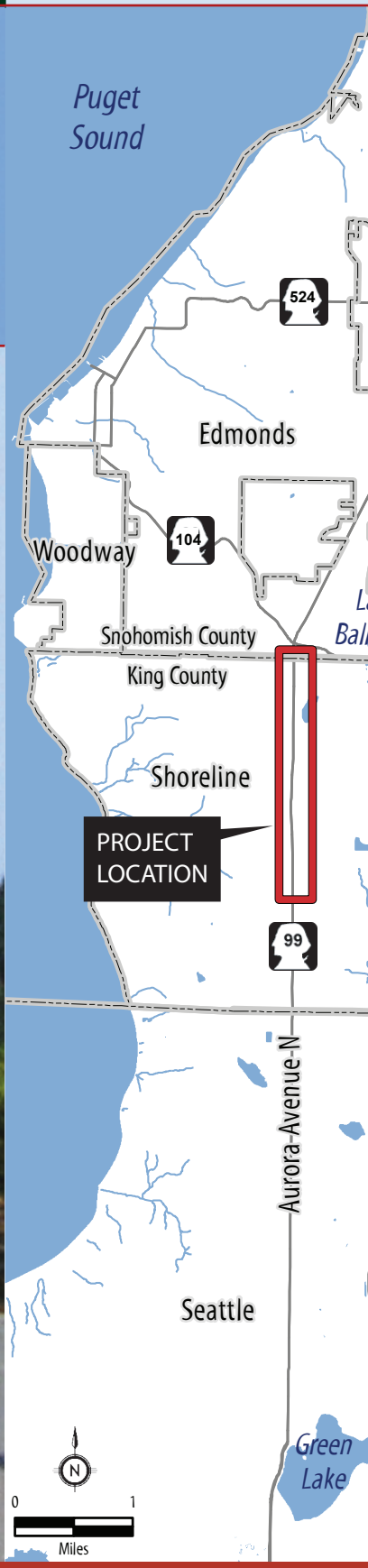
CITY OF SHORELINE

AURORA CORRIDOR

Noise
Discipline Report

Aurora Corridor Improvement Project
N 165th Street to N 205th Street



AUGUST 2007

Noise Discipline Report

Aurora Corridor Improvement Project: N 165th Street – N 205th Street

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Appendix A. Noise Measurement Data and Traffic Noise Model Validation Reports

Appendix B. Baseline Year and Design Year Traffic Noise Model Reports

Acronyms and Abbreviations

ADT	average daily traffic
BAT	Business Access and Transit
CAA	Clean Air Act
City	City of Shoreline
CTR	Commute Trip Reduction
dB	decibel
dBA	A-weighted decibel scale
DU	dwelling unit
FGTS	Freight and Goods Transportation System
GMA	Growth Management Act
HAC	High Accident Corridor
HAL	High Accident Location
I	Interstate
L_{eq}	equivalent sound level
LOS	level of service
N	North
NAC	Noise Abatement Criteria
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NHS	National Highway System
PAL	Pedestrian Accident Location

Project	Aurora Corridor Improvement Project
PSRC	Puget Sound Regional Council
RCW	Revised Code of Washington
ROD	Record of Decision
RTP	Regional Transportation Plan
SEPA	State Environmental Policy Act
SLM	sound level measurements
SR	State Route
TNM	Traffic Noise Model
V/C	volume to capacity ratio
vph	vehicles per hour
WSDOT	Washington State Department of Transportation

Glossary

A-weight	A standard frequency weighting that simulates how humans perceive sound. The intensity of sound is measured as an A-weighted decibel (dBA).
ambient noise	The totality of noise associated with a given environment encompassing sounds from many sources near and far.
attenuation rate	The rate at which the intensity of a sound signal declines as it travels outward from its source.
best management practice (BMP)	Innovative and improved environmental protection tools, practices, and methods that have been determined to be the most effective, practical means of avoiding or reducing environmental impacts.
decibel (dB)	A logarithmic-based unit of measure of sound pressure.
duration	Length of time of the noise event.
equivalent sound level (L_{eq})	The equivalent steady-state sound level in A-weighted decibels for a stated period of time, which contains the same acoustic energy as the actual time-varying sound level for the same period of time.
hertz (Hz)	A unit of frequency measured in cycles per second.
logarithm	The exponent that indicates the power to which a number must be raised to produce a given number. For example: if B2 = N, the 2 is the logarithm of N (to the base B), or 102 =100, and the logarithm of 100 (to the base 10) = 2. Also abbreviated to log.
noise abatement criteria (NAC)	Noise levels for various activities or land uses which, when approached or exceeded, are considered to be traffic noise impacts.
noise	Unwanted sound that adversely affects any given receiver location.
noise level	The weighted sound pressure level measured by using a metering characteristic with an A frequency weighting network and reported as dBA.
peak hour	The time of day when traffic is most congested. Peak hours typically occur during the morning (AM) and evening (PM) commutes.
sound	A human auditory response to the pressure waves caused by a vibration. The human perception of sound varies according to the characteristics of the sound waves and the characteristics of the media through which the sound travels.
unmet demand	Additional traffic not served by the existing roadway capacity.

Chapter 1. Introduction

This chapter introduces the proposed project, explains why noise is analyzed in the environmental process, and summarizes the key findings presented in this report.

What is the purpose of this report?

The City of Shoreline (City) proposes to construct the Aurora Corridor Improvement Project, N 165th Street to N 205th Street (Project), which will improve a 2-mile-long segment of State Route (SR) 99, named Aurora Avenue North (N) within the City. This project must be developed in compliance with the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA).

This Noise Discipline Report was prepared in general accordance with Section 446 of the Washington State Department of Transportation (WSDOT) Environmental Procedures Manual (WSDOT 2006a). This report includes a discussion of noise regulations that apply to the Project, models of existing and future sound levels at representative noise-sensitive receiver locations, and a determination of noise effects and mitigation.

Where is the Project located?

The Project is located within the city limits of the City of Shoreline on Aurora Avenue N between N 165th Street and N 205th Street (See Figure 1, *Project Vicinity*).

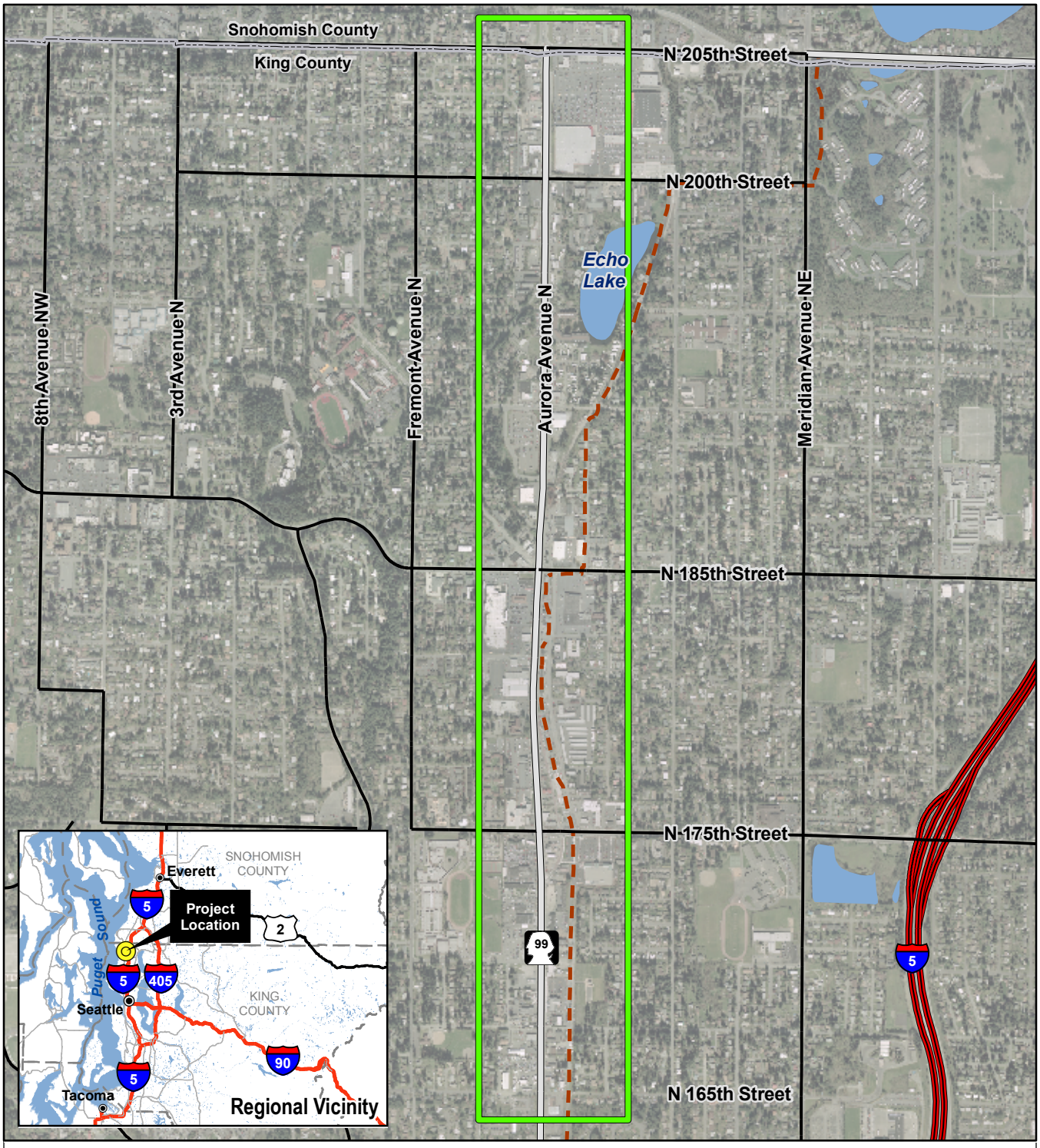
What are the existing characteristics of the Aurora Avenue N corridor?

Aurora Avenue N is a major north/south urban highway that serves both local and regional traffic within the City of Shoreline (see Figure 1, *Project Vicinity*). It is a key regional vehicular, transit, and truck corridor within the greater area of Puget Sound and serves as the City's primary arterial roadway, running approximately parallel to Interstate (I)-5 with connections at N 145th Street, N 175th Street, and N 205th Street. Development along the corridor is predominantly commercial, mixed with some multi-family housing. Echo Lake is located approximately 200 feet to the east of the roadway, north of N 192nd Street. The Interurban Trail, currently under construction, runs roughly parallel to Aurora Avenue N, to the east in the Project corridor (City of Shoreline 2007). Aurora Avenue N has two general-purpose lanes in each direction and a center two-way-left-turn lane, with shoulder and sidewalk of varying width located sporadically along the corridor, no curb or gutter, and little landscaping.

Under existing conditions, average daily traffic (ADT) on the roadway is 33,000 to 39,000 vehicles per day. A steady level of pedestrian and bicycle travel occurs along and across the roadway, but the corridor is heavily oriented to vehicle travel and is generally not conducive to non-motorized travel. WSDOT has designated several areas of Aurora Avenue N between N 165th Street and 205th Street with adverse safety ratings, which are described in Chapter 2. The corridor is served heavily by public transit provided by King County Metro, with additional service at the north end of the corridor provided by Community Transit.

Average Daily Traffic (ADT)

ADT represents the average number of vehicles that travel on a roadway on typical day. Under existing conditions, ADT on Aurora Avenue N is 33,000 to 39,000 vehicles per day.



Sources: City of Shoreline (2006); Jones & Stokes (2007)

- City Boundary
- Project Area
- Interstate
- State Route
- Arterial
- Interurban Trail

N

Feet

0 1,000 2,000

Figure 1. Project Vicinity
Aurora Corridor Improvement Project
August 2007

Why improve Aurora Avenue N?

The purpose of the Aurora Corridor Improvement Project, N 165th Street to N 205th Street, is to improve safety, circulation, and operations for vehicular and non-motorized users of the roadway corridor, to support multi-modal transportation within the corridor, and to support economic stability along the corridor. The Purpose and Need identified for this project is described further in Chapter 2.

What are the major characteristics of the proposed project?

The Aurora Corridor Improvement Project, N 165th Street to N 205th Street, would include the following elements:

- Business Access and Transit (BAT) lane in each direction;
- two general-purpose lanes in each direction;
- continuous sidewalk, curb, and gutter on each side of the roadway;
- landscaped center median with left-turn and u-turn pockets;
- interconnected, coordinated signal system with transit signal priority;
- improvements to intersections, including proposed new traffic signals at the intersections of Aurora Avenue N with Firlands Way N/N 196th Street and N 182nd Street;
- marked pedestrian crossings at signalized intersections;
- improvements to Midvale Avenue N, between N 175th Street and N 182nd Street;
- improvements to Echo Lake Place, north of N 195th Street;
- new street and sidewalk lighting;
- undergrounding of utilities; and
- stormwater facilities.

Business Access and Transit (BAT) Lane

Right-side lane that serves exclusively for bus travel, and for right-turn access in and out of driveways located along the corridor.

In addition to a No Build Alternative, three Build Alternatives, called Alternative A, B and C, respectively, are under consideration. In general, they vary in centerline location, width of median, and presence or absence of an amenity zone between the curb and sidewalk. The three Build Alternatives are described in detail in Chapter 3 of this report.

Why is noise considered for this Project?

The Federal Noise Control Act of 1972 (Public Law 92-574) requires that all federal agencies administer their programs in a manner that promotes an environment free from noises that may jeopardize public health or welfare.

This noise analysis will determine if traffic noise effects would occur and if the Project should include mitigation measures such as noise barriers to buffer noise-sensitive areas from the roadway.

What are the key points of this report?

Following are the key points of this report:

- The Project will involve federal funding; therefore, the Federal Highway Administration (FHWA) procedures specified in the Code of Federal Regulations (CFR) (23 CFR 772) and the WSDOT Noise Policies and Procedures (WSDOT 2006b) were used in this assessment.
- The Project would widen Aurora N to include medians and BAT lanes, and is subject to FHWA and WSDOT noise policies.
- The FHWA Traffic Noise Model Version 2.5 (TNM) was used to predict existing and future noise levels during the evening peak hour period for the baseline year (2005) and the design year (2030). Noise levels were modeled at receiver locations consisting of houses, apartments and condominium with outdoor usages, and businesses with outdoor seating areas within 500 feet of the roadway. Predicted peak-hour noise levels were compared to FHWA's Noise Abatement Criteria (NAC) to determine if the Project would result in traffic noise impacts.

Noise Abatement Criteria (NAC)

Noise levels for various activities or land uses which, when approached or exceeded, are considered to be traffic noise impacts.

- For the baseline year (2005), the noise modeling results indicated that traffic noise levels at the following food service outdoor seating area currently exceeds the NAC.
  - Starbucks at 20121 Aurora Avenue N (labeled Outdoor Seating-3 in the noise analysis)
- For the design year (2030), the modeled noise levels at the following locations would exceed the NAC for No Build and all three Build Alternatives:
  - Outdoor Seating-3: Starbucks at 20121 Aurora Avenue N
  - The Mattino Condominium at 935 N 200th Street (labeled Apartment-8 in the noise analysis)
  - Firlands Way Condominium at 19523 Firlands Way N (labeled Apartment-9 in the noise analysis)
  - 19370 Firlands Way N (labeled House-21 in the noise analysis)
  - 19344 Firlands Way N (labeled House-29 in the noise analysis)
- Noise barriers installed along the right-of-way to protect the affected homes and business would not be technically feasible because the affected units require driveway access to Aurora Avenue N.

Table 1 summarizes the potential noise effects that are identified in this report for the No Build and three Build Alternatives, and the mitigation measures that are proposed to address those effects.

Table 1. Summary of Potential Noise Effects and Mitigation

	Alternatives			
Potential Effects and Mitigation	No Build	A	B	C
Potential Operational Effects				
Modeled noise levels exceed NAC at Outdoor Seating-3, Apartment-8, Apartment-9, House-21-and House-29	X	X	X	X
Mitigation: No noise abatement measures would satisfy WSDOT's feasibility and reasonableness criteria.				
Potential Construction Effects				
Temporary construction noise at nearby noise-sensitive receivers		X	X	X
Mitigation: Implement Construction Noise Reduction Plan.				

Chapter 2. Purpose and Need

This chapter describes the overall purpose of the proposed project and identifies the specific needs that the Project would address.

What is the purpose of the Aurora Corridor Improvement Project?

The purpose of the Aurora Corridor Improvement Project: N 165th Street to N 205th Street, is to improve safety, circulation, and operations for vehicular and non-motorized users of the roadway corridor, to support multi-modal transportation within the corridor, and to support economic stability along the corridor.

How were the needs of the Aurora Avenue North corridor identified?

The needs of the Aurora Avenue North corridor that would be addressed by this Project were identified through the:

- Regional Metropolitan Transportation Plan;
- City Comprehensive Plan; and
- City Multimodal Pre-Design Study.

Regional Metropolitan Transportation Plan

Improvement to Aurora Avenue N between N 165th Street and N 205th Street is identified in *Destination 2030,* which is the regional Metropolitan Transportation Plan that addresses long-range transportation needs of a growing population (PSRC 2001). The plan includes a detailed set of projects and programs that recognize the link between transportation and growth planning. It identifies more than 2,000 specific projects that will improve roads, transit and ferry service, bicycle and pedestrian systems, freight mobility, and traffic management and operations. *Destination 2030* calls for the development of new state and regional funding mechanisms to provide sustained and flexible revenues that support plan strategies, and it outlines a monitoring and review process for ensuring that plans are current and that implementation stays on course.

City Comprehensive Plan

Improving Aurora has been a community goal since the City of Shoreline incorporated in 1995. However, regional and local governments recognized the need for improvements along Aurora Avenue N even prior to the City's incorporation. Before the City was incorporated, King County initiated a project to provide transit enhancements along Aurora Avenue N. After incorporation, the City requested that the project be postponed until the City could complete its comprehensive planning process to define improvements in the Aurora Avenue N corridor.

The City of Shoreline Comprehensive Plan was first adopted in November 1998 and most recently updated in June 2005. The Plan establishes the City's vision, and establishes Framework Goals intended to guide the City to meet that vision. The City's goals for Aurora Avenue N, as stated in its Comprehensive Plan, are to improve safety for all users on the roadway, to support economic stability along the corridor, and to improve mobility by supporting multimodal transportation services (City of Shoreline 2005). Assessment of the City's goals and policies, as established in the Comprehensive Plan, is provided in the Land Use, Plans, and Policies report prepared as part of the environmental analysis for this Project.

Multimodal Pre-Design Study

In 1998, the City of Shoreline began the 1-year Aurora Corridor Multimodal Pre-Design Study (CH2M Hill 1999). The study included an extensive Community and Agency Involvement Program involving a variety of public and private stakeholders in the plan development. Multiple opportunities for community input were provided, and emphasis was placed on clearly articulating the technical elements of the plan. The Community and Agency Involvement Program included both the community and agencies because both are necessary for consensus building. A key Community and Agency Involvement Program component was the participation of a Citizen's Advisory Task Force, made up of representatives from the business and residential communities and transit users. An Interagency Technical Advisory Committee also included public sector stakeholders. These advisory committees recommended a preferred design concept, described in the following section.

Multimodal Transportation

Multimodal transportation refers to multiple choices for travel, including driving alone, carpooling, walking, biking, or riding transit.

Community and Agency Involvement Program elements included:

- ongoing participation of the Citizen's Advisory Task Force, Interagency Advisory Committee, and Policy Advisory Committee;
- project briefings with City Council and Planning Commission;
- three public open houses;
- open house announcements mailed to 3,000 addresses each time an event was held;
- canvassing by the Citizen's Advisory Task Force;
- meetings with property owners within the study area;
- meetings with community interest groups;
- newsletters distributed to landowners, business owners, and other interested parties; and
- press releases distributed to neighborhood associations, community groups, and local media.

Community Outreach

The City conducted a total of 23 meetings with the Citizen's Advisory Task Force, Interagency Technical Advisory Committee, and the general public. The City also conducted eight City Council briefings and two planning commission presentations. Three open houses were held during the course of the Pre-Design Study. Each meeting was designed to encourage interactive involvement through small group design workshops, informal ballots, prioritization exercises, and comment sheets.

32 Points

The corridor project design concept and the 32 Points (see exhibit on following page) were approved unanimously by the Citizen Advisory Task Force on July 8, 1999, and were adopted unanimously by the City Council as part of Resolution 156 on August 23, 1999. The 32 Points are to be used as guides during implementation and design of Aurora Avenue improvement projects, to ensure that concerns of the community and the vision of the City Council are fully addressed.

The main features of the adopted design concept include the addition of BAT lanes in each direction on the roadway; curbs, gutters, a landscaping/street furnishing strip, and sidewalks on both sides; and a landscaped center median safety lane with left and u-turn pockets. The 32 Points also recommended four new signalized intersections and four new pedestrian-activated signalized crossings along the 3-mile length of Aurora Avenue N within the city limits.

The main features of the adopted design concept include:

- the addition of BAT lanes in each direction on the roadway;
- curbs, gutters, landscaping/street furnishing strip, and sidewalks on both sides; and
- the creation of a landscaped center median safety lane with left and u-turn pockets.

Exhibit. The "32 Points"

1. The maximum number of lanes on an intersection leg shall not exceed eight lanes including turning lanes. Seven lanes is the desired width.
2. Provide ability at intersections for all pedestrians to safely cross (and include median refuge at intersections with pedestrian pushbuttons). New mid-block pedestrian crossings should include pedestrian activated signals. Bus stops and pedestrian crossings will complement each other.
3. Twelve foot sidewalks will be provided on both sides of Aurora the entire length. Consider reducing the initial sidewalk width to mitigate land impacts/acquisitions on existing businesses. Note: a minimum of four feet of a landscaping/street furnishing zone is included in the twelve foot width total above.
4. Utilize more landscaping or colored pavement in sidewalk areas to soften the look. The four foot landscaping/street furnishing strip behind the curb should utilize trees in tree grates/pits (consider a combination tree protector/bike rack), low growing ground cover/shrubs, and could utilize some special paving (or brick) between curb and sidewalk to strengthen the identity of an area.
5. Strive to design the project so that new sidewalks can link to existing recently constructed sidewalks (such as Seattle Restaurant Supply, Drift-on-Inn, Schucks, Hollywood Video, and Easley Cadillac).
6. Re-align the street where possible to avoid property takes.
7. As the final design is developed, work with WSDOT to obtain design approvals for lane width reductions, and look for opportunities to reduce (but not eliminate) the median width both to enable reduction of pavement widths, construction costs, and land impacts/acquisition on existing businesses.
8. Develop median breaks or intersections for business access and U-turns at least every 800-to-1000 feet (these details will be worked out during future design phases and will be based in part on the amount of traffic entering and exiting businesses).
9. Use low growing drought resistant ground-cover and space trees in the median to allow visibility across it.
10. Unify the corridor by adding art, special light fixtures, pavement patterns (and coloring at crosswalks), street furniture, banners, unique bus shelters, etc. to dramatically enhance image and uniqueness of the streetscape and develop it differently than the standard design that has been constructed for most streets.
11. Unify the entire corridor by the use of street trees, lighting, special paving, bus zone design, and other elements to visually connect the corridor along its length.
12. Provide elements in the Interurban/Aurora Junction area, between 175th and 185th that create a safe, pedestrian oriented streetscape. Elements can include special treatments of crossings, linkages to the Interurban Trail, etc.
13. Develop signature gateway designs at 145th and 205th with special interest landscaping, lighting, paving and public art to provide a visual cue to drivers that they have entered a special place.
14. Develop themes that reflect the character and uses of different sections of the street (such as the 150th to 160th area which has a concentration of international businesses, recall the historic significance of the Interurban or other historic elements, and Echo Lake).
15. Utilize the Arts Council and neighborhoods to solicit and select art along the corridor.
16. Strengthen connections to the Interurban Trail through signing and other urban design techniques.
17. Develop a design for closure of Westminster Road between 158th and 155th by developing a southbound right turn lane at 155th Street and converting the existing road section to a driveway entrance to Aurora Square. Also, develop an elevated Interurban trail crossing through "the Triangle" that is integrated with future development of the Triangle (reserve the option to build above Westminster should we not be successful in closing the roadway).
18. Pursue modifying the access to Firlands at 185th, closing Firlands north of 195th, and developing a new signal at 195th.
19. The preferred design shall include:
    - Stormwater management improvements to accompany the project that follow the city's policies;
    - Traffic signal control and coordination technology (including coordination with Seattle and Edmonds SR 99 signal systems);
    - Traffic signal technology to enable transit priority operations;
    - Continuous illumination for traffic safety and pedestrian scale lighting;
    - Undergrounding of overhead utility distribution lines.
20. Traffic signals will include audible elements for the sight-impaired, and wheelchair detection loops for wheelchair users.
21. The City should establish a right-of-way policy to retain or relocate existing businesses along the corridor, including those that do not own the land on which they are located. Consideration should be given to providing financial incentives to those businesses.
22. Work with property and business owners during the preliminary engineering phase to consolidate driveways, share driveways, and potentially to share parking and inter business access across parcel lines. Be creative and sensitive to the parking needs of businesses, including consideration for some potential clustered/shared parking lots (especially if remnant parcels are available).
23. Provide improvements that will not generate an increase in neighborhood spillover traffic.
24. Work with transit agencies to provide increased service and seek capital investments from them to support this project.
25. Develop partnerships with WSDOT and King County/Metro to jointly fund the project.
26. Provide curb bulbs where practical on side streets to reduce pedestrian crossing width and to discourage cut-through traffic.
27. Strengthen and preserve the heritage of the red brick road. If the design impacts the red brick road in its current configuration/location north of 175th, preserve its heritage by relocating it elsewhere.
28. Consider new signalized intersections at 152nd, 165th, 182nd, and 195th.
29. Consider new pedestrian only signalized crossings in the vicinity of 149th, 170th, 180th and 202nd.
30. Sign Ronald Place south of 175th as the route to I-5.
31. Pursue reducing the speed limit to 35 mph where appropriate recognizing the potential impacts of spillover traffic with a lower posted speed.
32. Seek funding to develop a program to assist and encourage businesses to improve their facades.

City of Shoreline (Resolution 156, August 23, 1999)

What are the needs addressed by the Project?

System Linkage

The proposed project would improve regional system linkage by providing additional lane capacity, improved intersection capacity, and improved signal coordination. It would also continue the improvements underway between N 145th Street and N 165th Street, creating a consistent continuous corridor throughout the City.

Aurora Avenue N is a major north/south arterial link that serves both local and regional traffic within the City of Shoreline. It is part of the National Highway System (NHS). The portion of Aurora Avenue N within the City connects SR 104 and SR 523. In addition to serving intra-city traffic, the route serves as a regional link between cities in the Puget Sound region, connecting to the City of Seattle to the south and Snohomish County to the north. It is the significant alternative to I-5 in providing north/south regional linkage. The portion of SR 99 located within the City has also been identified as a Highway of Statewide Significance (Washington State Transportation Commission 1998). Highways of Statewide Significance, identified under the Revised Code of Washington (RCW) 47.06.140, are those facilities deemed to provide and support transportation functions that promote and maintain significant statewide travel and economic linkages. The legislation emphasizes that these significant facilities should be planned from a statewide perspective (WSDOT 2002).

National Highway System

Federally identified highways that are most important to interstate travel and national defense, connect other modes of transportation, and are essential for international commerce.

Highway of Statewide Significance

Highways identified by the Washington State Transportation Commission that provide significant statewide travel and economic linkages.

The timely delivery of goods is extremely important to business operations and economic vitality. Aurora Avenue N is identified by WSDOT as a truck freight route in the statewide Freight and Goods Transportation System (FGTS). It carries more than 5 million tons of freight annually, so is classified as a T-2 tonnage class roadway (WSDOT 2005). It has also been identified as part of the King County Regional Arterial Network, and the Puget Sound Regional Council (PSRC) Metropolitan Transportation and Freight and Goods Systems. Aurora Avenue N also provides a connection between other routes on the FGTS, including Westminster Way/Greenwood Avenue (class T-2), SR 523 (class T-3), N 185th Street (class T-2), and SR 104 (class T-3) (WSDOT 2005).

WSDOT Freight and Goods Transportation System (FGTS) Classifications

Roadways are classified according to the average volume of freight they carry each year:

T-1 > 10 million tons per year

T-2 4 million – 10 million tons per year

T-3 300,000 – 4 million tons per year

T-4 100,000 – 300,000 tons per year

T-5 At least 20,000 tons in 60 days

Aurora Avenue N provides a linkage for commuters and transit to two regional Park and Ride facilities located at N 192nd Street and Aurora Avenue; and on N 200th Street, two blocks east of Aurora Avenue N.

The City is currently completing improvements to Aurora Avenue N between N 145th Street and N 165th Street, which include similar elements to those proposed for this Project. Improvements include BAT lanes; curbs, gutters, landscaping/utility strip, and sidewalks on both sides; a landscaped center median with left and u-turn pockets, new signalized intersections, pedestrian-activated signalized crossings, undergrounding of utilities, and stormwater facilities.

Capacity

The proposed project would address capacity needs through improvements to intersection geometry and capacity, channelization, signal improvements, and additional lane capacity for business access and transit. By reducing the number of access points according to WSDOT criteria, capacity in the corridor would be improved through the reduction of conflicts and traffic friction.

