FINAL Study Report

Audible/Tactile Pedestrian Signal Device Study

Monroe County

April 2011

PREPARED FOR:

Monroe County Department of Transportation
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T.Y. Lin International Project #434933.00

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EXECUTIVE SUMMARY

The Monroe County Audible/Tactile Pedestrian Signal Device Study was initiated by the Monroe County Department of Transportation (MCDOT) to update existing protocol and to further identify locations in the highest need of the installation of audible/tactile pedestrian signal devices (ATPSD) to improve accessibility within Monroe County. The implementing regulations of ADA and the Draft Public Rights-of-Way Accessibility Guidelines are moving towards the installation of ATPSD at all new signals equipped with pedestrian signals. Installation of these devices at existing locations with pedestrian signals is also desired, and that is the focus of this study. The MCDOT plans to add ATPSD equipment at traffic signals that they operate each year as their budget permits, and this study will help identify which intersections and crosswalks should be done first.

T.Y. Lin International (TYLI) and Accessible Design for the Blind worked with MCDOT in determining a prioritized list of crosswalks at signalized intersections for audible/tactile devices to be installed based on destination locations, bus routes and origins of visually impaired people. The study team was assisted by an advisory group – the Accessible Pedestrian Advisory Committee (APAC) - representing ABVI-Goodwill, American Council for the Blind, Commission for the Blind, Center for Disability Rights, Lifespan, Monroe County Office of the Aging, Genesee Transportation Council (GTC), and Rochester Genesee Regional Transportation Authority (RGRTA), as well as members of the blind and visually impaired community.

Summary of Project Scope

The study scope of work included the following work efforts:

- Assembly of the Accessible Pedestrian Advisory Committee (APAC) & Committee Meetings – to obtain the perspective of the visually impaired community
- Two Public Meetings – to present project status and receive feedback
- Mapping of pedestrian needs & Activity Analysis – Filter A
- Identification of geometric needs through the Intersection Analysis - Filter B
- Detailed data collection & Crosswalk Analysis – Filter C
- Identification of needs & appropriate solutions – prioritized list of crosswalks
- Cost estimate & implementation priority
- Expansion of MCDOT Guidelines

Meetings

An advisory group was assembled which included members of the blind and visually impaired community, to obtain input into the process. The team met with the committee on several occasions to discuss the process and results of the Filter analyses. Two public meetings were also held, one on January 28, 2010 and another on October 21, 2010, to present and discuss the project methodologies and results.

Project Set-Up

To set up the project, the existing ATPSD Request Evaluation Procedure of the MCDOT was reviewed. The MCDOT provided data regarding all of the existing signal types and locations, as well as locations with existing ATPSD. These existing utilities were

mapped in ArcGIS – a mapping software consisting of a group of geographic information system (GIS) software products which allows several layers of geographic data to be analyzed – which was then used as the base of the mapping data for the project.

Project Approach

This study consisted of a three-step process in order to identify the highest priority crosswalks where ATPSD are in need of installation. For each step a 'Filter' was created to narrow the candidate locations based on the 2006 NCHRP Project 3-62: Guidelines for Accessible Pedestrian Signals criteria. These Filters (A, B, and C) were designed to reduce the number of signalized intersections and more specifically crosswalks as each one was applied. Each Filter used a unique scoring system to rank the locations in order of priority. Statistical analysis was then used to group the remaining locations from each Filter into high, medium and low priority. For the statistical grouping, the scores were plotted on a graph, and then separated into these three categories. The locations with the highest priority moved through to the next Filter. The three Filters include the following ranking criteria:

Filter A – Activity Analysis

The first step looked at the broad influences of Origin, Transportation, Destination, and Signal Type data that was reviewed in order to develop an initial list of the highest priority signalized intersections based on the level of approximated pedestrian activity. Origins included ZIP Codes with high concentrations of ABVI consumers as well as Lift Line passengers. Transportation included bus routes and the concentration of ridership. Destinations included: residential complexes; assisted living complexes; hospitals and health care centers; support service centers; civic and municipal buildings; food and shopping centers; entertainment locations; and other locations such as Universities, and the airport. The signal timing type was reviewed and identified as pre-timed, actuated or semi-actuated. Each influence was given a point value and the points for each of the traffic signals evaluated was totaled. Using statistical analysis the intersections with the highest scores (ranging from 22 to 57 points) were identified as candidates for further review. Through this process 103 out of 628 (17%) intersections were identified as high priority candidates and applied to Filter B.

Filter B – Intersection Analysis

The second step further reduced the 103 intersections by evaluating the existing pedestrian accommodations including intersection geometrics, signal phasing, and nearby influences. These factors help to identify the relative difficulty of crossing at each location. The geometric analysis included the intersection configuration noting the number of legs, and the presence/lack of skew in each leg. The signal phasing analysis determined what type of signalization was present at each intersection with the order rising in influence from pre-timed, to actuated, to split phasing, and finally the highest influence of exclusive pedestrian phasing. Also taken into consideration for this Filter was the distance to support service facilities, distance to inaccessible destinations – locations with unfriendly pedestrian access or no sidewalks, and distance to pedestrian attractions. Each of the Intersection Analysis criteria was given a point value and the points for each of the 103 intersections evaluated was totaled.

Using statistical analysis the intersections with highest scores (ranging from 18 to 47 points) were identified as high priority intersections for further review of their crosswalks in Filter C. This Filter found 28 intersections (83 crosswalks – 6 of which are already equipped with ATPSD devices) as high priority locations that potentially meet the needs for ATPSD as shown on **Figure ES-1**.

Filter C – Crosswalk Analysis

The third step developed criteria to rank each of the 83 crosswalks in order of priority. Six of the crosswalks are already equipped with ATPSD devices, therefore only the remaining 77 crosswalks were analyzed. Each crosswalk was inspected in the field to assign a value to each ranking criteria of detailed intersection geometry and crosswalk amenities. Criteria analyzed in Filter C were:

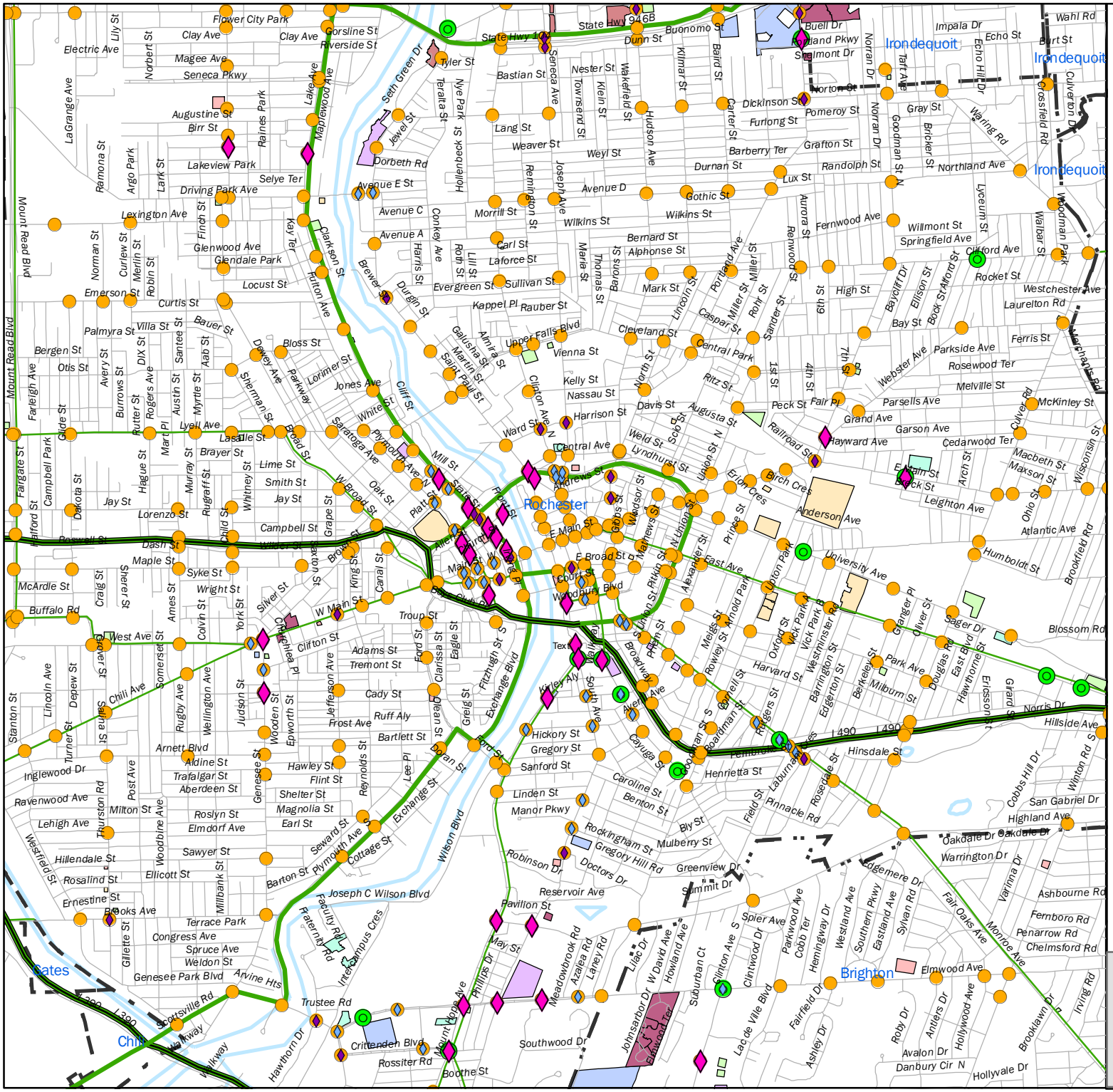
- Important roadway network features such as posted speed limits, off-peak traffic presence distances to alternative ATPSD devices, and availability of alternate crosswalks within the intersection;
- Specific intersection/crosswalk geometrics such as curb radius, islands or medians, traverse (cross) slope, apex curb ramps, channelized right turn islands, and skewed crosswalks; and
- Signal operation specifics such as push-button actuation requirements, non-concurrent walk intervals, leading pedestrian intervals, right-turn-on-read permission, protected left-turn phases, protected right-turn phases or right-turn overlap, signalization of channelized right-turn lanes, and pushbutton locations.

Each of the Crosswalk Analysis criteria was given a point value and the points for each of the crosswalks evaluated was totaled. The highest possible crosswalk score is 75 points.

Summary of Priority Crosswalks & Study Recommendations

The final priority list of crosswalks that will be the first locations recommended to be equipped with ATPSD was determined by the Total Crosswalk Score. This Total Score is the sum of the Intersection Score (Intersection Analysis - Filter B) and the Crosswalk Score (Crosswalk Analysis – Filter C), ranging from zero to 122 points. Using statistical analysis the crosswalks with the highest scores were identified as candidates for the installation of ATPSD devices.

The study concludes that 33 crosswalks (at 19 intersections) were found to be in the highest priority for the installation of ATPSD, which are shown on **Figure ES-2** and in **Table ES-1**. The MCDOT will also consider adding an ATPSD to additional crosswalks at each priority intersection, as they deem necessary.



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Legend

- MCDOT Traffic Signal Locations
- Existing ATPSD Locations

Intersection Analysis

- Highest Priority
- Mid Priority
- Low Priority

Destinations

- Support Services
- Health Care
- Civic/Municipal
- Food/Shopping
- Residence (Apartments)
- Residence (Assisted Living)
- Entertainment
- Other

Mapping

- County Boundaries
- City/Town Boundries
- Hydrography

Roads

CLASS

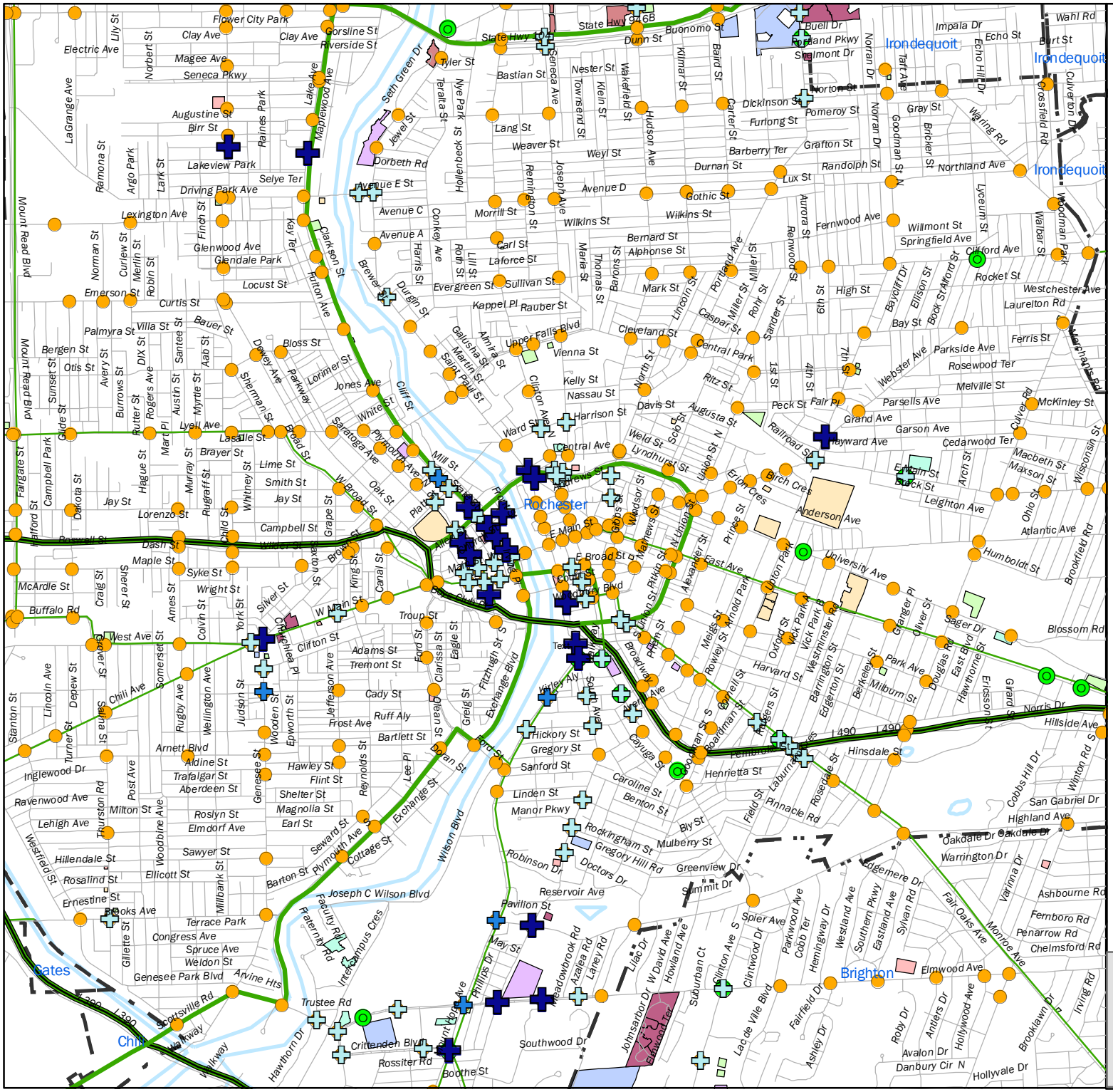
- Interstate
- Principal Arterial
- Minor Arterial
- Streets

FIGURE ES-1

Audible/Tactile Pedestrian Signal Device Study

Intersection Analysis - Filter B

Project # 43.4933 4/28/2011



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- MCDOT Traffic Signal Locations
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- Mid Priority
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FIGURE ES-2

Audible/Tactile Pedestrian Signal Device Study

Crosswalk Analysis - Filter C

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Table ES-1: Recommended Crosswalks for ATPSD Installation

Intersection	Crosswalks Leg (Rank)			
1. South @ Griffith/I490	East Leg (1),	North Leg (12)		
2. Lake @ Nazareth Academy (PED)	North Leg (2)			
3. South @ Elmwood	West Leg (3), South Leg (13)	NW Leg (4),	North Leg (5),	East Leg (8),
4. St. Paul @ Inner loop/ Cumberland	West Leg (6), East Leg (16),	East Leg (7), SW Leg (24),	North Leg (9), West Leg (25)	SE Leg (15),
5. Plymouth @ Church	NW Leg (10),	SE Leg (17),	NE Leg (67)	
6. Goodman @ Garson/Webster	NE Leg (11), East Leg (48),	SW Leg (28), West Leg (61)	NW Leg (36),	SE Leg (37),
7. Plymouth @ Allen	South Leg (14),	West Leg (47)		
8. State @ Commercial	NW Leg (18),	NE Leg (70)		
9. South @ Highland	South Leg (19),	North Leg (40),	East Leg (59),	West Leg (66)
10. Mt. Hope @ E.Hen/Crittenden Blvd	West Leg (20)			
11. Dewey @ Bryan (PED)	North Leg (21)			
12. Elmwood @ Roch Psych Ctr	East Leg (22),	West Leg (38),	North Leg (43),	South Leg (62)
13. South @ Woodbury	North Leg (23),	East Leg (76)		
14. South @ Byron/ Mt. Hope	East Leg (26),	West Leg (54)		
15. Main @ Brown/Genesee	East Leg (27),	West Leg (39),	North Leg (63),	South Leg (69)
16. State @ Church	South Leg (29),	North Leg (49),	West Leg (51)	
17. State @ Andrews	SE Leg (30),	NW Leg (34),	NE Leg (55)	
18. Plymouth @ Spring	North Leg (31),	South Leg (32),	West Leg (56)	
19. Andrews @ Front	East Leg (33),	North Leg (74),	South Leg (77)	

NOTE: Crosswalks with existing ATPSD devices were removed from this list.

The full lists of ranked locations from Filters A, B, and C are shown in **Appendix H**.

Implementation Considerations

The study concludes that the cost of installation of an ATPSD device at a single crosswalk is approximately $1,200. To install a device at every crosswalk at the high priority intersections from Filter B, the total project cost will be approximately $92,400. MCDOT has approximately $30,000 per year for installing new devices, which means it will take approximately 3 years for all of the high priority intersections to be equipped with ATPSD devices, or as their budget permits. After the high priority intersections are complete, MCDOT may choose to move on to the medium-priority intersections and then low priority intersections of Filter B. If all 331 crosswalks - crosswalks that do not currently have an ATPSD device - in the intersections analyzed in Filter B were to be equipped with a device, it would cost approximately $435,600, and take approximately 14 and ½ years to complete. In addition, the existing 24 pair of devices should be replaced with updated hardware as they wear out or as the budget permits, at an additional cost of $28,800. Thus, the total cost to completely install the current hardware standards at all these locations would be $464,400. However, it should be noted that current guidelines do not require these devices to be used in all situations.

To accelerate the pace of device installation, a joint letter from both the blind and visually impaired community and MCDOT to State legislators is recommended as a starting point for requesting additional funding for this specific purpose.

Summary of New Guidelines

New guidelines for assessing the need for audible/tactile pedestrian signal devices at intersections and crosswalks equipped with pedestrian signals are included in **Appendix N**. The new guidelines provide instructions for three scenarios a crosswalk can be considered for an ATPSD as listed below.

