Monroe Street Neighborhood Greenway
Concept Design

Needs and Opportunities Memorandum

Prepared for

City of Milwaukie, Oregon

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1. Introduction and Context

The Monroe Street Neighborhood Greenway Concept Design Project is a planning effort to advance active transportation in the city of Milwaukie, creating a two-mile east-west corridor that prioritizes pedestrian and bicycle travel in a low-stress "shared space" environment that is safe and comfortable for all users. The project area extends along Monroe Street from 21st Avenue in downtown Milwaukie to Linwood Avenue at the city's eastern boundary. A separate planning effort will consider extending the neighborhood greenway east of Linwood Avenue into unincorporated Clackamas County.

Median island on Monroe Street near 25th Avenue

Distinctive bicycle parking where Monroe Street intersects with the Trolley Trail

Currently designated as a collector street in the City's Transportation System Plan (TSP; City of Milwaukie, 2013), Monroe Street is characterized by traffic speeds and volumes that are generally not compatible with the character of a successful neighborhood greenway. To achieve the vision for improved pedestrian and bicycle conditions on Monroe Street articulated in the TSP, this project will develop a new conceptual design for Monroe Street that includes a range of traffic-calming, placemaking, and stormwater management features. The Concept Plan will guide funding efforts and implementation of the neighborhood greenway.

This memorandum identifies the needs, opportunities, and constraints to be considered in developing the Monroe Street Neighborhood Greenway Concept Plan. Proposed improvements will be determined based on a review of these conditions and stakeholder feedback. In addition, this memorandum contains an overview of design tools that may be applied during the conceptual design phase.

1.1 Neighborhood Greenway Objectives and Characteristics

The concept of neighborhood greenways evolved from "bicycle boulevards" designed to provide low-stress, low-volume routes for cyclists. These "boulevards" are distinct from separated facilities

such as bicycle lanes, and often serve as alternatives to busier parallel routes. The primary objective of a neighborhood greenway is to create a *shared* space that is safe for pedestrians and bicyclists. The key to achieving this is reducing motor vehicle speeds and volumes. In addition, neighborhood greenways often incorporate stormwater management features to enhance traffic-calming measures.

The *Urban Bikeway Design Guide* produced by the National Association of City Transportation Officials (NACTO) recommends a maximum daily travel volume of 3,000 vehicles per day for neighborhood greenways, with an ideal volume of 1,500 vehicles per day (NACTO, 2013). In addition, streets developed as bicycle boulevards should have 85th percentile speeds[1] at 25 miles per hour or less, with 20 miles per hour (mph) being preferred NACTO, 2013). The "Bicycle Facility Improvement Toolbox" in Milwaukie's TSP describes potential design features for neighborhood greenways. Within the toolbox, common improvements are tiered based on their cost and degree of physical intensity. Improvement levels, listed in Table 1-1, range from minor street enhancements to larger-scale projects. Corridors targeted for higher-level applications also receive relevant lower-level treatments. (See **Appendix A** for the complete toolbox.)

Table 1-1. Neighborhood Greenway Application Levels

Level	Sample Features
1—Signage	Wayfinding and warning signs along and approaching the neighborhood greenway
2—Pavement Markings	Directional pavement markings, shared lane markings
3—Intersection Treatment	Signalization, curb extensions, refuge islands
4—Traffic Calming	Speed humps, mini traffic circles
5—Traffic Diversion	Choker entrances, traffic diverters

Neighborhood greenways improve safety and comfort for pedestrians and residents, as well as for bicyclists, and may include new sidewalks and safety crossing treatments at busy intersections. Landscaped elements often provide "green" stormwater treatment measures, including bioswales, infiltration basins, and rain gardens. These help to calm traffic and improve streetscape aesthetic. Finally, neighborhood greenways can feature decorative elements, such as sign toppers, painted intersections, and other features that can help to create a memorable place.

[1] 85th percentile speed is the speed at which 85 percent of traffic is observed traveling at or below. With findings and review approval from ODOT, posted speeds may be within 10 mph of the 85th percentile observed speed.

Low overall traffic volumes are a critical feature of neighborhood greenways, which are intended to prioritize safety for pedestrians and bicyclists over motor vehicle movement. Many neighborhood greenways also feature one or more traffic-calming mechanisms to keep speeds (and often volumes, by extension) low. The success of identifying features and minor crossing treatments depends on lower volumes to make active transportation comfortable and accessible for pedestrians and bicyclists of all ages and abilities.

Children crossing Monroe Street at the intersection of Oak Street and Railroad Avenue

Traffic-calming tools to reduce speed include **speed cushions**, **curb extensions**, **chicanes**, and **traffic circles**. The Milwaukie TSP includes a guide to commonly implemented neighborhood greenway traffic-calming features (City of Milwaukie, 2013). This section of the Milwaukie TSP is located in **Appendix E**. Using these tools to minimize the speed differential between bicycles and automobiles allows vulnerable road users to feel comfortable on roadways where space is shared with motorists.

In addition to the "incidental" diversion that often occurs when speed reduction measures are put in place, neighborhood greenways may utilize **semi-diverters** to help reduce volumes. These discourage "through" traffic by blocking access in one or both directions. Traffic-control devices such as **pedestrian- and bicycle-activated signals** and **flashing beacons** also can be incorporated along a neighborhood greenway to assign priority to pedestrians and bicyclists while encouraging through traffic to use alternate parallel routes.

After measures are implemented to reduce motor vehicle speed and volumes, additional actions can improve conditions for bicyclists and help establish the street as a place for slower-moving traffic, including the following:

- **Turning stop signs** along the route to face side streets in order to avoid a loss of momentum from constant stopping and starting; and
- **Painting intersections** and/or installing **thematic "sign toppers"** to help create a sense of purpose and place.

Finally, signage can be an important neighborhood greenway element. Typically routed along calm residential streets located a block or more off a major thoroughfare, neighborhood greenways connect users to shopping, schools, parks, and other community amenities. **Wayfinding features**

such as **signage** and **pavement markings** help direct bicycle riders toward these destinations, which may not be visible from the neighborhood greenway. Wayfinding signage includes time and distance indicators, helping users get to their destination efficiently and reassuring them that they are following the designated route.

1.2 Policy Context

In 2013, the City of Milwaukie adopted its 20 –year long-range Transportation System Plan (TSP), establishing a set of goals and policies that were aimed at building out a comprehensive and well-designed transportation system including pedestrian and bicycle network (City of Milwaukie, 2013). The table in **Appendix B** lists TSP goals and policies most directly supported by a Monroe Street Neighborhood Greenway.

Milwaukie's TSP identifies neighborhood greenways as an important means of improving pedestrian and bicycle safety throughout Milwaukie over the next 20 years. The TSP envisions a network of greenways across the city, connecting local neighborhoods with downtown and the Portland-Milwaukie Light Rail Metropolitan Area Express (MAX) Light Rail extension slated to open in 2015. In addition to Monroe Street, the TSP proposes neighborhood greenways on 29th Avenue, Harvey Street, 40th Avenue, Stanley Avenue and others. Monroe Street is among the highest priority of these projects. These investments in the transit and neighborhood greenway networks are integral strategies for Milwaukie to attain regionally-mandated targets of 45-55 percent non-single occupant vehicle (SOV) mode share by 2035 based on travel demand modelling, with the highest mode split targets in downtown where transit service is most concentrated. Developing neighborhood greenway corridors such as Monroe Street can help the city reach desired mode split goals (City of Milwaukie, 2013).

In addition to the neighborhood greenway network, the TSP identifies a set of proposed safety improvements, including installing bicycle lanes on several local collector streets and constructing sidewalks on Monroe Street east of 42nd Avenue. The TSP specifically calls for installing enhanced crossings to improve pedestrian and bicycle safety where Monroe Street intersects with Oregon Route (OR) 99E, OR 224, and Linwood Avenue, which are all high-traffic thoroughfares. In the near future, the City will develop a Corridor Refinement Plan in coordination with the Oregon Department of Transportation (ODOT) along OR 224 to identify mobility targets which will likely incorporate strategies to better manage congestion and reduce SOV trips. The Monroe Street Neighborhood Greenway, when implemented, has the potential to help meet these goals as the plan will encompass the Monroe Street approaches for several hundred feet in both directions.

The following are key improvements along Monroe Street recommended by the TSP:

- Bicycle corridor improvements between 21st Avenue and Linwood Avenue
- Pedestrian corridor improvements between 42nd Avenue and Linwood Avenue
- Multimodal intersection improvements at OR 224
- Multimodal intersection improvements at Stanley Avenue
- Multimodal intersection improvements at Linwood Avenue

Appendix C contains a list of other Milwaukie pedestrian and bicycle projects included in the TSP.

1.3 The Case for a Monroe Street Neighborhood Greenway

Several aspects of Monroe Street make it a strong neighborhood greenway candidate. The corridor provides a nearly continuous east-west route through Milwaukie, connecting downtown to several local neighborhoods, schools, and parks. The corridor provides access to the new MAX Orange Line light rail station at Main Street in downtown Milwaukie and a connection to the Trolley Trail located just west of OR 99E. Monroe Street traverses a tightly connected street grid for much of its length, allowing for relatively easy connections from side streets to homes or businesses along the route – and the street parallels several arterial and collector routes (Harrison Street/King Road and Railroad Avenue) onto which through vehicle traffic can potentially be redirected.

Although much of the Monroe Street corridor has higher traffic volumes and speeds today than are desirable for a neighborhood greenway, the community has already expressed support for lowering speeds and reducing the amount of traffic on the street.

Finally, this project complements Clackamas County's upcoming planning work on the section of Monroe Street east of Linwood Avenue. Extending the neighborhood greenway eastward from Linwood Avenue to OR 213 (82nd Avenue) would improve pedestrian and bicycle access to the MAX Green Line and Clackamas Town Center.

While other design applications (such as shared-use paths and cycle tracks) offer a completely separated experience and more protection for cyclists and walkers, these facility types may be more appropriate for areas where travel volumes are higher and slowing/diversion are difficult or infeasible. With that said, this type of solution may be necessary on Monroe Street in the vicinity of the Union Pacific Railroad (UPRR) Main Line crossing, where limited access points across the railroad lead to high volumes.

1.4 Active Transportation is a Key Strategy to Improve Public Health

Active transportation (walking, bicycling, and transit) offers transportation choices for the young, old poor, disabled and those that cannot drive. Furthermore, numerous studies have documented lower obesity rates in places with higher active transportation levels, as shown in Figure 1-1.

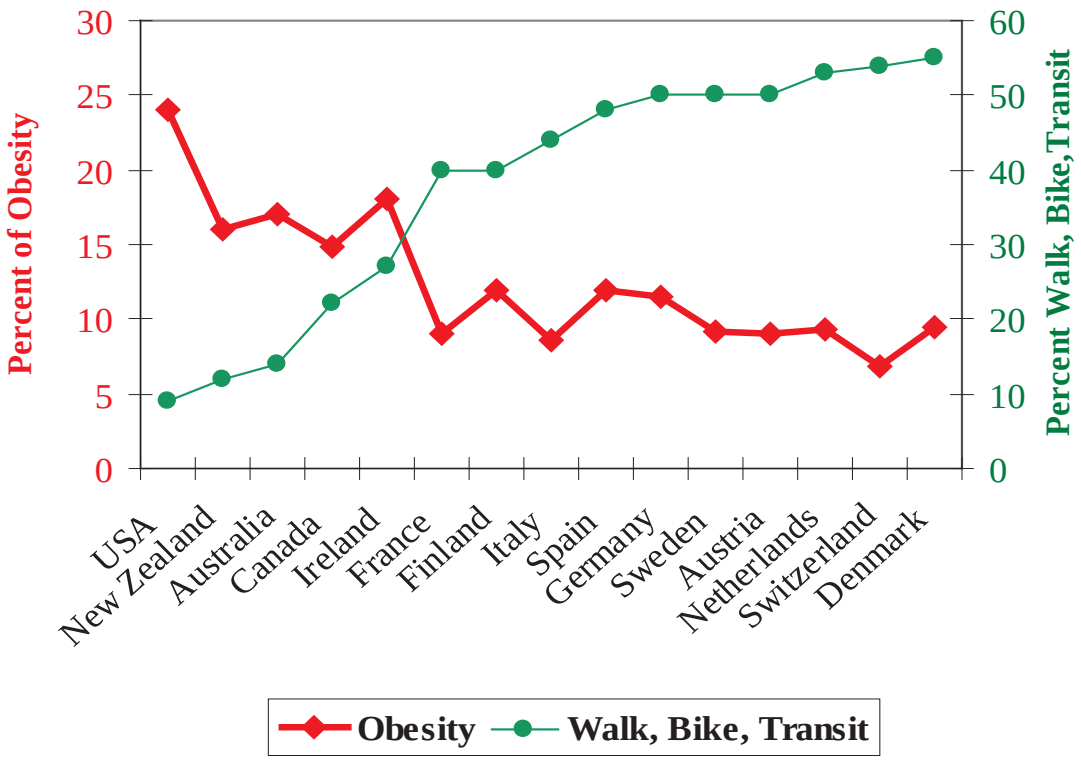


Figure 1-1. Obesity/Active Transportation Relationship Source (Source: Pucher and Dijkstra, 2003)

The *Metro 2014 Regional Active Transportation Plan* (adopted July 17, 2014) describes a strategy to increase walking and bicycling throughout the Portland Metro region. The plan identifies improved public health as a desired outcome for the region that is supported by active transportation, in addition to vibrant communities and economic prosperity.

The City of Milwaukie is one of 24 cities partnering with Metro to work towards developing the regional active transportation network to help achieve these outcomes, and the Monroe Street Neighborhood Greenway project is a key component of that network.

1.5 Stormwater Management

Stormwater management options considered during the development of neighborhood greenways provide an opportunity to create aesthetically appealing stormwater facilities. Instead of collecting stormwater runoff and directing it to the underground storm/sewer system, runoff can be intercepted at the source and directed to features such as swales, curb extensions, and planters.

Curb extensions provide a location for landscaped swales that collect stormwater runoff

Swales are typically oblong, gently sloping, landscaped depressions that capture and utilize stormwater runoff. Swales can be incorporated into curb extensions and landscaped with low shrubs or trees. Landscaped swales and planters incorporated into curb extensions help calm traffic by narrowing the street width, and serve as neighborhood “green” amenities. Street trees can also be planted to add appeal to the neighborhood.

Pervious pavement is also a form of stormwater management that can be used in pedestrian areas as well as driveway and parking areas. Permeable pavement reduces stormwater runoff and allows for infiltration. Grass pavers may be used for better site aesthetics.

2. Corridorwide Conditions

While the cross section and overall character of Monroe Street vary considerably along its two-mile length, there are several common themes and conditions along the entire corridor; these are discussed in this section.

2.1 Collector Roadway Classification

The first of these common themes and conditions along Monroe Street—and a potential policy barrier to implementing a neighborhood greenway—is that the street is classified as a collector for its entire length. According to the Milwaukie TSP, collectors have the following characteristics:

- Collector streets are *moderate volume*, *moderate speed* streets that provide access and circulation within and between residential neighborhoods, commercial areas, and industrial areas (emphasis added).
- They serve a citywide function of connectivity and are typically spaced about 0.5 miles apart.
- They distribute trips between the neighborhood street system and the arterial street system, linking a wide range of land uses.
- Access management is needed, especially near larger intersections.
- Since collectors often traverse residential neighborhoods, neighborhood traffic management measures are often needed to manage traffic impacts through these areas.

At approximately 1,000 to 8,000 vehicles per day (see Table 2-1 below), Monroe Street volumes are generally higher than is typical for neighborhood greenways. NACTO recommends a maximum daily travel volume of 3,000 vehicles per day for neighborhood greenways, with an ideal volume of 1,500 vehicles per day. By contrast, collector roadways typically experience 5,000 to 10,000 vehicles per day, a level of traffic volume that is high enough to warrant bicycle lanes to segregate motorists and bicyclists.[2] Greater volumes tend to create a higher-stress environment, discouraging less confident cyclists from using the facility.

As shown in Table 2-1, Monroe Street has a posted 25 mph speed limit along its entire length, which is considered acceptable for greenways. However, vehicle speeds were observed between 23 to 31 mph along the corridor, which is above the NACTO-recommended 85th percentile speed for greenways. In 2011, the Oregon Legislature passed a law allowing municipalities to lower the speed limits on local residential streets from 25 mph to 20 mph, provided average daily traffic was fewer than 2,000 vehicles per day and the 85th percentile vehicle speed was observed at below 30 mph.[3]

[2] Oregon's statewide Transportation Planning Rule and the Metro Regional Transportation Functional Plan generally require installing bicycle lanes along newly built or reconstructed major collector roadways.

[3] In accordance with the new law, the City of Portland lowered the speed limit on several neighborhood greenways (including SE Ankeny Street and NE Going Street) in an effort to create a lower-stress environment for bicyclists and pedestrians.

While Monroe Street could qualify for reduced speed limits based on its average observed speed, it currently experiences traffic volumes well above the maximum limit of 2,000 vehicles per day in most sections.

Table 2-1. Observed Weekday Speeds and Volumes by Section

	Observation Location	Total Volumes (vehicles per day)	85th Percentile Speed (miles per hour)
Section A: 21st Avenue to OR 224	25th Avenue	1,800 to 2,000	23 (westbound)
Section B: OR 224 to Oak Street	Penzance Street	1,000 to 1,500	N/A [a]
Section C: UPRR Main Line Crossing	Oak Street	7,500 to 8,000	N/A [a]
Section D: Railroad Avenue to 42nd Avenue	35th Avenue	5,000 to 5,500	31 (westbound)
	40th Avenue	3,500 to 4,000	30 (eastbound)
Section E: 42nd Avenue to Linwood Avenue	44th Avenue	2,500 to 3,000	25 (eastbound)
	58th Avenue	4,000 to 4,500	28 (eastbound)

[a] Speed data was not collected at this location.

