PORTLAND'S

NEIGHBORHOOD GREENWAYS

ASSESSMENT REPORT

PBOT
PORTLAND BUREAU OF TRANSPORTATION


STOP

PORTLAND'S NEIGHBORHOOD GREENWAYS

ASSESSMENT REPORT

Executive Summary.....4

SECTIONS:

I. Introduction to Neighborhood Greenways.....6

II. Recommended Performance Guidelines for Neighborhood Greenways 10

III. Existing Conditions on Neighborhood Greenways 14

IV. Conclusion and Recommendations 21

APPENDICES:

A. Policy Support for Neighborhood Greenways.....24

B. Existing Conditions on Neighborhood Greenways – Additional Information 29

C. Tools and Designs for Neighborhood Greenways 39

EXECUTIVE SUMMARY

Portland's neighborhood greenways (formerly known as "bicycle boulevards") are residential streets designed to prioritize bicycling and enhance conditions for walking. In Portland, there are currently more than 70 miles of neighborhood greenways, which were developed in three distinct phases since the first project on SE Salmon and Taylor streets more than 30 years ago. This report aims to:

- **Identify where neighborhood greenways are working well and where they are not;**
- **Create an understanding of the role neighborhood greenways play in Portland's transportation system; and**
- **Offer recommendations on policy guidance and performance guidelines to expand and improve the neighborhood greenways system.**

There is specific and strong policy support for neighborhood greenways and bicycle transportation in general at both the local and regional levels. The Portland Plan, The Climate Action Plan, The Portland Bicycle Plan for 2030, The Regional Transportation Plan and Climate Smart Communities Strategies all envision a growing role for bicycle transportation. Most plans recommend that Portland as a whole achieve 25 percent of all trips by bicycle. This is in service to reducing overall automobile use to no more than 30 percent of all trips.

This report sets forth guidelines for how neighborhood greenways should operate. Neighborhood greenways are a key component of Portland's transportation system, and must operate as such. The recommended performance guidelines are based on national and local guidance, Portland Bureau of Transportation's (PBOT's) experience constructing and operating neighborhood greenways for more than 30 years, and an understanding of the role neighborhood greenways must play in Portland's transportation system in promoting health, prosperity and equity, as well as in reducing congestion. The report recommends the following operational performance guidelines for neighborhood greenways:

- **Vehicle speeds of 20 mph, measured as 85th percentile speed;**
- **Automobile volume target of 1,000 Average Daily Traffic (ADT), with 1,500 ADT acceptable and 2,000 ADT maximum; and**
- **Bicycle and pedestrian crossing opportunities, measured as a minimum of 50 crossing opportunities per hour, with 100 crossing opportunities per hour the preferred level of service.**

To assess how neighborhood greenways are performing, PBOT staff collected data on automobile speeds and volumes, ease of crossing busy streets, and bicycle volumes. We found that:

- **In Portland neighborhoods where overall bicycle use is high, bicycle ridership on neighborhood greenways is also high;**
- **The vast majority of neighborhood greenways are meeting PBOT's suggested operating speed and volume guidelines for automobiles, including nearly all segments built after 2008; and**
- **Short, but significant, sections of older neighborhood greenways that should serve as the foundation of the bikeway system are not meeting PBOT's operating speed and volume goals for automobiles and should be improved.**

In addition to adopting the recommended performance guidelines above, this report also recommends modifying several existing Transportation System Plan (TSP) policies to clarify the role and importance of neighborhood greenways in the transportation system.

INTENT OF REPORT

This report is an assessment of the city's neighborhood greenways and the vital role they play in Portland's transportation system. The report is intended to:

- **Identify where neighborhood greenways are working well and where they are not;**
- **Create an understanding of the role neighborhood greenways play in Portland's transportation system; and**
- **Offer recommendations on policy guidance and performance guidelines to expand and improve the neighborhood greenways system.**

I. INTRODUCTION TO NEIGHBORHOOD GREENWAYS

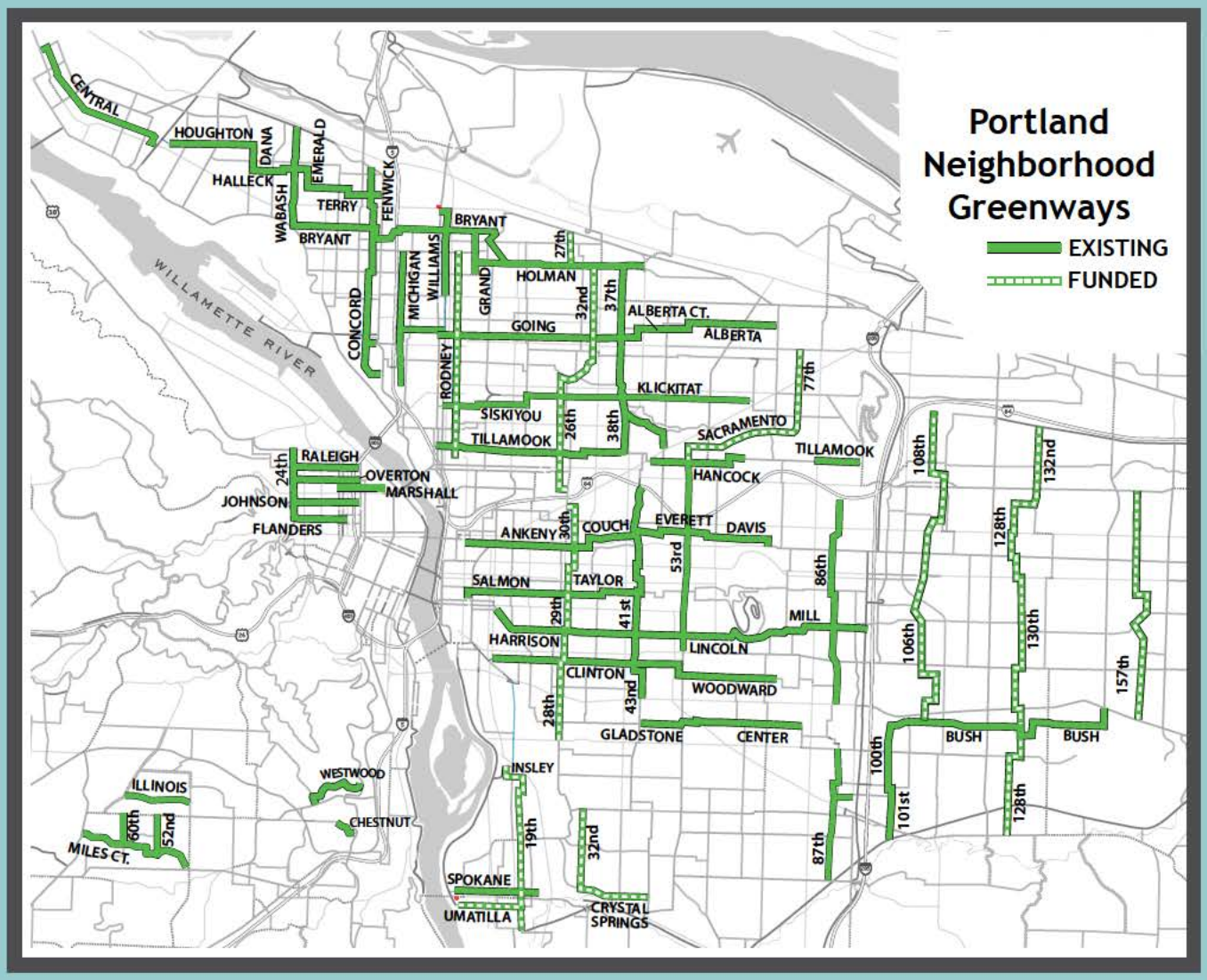
Neighborhood greenways are a defining element of Portland. They are almost as integral to our city as the Willamette River and arguably as iconic as the bridges that cross it. They have long represented and fostered the best elements of Portland's transportation culture by creating safe streets where people want to bike, walk and play. Neighborhood greenways support an array of city goals, including equity, sustainability, community-building, prosperity and healthy living.

Formerly called "bicycle boulevards," neighborhood greenways are residential streets with few, slowly traveling automobiles, with a design that prioritizes bicycling and enhances conditions for walking. Neighborhood greenways use a variety of engineering tools to reduce the number and speed of cars. This reduction is critical to their operations. Streets with few cars and slow speeds create safer, more comfortable conditions for bicycling and walking. Neighborhood greenways also include safe crossings of major streets and "guide signs" to direct travelers along the route and to their destinations.

In Portland, there are currently more than 70 miles of neighborhood greenways located in all five quadrants of Portland. Their role is slightly different in each quadrant, reflecting the land uses, street patterns and topography of each. In some areas neighborhood greenways carry high volumes of bicycle traffic and as a result are given a higher priority in city policy than other neighborhood greenways. These Major City Bikeways, such as SE Clinton and NE Tillamook streets, are a foundational part of Portland's transportation system and are a crucial component of Portland achieving its transportation goals.

This report describes the important role neighborhood greenways play in the city's transportation system. Neighborhood greenways support the city's stated goal of bringing automobile use down to 30 percent of all trips made by Portlanders. This goal is clearly stated in the Portland Plan, the Climate Action Plan and the Portland Bicycle Plan for 2030, as well as in the current draft of the Comprehensive Plan. Because they are safe and comfortable, neighborhood greenways encourage people of all ages and abilities to ride bicycles more than standard bike lanes do. As such, neighborhood greenways provide critical connections to schools, parks, business districts and all places where people want to go.

Fig. 1: Existing and Funded Neighborhood Greenways



HISTORY OF NEIGHBORHOOD GREENWAYS

Neighborhood greenways were born in the 1980s as residential traffic-calming projects and bicycle routes in Portland's inner east side. Residents living in neighborhoods with high amounts of cut-through automobile traffic took steps to reduce the volume and speed of cars on the streets. The city employed tools to calm and divert traffic on these neighborhood streets. The traffic-calmed streets quickly became popular with people bicycling, and certain traffic-calmed streets improved for bicycle traffic became known as "bicycle boulevards." The city's original Bicycle Master Plan, adopted in 1996, officially recognized bicycle boulevards as part of Portland's transportation system. Title 16 of Portland's City Code defines bicycle boulevards as roadways "with low vehicle traffic volumes where the movement of bicycles is given priority." Several corridors in inner Southeast Portland became bike boulevards, including SE Salmon, SE Clinton, SE Lincoln-Harrison, and SE Ankeny streets. These streets contributed to a dramatic increase in the development of the city's bicycle network and the number of people bicycling.

Recognizing the myriad factors that contributed to the success of Portland's bicycle boulevards in their first years, city planners suggested—and the public and City Council agreed—to dramatically increase the number

of bike boulevards in Portland. In 2010, as part of an update, City Council adopted by resolution the updated Portland Bicycle Plan for 2030. This plan includes a greatly expanded network of bicycle boulevards. Because bicycle boulevard improvements also benefit people walking and living along the routes, PBOT began referring to them as neighborhood greenways.

The approach identified in the 2030 bicycle transportation plan succeeded in growing both the miles of neighborhood greenways and community participation in their development. Portland hosts Sunday Parkways events on neighborhood greenways to showcase the developing network to families. Community gatherings, such as meeting spots for families bicycling to school, are hosted on neighborhood greenways. Intersection repair designs, Portland's famous painted intersections, bring community members together on the traffic-calmed streets. More than 500 trees have been planted and thousands of gallons of storm water runoff have been diverted from the sewers by strategically locating bio-swales on neighborhood greenways. Portlanders like to gather, travel and live on neighborhood greenways because they create safe, welcoming streets for people.

A CHANGING CITY

As the neighborhood greenway system expanded, the city around the greenways continued changing as well. Portland's population and density have increased rapidly in the past 15 years. People are moving to Portland from across the United States. According to the 2013 Census, Portland ranked 14th in domestic migration among the 50 largest U.S. metro areas. For the second year in a row United Van Lines ranked Portland as the top city in America for people moving. In addition, commercial development, especially in the inner Southeast and inner Northeast neighborhoods, is increasing rapidly. This growth is projected to continue, with Metro and the city's Bureau of Planning and Sustainability both predicting approximately 120,000 new households in Portland 20 years from now. That would be 40 percent more households than Portland has now. Although Portland's vehicle miles traveled (VMT) continues to decrease per capita, the overall VMT is increasing simply due to population increase. This means more people are traveling on Portland's streets. Increased residential and commercial development is requiring new strategies for managing the neighborhood greenway system.

Fortunately, recent Portland population growth has had only limited impact on the number of cars on our streets. Of the additional 40,000 daily Portland commute trips in 2013 as compared to 2000, one-third are by bicycle. Bicycle transportation has been the leading factor in keeping congestion at bay since 2000.

LEVEL OF STRESS WHILE TRAVELING

Despite the city's success in growing bicycle ridership, increases in population and development in Portland translate into more automobile traffic. More cars on neighborhood greenways contribute to an increased level of stress experienced by people bicycling. Increased stress is detrimental to increasing bicycle transportation as well as the overall livability of our city.

Level of stress is not easily quantifiable, nor is it directly comparable from one person to the next. Still, there are broadly accepted typologies into which people may be placed based on their willingness to ride a bicycle in different traffic conditions. A relatively small fraction of the overall population is willing to ride on busy streets without bike lanes (the "strong and fearless") or with standard bicycle lanes (the "enthused and confident"). A much larger group of the population (the "interested but concerned") need the types of low-stress traffic environments found in the world's best bicycling cities.[1]

A study published by the Mineta Transportation Institute in 2012 describes the conditions necessary to achieve low-stress bicycle routes on roadways where people bicycling and driving share the same space. The study described its lowest stress level as a bicycle route with "little traffic stress and demanding little attention from cyclists, and attractive enough for a relaxing bike ride. Suitable for almost all cyclists, including children trained to safely cross intersections

> On a shared road [people bicycling] interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential."[2]

Achieving "little traffic stress" requires neighborhood

1. "FOUR TYPES OF CYCLISTS? Testing a Typology to Better Understand Bicycling Behavior and Potential," Jennifer Dill & Nathan McNeil, August 2012. "Four Types of Cyclists," Roger Geller, 2004 http://www.portlandoregon.gov/transportation/article/264746.

2. "Low-Stress Bicycling and Network Connectivity," Maaza C. Mekuria, May 2012.

greenways to operate with low auto volumes and speeds, provide protected crossings at major intersections, and maintain an environment that encourages people of all ages and abilities to travel actively.

This report recommends guidelines intended to address deficiencies in the performance of neighborhood greenways today, and protect them from potential transportation pressures associated with population and commercial growth. The intent of these actions is to improve and preserve neighborhood greenways as an increasingly attractive means of transportation now and into the future.

POLICY SUPPORT FOR NEIGHBORHOOD GREENWAYS

There is both broad and specific policy support for neighborhood greenways in Portland's and the region's plans, policies and priorities. The Portland Plan, the city's guiding document for the next 20 years, calls on neighborhood greenways to act "as a spine of Portland's civic, transportation and green infrastructure systems." The city is currently working on the specific strategies and projects in the Comprehensive Plan update to carry out the Portland Plan's vision. The importance of neighborhood greenways is reflected in the overall goals of the Comprehensive Plan draft update, and specifically in the modal policies "Bicycle Transportation (Policy 9.19) and "Accessible Bicycle System" (Policy 9.20). These policies direct the city to "create conditions that make bicycling more attractive than driving for most trips of approximately three miles or less," and to "create a bicycle system that is safe, comfortable, and accessible to people of all ages and abilities," respectively.

In addition to city-wide plans and policies, PBOT's Portland Progress, a two-year work plan for the agency, embraces a Vision Zero policy that aims to make our transportation system the safest possible and continually move toward zero traffic-related fatalities and serious injuries. A key component of PBOT's Vision Zero goals includes building or upgrading five neighborhood greenways and expanding the bicycle system so 80 percent of Portlanders live within one-half mile of a low-stress bicycle way.[3]

Despite the overwhelming policy support in city and regional plans, the Portland Transportation System Plan (TSP) includes several policies that conflict with the goals and policies of other city plans in regards to neighborhood greenway development. In particular, TSP policy 6.13 Traffic Calming Objective D[4] may be interpreted to prohibit traffic-calming measures on neighborhood greenways if they impact other local streets.

