



# ROCHESTER HILLS TRANSPORTATION MASTER PLAN 2021

City of Rochester Hills, Michigan  
**FEBRUARY 22, 2021**



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# PURPOSE

A **Transportation Master Plan** is a review of the entire transportation system, including vehicles, pedestrians, safety, and congestion. The plan provides recommended improvements and best practices for accommodating future growth and trends.

This Plan emphasizes improvements to priority corridors to address capacity issues, overall system management (traffic improvements and signal technologies), while also planning for emerging technology and travel modes beyond just vehicles.

Most importantly, an Action Plan is included that summarizes and prioritizes the recommended improvements to the transportation system in Rochester Hills over the next 10-15 years. This Action Plan includes critical implementation factors, such as cost estimates, logical phasing options, and potential funding sources.

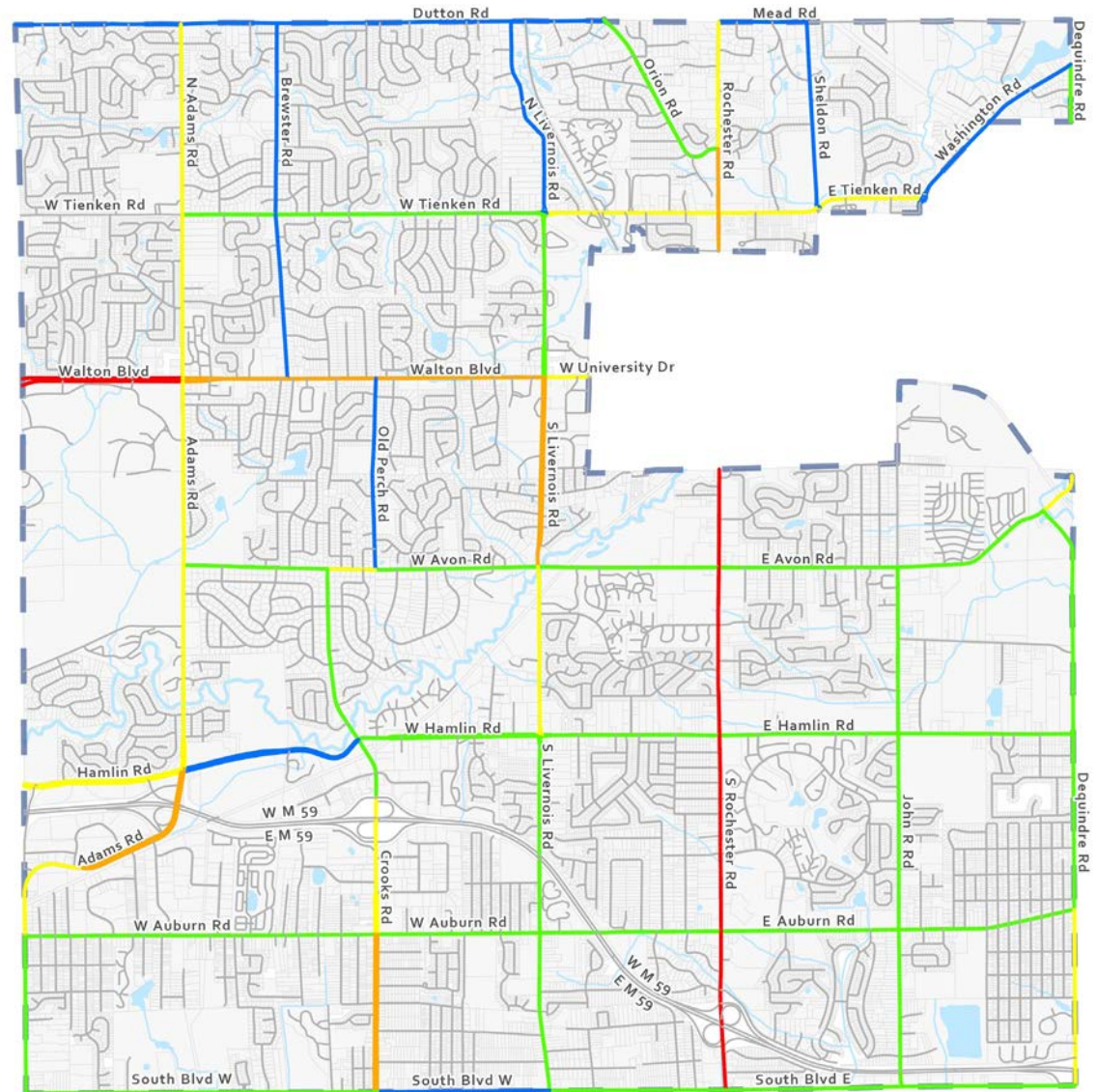


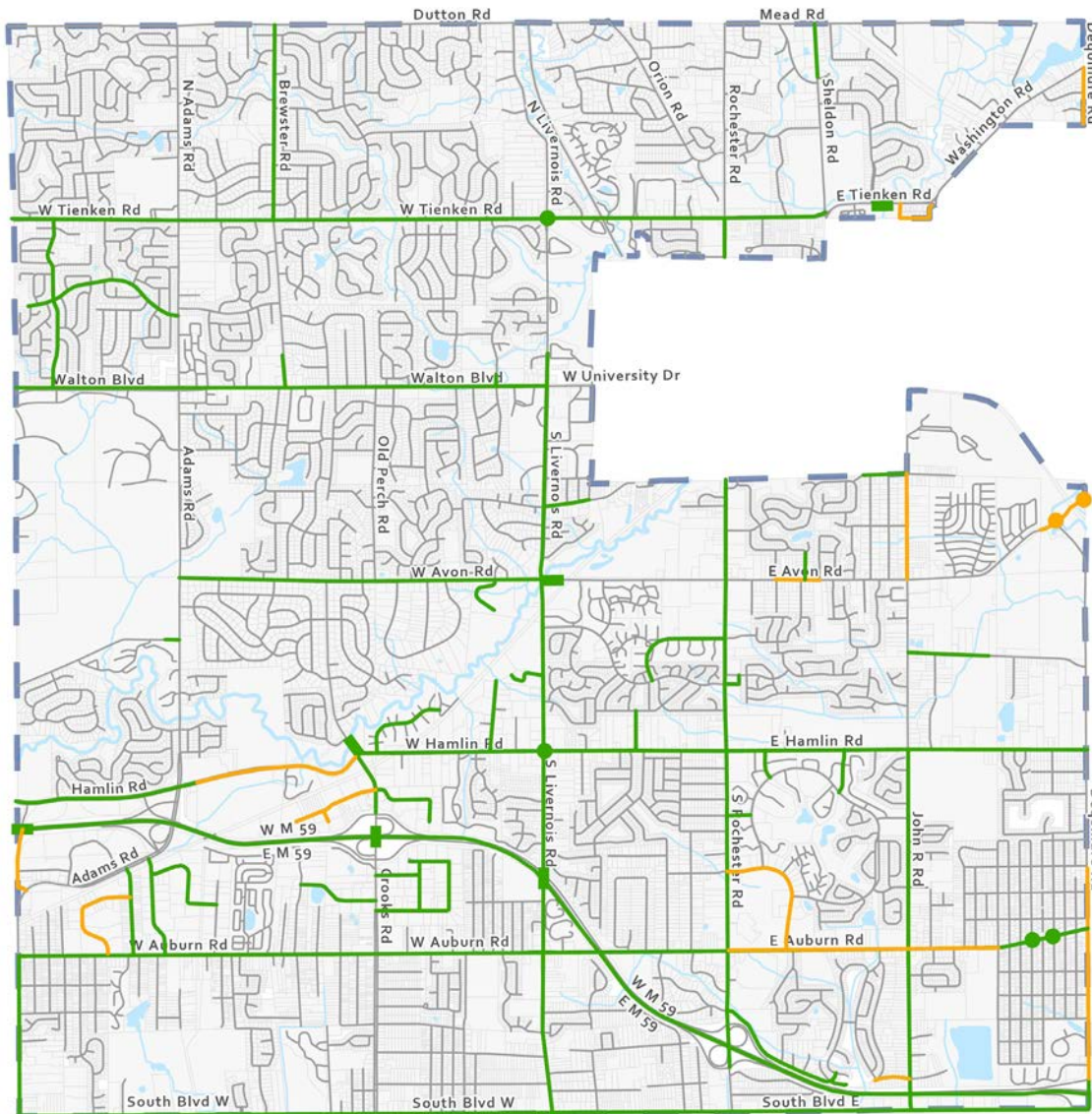
Figure 1: 2020 AVERAGE DAILY TRAFFIC (Pre-COVID)

- <10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- No Data

# COMPLETED AND PROPOSED ROAD PROJECTS

A review of completed and proposed road infrastructure projects was conducted on projects dating back to 2008, when the last Transportation Master Plan was completed. These projects were accounted for when formulating recommendations described and illustrated in this document.

The list of projects is based on SEMCOG's Transportation Improvement Program (TIP) project list between Fiscal Year (FY) 2008 and 2023, and the City of Rochester Hills' Capital Improvement Programs (CIP) from 2008 to 2025. Figure 2 presents a compilation of select projects which have been completed since 2008 or are proposed for construction in the near future.



**Figure 2: COMPLETED AND PROPOSED PROJECTS (2008-2025)**

- |                         |                        |
|-------------------------|------------------------|
| Completed Road Projects | Proposed Road Projects |
| — Segment Improvement   | — Segment Improvement  |
| ● Roundabout            | ● Roundabout           |
| ■ Bridge Improvement    |                        |



# ENGAGEMENT

Engagement was a critical component in the overall planning process. City Administration, agencies and stakeholders, City Council, City Planning Commission, and the community were all prompted to weigh in on future transportation improvements in Rochester Hills.

Both in-person and virtual meetings and workshops took place throughout the process. A project website allowed for continued input and an online survey was sent out to get feedback from the community on transportation priorities.



Figure 3: TRANSPORTATION PRIORITIES TO ADDRESS

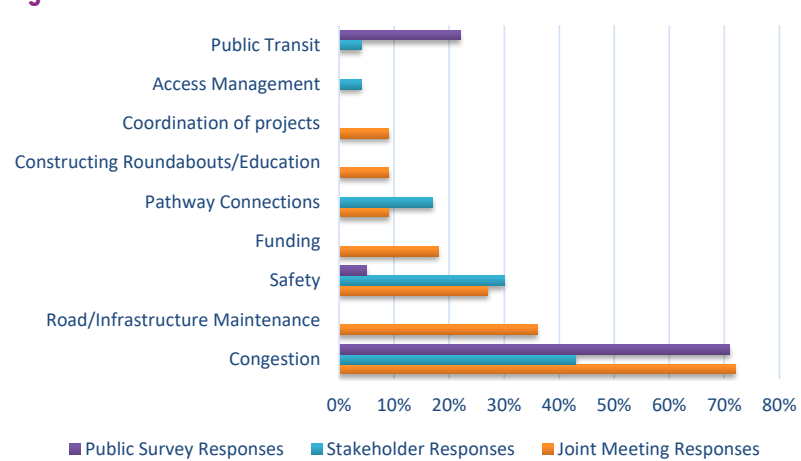
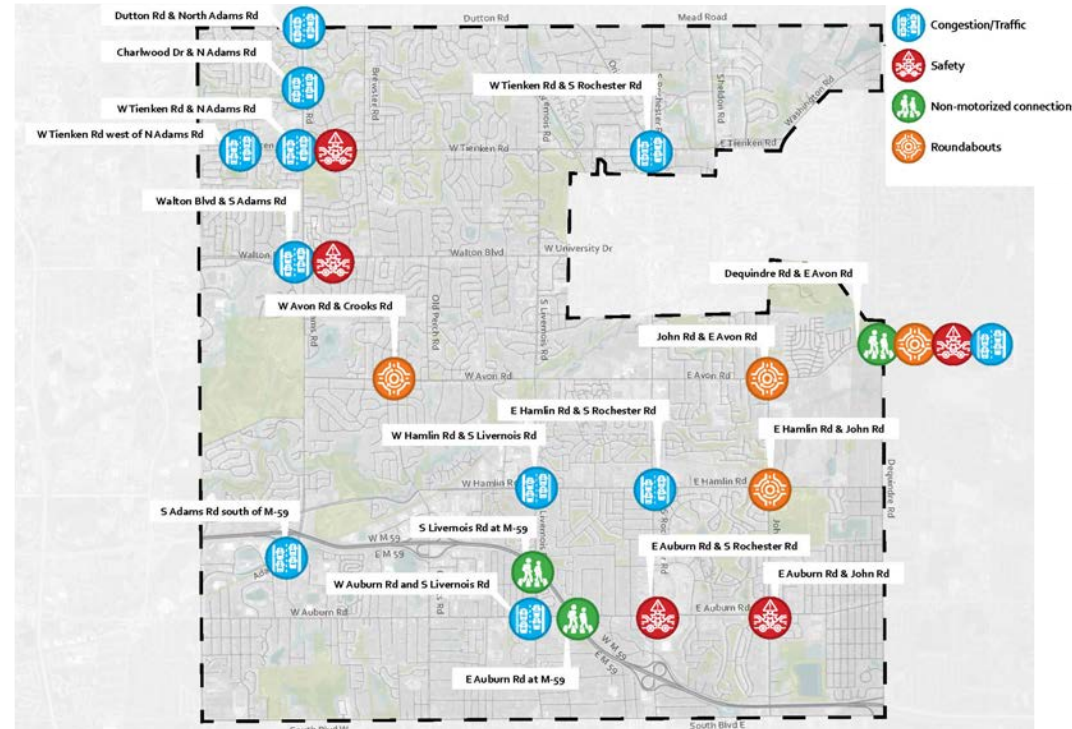


Figure 4: PRIORITY LOCATIONS TO ADDRESS (PLANNING COMMISSION, CITY COUNCIL, STAKEHOLDERS & PUBLIC)



## VISION AND GOALS

### Vision:

*The transportation system of Rochester Hills will be a reliable network that provides travel options for vehicles, pedestrians, and bicyclists. The transportation network will emphasize safe and efficient travel.*

### Goals:

- Provide for a safer transportation system by continuing to implement access management techniques and proven safety countermeasures.
- Ease strategic areas of traffic congestion through a multi-pronged approach.
- Enhance and maintain existing multi-modal facilities and create new connections where safety and access are priorities.
- Prepare for advanced technologies, such as connected and autonomous vehicles and developing smart corridors.
- Maintain current infrastructure, including roads and non-motorized pathways.
- Explore public transportation options along select major corridors.

### SAFER TRANSPORTATION SYSTEM



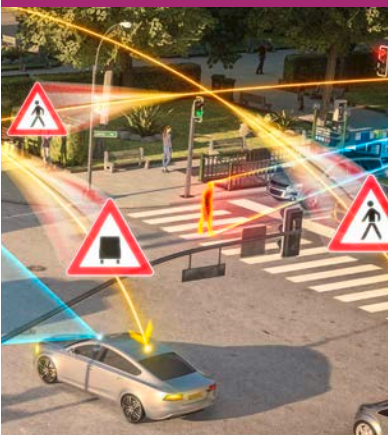
### EASE TRAFFIC CONGESTION



### ENHANCE MULTI- MODAL FACILITIES



### PREPARE FOR NEW TECHNOLOGY



### MAINTAIN CURRENT INFRASTRUCTURE



### EXPLORE PUBLIC TRANSPORTATION OPTIONS



# CITYWIDE RECOMMENDATIONS

The corridor and intersection recommendations shown in Figure 5 were derived from the complete list of corridor and intersection observations found in the Appendix. These location-specific recommendations are a combination of congestion, safety, non-motorized and intersection improvements, as well as proposed road diets and one freeway crossing. These recommendations, as well as the Action Plan which is a subset of the recommendations intended to be implemented in the short term, are described in greater detail in the Applied Recommendations and Action Plan section of this plan.

Table 1 contains citywide recommendations related to policy, funding and best practices. These recommendations are discussed in greater detail in the recommendations and toolkit sections of this plan.

Implementation of the plan's recommendations will require collaboration between local, regional, state, federal, and transit agencies, as well as residents, property/business owners, and other stakeholders. The Action Plan is intended to serve as a guiding tool for implementation and should be revisited on an annual basis to track progress and make necessary adjustments to projects and priorities.

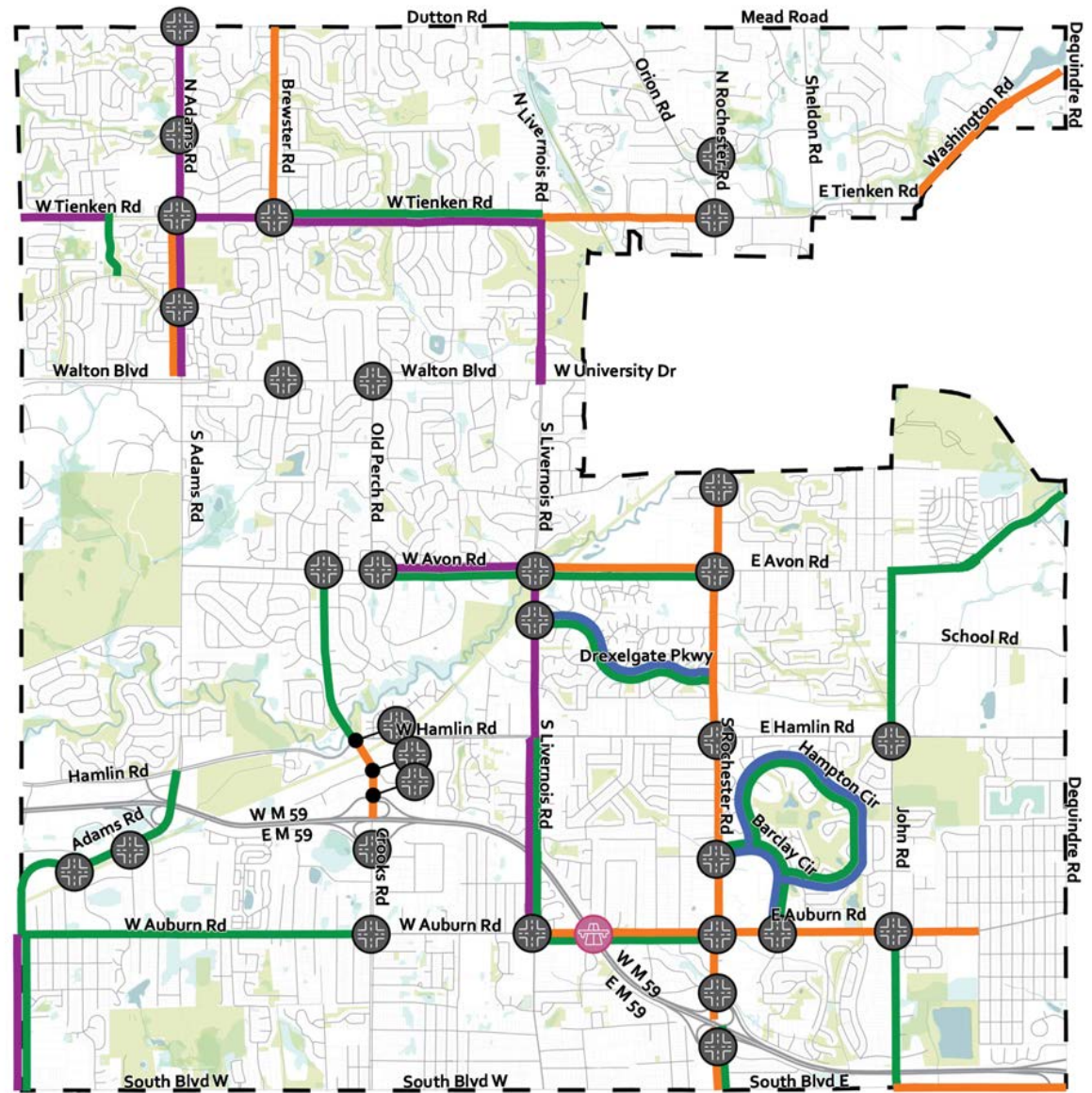












Figure 5: CORRIDOR AND INTERSECTION RECOMMENDATIONS





Table 1: CITYWIDE RECOMMENDATIONS

Recommendation Number & Type	Recommendation Description
 01	Work with School District to implement SRTS recommendations, particularly along key walking routes to elementary schools.
 02	Connect neighborhoods with City Forestry department for planting of street trees as part of a traffic calming program.
 03	Amend City ordinance to allow Class I e-bikes to use pathways, coordinate with other trails and pathways organizations in the city and surrounding communities.
 04	Monitor experiences of other communities and agencies with e-bikes and e-scooters to determine if other ordinance amendments should be considered.
05	Work with OPC, County, RTA, SMART to evaluate connections to regional transit and destinations; development of mobility hubs within the city.
06	Work with OPC on maintaining and extending transit service within the city.
 07	Coordinate with MDOT to study, seek funding, and approve non-motorized crossings of M-59.
 08	Work with RCOC, MDOT, SEMCOG to implement new transportation technologies, including potential pilots along Walton Blvd and Adams Rd.
 09	Require a Multi-Modal Transportation Impact Assessment (MMTIA) to be completed with new developments.
 10	Apply access management principles as part of site plan review for new development and redevelopment along major corridors.
 11	Study the implementation of road diet and bicycle facilities throughout the city to calm traffic and expand the non-motorized transportation network.
 12	Improve trail crossings along major roadways.
13	Explore incentives for electric vehicle charging stations.

01

# INTRODUCTION



# PURPOSE OF THE PLAN

A Transportation Master Plan is a review of the entire transportation system, including vehicles, pedestrians, safety, and congestion. The plan provides recommended improvements and best practices for accommodating future growth and trends.

Previous Transportation Master Plans in Rochester Hills were prepared during periods of growth. Those plans emphasized tackling the increases in traffic volumes and congestion and modeling to estimate future traffic forecasts and capacity demands as a priority. Since that time, population and traffic volumes have generally stabilized. While there is still congestion present in the city, a number of traffic capacity improvements have been made recently or are currently underway to address this issue. The city has also made a significant investment in pathways along major roads and trails to

connect to the larger regional non-motorized network.

This Transportation Master Plan emphasizes improvements to priority corridors to address capacity issues, overall system management (traffic improvements and signal technologies), while also planning for emerging technology and travel modes beyond just vehicles.

Based on the Complete Streets policy that the city adopted in 2011, a “Complete Network” approach was applied to identify key corridors where certain design elements may be appropriate and emphasize safety for all road users (vehicles, pedestrians, and bicyclists). Improvements include traffic calming, upgrades to the pathway system, and assertive access management approaches.

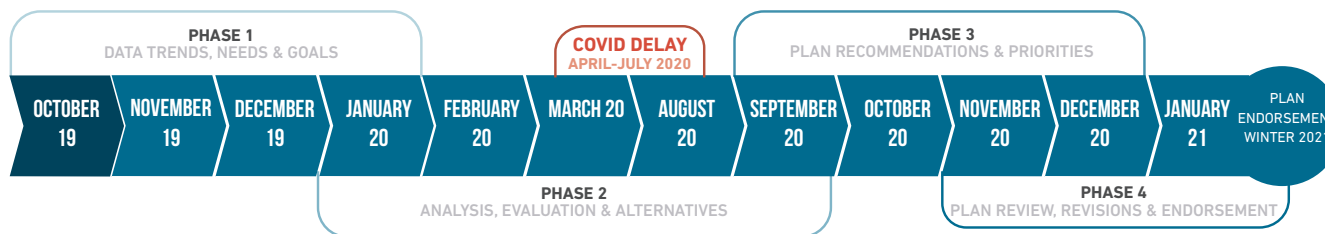
Most importantly, the Transportation Master

Plan includes an Action Plan that summarizes and prioritizes the recommended improvements to the transportation system in Rochester Hills over the next 10-15 years.

## PROCESS & TIMELINE

This multi-phase process took over just one year to complete, with engagement being a central focal point to influence the direction of the plan.

- **Phase 1** explored existing conditions and initial conversations took place with agencies and stakeholders to discover opportunities for improvements.
- During **Phase 2**, key priority topics were discussed and evaluated, such as safety, congestion, and non-motorized options. Engagement continued in order to learn and test ideas.
- Plan recommendations and an action plan were drafted during **Phase 3** of the project.
- The plan was finalized during **Phase 4** which included presentations to the City, public, agencies, and stakeholders.



## GLOSSARY OF RELEVANT TRANSPORTATION TERMS

The Glossary of Relevant Transportation Terms is a catalogue of relevant terms referenced throughout this document and defined as they pertain to Rochester Hills.

Term	Definition
<b>Access Management</b>	Set of techniques which ensure convenient and adequate access to adjacent land uses while striving to improve safety and efficiency of the transportation network. This involves efforts to reduce the number of driveways along a major roadway, and to space driveways to reduce congestion and potential for crashes.
<b>Average Annual Daily Traffic (AADT)</b>	Total number of vehicles on a transportation facility in a year divided by the number of days in that year.
<b>Average Daily Traffic (ADT)</b>	The number of vehicles that travel along a road, based on actual counts. This may be an estimate based on counts taken at various times of the year.
<b>Autonomous and Connected Vehicles</b>	Vehicles with a greater level of autonomy and which have on-board sensors and can communicate with the systems in other vehicles or infrastructure. The National Highway Traffic Safety Administration has established five level of autonomous vehicles based on the degree of vehicle automation as described in the Plan.
<b>Bump Outs</b>	Extensions of the sidewalk and curb towards the roadway. They shorten crossing distances, enhance pedestrian safety by increasing pedestrian visibility, and potentially reduce speeds by narrowing the roadway.
<b>Backplate</b>	A device installed behind a traffic signal head which improves signal visibility by providing a visual contrast between the signal and surrounding environment.
<b>Capacity</b>	A calculation of the number of vehicles that can travel along a roadway without experiencing congestion. The capacity of a roadway is typically evaluated by the amount of delay for the average vehicle traveling through a signalized intersection at the peak (rush) hours. A more general capacity for a roadway is typically based on the number of lanes and other factors such as the frequency of traffic signals, number of driveways, traffic speeds, and other factors that may reduce traffic flow.
<b>Classes of E-Bikes</b>	E-bike classification based on how an e-bike can operate. There are three classes of e-bikes, distinguished by maximum assisted speed and level of pedal-assist. The e-bike class can guide the way they are regulated.
<b>Complete Streets</b>	A transportation approach which requires transportation facilities to be safe, accessible, convenient, and comfortable for all individuals regardless of age, ability, or mode of transportation (meaning walking, bicycling, driving, using transit or other ways of traveling).
<b>Crash Density</b>	Spatial analysis method which identifies location specific crash patterns or hot spots. A hot spot indicates a concentration of crashes and thus a potential safety concern.

Term	Definition
<b>Crash Frequency</b>	The number of crashes occurring on a specific segment or intersection over a specified time.
<b>Crash Rate</b>	The number of crashes occurring on a specific segment or intersection over a specified time while accounting for traffic volumes (exposure variable).
<b>Conflict Point</b>	A place where two or more vehicle, bicycle, and/or pedestrian paths cross each other. The more conflict points in an area, the higher chance for a crash. Reduction in conflict points is one objective of Access Management defined above.
<b>Electric Vehicle (EV) Charging Station</b>	Infrastructure used in recharging plug-in electric vehicles. The stations are typically on-street facilities with access to an electric source installed at parking spaces in locations such as shopping centers, restaurants, and places of employment.
<b>Federal Aid Committee (FAC)</b>	The body which allocates federal aid road funding for a particular jurisdiction. In Oakland County, the Oakland County FAC uses objective scoring criteria to select road projects which will receive federal funding in future years.
<b>Fixed Route Bus Service</b>	Buses that pick up and drop off at designated bus stops and times, along fixed routes. SMART provides fixed route bus service to neighboring communities in Oakland County.
<b>Free Flow Speed (FFS)</b>	The speed at which drivers feel comfortable to drive on uncongested road conditions. This may be greater than the posted speed limit.
<b>Highway Capacity Manual (HCM)</b>	The primary publication prescribing methods for quantifying highway capacity.
<b>Highway Safety Manual (HSM)</b>	The primary publication prescribing methods for quantifying highway safety.
<b>Leading Pedestrian Interval (LPI)</b>	Gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk. (FHWA definition)
<b>Level of Service (LOS)</b>	A quantitative measure describing how a transportation facility operates for vehicles. LOS is typically a measurement of the delay for the average vehicle at a signalized intersection during the peak hours. This ranges from a low delay or free (A) to heavy congestion (F). Given a variety of factors, the target for a city like Rochester Hills is typically D. (a similar but more qualitative measurement, called Quality of Service, is often applied to evaluate the service for pedestrians, bicyclists and transit users.
<b>Level of Service Safety (LOSS)</b>	A safety performance measure used to identify high-risk safety locations by determining the degree to which the observed crash frequency varies from the predicted crash frequency on a similar roadway.
<b>Low Level Signal</b>	A traffic signal head typically installed on a pole at an intersection corner used to supplement the primary signals. They are installed at locations where signal visibility may be of concern due to factors such as grade and angle of intersection.
<b>Long Range Transportation Plan</b>	A detailed road map on how the transportation system will be developed and maintained over a 25-year period. SEMCOG is the agency administering the long-range transportation plan for the Metro Detroit region.

## GLOSSARY OF RELEVANT TRANSPORTATION TERMS

Term	Definition
<b>Manual on Uniform Traffic Control Devices (MUTCD)</b>	Manual listing the standards for all nationwide traffic control devices and their use on all public transportation facilities.
<b>Micromobility</b>	Small human- or electric-powered vehicles/devices such as bikeshare, e-bikes, and e-scooters. Shared services are available on-demand and can be docked or dockless.
<b>Micro-Transit</b>	Transit service that is privately or publicly operated and typically uses multi-passenger shuttles or vans to provide on-demand or fixed-schedule services with either dynamic or fixed routing.
<b>Mobility-as-a-Service (MaaS)</b>	The integration of various forms of transportation services, including private and public services, into a single mobility service, accessible on demand. MaaS systems integrate trip planning, booking, and payment to create a seamless system for the end user. Services may include ridehailing services like Uber and Lyft, bike sharing, scooter sharing, car sharing, transit, and micro-transit.
<b>Mobility Hubs</b>	Select locations of connectivity where different travel options, including walking, biking, transit, and new and shared mobility, come together. These centers may include amenities to support different types of mobility services.
<b>National Functional Class (NFC)</b>	Federal classification which groups public roads based on mobility and land access.
<b>National Highway System (NHS)</b>	Federal identification for those roads important to the nation's economy, defense, and mobility.
<b>Non-Motorized Transportation</b>	Traditionally includes walking and biking. Definition may be expanded to include new micromobility vehicles/devices that enhance the non-motorized travel experience, as legally permitted.
<b>Pavement Friction</b>	Road pavement must have an appropriate level of friction for drivers to be able to maintain the vehicle safely on the road. The pavement friction quality can erode over time and lead to skidding or hydroplaning. Improving the pavement friction is a safety related countermeasure applied in area where run off the road crashes are common.
<b>Pavement Surface Evaluation and Rating (PASER)</b>	Pavement evaluation method which uses visual inspection conducted by a trained engineer and assigns a rating number based on pavement type (asphalt or concrete) and magnitude of deterioration present. The PASER system is the statewide standard for evaluating pavement conditions.
<b>Peak Hour</b>	The hour of the day that a transportation facility experiences the highest volume. This is typically experienced during weekday PM hours, and is used as basis for capacity analysis. Peak hour may be different for different modes.
<b>Pedestrian Countdown Timer</b>	Pedestrian signal which provides pedestrians or bicyclists with the remaining time in seconds for them to cross the roadway or the pedestrian phase to end.

Term	Definition
<b>Pedestrian Hybrid Beacon (PHB)</b>	A traffic control device used on higher speed and/or higher volume road to allow pedestrian cross safely by alerting drivers to stop for oncoming pedestrians.
<b>Performance Measures</b>	A set of metrics used to define the performance of a transportation facility. Congestion and safety are the primary performance measures used in this master plan.
<b>Rectangular Rapid Flashing Beacon (RRFB)</b>	Pedestrian-activated LED lights that supplement pedestrian warning signs at un-signalized intersections or midblock crossings. Once activated, the lights flash in rapid succession to alert drivers to stop at oncoming pedestrian crossings.
<b>Refuge Island</b>	Raised pavement sections placed on streets at an intersection or midblock to provide pedestrians with a protected resting place as they generally wait for drivers to stop or for a gap in traffic to finish crossing the road.
<b>Retroreflectivity</b>	The ability of the material to reflect light back to its original path. This material is used on road features such as signs and pavement markings to allow them to be seen, in particular at night.
<b>Road Diet</b>	A method used to reconfigure the road by removing excess lanes and/or reducing lane widths to improve safety and accessibility of the road. Road diets are typically implemented through restriping and may be permanently implemented through moving curbs. They often are implemented hand-in-hand with enhancements to pedestrian and bicycle facilities.
<b>Roadside Unit (RSU)</b>	Devices installed typically at intersections to communicate information to vehicles and vice versa.
<b>Quality of Service</b>	See Level of Service above.
<b>Queue</b>	The number of vehicles, pedestrians, or bicycles waiting in line to be serviced by a system (i.e. vehicles waiting at an intersection for the red light to turn green).
<b>Safe Routes to School (SRTS)</b>	An international movement and now a federal program to make it safe, convenient, and fun for children, including those with disabilities, to bicycle and walk to school. State of Michigan and Rochester Community School District (RCSD) are active participants.
<b>Safety Countermeasure</b>	Techniques used to improve roadway safety through engineering, education, enforcement, and emergency medical service strategies.
<b>Safety Edge</b>	Reshaping of the edge of the pavement into a 30-degree angle during installation. The angled safety edge avoids vertical drop-offs if the granular shoulder shifts from the pavement edge.
<b>Safety Performance Function (SPF)</b>	Statistical equation used to determine the expected crash frequency of a transportation facility based on various exposure factors such as traffic volumes.
<b>Shared Use Path</b>	A facility designed for recreational and transportation use for a wide array of users including pedestrians and bicyclists. Shared use paths are typically two-way and 8-10 feet wide.

## GLOSSARY OF RELEVANT TRANSPORTATION TERMS

Term	Definition
<b>Sight Distance</b>	The portion of the roadway visible to the driveway.
<b>Signal Warrant</b>	A condition or set of conditions which a location must meet to justify the installation of the traffic signal. The conditions are set forth in the Manual on Uniform Traffic Control Devices.
<b>Smart Mobility</b>	Refers to new technologies that increase communication between transportation vehicles and devices. Refers to the application of real-time data analytics and machine learning to make transportation safer and more efficient. Includes CAVs, MaaS, micromobility, micro-transit, curbside management, and more.
<b>Storage Length</b>	The area that accommodates vehicles lined up or queued in a lane. It is used to prevent vehicles in queue from obstructing traffic movement in other lanes.
<b>Traffic Calming</b>	A set of measures and strategies used to improve safety and comfort for all road users by discouraging high speeds or risky driver behaviors.
<b>Traffic Demand Model</b>	A model developed by SEMCOG which estimates existing and future traffic volumes and other traffic factors for the SEMCOG region. It is used to inform decision making for various transportation plans, such as the long-range transportation plan.
<b>Traffic Signal Modernization</b>	The rebuilding of a traffic signal to update all outdated signal infrastructure. Signal modernization can improve both the safety and efficiency of a signal.
<b>Traffic Signal Optimization</b>	Improvements to signal timing and coordination along the mainline or signal improvement with newer equipment to optimize signal operations proactively in order to improve signal efficiency.
<b>Transportation Improvement Program (TIP)</b>	A federally mandated document which describes how federal transportation funds will be used to improve and support a regional transportation system.
<b>Two-Way Left-Turn Lane (TWLTL)</b>	A third lane installed on two-lane roads to facilitate left-turning movements. They are used improve safety on two-lane roads by removing turning vehicles from the primary lane and providing these vehicles with more acceptable gaps. TWLTLs can also reduce congestion along two-lane roadways with a high driveway density and/or high number of left-turning vehicles.
<b>Vehicle-to-Infrastructure (V2I)</b>	Exchange of information in connected and autonomous vehicles between vehicle and infrastructure and vice versa.
<b>Vehicle-to-Vehicle (V2V)</b>	Exchange of information in connected and autonomous vehicles between vehicles.
<b>Volume-to-Capacity (V/C) Ratio</b>	A general measure of the amount of congestion experienced along a transportation corridor. It compares the average daily weekday traffic (Volume) to the maximum traffic flow that can be accommodated by the facility during a given time under various road conditions (Capacity)
<b>Wet Reflective Pavement Markings</b>	Type of pavement marking designed to provide improved retroreflectivity during wet road surface conditions.