- Recommended from the ATPSD Study
- Individual Request
- Roadway Project

The recommended list of prioritized crosswalks created through this study should be equipped with ATPSD starting with highest priority locations first until all the priority locations are complete. If an individual requests an ATPSD or a public project involves alteration of an existing signal or installation of a new signal, the same methodologies used in the ATPSD study should be used to evaluate the location. In order to follow the same methodologies, an ATPSD Scoring Evaluation Sheet has been created to determine the location's Intersection Analysis - Filter B score and Crosswalk Analysis - Filter C score. The Scoring Evaluation Sheet then shows the combined Total Crosswalk Score, which can then be used to determine where the crosswalk ranks in terms of priority for installation. Refer to the following two cases:

- Case 1 – Not Evaluated in the ATPSD Study
  If the location was not previously evaluated, then a Total Crosswalk Score should be determined using the ATPSD Scoring Evaluation Sheets.

- Case 2 - Previously Evaluated in the ATPSD Study
  If the crosswalk was previously evaluated, the Total Crosswalk Score should be updated, as modifications may have been made to the location.

If the Total Crosswalk Score falls within the high or medium point values (34 points or higher), the request should be approved and installation of an ATPSD should be done in advance of any remaining locations on the ATPSD Study prioritized list. If the Total Crosswalk Score falls below 34 points, the location should be added to the ATPSD Study prioritized list and evaluated once all the locations with higher scores have been equipped with ATPSD.

1.0 INTRODUCTION

The Monroe County Audible/Tactile Pedestrian Signal Device Study was initiated by the Monroe County Department of Transportation (MCDOT) to update existing protocol and to further identify locations in the highest need of the installation of audible/tactile pedestrian signal devices (ATPSD) to improve accessibility within Monroe County. The implementing regulations of ADA and the Draft Public Rights-of-Way Accessibility Guidelines are moving towards the installation of ATPSD at all new signals equipped with pedestrian signals. Installation of these devices at existing locations with pedestrian signals is also desired, and that is the focus of this study. The MCDOT plans to add ATPSD equipment at traffic signals that they operate each year as their budget permits, and this study will help identify which intersections and crosswalks should be done first.

T.Y. Lin International and Accessible Design for the Blind worked with MCDOT in determining a priority list of signalized crosswalks for ATPSD to be installed based on destination locations, bus routes and origins of visually impaired people. The study team was assisted by an advisory group representing the blind and visually impaired community.

This study is unique in that it is the analysis of all Monroe County operated traffic signals, which includes the signals in the City of Rochester. Traffic signals owned and operated by the New York State Department of Transportation (NYSDOT) were not included in this study. A three-step process was created to identify the highest priority crosswalks where ATPSD are in need of installation. For each step a 'Filter' was created to narrow the candidate locations based on the 2006 NCHRP Project 3-62: Guidelines for Accessible Pedestrian Signals criteria. These Filters (A, B, and C) were designed to reduce the number of signalized intersections and more specifically crosswalks as each one was applied so that the most important ones could be identified. The end result is a list of the key crosswalk locations where ATSPD should be installed, presented in priority order.

1.1 Project Scope

The scope of work included the following work efforts:

1. Assembly of the Accessible Pedestrian Advisory Committee (APAC):
   TYLI assembled an advisory committee to provide guidance and to act as a sounding board at key decision points during the course of the study. The committee included representatives from the following agencies:
   - Accessible Design for the Blind
   - ABVI-Goodwill
   - American Council for the Blind
   - Commission for the Blind
   - Center for Disability Rights
   - Lifespan

- Monroe County Office of the Aging
- Genesee Transportation Council (GTC)
- Rochester Genesee Regional Transportation Authority (RGRTA)

Individuals from the community who are blind or visually impaired also participated.

2. Public Meetings:
   Two public meetings were held, one on January, 28, 2010 and one on October 21, 2010, to present and discuss the project methodologies and results.

3. Mapping of Pedestrian Needs & Activity Analysis – Filter A:
   TYLI conducted an inventory of existing intersections, pedestrian generators, attractions, routes and crossing locations where ATPSD exist, and where they might be needed. This inventory was conducted using ArcGIS to help overlay potential pedestrian opportunities and was based on input from the APAC. A map was created and used to help screen the MCDOT operated traffic signals to determine where ATPSD may be needed.

4. Identification of Geometric Needs through Intersection Analysis – Filter B:
   With the feedback obtained with the assistance of the APAC, and from the first public meeting, the TYLI Team identified intersections that may be difficult to cross and have a high potential for selection for the application of ATPSD. This Filter was based on the geometry of the intersection and a closer look at the destination influences.

5. Detailed Data Collection and Crosswalk Analysis – Filter C:
   With assistance from Ravi Engineering and Land Surveying, P.C., the crosswalks at the 28 highest priority intersections (83 crosswalks), as identified in the Intersection Analysis (Filter B), were visited for evaluation.

6. Identification of Needs and Appropriate Solutions:
   A prioritized list of the crosswalks recommended to be equipped with ATPSD has been provided. The list is broken down into high, medium, and low priority crosswalks.

7. Cost Estimates and Implementation Priorities:
   A cost estimate has been provided for the priority intersections identified in Filter B along with a time frame for completion.

8. Report Preparation and Expansion of MCDOT Guidelines:
   MCDOT's existing guidelines were updated to incorporate the findings of this study.

1.2 Explanation of Audible/Tactile Pedestrian Signal Devices

Audible/tactile pedestrian signal devices (ATPSD) "provide information in non-visual formats (such as audible tones, speech messages, and/or vibrating surfaces)" per the Manual of Uniform Traffic Control Devices (MUTCD), Section 4E.09. The sounds created by traffic are key cues that help blind and visually impaired pedestrians cross the street and when these cues don't exist the intersection can be very difficult to navigate. These devices are used to indicate when to start crossing the road at signalized intersections and can also provide additional information to pedestrians such as location of the pushbuttons, as well as the direction of the crosswalk and location of the destination curb.

The benefits of ATPSD to blind and visually impaired pedestrians include more accurate judgments of the onset of the 'walk' interval, reduction in crossings begun during 'Don't' Walk', reduced delay, significantly more crossings completed before the signal changed, and sighted pedestrians also begin crossing faster (Accessible Pedestrian Signals: A Guide to Best Practices).

In Section 4E.09 of the MUTCD, guidance for choosing when to install an ATPSD is provided. The following factors are required to be considered when determining the need of an ATPSD:

A. Potential demand for accessible pedestrian signals;
B. A request for accessible pedestrian signals;
C. Traffic volumes during times when pedestrians might be present, including periods of low traffic volumes or high right-turn-on-red volumes;
D. The complexity of traffic signal phasing (such as split phases, protected turn phases, leading pedestrian intervals, and exclusive pedestrian phases0; and
E. The complexity of intersection geometry.

As stated in the MUTCD, "accessible pedestrian signals are typically integrated into the pedestrian detector (pushbutton), so the audible tones and/or messages come from the pushbutton housing." The pushbuttons are required to have a tactile arrow which communicates to the pedestrian the start of the 'walk' interval. Pedestrians can feel the raised arrow vibrate to signify when it is time to cross by keeping in contact with the raised arrow.

Push button locator tones are also required by the MUTCD for any ATPSD which enables blind or visually impaired pedestrian to locate the pushbutton. This feature is a repeating sound that informs approaching pedestrians that a pushbutton to actuate pedestrian timing or receive additional information exists.

Audible tones are required to adjust to ambient traffic sound levels and are only intended to be heard up to six to twelve feet away from the push-button. Typically they are not intended to be used to guide visually impaired persons across the street, only to signify when it is the correct time to cross the street, however audible beaconing can be added as a special feature.

Audible/Tactile Pedestrian Devices can be beneficial to all pedestrians. Locator tones indicate that a button needs to be pushed to activate the 'walk' interval, and the audible 'walk' tone provides another indication it is time to cross the street after checking for any traffic conflicts.

According to MUTCD, "at accessible pedestrian signal locations where pedestrian pushbuttons are used, each pushbutton shall activate both the walk interval and the accessible pedestrian signal." This means an ATPSD can replace an existing pushbutton.

1.3 MCDOT's Existing ATPSD Request Evaluation Procedure

In July of 1996, MCDOT established guidelines (located in **Appendix A**) for evaluating requests for audible pedestrian signal devices. These guidelines were most recently updated in May of 2003 to reference the community resources that are involved in reviewing the need for each location, and incorporated the newer tactile devices.

The first step in response to requests was to explain to the requestor that audible and tactile pedestrian signal devices are not universally accepted by the visually impaired community because they introduce a dependency on mechanical devices which may fail and because the audible signals mask vehicle noises that may prevent the pedestrian from hearing an approaching vehicle that is not stopping for the red light.

The second step was to determine the likelihood of usage (one individual or a group) of the proposed ATPSD, as well as whether the requestor had been in contact with an Orientation and Mobility Specialist (available at the Association for the Blind and Visually Impaired (ABVI) who provide training for the visually impaired. If the requestor had not done so, they were encouraged to do so first.

The third step was to review the individual crossing (with the help of a local assistance agency) to determine if ATPSD were necessary. If the crossing met one of two following criteria, the device was considered necessary:

1) The intersection has non-standard geometrics such as skewed intersection approaches, and unusual traffic signal phasing such as split phasing, exclusive pedestrian phasing, or multiple left turn phases that make it difficult for a pedestrian to cross safely based on audible clues alone.
2) The intersection has little or no side street traffic during off-peak hours, and therefore few audible cues available to determine when to start crossing.

If the request was approved, the appropriate type of device (audible and/or tactile) for the crossing was installed.

1.4 Existing MCDOT Operated Traffic Signals

MCDOT provided the Monroe County signal locations GIS database to form the 'MCDOT Signals' layer of the analysis database. Monroe County operates 628 signals, 74 of which are owned by the New York State Department of Transportation. **Figures 2-1A & 2-1B** show all of the signals operated by MCDOT. Traffic signals owned and operated by the New York State Department of Transportation (NYSDOT) were not considered for this study.

Six of the traffic signals operated by MCDOT include a leading pedestrian interval (LPI). An LPI is a traffic signalization strategy that assigns pedestrians an exclusive 3 to 5 second 'walk' signal to begin crossing the street before cars get a green light. This permits pedestrians to gain a head start before turning vehicles are released. This type of operation was a part of the criteria for this study. The list of specific locations where LPI's are currently located is shown in **Table 1-1**.

Table 1-1 – Existing Leading Pedestrian Interval Locations

LPI Locations:	East/West	North/South
Monroe & Goodman	Y	Y
Monroe & Alexander	Y	Y
Kendrick & Crittenden	Y	
South & Court	Y	
Main & South-St. Paul	Y	Y
Hudson & Seneca Manor	Y	
Elmwood/Scottsville/Genesee		Y
Broad & South	Y	Y
Avenue E & St. Paul	Y	Y

1.5 Existing Audible/Tactile Pedestrian Signal Device Locations

As of February 25, 2011 the total number of ATPSD in Monroe County was 24 pair (i.e. 24 crosswalks are covered) at 22 intersections. MCDOT provided a list of existing ATPSD locations (**Appendix A**) as listed in **Table 1-2** and also shown in **Figures 2-1A & 2-1B**.

Table 1-2 – Existing Audible/Tactile Pedestrian Signal Device Locations

Location	Leg	Type
Portland/Pedestrian Crosswalk (RGH)	Ped Crossing	Advanced
Clinton S./Byron	South	Bell
Ridge E./Brown	East	Bell
South/Mt Hope/Byron	South	Bell
Clinton S./Alexander	North	Cuckoo/Chirp
Clinton S./Elmwood	South	Cuckoo/Chirp
Dewey/Bennington	North	Cuckoo/Chirp
East/Colby	East	Cuckoo/Chirp
East/Probert	West	Cuckoo/Chirp
East/Winton	North	Cuckoo/Chirp
Edgewood/Westfall	East	Cuckoo/Chirp
Elmwood/U of R	East	Cuckoo/Chirp
Long Pond/Maiden	North & West	Cuckoo/Chirp
Monroe/Canterbury/Dartmouth	West	Cuckoo/Chirp
Mt Hope/E Henrietta/Crittenden	West & North	Cuckoo/Chirp
Phillips/Pedestrian Crosswalk (Xerox)	Ped Crossing	Cuckoo/Chirp
St. Paul/Colebrook	South	Cuckoo/Chirp
St. Paul/Ridge E.	North	Cuckoo/Chirp
University/Atlantic	East	Cuckoo/Chirp
Clinton S./Karges	North	Tactile
Dewey/Northgate	North	Tactile
Main/Mustard	East	Tactile

Notes:

1. The total number of devices is 24 pair (i.e. 24 crosswalks are covered) at 22 intersections
2. The "advanced" device at the Portland Avenue pedestrian crossing for Rochester General Hospital includes both standard and custom audible messaging and audible countdown of the time remaining to cross.

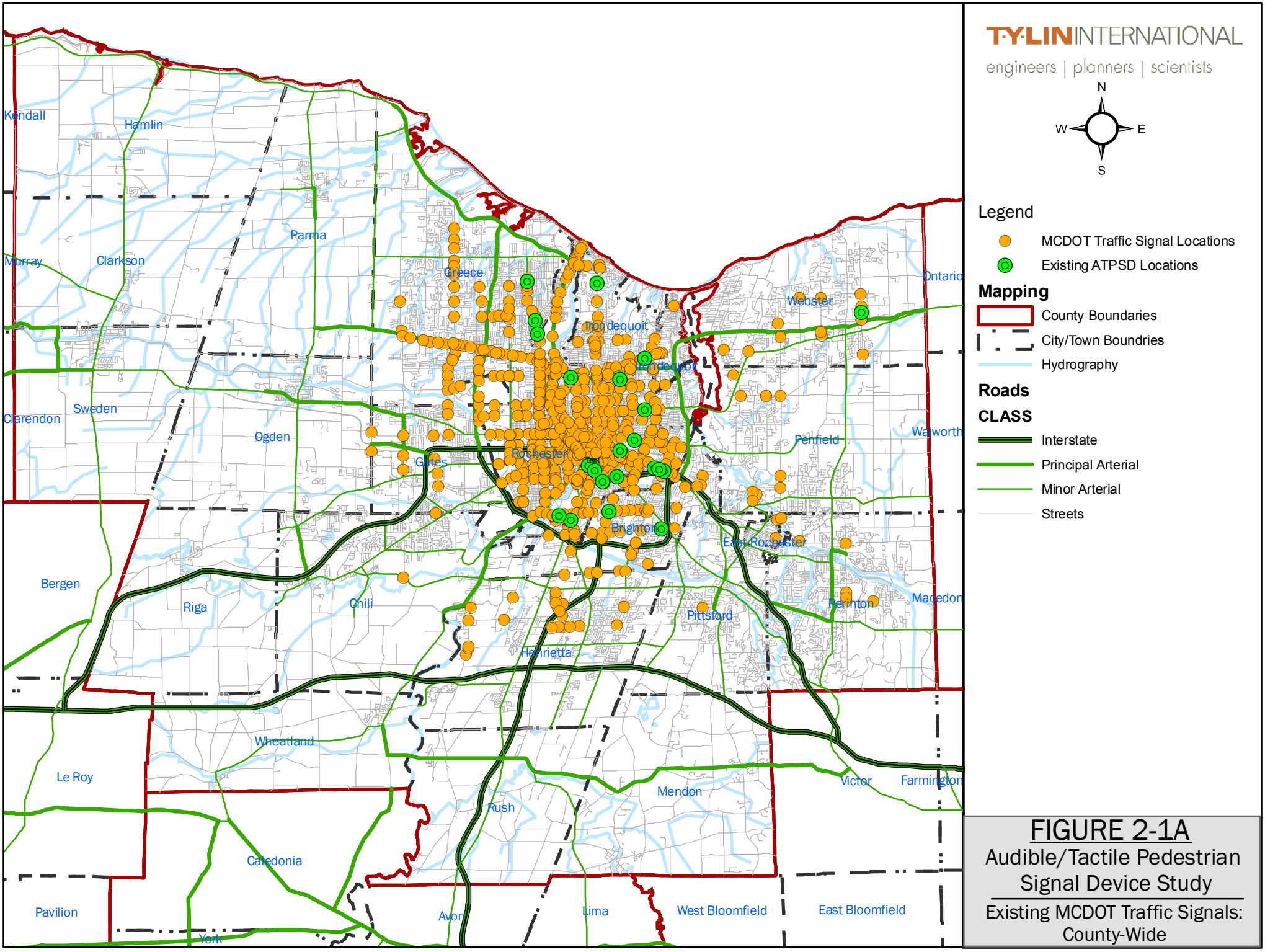

FIGURE 2-1A

Audible/Tactile Pedestrian Signal Device Study

Existing MCDOT Traffic Signals: County-Wide

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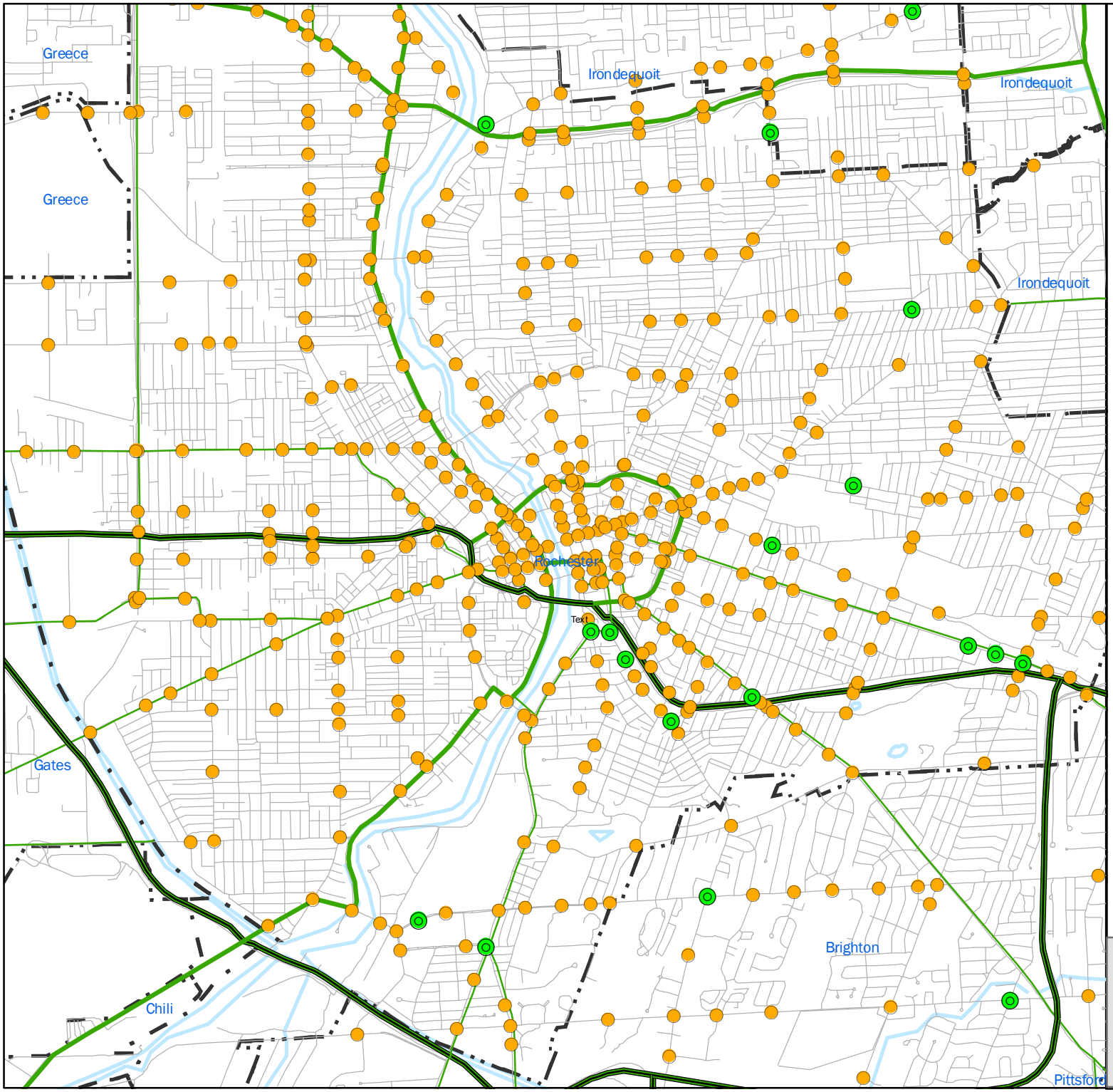

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FIGURE 2-1B

Audible/Tactile Pedestrian Signal Device Study

Existing MCDOT Traffic Signals: Downtown

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2.0 APAC Meetings & Public Meetings

2.1 Kick-off APAC Meeting

In order to develop an understanding of accessible needs locally, the team met with the APAC on July 29, 2009 to introduce the project objectives and to discuss what data should be collected.

