APPENDICES

WILBURTON COMMERCIAL AREA

Land Use and Transportation Project

DRAFT
ENVIRONMENTAL
IMPACT
STATEMENT

CITY OF BELLEVUE

FEBRUARY 2018

APPENDIX A
SCOPING NOTICE AND COMMENTS

This appendix includes the following:

- Determination of Significance and Scoping Notice (City of Bellevue)
- Frequently Asked Questions handout (BERK)
- Scoping comment form (City of Bellevue)
- Draft Performance Measures (City of Bellevue, BERK, Fehr & Peers, CH2M)
- Alternatives and Environmental Review Summary (BERK)

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NOTICE OF DETERMINATION OF SIGNIFICANCE

NOTICE OF ENVIRONMENTAL IMPACT STATEMENT SCOPING PERIOD

NOTICE OF PUBLIC SCOPING MEETINGS/OPEN HOUSE

Wilburton Commercial Area Land Use and Transportation Project

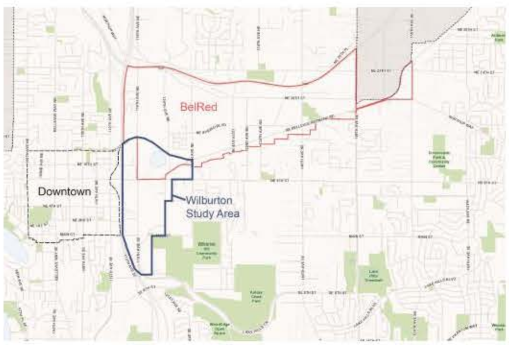
Location: The Wilburton Commercial Area study area is bound by NE 12th Street to the north, I-405 to the west, SE 5th Street to the south, 120th Avenue NE to the east, and a smaller area bound by NE 8th Street and 124th Avenue NE to the east. See Figure 1.
Project Proponent: City of Bellevue
File Number: 17-108502-LE
Description: The purpose of this project is to develop a preferred long range land use and transportation vision for the project area. The project will include technical work involving real estate, economics, land use, urban design, transportation, and environmental review. Opportunity for comment by stakeholders and the general public is provided through a Citizen Advisory Committee, meetings of the Planning and Transportation Commissions, the City Council, and project related public meetings. Once the final recommendations from the project are approved by the City Council, implementation of these recommendations will begin, likely in 2018. These implementation actions may include amendments to the City's comprehensive plan, subarea plans, Land Use Code, and Capital Improvements Program. The city will conduct a programmatic environmental review under the auspices of WAC 197-11-210 SEPA/GMA integration, with expanded scoping consistent with WAC 197-11-41-. This approach will integrate the Wilburton Commercial Area planning and decision making with the environmental review while facilitating consideration of environmental issues, and promoting public participation and interagency cooperation.
EIS Required: The City of Bellevue (Lead Agency) has determined that this proposal is a major action item under SEPA, having a probable significant adverse impact on the environment. An EIS is required and will be prepared at a programmatic level, appropriate to the early planning stage. The City has preliminarily concluded that the EIS will discuss impacts to geology and soils, water resources, air quality/greenhouse gas, ecosystems, land use and economic activity, neighborhoods and population, aesthetics, transportation, noise, energy, environmental health, and public services and utilities
Alternatives: A No Action Alternative for the 2035 planning horizon will assume a continuation of existing zoning, committed and planned transportation system changes, and adopted regional growth assumptions. The No Action Alternative will provide a baseline for comparison with up to three alternatives including varying assumptions of increased development density of differing land use types, coupled with transportation system changes such as arterial roadway improvements, High Capacity Transit routes and stations, and upgrades to the non-motorized system.
Scoping Meeting: Thursday April 6, 2017, Open House 5:00 – 6:00 p.m. Public Meeting, 6:00 – 8:00 p.m.
Location: Bellevue City Hall, 450 110th Avenue NE, Bellevue, WA 98009
Comments: Agencies, affected tribes and members of the public are invited to comment. You may comment on the alternatives, elements of the environment, probable significant impacts, mitigation measures, and potential conditions on any licenses or approvals to be considered by the City.

PUBLIC COMMENT PERIOD: The comment period opens March 23, 2017. The deadline for submitting your comments is April 13, 2017. All comments related to project scoping must be submitted by this date. Comments may be submitted orally at the public meeting or in writing. Comments will be accepted by email; however, a valid physical mailing address is required to establish status as an official part of record.
Written comments may be submitted:
By email to: bcalvert@bellevueawa.gov
By letter to:

City of Bellevue
Planning and Community Development Department
Attn: Bradley Calvert

450 110th Avenue NE
Bellevue, WA 98004

Applicant Contact: Bradley Calvert
Applicant Contact Phone: 425.452.6930
Applicant Contact Email:
bcalvert@bellevuewa.gov
Lead Agency Contact: Carol Helland,
Environmental Coordinator
Lead Agency Contact Phone: 425-452-2724
Lead Agency Contact Email:
chelland@bellevuewa.gov



Wilburton Commercial Area Land Use & Transportation Project

Frequently Asked Questions | April 6, 2017

What is the Wilburton Commercial Area Land Use and Transportation Project?

Wilburton is strategically located between two centers in Bellevue – Downtown and BelRed. The City of Bellevue has identified the Wilburton area as a future urban neighborhood, serving as a center for business, entertainment, and new housing opportunities. The City is planning for Wilburton to have a unique urban design, mixed use finer-grained block pattern, and multimodal connections, particularly a light rail transit station, and as the eastern terminus of the nonmotorized Grand Connection that interfaces with the Eastside Rail Corridor. Based on a new vision developed with the guidance of a Citizen's Advisory Committee, amendments to the City's Comprehensive Plan, Land Use Code, and Zoning Map would be made for City Council consideration.

What is the Study Area?

The Wilburton Commercial Area study area is bound by NE 12th Street to the north, I-405 to the west, SE 5th Street to the south, 120th Avenue NE to the east, and a smaller area bound by NE 8th Street and 124th Avenue NE to the east.

What is an Environmental Impact Statement?

An EIS is an informational document that provides the City, public, and other agencies with environmental information to be considered in the decision-making process. It also allows the public and government agencies to comment on proposals and alternatives. An EIS describes: proposed actions and alternatives; existing conditions of the study area; impacts that may occur if an alternative were implemented; mitigation measures to reduce or eliminate adverse impacts; and potential significant, unavoidable, and adverse impacts. The EIS will also identify potential beneficial outcomes, where alternatives incorporate existing environmental features (e.g. streams and wetlands) in a sustainable manner, improve environmental characteristics (e.g. stormwater quality), and emphasize improved walkability/bikability.

What EIS topics will be evaluated?

Bellevue has identified the following elements of the environment for discussion in the EIS: geology and soils, water resources, air quality/greenhouse gas, ecosystems, land use and economic activity, neighborhoods and population, aesthetics, transportation, noise, energy, environmental health, and public services and utilities.

What Alternatives would be studied?

An alternative describes a different means of achieving a proposal. In the Wilburton Commercial Area Land Use & Transportation Project EIS a No Action (current plan; SEPA required) and two Action Alternatives will be tested. The Alternatives will explore different land use and transportation patterns in the Wilburton study area and how alternatives incorporate City Council guiding principles. Input received during the scoping process will help to define the Action Alternatives. The project will culminate in a preferred land use and transportation alternative, and amendments to the City's Comprehensive Plan, Land Use Code, and Zoning Map. The preferred alternative will be evaluated in the Final EIS.

What is a Non-Project EIS?

The Wilburton Commercial Area Land Use & Transportation Project EIS will be a non-project EIS that analyzes actions broadly across the neighborhood. See the table below for features of a non-project EIS.

FEATURE	PROJECT ENVIRONMENTAL REVIEW	NON-PROJECT ENVIRONMENTAL REVIEW (WAC 197-11-442, -774)
Location	Site-specific	Areawide / neighborhood
Analysis Level of Detail	Detailed	Broad / order-of-magnitude
Alternatives	Specific construction proposals	Conceptual based on vision
Mitigation	Specific, alters project, project proponent responsibility	Broader; changes policies, plans, or code. City or future developer responsibility.
Future Environmental Review	No additional SEPA review	Subject to additional SEPA Review

What is Scoping?

Scoping is a process intended to focus the scope of every EIS on the probable significant adverse impacts and reasonable alternatives, including mitigation measures. Interested parties, agencies, and tribes may comment on EIS alternatives, issues the EIS should evaluate, probable significant adverse impacts, and licenses or other approvals that may be required.

How do I comment on the scope of the EIS?

Submit written comments between **March 23 to April 13, 2017** to:

City of Bellevue, Planning and Community Development Department
Attn: Bradley Calvert
450 110th Avenue NE
Bellevue, WA 98004

Additional comment opportunities will be available following the preparation of the Draft EIS.

For more information

See the project website at: http://www.ci.bellevue.wa.us/grand-connection.htm.

Contact: Bradley Calvert

bcalvert@bellevuewa.gov

425.452.6930

Wilburton Commercial Area Land Use & Transportation Project

Scoping Open House | April 6, 2017

Do you have a comment or question about the Wilburton Commercial Area Land Use & Transportation Project or the scope of the Environmental Impact Statement?

Your Contact information (Optional):

Name	Email
Phone Number	Mailing Address

Please Return Comments by April 13, 2017 to:

City of Bellevue, Planning and Community Development Department
Attn: Bradley Calvert
450 110th Avenue NE
Bellevue, WA 98004

For more information

See the project website at: http://www.ci.bellevue.wa.us/grand-connection.htm.

Contact: Bradley Calvert
bcalvert@bellevuewa.gov
425.452.6930

Transportation & Environmental Performance Measures

Performance Measures are qualitative and quantitative indicators used to compare, contrast, and describe each alternative's ability to achieve Wilburton-Grand Connection Study City Council Principles.

Preliminary Wilburton-Grand Connection Study EIS – Alternative Performance Measures

	City Council Principles										
Preliminary Performance Measure	Grand Vision	Special Niche	Grand Connection	Neighborhood Identity	Emerging Opportunities	Integrated Station Area Planning	Community Benefit	Affordable Housing Opportunities	Impact Mitigation	Economic Vitality	Timing
Land Use & Aesthetics											
Character, intensity, and extent of transit-oriented mixed-use development around Wilburton station	●				●	●					
Addressing the eastern terminus of the Grand Connection and station area planning		●			●	●					
Density of community gathering spaces and increase in usable public space	●		●	●		●					
Amount and location of open spaces and parks, including goals identified in the park and recreation system plan, e.g. neighborhood park			●	●		●	●				
Increased opportunities for skyline and water views			●								
Height of development, location of roads, and landscaping abutting surrounding neighborhoods									●		
Concentration of development and activity at perimeter of neighborhoods									●		
Amount of growth on catalyst sites and needed capital facilities. Potential for near-term and mid-term implementation.					●						●
Transportation											
Connectivity index and map	●				●	●	●				
Access to services (parks, schools etc.)	●				●	●	●				
Multimodal level of service performance measures	●		●		●	●		●	●		
Increase in walk and bike trips			●		●			●			
Transportation engineering complexity, cost, and funding availability											●
Economic Activity											
Diversity and number of jobs that support the Economic Development Strategic Plan	●									●	
Opportunities to leverage jobs in medical and technology sectors, as well as commercial uses, as part of mixed-use development		●		●	●	●					

Preliminary Performance Measure	City Council Principles: Grand Vision	Special Niche	Grand Connection	Neighborhood Identity	Emerging Opportunities	Integrated Station Area Planning	Community Benefit	Affordable Housing Opportunities	Impact Mitigation	Economic Vitality	Timing
A strengthened and diversified economic base: capacity for job growth by sector, business starts					●					●	
Auto sales tax revenue offset by new economic development activity										●	
Towards a sustainable city: mobility and congestion, workforce housing, natural environment					●					●	
Create an opportunity for a district that promotes health and wellness (based on land use case studies)		●			●						
Urban amenities measure such as potential future density of stores, parks, etc.)							●				
Neighborhoods and Population											
Capacity for housing and densities that support the light rail station				●	●						
Housing quantity and diversity in housing forms and affordability	●				●			●			
Number of affordable units (at x% AMI) incentivized								●			
Ecosystems/Water Resources/Air Quality											
Stream/lake restoration / connecting habitats	●	●			●				●		
Per capita greenhouse gas emissions									●		
Amount of effective impervious surfaces					●				●		
Percent of tree cover					●				●		
Public Services											
Benefits in relationship to cost of infrastructure or public realm investments				●		●					
Amount of investment in infrastructure that supports physical activity (e.g. recreation facilities, walking facilities, playgrounds), park and green space							●				●

ONE MORE COUNCIL PRINCIPLE – PUBLIC ENGAGEMENT. All alternatives will be developed with public engagement. The degree to which each alternative emphasizes topics raised in public comments can be qualitatively addressed.

