APPENDIX L: NOISE DISCIPLINE REPORT

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I-405, Bellevue to Lynnwood Improvement Project

INTERSTATE 405 Corridor Program

Congestion Relief & Bus Rapid Transit Projects

NOISE DISCIPLINE REPORT

April 2011

Washington State Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

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SUMMARY

To relieve congestion and improve mobility, WSDOT is proposing to construct the I-405, Bellevue to Lynnwood Improvement Project (Bellevue to Lynnwood Improvement Project). I-405 Team noise specialists considered the project's effect on noise levels to understand the potential effect of traffic and construction on public health and welfare.

Study approach

Noise levels were evaluated at 246 noise receptor locations that represent noise exposure at 1,770 residences, one hotel, two schools, one church and one park in the study area during the loudest hours of the day. Noise receptors are used in the noise model to evaluate noise levels at multiple locations that have similar characteristics in relation to the noise source. The loudest hours occur when traffic volumes are high but not congested. The noise receptors were used to validate the Existing Conditions (year 2005) computer model generated with the Federal Highway Administration (FHWA)'s Traffic Noise Model (TNM) Version 2.5.

The I-405 Team noise specialists used the TNM to predict noise levels at the 246 locations for the No Build Alternative (year 2030), and the Build Alternatives (design year 2030). I-405 Team noise specialists also used relevant design files, traffic volumes and vehicle mixes based on the *I-405, Bellevue to Lynnwood Project Transportation Discipline Report*[1] (WSDOT, 2011b) to create the noise models for this project. The results of the No Build and Build Alternative models are compared in order to determine project effects.

All noise-sensitive locations within the Bellevue to Lynnwood Improvement Project study area are residential and public use buildings or outdoor recreational areas, which fall under the noise abatement (mitigation) criterion (NAC) of 67 decibels in the A-weighted scale (dBA). I-405 Team noise specialists evaluated mitigation measures at receptors where noise levels are modeled to approach within 1 dBA of or exceed the NAC. The noise team used WSDOT feasibility and reasonability

[1] *I-405, Bellevue to Lynnwood Improvement Project Transportation Discipline Report*, I-405 Corridor Program, February 2011.

criteria to determine whether the reduction in traffic noise will be substantial enough to warrant constructing, replacing, or upgrading noise barriers.

No Build conditions

Under existing (2005) condition, some study area locations already approach or exceed the NAC for sensitive receptors. Locations that currently approach or exceed 67 dBA include approximately 446 residences.

No Build conditions include ten noise barriers that have been or will be built under Stage 1 and Stage 2 of the Kirkland Nickel Project, and the NE 195th Street to SR 527 Auxiliary Lane Project. These barriers are located parallel to I-405 within the project limits. Retaining walls, limited traffic barriers, and topography also shield some residential areas.

Under design year (2030) No Build conditions, locations with approximately 368 residences will approach or exceed the 67 dBA NAC.

Project effects

Modeling indicates that the two Build Alternatives will have the same effects on noise levels in the area. The Bellevue to Lynnwood Improvement Project will cause noise levels to either stay the same, decrease by as much as 4 dBA, or increase by up to 5 dBA by the year 2030, compared with the No Build Alternative, depending on the receptor's location within the study area.

If the Bellevue to Lynnwood Improvement Project is built, 38 residences will go from being below the NAC to approaching within 1 dBA of or exceeding the NAC. A total of 406 residences are predicted to experience noise levels that approach or exceed the NAC of 67 dBA for residences in 2030.

Noise levels at 354 residences will continue to approach or exceed the criteria with the noise mitigation measures proposed as part of the Bellevue to Lynnwood Improvement Project.

If this project is not built, 368 residences will approach or exceed the NAC in 2030.

Construction activities will generate noise during this project's construction period. Construction is normally carried out in stages, each with its own mix of equipment and its own noise characteristics. Noise levels generated during construction by heavy equipment (e.g., heavy trucks, excavators, jackhammers, and pile drivers) may result in adverse noise effects. However, this noise will be temporary and will occur only during the construction period.

Measures to avoid or minimize effects

WSDOT can control noise at three locations: 1) at noise sources (with mufflers and quieter engines); 2) along noise paths (with barriers); and 3) at receptors (with insulation). Noise abatement is only necessary where frequent human use occurs and where a lower noise level will provide benefits (USDOT, 1982). The following mitigation measures are proposed as potential measures to control noise as a result of construction activities:

- Limit the noisiest construction activities (e.g., pile driving) to between 7 AM and 10 PM to reduce construction noise levels during sensitive nighttime hours;
- Use quiet equipment by equipping construction equipment engines with adequate mufflers, intake silencers, and engine enclosures to reduce their noise;
- Minimize operation time by turning off construction equipment during prolonged periods of nonuse to eliminate noise; and
- Where possible, locate stationary equipment away from sensitive receptors such as residences to decrease noise.

Noise Barrier NW1 located at north of the NE 160th Street interchange, which will be constructed as part of the Kirkland Nickel Project Stage 2, will have to be relocated for the Bellevue to Lynnwood Improvement Project to be constructed.

Two new noise barriers are recommended for the Bellevue to Lynnwood Improvement Project. These noise barriers will provide noise level reductions of 3 dBA or greater at 82 residences. With the proposed noise mitigation (noise abatement measures), 58 residences at the two barrier locations will continue to approach or exceed the NAC,

although the magnitude of the effects will be minimized by the barriers' shielding effects.

Unavoidable adverse effects

Modeling for the Build Alternatives indicates that without mitigation, study area noise levels will approach or exceed the NAC at 406 residences. With the proposed mitigation measures, noise levels at 354 residences, will continue to approach or exceed the NAC.

Receptors 146 and 151C represent 9 residences that experiences substantial noise effect levels (75 to 79 dBA) under design year Build Alternative conditions. Noise levels are predicted to increase by 1 dBA over No Build conditions at Receptor 146 and remain constant at Receptor 151C. Noise barriers were not recommended in the vicinity of Receptors 146 and 151 because these areas did not meet WSDOT feasibility and reasonability criteria.

FHWA guidance stipulates that construction of the Bellevue to Lynnwood Improvement Project will not cause substantial unavoidable adverse noise effects and that temporary construction noise effects are not substantial.

ACRONYMS AND ABBREVIATIONS

Term	Meaning
CFR	Code of Federal Regulations
dB	decibel
dBA	decibels in the A-weighted scale
Ecology	Washington State Department of Ecology
EDNA	Environmental Designation for Noise Abatement
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
HOV	high-occupancy vehicle
Hz	hertz
I	Interstate
Leq	equivalent A-weighted sound level
Leq(h)	equivalent A-weighted sound level averaged hourly
NAC	Noise Abatement Criteria
SR	State Route
TNM	Traffic Noise Model
USDOT	U.S. Department of Transportation
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

GLOSSARY

Term	Meaning
A-weight	A standard frequency weighting that simulates how humans perceive sound (dBA).
ambient noise	The totality of noise associated with a given environment, encompassing sounds from many sources near and far.
calibration	Adjustment of the noise measurement system so the measured sound level agrees with a reference sound level.
calibration check	A check of a noise meter for variations between the measured sound level and a reference level; no adjustment is made to the noise monitoring system.
decibel (dB)	A logarithmic-based unit of measure of sound pressure.
duration	The length of time of an event.
energy average	The average of two or more acoustic energies expressed on a common decibel logarithmic scale.
equivalent sound level (Leq)	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.
express toll lane	A limited-access freeway lane that is actively managed through a variable toll system to regulate its use and thereby maintain express travel speeds and reliability. Toll prices rise or fall in real time as the lane approaches capacity or becomes less used. This ensures that traffic in the express toll lane remains flowing at express travel speeds of 45 to 60 miles per hour. Transit and carpools do not pay a toll.
hertz (Hz)	A unit of frequency measured in cycles per second.
Jersey barrier	A type of protective concrete barrier used as a highway divider or as a general traffic barrier.
logarithm	The exponent that indicates the power to which a number must be raised to produce a given number. For example: if $B^2 = N$, then 2 is the logarithm of N (to the base B), or $10^2 = 100$, and the logarithm of 100 (to the base 10) = 2. Also abbreviated to "log."
noise level	The sound pressure level, measured using a meter with an "A" frequency weighting and reported as dBA.
peak	The maximum sound level during a given time interval when the normal frequency and time weighting is not used.
sound pressure level or noise level	A noise measurement that uses an A-weighting to modify the frequency response of the measuring instrument so that it more closely mimics the frequency characteristics of the human ear.

SECTION 1 INTRODUCTION

What are the primary features of the I-405, Bellevue to Lynnwood Improvement Project?

The I-405, Bellevue to Lynnwood Improvement Project (Bellevue to Lynnwood Improvement Project) is part of the overall I-405 master plan designed to improve safety, reduce congestion, and add travel capacity. The project extends approximately 17 miles along I-405 from NE 6th Street in Bellevue at the southern limit, to I-5 in Lynnwood at the northern limit (see Exhibit 2-1). The Washington State Department of Transportation has identified the primary construction elements of the Bellevue to Lynnwood Improvement Project to be: construct one northbound lane between NE 124th Street and SR 522; construct one northbound lane between NE 195th Street and SR 527; reconstruct the bridge structures at NE 132nd Street; and construct a grade separation between the I-405 northbound on-ramp from NE 160th Street and the northbound I-405 off-ramp to SR 522. The Bellevue to Lynnwood Improvement Project complements the I-405, SR 520 to SR 522 Kirkland Nickel Improvement Project (Kirkland Nickel Project).

The purpose of the Bellevue to Lynnwood Improvement Project is to improve personal and freight mobility, and reduce traffic congestion in the I-405 corridor from Bellevue to Lynnwood. Specific benefits of the project include improved safety, reduced traffic congestion, increased travel speeds during peak travel periods, improved freight movement, and environmental improvements.

The baseline condition for the Bellevue to Lynnwood Improvement Project assumes completion of the improvements that have already been environmentally cleared and permitted as a part of the Kirkland Nickel Project (Kirkland Nickel Stage 1 is completed and Kirkland Nickel Stage 2 will be constructed concurrent with the Bellevue to Lynnwood Improvement Project). The baseline condition also includes the NE 8th Street to SR 520 Braided Ramps Project, scheduled to open in 2012 and the NE 195th Street to SR 527 Auxiliary Lane Project which opened in 2010.

The Bellevue to Lynnwood Improvement Project will analyze two Build Alternatives and the No Build Alternative. Both Build Alternatives will improve overall operations of I-405, and will complement the Kirkland Nickel Project transportation improvements that have already been environmentally cleared.

Both Build Alternatives add capacity and restripe existing pavement. The proposed additional pavement (footprints) for Build Alternatives 1 and 2 are the same; the difference between the two alternatives is operational. These operational differences will be implemented through different lane striping, and, in the case of Alternative 1, addition of electronic toll gantries and signage to accommodate tolling of the express toll lanes. Under both build alternatives, Lanes that are not managed as express toll lanes or High-Occupancy Vehicle (HOV) lanes will be operated as general-purpose lanes (Exhibit 2-2).

Build Alternative 1

Build Alternative 1 will result in a two-lane express toll lane system in both directions between NE 6th Street and SR 522, transitioning to a one-lane express toll lane system in both directions between SR 522 and I-5. With this alternative, the proposed express toll lanes will replace the existing HOV lane and the general-purpose lane south of SR 522 that will be built as part of the Kirkland Nickel Project.

Are you new to reading noise reports?

Environmental disciplines generally have vocabularies all their own. We encourage readers who are new to noise-related terminology to invest a few minutes now reviewing the Glossary and the Acronyms and Abbreviations list in the preceding sections. An understanding of the A-weighted decibel (dBA) and the Equivalent A-weighted sound levels (Leq) will be especially helpful in following our analysis of this important environmental element.

Build Alternative 2

Build Alternative 2 will retain the current one-lane HOV system in both directions throughout the project length from SR 520 to I-5. Build Alternative 2 makes minor improvements to the existing HOV system; however, the HOV lane occupancy requirement may change from 2+ to 3+ in response to current WSDOT and FHWA policy, which states that HOV lanes should operate at 45 mph for 90 percent of the time (this goal is currently not being met).

What is the purpose of this report?

The purpose of the Bellevue to Lynnwood Improvement Project Noise Discipline Report is to describe current noise levels in the study area and how noise levels will increase, decrease, or remain unchanged once the project is built.

Why do we consider noise as we plan for this project?

Sound is an element of daily life that when perceived as unpleasant, unwanted, or disturbingly loud, is called *noise*. I-405 Team noise specialists consider the effects of noise in order to understand the potential effect of traffic and construction noise on public health and welfare. Federal regulations (23 CFR 772) and WSDOT Noise Abatement Criteria (NAC) require a noise analysis for projects that add new through capacity to a highway or when a highway is realigned.

Additional travel lanes on I-405 and higher peak-hour speeds that result from reduced congestion could increase perceived noise levels at sensitive receptors, such as residences, churches, and parks in the study area. This noise analysis determines whether mitigation measures such as noise barriers are warranted to buffer noise-sensitive areas from the roadway.

