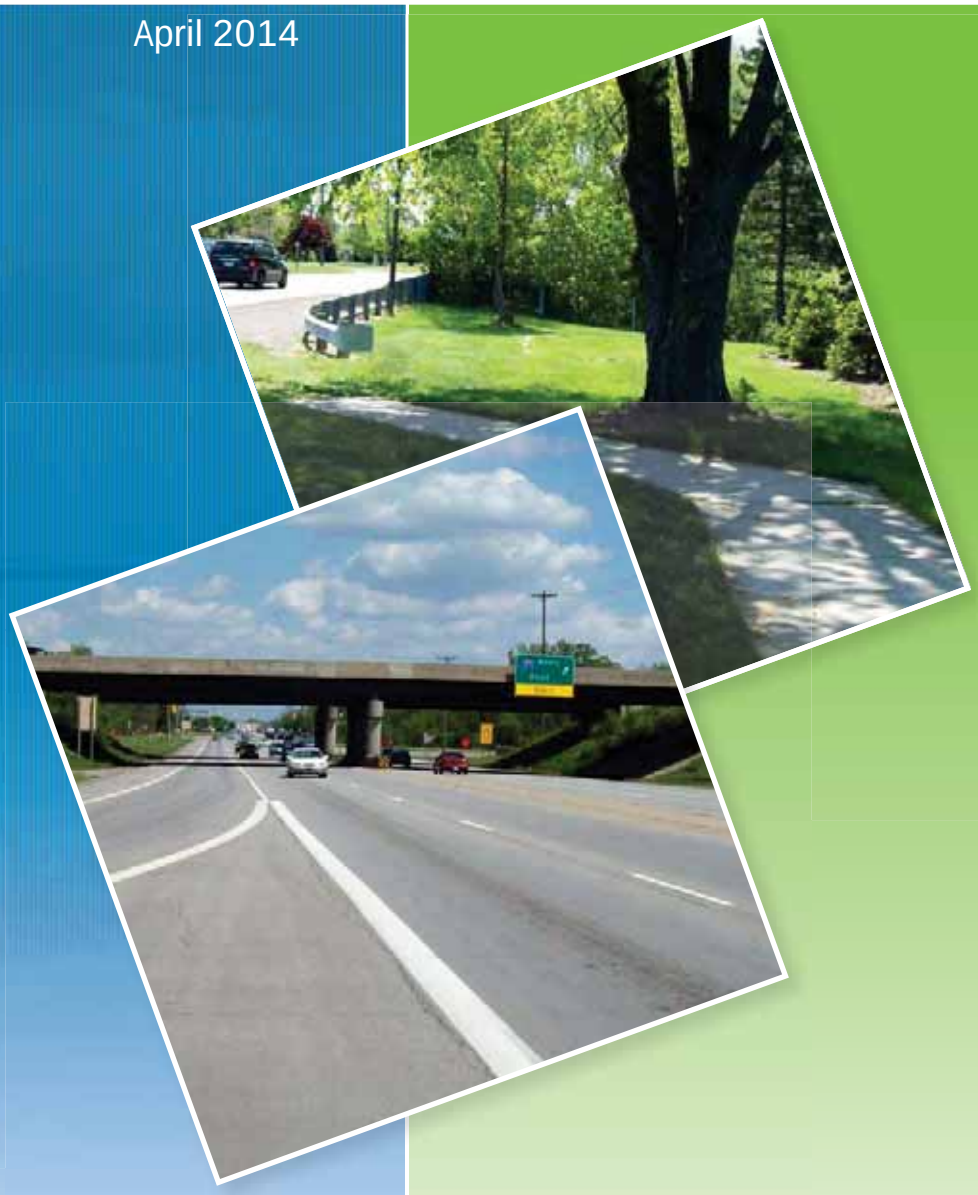
M-153 (FORD ROAD) at I-275 AREA

Traffic and Environmental Study

FINAL REPORT

April 2014



Prepared for:
Michigan Department of Transportation

MDOT
Michigan Department of Transportation

Prepared by:
CDM Smith Michigan Inc.

CDM Smith

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Executive Summary

M-153 (Ford Road) is an east-west roadway with a posted speed limit of 45 mph throughout the study area and is classified as an urban principal arterial in the 2004 Sufficiency Report. This segment of Ford Road is on the National Highway System (NHS) but is not on the Priority Commercial Network (PCN). Ford Road varies from five-lanes to seven-lanes (two to three lanes in each direction of travel with a center left-turn lane). The roadway is primarily undivided; however, between the southbound I-275 exit ramp and the northbound I-275 exit ramp, travel directions on Ford Road are separated by a raised median. Land uses along the Ford Road project area are highly commercial with businesses ranging from small restaurants to an IKEA big box store. Residential properties border the commercial zone making the Ford Road and I-275 interchange a significant commuter corridor.

Other major roadways in the study area include Cherry Hill Road, Warren Road and Haggerty Road. Each of these roadways are major collector-distributor roads. These roadways mainly service local traffic with Haggerty Road also carrying a large volume of commercial traffic north of Ford Road.

Planning and Environmental Linkage (PEL)

The Study Team has followed FHWA's Planning and Environmental Linkages (PEL) process throughout the study. The PEL process is documented to ensure environmental issues are considered early in the transportation planning process and information collected can be used if further NEPA compliance is required. The PEL checklist can be found in **Appendix A**.

Project Purpose and Need

The draft Purpose and Need was developed with input from the Study Team and public prior to alternatives analysis, and provided the criteria for alternative comparison. After presenting the draft Purpose and Need at the second public information meeting and incorporating comments, the below final Purpose and Need was developed.

Project Purpose:

The project will need to improve operational service on Ford Road between Lotz Road and Sheldon Road, without degrading I-275 interchange operations, and will:

- Consider improvements to key intersections along Ford Road at Lotz, Haggerty, Lilley, Morton Taylor, and Sheldon roads.
- Consider improvements on Ford Road and on local roads benefitting the operation of Ford Road.
- Incorporate existing and future transportation needs while respecting local land use.

- Increase users' safety and convenient travel while serving key destinations.
- Better separate and prioritize commuter, business, and residential traffic.
- Give attention to truck traffic movements.
- Support smart sustainable growth and apply access management principles.

Project Need:

The project is needed as a result of:

- Growing use of Ford Road by commuter, businesses, and residents.
- Traffic operational levels-of-service at key intersections along the Ford Road corridor.
- Current level of safety.
- Decreasing traffic flow and mobility along Ford Road.

Data Collection

Key data collected for the alternatives development process included; crash data, traffic counts, previous study reports, geotechnical data, Geographical Information System (GIS) information, survey, ecological assessments, noise measurements, and Project Area Contamination Survey (PACS). A Road Safety Audit (RSA) was conducted May 8-10, 2012 to provide additional data related to traffic and safety concerns which are not included in prior studies. Findings from the RSA can be found in **Section 6.2.9** and **Appendix D**. Additional information on data collected can be found in **Section 3**.

Project Meetings and Stakeholder/Public Engagement

The Study Team has met on numerous occasions to discuss the project, meet with stakeholders, and work on developing alternatives for the project. The Study Team is an integral component of this study as progression of the project is dependent upon engaging each member and gathering important feedback. Each meeting has required that a decision be made regarding the study approach or the alternatives presented. All Study Team meeting notes can be found in **Appendix I**. Further information for all four meetings can be found in their summaries located in **Appendix K**.

Table ES-1 Study Team Meetings

Meeting Name	Meeting Date
Study Team Kick-Off Meeting	April 4, 2012
Traffic Meeting #1	April 12, 2012
Traffic Meeting #2	May 17, 2012
Public Information Meeting #1	June 7, 2012
Illustrative Alternatives Study Team Workshop	August 16, 2012
Canton Township Supervisor Meeting	August 23, 2012
Canton Township DDA Meeting #1	September 19, 2012
Public Information Meeting #2	October 11, 2012
Practical Alternative Selection Study Team Meeting	November 14, 2012

Practical Alternative Study Team Workshop	January 9, 2013
Canton Township DDA Meeting #2	February 20, 2013
Public Information Meeting #3	March 27, 2013
Preferred Alternative Selection Study Team Meeting	May 15, 2013
Traffic Meeting #3	May 23, 2013
Public Information Meeting #4	May 30, 2013

Study Team Kick-off Meeting

A project kick-off meeting was held on April 4, 2012 and defined the Study Team as MDOT, FHWA, Canton Township, Canton Township Downtown Development Authority (DDA), City of Westland, Wayne County Department of Public Works, and the consultant team. A listing of individual study team members is located in **Appendix J**. During this meeting, critical project data was shared and the study area defined. The city of Westland requested that the study area be expanded further east to consider traffic backups from the I-275 interchange to the railroad overpass. Canton Township described previous improvements along the corridor through efforts of the DDA as well as their concerns with impacts to businesses during construction.

Traffic Meetings #1 and #2

Traffic meeting #1 was held on April 12, 2012 to establish traffic modeling methodology and obtain the latest Southeast Michigan Council of Governments (SEMCOG) travel demand model. Attendees included SEMCOG representatives and MDOT Traffic and Modeling Departments. A follow-up Traffic Meeting #2 was held on May 17, 2012 to discuss findings from the SEMCOG model. Attendees at this meeting included Canton Township, SEMCOG, and MDOT's Traffic, Modeling, and Special Projects Departments. It was determined that no-build conditions would be modeled based on applying a static growth rate to the turning data collected. For testing alternatives, CDM Smith modified the 2035 Trans CAD network and reran only the traffic assignment phase of the model using the application provided by SEMCOG to test impacts on the traffic patterns in the study area. The group also agreed to use a growth rate of 0.5% per year which would be a conservative estimate of the population and employment growth in the study area.

Public Information Meeting #1

The Study Team introduced the project to the public at an open-house format public meeting held at The Summit in Canton Township on June 7, 2012. The public was given the opportunity to learn about the project through exhibits depicting data gathered to date and a traffic simulation video depicting existing traffic conditions through the study area intersections. Information gathered via comment sheets was used to help establish the draft Purpose and Need statement.
General comments received at this meeting include:

- Provide proper timing of signals within the study area
- Prohibit left turns to/from Ford Road
- Provide additional access to/from I-275 to avoid Ford Road interchange
- Add an access road behind businesses

Illustrative Alternatives Study Team Workshop

The Study Team presented the Illustrative Alternatives to the Study Team on August 16, 2012 to gather additional feedback and gain concurrence from the Study Team prior to proceeding.

Canton Township Supervisor and DDA Meeting #1

MDOT and CDM Smith met with the Canton Township Supervisor on August 23, 2012 to discuss the Illustrative Alternatives and gather feedback. The Supervisor expressed concerns with impacts to existing aesthetic features where the DDA has spent nearly $9M in improvements and economic impacts would be too great if full right-of-way takes were required. Construction impacts to businesses were also identified as a concern. The Supervisor requested impacts to right-of-way be minimized in Alternative 3 – Boulevard, however stated the information is sufficient to present to the DDA.

MDOT and CDM Smith next met with the DDA on September 19, 2012. The DDA expressed a similar concern over losing the investment in the corridor and construction duration related impacts. The DDA stated they prefer the slip ramp in Alternative 4 – WWTIP Study as it does not have any impact on Ford Road. The DDA also requested that alternatives be combined where possible to get the best advantages of each into one alternative.

Where possible the Supervisor and DDA's comments and recommendations were addressed in the Illustrative Alternatives prior to being presented at Public Meeting #2 and are further discussed in **Section 6**.

Public Information Meeting #2 – Illustrative Alternatives Meeting

MDOT and the CDM Smith team introduced the five Illustrative Alternatives (including advantages and disadvantages of each) to the public in an open-house format on October 11, 2012. Attendees were asked to vote on their top three alternatives and provide feedback on each. A total of 60 votes were received the majority of which favored Alternative 3 – Boulevard. Feedback included concerns over property impacts, accessibility to businesses, truck circulation, and pedestrian mobility.

Practical Alternatives Selection Meeting

The Practical Alternatives Selection Meeting was held on November 14, 2012 with the entire study team present. CDM Smith provided a project update, a summary of Public Meeting #2 including comments received from the public and project stakeholders. The intent of this meeting was to select alternatives to advance as Practical Alternatives. The study team was presented each alternative as well as advantages and disadvantages of each. Based on the support material presented, comments received from the public and stakeholders, the Study Team decided unanimously to advance Alternative 1 – No-Build, Alternative 2 – Operational Improvements, and Alternative 3 – Boulevard as Practical Alternatives. Further discussion of this process can be found in **Section 7**.

Practical Alternatives Study Team Workshop

The Practical Alternatives Workshop was held on January 9, 2013 with the entire study team present. CDM Smith presented a project update along with information to facilitate discussion for each alternative. The intent of the meeting was to discuss concerns and gather feedback prior to additional analysis. The key points of discussion are included in **Section 7**.

Canton Township DDA Meeting #2

MDOT and CDM Smith presented the Practical Alternatives to the DDA during their regular meeting on February 20, 2013. In general the DDA was most interested in Alternative 3 – Boulevard. Their key

concerns related to the loon and crossover locations along with associated impacts, pedestrian crossings at I-275 entrance ramps, and a grade separated crossing for the I-275 Metro Trail at Ford Road. Where possible the DDA's comments and recommendations were addressed in the Practical Alternatives prior to being presented at Public Meeting #3 and are further discussed in **Section 7**.

Public Information Meeting #3 – Practical Alternatives Meeting

MDOT and the CDM Smith team introduced the three Practical Alternatives (including advantages and disadvantages of each) to the public in an open-house format on March 27, 2013. Attendees were asked to vote for their preferred alternative. A total of 15 votes were received, the majority of which favored Alternative 3 – Boulevard.

Preferred Alternative Selection Meeting

The Preferred Alternatives Selection Meeting was held on May 15, 2013 with the entire study team present. CDM Smith provided a project update, a summary of Public Meeting #3 including comments received from the public and project stakeholders. The intent of this meeting was to select the Preferred Alternative. Based on the support material presented, comments received from the public and stakeholders, the Study Team decided unanimously to advance Alternative 3 – Boulevard as the Preferred Alternative. Further discussion of this process can be found in **Section 8**.

Traffic Meeting #3

A follow-up meeting was held with the traffic experts on May 23, 2013 to discuss the latest results from the revised traffic demand model. Attendees at this meeting included Canton Township, SEMCOG, and MDOT's Traffic and Modeling Departments. The traffic demand model was revised to match the latest alternative geometrics and to provide a true comparison. All participants were in agreement on the method and results produced.

Public Information Meeting #4 – Preferred Alternative Meeting

MDOT and the CDM Smith team introduced the Preferred Alternative to the public in an open-house format on May 30, 2013. The public was encouraged to ask questions and discuss the alternatives with the study team members at the meeting. The majority of attendees were in favor of the boulevard being selected as the Preferred Alternative.

Illustrative Alternative Development and Analysis

Initial constraints were considered in the Illustrative Alternative process to the extent data had been collected, primarily from GIS mapping. This information included right-of-way, wetland boundaries, existing water courses, potential contaminated soils, and known conservation easements.

The following seven Illustrative Alternatives were developed or presented for further analysis.

1. No-Build
    - No change from current traffic operations
2. Operational Improvements
    - Addition of westbound through-lane on Ford Road from I-275 to Sheldon Road and conversion of existing eastbound right-turn lane at Haggerty Road to shared right through-lane, with additional pedestrian and safety improvements

3a. Ford Road Boulevard

- Provides a boulevard with two through-lanes in each direction throughout, a dedicated right/through lane westbound from I-275 to the IKEA entrance and an eastbound right turn bay at Haggerty Road, with restricted left turns at intersections, numerous passenger vehicle turnarounds, and truck turnarounds (loons) where necessary, with additional pedestrian and safety improvements

3b. Haggerty Road Boulevard

- Provides a Haggerty Road boulevard with two through-lanes in each direction, with restricted left turns at Ford Road, with additional pedestrian and safety improvements

3c. Ford/Haggerty Boulevard

- Provides a Ford Road and Haggerty Road boulevard with two through-lanes in each direction, with restricted left turns at intersections, numerous passenger vehicle turnarounds, and truck turnarounds (loons) where necessary, with additional pedestrian and safety improvements

4. Western Wayne Transportation Improvement Plan (WWTIP)

- Provides direct southbound I-275 ramp access to Haggerty Road north and south of Ford Road, reducing congestion at the Ford Road/Haggerty Road intersection. Includes a frontage road from Cherry Hill Road north to Ford Road and a modification of the northbound I-275 entrance ramp, additional pedestrian and safety improvements

5. New Interchanges

- Provides full access interchanges at Cherry Hill Road and Warren Road to alleviate traffic at the Ford Road/Haggerty Road intersection as well as the Ford Road/I-275 interchange, additional pedestrian and safety improvements

Additional considerations from the RSA were also noted as potential improvements and included the following;

- Intersection improvements along Cherry Hill Road
- Paving Lotz Road and improving the Lotz Road/Ford Road intersection
- Additional pedestrian crossings with pushbutton signals
- Provide bike crossings at bike path
- Provide overhead lighting at signals
- Access management with potential shared drives

Exhibits of all seven Illustrative Alternatives can be found in **Appendix L** with detailed descriptions in **Section 6** of this report.

The process to evaluate each alternative consisted of a high-level cost comparison between each alternative, how well the alternative addresses safety issues identified in the Road Safety Audit (RSA) process, traffic operational improvements at each intersection, negative impacts to I-275 freeway and ramp traffic, constructability, and potential right-of-way and environmental impacts. The three boulevard variations were consolidated into one and the Warren and Cherry Hill Road interchanges combined into one alternative for a total of five Illustrative Alternatives. Feedback from the Study Team was a critical element to progress the alternatives into further analysis.

Practical Alternative Development and Analysis

The Illustrative Alternatives selected to advance as Practical Alternatives are Alternative 1 – No-Build, Alternative 2 – Operational Improvements, and Alternative 3 – Boulevard. These were selected based on comments received from the public and Study Team. The results of the comparison criteria also supported these decisions. Further discussion on each alternative and why it was dismissed or advanced is included below. Exhibits of the build Practical Alternatives are shown in **Appendix M** with additional analysis located in **Section 7**.

Alternative 1 – No-Build

- This alternative will continue through the Practical Alternative stage as a base-line to compare other alternatives to.

Alternative 2 – Operational Improvements

- This alternative will advance since it has no right-of-way and environmental impacts along with a lower construction cost relative to the other Illustrative Alternatives.
- Initially this alternative was analyzed further as a short term fix since traffic operations will degrade to existing levels within approximately ten years after implementation. This short term fix would allow time for funding, design and construction of long term alternative. Later in the Practical Alternative analysis the Study Team determined that additional operational improvements be added to make it a more viable long term solution.

Alternative 3- Boulevard

- This alternative will advance since it has minimal right-of-way and environmental impacts along with a lower construction cost relative to some of the other Illustrative Alternatives.
- Improves both safety and traffic operations along Ford Road.
- Environmentally this alternative has no detrimental impacts if the ROW impact is deemed acceptable by the public and FHWA.

Alternative 4 – WWTIP Study

Not advanced for the following reasons:

- Does not meet the Purpose and Need due to negative impact on I-275 without addressing safety and traffic operations on Ford Road.
- May require design exceptions for proximity of sequential ramps and weave/merge distance for slip ramps.
- FHWA would not grant an Interstate Access Change Request.

- Environmental impacts including the potential of contaminated soils in the NE quadrant of I-275 and Cherry Hill Road and a conservation easement in the same quadrant.

Alternative 5 – Warren and Cherry Hill Road Interchanges

Not advanced for the following reasons:

- Does not meet the Purpose and Need due to negative impact on I-275 without addressing safety and traffic operations on Ford Road.
- Environmental impacts including the potential of contaminated soils in the NE quadrant of I-275 and Cherry Hill Road and a conservation easement in the same quadrant.
- High costs with less than desired traffic diversion from Ford Road.
- Would require a design exception due to inadequate distance between interchanges (Warren and Ford) and an unsafe weave/merge lane.
- FHWA would not grant an Interstate Access Change Request

After the Practical Alternative selection was made additional analysis and development was conducted. These included the following:

- A geotechnical review of historical soil borings to determine existing pavement conditions. Due to the findings and since the existing pavement is over 30 years, the existing pavement is anticipated to require reconstruction within ten years. This analysis can be found in the Geotechnical Conditions Report found in **Appendix H**.
- An updated traffic demand model and analysis for Alternatives 2 and 3 to ensure the volumes assigned to each was consistent and accurate. This analysis can be found in the Traffic Operations Report found in **Appendix B**.
- An expected average crash frequency was done for all three Practical Alternatives utilizing the Highway Safety Manual, First Edition. This analysis can be found in **Appendix C**.
- A hydraulic analysis was done at Willow Creek (north of Ford Road on Haggerty Road) and Smith Drain (a Tributary of Willow Creek south of Ford Road on Haggerty Road). The Willow Creek structure is not anticipated to be impacted by this project but was close enough to warrant analysis. Proposed structure type, size, and elevations along with additional analysis in **Appendix N**.

Additional improvements that do not meet the project Purpose and Need but were investigated during this process to assist MDOT and Wayne County in future project scoping include the southbound I-275 exit ramp weave extension, southbound I-275 exit slip ramp to northbound Haggerty Road, southbound Haggerty Road truck reroute, and paving Lotz Road. Memorandums concerning these additional improvements can be found in **Appendix O**.

Preferred Alternative Development and Analysis

The Practical Alternative selected as the Preferred Alternative is Alternative 3 – Boulevard. This was selected based on comments received from the public and Study Team. Further discussion on each alternative and why it was dismissed or advanced is included below. An exhibit and further analysis of the Preferred Alternative can be found in **Section 8**. This information includes a detailed Preferred Alternative description and additional considerations including geotechnical, potential traffic operation improvements, and design components.

Alternative 1 – No-Build

- Does not address key project Purpose and Need of improving traffic operations and safety concerns along Ford Road.

Alternative 2 – Operational Improvements

- Despite improved traffic operations along Ford Road, failing turning movements still exist.
- Does not significantly improve safety.

Alternative 3 – Boulevard

- Addresses the project Purpose and Need by significantly improving traffic operations and safety concerns along Ford Road.

A summary of the environmental analysis for the Preferred Alternative can be found in **Section 9**. This documentation is not meant to provide MDOT with enough information for NEPA environmental clearance for this project, but to instead provide MDOT with the information necessary to make a determination of needed environmental documentation (CE or EA) once the project moves into the next phase of project development. Potential project mitigation measures are listed in **Appendix Q**.

The Preferred Alternative has no detrimental environmental impacts. The biggest community concerns resulted from the acquisition of property from commercial establishments, the impacts on business during construction, and the locations of turn-around loons. In the end, the Preferred Alternative poses more concerns for the community than it does for regulatory agencies. Acceptance of the study process, findings, and recommendations by FHWA and all other stakeholders can be found in **Appendix S.**

If the project does not proceed to construction within ten years a new study will need to be conducted. Furthermore, an update of the traffic analysis is necessary after five years and three years for the environmental analysis. The re-evaluation does not occur automatically, but should be triggered by the scheduling of a construction project. However, the review should be limited to updating existing information related to significant changes within the study area in the time between completion of the PEL and a construction date.

Section 1
Introduction

This report includes a summary of the processes followed to date for the Illustrative Alternatives analysis of the M-153 (Ford Road) at I-275 Area Study with a goal of upgrading the current roadway within the study area to improve safety, capacity, and pedestrian mobility while minimizing impacts to businesses along Ford Road. As shown in **Figure 1-1** below, the study area of this project is defined by Lotz Road to the east and Sheldon Road to the west; Warren Road to the north and Cherry Hill to the south. This study investigates different interchange configurations, improvements to roadway geometrics, and pedestrian facilities.

Figure 1-1 Project Study Area

The Ford Road corridor has seen unprecedented growth the past two decades which has increased traffic volumes to a level which causes safety and mobility concerns for pedestrians and the motorized public. It is difficult for drivers to make left turns into or out of driveways along the corridor due primarily to queued vehicles between traffic signals. Additionally, traffic queues at the Haggerty and Ford Road intersection can extend into the I-275 interchange which results in backups on the freeway ramps creating a safety and operation issue at the freeway interchange.

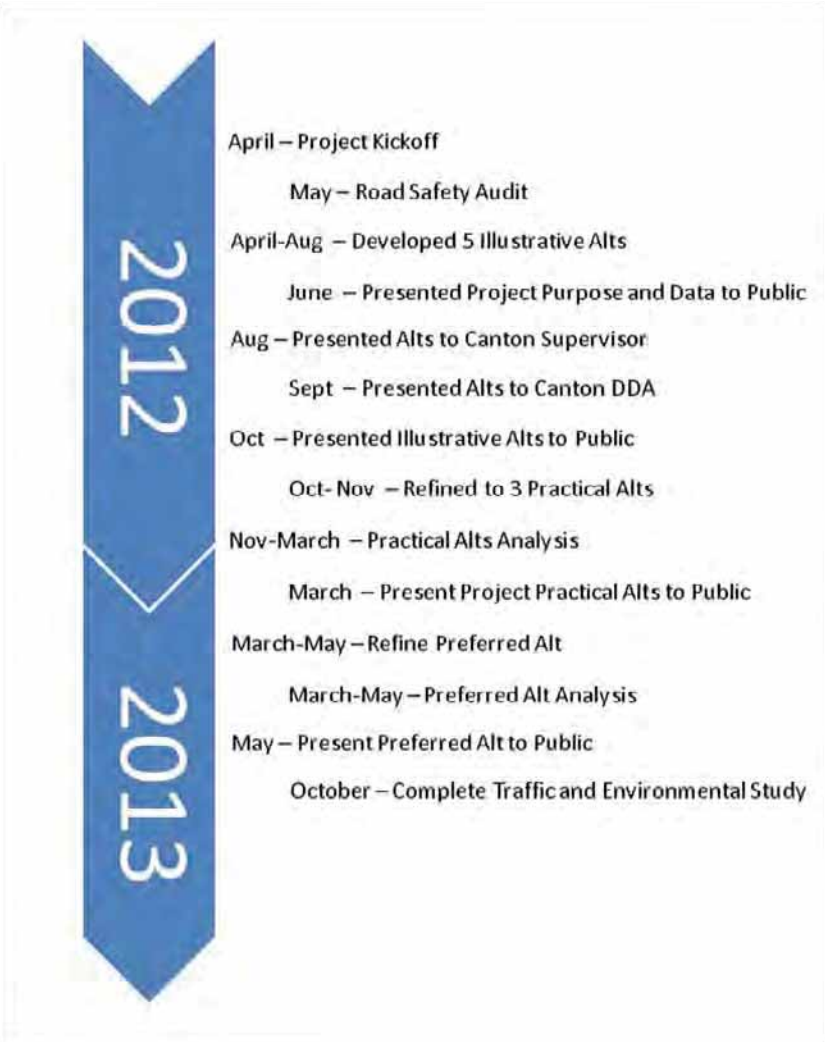
The Michigan Department of Transportation (MDOT), along with their partners; Canton Township, Canton Township Downtown Development Authority (DDA), Wayne County Public Works, and the city of Westland have analyzed the I-275 interchange with Ford Road through the below past studies.

- 2003 Ford Road/I-275 Traffic Study from Lilley Road to Hix Road. The long-term capacity improvement recommendation was a boulevard which advanced as an Illustrative Alternative for this Ford Road at I-275 Area Traffic and Environmental Study.
- 2004 Ford Road Access Management and Traffic Operations Study. This study provided recommendations to reduce congestion, maintain the roadway capacity, reduce crashes, identify additional turn lanes, and improve business ingress/egress.
- 2006 Western Wayne County Transportation Improvement Study. This study addressed freeway access issues focusing on seven key corridors including Ford Road. One of the recommendations was carried forward as Illustrative Alternative #4 for this Ford Road at I-275 Area Traffic and Environmental Study.

This study includes considerations for traffic and pedestrian safety and mobility, but also wetlands, threatened/endangered species, hydraulics at stream crossings, and air and noise impacts. Furthermore, FHWA's Planning and Environmental Linkages (PEL) process is being followed to ensure environmental factors are considered throughout the study process and to improve planning and project level decision-making. The PEL process also promotes a partnership with the key stakeholders within the study area leading to a balanced decision-making process. The final PEL checklist can be found in **Appendix A**.

The following timeline of events was established at the onset of the project and has been adjusted as additional time was required for certain tasks. Initially the project was considered fast-track to be able to complete the Environmental and Transportation Study prior to 2013 in anticipation of a Tiger Grant award. The schedule was modified however when this award was not received.

Figure 1-2 Project Timeline



Section 2
Existing Conditions

M-153 (Ford Road) is an east-west roadway with a posted speed limit of 45 mph throughout the study area and is classified as an urban principal arterial in the 2004 Sufficiency Report. This segment of Ford Road is on the National Highway System (NHS) but is not on the Priority Commercial Network (PCN). Ford Road varies from five-lanes to seven-lanes (two to three lanes in each direction of travel with a center left-turn lane). The roadway is primarily undivided; however, between the southbound I-275 exit ramp and the northbound I-275 exit ramp, travel directions on Ford Road are separated by a raised median. Land uses along the Ford Road project area are highly commercial with businesses ranging from small restaurants to an IKEA big box store. Residential properties border the commercial zone making the Ford Road and I-275 interchange a significant commuter corridor.

Other major roadways in the study area include Cherry Hill Road, Warren Road and Haggerty Road. Each of these roadways are major collector-distributor roads. These roadways mainly service local traffic with Haggerty Road also carrying a large volume of commercial traffic north of Ford Road.

Ford Road consists primarily of a five-lane cross section throughout the study area, with additional right turn bays provided at larger storefront entrances. Dedicated right turn lanes are provided at Ford Road and Sheldon Road, Lilley Road, and Haggerty Road with a continuous westbound dedicated right turn lane from Haggerty Road to Lilley Road. East of Haggerty Road, Ford Road consists of three eastbound lanes, and two westbound lanes plus a dedicated right turn lane from the I-275 ramp to Haggerty Road. Sheldon, Morton Taylor, and Lilley roads consist of four lanes with dedicated turn lanes at Ford Road, to two lanes within a half mile of Ford Road. Haggerty Road is a five lane cross section at Ford Road, and then gradually tapers to a two lane section to the south. North of Ford Road, Haggerty Road is a five-lane section. Warren Road is primarily a two-lane section, however it widens to four lanes at the Haggerty Road intersection. Cherry Hill varies from two lanes to three lanes with additional turn lanes provided at intersections.

The existing pavement condition along Ford Road is in fair to good condition; however there is no record of pavement reconstruction in over 30 years. Based upon increased traffic volumes, the presence and extent of surface cracking, the ability of the subgrade soils to drain properly, and maintenance costs to upkeep the current condition of the pavement, it is anticipated a total pavement reconstruction will be required within the next 5 - 10 years.

The existing traffic conditions within the study area were modeled using Synchro and HCS software to measure the performance of the existing traffic operations and provide a base condition for comparison of future alternatives. Three peak periods were analyzed, AM peak (7:00 to 8:00 am), PM peak (5:00 to 6:00 pm), and off-peak (Saturday afternoon). Many of the key intersections within the Ford Road study

area were found to be at or near capacity congestion with Levels of Service (LOS) of E or F, as illustrated in **Table 2-1** below. These over-capacity conditions are amplified in the future conditions as traffic volumes gradually increase. Further traffic discussion found throughout this report and in the Traffic Operations Report located in **Appendix B**.

Table 2-1 Existing Intersections with Overall Intersection LOS E or F

Intersection	Period of Overall Intersection LOS E or F
Ford & Haggerty Road	AM & PM Peak Hour
Ford & Lilley Road	PM & Off-Peak Hour
Ford & Sheldon Road	Off-Peak Hour
Warren & Haggerty Road	AM Peak Hour

Existing traffic volumes are exceeding the capacity of the current corridor which causes residual queues at each intersection with some vehicles not clearing each signal. This leads to vehicles blocking the intersection and preventing cross street green phases from proceeding efficiently. This condition is especially prevalent at the southbound I-275 ramp intersection where westbound traffic queues from Haggerty Road block the ramp movement which causes excessive queuing on the ramp, and at times onto I-275. As a general observation traffic conditions are most congested eastbound during the AM peak hour and westbound during the PM peak hour. Safety has become a primary concern and focus of the alternatives analysis as a number of crashes have been documented at each of the key intersections within the corridor, as shown in **Figure 2-1** below. Further crash history discussion can be found throughout this report and in **Appendix C**.

Figure 2-1 Crash History from 2006 to 2011

Ford Road has a 120 foot typical right-of-way and has commercial development and other amenities (parking lots, sidewalks, retaining walls) built immediately behind with very little clear space.

Land uses surrounding the Ford Road project area are highly commercial with businesses ranging from small restaurants to an IKEA big box store. Residential properties border the commercial zone making the Ford Road and I-275 interchange a significant commuter corridor.

Lighting is located throughout the Ford Road corridor with the exception of a short segment on the south side of Ford Road west of Haggerty Road and through the I-275 interchange. Based upon field observation, the lighting has been found primarily to light sidewalks. Sidewalks are also present throughout the corridor with the exception of within the I-275 interchange.

Section 3
Data Collected

3.1 MDOT Data

Data collected from MDOT at the onset or during the project has been included in project files and is listed below. This data was utilized in the analysis of each alternative and is discussed in greater detail throughout this report.

- Conservation Easement locations
- Crash Data
- Existing Road Plans
- Existing Bridge Plans
- Existing Studies and Reports
- Geotechnical data
- Traffic data
- Utility contact information

3.2 Canton Township Data

Canton Township provided the following GIS data which was utilized to establish base mapping for the alternatives analysis.

- Hydrology – rivers, lakes, etc.
- Wetland Data
- Soils Data
- Floodplain Data
- Park Information
- Census Block Groups
- Zoning Data
- Existing and Future Land Uses
- Parcel Data and Building Footprints
- Utilities and Aerial Photography

3.3 Traffic Counts and Models

MDOT provided traffic counts for the 28 signalized intersections and adjoining roadway segments within the study area taken in March 2012. MDOT also provided Synchro base models along Ford Road. Southeast Michigan Council of Governments (SEMCOG) provided the 2035 regional travel demand

model. This data was modified and expanded as necessary to model the study area. Further discussion of this can be found throughout this report and in the Traffic Operations Report located in **Appendix B**.

3.4 Crash History

Team member Bergmann Associates summarized the MDOT provided crash data for use in the Road Safety Audit (RSA), public meetings and alternative development. Identified locations of high crash frequency and/or severity allowed the Study Team to focus their alternative development efforts. A summary of the existing crash history can be found in **Appendix C**.

3.5 Road Safety Audit

Team member Bergmann Associates led the RSA which is the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. The M-153 (Ford Rd) at I-275 Area Study RSA was conducted May 8-10, 2012 with a goal to answer the following questions:

- *What elements of the road may present a safety concern: to what extent, to which road users, and under what circumstances?*
- *What opportunities exist to eliminate or mitigate identified safety concerns?*

The RSA team for the project consisted of representatives from MDOT's Traffic and Safety, Geometrics, Operations, and Multi-Modal Departments, and the Canton Township Police Department that were independent from the project Study Team and were led by members of the consultant team.

The Ford Road roadway corridor from Lilley Road to Lotz Road was the primary focus of the examination; however the entire area bounded by Sheldon Road (west) to Lotz Road (east) and from Cherry Hill Road (south) to Warren Road (north) was reviewed. Based on the RSA observations and findings a series of suggestions were identified for potential inclusion in the Ford Road Corridor improvements or for consideration by Wayne County for future projects. The improvements were identified based on documented crashes, and low cost general safety improvements. These improvements can be found in **Section 6.2.9** or in the Road Safety Audit Report located in **Appendix D**.

3.6 Survey

Team member Surveying Solutions performed roadway, hydraulic and right-of-way survey necessary for the other team members to complete their tasks. The 2D roadway survey was obtained in July 2012 utilizing Mobile LiDAR Scanning. This survey can be easily converted to 3D if needed in the future by tying it to vertical control. The hydraulic survey was conducted in January 2013 at Willow Creek (Haggerty crossing north of Ford Road) and a Smith Drain tributary (Haggerty crossing south of Ford Road) following a site visit with MDOT on December 20, 2012 to verify needs and limits. This survey was provided to team member HH Engineering for their hydraulic analysis. The right-of-way survey along Ford Road from Sheldon Road to Lotz Road uncovered some locations of concern where the

existing right-of-way is within the roadway. These locations will be explored further in future project phases.

3.7 Ecological Assessment

Team member Cardno JFNew performed an ecological assessment to assist the project team in the environmental impacts of the alternatives developed and analyzed. Their field work was conducted in July 2012 and included regulatory wetland delineations, vegetative community assessments, and Procedure 51 stream assessments. The formal threatened and endangered species survey and evaluation was conducted by MDOT biologists. The results of these assessments were used during the alternative screening process with specific pertinent findings discussed in those sections and summarized in **Section 9.3.1**. All findings are contained in the Ecological Assessment Repot which can be found in **Appendix E**.

3.8 Noise Levels

Team member Bergmann Associates performed a noise analysis along Ford Road to determine the baseline noise level for comparison to the Preferred Alternative along with potential mitigation. Their field measurements were taken on October 26, 2012 at seven representative sites while leaves were still present to obtain accurate results. These measurements were taken during peak and off-peak times that coincided with peak traffic volumes. The traffic noise prediction program, FHWA Traffic Noise Model version 2.5, was used to model the existing, 2035 No-Build and 2035 Preferred Alternative Build option for traffic noise levels within the study area. The results of this analysis are contained in the Noise Analysis Report found in **Appendix F** along with discussion found in **Section 9.3.2**.

3.9 Project Area Contamination Survey

Team member Somat Engineering prepared a Limited Project Area Contamination Survey (PACS) Report, located in **Appendix G**, to provide a professional opinion of recognized environmental conditions (RECs) in connection with the past and current uses of properties along the project corridor where known or potential contamination may impact and/or intersect the project. RECs were identified from site reconnaissance consisting of a "windshield survey" and a review of historical photographs and environmental databases in July and August 2012. Municipal office files were also reviewed to supplement the initial review in June 2013. Further discussion of the PACS can be found in **Section 9.3.3**.

3.10 Geotechnical Investigation

Team member Somat Engineering provided geotechnical analysis for the project based on historical soil boring information since no new pavement cores or soil borings were included with this project. This information was compiled to determine existing pavement conditions and analyzed to provide recommendations concerning the Preferred Alternative, which are discussed in **Section 8**. The Geotechnical Considerations Report can be found in **Appendix H**.

Section 4
Project Meetings and Stakeholder/Public Engagement

4.1 Study Team Meetings

The Study Team has met on numerous occasions to discuss the project, meet with stakeholders, and work on developing alternatives for the project. The Study Team is an integral component of this study as progression of the project is dependent upon engaging each member and gathering important feedback. Each meeting has required that a decision be made regarding the study approach or the alternatives presented. All Study Team meeting notes can be found in **Appendix I**.

Table 4-1 Study Team Meetings

Meeting Name	Meeting Date
Study Team Kick-Off Meeting	April 4, 2012
Traffic Meeting #1	April 12, 2012
Traffic Meeting #2	May 17, 2012
Public Information Meeting #1	June 7, 2012
Illustrative Alternatives Study Team Workshop	August 16, 2012
Canton Township Supervisor Meeting	August 23, 2012
Canton Township DDA Meeting #1	September 19, 2012
Public Information Meeting #2	October 11, 2012
Practical Alternative Selection Study Team Meeting	November 14, 2012
Practical Alternative Study Team Workshop	January 9, 2013
Canton Township DDA Meeting #2	February 20, 2013
Public Information Meeting #3	March 27, 2013
Preferred Alternative Selection Study Team Meeting	May 15, 2013
Traffic Meeting #3	May 23, 2013
Public Information Meeting #4	May 30, 2013

4.1.1 Kick-Off Meeting

A Study Team was assembled at the kick-off of the project on April 4, 2012 and has been consistent throughout the process. The team consists of the MDOT, FHWA, Canton Township, Canton Township DDA, City of Westland, Wayne County Department of Public Works, and the consultant team. A listing of individual study team members is located in **Appendix J**. During this meeting, critical project data was shared and the study area was defined. The city of Westland requested that the study area be expanded further east to consider traffic backups from the interchange to the railroad overpass. Canton Township described previous improvements along the corridor that have been made through efforts of the DDA as well as their concern with impacts to businesses during construction.

4.1.2 Traffic Meeting #1

The purpose of this initial traffic meeting, held on April 12, 2012, was to bring the traffic experts together, review the scope and schedule of the project, and come to an agreement on the traffic modeling methodology. Attendees included SEMCOG representatives and MDOT Traffic and Modeling Departments. The following key points were agreed upon:

- The use of the SEMCOG Model will be used to develop a subarea trip table and network for the study area
- The subarea trip table will be adjusted to current conditions based on traffic counts and additional information from MDOT
- The adjustment factors will be used in the forecasting process on the No-Build and other alternatives. The alternatives will be tested with the subarea assignment model to produce revised volumes
- The 2035 model will be used with a growth rate of 9-10%

4.1.3 Traffic Meeting #2

A follow-up meeting was held with the traffic experts on May 17, 2012 to discuss findings from the SEMCOG model as it related to the I-275 at Ford Road Study and to agree on a methodology prior to moving forward. Attendees at this meeting included Canton Township, SEMCOG, and MDOT's Traffic, Modeling, and Special Projects Departments. Key items of discussion included:

- No-build conditions would be modeled based on applying a static growth rate to the turning data collected. For testing alternatives, CDM Smith modified the 2035 Trans CAD network and reran only the traffic assignment phase of the model using the application provided by SEMCOG to test impacts on the traffic patterns in the study area.
- The group agreed to use a growth rate of 0.5% per year which would be a conservative estimate of the population and employment growth in the study area.

4.1.4 Illustrative Alternatives Study Team Workshop

The CDM Smith team presented the Illustrative Alternatives to the Study Team along with the pros and cons of each relative to cost, right-of-way impacts, level-of-service, and geometrics. The discussion also included project background, comments received from the public (see **Section 4.2.1** below), draft Purpose and Need, steps taken to reach this point, and additional improvements that could apply to numerous alternatives. The objective of the meeting was to reach consensus that the Illustrative Alternatives meet the draft Purpose and Need statement and to determine which alternatives should be presented as moving on to the Practical Alternative stage. Key items of discussion included:

- Alternative 2 – Operational Improvements
    - MDOT Traffic asked how soon after additional capacity is added the LOS would deteriorate to existing conditions.
- Alternative 3a – Ford Road Boulevard
    - Median width can be reduced to 30 feet with addition of loons to reduce footprint.

  - Wetlands exist outside MDOT right-of-way and a MDEQ conservation easement exists in SE quadrant of Morton Taylor Road and Ford Road.

- Alternative 3b – Haggerty Road Boulevard
  - This alternative does not improve the Haggerty/Ford intersection as well as Alternative 3b.

- Alternative 4 – WWTIP Study
  - This alternative does not improve Haggerty Road from the existing condition.
  - FHWA stated this alternative would be difficult to get an Interchange Access Change Request for as there will be a difficulty in conveying movements based upon driver expectation. FHWA stated they do not believe Alternative 4 can be brought forward as a Practical Alternative because it does not meet the Purpose and Need and changes the configuration of I-275, which could also degrade the freeway operations at the interchange.

- Alternative 5 – New Interchanges
  - There is a DEQ conservation easement in the northeast quadrant of Cherry Hill Road and I-275. Difficulties in this alternative were discussed regarding proximity of new interchanges to Ford Road and the weave/merge movements that would be introduced. If operational problems were discovered during the traffic analysis this alternative may not meet the IACR requirement for approval.

The Study Team recommended that all alternatives be presented to the public along with pros and cons and relative information.

4.1.5 Canton Township Supervisor Meeting

MDOT and CDM Smith met with Canton Township Supervisor, Phil Lajoy and others from Canton Township on August 23, 2012 to further discuss the Illustrative Alternatives and gather any specific feedback the township might have. This meeting was also to prepare for a recommended follow-up meeting with the DDA. Key items of discussion included:

- The Supervisor had concerns over impacts to existing aesthetic features where the DDA has spent nearly $9M in improvements. These features include retaining walls, lighting, and signing.
- The economic impact would be too great if full right-of-way takes were required. Construction impacts to businesses also were identified as a concern. The Supervisor asked that access be a priority when undertaking construction.
- The Supervisor requested impacts to right-of-way be minimized to the greatest extent in Alternative 3 – Boulevard, however stated the information presented to him is sufficient to present to the DDA.

Where possible the Supervisor's comments and recommendations were addressed in the Illustrative Alternatives prior to being presented at Public Meeting #2 and are further discussed in **Section 6**.

4.1.6 Canton Township DDA Meeting #1

MDOT and CDM Smith presented the Illustrative Alternatives to the DDA during their regular meeting on September 19, 2012. Key items of discussion included:

- DDA concerned over losing their investment in the corridor and duration of construction
- The DDA stated they prefer the slip ramp in Alternative 4 – WWTIP Study as it does not have any impact on Ford Road
- The DDA requested that alternatives be combined where possible to get the best advantages of each alternative
- The DDA prepared formal minutes from the meeting with comments that MDOT addressed in a letter found in **Appendix P**. Comments from the minutes are included following the Illustrative Alternatives in **Section 6.3.1**.

Where possible the DDA's comments and recommendations were addressed in the Illustrative Alternatives prior to being presented at Public Meeting #2 and are further discussed in **Section 6**.

4.1.7 Practical Alternative Selection Meeting

The Practical Alternatives Selection Meeting was held on November 14, 2012 with the entire study team present. CDM Smith provided a project update, a summary of Public Meeting #2 including comments received from the public and project stakeholders. The intent of this meeting was to select alternatives to advance as Practical Alternatives. The study team was presented each alternative as well as advantages and disadvantages of each. Based on the support material presented, comments received from the public and stakeholders, the Study Team decided unanimously to advance Alternative 1 – No-Build, Alternative 2 – Operational Improvements, and Alternative 3 – Boulevard as Practical Alternatives. Further discussion of this process can be found in **Section 7**.

4.1.8 Practical Alternative Workshop

The Practical Alternatives Workshop was held on January 9, 2013 with the entire study team present. CDM Smith presented a project update along with information to facilitate discussion for each alternative. The intent of the meeting was to discuss concerns and gather feedback prior to additional analysis. The key points of discussion are included in **Section 7**.

4.1.9 Canton Township DDA Meeting #2

MDOT and CDM Smith presented the Practical Alternatives to the DDA during their regular meeting on February 20, 2013. In general the DDA was most interested in Alternative 3 – Boulevard. Key items of discussion included:

- Suggestions on loon location adjustments to reduce potential right-of-way acquisition, landscaping and environmental issues.
- Suggestions on crossover locations to accommodate turns from large traffic generating businesses.
- Expressed concern for pedestrians crossing freeway entrance ramps.
- Expressed desire for a pedestrian bridge or tunnel at the I-275 Metro Trail crossing.

- Indicated a desire to create an access road behind businesses along Ford Road between Lilley and Haggerty Roads.

Where possible the DDA's comments and recommendations were addressed in the Practical Alternatives prior to being presented at Public Meeting #3 and are further discussed in **Section 7**.

4.1.10 Preferred Alternative Selection Meeting

The Practical Alternatives Selection Meeting was held on May 15, 2013 with the entire study team present. CDM Smith provided a project update, a summary of Public Meeting #3 including comments received from the public and project stakeholders. The intent of this meeting was to select the Preferred Alternative. The study team was presented each alternative as well as advantages and disadvantages of each. Based on the support material presented, comments received from the public and stakeholders, the Study Team decided unanimously to advance Alternative 3 – Boulevard as the Preferred Alternative. Further discussion of this process can be found in **Section 8**.

4.1.11 Traffic Meeting #3

A follow-up meeting was held with Canton Township, SEMCOG, and MDOT's Traffic and Modeling Departments on May 23, 2013 to discuss the latest results from the revised traffic demand model. The traffic demand model was revised to match the latest alternative geometrics and to provide a true comparison. All participants were in agreement on the method and results produced.

4.2 Public Information Meetings

Four public information meetings were held for the project. Each meeting was held to share information such as a project description, data collected to date, alternative development, and, most importantly, to get feedback from the public as to what they see as problems in the study area and to get suggestions as to how the Study Team might address those problems. Further information for all four meetings can be found in their summaries located in **Appendix K**.

4.2.1 Public Information Meeting #1

The first public information meeting was held on June 7, 2012. This open-house style meeting was a success in that there were approximately 50 people in attendance which helped to build a database of perceived issues, problems, and suggestions on how to fix those problems.

Comments received from the public included;

- Provide alternative access on/off I-275
- Limit left turns on Ford Road (to and from businesses)
- Add additional travel and turn lanes on Ford Road
- Create an access road/service drive behind businesses
- Improve other roads within the study area

This information was taken to the brainstorming session for the Illustrative Alternatives.

4.2.2 Public Information Meeting #2

The second public information meeting was held on October 11, 2012. This meeting was also an open-house style meeting and the public was updated on the history of the project, updated on what data had been gathered to-date, and the five Illustrative Alternatives including pros and cons were presented. The public was encouraged to ask questions and discuss the alternatives with the study team members at the meeting. The public was also encouraged to fill out comment sheets for the study team to review.

Feedback from the meeting, including number of votes received is summarized in **Section 6.3.4**, following a detailed description of the Illustrative Alternatives.

4.2.3 Public Information Meeting #3

The third public information meeting was held on March 27, 2013. This meeting was also an open-house style meeting and the public was updated on the history of the project, data gathered to-date and the Illustrative Alternatives. The new material presented included the alternatives selected as Practical Alternatives, pros and cons, and performance measures. The public was encouraged to ask questions and discuss the alternatives with the study team members at the meeting. The public was also encouraged to fill out comment sheets for the study team to review.

Feedback from the meeting, including number of votes received is summarized in **Section 7.3.4**, following a detailed description of the Practical Alternatives.

4.2.4 Public Information Meeting #4

The fourth public information meeting was held on May 30, 2013. This meeting was also an open-house style meeting and the public was updated on the history of the project, data gathered to-date, the Illustrative Alternatives and the Practical Alternatives. The Preferred Alternative was presented in a large format where the public was able to see improvements within the study limits along the entire corridor. Benefits of the alternative were highlighted and next steps in the study and design process were also presented. The public was encouraged to ask questions and discuss the alternative with the study team members at the meeting. The public was also encouraged to fill out comment sheets for the study team to review.

Feedback from the meeting is summarized in **Section 8.1**.

Section 5
Purpose and Need

The project purpose and need was developed in cooperation with MDOT, FHWA, and the public after the first public information meeting, held on June 7, 2012. The project's purpose is to improve operational service on Ford Road and support local land use within the study area which is defined by Lotz Road to the east and Sheldon Road to the west; Warren Road to the north and Cherry Hill to the south. Improving operational service on Ford Road may also involve improvements to the network of local roads within the study area. Comments received by stakeholders, specifically Canton Township DDA, state a desire by the board and residents to "improve safety and traffic movements along the Ford Road corridor, and accessibility of the interchange at I-275/Ford Road."

5.1 Draft Project Purpose and Need

During and after the first public information meeting the Study Team received feedback expressing an overwhelming desire to reduce the congestion on Ford Road to make traffic flow "efficiently and safely". The Study Team went on to develop the Draft Project Purpose and Need.

5.1.1 Draft Project Purpose

The project purpose is to improve existing operational service on Ford Road within the study area by improving traffic operation at the I-275 interchange and at key intersections along the Ford Road corridor, as well as other existing and future transportation needs. The project will promote safe, convenient travel; serve key destinations; and better separate and prioritize commuter, business, and residential traffic along Ford Road in the study area. The project will also support smart, sustainable growth and access management principles in the study area's development and redevelopment.

5.1.2 Draft Project Need

The project need is based on the growing demand for the use of Ford Road for commuter, business, and residential access within the study area, and the need to improve traffic operational levels of service at key intersections and I-275 ramp terminals along the Ford Road corridor. Project needs include improved access and egress from Ford Road to I-275, and improved safety, traffic flow and mobility along Ford Road. Project alternatives will investigate study area system signal timing optimization, limiting left turns to and from Ford Road to major intersections, and connecting business parking areas and driveways as potential short-term solutions. Investigating the addition of through- and turning lanes to Ford Road and the surrounding road network could be part of a long-term solution to alleviate exit ramp queues from I-275 to Ford Road, as well as improve Ford Road safety, efficiency, and capacity.

As indicated, the Draft Project Purpose and Need addressed the issues important to the public, primarily focusing on improving safety and traffic movements along the Ford Road corridor. By identifying where the issues are along the corridor and improving them, the second concern to improve accessibility of the interchange at I-275/Ford Road is addressed. Based upon analysis and further discussion in Study Team meetings, it was determined that modifications to the I-275 freeway and ramps to improve the Ford Road corridor actually degrade the operation of the freeway. Therefore, any reference to suggested improvements to the I-275 freeway was removed from the Project Purpose and Need.

5.2 Final Project Purpose and Need

The Draft Project Purpose and Need was unveiled at the second public information meeting and comments were collected from the public and stakeholders. The Draft Final Project Purpose and Need was developed and submitted once again to the Study Team and discussed thoroughly during the Practical Alternatives Selection Meeting on November 14, 2012. A recommendation was made to remove any reference to improving the I-275 interchange as it had been determined during the Illustrative Alternatives process and through feedback from FHWA that the primary issues were related to the M-153 (Ford Rd) corridor and not the freeway or its ramps.

5.2.1 Final Project Purpose

The project will need to improve operational service on Ford Road between Lotz Road and Sheldon Road, without degrading I-275 operations, and will:

- Consider improvements to key intersections along Ford Road at Lotz, Haggerty, Lilley, Morton Taylor, and Sheldon Roads.
- Consider improvements on Ford Road and on local roads benefitting the operations of Ford Road.
- Incorporate existing and future transportation needs while respecting local land use.
- Increase users' safety and convenient travel while serving key destinations.
- Better separate and prioritize commuter, business, and residential traffic.
- Give attention to truck traffic movements.
- Support smart sustainable growth and apply access management principles.

5.2.2 Final Project Need

The project is needed as a result of:

- Growing use of Ford Road by commuter, businesses, and residents.
- Traffic operational levels-of-service at key intersections along the Ford Road corridor.
- Current level of safety.
- Decreasing traffic flow and mobility along Ford Road.

Section 6
Illustrative Alternatives Development

6.1 Illustrative Alternatives Traffic Analysis

Traffic analysis was performed within the Ford Road and I-275 study area and is documented in the Traffic Operations Report attached as **Appendix B**. The following section summarizes the analysis and results of the traffic analysis process and a comparison of Illustrative Alternatives.

Existing traffic data was gathered at the 28 signalized intersections and adjoining roadway segments within the study boundary and projected to the design year 2035 at a rate of 0.5 percent per year, based on coordination with the study team including; MDOT, SEMCOG, and Canton Township.

Traffic operations were analyzed for existing and future conditions using Synchro for the signalized intersection and HCS+ for the freeway segments and ramp merge and diverge points. The first step in the analysis was to develop a Synchro model based on 2012 traffic counts which was calibrated to match documented signal plans and observed field conditions. The 2012 traffic volumes were then forecast to 2035 future No-Build volumes and modeled using Synchro. Similarly, freeway 2012 traffic counts were analyzed and projected to 2035 volumes.

The No-Build and six Illustrative Alternatives were developed and their traffic volumes modeled using the SEMCOG Travel Demand Model (TDM) to determine the modified travel patterns within the sub-area Ford Road/I-275 project limits. CDM Smith coded the network changes into the TDM and changes in traffic volumes observed in the TDM were used to adjust the forecasted counts in the micro simulation model, Synchro.

The traffic analysis revealed that the majority of intersections within the study limits are projected to operate acceptably in the future with the exception of Ford Road between Sheldon Road and Haggerty Road.

6.2 Illustrative Alternatives

The Illustrative Alternatives process began with a design team brainstorming session where numerous alternatives were developed. The Draft Purpose and Need and public feedback from Public Information Meeting #1 (see **Section 4.2.1**) as a guide during this process and attempted to minimize impacts to right-of-way or other known environmental features as each alternative was developed. Through much deliberation, the following eight Illustrative Alternative concepts were considered worthy of additional analysis and are included in **Appendix L**;

- Alternative 1 – No-Build
- Alternative 2 – Operational Improvements
- Alternative 3a – Ford Road Boulevard
- Alternative 3b – Haggerty Road Boulevard
- Alternative 3c – Ford/Haggerty Boulevard

- Alternative 4 – WWTIP Study
- Alternative 5a – Warren Road Interchange
- Alternative 5b – Cherry Hill Road Interchange

Additional improvements were also presented which included various safety-related features or those that would benefit other modes of travel such as pedestrian or bicycle. These improvements were to be considered applicable to each of the above alternatives.

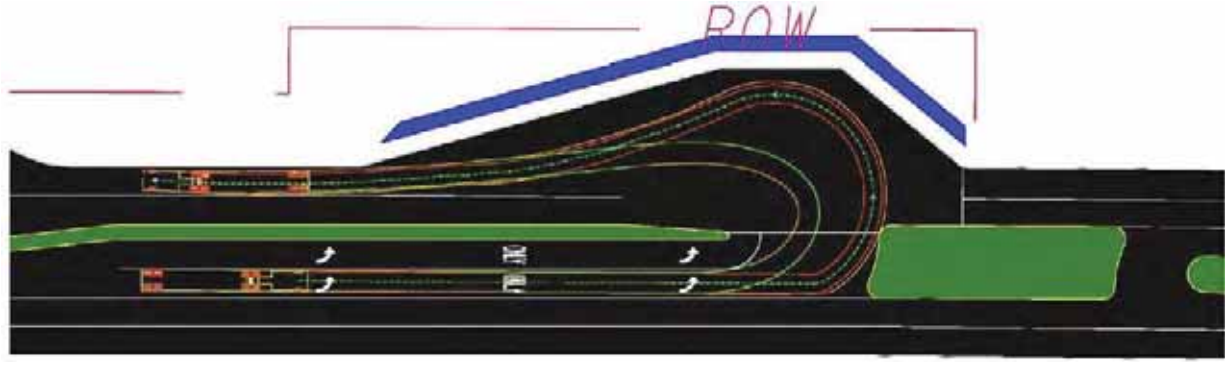
Through numerous iterations of geometric and traffic analysis each of the alternatives evolved from their initial concepts. These iterations were done to further minimize right-of-way impacts, minimize cost, optimize traffic operations, and minimize/avoid environmental impacts. For example, Alternative 5a and 5b had numerous interchange configurations at both Cherry Hill and Warren Road including a split, a single point urban interchange. Each version of the eight alternatives developed went through this process to determine which one provides the most benefit relative to the estimated construction cost.