Once performance measures are finalized, each alternative would be screened like the example below.

Performance Measure	Alternative 1 No Action	Alternative 2	Alternative 3
Measure X			
Measure Y			

Strong emphasis   Moderate emphasis   Weak emphasis

From: Karen Walter [mailto:KWalter@muckleshoot.nsn.us]
Sent: Wednesday, April 12, 2017 11:52 AM
To: Calvert, Bradley <BCalvert@bellevuewa.gov>
Subject: Wilburton Commercial Area Land Use and Transportation Project, Scoping Notice for Environmental Impact Statement, 17-108502-LE

Bradley,

We have reviewed the City of Bellevue's Scoping Notice for the Wilburton Commercial Area Land Use and Transportation Project referenced above. As part of the environmental review and three action alternatives, the City should consider and analyze the following:

1. Future culvert project under I-405 to restore fish passage on Sturtevant Creek. Since WSDOT is obligated to replace the current fish passage barriers under I-405 as part of the court injunction under U.S *v.* Washington, the City should not preclude WSDOT's replacement of this culvert using a bridge or a culvert designed using WDFW's stream simulation design with this future land use and transportation plan.

2. Similarly, the City should be replacing all existing fish passage barrier culverts in the planning area to restore passage to the area streams and require any culverts on private property that is redeveloped in the project area to do the same. Fish passage barrier improvements in urban areas can require quite a bit of planning and coordination; therefore, they should be part of the overall land use and transportation planning for this project.

3. The EIS and alternatives should also discuss and provide for the opportunity to do stormwater retrofitting for sites that ultimately drain to project area streams and wetlands. Again, this issue can be complex and requires substantial planning efforts and should be part of this programmatic effort.

We appreciate the opportunity to review this proposal and look forward to the City's responses to these EIS scoping comments. Please let me know if you have any questions.

Thank you,
Karen Walter
Watersheds and Land Use Team Leader

Muckleshoot Indian Tribe Fisheries Division
Habitat Program
Phillip Starr Building
39015-A 172nd Ave SE
Auburn, WA 98092

Wilburton Commercial Area Land Use & Transportation Project

Alternatives and Environmental Review | Fact Sheet | August 16, 2017

What is the Wilburton Commercial Area Land Use and Transportation Project?

Wilburton is strategically located between two centers in Bellevue – Downtown and BelRed. The City is planning for Wilburton to have a unique urban design, mixed use finer-grained block pattern, and multimodal connections, particularly a light rail transit station, and as the eastern terminus of the nonmotorized Grand Connection that interfaces with the Eastside Rail Corridor. Based on a new vision developed with the guidance of a Citizen's Advisory Committee (CAC), amendments to the City's Comprehensive Plan, Land Use Code, and Zoning Map would be made for City Council consideration.

WILBURTON COMMERCIAL AREA DRAFT VISION STATEMENT

The Wilburton Commercial Area is Bellevue's next urban mixed-use community that enhances livability, promotes healthy living, supports economic vitality, and serves the needs of a diverse population. As Bellevue's cultural and innovative hub, it serves as a regional and international destination that connects people and fosters community by leveraging its existing assets to define a unique sense of place and character.

~Citizen's Advisory Committee Spring 2017

What is the Study Area?

The Wilburton Commercial Area study area is bounded by NE 12th Street to the north, I-405 to the west, SE 5th Street to the south, 120th Avenue NE to the east, and a smaller area bound by NE 8th Street and 124th Avenue NE to the east.

What is the status of the Wilburton Commercial Area planning effort?

The CAC has met monthly between January and July 2017 and has developed a draft vision, developed conceptual land use and transportation options, and considered comments from property owners and other stakeholders.

To help the CAC and other City decision makers consider the implications of alternative land use and transportation options on the environment, the City initiated an environmental impact statement (EIS). The EIS will provide information and analysis comparing the alternative land use and transportation options, as well as Grand Connection and open space options in the study area. The EIS will also consider how the alternatives incorporate City Council guiding principles and the CAC Vision.

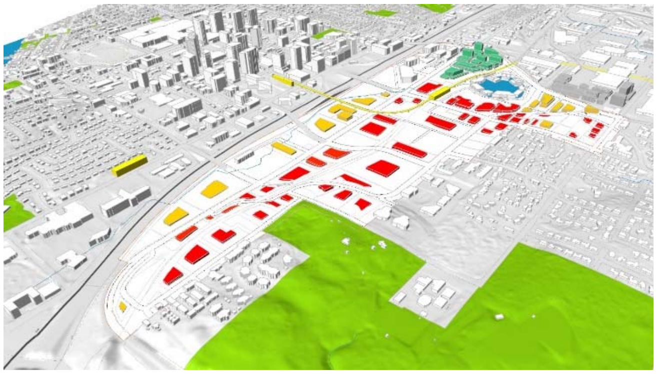
To help scope the EIS, the City held a scoping meeting and a written comment period in April 2017. At the scoping meeting, interactive exercises with the CAC and property owners were conducted, highlighting options for building form, open space, and transportation. One comment letter requested fish passage and stormwater retrofitting be addressed.

What Alternatives would be studied in the EIS?

Alternatives include a range of land use and transportation options in the study area. Alternatives incorporate Grand Connection and open space options as well. Key aspects of the alternatives are highlighted below including recent refinements.

Land Use: Building Form, Height, and Space

Exhibit 1. Building Form, Height, and Space



Alternative 1: No Action Future Baseline

Building Form~4.2 Million Square Feet

Alternative 1 is the SEPA-required "No Action" meaning development under current plans and codes. It grows by ~626,000 square feet of building space above the today's approximately 3.6 million square feet of development.

Alternative 2: Medium

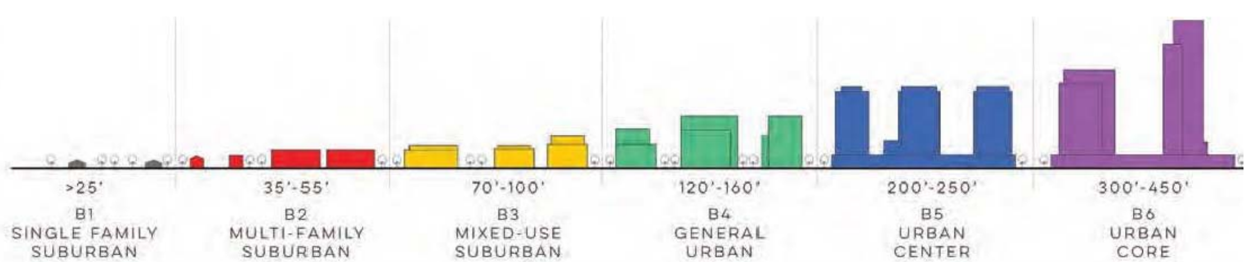
13.1 Million Square Feet 2035 Space
~16.3 Million Square Feet Ultimate Space

Alternative 2 reflects CAC discussions about creating a cohesive urban form reflecting the investment in the Light Rail station and Eastside Rail Corridor (ERC), and attracting mixed uses.

Alternative 3: High

16.3 Million Square Feet 2035 Space
~22.8 Million Square Feet Ultimate Space

Alternative 3 reflects some property owner and stakeholder input as well as CAC discussions about an urban form that may occur within and beyond the 2035 planning period at greater intensities along the ERC and Light Rail Station, assuming a higher market capture.



Source: NBBJ 2017

Land Use: Growth Ranges and Refinements

The EIS will review ultimate building form, height, and space like the range considered by the CAC through July 2017. However, growth ranges have been adjusted to reflect the year 2035 likely development level based on near-term redevelopment potential, market study results, and preliminary transportation modeling results for the No Action Alternative. This helps the City consider what investments would be needed in transportation and public services in a timeframe consistent with the Comprehensive Plan, without over or under planning.

Exhibit 2. Future Growth Range: Total Building Space

BUILDING SPACE	CURRENT	ALTERNATIVE 1 (NO ACTION)	ALTERNATIVE 2 (MEDIUM)	ALTERNATIVE 3 (HIGH)
Housing	250,000	335,440	3,798,600	5,050,000
Office	980,000	1,350,299	4,787,400	5,980,000
Retail/Commercial	955,000	1,081,010	1,488,800	1,827,000
Hotel	250,000	292,904	970,900	1,225,000
Medical	1,140,000	1,140,000	1,953,300	2,240,000
Industrial	30,000	30,983	30,000	30,000
Total Square Feet 2035	**3,605,000**	**4,230,636**	**13,029,000**	**16,352,000**
Post 2035 Ultimate Space	--	4,230,636	16,352,000	22,800,500

Note: Medical includes institutional and office space.
Source: Leland Consulting Group 2017; BERK Consulting 2017

The 2035 growth studied reflects high-range market capture projections from Leland Consulting Group (March 2017) and the Urban Land Institute.

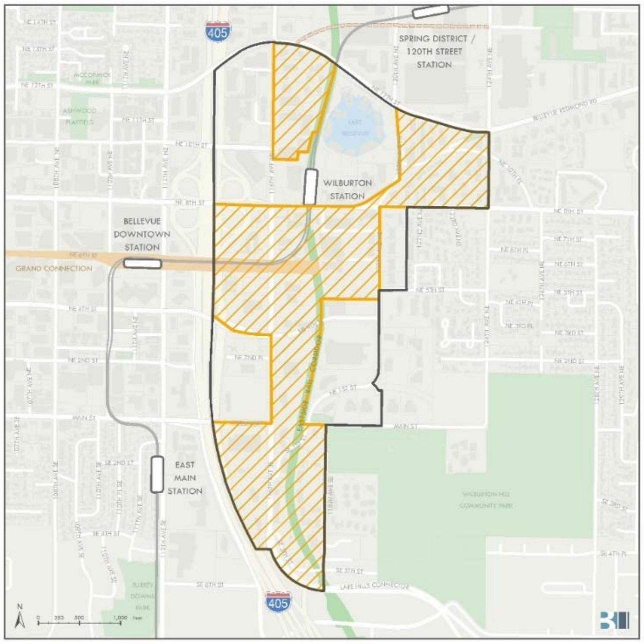
Exhibit 3. Comparison to Market Studies: Net Dwellings and Commercial Space to 2035

LAND USE	LELAND MARKET FORECAST: LOW	LELAND MARKET FORECAST: HIGH	ULI MARKET FORECAST	ALTERNATIVE 1: NO ACTION 2035	ALTERNATIVE 2: MEDIUM 2035	ALTERNATIVE 3: HIGH 2035
Housing (units)	3,480	4,500	5,000	89	3,700	5,000
Office (SF)	1,800,000	3,000,000	5,000,000	370,299	3,696,500	5,000,000
Retail (SF)	416,000	722,000	310,000	126,010	533,800	722,000

Source: Leland Consulting Group, March 2017

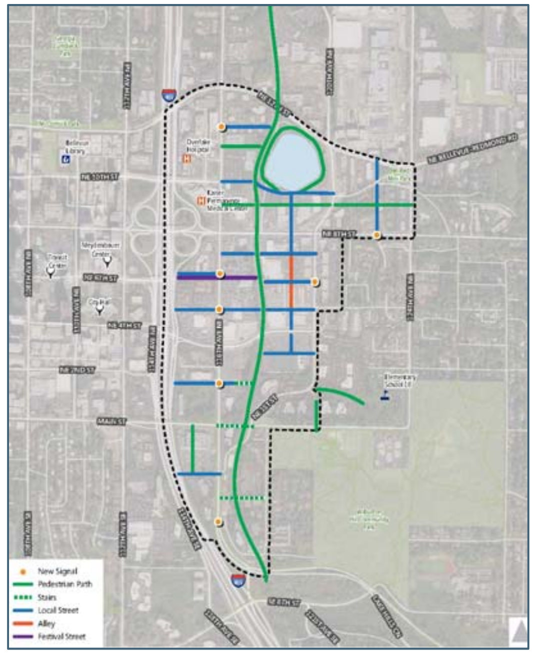
To determine the growth ranges through 2035, building space on potentially redevelopable properties were considered on several blocks shown below.

