

TECH MEMOS #3 & #4
EXISTING AND FUTURE TRAFFIC CONDITIONS
TRAVEL FORECASTING APPROACH



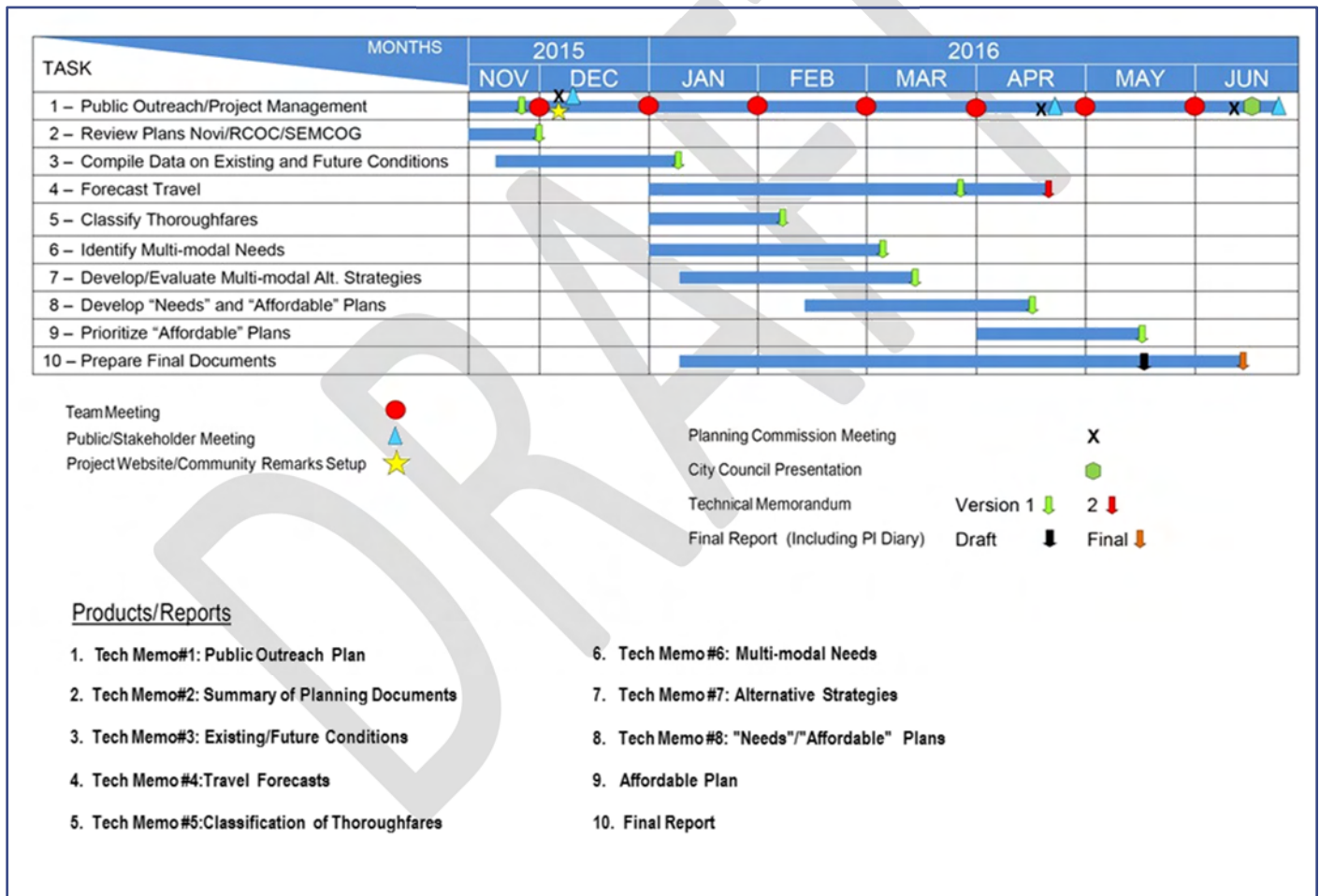
CITY OF NOVI
THOROUGHFARE MASTER PLAN

1. Introduction

This report is prepared as part of the 2016 Novi Thoroughfare Master Plan (TMP) in completion of Task 3 and partial completion of Task 4 (Figure 1). This Plan requires the integration of projects among transportation modes to form a plan that complements the soon-to-be-finalized 2015 Master Land Use Plan. To assist in preparing the TMP, Novi has engaged The Corradino Group of Michigan consulting firm.

The TMP will be completed in June, 2016. The draft Final Report (which will include the Public Involvement Diary as a separate document) will be provided to Novi for review in May, 2016. Based on comments received, that document, and all other deliverables will be completed by mid-June, 2016 (Task 10). A Technical Memorandum will be completed at the completion of each task from 1 through 9. They will be blended into the Final Report.