Comparison criteria were established for further analysis of each alternative based upon the data collected to date. The comparison considerations were as follows:

- Estimated Cost (high level and compared to other alternatives)
- Right-of-way Impact
- Level of Service at major cross street intersections with Ford Road
- Geometrics (design exceptions)
- Constructability
- Maintenance
- Environmental Impacts (primarily conservation easement and wetland encroachment)

Through development of the Illustrative Alternatives and an initial run through the comparison criteria, it was determined that combining the variations of Alternative 5 (separate interchanges) into one was most feasible as they both achieved the same goal, which was providing a diversion of traffic (primarily residential) away from the I-275 at Ford Road interchange. Furthermore, the Study Team did not see the benefit in only providing a boulevard on Haggerty as this did not correct deficiencies at other intersections along Ford Road. Alternative 3b – Haggerty Boulevard was then removed from consideration, and the Ford/Haggerty Road Boulevards became the new Alternative 3b. This then reduced the alternatives to seven. A variation to the boulevard options was prepared which included trunk turnarounds (loons); see **Figure 6-1**, along Ford and Haggerty which then restricted truck turns at the signal. The loons were provided as an option to reduce right-of-way impacts along the entire corridor by reducing the median width. The loons were presented as an option to be considered however was not included in the initial alternatives investigation.

Figure 6-1 Commercial Vehicle Turn-around (Loon)



The seven alternatives were initially presented to the Study Team at the Illustrative Alternatives Study Team Meeting, held on August 16, 2012. The goal of this meeting was to seek consensus that the public feedback was addressed and that each were in keeping with the Draft Purpose and Need. Overall peak levels of service (LOS) were presented on each alternative exhibit which indicated if any failing movement existed and at what time (AM peak, PM peak, or off peak). Diversion percentages were also presented detailing the amount of traffic that the Alternative 5 new interchanges provided. Detailed description of each alternative, as well as the advantages and disadvantages of each follows while feedback from Study Team members and the public is included in **Section 6.3** below.

6.2.1 Alternative 1 – No-Build

Description:

- Maintains the existing geometry and operations along Ford Road with optimized signal timings

Advantages:

- No additional right-of-way or environmental impacts

Disadvantages:

- Does not address operational deficiencies along Ford Road
- Ford Road at capacity for 2012 traffic, which consistently gets worse through 2035 study year
- Traffic backups continue at each intersection and on southbound I-275 ramp at Ford Road
- Does not improve existing Ford Road pavement condition

Traffic Summary:

Overall intersection LOS degraded between 2012 and 2035, with overall intersection LOS F projected at Haggerty Road and Sheldon Road simply due to the increased traffic volumes and lack of operational improvements.

6.2.2 Alternative 2 – Operational Improvements

This alternative provides some short-term benefit as the addition of through and turn lanes allow additional volumes of traffic to progress along Ford Road. The duration of the benefit is not anticipated to be long however as Ford Road quickly reaches capacity and intersections are degraded back to current LOS. Access management could also be a focus primarily between Haggerty Road and Lilley Road, where driveway access could be restricted to right in/right out and service drives could be investigated further to relieve congestion on Ford between the two intersections.

Description:

- Addition of westbound through-lane on Ford Road from I-275 to Sheldon Road
- Addition of eastbound through-lane from Lilley Road to Haggerty Road
- Conversion of westbound right turn bay to thru and right at Haggerty Road
- Conversion of northbound right turn bay to through and right at Lilley Road, and additional pavement for receiving lane
- Addition of southbound and westbound right turn bay at Lilley Road
- Addition of northbound right turn bay at Sheldon Road
- Modified geometry of I-275 northwest loop ramp
- Continuity and addition of sidewalks
- Additional pedestrian and safety improvements

Advantages:

- No right-of-way impacts anticipated. Most lane improvements can be completed within MDOT right-of-way.
- Low construction impact relative to other options
- Low construction cost relative to other options
- Provides short-term relief and some additional safety improvements, such as sidewalk and pushbutton pedestrian signals

Disadvantages:

- Attracts approximately 15 to 25 percent more vehicles with an added lane on Ford Road
- Quickly reaches capacity and only achieves minor levels of service improvement relative to existing condition
- Traffic backups continue on southbound I-275 ramp at Ford Road
- Does not improve existing Ford Road pavement condition

Traffic Summary:

Due to the addition of a westbound through lane, traffic volumes are projected to grow by approximately 15-25 percent in 2035 along westbound Ford Road. The Overall intersection LOS marginally improves along Ford Road compared to Alternative 1; however intersection LOS F is still projected at Haggerty Road and Sheldon Road.

6.2.3 Alternative 3a – Ford Road Boulevard

Description:

- Provides a boulevard with two through-lanes in each direction throughout, a dedicated right/through lane westbound and eastbound from I-275 to the IKEA entrance, with restricted left turns at intersections, numerous passenger vehicle turnarounds, and truck turnarounds (loons) where necessary
- Additional pedestrian and safety improvements
- Other boulevard options may also be investigated, such as adding boulevards to other major north/south crossings, limiting truck turnarounds, or a modified roadway alignment
- Signals may be required at indirect left/loon locations based upon further traffic analysis

Advantages:

- Moderate construction impacts relative to other options
- Moderate construction cost relative to other options
- Moderate right-of-way impacts
- Improved safety (restricted left turns) – safer access to businesses
- Minimal environmental impacts
- Improved level of service at major signalized intersections along Ford Road
- Continuity of sidewalks and improved safety by providing crossings and pedestrian islands
- Reduction in traffic backups on southbound I-275 at Ford Road due to improved Ford Road operations

Disadvantages:

- Limited truck turnarounds along Ford Road and/or Haggerty Road
- Indirect access to businesses

Traffic Summary:

Operations are projected to improve along Ford Road to overall intersection LOS C or better due to the restriction of left turns at all Ford Road signalized intersections. Signals at loon locations would be in close proximity to intersection signal but all three would be regulated by the same controller allowing for fluid traffic movements, without the propagated backup currently seen along Ford Road at I-275 and Lotz Road from the Haggerty Road signal.

6.2.4 Alternative 3b – Haggerty Road Boulevard

Description:

- Provides a Haggerty Road boulevard with two through-lanes in each direction, with restricted left turns at Ford Road
- Additional pedestrian and safety improvements

Advantages:

- Moderate construction impacts relative to other options
- Moderate construction cost relative to other options
- Low/moderate right-of-way impacts
- Improved safety (restricted left turns) – safer access to businesses
- Minimal environmental impacts
- Improved level of service only at Haggerty Road Intersection
- Continuity of sidewalks and improved safety by providing crossings and pedestrian islands
- Reduction in traffic backups on southbound Haggerty Road at Ford Road

Disadvantages:

- Does not provide improvements to other major intersections within study area
- Indirect access to businesses

Traffic Summary:

Operations are projected to improve at Haggerty Road to overall intersection LOS C or better; however LOS F is still projected at Sheldon Road.

6.2.5 Alternative 3c – Ford Road and Haggerty Road Boulevards

Description:

- Provides Ford Road and Haggerty Road boulevards with two through-lanes in each direction, with restricted left turns at intersections, numerous passenger vehicle turnarounds, and truck turnarounds (loons) where necessary

- Additional pedestrian and safety improvements
- Other boulevard options may also be investigated, such as adding boulevards to other major north/south crossings, limiting truck turnarounds, or a modified roadway alignment

Advantages:

- Moderate construction impacts relative to other options
- Moderate construction cost relative to other options
- Moderate right-of-way impacts
- Improved safety (restricted left turns) – safer access to businesses
- Minimal environmental impacts
- Improved level of service at major signalized intersections along Ford Road
- Continuity of sidewalks and improved safety by providing crossings and pedestrian islands
- Reduction in traffic backups on southbound I-275 at Ford Road due to improved Ford Road operations
- Eliminates need for dual lane loon with signal between Haggerty Road and I-275 which, due to close signal proximity, would be detrimental to traffic operations

Disadvantages:

- Limited truck turnarounds along Ford Road and/or Haggerty Road
- Indirect access to businesses

Traffic Summary:

Operations are projected to improve along Ford Road to overall intersection LOS C or better with slightly improved operations at Haggerty Road over Alternative 3a.

6.2.6 Alternative 4 – Western Wayne Transportation Improvement Plan (WWTIP)

Description:

- Provides direct southbound I-275 ramp access to Haggerty Road north and south of Ford Road, reducing congestion at the Ford Road/Haggerty Road intersection. It is anticipated this will be a left turn only (south of Ford Road) and a right turn only (north of Ford Road) condition and a signal may be required based upon further traffic analysis. Includes a frontage road from Cherry Hill Road north to Ford Road and a modification of the northbound I-275 entrance ramp.
- Additional pedestrian and safety improvements

Advantages:

- Minimal construction impacts to Ford Road (off alignment)
- Improvement in level of service at Ford Road/Haggerty Road
- Draws traffic away from Haggerty Road
- Safety improvements, such as sidewalk and pushbutton pedestrian signals along Ford Road

Disadvantages:

- Reduction in LOS on I-275, which would degrade operation and safety of the interchange ramps
- Many right-of-way impacts anticipated including multi-family housing, businesses, and undeveloped land with sensitive natural resources and water quality concerns
- Impacts a conservation easement in the NE quadrant of I-275 and Cherry Hill Road identified as wetland complex #081 in the Ecological Assessment Report located in **Appendix E**
- Potentially contaminated soils in the NE quadrant of I-275 and Cherry Hill Road identified as RECs #47, #48 and #49 in the PACS Report located in **Appendix G**
- Moderate to high construction cost compared to other alternatives
- Does not address congestion on Ford Road except at Haggerty Road
- All other intersections similar to No-Build
- No change to Ford Road relative to safety, difficult access to businesses during peak times, etc.
- Confusing interchange ramp operations and geometric configuration with multiple decision points
- Increased maintenance costs due to addition of pavement, retaining walls, and bridge widening
- Does not improve existing Ford Road pavement condition

Traffic Summary:

Operations are projected to improve marginally at Haggerty Road to overall intersection LOS E; however LOS F is still projected at Sheldon Road. It is anticipated that this non-typical, successive ramp configuration will cause confusion for motorists and may potentially result in accidents on the ramp or along the freeway. The interchange modification will also not meet FHWA's freeway access requirements. Furthermore, a new signal is anticipated at the new southbound slip ramp and Haggerty Road which may result in traffic backing up into the Ford Road/Haggerty Road intersection.

6.2.7 Alternative 5 – New Interchanges

Description:

- Provides full access interchanges at Cherry Hill Road and Warren Road to alleviate traffic at the Ford Road/Haggerty Road intersection as well as the Ford Road/I-275 interchange
- Additional pedestrian and safety improvements

Advantages:

- Provides full access to and from Cherry Hill Road and Warren Road
- Diverts traffic away from Haggerty Road
- Safety improvements, such as sidewalk and pushbutton pedestrian signals along Ford Road

Disadvantages:

- High construction cost and future maintenance costs
- Major right-of-way impacts
- Many environmental impacts anticipated including within a conservation easement and REC locations
- Introduces conflicts with existing ramps to Ford Road which makes the freeway less safe
- Cherry Hill Rest Area entrance ramp to northbound I-275 too close to proposed exit ramp to Cherry Hill Road
- Minimal diversion of traffic from Ford Road and Haggerty Road
- Does not improve existing Ford Road pavement condition

Traffic Summary:

The additional interchange access points are projected to divert approximately 20-30 percent of the traffic away from Ford Road interchange, however only a 10 percent reduction at the Haggerty Road intersection and to the west. The Warren Road interchange will require two new signals at the I-275 ramp terminals and Warren road will need to be expanded to a five lane section. The Cherry Hill Road interchange will also require two new signals at the I-275 ramp terminals and Cherry Hill Road will need to be expanded to a five lane section. No additional improvements were included along Ford Road and overall intersection LOS F is still projected at Haggerty Road and Sheldon Road.

6.2.8 Levels of Service Summary

Table 6.1 below illustrates the overall intersection LOS for each of the Illustrative Alternatives. As indicated, only Alternatives 3a – Ford Road Boulevard and Alternative 3c – Ford/Haggerty Boulevards have acceptable LOS for the 2035 study year.

Table 6-1 Illustrative Alternative Overall 2035 Intersection LOS

Intersection	Peak Hour	Illustrative Alternative						
		1	2	3a	3 b	3c	4	5
Sheldon	AM	C	C	B	C	B	C	C
	PM	D	D	B	D	B	D	D
	OP	F	E	C	F	C	F	F
Morton Taylor	AM	B	B	A	B	A	B	B
	PM	B	C	B	C	B	C	C
	OP	C	C	B	C	B	C	C
Lilley	AM	D	C	B	D	B	D	D
	PM	F	F	C	E	C	F	E
	OP	E	E	C	E	C	E	E
Haggerty	AM	F	D	B	B	B	D	F
	PM	F	F	B	B	B	D	F
	OP	D	E	C	C	C	D	D

6.2.9 Additional Improvements for Alternatives 1-5

The following improvements are a complete list from the RSA and Public Information Meeting #1 comments. Improvements exclusive to the public meeting are noted as such. Some of these such as the Ford and Haggerty Road Boulevards are incorporated into the Illustrative Alternatives. The others could be applied to any of the Illustrative Alternatives or included as a standalone project by either MDOT or Wayne County.

Crash Specific Improvements

- Construct a boulevard section on Ford Road from west of I-275 to west of Sheldon Road
- Construct a boulevard section on Haggerty Road from south of Ford Road to north of Ford Road
- Construct three through lanes on westbound Ford Road from east of I-275 to Sheldon Road
- Construct dual left turn lanes
- Provide a pedestrian crossing at the existing northbound I-275 exit ramp signalized intersection
- Provide street lighting at signalized intersections
- Reduce the length of the existing raised median on Ford Road to provide additional storage for westbound left-turn movements
- Provide a pedestrian crossing with refuge island at on Ford Road east of the IKEA drive
- Extend the two-way center turn lane on Haggerty Road between Cherry Hill Road and Ford Road
- Provide a roundabout at Cherry Hill Road/Haggerty Road
- Provide a vehicle sensor for westbound Cherry Hill Road and the I-275 overpass to alert drivers of queuing over the bridge
- Extend the merge taper on southbound Lilley Road south of Ford Road

General Improvements

- Connect gaps in existing sidewalk especially through I-275 interchange
- Provide hatching in gore/shoulder area on the eastbound Ford Road to northbound I-275 ramp
- Install back plates on all traffic signal heads
- Pave Lotz Road between Ford and Cherry Hill Roads
- Provide countdown timers at all signals and pedestrian pushbuttons to cross Ford Road
- Pursue improvements to access management throughout Ford Road corridor
- Signal optimization (PIM #1)
- Eliminate left turns at non-signalized driveways and intersections (PIM #1)
- Provide parking lot connectivity and service roads, namely south of Ford Road between Haggerty and Lilley Roads (PIM #1)
- Direct parking lot traffic to existing signals (PIM #1)
- Add pavement markings to guide motorists through dual ramp turns (PIM #1)

6.3 Illustrative Alternatives Feedback

Below is a brief summary of comments that have been received for each of the Illustrative Alternatives from the Illustrative Alternatives Study Team meetings. Study Team member, city of Westland, only attended the kickoff meeting. However they were invited to all meetings and provided meetings materials like the other invitees.

6.3.1 Canton Township DDA Comments

The DDA presented MDOT with formal meeting minutes and the following comments;

- Alternative 1 – Not supported, would eventually lead to gridlock.
- Alternative 2 – Supported, would offer short-term relief, in favor of initial effort.
- Alternative 3 – Supported, would consider alt moving forward with questions.
- Alternative 4 – Supported, perhaps in combination with other alternatives.
- Alternative 5 – Not supported based on high costs and impacts to developments at interchanges.
- Significant funds have been invested on Ford Road. Canton Twp. /DDA will be interested in investigating cost share of impacts to these investments with MDOT.

6.3.2 Wayne County DPS Comments

Additional Improvements:

- Does not favor roundabouts and would prefer other treatments be examined.
- Is there an option to adding these or <u>should</u> they be included to achieve a certain LOS per alternative?
- Would this require widening/reconstruction of Cherry Hill over I-275?

- Site access impacts near roundabouts.
- Has a 3-lane boulevard been investigated for Ford Road similar to US-12 (Michigan Ave.)?

6.3.3 FHWA Comments

Believes Alternative 3a (Ford Road Boulevard) to be the best alternative because it best addresses the project Purpose and Need:

- It provides very good increases in Level of Service (LOS) as compared to the other alternatives with some right-of-way impacts and has no I-275 impacts.
- It offers the option of pursuing Alternative 3b (Haggerty Road Boulevard) as part of an initial project or as a future project.

Alternative 4 WWTIP Study should be rejected. It requires an Interstate Access Change Request (IACR) approval by FHWA. FHWA will not approve the alternate as proposed because:

- The project Purpose and Need can be addressed by improvements to local roadways without altering I-275.
- This alternative would degrade the LOS for I-275.
- The merging of traffic on entrance and exit ramps on I-275 is not acceptable.
- The non-typical slip ramp for South Bound Haggerty Road traffic would be very confusing.

Alternative 5 New Interchanges do not meet the project Purpose and Need due to degradation of freeway and FHWA would not grant an IACR due to inadequate and unsafe distances between proposed and existing interchanges.

6.3.4 Public Comments

Based upon comments received from the Study Team and those presented above, the CDM Smith team revised the alternatives and modified exhibits for presentation to the public at Public Information Meeting #2. Further detail on this meeting can be found in **Section 4.2.2**.

The public was asked to vote for their favorite three alternatives based on the information provided at the public meeting along with providing input on important factors for analyzing alternatives. The votes were tallied and are presented below.

Alternative 1 – No-Build (0 votes)

- Unacceptable option
- Not a desirable option, something needs to be done!

Alternative 2 – Operational Improvements (6 votes)

- Too short term of a fix
- Install Smart Lights which are timed based on volume of traffic

- Prohibit left turns from/to Ford Road
- Would be a good start toward better traffic movements through corridor

Alternative 3 – Boulevard Option (24 votes)

- Turnarounds will save time and add safety
- Want access to businesses investigated further
- Fully support option, as a resident, never travel on Ford Road unless there is no other option
- Don't need another Michigan Avenue
- Strong support for paving Lotz Road
- Need to find a way to reduce traffic in study area
- Concerned with construction impacts

Alternative 4 – WWTIP Alternative (18 votes)

- Some items might work to improve situation
- Too complicated for southbound Haggerty from southbound I-275
- Too expensive, not enough access
- Separate commercial traffic from corridor as much as possible
- Spurs (slip ramps) and frontage road great ideas, in combination with boulevard option

Alternative 5 – New Interchanges (12 votes)

- Do not like new interchange option
- Moderate improvement, may be better than ramp project
- This will help the best and will separate those going to businesses on Ford and those trying to go home
- Adding an interchange at Cherry Hill or Warren is unrealistic as all four quadrants are developed in each
- Approve, but only at Cherry Hill
- Far too costly with detrimental impact on existing development

Table 6-2 Important Factors for Analyzing Alternatives

Noise	8
Natural Resources (waterways)	5
Direct Access to Businesses	12
Property Impacts (Right of Way/Land Use)	13
Parkland/Greenspace	5
Contamination	6
Air Quality	6
Water Quality	6
Pedestrian and Bike Access	10
Other: Traffic Flow	13

Section 7
Practical Alternatives Development

7.1 Practical Alternatives

As stated previously in **Section 4.1.7** the alternatives advanced as Practical Alternatives included Alternative 1 – No-Build, Alternative 2 – Operational Improvements, and Alternative 3 – Boulevard which are shown in **Appendix M**. Comments received from the public and stakeholder meetings drove the refinement and development of the Practical Alternatives. The reasons for these selections are listed below.

Alternative 1 – No-Build

- Carried forward as a base-line to compare with other alternatives.

Alternative 2 – Operational Improvements

- Has no right-of-way and environmental impacts.
- Has a lower construction cost relative to other build alternatives.
- This alternative can be constructed relatively quickly to alleviate existing congestion allowing time to obtain funding and complete final design on a long term solution.
- Satisfies the Purpose and Need for the most part

Alternative 3 – Boulevard

- Has minimal environmental impacts relative to other build alternatives.
- Has a lower construction cost relative to other build alternatives.
- Improves safety and traffic operations along Ford Road.
- Satisfies the Purpose and Need the best

Alternative 4 – WWTIP Study

- Does not meet the Purpose and Need which focuses on addressing safety and traffic operations on Ford Road.
- FHWA would not grant an Interstate Access Change Request because the alternative potentially degrades the functioning of I-275, which operates well now and into the future if all other conditions remain constant.
- May require design exceptions for proximity of sequential ramps and weave/merge distance for slip ramps to Haggerty Road.

- Excessive environmental impacts including the potential of contaminated soils in the NE quadrant of I-275 and Cherry Hill Road and a conservation easement in the same quadrant. Other impacts include the purchase of undeveloped land with sensitive natural resources and water quality concerns.

Alternative 5 – Warren and Cherry Hill Road Interchanges

- Does not meet the Purpose and Need which focuses on addressing safety and traffic operations on Ford Road.
- FHWA would not grant an Interstate Access Change Request because the alternative potentially degrades the functioning of I-275, which operates well now and into the future if all other conditions remain constant.
- Excessive environmental impacts including the potential of contaminated soils in the NE quadrant of I-275 and Cherry Hill Road and a conservation easement in the same quadrant. Other impacts include the purchase of multi-family housing, businesses, and undeveloped land with sensitive natural resources and water quality concerns.
- High costs with only minimal percentage of Ford Road traffic diverted.
- Would require a design exception due to inadequate distance between interchanges (Warren and Ford) and an unsafe weave/merge lane that is introduced.
- Increases traffic on Warren and Cherry Hill Roads, which currently carries residential traffic and does not have the capacity to accommodate the additional traffic.

7.1.1 Alternative 1 – No-Build

Alternative 1 was not modified from the Illustrative Alternative discussed in **Section 6.2.1**. Additional analysis for this alternative was done by team member Somat Engineering to determine the existing pavement conditions based on historical soil boring information. Some of the 1999 pavement core records show either fair or poor pavement conditions. Clay or clayey subgrade soils were also encountered. MDOT records do not show a pavement reconstruction on this stretch of Ford Road for the last 30+ years. Due to these findings, Alternative 1 was anticipated to require a full reconstruct, even if capacity improvements are not done, within ten years making it a comparable construction cost to the other Practical Alternatives. This analysis can be found in the Geotechnical Conditions Report located in **Appendix H**.

7.1.2 Alternative 2 – Operational Improvements

Further analysis of Alternative 2 included providing additional capacity for it to be considered a more viable long term solution. Improvements included a third eastbound through lane from Lilley Road and I-275 along with additional turn and receiving lanes at intersections with Ford Road. These items led to an anticipated additional right-of-way impact but improved overall intersection LOS at Sheldon, Lilley and Haggerty Roads as can be seen by comparing **Tables 6-1** and **7-1**. A traffic operations sensitivity analysis was also completed which resulted in Lilley Road degrading to an LOS E by 2030 and Haggerty Road by 2025. Similar to Alternative 1, Alternative 2 was anticipated to require a full reconstruct within ten years making it a comparable construction cost to the other Practical Alternatives.

7.1.3 Alternative 3 –Boulevard

The only capacity modification to Practical Alternative 3 from the Illustrative Alternative stage was providing a third westbound through lane from I-275 to Lilley Road. Utilizing a six-lane boulevard for the entire project limits was investigated but was not necessary to accommodate 2035 traffic. Right-of-way will likely need to be purchased along the entire six-lane boulevard section including at the existing MDEQ conservation easement in the southeast quadrant of Morton Taylor Road, shown in Figure 5 of the Ecological Assessment Report located in **Appendix E**. Loon locations were also modified to improve operations and reduce real estate impact. Some options discussed to further minimize the real estate impact included:

- Do not provide loons at every intersection and only provide passenger vehicle turnarounds directly opposite some intersections. This option would not meet driver expectation and could lead to larger vehicles attempting to use inadequately sized turnaround regardless of adequate signing.
- Allow direct left turns at problematic intersections or where LOS allows, such as Morton Taylor Road. This option will be considered if issues arise during future project phases such as real estate acquisition.
- Utilize a meandering alignment which would result in an equal width right-of-way impact on both sides of Ford Road possibly leading to partial instead of full parcel acquisitions. The overall right-of-way impact area would increase with one of those impacts being at the existing conservation easement in the southeast quadrant of Morton Taylor Road. Due to this impact and operation concerns, this option was removed from consideration.

7.1.4 Traffic Analysis

The Travel Demand Model (TDM) was modified for Practical Alternatives 2 and 3 to reflect the latest alternative geometrics discussed above. This additional analysis ensured the traffic volumes assigned to each alternative was consistent and accurate. **Table 7.1** below illustrates the overall intersection LOS for each of the Practical Alternatives. As indicated, only Alternative 3 – Boulevard has acceptable intersection LOS for the 2035 study year.

Table 7-1 Practical Alternative Overall Intersection LOS

Intersection	Peak Hour	Practical Alternative		
		1	2	3
Sheldon	AM	C	C	A
	PM	D	D	A
	OP	F	D	B
Morton Taylor	AM	B	B	A
	PM	B	C	B
	OP	C	C	B
Lilley	AM	D	C	A
	PM	F	D	B
	OP	E	D	C
Haggerty	AM	F	E	B
	PM	F	E	B
	OP	D	C	B

A sensitivity analysis was also completed to verify that additional potential developments could be accommodated within the corridor by the proposed network improvements. The operational sensitivity of Practical Alternative 2 and 3 was tested for two scenarios:

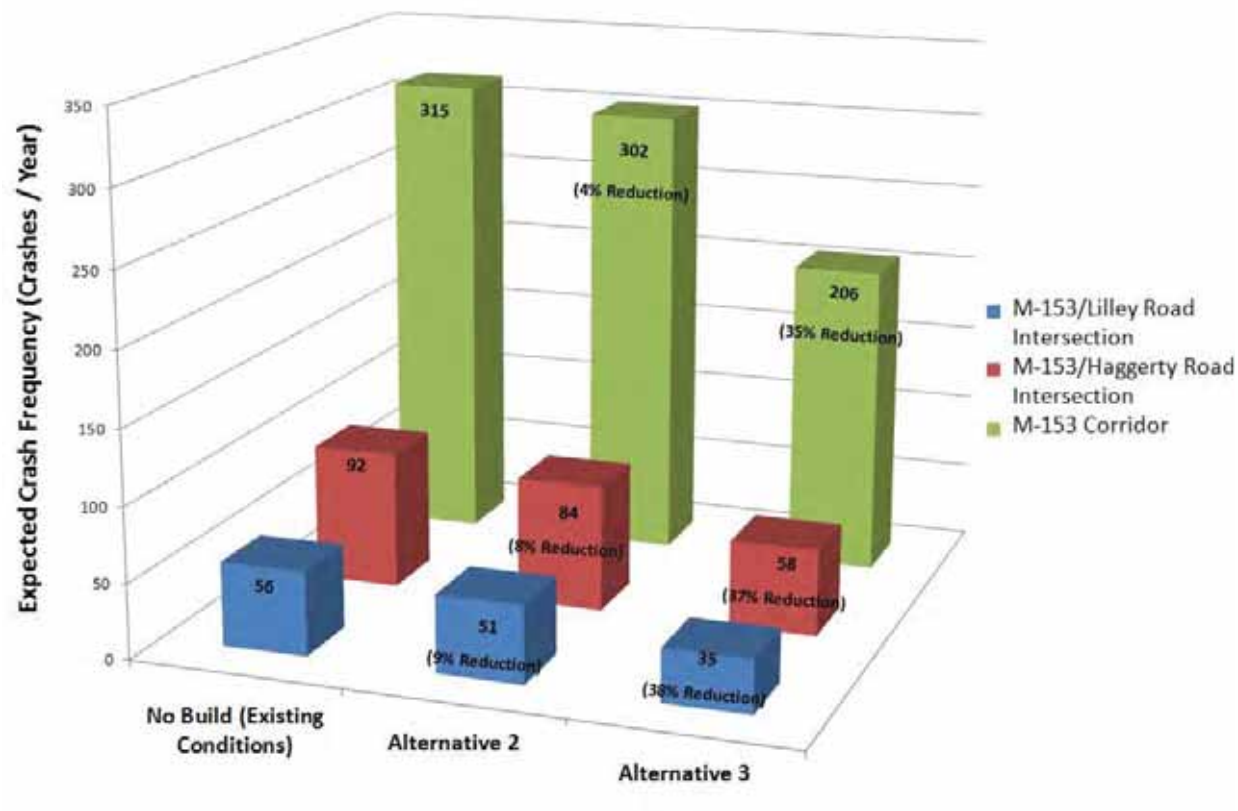
- Development of a large manufacturing facility requiring 2,000 weekly truck trips on Haggerty Road, north of Warren Road. Rerouting from Haggerty Road to Warren Road and Lotz Road to access the freeway.
- Future development of four commercial parcels in the vicinity of Ford Road and Lotz Road. The intersection of Ford Road and Lotz Road would require significant geometric improvements if the Lotz Road commercial parcels were to be fully developed.

Refer to the Traffic Operations Report located in **Appendix B** for full analysis.

7.1.5 Anticipated Crash Summary

The Study Team performed an analysis of the crash history within the project limits as discussed previously in **Section 3.4**. They also utilized the Highway Safety Manual, First Edition, to estimate the expected average crash frequency of the Practical Alternatives. As shown below in **Figure 7-1** Alternative 3 results in a significant reduction in expected crashes along Ford Road relative to existing conditions while Alternative 2 is anticipated to have a slight reduction. The turn lanes added to Alternative 2 decreases the anticipated crash frequency but the additional through lanes nearly offsets that improvement since mid-block left turns would cross more lanes. Utilizing a boulevard for Alternative 3 reduces the anticipated crash frequency since left turns are removed from both intersections and mid-block, which are accommodated by median crossovers. The memorandum discussing this analysis along with calculations can be found in **Appendix C**.

Figure 7-1 Anticipated 2035 Practical Alternative Crash Frequency



7.1.6 Hydraulic Analysis

A hydraulic analysis was conducted for the Willow Creek and Smith Drain (Willow Creek Tributary) structures under Haggerty Road. The Willow Creek crossing is north of Ford Road and is currently outside of the project limits. This analysis was completed in case the project limit was lengthened. The Smith Drain crossing is south of Ford Road within the project limits and may be replaced in conjunction with the road work. The existing Willow Creek crossing consists of two 11-foot span by 8-foot rise culverts with a length of 100 feet. The proposed Willow Creek crossing is a 28-foot span prestressed concrete box bream bridge. The 100-year water surface elevation decreases by 0.02 feet from 672.13 to 672.11. The existing Smith Drain crossing consists of one 11-foot span by 8-foot rise culvert with a length of 149 feet. The proposed Smith Drain crossing is a 16-foot span by 7-foot rise three-sided concrete culvert with a length of 184 feet. The additional length is due to a truck turnaround being proposed at this location to minimize impact to adjacent businesses. If this location becomes an environmental constraint, it could shift to the north depending on impacts to the business located there. Smith Drain is a MDEQ regulated watercourse and will require a permit. The 100-year water surface elevation decreases by 0.05 feet from 670.94 to 670.89. Additional information can be found in the Smith Drain and Willow Creek Hydraulic Reports located in **Appendix N**.

7.1.7 Additional Improvements

As discussed previously in **Section 6.2.9** there are numerous additional improvements that were identified during the Road Safety Audit and at the Public Information Meetings. Some of these do not meet the project Purpose and Need and will not be constructed as part of this project. Instead information on the following improvements has been provided to MDOT and Wayne County to assist in future project planning and scoping.

Southbound I-275 Exit Ramp Weave Extension

Extending the weave lane for southbound I-275's exit ramp to Ford Road further north a double exit can be accommodated. This improvement will allow for a more gradual transition to the four-lane terminus at Ford Road than what currently exists and improve the No-Build future year LOS from F to B. No right-of-way impact is anticipated but lengthening the Warren Road structure may be necessary. Another option is to modify the existing gore location and widen to the inside to reduce the northerly expansion and the associated impact at Warren Road. An exhibit of this potential improvement is located in **Appendix O**.

Southbound I-275 Exit Slip Ramp to Northbound Haggerty Road

One potential improvement that warranted further analysis is the southbound I-275 exit slip ramp to northbound Haggerty Road as an option to accommodate the large volume of trucks making this movement. A signal at the Haggerty Road terminus would be likely to prevent vehicles queuing onto the freeway. The signal would be in close proximity to the Ford and Haggerty Road intersection potentially leading to backups between the two signals during peak hours. In addition to the ramp terminal concerns, providing a slip ramp to northbound Haggerty Road would require a successive exit ramp configuration that would cause confusion for motorists and potentially result in accidents on the ramp or along the freeway. This is partly due to the heavy freeway volumes that are approaching capacity especially by 2025, which results in a high sensitivity to congestion based on minor geometric modifications. Adding an exit to northbound Haggerty Road could trigger a queue on the freeway which in turn could increase the crash occurrence. Due to these operational issues the improvement was not advanced. To accommodate this movement a dedicated right turn lane from the southbound I-275 exit ramp to Haggerty Road was added instead.

Southbound Haggerty Road Truck Reroute

Another downfall of the southbound I-275 exit slip ramp to northbound Haggerty Road is that southbound Haggerty Road trucks must still negotiate the Ford and Haggerty Road intersection. An improvement explored was to reroute southbound Haggerty Road trucks to the I-275 interchange via Warren and Lotz Roads. To accommodate this movement Warren Road would have to be upgraded to a Class A roadway, the Warren and Lotz Road intersection widened and improvements at the Lotz and Ford Road intersection. A memorandum was compiled, included in **Appendix O**, which was provided to Wayne County for reference if this project is pursued in the future.

Paving Lotz Road

Another potential improvement is paving Lotz Road between Ford and Cherry Hill Roads. Paving Lotz Road would require upgrading the road to a design speed of 50 miles per hour which would lead to an alignment shift of 20 to 30 feet for one of the existing curves. Canton Township currently owns property at this location in anticipation of such an upgrade. Multiple culverts, including two 96 inch metal culverts, would need to be lengthened or replaced to accommodate the proposed three-lane roadway. Currently Lotz Road is not a federal fund eligible roadway but information was provided to Wayne County to assist in becoming eligible. A memorandum was compiled, included in **Appendix O**, which was provided to Wayne County for reference if this project is pursued in the future.

7.2 Practical Alternatives Feedback

Below is a brief summary of comments received for each of the Practical Alternatives from the Practical Alternatives Study Team meetings.

7.2.1 Canton Township DDA Comments

As stated in **Section 4.1.9** the Canton Township DDA was most interested in discussing Alternative 3 at the February 20, 2013 meeting. This interest was due to their desire to see Alternative 3 advance as the Preferred Alternative.

7.2.2 Wayne County DPS Comments

Alternative 2 – Operational Improvements

- Requested that something be done to address left turn issues at southbound Haggerty Road to eastbound Ford Road

Alternative 3 – Boulevard

- In favor of locating loons directly adjacent to intersections to discourage trucks from using them
- Suggested that a six-lane boulevard be explored to remove the need for loons

7.2.3 FHWA Comments

FHWA suggested that all additional improvement are not added to each Practical Alternative and instead create a prioritized list of additional improvements. Documentation of the decision making process will be necessary.

7.2.4 Public Comments

The public was asked to vote for their choice of a Preferred Alternative based on the information provided at the public meeting. The votes were tallied and presented below (in parenthesis) along with some of the key comments.

Alternative 1 – No-Build (0 votes)

- This one is a non-starter, something needs to be done
- The backup and traffic every weekend is getting worse and worse

Alternative 2 – Operational Improvements (2 votes)

- Seems like a short-term fix
- Improves conditions while keeping some function to the streetscape already in place

Alternative 3 – Boulevard Option (13 votes)

- This is, by far, the best option
- This is the only one that will fix the left turn problem
- This would help with flow of traffic and appears that it would make the road safer
- Best option given the existing building constraints

Section 8
Preferred Alternative Development

8.1 Preferred Alternative Selection

As stated previously in **Section 4.10** the alternative chosen as the Preferred Alternative is Alternative 3 – Boulevard. This decision and alternative was driven by feedback received from stakeholders and the public. Outreach was a key part of the successful development of this alternative. The reasons for this selection are listed below.

Alternative 1 – No-Build

- Does not address key project Purpose and Need elements of improving traffic operations and safety concerns along Ford Road.
- Due to an anticipated need for pavement reconstruction in the next ten years, the construction cost is similar to Alternative 3.

Alternative 2 – Operational Improvements

- Despite improved traffic operations along Ford Road, failing turning movements still exist.
- Does not significantly improve safety.
- Due to an anticipated need for pavement reconstruction in the next ten years, the construction cost is similar to Alternative 3.

Alternative 3 – Boulevard

- Addresses the project Purpose and Need by significantly improving traffic operations and safety concerns along Ford Road.
- Due to an anticipated need for pavement reconstruction in the next ten years, the construction cost is similar to Alternatives 1 and 2.

Some of the comments received at Public Information Meeting #4 concerning the boulevard being selected as the Preferred Alternative are listed below. Further detail on this meeting can be found in **Section 4.2.4**.

- The boulevard alternative is great. My concern is still Ford Road eastbound of Lilley to Haggerty – should be three lanes. Then add a fourth right turn lane at Haggerty and use this fourth lane to allow access to southbound I-275. The 3rd lane would allow access to I-275 northbound without lane shifting.
- Very glad to see non-motorized crossings on both sides of Ford Road that help people safely get to I-275 metro trail. Would love to see the Metro Trail crossing at Ford Road included in plans. Improvements are most definitely needed to improve safety of all people and vehicles.

- I am happy to see this as the Preferred Alternative for Ford Road because it addresses the whole area that has been a problem, not just the interchange with I-275. It's a well-thought out process. I'm not looking forward to when the "barrels go up" but I think it will be so much better! Thank you for this process.

- A boulevard will be a very welcomed addition to Ford Road. Currently my wife and I avoid the road (Ford) at all costs. If we must travel the road we access our destination via back parking lots. I couldn't tell you the store fronts because, currently, we see them from the back.

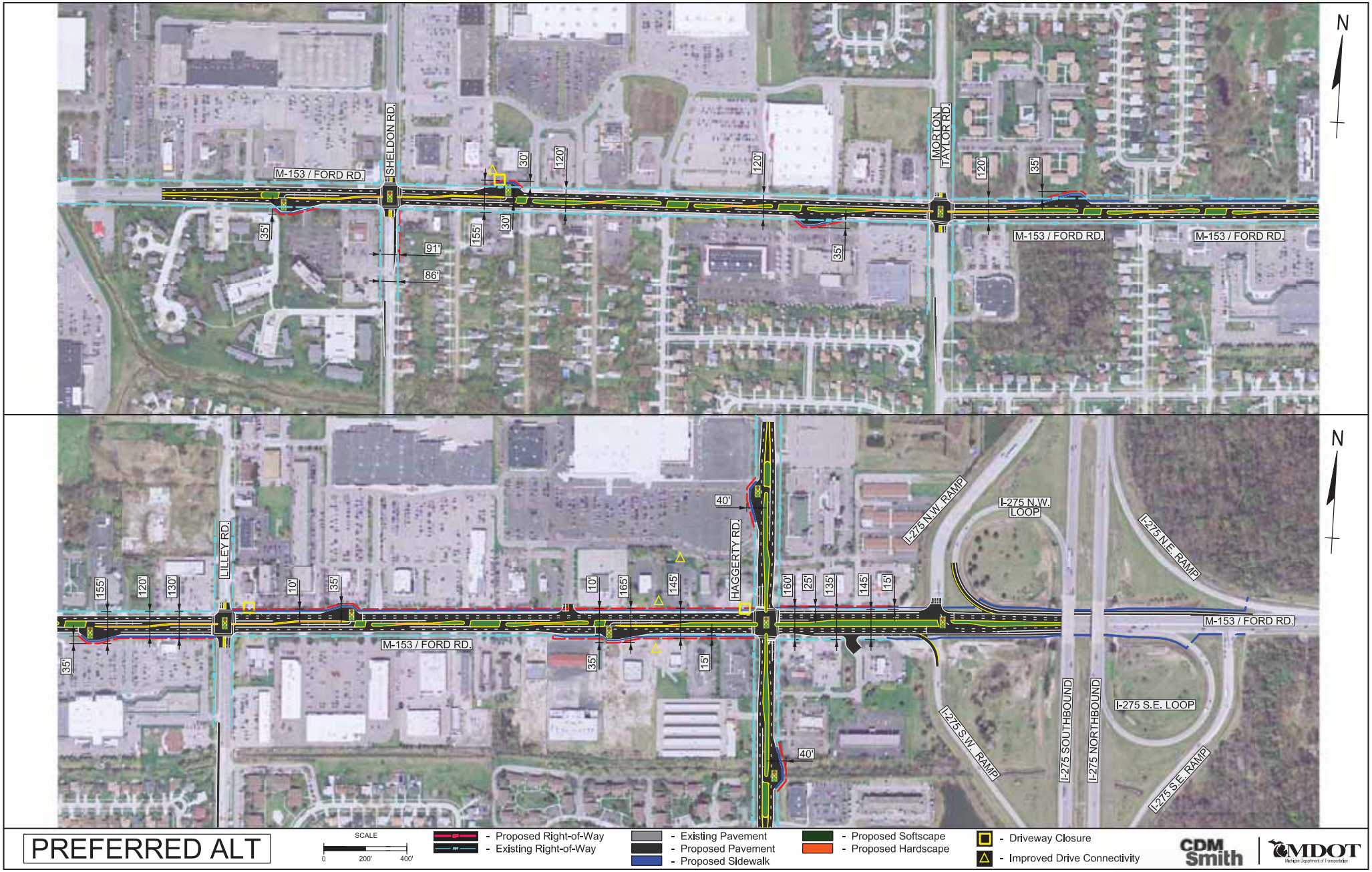
8.2 Preferred Alternative Description

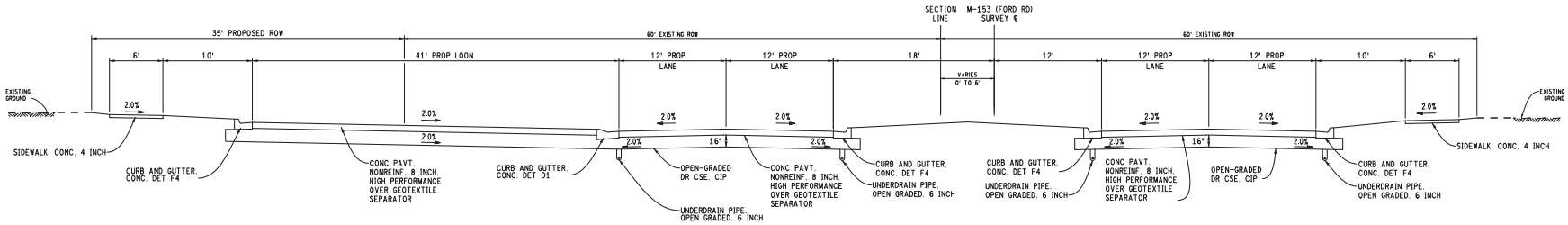
The preferred alternative can be seen in **Figure 8-1**. The Ford Road boulevard has three lanes in each direction from I-275 to the IKEA drive, where eastbound Ford Road reduces to two lanes. Westbound Ford Road continues with three lanes to Lilley Road where it terminates as a right turn only lane. As stated in **Section 3.6** the survey for this project is only two dimensional. Evaluation of the Preferred Alternative without elevation information combined with the very preliminary design requires the shown right-of-way impacts of a total 2.34 acres to be considered approximate and require further design prior to commencing real estate discussions. In general right-of-way impacts are anticipated between Lilley and Haggerty Roads where three lanes are provided for the concerned bound, 15' for eastbound and 10' for westbound. Between Haggerty Road and I-275 the existing right-of-way is slightly wider so a 15' right-of-way impact is only anticipated where four lanes are provided along westbound. The reason for this five foot difference is the Ford Road boulevard is centered on the existing construction alignment which is five to six feet south of the section line. This was done to avoid having to shift roadway at each ends and since more right-of-way takes exist to the north.

An approximate 35' right-of-way impact will be necessary at the truck turnaround (loon) locations. Implementation of additional traffic operation items such as those discussed in **Section 8.3.2** may lead to a greater right-of-way impact. A similar right-of-way impact is anticipated along Haggerty Road. As discussed previously, coordination with Canton Township led to adjustments to loon locations to reduce impact to adjacent businesses and landscaping. MDOT Geometrics stated that the loon locations could be located within a 450' to 850' range from the intersection. The ideal distance is 660' with a typical range of 560' to 760'. Additional coordination during future project stages is anticipated and recommended. One loon option discussed was to locate them at driveways to mitigate potential business encroachment. This option was discarded due to safety and operation concerns. The shown access management recommendations will require coordination with business owners during design.

A typical cross section of the Ford Road boulevard through the six lane section at a loon is shown in **Figure 8-2**. The median lane is shown sloping towards the median. This cross slope would require median catch basins and storm sewer along both bounds of both Ford and Haggerty Road boulevards. One potential design option would be to reverse the gutter of the median curb and slope the entire roadway to the outside, allowing the omission of the median catch basins and storm sewer. The outside storm sewer system would need to be adequately sized and spaced to accommodate such a design. To reduce the right-of-way impact constructing sidewalks through the loons rather than to the outside was discussed. This option was deemed undesirable due to turning vehicles unanticipated interaction with pedestrian movements.

Figure 8-1 Preferred Alternative Plan View





PROPOSED M-153 (FORD RD) BLVD LOON TYPICAL SECTION

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

CDM Smith

MDOT Michigan Department of Transportation

NO SCALE

	DATE:	CS: 82292	FIGURE 8-2	DRAWING	SHEET
	DESIGN UNIT: YUNG	JN: 115177	PREFERRED ALTERNATIVE TYPICAL CROSS SECTION		SECT 1
FILE:115177_Typ_Loons.dgn	TSC: TAYLOR				

8.3 Additional Considerations

The below items are considerations that should be taken into account as this project moves forward.

8.3.1 Geotechnical

The Study Team completed a Geotechnical Considerations Report, located in **Appendix H**. One consideration of concern is the construction of sidewalk through the I-275 interchange which would require modification to the existing slope paving and construction of retaining walls. To construct the wall along westbound Ford Road it is anticipated that abutment support will be needed due to a less than acceptable global stability factor of safety. As stated in **Section 3.10** no new soil borings were conducted during this project so all analysis shall be considered preliminary.

8.3.2 Traffic Operation Improvements

As this project advances into the right-of-way acquisition process and accompanying final design there are multiple traffic operation improvements that would be beneficial if feasible. These include:

- Extend the 3rd eastbound lane to Lilley Road. Currently the 3rd lane develops at the IKEA drive and this segment operates at a LOS C. Extending the 3rd lane to Lilley Road would not change the LOS but would provide lane continuity and improved driveway access by not impacting through traffic. The right turn only at the Lilley Road intersection could then be a shared right/thru lane which would not degrade the eastbound through movement from the projected LOS C. As a further enhancement right turn only lanes would be beneficial at Lilley Road and Ford Road, in both the eastbound and westbound directions. Add a right turn lane for eastbound Ford Road at the Haggerty Road intersection. This would improve the LOS from C to B during the PM peak and accommodate the over 700 vehicles making this movement. The larger benefit would be to reduce the traffic shift that occurs east of the Haggerty Road intersection to enter the proper southbound and northbound I-275 entrance ramp lanes. As currently displayed southbound I-275 entrance ramp traffic that attempts to bypass the right turning traffic in the shared right and thru lane must shift two lanes east of the intersection. Excessive lane shifting over a short distance results in traffic operations and safety concerns.

- Adding a right turn only lane for the eastbound and westbound movements at the remaining major Ford Road intersections, Sheldon and Morton Taylor Roads would provide operational improvements.

- An operational improvement that would be directed towards non-motorized benefit instead of motorized would be to extend the limits of the boulevard through the northbound I-275 ramps. This configuration could provide a refuge area for I-275 Metro Trail users and allow them to cross Ford Road at the trail rather than at Lotz Road, which is 1800 feet east of the trail. At grade sidewalk crossing the northbound I-275 entrance ramp are already proposed so creating a safe crossing is desirable for users as stated at the public information meetings.

8.3.3 Design

Other items of design that have not been previously discussed include roadway drainage, MOT, signing, striping and traffic signals. Within the Ford and Haggerty Road footprints there is an approximate increase in impervious area from 21.2 acres existing to 24.4 acres after construction. The 3.2 acres

difference is a 15% increase. During design a combination of retention, detention and Best Management Practices will be necessary to mitigate this increase.

Clear and concise signing and pavement markings will be necessary to assist motorists when navigating the new boulevard cross section. An important location of quality signing will be the near side of Ford Road intersections where the left turn lane develops for the far side crossover. These intersection lane designation signs may need to be mounted on span wires due to limited roadside width for large signs and the number of lanes. One public information meeting suggestion was to efficiently sign parking lot traffic to exit commercial developments at traffic signals. While this is outside MDOT right-of-way this suggestion could be part of the local business outreach plan. Pavement markings at the Haggerty, Lilley and Sheldon Road double lane crossovers will be important to delineate based on the dual turn paths especially with a narrow median. Crossover traffic signals will need to be synchronized with the intersection signal. The signal head angle of the crossover signal will likely be facing the incoming crossover traffic, and a second set of signal heads could be provided at parallel to Ford Road to reassure U-turn traffic. To prevent confusion with through traffic, all green signal head arrows could be utilized.

One of the most important considerations is how traffic will be maintained during construction. This concern was frequently stated by both residents and business owners due to both existing traffic congestion and the potential economic impact to the numerous businesses. One possible construction staging plan would be to split construction up into three stages; Haggerty Road boulevard, Ford Road from Lilley to Lotz Road and Ford Road from Sheldon to Lilley Road. While the phases of each stage may vary from one another the below phasing applies for all. One lane in each direction along with a center left turn lane is maintained unless otherwise stated.

- Phase 1: Construct sufficient width of temporary pavement to maintain stated lanes.
- Phase 2: Maintain traffic on existing and temporary pavement while constructing opposite bound lanes and temporary pavement if needed.
- Phase 3: Maintain traffic on temporary and permanent pavement constructed in Phase 2 and construct opposite bound lanes.
- Phase 4: Maintain at least one lane in each direction on temporary and permanent pavement while constructing median.
- Phase 5 & 6: Maintain at least one lane in concerned bound while removing temporary pavement and constructing curb and gutter.

The agreed upon maintenance of traffic (MOT) layout will be developed during the final design phase after input from project stakeholders have been incorporated. Final real estate acquisition along with stakeholder input will help decide which side of Haggerty Road and Ford Road temporary widening will take place. Eliminating Phase 4 so that construction does not occur within live traffic will be a point of emphasis for the final MOT layout. This could be accomplished by constructing additional width of temporary pavement so the median curb can be placed during Phase 2 operations. This phasing will both be safer and shorten the construction duration but will be dependent on the amount of right-of-way acquired.

Section 9
Environmental Summary

9.1 Overview

This section provides a summary of environmental analysis completed as part of the overall study and potential environmental impacts based on information known to date about the proposed project. This documentation is not meant to provide MDOT with enough information for NEPA environmental clearance for this project, but to instead provide MDOT with the information necessary to make a determination of needed environmental documentation (CE or EA) once the project moves into the next phase of project development. The source of this information includes field work conducted during the study, a scoping review completed by MDOT's Environmental Section in 2010/2011 and updated in 2013, and reasonable assumptions made based on the knowledge obtained during this project. MDOT's initial scoping review covered only the I-275 at Ford Road interchange area with the update including Ford Road west of Haggerty Road. The initial scoping review can be found in **Appendix P**.

As part of the study a Purpose and Need Statement was created, reviewed, and approved by MDOT and FHWA with input provided by the public and is provided in **Section 5.0**. Alternatives considered as part of the study are presented in **Sections 6.0** (Illustrative) and **7.0** (Practical) and describes how potential environmental impacts affected the development and selection of the Preferred Alternative.

9.2 Affected Environment

The Preferred Alternative (Practical Alternative 3) proposes to provide a boulevard along Ford Road from I-275 west to a point approximately 600 feet west of Sheldon Road, and along Haggerty Road from 700 feet north of Ford Road to 900 feet south of Haggerty Road. In order to provide the boulevard section along Ford Road right-of-way will be needed on both sides of the road between Haggerty Road and the west end of the project. Approximately 15 feet of additional right-of-way is needed along the south side of Ford Road while approximately 10 feet will be needed on along the north side. Since the existing right-of-way is wider between I-275 and Haggerty Road only minor right-of-way impacts are expected in this area. Additional right-of-way is necessary at dedicated intersection turn lanes and loon locations. The total approximate right-of-way impact is 2.34 acres. Refer to **Section 8.2** for further detail on right-of-way impacts.

9.3 Environmental Technical Studies Completed

9.3.1 Ecological Assessment

Team member Cardno JFNew performed ecological assessments of the Ford Road at I-275 study area in Canton Township, Wayne County, Michigan from July 2 to August 1, 2012. These ecological assessments included regulatory wetland delineations, vegetative community assessments, and Michigan Surface Water Assessment Section Procedure 51 Qualitative Biological and Habitat Survey Protocol (Procedure 51) evaluations. MDOT biologists performed additional threatened and endangered species assessments within the study area from May 30, 2012 through May 9, 2013.

Wetland and Stream Delineation

A total of 112 wetland complexes, of which 19 contained stream segments, were identified within or immediately adjacent to the study area. Of the 112 wetland complexes identified during the study, 110

are likely regulated by the MDEQ under Part 303 of P.A. 452 due to their close proximity to a river, stream, lake, or pond, or because they are greater than five acres in size. The remaining two delineated wetlands are not likely regulated by the MDEQ since they appear to be greater than 500 feet away from any defined waterbody or watercourse and are less than five acres in size. Any dredging, draining, filling, or construction in any of the regulated wetlands will require a permit from the Michigan Department of Environmental Quality (MDEQ) under Part 303.

None of the identified wetland complexes are anticipated to be impacted by the Preferred Alternative as currently proposed. The closest wetland area to the proposed improvements is the wetland complex associated with the conservation easement located on the south side of Ford Road just east of Morton Taylor Road, which has been classified as a low quality forested wetland.

All four streams identified in the study area (Tonquish Creek, Willow Creek, Fellows Creek, and Smith Drain, a tributary to Willow Creek) have a defined bed and bank, meet the MDEQ definition of a stream, and are therefore regulated under Part 301 of P.A. 451. Any manipulation of regulated lakes, ponds, streams, or drains will require a permit from the MDEQ under Part 301.

It is important to note that the MDEQ and USACE have final discretionary authority over all jurisdictional determinations of wetlands, streams, and waterbodies within the state of Michigan.

Stream Assessment

The macroinvertebrate community, fish community, and habitat conditions were assessed at six locations along three streams within the study area. In all streams, macroinvertebrate and fish communities were rated as poor or acceptable, and habitat conditions were rated as poor or marginal. These conditions are typical of streams in highly urbanized settings. Urban streams often experience high stormwater flows and high inputs of sediments, road salts, and other pollutants because of the high percentage of impervious surfaces within the watershed. These conditions can reduce the quality of instream habitat and prohibit the full development of macroinvertebrate and fish communities. Because the streams located within the study area are already of low ecological quality, it is anticipated the proposed project activities will have minimal impact on the quality of stream resources within the study area. Applicable water resource regulations and permit conditions will serve to protect or potentially enhance existing stream conditions.

The Smith Drain crossing is south of Ford Road within the project limits and may be replaced in conjunction with the road work. The existing structure consists of one 11-foot span by 8-foot rise culvert with a length of 149 feet. The proposed Smith Drain crossing is a 16-foot span by 7-foot rise three-sided concrete culvert with a length of 184 feet. The additional length is due to a truck turnaround being proposed at this location to minimize impact to adjacent businesses. If this location becomes an environmental constraint, it could shift to the north depending on impacts to the business located there. Smith Drain is a MDEQ regulated watercourse and will require a permit. Currently the Willow Creek structure on Haggerty Road north of Ford Road is not impacted.

Vegetative Community Assessment

Six distinct vegetative community types were identified within the study area, of which three were wetland and three were upland. Based on Floristic Quality Index (FQI) values, most areas were considered to be low quality. Five main areas of moderate quality occurred in woodland and forested wetland vegetative communities located in the northeast quadrant of I-275 and Cherry Hill Road and the southeast quadrant of I-275 and Warren road. There were no high quality areas documented within the study area. Therefore, it is anticipated the proposed project activities will have minimal impact on most

vegetative communities within the study area. However, it is recommended the project should avoid construction activities that would impact the moderate quality woodlands because of their higher ecological quality and their potential to provide suitable habitat for Indiana bat and/or other threatened and endangered species.

Threatened and Endangered Species Assessment

No state or federally listed plant or animal species were observed within the study area during the field surveys. Based on the findings of the field surveys and vegetative community assessments performed for this project, it is highly unlikely that there are state or federally listed plants or animal species within the project limits. Since there are no listed species present, no further coordination is currently required with the Michigan Department of Natural Resources (state listed species) or the U.S. Fish and Wildlife Service (federally listed species).

More information can be found in the June 29, 2013 *Final Ecological Assessment Report* located in **Appendix E**. No additional investigation is expected to be required.

9.3.2 Noise Analysis

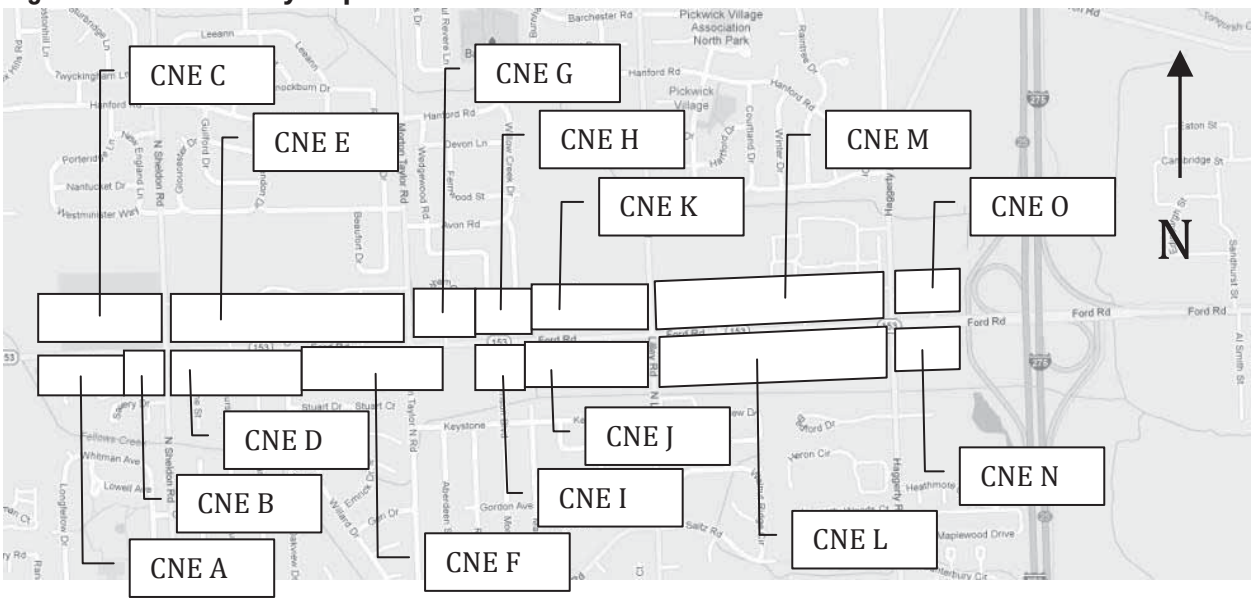
Team member Bergmann Associates performed a noise analysis and submitted a Noise Analysis Report, found in **Appendix F**, along Ford Road to determine the baseline noise level for comparison to the Preferred Alternative along with potential mitigation. Their field measurements were taken on October 26, 2012 at seven representative sites while leaves and vegetation were still present to obtain accurate results. These measurements were taken during peak and off-peak times that coincided with peak traffic volumes. The traffic noise prediction program, FHWA Traffic Noise Model version 2.5, was used to model the existing, 2035 No-Build and 2035 Preferred Alternative Build option for traffic noise levels within the study area.