Appendix A: Policy Support for Neighborhood Greenways fully documents the regional and city plans that highlight the role bicycle transportation and neighborhood greenways are intended to play now and in the future in creating a healthy, equitable and prosperous Portland.

3. Portland's low-stress bicycle network is made up of neighborhood greenways, physically protected bicycle lanes and off-street trails.

4. TSP policy 6.13 Traffic Calming: "Manage traffic on Neighborhood Collectors and Local Service Traffic Streets, along main streets, and in centers consistent with their street classifications, classification descriptions, and desired land uses. Objectives: D. Implement measures on Local Service Traffic Streets that do not significantly divert traffic to other streets of the same classification. E. Implement measures on Neighborhood Collectors that do not result in significant diversion of traffic to streets of lower classification."

II. RECOMMENDED PERFORMANCE GUIDELINES FOR NEIGHBORHOOD GREENWAYS

Portland has adopted several key plans and policies that call out the importance of shifting trips from people driving alone to people walking, bicycling and using transit. An important element to realizing these goals is to design, build, operate and maintain neighborhood greenways to create a low-stress environment for people of all ages to bike and walk.

The following performance guidelines are a key component of creating low-stress neighborhood greenways, and provide a clear measure to assess their performance.

This report recommends three principal performance guidelines for motor vehicle speeds, volumes and arterial crossings. Numerical targets for these three categories are based on three decades of experience, guidance, analysis, research and public feedback. Portland's 1996 Bicycle Design Guide, Appendix D of the Portland Bicycle Plan for 2030, the NACTO Urban Bikeway Design Guide and other guides all highlight the need for low automobile volumes and speeds on bicycle boulevards and safe crossings. As noted previously, recent policies direct the city to create conditions that are safe and comfortable for people of all ages and abilities to bicycle.

Fig. 2: Performance Guidelines

PERFORMANCE GUIDELINES AT A GLANCE

VEHICLE SPEEDS:

- 20 mph measured as 85th percentile speed

AUTOMOBILE VOLUMES:

- 1,000 Average Daily Traffic (ADT) as goal
- 1,500 ADT acceptable
- 2,000 ADT maximum
- Over 2,000 ADT triggers changes

BICYCLE AND PEDESTRIAN CROSSING OPPORTUNITIES:

- 100 crossing opportunities per hour as preferred level of service
- Minimum 50 crossing opportunities per hour

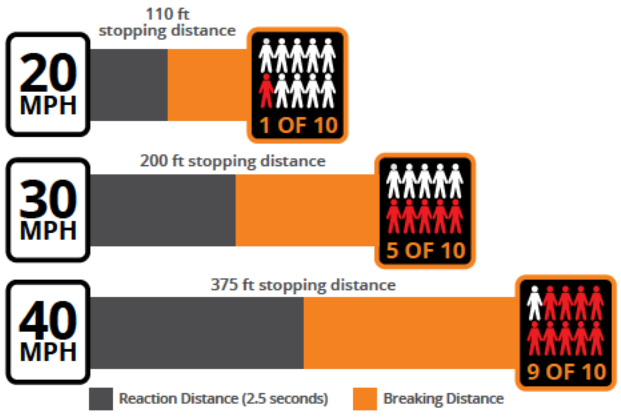
VEHICLE SPEEDS

While traffic speeds are relatively easy to control by using well-established traffic-calming tools, neighborhood greenways in all quadrants of Portland have segments where 85th percentile speeds exceed 25 miles per hour (mph).[5]

Guideline for Vehicle Speeds: *To design, build and maintain for a vehicle speed (85th percentile) of 20 mph on neighborhood greenways.*

Rationale: This goal is supported by traffic engineering and safety research indicating that a person who is struck by a vehicle at 20 mph has less than 15 percent risk of fatality. When cars travel 30 mph, the risk of fatality rises to 50 percent. Lowering speeds creates a more comfortable and less stressful environment for people walking and bicycling. Faster cars, posing a well-understood and documented jump in risk, depress bicycle use.

Fig. 3: Effects of Vehicle Speed on Braking Distance and Fatality Rate in Collisions



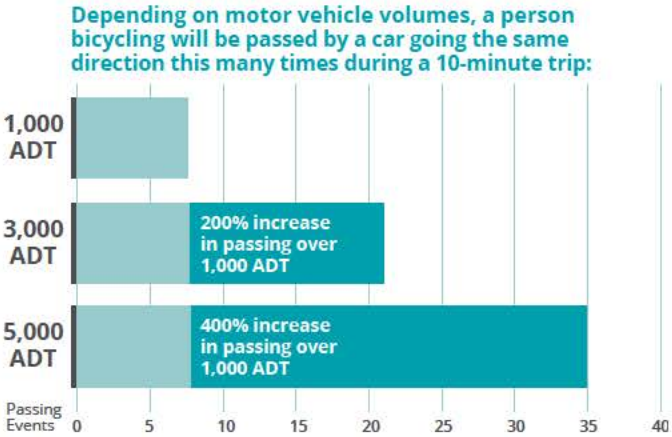
5. All speeds referenced in this document are what is known as the 85th percentile speed. A standard traffic measure, it is the maximum speed at which 85 percent of vehicles are traveling. This means that some vehicles within that 85 percent may be traveling slower. It definitely means that 15 percent of vehicles are traveling faster. Traffic engineers aim to achieve an 85th percentile speed that is identical to the posted speed limit on the street.

VEHICLE VOLUMES

The presence of many automobiles on a roadway creates a less inviting, less comfortable and less safe bicycling and walking environment than when cars are fewer. With higher volumes of cars, the number of conflicts between modes increases. A person bicycling on a street with 3,000 cars per day will be passed an average of 23 times in 10 minutes (see Fig. 4). With only 1,000 cars on that same roadway each day, a person will be passed only seven times in 10 minutes.

Most segments of Portland's neighborhood greenways have 1,000 cars per day or fewer. However, some key segments of Portland's neighborhood greenways have double that volume or more. In the instances where daily automobile volumes exceed 2,000 there a statutory obstacle[6] to lowering the speed limit to 20 mph. In some instances car volumes are very high, with 3,000 or more cars per day.

Fig. 4: Performance Guidelines



Values shown assume a 20 mph posted speed. Local street peak hour is 15 percent of ADT. 70 percent of peak hour traffic is in the peak direction. Cars are evenly spaced along street; no platooning. 10-minute trip calculated during peak hous. Cars are traveling the posted speed limit (speed management techniques may be necessary). Note: Cars may pass people bicycling more or less frequently depending on how well these assumptions reflect reality.

Many of the neighborhood greenway segments with higher traffic volumes are located in the inner neighborhoods and central city. This includes:

- **All the Northwest Portland neighborhood greenways;**
- **The NE Tillamook neighborhood greenway;**
- **The 40s and 50s neighborhood greenways in Northeast and Southeast Portland;**
- **The SE Clinton-Woodward, SE Lincoln-Harrison, SE Ankeny, SE Salmon-Taylor and the Southeast portion of the 80s neighborhood greenways; and**
- **The N Michigan, N Central and N Concord neighborhood greenways.**

Guideline for Vehicle Volumes: *To design, build and maintain for an average of 1,000 motor vehicles a day. A neighborhood greenway can operate effectively with an average of 1,500 cars per day, but should be improved or maintained to not exceed an average of 2,000 a day.*

Rationale: When automobile volumes exceed 2,000 cars per day, state law does not allow the creation of a 20 mph speed limit. Higher volumes result in cars passing bikes more frequently, which creates a higher-stress environment for people walking and bicycling.

Alternate Guideline: *An alternate vehicle volume measurement based on vehicles per hour may be used in lieu or in addition to ADT: to design, build and maintain for an average of 50 vehicles per hour in the peak direction, understanding that a neighborhood greenway can operate at an average of 75 vehicles per hour in the peak direction, but should be improved or maintained to not exceed 100 vehicles per hour in the peak direction.*

This measure may more effectively capture short periods of time when neighborhood greenways experience significant increases in traffic volume that jeopardize their primary goal as a priority active transportation route. For example, traffic volume may increase at the 4 to 6 p.m. peak travel period as people driving use a neighborhood greenway to avoid a nearby arterial. The traffic volume during the rest of the day may be very low, but the significant increase in peak-period autos creates a high-stress environment for people biking during that time.

Guidelines for local service streets: As a result of traffic calming efforts on neighborhood greenways traffic volumes should not exceed 1,000 cars per day or 50 cars per hour during peak demand on adjacent local service streets.

Rationale: 1,000 cars per day or 50 cars per peak hour serve as the target volumes for neighborhood greenway operations. Local service streets can operate efficiently within the automobile volume thresholds recommended for neighborhood greenways.

6. ORS 810.180 (Section 10).

Designing, building and maintaining neighborhood greenways for less than 1,000 cars per day also means it is important to prevent potential or future increases in car traffic. There are circumstances when a neighborhood greenway design will need to ensure that a future or existing neighborhood greenway maintains the volume thresholds outlined above, or ensure that automobile traffic volume does not increase substantially.

In specific cases, even when automobile volumes have not exceeded 1,000 ADT but there is a well-understood likelihood that they will, a neighborhood greenway may need to employ engineering and education tools to maintain design volumes. These measures may be used when PBOT considers automobile traffic volumes as very likely to increase, or when they are increasing at a rate that is impacting the success of a neighborhood greenway. These measures serve as a key component to building and maintaining a neighborhood greenway system that meets existing and future demands.

Curb Extension with Island Semi-Diverter: blocks vehicle entry to a street by closing off the parking lane on the entry street. This semi-diverter includes a bio-swale as part of the design.

ARTERIAL ROADWAY CROSSINGS

Neighborhood greenways are transportation corridors that bring people wholly or in partially to all corners of the city and beyond. Such a fully-functioning transportation network means that neighborhood greenways necessarily cross arterial roadways, including some of Portland's largest, busiest and fastest roadways. Crossing such streets must be as safe and comfortable as riding along the entirety of the neighborhood greenway.

Arterial Roadway Crossing Goal: *To design, build and maintain neighborhood greenways to provide a minimum 50 crossings per hour (100 per hour preferred) for people bicycling and walking during the peak hour.*

Rationale: These goals are based on historical data showing that Portland's most popular neighborhood greenway routes are already achieving peak-hour demand levels in the range of 100+ people bicycling per hour. These guidelines are used for neighborhood greenways constructed after 2008 and were established based on historical use of Portland's most successful neighborhood greenways.

The design of neighborhood greenways should use these guidelines when identifying the appropriate tools to provide the desired level of service. These performance guidelines will help PBOT create and maintain a neighborhood greenway system that contributes to the city's objectives, creates a consistent user experience, and ensures that PBOT and the public have a clear set of metrics for building and evaluating neighborhood greenways.

III. EXISTING CONDITIONS ON NEIGHBORHOOD GREENWAYS

This section applies the principal guidelines to examine how existing neighborhood greenways are performing. This is a high-level view of the neighborhood greenway system that provides important information, especially about which underperforming areas require additional attention. The data presented below comes from PBOT volume and speed counts, as well as from volunteers who perform manual bicycle counts annually. The data is publically available on portlandmaps.com.

This chapter also considers other quantitative and qualitative information about neighborhood greenways, such as pavement condition and community-building activities. Additional charts, graphs and information can be found in *Appendix B: Existing Conditions on Neighborhood Greenways – Additional Information.*

KEY FINDINGS:

- **In Portland neighborhoods where overall bicycle use is high, bicycle ridership on neighborhood greenways is also high.**
- **The majority of neighborhood greenways are meeting PBOT's recommended guidelines for automobile speed and volume.**
- **Several key neighborhood greenways are not meeting PBOT's recommended guidelines for automobile speed and volume. This includes short but significant sections of older neighborhood greenways such as SE Clinton, SE Lincoln-Harrison and NE Tillamook-Hancock.**
- **Nearly all segments of neighborhood greenways built after 2008 are meeting PBOT's guidelines. These more recent neighborhood greenways took advantage of improved engineering tools and more stringent performance guidelines than neighborhood greenways built from 1988 to 2007.**

SECTION A – BICYCLE TRAFFIC VOLUMES

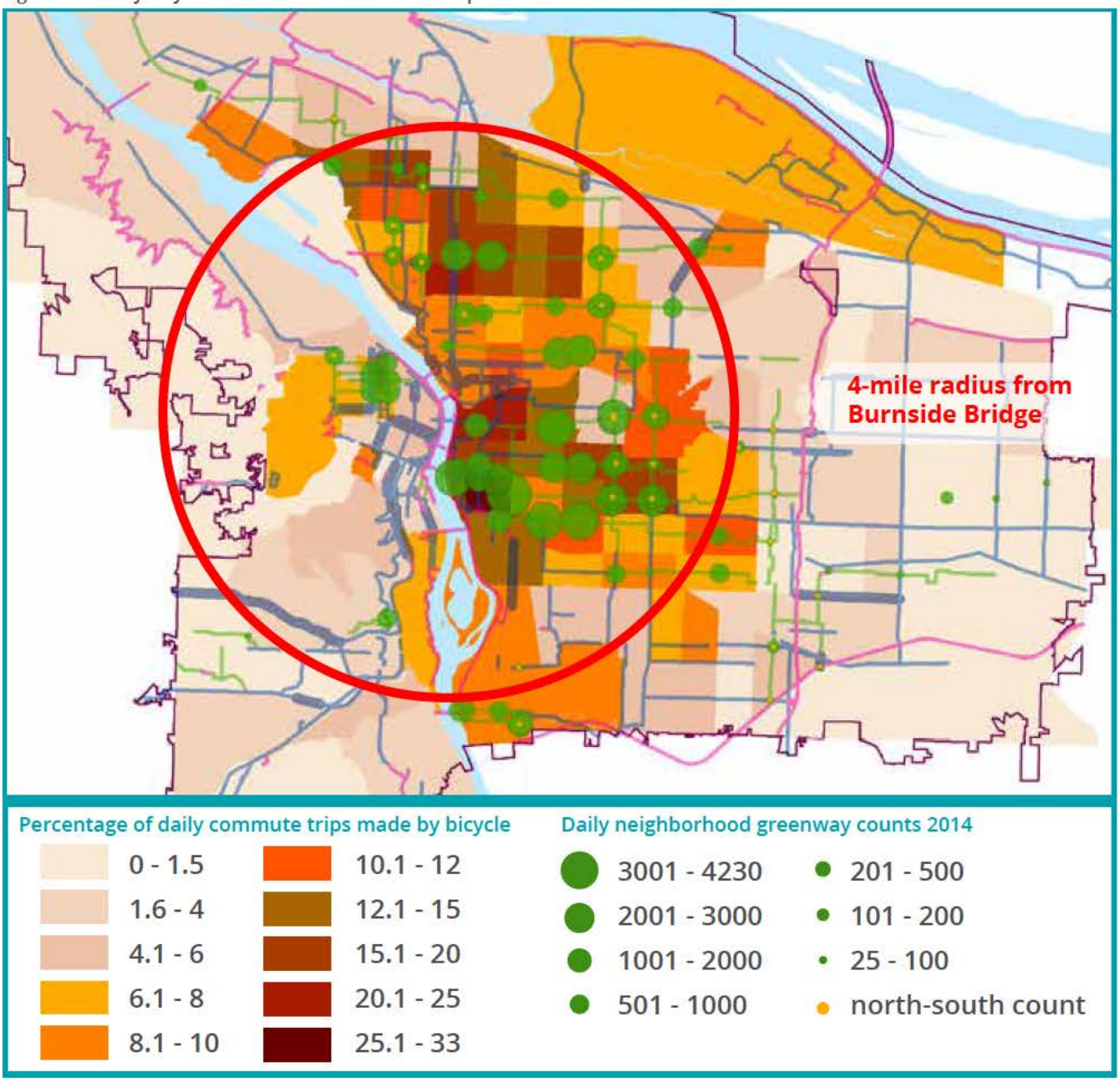
Neighborhood greenways have contributed to the increase in bicycling in the city, and therefore they have experienced it, too. They have seen a dramatic increase in bicycle use that parallels the overall increase in bicycling in Portland. Since 2000, the number of Portlanders riding bicycles to work has increased nearly 250 percent. In some census tracts of Northeast and Southeast Portland, bicycle commuting approaches 25 percent of all trips to work.