Lowering speeds and volumes on Monroe Street may enable re-classification from a collector to a local street, a designation more consistent with neighborhood greenway facilities. Such changes, however, will impact Monroe Street's carrying capacity and throughput – and could impact the broader transportation system in Milwaukie. Potential impacts include the following:

- The Regional Transportation Functional Plan recommends a network of minor arterial streets or collectors at half-mile spacing (Oregon Metro, 2010). Lack of connectivity in the existing street network and the presence of the UPRR Main Line rail line would result in a 1.1 mile gap between collectors if Monroe Street was downgraded to a local facility.
- Milwaukie's TSP projects that motor vehicle trips in the city will increase 16 percent between 2010 and 2035 (City of Milwaukie, 2013). With this increase, several intersections near the Monroe Street project area are at risk of exceeding the City's acceptable mobility standards, including the following:
  - Linwood Avenue/Harmony Road/Railroad Avenue
  - King Road/Linwood Avenue intersection
  - Linwood Avenue/Monroe Street intersection

As the Monroe Street Neighborhood Greenway project proceeds, further analysis is needed to assess potential impacts on these intersections and nearby arterial and collector routes such as King Road/Harrison Street, Railroad Avenue, 37th Avenue, 42nd Avenue, and Linwood Avenue.

In addition, future street network projects along nearby arterials and collector roadways could be developed or prioritized in a subsequent TSP update in response to potential impacts of Monroe Street neighborhood greenway implementation.

Successfully implementing a neighborhood greenway on Monroe Street will require reducing both speed and volumes. As work on the concept plan proceeds, it will be important to thoroughly consider the tradeoffs between implementing safety improvements on Monroe Street and the impacts on the larger transportation system that could result from diverting and calming traffic along the neighborhood greenway.

2.2 Double Yellow Centerline

Monroe Street is characterized by a double yellow centerline for most of the sections under discussion in this memo, with the exception of the section between 21st Avenue and Oak Street. (That section was recently repaved and the City has not reinstalled the centerline pending the outcome of this planning process).

The double yellow line suggests a higher-speed, higher-volume environment

In general, federal and ODOT guidelines recommend a centerline where volumes exceed 3,000 vehicles per day (ODOT, 2011). Some sections of Monroe Street under consideration here come close to—or exceed—that volume. However, best practices for developing neighborhood greenways now suggest removing the roadway centerline. Removing the centerline has several benefits. It encourages cyclists to follow a track closer to the center of the street away from the curb or parked cars. (Riding near the center deters unsafe passing maneuvers and avoids hazards such as opening car doors, right turn conflicts, and road debris). It encourages motorists to give bicycles more space when overtaking bicycles by eliminating the need to stay within a double yellow line. Finally, removing the centerline signals to users that the street is a lower-speed, shared environment where bicycle travel is prioritized. The presence of a centerline can lead to aggressive tailgating by motorists, frustrated that their progress is impeded by a slower-moving road user.

2.3 Sharrows and Wayfinding Signs

Sharrows and wayfinding signs are present along the length of Monroe Street, although sharrows are placed only intermittently. Sharrows are pavement markings that help identify for all users the fact that bicyclists are expected to share the roadway and act as a reassurance symbol, informing riders that they are on the correct path. Wayfinding signs identify the street as a bicycle route, and often show approximate time and distance to nearby destinations (such as downtown Milwaukie, the Springwater Corridor trail, and local schools). Both sharrows and wayfinding signage are important neighborhood greenway elements, and the opportunity exists to apply them with greater frequency and consistency throughout the corridor.

Sharrows provide wayfinding and indicate that cyclists are expected roadway users

Section by section maps are presented in Figures 2-1 and 2-2.

Trolley Trail Connection
1 Monroe Street connects to the Trolley Trail along the Willamette River waterfront.

PMLR MAX/OPR Rail Crossing
3 New splitter islands have been installed as part of the PMLR MAX project which create a pinch point at the rail crossing.

Narrow Cross-Section
5 Monroe Street in this section is 27 feet curb-to-curb with 4-5 foot curb-tight sidewalks that limit opportunities for improvement.

YMCA Center
7 The Monroe Street YMCA Child Development Center is located just west of OR 224 and is a popular family destination.

Sequential Route Deviations
9 From Campbell Street to 37th Avenue, the greenway corridor deviates three times. Currently, wayfinding in this area is inadequate.

Union Pacific Railroad Crossing
11 The UPRR tracks are a major connectivity barrier. Improvements would require working with UPRR.

Public Safety Building
13 The Public Safety Building is a civic destination located in short proximity to Monroe Street.

High Traffic Volumes and Speeds
15 The section between Oak Street and 37th Avenue (including UPRR crossing) experiences high speeds and volumes relative to the corridor.

Potential for Separated Bikeway
17 With high volumes and available space, the section of Monroe Street between Oak Street and 37th Avenue is well-suited for a separate path or cycle track.

Connection to Future Neighborhood Greenway
19 The City has proposed a new north-south greenway along 40th Avenue in its Bicycle Master Plan.

A | A B | B C | C D | D E

A | A B | B C | C D | D E

Downtown Access
2 Monroe Street connects to shops, restaurants, transit, and other key civic destinations in downtown Milwaukie.

Elevation Gain Eastbound
4 Eastbound direction has short, steep sections up to 5.5% grade which can create a disparity in speeds between motorists and bicycle

Lower Traffic Volumes and Speeds
6 Monroe Street between downtown and Campbell Street has fairly light traffic volumes, and currently has no double-yellow centerline.

Difficult Signalized Crossing at OR 224
8 OR 224 is a major state highway and is a major barrier to east-west travel. OR 224 is 100 feet wide with no median crossing refuge.

Access to Shopping
10 Monroe Street provides access to goods and services at the Milwaukie Marketplace and King Road shopping centers.

Potential for Roundabout
12 A roundabout at the Oak Street/Railroad Avenue intersection could help calm traffic and improve flow, but likely requires property acquisition.

Connection to Future Multi-Use Trail
14 A multi-use trail is envisioned along the UPRR tracks to connect Oak Street with Railroad Avenue at 37th Avenue.

Future Development Opportunity
16 A vacant parcel just north of the railroad tracks is envisioned as a future mixed-use development site.

Uphill Section and Substandard Bike Lane
18 The section between 37th and 42nd Avenues has a 6.6% grade going eastbound. Currently there is a substandard 4-foot bike lane eastbound.

Potential for Diverters at 37th and 42nd Aves
20 The intersections at 37th and 42nd Avenues may be good candidates for partial traffic diversion in order to reduce volumes on Monroe Street.

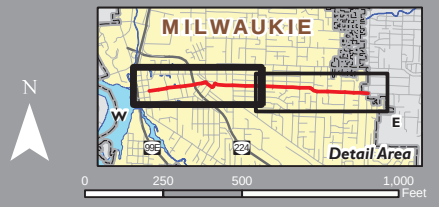
Figure 2-1

Monroe Street Neighborhood Greenway

Existing Conditions: Opportunities and Constraints (West Section)

Legend

- Corridor Opportunities
- Corridor Constraints
- A | B Section Boundaries
- Monroe Street Study Area
- Future MAX Light Rail
- Multi-Use Paths
- Railroads
- Railroad Crossings
- Existing Traffic Signals
- Existing Stop Signs (for Monroe Street traffic)
- Speed Zones



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No Sidewalks

1 There are no sidewalks or curbs between 42nd and Linwood Avenues, forcing pedestrians to walk along the gravel shoulder.

Lack of Stop Sign Compliance

3 Residents observe frequent violations of the four-way stop sign at Home Avenue.

Visibility Issues

5 The road bends near 52nd Avenue, which can make it difficult for drivers to see pedestrians, especially if exceeding the speed limit.

Higher Speeds and Volumes

7 This section of Monroe Street is rural in nature and lacks visual cues to slow motorists down. It also experiences higher speeds and volumes than desired.

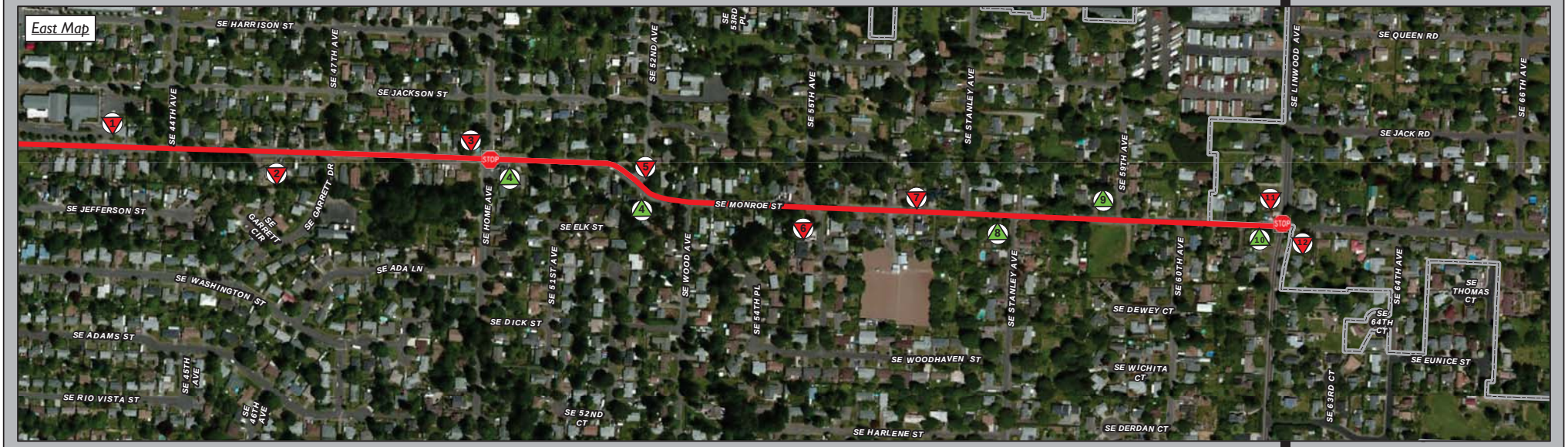
Access to Wichita Park

9 Wichita Park is located along the corridor at 59th Avenue.

Difficult Connection Across Linwood Ave

11 The two-way stop at Linwood Avenue is difficult to navigate for all modes, including for pedestrians crossing busy Linwood Avenue.

E



E

Encroachments onto Public Right of Way

2 While the ROW is 40 feet wide in this section, only about 22 feet is paved. The rest is used as makeshift on-street parking or as extensions of front yards.

Placemaking Opportunity

4 The Home and 52nd Avenue intersections provide opportunities for an "Intersection Repair" treatment, similar to examples in Portland.

Drainage Issues

6 The rural section of Monroe Street has been susceptible to flooding after heavy rains. One particular problem sport is at 55th Avenue.

Connection to Future Neighborhood Greenway

8 The City has proposed a new north-south greenway along Stanley Avenue in its Bicycle Master Plan.

Partial Diverter at Linwood Avenue

10 The intersection at Linwood Avenue may be a good candidate for partial traffic diversion in order to reduce volumes on Monroe Street.

Coordination with County Needed

12 Monroe Street is outside City limits east of Linwood Avenue, requiring Milwaukie to coordinate with Clackamas County on potential improvements.

Figure 2-2

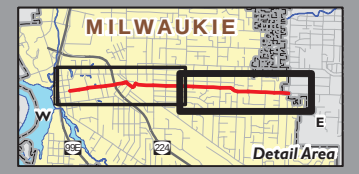
Monroe Street Neighborhood Greenway

Existing Conditions: Opportunities and Constraints (East Section)

Legend

- 6 Corridor Opportunities
- 9 Corridor Constraints
- A | B Section Boundaries
- Monroe Street Study Area
- Future MAX Light Rail
- Multi-Use Paths
- Railroads
- Railroad Crossings
- Existing Traffic Signals
- STOP Existing Stop Signs *(for Monroe Street traffic)*
- 20 Speed Zones

N



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3. Section-by-Section Analysis: Needs, Constraints, Opportunities, and Tools

For analysis purposes, the project (and this section of this memo) has been separated into the following five sections based on the existing conditions within the Monroe Street corridor (see Figures 2-1 and 2-2):

- Section A: 21st Avenue to just west of OR 224
- Section B: OR 224 to Campbell Street
- Section C: Campbell Street to Railroad Avenue through UPRR Main Line Crossing
- Section D: Railroad Avenue to 42nd Avenue
- Section E: 42nd Avenue to Linwood Avenue

Appendix D contains a summary of characteristics (including speed and volumes) for each section of the corridor. The remainder of this memorandum describes each of these individual sections and provides a more detailed discussion of the needs, opportunities, and constraints therein. In addition, the sections below describe potential design tools that could address the identified needs and opportunities. Existing conditions vary throughout the project corridor—and the applicable design tools for each section vary as a result.

The Milwaukie TSP includes a "Neighborhood Traffic Management Tool Box" that describes possible solutions for regulating motor vehicle traffic on local streets (see **Appendix E**), some of which are discussed below. Effective use of these traffic calming tools on Monroe Street will help address community needs and concerns related to speeding, cut-through traffic, and pedestrian and bicycle safety. The Monroe Street Concept Plan will integrate many of the "tool box" solutions as part of the plan. A section-by-section discussion of tool applications follows in Sections 3.1 through 3.5. **Appendix F** provides construction cost estimates for common greenway tools.

In general, **wayfinding tools** (in the form of **sharrows** and **signage)** should be utilized throughout the corridor. The *Milwaukie Bicycle Wayfinding Signage Plan* (City of Milwaukie, 2012) states that signs should be placed where the route changes direction, at intersections along developed bikeways, at key decision points, and as guidance through difficult turns. Signage should be visible from approximately 100 feet away.

Speed cushions are a low-cost option that can be applied along the entire corridor to help reduce speeds and encourage cut-through traffic to use parallel routes (such as Harrison Street/King Road and Railroad Avenue) for non-local trips.

Semi-diverters partially restrict access, further reducing speeds and volumes.[4] **Roundabouts** slow traffic and provide visibility and predictability for multiple users. **Curb extensions** and **bulb-outs** provide additional safety at difficult pedestrian crossings.

3.1 Section A (21st Avenue to OR 224)

Recent sidewalk and roadway improvements around the future MAX Light Rail crossing at 23rd Avenue

Monroe Street begins at OR 99E/McLoughlin Boulevard and continues east for two blocks through a traditional, mixed-use downtown in a low-speed, shared-use environment. The official project study area begins at the east edge of downtown at the four-way stop intersection with 21st Avenue, where the corridor becomes more residential in character. The newly constructed MAX Orange Line crosses Monroe Street at 23rd Avenue, adjacent to the UPRR Tillamook Branch crossing. From this point, there is a moderate 2.4 percent grade increase from west to east. Average daily traffic is just over 2,000 vehicles per day at 25th Avenue, with 85th percentile westbound speeds at 23 mph. This section includes bicycle-specific wayfinding signage, but otherwise features no markings or specialized infrastructure.

3.1.1 Needs

3.1.1.1 Lower Motor Vehicle Speeds (Closer to that of Cyclists)

While this section of the route is characterized by relatively low speeds and volumes, the gradual incline increases the speed differential eastbound between motorists and bicycle riders. In addition, Monroe Street narrows to 27 feet between the curbs from 21st to 29th Avenue. During a project tour in September 2014, members of the Project Advisory Committee[5] (PAC) noted concern about motorists wishing to overtake slower-moving cyclists heading uphill through this section.

[4] To ensure emergency vehicle access, the Clackamas Fire District has given approval in concept to speed cushions with gaps set to accommodate the wheel base of emergency vehicles. Further coordination will be necessary prior to the design of facilities such as diverter islands and roundabouts to ensure that new facilities allow adequate access for emergency vehicles.

[5] Chartered by the City of Milwaukie to guide the development of the Concept Plan, the PAC comprises neighborhood representatives, local bicycle advocates, community volunteers, and agency-based technical advisors.

3.1.1.2 Better Pedestrian Infrastructure

This section of the corridor is characterized by narrow, curb-tight sidewalks that lack American with Disabilities Act (ADA) compliant ramps in many locations. While sidewalks are present on both sides of the street, they are just 4 feet wide between 28th Avenue and OR 224.

Overgrown vegetation in the area near Spring Creek encroaches onto the sidewalk, further limiting the amount of usable space for pedestrians. The condition of the sidewalks is also generally poor.

Example of deteriorating sidewalk condition on Monroe Street near 25th Avenue

3.1.2 Constraints

3.1.2.1 Slight Grade Eastbound (Slowing Cyclists)

Between 21st Avenue and OR 224, there is a 2.4 percent grade, coupled with short, steeper sections, that slows cyclists considerably as they climb the hill, creating a disparity in speeds between motorists and bicycle riders. For a slower-moving cyclist, being overtaken in a shared space by faster vehicles can be uncomfortable—and in some instances unsafe. Design solutions in this area should seek to lower traffic speed and volumes to address this issue.

Overgrown vegetation impedes pedestrian passage on already narrow sidewalks near 28th Avenue

3.1.2.2 Limited Width

The main constraint in this section is the lack of available space between curbs to allocate between different modes, which reduces the flexibility of potential solutions. West of 29th Avenue, there is 40 feet of available right-of-way and 27 feet of available curb-to-curb width, with 10-foot-wide vehicle travel lanes and 7 to 8 feet occupied by a parking lane on the south side. In addition, there are substandard 5-foot-wide curb-tight sidewalks that could be widened to provide more comfortable facilities. Based on the City's Public Works Design Standards Manual, curb-tight

sidewalks should be 6 feet wide on local streets and 8 feet wide on collectors (City of Milwaukie, 2014). In addition to a short median island east of 25th Avenue, splitter islands were installed as part of the MAX Orange Line project, narrowing the roadway at the track crossing.