The capacity of the current facility is inadequate to accommodate projected traffic volumes. The corridor currently supports 33,000 to 39,000 daily vehicle trips. Traffic analysis completed for the Aurora Avenue N corridor assessed level of service (LOS) from now through the future planning year of 2030, under conditions both with and without the proposed project. Over the next 20 years, volumes along the corridor are expected to increase by 1.1% annually.

LOS is the primary measurement used to determine the operating quality of a roadway segment or intersection. LOS is generally measured by the ratio of traffic volume to capacity (V/C) or by the average delay experienced by vehicles on the facility. The quality of traffic operation is graded into one of six LOS designations: A, B, C, D, E, or F. LOS A represents the best range of operating conditions and LOS F represents the worst. LOS on transportation facilities is analyzed and measured according to procedures provided in the Highway Capacity Manual (Transportation Research Board 2000). In an urban corridor such as Aurora Avenue N, LOS at intersections controls the overall LOS of the roadway. LOS for signalized intersections is determined by the average amount of delay experienced by vehicles at the intersection. LOS standards are used

Level of Service (LOS) - Characteristics of Traffic Flow

LOS A	Free flow, little or no restriction on speed or maneuverability caused by the presence of other vehicles.
LOS B	Stable flow, operating speed is beginning to be restricted by other traffic.
LOS C	Stable flow, volume and density levels are beginning to restrict drivers in their maneuverability.
LOS D	Stable flow, speeds and maneuverability closely controlled due to higher volumes.
LOS E	Unstable flow, low speeds, considerable delay, volume at or near capacity, freedom to maneuver is difficult.
LOS F	Forced traffic flow, very low speeds, traffic volumes exceed capacity, long delays with stop and go traffic.

to evaluate the transportation impacts of long-term growth. The Washington State Growth Management Act (GMA) (RCW 36.70A, 1990) requires that jurisdictions adopt standards by which the minimum acceptable roadway operating conditions are determined and deficiencies may be identified. The City has adopted a standard of LOS E for intersections within the City (City of Shoreline 2005).

Detailed traffic analysis of Aurora Avenue N is presented in the Transportation Discipline Report prepared for this Project. The analysis shows that without improvements, average delay at key signalized intersections along Aurora Avenue N will fall to LOS F. These conditions are considered unacceptable by most drivers and fail to meet the City's adopted standard of LOS E. A lack of adequate capacity along Aurora Avenue N could encourage drivers to use parallel neighborhood routes.

Regional Transportation Demand

The proposed project would provide additional automobile and transit capacity to help meet the demand that is anticipated to occur in the Aurora Corridor over the next 20 years. The City's design concept for the Project satisfies the following regional policies:

- Optimize and manage the use of transportation facilities and services.
- Manage travel demand by addressing traffic congestion and environmental objectives.
- Focus transportation investments by supporting transit-and pedestrian-oriented land use patterns.
- Expand transportation capacity by offering greater mobility options.

The PSRC has adopted a Regional Transportation Plan (RTP), the Transportation Element of *Destination 2030* (PSRC 2001). The RTP provides the long-range strategy for future investments in the central Puget Sound region's transportation system. It responds to federal legislative mandates such as the federal Transportation Equity Act for the 21st Century and the Clean Air Act (CAA); and state mandates such as the Commute Trip Reduction Law RCW (70.94.521-551) and the GMA (RCW 36.70A). It also is intended to respond to regional concerns of pressing transportation problems.

Regional Transportation Plan (RTP)

The RTP provides the long-range strategy for future investments in the central Puget Sound region's transportation system.

The basic building blocks for the RTP are state, city, county, and transit agency plans and policies.

Improvements to Aurora Avenue N through Shoreline are included in the list of capital projects identified by the RTP as critical, and as part of the Metropolitan Transportation System required to satisfy regional needs through 2030.

Modal Interrelationships

The proposed project would enhance mobility and safety for pedestrians by providing continuous sidewalk, curbs, and gutter along both sides of the roadway. Additional crosswalks will provide more safe crossings for pedestrians. Pedestrian links would be also provided to the adjacent Interurban Trail.

The Interurban Trail

The Interurban Trail is a regional pedestrian and bicycle facility that runs roughly parallel to Aurora Avenue N. Construction is currently underway, with completion planned for July 2007. After construction is complete, the Interurban Trail will run throughout the entire City length, between N 145th Street and N 205th Street.

Bicyclists traveling along Aurora Avenue N would be allowed to travel on the sidewalks or in the BAT lanes, and would also benefit from connections provided to the Interurban Trail.

The Project would also improve transit operations and reliability through the addition of the BAT lanes, providing a lane for bus operation outside the general-purpose traffic flow.

The portion of Aurora Avenue N within the City is heavily automobile-oriented, and lacking in pedestrian or bicycle facilities. Driveway access along the corridor is largely undefined and sidewalk facilities are discontinuous and do not meet City standards. The only areas where sidewalks meet City standards are areas along developments that have been built within the last 10 years.

Buses on Aurora Avenue N travel in the general-purpose lanes and are subject to congestion. When traffic is congested, the buses are likely to be delayed. When buses stop to pick up and drop off passengers, they block traffic in one of the two general-purpose lanes that currently exist in each direction. Discontinuous sidewalks make access to transit difficult, especially for those with disabilities. The absence of even, wide, continuous pedestrian facilities can dissuade potential transit patrons from using the bus system. Bicyclists currently have to travel either on shoulders, where they exist, or in the general-purpose traffic lanes, discouraging most bicyclists.

The Interurban Trail is a pedestrian and bicycle facility that runs roughly parallel to Aurora Avenue N, providing regional connection

from Everett through Seattle. Construction within the City is currently underway, with completion planned for July 2007. After construction is complete, the Interurban Trail will run throughout the entire City length, between N 145th Street and N 205th Street. In the Project area, the trail is located approximately one block east of Aurora Avenue N between N 165th Street and N 192nd Street; runs to the east of Echo Lake; runs east-west along N 200th Street to Meridian Avenue; and then runs north-south on the east side of Meridian Avenue through Ballinger Commons (City of Shoreline 2007). Existing sidewalks are inadequate to provide pedestrian connectivity along Aurora Avenue N and to the Interurban Trail.

Safety

Project elements would improve channelization; separate pedestrians from vehicular traffic; and reduce potential conflicts between vehicles, pedestrians, and bicyclists. The City is working with businesses and property owners to develop appropriate solutions that address access and parking issues, while still maintaining Project goals.

WSDOT collects and compiles historical collision data for state highways, including Aurora Avenue N (SR 99). Several areas of Aurora Avenue N, between N 165th Street and N 205th Street, have been given poor safety designations by WSDOT. WSDOT has identified one high accident corridor (HAC), three high accident locations (HALs), and two pedestrian accident locations (PALs) on Aurora Avenue N, between N 165th Street and N 205th Street, for the 2007–2009 biennium. Between 2003 and 2005, the average annual collision rate for the entire Aurora Avenue N corridor within Shoreline was calculated to be 5.5 accidents per million vehicle miles traveled. This greatly exceeds the most recently compiled (2005) statewide average for urban principal arterials of 2.6 accidents per million vehicle miles. There is strong public concern for general traffic safety and pedestrian safety along the corridor. Collision history and WSDOT safety designations are discussed in further detail in the Transportation Discipline Report prepared as part of the environmental analysis for this Project.

Aurora Avenue N currently lacks adequate access management. Land use along Aurora Avenue N is predominantly commercial/retail. Most of the businesses are freestanding, with defined and undefined individual driveways, or continuous shoulder

High Accident Corridor (HAC)

A highway corridor one mile or greater in length where a 5-year analysis of collision history indicates that the section has higher than average collision and severity factors.

Pedestrian Accident Location (HAL)

A highway section typically less than 0.25 mile in length where a 2-year analysis of collision history indicates that the section has a significantly higher than average collision and severity rate.

Pedestrian Accident Location (PAL)

A highway section typically less than 0.25 mile in length where a 6-year analysis of collision history indicates that the section has had four pedestrian accidents in a 0.1 mile segment.

access. Numerous driveways, limited curbs and sidewalks, and erratic parking all contribute to a general lack of safe passage for pedestrians, bicyclists, and vehicles. This type of development has resulted in a very high number of individual access points that increase conflict and impact safety along the corridor. In total, there are 154 access points along the 2-mile length within the Project corridor. National Cooperative Highway Research Program (NCHRP) Report 420 indicates that the ideal number of access points is fewer than 30 per mile (Gluck et al. 1999).

Much of the existing business parking along the corridor is directly adjacent to the roadway shoulders and is angled or perpendicular to the street. Many existing parking spaces require motorists to back onto the roadway to exit. Parking within the Aurora Avenue N roadway right-of-way occurs primarily near retail and commercial land uses within the project area. Several businesses along the roadway between N 165th Street and N 205th Street use the shoulder for parking in areas where there is no curb, effectively blocking pedestrians and people in wheelchairs.

The Project elements that would improve safety conditions along Aurora Avenue N include:

- addition of curbs and gutters and consolidated driveway locations;
- even, wide, continuous sidewalks that would be safer for pedestrians and transit patrons;
- application of driveway width and spacing standards;
- proposed traffic signals and pedestrian crosswalks;
- conversion of the existing two-way left-turn-lane into a median with channelized left-turn and u-turns;
- restriction of driveways to right-turn-in and right-turn-out only;
- elimination of motorists' ability to back onto the roadway to exit; and
- provision of the BAT lanes that would allow traffic to safely enter and exit the roadway with fewer conflicting movements and lower risk of crashes.

Social and Economic Development

The Project would address the need to continue to enhance the movement of people and goods within the SR 99 commercial corridor, as identified in the Comprehensive Plan, by improving person and freight mobility; pedestrian, bicycle, and transit linkages; and overall safety for vehicular and non-vehicular travelers.

The City Comprehensive Plan provides forecasts of job growth within the Aurora Avenue N corridor. This growth depends on a revitalized roadway corridor along all of Aurora Avenue N, including the area between N 165th Street and N 205th Street.

The City Comprehensive Plan provides forecasts of job growth within the Aurora Avenue N corridor. This growth depends on a revitalized roadway corridor along all of Aurora Avenue N, including the area between N 165th Street and N 205th Street.

The Comprehensive Plan sets forth a vision that concentrated activity centers will develop at several locations along the corridor. These are located between N 175th Street and N 185th Street, and between N 200th Street and N 205th Street (Aurora Village). To support the economic development goals of the Comprehensive Plan, improvements are needed for pedestrian and transit access to and between these locations. The City's objective for Aurora Avenue N is to install improvements that would lead people to the community and its businesses (City of Shoreline 2005).

What is the legislative context for the Project?

There are three articles of legislation that provide specific direction for the project. City Resolution 156, City Ordinance 326, and RCW 47.50 are discussed below.

City Resolution 156

Resolution 156 was adopted unanimously by the Shoreline City Council on August 23, 1999, at an open meeting that included opportunities for public testimony. This resolution accepted the recommendation of the CATF for the 3-mile Aurora Avenue N corridor within the city limits; found the recommendation to be in conformance with the City Comprehensive Plan (2005); initiated an amendment to the Capital Improvement Program; and directed staff to pursue environmental analysis for the corridor improvement. Resolution 156 included the 32 Points directive described earlier in this chapter.

City Ordinance 326

Ordinance 326, which consists of revisions to the City's Comprehensive Plan, was passed 5 to 1 by the Shoreline City Council on July 14, 2003. This ordinance amended the text of Land Use Policy LU48 and added a new Transportation Policy 5.1 for the purpose of identifying future right-of-way needs of Aurora Avenue N, between N 172nd Street and N 192nd Street. The ordinance also added a right-of-way map for this area to the Transportation Element. In general, this ordinance identifies any widening that occurs along this segment of the roadway, and resulting right-of-way acquisition needed, as occurring to the east of the existing roadway. SEPA review was completed for Ordinance 326, prior to adoption. The ordinance was not subject to NEPA. However, for the purposes of the NEPA and SEPA evaluation of the Project, the separate Build Alternatives were defined to reflect widening to both the east and the west, so that the potential impacts under the full possible range of build options would be evaluated. If the Recommended Alternative that is ultimately selected requires right-of-way outside of the boundaries defined in the ordinance, Policy T5.1 in the Comprehensive Plan, which specifically defines the boundaries, would need to be amended.

Access Management RCW 47.50

To preserve the safety and operational characteristics of state highways, RCW 47.50 was enacted in 1991, designating all highways in Washington as controlled-access facilities. Aurora Avenue N, part of SR 99, is a class 4 facility according to the WSDOT access control classification system and standards. Within this class, access management measures are identified, such as minimum driveway spacing of 250 feet and installation of medians to mitigate turning, weaving, and crossing conflicts that affect safe travel. Based on the urban environment served by Aurora Avenue N and the high traffic volumes it carries, the street's design is deficient in terms of access management for the preservation of safety and traffic operations. Any improvement to Aurora Avenue N would have to comply with access management standards defined under this law.

Chapter 3. Alternatives

This chapter describes the alternatives that are being evaluated for the proposed project.

What alternatives are considered in this discipline report?

This report evaluates the potential effects of a No Build Alternative and three Build Alternatives, described in the following sections.

No Build Alternative

Under the No Build Alternative, Aurora Avenue N would remain exactly as it is today. The roadway has two general-purpose lanes in each direction with a center two-way left-turn lane. Shoulder and sidewalk of varying widths are located sporadically along the corridor with no curb or gutter and little landscaping. The corridor is served heavily by public transit provided by King County Metro, with additional service at the north end of the corridor provided by Community Transit. Buses on Aurora Avenue N would continue to travel and stop in the general-purpose lanes.

Build Alternatives

The City has proposed three Build Alternatives: Alternative A, Alternative B, and Alternative C. Table 2 provides an overview of Project features unique in an individual Build Alternative and features common among them.

Table 2. Common and Unique Features of the Aurora Corridor Improvement Project Build Alternatives

Features Common among Build Alternatives A, B, and C	
General -purposes lanes	Project design includes two general-purpose lanes in each direction.
BAT lane	Each Build Alternative would include one Business Access and Transit (BAT) lane in each direction.
Sidewalk	7-foot sidewalks would be constructed along both sides of the corridor.
Curb and Gutter	Curb and gutter would be constructed along both sides of the corridor. Curb ramps would be constructed at all intersections in accordance with ADA requirements.
Underground utilities	Utilities would be placed underground for each of the three Build Alternatives.
Vegetation	Each of the alternatives includes vegetative plantings. Extent and location vary as described below.
Center median	A center median would be added, with left-turn and u-turn pockets (width of the center median varies by alternative, as described below).
Traffic signals	New traffic signals proposed at Aurora Avenue N/N 182nd Street and Aurora Avenue N/Firlands Way N (north of N 195th Street). Signalized intersections will be widened to improve east-west capacity and traffic flow.
Road improvements	Improvements would be made to: • Echo Lake Place (north of N 195th Street), including realignment and a connection to Aurora Avenue N at Firlands Way N; and • Midvale Ave N (N 175th Street – N 183rd Street), including realignment, addition of a center turn lane, curb and gutter, and sidewalk on the east side of the roadway. The new Interurban Trail will serve as the walking path on the west side of the roadway.

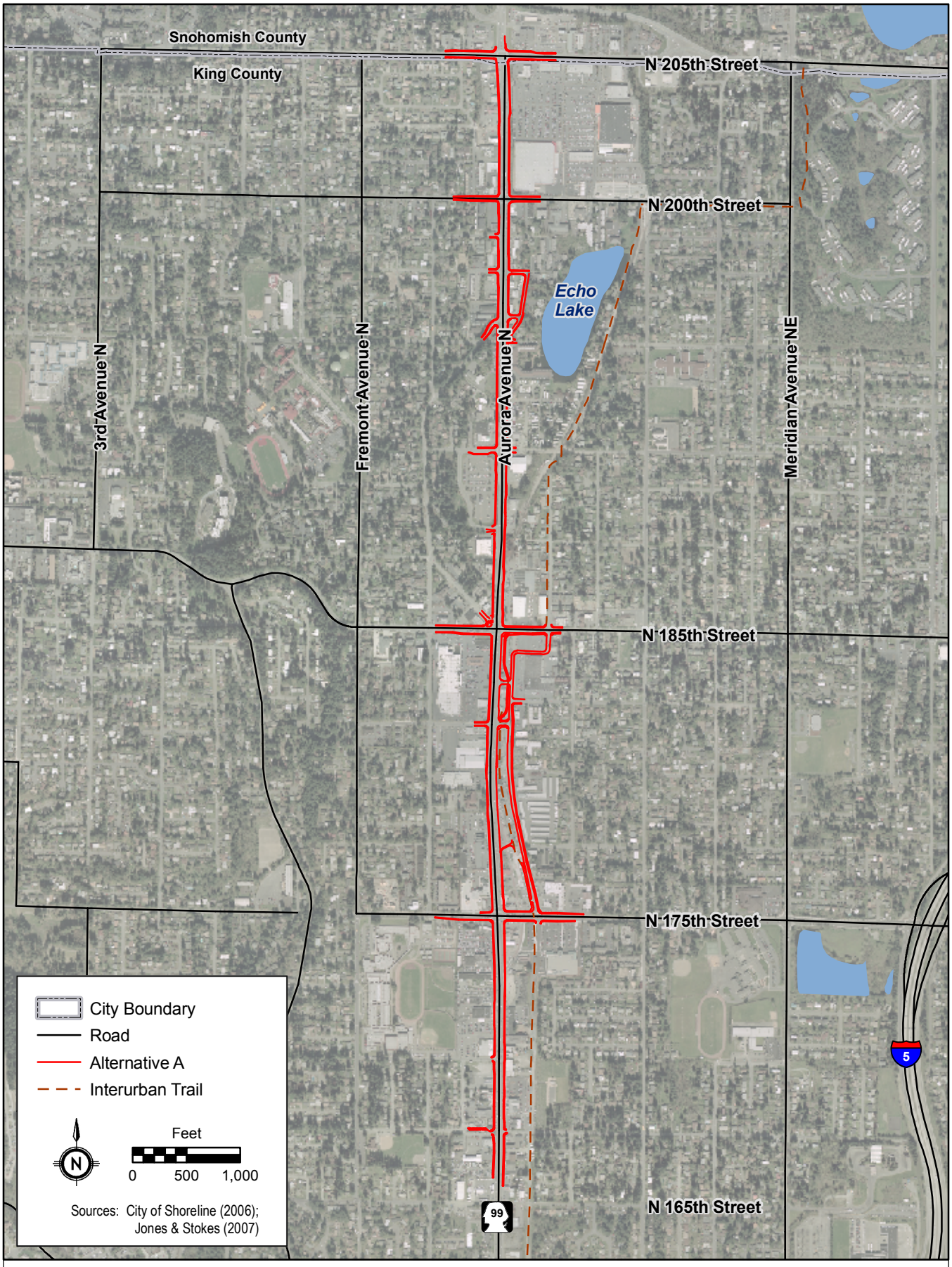
Features that vary among Alternatives A, B, and C	Alternative A	Alternative B	Alternative C
Cross Section	Typically 98 feet from back-of-sidewalk to back-of-sidewalk. The cross section will be wider where utility vaults, light/signal poles, and bump outs are located, as described below. This dimension is 12 feet narrower than the cross sections proposed under Alternatives B and C, due to a narrower median (12 feet instead of 16 feet) and the absence of the 4-foot amenity zone on each side of the roadway. The City would also acquire a continuous 3-foot-wide easement behind the sidewalk on each side of the roadway for placement of utilities.	110 feet from back-of-sidewalk to back-of-sidewalk.	
Median Width	Center median would be 12 feet wide.	Center median would be 16 feet wide.	
Amenity Zone	No amenity zone provided. Utility vaults and light/signal poles would be located behind the sidewalks in the 3-foot easement area.	A 4-foot amenity zone would be located between the curb and sidewalk on each side of the street. Utility vaults, light/signal poles, bus stop signs, hydrants, and other pedestrian amenities would be located in this area.	
Bump Outs	Bump outs approximately 4 feet in additional width would be needed at u-turn and left-turn locations to achieve the turning radii needed to accommodate u-turns.	None needed. U-turns would be sufficiently accommodated within the standard roadway width.	
Placement of Alignment	Required widening would be shifted to the east of the existing right-of-way in the vicinity of N 175th Street, N 185th Street, and N 200th Street.	Required widening would be shifted to the east of the existing right-of-way in the vicinity of N 175th Street, N 185th Street, and N 200th Street.	Required widening would be shifted to the west of the existing right-of-way in the vicinity of N 175th Street, N 185th Street, and N 200th Street.
Vegetation	Limited vegetation would be provided in the median.	More vegetation accommodated by wider median. Vegetation could also be planted in areas within the amenity zone.	

All three Build Alternatives are similar in traffic operations and safety benefits with one small exception. Alternative B includes an additional westbound right-turn pocket at Aurora Avenue N and N 175th Street. Figures 2, 3, and 4 present plan views of the three Build Alternatives, respectively. Figure 5 presents more detailed schematic drawings of the proposed roadway configurations under each of the three alternatives. The drawing shows one direction of travel of the proposed roadway alternatives, which is typical of both directions.

When will the Recommended Alternative be selected?

The Recommended Alternative will be selected after all of the environmental analysis has been completed for the No Build Alternative and three Build Alternatives. The discipline reports that summarize the environmental analysis will be available for public review after they are finalized.

The boundaries of the three Build Alternatives encompass the maximum possible footprint of the Project. The Recommended Alternative ultimately selected for the Project may combine different elements from the different Build Alternatives. However, no part of the Project will occur outside of the study area analyzed in this report.



AURORA CORRIDOR

Figure 2. Alternative A
Aurora Corridor Improvement Project
August 2007

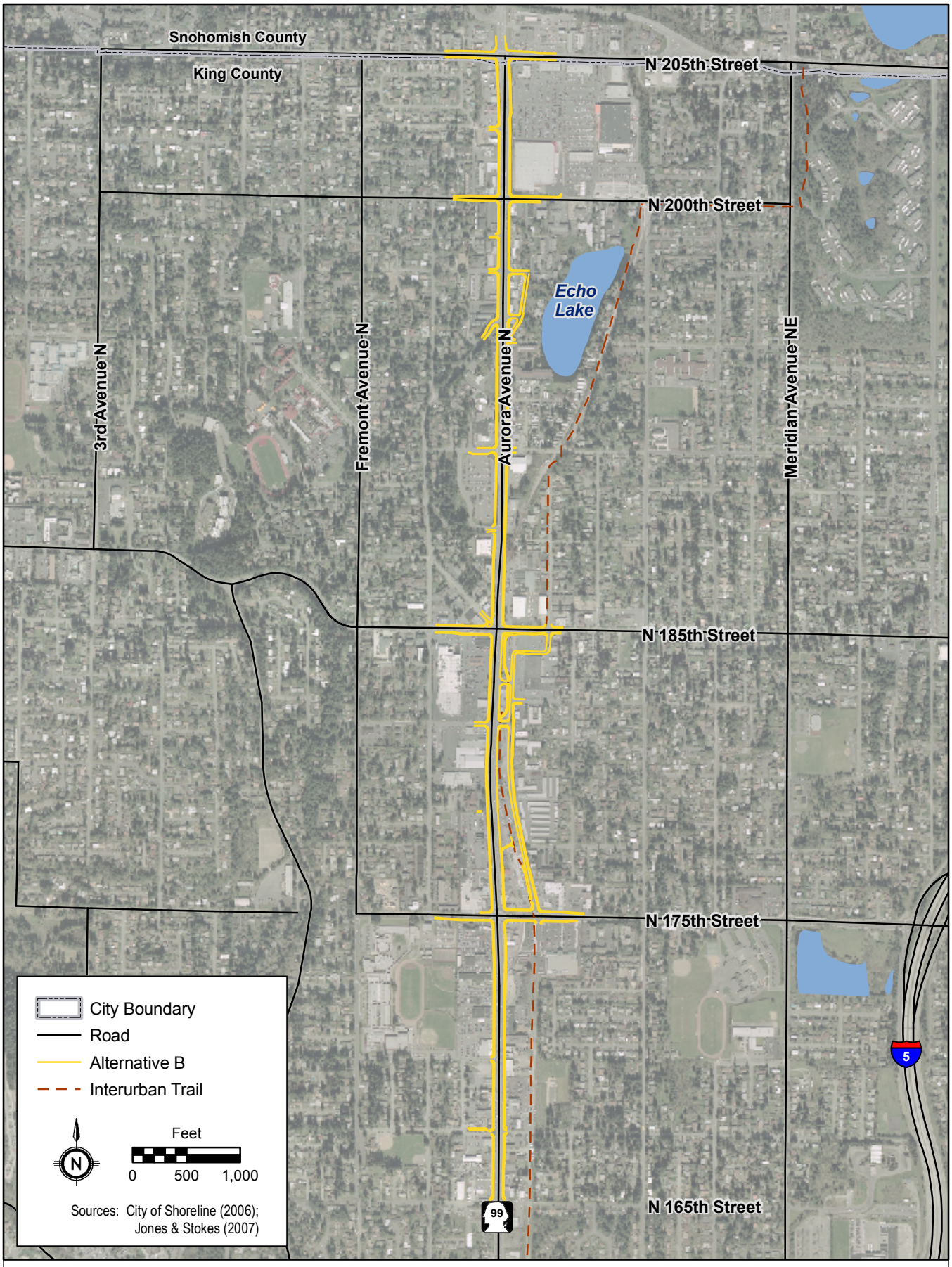


Figure 3. Alternative B
Aurora Corridor Improvement Project
August 2007

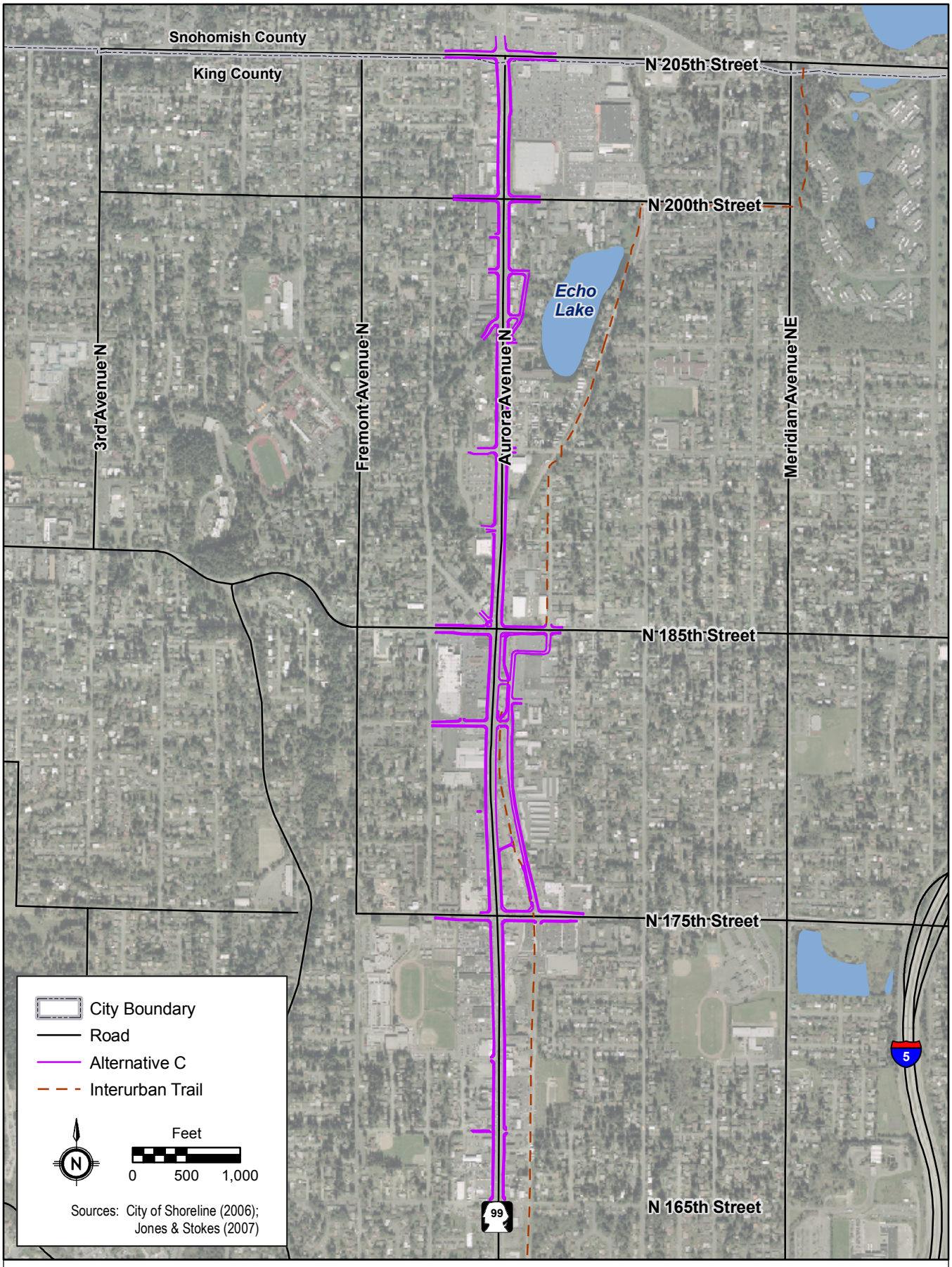
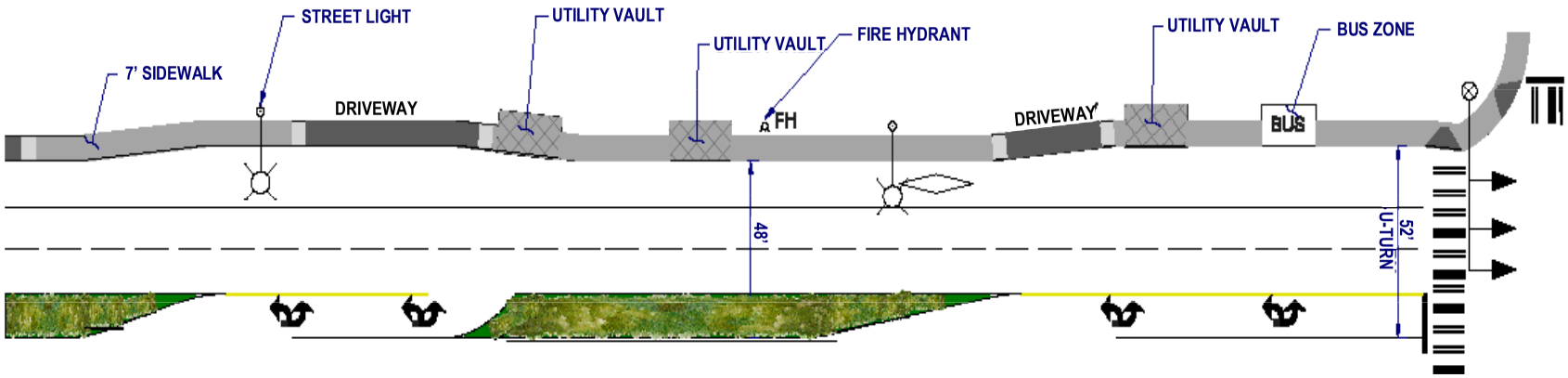


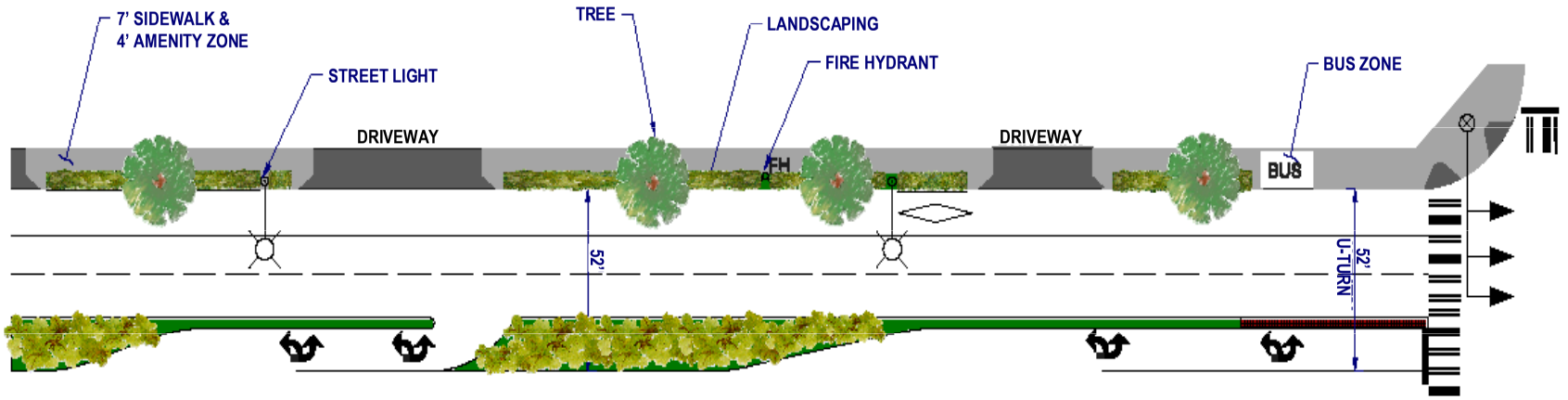
Figure 4. Alternative C
Aurora Corridor Improvement Project
August 2007

Alternative A



Alternatives B and C

Note: Drawing shows one direction of travel of the proposed roadway alternatives, which is typical of both directions



CITY OF SHORELINE AURORA CORRIDOR

Figure 5. Proposed Plan Detail for Build Alternatives
Aurora Corridor Improvement Project
August 2007

Chapter 4. Affected Environment

This chapter describes existing regulations and conditions of the environment as they relate to noise.