Table 9-1 shows the number of locations within a Common Noise Environment (CNE) that approach or exceed the FHWA Noise Abatement Criteria (NAC). **Figure 9-1** shows the limits of the CNEs. The maximum traffic noise level increases of 1 and 5 dB(A) over the existing conditions are predicted for the 2035 No-Build and 2035 Preferred Alternative Build option.

Table 9-1 Number of Locations within CNEs that Approach or Exceed the NAC

Activity Description	Existing	2035 No Build	2035 Build (Boulevard Section)
CNE Area A – Residential	3	3	4
CNE Area B – Commercial	N/A	N/A	N/A
CNE Area C – Commercial	0	0	0
CNE Area D – Commercial	0	0	0
CNE Area E – Commercial	N/A	N/A	N/A
CNE Area F – Commercial	N/A	N/A	N/A
CNE Area G – Residential	4	4	4
CNE Area H – Residential	3	3	3
CNE Area I – Commercial	0	0	0
CNE Area J – Commercial	0	0	0
CNE Area K – Commercial	N/A	N/A	N/A
CNE Area L – Commercial	0	0	0
CNE Area M – Commercial	0	0	0
CNE Area N – Commercial	0	0	0
CNE Area O – Commercial	0	0	0

Figure 9-1 CNE Vicinity Map



CNE B, E, F K are commercial properties and have been identified as having an Activity Category NAC E (from FHWA Noise Abatement Criteria [NAC] Table 3). These CNEs were reviewed in the field and evidence of outdoor areas with frequent human use could not be located. Thus, no noise abatement assessments were performed at those locations. The remaining Activity Category NAC E land uses (CNE C, D, I, J, L, M, N, and O) contained at least one property with outdoor dining tables or fuel pumps.

Three barriers were evaluated for the Preferred Alternative Build condition. These barriers were located at the edge of the Right-of-Way at CNE A, G, and H. The noise barrier at CNE A (proposed noise barrier A [northbound A]) failed to satisfy MDOT's feasibility and reasonableness criteria. The noise

barriers at CNE G and H (northbound G and H) were evaluated separately but an overlap of mitigation was observed. To maximize the number of benefited residences, feasibility, and reasonableness, these barriers were combined and evaluated as a single barrier (northbound G/H) with gaps for Fordham Circle and Willow Creek Road. northbound G/H was found to satisfy MDOT's feasibility criteria but failed to meet the reasonableness criteria.

MDOT's noise policy states that when noise impacts are identified, feasible and reasonable noise abatement measures shall be incorporated into the transportation improvement project. Based on the study completed, abatement of noise impacts for the Preferred Alternative Build does not appear to be feasible and reasonable at any of the sites along Ford Road.

9.3.3 Project Area Contamination Survey

Team member Somat Engineering prepared a Limited Project Area Contamination Survey (PACS) Report, located in **Appendix G**, to provide a professional opinion of Recognized Environmental Conditions (RECs) in connection with the past and current uses of properties along the project corridor where known or potential contamination may impact and/or intersect the project. RECs were identified from site reconnaissance consisting of a "windshield survey" and a review of historical photographs and environmental databases in July and August 2012. Municipal office files were also reviewed to supplement the initial review in June 2013.

There were 49 RECs identified within or adjacent to the study area which are summarized and displayed in the report. Five of the RECs were identified as within the study area boundaries with two of these sites being within the potential footprint of the Preferred Alternative.

- REC#2 – BP Gas Station located at 41345 Ford Road: Contains four underground storage tanks (UST's) which are currently in use.
- REC#17 – Valero Gas Station located at 41350 Ford Road: Contains three UST's which are currently in use. A gasoline release was also indicated at this property in 2008.

No evidence of RECs was encountered during the PAC survey that would suggest or indicate there has been a release of substances on or to the project site which could necessitate an environmental response action or otherwise result in a material financial liability for owners or operators of the site.

The on-site RECs and adjoining RECs may have adversely impacted the subsurface soil and/or groundwater beneath the surface. If the proposed project will involve subsurface work such as excavation or dewatering it is recommended that further environmental evaluation, in the form of a Phase II ESA, be conducted to assess the presence of soil/groundwater contamination. The information obtained from the PACS was used in the alternative analysis to determine constraints.

9.4 Environmental Factors Considered

9.4.1 Cultural Resources and Section 106

Potential cultural resources were checked by MDOT's historian and archaeologist. No historic above-ground resources are located within or in proximity to the project area (Area of Potential Effect). Based on consultation with the Office of the State Archaeologist, the areas west of I-275 along Ford Road will not require any archaeological survey. However, they do have concerns regarding any work that could impact the currently undisturbed land located east of I-275 between Ford Road and Cherry Hill Road. As currently proposed, this area of undeveloped land will not be impacted as a result of this project.

9.4.2 Section 4(f) and 6(f) Evaluation

There are a number of park properties located in Canton Township but none are located within the limits of the study area. The I-275 Metro Trail (non-motorized paved path) that runs north and south just east of the I-275/Ford Road interchange lies entirely within MDOT right-of-way and is not considered a 4(f) property.

9.4.3 Relocation Impacts

In general full relocations are not anticipated. Canton Township stated that since the anticipated right-of-way acquisitions lie within the central business district, zoning waivers can be granted which may reduce or eliminate the need for full parcel purchases. This letter can be found in **Appendix P**. The only locations where full relocations could be necessary pending zoning and waivers are at the loon locations. During this project phase the Study Team inspected the proposed loon locations and has located them to minimize impact and avoid full relocations. Early coordination efforts have been proposed with potentially affected businesses to mitigate impacts such as relocate parking or provide aesthetic barrier features.

9.4.4 Change in Land Use

The project area along Ford Road is highly developed with commercial and retail businesses ranging from chain family restaurants to an IKEA big box store. Residential properties border the commercial zone to both the north and south making Ford Road and the I-275 interchange a significant shopping and commuter corridor. The future roadway layout and traffic patterns are not anticipated to change the current commercial land use along Ford Road.

9.4.5 Economic Impacts

The project lies within Canton Townships established Downtown Development Authority (DDA) which runs along Ford Road from just east of Lotz Road to just west of Canton Center Road. According to Canton Township's 2003 DDA Comprehensive Master Plan, the Canton DDA district has a sizeable and affluent trade area, currently estimated at 140,000 persons with a median household income of $72,661 in 2000. Three census tracts within the trade area have median household incomes in excess of $100,000. In addition, there is substantial close-in population which finds the Canton Downtown Development Authority District to be convenient for their shopping needs. Regional accessibility is excellent as provided by I-275 and also by Ford Road and a number of north/south arterials.

The Canton DDA District has over 200 retail establishments, which provide mass and makes it a viable retail shopping node. Furthermore, the Canton business district has strong representation in the restaurant category as well as the personal services category.

There is almost universal agreement that the number one problem in the Canton downtown area is traffic which was heard often at the stakeholder and public information meetings. Traffic congestion is viewed as hindering existing businesses which is a concern for both the business owners and township officials.

Improving traffic operations and reducing congestion throughout the corridor will likely improve business activity within the corridor and the overall demand for future commercial development.

9.4.6 Agricultural Impacts

MDOT's Environmental Section scoping review found no Federal Farmland Protection Act PA 116 enrolled parcels within the study area. Due to the urban nature of this project and that the majority of

the project will be constructed within the existing right-of-way, no impacts to agricultural lands or support services along Ford Road between Sheldon and Haggerty Roads are anticipated.

9.4.7 Environmental Justice

An environmental justice analysis was not completed as part of this environmental study. However, no relocations are anticipated and the proposed changes to the roadway should not affect any environmental justice populations. If changes are made to the Preferred Alternative that result in relocations, census and other data sources should be checked to determine the potential of environmental justice populations being affected.

9.4.8 Social Impacts

MDOT's Environmental Section scoping review concluded that no long-term adverse impacts will occur due to the purchase of right-of-way provided that all state and federal guidelines and regulations pertaining to real estate acquisitions are followed, including the *Uniform Relocation Assistance and Real Property Acquisition Act of 1970*. If total takes are needed then additional review and FHWA coordination is required. Occupied parcels will require a relocation plan. Access to businesses and residential properties will be maintained throughout construction. If sidewalks are closed a pedestrian detour route will be posted.

9.4.9 Air Quality

The Preferred Alternative as currently proposed will add little or no additional capacity to the existing roads. Compared to the future no-build condition the Preferred Alternative will likely result in a shift in traffic patterns which includes more vehicles passing through the project surrounding area during the peak hours. The reason for this growth in traffic is the improved traffic operations and reduced vehicle delay as a result of the new roadway improvements which in turn will encourage motorists who currently avoid the existing gridlock to use the roadway. However, air quality is anticipated to improve during off-peak hours along the corridor as well as the surrounding roadway network due to the same improvements. The entire seven-county SEMCOG region is an attainment area for ozone and attainment/maintenance area for carbon monoxide. Since this project is not intended to add capacity to the roadway network, it is anticipated there will not be any air quality impacts as a result of this project. A memorandum discussing the air quality analysis can be found in **Appendix P**.

9.4.10 Visual Impacts

No visual impacts are anticipated as a result of this project. Additional roadway aesthetic potentials exist within the boulevard median such as brick pavers and low growth vegetation. During future project discussion the Canton Township DDA will need to be involved in maintaining or replacing their current roadside aesthetic treatments.

9.4.11 Secondary Development and Cumulative Impacts

Due to the Ford Road corridor being nearly fully developed there are limited opportunities for secondary development impacts. A sensitivity analysis was completed to test the impacts of developing out the remaining parcels east of I-275 on adjacent Ford Road. The intersection of Ford Road and Lotz Road would require significant geometric improvements if the Lotz Road Area commercial parcels were to be fully developed. This analysis is discussed in **Section 7.1.4** and in the *Traffic Operations Report* found in **Appendix B**. It was determined at the Practical Alternatives stage that the alternatives presented do not cause cumulative impacts because they are confined mostly to existing right-of-way and the developed corridors.

9.4.12 Construction Impacts

During construction noise, vibration, and air impacts will likely occur. Prior to commencing construction sensitive locations will be identified and mitigation measure put in place to reduce these impacts. Earth disturbance near a receiving waterbody will require a National Pollutant Discharge Elimination System (NPDES) permit since over five acres will be disturbed. A *Notice of Coverage* form will need to be submitted prior to start of construction to ensure coverage and protection of water quality.

9.4.13 Floodplain Impacts

FEMA 2011 floodplain GIS information was received from Canton Township. The 100-year floodplain is adjacent and/or within MDOT right-of-way along the southbound I-275 exit ramp and the northbound I-275 exit and entrance ramps. It also encroaches on the Ford Road right-of-way at the Ford Road crossing just east of the I-275 interchange. No floodplain fill is anticipated at these locations. If it occurs, a Joint Permit Application will be necessary as part of PA 451 under Part 301 Inland Lakes and Streams and Part 31 Water Resources Protection.

9.5 Mitigation

To minimize property impacts, future design should carefully consider the design and locations of turn-around loons for trucks. Mitigation measures have not been specifically discussed with the Study Team but a list was created based on their input and information gathered throughout the project. This list can be found in **Appendix Q**.

9.6 Future Considerations

According to MDOT, FHWA, and based upon the analysis completed as part of this study, the Preferred Alternative has no detrimental environmental impacts. The greatest community concerns at this time are the potential acquisition of property from commercial establishments, the impacts to businesses during construction, impacts on existing aesthetic treatments already located in the corridor, and the locations of the proposed turn-around loons. The Preferred Alternative would avoid impacts to the conservation easement near Morton Taylor Road. Acceptance of the study process, findings, and recommendations by FHWA and all other stakeholders can be found in **Appendix S.**

In the end, the Preferred Alternative poses more concerns for the community than it does for regulatory agencies. The project will improve an existing transportation corridor largely avoiding impacts to natural and cultural resources. Future design activities should incorporate public engagement to ensure that the project considers all community concerns while offering stakeholders an opportunity to shape the look of the corridor. Continued close coordination with township officials and the DDA should benefit future project development.

If the project does not proceed to construction within ten years a new study will need to be conducted. An update of the traffic analysis is necessary after five years and three years for the environmental analysis. The re-evaluation does not occur automatically, but should be triggered by the scheduling of a construction project. However, the review should be limited to updating existing information related to significant changes within the study area in the time between completion of the PEL and a construction date.

Section 10
Project Programming

10.1 Construction Phasing

CDM Smith worked with MDOT and Canton Township to develop potential construction phasing for both short-term operation improvements and boulevard. The current traffic operations and safety issues necessitate immediate action. In addition the public stated numerous times at the four public information meetings that something needs to be done now. Numerous potential short-term improvements were identified on Ford Road to extend the operational service life to allow the final environmental, real estate acquisition and design processes for the boulevard to occur. These short-term improvements are within existing right-of-way and can be implemented quickly. Figures showing these and the boulevard construction phasing can be found in **Appendix R** along with a description of the short-term improvements. The anticipated construction phasing is as follows:

- Ford Road Operation Improvements: These are summarized in **Appendix R** along with a memorandum on providing sidewalk connectivity along Ford Road through the I-275 interchange.
- Ford Road Phase 1: Construct the boulevard and reconstruct Ford Road from west of Lilley Road to Lotz Road. West of Lilley Road the boulevard would transition back to existing pavement. This phase would address the main congestion and safety issues at Lilley and Haggerty Roads.
- Ford Road Phase 2: Construct the remaining boulevard from Sheldon Road to the previously constructed portion west of Lilley Road.

10.2 Construction Funding

On May 31, 2013 Canton Township submitted a TIGER V grant application "Grey to Green - A Ford Road Multi-Modal Renovation" for $15.85 million. MDOT and CDM Smith both advised Canton Township during the application compilation. MDOT and CDM Smith were informed on September 6, 2013 that the TIGER grant was not received. It is anticipated moving forward that MDOT will follow traditional funding sources for design and construction of this project.

Section 11
Conclusion

An extensive stakeholder and public involvement process was followed to assist in developing the Illustrative Alternatives and advancing them through the Practical Alternative stage to the Preferred Alternative, a boulevard along Ford and Haggerty Roads. This alternative best addresses the project Purpose and Need which identified current operation and safety issues along Ford Road as the upmost concerns. The Preferred Alternative will require minor right-of-way acquisitions although no relocations are anticipated. Since the Preferred Alternative is primarily contained within existing right-of-way no significant environmental impacts are expected. According to MDOT, FHWA, and based upon the analysis completed as part of this study, the Preferred Alternative has no detrimental environmental impacts. All study stakeholders have provided signed acceptance of the study process, findings, and recommentations. If the project does not proceed to construction within ten years a new study will need to be conducted. Furthermore, an update of the traffic analysis is necessary after five years and three years for the environmental analysis.

Appendix A

PEL Checklist

M-153 (Ford Road) at I-275 Area Traffic and Environmental Study

JN 115177, CS 82292

Planning and Environmental Linkages (PEL) Process

Prepared for:

The Michigan Department of Transportation

MDOT
Michigan Department of Transportation

Submitted by:

CDM Smith Michigan Inc.

CDM Smith

Submitted:

December, 2013

FHWA's Planning and Environment Linkages (PEL) process ensures the planning process follows the necessary steps in order to ease the transition from planning to a NEPA analysis, if deemed necessary. This PEL process was followed for the *M-153 (Ford Road) at I-275 Area Traffic and Environmental Study* which is illustrated by the project limits shown below.

Figure 1 Project Study Area

Ford Road traffic is currently over capacity for numerous intersection movements and the intersections with Haggerty, Lilley and Sheldon Roads as a whole have failing levels of service. This excessive traffic queue at these intersections in turn creates issues at lateral intersections, mainly east of Haggerty Road through the I-275 interchange. During peak traffic, backups can occur all the way up the SB I-275 exit ramp on to I-275. Excessive traffic and the accompanying motorist frustration have led to a large volume of crashes at all corridor intersections and segments. The existing Ford Road pavement has not been reconstructed in at least 30 years. Analysis of historical geotechnical information shows some pavement locations in poor or fair condition. Due to these facts a pavement reconstruction is anticipated within the next ten years.

The following are key elements of the PEL questionnaire:

1. Background

MDOT was the sponsor of the study which began in April 2012 and completed in September 2013. The study team included: MDOT, FHWA, Charter Township of Canton, Canton Township Downtown Development Authority (DDA), City of Westland, Wayne County, Southeastern Michigan Council of Governments (SEMCOG), and consultants CDM Smith, Bergmann Associates, HH Engineering, Cardno JFNew, SOMAT Engineering, and Surveying Solutions Incorporated. A list of all individual study team members can be found in Appendix J of the project *Traffic and Environmental Study Final Report*.

Ford Road is an east-west roadway with a posted speed limit of 45 mph throughout the study area and is classified as an urban principal arterial in the 2004 Sufficiency Report. This segment of Ford Road is on the National Highway System (NHS) but is not on the Priority Commercial Network (PCN). Ford Road varies from five-lanes to seven-lanes (two to three lanes in each direction of travel with a center left-turn lane). The roadway is primarily undivided; however, between the southbound I-275 exit ramp and the northbound I-275 exit ramp, travel directions on Ford Road are separated by a raised median. This area along Ford Road is highly developed with commercial and retail businesses ranging from chain family restaurants to an IKEA big box store. Residential properties border the commercial zone making Ford Road and the I-275 interchange a significant commuter corridor.

Three previous area studies have been completed along with other various site studies including bridge inspection reports for the I-275 bridges over Ford Road. In addition two traffic impact studies were conducted for the IKEA and Wal-Mart developments (west and east of the I-275 interchange respectively). The previous area studies were conducted for MDOT in partnership with FHWA, SEMCOG, Wayne County, the Townships of Canton, Plymouth, and Van Buren, and the City of Westland.

In 2003, the *I-275/M-153 Traffic Study* (Lilley Road to Hix Road) was completed. This study took a three-fold approach in its analysis of potential improvements along the Ford Road corridor. Traffic signal timing improvements along Ford Road were investigated first which could be implemented immediately. Second, near-term capacity improvements along the corridor were investigated that could be implemented with little or no right-of-way impacts. Finally, long-term capacity improvements along the Ford Road corridor were investigated that would satisfy 2025 traffic projections. The long-term capacity improvement recommended a boulevard for Ford Road. This recommendation was carried forward as an Illustrative Alternative in the current study.

In 2004, the *M-153/Ford Road Access Management and Traffic Operations Study* was completed. The study objectives were to develop access management and traffic operations improvements to reduce congestion and delay along the corridor, maintain the roadway capacity, reduce traffic crashes, identify acceleration and deceleration lanes, improve ingress and egress to businesses, coordinate land use decisions, and improve the aesthetic appeal of the Ford Road corridor. Access management activities based on this study continue to be planned, coordinated and implemented through the local Access Management Traffic Operations Planning group. Numerous public involvement opportunities occurred during this project

including interviews, three workshops, and a public meeting. Land use and zoning recommendations were included as part of the decision making process.

The *Western Wayne County Transportation Improvement Plan Study* (WWTIP) was conducted in 2006 to address freeway access issues from the high growth areas of western Wayne County focusing on seven key corridors including Ford Road. Alternatives that had the most potential benefit for their cost were analyzed and listed by priority. One of the recommendations from the study was carried forward as an Illustrative Alternative for the current study. Public involvement was not included in this project as part of the decision making process. Land use, demographics, natural features, socio-economic, and cultural/historic properties were considered as part of this study. Key recommendations from the study include:

- Widening Ford Road from I-275 to Lilley Road
- New service drive along north bound 1-275 from Cherry Hill Road to the I-275 at Ford Road Interchange
- Realign northbound entrance ramp to I-275 from Ford Road
- New southbound exit slip ramp from I-275 to northbound Haggerty Road
- New southbound exit slip ramp from I-275 to southbound Haggerty Road

These improvements were focused primarily on the interchange. However, the study recommendations served the needs of an area-wide analysis but did not include the level of detail needed to more finitely define the problems at Ford Road and I-275. Following completion of the WWTIP Study, MDOT Environmental Section performed a desk review of potential environmental impacts for the WWTIP Study recommended alternative at the I-275/Ford Road interchange. The results indicated that the potential for secondary and cumulative effects on a large undeveloped parcel in the southeast quadrant of the interchange, along with other concerns for threatened and endangered plant species, wetlands, and streams would require preparation of an Environmental Impact Statement. Given the time and funds needed to pursue an EIS, MDOT recommended that avoidance alternatives should be considered.

As a result of the potential need for an EIS from the prior WWTIP Study, MDOT determined that the best approach was to focus on the Ford Road and I-275 interchange area and complete the PEL process as part of the *M-153 (Ford Road) at I-275 Area Traffic and Environmental Study*. This study is included in SEMCOG's 2011 – 2014 Transportation Improvement Program. MDOT Environmental Section updated the desk review completed for the WWTIP Study recommended alternative to cover the extent of this study's Preferred Alternative. Construction is not part of the program since funding sources have not yet been secured.

2. Methodology Used

The methodology used for this study was based on past MDOT studies of similar type projects and follows an alternatives development and evaluation process typically associated with NEPA alternatives analysis. The scope of work for this study included documentation of the PEL process which was done throughout as the study developed. The purpose for completing this documentation is to:

- Summarize the environmental analysis and potential impacts completed thus far for use when funding is secured and NEPA classification is pursued.

- Engage and solicit input from stakeholders and members of the public, including Canton Township.
- Refine the study problem statement.
- Develop a Preferred Alternative for use in securing funding and considering phasing.
- Document the method of solving existing traffic congestion and crash issues.

NEPA-like terminology was used in the project documentation to accommodate future NEPA classification if necessary. For instance, the study includes a Purpose and Need Statement which went through multiple reviews.

The decision makers throughout the study process consisted of the entire Study Team as described above in the Background. Key coordination points between decision makers included the collection of relevant data, environmental field work, crash analysis, the Road Safety Audit, and traffic operation analysis. Summaries of these coordination points can be found in the project *Traffic and Environmental Study Final Report* and associated appendices. Important alternative decisions were made by the Consultant Team and MDOT utilizing this information. These decisions were communicated to the Study Team at the following meetings to obtain concurrence.

3. Agency Coordination

Coordination with FHWA, other MDOT divisions, and local agencies occurred throughout the planning process. Milestone meetings included: Study Kick-off, Illustrative Alternatives Meeting, Practical Alternatives Selection and Workshop Meetings and the Preferred Alternative Selection Meeting with the Study Team. A series of project progress/informational meetings also occurred with the Canton DDA to present the Illustrative and Practical Alternatives and keep them updated on project progress and the justification for project decision making. A list of meetings is provided in Table 1 on the next page. All Study Team meeting notes can be found in the project *Traffic and Environmental Study Final Report* Appendix I. MDOT divisions represented include; Bridge, Environmental, Planning, Real Estate, Traffic & Safety (Geometrics), Geotechnical, Operations, and Hydraulics. The Michigan Department of Environmental Quality (MDEQ) was also contacted by MDOT to ensure limits of conservation easements were known and properly documented. In addition to milestone meetings, the MDOT project manager communicated frequently with Canton Township, Canton Township DDA, City of Westland, Wayne County, and SEMCOG. All Study Team members were in unanimous support of the Preferred Alternative.

The following is a list of project meetings held.

Table 1 Study Team Meetings

Meeting Name	Meeting Date
Study Team Kick-Off Meeting	April 4, 2012
Traffic Meeting #1	April 12, 2012
Traffic Meeting #2	May 17, 2012
Public Information Meeting #1	June 7, 2012
Illustrative Alternatives Study Team Workshop	August 16, 2012
Canton Township Supervisor Meeting	August 23, 2012
Canton Township DDA Meeting #1	September 19, 2012
Public Information Meeting #2	October 11, 2012
Practical Alternative Selection Study Team Meeting	November 14, 2012
Practical Alternative Study Team Workshop	January 9, 2013
Canton Township DDA Meeting #2	February 20, 2013
Public Information Meeting #3	March 27, 2013
Preferred Alternative Selection Study Team Meeting	May 15, 2013
Traffic Meeting #3	May 23, 2013
Public Information Meeting #4	May 30, 2013

4. Public Coordination

As shown in the table above, four (4) public meetings were held during this study. For each meeting postcards were sent to businesses within the project study area along with a meeting notice posted to MDOT's, Friends of the I-275 Metro Trail's, and Canton Township's websites. Other outreach resources utilized included The Canton Observer, Canton Community Television, and Canton Township's Twitter page.

The first meeting was held to describe the study process, introduce a timeline, and provide an opportunity for public and project stakeholder input on perceived problems and potential project alternatives. Forty-five people signed in and 55 comment forms were received either at the meeting or via mail or e-mail. The most frequent comments include:

- Retime all traffic signals
- Prohibit left turns out of businesses to Ford Road
- Provide additional access on and off I-275
- Increase capacity of Ford Road
- Increase capacity and improve operations on adjacent roads

The second meeting presented the Illustrative Alternatives and provided an opportunity for the public and project stakeholders to comment on each of the alternatives. Forty people signed in and 60 Practical Alternative votes were received, distributed as shown:

- Illustrative Alternative 1 – No-Build (0 votes)

- Illustrative Alternative 2 – Operational Improvements (6 votes)
- Illustrative Alternative 3 – Boulevard (24 votes)
- Illustrative Alternative 4 – WWTIP (18 votes)
- Illustrative Alternative 5 – New Interchanges (12 votes)

The third meeting summarized what was heard at the previous meeting and presented the Practical Alternatives. Fifty people signed in and 15 Preferred Alternative votes were received, distributed as shown:

- Practical Alternative 1 – No-Build (0votes)
- Practical Alternative 2 – Operational Improvements (2 votes)
- Practical Alternative 3 – Boulevard (13 votes)

The fourth and final meeting summarized the alternative development process and presented the Preferred Alternative. The public and project stakeholders were allowed to comment on the Preferred Alternative. Fifty-seven people signed in and 12 of 18 comments supported the Preferred Alternative, with the remaining comments concerned about other items, but did not indicate a dislike of the boulevard alternative. All meeting summaries can be found in Appendix K of the project *Traffic and Environmental Study Final Report*.

5. Purpose and Need Statement for the PEL Study

The study's draft Purpose and Need was developed by MDOT with input provided by the public and Study Team and considered the results from the traffic analysis and Road Safety Audit. FHWA provided review and concurrence prior to the commencement of the alternatives investigation process. The draft Purpose and Need provided criteria such as safety and traffic operations for alternatives to be compared against. The Purpose and Need was refined prior to the Practical Alternative meetings based on comments received from the public meetings and stakeholder outreach.

Project Purpose:

The project's purpose is to improve operational service on Ford Road and support local land use within the study area. Improving operational service on Ford Road may also involve improvements to the network of local roads within the study area. The study area for this project is defined by Lotz Road to the east to Sheldon Road to the west; and Warren to the north to Cherry Hill to the south.

The project will need to improve operational service on Ford Road between Lotz Road and Sheldon Road, without degrading I-275 operations, and will:

- Consider improvements to key intersections along Ford Road at Lotz, Haggerty, Lilley, Morton Taylor, and Sheldon Roads.
- Consider improvements on Ford Road and on local roads benefitting the operation of Ford Road.
- Incorporate existing and future transportation needs while respecting local land use.
- Increase users' safety and convenient travel while serving key destinations.
- Better separate and prioritize commuter, business, and residential traffic.
- Give attention to truck traffic movements.

- Support smart sustainable growth and apply access management principles.

Project Need:

The project is needed as a result of:

- Growing use of Ford Road by commuters, businesses, and residents.
- Traffic operational levels-of-service at key intersections along the Ford Road corridor.
- Current level of safety.
- Decreasing traffic flow and mobility along Ford Road.

6. Range of Alternatives

Initially, eight Illustrative Alternatives were developed and included: the No-Build, Operational Improvements Alternative, three variations of the Boulevard alternative, the 2006 WWTIP Study recommended alternative, and two new interchange alternatives at Warren and Cherry Hill Roads. These alternatives were brought forward from previous studies or developed as concepts during the Consultant Team brainstorm meeting held on June 6, 2012. The three boulevard variations were consolidated into one alternative while the Warren and Cherry Hill Road interchange alternatives were combined into one alternative for a total of five Illustrative Alternatives.

The following comparison criteria was developed by the Study Team and utilized in the alternative analysis process:

- Estimated Cost
- Right-of-way Impacts
- Level of Service at major cross street intersections with Ford Road
- Geometrics (design exceptions)
- Constructability
- Maintenance
- Environmental Impacts (primarily conservation easement and wetland encroachment)

The following additional improvements were also offered that could be implemented with any of the alternatives:

1. Provide sidewalks through I-275 interchange
2. Pave Lotz Road between Ford and Cherry Hill Roads
3. Southbound Haggerty Road truck reroute to I-275, utilizing Warren and Lotz Roads
4. Additional pedestrian crossing with push buttons
5. Provide bike crossings at bike paths
6. Provide overhead lighting at major intersection signals
7. Access Management – shared drives providing continuity

Illustrative Alternatives

A description of the five Illustrative Alternatives carried forward and presented at Public Information Meeting #1 can be found below. Exhibits of the build Illustrative Alternatives are shown in Appendix L of the project *Traffic and Environmental Study Final Report*. Additional information concerning Illustrative Alternative development can be found in Section 6 of the same report.

Alternative 1 – No-Build

- The No-Build was used as the baseline case to compare all other alternatives. This alternative does not provide any change from current traffic operations.

Alternative 2 – Operational Improvements

- Operational Improvements were viewed as a short term fix that could be implemented while waiting for project funding and for completion of the final design of the ultimate long term improvement alternative. This alternative adds a westbound through lane on Ford Road from I-275 to Sheldon Road and converts the existing eastbound right-turn lane at Haggerty Road to a shared right through lane.

Alternative 3 – Boulevard

- This alternative provides a Ford and/or Haggerty Road boulevard with two through-lanes in each direction, with restricted left turns at intersections, numerous passenger vehicle turnarounds, and truck turnarounds (loons) where needed.

Alternative 4 – WWTIP Study Recommended Alternative

- This alternative provides direct southbound I-275 ramp access to Haggerty Road north and south of Ford Road, reducing congestion at the Ford/Haggerty Road intersection. It also includes a frontage road from Cherry Hill Road north to Ford Road and a modification of the northbound I-275 entrance ramp.

Alternative 5 – New Warren and Cherry Hill Road Interchanges

- This alternative provides full access interchanges at Cherry Hill Road and Warren Road to alleviate traffic at the Ford/Haggerty Road intersection as well as the Ford Road/I-275 interchange.

Practical Alternatives

The Illustrative Alternatives selected to advance to Practical Alternatives were Alternative 1 – No-Build, Alternative 2 – Operational Improvements, and Alternative 3 – Boulevard. These were selected based on comments received from the public and Study Team. The results of the comparison criteria also supported the decision to move these alternatives forward. Further discussion on each alternative and why it was dismissed or advanced is included below. Exhibits of the build Practical Alternatives are shown in Appendix M of the project *Traffic and*

Environmental Study Final Report. Additional information concerning Practical Alternative development can be found in Section 7 of the same report.

Alternative 1 – No-Build

- This alternative does not meet the Purpose and Need but continues through the Practical Alternative stage as a base-line of comparison to the other alternatives.
- Due to existing pavement condition, a full reconstruction is anticipated within the next ten years, thus motorists and businesses will be impacted by construction regardless of alternative.

Alternative 2 – Operational Improvements

- This alternative partially meets the Purpose and Need since traffic operations are improved for most intersection movements.
- This alternative advanced forward since it has no right-of-way and environmental impacts along with a lower construction cost relative to the other Illustrative Alternatives.
- Initially this alternative was analyzed further as a short term fix since traffic operations will degrade to existing levels within approximately ten years after implementation. These short term operational improvements would provide some congestion relief while waiting for project funding and for completion of the final design of the ultimate long term improvement alternative. Later during the Practical Alternative analysis the Study Team determined that operational improvements be added to the final recommendation to make it a more viable long term solution. Without this the only full build alternative would be Alternative 3.
- Due to existing pavement condition, a full reconstruction is anticipated within the next ten years, thus motorists and businesses will be impacted by construction regardless of alternative.

Alternative 3- Boulevard

- This alternative meets the Purpose and Need.
- This alternative will advance since it has minimal ROW and environmental impacts along with a lower construction cost relative to some of the other Illustrative Alternatives.
- Improves both safety and traffic operations along Ford Road.
- Environmentally this alternative has no detrimental impacts if the ROW impact is deemed acceptable by the public and FHWA.
- A concern of Canton Township is the potential impact to improvements previously completed and the cost share if this alternative is chosen as the Preferred Alternative and advances to design.

Alternative 4 – WWTIP Study Recommended Alternative

Not advanced for the following reasons:

- Does not meet the Purpose and Need due to negative impact on I-275 without addressing safety and traffic operations on Ford Road.

- May require design exceptions for proximity of sequential ramps and weave/merge distance for slip ramps.
- FHWA would not grant an Interstate Access Change Request.
- Environmental impacts including the potential of contaminated soils in the northeast quadrant of I-275 and Cherry Hill Road and a conservation easement in the same quadrant.

It was noted however that a concern over truck movements at the Ford and Haggerty Road intersection makes the north slip ramp alternative attractive. The design team will explore other options to improve truck movements through the Ford Road and Haggerty Road intersection such as a dedicated right turn lane to Haggerty Road all the way to I-275.

Alternative 5 – Warren and Cherry Hill Road Interchanges

Not advanced for the following reasons:

- Does not meet the Purpose and Need due to negative impact on I-275 without addressing safety and traffic operations on Ford Road.
- Environmental impacts including the potential of contaminated soils in the NE quadrant of I-275 and Cherry Hill Road and a conservation easement in the same quadrant. Other impacts include the purchase of seven multi-family housing units, two businesses, and undeveloped land with sensitive natural resources and water quality concerns.
- High costs with less than desired traffic diversion from Ford Road.
- Would require a design exception due to inadequate distance between interchanges (Warren and Ford) and an unsafe weave/merge lane.
- FHWA would not grant an Interstate Access Change Request.
- Increases traffic on Warren and Cherry Hill Roads, which currently carry residential traffic.

Additional Improvements

- Numerous additional improvements for potential inclusion in the Preferred Alternative were identified during the Road Safety Audit and from public meeting comments.
- Final inclusion of additional improvements depends whether or not they meet the project Purpose and Need and provide sufficient benefit versus cost.
- The additional improvements recommended are on Wayne County roads. Construction of these recommendations is not essential for the success of the Ford Road improvement project.

Preferred Alternative

The Practical Alternative selected to advance as the Preferred Alternative is Alternative 3 – Boulevard. This alternative was selected based on comments received from the public and Study Team. Further discussion on the Practical Alternatives dismissed is included below, along with a discussion on why the Boulevard Alternative is the Preferred Alternative. An exhibit and additional discussion of the Preferred Alternative can be found in Section 8 of the project Traffic and Environmental Study Final Report.

Alternative 1 – No-Build

Not advanced for the following reasons:

- Does not address project Purpose and Need for improving traffic operations and safety concerns along Ford Road.
- Due to assumed need for pavement reconstruction in the next ten years, the construction cost is similar to Alternative 3, but will be a lower total cost due to no right-of-way cost.

Alternative 2 – Operational Improvements

Not advanced for the following reasons:

- Despite improved traffic operations along Ford Road, failing turning movements would still exist at Haggerty Road
- Does not significantly improve safety.
- Due to assumed need for pavement reconstruction in the next ten years, the construction cost is similar to Alternative 3 but will be a lower total cost due to a lower right-of-way cost.

Alternative 3- Boulevard

This alternative was selected as the Preferred Alternative for the following reasons:

- Addresses the project Purpose and Need by significantly improving traffic operations and safety concerns along Ford Road.
- Due to assumed need for pavement reconstruction in the next ten years, the construction cost is similar to Alternatives 1 and 2.
- Nearly unanimous selection as Preferred Alternative by both public and Study Team.

7. Planning Assumptions and Analytical Methods

The forecast year is 2035 which was used for the alternative analysis. MDOT provided the 2012 existing traffic data which was then projected to produce the 2035 forecast based on the SEMCOG model runs to ensure the traffic analysis is consistent with SEMCOG's long range plan. Further information can be found in the Traffic Operations Report found in Appendix B of the project Traffic and Environmental Study Final Report.

A Road Safety Audit was conducted with a team comprised of local emergency officials, and experts from various disciplines within MDOT. The RSA was a critical element in framing safety related issues, assumptions, and proposed improvements during the analysis process. Below are some of the key issues identified along with recommended solutions for incorporation into the alternatives. The Road Safety Audit Report can be found in Appendix D of the project Traffic and Environmental Study Final Report.

A high number of crashes occur at the Haggerty Road/Ford Road intersection. The recommended solutions included Ford Road and/or Haggerty Road boulevards and additional Ford Road capacity.

Address existing sidewalk gaps especially through the I-275 interchange by retaining the I-275 bridges slope paving to accommodate sidewalk along eastbound and westbound Ford Road.

Lighting exists along Ford Road but mainly lights up the sidewalks and not the roadway creating low to no visibility at intersections. Street lighting at least at intersections will be included to address this issue and concern.

This study is included in SEMCOG's 2011 – 2014 Transportation Improvement Program. Construction is not part of the program since funding sources have not yet been secured.

8. Environmental Resources Reviewed

During the alternative development process, decisions were made based on potential environmental impacts for each of the alternatives. As part of this process, the public was asked at Public Information Meeting #2 what environmental factors should be considered and evaluated. They indicated noise, property impacts (ROW/land use), contamination, air quality, water quality, natural resources (waterways) and parkland/green space.

MDOT's Environmental Section was engaged in this study from the beginning of the project and assisted in the identification of potential impacts to wildlife habitat. Potential environmental resources were documented based on field reconnaissance surveys, database reviews, and review of past studies completed in the project study area. Field surveys and measurements were conducted for the ecological assessment, noise analysis, and project area contamination survey. These reports can be found in Appendices E, F, and G, respectively, in the project Traffic and Environmental Study Final Report. The other potential environmental impacts considered were cultural resources, Section 4(f) and 6(f), relocation, change in land use, economic, agricultural, environmental justice, social, air quality, visual, secondary development and cumulative, construction, and floodplain. A complete environmental summary can be found in Section 9 of the project Traffic and Environmental Study Final Report.

9. Environmental Resources Not Involved in Study

All environmental resources were involved in this study as stated above.

10. Cumulative Impacts

It was determined at the Practical Alternatives stage that the alternatives presented would not result in any cumulative impacts because impacts are confined to existing developed right-of-way and roadway corridors. No impacts are anticipated to adjacent land uses or environmental resources as a result of this project.

11. Mitigation Strategies

To minimize property impacts, future design should carefully consider the design and locations of turn-around loons for trucks. A list has been created identifying likely mitigation measures

that should be implemented if this project is built as described in this document. This can be found in Appendix Q of the project Traffic and Environmental Study Final Report.

12. Future NEPA Coordination

According to MDOT, FHWA, and based upon the analysis completed as part of this study, no detrimental environmental impacts were identified with the Preferred Alternative, which is in contrast to a likely Environmental Impact Statement for the WWTIP Study recommended alternative. The biggest community concerns at this time are the potential acquisition of property from commercial establishments, the impacts to businesses during construction, impacts on existing aesthetic treatments already located in the corridor, and the locations of the proposed turn-around loons. The Preferred Alternative would avoid impacts to the conservation easement near Morton Taylor Road. A complete environmental summary can be found in Section 9 of the project Traffic and Environmental Study Final Report.

Study results are also available on the MDOT website. The documentation provides a firm foundation for NEPA classification and environmental clearance should funding be identified in the future.

13. Potential Issues for Future Consideration

In the end, the Preferred Alternative poses more concerns for the community than it does for regulatory agencies. These include acquisition of commercial property, construction impacts, impact on aesthetic treatments, and the locations of turn-around loons. The project will improve an existing transportation corridor largely avoiding impacts to natural and cultural resources. Future design activities should incorporate public engagement to ensure that the project considers all community concerns while offering stakeholders an opportunity to shape the look of the corridor. Continued close coordination with township officials and the DDA should benefit future project development. Permitting needs will include National Pollutant Discharge Elimination System for earth disturbance and possibly PA 451 under Part 301 Inland Lakes and Streams and Part 31 Water Resources Protection. Additional environmental investigation is anticipated during future project phases.

If the project does not proceed to construction within ten years a new study will need to be conducted. Furthermore, an update of the traffic analysis is necessary after five years and three years for the environmental analysis. The re-evaluation does not occur automatically, but should be triggered by the scheduling of a construction project. However, the review should be limited to updating existing information related to significant changes within the study area in the time between completion of the PEL and a construction date. Since the Ford Road corridor is almost completely built out, it is unlikely that further significant land use changes in the immediate vicinity will occur. Since Canton Township has an access management program, it is also hoped that the community will continue to consolidate driveways to facilitate safe access to its retail corridor.

Appendix B

Traffic Operations Report

(Submitted under separate cover)

Appendix C

Crash History and Anticipated Future Frequency

Memorandum

Crash Analysis: M-153 from Sheldon Rd to Lotz Rd
CS 82081 - JN 115117
PR # 1595510 MP 3.428 – 3.542: M-153/Sheldon Rd Intersection
PR # 1595510 MP 3.542 – 3.893: M-153 from Sheldon Rd to Morton Taylor Rd
PR # 1595510 MP 3.893 – 4.083: M-153/Morton Taylor Rd Intersection
PR # 1595510 MP 4.083 – 4.390: M-153 from Morton Taylor Rd to Lilley Rd
PR # 1595510 MP 4.390 – 4.580: M-153/Lilley Rd Intersection
PR # 1595510 MP 4.580 – 4.885: M-153 from Lilley Rd to Haggerty Rd
PR # 1595510 MP 4.885 – 5.075: M-153/Haggerty Rd Intersection
PR # 1595510 MP 5.075 – 5.271: M-153/ SB I-275 Ramp Intersection
PR # 1595510 MP 5.271 – 5.496: M-153/NB I-275 to M-153 Ramp Intersection
PR # 1595510 MP 5.496 – 5.680: M-153 from NB I-275 to M-153 Ramp to Lotz Rd
PR # 1595510 MP 5.680 – 5.832: M-153 and Lotz Rd Intersection

1) Crash Analysis

A crash analysis on M-153 (Ford Rd) from Sheldon Rd to Lotz Rd was conducted for the five-year period between January 1st, 2007 and December 31st, 2011. The crash data utilized in this analysis was developed from MDOT single line crash data. The distribution of crashes by type of collision and location are shown in the following table.

Overall trends for this segment of roadway are that the majority of overall crashes were rear end straight crashes, consisting of approximately fifty percent (50%) of the total, with the next most common crash type being angle crashes, consisting of approximately ten percent (10%) of the overall total. Intersections with the highest percentage of total crashes were the M-153/Haggerty Rd intersection and M-153/Lilley Rd intersection, which accounted for twenty five percent (25%) and nineteen percent (19%) of the total crashes, respectively. The Southeast Michigan Council of Governments (SEMCOG) has identified both of these intersections as high-frequency crash locations within Wayne County (excluding the City of Detroit). The road segment with the highest percentage of total crashes was the roadway segment between Lilley Rd and Haggerty Rd which accounted for eleven percent (11%) of the total crashes.

As part of this analysis, crash rates, frequencies, and casualty ratios have been calculated to examine each of the road segments and intersections within the limits of the analysis. Crash rates compare the number of crashes occurring in a road segment or intersection to the volume of traffic utilizing the roadway facility. The crash rates that have been calculated in this analysis include total crash rates, fatal crash rates, injury crash rates, and property damage only (PDO) crash rates. Road segment crash rates are expressed in terms of “crashes per 100 million vehicle miles traveled” and intersection rates in terms of “crashes per 1 million entering vehicles”. Crash frequencies compare the total number of crashes that occur during the evaluation period to time. Road segment crash frequencies are in terms of “crashes per year per mile” and intersection frequencies in terms of “crashes per year”. Casualty ratios compare the number of injury and fatal crashes to the total number of crashes in the evaluation period.

The calculated crash rates, frequencies, and casualty ratios have been compared to either statewide averages from the Michigan Office of Highway Safety Planning (MOHSP) or to regional averages for similar facilities published by the Southeast Michigan Council of Governments (SEMCOG). Detailed analysis of each of the above intersections and road segments are shown in the following sections. The distribution of crashes by type of collision and location are shown in the following table.

Table 1 Crash Analysis Summary

Crash Type	Location (See Key Below)											Total	Percentage
	1	2	3	4	5	6	7	8	9	10	11		
Angle Drive	10	8	3	5	39	21	53	4	0	1	2	**146**	7.75%
Angle Straight	12	4	14	1	14	3	44	6	6	0	9	**113**	6.00%
Angle Turn	14	7	4	2	48	25	53	7	0	2	12	**174**	9.24%
Backing	0	0	0	1	3	0	5	2	2	0	1	**14**	0.74%
Dual Left Turn	1	0	1	0	0	0	0	2	4	0	0	**8**	0.42%
Dual Right Turn	0	0	1	0	0	0	0	2	0	0	1	**4**	0.21%
Fixed Object	1	2	2	2	3	2	1	1	3	1	1	**19**	1.01%
Head On Left Turn	6	2	10	1	18	3	23	1	0	0	4	**68**	3.61%
Head On	1	0	0	0	1	1	2	1	2	0	0	**8**	0.42%
Overturn	0	0	0	0	0	0	1	0	0	0	0	**1**	0.05%
Pedestrian	0	1	0	0	1	1	5	0	0	0	0	**8**	0.42%
Bike	1	1	0	0	0	0	0	1	0	0	1	**4**	0.21%
Parking	0	0	0	0	4	0	0	0	0	0	0	**4**	0.21%
Rear End Drive	8	2	3	1	14	5	24	3	3	0	6	**69**	3.66%
Rear End Left Turn	1	0	1	0	2	0	6	0	0	0	0	**10**	0.53%
Rear End Right Turn	0	0	0	0	2	0	2	2	2	0	0	**8**	0.42%
Rear End Straight	89	30	37	28	128	120	232	111	80	10	63	**928**	49.26%
Side-Swipe Opposite	2	0	2	0	4	1	9	1	1	0	2	**22**	1.17%
Side-Swipe Same	5	12	15	1	24	8	23	16	13	3	8	**158**	8.39%
Other Drive	1	2	0	1	24	12	16	3	0	0	1	**60**	3.18%
Animal	0	0	0	0	0	0	1	0	3	2	3	**9**	0.48%
Misc. Multiple Vehicle	2	0	1	3	11	1	9	3	0	0	6	**36**	1.91%
Misc. Single Vehicle	0	1	0	1	2	0	3	2	0	1	1	**11**	0.58%
Other Object	0	0	0	0	0	0	2	0	0	0	0	**2**	0.11%
Total	**154**	**72**	**94**	**47**	**342**	**203**	**544**	**168**	**119**	**20**	**121**	**1884**	**100.00%**

= Intersection

Location Key	
1. **Intersection:** M-153/Sheldon Rd (PR 1595510: MP 3.428 - 3.542)	7. **Intersection:** M-153/Haggerty Rd (PR 1595510: MP 4.885 - 5.075)
2. **Segment:** M-153 from Sheldon Rd to Morton Taylor Rd (PR 1595510: MP 3.542 - 3.893)	8. **Intersection:** M-153/South I-275 Ramp (PR 1595510: MP 5.075 – 5.271)
3. **Intersection:** M-153/Morton Taylor Rd (PR 1595510: MP 3.893 - 4.083)	9. **Intersection:** M-153/North I-275 Ramp (PR 1595510: MP 5.271- 5.496)

4. **Segment:** M-153 from Morton Taylor Rd to Lilley Rd (PR 1595510: MP 4.083 - 4.390)	10. **Segment:** M-153 from North I-275 Ramp to Lotz Rd (PR 1595510: MP 5.496 - 5.680)
5. **Intersection:** M-153/Lilley Rd (PR 1595510: MP 4.390 - 4.580)	11. **Intersection:** M-153/Lotz Rd (PR 1595510: MP 5.680 - 5.832)
6. **Segment:** M-153 from Lilley Rd to Haggerty Rd (PR 1595510: MP 4.580 - 4.885)	

Table 2 Crash Rate Summary

	Location (See Key)										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Calculated Crash Rate	**1.90**[1]	276.55[2]	**1.29**[1]	206.28[2]	**3.97**[1]	**896.77**[2]	**4.96**[1]	**1.47**[1]	**1.26**[1]	143.89[2]	**1.92**[1]
Average Crash Rate	1.07[4]	288.9[3]	0.97[4]	288.9[3]	1.07[4]	288.9[3]	1.22[4]	1.22[4]	1.23[4]	288.9[3]	0.97[4]

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 Average crash rates in number of crashes occurring per 100 million vehicle miles traveled from the Michigan Office of Highway Safety Planning (MOHSP)
4 Average crash rates in number of crashes occurring per 1 million entering vehicles for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 3 Casualty Ratio Summary

	Location (See Key)										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Casualty Ratio	0.15	**0.35**	**0.24**	**0.30**	0.22	**0.26**	0.19	0.17	0.18	0.25	0.22
Average Casualty Ratio	0.23[1]	0.25[2]	0.22[1]	0.25[2]	0.23[1]	0.25[2]	0.20[1]	0.20[1]	0.21[1]	0.25[2]	0.23[1]

1 Average casualty ratio values for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)
2 Average casualty ratio values for roadway segments without intersections and with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 4 Crash Frequency Summary

	Location (See Key)										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Crash Frequency	**30.80**[1]	**40.97**[2]	18.80[1]	**30.56**[2]	**68.40**[1]	**132.85**[2]	**108.80**[1]	**33.60**[1]	23.80[1]	**21.74**[2]	**24.20**[1]
Average Crash Frequency	17.38[3]	5.93[4]	20.56[3]	5.93[4]	17.38[3]	5.93[4]	28.13[3]	28.13[3]	24.33[3]	5.93[4]	17.38[3]

1 Crash frequency calculated in crashes per year
2 Crash frequency calculated in crashes per year per mile of roadway
3 Average crash frequencies in crashes per year for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)
4 Average crash frequencies in crashes per year per mile for roadway segments without intersections and with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 5 Injury and Fatal Crash Rate Summary

	Location (See Key)										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Number of Injury Crashes	23	24	23	14	74	53	102	29	21	5	25
Calculated Injury Crash Rate	0.28[1]	**92.18[2]**	0.32[1]	**61.44[2]**	0.86[1]	**234.13[2]**	0.93[1]	0.25[1]	0.22[1]	35.97[2]	0.41[1]
Average Injury Crash Rate	N/A[3]	52.9[5]	N/A[3]	52.9[5]	N/A[3]	52.9[5]	N/A[3]	N/A[3]	N/A[3]	52.9[5]	N/A[3]
Number of Fatal Crashes	0	1	0	0	0	0	1	0	0	0	1
Calculated Fatal Crash Rate	0.00	**3.84[2]**	0.00	0.00	0.00	0.00	0.01[1]	0.00	0.00	0.00	0.02[1]
Average Fatal Crash Rate	N/A[3]	0.9[4]	N/A[3]	0.9[4]	N/A[3]	0.9[4]	N/A[3]	N/A[3]	N/A[3]	0.9[4]	N/A[3]

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 No average injury or fatal crash rates in number of crashes per 1 million entering vehicles are available from the Michigan Office of Highway Safety Planning or the Southeast Michigan Council of Governments
4 Average fatal crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)
5 Average injury crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

Table 6 Property Damage Crash Rate Summary

	Location (See Key)										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Number of Property Damage Only Crashes	131	47	71	33	268	150	441	139	97	15	95
Calculated PDO Crash Rate	1.61[1]	180.52[2]	0.97[1]	144.83[2]	3.11[1]	**662.64[2]**	4.02[1]	1.22[1]	1.04[1]	107.92[2]	1.49[1]
Average PDO Crash Rate	N/A[3]	235.1[4]	N/A[3]	235.1[4]	N/A[3]	235.1[4]	N/A[3]	N/A[3]	N/A[3]	235.1[4]	N/A[3]

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 No average property damage only crash rates in number of crashes per 1 million entering vehicles are available from the Michigan Office of Highway Safety Planning (MOHSP) or the Southeast Michigan Council of Governments (SEMCOG)
4 Average property damage only crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

1. M-153/Sheldon Rd Intersection (PR 1595510: MP 3.428 – 3.542)

The M-153/Sheldon Rd intersection experienced one hundred and fifty four (154) crashes within the five (5) year analysis period. Eighty Nine (89) (57.79%) crashes transpired as rear end straight crashes, while fourteen (14) (9.09%) angle turn crashes, twelve (12) (7.79%) angle straight crashes, and ten (10) (6.49%) angle drive crashes also occurred. The remaining twenty nine (29) (18.84%) crashes consisted of dual left turn, fixed object, head on left turn, head on, bike, rear end drive, rear end left turn, side swipe same and opposite, misc multiple vehicle, and other drive crashes.

Of the one hundred and fifty four (154) crashes that occurred, there were zero (0) fatal crashes and twenty three (23) injury related crashes. Of the twenty three (23) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining one hundred and thirty one (131) crashes were PDO (Property Damage Only) crashes.

The crash rate for this intersection is 1.90 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 1.07 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.28 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.15 which is lower than the SEMCOG average of 0.23. The crash frequency of 30.80 crashes per year is higher than the average for signalized intersections with similar traffic volumes at 17.38 crashes per year.

2. M-153 from Sheldon Rd to Morton Taylor Rd (PR 1595510: MP 3.542 – 3.893)

This 0.351 mile segment of roadway experienced seventy two (72) crashes within the five (5) year analysis period. Thirty (30) (41.67%) crashes transpired as rear end straight crashes, while twelve (12) (16.67%) side swipe same crashes, eight (8) (11.11%) angle drive crashes, and seven (7) (9.72%) angle turn crashes also occurred. The remaining fifteen (15) (20.83%) crashes consisted of fixed object, head on left turn, pedestrian, bike, rear end drive, misc. single vehicle, and other drive crashes.

Of the seventy two (72) crashes that occurred there was one (1) fatal crash and twenty four (24) injury crashes. Of the twenty four (24) injury crashes, zero (0) were A-Level (incapacitating) injuries. See Table 7 for details involving the fatal crash. The remaining forty seven (47) crashes were PDO (Property Damage Only) crashes.

Table 7 M-153 from Sheldon Rd to Morton Taylor Rd – Fatal Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 3.687 (75' East of Marlowe Blvd)	K	Single Motor Vehicle	Dry	Clear	No	UD-10 information states that a pedestrian was attempting to cross M-153 during nighttime conditions east of Marlowe Blvd where there is not a cross walk. Vehicle 1 was traveling westbound on M-153 in the left lane and the driver stated that they were unable to avoid the collision.

A review of the fatal crash shows that it occurred at 6:20 AM and that it was dark at the time of the crash. The weather was clear and the road was dry. Alcohol or drugs were not stated as having been a factor in the crash. To the north of Marlowe Blvd there is a mall and several restaurants. To the south, there are small shops and residences. Based on a field review of this segment of road, it was found that while major intersections and sidewalks are lighted, the roadway between major intersections is not well lit by the existing lighting. The UD-10 information states that the driver of Vehicle 1 was not able to avoid the collision. Because of this information, it is most likely that the cause of this crash was poor lighting, where the driver of Vehicle 1 was not able to see the pedestrian crossing M-153.

The crash rate for the above segment of roadway is 276.55 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 92.18 and 3.84 crashes per 100 million vehicle miles traveled, respectively. Both rates are higher than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.35 and 40.97 crashes per year per mile respectively, both of which are higher than SEMCOG averages of 0.25 and 5.93 crashes per year per mile, respectively.

3. M-153/Morton Taylor Rd Intersection (PR 1595510: MP 3.893 – 4.083)

The M-153/Morton Taylor Rd intersection experienced ninety four (94) crashes within the five (5) year analysis period. Thirty seven (37) (39.36%) crashes transpired as rear end straight crashes, while fifteen (15) (15.96%) side swipe same crashes, fourteen (14) (14.89%) angle straight crashes, and ten (10) (10.64%) head on left turn crashes also occurred. The remaining eighteen (18) (18.55%) crashes consisted of angle drive and turn, dual left and right turn, fixed object, rear end drive and left turn, side swipe opposite, and misc. multiple vehicle crashes.

Of the ninety four (94) crashes that occurred, there were zero (0) fatal crashes and twenty three (23) injury related crashes. Of the twenty three (23) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining seventy one (71) crashes were PDO (Property Damage Only) crashes.

The crash rate for this intersection is 1.29 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.97 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.32 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.24 which is higher than the SEMCOG average of 0.22 while the crash frequency of 18.80 crashes per year is lower than the average for signalized intersections with similar traffic volumes at 20.56 crashes per year.

4. M-153 from Morton Taylor Rd to Lilley Rd (PR 1595510: MP 4.083 – 4.390)

This 0.307 mile segment of roadway experienced forty seven (47) crashes within the five (5) year analysis period. Twenty eight (28) (59.57%) crashes transpired as rear end straight crashes, while five (5) (10.64%) angle drive crashes also occurred. The remaining fourteen (14)

(29.79%) crashes consisted of angle straight and turn, backing, head on left turn, rear end drive, side swipe same, other drive, and misc. single and multiple vehicle.

Of the forty seven (47) crashes that occurred there were zero (0) fatal crashes and fourteen (14) injury crashes. Of the fourteen (14) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining thirty three (33) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 206.28 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury rate within the same corridor is 61.44 crashes per 100 million vehicle miles traveled which is higher than the statewide average of 52.9 injuries per 100 million vehicle miles traveled. The fatal crash rate of 0.00 crashes per 100 million vehicle miles traveled is lower that the statewide average of 0.9 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.30 and 30.56 crashes per year per mile respectively, both of which are higher than the regional averages of 0.25 and 5.93 crashes per year per mile, respectively.

5. M-153/Lilley Rd Intersection (PR 1595510: MP 4.390 – 4.580)

The M-153/Lilley Rd intersection experienced three hundred and forty two (342) crashes within the five (5) year analysis period. One hundred and twenty eight (128) (37.43%) crashes transpired as rear end straight crashes, while forty eight (48) (14.04%) angle turn crashes, thirty nine (39) (11.40%) angle drive crashes, twenty four (24) (7.02%) side swipe same, twenty four (24) (7.02%) other drive crashes, and eighteen (18) (5.26%) head on left turn crashes also occurred. The remaining sixty one (61) (17.83%) crashes consisted of backing, fixed object, head on, pedestrian, parking, rear end right and left turn, side swipe opposite, and misc. single and multiple vehicle crashes.

Of the three hundred and forty two (342) crashes that occurred, there were zero (0) fatal crashes and seventy four (74) injury related crashes. Of the seventy four (74) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 8 for details involving the A-Level injury crash. The remaining two hundred and sixty eight (268) crashes were PDO (Property Damage Only) crashes.