Exhibit 4. Potential 2035 Growth Focus Areas



BERK 2017

Exhibit 5. Draft Street Grid – Permeability Map



Fehr & Peers 2017

Transportation

Transportation concepts include multimodal improvements such as East Link Light Rail, Eastside Rail Corridor Trail (ERC), network improvements, and a new street grid. Some of the key network assumptions are listed in the table.

Exhibit 6. Transportation Network Assumptions

LOCATION	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2	ALTERNATIVE 3
NE 6th Street Extension	To 120th, or To 116th	To 120th	To 120th, or To 116th
NE 4th St/ERC	At grade	At grade	At grade
NE 8th St/ERC	Overcrossing	Overcrossing	Overcrossing, or At grade crossing
116th Ave NE	No changes	5 lanes with buffered bike lanes	5 lanes with buffered bike lanes
New street grid	No changes	See map	See map

Source: Fehr & Peers 2017

Next Steps and Schedule

The Draft EIS is anticipated to be published in late September 2017 with a 30-day public comment period. The Final EIS would likely be available in January 2018.

For more information

See the project website at: http://www.ci.bellevue.wa.us/grand-connection.htm.

Contact: Bradley Calvert bcalvert@bellevuewa.gov
425.452.6930

APPENDIX B
EPA CARBON MONOXIDE CONFORMITY LETTER

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
AIR AND WASTE

DEC 16 2016

Puget Sound Transportation Conformity Air Quality Consultation Partners
c/o Mr. Josh Brown, Executive Director
Puget Sound Regional Council
1011 Western Avenue, Suite 500
Seattle, Washington 98104-1035

Dear Puget Sound Transportation Conformity Air Quality Consultation Partners:

Congratulations on reaching the end of the 20-year maintenance period for carbon monoxide!

The U.S. Environmental Protection Agency (EPA) is providing this letter in its consultative role to document that the transportation conformity requirements, under Clean Air Act (CAA) section 176(c), for the Seattle-Tacoma carbon monoxide (CO) area ended on October 11, 2016. This date marks 20 years from the effective date of redesignation of the area to attainment for the CO National Ambient Air Quality Standard (NAAQS). See 61 FR 53323 (October 11, 1996).

Under 40 CFR 93.102(b)(4) of the EPA's regulations, transportation conformity applies to maintenance areas through the 20-year maintenance planning period, unless the maintenance plan specifies that the transportation conformity requirements apply for a longer time period. Pursuant to CAA section 176(c)(5) and as explained in the preamble of the 1993 final rule, conformity applies to transportation related pollutants and their precursors for which an area is designated nonattainment or is subject to a maintenance plan approved under CAA section 175A for areas redesignated to attainment. The section 175A maintenance planning period is 20 years, unless the applicable implementation plan specifies a longer maintenance period, see 58 FR 62188, 62206 (November 24, 1993). The EPA further clarified this conformity provision in its January 24, 2008 final rule (73 FR 4434-5).

This letter documents that, because the approved maintenance plan for the Seattle-Tacoma CO area did not extend the maintenance period beyond 20 years from redesignation, transportation conformity requirements for CO ceased to apply after October 11, 2016 (i.e., 20 years after the effective date of the EPA's approval of the first 10-year maintenance plan and redesignation of the area to attainment for the CO NAAQS). As a result, the Puget Sound Regional Council may reference this letter to indicate that the transportation conformity requirements of 40 CFR Part 93 no longer apply for the CO NAAQS. In addition, project sponsors can reference this letter to indicate that as of October 11, 2016, transportation conformity requirements also no longer apply for the CO NAAQS for FHWA/FTA projects as defined in 40 CFR 93.101. Even though the conformity obligation for CO has ended, the terms of the maintenance plan remain in effect and all measures and requirements contained in the plan must be complied with until the state submits, and the EPA approves, a revision to the state plan, see *GM Corp.* v. *United States,* 496 U.S. 530 (June 14, 1990). Such a State Implementation Plan revision would have to comply with the anti-backsliding requirements of CAA section 110(1), and if applicable, CAA section 193, if the intent of the revision is to remove a control measure or to reduce its stringency.

The EPA notes that there is an approved limited maintenance plan in place for the Seattle-Tacoma PM_{10} area, see 79 FR 49239 (August 20, 2014). Although regional emissions analyses are not required for PM_{10} under the limited maintenance plan provisions in 40 CFR 93.109(e), conformity determinations for the PM_{10} NAAQS continue to be required for transportation improvement programs, and non-exempt FHWA/FTA projects, and all other transportation conformity requirements apply, see 79 FR 49239 (August 20, 2014). Similarly, the EPA notes that there is an approved maintenance plan in place for the Tacoma $PM_{2.5}$ area, see 80 FR 7347(February 10, 2015). Transportation conformity determinations for the $PM_{2.5}$ NAAQS continue to be required in this area, see 80 FR 7347 (February 10, 2015).

If you have questions about the transportation conformity requirements in the Seattle-Tacoma area, please contact Karl Pepple, of my staff, at (206) 553-1778 or pepple.karl@epa.gov.

Sincerely,

Tim Hamlin

Timothy B. Hamlin
Director

cc: Mr. Craig Kenworthy
Puget Sound Clean Air Agency

Mr. Stu Clark
Washington State Department of Ecology

Mr. Mike Boyer
Washington State Department of Ecology

Ms. Karin Landsberg
Washington State Department of Transportation

Mr. Cliff Hall
Washington State Department of Transportation

Ms. Sharleen Bakeman
Federal Highway Administration

Mr. Ned Conroy
Federal Transit Administration

APPENDIX C
TABLE OF POTENTIAL POLICY CHANGES BY ALTERNATIVE

Exhibit C-1 Potential Policy Changes by Alternative

	NO ACTION ALTERNATIVE	ALTERNATIVE 1	ALTERNATIVE 2
Land Use Element–*Housing and Job Growth Forecasts and Policies LU-1 and LU-21* Half of Bellevue's growth is anticipated to occur in Downtown, the vast majority of the remaining growth will occur in mixed use centers, including Wilburton.	Consistent.	Consistent.	Consistent.
Land Use Element–*Figure LU-3* Assigns housing growth to Downtown, SR-520/Bel-Red, Eastgate-Factoria, and the remainder of the city. 900 new housing units are assigned to the "remainder of the city" which includes Wilburton.	Consistent.	Update. Alternative 1 estimates 3,946 new housing units.	Update. Alternative 2 estimates 5,246 new housing units.
Land Use Element–*Figure LU-4* Assigns employment growth to Downtown, SR-520/Bel-Red, Eastgate-Factoria, and the remainder of the city. 2,200 additional jobs are assigned to the "remainder of the city" which includes Wilburton.	Consistent. However, the No Action Alternative estimates 1,780 new jobs for Wilburton. Consider reviewing to ensure that it is appropriate for Wilburton to receive the majority of employment assigned to the "remainder of the city."	Update. Alternative 1 estimates 17,541 new jobs for Wilburton.	Update. Alternative 2 estimates 23,726 new jobs for Wilburton.

Source: City of Bellevue, BERK, 2017

	NO ACTION ALTERNATIVE	ALTERNATIVE 1	ALTERNATIVE 2
Land Use Element–*Bellevue's Land Use Plan: Downtown and Mixed Use Centers* Acknowledges that the Wilburton mixed use center has the potential to change significantly due to its location.	Consistent.	Consistent, but update to reflect the intended character of the area.	Consistent, but update to reflect the intended character of the area.
Land Use Element–*Map LU-1* Shows generalized Comprehensive Plan Land Use Designations.	Consistent.	Update will be needed to reflect future changes in land use designations.	Update will be needed to reflect future changes in land use designations.
Land Use Element–*Map LU-2* Shows Neighborhood Area (Subarea) Boundaries.	Consistent.	Update. Amend the boundaries to include that portion of the current BelRed subarea that is included in this study into the Wilburton Subarea.	Update. Amend the boundaries to include that portion of the current BelRed subarea that is included in this study into the Wilburton Subarea
Land Use Element–*Map LU-4* Shows the location of the city's Mixed Use Centers.	Consistent.	Consistent.	Consistent.
Neighborhoods Element–*Map N-1* Shows Neighborhood Area (Subarea) Boundaries.	Consistent.	Update. Amend the boundaries to include that portion of the current BelRed subarea that is included in this study into the Wilburton Subarea.	Update. Amend the boundaries to include that portion of the current BelRed subarea that is included in this study into the Wilburton Subarea
Economic Development Element–*Map ED-1.* Shows major employment centers.	Consistent.	May want to update map showing 116th/Bellefield employment center as the Wilburton Commercial Area or other appropriate name.	May want to update map showing 116th/Bellefield employment center as the Wilburton Commercial Area or other appropriate name.
Wilburton-NE 8th Subarea Plan–*Land Use Policies* Policies support: protection of existing single-family residential uses, the development of mixed use development in the commercial area, the development of the medical institution area, and maintaining "auto row."	Consistent.	Policies S-WI-2 and S-WI-6 will need to be updated to remove the emphasis on "auto row." Policy S-WI-4 may need to be updated to reflect allowance for heights over 75 feet. Policies S-WI-10 and S-WI-15, may need to be updated to reflect changes in land use designation.	Policies S-WI-2 and S-WI-6 will need to be updated to remove the emphasis on "auto row." Policy S-WI-4 may need to be updated to reflect allowance for heights over 75 feet. Policies S-WI-10 and S-WI-15, may need to be updated to reflect changes in land use designation.

Source: City of Bellevue, BERK, 2017

	NO ACTION ALTERNATIVE	ALTERNATIVE 1	ALTERNATIVE 2
Wilburton-NE 8th Subarea Plan–*Natural Determinants* Policies protect the natural and stormwater functions of the Kelsey Creek Basin and Lake Bellevue.	Consistent.	Consistent.	Consistent.
Wilburton-NE 8th Subarea Plan–*Residential Development* Policies support the development of new "work force" and housing with amenities for families.	Consistent.	Consistent.	Consistent.
Wilburton-NE 8th Subarea Plan–*Circulation* Policies aim to preserve safe, efficient circulation for people, bicycles, and automobiles and to keep auto traffic out of single-family residential neighborhoods.	Consistent.	Consistent. New street network further advances the policy on circulation.	Consistent. New street network further advances the policy on circulation.
Wilburton-NE 8th Subarea Plan–*Parks, Recreation, and Open Space Policies* Encourages the development of open spaces for a variety of purposes, and a connection of the Lake to Lake trail.	Consistent.	Consistent. Policy S-WI-33 may be updated depending upon the options chosen for the Grand Connection and for parks and open space.	Consistent. Policy S-WI-33 may be updated depending upon the options chosen for the Grand Connection and for parks and open space.
Wilburton-NE 8th Subarea Plan–*Community Design Policies* Ensure that new development protects views, is well-landscaped, and provides pedestrian amenities.	Consistent.	Mostly consistent, but should be reviewed with the adoption of design requirements. Policy S-WI-40 refers to views and should be reviewed with the adoption of design standards. Policies S-WI-51 through S-WI-53 refer to the community design of auto-row and may need to be updated.	Mostly consistent, but should be reviewed with the adoption of design requirements. Policy S-WI-40 refers to views and should be reviewed with the adoption of design standards. Policies S-WI-51 through S-WI-53 refer to the community design of auto-row and may need to be updated.
Wilburton-NE 8th Subarea Plan–*Figure S-WI-1* Shows land use designations for the Wilburton/NE 8th Subarea.	Consistent.	Update will be needed to reflect future changes in land use designations, subarea boundaries, and policies.	Update will be needed to reflect future changes in land use designations, subarea boundaries, and policies.