Figure 1. Schedule



Source: The Corradino Group

2. Travel Forecasting

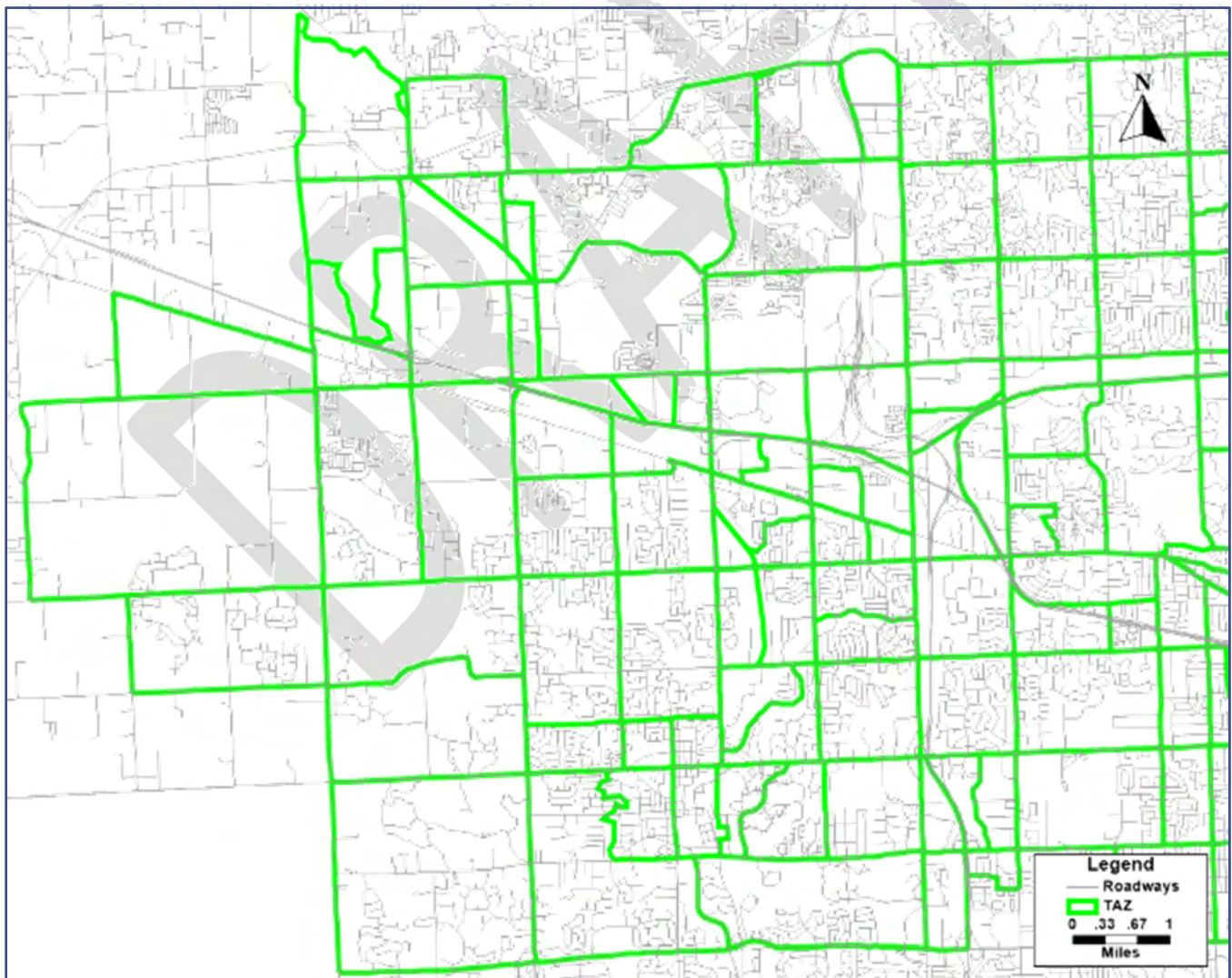
2.1 2015 Base Model

Corradino developed daily and PM peak-period (3-6 p.m.) travel forecasting models using the TransCAD software to develop the Thoroughfare Master Plan. The 2015 Base Model is developed based on the modeling of the *2011 Novi and Wixom Transportation Plan* plus available Southeast Michigan Council of Governments (SEMCOG) model files, and the latest traffic data available through the Road Commission for Oakland County (RCOC), SEMCOG, the Michigan Department of Transportation (MDOT), and the Traffic Improvement Association of Michigan.

2.1.1 2015 Model TAZ

The Novi model traffic analysis zones (TAZs) form a subset of the SEMCOG Regional Model TAZs (**Figure 2**). The zone structure provides sufficient detail of the study area; no TAZ refinement was needed. The Novi model TAZs include 148 internal zones and 54 external stations.

Figure 2. 2015 Base Model TAZs



Source: The Corradino Group

Corradino used the 2010 network from its 2011 Study, which had been extracted from the SEMCOG model, as a starting point to create an updated 2015 Novi sub-area network. Novi provided a list of projects completed since 2011. The following capacity improvements are coded into the 2015 Base network.

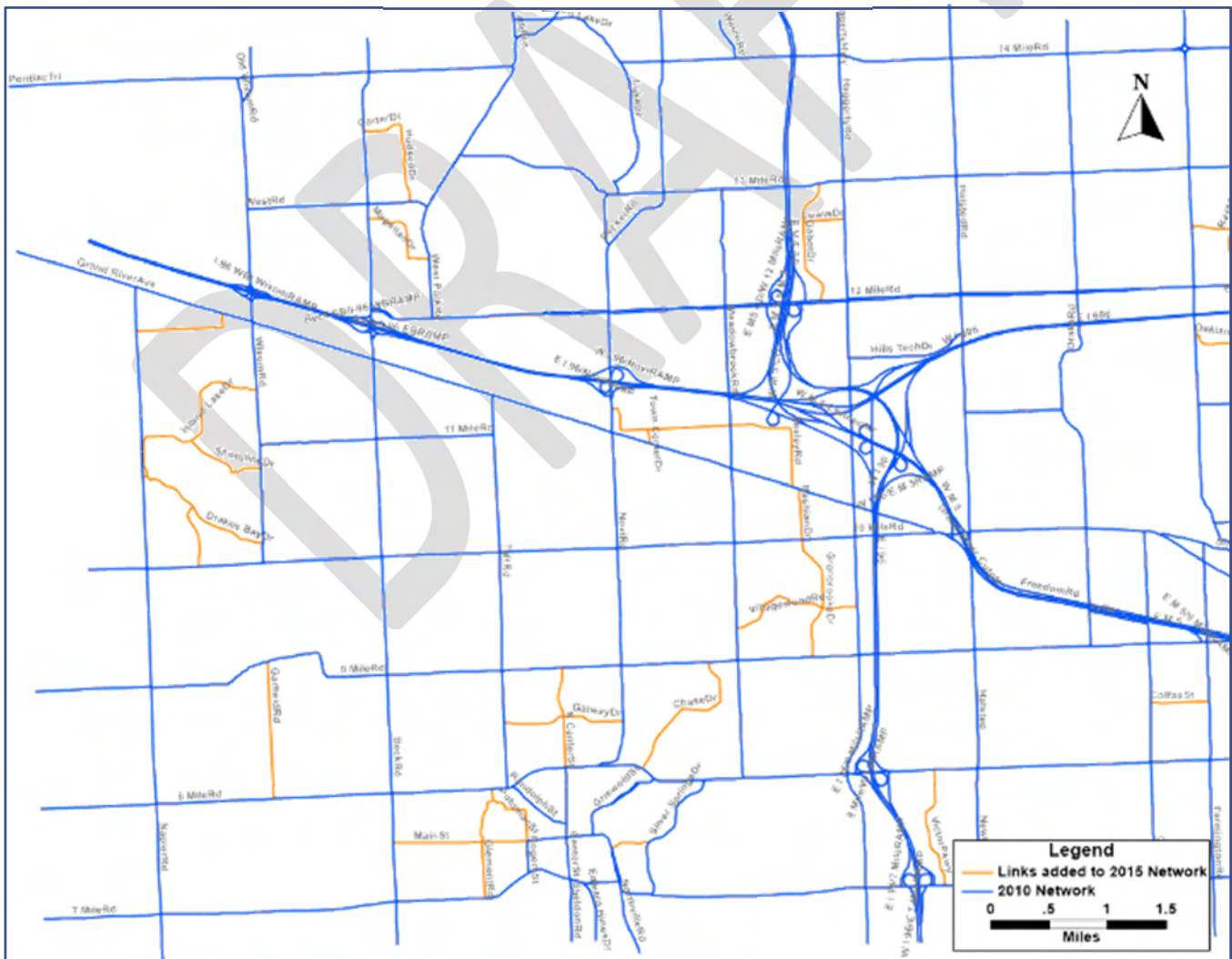
- Novi Road Reconstruction – Widen from two to five (RCOC project, completed in 2011);
- Reconstruct Grand River Avenue – Novi Road to Haggerty Road (RCOC project, completed in 2012); and,
- Haggerty Road – Add second SB lane to fill gap at Stonehenge (completed in 2014).