Unsurprisingly, bicycle use on neighborhood greenways reflects the level of bicycle use in the area where the neighborhood greenway is located. Bicycle use is higher on those neighborhood greenways located in the inner Northeast and Southeast neighborhoods, and lower near St. Johns and in Southwest and East Portland.

The neighborhood greenways with the highest bicycle traffic volumes (as of 2013) are, in order:

- **SE Lincoln-Harrison (4,230 daily bicycle trips on Harrison at Ladd);**
- **SE Clinton-Woodward (2,870 daily bicycle trips on Clinton at 26th);**
- **Burnside Corridor Bikeway (2,115 daily bicycle trips on Ankeny at 28th);**
- **NE Going Street Bikeway (1,920 daily bicycle trips on Going at 9th);**
- **SE Salmon-Taylor (1,760 daily bicycle trips on Salmon at 34th);**
- **40s Bikeway (1,315 daily bicycle trips on NE 41st at Couch);**
- **NE Tillamook-Hancock (1,165 daily bicycle trips on Tillamook at 28th);**
- **SE Sellwood Bikeways (1,160 daily bicycle trips on Spokane at Springwater); and**
- **NW Johnson Bikeway (960 daily bicycle trips on Johnson at 14th).**

Fig. 5: Greenway Bicycle Counts and Commute Mode Split



Source: Portland Oregon Bicycle Commute Mode Split by Census Tract 2010, juxtaposed with 2014 Neighborhood Greenway Counts

The top eight (of the nine) bikeways listed above are "Major City Bikeways" (or, in the case of NE Going, functioning as a Major City Bikeway). Major City Bikeway is a policy classification. Major City Bikeways are intended to carry high volumes of bicycle traffic and to serve a foundational role in Portland's transportation system.

Many of the neighborhood greenways with the highest bicycle traffic volumes are among the earliest neighborhood greenways and were built to different specifications than what is constructed today. The top two neighborhood greenways for ridership (SE Lincoln-Harrison and SE Clinton) were not only among the first neighborhood greenways, but also located in the quickly growing and dense neighborhoods of inner Southeast Portland.

The number of bicycle trips made on neighborhood greenways (and citywide) has increased steadily since the early 1990s, and showed dramatic increases in the period between 2000 and 2008. Since 2008 the number of bicycle trips has been increasing more slowly and, in some cases, leveling off or declining slightly. In one instance, NW Marshall, which was developed as a bikeway after NW Lovejoy became a one-way roadway, has shown a decline in ridership since 2012.

Portland's inner neighborhoods in Southeast, Northeast, North and, to a lesser extent, Northwest offer good conditions for developing neighborhood greenways. They all possess a relatively closely spaced street grid that offers good opportunities for east-west and north-south travel. Because of the well-developed grid many of the residential streets carry relatively low volumes of automobile traffic. They also all have low-volume roadways that extend far enough to create connected, linear transportation options. These conditions allow for planning and implementing a relatively dense network of neighborhood greenways.

MAJOR CITY BIKEWAYS

are intended to form the "mobility backbone" of Portland's bicycle transportation system and provide primary connections to major attractors throughout the city, such as downtown or regional centers. Fifty-four miles of neighborhood greenways are identified as Major City Bikeways in the city's bicycle plan.

Conditions in East Portland (east of I-205), and especially in Southwest Portland neighborhoods, are not as favorable. Neither location benefits from the type of closely spaced grid found closer to the center of the city. In the case of Southwest Portland especially, the topography restricts both the connectivity of potential neighborhood greenway routes and their desirability for bicycling, because of the hilly terrain. In East Portland, continuous greenway routes can be cobbled together, but often require significant jogs to match up segments in an overall discontinuous grid. Despite these challenges, neighborhood greenways still have an important role to play in these two quadrants.

There are three existing neighborhood greenway segments in Southwest Portland: SW Westwood-Cheltenham, SW Illinois and SW Maplewood-Custer-Miles. They are relatively short segments that provide neighborhood connections to roadways with existing bicycle lanes. While bicycle use is generally low, the overall network is also poorly developed. In East Portland, bicycle use is also low on the two existing neighborhood greenways; however, several funded capital projects will greatly add to East Portland's active transportation network and probably add to bicycle use on all the neighborhood greenways in this part of the city.

In general, location is destiny. Neighborhood greenways that are part of a cohesive network of bikeways within high-density, mixed-used areas where trip distances are short carry higher volumes of bicycle traffic than similarly (or even better) designed neighborhood greenways that do not share those characteristics.

SECTION B – AUTOMOBILE TRAFFIC SPEEDS

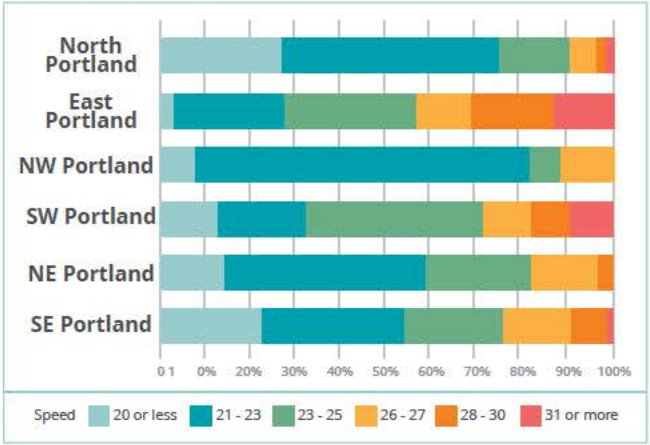
The goal for traffic speeds on neighborhood greenways is 20 mph. This is a relatively new goal. Until the amendment of ORS 810.180 in 2011, which allowed local jurisdictions to lower speed limits to 20 mph on neighborhood greenways, the lowest speed attainable was generally 25 mph. As a result, many of Portland's older greenways were designed to achieve a 25 mph speed limit. Newer greenways, built after 2009 (and some that were subsequently retrofitted after 2011) are generally designed to achieve a 20 mph speed limit. This divide is clearly reflected in the data, as presented below.

All speeds referenced in this document are what is known as 85th percentile speed. A standard traffic measure, it is the maximum speed at which 85 percent of vehicles are traveling. This means that some within that 85 percent may be traveling slower. It definitely means that 15 percent of vehicles are traveling faster. Traffic engineers want to achieve an 85th percentile speed that is identical to the posted speed limit on the street.

Many of Portland's neighborhood greenways do not achieve the design goals of 20 mph. During the period of 2008 to 2014, PBOT recorded automobile speeds at more than 1,500 locations on neighborhood greenways. The data collected shows a system where only slightly more than 16 percent of

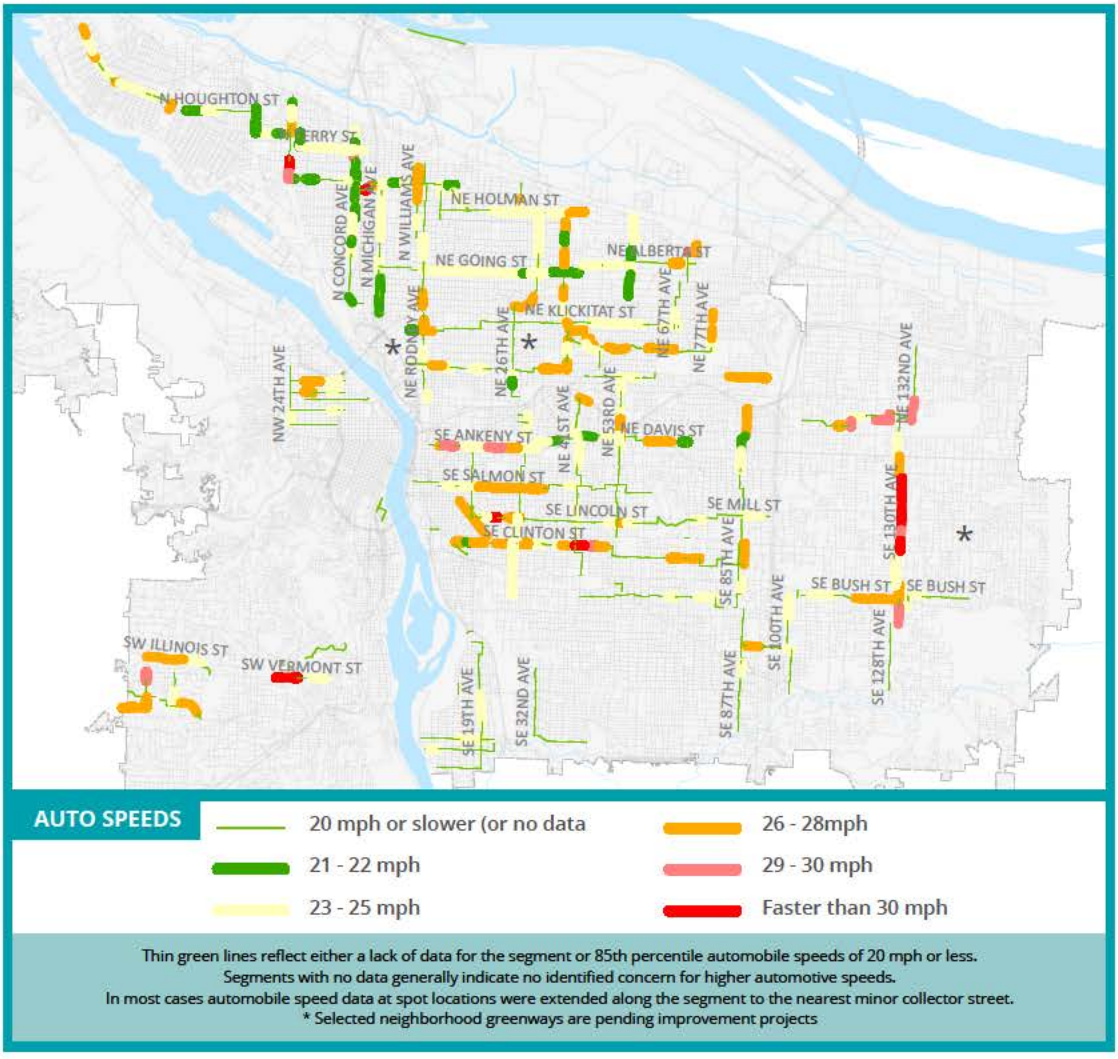
locations have achieved the desired design speed of 20 mph or less. Only slightly more than half (52 percent) are at 23 mph or less. Almost four-fifths of locations (78 percent) show a speed at 25 mph or less. Fully 4 percent of counted locations show speeds greater than 30 mph.

Fig. 6: Speeds on Portland's Neighborhood Greenways by Sector 2008–2014



In general, neighborhood greenways in North Portland and Northwest Portland show the lowest speed profiles, for very different reasons. Speeds on the neighborhood greenways in Northwest are likely low because of short intersections with stop signs on almost every other block. In contrast, the neighborhood greenways in North Portland were generally built to modern guidelines and include frequent speed bumps. The neighborhood greenways in Portland's East and Southwest quadrants have the highest recorded speed profiles, with neighborhood greenways in Southeast and Northeast being in the middle of the pack. In the East and Southwest quadrants with the highest recorded speeds, the neighborhood greenways generally have infrequent or insufficient speed controls (such as speed bumps). Speeds on many of the roads in East and Southwest Portland are higher than in the other quadrants, which may result in the increased speeds recorded on neighborhood greenways in those areas. Additionally, in East Portland some of the data includes speeds recorded before any capital

Fig. 7: Automobile Speeds on Neighborhood Greenways



improvement projects were constructed. Thus, East Portland's speeds appear particularly high and should come down dramatically after construction, scheduled in 2016.

Looking at specific neighborhood greenways that are also classified as Major City Bikeways highlights the variance and lack of consistency in automobile speeds on neighborhood greenways. Some of these neighborhood greenways, notably NE Holman, the North Portland Connector, the Sellwood neighborhood greenways (Spokane and Umatilla) and NE Going, display desired traffic speed characteristics along most segments. These neighborhood greenways are among the more recently implemented in Portland (post-2008), and their speed profiles reflect the more recent guidelines used for their construction compared to those built in the 1990s and early 2000s. All the neighborhood greenways built after 2009 record approximately 80 percent of speed counts at 23 mph or lower.

Conversely, many of the older neighborhood greenways show higher automobile speed profiles. While NE Tillamook, SE Lincoln-Harrison and SE Clinton stand out as having high proportions of locations with speeds greater than 25 mph (34 percent, 33 percent and 63 percent, respectively), they are not alone. The Burnside Corridor (Ankeny, Couch, Davis, Everett), SE Salmon-Taylor, and the 40s bikeway neighborhood greenways all display between one-fifth and one-third of counted locations with speeds above 25 mph. In both Southeast and North Portland, neighborhood greenways that are classified as Major City Bikeways have much higher automobile speeds than the other neighborhood greenways in those sectors. Ideally all neighborhood greenways would meet recommended design guidelines; however, the fact that neighborhood greenways that are classified as Major City Bikeways are displaying higher recorded automobile speeds than other area facilities is in direct conflict with their specified role. Major City Bikeways are designed to carry high volumes of bicycle traffic and form the foundation of the bikeway network. High automobile volumes on these neighborhood greenways present a significant challenge, not only for the specific neighborhood greenway in question, but also for the entire bikeway network that relies on that neighborhood greenway to carry significant bicycle traffic.

Overall, many neighborhood greenways are showing recorded speeds higher than 20 mph at the 85th percentile. While there are few segments achieving 20 mph, recorded speeds on neighborhood greenways built or retrofitted after 2009 (such as NE Going) show overall lower speeds compared with older neighborhood greenways. For the neighborhood greenways that were originally built for 25 mph or higher, the current speeds exceed both the original 25 mph speed goal and the new 20 mph speed goal.

SECTION C – AUTOMOBILE TRAFFIC VOLUMES

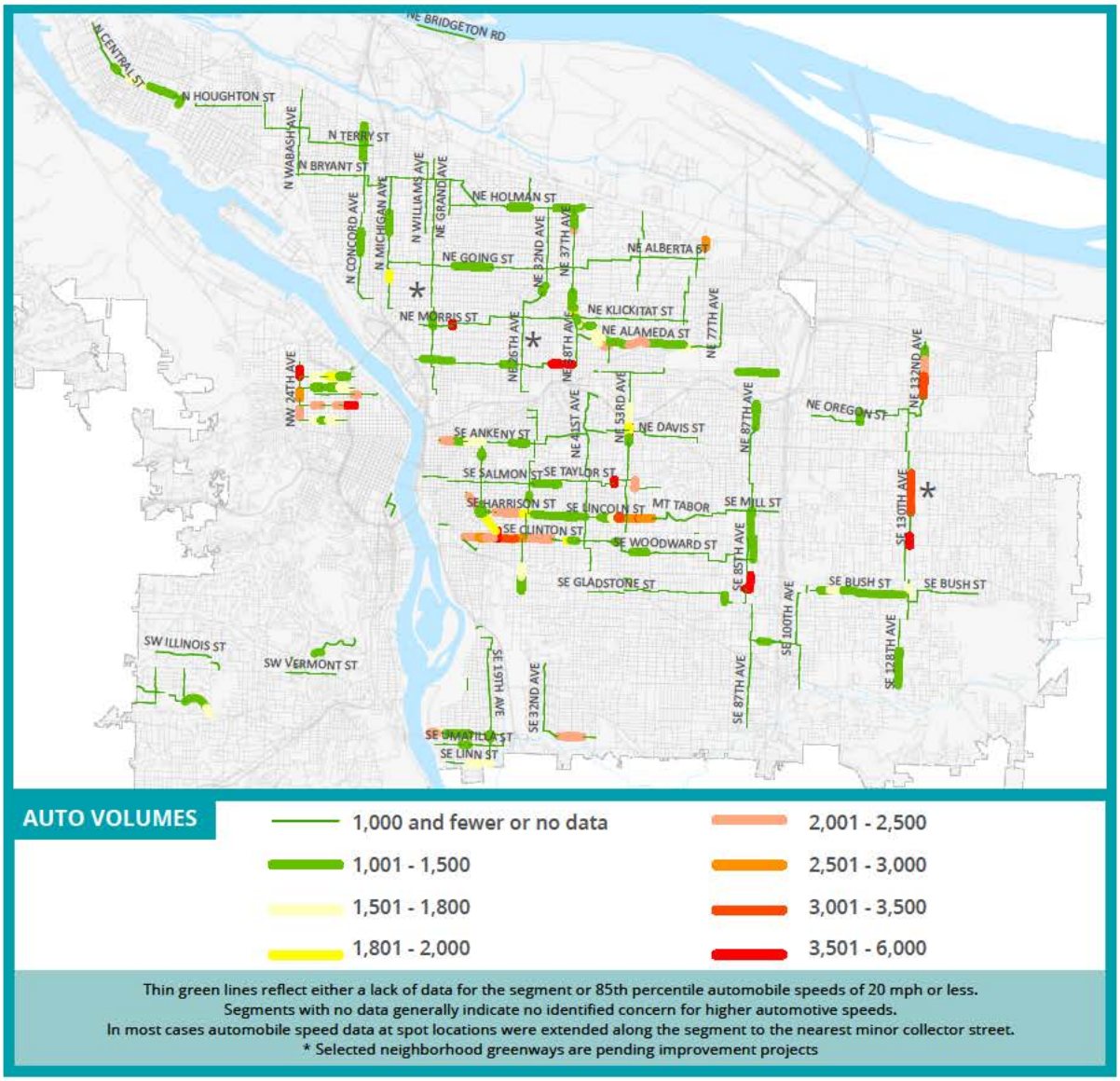
While the goal for traffic speeds can be tied directly to the actual physical safety of people traveling along neighborhood greenways, the volume of automobile traffic is more directly tied to comfort. Policies at the local and regional level acknowledge this distinction between comfort and safety, as do national design guidelines for neighborhood greenways. Comfort is an important characteristic; it directly influences whether people of "all ages and abilities" will be willing to ride bicycles on city streets. To increase comfort and decrease multi-modal conflicts, the recommendation is to build neighborhood greenways for less than 1,000 automobiles and strive to keep them below 2,000 vehicles a day.