What are sound and noise?

Sound is caused by vibration that produces pressure waves that travel outward from the source of the disturbance. The human perception of sound varies according to the characteristics of the sound waves (e.g., period, amplitude, frequency, speed, and wavelength) and the characteristics of the media through which the sound travels (e.g., air, water, and solids). Noise is defined as unwanted sound that adversely affects any given receiver location. In general, sound waves travel away from a ground level noise source in a hemispherical pattern. As a result, the energy contained in a sound wave is spread over an increasing area as it travels away from the source. This results in a decrease in loudness at greater distances from the noise source.

Sound level meters measure the air pressure fluctuations caused by sound waves, with separate measurements made for different sound frequency ranges. The decibel (dB) scale used to describe sound is a logarithmic scale, which accounts for the large range of audible sound intensities.

Most sounds consist of a broad range of sound frequencies. Several frequency weighting schemes have been used to develop composite decibel scales that approximate the way the human ear responds to

Sound is caused by a vibration that produces pressure waves that travel outward from the source of the disturbance. The human perception of sound varies according to the characteristics of the sound waves and the characteristics of the media through which the sound travels.

Noise

Noise is defined as unwanted sound that adversely affects any given receiver location.

Decibel (dB)

A logarithmic-based unit of measure of sound pressure.

noise levels. The weighting of noise levels at different frequencies accounts for the human perception of noise. The A-weighted decibel scale (dBA) measures the intensity of sound, and is the scale most widely used for this purpose. Typical A-weighted noise levels for various types of sound sources are summarized in Table 3.

A-Weighted Decibel Scale (dBA)

A standard frequency weighting that simulates how humans perceive sound. The intensity of sound is measured as an A-weighted decibel (dBA).

Table 3. Typical A-Weighted Sound Levels

Sound Source	dBA	Typical Response
Carrier deck jet operation	140	
Limit of amplified speech	130	Painfully loud
Jet takeoff (200 feet) Auto horn (3 feet)	120	Threshold of feeling and pain
Riveting machine Jet takeoff (2,000 feet)	110	
Shout (0.5 foot) New York subway station	100	Very annoying
Heavy truck (50 feet) Pneumatic drill (50 feet)	90	Hearing damage (8-hour exposure)
Passenger train (100 feet) Helicopter (in flight, 500 feet) Freight train (50 feet)	80	Annoying
Freeway traffic (50 feet)	70	Intrusive
Air conditioning unit (20 feet) Light auto traffic (50 feet)	60	
Normal speech (15 feet)	50	Quiet
Living room Bedroom Library	40	
Soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	
	10	Just audible
	0	Threshold of hearing

Noise levels that vary with time are often described in terms of the equivalent sound level (L_{eq}). The L_{eq} is the average noise level in a given period of time. It represents the same acoustic energy as the time-varying sound level during the same period of time. The L_{eq} data used for these average noise exposure descriptors are generally based on A-weighted sound-level measurements.

Equivalent Sound Level (L_{eq})

The equivalent sound level (L_{eq}) is the average noise level in a given period of time. It represents the same acoustic energy as the time-varying sound level during the same period of time.

Because of the logarithmic decibel scale, sound levels from different noise sources cannot be added directly to give a combined noise

level. Instead, the combined noise level produced by multiple sources is calculated logarithmically. For example, if one bulldozer produces a noise level of 80 dBA, then two bulldozers would generate a combined noise level of 83 dBA, not 160 dBA. For another example, if a steady stream of cars on a roadway causes an L_{eq} noise level of 60 dBA at the nearest home and occasional trucks (by themselves) cause 50 dBA, then the noise caused by the combined traffic (cars plus trucks) would be 60.4 dBA.

People generally perceive a 10-dBA increase in a noise source as a doubling of loudness. For example, an average person would perceive a 70 dBA sound level as being twice as loud as a 60 dBA sound. People generally cannot detect differences of 1 to 2 dBA between noise levels of a similar nature (e.g., an increase in traffic noise compared to existing traffic noise). However, under ideal listening conditions, some people can detect differences of 2 or 3 dBA. Under normal listening conditions, most people would likely perceive a 5 dBA change in sounds of a similar nature. When the new sound is of a different nature than the background sound (e.g., backup alarms compared to quiet residential sounds), most people can discern the new noise even if it increases the overall L_{eq} noise by less than 1 dBA.

When distance is the only factor considered, sound levels from isolated point sources of noise typically decrease by about 6 dBA for every doubling of distance from the noise source. When the noise source is a continuous line (e.g., vehicle traffic on a highway), sound levels decrease by about 3 dBA for every doubling of distance. Attenuation rate is used to describe the rate at which the intensity of a sound signal declines as it travels outward from its source. For traffic noise studies, an attenuation rate of 4.5 dBA per doubling of distance is often used when the roadway is at ground level and the intervening ground is effective in absorbing sound (e.g., ground vegetation, scattered trees, clumps of bushes). When the roadway is elevated, 3 dBA of noise attenuation per doubling of distance is used because the sound-absorbing effects of the intervening ground are limited.

Attenuation Rate

Attenuation rate is used to describe the rate at which the intensity of a sound signal declines as it travels outward from its source.

Noise levels can also be affected by several factors other than the distance from the noise source. Topographic features and structural barriers that absorb, reflect, or scatter sound waves can affect the reduction of noise levels. Atmospheric conditions (e.g., wind speed

and direction, humidity levels, and temperatures) can also affect the degree to which sound is attenuated over distance.

Echoes off of topographical features or buildings can sometimes result in higher sound levels (lower sound attenuation rates) than normally expected. Temperature inversions and attitudinal changes in wind conditions can also refract and focus sound waves toward a location at considerable distance from the noise source. These effects are usually noticeable only for very intense noise sources, such as blasting operations. As a result, the existing noise environment can be highly variable depending on local conditions.

What noise guidelines and regulations apply to the Project?

Federal and State Traffic Noise Regulations

FHWA has adopted criteria for evaluating noise impacts associated with federally funded or state-funded highway projects, and for determining whether such impacts are sufficient to justify funding of noise abatement. These criteria, summarized in Table 4, are specified in Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR 772).

Table 4. Federal Highway Administration Noise Abatement Criteria

Activity Category	L_{eq} Noise Levels (dBA)	Description of Activity Category
A	57 (exterior)	Lands where 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, places of worship, 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, places of worship, libraries, hospitals, and auditoriums.

Source: 23 CFR 772

Abbreviations: NAC: noise abatement criteria; L_{eq}: equivalent sound level; dBA: A-weighted decibels

WSDOT has adopted the FHWA criteria for evaluating noise impacts, and for determining whether such impacts are sufficient to justify funding of noise abatement. These criteria are specified in the WSDOT Noise Policy and Procedures (WSDOT 2006b). Noise abatement is required only for Type I roadway projects. This category applies to improvements to existing roadways that consist either of significant widening, or of adding new through-lanes. WSDOT defines significant widening to mean that the existing travel lanes would be moved closer to homes to the extent that the design-year noise level with the project would increase noise levels by more than 3 dBA as compared to the No Build Alternative.

For Type I projects, a noise impact occurs when a predicted traffic noise level under design-year conditions approaches the NAC listed in Table 4, or when the predicted traffic noise level substantially exceeds the existing noise level. As defined by WSDOT, a noise level within 1 dBA of the NAC is considered to approach the NAC, while a noise level greater than or equal to the NAC is considered to exceed the NAC. A 10 dBA increase over existing noise levels is considered a substantial increase under the WSDOT guidance. Thus, for the Project, a noise impact would consist of either of the following:

- an increase in outdoor peak-hour noise of 10 dBA or greater caused by the Project (2030 Build Alternative minus existing year [2005]); or
- a design-year (2030) peak-hour traffic noise exceeding the NAC (66 dBA for Activity Category B and 71 dBA for Activity Category C) for the Build Alternative.

WSDOT Criteria for Noise Abatement

According to the WSDOT Noise Policy and Procedures (WSDOT 2006b), the following noise abatement measures may be evaluated and incorporated into a project to reduce traffic noise impacts:

- traffic management measures;
- horizontal and vertical alignment alterations;
- noise barrier construction;

- real property acquisitions to create a buffer zone to preempt future development that would be adversely impacted by traffic; and
- noise insulation of public use or nonprofit institutional structures.

WSDOT guidance stipulates that noise mitigation shall be eligible for funding only if it is both "feasible" and "reasonable." A number of factors go into determining whether noise abatement measures are feasible and/or reasonable, including the following:

The feasibility requirement for noise barrier construction includes stipulations about constructability and noise reductions. The barrier must provide a 5-dBA reduction at 60% of the receivers, with at least one receiver having at least a 7-dBA reduction.

The reasonableness requirement for noise barrier construction is based on cost-effectiveness. This is evaluated by comparing the estimated construction cost to the acceptable cost. The acceptable cost is calculated by multiplying the number of impacted/benefited dwelling units by the allowable cost per impacted household.

- noise reduction achievability;
- abatement costs;
- highway safety (obstruction of sight distance along curves); and
- environmental effects of abatement construction.

For a noise barrier to be considered acoustically feasible, it must be constructible without adversely affecting either the structural integrity of the roadway or sight distances along curves. Furthermore, the barrier must provide a 5 dBA reduction at a majority of homes (defined as 60%) in the first row of receivers with at least one receiver having at least a 7 dBA reduction. Efforts must also be made to attain a 10 dBA or greater reduction in sound levels at the first row of receivers, but the noise abatement is considered feasible if it achieves the 7 dBA target.

Once the construction of a noise barrier has been determined to be acoustically feasible, the cost-effectiveness, or reasonableness, of the barrier is evaluated using the following criteria:

- The actual cost of the noise barrier is estimated using WSDOT's recommended unit construction cost of $53.40 per square foot.
- The cost-effectiveness of constructing a noise barrier is evaluated by comparing the estimated actual construction cost to the acceptable cost. The acceptable cost is calculated by multiplying the number of impacted/benefited dwelling units times the allowable cost per impacted household Table 5 summarizes the allowable noise barrier unit costs per impacted household (WSDOT 2006b).

- A majority of the residents near the barrier (defined as at least 60% of the owners in the first row of homes facing the proposed wall) must desire its construction, considering factors such as aesthetics.

Table 5. Cost Allowance for Impacts Caused by Traffic Noise

Design Year (2030) Traffic Noise Decibel Level	Allowed Cost Per Impacted/Benefited Household *
66 dBA	$37,380
67 dBA	$41,110
68 dBA	$44,640
69 dBA	$48,270
70 dBA	$51,900
71 dBA	$55,530
72 dBA	$59,160
73 dBA	$62,790
74 dBA	$66,420

* Based on $53.40 per square foot constructed cost.

Source: WSDOT 2006b.

Construction Noise Regulations

Noise within the City is regulated by Chapter 9.05 of the Shoreline City Code. The City noise ordinance does not set numerical restrictions on construction noise. Instead, the City ordinance exempts all temporary daytime construction from noise regulations, and exempts all nighttime construction (defined as 10:00 pm to 7:00 am on weekdays and 10:00 pm to 9:00 am on weekends), provided the "activities have been conditioned by the City Manager to minimize the impact on adjacent property owners". The ordinance does not define what constitutes an "impact on adjacent property owners". Therefore, for this report the Washington Administrative Code (WAC) 173-60, Maximum Environmental Noise Levels, was used to assess construction noise impacts on nearby property. If nighttime construction is required for the Project, the construction contractor will be required to use noise abatement measures to limit nighttime noise levels at the property line of any residential receiver, in order to meet the WAC noise limits listed in Table 6. Alternatively, the construction contractor could apply to the City for a nighttime construction noise variance.

Table 6. Nighttime Construction Noise Limits

Duration of Noise	Allowable Limit (dBA)
1.5 minutes in any hour	65 dBA
5 minutes in any hour	60 dBA
15 minutes in any hour	55 dBA

Source: WAC 173-60.

Abbreviations: dBA: A-weighted decibels

What is the study area for noise and how was it defined?

The study area defines the area of significance for each environmental resource. According to the WSDOT Noise Policy and Procedures (WSDOT 2006b), the study area for noise was established at 500 feet on either side of the proposed roadway for the length of the Project, stopping at the end of the Project boundary line.

Study Area

The study area defines the area of significance for each environmental resource. For noise, the study area was established at 500 feet on either side of the proposed roadway for the length of the Project.

What is a noise-sensitive receiver?

Noise-sensitive receivers are outdoor areas where frequent human activities occur, and where occupants may be sensitive to varying levels of sound. In the Aurora Avenue corridor these noise-sensitive receivers currently include homes, condominium and apartments with outdoor usage, and commercial buildings with outdoor seating areas. WSDOT was consulted regarding car dealerships, and they indicated that for this noise analysis car dealerships should not be considered noise-sensitive receivers because they are commercial establishments where quiet conditions are not essential for the business operation (Laughlin pers. comm.).

For this analysis the following types of receivers were used:

- House, defined as a detached single-family dwelling.
- Apartment, defined as multi-family dwelling units with outdoor balconies.
- Outdoor Seating. Commercial businesses with dedicated areas where people can sit (e.g., outdoor dining areas at cafes).

Each receiver is assigned a number of representative "dwelling units." Each home or apartment unit represents one dwelling unit. Note that some individual modeling receivers can represent a cluster of homes or an apartment complex with multiple units, and in that case the modeling receiver can be assigned more than one dwelling unit. In the case of apartment buildings, the number of assigned dwelling units represents the number of units with outdoor balconies with a line of sight to the roadway being modeled. For example, as listed in Table 7, receiver House-1 represents a cluster of 7 individual homes and was assigned 7 dwelling units.

Table 7. Identified Noise-Sensitive Receivers

Receiver	WSDOT NAC (dBA)	Dwelling Units
House-1	66	7
House-2	66	11
Outdoor Seating-1	71	1
Apartment-1	66	5
House-3	66	5
House-4	66	8
Apartment-2	66	21
Apartment-3	66	6
House-5	66	6
House-6	66	6
Outdoor Seating-2	71	1
House-7	66	4
House-8	66	18
Apartment-4	66	12
House-9	66	2
House-10	66	1
House-11	66	1
House-12	66	4
House-13	66	4
Apartment-5	66	6
House-14	66	6
House-15	66	3
Outdoor Seating-3	71	1
Apartment-6	66	16

Receiver	WSDOT NAC (dBA)	Dwelling Units
Apartment-7	66	12
House-16	66	5
House-17	66	8
Apartment-8	66	24
Lot-1	N/A	0
House-18	66	5
House-19	66	7
Apartment-9	66	4
House-20	66	8
House-21	66	1
Lot-2	N/A	0
House-22	66	4
House-23	66	10
House-24	66	2
House-25	66	4
House-26	66	3
Apartment-10	66	6
House-27	66	4
House-28	66	9
House-29	66	1
Commercial-1	N/A	0
House-30	66	1
Proposed Apartment-1	66	Future development. Not available.

Abbreviations–NAC: noise abatement criteria; WSDOT: Washington State Department of Transportation
dBA: A-weighted decibel

How was the City consulted regarding planned future development?

Jones & Stokes consulted with the city planner in the Aurora Corridor Project office by telephone on March 14, 2007, at which time she provided all future planned and permitted development expected to occur within the study area over the next 2 years (Sherman 2007).

In accordance with the WSDOT Noise Policy and Procedures (WSDOT 2006b), noise impacts and potential mitigation were considered for future development planned to occur within the study area by the time the Record of Decision (ROD) for the environmental documentation is issued.

What planned future development was considered in the noise analysis?

The City identified one area in which new development is expected to occur by the time the ROD for the environmental documentation is issued. The South Echo Lake Development would occur within the study area and would include potential noise-sensitive receivers.

The South Echo Lake Development is a planned mixed-use development located northeast of the intersection of Aurora Avenue N and N 192nd Street (City of Shoreline 2005b). Commercial buildings are planned along the row adjacent to Aurora Avenue N. Apartment buildings are planned to the east of the commercial development. The apartment buildings, which have been identified as a noise-sensitive receiver (receiver Proposed Apartment-1), will be farther from Aurora Avenue N and shielded from the roadway by the commercial buildings. Apartments on the upper floors of the buildings will likely have balconies facing Aurora Avenue N. However, at this time the number of balconies that will face that direction is uncertain. Regardless, as described later in this report, these future apartments are far enough away so they would not be impacted by noise from Aurora Avenue N, so the exact number of dwelling units is not important for this analysis.

The applicant for the South Echo Lake Development has also speculated they might choose to put apartment units on the upper floors of the first row of proposed future commercial buildings facing Aurora Avenue, in which case the outdoor balconies of those apartments might be within 20 to 30 feet of the street. At this time the applicant has not submitted plans to the City, so it is unknown whether they plan to build those apartments. The number of proposed street-facing units is unknown, and it is unknown whether they would include outdoor balconies. Due to the lack of information about the future existence and/or design of those apartment units, their noise impacts and mitigation have not been quantitatively evaluated for this report. However, the following

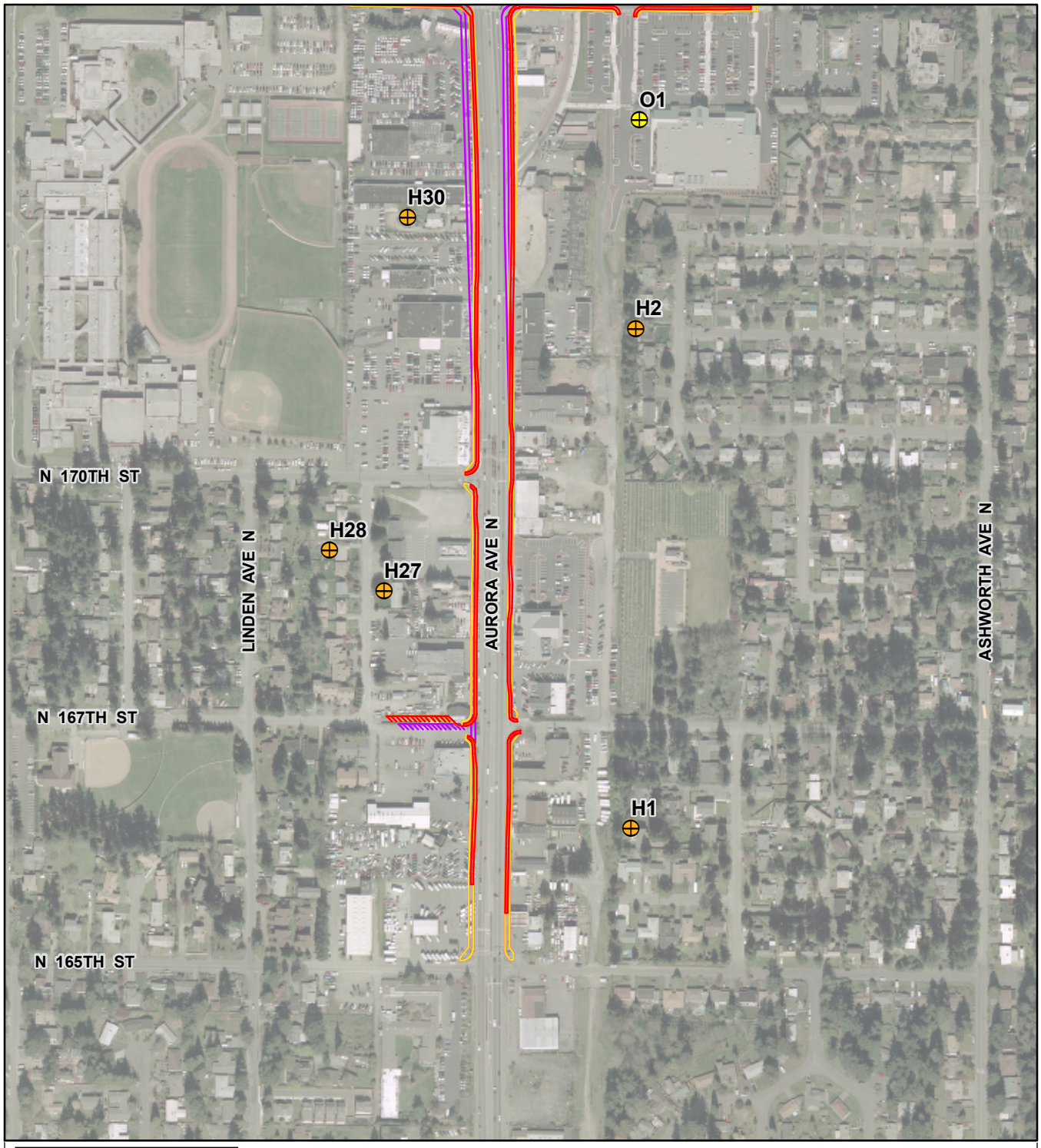
qualitative noise assessment for those speculative units can be concluded:

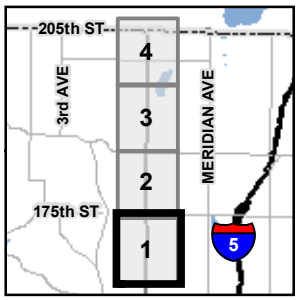
- If the upper-floor apartment units have outdoor balconies, then outdoor noise levels would likely exceed 66 dBA, so any such outdoor balconies would likely be impacted.
- If the ground-floor commercial businesses choose to use outdoor seating areas, then outdoor noise levels will likely exceed 71 dBA, so any such outdoor seating areas would likely be impacted.
- There would be no feasible and reasonable way for the City to construct noise barrier walls at the right-of-way of Aurora Avenue N to shield the upper-floor residential units or outdoor seating areas at the ground-level commercial businesses.

Where are the modeled noise-sensitive receiver locations?

The noise-sensitive receivers along Aurora Avenue N were identified by inspecting aerial photographs combined with site reconnaissance. Noise-sensitive receivers considered for this assessment included homes, condominiums, and apartments with outdoor usage, and commercial buildings with outdoor seating areas. Figures 6a through 6d show the represented noise-sensitive receivers. In general, land use along Aurora Avenue N consists mainly of commercial businesses facing Aurora Avenue N, with residential homes located one block over.

The house and apartment noise-sensitive receivers are in FHWA Activity Category B, with a 66 dBA (L_{eq}) NAC for outdoor noise levels; and the commercial outdoor seating noise-sensitive receivers are in FHWA Activity Category C, with a 71 dBA (L_{eq}) NAC for outdoor noise levels. Table 7 lists identified noise-sensitive receivers and the dwelling units for each receiver. Proposed Apartment-1 refers to the proposed future senior citizen apartment in the South Echo Lake Development area.





