Galer Street within the study area is infeasible for the following reasons:

- No right-of-way exists to build a barrier. Residential properties and the proposed public park at the Upper Smith Cove Acquisition Area line the roadway for its entire length.
- For a noise wall to be effective, its length in each direction needs to be approximately four times the distance from the receptor to the wall. In a flat location, a receptor 40 feet behind a wall would require a wall 320 feet long in order to be feasible. Even narrow breaks in a noise wall would render it useless (USDOT 1995). An effective (unbroken) noise wall on West Galer Street would block driveways to residences and extend through intersections at Magnolia Way West, Thorndyke Avenue West, and 28th Avenue West. Such a wall would be over 850 feet long and would cost in excess of $400,000. As shown in Table 3, a maximum of 9 households represented by noise receptors 3 through 6 would benefit. The cost would exceed the amount allowed by WSDOT per benefited household, as stated above. Such a wall is unreasonable.
- A noise wall constructed to protect Receptor 10 would benefit only that receptor and would therefore not meet the WSDOT reasonableness criteria of the allowable cost per benefited household.
- A noise wall at Receptor 10 would be infeasible because the roadway declines at a sharp angle at the approach to the bridge. It would also be infeasible because noise from West Galer Street would skirt the barrier at its required termination point at the intersection of West Galer Street and Magnolia Way.
- For all communities, noise levels decrease with their distance from West Galer Street. Of the residences on the western bluff, only Receptor 10 of Community B, the closest of these houses to West Galer Street, is predicted to experience a noise impact under any of the proposed future conditions. As described above, the predicted impacts on Receptor 10 originate with traffic from West Galer Street, not from the Magnolia Bridge; therefore, a noise wall to reduce noise from the Magnolia Bridge would be ineffective.

Land Acquisition for Noise Buffers or Barriers

Under this mitigation method, right-of-way for the proposed project would be widened by purchasing land adjacent to those roadways with impacts at receptor locations. The purchased property would be used to construct noise barriers or set aside to prevent the possibility that noise-sensitive receptors might be built there in the future.

This mitigation measure was found to be infeasible for this project. There is no undeveloped land in the impacted community suitable to this purpose. West Galer Street is bordered by residential properties at all points within the study area.

No Build Alternative

Under the No Build Alternative, small improvements would be made to the existing Magnolia Bridge. Construction impacts are expected to be brief and less than those outlined in Alternative A below.

Alternative A

Construction Impacts

Construction activities under Alternative A would generate noise. Noise during the construction period could be bothersome to nearby residents and businesses. For example, construction noise as well as vibration may affect businesses that depend on low ambient noise (such as restaurants, music recording, and golf courses) and that are sensitive to vibration. (See the Geology and Soils Discipline Report for discussion of construction vibration effects and the Social, Economic, and Relocation Discipline Report for information on specific businesses that could be affected.) Construction workers also would be subject to construction noise while working on the site. However, any impacts from construction noise would be temporary and would not constitute a noise impact. Construction is usually carried out in several discrete steps, each of which has its own mix of equipment and consequently its own noise characteristics. Construction under this alternative would involve site preparation and grading, construction of multiple-story support structures, removal or reconditioning of old paved surfaces, pile-driving, and paving.

The most prevalent noise sources during construction would be the pile driving and various engines, particularly diesel, that power equipment. As shown in Table 4, noise levels from construction equipment range from 69 to 106 dBA at 50 feet (EPA 1971). Construction noise at receptors farther away would decrease at a rate of approximately 6 dBA per doubled distance from the source. Extrapolating from Table 4, noise levels from construction equipment would range from 57 to 94 dBA at 200 feet. Actual noise levels at any receptor would depend on what type of equipment is present, the number of pieces of equipment, how often the equipment operates, location within the construction area, and distance to receptors. Because construction equipment would not constantly operate at distances of 50 feet, average L_{eq} noise levels during the day would be less than the noise levels presented in Table 4.

Table 4
Construction Equipment Noise Ranges

Equipment	Examples	Noise Level (dBA) at 50 feet
Earth Moving	Compactors, loaders, backhoes, tractors, graders, pavers	73-96
Materials Handling	Concrete mixers and pumps, cranes, derricks	74-88
Stationary	Pumps, compressors, generators	69-87
Hauling	Trucks	83-94
Impact Equipment	Pile-drivers	95-106
Impact Tools	Jackhammers, rock drills, pneumatic wrenches	81-98

Source: EPA 1971.

Mitigation Measures

For all construction activities, mitigation measures would be implemented so that the maximum permissible construction noise levels specified in the Seattle noise control code (SMC 25.08.425) would not be exceeded.

Construction noise could be reduced if the City recommends the use of high performance silencers on engines and quieter equipment or construction practices. Also, turning off equipment when not in use would reduce noise levels. To reduce construction noise at nearby receptors, construction-industry best management practices would be incorporated into construction plans and contractor specifications. The proposed project would include the following construction noise mitigation measures:

- The City could explore the feasibility of using less noisy alternatives to pile driving. For example, pre-drilling a pile hole using an auger to place the pile at or near its design depth would reduce noise levels by 5 to 10 dBA. In addition, more specific construction times could be designated for pile-driving activities.
- Equipping engines of construction equipment with adequate mufflers, intake silencers, or engine enclosures would reduce their noise by 5 to 10 dBA (EPA 1971).
- Specifying the quietest equipment available would reduce noise by 5 to 10 dBA.
- Turning off construction equipment when not in use for long periods of time would eliminate noise from construction equipment during those time periods.
- Requiring contractors to maintain all equipment, and training their equipment operators, would reduce noise levels and increase efficiency of operation.
- Locating stationary equipment away from receiving properties would decrease noise from that equipment in relation to the increased distance.

Alternative C

See construction impact and mitigation discussion under Alternative A.

Alternative D

See construction impact and mitigation discussion under Alternative A.

Affected Environment

The dominant noise source in the study area is vehicular traffic on West Galer Street and across the Magnolia Bridge. Existing noise sources at nearby businesses, parks, and offices produce minor noise levels compared to existing traffic.

Ambient noise levels were measured at numerous locations in the study area to accurately establish existing noise conditions. These measurements indicate that existing noise levels in the study area range from a low of 54 dBA near the Elliott Bay Marina to a high of 68 dBA at a residence located on West Galer Street east of Thorndyke Avenue West. The majority of the existing noise levels fall below the NAC of 66 dBA for residences, parks, schools, churches, and similar areas (see Table 3).

Operational Impacts

Five noise-sensitive receptors in Community B, which represent 10 residences, are predicted to experience traffic noise impacts from this project. Table 5 summarizes the relative noise levels from the proposed alternatives. Note that all of these receptors will be subjected to noise levels that exceed the WSDOT NAC regardless of which alternative is chosen or whether the project is built.

Table 5
Summary of Noise Levels at Affected Receptors in dBA

Receptor Number	2030 No Build	Alternative A	Alternative C	Alternative D	Source of Noise
3	70	70	70	68	W.Galer St.
4	71	71	71	70	W.Galer St.
5	70	70	70	70	W.Galer St.
6	70	70	70	69	W.Galer St.
10	70	71	69	67	W.Galer St.

No Build Alternative

Compared with existing noise measurements, noise levels in 2030 could increase by 4 dBA at all receptors analyzed. The increase in traffic noise would result from the growth in traffic volumes through 2030 on Magnolia Bridge and surrounding streets, most significantly West Galer Street. Under the No Build Alternative, noise levels in 2030 would exceed the NAC by 3 to 4 dBA at five locations in Community B: Receptors 3, 4, 5, 6, and 10 (Table 3).

Alternative A

Alternative A has a similar alignment to the existing Magnolia Bridge and was modeled with the same traffic volumes as the No Build Alternative 2030 prediction. Thus, the predicted noise levels under Alternative A are similar to those predicted for the No Build Alternative in 2030. Compared to existing conditions, noise levels in 2030 are predicted to increase by 2 to 4 dBA at all receptors analyzed.

Areas along the westernmost end of Magnolia Bridge and those closest to West Galer Street (Community B, Receptors 3, 4, 5, 6, and 10) would experience a noise increase of 3 to 4 dBA, which would exceed the NAC. Residents in these areas, however, are expected to experience a nearly inaudible difference in noise levels over existing conditions.

Noise levels would exceed the NAC by 3 to 4 dBA in the same locations as the No Build Alternative. Alternative A would not create noise impacts that do not already exist or that would not occur with the No Build Alternative. Therefore, no significant noise consequences would be incurred by building this alternative compared to taking no action.

Alternative C

Alternative C was modeled with the same traffic volumes as the No Build Alternative and Alternative A. For this option, the Magnolia Bridge would extend farther north and west than the other alternatives. Receptors 17 and 18 (Community C) represent residences along the western bluff above Magnolia Bridge at the closest approach of the bridge as proposed in Alternative C. Traffic noise increases at these sites are predicted to be the highest in the study area, 4 to 7 dBA over existing conditions, because of the proximity of the new bridge. The predicted noise levels of 57 and 61 dBA at Receptors 18 and 17, respectively, would be perceptible but well below the NAC. Noise levels at other receptors in Community C are predicted to increase by 3 to 4 dBA.

Noise levels would exceed the NAC by 2 to 4 dBA at the same locations as described under the No Build Alternative and Alternative A. Alternative C would not create noise impacts that do not already exist or that not would occur with the No Build Alternative. Therefore, no significant noise consequences would be incurred by building this alternative compared to taking no action.