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02

## PREVIOUS PLANNING EFFORTS



# PREVIOUS TRANSPORTATION MASTER PLANS

The City of Rochester Hills has consistently placed importance on its transportation network. This is evident through the many roadmaps and studies developed through the years to determine appropriate infrastructure improvements and develop a vision for the future of its transportation system. Most recently, there were Rochester Hills Master Thoroughfare Plans completed in 1998 and 2008.

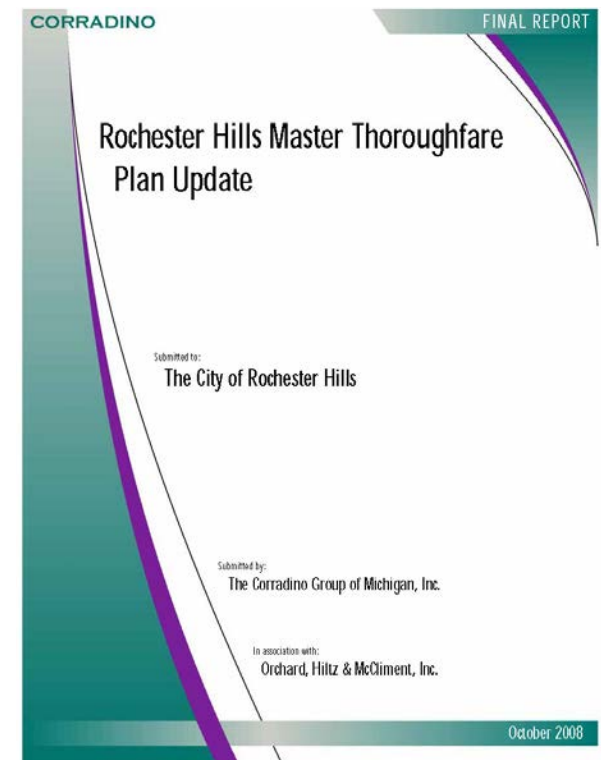
## 2008 Master Thoroughfare Plan

The 2008 Master Thoroughfare Plan's intent was to anticipate future travel needs in the community and identify improvements which are reasonable and feasible. It developed a list of roadway alternatives through factors such as public involvement, travel demand analysis, congestion analysis, safety, and land use considerations. A set of alternatives were developed as a result of these factors which were then ranked in terms

of priority. They included improvements such as access management along corridors of high driveway density, installation of two-way left-turn lanes (TWLTL), capacity increases at intersections, and alignment changes along areas such as Avon Rd and Dequindre Rd.

Several of the improvements or versions of the improvements identified in the 2008 Master Thoroughfare Plan have been or are currently being planned for implementation. For example, Avon Rd near Dequindre Rd is being reconstructed with two roundabouts to improve congestion and safety near the Yates Cider Mill.

It is the intent of this Transportation Master Plan to build on the findings of the 2008 Master Thoroughfare Plan, and develop a transportation roadmap for the future which fits the needs, direction, and vision of the community.



## 2011 ROCHESTER ROAD CORRIDOR ACCESS MANAGEMENT PLAN

Rochester Hills joined MDOT, SEMCOG, Rochester, Royal Oak, Clawson and Troy to prepare a detailed access management plan for Rochester Road. This Plan provides an overview of how traffic flow and safety can be improved through gradual changes to reduce the number of access points, increase the spacing between them, with a focus on driveways near signalized intersections and crash zones. Since Rochester Road is under the jurisdiction of MDOT, the Plan compares the number and location of existing driveways to MDOT's guidelines.

Specific recommendations are provided for the consolidation and relocation or redesign of specific driveways in Rochester Hills. Implementation can occur during redevelopment, future road reconstruction projects, and continued collaboration between MDOT and the city. This Plan forms a framework for the Access Management recommendations in this Plan.



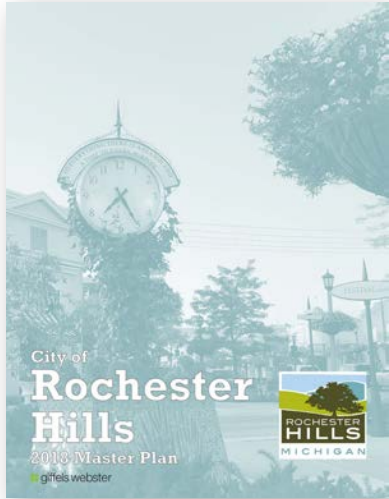
## 2017 AUBURN ROAD CORRIDOR PLAN

In early 2017, the City of Rochester Hills adopted the Auburn Road Corridor Plan, which provided recommendations for the six-mile corridor of Auburn Road through the southern part of city. There was a particular focus on the Brooklands neighborhood and business district between Culbertson Avenue and Dequindre Road. Traffic volumes were well below the capacity, so there was an opportunity to repurpose some of the roadway width (a "road diet" as described elsewhere). Among the goals for that district were to improve walkability, slow down traffic speeds, reduce potential for crashes, better organize parking, and create a more distinct and appealing area.

Building upon the plan's extensive community engagement program and its recommendations, the project moved from a conceptual plan into a more detailed design. The transformed street includes a center median, two roundabouts, on-street parking, improved pedestrian facilities, sidewalks, streetscape enhancements, landscaping, and lighting. As part of this process, the jurisdiction for this and some other segments of Auburn Road were transferred from MDOT to the city. This is an example of how a Plan can set the course to change a street. In this case, it was a relatively rapid five year process.



# 2018 ROCHESTER HILLS MASTER PLAN



The 2018 Rochester Hills Master Plan was evaluated to pinpoint relevant pieces that impacted the Transportation Master Plan. From the beginning, there was a need to ensure alignment and consistency amongst recent plans, including the visions and overall goals.

Most of the guiding themes in the 2018 Master Plan directly correspond to transportation in Rochester Hills. For example, improving and creating walkable places to enhance the city which will in turn support community health and residents of all ages if mobility options are increased. The plan also discusses accommodating alternative modes of transportation and new technologies.

Additionally, the plan emphasizes building more connections between neighborhoods, schools and parks, closing the gaps in the off-street pathway system, as well as working with adjacent communities.

## Guiding/Influencing Themes

- **Enhance.** Land Use policies and implementation strategies should focus on concentrating development to create more walkable places
- **Improve Community Health.** Accommodate for an aging population, walkability, and active lifestyles
- **Support Residents of All Ages.** Improve walkability and mobility, and make age-friendly activities and diverse housing choices available
- **Promote Sustainable Development.** Support changing modes of transportation, protect natural resources, encourage low-impact building techniques, and preserve open space/natural features

## Community Amenities and Services Objectives

- Close gaps in the off-street pathway system
- Link schools, neighborhood sidewalks, and parks to the off-street pathway system

## Land Use Planning Objectives

- Continue connections between neighborhoods and to schools, parks, civic uses, and goods/services

## Transportation Objectives

- Traffic calming and access management
- Expand non-motorized pathway system that links to various land uses and provides choice of mode
- Encourage innovative traffic design and flexible engineering standards for safety and efficiency
- Opportunities for alternative transportation
- Monitor and plan for future trends (i.e. Connected and Autonomous Vehicles)

## 2019 ROCHESTER HILLS PUBLIC OPINION SURVEY

In addition to reviewing the *Rochester Hills Master Plan*, the 2019 Public Opinion Survey was also analyzed (specifically for transportation priorities). This provided guidance for conversations with stakeholders, City Council, and Planning Commission. It also created the foundation for follow up questions as part of the public survey in the Transportation Master Plan.

**60%**

Cited **TRAFFIC CONGESTION** as the one of the most serious problems facing the city.



Many respondents stated that walking or biking on trails is what they like best about living in Rochester Hills.



Nearly one-third of respondents said **ADAMS ROAD** is in the most need of road widening.

**30%**

**ADAMS**

**18%**

**LIVERNOS**

**12%**

**ROCHESTER**



Most respondents have positive feelings toward roundabouts in the city.

On average, respondents would be willing to pay no more than \$71 on their property tax bill to fund public transportation



**12%**

Cited **LACK OF PUBLIC TRANSPORTATION** as the one of the most serious problems facing the city.

## 2019 LIVERNOIS ROAD RECONSTRUCTION PROJECT

The 2019 Livernois Road Reconstruction Project spanned from Avon Road to just north of Walton Road. Funding was split between federal, Road Commission, City of Rochester Hills and Oakland County general government (Tri-Party Program).

The project included the following enhancements:

- Removal of the existing concrete pavement
- Replacing the curbs and gutters
- Paving with Asphalt
- Traffic-signal modernization
- American with Disabilities Act (ADA) compliant sidewalks
- Guardrail upgrades
- Retaining wall repairs



## 2020 ROCHESTER ROAD IMPROVEMENT PROJECT

The 2020 Rochester Road Improvement Project began in Fall 2020 and was funded by the Michigan Department of Transportation (MDOT). The project spanned from Avon Road to the Clinton River.

The improvements included concrete patching and surface seal treatment to all for a smoother ride for drivers, and concrete sidewalk ramps to improve accessibility throughout the corridor.

MDOT is currently scoping the project to reconstruct two segments of Rochester Road (M-150):

- Rochester, from the Paint Creek bridge to Tienken Road, will be reconstructed in FY 2024. This project is investigating options to improve safety and operations at the Rochester and Tienken intersection.
- Rochester, from Avon to the Clinton River bridge, will be reconstructed in FY 2025.

03

# EXISTING CONDITIONS





## OVERVIEW

An analysis on the existing conditions presents a baseline for future recommendations.

This section presents a review of general road characteristics, road conditions, traffic operations, and safety. Additional reference material and maps not specifically presented in this section can be found in the Appendix.

This section contains text, maps and tables describing the following topics:

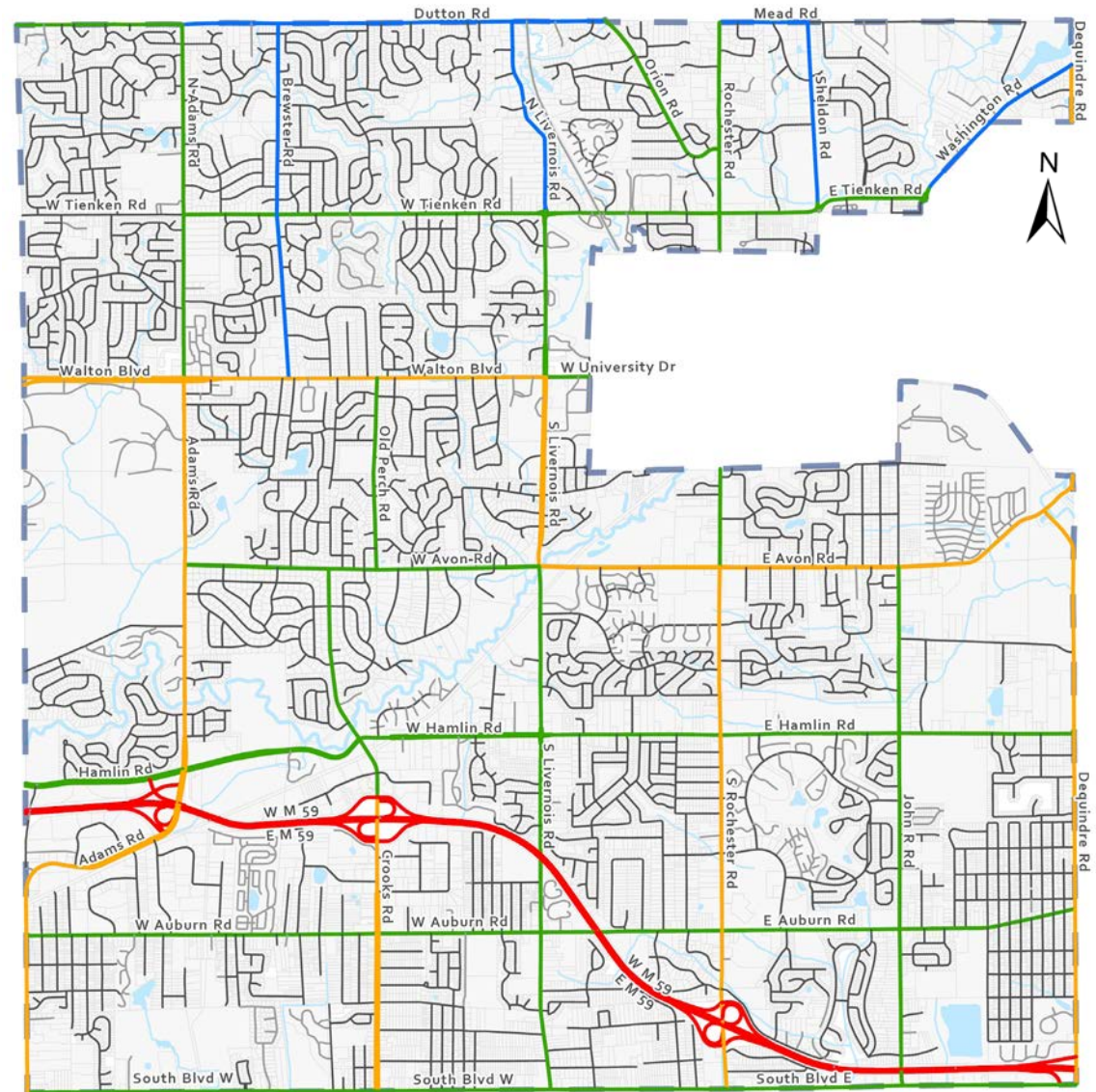
- Road Classification
- Road Ownership
- Truck Routes
- Road Condition
- Right-Of-Way
- Traffic Volume
- Traffic Safety



## ROAD CLASSIFICATION

The road network in the City of Rochester Hills is characterized by a grid-pattern, where primary routes run both in the east-west and north-south direction and generally extend through the entire city limits. Per the National Functional Class (NFC), which groups public roads based on mobility and land access, the network is characterized by a combination of freeways, principal arterials, minor arterials, collectors, local, and private roads, with a total of 397 miles of roadway. Figure 6 illustrates the road NFC for the City of Rochester Hills.

In addition, part of the city's transportation system also belongs in the National Highway System (NHS). These are roads important to the nation's economy, defense, and mobility. Approximately 43.7 miles of the transportation network are NHS routes.



**Figure 6: ROAD NATIONAL FUNCTIONAL CLASSIFICATION (NFC)**

- Freeway (35,000 – 129,000 vehicles per day)
- Principal Arterial: (7,000 – 27,000 vehicles per day)
- Minor Arterial: (3,000 – 14,000 vehicles per day)
- Collector: (1,100 – 6,300 vehicles per day)
- Local: (80 – 700 vehicles per day)
- Private: (AADT varies based on road function)

### **Freeway**

M-59 is approximately 19 miles in length and is the only freeway in the City. M-59 connects to the rest of the Rochester Hills transportation network through four interchanges.

### **Principal Arterials**

The most heavily traveled cross city routes within urbanized areas and which encourage mobility and commercial traffic. There are approximately 24.8 miles of principal arterials located within the city.

### **Minor Arterials**

Provide a lower level of mobility than principal arterials and are intended for shorter trip distances and less traffic. There are approximately 44 miles of minor arterials located within the city.

### **Collectors**

Major or minor roads which connect local roads to the arterials. They provide less mobility and more land access than arterials. There are approximately 8.3 miles of collectors located within the city.

### **Local Roads**

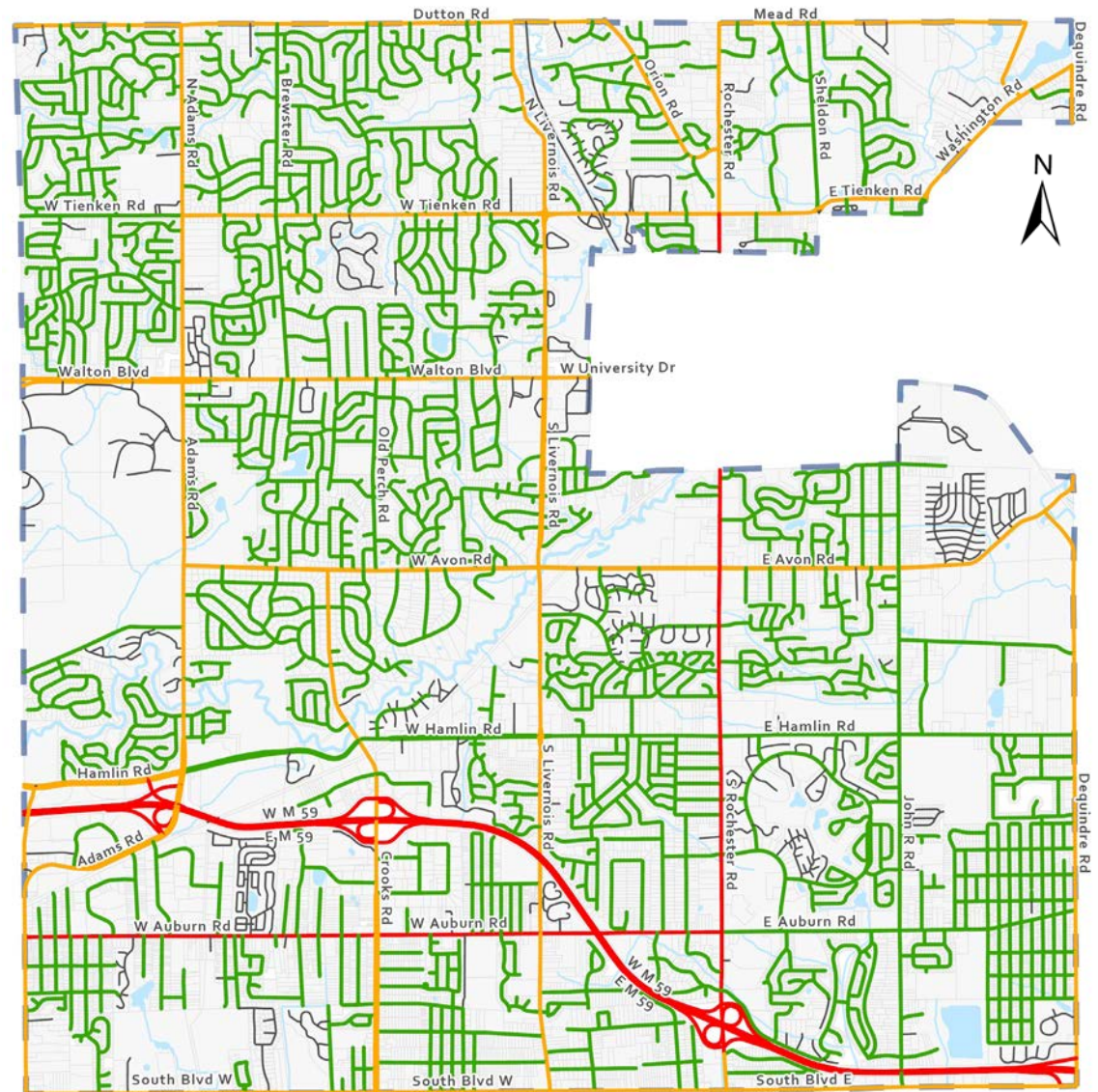
Provide limited mobility and are the primary access to residential neighborhoods and other local areas. Local roads comprise the majority of the road network in the city with approximately 247.2 miles.

### **Private Roads**

Roads not included in the public road system. While the reasons for not being designated as public may vary, they generally serve a similar purpose as local roads. There are approximately 53.7 miles of private roads distributed throughout the city.

## ROAD OWNERSHIP

Road ownership in the City of Rochester Hills fall under four main categories. These include the state trunkline, county roads (primary or local), city roads (major or local), and private roads. The state trunkline is under the Michigan Department of Transportation (MDOT) jurisdiction, consists of approximately 26.6 miles of roadway, and includes M-59 (both directions and all interchanges), and parts of Auburn Road and Rochester Road. County roads are under the Road Commission for Oakland County's (RCOC) jurisdiction, consisting of approximately 55.3 miles of roadway, and include most of the remaining major north-south and east-west roads. City roads are under the City of Rochester Hills' jurisdiction and comprise the majority of the road network with approximately 261.8 miles. Lastly, private roads are under the control of various private entities and include approximately 53.3 miles of roadway. Figure 7 illustrates road ownership in the City of Rochester Hills.

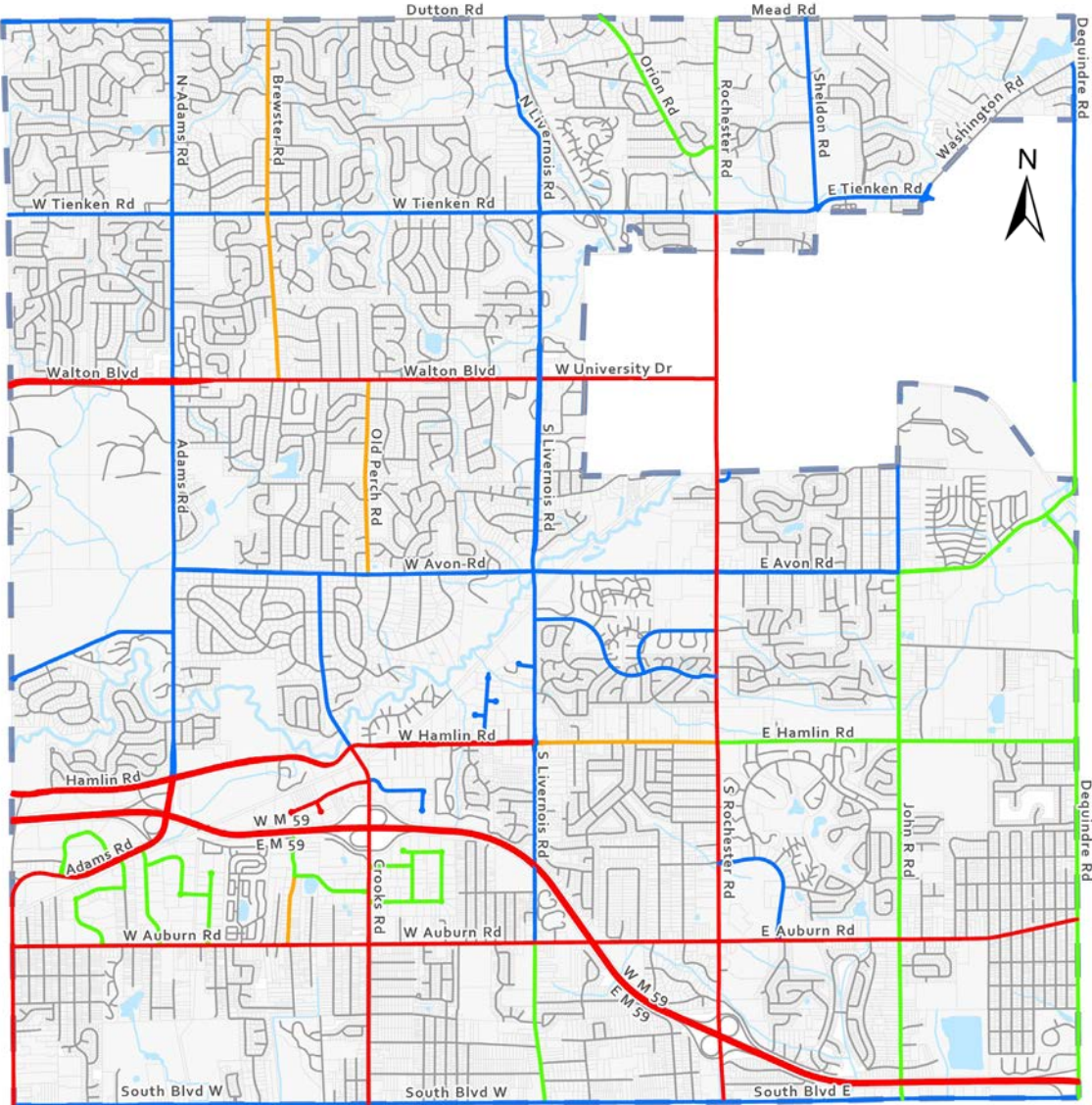


**Figure 7: ROAD OWNERSHIP**

- State Trunkline
- County Primary or Local
- City Major or Local
- Private

# TRUCK ROUTES

Truck routes in the city were reviewed to determine which roads are designated to support commercial traffic. Truck routes in the city are grouped in four categories based on vehicle weight restrictions. These include Special Designated, Designated, Normal, and City Weight Restricted. Special Designated roads are all season routes which have no weight restrictions at any time of the year. Designated roads are those which enforce a 25% vehicle weight reduction. Normal roads are those which enforce a 35% vehicle weight reduction. And lastly City Weight Restricted roads are those which allow a maximum gross vehicle weight of 8000 lbs. Any other city street not specifically designated under one of the four categories is considered a Normal road with a 35% vehicle weight reduction. Figure 8 illustrates the truck route designation in the City of Rochester Hills.



**Figure 8: TRUCK ROUTES**

- Designated
- Normal
- Special Designated (All Weather)
- City Weight Restricted (8000 LBS G.V.W.)

## ROAD CONDITION

The road conditions for the City of Rochester Hills' transportation system were evaluated using the Pavement Surface Evaluation and Rating (PASER) system. The Michigan Transportation Asset Management Council (TAMC) and MDOT have adopted the PASER system as the statewide standard for evaluating pavement conditions. The PASER system uses visual inspection conducted by a trained engineer and assigns a rating number based on pavement type (asphalt or concrete) and magnitude of deterioration present. The rating

system utilizes a 10-point scale with 10 indicating the pavement is in excellent condition (new construction) and 1 indicating the pavement has failed. Typically, ratings 8 to 10 require only routine maintenance, ratings 5 to 7 require preventative maintenance, and ratings 1 to 4 require structural improvements.

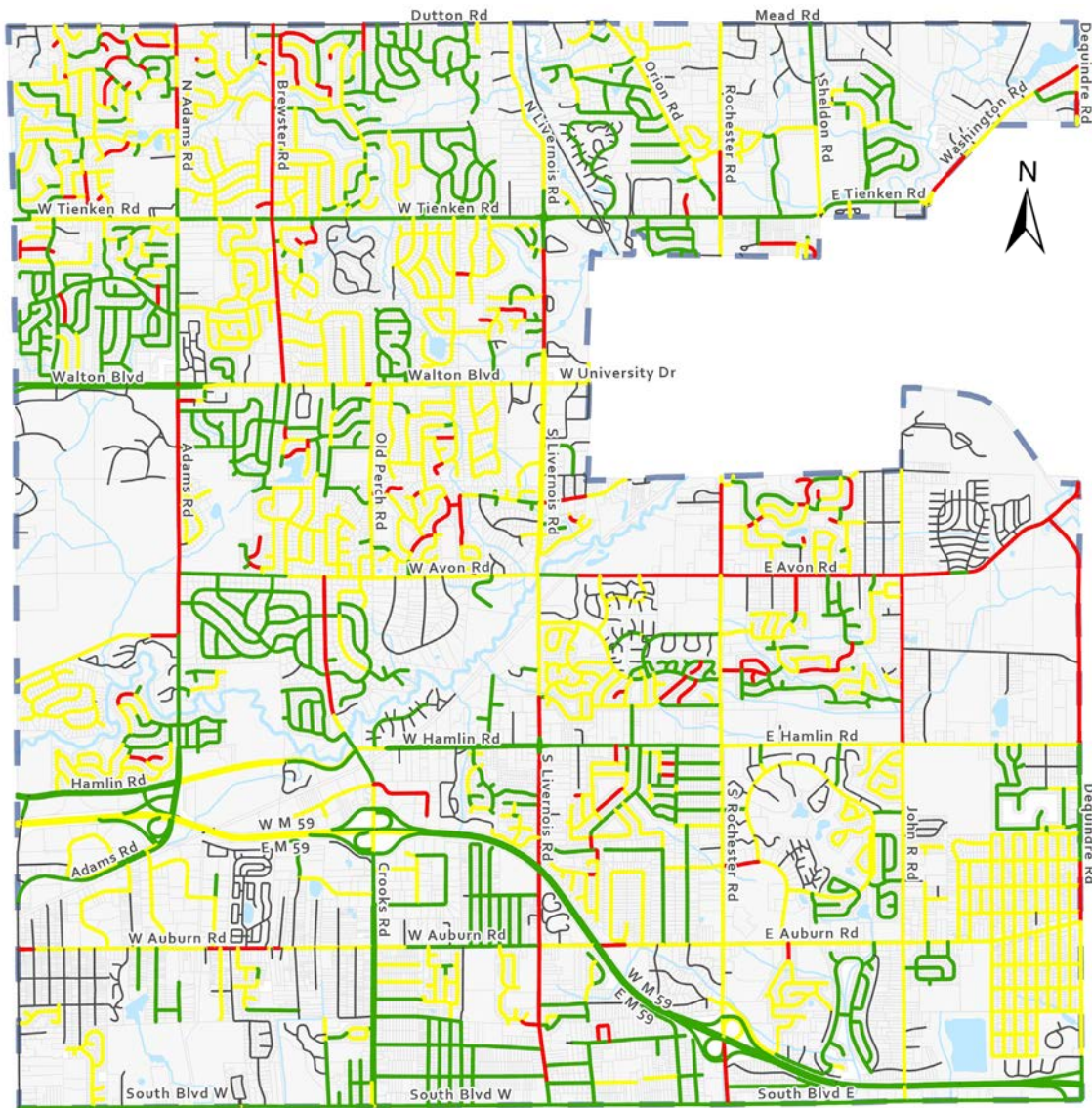
The analysis on the pavement conditions was based on existing 2017 to 2019 PASER data. These three years ensured that most of the road network had available ratings. Ratings between 7 to 10 indicate the pavement is in good conditions, ratings 4 to 6 indicate fair conditions, and ratings 1 to 3 indicate

poor conditions. The data was furthered separated by pavement type since rating methods differ between asphalt and concrete pavements. The results of this analysis are presented in Table 2, while Figure 9 provides a visual representation of the PASER ratings.

The PASER evaluation indicates that the road network is overall in fair condition with an average rating of 6.2. This value corresponds to a PASER rating of 6.3 for asphalt surfaces and 6.0 for concrete surfaces.

**Table 2: PASER Rating by Lane Miles and Pavement Surface Type**

Pavement Type	Ratings										Total
	Good Condition				Fair Condition			Poor Condition			
	10	9	8	7	6	5	4	3	2	1	
Asphalt Lane Miles	14.15	57.43	36.11	70.56	105.97	67.22	27.30	22.35	10.61	0.00	<b>411.68</b>
Concrete Lane Miles	5.53	9.72	42.49	47.01	27.97	42.97	37.29	23.19	0.23	0.00	<b>236.40</b>
Total Lane Miles	19.68	67.15	78.60	117.57	133.94	110.18	64.58	45.54	10.84	0.00	<b>648.07</b>
Percentage of Lane Miles by Rating	3.0%	10.4%	12.1%	18.1%	20.7%	17.0%	10.0%	7.0%	1.7%	0.0%	100%
	<b>43.7%</b>				<b>47.6%</b>			<b>8.7%</b>			



**Figure 9: EXISTING PASER RATING (2017-2019)**

- Poor: 1 - 3
- Fair: 4 - 6
- Good: 7 - 10
- Unpaved or Private Roads

## RIGHT-OF-WAY

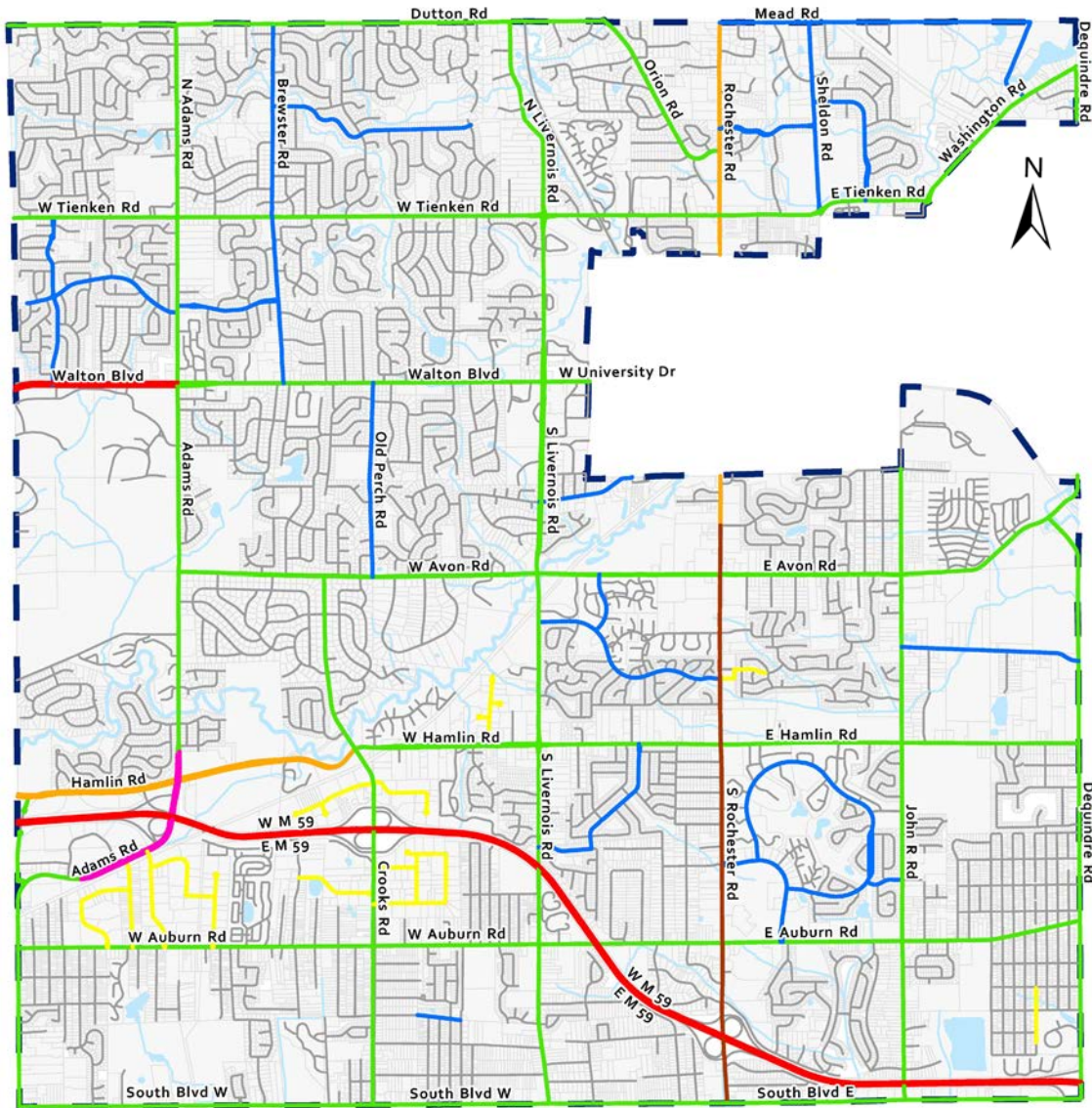
Right-of-way (ROW) is a critical element of the transportation infrastructure as it can determine the type of infrastructure improvements a segment or intersection can support. The typical road ROW was reviewed for all non-local roads to determine the existing and available ROW. ROW data was obtained from Oakland County and verified using aerial imagery. The verification process entailed measurements at select points on a road and typically extended from the outer edge of sidewalk to outer edge of sidewalk. Since the Oakland County ROW data was segmented, one average value was considered for each corridor. In this case, a corridor was defined as a segmented intersected by major roadways (i.e. Crooks Rd, from Auburn Rd to South Blvd). In addition to the existing ROW, planned ROW data was obtained as well. The planned ROW data represents the future potential ROW for each corridor. The two datasets, existing and planned, were then compared to determine any additional available ROW each corridor may have in the future.