City Boundary
Alternative A
Alternative B
Alternative C

House (e.g. H1)
Apartment/Condominium (e.g. A1)
Proposed Apartment (e.g. P1)
Outdoor Seating (e.g. O1)
Commercial (e.g. C1)
Lot (e.g. L1)
Sound Level Measurement Location (e.g. SLM1)

Sources: City of Shoreline (2006); Jones & Stokes (2007)

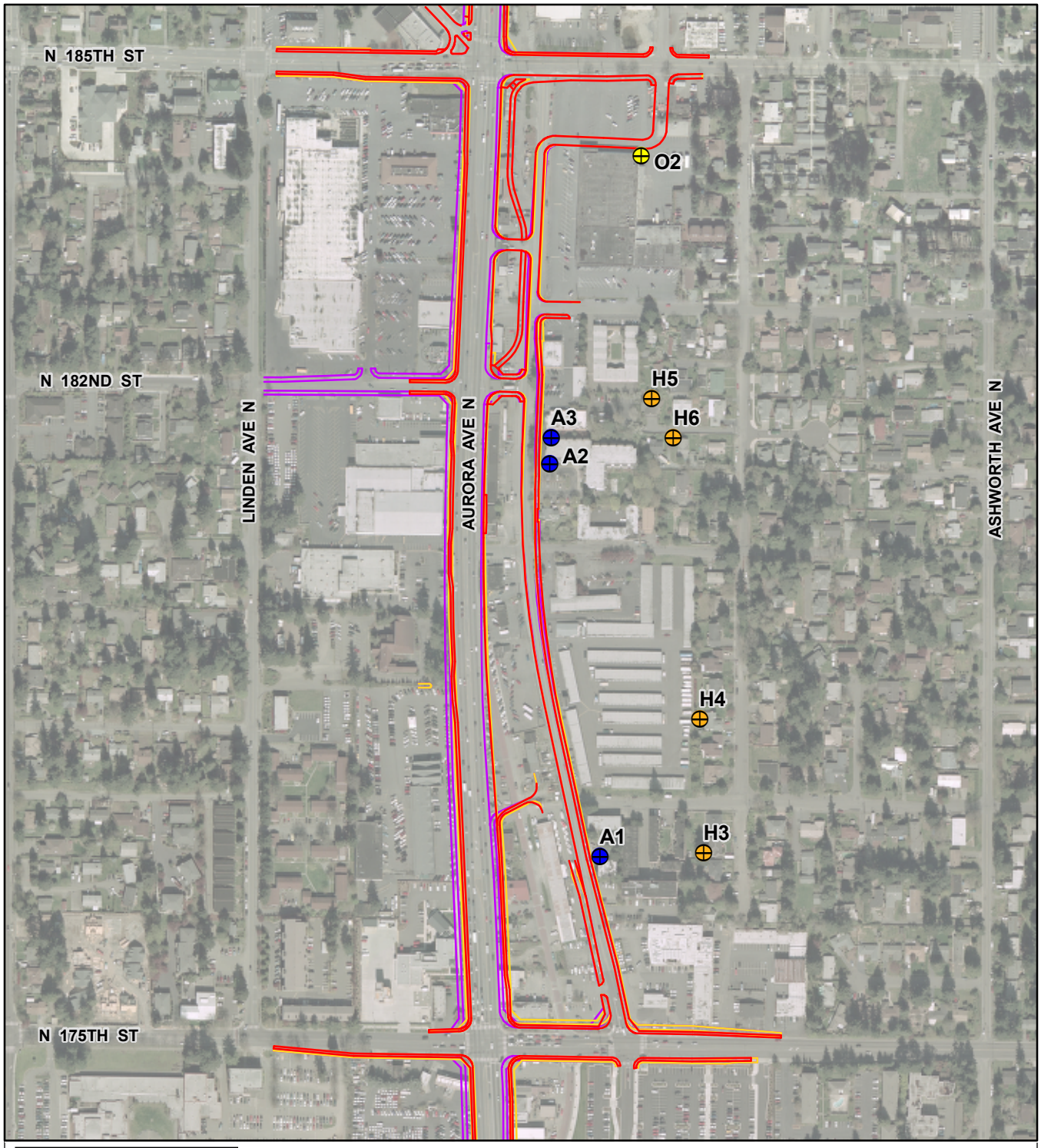
N

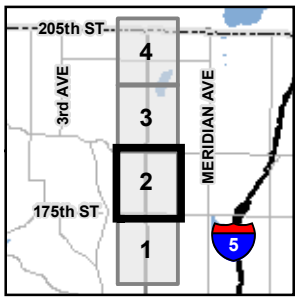
Feet

0 200 400

1" = 400'

Figure 6a. Modeled Noise-Sensitive Receivers - Sheet 1 of 4
Aurora Corridor Improvement Project
August 2007





City Boundary
Alternative A
Alternative B
Alternative C

House (e.g. H1)
Apartment/Condominium (e.g. A1)
Proposed Apartment (e.g. P1)
Outdoor Seating (e.g. O1)
Commercial (e.g. C1)
Lot (e.g. L1)
Sound Level Measurement Location (e.g. SLM1)

Sources: City of Shoreline (2006); Jones & Stokes (2007)

N

Feet

0 200 400

1" = 400'

Figure 6b. Modeled Noise-Sensitive Receivers - Sheet 2 of 4
Aurora Corridor Improvement Project
August 2007

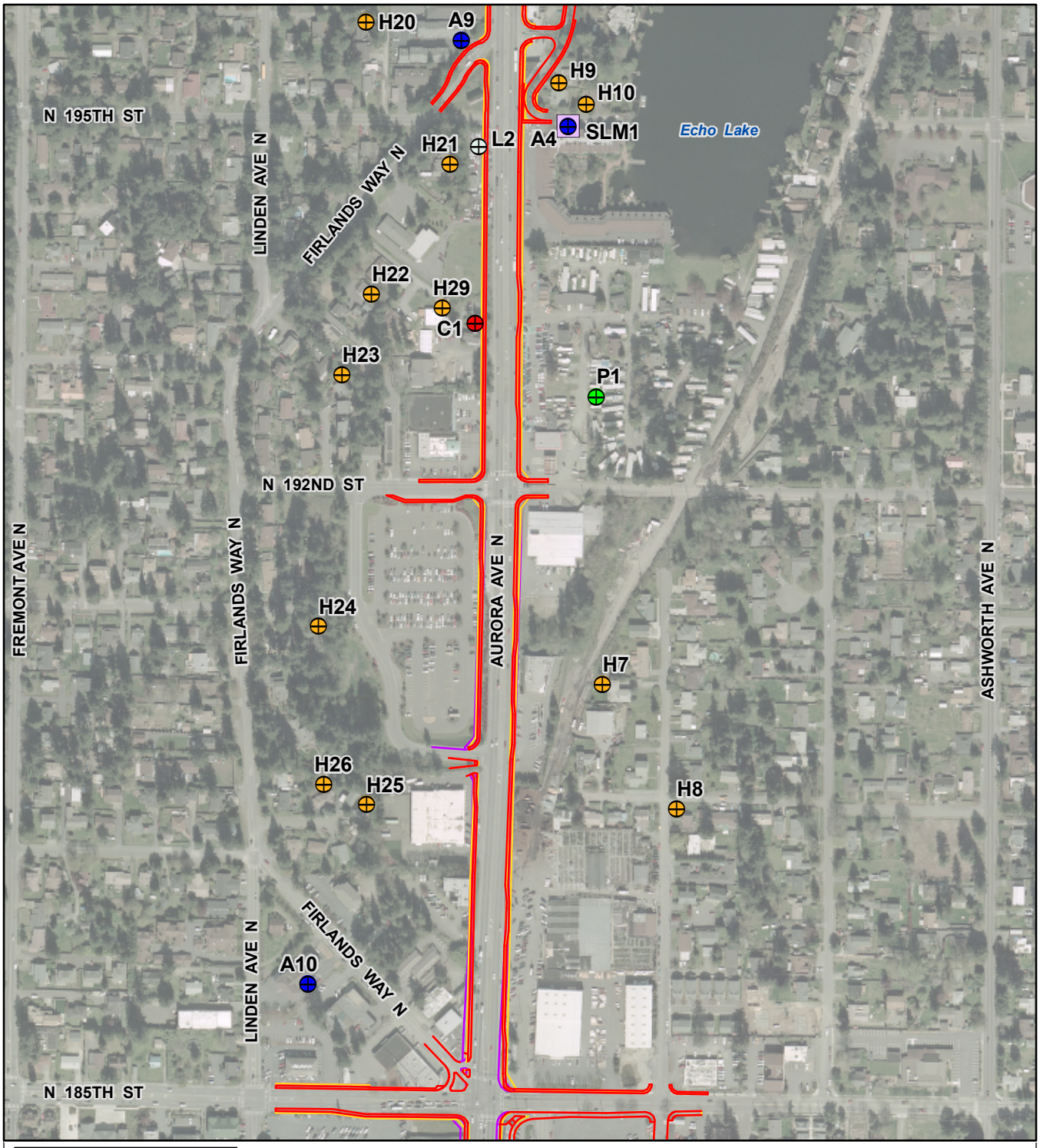
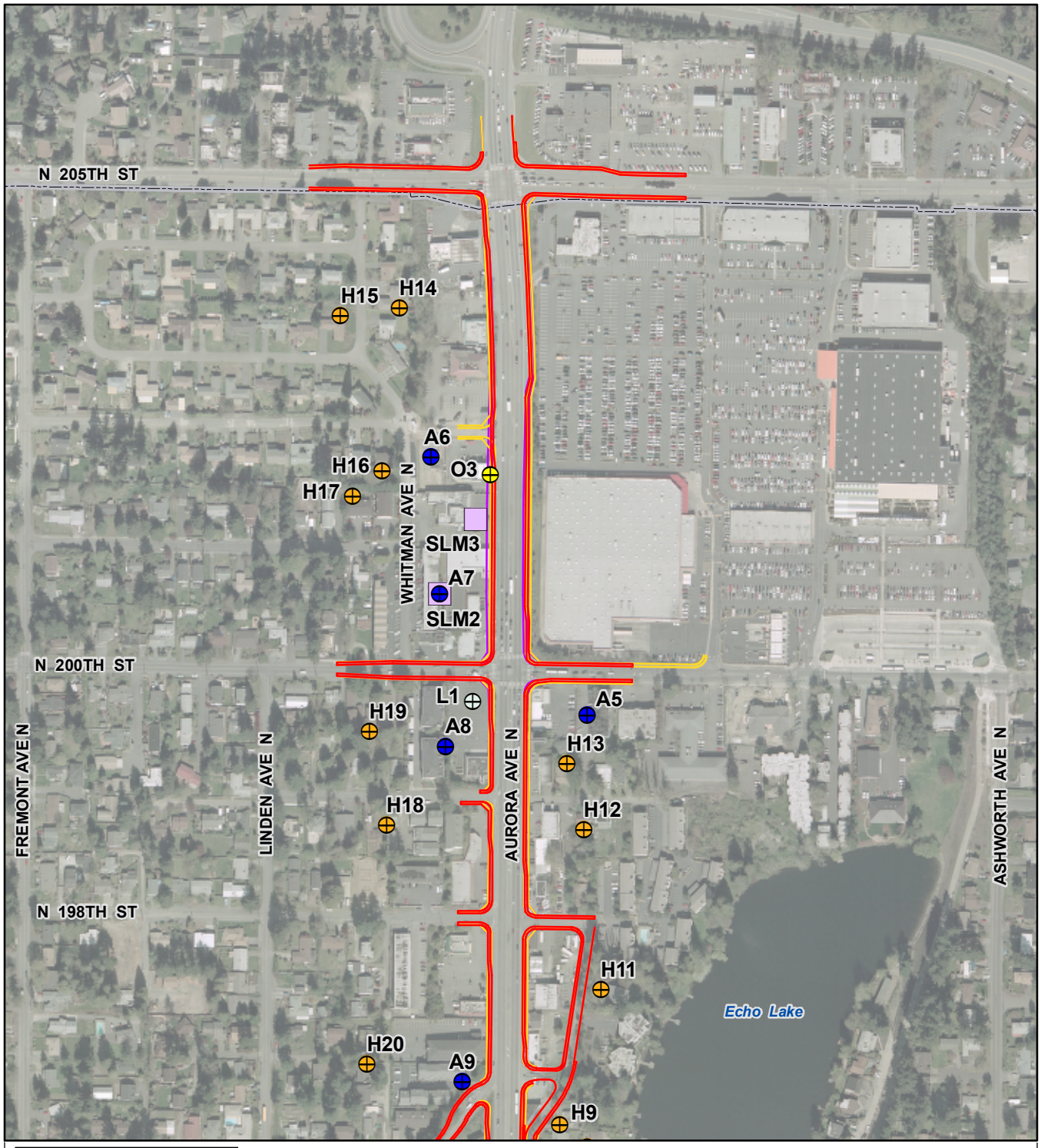
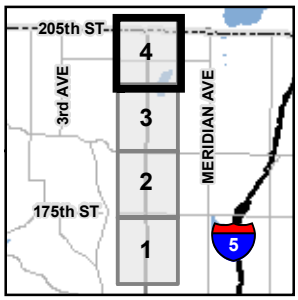


Figure 6c. Modeled Noise-Sensitive Receivers - Sheet 3 of 4
Aurora Corridor Improvement Project
August 2007





City Boundary
Alternative A
Alternative B
Alternative C

House (e.g. H1)
Apartment/Condominium (e.g. A1)
Proposed Apartment (e.g. P1)
Outdoor Seating (e.g. O1)
Commercial (e.g. C1)
Lot (e.g. L1)
Sound Level Measurement Location (e.g. SLM1)

Sources: City of Shoreline (2006); Jones & Stokes (2007)

N

Feet

0 200 400

1" = 400'

Figure 6d. Modeled Noise-Sensitive Receivers - Sheet 4 of 4
Aurora Corridor Improvement Project
August 2007

All human use areas including those in areas zoned for commercial use were included in the traffic noise analysis. Only outdoor areas of frequent human use were considered for traffic sound level analysis and abatement.

For a project with a large number of residences or residential equivalents, it is not necessary to have traffic sound level predictions at every residence or residential equivalent. However, sufficient sound level predictions were made to accurately represent the sound level conditions that are most likely to occur.

How was the traffic noise predicted?

Traffic noise levels at noise-sensitive receivers were modeled using the FHWA Traffic Noise Model (TNM) Version 2.5. The TNM was configured as follows:

- The model focused on the existing year (2005) and design year (2030) for the No Build Alternative and three Build Alternatives.
- Noise-sensitive receivers located within 500 feet of Aurora Avenue N were identified and included in the model.
- PM peak hour traffic volumes were used, because the PM period generates the highest traffic volume during a 24-hour day. The City provided 2005 and projected 2030 traffic volumes at key intersections (CH2M Hill 2007). Projected PM peak hour traffic volumes for each modeled year are shown in Table 8.

Peak Hour Traffic

Peak hour traffic refers to the time of day (often lasting more than an hour) when traffic is most congested. Peak hours typically occur during the morning (AM) and evening (PM) commutes.

Table 8. Modeled PM Peak Hour Traffic Volumes

Roadway Segment	Direction	2005 Existing Conditions (vph)	2030 No Build Alternative (vph)	2030 Build Alternatives (vph)
Aurora Avenue N	Northbound	1,615 - 1,820	2,035 - 2,245	2,050 - 2,255
	Southbound	1,055 - 1,408	1,345 - 1,798	1,358 - 1,810
Midvale Avenue N	Northbound	225	305	305
	Southbound	155	205	205
N 165th Street	Eastbound	70 - 135	100 - 185	100 - 185
	Westbound	50 - 280	70 - 370	70 - 370
N 175th Street	Eastbound	350 - 785	450 – 980	450 – 1,000
	Westbound	365 - 830	475 – 1,045	475 – 1,045

Roadway Segment	Direction	2005 Existing Conditions (vph)	2030 No Build Alternative (vph)	2030 Build Alternatives (vph)
N 182nd Street	Eastbound	120	160	98 - 160
	Westbound	80	105	113 - 105
N 185th Street	Eastbound	460 - 600	465 - 650	465 - 650
	Westbound	430 - 495	590 - 765	590 - 765
N 192nd Street	Eastbound	80 - 85	110 - 115	110 - 115
	Westbound	60 - 85	80 - 115	80 - 115
N 200th Street	Eastbound	220 - 425	290 - 550	290 - 550
	Westbound	235 - 430	305 - 555	305 - 555
N 205th Street	Eastbound	610 - 700	785 - 900	785 - 900
	Westbound	650 - 880	840 - 1130	840 - 1130

Abbreviations. vph: volume per hour

- The traffic noise model requires assumptions about the relative percentages of vehicles (two-axle, four-tire vehicles), medium trucks (two-axle, six-tire vehicles), and heavy trucks (three or more axles). Vehicle classifications assumed for the modeled roadways are listed in Table 9. The City provided vehicle classifications for study area roadways based on the existing traffic counts (CH2M Hill 2007).

Table 9. Assumed Vehicle Types and Speed Limits

Roadway Segment	Vehicle Types (percent)			Speed Limit (mph)
	Autos	Medium Trucks	Heavy Trucks	
Aurora Avenue N	97	2	1	40
Midvale Avenue N	98	2	0	30
N 165th Street	98	2	0	25
N 175th Street	98	2	0	35
N 182nd Street	98	2	0	25
N 185th Street	98	2	0	35
N 192nd Street	98	2	0	30
N 200th Street	98	2	0	30
N 205th Street	99	1	0	40

Abbreviations. mph: miles per hour

- Traffic in both directions was assumed to operate at the posted speed limit as listed in Table 9. The TNM accounts for the

increased noise associated with traffic accelerating away from each intersection after stopping for a stop sign or signal.

- For the baseline year and the 2030 No Build Alternative, Aurora Avenue N was modeled as two lanes each direction. For the 2030 Build Alternatives, Aurora Avenue N was modeled as two through-lanes with a BAT lane in each direction. Table 10 shows the existing bus volumes that would travel on BAT lanes during the PM peak hour.

Table 10. Existing PM Peak Hour Bus Volume on Aurora Avenue N

Segment of Aurora Avenue N	Transit Route	Metro Transit (buses/hour) 301	303	342	358	373	Community Transit (buses/hour)	Total
N 165th Street – N 175th Street	Northbound	--	--	--	10	--	--	10
	Southbound	--	--	--	5	--	--	5
N 175th Street - N 185th Street	Northbound	4	--	--	10	--	--	14
	Southbound	2	--	--	5	--	--	7
N 185th Street - N 192nd Street	Northbound	4	--	--	10	2	--	16
	Southbound	2	--	--	5	--	--	7
N 192nd Street - N 200th Street	Northbound	4	4	3	10	2	--	23
	Southbound	2	4	3	5	--	--	14
N 200th Street - N 205th Street	Northbound	4	4	3	10	2	10	33
	Southbound	2	4	3	5	--	12	26

Source: King County Metro Transit 2007.

- Topography inputs to the model were based on topographical surveys prepared for the Project, as confirmed by site reconnaissance.

- The ground between the roadway and nearby residential receivers consists mainly of asphalt and packed soil. Therefore, ground type was defined as pavement for the model.

- Large buildings that provide shielding at the noise-sensitive receiver locations were modeled as terrain features.

How was the existing model validated?

Traffic noise levels of identified receivers were modeled using TNM. In accordance with WSDOT guidelines, the TNM was validated based on simultaneous sound level measurements (SLM) and traffic counts conducted in the afternoon of February 27, 2007. The validation locations, labeled SLM-1 through SLM-3, are shown on Figure 6c and 6d. The validation measurements were taken at SLM-1 and SLM-2 to represent residential homes and at SLM-3 to represent the businesses situated directly on Aurora Avenue N. SLM-1 was taken on the top floor of Echo Cove Condominium (receiver Apartment-4), which has the same elevation as Aurora Avenue N. SLM-2 was taken on the first floor of Village Vista Apartment (receiver Apartment-7), which has an elevation above Aurora Avenue N. SLM-3 was taken on the parking lot next to the receiver Outdoor Seating-3. The measurement data are included in Appendix A.

A 15-minute noise reading was taken simultaneous to traffic counts and vehicle type observations for the eastbound and westbound lanes of Aurora Avenue N. The actual traffic speeds in both directions were determined by driving with the flow of traffic multiple times in each direction immediately following the noise monitoring. Table 11 shows the traffic counts, type of vehicles, and vehicle travel speeds at the noise measurement locations.

The TNM was then used to predict the noise level corresponding to the measured traffic counts. The TNM output reports for the validation runs are included in Appendix A. The predicted noise level was then compared to the actual measured noise level. The comparison determines the adjustment factor that accounts for site-specific variables such as variation in roadway surface condition. Table 11 shows the differences between the measured and modeled noise levels. The modeled noise level at SLM-3 was under-predicted by 1.9 dBA; therefore, an adjustment factor of +1.9 dBA was applied to the receiver Outdoor Seating-3. The modeled noise levels at SLM-1 and SLM-2 were only under-predicted by 0.2 dBA; therefore, no adjustment factor was applied to all other receivers.

Table 11. Noise Model Validation Measurement

Location	Direction	Traffic Counts (vehicle/hour)	Measured Travel Speed (mph)	Measured L_{eq} (dBA)	Modeled L_{eq} (dBA)	Difference (dBA)
SLM-1	Northbound	Auto: 1,284 Medium Truck: 60 Heavy Truck: 12	40	62.0	61.8	0.2 Under-predicted
	Southbound	Auto: 840 Medium Truck: 28 Heavy Truck: 0	40			
SLM-2	Northbound	Auto: 1,404 Medium Truck: 16 Heavy Truck: 4	40	61.6	61.4	0.2 Under-predicted
	Southbound	Auto: 816 Medium Truck: 8 Heavy Truck: 0	40			
SLM-3	Northbound	Auto: 1,628 Medium Truck: 28 Heavy Truck: 0	40	70.8	68.9	1.9 Under-predicted
	Southbound	Auto: 852 Medium Truck: 12 Heavy Truck: 0	40			

Abbreviations. dBA: A-weighted decibel level; mph: miles per hour; L_{eq}:equivalent sound level

What are the existing noise levels?

Table 12 shows the modeled existing noise levels with the adjustment factor applied to Outdoor Seating-3. TNM output reports are provided in Appendix B. With the exception of one receiver, all of the modeled existing noise levels are less than WSDOT's NAC. The noise modeling results indicate that traffic noise levels at Outdoor Seating-3 currently exceed the NAC. Outdoor Seating-3 refers to the outdoor seating area of the Starbucks coffee shop located at 20121 Aurora Avenue N.

Table 12. Modeled Existing (2005) PM Peak Hour Noise Levels

Receiver	WSDOT NAC (dBA)	Represented DUs	2005 Existing L_{eq} (dBA)
House-1	66	7	62
House-2	66	11	55
Outdoor Seating-1	71	1	62
Apartment-1	66	5	63

Receiver	WSDOT NAC (dBA)	Represented DUs	2005 Existing L_{eq} (dBA)
House-3	66	5	60
House-4	66	8	59
Apartment-2	66	21	64
Apartment-3	66	6	63
House-5	66	6	58
House-6	66	6	58
Outdoor Seating-2	71	1	61
House-7	66	4	62
House-8	66	18	57
Apartment-4	66	12	63
House-9	66	2	63
House-10	66	1	57
House-11	66	1	60
House-12	66	4	63
House-13	66	4	62
Apartment-5	66	6	64
House-14	66	6	63
House-15	66	3	60
Outdoor Seating-3	71	1	73
Apartment-6	66	16	63
Apartment-7	66	12	63
House-16	66	5	57
House-17	66	8	58
Apartment-8	66	24	64
Lot-1	N/A	0	66
House-18	66	5	56
House-19	66	7	55
Apartment-9	66	4	65
House-20	66	8	56
House-21	66	1	65
Lot-2	N/A	0	66
House-22	66	4	60
House-23	66	10	60

Receiver	WSDOT NAC (dBA)	Represented DUs	2005 Existing L_{eq} (dBA)
House-24	66	2	59
House-25	66	4	59
House-26	66	3	59
Apartment-10	66	6	59
House-27	66	4	62
House-28	66	9	59
House-29	66	1	65
Commercial-1	N/A	0	66
House-30	66	1	54
Proposed Apartment-1	66	Future development. Not available.	Future development. Not available.

Note: Bold indicates receiver exceeds WSDOT's NAC. The noise level is underlined.

Abbreviations. NAC: noise abatement criteria; WSDOT: Washington State Department of Transportation

dBA: A-weighted decibel; DU: dwelling unit

Chapter 5. Potential Effects

This chapter describes potential noise effects identified under the No Build and three Build Alternatives.

How will the Project affect noise levels in the study area?

Effects of the No Build Alternative

Traffic volumes and traffic noise along Aurora Avenue N will increase between 2005 and 2030 regardless of whether the proposed project is constructed. Table 13 shows the modeled PM peak hour noise levels for the 2030 No Build Alternative. TNM output reports are provided in Appendix B. With the exception of four receivers described below, the modeled future No Build noise levels are less than WSDOT's NAC. The noise modeling results indicate that the following four receivers would exceed the NAC limits under the No Build Alternative:

- Outdoor Seating-3: Starbucks at 20121 Aurora Avenue N
- Apartment-9: Firlands Way Condominium at 19523 Firlands Way N
- House-21: 19370 Firlands Way N
- House-29: 19344 Firlands Way N

Receiver Outdoor Seating-3 is already impacted under the 2005 existing conditions. Apartment-9 and House-21 are approximated 10 to 15 feet above Aurora Avenue N, and House-29 is approximated 5 to 10 feet above Aurora Avenue N. WSDOT is not required to consider noise abatement for existing roadways in the absence of a road-widening project. Thus, no noise mitigation would be warranted under the No Build Alternative.

Table 13. Modeled PM Peak Hour Noise Levels for 2030 No Build Alternative

Receiver	WSDOT NAC (dBA)	Represented DUs	2005 Existing L_{eq} (dBA)	2030 No Build L_{eq} (dBA)	Impacted DUs
House-1	66	7	62	63	0
House-2	66	11	55	56	0
Outdoor Seating-1	71	1	62	63	0
Apartment-1	66	5	63	64	0
House-3	66	5	60	61	0
House-4	66	8	59	60	0
Apartment-2	66	21	64	65	0
Apartment-3	66	6	63	63	0
House-5	66	6	58	59	0
House-6	66	6	58	59	0
Outdoor Seating-2	71	1	61	62	0
House-7	66	4	62	63	0
House-8	66	18	57	58	0
Apartment-4	66	12	63	64	0
House-9	66	2	63	64	0
House-10	66	1	57	58	0
House-11	66	1	60	61	0
House-12	66	4	63	64	0
House-13	66	4	62	63	0
Apartment-5	66	6	64	65	0
House-14	66	6	63	64	0
House-15	66	3	60	60	0
Outdoor Seating-3	71	1	73	74	1
Apartment-6	66	16	63	64	0
Apartment-7	66	12	63	64	0
House-16	66	5	57	58	0
House-17	66	8	58	59	0
Apartment-8	66	24	64	65	0
House-18	66	5	56	57	0

Receiver	WSDOT NAC (dBA)	Represented DUs	2005 Existing L_{eq} (dBA)	2030 No Build L_{eq} (dBA)	Impacted DUs
House-19	66	7	55	56	0
Apartment-9	66	4	65	66	4
Lot-1	N/A	0	66	67	0
House-20	66	8	56	57	0
House-21	66	1	65	66	1
Lot-2	N/A	0	66	67	0
House-22	66	4	60	61	0
House-23	66	10	60	61	0
House-24	66	2	59	60	0
House-25	66	4	59	60	0
House-26	66	3	59	60	0
Apartment-10	66	6	59	60	0
House-27	66	4	62	63	0
House-28	66	9	59	60	0
House-29	66	1	65	66	1
Commercial-1	N/A	0	66	67	0
House-30	66	1	64	65	1
Proposed Apartment-1	66	Future development. Not available.	Future development. Not available.	65	0
Total DUs		273			7

Note: Bold indicates receiver exceeds WSDOT's NAC. The noise level is underlined.

Abbreviations. NAC: noise abatement criteria; WSDOT: Washington State Department of Transportation

dBA: A-weighted decibel; DU: dwelling unit

Effects of the Build Alternatives

Table 14 shows the modeled noise levels for all three Build Alternatives. TNM output reports are provided in Appendix B. The modeled noise levels are compared to FHWA's noise abatement criteria.

The table shows that the overall traffic noise increase (2030 Build Alternatives as compared to existing conditions) is expected to be less than 3 dBA at the noise-sensitive receivers for all three Build Alternatives.

Table 14. Modeled PM Peak Hour Noise Levels for 2030 Build Alternatives

					2030 Build Alternatives			Noise Increases		
Receiver	WSDOT NAC (dBA)	Dwelling Units	2005 Existing L_{eq} (dBA)	2030 No Build L_{eq} (dBA)	Alt. A L_{eq} (dBA)	Alt. B L_{eq} (dBA)	Alt. C L_{eq} (dBA)	2030 Build Alt. Minus 2005 (dBA)	2030 Build Alt. Minus 2030 No Build (dBA)	Impacted DUs
House-1	66	7	62	63	63	63	63	1	0	0
House-2	66	11	55	56	56	56	56	1	0	0
Outdoor Seating-1	71	1	62	63	63	63	63	1	0	0
Apartment-1	66	5	63	64	64	64	64	1	0	0
House-3	66	5	60	61	61	61	61	1	0	0
House-4	66	8	59	60	60	60	60	1	0	0
Apartment-2	66	21	64	65	65	65	65	1	0	0
Apartment-3	66	6	63	63	64	64	64	1	1	0
House-5	66	6	58	59	60	60	59	1 - 2	0 - 1	0
House-6	66	6	58	59	59	59	59	1	0	0
Outdoor Seating-2	71	1	61	62	63	63	63	2	1	0
House-7	66	4	62	63	63	63	63	1	0	0
House-8	66	18	57	58	58	58	58	1	0	0
Apartment-4	66	12	63	64	65	65	65	2	1	0
House-9	66	2	63	64	64	64	64	1	0	0
House-10	66	1	57	58	59	59	59	1	0	0
House-11	66	1	60	61	62	62	62	2	1	0
House-12	66	4	63	64	65	65	65	2	1	0
House-13	66	4	62	63	64	65	65	2 - 3	1 - 2	0
Apartment-5	66	6	64	65	65	65	65	1	0	0

					2030 Build Alternatives			Noise Increases		
Receiver	WSDOT NAC (dBA)	Dwelling Units	2005 Existing L_{eq} (dBA)	2030 No Build L_{eq} (dBA)	Alt. A L_{eq} (dBA)	Alt. B L_{eq} (dBA)	Alt. C L_{eq} (dBA)	2030 Build Alt. Minus 2005 (dBA)	2030 Build Alt. Minus 2030 No Build (dBA)	Impacted DUs
House-14	66	6	63	64	64	64	64	1	0	0
House-15	66	3	60	60	60	60	60	0	0	0
Outdoor Seating-3	71	1	73	74	75	74	75	1 - 2	0 - 1	1
Apartment-6	66	16	63	64	65	64	65	1 - 2	0 - 1	0
Apartment-7	66	12	63	64	65	64	65	1 - 2	0 - 1	0
House-16	66	5	57	58	58	58	58	1	0	0
House-17	66	8	58	59	59	59	59	1	0	0
Apartment-8	66	24	64	65	66	66	66	2	1	24
Lot-1	N/A	0	66	67	68	68	68	2	1	0
House-18	66	5	56	57	57	57	57	1	0	0
House-19	66	7	55	56	56	56	56	1	0	0
Apartment-9	66	4	65	66	67	67	67	2	1	4
House-20	66	8	56	57	58	58	58	2	1	0
House-21	66	1	65	66	67	67	67	2	1	1
Lot-2	N/A	0	66	67	68	68	68	2	1	0
House-22	66	4	60	61	61	61	61	1	0	0
House-23	66	10	60	61	61	61	61	1	0	0
House-24	66	2	59	60	61	61	61	2	1	0
House-25	66	4	59	60	60	60	61	1 - 2	0 - 1	0
House-26	66	3	59	60	60	60	61	1 - 2	0 - 1	0
Apartment-10	66	6	59	60	60	60	61	1 - 2	0 - 1	0
House-27	66	4	62	63	63	63	63	1	0	0

					2030 Build Alternatives			Noise Increases		
Receiver	WSDOT NAC (dBA)	Dwelling Units	2005 Existing L_{eq} (dBA)	2030 No Build L_{eq} (dBA)	Alt. A L_{eq} (dBA)	Alt. B L_{eq} (dBA)	Alt. C L_{eq} (dBA)	2030 Build Alt. Minus 2005 (dBA)	2030 Build Alt. Minus 2030 No Build (dBA)	Impacted DUs
House-28	66	9	59	60	61	61	61	2	1	0
House-29	66	1	65	<u>66</u>	<u>66</u>	<u>66</u>	<u>66</u>	1	0	1
Commercial-1	N/A	0	66	67	68	68	68	2	1	0
House-30	66	1	54	55	55	55	55	1	0	0
Proposed Apartment-1	66	Future development. Not available.	Future development Not available.	65	65	65	65	Future development Not available.	0	0
Total DUs		273								31[(1)]

Note: Bold indicates receiver exceeds WSDOT's NAC. The noise level is underlined.