72% of locations assessed on Portland's neighborhood greenways show volumes at or less than 1,000 cars per day. 85% have volumes less than 1,500.

Overall the neighborhood greenways in North, Northeast and Southeast Portland are performing the best in terms of automobile volumes. Neighborhood greenways in those sectors have 90 percent, 92 percent and 80 percent of assessed segments with volumes at or less than 1,000 cars per day, respectively. The neighborhood greenways in Northwest Portland have the worst volume profiles. There are no segments in Northwest Portland with fewer than 1,000 cars per day, and only 29 percent with 1,500 cars per day or fewer. Neighborhood greenways in East and Southwest Portland have 60 percent and 62 percent of segments with 1,000 cars per day or fewer, respectively.

Fig. 8: Automobile Volumes on Neighborhood Greenways

The good news is that fully 72 percent of the more than 700 locations assessed on Portland's neighborhood greenways display automobile volumes at or less than 1,000 cars per day, and fully 85 percent have volumes at or less than 1,500 cars



per day. The bad news is that 9 percent of locations carry more than 2,000 cars per day, and 4 percent carry more than 3,000 cars per day. In addition, critical segments of the neighborhood greenway network—those classified as Major City Bikeways—are carrying auto volumes of more than 2,000 cars per day. This is especially the case in Southeast Portland, where 23 percent of neighborhood greenway segments classified as Major City Bikeways see more than 2,000 cars daily.

The higher-volume segments are concentrated in three Major City Bikeway neighborhood greenway corridors: SE Clinton-Woodward, SE Lincoln-Harrison and NE Tillamook-Hancock. On the SE Clinton -Woodward and SE Lincoln-Harrison neighborhood greenways, 40 percent of counted segments are carrying more than 2,000 cars, and 13 percent are carrying more than 3,000 cars. The NE Tillamook-Hancock neighborhood greenway has 8 percent of its assessed segments carrying more than 3,000 cars per day.

Fig. 9: Neighborhood Automobile Volumes and Speeds, By Quadrant

PORTLAND:	SE	NE	N	NW	E	SW	Citywide
Automobile volumes							
% 1500 ADT or less	80%	92%	97%	29%	75%	77%	85%
% 2000 ADT or less	15%	3%	0%	42%	18%	15%	10%
Automobile speeds							
% 20 mph or slower	22%	14%	27%	8%	2%	13%	16%
% 23 mph or slower	53%	59%	75%	81%	26%	32%	52%
% 26 mph or faster	25%	18%	10%	12%	44%	29%	23%

GOOD POOR

SECTION D – OTHER CONDITIONS

While bicycle use, automobile speeds and automobile volumes are the three main factors used to assess how neighborhood greenways are functioning, there are several other aspects that shape how the streets are used and experienced. Below is a brief summary of other conditions that are important components of how people experience neighborhood greenways, including pavement condition, community uses and stop-sign compliance at minor intersections. *Appendix B, Existing Conditions on Neighborhood Greenways - Additional Information* includes additional information on topics discussed below, as well as full discussions of environmental stewardship and street lighting on neighborhood greenways.

PAVEMENT CONDITION

While not as critical as other characteristics of neighborhood greenway design, the pavement condition affects the comfort of people biking as well as their safety. People biking have a heightened sensitivity to pavement conditions. This manifests itself in an uncomfortable ride at best; at worst it results in a compromised ability to maintain control of the bike, damage to the bike, and/or possible injury due to a crash.

For the 68 miles of existing neighborhood greenways evaluated, 48 percent of streets are in fair or better condition, with 52 percent in poor or very poor condition. In many cases the actual surface conditions on neighborhood greenway segments rated as "very poor" do not compromise cyclist safety or comfort; the pavement condition in these cases is a reflection of roadway deterioration that is not currently creating an operational problem for people biking. However, those roadway deteriorations could lead to future operational problems if not identified and rectified. Recognizing their importance to the transportation system, PBOT has recently focused maintenance priorities on neighborhood greenways. PBOT's efforts to increase the longevity of streets through fog sealing included 30 miles of neighborhood greenways in the past fiscal year.

COMMUNITY USES OF THE RIGHT OF WAY

A healthy urban environment provides places to linger. Benches, art installations, games and community-supported sustainability projects can all provide the opportunity to stop and enjoy the city. Neighborhood greenways strive to enhance neighborhoods as places to be. For example, several recent neighborhood greenway projects included pocket parks, essentially small parks that provide much-needed public spaces and traffic-calming features while making the route a place for people to both travel and gather.

Another key element for creating community-building opportunities is Intersection Repair Projects. Intersection Repair Projects are large street paintings that are designed, approved, installed and maintained by neighborhood residents. They

explore the boundaries of creative placemaking, leveraging the power citizens have to change their neighborhoods. Intersection Repair Projects build relationships between neighbors and directly empower people to shape their places.

INTERSECTION CONTROL AND COMPLIANCE

Because neighborhood greenways play a critical role in achieving the city's goals for transportation, equity, health and prosperity, they must function as great places to bicycle and walk. Neighborhood greenways should have a limited number of stop signs along the route. The National Association of City Transportation Officials' Urban Bikeway Design Guide reads:

> **Stop signs along a bicycle boulevard increase travel time for bicyclists and may be viewed as unnecessary, resulting in low compliance and unpredictability. On many local streets, stop signs are 'woven' such that travelers along local streets must stop at every other intersection. On bicycle boulevards this pattern should be altered to remove stop signs on the bikeway and reorient them towards intersecting local streets.**

PBOT has also heard concerns from the community that automobiles are failing to comply with stop signs at minor intersections, traveling across neighborhood greenways and creating an uncomfortable and unsafe environment. PBOT has not yet conducted an analysis. In order to determine if the problem is isolated or widespread, PBOT could consider a user survey to assess community concerns of potential problem intersections, conduct an analysis, and then recommend actions if a problem is determined.

IV. CONCLUSION AND RECOMMENDATIONS

Neighborhood greenways foster livability by creating a low-stress transportation network. Portland has successfully built a neighborhood greenway system that serves many areas and people in the city. By many measures, neighborhood greenways are performing well as a key component of the city's transportation system. In particular, the number of people who bike on neighborhood greenways demonstrates the importance and success Portland has had developing an innovative network of roads where people bicycling have priority.

After neighborhood greenways are built, Portland needs to maintain and operate them in a manner that creates conditions where people of all ages and abilities have the opportunity to bicycle, walk and play. To achieve that goal, neighborhood greenways need to maintain low auto volumes and speeds, provide protected crossings at major intersections, and create an environment that encourages people of all ages to travel actively. Many of the neighborhood greenways that are functioning with higher automobile volumes or speeds than intended when they were built more than 10 years ago.

POLICY CONSIDERATIONS

The Transportation System Plan (TSP) should be updated to recognize the important role neighborhood greenways play in the overall transportation system. PBOT is currently in the process of updating the TSP. The update should include:

- **Updating the Major City Bikeway classification to explicitly include engineering tools to reduce automobile speeds and volumes appropriate for use on neighborhood greenways;**
- **Evaluating and replacing conflicting policies regarding traffic diversion, particularly TSP Policy 6.13 Objective D, which may be interpreted to prohibit automobile diversion from neighborhood greenways to other local streets. Policy 6.13 Objective D should provide an exception for neighborhood greenways and other priority pedestrian and bicycle routes.**
- **Adopting TSP Policy 6.13 Objective G, which was accepted by City Council as part of the Portland Bicycle Plan for 2030. The objective specifically calls for employing traffic-calming tools and methods to create and maintain sufficiently low automobile volumes and speeds on neighborhood greenways.**
- **Formally including the term "neighborhood greenway" and potentially replacing "bicycle boulevard" as defined facility types.**

OPERATIONAL PERFORMANCE RECOMMENDATIONS

PBOT should adopt performance guidelines to direct the development and maintenance as follows:

- **Design and operate neighborhood greenways for 20 miles per hour at the 85th percentile speed;**
- **Design and operate neighborhood greenways for 1,000 vehicles a day, with 1,500 vehicles as an acceptable volume and 2,000 vehicles as a threshold; and**
- **Design and operate neighborhood greenways with the goal of 100 crossing opportunities for people biking and walking per hour, with 50 crossings per hour an acceptable level.**

PROJECT RECOMMENDATIONS

Based on our data analysis, the following six existing neighborhood greenways are in need of operational improvements to meet the guidelines above:

- **NE Alameda;**
- **SE Ankeny;**
- **SE Clinton-Woodward;**
- **SE Lincoln-Harrison-Ladd;**
- **NW Greenways, which includes short sections of several streets throughout inner Northwest; and**
- **NE Tillamook-Hancock.**

PBOT should temporarily test traffic diversions to manage automobile volumes and collect data to better understand how the measures impact traffic volumes, both on the neighborhood greenways and nearby local streets. The city should use the data collected to develop detailed guidelines for using traffic diversions as a preventative measure on neighborhood greenways. The city should also consider operations and enforcement options for managing speeds on the sections of these six neighborhood greenways that do not meet the recommended performance guidelines.

PBOT also has several new neighborhood greenway projects that are in, or nearing, the design and construction phases. PBOT should continue to move forward with these projects to expand the neighborhood greenways system as quickly as possible. These current projects include:

- **NE Rodney neighborhood greenway, a 2.1-mile north-south route adjacent to N Williams Ave. and NE MLK Blvd.;**
- **The 20s bikeway, a 9.1-mile north-south bicycle route in the inner east side, generally following streets in the "20s";**
- **The 100s neighborhood greenway, a 4.3-mile north-south route in East Portland, generally following streets in the "100s";**
- **The 130s neighborhood greenway and bikeway, an 8.6-mile north-south route in East Portland, generally following streets in the "130s"; and**
- **The 150s neighborhood greenway, a 3.7-mile north-south route in East Portland, generally following streets in the "150s."**

Funding is always a challenge. Transportation is underfunded at the federal, state and local level. To the extent that it identifies and priorities funding, Portland must continue to plan for and build out its neighborhood greenways network. PBOT should monitor performance of all our neighborhood greenways on a regular basis, and regularly analyze and prioritize needed upgrades. Monitoring neighborhood greenway performance and operations will provide public assurance that the city is working to ensure their success and the success of the surrounding neighborhoods.

APPENDIX A: POLICY SUPPORT FOR NEIGHBORHOOD GREENWAYS

There is both broad and specific policy support for neighborhood greenways in Portland's plans and policies, as well as the Portland metro region's priorities. The following section lays out the specific policies in several key city and regional plans that document the importance of neighborhood greenways and the role they will play in creating a healthy, equitable and prosperous Portland.

THE PORTLAND PLAN

The Portland Plan focuses on a core set of priorities: prosperity, education, health and equity. The plan emphasizes specific actions and strategies to achieve those priorities and sets numerical targets, such as achieving 70 percent of all commute trips by walking, bicycling, taking transit and other environmentally friendly modes. The plan is built around three main sections: Thriving, Educated Youth; Economic Prosperity and Affordability; and Healthy, Connected City.

Bicycle transportation is highlighted as a tool in the Portland Plan to help realize the city's goals related to Economic Prosperity and Affordability[1] and creating a Healthy, Connected City.[2] The Portland Plan identifies active transportation and neighborhood greenways as tools to improve Equity, Civic Engagement and Quality of Life, Human Health and Public Safety, Sustainability and the Natural Environment, Design, Planning and Public Spaces, and Neighborhood and Housing as well as (of course) Transportation.[3]

Neighborhood greenways are prominent in the Healthy, Connected City section of the Portland Plan. The goals of the Healthy, Connected City section are to:

- **Improve human and environmental health by creating safe and complete neighborhood centers linked by a network of city greenways that connect Portlanders with each other; and**
- **Encourage active transportation, integrate nature into neighborhoods, enhance watershed health and provide access to services and destinations, locally and across the city.**

Specifically, the Portland Plan calls for developing "city connections, greenways and corridors." Specifically, "a system of habitat connections, neighborhood greenways and civic corridors will weave nature into the city and sustain healthy, resilient neighborhoods, watersheds and Portlanders." Within the Healthy, Connected City section several guiding policies specifically call for the development of a neighborhood greenway system in Portland:

- **Guiding Policy H24 – Develop the network of habitat connections and neighborhood greenways, and plan for civic corridors as a spine of Portland's civic, transportation and green infrastructure systems. Enhance safety, livability and watershed health and catalyze private investment and support livability.**
- **Guiding Policy H27 – Build on Portland's green street, sidewalk and bikeway efforts to create a citywide greenway network of trails and pedestrian and bike-friendly green streets. Locate neighborhood greenways to serve currently underserved communities, improve accessibility, and make connections to the central city, neighborhood hubs, major employment and cultural centers, schools and universities, community centers, parks, natural areas and the Willamette and Columbia rivers.**

1. Guiding Policies P-10, P-18, P-39 in the Portland Plan.

2. Bicycle transportation is a key element of promoting complete and vibrant neighborhood centers (p. 73, 75, 77 of the Portland Plan; Guiding Policies H-18 and H-27).

3. The Portland Plan, Appendix A, p. A-5.

- **Guiding Policy H28 – Design neighborhood greenways and civic corridors to integrate safe and accessible facilities for pedestrians and cyclists, sustainable stormwater facilities, tree planting and community amenities.**

Neighborhood greenways are a foundational tool in the Portland Plan. They provide the network and framework that many of the outcomes and goals of the Healthy, Connected City component of the plan are built upon. The vision of both a healthy, connected city and in turn an equitable, profitable, educated and healthy Portland, requires a safe and accessible neighborhood greenway system.

Comprehensive Plan (Comprehensive Plan Updated July 2015 Proposed Draft)

Portland's draft comprehensive plan incorporates the vision laid out in the Portland Plan and sets the framework for the physical development of the city. The Comprehensive Plan lays out how to implement the strategic vision of the Portland Plan. The importance of neighborhood greenways is reflected in the overall goals of the plan, specifically:

Goal 9.A ("Safety") describes a city that "ensures that people of all ages and abilities feel comfortable and secure using City streets."

Goal 9.C ("Support great places") describes a transportation system that "reinforces neighborhoods, placemaking, and quality of life for all Portlanders."

Goal 9.D ("Environmentally sustainable") continues Portland's long-standing goal to reduce "air pollution, water pollution, noise and Portlanders' reliance on private vehicles."

Goal 9.E ("Equitable transportation") makes it a goal for Portlanders to have options for "affordable modes of transportation."

Goal 9.F ("Positive health outcomes") sets as a goal a transportation system that "promotes positive health outcomes by supporting active transportation, physical activity, and community and individual health."