What topics are included in the Noise Discipline Report?

This Noise Discipline report describes noise levels for Baseline, No Build, and Build alternatives. Where noise levels are over the NAC, mitigation measures are discussed.

What studies were completed?

Noise studies for this project were completed following FHWA and WSDOT guidance. These studies identified noise effects resulting from the I-405, Bellevue to Lynnwood Improvement Project and evaluated the feasibility and reasonableness of noise barriers in accordance with federal and state guidance.

What are the key messages from this report?

Under existing conditions, many study area locations already exceed the NAC, including approximately 450 residences.

If this project is built, two new noise barriers are recommended for the Bellevue to Lynnwood Improvement Project. These two noise barriers will provide noise-level reduction benefits at 82 residences. Fifty-eight residences, will continue to approach or exceed the NAC with the

recommended barriers, although the magnitude of the effects will be minimized by the barriers' shielding effects.

Noise Barrier NW1, which has not yet been constructed, was analyzed in the Kirkland Nickel Project (2005). This barrier would have to be relocated for the Bellevue to Lynnwood Improvement Project to be constructed.

Noise levels at 354 residences throughout the entire study area, will continue to approach or exceed the NAC with the noise barriers proposed as part of the Bellevue to Lynnwood Improvement Project.

What measures are proposed to avoid or reduce adverse effects?

Build Alternative 1

Two new noise barriers are proposed for the Bellevue to Lynnwood Improvement Project. These noise barriers will provide noise-level reduction benefits of 3 dBA or more to 82 residences. Fifty-eight residences, will continue to approach or exceed the NAC with the recommended barriers, although the magnitude of the effects will be minimized by the barriers' shielding.

Noise Barrier NW1, which has not yet been constructed, was analyzed in the Kirkland Nickel Project (2005). This barrier would have to be relocated for the Bellevue to Lynnwood Improvement Project to be constructed.

Noise levels at 354 residences throughout the entire study area, will continue to approach or exceed the NAC with the noise barriers proposed as part of the Bellevue to Lynnwood Improvement Project.

Build Alternative 2

The same noise mitigation (noise barriers) that is proposed for Build Alternative 1 is proposed for Build Alternative 2 and will provide the same results.

What will happen if we adopt the No Build Alternative?

If the Bellevue to Lynnwood Improvement Project is not built, no additional residences will approach or exceed the NAC

until at least the year 2030. No noise mitigation measures are proposed as part of the No Build Alternative.

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SECTION 2 PROJECT DESCRIPTION

What is the intent of the Bellevue to Lynnwood project and what are the improvements?

The Bellevue to Lynnwood Improvement Project is intended to improve safety and reduce congestion along I-405 between NE 6th Street in Bellevue and I-5 in Lynnwood. To accomplish this, WSDOT proposes the following improvements:

- Northbound lane from NE 124th Street to SR 522;
- Braided ramps between the I-405 northbound on-ramp from NE 160th Street and the northbound I-405 off-ramp to SR 522;
- Southbound transit shoulders between SR 522 and NE 160th Street and between SR 527 and NE 195th Street;
- New northbound and southbound structures over NE 132nd Street and a new northbound structure over the railroad for the I-405 northbound off-ramp to NE 124th Street;
- Small amounts of additional widening, between four and eight feet, at several locations for buffers, wider shoulders, tolling equipment, enforcement areas and maintenance pull-outs; and
- Minor upgrades to pedestrian facilities in some interchange areas.

What are braided ramps?

Braided ramps vertically separate movements with bridge structures to eliminate traffic conflicts between closely-spaced on-ramps and off-ramps.

What is a transit shoulder?

A transit shoulder is a freeway shoulder that is designated for use by buses during specific hours to avoid congestion in the general purpose lanes. Transit shoulders improve the appeal of transit by helping to maintain travel time and trip reliability. They also have a positive effect on the general purpose lanes, because buses cannot accelerate as quickly as vehicles and tend to slow traffic. Speeds for buses using the transit shoulder are usually restricted to ensure safety. Transit shoulders are always available as a refuge for disabled vehicles or incidents, which would close the transit shoulder to bus travel.

Exhibit 2-1 shows the Bellevue to Lynnwood project vicinity. Exhibit 2-2, sheets 1 through 17, shows more detail of the project improvements in the 17-mile long corridor.

Are there related projects?

The Bellevue to Lynnwood Improvement Project is designed to compliment other projects along I-405 including:

- Kirkland Nickel Stage 1 Project, which added one lane in each direction between NE 85th Street and NE 124th Street and opened to traffic in November 2007;
- NE 195th to SR 527 Auxiliary Lane Project, which added one northbound lane between NE 195th Street and SR 527 and opened to traffic in June 2010; and

- NE 8th Street to SR 520 Braided Ramps Project, which creates new multi-level "braided" ramps to separate vehicles entering and exiting northbound I-405 between NE 8th Street and SR 520 and is anticipated to be open to traffic during the summer of 2012.

What are baseline conditions?
Baseline conditions for the Bellevue to Lynnwood Improvement Project represent what will exist in the future after the Kirkland Nickel Project and the NE 8th Street to SR 520 Braided Ramps Project are complete. Baseline conditions provide an important point of comparison for understanding the effects of the proposed build alternatives.

Kirkland Nickel Project Stage 2 improvements are a baseline condition for natural environmental analyses such as ecosystems, water resources, and soils and geology, but not for traffic and transportation analysis.

The Kirkland Nickel Stage 2 Project will reconfigure the NE 116th Street interchange, build northbound and southbound lanes between NE 70th Street and NE 85th Street, and a southbound lane between SR 522 and NE 124th Street, and between NE 70th Street and SR 520. The Kirkland Nickel Stage 2 project has been environmentally cleared and permitted, and, along with the other projects mentioned in this section, is considered part of the baseline conditions for this analysis (see "*What are baseline conditions?*" sidebar). The Bellevue to Lynnwood Improvement Project will be constructed at the same time.

What will the completed project provide?

The Bellevue to Lynnwood Improvement Project fills in the remaining gaps and allows WSDOT to provide an improved system on I-405 between NE 6th Street and I-5. WSDOT has designed this project to maximize the use of existing pavement and minimize the need for new pavement. In some areas, small amounts of widening of less than a lane width, together with narrower shoulders and lanes, will allow an additional lane. In other areas, narrowing the shoulders and lanes will allow an additional lane without any pavement widening.

Exhibit 2-3 shows the configuration in each of the project segments when this project and the related projects described above are complete.

What is WSDOT's HOV Policy?
WSDOT has established performance standards to ensure that the state's freeway HOV system provides reliable travel time and dependability for transit users and carpoolers. Speeds and reliability of the HOV system are monitored year-round.

It is WSDOT's current policy that vehicles in an HOV lane should be able to maintain an average speed of 45 mph or greater at least 90% of the time during the morning and afternoon rush hour.

How will this portion of I-405 be operated after the project is completed?

In this environmental document, WSDOT and FHWA are considering two operational alternatives: 1) Express Toll and General Purpose Lanes (ETL); and 2) High Occupancy Vehicle and General Purpose Lanes (HOV). Under both scenarios, the project footprint is the same. The occupancy requirement for HOVs in this portion of the I-405 corridor is the same. It is assumed the occupancy requirement, to maintain HOV performance standards under WSDOT's HOV policy, will be

three or more people (HOV 3+). The difference is in how the roadway lanes would be managed.

Alternative 1: Express Toll and General Purpose Lanes (ETL)

This operational alternative will provide two express toll lanes in each direction between NE 6th Street in Bellevue and SR 522 in Bothell, and one express toll lane in each direction between SR 522 and I-5 in Lynnwood. The express toll lane system will be open toll free to all HOV traffic with three or more occupants and all transit vehicles. The express toll lane system will also be open to single occupant vehicles (SOVs) and HOVs with two occupants through tolling.

The southern end of the express toll lane system will be at the existing direct access ramps at NE 6th Street in Bellevue where one of the two northbound express toll lanes will begin and one of the two southbound express toll lanes will end. South of the NE 6th Street, the other express toll lanes will connect with the existing single northbound and southbound HOV lanes. The northern end of the system would be much like it is today with I-405 becoming SR 525. Access points will be at various locations along the mainline as shown in Exhibit 2-4. The express toll lanes will be separated from the general purpose (GP) lanes by a two- to four-foot wide buffer. At an access point, the buffer will open and a section of transition lane may be provided between the express toll and general purpose lanes to ease ingress and egress to the system.

What are express toll lanes?
Express toll lanes preserve trip reliability for transit and HOV users, while providing a new option to other motorists who choose to pay a toll when lane capacity is available. Express toll lanes on I-405 would be similar to the express toll lanes on SR 167.

Express toll lanes have been successfully implemented in several locations around the U.S: State Route 91 in Orange County; I-15 in San Diego; I-25 in Denver; and I-394 in Minneapolis to name a few. WSDOT is working with engineers from these existing facilities to capture lessons learned.

Alternative 2: High Occupancy Vehicle and General Purpose Lanes (HOV)

This operational alternative will allow HOV users with three or more occupants and transit vehicles to use the single HOV lane, similar to today's operation. Access between the HOV lane and GP lanes will be allowed throughout the project, except northbound between NE 6th Street and SR 520 where access is not allowed under today's operation. The new northbound lane between NE 124th Street and SR 522 will be operated as a GP lane.

What will conditions be like if the project is not built?

No Build Alternative

A No Build Alternative has been evaluated as the basis for comparing effects associated with the Build Alternatives. No new improvements would be made beyond those constructed as a part of the Kirkland Nickel Project Stage 2, the NE 8th Street to SR 520 Braided Ramps Project, and the NE 195th Street to SR 527 Auxiliary Lane Project.

The No Build Alternative does not include additional stormwater treatment or any roadway improvements that would increase roadway capacity, reduce congestion, or improve safety on I-405. Only routine activities such as road maintenance, repair, and minor safety improvements would occur. As with the two build alternatives, we assume that the occupancy requirement for HOVs in this portion of the I-405 corridor will be three or more people (HOV 3+).