Abbreviations. NAC: noise abatement criteria; WSDOT: Washington State Department of Transportation

dBA: A-weighted decibel; DU: dwelling unit; Alt.: Alternative

(1) 7 of 31 impacted dwelling units would also be impacted under the No Build Alternative.

The Project-related noise increase (2030 Build Alternative minus 2030 No Build Alternative) would be no greater than 2 dBA. It is unlikely such a small noise increase would be discernible at any receiver location. The following five receivers were modeled to exceed the NAC limit for all three 2030 Build Alternatives. These impacted receivers include a total of 31 impacted dwelling units.

- Outdoor Seating-3: Starbucks at 20121 Aurora Avenue N
- Apartment-8: The Mattino Condominium at 935 N 200th Street
- Apartment-9: Firlands Way Condominium at 19523 Firlands Way N
- House-21: 19370 Firlands Way N
- House-29: 19344 Firlands Way N
- Lot-1: the commercial parking lot between Apartment-8 and Aurora Avenue.
- Lot-2: the commercial parking lot between House-21 and Aurora Avenue.
- Commercial-1: the commercial business between Apartment-8 and Aurora Avenue.

Seven of the 31 impacted dwelling units (at receivers Outdoor Seating-3, Apartment-9, House-21, and House-29) would also be impacted under the No Build Alternative. Traffic noise impacts are predicted to occur at these receivers. Since the Project is a Type I roadway project, noise abatement measures must be considered for the impacted noise-sensitive receivers.

How will Project construction temporarily affect noise levels?

Construction activities would create temporary localized noise during the construction period. The nature of the construction noise and the overall noise level would depend on the specific construction activity being conducted at any given place and time. Each phase of construction typically involves its own mix of construction equipment and produces its own noise levels. Project construction

will involve routine roadway construction activities, including removing old roadbed material, site grading, and paving.

Noise levels caused by typical construction equipment (expressed as dBA at 50 feet from the source) are summarized in Table 15 (Thalheimer 2000). The table also lists typical utilization factors for each equipment item, defined as the fraction of time that the equipment typically runs at maximum capacity. The types of equipment likely to be used for typical roadway construction on this Project include trucks, pavers, backhoes, bulldozers, scrapers, loaders, and pneumatic tools. Engines on mobile construction equipment generally produce the most noticeable noise levels. Stationary construction equipment, such as generators, usually produces lower noise levels, but operate more continuously than mobile equipment.

Table 15. Typical Construction Equipment Noise Levels

Type of Equipment	Utilization Factor (percent)	Maximum Noise Level in dBA at 50 Feet
Backhoe	20	80
Compactor	20	80
Air Compressor	20	80
Concrete Mixer Truck	40	85
Concrete Pump	20	82
Concrete Saw	20	90
Dozer	40	85
Dump Truck	40	84
Excavator	40	85
Flatbed Truck	40	84
Front-end Loader	40	80
Generator	50	82
Grader	40	85
Jackhammer	20	85
Paver	50	85
Pickup Truck	40	55
Pneumatic Tools	50	85
Pumps	50	77

Type of Equipment	Utilization Factor (percent)	Maximum Noise Level in dBA at 50 Feet
Scraper	40	85
Tractor	40	84
Vacuum Street Sweeper	10	80
Welder	40	73

Source: Thalheimer 2000
dBA: A-weighted decibel

Temporary daytime construction activities are exempt from the City Code, so no regulatory requirements are applicable to daytime construction. However, nighttime construction (defined as 10:00 p.m. to 7:00 a.m.) within City-owned right-of-way is allowed only if the activity "has been conditioned by the City Manager to minimize the impact on adjacent property owners". If nighttime construction operations were required, then noise abatement would be considered on a case-by-case basis to ensure that the noise levels do not impact adjacent property. Alternatively, the City could issue temporary noise variances to allow nighttime construction in certain areas.

Chapter 6. Measures Taken to Avoid or Minimize Project Effects

How can effects from construction noise be minimized?

To reduce the potential for temporary, adverse noise impacts associated with construction, the contractor should be required to comply with all federal, state, and local regulations relating to construction noise. Construction noise could be reduced by using portable, temporary enclosures or walls to surround noisy stationary equipment, substituting quieter equipment or construction methods, minimizing time of operation, and locating equipment as far as practical from sensitive receptors. To reduce construction noise at nearby receivers, a Construction Noise Reduction Plan could be incorporated into construction plans and contractor specifications, including the following elements.

- Locating stationary equipment away from receiving properties would decrease noise from that equipment as a function of the increased distance.

- Erecting portable noise barriers around loud stationary equipment located near sensitive receivers would reduce noise.

- Limiting construction activities to between 7 a.m. and 10 p.m. would avoid sensitive nighttime hours.
- Turning off construction equipment during prolonged periods of nonuse would eliminate unnecessary noise.
- Requiring contractors to maintain all equipment and recommending they train their equipment operators to be aware of nearby noise sensitive areas would potentially reduce noise effects.
- Recommending training construction crews to avoid unnecessarily loud actions (e.g., dropping bundles of rebar onto the ground or dragging steel plates across pavement) near noise-sensitive areas would reduce noise effects.

How can effects from traffic noise be minimized?

As described previously, model results indicate that 2030 Build Alternative noise levels are expected to exceed WSDOT's NAC at the following five impacted receivers representing 31 dwelling units.

- Outdoor Seating-3: Starbucks at 20121 Aurora Avenue N
- Apartment-8: The Mattino Condominium at 935 N 200th Street
- Apartment-9: Firlands Way Condominium at 19523 Firlands Way N
- House-21: 19370 Firlands Way N
- House-29: 19344 Firlands Way N

A variety of noise abatement methods can theoretically reduce traffic noise. A number of possible mitigation measures were qualitatively evaluated for their potential to reduce noise impacts, and are described in the following sections.

Traffic Management Measures

Traffic management measures are administrative or engineering controls that reduce the presence of loud vehicles, or reduce their

speed and noise emissions. Such measures could theoretically include speed bumps, signage to prohibit certain vehicle types (such as motorcycles and heavy trucks), and reduced speed limits. Speed bumps would not be feasible along Aurora Avenue N. Aurora Avenue N is a busy commercial street, so it is not feasible to prevent trucks from using the street. The proposed project already includes relatively low speed limits, so no further management measures are available to reduce noise levels.

Land Acquisition for Noise Buffers

Acquiring noise-impacted property within a wide noise buffer is not a feasible option for this Project. A noise buffer roughly 100 to 200 feet from the edge of Aurora Avenue N would be required to eliminate future noise impacts. The City would be required to acquire all land and buildings within that wide buffer. The noise-sensitive receivers evaluated for this Project consist of existing homes, apartment buildings, and commercial businesses close to the roadway. It is not feasible to purchase the impacted buildings to create a 100 to 200-foot wide noise buffer due to the extremely high cost, which would greatly exceed WSDOT's noise abatement cost allowances as listed in Table 5.

Realigning the Roadway

Realigning the roadway is not a feasible option for this Project, as the horizontal alignment is defined by the current roadway and available right-of-way. In theory, the City could purchase additional right-of-way and shift the alignment by a small amount, but doing so would move the roadway slightly farther from some receivers while moving it closer to other receivers.

Noise Insulation of Buildings

Building insulation could be technically feasible. However, this remedy does not apply to the residential and commercial structures that constitute most impacted receptors in the project area because it does not address the outdoor activity areas that are likely to be impacted as well. WSDOT will not fund acoustical insulation of privately-owned buildings.

Noise Barriers

Noise barriers were considered for five impacted receiver locations as listed in Table 14 and shown in Figures 6a through 6d. As described below, noise barriers at Outdoor Seating-3, Apartment-8, Apartment-9, House-21, and House-22 are not warranted because they do not satisfy WSDOT's feasibility and reasonableness criteria.

Outdoor Seating-3 and Apartment-9 Noise Barrier Analysis

Noise barriers constructed along the right-of-way to protect Outdoor Seating-3 receiver (at Starbucks) and Apartment-9 receiver (at Firlands Way Condominium) would not be technically feasible because these two receivers require driveway access to Aurora Avenue N and Firlands Way N, respectively. Any noise wall along the right-of-way would have to include wide openings for the individual driveways, which would reduce the noise reduction efficiency that would be provided by a continuous noise wall.

Apartment-8 Noise Barrier Analysis

Apartment-8 includes noise-impacted dwelling units on the ground floor. That apartment complex is on a hillside overlooking Aurora Avenue, but is separated from the road by a commercial parking lot (Receiver Lot-1) owned by a different party. For purposes of assessing noise abatement, the parking lot (Lot-1) is the first-row receiver adjacent to the road, and the apartment building is the second-row receiver. WSDOT guidance requires that noise barriers must provide at least 7 dBA of noise reduction at the first row. It would not be feasible to construct a noise barrier in the Aurora Avenue N right-of-way to shield the first-row receiver (Lot-1), because that parcel requires driveway access to the street. Therefore, a noise barrier to shield Lot-1 and Apartment-8 would not satisfy WSDOT noise abatement criteria, and is not considered further.

House-21 and House-29 Noise Barrier Analysis

Receivers House-21 and House-29 are noise-impacted dwelling units. Those homes are on a hillside overlooking Aurora Avenue N, but are separated from the road by other commercial property (Commercial-1 and Lot-2). For purposes of assessing noise abatement, the commercial properties are the first-row receivers

adjacent to the road, and the two impacted homes are the second-row receivers. WSDOT guidance requires that noise barriers must provide at least 7 dBA of noise reduction at the first row. It would not be feasible to construct a noise barrier in the Aurora Avenue N right-of-way to shield the first-row (Commercial-1 and Lot-2), because those businesses require driveway access to the street. Therefore, a noise barrier to shield receivers Commercial-1, Lot-2, House-21 and House-22 would not satisfy WSDOT noise abatement criteria, and is not considered further.

What is the recommended mitigation?

Noise barriers to shield the impacted noise-sensitive receivers at Outdoor Seating-3, Apartment-8, Apartment-9, House-21, and House-29 do not satisfy WSDOT's feasibility and reasonableness criteria. Therefore, no noise barriers are recommended for these locations.

Chapter 7. References

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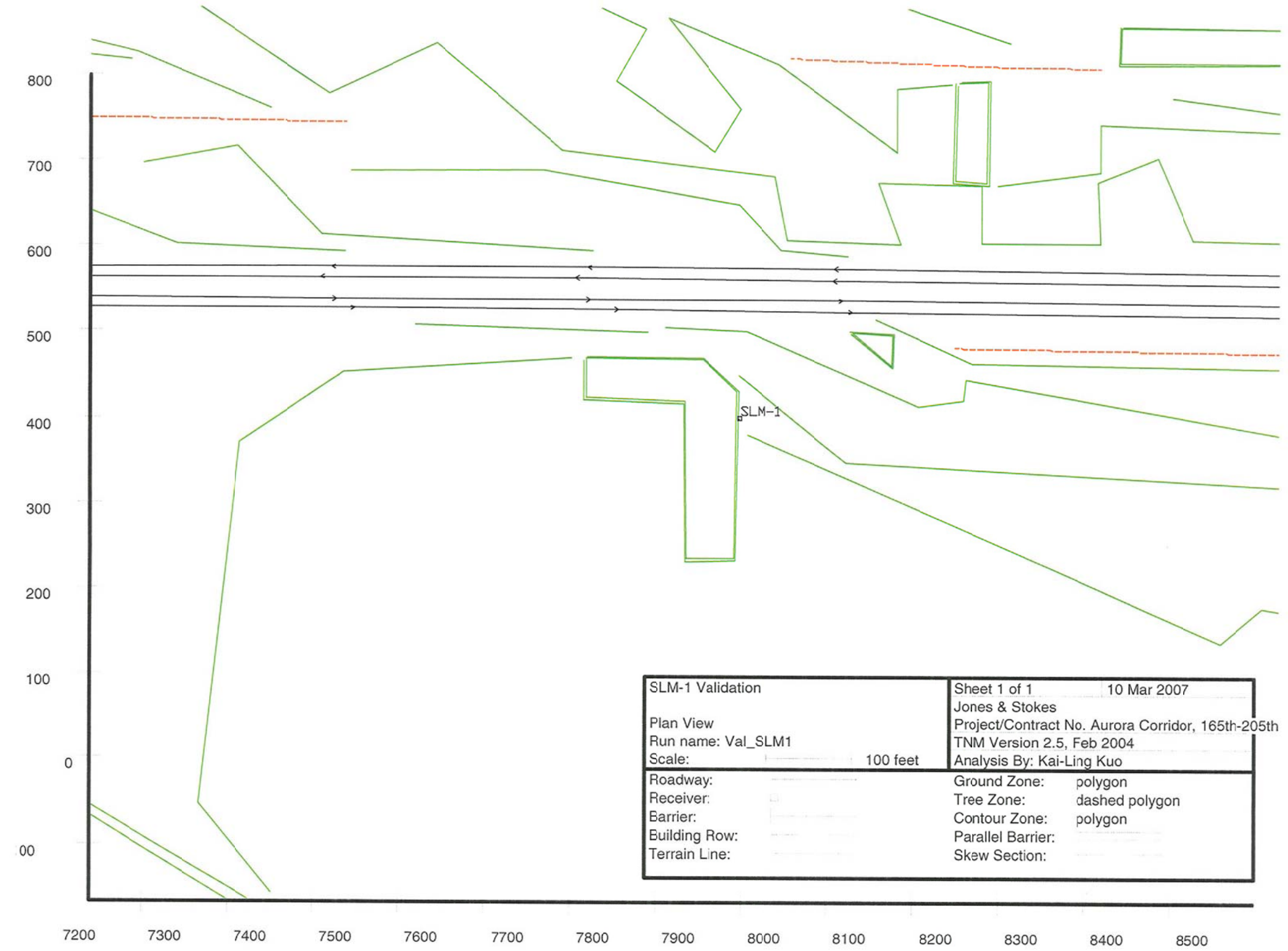
Appendix A

Noise Measurement Data and Traffic Noise Model Validation Reports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7300
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7800
7900
8000
8100
8200
8300
8400
8500
SLM-1 Validation
Plan View
Run name: Val_SLM1
Scale: 100 feet
Sheet 1 of 1 10 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:

Jones & Stokes
Kai-Ling Kuo

10 March 2007
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: SLM-1 Validation
BARRIER DESIGN: INPUT HEIGHTS

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

ATMOSPHERICS: 40 deg F, 70% RH

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Increase over existing Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
SLM-1	3	1	0.0	61.8	66	61.8	10	----	61.8	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min dB	Avg dB	Max dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Measured L_{eq} = 62.0

Jones & Stokes 10 March 200
Kai-Ling Kuo TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Percentages
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: SLM-1 Validation

Roadway Name	Points Name	No.	Segment Total Volume	Autos P %	Autos S mph	MTrucks P %	MTrucks S mph	HTrucks P %	HTrucks S mph	Buses P %	Buses S mph	Motorcycles P %	Motorcycles S mph
			veh/hr										
Aurora_165th-175th_1	point2	2		0	97	40	2	40	1	40	0	0	0
	point3	3		0	97	40	2	40	1	40	0	0	0
	point4	4		0	97	40	2	40	1	40	0	0	0
	point5	5		0	97	40	2	40	1	40	0	0	0
	point6	6											
Aurora_165th-175th_2	point7	7		0	97	40	2	40	1	40	0	0	0
	point8	8		0	97	40	2	40	1	40	0	0	0
	point9	9		0	97	40	2	40	1	40	0	0	0
	point10	10		0	97	40	2	40	1	40	0	0	0
	point11	11											
Aurora_175th-165th_1	point12	12		0	97	40	2	40	1	40	0	0	0
	point13	13		0	97	40	2	40	1	40	0	0	0
	point14	14		0	97	40	2	40	1	40	0	0	0
	point15	15		0	97	40	2	40	1	40	0	0	0
	point16	16											
Aurora_175th-165th_2	point17	17		0	97	40	2	40	1	40	0	0	0
	point18	18		0	97	40	2	40	1	40	0	0	0
	point19	19		0	97	40	2	40	1	40	0	0	0
	point20	20		0	97	40	2	40	1	40	0	0	0
	point21	21											
Aurora_175th-185th_1	point22	22		0	97	40	2	40	1	40	0	0	0
	point23	23		0	97	40	2	40	1	40	0	0	0

	point134	134	0	97	40	2	40	1	40	0	0	0	0
	point135	135	0	97	40	2	40	1	40	0	0	0	0
	point136	136	0	97	40	2	40	1	40	0	0	0	0
	point137	137	0	97	40	2	40	1	40	0	0	0	0
	point138	138											
Aurora_192nd-200th_1	point139	139	678	95	40	4	40	1	40	0	0	0	0
	point140	140	678	95	40	4	40	1	40	0	0	0	0
	point141	141	678	95	40	4	40	1	40	0	0	0	0
	point142	142	678	95	40	4	40	1	40	0	0	0	0
	point143	143											
Aurora_192nd-200th_2	point144	144	678	95	40	4	40	1	40	0	0	0	0
	point145	145	678	95	40	4	40	1	40	0	0	0	0
	point146	146	678	95	40	4	40	1	40	0	0	0	0
	point147	147	678	95	40	4	40	1	40	0	0	0	0
	point148	148											
Aurora_200th-192nd_1	point149	149	416	97	40	3	40	0	0	0	0	0	0
	point150	150	416	97	40	3	40	0	0	0	0	0	0
	point151	151	416	97	40	3	40	0	0	0	0	0	0
	point152	152	416	97	40	3	40	0	0	0	0	0	0
	point153	153											
Aurora_200th-192nd_2	point154	154	416	97	40	3	40	0	0	0	0	0	0
	point155	155	416	97	40	3	40	0	0	0	0	0	0
	point156	156	416	97	40	3	40	0	0	0	0	0	0
	point157	157	416	97	40	3	40	0	0	0	0	0	0
	point158	158											
Aurora_200th-205th_1	point159	159	0	97	40	2	40	1	40	0	0	0	0
	point160	160	0	97	40	2	40	1	40	0	0	0	0
	point161	161	0	97	40	2	40	1	40	0	0	0	0
	point162	162	0	97	40	2	40	1	40	0	0	0	0
	point163	163											
Aurora_200th-205th_2	point164	164	0	97	40	2	40	1	40	0	0	0	0
	point165	165	0	97	40	2	40	1	40	0	0	0	0
	point166	166	0	97	40	2	40	1	40	0	0	0	0
	point167	167	0	97	40	2	40	1	40	0	0	0	0
	point168	168											


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9100
9200
9300
9400
9500
9600
9700
9800
9900
10000
10100
SLM-2 Validation
Plan View
Run name: Val_SLM2
Scale: 100 feet
Sheet 1 of 1
10 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:

Jones & Stokes
Kai-Ling Kuo

10 March 2007
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: SLM-2 Validation
BARRIER DESIGN: INPUT HEIGHTS

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

ATMOSPHERICS: 40 deg F, 70% RH

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
SLM-2	9	1	0.0	61.4	66	61.4	10	----	61.4	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min dB	Avg dB	Max dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Measured L_{eq} = 61.6

Jones & Stokes
Kai-Ling Kuo

10 March 200
TNM 2.5

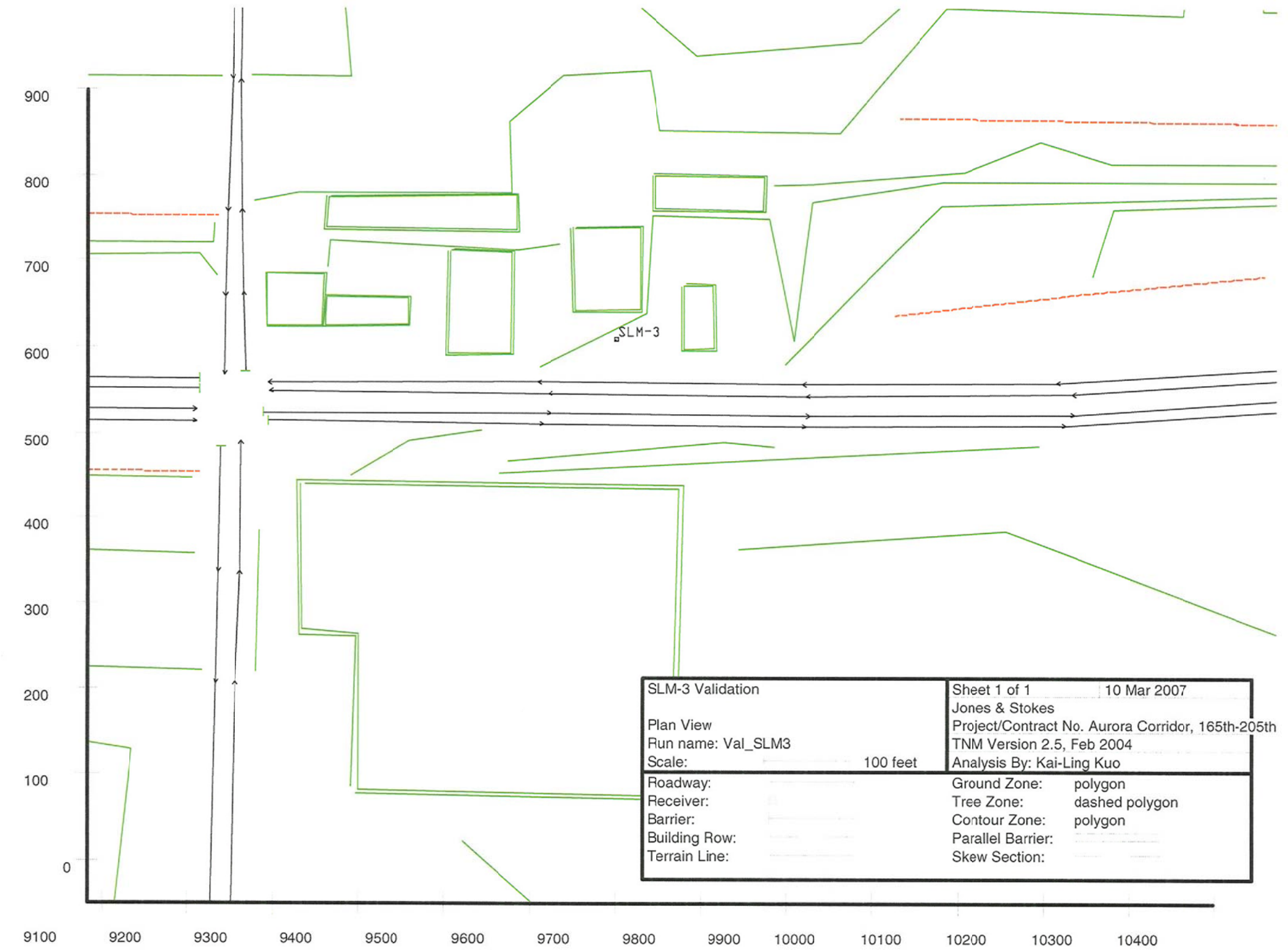
INPUT: TRAFFIC FOR LAeq1h Percentages
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: SLM-2 Validation

Roadway Name	Points Name	No.	Segment Total Volume	Autos P %	Autos S mph	MTrucks P %	MTrucks S mph	HTrucks P %	HTrucks S mph	Buses P %	Buses S mph	Motorcycles P %	Motorcycles S mph
			veh/hr										
Aurora_165th-175th_1	point2	2		0	97 40	2	40	1	40	0	0	0	0
	point3	3		0	97 40	2	40	1	40	0	0	0	0
	point4	4		0	97 40	2	40	1	40	0	0	0	0
	point5	5		0	97 40	2	40	1	40	0	0	0	0
	point6	6											
Aurora_165th-175th_2	point7	7		0	97 40	2	40	1	40	0	0	0	0
	point8	8		0	97 40	2	40	1	40	0	0	0	0
	point9	9		0	97 40	2	40	1	40	0	0	0	0
	point10	10		0	97 40	2	40	1	40	0	0	0	0
	point11	11											
Aurora_175th-165th_1	point12	12		0	97 40	2	40	1	40	0	0	0	0
	point13	13		0	97 40	2	40	1	40	0	0	0	0
	point14	14		0	97 40	2	40	1	40	0	0	0	0
	point15	15		0	97 40	2	40	1	40	0	0	0	0
	point16	16											
Aurora_175th-165th_2	point17	17		0	97 40	2	40	1	40	0	0	0	0
	point18	18		0	97 40	2	40	1	40	0	0	0	0
	point19	19		0	97 40	2	40	1	40	0	0	0	0
	point20	20		0	97 40	2	40	1	40	0	0	0	0
	point21	21											
Aurora_175th-185th_1	point22	22		0	97 40	2	40	1	40	0	0	0	0
	point23	23		0	97 40	2	40	1	40	0	0	0	0

	point134	134	0	97	40	2	40	1	40	0	0	0	0
	point135	135	0	97	40	2	40	1	40	0	0	0	0
	point136	136	0	97	40	2	40	1	40	0	0	0	0
	point137	137	0	97	40	2	40	1	40	0	0	0	0
	point138	138											
Aurora_192nd-200th_1	point139	139	712	99	40	1	40	0	0	0	0	0	0
	point140	140	712	99	40	1	40	0	0	0	0	0	0
	point141	141	712	99	40	1	40	0	0	0	0	0	0
	point142	142	712	99	40	1	40	0	0	0	0	0	0
	point143	143											
Aurora_192nd-200th_2	point144	144	712	99	40	1	40	0	0	0	0	0	0
	point145	145	712	99	40	1	40	0	0	0	0	0	0
	point146	146	712	99	40	1	40	0	0	0	0	0	0
	point147	147	712	99	40	1	40	0	0	0	0	0	0
	point148	148											
Aurora_200th-192nd_1	point149	149	412	99	40	1	40	0	0	0	0	0	0
	point150	150	412	99	40	1	40	0	0	0	0	0	0
	point151	151	412	99	40	1	40	0	0	0	0	0	0
	point152	152	412	99	40	1	40	0	0	0	0	0	0
	point153	153											
Aurora_200th-192nd_2	point154	154	412	99	40	1	40	0	0	0	0	0	0
	point155	155	412	99	40	1	40	0	0	0	0	0	0
	point156	156	412	99	40	1	40	0	0	0	0	0	0
	point157	157	412	99	40	1	40	0	0	0	0	0	0
	point158	158											
Aurora_200th-205th_1	point159	159	712	99	40	1	40	0	0	0	0	0	0
	point160	160	712	99	40	1	40	0	0	0	0	0	0
	point161	161	712	99	40	1	40	0	0	0	0	0	0
	point162	162	712	99	40	1	40	0	0	0	0	0	0
	point163	163											
Aurora_200th-205th_2	point164	164	712	99	40	1	40	0	0	0	0	0	0
	point165	165	712	99	40	1	40	0	0	0	0	0	0
	point166	166	712	99	40	1	40	0	0	0	0	0	0
	point167	167	712	99	40	1	40	0	0	0	0	0	0
	point168	168											