Alternative D

Alternative D was modeled with the same traffic volumes as the No Build Alternative and Alternatives A and C. Traffic noise is predicted to increase by 1 to 6 dBA throughout the study area. For this alternative, the Magnolia Bridge would extend farther north than the No Build Alternative and Alternative A but not as far as Alternative C. Therefore, similar to Alternative C, the highest increases in noise levels in 2030 are predicted to be 4 to 6 dBA at the residences on the western bluff above Magnolia Bridge (Community C) north of West Blaine Street, represented by Receptors 17 and 18.

Noise levels would equal or exceed the NAC by 1 to 4 dBA at the same locations as the No Build Alternative and Alternatives A and C. Alternative D would not create noise impacts that do not already exist or that would not occur with the No Build Alternative. Therefore, no significant noise consequences would be incurred by building this alternative compared to taking no action.

Construction Impacts

Construction activities under the Build Alternatives would generate noise. Any effect from construction noise would be temporary and would not constitute a noise impact. Pile driving, however, would be intermittently intrusive throughout the construction period and could interfere with face-to-face or telephone conversations and disrupt day sleepers and work that requires intense concentration at distances less than 500 feet from the construction area.

Secondary and Cumulative Impacts

No secondary noise impacts have been identified. The project alternatives would not induce growth and would not contribute to future increased noise in the Magnolia, Interbay, and Queen Anne areas.

The traffic noise impact analysis in this discipline report is based on projected future traffic volumes for the study area, as well as on forecasted background traffic growth and programmed transportation improvements. As such, this analysis includes much of the projected cumulative noise effects expected by 2030. However, the proposed Seattle Monorail Project could result in localized noise increases in the study area, particularly along the 15th Avenue West corridor.

Mitigation Measures

Operational Mitigation

No Build Alternative

No mitigation would be required for the No Build Alternative.

Build Alternatives A, C, and D

Receptors 3, 4, 5, 6, and 10 (Community B) are predicted to exceed the NAC under Alternatives A, C, and D. The following mitigation measures were considered:

Traffic Management Measures

A transportation system management plan to encourage the use of carpools, public transit, and shuttle buses would reduce vehicle trips and, subsequently, traffic noise. It is the only feasible mitigation measure to minimize the project's operational noise impacts; however, alterations to the regional transportation plan would neither be implemented nor funded by this project.

Realigning the Roadway

This mitigation measure was found to be infeasible for this project. The alignments in this study are considered by the project design team to be the only options capable of meeting the project's purpose and need .

Noise Barriers

This mitigation measure was found to be infeasible for this project. The receptors predicted to experience impacts from this project under all alternatives are the first and second row structures along West Galer Street from 30th Avenue West to the Magnolia Bridge. The analysis shows that the dominant source of noise for predicted noise impacts to these receptors is West Galer Street. A noise wall at this point on West Galer Street is infeasible due to inadequate right-of-way to build the barrier and interference with access to driveways and the intersections at Magnolia Way West, Thorndyke Avenue West, and 28th Avenue West.

Land Acquisition for Noise Buffers or Barriers

This mitigation measure was found to be infeasible for this project. The proposed roadways are bordered by residential properties, which would be unreasonably expensive to acquire for the purpose of noise mitigation.

Construction Mitigation

For all Build Alternatives, a construction management plan with an expanded noise control section would be prepared. The Seattle Department of Planning and Development would approve the specifications for noise control during construction. Construction industry best management practices would be incorporated into contractor specifications to reduce construction noise at nearby receptors. Specific recommendations would include, but not be limited to, the following: minimizing noisier construction activities, designating specific pile-driving times, using high performance silencers on engines, using quieter equipment or construction practices, such as augers to pre-drill pile holes, and turning off equipment when not in use.

References

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Appendix A - Field Measurements and Traffic Counts

Receiver 01
Thorndyke Park

NOISE MEASUREMENT DATA SHEET

#2

Shapiro & Associates, Inc. - Seattle, WA

Project Name/Number: Magnolia
Date/Time: 11/5/03 11:50
Data collected by: SM/JD

EQUIPMENT INFORMATION

Sound Meter: Larson-Davis Model 870, SN 870A0204
Microphone: Model 2560 SN 2948
Weighting: A
Response Time: Slow
Microphone Height: 5'

MISCELLANEOUS INFORMATION

Wind speed/Direction: 0
Ground Cover: pavement
Road Conditions: dry
Interval Length: 15 min
Posted MPH/Actual MPH:

RESULTS

Interval Number			
Leq	55		
Lmax	70		
Lmin	44		
Lsel	84		
L10	58		
L90	46		

TRAFFIC VOLUMES

96

Direction	Type	Number
Thorndyke N	Autos	11
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

Direction	Type	Number
Blaine E →	Autos	13
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

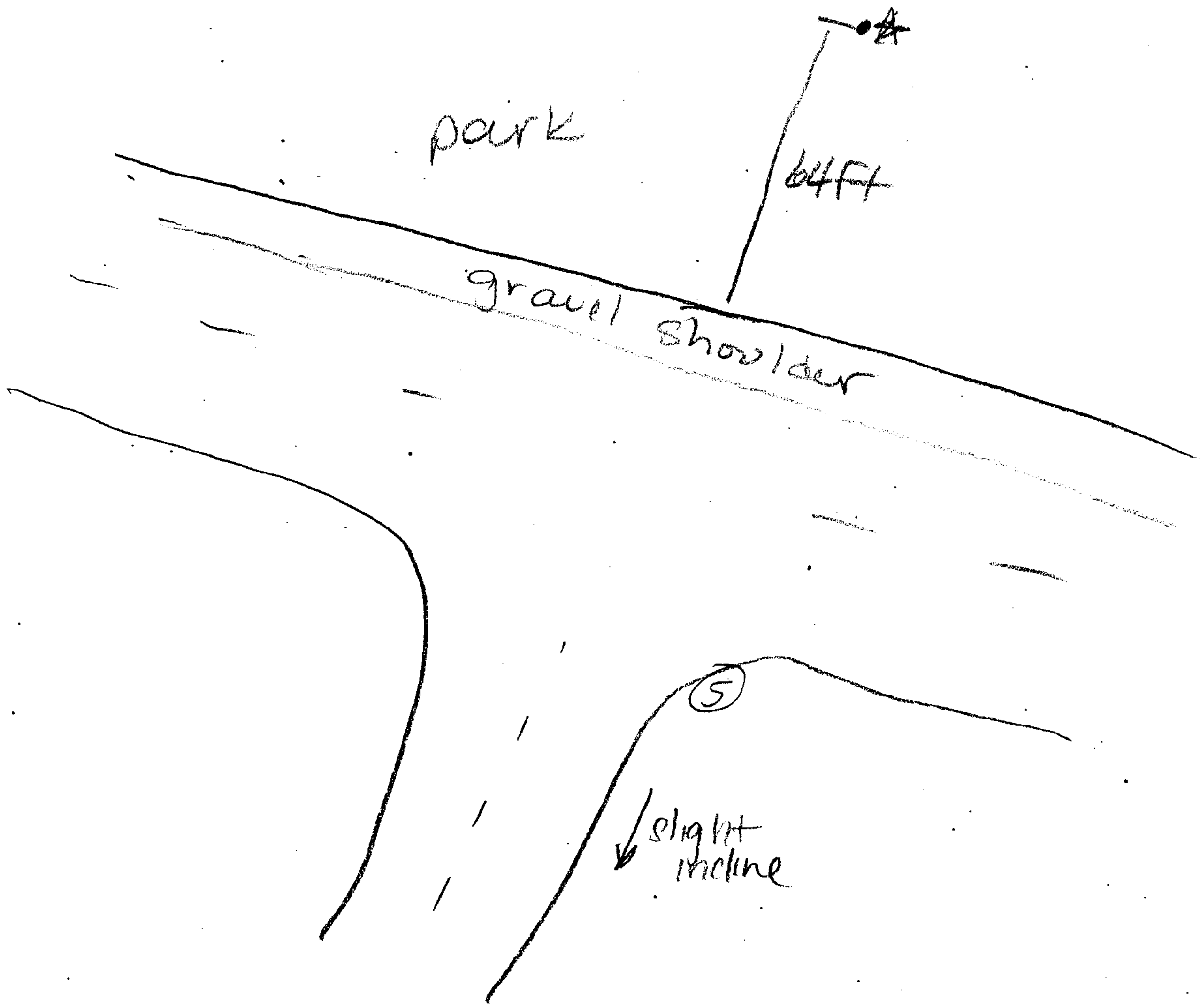
114

Direction	Type	Number
Thorndyke S	Autos	18
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

Direction	Type	Number
Blaine W ↙	Autos	11
	Medium Trucks	1
	Heavy Trucks	
	Buses	
	Motorcycles	

PLANES:	TRAINS:

DETAILED DRAWING OF SITE:



ADDITIONAL NOTES:

Receiver 02
24th Ave W @ W Blaine St

NOISE MEASUREMENT DATA SHEET #4

Shapiro & Associates, Inc. - Seattle, WA

Project Name/Number: Magnolia
Date/Time: 11/5 12:30
Data collected by: SM/JD

EQUIPMENT INFORMATION

Sound Meter: Larson-Davis Model 870, SN 870A0204
Microphone: Model 2560 SN 2948
Weighting: A
Response Time: Slow
Microphone Height: 5'