Table 8 M-153/Lilley Rd Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 4.483 (Lilley Rd Intersection)	A	Other/ Unknown	Dry	Clear	Yes	UD-10 information states that Vehicle 2 was stopped in the left through lane at a red light on eastbound M-153 at Lilley Rd when Vehicle 1, which was traveling southbound on Lilley Rd, turned right onto westbound M-153 and struck Vehicle 2. The driver of Vehicle 2 stated that Vehicle 1 cut the angle too sharp. Driver 1 was intoxicated and involved in another crash north on Lilley Rd just prior to this crash and was cited with an O.W.I.

A review of the A-Level (incapacitating) injury crash shows that the cause of this crash was an intoxicated driver. UD-10 information states that the driver of Vehicle 1 was intoxicated and was traveling southbound on Lilley Rd when the driver turned right onto westbound M-153 too sharp and struck Vehicle 2, which was stopped at a red light in the left hand through lane of eastbound M-153 at Lilley Rd.

The crash rate for this intersection is 3.97 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 1.07 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.86 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.22 which is lower than the SEMCOG average of 0.23. The crash frequency of 68.4 crashes per year is higher than the average for signalized intersections with similar traffic volumes at 17.38 crashes per year.

6. M-153 from Lilley Rd to Haggerty Rd (PR 1595510: MP 4.580 – 4.885)

This 0.305 mile segment of roadway experienced two hundred and three (203) crashes within the five (5) year analysis period. One hundred and twenty (120) (59.11%) crashes transpired as rear end straight crashes, while twenty five (25) (12.32%) angle turn, twenty one (21) (10.34%) angle drive, and twelve (12) (5.91%) other drive crashes also occurred. The remaining twenty five (25) (12.32%) crashes consisted of angle straight, fixed object, head on and head on left turn, pedestrian, rear end drive, side swipe same and opposite, and misc. multiple vehicle crashes.

Of the two hundred and three (203) crashes that occurred there were zero (0) fatal crashes and fifty three (53) injury crashes. Of the fifty three (53) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining one hundred and fifty (150) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 896.77 crashes per 100 million vehicle miles traveled. This is significantly higher than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 234.13 and 0.00 crashes per 100 million vehicle miles traveled, respectively. The injury rate is higher and the fatal rate is lower than statewide averages of 52.9 injuries and 0.9 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.26 and 132.85 crashes per year per mile respectively, both of which are higher than regional averages of 0.25 and 5.93 crashes per year per mile, respectively.

7. M-153/Haggerty Rd Intersection (PR 1595510: MP 4.885 – 5.075)

The M-153/Haggerty Rd intersection experienced five hundred and forty four (544) crashes within the five (5) year analysis period. Two hundred and thirty two (232) (42.65%) crashes transpired as rear end straight crashes, while fifty three (53) (9.74%) angle turn crashes, fifty three (53) (9.74%) angle drive crashes, fifty three (53) (9.74%) side swipe same crashes, forty four (44) (8.09%) angle straight, twenty four (24) (4.41%) rear end drive, and twenty three (23) (4.23%) head on left turn crashes also occurred. The remaining one hundred and six (106) (19.49%) crashes consisted of backing, fixed object, head on, overturn, pedestrian, rear end left

and right turn, side swipe opposite, other drive, animal, and misc. multiple and single vehicle, and other object crashes.

Of the five hundred and forty four (544) crashes that occurred, there was one (1) fatal crash and one hundred and two (102) injury related crashes. Of the one hundred and two (102) injury crashes, six (6) were A-Level (incapacitating) injuries. See Tables 9 and 10 for details involving the fatal and A-Level injury crashes. The remaining four hundred and forty one (441) crashes were PDO (Property Damage Only) crashes.

Table 9 M-153/Haggerty Rd Intersection – Fatal Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 5.037 (300' East of Haggerty Rd)	K	Single Motor Vehicle	Wet	Rain	Yes	UD-10 information states that a pedestrian attempted to cross M-153, from south to north, 300 feet east of Haggerty Rd. Vehicle 1 was traveling eastbound in the left lane of M-153 and struck the pedestrian.

A review of the fatal crash shows that it occurred at 6:30 PM and it was dark outside at the time of the crash. The weather was rainy and the road was wet. Alcohol was stated as being a factor in the crash as the pedestrian that was crossing the road was intoxicated. On the south side of the road, where the pedestrian started to cross, there is a pub and on the north side of the road there are multiple hotels. There was not a crosswalk where the pedestrian chose to cross M-153. Based on a field review of this segment of road, it was found that while major intersections and sidewalks are lighted, the roadway between major intersections is not well lit by the existing lighting. Because of this information, it was assumed that the cause of this crash was poor lighting and weather conditions, where the driver of Vehicle 1 was not able to see the pedestrian crossing M-153.

Table 10 M-153/Haggerty Rd Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 4.981 (5' East of Haggerty Rd)	A	Other/ Unknown	Wet	Rain	No	UD-10 information states Vehicle 2 was traveling eastbound on M-153 and had a green light when entering the intersection. Vehicle 1 was in the left hand turn lane of westbound M-153 and turned left in front of Vehicle 1. Light conditions were dark and it was rainy. The driver of Vehicle 1 was cited for a failure to yield.

Table 10 (Continued) M-153/Haggerty Rd Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 4.985 (25' East of Haggerty Rd)	A	Single Motor Vehicle	Dry	Clear	Yes	UD-10 information states that a pedestrian was crossing Haggerty Rd, from south to north, in the east crosswalk. Vehicle 1 was traveling eastbound in the left through lane and struck the pedestrian. Light conditions were dark and the weather was clear. UD-10 does not state whether Vehicle 1 had a green light. Both the driver and the pedestrian were under the influence of alcohol.
MP 4.986 (30' East of Haggerty Rd)	A	Angle	Dry	Clear	No	UD-10 crash diagram shows 4 vehicles involved in the crash. Vehicle 1 was traveling westbound on M-153 when it disobeyed a stop light and struck Vehicle 2, which was traveling northbound on Haggerty Rd in the right through lane. Vehicle 2 then hit Vehicle 3 because of the collision, which was traveling northbound in the left through lane. Vehicle 3 then hit Vehicle 4 which was in the southbound left turn lane on Haggerty Rd. The driver of Vehicle 1 was cited for disobeying a stop light.
MP 4.989 (50' East of Haggerty Rd)	A	Rear End	Wet	Rain	No	UD-10 information states Vehicles 2 & 3 were stopped at a red light at Haggerty Rd in the eastbound right hand through lane. Vehicle 1 was traveling westbound and failed to stop striking vehicle 2 which then in turn struck vehicle 3. The crash occurred at dawn and it was raining. The driver of Vehicle 1 was cited for the crash.
MP 5.037 (300' East of Haggerty Rd)	A	Single Motor Vehicle	Dry	Cloudy	Yes	UD-10 information states two pedestrians attempted to cross M-153, from south to north, 300' east of Haggerty Rd. The pedestrians were under the influence of alcohol and were crossing M-153 at an entrance drive of a pub. Vehicle 1 was traveling eastbound in the right through lane and struck one of the pedestrians. The light condition was dark and the weather was cloudy. No citations were given for this crash.
M-153 Intersection	A	Head On – Left Turn	Dry	Clear	No	UD-10 information states that Vehicle 2 was traveling northbound on Haggerty Rd through the M-153 intersection. Vehicle 1 was in the southbound left turn lane and turned in front of Vehicle 2, causing the collision. The driver of Vehicle 1 was cited for failure to yield right of way.

A review of the A-Level (incapacitating) injury crashes in Table 10 shows that five of these crashes occurred under either poor light or weather conditions. Four occurred under dark light conditions and one occurred at dawn. Two occurred in the rain. Alcohol was stated as being a

factor in two of the crashes, each of which involved a single motor vehicle striking a pedestrian. A pedestrian was struck in the cross walk of Haggerty Rd and both the pedestrian and driver of the vehicle had been under the influence of alcohol. The other pedestrian was struck three hundred feet east of the intersection where they were crossing at an entrance drive to a pub. Based on a field review of this segment of road, it was found that while sidewalks are lighted, the roadway is not well lit by the existing lighting which makes it difficult to see pedestrians when it is dark. The remaining three crashes occurred in the intersection. One rear end straight crash occurred on westbound M-153 under rainy conditions. One crash occurred because a driver disobeyed a stop light traveling westbound and struck a northbound vehicle, causing consecutive collisions of nearby vehicles. The final crash occurred when a vehicle failed to yield the right-of-way by turning left from the westbound turn lane in front of an eastbound vehicle with the green light.

The crash rate for this intersection is 4.96 crashes per 1 million entering vehicles. This is significantly higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 1.22 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.93 and 0.01 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.19 which is slightly lower than the SEMCOG average of 0.20. The crash frequency of 108.80 crashes per year is significantly higher than the average for signalized intersections with similar traffic volumes at 28.13 crashes per year.

8. M-153/South I-275 Ramp Intersection (PR 1595510: MP 5.075 – 5.271)

The M-153/S I-275 ramp intersection experienced one hundred and sixty eight (168) crashes within the five (5) year analysis period. One hundred and eleven (111) (66.07%) crashes transpired as rear end straight crashes, while sixteen (16) (9.52%) side swipe same crashes, seven (7) (4.17%) angle turn crashes, and six (6) (3.57%) angle straight crashes also occurred. The remaining twenty eight (28) (16.67%) crashes consisted of angle drive, backing, dual left and right turn, fixed object, head on and head on left turn, bike, rear end drive and right turn, side swipe opposite, misc. single and multiple vehicle, and other drive crashes.

Of the one hundred and sixty eight (168) crashes that occurred, there were zero (0) fatal crashes and twenty nine (29) injury related crashes. Of the twenty nine (29) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 11 for details involving the A-Level injury crash. The remaining one hundred and thirty nine (139) crashes were PDO (Property Damage Only) crashes.

Table 11 M-153/EB M-153 to S I-275 Ramp Intersection - A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 5.137 (M-153/ South I-275 Ramp)	A	Other/ Unknown	Dry	Cloudy	No	UD-10 information states that a bicycle was being ridden eastbound on the north shoulder of the westbound lanes at the South I-275/M-153 off ramp intersection. Vehicle 1 was turning right from the southbound exit ramp, had a flashing red, and did not see the bicycle crossing the intersection. The light conditions were dark and weather conditions cloudy. The driver of Vehicle 1 was cited for a failure to yield.

A review of the A-Level (incapacitating) injury crash shows that the driver of vehicle 1 did not see an unexpected bicycle crossing the freeway exit ramp. Based upon field review of this intersection, pedestrian accommodations (sidewalks, sidewalk ramps, crosswalks, pedestrian signal heads, etc.) are not present at this intersection however, there is a worn path in the grass at the SB I-275 Exit ramp approach to this intersection which indicates significant pedestrian use in this area.

The crash rate for this intersection is 1.47 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 1.22 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.25 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.17 which is lower than the SEMCOG average of 0.20. The crash frequency of 33.60 crashes per year is higher than the average for signalized intersections with similar traffic volumes at 28.13 crashes per year.

9. M-153/NB I-275 Ramp Intersection (PR 1595510: MP 5.271 – 5.496)

The M-153/N I-275 ramp intersection experienced one hundred and nineteen (119) crashes within the five (5) year analysis period. Eighty (80) (67.23%) crashes transpired as rear end straight crashes, while thirteen (13) (10.92%) side swipe same crashes, and six (6) (5.04%) angle straight crashes also occurred. The remaining twenty (20) (11.09%) crashes consisted of backing, dual left turn, fixed object, head on, rear end drive and right turn, side swipe opposite, and animal crashes.

Of the one hundred and nineteen (119) crashes that occurred, there were zero (0) fatal crashes and twenty one (21) injury related crashes. Of the twenty one (21) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 12 for details involving the A-Level injury crash. The remaining ninety eight (98) crashes were PDO (Property Damage Only) crashes.

Table 12 M-153/NB I-275 to M-153 Ramp Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 5.415 (75' East of the North I-275/ M-153 ramp)	A	Head-on	Dry	Cloudy	No	UD-10 information states that the driver of Vehicle 1 was under the influence of drugs traveling westbound in the left through lane when they veered left off center crossing into oncoming traffic. Vehicle 1 struck Vehicle 2, which was traveling eastbound in the left through lane. Vehicle 1 continued to cross eastbound lanes until it struck Vehicle 3, which was traveling eastbound in the right turn lane, in a head on collision. The driver of Vehicle 1 was cited for Operating While under the Influence. The light conditions were dark and the weather clear.

A review of the A-Level (incapacitating) injury crash shows that the cause of this accident was an intoxicated driver. The UD-10 information states that the driver of Vehicle 1 was under the influence of drugs and veered into oncoming traffic, striking two vehicles.

The crash rate for this intersection is 1.26 crashes per 1 million entering vehicles. This is slightly higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 1.23 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.22 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.18 which is the lower than the SEMCOG average of 0.21. The crash frequency of 23.80 crashes per year is lower than the regional average for signalized intersections with similar traffic volumes at 24.33 crashes per year.

10. M-153 from NB I-275 Ramp to Lotz Rd (PR 1595510: MP 5.496 – 5.680)

This 0.184 mile segment of roadway experienced twenty (20) crashes within the five (5) year analysis period. Ten (10) (50.0%) crashes transpired as rear end straight crashes, while three (3) (15.0%) side swipe same crashes, two (2) (10.0%) angle turn crashes, and two (2) (10.0%) animal crashes also occurred. The remaining three (3) (15.0%) crashes consisted of an angle drive crash, a fixed object crash, and a misc. single vehicle crash.

Of the twenty (20) crashes that occurred there were zero (0) fatal crashes and five (5) injury crashes. Of the five (5) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining fifteen (15) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 143.89 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 35.97 and 0.00 crashes per 100 million vehicle miles traveled respectively, which are both lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.25 and 21.74 crashes per year per mile, respectively. The casualty ratio is the same as the SEMCOG average for roadway segments without intersections and similar traffic volumes of 0.25. The crash frequency is higher than the regional average of 5.93 crashes per year per mile.

11. M-153/Lotz Rd Intersection (PR 1595510: MP 5.680 – 5.832)

The M-153/Lotz Rd intersection experienced one hundred and twenty one (121) crashes within the five (5) year analysis period. Sixty three (63) (52.07%) crashes transpired as rear end straight crashes, while twelve (12) (9.92%) angle turn crashes, nine (9) (7.44%) angle straight crashes, and eight (8) (6.61%) side swipe same crashes also occurred. The remaining twenty nine (29) (23.96%) crashes consisted of angle drive, backing, dual right turn, fixed object, head on left turn, bike, rear end drive, side swipe opposite, other drive, misc. single and multiple vehicle, and animal crashes.

Of the one hundred and twenty one (121) crashes that occurred, there was one (1) fatal crash and twenty six (26) injury related crashes. Of the twenty six (26) injury crashes, one (1) was an A-Level (incapacitating) injury. See Tables 13 and 14 for details involving the fatal and A-Level injury crashes. The remaining ninety five (95) crashes were PDO (Property Damage Only) crashes.

Table 13 M-153/Lotz Rd Intersection – Fatal Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 5.759 (15' East of Lotz Rd Intersection)	K	Single Motor Vehicle	Dry	Clear	Yes	UD-10 information states that a bicycle was attempting the cross M-153 at the Lotz Rd intersection in the east cross walk from south to north. The operator of the bicycle was under the influence of alcohol. Vehicle 2 was traveling eastbound in the right through lane and struck the bicycle. M-153 traffic had a flashing yellow at the intersection. The light condition was dark and the weather was clear.

A review of the fatal crash shows that it occurred at 11:10 PM and it was dark outside at the time of the crash. The weather was clear and the road conditions were dry. Alcohol was stated as being a factor in the crash as the operator of the bicycle that was crossing the road was under the influence of alcohol. On the south side of the road, where the bicycle started to cross, there is a restaurant and on the north side of the road there are apartments and multiple stores. The signal was flashing yellow for M-153 traffic. Based on a field review of this segment of road, it was found that the Lotz Rd crosswalks are unlighted, making it difficult to see pedestrians crossing the road when it is dark. Because of this information, the most likely cause of this crash was the cyclist failing to yield right of way to vehicular traffic and poor lighting, where the driver of Vehicle 1 was not able to see the bicycle after it entered M-153 to cross.

Table 14 M-153/Lotz Rd Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 5.756 (Lotz Rd Intersection)	A	Angle	Dry	Clear	No	UD-10 information states Vehicle 2 was traveling northbound on Lotz Rd at a green light through the M-153 intersection. Vehicle 1 was traveling eastbound on M-153 and ran a red light turning left onto northbound Lotz Rd. Vehicle 1 struck Vehicle 2 and the collision forced Vehicle 2 off the roadway and into a utility pole in the northeast quadrant of the intersection.

A review of the A-Level (incapacitating) injury crash shows that cause of this accident was a driver disobeying a red light. The weather was clear and the crash occurred in daylight conditions. UD-10 information does not show any citations given but that driver of Vehicle 1 left the scene of the crash.

The crash rate for this intersection is 1.92 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.97 crashes per 1 million entering vehicles for similar intersections. The injury and fatal rates for this intersection are 0.41 and 0.02 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.22 which is lower than the SEMCOG average of 0.23. The crash frequency of 24.2 crashes per year is higher than the average for signalized intersections with similar traffic volumes at 17.38 crashes per year.

2) Crash Concentration/Pattern Identifications and Potential Crash Mitigation Strategies

As shown in Tables 1 and 2, there is a significant number of crashes throughout this M-153 corridor. Locations of specific crash concentrations and patterns are difficult to identify due to the volume of crashes that are present through the entire segment of M-153 being analyzed. Based upon the number of crashes, a corridor-wide crash mitigation may be required rather than specific spot-location improvements at select locations. This portion of the document attempts to address the M-153 crashes on a corridor-wide scale with notable specific locations identified.

Crash Pattern #1:

As shown in Table 2, all of the existing signalized intersections on M-153 exceed the SEMCOG average intersection crash rate for signalized intersections with similar traffic volumes. These intersections generally service around 40,000 entering vehicles per day however, the Haggerty Road, I-275 SB Ramps, and I-275 NB Ramps intersections service between 52,000 and 62,000 vehicles per day. Based upon field review, significant queues develop throughout the corridor during peak periods particularly at the M-153/Haggerty Road and M-153/I-275 SB Ramps intersections. Due to the short distance between these two intersections (approximately 730 feet), the high volume of WB M-153 traffic, the high volume of SB I-275 exit traffic turning right onto WB M-153, and the high volume of traffic at the M-153/Haggerty Road intersection, WB

M-153 traffic queues from the Haggerty Road intersection spill back through the SB I-275 Ramps intersection and beyond, particularly during the evening peak hour. In addition, due to the interaction between the WB queues, traffic queues on SB I-275 were observed to extend onto mainline I-275 affecting operations on mainline SB I-275 during the evening peak hour as well. While queues at the remaining intersections were not observed to be as significant as those at the Haggerty Road and SB I-275 Ramps intersections, significant queues were also observed at the remaining M-153 signalized intersections during both peak periods.

Due to the extent of the delays and resulting queues at the signalized intersections, aggressive driving behaviors including extension of the traffic signal phase by travelling through red lights, short following distances between vehicles, aggressive lane changes, etc. were observed. These aggressive driving behaviors can lead to a multitude of crash types including rear-end, angle, sideswipe same, miscellaneous multiple, etc. crashes. As shown in Table 1, 740 (79.74%) of the rear end straight, 105 (92.92%) of the angle straight, 134 (84.81%) of the sideswipe same, 32 (88.89%) of the miscellaneous multiple vehicle crashes that occurred within this corridor during the five (5) year analysis period occurred at one of the signalized intersections.

In addition to the high number of crashes that have occurred at the signalized intersections within this corridor, high severity crashes have also occurred at the signalized intersections. Of the three (3) K-Level and nine (9) A-Level crashes that occurred within this segment of M-153, only one of these crashes (a K-Level crash between Sheldon and Morton Taylor) occurred on a roadway segment with the remaining high severity crashes occurring at one of the signalized intersections. A review of the UD-10 reports for these severe crashes shows that five (5) of these crashes involved either a pedestrian or a bicyclist, four (4) involved either drugs or alcohol, and eight (8) occurred during dark roadway conditions.

Countermeasure Recommendation: Options to improve capacity along the M-153 corridor including but, not limited to, lane additions, signal timing adjustments, clearance interval adjustments, etc. should be examined to reduce the potential for aggressive driving behaviors thereby, reducing the potential for crashes at the existing signalized intersections. Based upon review of the roadway features and crash occurrences, four (4) separate preliminary options for mitigation of crashes within the corridor have been developed as follows:

Option 1: Construct a boulevard cross section on M-153 from east of I-275 to west of Sheldon Road.

Figure 1 – Potential Boulevard Section on M-153 at Haggerty Road

This option would result in the need for indirect left-turn movements away from the existing congested signalized intersections which will add capacity to the signalized intersections which should improve driver behaviors not only at the signalized intersections but, also throughout the corridor, reduce the potential for angle crashes, and provide refuge for pedestrians when crossing M-153, among other benefits. This option would also eliminate left-turn movements at the many driveways along M-153 which will improve safety on the roadway segments as well.

Right-of-Way Impacts: **Right-of-Way impacts will be realized at the proposed "loon" (widened roadway portions to allow large trucks to complete U-turn movements at median crossovers) locations, near the M-153/Haggerty Road intersection (south side of roadway) and on the north side of M-153 between Sheldon and Morton Taylor and between Lilley and Haggerty.**

Estimated Cost: **$4,532,000 (without Right-of-Way costs)**

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 6.78. See the end of this section for the results of this analysis.

Option 2: Construct a boulevard cross section on Haggerty Rd from south of M-153 to north of M-153.

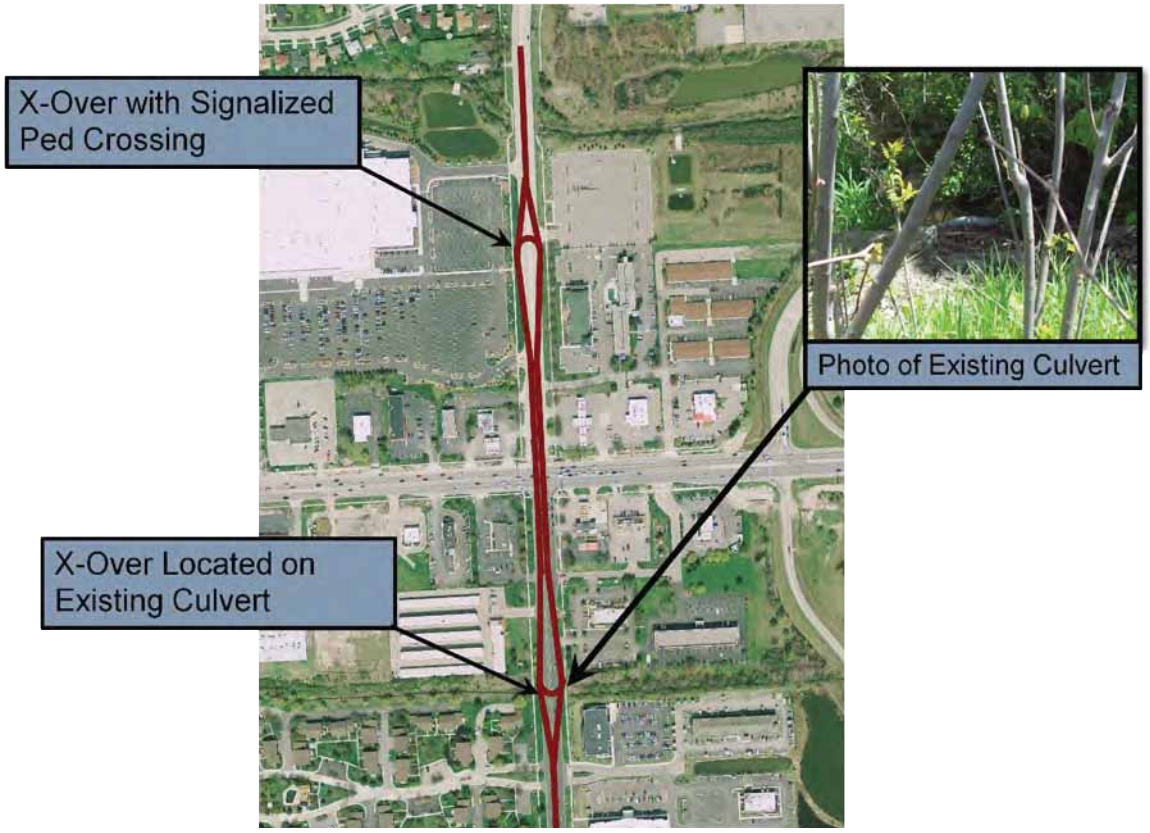


Figure 2 – Potential Boulevard Section on Haggerty Road at M-153

As shown in Table 1, the majority (544) (29.50%) of the signalized intersection crashes occurred at the M-153/Haggerty Rd intersection. Similar to the previous option, this option would result in the need for indirect left-turn movements away from the existing congested signalized intersection of M-153/Haggerty Rd which will add capacity to the intersection and should improve driver behaviors, reduce the potential for angle crashes, provide refuge for pedestrians when crossing Haggerty Rd, among other benefits.

Right-of-Way Impacts: **Right-of-Way impacts will be realized at the proposed "loon" (widened roadway portions to allow large trucks to complete U-turn movements at median crossovers) locations both north and south of M-153. These loons would affect the existing IKEA property and potentially require the lengthening of an existing culvert south of M-153.**

Estimated Cost: **$871,000 (without Right-of-Way costs)**

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-

injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 2.20. See the end of this section for the results of this analysis.

Option 3: Construct three (3) WB M-153 through lanes from east of I-275 to Sheldon Road and construct three (3) EB M-153 through lanes from I-275 to west of Haggerty Road.

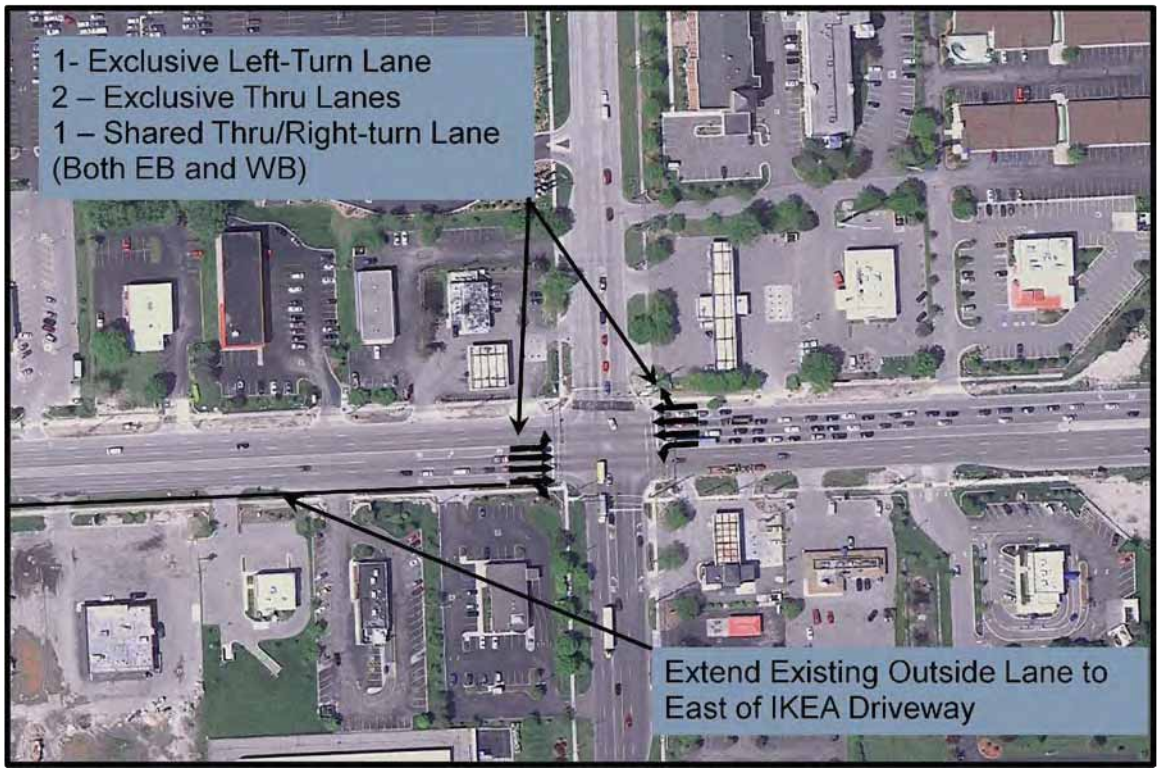


Figure 3 – Potential 3-Lane Section on M-153 at the Haggerty Road intersection

This option would improve capacity throughout the M-153 corridor thereby, improving driver behaviors and reducing the potential for congestion-related crashes (i.e. rear end, angle, etc.). In addition, left-turn phasing would be required to provide protected only phasing which would reduce the potential for angle crashes at the signalized intersections.

Right-of-Way Impacts: $201,000 (without Right-of-Way costs)

Estimated Cost: Right-of-Way impacts will be realized near the M-153/Haggerty Road intersection (south side of roadway). It is anticipated that approximately 1,350 sft of Right-of-Way may be required to accommodate the proposed third EB lane.

A Time of Return (TOR) analysis could not be conducted for this mitigation. No Crash Modification Factors for adding though lanes at urban signalized intersections were available at the time of this analysis to determine the potential benefits of this mitigation.

Option 4: Construct dual left-turn lanes on M-153 at the M-153 / Haggerty Road intersection.

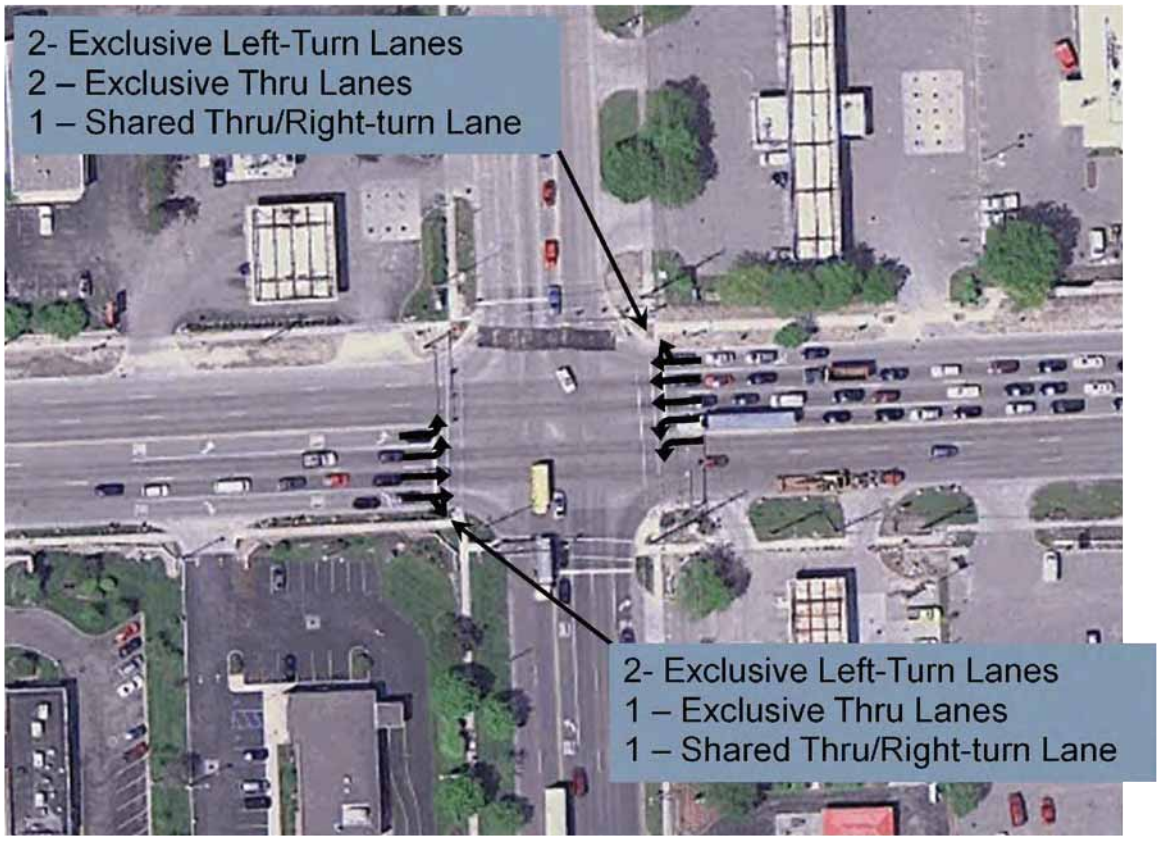


Figure 4 – Potential Dual Left-turn Lanes on M-153 at the Haggerty Road intersection

As stated earlier, the Haggerty Road intersection has a majority of the intersection-related crashes within this corridor. This option would improve capacity at the M-153/Haggerty Road intersection thereby, improving driver behaviors and reducing the potential for congestion-related crashes (i.e. rear end, angle, etc.). In addition, left-turn phasing would be required to provide protected only phasing which would reduce the potential for angle crashes at this signalized intersection.

Right-of-Way Impacts: Right-of-Way impacts will be realized near the M-153/Haggerty Road intersection (south side of roadway). It is anticipated that approximately 1,350 sft of Right-of-Way may be required to accommodate the proposed third EB lane.

Estimated Cost: $528,000 (without Right-of-Way costs)

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 2.01. See the end of this section for the results of this analysis.

Crash Pattern #2: Of the thirteen (13) high severity crashes (K or A-level crashes) that occurred within the M-153 corridor during the analysis period, six (6) (46.15%) involved a pedestrian or bicyclist. Of these six (6) crashes, five (5) (83.33%) occurred at a signalized intersection and all five of these crashes occurred under low-light conditions. Based upon field review, roadway lighting exists throughout the M-153 corridor with the exception of within the I-275 interchange however, the existing lighting illuminates primarily the pedestrian paths rather than the roadway. Due to the lack of illumination of the roadway, pedestrians/bicyclists crossing M-153 can be difficult to see even within the marked crosswalks.

Countermeasure Recommendation: Consideration of provision of roadway lighting at the signalized intersections or where pedestrians/bicyclists are expected to cross should be provided. This will illuminate the pedestrians/bicyclists when crossing the roadway and should reduce the potential of collisions.

Right-of-Way Impacts: **None**

Estimated Cost: **$90,000**

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 0.08. See the end of this section for the results of this analysis.

M-153 Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2011
Number of Years 5

	1	2	3	4	5	6	7	8	9	10	11		
Crash Type	**M-153/Sheldon Rd Intersection: MP 3.428 - 3.542 PR 1595510**	**M-153: Sheldon Rd to Morton Taylor Rd MP 3.542 - 3.893 PR 1595510**	**M-153/Morton Taylor Rd Intersection MP 3.893 - 4.083 PR 1595510**	**M-153: Morton Taylor Rd to Lilley Rd MP 4.083 - 4.390 PR 1595510**	**M-153/Lilley Rd Intersection MP 4.390 - 4.580 PR 1595510**	**M-153: Lilley Rd to Haggerty Rd MP 4.580 - 4.885 PR 1595510**	**M-153/Haggerty Rd Intersection MP 4.885 - 5.075 PR 1595510**	**M-153/E M-153/S I-275 Ramp intersection MP 5.075 - 5.271 PR 1595510**	**M-153/N I-275/M-153 Ramp Intersection MP 5.271 - 5.496 PR 1595510**	**M-153: N I-275/M-153 Ramp to Lotz Rd MP 5.496 - 5.680 PR 1595510**	**M-153/Lotz Rd Intersection MP 5.680 - 5.832 PR 1595510**	**Total**	**Percentage**
Angle Drive	10	8	3	5	39	21	53	4	0	1	2	**146**	7.75%
Angle Straight	12	4	14	1	14	3	44	6	6	0	9	**113**	6.00%
Angle Turn	14	7	4	2	48	25	53	7	0	2	12	**174**	9.24%
Backing	0	0	0	1	3	0	5	2	2	0	1	**14**	0.74%
Dual Left Turn	1	0	1	0	0	0	0	2	4	0	0	**8**	0.42%
Dual Right Turn	0	0	1	0	0	0	0	2	0	0	1	**4**	0.21%
Fixed Object	1	2	2	2	3	2	1	1	3	1	1	**19**	1.01%
Head On Left Turn	6	2	10	1	18	3	23	1	0	0	4	**68**	3.61%
Head On	1	0	0	0	1	1	2	1	2	0	0	**8**	0.42%
Overturn	0	0	0	0	0	0	1	0	0	0	0	**1**	0.05%
Pedestrian	0	1	0	0	1	1	5	0	0	0	0	**8**	0.42%
Bike	1	1	0	0	0	0	0	1	0	0	1	**4**	0.21%
Parking	0	0	0	0	4	0	0	0	0	0	0	**4**	0.21%
Rear End Drive	8	2	3	1	14	5	24	3	3	0	6	**69**	3.66%
Rear End Left Turn	1	0	1	0	2	0	6	0	0	0	0	**10**	0.53%
Rear End Right Turn	0	0	0	0	2	0	2	2	2	0	0	**8**	0.42%
Rear End Straight	89	30	37	28	128	120	232	111	80	10	63	**928**	49.26%
Side-Swipe Opposite	2	0	2	0	4	1	9	1	1	0	2	**22**	1.17%
Side-Swipe Same	5	12	15	1	24	8	53	16	13	3	8	**158**	8.39%
Other Drive	1	2	0	1	24	12	16	3	0	0	1	**60**	3.18%
Animal	0	0	0	0	0	0	1	0	3	2	3	**9**	0.48%
Misc. Multiple Vehicle	2	0	1	3	11	1	9	3	0	0	6	**36**	1.91%
Misc. Single Vehicle	0	1	0	1	2	0	3	2	0	1	1	**11**	0.58%
Other Object	0	0	0	0	0	0	2	0	0	0	0	**2**	0.11%
Total	**154**	**72**	**94**	**47**	**342**	**203**	**544**	**168**	**119**	**20**	**121**	**1884**	**100.00%**

	M-153/Sheldon Rd Intersection: MP 3.428 - 3.542 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)	**M-153: Sheldon Rd to Morton Taylor Rd MP 3.542 - 3.893 PR 1595510 (Crash rate calculated in crashes per 100 million vehicle miles traveled)**	**M-153/Morton Taylor Rd Intersection MP 3.893 - 4.083 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153: Morton Taylor Rd to Lilley Rd MP 4.083 - 4.390 PR 1595510 (Crash rate calculated in crashes per 100 million vehicle miles traveled)**	**M-153/Lilley Rd Intersection: MP 4.390 - 4.580 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153: Lilley Rd to Haggerty Rd MP 4.580 - 4.885 PR 1595510 (Crash rate calculated in crashes per 100 million vehicle miles traveled)**	**M-153/Haggerty Rd Intersection: MP 4.885 - 5.075 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153/E M-153/S I-275 Ramp Intersection: MP 5.075 - 5.271 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153/N I-275/M-153 Ramp Intersection MP 5.271 - 5.496 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153: N I-275/M-153 Ramp to Lotz Rd MP 5.496 - 5.680 PR 1595510 (Crash rate calculated in crashes per 100 million vehicle miles traveled)**	**M-153/Lotz Rd Intersection MP 5.680 - 5.832 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**
AADT	44472	40588	39908	40588	47167	40588	60067	62482	51553	41391	34491
Length of Roadway Segment	0.11	0.35	0.19	0.31	0.19	0.31	0.19	0.20	0.23	0.18	0.15
Calculated Crash Rate	**1.90**	276.55	**1.29**	206.28	**3.97**	**896.77**	**4.96**	**1.47**	**1.26**	143.89	**1.92**
Average Crash Rate	1.07	288.9	0.97	288.9	1.07	288.9	1.22	1.22	1.23	288.9	0.97
Casualty Ratio	0.15	**0.35**	**0.24**	**0.30**	0.22	**0.26**	0.19	0.17	0.18	0.25	0.22
Average Casualty Ratio	0.23	0.25	0.22	0.25	0.23	0.25	0.20	0.20	0.21	0.25	0.23
Crash Frequency	**30.80**	**40.97**	18.80	**30.56**	**68.40**	**132.85**	**108.80**	**33.60**	23.80	**21.74**	**24.20**
Average Crash Frequency	17.38	5.93	20.56	5.93	17.38	5.93	28.13	28.13	24.33	5.93	17.38

Crash Severity	**M-153/Sheldon Rd Intersection: MP 3.428 - 3.542 PR 1595510**	**M-153: Sheldon Rd to Morton Taylor Rd MP 3.542 - 3.893 PR 1595510**	**M-153/Morton Taylor Rd Intersection MP 3.893 - 4.083 PR 1595510**	**M-153: Morton Taylor Rd to Lilley Rd MP 4.083 - 4.390 PR 1595510**	**M-153/Lilley Rd Intersection MP 4.390 - 4.580 PR 1595510**	**M-153: Lilley Rd to Haggerty Rd MP 4.580 - 4.885 PR 1595510**	**M-153/Haggerty Rd Intersection MP 4.885 - 5.075 PR 1595510**	**M-153/E M-153/S I-275 Ramp intersection MP 5.075 - 5.271 PR 1595510**	**M-153/N I-275/M-153 Ramp Intersection MP 5.271 - 5.496 PR 1595510**	**M-153: N I-275/M-153 Ramp to Lotz Rd MP 5.496 - 5.680 PR 1595510**	**M-153/Lotz Rd Intersection MP 5.680 - 5.832 PR 1595510**	**Total**
Injury	23	24	23	14	73	53	96	28	20	5	25	**384**
A Level Injury	0	0	0	0	1	0	6	1	1	0	1	**10**
Fatal	0	1	0	0	0	0	1	0	0	0	1	**3**
PDO	131	47	71	33	268	150	441	139	98	15	94	**1487**
Total	**154**	**72**	**94**	**47**	**342**	**203**	**544**	**168**	**119**	**20**	**121**	**1884**

	M-153/Sheldon Rd Intersection: MP 3.428 - 3.542 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)	**M-153: Sheldon Rd to Morton Taylor Rd MP 3.542 - 3.893 PR 1595510 (Crash rate calculated in crashes per 100 million vehicle miles traveled)**	**M-153/Morton Taylor Rd Intersection MP 3.893 - 4.083 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153: Morton Taylor Rd to Lilley Rd MP 4.083 - 4.390 PR 1595510 (Crash rate calculated in crashes per 100 million vehicle miles traveled)**	**M-153/Lilley Rd Intersection: MP 4.390 - 4.580 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153: Lilley Rd to Haggerty Rd MP 4.580 - 4.885 PR 1595510 (Crash rate calculated in crashes per 100 million vehicle miles traveled)**	**M-153/Haggerty Rd Intersection: MP 4.885 - 5.075 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153/E M-153/S I-275 Ramp Intersection: MP 5.075 - 5.271 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153/N I-275/M-153 Ramp Intersection MP 5.271 - 5.496 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**	**M-153: N I-275/M-153 Ramp to Lotz Rd MP 5.496 - 5.680 PR 1595510 (Crash rate calculated in crashes per 100 million vehicle miles traveled)**	**M-153/Lotz Rd Intersection MP 5.680 - 5.832 PR 1595510 (Crash rate calculated in crashes per 1 million entering vehicles)**
Injury Crash Rate	0.28	**92.18**	0.32	**61.44**	0.86	**234.13**	0.93	0.25	0.22	35.97	0.41
Average Injury Crash Rate	N/A	52.9	N/A	52.9	N/A	52.9	N/A	N/A	N/A	52.9	N/A
Property Damage Crash Rate	1.61	180.52	0.97	144.83	3.11	**662.64**	4.02	1.22	1.04	107.92	1.49
Average PDO Crash Rate	N/A	235.1	N/A	235.1	N/A	235.1	N/A	N/A	N/A	235.1	N/A
Fatal Crash Rate	0.00	**3.84**	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02
Average Fatal Crash Rate	N/A	0.9	N/A	0.9	N/A	0.9	N/A	N/A	N/A	0.9	N/A

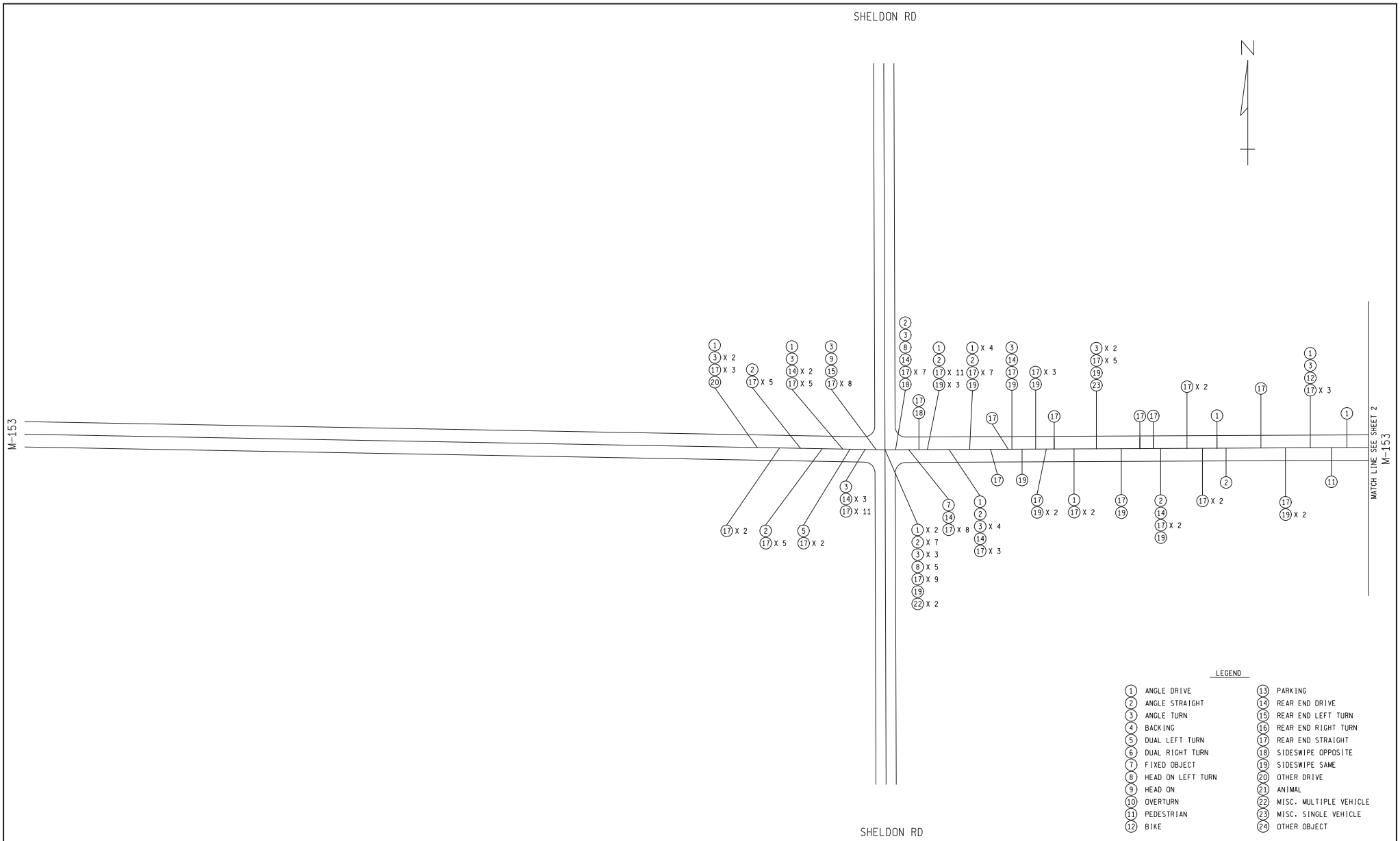
M-153 Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2011
Number of Years 5

Light Condition	M-153/Sheldon Rd Intersection: MP 3.428 - 3.542 PR 1595510	M-153: Sheldon Rd to Morton Taylor Rd MP 3.542 - 3.893 PR 1595510	M-153/Morton Taylor Rd Intersection MP 3.893 - 4.083 PR 1595510	M-153: Morton Taylor Rd to Lilley Rd MP 4.083 - 4.390 PR 1595510	M-153/Lilley Rd Intersection MP 4.390 - 4.580 PR 1595510	M-153: Lilley Rd to Haggerty Rd MP 4.580 - 4.885 PR 1595510	M-153/Haggerty Rd Intersection MP 4.885 - 5.075 PR 1595510	M-153/E M-153/S I-275 Ramp intersection MP 5.075 - 5.271 PR 1595510	M-153/N I-275/M-153 Ramp Intersection MP 5.271 - 5.496 PR 1595510	M-153: N I-275/M-153 Ramp to Lotz Rd MP 5.496 - 5.680 PR 1595510	M-153/Lotz Rd Intersection MP 5.680 - 5.832 PR 1595510	Total
Dark (Defined as 8 PM to 6 AM)	23	14	29	5	34	10	63	16	19	2	16	**231**
Dawn (Defined as 6 AM to 8 AM)	3	1	1	0	6	4	37	13	6	0	9	**80**
Daylight (Defined As 8 AM to 6 PM)	100	43	51	36	252	152	384	119	82	14	84	**1317**
Dusk (Defined as 6 PM to 8 PM)	28	14	13	6	50	37	60	20	12	4	12	**256**
Unknown	0	0	0	0	0	0	0	0	0	0	0	**0**
Total	**154**	**72**	**94**	**47**	**342**	**203**	**544**	**168**	**119**	**20**	**121**	**1884**

Weather Conditions	M-153/Sheldon Rd Intersection: MP 3.428 - 3.542 PR 1595510	M-153: Sheldon Rd to Morton Taylor Rd MP 3.542 - 3.893 PR 1595510	M-153/Morton Taylor Rd Intersection MP 3.893 - 4.083 PR 1595510	M-153: Morton Taylor Rd to Lilley Rd MP 4.083 - 4.390 PR 1595510	M-153/Lilley Rd Intersection MP 4.390 - 4.580 PR 1595510	M-153: Lilley Rd to Haggerty Rd MP 4.580 - 4.885 PR 1595510	M-153/Haggerty Rd Intersection MP 4.885 - 5.075 PR 1595510	M-153/E M-153/S I-275 Ramp intersection MP 5.075 - 5.271 PR 1595510	M-153/N I-275/M-153 Ramp Intersection MP 5.271 - 5.496 PR 1595510	M-153: N I-275/M-153 Ramp to Lotz Rd MP 5.496 - 5.680 PR 1595510	M-153/Lotz Rd Intersection MP 5.680 - 5.832 PR 1595510	Total
Uncoded - Errors	0	0	0	0	0	0	74	0	0	0	0	**74**
Clear	79	44	58	25	191	104	255	92	71	8	73	**1000**
Cloudy	49	18	23	17	104	70	144	54	36	8	29	**552**
Fog	0	0	0	0	0	0	0	0	1	0	1	**2**
Rain	19	9	7	5	37	21	52	14	6	2	13	**185**
Snow/Blowing Snow	6	1	4	0	8	5	14	6	4	2	5	**55**
Severe Wind	0	0	1	0	1	1	0	1	0	0	0	**4**
Sleet or Hail	0	0	0	0	1	0	0	0	0	0	0	**1**
Other	1	0	1	0	0	2	5	1	1	0	0	**11**
Total	**154**	**72**	**94**	**47**	**342**	**203**	**544**	**168**	**119**	**20**	**121**	**1884**

Pavement Conditions	M-153/Sheldon Rd Intersection: MP 3.428 - 3.542 PR 1595510	M-153: Sheldon Rd to Morton Taylor Rd MP 3.542 - 3.893 PR 1595510	M-153/Morton Taylor Rd Intersection MP 3.893 - 4.083 PR 1595510	M-153: Morton Taylor Rd to Lilley Rd MP 4.083 - 4.390 PR 1595510	M-153/Lilley Rd Intersection MP 4.390 - 4.580 PR 1595510	M-153: Lilley Rd to Haggerty Rd MP 4.580 - 4.885 PR 1595510	M-153/Haggerty Rd Intersection MP 4.885 - 5.075 PR 1595510	M-153/E M-153/S I-275 Ramp intersection MP 5.075 - 5.271 PR 1595510	M-153/N I-275/M-153 Ramp Intersection MP 5.271 - 5.496 PR 1595510	M-153: N I-275/M-153 Ramp to Lotz Rd MP 5.496 - 5.680 PR 1595510	M-153/Lotz Rd Intersection MP 5.680 - 5.832 PR 1595510	Total
Uncoded - Errors	1	0	3	0	3	1	97	0	2	0	1	**108**
Dry	110	54	72	38	255	149	345	122	81	13	103	**1342**
Wet	34	17	14	6	70	45	83	35	30	6	16	**356**
Icy	3	0	2	0	6	1	6	6	3	0	0	**27**
Snow/Blowing Snow	3	1	3	3	7	4	7	3	2	1	1	**35**
Muddy	0	0	0	0	0	0	0	0	0	0	0	**0**
Slushy	3	0	0	0	0	1	2	1	1	0	0	**8**
Covered With Debris	0	0	0	0	0	0	1	0	0	0	0	**1**
Other	0	0	0	0	1	2	3	1	0	0	0	**7**
Total	**154**	**72**	**94**	**47**	**342**	**203**	**544**	**168**	**119**	**20**	**121**	**1884**



FINAL ROW PLAN REVISIONS (PLANS SUBMITTAL REVISIONS)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

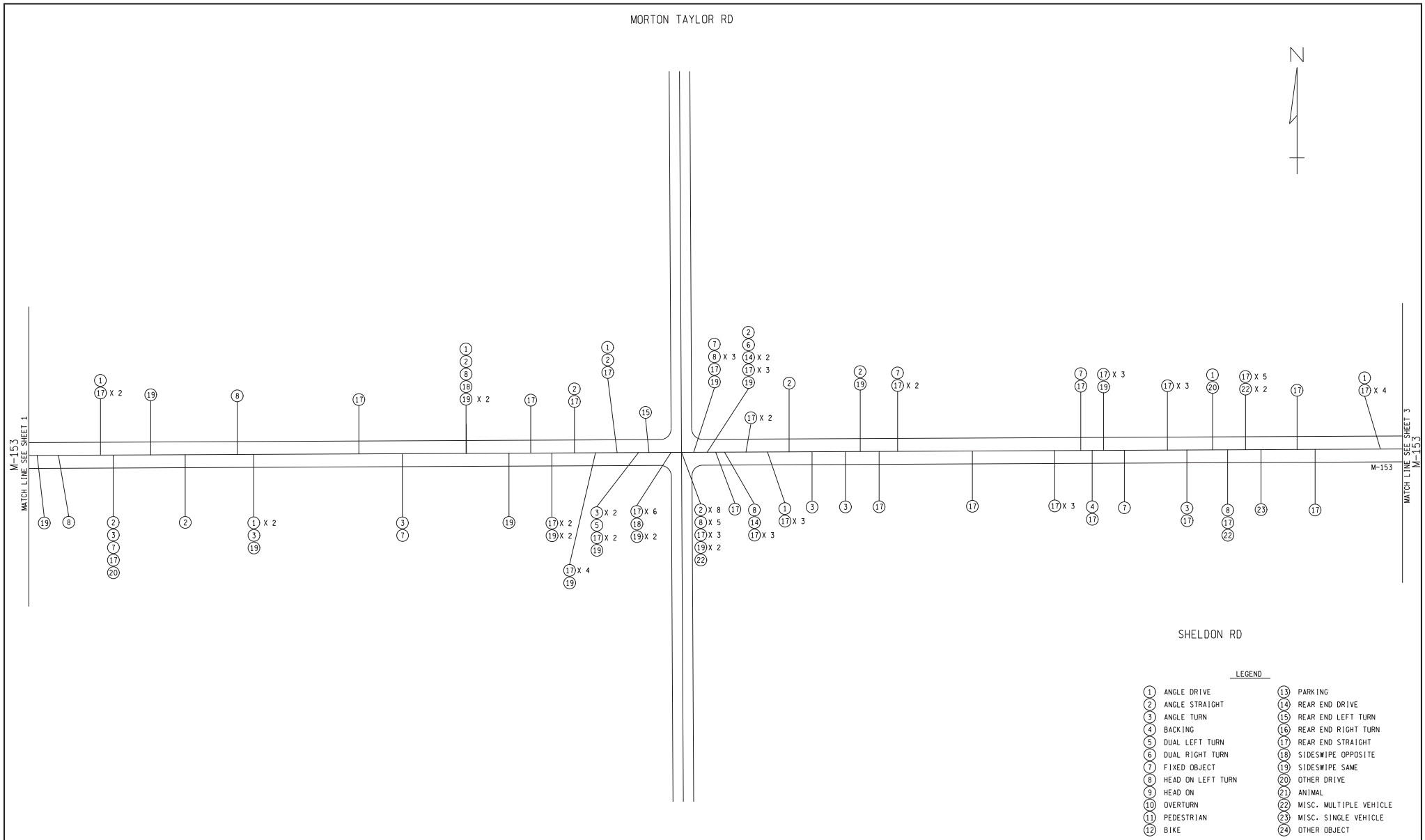
FILE: M-153-1.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

M-153 (FORD ROAD)
CRASH LOCATION MAP

DRAWING: 1
SHEET:



FINAL ROW PLAN REVISIONS (WEIGHTS AND MEASURES)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

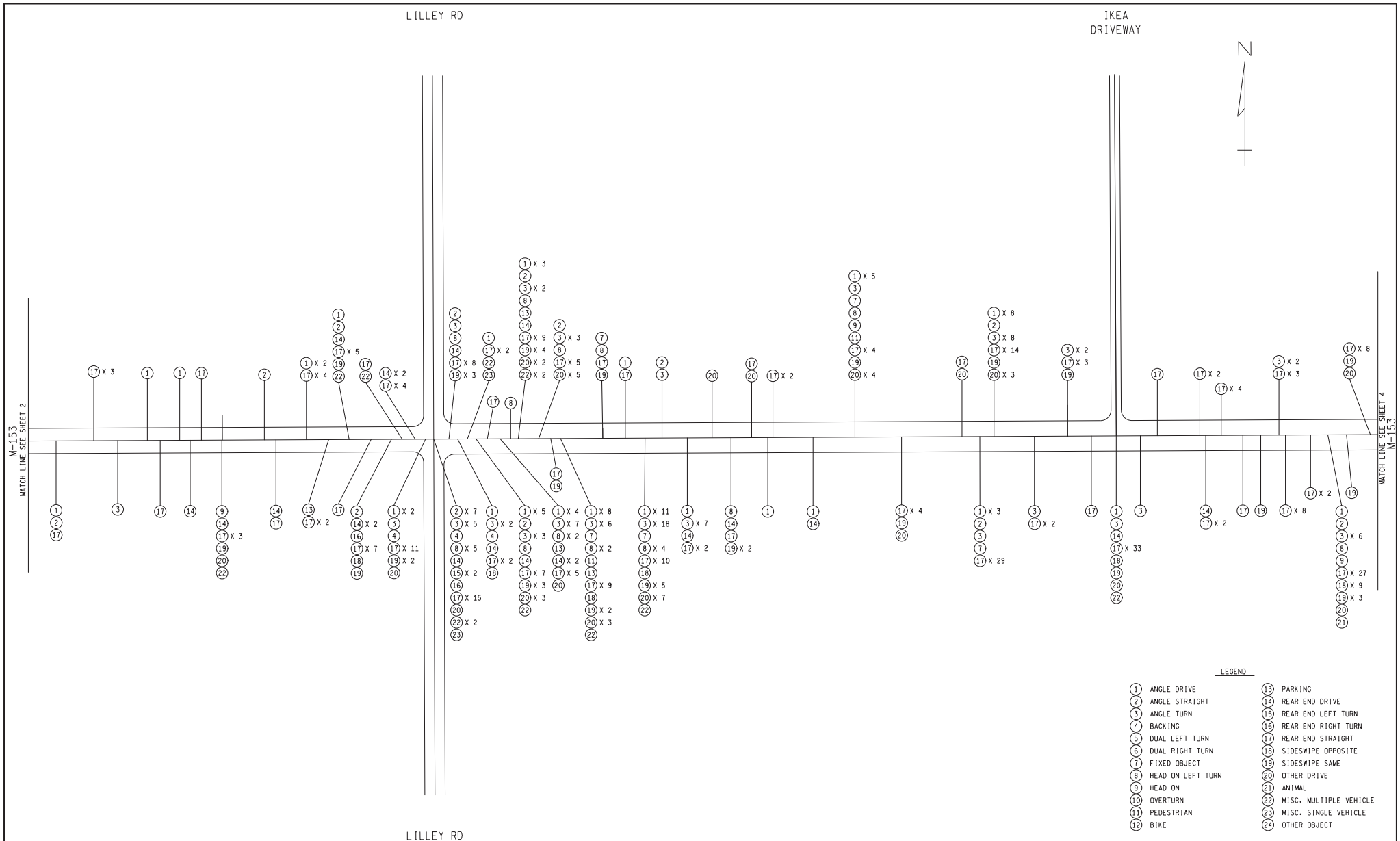
FILE: M-153-2.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