Nine categories were originally chosen as influences that would create a destination, attraction or origin of a visually impaired person. Discussions introduced the addition of a tenth category based on signal timing operation. The basis and mapping of this information as well as the use of the data to filter candidate locations from total signal locations was discussed with the APAC. The ten categories chosen were:

- ABVI & Lift Line consumers [Origin]
- Highest Used Bus Routes [Transportation]
- Support Centers [Necessary Destination]
- Health Care Centers/Hospitals [Necessary Destination]
- Food/Shopping Locations [Necessary Destination]
- Civic/Municipal Buildings [Necessary Destination]
- Residences (apartment complexes, senior living centers) [Origin]
- Entertainment Locations [Desired Destination]
- Other Locations (i.e. college campuses, office buildings, possible places of employment) [Desired Destination]
- Type of Signal Timing

To read the meeting minutes from this meeting, see "APAC – First Meeting" minutes in **Appendix B**.

2.2 Second APAC Meeting

A second APAC meeting was held on October 23, 2009 to present and discuss the data collected for Activity Analysis – Filter A. The maps of origin data, high priority bus route locations, and destination influences were reviewed.

The utilization of a 1,500 foot buffer zone around the bus routes and destinations was confirmed by committee members and supported by RGRTA's representative. The distance of 1,500 feet is considered a 'walkable' distance for most Lift Line consumers, and was the basis of the buffer zones for analysis in the Activity Analysis.

Additional destination locations were also suggested at this meeting. The inclusion of pharmacies, discount food stores, and dollar store locations was requested to be added to the "food/shopping" category. These destinations where included in the update to the Activity Analysis.

To read the meeting minutes from this meeting, see APAC Meeting #2 minutes in **Appendix B**.

2.3 Third APAC Meeting & First Public Meeting

At the third APAC meeting and first public meeting held on January 28, 2010, the origin/destination data and Activity Analysis – Filter A methodology was reviewed. The first draft of the ranked Activity Analysis was then presented to the APAC and to the public for comments. The overall response for the proposed ranking system was positive. The influences for the Intersection Analysis – Filter B as well as the Crosswalk Analysis – Filter C were discussed.

To read the meeting minutes from these meetings, see "Public Meeting #1" and "APAC Meeting #3" minutes in **Appendix B**.

2.4 Fourth APAC Meeting & Second Public Meeting

The fourth APAC meeting coincided with the second Public Meeting on October 21, 2010 and the results of the study were presented to the APAC and the public. The APAC was provided with a draft of the study to review prior to the meeting. The ranking systems of influences for the Intersection Analysis – Filter B as well as the Crosswalk Analysis – Filter C were discussed. Overall feedback from this meeting was positive and did not result in any changes to the study methodologies.

To read the meeting minutes from this meeting, see "Public Meeting #2" and "APAC Meeting #4" minutes in **Appendix B**.

3.0 Database Development and Activity Analysis (Filter A)

In order to identify the MCDOT operated signal locations that have the highest priority for the installation of an audible/tactile pedestrian signal device (ATPSD), an inventory of existing MCDOT operated traffic signal locations, and existing ATPSD locations were mapped. Also added to this map were origins and destinations of the visually impaired, and highest used bus routes. This allowed the identification of places where pedestrian activity would be most likely, particularly for the blind and visually impaired. With limited resources to install ATPSD, identifying locations that get the highest use was important for prioritizing the signalized intersections.

The candidate locations for the ATPSD were selected based on the Activity Analysis – Filter A which evaluated and ranked ten categories chosen by the APAC to determine which signals to focus on.

The ten categories chosen were:

- ABVI & Lift Line consumers [Origin]
- Highest Used Bus Routes [Transportation]
- Support Centers [Necessary Destination]
- Health Care Centers/Hospitals [Necessary Destination]
- Food/Shopping Locations [Necessary Destination]
- Civic/Municipal Buildings [Necessary Destination]
- Residences (apartment complexes, senior living centers) [Origin]
- Entertainment Locations [Desired Destination]
- Other Locations (i.e. college campuses, office buildings, possible places of employment) [Desired Destination]
- Type of Signal Timing

The data groupings were entered as several layers into a GIS (Geographic Information System) or "smart" mapping. By enhancing the data using this mapping software, an area of influence was projected around each location in the database. The traffic signal locations with the most influence areas overlapping the respective signal location indicate the intersections that would have the most pedestrian activity, and thus could be candidates for the installation of the audible/tactile devices. For each appropriate category, a ¼ mile buffer zone was applied to the influence locations. The existing MCDOT signals within each category's buffer zone were then recorded. A value was assigned to each category, based on necessity. When a signal fell into the buffer zone of a location within a category, that signal received that category's value. The value for each category was based on a weighted system, with the more necessary locations receiving a higher point value than the desired locations. The type of signal timing was not GIS mapped data; however, it was based on the existing operation of the signal, and included in the calculation of the Activity Analysis.

The values of each category were revised several times throughout the development of the Activity Analysis – Filter A. The point systems for each of the 4 categories described in the sections below are the final values used for analysis.

3.1 Origin Data

The origin data reflects the home address ZIP Code for both the number of ABVI consumers (**Appendix C**) as well as the number of Lift Line passengers (**Appendix D**). ABVI is a not-for-profit organization in the Greater Rochester area which provides services, education and training to people who are blind or visually impaired. Lift Line is a shared-ride, curb-to-curb public transportation service for handicapped people in the Greater Rochester area.

The results of the origin data are shown in **Figure 2-2**. The number of consumers is represented by circles proportionate in size to the volume of consumers within the area of each of Monroe Counties 38 zip codes. There are six different sizes of circles to represent the grouping of the number of consumers. The six groups were 0-11 consumers, 12-34 consumers, 35-68 consumers, 69-111 consumers, 112-196 consumers and 197-317 consumers. Three Zip Code areas had the most demand with 197-317 consumers. The most demand appears to be in the following areas:

- Just north of the city in the Irondequoit area (ZIP Code 14621)
- Culver Road, Bay Road & Merchants Street area (ZIP Code 14609)
- South of the city – Brighton area (ZIP Code 14620)

The downtown metro area did not have the high demand that may have been expected. This may be due to a lower residential population because there is less housing in this area.

MCDOT signals that fell within the Lift-line Consumer ZIP Code areas received 3 points for the 'ZIP Code' category in the Activity Analysis. Signals that fell within the zip code area of the top three groups of ABVI consumers were awarded points: 69-111 consumers got 1 point, 112-196 consumers got 2 points and 197-317 consumers got 3 points in the Activity Analysis.

3.2 Bus Routes

The RGRTA provided a list of the highest used bus routes within Monroe County, which is included in **Appendix E**. All bus routes run through downtown to the Main Bus Transfer Area on Main Street at Clinton Avenue. The routes with the most riders utilizing the public transit service provided by RTS were likely to have a greater need for ATPSD installations because there is a greater chance of ridership by visually impaired persons based on the overall ridership numbers. Therefore, intersections along these routes are more likely to be utilized by visually impaired pedestrians utilizing the RTS bus system. The list ranks the 27 bus routes in the order of most utilized to the least utilized routes for the month of February 2010. Given that visually impaired people have access to all RTS bus routes, it was determined that all routes with more than 500 riders should be included as influences on the need for an ATPSD. In order to utilize the bus route information in the weighted ranking system, a point value was assigned to bus routes based on ridership data. The routes with more than 500 riders were plotted in the GIS database for analysis, with the routes having 3,000 or more riders receiving 3 points, routes having between 1,000 and 2,200 riders receiving 2 points, and the routes having between 500 and 700 riders receiving 1 point. Each

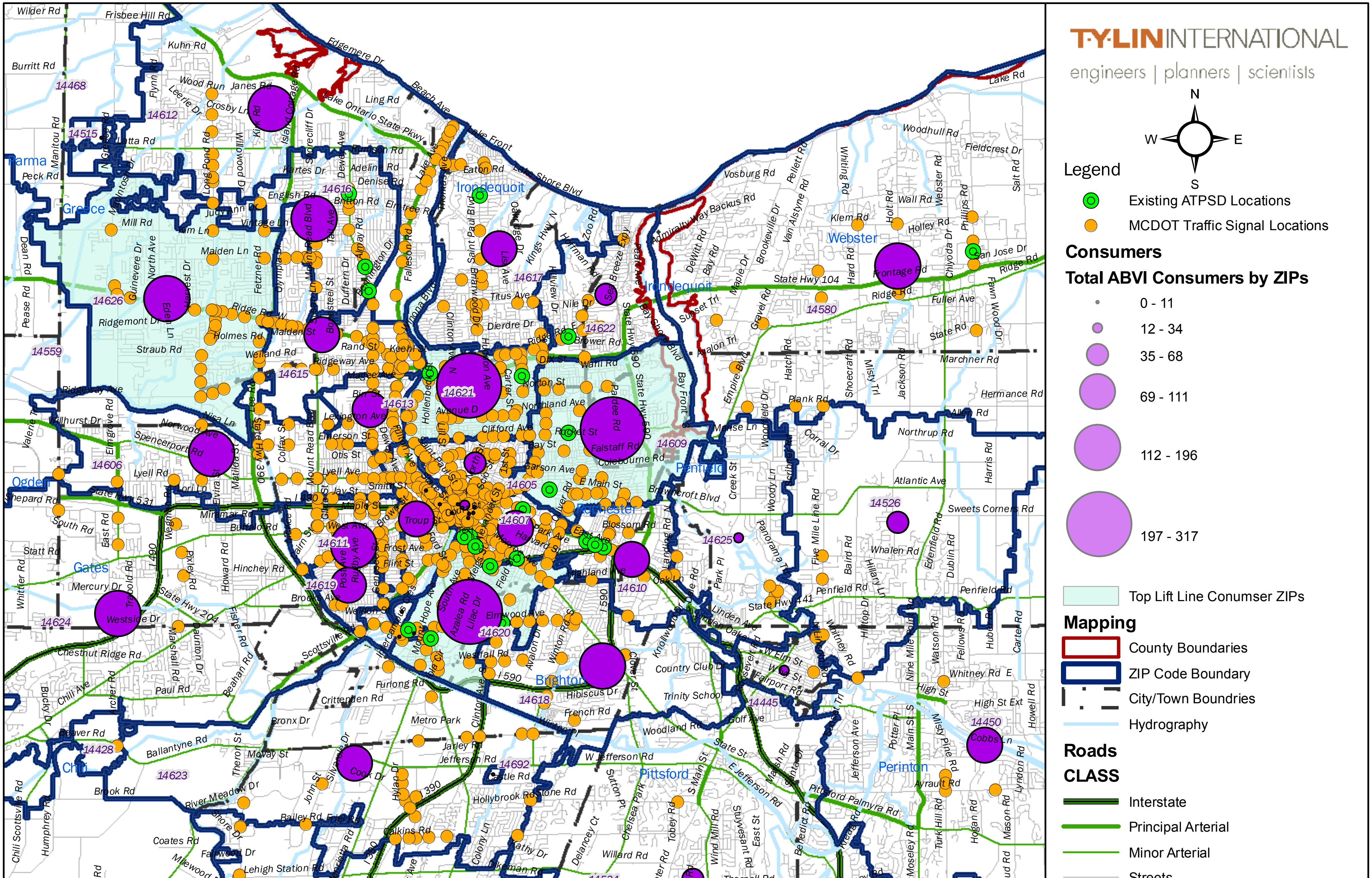


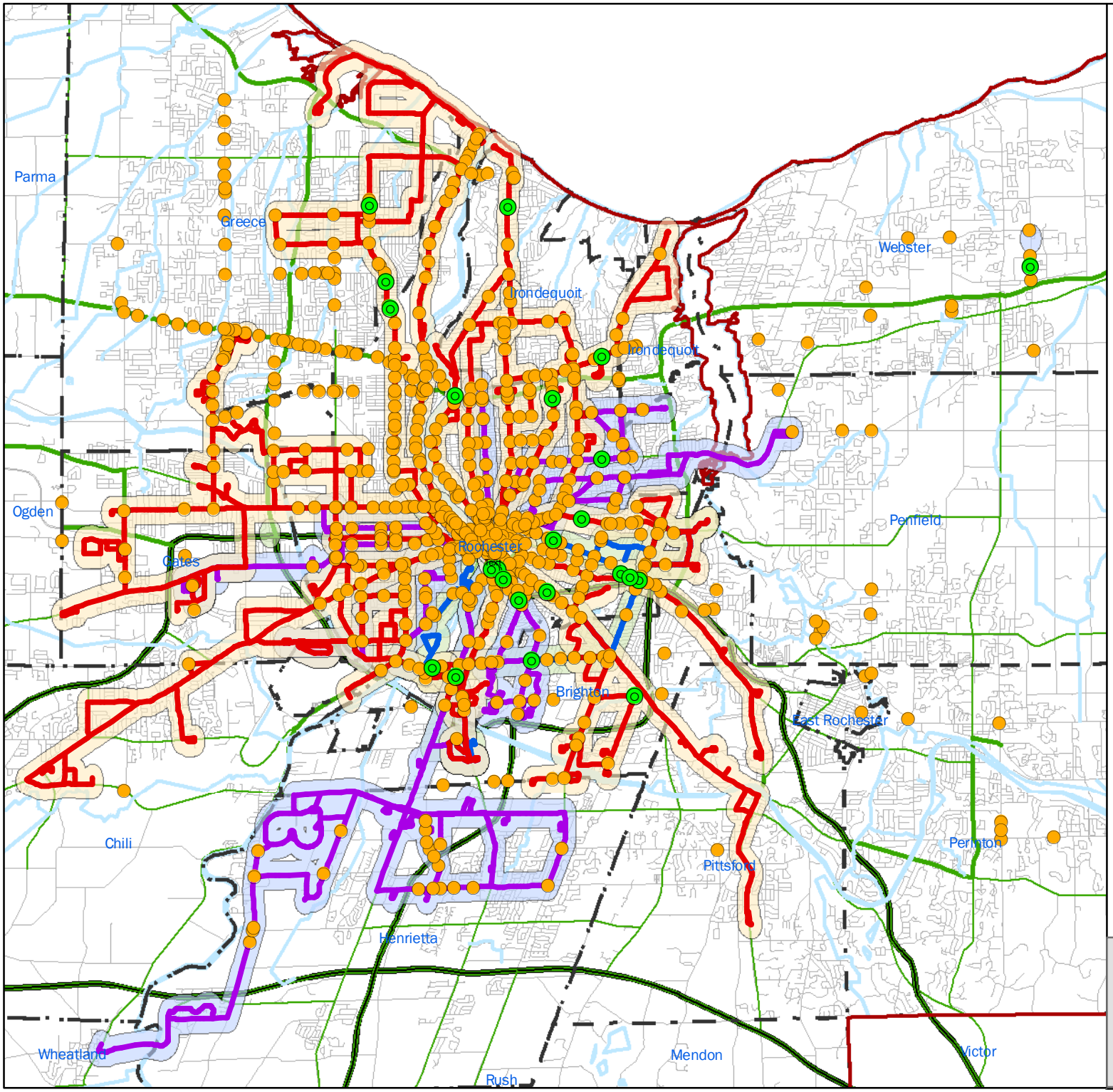
FIGURE 2-2
Audible/Tactile Pedestrian Signal Device Study
Origin Data: ABVI & Lift Line Consumers

Project # 43.4933 4/28/2011

signal could receive up to 6 points, if all three types of routes exist within ¼ mile of the signal. The following table lists the RTS bus routes: A 1,500 foot (¼ mile or approximately 3.5 city blocks) buffer zone was also applied to the routes, as listed in **Table 3-1** and as shown in **Figures 2-3A & 2-3B**.