Exhibit 2-1: Project vicinity

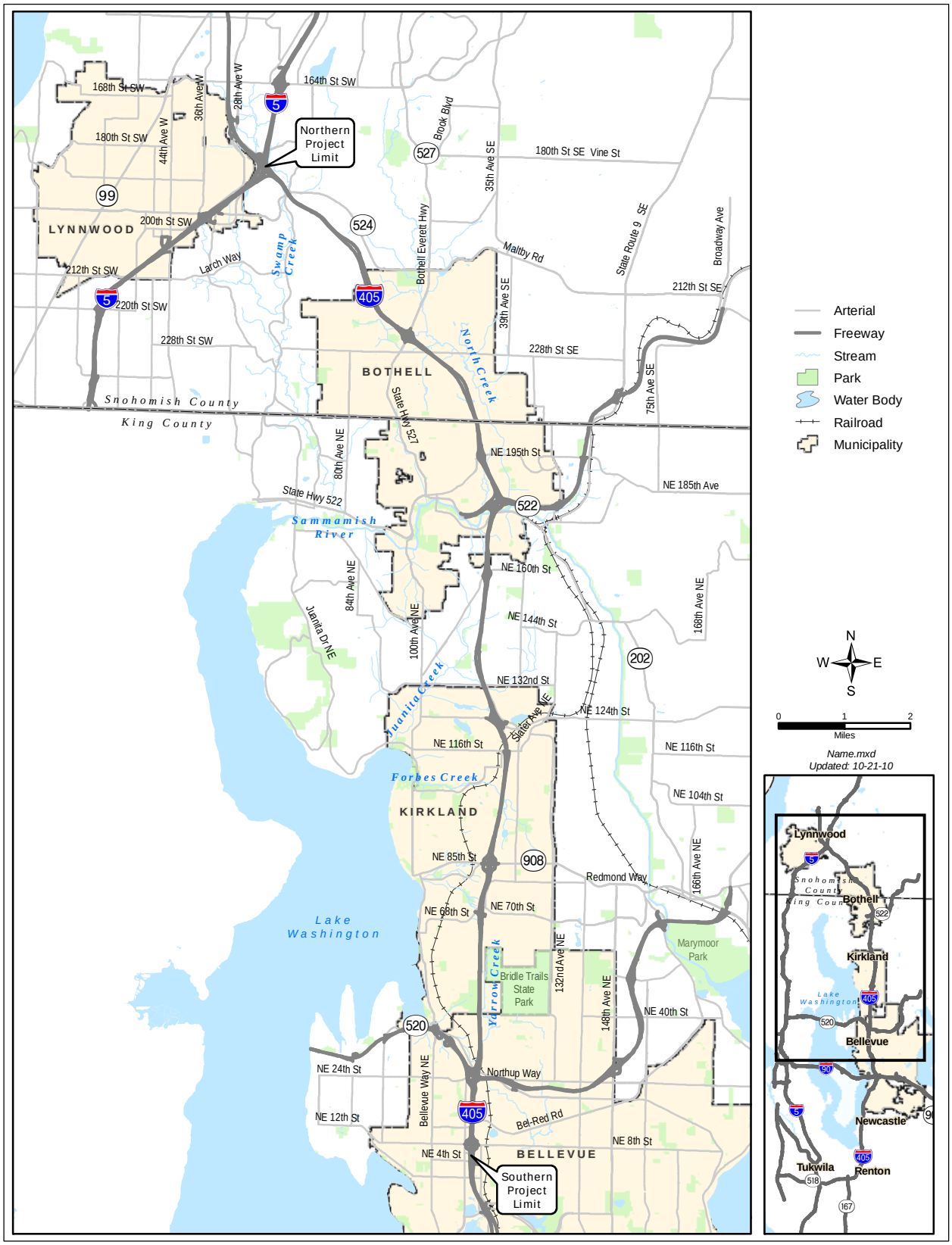


Exhibit 2-2: Project improvements – sheet 1 of 17

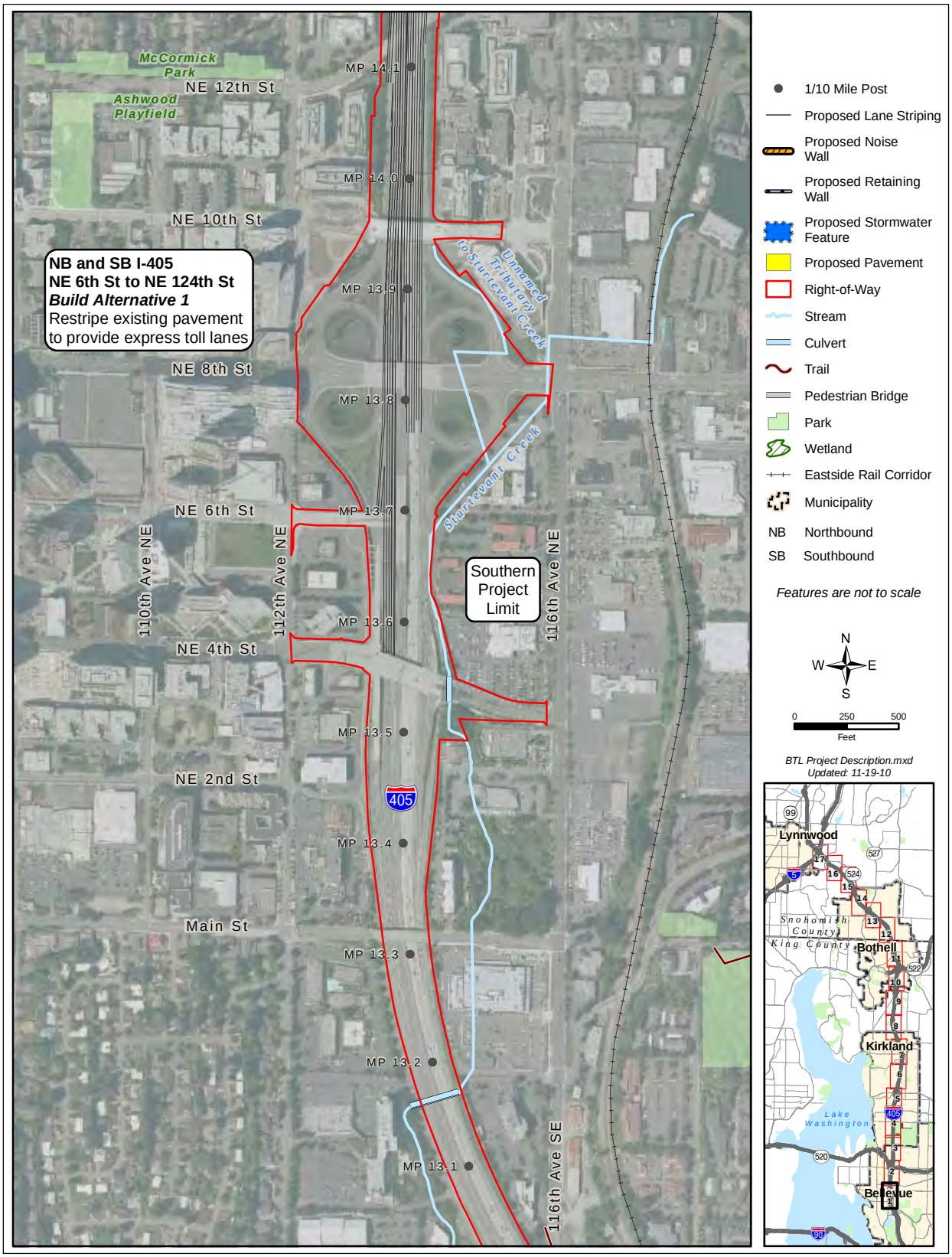


Exhibit 2-1: Project improvements – sheet 2 of 17

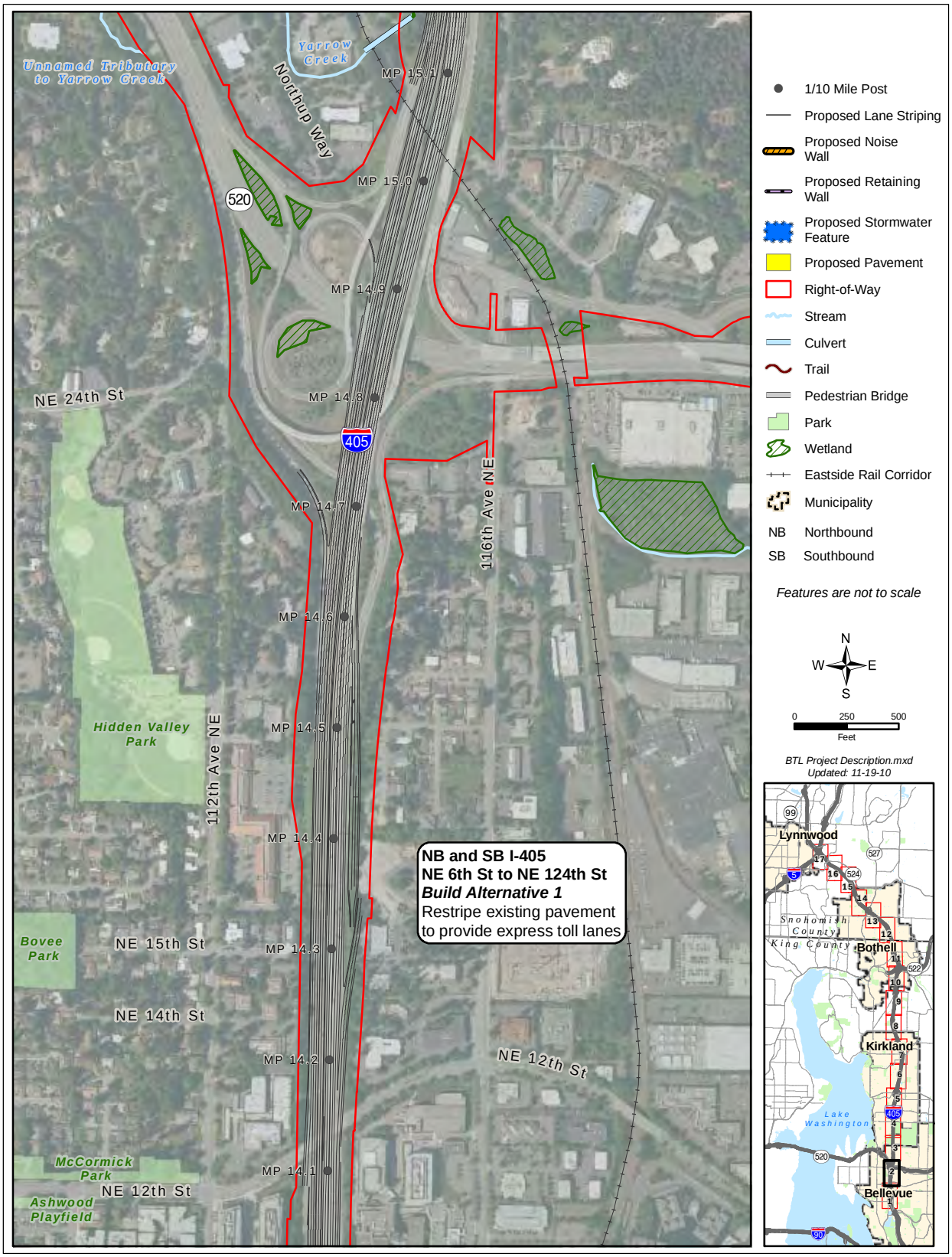


Exhibit 2-2: Project improvements – sheet 3 of 17

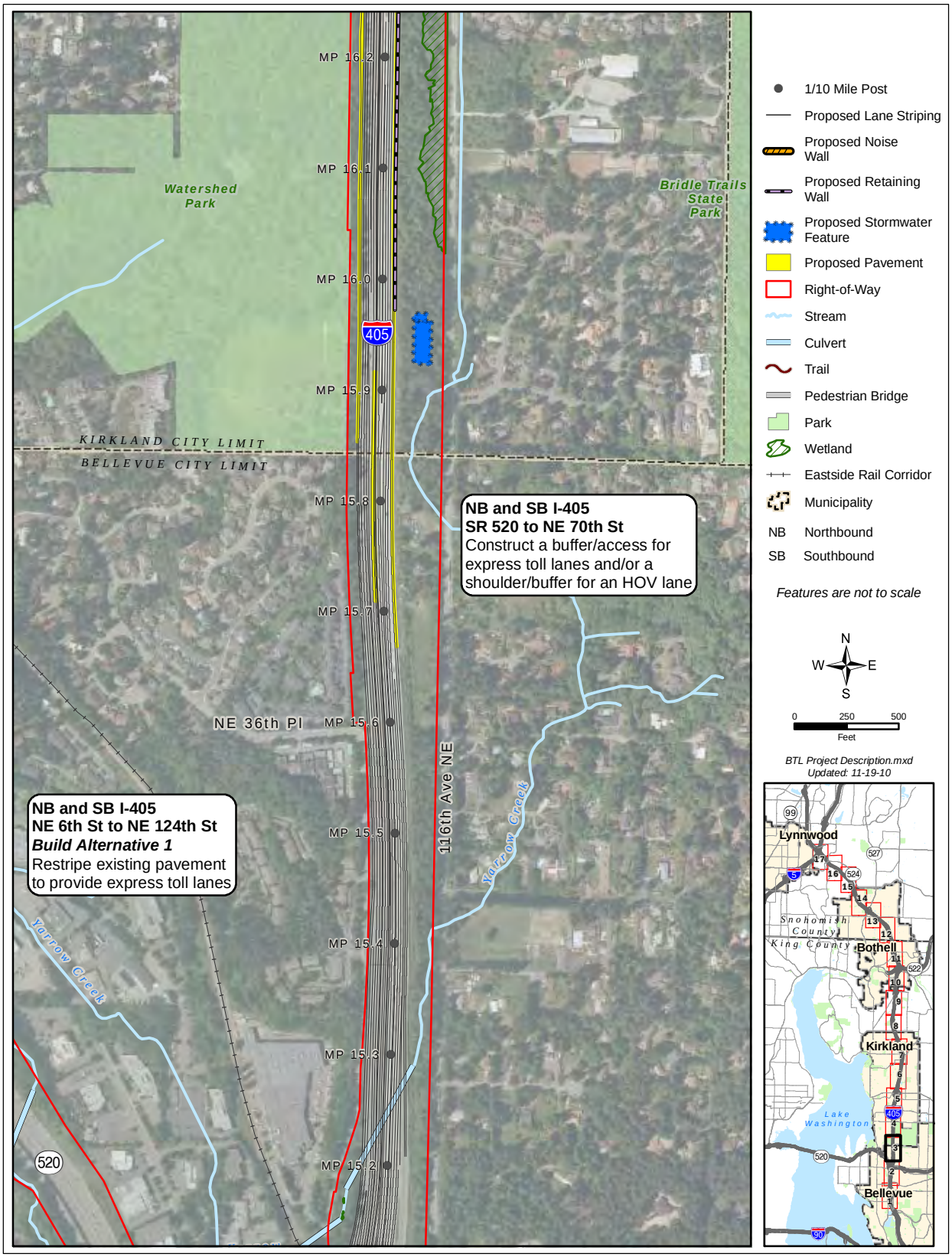