The 2015 regional road network was also based on SEMCOG's network. Corradino reviewed Google aerial

mapping (imagery date 4/11/2015) to ensure the 2015 Base network represents the existing condition of roadways in Novi. For example, the review indicates that 8 Mile Road currently has two lanes in each direction from South Lexington Boulevard to Haggerty Road at the southern edge of the Novi study area.

Corradino made additional refinements to the model network because a few, key local roads are not included in either the 2010 network from the 2011 Study or the SEMCOG Model network. Some missing roads are TAZ boundaries. The network refinement also included adjustment of centroid connectors at a few locations. **Figure 3** illustrates the new links, in orange, that are added into the 2015 Base network.

Figure 3. 2015 Refined Base Network



Source: The Corradino Group

2.1.2 Traffic Data

Corradino collected the latest traffic data from:

- RCOC;
- SEMCOG; and,
- MDOT.

Both daily and PM peak-period traffic counts were collected for freeways (I-96, I-275, I-696, and M-5), arterials and local roads throughout the Novi study area. A blend of data was used for model development, depending on data availability and quality (recent vs. old counts) of each source mentioned above. **Table 1** summarizes use of these data sources.

For some roadway segments where PM peak-period traffic counts are not available, time-of-day (TOD) factors were derived from data collected in the 2011 Study or older counts from aforementioned sources, then applied to the latest daily counts to obtain PM peak-period counts. Model development required traffic counts to be coded by direction. It is particularly critical for the PM model, as traffic

flows show significant directional difference during the afternoon peak. For roadway segments for which directional counts were not available, the directional factors were derived from data collected in the 2011 study. A reasonable 50/50 split is also used for daily directional counts at some locations. This data collection effort resulted in a sufficient sample size of daily counts (501) and PM peak period counts (425), to provide very good coverage of all roadways in the Novi study area.

2.1.3 2015 Base Model Calibration

The 2015 Base Model is calibrated to the latest traffic counts using the Origin-Destination Matrix Estimation (ODME) technique in TransCAD. The ODME is an iterative process that switches back and forth between a traffic assignment stage and an OD matrix estimation stage, until the estimated OD matrix achieves assigned network flows with the least difference from observed traffic counts.

Table 1. Utilization of Traffic Data Sources

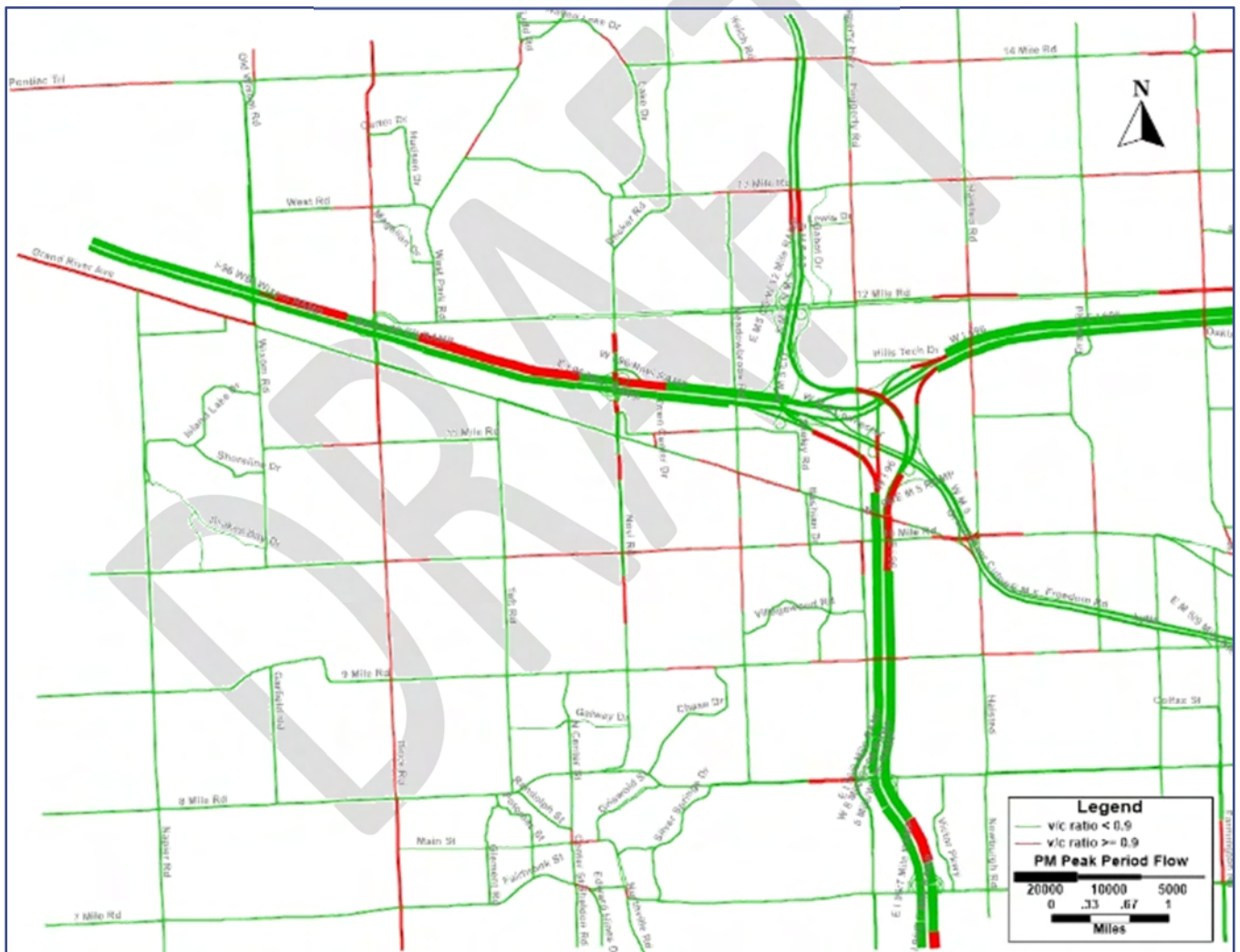
Data Source	Daily Counts		PM Peak Counts		Year of Data Used
	Freeways	Arterial and Local Roads	Freeways	Arterial and Local Roads	
RCOC		√		√	2012–2015
SEMCOG	√	√	√	√	2011–2014
MDOT	√				2014