Goal 9.G ("Opportunities for prosperity") makes it a goal to develop a transportation system that "helps people and businesses reduce spending and keep money in the local economy by providing affordable alternatives to driving."

Policy 9.5 ("Mode share goals and Vehicle Miles Travelled reduction") calls for efforts to "increase the share of trips made using active and low-carbon transportation modes and reduce VMT to achieve targets set in the most current Climate Action Plan and Transportation System Plan."

The Comprehensive Plan also calls for policies that support the development of a neighborhood greenway system, particularly in the bicycle- and pedestrian-specific policies in the plan. Modal policies 9.19 (Bicycle transportation) and 9.20 (Accessible bicycle system) direct the city to "create conditions that make bicycling more attractive than driving for most trips of approximately three miles or less," and to "create a bicycle system that is safe, comfortable, and accessible to people of all ages and abilities," respectively. Similarly, modal policies 9.17 (Pedestrian networks) and 9.18 (Pedestrian safety and accessibility) direct the city to "improve the quality of the pedestrian environment" and "improve safety, accessibility, and convenience for people of all ages and abilities," respectively.

Additionally, policies 8.42 (Community uses) and 9.13 (Streets for transportation and public spaces) allow "community use of rights-of-way for purposes such as public gathering space, events, or other temporary festivals " and calls for integrating "both the placemaking and transportation functions when designing and managing streets by encouraging design, development, and operation of streets to enhance opportunities for them to serve as places for community interaction, environmental function, open space, recreation, and other community purposes," respectively.

Neighborhood greenways are also a key component of the Comprehensive Plan's "City Greenways," which is a system of pedestrian- and bicycle-oriented streets and trails with large tree canopies and other natural features. The Comprehensive Plan calls for neighborhood greenways to work in conjunction with City Greenways to expand the system into all neighborhoods.

Neighborhood greenways meet all the above criteria. They are key transportation corridors, particularly for bicycling, that incorporate stormwater mitigation and urban tree restoration, while also encouraging neighbors to gather, recreate and engage with each other and the city around them.

In addition to specific policies, many of the "significant projects" in the Comprehensive Plan update are neighborhood greenways. These projects include bikeways for:

- **NW Flanders from NW 24th to Waterfront Park;**
- **N/NE Skidmore from N Interstate to NE Cully;**
- **The 20s through Southeast and Northeast;**
- **The 70s through Southeast and Northeast;**
- **NE San Rafael and NE Tillamook from 102nd to 148th; and**
- **SE Market/Mill/Main from 72nd to 175th.**

Climate Action Plan 2009 and Climate Smart

The introduction to the Climate Action Plan 2009 identified the need to "transform all our neighborhoods into places that provide a safe and healthy environment where all residents can meet their needs by foot, bike and public transit."[4] The Climate Action Plan lays out a vision for 2050 in which:

> **"Personal mobility and access to services has never been better. Every resident lives in a walkable and bikeable neighborhood that includes retail businesses, schools, parks and jobs. Most people rely on walking, bicycling and transit rather than driving. Pedestrians and bicyclists are prominent in the region's commercial centers, corridors and neighborhoods. Public transportation, bikeways, sidewalks and greenways connect neighborhoods. When people do need to drive, vehicles are highly efficient and run on low-carbon electricity and renewable fuels."**[5]

Bicycle transportation is highlighted in the Climate Action Plan's Urban Form and Mobility 2030 Objectives, where it calls on the city to "create vibrant neighborhoods where 90 percent of Portland residents and 80 percent of Multnomah County residents can easily walk or bicycle to meet all basic daily, non-work needs and have safe pedestrian or bicycle access to transit."[6] This is identified as Objective 5 in the plan.[7] One of the actions associated with this objective is to identify, for each type of urban neighborhood, the "land use planning changes and infrastructure investments, including public-private partnerships, that are needed to achieve a highly walkable and bikeable neighborhood and develop an implementation action plan."[8] A related action calls for adopting "a schedule for public investments to make neighborhoods highly walkable and bikeable, including sidewalks and improved access to transit for reaching destinations beyond a reasonable walking or biking distance."[9]

Objective 6 calls for the city and county to achieve an average 25 percent bicycle-commute mode split by 2030 as part of the overall goal of achieving a 70 percent non-automotive mode split.[10] The Climate Action Plan also specifically calls out the development of bicycle boulevards (as neighborhood greenways were formerly known), as well as to "aggressively implement the City's Bicycle Master Plan" as one of the actions to support Objective 6.[11]

The Climate Smart Strategy is a regional approach to "build more transportation choices, create healthy communities and grow our economy–all while reducing greenhouse gas emissions." It fulfills a 2009 mandate by the Oregon Legislature, requiring Metro to develop and implement a strategy to reduce the region's per-capita greenhouse gas emissions from cars and light trucks at least 20 percent by 2035. One of the key strategies associated with the regional Climate Smart Communities Scenarios Project is to "Make biking and walking safe and convenient."[12] That strategy identifies safety concerns as one of the main challenges keeping people from walking, bicycling and taking transit.

---

4. Climate Action Plan 2009, p. 3.

5. CAP, p 16: "A Vision for 2050."

6. CAP, p. 10.

7. CAP, p. 39.

8. Objective 5, CAP, p. 39.

9. Objective 5, CAP, p. 42.

10. CAP, p 44.

11. CAP, p. 45.

12. Climate Smart Strategy, December 9, 2014. This is the third of nine strategies. It is part of a larger effort described here (p. 12 of the Climate Smart Strategy): The Oregon Statewide Transportation Strategy (STS): A 2050 Vision for Greenhouse Gas Emissions Reduction, was accepted by the Oregon Transportation Commission in March 2013. The strategy resulted from a state-level scenario planning effort that examined all aspects of the transportation system, including the movement of people and goods, and identified a combination of strategies to reduce greenhouse gas emissions. The STS was developed as part of a larger effort known as the Oregon Sustainable Transportation Initiative (OSTI), an integrated statewide effort to reduce greenhouse gas emissions from Oregon's transportation sector. The effort responded to two bills passed by the Oregon Legislature, House Bill 2001 (2009) and Senate Bill 1059 (2010), which were crafted to help meet state GHG reduction goals set forth in Oregon Revised Statute 468a.205.

Fig. 10: Mode Splits by Plan

PLAN	Bicycle	Walk	Transit	Non-SOV
Climate Action Plan 2009 (commute trips, Multnomah County)	25%	7.5%	25%	70%
Portland Plan (commute trips, Portland)	25%	7.5%	25%	70%
Portland Bicycle Plan for 2030 (all trips, Portland)	25%			
Regional Transportation Plan (all trips, region)				
Portland Central City				60-70%
Regional & town centers; main streets, corridors				45-55%
Industrial areas; inner/outer neighborhoods; employment areas				40-45%

Portland Metro's Regional Active Transportation Plan

The Regional Active Transportation Plan (RATP) for the Portland metro area was adopted by Metro Council in July 2014.

Its functional classifications for bikeways, listed in order of importance in the system, include[13] Regional Bicycle Parkways and Regional Bikeways. Regional Bicycle Parkways are a new functional class for bicycle routes; they are "high-quality routes and make up the spine of the bicycle network—the highways of bicycle travel." Regional bikeways are intended to connect to bicycle parkways to complete the regional-level network of bicycle routes. The RATP recognizes that neighborhood greenways can serve as regional bikeways when they prioritize bicycle travel and if they are direct and have protected crossings and route signage. The RATP provides the following definition of a bicycle boulevard/neighborhood greenway: "Sometimes called a bicycle priority street, a bicycle boulevard is a low-traffic street where all types of vehicles are allowed, but the street is modified as needed to enhance bicycle safety and convenience by providing direct routes that allow free-flow travel for bicyclists at intersections where possible. Traffic controls are used at major intersections to help bicyclists cross streets. Typically these modifications also calm traffic and improve pedestrian safety."

The RATP also identifies that bicycle routes should be:

- **"safe and comfortable for people of all ages and abilities and welcoming to people of all income levels and backgrounds"; and**
- **"attractive … [so that] travel is enjoyable."**[14]

Policy 1 in the plan calls to "make walking and bicycling the most convenient, safe and enjoyable transportation choices for short trips less than three miles." It suggests accomplishing this by "increasing the comfort and perceived and real safety of walking, bicycling and access to transit."[15]

Policy 2 calls for the development of pedestrian and bicycle routes and districts that "prioritize safe, convenient, accessible and comfortable pedestrian and bicycle access for all ages and abilities."[16]

Portland Bicycle Plan for 2030

The Portland Bicycle Plan for 2030 was adopted by City Council in February 2010 by Resolution #36763 ("Adopt the Portland Bicycle Plan for 2030 to create a new 20-year vision for further integrating bicycling into daily life in Portland"). The adopting language noted that investing in bicycle transportation has the potential to achieve the most cost-effective and rapid implementation of transportation improvements to achieve the transportation goals of the city.

Neighborhood greenways are a key element in Portland's Bicycle Plan for 2030. While the 1996

13. Metro's classification also includes bicycle districts that refer to areas rather than specific facilities.

14. Regional Active Transportation Plan, Network Guiding Principles, p. 4-67.

15. RATP, p. 12-154.

16. RATP, p. 12-156.

Bicycle Master Plan called for a total of 81 miles of bike boulevards, the Portland Bicycle Plan for 2030 identifies a total of 286 miles of roadways to be given a neighborhood greenway or similar treatment.

Approximately one-fifth of the neighborhood greenways classified in the Portland Bicycle Plan for 2030 are to be designed as Major City Bikeways, which are expected to carry high volumes of people bicycling. The policy states that they must be designed to attract a high proportion of all trips. The expansion and improvement of neighborhood greenways corresponds closely to the tremendous growth in bicycle transportation in these inner neighborhoods. Their continued high performance is critical to those neighborhoods continuing to contribute a disproportionate share of bicycle trips to Portland's overall transportation, which they must do if Portland is to achieve its overall goals for reducing drive-alone trips.

The Portland Plan sets a goal of 25 percent of all commutes in Portland by bicycle by 2030. Achieving the city's ambitious mode-split goals will require maximizing the potential for the greatest gains in bicycling trips, which is in the household- and trip-rich east side (between the Willamette River and I–205). This is the area of the city where, because of the nature of Portland's street grid, neighborhood greenways play a prominent role in the bikeway network. It is the inner east neighborhoods that will have to carry a disproportionate share of the non-automotive trips if Portland is to approach a 25 percent mode split for bicycle transportation. To achieve that, the pace of growth in bicycle transportation for those neighborhoods between now and 2035 will have to slightly exceed the pace of growth seen in those neighborhoods over the past 20 years.

The policies and goals at the local and regional level lay the foundation for active transportation, particularly bicycling, and the role neighborhood greenways will play to achieve Portland's vision. Each of the plans outlined above specifically recognize that neighborhood greenways are a significant component of the transportation system and must operate as designed in order for the city and region to meet their goals.

APPENDIX B: EXISTING CONDITIONS ON NEIGHBORHOOD GREENWAYS – ADDITIONAL INFORMATION

This section expands upon ***Section III***. Existing Conditions on Neighborhood Greenways in the main document.

PAVEMENT CONDITION

As Section III explained, pavement condition of neighborhood greenways is a contributing factor to bicyclist comfort and safety. According to the Pedestrian and Bicycling Information Center, "research into hospital records shows that only a fraction of bicycle crashes causing injury are ever recorded by the police." A survey of emergency medical response calls involving bicycles (Boston, MA 2013 Cyclist Safety Report) found that 29 percent were bike-only crashes.

In a 2012 National Survey on Bicycle and Pedestrian Attitude and Behaviors conducted by the National Highway Traffic Safety Association, the top causes for a bike crash were identified as:

- **29 percent hit by car;**
- **17 percent fell;**
- **13 percent roadway not in good repair; and**
- **13 percent rider error/not paying attention.**

The Bike Level of Service (BLOS) assessment used by the USDOT Federal Highway Administration includes pavement condition as a factor. Similarly, their Bike Safety Guide and Countermeasure Selection System recognizes that: "In addition to causing bicyclist falls poor riding surfaces may also increase bicyclist discomfort and potentially discourage riding."

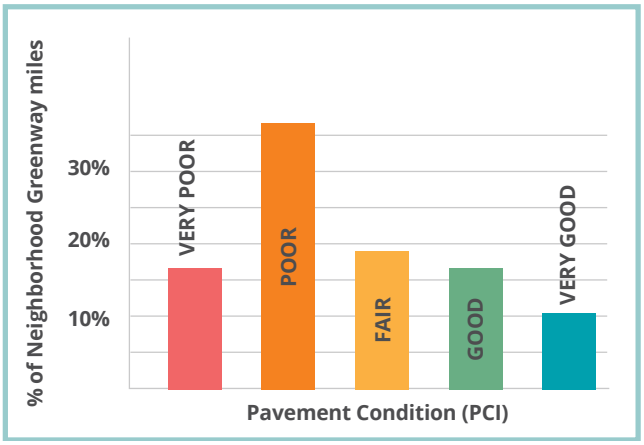
Pavement condition is an important consideration on any street used by cyclists. However, on neighborhood greenways it is of special importance due to the expected use by less experienced cyclists who may be less adept at negotiating roadway surface obstacles. A paved surface that is rough or otherwise uncomfortable to ride on could result in fewer people bicycling, or riders migrating to other (smoother) routes.

LOCAL CONDITION ASSESSMENT

A Pavement Condition Index (PCI) score based upon visual inspection is used to assess the condition of city streets. Using a scale of 0-100, a PCI score below 40 represents a street in very poor condition, while a PCI of 65 or higher is considered being in fair or better condition.

For the 68 miles of existing neighborhood greenways evaluated, 48 percent of streets are in fair or better condition, with 52 percent in poor or very poor condition. In many cases the actual surface conditions on neighborhood greenway segments rated as "very poor" do not compromise cyclist safety or comfort; the PCI in these cases is a reflection of roadway deterioration that is not currently creating an operational problem for cyclists. However,

Fig. 11: Pavement Conditions on Neighborhood Greenways



those roadway deteriorations could lead to future operational problems if not identified and rectified.

There are two separate pavement-condition problems on neighborhood greenways. In Fig. 11 transportation staff have identified sections of neighborhood greenways where pavement conditions create uncomfortable bicycling conditions. Because some of these roadway sections are streets that were not built to current standards, many will require extensive roadway work, including potentially having to fully rebuild the street. Full rebuilds are expensive projects that will require vast staff and financial resources. However, there are small-scale roadway surface problems that are solvable with current resources.

Currently, the public is able to report problems through a number of information channels, including PBOT's Maintenance Operations 24-hour hotline and the PDX Reporter smartphone app. By leveraging the public's input, PBOT is able to improve the conditions of neighborhood greenways by fixing smaller-scale issues such as potholes, failing roadway patches and other surface problems.

COMMUNITY USES OF THE RIGHT OF WAY

A healthy urban environment provides places to linger. Benches, art installations, games and community-supported sustainability projects can all provide the opportunity to stop and enjoy the city. Neighborhood greenways strive to enhance neighborhoods as places to be. One key element for creating these opportunities are Intersection Repair Projects.

Intersection Repair Projects are large street paintings that are designed, approved, installed and maintained by neighborhood residents. They explore the boundaries of creative placemaking, leveraging the power citizens have to change their neighborhoods. Intersection Repair Projects build relationships between neighbors and directly empower people to shape their places.

Residents follow requirements set by the City Council for a street painting to be approved. To obtain a permit, a successful design must not include speech, traffic control devices or copyright material. The City Traffic Engineer must approve the design. Upon approval of the design, a petition is circulated in the affected area. All adjacent properties must sign the petition. In addition, 80 percent of residents along the streets radiating from the intersection for 400 feet must sign the petition. If these requirements are met, a revocable encroachment permit is issued to allow the residents to paint their street.

The permit process requires a high degree of community consensus. The community process typically begins with a series of potlucks where neighbors become friends, talk about how to symbolize their neighborhood, and discuss projects that can make it a nicer place to live. The more neighbors are involved in the conversation, the smoother the permit process goes as they go door to door to gather petition signatures.

In addition to the street painting permit, neighbors must also acquire a permit for a block party. The block party permit allows them to close the street for the day so they can get together and paint. Portland currently has 30 Intersection Repair Project street paintings.