Exhibit 2-1: Project improvements – sheet 4 of 17

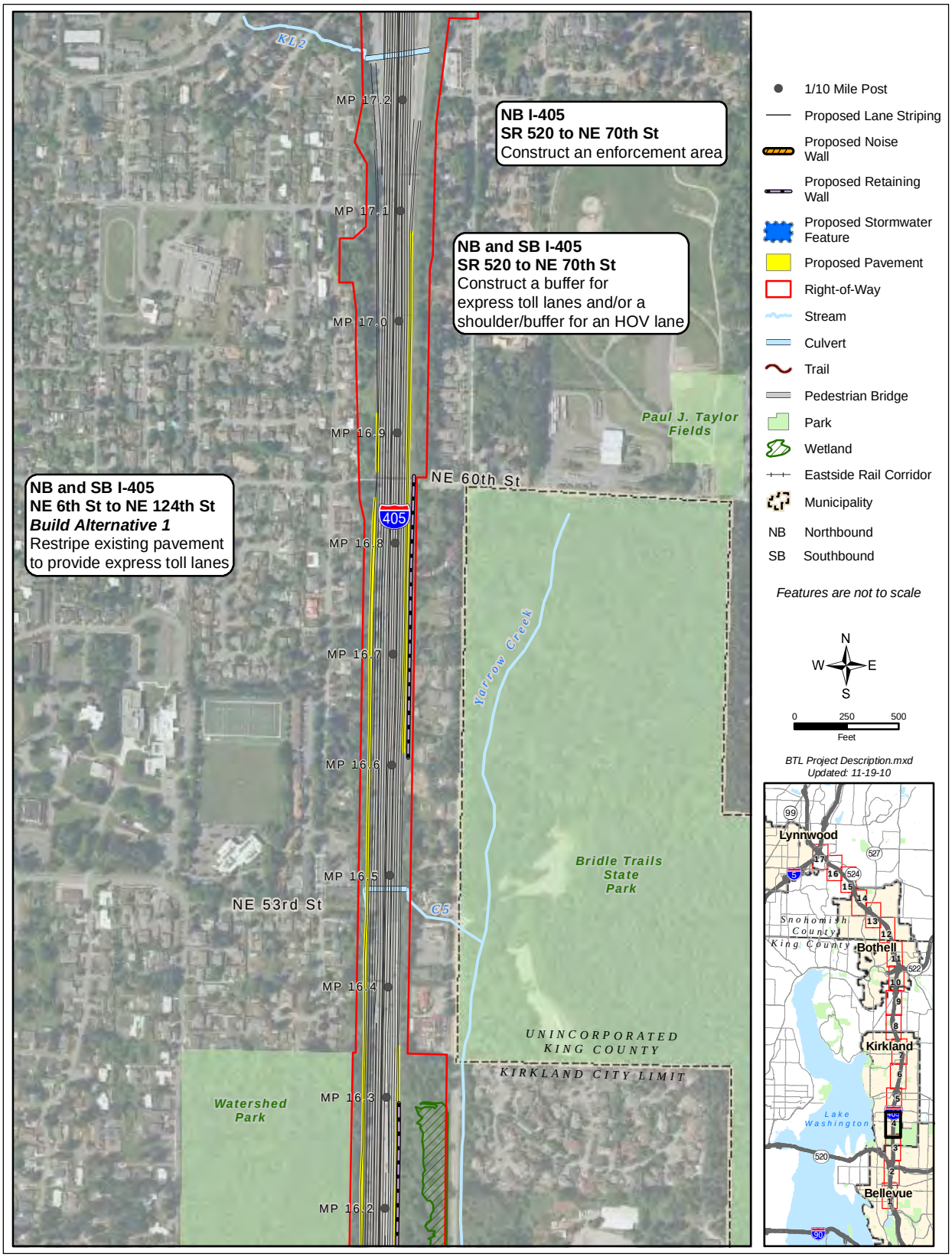


Exhibit 2-1: Project improvements – sheet 5 of 17

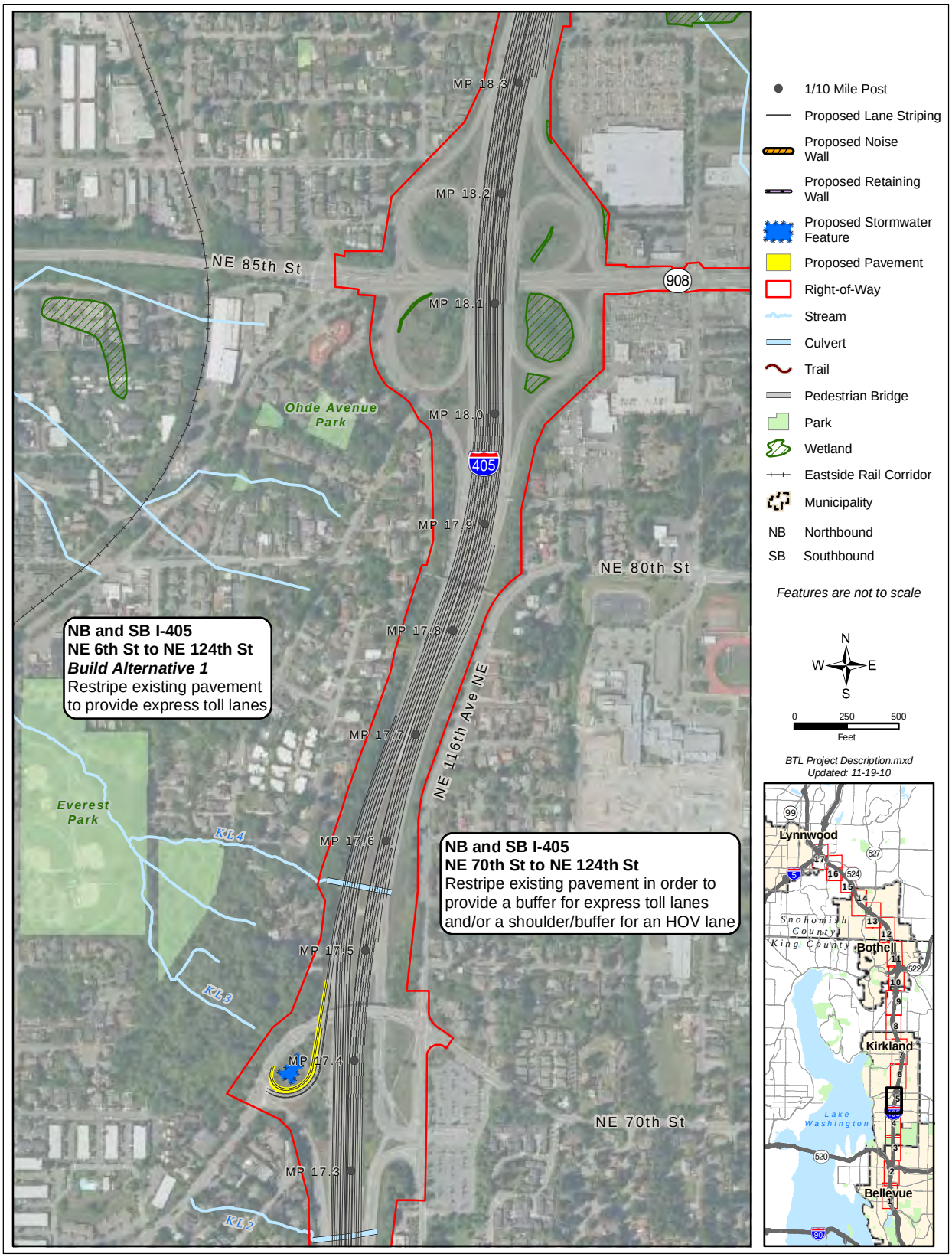


Exhibit 2-2: Project improvements – sheet 6 of 17

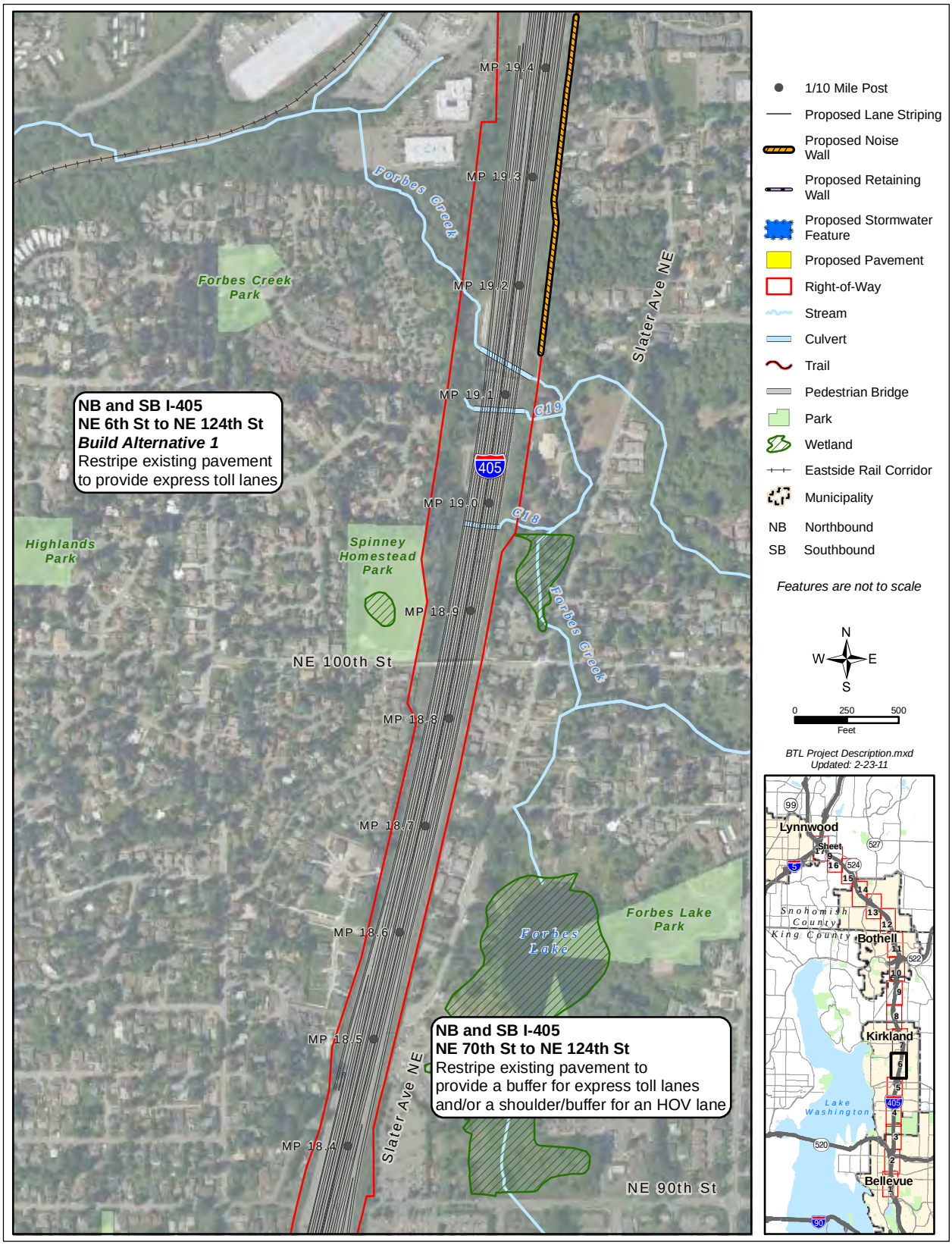


Exhibit 2-2: Project improvements – sheet 7 of 17