Table 3-1 – RGRTA Bus Routes

Route No.	Route Description
1st Ranked Bus Routes With More Than 3,000 Riders [3 points]	
➢ Route 10 –	Dewey/Portland: This route runs from Latta Rd. along Dewey Ave. through downtown and along Portland Ave., Ridge Rd. and Culver Rd. to Sea Breeze Amusement Park
➢ Route 8 –	Chili/East Main: This route runs from Chili along Chili Ave. through downtown and along Main St. to Browncroft Blvd.
➢ Route 4 –	Genesee/Hudson: This route runs from Irondequoit Plaza along Hudson Ave. through downtown and Genesee St. to Genesee Park Blvd./Elmwood Ave.
➢ Route 1 –	Lake/Park: This route runs from Charlotte along Lake Ave. through downtown and along Park Ave. to Winton Rd.
➢ Route 5 –	South/Saint Paul: This route runs from Lake Ontario along St. Paul Blvd. through downtown and along South Ave. to Monroe Community College (MCC) Brighton Campus.
➢ Route 3 –	Lyell/Goodman: This route runs from Manitou Rd. along Buffalo Rd., up Long Pond Rd. to Greece Ridge Center Mall, and along Lyell Ave., through downtown and along Goodman St, and Titus Ave. to the Irondequoit Plaza.
➢ Route 7 –	Monroe/Clinton: This route runs from the Irondequoit Plaza along Clinton Ave. through downtown and along Monroe Ave. to Thornell Park.
2nd Ranked Bus Routes With 1,000 to 2,200 Riders [2 points]	
➢ Route 2 –	Thurston/Parsells: This route runs from the Wegmans Distribution Center and the Greater Rochester International Airport along Brooks Ave., Thurston Rd., Arnett Blvd. and Genesee St. through downtown and along Parsells Ave. and Culver Pkwy to Winton Rd.
➢ Route 9 –	Jay-Maple/Bay: This route runs from the Pixley Industrial Park along Buffalo Rd., Maple St. and Jay St. through downtown and along Webster Ave., Bay St. and Union St. to Culver Rd.
➢ Route 6 –	Jefferson/Clifford: This route runs from Plymouth Ave. along Jefferson Ave., Dr. Samuel McCree Way and Ford St. through downtown and along North St., Clifford Ave. and Norton St. to the Newport Highland Apartments.
➢ Route 11 –	S. Clinton/Joseph: This route runs from Ridge Rd. along Seneca Ave. and Joseph Ave. through downtown and along S. Clinton Ave. and S. Goodman St. to Westfall Rd.
➢ Route 24 –	Market Place Mall: This route runs from Main St. along Mt. Hope Ave., E. Henrietta Rd., W. Henrietta Rd., Jefferson Rd. to Winton Rd. and also through RIT Campus along East River Rd. to Scottsville.
3rd Ranked Bus Routes With 500 to 700 Riders [1 points]	
➢ Route 18 –	University: This route runs from downtown along University Ave., Winton Rd. and Elmwood Ave. to Strong Hospital and the University of Rochester and continues along S. Plymouth Ave. to downtown.
➢ Route 19 –	Plymouth: This route runs from downtown along S. Plymouth Ave. to the University of Rochester and Strong Hospital, returning downtown along Elmwood Ave., Winton Rd. and University Ave.
➢ Route 50 –	Monroe Community College: This route runs from downtown along Mount Hope Ave., W. Henrietta Rd. and South Ave. to Monroe Community College (MCC) Brighton Campus.



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Legend

- Existing ATPSD Locations
- MCDOT Traffic Signal Locations

Bus Routes

- 1st Highest Used Bus Routes
- 2nd Highest Used Bus Routes
- 3rd Highest Used Bus Routes
- 1st Highest Use Bus Buffer
- 2nd Highest Use Bus Buffer
- 3rd Highest Use Bus Buffer

Mapping

- County Boundaries
- City/Town Boundries
- Hydrography

Roads

CLASS

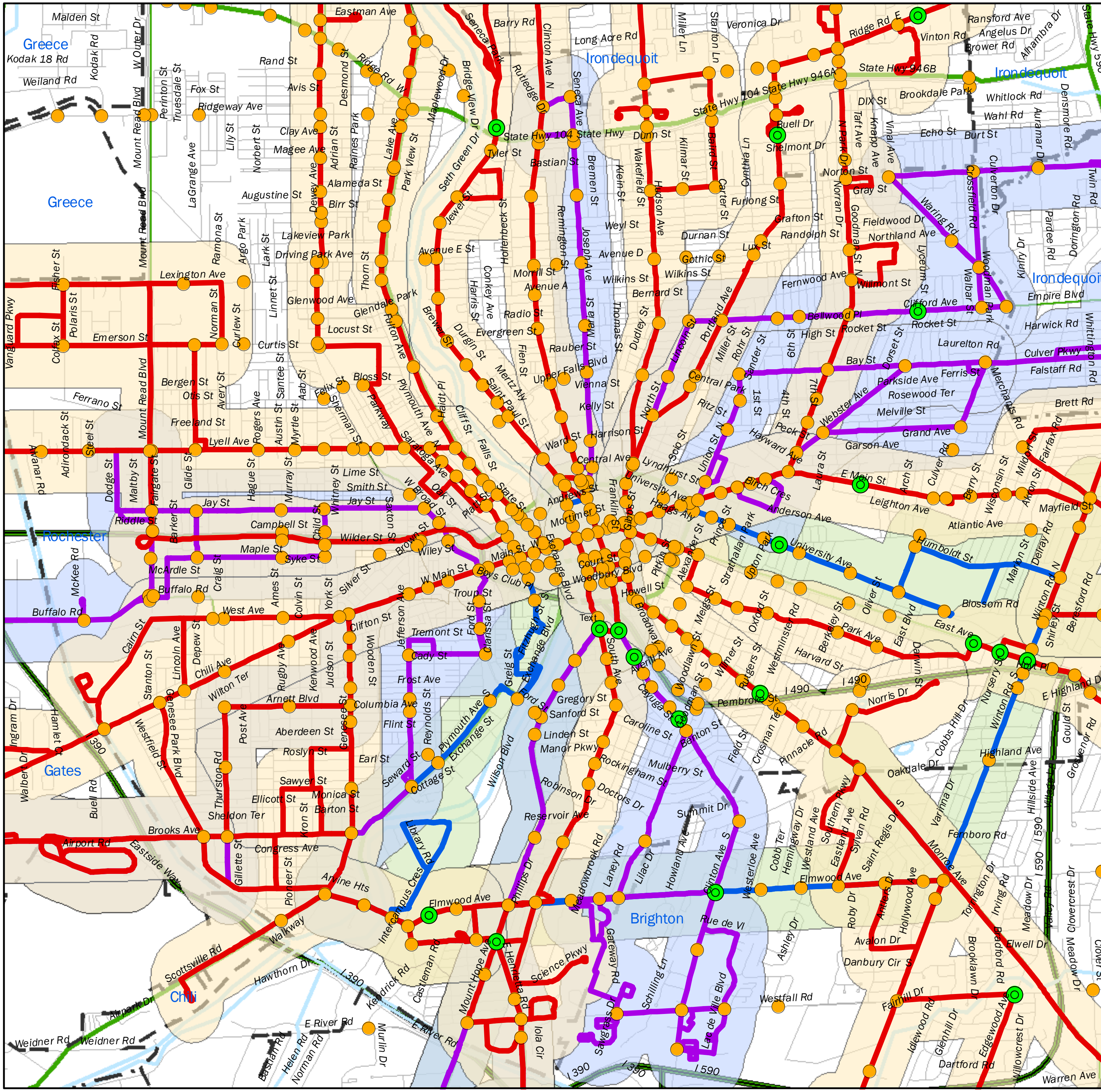
- Interstate
- Principal Arterial
- Minor Arterial
- Streets

FIGURE 2-3A

Audible/Tactile Pedestrian Signal Device Study

Bus Routes:
County-wide

Project # 43.4933 4/28/2011



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Legend

- Existing ATPSD Locations
- MCDOT Traffic Signal Locations

Bus Routes

- 1st Highest Used Bus Routes
- 2nd Highest Used Bus Routes
- 3rd Highest Used Bus Routes
- 1st Highest Use Bus Buffer
- 2nd Highest Use Bus Buffer
- 3rd Highest Use Bus Buffer

Mapping

- County Boundaries
- City/Town Boundries
- Hydrography

Roads

CLASS

- Interstate
- Principal Arterial
- Minor Arterial
- Streets

FIGURE 2-3B

Audible/Tactile Pedestrian Signal Device Study

Bus Routes:
Downtown

Project # 43.4933   4/28/2011

3.3 Destinations

The destinations data reflect many of the necessary destinations for visually impaired people to travel to and from such as support centers, health centers, hospitals, civic buildings and housing facilities, as well as desired destinations such as entertainment locations, office buildings and colleges. The general destinations were suggested by the APAC advisory committee. The following list explains the destination categories and their rank in the Activity Analysis – Filter A:

- Residential [R] – 2 points – Residential locations chosen are large apartment complexes. These locations may be originations of citizens who need Audible/Tactile Pedestrian Devices.
- Residential Assisted [RA] – 4 points – Residential Assisted locations selected are group housing locations, such as assisted living facilities and retirement communities. These spots are most likely originations of citizens who need Audible/Tactile Pedestrian Devices.
- Hospitals/Health Care Centers [H] – 6 points – Hospitals and health care centers are facilities that operate as Hospitals, and locations of larger medical facilities or medical complexes.
- Support Service Centers [S] – 6 points – Support service centers are facilities which provide service and/or assistance to those with vision impairment. These locations include ABVI, Commission for the Blind, and Rochester Eye Institute.
- Civic Centers/Municipal Buildings [C] – 6 points – This category includes locations of Public Libraries, Post Offices, and City & Town Halls.
- Food/Shopping [F] – 6 points – Food and shopping locations chosen are larger supermarkets such as Wegmans and Tops, and shopping mall areas. Discount grocery stores such as Aldi's and Price Rite, pharmacy/drug stores such as Rite-Aid, CVS and Walgreen's, and dollar stores such as Family Dollar, Dollar Tree and Dollar General were included. Shopping plazas were not highlighted, as they tend to make navigating more difficult for visually impaired pedestrians in locations with confusing parking lots.
- Entertainment [E] – 3 points – Entertainment locations are places of entertainment such as theatres and venues (Geva Theatre, The Little Theatre, Rochester Philharmonic Orchestra, etc.), museums (Rochester Museum & Science Center), parks and YMCA's.
- Other [O] – 3 points – Other locations of interest that were not included in the other seven categories but were important to include were places of higher education such as colleges and places of mass transportation. Colleges that were included were University of Rochester (Main Campus), Rochester Institute of Technology (and National Technical Institute for the Deaf), St. John Fisher College, and Nazareth College. Places of mass transportation included the Greater Rochester International Airport, the Amtrak Train Station, and the Greyhound Bus Station.

All the locations of these destinations were mapped using GIS and shown in relation to the locations of MCDOT traffic signals and existing ATPSD locations. An example of

these maps is shown in **Figure 2-4 [B2]** with all figures showing Monroe County broken down into quadrants provided in **Appendix L** as **Figures 2-4**.

3.4 Signal Timing Type

Signal timing is important in the analysis of determining the need of an ATPSD at an intersection or particular crosswalk. The timing type refers to the pattern, or lack of pattern, in the signal timing phases. Intersections that operate with a pre-timed signal tend to be more accessible to the visually impaired because the timing is consistent. Each cycle operates with the same amount of time per direction, per cycle. A visually impaired pedestrian can learn the pattern of the signal to know when to cross. Pre-timed signals were given zero points on the Activity Analysis. The signal type data was provided by MCDOT.

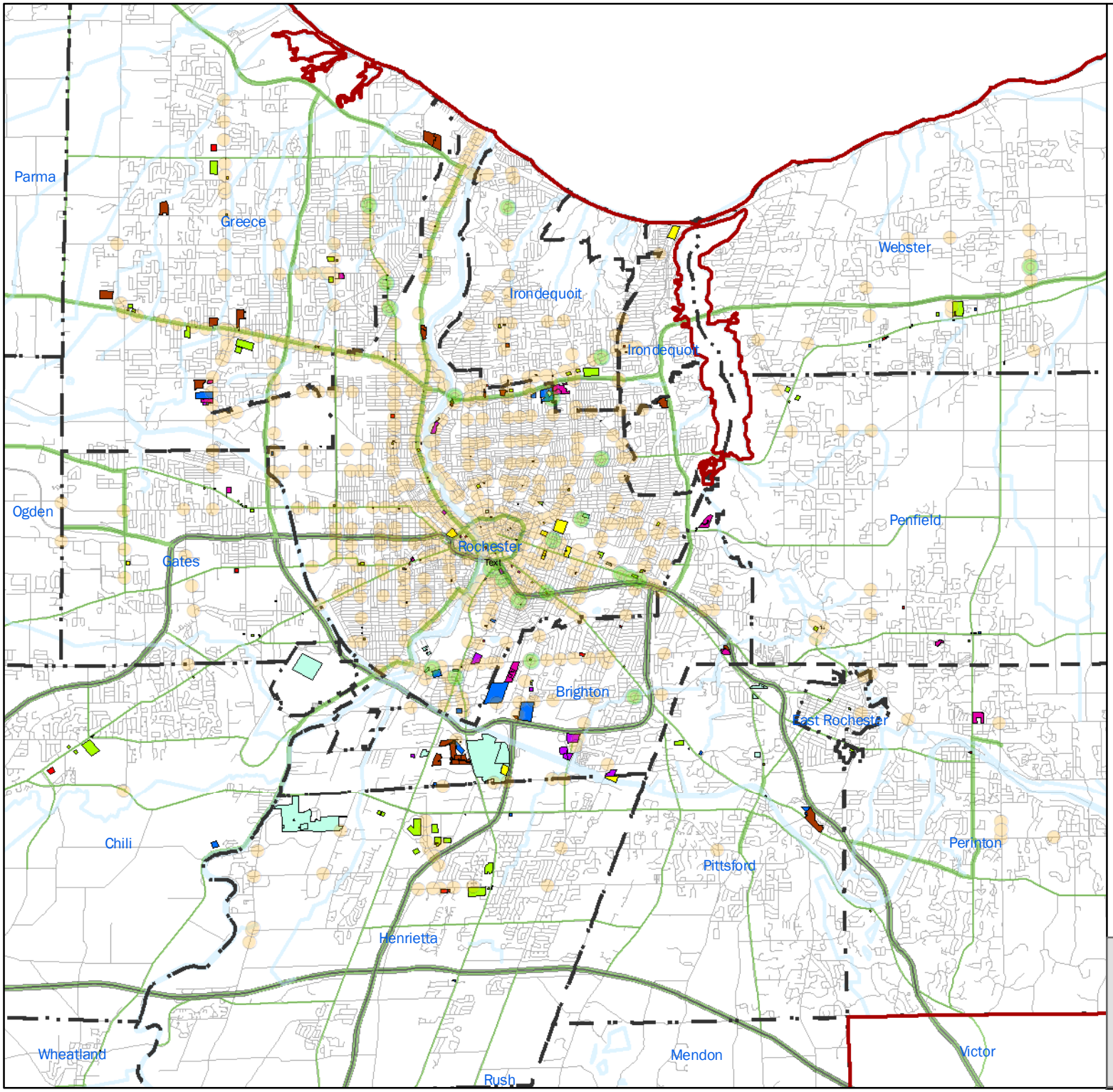
Fully actuated signals do not have a consistent pattern of green time for some or all movements within the intersection. Under an actuated operation, the length of green time for each approach and/or movement is dictated by the presence of vehicles. The green time only runs as long as the presence of vehicles exists within the minimum and maximum green setting. Actuated signals can be difficult for visually impaired persons to predict when to cross. Actuated signals were given 6 points on the Activity Analysis.

Semi-actuated signals also do not have a consistent pattern of green time for all movements. Typically the signal recalls the main street through phases to their maximum green time. Other assigned phases such as side-street traffic or left-turn traffic may skip or gap-out based on the presence of vehicles. This can be difficult for visually impaired persons to predict when to cross. Semi-actuated signals were given 3 points on the Activity Analysis.

3.5 Results of Activity Analysis – Filter A

The MCDOT operates 628 traffic signals that are eligible for the installation of ATPSDs. The Activity Analysis points for each signal were totaled, with the highest possible activity analysis score of 57, to give each signal a score (0-57). Of the evaluated signals, 103 received a score of 22 or better, with the highest ranking intersection being South Avenue at Griffith Street/I-490 Ramp receiving 39 points. 262 signals received a score of less than 22 and greater than or equal to 13. The remaining signals received a ranking score of less than 13 points.

A statistical analysis was used to identify the highest scoring locations in Filter A that will then be evaluated in Filter B. Shown graphically in **Figure 2-5**, the number of signals versus the Activity Analysis score can be divided into three groups with break points at scores of 10 and 22 that create three "bell-shaped" curves. The groups include; Low Score – 252 signals (41% of all signals) that have a score of 12 or less, Medium Score - 262 signals (42% of all signals) that have a score of 13 to 21 points, and High Score - 103 signals (17% of all signals) that have a score of 22 or more



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MCDOT Traffic Signal Locations
Existing ATPSD Locations

Destinations

- Support Services
- Health Care
- Civic/Municipal
- Food/Shopping
- Residence (Apartments)
- Residence (Assisted Living)
- Entertainment
- Other

Mapping

- County Boundaries
- City/Town Boundries
- Hydrography

Roads

CLASS

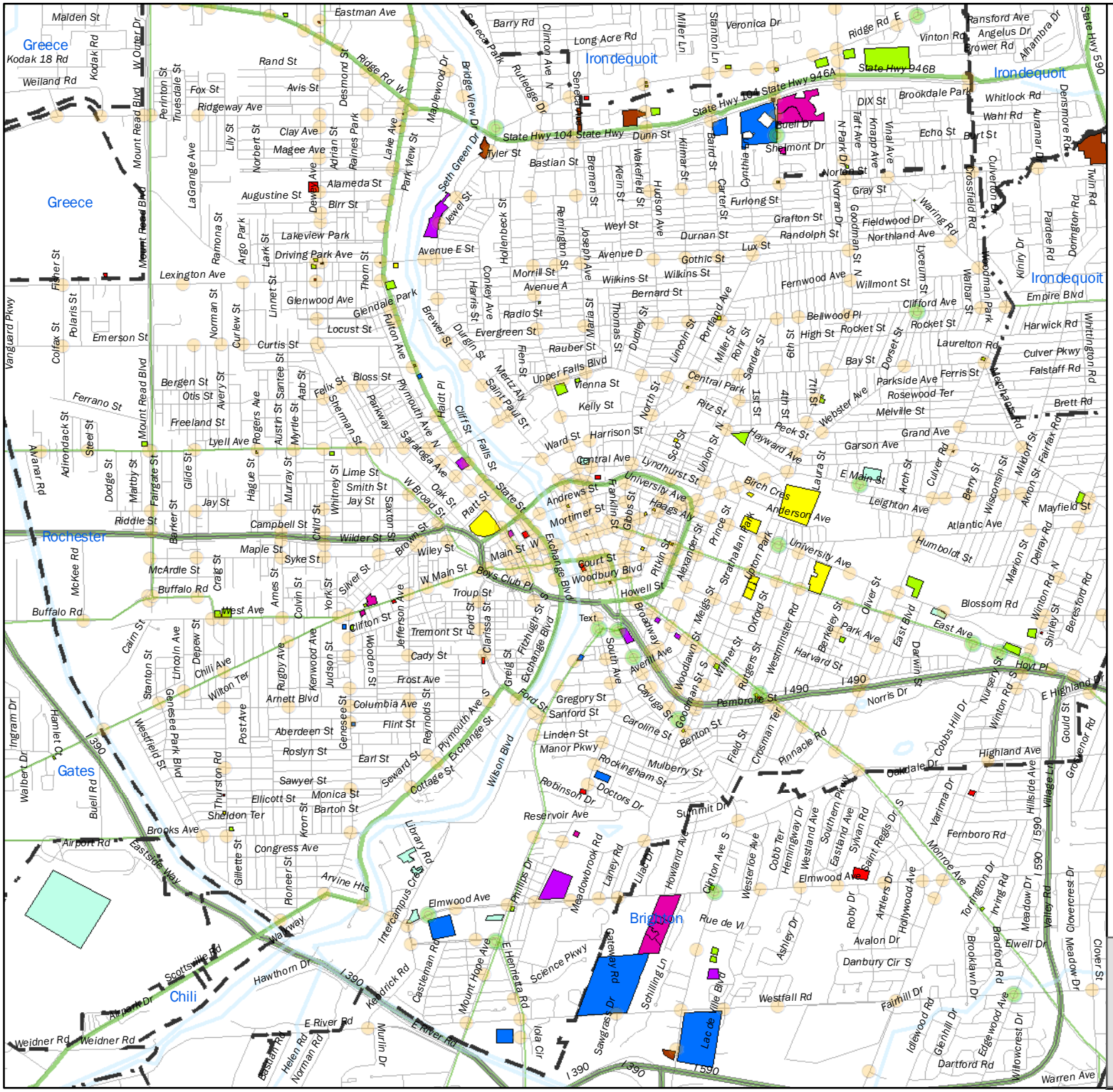
- Interstate
- Principal Arterial
- Minor Arterial
- Streets