Source: City of Bellevue, BERK, 2017

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APPENDIX D
TRANSPORTATION

This appendix includes the following:

- Memorandum on Transportation Performance Measures (Fehr & Peers)
- *Non-Motorized Access Influence on Transit Ridership in the Puget Sound, Washington* article by Aaron Gooze, Chris Breiland, and Daniel Rowe (Fehr & Peers)
- Intersection level of service results table (Fehr & Peers)

In addition, the City of Bellevue's 2015 *Transportation Demand Management Plan, 2015–2023*, is available to download online at https://transportation.bellevuewa.gov/planning/transit-commuting/transportation-demand-management/,

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FEHR PEERS

MEMORANDUM

Date: June 20, 2017

To: Bradley Calvert and Kevin McDonald, City of Bellevue

From: Ariel Davis and Chris Breiland, Fehr & Peers

Subject: Wilburton EIS Transportation Performance Measures

SE17-0514

This memo proposes five multimodal performance measures to evaluate the transportation network in the Wilburton EIS. These measures speak to pedestrian, bicycle, transit, and auto conditions and are based on Bellevue's multimodal level of service (MMLOS) standards. This memo summarizes how and where those concepts will be applied within the Wilburton study area.

Pedestrian

Pedestrian LOS will consider three factors: sidewalk and buffer width, arterial crossing frequency, and signalized intersection treatments. The MMLOS standards recommended by the Transportation Commission vary by neighborhood context; the Activity Center standards will apply to the Wilburton study area, as shown in **Figure 1**. Study facilities will include arterials that fall within or along the study area boundaries: 116th Ave NE, 120th Ave NE, 124th Ave NE, NE 12th St, NE 8th St, NE 4th St, Main St, NE/SE 1st St, and Bel-Red Rd. To meet the pedestrian LOS standard, each arterial corridor must:

- have sidewalk and buffer width of at least 16 feet
- have crossing frequency of no more than 600 feet at locations determined by the Transportation Department (unless there are steep grades or incompatible adjacent land uses)
- meet Downtown Transportation Plan Enhanced intersection standards – intersection elements could include weather protection, minor/local wayfinding, special paving treatment, wider crosswalk than standard, generous crossing time, curb bump-out, and alternative striping.

A portion of the study area falls within the BelRed subarea: east of 116th Ave NE, and north of NE 8th St/Bel-Red Rd. Therefore, sidewalk standards outlined in the BelRed Land Use Code will apply to NE 12th St.

Figure 1

PEDESTRIAN LOS

Context: / Component	Downtown	Activity Center	Neighborhood Shopping Center	Pedestrian Destination	Elsewhere
Sidewalk Width Landscape Buffer	Downtown Land Use Code	16 feet	13 feet	13 feet	Transportation Design Manual
Signalized Intersection Design	Downtown Transportation Plan	Downtown Transportation Plan "Enhanced"	Transportation Design Manual	Transportation Design Manual	Transportation Design Manual
Arterial Crossing Frequency	Downtown Transportation Plan	600- 800 feet	600 feet	300-600	N/A

Bicycle

Bicycle LOS will be measured using the level of traffic stress (LTS) concept as recommended by the Transportation Commission. LTS considers multiple factors (in this case, vehicle speed, auto volumes and facility type) to evaluate the level of comfort for a person riding a bicycle along a particular facility. There are also specific standards for intersections and trail crossings along each study corridor. In the Wilburton area, Bicycle LOS 3 (see **Figure 2**) will be used as the standard on the following facilities: 116th Ave NE, 120th Ave NE, 124th Ave NE, NE 4th St, Main St, and NE/SE 1st St. Definitions for each Bike LOS are provided in the following **Figures 3 and 4.**

Figure 2 - Bicycle LOS Recommended Standards

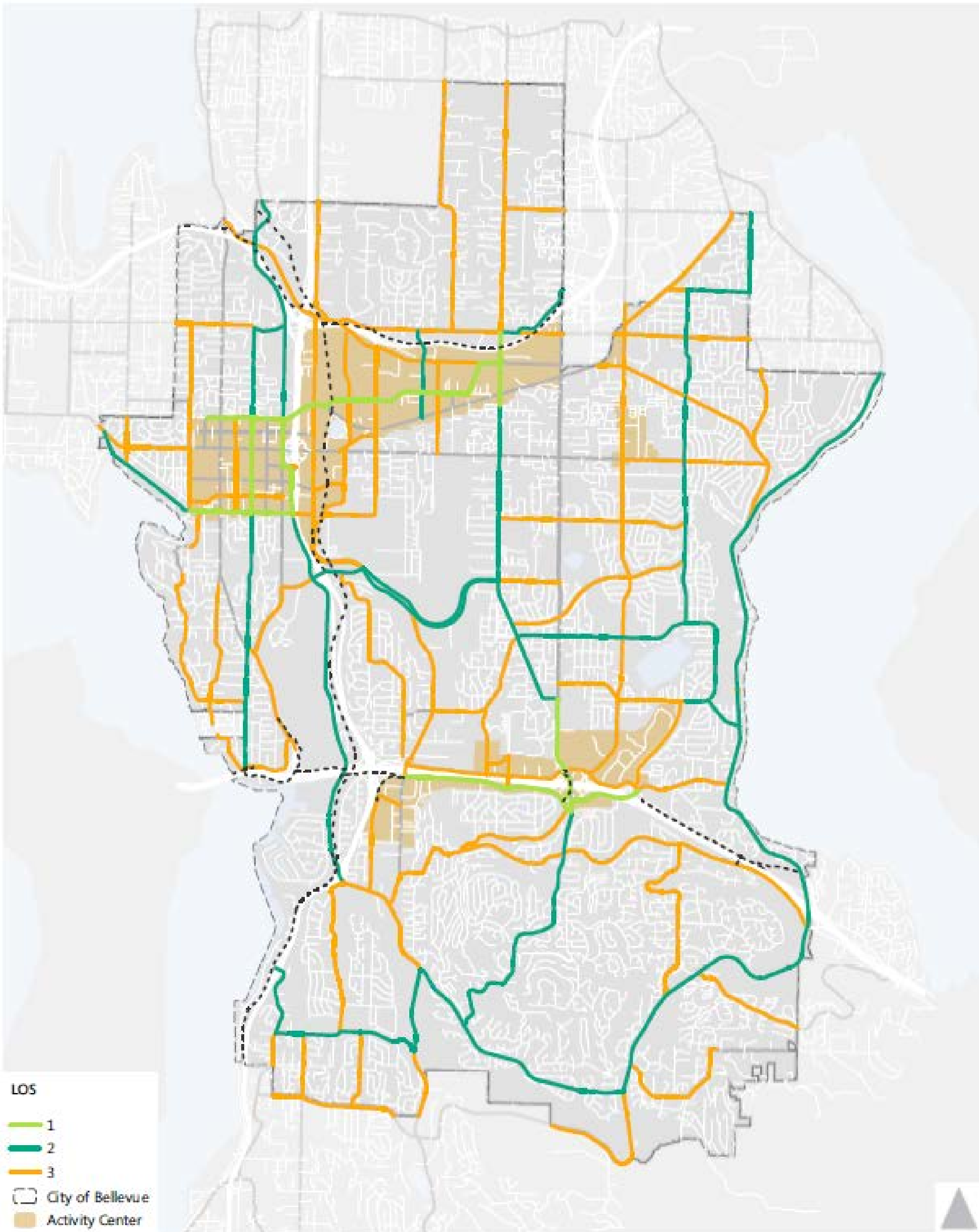


Figure 3 – Corridor Standards

BICYCLE RIDER LEVEL OF TRAFFIC STRESS (LTS)

LTS 1	LTS 2	LTS 3	LTS 4
Interested but Concerned – Children and Older Adults	Interested but Concerned – Adults	Enthused and Confident	Strong and Fearless

BICYCLE RIDER LTS/LOS

Roadway Characteristics		Bicycle Facility Components Guidelines to Achieve Intended Level of Service/Level of Traffic Stress					
Speed Limit (mph)	Arterial Traffic Volume*	No Marking	Sharrow Lane Marking	Striped Bike Lane	Buffered Bike Lane (Horizontal)	Protected Bike Lane (Vertical)	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	4	4	4	4	3	1

Figure 4 – Intersection Standards

BICYCLE LOS INTERSECTION COMPONENTS

Intersection Treatment / Bike LOS	Bike Signal	Street Crossing	Approach to Intersection	Approach to Intersection with Right Turn Lane
1	Bike signal	Green solid or skip stripe	Green bike box	Curb ramp to wide sidewalk
2	Bike signal	Skip stripe	Bike box	Green bike lane to left
3	Green cycle length	Sharrows	Signal actuation	Bike lane to left
Trail or Mid-Block Crossing	Full signal or HAWK or RRFB	Green solid or skip stripe	N/A	N/A

Transit – Stops/Stations

Transit LOS within the Wilburton area will be evaluated based on city controlled amenities at stops and stations such as weather protection, seating, transit landing zone and wayfinding, as shown below in **Figure 5**. Standards vary depending on the bus stop context. Local stops are defined as those serving a single route with headways greater than 30 minutes, primary stops are defined as those serving multiple routes or with headways of 30 minutes or less, and Frequent Transit Network (FTN)/RapidRide stops are those with frequent headways on the FTN or serving RapidRide routes.

Figure 5 – Transit LOS for Stops & Stations

TRANSIT PASSENGER LOS COMPONENTS

Context / Component	Local Stop	Primary Stop	Frequent Transit Network Stop
Weather Protection	Yes	Yes	Yes
Seating	Yes	Yes	Yes
Paved Bus Door Passenger Zone	15-30'	40'	60'
Wayfinding	Optional	Yes	Yes

Vehicle – Mobility Management Area (Long Range Planning Method)

Bellevue currently evaluates intersection LOS in Mobility Management Areas (MMAs) as shown in **Figure 7**. For long range planning such as the Wilburton EIS, the analysis period is the PM peak hour. Vehicle LOS is measured using the average control delay at designated system intersections within each MMA.