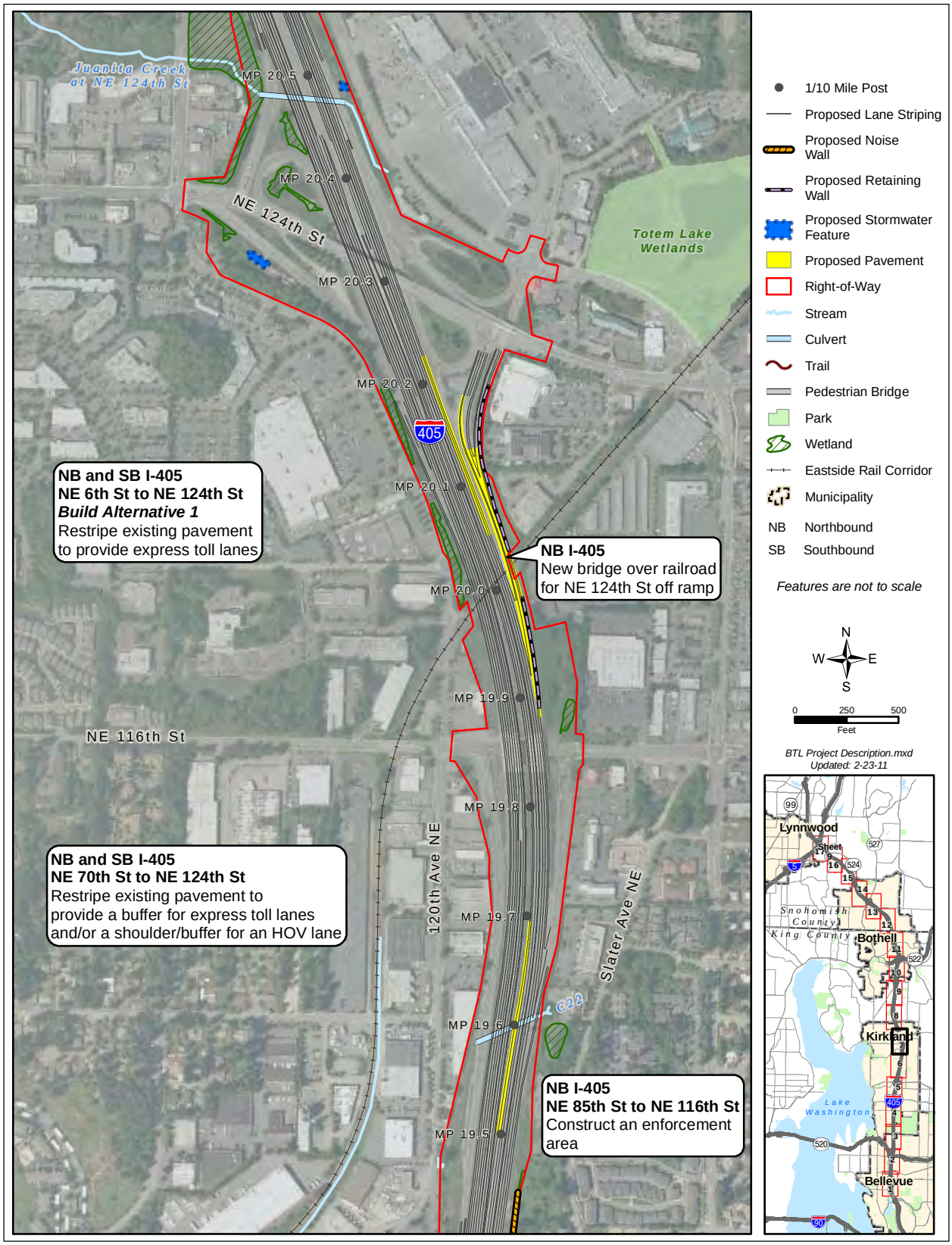


Exhibit 2-2: Project improvements – sheet 8 of 17

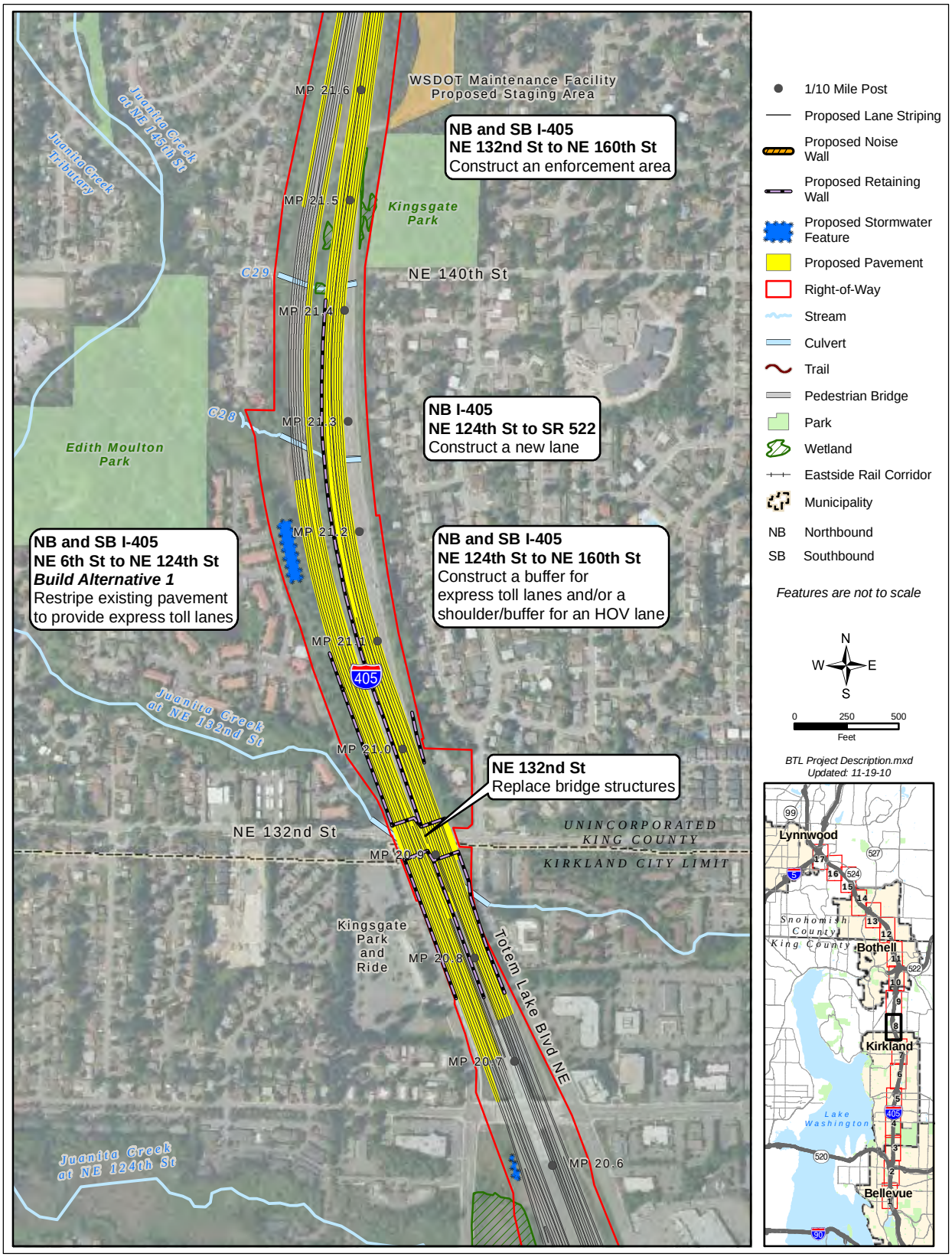


Exhibit 2-2: Project improvements – sheet 9 of 17

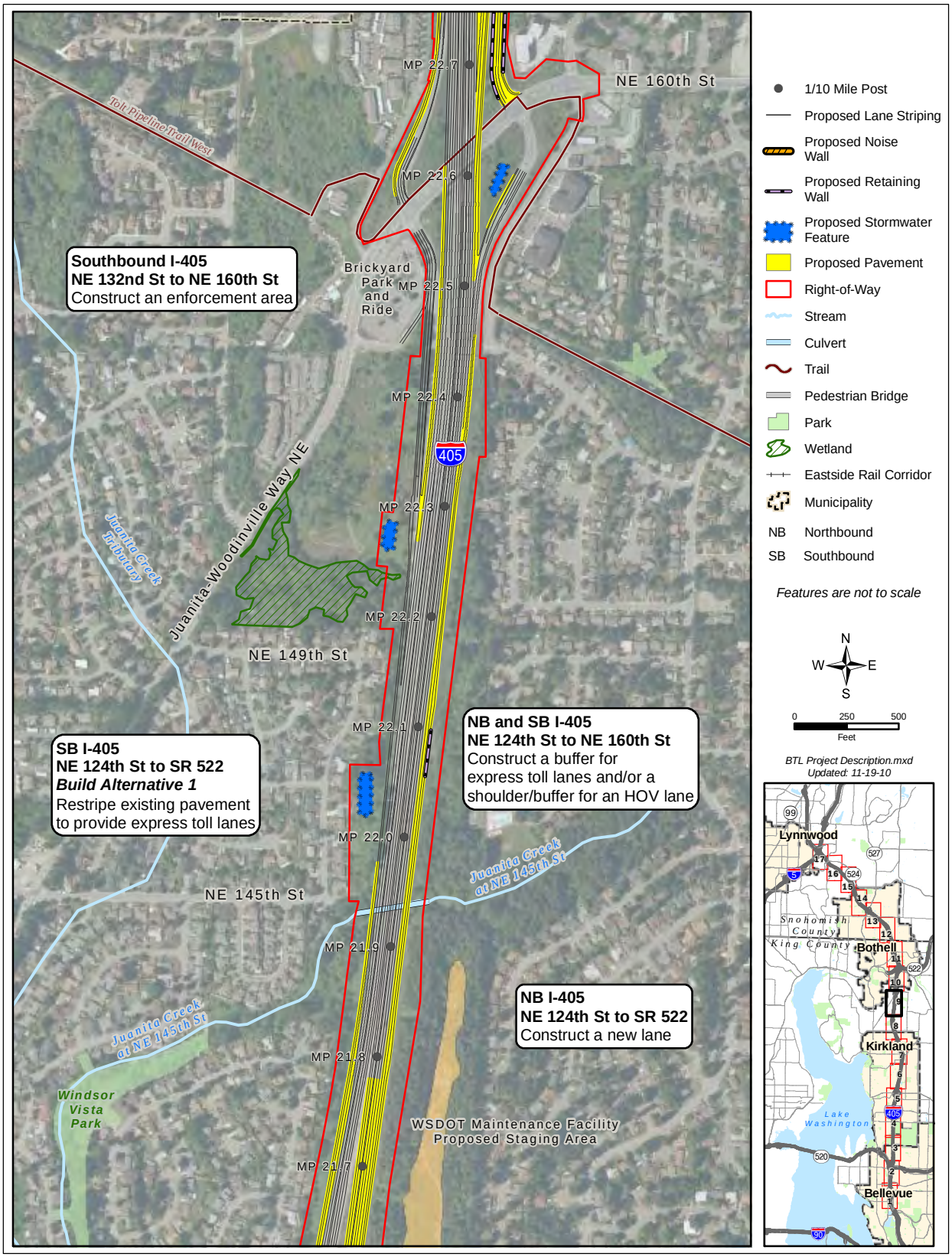


Exhibit 2-2: Project improvements – sheet 10 of 17

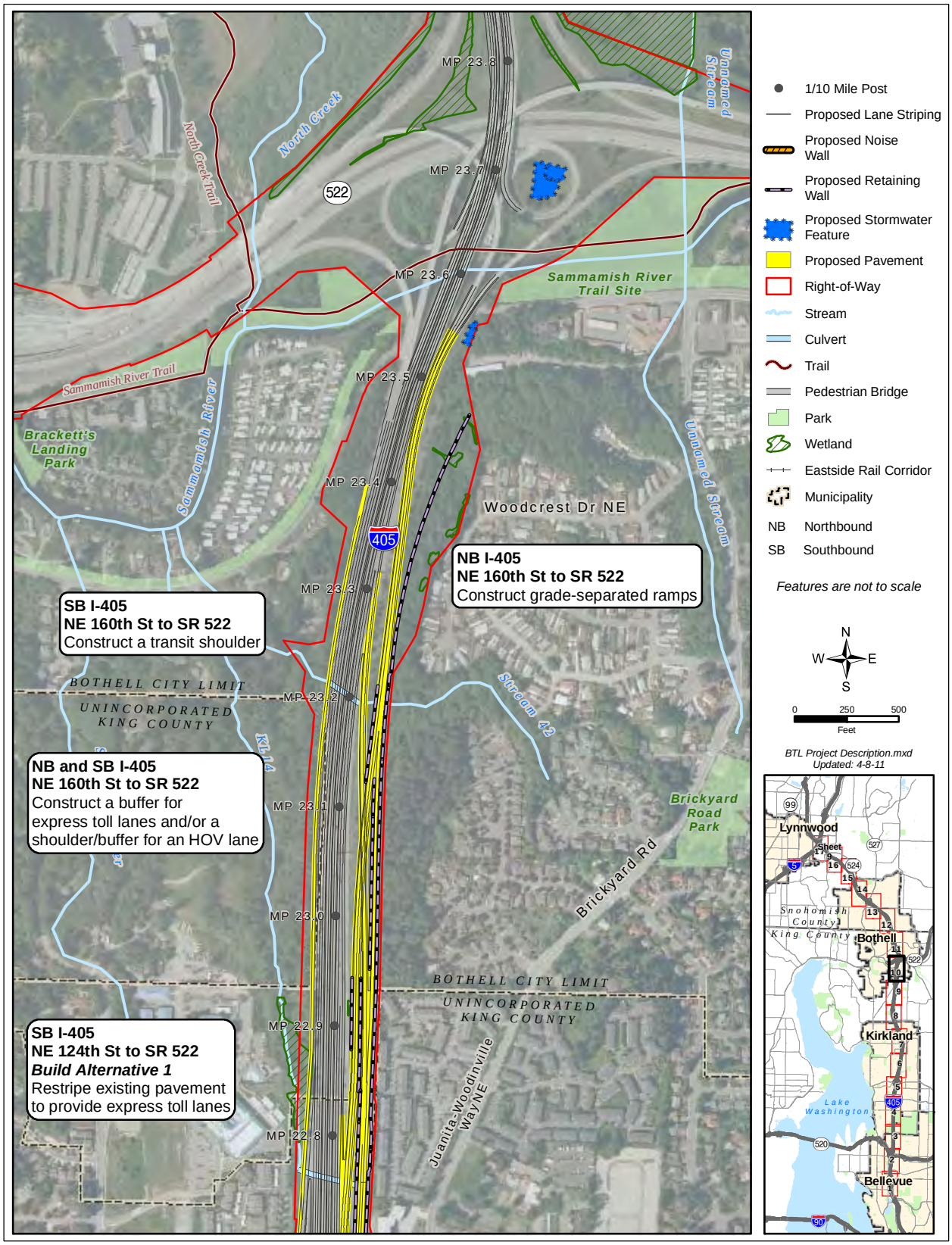