FIGURE 2-4A

Audible/Tactile Pedestrian Signal Device Study

Destinations:
County-Wide

Project # 43.4933 4/28/2011



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Legend

- MCDOT Traffic Signal Locations
- Existing ATPSD Locations

Destinations

- Support Services
- Health Care
- Civic/Municipal
- Food/Shopping
- Residence (Apartments)
- Residence (Assisted Living)
- Entertainment
- Other

Mapping

- County Boundaries
- City/Town Boundries
- Hydrography

Roads

CLASS

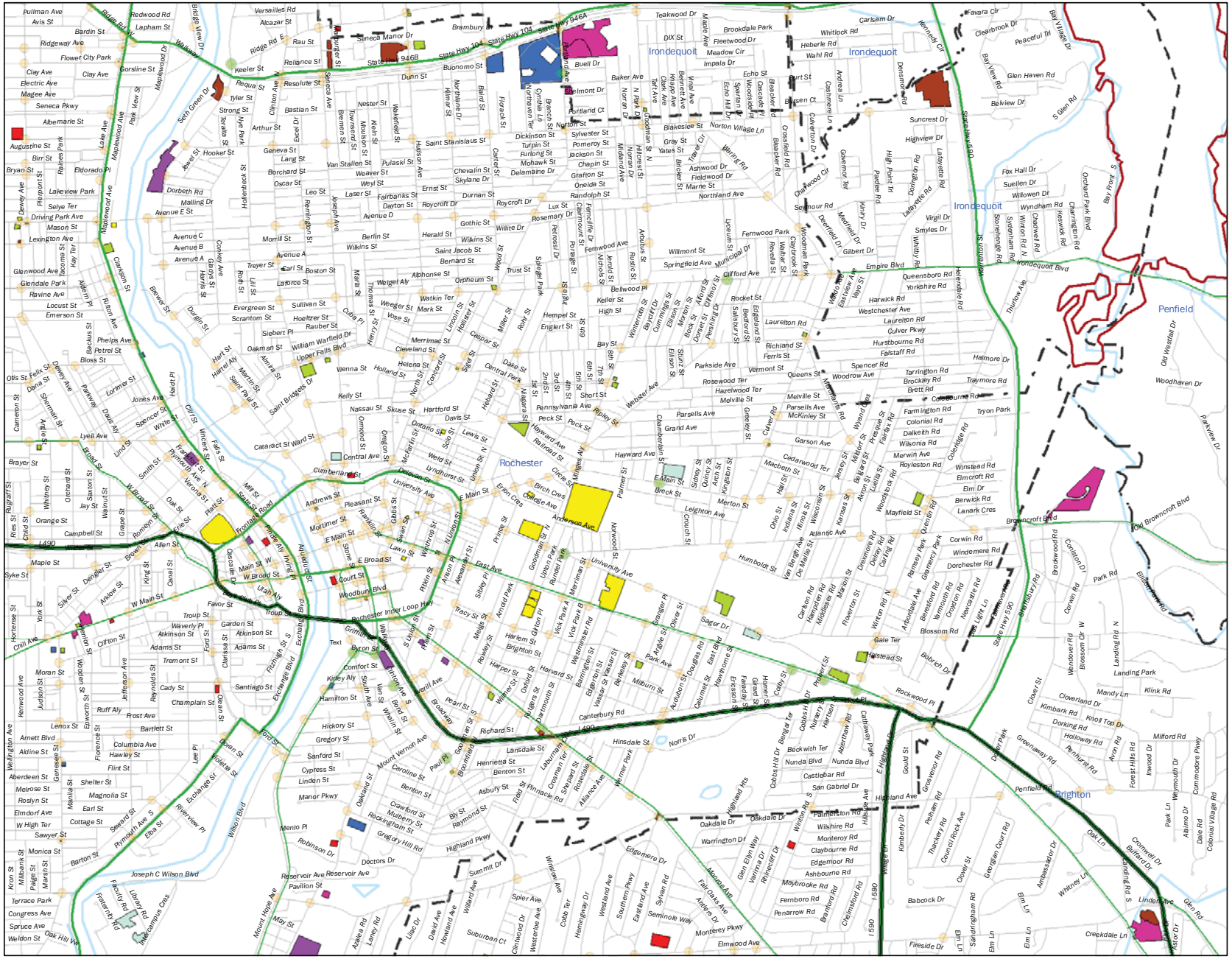
- Interstate
- Principal Arterial
- Minor Arterial
- Streets

FIGURE 2-4B

Audible/Tactile Pedestrian Signal Device Study

Destinations: Downtown

Project # 43.4933 4/28/2011



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MCDOT Traffic Signal Locations
Existing ATPSD Locations

Destinations

- Support Services
- Health Care
- Civic/Municipal
- Food/Shopping
- Residence (Apartments)
- Residence (Assisted Living)
- Entertainment
- Other

Mapping

- County Boundaries
- City/Town Boundries
- Hydrography

Roads

CLASS

- Interstate
- Principal Arterial
- Minor Arterial
- Streets

FIGURE 2-4 [B2]

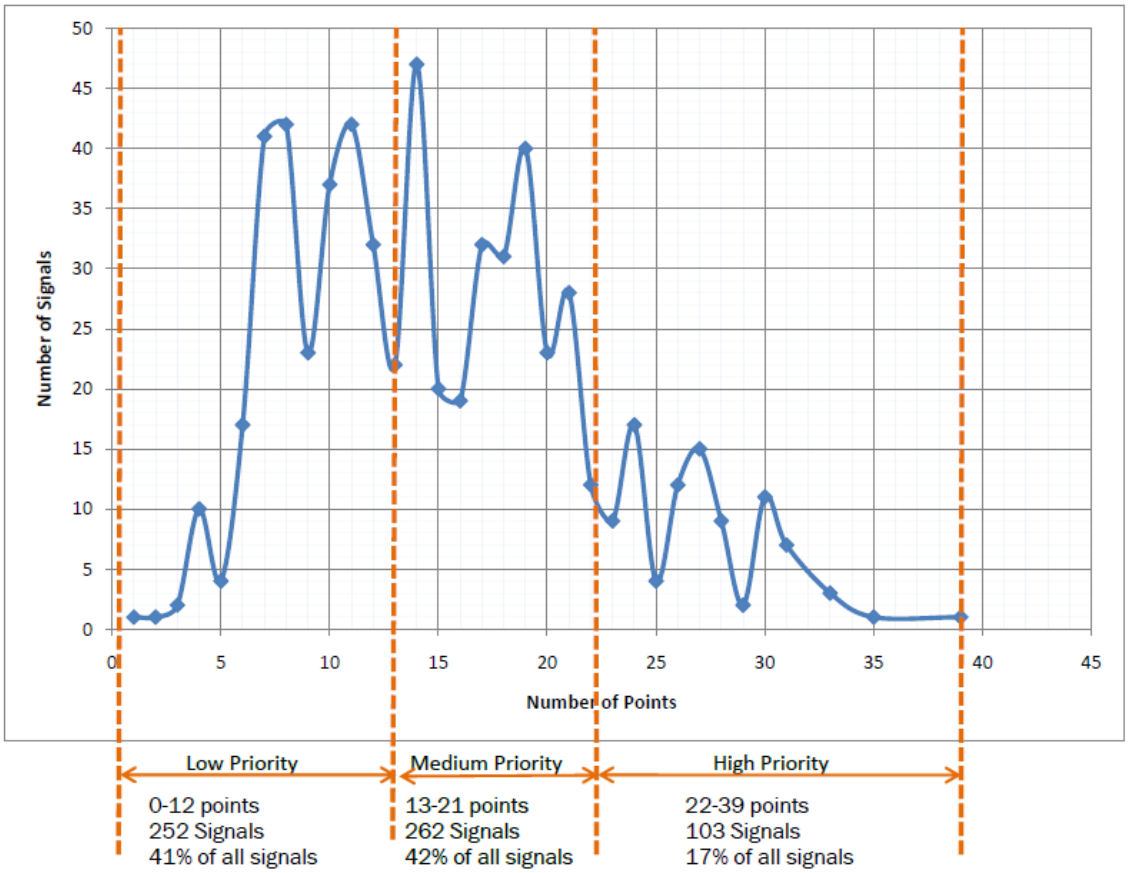
Audible/Tactile Pedestrian Signal Device Study

Destinations: Quadrant B2

Project # 43.4933 4/28/2011

points shown in the Activity Analysis table in **Appendix F**. This group typically includes points for at least 1 bus route (1 point), ZIP Code (3 points), ABVI Consumer influence (3 points), at least 2 residential origins or necessary destinations (12 points), and signal timing operation of at least semi-actuated (3 points).

Figure 2-5: Activity Analysis Score Vs. Number of Signals



A map of the results of the Activity Analysis is shown in **Figures 2-6A & 2-6B** and further broken down by quadrants on **Figures 2-6** in **Appendix L**.

4.0 Intersection Analysis (Filter B)

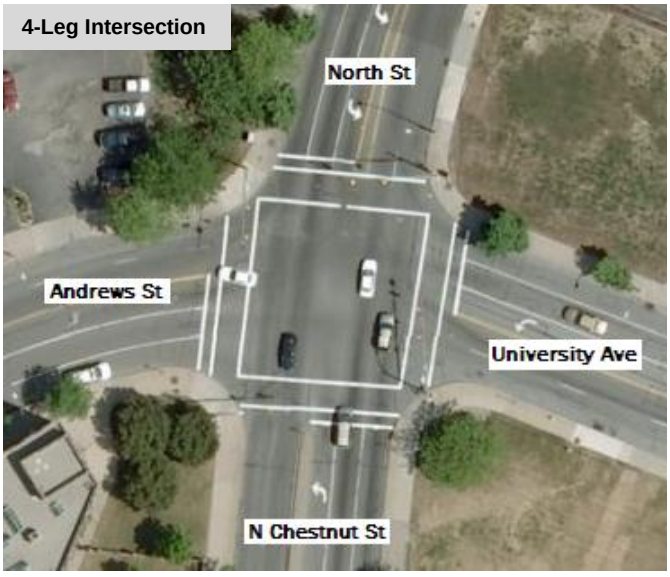
The Activity Analysis – Filter A provided a list of intersections which currently meet many qualities of a prime ATPSD location based on the level of pedestrian activity. However, each intersection needed to be further analyzed to determine if it truly meets the needs of an ATPSD installation based on the characteristics of the intersection's operation. The Intersection Analysis – Filter B further reduced the 103 intersections by evaluating the existing geometry and how the signal operates. The sounds created by traffic are key cues that help visually impaired pedestrians to cross a street. When the traffic begins to move on the street parallel to the crosswalk which is desired to be crossed, the visually impaired person may assume they have the right to cross at that time. A lack of traffic on a parallel street means there may be no cue from traffic to cross. A non-traditional intersection, such as a "T or Y", skewed or 5-legged intersection, can be more difficult to cross than a square four-leg intersection. Signal timing can also affect the traffic sound cues, such as when an exclusive pedestrian phase is used; this causes all traffic to stop, and a visually impaired person finds it difficult to determine when to cross, as there is no parallel traffic cue.

The Intersection Analysis – Filter B was based on the "Prioritization Tool for Installation of Accessible Pedestrian Signals" by the National Cooperative Highway Research Program (NCHRP), however the tool categories were slightly modified to fit the needs of this project. Six categories make up this Filter, as described in the sections below. Each of the categories was given a point value and the points for each of the 103 intersections evaluated was totaled. The highest point total for the Intersection Analysis is 46 points.

4.1 Configuration

The configuration of an intersection depends on the number of approaches or legs of an intersection, and the manner in which they align. A typical intersection has four legs resulting from two streets that intersect one another. An intersection may be considered offset if it has one or more legs that come in at an angle, or two opposing streets that do not line up with one another.

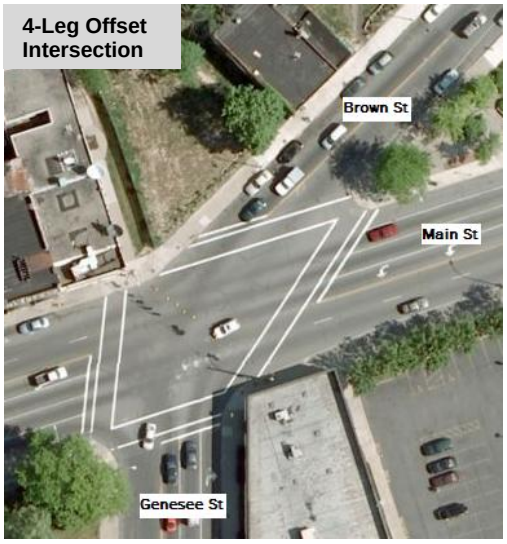
1)



The following are the four categories in which intersections may fall into geometrically, and the points awarded for each:

- leg = 0 points – Four-legged intersections are the easiest intersection for a visually impaired person to cross, as the crosswalks typically run parallel with the approaching and departing sidewalks and with traffic movement on the street parallel to the crosswalk.

2) **4-Leg Offset Intersection**

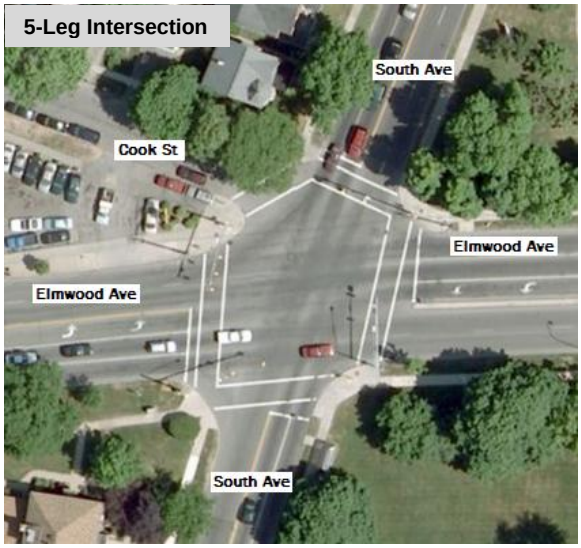


- 4 leg offset/skew = 3 points – Four-legged offset intersections are more difficult to cross than the traditional four-legged intersection because the crosswalk does not generally line up parallel to the approach or departing sidewalk or traffic movement. Approaches may be heavily skewed, or not directly opposing the opposite cross-street.

3) **3-Leg Intersection**

- 3 leg (T or Y) = 3 points –Three-legged intersections can be difficult to cross because there is a lack of parallel street traffic to indicate the proper time for pedestrians to cross the main street.

4) **5-Leg Intersection**



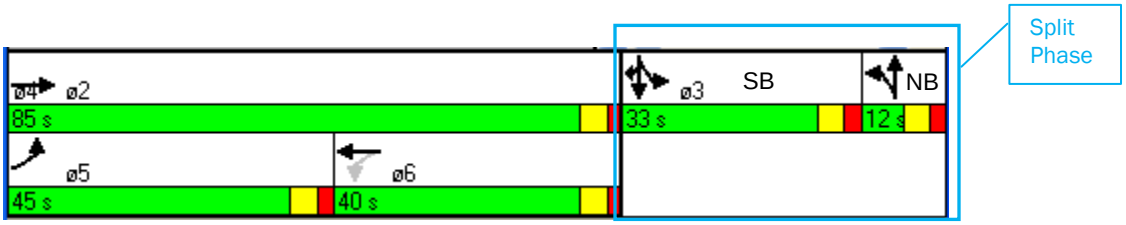
- 5 or more legs = 12 points – An intersection with five or more legs is also difficult to cross because the crosswalks are often not parallel to the approach leg, and the traffic pattern is often extremely difficult to assess for crossing guidance.

4.2 Signalization Type

The signalization type is slightly more detailed for the Intersection Filter, than it was for the Activity Analysis. In this case, a signal might fall under more than one category, in which it would take the label of the highest point valued type. For example, a signal that may be actuated may also have an exclusive pedestrian phase, in which case it would receive the label of exclusive pedestrian phase which is the higher score of the two. The following are the four categories in which signalization type may fall into, and the points awarded for each:

1. Pre-timed = 0 points – Pre-timed signals have consistent timing in which the green time for each movement is always constant and does not vary based on the presence of traffic. This is the easiest type of signal timing for visually impaired persons to cross, as they can be familiarized with the timing. A pedestrian phase is provided every cycle.
2. Fully Actuated = 2 points – Actuated signals have green time based on the presence of traffic. A minimum amount of green time is given to a movement, but it may be extended as cars approach the signal, up to its maximum green time. At these signals, the pedestrian phase is usually actuated by a push-button pressed by a pedestrian.
3. Split Phasing = 6 points – Signals that have split-phasing give green time to a single approach and then to the opposing approach. Typically opposing approaches run at the same time. At these signals, the pedestrian phase is usually actuated by a push-button pressed by a pedestrian.

One complete signal cycle



4. Exclusive Pedestrian Phase = 12 points – Signals with exclusive pedestrian phases have time allotted within the cycle for only pedestrians to cross the street while all vehicular traffic has a red light. At these signals, the exclusive pedestrian phase is usually actuated by a push-button pressed by a pedestrian.

One complete signal cycle

4.3 Transit Facilities within 1/8 Mile

Transit facilities include any of the RTS bus routes as described in the Activity Analysis – Filter A. The greater the number of bus routes at or near the intersection, the more pedestrian activity possible at the intersection, therefore a higher score was applied. The following point values were applied:

- No transit facilities = 0
- Single bus route = 1
- Multiple bus routes = 3
- Transit mall/rail station = 5

4.4 Distance to Support Service Facility

Support service facilities for this Filter are the same facilities as those that were used in the Activity Analysis. The following point values were applied:

- > 2,600 feet (~1/2 mile) = 0
- < 2,600 feet (~1/2 mile) = 4
- < 1,320 feet (~1/4 mile) = 6
- < 650 feet (~1/8 mile) = 8
- < 300 feet = 10

4.5 Distance to Inaccessible Destination

Plazas, large parking lots or sites with no pedestrian accommodations (sidewalks) are difficult and can be unsafe to navigate for visually impaired people. Intersections near inaccessible destinations are less of a priority, as additional site access mitigations may be required to make these sites accessible. By evaluating the distance to an inaccessible destination, intersections near un-accommodating sites will not appear as high priority intersections. The following point values were applied:

- If destinations within 1/8 of a mile of the intersection were inaccessible, the intersection received 0 points.
- If destinations within 1/8 of a mile of the intersection were accessible, the intersection received 3 points.