3.1.2.3 Bridge across Spring Creek

The bridge across Spring Creek (just west of 28th Avenue) is a potential barrier to future improvements given the likely expense of expanding or rehabilitating the bridge to widen the roadway or sidewalks.

3.1.3 Opportunities

3.1.3.1 Speed Control

Vehicle speeds and volumes in this section are already within the preferred range for a typical neighborhood greenway. Several low-cost improvements would help keep speeds low and ensure a shared facility that is comfortable for all users.

3.1.3.2 Improve Sidewalks

As previously mentioned, the sidewalks narrow as Monroe Street crosses Spring Creek. There also is a chain-link fence immediately adjacent to the sidewalk. Vegetation is encroaching onto the sidewalk with sections of sidewalk east of 25th Avenue in poor condition. Sidewalk rehabilitation and replacement could occur gradually as funding is available. East of 29th Avenue, the cross-section widens to 50 feet in the public right-of-way and 40 feet between curbs. On-street parking lanes exist on both sides, but the sidewalks narrow to a substandard 4 feet in this area (although they are set back from the roadway by a landscape strip). The City requires setback sidewalks to be 5 feet wide on local streets and 6 feet wide on collectors (City of Milwaukie, 2014). The wider cross-section offers an opportunity to expand the sidewalks toward the street with minimal impact on on-street parking. This would also narrow the street and, in turn, help calm traffic.

3.1.3.3 Do Not Replace Centerline

The City of Milwaukie recently (summer 2014) repaved the section of Monroe Street between 21st Avenue and OR 224 but did not reapply the centerline, in anticipation of the findings of the Monroe Street neighborhood greenway planning process with regard to future line striping. It was noted during the September 2014, PAC meeting that motor vehicle and bicycle conflicts appear to be less frequent since the centerline was removed.

3.1.4 Potential Tools

3.1.4.1 Wayfinding

In addition to wayfinding signage, pavement markings (sharrows) along the entire stretch are the first recommended treatment for Section A.

3.1.4.2 Widen Sidewalks and Reduce Parking

Existing infrastructure including walls, fences and vegetation may preclude widening sidewalks away from the street however the sidewalks could be widened toward the street by reducing or

eliminating the existing on street parking. This would narrow the street creating a tighter space typically associated with neighborhood greenways.

3.1.4.3 Narrow Roadway Width and Incorporate Stormwater Treatment

On-street parking is currently permitted on either one or both sides of Monroe Street in this section, which makes the roadway feel spacious (when parking lanes are unoccupied) and can lead to higher vehicle speeds. Installing curb extensions at intersections would narrow the roadway and provide a visual cue for motorists to slow down while also reducing pedestrian crossing distance. Bioswales incorporated into the curb extensions could provide stormwater treatment opportunities and add "green" elements, as shown in the photo at right.

Curb extension with landscaping

3.1.4.4 ADA Improvements

The curb ramps at each intersection should be examined with regard to ADA compliance and pedestrian visibility. Curb extensions could be implemented at the 29th Avenue intersection, providing the necessary space for ADA-compliant ramps and yellow detectable warning strips. Per ADA guidelines, the detectable warning strips must visually contrast the surrounding pavement area; currently, the strips at 29th Avenue lack this contrast.

3.1.4.5 Semi-Diverter at 25th Avenue

A PAC member suggested a diverter in the vicinity of 25th Avenue. A diverter at this location would require traffic from nearby residential properties, primarily apartments, to exit the property and head west on Monroe Street. This would reduce eastbound volumes where there are concerns with the uphill grade. If diversion at this location is considered, it should be as a later phase item so the effects of diversion at OR 224 can be examined. Diversion at 25th Avenue could have impacts on 25th Avenue.

3.2 Section B (OR 224 to Campbell Street)

This section includes the Monroe Street intersection with the Milwaukie Expressway (OR 224) and continues east to a T-intersection with Campbell Street. The existing land use character is a mix of professional offices, commercial and residential. OR 224 at Monroe Street is a wide, high-speed, high-traffic limited access facility that can be daunting for pedestrians and cyclists to cross at the existing signalized intersection. The large intersection with wide curb radii can make bicyclists feel exposed to motor vehicles, and long pedestrian crossing distances can lead to conflicts with turning

motorists. In addition, the intersection currently lacks bicycle-specific signal detection, which makes it difficult to trigger a green light.

As a result, the City has made it a priority to consider major improvements to help bicycle riders and pedestrians cross OR 224 more safely and comfortably. Tools such as bicycle boxes, bicycle signals, and leading pedestrian/bicycle signal intervals could help improve conditions. East of the intersection, lower travel volumes as compared with other sections in the corridor (see **Appendix D** for traffic counts) make this section fairly comfortable for bicyclists, although the distance between curbs (40 feet) and underutilized on-street parking lanes can encourage speeding in this section. Pedestrian conditions are a concern, as narrow, intermittent sidewalks are abutted by private property fences. The existing land use character is a mix of professional office, multifamily residential, and suburban commercial.

3.2.1 Needs

3.2.1.1 Safe Major Crossing at OR 224

Crossing at OR 224 requires waiting at a long light cycle with no median refuge island available

Monroe Street crosses OR 224 at the only signalized intersection along the entire study corridor. No median island is available to provide refuge for pedestrians needing extra time to cross the highway. Due to wide crossing distances, high traffic volumes, and turning movements, the crossing is a significant barrier to walking and bicycling. As a result, families using the nearby YMCA facility may decide not to walk or bike there due to current crossing conditions. A balance between vehicle mobility and the mobility and access needs of other roadway users will need to be achieved. Because OR 224 is a state highway, ODOT will actively review and provide guidance on potential modifications to the intersection signal or geometric design proposed as part of this project.

3.2.1.2 Wayfinding

Section B currently features bicycle-specific signage but no pavement markings. Sharrows and perhaps additional signage would help users navigate the jog from Monroe Street onto Campbell Street.

3.2.2 Constraints

3.2.2.1 Long Wait Times at Signal/Wide Crossing

Missing sidewalks on the east side of Campbell Street next to the UPRR Main Line corridor

At 100 feet wide, OR 224 forms one of the most significant connectivity barriers for pedestrian and bicycle travel on Monroe Street. Users crossing OR 224 face wait times of up to 2 minutes at signals depending on the time of day. There are existing pedestrian-activated timers but no pavement loops or markings specifically designed for bicycle riders to request a signal change. Currently, traffic on Monroe Street receives a green signal for a minimum of 6 seconds, but the signal can be up to 38 seconds, depending on whether there are pedestrians waiting to cross. If the pedestrian signal is actuated, then the walk signal for pedestrians crossing OR 224 remains illuminated for 10 seconds, followed by a flashing "do not walk" signal that remains illuminated for approximately 28 seconds.

3.2.2.2 Traffic Misdirected onto Monroe Street

Lower travel volumes (as compared with other sections of the corridor) and moderate speeds make this section fairly comfortable for bicyclists, but much less so for pedestrians. It was suggested during the September 2014 PAC meeting that truck drivers following global positioning system (GPS) directions tend to turn left onto Monroe Street from eastbound OR 224. Similarly, PAC members suggested that patrons exiting the bowling alley on Harrison Street inadvertently end up heading south on Campbell Street towards Monroe Street. These factors result in additional (and unnecessary) traffic on Monroe Street, including large trucks that present dangerous potential conflicts with pedestrians and bicyclists.

3.2.3 Opportunities

3.2.3.1 Improved Access and Safety

Sidewalk improvements, including ADA-compliant ramps along Campbell Street, would provide increased access to the YMCA for families with strollers or children on bikes crossing OR 224.

3.2.3.2 Provide Connectivity

Implementing enhanced crossing safety features such as bicycle-specific signals, median refuge islands, and bicycle boxes would improve connectivity, linking the neighborhoods along Monroe Street as well as businesses on each side of the highway. Depending on potential impacts to traffic, longer green times could be provided to Monroe Street traffic to account for slower acceleration speeds, or a leading pedestrian/bicycle interval could be added to provide these users a 5-second head start before motorists receive their green signal. Restricting access on Monroe Street from OR 224 or across OR 224 could also be considered to discourage excessive traffic volumes.

3.2.4 Potential Tools

3.2.4.1 Traffic Flow Restriction and Signage

To address safety and connectivity issues, the crossing at OR 224 could be modified by some combination of turn restrictions and signage. One option is to restrict movements at OR 224 to right-in/right-out only. This would help eliminate cut-through truck traffic on Monroe Street and could incorporate a median refuge area for pedestrians crossing OR 224, improving comfort and safety for vulnerable road users. A right-in/right-out only restriction would also eliminate the need for the left-turn lanes on OR 224 at the approaches to Monroe Street and could reduce the crossing distance for pedestrians and bicyclists. Diverted traffic could potentially be accommodated by using the nearby Oak Street or Harrison Street signals, both of which permit left turns from OR 224. In addition, both Harrison Street and Oak Street provide a direct crossing of the UPRR Main Line tracks to the east.

3.2.4.2 Median Refuge and Bicycle Detection

Eliminating the left-turn lanes would provide space to install a raised median with refuge islands for pedestrians and cyclists in the event that they cannot cross the entire intersection in one signal cycle. Bicycle detection loops or poles placed at locations for cyclists to activate the signal are also recommended. An example of this type of intersection treatment is shown in the photo to the right, from the NACTO *Urban Bikeway Design Guide* (2013).

Example of intersection with median refuge islands

3.2.4.3 Bicycle Boxes

Bicycle boxes are dedicated areas at signalized intersections that allow bicyclists to pull in front of waiting traffic at red lights. Bicycle boxes help to reduce conflicts between right-turning motorists and straight-through bicycle riders (known as "right hook" collisions) and increase cyclist visibility at busy intersections. They also provide the bicyclist a head start when the light turns green. Bicycle boxes are typically 14-foot-wide rectangles located in front of the stop bar for motorists but behind the pedestrian crosswalk and are painted green to catch the attention of motorists. Motorists cannot turn right on red at intersections when a bicycle box is present.

Bicycle boxes allow bicyclists to queue in front of motorists at signals to increase visibility and minimize conflicts (source: NACTO, undated)

3.2.4.4 Bicycle Signals and Leading Pedestrian/Bicycle Intervals

Bicycle signals are traffic signals specific for bicycle riders, with signal heads that are smaller and distinctive from traditional signals. These signals are used when bicycle and automobile movements need to be completely separated for the purposes of safety. It is currently against Federal Highway Administration (FHWA) policy to have potential conflicts between right-turning motorists and straight-through bicyclists; therefore, right turns are prohibited when a bicycle signal is green (FHWA, 2013).

Bicycle signals help separate bicycle movements from vehicle movements at major intersections and reduce conflict (source: ODOT, 2009)

Similarly, leading pedestrian or bicycle signal intervals provide pedestrians and bicyclists with a 5-second head start to enter the intersection before motorists receive a green signal. This helps them cross the intersection more easily, while also increasing their visibility to motorists. Right turns on red are prohibited with a leading interval. While FHWA currently prohibits using bicycle signal faces in conjunction with a leading interval (unless a protected right turn phase is used), bicyclists can legally be directed to obey the pedestrian walk signal.

3.3 Section C (Campbell Street through UPRR Main Line Crossing)

This section is the most challenging from a wayfinding perspective. It begins at the intersection of Monroe Street with Campbell Street which begins a series of three jogs and the UPRR Main Line crossing to navigate through this section. The existing land use character in this section is a mix of professional office, suburban commercial, multifamily residential, and vacant land.

UPRR crossing at Oak Street with splitter islands

Although the terrain is flat, this section presents some of the most significant challenges for safe pedestrian and bicycle travel in the corridor, with relatively high volumes and an active railroad crossing adjacent to a busy commercial intersection (see **Appendix D** for traffic counts and other corridor characteristics).

3.3.1 Needs

3.3.1.1 Better Pedestrian Access

Campbell Street abuts the UPRR Main Line tracks on its north side; there are no sidewalks on the north side of the street. The southwest corner of Monroe Street at the Campbell Street intersection has no curb ramp, and the southeast corner is not ADA compliant. The existing narrow curb-tight sidewalk along Campbell Street is substandard and lacks curb ramps at the intersection with Myrtle Street.

Narrow sidewalk without curb ramps at Campbell Street and Myrtle Street

3.3.1.2 Better Pedestrian Mobility

A clearly identified and continuous route for pedestrians in the vicinity of the UPRR Main Line crossing is needed. Because the north side of Campbell Street has no sidewalk, pedestrians heading southwest along the west side of Oak Street must either cross Campbell Street to the south sidewalk, or continue along the edge of pavement where there is no sidewalk. An improved crossing of Oak Street east of the tracks is also needed, as traffic heading northeast on Oak Street has the prevailing right-of-way at the T-intersection, and there is currently no marked crosswalk.

3.3.1.3 Wayfinding

Section C currently features no bicycle-specific infrastructure or pavement markings, although there is directional signage in this area. Wayfinding improvements are critical, as the corridor makes a jog to the left onto Oak Street and then a jog to the right to get back onto Monroe Street heading west to east.

Looking west, riders must cross the tracks on Oak Street and then make an immediate right north onto Campbell Street

3.3.1.4 Safe, Clearly Defined Route through the Railroad Crossing

The route east through the railroad crossing must navigate a series of turns through a high-traffic area across the tracks. Eastbound travelers must turn right from Monroe Street to Campbell Street, left onto Oak Street, and then finally right again to continue along Monroe Street. There are wayfinding signs but no sharrows in place to guide users along the route, nor is there any type of pedestrian or bicycle activated signalized crossing (or flashing lights) for the busy crossing at Oak Street.

Two bicycle riders take the sidewalk across the UPRR Main Line crossing at Oak Street

3.3.1.5 Safe, Clearly Defined Route at T-Intersection east of the UPRR Main Line Crossing

Immediately east of the UPRR Main Line crossing, there is a complex, three-legged intersection with Railroad Avenue and Monroe Street. The current operational configuration of the intersection of Oak Street/Railroad Avenue/Monroe Street precludes a safe and functional maneuver for westbound pedestrians and cyclists.

3.3.2 Constraints

3.3.2.1 Limited Options for Crossing the Tracks

The UPRR Main Line is a major barrier for pedestrians and bicyclists on Monroe Street. Because the number of railroad crossings in this area is limited, the volume of traffic traveling along this section of the proposed neighborhood greenway are the highest in the corridor, at 7,500-8,000 vehicles per day. The rail crossing creates a pinch point as

Looking east on Oak Street toward the intersection with Railroad Avenue and Monroe Street

the travel lanes on Oak Street are relatively narrow (12 feet) and separated by a splitter island,[6] creating a safety hazard for cyclists. In addition, pedestrian crossing aids such as additional signage, rapid flash beacons, and median refuge islands may also be considered at this location. UPRR and ODOT Rail Division will actively review and provide guidance on proposed improvements to this crossing as part of this effort.

3.3.2.2 Traffic Control on Oak Street

Traffic volumes are relatively high on Oak Street, due to the direct connections it provides to neighborhoods east of the railroad tracks and Milwaukie Marketplace and Oak Street Square, major shopping centers located at OR 224. Vehicles traveling east on Oak Street have the prevailing right-of-way with no stop control at the Railroad Avenue/Monroe Street/Oak Street tee-intersection. Proximity to the railroad crossing and the potential for queue spillback blocking business access along Oak Street may preclude installing a stop sign or signal at this location. The average daily count of trains passing through the Oak Street Crossing is 24. Any proposed changes to traffic control on Oak Street will required coordination with UPRR and ODOT Rail Division.

3.3.2.3 Narrow Sidewalks

There are 5- to 6-foot sidewalks on either side of Oak Street through the crossing. The west sidewalk is concrete and buffered from the pavement by a narrow landscape strip while the east sidewalk is a partially buffered 5-foot-wide asphalt strip. The east sidewalk in particular is in need of upgrades and could be widened into a multiuse path and/or converted to concrete surface. Asphalt sidewalks are more likely to buckle than concrete, resulting in uneven walking surfaces (City of Milwaukie, 2014).

3.3.3 Opportunities

3.3.3.1 Improve Connectivity and Enhance Development Opportunities near the Railroad Crossing

Safer access for pedestrians and cyclists through the UPRR Main Line crossing will offer multiple benefits. In addition to protecting vulnerable users, crossing improvements can calm traffic and "humanize" the space. Both would support redevelopment efforts for vacant parcels in the immediate vicinity of the crossing. Green stormwater management features could further enhance redevelopment potential in the area.

3.3.4 Potential Tools

3.3.4.1 Wayfinding

There are several options to create a clearly defined and safe route to approach the UPRR Main Line crossing. Wayfinding signage and pavement marking are important because neighborhood greenway users must navigate from Monroe Street to Campbell Street and then to Oak Street to cross the railroad tracks. The example to the right (from the NACTO *Urban*

Wayfinding sharrow

[6] The splitter islands and wayside horns are were installed recently as part of a set of Railroad Quiet Zone improvements.

Bikeway Design Guide [2013]) shows how pavement markings can be used to provide wayfinding. Signage directing vehicles out of the bowling alley parking lot to either Harrison Street or Oak Street is also recommended to reduce unnecessary vehicle traffic on this segment of Monroe Street.

3.3.4.2 Build Out Sidewalks and Improve ADA Accessibility on Campbell Street

The existing pavement on Campbell Street is 37 feet wide with one travel lane in each direction and on-street parking, allowing space to widen the sidewalk on the south side with ADA-compliant curb ramps constructed at each return. Because walls and fences abut the existing sidewalk, widening the sidewalk to the street side would be most feasible and cost-effective. This would improve pedestrian safety and narrow the roadway, eliminating unused space that currently encourages higher speeds. A sidewalk should also be added to the north side of Campbell Street between Oak and Monroe Streets.