**Figure 10: EXISTING RIGHT-OF-WAY (ROW) WIDTH (ft)**

- Data not shown (Local/Private Roads)
- 39 or below
- 40 - 69
- 70 - 99
- 100 - 129
- 130 - 159
- 160 or higher





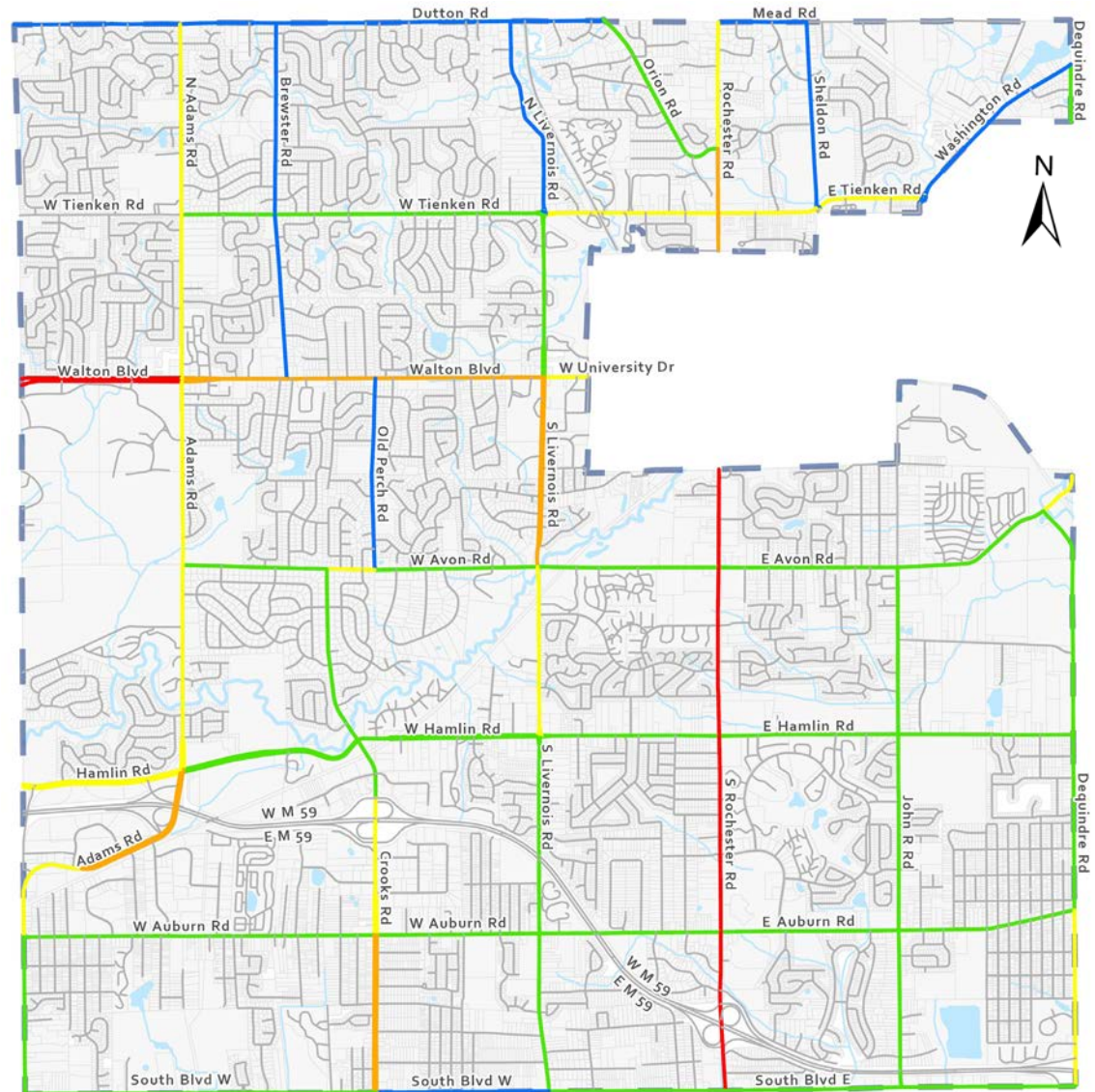
**Figure 11: PLANNED RIGHT-OF-WAY (ROW) WIDTH (ft)**

- 70
- 86
- 120
- 150
- 180
- 170 - 240
- 204 - 360

## TRAFFIC VOLUME

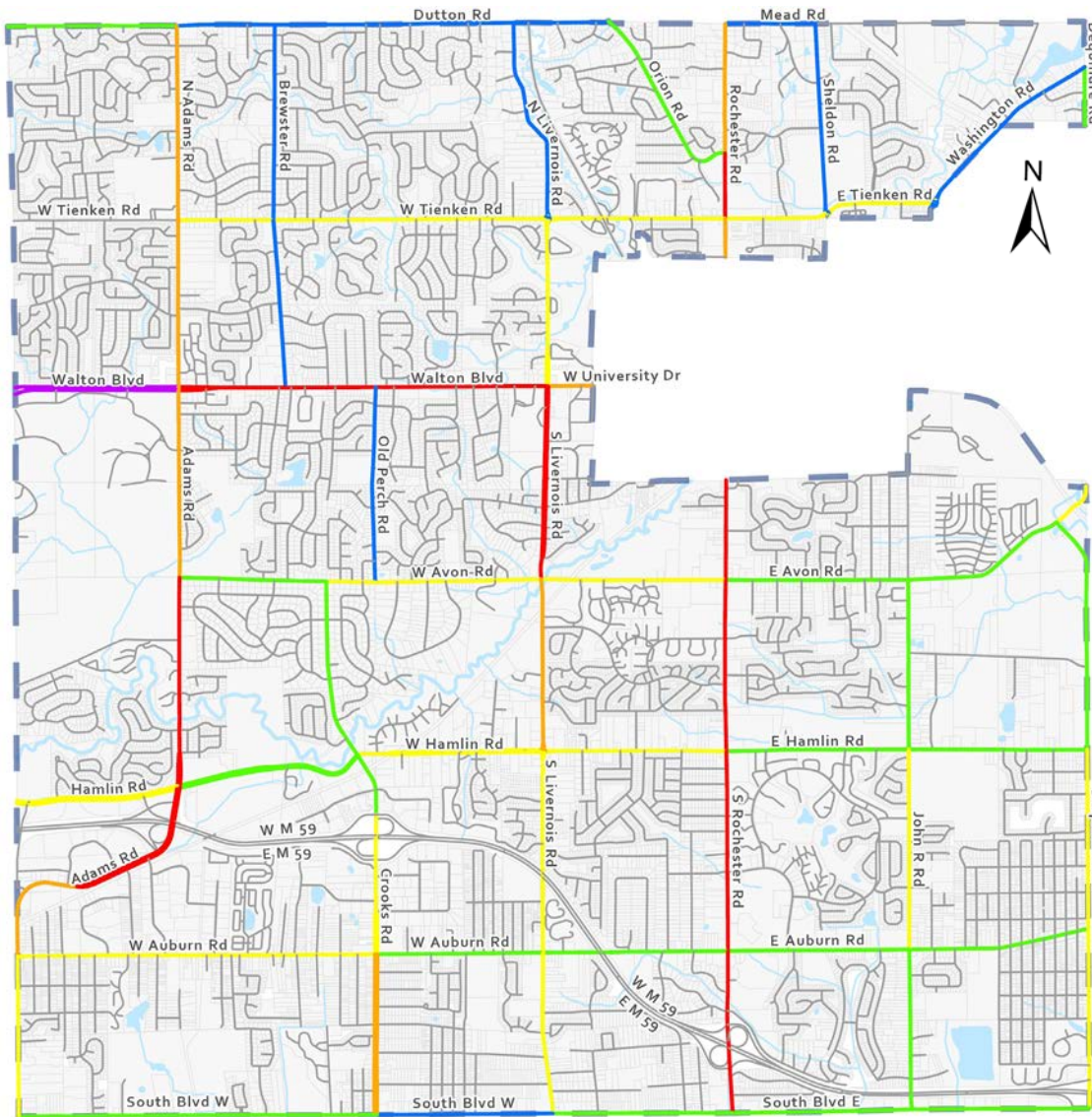
One of the more critical variables in the evaluation of transportation networks are traffic volumes. Traffic volumes represent the demand side of a transportation network and are thus critical in estimating congestion levels. In addition, they represent the key exposure variable in safety evaluations and are used in determining levels of funding for the maintenance and improvement of roadways. At the most basic level, traffic volumes are critical in determining what improvements are required in a transportation facility.

Traffic volumes were collected from a variety of reliable sources to obtain a complete dataset for all major roadways. These included the RCOG Transportation Data Management System (TDMS), RCOG Traffic Count Database System (TCDS), MDOT TDMS, SEMCOG Traffic Volumes, and SEMCOG Traffic Demand Forecast Model. The data was compiled together, cross-verified between the different sources, and reviewed by City staff for accuracy. Only traffic volumes collected since 2015 were considered in the analysis.



**Figure 12: 2020 AVERAGE DAILY TRAFFIC (Pre-COVID)**

- <10,000 vehicles per day
- 10,001 - 20,000 vehicles per day
- 20,001 - 30,000 vehicles per day
- 30,001 - 40,000 vehicles per day
- 40,001 - 50,000 vehicles per day
- No Data



**Figure 13: 2040 AVERAGE DAILY TRAFFIC**

- <10,000 vehicles per day
- 10,001 - 20,000 vehicles per day
- 20,001 - 30,000 vehicles per day
- 30,001 - 40,000 vehicles per day
- 40,001 - 50,000 vehicles per day
- 50,001 or more vehicles per day
- No Data

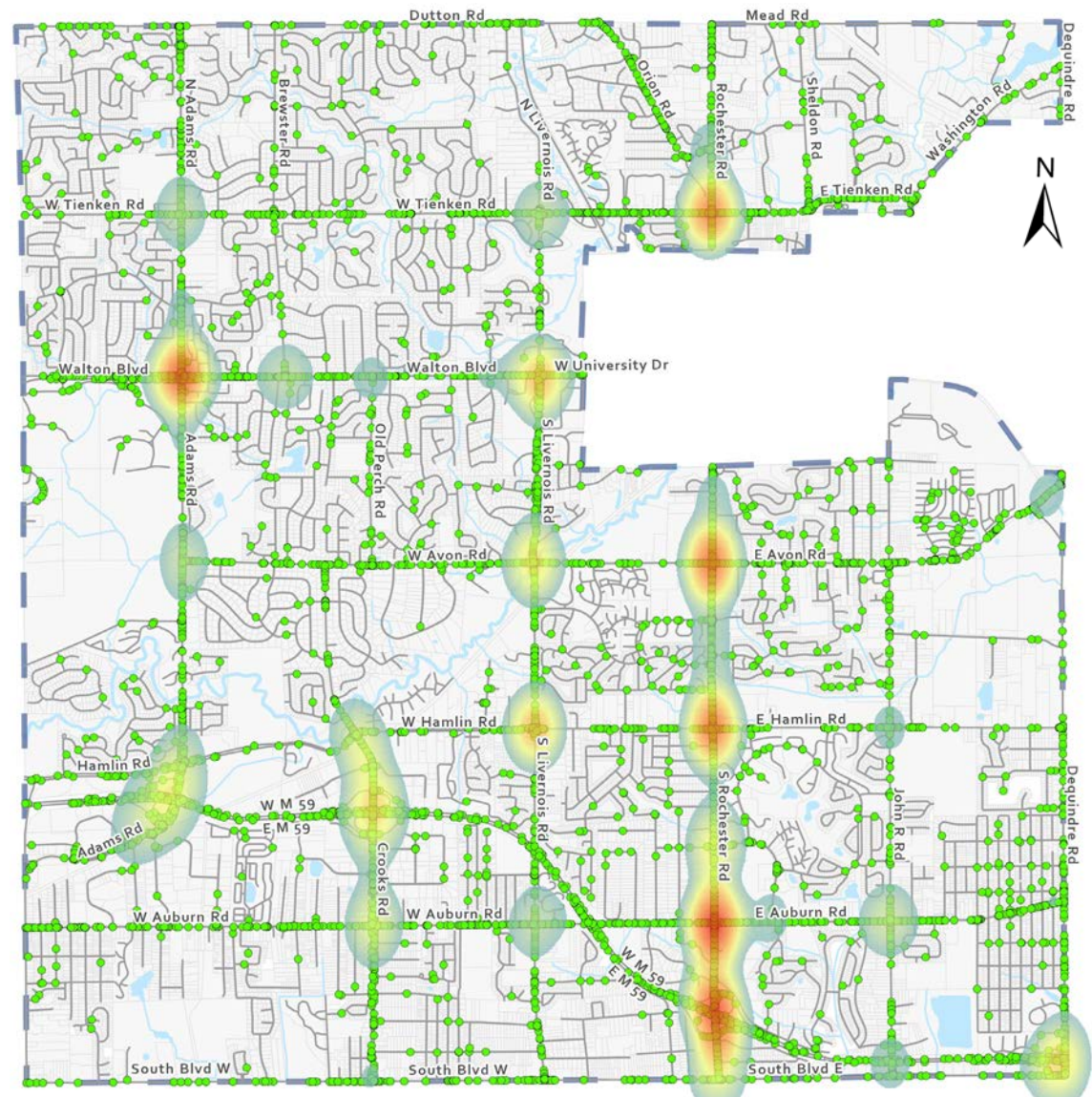
SEMCOG provided traffic growth rates from their Traffic Demand Forecast Model. The model estimates current and future traffic volumes, speeds, and traffic patterns in Southeast Michigan, and is used in the development of SEMCOG’s long-range transportation plan. These traffic growth rates were used to project all obtained volumes to 2020 traffic volumes (present volumes), and 2040 traffic volumes (future volumes). Figure 12 and Figure 13 presents the 2020 and 2040 traffic volumes respectively. These data were then used as basis for the evaluation of the transportation network.

## TRAFFIC SAFETY

Safety is a critical component of any transportation network. Every day, people use motorized and non-motorized facilities to travel to employment, school, shops, and home. Thus, the intent of road safety is to prevent fatalities and injuries for all road users by incorporating appropriate engineering, enforcement, education, and emergency services measures. The appropriate identification and incorporation of safety measures requires a data-driven approach and comprehensive safety analysis to identify areas of safety improvement opportunities.

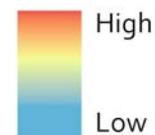
In order to identify areas of safety improvement opportunities, traffic crash data was obtained from the Transportation Improvement Association (TIA) Traffic Crash Analysis Tool (TCAT) for 2014-2018. These five years represent the most recent years of available crash data during the beginning phases of the development of this master plan. Only non-deer, non-animal related crashes were considered in the analysis to minimize the element of randomness associated with these types of crashes.

Several statistical and geographical techniques were used to assess existing safety conditions in the City of Rochester Hills. Based on the method of analysis, crashes were analyzed separately for segments and intersections to account for the

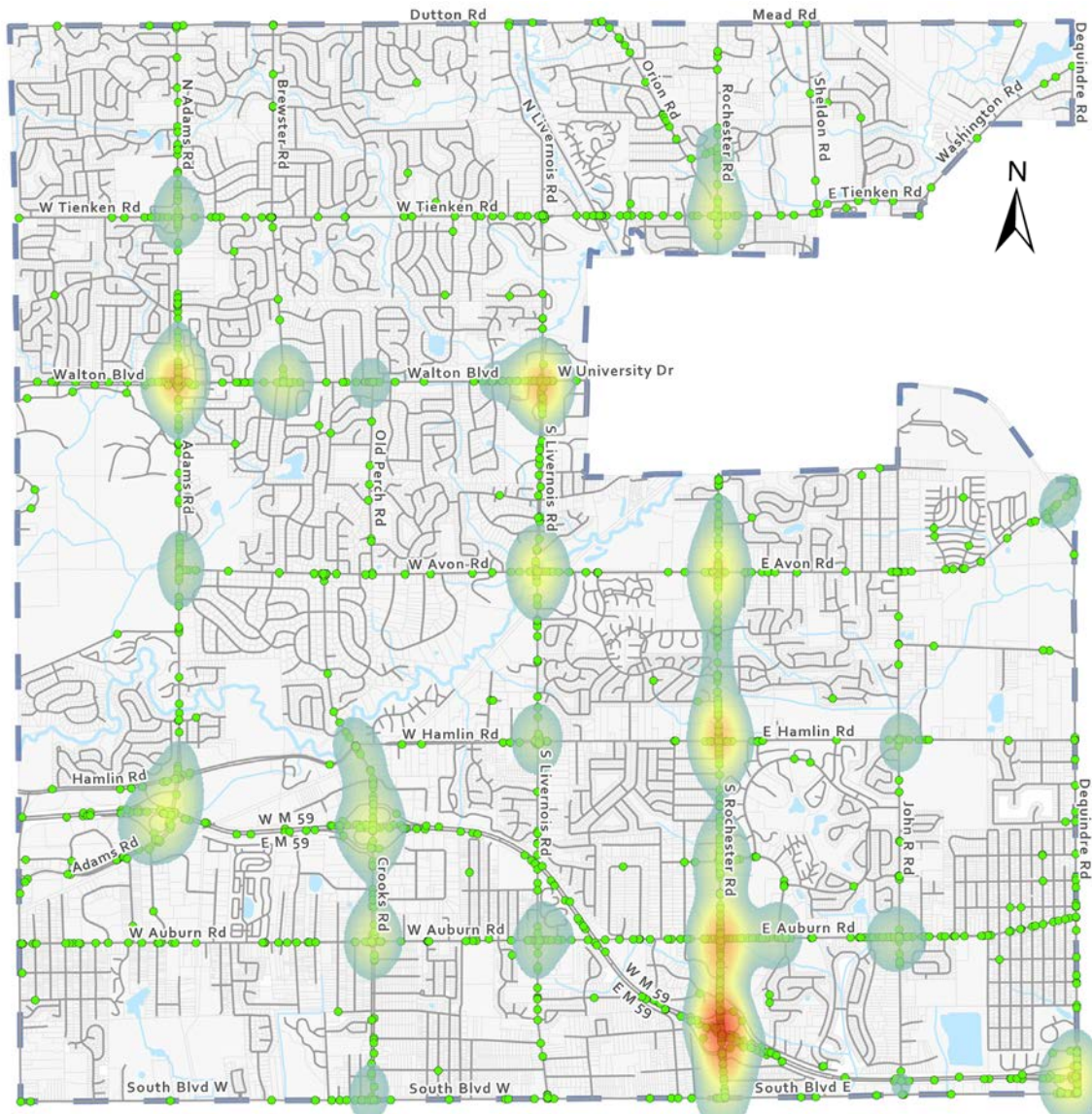


**Figure 14: 2014-2018 CRASH DENSITY**

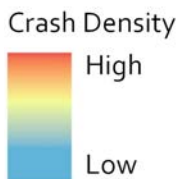
Crash Density



*NOTE: animal crashes are omitted.*



**Figure 15: 2014-2018 FATAL AND INJURY CRASH DENSITY**



*NOTE: animal crashes are omitted.*

differences between segment and intersection related crashes. Crashes were assessed based on the following methods:

- **Crash Frequencies** – the number of crashes occurring on a specific segment or intersection over a specified time period. A high magnitude of crashes may indicate a safety concern.
- **Crash Rate** – the number of crashes occurring on a specific segment or intersection over a specified time period while accounting for traffic volumes (exposure variable). A high crash rate may indicate a safety concern.
- **Crash Density** – geographic information system (GIS) based method which identifies location specific crash patterns or hot spots. A hot spot indicates a concentration of crashes and thus a potential safety concern.

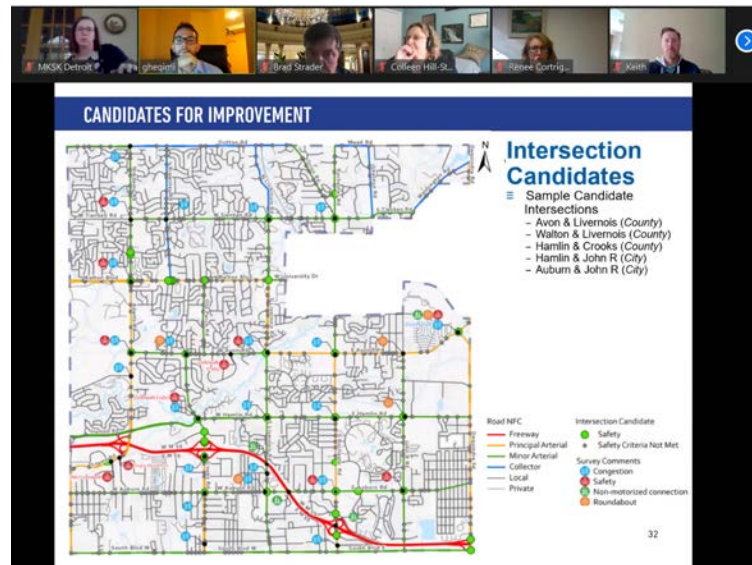
Figure 14 and Figure 15 presents a crash density map of all crashes and fatal and injury crashes. The areas in red or hot spots indicate a high concentration of crashes. Additional safety maps produced based on these methods can be found in the Appendix.

# 04

## PUBLIC AND STAKEHOLDER ENGAGEMENT



# SUMMARY OF ENGAGEMENT



Engagement was woven throughout the planning process to craft recommendations and determine transportation related priorities for Rochester Hills. City Administration, an Agency and Stakeholder group, Planning Commission, City Council, and the community were all included and prompted for feedback to guide the overall vision of the plan.

An Agency Group and Stakeholder Group were formed at the beginning of the planning process (later these two groups were combined for efficiency and ease as some of the members overlapped between groups). Members included representatives from City Council, City Planning Commission, SEMCOG, MDOT, Road Commission of Oakland County, the Older Persons' Commission, residents, the school district, adjacent communities, and committee/board members. This Agency and Stakeholder Group met three times (in-person and virtually) to guide in depth discussions regarding existing conditions and issues within the Rochester Hills transportation system, the vision and goals of the plan, as well as recommendations and priorities for improvements.

## SUMMARY OF ENGAGEMENT

In addition to the Agency and Stakeholder Group, City Planning Commission and City Council met twice, jointly, to provide their input on the Transportation Master Plan. An initial Joint Meeting took place on January 28, 2020 where existing conditions and best practices were presented. And another meeting took place on February 1, 2021 to present proposed recommendations and transportation improvements.

Public engagement was integrated early on in the planning process in the form of an online survey that was distributed out for feedback on transportation priorities with over 200 people who filled out the survey. Due to COVID-19, two public workshops (on November 9, 2020 and January 7, 2021) took place virtually to not only educate and inform the community about the plan, but to also build support for the plan's recommendations and get additional feedback on potential improvements throughout the transportation system.

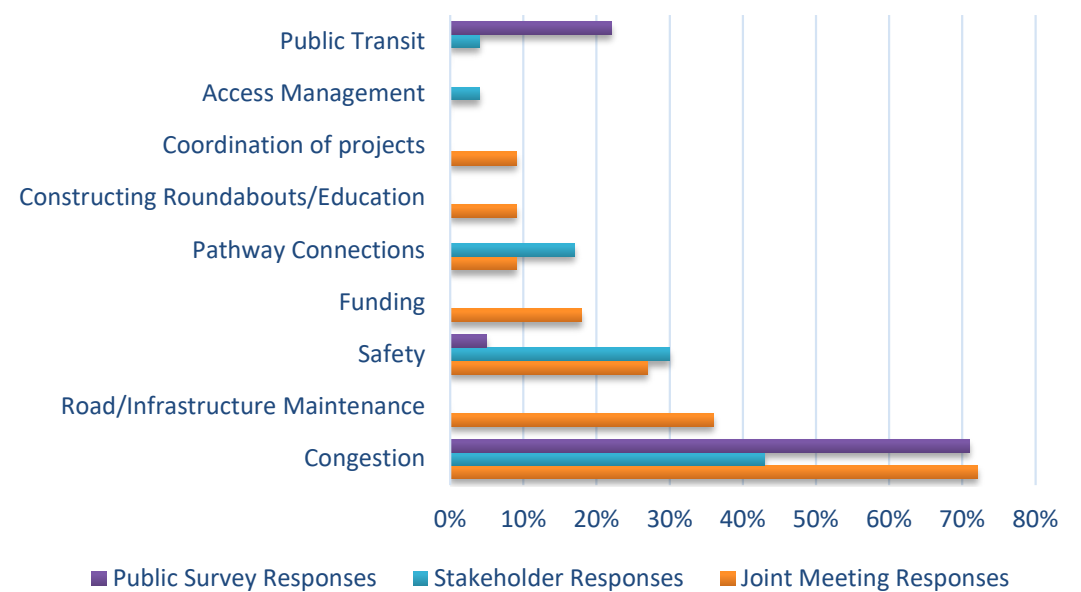
Top transportation comments were cataloged and included congestion, safety, pathway connections, and public transit. Priorities were also mapped out (see the following page) to show where areas of congestion, safety, non-motorized connections, and roundabouts are potentially needed.

Specifically, the following locations were noted:

- Congestion should be addressed along Adams, Livernois, and Rochester Roads
- Safety should be a focus at the northwest and southeast corners of the City
- Non-motorized connections need improvement across M-59, Dequindre, and Avon
- A few more possible locations for roundabouts were identified along Avon and also at Hamlin and John R



Figure 16: TRANSPORTATION PRIORITIES TO ADDRESS







05

**VISION AND  
GOALS**



# VISION AND GOALS

An overall vision and goals were created based on the review of existing conditions and outreach to agencies, stakeholders, City Council and City Planning Commission, and the public. The vision and goals provide guidance to address the priority issues within the context of the Rochester Hills transportation system. Ultimately, they provide the foundation for the recommended improvements and best practices in the Plan.

## Goals for the Rochester Hills Transportation System:

- Provide for a safer transportation system by continuing to implement access management techniques and proven safety countermeasures.
- Ease strategic areas of traffic congestion through a multi-pronged approach.
- Enhance and maintain existing multi-modal facilities and create new connections where safety and access are priorities.
- Prepare for advanced technologies, such as connected and autonomous vehicles and developing smart corridors.
- Maintain current infrastructure, including roads and non-motorized pathways.
- Explore public transportation options along select major corridors.

# VISION FOR ROCHESTER HILLS

*The transportation system of Rochester Hills will be a reliable network that provides travel options for vehicles, pedestrians, and bicyclists. The transportation network will emphasize safe and efficient travel.*

## SAFER TRANSPORTATION SYSTEM



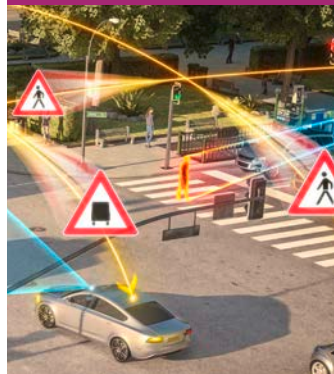
## EASE TRAFFIC CONGESTION



## ENHANCE MULTI-MODAL FACILITIES



## PREPARE FOR NEW TECHNOLOGY



## MAINTAIN CURRENT INFRASTRUCTURE



## EXPLORE PUBLIC TRANSPORTATION OPTIONS



06

# TRANSPORTATION SYSTEM EVALUATION AND RECOMMENDATIONS



# OVERVIEW

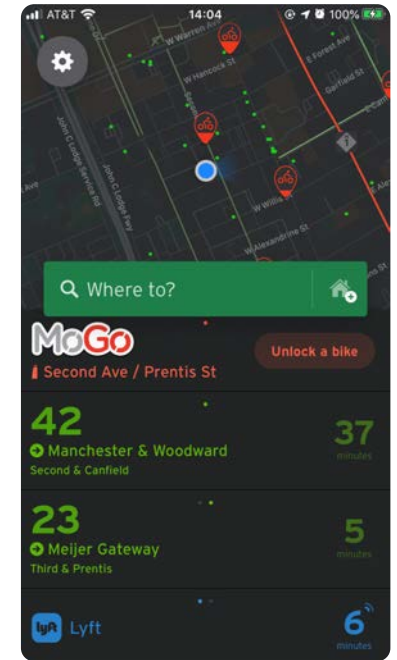
Several performance metrics were utilized to evaluate the transportation network of the City of Rochester Hills. These included capacity, safety, funding, non-motorized, public transportation, and emerging technology related performance measures. In all scenarios, findings from these factors were supplemented through the consideration of existing and future land uses and public input obtained throughout the development of this study.

The primary performance metrics used under each major evaluation factor are as follows:

- Capacity – volume-to-capacity (V/C) ratio, and microscopic analysis using Synchro 10 and methods prescribed in the Highway Capacity Manual (HCM)
- Safety – level of service safety (LOSS), crash frequency, crash rate, crash density (hot spot analysis)
- Funding – Federal aid committee scoring system

- Non-Motorized – non-motorized route gap analysis
- Public Transportation – inventory of existing infrastructure and public survey
- Emerging Technology – review of emerging technologies and applicability to existing and future transportation network

A more thorough discussion on each of these performance metrics is presented on the following pages.



# TRAFFIC OPERATIONS EVALUATION

Traffic operations for the transportation network were evaluated to assess network capacity performance. The V/C ratio was utilized to determine which parts of the network operate at acceptable levels and which have capacity constraints. The V/C ratio is a measure of the level of congestion on a given roadway, which ranges on a scale of 0 to 1 or greater and can generally be defined as follows:

- 0 = no demand
- 0.8 to 1 = demand reaching capacity
- 1 = demand equals capacity
- Greater than 1 = demand exceeds capacity

As the name suggests, the V/C ratio is a function of demand and capacity where demand is represented by traffic volumes and capacity represents the maximum traffic flow that can be accommodated in a transportation facility during a given time period under various road conditions. Capacity is typically expressed in passenger cars per hour per lane (pc/h/ln) and is a function of various elements such as the number of lanes and free flow speed (FFS).

The HCM 6th edition in conjunction with SEMCOG's Transportation Demand Model was used in determining the capacity of all

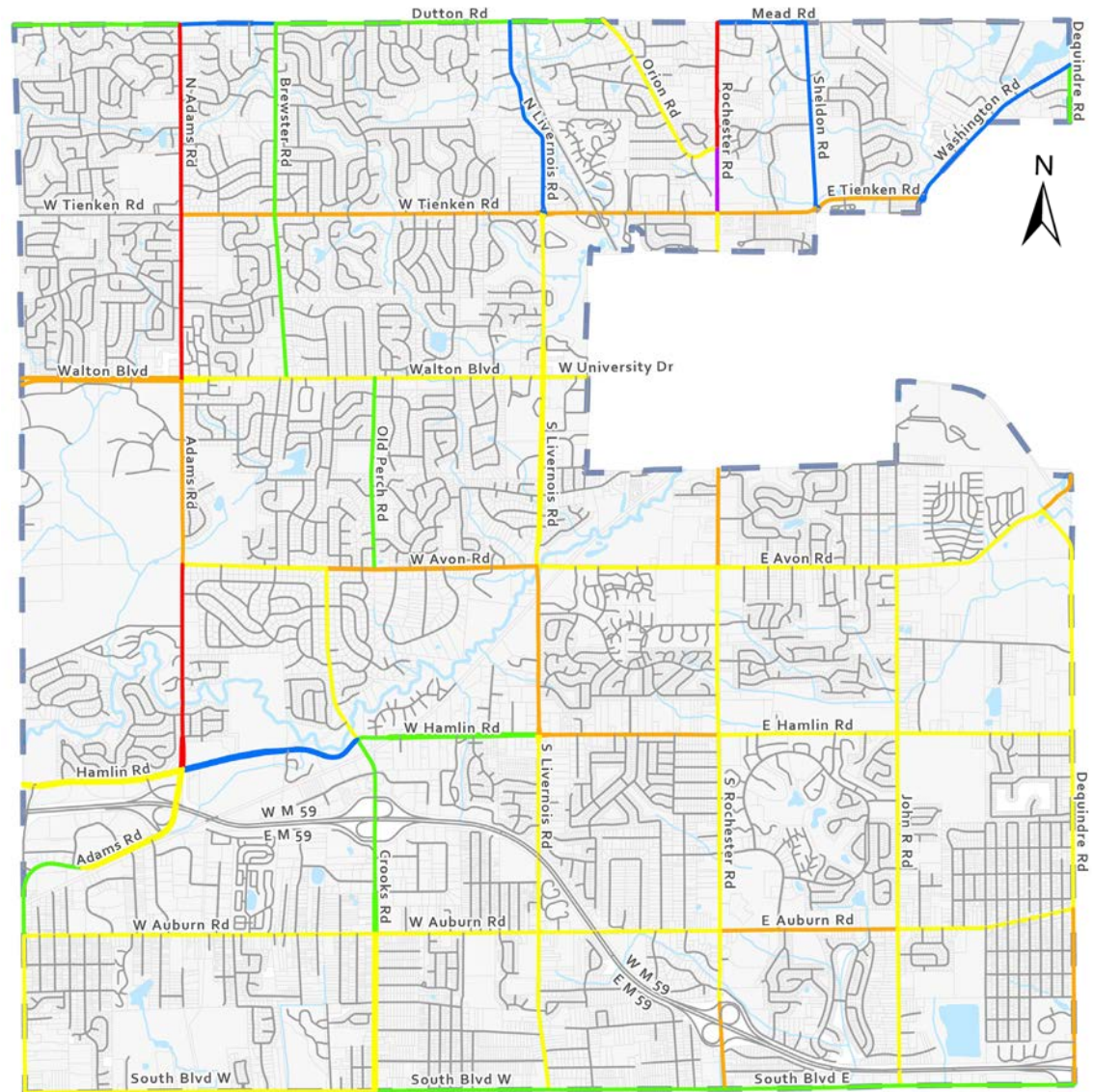
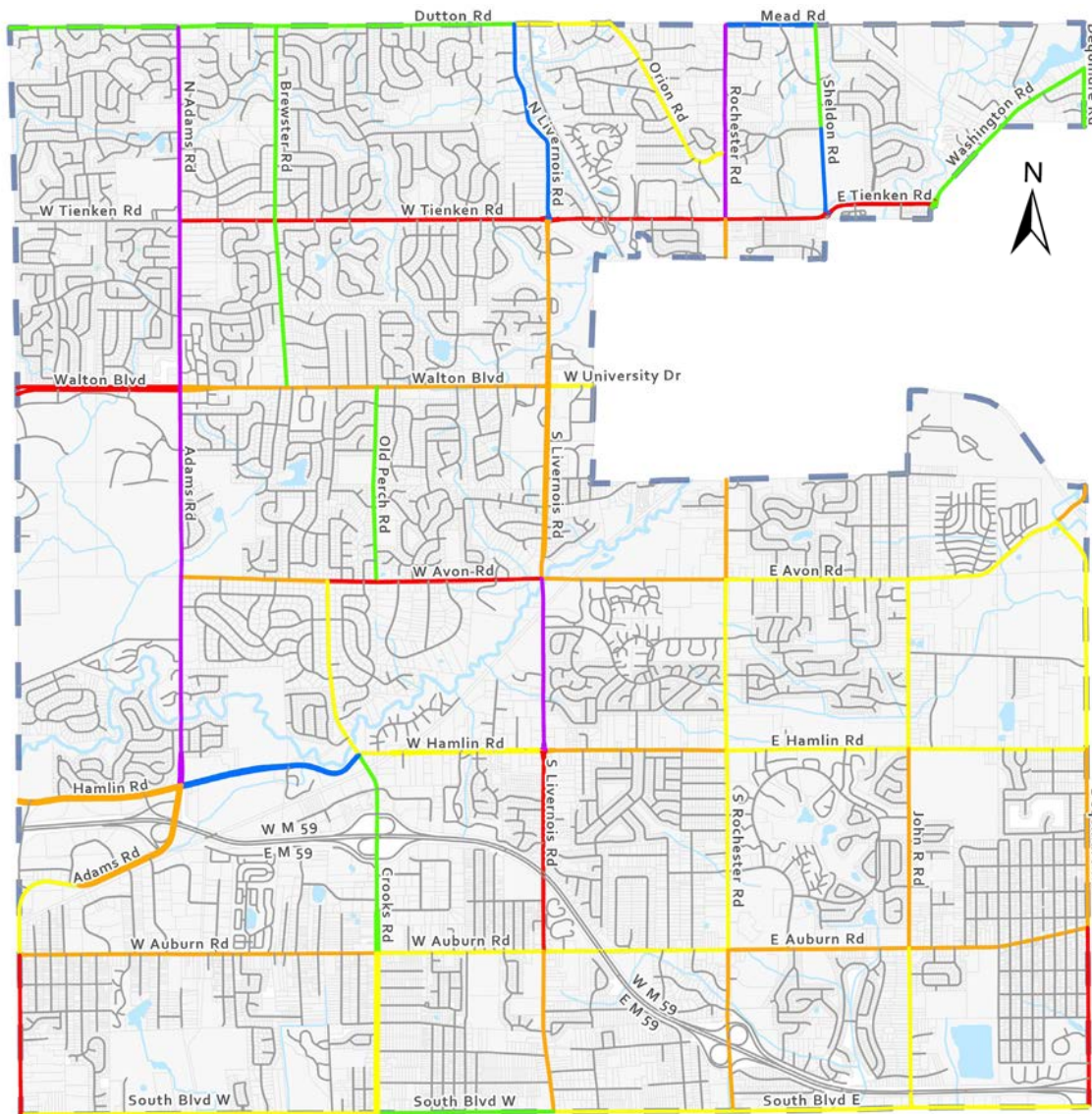


Figure 18: 2020 VOLUME-TO-CAPACITY (V/C) RATIO





**Figure 19: 2040 VOLUME-TO-CAPACITY (V/C) RATIO**



public non-local roads. Capacity was initially based on HCM’s definition of capacity for two-lane highway segments, multi-lane highway segments, and basic freeway segments. The HCM obtained capacity values were then cross-verified with the values provided in the SEMCOG’s Transportation Demand Model. The more conservative value was associated with the transportation network to determine the V/C ratios.