Exhibit 2-2: Project improvements – sheet 11 of 17

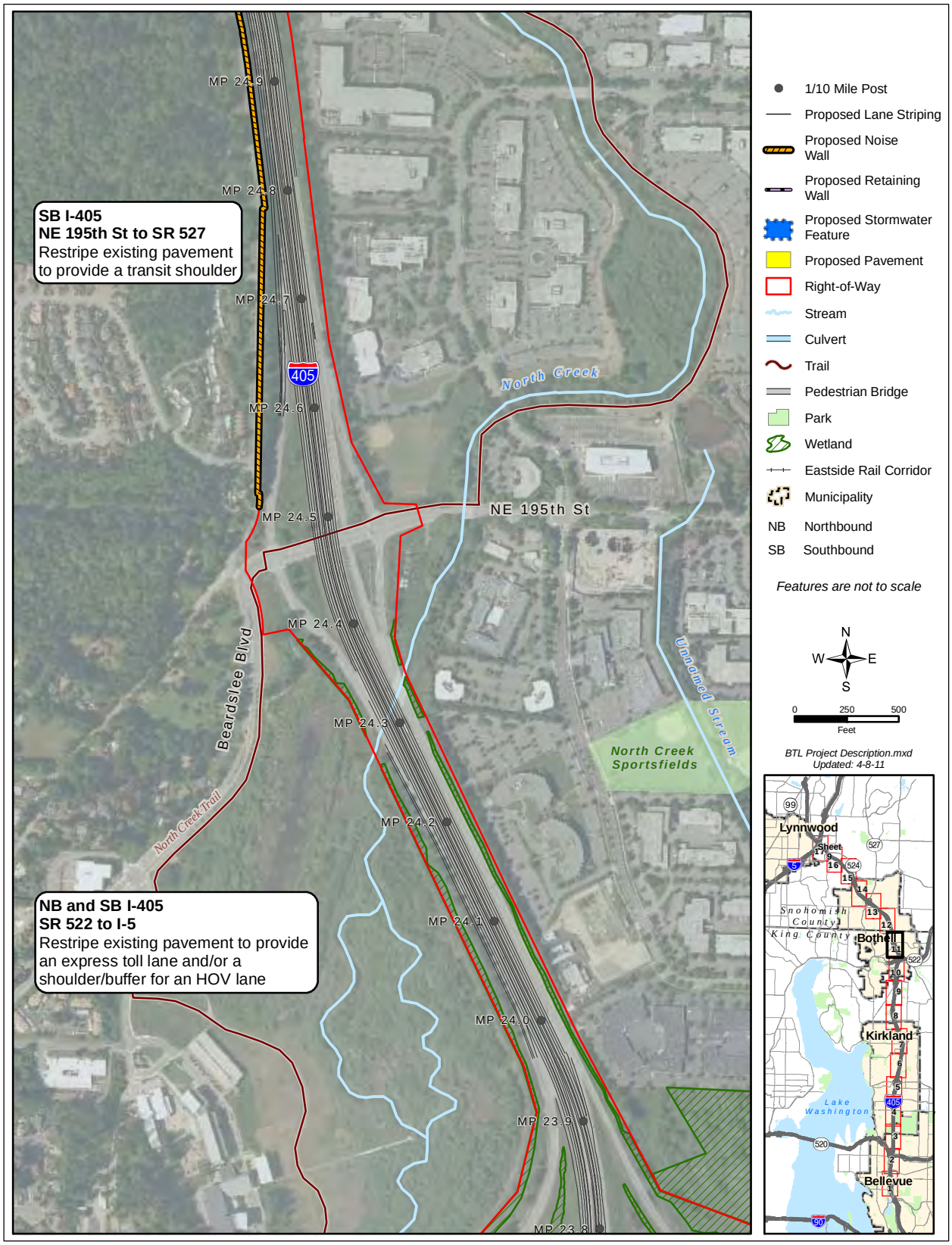


Exhibit 2-2: Project improvements – sheet 12 of 17

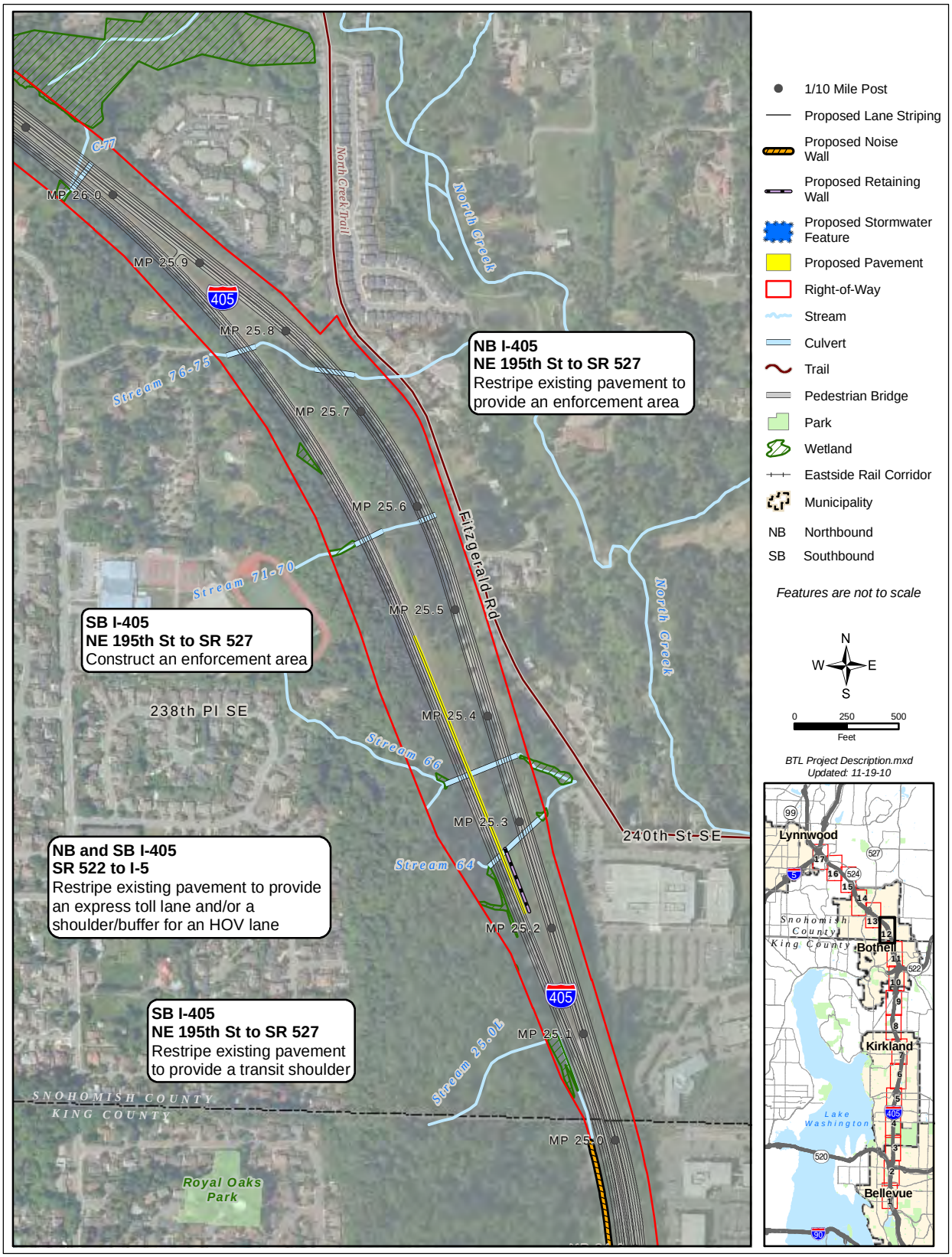


Exhibit 2-2: Project improvements – sheet 13 of 17

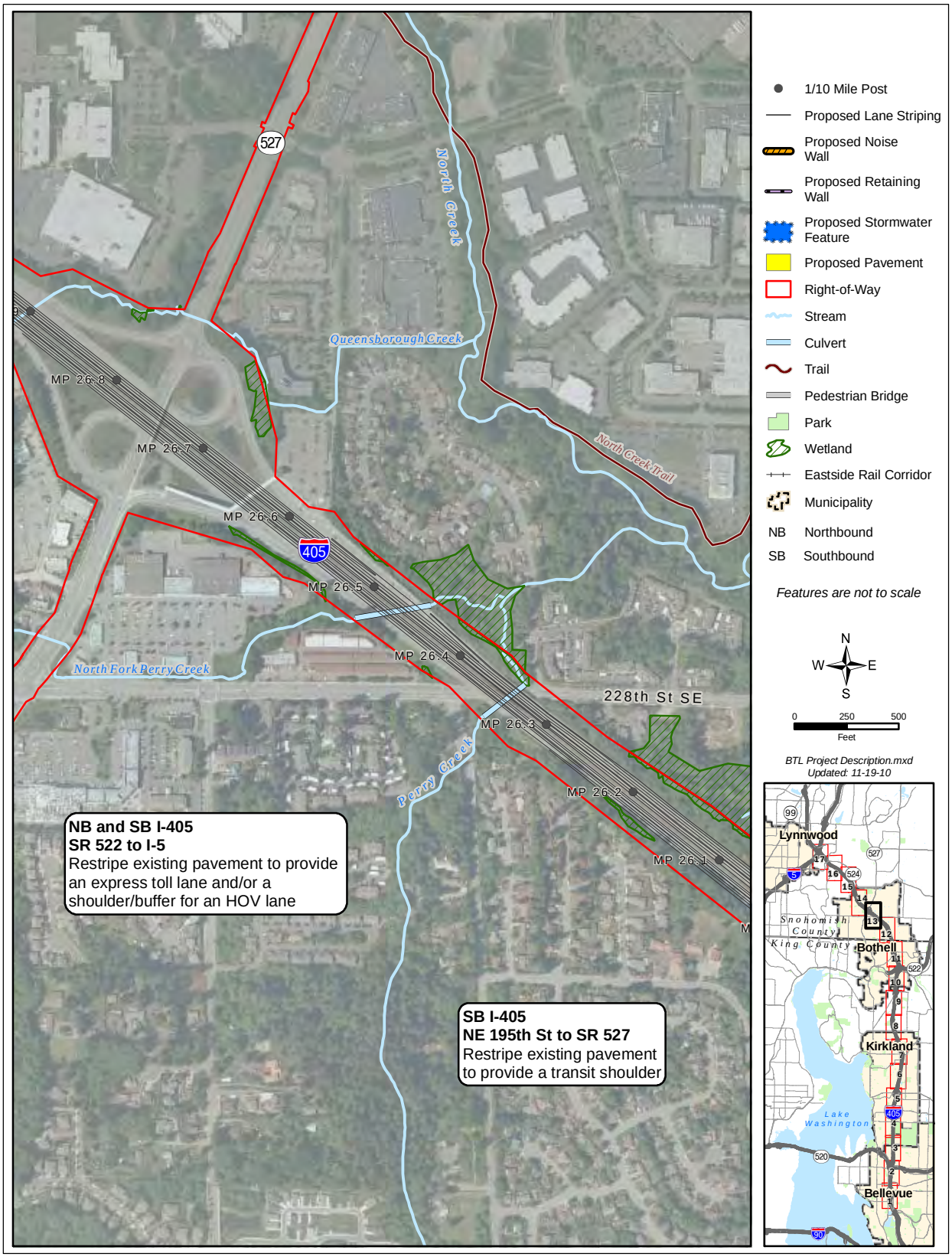


Exhibit 2-2: Project improvements – sheet 14 of 17