3.3.4.3 Shared-Use Paths

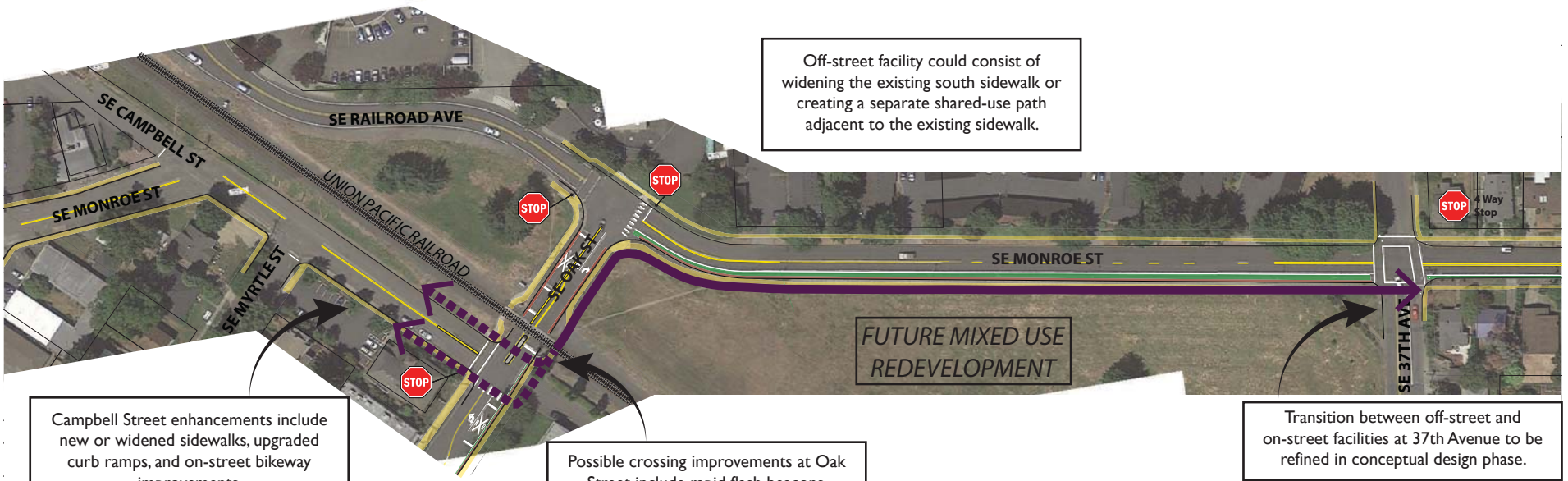
Shared use paths offer another means of making the UPRR Main Line crossing safer and more manageable. At the crossing, one or both of the Oak Street sidewalks could be converted to shared-use paths; a shared-use path on the east side of Oak could provide particularly significant benefit. Figure 3-1 shows a potential shared-use path route. The path would enable safe movement through the intersection at Oak Street/Campbell Street and also at Railroad Avenue/Monroe Street after crossing the tracks. Construction of such a path would require widening the existing sidewalk located on the east side of Oak Street to accommodate pedestrians and cyclists in a shared-use facility that is ADA-compliant. It would separate cyclists from motor vehicle traffic, allowing them to safely cross the tracks in a lower-stress, protected environment.

Alternatively (depending on the availability of right-of-way), the north side of Campbell Street could be used for a two-way path that connects to the path system at the crossing (along the west side of Oak Street). This would likely include an enhanced pedestrian/bicycle crossing at the south leg of the Oak Street/Railroad Avenue/Monroe Street T-intersection.

While the shared use path(s) are potentially most critical in the immediate vicinity of the crossing, there is also an opportunity to expand the path system further east. The large, undeveloped lot on the south side of Monroe Street east of Oak Street provides an opportunity to expand the street right-of-way to accommodate a path from Oak Street to 37th Avenue either adjacent to the Monroe Street public right-of-way or cutting across diagonally through the future development site. This is being explored as part of the *Moving Forward Milwaukie* Project. This would provide a crossing option (and trail connection), allowing bicycle riders to bypass this busy section of Monroe Street on their way to destinations further east. Finally, a new path could also be built along the UPRR Main Line corridor to connect Campbell Street to Railroad Avenue further to the southeast.

Figure 3-1

Potential Off-Street Facility in Vicinity of Union Pacific Railroad Main Line Crossing



Off-street facility could consist of widening the existing south sidewalk or creating a separate shared-use path adjacent to the existing sidewalk.

Campbell Street enhancements include new or widened sidewalks, upgraded curb ramps, and on-street bikeway improvements.

Transition between off-street and on-street facilities at Campbell Street to be refined in conceptual design phase.

Possible crossing improvements at Oak Street include rapid flash beacons, median refuge islands, and curb extensions.

Transition between off-street and on-street facilities at 37th Avenue to be refined in conceptual design phase.

LEGEND

- Off-Street Route
- Potential Options
- Existing Stop Sign

N

0 — 500 Feet

3.3.4.4 Rectangular Rapid Flash Beacon

Rectangular rapid flash beacons (RRFBs) are user-actuated amber lights that supplement warning signs at non-signalized intersections or mid-block crosswalks. They can be activated manually by a push button or passively by a pedestrian detection system. RRFBs use an irregular flash pattern that gets driver attention and encourages yielding to crossing pedestrians. In conjunction with a shared-use path, these could be installed on Oak Street at Campbell Street to help vulnerable road users cross this busy intersection.

3.3.4.5 Roundabout at Oak Street/Railroad Avenue/Monroe Street

A roundabout at the Oak Street/Railroad Avenue/Monroe Street intersection could alleviate the awkward and potentially unsafe pedestrian and bicycle crossings. Several design options could be implemented, potentially in combination with one of the shared-use path options described above. However, a roundabout could require significant right-of-way acquisition from neighboring property owners and may not provide the highest degree of needed pedestrian and bicycle safety due to high traffic volumes.

3.4 Section D (Oak Street to 42nd Avenue)

East of the UPRR Main Line crossing and after the turn from Oak Street back on to Monroe Street, the street widens and heads up the steepest hill along the Monroe Street corridor. An existing 5-foot bicycle lane on the eastbound side helps separate slower-moving cyclists from motor vehicles as they climb the hill. Between 37th and 40th Avenues the grade steepens, and the bicycle lane narrows to 4 feet. While this width would typically be considered substandard, the City design standards allow a minimum of 4 feet where “unusual circumstances exist, as determined by the Engineering Director, and where such a reduction would not result in a safety hazard” (City of Milwaukie, 2014). There is no westbound bicycle lane; instead, intermittent sharrows mark the pavement going downhill.

The eastbound bicycle lane narrows from 5 to 4 feet as Monroe Street climbs at 37th Avenue

The north side of the street has parking throughout the length of this section. The surrounding land uses are single-family residential, multifamily residential, and vacant land that is zoned for mixed use development. Sidewalk widths range between 4 to 5 feet in this section, all of which are buffered from the street by a landscape strip. The City requires that buffered sidewalks have a minimum width of 5 feet on local streets (City of Milwaukie, 2014).

3.4.1 Needs

3.4.1.1 Better Pedestrian Access

The intersections at 37th, 40th, and 42nd Avenues currently lack ADA-compliant curb ramps. The sidewalks are narrow on both sides of the street, making it challenging for pedestrians to walk side-by-side or pass one another on the steep grade.

3.4.1.2 Lower Vehicle Speeds and Volumes

The steep grade for eastbound cyclists creates a substantial speed difference between cars and cyclists. Reducing vehicle speeds would create more comfortable and safe conditions for cyclists.

Average daily traffic volumes were observed at 5,200 vehicles per day at 35th Avenue and 2,800 vehicles per day at 40th Avenue (see **Appendix D** for traffic counts). At approximately 30 mph, speeds are highest in this section as well

The bicycle lane currently ends at 42nd Avenue. Intersection treatments could help lower traffic volumes

3.4.2 Constraints

3.4.2.1 Delays for Cyclists at Intersections

The intersections at 37th and 42nd Avenues are four-way stop controlled. In the eastbound, uphill, direction, cyclists can find it difficult to regain momentum to continue to ascend the hill after having to stop at 37th Avenue. Cyclists then have to stop again at 42nd Avenue which adds additional cyclist delay.

3.4.3 Opportunities

3.4.3.1 Neighborhood Greenway Connectivity

The TSP proposes a new north-south neighborhood greenway connecting to Monroe Street at 40th Avenue. The intersecting neighborhood greenway would continue north and west along Harvey Street and 29th Avenue, ultimately connecting with the Springwater Corridor Trail.

3.4.3.2 Improved Pedestrian Access and Safety

The addition of ADA-compliant ramps at 37th, 40th, and 42nd Avenues would be an immediate improvement to pedestrian safety and mobility in this section. Widening the sidewalks in this section will be challenging due to the fact that property owners' fences abut the sidewalk at various places. However, there is an opportunity to widen sidewalks toward the street, improving pedestrian conditions and narrowing the roadway, which would in turn help slow traffic while minimizing impacts to existing on-street parking.

3.4.4 Potential Tools

3.4.4.1 Traffic Calming—Speed Cushions, Curb Extensions, and Regulatory Signage

Traffic volumes and speeds are high in this section of Monroe Street, and traffic calming measures will be key to reducing volumes and speeds to levels appropriate for a neighborhood greenway. Speed cushions, curb extensions, street narrowing, and a lower speed limit are all treatment options. The gradually increasing and sustained grade from Oak Street to 37th Avenue presents a real challenge for eastbound cyclists, and the four-way stop at 37th Avenue compounds the issue by eliminating any uphill momentum and creating a difficult restart as the grade increases to 6.6 percent. Modifying the existing traffic pattern and converting to a two-way stop could minimize cyclist delays on Monroe Street. Before doing so, however, calming traffic is a critical first step.

3.4.4.2 Shared-Use Path and ADA Accessibility

A shared-use path continued from Section C (and describe in Section 3.3.4.3) would allow bicycle riders to use a dedicated facility rather than sharing the roadway in this high-volume section of Monroe Street. While the path would potentially increase perceived safety and comfort, it would require users to transition on and off the path in the vicinity of the 37th Avenue intersection. In addition, this intersection also contains curb ramps that do not meet ADA requirements and need to be replaced.

3.4.4.3 Enhanced Bicycle Lanes

If traffic calming measures are unsuccessful in creating an environment that is comfortable for cyclists to share the road with motor vehicles, one option is to add a conventional, buffered, or protected bike lane for westbound cyclists heading downhill, and to improve the existing eastbound (uphill) bike lane between Oak Street and 37th Avenue. This option may preclude stormwater treatment options discussed below.

A conventional bike lane is a dedicated lane for bicycles immediately adjacent to the traffic lane. A buffered bike lane includes a marked buffer space between the traffic lane and bike lane. Protected bicycle lanes include physical separation between the regular travel lane and bicycle lane in the form of parking, candlestick bollards, planters, or other features. Adding a downhill bike lane or an enhanced bike lane on the uphill side would likely require the elimination of existing parking on the north side of Monroe Street.

3.4.4.4 Semi-Diverters

Semi-diverters are typically used where greenways intersect with higher-volume streets to restrict motor vehicle access into the neighborhood but allow bicycles to continue straight through. Placing traffic semi-diverters at the intersection of Monroe Street and 37th Avenue and/or 42nd Avenue would help create a more comfortable environment for pedestrians and bicyclists east of 37th Avenue.[7] A semi-diverter could be placed at one end of the intersection or in the median of

[7] A good median diverter example is located on page 10 of the Washington County Neighborhood Bikeway Toolkit.

the higher-volume street in conjunction with pedestrian refuge areas. Diverters could also incorporate curb extensions and green street features such as bioswales or infiltration basins.

Intersection with partial diverter, curb extension, and green street features (source: NACTO, undated)

Several types of semi-diverters can be considered for this section of Monroe Street. A **partial diverter** completely restricts automobile movement in one direction (usually by prohibiting motorists from turning onto a neighborhood street off a major roadway) but allows for through bicycle traffic, while permitting all travel in the opposite direction. The partial diverter narrows the travel lane to discourage wrong-way driving through the use of curb extensions or edge islands that can incorporate landscaping. These features can be mountable to allow for emergency vehicle access.

A **median diverter** is a barrier in the median of a major cross-street where it intersects with a neighborhood greenway, blocking all through and left-turn m otor vehicle traffic along the greenway in both directions but providing cut-outs that permit through bicycle movement. **Snake diverters** are mountable median diverters that reduce the volume of through traffic without narrowing the major cross-street. More elaborate median diverters are wider and incorporate refuge islands which provide a safe place for pedestrians and bicyclists to wait for a gap in traffic when crossing, while also narrowing the travel lanes along the cross-street to reduce speeds. A **right-in/right-out diverter** has similar function to a snake median diverter, using islands to prevent through motor vehicle movements while permitting through bicycle access. These diverters typically are not designed to be mountable.

Intersection with median refuge and diverter (source: NACTO, 2013)

Diagonal diverters reduce cut-through travel in by forcing motor vehicle traffic to proceed in one direction at a four-way intersection (either left or right), while allowing bicycle traffic full access in all directions at the intersection. Diagonal diverters can be constructed using elaborate landscaped curbs with ramps in the middle of the intersection or with simple planter boxes placed strategically at the intersection to allow bicycles to proceed through while limiting automobile access.

One or more semi-diverters in this section would help eliminate cut-through traffic and reduce volumes on Monroe Street. Median diverters could also create refuge areas for pedestrians and cyclists (provided the median island is wide enough).

It is important to note that such a modification would no longer allow motorists to proceed straight through at 37th Avenue. Traffic from Monroe Street could be diverted to Harrison Street (via 37th Avenue or Railroad Avenue), a parallel arterial route that also connects OR 99E to Linwood Avenue just two blocks north of Monroe Street.

3.4.4.5 Stormwater Treatment

The expansive (33 to 35 feet) pavement width in this section encourages higher vehicle speeds. Curb extensions could be installed in multiple locations to narrow the street and slow traffic and could be enhanced with bioswales, infiltration basins, and green spaces. Installation of curb extensions and/or other stormwater treatment features would likely require removal of on-street parking at specific locations.

Surface stormwater treatment options between Oak Street and 37th Avenue depend on available roadway space. Fewer options would be available if space is used for on-street dedicated bike lanes.

3.5 Section E (42nd Avenue to Linwood Avenue)

The eastern section of the corridor is the longest and also the most distinctive. The dominant land use form is single-family residential. Unlike the rest of Monroe Street, Section E consists of a rural cross-section through rolling topography with no sidewalk, curbs, or gutters except for a short section just east of 42nd Avenue fronting GracePointe Church. The public right-of-way is 40 feet wide while the extent of the pavement is only 22 feet wide. Front yards and vegetation encroach on Monroe Street at a number of points along the street, and the gravel shoulders are frequently used as on-street parking.

This section of Monroe Street lacks sidewalks, curbs, and gutters

3.5.1 Needs

3.5.1.1 Pedestrian Access and Visibility

There are no existing sidewalks in this section except for the sidewalk directly in front of GracePointe Church at 42nd Avenue. There are no established pedestrian crossings at any of the intersections within this section. Pedestrian visibility is a concern at Monroe Street intersections

with 52nd, Stanley, and Linwood Avenues. Wichita Park is a key destination within this segment, and a safe access route is needed for families either walking or biking to the park.

3.5.1.2 Safe and Continuous Route for Bicyclists

Four-way stops are located at the Monroe Street intersections with 42nd, Home, and Linwood Avenues, but some motorists reportedly drive through without seeing the signs or stopping. Section E currently features no bicycle-specific infrastructure except for one sharrow in each direction near 60th Avenue. There is an existing centerline stripe along this entire segment, which as previously noted, seems to make it more challenging for drivers and bicyclists to share the road.

Monroe Street at Linwood Avenue (looking west) lacks sidewalks and marked crosswalks, and also features a wide curb radius

3.5.1.3 Stormwater Management

Drainage is a major issue in this section. Regular flooding had previously occurred after heavy rainfalls, particularly around Home and 55th Avenues, until the City installed five drywells. The drywells have eased the problem but not eliminated it entirely; flooded basements are still relatively common in conjunction with major storm events.

3.5.1.4 Safe Crossing at Linwood Avenue

Monroe Street intersects with Linwood Avenue at the east end of the study area. Linwood is a relatively high-speed, high-volume roadway, and the intersection lacks sidewalks, corners or crossing treatments. With poor sightlines from every angle, the intersection is considered difficult and dangerous by drivers, pedestrians and cyclists alike. Currently, this intersection is projected to fall below minimum traffic standards in the year 2035 for Monroe Street traffic only, assuming the existing two-way stop controlled intersection is preserved. Previously, a full traffic signal has been proposed at this location when traffic demands warrant and funding is available.

3.5.2 Constraints

3.5.2.1 Vehicle Speed and Volumes

Volumes in this section are relatively high: 2,800 vehicles per day at 44th Avenue and 4,000 vehicles per day at 58th Avenue (see **Appendix D** for traffic counts). At 25 to 28 mph, 85th percentile speeds are higher than what is recommended for a neighborhood greenway. However, many community members have expressed concern about motorists speeding next to pedestrians who must walk in the street due to the lack of sidewalks. In addition, safety issues arise from lack of visibility near Wood Avenue where Monroe Street bends, and at the Linwood Avenue intersection.

3.5.2.2 Expense of Needed Infrastructure; Limited Available Funding

Separated pedestrian accommodation is needed throughout this section. Ultimately, conventional sidewalks may be the preferred solution however a phased approach may be required to achieve desired safety outcomes and provide pedestrian access. Sidewalks are in the Milwaukie TSP and a funding source is indicated, however the full funding may not be available to construct concrete sidewalks with curb and gutter for the full segment length.