MISCELLANEOUS INFORMATION

Wind speed/Direction: 0
Ground Cover: pavement
Road Conditions: dry
Interval Length: 15m
Posted MPH/Actual MPH:

RESULTS

Interval Number			
Leq	64		
Lmax	75		
Lmin	43		
Lsel	94		
L10	69		
L90	49		

TRAFFIC VOLUMES

Direction	Type	Number	
Thorndyke N	Autos	30	120
	Medium Trucks	1	4
	Heavy Trucks		
	Buses	2	8
	Motorcycles		

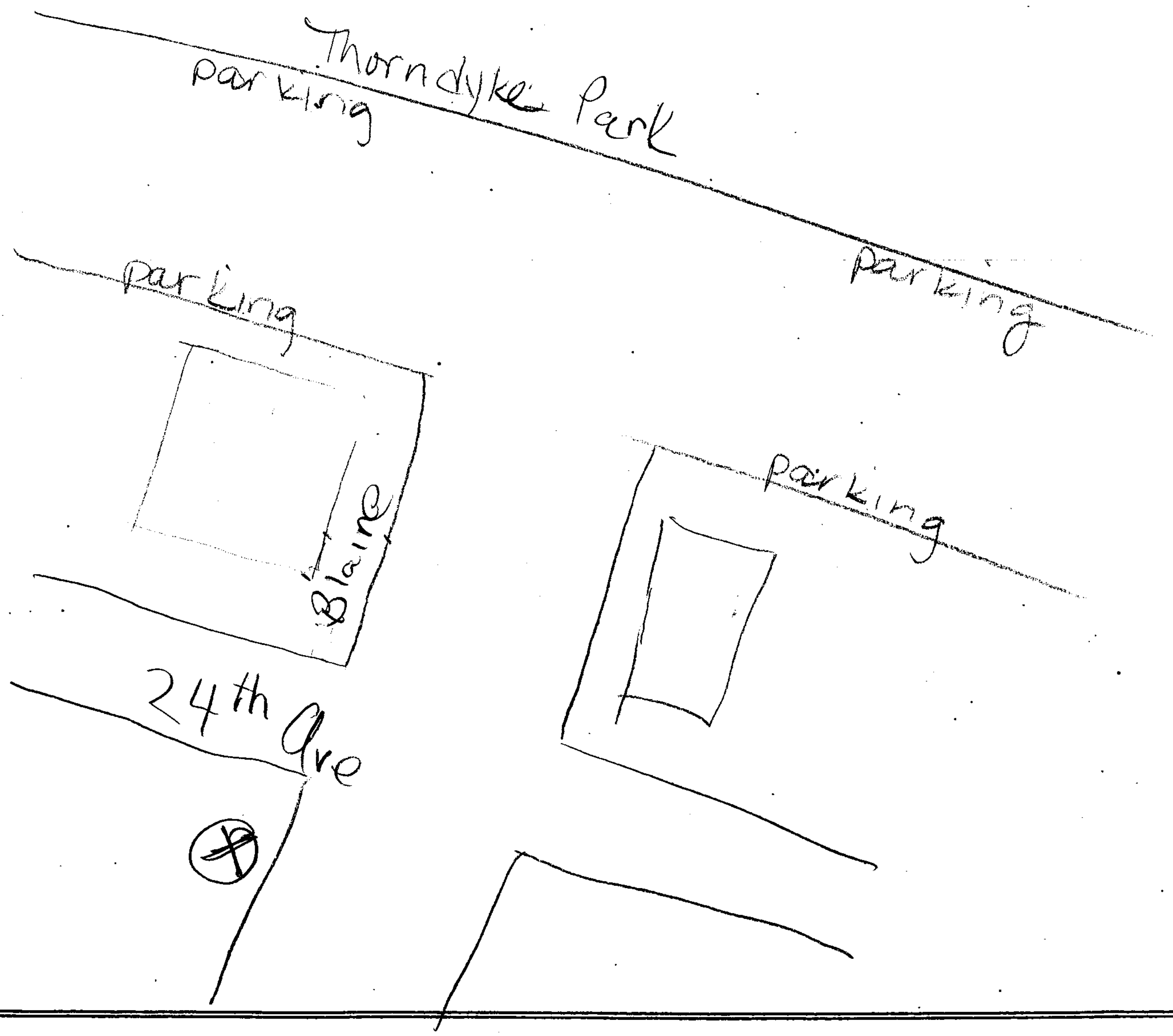
Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

Direction	Type	Number	
Thorndyke S	Autos	37	148
	Medium Trucks	1	4
	Heavy Trucks		
	Buses		
	Motorcycles	1	4

Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

PLANES:	TRAINS:

DETAILED DRAWING OF SITE:



ADDITIONAL NOTES:

Receiver 03
W. Galer St & Magnolia Way #8

bridge area

NOISE MEASUREMENT DATA SHEET

Shapiro & Associates, Inc. - Seattle, WA

Project Name/Number: Magnolia / #5
Date/Time: 11/5/03 1:30pm
Data collected by: SM / JD

EQUIPMENT INFORMATION

Sound Meter: Larson-Davis Model 870, SN 870A0204
Microphone: Model 2560 SN 2948
Weighting: A
Response Time: Slow
Microphone Height: 5'

MISCELLANEOUS INFORMATION

Wind speed/Direction: 0
Ground Cover: pavement
Road Conditions: dry
Interval Length: 15
Posted MPH/Actual MPH: 30

RESULTS

Interval Number			
Leq	63		
Lmax	74		
Lmin	43		
Lsel	92		
L10	67		
L90	49		

TRAFFIC VOLUMES

Direction	Type	Number	
magnolia E	Autos	101	404
	Medium Trucks	1	4
	Heavy Trucks	3	12
	Buses	2	8
	Motorcycles		

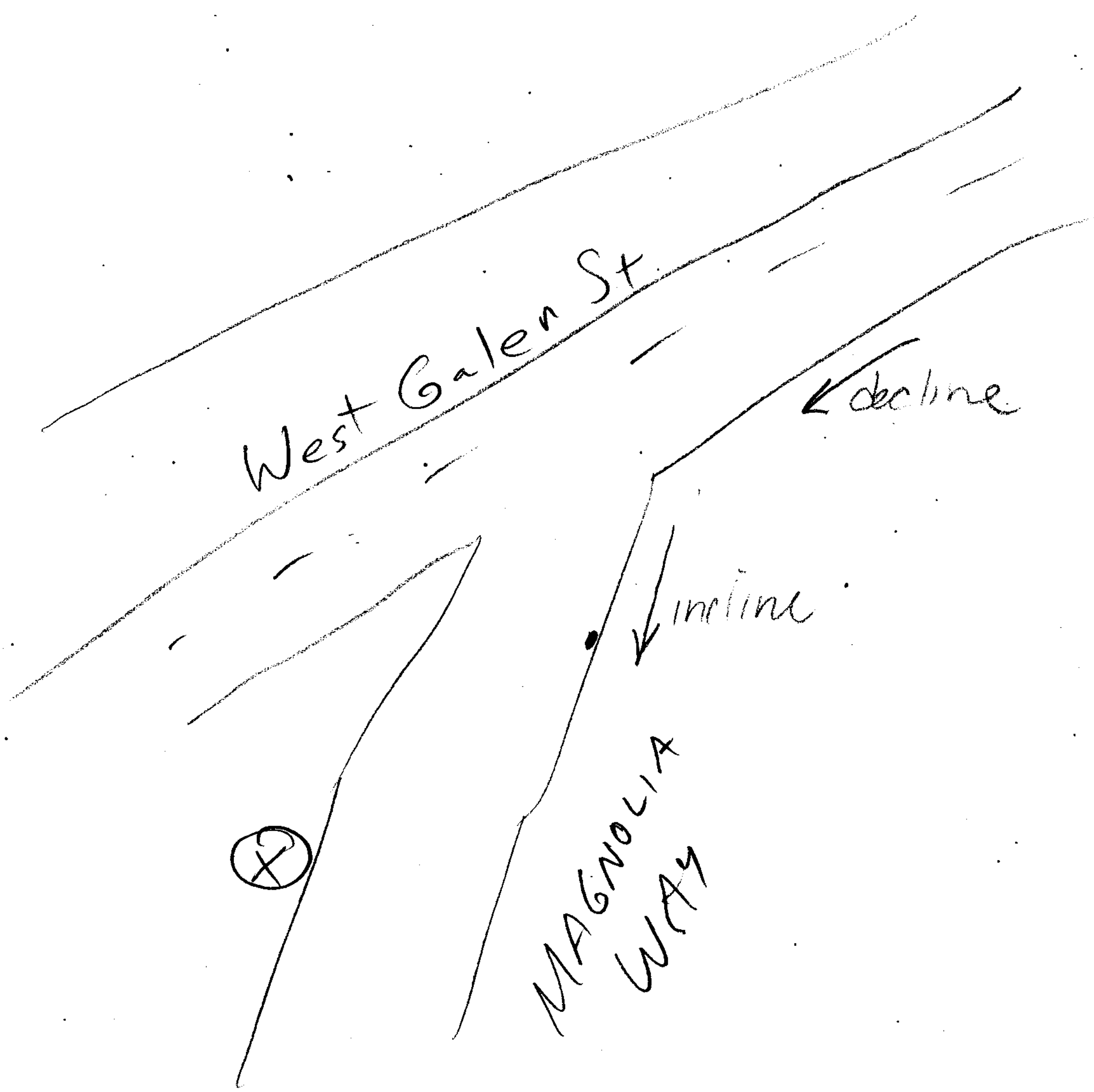
Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