4.6 Distance to Pedestrian Attraction

Pedestrian attractions for this Filter are the same destinations as those that were used in the Activity Analysis; however the type of attraction does not change the point value, and Support Service facilities were not included in this category as they are already accounted for with the 'Distance to Support Service Facility'. Intersections that were determined to be within 1/8 of a mile of a 'challenging' destination from the previous category) were not analyzed for this category, and received 0 points. The following point values were applied:

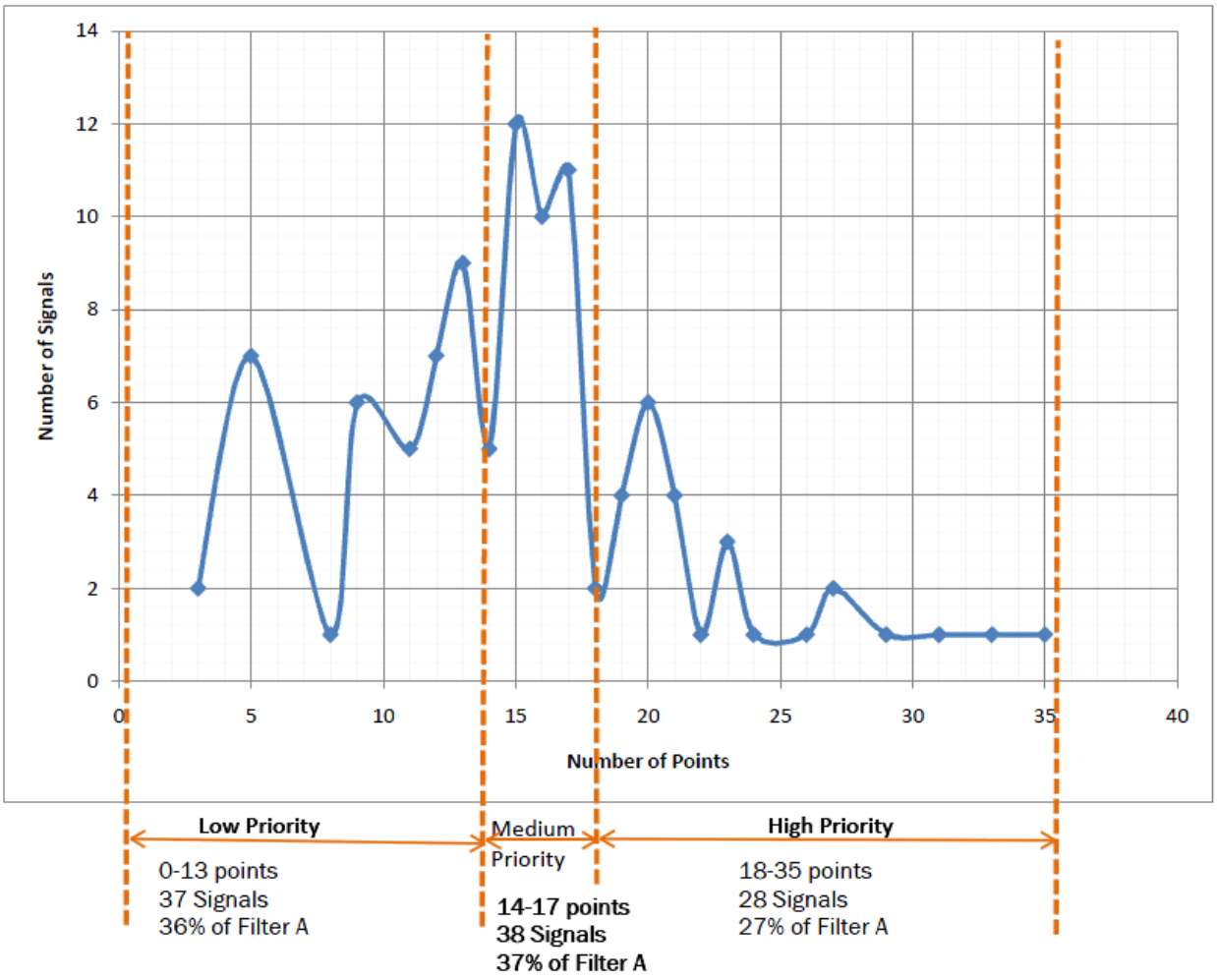
- Inaccessible = 0
- > 2,600 feet (~1/2 mile) = 0
- < 2,600 feet (~1/2 mile) = 2
- < 1,320 feet (~1/4 mile) = 3
- < 650 feet (~1/8 mile) = 4
- < 300 feet = 5

4.7 Results of Intersection Analysis – Filter B

The Intersection Analysis points for each signal were totaled, with the highest possible activity analysis score of 47, to give each signal a score (0-47). Of the 103 high-priority intersections, 28 signals received a ranking score of 18 or better, with the highest ranking signal being the Nazareth Academy Pedestrian Signal on Lake Avenue receiving 35 points. Thirty-eight signals received a score of 17 or less and greater than or equal to 14. The remaining 37 signals received a ranking score of 13 or less points.

A statistical analysis was used to identify the highest scoring locations in Filter B that will then be evaluated in Filter C. Shown graphically in **Figure 4-1**, the number of signals versus the Intersection Analysis score can be divided into three groups with break points at scores of 14 and 18 that create three "bell-shaped" curves. The groups include; Low Score - 37 signals (36% of Filter A) that have a score of 13 or less, Medium Score - 38 signals (37% of Filter A) that have a score of 14 to 17 points, and High Score - 28 signals (27% of Filter A) that have a score of 18 or more points. The full intersection analysis list of locations is in **Appendix G**.

Figure 4-1: Intersection Analysis Score Vs. Number of Signals

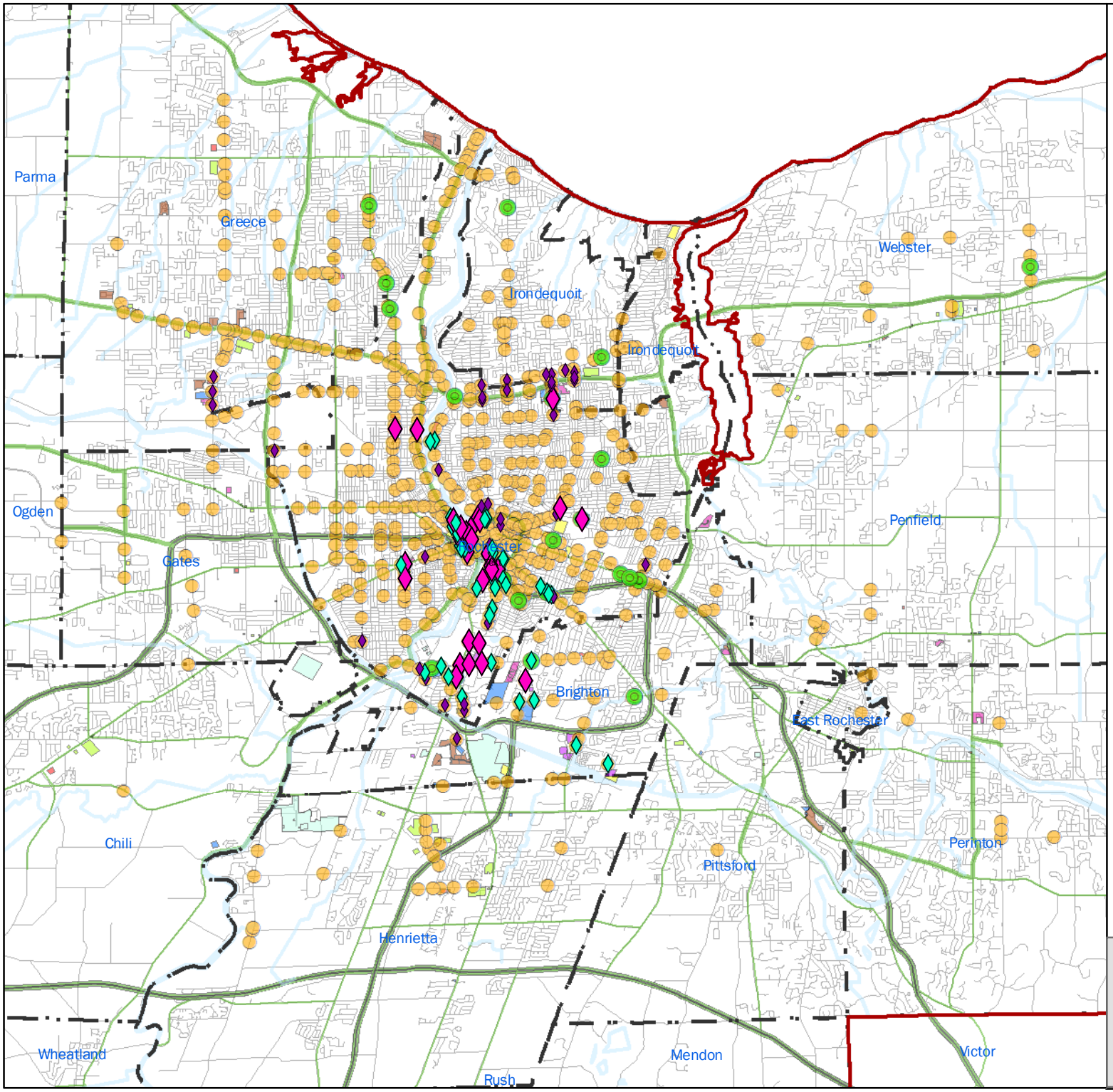


The 28 high priority intersections are shown in the following **Table 4-1**.

Table 4-1 – High Priority Intersections from Filter B

	Intersection	Points
1	Lake @ Nazareth Academy (PED)	35
2	South @ Elmwood	33
3	Mt. Hope @ E. Henrietta/Crittenden Blvd	31
4	Dewey @ Bryan (PED)	29
5	Portland @ Rochester General (PED)	27
6	St. Paul @ Innerloop/Cumberland	27
7	South @ Griffith/I-490	26
8	Plymouth @ Allen	24
9	Plymouth @ Church	23
10	Byron @ Clinton	23
11	Goodman @ Garson/Webster	23
12	State @ Church	22
13	South @ Byron/Mt. Hope	21
14	Elmwood @ Rochester Psychiatric Center	21
15	State @ Andrews	21
16	State @ Corinthian	21
17	Mt. Hope @ Highland	20
18	State @ Commercial	20
19	Main @ Brown/Genesee	20
20	Mt. Hope @ Alexander	20
21	State @ Factory	20
22	Plymouth @ Spring	20
23	Mt. Hope @ Elmwood	19
24	South @ Highland	19
25	Genesee @ Samuel McCree Way	19
26	South @ Woodbury	19
27	Main @ Mustard	18
28	Andrews @ Front	18

A map of the results of the Intersection Analysis is shown in **Figure 3-1A & 3-1B** and further broken down by quadrant in **Figures 3-1** in **Appendix L**.



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Legend

MCDOT Traffic Signal Locations
Existing ATPSD Locations

Intersection Analysis

Highest Priority
Mid Priority
Low Priority

Destinations

Support Services
Health Care
Civic/Municipal
Food/Shopping
Residence (Apartments)
Residence (Assisted Living)
Entertainment
Other

Mapping

County Boundaries
City/Town Boundries
Hydrography

Roads

CLASS

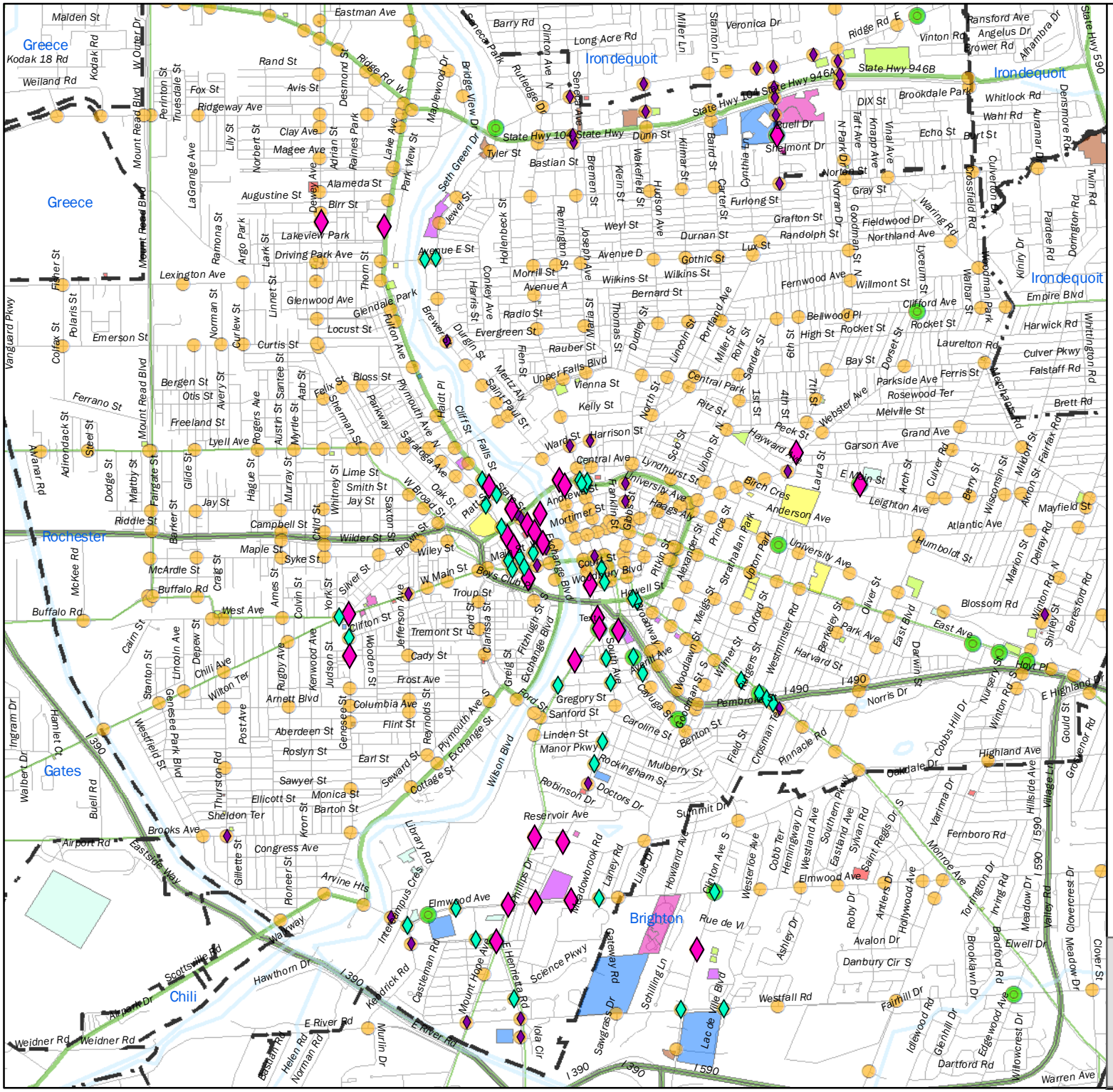
Interstate
Principal Arterial
Minor Arterial
Streets

FIGURE 3-1A

Audible/Tactile Pedestrian Signal Device Study

Intersection Analysis - Filter B: County-wide

Project # 43.4933 4/28/2011



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Legend

- MCDOT Traffic Signal Locations
- Existing ATPSD Locations

Intersection Analysis

- Highest Priority
- Mid Priority
- Low Priority

Destinations

- Support Services
- Health Care
- Civic/Municipal
- Food/Shopping
- Residence (Apartments)
- Residence (Assisted Living)
- Entertainment
- Other

Mapping

- County Boundaries
- City/Town Boundries
- Hydrography

Roads

CLASS

- Interstate
- Principal Arterial
- Minor Arterial
- Streets

FIGURE 3-1B

Audible/Tactile Pedestrian Signal Device Study

Intersection Analysis - Filter B: Downtown

Project # 43.4933 4/28/2011

5.0 Crosswalk Analysis (Filter C)

The Intersection Analysis – Filter B found 28 intersections (83 crosswalks) relevant locations that are in areas of need for ATPSD installations; however, it is not necessary for every crosswalk at each of these intersections to have the first priority of installation. For example, at a typical three-leg intersection, both of the parallel crosswalks do not have to have APTSD installed right away, because one crosswalk may be more difficult to cross than the other. The Crosswalk Analysis – Filter C analyzes each of the 83 crosswalks at the priority intersections and determines which specific crosswalks have the highest need for an ATPSD.

The Crosswalk Analysis was based on the "Prioritization Tool for Installation of Accessible Pedestrian Signals" by the National Cooperative Highway Research Program (NCHRP) with modifications by the project team. Each crosswalk was inspected in the field using the Filter C: Candidate Crosswalk Evaluation sheets, which were created based on the Prioritization Tool developed in the National Cooperative Highway Research Program (NCHRP) *Project 3-62: Guidelines for Accessible Pedestrian Signals* (2006). An example evaluation sheet is included in **Appendix I**. Each of the criteria was given a point value, and during the field inspection the points for each of the candidate crosswalks was recorded. For this study, the Off-Peak Traffic Presence was not observed in the field, as it was provided by the MCDOT.

The raw field data was then summarized and a raw Crosswalk Score was recorded. The Candidate Crosswalk Evaluation sheets are included in **Appendix J**. The field data raw Crosswalk Score was then combined with the Off-Peak Traffic Presence data provided by MCDOT as shown in **Appendix K**. TYLI engineers reviewed subjective data and made changes to any crosswalk analysis criteria determined to be incorrect. It should be noted that the scoring system was adjusted after the field study was conducted, with a change in the Leading Pedestrian Interval (LPI)/Exclusive Pedestrian Phase criteria where the LPI and Exclusive Pedestrian Phase were given equal weights of 8 points. Therefore, the total raw Crosswalk Scores on the evaluation sheet do not match the final Crosswalk Scores.

