Representative Infrastructure Studies

(Published October 2021)

Appendix 1. Supplemental Transportation Study

This Study is an Appendix to the **NE 85th Street Station Area Plan project** **Fiscal Impacts and Community Benefits Analysis Study Technical Memo (Technical Memo).** The Station Area Fiscal Impacts and Community Benefits Analysis was scoped to answer this question: If the City were to implement its vision of the Station Area as a thriving, walkable urban center with plentiful affordable housing, jobs, sustainable development, and shops and restaurants linked by transit, can the City afford the investments necessary to address increased demand on public services, especially schools, parks/open spaces, transportation, and utilities, and avoid a reduction in service for existing community members and businesses?

Study Purpose

To support the Technical Memo's assumptions, planning level **Representative Infrastructure Studies** were conducted to determine a set of representative infrastructure investments needed to maintain service levels in transportation, water and sewer, and stormwater, in alignment with the full 23-year buildout scenarios described for the two key development alternatives analyzed in the Technical Memo – June Alternatives A and B. The purpose of the Infrastructure Studies was to inform an understanding of area-wide representative infrastructure and service needs and costs and for incorporation as assumptions in the fiscal analysis. Note that as "representative infrastructure," these identified investments are ones that are likely to be similar in scale and type to those needed to support future Station Area development, but are likely to differ somewhat from the specific infrastructure investments that will ultimately be adopted for the Station Area. Information about the Representative Infrastructure Studies is presented in Section 3 of the Fiscal Impacts and Community Benefits Technical Memo. The Fiscal Impact model assigns all representative infrastructure investments either to development projects or to the City, roughly following City policy. Any assumptions about parcel- and quadrant-level development and phasing included in the studies are hypothetical and not meant to presuppose decision- making by private landowners or the actions of the market. The representative investments identified in the Infrastructure Studies are distinct from and should not be construed as preferred plan recommendations or final project configurations, which will be developed in later stages of planning and are subject to City Council approval.

Key Contacts

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Fiscal Impacts and Community Benefits Supplemental Study Technical Memo

Lead Author: BERK; Contributors: EcoNorthwest, Fehr and Peers, Mithun

Representative Infrastructure Studies

Appendix 1. Supplemental Transportation Study Lead Author: Fehr and Peers

Appendix 2. Supplemental Water and Sewer Study Lead Author: RH2

Appendix 3. Supplemental Stormwater Memo Lead Author: RKI

FEHR PEERS

Memorandum

Date: October 12, 2021

To: Allison Zike, Jeremy McMahan, Joel Pfundt, and Thang Nguyen, City of Kirkland

CC: Erin Christensen Ishizaki, Brad Barnett, and Becca Book, Mithun

From: Kendra Breiland and Team, Fehr & Peers

Subject: Kirkland 85th Station Area Plan – Supplemental Transportation Summary

SE20-0719.01

As part of the Mithun project team, Fehr & Peers is supporting the City of Kirkland in providing supplemental information to understand the community benefits, tradeoffs, and fiscal impacts of different alternatives for the I-405/NE 85th Street Station Area Plan (SAP) from the perspective of transportation. This memo and attached exhibits present the findings of our analysis, spanning the following topics:

- Travel modeling for the two new future year alternatives: June Alternatives A and B
- Traffic operations analysis for June Alternatives A and B within the study area, including interchange operations
- Transit analysis for June Alternatives A and B
- Analysis of the comfort of facilities for people walking and biking in the study area with existing and committed[1] transportation investments and how that could change with recommended investments for the SAP
- Analysis of how far people can comfortably walk or bike within 5, 10, and 15-minutes of the proposed station with existing and committed transportation investments and how that could change with recommended investments for the SAP
- Potential package of investment strategies to support full implementation of June Alternatives A and B:
    - Roadway geometric & operational changes
    - Implementation of a robust transportation demand management strategy
    - Transit access & speed and reliability considerations

[1] Committed projects are transportation infrastructure, such as sidewalks, trails, and bike lanes that are likely to move forward independent of the 85th Street Station Area Plan.

- System improvements to improve conditions for walking and biking

This memo has been revised based on feedback from City staff and the Transportation Commission on the merits of the proposed package of investment strategies in meeting the City's vision for the SAP.

Land Use Discussion

Based on public comment and community feedback, a charrette held with City staff in May, and guidance from the City Council and Planning Commission, two alternatives were developed (known as the June Alternatives). These June Alternatives narrow the range of alternatives studied in the DSEIS in the following ways:

- Remove the level of growth shown in DSEIS Alternative 3 from further consideration
- Use a revised version of DSEIS Alternative 1 as the lower limit of growth to be studied (June Alternative A: Current Trends)
- Use a reduced version of DSEIS Alternative 2 as the upper limit of growth to be studied (June Alternative B: Transit Connected Growth)

These scenarios represent a range of possibilities to be studied for the Station Area, defined by the total potential growth in employment and residential housing units that the City of Kirkland could plan for over the next two decades.

June Alternative A: Current Trends

This alternative maintains existing zoning heights throughout the district and slightly adjusts the assumed 2044 growth projections to reflect current market trends, showing more jobs, and only slightly more housing than DSEIS Alternative 1 (**Exhibit 1**). The additional jobs were studied in portions of the study area currently zoned for more intensive development.

Exhibit 1: June Alternative A "Current Trends" (Growth through 2044)

Quadrant	Households	Employment
NW	515	1,164
NE	1,104	3,918
SW	710	3,787
SE	600	3,449
Totals	**2,929**	**12,317**

Source: Mithun/EcoNW, 2021

June Alternative B: Transit Connected Growth

This alternative is aligned with the overall SAP growth framework in the Initial Concepts and incorporates elements shown in the commercial corridors of DSEIS Alternative 3 into the overall land use pattern established in DSEIS Alternative 2. The intent of this strategy is to:

- Optimize for workforce and affordable housing, in particular the number of units provided through linkage fees and/or inclusionary zoning.
- Attract new jobs to foster economic activity and meet Citywide targets.
- Balance the distribution of commercial-focused development across the study area.
- Foster an environmentally-sound land use pattern that helps achieve the City's sustainability goals.

June Alternative B responds to the public comment heard during the DSEIS comment period and the May 26, 2021 Council Listening Session. Although a wide range of comments were shared, many participants reiterated a desire to maintain existing residential character, and concerns regarding the maximum allowable zoning heights proposed in DSEIS Alternative 3. June Alternative B only studies increased allowable heights in areas that provide clear benefits to the community and take advantage of regional transit connections. To that end, several areas where height increases had been proposed as part of DSEIS Alternative 2 and 3 have been removed from consideration in this alternative. These include areas that are unlikely to redevelop due to market forces, are limited by development feasibility, or are constrained by other considerations.

This alternative results in similar household growth to DSEIS Alternative 2, but lower overall employment, showing a better jobs-housing balance (**Exhibit 2**). The Southwest Quadrant has lower growth numbers, closer to what was proposed for DSEIS Alternative 1.

Exhibit 2: June Alternative B "Transit Connected Growth" (Growth through 2044)

Quadrant	Households	Employment
NW	568	1,561
NE	2,670	8,660
SW	916	3,356
SE	3,998	9,174
Totals	**8,152**	**22,751**

Source: Mithun/EcoNW, 2021

Overall Objectives for Both Alternatives

For both June Alternatives, the project team has been charged with identifying necessary infrastructure and policies that support achieving the following objectives related to transportation:

- Preserve the functionality of NE 85th Street, while enhancing and expanding its role as an urban, multimodal street.
- Incorporate transportation improvements that preserve community character, including minimizing significant changes such as road widening in areas outside of where proposed growth is occurring.
- Accommodate transit effectively along NE 85th Street and other streets in the study area.
- Establish a low-street priority bike and pedestrian network that serves the full study area

The remainder of this memo describes the travel modeling and mobility analysis conducted to identify a transportation system that would achieve these objectives.

Travel Demand Modeling and Forecasting

Fehr & Peers incorporated land use assumptions for future alternatives in the Bellevue-Kirkland-Redmond (BKR) travel demand model to fully capture the resulting impact on traffic operations in the station area. The alternatives considered in the travel modeling include:

- 2035 No Action Alternative from the DSEIS
- 2044 Alternative 2 from the DSEIS
- 2044 June Alternative A (identified by Kirkland City Council in June 2021)
- 2044 June Alternative B (identified by Kirkland City Council in June 2021)

As discussed in the prior section, June Alternative A represents 2044 conditions with similar development patterns to the 2035 No Action Alternative. Similarly, June Alternative B represents 2044 conditions but with greatly increased office employment and housing in the study area relative to the No Action Alternative. June Alternative B represents a refinement to Alternative 2, which was evaluated in the DSEIS.

The BKR travel demand model was used to develop traffic volume forecasts for future alternatives based on the transportation infrastructure envisioned in the 2035 Comprehensive Plan and respective land use forecasts. Prior to the modeling process, MXD+, a trip generation tool that accounts for the variation in land use type and density, provided estimates of new vehicle trips for the future alternatives. **Exhibit 3** shows the net new vehicle trips for each alternative by quadrant of the station area, as well as the single occupancy vehicle (SOV), carpool, and transit mode share estimates in the BKR travel model for each scenario. Of note, while the mode share estimates are relatively similar among future year alternatives (due to consistent assumptions about transit

services and parking charges in the BKR travel model), the number of vehicle and transit trips vary greatly due to the differences in development intensity assumed under each alternative.

Exhibit 3: PM Peak Hour Vehicle Trip Generation using MXD+/BKR Model Mode Share Estimates

Quadrants	2035 No Action	2044 Alternative A	2044 Alternative B	2044 Alternative 2
NW	930	930	1,280	1,000
NE	3,850	4,480	4,920	10,110
SW	1,910	1,850	2,360	2,190
SE	3,630	3,880	7,580	4,300
Total	**10,320**	**11,140**	**16,140**	**17,600**
Mode Share Estimates (SOV/Carpool/Transit)	70%/23%/7%	70%/22%/8%	71%/21%/8%	72%/21%/7%

Source: Fehr & Peers, 2021

Consistent with land use trends, Alternative A includes modest growth in vehicle trips in the NE and SE quadrants. The total vehicle trips generated by Alternative B and Alternative 2 are similar; however, there is a substantial shift in which quadrants the land use growth is located (from NE to SE). These results were used to calibrate the BKR travel demand model to reflect similar growth in trips. Additional adjustments were also made to the BKR travel demand model for adequate distribution of trips, particularly trips accessing the Lee Johnson site. **Exhibits 4 and 5** show the modeled increase in roadway volumes that would occur under Alternative 2 and Alternative B relative to the No Action Alternative. As the exhibits show, Alternative B features a more even distribution of trips than Alternative 2.

Exhibit 4: Traffic Volume Increase (2035 No Action vs. 2044 Alternative 2)

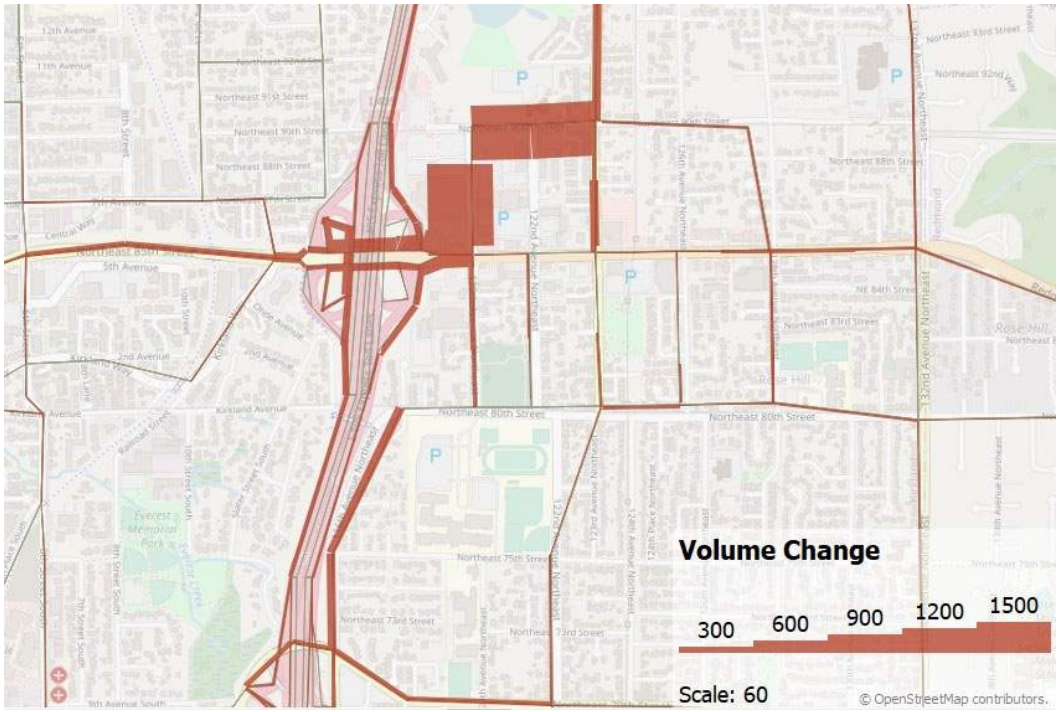
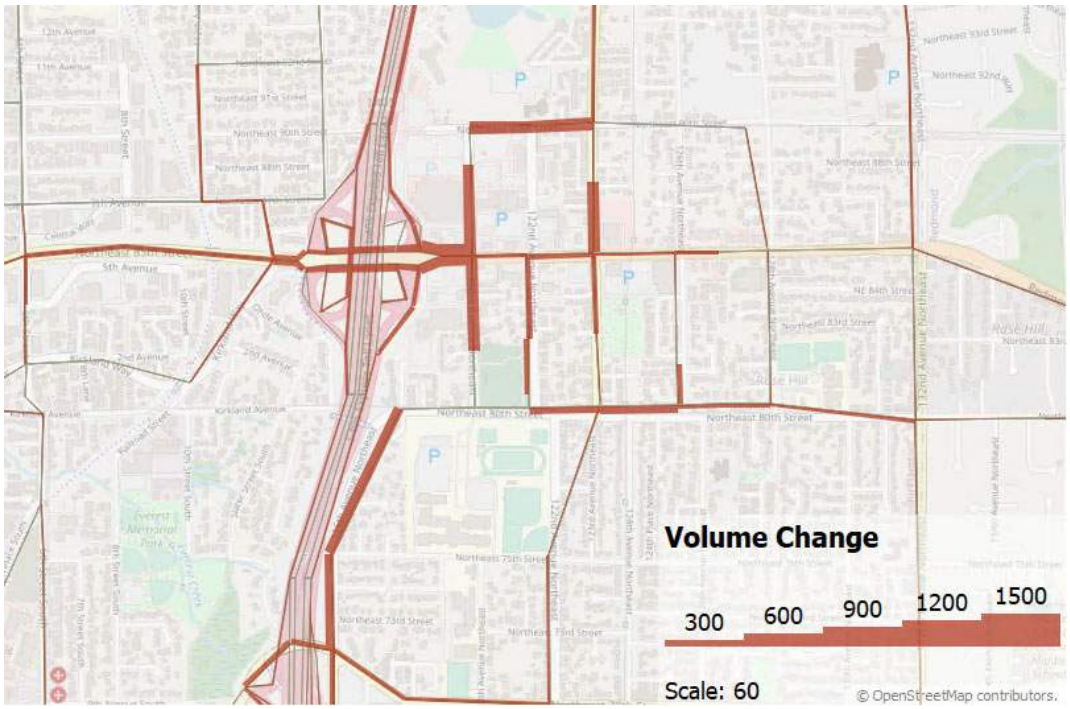


Exhibit 5: Traffic Volume Increase (2035 No Action vs. 2044 Alternative B)



Traffic volume forecasts from the refined versions of the BKR model were then used to evaluate traffic operations at the following intersections (**Exhibit 6a**):

1. NE 90th Street & 124th Avenue NE (Intersection 8 in DSEIS)
2. NE 85th Street & 6th Avenue NE (Intersection 1 in DSEIS)
3. NE 85th Street & 120th Avenue NE (Intersection 6 in DSEIS)
4. NE 85th Street & 124th Avenue NE (Intersection 9 in DSEIS)
5. NE 83rd Street & 120th Avenue NE
6. NE 80th Street & 118th Avenue NE
7. NE 80th Street & 122nd Avenue NE
8. NE 70th Street & 116th Avenue NE

Exhibit 6b shows the original list of intersections evaluated in the DSEIS.

Exhibit 6a: Supplemental Study Intersections

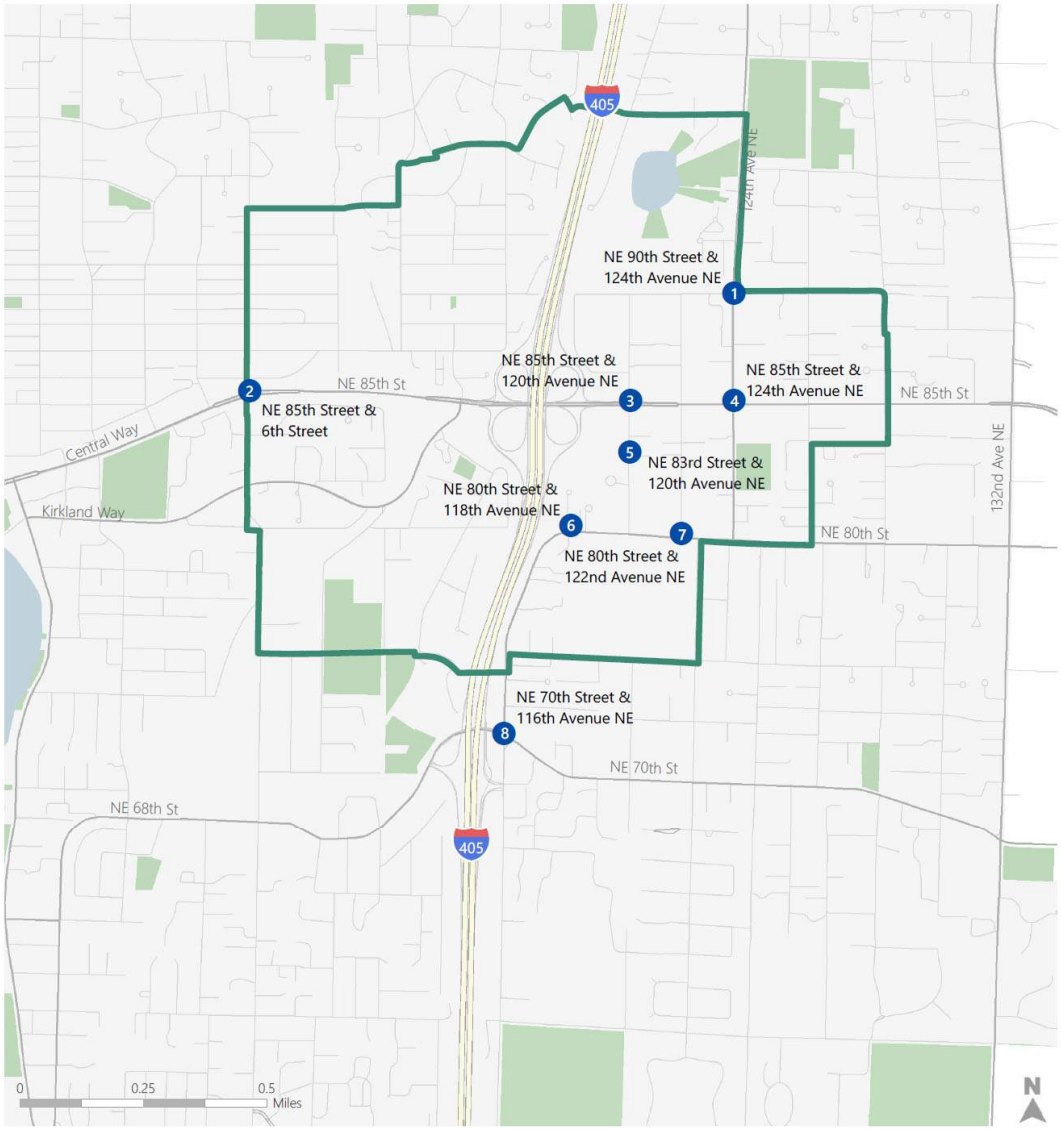
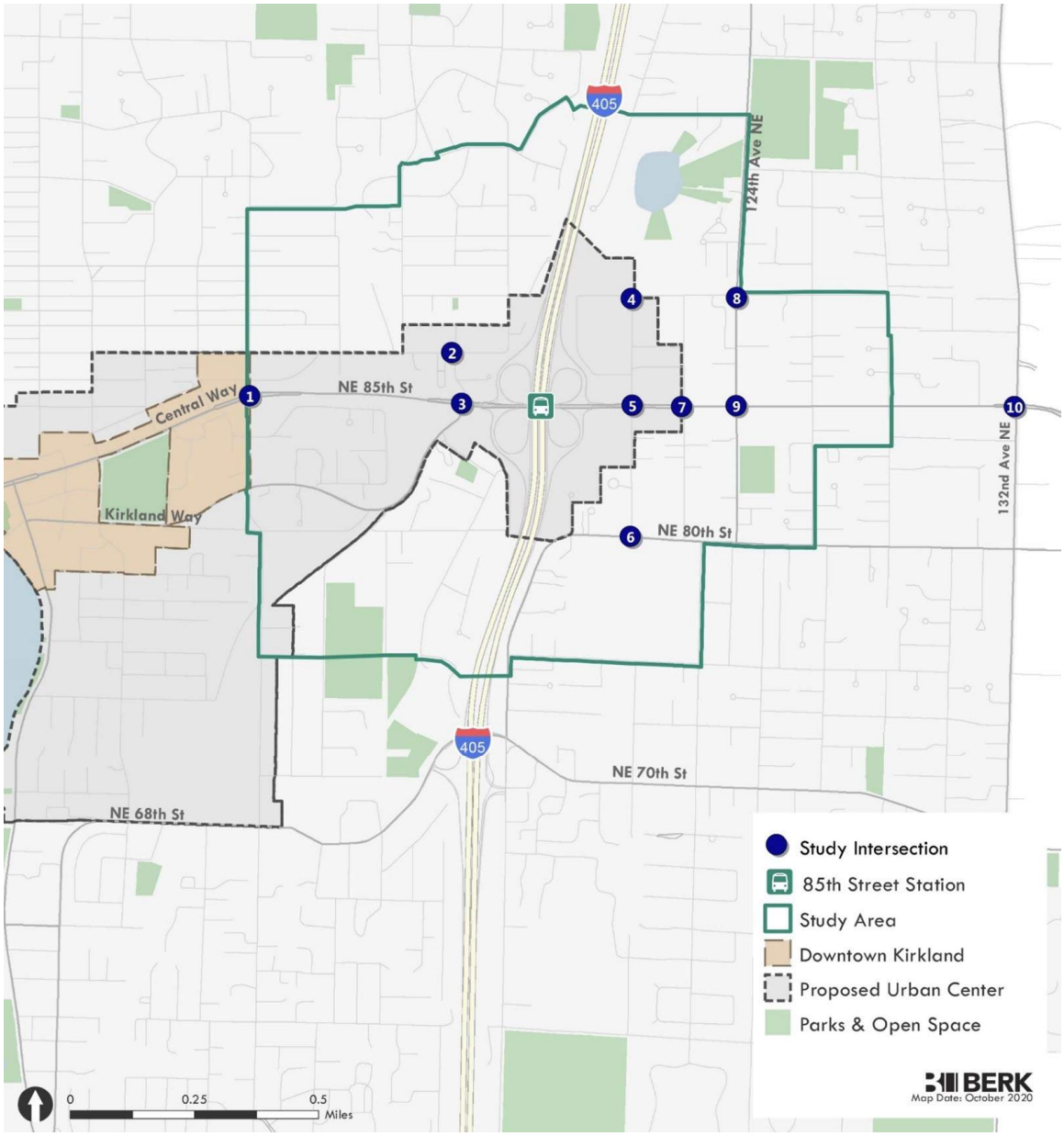


Exhibit 6b: Study Intersections Originally Considered in the DSEIS



Intersection Level of Service

Intersection level of service (LOS) is a concept used to describe traffic operations from the driver's perspective. LOS is defined by intersection delay in seconds and ranges from LOS A with no congestion and little delay to LOS F with substantial congestion and delay. Traffic operations were analyzed using the Synchro 10 software package and Highway Capacity Manual (HCM) 6th Edition methodology. We performed PM peak hour analysis for all intersections shown in **Exhibit 6a**, and AM peak hour analysis was exclusive to two intersections (NE 85th Street & 120th Avenue NE and

NE 85th Street & 124th Avenue NE). The project team modeled the existing (2019) conditions and each of the future alternatives bulleted below.