There are two standards for each MMA:

- Areawide average of vehicle LOS at the designated system intersections
- Congestion allowance: limit on the number of system intersections allowed to exceed the LOS standard for the area

The EIS will consider the Wilburton MMA (#4) which includes the following system intersections:

- NE 8th St/116th Ave NE
- NE 8th St/120th Ave NE
- NE 4th St/116th Ave NE
- Main St/116th Ave NE
- NE 1st St/116th Ave SE

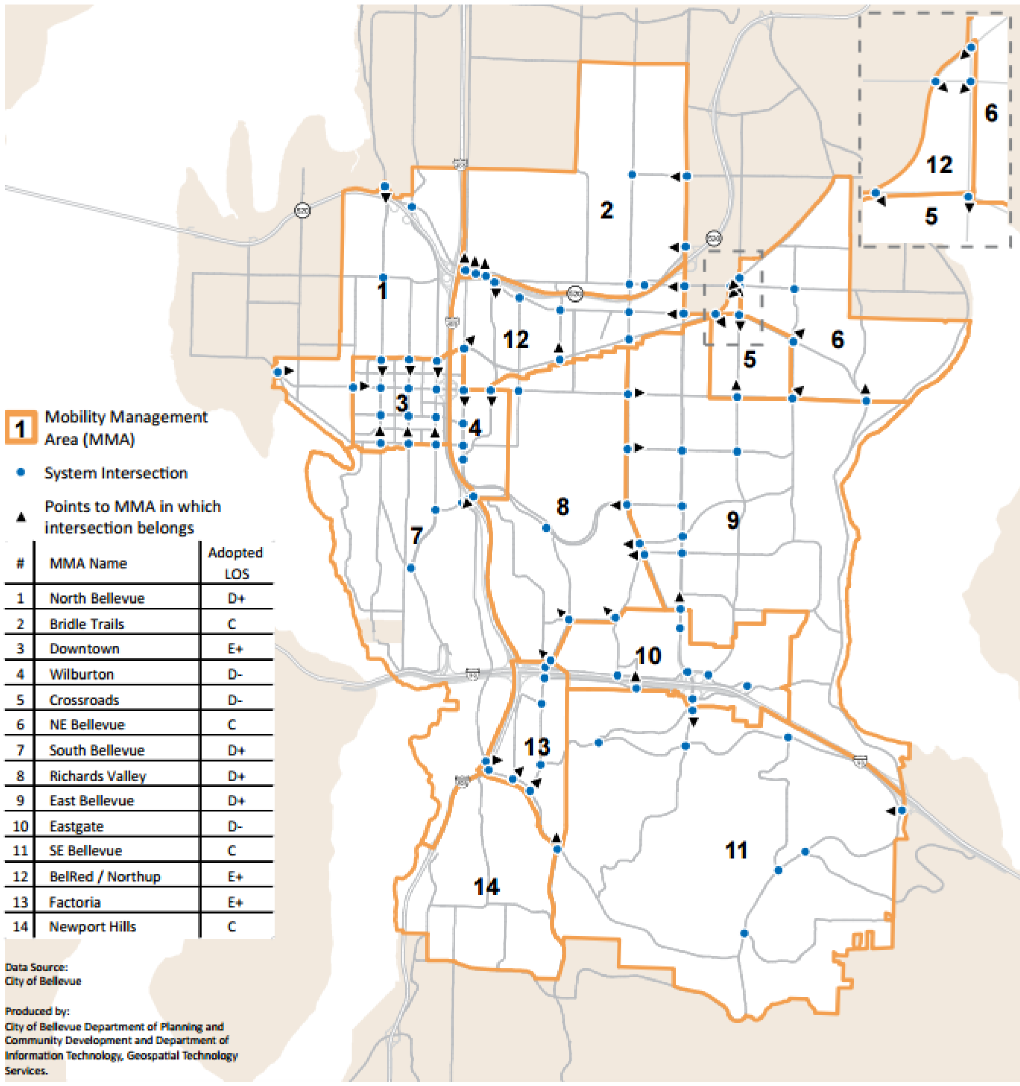
As shown in **Figure 8**, the LOS standard for the Wilburton MMA is D. For signalized intersections, the LOS standard corresponds to no more than 55 seconds of delay. The congestion allowance for the Wilburton MMA is three, meaning no more than three intersections can exceed the 55 second delay threshold.

The Wilburton MMA does not include two intersections on the border of the study area: NE 12th St/116th Ave NE (BelRed/Northup MMA 12) and NE 8th St/124th Ave NE (Richards Valley MMA 8). We will report the levels of service at those two intersections individually.

Figure 7

Map TR-1. Mobility Management Areas and System Intersections

Mobility Management Areas (MMAs) are discrete areas for which level of service (LOS) standards are tailored to reflect the unique conditions and community objectives in the area. System Intersections are the locations where LOS is measured.



#	MMA Name	Adopted LOS
1	North Bellevue	D+
2	Bridle Trails	C
3	Downtown	E+
4	Wilburton	D-
5	Crossroads	D-
6	NE Bellevue	C
7	South Bellevue	D+
8	Richards Valley	D+
9	East Bellevue	D+
10	Eastgate	D-
11	SE Bellevue	C
12	BelRed / Northup	E+
13	Factoria	E+
14	Newport Hills	C

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Vehicle – Primary Vehicle Corridor Speed

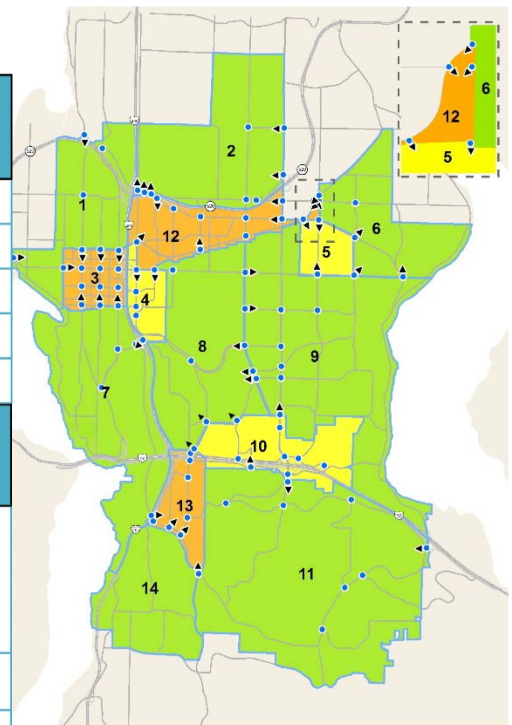
Vehicle speed on primary vehicle corridors will also be used to evaluate each alternative. The LOS is based on percent of typical urban travel time which is based on the speed limit, as shown in **Figure 8**.

Figure 8

Level-of-Service in Bellevue

Toward a Multimodal Approach to Mobility

LOS	Percent of Typical Urban Travel Time on Corridors Based on 40% of the Posted Speed Limit
	Less than 90% of Typical Urban Travel Time
	90-110% of Typical Urban Travel Time
	110-155% of Typical Urban Travel Time
	155-200% of Typical Urban Travel Time
	More than 200% of Typical Urban Travel Time
LOS	**As applied to Mobility Management Areas**
	Bridle Trails, East Bellevue, NE Bellevue, Newport Hills, North Bellevue, SE Bellevue, South Bellevue, Richards Valley
	Crossroads, Eastgate, Wilburton
	BelRed/Northup, Downtown, Factoria

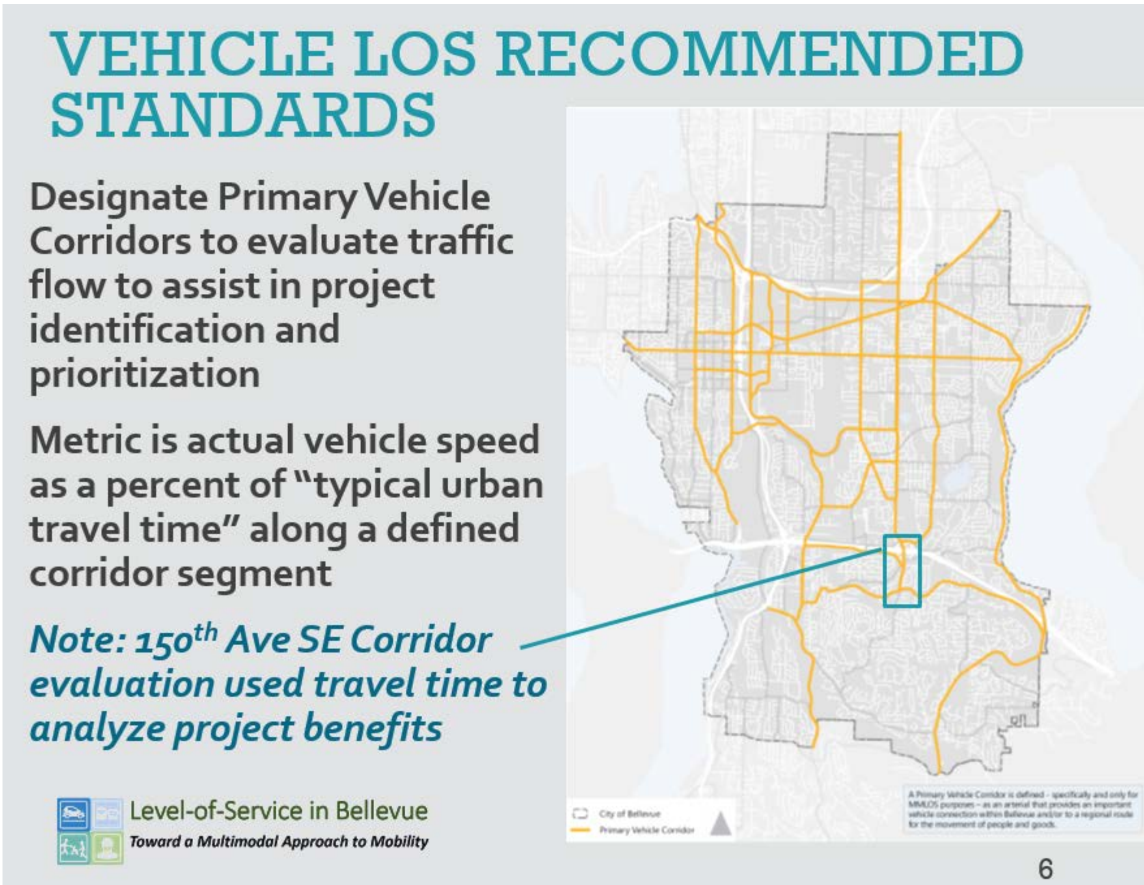


The citywide priority vehicle corridors are shown in **Figure 9**. For the Wilburton EIS, we plan to evaluate the following segments:

- 116th Ave NE between Northrup Way and SE 8th St
- 120th Ave NE/ 1st St between NE 12th St and 116th Ave NE
- NE 12th St between 112th Ave NE and 140th Ave NE
- NE 8th St between 112th Ave NE and 140th Ave NE
- NE 4th St between 112th Ave NE and 120th Ave NE

Existing travel times will be collected along each corridor during the PM peak period. Future travel times will be estimated using Synchro/SimTraffic where available. BKR model outputs will be used for those segments that are not available via Synchro.

Figure 9



Title: *Non-Motorized Access Influence on Transit Ridership in the Puget Sound, Washington*

Submission Date: August 1, 2014

Word Count: 5,063+ 1,750 (tables and figures)

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ABSTRACT

Transit agencies and local jurisdictions are increasingly developing initiatives to improve non-motorized connections to transit in an effort to increase travel options for residents. Traditionally non-motorized access projects for transit are developed and prioritized by identifying gaps in the system, interviewing transit patrons, or by using the expertise of agency staff or consultants. One drawback to this approach is that the amount of transit ridership that could potentially be gained from the non-motorized access improvement is unknown. To better answer this question, this research developed a transit ridership regression model for the Puget Sound region that includes non-motorized connectivity variables. This model is being used to identify and prioritize non-motorized access to transit projects by transit agencies in the Puget Sound area.

INTRODUCTION

Transit agencies and local jurisdictions are increasingly developing initiatives to improve non-motorized connections to transit in an effort to increase travel options for residents. Transit agencies can be interested in increasing transit ridership through first and last mile connections without investing in new service or costly park-and-ride facilities. Jurisdictions may develop a bicycle or pedestrian master plan with the intention of prioritizing investments to meet a variety of goals, including improved access to transit. Low-cost pedestrian and bicycle transit access improvements can be a priority for jurisdictions, but these types of projects are not always immediately apparent when planning and prioritizing non-motorized investments. By identifying deficient or new bike/walk pathways between adjacent neighborhoods and business areas, bus stops, and stations, more residents could access transit facilities, increasing travel options.

This research attempts to quantify the change in transit ridership based on the variation in non-motorized access to transit. Five key connectivity variables were used to evaluate the non-motorized access conditions: route directness index (RDI), sidewalk/walkway density, intersection density, arterial crossing index, and bike stress index. Regression analysis was used to develop a transit ridership model that can evaluate how non-motorized connectivity is related to transit ridership. The model includes “base” variables well known to be strongly correlated with transit ridership including land use, demographic, and transit service factors. The connectivity variables were evaluated along with the base variables above, to develop a model to relate non-motorized connectivity to transit ridership at 170 station-areas in the Puget Sound region. Using this model, decision makers and agency staff can better understand how non-motorized projects can help to improve access to transit and increase transit ridership.