V/C ratios were calculated for every segment where traffic volumes were available. They were developed for 2020 and 2040 volumes to determine changes in the level of congestion given the expected traffic growth throughout the network. These results are presented in Figure 18 and Figure 19 respectively.

In addition to the V/C ratio, a microscopic level capacity analysis was conducted on Livernois Road per the direction of the city. The analysis was conducted using Synchro 10 and following the procedures outlined in the HCM to assess the performance of the corridor and major intersections. These findings along with those stemming from the overall V/C analysis have been incorporated in the recommendations section.

# SAFETY EVALUATION

The safety evaluation was conducted on the transportation network to determine the safety performance of the various infrastructure facilities. Safety was evaluated based on the LOSS. The LOSS is an advanced safety performance measure based on the Highway Safety Manual (HSM) used in identifying high-risk locations. LOSS is used to determine the degree to which the observed crash frequency varies from the predicted crash frequency on a similar roadway. The predicted crash frequency was based on Michigan based Safety Performance Functions (SPF) which determine the expected crash frequency based on various road factors such as Average Annual Daily Traffic (AADT), segment length, intersection type, etc.

The LOSS contains four qualitative categories that indicate the degree of deviation from the predicted average crash frequency. These categories are defined as:

- LOSS I – low potential for crash reduction
- LOSS II – low to moderate potential for crash reduction
- LOSS III – moderate to high potential for crash reduction
- LOSS IV – high potential for crash reduction

The LOSS categories are further illustrated in Figure 22, where AADT is located on the x-axis and Accidents per Mile per Year (APMPY) are located in the y-axis. In this example, a segment with 100,000 ADT experiencing 80 APMPY would be considered to have a LOSS IV.

The obtained LOSS categories for the network for both segments and intersections are presented in Figure 20 and

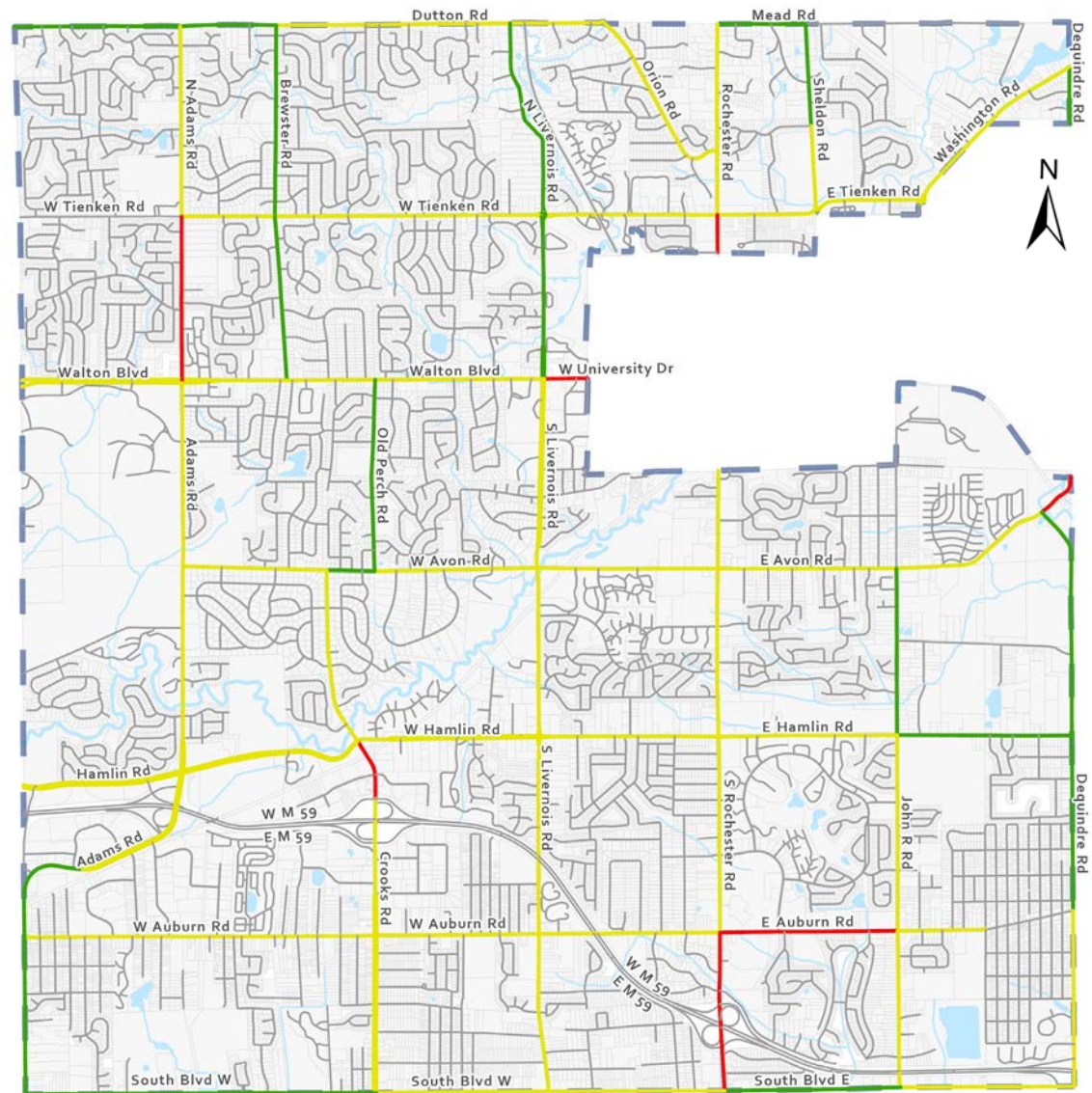
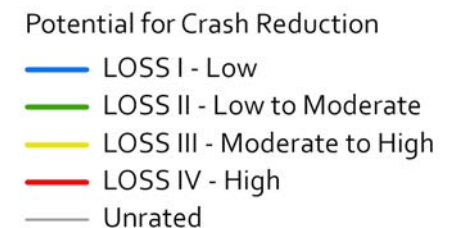
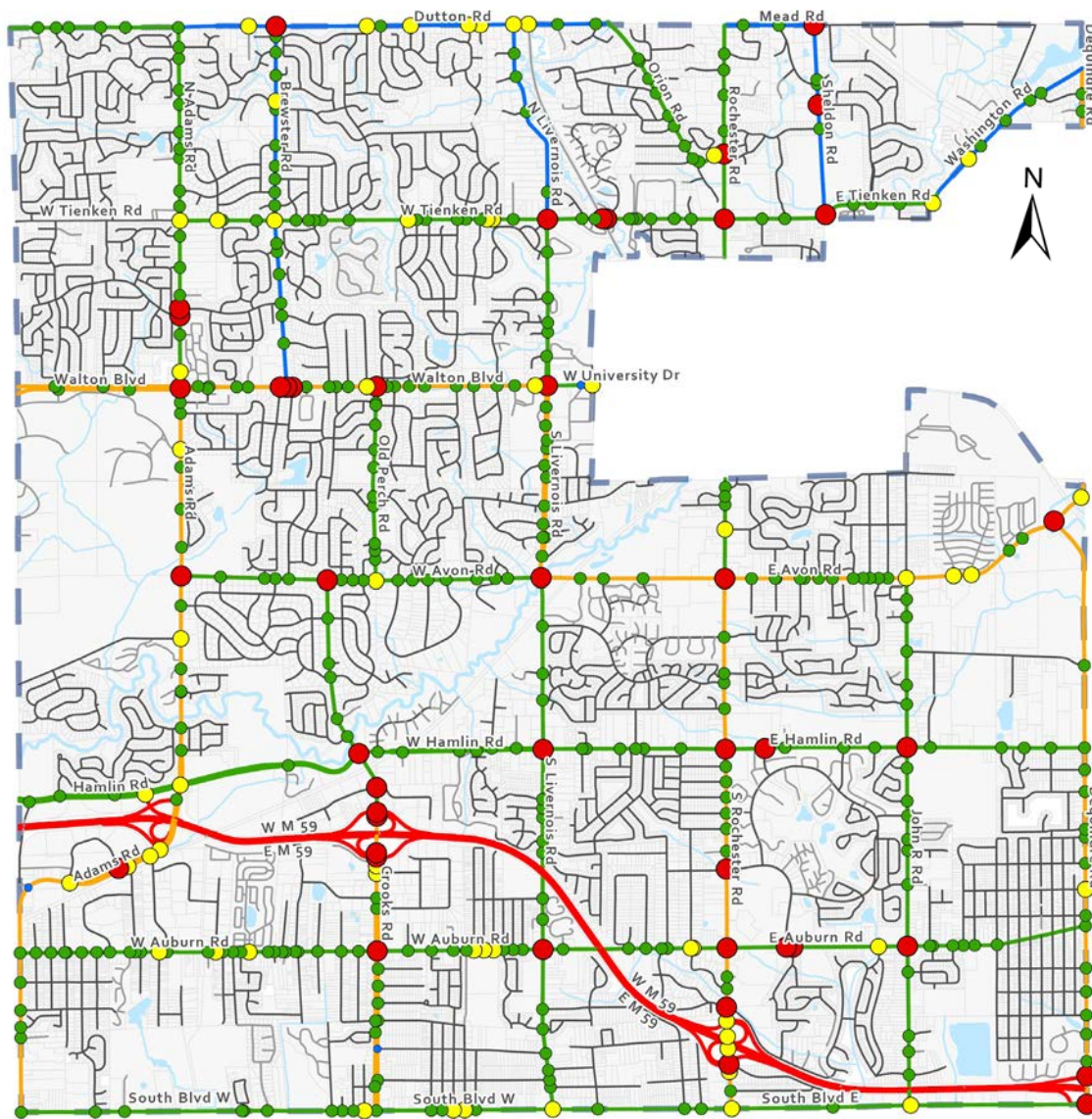


Figure 20: SEGMENT LOSS







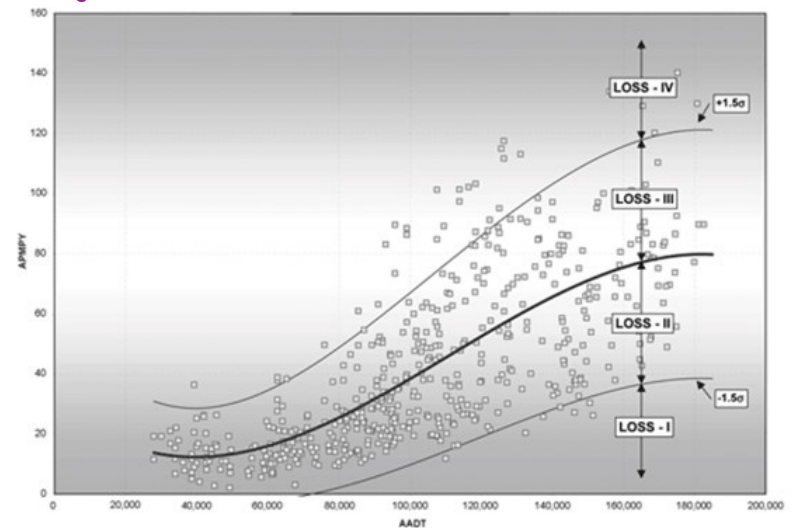
**Figure 21: INTERSECTION LOSS** Road NFC Potential for Crash Reduction

- |                                                          |                                                                   |
|----------------------------------------------------------|-------------------------------------------------------------------|
| <span style="color: red;">—</span> Freeway               | <span style="color: blue;">●</span> LOSS I - Low                  |
| <span style="color: orange;">—</span> Principal Arterial | <span style="color: green;">●</span> LOSS II - Low to Moderate    |
| <span style="color: green;">—</span> Minor Arterial      | <span style="color: yellow;">●</span> LOSS III - Moderate to High |
| <span style="color: blue;">—</span> Collector            | <span style="color: red;">●</span> LOSS IV - High                 |
| <span style="color: grey;">—</span> Local                |                                                                   |
| <span style="color: lightgrey;">—</span> Private         |                                                                   |

Figure 21 respectively. In both maps, the sections in red indicate segments or intersections with a LOSS IV. These represent those locations with the highest potential for crash reduction.

Since the LOSS method describes only the magnitude of the safety problem, information obtained from additional methods of safety analysis which included crash frequencies, crash rates, and crash density was utilized to supplement and aid in determining crash causality for those segments or intersections which indicated a high potential for crash reduction.

**Figure 22: TYPICAL L.O.S.S. CATEGORIES BY AADT**



Source: U.S. FHWA. HSIP Noteworthy Practice Series, HSIP Project Identification. Level of Service Safety and Diagnostic Analysis – Colorado. FHWA-SA-11-02, 2011.

# FEDERAL AID COMMITTEE SCORING

An additional level of analysis was conducted on the transportation network to evaluate federal funding potential for any of the recommendations identified in this plan. All federal-aid eligible roads were scored against the Oakland County Federal Aid Committee (FAC) scoring criteria for reconstruction (4R) and resurfacing (3R). Oakland County FAC is the body that allocates federal road funding for the county. The committee uses objective scoring criteria to select road projects which will receive federal funding in future years.

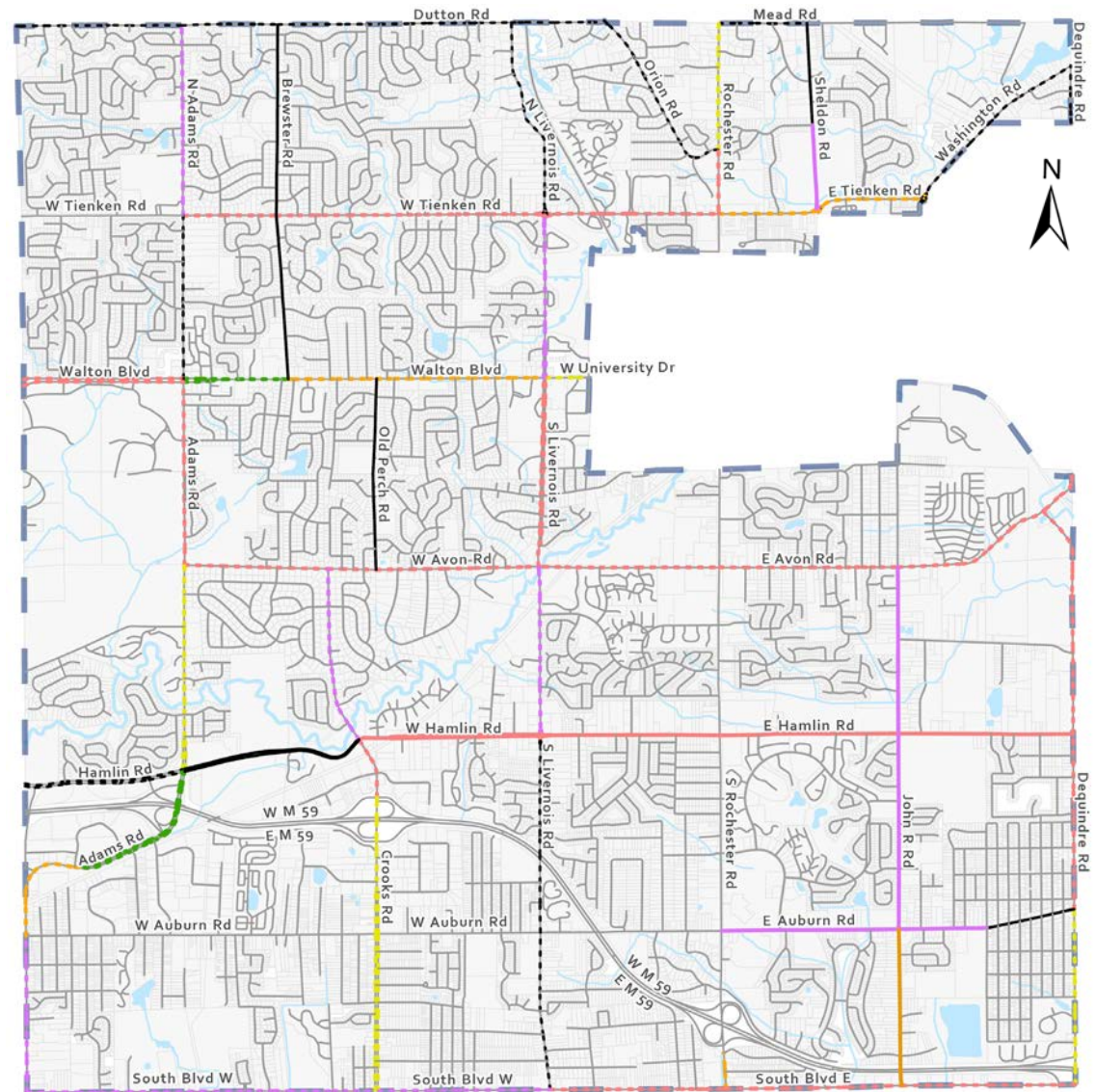
Roads with a PASER rating of 1 to 4 were scored under the 4R scoring criteria, whereas roads with a PASER rating of 5 to 10 were scored using 3R guidelines. This threshold was defined based on the premise that roads with a PASER rating of 4 or below generally need reconstruction.

Because full scoping was not completed for all segments, not all FAC scoring categories could be scored. Instead, 41 of 83 points for 4R and 48 of 94 points for RRR could be scored. This information is summarized in Table 3.

**Table 3: Oakland County FAC Points Possible vs Points Scored**

Application Type	Points Possible	Points Not Rated	Points Rated
Resurfacing (RRR)	94	46	48
Reconstruction (4R)	83	42	41

Figure 23 illustrates the Oakland County FAC scoring for the Rochester Hills transportation network. Data has been further split by county roads and city roads. The average score for the network was 25. Given the scoring categories, segments with a score above 30 have the potential of being funded under the Oakland County FAC criteria.



**Figure 23: FEDERAL AID COMMITTEE (FAC) SEGMENT RATING**





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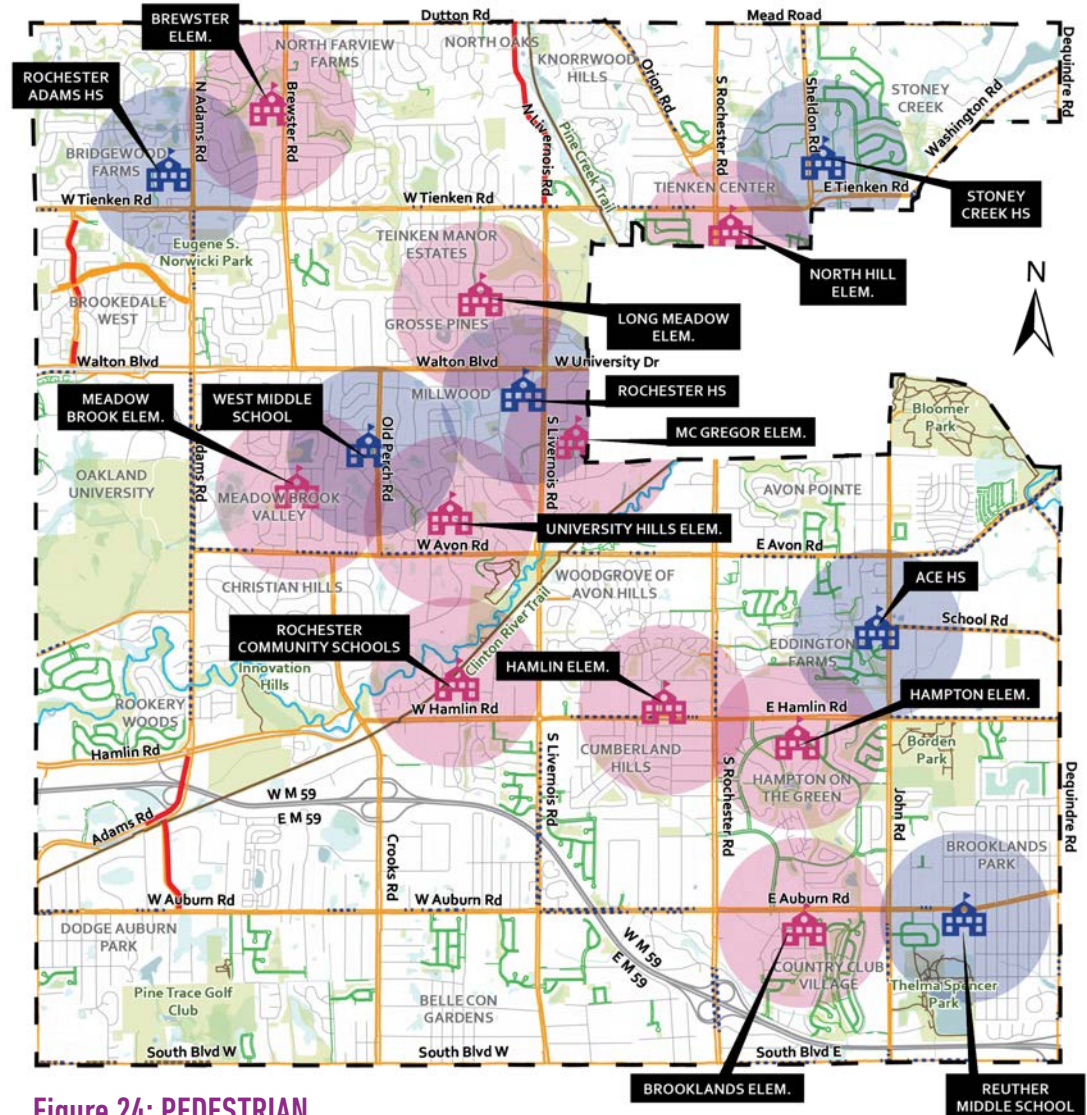
# PEDESTRIAN AND BICYCLE NETWORK EVALUATION AND RECOMMENDATIONS

## Non-Motorized Network Evaluation

Rochester Hills already has a robust and well established network of pathways along primary streets, with over 100 miles of pathway throughout the City.

During the analysis of the pedestrian and bicycle system, some gaps were identified (visualized in red on the adjacent map). Other gaps exist, but have planned pathway projects to create new pathways (noted in the dotted blue on the adjacent map). There are also missing sidewalk connections to subdivisions, schools, and the primary pathway network within many of the city's residential neighborhoods.

Currently, there is a restriction on motorized devices on the pathway system in Rochester Hills (with the exception of motorized wheelchairs and service vehicles). However, many residents are electing to use electric scooters (e-scooters) or electric bicycles (e-bikes) for short trips instead of driving. As noted in the public online survey and the first public workshop, as well as discussions with stakeholders, many residents find it uncomfortable and unsafe to ride e-bikes or e-scooters in traffic lanes with vehicles. Others voiced some concern about potential conflicts with pedestrians with these devices on the pathways.



**Figure 24: PEDESTRIAN AND BICYCLE NETWORK EVALUATION AND RECOMMENDATIONS**

- Pathways
- Sidewalks
- Trails & Park Paths
- Water Trails
- Gap in Pathway
- - - Planned Pathway Project\*
- - - Planned Trails
- Elementary School
- Elementary School Half-Mile Walkshed
- Middle/High School
- Middle/High School Half-Mile Walkshed

\*includes improvements to existing pathways and the construction of new pathways

## Walking and Biking Routes to Schools

Proximity to schools should be highly considered when prioritizing corridors and neighborhoods for sidewalk and pathway infill, bicycle facilities, and crossing safety enhancements.

To be used as a resource by the city, half-mile buffers around Rochester Hills schools were mapped in Figure 24 to illustrate where investments in connections to the greater pathway system would have the greatest impact.

### SCHOOL DISTRICT TRANSPORTATION ROUTES AND POLICIES

In 2018, the Rochester Community School District published a School Transportation Study: Policy and Walking Routes. This document audited existing school transportation policies and found that the Rochester District is consistent with other districts in southeast Michigan in how transportation options and service boundaries are determined.

The document also explains how walking boundaries are drawn (1.0 miles for Elementary and Middle Schools, 1.5 miles for High Schools) and why these boundaries are truncated at primary roadways.

The Transportation Master Plan recommends that the city work with the School District to prioritize non-motorized improvements in locations where walking boundaries were truncated at primary/non-residential roadways. Pathways along primary roadways are the backbone of the city's non-motorized transportation network that is designed for users of all ages and abilities. While these corridors may not currently be deemed safe for school-aged children to cross, many of them are a few spot-improvements away from being deemed safe and adequate for such.



*The red arrows in this Long Meadow Elementary Access Diagram show all access points to the school building. Walking and biking improvements to better connect schools to their surrounding neighborhoods should be planned with access and circulation within the school grounds in mind. Source: RCSD School Transportation Study*

These spot improvements are also important for children and families who live outside of their school's walking boundaries, for whom safer infrastructure would provide a choice to walk or bike to school.



*This Brooklands Elementary Walking Map shows a walking radius of one mile around the school. The walking radius is truncated north of Auburn Rd and west of John R Rd.*

*Source: RCSD School Transportation Study*

## PEDESTRIAN AND BICYCLE NETWORK EVALUATION AND RECOMMENDATIONS

### SAFE ROUTES TO SCHOOL (SRTS)

SRTS resources, programming, and grants are important tools for improving health and safety outcomes and making Rochester Hills neighborhoods more pedestrian and bicycle friendly. SRTS goes hand-in-hand with the Rochester Community School District's efforts to improve walking and biking connections to schools for students.

SRTS is built around Six E's that summarize the key components of a comprehensive approach. Descriptions and examples of each may be found on the Safe Routes to School Partnership website:

- Engagement
- Equity
- Engineering
- Encouragement
- Education
- Evaluation



Michigan boasts one of the largest SRTS networks in the nation. In 2019, 78 Michigan schools received program or infrastructure grants to improve facilities and encourage students to walk and bike to school safely. At least eight Rochester Hills elementary and middle schools have recently participated in Walk to School Day.

Michigan SRTS grants are opportunities for Rochester Hills schools to continue to fund programming and infrastructure projects to create more pedestrian- and bicycle-friendly environments as they have done in recent years.

Michigan SRTS offers free recurring SRTS Basics Training webinars that are open to anyone, including



2016 Bike2School event. Source: SRTS Michigan

parents, students, teachers, residents, city staff and city officials, local law enforcement, non-profit staff, advocates, and other community members. A Michigan white paper titled Effectively Planning and Implementing SRTS for Students with Disabilities may also be downloaded on the SRTS website.

Even in the absence of grants, the city and engaged constituents may use SRTS resources including the SRTS Handbook and guidance for surveying, walking audits, and action planning to guide the city's messaging and prioritize certain types of infrastructure improvements.



Oakland County schools participate in Walk to School Day in 2018. Source: Oakland Press

## Recommendations

Based on feedback and analysis of network gaps, there are several recommendations to enhance the pedestrian and bicycle realm in Rochester Hills, described below:

- **Prioritize the infill of pathway gaps**, including alignment with recommendations from the Rochester Community School District's *School Transportation Study: Policy and Walking Routes*, especially along Tienken, Avon, Auburn, Adams, and Livernois Roads.
- **Construct a shared use pathway along the north side of the Auburn Road-M-59 overpass** to fill in a major non-motorized gap.
- **Revise the City's ordinance** to permit Class 1 e-bikes and e-scooters to operate on shared use pathways, as permitted by the State of Michigan.
- **Encourage bicycle parking** which can be incentivized or required of developers through the city's Zoning Ordinance.
- **Implement road diets on Hampton Circle, Barclay Circle and Drexelgate Parkway** to add safe pedestrian crossings and bicycle facilities.

- **Require Multi-Modal Transportation Impact Assessments (MMTIAs)** which typically apply to developments that meet certain square footage, trip generation, or other use-specific thresholds. These assessments help the city as well as neighborhood residents and stakeholders

understand the potential implications of a development on the greater transportation system, and the resulting improvements needed. All modes of travel are considered in a MMtIA, unlike in a traditional one-dimensional traffic analysis.



### SHARED USE PATHWAY

100 miles of city-owned and maintained pathways in Rochester Hills

- Typically 8 feet wide in Rochester Hills.
- City owned and maintained.
- Supports different modes of active transportation (walking, bicycling, etc.)



### SIDEWALKS

Sidewalks typical in recently developed residential neighborhoods

- Typically 5 feet wide in Rochester Hills.
- Sidewalks owned and maintained by adjacent property owner, not City.
- Mainly for walking.
- Some limitations in supporting different active transportation/micromobility modes.



### TRAILS

Found in parks and regional trail networks

- Width varies
- Paved or unpaved
- Supports active recreation opportunities (walking, bicycling, etc.)



### BIKE LANES

- Typically 5-6 feet wide
- Non-motorized connectivity in absence of Shared Use Pathways
- Supports different modes of transportation on the street

## TRANSIT EVALUATION AND OPTIONS

### Existing Transportation Services

Public transportation provides residents and employees with an alternative to driving an automobile. Typically transit users include two types, those who do not have an option to drive (due to age, health, income, etc.) and those who prefer to use transit for a variety of reasons (cost, environmental impacts, productivity while letting someone else drive, etc.). Public transit is typically viewed as being a fixed route bus (such as SMART in Metro Detroit), however, transit includes a wide array of options, such as fixed route standard buses, express or rapid buses with limited stops, demand responsive (like Dial-A-Ride or Scheduled services), and emerging types of transit using new types of vehicles. This section describes the current transit system in and around Rochester Hills, the services provided by the Older Persons' Commission programs, and some potential transit options for the future.



The key transit service in Rochester Hills is provided by the Older Persons' Commission (OPC). The OPC provides door-to-door transportation service for people 60 years and older as well as for disabled persons. In 2019, the OPC provided close to 50,000 trips - most of which were for medical appointments, grocery shopping, attending religious services, and traveling to work or a training center. The map on the following page shows the popular OPC destinations including a service area extending from Rochester Hills into Rochester, Oakland Township, Oakland University, and Troy Beaumont Hospital Complex. This is an invaluable service for City residents, especially those whose health or age may limit their ability to drive an automobile.

SMART is the organization that provides fixed route transit service in the suburban communities in Metro Detroit. Cities have the authority to determine if they wish to be included in the SMART service area by "opting" in or out. Cities that opt in typically have a local milage to help fund that service. In the past, the Rochester Hills City Council has had numerous discussions about offering SMART service within the City. After thoughtful consideration, it was determined that, while there is interest from some residents, there would not be enough use by residents to justify the cost to all property owners. So currently, residents and employees in the city that desire to use a SMART bus need to drive or otherwise connect with a SMART route outside of the city.

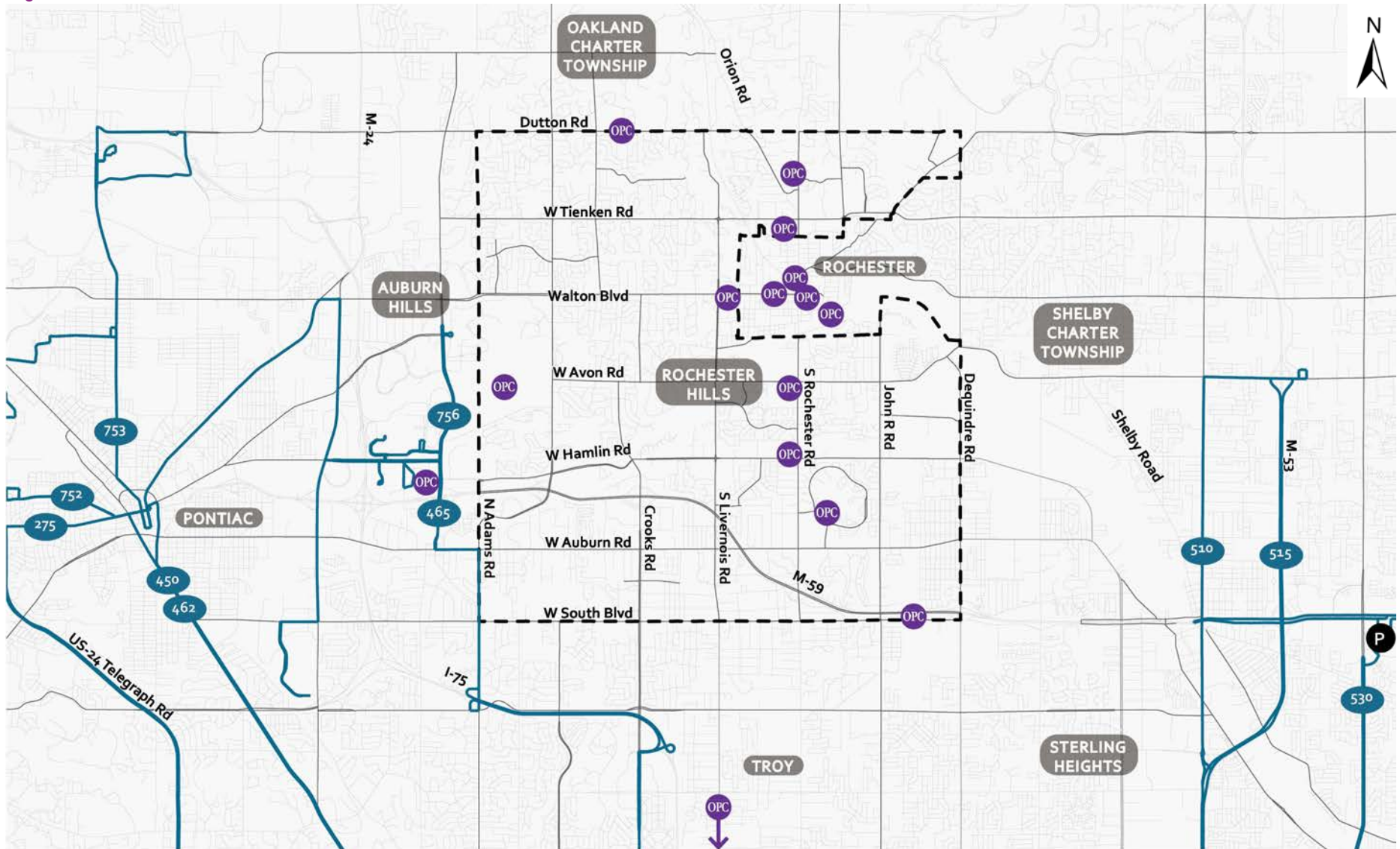
The Regional Transit Authority (RTA) has explored a different service program for Southeast Michigan that would include SMART and other services. This could be funded through a regional milage rather than city-by-city, where all cities in the service area would have bus routes. Voters in 2018 rejected that option by a slim margin, so another effort has been considered that would focus on the more developed communities and exclude the rural ones.