- 2044 Alternative A
- 2044 Alternative B
- 2044 Alternative 2

The modeled Synchro networks reflect traffic volumes (passenger vehicles, heavy vehicles, and pedestrian and bicycle counts) and roadway network assumptions, including segment and intersection geometry and signal timings that align with each scenario. For signalized and all-way stop controlled intersections, LOS is based on the average delay of all movements. For side street stop-controlled intersections, LOS is based on the movement with the highest delay. **Exhibit 7** summarizes the LOS and delay thresholds specified in the Highway Capacity Manual, which is a standard methodology for measuring intersection performance.

Exhibit 7: LOS and Delay Thresholds for Signalized and Unsignalized Intersections

LOS	Signalized Intersections (Delay in Seconds)	Unsignalized Intersections (Delay in Seconds)
A	≤ 10	≤ 10
B	> 10 to 20	> 10 to 15
C	> 20 to 35	> 15 to 25
D	> 35 to 55	> 25 to 35
E	> 55 to 80	> 35 to 50
F	> 80	> 50

Source: Highway Capacity Manual (Transportation Research Board), 2016.

Findings

Exhibit 8 reports the findings of the intersection analysis conducted by the methodologies described above. Key findings include:

- All study intersections are currently operating within the City's or WSDOT's standards.
- Under Alternative A, which represents current growth trends continuing through 2044, the following intersections would fail to meet adopted LOS standards:
    - **NE 90th Street & 124th Avenue NE:** this intersection would operate at LOS F due to land use growth anticipated in the NE quadrant and the lack of streets connecting north of NE 90th Street.

- **NE 85th Street & 6th Street:** this intersection will operate at LOS F under all future year alternatives due to planned modifications to better accommodate transit, walking, and biking modes.

- Alternative B considered two transportation scenarios for the southeast quadrant, with allowed development at 250 feet maximum height:
  - The first assumes only one general access driveway[2] to the Lee Johnson site via NE 83rd Street to a signalized intersection with 120th Avenue NE;
  - The second scenario considers the same access as above, plus an additional south access to the site along 118th Avenue NE, which connects to 80th Street NE with a newly signalized intersection.
- The reconfiguration of land use growth in Alternative B would substantially improve intersection operations relative to Alternative 2. However, the land use growth envisioned by this alternative would increase vehicle trips on the roadway network (compared to existing conditions or Alternative A/No Action scenario) such that the following intersections would not meet adopted LOS standards under Alternative B:
  - **NE 85th Street & 6th Street:** this intersection will operate at LOS under all future year alternatives due to planned modifications to better accommodate transit, walking, and biking modes. Moreover, additional growth throughout the SAP would result in higher delays than are anticipated for Alternative A.
  - **NE 85th Street & 120th Avenue NE:** this intersection could not meet City standards without mitigation, as this is the main access point for growth in the SE quadrant.
  - **NE 90th Street & 124th Avenue NE:** this intersection could not meet City standards without mitigation, as this is the main access point for growth in the NE quadrant.
  - **NE 83rd Avenue & 120th Avenue NE:** under the scenario in which this intersection serves as the only general access to the Lee Johnson site, it will require signalization (as assumed) as well as additional lanes.
  - **NE 80th Street & 120th Avenue NE:** under the scenario in which only one general access is provided to the Lee Johnson site along NE 83rd Avenue, increased traffic through this intersection would result in LOS F delays without mitigation.
  - **80th Street & 118th Avenue NE**: similarly, under a single access point scenario to the Lee Johnson site, this intersection would also be impacted by additional traffic along 80th Street, although it is unclear whether a signal would be warranted to address the side street delay.

[2] Assumes the Lee Johnson site's direct access to NE 85th Street would be limited to a controlled access point for select trip or vehicle-types.

Exhibit 8: LOS Results for Evaluated Alternatives (Without Mitigation)

ID	Intersection	LOS Standard	Peak Hour	2019 Existing	2044 Alternative A	2044 Alternative B-1: 2 Driveways	2044 Alternative B-2: 1 Driveway	2044 Alternative 2 (DSEIS Results)
1	NE 90th Street & 124th Avenue NE	D	PM	C / 21	**F / 83**	**F / 158**	**F / 158**	**F / 380**
2	NE 85th Street & 6th Street	E	PM	D / 41	**F/109^**	**F / 145^**	**F / 145^**	**F / 138^**
3	NE 85th Street & 120th Avenue NE	D	AM PM	C / 22 C / 21	C / 24 D / 39	**F/ 114** **F/ 113**	**F/ 114** **F/ 113**	**F / 572** **F / 616**
4	NE 85th Street & 124th Avenue NE	D	AM PM	C / 29 D / 35	C / 33 D / 41	D / 39 D / 45	D / 39 D / 45	D / 35 **E / 59**
5	NE 83rd Street & 120th Avenue NE	D	PM	B / 11	B / 13	B / 18*	B / 20**	A / 8*
6	NE 80th Street & 118th Avenue NE	D	PM	B / 15	C / 20	A / 8**	**F / 94**	A / 6**
7	NE 80th Street & 120th Avenue NE	E	PM	B / 11	B / 14	B / 13	**F / 222**	B / 20
8	NE 70th Street & 116th Avenue NE	E	PM	C / 28	D / 35	E / 75	E / 75	E / 67

Source: Fehr & Peers.
Notes:
^ Intersection reconfiguration with transit queue jump and dedicated WBR turn pocket
* Signalized without any geometric improvements
**Signalized with EBL, SBR turn pockets

Proposed Geometric Mitigation Strategies

Exhibit 9 summarizes the results of mitigations tested to address impacted intersections. The following summarizes modifications to the roadway network that would be necessitated by traffic impacts measured for Alternatives A or B.

- **NE 90th Street & 124th Avenue NE:** This intersection is impacted under both Alternatives A and B. Identified mitigation for this intersection includes adding northbound and southbound through lanes and restriping the eastbound through lane to be an eastbound through/left/right lane with east/west split phasing. The additional northbound lane would need to be carried through to north of NE 90th Street. With these improvements in place, the intersection would meet the City's LOS standard under both Alternatives A and B.
- **NE 85th Street & 120th Avenue NE:** Given high delays measured at this intersection under Alternative B during both the AM and PM peak hours, we tested several potential mitigation scenarios to address capacity needs. Based on a site visit, as well as feedback from City staff and the Transportation Commission, two potential geometric mitigation options were identified:
    - Option 1 (See **Exhibit 10a**):
        - Adding an eastbound right turn lane from the I-405 off ramp to 120th Avenue NE to facilitate trips for future intensive development
        - Removal of the western crosswalk of NE 85th Street (since pedestrians would have to cross at least eight vehicle travel lanes with planned widening related to both the interchange and eastbound right turn lane proposed above)
        - Restriping the northbound approach to include a left turn lane and a shared left/through/right turn lane
        - Restriping the southbound approach to include dedicated left, through, and right lanes, with the right turn lane protected by a "pork chop" to create a free movement[3]
        - Revising the signal to provide northbound/southbound split phasing to allow for left turn movements out of either lane from the south approach
    - Option 2 (See **Exhibit 10b**):
        - Restriping the northbound approach to include a left turn lane and a shared left/through/right turn lane
        - Restriping the southbound approach to include dedicated left, through, and right lanes, with the right turn lane protected by a "pork chop."

[3] In designing this improvement it would be important to consider weaving interactions between traffic making the southbound free right and westbound traffic accessing northbound I-405. The viability of installing a pork chop should also be evaluated in final intersection design.

Unlike Option 1, the right turn would not be a free movement since the western crosswalk would remain.
    - Revising the signal to provide northbound/southbound split phasing to allow for left turn movements out of either lane from the south approach
- **NE 83rd Street & 120th Avenue NE:** With the allowed development in the southeast quadrant at a maximum height of 250 feet anticipated under Alternative B, this intersection would need to be signalized. If this intersection serves as the only primary entrance (and a southern entrance via 118th Avenue NE is not provided), this intersection requires additional geometric modification. There are various ways that this intersection could be configured. For the purposes of this modeling, it was assumed that the west leg would include a left-turn pocket, plus a shared left/through/right lane with all other approaches served by one lane. This would require that the northbound left turn lane at the 85th Street intersection be extended to provide a second northbound receiving lane. These improvements are illustrated in **Exhibits 10c**.
- **NE 80th Street & 118th Avenue NE:** Based on delay analysis, this intersection would require mitigation under Alternative B regardless of whether 118th Avenue NE serves as a primary access point. This is due to additional traffic passing through the intersection along 80th Avenue. It should be noted that this intersection is located on a curve and may require additional treatments to ensure safe sight distance. Before constructing a signal, it would also be important to conduct a signal warrant analysis.
- **NE 80th Street & 120th Avenue NE:** If the Lee Johnson site has only one primary entrance (via 83rd Street & 120th Avenue NE), this intersection would require geometric mitigation (a southbound left turn pocket) to maintain the City's LOS standard. This improvement, illustrated in **Exhibit 10d**, could be a standalone improvement, as it would better serve areawide circulation.

No additional geometric modifications have been identified to address impacts at NE 85th Street & 6th Street.

Exhibit 9: LOS Results for Evaluated Alternatives with Geometric Mitigations

ID	Intersection	LOS Standard	Peak Hour	2019 Existing	2044 Alternative A	2044 Alternative B: 2 Driveways	2044 Alternative B: 1 Driveway	2044 Alternative B: 1 Driveway (Mitigated)
1	NE 90th Street & 124th Avenue NE	D	PM	C / 21	**F / 83**	**F / 158**	**F / 158**	D / 52
2	NE 85th Street & 6th Street	E	PM	D / 41	**F/109^**	**F / 145^**	**F / 145^**	**same**
3	NE 85th Street & 120th Avenue NE	D	AM PM	C / 22 C / 21	C / 24 D / 39	**F/ 114** **F/ 113**	**F/ 114** **F/ 113**	**F / 104** **F / 88** **(Mit. Option 1)** **F / 126** **F / 96** **(Mit. Option 2)**
4	NE 85th Street & 124th Avenue NE	D	AM PM	C / 29 D / 35	C / 33 D / 41	D / 39 D / 45	D / 39 D / 45	same
5	NE 83rd Street & 120th Avenue NE	D	PM	B / 11	B / 13	B / 18*	B / 20**	D / 37
6	NE 80th Street & 118th Avenue NE	D	PM	B / 15	C / 20	A / 8***	**F / 94**	A / 5*
7	NE 80th Street & 120th Avenue NE	F	PM	B / 11	B / 14	B / 13	**F / 222**	D / 52
8	NE 70th Street & 116th Avenue NE	E	PM	C / 28	D / 35	E / 75	E / 75	same

Source: Fehr & Peers.
Notes:

* Signalized without any geometric improvements
** Signalized with EBL, NBL, SBR turn pockets
*** Signalized with EBL, SBR turn pockets
^ Intersection reconfiguration with transit queue jump and dedicated WBR turn pocket

Exhibit 10a: Potential Geometric Modifications to NE 85th Street/120th Avenue NE

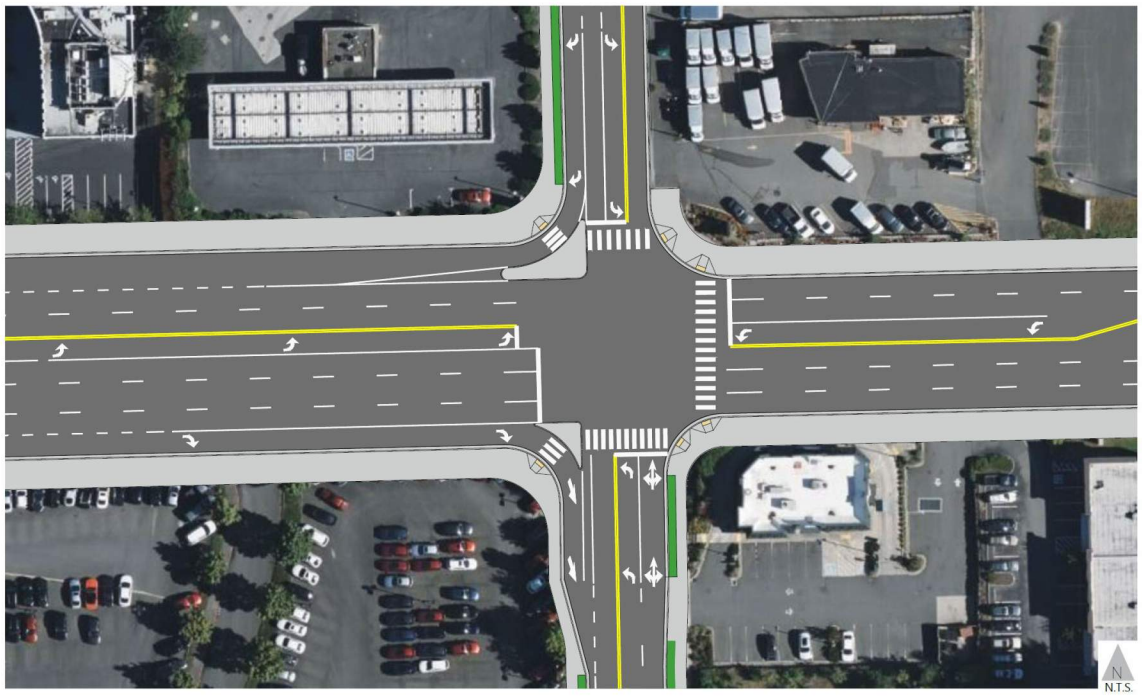


Exhibit 10b: Potential Geometric Modifications to NE 85th Street/120th Avenue NE

Exhibit 10c: Potential Geometric Modifications to NE 83rd Street/120th Avenue NE

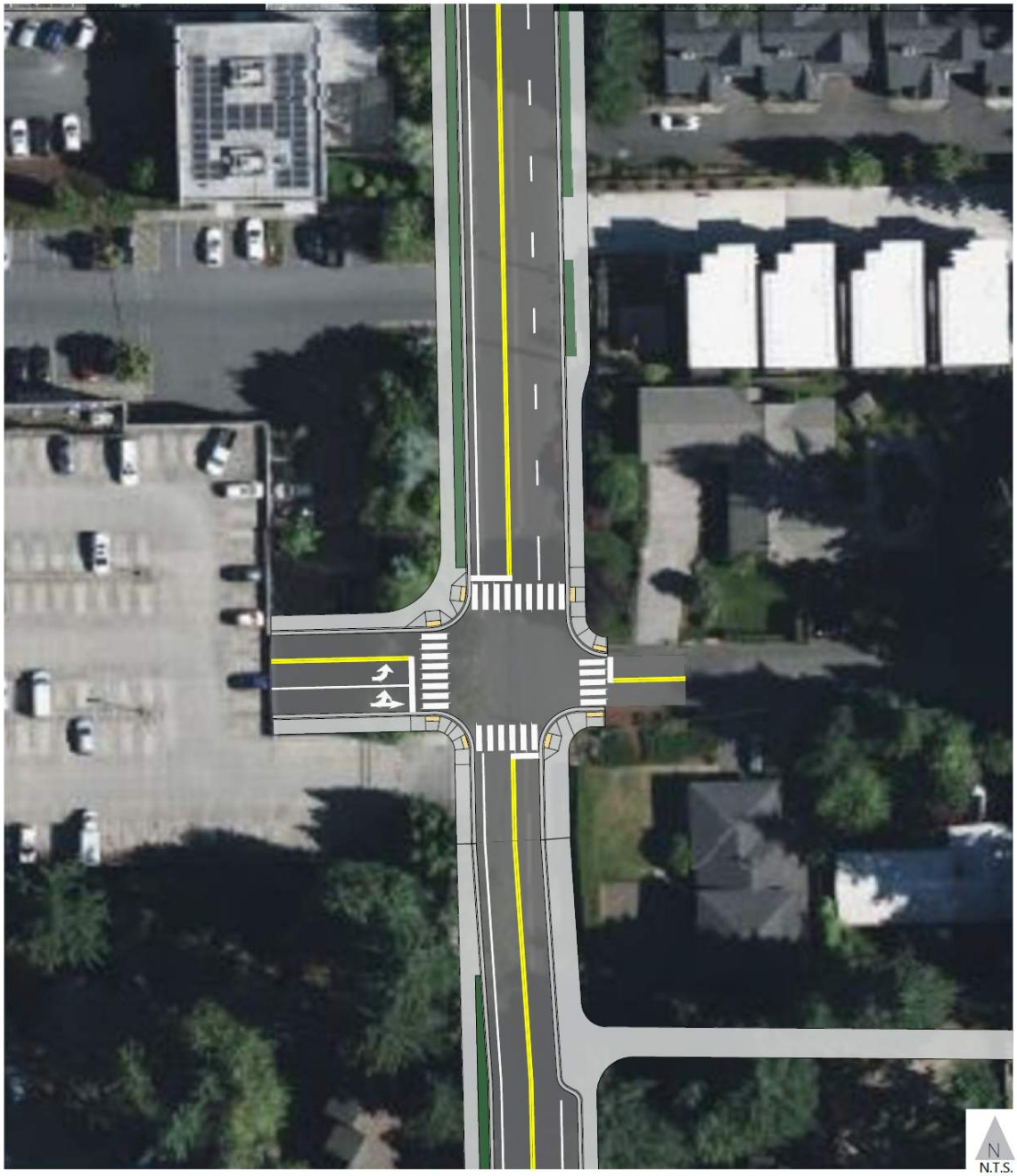
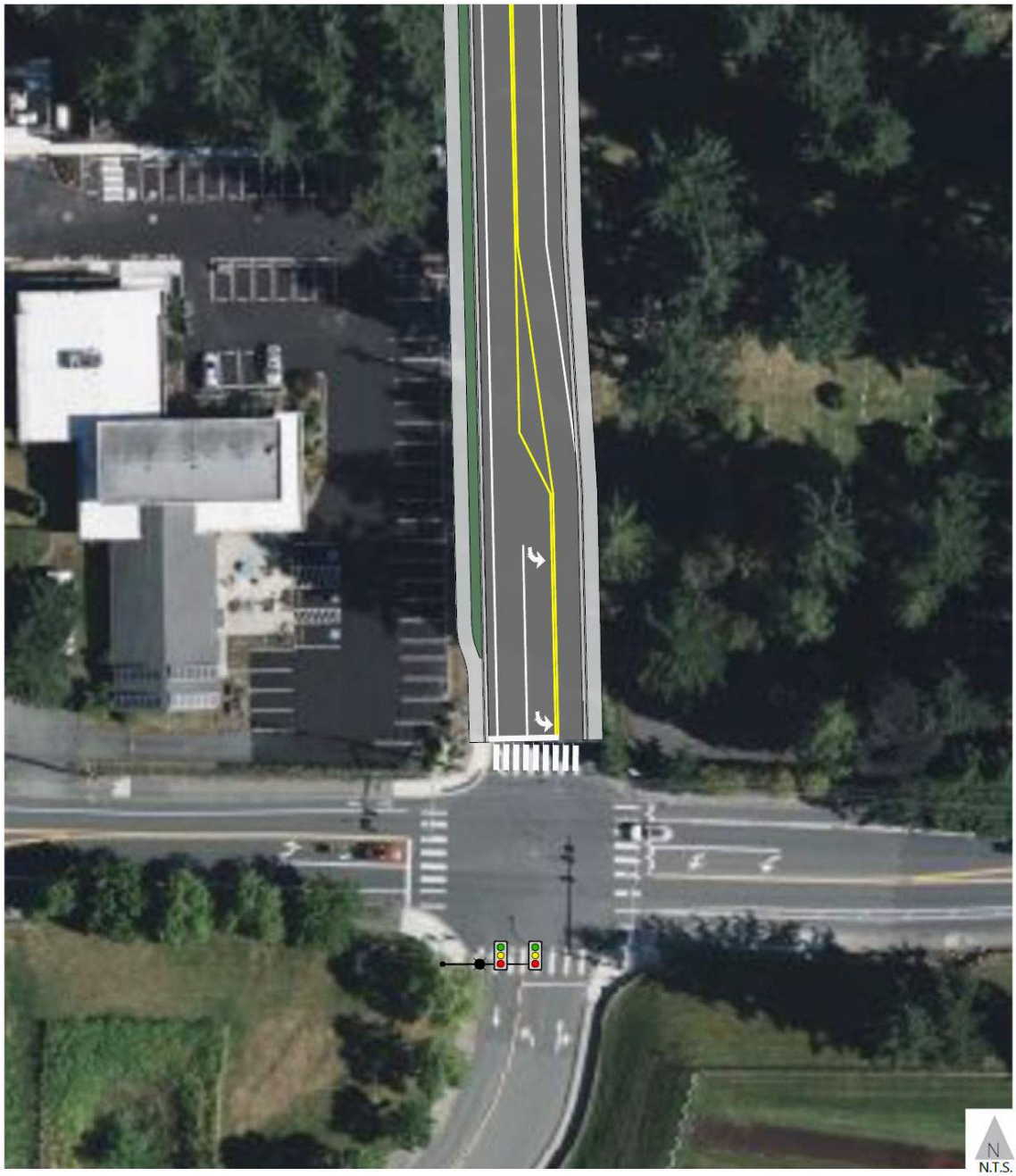


Exhibit 10d: Potential Geometric Modifications to NE 80th Street/120th Avenue NE



NE 85th Street Interchange Analysis

The operations at the I-405/NE 85th Street interchange were evaluated using the microsimulation traffic models developed by WSDOT for their interchange study. This sensitivity test was conducted to determine whether the additional land use growth allowed under the 85th Station Area Plan would affect the operations at the redesigned interchange. The Vissim model provided by WSDOT simulates NE 85th Street between 6th Street and 124th Avenue NE, including the freeway ramps to and from I-405 as well as the BRT station and access points.