Direction	Type	Number	
magnolia W	Autos	80	320
	Medium Trucks	3	12
	Heavy Trucks		
	Buses	2	8
	Motorcycles		

Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

PLANES:	TRAINS:

DETAILED DRAWING OF SITE:



ADDITIONAL NOTES:

Receiver 17
End of W. Plymouth St

NOISE MEASUREMENT DATA SHEET

Shapiro & Associates, Inc. - Seattle, WA

Project Name/Number: Magnolia Bridge/1023001X
Date/Time: 10 August 2004/ 14:00
Data collected by: Dale Mirenda, Anthony Katsaros

EQUIPMENT INFORMATION

Sound Meter: Larson-Davis Model 870, SN 870A0204
Microphone: Model 2560 SN 2948
Weighting: A
Response Time: Slow
Microphone Height: 5'

MISCELLANEOUS INFORMATION

Wind speed/Direction: < 2 mph
Ground Cover: Soft
Road Conditions: Dry
Interval Length: 15 min
Posted MPH/Actual MPH: 25

RESULTS

Interval Number	1	2	
Leq		60.0	
Lmax			
Lmin			
Lsel			
L10			
L90			

TRAFFIC VOLUMES

Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

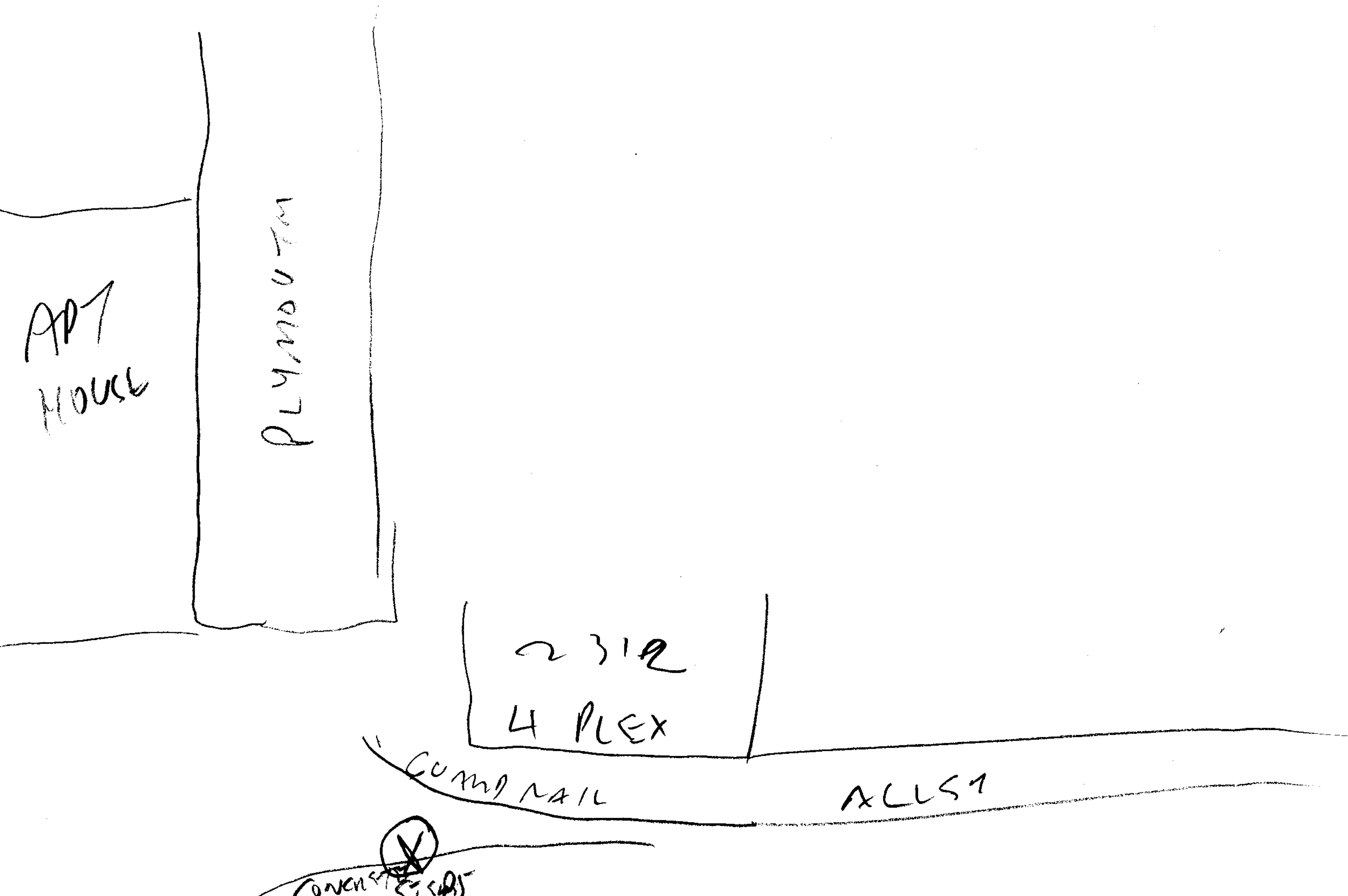
Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

PLANES:	TRAINS:
1:55 7:10 10:10 11:45 13:15 14:20	NOISE FROM TRAIN YARD IS A CONSTANT 57 dB

DETAILED DRAWING OF SITE:



ADDITIONAL NOTES:

Receiver 18
W. Crockett St & 23rd Ave W

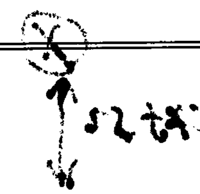
NOISE MEASUREMENT DATA SHEET

Shapiro & Associates, Inc. - Seattle, WA

Project Name/Number: Magnolia Bridge/1023001X
Date/Time: 10 August 2004/ 14:30
Data collected by: Dale Mirenda, Anthony Katsaros

EQUIPMENT INFORMATION

Sound Meter: Larson-Davis Model 870, SN 870A0204
Microphone: Model 2560 SN 2948
Weighting: A
Response Time: Slow
Microphone Height: 5'



MISCELLANEOUS INFORMATION

Wind speed/Direction: < 5 mph W
Ground Cover: Soft
Road Conditions: Dry
Interval Length: 15 min
Posted MPH/Actual MPH: 25 mph

RESULTS

Interval Number	2		
Leq	54.8		
Lmax			
Lmin			
Lsel			
L10			
L90			

TRAFFIC VOLUMES

Direction	Type	Number
N	Autos	|||
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

61 dB

Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

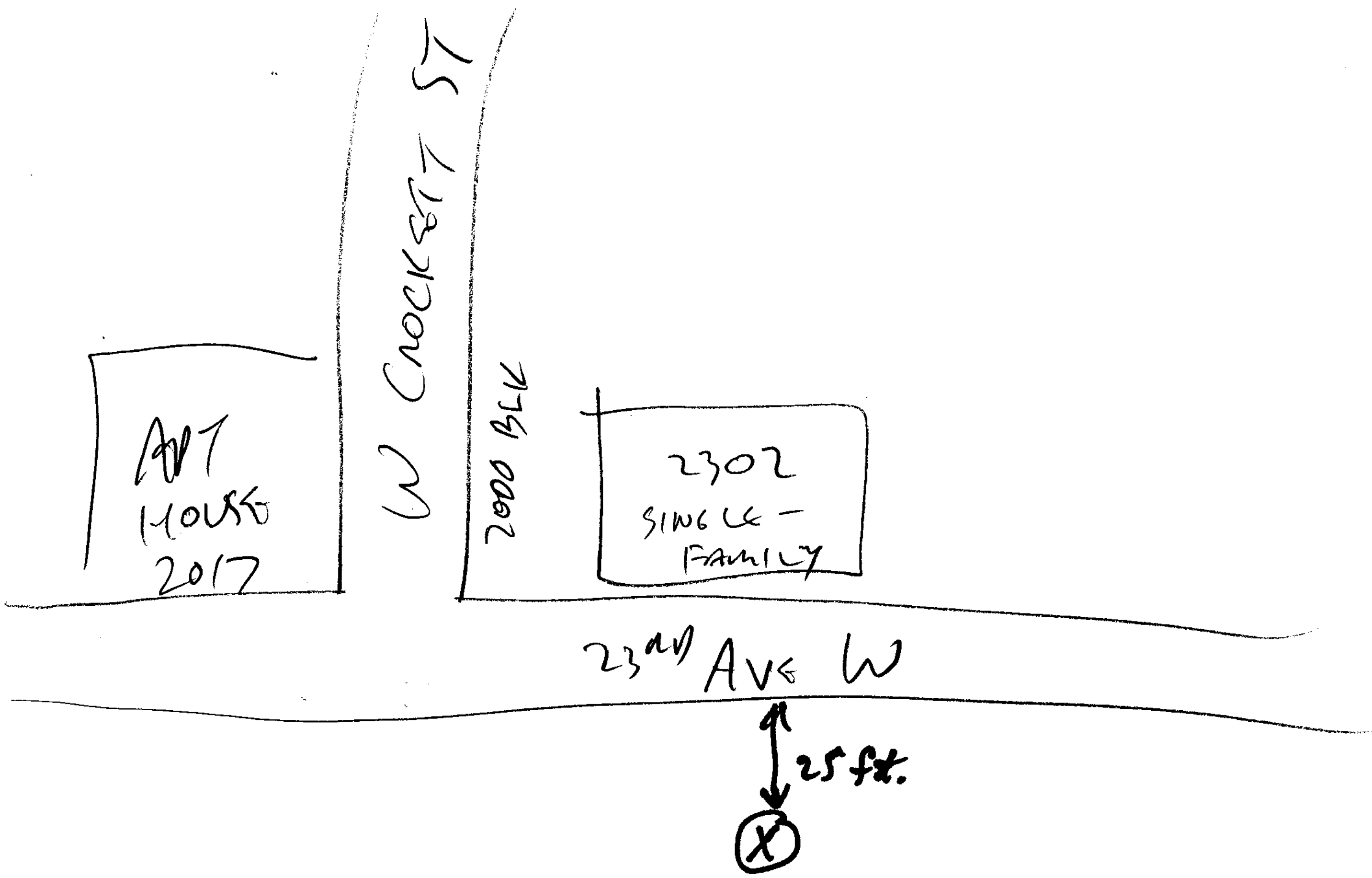
Direction	Type	Number
S	Autos		
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