3.5.3 Opportunities

3.5.3.1 Placemaking

Although the primary focus of the Monroe Street Neighborhood Greenway Concept Design Project is safety improvements, the project offers multiple opportunities to strengthen community connections and build identity along Monroe Street. One such opportunity is known as "neighborhood repair" or "intersection repair," using painted pavement murals to slow traffic at intersections. Neighbors work together to choose a theme, and participate in mural installation. These murals have been shown to reduce speeds, and could be considered at one or more intersection(s) where failure to stop or pedestrian visibility are a concern. Designs can vary widely based on neighborhood preference, as shown in the photographs above.

Community members work together to plan and install "intersection repair" murals

3.5.3.2 Innovative Pedestrian Accommodations

As noted above, pedestrian accommodation in this section of Monroe Street may require a phased approach, if conventional sidewalk installation is not determined to be desirable or immediately feasible. Pedestrian accommodation could include separated paths constructed with asphalt or permeable pavement and curb extensions at intersections.

Utilizing permeable pavement for the sidewalk material provides an opportunity to improve the pedestrian access in this section while also providing stormwater treatment. The permeable pavement options are ADA compatible and allow stormwater to infiltrate through the pavement instead of running off into the storm system. Curb extensions physically narrow the driving lane and create a shorter distance for pedestrian crossings while also creating an ideal area for stormwater treatment.

3.5.3.3 Stormwater Treatment

As pedestrian and bicycle accommodation concepts and designs are developed, various opportunities exist to integrate stormwater treatment elements into these facilities. Green street enhancements have the potential to resolve the issue of flooding that is prevalent along this section of Monroe Street.

3.5.3.4 Connectivity

The TSP proposes a new north-south neighborhood greenway along Stanley Avenue that would connect to Monroe Street.

3.5.3.5 Better Define Home Avenue Intersection

At the existing intersection of Monroe Street and Home Avenue, there is a convenience store on the southeast corner without well-defined access points into and out of its parking area. Because there are no curbs or fences surrounding the property, the expanse of asphalt bleeds into the intersection, creating a safety hazard for patrons of the establishment and other road users. Improvements to Monroe Street can help better define that particular private property and establish access points into the parking area to reduce this safety hazard.

3.5.4 Potential Tools

This section of Monroe Street provides the greatest opportunity for "placemaking." Project cost is an issue, but some type of pedestrian safety improvements will be critical. As previously noted, residents currently use the gravel shoulder for parking, and lawns have encroached into the City right-of-way. A phased approach could provide an avenue for the City to gradually recover the space to accommodate safety improvements. Several key improvements need to be made in Section E:

- Create a safe pedestrian route
- Plant trees and other vegetation
- Incorporate stormwater management strategies
- Provide bicycle safety improvements
- Provide better crossings at busy streets

3.5.4.1 Traffic Calming

Removing the centerline from Monroe Street could serve as a starting point for changing the character of the street. Other traffic calming measures to lower vehicle speeds and volumes in this section include pavement markings, speed cushions, stormwater treatment facilities, curb extensions, semi-diverters, and a range of intersection treatments.

The speed limit could be reduced in conjunction with these measures. However, speed limit changes have little effect as a stand-alone measure. Actually changing speeds requires enforcement and physical changes to the roadway such as those discussed above.

3.5.4.2 Sidewalks

A safe pedestrian facility along this section is critical to a successful neighborhood greenway project. An initial solution could include providing a pedestrian route along one side of the street – perhaps constructed initially as an asphalt pathway. An asphalt path could be constructed without the added costs of curb and gutter and underground stormwater collection.

Assuming a narrowed-width greenway, the City does own enough right-of-way to construct sidewalks on both sides of Monroe Street, many property owners have constructed walls and fences that either abut or encroach upon the City right-of-way. Sidewalks construction could potentially impact these property owners.

3.5.4.3 Curb Extensions, Bioswales, and Infiltration Basins

Because the actual pavement is only 22 feet wide for most of this section, narrowing the street may not be feasible; however, using gravel (or permeable pavement) shoulders can result in a narrower-feeling street, in addition to providing for stormwater infiltration. This type of stormwater management can help create neighborhood "places", using curbed bioswales or vegetated infiltration basins. In addition to curb extensions providing green opportunities for stormwater treatment, they can also be used to help delineate the pedestrian crossings at intersections. It is feasible to incorporate curb extensions into street without providing curb and gutter along the entire street. An ADA-compatible curb ramp could also be added at the intersection. Street parking would still be available between the bioswale areas.

Landscaped curb extension along street without full length curb and gutter

3.5.4.4 Median Refuge Island and Semi-Diverters

Placing semi-diverters at either end of this section (at 42nd and at Linwood) would calm traffic significantly. (As noted above, Harrison Street/King Road parallels the project from end to end, and could accommodate diverted cut-through traffic). The improvements could be phased initially to allow right-in/right-out at both Linwood and 42nd Avenues, with subsequent monitoring of traffic speed and volumes.

3.5.4.5 Intersection Treatments

Individual intersections along Section E should be analyzed to determine the best treatment for each. Traffic islands or circles could be incorporated at one or more intersections within this segment. Traffic islands have been shown to effectively reduce vehicular speeds at intersections and were suggested by several PAC members at the October 2014 PAC meeting.

- As noted above, median diverters on 42nd Avenue would provide significant traffic calming benefits. Each curb ramp at the intersection also would require ADA-compliant curb ramps.

- 44th Avenue is a T-intersection to the north. If a pedestrian pathway was constructed on the north side of Monroe Street, an ADA-compliant crossing of 44th Avenue would be needed. While there would not be a curb ramp, providing detectable warnings to alert pathway users they are leaving the path and entering the street would likely be required.

- 47th Avenue is a four-legged intersection that would also require ADA-compliant crossing improvements.

Pedestrian-activated hybrid beacons draw attention to bicyclists and pedestrians crossing the intersection

- Home Avenue is a four-way stop, but as previously noted, some motorists seem to miss the stop signs and drive through the intersection without stopping. It also has poorly defined boundaries on the southeast corner where there is a convenience store and adjacent parking lot. Once vehicle speeds and volumes are lowered by traffic calming, this intersection could be modified to a two-way stop, with Monroe Street having the right-of-way.

- Traffic calming is key to addressing visibility concerns at the 52nd Avenue intersection. Slowing traffic would provide more time for drivers to see pedestrians and cyclists. This area should be monitored after traffic calming measures are implemented to determine whether additional steps should be taken. Signage or flashing lights preceding the curves may be a desirable option.

- Intersections at Wood Avenue (T-intersection to the south), 55th Avenue (offset intersection), 59th Avenue (T-intersection to the north), and 60th Avenue (T-intersection to the south) would each benefit from an ADA-compliant crossing similar to what was discussed at 44th Avenue.

- The Stanley Avenue intersection is also an offset intersection, and Stanley Avenue is proposed as a new north-south neighborhood greenway route in the TSP. In addition to ADA-compliant crossings and connections, clear wayfinding signage and pavement marking would improve pedestrian and bicycle conditions at the conjunction of these two neighborhood greenways.

3.5.4.6 Pedestrian and Bicycle Signals

A hybrid beacon is a special type of signalized crossing treatment used to warn and control traffic on a major street at an intersection with a minor street. The beacon is activated by a push-button and is used to assist pedestrians and bicyclists in crossing a major street or highway at a marked

crosswalk. This may be an appropriate crossing treatment for the intersection with Linwood Avenue, which is a collector road with higher motor vehicle speeds and volumes.[8] An example from the NACTO *Urban Bikeway Design Guide* is shown at right.

Rectangular rapid flash beacons (RRFBs) are a lower-cost option that could help pedestrians and bicyclists cross Linwood Avenue safely. RRFBs have yellow flashing lights activated via pushbutton or detection.

Rectangular rapid flash beacon and median island

[8] The pedestrian volume thresholds required for this type of signal are significantly lower than for a traditional traffic signal.

4. Conclusion and Next Steps

As described in the sections above, much of the Monroe Street corridor currently has higher traffic volumes and speeds than are typical – or desirable – for a neighborhood greenway. Reducing both will be necessary to achieve the goals for Monroe Street set out in the Milwaukie Transportation System Plan. With lower speed and volumes come opportunities for pedestrian improvements, safer crossings, attractive stormwater treatment features, and community building.

The Monroe Street Neighborhood Greenway Conceptual Plan will implement several pedestrian and bicycle improvements programmed in the City's TSP, and will identify new elements that support the creation of a neighborhood greenway on Monroe Street. Further discussion of these potential elements will take place as the plan is developed.

This memo highlights needs and opportunities along Monroe Street, and describes potential improvements to successfully implement a neighborhood greenway. To varying degrees, many of those proposed improvements would require tradeoffs in terms of motor vehicle access and mobility. Key issues will likely include the following:

- Lowering speeds and volumes on will require the City to monitor and mitigate congestion impacts on nearby collectors and arterials.
- Further analysis is needed to assess potential impacts of pedestrian and bicycle safety improvements at the intersection of Monroe Street and OR 224.
- Potential improvements at the UPRR Main Line crossing need to be better defined – and, moving forward, will need to be approved by UPRR.
- Further analysis is needed to assess the traffic impacts of potential semi-diverters at 37th Avenue and 42nd Avenue.
- It will be important to understand the costs, benefits, and impacts of providing sidewalks and curbs on Monroe Street east of 42nd Avenue, and to get input from the community on lower-cost safety improvements that provide a dedicated space for pedestrians.

Further analysis is needed to assess the traffic impacts of potential improvements at the Linwood Avenue intersection (which is under joint City/Clackamas County jurisdiction). As the planning process moves forward, discussion of those tradeoffs will be critical – and, along with other components of the plan, will require further refinement based on input from the Project Advisory Committee and the general public.

The next step in the Monroe Street Neighborhood Greenway Concept Design Project is to share the needs, opportunities, and constraints outlined in this report with the Project Advisory Committee, Monroe Street residents and neighbors, and the community at large. Public input will help determine which of the potential tools described here are included in the Concept Plan for the project. When completed in spring 2015, the Concept Plan will likely set out a phased approach to funding and implementing the improvements it describes.

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Appendix A
Bicycle Facility Improvement Toolbox

BICYCLE FACILITY IMPROVEMENT TOOLBOX

Types of Bicyclists

Bicyclists are a varied group of people with different skill levels, abilities, bicycling experience, and trip types. For example, there are everyday commuters, avid recreational riders, children going to school, and families riding around in their neighborhoods. Their needs and comfort level with the bicycle infrastructure in Milwaukie will vary as a result of these differences. The City needs to accommodate these different types of bicyclists by providing adequate facilities for all different types of riders.

Bicycle trips are typically longer than walking trips and shorter than motor vehicle trips, and are attractive at distances up to three miles. Bicycle facilities can generally be categorized as multiuse paths, cycle tracks, bike lanes, shared roadways, and neighborhood greenways. Each of these facilities serves a particular purpose for bicycle travel. Bike lanes, cycle tracks, and multiuse paths can all accommodate trips of up to three miles. However, if the trip is shorter, or if the destination or origin of the trip is not next to a roadway with a bike lane, many bicycle trips can also be made on local streets. Table 6-1 summarizes each of these facilities with a general description of the elements inherent to each facility.

Table 6-1 Bikeway Types

Bikeway	Description
Multiuse path	Off-street route, typically recreational-focused, which can be used by several transportation modes, including bicycles, pedestrians, and other nonmotorized modes (i.e., skateboards, roller blades, etc.).
Cycle track	Exclusive bike facility within the roadway, with elements of both a separated path and a bike lane. Separated from motor vehicle traffic by parked cars, bollards, landscaping, or other barriers.
Bike lane	Area within street right-of-way specifically designated for bicycle use.
Shared roadway	Roadways where bicyclists and autos share the same travel lane. May include a wider outside lane and/or bike boulevard treatment (priority given to through bikes on local streets).
Neighborhood greenway	Lower-order, lower-volume streets with various treatments to promote safe and convenient bicycle travel and enhance pedestrian travel as well. Usually accommodate bicyclists and motorists in the same travel lanes, often with no specific vehicle or bicycle lane delineation. Assign higher priority to through bicyclists, with secondary priority assigned to motorists. Also include treatments to slow vehicle traffic to enhance the bicycling environment.

Bicycle Facility Design Considerations

Multiuse Paths

As their name implies, multiuse paths are designed to accommodate many types of users, and are typically constructed along an independent path such as a stream or greenway. Paths can also be built parallel to a roadway, but are most effective when built independent of a road, separating bicyclists from auto traffic. The American Association of State Highway Transportation Officials (AASHTO)[1] and the Oregon Department of Transportation (ODOT)[2] state that mixed-use paths can be designed along roadways, provided several design considerations are met:

Figure 6-1 Multiuse Path

Photo credit: Vince Schreck, www.pdxfamilyadventures.com

- A minimum 5-foot buffer should be provided between the path and roadway to protect path users from conflicts with motorists.
- Relatively few vehicle/path user conflict points (e.g., cross-streets or driveways).
- The path can be terminated at each end onto streets with good bicycle/pedestrian facilities or onto another safe, well-designed path.
- The path should not take the place of bicycle/pedestrian facilities (e.g., sidewalks and bicycle lanes) on the parallel street.

Cycle Tracks

Figure 6-2 Cycle Track

Cycle tracks can take a number of forms, depending on the nature of the existing street infrastructure. They combine some elements of a fully separated path with those of a bike lane in the roadway. The key element of a cycle track is that it uses parked cars, bollards, landscaping, curbing, or other barriers to provide some separation from motor vehicle traffic. Cycle tracks may be one-way or two-way, and they may be located at road level, sidewalk level, or an intermediate level. They are distinct from the sidewalk and are designed exclusively as bike facilities. A recommended minimum width is 7 feet, with an additional 2-ft "door zone" buffer (where adjacent to parked cars). Pavement markings on the cycle track provide guidance for bicyclists, as well as for motorists and pedestrians that may cross the cycle track at driveways or intersections.

Photo credit: Michael O'Hare, www.citiesforpeople.net

There are currently no cycle tracks in Milwaukie, and no potential cycle track routes have been identified to date. However, this type of facility represents an option for future bike improvements that might be most appropriate in certain settings to provide safer bike routes in high-traffic corridors.

[1] *A Guide for the Development of Bicycle Facilities*, American Association of State Highway and Transportation Officials, 1999.
[2] *Oregon Bicycle and Pedestrian Plan, An Element of the Oregon Transportation Plan*, Oregon Department of Transportation, Adopted June 14, 1995.

Bike Lanes

When possible, bike lanes should be directly adjacent to the curb, rather than adjacent to parked cars or combined with sidewalks. The recommended width of six feet provides sufficient travel space and additional room for bicyclists to steer clear of the curb or parked cars while maintaining a comfortable distance from adjacent moving traffic. Wide bike lanes also enable bicyclists to maneuver around drainage grates, manhole covers, glass and debris. Provision of bike lanes also benefits motor vehicles, which gain greater shy distance/emergency shoulder area, and pedestrians, who gain a buffer between walking areas and moving vehicles. Where right-of-way is limited, the bike lane can be reduced to 5 feet. Alternatively, widening the curb travel lane (for example, from 12 feet to 14 or 15 feet) can provide better bicycle accommodations and a greater measure of safety as well. However, with higher-volume roadways (e.g., streets with more than 3,000 Average Daily Trips), dedicated bike lanes are much more desirable than wide outside lanes.

Figure 6-3 Bike Lane

Photo credit: LA-32 Neighborhood Council, http://la32nc.org/category/transportation/

The signing and marking of bike lanes should follow the *Manual on Uniform Traffic Control Devices* (MUTCD). Design features in the roadway can improve bicycle safety as well. For example, using curb storm drain inlets rather than catch basins significantly improves bicycle facilities.

Shared Roadways

Figure 6-4 Shared Roadway

Shared roadways can be designed to safely accommodate both bicycle and auto traffic. Figure 6-5 illustrates an example of an appropriate warning sign with a supplemental "Share the Road" plaque that may be used to draw more attention to the fact that slow-moving forms of transportation may be using the roadway. When used, the supplemental plaque must be installed below the warning sign on the same signpost. Directional pavement markings may also be considered on shared roadways to supplement the bicycle warning signs when desired. The pavement markings illustrated in Figure 6-5 below are typically called "Sharrows" or "Shared Lane Markings" and are utilized on bicycle travel routes that have on-street parking but no designated bike lanes. Sharrows are commonly used on streets where dedicated bike lanes are desirable but are not possible for any number of reasons. The marking helps to align bicyclists, to shift their travel pattern out of the direction of a parked car door opening into their travel path.

Photo credit: Portland Bureau of Transportation, www.portlandoregon.gov/transportation/

Figure 6-5 Bicycle Signs and Markings

Bicycle Warning Sign

"Share the Road" Plaque

Bike Route Sign

Bicycle Pavement Marking

Bicycle Wayfinding Signage

It should be noted, however, that while posting "Bike Route" signage for bicyclists is an acceptable way for the City to demarcate bike routes, such signs should be coupled with pavement markings and/or way finding signage for bicyclists to get the most value out of the City's investment. Although this is an adopted MUTCD sign, it does not provide much information. Adding wayfinding information such as distances to various destinations, directional arrows, and estimated travel times makes the sign much more useful. These signs are most effective when placed in useful locations, such as where a bike route makes a turn that is not intuitive to riders.

Neighborhood Greenways

The term "neighborhood greenway" has recently evolved from the "bike boulevard" concept of treatments, which improve the network of safe bicycle routes by generally utilizing streets with lower traffic volumes and vehicle speeds, such as minor collectors or local streets that pass through residential neighborhoods. The neighborhood greenway treatments also make these routes safer for pedestrians and motorists (for example, through inclusion of traffic-calming devices), while at the same time incorporating low-impact stormwater treatment measures such as bioswales and raingardens. The general traffic calming provided by neighborhood greenway improvements adds to neighborhood livability.