Details about our analysis and overall findings are included in **Appendix A**. Overall, the Station Area Plan will result in slightly higher delays and queuing along NE 85th Street in the future than estimated by WSDOT in their interchange analysis. However, the increases do not significantly affect the operations of the interchange or the freeway mainline.

Transportation Demand Management Strategies

The trip generation estimates produced from the BKR model and MXD trip generation tool predict mode share based primarily on land use and demographic information but do not take additional TDM measures into account. This approach provides a conservative estimate of the transportation conditions for each alternative in the absence of robust TDM measures. However, additional mitigation measures could be considered to modify and expand current TDM strategies. These strategies would not only help to reduce driving, which in turn lessens traffic congestion and greenhouse gas impacts, but fundamentally align with the City's values and vision for the station area.

Potential TDM Strategies

A comprehensive set of strategies were considered by City staff to select those that are most likely to be implemented both because they are within the City's control and consistent with the City's vision for the study area; these are listed as Tier 1 strategies below. While these actions are within the City's control, many would require investment of additional City staff time or code revisions to implement. An additional set of strategies, listed below as Tier 2, could also be pursued but would either be led by developers or would require additional partnerships beyond sole City control.

Tier 1 TDM Strategies

- Unbundle parking to separate parking costs from total property cost, allowing buyers or tenants to forgo buying or leasing parking spaces if they do not park a car.
- Revise parking code to reduce the amount of parking new developments must provide or implement parking maximums to further reduce the amount of parking supply in the

Study Area beyond what is assumed under Alternatives 2 and 3. This would limit the number of parking spaces which can be built with new development.

- Implement managed on-street parking strategies (e.g., designate special use zone for activities such as loading/unloading or emergencies, implement time restricted parking, and charge for parking).
- Require new development to charge for parking off-street.
- Implement requirements for robust monitoring and management of parking and the TDM measures in the Study Area to ensure that people are not parking in the surrounding neighborhood to avoid these parking management measures.
- Encourage or require transit pass subsidies from developers/property owners.
- Expand upon Kirkland's Green Trip program to utilize commute marketing programs to advertise different commuting options and encourage walking, biking, transit use, carpooling, vanpooling, or other means of travel.
- Utilize an Emergency Ride Home program to provide a taxi voucher or other way for employees to travel home if an emergency or unexpected late work makes them miss their normal transit, carpool, or bike ride home.
- Accommodate bicyclists by requiring development to provide secure, covered, and convenient bicycle parking at office and residential buildings; showers and lockers at offices; and public repair stations.
- Utilize a Ridematch Program to assist potential carpoolers in finding other individuals with similar travel routes. These may be open or closed systems, but generally a larger population will have more potential matches.

Tier 2 TDM Strategies

- Provide shared off-street parking with new developments.
- Provide private shuttle service or gondola as a first mile/last mile solution to make the 85th Street Station more accessible from Downtown Kirkland, the 6th Street Google campus, Kirkland Urban, and other destinations, and to provide an attractive transportation alternative for locations that are less served by fixed-route transit. Two shuttle routes should be explored – one to Downtown Kirkland and Kirkland Urban using NE 87th Street/7th Avenue and 5th Street, and one that goes to the 6th Street Google Campus and Houghton/Everest Neighborhood Center at 108th Avenue NE & NE 68th Street using the Cross Kirkland Corridor. This could start as a pilot program in partnership with Uber or Lyft to provide subsidized rides to gauge demand for a shuttle. Ultimately, Gondola service routes should be further explored connecting the station area to Downtown Kirkland using the NE 85th Street/Central Way corridor with three stations - the first station would be in the vicinity of the NE 85th Street/I-405 In-line Station and Interchange, the second station could be located in the northeast corner of the 6th Street

and NE 85th Street Intersection and the third station would be in the vicinity of the downtown Kirkland Transit Center.

- Encourage or require transit pass provision programs for residents— King County Metro has a Passport program for multifamily housing that is similar to its employer-based Passport program. The program discounts transit passes purchased in bulk for residences of multifamily properties.
- Partner with Transportation Network Companies (TNCs) such as Uber or Lyft to provide pooled ridesharing options, ideally as a last-mile connection to transit or as an aspect of an Emergency Ride Home program.
- Launch a bikeshare or other micromobility system in Kirkland.

Efficacy of TDM Strategies

Because the Tier 1 strategies are most likely to be implemented, the quantitative efficacy of those strategies was estimated and the resulting trip reductions were incorporated into the traffic operations analysis to understand how the strategies would affect operations at the intersection level. Tier 2 strategies could still be pursued but have not been quantified in terms of their effects on traffic operations because they are more speculative at this time.

To evaluate the potential efficacy of the proposed TDM measures, Fehr & Peers used its TDM+ tool. TDM+ is a tool that allows the user to estimate how a set of TDM strategies will affect vehicle trip generation. The tool uses a realistic, evidence-based assessment of how similar strategies have worked in similar locations. By incorporating nuances such as the urban form and limiting the measures included to those with well-documented research, the TDM+ approach allows for a high level of technical rigor and defensibility when quantifying a program's potential to reduce vehicle trips or vehicle miles.

This quantitative approach emerged from a 2010 partnership with the California Air Pollution Control Officers Association (CAPCOA) to develop a comprehensive set of guidelines for assessing and quantifying reductions in vehicle miles traveled and greenhouse gas emissions associated with more than 50 TDM strategies, both individually and in combination.[4] The CAPCOA report is a resource for local agencies to quantify the benefit, in terms of reduced travel demand, of implementing various TDM strategies. Working with the Bay Area Air Quality Management District, the evaluation methods were validated by comparing the strategies to the San Francisco Bay Area. Fehr & Peers has continued to update TDM+ since the initial CAPCOA report, with the most recent iteration incorporating information from new studies published through 2018.

Exhibit 11 summarizes the range of estimated efficacy for each of the Tier 1 strategies. Combined these strategies have an estimated overall efficacy of 9 to 38 percent, with 13 percent

[4] California Air Pollution Control Officers Association, Quantifying Greenhouse Gas Mitigation Measures. August 2010.

recommended for typical planning applications.[5] In **Exhibit 12**, we apply these strategies to our traffic operations analysis to see the combined efficacy of geometric and TDM strategies in mitigating transportation impacts. As the exhibit shows, TDM serves to reduce delays, although the intersections of NE 85th Street with 6th Street and 120th Avenue NE would have delays exceeding City standards.

[5] Full implementation of Tier 2 strategies could result in vehicle trip reductions that range from 10-40%, with 16% recommended for typical planning applications. It is worthwhile to note that some of the measures in the Tier 2 list, including shared off-street parking and implementation of a gondola, could not be quantified.

Exhibit 11: Tier 1 Transportation Demand Management Strategies

TDM Reduction Summary Report: Kirkland 85th Station Area Plan				
Parking	VMT % Reduction by Land Use			
	Office	Residential	Retail	Other
Increased Off-Street Fees	6% to 11%	6% to 11%	6% to 11%	
Increased On-Street Fees	1% to 5%	1% to 5%	1% to 5%	
Unbundled Parking	–	–	–	
Pay-as-you-Go Parking Rates				
Parking Supply	up to 4%	4% to 4%	up to 4%	
Transit	**Office**	**Residential**	**Retail**	**Other**
Subsidies	up to 2%	–	–	
Transit Frequency				
Transit Coverage				
Private Point-to-Point Shuttles				
Last Mile Shuttle				
Commute Programs	**Office**	**Residential**	**Retail**	**Other**
Commuter Incentives				
Commute Marketing Program	2% to 16%	3% to 21%	up to 3%	
Emergency Ride Home	up to 1%	–	–	
TNC Partnerships				
Bike and Walk	**Office**	**Residential**	**Retail**	**Other**
Secure Parking	–	up to 1%	–	
Showers & Lockers	–	–	–	
End of Trip Repair Stations	–	up to 1%	–	
Pedestrian-Oriented Design				
Bikeshare System & Subsidies				
Ride	**Office**	**Residential**	**Retail**	**Other**
Carpool/Vanpool Incentives				
Ridematch Program	up to 6%	up to 6%	up to 6%	up to 6%
Carshare				
Carshare Subsidy				
Total of All Measures	9% to 38%	13% to 40%	7% to 22%	-

Exhibit 12: Transportation Demand Management Strategies Efficacy in Mitigating Intersection Impacts

ID	Intersection	LOS Standard	Peak Hour	2019 Existing	2044 Alternative A	2044 Alternative B: 2 Driveways	2044 Alternative B: 1 Driveway	2044 Alternative B: 1 Driveway (TDM + Geometric Mitigations)
1	NE 90th Street & 124th Avenue NE	D	PM	C / 21	**F / 83**	**F / 158**	**F / 158**	D / 46
2	NE 85th Street & 6th Street	E	PM	D / 41	**F/109^**	**F / 145^**	**F / 145^**	**F / 139^**
3	NE 85th Street & 120th Avenue NE	D	AM PM	C / 22 C / 21	C / 24 D / 39	**F/ 114** **F/ 113**	**F/ 114^^** **F/ 113**	**F / 85^^** **E/ 80**
7	NE 80th Street & 120th Avenue NE	F	PM	B / 11	B / 14	B / 13	**F / 222**	B / 13

Source: Fehr & Peers.
Notes:
* Signalized without any geometric improvements
** Signalized with EBL, NBL, SBR turn pockets
*** Signalized with EBL, SBR turn pockets
^ Intersection reconfiguration with transit queue jump and dedicated WBR turn pocket
^^ Assumes Option 1 geometric mitigations

TDM Strategy Implementation

As noted above, implementation of TDM strategies would require investments by the City in several forms, including:

- City staff time to develop code revisions and manage compliance, for example requiring developers to provide a transit subsidy to tenants.
- Creation of new staff positions to implement and operate new programs, for example on-street parking policing and management and off-street parking program implementation.
- Capital investments, for example micromobility charging stations.

These costs, both for initial start-up and ongoing program management, should be considered within the financial evaluation of the plan.

Transit Analysis

As of 2021, the Station Area is served by 14 transit routes, as summarized in **Exhibit 13.**

Exhibit 13: Transit Routes in the Station Area Plan (2021)

Route Number	Agency	Route Description	PM Headway (min)
230	King County Metro	North Creek - Bothell - Juanita - Kirkland TC	30 - 32
231	King County Metro	Woodinville - Brickyard - Juanita - Kirkland TC	30 - 33
237	King County Metro	Woodinville P&R - Bellevue TC	47
239	King County Metro	UW/Cascadia Coll - Totem Lake TC - Kirkland TC	27 - 36
245	King County Metro	Kirkland Transit Center - Crossroads - Factoria	14 - 16
250	King County Metro	Avondale - Redmond TC - Kirkland TC - Bellevue TC	15 - 16
255	King County Metro	Totem Lake TC-Kirkand TC-UW Link Sta-Univ Dist	7 - 15
257	King County Metro	Brickyard P&R - Downtown Seattle	22 - 36
311	King County Metro	Woodinville - Downtown Seattle	20 - 25
342	King County Metro	Shoreline P&R - Renton TC	28 - 71
424	Community Transit	Snohomish - Seattle	94
532	Sound Transit	Everett - Bellevue	15 - 30
535	Sound Transit	Lynnwood - Bellevue	30
230	King County Metro	North Creek - Bothell - Juanita - Kirkland TC	30 - 32

Source: Fehr & Peers, 2021

Fehr & Peers considered three primary elements to understand potential change to transit conditions under the different land use alternatives: passenger loads, speed and reliability, and access-to-transit. We briefly describe how the growth anticipated by Alternatives A and B influences these transit elements and then present our analysis of the relative impact of each land use alternative on these elements of the transit environment.

- **Passenger load analysis** provides an understanding into how land use growth may generate additional transit ridership and potentially cause overcrowding on routes that access the area.
- The additional vehicles trips land use growth generated within the subarea may cause challenges with **transit speed and reliability**.
- Land use growth also brings new transit riders and a need for enhanced **access-to-transit** solutions

Ridership and Passenger Loads

To evaluate the impact of the future year action alternatives on the transit passenger loads in the study area, Fehr & Peers utilized the 2042 Sound Transit (ST) Model[6] and bus crowding threshold guidance from King County (KC) Metro[7]. The 2042 ST Model provided PM peak period transit boardings and alightings at stops within a block of NE 85th Street, which were used to determine transit ridership distribution and average transit trips along various routes in the station area. The data was extracted directly from an 'Off-the-shelf ST Model run'; therefore, no new transit ridership modeling was performed for this effort. KC Metro ridership data offered guidance on bus crowding based on available seats on a bus and route frequency to determine if a route can accommodate anticipated passenger loads. However, it should be noted that KC Metro's bus crowding thresholds do not guarantee a seat for every rider on the bus. The thresholds account for an acceptable number of both seated and standing riders.

Consistent with the 85th Station Area Plan DSEIS, an impact was identified based on the following criteria:

- The forecast passenger loads exceed the KC Metro/ST overcrowding threshold on any route in the study area that have passenger loads below the crowding threshold under the No Action Alternative
- The forecast ridership increases the passenger load by at least 5% on a route that already exceeds the guidelines under the No Action Alternative

[6] The 2042 ST Model closely represents projected 2035 land use, as identified by PSRC LUV.2 forecasts, which are consistent with the Kirkland 2035 Comprehensive Plan reflected in No Action Alternative.
[7] Bus seat capacity and crowding thresholds from Fall 2018 KCM Ridership Data.

Out of all the routes that run through the study area, only the I-405 BRT has a passenger load factor that exceeds 1.0 in the No Action Alternative. **Exhibit 14** indicates that all the reviewed action alternatives further impact the I-405 BRT due to the new PM peak hour transit trips; transit ridership growth for these alternatives exceeds 15 percent. There is an additional impact on Route 250 for Alternative 2 as a result of substantial (248%) growth in transit ridership and forecast passenger loads above the King County Metro crowding threshold. Alternative B also sees substantial growth, but does not exceed Metro's crowding threshold.

Exhibit 14: Impacted Transit Ridership

Action Alternative	New PM Peak Hour Transit Trips in Station Area	Routes With Passenger Load Factors Above the Threshold	New PM Peak Hour Riders per Route	Passenger Load Factor^	Transit Ridership Growth
Alternative A	372	I-405 BRT North	11	1.16	15%
Alternative B	603	I-405 BRT North	18	1.25	24%
Alternative 2	669	Route 250	38	1.06	285%
		I-405 BRT North	20	1.28	26%

Source: Fehr & Peers, 2021
Notes:
^ Passenger load factor is a ratio of anticipated ridership compared to KC Metro's crowding threshold.

To address the projected overcrowding of buses along the impacted routes in **Exhibit 14**, some riders may slightly shift their commute time to avoid the peak period or access their destination via different routes. Transit agencies also regularly monitor the passenger load factor and adjust scheduling to best accommodate ridership demand. An expanded safe bicycle network to additional areas within the city and region would also help alleviate transit overcrowding by providing alternatives to riding transit.

Transit Speed and Reliability

As shown in the previous traffic operations section, several intersections along NE 85th Street that transit serves will operate at LOS E or worse with the future land use alternatives, including at the intersections with 6th Street and 120th Avenue NE. Additional delay at these intersections may slow down transit and degrade the reliability of service. A queue jump is currently being planned at NE 85th Street and 6th Street to improve transit operations through that intersection. The project stemmed from an initial project identified in ST3 to fund bus-only lanes along NE 85th Street between the I-405 BRT station and Downtown Kirkland. The Kirkland Transit Implementation Plan (KTIP), adopted in early 2019, identified the 6th Street queue jump along with other transit-supportive projects across the city. Several alternatives were reviewed during the KTIP development to identify optimal transit priority solutions along NE 85th Street, including side and

center-running transit lanes between I-405 and 6th Street. However, the transit lane options were removed for further consideration because the transit lanes would provide limited speed and reliability benefits for the substantial cost while potentially constraining pedestrian access and limiting bus station location options. In addition, the KTIP identified the NE 85th Station as a top priority to provide non-motorized access improvements. The KTIP also evaluated a potential queue jump at NE 85th Street and 124th Avenue NE, but the project was not advanced to the final project list in the plan.

Transit Access

The next section of the memo focuses on infrastructure for people walking and bicycling. Many of the improvements have been identified for the purpose of enhancing transit access. Key improvements include:

- Construction of shared use trail connections to transit stops along 85th Street and the BRT station
- Complete street and greenway improvements on key routes accessing transit stops along 85th Street and the BRT station, including 5th Avenue, 7th Avenue/87th Street, 116th Avenue, and 90th Street
- Widened sidewalks along 85th Street throughout the SAP

To create a seamless system of transit access for all users, these investments could be paired with first/last mile rideshare services and enhanced stop amenities along NE 85th Street, recognizing the waiting conditions along a busy corridor (at Kirkland Way, 120th Ave NE, etc.)

Comfort for People Walking and Biking

Fehr & Peers evaluated how well the study area can accommodate people walking and biking under two scenarios:

- **Existing Plus Committed Project Conditions:** This scenario considers transportation infrastructure on the ground today, as well as transportation infrastructure that is likely to be constructed independent of the SAP. Infrastructure assumed under this scenario is mapped in **Exhibit 15**.
- **Recommended Station Area Investments:** This scenario considers all of transportation infrastructure from the prior scenario plus capital investments recommended as part of the SAP to accommodate trip growth anticipated with development, better connect to the BRT station, and/or provide a more complete and low-stress active transportation network. Infrastructure assumed under this scenario is listed below and mapped in **Exhibit 16** and more fully described in the Factsheets, which are **Appendix B** to this memo.