60 dB

Direction	Type	Number
	Autos	
	Medium Trucks	
	Heavy Trucks	
	Buses	
	Motorcycles	

PLANES:	TRAINS:
00:10 5:55 7:35 8:15 8:25 9:20 10:30	TRAIN YARD NOISE IS 52dB CONSTANT

DETAILED DRAWING OF SITE:



ADDITIONAL NOTES:

Appendix B - Traffic Noise Model Input Data

Shapiro and Associates, Inc.
Dale Mirenda

21 July 2005
TNM 2.1

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: Magnolia Bridge Replacement/1023001X
RUN: Existing PM Peak

Roadway	Points											
Name	Name	No.	Segment									
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
ThorndykeNB_Galer-Blaine	point54	54	88	30	2	30	0	0	0	0	0	0
	point53	53	88	30	2	30	0	0	0	0	0	0
	point52	52	88	30	2	30	0	0	0	0	0	0
	point51	51										
ThorndykeNB_Blaine-Dravus	point55	55	284	30	4	30	0	0	0	0	4	30
	point56	56	133	30	4	30	0	0	0	0	4	30
	point57	57	132	30	4	30	0	0	0	0	4	30
	point93	93	132	30	4	30	0	0	0	0	4	30
	point58	58	183	30	4	30	0	0	0	0	0	0
	point59	59	183	30	4	30	0	0	0	0	0	0
	point60	60	183	30	4	30	0	0	0	0	0	0
	point61	61										
15thAveNB_Garfield-Wheeler	point63	63	2235	40	60	40	60	40	30	40	0	0
	point64	64	2235	40	60	40	60	40	30	40	0	0
	point65	65										
15thAveNB_Wheeler-Davis	point66	66	2124	40	60	40	60	40	30	40	0	0
	point67	67	2124	40	60	40	60	40	30	40	0	0
	point68	68										
15thAveSB_Wheeler-Davis	point69	69	1275	40	20	40	20	40	12	40	8	40
	point70	70	1275	40	20	40	20	40	12	40	8	40
	point71	71										

15thAveSB_Garfield-Wheeler	point72	72	1352	40	20	40	20	40	20	40	8	40
	point73	73	1352	40	20	40	20	40	20	40	8	40
	point74	74										
GilmanDrW_SB	point75	75	0	0	0	0	0	0	0	0	0	0
	point76	76	0	0	0	0	0	0	0	0	0	0
	point77	77										
GilmanDrW_NB	point78	78	0	0	0	0	0	0	0	0	0	0
	point79	79	0	0	0	0	0	0	0	0	0	0
	point80	80										
ThorndykeSB_Blaine-Dravus	point81	81	197	30	4	30	0	0	8	30	0	0
	point82	82	186	30	0	0	0	0	0	0	0	0
	point83	83	136	30	4	30	0	0	8	30	0	0
	point92	92	136	30	4	30	0	0	8	30	0	0
	point84	84	137	30	4	30	0	0	8	30	0	0
	point85	85	197	35	4	30	0	0	8	30	0	0
	point86	86										
ThorndykeSB_Galer-Blaine	point87	87	304	30	6	30	0	0	0	0	0	0
	point88	88	304	30	6	30	0	0	0	0	0	0
	point89	89	304	30	6	30	0	0	0	0	0	0
	point91	91										
Galer-MagBR_WB	point1	1	852	35	20	35	20	35	8	35	0	0
	point2	2	300	35	12	30	0	0	8	30	0	0
	point3	3	300	35	12	30	0	0	8	30	0	0
	point4	4	300	35	12	30	0	0	8	30	0	0
	point5	5	300	35	12	30	0	0	8	30	0	0
	point6	6	1052	35	20	35	20	35	8	35	0	0
	point7	7	300	35	12	30	0	0	8	30	0	0
	point8	8	1052	35	20	35	20	35	8	35	0	0
	point9	9	1052	35	20	35	20	35	8	35	0	0
	point10	10	1052	35	20	35	20	35	8	35	0	0
	point11	11	300	35	12	30	0	0	8	30	0	0
	point12	12	1052	35	20	35	20	35	8	35	0	0
	point13	13	902	35	20	35	20	35	8	30	0	0
	point14	14	902	35	20	35	20	35	8	30	0	0

	point15	15	924	30	18	30	0	0	8	30	0	0
	point16	16	924	30	18	30	0	0	8	30	0	0
	point17	17	300	35	12	30	0	0	8	30	0	0
	point18	18	924	30	18	30	0	0	8	30	0	0
	point19	19	924	30	18	30	0	0	8	30	0	0
	point20	20	300	35	12	30	0	0	8	30	0	0
	point21	21	924	30	18	30	0	0	8	30	0	0
	point22	22	930	30	12	30	0	0	8	30	0	0
		23	924	30	18	30	0	0	8	30	0	0
	point24	24	924	30	18	30	0	0	8	30	0	0
	point25	25	932	30	18	30	0	0	0	0	0	0
	point26	26	932	30	18	30	0	0	0	0	0	0
	point27	27	652	30	8	30	0	0	0	0	0	0
	point28	28	300	35	12	30	0	0	8	30	0	0
	point94	94	652	30	8	30	0	0	0	0	0	0
	point95	95										
Galer-MagBR_EB	point96	96	363	30	7	30	0	0	0	0	0	0
	point97	97	228	35	16	30	0	0	0	0	0	0
	point29	29	363	30	7	35	0	0	0	0	0	0
	point30	30	363	30	7	30	0	0	0	0	0	0
	point31	31	441	35	9	35	0	0	0	0	0	0
	point32	32	441	35	9	35	0	0	0	0	0	0
	point33	33	441	35	9	35	0	0	0	0	0	0
	point34	34	441	35	9	35	0	0	0	0	0	0
	point35	35	441	35	9	35	0	0	0	0	0	0
	point36	36	380	35	4	30	12	30	8	30	0	0
	point37	37	441	35	9	35	0	0	0	0	0	0
	point38	38	441	35	9	35	0	0	0	0	0	0
	point39	39	441	35	9	35	0	0	0	0	0	0
	point38	40	380	35	4	30	12	30	8	30	0	0
	point41	41	380	35	4	30	12	30	8	30	0	0
	point42	42	380	35	4	30	12	30	8	30	0	0
	point43	43	380	35	4	30	12	30	8	30	0	0
	point44	44	380	35	4	30	12	30	8	30	0	0

	point45	45	380	35	4	30	12	30	8	30	0	0
	point46	46	380	35	4	30	12	30	8	30	0	0
	point47	47	380	35	4	30	12	30	8	30	0	0
	point48	48	574	35	6	35	12	35	8	35	0	0
	point49	49	576	35	4	35	12	35	8	35	0	0
	point50	50										
GarfieldEB_Ramp	point98	98	594	35	6	35	0	0	0	0	0	0
	point99	99	594	35	6	35	0	0	0	0	0	0
	point100	100										

Shapiro and Associates, Inc. 22 July 2005
Dale Mirenda TNM 2.1

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: Magnolia Bridge Replacement/1023001X
RUN: No Build PM Peak, 2030

Roadway	Points												
Name	Name	No.	Segment										
			Autos		MTrucks		HTrucks		Buses		Motorcycles		
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
ThorndykeNB_Galer-Blaine	point54	54	147	30	1	30	1	30	1	30	0	0
	point53	53	147	30	1	30	1	30	1	30	0	0
	point52	52	147	30	1	30	1	30	1	30	0	0
	point51	51										
ThorndykeNB_Blaine-Dravus	point55	55	530	30	5	30	5	30	10	30	0	0
	point56	56	280	30	6	30	6	30	8	30	0	0
	point57	57	254	30	4	30	4	30	8	30	0	0
	point93	93	258	30	3	30	3	30	6	30	0	0
	point58	58	184	30	4	30	4	30	8	30	0	0
	point59	59	262	30	4	30	4	30	0	0	0	0
	point60	60	262	30	4	30	4	30	0	0	0	0
	point61	61										
15thAveNB_Garfield-Wheeler	point63	63	2185	40	100	40	41	40	24	40	0	0
	point64	64	2185	40	100	40	41	40	24	40	0	0
	point65	65										
Roadway11	point66	66	2185	40	100	40	41	40	24	40	0	0
	point67	67	2185	40	100	40	41	40	24	40	0	0
	point68	68										
Roadway13	point69	69	1790	40	90	40	40	40	20	40	0	0
	point70	70	1790	40	90	40	40	40	20	40	0	0
	point71	71										