Due to traffic and weather, the paint tends to wear off the street. Residents get together every one or two years to refresh the paint. Repainting the street brings people back together for regular block parties and gatherings. During the repainting process, neighbors share food, music and ideas. Many other projects have blossomed from the conversations.

These additional projects have included elements like community composting and gardening, community kiosks and free libraries. There are places where children are sharing toys and where poetry kiosks offer children and adults a free poem to consider along their journey.

Of the 30 Intersection Repair Projects, seven have taken place on neighborhood greenways. These installations have created special identities for the routes and offer a nice surprise for people walking and biking in the corridors. The neighborhood greenways program encourages neighbors to

consider installing an Intersection Repair Project as a way to announce the route as one that is a pleasant place to walk, bike, live and play.

As of 2014, the following intersections have Intersection Repair Projects along a neighborhood greenway route:

- **NE 8th & Holman;**
- **N Central & St John;**
- **NE 77th & Beach;**
- **N Concord & Overlook;**
- **NE Tillamook & Rodney;**
- **SE 16th & Ash; and**
- **NE 6th & Going.**

ENVIRONMENTAL STEWARDSHIP AND BIO-SWALES

Portland receives an average of 37 inches of precipitation annually. That creates about 10 billion gallons of stormwater runoff per year that washes over streets, parking lots, buildings and other hard surfaces, carrying pollutants to rivers and streams. Stormwater runoff can cause flooding and erosion, destroy natural habitat and contribute to combined sewer overflows into rivers and streams.

Green streets transform impervious street surfaces into landscaped green spaces that capture stormwater runoff and let water soak into the ground as plants and soil filter pollutants. The city of Portland has a policy that green streets should be built whenever a curb line is adjusted for elements such as curb extensions, traffic diverters or larger features like pocket parks.

Neighborhood greenways support the green street policy goals by incorporating sustainability as a central goal of the network. To date, 113 green streets have been constructed on the neighborhood greenways system.

STREET LIGHTING

The presence of street lighting on neighborhood greenways enhances visibility for bicyclists and pedestrians, providing comfortable and safe places for active transportation during non-daylight hours.

PBOT strives to adhere to minimum light standards approved by the City Council based on street classifications, from Local Service (typically low-volume residential) streets to Regional Trafficways (large-volume arterials). In 2014, PBOT started converting existing cobra-head fixtures from high-pressure sodium to more efficient LED models, which produce whiter light and enhance visibility. This conversion is anticipated to be completed over a two-year period and will address the majority of street lights in Portland.

Since neighborhood greenways are predominantly on local service streets, low-wattage fixtures are generally appropriate. Not only does a low-wattage fixture reduce electricity consumption, it enhances livability by reducing the level of light-trespass for adjacent properties. Street lights are often installed on existing utility poles, and are typically found at intersections, anticipated conflict points. and midblock on long street sections in neighborhood areas. On local service streets, the standards allow longer spacing between lights than on arterials, and dark areas between lights are common.

For neighborhood greenway areas where lighting is found to be deficient, infilling with additional lights or increasing the wattage of existing fixtures may be options to alleviate the concern; PBOT can evaluate those areas and make recommendations on a case-by-case basis.

Other techniques, such as in-street LEDs that PBOT tested on the eastern approach to the Burnside Bridge, could be explored to test creative approaches to neighborhood greenway lighting.

MINIMUM STREET WIDTHS

Neighborhood greenways are most often found on local service streets that can have a large range of street widths. Neighborhood greenways typically include two shared travel lanes and two parking lanes. For streets that are 24 feet wide, for example, parked cars on either side of the road essentially narrow the travel space to 8 to 12 feet. Narrowing the travel spaces can serve as a traffic-calming measure by keeping speeds slow; however, it can also make passing uncomfortable for traffic traveling in opposite directions. As the neighborhood greenway system expands and demands on the roadway continue to increase, the width and uses of the street will need to be taken into consideration to maintain the priority on bicycle comfort and safety.

QUADRANT ANALYSIS OF NEIGHBORHOOD GREENWAYS

The design of Portland's neighborhood greenways reflects the changing design guidelines that have been used in Portland and nationally over the three-plus decades they have been integrated into the city's transportation system. Early neighborhood greenways were created with little more than a diverter or two and several traffic circles. More recent neighborhood greenways include tightly spaced pavement markings, preventive diverters, advanced crossing treatments, traffic calming that brings speeds down to 20 mph, and little need to stop when bicycling the corridor. Portland's neighborhood greenways display both extremes of this spectrum, and many designs in between. This next section builds upon the information in ***Section III***. Existing Conditions on Neighborhood Greenways, exploring how Portland's neighborhood greenways are functioning in different areas of the city.

The ultimate yardstick for a bikeway's performance is bicycle use. Is the bikeway successfully attracting its share of trips in the local network? Is it being used by the "interested but concerned," who are less traffic-tolerant cyclists? These measurements are influenced not only by overall design of the bikeway, but also by factors identified such as the overall quality of the local bikeway network; the accessibility of common destinations within distances amenable to bicycling (land use); and topography. The factors related to the design of any individual neighborhood greenway include automobile volumes and speeds, quality of crossings of other streets and the density of stop signs, as well as other considerations such as pavement condition and street lighting. This section takes a summary look at the design and performance of neighborhood greenways found in different parts of Portland.

The following quadrant-by-quadrant descriptions of Portland's 73.8 miles of neighborhood greenways provides a brief overview of the history and function of this key element in Portland's transportation system.

INNER SOUTHEAST PORTLAND

For a long time, when Portlanders thought of neighborhood greenways they thought exclusively of inner Southeast Portland, and for good reason. Beginning in the late 1980s Portland had in place the framework of what would ultimately be recognized as neighborhood greenways on three important corridors: SE Clinton, SE Lincoln-Harrison and SE Salmon-Taylor. These streets had traffic calming provided by traffic circles, and lowered volumes of automobiles because of strategically placed diverters. Most important, they were within easy bicycling distance of, and provided direct connections to, downtown Portland via the Hawthorne Bridge, which had shared pedestrian-bicycle sidewalks. By the mid-1990s the city added SE Ankeny to the mix to complete those bikeways providing direct connections to the central city and downtown.

Initially built to the minimal standards that existed at the time, the city undertook efforts to improve conditions on these older neighborhood greenways, including additional traffic calming on Clinton, Ankeny and Lincoln-Harrison, crossing improvements of Cesar Chavez Boulevard, pavement markings on all streets and branding treatments on Clinton. Still, none of these roadways fully meet the design guidelines identified in the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide, which the city of Portland adopted as official guidance in 2012. The performance guidelines recommended in this document (Section II) use the NACTO Urban Bikeway Design guidelines as the foundation for operational targets specific to Portland.

Today, inner Southeast Portland's neighborhood greenways include north-south routes on 16th and through the 40s, 50s and 80s, extensions of Lincoln-Harrison and Clinton-Woodward that reach to the boundaries of East Portland, and an additional east-west route along Gladstone and Center streets toward Lents. Also included in the mix of Southeast neighborhood greenways are Spokane and Umatilla in the Sellwood neighborhood. Those neighborhood greenways built since 2009 (Gladstone-Center, 50s, 80s) generally follow modern design guidelines for spacing of speed bumps, use of diversion to maintain existing low automotive volumes, and crossing treatments. The older neighborhood greenways, though updated, still do not reflect current design guidelines or performance goals.

Topography, Land Use and Other Characteristics

Inner Southeast Portland has one of the lowest rates of automobile use in Portland (second only to Northwest Portland) and one of the highest rates of bicycle use. Its tight transportation grid, relatively low speed and small collector streets, high density of neighborhood greenways and—perhaps most important—short trip distances to many destinations

including Portland's central city, have all contributed to high bicycle use. This is likely augmented by the presence of a fairly well-developed grid of bikeways for more than 20 years that has contributed to a consistent growth in local acceptance of bicycling as a primary means of transportation. Bicycle use for commuting in inner Southeast is almost 11 percent.

Bicycle Use

Inner Southeast Portland's neighborhood greenways see the highest neighborhood greenway bicycle use in the city. The number of bicycle trips recorded on neighborhood greenways in Southeast Portland showed consistent growth from the early 2000s through the current year, though the pace of growth has leveled off across the board and, at some locations in recent years, shown a slight decrease from peak use in 2008-2009.

With few exceptions, daily bicycle traffic on these neighborhood greenways exceeds 1,000 trips per day. On SE Clinton and SE Ankeny daily bicycle trips exceed 2,000 and are approaching 3,000 trips per day. At Ladd Circle, where several routes meet, daily bicycle trips regularly exceed 4,000 per day.

The farther from the city center, the lower the bicycle counts. The exception to this is in Sellwood, where the connection the neighborhood greenways provide to the Springwater Corridor Trail ensures bicycle traffic exceeding 1,000 trips per day.

The difference in performance of these neighborhood greenways can be understood, in part, by the role they play in the transportation network. SE Clinton, SE Lincoln-Harrison, SE Salmon-Taylor and SE Ankeny were all classified as Major City Bikeways in the Portland Bicycle Plan for 2030. They all provide direct connections to Willamette River bridges. SE Spokane and SE Umatilla were also classified as Major City Bikeways because of the connections they provide to the Springwater Corridor Trail and its direct access to the central city. With the exception of the 40s bikeway—which serves as a key north-south corridor—all other Southeast neighborhood greenways are classified as City Bikeways and serve as feeder routes to more major routes.

Traffic Volumes

Less than ideal conditions on several Major City Bikeways—as evidenced by recent activism focused on uncomfortable conditions—serves to stymie the full potential of some Southeast neighborhood greenways. Earlier analysis of Metro's 2011 personal household transportation survey data suggests it is Portland's inner eastside neighborhoods that will have to carry a disproportionate share of bicycle mode-split if the city is to reach its overall bicycle mode-split goals. High traffic volumes and high speeds on Portland's neighborhood greenways work against achieving these goals.

That said, traffic volumes on many of Southeast Portland's neighborhood greenways are at levels below or barely above 1,000 cars per day, thus meeting the recommended performance guidelines. This is true on 16th, 19th, Umatilla, Center-Gladstone, the 40s bikeway and much of Salmon-Taylor outside the industrial district. Traffic on the 80s bikeway is also low, except for one especially problematic section between Eastport Mall and Powell Boulevard. However, traffic volumes on many of Southeast Portland's neighborhood greenways, including those identified as Major City Bikeways and with high bicycle use, also have very high automotive use. This is especially true on Clinton-Woodward, Lincoln-Harrison and Ankeny.

Some of the segments on those neighborhood greenways experience motor vehicle traffic ranging from 2,000 to more than 3,000 cars per day. Beyond the uncomfortable conditions such volumes create for people bicycling on the street because of frequent passing (or desire to pass) by people driving, automotive volumes greater than 2,000 per day eliminates the possibility of bringing speeds down to the preferred limit of 20 mph. State law (ORS 810.180) does not allow lowering the speed limit when there are more than 2,000 motor vehicles per day.

Traffic Speeds

At most locations where speed data has been collected along Southeast Portland's neighborhood greenways (2008-2014), the city failed to achieve its desired speed goal of 20 mph. Approximately one-fifth of all speed counts show speeds greater than 25 mph. Only about one-fifth of locations counted achieved the target speed of 20 mph or less.

Arterial Intersection and Crossing Treatments

One reason the inner Southeast neighborhood greenways work well for people bicycling is that they generally allow free-flow conditions. Most of the minor intersections have stop control at the cross-streets, meaning bicycle traffic rarely has to stop.

Most major intersection crossings have good crossing treatments, ranging from signals (both full and bicycle-pedestrian-specific), median refuges, two-way cycle tracks and bike boxes.

A long-time complaint about intersection treatments on Portland's neighborhood greenways centers on the use of traffic circles. These were first introduced as traffic-calming devices in the late 1980s. Subsequent studies indicate that they are not as effective at maintaining consistent slow speeds as are speed bumps. Another significant complaint is that motor vehicle cross traffic often does not stop at stop signs when crossing the neighborhood greenway.

INNER NORTHEAST

Similar to Southeast Portland, inner Northeast Portland has a land form and development pattern that lends itself to the development of a healthy network of neighborhood greenways. The first greenways to be developed in this part of town were the NE Tillamook neighborhood greenway and the northern extension of the 40s bikeway. Both were constructed in 1999-2000.

These two initial neighborhood greenways were built with small budgets and guidelines based on those found in the city's 1996 Bicycle Master Plan. As such, they do not include traffic-calming features, have relatively frequent stops at cross-streets and do not employ best-practice crossing treatments of busier streets. These older neighborhood greenways do not fully meet the design guidelines identified in the NACTO Urban Bikeway Design Guide, nor the performance standards recommended in Section II of this report.

Northeast Portland also includes neighborhood greenways built to the higher standards found in the NACTO guide. These neighborhood greenways were built in the years 2010-2013 and include NE Going, NE Holman, NE Klickitat-Siskiyou and NE Bryant, which includes a short cluster of streets in the Woodlawn neighborhood.

Topography, Land Use and Other Characteristics

Bicycle use in inner Northeast Portland is second only to inner Southeast Portland. Like inner Southeast, Northeast Portland benefits from a tight transportation grid, relatively low speed and small collector streets, and short trip distances to many destinations including Portland's central city.

Many of Northeast's neighborhood greenways connect to the Vancouver-Williams couplet. This couplet carries the highest bicycle volumes in the city (other than several of the Willamette River bridges) and are directly fed by the Northeast neighborhood greenways that connect to them.

Bicycle Use

The Going neighborhood greenway, the 40s bikeway and the Tillamook bikeway all see healthy bicycle use, with weekday bicycle trips exceeding 1,000 per day. On Going, the number of daily bicycle trips is approaching 2,000. That street, in particular, has seen dramatic growth in bicycle use since its development as a greenway in 2010 and subsequent improvements at NE 15th to divert motor vehicle traffic. This is likely due, in part, to the location of Going Street. Its development as a bikeway filled in a significant gap in east-west bicycle facilities north of the Alameda Ridge. It is essentially serving the role of a Major City Bikeway, though that designation is currently carried by the undeveloped Mason-Skidmore neighborhood greenway, located approximately three blocks to the south. Other inner Northeast neighborhood greenways show lower bicycle use, with daily trips in the range of 400 to 600 per day.

As with other bikeways in Portland, inner Northeast's neighborhood greenways showed robust growth in the period from 2006 through 2011-2012, following by a leveling off or even a slight decline at some locations.

Traffic Volumes

With a few exceptions, traffic volumes on inner Northeast Portland neighborhood greenways achieve the target goal of being below 1,000 cars per day. The minor exception includes volumes on inner NE Going (1,200 cars per day near NE 9th), on the 40s bikeway (less than 1,500 cars per day near Wasco, Failing and Alameda) and on NE Holman (between 1,100-1,400 cars per day near 27th and 37th-Cesar Chavez Boulevard). More notable exceptions occur on the 40s bikeway near NE Jessup, where traffic volumes exceed 2,000 cars per day; on NE Holman, where volumes at 38th exceed 1,600 cars per day; and on NE Tillamook near both NE 82nd and near Martin Luther King, Jr. Blvd., where traffic volumes approach and sometimes exceed 1,500 cars per day. More difficult still are conditions on the NE Tillamook neighborhood greenway, where traffic volumes (on U.S. Grant) adjacent to Grant Park and Grant High School daily exceed 3,000 cars per day.

Traffic Speeds

Of the many locations where traffic speeds on Northeast Portland neighborhood greenways were measured between 2008 and 2014, only 17 percent show 85th percentile speeds in excess of 25 mph. More than half of all speeds counted on those neighborhood greenways (60 percent) were below 24 mph. There were no speeds recorded greater than 30 mph. Of the more established neighborhood greenways, only U.S. Grant Place displayed speeds at the 28 mph range. Other higher-speed locations included 53rd near Davis and Couch streets, 87th near Pacific Street, and a few locations near Woodlawn.

Arterial Intersection and Crossing Treatments

Crossings of major intersections by inner Northeast's neighborhood greenways reflect the changing tools and guidelines employed by PBOT and nationally in the past 20 years. Simple curb extensions are used at key crossings of the 40s bikeway at Killingsworth, and pedestrian hybrid beacons are used farther south on the 40s at Burnside (with more planned for north-south bikeways currently under development). Rectangular rapid flashing beacons are used on Klickitat, and median refuges are used to cross the very busy Martin Luther King, Jr. and Cesar Chavez boulevards. The crossing of NE 33rd at Going saw the city's first two-way cycle track, though no further crossing enhancement was used at that location. In general, the crossings of most major roadways are functioning well, though upgrades on some of the older neighborhood greenways would be beneficial.