Project Number	Recommended Station Area Investment
1	Lee Johnson East Access (Including 120th Corridor from NE 83rd to NE 85th Street)
2	Lee Johnson South Access
3	NE 80th Street/120th Avenue NE Signal Improvement (Including 120th Corridor from NE 80th to NE 83rd Street)
4	124th Avenue NE Widening
5	NE 85th Street/120th Avenue NE Improvements
6	5th Avenue to Kirkland Way Shared Use Trail
7	5th Avenue Greenway
8	6th Street Widened Sidewalks
9	Kirkland Way Complete Street
10	7th Avenue/NE 87th Street Complete Street
11	NE 87th Street/116th Avenue NE Complete Street
12	116th Avenue NE Greenway
13A	405 Interchange Path (SW)
13B	405 Interchange Path (NE)
13C	405 Interchange Path (SE)
14	NE 90th Street Complete Street
15	NE 90th Street Greenway
16	122nd Avenue NE Bike Route
17	120th Avenue NE to 122nd Avenue NE Ped-Bike Connection
18A	NE 85th Street Enhanced Sidewalks
18B	NE 85th Street Enhanced Sidewalks
18C	NE 85th Street Enhanced Sidewalks
18D	NE 85th Street Enhanced Sidewalks
18E	NE 85th Street Enhanced Sidewalks
19	116th Avenue NE Pedestrian/Bike Access to Overcrossing
20	120th Avenue NE improvements (NE 85th Street to NE 90th Street)
P1	6th Street/7th Avenue Intersection Treatment
P2	NE 85th Street / 122nd Avenue NE Bicycle Signal Improvements
P3	NE 87th Street/116th Avenue NE Enhanced Intersection
P4	122nd Avenue NE and NE 80th Street Intersection Treatment

Exhibit 15: Existing Plus Committed Projects

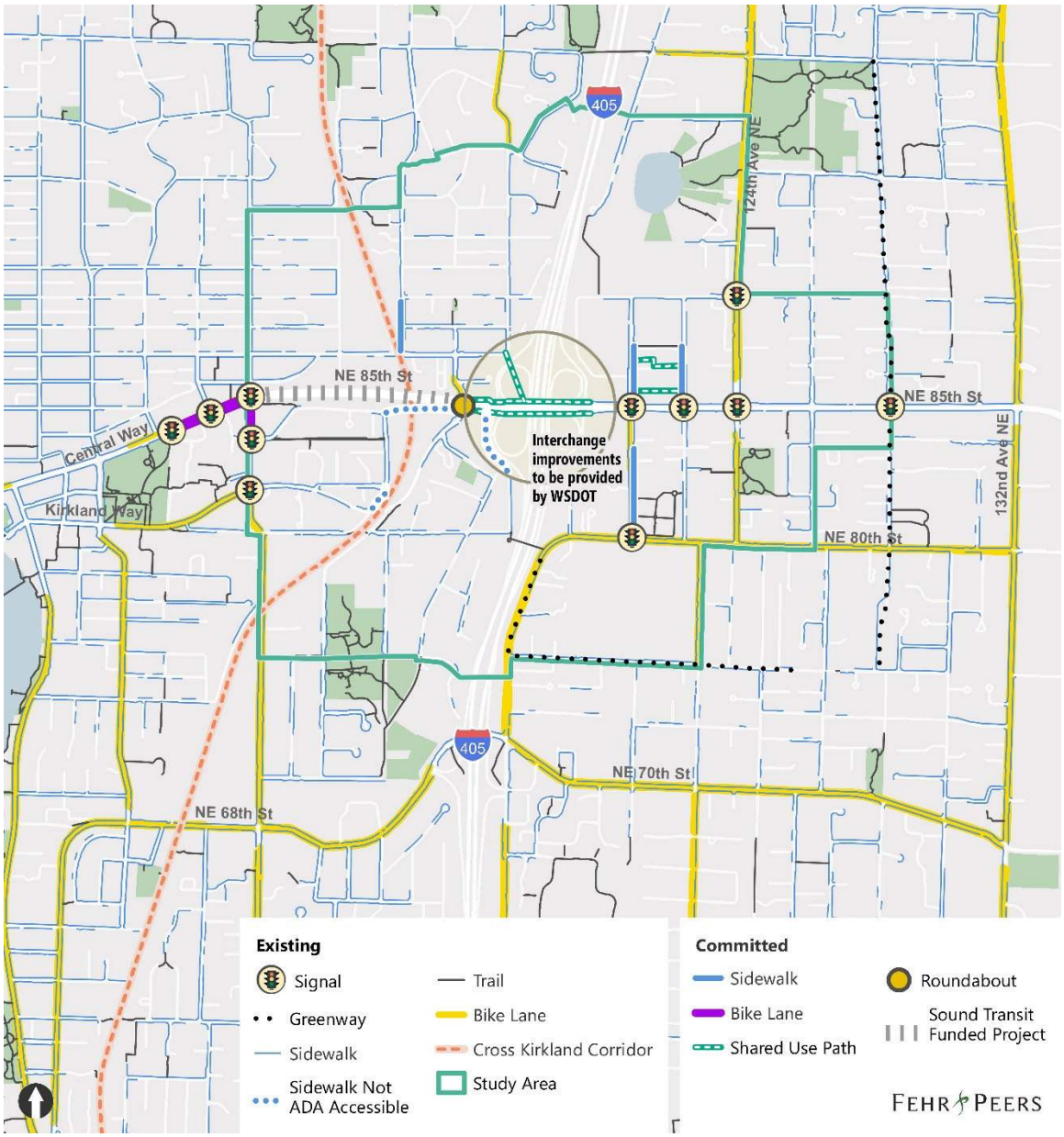
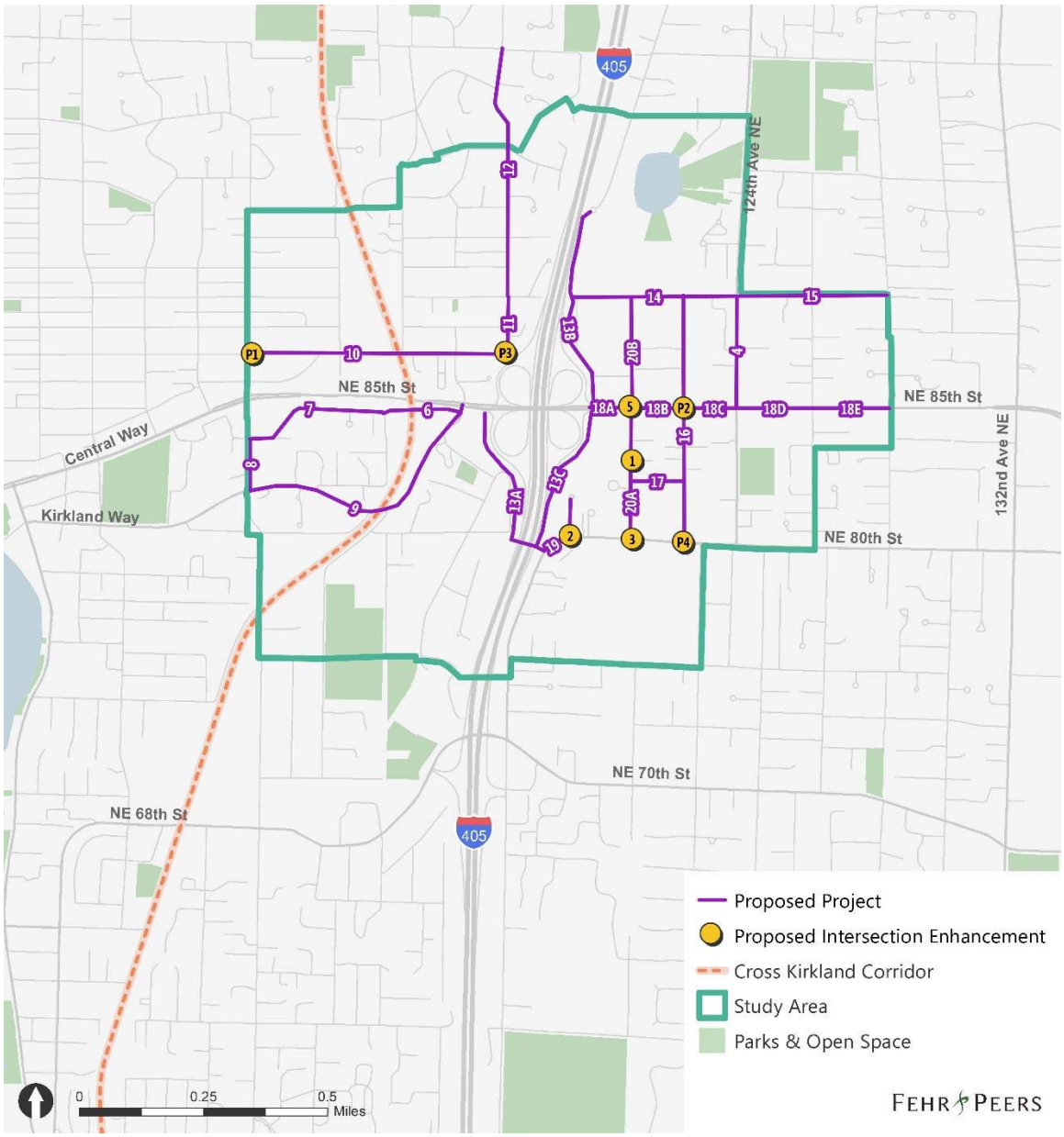
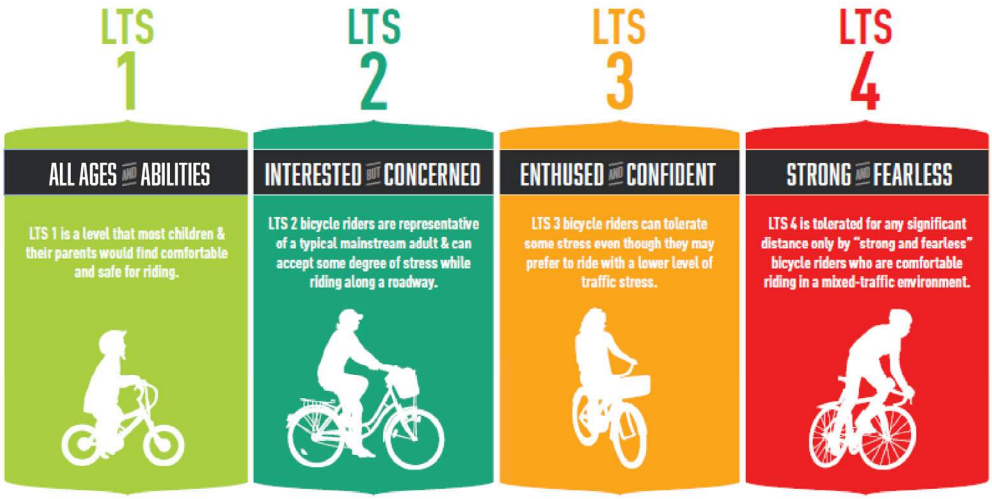


Exhibit 16: Recommended Station Area Investments



The comfort of facilities for people walking and biking is measured quantitatively using a metric called "level of traffic stress." This metric describes conditions for on a scale of 1-4, with level 1 representing conditions that are comfortable for people of all ages and all abilities and level 4 representing conditions that are stressful for almost everyone (see **Exhibit 17**). To increase the number of people who choose to walk or bike, communities should strive to provide the most comfortable facilities possible within given constraints such as right of way, slope, environmental feasibility, modal conflicts, and cost.

Exhibit 17: Level of Traffic Stress Concept



Exhibits 18-**19** present the criteria that was used to screen level of traffic stress for people walking under the Existing Plus Committed Infrastructure scenario. These criteria recognize that increases in the number of travel lanes and posted speeds lead to a more stressful network, as does a narrower sidewalk environment.

It should be noted that this screening methodology identifies areas of potential high stress for people walking, but is not an algorithm intended to be employed once a low-stress intervention, such as wider, physically separated sidewalks buffered from vehicle traffic are in place. It is assumed that the treatments recommended for the station area, which include wider sidewalks and buffering from vehicle traffic by bike facilities, landscaping, and on-street parking would provide a low-stress environment that fits the context of the overall station area plan vision. The measured comfort levels of transportation facilities in the study area under the Existing Plus Committed Conditions and with Recommended Station Area Investments scenarios are shown in **Appendix C** of this memo.

Exhibit 18: Pedestrian LTS – Detached[1] Sidewalk Screening Criteria

Criteria	LTS 1	LTS 2	LTS 3	LTS 4
# of Travel Lanes	2-3 lanes	4-5 lanes	6+ lanes	(no effect)
Usable Sidewalk Width	>= 10 feet	9 to 8 feet	6 to 7 feet	< 6 feet
Posted Speed Limit	<= 25 MPH	26-30 MPH	31-35 MPH	>=36 MPH

Source: Fehr & Peers, 2021
Notes:
1 Detached sidewalks have a buffer between the sidewalk and the adjacent curb, which could include on-street or off-street bicycle facilities, on-street parking, landscaping, or an amenity zone.

Exhibit 19: Pedestrian LTS – Attached[1] Sidewalk Screening Criteria

Criteria	LTS 1	LTS 2	LTS 3	LTS 4
# of Travel Lanes	2-3 lanes	(no effect)	4-5 lanes	6+ lanes
Usable Sidewalk Width	>= 10 feet	9 to 8 feet	6 to 7 feet	< 6 feet
Posted Speed Limit	<= 20 MPH	21-25 MPH	26 - 30 MPH	31 – 35 MPH

Source: Fehr & Peers, 2021
Notes:
1 Attached sidewalks are directly adjacent to the travel-way and separated by only a curb.

Exhibit 20 presents the criteria used to evaluate level of traffic stress for biking. These criteria were applied to evaluate comfort levels of cyclists under both the Existing Plus Committed Infrastructure and Recommended Station Area Improvements scenarios. The measured comfort levels of transportation facilities in the study area under the Existing Plus Committed Conditions and with Recommended Station Area Investments scenarios are shown in **Appendix C** of this memo.

Exhibit 20: Bicycle LTS and Roadway Characteristics

Speed Limit (mph)	Arterial Traffic Volume	No Marking	Sharrow Lane Marking	Striped Bike Lane	Buffered Bike Lane	Protected Bike Lane	Physically Separated Bikeway
≤25	<3k	1	1	1	1	1	1
	3-7k	3	2	2	2	1	1
	≥7k	3	3	2	2	1	1
30	<15k	4	3	2	2	1	1
	15-25k	4	4	3	3	3	1
	≥25k	4	4	3	3	3	1
35	<25k	4	4	3	3	3	1
	≥25k	4	4	4	3	3	1
40	Any volume	4	4	4	4	3	1

Source: Fehr & Peers, 2021

Accessibility Analysis

Fehr & Peers evaluated how accessible the study area will be under from the perspective of people walking and biking. To make this determination, we considered how far someone could get traveling to or from the proposed station (assumed to be at the I-405/NE 85th Street interchange) on foot or by bike under the Existing Plus Committed Conditions and with Recommended Station Area Investments Scenarios. Our specific study parameters for each analysis are documented below and the results are mapped in **Appendix D**.

Pedestrian Walkshed Assumptions

Pedestrians are assumed to use sidewalks, trails, and/or low volume/speed residential roads (with or without sidewalks). Arterials without sidewalks were not included in the network. Existing sidewalks, trails, and committed projects were included to create walksheds based on the actual walking path of a pedestrian both to and from the station. Walk time (in minutes) along each segment in the network is calculated by dividing the length of each sidewalk by an assumed walking speed of 3 mph (265 feet per minute). Walksheds were created for the full network, and a network that excludes ADA non-compliant facilities.

Bicycle Walkshed Assumptions

To plan for the broader cycling population, cyclists are assumed to only use low stress networks (LTS 1 and LTS 2). It is assumed that cyclists will walk their bike on the sidewalk of any LTS 3 or LTS 4 portion of a network. Existing bicycle infrastructure and committed projects were included to create bikesheds based on the actual biking path of a cyclist to and from the station. Bicycle travel time (in minutes) along each segment in the network is calculated by dividing the length of each segment by an assumed cycling speed of 10 mph. On LTS 3 or LTS 4 portions of the network, cyclists are assumed to walk their bike on a sidewalk at a walking speed of 3 mph (265 feet per minute.

It was assumed that the baseline speed of bicyclists on flat terrain is 10 MPH. Bicycle impedances were introduced if a slope was encountered in the direction of travel. The impedance (minutes of travel time) was inflated along the segment based on the change in energy requirements to bicycle uphill relative to the energy requirement to bicycle up a 2% slope. Slopes less than 2% are assumed to be at a speed that is the same as the baseline speed of 10 MPH. The equations used to compute changes in energy requirements are based on literature from sports science[8] looking at changes in energy requirements in response to slopes. In our equation, we only accounted for changes in rolling resistance and gravitation potential energy based on the following equation:

$$Watts = k^r * M * s + g * i * M * s$$

[8] Cycling Uphill and Downhill. David Swan. Wellness Institute & Research Center. Sports Science, 1998.

- K^r – is the coefficient of rolling resistance, in our case for bitumen we used 0.005
- M – is the mass of the cyclist and the bike, in our case 90 kg.
- s – is the speed of the cyclists going uphill, we used 5.5 mph
- g – is the gravitation acceleration of earth at 9.8 m/s^2 at sea level
- i – is the incline or grade of the slope, this is an approximation since the sine of the road angle should be technically used

Based on a comparison of a segment slope to the energy required for a 2% incline, a ratio is derived that is used to inflate the impedance values for the uphill slope of the segment. All downhill slopes were assumed to have no significant change in impedances.

Proposed Package of Investment Strategies

In this section, we describe the full package of improvements recommended to provide safe and comfortable mobility for all within the SAP should the City move to selected growth aligned with June Alternative B.

Roadway and Geometric Changes

The following modifications are recommended to provide capacity to lessen or fully mitigate impacts on the roadway system:

- **NE 90th Street & 124th Avenue NE (Alternatives A and B):** Identified mitigation for this intersection includes adding northbound and southbound through lanes and restriping the eastbound through lane to be an eastbound through/left/right lane with east/west split phasing. The additional northbound lane would need to be carried through to north of NE 90th Street. With these improvements in place, the intersection would meet the City's LOS standard under both Alternatives A and B.
- **NE 85th Street & 120th Avenue NE (Alternative B):** Based on a site visit, as well as feedback from City staff and the Transportation Commission, two potential geometric mitigation options were identified:
    - Option 1:
        - Adding an eastbound right turn lane from the I-405 off ramp to 120th Avenue NE to facilitate trips for future intensive development
        - Removal of the western crosswalk of NE 85th Street (since pedestrians would have to cross at least eight vehicle travel lanes with planned widening related to both the interchange and eastbound right turn lane proposed above)
        - Restriping the northbound approach to include a left turn lane and a shared left/through/right turn lane

        - Restriping the southbound approach to include dedicated left, through, and right lanes, with the right turn lane protected by a "pork chop" to create a free movement[9]
        - Revising the signal to provide northbound/southbound split phasing to allow for left turn movements out of either lane from the south approach
    - Option 2:
        - Restriping the northbound approach to include a left turn lane and a shared left/through/right turn lane
        - Restriping the southbound approach to include dedicated left, through, and right lanes, with the right turn lane protected by a "pork chop." Unlike Option 1, the right turn would not be a free movement since the western crosswalk would remain.
        - Revising the signal to provide northbound/southbound split phasing to allow for left turn movements out of either lane from the south approach
- **NE 83rd Street & 120th Avenue NE (Alternative B):** With the intensive allowed development of 250 feet of maximum height allowed in the southeast quadrant, this intersection would need to be signalized. If this intersection serves as the only primary entrance (and a southern entrance via 118th Avenue NE is not provided), this intersection requires additional geometric modification. There are various ways that this intersection could be configured. For the purposes of this modeling, it was assumed that the west leg would include a left-turn pocket, plus a shared left/through/right lane with all other approaches served by one lane. This would require that the northbound left turn lane at the 85th Street intersection be extended to provide a second northbound receiving lane.
- **NE 80th Street & 118th Avenue NE (Alternative B):** Based on delay analysis, this intersection would require mitigation regardless of whether 118th Avenue NE serves as a primary access point. This is due to additional traffic passing through the intersection along 80th Avenue. It should be noted that this intersection is located on a curve and may require additional treatments to ensure safe sight distance. Before constructing a signal, it would also be important to conduct a signal warrant analysis.
- **NE 80th Street & 120th Avenue NE (Alternative B):** If the Lee Johnson site has only one primary entrance (via 83rd Street & 120th Avenue NE), this intersection would require geometric mitigation (a southbound left turn pocket) to maintain the City's LOS standard. It should be noted that this improvement, while necessary to mitigate impacts of the intensive allowed development contemplated by Alternative B, could be a standalone improvement, as it would better serve areawide circulation.

[9] In designing this improvement it would be important to consider weaving interactions between traffic making the southbound free right and westbound traffic accessing northbound I-405. The viability of installing a pork chop should also be evaluated in final intersection design.

Transportation Demand Management

This report identifies a suite of TDM strategies that could be implemented by the City or required of development over time within the SAP. Implementation of these strategies would not only help to reduce driving, which in turn lessens traffic congestion and greenhouse gas impacts, but fundamentally align with the City's values and vision for the station area. It is recommended that these strategies be implemented as part of **Alternative B**.

Implementation of TDM strategies would require investments by the City in several forms, including:

- City staff time to develop code revisions and manage compliance, for example requiring developers to provide a transit subsidy to tenants.
- Creation of new staff positions to implement and operate new programs, for example on-street parking policing and management and off-street parking program implementation.
- Capital investments, for example micromobility charging stations.

These costs, both for initial start-up and ongoing program management, should be considered within the financial evaluation of the plan.

Transit Access & Speed and Reliability Improvements

This report considers evolution of a Station Area Plan, thus consideration of high-quality transit service, speed and reliability, and stop and station access should always be front of mind. The following recommendations apply to either **Alternative A or Alternative B**:

- Continue to support King County Metro in moving forward with implementation of the Metro K-Line Rapid Ride.
- Consider incorporation of transit priority infrastructure such as queue jumps and signal priority at NE 85th Street and 120th Avenue NE, NE 85th Street and 124th Avenue NE, and signal priority along the full extent of the NE 85th Street corridor within Kirkland
- Transit access strategies, such as first-last mile rideshare connections, bikeshare support, and specific pedestrian and bicycle infrastructure projects (perhaps identified in the walking/biking section)
- Coordination with King County Metro and Sound Transit to plan for and implement a pilot first/last mile shuttle connection for residents, visitors, and employees within the subarea to access the NE 85th Street BRT station
- Enhanced amenities at stops along NE 85th Street such as real-time arrival signage, expanded shelters, and bike parking and re-balanced stop locations to better align with safe signalized crossing locations.

Building a Robust System for Walking and Biking

Exhibit 16 summarizes the transportation capital investments recommended as part of the SAP to accommodate trip growth anticipated with development, better connect to the BRT station, and/or provide a more complete and low-stress active transportation network. These investments are more fully described in the Factsheets, which are **Appendix B** to this memo.