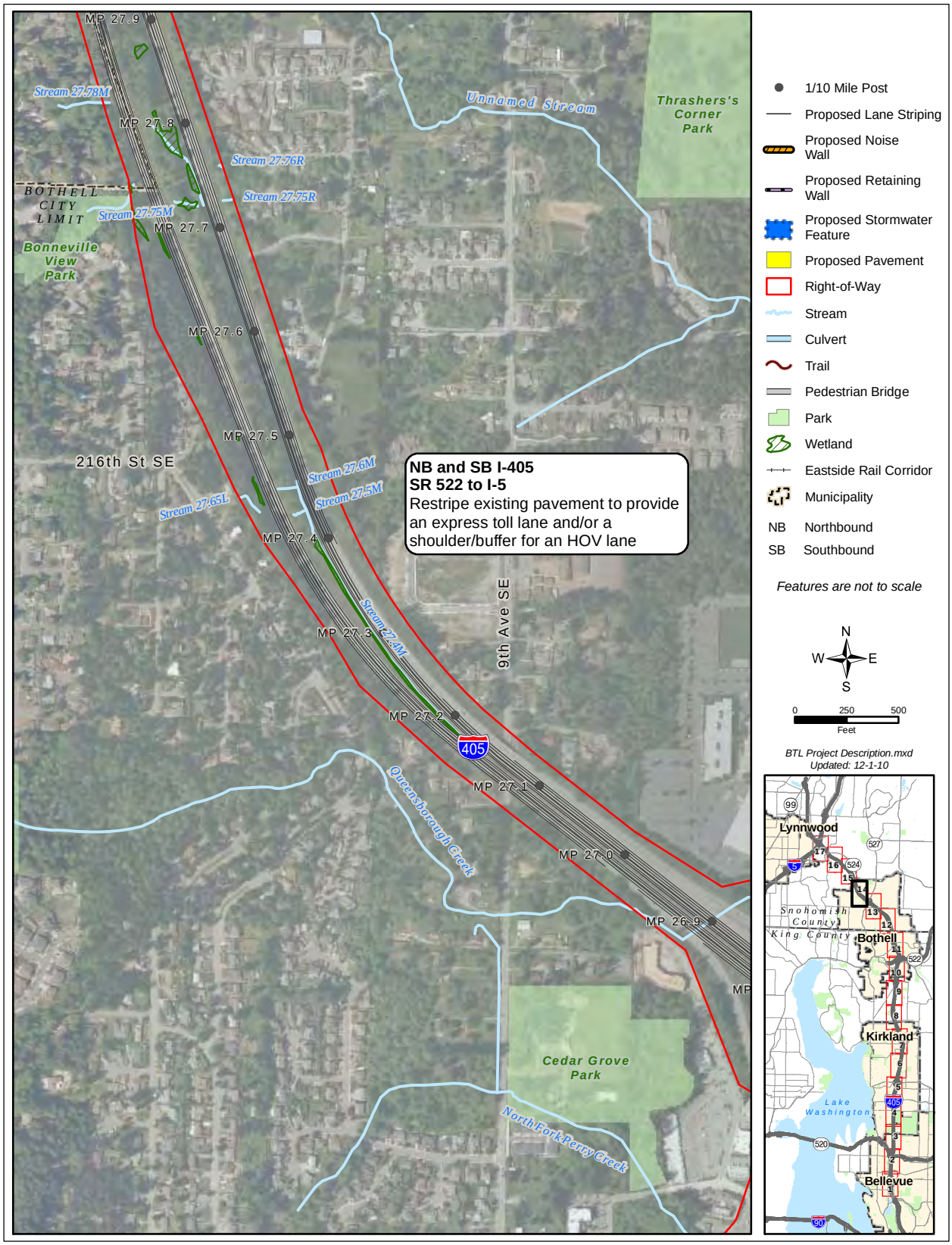


Exhibit 2-2: Project improvements – sheet 15 of 17

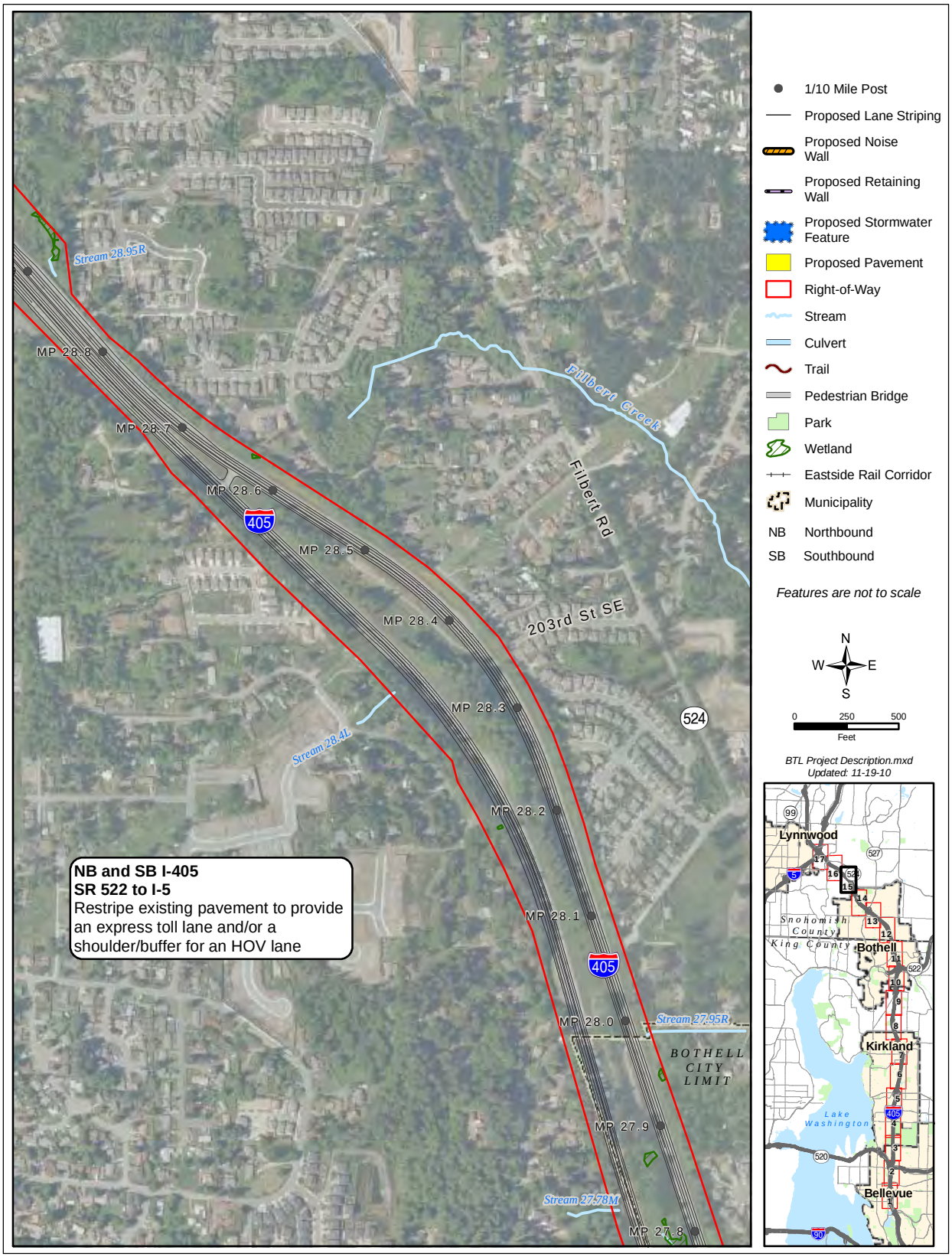


Exhibit 2-2: Project improvements – sheet 16 of 17

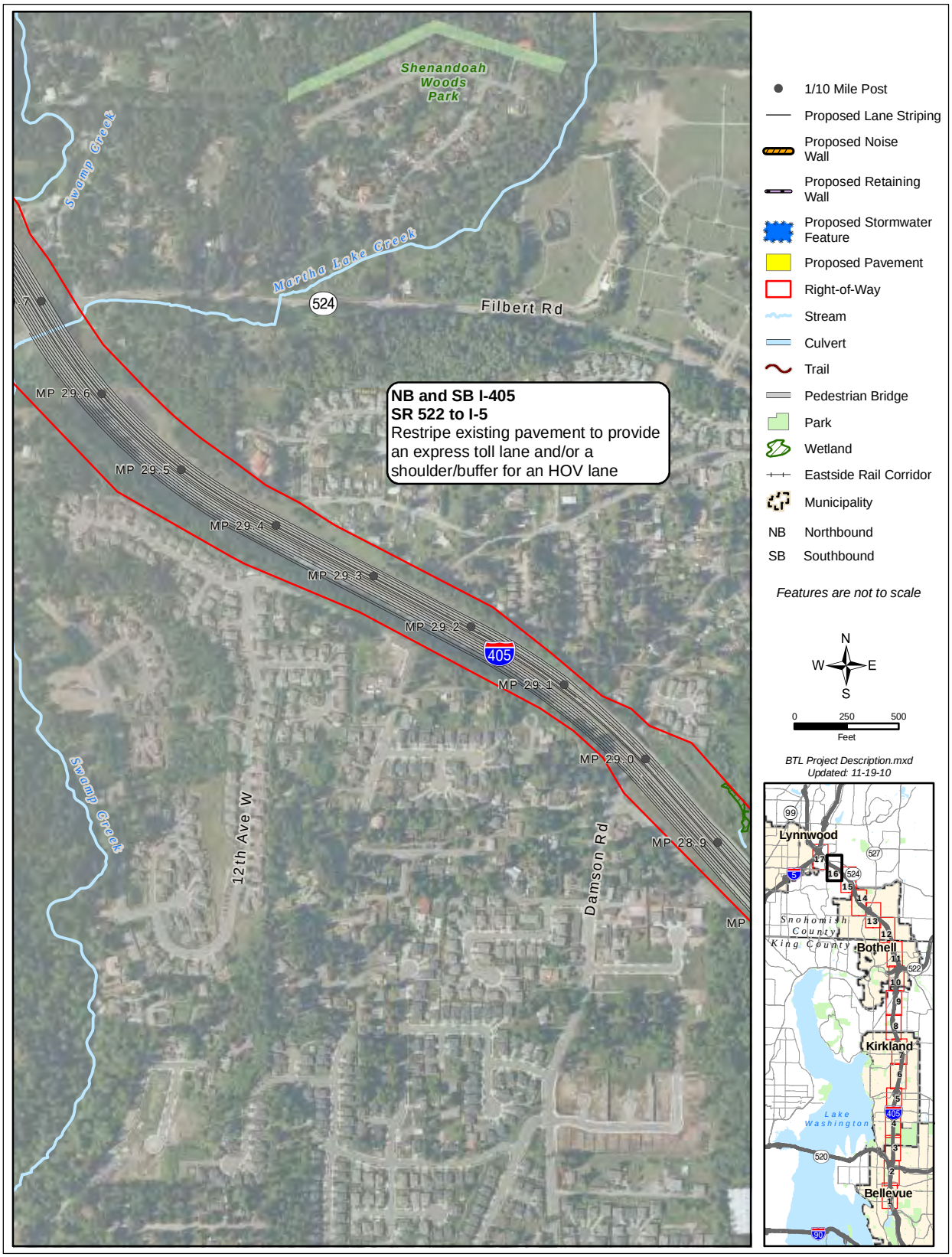


Exhibit 2-2: Project improvements – sheet 17 of 17

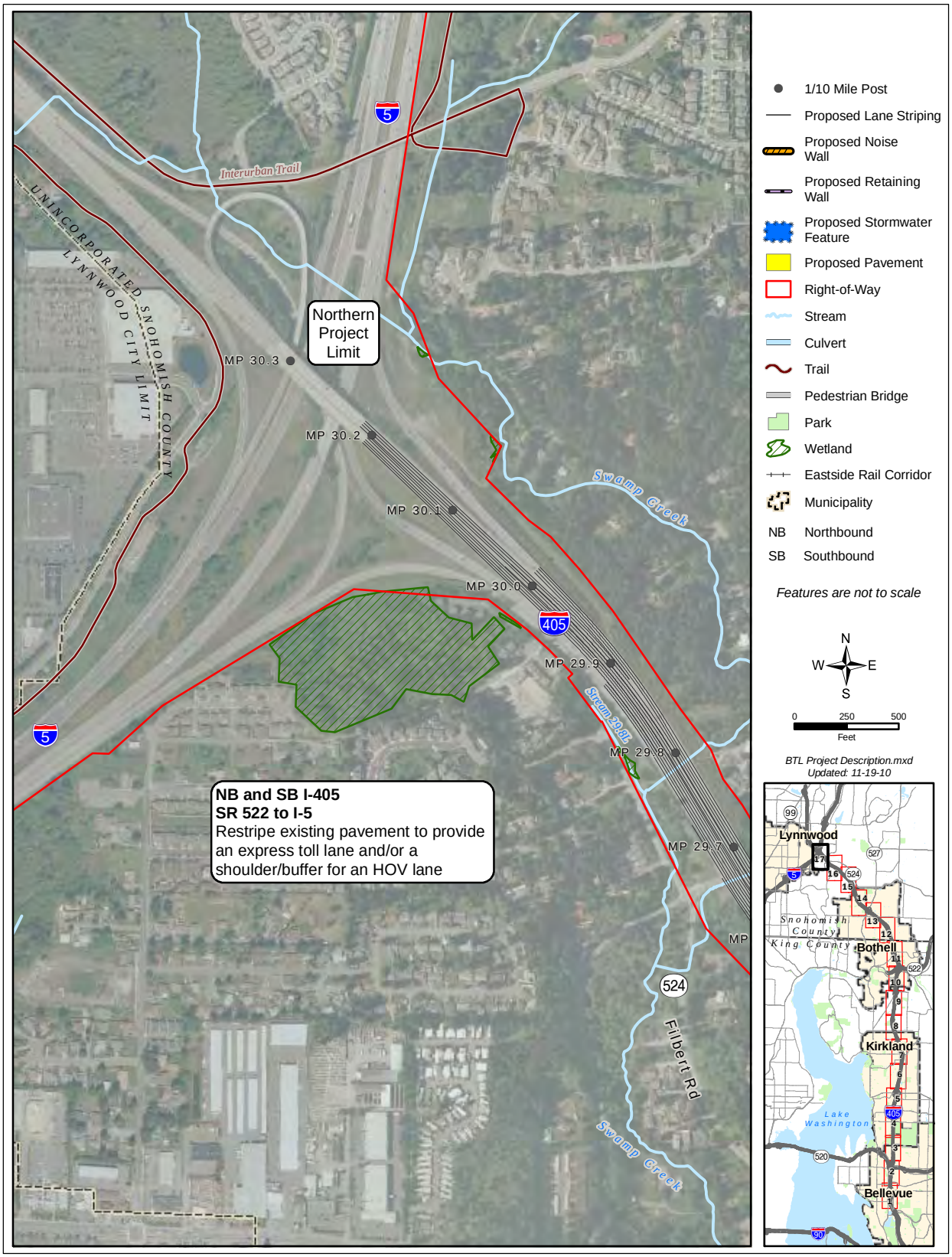