Aurora_205th-200th_1	point169	169	412	99	40	1	40	0	0	0	0	0	0
	point170	170	412	99	40	1	40	0	0	0	0	0	0
	point171	171	412	99	40	1	40	0	0	0	0	0	0
	point172	172	412	99	40	1	40	0	0	0	0	0	0
	point173	173											
Aurora_205th-200th_2	point174	174	412	99	40	1	40	0	0	0	0	0	0
	point175	175	412	99	40	1	40	0	0	0	0	0	0
	point176	176	412	99	40	1	40	0	0	0	0	0	0
	point177	177	412	99	40	1	40	0	0	0	0	0	0
	point178	178											
205th WBTA_1	point179	179	0	98	40	2	40	0	0	0	0	0	0
	point180	180	0	98	40	2	40	0	0	0	0	0	0
	point181	181											
205th WBTA_2	point182	182	0	98	40	2	40	0	0	0	0	0	0
	point183	183	0	98	40	2	40	0	0	0	0	0	0
	point184	184											
205th EBTD_1	point185	185	0	98	40	2	40	0	0	0	0	0	0
	point186	186	0	98	40	2	40	0	0	0	0	0	0
	point187	187											
205th EBTD	point188	188	0	98	40	2	40	0	0	0	0	0	0
	point189	189	0	98	40	2	40	0	0	0	0	0	0
	point190	190											
205th WBTD	point191	191	0	99	40	1	40	0	0	0	0	0	0
	point192	192	0	99	40	1	40	0	0	0	0	0	0
	point193	193											
205th EBTA	point194	194	0	99	40	1	40	0	0	0	0	0	0
	point195	195	0	99	40	1	40	0	0	0	0	0	0
	point196	196											
200th WBTA	point197	197	430	98	30	2	30	0	0	0	0	0	0
	point198	198	430	98	30	2	30	0	0	0	0	0	0
	point199	199	430	98	30	2	30	0	0	0	0	0	0
	point200	200											
200th EBTD	point201	201	425	98	30	2	30	0	0	0	0	0	0
	point202	202	425	98	30	2	30	0	0	0	0	0	0
	point203	203	425	98	30	2	30	0	0	0	0	0	0

	point204	204											
200th WBTD	point205	205	235	98	30	2	30	0	0	0	0	0	0
	point206	206	235	98	30	2	30	0	0	0	0	0	0
	point207	207	235	98	30	2	30	0	0	0	0	0	0
	point208	208	235	98	30	2	30	0	0	0	0	0	0
	point209	209											
200th EBTA	point210	210	220	98	30	2	30	0	0	0	0	0	0
	point211	211	220	98	30	2	30	0	0	0	0	0	0
	point212	212	220	98	30	2	30	0	0	0	0	0	0
	point213	213	220	98	30	2	30	0	0	0	0	0	0
	point214	214											
192nd WBTA	point215	215	0	98	30	2	30	0	0	0	0	0	0
	point216	216	0	98	30	2	30	0	0	0	0	0	0
	point217	217	0	98	30	2	30	0	0	0	0	0	0
	point218	218											
192nd EBTD	point219	219	0	98	30	2	30	0	0	0	0	0	0
	point220	220	0	98	30	2	30	0	0	0	0	0	0
	point221	221	0	98	30	2	30	0	0	0	0	0	0
	point222	222											
192nd WBTD	point223	223	0	98	30	2	30	0	0	0	0	0	0
	point224	224	0	98	30	2	30	0	0	0	0	0	0
	point225	225	0	98	30	2	30	0	0	0	0	0	0
	point226	226	0	98	30	2	30	0	0	0	0	0	0
	point227	227											
192nd EBTA	point228	228	0	98	30	2	30	0	0	0	0	0	0
	point229	229	0	98	30	2	30	0	0	0	0	0	0
	point230	230	0	98	30	2	30	0	0	0	0	0	0
	point231	231	0	98	30	2	30	0	0	0	0	0	0
	point232	232											
Aurora_N 205th_NBTD_1	point233	233	0	97	40	2	40	1	40	0	0	0	0
	point234	234	0	97	40	2	40	1	40	0	0	0	0
	point235	235	0	97	40	2	40	1	40	0	0	0	0
	point239	239											
Aurora_N 205th_NBTD_2	point236	236	0	97	40	2	40	1	40	0	0	0	0
	point237	237	0	97	40	2	40	1	40	0	0	0	0


SLM-3
900
800
700
600
500
400
300
200
100
0
9100
9200
9300
9400
9500
9600
9700
9800
9900
10000
10100
10200
10300
10400
SLM-3 Validation
Plan View
Run name: Val_SLM3
Scale: 100 feet
Sheet 1 of 1
10 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:

Jones & Stokes
Kai-Ling Kuo

10 March 2007
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: SLM-3 Validation
BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 40 deg F, 70% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
SLM-3	7	1	0.0	68.9	66	68.9	10	Snd Lvl	68.9	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min dB	Avg dB	Max dB
All Selected	1	0.0	0.0	0.0
All Impacted	1	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Measured L_{eq} = 70.8

Jones & Stokes 10 March 200
Kai-Ling Kuo TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Percentages
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: SLM-3 Validation

Roadway Name	Points Name	No.	Segment Total Volume	Autos P %	Autos S mph	MTrucks P %	MTrucks S mph	HTrucks P %	HTrucks S mph	Buses P %	Buses S mph	Motorcycles P %	Motorcycles S mph
			veh/hr										
Aurora_165th-175th_1	point2	2	0	97	40	2	40	1	40	0	0	0	0
	point3	3	0	97	40	2	40	1	40	0	0	0	0
	point4	4	0	97	40	2	40	1	40	0	0	0	0
	point5	5	0	97	40	2	40	1	40	0	0	0	0
	point6	6											
Aurora_165th-175th_2	point7	7	0	97	40	2	40	1	40	0	0	0	0
	point8	8	0	97	40	2	40	1	40	0	0	0	0
	point9	9	0	97	40	2	40	1	40	0	0	0	0
	point10	10	0	97	40	2	40	1	40	0	0	0	0
	point11	11											
Aurora_175th-165th_1	point12	12	0	97	40	2	40	1	40	0	0	0	0
	point13	13	0	97	40	2	40	1	40	0	0	0	0
	point14	14	0	97	40	2	40	1	40	0	0	0	0
	point15	15	0	97	40	2	40	1	40	0	0	0	0
	point16	16											
Aurora_175th-165th_2	point17	17	0	97	40	2	40	1	40	0	0	0	0
	point18	18	0	97	40	2	40	1	40	0	0	0	0
	point19	19	0	97	40	2	40	1	40	0	0	0	0
	point20	20	0	97	40	2	40	1	40	0	0	0	0
	point21	21											
Aurora_175th-185th_1	point22	22	0	97	40	2	40	1	40	0	0	0	0
	point23	23	0	97	40	2	40	1	40	0	0	0	0

	point134	134	0	97	40	2	40	1	40	0	0	0	0
	point135	135	0	97	40	2	40	1	40	0	0	0	0
	point136	136	0	97	40	2	40	1	40	0	0	0	0
	point137	137	0	97	40	2	40	1	40	0	0	0	0
	point138	138											
Aurora_192nd-200th_1	point139	139	828	98	40	2	40	0	0	0	0	0	0
	point140	140	828	98	40	2	40	0	0	0	0	0	0
	point141	141	828	98	40	2	40	0	0	0	0	0	0
	point142	142	828	98	40	2	40	0	0	0	0	0	0
	point143	143											
Aurora_192nd-200th_2	point144	144	828	98	40	2	40	0	0	0	0	0	0
	point145	145	828	98	40	2	40	0	0	0	0	0	0
	point146	146	828	98	40	2	40	0	0	0	0	0	0
	point147	147	828	98	40	2	40	0	0	0	0	0	0
	point148	148											
Aurora_200th-192nd_1	point149	149	432	99	40	1	40	0	0	0	0	0	0
	point150	150	432	99	40	1	40	0	0	0	0	0	0
	point151	151	432	99	40	1	40	0	0	0	0	0	0
	point152	152	432	99	40	1	40	0	0	0	0	0	0
	point153	153											
Aurora_200th-192nd_2	point154	154	432	99	40	1	40	0	0	0	0	0	0
	point155	155	432	99	40	1	40	0	0	0	0	0	0
	point156	156	432	99	40	1	40	0	0	0	0	0	0
	point157	157	432	99	40	1	40	0	0	0	0	0	0
	point158	158											
Aurora_200th-205th_1	point159	159	828	98	40	2	40	0	0	0	0	0	0
	point160	160	828	98	40	2	40	0	0	0	0	0	0
	point161	161	828	98	40	2	40	0	0	0	0	0	0
	point162	162	828	98	40	2	40	0	0	0	0	0	0
	point163	163											
Aurora_200th-205th_2	point164	164	828	98	40	2	40	0	0	0	0	0	0
	point165	165	828	98	40	2	40	0	0	0	0	0	0
	point166	166	828	98	40	2	40	0	0	0	0	0	0
	point167	167	828	98	40	2	40	0	0	0	0	0	0
	point168	168											

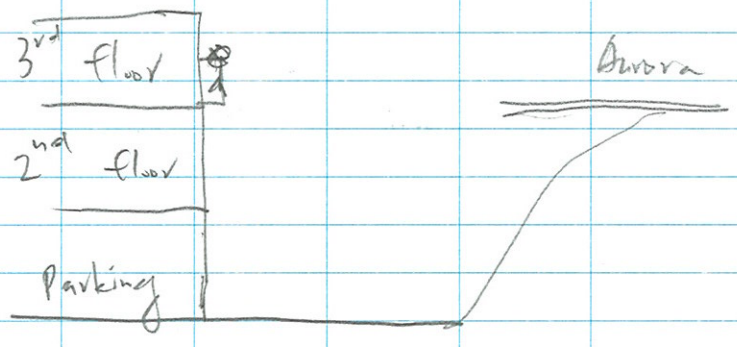
Aurora_205th-200th_1	point169	169	432	99	40	1	40	0	0	0	0	0	0
	point170	170	432	99	40	1	40	0	0	0	0	0	0
	point171	171	432	99	40	1	40	0	0	0	0	0	0
	point172	172	432	99	40	1	40	0	0	0	0	0	0
	point173	173											
Aurora_205th-200th_2	point174	174	432	99	40	1	40	0	0	0	0	0	0
	point175	175	432	99	40	1	40	0	0	0	0	0	0
	point176	176	432	99	40	1	40	0	0	0	0	0	0
	point177	177	432	99	40	1	40	0	0	0	0	0	0
	point178	178											
205th WBTA_1	point179	179	0	98	40	2	40	0	0	0	0	0	0
	point180	180	0	98	40	2	40	0	0	0	0	0	0
	point181	181											
205th WBTA_2	point182	182	0	98	40	2	40	0	0	0	0	0	0
	point183	183	0	98	40	2	40	0	0	0	0	0	0
	point184	184											
205th EBTD_1	point185	185	0	98	40	2	40	0	0	0	0	0	0
	point186	186	0	98	40	2	40	0	0	0	0	0	0
	point187	187											
205th EBTD	point188	188	0	98	40	2	40	0	0	0	0	0	0
	point189	189	0	98	40	2	40	0	0	0	0	0	0
	point190	190											
205th WBTD	point191	191	0	99	40	1	40	0	0	0	0	0	0
	point192	192	0	99	40	1	40	0	0	0	0	0	0
	point193	193											
205th EBTA	point194	194	0	99	40	1	40	0	0	0	0	0	0
	point195	195	0	99	40	1	40	0	0	0	0	0	0
	point196	196											
200th WBTA	point197	197	435	98	30	2	30	0	0	0	0	0	0
	point198	198	435	98	30	2	30	0	0	0	0	0	0
	point199	199	435	98	30	2	30	0	0	0	0	0	0
	point200	200											
200th EBTD	point201	201	425	98	30	2	30	0	0	0	0	0	0
	point202	202	425	98	30	2	30	0	0	0	0	0	0
	point203	203	425	98	30	2	30	0	0	0	0	0	0

	point204	204											
200th WBTD	point205	205	235	98	30	2	30	0	0	0	0	0	0
	point206	206	235	98	30	2	30	0	0	0	0	0	0
	point207	207	235	98	30	2	30	0	0	0	0	0	0
	point208	208	235	98	30	2	30	0	0	0	0	0	0
	point209	209											
200th EBTA	point210	210	220	98	30	2	30	0	0	0	0	0	0
	point211	211	220	98	30	2	30	0	0	0	0	0	0
	point212	212	220	98	30	2	30	0	0	0	0	0	0
	point213	213	220	98	30	2	30	0	0	0	0	0	0
	point214	214											
192nd WBTA	point215	215	0	98	30	2	30	0	0	0	0	0	0
	point216	216	0	98	30	2	30	0	0	0	0	0	0
	point217	217	0	98	30	2	30	0	0	0	0	0	0
	point218	218											
192nd EBTD	point219	219	0	98	30	2	30	0	0	0	0	0	0
	point220	220	0	98	30	2	30	0	0	0	0	0	0
	point221	221	0	98	30	2	30	0	0	0	0	0	0
	point222	222											
192nd WBTD	point223	223	0	98	30	2	30	0	0	0	0	0	0
	point224	224	0	98	30	2	30	0	0	0	0	0	0
	point225	225	0	98	30	2	30	0	0	0	0	0	0
	point226	226	0	98	30	2	30	0	0	0	0	0	0
	point227	227											
192nd EBTA	point228	228	0	98	30	2	30	0	0	0	0	0	0
	point229	229	0	98	30	2	30	0	0	0	0	0	0
	point230	230	0	98	30	2	30	0	0	0	0	0	0
	point231	231	0	98	30	2	30	0	0	0	0	0	0
	point232	232											
Aurora_N 205th_NBTD_1	point233	233	0	97	40	2	40	1	40	0	0	0	0
	point234	234	0	97	40	2	40	1	40	0	0	0	0
	point235	235	0	97	40	2	40	1	40	0	0	0	0
	point239	239											
Aurora_N 205th_NBTD_2	point236	236	0	97	40	2	40	1	40	0	0	0	0
	point237	237	0	97	40	2	40	1	40	0	0	0	0

SLM-1 2/27/07

Eco Lake Condo

Top floor



19414 Echo Cove Condo
19428

SLM 1

cold, Calm
Cloudy

3:10 ~ 3:25

69.5 MT 67.3
66.5 MT

NB Bus ||||
SB Bus3 ||||

NB Motor 1

No Cnr 49

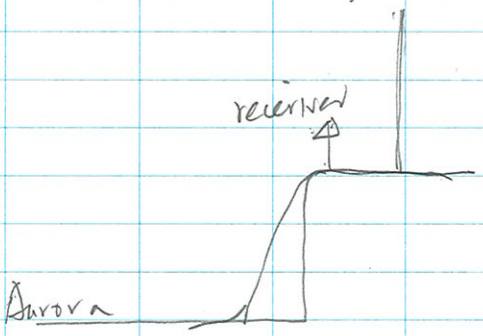
NB 321 / 15 / 3

SB 201 / 7 / 0

Leq 62.0
L10 64.2
L33 62.6
L50 61.6
L90 56.4

SLM-2

Apartment North of 200th St west of Aurora



20060 Whitman Ave N
Village Vista

= 3:55 ~ 4:10

NB Bus 67 69.5 71.5

SB Car 66

NB Bus 111

NB 351 / 4 / 1

SB 204 / 2 / 0

Leq 61.6

L_{10} 64.7

L_{33} 62.1

L_{50} 60.7

L_{90} 54.9

SLM 3

Starbucks

20121 Aurora Ave N

4:35 - 4:50

SB Loud Car 73 73.5
NB Loud Car 72
NB Truck 73
SB bus 111 79
NB bus 1 73

: 50' W of fog line at Starbucks Parking Lot S of

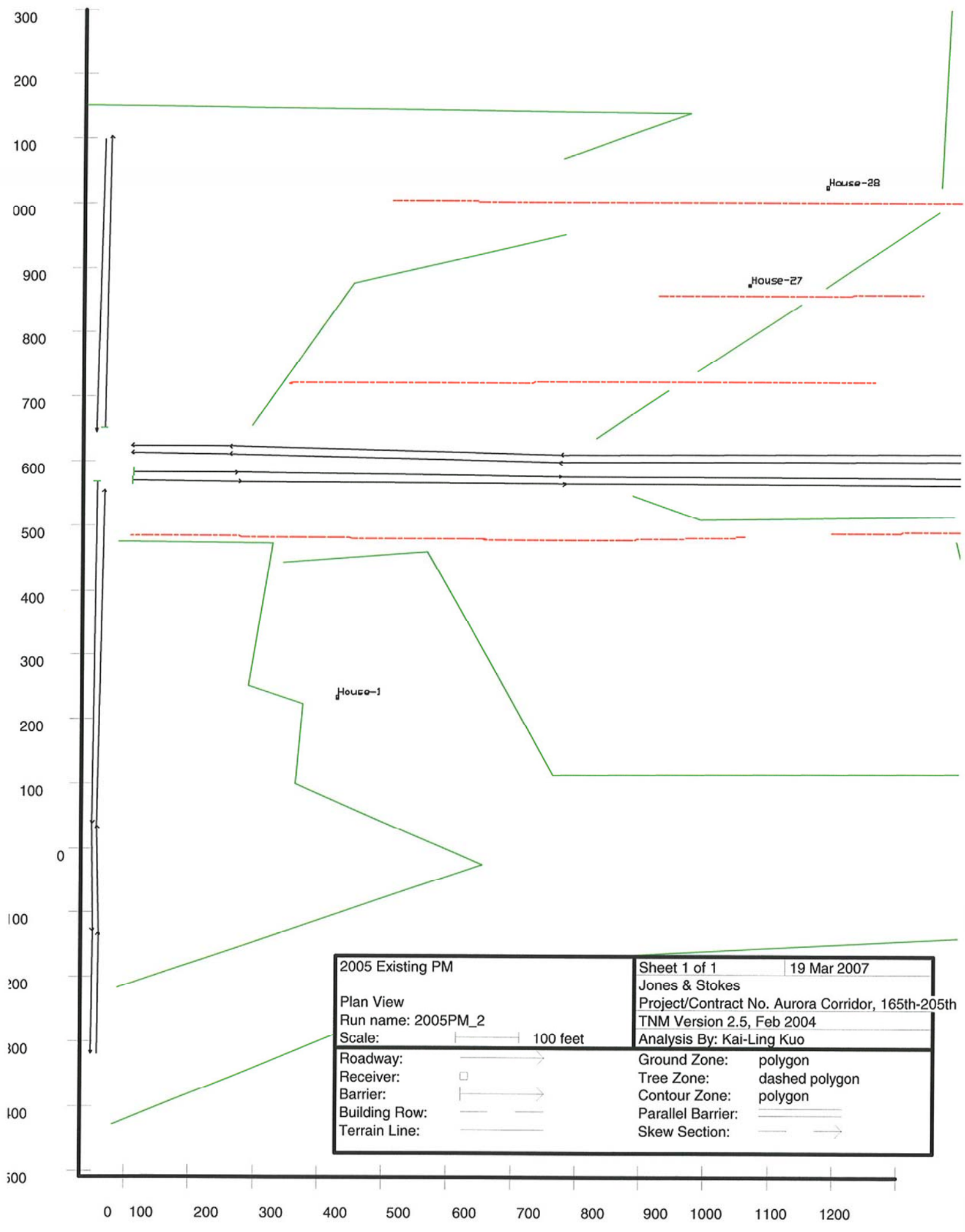
No Car 56

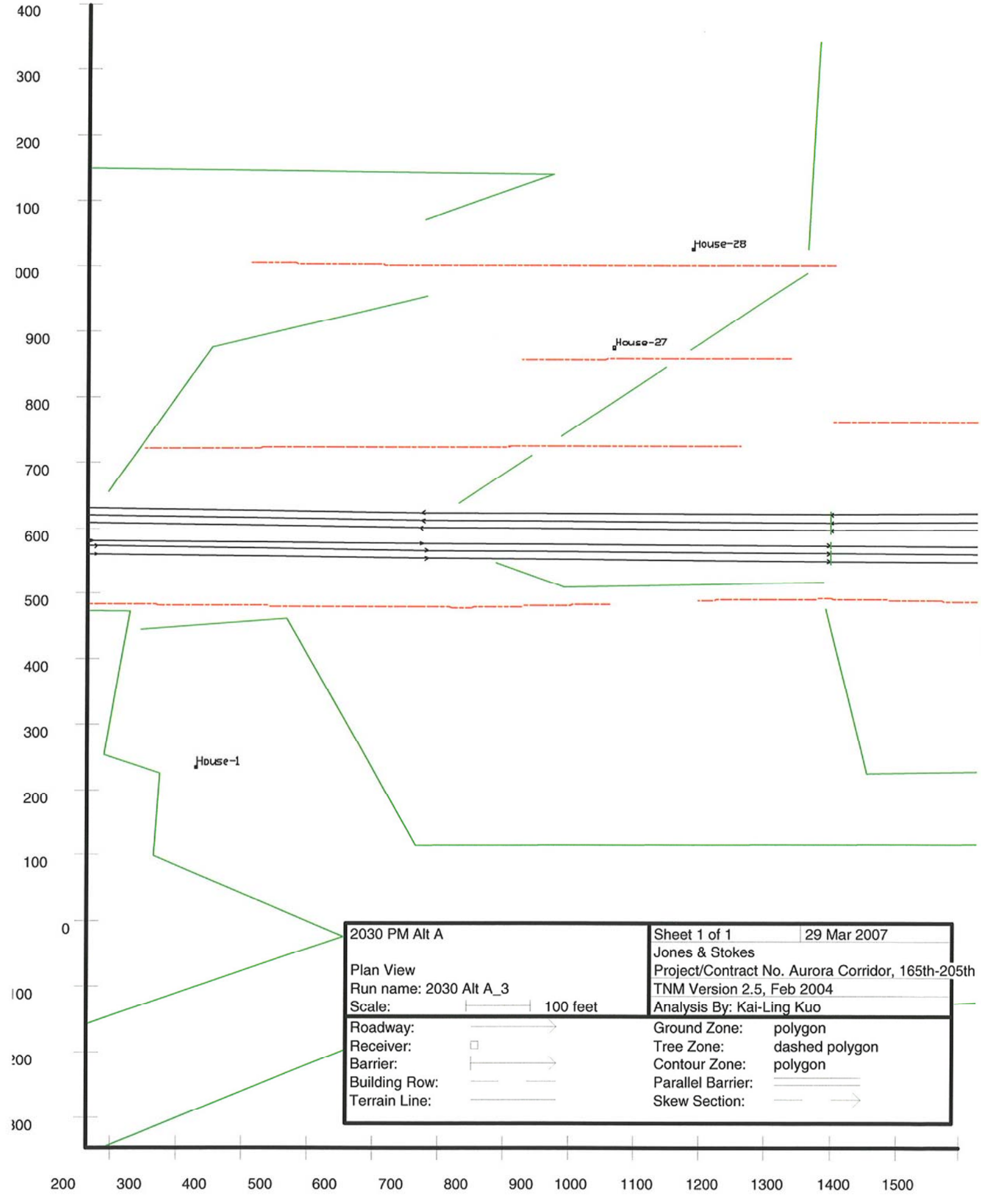
NB 407 / 7 / 0
SB 213 / 3 / 0

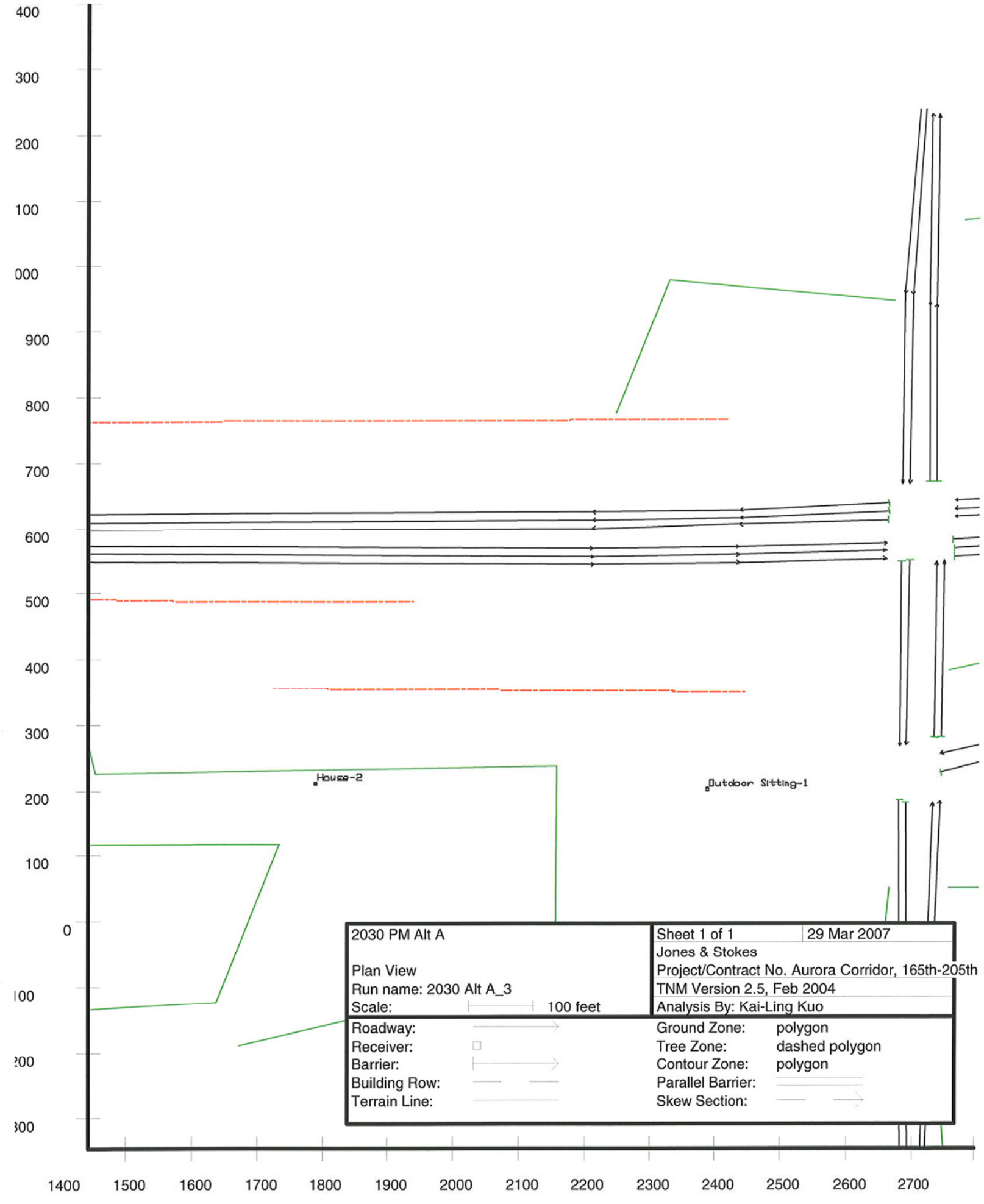
Leq 70.8 Lmax 77.8
L10 74 Lmin 56.1
L33 71.1
L50 69.5
L90 64.1

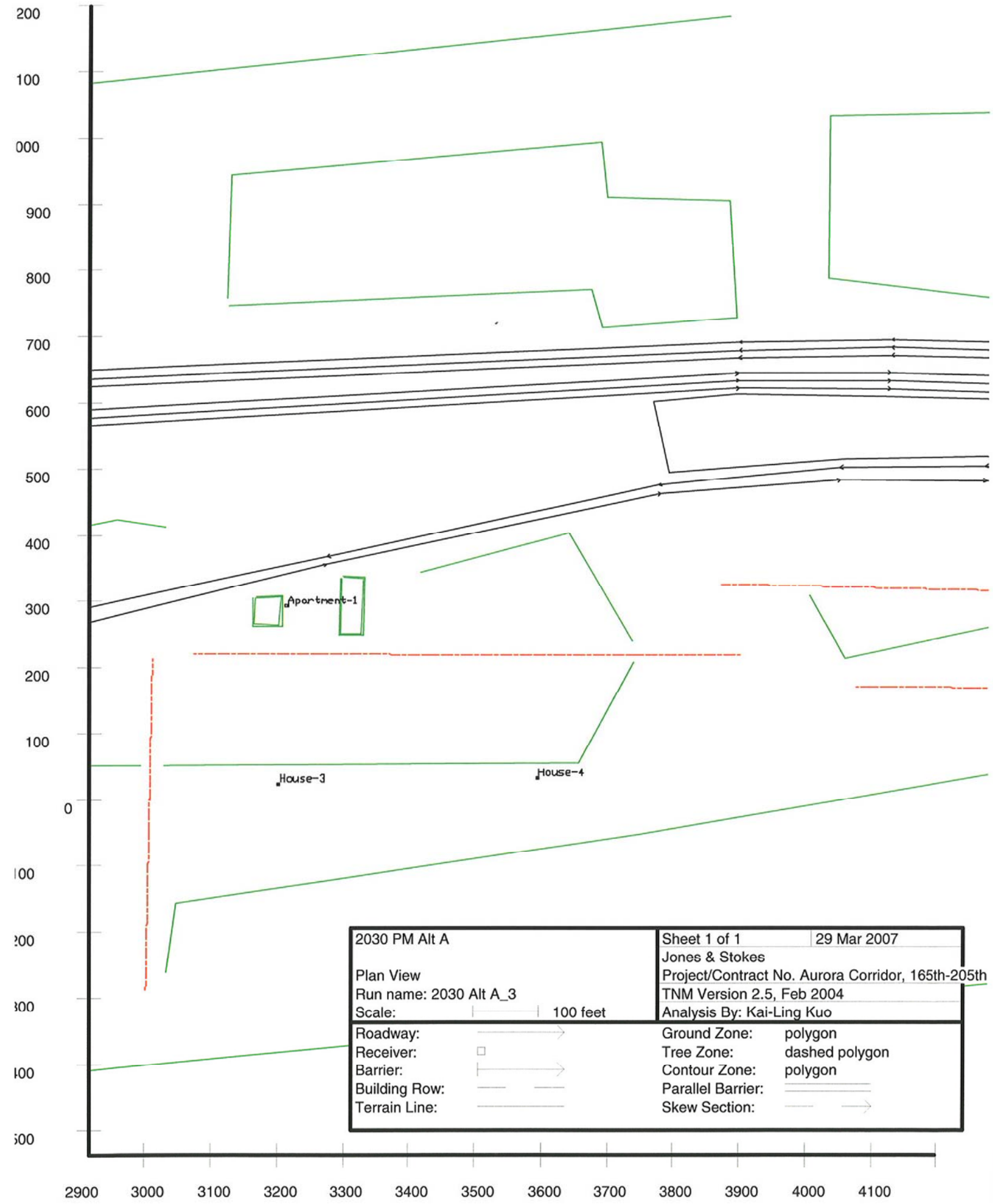
Appendix B

Baseline Year and Design Year Traffic Noise Model Reports


House-28
House-27
House-1
2005 Existing PM
Plan View
Run name: 2005PM_2
Scale: 100 feet
Sheet 1 of 1
19 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:
300
200
100
000
900
800
700
600
500
400
300
200
100
0
100
200
300
400
500
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