Appendix A

Kirkland 85th Interchange Analysis

The operations at the I-405/NE 85th St interchange were evaluated using the microsimulation traffic models developed by WSDOT for their interchange study. This sensitivity test was conducted to determine whether the additional land use growth allowed under the 85th Station Area Plan would affect the operations at the redesigned interchange. The Vissim model provided by WSDOT simulates NE 85th St between 6th St and 124th Ave NE, including the freeway ramps to and from I-405 as well as the BRT station and access points.

The sensitivity analysis started with the 2045 PM peak hour model for the proposed interchange project. The input volumes were then adjusted to reflect the anticipated demand and travel patterns forecasted for the 2044 June Alternative B. These adjustments increased the total demand within the model by approximately 400 PM peak hour trips or about 4% higher than the initial assumptions in WSDOT's model. A second scenario was evaluated that assumed that TDM implementation would reduce the growth associated with the Station Area Plan. For this scenario, the forecasted growth between 2018 and 2044 was reduced by 20%, which resulted in 500 less peak hour trips in the network. These two demand scenarios provide high and low bookends for the anticipated operations along NE 85th St and at the interchange. No other adjustments to the WSDOT models were made beyond updating the demand volumes.

Using the microsimulation models, the LOS was calculated at 5 intersections along NE 85th St. The LOS grade and average control delay are shown in the table below for each of the scenarios. The results show increased delay west of the interchange along NE 85th St. The 2044 SAP scenario has higher eastbound demand than the 2045 WSDOT scenario heading towards and through the I-405 interchange. This results in queuing along NE 85th St between the interchange and 6th St affecting operations are these locations. The volume reductions associated with the implementation of some TDM measures mitigates these concerns and reduces the delay and queuing. The average delay at the roundabout at Kirkland Way is still higher than was assumed in the WSDOT scenario and there is some eastbound queuing at this location, though it does extend to the intersection at 6th St.

Level of Service and Average Control Delay

Intersection	Control	2045 WSDOT	2044 85th SAP	2044 85th SAP w/ TDM
6th St / NE 85th St	Signal	E / 68 sec	F / 128 sec	D / 52 sec
Kirkland Way / NE 85th St	Roundabout	C / 18 sec	F / 75 sec	E / 37 sec
120th Ave NE / NE 85th St	Signal	D / 39 sec	D / 54 sec	D / 52 sec
122nd Ave NE / NE 85th St	Signal	C / 28 sec	C / 33 sec	C / 27 sec
124th Ave NE / NE 85th St	Signal	F / 93 sec	F / 94 sec	E / 63 sec

The average and maximum queue lengths, estimated using the microsimulation models, are shown in the following table for several locations. The first two locations show the eastbound queues at the Kirkland Way and 120th Ave NE intersections. The anticipated queue lengths are longer than in the

WSDOT scenario for both of the Station Area Plan scenarios. The scenario with TDM reductions does significantly reduce the average queue eastbound at Kirkland Way.

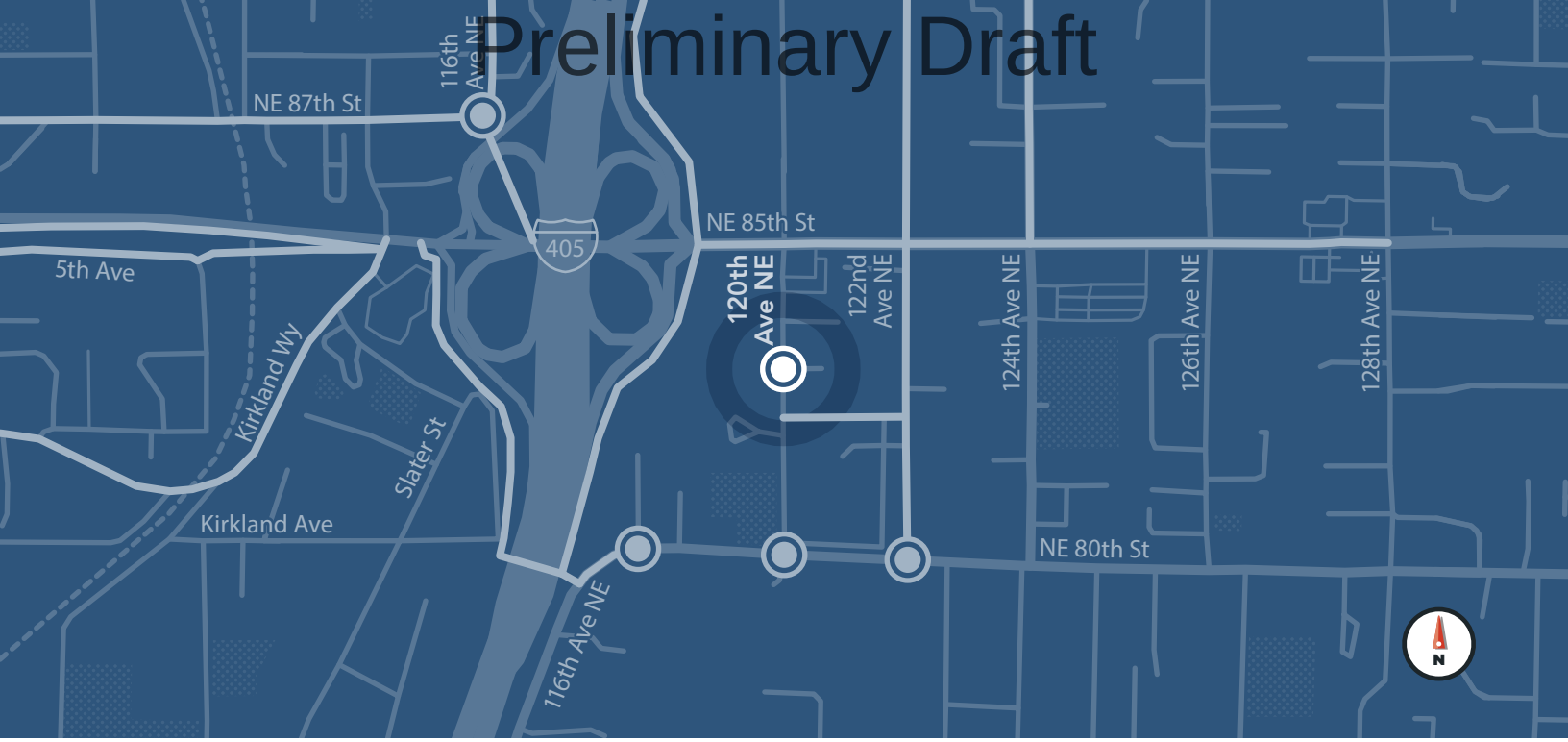
The last two locations show the queue lengths on the northbound and southbound off-ramps from I-405. There is over 1,500 feet of available storage on both ramps and the maximum queues do not spill back onto the freeway mainline in any of the scenarios.

Average and Maximum Queue Lengths

Location	2045 WSDOT	2044 85th SAP	2044 85th SAP w/ TDM
EB at Kirkland Way / NE 85th St	175ft / 625ft	1,275ft / 2,150ft	340ft / 1,150ft
EB at 120th Ave NE / NE 85th St	175ft / 675ft	475ft / 1,250ft	325ft / 1,100ft
I-405 NB off-ramp	50ft / 250ft	125ft / 350ft	125ft / 375ft
I-405 SB off-ramp	50ft / 275ft	375ft / 1,025ft	110 ft / 400ft

Overall, the Station Area Plan will result in slightly higher delays and queuing along NE 85th St in the future than estimated by WSDOT in their interchange analysis. However, the increases do not significantly affect the operations of the interchange or the freeway mainline.

Appendix B: Potential Station Area Investments Factsheets



Project #1

LEE JOHNSON EAST ACCESS (INCLUDING 120TH CORRIDOR FROM NE 83RD TO NE 85TH STREET)

PROJECT DESCRIPTION

New complete street and signalized connection to 120th Avenue NE, as well as a new northbound lane on 120th Avenue NE connecting to NE 85th Street.

Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Cost
- Right-of-way

Planning-level Cost

Low
$1,140,000

High
1,650,000

Project #2

LEE JOHNSON SOUTH ACCESS

PROJECT DESCRIPTION

New complete street and signalized connection to NE 80th Street via 118th Avenue NE

Project Catalyst

Station Access

Complete Network

Capacity for Growth

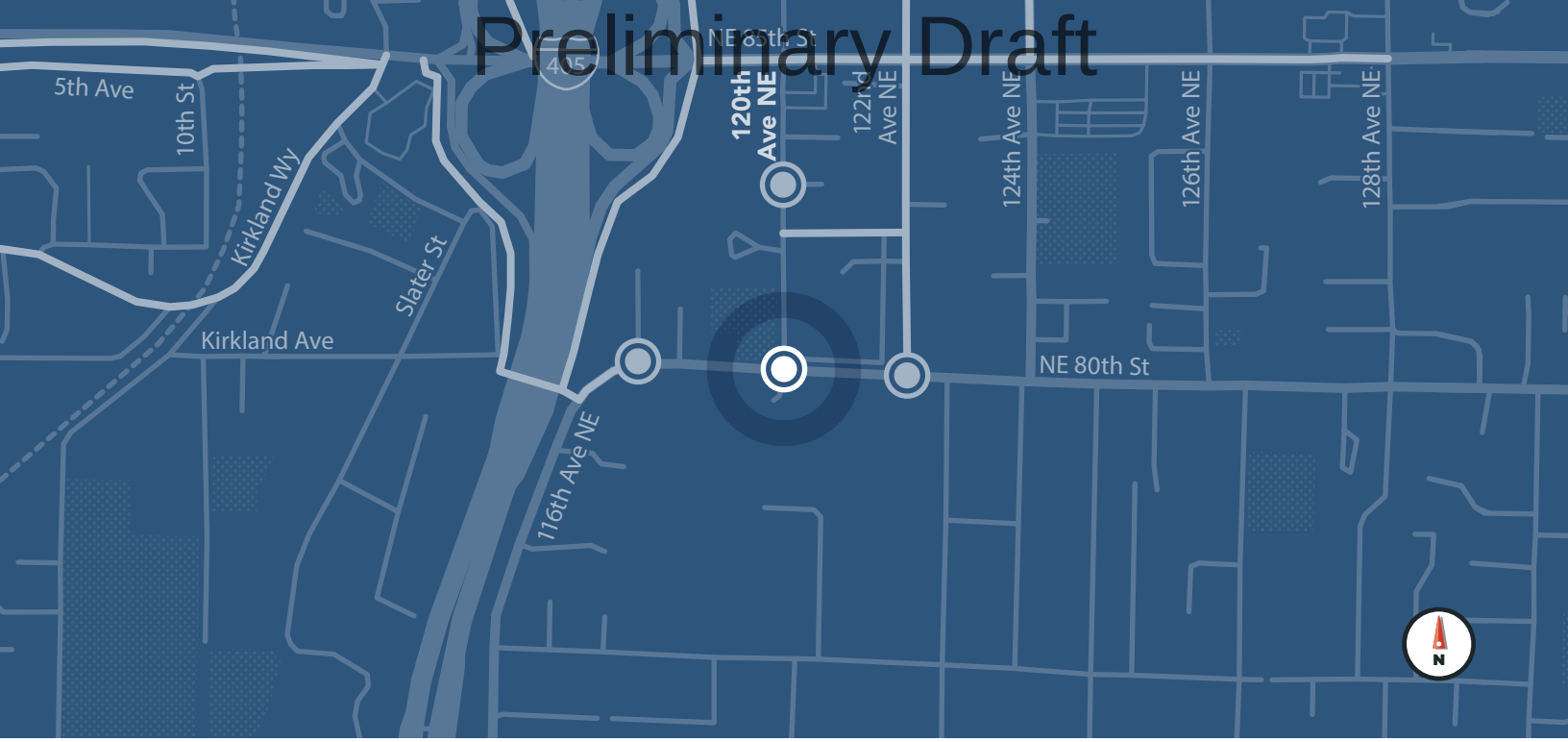
Implementation Considerations

- Cost
- Right-of-way
- Neighborhood impacts
- Sight distance at NE 80th Street intersection

Planning-level Cost

Low
$1,500,000

High
$2,160,000



Project #3

NE 80TH STREET/120TH AVENUE NE SIGNAL IMPROVEMENT

(INCLUDING 120TH CORRIDOR FROM NE 80TH TO NE 83RD STREET)

PROJECT DESCRIPTION

Improve 120th Avenue between NE 80th Street and NE 83rd Street and improve intersection with NE 80th Street to add southbound left turn pocket to separate left and right turning movements.

Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Cost
- Right-of-way

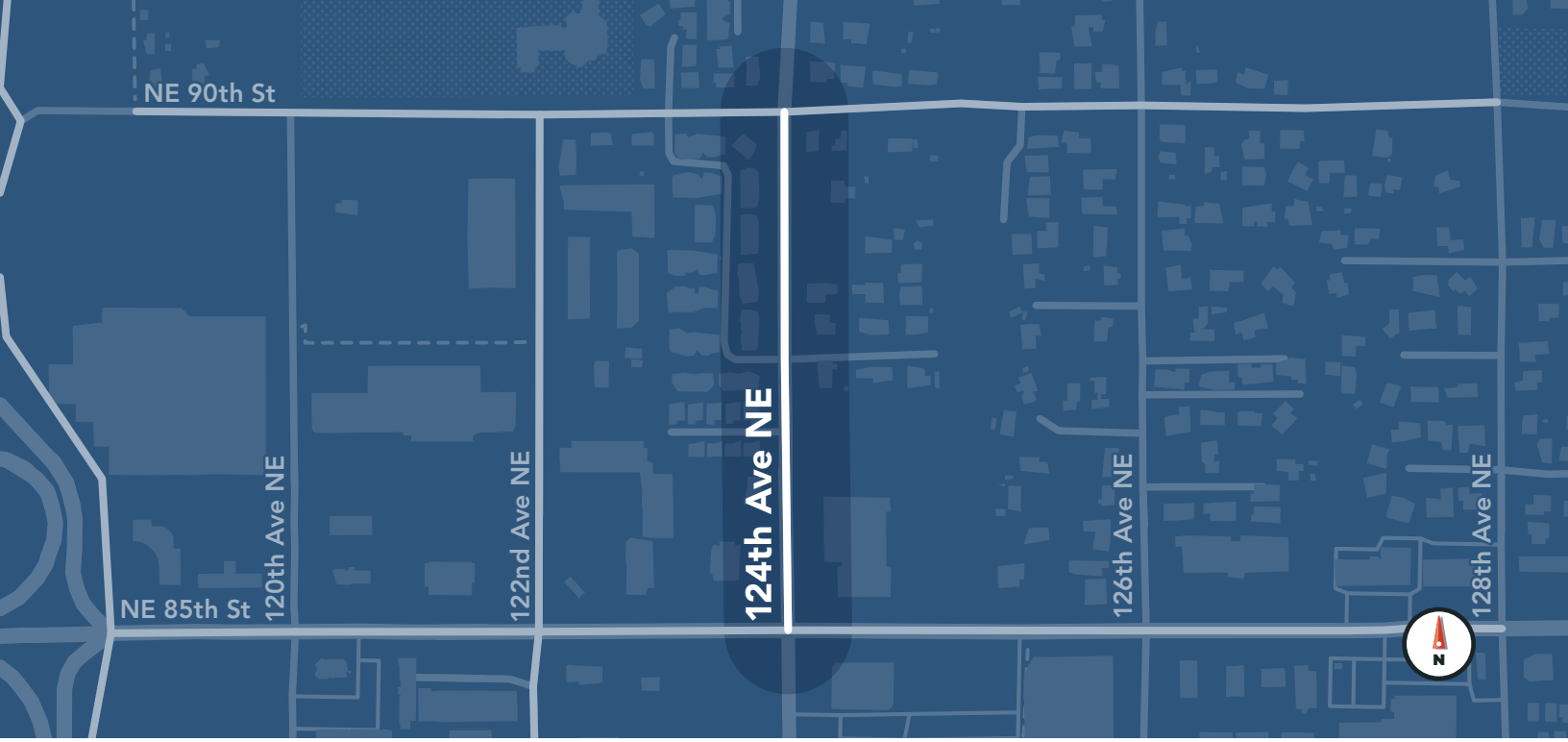
Planning-level Cost

Low

$970,000

High

$1,400,000

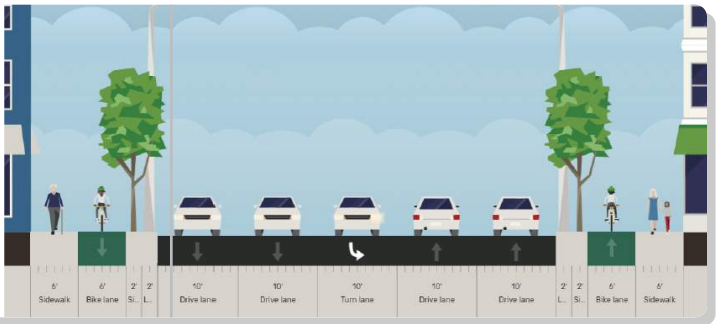


Project #4

124TH AVENUE NE WIDENING

PROJECT DESCRIPTION

Widen 124th Avenue NE to five lanes plus physically-separated bike lanes from NE 85th Street through the NE 90th Street intersection.



Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way constraints
- Cost

Planning-level Cost

Low

$8,300,000

High

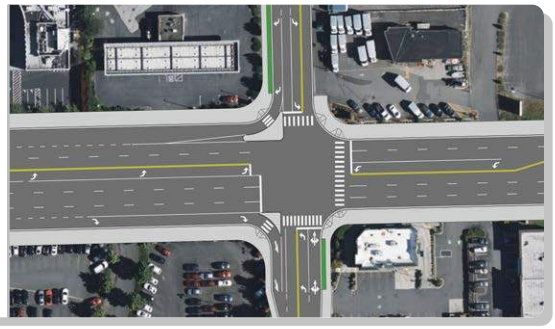
$11,980,000

Project #5

NE 85TH STREET/120th (OPTION 1)

PROJECT DESCRIPTION

New eastbound right turn lane on NE 85th Street from I-405 off ramp to 120th Avenue NE provides additional access to Lee Johnson site



Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way constraints
- Cost
- Impact on pedestrian environment (longer crossings)

Planning-level Cost

Low
$1,550,000

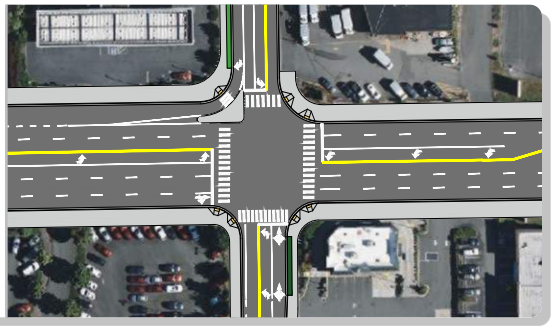
High
$2,240,000

Project #5

NE 85TH STREET/120th (OPTION 2)

PROJECT DESCRIPTION

Modifications to NE 85th Street and 120th Avenue NE intersection to provide additional access to Lee Johnson site.