Source: The Corradino Group

The 2010 daily and PM peak-period trip tables, which were extracted from the SEMCOG model and used in the 2011 Study, were used separately as “seed” matrices in the ODME process. The daily model has a Root Mean Square Error percentage (RMSE%) of 18.5%, and the PM peak-period model has RMSE% of

18.3%, which indicate the modeled volumes are very close to traffic counts from a system-wide perspective. **Figure 4** shows the 2015 volume/capacity (V/C) ratios in the PM peak period. In this analysis, **RED** indicates the V/C ratio exceeds 0.90, reflecting congestion. **GREEN** signifies congestion is not expected.

Figure 4. 2015 PM Peak-period Traffic Conditions



Source: The Corradino Group

2.2 2040 E+C Model

The City of Novi provided a list of projects that are in the city's Six-Year Plan that will improve roadway link capacity or change road geometry. They are identified as *existing and committed* (E+C) projects and are coded into the study's 2040 E+C network. SEMCOG's latest 2014–2017 Transportation Improvement Program (TIP) was also reviewed to identify E+C projects in Novi. The TIP does not show any roadway link capacity improvements in Novi. There is a new roundabout construction project on Orchard Lake Road at 14 Mile Road in the Novi study area, according to the TIP. Although this project is not within the Novi city limits, it is coded into the 2040 E+C network as it will change road geometry in the model network. **Table 2** summarizes the E+C projects.

The 2010 and 2035 trip tables used in the 2011 Study, which were extracted from the SEMCOG model, were used to estimate origin-to-destination (trip) growth. The production (row total) and attraction (column total) of each

zone are interpolated for the 2015 Base Year and extrapolated for the 2040 Future Year. For each zone, the 2015–2040 growth is derived using a ratio method and a net growth (difference) method separately. Two sets of 2040 zonal trip control totals were obtained by applying the ratio and net growth to the 2015 ODME calibrated trip matrix. The final 2040 zonal control totals are the average of the two methods. This estimation procedure of future trips is consistent with the method recommended by *NCHRP 255: Highway Traffic Data for Urbanized Area Project Planning and Design*.

The 2040 OD matrix was then obtained by applying a growth factor (Fratar) process to the 2015 ODME calibrated trip matrix. The aforementioned process was performed for daily and PM peak period traffic, separately.

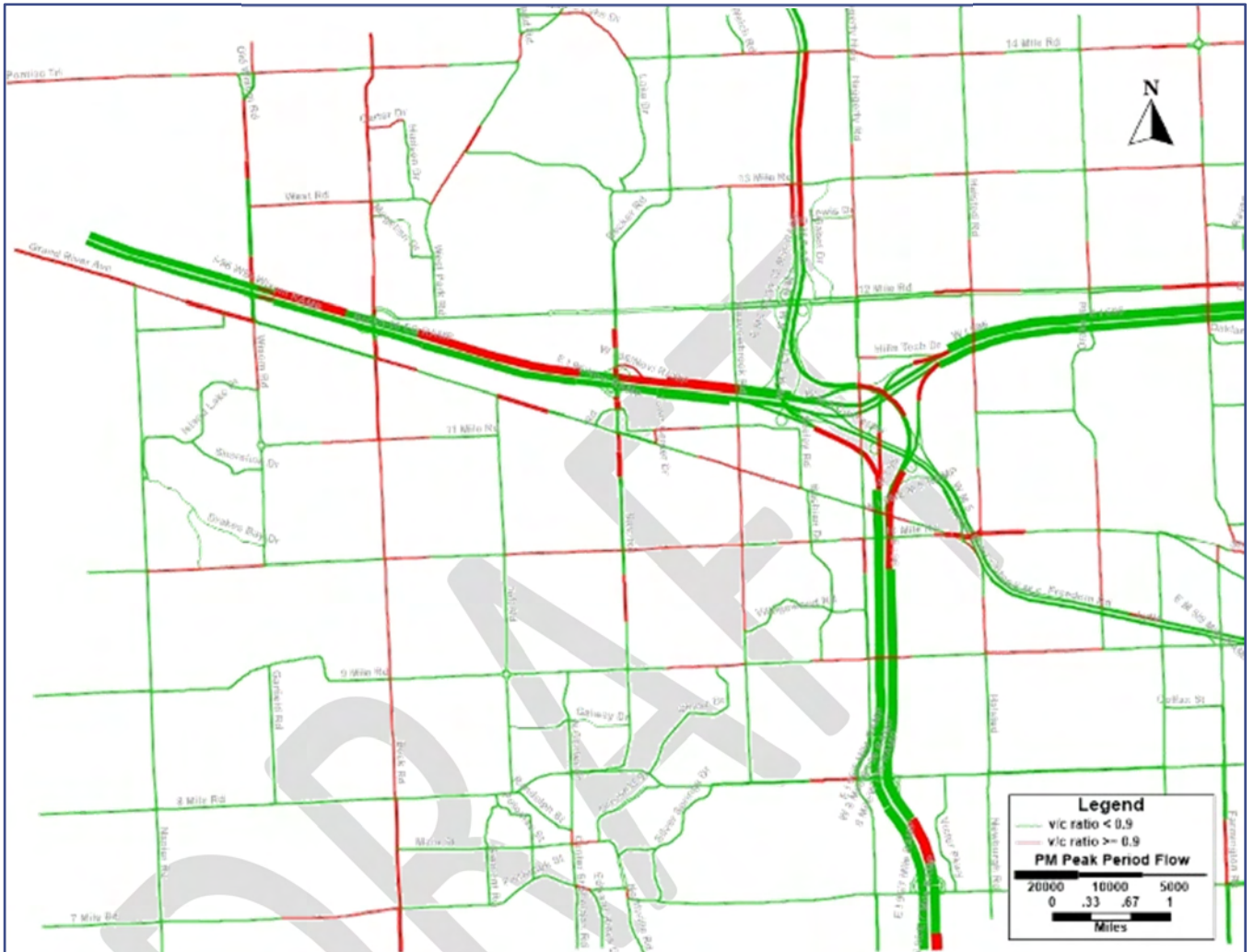
The 2040 OD matrices are assigned to 2040 E+C network to obtain 2040 E+C traffic flows. **Figure 5** shows the 2040 V/C ratios for the E+C network in the PM peak period.