Figure 6-6 Neighborhood Greenway

Image credit: Bicycle Transportation Alliance/Owen Walz, owenwalzdesign.com

Traffic controls along a neighborhood greenway assign priority to bicyclists while encouraging through-vehicle traffic to use alternate parallel routes. Traffic calming and other treatments along the corridor reduce motor vehicle speeds so that motorists and bicyclists generally travel at the same speed, creating a safer and more comfortable environment for all users. Neighborhood greenways also incorporate treatments to facilitate safe and convenient crossings of major streets. Neighborhood greenways work best in well-connected street grids, where riders can follow reasonably direct and logical routes and where higher-order, parallel streets exist to serve through-vehicle traffic.

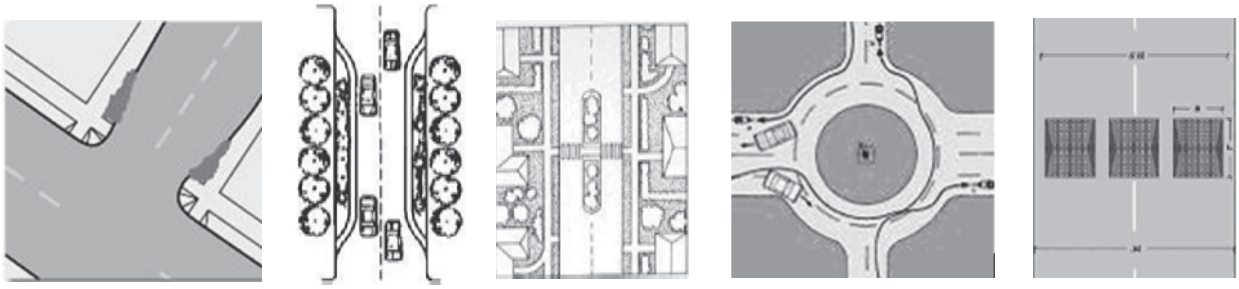
Milwaukie's neighborhood greenway network could be developed through a variety of improvements ranging from minor street enhancements (e.g., directional pavement markings) to larger-scale projects (e.g., intersection signalization). The various treatments fall into five major application levels based on their degree of physical intensity, with Level 1 representing the least physically intensive treatments that can be implemented at relatively low cost:

- **Level 1: Signage** (e.g., wayfinding and warning signs along and approaching the neighborhood greenway).
- **Level 2: Pavement markings** (e.g., directional pavement markings, shared lane markings).
- **Level 3: Intersection treatments** (e.g., signalization, curb extensions, refuge islands).
- **Level 4: Traffic calming** (e.g., speed humps, mini traffic circles).
- **Level 5: Traffic diversion** (e.g., choker entrances, traffic diverters).

Corridors targeted for higher-level applications would also receive relevant lower-level treatments. For instance, a street targeted for Level 3 applications should also include Level 1 and 2 applications as necessary. It should be noted that some applications might not be appropriate on all streets. In other words, it may not be necessary to implement all Level 2 applications on a particular street designated for Level 2 treatment in order to create a functional neighborhood greenway.

Figure 6-7 shows examples of some of the types of intersection treatments and traffic-calming measures that could be appropriate for application on neighborhood greenway routes. Some study and analysis is necessary to determine which measures would be most effective in specific locations. Within Chapter 11 Neighborhood Traffic Management, Table 11-1 provides more examples of traffic-calming measures.

Figure 6-7 Sample Traffic-Calming Measures



Bulbout **Choker** **Center Median** **Traffic Circle** **Speed Cushion**

Experience from other cities that have implemented neighborhood greenways shows that on-street vehicle parking can function as a traffic-calming measure. Drivers generally seem to slow down in response to the physical narrowing of the travel lane and the higher perceived risk of collision. In addition, parked cars create a barrier between moving cars on the street and pedestrians on the sidewalk. This barrier enhances both actual and perceived safety for pedestrians. Allowing or encouraging on-street vehicle parking can be one tool employed to make neighborhood greenways safe and pleasant for nonmotorized travel.

Bicycle Parking

Bicycle parking and storage facilities are an important component of an effective bicycle system. Lack of proper storage facilities discourages potential riders from traveling by bicycle. Bike racks should be located at significant activity generators including schools, parks, and commercial areas, as well as at major transit stops. Racks should be placed in highly visible locations and within convenient proximity to main building entrances. Bike racks should be designed to

provide two points of contact to the bicycle so the user can lock both the wheel and the frame to the rack. Bike lockers, showers, and caches of repair equipment (patch kits, tire tubes, etc.) would be helpful at locations where long-term parking is expected, such as the future light rail (MAX) stations (downtown, on Park Ave, and at Tacoma St), downtown bus stops, and major employment centers. The attractiveness of bicycle parking is also improved by providing covered parking and/or secured facilities where bicycles may be locked away.

RECOMMENDATIONS

Strategies

Bikeway improvements are aimed at closing the gaps in the bicycle network along arterial and collector roadways, establishing low-traffic routes that parallel arterials and collectors, and providing multimodal links to improve livability. To meet the TSP goals and policies outlined in Chapter 2, and address the needs outlined in this chapter, the City should take the following steps for improving the bicycle system:

- Fill in gaps in the existing bike corridor network (on arterials and collectors).
- Construct new bike lanes on strategic arterials and collectors.
- Connect key bicycle corridors to schools, parks, activity centers, and major transit stops.
- Improve crossing safety and connectivity.
- Designate neighborhood greenways on lower-volume streets that connect major bicycle facilities and/or bicycle destinations.
- Maintain bike lanes, off-street paths, signage, and other facility improvements.
- Construct and improve multiuse paths for recreational and commuter use.
- Involve bicyclists in the design and planning of bicycle and road facilities.
- Educate bicyclists and motorists about bicycle routes, laws, and opportunities.
- Directly implement or encourage the establishment of a bike-share program. This strategy could range from City ownership and administration of a bike-share system to revisions to the Municipal Code to allow for bike-share facilities owned by other private or public entities.

These strategies will be used to guide and develop projects that address the needs of the bicycling community in Milwaukie as well as those of bicyclists throughout the region. The projects resulting from these strategies fall into three categories: capital, operational and maintenance, and policy. Capital strategies involve building physical infrastructure. Operational and maintenance strategies aim to make existing infrastructure more usable. Policy-oriented strategies seek to modify public processes in order to more effectively support bicycling as a viable transportation mode. Key projects in each of these categories are described below.

Capital

These projects are typically large-scale infrastructure projects or projects that require some sort of physical infrastructure to be built. Capital projects also typically require ongoing maintenance that must be programmed into the existing maintenance schedule.

Key projects

17th Ave between Waverly Dr and Harrison St is a key bicycle connection between downtown Milwaukie and the Sellwood neighborhood in Portland. This connection will be improved by constructing bike lanes and/or a multiuse path. In addition, several potential neighborhood greenway corridors have been identified to enhance Milwaukie's bicycle network. The corridors

were identified with respect to major bicycling destinations as well as their proximity to desired bicycle travel routes. The recommended corridors are shown in Figure 6-8a and described below:

- Monroe St between downtown Milwaukie and Linwood Ave.
- Stanley Ave between Railroad Ave and Johnson Creek Blvd.
- A corridor roughly following 40th Ave north from Monroe St and then splitting into two separate corridors at Harvey St. One neighborhood greenway would continue north on 40th Ave and follow Olsen St and 42nd Ave to connect with Johnson Creek Blvd. The second neighborhood greenway would follow Harvey St west from 40th Ave and follow Balfour St, 29th Ave, and Van Water St to connect with the Springwater Corridor. If 29th Ave is extended to the south, the neighborhood greenway should connect to the south as well (see Figure 8-4, which shows the future extension of 29th Ave).
- A corridor following 19th Ave south from Eagle St to Sparrow St, then east on Sparrow St to River Rd. This corridor could be extended east on Sparrow St with construction of a multiuse path connecting to the Trolley Trail.

These neighborhood greenways should be targeted for Level 4 applications, including signage, pavement markings, intersection treatments, and traffic calming. Each corridor currently includes some boulevard components (e.g., speed humps). Due to limited street connectivity, Level 5 bike boulevard applications (traffic diversion) are not recommended for these corridors. To identify and develop additional site-specific treatments, the City should involve the bicycling community, neighborhood groups, and the Public Works Department. Further analysis and engineering work may also be necessary to determine the feasibility of some applications.

Operational and Maintenance

These projects involve actions that make existing infrastructure more useable. They include upkeep of existing facilities, educational campaigns, or distributing information about the use of the transportation network. They are typically smaller in scale and dollars than capital projects and are implemented more broadly than in one specific location.

Key projects

- Driver and bicyclist education, including driver and biker awareness classes, "Share the Road" safety class, bike safety education for kids and adults.
- Encouraging bicycling through community events to get new bicyclists involved and interested in how to commute by bike.
- Consider applying rumble strips or other treatments to safely define bike lanes in places, such as Johnson Creek Blvd, where vehicles commonly cross into the bike lane.

Policy

These projects do not typically improve the bicycle environment in a physical manner, but rather result in a fundamental change to the way bicycle travel is thought of and treated within the city of Milwaukie.

Key projects

- Enforce traffic laws that protect bicyclists.
- Collect and maintain bicycling traffic counts to measure the effect of improvements.

- Work with the City of Portland and Clackamas County when implementing bike boulevards, bike lanes, and multiuse paths to ensure good connectivity beyond Milwaukie.
- Consider establishing a committee to advise and advocate for implementation of the projects in this plan.

Master Plan

The Bicycle Master Plan is composed of a list of projects that address the identified needs (see Figure 6-8a). An inset map showing more detail in the downtown area is provided in Figure 6-8b. Summarized in Table 6-2, the master plan represents the "wish list" of bicycle-related projects in Milwaukie. The planning-level cost estimates provided in Table 6-2 are based on general unit costs for transportation improvements but do not reflect the unique elements that can significantly add to project costs. As projects are pursued, each of these project costs will need further refinement in order to detail right-of-way requirements and costs associated with special design details.

Appendix B
Transportation System Plan Goals and Policies Supported by Neighborhood Greenway

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Transportation System Plan Goals and Policies Supported by Neighborhood Greenway

Transportation System Plan Goals and Policies Supported by Neighborhood Greenway	
Goal 1 – Livability: Design and construct transportation facilities in a manner that enhances the livability of Milwaukie's community	
Policy A	Provide convenient walking and bicycling facilities to promote the health and physical well-being of Milwaukie citizens.
Policy B	Protect residential neighborhoods from excessive through traffic and travel speeds while providing reasonable access to and from residential areas.
Policy C	Protect residential neighborhoods from excessive noise and pollutants associated with higher functional class streets, industrial uses, and rail activities.
Policy D	Minimize the "barrier" effect of large transportation facilities on nonmotorized modes of travel.
Policy E	Construct a transportation system that is accessible to all members of the community.
Policy F	Provide a seamless and coordinated transportation system that is barrier-free, provides affordable and equitable access to travel choices, and serves the needs of all people and businesses, including citizens of low income, people with disabilities, children, and seniors.
Goal 2 – Safety: Develop and maintain a safe and secure transportation system.	
Policy A	Design and maintain safe and secure walkways and bikeways between parks, schools, and other activity centers in Milwaukie.
Policy B	Design and construct transportation-related improvements to meet City standards as outlined in the City's Transportation Design Manual and the Americans with Disabilities Act (ADA).
Goal 3 - Travel Choices: Plan, develop, and maintain a transportation system that provides travel choices and allows people to reduce the number of trips made by single-occupant vehicles.	
Policy A	Provide a citywide network of convenient walkways and bikeways that are integrated with other transportation modes and regional destinations.
Policy C	Support travel options that allow individuals to reduce single-occupant vehicle trips.
Policy F	Ensure bike and bus routes are well separated, marked, mapped, and marketed.
Goal 4 - Quality Design: Establish and maintain a set of transportation design and development regulations that are sensitive to local conditions.	
Policy A	Design streets to support their intended users.
Policy B	Integrate pedestrian and bicycle facilities into street planning, design, construction, and maintenance activities.

Transportation System Plan Goals and Policies Supported by Neighborhood Greenway	
Policy C	Require developers to include pedestrian-, bicycle-, and transit-supportive improvements within proposed developments and adjacent rights-of-way in accordance with adopted policies and standards.
Policy D	Promote context-sensitive transportation facility design, which fits the physical context, responds to environmental resources, and maintains safety and mobility.
Policy E	Consider maintenance costs and issues when developing and implementing design standards.
Policy F	Promote landscaping and pervious surfaces wherever practical and feasible.
Goal 5 - Reliability and Mobility: Develop and maintain a well-connected transportation system that reduces travel distance, improves reliability, and manages congestion.	
Policy A	Enhance street system connectivity wherever practical and feasible. In particular, improve east-west connectivity across the community, especially to connect the eastern neighborhoods across Hwy 224 to downtown.
Goal 6 – Sustainability: Provide a sustainable transportation system that meets the needs of present and future generations.	
Policy A	Encourage an energy efficient transportation system.
Policy B	Increase the use of walking and bicycling for all travel purposes.
Policy C	Improve and enhance the livability of Milwaukie by decreasing reliance on automobile transportation and increasing the use of other modes to minimize transportation system impacts on the environment.
Policy D	Practice stewardship of air, water, land, wildlife, and botanical resources. Take into account the natural environments in the planning, design, construction, and maintenance of the transportation system.
Goal 7 - Effective and Innovative Funding: Efficiently allocate available funding for recommended transportation improvements, and pursue additional transportation funding that includes innovative funding methods and sources.	
Policy A	Plan for an economically viable and cost-effective transportation system.
Policy C	Prioritize maintenance of the transportation system.
Policy E	Provide funding for local match share of jointly funded capital projects with other public partners.
Policy F	Prioritize funding of projects that are most effective at meeting the goals and policies of the TSP.
Goal 8 – Compatibility: Develop a transportation system that is consistent with the City's Comprehensive Plan and coordinates with County, State, and regional plans.	
Policy A	Coordinate and cooperate with adjacent jurisdictions and other transportation agencies to develop transportation projects that benefit the city of Milwaukie and the region as a whole.
Policy B	Work collaboratively with other jurisdictions and agencies so the transportation system can function as one.

Transportation System Plan Goals and Policies Supported by Neighborhood Greenway	
Policy G	Coordinate with ODOT to address improvements to State highways within Milwaukie to benefit all modes of transportation.

Appendix C
Relevant TSP Master Plan Projects

Appendix C
Relevant TSP Master Plan Projects

Network Type	Priority	Project Type	Project Name	Project Description	From	To	Cost ($1,000s) [a]
Street	High	Capital	OR 224 and OR 99E Refinement Plan	Conduct refinement study to establish mobility targets for OR 99E and OR 224 for locations not meeting applicable street targets, and explore ways to minimize barrier effect and improve auto and freight mobility	OR 99E Project Limits: Tacoma Street to River Road	OR 224 Project Limits: OR 99E to Lake Road interchange	$270
Street	High	Capital	Linwood Avenue Capacity Improvements (south)	Widen to standard three-lane cross-section	King Road	Harmony Road	$12,500
Street	High	Capital	Stanley Avenue Connectivity at Monroe Street	Enhance connection along Stanley Avenue at Monroe Street	Location-specific	Location- specific	$60
Pedestrian	High	Policy	Study of Pedestrian Crossings on OR 224	Examine alternatives for improving pedestrian crossings at five intersections along OR 224 (including Monroe Street)	Harrison Street	Freeman Way	$50

Network Type	Priority	Project Type	Project Name	Project Description	From	To	Cost ($1,000s) [a]
Pedestrian	High	Capital	Intersection Improvements at OR 224 and Monroe Street	Improve pedestrian crossing	Location-specific	Location- specific	$20
Pedestrian	High	Capital	Monroe Street Neighborhood Greenway	Fill in sidewalk gaps on both sides of street	42nd Avenue	City limit	$1,800
Pedestrian	High	Capital	Intersection Curb Ramp Improvements	Install curb ramps at all intersections with sidewalks	Citywide	Citywide	$3,500
Pedestrian	Medium	Capital	Downtown Streetscape Improvements	Install sidewalk bulbouts, lighting, and pedestrian amenities	Downtown	Downtown	$7,300
Pedestrian	Medium	Operation	Pedestrian Walkway Amenities	Install amenities, such as benches, along key walking routes	Citywide	Citywide	$60
Pedestrian	Low	Capital	Intersection Improvement at All Crossings of OR 99E (includes Monroe Street)	Improve all existing crossings of OR 99E (e.g., extended time for crossing, signage) (ODOT to complete)	Location-specific	Location- specific	-
Pedestrian	Low	Operation	Pedestrian Walkway Signage	Provide maps and wayfinding signage on streets that identify ways to get around the city	Citywide	Citywide	$10
Bicycle	High	Capital	Intersection Improvements at Linwood Avenue and Monroe Street	Improve safety of crossing at intersection	Location-specific	Location- specific	$10

Network Type	Priority	Project Type	Project Name	Project Description	From	To	Cost ($1,000s) [a]
Bicycle	High	Capital	Monroe Street Neighborhood Greenway (Downtown)	Designate as a "neighborhood greenway" and install traffic-calming improvements	21st Avenue	OR 224	$85
Bicycle	High	Capital	Monroe Street Neighborhood Greenway (Central)	Designate as a "neighborhood greenway" and install traffic-calming improvements	OR 224	42nd Avenue	$80
Bicycle	High	Capital	Monroe Street Neighborhood Greenway (East)	Designate as a "neighborhood greenway" and install traffic-calming improvements	42nd Avenue	Linwood Avenue	$165
Bicycle	High	Capital	29th Avenue/ Harvey Avenue/ 40th Avenue Neighborhood Greenway	Designate as a "neighborhood greenway" and install traffic-calming improvements	Springwater Trail	Monroe Street	$220
Bicycle	High	Capital	Stanley Avenue Neighborhood Greenway (South)	Designate as a "neighborhood greenway" and install traffic-calming improvements	King Road	Railroad Avenue	$195
Bicycle	High	Operation	Bicycle Lane Maintenance	Sweep bicycle lanes to remove debris	Citywide	Citywide	$1,200
Bicycle	High	Operation	Bicycle-friendly Street Grates	Install bicycle-friendly street grates	Citywide	Citywide	$60
Bicycle	Medium	Operation	Bicyclist Education	Promote bicycling through bicycle use and route selection education	Citywide	Citywide	$10

Network Type	Priority	Project Type	Project Name	Project Description	From	To	Cost ($1,000s) [a]
Bicycle	Medium	Operation	Community Bicycle Rides	Support community bicycle rides to encourage bicycle use	Citywide	Citywide	$5
Bicycle	Low	Capital	37th Avenue Bicycle Lanes	Fill in gaps in existing bicycle network with bicycle lanes	Harrison Street	OR 224	$3,200 [b]
Bicycle	Low	Operation	Milwaukie Bicycle Map	Produce a Milwaukie bicycle map	Citywide	Citywide	$60
Bicycle	Low	Operation	Police Enforcement on Drivers	Enforce laws related to bicycle lanes and bicycle safety	Citywide	Citywide	$10
Bicycle	Low	Operation	Bicycle Lane Striping	Restripe existing bicycle lanes and stripe bicycle lanes on streets where buses and bicyclists share the road	Citywide	Citywide	$20

[a] Project costs are order-of-magnitude estimates and are in 2012 dollars. Future costs may be more due to inflation. In the case of operational projects, estimated costs are for the entire 22-year planning period of the TSP (2013 to 2035).
[b] Establishing bicycle lanes on this section of street will involve significant reconstruction of some portions of the existing roadway, including street widening, curb relocation, and modifications related to the railroad crossing.