Project Catalyst

- Station Access
- Complete Network
- **Capacity for Growth**

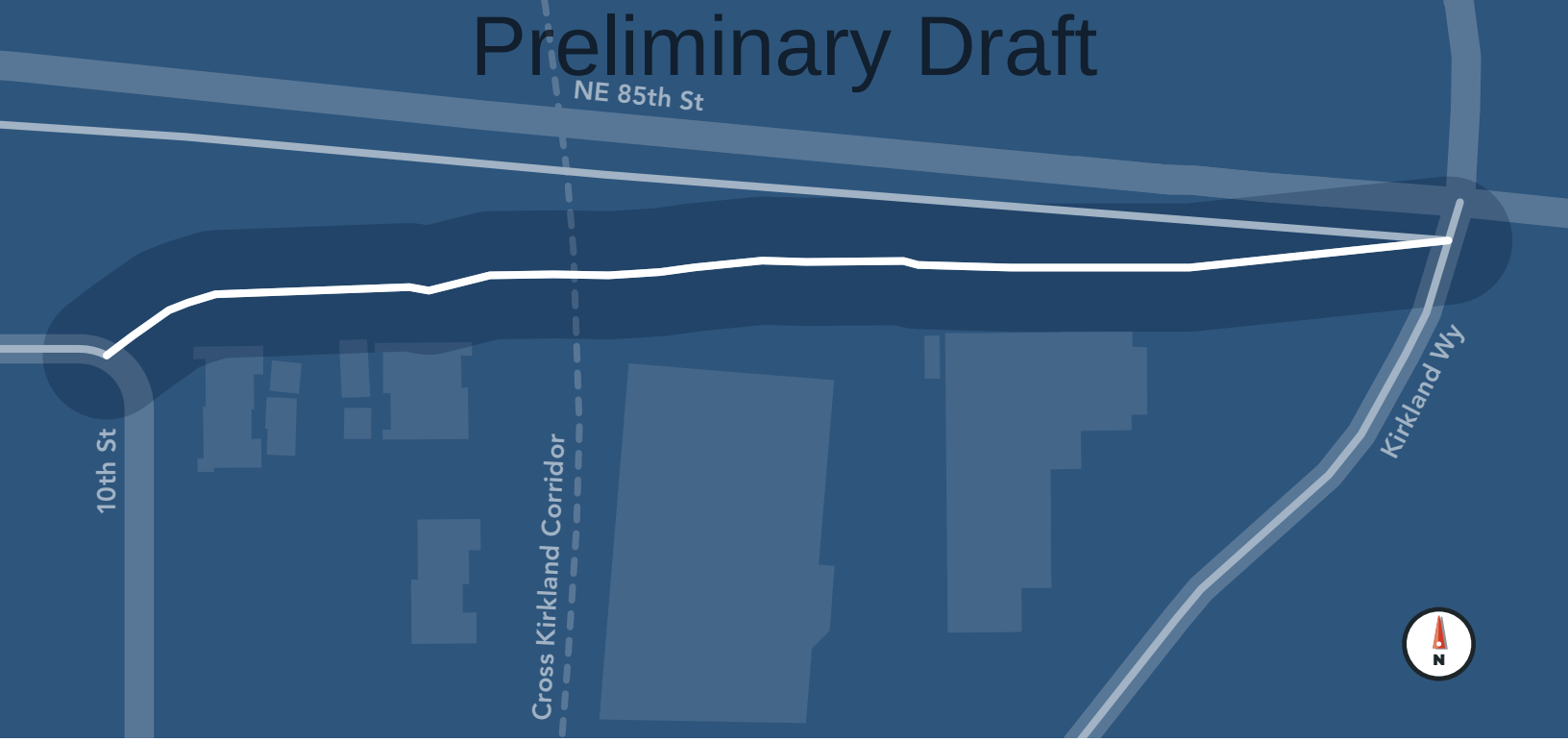
Implementation Considerations

- Right-of-way constraints
- Cost
- Additional intersection delay

Planning-level Cost

Low
$1,550,000

High
$2,240,000



Project #6

5TH AVENUE TO KIRKLAND WAY SHARED USE TRAIL

PROJECT DESCRIPTION

Improve shared use trail from 5th Avenue to Kirkland Way by widening to 12 feet, minimizing grade, and adding lighting

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Right-of-way constraints
- Cost
- Grade

Planning-level Cost

Low

$4,010,000

High

$5,790,000

Project #7

5TH AVENUE GREENWAY

PROJECT DESCRIPTION

Add sharrows and signage to make these quiet streets serve as a greenway

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

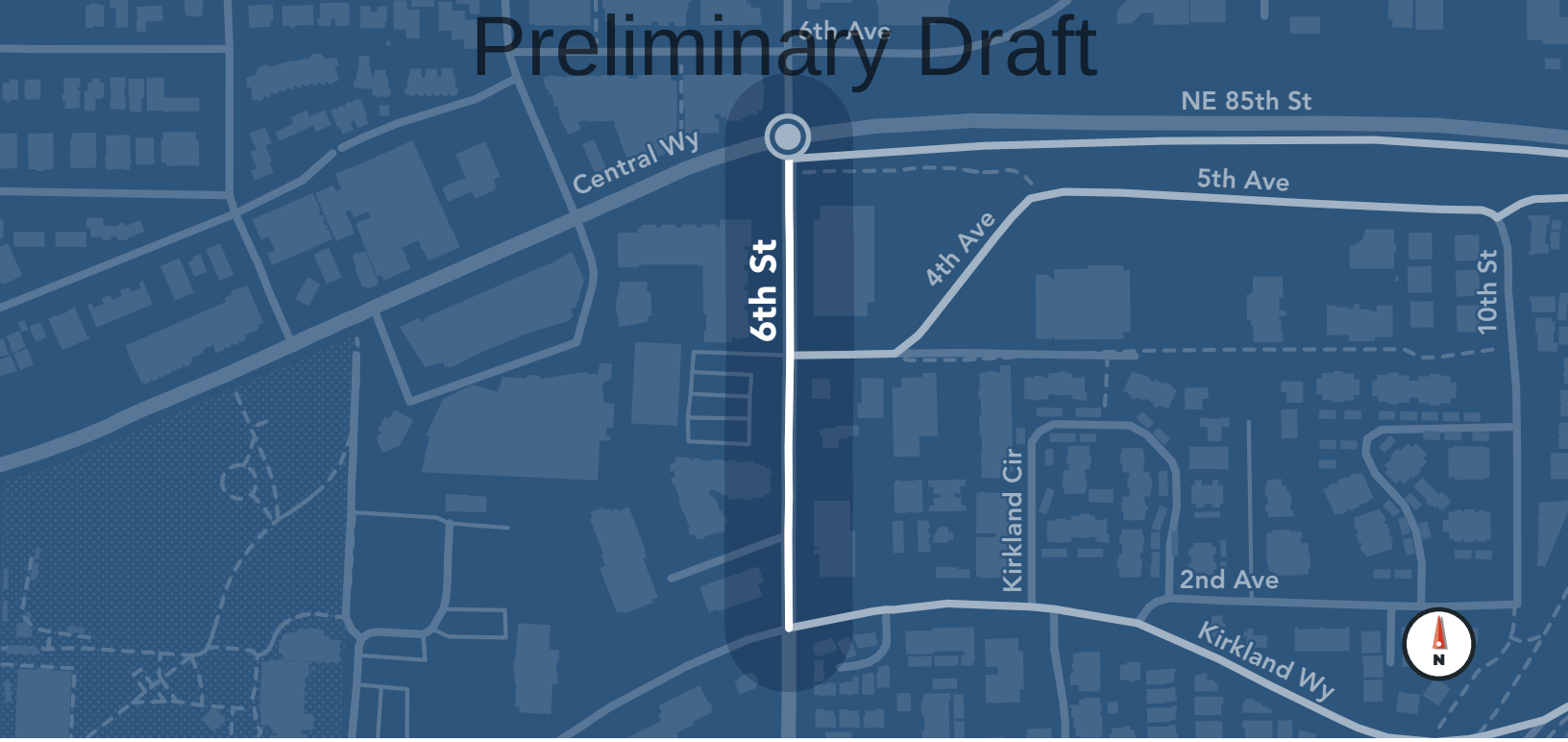
Implementation Considerations

- May require enhanced treatment on west end of corridor

Planning-level Cost

Low
$10,000

High
$15,000



Project #8

6TH STREET WIDENED SIDEWALKS

PROJECT DESCRIPTION

Add widened sidewalk on the east side of 6th Street between Kirkland Way and Central Avenue so that northbound bicyclists can share the facility with pedestrians

Project Catalyst

- Station Access
- **Complete Network**
- Capacity for Growth

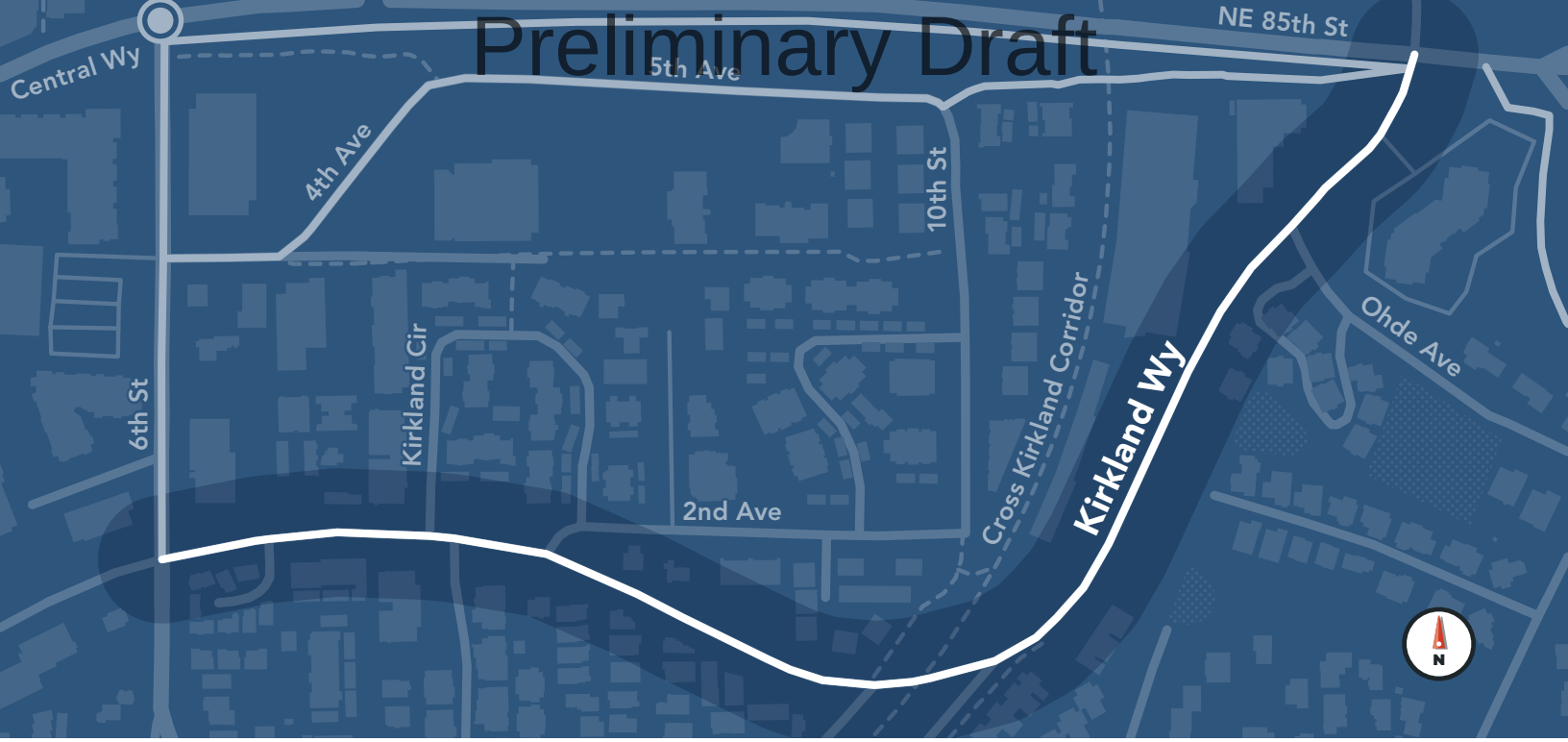
Implementation Considerations

- Right-of-way constraints
- Cost
- Phasing with planned developments

Planning-level Cost

Low
$1,870,000

High
$2,700,000

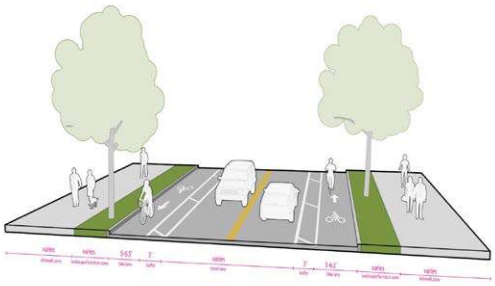


Project #9

KIRKLAND WAY COMPLETE STREET

PROJECT DESCRIPTION

Provide buffered bike lanes and standard sidewalks (both sides of street) between 6th Avenue NE and NE 85th Street



Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way constraints
- Cost
- Need to replace the CKC bridge

Planning-level Cost

Low
$14,200,000

High
$20,500,000

Project #10

7TH AVENUE/NE 87TH STREET COMPLETE STREET

PROJECT DESCRIPTION

Reconfigure street to provide parking-protected bike lanes and sidewalks between 6th Street and 116th Avenue NE.

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Cost
- Grade
- Treatments at intersections

Planning-level Cost

Low
$2,290,000

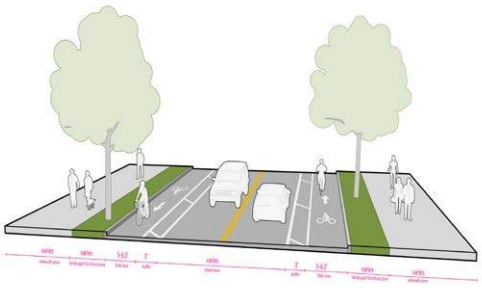
High
$3,310,000

Project #11

NE 87TH STREET/116TH AVENUE NE COMPLETE STREET

PROJECT DESCRIPTION

Provide buffered bike lanes and standard sidewalks (both sides of street) north of the station access to NE 90th Street



Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Right-of-way constraints

Planning-level Cost

Low

$450,000

High

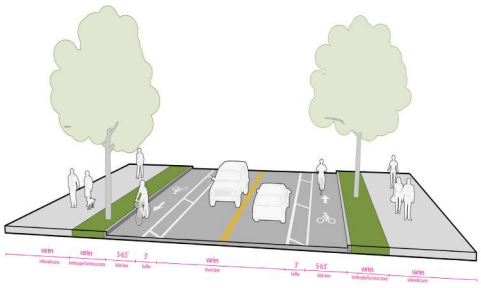
$650,000

Project #12

116TH AVENUE NE GREENWAY

PROJECT DESCRIPTION

Provide buffered bike lanes and standard sidewalks (both sides of street) north of NE 90th Street



Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way constraints

Planning-level Cost

Low
$1,990,000

High
$2,880,000

Project #13A

405 INTERCHANGE PATH (SW)

PROJECT DESCRIPTION

Shared-use trail connecting BRT station to 116th Avenue NE

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost

Planning-level Cost

Low

$1,530,000

High

$2,210,000

Project #13B

405 INTERCHANGE PATH (NE)

PROJECT DESCRIPTION

Shared-use trail connecting BRT station to Slater Avenue

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost

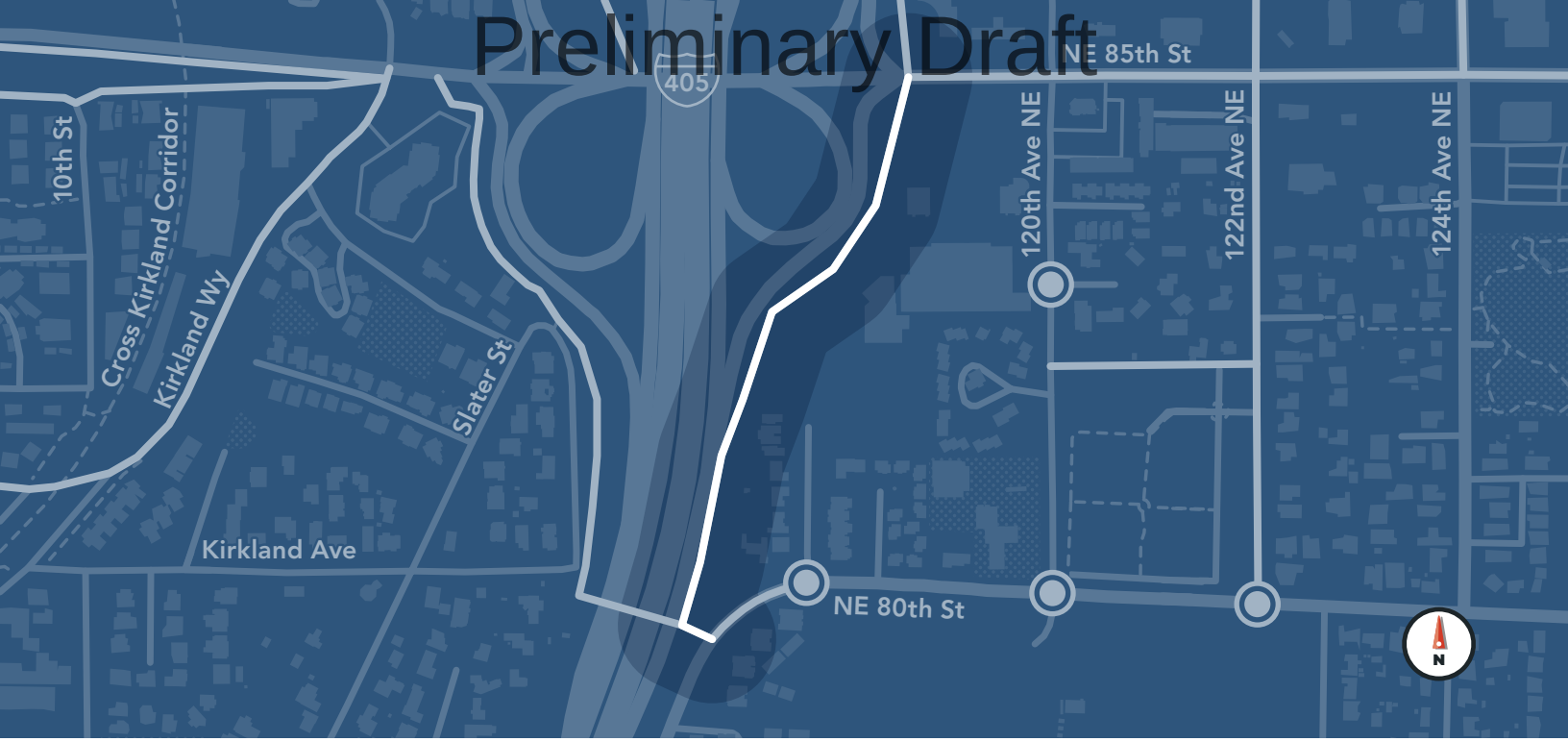
Planning-level Cost

Low

$1,910,000

High

$2,750,000



Project #13C

405 INTERCHANGE PATH (SE)

PROJECT DESCRIPTION

Shared-use trail connecting BRT station to NE 80th Street

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost

Planning-level Cost

Low

$1,500,000

High

$2,160,000

Project #14

NE 90TH STREET COMPLETE STREET

PROJECT DESCRIPTION

Reconfigure street to provide parking-protected bike lanes and sidewalks between the planned 405 Interchange Path and124th Avenue NE

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost
- Treatments at intersections

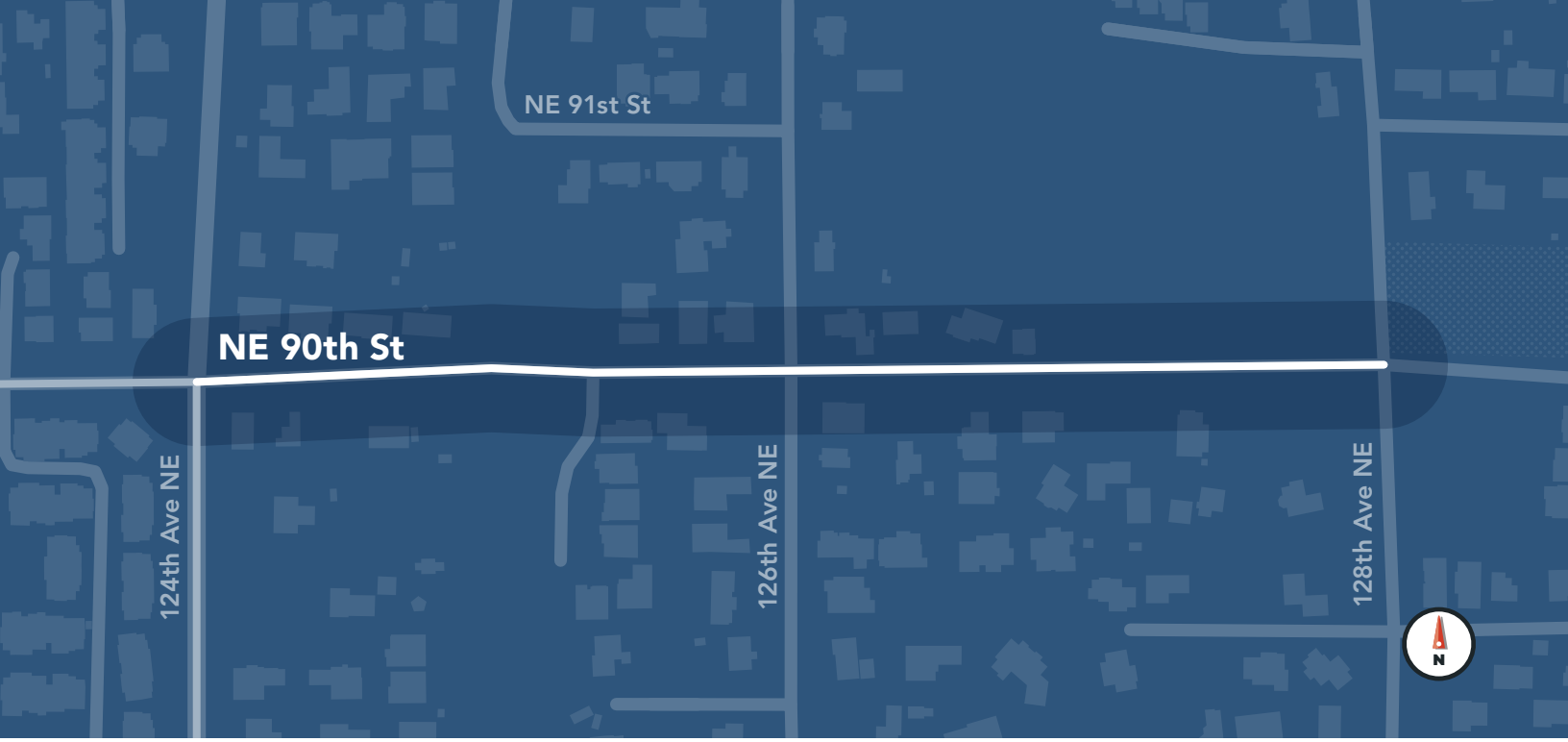
Planning-level Cost

Low

$4,270,000

High

$6,170,000

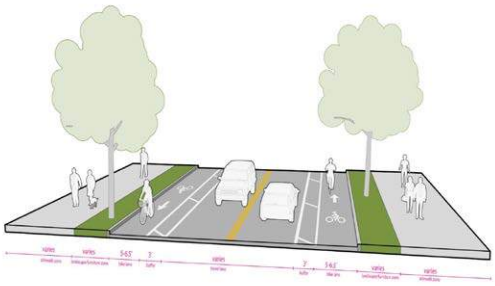


Project #15

NE 90TH STREET GREENWAY

PROJECT DESCRIPTION

Provide buffered bike lanes and standard sidewalks (at least one side of the street) between 124th Avenue NE and 128th Avenue NE



Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost
- Treatments through wetlands