15thAveSB_Garfield-Wheeler	point72	72	1786	40	90	40	40	40	24	40	0	0
	point73	73	1786	40	90	40	40	40	24	40	0	0
	point74	74										
Roadway15	point75	75	0	0	0	0	0	0	0	0	0	0
	point76	76	0	0	0	0	0	0	0	0	0	0
	point77	77										
Roadway16	point78	78	0	0	0	0	0	0	0	0	0	0
	point79	79	0	0	0	0	0	0	0	0	0	0
	point80	80										
ThorndykeSB_Blaine-Dravus	point81	81	384	30	8	30	8	30	0	0	0	0
	point82	82	384	30	8	30	8	30	0	0	0	0
	point83	83	374	30	8	30	8	30	10	30	0	0
	point92	92	308	30	6	30	6	30	10	30	0	0
	point84	84	214	30	4	30	4	30	8	30	0	0
	point85	85	490	30	5	30	5	30	10	30	0	0
	point86	86										
ThorndykeSB_Galer-Blaine	point87	87	324	30	3	30	3	30	0	0	0	0
	point88	88	324	30	3	30	3	30	0	0	0	0
	point89	89	324	30	3	30	3	30	0	0	0	0
	point91	91										
Galer-MagBR_WB	point1	1	945	35	20	35	20	35	15	35	0	0
	point2	2	945	35	20	35	20	35	15	35	0	0
	point3	3	945	35	20	35	20	35	15	35	0	0
	point4	4	945	35	20	35	20	35	15	35	0	0
	point5	5	945	35	20	35	20	35	15	35	0	0
	point6	6	945	35	20	35	20	35	15	35	0	0
	point7	7	945	35	20	35	20	35	15	35	0	0
	point8	8	945	35	20	35	20	35	15	35	0	0
	point9	9	945	35	20	35	20	35	15	35	0	0
	point10	10	945	35	20	35	20	35	15	35	0	0
	point11	11	945	35	20	35	20	35	15	35	0	0
	point12	12	945	35	20	35	20	35	15	35	0	0
	point13	13	945	35	20	35	20	35	15	35	0	0
	point14	14	945	35	20	35	20	35	15	35	0	0

	point15	15	945	35	20	35	20	35	15	35	0	0
	point16	16	945	35	20	35	20	35	15	35	0	0
	point17	17	945	35	20	35	20	35	15	35	0	0
	point18	18	945	35	20	35	20	35	15	35	0	0
	point19	19	945	35	20	35	20	35	15	35	0	0
	point20	20	945	35	20	35	20	35	15	35	0	0
	point21	21	945	35	20	35	20	35	15	35	0	0
	point22	22	945	35	20	35	20	35	15	35	0	0
		23	945	35	20	35	20	35	15	35	0	0
	point24	24	945	35	20	35	20	35	15	35	0	0
	point25	25	692	30	14	30	14	30	10	30	0	0
	point26	26	692	30	14	30	14	30	10	30	0	0
	point27	27	692	30	14	30	14	30	10	30	0	0
	point28	28	692	30	14	30	14	30	10	30	0	0
	point94	94	692	30	14	30	14	30	10	30	0	0
	point95	95										
Galer-MagBR_EB	point96	96	414	30	8	30	8	30	10	30	0	0
	point97	97	414	30	8	30	8	30	10	30	0	0
	point29	29	414	30	8	30	8	30	10	30	0	0
	point30	30	414	30	8	30	8	30	10	30	0	0
	point31	31	434	30	10	30	10	30	16	30	0	0
	point32	32	434	35	10	35	10	35	16	35	0	0
	point33	33	434	35	10	35	10	35	16	35	0	0
	point34	34	434	35	10	35	10	35	16	35	0	0
	point35	35	434	35	10	35	10	35	16	35	0	0
	point36	36	434	35	10	35	10	35	16	35	0	0
	point37	37	434	35	10	35	10	35	16	35	0	0
	point38	38	434	35	10	35	10	35	16	35	0	0
	point39	39	434	35	10	35	10	35	16	35	0	0
	point38	40	434	35	10	35	10	35	16	35	0	0
	point41	41	434	35	10	35	10	35	16	35	0	0
	point42	42	434	35	10	35	10	35	16	35	0	0
	point43	43	434	35	10	35	10	35	16	35	0	0
	point44	44	434	35	10	35	10	35	16	35	0	0

	point45	45	434	35	10	35	10	35	16	35	0	0
	point46	46	434	35	10	35	10	35	16	35	0	0
	point47	47	434	35	10	35	10	35	16	35	0	0
	point48	48	434	35	10	35	10	35	16	35	0	0
	point49	49	434	35	10	35	10	35	16	35	0	0
	point50	50										

Shapiro and Associates, Inc. 22 July 2005
Dale Mirenda TNM 2.1

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: Magnolia Bridge Replacement/1023001X
RUN: Alternative A, PM Peak, 2030

Roadway	Points												
Name	Name	No.	Segment										
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
ThorndykeNB_Galer-Blaine	point54	54	147	30	1	30	1	30	1	30	0	0
	point53	53	147	30	1	30	1	30	1	30	0	0
	point52	52	147	30	1	30	1	30	1	30	0	0
	point51	51										
ThorndykeNB_Blaine-Dravus	point55	55	530	30	5	30	5	30	10	30	0	0
	point56	56	280	30	6	30	6	30	8	30	0	0
	point57	57	254	30	4	30	4	30	8	30	0	0
	point93	93	258	30	3	30	3	30	6	30	0	0
	point58	58	184	30	4	30	4	30	8	30	0	0
	point59	59	262	30	4	30	4	30	0	0	0	0
	point60	60	262	30	4	30	4	30	0	0	0	0
	point61	61										
15thAveNB_Garfield-Wheeler	point63	63	2185	40	100	40	41	40	24	40	0	0
	point64	64	2185	40	100	40	41	40	24	40	0	0
	point65	65										
15thAveNB_Wheeler-Davis	point66	66	2185	40	100	40	41	40	24	40	0	0
	point67	67	2185	40	100	40	41	40	24	40	0	0
	point68	68										
15thAveSB_Wheeler-Davis	point69	69	1790	40	90	40	40	40	20	40	0	0
	point70	70	1790	40	90	40	40	40	20	40	0	0
	point71	71										

15thAveSB_Garfield-Wheeler	point72	72	1786	40	90	40	40	40	24	40	0	0
	point73	73	1786	40	90	40	40	40	24	40	0	0
	point74	74										
GilmanDrW_SB	point75	75	0	0	0	0	0	0	0	0	0	0
	point76	76	0	0	0	0	0	0	0	0	0	0
	point77	77										
GilmanDrW_NB	point78	78	0	0	0	0	0	0	0	0	0	0
	point79	79	0	0	0	0	0	0	0	0	0	0
	point80	80										
ThorndykeSB_Blaine-Dravus	point81	81	384	30	8	30	8	30	0	0	0	0
	point82	82	384	30	8	30	8	30	0	0	0	0
	point83	83	374	30	8	30	8	30	10	30	0	0
	point92	92	308	30	6	30	6	30	10	30	0	0
	point84	84	214	30	4	30	4	30	8	30	0	0
	point85	85	490	30	5	30	5	30	10	30	0	0
	point86	86										
ThorndykeSB_Galer-Blaine	point87	87	324	30	3	30	3	30	0	0	0	0
	point88	88	324	30	3	30	3	30	0	0	0	0
	point89	89	324	30	3	30	3	30	0	0	0	0
	point91	91										
Galer-MagBR_WB	point1	1	945	35	20	35	20	35	15	35	0	0
	point2	2	945	35	20	35	20	35	15	35	0	0
	point3	3	945	35	20	35	20	35	15	35	0	0
	point4	4	945	35	20	35	20	35	15	35	0	0
	point5	5	945	35	20	35	20	35	15	35	0	0
	point6	6	945	35	20	35	20	35	15	35	0	0
	point7	7	945	35	20	35	20	35	15	35	0	0
	point8	8	945	35	20	35	20	35	15	35	0	0
	point9	9	945	35	20	35	20	35	15	35	0	0
	point10	10	945	35	20	35	20	35	15	35	0	0
	point11	11	945	35	20	35	20	35	15	35	0	0
	point12	12	945	35	20	35	20	35	15	35	0	0
	point13	13	945	35	20	35	20	35	15	35	0	0
	point14	14	945	35	20	35	20	35	15	35	0	0