Table 2. 2040 E+C Projects

2040 E+C Projects	Source
Crescent Blvd extension – Novi to Grand River (Ring Rd)	Novi Six-Year Plan
Taft Rd at 9 Mile Rd, new roundabout to replace all-way stop	Novi Six-Year Plan
11 Mile Rd at Wixom Rd, add roundabout to replace stop control on 11 Mile Rd	Novi Six-Year Plan
Construct modern roundabout on Orchard Lake Rd at 14 Mile Rd	SEMCOG 2014-2017 TIP

Source: *The Corradino Group*

Figure 5. 2040 E+C PM Peak Period Traffic Condition



Source: The Corradino Group

3. Existing and Future Traffic Conditions¹

Based on the above discussion, the growth in trips in Novi from 2015 to 2040 is forecast to be 4.9% on a daily basis and 5.4% during the afternoon peak period (Table 3).

Table 3. Novi Trip Growth –2015 to 2040

Year	Novi total trips	
	PM	Daily
2015	356,470	1,447,125
2040	375,859	1,518,272
growth%	5.4%	4.9%

Source: The Corradino Group and SEMCOG database

In 2015 (Figure 4), Beck has the most extensive congestion in Novi. Every “Mile Road” experiences significant PM peak-period congestion, with the worst on 10 Mile and 14 Mile Roads. Grand River Avenue in the sections from Seeley Road to just east of Town Center Drive/Main Street., and west of Wixom Road is also very congested in the afternoon peak period.

By comparing Figures 4 and 5, it can be seen that congestion expands along segments of 14 Mile Road. Congestion remains on the same *segments* of 10 Mile, but the V/C ratios worsen. In 2040, Beck Road will continue to be the most congested road in Novi, if improvements are not made. By 2040, all of West Road between Beck and Wixom Roads is forecast to be congested, as is Wixom Road north of West Road and south of Grand River Avenue. Without improvements, Grand River Avenue can be expected to become more congested than today while segments between Lannys Road and Taft Road, and between Heyn Drive and Beck Road are added to the list of congested roadway links.

Eleven intersections that are expected to require attention are listed below and located on Figure 6. This list, which will be refined, is based on the analysis included in Appendix A.

- Beck Rd. @ I-96 Interchange
- Beck Rd. @ Pontiac Trail
- W 14 Mile Rd. @ M5
- W 14 Mile Rd @ Haggerty Rd.
- W 12 Mile Rd. @ Novi Rd.
- W 12 Mile rd. @ Haggerty Rd.
- W 12 Mile Rd. @ W Park Dr.
- W 10 Mile Rd. @ Beck Rd.
- W 10 Mile Rd. at Novi Rd.
- W 8 Mile Rd. @ Haggerty Rd.
- Novi Rd. @ Grand River