In the past, Oakland University (OU) operated a Bear Bus shuttle program. This service ended in August 2020. At the time this Plan was prepared, the University still had the shuttle vehicles and bus shelters, one of which is used for the SMART regional transit service. In the future, restoration of this service, potentially through a partnership with SMART, may be considered to improve connectivity between OU and Rochester Hills.

In the last few years, private rideshare services (including Uber and Lyft) have emerged as a viable alternative to driving. These services provide door-to-door transportation both within the city and to the rest of the region. This option is especially popular with younger people. While very convenient, the relatively high cost of these services makes it less suitable to regular commuting use. In addition, there can be a shortage of available drivers in parts of the city compared with high use zones such as more densely populated cities.



**Figure 25: OLDER PERSONS' COMMISSION (OPC) POPULAR DESTINATIONS AND SMART BUS CONNECTIONS IN NEARBY COMMUNITIES**



- City of Rochester Hills
- SMART Route
- SMART Park and Ride Location
- OPC Popular Destination

*Figure 25 illustrates popular OPC destinations in and around Rochester Hills, as well as connections to SMART routes in surrounding communities.*

## TRANSIT EVALUATION AND OPTIONS

### Transportation Service Expansion Options to Explore

The typical person who lives, shops or works in Rochester Hills, that has the option to drive, does so. Still there is a segment of the population that is looking for transit options. Approximately 50% of stakeholders and the public who responded to the surveys taken during this Planning process supported exploring public transportation options in Rochester Hills.

There are several potential public and private transportation services the City may wish to explore to increase equitable access to employment and shopping opportunities for residents and commuters:

- Continue to coordinate with the OPC to sustain or improve the current service. OPC could also seek opportunities to expand and to serve additional riders or destinations depending upon the level of interest and funding.
- Collaborate with the OPC, nearby cities, Oakland County, SMART, the Southeast Michigan Regional Transit Authority (RTA), and private enterprises to evaluate options to enhance transit options including micro-transit connections. This could include connections to existing or future SMART “FAST” express bus service to key destinations and transit corridors such as Woodward Ave., Somerset Mall, Downtown Detroit or the Detroit/Wayne County International Airport.
- Work with those same organizations to explore a Mobility Hub Demonstration Project in the city. As shown in Figure 26, a mobility hub is a place where different types of transportation services merge. Those may include an OPC stop, car sharing, bike sharing, micromobility options including e-bikes and e-scooters, ridehailing pickup and drop off areas, and a mix of other services based on the preferences of travelers and cost-benefit considerations. A pilot program can help identify effective mobility options and best practices so that the city and developers can include these options and services in future projects. This Plan suggests a Mobility Hub could be located near concentrations of multiple-family housing. Other possible locations could be near major employment centers, universities (OU and RU), or high activity shopping districts like the Village of Rochester Hills, Winchester Shopping Center and Hampton Village Center.



Image Source:  
Cavenue

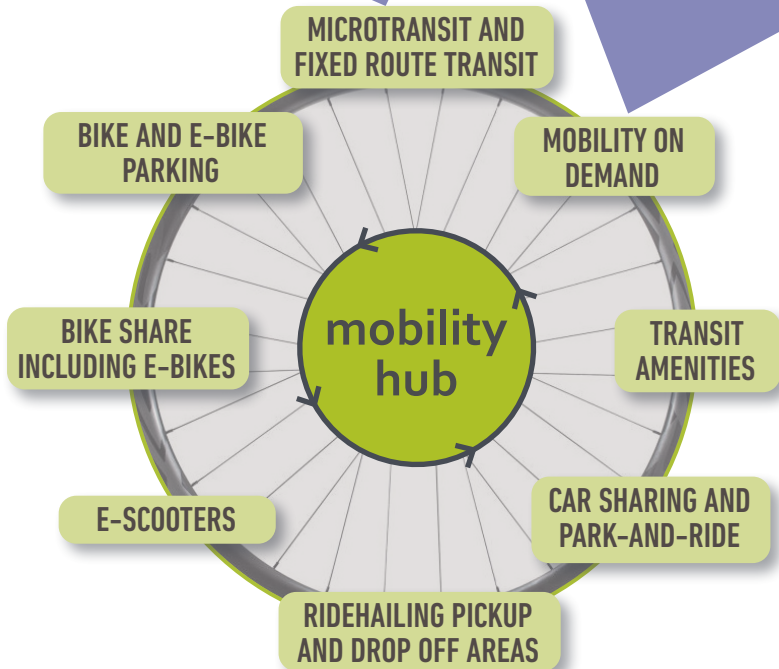
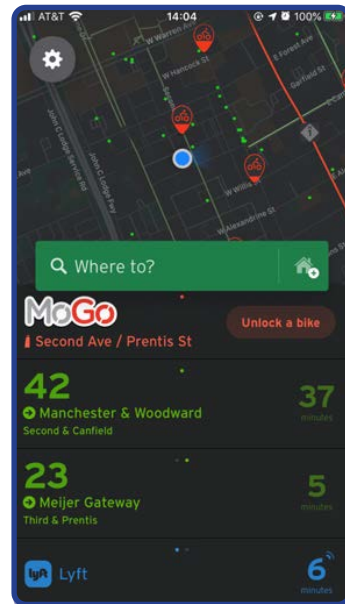


Figure 26: Mobility Hubs



### Micro-Transit in Southeast Michigan

**Micro-Transit** is a term used to describe a smaller transit vehicle than a typical bus. Its size and flexible routing can make it easier to provide service compared to a regular bus with a fixed route and schedule. Since costs associated with drivers is a significant part of transit costs, future micro-transit service may be a combination of public, private and autonomous vehicles.

SMART is moving forward with a Micro-Transit pilot in three clusters of communities in Metro Detroit, including in the neighboring communities of Troy, Madison Heights, Sterling Heights, Utica, and Macomb. These services will expand the transit-shed into areas that do not currently have convenient access to fixed route transit. They will provide on-demand rides to local destinations as well as to and from fixed bus routes in the area.

These pilots will include mobility hubs, the services and amenities of which will be determined by the needs of each community. Via, a national on-demand transit provider primarily focused on shared rides, has been contracted to provide the Micro-Transit services.

Rochester Hills may consider supplemental services like these as part of opting into SMART service in the future, in addition to considering fixed route bus service on high demand corridors such as Rochester Road.

# EMERGING TECHNOLOGY PREPAREDNESS

## Emerging Transportation Technology and its Influence on Future

In terms of transportation, we are moving into a new era with dynamic and dramatic changes intended to improve mobility and that prioritizes safety. Some of these technologies are visible today, such as on-board assistance in automobiles, and apps such as Google

Maps, Waze and the Transit App that provide real time information on the best time saving route to use based on current conditions and schedules and availability of transportation services. Other technologies, such as autonomous vehicles are still under development and testing, with a wide range of opinions on when they will become common. This section of the Plan provides a summary of some of this emerging mobility technology. Since this is

evolving, the intent to help position the City of Rochester Hills to work with the transportation agencies to help identify the technologies that are most suited to the city. In that way, the city can be one of the leading communities in being prepared to employ this technology in the future.

These technology advances offer many promising benefits – improved safety, less congestion, and

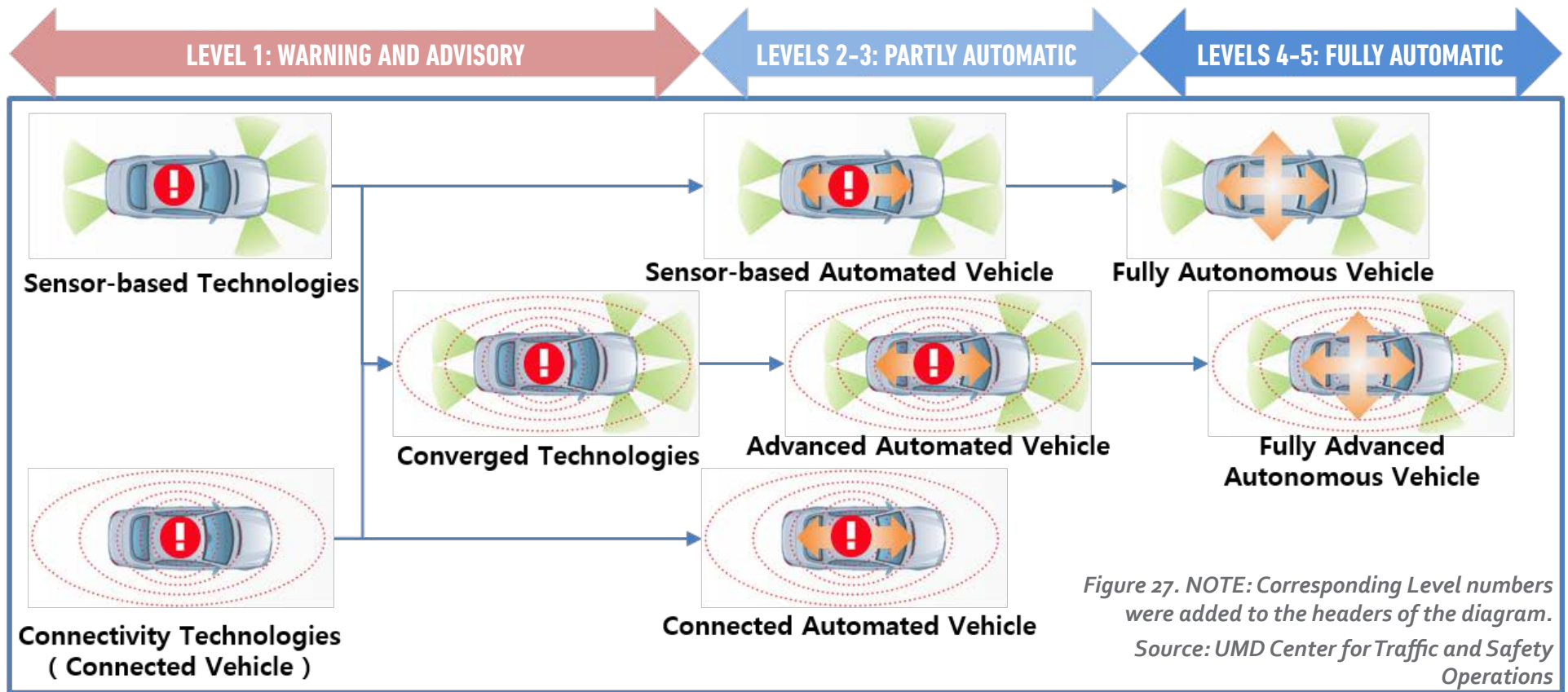


Figure 27. NOTE: Corresponding Level numbers were added to the headers of the diagram. Source: UMD Center for Traffic and Safety Operations

greater accessibility for those who need an option to driving. Some of these changes may also raise concerns about security, cost of implementation, taking certain decisions away from a human driver, and whether this technology will be available to everyone or just those who can afford it. And there may be resistance from some motorists who prefer to drive their own vehicle and have no interest in sharing a vehicle.

The level of benefits in terms of safety and congestion relief, is dependent upon the pace of having the technology in the vehicles on the road (the vehicle fleet) and the availability of infrastructure to support them (“Smart Technology”). Opinions vary on the pace of implementation, but gradual progress is anticipated. One source, U.S. DOT deployment models in 2019 predicted 80% of the vehicle fleet will be Connected and Autonomous (CAV) equipped in 15 to 25 years. The initial wave of fully autonomous vehicles may be trucks, micro-transit and shared ride vehicles. Metro Detroit is at the forefront of testing Smart Technologies and Autonomous Vehicles, for example the announcement in late 2020 of a vehicle testing corridor between Detroit and Ann Arbor. So Metro Detroit may see an accelerated implementation of new technologies compared to much of the U.S.

Generally, the technology can be classified into these four categories:

- 1. Connected Vehicles (CVs):** Connected in this case means vehicles that have on-board sensors and can communicate with the systems in other vehicles or with traffic signals. This communication can help avoid crashes or reduce their severity, among other benefits.
- 2. Autonomous Vehicles (AVs):** Different levels of autonomy in passenger automobiles, shuttles, trucking, and transit are already in use from controlled test environments to everyday use on the road. It is anticipated that the vehicle fleet will gradually move to greater automation and ultimately driverless travel. The National Highway Traffic Safety Administration (NHTSA) has established five levels of autonomous



*Autonomous shuttle bus at the MCity testing grounds in Ann Arbor. Source: New York Times*

vehicles based on the degree of vehicle automation that align with Figure 27.

- Level 1: Driver Assistance
  - Levels 2-3: Partial to Conditional Automation
  - Levels 4-5: High to Full Automation
- 3. Mobility as a Service (MaaS):** This is a gradual shift away from personally-owned vehicles towards mobility tailored to the user for use only when needed, and at other times the vehicle is available for use by others. For example, instead of driving a car to work and parking it all day, the traveler might use a ridehailing vehicle (like Uber or Lyft), a shared-bike, transit vehicle or another service. A user may connect with these services through a gateway (such as a mobile app) that creates and manages the trip.



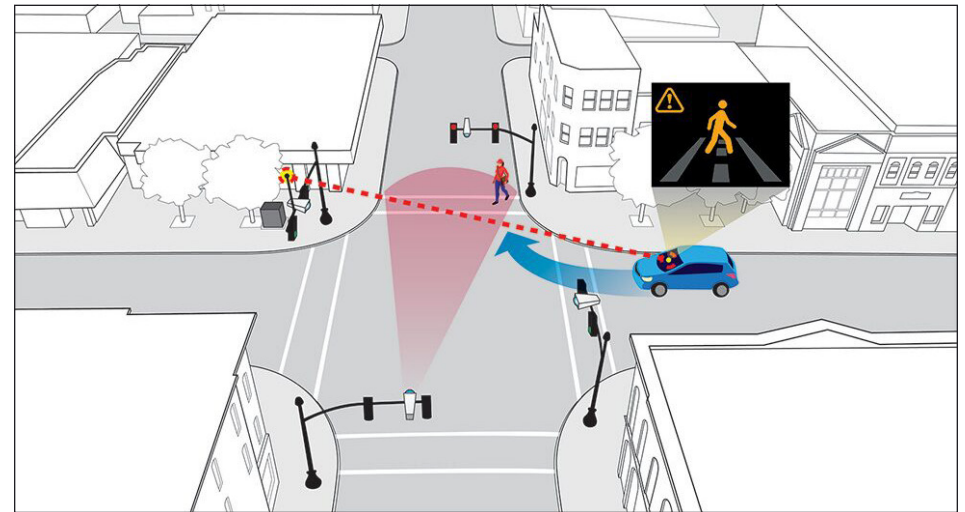
## EMERGING TECHNOLOGY PREPAREDNESS

4. **Smart Mobility Infrastructure:** Continued investments in public infrastructure will be needed to advance the three categories listed above (CVs, AVs, MaaS). This includes e-infrastructure (collaboration on software, data gathering, sharing real-time condition information), and physical infrastructure. Some of these are already available, others are still under development. And, this list is expected to expand as the technologies evolve from more research and agencies establish protocols. Examples include the following:

- Intelligent traffic signals, street lights, sensors
- Wide pavement markings that are wet reflective to improve visibility by bouncing light back to the vehicle at night or in rainy conditions. This will be an additional cost to install and maintain compared to the markings used today.
- Signage will need to have a high degree of reflectivity. Some signs may have communication directly with the vehicles such as to lower speeds approaching a work zone.
- Fiber optic systems to support 5G network and communications, or even a higher future level, for effective dissemination of information between vehicles and the smart infrastructure.
- Drainage and snow removal may become even more important to reduce damage to vehicle systems and help vehicle sensor capabilities.
- Roadside Units (RSU) – RSUs communicate information to the vehicles and vice versa. They are installed primarily at intersections. While this technology and standards are still changing, Walton Boulevard and Adams Road present an ideal corridor for installing such technology due to their proximity to Oakland University and connections to surrounding communities.

Implementation of these technologies will involve cooperation and participation with RCOC, MDOT, SEMCOG and other agencies on the forefront of this technology on studies and pilot projects for CAV technology and bring investment to support this technology to the community.

As noted previously, these technology advancements are expected to reduce the number and severity of crashes. They should also improve roadway capacity. More autonomous vehicles will be able to move through a signalized intersection than vehicles driven by a human due to closer spacing (and no distractions). There are likely to be other longer term consequences that could lead to future changes in city policies, budgeting, and ordinances, such as:



*Smart Intersection Technology.*  
Source: Honda

- Less parking demand – since vehicles are likely to be moving instead of parked. Thus parts of some parking lots may be available for a different use in the future. On-site parking requirements in the Zoning Ordinance can be relaxed.
- More demand for curbside access – ridehailing vehicles, micro-transit, and autonomous vehicles will need more space for drop-offs and pick-ups. Mobility hubs may help meet this need. These will require studies to determine the best locations and space to accommodate them (Mobility Hubs are described in the Transit section).



Source: USDOT Automated Vehicles 3.0 Preparing for the Future of Transportation.

- Vehicles will likely become more expensive – this could lead to greater interest in public transit, bicycling, e-bikes or other alternatives to driving alone.
- Increased infrastructure and maintenance costs – additional technology will require special features in traffic signals, wireless networks, and in the roadway, and likely more frequent maintenance to maintain pavement markings and signs. Funding will be needed to pay for those investments.

Addition information can be found in the USDOT report [Automated Vehicles 3.0 Preparing for the Future of Transportation](#).



Source: Lyft.

## EMERGING TECHNOLOGY PREPAREDNESS

### Electric Vehicle (EV) Charging Stations

It is anticipated the current trend to transition from gasoline powered vehicles to those powered by electricity will continue. This has many benefits, particularly environmental. Electric vehicle technology (as of 2021) requires regular charging of the vehicle via plugging into an outlet. As the fleet transitions to more electric vehicles, EV charging station demand will likely increase substantially. These charging stations can be at home, on-street, and in public or private parking lots. These do add costs both for the installation and the power required. Capacity of the power grid will need to be monitored as EV charging becomes more prevalent. There are a number of ways Rochester Hills can begin to meet this current and future demand for EV charging stations.

- Installation of some EV charging stations at City-owned parking lots. These could be available for both visitors (short duration, fast-charging) and employees or residents (slower chargers). These could begin as a pilot project to monitor use to help inform if and when additional chargers should be added.
- Funding assistance may be available. For example, in 2020, applicants from Shelby and Northville Townships were awarded grant funding from the Michigan Department of Environment, Great Lakes, and Energy (EGLE) to install EV charging stations at various locations.
- Incentives through zoning or funding assistance to install them in larger parking lots such as shopping centers, restaurants, major office complexes, multiple-family residential neighborhoods.

#### *Additional information:*

[How to build an electric vehicle city: deploying charging infrastructure](#)  
[Electric Vehicle Charging Infrastructure: A quick guide for cities](#)

### E-Bikes and E-Scooters (Micro-Mobility)

E-bikes and e-scooters are becoming more prevalent, especially as alternatives to short vehicle trips (typically within 1-2 miles). These vehicles can be owned by an individual or shared, with pick-ups and drop-offs at stations, in zones or randomly situated. Use of the shared e-bikes and e-scooters began in the densest parts of larger cities, like Detroit. However, these types of vehicles are becoming more common in suburban cities like Rochester Hills and could be anticipated to serve downtown Rochester and nearby universities. Oakland University is currently served by an e-scooter provider named Spin.

These electric-assisted vehicles help provide an alternative to driving, which can reduce congestion and emissions. These vehicles also create some issues and challenges, including where the vehicles can be used - within the road, on pathways or sidewalks is usually regulated by local ordinances and enforcement. Pick-up and drop off zones, if not organized and regulated, can lead to clutter and conflicts with bicycles and pedestrians. There are also safety issues both for the riders, and when the vehicles create conflicts with pedestrians, bicyclists, and vehicles. In some cases, geo-fencing can be used to restrict e-scooter speeds in certain areas.

One of the topics discussed during the development of this Plan was whether to allow e-bikes to use the pathways currently restricted to pedestrians, bicyclists, and electric wheelchairs (permitted to use the pathways that are otherwise restricted to non-motorized travel by the American's with Disabilities Act, ADA). In Michigan, the State allows only Class 1 e-bikes on paved trails (classes listed below). The higher classes of e-bikes are directed to use bike lanes or vehicle lanes in the street, or trails where motorized vehicles are allowed. The city has the authority to regulate the allowance or restriction of e-bikes on the pathways.



- **Class 1** – equipped with motor that assists only when pedaling and disengages when bike reaches 20 mph.
- **Class 2** – equipped with motor that propels the bike regardless of pedaling to a maximum speed of 20 mph and disengages when brakes are applied, or throttle is released.
- **Class 3** – equipped with motor that assists only when pedaling and disengages when bike reaches 28 mph.

*Source: State of Michigan DOT*

*Note: Every e-bike is required to have a label indicating the class.*

Research on communities with e-bike regulation indicated that the facilities on which these e-bikes are allowed are dependent on community preference and facility design. In general, the lower speed Class 1 e-bikes are allowed on paved trails or shared use pathways. Class 2 and Class 3 e-bikes are often restricted due to the maximum speed possible for these vehicles can create hazards for other pathway users.

Given these findings and the increasing use of e-bikes, regulations should be established to dictate use on the pathways. During this Plan’s development, the input was very split. The conclusion was that the city should coordinate with the adjacent municipalities, and the organizations with trails in the city toward a shared approach to reduce confusion. The first step would be consideration to allow Class 1 e-bikes on the city’s pathways.

A similar, but distinct type of micro-mobility are e-scooters. Most of these are offered and operated by private mobility companies, and often there can be competing companies within a city. These scooters offer a convenient and inexpensive option for short trips, with similar benefits as the e-bikes. They can also be used to provide connections to transit, future micro-transit or Mobility Hubs.

When e-scooters first began appearing, most cities were caught unaware and did not have any direction or regulations in place for their operation. Some riders use the streets, others the sidewalk, and it varies based on the level of pedestrian and vehicle volumes. Conflicts with other travelers, and a random dispersal of the scooters on sidewalks and pathways often causes problems. Some cities now require the scooters be returned to designated places or otherwise restrict their locations. The city should monitor the potential deployment of e-scooter providers as they move from Detroit into other cities. An ordinance to regulate them should be considered.

*Additional Information:*

[Michigan DNR: Electric Bikes in Michigan](#)



*MoGo electric pedal-assist bicycles.*

*Source: Crains Detroit*

07

APPLIED  
RECOMMENDATIONS  
AND ACTION PLAN



# OVERVIEW

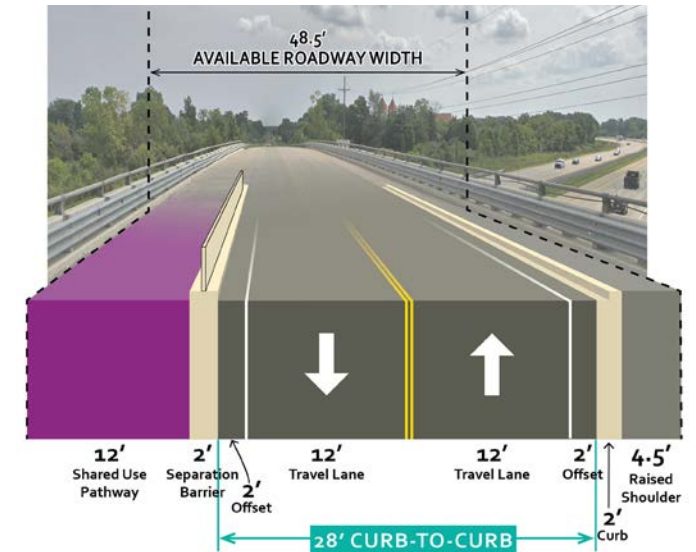
This section first describes the ranking criteria used to determine candidate improvement corridors and intersections. This process, along with the results of the engagement process, was used to inform the citywide recommendations in the Action Plan. Recommendations were designated as a result of the analysis, engagement, and cost evaluation conducted as part of this planning process.

Implementation of the plan's recommendations will require collaboration between local, regional, state, federal, and transit agencies, as well as residents, property/business owners, and other stakeholders. The Action Plan is intended to serve as a guiding tool for implementation

and should be revisited on an annual basis to track progress and make necessary adjustments to projects and priorities.

Following the recommendation maps and tables are descriptions and illustrations of three proposed Road Diet corridors and one proposed location for non-motorized facilities on an M-59 overpass. This section concludes with a cost overview for short-term and long-term improvements.

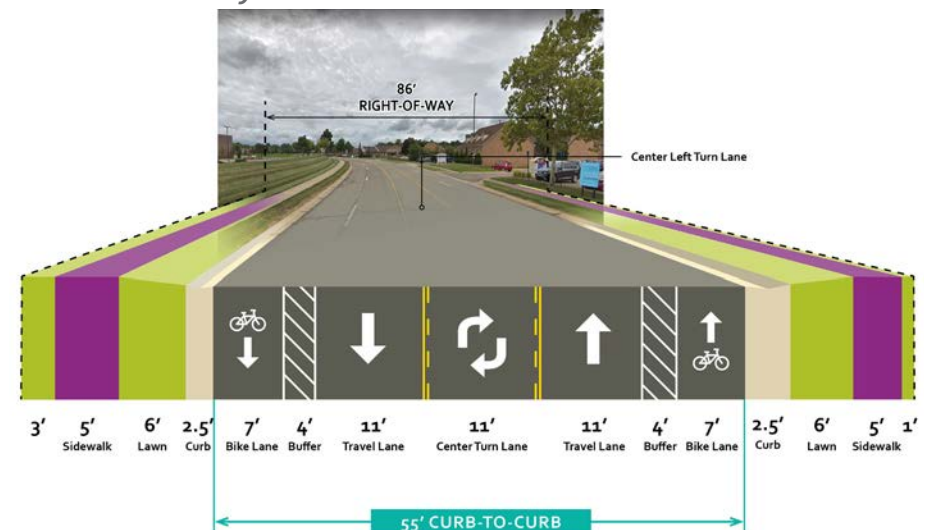
*Auburn Rd M-59 Overpass - Alternative Cross Section*



*Hampton Circle - Alternative Cross Section*



*Barclay Circle - Alternative Cross Section*



# PROJECT RANKING FACTORS

The last step in the network evaluation process was to combine the primary performance metrics of capacity and safety, and supplemented by funding, non-motorized, public transportation, emerging technologies, and public input to produce a list of candidate segments and intersections for which recommendations can be produced. The thresholds established were guided by engineering principles and the data obtained through the above noted methods of analysis.

The primary criteria for identifying segment candidates were as follows:

- Segment has an estimated 2040 V/C ratio of 0.8 or higher, OR
- Segment has a LOSS IV, OR
- Segment has crash rate above 3.08 per million vehicle miles traveled (2019 Michigan statewide average crash rate)

The primary criteria for identifying intersection candidates were as follows:

- Intersection has a LOSS IV, AND
- Intersection has 5 or more crashes per year

In all cases, consideration was given to those locations which received public comments, and those segments with a FAC score of 30 or higher. The identified candidate locations based on these performance measures for both segments and intersections are presented in Figure 28 and Figure 29.

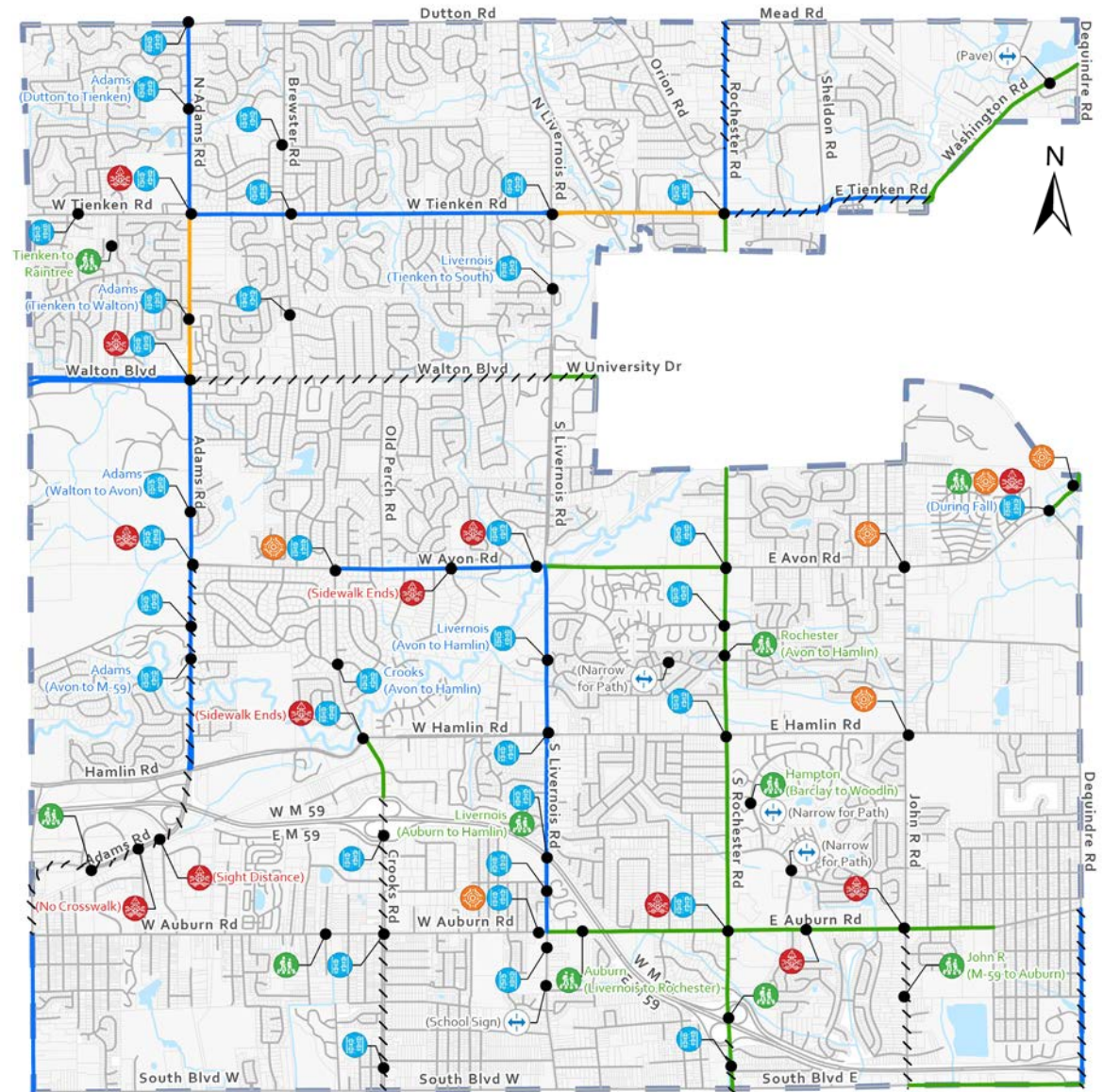
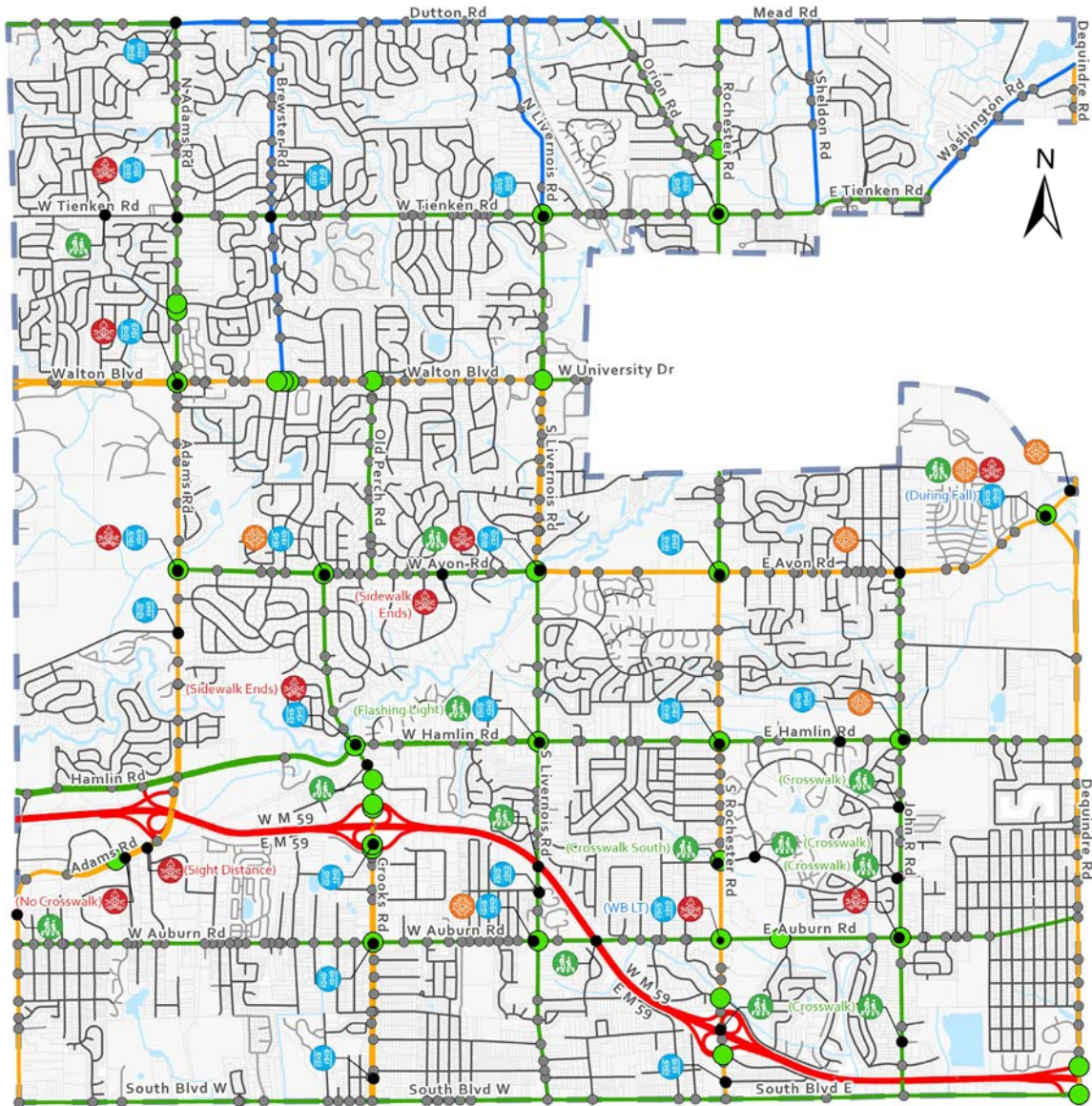


Figure 28: SEGMENT CANDIDATES

<p>Segment Candidates</p> <ul style="list-style-type: none"> <li><span style="color: blue;">—</span> Capacity</li> <li><span style="color: green;">—</span> Safety</li> <li><span style="color: orange;">—</span> Capacity &amp; Safety</li> <li><span style="border-bottom: 1px dashed black; width: 20px; display: inline-block;"></span> FAC Overlay</li> <li><span style="border-bottom: 1px solid black; width: 20px; display: inline-block;"></span> Criteria Not Met</li> </ul>	<p>Stakeholder Comments</p> <ul style="list-style-type: none"> <li><span style="color: blue;">●</span> Congestion</li> <li><span style="color: red;">●</span> Safety</li> <li><span style="color: green;">●</span> Non-motorized connection</li> <li><span style="color: orange;">●</span> Roundabout</li> <li><span style="color: blue;">⬇</span> Other</li> </ul>
----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------



**Figure 29: INTERSECTION CANDIDATES**

- |                                                          |                                                               |
|----------------------------------------------------------|---------------------------------------------------------------|
| <b>Road NFC</b>                                          | <b>Intersection Candidate</b>                                 |
| <span style="color: red;">—</span> Freeway               | <span style="color: green;">●</span> Safety                   |
| <span style="color: orange;">—</span> Principal Arterial | <span style="color: grey;">●</span> Safety Criteria Not Met   |
| <span style="color: green;">—</span> Minor Arterial      | <b>Survey Comments</b>                                        |
| <span style="color: blue;">—</span> Collector            | <span style="color: blue;">●</span> Congestion                |
| <span style="color: grey;">—</span> Local                | <span style="color: red;">●</span> Safety                     |
| <span style="color: lightgrey;">—</span> Private         | <span style="color: green;">●</span> Non-motorized connection |
|                                                          | <span style="color: orange;">●</span> Roundabout              |

# CITYWIDE RECOMMENDATIONS

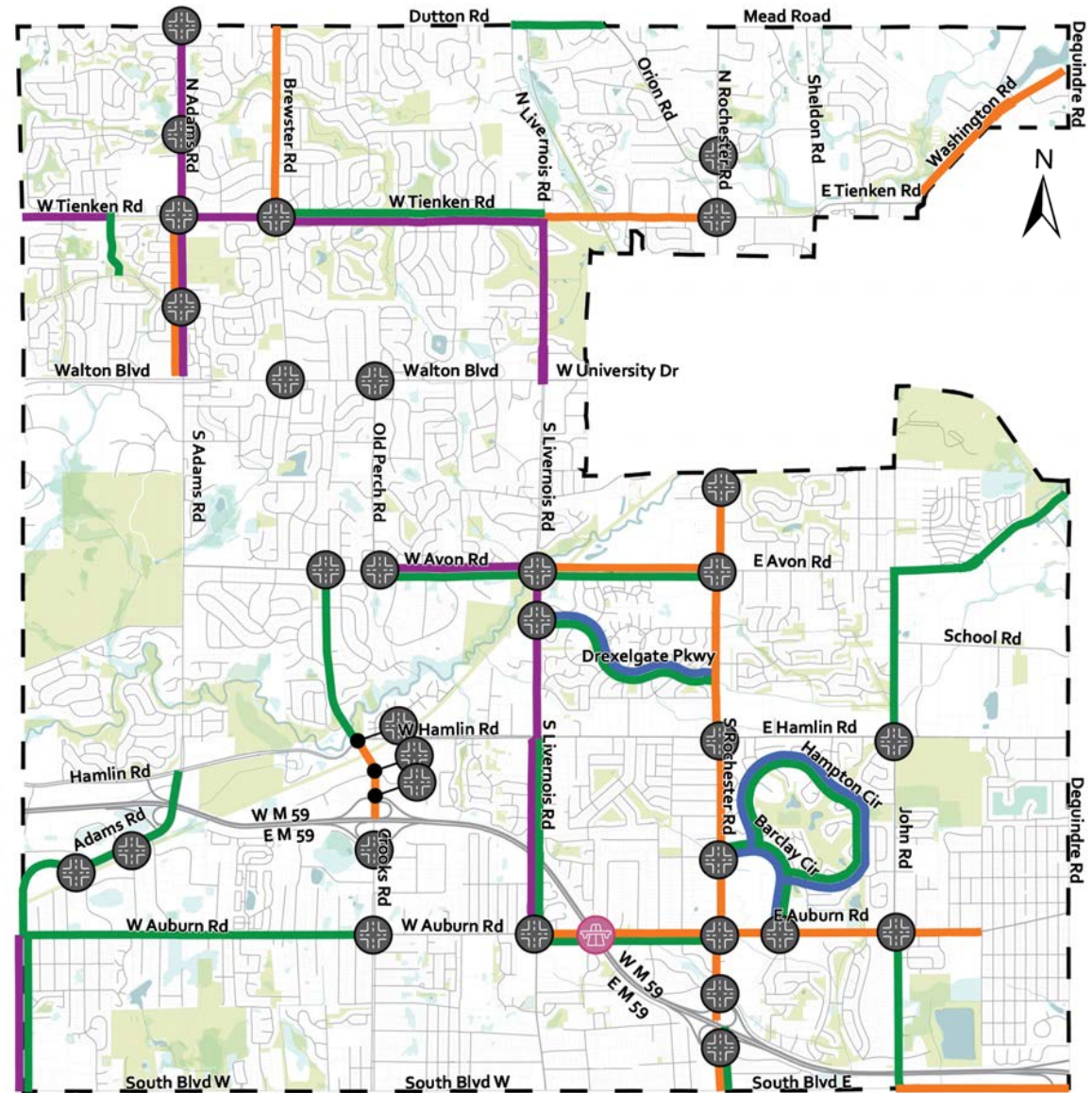
The observation corridors and intersections (mapped in the Appendix) were reviewed to determine the citywide recommendations illustrated in Figure 30 and Table 4.