M-153 (FORD ROAD)
CRASH LOCATION MAP

DRAWING: 2
SHEET:



FINAL ROW PLAN REVISIONS (RIGHT OF WAY REVISIONS)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

FILE: M-153-3.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

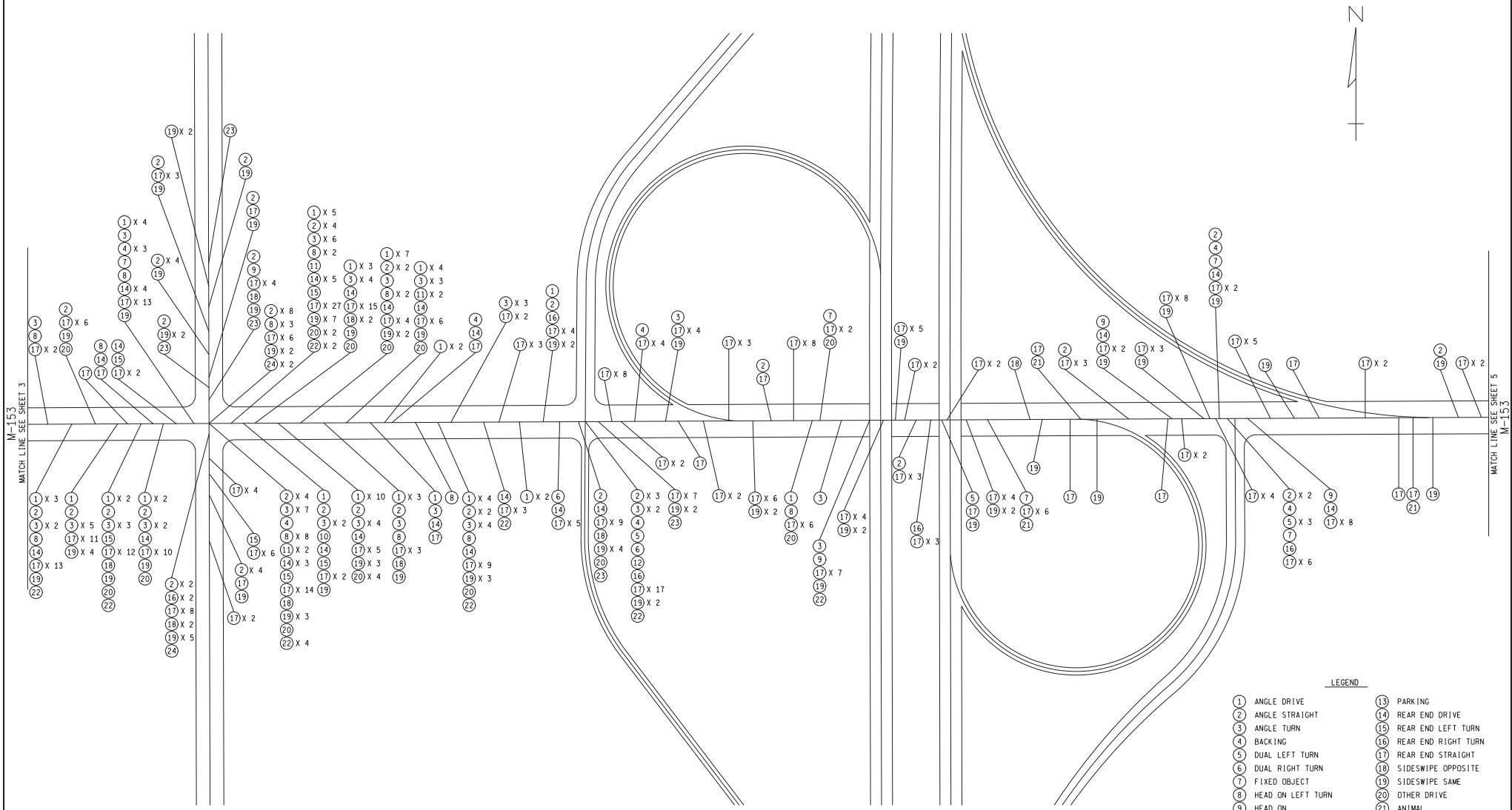
CS:
JN: 115177 & 115379

M-153 (FORD ROAD)
CRASH LOCATION MAP

DRAWING: 3
SHEET:

HAGGERTY RD

I-275 SB I-275 NB



LEGEND

1	ANGLE DRIVE	13	PARKING
2	ANGLE STRAIGHT	14	REAR END DRIVE
3	ANGLE TURN	15	REAR END LEFT TURN
4	BACKING	16	REAR END RIGHT TURN
5	DUAL LEFT TURN	17	REAR END STRAIGHT
6	DUAL RIGHT TURN	18	SIDESWIPE OPPOSITE
7	FIXED OBJECT	19	SIDESWIPE SAME
8	HEAD ON LEFT TURN	20	OTHER DRIVE
9	HEAD ON	21	ANIMAL
10	OVERTURN	22	MISC. MULTIPLE VEHICLE
11	PEDESTRIAN	23	MISC. SINGLE VEHICLE
12	BIKE	24	OTHER OBJECT

HAGGERTY RD

I-275 SB I-275 NB

FINAL ROW PLAN REVISIONS (WESTERN SAW REVISIONS)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 12
0 HORZ. (FT) 12

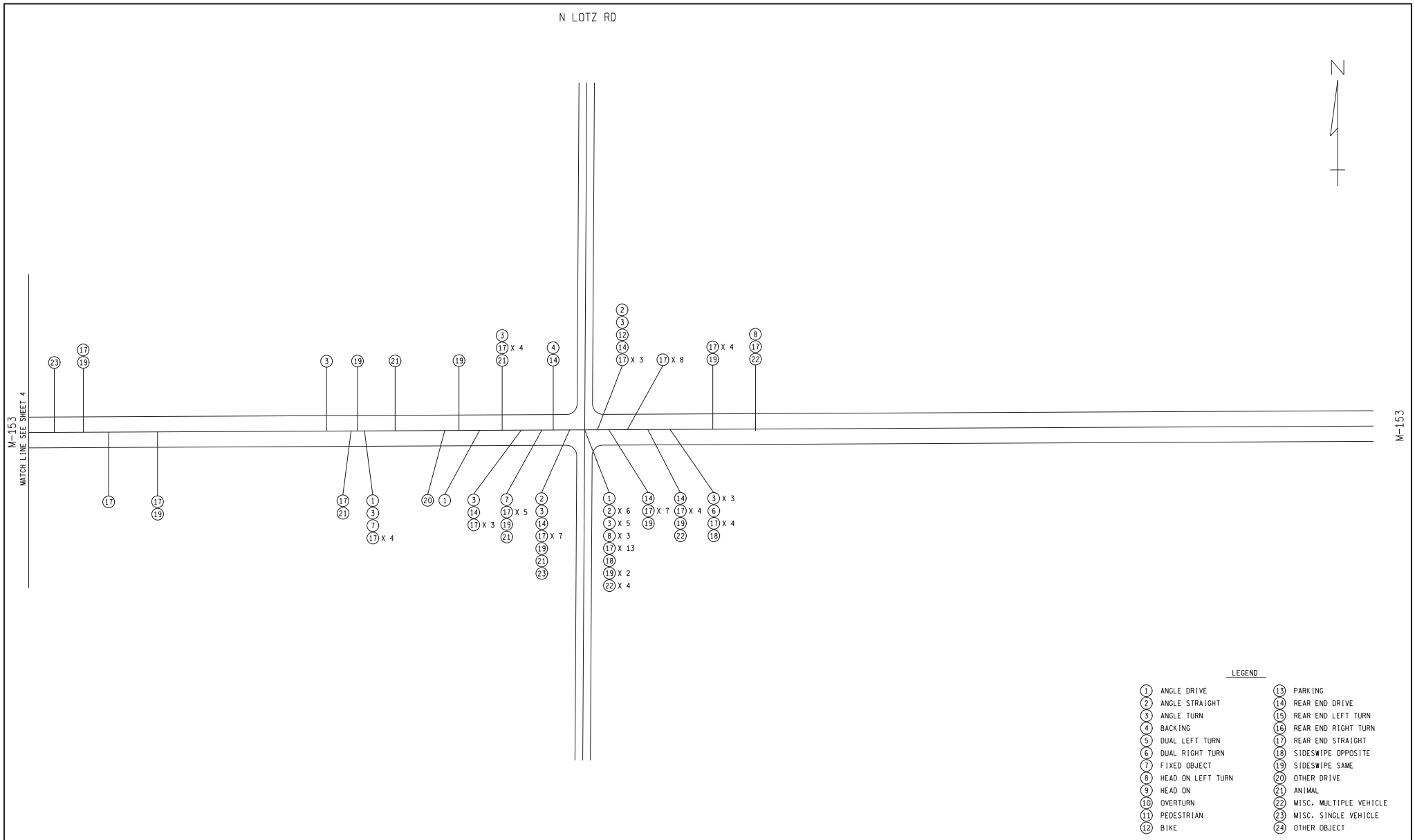
FILE: M-153-4.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

M-153 (FORD ROAD)
CRASH LOCATION MAP

DRAWING: 4
SHEET:



LEGEND

1	ANGLE DRIVE	13	PARKING
2	ANGLE STRAIGHT	14	REAR END DRIVE
3	ANGLE TURN	15	REAR END LEFT TURN
4	BACKING	16	REAR END RIGHT TURN
5	DUAL LEFT TURN	17	REAR END STRAIGHT
6	DUAL RIGHT TURN	18	SIDESWIPE OPPOSITE
7	FIXED OBJECT	19	SIDESWIPE SAME
8	HEAD ON LEFT TURN	20	OTHER DRIVE
9	HEAD ON	21	ANIMAL
10	OVERTURN	22	MISC. MULTIPLE VEHICLE
11	PEDESTRIAN	23	MISC. SINGLE VEHICLE
12	BIKE	24	OTHER OBJECT

FINAL ROW PLAN REVISIONS (IF APPLICABLE)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

FILE: M-153-5.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

M-153 (FORD ROAD)
CRASH LOCATION MAP

DRAWING: 5
SHEET:

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
Provide Median	%REDUCTION		15%			
Number of Crashes		386	349	366	343	347
PDO+Minor Inj Crashes		384	345	360	343	346
A-Injured or Killed Persons		2	4	6	0	1
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0

# of A-injuries:	10	For reference only
# of Fatalilties:	3	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$4,532,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	5.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

M-153 Crash Analysis - Crash Pattern #1-1
M-153 from Sheldon Rd to Lotz Rd
1595110
3.428-5.832
Provide Median

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **M-153 Crash Analysis - Crash Pattern #1-1** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **1595110** PR MP Range: **3.428-5.832**

CS: **82081** CS MP Range: **3.428-5.832**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$2,611,472
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	2.0
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	266.7
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 5.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $522,294

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $668,581

C = Project Cost $4,532,000

TOR=C/B=COST/ANNUAL BENEFIT= **6.78**

NUMBER OF CRASHES OR INJURED PERSONS.

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
	2007	2008	2009	2010	2011
Add indirect left-turn treatmer	%REDUCTION	26%			
Number of Crashes	105	91	92	88	75
PDO+Minor Inj Crashes	104	88	91	88	74
A-Injured or Killed Persons	1	3	1	0	1
Provide Median	%REDUCTION	15%			
Number of Crashes	27	26	21	24	22
PDO+Minor Inj Crashes	26	26	21	24	22
A-Injured or Killed Persons	1	0	0	0	0
0	%REDUCTION	0%			
Number of Crashes	0	0	0	0	0
PDO+Minor Inj Crashes	0	0	0	0	0
A-Injured or Killed Persons	0	0	0	0	0
0	%REDUCTION	0%			
Number of Crashes	0	0	0	0	0
PDO+Minor Inj Crashes	0	0	0	0	0
A-Injured or Killed Persons	0	0	0	0	0
0	%REDUCTION	0%			
Number of Crashes	0	0	0	0	0
PDO+Minor Inj Crashes	0	0	0	0	0
A-Injured or Killed Persons	0	0	0	0	0

# of A-injuries:	6	For reference only
# of Fatalilties:	1	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$871,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	5.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

M-153 Crash Analysis - Crash Pattern #1-2
M-153 / Haggerty Rd Intersection
4706524
7.736-8.114
Indirect Left Turns

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **M-153 Crash Analysis - Crash Pattern #1-2** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **4706524** PR MP Range: **7.736-8.114**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	#########
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	1.7
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	133.6
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21] for AREA TYPE ERR	$191,700
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 5.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $292,475

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $374,393

C = Project Cost $871,000

TOR=C/B=COST/ANNUAL BENEFIT= **2.33**

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
Add Dual Left Turns	%REDUCTION		20%			
Right Angle Fatal/A Crashes		1	0	0	0	0
Right Angle Minor Injury Crashes		4	2	5	3	5
Add Dual Left Turns	%REDUCTION		8%			
Right Angle PDO Crashes		23	12	12	16	10
Add Dual Left Turns	%REDUCTION		29%			
Rear End Fatal/A Crashes		0	1	0	0	0
Rear End Minor Injury Crashes		10	6	12	7	2
Add Dual Left Turns	%REDUCTION		32%			
Rear End PDO Crashes		50	44	45	40	47
Add Dual Left Turns	%REDUCTION		50%			
Sideswipe Minor Injury Crashes		1	1	0	2	0
Add Dual Left Turns	%REDUCTION		75%			
Head-on Minor Injury Crashes		1	2	1	3	1

# of A-injuries:	6	For reference only
# of Fatalilties:	1	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$528,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	5.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0	M-153 Crash Analysis - Crash Pattern #1-3 M-153 / Haggerty Rd Intersection 1595510 4.885-5.075 Add Dual Left Turn

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **M-153 Crash Analysis - Crash Pattern #1-3** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **1595510** PR MP Range: **4.885-5.075**

CS: **82081** CS MP Range: **4.885-5.075**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$1,024,817
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	0.49
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	100.93
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 5.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $204,963

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $262,370

C = Project Cost $528,000

TOR=C/B=COST/ANNUAL BENEFIT= **2.01**

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
Install Lighting	%REDUCTION		30%			
Number of Crashes		335	275	295	279	261
PDO+Minor Inj Crashes		333	271	291	279	263
A-Injured or Killed Persons		2	4	4	0	1
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0

# of A-injuries:	10	For reference only
# of Fatalilties:	3	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$90,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	5.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

M-153 Crash Analysis - Crash Pattern #2
Signalized Intersections on M-153 from Sheldon to Lotz Rd
1595110
Varies
Install Lighting

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **M-153 Crash Analysis - Crash Pattern #2** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **1595110** PR MP Range: **Varies**

CS: **82081** CS MP Range: **Varies**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	#########
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	3.3
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	431.1
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 5.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $850,489

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $1,088,698

C = Project Cost $90,000

TOR=C/B=COST/ANNUAL BENEFIT= **0.08**

Memorandum

Crash Analysis: M-153 & I-275 Interchange Ramps
CS 82292, 82293 - JN 115117
PR # 1595802 MP 0.000 – 0.405: WB M-153 to NB I-275 Ramp
PR # 1595707 MP 0.000 – 0.247: WB M-153 to SB I-275 Ramp
PR# 1595710 MP 0.000 – 0.236: EB M-153 to NB I-275 Ramp
PR # 1595705 MP 0.000 – 0.318: EB M-153 to SB I-275 Ramp
PR # 1595801 MP 0.000 – 0.412: NB I-275 to M-153 Ramp
PR# 1595706 MP 0.000 – 0.377: SB I-275 to M-153 Ramp

1) Crash Analysis

A crash analysis for the I-275 ramps at the M-153 interchange was conducted for a five-year period between January 1st, 2007 and December 31st, 2011. The crash data utilized in this analysis was developed from MDOT single line crash data.

Overall trends for these ramp segments are that approximately fifty one percent (51%) of the overall crashes were rear end straight crashes with the next most frequent crash type being side swipe same crashes consisting of approximately thirteen percent (13%) and fixed object crashes consisting of approximately eleven percent (11%) of the overall total. The ramps with the highest percentage of total crashes for the analysis period were the south I-275 exit to M-153 ramp, which accounted for forty six percent (46%), and the north I-275 exit to M-153 ramp, which accounted for thirty three percent (33%) of the total crashes.

As part of this analysis, crash rates, frequencies, and casualty ratios have been calculated to examine each of the road segments within the limits of the analysis. Crash rates compare the number of crashes occurring in a road segment or intersection to the volume of traffic utilizing the roadway facility. The crash rates that have been calculated in this analysis include total crash rates, fatal crash rates, injury crash rates, and property damage only (PDO) crash rates. Road segment crash rates are expressed in terms of "crashes per 100 million vehicle miles traveled". Crash frequencies compare the total number of crashes that occur during the evaluation period to time. Road segment crash frequencies are in terms of "crashes per year per mile". Casualty ratios compare the number of injury and fatal crashes to the total number of crashes in the evaluation period.

The calculated crash rates, frequencies, and casualty ratios have been compared to either statewide averages from the Michigan Office of Highway Safety Planning (MOHSP) or to regional averages for similar facilities published by the Southeast Michigan Council of Governments (SEMCOG). Detailed analysis of each of the above road segments are shown in the following sections. The distribution of crashes by type of collision and location are shown in the following table.

Table 1 Crash Analysis Summary

Crash Type	Location (See Key Below)						Total	Percentage
	1	2	3	4	5	6		
Angle Straight	0	0	1	0	1	3	**5**	6.3%
Angle Turn	0	0	0	0	0	1	**1**	0.7%
Backing	0	0	0	0	1	1	**2**	1.4%
Dual Right Turn	0	0	0	0	0	1	**1**	0.7%
Fixed Object	4	2	3	1	6	4	**20**	11.1%
Head On	0	0	0	0	1	0	**1**	0.7%
Overturn	0	0	0	0	2	0	**2**	1.4%
Rear End Drive	0	0	0	0	0	1	**1**	0.7%
Rear End Right Turn	0	0	0	0	2	6	**8**	5.6%
Rear End Left Turn	0	0	0	0	2	0	**2**	1.4%
Rear End Straight	1	0	6	4	26	37	**74**	51.4%
Side-Swipe Same	2	1	1	2	5	7	**18**	12.5%
Misc. Multiple Vehicle	0	0	0	0	0	2	**2**	1.4%
Misc. Single Vehicle	0	1	1	0	2	3	**7**	4.9%
Total	**7**	**4**	**12**	**7**	**48**	**66**	**144**	**100.0%**

Location Key	
1. Segment: WB M-153 to NB I-275 Ramp (PR 1595802: MP 0.000 – 0.405)	**4. Segment:** EB M-153 to SB I-275 Ramp (PR 1595705: MP 0.000 – 0.318)
2. Segment: WB M-153 to SB I-275 Ramp (PR 1595707: MP 0.000 – 0.247)	**5. Segment:** NB I-275 to M-153 Ramp (PR 1595801: MP 0.000 – 0.412)
3. Segment: EB M-153 to NB I-275 Ramp (PR 1595710: MP 0.000 – 0.236)	**6. Segment:** SB I-275 to M-153 Ramp (PR 1595706 MP 0.000 – 0.377)

Table 2 Crash Rate Summary

	Location (See Key)					
	1	2	3	4	5	6
Calculated Crash Rate[1]	96.87	182.21	199.71	208.32	**628.21**	**438.14**
Average Crash Rate[2]	288.90	288.90	288.90	288.90	288.90	288.90

1 Crash rates calculated in crashes per 100 million vehicle miles traveled

2 Average crash rates in number of crashes occurring per 100 million vehicle miles traveled from the Michigan Office of Highway Safety Planning (MOHSP)

Table 3 Casualty Ratio Summary

	Location (See Key)					
	1	2	3	4	5	6
Casualty Ratio	0.00	0.00	0.08	0.00	0.17	0.18
Average Casualty Ratio[1]	0.25	0.25	0.23	0.25	0.23	0.19

1 Average casualty ratio values for freeway facilities with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 4 Crash Frequency Summary

	Location (See Key)					
	1	**2**	**3**	**4**	**5**	**6**
Crash Frequency[1]	**3.46**	**3.24**	**10.17**	**4.40**	**23.30**	**35.01**
Average Crash Frequency[2]	1.16	1.16	1.98	1.16	1.98	3.79

1 Crash frequency calculated in crashes per year per mile of roadway
2 Average crash frequencies in crashes per year per mile for freeway facilities with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 5 Injury and Fatal Crash Rate Summary

	Location (See Key)					
	1	**2**	**3**	**4**	**5**	**6**
Number of Injury Crashes	0	0	1	0	8	12
Calculated Injury Crash Rate[1]	0	0	16.64	0	**104.70**	**79.66**
Average Injury Crash Rate[2]	52.9	52.9	52.9	52.9	52.9	52.9
Number of Fatal Crashes	0	0	0	0	0	0
Calculated Fatal Crash Rate[1]	0.00	0.00	0.00	0.00	0.00	0.00
Average Fatal Crash Rate[3]	0.90	0.90	0.90	0.90	0.90	0.90

1 Crash rates calculated in crashes per 100 million vehicle miles traveled
2 Average injury crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)
3 Average fatal crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

Table 6 Property Damage Crash Rate Summary

	Location (See Key)					
	1	**2**	**3**	**4**	**5**	**6**
Number of Property Damage Only Crashes	7	4	11	7	40	54
Calculated PDO Crash Rate[1]	96.87	182.21	183.07	**208.32**	**523.50**	**358.48**
Average PDO Crash Rate[2]	235.1	235.1	235.1	235.1	235.1	235.1

1 Crash rates calculated in crashes per 100 million vehicle miles traveled
2 Average property damage only crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

1. WB M-153 to NB I-275 Ramp (PR 1595802: MP 0.000 – 0.405)
This 0.405 mile segment of roadway experienced seven (7) crashes within the five (5) year analysis period. Four (4) (57.14%) crashes transpired fixed object crashes, two (2) (28.57%) were side swipe same crashes, and one (1) (14.29%) was a rear end straight crash. Of the four (4) fixed object crashes, three (3) occurred within fifty (50) feet of the start of the ramp, two of which transpired under rainy conditions and one in snowy conditions.

Of the seven (7) crashes that occurred, there were zero (0) fatal crashes and zero (0) injury crashes. All seven (7) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 96.87 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 0.00 and 0.00 crashes per 100 million vehicle miles traveled, respectively, which are both lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.00 and 3.46 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than regional averages of 0.25 and 1.16 crashes per year per mile, respectively.

2. WB M-153 to SB I-275 Ramp (PR 1595707: MP 0.000 – 0.247)
This 0.247 mile segment of roadway experienced four (4) crashes within the five (5) year analysis period. Two (2) (50.0%) crashes transpired as fixed object crashes, one (1) (25.0%) was a side swipe same crash, and one (1) (25.0%) was a misc. single vehicle crash.

Of the four (4) crashes that occurred, there were zero (0) fatal crashes and zero (0) injury crashes. All four (4) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 182.21 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 0.00 and 0.00 crashes per 100 million vehicle miles traveled, respectively, which are lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.00 and 3.24 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than regional averages of 0.25 and 1.16 crashes per year per mile, respectively.

3. EB M-153 to NB I-275 Ramp (PR 1595710: MP 0.000 – 0.236)
This 0.236 mile segment of roadway experienced twelve (12) crashes within the five (5) year analysis period. Six (6) (50.0%) crashes transpired as rear end straight crashes, three (3)

(25.00%) were fixed object crashes, one (1) (8.33) was an angle straight crash, one (1) (8.33) was a side swipe same crash, and one (1) (8.33%) was a misc. single vehicle crash.

Of the twelve (12) crashes that occurred, there were zero (0) fatal crashes and one (1) injury crash which did not result in an A-Level (incapacitating) injury. The remaining eleven (11) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 199.71 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 16.64 and 0.00 crashes per 100 million vehicle miles traveled, respectively, which are both lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.08 and 10.17 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than averages of 0.23 and 1.98 crashes per year per mile, respectively.

4. EB M-153 to SB I-275 Ramp (PR 1595705: MP 0.000 – 0.318)

This 0.318 mile segment of roadway experienced seven (7) crashes within the five (5) year analysis period. Four (4) (57.14%) crashes transpired as rear end straight crashes, two (2) (10.42%) were side swipe same crashes, and one (1) (14.29%) was a fixed object crash.

Of the seven (7) crashes that occurred, there were zero (0) fatal crashes and zero (0) injury crashes. All seven (7) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 208.32 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 0.00 and 0.00 crashes per 100 million vehicle miles traveled, respectively, which are both lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.00 and 4.40 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than averages of 0.25 and 1.16 crashes per year per mile, respectively.

5. NB I-275 to M-153 Ramp (PR 1595801: MP 0.000 – 0.412)

This 0.412 mile segment of roadway experienced forty eight (48) crashes within the five (5) year analysis period. Twenty six (26) (54.17%) crashes transpired as rear end straight crashes, while six (6) (12.50%) fixed object crashes, and five (5) (10.42%) side swipe same crashes also occurred. The remaining eleven (11) (22.91%) consisted of angle straight, backing, head on, overturn, rear end right and left turn, and misc. single vehicle crashes. As shown in the attached crash diagrams, thirty eight (38) (79.17) crashes, constituting the majority of the total

crashes, occurred within two hundred and fifty (250) feet of the NB I-275 exit ramp and M-153 intersection.

Of the forty eight (48) crashes that occurred, there were zero (0) fatal crashes and eight (8) injury crashes. Of the eight (8) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 7 for details involving the A-Level injury crash. The remaining forty (40) crashes were PDO (Property Damage Only) crashes.

Table 7 NB I-275 to M-153 Ramp – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 0.374 200' South of M-153	A	Single Motor Vehicle	Dry	Clear	No	UD-10 information states that Vehicle 1 was traveling NB on the I-275 off-ramp when the driver lost control and rolled the vehicle, partially ejecting the driver. The driver was under the influence of drugs but information on why the driver lost control was not given and no citation was given. Light conditions were dark and the weather was clear.

The crash rate for the above segment of roadway is 628.21 crashes per 100 million vehicle miles traveled. This is significantly higher than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 104.70 and 0.00 crashes per 100 million vehicle miles traveled, respectively. The injury rate is higher and the fatal rate is lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.17 and 23.30 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than regional averages of 0.23 and 1.98 crashes per year per mile, respectively.

6. SB I-275 to M-153 Ramp (PR 1595706: MP 0.000 – 0.377)

This 0.377 mile segment of roadway experienced sixty six (66) crashes within the five (5) year analysis period. Thirty seven (37) (56.06%) crashes transpired as rear end straight crashes, while seven (7) (10.61%) side swipe same crashes, and six (6) (9.09%) rear end right turn crashes also occurred. The remaining sixteen (16) (24.24%) consisted of angle straight and turn, backing, dual right turn, fixed object, rear end drive, misc. multiple vehicle, and misc. single vehicle crashes. As shown in the attached crash diagrams, fifty nine (59) (89.39%) of the crashes, constituting the majority of the total crashes, occurred within two hundred (200) feet of the SB I-275 ramp and M-153 signalized intersection. Rear end crashes are common in areas where traffic is required to stop, similar to signalized intersections. In addition, based upon field review, this intersection queues significantly during peak periods which also likely contributes to several crashes.

Of the sixty six (66) crashes that occurred, there were zero (0) fatal crashes and twelve (12) injury crashes. Of the twelve (12) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining fifty four (54) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 438.14 crashes per 100 million vehicle miles traveled. This is higher than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 79.66 and 0.00 crashes per 100 million vehicle miles traveled, respectively. The injury rate is higher and the fatal rate is lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.18 and 35.01 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than averages of 0.19 and 3.79 crashes per year per mile, respectively.

Crash Concentration/Pattern Identification and Potential Crash Mitigation Strategies

Crash Pattern #1: Crash concentrations were observed at each of the signalized intersections located at the ends of the NB I-275 exit ramp and the SB I-275 exit ramp to M-153. Due to the high number of crashes occurring at these ramp terminals, both of these ramps exceeded the Michigan Office of Highway Safety Planning average crash rate and together accounted for approximately seventy nine percent (79.17%) of the total crashes noted in this interchange ramps analysis. As discussed earlier in this report, the majority of these crashes occurred as a result of rear end straight crashes. Rear end straight crashes accounted for fifty four percent (54.17%) and fifty six percent (56.06%) of the crashes occurring at the NB I-275 exit ramp and the SB I-275 exit ramp, respectively.

Countermeasure Recommendation: Review of the existing clearance intervals should be provided for the signalized intersections to ensure adequate time is provided for motorists to perceive the changing signal phases and react accordingly.

Right-of-Way Impacts: None

Estimated Cost: $7,000

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 0.42. See the end of this section for the results of this analysis.

Crash Pattern #2: Sixteen (16) fixed object crashes occurred within the I-275 / M-153 interchange. Fixed object crashes are common in areas where tight curvature is present, similar to freeway interchanges.

Countermeasure Recommendation: Review of the existing superelevation rates should be provided. Improved superelevation rates could reduce the potential for vehicles to leave the roadway by improving centrifugal forces while traversing horizontal curvature.

Right-of-Way Impacts: None

Estimated Cost: None

M-153 & I-275 Interchange Ramps Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2011
Number of Years 5

	1	2	3	4	5	6		
Crash Type	**WB M-153 to NB I-275 Ramp: MP 0.000 - 0.405 PR 1595802**	**WB M-153 to SB I-275 Ramp: MP 0.000 - 0.247 PR 1595707**	**EB M-153 to NB I-275 Ramp: MP 0.000 - 0.236 PR 1595710**	**EB M-153 to SB I-275 Ramp: MP 0.000 - 0.318 PR 1595705**	**NB I-275 to M-153 Ramp: MP 0.000 - 0.412 PR 1595801**	**SB I-275 to M-153 Ramp: MP 0.000 - 0.377 PR 1595706**	**Total**	**Percentage**
Angle Straight	0	0	1	0	1	3	**5**	3.5%
Angle Turn	0	0	0	0	0	1	**1**	0.7%
Backing	0	0	0	0	1	1	**2**	1.4%
Dual Right Turn	0	0	0	0	0	1	**1**	0.7%
Fixed Object	4	2	3	1	6	4	**20**	13.9%
Head On	0	0	0	0	1	0	**1**	0.7%
Overturn	0	0	0	0	2	0	**2**	1.4%
Rear End Drive	0	0	0	0	0	1	**1**	0.7%
Rear End Right Turn	0	0	0	0	2	6	**8**	5.6%
Rear End Left Turn	0	0	0	0	2	0	**2**	1.4%
Rear End Straight	1	0	6	4	26	37	**74**	51.4%
Side-Swipe Same	2	1	1	2	5	7	**18**	12.5%
Misc. Multiple Vehicle	0	0	0	0	0	2	**2**	1.4%
Misc. Single Vehicle	0	1	1	0	2	3	**7**	4.9%
Total	**7**	**4**	**12**	**7**	**48**	**66**	**144**	**100.0%**

	WB M-153 to NB I-275 Ramp: MP 0.000 - 0.405 PR 1595802	**WB M-153 to SB I-275 Ramp: MP 0.000 - 0.247 PR 1595707**	**EB M-153 to NB I-275 Ramp: MP 0.000 - 0.236 PR 1595710**	**EB M-153 to SB I-275 Ramp: MP 0.000 - 0.318 PR 1595705**	**NB I-275 to M-153 Ramp: MP 0.000 - 0.412 PR 1595801**	**SB I-275 to M-153 Ramp: MP 0.000 - 0.377 PR 1595706**
AADT	9777	4870	13951	5790	10162	21894
Length of Roadway Segment	0.41	0.25	0.24	0.32	0.41	0.38
Calculated Crash Rate*	96.87	182.21	199.71	208.32	**628.21**	**438.14**
Average Crash Rate**	288.9	288.9	288.9	288.9	288.9	288.9
Casualty Ratio*	0.00	0.00	0.08	0.00	0.17	0.18
Average Casualty Ratio**	0.25	0.25	0.23	0.25	0.23	0.19
Crash Frequency*	**3.46**	**3.24**	**10.17**	**4.40**	**23.30**	**35.01**
Average Crash Frequency**	1.16	1.16	1.98	1.16	1.98	3.79

Crash Severity	**WB M-153 to NB I-275 Ramp: MP 0.000 - 0.405 PR 1595802**	**WB M-153 to SB I-275 Ramp: MP 0.000 - 0.247 PR 1595707**	**EB M-153 to NB I-275 Ramp: MP 0.000 - 0.236 PR 1595710**	**EB M-153 to SB I-275 Ramp: MP 0.000 - 0.318 PR 1595705**	**NB I-275 to M-153 Ramp: MP 0.000 - 0.412 PR 1595801**	**SB I-275 to M-153 Ramp: MP 0.000 - 0.377 PR 1595706**	**Total**
Injury	0	0	1	0	7	12	**20**
A Level Injury	0	0	0	0	1	0	**1**
Fatal	0	0	0	0	0	0	**0**
PDO	7	4	11	7	40	54	**123**
Total	**7**	**4**	**12**	**7**	**48**	**66**	**144**

	WB M-153 to NB I-275 Ramp: MP 0.000 - 0.405 PR 1595802	**WB M-153 to SB I-275 Ramp: MP 0.000 - 0.247 PR 1595707**	**EB M-153 to NB I-275 Ramp: MP 0.000 - 0.236 PR 1595710**	**EB M-153 to SB I-275 Ramp: MP 0.000 - 0.318 PR 1595705**	**NB I-275 to M-153 Ramp: MP 0.000 - 0.412 PR 1595801**	**SB I-275 to M-153 Ramp: MP 0.000 - 0.377 PR 1595706**
Injury Crash Rate*	0.00	0.00	16.64	0.00	**104.70**	**79.66**
Average Injury Crash Rate**	52.9	52.9	52.9	52.9	52.9	52.9
Property Damage Crash Rate*	96.87	182.21	183.07	**208.32**	**523.50**	**358.48**
Average PDO Crash Rate**	235.1	235.1	235.1	235.1	235.1	235.1
Fatal Crash Rate*	0.00	0.00	0.00	0.00	0.00	0.00
Average Fatal Crash Rate**	0.9	0.9	0.9	0.9	0.9	0.9

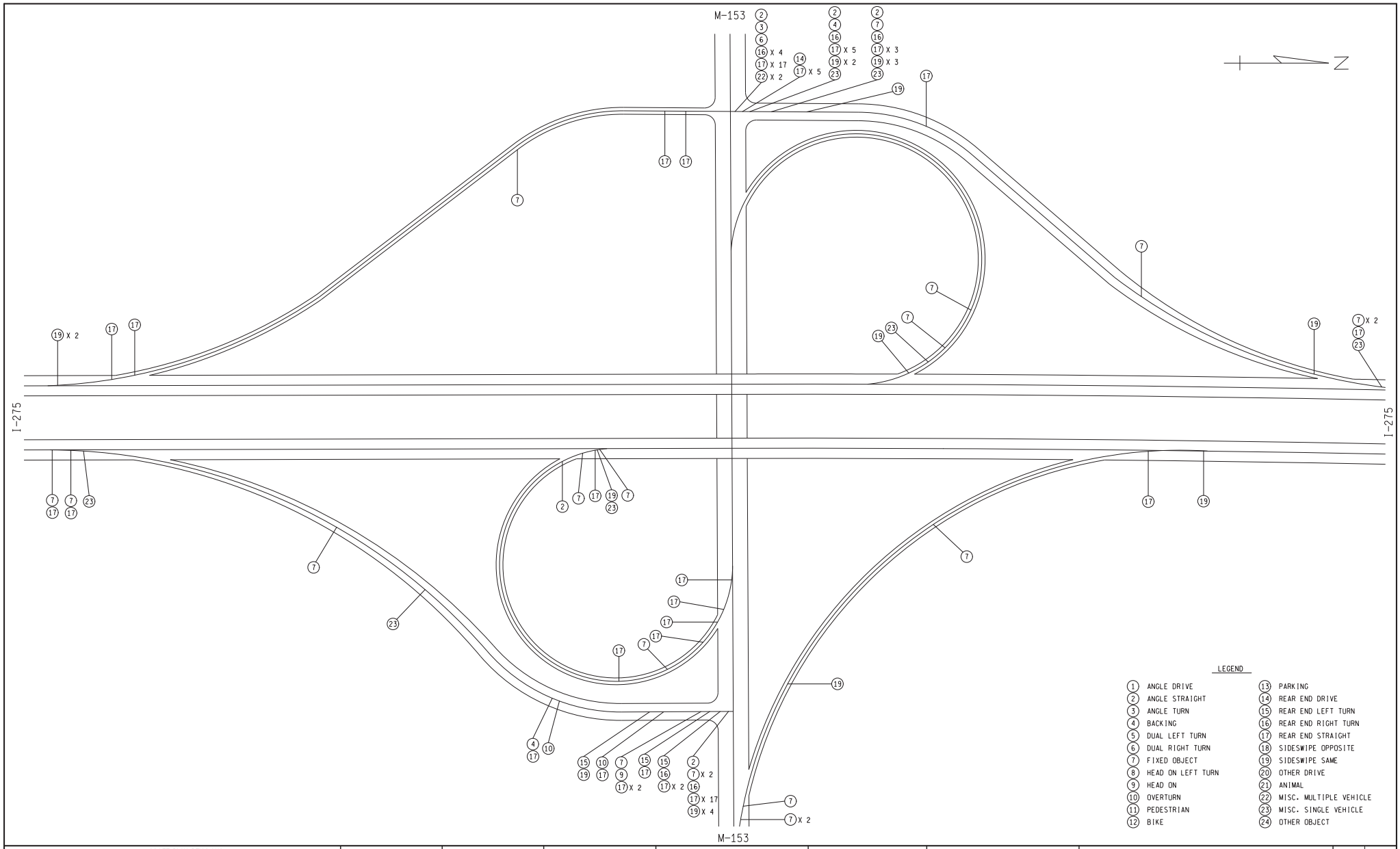
M-153 & I-275 Interchange Ramps Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2011
Number of Years 5

Light Condition	WB M-153 to NB I-275 Ramp: MP 0.000 - 0.405 PR 1595802	WB M-153 to SB I-275 Ramp: MP 0.000 - 0.247 PR 1595707	EB M-153 to NB I-275 Ramp: MP 0.000 - 0.236 PR 1595710	EB M-153 to SB I-275 Ramp: MP 0.000 - 0.318 PR 1595705	NB I-275 to M-153 Ramp: MP 0.000 - 0.412 PR 1595801	SB I-275 to M-153 Ramp: MP 0.000 - 0.377 PR 1595706	Total
Dark	0	2	0	1	4	10	**17**
Dawn	0	1	0	0	5	2	**8**
Daylight	6	1	12	5	32	42	**98**
Dusk	1	0	0	1	7	12	**21**
Unknown	0	0	0	0	0	0	**0**
Total	**7**	**4**	**12**	**7**	**48**	**66**	**144**

Weather Conditions	WB M-153 to NB I-275 Ramp: MP 0.000 - 0.405 PR 1595802	WB M-153 to SB I-275 Ramp: MP 0.000 - 0.247 PR 1595707	EB M-153 to NB I-275 Ramp: MP 0.000 - 0.236 PR 1595710	EB M-153 to SB I-275 Ramp: MP 0.000 - 0.318 PR 1595705	NB I-275 to M-153 Ramp: MP 0.000 - 0.412 PR 1595801	SB I-275 to M-153 Ramp: MP 0.000 - 0.377 PR 1595706	Total
Uncoded - Errors	0	0	0	0	0	1	**1**
Clear	1	0	2	2	22	34	**61**
Cloudy	0	2	6	2	12	17	**39**
Fog	0	0	0	0	0	0	**0**
Rain	5	0	4	0	6	5	**20**
Snow/Blowing Snow	1	2	0	3	8	9	**23**
Severe Wind	0	0	0	0	0	0	**0**
Sleet or Hail	0	0	0	0	0	0	**0**
Other	0	0	0	0	0	0	**0**
Total	**7**	**4**	**12**	**7**	**48**	**66**	**144**

Pavement Conditions	WB M-153 to NB I-275 Ramp: MP 0.000 - 0.405 PR 1595802	WB M-153 to SB I-275 Ramp: MP 0.000 - 0.247 PR 1595707	EB M-153 to NB I-275 Ramp: MP 0.000 - 0.236 PR 1595710	EB M-153 to SB I-275 Ramp: MP 0.000 - 0.318 PR 1595705	NB I-275 to M-153 Ramp: MP 0.000 - 0.412 PR 1595801	SB I-275 to M-153 Ramp: MP 0.000 - 0.377 PR 1595706	Total
Uncoded - Errors	0	0	0	0	0	2	**2**
Dry	1	0	3	3	30	43	**80**
Wet	4	0	8	0	10	9	**31**
Icy	1	3	0	4	1	4	**13**
Snow/Blowing Snow	1	1	0	0	7	5	**14**
Muddy	0	0	0	0	0	0	**0**
Slushy	0	0	1	0	0	2	**3**
Covered With Debris	0	0	0	0	0	0	**0**
Other	0	0	0	0	0	1	**1**
Total	**7**	**4**	**12**	**7**	**48**	**66**	**144**



AS-LET PLAN REVISIONS							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT
Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

FILE: RAMPS.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

I-275 & M-153 INTERCHANGE
CRASH LOCATION MAP
RAMPS

DRAWING: -
SHEET:

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
-	-	-	-	-	-	-
Improve Signal Timing	%REDUCTION		8%			
Number of Crashes		17	20	15	21	25
PDO+Minor Inj Crashes		17	20	15	21	25
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-

# of A-injuries:	10	For reference only
# of Fatalilties:	3	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$7,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	5.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0	I-275 Ramps Crash Analysis - Crash Pattern #1 I-275 / M-153 Signalized Ramps 1595801 & 1595706 Varies Improve Signal Timing

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **I-275 Ramps Crash Analysis - Crash Pattern #1** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **1595801 & 1595706** PR MP Range: **Varies**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$64,680
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	0.0
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	7.8
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 5.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $12,936

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $16,559

C = Project Cost $7,000

TOR=C/B=COST/ANNUAL BENEFIT= **0.42**

Memorandum

Crash Analysis: I-275 from Cherry Hill Rd to Warren Rd
CS 82292, 82293 - JN 115117
PR # 1607208 MP 16.135 – 17.337: NB I-275 from Cherry Hill Rd to M-153
PR # 1607208 MP 17.337 – 18.088: NB I-275 from M-153 to Warren Rd
PR # 1607610 MP 16.133 – 17.344: SB I-275 from Cherry Hill Rd to M-153
PR # 1067610 MP 17.344 – 18.099: SB I-275 from M-153 to Warren Rd

1) Crash Analysis

A crash analysis on I-275 from Cherry Hill Rd northerly to Warren Rd was conducted for a five-year period between January 1st, 2007 and December 31st, 2011. The crash data utilized in this analysis was developed from MDOT single line crash data.

Overall trends for this segment of freeway are that approximately thirty eight percent (38%) of the overall crashes were rear end straight crashes with the next most frequent crash type being fixed object crashes and side swipe same crashes, each consisting of approximately seventeen percent (17%) of the overall total. Rear end crashes occurred predominantly at on and off ramp locations and the majority of fixed object crashes occurred at the I-275 bridge over M-153 and at the Warren Rd bridge. The I-275 and M-153 interchange experiences a high volume of traffic and vehicles frequently queue from the ramps onto I-275 causing a high number of rear end crashes.

As part of this analysis, crash rates, frequencies, and casualty ratios have been calculated to examine each of the road segments within the limits of the analysis. Crash rates compare the number of crashes occurring in a road segment or intersection to the volume of traffic utilizing the roadway facility. The crash rates that have been calculated in this analysis include total crash rates, fatal crash rates, injury crash rates, and property damage only (PDO) crash rates. Road segment crash rates are expressed in terms of "crashes per 100 million vehicle miles traveled". Crash frequencies compare the total number of crashes that occur during the evaluation period to time. Road segment crash frequencies are in terms of "crashes per year per mile". Casualty ratios compare the number of injury and fatal crashes to the total number of crashes in the evaluation period.

The calculated crash rates, frequencies, and casualty ratios have been compared to either statewide averages from the Michigan Office of Highway Safety Planning (MOHSP) or to regional averages for similar facilities published by the Southeast Michigan Council of Governments (SEMCOG). Detailed analysis of each of the above road segments are shown in the following sections. The distribution of crashes by type of collision and location are shown in the following table.

Table 1 Crash Analysis Summary

Crash Type	Location (See Key Below)				Total	Percentage
	1	2	3	4		
Angle Straight	5	7	4	1	**18**	4.7%
Fixed Object	12	27	11	15	**65**	16.8%
Head On	1	0	1	2	**4**	1.0%
Overturn	0	2	2	1	**5**	1.3%
Pedestrian	0	1	1	0	**2**	0.5%
Bike	0	0	0	1	**1**	0.3%
Parked Vehicle	0	0	1	0	**1**	0.3%
Rear End Right Turn	2	0	0	0	**2**	0.5%
Rear End Straight	44	51	15	37	**147**	38.1%
Side-Swipe Opposite	1	2	0	0	**3**	0.8%
Side-Swipe Same	15	24	11	15	**64**	16.6%
Animal	2	2	4	1	**9**	2.3%
Misc. Multiple Vehicle	6	8	5	6	**25**	6.5%
Misc. Single Vehicle	10	6	3	3	**22**	5.7%
Other Object	4	4	6	4	**18**	4.7%
Total	**102**	**134**	**64**	**86**	**386**	**100.0%**

Location Key	
1. **Segment**: NB I-275 Cherry Hill Rd to M-153 (PR1607208: MP 16.135 - 17.337)	3. **Segment**: SB I-275 Cherry Hill to M-153 (PR 1607610: 16.133 - 17.344)
2. **Segment**: NB I-275 M-153 to Warren Rd (PR 1607208: MP 17.337 - 18.088)	4. **Segment**: SB I-275 M-153 to Warren Rd (PR 1607610: MP 17.344 - 18.099)

Table 2 Crash Rate Summary

	Location (See Key)			
	1	2	3	4
Calculated Crash Rate[1]	100.45	168.13	62.56	107.33
Average Crash Rate[2]	288.90	288.90	288.90	288.90

1 Crash rates calculated in crashes per 100 million vehicle miles traveled

2 Average crash rates in number of crashes occurring per 100 million vehicle miles traveled from the Michigan Office of Highway Safety Planning (MOHSP)

Table 3 Casualty Ratio Summary

	Location (See Key)			
	1	2	3	4
Calculated Casualty Ratio	0.20	**0.24**	0.14	0.17
Average Casualty Ratio[1]	0.26	0.22	0.26	0.22

1 Average casualty ratio values for freeway segments with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 4 Crash Frequency Summary

	Location (See Key)			
	1	2	3	4
Crash Frequency[1]	**16.97**	**35.69**	**10.57**	**22.78**
Average Crash Frequency[2]	4.69	6.29	4.69	6.29

1 Crash frequency calculated in crashes per year per mile of roadway
2 Average crash frequencies in crashes per year per mile for freeway segments with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 5 Injury and Fatal Crash Rate Summary

	Location (See Key)			
	1	2	3	4
Number of Injury Crashes	20	32	9	15
Calculated Injury Crash Rate[1]	19.70	40.15	8.80	18.72
Average Injury Crash Rate[2]	52.90	52.90	52.90	52.90
Number of Fatal Crashes	0	0	0	0
Calculated Fatal Crash Rate[1]	0.00	0.00	0.00	0.00
Average Fatal Crash Rate[3]	0.90	0.90	0.90	0.90

1 Crash rates calculated in crashes per 100 million vehicle miles traveled
2 Average injury crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)
3 Average fatal crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

Table 6 Property Damage Crash Rate Summary

	Location (See Key)			
	1	2	3	4
Number of Property Damage Only Crashes	82	102	55	71
Calculated PDO Crash Rate[1]	80.75	127.98	53.76	88.61
Average PDO Crash Rate[2]	248.0	248.0	248.0	248.0

1 Crash rates calculated in crashes per 100 million vehicle miles traveled
2 Average property damage only crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

1. NB I-275 from Cherry Hill Rd to M-153 - MP 16.135 – 17.337

This 1.202 mile segment of freeway experienced one hundred and two (102) crashes within the five (5) year analysis period. Forty four (44) (43.14%) crashes transpired as rear end straight crashes, while fifteen (15) (14.71%) side swipe same crashes, twelve (12) (11.76%) fixed object crashes, and ten (10) (9.80%) misc. single vehicle crashes also occurred. The remaining twenty one (21) (20.6%) crashes consisted of angle straight, head on, rear end right turn, side swipe opposite, animal, misc. multiple vehicle, and other object crashes.

Of the twelve (12) fixed object crashes, five (5) were located at the M-153 bridge crossing I-275. Two (2) occurred under clear conditions, two (2) occurred under cloudy conditions, and one (1) occurred under conditions of snow/blowing snow.

Of the one hundred and two (102) crashes that occurred there were zero (0) fatal crashes and twenty (20) injury crashes. Of the twenty (20) injury crashes one (1) was an A-Level (incapacitating) injury. See Table 7 for details involving the A-Level injury crash. The remaining eighty two (82) crashes were PDO (Property Damage Only) crashes.

Table 7 NB I-275 from Cherry Hill Rd to M-153 – A-Level Injuries

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 17.087 0.25 miles South of M-153	A	Sideswipe-Same	Snowy	Snowy/ Blowing Snow	No	UD-10 information states that Vehicle 1 was traveling northbound in the left lane of I-275 behind another vehicle and attempted to pass this vehicle by entering the middle lane. Vehicle 1 then lost control and veered into the right lane striking Vehicle 2, which was traveling northbound in the right lane of I-275. Both Vehicle 1 and Vehicle 2 left the roadway and Vehicle 1 rolled over. The driver of Vehicle 1 was cited for improper passing.

A review of the A-Level (incapacitating) injury crash shows that cause of the accident was an improper pass by the driver of Vehicle 1 under poor road conditions. The weather conditions were snowy with snow on the road. UD-10 information states that the driver of Vehicle 1 lost control of the vehicle while trying to pass another vehicle that was in the left lane by entering the middle lane, then veering into the right lane striking a vehicle. Both vehicles left the roadway with Vehicle 1 rolling over and Vehicle 2 spinning into the ditch.

The crash rate for the above segment of freeway is 100.45 crashes per 100 million vehicle miles traveled which is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 19.70 and 0.00 crashes per 100 million vehicle miles traveled respectively, which are both lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.20 and 16.97 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than regional averages of 0.26 and 4.69 crashes per year per mile, respectively.

2. NB I-275 from M-153 to Warren Rd - MP 17.337 – 18.088

This 0.751 mile segment of freeway experienced one hundred and thirty four (134) crashes within the five (5) year analysis period. Fifty one (51) (38.06%) crashes transpired as rear end straight crashes, while twenty seven (27) (20.15%) fixed object crashes, and twenty three (23) (17.16%) side swipe same crashes also occurred. The remaining thirty three (33) (24.63%) crashes consisted of angle straight, overturn, pedestrian, side swipe opposite, animal, misc. multiple vehicle, misc. single vehicle, and other object crashes.

Of the twenty seven (27) fixed object crashes, twelve (12) were located at the M-153 bridge crossing I-275 and five (5) were located at the Warren Rd bridge crossing I-275. Of the crashes located at M-153, five (5) occurred under cloudy, four (4) occurred under rainy, and three (3) occurred under conditions of snow/blowing snow. Of the crashes located at the Warren Rd bridge, three (3) occurred under clear, one (1) occurred under cloudy, and one (1) occurred under snow/blowing snow conditions.

Of the one hundred and thirty four (134) crashes that occurred there were zero (0) fatal crashes and thirty two (32) injury crashes. Of the thirty two (32) injury crashes, four (4) were A-Level (incapacitating) injuries. See Table 8 for details involving the A-Level injury crashes. The remaining one hundred and two (102) crashes were PDO (Property Damage Only) crashes.

Table 8 NB I-275 from M-153 to Warren Rd – A-level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 17.339 10' North of M-153	A	Sideswipe-Same	Dry	Clear	No	UD-10 information states that Vehicle 2 was slowing for a stopped traffic in the left lane. Vehicle 1 was behind Vehicle 2 and braked suddenly losing control of the vehicle. Vehicle 1 spun and struck the east bridge barrier wall then spun once more off of the barrier wall striking Vehicle 2 in the front quarter panel. The driver of Vehicle 1 was cited for hazardous driving.
MP 17.394 300' North of M-153	A	Sideswipe-Same	Dry	Clear	No	UD-10 crash diagram shows that 4 vehicles were involved in this crash. Vehicle 1 entered NB I-275 at a high rate of speed and cut across all three lanes of NB I-275. This forced Vehicle 2, which was in the left lane, off of the roadway which then proceeded to lose control and veer back into the left lane where it was struck by Vehicle 1. This collision caused Vehicle 2 to cross the roadway to the right and was struck a second time by Vehicle 3 in the middle lane. Vehicle 3 was then forced into the right lane and was struck by Vehicle 4 which was in the right lane. The driver of Vehicle 1 was cited for careless driving.

Table 8 (Continued) NB I-275 from M-153 to Warren Rd – A-level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 17.931 300' South of Warren Rd	A	Rear End	Wet	Cloudy	N/A	UD-10 information states that Vehicle 1 was parked partially on the left shoulder/lane policing a three vehicle PDO. Vehicle 2 was NB on I-275 in the left lane when the driver braked to avoid Vehicle 1. Vehicle 2 rear ended Vehicle 1 which rear ended Vehicle 3. Vehicle 4 was struck by Vehicle 3 and thrown into the center median. Vehicle 5 was pinned between Vehicles 3 and 4. The driver of Vehicle 2 was cited for reckless driving.
MP 17.977 60' South of Warren Rd	A	Single Motor Vehicle	Dry	Clear	Yes	UD-10 information states that the driver of Vehicle 1 was under the influence of alcohol and sleeping pills when the vehicle veered from the right lane of NB I-275 off of the roadway hitting a freeway fence and sign. UD-10 information does not state if the driver fell asleep while driving. The driver was cited for Operating While Under the Influence.

A review of the A-Level (incapacitating) injury crashes shows that driver error was the cause of each of the four crashes. The drivers in three of the four crashes were cited either for hazardous, reckless, or careless driving. The fourth crash was attributed to operating a vehicle while under the influence of drugs and alcohol.

The crash rate for the above segment of freeway is 168.13 crashes per 100 million vehicle miles traveled which is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 40.15 and 0.00 crashes per 100 million vehicle miles traveled respectively, which are both lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.24 and 35.69 crashes per year per mile respectively, both of which are higher than regional averages of 0.22 and 6.29 crashes per year per mile, respectively.

3. SB I-275 from Cherry Hill Rd to M-153 - MP 16.133 – 17.344

This 1.211 mile segment of freeway experienced sixty four (64) crashes within the five (5) year analysis period. Fifteen (15) (23.44%) crashes transpired as rear end straight crashes, while eleven (11) (17.19%) fixed object crashes, eleven (11) (17.19%) side swipe same crashes, six (6) (9.38%) other object crashes, and five (5) (7.81%) misc. multiple vehicle crashes also occurred. The remaining sixteen (16) (24.99%) crashes consisted of angle straight, head on, overturn, parked vehicle, animal, and misc. single vehicle crashes.

Of the eleven (11) fixed object crashes, seven (7) were located at the bridge crossing M-153. Two (2) occurred under clear, two (2) occurred under cloudy, and three (3) occurred under conditions of snow/blowing snow.

Of the sixty four (64) crashes that occurred there were zero (0) fatal crashes and nine (9) injury crashes. Of the nine (9) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 9 for details involving the A-Level injury crash. The remaining fifty five (55) crashes were PDO (Property Damage Only) crashes.

Table 9 SB I-275 from Cherry Hill Rd to M-153 – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 16.227 600' south of Cherry Hill Rd	A	Single Motor Vehicle	Dry	Clear	No	UD-10 information states that Vehicle 1 was traveling in the left lane of SB I-275 when it crossed to the right into the shoulder and lost control, overturning several times. The light conditions were dark but the UD-10 data does not give an explanation why the vehicle lost control. The influence of alcohol or drugs was not stated as being a factor in the crash and no citation was given.

The crash rate for the above segment of freeway is 62.56 crashes per 100 million vehicle miles traveled. This is lower that the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 8.80 and 0.00 crashes per 100 million vehicle miles traveled, respectively. Both rates are lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.14 and 10.57 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than averages of 0.26 and 4.69 crashes per year per mile, respectively.

4. SB I-275 from M-153 to Warren Rd - MP 17.344 – 18.099

This 0.755 mile segment of freeway experienced eighty six (86) crashes within the five (5) year analysis period. Thirty seven (37) (43.02%) crashes transpired as rear end straight crashes, while fifteen (15) (17.44%) fixed object crashes, fifteen (15) (17.44%) side swipe same crashes, and six (6) (6.98%) misc. multiple vehicle crashes also occurred. The remaining thirteen (13) (15.12%) crashes consisted of angle straight, head on, overturn, bike, animal, misc. single and multiple vehicle, and other object crashes.

Of the fifteen (15) fixed object crashes, three (3) were located at the bridge crossing M-153 and one (1) was located at the Warren Rd bridge. Of the crashes located at M-153, two (2) occurred under clear and one (1) occurred under conditions of snow/blowing snow. The crash that occurred at the Warren Rd Bridge transpired under clear conditions.

Of the eighty six (86) crashes that occurred there were zero (0) fatal crashes and fifteen (15) injury crashes. Of the fifteen (15) injury crashes, two (2) were A-Level (incapacitating) injuries. See Table 10 for details involving the A-Level injury crashes. The remaining seventy one (71) crashes were PDO (Property Damage Only) crashes.