Appendix D
Monroe Street Greenway Corridor Characteristics

Appendix D
Monroe Street Greenway Corridor Characteristics

Section A 21st Avenue to OR 224	Section B OR 224 to Campbell Street	Section C Campbell Street to UPRR Main Line Railroad Crossing	Section D Railroad Avenue to 42nd Avenue	Section E 42nd Avenue to Linwood Avenue
Industrial/residential 50-foot elevation gain west to east (2.4 percent grade). Width: 28 to 40 feet curb to curb. Parking on south side only, except for one double-sided block. Narrow (4 to 5 feet) sidewalks on both sides. No sharrows; centerlines are present. 25 mph speed limit. Future MAX crossing at 23rd. Major signalized crossing at OR 224 with pedestrian timer buttons but no bicycle-activated buttons or pavement loops. **VOLUME/SPEED:** **Westbound at 25th** 956 vehicles per day. 88 vehicles per hour average during peak hour. Average speed: 19 mph. 85th percentile speed: 23 mph.	Office/residential. Flat terrain. Width: 40-foot curb to curb. Parking on both sides. No sharrows**;** centerlines are present. 25 mph speed limit. Jog in route at Campbell. Skewed intersection at Penzance. **VOLUME/SPEED:** No official counts. Perceived light traffic.	Vacant land. Flat terrain. No on-street parking. Pinch point at railroad crossing, with 11- to 13-foot lane width. Campbell has 4 to 5 feet sidewalks, south side only. Oak has asphalt or concrete sidewalks (6 feet) on both sides. No sharrows**;** centerlines are present. 25 mph speed limit (unsigned). Series of jogs in route. Complex T-junction at east end with Oak. Rail crossing is connectivity barrier – includes median islands and wayside horns. Improvements require Union Pacific involvement. **VOLUME/SPEED:** No official counts. Presumably busiest section of corridor on Oak.	Residential. 56-foot elevation gain west to east from 37th to 40th (6.6 percent grade). Width: 33 feet curb to curb. Parking on north side only. Narrow (4 feet) uphill bike lane on eastbound side; sharrows on downhill westbound side; centerlines are present. Narrow sidewalks on both sides. 25 mph speed limit. **VOLUME/SPEED:** **Westbound at 35th:** 2,604 vehicles per weekday. 203 vehicles per hour average during peak hour. Average speed: 27 mph. 85th percentile speed: 31 mph. **Eastbound at 40th:** 1,882 vehicles per weekday. 138 vehicles per hour during peak hour. Average speed: 26 mph. 85th percentile speed: 30 mph.	Residential, rural character. Rolling hills. Width: 22 to 25 feet (pavement width). Gravel shoulders in some locations; no sidewalks or curbs. Intermittent sharrows; centerlines are present. 25 mph speed limit. **VOLUME/SPEED:** **Eastbound at 44th:** 1,385 vehicles per day. 166 vehicles per hour average during peak hour. Average speed: 21 mph. 85th percentile speed: 25 mph. **Eastbound at 58th:** 2,044 vehicles per day. 181 vehicles per hour during peak hour. Average speed: 21 mph. 85th percentile speed: 28 mph.

Comparable Greenways
SE Clay, Portland
SE Ankeny, Portland
NE Hancock, Portland
	Comparable Greenways
	NE Going, Portland
		Comparable Greenways
		SE Bush at 136th, Portland
		SE Division at 87th, Portland
		NE Going at 33rd, Portland
			Comparable Greenways
			NE Klickitat, Portland
			SE Gladstone, Portland
			NE Tillamook, Portland
				Comparable Greenways
				SW Maplewood, Portland
				SW Sunset, Portland
				SE Woodward, Portland
				SE Mill, Portland

Appendix E
Neighborhood Traffic Management Tool Box

11 Neighborhood Traffic Management

Neighborhood traffic management is a term used to describe the many and varied traffic management approaches used to reduce the impacts of traffic volumes and speeds on residential neighborhoods and improve safety for pedestrians and bicyclists. This chapter describes the need for neighborhood traffic management, identifies tools that the City can use to slow and/or divert traffic, and outlines a process for implementing neighborhood traffic management measures. It is not the purpose of this chapter to identify streets in need of traffic management or to propose projects at specific locations.

GOALS AND POLICIES

Milwaukie has developed a set of goals to guide the development of its transportation system (see Chapter 2). Listed below are the specific TSP Goals that guide the City's policies on neighborhood traffic management:

- **Goal 1 Livability** guides the City to protect residential neighborhoods from excessive through traffic and travel speeds while providing reasonable access to and from residential areas.
- **Goal 2 Safety** guides the City to maintain a safe transportation system.
- **Goal 4 Quality Design** guides the City to design streets to support their intended users and respond to the surrounding natural and built environments.

The main benefits of effective neighborhood traffic management are improved livability and safety. Reduced vehicle speeds are a safety benefit for all modes of travel. Reduced cut-through traffic improves livability through the reduction of vehicular noise, pollutants, and traffic volumes. Additionally, streets that are used in ways for which they weren't designed lead to congestion and safety hazards.

NEEDS

Most of the land within Milwaukie consists of residential neighborhoods. The city, with just over 20,000 citizens, has a relatively small population compared to the surrounding Portland metropolitan area. Because of Milwaukie's proximity to the city of Portland, its employment centers, and the two major regional routes through the city (Hwys 99E and 224), cut-through traffic and speeding is an ongoing concern for citizens. Cut-through traffic most often occurs when congestion occurs on regional routes and major streets and nonlocal traffic goes in search of less congested or more direct routes. Speeding can occur under many different

circumstances; however, the city has a number of streets that are relatively straight with few intersections or traffic control devices. These types of streets often invite speeding violations.

Neighborhood traffic management is a means to address the negative impacts of unchecked traffic speed and volume on neighborhood streets. Effective use of neighborhood traffic management can address neighborhood needs and concerns, including, but not limited to, the following:

- Speeding.
- Cut-through traffic, especially by heavy freight trucks.
- Bicycle and pedestrian safety.
- Student safety around school zones.

Student safety around school zones has been and continues to be a concern in Milwaukie neighborhoods. In 1995, the Milwaukie Traffic Safety Commission was charged with identifying and implementing school trip safety improvements in collaboration with schools, parent teacher organizations, neighborhood district associations, residents, and staff. The now defunct commission enacted many safety improvements, but not all recommended projects were pursued or implemented. This chapter does not recommend specific traffic management measures at specific locations, such as schools; however, Chapter 5 Pedestrian Element and Chapter 6 Bicycle Element recommend projects that directly address student safety. In addition, the various Neighborhood District Associations can choose to develop neighborhood traffic management plans that identify more specific issues to be addressed.

TOOLS

There are many different measures available in the neighborhood traffic management "tool box," but not all of these measures are appropriate for all streets or in all situations. As with street design, traffic management measures need to take street functional classification, surrounding land uses, existing street design, emergency service provider access needs, and neighborhood preferences into account.

Table 11-1 groups neighborhood traffic management measures into four categories and shows the recommended application based on street functional classification. The four categories are as follows:

- Horizontal deflection (reduces traffic speeds).
- Vertical deflection (reduces traffic speeds).
- Volume control measures (reduces or diverts traffic volumes).
- Other measures.

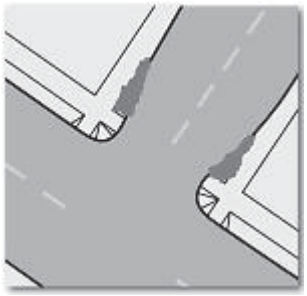
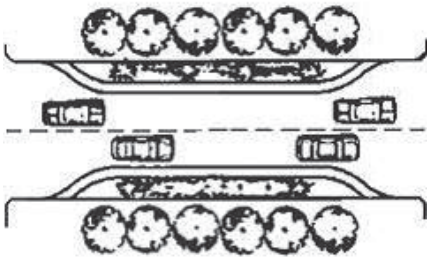
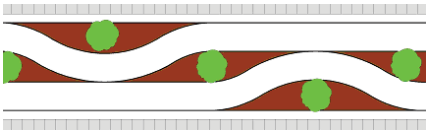
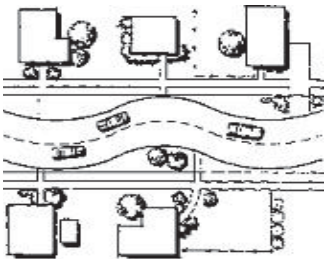
Most of the measures in the first three categories require physical changes to the street; whereas, most of the measures in the last category involve nonphysical changes such as signage, education, enforcement, speed monitoring trailers, and signal timing.

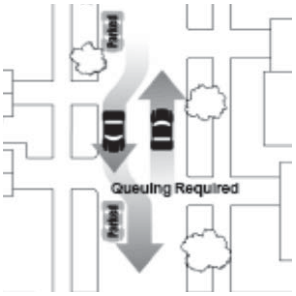
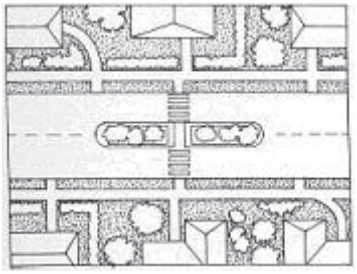
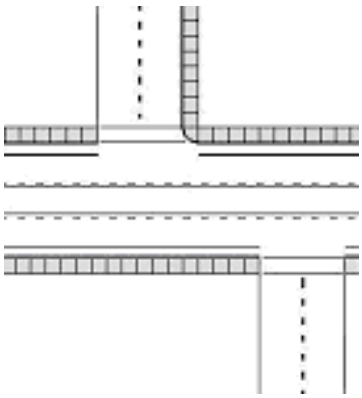
Additionally, State law provides the City with the authority to lower the speed limit of a residential street to 5 miles per hour below the the statutory speed required by the Oregon Department of Transportation.[1] The statutory speed for local streets is 25 miles per hour; therefore, the City can lower the speed limit on local streets to 20 miles per hour. Three criteria must be met to establish the ordinance, in addition to posting new speed limit signs:

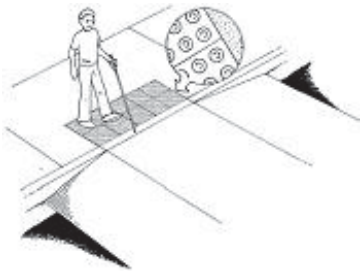
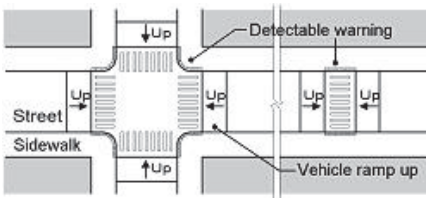
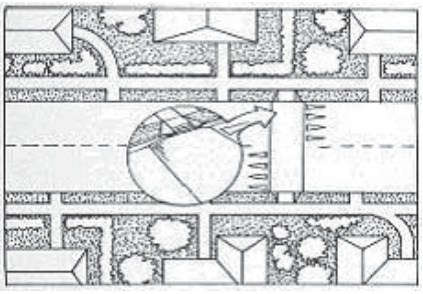
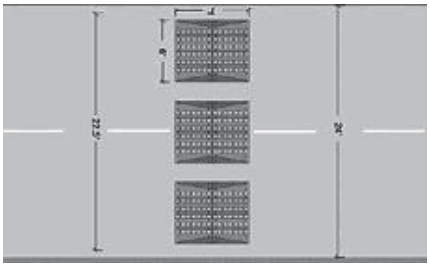
[1] ORS 810.180(10)

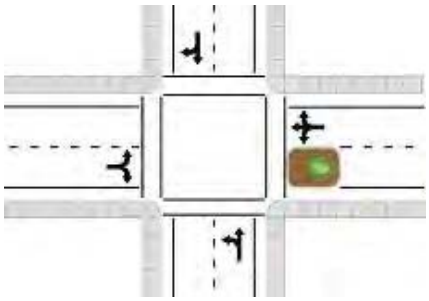
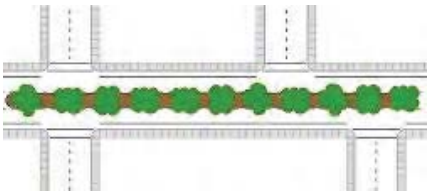
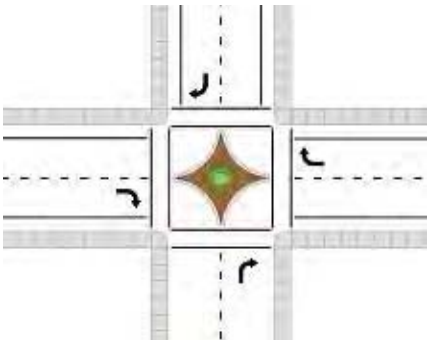
1. The street is located in a residential district.
2. The street has an average volume of fewer than 2,000 motor vehicles per day, more than 85% of which are traveling less than 30 miles per hour.
3. A traffic control device is used to indicate the presence of pedestrians and bicyclists.

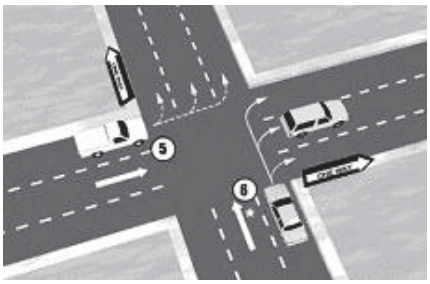
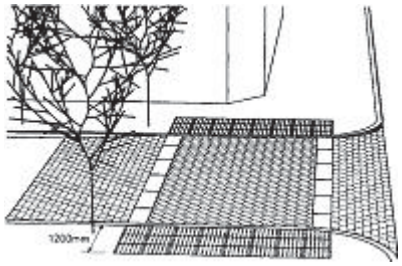
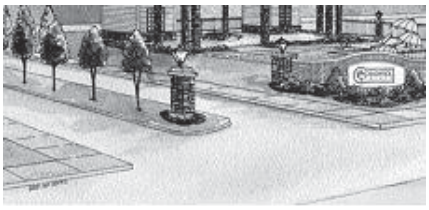
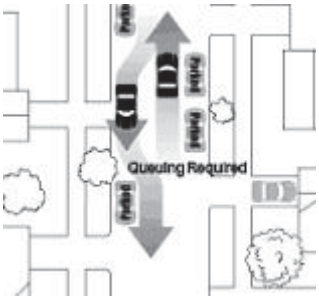
Table 11-1 Neighborhood Traffic Management (NTM) "Tool Box"

NTM Measure	Description	Example	■ Recommended ⊡ Optional ☐ Not Recommended Functional Classification				
			Arterial	Collector	Neighborhood Route	Local Street	Skinny Street
Horizontal Deflection							
Bulbout	Curb extension at an intersection that reduces the pedestrian crossing distance by bringing the curb out into the parking lane. Reduces speeds and increases pedestrian safety by reducing crossing distance.		☐	⊡	■	■	☐
Choker	Midblock pedestrian or landscaped curb extension that narrows the roadway. Reduces speeds and, if designed for pedestrians, increases pedestrian safety by reducing crossing distance.		☐	☐	■	■	☐
Chicane	Curb extensions or offsets along a portion of a roadway. Prevents drivers from taking a "straight shot" down the street, thereby reducing speeds.		☐	⊡	■	■	☐
Curvilinear Street	Similar to a chicane. A street with a series of 25 MPH reverse curves along its length. Prevents drivers from taking a "straight shot" down the street, thereby reducing speeds.		☐	⊡	■	■	■

NTM Measure	Description	Example	■ Recommended ⊡ Optional ☐ Not Recommended Functional Classification				
			Arterial	Collector	Neighborhood Route	Local Street	Skinny Street
Skinny Street	Street with narrower than normal travel lane widths. May involve overlap of parking and travel lanes. Reduces speeds and increases pedestrian safety by reducing crossing distance.		⊡	⊡	■	■	☐
Center Median	Median in the middle of the roadway that narrows the adjacent travel lanes. Reduces speeds and increases pedestrian safety by providing a pedestrian refuge.		☐	⊡	■	⊡	☐
Traffic Circle	A round island in the middle of an intersection. Reduces vehicle speeds and collisions at intersections.		☐	⊡	■	■	■
Offset Intersection Alignment	Intersection alignment that requires through traffic to jog left or right. Reduces speeds and cut-through traffic by providing a less direct path.		☐	☐	⊡	■	■