Recommendations were based on data analysis findings for congestion, safety, non-motorized access, and implementation feasibility. Findings were supplemented with pavement conditions and public input. Citywide recommendations are discussed in detail throughout Chapters 6 and 7 of this document.

It should be noted that road corridors currently planned for reconstruction have not been included in this list, but rather have been considered when providing recommendations for the adjacent network. Examples of these include Adams Rd between Walton Blvd to Hamlin Rd, Avon Rd between John R Rd to Dequindre Rd, and all associated intersections.

Similarly, several intersections were modernized during the years considered in the safety analysis. While the analysis may have shown safety concerns at these intersections, these improvements have addressed the identified safety deficiencies. These intersections have not been included in the recommendations.











Detailed descriptions of corridor and intersection recommendations can be found in the Appendix.



**Figure 30: CITYWIDE RECOMMENDATIONS**



**Table 4: CITYWIDE RECOMMENDATIONS**

Recommendation Number & Type	Recommendation Description
 01	Work with School District to implement SRTS recommendations, particularly along key walking routes to elementary schools.
 02	Connect neighborhoods with City Forestry department for planting of street trees as part of a traffic calming program.
 03	Amend city ordinance to allow Class I e-bikes to use pathways, coordinate with other trails and pathways organizations in the city and surrounding communities.
 04	Monitor experiences of other communities and agencies with e-bikes and e-scooters to determine if other ordinance amendments should be considered.
05	Work with OPC, County, RTA, SMART to evaluate connections to regional transit and destinations, development of mobility hubs within the city.
06	Work with OPC on maintaining and extending transit service within the city.
 07	Coordinate with MDOT to study, seek funding, and approve non-motorized crossings of M-59.
 08	Work with RCOC, MDOT, SEMCOG to implement new transportation technologies including potential pilots along Walton Blvd and Adams Rd.
 09	Require a Multi-Modal Transportation Impact Assessment (MMTIA) to be completed with new developments.
 10	Apply access management principles as part of site plan review for new development and redevelopment along major corridors.
 11	Study the implementation of road diet and bicycle facilities throughout the city to calm traffic and expand the non-motorized transportation network.
 12	Improve trail crossings along major roadways.
13	Explore incentives for electric vehicle charging stations.

Lastly, the analysis indicated non-motorized gaps at the freeway crossings of M-59/ Livernois Rd and M-59/Rochester Rd. These are priority crossings, and it is recommended that connected and continuous non-motorized routes are provided through these locations. However due to the lack of available space to retrofit these crossings, these improvements are considered long-term and thus have not been included in the list of recommendations.

# ACTION PLAN

An Action Plan corridor or intersection is a facility from the overall recommendations that is critical to the City's transportation network (i.e. arterials and/or primary east-west and north-south corridors). These are locations for which the analysis indicated a greater magnitude of congestion, non-motorized need/demand, and safety concerns. Similar to the prior levels of analysis, findings were supplemented by the physical road conditions and public input. Implementation feasibility was also considered.

As part of this selection and per the direction of city staff, Livernois Road was included as an Action Plan corridor. Livernois Road was analyzed in depth by modeling the corridor using Synchro 10 and following the procedures outlined in the Highway Capacity Manual (HCM) to assess the performance of the corridor and major intersections.

The results of this analysis are presented in Figure 31, which illustrates the location and extent of the Action Plan corridors and intersections. Action Plan recommendations are described in greater detail in Table 5. It should be noted that improvements along one corridor can have an impact on adjacent corridors.

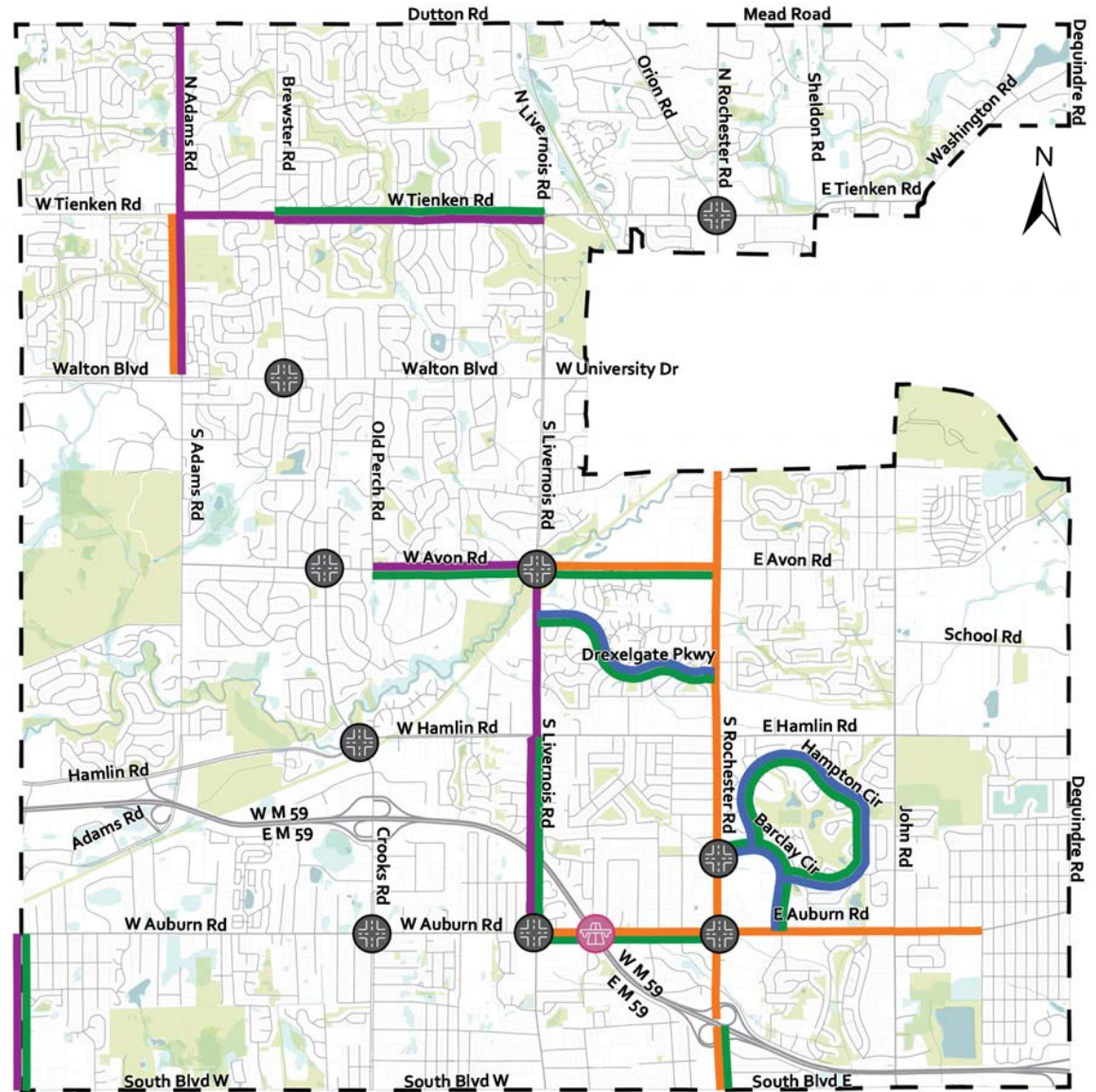




















Figure 31: ACTION PLAN





**Table 5: ACTION PLAN**

Recommendation Number & Type	Corridor	Extents	Recommendation Description (may include multiple alternatives)
 01	Adams Rd	Dutton Rd to Walton Blvd, Auburn Rd to South Blvd	Explore options to increase capacity by adding TWLTL or widening to 5-lane cross section, signal modernization, and roadway safety countermeasures.
 02	Auburn Rd	Livernois Rd to Rochester Rd	Complete non-motorized route gaps, add turn lanes and increase storage lengths at signalized intersections, and strategically implement access management along commercial clusters.
 03	Auburn Rd	Rochester Rd to Culbertson Rd	Install TWLTL in strategic locations, strategically implement access management along commercial clusters, enhance pedestrian crossing at Barclay Rd.
 04	Avon Rd	Old Perch Rd to Rocheser Rd	Upgrade the Clinton River Trail pedestrian crossing, complete sidewalk gaps on the north side of the road, increase intersection capacity, and install a TWLTL.
 05	Livernois Rd	Avon Rd to Auburn Rd	Complete non-motorized route gaps, increase intersection capacity, and signal modernization.
 06	Rochester Rd	Tienken Rd to South Blvd	Strategically implement access management along commercial clusters, implement roadway safety countermeasures, increase turn lane capacities, and signal modernization.
 07	Tienken Rd	Adams Rd to Livernois Rd	Install TWLTL throughout corridor, complete non-motorized route gaps on north side of road, examine ways to increase intersection capacity including increased turn lane capacity or roundabout feasibility.
 08	Auburn Rd	M-59 Overpass	Install non-motorized facilities to connect destinations on either side of M-59.
 09	Barclay Cir, Hampton Cir, Drexelgate Pkwy		Implement road diets, complete non-motorized facility gaps, install proposed pedestrian crossings and bicycle facilities.
 10	Intersection at Auburn Rd and Crooks Rd		Implement access management strategies at the SW and SE intersection quadrants, intall backplates.
 11	Intersection at Auburn Rd and Livernois Rd		Implement access management strategies at the SE intersection quadrant, increase turn lane storage lengths.
 12	Intersection at Avon Rd and Crooks Rd		Examine options to increase intersection capacity including increased turn lane capacity or roundabout feasibility.
 13	Intersection at Avon Rd and Livernois Rd		Examine options to improve intersection operations.
 14	Intersection at Hamlin Rd and Crooks Rd		Examine need for protected only left turn phase, install backplates, and consider low-level signal for critical movements.
 15	Intersection at Rochester Rd and Auburn Rd		Implement access management strategies at the NW intersection quadrant, consider low-level signal for critical movements, and signal modernization.
 16	Intersection at Rochester Rd and Tienken Rd		Implement access management strategies at the SW and NW intersection quadrants, install backplates, consider low-level signal for critical movements, and consider median to prevent direct left turns.
 17	Intersection at Rochester Rd and Barclay Cir/Wabash Rd		Implement access management strategies at the NE intersection quadrant, improve east-west alignment, examine installing right turn lanes, implement roadway safety countermeasures, and signal modernization.
 18	Intersection at Walton Blvd and Brewster Rd/Maryknoll Rd/Canterbury Tr		Examine intersection realignment or signal reconfiguration, install backplates.

*NOTE: Details on longer term improvements can be found in the Appendix.*

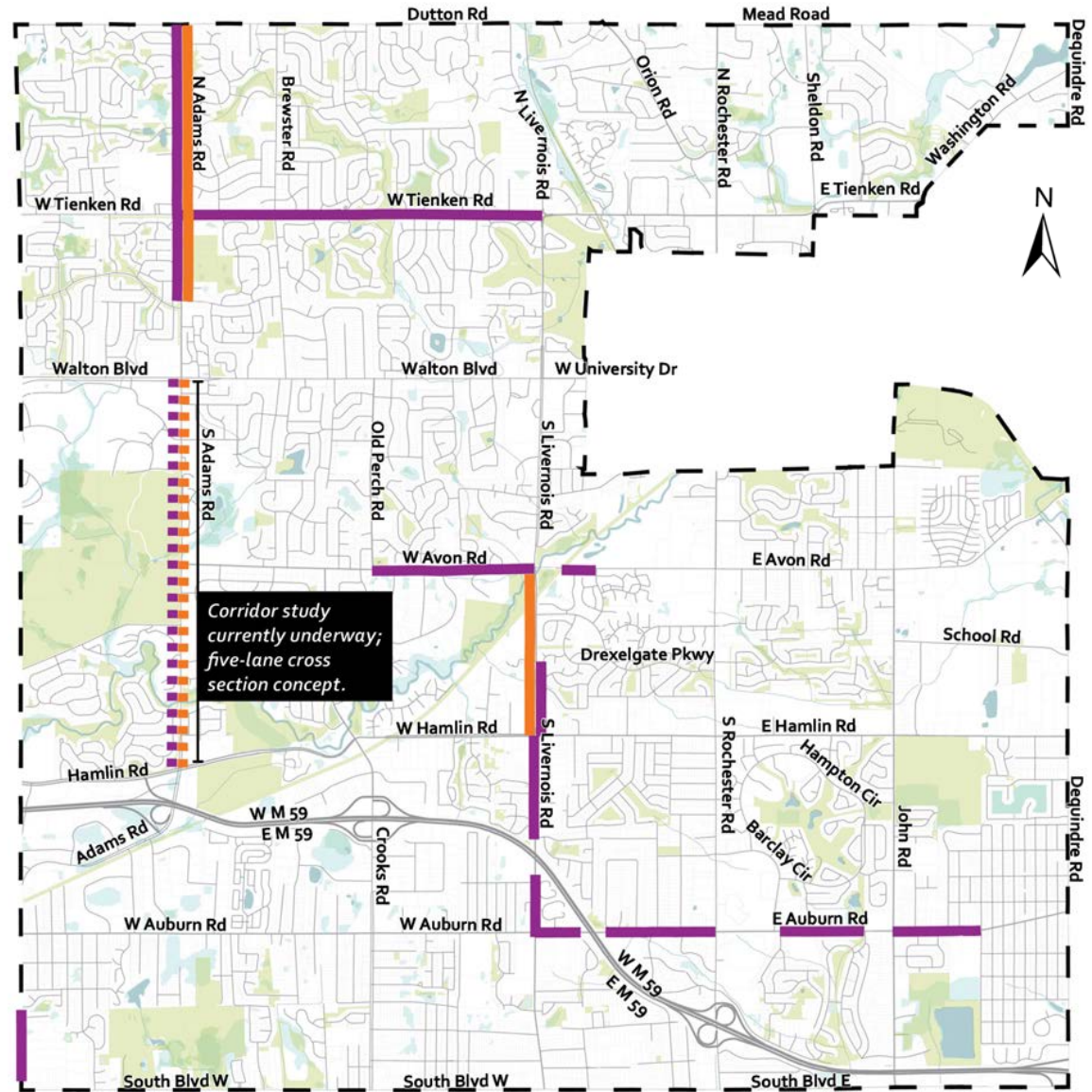
# ACTION PLAN ROAD WIDENING

The previously provided performance measures for the corridor and intersection recommendations are based primarily on road widening improvements. Figure 32 presents all proposed road widening recommendations included in the Action Plan.

Although road widening throughout a network has been proven an ineffective strategy to alleviate congestion in the long term due to the concept of induced demand, widening in strategic bottleneck locations can improve traffic operations throughout the network. The addition of a center turn lane, which is the proposed widening improvement on the majority of the Action Plan corridors, improves access management and reduces conflicts with left turning vehicles, in addition to addressing congestion.

## Action Plan Road Widening Corridors (and Jurisdictions)

- **Tienken Rd** (Oakland County)
- **Avon Rd** (Oakland County)
- **Auburn Rd** (MDOT west of Rochester Rd, City east of Rochester Rd)
- **Adams Rd** (Oakland County) - *Two widening alternatives illustrated*
- **Livernois Rd** (Oakland County) - *Two widening alternatives illustrated*



**Figure 32: PROPOSED ROAD WIDENINGS IN ACTION PLAN**

- Widen to three-lane cross section
- Widen to five-lane cross section
- Three-lane and five-lane cross section widening options



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# ROAD DIETS

## Overview

Expansion of non-motorized connections is a top priority, as well as increasing safety within the transportation system. This section highlights three corridors that were identified as priorities during the engagement process and are recommended for road diets to better accommodate pedestrian and bicycle facilities.

A road diet is a design-based safety solution that reconfigures a street by removing travel lanes to repurpose the old travel lanes for other

uses and travel modes. Benefits of a road diet include safer traffic speeds, reduction of the overall crossing distance for pedestrians, and improved safety for all users.

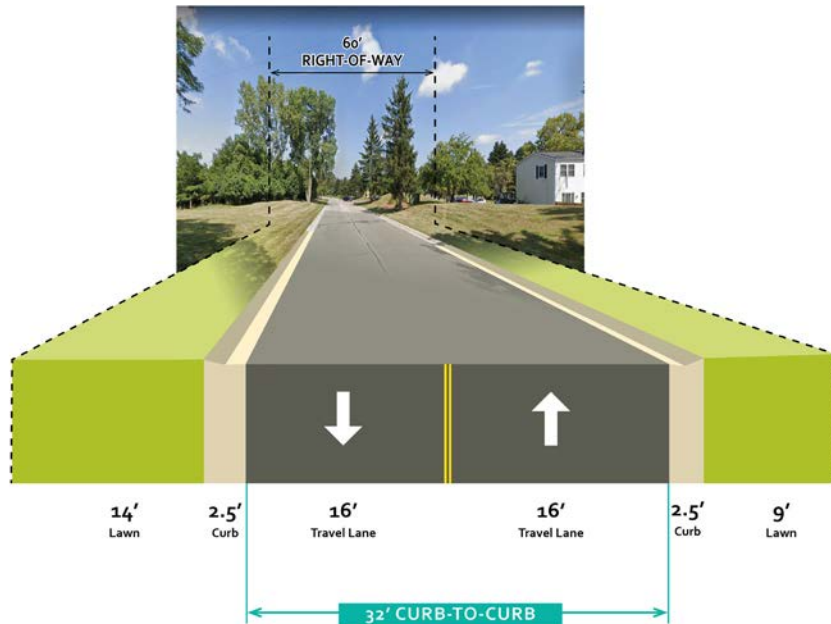
## Drexelgate Parkway Non-Motorized Connectivity

Drexelgate is a wide two-lane road, surrounded by residential, that connects Livernois Road to Rochester Road. This is also an ideal connection from this residential area to the Clinton River Trail (located off of Livernois Road). Only two pedestrian crosswalks exist along Drexelgate (at Livernois and

Rochester Roads). It is recommended to add at least three mid block crossings to safely cross pathway users.

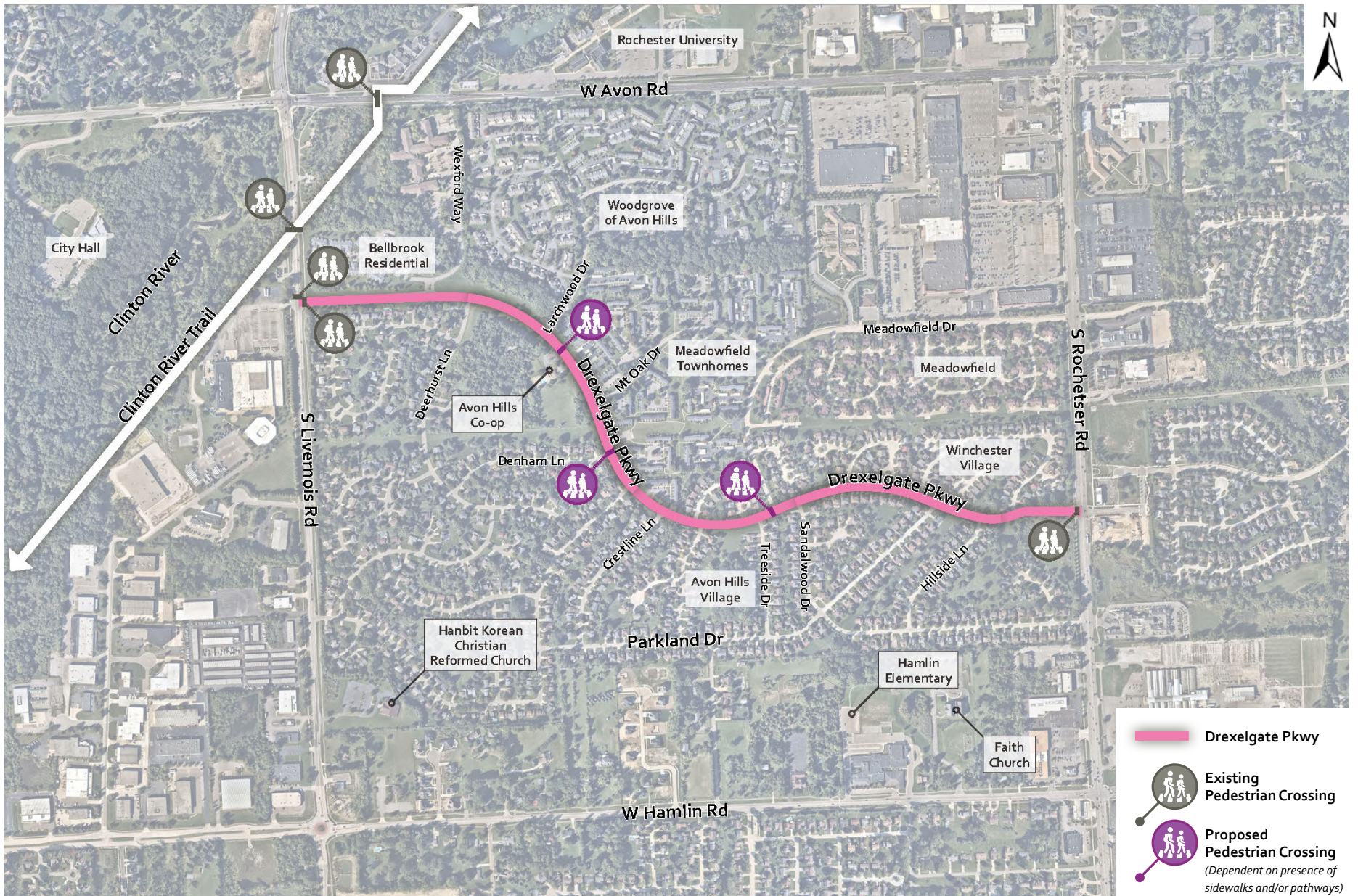
Due to the wide nature of the road, there is room to shift the north side curb and narrow the road to accommodate an 8 foot wide pathway on the north side. Additionally, sharrows are recommended to indicate that vehicles should share the road with bicycles. In the short-term, before the pathway can be implemented, the road can be restriped to narrow the lanes to help slow down traffic.

DREXELGATE EXISTING



DREXELGATE PROPOSED





**Figure 33: DREXELGATE PARKWAY CONNECTIVITY AND PROPOSED CROSSING LOCATIONS**

## ROAD DIETS

### Barclay Circle and Hampton Circle Non-Motorized Connectivity

Barclay Circle and Hampton Circle were targeted for road diets. Both of these roads currently serve as connectors between residential neighborhoods and commercial businesses along Rochester and Auburn Road.

Barclay Circle is a five-lane road, with four travel lanes and a center turn lane. There are sidewalks on both sides of the road, but few crosswalks exist to safely cross pedestrians (only one actually connects to Hampton Circle currently).

Hampton Circle connects the residential subdivisions to Barclay Circle. This road varies in width (from 48' to 36' curb to curb) and is three lanes across (two travel lanes and a center turn lane). Hampton Circle contains sidewalks on both sides of the street with the exception of a few locations, however, only two midblock crossings occur along the entire road.

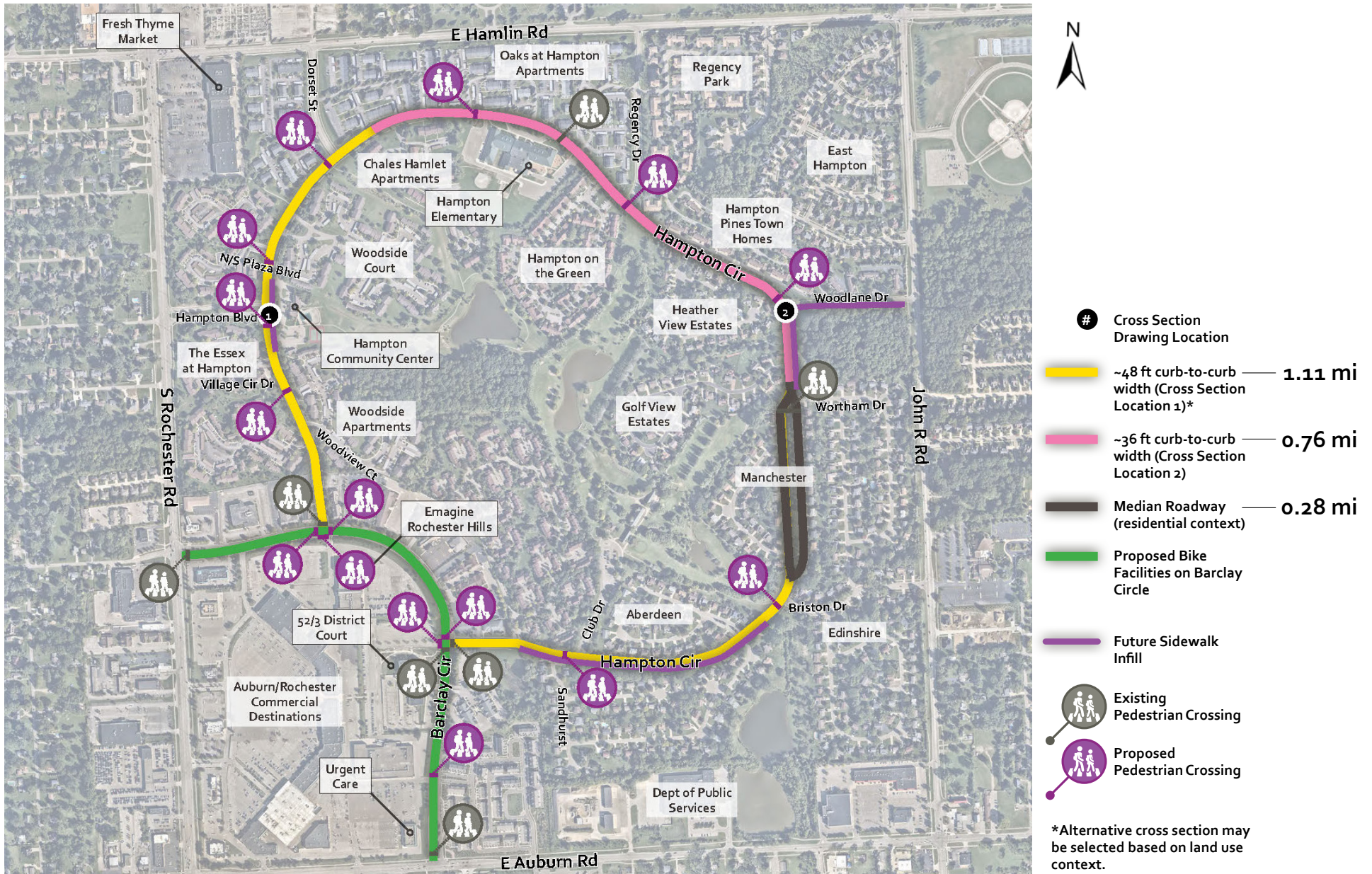
A total of 15 additional pedestrian crosswalks are proposed along Barclay and Hampton Circles. This will greatly improve connectivity and provide safe connections, especially where Hampton and Barclay Circles intersect.



*Existing Conditions: Barclay Circle*



*Existing Conditions: Hampton Circle*



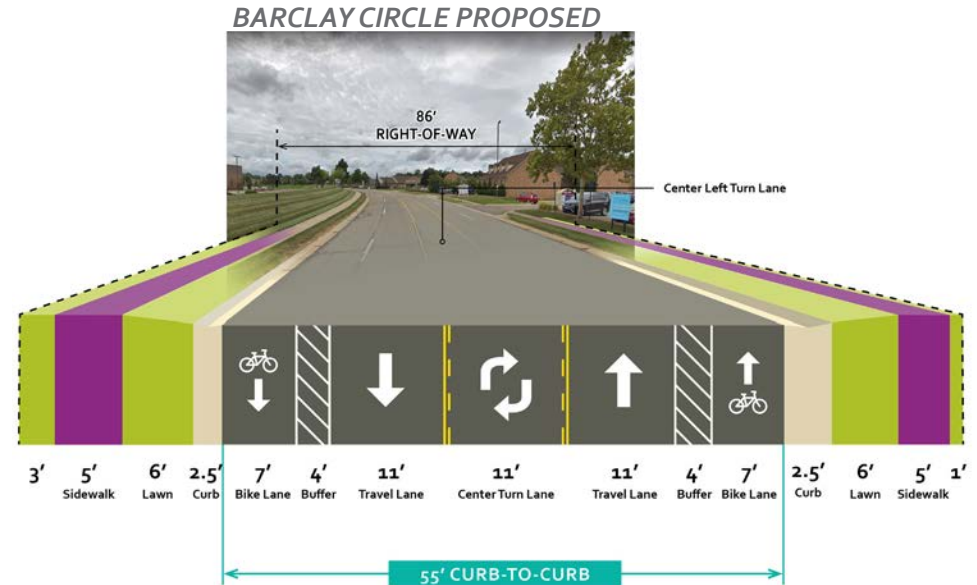
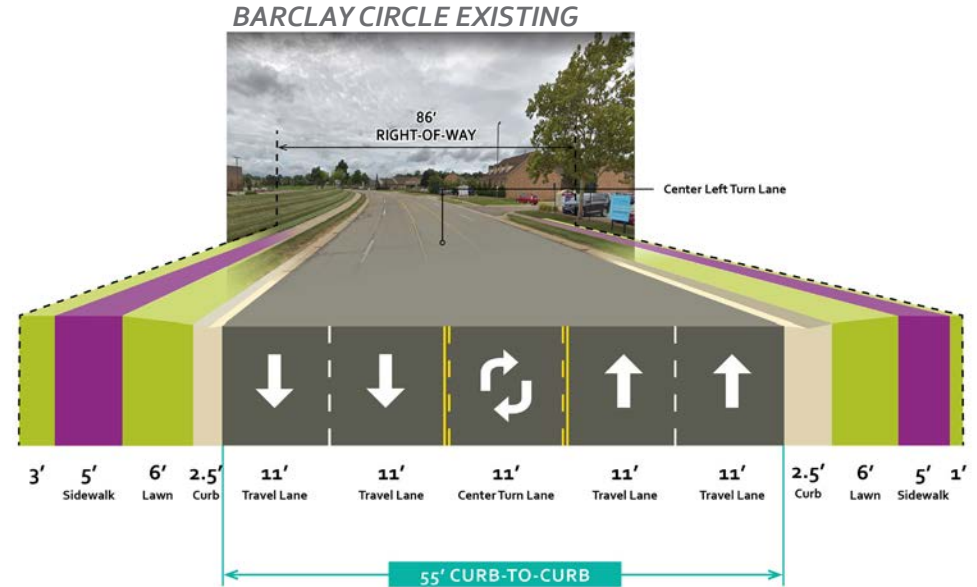
**Figure 34: BARCLAY CIRCLE AND HAMPTON CIRCLE PROPOSED NON-MOTORIZED FACILITIES AND PEDESTRIAN CROSSING LOCATIONS**

# ROAD DIETS

## Barclay Circle Road Diet

Barclay Circle is an ideal location for a road diet with an expansive right-of-way and traffic counts indicating that a five-lane road is well above the needed threshold for efficient vehicular travel.

Recommendations include converting the road from five to three lanes, still retaining the center turn lane. With the remaining right-of-way, buffered bike lanes can be implemented (7' bike lanes on both sides of the road with 4' buffers). The travel lanes and center turn lane would remain 11' wide.



Buffered bike lane in Fairfax, CA.