NORTHWEST

With the exception of NW Marshall (which was developed as a replacement for the bike lane that was removed on NW Lovejoy when an additional streetcar line was added to that street), the neighborhood greenways in Northwest Portland were developed in one fell swoop as part of the Northwest Bikeways Project in the late 1990s. With the exception of NW 24th, which runs from Flanders to Vaughn, all other Northwest greenways run east-west along Raleigh, Overton, Marshall, Johnson and Flanders between NW 24th and various east terminuses.

These bikeways were developed to minimal guidelines: crossing treatments are generally curb extensions with unmarked crosswalks; few stop signs were moved, so there are generally stops every two blocks or more; and neither traffic calming nor traffic diversion was installed as part of the original projects. The one exception was NW Marshall, which was developed in 2012. There, Portland installed a diverter at NW 11th to reduce the volume of motorists bypassing the Lovejoy-Northrup couplet.

Topography, Land Use and Other Characteristics

Northwest Portland is one of the densest residential neighborhoods in Oregon. It includes many local destinations and is within close proximity of downtown. Not surprisingly, U.S. Census data shows car commuting here to be the lowest of any sector in Portland (51 percent in 2010) and commuting by walking, at almost 16 percent, is more than three times greater than commuting by bicycle, at 4.9 percent.

The Northwest neighborhood greenways are isolated in a somewhat disconnected bicycle transportation network. Access out of Northwest Portland is not easily accomplished on a connected or completed bikeway network. The principal roadways connecting to downtown or to the Willamette River bridges all include significant gaps where bikeways drop. Almost all bikeways drop before reaching either the Willamette River bridges or the central core.

Traffic Volumes

Recent traffic volume counts on the Northwest greenways show relatively high automobile volumes. Only a single recent traffic count at one location shows automotive volumes within 5 percent of the target of 1,000 daily vehicles. Most counts show volumes well in excess of that goal, with a significant range depending on the neighborhood greenway:

- **More than 2,000 automobiles per day on NW Johnson;**
- **Between 1,200 and 1,600 on NW Flanders;**
- **Between 1,000 and 1,800 on NW Raleigh;**
- **Just under 1,500 on NW Overton;**
- **Between 2,000 and 4,000 on NW 24th, depending on location; and**
- **Upwards of 4,500 on NW Marshall near NW 13th.**

The automobile volumes on Northwest neighborhood greenways are likely a contributing factor to the low number of bicycles and overall ridership in the area.

Traffic Speeds

Traffic speeds are generally low on the Northwest neighborhood greenways, mostly due to the land use and frequent stop signs where the routes cross other streets.

Arterial Intersection and Crossing Treatments

Because of the density of the street network and the prevalence of north-south streets operating as collectors (23rd, 21st, 19th, 18th, 16th) people travelling on the Northwest neighborhood greenways are frequently halted by stop signs. Treatments to cross these streets range from no improvements to the placement of curb extensions to reduce overall crossing distance. These minimal treatments result in significant delay to people traveling by bicycle.

Bicycle Use

Daily bicycle use on the Northwest neighborhood greenways hovers near 1,000 trips per day at almost all locations counted. With the exception of NW Marshall, the number of people bicycling on the Northwest neighborhood greenways has been relatively constant over the past few years, though it has shown good growth relative to 2007-2009. NW Marshall, established in 2012 as a substitute for the NW Lovejoy bike lane removal, has shown a steady decline in bicycle use. NW 24th, the sole north-south neighborhood greenway in the area, does not truly function as a neighborhood greenway. NW 24th's traffic volumes regularly exceed 4,000 cars per day to the far north and exceed 2,000 cars per day farther south.

NORTH

With the exception of the northern end of N Williams, prior to 2010 there were no neighborhood greenways in North Portland. 2010 saw development of the Concord, Wabash and Bryant neighborhood greenways. By 2012 the Central Street and North Portland Connector (roughly parallel to N Lombard) neighborhood greenways had been built. In 2013, the N Michigan neighborhood greenway was constructed.

Topography, Land Use and Other Characteristics

West of I-5 there are two principal commercial districts in North Portland: Kenton and St. Johns. Much of the current greenway network provides indirect access to both, though the Kenton district is served by bicycle lanes on N Denver and N Interstate as well as by the N Concord neighborhood greenway.

Bicycle Use

At 6.6 percent of all commute trips (2010 Census data), bicycle commute rates in North Portland are the third highest in the city, behind inner Southeast and Northeast. Most of that cycling activity is centered on the University Park, Overlook, Eliot, Arbor Lodge, Boise and Humboldt neighborhoods, with higher concentrations of bicycling activity especially in the latter three neighborhoods. Bicycle traffic on the North Portland neighborhood greenways is relatively low (fewer than 500 trips per day) and has shown scant growth in the period 2012-2014.

Traffic Volumes

As is true on most neighborhood greenways, traffic volumes are generally low and achieve the city's design objective of fewer than 1,000 cars per day. As with most greenways there are a few exceptions. N Fenwick (part of the N Concord greenway) in the vicinity of Kenton (between Lombard and Interstate) has volumes exceeding 1,000 cars per day and occasionally exceeding 1,500 cars per day.

N Michigan has volumes at many locations that exceed 1,000 cars per day. This is especially true immediately adjacent to the Mississippi commercial district. N Central in the St. Johns neighborhood is another neighborhood greenway with higher than desired traffic volumes close to major attractions. In this case it is the St. Johns Town Center (near Mohawk and Richmond avenues) and Pier Park (near St. Johns Ave.), where automobile volumes exceed 1,000 cars per day.

Traffic Speeds

The highest speeds on North Portland's neighborhood greenways are generally concentrated on N Wabash in the segments just north of Willamette Boulevard. Elsewhere, North Portland's neighborhood greenways generally have a more enviable speed profile than those found in other east-side neighborhoods or in Southwest Portland. Only Northwest Portland's greenways show a better speed profile.

Arterial Intersection and Crossing Treatments

Because most of the North neighborhood greenways have been built after 2009, they include crossing treatments that meet the recommended performance guidelines. Additionally, many of these routes were designed using existing crossing treatments, such as stoplights at major intersections, to take advantage of existing infrastructure as much as possible.

SOUTHWEST AND EAST PORTLAND

Portland's inner neighborhoods in Southeast, Northeast, North and, to a lesser extent, Northwest offer good conditions for developing neighborhood greenways. They all possess a relatively closely spaced street grid that offers good opportunities for east-west and north-south travel. Because of the well-developed grid many of the residential streets carry relatively low volumes of automotive traffic. They also all have low-volume roadways that extend far enough to create connected, linear transportation options. These conditions allow for planning and implementing a relatively dense network of neighborhood greenways.

Conditions in East Portland and Southwest Portland, are not as favorable. Neither location benefits from the type of closely spaced grid found closer to the center. In the case of Southwest Portland especially, the topography restricts both the connectivity of potential neighborhood greenway routes and their desirability for bicycling because of the hilly terrain. In East Portland, continuous greenway routes can be cobbled together, but often require significant jogs to match up segments in an overall discontinuous grid. Despite these challenges, neighborhood greenways still have a role to play in these two quadrants.

There are three existing neighborhood greenway segments in Southwest Portland: SW Westwood-Cheltenham, SW Illinois and SW Maplewood-Custer-Miles. They are relatively short segments that provide neighborhood connections to roadways with existing bicycle lanes.

East Portland is relatively flat and, as opposed to Southwest, offers few topographic challenges to riding a bicycle. Because of its discontinuous street grid, past bicycle transportation planning efforts relied almost exclusively on making the major roadways work by adding bicycle lanes. Prior to the adoption of the Portland Bicycle Plan for 2030 there were few recommended neighborhood greenways in East Portland. Now there are a number of planned neighborhood greenway corridors that assemble continuous routes that rely on often sinuous street segments. There are now three developed neighborhood greenways in East Portland. One runsg principally along SE Bush, which connects south to the lower 100s and has a segment of SE Steele connecting to it across I-205. The 80s neighborhood greenway is also built, with a small section through Eastport Plaza still in need of design and construction.

Bicycle Use

At approximately 2.2 percent of commute trips, residential Southwest Portland has among the lowest bicycling rates in Portland. With people biking challenged by topography and busy roadways with inadequate bikeways, this low rate is not surprising. Bicycle traffic on Southwest Portland's neighborhood greenways corresponds to this low use. The highest daily total was on SW Westwood, which provides a cut-through to Hillsdale from Terwilliger. There the city recorded approximately 250 daily bike trips in 2014. The lowest recorded total was on SW Illinois, which in 2013 saw fewer than 50 daily bicycle trips.

At slightly less than 1 percent, East Portland has the lowest bicycle commute rate in the city (2010). Bicycle counts on East Portland's neighborhood greenways are consistent with this low bicycle use. There were fewer than 100 daily bicycle trips on the SE Bush and SE 100s neighborhood greenways in 2013 and 2014. Interestingly, the highest bicycle counts on a shared roadway were recorded on SE Mill at 135th. This future neighborhood greenway saw 120 daily bicycle trips in 2014.

Traffic Volumes

Automobile volumes are generally supportive of bicycle travel on Southwest's greenways. There are few instances where volumes exceed 1,000 cars per day. In East Portland, automobile volumes are generally supportive of bicycle travel. With few exceptions, traffic volumes on SE Bush are generally below 1,500 cars per day; on the SE 100s they are below 1,000 cars per day.

Traffic Speeds

The speed profiles on Southwest Portland's greenways are often unsatisfactory. More than one-quarter of recorded speed counts had 85th percentile speeds greater than 28 mph. Similarly, speeds on East Portland's neighborhood greenways tend to be higher than in other parts of the city, with many segments experiencing speeds greater than 25 mph and ranging as high as 35 mph.

Arterial Intersection and Crossing Treatments

Similarly to the neighborhood greenways developed recently in North Portland, those in Southwest and East Portland have largely been constructed after 2008. Thus, the design treatments used to cross major arterials and other streets meet the performance guidelines recommended in this document.

Fig. 11: Auto Speeds on Portland's Neighborhood Greenways by Sector 2008–2014

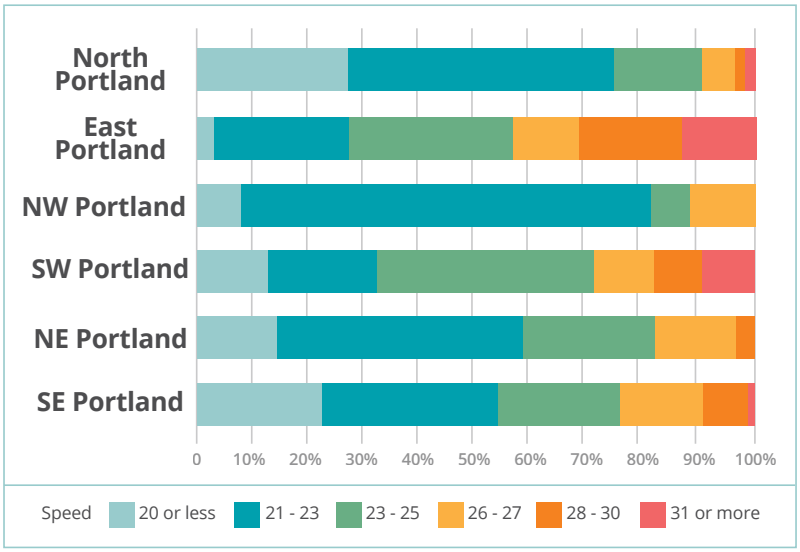
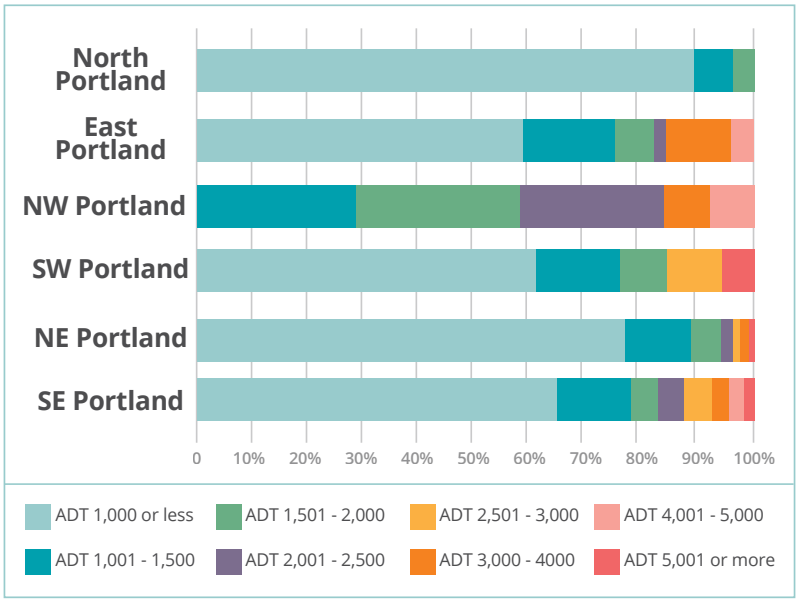


Fig. 12: Auto Volumes on Portland's Neighborhood Greenways by Sector 2006–2014



APPENDIX C: TOOLS AND DESIGNS FOR NEIGHBORHOOD GREENWAYS

PBOT employs many tools to build neighborhood greenways, encourage their use and ensure that they are operating safely.

The following pages describe various engineering treatments used to achieve common goals along Portland's neighborhood greenways. The various treatments can be combined for greater effect where their construction is not physically in conflict, or duplicative.

AUTO SPEED REDUCTION ALONG NEIGHBORHOOD GREENWAYS

Speed bumps are the primary tool to manage auto speeds along neighborhood greenway routes where speeding is a problem. The desired 85th percentile operational speed on neighborhood greenways is 20 miles per hour (mph). This goal is supported by international research indicating a cyclist struck at 20 mph has less than 15 percent risk of fatality[1].

Research indicates that the spacing of speed bumps and speed tables should not exceed 350 feet in order to achieve the desired operating speed of 20 mph. The spacing of speed bumps should be reduced to as close as 300 feet apart in response to higher pre-project 85th percentile speeds. Reference Portland's 2013 Draft Traffic Manual, Section 3.1 – Traffic Calming, Speed Bumps for detail design guidance, unless otherwise stated. The following are examples of speed bumps used in Portland.

14-FOOT SPEED BUMP

14-foot speed bumps are used on Local Service streets to achieve residential speeds. They have a parabolic profile and maximum height of 3 inches. Worst-case fire engine delay per 14-foot speed bump is approximately 9.4 seconds.

1. Wramborg, P. (2005) "A New Approach to a Safe and Sustainable Road Structure and Street Design for Urban Areas," paper presented at Road Safety on Four Continents Conference, Warsaw, Poland.

22-FOOT SPEED BUMP (AKA SPEED TABLE)

22-foot speed bumps use two 6-foot parabolic ramps and a 10-foot flat section between the ramps, and 3-inch maximum height. The flat section reduces the slowing effect on motorists at the bump. 22-foot speed bumps are used on Neighborhood Collector streets not designated as Major Emergency Response routes and on Local Service streets with active transit routes. Worst-case fire engine delay per 22-foot speed bump is approximately 9.2 seconds. This photo shows the former marking standard.

RAISED CROSSWALKS

Raised crosswalks use the 22-foot speed bump profile and add the continental-style crosswalk marking. Type 1 raised crosswalks meet the curb, and the curb ramp is constructed to match the 3-inch speed bump height. Type 2 raised crosswalks, as shown here, have a 3-foot-wide tapered edge down to the roadside. See the Draft Traffic Manual Section 3.6 for design details.

SPEED CUSHIONS

Speed cushions are a "fire-friendly" version of the 14-foot speed bump. Channels are incorporated to permit fire trucks to straddle the narrower bump sections and, ideally, minimize delay. Estimated delay per device for a fire truck is under 2 seconds.