Table 10 SB I-275 from M-153 to Warren Rd – A-Level Injuries

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 17.544 O.2 miles North of M-153	A	Single Motor Vehicle	Dry	Clear	Yes	UD-10 information states that the driver was under the influence of alcohol when he crossed from the left lane of SB I-275 and left the roadway, striking an end section of a guardrail. The light conditions were dark but no explanation was given other than the influence of alcohol for the vehicle leaving the roadway. The driver was cited for hazardous driving.
MP 18.099 500' North of Warren Rd	A	Single Motor Vehicle	Dry	Cloudy	No	UD-10 information states that the driver of the Vehicle 1 was diabetic and did not take his insulin. The driver lost control and struck the median barrier wall then crossed all three lanes of SB I-275 before stopping in the right ditch.

A review of the A-Level (incapacitating) injury crashes shows that driver error was the cause of each of the two crashes. The driver in the first was under the influence of alcohol and lost control of the vehicle. The driver in the second was diabetic and did not take his insulin causing him to lose control of the vehicle.

The crash rate for the above segment of freeway is 107.33 crashes per 100 million vehicle miles traveled. This is lower that the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 18.72 and 0.00 crashes per 100 million vehicle miles traveled, respectively which are both lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.17 and 22.78 crashes per year per mile respectively, both of which are higher than averages of 0.22 and 6.29 crashes per year per mile, respectively.

Crash Concentration / Pattern Identification and Potential Crash Mitigation Strategies

Crash Pattern #1: Sixty five (65) fixed object crashes occurred within these segments of I-275 which constituted seventeen percent (16.8%) of the total crashes within this corridor. Based upon review of these fixed object crashes, 33 (50.77%) occurred at either the I-275 over M-153 or the Warren Road over I-275 structures while two (2) (3.08%) occurred in the vicinity of the existing cantilever sign located at the SB I-275 exit terminal and one (1) (1.54%) occurred in the

vicinity of the existing cantilever sign located at the NB I-275 exit terminal. The remaining 29 (44.62%) were evenly distributed throughout the corridor. The three (3) (4.62%) fixed object crashes that occurred in the vicinity of both the NB and SB existing cantilever sign transpired under icy pavement conditions. See Table 11 below for the details surrounding the crashes occurring at the I-275 over M-153 and the Warren Road over I-275 structures:

Table 11 Fixed Object Crash Concentration Details

Pavement Conditions	Fixed Object Crashes				Total	Percentage
	NB I-275 over M-153	SB I-275 over M-153	Warren Rd Over NB I-275	Warren Rd Over SB I-275		
Dry	2	3	3	1	**9**	27.3%
Wet	5	2	1	0	**8**	24.2%
Icy	7	4	0	0	**11**	33.3%
Snowy	1	0	1	0	**2**	6.1%
Slushy	2	0	0	0	**2**	6.1%
Unknown	0	1	0	0	**1**	3.0%
Total	**17**	**10**	**5**	**1**	**33**	100.0%

As shown in Table 11, the majority (23 or 69.70%) of the fixed object crashes at these locations occurred under poor pavement conditions where the pavement was either wet, icy, or snowy/slushy. Based on this review, poor pavement conditions played a significant role in the number of fixed object crashes at these locations.

Countermeasure Recommendation: I-275 is a tangent section with eight (8) ft shoulders in the vicinity of the M-153 structures. A slight horizontal curve is located just north of Warren Road on I-275. The existing I-275 pavement in both of these locations is in fair condition according to the 2010 Sufficiency Manual. Review of improving pavement skid resistance should be provided.

Right-of-Way Impacts: None

Estimated Cost: $317,500

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 2.12. See the end of this section for the results of this analysis.

Crash Pattern #2: One hundred forty seven (147) (38.1%) rear end straight crashes occurred within these segments of I-275. Of these crashes ninety five (95) (64.63%) occurred on NB I-275. Based upon review of the traffic operations on NB I-275, both segments of NB I-275 are currently operating at acceptable levels of service (LOS) during all peak periods (morning,

evening, and Saturday peaks). Based upon the UD-10 reports reviewed and a review of the traffic operations, aggressive driving behaviors are common throughout this corridor. Vehicles following at close distances and high rates of speed are common.

Countermeasure Recommendation: Additional enforcement of existing speed limits and car-following laws should be reviewed to limit aggressive driving behaviors throughout this corridor.

Right-of-Way Impacts: None

Estimated Cost: None

I-275 Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2011
Number of Years 5

	1	2	3	4		
Crash Type	**NB I-275: MP 16.135 - 17.337 PR 1607208**	**NB I-275: MP 17.337 - 18.088 PR 1607208**	**SB I-275: MP 16.133 - 17.344 PR 1607610**	**SB I-275: MP 17.344 - 18.099 PR 1607610**	**Total**	**Percentage**
Angle Straight	5	7	4	1	**17**	4.4%
Fixed Object	12	27	11	15	**65**	16.8%
Head On	1	0	1	2	**4**	1.0%
Overturn	0	2	2	1	**5**	1.3%
Pedestrian	0	1	1	0	**2**	0.5%
Bike	0	0	0	1	**1**	0.3%
Parked Vehicle	0	0	1	0	**1**	0.3%
Rear End Right Turn	2	0	0	0	**2**	0.5%
Rear End Straight	44	51	15	37	**147**	38.1%
Side-Swipe Opposite	1	2	0	0	**3**	0.8%
Side-Swipe Same	15	24	11	15	**65**	16.8%
Animal	2	2	4	1	**9**	2.3%
Misc. Multiple Vehicle	6	8	5	6	**25**	6.5%
Misc. Single Vehicle	10	6	3	3	**22**	5.7%
Other Object	4	4	6	4	**18**	4.7%
Total	**102**	**134**	**64**	**86**	**386**	100.0%

	NB I-275: MP 16.135 - 17.337 PR 1607208	**NB I-275: MP 17.337 - 18.088 PR 1607208**	**SB I-275: MP 16.133 - 17.344 PR 1607610**	**SB I-275: MP 17.344 - 18.099 PR 1607610**
AADT	46289	58150	46289	58150
Length of Roadway Segment	1.20	0.75	1.21	0.75
Calculated Crash Rate*	100.45	168.13	62.56	107.33
Average Crash Rate**	303.4	303.4	303.4	303.4
Casualty Ratio*	0.20	**0.24**	0.14	0.17
Average Casualty Ratio**	0.26	0.22	0.26	0.22
Crash Frequency*	**16.97**	**35.69**	**10.57**	**22.78**
Average Crash Frequency**	4.69	6.29	4.69	6.29

Crash Severity	**NB I-275: MP 16.135 - 17.337 PR 1607208**	**NB I-275: MP 17.337 - 18.088 PR 1607208**	**SB I-275: MP 16.133 - 17.344 PR 1607610**	**SB I-275: MP 17.344 - 18.099 PR 1607610**	**Total**
Injury	19	28	8	13	**68**
A Level Injury	1	4	1	2	**8**
Fatal	0	0	0	0	**0**
PDO	82	102	55	71	**310**
Total	**102**	**134**	**64**	**86**	**386**

	NB I-275: MP 16.135 - 17.337 PR 1607208	**NB I-275: MP 17.337 - 18.088 PR 1607208**	**SB I-275: MP 16.133 - 17.344 PR 1607610**	**SB I-275: MP 17.344 - 18.099 PR 1607610**
Injury Crash Rate*	19.70	40.15	8.80	18.72
Average Injury Crash Rate**	54.5	54.5	54.5	54.5
Property Damage Crash Rate*	80.75	127.98	53.76	88.61
Average PDO Crash Rate**	248.0	248.0	248.0	248.0
Fatal Crash Rate*	0.00	0.00	0.00	0.00
Average Fatal Crash Rate**	0.9	0.9	0.9	0.9

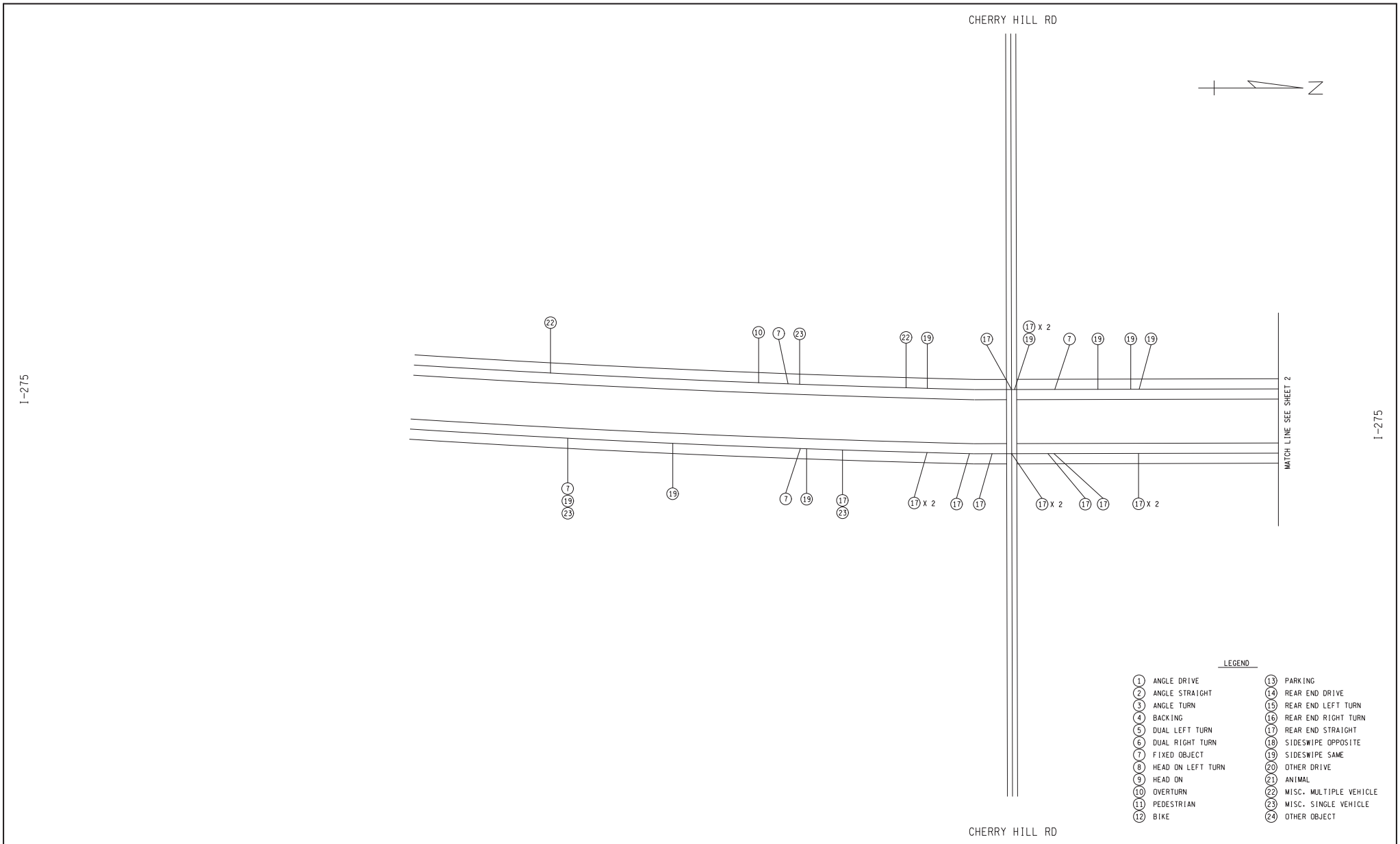
I-275 Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2011
Number of Years 5

Light Condition	NB I-275: MP 16.135 - 17.337 PR 1607208	NB I-275: MP 17.337 - 18.088 PR 1607208	SB I-275: MP 16.133 - 17.344 PR 1607610	SB I-275: MP 17.344 - 18.099 PR 1607610	Total
Dark	11	24	25	19	**79**
Dawn	15	33	9	1	**58**
Daylight	67	72	27	55	**221**
Dusk	9	5	3	11	**28**
Unknown	0	0	0	0	**0**
Total	**102**	**134**	**64**	**86**	**386**

Weather Conditions	NB I-275: MP 16.135 - 17.337 PR 1607208	NB I-275: MP 17.337 - 18.088 PR 1607208	SB I-275: MP 16.133 - 17.344 PR 1607610	SB I-275: MP 17.344 - 18.099 PR 1607610	Total
Uncoded - Errors	2	0	1	0	**3**
Clear	45	61	28	42	**176**
Cloudy	30	48	19	26	**123**
Fog	0	0	0	0	**0**
Rain	14	15	2	5	**36**
Snow/Blowing Snow	10	9	13	11	**43**
Severe Wind	0	0	0	0	**0**
Sleet or Hail	1	0	1	2	**4**
Other	0	1	0	0	**1**
Total	**102**	**134**	**64**	**86**	**386**

Pavement Conditions	NB I-275: MP 16.135 - 17.337 PR 1607208	NB I-275: MP 17.337 - 18.088 PR 1607208	SB I-275: MP 16.133 - 17.344 PR 1607610	SB I-275: MP 17.344 - 18.099 PR 1607610	Total
Uncoded - Errors	2	2	3	2	**9**
Dry	56	78	36	57	**227**
Wet	28	30	8	13	**79**
Icy	5	14	10	9	**38**
Snow/Blowing Snow	8	9	4	5	**26**
Muddy	0	0	0	0	**0**
Slushy	3	1	3	0	**7**
Covered With Debris	0	0	0	0	**0**
Other	0	0	0	0	**0**
Total	**102**	**134**	**64**	**86**	**386**



AS-LET PLAN REVISIONS							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

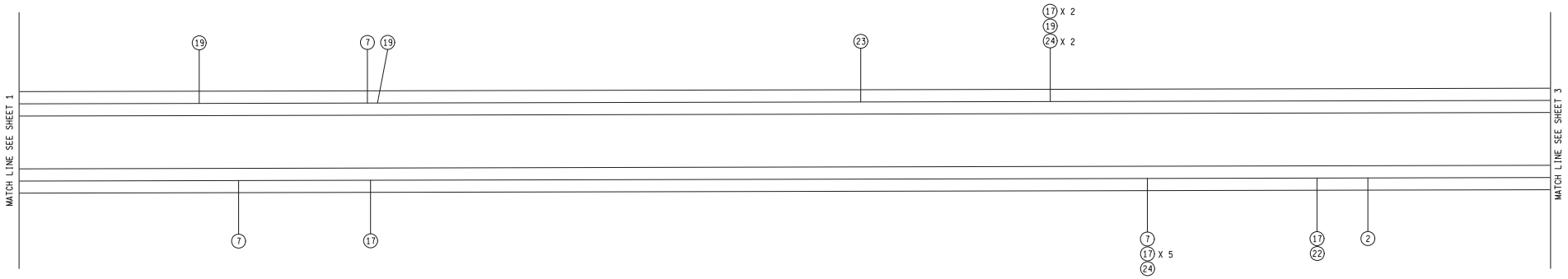
FILE: INTERCHANGE-1.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

MAINLINE I-275
CRASH LOCATION MAP

DRAWING: 1
SHEET:



LEGEND

1	ANGLE DRIVE	13	PARKING
2	ANGLE STRAIGHT	14	REAR END DRIVE
3	ANGLE TURN	15	REAR END LEFT TURN
4	BACKING	16	REAR END RIGHT TURN
5	DUAL LEFT TURN	17	REAR END STRAIGHT
6	DUAL RIGHT TURN	18	SIDESWIPE OPPOSITE
7	FIXED OBJECT	19	SIDESWIPE SAME
8	HEAD ON LEFT TURN	20	OTHER DRIVE
9	HEAD ON	21	ANIMAL
10	OVERTURN	22	MISC. MULTIPLE VEHICLE
11	PEDESTRIAN	23	MISC. SINGLE VEHICLE
12	BIKE	24	OTHER OBJECT

AS-LET PLAN REVISIONS

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

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0 VERT. (FT) 200
0 HORZ. (FT) 200

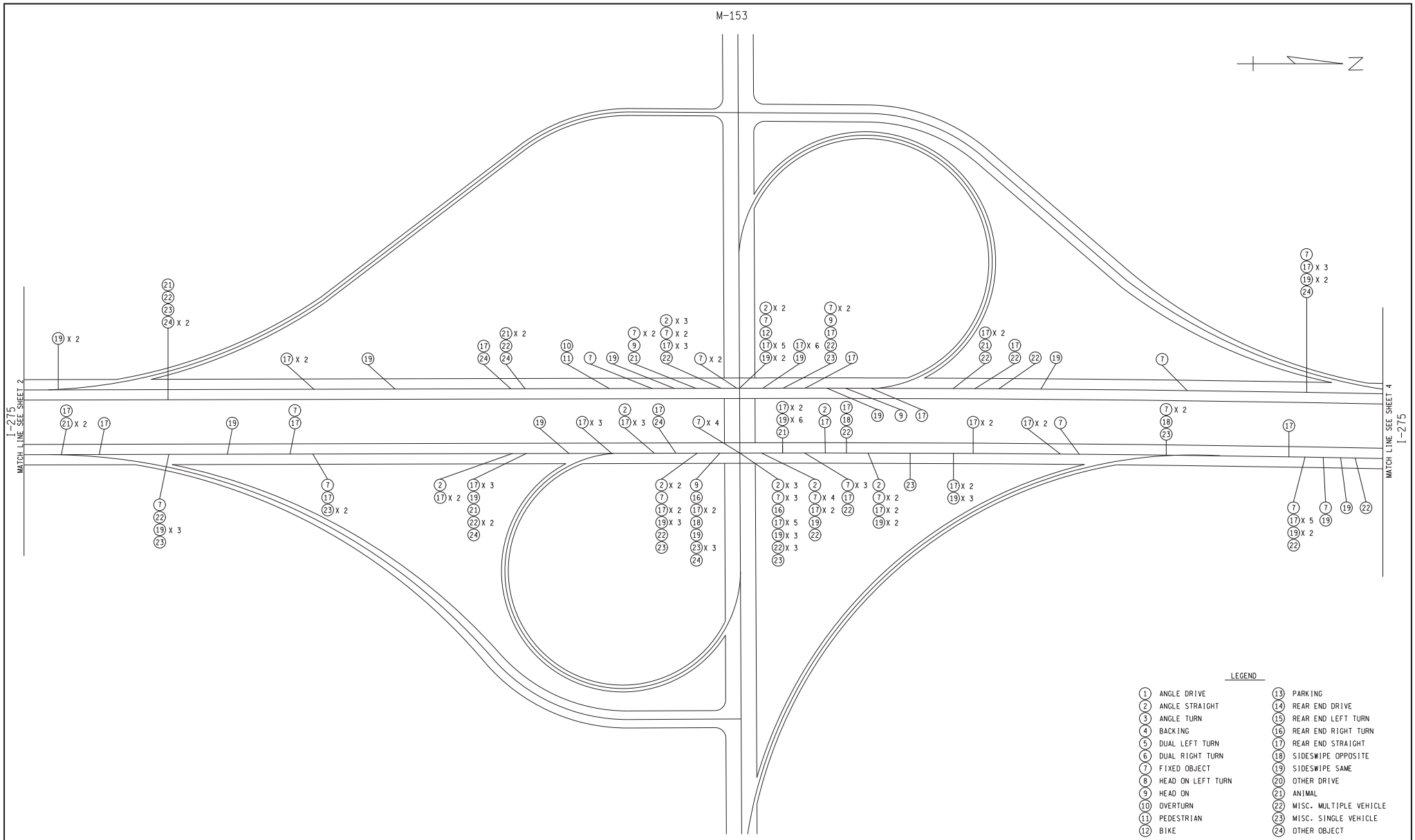
FILE: INTERCHANGE-2.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

MAINLINE I-275
CRASH LOCATION MAP

DRAWING: 2
SHEET:



LEGEND

1	ANGLE DRIVE	13	PARKING
2	ANGLE STRAIGHT	14	REAR END DRIVE
3	ANGLE TURN	15	REAR END LEFT TURN
4	BACKING	16	REAR END RIGHT TURN
5	DUAL LEFT TURN	17	REAR END STRAIGHT
6	DUAL RIGHT TURN	18	SIDESWIPE OPPOSITE
7	FIXED OBJECT	19	SIDESWIPE SAME
8	HEAD ON LEFT TURN	20	OTHER DRIVE
9	HEAD ON	21	ANIMAL
10	OVERTURN	22	MISC. MULTIPLE VEHICLE
11	PEDESTRIAN	23	MISC. SINGLE VEHICLE
12	BIKE	24	OTHER OBJECT

AS-LET PLAN REVISIONS

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

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0 VERT. (FT) 200
0 HORZ. (FT) 200

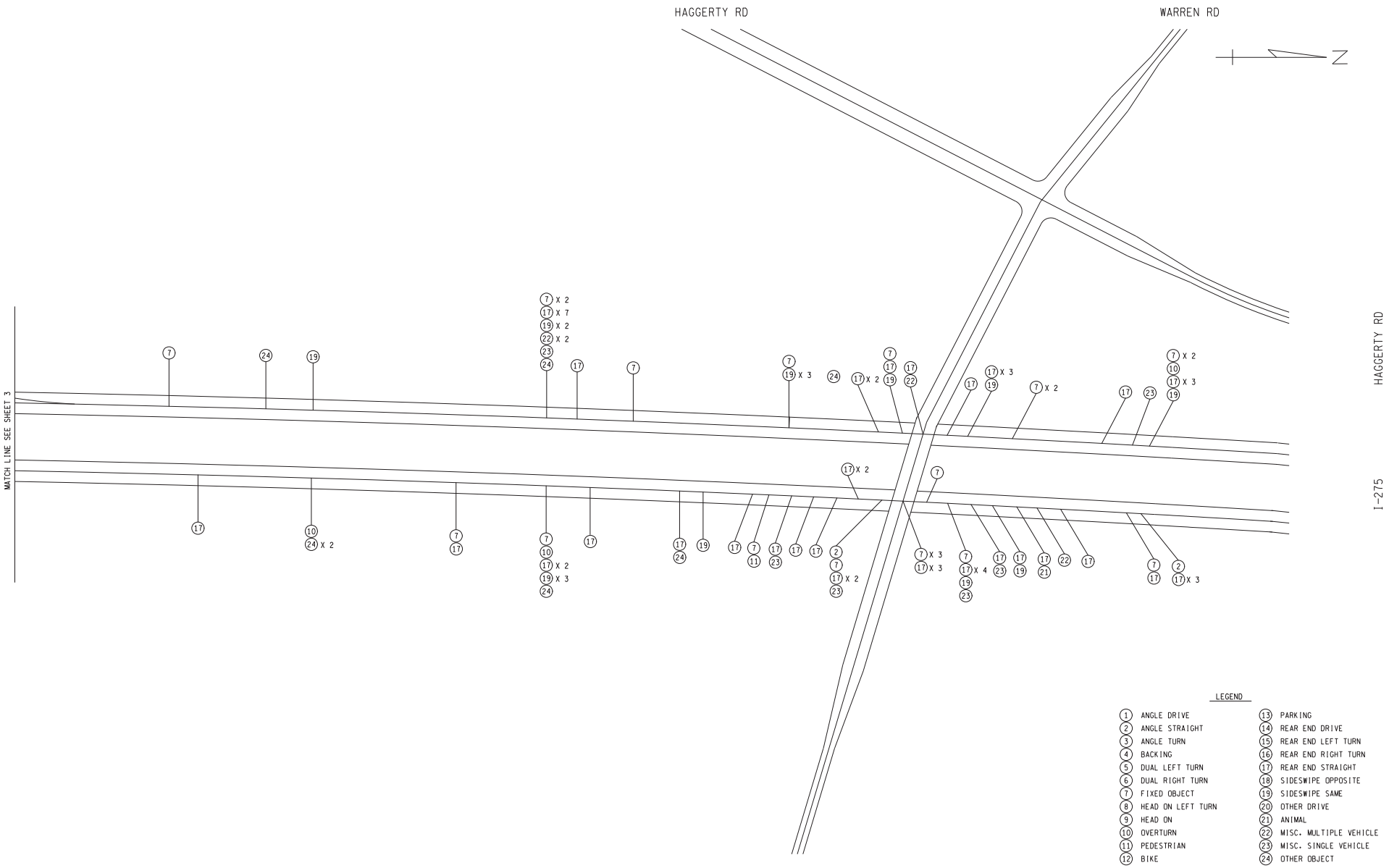
FILE: INTERCHANGE-3.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

MAINLINE I-275
CRASH LOCATION MAP

DRAWING: 3
SHEET:



AS-LET PLAN REVISIONS							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

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0 VERT. (FT) 200
0 HORZ. (FT) 200

FILE: INTERCHANGE-4.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

MAINLINE I-275
CRASH LOCATION MAP

DRAWING 4
SHEET

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
Improve pavement friction (overlay)	%REDUCTION	20%				
Number of Crashes		46	56	44	45	41
PDO+Minor Inj Crashes		45	53	44	44	41
A-Injured or Killed Persons		1	3	0	1	0
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0

# of A-injuries:	5	For reference only
# of Fatalilties:	0	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$317,500	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.1	default ADT values.
# OF YEARS OF DATA:	5.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

I-275 Crash Analysis - Crash Pattern #1
I-275 Bridge over M-153 and Warren Bridge over I-275
1607208 & 1607610
Varies
HMA overlay within 500' N and S of each Bridge

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **I-275 Crash Analysis - Crash Pattern #1** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **1607208 & 1607610** PR MP Range: **Varies**

CS: **82292** CS MP Range: **Varies**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$585,420
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	1.0
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	45.4
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 5.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $117,084

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $149,877

C = Project Cost $317,500

TOR=C/B=COST/ANNUAL BENEFIT= **2.12**

Memorandum

Crash Analysis: Haggerty Rd from Cherry Hill Rd to Warren Rd
JN 115117
PR # 4706524 MP 6.885 – 6.961: Haggerty Rd/Cherry Hill Rd Intersection
PR # 4706524 MP 6.691 – 7.395: Haggerty Rd from Cherry Hill Rd to Canterbury Circle
PR # 4706524 MP 7.395 – 7.489: Haggerty Rd/Canterbury Circle Intersection
PR # 4706524 MP 7.489 – 7.878: Haggerty Rd from Canterbury Circle to M-153
PR # 4706524 MP 7.878 – 7.972: Haggerty Rd/M-153 Intersection*
PR # 4706524 MP 7.972 – 8.283: Haggerty Rd from M-153 to Hanford Rd
PR # 4706524 MP 8.283 – 8.377: Haggerty Rd/Hanford Rd Intersection
PR # 4706524 MP 8.377 – 8.626: Haggerty Rd from Hanford Rd to Warren Rd
PR # 4706524 MP 8.626 – 8.738: Haggerty Rd/Warren Rd Intersection
*Please See the *M-153 from Sheldon Road to Lotz Road Crash Analysis* for the Haggerty Rd/M-153 Intersection crash details.

1) Crash Analysis

A crash analysis on Haggerty Rd from Cherry Hill Rd to Warren Rd was conducted for a four-year period between January 1st, 2007 and December 31st, 2010. The crash data utilized in this analysis was developed from Southeast Michigan Council of Governments (SEMCOG) crash data. Please note that for this analysis, the intersections of Haggerty Rd with Cherry Hill Rd and Warren Road include crash data for all four approaches with the remaining intersections only accounting for crashes on Haggerty Rd within the limits of the intersection. Also, the Haggerty Rd/M-153 intersection is not included in this analysis as it is detailed in the *M-153 from Sheldon Road to Lotz Road Crash Analysis.*

Haggerty Rd is a two-lane to five-lane, undivided, north-south collector-distributor located approximately one third (.33) miles west of I-275. The land use in this study area consists of both commercial and residential usage with multiple un-signalized driveways and intersections. Current lane and shoulder widths include 12 foot driving lanes with varying 6 to 8 foot shoulders in non-curbed sections.

Overall trends for this segment of roadway are that approximately forty two percent (42%) of the overall crashes were rear end straight crashes with the next highest frequency crash type being angle crashes, consisting of approximately twenty four percent (24%) of the overall total. The majority of these crashes occurred at the intersections noted in this analysis.

As part of this analysis, crash rates, frequencies, and casualty ratios have been calculated to examine each of the road segments and intersections within the limits of the analysis. Crash rates compare the number of crashes occurring in a road segment or intersection to the volume of traffic utilizing the roadway facility. The crash rates that have been calculated in this analysis include total crash rates, fatal crash rates, injury crash rates, and property damage only (PDO) crash rates. Road segment crash rates are expressed in terms of “crashes per 100 million vehicle miles traveled” and intersection rates in terms of “crashes per 1 million entering vehicles”. Crash frequencies compare the total number of crashes that occur during the evaluation period to time. Road segment crash frequencies are in terms of “crashes per year

per mile" and intersection frequencies in terms of "crashes per year". Casualty ratios compare the number of injury and fatal crashes to the total number of crashes in the evaluation period.

The calculated crash rates, frequencies, and casualty ratios have been compared to either statewide averages from the Michigan Office of Highway Safety Planning (MOHSP) or to regional averages for similar facilities published by the Southeast Michigan Council of Governments (SEMCOG). Detailed analysis of each of the above intersections and road segments are shown in the following sections. The distribution of crashes by type of collision and location are shown in the following table.

Table 1 Crash Analysis Summary

Crash Type	Location (See Key Below)									Total	Percentage
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		
Single Motor Veh	0	2	2	4	-	1	0	0	2	**11**	3.82%
Head On	1	0	1	1	-	0	0	0	0	**3**	1.04%
Head On Left Turn	17	3	0	2	-	0	1	1	3	**27**	9.38%
Angle	40	5	5	8	-	5	0	0	8	**71**	24.65%
Rear End Straight	44	15	10	9	-	2	8	4	29	**121**	42.01%
Rear End Left Turn	0	1	2	0	-	0	0	0	2	**5**	1.74%
Rear End Right Turn	3	0	0	0	-	0	0	0	1	**4**	1.39%
Side-Swipe Same	2	3	3	3	-	7	1	2	8	**29**	10.07%
Side-Swipe Opposite	3	1	1	1	-	0	1	0	0	**7**	2.43%
Other Object	3	0	1	2	-	0	0	0	4	**10**	3.47%
Total	**113**	**30**	**25**	**30**	**-**	**15**	**11**	**7**	**57**	**288**	**100.00%**

= Intersection

Location Key	
1[1]. Intersection: Haggerty Rd/Cherry Hill Rd (PR 4706524: MP 6.885 – 6.961)	**6. Segment:** Haggerty Rd M-153 to Hanford Rd (PR 4706524: MP 7.972 – 8.283)
2. Segment: Haggerty Rd from Cherry Hill Rd to Canterbury Circle (PR 4706524: MP 6.691 – 7.395)	**7. Intersection:** Haggerty Rd/Hanford Rd (PR 4706524: MP 8.283 – 8.377)
3. Intersection: Haggerty Rd/Canterbury Circle (PR 4706524: MP 7.395 – 7.489)	**8. Segment:** Haggerty Rd from Hanford Rd to Warren Rd (PR 4706524: MP 8.377 – 8.626)
4. Segment: Haggerty Rd from Canterbury Circle to M-153 (PR 4706524: MP 7.489 – 7.878)	**9[3]. Intersection:** Haggerty Rd/Warren Rd (PR 4703524 MP 8.626 – 8.738)
5[2]. Intersection: Haggerty Rd/M-153 (PR 4706524: MP 7.878 – 7.972)	

1 Includes crash data from Cherry Hill Road
2 See *M-153 from Sheldon Road to Lotz Road Crash Analysis* for intersection details
3 Includes crash data from Warren Road

Table 2 Crash Rate Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Calculated Crash Rate	**2.18**[1]	236.27[2]	**0.88**[1]	263.60[2]	-	187.38[2]	0.46[1]	109.22[2]	**1.73**[1]
Average Crash Rate	0.71[4]	288.9[3]	0.70[4]	288.9[3]	-	288.9[3]	0.70[4]	288.9[3]	0.72

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 Average crash rates in number of crashes occurring per 100 million vehicle miles traveled from the Michigan Office of Highway Safety Planning (MOHSP)
4 Average crash rates in number of crashes occurring per 1 million entering vehicles for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 3 Casualty Ratio Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Calculated Casualty Ratio	**0.26**	0.17	**0.36**	**0.23**	**-**	0.20	**0.27**	**0.43**	0.18
Average Casualty Ratio	0.22[1]	0.22[2]	0.23[1]	0.22[2]	-	0.23[2]	0.23[1]	0.23[2]	0.21[1]

1 Average casualty ratio values for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)
2 Average casualty ratio values for roadway segments with intersections and similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 4 Crash Frequency Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Calculated Crash Frequency	**28.25**[1]	**17.28**[2]	**6.25**[1]	**19.28**[2]	-	**12.06**[2]	2.75[1]	**7.03**[2]	**14.25**[1]
Average Crash Frequency	8.96[3]	9.05[4]	3.73[3]	9.05[4]	-	6.44[4]	3.73[3]	6.44[2]	6.56[1]

1 Crash frequency calculated in crashes per year
2 Crash frequency calculated in crashes per year per mile of roadway
3 Average crash frequencies in crashes per year for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)
4 Average crash frequencies in crashes per year per mile for roadway segments with intersections and similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 5 Injury and Fatal Crash Rate Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Number of Injury Crashes	29	5	9	7	-	3	3	3	10
Calculated Injury Crash Rate	0.56[1]	39.38[2]	0.32[1]	**61.51[2]**	-	37.48[2]	0.13[1]	46.81[2]	0.30[1]
Average Injury Crash Rate	N/A[3]	52.9[4]	N/A[3]	52.9[4]	-	52.9[4]	N/A[3]	52.9[4]	N/A[3]
Number of Fatal Crashes	0	0	0	0	-	0	0	0	0
Calculated Fatal Crash Rate	0.00	0.00	0.00	0.00	-	0.00	0.00	0.00	0.00
Average Fatal Crash Rate	N/A[3]	0.90[5]	N/A[3]	0.90[5]	-	0.90[5]	N/A[3]	0.90[5]	N/A[3]

1 Injury crash rates calculated in crashes per 1 million entering vehicles
2 Injury crash rates calculated in crashes per 100 million vehicle miles traveled
3 No average rates in number of crashes per 1 million entering vehicles are available from the Michigan Office of Highway Safety Planning or the Southeast Michigan Council of Governments
4 Average injury crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)
5 Average fatal crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

Table 6 Property Damage Crash Rate Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Number Property Damage Only Crashes	84	25	16	23	-	12	8	4	47
Calculated PDO Crash Rate	1.62[1]	196.89[2]	0.56[1]	202.09[2]	-	149.90[2]	0.34[1]	62.41[2]	1.43[1]
Average PDO Crash Rate	N/A[3]	235.1[4]	N/A[3]	235.1[4]	-	235.1[4]	N/A[3]	235.1[4]	N/A[3]

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 No average property damage only crash rates in number of crashes per 1 million entering vehicles are available from the Michigan Office of Highway Safety Planning (MOHSP) or the Southeast Michigan Council of Governments (SEMCOG)
4 Average property damage only crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

1. Haggerty Rd/Cherry Hill Rd Intersection (PR 4706524: MP 6.885 – 6.961)

The Haggerty Rd/Cherry Hill intersection experienced one hundred and thirteen (113) crashes within the four (4) year analysis period. Forty Four (44) (38.94%) crashes transpired as rear end straight crashes, while forty (40) (35.40%) angle and seventeen (17) (15.04%) head on left turn crashes also occurred. The remaining twelve (12) (10.62%) crashes consisted of head on, rear end right turn, side swipe same, sideswipe opposite, and other object crashes.

Of the fifty five (55) crashes that occurred, there were zero (0) fatal crashes and twenty nine (29) injury related crashes. Of the twenty nine (29) injury crashes zero (0) were A-Level (incapacitating) injuries. The remaining eighty four (84) crashes were PDO (Property Damage Only) crashes.

The crash rate for this intersection is 2.18 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.71 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.56 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.26 which is slightly higher than the SEMCOG average of 0.22. The crash frequency of 28.25 crashes per year is much greater than the average for signalized intersections with similar traffic volumes at 8.96 crashes per year.

2. Haggerty Rd from Cherry Hill Rd to Canterbury Circle (PR 4706524: MP 6.691 – 7.395)
This 0.43 mile segment of roadway experienced thirty (30) crashes within the four (4) year analysis period. Fifteen (15) (50.00%) crashes transpired as rear end straight crashes, while five (5) (16.67%) angle crashes, three (3) (10.00%) side swipe same crashes also occurred. The remaining seven (7) (23.33%) crashes consisted of single motor vehicle, head on, rear end left turn, side swipe opposite, and other object crashes.

Of the thirty (30) crashes that occurred, there were zero (0) fatal crashes and five (5) injury crashes. Of the five (5) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 7 for details involving the A-Level crash. The remaining twenty five (25) crashes were PDO (Property Damage Only) crashes.

Table 7 Haggerty Rd from Cherry Hill Rd to Canterbury Circle – A-Level Injuries

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 7.185 15' N of Village Green Blvd	A	Rear End Straight	Dry	Clear	No	UD-10 information states that Vehicle 2 was traveling southbound on Haggerty Rd when they stopped for a vehicle turning left onto Village Green Blvd. Vehicle 1 was also traveling southbound and was unable to see the brake lights on Vehicle 2 and rear ended Vehicle 2. The driver of Vehicle 1 was cited for failure to stop within assured clear distance.

The crash rate for the above segment of roadway is 236.27 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 39.38 and 0.00 crashes per 100 million vehicle miles traveled,

respectively. Both are lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.17 and 17.28 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than the regional averages of 0.22 and 9.05 crashes per year per mile, respectively.

3. Haggerty Rd/Canterbury Circle Intersection (PR 4706524: MP 7.395 – 7.489)

The Haggerty Rd/Canterbury Circle intersection experienced twenty five (25) crashes within the four (4) year analysis period. Ten (10) (40.00%) crashes transpired as rear end straight crashes, while five (5) (20.00%) angle and three (3) (12.00%) side swipe same crashes also occurred. The remaining seven (7) (28.00%) crashes consisted of single motor vehicle, head on, rear end left turn, side swipe opposite, and other object crashes.

Of the twenty five (25) crashes that occurred, there were zero (0) fatal crashes and nine (9) injury related crashes. Of the nine (9) injury crashes that occurred, zero (0) were A-Level (incapacitating) injuries. The remaining sixteen (16) crashes were PDO (Property Damage Only) crashes.

The crash rate for this intersection is 0.88 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.70 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.32 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.36 which is higher than the SEMCOG regional average of 0.23. The crash frequency of 6.25 crashes per year is higher than the regional average for signalized intersections with similar traffic volumes at 3.73 crashes per year.

4. Haggerty Rd from Canterbury Circle to M-153 (PR 4706524: MP 7.489 – 7.878)

This 0.39 mile segment of roadway experienced thirty (30) crashes within the four (4) year analysis period. Nine (9) (30.00%) crashes transpired as rear end straight crashes, while eight (8) (26.67%) angle crashes, and four (4) (13.33%) single motor vehicle crashes also occurred. The remaining nine (9) (30.00%) crashes consisted of head on, head on left turn, side swipe same, side swipe opposite, and other object crashes.

Of the thirty (30) crashes that occurred, there were zero (0) fatal crashes and seven (7) injury crashes. Of the seven (7) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 8 for details involving the A-Level crash. The remaining twenty three (23) crashes were PDO (Property Damage Only) crashes.

Table 8 Haggerty Rd from Canterbury Circle to M-153 – A-Level Injuries

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 7.675 0.25 mi South of M-153	A	Single Motor Vehicle	Dry	Clear	Yes	UD-10 crash diagram shows two pedestrians, one of which was under the influence of alcohol, attempted to cross Haggerty Rd at an entrance drive for a mall on the east side of the road. Vehicle 1 was traveling southbound in the left hand through lane and struck both pedestrians. The light conditions were dark and the weather conditions were clear. UD-10 information does not state if a citation was given to the driver of Vehicle 1.

The crash rate for the above segment of roadway is 263.60 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 61.51 and 0.00 crashes per 100 million vehicle miles traveled, respectively. The injury rate is higher but, the fatal rate is lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.23 and 19.28 crashes per year per mile, respectively. Both rates are higher than the regional averages of 0.22 and 9.05 crashes per year per mile, respectively.

5. Haggerty Rd/M-153 Intersection (PR 4706524: MP 7.878 – 7.972)

Please refer to the *M-153 from Sheldon Road to Lotz Road Crash Analysis* for the details involving the crashes at this intersection.

6. Haggerty Rd from M-153 to Hanford Rd (PR 4706524: MP 7.972 – 8.283)

This 0.311 mile segment of roadway experienced fifteen (15) crashes within the four (4) year analysis period. Seven (7) (46.67%) crashes transpired as side swipe same crashes, while five (5) (33.33%) angle, two (2) (13.33%) rear end straight, and one (1) (6.67%) single motor vehicle crashes also occurred.

Of the fifteen (15) crashes that occurred, there were zero (0) fatal crashes and three (3) injury crashes. Of the three (3) injury crashes zero (0) were A-Level (incapacitating) injuries. The remaining twelve (12) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 187.38 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 37.48 and 0.00 crashes per 100 million vehicle miles traveled,

respectively. Both rates are lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.20 and 12.06 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than averages of 0.23 and 6.44 crashes per year per mile, respectively.

7. Haggerty Rd/Hanford Rd Intersection (PR 4706524: MP 8.283 – 8.377)

The Haggerty Rd/Hanford Rd intersection experienced eleven (11) crashes within the four (4) year analysis period. Eight (8) (72.73%) crashes transpired as rear end straight, while the remaining three (3) (27.27%) consisted of head on left turn, side swipe same, and side swipe opposite crashes.

Of the eleven (11) crashes that occurred, there were zero (0) fatal crashes and three (3) injury related crashes. Of the three (3) injury crashes zero (0) were A-Level (incapacitating) injuries. The remaining eight (8) crashes were PDO (Property Damage Only) crashes.

The crash rate for this intersection is 0.46 crashes per 1 million entering vehicles. This is lower than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.70 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.13 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.27 which is higher than the SEMCOG average of 0.23. The crash frequency of 2.75 crashes per year is less than the average for signalized intersections with similar traffic volumes at 3.73 crashes per year.

8. Haggerty Rd from Hanford Rd to Warren Rd (PR 4706524: MP 8.377 – 8.626)

This 0.249 mile segment of roadway experienced seven (7) crashes within the four (4) year analysis period. Four (4) (57.14%) crashes transpired as rear end straight, while two (2) (28.57%) side swipe same, and one (1) (14.29%) head on left turn crashes also occurred.

Of the seven (7) crashes that occurred, there were zero (0) fatal crashes and three (3) injury crashes. Of the three (3) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining four (4) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 109.22 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 46.81 and 0.00 crashes per 100 million vehicle miles traveled, respectively. Both rates are lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.43 and 7.03 crashes per year per mile, respectively. Both are higher than the regional averages of 0.23 and 6.44 crashes per year per mile, respectively.

9. Haggerty Rd/Warren Rd Intersection (PR 4706524: MP 8.626 – 8.738)

The Haggerty Rd/Warren Rd intersection experienced fifty seven (57) crashes within the four (4) year analysis period. Twenty nine (29) (50.88%) crashes transpired as rear end straight, while eight (8) (14.04%) angle, and eight (8) (14.04%) side swipe same crashes also occurred. The remaining twelve (12) (21.05%) consisted of single motor vehicle, head on left turn, rear end left and right turn, and other object crashes.

Of the fifty seven (57) crashes that occurred, there were zero (0) fatal crashes and ten (10) injury related crashes. Of the ten (10) injury crashes zero (0) were A-Level (incapacitating) injuries. The remaining forty seven (47) crashes were PDO (Property Damage Only) crashes.

The crash rate for this intersection is 1.73 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.72 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.30 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.18 which is lower than the SEMCOG average of 0.21. The crash frequency of 14.25 crashes per year is also higher than the average for signalized intersections with similar traffic volumes at 6.56 crashes per year.

Crash Concentration/Pattern Identification and Potential Crash Mitigation Strategies

Crash Pattern #1: A crash concentration was observed at the Cherry Hill Rd/Haggerty Rd intersection with the crash details outlined in Table 1. One hundred and thirteen (113) crashes occurred at this location, accounting for approximately thirty nine percent (39.24%) of the overall total number of crashes within this analysis. The majority of crashes consisted of rear end straight crashes and angle crashes. Forty four (44 or 36.36%) of the rear end straight and forty (40 or 56.33%) of the overall corridor angle crashes occurred at this location. This intersection services a high number of vehicles at 35,500 vehicles per day and, based upon field reviews, significant queues form on all approaches with the westbound approach experiencing the largest, extending to and beyond the bridge over I-275 which is 1500' east of the intersection. There are significant grades approaching the bridge over I-275 from the west with a crest vertical curve that has its peak at the bridge. This may limit sight distance for westbound vehicles and creates a sight distance concern. This, coupled with the large queues, creates a scenario where vehicles, not expecting to stop, are confronted with a large queue of stopped vehicles east of the intersection.

Additionally, due to long delays and excessive queues, drivers use aggressive behaviors which can lead to the high number of both rear end straight and angle crashes, as drivers are following too close and trying to turn at the intersection through yellow and red lights.

Countermeasure Recommendation: Two recommendations have been formed to improve safety and capacity at the Cherry Hill Rd/Haggerty Intersection and are as follows:

1. Construct a roundabout at the intersection instead of the existing four-legged signalized intersection. This would improve the capacity of the intersection while reducing vehicle queuing. Based upon the Federal Highway Administration's (FHWA) Crash Reduction Factors, the addition of a roundabout instead of a signalized intersection may result in a 35% reduction in total crashes.

Right-of-Way Impacts: Minor Right-of-Way impacts may be realized in each quadrant of the intersection without major impacts to local businesses.

Estimated Cost: $1,590,000

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 15.23. See the end of this section for the results of this analysis.

2. Review for the need of a vehicle sensor west of the I-275 bridge which is connected to a flashing beacon atop a "Prepare to Stop When Flashing" (W3-4b) sign east of the bridge. Under this option, as westbound queues approach the bridge over I-275, the in-pavement sensor would activate the flashing beacon to alert approaching vehicles of the long queues.

Right-of-Way Impacts: None

Estimated Cost: $13,750

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 0.17. See the end of this section for the results of this analysis.

Crash Pattern #2: Crash concentrations were observed at each of the remaining signalized intersections that have been detailed in this analysis with the crash details for each outlined in Table 1. The crash types that made up the majority of the crashes at these intersections include rear end straight and angle crashes. Seventy seven (77 or 63.64%) of the rear end straight and

thirty one (31 or 43.66%) of the angle crashes occurred at a signalized intersection. Based upon field review, it was found that many drivers use aggressive techniques when trying to travel through these signalized intersections. This can lead to a high number of rear end and angle crashes. Protected left-hand turn phases exist at both the Haggerty Rd/Canterbury Circle and Haggerty Rd/Warren Rd intersections but not at the Haggerty Rd/Hanford Rd intersection.

Countermeasure Recommendation: Review of the existing clearance intervals at the Haggerty Rd/Canterbury Rd intersection, the Haggerty Rd/Hanford Rd intersection, and the Haggerty Rd/Warren Rd intersection to ensure adequate time is provided for motorists to perceive the changing signal phases and react accordingly. Also, review for the need for a protected left turn phase should be provided at the Haggerty Rd/Hanford Rd intersection.

Right-of-Way Impacts: None

Estimated Cost: $10,500

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 0.31. See the end of this section for the results of this analysis.

Haggerty Road Crash Analysis - Crash Tables

Time Period: January 1st, 2007 to December 31st, 2010
Number of Years: 4

	1	2	3	4	5	6	7	8	9		
Crash Type	**Haggerty Rd/Cherry Hill Rd Intersection: MP 6.885 - 6.961 PR 4706524**	**Haggerty Rd: Cherry Hill Rd to Canterbury Cir MP 6.961 - 7.395 PR 4706524**	**Haggerty Rd/ Canterbury Cir Intersection: MP 7.395 - 7.489 PR 4706524**	**Haggerty Rd: Canterbury Cir to M-153 MP 7.489 - 7.878 PR 4706524**	**Haggerty Rd/M-153 Intersection: MP 7.878 - 7.972 PR 4706524**	**Haggerty Rd: M-153 to Hanford Rd MP 7.972 - 8.283 PR 4706524**	**Haggerty Rd/Hanford Rd Intersection: MP 8.283 - 8.377 PR 4706524**	**Haggerty Rd: Hanford Rd to Warren Rd MP 8.377 - 8.626 PR 4706524**	**Haggerty Rd/Warren Rd Intersection: MP 8.626 - 8.738 PR 4703524**	**Total**	**Percentage**
Single Motor Veh	0	2	2	4	See the M-153 from Sheldon Road to Lotz Road Crash Analysis	1	0	0	2	**11**	3.82%
Head On	1	0	1	1		0	0	0	0	**3**	1.04%
Head On Left Turn	17	3	0	2		0	1	1	3	**27**	9.38%
Angle	40	5	5	8		5	0	0	8	**71**	24.65%
Rear End Straight	44	15	10	9		2	8	4	29	**121**	42.01%
Rear End Left Turn	0	1	2	0		0	0	0	2	**5**	1.74%
Rear End Right Turn	3	0	0	0		0	0	0	1	**4**	1.39%
Side-Swipe Same	2	3	3	3		7	1	2	8	**29**	10.07%
Side-Swipe Opposite	3	1	1	1		0	1	0	0	**7**	2.43%
Other Object	3	0	1	2		0	0	0	4	**10**	3.47%
Total	**113**	**30**	**25**	**30**	**-**	**15**	**11**	**7**	**57**	**288**	**100.00%**

	Haggerty Rd/Cherry Hill Rd Intersection: MP 6.885 - 6.961 PR 4706524 (Crash rate calculated in crashes per 1 million entering vehicles)	**Haggerty Rd: Cherry Hill Rd to Canterbury Cir MP 6.961 - 7.878 PR 4706524** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Haggerty Rd/ Canterbury Cir Intersection: MP 7.395 - 7.489 PR 4706524** (Crash rate calculated in crashes per 1 million entering vehicles)	**Haggerty Rd: Canterbury Cir to M-153 MP 6.961 - 7.878 PR 4706524** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Haggerty Rd/M-153 Intersection: MP 7.878 - 7.972 PR 4706524** (Crash rate calculated in crashes per 1 million entering vehicles)	**Haggerty Rd: M-153 to Hanford Rd MP 7.972 - 8.283 PR 4706524** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Haggerty Rd/Hanford Rd Intersection: MP 8.283 - 8.377 PR 4706524** (Crash rate calculated in crashes per 1 million entering vehicles)	**Haggerty Rd: Hanford Rd to Warren Rd MP 8.377 - 8.626 PR 4706524** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Haggerty Rd/Warren Rd Intersection: MP 8.626 - 8.738 PR 4703524** (Crash rate calculated in crashes per 1 million entering vehicles)
AADT	35566	20039	19530	20039		17630	16346	17630	22509
Length of Roadway Segment	0.08	0.43	0.09	0.39		0.31	0.09	0.25	0.11
Calculated Crash Rate	**2.18**	236.27	**0.88**	263.60		187.38	0.46	109.22	**1.73**
Average Crash Rate	0.71	288.9	0.7	288.9		288.9	0.7	288.9	0.72
Casualty Ratio	**0.26**	0.17	**0.36**	**0.23**		0.20	**0.27**	**0.43**	0.18
Average Casualty Ratio	0.22	0.22	0.23	0.22		0.23	0.23	0.23	0.21
Crash Frequency	**28.25**	**17.28**	**6.25**	**19.28**		**12.06**	2.75	**7.03**	**14.25**
Average Crash Frequency	8.96	9.05	3.73	9.05		6.44	3.73	6.44	6.56

Crash Severity	**Haggerty Rd/Cherry Hill Rd Intersection: MP 6.885 - 6.961 PR 4706524**	**Haggerty Rd: Cherry Hill Rd to Canterbury Cir MP 6.961 - 7.395 PR 4706524**	**Haggerty Rd/ Canterbury Cir Intersection: MP 7.395 - 7.489 PR 4706524**	**Haggerty Rd: Canterbury Cir to M-153 MP 7.489 - 7.878 PR 4706524**	**Haggerty Rd/M-153 Intersection: MP 7.878 - 7.972 PR 4706524**	**Haggerty Rd: M-153 to Hanford Rd MP 7.972 - 8.283 PR 4706524**	**Haggerty Rd/Hanford Rd Intersection: MP 8.283 - 8.377 PR 4706524**	**Haggerty Rd: Hanford Rd to Warren Rd MP 8.377 - 8.626 PR 4706524**	**Haggerty Rd/Warren Rd Intersection: MP 8.626 - 8.738 PR 4703524**	**Total**
Injury	29	4	9	6		3	3	3	10	**67**
A Level Injury	0	1	0	1		0	0	0	0	**2**
Fatal	0	0	0	0		0	0	0	0	**0**
PDO	84	25	16	23		12	8	4	47	**219**
Total	**113**	**30**	**25**	**30**	**-**	**15**	**11**	**7**	**57**	**288**

	Haggerty Rd/Cherry Hill Rd Intersection: MP 6.885 - 6.961 PR 4706524 (Crash rate calculated in crashes per 1 million entering vehicles)	**Haggerty Rd: Cherry Hill Rd to Canterbury Cir MP 6.961 - 7.878 PR 4706524** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Haggerty Rd/ Canterbury Cir Intersection: MP 7.395 - 7.489 PR 4706524** (Crash rate calculated in crashes per 1 million entering vehicles)	**Haggerty Rd: Canterbury Cir to M-153 MP 6.961 - 7.878 PR 4706524** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Haggerty Rd/M-153 Intersection: MP 7.878 - 7.972 PR 4706524** (Crash rate calculated in crashes per 1 million entering vehicles)	**Haggerty Rd: M-153 to Hanford Rd MP 7.972 - 8.283 PR 4706524** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Haggerty Rd/Hanford Rd Intersection: MP 8.283 - 8.377 PR 4706524** (Crash rate calculated in crashes per 1 million entering vehicles)	**Haggerty Rd: Hanford Rd to Warren Rd MP 8.377 - 8.626 PR 4706524** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Haggerty Rd/Warren Rd Intersection: MP 8.626 - 8.738 PR 4703524** (Crash rate calculated in crashes per 1 million entering vehicles)
Injury Crash Rate	0.56	39.38	0.32	**61.51**		37.48	0.13	46.81	0.30
Average Injury Crash Rate	N/A	52.9	N/A	52.9		52.9	N/A	52.9	N/A
Property Damage Crash Rate	1.62	196.89	0.56	202.09		149.90	0.34	62.41	1.43
Average PDO Crash Rate	N/A	235.1	N/A	235.1		235.1	N/A	235.1	N/A
Fatal Crash Rate	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
Average Fatal Crash Rate	N/A	0.9	N/A	0.9		0.9	N/A	0.9	N/A

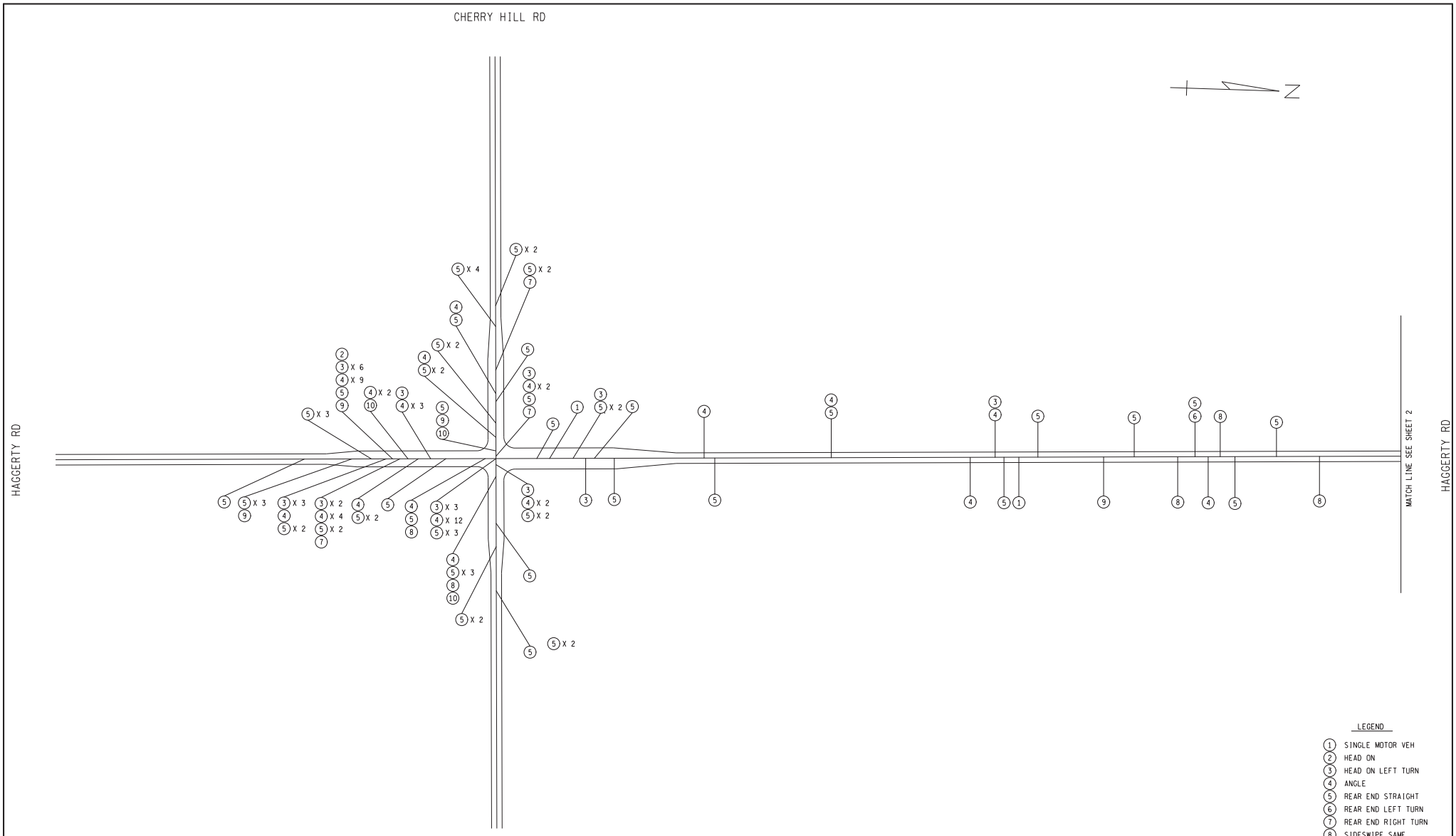
Haggerty Road Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2010
Number of Years 4