Source: NACTO



**BARCLAY CIRCLE EXISTING**



**BARCLAY CIRCLE PROPOSED**



*Buffered bike lane in Atlanta, GA.*

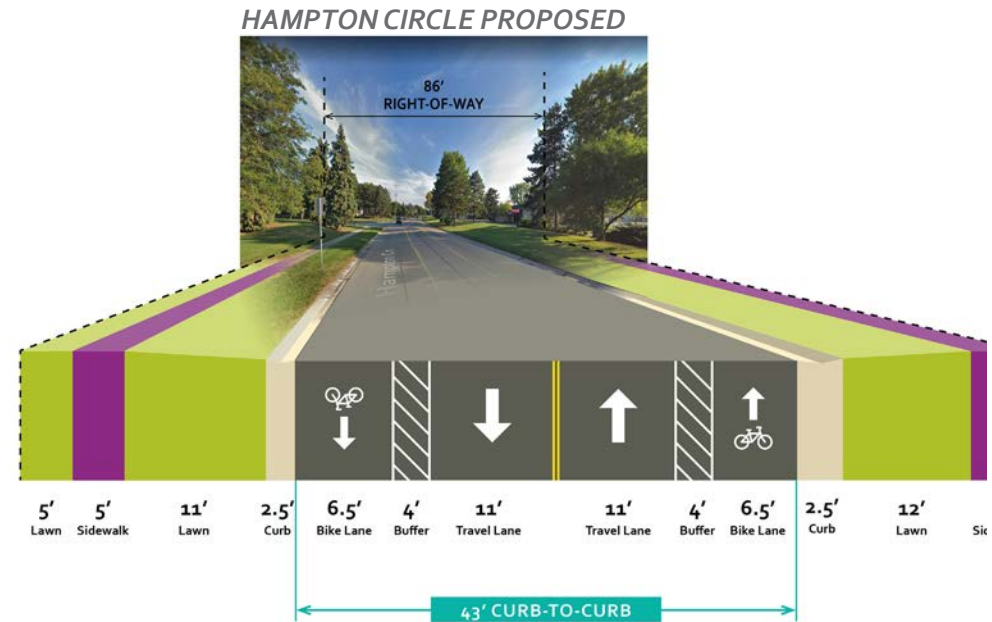
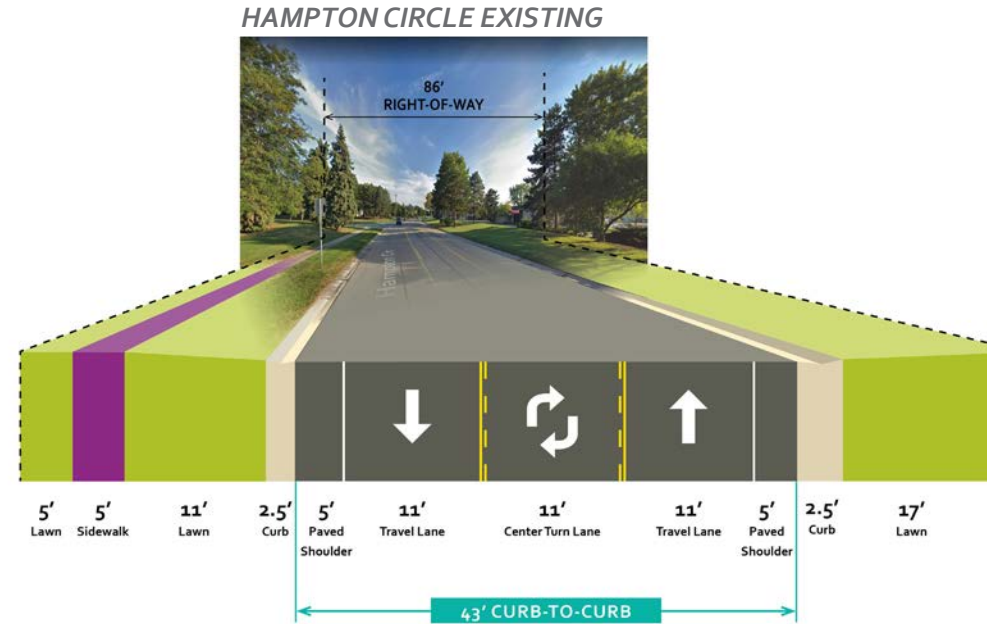
Source: NACTO

# ROAD DIETS

## Hampton Circle Road Diet - Location 1

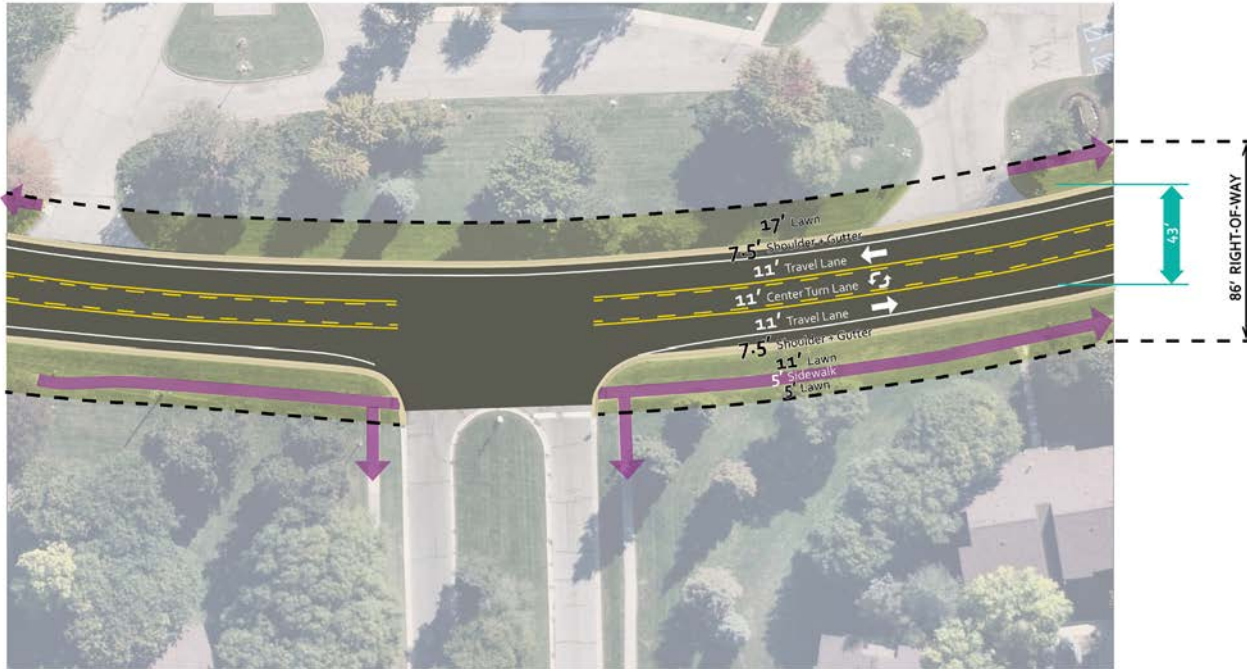
The existing conditions of Hampton Circle vary. This section of Hampton Circle (as shown in yellow on the overall map) is 48' wide curb to curb with three lanes and 5' wide shoulders.

It is recommended that the road be narrowed from three lanes to 2 lanes, thus eliminating the center turn lane. Buffered bike lanes can then be added. There are also a few locations where sidewalk should be constructed to complete the nonmotorized network along Hampton Circle (those are shown in purple on the previous map).

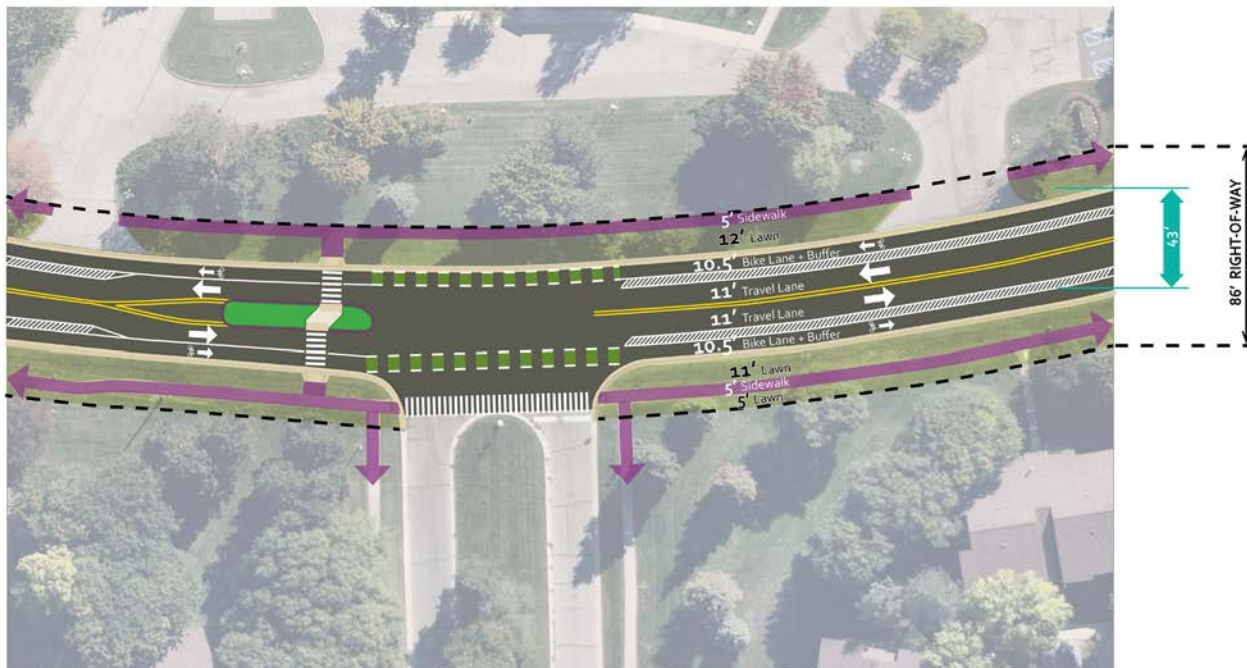


Mid-block crossing with pedestrian bicycle signage on Normandy Road in Royal Oak, MI.

**HAMPTON CIRCLE EXISTING**



**HAMPTON CIRCLE PROPOSED**



*Buffered and protected bike lane in Seattle, WA.  
Source: The Northwest Urbanist*

# ROAD DIETS

## Hampton Circle Road Diet - Location 2

The northern half of Hampton Circle, as demarcated in pink on Figure 34, has a curb-to-curb width of approximately 36'. Two potential design alternatives are depicted.

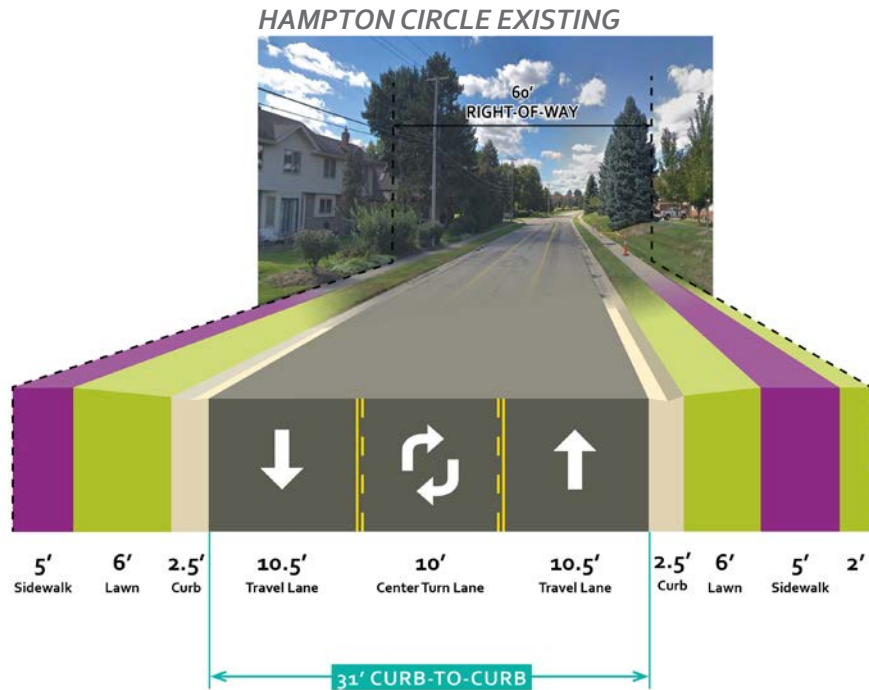
Alternative A illustrates sharrows to increase the awareness of bicyclists sharing the road with vehicles, and a mid-block crossing design with a refuge island at

Woodlane Dr. This crossing would be typical of pedestrian crossings in this three-lane cross section throughout the corridor.

Alternative B illustrates a road diet to two travel lanes due to relatively low traffic volumes on Hampton Circle, which would create room for on-street bicycle lanes. Since this section of Hampton Circle is slightly narrower than Location 1, bike lanes would need to be narrower with no buffer provided.



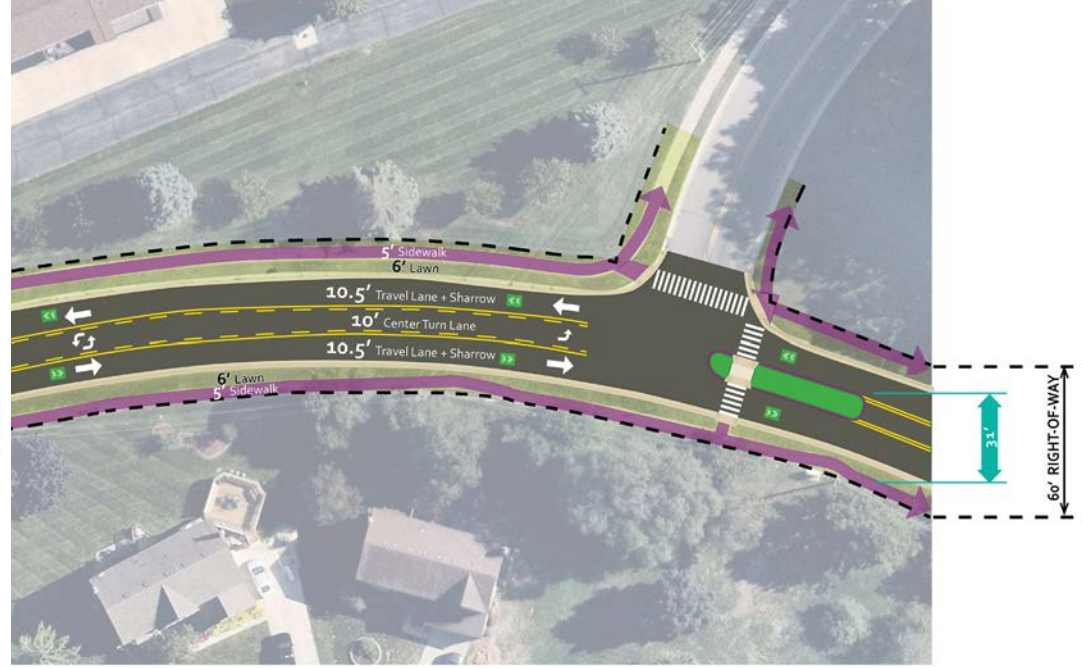
*On-street bike lane on Saginaw St in Pontiac, MI. Source: Oakland University*



**HAMPTON CIRCLE ALTERNATIVE A**



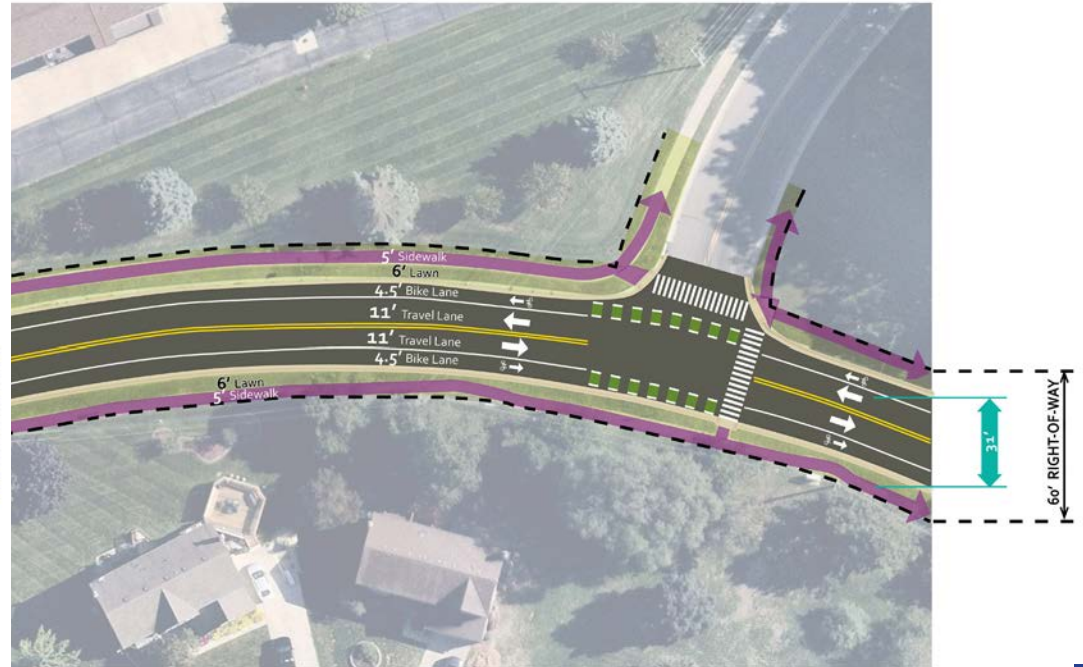
**HAMPTON CIRCLE ALTERNATIVE A**



**HAMPTON CIRCLE ALTERNATIVE B**



**HAMPTON CIRCLE ALTERNATIVE B**



# FREEWAY CROSSINGS

## M-59 Overpass: W Auburn Rd

Auburn Road is an important east-west connection for the City of Rochester Hills that connects the Innovation District, residential neighborhoods, destinations along Rochester Road, and the commercial corridor and recent streetscape project on Auburn Road. The Auburn Road M-59 overpass is the primary non-motorized facility gap hindering connectivity between these destinations. The existing configuration on the bridge, as shown in Figure 35, is one travel lane in each direction with generous paved shoulders that would allow the addition of non-motorized facilities without having to widen the bridge.

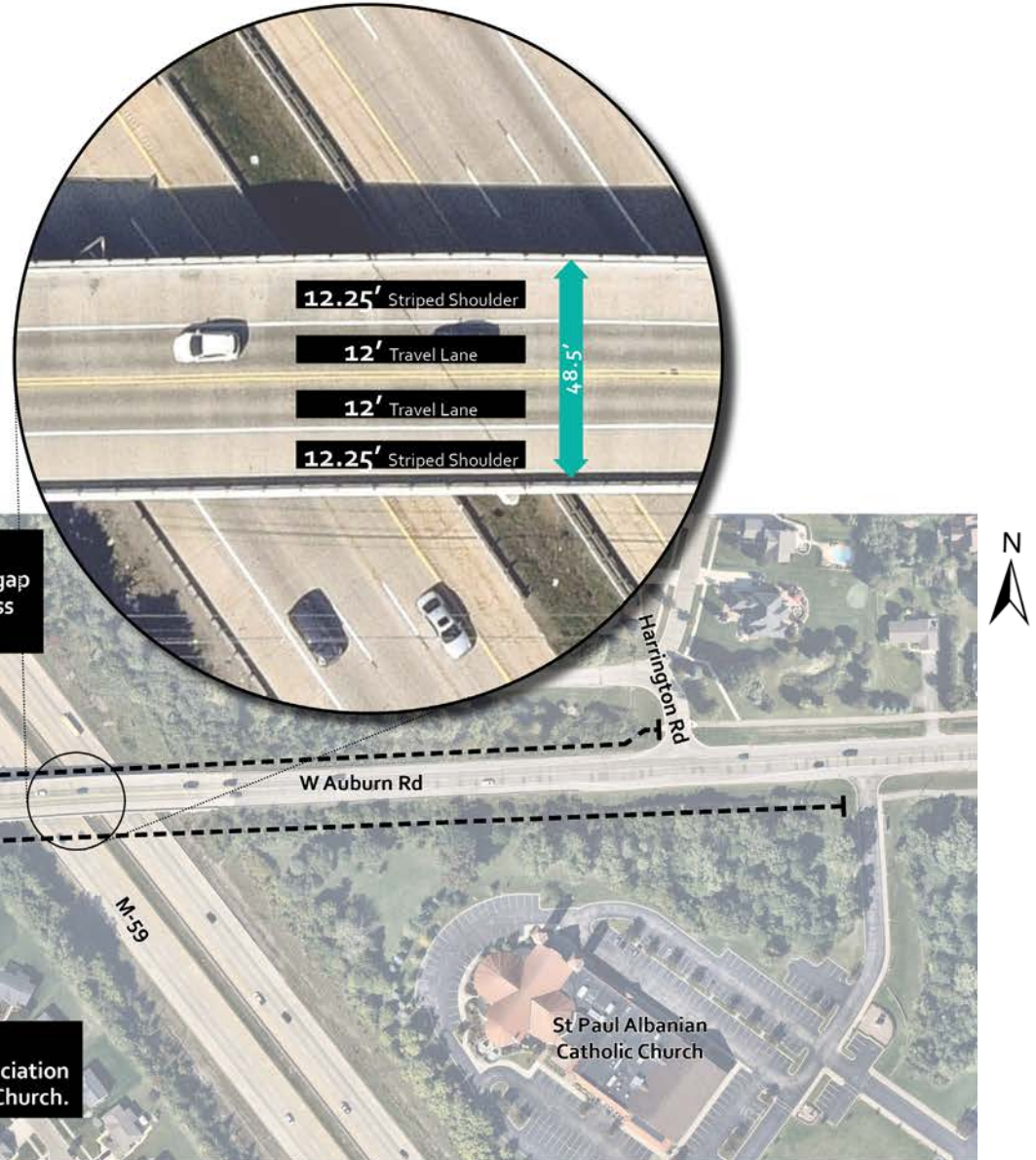
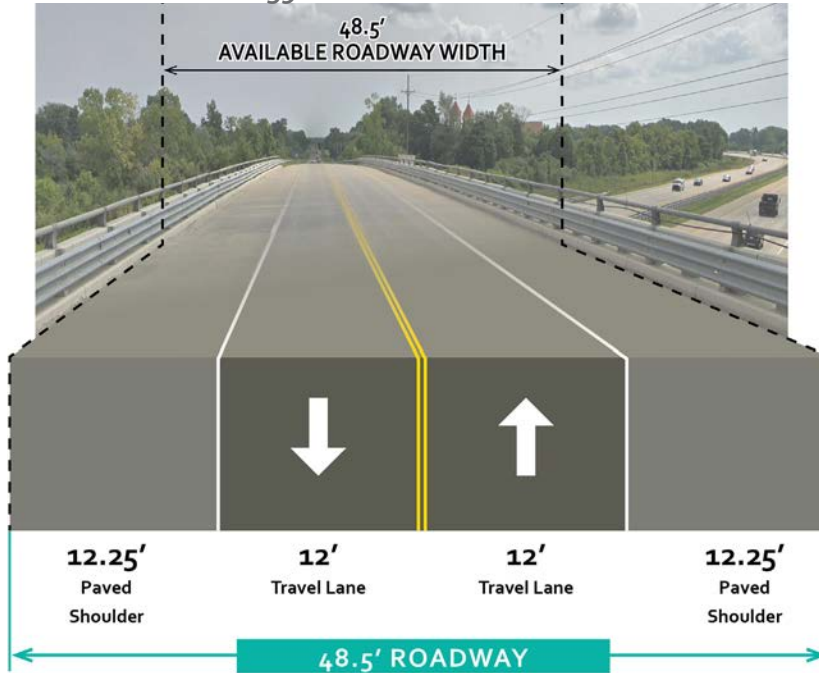
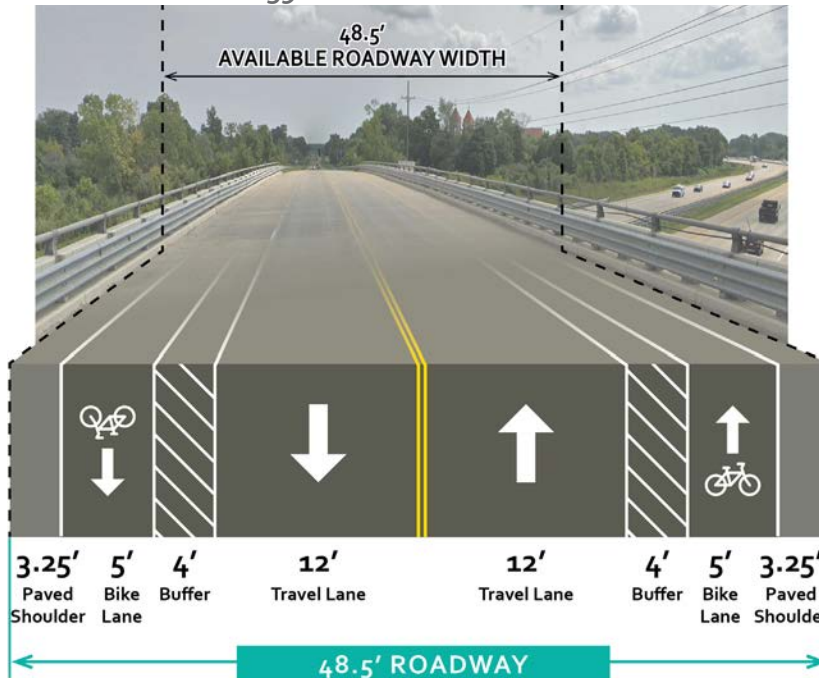


Figure 35: W AUBURN RD M-59 OVERPASS CONTEXT AND EXISTING CONDITIONS

W AUBURN RD M-59 OVERPASS EXISTING



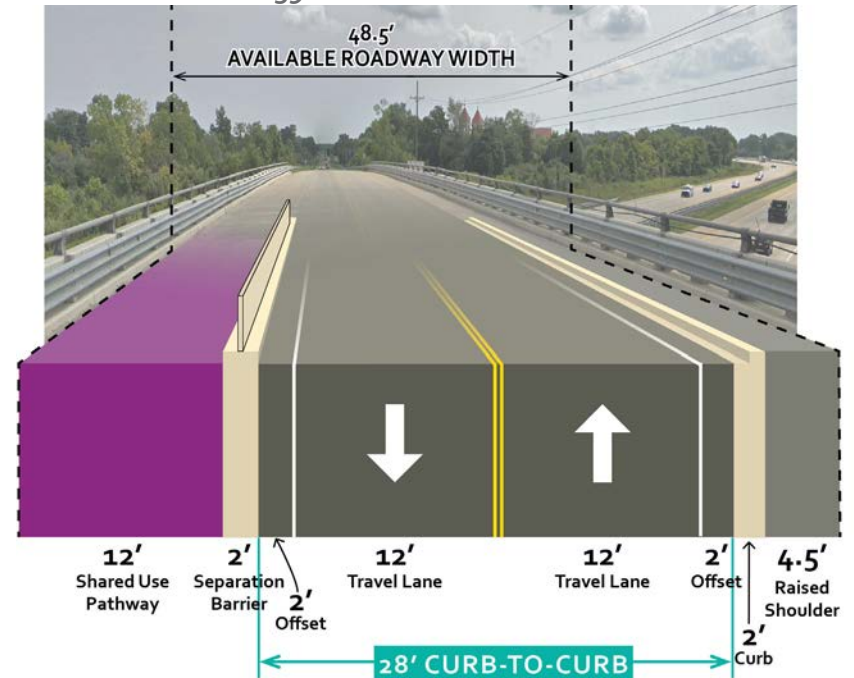
W AUBURN RD M-59 OVERPASS ALTERNATIVE A



The alternatives on this spread may also inform future non-motorized improvements on other M-59 overpasses in the city. Alternative A features bike lanes with a striped buffer for separation from traffic. Alternative B features a wide shared use path on the north side of the bridge. Mid-block crossing opportunities should be considered on either side of the overpass to connect to immediate destinations on either side, especially if Alternative B is implemented.

These design changes may be planned in concert with upcoming M-59 reconstruction. Other M-59 overpass locations should also be considered for future investments in non-motorized facilities.

W AUBURN RD M-59 OVERPASS ALTERNATIVE B



## PHASING AND PLANNING LEVEL COSTS

**Table 6: PLANNING LEVEL COSTS FOR SHORT TERM IMPROVEMENTS**

IMPROVEMENT TYPE	UNIT	EXISTING CONDITION	PLANNING LEVEL COST
Intersection: RT Lane	1 RT Lane (100 ft)	No RT Lane	\$100,000 - \$150,000
Intersection: Storage Length LT	Increase by 100 ft	LT Lane Present	\$250,000 - \$350,000
Intersection: Storage Length RT	Increase by 100 ft	RT Lane Present	\$80,000 - \$120,000
Non-Motorized: Pedestrian Crossing Upgrade (Signs, Markings, Median)	1 Pedestrian Crossing Only	Existing Pedestrian Crossing	\$50,000 - \$100,000
Non-Motorized: RRFB	1 Pedestrian Crossing with RRFB Only	Existing Pedestrian Crossing	\$100,000 - \$150,000
Other: Vegetation trimming	1 Intersection Approach	Vegetation Present	\$500 - \$2,000
Pavement Marking: Edge Line	1 Mile	Outdated Edge Line Present	\$100,000 - \$150,000
Pavement Marking: Intersection Guide Lines	1 Set of Intersection Guide Lines	No Intersection Guide Lines	\$1,000 - \$2,000
Pavement Marking: Stop Bar Removal	1 Stop Bar	Stop Bar Present	\$200 - \$500
Pavement Marking: Wet Reflective	1 Lane-Mile	No Wet Reflective Pavement Markings	\$100,000 - \$150,000
Signal: Backplates	1 Backplate with Tether	No Backplates or Tether	\$2,000 - \$4,000
Signal: Low-Level Signal	1 Low-Level Signal Only	No Low-Level Signal	\$2,000 - \$4,000
Signal: LT Phase	1 LT Phase with Signal	No LT Phase or LT Signal	\$3,000 - \$5,000
Signal: Modernization	1 Signal	Diagonal Span Signal	\$300,000 - \$350,000
Signing: Fluorescent Yellow Sheeting on Warning Sign	1 Sign	No Fluorescent Yellow Sheeting on Sign	\$500 - \$1,000
Signing: Reflective Sheeting on Stop Signs	1 Set of Reflective Sheeting	No Reflective Sheeting on Sign	\$200 - \$500
Signing: Upgrade to MUTCD	1 Sign	Outdated Sign	\$500 - \$1,000
Signing: W4-4P (Cross Traffic Does Not Stop) Sign	1 Sign	No Sign	\$200 - \$500

**NOTES:**

- *Low cost pricing would be for maintenance crews to complete. Contractor pricing may be higher.*
- *Costs do not include ROW, utilities, or engineering.*
- *Costs are based on 2020 dollar amounts.*



**Table 7: PLANNING LEVEL COSTS FOR LONG TERM IMPROVEMENTS**

IMPROVEMENT TYPE	UNIT	EXISTING CONDITION	PLANNING LEVEL COST
Intersection: Reconfiguration	1 Intersection (Design Varies and Assumes no Bridge Work)	Signalized Intersection	\$2,000,000 - \$4,000,000
Intersection: Roundabout	1 Single or Multilane Roundabout	Signalized Intersection	\$1,500,000 - \$3,000,000
Non-Motorized: Route Gap	5-ft Wide (100 ft)	No Non-Motorized Route	\$20,000 - \$30,000
Road Improvement: Access Management	1 Driveway	Existing Driveway	\$25,000 - \$35,000
Road Improvement: Pave Road (Asphalt)	1 Lane-Mile	Unpaved Road	\$1,000,000 - \$1,500,000
Road Improvement: Safety Edge	1 Mile (during Installation of New Pavement)	No Safety Edge	\$10,000 - \$20,000
Road Widening: 5-Lane Crosssection	1 Mile	2-Lane Road with Reconstruction Needs	\$5,000,000 - \$8,000,000
Road Widening: TWLTL	1 Mile	2-Lane Road with Reconstruction Needs	\$3,000,000 - \$5,000,000
Signal: New	1 Signal	Stop or Yield Controlled Intersection	\$250,000 - \$300,000

Recommendations were subdivided into short- and long-term improvements based on ease of implementation and cost. Short-term improvements are those recommended for implementation in the near future, whereas long-term improvements are recommendations which take longer to implement due to factors such as ROW and environmental impacts, and cost.

Planning level costs were developed for each category of improvements provided. These were developed based on the typical cost of the improvement on a per unit basis (i.e. lane mile, signal modernization, etc). General costs were then applied to each individual improvement by adjusting the base values based on external factors such as length of corridor, number of lanes, current pavement conditions, size and type of intersection, etc. Costs associated with ROW acquisition, utilities, or engineering fees were not included. All costs presented are in FY 2020 dollars. Future use of these baseline costs must be adjusted for inflation prior to use. Table 6 and Table 7 presents the planning level costs for typical recommendations for short-term and long-term improvements. Individual project level costs are provided in the Appendix. It should be noted that costs are also dependent on timing of the improvement. Improvements are expected to be more cost effective when combined with additional road projects due to economies of scale.

08

TRANSPORTATION  
IMPROVEMENT  
TOOLKIT



## OVERVIEW



Improving safety, lessening congestion, and enhancing the pedestrian environment are all goals of the Transportation Master Plan. Increasing accessibility, efficiency, and safety in Rochester Hills will lead to an overall enhanced quality of life for Rochester Hills' residents.

This section focuses on providing options for tools that can be used to achieve some of the desired changes and improvements in the Transportation Master Plan. This includes tools to improve safety and help alleviate congestion, improving access management, cataloging design standards for crosswalks, and intersection design options.

These strategies and countermeasures are context sensitive. Consideration must be given to location and conditions in which they are implemented. A strategy, improvement, or countermeasure may address multiple areas of concern (i.e. congestion and safety).

The improvements featured in this section are a select list. Additional improvements are provided in the Appendix.

## NON-MOTORIZED SAFETY

### Bicycle Facility Installation & Maintenance

The American Association of State Highway and Transportation Officials (AASHTO) defines a bike lane as the “portion of a roadway which has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists.” They are typically located on the right side of the roadway with pavement markings that direct bicyclists toward the direction of travel.

Bicycle lane design standards vary based on context. In some instances, horizontal buffers and vertical barriers may be warranted to protect bicyclists from moving traffic. Examples of these barriers include painted buffers, flex-posts, bollards, movable planters, on-street parking, and curbs.



Intersection design along the bicycle network is also critical to ensuring a safe and comfortable bicyclist experience. Bicycle intersection enhancements worth consideration include signage, bike boxes, treatments to minimize conflicts between bikes and right-turning vehicles, and bicycle signals.

Bicycle facilities should be designed with the intended user in mind. Rochester Hills' connected bicycle network should be designed for users of all ages and abilities.

### Leading Pedestrian Interval (LPI)

LPI's give pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication (FHWA). With this head start, pedestrians can better establish their presence in the crosswalk.



Source: FHWA

### Pedestrian Bump-Outs

Bump-outs or bulb-outs are extensions of the sidewalk and curb towards the roadway. They shorten crossing distances, enhance pedestrian safety by increasing pedestrian visibility, and potentially reduce speeds by narrowing the roadway. When the extension is in the proximity of an intersection, the turning needs of the larger vehicles using the facility must be assessed.

### Pedestrian Countdown Timer

Pedestrian countdown timers provide pedestrians or bicyclists with the remaining time in seconds for them to cross the roadway or the pedestrian phase to end. They can be passive or active (i.e., operate via a push-button). They can also be associated with auditory warnings to alert pedestrians whose vision may be limited. Because of the additional information that countdown timers provide, they are associated with increased crossing compliance and may have



Source: MDOT

an impact on motorized users. They are most common in urban and suburban areas.

## Pedestrian Refuge Island

Raised pavement sections placed on streets at an intersection or midblock to provide pedestrians with a protected resting place as they generally wait for a gap in traffic to finish crossing the road. They are generally installed on wide roadways to make crossing easier by allowing pedestrians to identify gaps one approach at a time.

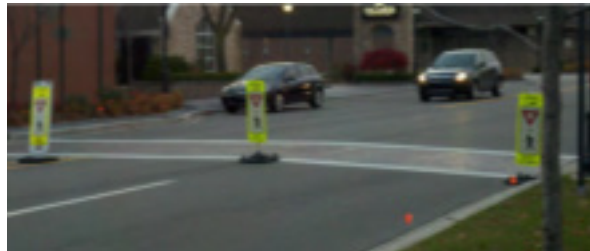


Source: MDOT

## R1-6 In-Street & Gateway Treatment

The R1-6 treatment involves the use of R1-6 in-street signs to remind drivers to yield to pedestrians within the crosswalk. This treatment is particularly useful at signalized pedestrian crosswalks with high volume and low speeds such as downtowns or low-speed subdivision roads. The use of R1-6 signs have been shown to significantly increase pedestrian yield rates. While the use of a single in-street R1-6 sign on the centerline can lead to increased yield rates, a gateway treatment has been shown to be more effective since the increased yielding compliance is related to the narrowness created by the gap between the signs.