The Crosswalk Analysis - Filter C criteria is described in the following sections:

5.1 Posted Speed Limit

Speed is important when analyzing the safety of crossing at an intersection. The higher the posted speed limit, the more difficult a road is to cross for visually impaired pedestrians and the higher the probability of an injury should a crash occur. The posted speed limit in the City of Rochester, and a majority of the towns surrounding the City, is 30mph. The following point values were applied:

- <20 mph = 0
- 25 mph = 1
- 30 mph = 2
- 35 mph = 3
- 40 mph = 4
- >45 mph = 5

5.2 Off-Peak Traffic

The presence of vehicular traffic on streets at an intersection can help indicate which direction of traffic has the green signal and the right of way. A visually impaired person relies on the presence of vehicular traffic on the street parallel to the crosswalk they are attempting to use. If there is erratic traffic flow on a parallel street then a key indicator is not present at that crosswalk. The off-peak traffic data was provided by the MCDOT and provided in **Appendix K**. The following point values were applied:

- Constant (>80% of ten cycles) = 1
- Heavy (70 - 80% of ten cycles) = 2
- Moderate (50 - 60% of ten cycles) = 3
- Light (30 - 40% of ten cycles) = 4
- Occasional (<30% of ten cycles) = 5
- None (no through lanes or T intersection) = 6

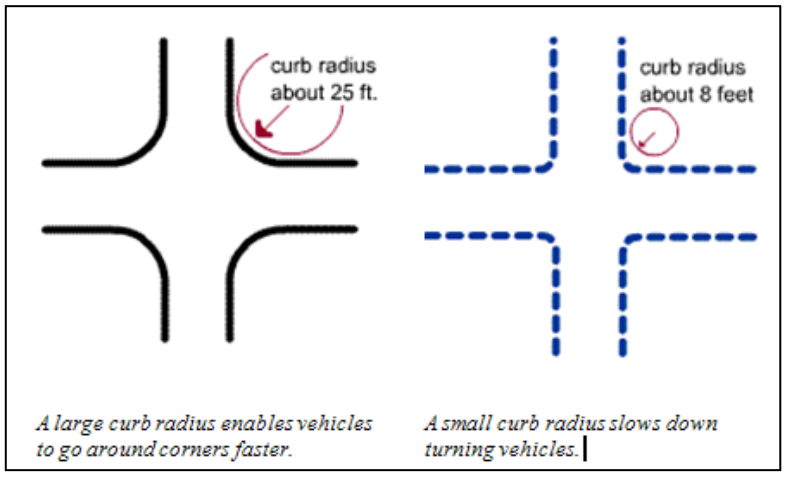
5.3 Distance to Alternative ATPSD

The distance to another Audible/Tactile Pedestrian Signal Device that crosses the same street may indicate that there is already access to the origin or destination being considered. The following point values were applied:

- > 2600 ft (~1/2 mile) = 4 points
- 2600 ft (~1/2 mile) > 1300 ft (~1/4 mile) = 3 points
- 1300 ft (~1/4 mile) > 650 ft (~1/8 mile) = 2 points
- 650 ft (~1/8 mile) > 300 ft = 1 points
- < 300 ft = 0 points

5.4 Curb Radius > 25 Feet (Either Corner)

The curb radius at the corner of an intersection can influence the speed of vehicles turning a corner. Corners with a larger curb radius will allow cars to turn corners at higher speeds because they are not forced to make a sharp turn. These locations are more difficult for visually impaired pedestrians to cross. A larger curb radius also increases the crosswalk length. The following point values were applied:



- >25 feet = 1
- <25 feet = 0

5.5 Islands or Medians (painted, raised or cut-through)

Islands and medians can be confusing to visually impaired people. If they encounter a median they may think they have reached their desired corner, and/or slow or delay their crossing. The following point values were applied:

- Has island or median = 1
- Does not have island or median = 0

5.6 Traverse (cross) Slope on Crosswalk

A crosswalk that has a large traverse (cross) slope may cause difficulty in orientation and navigation for visually-impaired pedestrians. A slope of greater than 5% can cause these issues. The following point values were applied:

- Has slope >5% = 1
- Does not have slope >5% = 0

5.7 Apex (Diagonal) Curb Ramp

Apex or diagonal curb ramps may be difficult for pedestrians who are visually impaired as they do not guide the pedestrian towards a specific opposing corner, giving no indication where the desired corner is. The following point values were applied:

- Has apex = 2
- Does not have apex = 0

5.8 Channelized Right Turn Island

Channelized right-turn lanes generally necessitate the pedestrian to cross to the island in one direction, reorient themselves, and then complete the crossing in a different direction. This can be confusing to visually impaired pedestrians. Channelized right-turn lanes typically do not have pedestrian signals. Also, the channelized lane is not usually signalized; therefore this traffic is not controlled. The following point values were applied:

- Has a channelized right turn island = 2
- Does not have a channelized right turn island = 0

5.9 Skewed Crosswalk

A crosswalk is considered skewed if it does not align with the approaching sidewalk. If a visually impaired pedestrian were to continue to walk the same line of travel as the approaching sidewalk they may end up in the middle of the vehicular travel lane of the parallel street or in the intersection. The following point values were applied:

- Has a skewed crosswalk = 7
- Does not have a skewed crosswalk = 0

5.10 Push Button Actuation Required for 'Walk' Signal

Push button actuation requires a push button to be pushed to activate the 'walk' signal. These locations may have a need for an ATPSD with a locator tone because a visually impaired person has to find and use the pushbutton and may not know when the 'walk' signal is active if there is no parallel traffic at that time. The following point values were applied:

- Has push button actuation = 4
- Does not have push button actuation = 0

5.11 Non-concurrent 'Walk' Interval

Intersections that have 'walk' intervals not concurrent with the green phase for adjacent parallel traffic may be difficult for a visually impaired person to cross because they do not know the appropriate time to cross. The following point values were applied:

- Has a non-concurrent 'walk' interval = 4
- Does not have a non-concurrent 'walk' interval = 0

5.12 Leading Pedestrian Interval (LPI) With Parallel Street Green

A Leading Pedestrian Interval (LPI) permits pedestrians parallel to traffic to move prior to the vehicle receiving a green signal. A minimum of 3 seconds is required per the MUTCD where all traffic is stopped at the intersection and the pedestrian 'walk' interval begins. Intersections with LPI on the parallel street are difficult for visually impaired people to cross because they are unable to detect the beginning of the 'walk' interval when there is no audible cue from vehicular traffic. The following point values were applied:

- Intersection has LPI = 8
- Intersection does not have LPI = 0

Please note that existing LPI locations were provided by MCDOT as shown in **Table 1-1** in **Section 1.4** of this report.

5.13 Right-Turn-On-Red Permitted on Parallel Street

When vehicles are permitted to turn Right-On-Red (RTOR), they may create a false audible cue for a visually impaired pedestrian. Also, if vehicles are turning, blind or visually impaired pedestrians may not be aware that they have a 'walk' interval. The following point values were applied:

- Has RTOR on parallel street = 2
- Does not have RTOR on parallel street = 0

5.14 Protected Left-Turn Phase on Parallel Street

A protected left-turn phase on a parallel street can make the crossing more difficult for visually impaired pedestrians as they may hear the parallel street traffic and think that it is safe to cross, though the parallel traffic may be the exclusive left turning traffic, and the 'walk' interval is not provided. The following point values were applied:

- Has a left-turn phase on parallel street = 3
- Does not have a left-turn phase on parallel street = 0

5.15 Protected Right-Turn Phase or Right-Turn Overlap on Parallel Street

The surge of traffic generated by a protected right-turn phase or right-turn overlap on parallel streets at an intersection may be misleading and confusing for visually impaired pedestrians, as they may mistake the right-turning traffic as the beginning of the parallel street green phase. The following point values were applied:

- Has a right-turn phase on parallel street = 7
- Does not have a right-turn phase on parallel street = 0

5.16 Channelized Right-Turn Lane Under Signalized Control

A crosswalk which crosses a channelized right-turn lane under signalized control may be a difficult crossing for a visually impaired person. Pedestrians may not know that the crossing is under signalized control and may attempt to cross when traffic has a green light. The following point values were applied:

- Has a channelized right-turn lane under signalized control = 8
- Does not have a channelized right-turn lane under signalized control = 0

5.17 Pedestrian Pushbutton Location Greater Than 10 Feet from Curb

When the pedestrian pushbutton location is greater than 10 feet from curb, a visually impaired person may have a difficult time finding the pushbutton to activate the 'walk' interval. The following point values were applied:

- Has a Pedestrian pushbutton location greater than 10' from curb= 3
- Does not have a Pedestrian pushbutton location greater than 10' from curb = 0

5.18 Pedestrian Pushbutton Location Greater Than 5 Feet from the Crosswalk

When the pedestrian pushbutton location greater than 5 feet from the crosswalk, a pedestrian must push the button and then orient themselves to cross the crosswalk. This could be a challenge for a visually impaired pedestrian whom may push the button but have a difficult time orienting themselves to cross the crosswalk, at which time they may not have enough time to cross the street. The following point values were applied:

- Has a Pedestrian pushbutton location greater than 5' from the crosswalk = 3
- Does not have a Pedestrian pushbutton location greater than 5' from the crosswalk = 0

5.19 Alternative Crosswalks at Intersection

The purpose of this analysis is to determine the necessity of crossing a particular crosswalk at an intersection. In locations that have more than one crosswalk to cross a street, this will give the more utilized crosswalk a higher rank. In locations where there is only one crosswalk, by default the crosswalk will get a higher score. This is a subjective determination based on the most logical route from the origins in the area to the destinations.

- Only crosswalk for street= 4
- Most likely crossed (crosswalk) = 4
- Not likely crossed (crosswalk) = 0

5.20 Results of Crosswalk Analysis – Filter C

The Intersection Analysis – Filter B filtered out the top 28 intersections that have the highest priority for the installation of ATPSD. At these intersections there were a total of 83 crosswalks to be analyzed. Six of the crosswalks are already equipped with existing ATPSD, therefore only the remaining 77 crosswalks were analyzed in the Crosswalk Analysis – Filter C.

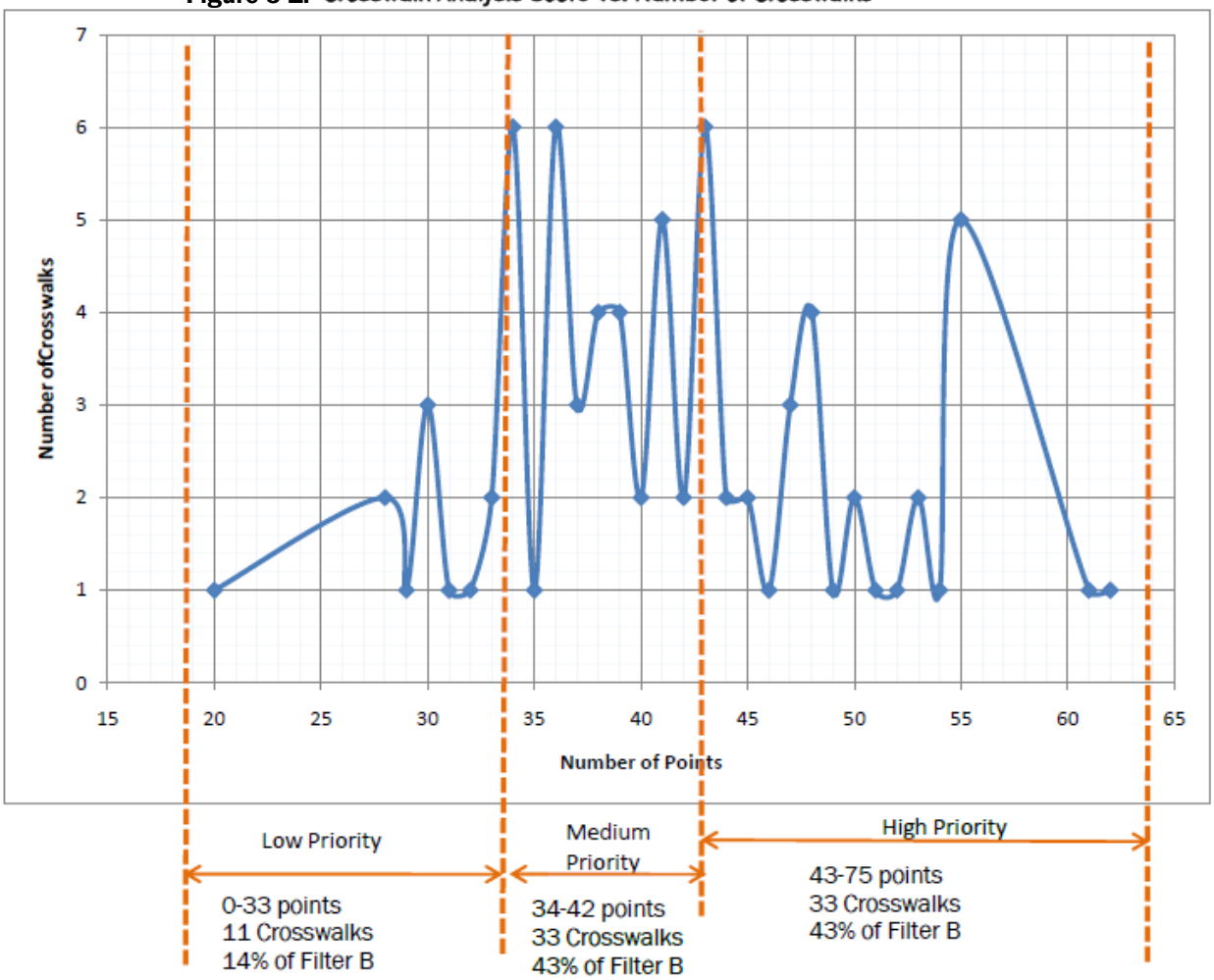
The Crosswalk Analysis – Filter C points for each crosswalk were totaled, with the highest possible score of 75 points. The full crosswalk analysis list of locations is shown in **Appendix H.**

6.0 Results and Recommendations

The final priority list of crosswalks that will be the first locations considered by the MCDOT to be equipped with ATPSD was determined by the Total Crosswalk Score. The Total Score is the sum of the Intersection Score (Intersection Analysis - Filter B) and the Crosswalk Score (Crosswalk Analysis – Filter C), ranging from zero to 122 points.

A statistical analysis was used to identify the highest scoring crosswalks. Shown graphically in **Figure 5-1**, the Total Crosswalk Score versus number of crosswalks scored can be divided into three groups with break points at scores of 34 and 43 that create three "bell-shaped" curves. The groups include; Low Score - 11 crosswalks (14% of Filter C) that have a score of 33 or less total points; Medium Score – 33 crosswalks (43% of Filter C) that have a score of 34 to 42 points; and High Score – 33 crosswalks (43% of Filter C) that have a score of 43 or more points.

Figure 5-1: Crosswalk Analysis Score Vs. Number of Crosswalks



The priority list of crosswalks is shown in **Table 6-1** and can be used by the MCDOT for the installation of ATPSD in addition to specific individual requests.

Table 6-1: Recommended Crosswalks for ATPSD

	Crosswalk Rank	Intersection	Crosswalk	Intersection Score	Crosswalk Score	TOTAL Crosswalk Score
High Priority	1	South @ Griffith/I490	East Leg	26	36	62
	2	Lake @ Nazareth Academy (PED)	North Leg	35	26	61
	3	South @ Elmwood	West Leg	33	22	55
	4	South @ Elmwood	NW Leg	33	22	55
	5	South @ Elmwood	North Leg	33	22	55
	6	St. Paul @ Inner Loop/Cumberland	West Leg	27	28	55
	7	St. Paul @ Inner Loop/Cumberland	East Leg	27	28	55
	8	South @ Elmwood	East Leg	33	21	54
	9	St. Paul @ Inner Loop/Cumberland	North Leg	27	26	53
	10	Plymouth @ Church	NW Leg	23	30	53
	11	Goodman @ Garson/Webster	NE Leg	23	29	52
	12	South @ Griffith/I490	North Leg	26	25	51
	13	South @ Elmwood	South Leg	33	17	50
	14	Plymouth @ Allen	South Leg	24	26	50
	15	St. Paul @ Inner Loop/Cumberland	SE Leg	27	22	49
	16	St. Paul @ Inner Loop/Cumberland	East Leg	27	21	48
	17	Plymouth @ Church	SE Leg	23	25	48
	18	State @ Commercial	NW Leg	20	28	48
	19	South @ Highland	South Leg	19	29	48
	20	Mt. Hope @ E.Hen/Crittenden Blvd	West Leg	31	16	47
	21	Dewey @ Bryan (PED)	North Leg	29	18	47
	22	Elmwood @ Roch Psych Ctr	East Leg	21	26	47
	23	South @ Woodbury	North Leg	19	27	46
	24	St. Paul @ Inner Loop/Cumberland	SW Leg	27	18	45
	25	St. Paul @ Inner Loop/Cumberland	West Leg	27	18	45
	26	South @ Byron/Mt. Hope	East Leg	21	23	44
	27	Main @ Brown/Genesee	East Leg	20	24	44
	28	Goodman @ Garson/Webster	SW Leg	23	20	43
	29	State @ Church	South Leg	22	21	43
	30	State @ Andrews	SE Leg	21	22	43
	31	Plymouth @ Spring	North Leg	20	23	43
	32	Plymouth @ Spring	South Leg	20	23	43
	33	Andrews @ Front	East Leg	18	25	43
Medium Priority	34	State @ Andrews	NW Leg	21	21	42
	35	State @ Factory	NW Leg	20	22	42
	36	Goodman @ Garson/Webster	NW Leg	23	18	41
	37	Goodman @ Garson/Webster	SE Leg	23	18	41
	38	Elmwood @ Roch Psych Ctr	West Leg	21	20	41
	39	Main @ Brown/Genesee	West Leg	20	21	41
	40	South @ Highland	North Leg	19	22	41
	41	State @ Corinthian	North Leg	21	19	40
	42	Genesee @ Samuel McCree Way	South Leg	19	21	40
	43	Elmwood @ Roch Psych Ctr	North Leg	21	18	39
	44	Mt. Hope @ Highland	South Leg	20	19	39
	45	Genesee @ Samuel McCree Way	North Leg	19	20	39
	46	Main @ Mustard	East Leg	18	21	39
	47	Plymouth @ Allen	West Leg	24	14	38
	48	Goodman @ Garson/Webster	East Leg	23	15	38
	49	State @ Church	North Leg	22	16	38

Table 6-1: Crosswalk Analysis – Filter C Summary (Continued)