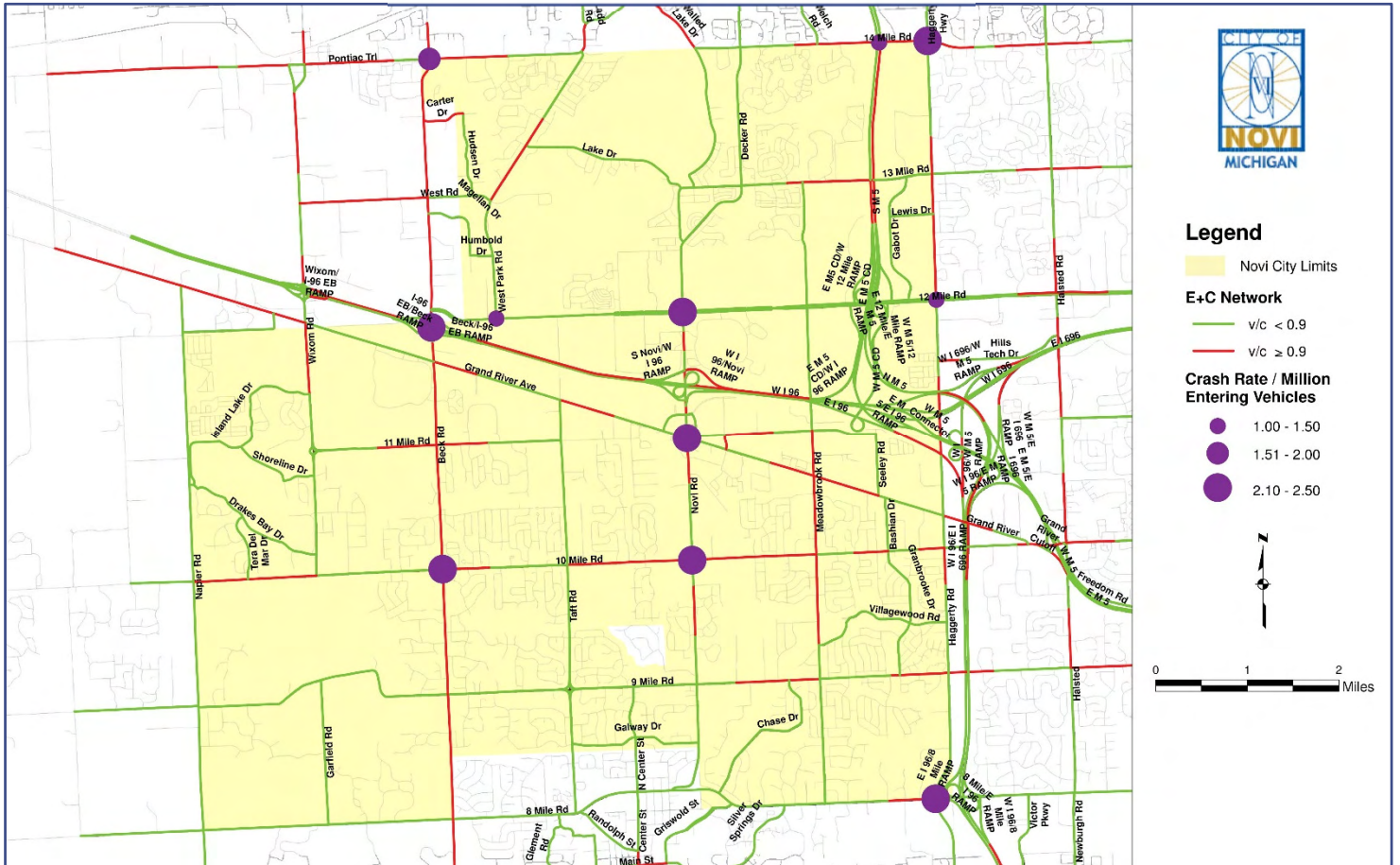
Graphics of these intersections are included in Appendix B.

4. Next Steps

Based on the information discussed above, multimodal solutions to roadway needs will be developed to determine where additional capacity can be provided. Non-motorized needs/improvements will be drawn from the annually updated *Non-Motorized Master Plan* enhanced by results of “Community Remarks” and input of the Steering Committee. Existing off-road pathways will also be evaluated to see if they can be improved. Transit needs will be drawn from the 2012 *Community Assessment Survey of Older Adults* augmented by information obtained through use of “Community Remarks”. A Steering Committee workshop is anticipated to be held in February to review preliminary improvements developed by the consultant.

¹ This discussion is limited to non-interstate roads.

Figure 6. Novi Intersections to be Studied Further



Source: The Corradino Group

Appendix A

Novi Thoroughfare Master Plan Preliminary Intersection Crash Analysis

The Corradino Group (Corradino) completed a preliminary intersection crash analysis as part of the Novi Thoroughfare Master Plan. Crash data were received from the Traffic Improvement Association of Michigan (TIA) for the 50 intersections in Novi with the highest crash frequency. The results of analyzing these data for 2012-2014 were compared with those in the January 2012, Birchler Arroyo Associates report titled: *“Crash-Data-Assisted Safety Evaluation of 12 Intersections in the City of Novi.”*

For the 2015 Thoroughfare Master Plan, Corradino used an approach that examines crash rates per million vehicles entering the intersection (based on available traffic data provided by TIA that corresponds with the years the crash data were collected) (Table 1). Additionally, a *Severity Index* was developed for each intersection that weights fatal crashes with a factor of 12, injury crashes with a factor of 3, and non-injury crashes with a factor of 1, then averages the total. While judgement, based on experience, was used to establish these factors, the overall approach is that found in the Federal Highway Administration Road Safety Information Analysis:

(http://safety.fhwa.dot.gov/local_rural/training/fhwasaxx1210/s5.cfm).

Birchler Arroyo Associates' (BAA) report identified 12 Novi intersections with the highest crash rates or casualty ratios (2006 thru 2010 data). In June, 2012, that analysis was advanced to identify significant crash patterns and proposed possible causes and countermeasures, based on field inspection and the SEMCOG *Traffic Safety Manual*.

With the data provided by TIA, all 12 BAA intersections were confirmed by Corradino as candidates for crash countermeasures. Those intersections are:

1. W 14 Mile Road at M5;
2. W 12 Mile Road at Novi Road;
3. Beck Road at Grand River Avenue;
4. Pontiac Trail at Beck Road;
5. Novi Road at Grand River Avenue;

6. W 12 Mile Road at Haggerty Road;
7. W 10 Mile Road at Novi Road;
8. W 10 Mile Road at Napier Road;
9. Beck Road at W 8 Mile Road;
10. Haggerty Road at W 14 Mile Road;
11. Haggerty Road at Grand River Avenue; and,
12. Haggerty Road at W 8 Mile Road.

The results of the Corradino analysis also indicated two intersections with a high *crash rate* are not on the Birchler Arroyo “Top-12” list:

- Beck Road at the I-96 interchange ramps, and,
- Beck Road at W 10 Mile Road.

The Corradino analysis also found one intersection with a high *Severity Index* that does not appear on the BAA “Top-12” list. While this intersection may not have a particularly high number of crashes or crash rate, the crashes that occur are of a significant nature.

- W 12 Mile Road at W Park Drive.

Details on the type and location of crashes occurring at these three additional locations, using TIA data, led to proposed countermeasures to mitigate the crash situation. Data supporting this analysis are provided on Table 1 at the end of this paper.

Beck Road at I-96 Ramps

Beck Road at I-96 is a single-point urban interchange (SPUI). The signals are span-wire mounted and do not include back-plates. The roadways are curb-and-gutter. Sight distances appear adequate.