Exhibit 2-3: Project alternatives – sheet 1 of 2

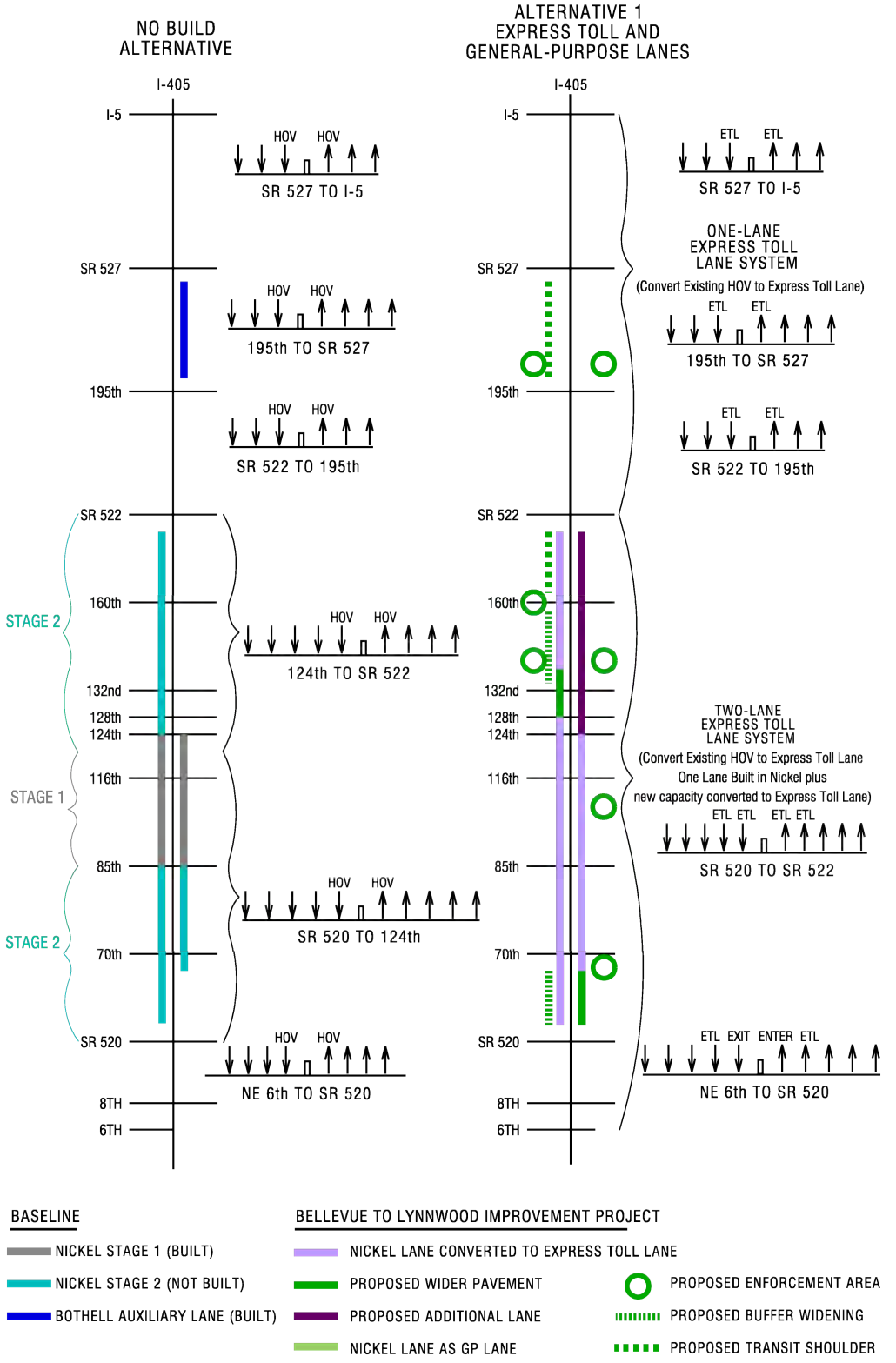


Exhibit 2-3: Project alternatives – sheet 2 of 2

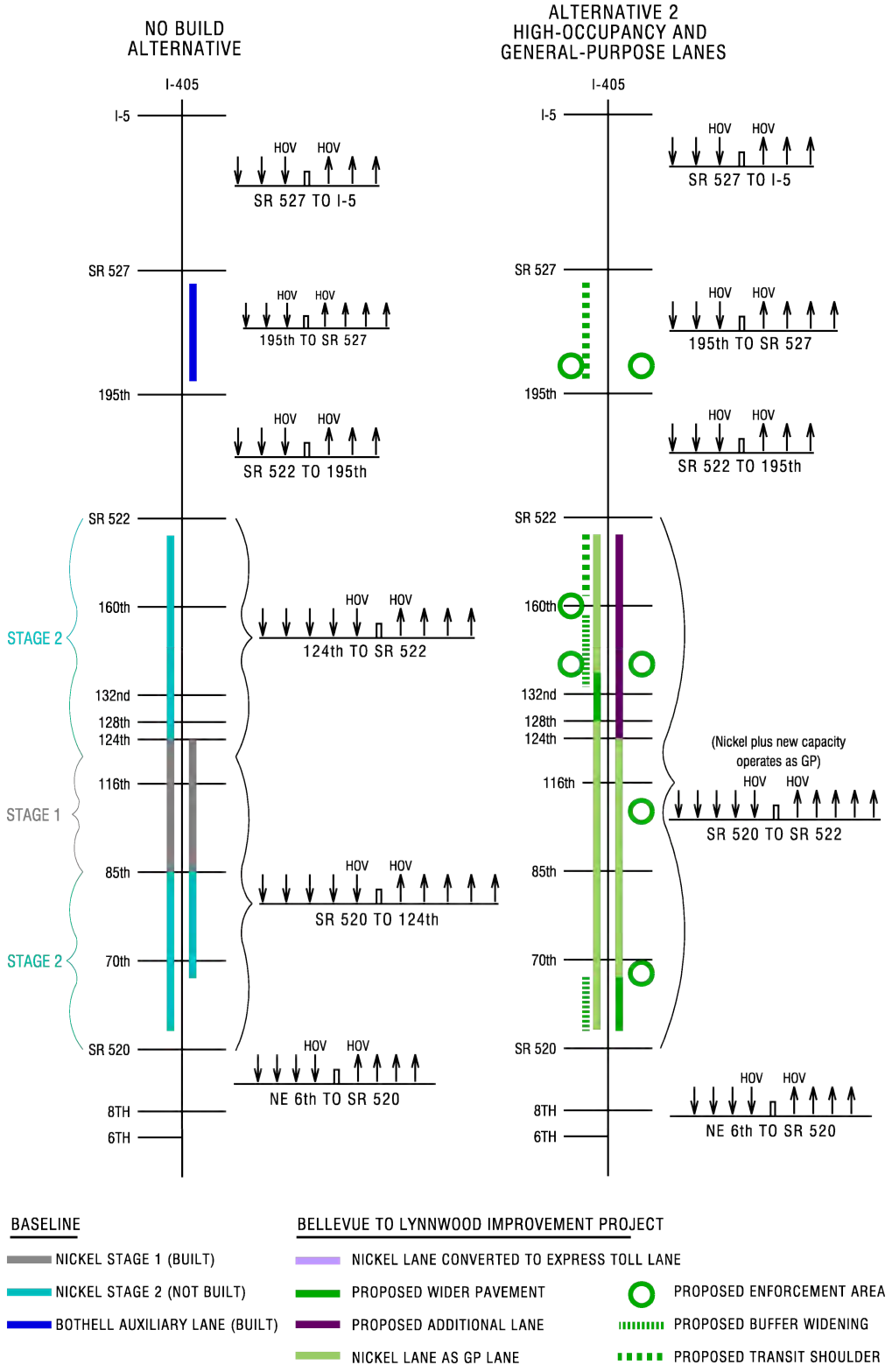
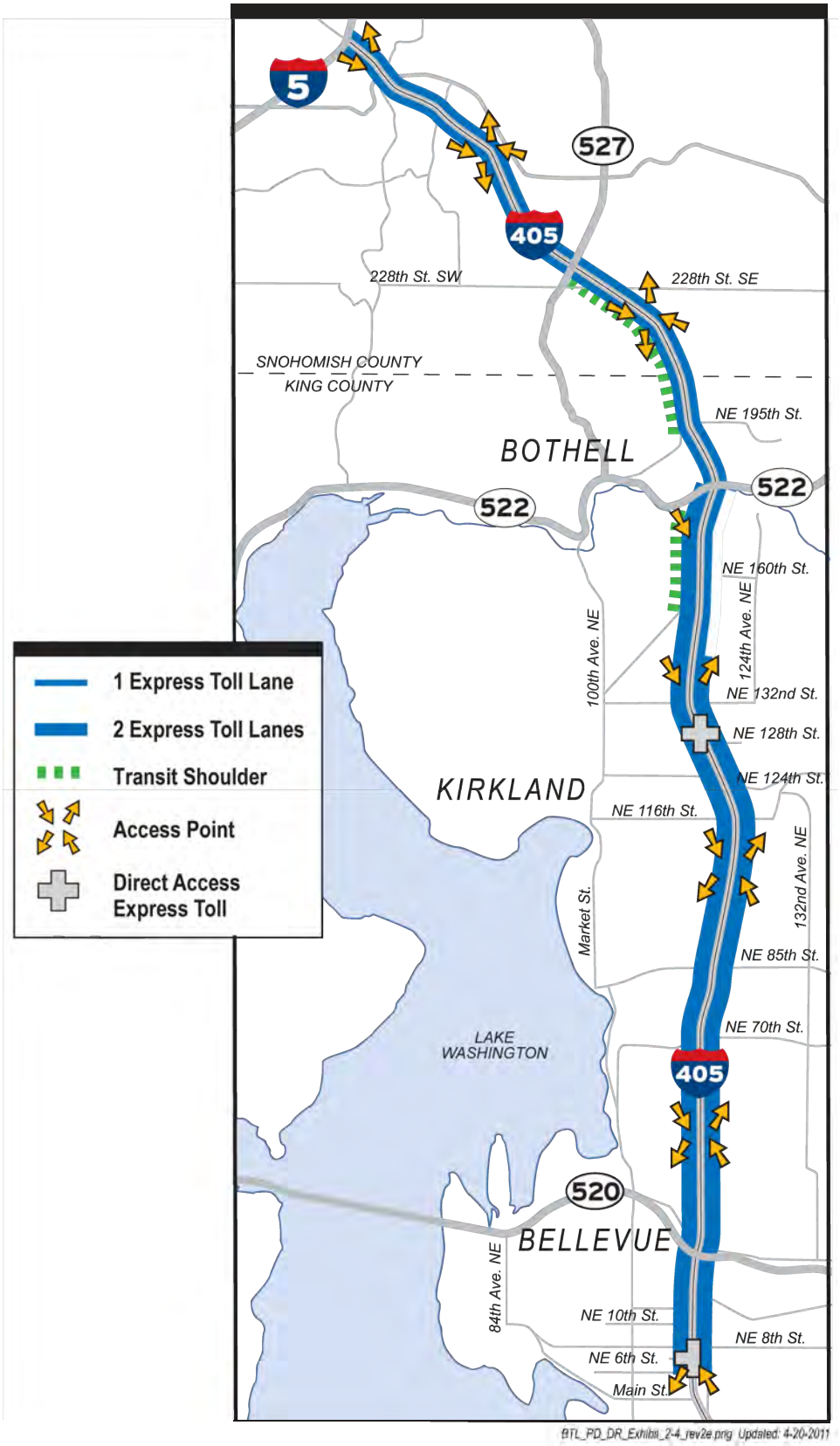


Exhibit 2-4: Express Toll Lanes access locations



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