	point15	15	945	35	20	35	20	35	15	35	0	0
	point16	16	945	35	20	35	20	35	15	35	0	0
	point17	17	945	35	20	35	20	35	15	35	0	0
	point18	18	945	35	20	35	20	35	15	35	0	0
	point19	19	945	35	20	35	20	35	15	35	0	0
	point20	20	945	35	20	35	20	35	15	35	0	0
	point21	21	945	35	20	35	20	35	15	35	0	0
	point22	22	945	35	20	35	20	35	15	35	0	0
		23	945	35	20	35	20	35	15	35	0	0
	point24	24	945	35	20	35	20	35	15	35	0	0
	point25	25	692	35	14	35	14	35	10	35	0	0
	point26	26	692	35	14	35	14	35	10	35	0	0
	point27	27	692	35	14	35	14	35	10	35	0	0
	point28	28	692	35	14	35	14	35	10	35	0	0
	point94	94	692	35	14	35	14	35	10	35	0	0
	point95	95										
Galer-MagBR_EB	point96	96	414	30	8	30	8	30	10	30	0	0
	point97	97	414	30	8	30	8	30	10	30	0	0
	point29	29	414	30	8	30	8	30	10	30	0	0
	point30	30	414	30	8	30	8	30	10	30	0	0
	point31	31	434	30	10	30	10	30	16	30	0	0
	point32	32	434	35	10	35	10	35	16	35	0	0
	point33	33	434	35	10	35	10	35	16	35	0	0
	point34	34	434	35	10	35	10	35	16	35	0	0
	point35	35	434	35	10	35	10	35	16	35	0	0
	point36	36	434	35	10	35	10	35	16	35	0	0
	point37	37	434	35	10	35	10	35	16	35	0	0
	point38	38	434	35	10	35	10	35	16	35	0	0
	point39	39	434	35	10	35	10	35	16	35	0	0
	point38	40	434	35	10	35	10	35	16	35	0	0
	point41	41	434	35	10	35	10	35	16	35	0	0
	point42	42	434	35	10	35	10	35	16	35	0	0
	point43	43	434	35	10	35	10	35	16	35	0	0
	point44	44	434	35	10	35	10	35	16	35	0	0

	point45	45	434	35	10	35	10	35	16	35	0	0
	point46	46	434	35	10	35	10	35	16	35	0	0
	point47	47	434	35	10	35	10	35	16	35	0	0
	point48	48	434	35	10	35	10	35	16	35	0	0
	point49	49	434	35	10	35	10	35	16	35	0	0
	point50	50										

Shapiro and Associates, Inc. 22 July 2005
Dale Mirenda TNM 2.1

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: Magnolia Bridge Replacement/1023001X
RUN: Alternative C, PM Peak, 2030

Roadway	Points		Segment									
Name	Name	No.	Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
ThorndykeNB_Galer-Blaine	point54	54	120	30	1	30	1	30	1	30	0	0
	point53	53	120	30	1	30	1	30	1	30	0	0
	point52	52	120	30	1	30	1	30	1	30	0	0
	point51	51										
ThorndykeNB_Blaine-Dravus	point55	55	550	30	5	30	5	30	10	30	0	0
	point56	56	300	30	6	30	6	30	8	30	0	0
	point57	57	270	30	4	30	4	30	8	30	0	0
	point93	93	270	30	3	30	3	30	6	30	0	0
	point58	58	270	30	4	30	4	30	8	30	0	0
	point59	59	270	30	4	30	4	30	0	0	0	0
	point60	60	270	30	4	30	4	30	0	0	0	0
	point61	61										
15thAveNB_Garfield-Wheeler	point63	63	2350	40	100	40	41	40	24	40	0	0
	point64	64	2350	40	100	40	41	40	24	40	0	0
	point65	65										
15thAveNB_Wheeler-Davis	point66	66	2350	40	100	40	41	40	24	40	0	0
	point67	67	2350	40	100	40	41	40	24	40	0	0
	point68	68										
15thAveSB_Wheeler-Davis	point69	69	1940	40	90	40	40	40	20	40	0	0
	point70	70	1940	40	90	40	40	40	20	40	0	0
	point71	71										

15thAveSB_Garfield-Wheeler	point72	72	1940	40	90	40	40	40	24	40	0	0
	point73	73	1940	40	90	40	40	40	24	40	0	0
	point74	74										
GilmanDrW_SB	point75	75	0	0	0	0	0	0	0	0	0	0
	point76	76	0	0	0	0	0	0	0	0	0	0
	point77	77										
GilmanDrW_NB	point78	78	0	0	0	0	0	0	0	0	0	0
	point79	79	0	0	0	0	0	0	0	0	0	0
	point80	80										
ThorndykeSB_Blaine-Dravus	point81	81	400	30	8	30	8	30	0	0	0	0
	point82	82	400	30	8	30	8	30	0	0	0	0
	point83	83	400	30	8	30	8	30	10	30	0	0
	point92	92	330	30	6	30	6	30	10	30	0	0
	point84	84	200	30	4	30	4	30	8	30	0	0
	point85	85	510	30	5	30	5	30	10	30	0	0
	point86	86										
ThorndykeSB_Galer-Blaine	point87	87	330	30	3	30	3	30	0	0	0	0
	point88	88	330	30	3	30	3	30	0	0	0	0
	point89	89	330	30	3	30	3	30	0	0	0	0
	point91	91										
Galer-MagBR_WB	point1	1	1000	35	20	35	20	35	15	35	0	0
	point2	2	1000	35	20	35	20	35	15	35	0	0
	point3	3	1000	35	20	35	20	35	15	35	0	0
	point4	4	1000	35	20	35	20	35	15	35	0	0
	point5	5	1000	35	20	35	20	35	15	35	0	0
	point6	6	1000	35	20	35	20	35	15	35	0	0
	24	7	1000	35	20	35	20	35	15	35	0	0
	26	8	1000	35	20	35	20	35	15	35	0	0
	32	9	1000	35	20	35	20	35	15	35	0	0
	36	10	1000	35	20	35	20	35	15	35	0	0
	44	11	1000	35	20	35	20	35	15	35	0	0
	46	12	1000	35	20	35	20	35	15	35	0	0
	48	13	1000	35	20	35	20	35	15	35	0	0
	54	14	1000	35	20	35	20	35	15	35	0	0

	56	15	1000	35	20	35	20	35	15	35	0	0
	58	16	1000	35	20	35	20	35	15	35	0	0
	60	17	1000	35	20	35	20	35	15	35	0	0
	70	18	1000	35	20	35	20	35	15	35	0	0
	72	19	1000	35	20	35	20	35	15	35	0	0
	74	20	1000	35	20	35	20	35	15	35	0	0
	76	21	1000	35	20	35	20	35	15	35	0	0
	78	22	1000	35	20	35	20	35	15	35	0	0
	80	23	1000	35	20	35	20	35	15	35	0	0
	point24	24	1000	35	20	35	20	35	15	35	0	0
	point25	25	1000	30	20	30	20	30	15	30	0	0
	point26	26	730	30	14	30	14	30	10	30	0	0
	point27	27	730	30	14	30	14	30	10	30	0	0
	point28	28	1000	35	20	35	20	35	15	35	0	0
	point94	94	730	30	14	30	14	30	10	30	0	0
	point95	95										
Galer-MagBR_EB	point96	96	440	30	8	30	8	30	10	30	0	0
	point97	97	500	35	10	35	10	35	16	35	0	0
	point29	29	440	30	8	30	8	30	10	30	0	0
	point30	30	440	30	8	30	8	30	10	30	0	0
	point31	31	500	30	10	30	10	30	16	30	0	0
	point32	32	500	35	10	35	10	35	16	35	0	0
	80	33	500	35	10	35	10	35	16	35	0	0
	78	34	500	35	10	35	10	35	16	35	0	0
	76	35	500	35	10	35	10	35	16	35	0	0
	74	36	500	35	10	35	10	35	16	35	0	0
	72	37	500	35	10	35	10	35	16	35	0	0
	70	38	500	35	10	35	10	35	16	35	0	0
	60	39	500	35	10	35	10	35	16	35	0	0
	58	40	500	35	10	35	10	35	16	35	0	0
	56	41	500	35	10	35	10	35	16	35	0	0
	54	42	500	35	10	35	10	35	16	35	0	0
	48	43	500	35	10	35	10	35	16	35	0	0
	46	44	500	35	10	35	10	35	16	35	0	0

	44	45	500	35	10	35	10	35	16	35	0	0
	36	46	500	35	10	35	10	35	16	35	0	0
	32	47	500	35	10	35	10	35	16	35	0	0
	26	48	500	35	10	35	10	35	16	35	0	0
	24	49	500	35	10	35	10	35	16	35	0	0
	point50	50										

Shapiro and Associates, Inc. 22 July 2005
Dale Mirenda TNM 2.1

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: Magnolia Bridge Replacement/1023001X
RUN: Alternative D, PM Peak, 2030

Roadway Name	Points Name	No.	Segment Autos V veh/hr	Autos S mph	MTrucks V veh/hr	MTrucks S mph	HTrucks V veh/hr	HTrucks S mph	Buses V veh/hr	Buses S mph	Motorcycles V veh/hr	Motorcycles S mph
ThorndykeNB_Galer-Blaine	point54	54	147	30	1	30	1	30	1	30	0	0
	point53	53	147	30	1	30	1	30	1	30	0	0
	point52	52	147	30	1	30	1	30	1	30	0	0
	point51	51										
ThorndykeNB_Blaine-Dravus	point55	55	530	30	5	30	5	30	10	30	0	0
	point56	56	280	30	6	30	6	30	8	30	0	0
	point57	57	254	30	4	30	4	30	8	30	0	0
	point93	93	258	30	3	30	3	30	6	30	0	0
	point58	58	184	30	4	30	4	30	8	30	0	0
	point59	59	262	30	4	30	4	30	0	0	0	0
	point60	60	262	30	4	30	4	30	0	0	0	0
	point61	61										
15thAveNB_Garfield-Wheeler	point63	63	2185	40	100	40	41	40	24	40	0	0
	point64	64	2185	40	100	40	41	40	24	40	0	0
	point156	156										
15thAveNB_Wheeler-Davis	point66	66	2185	40	100	40	41	40	24	40	0	0
	point67	67	2185	40	100	40	41	40	24	40	0	0
	point68	68										
15thAveSB_Wheeler-Davis	point69	69	1790	40	90	40	40	40	20	40	0	0
	point70	70	1790	40	90	40	40	40	20	40	0	0
	point71	71										