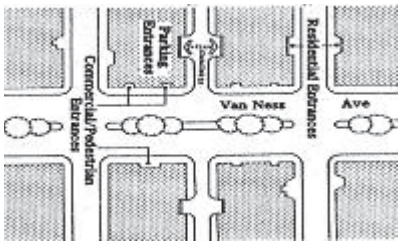
NTM Measure	Description	Example	■ Recommended ⊡ Optional ☐ Not Recommended Functional Classification				
			Arterial	Collector	Neighborhood Route	Local Street	Skinny Street
Vertical Deflection							
Raised Crosswalk	Raised pavement surface at a crosswalk location. Reduces speeds and increases pedestrian safety by emphasizing the pedestrian crossing and eliminating the need for pedestrians to step down into the roadway.		☐	☐	■	■	■
Raised Intersection	Raised pavement surface throughout entire intersection area. Reduces speeds and increases pedestrian safety by emphasizing pedestrian crossings and eliminating the need for pedestrians to step down into the roadway.		☐	☐	■	■	■
Speed Hump/Table	Raised pavement surface across the entire width of a roadway. Humps are designed so that a vehicle's front and rear wheels travel over the hump at different times. Tables are longer than humps and accommodate a vehicle's front and rear wheels at the same time. Reduces vehicle speeds.		☐	☐	■	■	■
Speed Cushion	Similar to speed humps but not raised across the entire width of the roadway. Reduces vehicle speeds while allowing emergency vehicles to travel unimpeded due to their wider axles.		☐	⊡	■	■	■

NTM Measure	Description	Example	■ Recommended ⊡ Optional ☐ Not Recommended Functional Classification				
			Arterial	Collector	Neighborhood Route	Local Street	Skinny Street
Volume Control Measures							
Full/Partial Closure	The complete or partial closure of a roadway to all through traffic by means of a physical barrier. Pedestrian and emergency access usually allowed. Reduces cut-through traffic.		☐	☐	⊡	■	■
Center Median Barrier	Median in the middle of the roadway that separates vehicles traveling in opposite directions and restricts left-turn movements. Median may extend through an intersection so as to block through movements on cross streets. Prevents cut-through traffic and increases vehicular safety by reducing turning conflicts.		■	■	■	⊡	☐
Diverter	A median or other barrier, such as a curb extension, that forces traffic to turn in a particular direction. Reduces cut-through traffic and decreases vehicular conflicts.		☐	☐	⊡	■	■

NTM Measure	Description	Example	■ Recommended ⊡ Optional ☐ Not Recommended Functional Classification				
			Arterial	Collector	Neighborhood Route	Local Street	Skinny Street
One-way Street	A street that accommodates vehicular travel in only one direction. Reduces the number of available travel routes.		☐	☐	⊡	■	■
Other Elements							
Pavement Alternatives	Use of bricks or colored pavement to emphasize pedestrian crossing locations.		⊡	⊡	■	■	■
Entry Treatments	Use of landscaping to delineate and enhance a neighborhood entrance.		☐	☐	⊡	■	■
On-Street Parking	Use of parked cars to buffer pedestrians from moving vehicles and to reduce speeds, particularly on skinny streets where travel lanes and parking lanes overlap and must be shared by moving and parked vehicles.		☐	☐	⊡	■	■

NTM Measure	Description	Example	■ Recommended ⊡ Optional ☐ Not Recommended Functional Classification				
			Arterial	Collector	Neighborhood Route	Local Street	Skinny Street
Informational Sign	Use of signs to alert drivers to various hazards.		☐	⊡	■	■	■
Stop Sign	Use of stop signs to increase safety and interrupt traffic flow making routes less desirable for cut-through traffic. Typically placed at intersections. Warrants determined by the Manual on Uniform Traffic Control Devices (MUTCD). Not a speed control measure per MUTCD.		☐	☐	⊡	■	■
Truck Restrictions	Use of "No Truck" signs at key intersections to restrict through truck trips but not local truck trips.		☐	☐	⊡	■	■
Part Time Restrictions	Use of signs to limit through and/or turn movements during key times, typically during peak hours. Reduces cut-through traffic and facilitates traffic flow during peak hours.		■	■	■	⊡	⊡

NTM Measure	Description	Example	■ Recommended ⊡ Optional ☐ Not Recommended Functional Classification				
			Arterial	Collector	Neighborhood Route	Local Street	Skinny Street
Signal Timing	Coordination of signals to reduce stops along corridors and delays at intersections. Reduced green time on side streets discourages cut-through travel.		■	■	☐	☐	☐
Police Enforcement	Use of regulatory authority to cite violators for speeding and other traffic infractions, such as illegal turning movements, to reduce such violations in the future.		■	■	■	■	■
Education	Education of the public regarding the hazards of speeding and the impacts of cut-through traffic through public service announcements, direct mailings, and driver education courses.		■	■	■	■	■
Speed Reader Board	Use of speed reader board to measure and display a driver's speed.		■	■	■	■	■
Photo Radar Van	Use of photo radar van to measure a driver's speed and issue speeding tickets for violations.		■	■	■	■	■

NTM Measure	Description	Example	■ Recommended ⊡ Optional ☐ Not Recommended Functional Classification				
			Arterial	Collector	Neighborhood Route	Local Street	Skinny Street
Neighborhood Speed Watch	Citizen-based traffic management program that allows citizens to identify speeders with speed measuring devices and send them a standardized letter regarding the hazards of speeding.		☐	☐	■	■	■
Shared Street	A street without curbs where bollards, chokers, and/or landscape elements define vehicle and pedestrian areas. Reduces speeds through shared use of roadway by all travel modes. Originated in Europe.		☐	☐	⊡	■	■
Short Blocks	Use of shorter blocks to create more intersections and more streets to distribute traffic. Closely spaced intersections reduce speeds and provide more potential locations for stop signs and signals.		☐	☐	⊡	■	■
Enhanced Major Street Performance	Provision of adequate capacity and connectivity on arterials and collectors to encourage longer trips on these facilities and to discourage cut-through trips on local streets and neighborhood routes.		■	■	☐	☐	☐

IMPLEMENTATION

Successful neighborhood traffic management requires the following:

- A process that identifies, evaluates, and prioritizes traffic management needs.
- Citizen involvement in traffic management measure selection.
- Professional design that considers the safety of all users.
- Funding and implementation of prioritized needs.

The Milwaukie Public Safety Advisory Committee is responsible for administering the City's neighborhood traffic management program. This committee meets once a month and has addressed the enforcement and education aspects of neighborhood traffic management through both the Traffic Safety Program and the Walk Safely Milwaukie Program. Engineering staff assist this committee to improve neighborhood traffic management program coordination and to provide the technical expertise needed for evaluation and implementation of deflection and volume control traffic management measures.

The neighborhood traffic management program relies on citizens to identify neighborhood traffic concerns. This identification process, by its very nature, is reactive. However, the funding level and evaluation process will be deliberate and methodical to allow for equitable and efficient use of limited funds. Any Neighborhood District Association can develop a traffic management plan that identifies more specific issues or needs. The City will endeavor to allocate money each year to undertake selected neighborhood traffic management measures (see Table 11-2).

RECOMMENDATIONS

Figure 11-1 outlines the proposed neighborhood traffic management process for the City of Milwaukie. As shown in this figure, there are multiple points in the process for public input and involvement and a feedback loop at the end to monitor the success of neighborhood traffic management measures that have been implemented.

It is recommended that the City annually fund the neighborhood traffic management program so that prioritized needs are implemented over time. The Neighborhood Traffic Management Action Plan (see Table 11-2) does not identify specific projects, but it does show the level of funding the City aspires to commit to the neighborhood traffic management program for the duration of this plan. With regard to this funding, it is recommended that the City develop a process that ensures neighborhood traffic management funding is equitably distributed throughout the city.

Many of the policy recommendations contained in the Street Design chapter are applicable to neighborhood traffic management as well, the most relevant of which are summarized below.

- **Variety:** Allow for a wide variety of traffic management measures, as identified in this chapter's neighborhood traffic management "tool box."
- **Effectiveness:** Ensure that the chosen measure addresses the identified problem.
- **Landscaping:** Provide for landscaping wherever feasible and practicable.
- **Maintenance:** Consider maintenance needs and issues when designing traffic management measures and ensure long-term maintenance needs can be met.
- **Neighborhood Input:** Provide for neighborhood input when designing traffic management measures.

Figure 11-1 Neighborhood Traffic Management Process

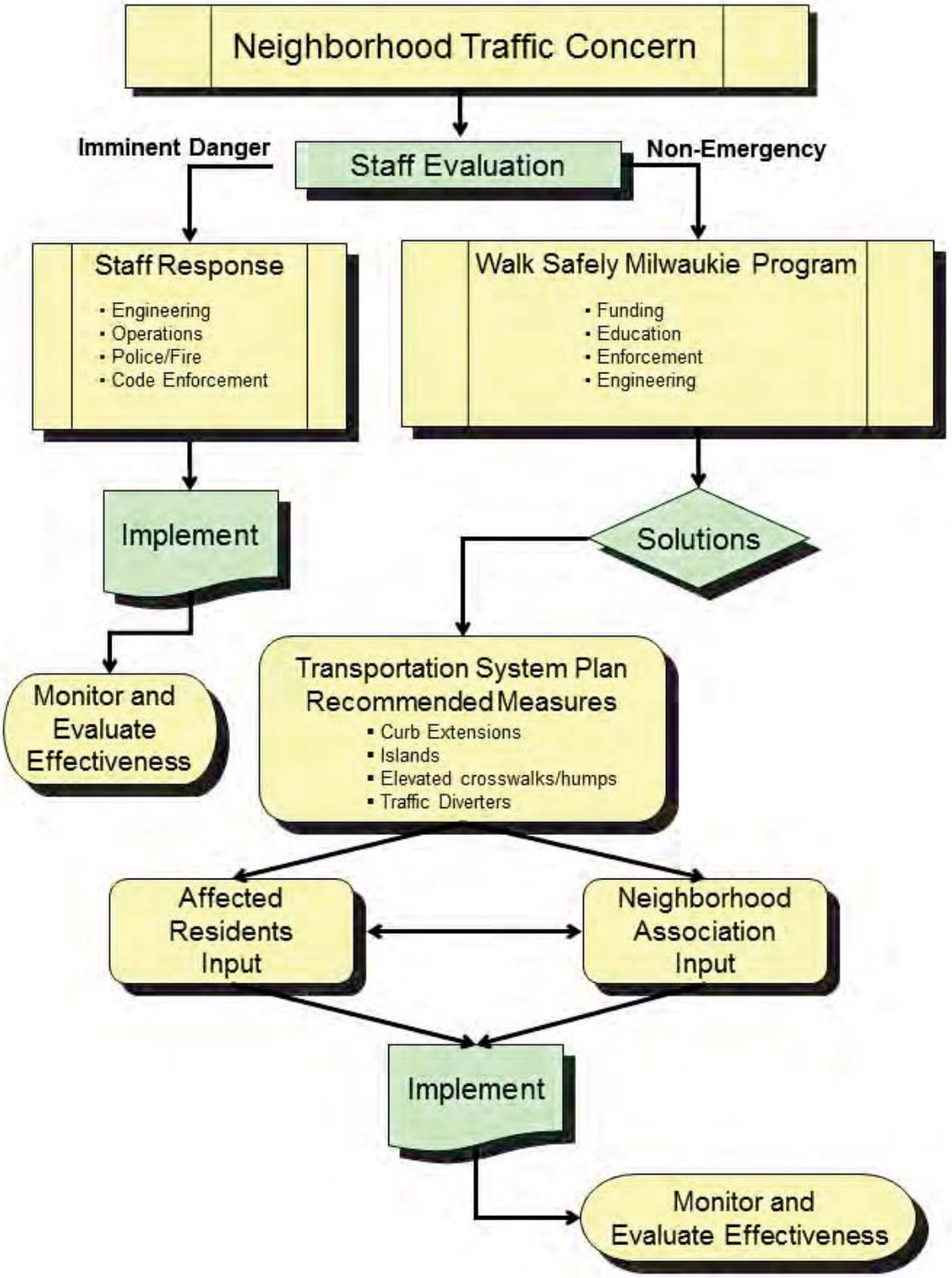


Table 11-2 Neighborhood Traffic Management Action Plan

Project Name	Project Description	From	To	Project Cost ($1,000s[2])	Direct Funding or Grant Match
Walk Safely Milwaukie Program	Complete a few small traffic-calming and pedestrian safety projects throughout the city each year.	Citywide	Citywide	$300 ($13 annually)[3]	Direct

[2] Project costs are order-of-magnitude estimates and are in 2012 dollars. Future costs may be more due to inflation.
[3] Historically, the Neighborhood Pedestrian and Traffic Safety Program received $13,000 annually. In more recent years, the program name changed to Walk Safely Milwaukie and funding was raised to $100,000 annually. Future funding for the program will be evaluated on a biennial basis with the budget.

Appendix F
Cost Estimate for Greenway Tools

Appendix F
Cost Estimate for Greenway Tools

Tools	Speed Reduction	Less Traffic	Estimated Construction Cost	Unit (if applicable)
1. Speed reader board	Varies	No	$60 to $90	Per hour
2. 14-foot speed bumps	Yes, 85 percent to 25 mph	Maybe	$2,000	Each
3. Chicanes	Varies	Maybe	$10,000 to $20,000	Per set
4. 12-foot-wide multiuse path	No	No	$188 (asphalt) to $223 (concrete)	Per linear foot
5. 6-foot-wide concrete sidewalk	No	No	$27	Per linear foot
6. 6-foot-wide concrete sidewalk + curb	No	No	$170	Per linear foot
7. 6-foot-wide asphalt sidewalk	No	No	$16	Per linear foot
8. 6-foot asphalt-paved shoulder	No	No	$6	Per square foot
9. Refuge island	1 to 3 mph	No	$14,000 to $60,000	Per island
10. Curb extension	No	No	$13,000 to $40,000	Per extension
11. Marked crosswalk	No	No	$1,000 to $1,500	Per crosswalk
12. Raised crosswalk	Yes	Maybe	$3,500	Per crosswalk
13. Hybrid beacons	No	No	$150,000	Per location
14. Full signal	No	No	$250,000	Per intersection
15. Crossing signs	No	No	$200	Per two signs
16. Rapid flash beacons	No	No	$12,000	Per beacon pole
17. Shared lane markings - sharrows	No	No	$250	Each
18. Forward stop bar	No	No	$300	Each
19. Bike button	No	No	$5,000	Each
20. Bike box	No	No	$5,000	Each
21. Bike signals	No	No	$10,000	Each
22. Two-way cycle track, marked roadside	No	No	$10 to $60	Per linear foot
23. Two-way cycle track, raised roadside	No	No	$700	Per linear foot

Tools	Speed Reduction	Less Traffic	Estimated Construction Cost	Unit (if applicable)
24. Stop sign	Unlikely	Maybe	$200	Each
25. Fire-truck friendly speed cushion	Maybe	Maybe	$3,000	Each
26. Mini-roundabout	Yes	No	$6,000 or more	Each
27. Traffic circle	Likely	Maybe	$20,000	Each
28. Roundabout	Yes	No	$200,000 or more	Each
29. Semi-diverter island	No	Yes, directional	$10,000	Each
30. Pinch points	Localized	Maybe	$10,000 or more	Each
31. Full diversion	No	Yes	$15,000 or more	Each
32. Green curb extension diverter	No	Yes	$40,000	Each

Tools	Estimated Construction Cost	Unit (if applicable)
33. Bioswale	$8 to $30	Per linear foot
34. Planter boxes	Varies	Depends on sizing and materials
35. Rain gardens	$500 to $6,500	Per bioretention area
36. Permeable pavement	$2 to $17	Per square foot

Sources:
Estimated Costs for items 01-03 and 08-33 attained from *Matching Engineering Tools to Neighborhood Livability Goals*, City of Portland, Oregon, Community and Schools Traffic Safety Partnership; available at http://seattlegreenways.org/wp-content/uploads/00-Mode-Goals-Tools-Table-2.pdf.

Estimated costs for item 04 attained from *Report on Shared-Use Path and Sidewalk Unit Costs,* Vermont Agency of Transportation, 2014. Available at http://vtransengineering.vermont.gov/sites/aot_program_development/files/documents/ltf/Cost_Report_2014.pdf.

Estimated costs for items 05-08 attained from *Costs for Pedestrian and Bicyclist Infrastructure Improvements*, Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, Daniel A. Rodriguez, 2013 Available at http://www.ssti.us/wp/wp-content/uploads/2013/10/PedBikeCosts.pdf.

Estimated cost for item 33 attained from *Stormwater Technology Fact Sheet: Vegetated Swales*, EPA, 1999. Available at http://water.epa.gov/scitech/wastetech/upload/2002_06_28_mtb_vegswale.pdf. Adjusted for 2014 values.

Estimated cost for item 35 attained from *Stormwater Technology Fact Sheet: Bioretention*, EPA, 1999. Available at http://water.epa.gov/scitech/wastetech/upload/2002_06_28_mtb_vegswale.pdf. Adjusted for 2014 values.

Estimated cost for item 36 attained from *Reducing Urban Heat Islands: Compendium of Strategies, Cool Pavements*, EPA, 2008, and *Porous Pavement Alternatives Cost Analysis*, Century West Engineering, 2013. Available at http://www.epa.gov/heatisland/resources/pdf/CoolPavesCompendium.pdf and http://www.centurywest.com/wp-content/uploads/2013/11/Metro-Porous-Pavement-Cost-Analysis.pdf, respectively.