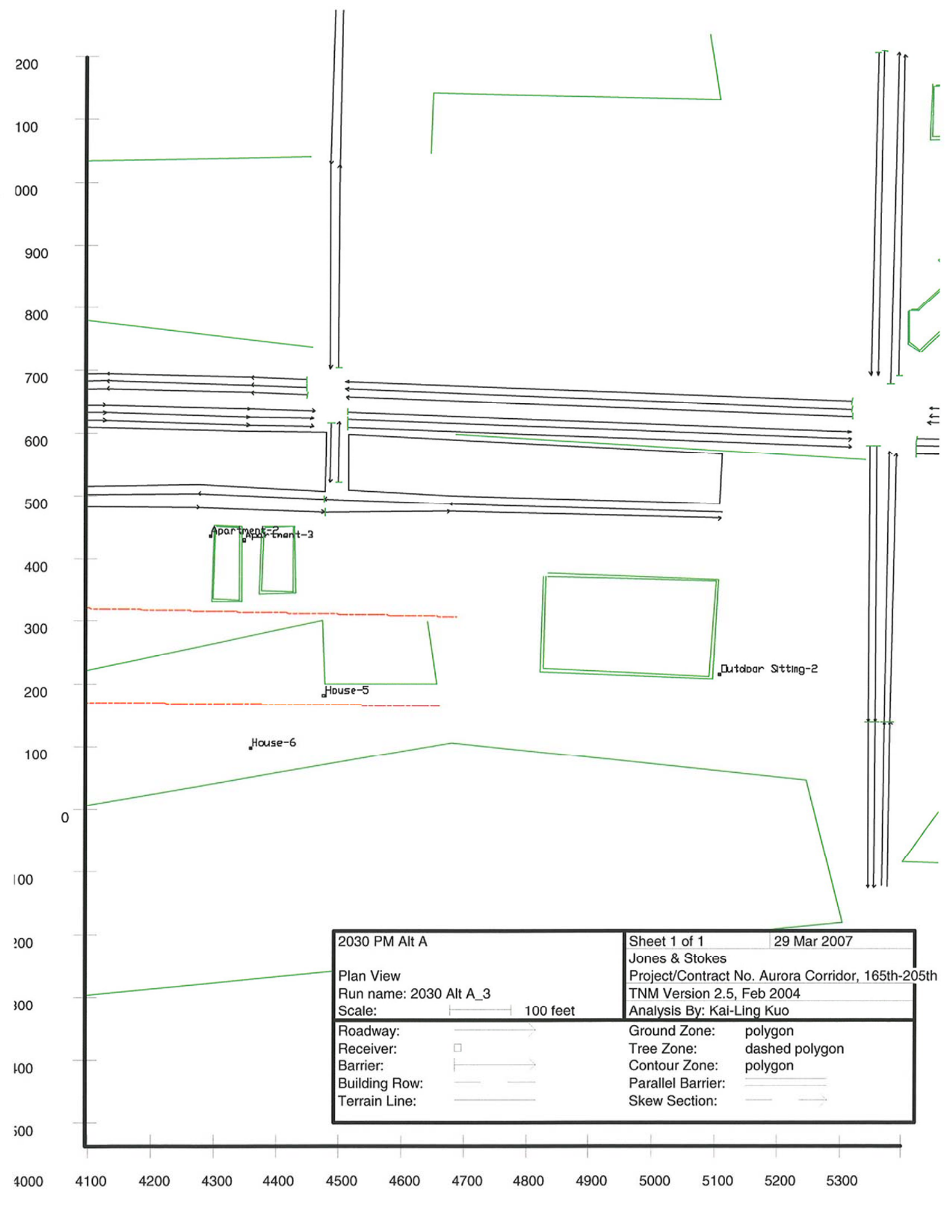

House-28
House-27
House-1
2030 PM Alt A
Plan View
Run name: 2030 Alt A_3
Scale: 100 feet
Sheet 1 of 1
29 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:
400
300
200
100
000
900
800
700
600
500
400
300
200
100
0
100
200
300
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500

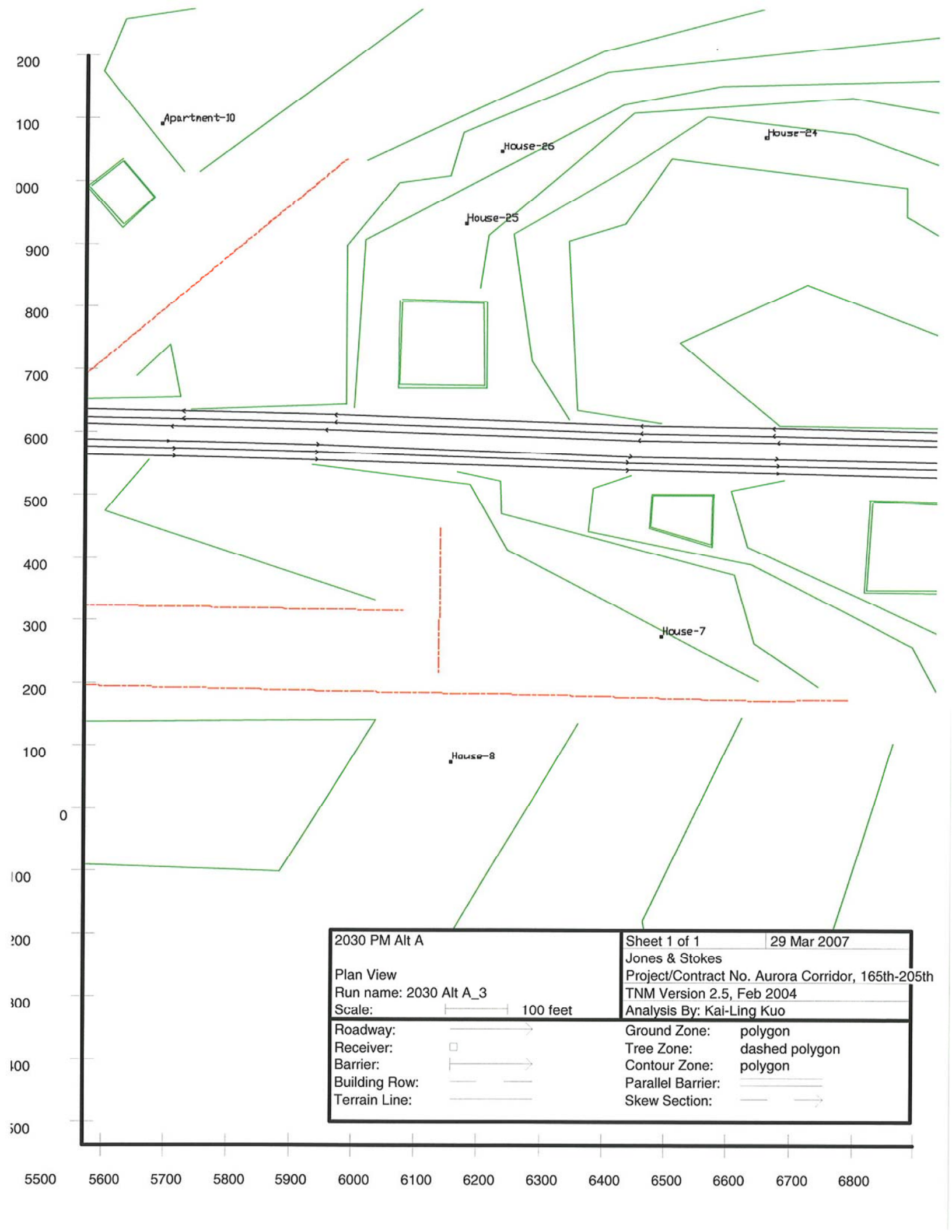

House-2
Outdoor Sitting-1
2030 PM Alt A
Plan View
Run name: 2030 Alt A_3
Scale: 100 feet
Sheet 1 of 1
29 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:
400
300
200
100
000
900
800
700
600
500
400
300
200
100
0
100
200
300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700

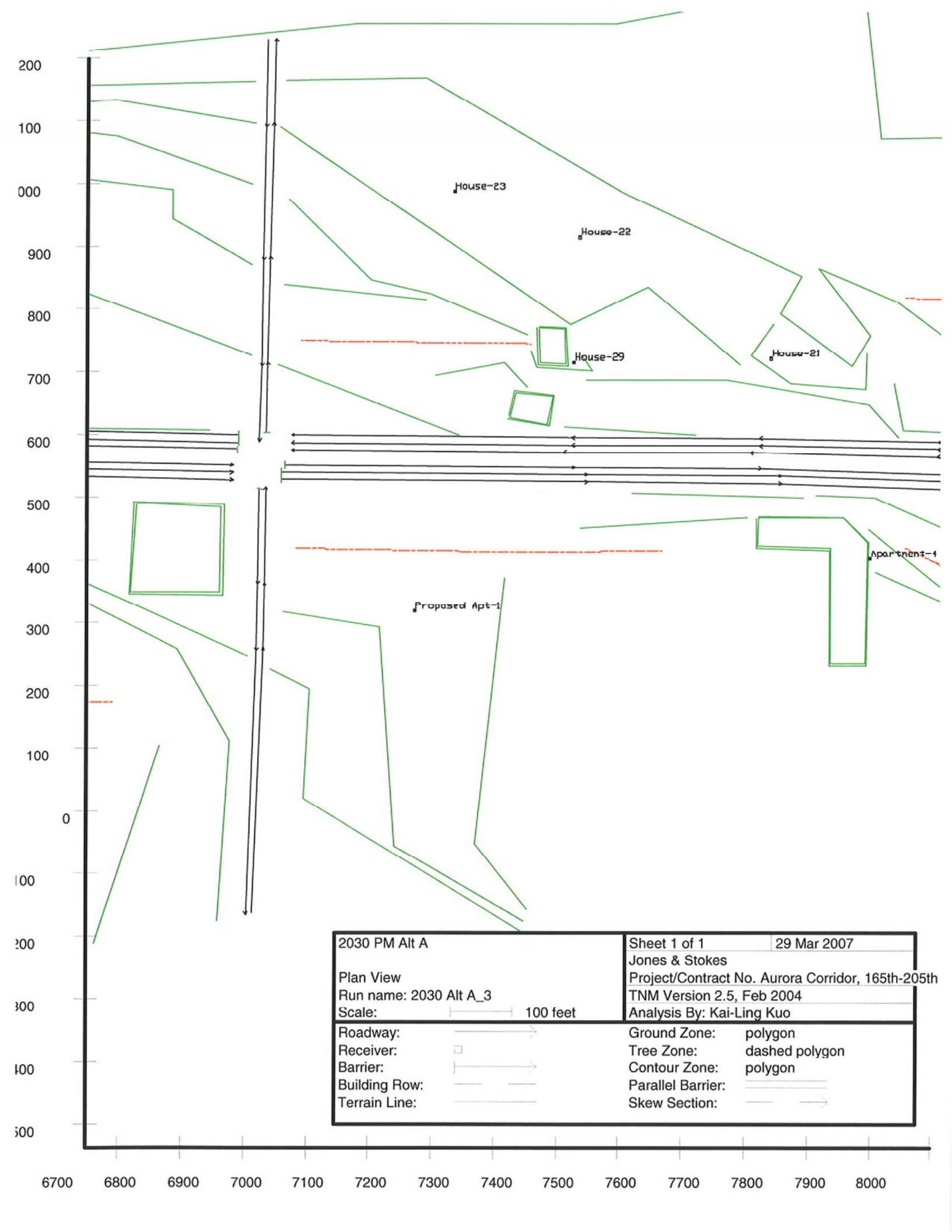


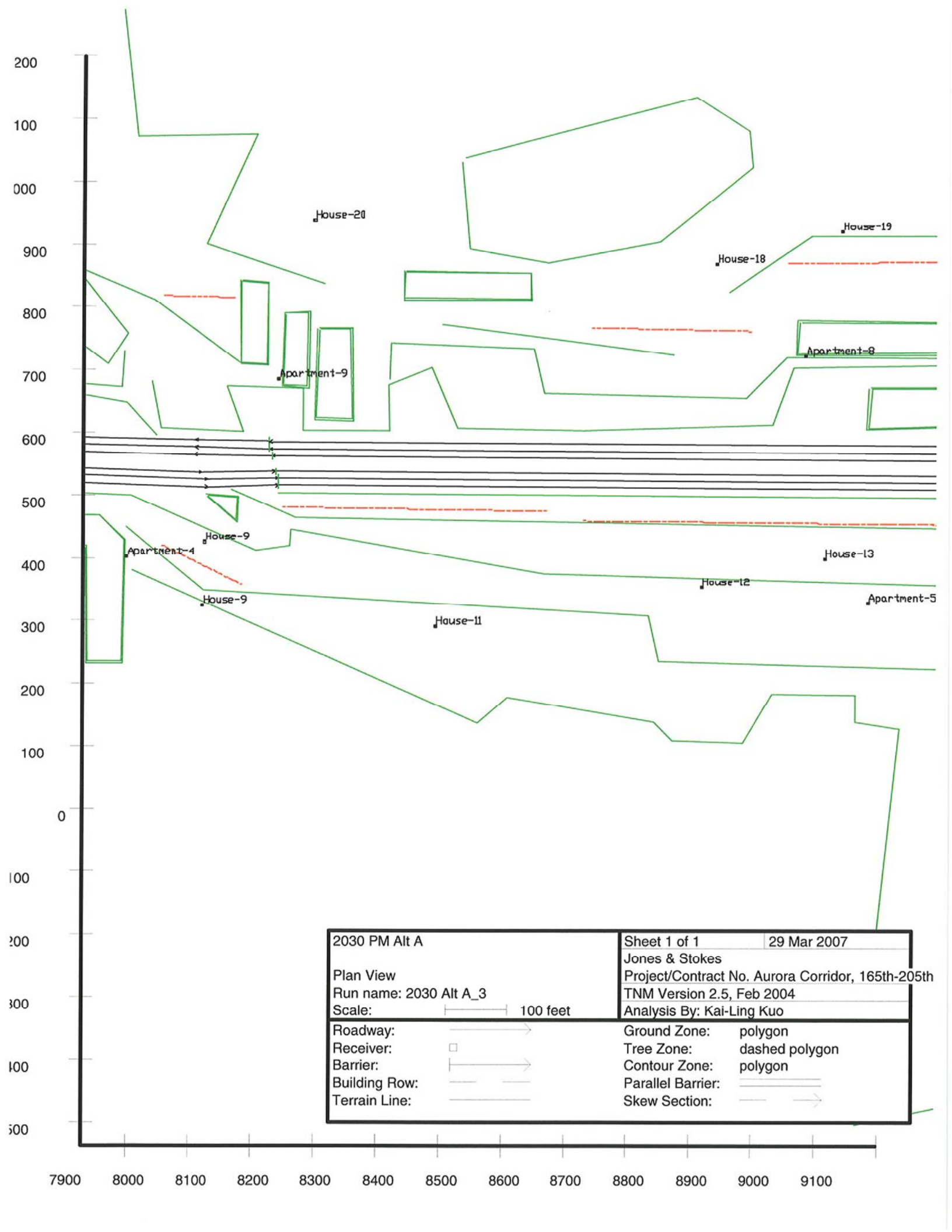
2030 PM Alt A	Sheet 1 of 1 | 29 Mar 2007
	Jones & Stokes
Plan View	Project/Contract No. Aurora Corridor, 165th-205th
Run name: 2030 Alt A_3	TNM Version 2.5, Feb 2004
Scale: 100 feet	Analysis By: Kai-Ling Kuo

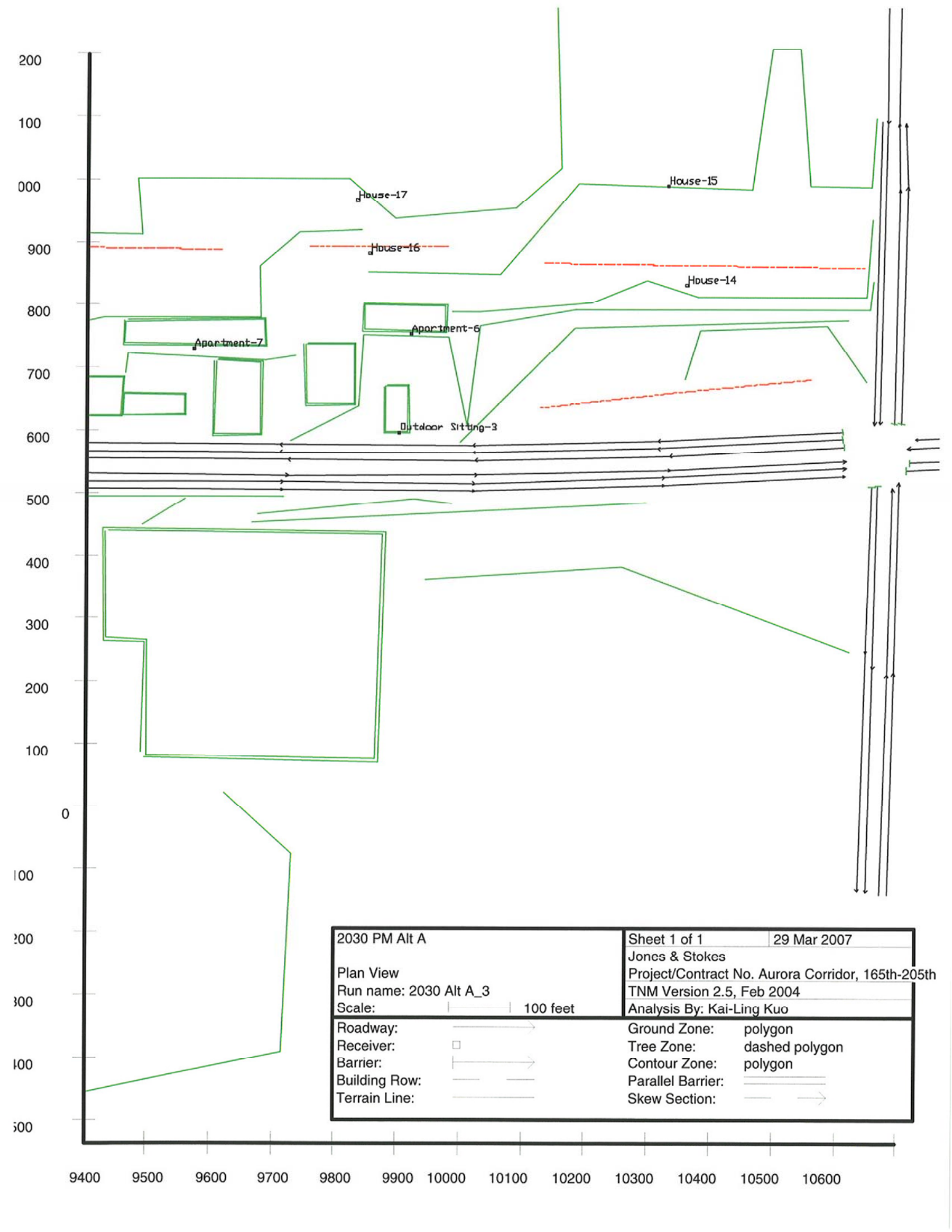
Roadway:		Ground Zone:	polygon
Receiver:	□	Tree Zone:	dashed polygon
Barrier:		Contour Zone:	polygon
Building Row:		Parallel Barrier:	
Terrain Line:		Skew Section:	


200
100
000
900
800
700
600
500
400
300
200
100
0
100
200
300
400
500
4000
4100
4200
4300
4400
4500
4600
4700
4800
4900
5000
5100
5200
5300
Apartment-2
Apartment-3
House-5
House-6
Outdoor Sitting-2
2030 PM Alt A
Plan View
Run name: 2030 Alt A_3
Scale: 100 feet
Sheet 1 of 1
29 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:


Apartment-10
House-26
House-24
House-25
House-7
House-8
200
100
000
900
800
700
600
500
400
300
200
100
0
100
200
300
400
500
5500
5600
5700
5800
5900
6000
6100
6200
6300
6400
6500
6600
6700
6800
2030 PM Alt A
Plan View
Run name: 2030 Alt A_3
Scale: 100 feet
Sheet 1 of 1
29 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:


House-23
House-22
House-29
House-21
Apartment-1
Proposed Apt-1
200
100
000
900
800
700
600
500
400
300
200
100
0
100
200
300
400
500
6700
6800
6900
7000
7100
7200
7300
7400
7500
7600
7700
7800
7900
8000
2030 PM Alt A
Plan View
Run name: 2030 Alt A_3
Scale: 100 feet
Sheet 1 of 1
29 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:


House-20
House-19
House-18
Apartment-8
Apartment-9
House-9
Apartment-4
House-9
House-13
House-12
Apartment-5
House-11
200
100
000
900
800
700
600
500
400
300
200
100
0
100
200
300
400
500
7900
8000
8100
8200
8300
8400
8500
8600
8700
8800
8900
9000
9100
2030 PM Alt A
Plan View
Run name: 2030 Alt A_3
Scale: 100 feet
Sheet 1 of 1
29 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:


House-17
House-15
House-16
House-14
Apartment-7
Apartment-6
Outdoor Sitting-3
200
100
000
900
800
700
600
500
400
300
200
100
0
100
200
300
400
500
9400
9500
9600
9700
9800
9900
10000
10100
10200
10300
10400
10500
10600
2030 PM Alt A
Plan View
Run name: 2030 Alt A_3
Scale: 100 feet
Sheet 1 of 1
29 Mar 2007
Jones & Stokes
Project/Contract No. Aurora Corridor, 165th-205th
TNM Version 2.5, Feb 2004
Analysis By: Kai-Ling Kuo
Roadway:
Receiver:
Barrier:
Building Row:
Terrain Line:
Ground Zone: polygon
Tree Zone: dashed polygon
Contour Zone: polygon
Parallel Barrier:
Skew Section:

Jones & Stokes
Kai-Ling Kuo

29 March 2007
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: 2030 PM Alt A
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 40 deg F, 70% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
House-1	12	7	0.0	63.0	66	63.0	10	----	63.0	0.0	8	-8.0
House-2	13	11	0.0	56.2	66	56.2	10	----	56.2	0.0	8	-8.0
Outdoor Sitting-1	14	1	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
Apartment-1	15	5	0.0	64.2	66	64.2	10	----	64.2	0.0	8	-8.0
House-3	16	5	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
House-4	17	8	0.0	59.9	66	59.9	10	----	59.9	0.0	8	-8.0
Apartment-2	18	21	0.0	65.1	66	65.1	10	----	65.1	0.0	8	-8.0
Apartment-3	19	6	0.0	64.3	66	64.3	10	----	64.3	0.0	8	-8.0
House-5	20	6	0.0	59.5	66	59.5	10	----	59.5	0.0	8	-8.0
House-6	21	6	0.0	59.0	66	59.0	10	----	59.0	0.0	8	-8.0
Outdoor Sitting-2	22	1	0.0	62.8	66	62.8	10	----	62.8	0.0	8	-8.0
House-7	24	4	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
House-8	25	18	0.0	58.2	66	58.2	10	----	58.2	0.0	8	-8.0
Apartment-4	26	12	0.0	64.7	66	64.7	10	----	64.7	0.0	8	-8.0
House-9	27	2	0.0	64.0	66	64.0	10	----	64.0	0.0	8	-8.0
House-9	28	1	0.0	58.5	66	58.5	10	----	58.5	0.0	8	-8.0
House-11	29	1	0.0	61.6	66	61.6	10	----	61.6	0.0	8	-8.0
House-12	30	4	0.0	65.1	66	65.1	10	----	65.1	0.0	8	-8.0
House-13	31	4	0.0	64.1	66	64.1	10	----	64.1	0.0	8	-8.0
Apartment-5	32	6	0.0	65.4	66	65.4	10	----	65.4	0.0	8	-8.0
House-14	33	6	0.0	64.3	66	64.3	10	----	64.3	0.0	8	-8.0
House-15	34	3	0.0	59.9	66	59.9	10	----	59.9	0.0	8	-8.0
Outdoor Sitting-3	35	1	0.0	72.9	66	72.9	10	Snd Lvl	72.9	0.0	8	-8.0

Apartment-6	36	16	0.0	64.6	66	64.6	10	----	64.6	0.0	8	-8.0
Apartment-7	37	12	0.0	64.6	66	64.6	10	----	64.6	0.0	8	-8.0
House-16	38	5	0.0	58.4	66	58.4	10	----	58.4	0.0	8	-8.0
House-17	39	8	0.0	58.7	66	58.7	10	----	58.7	0.0	8	-8.0
Apartment-8	40	24	0.0	65.6	66	65.6	10	----	65.6	0.0	8	-8.0
House-18	41	5	0.0	56.9	66	56.9	10	----	56.9	0.0	8	-8.0
House-19	42	7	0.0	56.3	66	56.3	10	----	56.3	0.0	8	-8.0
Apartment-9	43	4	0.0	67.2	66	67.2	10	Snd Lvl	67.2	0.0	8	-8.0
House-20	44	8	0.0	57.7	66	57.7	10	----	57.7	0.0	8	-8.0
House-21	45	1	0.0	66.7	66	66.7	10	Snd Lvl	66.7	0.0	8	-8.0
House-22	46	4	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
House-23	47	10	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
House-24	48	2	0.0	60.6	66	60.6	10	----	60.6	0.0	8	-8.0
House-25	49	4	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
House-26	50	3	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
Apartment-10	51	6	0.0	60.0	66	60.0	10	----	60.0	0.0	8	-8.0
House-27	53	4	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
House-28	54	9	0.0	60.7	66	60.7	10	----	60.7	0.0	8	-8.0
House-29	56	1	0.0	65.9	66	65.9	10	----	65.9	0.0	8	-8.0
Proposed Apt-1	57	1	0.0	65.3	66	65.3	10	----	65.3	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	273	0.0	0.0	0.0
All Impacted	6	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Jones & Stokes
Kai-Ling Kuo

29 March 200
TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Percentages
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: 2030 PM Alt A

Roadway	Points		Segment											
Name	Name	No.	Total	Autos		MTrucks		HTrucks		Buses		Motorcycles	
			Volume	P	S	P	S	P	S	P	S	P	S
			veh/hr	%	mph	%	mph	%	mph	%	mph	%	mph
Aurora_165th-170th_1	point2	2	1128	97	40	2	40	1	40	0	0	0	0
	point3	3	1128	97	40	2	40	1	40	0	0	0	0
	point4	4	1128	97	40	2	40	1	40	0	0	0	0
	point611	611											
Aurora_165th-170th_2	point7	7	1128	97	40	2	40	1	40	0	0	0	0
	point8	8	1128	97	40	2	40	1	40	0	0	0	0
	point9	9	1128	97	40	2	40	1	40	0	0	0	0
	point610	610											
Aurora_175th-170th_1	point12	12	905	97	40	2	40	1	40	0	0	0	0
	point598	598	905	97	40	2	40	1	40	0	0	0	0
	point13	13	905	97	40	2	40	1	40	0	0	0	0
	point609	609											
Aurora_175th-170th_2	point17	17	905	97	40	2	40	1	40	0	0	0	0
	point599	599	905	97	40	2	40	1	40	0	0	0	0
	point18	18	905	97	40	2	40	1	40	0	0	0	0
	point608	608											
Aurora_175th-182nd_1	point22	22	1008	97	40	2	40	1	40	0	0	0	0
	point23	23	1008	97	40	2	40	1	40	0	0	0	0
	point607	607	1008	97	40	2	40	1	40	0	0	0	0
	point24	24	1008	97	40	2	40	1	40	0	0	0	0
	point264	264											
Aurora_175th-182nd_2	point26	26	1008	97	40	2	40	1	40	0	0	0	0

	point27	27	1008	97	40	2	40	1	40	0	0	0	0
	point606	606	1008	97	40	2	40	1	40	0	0	0	0
	point28	28	1008	97	40	2	40	1	40	0	0	0	0
	point263	263											
Aurora_185th-182nd_1	point30	30	794	97	40	2	40	1	40	0	0	0	0
	point258	258											
Aurora_185th-182nd_2	point34	34	794	97	40	2	40	1	40	0	0	0	0
	point259	259											
Midvale_175th-182nd	point38	38	305	98	30	2	30	0	0	0	0	0	0
	point39	39	305	98	30	2	30	0	0	0	0	0	0
	point40	40	305	98	30	2	30	0	0	0	0	0	0
	point41	41	305	98	30	2	30	0	0	0	0	0	0
	point42	42	305	98	30	2	30	0	0	0	0	0	0
	point268	268											
Midvale_183rd-182nd	point45	45	80	98	30	2	30	0	0	0	0	0	0
	point46	46	80	98	30	2	30	0	0	0	0	0	0
	point267	267											
165th WBTA	point54	54	70	98	25	2	25	0	0	0	0	0	0
	point55	55	70	98	25	2	25	0	0	0	0	0	0
	point56	56	70	98	25	2	25	0	0	0	0	0	0
	point57	57											
165th EBTD	point58	58	125	98	25	2	25	0	0	0	0	0	0
	point59	59	125	98	25	2	25	0	0	0	0	0	0
	point60	60	125	98	25	2	25	0	0	0	0	0	0
	point61	61											
165th WBTD	point62	62	380	98	25	2	25	0	0	0	0	0	0
	point63	63											
165th EBTA	point64	64	185	98	25	2	25	0	0	0	0	0	0
	point65	65											
175th WBTA_1	point66	66	523	97	35	2	35	1	35	0	0	0	0
	point67	67											
175th EBTD_1	point68	68	490	97	35	2	35	1	35	0	0	0	0
	point69	69											
175th EBTD_2	point70	70	490	97	35	2	35	1	35	0	0	0	0
	point71	71											