There were 109 crashes at this location in 2012, 2013, and 2014. The crash rate of the intersection is 2.46 crashes per million entering vehicles, matching the highest crash rate of the intersections being analyzed. Eleven percent were injury crashes. The majority of the crashes were rear-end (75%), during the morning and afternoon peak hours, in

clear or cloudy weather conditions (87%), and on dry pavement (81%). Based on these characteristics, congestion appears to be a leading factor in the crashes. Proposed countermeasures are to:

1. Investigate retiming the signal to mitigate congested conditions and long queues.
2. Replace the existing span-wire signal configuration with a mast-arm configuration to improve the visibility of the signal heads.
3. Place an advance-warning sign on the southbound Beck Road approach to the I-96 interchange. The preferred warning sign is a *"Be Prepared to Stop"* with a *"When Flashing"* supplemental plaque and a flashing beacon that is interconnected with the signal.
4. As an alternate to the sign assembly noted above, place a *"Signal Ahead"* sign could be placed on the southbound approach.
5. An advance warning sign is not recommended on northbound Beck Road due to the close signalized intersection spacing south of the interchange.
6. Install back-plates with retro-reflective yellow borders on all signal heads to improve their visibility.
7. Replace the existing span-wire signal configuration with a mast-arm configuration to improve the visibility of the signal heads.
8. Replace the pavement markings within the interchange.

Beck Road at I-96



Beck Road at W 10 Mile Road

Each approach to this signalized intersection includes one through-lane, one left-turn lane and one right-turn lane. The signals are span-wire mounted and do not include back-plates. The roadways are curb-and-gutter with sidewalks. Sight distances appear adequate.

There were 89 crashes at this location in 2012, 2013, and 2014. The crash rate of the intersection is 2.46 crashes per million entering vehicles; equal to the highest rate of the intersections being analyzed. Twenty-five percent were injury crashes. The majority of the crashes were rear-end (62%), during the afternoon peak hours, in clear weather (71%), and on dry pavement (79%). Based on these characteristics, congestion appears to be a leading factor in the crashes.

Proposed countermeasures are:

1. Replace the existing span-wire signal configuration with a mast-arm configuration to improve the visibility of the signal heads.
2. Investigate retiming the signal to mitigate congested conditions and long queues.
3. Place advance warning signs on all four approaches to the intersection. The preferred warning sign is a *"Be Prepared to Stop"* with a *"When Flashing"* supplemental plaque and a flashing beacon that is interconnected with the signal.
4. As an alternate to the sign assembly noted above, a *"Signal Ahead"* sign could be placed on each approach.
5. Install back-plates with retro-reflective yellow borders on all signal heads to improve their visibility.
6. Replace the pavement markings on all four approaches to the intersection.

Twelve Mile Road at West Park Drive

The east and west legs of this intersection are Twelve Mile Road and the north leg is West Park Drive. A private drive is the south leg. The eastbound and westbound approaches of Twelve Mile Road include one through-lane, one left-turn lane and one right-turn lane. The southbound approach of West Park Drive includes a shared through/right-turn lane and a left-turn lane. The northbound approach of the private drive includes a shared through/right-turn lane and a left-turn lane. The signals are span-wire mounted and do not include back-plates. The roadways are curb-and-gutter with sidewalks. Sight distance appears adequate.

There were 26 crashes at this location in 2012, 2013, and 2014. The crash rate of the intersection is 1.25 crashes per million entering vehicles, which is relatively low compared to other intersections in the city. However, 50% were injury crashes. The intersection is recommended for additional study due to this high percentage of injury crashes. The majority of the crashes were rear-end (54%), during the afternoon peak hours (69%), in clear or cloudy weather conditions (76%), and on dry pavement (73%). Based on these characteristics, congestion appears to be a leading factor in the crashes. Proposed countermeasures are:

1. Replace the existing span-wire signal configuration with a mast-arm configuration to improve the visibility of the signal heads.
2. Investigate retiming the signal to mitigate congested conditions and long queues.
3. Place advance-warning signs on the Twelve Mile Road and West Park Drive approaches to the intersection. The preferred warning sign is a "*Be Prepared to Stop*" with a "*When Flashing*" supplemental plaque and a flashing beacon that is interconnected with the signal.
4. As an alternate to the sign assembly noted above, a "*Signal Ahead*" sign could be placed on each approach listed.
5. Install back-plates with retro-reflective yellow borders on all signal heads to improve their visibility.
6. Replace the pavement markings on all three public road approaches to the intersection.

Twelve Mile Road at West Park Drive



Source: Google Earth 2015

Additional information from the City of Novi indicated improvements had been made since 2011, allowing the following intersections to be removed from the list:

- Beck Rd and Grand River Ave.;
- W 10 Mile Rd. at Napier Rd.;
- Beck Rd. at W 8 Mile Rd.; and,
- Haggerty Rd. at Grand River Ave.

Then the intersections that need further review are:

- Beck Rd. @ I-96 Interchange;
- Beck Rd. @ Pontiac Trail;
- W 14 Mile Rd. @ M5;
- W 14 Mile Rd @ Haggerty Rd.;
- W 12 Mile Rd. @ Novi Rd.;
- W 12 Mile rd. @ Haggerty Rd.;
- W 12 Mile Rd. @ W Park Dr.;
- W 10 Mile Rd. @ Beck Rd.;
- W 10 Mile Rd. at Novi Rd.;
- W 8 Mile Rd. @ Haggerty Rd.; and,
- Novi Rd. @ Grand River Ave.