This research was developed through a partnership between King County Metro Transit and Sound Transit, the two largest transit providers in the Puget Sound. The research is part of a project that provides an assessment of potential and priority locations where improvements can increase walk/bike access to bus stops for major transit routes. Improvements range from small-scale projects such as crosswalks, curb cuts, and crossing signals, to construction of separate facilities, such as bicycle trails, non-motorized overpasses, and similar improvements. The project study area consists of approximately 400 square miles, including 19 separate jurisdictions, shown in Figure 1.

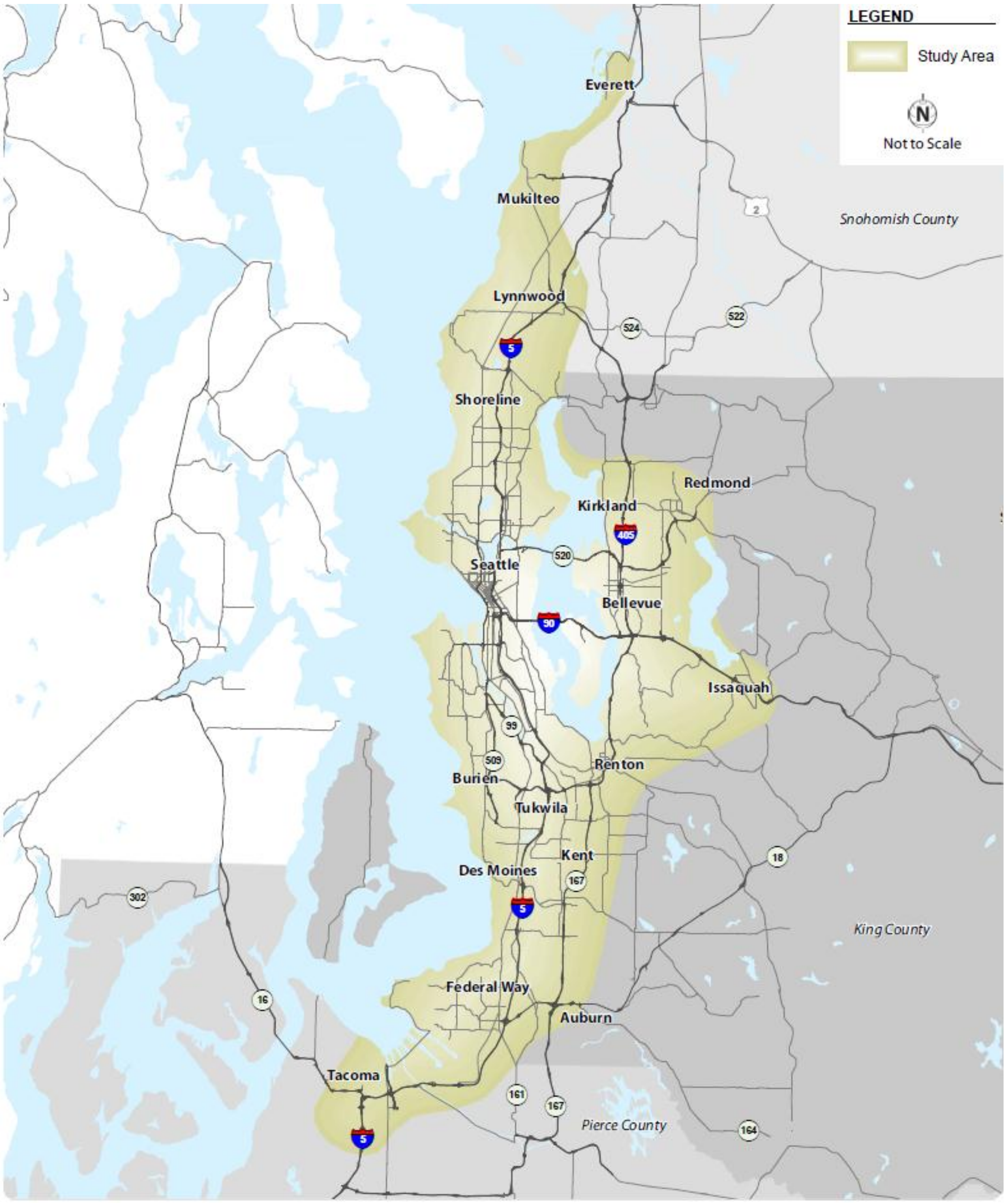

FIGURE 1 Study Area.

LITERATURE REVIEW

Literature was reviewed to assess if and how bicycle and pedestrian improvements around transit stops/stations may be correlated with a change in transit ridership. While many studies have evaluated the effects of the built environment on increased walking and cycling, few have sought to directly link the non-motorized environment to specific transit ridership changes. This section summarizes the principal research on the topic.

Cervero evaluated factors that influence work-trip transit ridership for residents living near rail lines in California and found that certain variables had “significant marginal influences” on mode choice. While, in general, workplace variables such as flextime schedules were the most influential, non-motorized connectivity levels at the destination were also significant factors. The desire to live in an area close to transit was also an indicator of transit ridership.

Streetscape improvements, presence of paid parking, and other physical design elements of station area housing apparently did not influence whether station area residents took transit for work trips. Housing density around station areas made the biggest difference in adding trips to the transit system. In other words, on a per-capita basis denser areas have higher transit ridership per-capita than less dense areas, regardless of the pedestrian/parking environment of the station area. Among Californians living within one-half mile of rail stations, only one urban design variable had significant influence on whether people biked or walked to the station: street lighting density (*1*).

Ryan and Frank utilized data from the San Diego region to assess relationships between transit ridership and the quality of pedestrian environments around bus stops. The study authors defined the station catchment area as a half-mile along the street network from each transit stop. The analysis showed a “significant and expected” relationship between bus ridership and walkability. While the “walkability index” variable was deemed statistically significant, it explained only 0.5% of variation in transit ridership. According to the authors, the walkability index variable is a combination of land use density, land use mix, and street network pattern (*2*).

Schlossberg et. al of the Mineta Transportation Institute did not address relationships between the pedestrian environment and transit ridership but did identify key factors influencing why people choose certain routes and how far they are willing to walk to transit. Survey responses indicated that people walk on average 0.5 miles to access rail transit. Other data cited by the authors note that people in suburban areas are more willing to walk longer distances (average of 0.4 miles versus 0.2 miles) than similar people in urban areas to reach high-frequency transit (either rail or bus). According to the survey, the most important factor in choosing a walking route is directness (minimizing time and distance). Secondary factors are safety, attractiveness of the route, sidewalk quality, and absence of long waits at traffic lights. The study authors equated “safety” to the presence of adequate traffic control devices at crossings, as well as lower traffic speeds (*3*).

In a recent study analyzing multiple Bay Area Rapid Transit (BART) stations, Cervero et. al. assessed how changes in bicycle environments influenced access-to-transit mode split between 1998-2008. The BART stations were characterized by typologies (urban, urban with parking, balanced intermodal, intermodal-auto reliant, or auto-dependent). Several stations in the study experienced significant increases in bicycle mode share access to transit, attributed to infrastructure investments. For instance, Ashby Station in Berkeley increased its bicycle mode share from 7.4% in 1998 to 11.7% in 2008 and significantly expanded its bike access shed through multiple infrastructure improvements at and around the station. In addition, Fruitvale station increased its bike mode share from 4.3% to 9.9% from 1998-2008, which the authors attribute to an improved bicycle network around the station, wayfinding, attended bike parking, and car parking fees (*4*).

NCHRP Project 08-78a takes a more general look at the factors that influence people’s choice to walk and bicycle, providing a method to estimate walking and bicycling trips for transportation planning applications. The study focuses on several factors that are important in predicting pedestrian and bicycle trips, including age, income, gender, trip purpose, land use and built environment, facilities and infrastructure, and natural environment characteristics, like climate, temperature variation, and terrain. The results indicate that factors such as high street/intersection density, direct routes, sidewalks on arterial streets, controlled arterial crossings, and non-arterial bike routes are of primary importance. Of lesser importance is the presence of sidewalks on local roads, bike lanes on arterial roads, and pavement quality (*5*).

A study published by the Environmental Protection Agency (EPA) contains some of the most detailed regression analysis results on the factors that influence the choice to walk and bicycle. As opposed the fairly simple measures, such as intersection density and street density, used commonly in past studies, the EPA paper contained a more complete, yet more data-intensive measure of active transportation connectivity. The "design index" component described in this paper is a combination of street network density, sidewalk completeness, and route directness. In terms of correlation with non-motorized travel, street network density has the strongest correlation, followed by route directness and sidewalk completeness (*6*).

In summary, many studies have addressed methods, data collection, and relationships to transit ridership, but few have directly and quantitatively linked specific non-motorized improvements to changes in transit ridership. Based on the literature findings, the research team identified the following variables to explore further in this study: intersection density, street lighting, land use density (population and employment), street/sidewalk/walkway density, route directness index, bicycle facility density/coverage, bicycle stress index, and signalized arterial crossing density.

METHODS

This research attempts to quantify the change in transit ridership that can be attributed to the non-motorized access environment. Since transit ridership is strongly influenced by factors outside of the non-motorized network, an initial "base" transit ridership model was developed to understand the most important factors that influence transit ridership in the Puget Sound region. A variety of base variables were evaluated, including the land use mix, land use density, household income, car ownership, etc. These land use/demographic variables were combined with transit service variables to develop the base transit ridership model. With the base model constructed, the non-motorized connectivity variables were added to measure their effect and a final combined model that incorporates the demographic, land use, and connectivity variables was constructed. See Figure 2 for a flowchart outlining the modeling process. This section describes the variables evaluated and the methods used to develop this model.

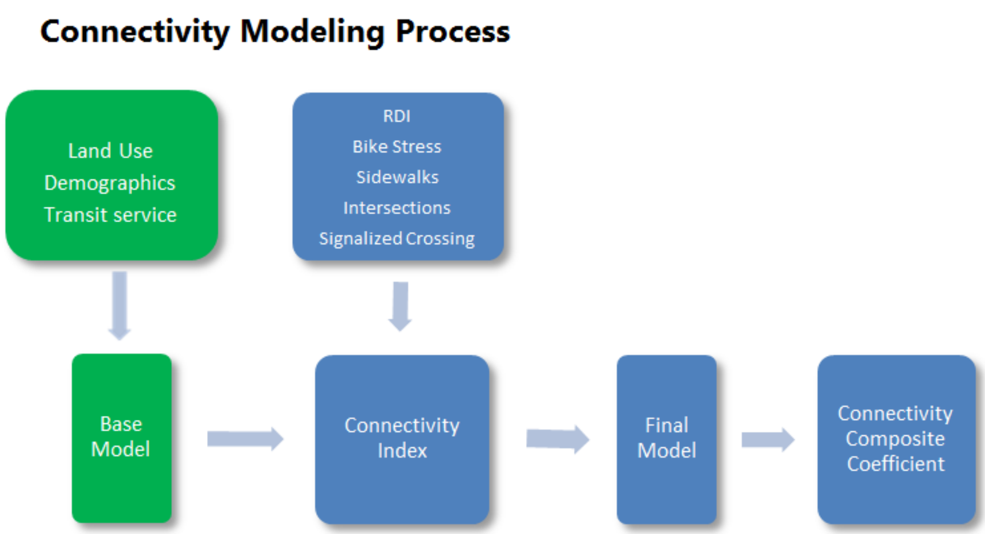

FIGURE 2 Connectivity Modeling Process.

Study Area

The study area includes 170 transit stop/station areas covering about 400 square miles of urban and suburban development. To consolidate information at transit centers and to aggregate inbound and outbound stop pairs, ridership was totaled within a 450 foot buffer of each transit stop/transit center. After reviewing all the stop data, Downtown Seattle bus stops and train stations were removed from the sample. Downtown Seattle is unique in that there is a high density of stops/stations and high variability in ridership at those stops. The ridership variability is largely due to small-scale land use characteristics adjacent to the transit stops. Unfortunately, the land use data (available from the Puget Sound Regional Council) is at a larger scale than can be appropriately analyzed at the Downtown Seattle stop level, so the project team removed these stops. Sound Transit Sounder stations, a commuter rail service, were also removed since Sounder has different travel characteristics (peak service only) and the travel sheds for Sounder stations tend to be much larger than for the other stops/stations in the sample.