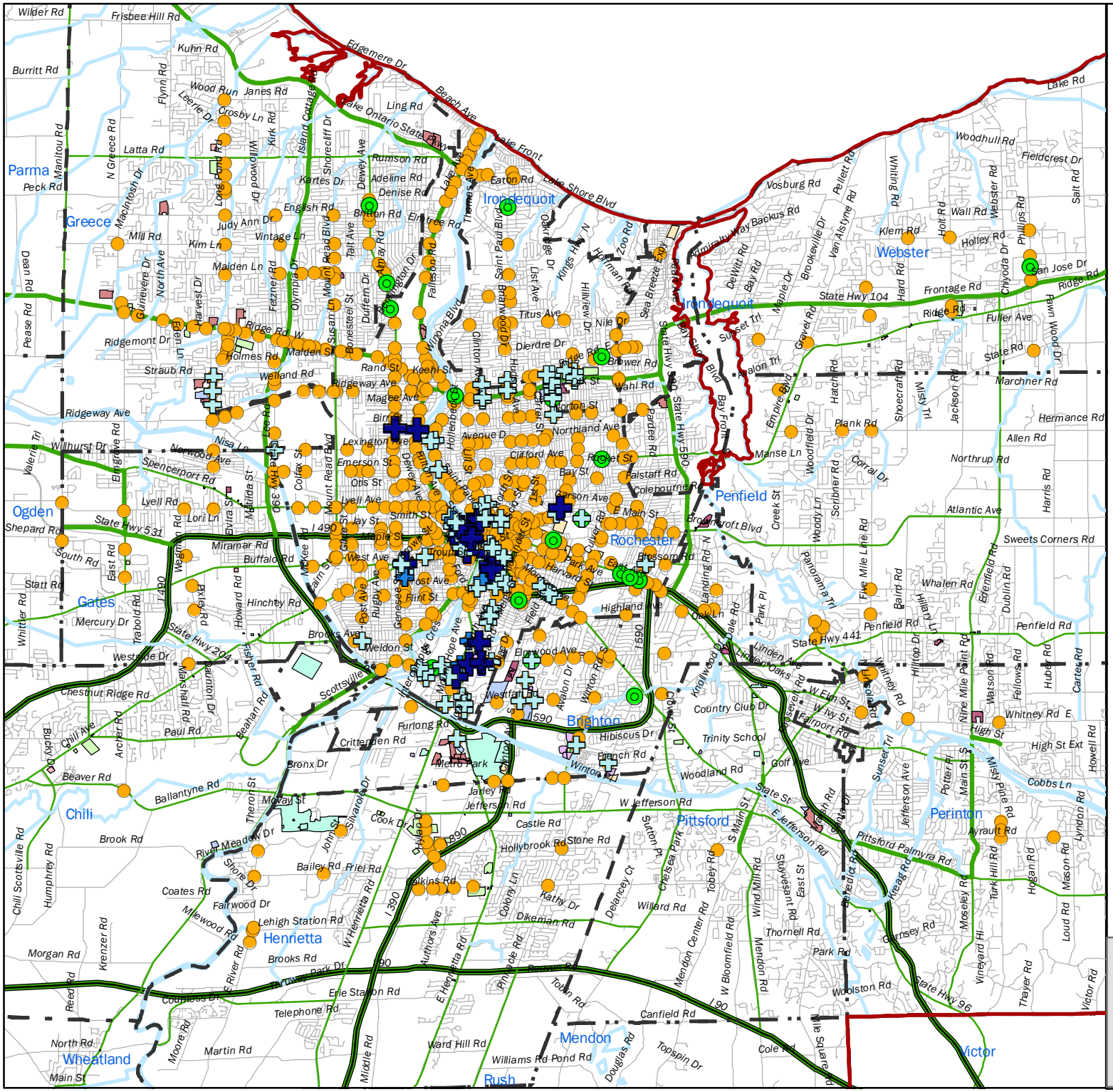
	Crosswalk Rank	Intersection	Crosswalk	Intersection Score	Crosswalk Score	TOTAL Crosswalk Score
	47	Plymouth @ Allen	West Leg	24	14	38
	48	Goodman @ Garson/Webster	East Leg	23	15	38
	49	State @ Church	North Leg	22	16	38
	50	Mt. Hope @ Alexander	East Leg	20	18	38
	51	State @ Church	West Leg	22	15	37
Medium Priority	52	State @ Factory	SE Leg	20	17	37
	53	Main @ Mustard	North Leg	18	19	37
	54	South @ Byron/Mt. Hope	West Leg	21	15	36
	55	State @ Andrews	NE Leg	21	15	36
	56	Plymouth @ Spring	West Leg	20	16	36
	57	Mt. Hope @ Elmwood	West Leg	19	17	36
	58	Mt. Hope @ Elmwood	South Leg	19	17	36
	59	South @ Highland	East Leg	19	17	36
	60	Mt. Hope @ Elmwood	North Leg	19	16	35
	61	Goodman @ Garson/Webster	West Leg	23	11	34
	62	Elmwood @ Roch Psych Ctr	South Leg	21	13	34
	63	Main @ Brown/Genesee	North Leg	20	14	34
	64	State @ Factory	NE Leg	20	14	34
	65	Mt. Hope @ Elmwood	East Leg	19	15	34
	66	South @ Highland	West Leg	19	15	34
	67	Plymouth @ Church	NE Leg	23	10	33
	68	Genesee @ Samuel McCree Way	East Leg	19	14	33
	69	Main @ Brown/Genesee	South Leg	20	12	32
	70	State @ Commercial	NE Leg	20	11	31
Low Priority	71	Mt. Hope @ Highland	East Leg	20	10	30
	72	Genesee @ Samuel McCree Way	West Leg	19	11	30
	73	Main @ Mustard	South Leg	18	12	30
	74	Andrews @ Front	North Leg	18	11	29
	75	State @ Corinthian	East Leg	21	7	28
	76	South @ Woodbury	East Leg	19	9	28
	77	Andrews @ Front	South Leg	18	15	20

NOTE: Crosswalks that have existing ATPSDs have been removed from this list

A map of the results of the Crosswalk Analysis is shown in **Figure 6-1A & 6-1B** and further broken down by quadrant in **Figures 6-1** in **Appendix L**. The high priority crosswalks should be the first crosswalks considered for ATPSD installation.

All crosswalks at an intersection that are in need of an ATPSD can be equipped at once. For example, the crosswalks at the intersection of South @ Elmwood are ranked as 3, 4, 5, 8, & 13. When an ATPSD is being installed at the West leg (ranked 3rd), NW leg (ranked 4th) and the North leg (ranked 5th) crosswalks, the East leg (ranked 8th) and South leg (ranked 13th) crosswalks can also be equipped with an ATPSD. In some cases MCDOT may determine that an ATPSD is not beneficial at a particular crosswalk at the time of installation and these crosswalks may be revisited at a later time.

Locations with existing ATPSD are not required to be replaced at this time. However, these locations will be upgraded with the new ATPSD compliant with the MUTCD with reconstruction projects or as they are needed.



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- MCDOT Traffic Signal Locations
- Existing ATPSD Locations

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- High Priority
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- Low Priority

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CLASS

- Interstate
- Principal Arterial
- Minor Arterial
- Streets

FIGURE 6-1A

Audible/Tactile Pedestrian Signal Device Study

Crosswalk Analysis - Filter C: County-wide

Project # 43.4933 4/28/2011

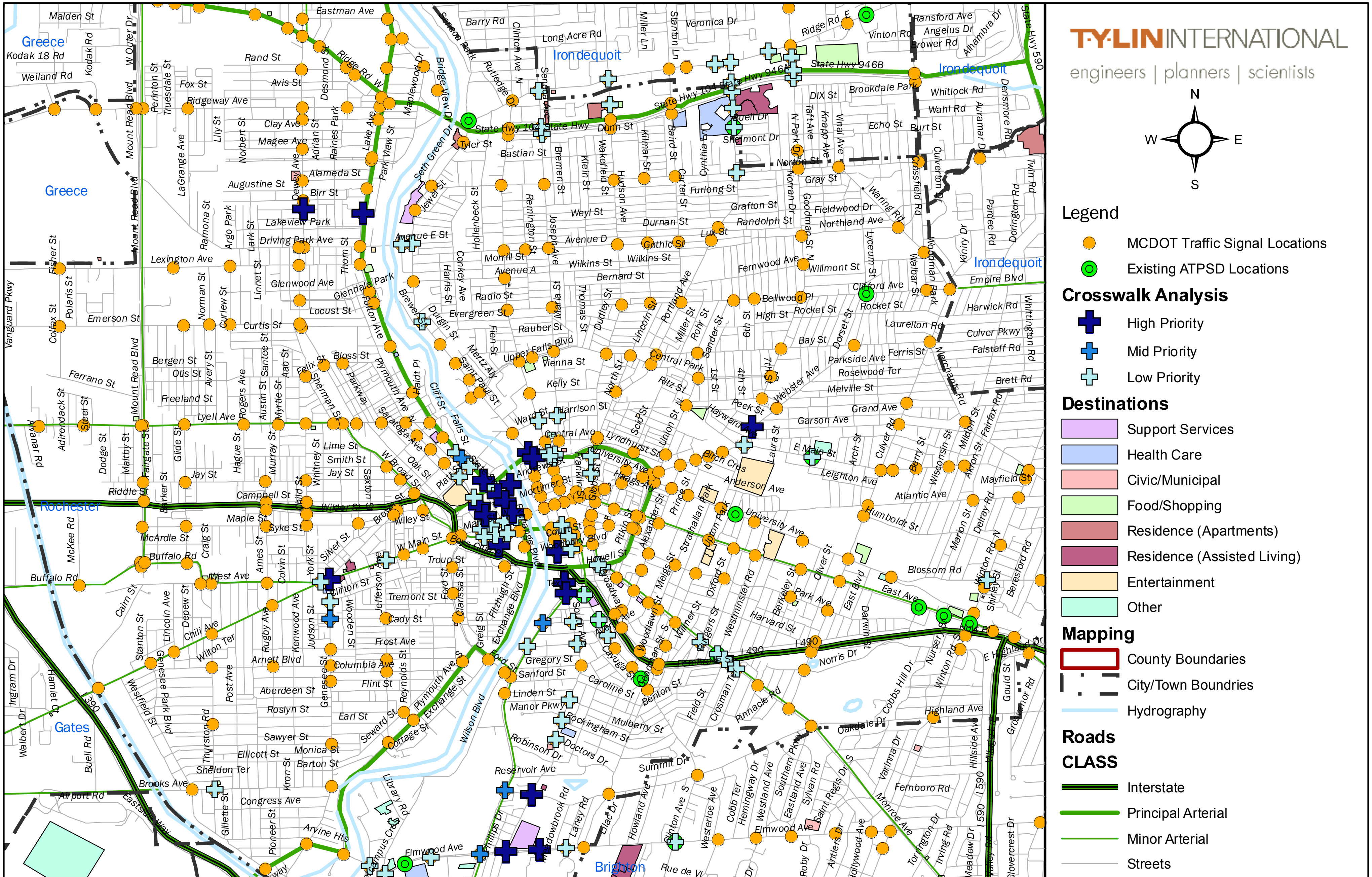

FIGURE 6-1B

Audible/Tactile Pedestrian Signal Device Study

Crosswalk Analysis - Filter C: Downtown

Project # 43.4933 4/28/2011

A list of intersections equipped with ATPSD should be included on the Monroe County Department of Transportation website, so the general public can review which locations are accessible pedestrian signals. The availability of this information may improve the mobility of visually impaired pedestrians, by informing them of more accessible routes to their common destinations.

7.0 Device Requirements & Cost Estimates

7.1 Device Requirements

Since the Manual on Uniform Traffic Control Devices (MUTCD) requires ATPSD to be audio-vibro-tactile devices, the same kind of device will be installed at every recommended crosswalk as reviewed by the MCDOT. The MUTCD Sections 4E.09 through 4E.12 includes the following requirements and recommendations where ATPSD are used at an intersection:

Requirements:

- Each pushbutton is required to activate both the walk interval and the accessible pedestrian signals;
- Accessible pedestrian signals are required to have both audible and vibrotactile walk indications. Vibrotactile indications are required to be provided by a tactile arrow on the pushbutton that vibrates during the walk interval;
- Accessible pedestrian signals are required to have an audible walk indication during the walk interval only;
- Automatic volume adjustment in response to ambient traffic sound level is required to be provided up to a maximum volume of 100 dBA;
- Where two accessible pedestrian signals are separated by a distance of at least 10 feet, the audible walk indication is required to be a percussive tone;
- Speech walk messages are required to be used only at intersections where it is technically infeasible to install two accessible pedestrian signals at one corner separated by a distance of at least 10 feet;
- Audible tone walk indications are required to repeat at 8 to ten ticks per second;
- Each pushbutton is required to incorporate a locator tone which shall be intensity responsive to ambient sound and be audible 6 to 12 feet from the pushbutton, or the building line, whichever is less. They are required to have a duration of 0.15 seconds or less, and repeat at 1-second intervals;

Recommendations:

- At locations with pre-timed traffic control signals or non-actuated approaches, pedestrian pushbuttons may be used to activate the accessible pedestrian signals;
- Accessible pedestrian signals are typically integrated into the pedestrian pushbutton, so the audible tones and/or messages come from the pushbutton housing.
- Speech walk messages may provide similar message in languages other than English, if needed, except for the terms “walk sign” and “wait”.

7.2 Cost Estimates

To estimate the cost of the installation of ATPSD devices at the recommended crosswalks, the number of devices, the cost of each device, and the cost of labor was calculated.

Three companies that currently offer MUTCD qualifying devices are Campbell Company, Polara Engineering Inc., and Novax Industries Corporation. The specifications for each device are located in **Appendix 'M'**.

Campbell Company offers the Advisor A57 audio/vibrotactile pushbutton device. Each device utilizes the existing wiring from the traffic control cabinet, and gathers information from the signal sent to the walk display. This device displays a 5" x 7¾" sign with a vibrating arrow and an LED to confirm actuation, and responds to ambient sounds.

Campbell Advisor A57

Polara's Navigator APS Device

Polara Engineering Inc offers the Navigator Accessible Pedestrian Signal device. This device can utilize the wires from existing pushbuttons. All sounds are synchronized and respond to ambient volumes. Each device displays a 9" x 12" sign and has a vibrating arrow.

Novax SoundSafe APS Button Station

Novax Industries Corporation offers the SoundSafe APS Button Station. This device can deliver a directional message to the pedestrian in the crossing, as well as provide standard push button capability. This device requires the purchasing of a wireless held device for remote configuration. Only one device is needed for programming of all SoundSafe APS Button Stations. To meet MUTCD guidelines, the tactile arrow must be on the push button as well.

According to MCDOT, the cost of labor for the installation of one ATPSD device is approximately $50. Considering that each crosswalk will have two devices installed, the labor for each crosswalk will be approximately $100.

The cost estimate of the intersections shown in **Table 7-1** is based on an approximation of $550 per device and an installation cost of $50 per device. Each crosswalk would cost about $1,200 to be upgraded with ATPSD.

Table 7-1: Cost Estimate for Recommended Crosswalks for ATPSD Installation

Intersection	Crosswalks Leg (Rank)			
1. South @ Griffith/I490	East Leg (1),	North Leg (12)		
2. Lake @ Nazareth Academy (PED)	North Leg (2)			
3. South @ Elmwood	West Leg (3), South Leg (13)	NW Leg (4),	North Leg (5),	East Leg (8),
4. St. Paul @ Inner loop/ Cumberland	West Leg (6), East Leg (16),	East Leg (7), SW Leg (24),	North Leg (9), West Leg (25)	SE Leg (15),
5. Plymouth @ Church	NW Leg (10),	SE Leg (17),	NE Leg (67)	
6. Goodman @ Garson/Webster	NE Leg (11), East Leg (48),	SW Leg (28), West Leg (61)	NW Leg (36),	SE Leg (37),
7. Plymouth @ Allen	South Leg (14),	West Leg (47)		
8. State @ Commercial	NW Leg (18),	NE Leg (70)		
9. South @ Highland	South Leg (19),	North Leg (40),	East Leg (59),	West Leg (66)
10. Mt. Hope @ E.Hen/Crittenden Blvd	West Leg (20)			
11. Dewey @ Bryan (PED)	North Leg (21)			
12. Elmwood @ Roch Psych Ctr	East Leg (22),	West Leg (38),	North Leg (43),	South Leg (62)
13. South @ Woodbury	North Leg (23),	East Leg (76)		
14. South @ Byron/ Mt. Hope	East Leg (26),	West Leg (54)		
15. Main @ Brown/Genesee	East Leg (27),	West Leg (39),	North Leg (63),	South Leg (69)
16. State @ Church	South Leg (29),	North Leg (49),	West Leg (51)	
17. State @ Andrews	SE Leg (30),	NW Leg (34),	NE Leg (55)	
18. Plymouth @ Spring	North Leg (31),	South Leg (32),	West Leg (56)	
19. Andrews @ Front	East Leg (33),	North Leg (74),	South Leg (77)	

NOTE: Crosswalks with existing ATPSD devices were removed from this list.

The study concludes that the cost of installation of an ATPSD device at a single crosswalk is approximately $1,200. To install a device at every crosswalk at the high priority intersections from Filter B, the total project cost will be approximately $92,400. MCDOT has approximately $30,000 per year for installing new devices, which means it will take approximately 3 years for all of the high priority intersections to be equipped with ATPSD devices, or as their budget permits. After the high priority intersections are complete, MCDOT may choose to move on to the medium-priority intersections and then low priority intersections of Filter B. If all 331 crosswalks - crosswalks that do not currently have an ATPSD device - in the intersections analyzed in Filter B were to be equipped with a device, it would cost approximately $435,600, and take approximately 14 and ½ years to complete. In addition, the existing 24 pair of devices should be replaced with updated hardware as they wear out or as the budget permits, at an additional cost of $28,800. Thus, the total cost to completely install the current hardware standards at all these locations would be $464,400. However, it should be noted that current guidelines do not require these devices to be used in all situations.

The MUTCD has more specific standards and guidance for pushbuttons and accessible pedestrian signal device locations in relation to the crosswalk. For new construction, ATPSD are required to be on separate poles when feasible, located near the crosswalk line furthest from the center of the intersection. MCDOT has made this their standard practice for new construction where practical. When replacing existing pedestrian pushbuttons with an ATPSD, the need for separated new pedestrian poles will be considered. Since separate pedestrian poles are not required and the utility and other

impacts may be considerable when done outside of a project, MCDOT will comply with the MUTCD requirements when installing two devices on one pole. The cost estimate does not include the cost of new pedestrian poles.

To accelerate the pace of device installation, a joint letter from both the blind and visually impaired community and MCDOT to State legislators is recommended as a starting point for requesting additional funding for this specific purpose.

8.0 Expansion of MCDOT Guidelines

New guidelines for assessing the need for audible/tactile pedestrian signal devices at intersections and crosswalks equipped with pedestrian signals are included in **Appendix N**. The new guidelines provide instructions for three scenarios a crosswalk can be considered for an ATPSD as listed below.

- Recommended from the ATPSD Study
- Individual Request
- Roadway Project

The recommended list of prioritized crosswalks created through this study should be equipped with ATPSD starting with highest priority locations first until all the priority locations are complete. If an individual requests an ATPSD or a public project involves alteration of an existing signal or installation of a new signal, the same methodologies used in this ATPSD study should be used to evaluate the location. In order to follow the same methodologies, an ATPSD Scoring Evaluation Sheet has been created to determine the location's Intersection Analysis - Filter B score and Crosswalk Analysis - Filter C score. The Scoring Evaluation Sheet then shows the combined Total Crosswalk Score, which can be used to determine where the crosswalk ranks in terms of priority for installation. Refer to the following two cases:

- Case 1 – Not Evaluated in the ATPSD Study
  If the location was not previously evaluated, then a Total Crosswalk Score should be determined using the ATPSD Scoring Evaluation Sheets.

- Case 2 - Previously Evaluated in the ATPSD Study
  If the crosswalk was previously evaluated, the Total Crosswalk Score should be updated, as modifications may have been made to the location.

If the Total Crosswalk Score falls within the high or medium point values (34 points or higher), the request should be approved and installation of an ATPSD should be done in advance of any remaining locations on the ATPSD Study prioritized list. If the Total Crosswalk Score falls below 34 points, the location should be added to the ATPSD Study prioritized list and evaluated once all the locations with higher scores have been equipped with ATPSD.

REFERENCES

1. National Cooperative Highway Research Program, *Project 3-62: Guidelines for Accessible Pedestrian Signals,* 2006.

2. Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, Washington, DC, 2009