Novi Intersection Crash Analysis

Main Road	Crossroad	ADT	Total Crashes	Crash Rate*	Severity Index**	Safety Improvement Recommendations by BAA and Corradino	Improvements Planned by City (from e-mail from Brian Coburn on 1/13/16)	Improvements Still Needed?
Haggerty Rd	W 8 Mile Rd	59,004	134	2.07	1.58	Evaluate overall signal configuration; back plates; left-turn phasing on both roads; street lighting; maintenance of transverse markings.		Yes
W 14 Mile Rd	M5	86,950	130	1.37	1.38	Reevaluate signal timing; back plates; Signal Ahead signs on M-5; Turning Vehicles Yield to Pedestrian signs on WB & SB approaches.		Yes
W 12 Mile Rd	Novi Rd	36,601	97	2.42	1.45	Pedestrian refuge in each of two Novi Road crosswalks; enhanced crosswalk markings; signal back plates.		Yes
Beck Rd	Grand River Ave	43,847	85	1.77	1.26	Move SB stop bar south; maintenance of transverse pavement markings; street lighting; traffic study of potential EB dual-left lanes.	An extension of the WB right turn lane was completed in 2015 and an EB Dual Left is under contract for construction in 2016.	No
Pontiac Trl	Beck Rd	35,511	67	1.72	1.45	Cross access between gas station on NE corner & adjoining shopping center; sidewalk on NE corner; marking of Beck narrowing SB.		Yes
Novi Rd	Grand River Ave	47,023	108	2.10	1.43	Extend Crescent Blvd west to Grand River; enhanced crosswalks; area-wide street lighting.		Yes
W 12 Mile Rd	Haggerty Rd	46,235	76	1.50	1.47	Remove shrubbery in median; prune street trees; extend sidewalks on west side of I/S; consider conducting speed study on 12 Mile.		Yes
W 10 Mile Rd	Novi Rd	38,607	96	2.27	1.44	Traffic study to determine current volumes & evaluate benefit of adding SB right-turn lane & overlap phasing; enhanced crosswalks.	Novi Road North of 10 Mile Road was widened from 2-5 lanes in 2011, although the configuration of the intersection remained the same.	Yes
W 10 Mile Rd	Napier Rd	15,261	27	1.62	1.96	Clear-vision triangles; intersection warning signs; plan future realignment & widening; speed study & future signal warrant study.	The reconstruction of this intersection, removal of the hill to the west of the intersection and a new signal are proposed for construction in 2017.	No
Beck Rd	W 8 Mile Rd	32,438	78	2.20	1.15	Extend speed zone; post No RTOR NB & WB; reevaluate 8 Mile yellow; traffic study of future I/S design; delineate corners &/or add lighting.	The intersection was reconstructed in 2013 and added right turn lanes for SB, WB, and EB legs and reconstructed the signal as a FYA, box span, with right turn overlap on the left turn phase.	No
Haggerty Rd	W 14 Mile	35,230	86	2.23	1.37	Access management plan; longer all-red; no RTOR westbound; improved street lighting; sidewalk on NW corner.		Yes
Haggerty Rd	Grand River Ave	29,364	59	1.83	1.31	Traffic study to evaluate benefit of adding SB right-turn lane & overlap phasing; box span with back plates; reoriented WB stop bar.	The traffic signal was reconstructed and replaced as a box span, FYA in 2013 by RCOC and then improved by the City in 2014 to add a SB right turn lane and a right turn overlap on the left turn phase.	No
Corradino Recommendations								
Beck Rd	I 96 Interchange Ramps	40,520	109	2.46	1.22	Reevaluate signal timing; back plates; mast arms; advance warning signage on Beck; update pavement markings.		Yes
W 10 Mile Rd	Beck Rd	33,107	89	2.46	1.49	Reevaluate signal timing; back plates; mast arms; advance warning signage; update pavement markings; consider roundabout configuration.		Yes
W 12 Mile Rd	W Park Dr	18,922	26	1.25	2.00	Reevaluate signal timing; back plates; mast arms; advance warning signage on Beck; update pavement markings.		Yes

Source: The Corradino Group

Appendix B

Novi Thoroughfare Master Plan Intersections to Receive Additional Analysis

Beck Road at I-96 Interchange



Beck Road at Pontiac Trail



W 14 Mile Road at M5



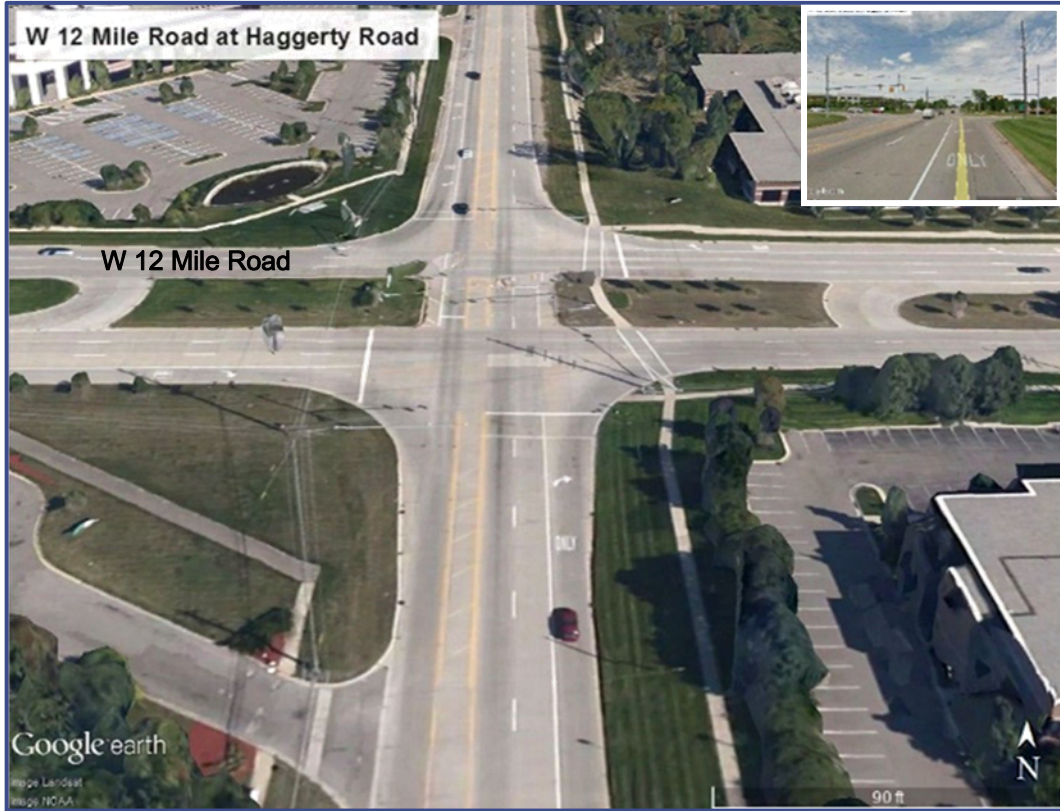
W 14 Mile Road at Haggerty Road



W 12 Mile Road at Novi Road



W 12 Mile Road at Haggerty Road



W 12 Mile Road at W Park Drive



W 10 Mile Road at Beck Road



W 10 Mile Road at Novi Road



W 8 Mile Road at Haggerty Road



Novi Road at Grand River Avenue