Connectivity Variables

The literature review guided which connectivity variables to include in the model. However, before the model was developed, an extensive data collection effort was made across the study area to understand what data were available and the quality of the available data. The data collection effort involved contacting 23 agencies and jurisdictions to obtain available GIS data on non-motorized connectivity and other transportation and utilities information. Upon reviewing the collected data, it became clear that there was not adequate data to include street illumination in the analysis and model. However, there was adequate information about the street network, sidewalk coverage, bicycle facilities, and traffic control devices to develop the non-motorized connectivity variables described below. Figure 3 provides an example of each of the surfaces generated through the analysis including:

- Route Directness Index (RDI)
- Sidewalk/walkway Density
- Bike Stress
- Intersection Density
- Signalized Arterial Crossing Index

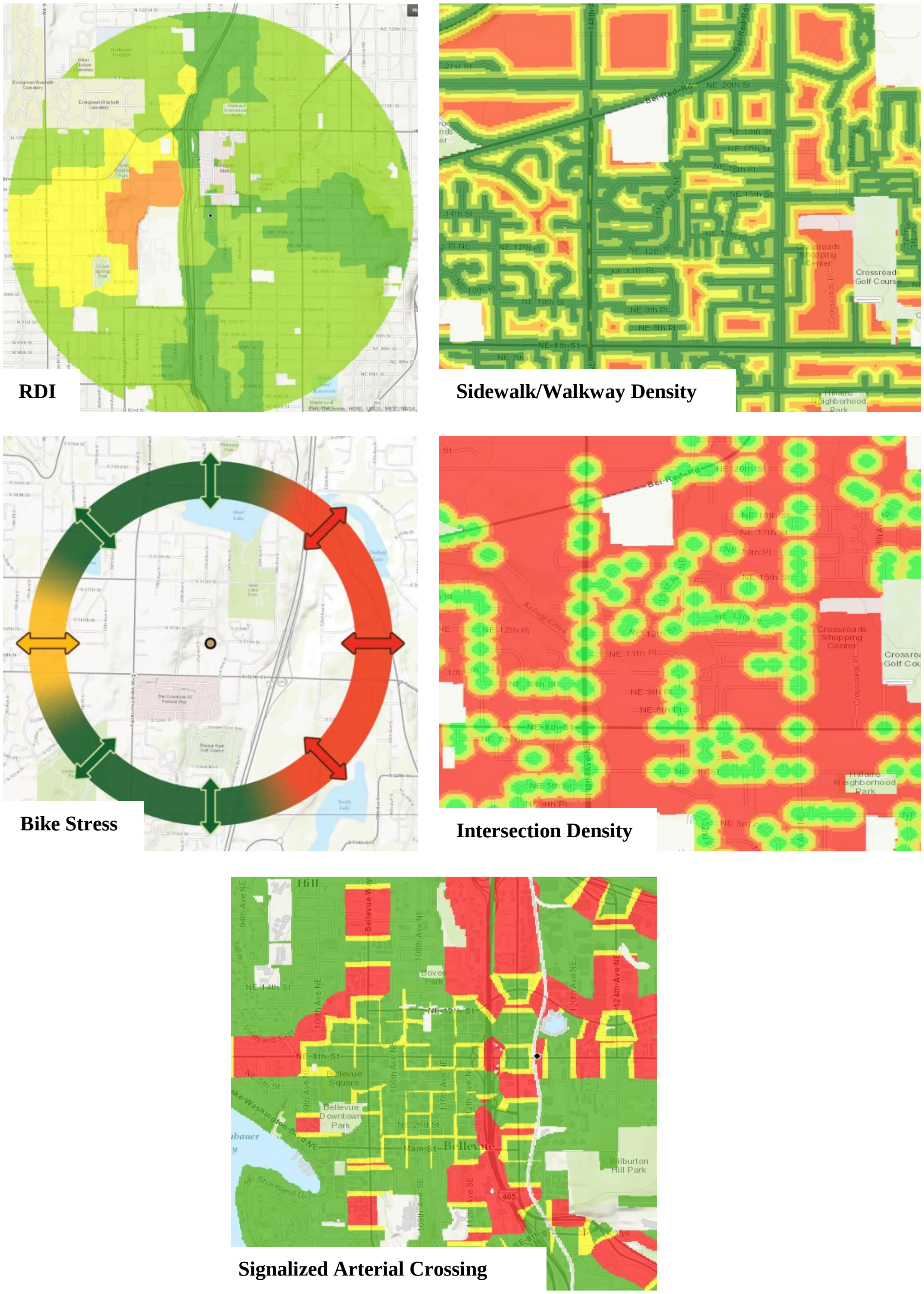

FIGURE 3 Examples of Connectivity Surfaces

Route Directness Index

Route Directness Index (RDI) is an increasingly common measure of how well connected areas are, particularly for pedestrian travel. RDI measures the ratio of the actual network distance and the "crow fly" distance between two points (*7*). This study evaluates RDI at a many-to-one basis with the index calculated for all intersections within three miles relative to the study transit stop. The final result of the calculation is a raster "surface" of RDI relative to the transit stop. RDI is very sensitive to barriers to non-motorized access immediately adjacent to the transit station. Features like freeways, large buildings (such as shopping centers and warehouses), and large street blocks are readily evident with the RDI calculation.

Bike Stress

The concept of bike stress was developed by the Mineta Institute and considers how comfortable a street is to cycle along (8). Low stress routes include low-volume residential streets, moderate volume streets with bicycle lanes, and separated facilities such as bike trails or cycletracks. High stress routes include moderate volume streets with no bike lanes or high volume/high speeds even if bike lanes are present. Bike stress was calculated for each link on the roadway network within the study area by considering the roadway's functional classification (a proxy for traffic volume), speed, and the presence of bicycle facilities. The connectivity analysis compares the network distance required to reach each transit stop/station from eight cardinal points located one mile away from the study transit stop. This represents a cordon that cyclists one mile or more away must cross to reach the transit stop/station. The network distance is first computed using the full transportation network, regardless of the bike stress on each link (representing the shortest path – note that links where bicyclists are prohibited, such as freeways, were removed from the network). A second network routing analysis is conducted with a network constrained to only those links with "lower stress." The distance traveled along the constrained low stress network is compared to the full network in order to determine a difference ratio, or the amount of diversion required for a cyclist to remain on a lower stress network. The Mineta Institute research states that a majority of cyclists will travel at most 25% out-of-route in order to travel along a lower stress street segment if they approach a high stress segment. To calculate a station-area score, the eight bike stress ratios weighted using the population density within each bike stress analysis segment.

Intersection and Sidewalk/Walkway Density

Sidewalk/walkway and intersection density are evaluated by generating a raster surface depicting the distance from a sidewalk/walkway and intersection, respectively. The raster is calculated using a linear distance decay function to assign values from the sidewalk/walkway or intersection feature to an extent of 300 feet. This surface is calculated for the entire study area and then aggregated to each station area. 300 feet was selected for the limit of the decay function since Downtown Seattle has a 300 foot street grid, which most other cities in the region strive to mirror when breaking up large blocks.

It is notable that the sidewalk/walkway raster was generated not purely based on where sidewalks and trails are present. Much of the study area was built during a period where sidewalks were not provided along roadways. While most of the gaps in the arterial sidewalk system have been filled over time, a large proportion of study area residential streets lack sidewalks. Based on the literature review which indicated that local street sidewalks were not as important of a factor when accessing transit compared to arterial sidewalks (*3, 5*), residential and local access streets without sidewalks were treated as if they were present when the raster was calculated.

Arterial Signalized Crossings

Signalized crossings of arterial streets were demonstrated to be an important factor in accessing transit in the literature review (*5*). Similar to the intersection and sidewalk/walkway density calculation, a raster surface was created to evaluate the presence and proximity of signalized arterial crossings. As with the prior variable, the goal was to assign a good/high rating to areas with signalized arterial crossings every 300 feet or less (again this represents conditions in the Downtown Seattle grid). Scores are generated in a linear manner along the arterial in either direction of the signal to summarize how easy it is for businesses and homes along the street and in the neighborhoods adjacent to the street to cross in order to access transit stops.

Final Raster Surfaces

As described above, raster surfaces were developed for each of the connectivity measures to help visualize the results and to facilitate the creation of a composite connectivity index that was used for ridership regression modeling. Each surface includes areas that are “masked-off” from the connectivity analysis. These areas include parks, water bodies, schools, colleges/universities, cemeteries, golf courses, and large commercial areas (e.g., malls). The masked areas tend to have limited transportation infrastructure and tend have low connectivity scores. However, since these areas tend to be destinations, the authors did not want the lack of intersections or sidewalks in a park, for example, to negatively affect the connectivity score of an area. It is important to note that these masked areas do influence scores like RDI since they can act as a barrier to traveling to a transit stop if a street or path does not pass through them.

Ridership Regression Analysis

The goal of this research is to understand how the connectivity variables described in the prior section relate to transit ridership. To understand this relationship, linear regression modeling techniques were used. The first step in developing the regression model was to develop a “base” ridership model that relates land use, demographic, and transit-service factors to ridership. We wanted to understand the relationship between the base variables and transit ridership first so that when the connectivity variables were added, we would be sure that they would have coefficients of a reasonable magnitude and that they would not be “taking credit” for key land use, demographic, or transit service variables.

Base Model Development

More than 20 base model forms were evaluated. Different input variables were evaluated along with different variable transformations. Examples included population, employment, population/employment density, stop type, number of routes, number of transit stops, population below the poverty line, population that is minority, amount of zero car households, median income, transit service hours, and employment/population reach of the routes served. Ultimately, the best performing model was based on a logarithmic transformation of total transit stop ridership and linear independent variables. This model is summarized in Table 1 and had an adjusted R-squared value of 0.633. This type of log-linear relationship between the dependent and independent variables is not uncommon in transit ridership-type models that have a mix of lower ridership and higher ridership stops/stations, where the high ridership stops have many times the ridership of the median stop.

TABLE 1: Base Ridership Model Results

	Estimate	Significance
Intercept	2.34	**
Population Density	0.007	**
Total Daily Trips	0.0054	***
Parking Spaces	0.001	***
Hours of Service	0.0905	***
Area Median income	-0.002	*
Employment Density	0.003	*

Sig. Levels: *** = > 99%, ** > 90%, * > 70%

Connectivity Model Development

With the base model established, the non-motorized connectivity variables were added to measure their effect on transit ridership. Initial modeling was performed with each of the five variables (RDI, bike stress, sidewalk/walkway density, intersection density, and signalized crossing density) included. However, models with the individual connectivity variables did not indicate that any of the variables had a statistically significant relationship with transit ridership. This result was not unexpected since the individual connectivity variables were expected to have a marginal relationship with transit ridership compared to the variables included in the base model. While each of the variables were not statistically significant, the signs and magnitudes of the connectivity variable coefficients were reasonable.

To address the issue of statistical significance, a single composite of the five connectivity variables was developed. This was done by evaluating the base model with each of the five connectivity variables added in turn. Since each of the raster surfaces were developed using the same scale (an ordinal score of one through five), the coefficients of base models including each of the connectivity variables could be compared. The relative values of the coefficients defined the weight of each connectivity variable in the composite variable. When developing the composite variable, multi-collinearity was a concern. Evaluating the Variance Inflation Factor for each of the variables, two variables were found to be collinear: sidewalk/walkway density and intersection density. The collinearity between sidewalk/walkway and intersection density is expected due to the related nature of how the two variables were computed (sidewalks and walkways are along the same streets that intersect). To account for this collinearity, the coefficients of these two variables were halved and the weighting percentages were calculated as shown in Table 2. The final connectivity composite was calculated by weighting the station-area score for each of the five connectivity variables by their relative weight percentages to result in a connectivity score between 1 and 5.