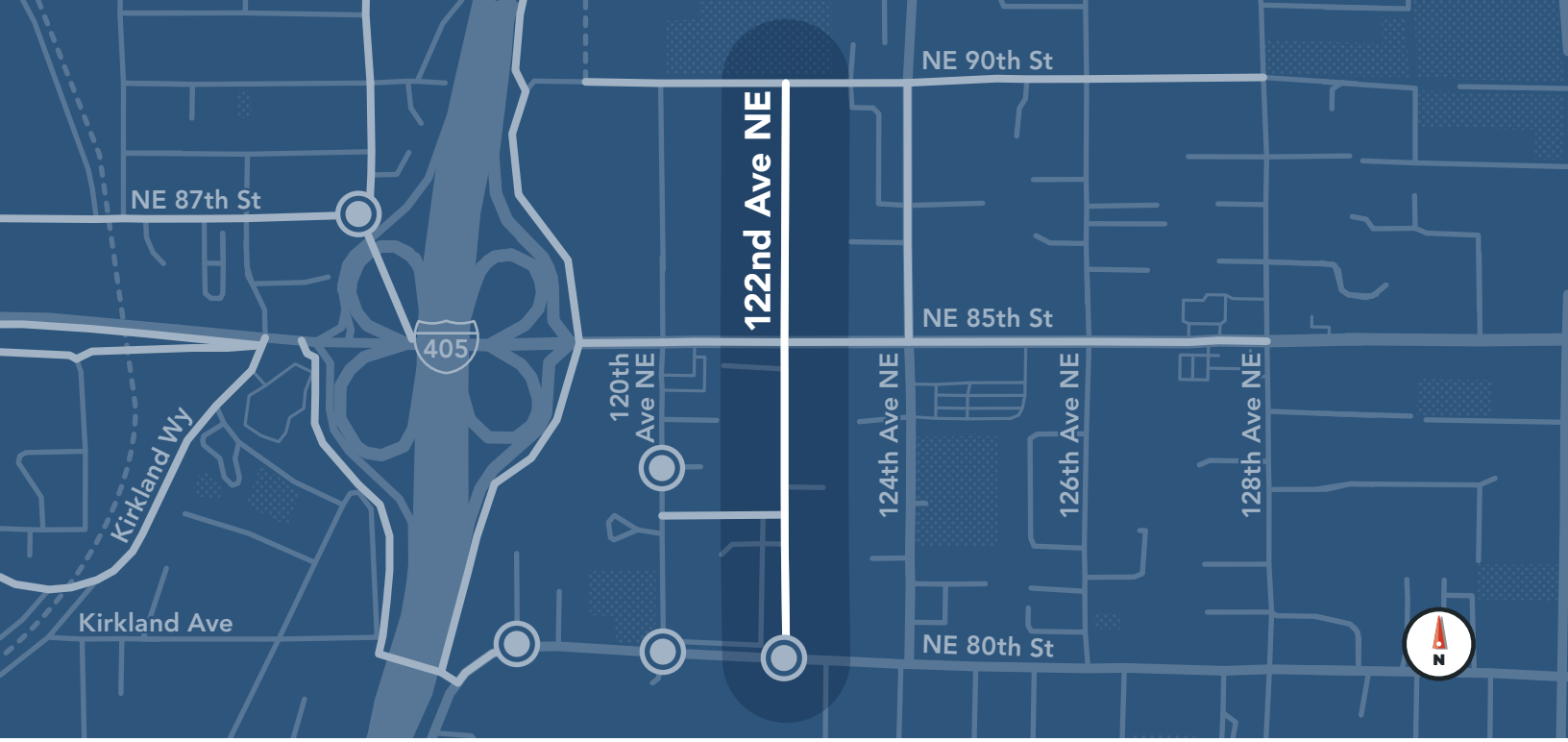
Planning-level Cost

Low

$4,780,000

High

$6,900,000

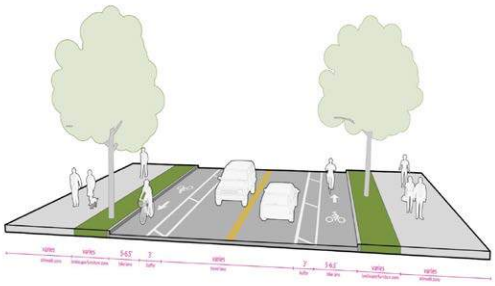


Project #16

122ND AVENUE NE BIKE ROUTE

PROJECT DESCRIPTION

Provide buffered bike lanes and standard sidewalks (both sides of street) between NE 80th Street and NE 90th Street



Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost
- Grade

Planning-level Cost

Low

$2,890,000

High

$4,180,000

Project #17

120TH AVENUE NE TO 122ND AVENUE NE PED-BIKE CONNECTION

PROJECT DESCRIPTION

Provide a 12-foot path for walking and biking in the vicinity of NE 82nd Street.

Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Cost

Planning-level Cost

Low

$660,000

High

$1,000,000

Project #18A

NE 85TH STREET ENHANCED SIDEWALKS

PROJECT DESCRIPTION

Provide 15-20 foot sidewalks (including amenity zones) on both sides of NE 85th Street to provide a high-quality experience for walking and opportunity for last-mile bike connections between I-405 and 120th Avenue NE.

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Cost
- Right-of-way

Planning-level Cost

Low

$1,460,000

High

$2,120,000

Project #18B

NE 85TH STREET ENHANCED SIDEWALKS

PROJECT DESCRIPTION

Provide 15-20 foot sidewalks (including amenity zones) on both sides of NE 85th Street to provide a high-quality experience for walking and opportunity for last-mile bike connections between 120th Avenue NE and 122nd Avenue NE.

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Cost
- Right-of-way

Planning-level Cost

Low

$1,290,000

High

$1,870,000

Project #18C

NE 85TH STREET ENHANCED SIDEWALKS

PROJECT DESCRIPTION

Provide 15-20 foot sidewalks (including amenity zones) on both sides of NE 85th Street to provide a high-quality experience for walking and opportunity for last-mile bike connections between 122nd Avenue NE and 124th Avenue NE.

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Cost
- Right-of-way

Planning-level Cost

Low

$1,120,000

High

$1,610,000

Project #18D

NE 85TH STREET ENHANCED SIDEWALKS

PROJECT DESCRIPTION

Provide 15-20 foot sidewalks (including amenity zones) on both sides of NE 85th Street to provide a high-quality experience for walking and opportunity for last-mile bike connections between 124th Avene NE and 126th Avenue NE.

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Cost
- Right-of-way

Planning-level Cost

Low

$2,680,000

High

$3,871,000

Project #18E

NE 85TH STREET ENHANCED SIDEWALKS

PROJECT DESCRIPTION

Provide 15-20 foot sidewalks (including amenity zones) on both sides of NE 85th Street to provide a high-quality experience for walking and opportunity for last-mile bike connections between 126th Avenue NE and 128th Avenue NE.

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Cost
- Right-of-way

Planning-level Cost

Low

$2,740,000

High

$3,960,000

Project #19

116TH AVENUE NE PEDESTRIAN/BIKE ACCESS TO OVERCROSSING

PROJECT DESCRIPTION

Improve space allocated for bikes and pedestrians on west side of NE 116th to provide a more comfortable connection, including provision of an enhanced crossing of NE 116th Avenue to the south.

Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost

Planning-level Cost

Low

$190,000

High

$280,000

Project #20

120TH AVENUE NE IMPROVEMENTS (NE 85TH STREET TO NE 90TH STREET)

PROJECT DESCRIPTION

Overlay and sidewalk infill between along 120th Avenue NE between NE 85th Street and NE 90th Street

Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost

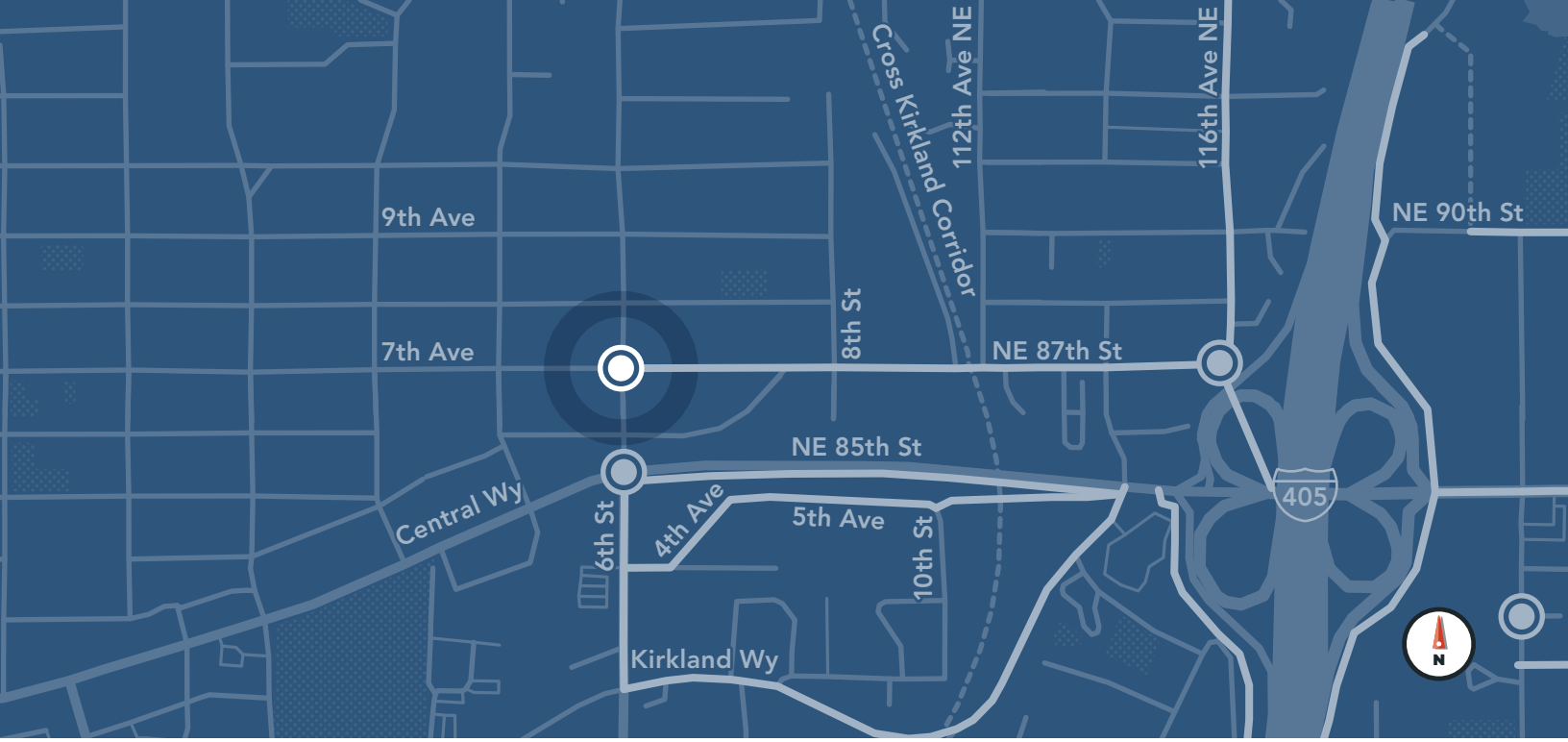
Planning-level Cost

Low

$500,000

High

$720,000



Project #P1

6TH STREET/7TH AVENUE INTERSECTION TREATMENT

PROJECT DESCRIPTION

Improve treatments for people walking and biking

Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way

Planning-level Cost

Low

$610,000

High

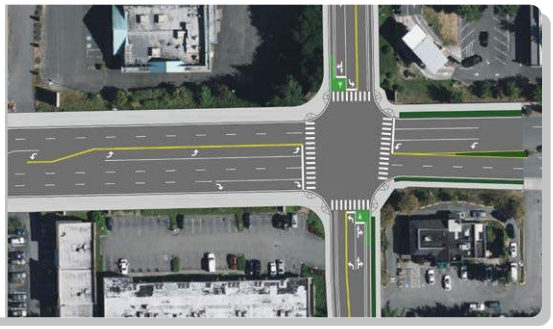
$880,000

Project #P2

NE 85TH STREET / 122ND AVENUE NE BICYCLE SIGNAL IMPROVEMENTS

PROJECT DESCRIPTION

Improve intersection and signal to better accommodate bikes along 122nd Avenue NE and in crossing NE 85th Street



Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way
- Cost
- Treatments at intersections

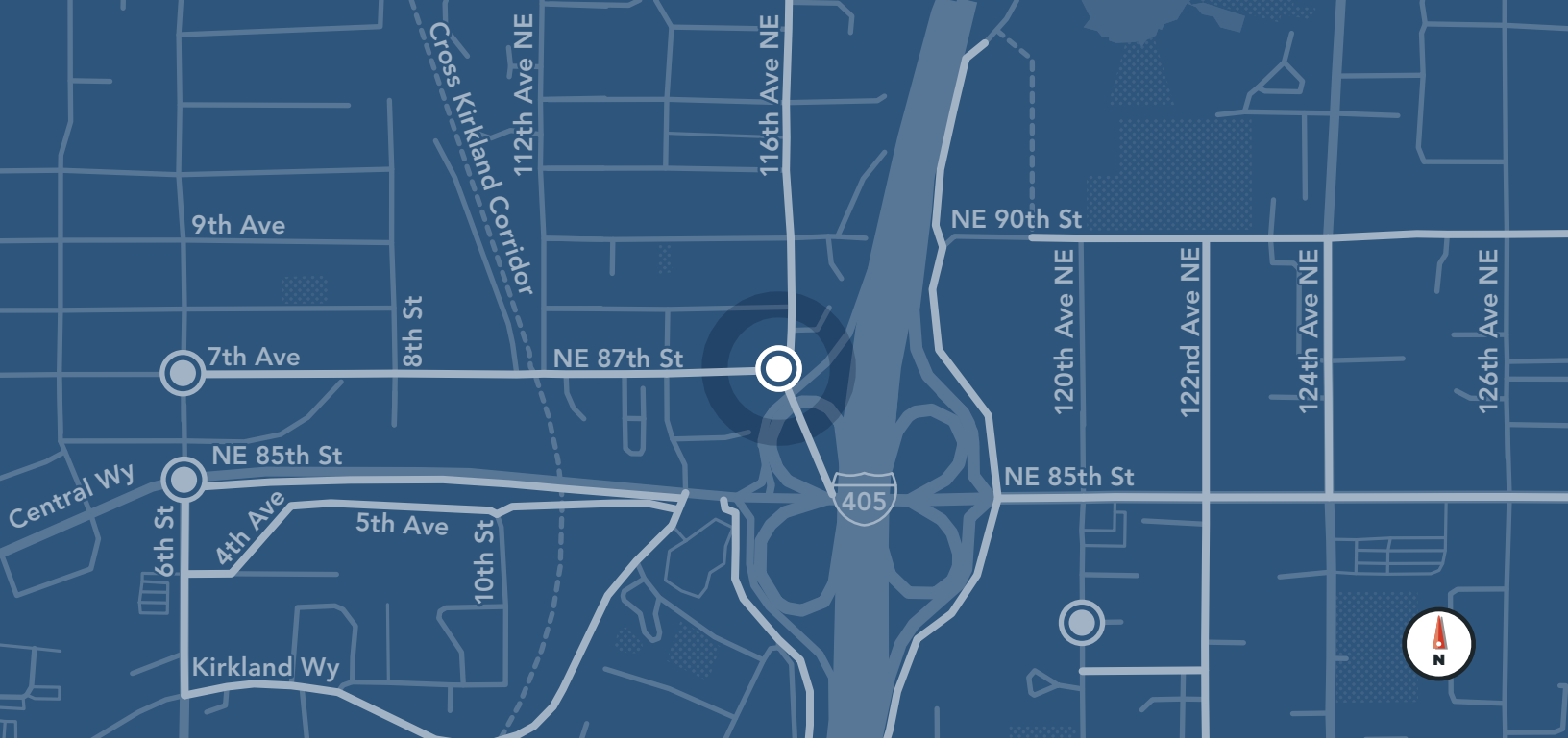
Planning-level Cost

Low

$320,000

High

$470,000



Project #P3

NE 87TH STREET/116TH AVENUE NE ENHANCED INTERSECTION

PROJECT DESCRIPTION

Improve treatments for people walking and biking at this challenging intersection in front of the BRT station. Treatments may include a raised intersection with all-way stop or a mini-roundabout.

Project Catalyst

- Station Access
- Complete Network
- Capacity for Growth

Implementation Considerations

- Right-of-way
- Sight distance
- Cost

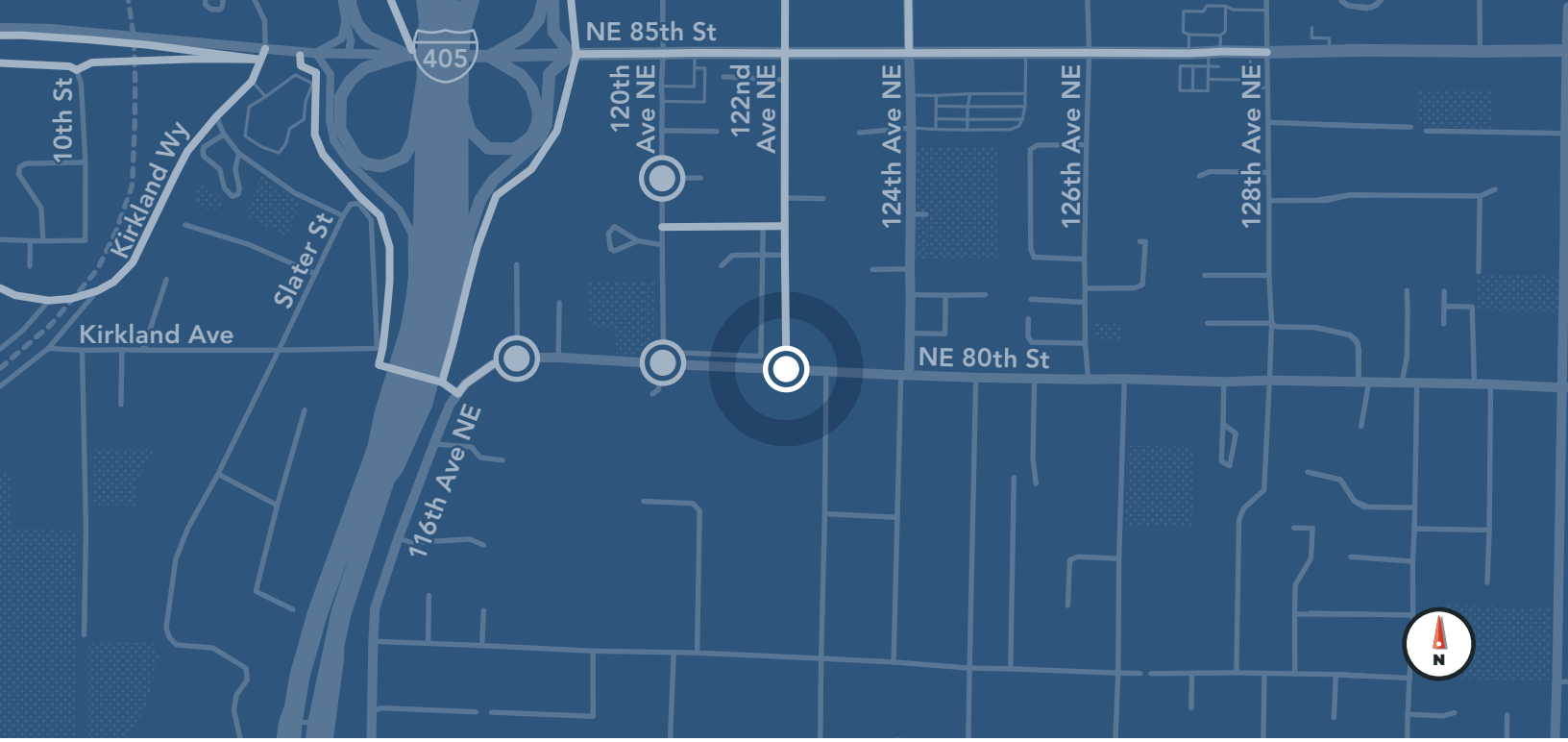
Planning-level Cost

Low

$840,000

High

$1,210,000



Project #P4

122ND AVENUE NE AND NE 80TH STREET INTERSECTION TREATMENT

PROJECT DESCRIPTION

Add treatments, including a RRFB, to improve crossing comfort for people walking and biking