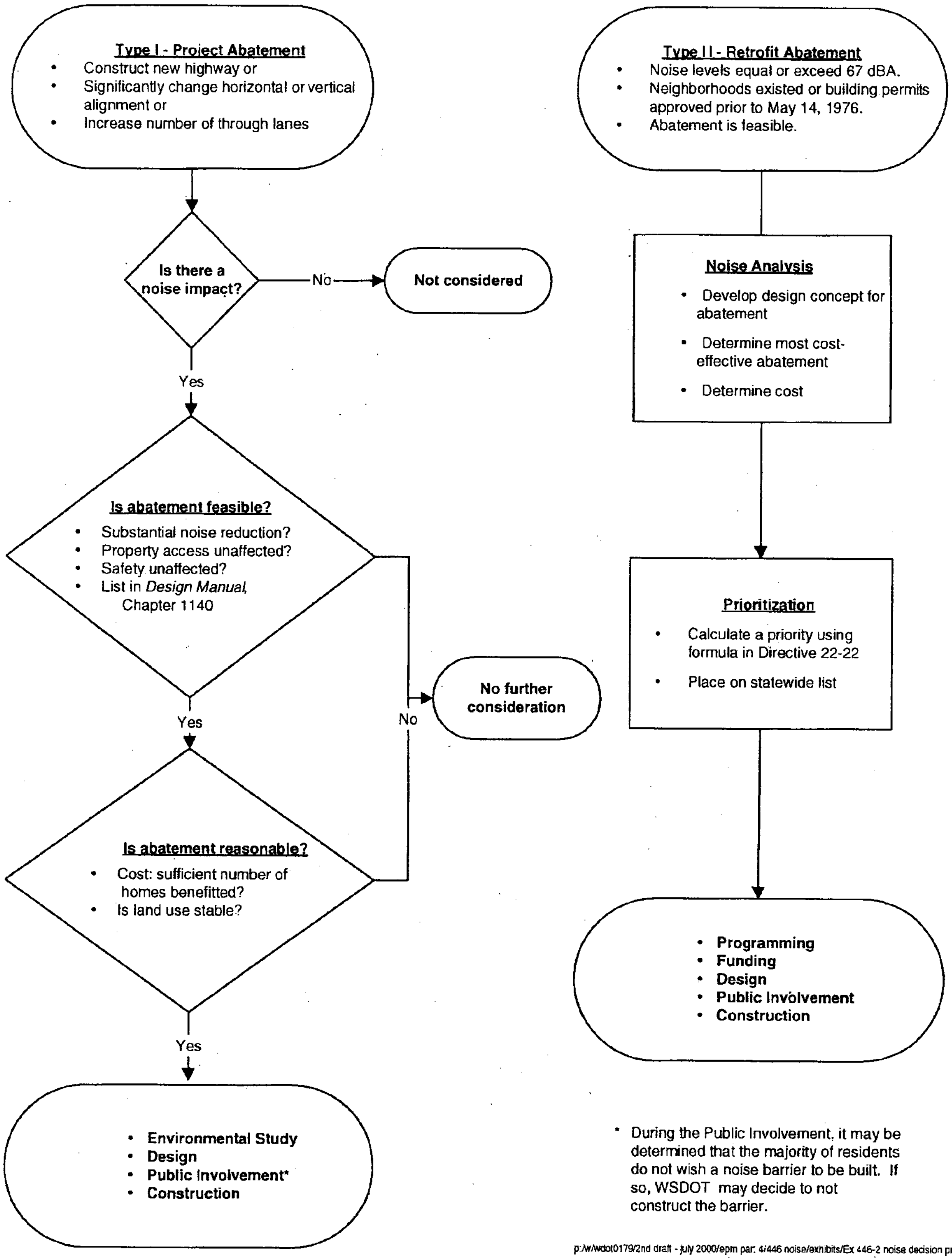
15thAveSB_Garfield-Wheeler	point158	158	1786	40	90	40	40	40	24	40	0	0
	point73	73	1786	40	90	40	40	40	24	40	0	0
	point74	74										
GilmanDrW_SB	point75	75	0	0	0	0	0	0	0	0	0	0
	point76	76	0	0	0	0	0	0	0	0	0	0
	point77	77										
GilmanDrW_NB	point78	78	0	0	0	0	0	0	0	0	0	0
	point79	79	0	0	0	0	0	0	0	0	0	0
	point80	80										
ThorndykeSB_Blaine-Dravus	point81	81	384	30	8	30	8	30	0	0	0	0
	point82	82	384	30	8	30	8	30	0	0	0	0
	point83	83	374	30	8	30	8	30	10	30	0	0
	point92	92	308	30	6	30	6	30	10	30	0	0
	point84	84	214	30	4	30	4	30	8	30	0	0
	point85	85	490	30	5	30	5	30	10	30	0	0
	point86	86										
ThorndykeSB_Galer-Blaine	point87	87	324	30	3	30	3	30	0	0	0	0
	point88	88	324	30	3	30	3	30	0	0	0	0
	point89	89	324	30	3	30	3	30	0	0	0	0
	point91	91										
ArmoryWy_EB	point150	150	384	30	8	30	8	30	0	0	0	0
	point151	151	384	30	8	30	8	30	0	0	0	0
	point152	152	384	30	8	30	8	30	0	0	0	0
	point153	153	384	30	8	30	8	30	0	0	0	0
	point154	154										
Galer-MagBR_WB	point129	129	945	35	20	35	20	35	15	35	0	0
	point128	128	945	35	20	35	20	35	15	35	0	0
	point127	127	945	35	20	35	20	35	15	35	0	0
	point126	126	945	35	20	35	20	35	15	35	0	0
	point125	125	945	35	20	35	20	35	15	35	0	0
	point124	124	945	35	20	35	20	35	15	35	0	0
	point123	123	945	35	20	35	20	35	15	35	0	0
	point122	122	945	35	20	35	20	35	15	35	0	0
	point121	121	945	35	20	35	20	35	15	35	0	0

	point120	120	945	35	20	35	20	35	15	35	0	0
	point119	119	945	35	20	35	20	35	15	35	0	0
	point118	118	945	35	20	35	20	35	15	35	0	0
	point117	117	945	35	20	35	20	35	15	35	0	0
	point116	116	945	35	20	35	20	35	15	35	0	0
	point115	115	945	35	20	35	20	35	15	35	0	0
	point114	114	945	35	20	35	20	35	15	35	0	0
	point24	24	945	35	20	35	20	35	15	35	0	0
	point25	25	692	35	14	35	14	35	10	35	0	0
	point26	26	692	35	14	35	14	35	10	35	0	0
	point27	27	692	35	14	35	14	35	10	35	0	0
	point28	28	692	35	14	35	14	35	10	35	0	0
	point94	94	692	35	14	35	14	35	10	35	0	0
	point95	95										
Galer-MagBR_EB	point96	96	414	30	8	30	8	30	10	30	0	0
	point97	97	414	30	8	30	8	30	10	30	0	0
	point29	29	414	30	8	30	8	30	10	30	0	0
	point30	30	414	30	8	30	8	30	10	30	0	0
	point31	31	434	30	10	30	10	30	16	30	0	0
	point32	32	434	35	10	35	10	35	16	35	0	0
	point33	33	434	35	10	35	10	35	16	35	0	0
	point98	98	434	35	10	35	10	35	16	35	0	0
	point99	99	434	35	10	35	10	35	16	35	0	0
	point100	100	434	35	10	35	10	35	16	35	0	0
	point101	101	434	35	10	35	10	35	16	35	0	0
	point102	102	434	35	10	35	10	35	16	35	0	0
	point103	103	434	35	10	35	10	35	16	35	0	0
	point104	104	434	35	10	35	10	35	16	35	0	0
	point105	105	434	35	10	35	10	35	16	35	0	0
	point106	106	434	35	10	35	10	35	16	35	0	0
	point107	107	434	35	10	35	10	35	16	35	0	0
	point108	108	434	35	10	35	10	35	16	35	0	0
	point109	109	434	35	10	35	10	35	16	35	0	0
	point110	110	434	35	10	35	10	35	16	35	0	0

	point111	111	434	35	10	35	10	35	16	35	0	0
	point112	112	434	35	10	35	10	35	16	35	0	0
	point113	113										
15thAveNB_Gilman-Wheeler	point159	159	2816	40	100	40	40	40	24	40	0	0
	point160	160										
15thAveSB_Gilman-Wheeler	point161	161	1906	40	100	40	40	40	24	40	0	0
	point162	162										
ArmoryWy_WB	point163	163	384	30	8	30	8	30	0	0	0	0
	point164	164	384	30	8	30	8	30	0	0	0	0
	point165	165	384	30	8	30	8	30	0	0	0	0
	point166	166	384	30	8	30	8	30	0	0	0	0
	point167	167										

Appendix C - WSDOT Environmental Procedures Manual Exhibit 446-1

Traffic Noise Abatement Decision Process



* During the Public Involvement, it may be determined that the majority of residents do not wish a noise barrier to be built. If so, WSDOT may decide to not construct the barrier.

p:/w/wdot0179/2nd draft - july 2000/epm par. 4/446 noise/exhibits/Ex 446-2 noise decision prcs.vs