TABLE 2 Coefficients and Weighting of Connectivity Composite Variable

	Coefficient	Weight Percentage
RDI	0.860	36%
Bike Stress (BS)	0.145	6%
Sidewalk/Walkway Density (SW)	0.669	14%
Intersection Density (ID)	0.393	8%
Signalized Crossing (SC)	0.878	36%

Model Calibration

The base model with the composite connectivity variable was calibrated using 24 case study locations. The calibration sites included a mix of large transit centers, park-and-ride lots and several lower-ridership locations. The model was calibrated by looking at how well the model performed under both static conditions (i.e., how well did the model match the observed ridership) and dynamic conditions (i.e., is the model appropriately sensitive to changes to independent variable values). Through the calibration process, the following issues were identified:

- A light rail factor was added into the model since ridership at Sound Transit light rail stations is consistently higher than comparable bus stop locations. This type of light rail “dummy” variable is often included in transit ridership models to account for people’s bias to ride rail more than other modes of transit.
- A “subgroup” analysis was performed to determine if there were any biases in different types of transit stop types. In the case of the large transit centers with large parking lots, the Parking Space variable was consistently leading to an over-prediction of ridership. The coefficient on the Parking Space variable was reduced and all other of the coefficients were increased proportionally to improve the model fit for major transit centers.
- Based on feedback from jurisdictions, the predicted change in ridership from connectivity improvements was too sensitive to the bike stress variable. As a result, the weight of the Bike Stress component of the connectivity variable was modified to produce results that were more in line with the region’s bike access-to-transit mode share of between 0.5% and 2%. The Bike Stress weight was refined to ensure that the expected number of new riders that were being predicted as a result of new bicycle infrastructure was not out-of-magnitude with observed bicycle mode shares in the region.

With these model calibration adjustments in place, the connectivity model was finalized and is shown in Table 3. The final R-squared of the calibrated model was 0.730. The effect of the connectivity index variable on ridership can be interpreted as “a one unit improvement in the connectivity composite will result in 25% increase in daily boardings.”

TABLE 3 Final Regression Model

	Coefficient	Significance
Intercept	*1.88*	**
Employment Density	0.002	*
Link factor	0.98	***
Population Density	0.005	*
Total Daily Trips	0.0049	***
Parking Spaces	0.0013	***
Hours of Service	0.097	**
Area Median Income	-0.002	*
Connectivity Composite	0.25	*

Sig. Levels: *** = > 99%, ** > 90%, * > 70%

Model Assessment

The model performs best for transit stops and stations with more than 200 average daily boardings. For the lower ridership transit stops, the model tends to over-predict ridership as shown in Figure 4. However, it is important to keep in mind that the primary goal of the model was not to predict ridership exclusively (there are several other models that are better predictors of transit ridership in the Puget Sound region), but to understand the potential change in ridership that could result from improved non-motorized connectivity conditions. With this in mind, the model is well suited to estimate the change in transit ridership that could result from non-motorized connectivity improvements at both high and low-ridership transit stops. This ability to predict non-motorized connectivity's effect on ridership is in large part due to the logarithmic structure of the model. Since the model predicts the percent-change in transit ridership as opposed to the absolute change in ridership, low-ridership stops are not as prone to being overestimated, particularly if the percent change is applied to observed ridership (appropriate for near-term analysis) or a more robust ridership forecast (for long-term analysis).

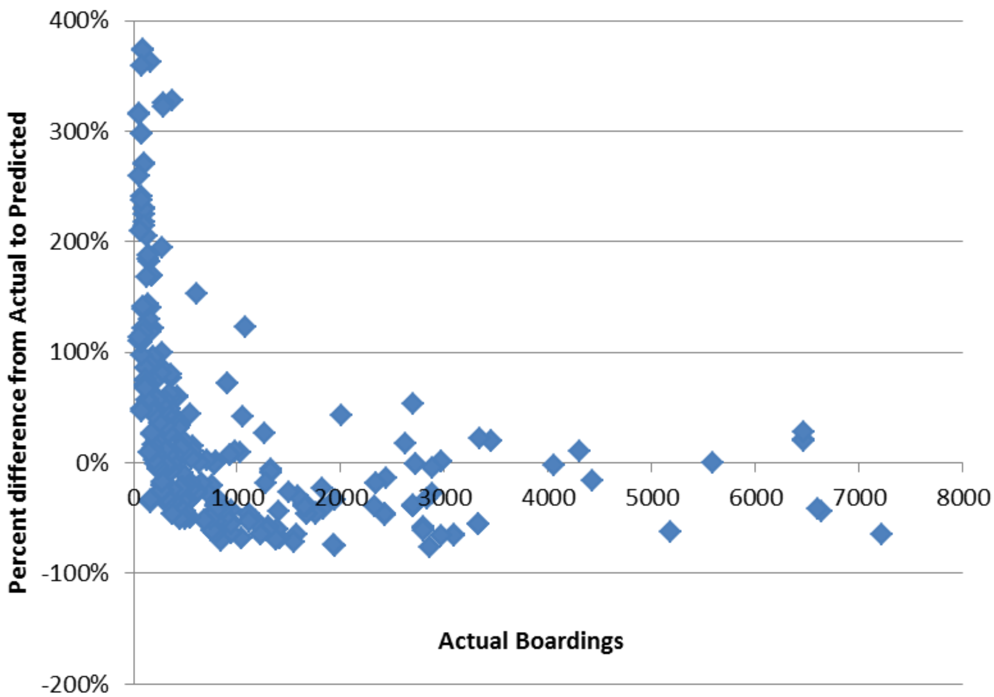

FIGURE 4 Scatter Plot of Actual vs. Predicted Boardings

Model Applications

The calibrated transit ridership model is being used by King County Metro and Sound Transit as part of the following applications:

- **Market-area assessments** – King County Metro is interested in answering the following questions across the study area based on an assessment of land use patterns/zoning, demographics, and non-motorized connectivity: Which areas are the highest priority for non-motorized connectivity enhancements (areas with poor non-motorized connectivity, good demographic characteristics, and favorable land use and zoning patterns)? Which areas are well suited for additional transit marketing (areas with good non-motorized connectivity, good demographic characteristics, but low transit ridership)? Which areas could benefit from improved land use/zoning (areas with good non-motorized connections and favorable demographics, but low densities)? This analysis is being conducted at the census tract level to identify targeted strategies to increase transit ridership across the service area.

- **Project prioritization** – Most of the jurisdictions within the study area have developed non-motorized transportation plans to improve the quality and coverage of pedestrian and bicycle facilities. While access to transit is often a consideration of local jurisdictions, it is balanced amongst other objectives when identifying and prioritizing non-motorized improvements. As part of this project, the project team prioritized the jurisdiction’s non-motorized projects from the narrow perspective of generating additional transit riders. The model’s estimate of additional ridership generated by proposed projects was ranked to develop a project list. This list was further refined using planning-level cost estimates to understand the cost-per-rider of potential projects. The prioritized project list from this analysis could be used by the transit agencies to help support local-agency projects by partnering on grant applications.

LIMITATIONS

As noted earlier, the model calibration effort focused on specific details to ensure that the tool would perform well in the Puget Sound region. This focus on station types and input variables (e.g., transit centers and parking spaces) could make it difficult to transfer this model to other regions. It is likely that the model would need to be recalibrated for use in other regions.

As noted earlier, most of the data for this project were collected in urban/suburban areas. Like most areas, the Puget Sound region has transit service that extends well beyond the urban/suburban core and into low density exurban areas and fringe suburbs that are relatively isolated from other development. While the model can be used to analyze the benefits of non-motorized connectivity in these areas, the results should be reviewed carefully. The model may tend to over-state the percent change in ridership in more auto-dependent and exurban areas with more limited transit service. The logarithmic nature of the model helps to reduce the tendency to overstate ridership gains, but users should always compare outputs to the existing mode-split to ensure a reasonable estimate.

Another limitation to reiterate is the regional nature of the model. Given the need to unify data from multiple jurisdictions, some of the more detailed non-motorized data, such as sidewalk width, pavement condition, and street illumination could not be included in the model. Additionally, in order to ensure accuracy across the entire study area, the model tends to be sensitive to larger-scale changes in connectivity. It is likely that some smaller-scale projects could be important in terms of how people access transit (e.g., filling in small arterial sidewalk gaps directly adjacent to transit stops), but the model may not be sensitive to these types of projects. It is recommended that the model be used in conjunction with a more detailed analysis of station/stop-area non-motorized connectivity so that the major projects the model is sensitive to can be complemented by other smaller-scale projects.

CONCLUSIONS

The research summarized in this paper identified a model that relates non-motorized connectivity to increased transit ridership. Key connectivity variables include route directness index, bike stress, sidewalk/walkway density, intersection density, and signalized arterial crossing density. This model has been applied in the Puget Sound region to identify areas that would benefit from improved non-motorized access to transit and to identify and prioritize local agency non-motorized projects that would generate the most new transit ridership. While jurisdictions have numerous goals regarding bicycle and pedestrian infrastructure, this model provides an added perspective to help in non-motorized planning efforts.

While the model works well in the Puget Sound region, it is likely not directly transferrable to other areas without recalibration. Additionally, because of the regional nature of the data collection and analysis, details such as sidewalk quality, street lighting, and the adjacent urban form were not collected. As cities develop more robust pedestrian and bicycle infrastructure databases over time, there is the potential that these elements could be added to the model, which would enhance its performance and assist in identifying smaller-scale non-motorized access to transit projects.

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Intersection Level of Service Results		Existing		2035 No Action - 6th to 120th		2035 No Action - 6th to 116th		2035 Alt 1 - 6th to 120th		2035 Alt 2 - 6th to 120th		2035 Alt 2 - 6th to 116th		2035 Alt 1 - 6th to 120th - MITIGATED		2035 Alt 2 - 6th to 120th - MITIGATED	
ID	Intersection	Delay	Volume Served	Delay	Volume Served	Delay	Volume Served	Delay	Demand Volume	Delay	Demand Volume	Delay	Demand Volume	Delay	Demand Volume	Delay	Demand Volume
1	116th Avenue NE and NE 12th Street	39		96		108		112		117		141		86		89	
2	120th Avenue NE and NE 12th Street	25		86		85		103		104		102		82		78	
3	124th Avenue NE and NE 12th Street	37		60		56		64		65		64		64		65	
4	116th Avenue NE and NE 10th Street	18		24		21		25	3,500	27	3,480	25	3,845	25	3,500	27	3,480
5	116th Avenue NE and NE 8th Street	39	4,982	51	4,688	136	3,887	53	6,955	71	7,490	>150	8,220	53	6,955	58	7,490
6	120th Avenue NE and NE 8th Street	48	3,015	42	3,730	51	2,947	56	4,955	58	5,115	65	4,180	56	4,955	34	5,115
7	124th Avenue NE and NE 8th Street	28		56		50		103		112		71		53		56	
8	116th Avenue NE and NE 4th Street	48	3,218	105	3,205	64	2,137	>150	5,215	>150	5,630	>150	5,530	85	5,215	72	5,630
9	120th Avenue NE and NE 4th Street	11		12		12		14	1,615	16	1,650	14	2,010	14	1,615	16	1,650
10	116th Avenue NE and Main Street	27	2,802	27	2,857	26	2,298	37	3,595	39	3,705	33	4,030	37	3,595	39	3,705
11	116th Avenue NE and SE 1st Street	26	2,828	26	3,158	29	2,713	26	3,715	29	3,785	34	3,735	26	3,715	29	3,785
12	120th Avenue NE and NE 6th Street	N/A		22		N/A		23		28		N/A		23		28	
13	116th Avenue NE and NE 6th Street	N/A		N/A		90		N/A		N/A		>150		N/A		N/A	
14	Spring Boulevard and Bel-Red Road	N/A		68		81		77		79		100		54		55	
	Wilburton MMA Average	38		51		68		74		81		117		54		49	

Note: Wilburton MMA #4 includes intersections 4, 5, 7, 9 & 10. LOS Standard is average delay of 55 seconds and delay is weighted by volume.