Light Condition	Haggerty Rd/Cherry Hill Rd Intersection: MP 6.885 - 6.961 PR 4706524	Haggerty Rd: Cherry Hill Rd to Canterbury Cir MP 6.961 - 7.395 PR 4706524	Haggerty Rd/ Canterbury Cir Intersection: MP 7.395 - 7.489 PR 4706524	Haggerty Rd: Canterbury Cir to M-153 MP 7.489 - 7.878 PR 4706524	Haggerty Rd/M-153 Intersection: MP 7.878 - 7.972 PR 4706524	Haggerty Rd: M-153 to Hanford Rd MP 7.972 - 8.283 PR 4706524	Haggerty Rd/Hanford Rd Intersection: MP 8.283 - 8.377 PR 4706524	Haggerty Rd: Hanford Rd to Warren Rd MP 8.377 - 8.626 PR 4706524	Haggerty Rd/Warren Rd Intersection: MP 8.626 - 8.738 PR 4703524	Total
Dark (Defined as 8 PM to 6 AM)	13	4	4	5		4	1	1	6	**38**
Dawn (Defined as 6 AM to 8 AM)	6	1	4	8		0	0	2	5	**26**
Daylight (Defined As 8 AM to 6 PM)	79	22	13	15		9	7	4	40	**189**
Dusk (Defined as 6 PM to 8 PM)	15	3	4	2		2	3	0	6	**35**
Unknown	0	0	0	0		0	0	0	0	**0**
Total	**113**	**30**	**25**	**30**	**-**	**15**	**11**	**7**	**57**	**288**

Weather Conditions	Haggerty Rd/Cherry Hill Rd Intersection: MP 6.885 - 6.961 PR 4706524	Haggerty Rd: Cherry Hill Rd to Canterbury Cir MP 6.961 - 7.395 PR 4706524	Haggerty Rd/ Canterbury Cir Intersection: MP 7.395 - 7.489 PR 4706524	Haggerty Rd: Canterbury Cir to M-153 MP 7.489 - 7.878 PR 4706524	Haggerty Rd/M-153 Intersection: MP 7.878 - 7.972 PR 4706524	Haggerty Rd: M-153 to Hanford Rd MP 7.972 - 8.283 PR 4706524	Haggerty Rd/Hanford Rd Intersection: MP 8.283 - 8.377 PR 4706524	Haggerty Rd: Hanford Rd to Warren Rd MP 8.377 - 8.626 PR 4706524	Haggerty Rd/Warren Rd Intersection: MP 8.626 - 8.738 PR 4703524	Total
Uncoded - Errors	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Clear	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Cloudy	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Fog	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Rain	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Snow/Blowing Snow	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Severe Wind	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Sleet or Hail	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Other	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Total	**0**	**0**	**0**	**0**	**-**	**0**	**0**	**0**	**0**	**0**

Pavement Conditions	Haggerty Rd/Cherry Hill Rd Intersection: MP 6.885 - 6.961 PR 4706524	Haggerty Rd: Cherry Hill Rd to Canterbury Cir MP 6.961 - 7.395 PR 4706524	Haggerty Rd/ Canterbury Cir Intersection: MP 7.395 - 7.489 PR 4706524	Haggerty Rd: Canterbury Cir to M-153 MP 7.489 - 7.878 PR 4706524	Haggerty Rd/M-153 Intersection: MP 7.878 - 7.972 PR 4706524	Haggerty Rd: M-153 to Hanford Rd MP 7.972 - 8.283 PR 4706524	Haggerty Rd/Hanford Rd Intersection: MP 8.283 - 8.377 PR 4706524	Haggerty Rd: Hanford Rd to Warren Rd MP 8.377 - 8.626 PR 4706524	Haggerty Rd/Warren Rd Intersection: MP 8.626 - 8.738 PR 4703524	Total
Uncoded - Errors	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Dry	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Wet	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Icy	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Snow/Blowing Snow	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Muddy	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Slushy	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Covered With Debris	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Other	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	**0**
Total	**0**	**0**	**0**	**0**	**-**	**0**	**0**	**0**	**0**	**0**



FINAL ROW PLAN REVISIONS (IF APPLICABLE)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

FILE: HAGGERTY-1.dgn

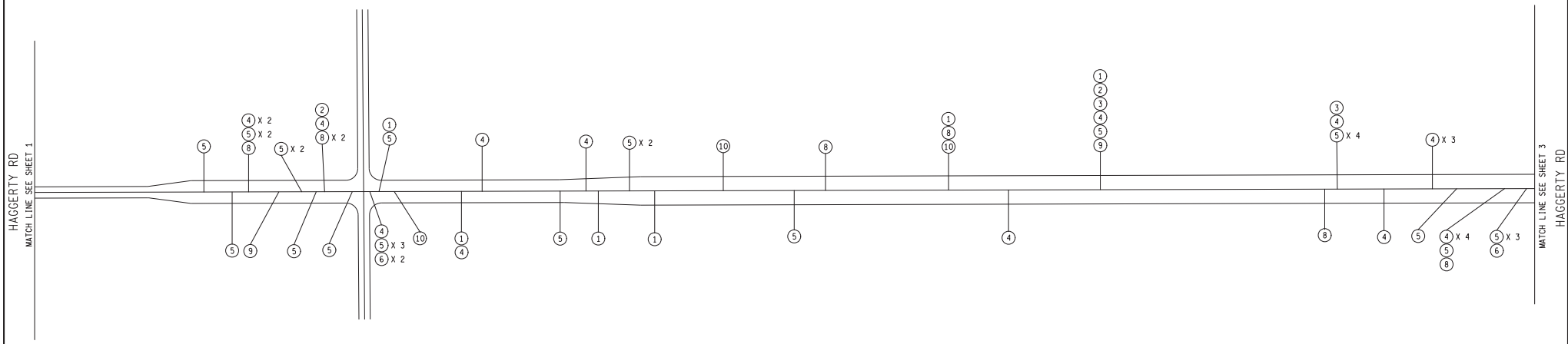
DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

HAGGERTY ROAD
CRASH LOCATION MAP

DRAWING: 1
SHEET:

CANTERBURY



LEGEND

1. SINGLE MOTOR VEH
2. HEAD ON
3. HEAD ON LEFT TURN
4. ANGLE
5. REAR END STRAIGHT
6. REAR END LEFT TURN
7. REAR END RIGHT TURN
8. SIDESWIPE SAME
9. SIDESWIPE OPPOSITE
10. OTHER OBJECT

CANTERBURY

FINAL ROW PLAN REVISIONS (WEST SIDE REVISIONS)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

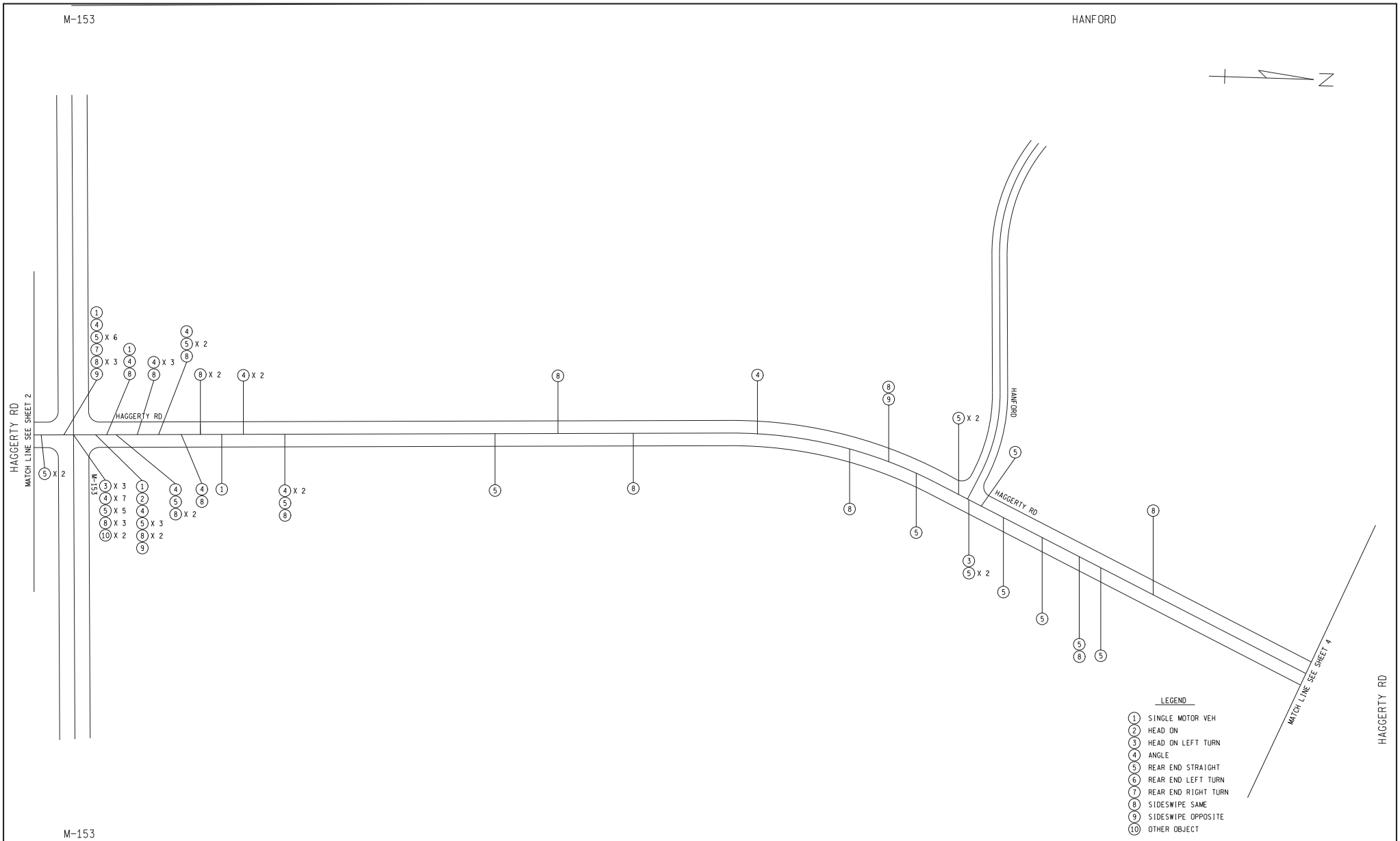
FILE: HAGGERTY-2.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

HAGGERTY ROAD
CRASH LOCATION MAP

DRAWING: 2
SHEET:



M-153

FINAL ROW PLAN REVISIONS (NO STRUCTURAL REVISIONS)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

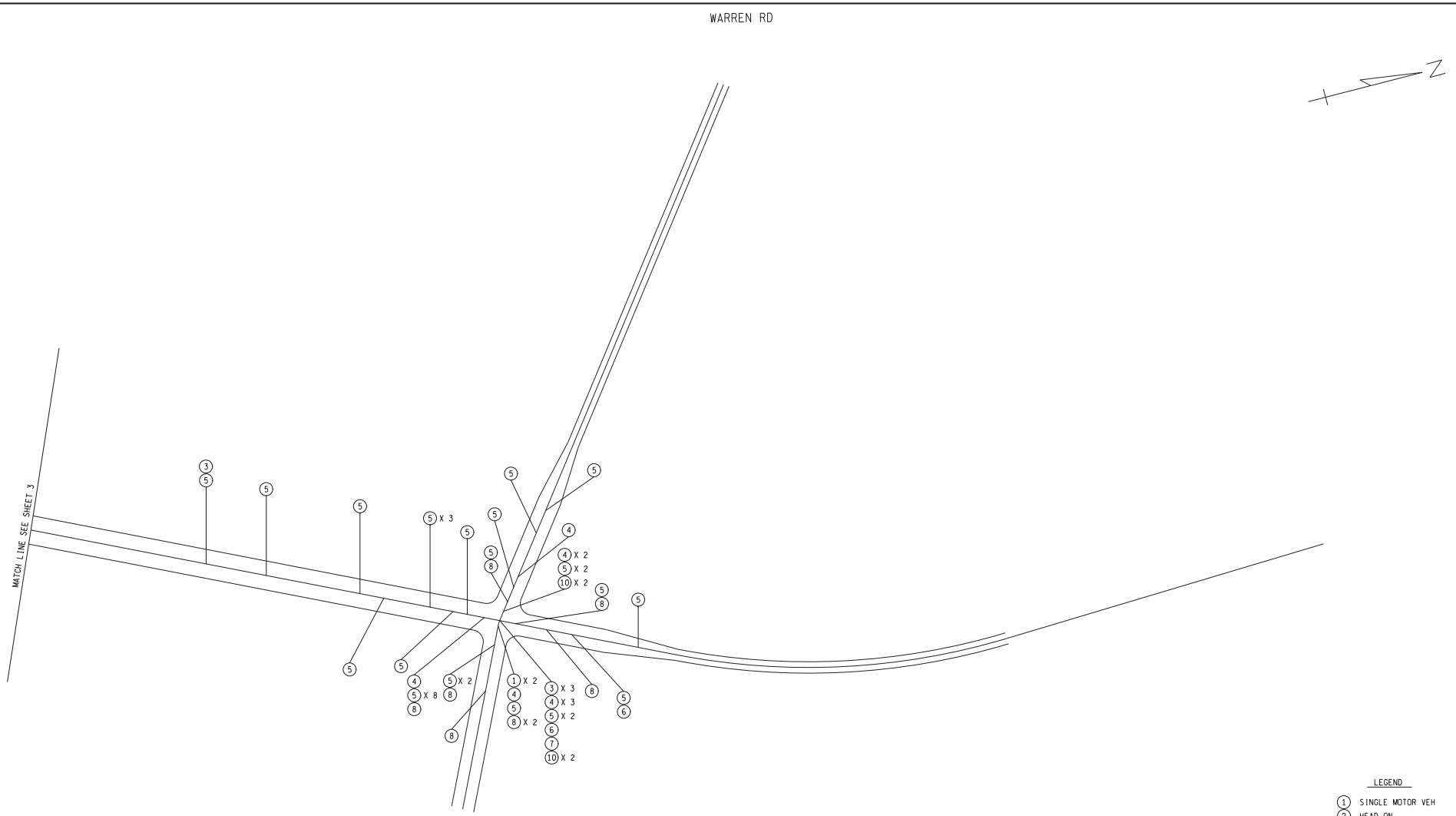
FILE: HAGGERTY-3.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

HAGGERTY ROAD
CRASH LOCATION MAP

DRAWING: 3
SHEET:



FINAL ROW PLAN REVISIONS (SEE RIGHT FOR ADDITIONAL REVISIONS)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

FILE: HAGGERTY-4.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

HAGGERTY ROAD
CRASH LOCATION MAP

DRAWING: 4
SHEET:

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
-	-	-	-	-	-	-
Convert Intersection to Rounda	%REDUCTION		35%			
Number of Crashes		33	24	28	28	0
PDO+Minor Inj Crashes		33	24	28	28	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-

# of A-injuries:	0	For reference only
# of Fatalilties:	0	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$1,590,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	4.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

Haggerty Rd Crash Analysis - Crash Pattern 1-1
Haggerty Rd / Cherry Hill Intersection
4706524
6.885-6.961
Convert Intersection to Roundabout

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **Haggerty Rd Crash Analysis - Crash Pattern 1-1** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **4706524** PR MP Range: **6.885-6.961**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$326,288
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	0.0
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	39.6
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21] for AREA TYPE ERR	$191,700
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 4.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $81,572

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $104,419

C = Project Cost $1,590,000

TOR=C/B=COST/ANNUAL BENEFIT= **15.23**

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
-	-	-	-	-	-	-
Install flashing beacon as advai	%REDUCTION	27%				
Number of Crashes		33	24	28	28	0
PDO+Minor Inj Crashes		33	24	28	28	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-

# of A-injuries:	0	For reference only
# of Fatalilties:	0	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$13,750	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	4.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

Haggerty Rd Crash Analysis - Crash Pattern 1-2
Haggerty Rd / Cherry Hill Intersection
4706524
6.885-6.961
Install Flashing Warning Beacon

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **Haggerty Rd Crash Analysis - Crash Pattern 1-2** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **4706524** PR MP Range: **6.885-6.961**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$251,708
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	0.0
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	30.5
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 4.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $62,927

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $80,552

C = Project Cost $13,750

TOR=C/B=COST/ANNUAL BENEFIT= **0.17**

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
Improve Signal Timing	%REDUCTION		8%			
Number of Crashes		33	24	28	28	0
PDO+Minor Inj Crashes		33	24	28	28	0
A-Injured or Killed Persons		0	0	0	0	0
Provide protected left turn phase	%REDUCTION		36%			
Number of Crashes		3	3	1	4	0
PDO+Minor Inj Crashes		3	3	1	4	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0

# of A-injuries:	0	For reference only
# of Fatalilties:	0	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$10,500	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	4.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

Haggerty Rd Crash Analysis - Crash Pattern #2
Haggerty / Canterbury, Hanford, & Warren Intersections
4706524
Varies
Improve Signal Timing (All) & Left turn phase (Haggerty/Hanford)

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **Haggerty Rd Crash Analysis - Crash Pattern #2** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **4706524** PR MP Range: **Varies**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$107,250
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	0.0
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	13.0
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 4.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $26,813

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $34,322

C = Project Cost $10,500

TOR=C/B=COST/ANNUAL BENEFIT= **0.31**

Memorandum

Crash Analysis: Warren Rd from Sheldon Rd to Lotz Rd
JN 115117
PR # 4710470 MP 3.440 – 3.516: Warren Rd/Sheldon Rd Intersection
PR # 4710470 MP 3.516 – 3.932: Warren Rd from Sheldon to Morton Taylor Rd
PR # 4710470 MP 3.932 – 4.026: Warren Rd/Morton Taylor Rd Intersection
PR # 4710470 MP 4.026 – 4.430: Warren Rd from Morton Taylor Rd to Lilley Rd
PR # 4710470 MP 4.430 – 4.524: Warren Rd/Lilley Rd Intersection
PR # 4710470 MP 4.524 – 5.220: Warren Rd from Lilley Rd to Haggerty Rd
PR # 4710470 MP 5.220 – 5.314: Warren Rd/Haggerty Rd Intersection
PR # 4710470 MP 5.314 – 5.840: Warren Rd from Haggerty Rd to Lotz Rd
PR # 4710470 MP 5.840 – 5.916: Warren Rd/Lotz Rd Intersection
*Please See the *Haggerty Road from Cherry Hill Road to Warren Road Crash Analysis* for the Warren Rd/Haggerty Road intersection crash details

1) Crash Analysis
A crash analysis on Warren Rd from Sheldon Rd to Lotz Rd was conducted for a four-year period between January 1st, 2007 and December 31st, 2010. The crash data utilized in this analysis was developed from Southeast Michigan Council of Governments (SEMCOG) crash data. Please note that for this analysis, the Warren Rd/Haggerty Rd intersection is not included as it is detailed in the *Haggerty Road from Cherry Hill Road to Warren Road Crash Analysis*.

Warren Rd is a two-lane to five-lane, undivided, east-west collector-distributor located one mile north of M-153. The land use in this study area consists of both commercial and residential uses, with multiple un-signalized drives to subdivisions and businesses. Current lane and shoulder widths include 12 foot driving lanes with varying 6 to 8 foot shoulders in non-curbed sections.

Overall trends for this segment of roadway are: approximately fifty two percent (52%) of the overall crashes were rear end straight crashes; with the next closest being angle crashes, consisting of approximately seventeen percent (17%) of the overall total. The intersection with the highest percentage of total crashes was the Warren Rd/Lilley Rd intersection, which accounted for approximately nineteen percent (19%) of the total crashes within this segment of Warren Rd. The road segment with the highest percentage of total crashes was the roadway segment between Morton Taylor Rd and Lilley Rd which accounted for approximately seventeen percent (17%) of the total crashes within this segment of Warren Rd.

As part of this analysis, crash rates, frequencies, and casualty ratios have been calculated to examine each of the road segments and intersections within the limits of the analysis. Crash rates compare the number of crashes occurring in a road segment or intersection to the volume of traffic utilizing the roadway facility. The crash rates that have been calculated in this analysis include total crash rates, fatal crash rates, injury crash rates, and property damage only (PDO) crash rates. Road segment crash rates are expressed in terms of “crashes per 100 million vehicle miles traveled” and intersection rates in terms of “crashes per 1 million entering

vehicles". Crash frequencies compare the total number of crashes that occur during the evaluation period to time. Road segment crash frequencies are in terms of "crashes per year per mile" and intersection frequencies in terms of "crashes per year". Casualty ratios compare the number of injury and fatal crashes to the total number of crashes in the evaluation period.

The calculated crash rates, frequencies, and casualty ratios have been compared to either statewide averages from the Michigan Office of Highway Safety Planning (MOHSP) or to regional averages for similar facilities published by the Southeast Michigan Council of Governments (SEMCOG). Detailed analysis of each of the above intersections and road segments are shown in the following sections. The distribution of crashes by type of collision and location are shown in the following table.

Table 1 Crash Analysis Summary

Crash Type	Location (See Key Below)									Total	Percentage
	1	**2**	**3**	**4**	**5**	**6**	**7[1]**	**8**	**9**		
Single Motor Veh	1	0	1	0	2	6	-	5	5	**20**	10.53%
Head On	1	0	0	0	0	1	-	0	1	**3**	1.58%
Head On Left Turn	3	0	2	2	5	1	-	0	3	**16**	8.42%
Angle	5	2	10	2	8	0	-	0	5	**32**	16.84%
Rear End Straight	16	2	7	27	19	6	-	7	15	**99**	52.11%
Rear End Left Turn	0	0	0	1	0	0	-	0	0	**1**	0.53%
Side-Swipe Same	1	2	0	0	1	3	-	0	2	**9**	4.74%
Side-Swipe Opposite	0	0	0	0	1	1	-	1	1	**4**	2.11%
Other Object	2	0	0	1	1	1	-	1	0	**6**	3.16%
Total	**29**	**6**	**20**	**33**	**37**	**19**	**-**	**14**	**32**	**190**	**100.00%**

= Intersection

Location Key	
1. Intersection: Warren Rd/Sheldon Rd (PR 4710470: MP 3.440 – 3.516)	**6. Segment:** Warren Rd from Lilley Rd to Haggerty Rd (PR 4710470: MP 4.524 – 5.220)
2. Segment: Warren Rd from Sheldon to Morton Taylor Rd (PR 4710470: MP 3.516 – 3.932)	**7[1]. Intersection:** Warren Rd/Haggerty Rd (PR 4710470: MP 5.220 – 5.314)
3. Intersection: Warren Rd/Morton Taylor Rd (PR 4710470: MP 3.932 – 4.026)	**8. Segment:** Warren Rd from Haggerty Rd to Lotz Rd (PR 4710470: MP 5.314 – 5.840)
4. Segment: Warren Rd from Morton Taylor Rd to Lilley Rd (PR 4710470: MP 4.026 – 4.430)	**9. Intersection:** Warren Rd/Lotz Rd (PR 4710470: MP 5.840 – 5.916)
5. Intersection: Warren Rd/Lilley Rd (PR 4710470: MP 4.430 – 4.524)	

1 See *Haggerty Road from Cherry Hill Road to Warren Road Crash Analysis* for intersection crash details

Table 2 Crash Rate Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Calculated Crash Rate	0.88[1]	51.07[2]	0.57[1]	**319.59[2]**	0.88[1]	149.25[2]	-	108.43[2]	**1.32[1]**
Average Crash Rate	0.92[4]	288.9[3]	0.92[4]	288.9[3]	0.92[4]	288.9[3]	-	288.9[3]	0.87[4]

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 Average crash rates in number of crashes occurring per 100 million vehicle miles traveled from the Michigan Office of Highway Safety Planning (MOHSP)
4 Average crash rates in number of crashes occurring per 1 million entering vehicles for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 3 Casualty Ratio Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Calculated Casualty Ratio	**0.34**	0.17	**0.30**	**0.36**	**0.24**	0.16	-	0.14	**0.25**
Average Casualty Ratio	0.22[1]	0.23[2]	0.22[1]	0.23[2]	0.22[1]	0.23[2]	-	0.23[2]	0.23[1]

1 Average casualty ratio values for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)
2 Average casualty ratio values for roadway segments with intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 4 Crash Frequency Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Crash Frequency	7.25[1]	3.61[2]	5.00[1]	**20.42[2]**	**9.25[1]**	**6.82[2]**	-	**6.65[2]**	**8.00[1]**
Average Crash Frequency	8.34[3]	6.44[4]	8.34[3]	6.44[4]	8.34[3]	6.44[4]	-	6.44[4]	4.69[3]

1 Crash frequency calculated in crashes per year
2 Crash frequency calculated in crashes per year per mile of roadway
3 Average crash frequencies in crashes per year for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)
4 Average crash frequencies in crashes per year per mile for roadway segments with intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 5 Injury and Fatal Crash Rate Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Number of Injury Crashes	10	1	6	12	9	3	-	2	8
Calculated Injury Crash Rate	0.30[1]	8.51[2]	0.17[1]	**116.21[2]**	0.21[1]	23.57[2]	-	15.49[2]	0.33[1]
Average Injury Crash Rate	N/A[3]	52.9[4]	N/A[3]	52.9[4]	N/A[3]	52.9[4]	-	52.9[4]	N/A[3]
Number of Fatal Crashes	0	0	0	0	0	0	-	0	0
Calculated Fatal Crash Rate	0.00	0.00	0.00	0.00	0.00	0.00	-	0.00	0.00
Average Fatal Crash Rate	N/A[3]	0.90[5]	N/A[3]	0.90[5]	N/A[3]	0.90[5]	-	0.90[5]	N/A[3]

1 Injury crash rates calculated in crashes per 1 million entering vehicles
2 Injury crash rates calculated in crashes per 100 million vehicle miles traveled
3 No average rates in number of crashes per 1 million entering vehicles are available from the Michigan Office of Highway Safety Planning or the Southeast Michigan Council of Governments
4 Average injury crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)
5 Average fatal crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

Table 6 Property Damage Crash Rate Summary

	Location (See Key)								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Number Property Damage Only Crashes	19	5	14	21	28	16	-	12	24
Calculated PDO Crash Rate	0.58[1]	42.6[2]	0.40[1]	203.4[2]	0.67[1]	125.7[2]	-	92.9[2]	0.99[1]
Average PDO Crash Rate	N/A[3]	235.1[4]	N/A[3]	235.1[4]	N/A[3]	235.1[4]	-	235.1[4]	N/A[3]

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 No average property damage only crash rates in number of crashes per 1 million entering vehicles are available from the Michigan Office of Highway Safety Planning (MOHSP) or the Southeast Michigan Council of Governments (SEMCOG)
4 Average property damage only crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

1. Warren Rd/Sheldon Rd Intersection (PR 4710470: MP 3.440 – 3.516)

The Warren Rd and Sheldon Rd intersection experienced twenty nine (29) crashes within the four year analysis period. Sixteen (16) (55.20%) crashes transpired as rear end straight crashes, while five (5) (17.24%) angle crashes and three (3) (10.34%) head on left turn crashes also occurred. The remaining five (5) (17.22%) crashes consisted of single motor vehicle, head on, side swipe same and other object crashes.

Of the twenty nine (29) crashes that occurred, there were zero (0) fatal crashes and ten (10) injury related crashes. Of the ten (10) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 7 for details involving the A-Level crash. The remaining nineteen (19) crashes were PDO (Property Damage Only) crashes.

Table 7 Warren Rd/Sheldon Rd Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 3.477 Sheldon Rd Intersection	A	Head On	Snowy	Snow/ Blowing Snow	No	UD-10 information states that Vehicle 2 was traveling westbound in the right through lane when they entered the Sheldon Rd intersection on a green light. Vehicle 1 was traveling eastbound and crossed left of center striking Vehicle 2. The driver of Vehicle 1 stated they were trying to turn right onto southbound, but did not know what happened after this. The driver of Vehicle 1 was cited for driving left of center.

A review of the A-Level injury crash does not show a clear cause for this crash. The crash occurred at 6:20 PM with snowy weather and road conditions. The driver of Vehicle 1, which was traveling eastbound on Warren Rd, stated that they were trying to turn right onto southbound Sheldon Rd but does not remember anything that happened after. The driver of Vehicle 2, which was traveling westbound in the right through lane on Warren Rd, stated they entered the intersection on a green light but also does not remember what happened after. A witness stated in the UD-10 report only that they observed Vehicle 1 cross into the westbound lanes. As shown in the UD-10 report weather and road conditions at the time of the crash were snowy and snow/blowing snow, respectively.

The crash rate for this intersection is 0.88 crashes per 1 million entering vehicles. This is lower than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.92 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.30 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.34 which is higher than the SEMCOG average of 0.22. The crash frequency of 7.25 crashes per year is less than the average for signalized intersections with similar traffic volumes at 8.34 crashes per year.

2. Warren Rd from Sheldon to Morton Taylor Rd (PR 4710470: MP 3.516 – 3.932)
This 0.416 mile segment of roadway experienced six (6) crashes within the four (4) year analysis period. Two (2) (33.33%) crashes transpired as rear end straight crashes, two (2) (33.33%) were angle crashes, and two (2) (33.33%) were side swipe same.

Of the six (6) crashes that occurred, there were zero (0) fatal crashes and one (1) injury crash, which was not an A-Level (incapacitating) injury crash. The remaining five (5) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 51.07 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 8.51 and 0.00 crashes per 100 million vehicle miles traveled, respectively, which are both lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.17 and 3.61 crashes per year per mile, respectively. Both are lower than regional averages of 0.23 and 6.44 crashes per year per mile, respectively.

3. Warren Rd/Morton Taylor Rd Intersection (PR 4710470: MP 3.932 – 4.026)
The Warren Rd/Morton Taylor Rd intersection experienced twenty (20) crashes within the four year analysis period. Ten (10) (50.0%) crashes transpired as angle crashes, while seven (7) (35.0%) rear end straight crashes, two (2) (10.0%) head on left turn crashes, and one (1) (5.0%) single motor vehicle crash also occurred. Please note, based on field review, this intersection was recently widened to include exclusive left-turn lanes with protected left-turn traffic signal phasing, which will likely reduce angle, rear end, and left turn crashes.

Of the twenty (20) crashes that occurred, there were zero (0) fatal crashes and six (6) injury related crashes. Of the six (6) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 8 for details involving the A-Level crash. The remaining fourteen (14) crashes were PDO (Property Damage Only) crashes.

Table 8 Warren Rd/Morton Taylor Rd Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 3.979 Morton Taylor Rd Intersection	A	Angle	Dry	Clear	No	UD-10 information states that Vehicle 2 was eastbound on Warren Rd when Vehicle 1, which was in the westbound left turn lane, turned left in front of Vehicle 2 causing the collision. The driver of Vehicle 1 was cited for this crash.

A review of the A-Level injury crash shows that failure to yield right of way was the cause of this crash. The crash occurred at 11:00 AM with clear and dry weather and road conditions. The

available UD-10 information does not state why the driver of Vehicle 1 turned left in front of Vehicle 2 or if Vehicle 2 was not able to see Vehiclev1. Based upon field reviews of the intersections on Warren Rd, aggressive driving techniques at intersections are used by drivers because of large queues.

The crash rate for this intersection is 0.57 crashes per 1 million entering vehicles. This is lower than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.92 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.17 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.30 which is higher than the SEMCOG average of 0.22. The crash frequency of 5.00 crashes per year is less than the average for signalized intersections with similar traffic volumes at 8.34 crashes per year.

4. Warren Rd from Morton Taylor Rd to Lilley Rd (PR 4710470: MP 4.026 – 4.430)

This 0.404 mile segment of roadway experienced thirty three (33) crashes within the four (4) year analysis period. Twenty seven (27) (81.82%) crashes transpired as rear end straight crashes, two (2) (6.06%) were angle crashes, two (2) (6.06%) were head on left turn crashes, one (1) (3.03) was a rear end left turn, and one (1) (3.03%) was an other object crash.

Of the thirty three (33) crashes that occurred, there were zero (0) fatal crashes and twelve (12) injury crashes. Of the twelve (12) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining twenty one (21) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 319.59 crashes per 100 million vehicle miles traveled. This is higher than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 116.21 and 0.00 crashes per 100 million vehicle miles traveled, respectively. The injury rate is higher and the fatal rate is lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.36 and 20.42 crashes per year per mile, respectively, both of which are higher than regional averages of 0.23 and 6.44 crashes per year per mile, respectively.

5. Warren Rd/Lilley Rd Intersection (PR 4710470: MP 4.430 – 4.524)

The Warren Rd/Lilley Rd intersection experienced thirty seven (37) crashes within the four year analysis period. Nineteen (19) (51.35%) crashes transpired as rear end straight crashes, while eight (8) (21.62%) angle crashes, and five (5) (13.51%) head on left turn crashes occurred. The remaining five (5) (13.52%) crashes consisted of single motor vehicle, side swipe same, side swipe opposite, and other object crashes. Please note, based upon field review, this intersection was recently widened to include exclusive right-turn lanes on the eastbound, westbound, and southbound approaches which will increase the capacity of the intersection.

This may reduce the occurrences of rear end crashes by reducing queue lengths and reduce all crash types by reducing aggressive maneuvers caused by inadequate intersection capacity.

Of the thirty seven (37) crashes that occurred, there were zero (0) fatal crashes and nine (9) injury related crashes. Of the nine (9) injury crashes, one (1) was an A-Level (incapacitating) injury. See Table 9 for details involving the A-Level crash. The remaining twenty eight (28) crashes were PDO (Property Damage Only) crashes.

Table 9 Warren Rd/Lilley Rd Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 4.477 Lilley Rd Intersection	A	Head On–Left Turn	Dry	Clear	No	UD-10 information states that Vehicle 2 was traveling northbound on Lilley Rd when Vehicle 1, which was in the southbound left turn lane, turned in front of Vehicle 2, causing the collision. The driver of Vehicle 1 was cited for failure to yield.

A review of the A-Level injury crash shows that failure to yield right of way was the cause of this crash. The crash occurred at 11:00 PM with clear and dry weather and road conditions. The available UD-10 information does not state why the driver of Vehicle 1 turned left in front of Vehicle 2. Based on field reviews of the intersections on Warren Rd, aggressive driving techniques at intersections are used by drivers because of large queues.

The crash rate for this intersection is 0.88 crashes per 1 million entering vehicles. This is lower than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.92 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.21 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.24 which is higher than the SEMCOG average of 0.22. The crash frequency of 9.25 crashes per year is also higher than the average for signalized intersections with similar traffic volumes at 8.34 crashes per year.

6. Warren Rd from Lilley Rd to Haggerty Rd (PR 4710470: MP 4.524 – 5.220)

This 0.696 mile segment of roadway experienced nineteen (19) crashes within the four (4) year analysis period. Six (6) (31.58%) crashes transpired as rear end straight crashes, six (6) (31.58%) were single motor vehicle crashes, and three (3) (15.79%) were side swipe same crashes. The remaining four (4) (21.05%) crashes consisted of head on, head on left turn, side swipe opposite, and other object crashes.

Of the nineteen (19) crashes that occurred, there were zero (0) fatal crashes and three (3) injury crashes. Of the three (3) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining sixteen (16) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 149.25 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 23.57 and 0.00 crashes per 100 million vehicle miles traveled, respectively. Both rates are lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.16 and 6.82 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is slightly higher than regional averages of 0.23 and 6.44 crashes per year per mile, respectively.

7. Warren Rd/Haggerty Rd Intersection (PR 4710470: MP 5.220 – 5.314)
Please refer to the *Haggerty Road from Cherry Hill Road to Warren Road Crash Analysis* for the details involving the crashes at this intersection.

8. Warren Rd from Haggerty Rd to Lotz Rd (PR 4710470: MP 5.314 – 5.840)
This 0.526 mile segment of roadway experienced fourteen (14) crashes within the four (4) year analysis period. Seven (7) (50.0%) crashes transpired as rear end straight crashes, five (5) (35.71%) were single motor vehicle crashes, one (1) (7.14%) was a side swipe opposite crash, and one (1) (7.14%) was an other object crash.

Of the fourteen (14) crashes that occurred, there were zero (0) fatal crashes and two (2) injury crashes. Of the two (2) injury crashes, zero (0) were A-Level (incapacitating) injuries. The remaining twelve (12) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 108.4 crashes per 100 million vehicle miles traveled, which is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 15.49 and 0.00 crashes per 100 million vehicle miles traveled, respectively. Both rates are lower than the statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.14 and 6.65 crashes per year per mile, respectively. The casualty ratio is lower but the crash frequency is slightly higher than the regional averages of 0.23 and 6.44 crashes per year per mile, respectively.

9. Warren Rd/Lotz Rd Intersection (PR 4710470: MP 5.840 – 5.916)
The Warren Rd/Lotz Rd intersection experienced thirty two (32) crashes within the four (4) year analysis period. Fifteen (15) (46.88%) crashes transpired as rear end straight crashes, while five (5) (15.63%) single motor vehicle crashes, five (5) (15.63%) angle crashes, and three (3) (9.38%) head on left turn crashes also occurred. The remaining four (4) (12.48%) crashes consisted of head on, side swipe same, and side swipe opposite crashes.

Of the thirty two (32) crashes that occurred, there were zero (0) fatal crashes and eight (8) injury related crashes. Of the eight (8) injury crashes, zero (0) were A-Level (incapacitating) injury. The remaining twenty four (24) crashes were PDO (Property Damage Only) crashes.

The crash rate for this intersection is 1.32 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.87 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.33 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.25 which is slightly higher than the SEMCOG average of 0.23. The crash frequency of 8.00 crashes per year is also higher than the average for signalized intersections with similar traffic volumes at 4.69 crashes per year.

Crash Concentration/Pattern Identification and Potential Crash Mitigation Strategies

Crash Pattern #1: The majority of crashes within the study area (99 or 52.11%) were a result of rear end crashes. This section of Warren Rd consists primarily of a two lane, two way roadway with the exception of the segment between Sheldon Rd and Morton Taylor Rd, which consists of a five lane undivided roadway. There are multiple signalized intersections and un-signalized drives for both residential access and commercial access on both sides of the road. Rear end crashes are common in areas that include features that require drivers to slow or stop in travel lanes such as traffic signals or un-signalized intersections without dedicated turn lanes.

A review of the weather conditions was prepared to determine if poor pavement conditions led to the high number of rear end crashes and is presented in the following table:

Table 10 Rear End Straight Pavement Conditions

Pavement Conditions	Rear End Straight Crashes	Percentage
Uncoded - Errors	0	0.00%
Dry	81	81.82%
Wet	12	12.12%
Icy	4	4.04%
Snow/Blowing Snow	1	1.01%
Muddy	0	0.00%
Slushy	1	1.01%
Covered With Debris	0	0.00%
Other	0	0.00%
Total	**99**	100.00%

As shown in Table 10, the majority (81 or 81.82%) of the rear end straight crashes occurred under dry pavement conditions with the next highest (12 or 12.12%) occurring under wet conditions. Based on this review, poor pavement conditions did not play a significant role in the high number of rear end crashes in this study area.

As shown in Table 2, segment 4 and intersection 9 (detailed in the location key) have overall crash rates higher than the Michigan Office of Highway Safety Planning statewide average and SEMCOG regional average for intersections with similar traffic volumes, respectively. This is due to the high number of rear end straight crashes occurring in this segment and at this intersection constituting the majority of crashes in each as shown in Table 1. It is notable that in segment 4, from Morton Taylor Rd to Lilley Rd, twenty seven (27) of the thirty three (33) total crashes were rear end straight crashes, constituting approximately eight two percent (81.82%) of the total crashes within this segment of roadway.

In addition, segment 4 had an injury rate significantly higher than the Michigan Office of Highway Safety Planning statewide average injury rate as shown in Table 5. However, no fatal or A-Level (incapacitating) injury crashes occurred in this segment. All three A-Level (incapacitating) injuries transpired at intersections and will be detailed in the following section.

Countermeasure Recommendation: A review of the need for a two-way left-turn lane between Morton Taylor Rd and Lilley Rd should be provided to allow slowing vehicles that are turning into drives on this segment of road to exit the through lane. Based upon Federal Highway Administration (FHWA) crash reduction factors, the addition of a two-way left-turn lane could result in a 30% reduction in crashes.

Right-of-Way Impacts: None

Estimated Cost: $639,000

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 24.45. See the end of this section for the results of this analysis.

Crash Pattern #2: Crash concentrations were observed at each of the signalized intersections in this study area with the crash details for each outlined in Table 1. Fifty seven (57) (57.58%) of the rear end straight crashes and twenty eight (28) (87.50%) of the angle crashes occurred at one of these intersections. Of the four (4) signalized intersections, only the Warren Rd/Lotz Rd intersection exceeded the SEMCOG average intersection crash rate for signalized intersections with similar traffic volumes. Currently, the Lilley Rd and Lotz Rd intersections have left turn

lanes but not a left turn phase. All other intersections along the Warren Rd corridor have protected left-turn phasing.

Of the forty eight (48) injury crashes, three (3) were A-Level (incapacitating) injury crashes, and each transpired at a signalized intersection. A review of the UD-10 reports for these high severity crashes shows that two (2) involved a left-turning vehicle turning in front of another vehicle, and one (1) involved a driver losing control during snowy road and weather conditions.

Countermeasure Recommendation: Review of the need for protected left-turn traffic signal phasing and review of the existing clearance intervals should be provided for the signalized intersections of Sheldon Rd, Morton Taylor Rd, Lilley Rd, and Lotz Rd with Warren Rd to ensure adequate time is provided for motorists to perceive the changing signal phases and react accordingly.

Right-of-Way Impacts: None

Estimated Cost: $14,000

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 0.06. See the end of this section for the results of this analysis.

Warren Road Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2010
Number of Years 4

	1	2	3	4	5	6	7	8	9		
Crash Type	**Warren Rd/Sheldon Rd Intersection: MP 3.440 - 3.516 PR 4710470**	**Warren Rd: Sheldon Rd to Morton Taylor Rd MP 3.516 - 3.932 PR 4710470**	**Warren Rd/Morton Taylor Rd Intersection: MP 3.932 - 4.026 PR 4710470**	**Warren Rd: Morton Taylor Rd to Lilley Rd MP 4.026 - 4.430 PR 4710470**	**Warren Rd/Lilley Rd Intersection: MP 4.430 - 4.524 PR 4710470**	**Warren Rd: Lilley Rd to Haggerty Rd MP 4.524 - 5.220 PR 4710470**	**Warren Rd/Haggerty Rd Intersection: MP 5.220 - 5.314 PR 4710470**	**Warren Rd: Haggerty Rd to Lotz Rd MP 5.314 - 5.840 PR 4710470**	**Warren Rd/Lotz Rd Intersection: MP 5.840 - 5.916 PR 4710470**	**Total**	**Percentage**
Single Motor Veh	1	0	1	0	2	6	See the Haggerty Road from Cherry Hill to Warren Road Crash Analysis	5	5	**20**	10.53%
Head On	1	0	0	0	0	1		0	1	**3**	1.58%
Head On Left Turn	3	0	2	2	5	1		0	3	**16**	8.42%
Angle	5	2	10	2	8	0		0	5	**32**	16.84%
Rear End Straight	16	2	7	27	19	6		7	15	**99**	52.11%
Rear End Left Turn	0	0	0	1	0	0		0	0	**1**	0.53%
Side-Swipe Same	1	2	0	0	1	3		0	2	**9**	4.74%
Side-Swipe Opposite	0	0	0	0	1	1		1	1	**4**	2.11%
Other Object	2	0	0	1	1	1		1	0	**6**	3.16%
Total	**29**	**6**	**20**	**33**	**37**	**19**	**-**	**14**	**32**	**190**	**100.00%**

	Warren Rd/Sheldon Rd Intersection: MP 3.440 - 3.516 PR 4710470 (Crash rate calculated in crashes per 1 million entering vehicles)	**Warren Rd: Sheldon Rd to Morton Taylor Rd MP 3.516 - 3.932 PR 4710470** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Warren Rd/Morton Taylor Rd Intersection: MP 3.932 - 4.026 PR 4710470** (Crash rate calculated in crashes per 1 million entering vehicles)	**Warren Rd: Morton Taylor Rd to Lilley Rd MP 4.026 - 4.430 PR 4710470** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Warren Rd/Lilley Rd Intersection: MP 4.430 - 4.524 PR 4710470** (Crash rate calculated in crashes per 1 million entering vehicles)	**Warren Rd: Lilley Rd to Haggerty Rd MP 4.524 - 5.220 PR 4710470** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Warren Rd/Haggerty Rd Intersection: MP 5.220 - 5.314 PR 4710470** (Crash rate calculated in crashes per 1 million entering vehicles)	**Warren Rd: Haggerty Rd to Lotz Rd MP 5.314 - 5.840 PR 4710470** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Warren Rd/Lotz Rd Intersection: MP 5.840 - 5.916 PR 4710470** (Crash rate calculated in crashes per 1 million entering vehicles)
AADT	22471	19345	23875	17506	28796	12528		16813	16588
Length of Roadway Segment	0.08	0.42	0.09	0.40	0.09	0.70		0.53	0.08
Calculated Crash Rate	0.88	51.07	0.57	**319.59**	0.88	149.25		108.43	**1.32**
Average Crash Rate	0.92	288.9	0.92	288.9	0.92	288.9		288.9	0.87
Casualty Ratio	**0.34**	0.17	**0.30**	**0.36**	**0.24**	0.16		0.14	**0.25**
Average Casualty Ratio	0.22	0.23	0.22	0.23	0.22	0.23		0.23	0.23
Crash Frequency	7.25	3.61	5.00	**20.42**	**9.25**	**6.82**		**6.65**	**8.00**
Average Crash Frequency	8.34	6.44	8.34	6.44	8.34	6.44		6.44	4.69

Crash Severity	**Warren Rd/Sheldon Rd Intersection: MP 3.440 - 3.516 PR 4710470**	**Warren Rd: Sheldon Rd to Morton Taylor Rd MP 3.516 - 3.932 PR 4710470**	**Warren Rd/Morton Taylor Rd Intersection: MP 3.932 - 4.026 PR 4710470**	**Warren Rd: Morton Taylor Rd to Lilley Rd MP 4.026 - 4.430 PR 4710470**	**Warren Rd/Lilley Rd Intersection: MP 4.430 - 4.524 PR 4710470**	**Warren Rd: Lilley Rd to Haggerty Rd MP 4.524 - 5.220 PR 4710470**	**Warren Rd/Haggerty Rd Intersection: MP 5.220 - 5.314 PR 4710470**	**Warren Rd: Haggerty Rd to Lotz Rd MP 5.314 - 5.840 PR 4710470**	**Warren Rd/Lotz Rd Intersection: MP 5.840 - 5.916 PR 4710470**	**Total**
Injury	9	1	5	12	8	3		2	8	**48**
A Level Injury	1	0	1	0	1	0		0	0	**3**
Fatal	0	0	0	0	0	0		0	0	**0**
PDO	19	5	14	21	28	16		12	24	**139**
Total	**29**	**6**	**20**	**33**	**37**	**19**	**-**	**14**	**32**	**190**

	Warren Rd/Sheldon Rd Intersection: MP 3.440 - 3.516 PR 4710470 (Crash rate calculated in crashes per 1 million entering vehicles)	**Warren Rd: Sheldon Rd to Morton Taylor Rd MP 3.516 - 3.932 PR 4710470** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Warren Rd/Morton Taylor Rd Intersection: MP 3.932 - 4.026 PR 4710470** (Crash rate calculated in crashes per 1 million entering vehicles)	**Warren Rd: Morton Taylor Rd to Lilley Rd MP 4.026 - 4.430 PR 4710470** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Warren Rd/Lilley Rd Intersection: MP 4.430 - 4.524 PR 4710470** (Crash rate calculated in crashes per 1 million entering vehicles)	**Warren Rd: Lilley Rd to Haggerty Rd MP 4.524 - 5.220 PR 4710470** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Warren Rd/Haggerty Rd Intersection: MP 5.220 - 5.314 PR 4710470** (Crash rate calculated in crashes per 1 million entering vehicles)	**Warren Rd: Haggerty Rd to Lotz Rd MP 5.314 - 5.840 PR 4710470** (Crash rate calculated in crashes per 100 million vehicle miles traveled)	**Warren Rd/Lotz Rd Intersection: MP 5.840 - 5.916 PR 4710470** (Crash rate calculated in crashes per 1 million entering vehicles)
Injury Crash Rate	0.30	8.51	0.17	**116.21**	0.21	23.57		15.49	0.33
Average Injury Crash Rate	N/A	52.9	N/A	52.9	N/A	52.9		52.9	N/A
Property Damage Crash Rate	0.58	42.56	0.40	**203.38**	0.67	125.68		92.94	0.99
Average PDO Crash Rate	N/A	235.1	N/A	235.1	N/A	235.1		235.1	N/A
Fatal Crash Rate	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Average Fatal Crash Rate	N/A	0.9	N/A	0.9	N/A	0.9		0.9	N/A

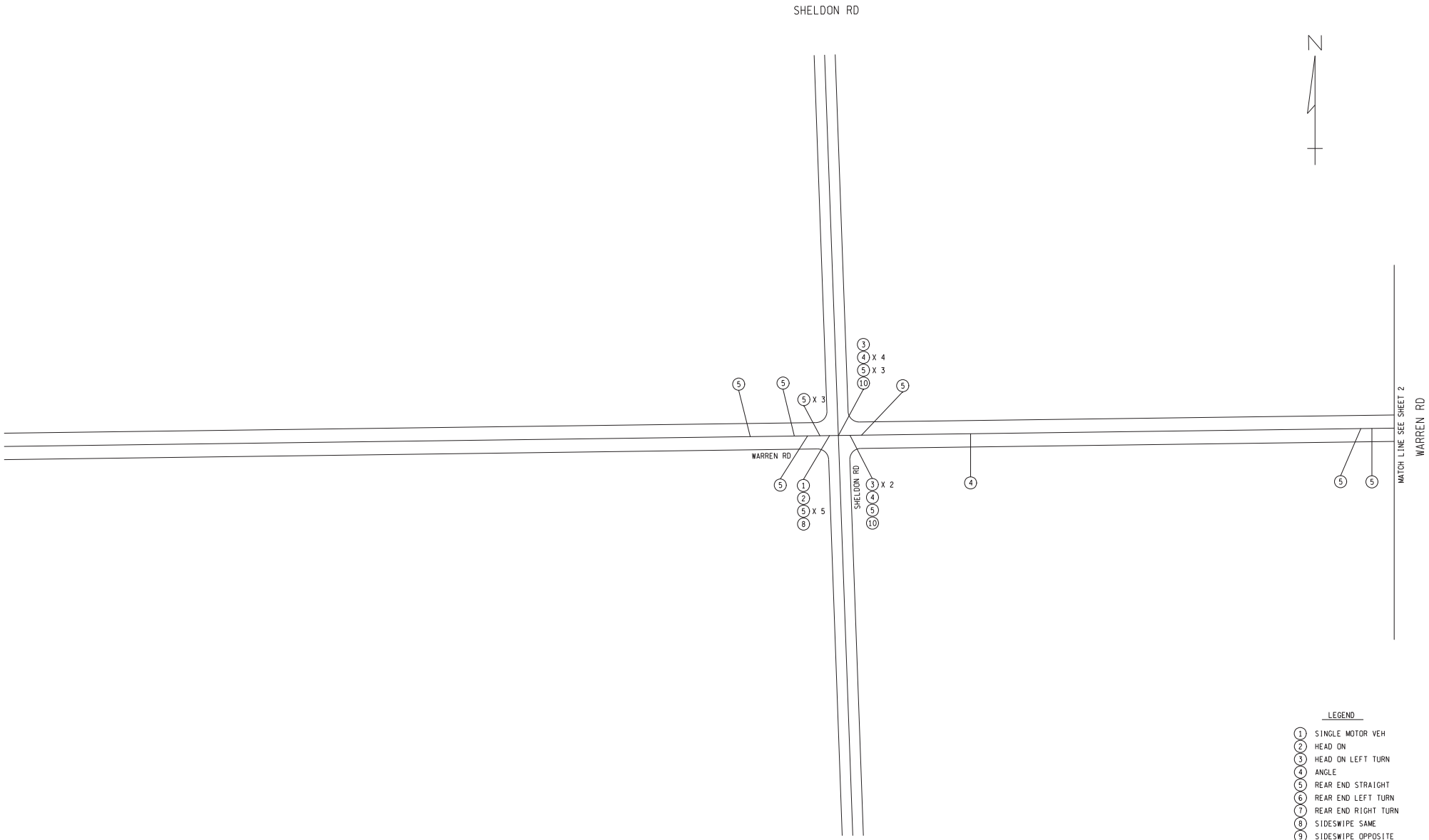
Warren Road Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2010
Number of Years 4

Light Condition	Warren Rd/Sheldon Rd Intersection: MP 3.440 - 3.516 PR 4710470	Warren Rd: Sheldon Rd to Morton Taylor Rd MP 3.516 - 3.932 PR 4710470	Warren Rd/Morton Taylor Rd Intersection: MP 3.932 - 4.026 PR 4710470	Warren Rd: Morton Taylor Rd to Lilley Rd MP 4.026 - 4.430 PR 4710470	Warren Rd/Lilley Rd Intersection: MP 4.430 - 4.524 PR 4710470	Warren Rd: Lilley Rd to Haggerty Rd MP 4.524 - 5.220 PR 4710470	Warren Rd/Haggerty Rd Intersection: MP 5.220 - 5.314 PR 4710470	Warren Rd: Haggerty Rd to Lotz Rd MP 5.314 - 5.840 PR 4710470	Warren Rd/Lotz Rd Intersection: MP 5.840 - 5.916 PR 4710470	Total
Dark (Defined as 8 PM to 6 AM)	4	0	6	3	9	5		3	4	**34**
Dawn (Defined as 6 AM to 8 AM)	2	0	1	2	3	0		2	3	**13**
Daylight (Defined As 8 AM to 6 PM)	19	5	10	21	18	10		8	21	**112**
Dusk (Defined as 6 PM to 8 PM)	4	1	3	7	7	4		1	4	**31**
Unknown	0	0	0	0	0	0		0	0	**0**
Total	**29**	**6**	**20**	**33**	**37**	**19**	**-**	**14**	**32**	**190**

Weather Conditions	Warren Rd/Sheldon Rd Intersection: MP 3.440 - 3.516 PR 4710470	Warren Rd: Sheldon Rd to Morton Taylor Rd MP 3.516 - 3.932 PR 4710470	Warren Rd/Morton Taylor Rd Intersection: MP 3.932 - 4.026 PR 4710470	Warren Rd: Morton Taylor Rd to Lilley Rd MP 4.026 - 4.430 PR 4710470	Warren Rd/Lilley Rd Intersection: MP 4.430 - 4.524 PR 4710470	Warren Rd: Lilley Rd to Haggerty Rd MP 4.524 - 5.220 PR 4710470	Warren Rd/Haggerty Rd Intersection: MP 5.220 - 5.314 PR 4710470	Warren Rd: Haggerty Rd to Lotz Rd MP 5.314 - 5.840 PR 4710470	Warren Rd/Lotz Rd Intersection: MP 5.840 - 5.916 PR 4710470	Total
Uncoded - Errors	0	0	0	0	0	0		0	0	**0**
Clear	17	4	14	22	21	10		7	15	**110**
Cloudy	5	1	3	9	11	4		5	10	**48**
Fog	0	0	0	0	0	0		0	0	**0**
Rain	4	0	2	1	4	1		1	3	**16**
Snow/Blowing Snow	1	1	1	0	1	3		1	4	**12**
Severe Wind	0	0	0	0	0	0		0	0	**0**
Sleet or Hail	1	0	0	1	0	0		0	0	**2**
Other	1	0	0	0	0	1		0	0	**2**
Total	**29**	**6**	**20**	**33**	**37**	**19**	**-**	**14**	**32**	**190**

Pavement Conditions	Warren Rd/Sheldon Rd Intersection: MP 3.440 - 3.516 PR 4710470	Warren Rd: Sheldon Rd to Morton Taylor Rd MP 3.516 - 3.932 PR 4710470	Warren Rd/Morton Taylor Rd Intersection: MP 3.932 - 4.026 PR 4710470	Warren Rd: Morton Taylor Rd to Lilley Rd MP 4.026 - 4.430 PR 4710470	Warren Rd/Lilley Rd Intersection: MP 4.430 - 4.524 PR 4710470	Warren Rd: Lilley Rd to Haggerty Rd MP 4.524 - 5.220 PR 4710470	Warren Rd/Haggerty Rd Intersection: MP 5.220 - 5.314 PR 4710470	Warren Rd: Haggerty Rd to Lotz Rd MP 5.314 - 5.840 PR 4710470	Warren Rd/Lotz Rd Intersection: MP 5.840 - 5.916 PR 4710470	Total
Uncoded - Errors	0	0	0	0	0	0		0	0	**0**
Dry	19	5	16	30	29	14		8	23	**144**
Wet	6	0	3	2	6	1		2	3	**23**
Icy	3	0	0	0	1	2		4	0	**10**
Snow/Blowing Snow	1	1	0	0	1	1		0	5	**9**
Muddy	0	0	0	0	0	0		0	0	**0**
Slushy	0	0	1	1	0	0		0	1	**3**
Covered With Debris	0	0	0	0	0	0		0	0	**0**
Other	0	0	0	0	0	1		0	0	**1**
Total	**29**	**6**	**20**	**33**	**37**	**19**	**-**	**14**	**32**	**190**



FINAL ROW PLAN REVISIONS (IF APPLICABLE)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