Project Catalyst

Station Access

Complete Network

Capacity for Growth

Implementation Considerations

- Right-of-way

Planning-level Cost

Low

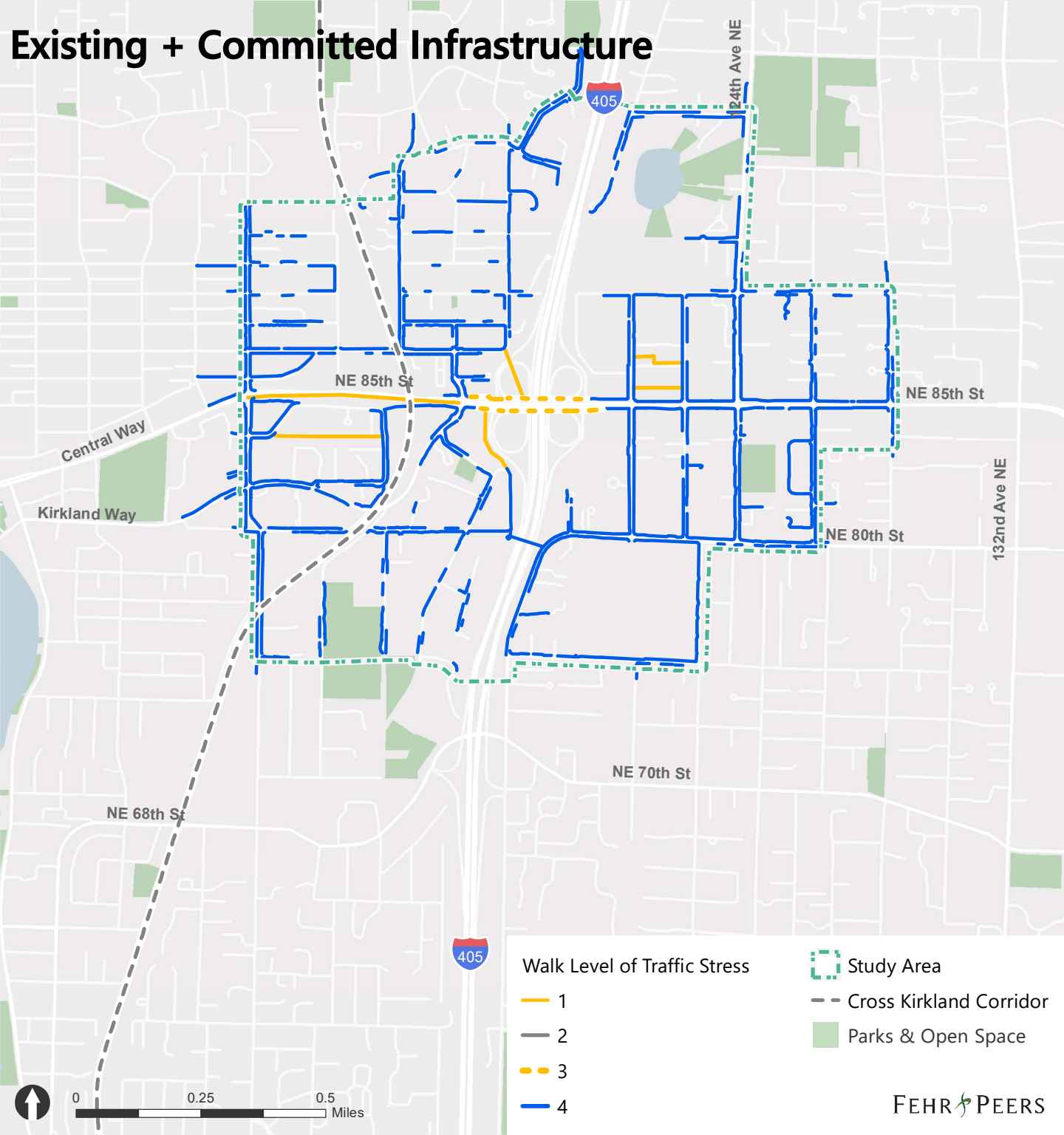
$330,000

High

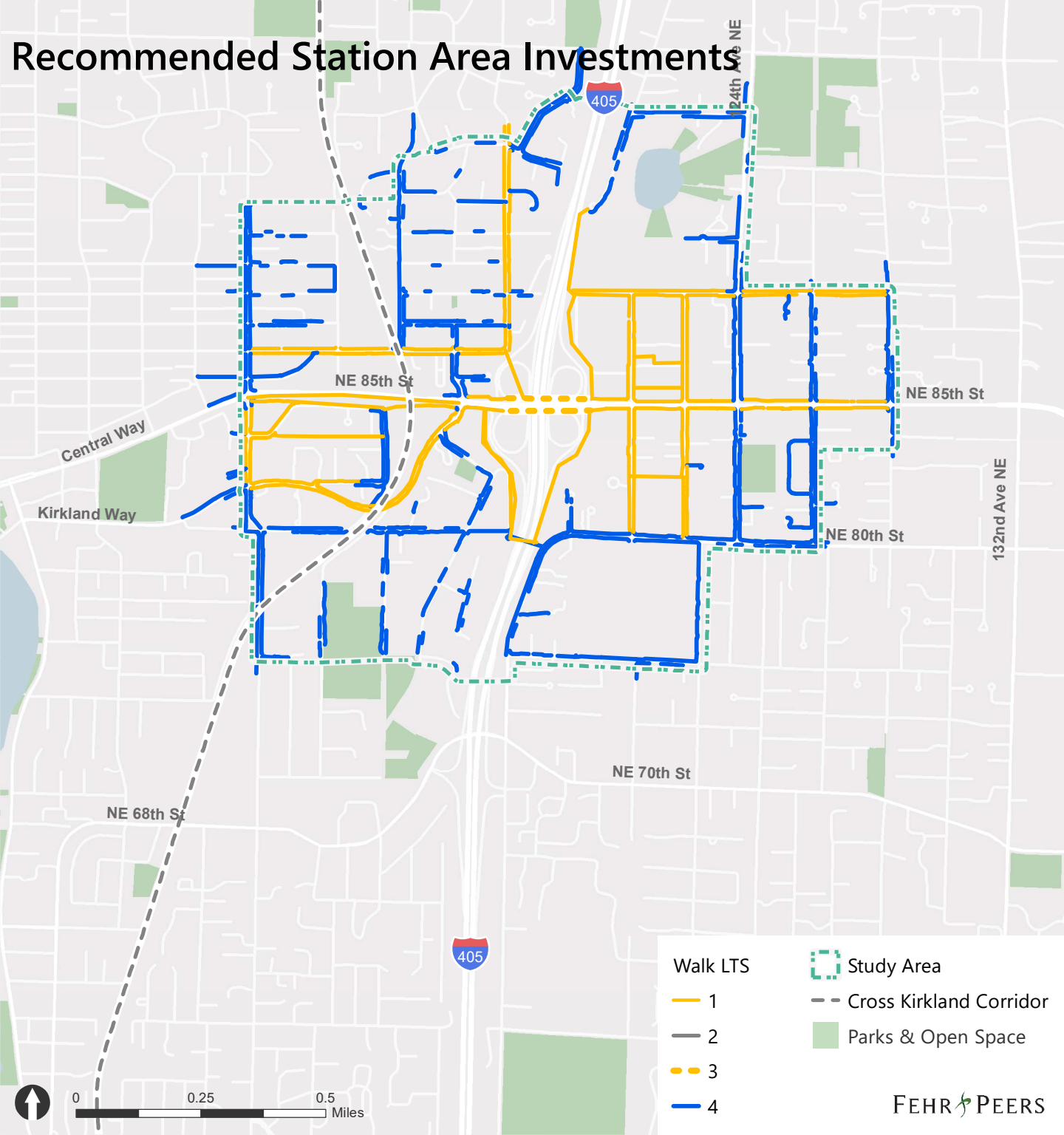
$480,000

Appendix C: Level of Traffic Stress Analysis for Walking and Biking

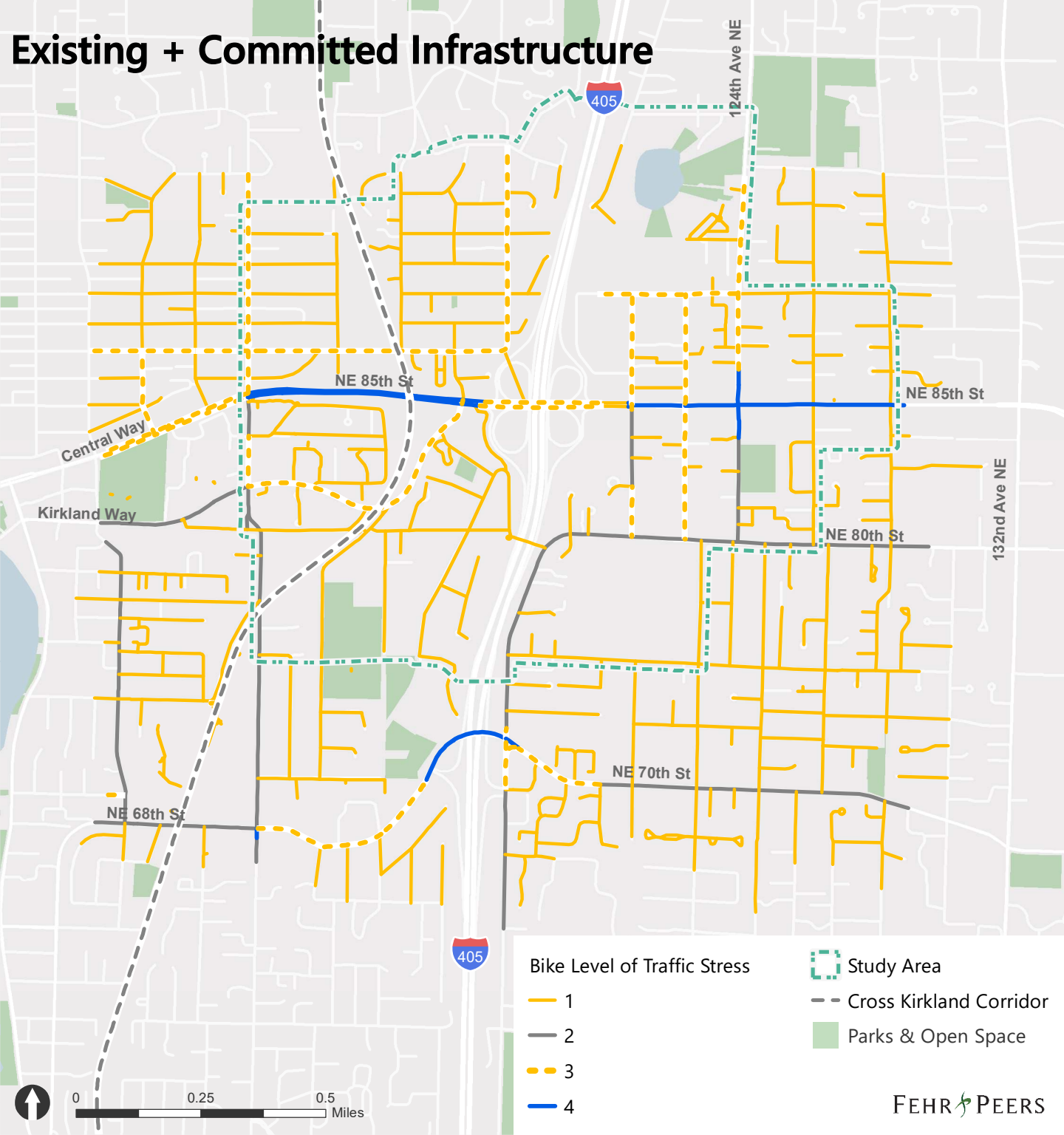
Existing + Committed Infrastructure



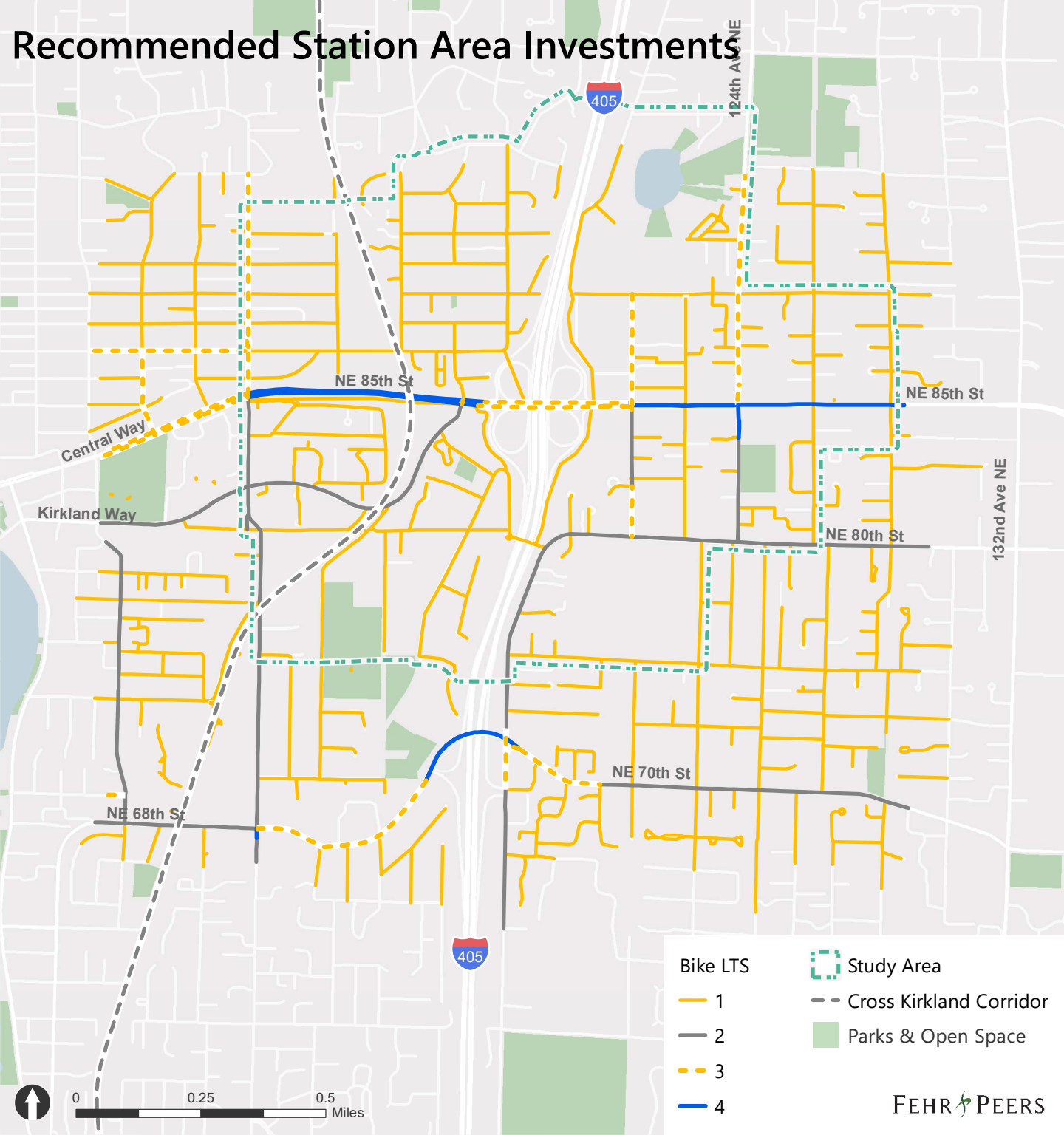
Recommended Station Area Investments



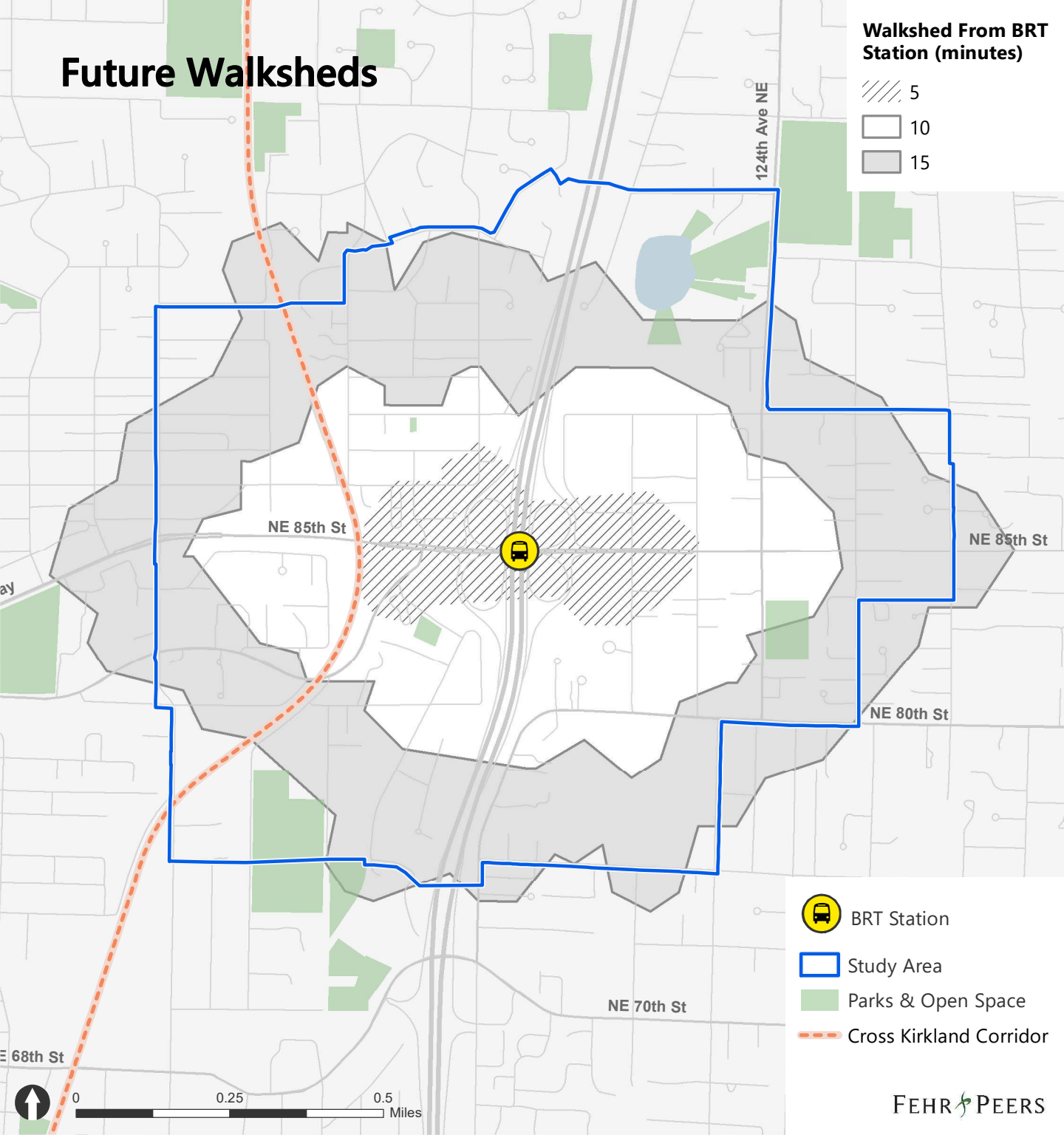
Existing + Committed Infrastructure



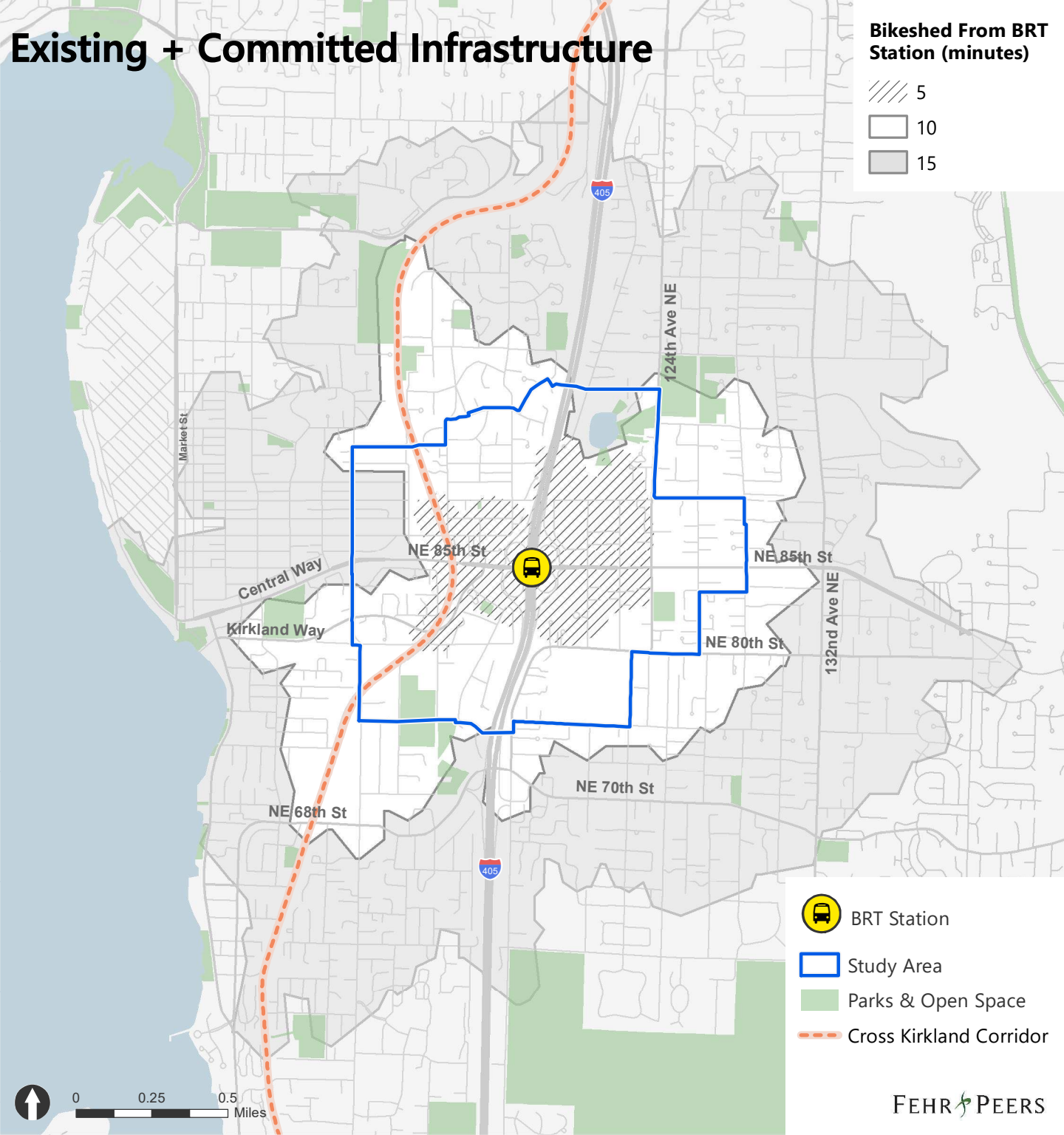
Recommended Station Area Investments



Appendix D: Travelshed Analysis for Walking and Biking


Future Walksheds
Walkshed From BRT Station (minutes)
5
10
15
124th Ave NE
NE 85th St
NE 85th St
NE 80th St
NE 70th St
68th St
BRT Station
Study Area
Parks & Open Space
Cross Kirkland Corridor
0
0.25
0.5
Miles
FEHR PEERS

Existing + Committed Infrastructure



Recommended Station Area Investment