One advantage to the use of such treatments, in addition to its low cost, corresponds to the fact that it does not require any action from the pedestrian crossing the street. Disadvantages include signs being struck by vehicles and/or snowplow trucks. If R1-6 are installed, the city must have an ordinance which requires vehicles to yield to pedestrians as this is not currently state law.



Source: MDOT

## Rectangular Rapid Flash Beacon (RRFB)

RRFBs are pedestrian-activated LED lights that supplement pedestrian warning signs at un-signalized intersections or midblock crossings. Once activated, the lights flash in rapid succession to alert drivers of oncoming pedestrian crossings. Their installation is generally a factor of traffic volumes and pedestrian crossing volumes and can be installed on two-lane or multi-lane roadways. They are less costly than traffic signals or pedestrian hybrid beacons and have been shown to increase driver yielding rates to pedestrians significantly.

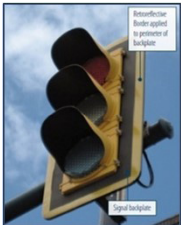


Source: FHWA

# TRAFFIC SAFETY

## Backplates

Traditional signals can be difficult to see. Installing backplates on signal heads increases signal feasibility, particularly at night. Visibility is increased further if the backplate is reflective. Both backplates and retroreflective borders are low-cost safety treatments that can be easily added to existing span and mast arm assemblies as long as the supports' structural capacity is evaluated.



Source: FHWA

## Fluorescent Yellow Sheeting on Warning Signs

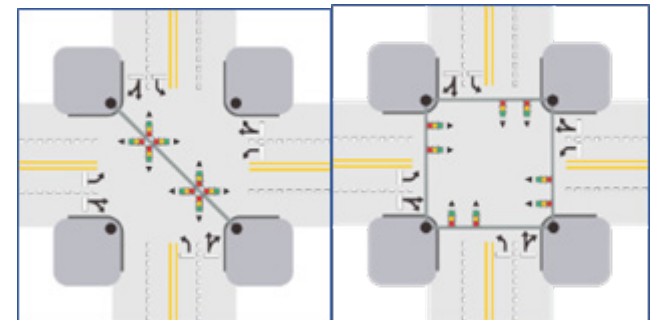
Fluorescent yellow sheeting in place of the standard yellow sheeting on warning signs is a relatively inexpensive method to increase the luminance and visibility of the roadway's applicable traffic signs. Thus, drivers may be better informed and alerted of potentially hazardous conditions along the roadway. The improved visibility is applicable in both daytime and particularly nighttime conditions.



Source: FHWA

## Diagonal Span to Box Span Configuration

An adequate number and the proper placement of signal heads at an intersection are a recognized safety benefit. It improves the visibility of the traffic signals by providing drivers with the opportunity to quickly view the signal instead of searching the vicinity while approaching the intersection. In a diagonal span configuration, the adequate number and placement of the signal heads cannot be properly achieved. Switching to a box span configuration mitigates this issue as it provides flexibility relative to the signal head location and allows for the signal head to be placed over each lane of travel.



Source: MDOT

## Left-Turn Signal Phasing

Left-turn movements represent a high-risk intersection movement. When a left-turn phase is warranted, it should be provided. This decision is not only a function of through volumes and left-turn volumes and delay, but it may also be based on left-turn crash frequency. The addition of a left-turn signal phase can significantly reduce left-turn crashes.



Source: MDOT

## Low-Level Signal Heads

At some signalized intersections, a driver's line of sight to a traffic signal may be obscured by hills, buildings, or large profile vehicles. A low-level supplemental signal head placed on a pedestal or existing signal pole providing additional information for a driver.



## Reflective Sheeting for Sign Posts

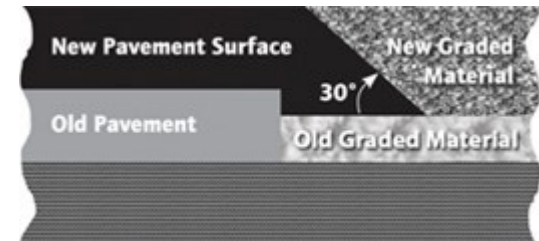
Reflectivity is the property of the material that reflects a portion of the light back to the light source. Reflectivity improvements can be applied to the sign and/or signposts. In both scenarios, depending on environmental conditions, the sign becomes more visible to the drivers from the vehicle's headlights. These can be particularly useful for stop signs.



Source: FHWA

## Safety Edge

Safety edge is the reshaping of the edge of the pavement into a 30-degree angle during installation. The angled safety edge avoids vertical drop-offs if the granular shoulder shifts from the pavement edge. Safety edges are a simple and effective way to reduce fatal crashes on high-speed roadways as the angle makes it safer and easier for drivers to reenter the roadway following a roadway departure.

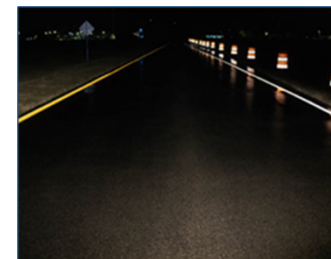


Source: FHWA

## Wet Reflective Pavement Markings

Water can significantly reduce pavement marking retroreflectivity, which affects the drivers' ability to stay in their lane or on the roadway. The effect is exacerbated during nighttime. Wet reflective pavement markings are applied as opposed to standard pavement marking materials to rectify this condition.

These markings can be applied as paint, tape, or thermoplastic material and designed to provide improved retroreflectivity during wet road surface conditions.



# CONGESTION

The benefits of reducing congestion in Rochester Hills include environmental and air quality benefits (fuel reduction) and quality of life benefits (travel time savings).

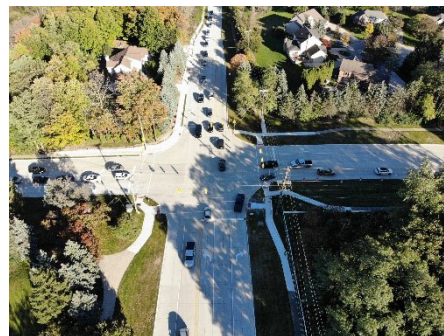
## Add Travel Lanes

Widening roadways to accommodate additional lanes is a traditional strategy for improving traffic flow. While widening roadways is not always a solution due to cost and high-impact level, it is effective when the road can no longer handle demand and other more low-cost and low-impact solutions have been exhausted. Road widenings are major projects which require significant planning, environmental and ROW consideration, financing, and public engagement.



## Intersection Turn Lanes

Intersections are often the primary point of congestion along a corridor. Turning traffic at an intersection with inadequate or no turn lanes often causes increased delay and safety concerns for the through traffic. Installing new turn lanes or increasing turn lane storage lengths to handle more vehicles can often improve intersection operations. Typical locations for modification or installation of turn lanes are those with a high number and long delay for turning vehicles, locations where speeds are too high to turn safely, and locations with a rear-end crash pattern, sideswipe, or other crashes related to turning movements. Akin to road widening, consideration must be given to environmental and ROW impacts. In general, modifications to left-turn lanes are associated with more significant costs and higher impacts than right-turn lanes.



## Roundabouts

Traditional intersections are a common location of congestion as they stop traffic in one direction to allow the other to proceed. Modern roundabouts circumvent this condition by forcing vehicles to yield and by controlling speeds through their circular design. These factors allow vehicles to enter the roundabout without complete stops in one direction. Thus, while speeds are slower, traffic flow often proceeds with less delay. In addition to congestion improvements, roundabouts also provide safety improvements through lower speeds and fewer conflict points than those found in a typical intersection. They reduce head-on, left-turn, and angle type crashes, which frequently result in serious or fatal injuries. While the frequency of fatal and injury crashes decreases, there may be increased property damage crashes. A roundabout design is crucial to fostering an efficient and safe environment for drivers and pedestrians alike. When the design and geometry force traffic to enter and circulate slowly, roundabouts operate safely and effectively handle turning traffic.





## Signal Optimization

Signal optimization is one of the most common and cost-effective strategies to reduce congestion. This strategy can involve either improvement to signal timing and coordination along the mainline or signal improvements with newer equipment to optimize signal operations proactively. Congestion is reduced by implementing timing that is appropriate to the intersection operations. Additional benefits can include safety improvements due to congestion improvements.



## Traveler Information Systems

Traveler information systems inform drivers of roadway conditions or other relevant roadway information during their trips. This provides the driver with the ability to make informed travel decisions in departure times, route, mode selection, etc. The information can be distributed through various mediums such as mobile device applications, dynamic roadside messages, websites, or radio.

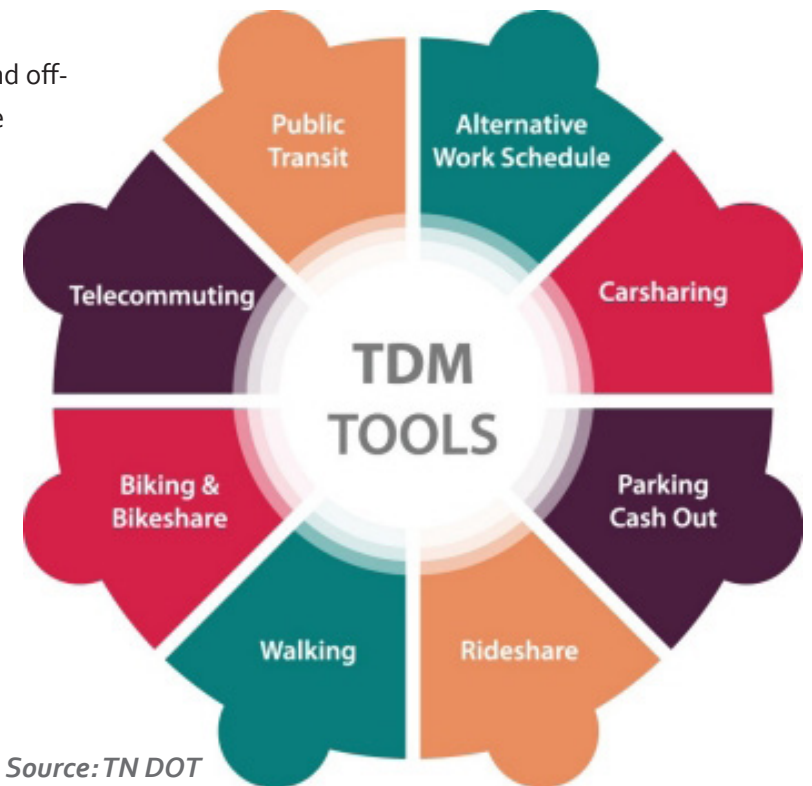
## Transportation Demand Management (TDM)

Transportation Demand Management (TDM) is the application of strategies and policies to reduce travel demand, or to redistribute this demand in space or in time. This may include improving alternatives to private vehicle trips (especially single occupancy trips) such as walking, biking, ridesharing, micro-transit and transit, and other modes of travel.

Implementing flexible work hours and off-peak delivery schedules are effective strategies to reduce trips during AM and PM weekday peak hours

when the transportation system handles the largest number of vehicles. Additional benefits include time and fuel savings associated with travel at off-peak hours.

TDM programs may be implemented by the city or in partnership with large employers, institutions, business owners, and developers.



Source: TN DOT

## ACCESS MANAGEMENT

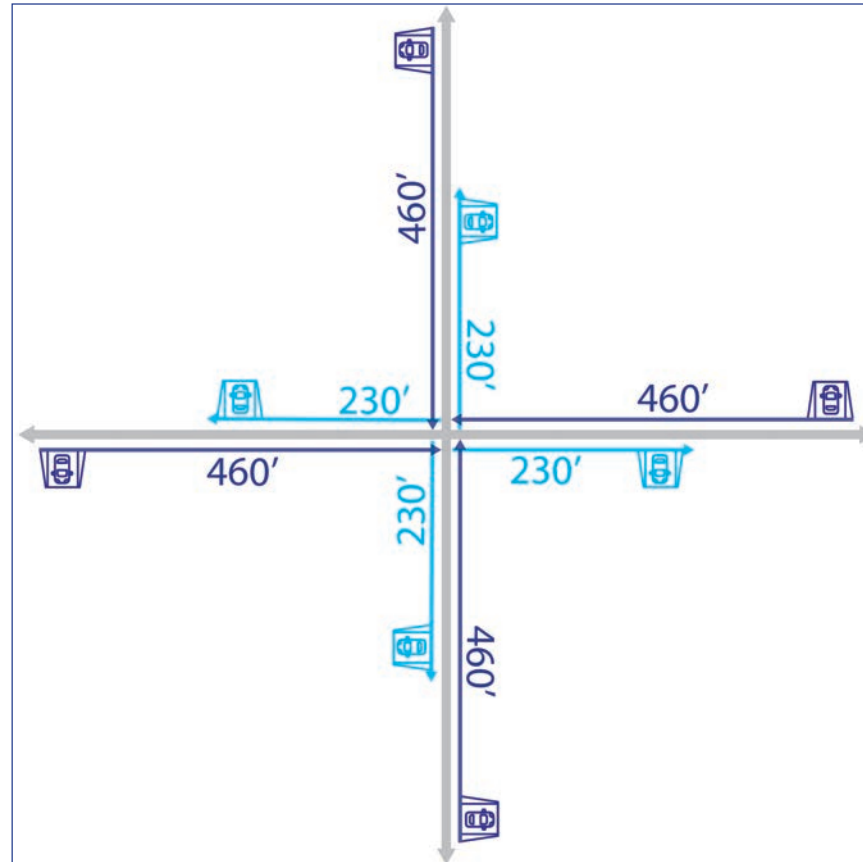
### Importance of Access Management

Access management ensures convenient access to adjacent land uses along thoroughfares in Rochester Hills while striving to improve the safety and efficiency of the transportation network. Access management is a balancing act between providing adequate and convenient access to businesses and residences, safety concerns for all road users, and overall user experience of Rochester Hills' transportation network.

This section of the plan identifies access management issues found in Rochester Hills, illustrates desired driveway spacing and design standards, and describes implementation strategies for improving access management in Rochester Hills.

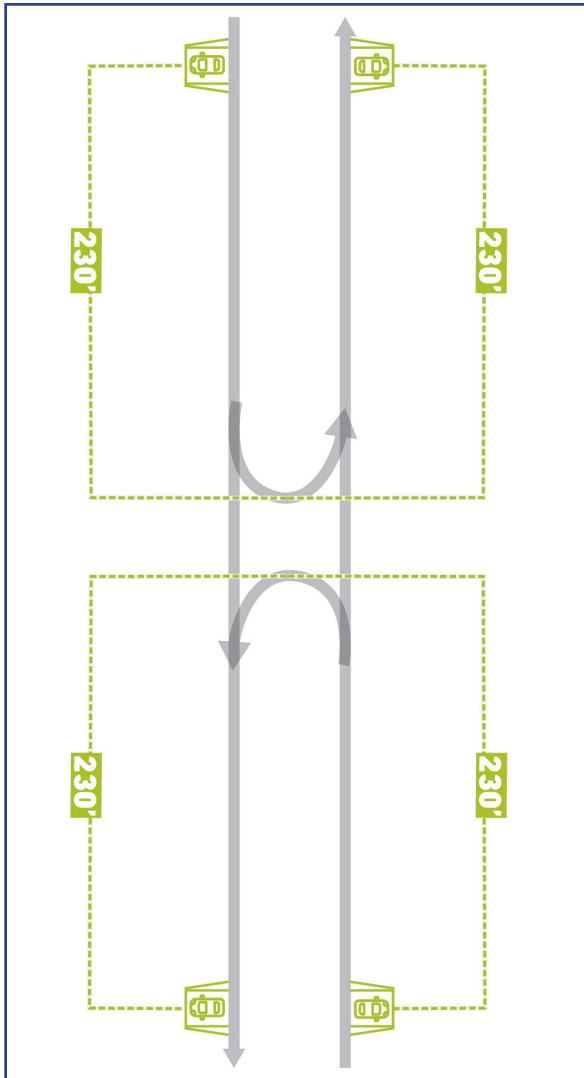
The primary goals of access management implementation in Rochester Hills are as follows:

1. Decrease the frequency and severity of crashes.
2. Smooth and efficient traffic flow.
3. Improve safety and comfortability for sidewalk and pathway users.



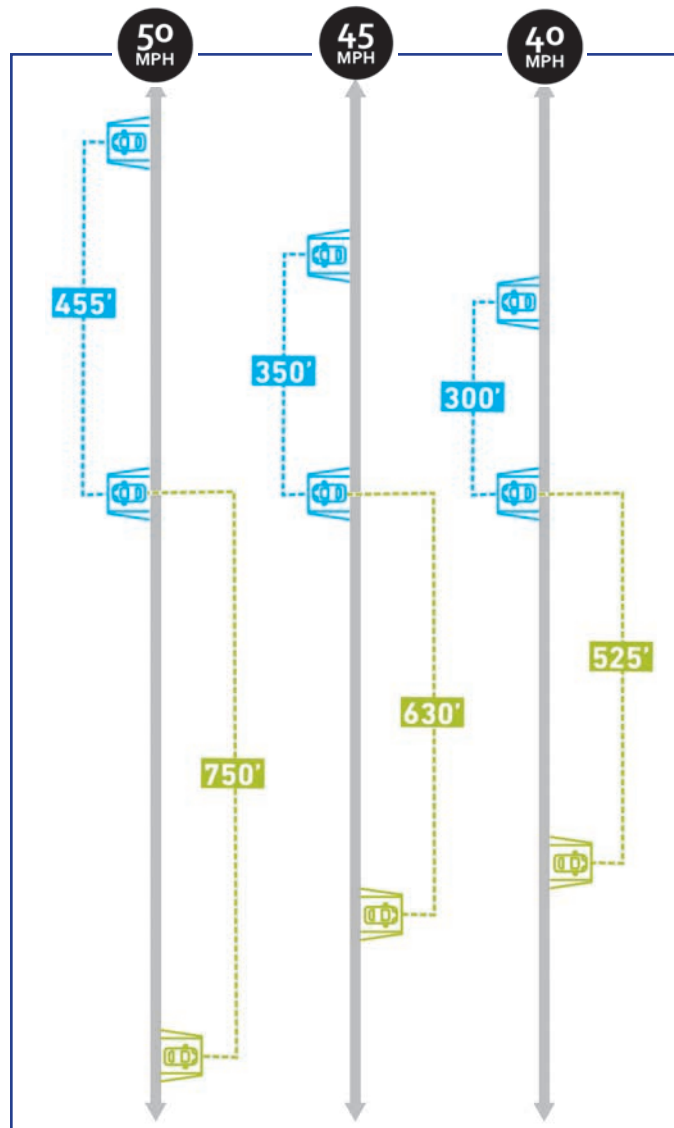
**Figure 36: RECOMMENDED DRIVEWAY SPACING FROM INTERSECTIONS**

*Recommended driveway spacing from signalized intersections for Upstream (460') and Downstream (230') driveways to prevent conflicts with vehicles approaching or traveling through an intersection.*



**Figure 37: RECOMMENDED DRIVEWAY SPACING FROM MEDIAN CROSSOVERS**

Recommended Upstream and Downstream driveway spacing from median crossovers to prevent unsafe weaving (230').



**Figure 38: RECOMMENDED SPACING BETWEEN DRIVEWAYS**

Recommended spacing between adjacent driveways (blue) and between driveway offsets (yellow) on thoroughfares with speed limits of 40, 45 and 50MPH.

## Access Management Standards and Principles

Access Management standards applied in Rochester Hills adhere to the MDOT Access Management Manual, which provides standards for the primary access issues found on city's thoroughfares. These standards change based on the speed limit, number of lanes, intersection type, and presence of a median on a roadway.

Under Michigan law, each property must be provided with "reasonable" access. This might mean fewer access points than a particular business would desire, or access on a side street instead of directly on a major thoroughfare.

Many of Rochester Hills' thoroughfares were developed incrementally with narrow parcels and as a result do not meet current driveway spacing standards. As these parcels redevelop over time and many are consolidated, the city can hold developers accountable to new spacing and design standards. Sometimes, shared access between narrow parcels is possible.

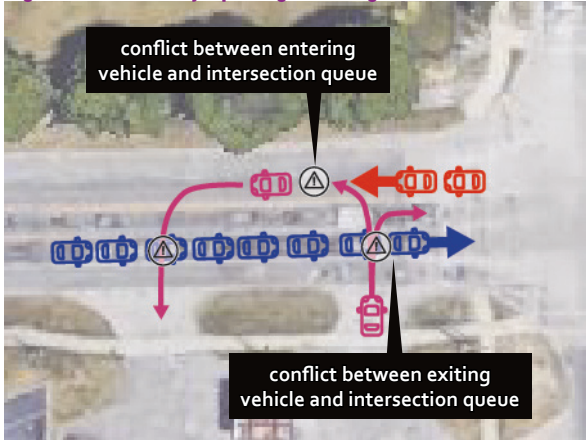
The diagrams to the left illustrate access management standards applicable to Rochester Hills including spacing from signalized intersections, spacing from crossovers, spacing from other driveways, and driveway offset spacing.

# ACCESS MANAGEMENT

## Typical Access Management Conflicts in Rochester Hills

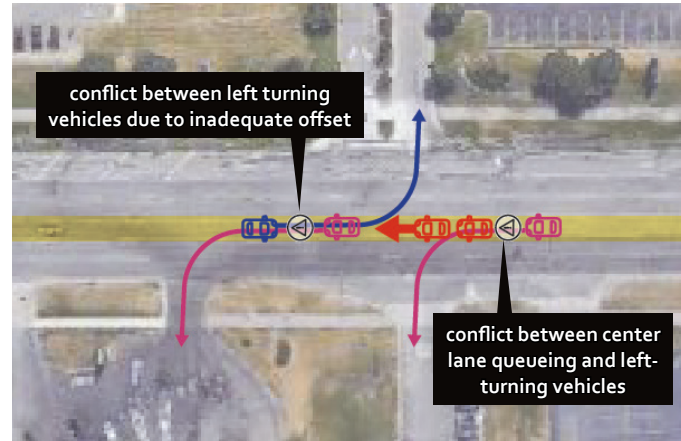
The diagrams below illustrate typical access conflicts created by existing development that does not meet desired spacing and design standards.

Figure 39: Driveway Spacing from Signalized Intersections



S Rochester Rd & Avon Rd

Figure 40: Driveway Offset Spacing



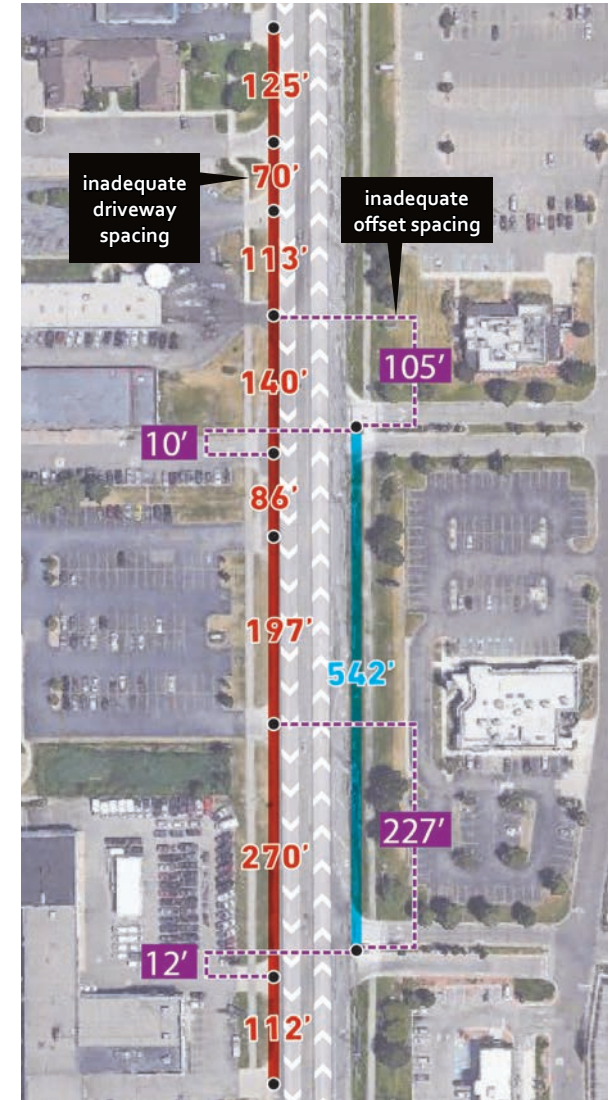
S Rochester Rd, north of Auburn Rd

Figure 41: Driveway Spacing from Crossovers (Median Roadways)

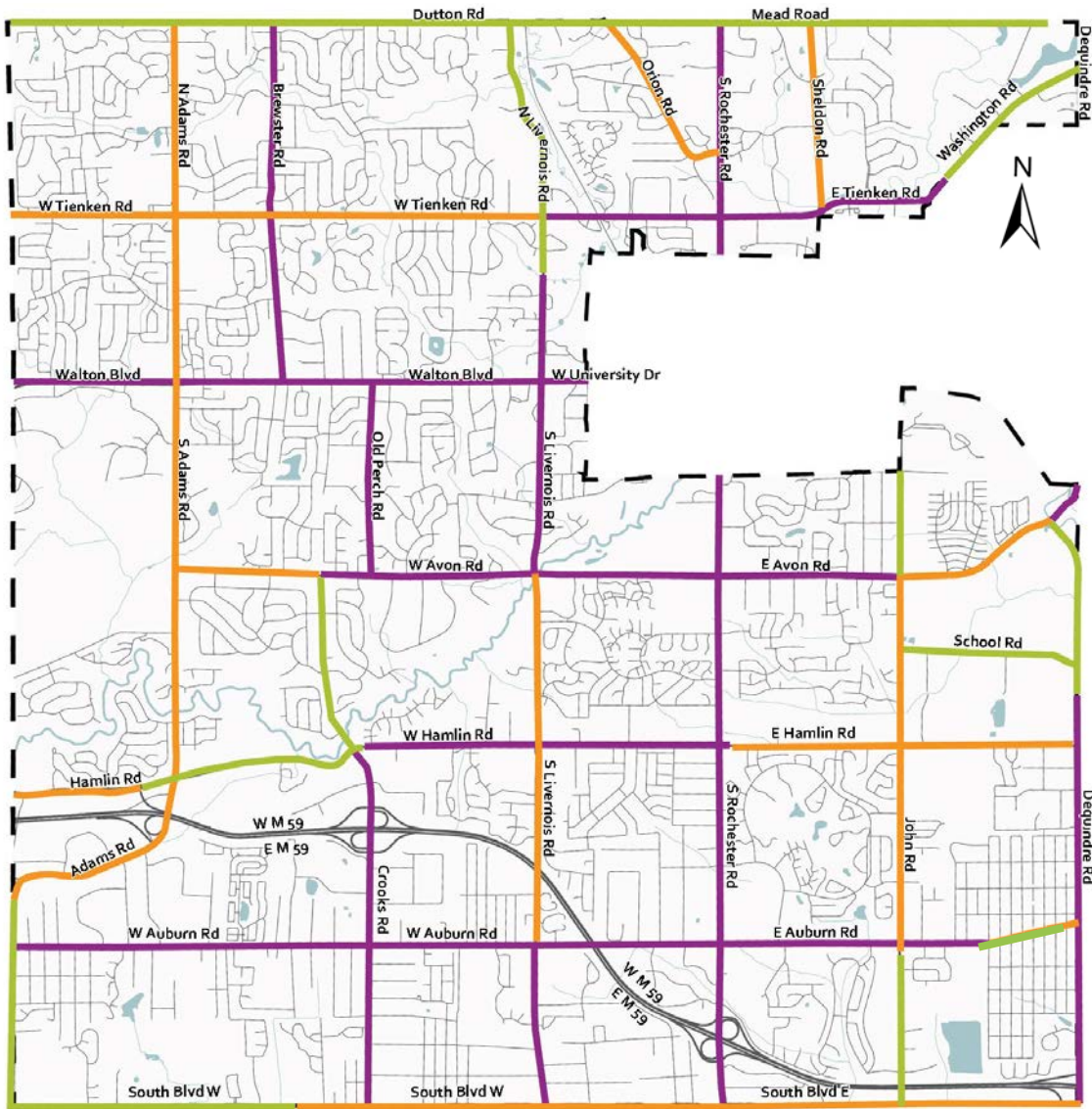


Hamlin Rd

Figure 41: Driveway Spacing from Other Driveways



S Rochester Rd, north of Auburn Rd



**Priority Access Management Segments**

The map to the left illustrates an analysis of access management conflicts on Rochester Hills thoroughfares that assigns roadways into three categories:

**Level 1: Least Through/Access Conflicts**

**Level 2: Moderate Through/Access Conflicts**

**Level 3: Highest Through/Access Conflicts**

On many of these roadways, higher level of conflict is synonymous with level of commercial activity. Access improvements and driveway consolidation should be a high priority on Level 3 roadways. The city should refer to this map when conducting corridor studies or reconstructing a roadway to evaluate the magnitude of access conflicts. Regardless of which level a roadway is assigned, however, all access conflicts and potential mitigations should still be evaluated.

**Figure 42: FREQUENCY OF DRIVES AND INTERSECTIONS BY SEGMENT**

- Level 1: Least Through/ Access Conflicts
- Level 2: Moderate Through/ Access Conflicts
- Level 3: Highest Through/ Access Conflicts

# ACCESS MANAGEMENT

## Access Management Improvement Strategies

### Redevelopment

When new development, redevelopment or site expansion occurs, the developer should work with the city to achieve as close to full compliance as possible adhering to the relevant access management standards, taking site constraints into account.

This will often include the elimination of unnecessary driveways, redesigning of existing driveways, placement of new driveways an adequate distance from intersections and/or adjacent driveways, and evaluation of potential shared access schemes with neighboring property owners and businesses.

The proposed Speedway redevelopment site plan at the intersection of Avon Rd and S Rochester Rd, pictured to the right, is an example of collaboration to:

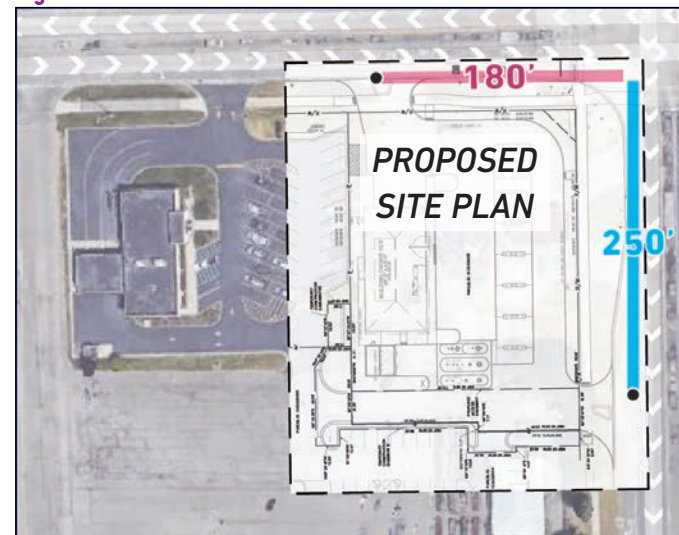
- Eliminate two unnecessary driveways
- Relocate driveways to the maximum possible distance from the Rochester-Avon intersection
- Maintain shared access with adjacent properties.

Figure 43



Present Day Speedway Site Design and Access Conflicts

Figure 44



Proposed Speedway Site Plan with Mitigation

**Figure 45**



*Access Management on Hamlin Rd.*



*Access Management implementation on Auburn Rd via planted center median and streetscaping.*

Reducing the total number of driveways also creates a safer and more comfortable environment for pedestrians and bicyclists traveling near the intersection.

### ***Road Reconstruction***

During multi-faceted road reconstruction projects, the city will work with property owners to close or redesign driveways as part of the project. Changes made within the right-of-way during a reconstruction project are often completed at no cost to the property owner.

Road reconstruction projects may also involve the construction or removal of a center median. The construction of a median will eliminate many driveway offset spacing conflicts, but median crossover placement must be done strategically in partnership with property owners and stakeholders to minimize potential conflicts from vehicle weaving.

### ***Shared Access Schemes***

In special circumstances, property owners may work with the city to address congestion or safety concerns from the existing access configuration. Property owners may collaborate to agree on a shared access circulation plan that will allow them to close driveways, creating more space for planting, beautification, signage, additional surface parking, or other amenities.

## NON-MOTORIZED

### Pedestrian Crossing Design Options

Pedestrians typically cross the street at a point where it is most convenient for their path of travel. This is often at locations where there is no traffic signal or marked pedestrian crossing, but is in fact a direct line between their origin and destination. It is critical to provide consistent, safe, and convenient crossings often enough to encourage safe crossing behavior and travel.



The U.S. Department of Transportation Federal Highway Administration (FHWA) has a Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations that provides a step-by-step process for selecting appropriate treatments which include the following:

- Crosswalk visibility enhancements
- In-street pedestrian crossing signage
- Advance yield signage and markings
- Curb extensions
- Raised crosswalks
- Pedestrian refuge islands
- Pedestrian Hybrid Beacons (PHBs)
- Road diets

Not all of these treatments are appropriate in every location. Figure 46 summarizes where specific treatments are appropriate based on street configuration and traffic conditions.

The numbers in each cell of the chart represent the treatments that are appropriate for that context (the identified roadway configuration, traffic volumes, and speed limit). Numbers highlighted in dark circles are those that are recommended for use in that particular location. Numbers without the highlight could be appropriate, but may require engineering judgment based on the context. Numbers that are missing from the cells are treatments that *are not* appropriate for that location.



Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
<b>2 lanes</b> (1 lane in each direction)	① 2 4 5 6	① 5 6 7 9	① 5 6 ⑦ ⑨	① 4 5 6 7 9	① 5 6 7 9	① 5 6 ⑦ ⑨	① 4 5 6 7 9	① 5 6 7 9	① 5 6 ⑨
<b>3 lanes with raised median</b> (1 lane in each direction)	① 2 3 4 5	① ③ 5 7 9	① ③ 5 ⑦ ⑨	① 3 4 5 7 9	① ③ 5 ⑦ ⑨	① ③ 5 ⑦ ⑨	① ③ 4 5 7 9	① ③ 5 ⑦ ⑨	① ③ 5 ⑨
<b>3 lanes w/o raised median</b> (1 lane in each direction with a two-way left-turn lane)	① 2 3 4 5 6 7 9	① ③ 5 6 7 9	① ③ 5 6 ⑨	① 3 4 5 6 7 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑨	① ③ 4 5 6 7 9	① ③ 5 6 ⑨	① ③ 5 6 ⑨
<b>4+ lanes with raised median</b> (2 or more lanes in each direction)	① ③ 5 7 8 9	① ③ 5 7 8 9	① ③ 5 8 ⑨	① ③ 5 7 8 9	① ③ 5 ⑦ 8 ⑨	① ③ 5 8 ⑨	① ③ 5 ⑦ 8 ⑨	① ③ 5 8 ⑨	① ③ 5 8 ⑨
<b>4+ lanes w/o raised median</b> (2 or more lanes in each direction)	① ③ 5 6 7 8 9	① ③ 5 ⑥ 7 8 9	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ 7 8 9	① ③ 5 ⑥ ⑦ 8 ⑨	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ ⑦ 8 ⑨	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ 8 ⑨

Given the set of conditions in a cell,

# Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.

● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.

○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.\*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs

2 Raised crosswalk

3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line

4 In-Street Pedestrian Crossing sign

5 Curb extension

6 Pedestrian refuge island

7 Rectangular Rapid-Flashing Beacon (RRFB)\*\*

8 Road Diet

9 Pedestrian Hybrid Beacon (PHB)\*\*

**Figure 46**

*Field Guide for Selecting Countermeasures at Uncontrolled Pedestrian Crossing Locations.*

Source: FHWA

09

**APPENDIX**

**EXISTING CONDITIONS MAPS**

**ONLINE SURVEY RESULTS**

**STAKEHOLDER / PUBLIC COMMENT SPREADSHEET**

**DETAILED IMPROVEMENT RECOMMENDATIONS SPREADSHEET**