OFFSET SPEED BUMPS

Offset speed bumps have the same dimensions as standard 22-foot speed bumps but are split down the centerline of the street with the two halves separated. Offset speed bumps permit emergency response vehicles to bypass the bumps by placing one or both sides of the vehicle into the opposing traffic lane. This action can significantly reduce the delay to emergency response vehicles associated with driving both sides of the vehicle over a speed bump. Estimated delay per device for a fire truck is under 2 seconds. This photo is from Beaverton, Oregon.

Traffic circles have been used in the past to reduce vehicle speeds; however, research has shown that the speed-reduction effect of traffic circles is limited to within about 100 feet of the intersection at which they are placed. When placing speed bumps along a neighborhood greenway with existing traffic circles, it is permissible to place speed bumps within 200 feet of a traffic circle, or remove the circle to achieve a more uniform speed-bump spacing.

TRAFFIC CIRCLE, FORMER CURB

Portland first adopted traffic circles to address speeding concerns, but has found them to be of limited influence on speeds and expensive to construct. Traffic circles also are unwelcome by people biking due to a perception that people driving speed up to pass people biking before the circle. In testing, traffic circles presented the greatest delay to fire engines, at up to 10.7 seconds per circle. Existing traffic control is usually maintained after traffic circle construction. See the Draft Traffic Manual, Section 3.2, for design details.

TRAFFIC CIRCLE, CURRENT CURB

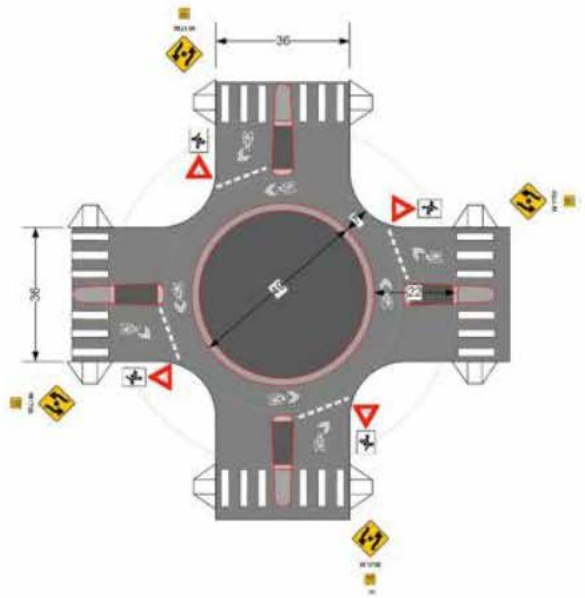
Current design standards have moved to a low curb, more similar to the truck apron of a modern roundabout.

Mini-roundabouts are a tool to reduce speeds at busier Local Service intersections. Mini-roundabouts used at minor intersections should use an automobile as the circular roadway design vehicle, so that speeds are reduced as much as possible. Reference Portland's 2013 Draft Traffic Manual, Section 3.3 – Traffic Calming, Roundabouts for detail design guidelines.

MINI-ROUNDABOUT, PORTLAND TEST SITE

Mini-roundabouts use all the design and operational features of a modern roundabout (deflection, low-speed operation, all-way yield), but do not have a central landscaped circular island. Instead the center island is all at truck-apron height. This permits mini-roundabouts to be used in constrained environments where truck and bus access is to be maintained.

BIKE MINI-ROUNDABOUT



A bike mini-roundabout would be designed so that only passenger vehicles and people biking could move around the central island on the roadway. All other vehicles would need to use some portion of the truck apron regardless of the desired travel path.

AUTO TRAFFIC VOLUME MANAGEMENT ALONG NEIGHBORHOOD GREENWAYS

PBOT has traditionally limited its use of access management due to concerns of diverting traffic to adjacent streets where it would be equally undesirable, as well as the impacts on convenient access. PBOT recommends minimal increase in auto traffic volumes on streets designated as neighborhood greenways where those automobile volumes are already below 1,000 average daily traffic (ADT). For streets currently above 1,000 ADT, the access management tools described below can bring traffic volumes to recommended levels. In certain cases, access management may not be the most desirable tool, and other roadway designs, education campaigns or enforcement actions could be implemented.

Access management devices are typically located at major cross streets and take the form of constructed barriers that limit access onto the neighborhood greenway route from the major cross-street by automobile traffic. Internal access management for automobiles should be considered when community amenities, such as parks or community centers, are located along a neighborhood greenway route near a major cross street or without other convenient access. Automobile access management devices can take several forms. They should permit access by people walking and biking, and accommodate the access needs of emergency response vehicles, if necessary. The following are examples of common access management devices, which can be combined to achieve greater restriction of access.

SOFT DIVERSION – PINCH POINTS

Pinch points introduce friction for automobile traffic. Instead of blocking one direction of access, two directions are constricted to a single lane, requiring opposing motorists to take turns passing through. The nature of this treatment makes it most appropriate for application along a neighborhood greenway, away from main road crossings.

CURB EXTENSION ALONE SEMI-DIVERTER

This is a curb extension that blocks vehicle entry to a street by closing off the parking lane and a portion of the entry lane on the entry street. Space is retained to permit bicycle entry as well as space for a fire truck to enter. The version depicted also incorporates a storm water swale in the curb extension. See the Draft Traffic Manual, Section 3.5, for design details.

CURB EXTENSION WITH ISLAND SEMI-DIVERTER

This curb extension blocks vehicle entry to a street by closing off the parking lane on the entry street. A fire-truck-mountable island is placed near the centerline with a 6-foot minimum space between the island and curb extension to permit bicycle entry. It is recommended that the island include vertical delineators to further discourage auto use. The version depicted also incorporates a storm water swale in the curb extension..

ISLAND SEMI-DIVERTER TYPE A

This island blocks vehicle entry to a street by closing off the parking lane and a portion of the entry lane on the entry street. Space is retained next to the centerline to permit bicycle entry, as well as space for a fire truck to enter. Space is retained next to the curb to permit drainage. The version depicted shows the common signing used to discourage motorist violations.

ISLAND SEMI-DIVERTER TYPE B

This is an island that blocks vehicle entry to a street by closing off the travel lane and a portion of the parking lane on the entry street. Space is retained next to the curb for drainage and to permit bicycle entry. The version depicted shows the common signing used to discourage motorist violations. Emergency responder access is via the opposing lane.

MEDIAN BARRIER, NON-MOUNTABLE

This island blocks vehicle entry to a street, eliminating left turns from the cross street – usually a major cross street – and uses a full-height (6-inch) curb for all sections of the island. The island also eliminates left turns from the side street, making the side street operate as "right in, right out" only. Gaps are retained for pedestrian and bike access. Left-turn emergency responder access is via the opposing lane. See the Draft Traffic Manual, Section 3.4, for design details.

MEDIAN BARRIER, MOUNTABLE

This is an island that blocks vehicle entry to a street, eliminating left turns from the cross street – usually a major cross street. The island also discourages left turns from the side street, making the side street operate as "right in, right out" only. Gaps are retained for pedestrian and bike access. Left-turn emergency responder access is via the opposing lane, or a lowered middle section (3- to 4-inch height curb with angle face). The lowered islands have less deterrence for motorists than a full-height curb.

MEDIAN BARRIER, SKINNY

While most medians will provide a refuge space for pedestrians and cyclists, on occasion there is not sufficient road width available. This location depicts enhancements with vertical delineation to deter violations. Left-turn emergency responder access is via the opposing lane.

DIAGONAL DIVERTER, IMPERMEABLE

A diagonal diverter breaks a standard four-leg intersection into two opposing left- or right-turn corners. The diagonal diverter shown here is accomplished with full curb and sidewalk connections, though small islands are also possible. Bicycle access is via widened ramps at the former corners (see next photo), while pedestrian pathways remain the same. Stop signs are frequently used at all approaches, since people biking may proceed after stopping and come out from behind vegetation. This feature requires an alternate emergency response route.

DIAGONAL DIVERTER BIKE ACCESS

Bike access at a diagonal diverter, combined with corner ramps.

DIAGONAL DIVERTER, PERMEABLE

With this low-cost diversion method, the placement of tall planters is used to prevent all automobile through movement at this right-offset intersection. The crosswalk is inside the planters, and the planters are spaced 4 to 5 feet apart. The planters are not secured to the roadway, and can be pushed aside by emergency vehicles if needed.

DIAGONAL DIVERTER, CUL-DE-SAC / DEAD END

Closure of a street at an intersection can be accomplished in a variety of ways, from temporary planters to small islands, or full curb and sidewalk connections. Frequently such closures include ramps with break-away posts to permit bicycle and fire truck access.

FULL DIVERTER, POCKET PARK

One of the most aesthetically pleasing, and most expensive, full diversion methods, pocket parks retain access for people walking and biking, with the addition of green space for the local community.

SHARED USE PATHS ON UNIMPROVED ROAD

Developing unimproved rights-of-way for non-motorized use is a good way to improve connectivity for cyclists and pedestrians without encouraging auto cut-through traffic.

CONTRA-FLOW BIKE LANE

Contra-flow bike lanes involve the conversion of a street (usually narrow) to one-way operation for auto traffic, with the placement of a bike only lane in the opposing direction. Parking removal is often needed, if not already in place. Reinforcement of the bike-only access may be necessary, using a small diversion island. Alternating contra-flow bike lanes along a corridor can effectively reduce auto traffic volumes at a low cost. On wider streets, changing the remaining parking to angle alignment can offset parking loss from the bike lane. Alternatively, the contra-flow bike lane can have a parking lane adjacent to it on wider streets, eliminating most parking loss.

ACCESS MANAGEMENT SIGNING EXAMPLES

ENHANCING CROSSING SAFETY AT BUSIER CROSS STREETS

While a neighborhood greenway may have the slowest speeds and fewest automobiles in the city, crossing busy arterial roadways presents a challenging, uncomfortable environment for people walking and bicycling. PBOT recommends a minimum crossing level-of-service guideline of 50 people walking and/or biking per hour, and a preferred goal of 100 per hour, when considering how to improve crossings at busier intersections on new neighborhood greenways. These guidelines are based on historical data showing that Portland's most popular bike boulevard routes are already achieving peak-hour demand levels in the 100+ cyclists per hour range.

Portland uses protocols identified in the National Cooperative Highway Research Program Report 562 (NCHRP 562), Improving Pedestrian Safety at Unsignalized Crossings (2006), to evaluate how to improve a crossing to achieve Portland's crossing service guidelines. As Portland has established service level targets, the data collection for current pedestrian and cyclist crossing use is eliminated from the standard protocols identified in NCHRP 562, making the analysis simpler. Standard crossing enhancements at busier intersections, in preferred ascending order, include:

1. **Signing and marking (minimum);**
2. **Pedestrian refuge islands;**
3. **Curb extensions;**
4. **The addition of rapid flashing beacons to any of items 1-3;**
5. **Combinations of items 2-4 in addition to item 1;**
6. **Pedestrian hybrid beacons; and**
7. **Full signalization with bike buttons or loops.**

NEIGHBORHOOD GREENWAY MARKED CROSSING

In every case, marked crossings are added on both legs of the busier cross street. At two-lane crossings, near-right signing is added as a minimum. At multi-lane crossings, islands are common features and additional signing is usually added on the median and at the far right crossing as well. Multi-lane crossings also include advance stop bars and signing; and five-lane crossings include rapid flash beacons with refuge islands.

CROSSING SIGNS

Portland's standard sign for a neighborhood greenway crossing.

PEDESTRIAN REFUGE ISLANDS

Refuge islands are raised concrete islands at crosswalks that break a crossing into two halves. This permits people crossing to concentrate on a single direction of traffic and string together two opposing gaps that do not coincide by pausing at the island. This is especially helpful for the youngest and oldest pedestrians. See the Draft Traffic Manual, Section 3.4, for design details.

CURB EXTENSIONS

Curb extensions shorten the crossing distance, reducing exposure to cross-traffic and permitting the use of shorter gaps in traffic. Curb extensions also bring people walking and biking closer to the street centerline, increasing visibility between motorists and those wishing to cross. People crossing still must find gaps in two directions of traffic that coincide, a more difficult task for the youngest and oldest pedestrians. See the Draft Traffic Manual, Section 3.5, for design details.

BUFFERED BIKE LANE AND BICYCLE TURN BOX

When bike routes that share the roadway with auto traffic have to cross busier roads and a jog is involved, this treatment helps guide people biking and keep bicycle and auto traffic separated. A street-level treatment without vertical delineation is easier to maintain with standard equipment. This application also requires people biking to look back over their shoulder to check for conflicts, an action older cyclists may have difficulty with.

RAISED CYCLE TRACKS

Extended lengths of curb extensions can be used to provide a raised separated space where a neighborhood greenway must jog from one side of a busy street to another. The space created can be shared with pedestrians, or delineated for separate use as shown here. This application shows the contra-flow lane next to opposing traffic to prevent cyclist path crossover.

RAPID FLASHING BEACONS

Rapid flashing beacons are activated by push button and provide positive guidance to motorists that a person walking or biking wishes to cross but, as a flashing yellow beacon, do not require motorists to stop. Such beacons usually include a verbal warning to pedestrians that autos may not stop, and can include illumination that activates when the button is pushed.

PEDESTRIAN HYBRID BEACONS (PHB)

PHBs rest in "off" position. Once a button is actuated, they begin flashing yellow, go to solid yellow, then solid red, and require motorists to stop as with a standard signal. Once the crossing signal phase is complete, the motorist signal heads begin flashing red, permitting people driving to proceed if the path is clear, before going dark.

BIKE SIGNALS

Bike signals are added where there are potential conflicts between people driving and people biking using the same intersection. Common conflicts involve left-turning motorists and through cyclists. Less common is the diagonal cycle path at a signalized intersection.

FULL SIGNALS

Though uncommon, full signals are sometimes recommended at the busiest of crossings, particularly where other safety needs exist. This location includes a school crossing upgrade with a two-way cycle track connection.

PEDESTRIAN COUNTDOWN SIGNAL HEADS

Pedestrian countdown signal heads provide information to road users regarding remaining time before the signal will go to amber. This assists people walking and biking to determine if there is sufficient time to cross a street based on that user's abilities.

CYCLIST PUSH BUTTONS

When electronic warnings or traffic controls are installed at neighborhood greenway crossings, either inductive loops or push buttons at the roadside are provided so people biking can actuate the controls.

NEIGHBORHOOD GREENWAY WAYFINDING

The primary marking for neighborhood greenways is the shared roadway marking, aka sharrow. Portland uses guide sharrows, with a tail added to the standard chevron markings, to inform cyclists of a direction change along a neighborhood greenway. Sharrow legends are placed 25 to 50 feet from major cross streets and spaced at up to 250-foot intervals after that initial marking. Opposite-direction sharrows are typically placed at the mid-point of the first direction such that alternating directional sharrows are encountered every 125 feet along a neighborhood greenway. In advance of a direction change, or decision point, along the neighborhood greenway, the last sharrow will use the directional chevron to inform cyclists of the change of direction, or a pending decision point, where the neighborhood greenway intersects another bikeway.

The bike-person symbol with arrow legend is used on bike lanes, and the bike-person alone at bike median crossings. Guide signing of neighborhood greenways will occur in advance of major cross-streets and intersections with other bikeways. Guide signing will identify major destinations, distance to the tenth of a mile, and approximate time to achieve that distance at 8 mph.

STANDARD SHARROW

The standard shared lane marking, aka sharrow, is a bike symbol with a double chevron on top. The chevron can be rotated to the right or left side to indicate changes of direction, if turn sharrow markings are not used. Multiple chevrons can indicate crossing choices. Shown here is the former "dinner plate" marking that the sharrow replaced, and a previous version of the sharrow.

TURN SHARROW

Shown here is the right turn sharrow marking.

DECISION POINT SHARROW

Multiple chevrons can indicate direction choices.

BIKE LANE SYMBOL (BIKE PERSON + ARROW)

BIKE-PERSON SYMBOL AT MEDIAN

The bike-person symbol is used at standard-width medians to identify the gap for the exclusive use of people biking.

ROUTE GUIDE SIGNING

A standard bikeway guide signing showing destination, distance and time.

LOCATION DESTINATION GUIDE SIGNS

Local destination guide signing is intended to inform people biking on neighborhood greenways of nearby destinations or amenities on adjacent, parallel auto collector streets.

LOCAL DESTINATION GUIDE SIGNS

Artwork and other creative designs can enhance the street and highlight its unique function as a place for people.

PBOT
PORTLAND BUREAU OF TRANSPORTATION