175th WBTA_2	point72	72	523	97	35	2	35	1	35	0	0	0	0
	point73	73												
175th_Midvale-Aurora_2	point74	74	484	97	35	2	35	1	35	0	0	0	0
	point75	75												
175th_Midvale-Aurora_1	point76	76	484	97	35	2	35	1	35	0	0	0	0
	point77	77												
175th_Aurora-Midvale_2	point78	78	485	97	35	2	35	1	35	0	0	0	0
	point79	79												
175th_Aurora-Midvale_1	point80	80	485	97	35	2	35	1	35	0	0	0	0
	point81	81												
175th WBTD-1	point84	84	248	98	35	2	35	0	0	0	0	0	0
	point85	85	248	98	35	2	35	0	0	0	0	0	0
	point86	86												
175th EBTA-1	point87	87	225	98	35	2	35	0	0	0	0	0	0
	point88	88	225	98	35	2	35	0	0	0	0	0	0
	point89	89												
Aurora_S 165th_NBTA_1	point91	91	1273	97	40	2	40	1	40	0	0	0	0
	point92	92												
Aurora_S 165th_NBTA_2	point93	93	1273	97	40	2	40	1	40	0	0	0	0
	point94	94												
Aurora_S 165th_SBTD_1	point95	95	900	97	40	2	40	1	40	0	0	0	0
	point96	96												
Aurora_S 165th_SBTD_2	point97	97	900	97	40	2	40	1	40	0	0	0	0
	point98	98												
185th WBTA_1	point99	99	325	98	35	2	35	0	0	0	0	0	0
	point616	616												
185th WBTA_2	point101	101	325	98	35	2	35	0	0	0	0	0	0
	point617	617												
185th EBTD_1	point103	103	308	98	35	2	35	0	0	0	0	0	0
	point619	619												
185th EBTD_2	point105	105	308	98	35	2	35	0	0	0	0	0	0
	point618	618												
185th WBTD_1	point107	107	290	96	35	3	35	1	35	0	0	0	0
	point108	108												
185th WBTD_2	point109	109	290	96	35	3	35	1	35	0	0	0	0

	point110	110											
185th EBTA_1	point111	111	383	96	35	3	35	1	35	0	0	0	0
	point112	112											
185th EBTA_2	point113	113	383	96	35	3	35	1	35	0	0	0	0
	point114	114											
Aurora_185th-192nd_1	point115	115	1080	97	40	2	40	1	40	0	0	0	0
	point116	116	1080	97	40	2	40	1	40	0	0	0	0
	point117	117	1080	97	40	2	40	1	40	0	0	0	0
	point118	118	1080	97	40	2	40	1	40	0	0	0	0
	point119	119	1080	97	40	2	40	1	40	0	0	0	0
	point120	120											
Aurora_185th-192nd_2	point121	121	1080	97	40	2	40	1	40	0	0	0	0
	point122	122	1080	97	40	2	40	1	40	0	0	0	0
	point123	123	1080	97	40	2	40	1	40	0	0	0	0
	point124	124	1080	97	40	2	40	1	40	0	0	0	0
	point125	125	1080	97	40	2	40	1	40	0	0	0	0
	point126	126											
Aurora_192nd-185th_1	point127	127	679	97	40	2	40	1	40	0	0	0	0
	point128	128	679	97	40	2	40	1	40	0	0	0	0
	point129	129	679	97	40	2	40	1	40	0	0	0	0
	point130	130	679	97	40	2	40	1	40	0	0	0	0
	point131	131	679	97	40	2	40	1	40	0	0	0	0
	point132	132											
Aurora_192nd-185th_2	point133	133	679	97	40	2	40	1	40	0	0	0	0
	point134	134	679	97	40	2	40	1	40	0	0	0	0
	point135	135	679	97	40	2	40	1	40	0	0	0	0
	point136	136	679	97	40	2	40	1	40	0	0	0	0
	point137	137	679	97	40	2	40	1	40	0	0	0	0
	point138	138											
Aurora_192nd-195th_1	point139	139	1075	97	40	2	40	1	40	0	0	0	0
	point140	140	1075	97	40	2	40	1	40	0	0	0	0
	point141	141	1075	97	40	2	40	1	40	0	0	0	0
	point142	142	1075	97	40	2	40	1	40	0	0	0	0
	point282	282											
Aurora_192nd-195th_2	point144	144	1075	97	40	2	40	1	40	0	0	0	0

	point145	145	1075	97	40	2	40	1	40	0	0	0	0
	point146	146	1075	97	40	2	40	1	40	0	0	0	0
	point147	147	1075	97	40	2	40	1	40	0	0	0	0
	point283	283											
Aurora_200th-195th_1	point149	149	681	97	40	2	40	1	40	0	0	0	0
	point285	285											
Aurora_200th-195th_2	point154	154	681	97	40	2	40	1	40	0	0	0	0
	point284	284											
Aurora_200th-205th_1	point159	159	1025	97	40	2	40	1	40	0	0	0	0
	point160	160	1025	97	40	2	40	1	40	0	0	0	0
	point161	161	1025	97	40	2	40	1	40	0	0	0	0
	point162	162	1025	97	40	2	40	1	40	0	0	0	0
	point163	163											
Aurora_200th-205th_2	point164	164	1025	97	40	2	40	1	40	0	0	0	0
	point165	165	1025	97	40	2	40	1	40	0	0	0	0
	point166	166	1025	97	40	2	40	1	40	0	0	0	0
	point167	167	1025	97	40	2	40	1	40	0	0	0	0
	point168	168											
Aurora_205th-200th_1	point169	169	680	97	40	2	40	1	40	0	0	0	0
	point170	170	680	97	40	2	40	1	40	0	0	0	0
	point171	171	680	97	40	2	40	1	40	0	0	0	0
	point172	172	680	97	40	2	40	1	40	0	0	0	0
	point173	173											
Aurora_205th-200th_2	point174	174	680	97	40	2	40	1	40	0	0	0	0
	point175	175	680	97	40	2	40	1	40	0	0	0	0
	point176	176	680	97	40	2	40	1	40	0	0	0	0
	point177	177	680	97	40	2	40	1	40	0	0	0	0
	point178	178											
205th WBTA_1	point179	179	565	98	40	2	40	0	0	0	0	0	0
	point180	180	565	98	40	2	40	0	0	0	0	0	0
	point181	181											
205th WBTA_2	point182	182	565	98	40	2	40	0	0	0	0	0	0
	point183	183	565	98	40	2	40	0	0	0	0	0	0
	point184	184											
205th EBTD_1	point185	185	450	98	40	2	40	0	0	0	0	0	0

	point186	186	450	98	40	2	40	0	0	0	0	0	0
	point187	187											
205th EBTD	point188	188	450	98	40	2	40	0	0	0	0	0	0
	point189	189	450	98	40	2	40	0	0	0	0	0	0
	point190	190											
205th WBTD-1	point191	191	210	99	40	1	40	0	0	0	0	0	0
	point404	404	210	99	40	1	40	0	0	0	0	0	0
	point192	192											
205th EBTA	point194	194	393	99	40	1	40	0	0	0	0	0	0
	point195	195											
200th WBTA	point197	197	555	98	30	2	30	0	0	0	0	0	0
	point198	198	555	98	30	2	30	0	0	0	0	0	0
	point199	199	555	98	30	2	30	0	0	0	0	0	0
	point200	200											
200th EBTD	point201	201	570	98	30	2	30	0	0	0	0	0	0
	point202	202	570	98	30	2	30	0	0	0	0	0	0
	point203	203	570	98	30	2	30	0	0	0	0	0	0
	point204	204											
200th WBTD	point205	205	320	98	30	2	30	0	0	0	0	0	0
	point206	206	320	98	30	2	30	0	0	0	0	0	0
	point207	207	320	98	30	2	30	0	0	0	0	0	0
	point208	208	320	98	30	2	30	0	0	0	0	0	0
	point209	209											
200th EBTA	point210	210	290	98	30	2	30	0	0	0	0	0	0
	point211	211	290	98	30	2	30	0	0	0	0	0	0
	point212	212	290	98	30	2	30	0	0	0	0	0	0
	point213	213	290	98	30	2	30	0	0	0	0	0	0
	point214	214											
192nd WBTA	point215	215	115	98	30	2	30	0	0	0	0	0	0
	point216	216	115	98	30	2	30	0	0	0	0	0	0
	point217	217	115	98	30	2	30	0	0	0	0	0	0
	point218	218											
192nd EBTD	point219	219	135	98	30	2	30	0	0	0	0	0	0
	point220	220	135	98	30	2	30	0	0	0	0	0	0
	point221	221	135	98	30	2	30	0	0	0	0	0	0

	point222	222											
192nd WBTD	point223	223	95	98	30	2	30	0	0	0	0	0	0
	point224	224	95	98	30	2	30	0	0	0	0	0	0
	point225	225	95	98	30	2	30	0	0	0	0	0	0
	point226	226	95	98	30	2	30	0	0	0	0	0	0
	point227	227											
192nd EBTA	point228	228	110	98	30	2	30	0	0	0	0	0	0
	point229	229	110	98	30	2	30	0	0	0	0	0	0
	point230	230	110	98	30	2	30	0	0	0	0	0	0
	point231	231	110	98	30	2	30	0	0	0	0	0	0
	point232	232											
Aurora_N 205th_NBTD_1	point233	233	1180	97	40	2	40	1	40	0	0	0	0
	point234	234	1180	97	40	2	40	1	40	0	0	0	0
	point235	235	1180	97	40	2	40	1	40	0	0	0	0
	point239	239											
Aurora_N 205th_NBTD_2	point236	236	1180	97	40	2	40	1	40	0	0	0	0
	point237	237	1180	97	40	2	40	1	40	0	0	0	0
	point238	238	1180	97	40	2	40	1	40	0	0	0	0
	point240	240											
Aurora_N 205th_SBTA_1	point244	244	803	97	40	2	40	1	40	0	0	0	0
	point241	241	803	97	40	2	40	1	40	0	0	0	0
	point242	242	803	97	40	2	40	1	40	0	0	0	0
	point243	243											
Aurora_N 205th_SBTA_2	point251	251	803	97	40	2	40	1	40	0	0	0	0
	point248	248	803	97	40	2	40	1	40	0	0	0	0
	point249	249	803	97	40	2	40	1	40	0	0	0	0
	point250	250											
182nd WBTD	point252	252	125	96	25	3	25	1	25	0	0	0	0
	point253	253	125	96	25	3	25	1	25	0	0	0	0
	point254	254											
182nd EBTA	point255	255	160	96	25	3	25	1	25	0	0	0	0
	point256	256	160	96	25	3	25	1	25	0	0	0	0
	point257	257											
Aurora_182nd-175th_1	point261	261	826	97	40	2	40	1	40	0	0	0	0
	point31	31	826	97	40	2	40	1	40	0	0	0	0

	point604	604	826	97	40	2	40	1	40	0	0	0	0
	point32	32	826	97	40	2	40	1	40	0	0	0	0
	point33	33											
Aurora_182nd-175th_2	point262	262	826	97	40	2	40	1	40	0	0	0	0
	point35	35	826	97	40	2	40	1	40	0	0	0	0
	point605	605	826	97	40	2	40	1	40	0	0	0	0
	point36	36	826	97	40	2	40	1	40	0	0	0	0
	point37	37											
Aurora_182nd-185th_2	point265	265	1060	97	40	2	40	1	40	0	0	0	0
	point29	29											
Aurora_182nd-185th_1	point266	266	1060	97	40	2	40	1	40	0	0	0	0
	point25	25											
Midvale_182nd-175th	point269	269	205	98	30	2	30	0	0	0	0	0	0
	point47	47	205	98	30	2	30	0	0	0	0	0	0
	point48	48	205	98	30	2	30	0	0	0	0	0	0
	point49	49	205	98	30	2	30	0	0	0	0	0	0
	point50	50	205	98	30	2	30	0	0	0	0	0	0
	point51	51											
Midvale NB-2	point270	270	95	98	30	2	30	0	0	0	0	0	0
	point43	43	95	98	30	2	30	0	0	0	0	0	0
	point44	44											
182nd EBTD	point272	272	98	98	25	2	25	0	0	0	0	0	0
	point273	273											
182nd WBTA	point274	274	113	98	25	2	25	0	0	0	0	0	0
	point275	275											
Aurora_195th-192nd_1	point286	286	696	97	40	2	40	1	40	0	0	0	0
	point150	150	696	97	40	2	40	1	40	0	0	0	0
	point151	151	696	97	40	2	40	1	40	0	0	0	0
	point152	152	696	97	40	2	40	1	40	0	0	0	0
	point153	153											
Aurora_195th-192nd_2	point287	287	696	97	40	2	40	1	40	0	0	0	0
	point155	155	696	97	40	2	40	1	40	0	0	0	0
	point156	156	696	97	40	2	40	1	40	0	0	0	0
	point157	157	696	97	40	2	40	1	40	0	0	0	0
	point158	158											

Aurora_195th-200th_2	point288	288	1050	97	40	2	40	1	40	0	0	0	0
	point148	148											
Aurora_195th-200th_1	point289	289	1050	97	40	2	40	1	40	0	0	0	0
	point143	143											
205th EBTA-1	point406	406	197	99	40	1	40	0	0	0	0	0	0
	point196	196											
205th WBTD-1-2	point407	407	420	99	40	1	40	0	0	0	0	0	0
	point193	193											
205th WBTD-2	point408	408	210	99	40	1	40	0	0	0	0	0	0
	point409	409	210	99	40	1	40	0	0	0	0	0	0
	point410	410											
205th EBTA-2	point411	411	197	99	40	1	40	0	0	0	0	0	0
	point412	412											
175th WBTD-2	point590	590	248	98	35	2	35	0	0	0	0	0	0
	point591	591	248	98	35	2	35	0	0	0	0	0	0
	point592	592											
175th EBTA-2	point593	593	225	98	35	2	35	0	0	0	0	0	0
	point594	594	225	98	35	2	35	0	0	0	0	0	0
	point595	595											
Aurora_170th-165th_1	point612	612	905	97	40	2	40	1	40	0	0	0	0
	point14	14	905	97	40	2	40	1	40	0	0	0	0
	point15	15	905	97	40	2	40	1	40	0	0	0	0
	point16	16											
Aurora_170th-165th_2	point613	613	905	97	40	2	40	1	40	0	0	0	0
	point19	19	905	97	40	2	40	1	40	0	0	0	0
	point20	20	905	97	40	2	40	1	40	0	0	0	0
	point21	21											
Aurora_170th-175th_2	point614	614	1128	97	40	2	40	1	40	0	0	0	0
	point10	10	1128	97	40	2	40	1	40	0	0	0	0
	point597	597	1128	97	40	2	40	1	40	0	0	0	0
	point11	11											
Aurora_170th-175th_1	point615	615	1128	97	40	2	40	1	40	0	0	0	0
	point5	5	1128	97	40	2	40	1	40	0	0	0	0
	point596	596	1128	97	40	2	40	1	40	0	0	0	0
	point6	6											

185th EBTD_1-2	point621	621	308	98	35	2	35	0	0	0	0	0	0
	point104	104											
185th EBTD_2-2	point622	622	308	98	35	2	35	0	0	0	0	0	0
	point106	106											
185th WBTA_2-2	point623	623	325	98	35	2	35	0	0	0	0	0	0
	point102	102											
185th WBTA_1-2	point624	624	325	98	35	2	35	0	0	0	0	0	0
	point100	100											
Aurora_S 165th_NBTA_BAT	point783	783	10	1	40	0	0	0	0	99	40	0	0
	point784	784											
Aurora_S 165th_SBTD_BAT	point785	785	5	1	40	0	0	0	0	99	40	0	0
	point786	786											
Aurora_165th-170th_BAT	point787	787	10	1	40	0	0	0	0	99	40	0	0
	point788	788	10	1	40	0	0	0	0	99	40	0	0
	point789	789	10	1	40	0	0	0	0	99	40	0	0
	point790	790											
Aurora_170th-165th_BAT	point791	791	5	1	40	0	0	0	0	99	40	0	0
	point792	792	5	1	40	0	0	0	0	99	40	0	0
	point793	793	5	1	40	0	0	0	0	99	40	0	0
	point794	794											
Aurora_170th-175th_BAT	point795	795	10	1	40	0	0	0	0	99	40	0	0
	point796	796	10	1	40	0	0	0	0	99	40	0	0
	point797	797	10	1	40	0	0	0	0	99	40	0	0
	point798	798											
Aurora_175th-170th_BAT	point799	799	5	1	40	0	0	0	0	99	40	0	0
	point800	800	5	1	40	0	0	0	0	99	40	0	0
	point801	801	5	1	40	0	0	0	0	99	40	0	0
	point802	802											
Aurora_175th-182nd_BAT	point803	803	14	1	40	0	0	0	0	99	40	0	0
	point804	804	14	1	40	0	0	0	0	99	40	0	0
	point805	805	14	1	40	0	0	0	0	99	40	0	0
	point806	806	14	1	40	0	0	0	0	99	40	0	0
	point807	807											
Aurora_182nd-175th_BAT	point808	808	7	1	40	0	0	0	0	99	40	0	0
	point809	809	7	1	40	0	0	0	0	99	40	0	0

	point810	810	7	1	40	0	0	0	0	99	40	0	0
	point811	811	7	1	40	0	0	0	0	99	40	0	0
	point812	812											
Aurora_182nd-185th_BAT	point813	813	14	1	40	0	0	0	0	99	40	0	0
	point814	814											
Aurora_185th-182nd_BAT	point815	815	7	1	40	0	0	0	0	99	40	0	0
	point816	816											
Aurora_185th-192nd_BAT	point817	817	16	1	40	0	0	0	0	99	40	0	0
	point818	818	16	1	40	0	0	0	0	99	40	0	0
	point819	819	16	1	40	0	0	0	0	99	40	0	0
	point820	820	16	1	40	0	0	0	0	99	40	0	0
	point821	821	16	1	40	0	0	0	0	99	40	0	0
	point822	822											
Aurora_192nd-185th_BAT	point823	823	7	1	40	0	0	0	0	99	40	0	0
	point824	824	7	1	40	0	0	0	0	99	40	0	0
	point825	825	7	1	40	0	0	0	0	99	40	0	0
	point826	826	7	1	40	0	0	0	0	99	40	0	0
	point827	827	7	1	40	0	0	0	0	99	40	0	0
	point828	828											
Aurora_192nd-195th_BAT	point829	829	23	1	40	0	0	0	0	99	40	0	0
	point830	830	23	1	40	0	0	0	0	99	40	0	0
	point831	831	23	1	40	0	0	0	0	99	40	0	0
	point832	832	23	1	40	0	0	0	0	99	40	0	0
	point833	833											
Aurora_195th-192nd_BAT	point834	834	14	1	40	0	0	0	0	99	40	0	0
	point835	835	14	1	40	0	0	0	0	99	40	0	0
	point836	836	14	1	40	0	0	0	0	99	40	0	0
	point837	837	14	1	40	0	0	0	0	99	40	0	0
	point838	838											
Aurora_195th-200th_BAT	point839	839	23	1	40	0	0	0	0	99	40	0	0
	point840	840											
Aurora_200th-195th_BAT	point841	841	14	1	40	0	0	0	0	99	40	0	0
	point842	842											
Aurora_200th-205th_BAT	point843	843	23	1	40	0	0	0	0	99	40	0	0
	point844	844	23	1	40	0	0	0	0	99	40	0	0

	point845	845	23	1	40	0	0	0	0	99	40	0	0
	point846	846	23	1	40	0	0	0	0	99	40	0	0
	point847	847											
Aurora_205th-200th_BAT	point848	848	14	1	40	0	0	0	0	99	40	0	0
	point849	849	14	1	40	0	0	0	0	99	40	0	0
	point850	850	14	1	40	0	0	0	0	99	40	0	0
	point851	851	14	1	40	0	0	0	0	99	40	0	0
	point852	852											

Jones & Stokes
Kai-Ling Kuo

29 March 2007
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: 2030 PM Alt B
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 40 deg F, 70% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
House-1	12	7	0.0	62.9	66	62.9	10	----	62.9	0.0	8	-8.0
House-2	13	11	0.0	56.2	66	56.2	10	----	56.2	0.0	8	-8.0
Outdoor Sitting-1	14	1	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
Apartment-1	15	5	0.0	64.2	66	64.2	10	----	64.2	0.0	8	-8.0
House-3	16	5	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
House-4	17	8	0.0	59.9	66	59.9	10	----	59.9	0.0	8	-8.0
Apartment-2	18	21	0.0	65.1	66	65.1	10	----	65.1	0.0	8	-8.0
Apartment-3	19	6	0.0	64.3	66	64.3	10	----	64.3	0.0	8	-8.0
House-5	20	6	0.0	59.5	66	59.5	10	----	59.5	0.0	8	-8.0
House-6	21	6	0.0	59.0	66	59.0	10	----	59.0	0.0	8	-8.0
Outdoor Sitting-2	22	1	0.0	62.8	66	62.8	10	----	62.8	0.0	8	-8.0
House-7	24	4	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
House-8	25	18	0.0	58.3	66	58.3	10	----	58.3	0.0	8	-8.0
Apartment-4	26	12	0.0	64.7	66	64.7	10	----	64.7	0.0	8	-8.0
House-9	27	2	0.0	64.0	66	64.0	10	----	64.0	0.0	8	-8.0
House-9	28	1	0.0	58.5	66	58.5	10	----	58.5	0.0	8	-8.0
House-11	29	1	0.0	62.0	66	62.0	10	----	62.0	0.0	8	-8.0
House-12	30	4	0.0	65.3	66	65.3	10	----	65.3	0.0	8	-8.0
House-13	31	4	0.0	65.0	66	65.0	10	----	65.0	0.0	8	-8.0
Apartment-5	32	6	0.0	65.4	66	65.4	10	----	65.4	0.0	8	-8.0
House-14	33	6	0.0	64.1	66	64.1	10	----	64.1	0.0	8	-8.0
House-15	34	3	0.0	59.8	66	59.8	10	----	59.8	0.0	8	-8.0
Outdoor Sitting-3	35	1	0.0	72.2	66	72.2	10	Snd Lvl	72.2	0.0	8	-8.0

Apartment-6	36	16	0.0	64.3	66	64.3	10	----	64.3	0.0	8	-8.0
Apartment-7	37	12	0.0	64.3	66	64.3	10	----	64.3	0.0	8	-8.0
House-16	38	5	0.0	58.3	66	58.3	10	----	58.3	0.0	8	-8.0
House-17	39	8	0.0	58.6	66	58.6	10	----	58.6	0.0	8	-8.0
Apartment-8	40	24	0.0	65.5	66	65.5	10	----	65.5	0.0	8	-8.0
House-18	41	5	0.0	56.9	66	56.9	10	----	56.9	0.0	8	-8.0
House-19	42	7	0.0	56.3	66	56.3	10	----	56.3	0.0	8	-8.0
Apartment-9	43	4	0.0	67.2	66	67.2	10	Snd Lvl	67.2	0.0	8	-8.0
House-20	44	8	0.0	57.7	66	57.7	10	----	57.7	0.0	8	-8.0
House-21	45	1	0.0	66.7	66	66.7	10	Snd Lvl	66.7	0.0	8	-8.0
House-22	46	4	0.0	60.9	66	60.9	10	----	60.9	0.0	8	-8.0
House-23	47	10	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
House-24	48	2	0.0	60.6	66	60.6	10	----	60.6	0.0	8	-8.0
House-25	49	4	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
House-26	50	3	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
Apartment-10	51	6	0.0	60.0	66	60.0	10	----	60.0	0.0	8	-8.0
House-27	53	4	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
House-28	54	9	0.0	60.7	66	60.7	10	----	60.7	0.0	8	-8.0
House-29	56	1	0.0	66.4	66	66.4	10	Snd Lvl	66.4	0.0	8	-8.0
Proposed Apt-1	57	1	0.0	65.3	66	65.3	10	----	65.3	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	273	0.0	0.0	0.0
All Impacted	7	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Jones & Stokes
Kai-Ling Kuo

29 March 2007
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Aurora Corridor, 165th-205th
RUN: 2030 PM Alt C
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 40 deg F, 70% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
House-1	12	7	0.0	62.9	66	62.9	10	----	62.9	0.0	8	-8.0
House-2	13	11	0.0	56.0	66	56.0	10	----	56.0	0.0	8	-8.0
Outdoor Sitting-1	14	1	0.0	63.1	66	63.1	10	----	63.1	0.0	8	-8.0
Apartment-1	15	5	0.0	63.9	66	63.9	10	----	63.9	0.0	8	-8.0
House-3	16	5	0.0	60.9	66	60.9	10	----	60.9	0.0	8	-8.0
House-4	17	8	0.0	59.7	66	59.7	10	----	59.7	0.0	8	-8.0
Apartment-2	18	21	0.0	64.9	66	64.9	10	----	64.9	0.0	8	-8.0
Apartment-3	19	6	0.0	64.2	66	64.2	10	----	64.2	0.0	8	-8.0
House-5	20	6	0.0	59.3	66	59.3	10	----	59.3	0.0	8	-8.0
House-6	21	6	0.0	58.9	66	58.9	10	----	58.9	0.0	8	-8.0
Outdoor Sitting-2	22	1	0.0	62.8	66	62.8	10	----	62.8	0.0	8	-8.0
House-7	24	4	0.0	63.3	66	63.3	10	----	63.3	0.0	8	-8.0
House-8	25	18	0.0	58.2	66	58.2	10	----	58.2	0.0	8	-8.0
Apartment-4	26	12	0.0	64.7	66	64.7	10	----	64.7	0.0	8	-8.0
House-9	27	2	0.0	64.0	66	64.0	10	----	64.0	0.0	8	-8.0
House-9	28	1	0.0	58.6	66	58.6	10	----	58.6	0.0	8	-8.0
House-11	29	1	0.0	62.0	66	62.0	10	----	62.0	0.0	8	-8.0
House-12	30	4	0.0	65.2	66	65.2	10	----	65.2	0.0	8	-8.0
House-13	31	4	0.0	65.0	66	65.0	10	----	65.0	0.0	8	-8.0
Apartment-5	32	6	0.0	65.4	66	65.4	10	----	65.4	0.0	8	-8.0
House-14	33	6	0.0	64.3	66	64.3	10	----	64.3	0.0	8	-8.0
House-15	34	3	0.0	59.9	66	59.9	10	----	59.9	0.0	8	-8.0
Outdoor Sitting-3	35	1	0.0	73.1	66	73.1	10	Snd Lvl	73.1	0.0	8	-8.0

Apartment-6	36	16	0.0	64.6	66	64.6	10	----	64.6	0.0	8	-8.0
Apartment-7	37	12	0.0	64.6	66	64.6	10	----	64.6	0.0	8	-8.0
House-16	38	5	0.0	58.4	66	58.4	10	----	58.4	0.0	8	-8.0
House-17	39	8	0.0	58.7	66	58.7	10	----	58.7	0.0	8	-8.0
Apartment-8	40	24	0.0	65.5	66	65.5	10	----	65.5	0.0	8	-8.0
House-18	41	5	0.0	56.9	66	56.9	10	----	56.9	0.0	8	-8.0
House-19	42	7	0.0	56.3	66	56.3	10	----	56.3	0.0	8	-8.0
Apartment-9	43	4	0.0	67.2	66	67.2	10	Snd Lvl	67.2	0.0	8	-8.0
House-20	44	8	0.0	57.7	66	57.7	10	----	57.7	0.0	8	-8.0
House-21	45	1	0.0	66.7	66	66.7	10	Snd Lvl	66.7	0.0	8	-8.0
House-22	46	4	0.0	60.9	66	60.9	10	----	60.9	0.0	8	-8.0
House-23	47	10	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
House-24	48	2	0.0	60.6	66	60.6	10	----	60.6	0.0	8	-8.0
House-25	49	4	0.0	60.6	66	60.6	10	----	60.6	0.0	8	-8.0
House-26	50	3	0.0	60.6	66	60.6	10	----	60.6	0.0	8	-8.0
Apartment-10	51	6	0.0	60.6	66	60.6	10	----	60.6	0.0	8	-8.0
House-27	53	4	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
House-28	54	9	0.0	60.7	66	60.7	10	----	60.7	0.0	8	-8.0
House-29	58	1	0.0	66.4	66	66.4	10	Snd Lvl	66.4	0.0	8	-8.0
Proposed Apt-1	61	1	0.0	65.4	66	65.4	10	----	65.4	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	273	0.0	0.0	0.0
All Impacted	7	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0