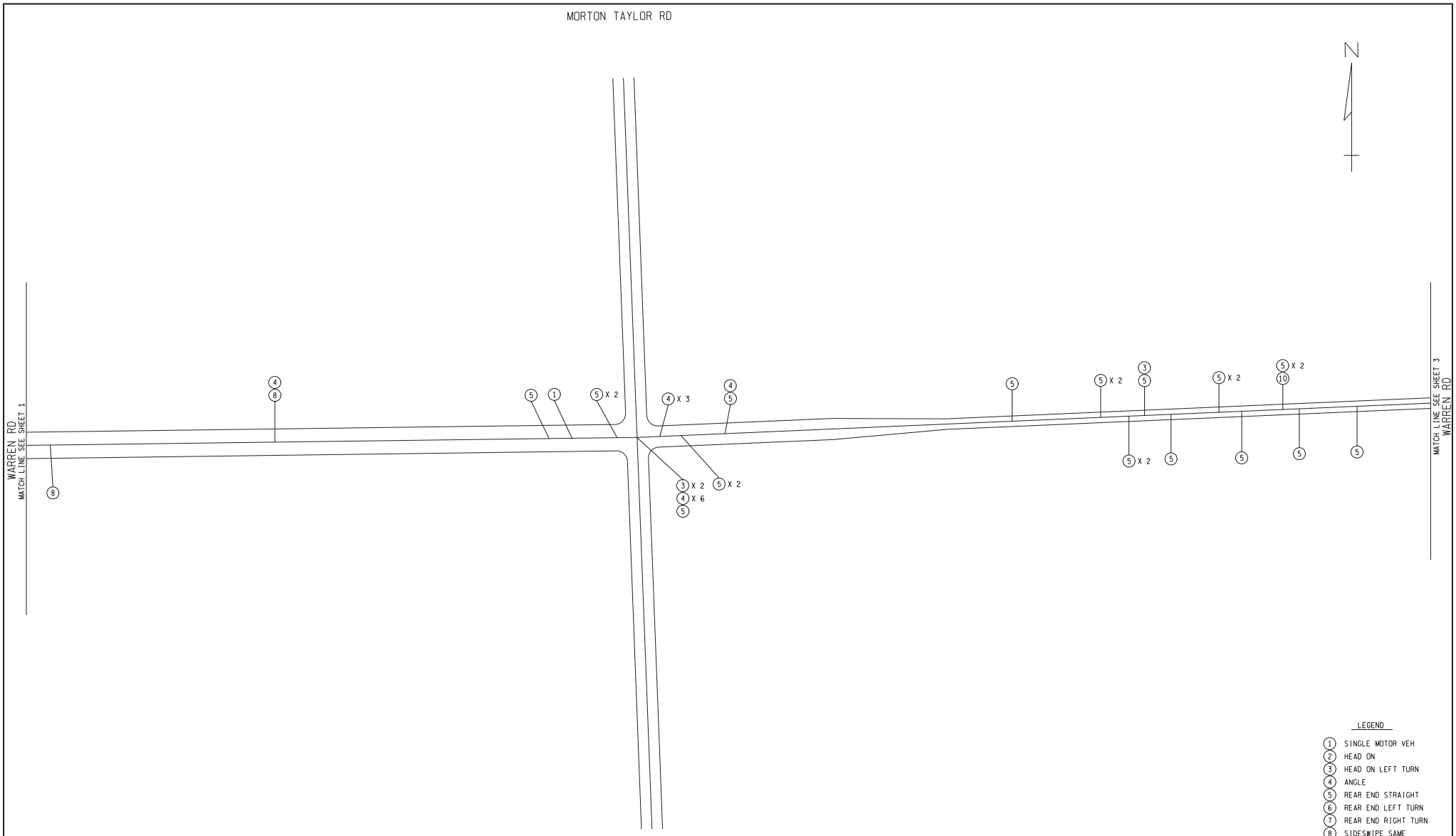
FILE: WARREN-1.dgn

DATE: 07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

WARREN ROAD
CRASH LOCATION MAP

DRAWING	SHEET
1	1



FINAL ROW PLAN REVISIONS (PRELIMINARY REVISIONS)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

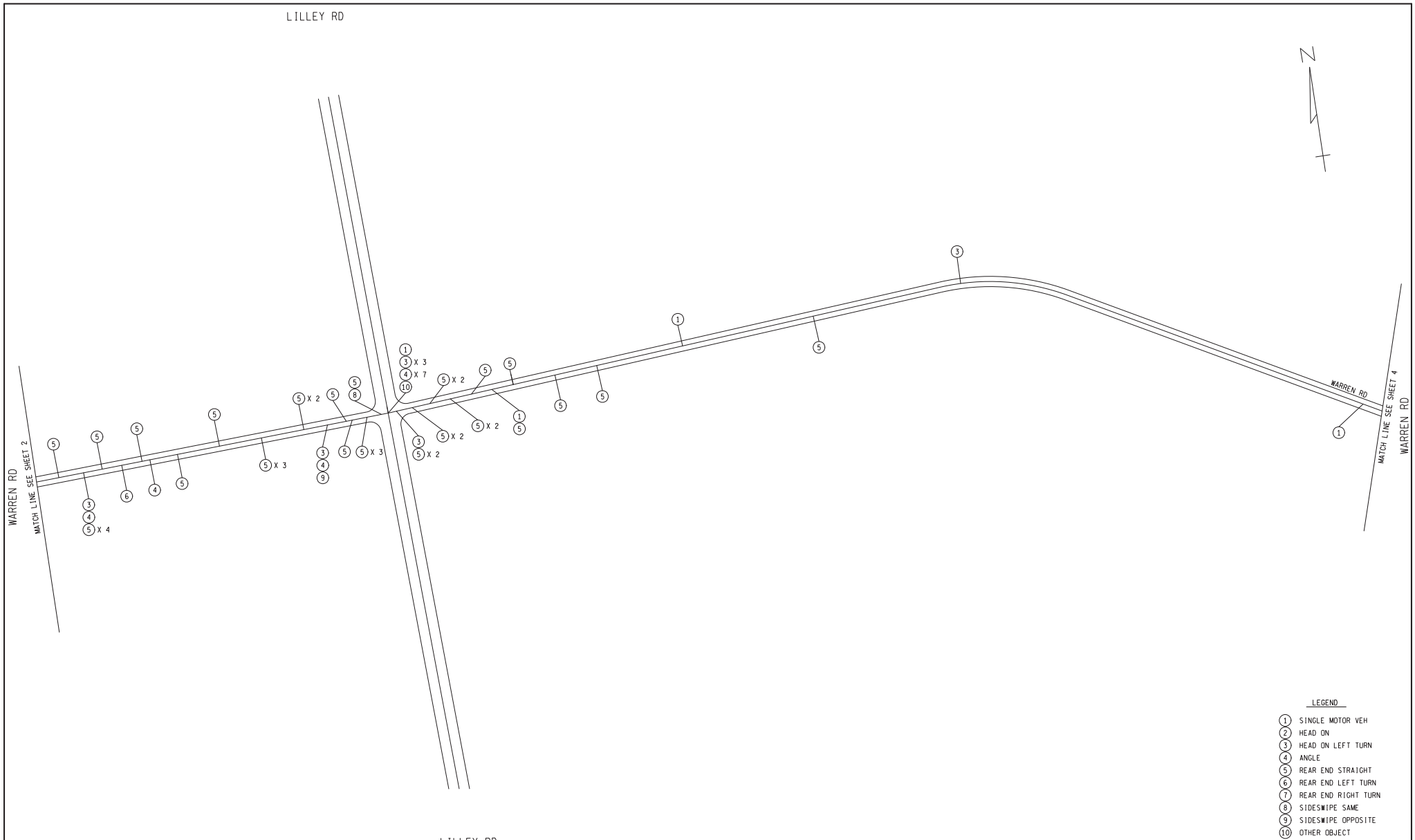
FILE: WARREN-2.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

WARREN ROAD
CRASH LOCATION MAP

DRAWING: 2
SHEET:



FINAL ROW PLAN REVISIONS (PLANS PACKAGE REVISIONS)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

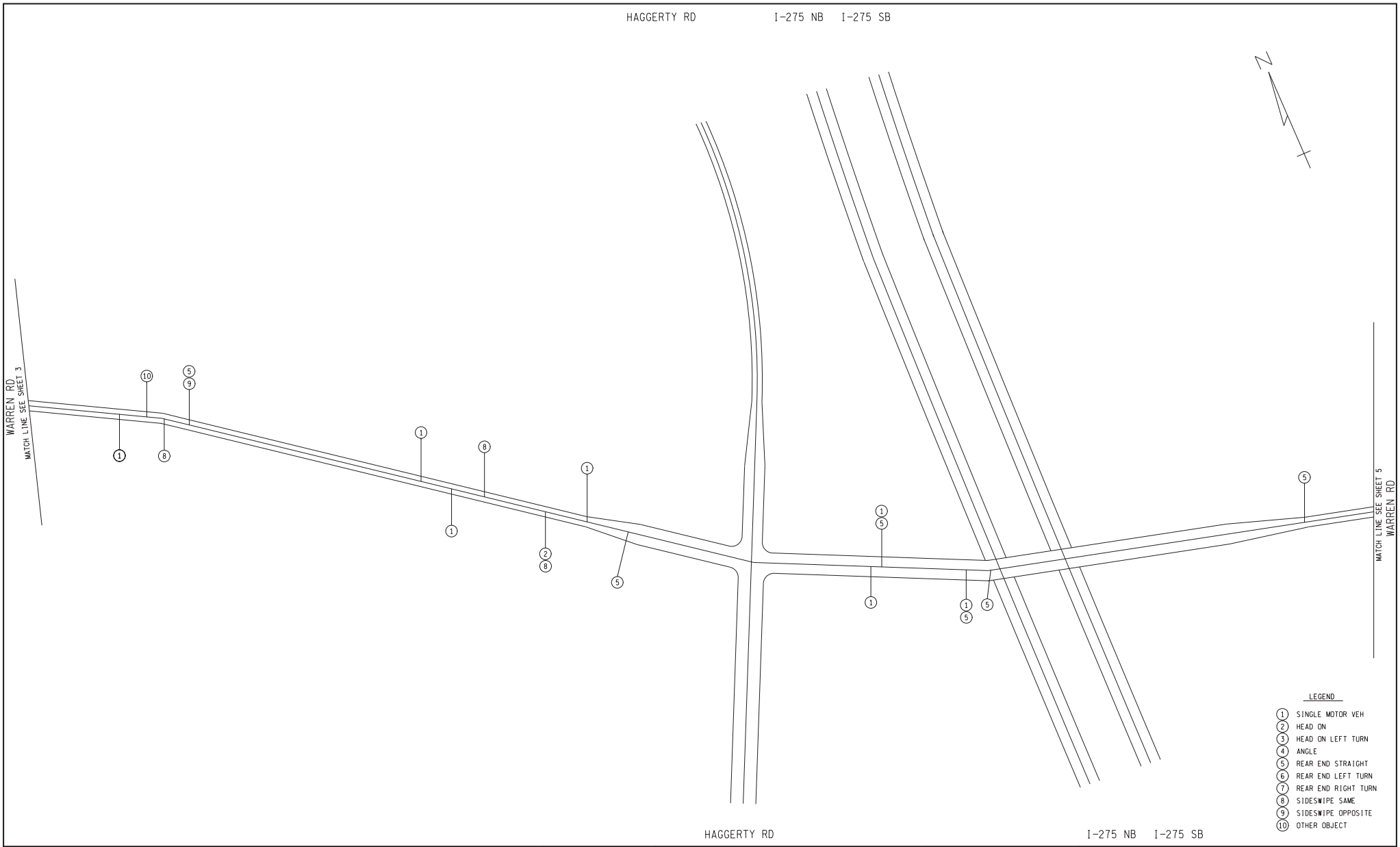
FILE: WARREN-3.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

WARREN ROAD
CRASH LOCATION MAP

DRAWING: 3
SHEET:



FINAL ROW PLAN REVISIONS (PRELIMINARY REVISIONS)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

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MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

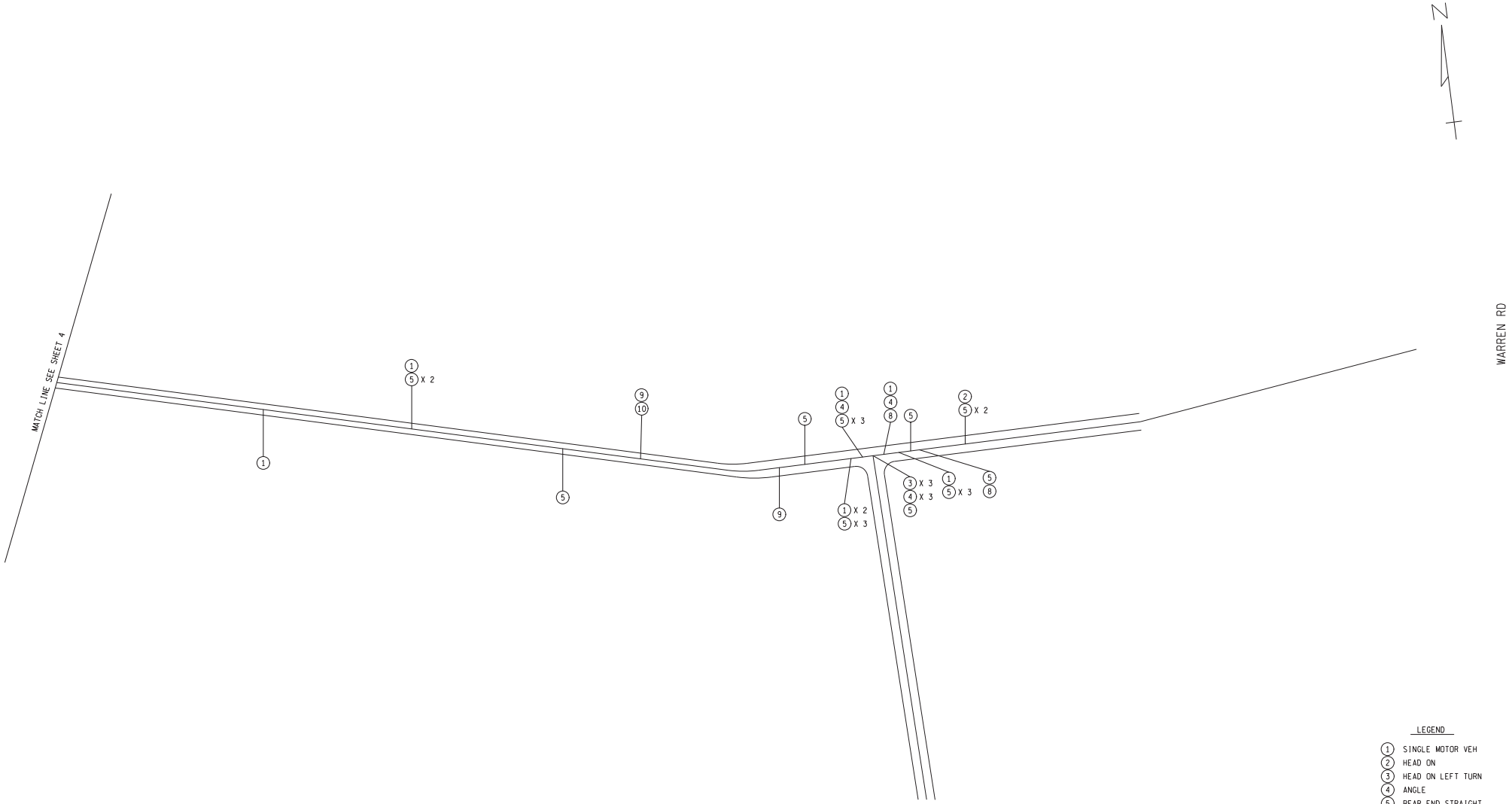
FILE: WARREN-4.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

WARREN ROAD
CRASH LOCATION MAP

DRAWING: 4
SHEET:



FINAL ROW PLAN REVISIONS (WEST/SOUTH REVISIONS)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

FILE: WARREN-5.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

WARREN ROAD
CRASH LOCATION MAP

DRAWING: 5
SHEET:

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
- -		-	-	-	-	-
Provide two-way left-turn lane	%REDUCTION		30%			
Number of Crashes		16	6	5	6	0
PDO+Minor Inj Crashes		16	6	5	6	0
A-Injured or Killed Persons		0	0	0	0	0
- -		-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
- -		-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
- -		-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
- -		-	-	-	-	-
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
- -		-	-	-	-	-

# of A-injuries:	0	For reference only
# of Fatalilties:	0	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$639,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	4.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0	Warren Rd Crash Analysis - Crash Pattern #1 Warren Rd from Morton Taylor to Lilley 4710470 4.026-4.430 Provide Two-way left-turn lane

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **Warren Rd Crash Analysis - Crash Pattern #1** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **4710470** PR MP Range: **4.026-4.430**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$81,675
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	0.0
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	9.9
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 4.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $20,419

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $26,138

C = Project Cost $639,000

TOR=C/B=COST/ANNUAL BENEFIT= **24.45**

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
-	-	-	-	-	-	-
Provide Left Turn Phase		%REDUCTION	36%			
Number of Crashes		39	39	24	16	0
PDO+Minor Inj Crashes		38	38	23	16	0
A-Injured or Killed Persons		1	1	1	0	0
-	-	-	-	-	-	-
Improve Signal Timing		%REDUCTION	8%			
Number of Crashes		39	39	24	16	0
PDO+Minor Inj Crashes		38	38	23	16	0
A-Injured or Killed Persons		1	1	1	0	0
-	-	-	-	-	-	-
0		%REDUCTION	0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0		%REDUCTION	0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-
0		%REDUCTION	0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
-	-	-	-	-	-	-

# of A-injuries:	3	For reference only
# of Fatalilties:	0	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$14,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	4.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

Warren Rd Crash Analysis - Crash Pattern #2
Warren Rd / Sheldon, Morton Taylor, Lilley, & Lotz Rd Intersections
4710470
Varies
Provide Left Turn Phase & Improve Signal Timing

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **Warren Rd Crash Analysis - Crash Pattern #2** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **4710470** PR MP Range: **Varies**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$695,798
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	1.3
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	50.6
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 4.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $173,950

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $222,670

C = Project Cost $14,000

TOR=C/B=COST/ANNUAL BENEFIT= **0.06**

Memorandum

Crash Analysis: Cherry Hill Rd from Sheldon Rd to Lotz Rd
CS 82081 - JN 115117
PR # 1607409 MP 3.444 – 3.520: Cherry Hill Rd/Sheldon Rd Intersection
PR # 1607409 MP 3.520 – 4.433: Cherry Hill Rd from Sheldon Rd to Lilley Rd
PR # 1607409 MP 4.433 – 4.527: Cherry Hill Rd/Lilley Rd Intersection
PR # 1607409 MP 4.527 – 4.929: Cherry Hill Rd from Lilley Rd to Haggerty Rd
PR # 1607409 MP 4.929 – 5.023: Cherry Hill Rd/Haggerty Rd Intersection*
PR # 1607409 MP 5.023 – 5.452: Cherry Hill Rd from Haggerty Rd to Lotz Rd
PR # 1607409 MP 5.452 – 5.528: Cherry Hill Rd/Lotz Rd Intersection
*Please See the *Haggerty Road from Cherry Hill Road to Warren Road Crash Analysis* for the Cherry Hill/Haggerty Road intersection crash details

1) Crash Analysis

A crash analysis on Cherry Hill Rd from Sheldon Rd to Lotz Rd was conducted for a four-year period between January 1st, 2007 and December 31st, 2010. The crash data utilized in this analysis was developed from Southeast Michigan Council of Governments (SEMCOG) crash data. Please note that for this analysis, the Cherry Hill Rd/Haggerty Rd intersection is not included as it is detailed in the *Haggerty Road from Cherry Hill Road to Warren Road Crash Analysis*.

Cherry Hill Rd is a two lane, undivided, east-west collector-distributor located one mile south and paralleling M-153. The land use surrounding this study area is primarily residential with access to subdivisions and apartment complexes. Current lane and shoulder widths include 12 foot driving lanes with varying 6 to 8 foot shoulders in non-curbed sections.

Overall trends for this segment of roadway are: approximately forty four percent (44%) of the overall crashes were rear end straight crashes; with the next most frequent crash type being angle crashes, consisting of approximately twenty four percent (24%) of the overall total. Of the intersections, the Cherry Hill Rd / Lilley Rd intersection had the highest percentage of total crashes accounting for approximately twenty six percent (26%) of the total crashes. The road segment with the highest percentage of total crashes was the roadway segment between Sheldon Rd and Lilley Rd, which accounted for approximately twenty six percent (26%) of the total crashes.

As part of this analysis, crash rates, frequencies, and casualty ratios have been calculated to examine each of the road segments and intersections within the limits of the analysis. Crash rates compare the number of crashes occurring in a road segment or intersection to the volume of traffic utilizing the roadway facility. The crash rates that have been calculated in this analysis include total crash rates, fatal crash rates, injury crash rates, and property damage only (PDO) crash rates. Road segment crash rates are expressed in terms of “crashes per 100 million vehicle miles traveled” and intersection rates in terms of “crashes per 1 million entering vehicles”. Crash frequencies compare the total number of crashes that occur during the evaluation period to time. Road segment crash frequencies are in terms of “crashes per year

per mile" and intersection frequencies in terms of "crashes per year". Casualty ratios compare the number of injury and fatal crashes to the total number of crashes in the evaluation period.

The calculated crash rates, frequencies, and casualty ratios have been compared to either statewide averages from the Michigan Office of Highway Safety Planning (MOHSP) or to regional averages for similar facilities published by the Southeast Michigan Council of Governments (SEMCOG). Detailed analysis of each of the above intersections and road segments are shown in the following sections. The distribution of crashes by type of collision and location are shown in the following table.

Table 1 Crash Analysis Summary

Crash Type	Location (See Key Below)							Total	Percentage
	1	2	3	4	5[1]	6	7		
Single Motor Veh	2	10	2	5	-	2	5	**26**	12.44%
Head On	0	2	1	0	-	0	0	**3**	1.44%
Head On Left Turn	2	2	7	0	-	0	0	**11**	5.26%
Angle	8	10	19	1	-	1	11	**50**	23.92%
Rear End Straight	12	16	19	15	-	22	9	**93**	44.50%
Rear End Left Turn	0	1	2	0	-	0	0	**3**	1.44%
Rear End Right Turn	0	0	1	0	-	0	0	**1**	0.48%
Side-Swipe Same	3	3	3	1	-	1	0	**11**	5.26%
Side-Swipe Opposite	0	4	1	1	-	0	0	**6**	2.87%
Other Object	1	1	0	0	-	2	1	**5**	2.39%
Total	**28**	**49**	**55**	**23**	**-**	**28**	**26**	**209**	**100.00%**

= Intersection

Location Key	
1. Intersection: Cherry Hill Rd/Sheldon Rd (PR 1607409: MP 3.444 – 3.520)	**5[1]. Intersection:** Cherry Hill Rd/Haggerty Rd (PR 1607409: MP 4.929 – 5.023)
2. Segment: Cherry Hill Rd from Sheldon Rd to Lilley Rd (PR 1607409: MP 3.520 – 4.433)	**6. Segment:** Cherry Hill Rd from Haggerty Rd to Lotz Rd (PR 1607409: MP 5.023 – 5.452)
3. Intersection: Cherry Hill Rd/Lilley Rd (PR 1607409: MP 4.433 – 4.527)	**7. Intersection:** Cherry Hill Rd/Lotz Rd (PR 1607409: MP 5.452 – 5.528)
4. Segment: Cherry Hill Rd from Lilley Rd to Haggerty Rd (PR 1607409: MP 4.527 – 4.929)	

1 See *Haggerty Road from Cherry Hill Road to Warren Road Crash Analysis* for intersection crash details

Table 2 Crash Rate Summary

	Location (See Key)						
	1	2	3	4	5	6	7
Calculated Crash Rate	0.66[1]	198.10[2]	**1.14[1]**	218.32[2]	**-**	255.41[2]	0.86[1]
Average Crash Rate	0.92[4]	288.90[3]	0.97[4]	288.90[3]	-	288.90[3]	0.92[4]

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 Average crash rates in number of crashes occurring per 100 million vehicle miles traveled from the Michigan Office of Highway Safety Planning (MOHSP)
4 Average crash rates in number of crashes occurring per 1 million entering vehicles for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 3 Casualty Ratio Summary

	Location (See Key)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Casualty Ratio	0.18	0.22	0.20	**0.26**	**-**	**0.32**	**0.46**
Average Casualty Ratio	0.22[1]	0.23[2]	0.22[1]	0.23[2]	-	0.23[2]	0.22[1]

1 Average casualty ratio values for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)
2 Average casualty ratio values for roadway segments with intersections and similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 4 Crash Frequency Summary

	Location (See Key)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Crash Frequency	7.00[1]	**13.42[2]**	**13.75[1]**	**14.30[2]**	**-**	**16.32[2]**	6.50[1]
Average Crash Frequency	8.34[3]	6.44[4]	12.27[3]	6.44[4]	-	6.44[4]	8.34[3]

1 Crash frequency calculated in crashes per year
2 Crash frequency calculated in crashes per year per mile of roadway
3 Average crash frequencies in crashes per year for signalized intersections with similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)
4 Average crash frequencies in crashes per year per mile for roadway segments with intersections and similar traffic volumes published by the Southeast Michigan Council of Governments (SEMCOG)

Table 5 Injury and Fatal Crash Rate Summary

	Location (See Key)						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Number of Injury Crashes	5	11	11	6	-	9	12
Calculated Injury Crash Rate	0.12[1]	44.47[2]	0.23[1]	**56.95[2]**	-	**82.10[2]**	0.40[1]
Average Injury Crash Rate	N/A[3]	52.9[5]	N/A[3]	52.9[5]	-	52.9[5]	N/A[3]
Number of Fatal Crashes	0	0	0	0	-	0	0
Calculated Fatal Crash Rate	0.00	0.00	0.00	0.00	-	0.00	0.00
Average Fatal Crash Rate	N/A[3]	0.90[4]	N/A[3]	0.90[4]	-	0.90[4]	N/A[3]

1 Injury crash rates calculated in crashes per 1 million entering vehicles
2 Injury crash rates calculated in crashes per 100 million vehicle miles traveled
3 No average rates in number of crashes per 1 million entering vehicles are available from the Michigan Office of Highway Safety Planning or the Southeast Michigan Council of Governments
4 Average fatal crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)
5 Average injury crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

Table 6 Property Damage Crash Rate Summary

	Location (See Key)						
	1	2	3	4	5	6	7
Number of Property Damage Only Crashes	23	38	44	17	-	19	14
Calculated PDO Crash Rate	0.55[1]	153.63[2]	0.91[1]	161.36[2]	-	173.31[2]	0.47[1]
Average PDO Crash Rate	N/A[3]	235.1[4]	N/A[3]	235.1[4]	-	235.1[4]	N/A[3]

1 Crash rates calculated in crashes per 1 million entering vehicles
2 Crash rates calculated in crashes per 100 million vehicle miles traveled
3 No average property damage only crash rates in number of crashes per 1 million entering vehicles are available from the Michigan Office of Highway Safety Planning (MOHSP) or the Southeast Michigan Council of Governments (SEMCOG)
4 Average property damage only crash rates in number of crashes per 100 million vehicle miles of travel from the Michigan Office of Highway Safety Planning (MOHSP)

1. Cherry Hill Rd / Sheldon Rd Intersection (PR 1607409: MP 3.444 – 3.520)

The Cherry Hill Rd / Sheldon Rd intersection experienced twenty eight (28) crashes within four (4) year analysis period. Twelve (12) (42.86%) crashes transpired as rear end straight crashes, while eight (8) (28.57%) angle crashes and three (3) (10.71%) side swipe same crashes also occurred. The remaining five (5) (17.86%) crashes consisted of single motor vehicle, head on left turn, and other object crashes.

Of the twenty eight (28) crashes that occurred, there were zero (0) fatal crashes and five (5) injury related crashes. No injury crashes were A-Level (incapacitating) injuries. The remaining twenty three (23) crashes were PDO (Property Damage Only) crashes.

The crash rate for this intersection is 0.66 crashes per 1 million entering vehicles, which is lower than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.92 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.12 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.18 which is lower than the SEMCOG average of 0.22. The crash frequency of 7.0 crashes per year is also lower than the regional average for signalized intersections with similar traffic volumes at 8.34 crashes per year.

2. Cherry Hill Rd from Sheldon Rd to Lilley Rd (PR 1607409: MP 3.520 – 4.433)

This 0.913 mile segment of roadway experienced forty nine (49) crashes within the four (4) year analysis period. Sixteen (16) (32.65%) crashes transpired as rear end straight crashes, while ten (10) (20.41%) single motor vehicle and ten (10) (20.41%) angle crashes also occurred. The remaining thirteen (13) (26.53%) crashes consisted of head on, head on left turn, rear end left turn, side swipe same, side swipe opposite, and other object crashes.

Of the forty nine (49) crashes that occurred, there were zero (0) fatal crashes and eleven (11) injury crashes. Of the eleven (11) injury crashes zero (0) were A-Level (incapacitating) injuries. The remaining thirty eight (38) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 198.10 crashes per 100 million vehicle miles traveled. This is lower that the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 44.47 and 0.00 crashes per 100 million vehicle miles traveled, respectively. Both rates are lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.22 and 13.42 crashes per year per mile, respectively. The casualty ratio is lower and the crash frequency is higher than regional averages of 0.23 and 6.44 crashes per year per mile, respectively.

3. Cherry Hill Rd / Lilley Rd Intersection (PR 1607409: MP 4.433 – 4.527)

The Cherry Hill Rd / Lilley Rd intersection experienced fifty five (55) crashes within the four (4) year analysis period. Nineteen (19) (34.55%) crashes transpired as rear end straight crashes, while nineteen (19) (34.55%) angle crashes and seven (7) (12.73%) head on left turn crashes also occurred. The remaining ten (10) (18.17%) crashes consisted of single motor vehicle, head on, rear end right turn, side swipe same, and side swipe opposite crashes.

Of the fifty five (55) crashes that occurred, there were zero (0) fatal crashes and eleven (11) injury related crashes. Of the eleven (11) injury crashes one (1) was an A-Level (incapacitating) injury. See Table 7 for details involving the A-Level crash. The remaining forty four (44) crashes were PDO (Property Damage Only) crashes.

Table 7 Cherry Hill Rd / Lilley Rd Intersection – A-Level Injury Crash Details

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 4.48 Lilley Rd Intersection	A	Angle	Dry	Clear	No	UD-10 information states that Vehicle 1 was traveling westbound on Cherry Hill Rd and entered the Cherry Hill Rd/Lilley Rd intersection on a yellow light. Vehicle 2 was in the eastbound left turn lane and the driver thought that Vehicle 1 was going to stop and proceeded to turn left and was struck by Vehicle 1. The drivers of both vehicles were issued citations for disregarding traffic control. The crash occurred in the daylight and the weather was clear.

The crash rate for this intersection is 1.14 crashes per 1 million entering vehicles. This is higher than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.97 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.23 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.20 which is lower than the SEMCOG average of 0.22. The crash frequency of 13.75 crashes per year is greater than the average for signalized intersections with similar traffic volumes at 12.27 crashes per year.

4. Cherry Hill Rd from Lilley Rd to Haggerty Rd (PR 1607409: MP 4.527 – 4.929)
This 0.402 mile segment of roadway experienced twenty three (23) crashes within the four (4) year analysis period. Fifteen (15) (65.22%) crashes transpired as rear end straight crashes, while five (5) (21.74%) single motor vehicle crashes also occurred. The remaining three (3) (13.04%) crashes consisted of angle, side swipe same and side swipe opposite crashes.

Of the twenty three (23) crashes that occurred, there were zero (0) fatal crashes and six (6) injury crashes. Of the six (6) injury crashes zero (0) were A-Level (incapacitating) injuries. The remaining seventeen (17) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 218.32 crashes per 100 million vehicle miles traveled, which is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 56.95 and 0.00 crashes per 100 million vehicle miles traveled, respectively. The injury rate is slightly higher and the fatal rate is lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.26 and 14.30 crashes per year per mile, respectively, which are both higher than the regional averages of 0.23 and 6.44 crashes per year per mile, respectively.

5. Cherry Hill Rd / Haggerty Rd Intersection (PR 1607409: MP 4.929 – 5.023)
Please refer to the *Haggerty Road from Cherry Hill Road to Warren Road Crash Analysis* for the details involving the crashes at this intersection.

6. Cherry Hill Rd from Haggerty Rd to Lotz Rd (PR 1607409: MP 5.023 – 5.452)
This 0.429 mile segment of roadway experienced twenty eight (28) crashes within the four (4) year analysis period. Twenty two (22) (78.57%) crashes transpired as rear end straight crashes, while two (2) (7.14%) other object and two (2) (7.14) single motor vehicle crashes also occurred. The remaining two (2) (7.15%) crashes consisted of angle, and side swipe same crashes.

Of the twenty eight (28) crashes that occurred, there were zero (0) fatal crashes and nine (9) injury crashes. Of the nine (9) injury crashes zero (0) were A-Level (incapacitating) injuries. The remaining nineteen (19) crashes were PDO (Property Damage Only) crashes.

The crash rate for the above segment of roadway is 255.41 crashes per 100 million vehicle miles traveled. This is lower than the Michigan Office of Highway Safety Planning (MOHSP) average crash rate of 288.9 crashes per 100 million vehicle miles traveled. The injury and fatal rates within the same corridor are 82.10 and 0.00 crashes per 100 million vehicle miles traveled,

respectively. The injury rate is higher and the fatal rate is lower than statewide averages of 52.9 injuries and 0.90 fatalities per 100 million vehicle miles traveled.

The casualty ratio and crash frequency for this segment of roadway are 0.32 and 16.32 crashes per year per mile, respectively, which are both higher than the regional averages of 0.23 and 6.44 crashes per year per mile, respectively.

7. Cherry Hill Rd / Lotz Rd Intersection (PR 1607409: MP 5.452 – 5.528)

The Cherry Hill Rd / Lotz Rd intersection experienced twenty six (26) crashes within the four (4) year analysis period. Eleven (11) (42.31%) crashes transpired as angle crashes, while nine (9) (34.62%) rear end straight crashes, five (5) (19.22%) single motor vehicle crashes, and one (1) (3.85%) other object crash also occurred.

Of the twenty six (26) crashes that occurred, there were zero (0) fatal crashes and twelve (12) injury related crashes. Of the twelve (12) injury crashes one (1) was an A-Level (incapacitating) injury. See Table 8 for details involving the A-Level injury crash. The remaining fourteen (14) crashes were PDO (Property Damage Only) crashes.

Table 8 Cherry Hill Rd / Lotz Rd Intersection – A-Level Injuries

Location	Severity	Crash Type	Road Surface Condition	Weather Condition	Alcohol a factor	Notes (UD-10 Information)
MP 5.488 Lotz Rd Intersection	A	Angle	Dry	Clear	No	UD-10 information states that Vehicle 2 was traveling northbound on Lotz Rd and entered the Cherry Hill Rd/Lotz Rd intersection with a green light. Vehicle 1 was traveling westbound on Cherry Hill Rd and ran the red light at the intersection, striking Vehicle 2. No drugs or alcohol were reported and the crash occurred during daylight with clear weather conditions. The driver of Vehicle 1 was issued a citation for running a red light.

The crash rate for this intersection is 0.86 crashes per 1 million entering vehicles. This is lower than the Southeast Michigan Council of Governments (SEMCOG) average crash rate of 0.92 crashes per 1 million entering vehicles for signalized intersections with similar traffic volumes. The injury and fatal rates for this intersection are 0.40 and 0.00 crashes per 1 million entering vehicles, respectively. No average injury or fatal crash rates were available for comparison.

The casualty ratio for this intersection is 0.46 which is higher than the SEMCOG average of 0.22. The crash frequency of 6.50 crashes per year is lower than the average for signalized intersections with similar traffic volumes at 8.34 crashes per year.

Crash Concentration / Pattern Identification and Potential Crash Mitigation Strategies

Crash Pattern #1: Crash concentrations were observed at each of the signalized intersections in this study area with the crash details for each outlined in Table 1. The crash types that made up the majority of the crashes at these intersections include rear end straight and angle crashes. Forty (40 or 43.01%) of the rear end straight and thirty eight (38 or 76.00%) of the angle crashes occurred at a signalized intersection. Of the three (3) signalized intersections, the Cherry Hill Rd / Lilley Rd intersection exceeded the SEMCOG average intersection crash rate for signalized intersections with similar traffic volumes and accounted for approximately twenty six (26.32%) of the total crashes noted in this analysis.

Of the fifty two (52) injury crashes, two were A-Level (incapacitating) injury crashes and both happened at a signalized intersection. A review of the UD-10 reports for these crashes shows that one (1) involved a left-turning vehicle turning in front of another vehicle on a yellow light at the Lilley Rd intersection, and one (1) involved a driver disobeying a stop light at the Lotz Rd intersection. Please note, left-turn phasing is currently present at the Lilley Rd intersection only.

Countermeasure Recommendation: Review of the existing clearance intervals should be provided for the signalized intersections of Cherry Hill Rd with Sheldon Rd, Lilley Rd, and Lotz Rd to ensure adequate time is provided for motorists to perceive the changing signal phases and react accordingly. Also, review of the need for protected left turn phasing at the signalized intersection of Cherry Hill Rd with Sheldon Rd should be provided.

Right-of-Way Impacts: None

Estimated Cost: $14,000

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 0.23. See the end of this section for the results of this analysis.

Crash Pattern #2: Although the crash rate for the Cherry Hill / Lotz Rd intersection is below the statewide average for similar facilities, it was noted that a high percentage of the crashes occurring at this intersection were a result of angle crashes. Of the twenty-six (26) total crashes that occurred at this intersection, eleven (11) (42.31%) were caused by angle crashes.

Countermeasure Recommendation: This intersection currently does not employ protected left-turn phasing. Review of the need for left-turn phasing should be provided.

Right-of-Way Impacts: None

Estimated Cost: $3,500

A Time of Return (TOR) analysis was conducted per the MDOT methodology given in the Bureau of Public Roads IM-21-3-67 as adapted using the Q formula to blend fatalities and A-injuries only. The results of this analysis show a cost-to-annual benefit ratio (C/B) of 0.07. See the end of this section for the results of this analysis.

Crash Pattern #3: As shown in Table 1, 55 of the 209 (26.32%) of the crashes that occurred within the Cherry Hill corridor, occurred at the Cherry Hill / Lilley Rd intersection. Of these 55 crashes, 19 angle and 19 rear end (34.55% each) occurred. As noted earlier, this crash analysis reviewed the four-year period between January 1st, 2007 and December 31st, 2010. In 2010, traffic signal modifications were implemented at this intersection, including left-turn phasing which may mitigate both of these crash types.

Countermeasure Recommendation: Further review of this intersection should be provided as crash data is available for conditions after the implementation of these revised signal timings/phasing.

Right-of-Way Impacts: None

Estimated Cost: None

Cherry Hill Rd Crash Analysis - Crash Tables

Time Period January 1st, 2007 to December 31st, 2010
Number of Years 4

Crash Type	1 Cherry Hill Rd/Sheldon Rd Intersection: MP 3.444 - 3.520 PR 1607409	2 Cherry Hill Rd: Sheldon Rd to Lilley Rd MP 3.520 - 4.433 PR 1607409	3 Cherry Hill Rd/Lilley Rd Intersection: MP 4.433 - 4.527 PR 1607409	4 Cherry Hill Rd: Lilley Rd to Haggerty Rd: MP 4.527 - 4.929 PR 1607409	5 Cherry Hill Rd/Haggerty Rd Intersection: MP 4.929 - 5.023 PR 1607409	6 Cherry Hill Rd: Haggerty Rd to Lotz Rd: MP 5.023 - 5.452 PR 1607409	7 Cherry Hill Rd/Lotz Rd Intersection: MP 5.452 - 5.528 PR 1607409	Total	Percentage
Single Motor Veh	2	10	2	5	See the Haggerty Road from Cherry Hill to Warren Road Crash Analysis	2	5	**26**	12.44%
Head On	0	2	1	0		0	0	**3**	1.44%
Head On Left Turn	2	2	7	0		0	0	**11**	5.26%
Angle	8	10	19	1		1	11	**50**	23.92%
Rear End Straight	12	16	19	15		22	9	**93**	44.50%
Rear End Left Turn	0	1	2	0		0	0	**3**	1.44%
Rear End Right Turn	0	0	1	0		0	0	**1**	0.48%
Side-Swipe Same	3	3	3	1		1	0	**11**	5.26%
Side-Swipe Opposite	0	4	1	1		0	0	**6**	2.87%
Other Object	1	1	0	0		2	1	**5**	2.39%
Total	**28**	**49**	**55**	**23**	**-**	**28**	**26**	**209**	**100.00%**

	Cherry Hill Rd/Sheldon Rd Intersection: MP 3.444 - 3.520 PR 1607409 (Crash rate calculated in crashes per 1 million entering vehicles)	Cherry Hill Rd: Sheldon Rd to Lilley Rd MP 3.520 - 4.433 PR 1607409 (Crash rate calculated in crashes per 100 million vehicle miles traveled)	Cherry Hill Rd/Lilley Rd Intersection: MP 4.433 - 4.527 PR 1607409 (Crash rate calculated in crashes per 1 million entering vehicles)	Cherry Hill Rd: Lilley Rd to Haggerty Rd: MP 4.527 - 4.929 PR 1607409 (Crash rate calculated in crashes per 100 million vehicle miles traveled)	Cherry Hill Rd/Haggerty Rd Intersection: MP 4.929 - 5.023 PR 1607409 (Crash rate calculated in crashes per 1 million entering vehicles)	Cherry Hill Rd: Haggerty Rd to Lotz Rd: MP 5.023 - 5.452 PR 1607409 (Crash rate calculated in crashes per 100 million vehicle miles traveled)	Cherry Hill Rd/Lotz Rd Intersection: MP 5.452 - 5.528 PR 1607409 (Crash rate calculated in crashes per 1 million entering vehicles)
AADT	28870	18556	33112	17950		17503	20590
Length of Roadway Segment	0.08	0.91	0.09	0.40		0.43	0.08
Calculated Crash Rate	0.66	198.10	**1.14**	218.32		255.41	0.86
Average Crash Rate*	0.92	288.9	0.97	288.9		288.9	0.92
Casualty Ratio	0.18	0.22	0.20	**0.26**		**0.32**	**0.46**
Average Casualty Ratio	0.22	0.23	0.22	0.23		0.23	0.22
Crash Frequency	7.00	**13.42**	**13.75**	**14.30**		**16.32**	6.50
Average Crash Frequency	8.34	6.44	12.27	6.44		6.44	8.34

Crash Severity	Cherry Hill Rd/Sheldon Rd Intersection: MP 3.444 - 3.520 PR 1607409	Cherry Hill Rd: Sheldon Rd to Lilley Rd MP 3.520 - 4.433 PR 1607409	Cherry Hill Rd/Lilley Rd Intersection: MP 4.433 - 4.527 PR 1607409	Cherry Hill Rd: Lilley Rd to Haggerty Rd: MP 4.527 - 4.929 PR 1607409	Cherry Hill Rd/Haggerty Rd Intersection: MP 4.929 - 5.023 PR 1607409	Cherry Hill Rd: Haggerty Rd to Lotz Rd: MP 5.023 - 5.452 PR 1607409	Cherry Hill Rd/Lotz Rd Intersection: MP 5.452 - 5.528 PR 1607409	Total
Injury	5	11	10	6		9	11	**52**
A Level Injury	0	0	1	0		0	1	**2**
Fatal	0	0	0	0		0	0	**0**
PDO	23	38	44	17		19	14	**155**
Total	**28**	**49**	**55**	**23**	**-**	**28**	**26**	**209**

	Cherry Hill Rd/Sheldon Rd Intersection: MP 3.444 - 3.520 PR 1607409 (Crash rate calculated in crashes per 1 million entering vehicles)	Cherry Hill Rd: Sheldon Rd to Lilley Rd MP 3.520 - 4.433 PR 1607409 (Crash rate calculated in crashes per 100 million vehicle miles traveled)	Cherry Hill Rd/Lilley Rd Intersection: MP 4.433 - 4.527 PR 1607409 (Crash rate calculated in crashes per 1 million entering vehicles)	Cherry Hill Rd: Lilley Rd to Haggerty Rd: MP 4.527 - 4.929 PR 1607409 (Crash rate calculated in crashes per 100 million vehicle miles traveled)	Cherry Hill Rd/Haggerty Rd Intersection: MP 4.929 - 5.023 PR 1607409 (Crash rate calculated in crashes per 1 million entering vehicles)	Cherry Hill Rd: Haggerty Rd to Lotz Rd: MP 5.023 - 5.452 PR 1607409 (Crash rate calculated in crashes per 100 million vehicle miles traveled)	Cherry Hill Rd/Lotz Rd Intersection: MP 5.452 - 5.528 PR 1607409 (Crash rate calculated in crashes per 1 million entering vehicles)
Injury Crash Rate	0.12	44.47	0.23	**56.95**		**82.10**	0.40
Average Injury Crash Rate	N/A	52.9	N/A	52.9		52.9	N/A
Property Damage Crash Rate	0.55	153.63	0.91	161.36		173.31	0.47
Average PDO Crash Rate	N/A	235.1	N/A	235.1		235.1	N/A
Fatal Crash Rate	0.00	0.00	0.00	0.00		0.00	0.00
Average Fatal Crash Rate	N/A	0.9	N/A	0.9		0.9	N/A

Cherry Hill Rd Crash Analysis - Crash Tables

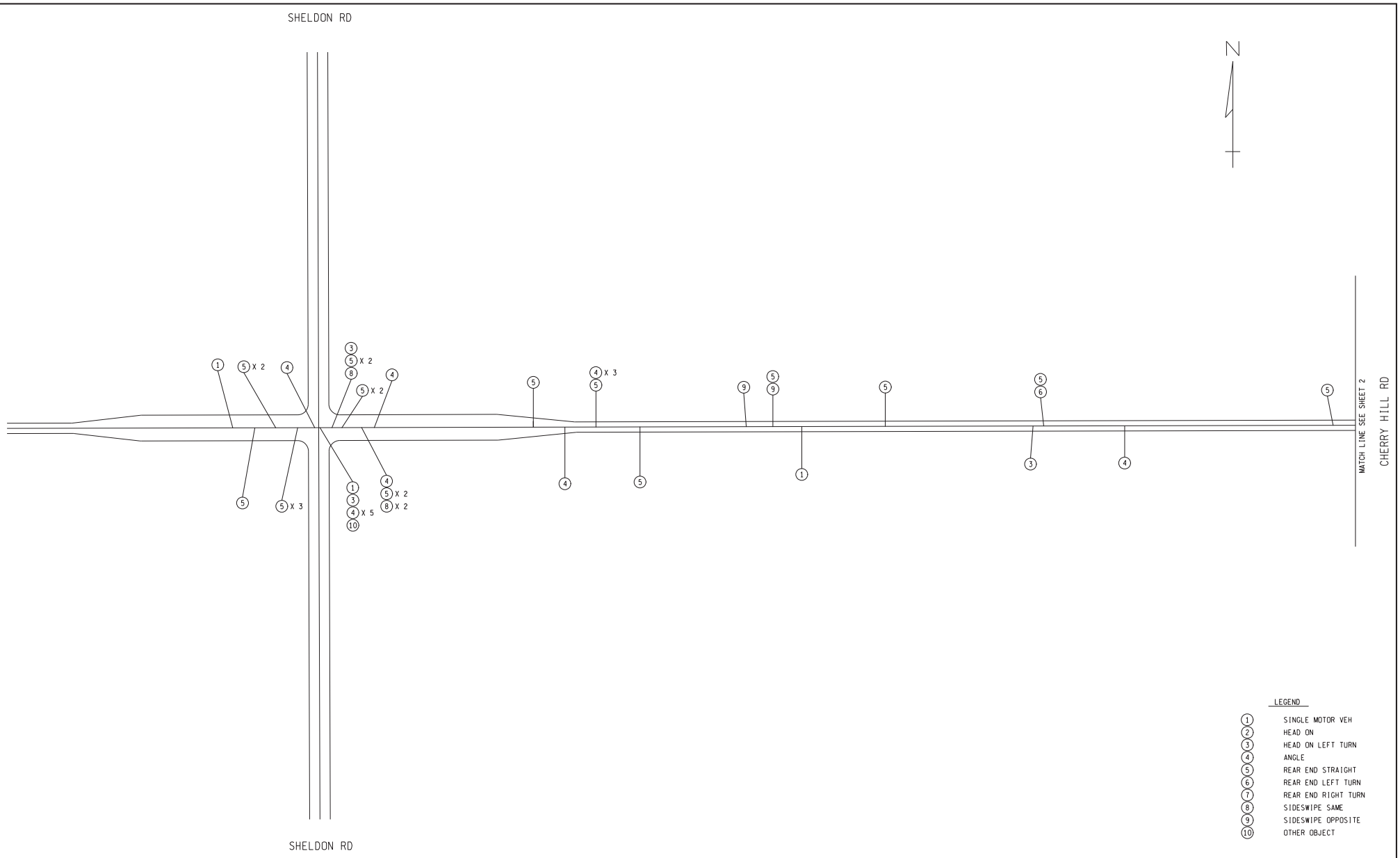
Time Period January 1st, 2007 to December 31st, 2010
Number of Years 4

Light Condition	Cherry Hill Rd/Sheldon Rd Intersection: MP 3.444 - 3.520 PR 1607409	Cherry Hill Rd: Sheldon Rd to Lilley Rd MP 3.520 - 4.433 PR 1607409	Cherry Hill Rd/Lilley Rd Intersection: MP 4.433 - 4.527 PR 1607409	Cherry Hill Rd: Lilley Rd to Haggerty Rd: MP 4.527 - 4.929 PR 1607409	Cherry Hill Rd/Haggerty Rd Intersection: MP 4.929 - 5.023 PR 1607409	Cherry Hill Rd: Haggerty Rd to Lotz Rd: MP 5.023 - 5.452 PR 1607409	Cherry Hill Rd/Lotz Rd Intersection: MP 5.452 - 5.528 PR 1607409	Total
Dark (Defined as 8 PM to 6 AM)	3	7	7	2		4	9	**32**
Dawn (Defined as 6 AM to 8 AM)	2	3	4	2		1	3	**15**
Daylight (Defined As 8 AM to 6 PM)	18	28	36	14		20	13	**129**
Dusk (Defined as 6 PM to 8 PM)	5	11	8	5		3	1	**33**
Unknown	0	0	0	0		0	0	**0**
Total	**28**	**49**	**55**	**23**	**-**	**28**	**26**	**209**

Weather Conditions	Cherry Hill Rd/Sheldon Rd Intersection: MP 3.444 - 3.520 PR 1607409	Cherry Hill Rd: Sheldon Rd to Lilley Rd MP 3.520 - 4.433 PR 1607409	Cherry Hill Rd/Lilley Rd Intersection: MP 4.433 - 4.527 PR 1607409	Cherry Hill Rd: Lilley Rd to Haggerty Rd: MP 4.527 - 4.929 PR 1607409	Cherry Hill Rd/Haggerty Rd Intersection: MP 4.929 - 5.023 PR 1607409	Cherry Hill Rd: Haggerty Rd to Lotz Rd: MP 5.023 - 5.452 PR 1607409	Cherry Hill Rd/Lotz Rd Intersection: MP 5.452 - 5.528 PR 1607409	Total
Uncoded - Errors	0	0	0	0		0	0	**0**
Clear	13	29	39	11		16	16	**124**
Cloudy	12	13	7	3		8	7	**50**
Fog	0	0	0	0		0	0	**0**
Rain	1	5	5	8		3	1	**23**
Snow/Blowing Snow	2	1	3	0		1	2	**9**
Severe Wind	0	0	1	0		0	0	**1**
Sleet or Hail	0	1	0	0		0	0	**1**
Other	0	0	0	1		0	0	**1**
Total	**28**	**49**	**55**	**23**	**-**	**28**	**26**	**209**

Pavement Conditions	Cherry Hill Rd/Sheldon Rd Intersection: MP 3.444 - 3.520 PR 1607409	Cherry Hill Rd: Sheldon Rd to Lilley Rd MP 3.520 - 4.433 PR 1607409	Cherry Hill Rd/Lilley Rd Intersection: MP 4.433 - 4.527 PR 1607409	Cherry Hill Rd: Lilley Rd to Haggerty Rd: MP 4.527 - 4.929 PR 1607409	Cherry Hill Rd/Haggerty Rd Intersection: MP 4.929 - 5.023 PR 1607409	Cherry Hill Rd: Haggerty Rd to Lotz Rd: MP 5.023 - 5.452 PR 1607409	Cherry Hill Rd/Lotz Rd Intersection: MP 5.452 - 5.528 PR 1607409	Total
Uncoded - Errors	1	1	0	0		0	0	**2**
Dry	19	38	38	13		20	20	**148**
Wet	2	6	9	7		5	2	**31**
Icy	5	3	4	2		2	4	**20**
Snow/Blowing Snow	1	0	4	0		1	0	**6**
Muddy	0	0	0	0		0	0	**0**
Slushy	0	1	0	0		0	0	**1**
Covered With Debris	0	0	0	0		0	0	**0**
Other	0	0	0	1		0	0	**1**
Total	**28**	**49**	**55**	**23**	**-**	**28**	**26**	**209**

* Average crash rates for segments in number of crashes occuring per 100 million vehicle miles traveled from the Michigan Office of Highway Safety Planning (MOHSP) - Average Crash Rates for intersections in number of crashes occurring per 1 million entering vehicles for signalized intersections with similar traffic volumes from the Southeast Michigan Council of Governments (SEMCOG)



NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

FINAL ROW PLAN REVISIONS (IF APPLICABLE)

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

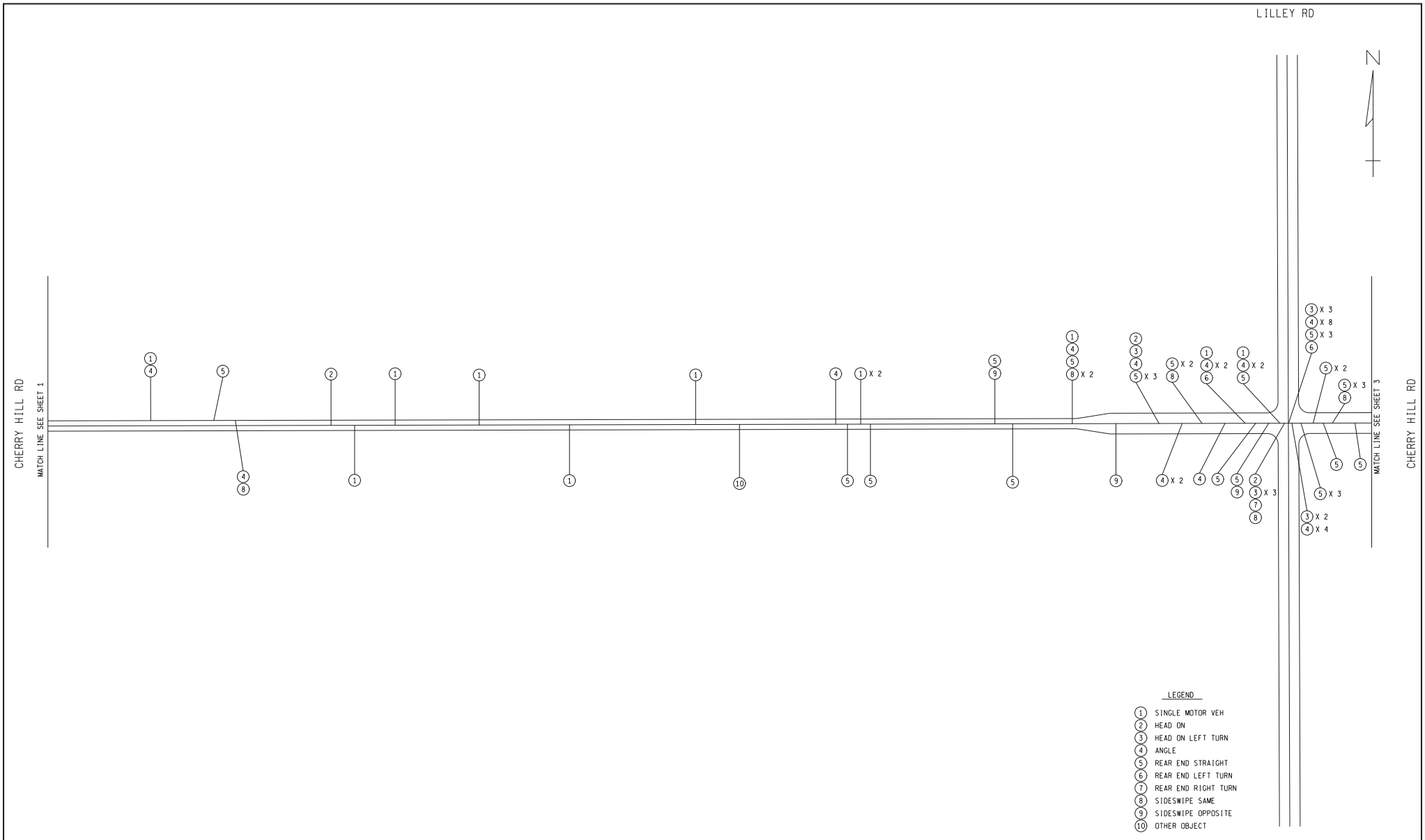
FILE: CHERRY HILL-1.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

CHERRY HILL ROAD
CRASH MAP LOCATION

DRAWING: 1
SHEET:



FINAL ROW PLAN REVISIONS (PLANS PACKAGE REVISIONS)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

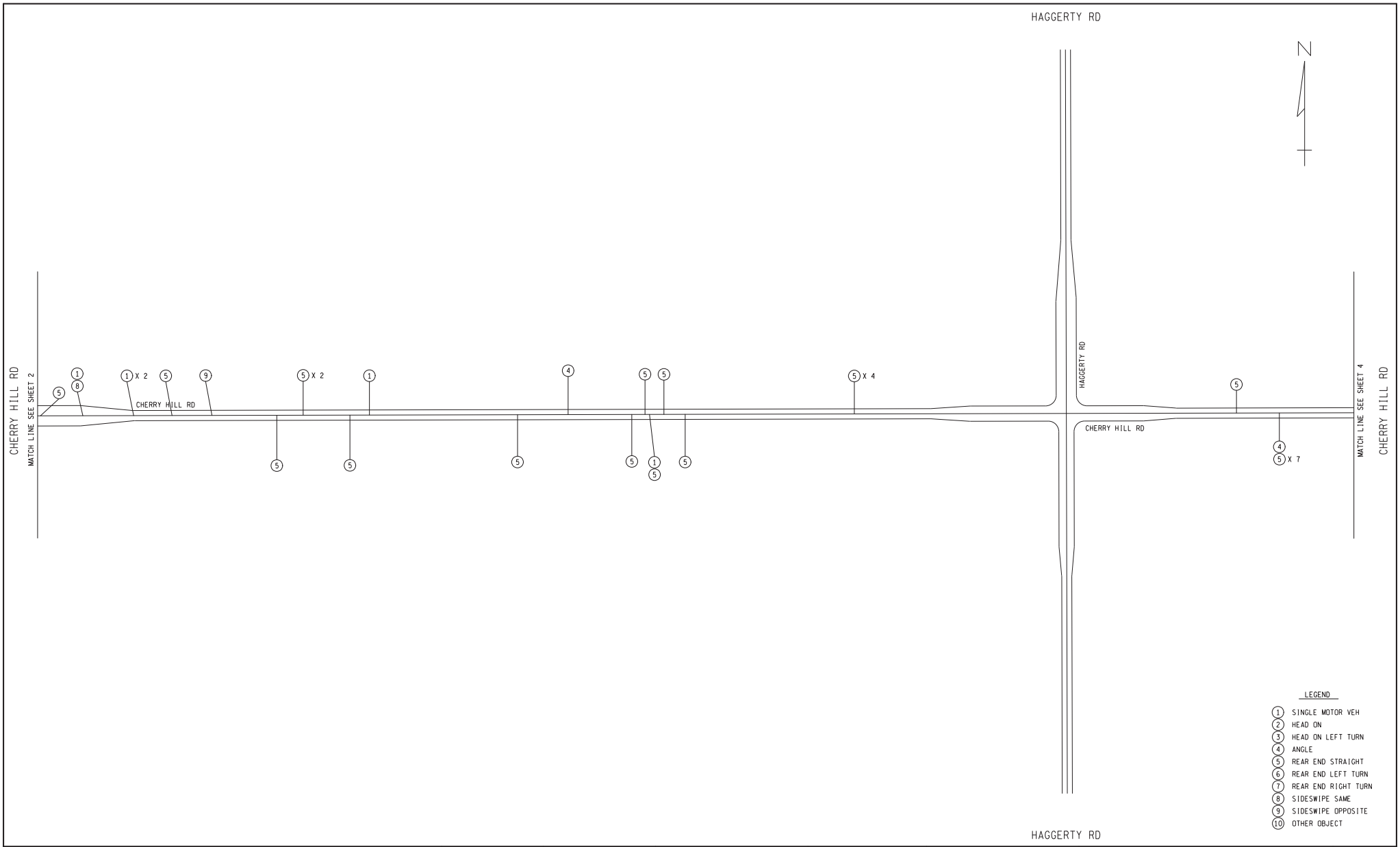
FILE: CHERRY HILL-2.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

CHERRY HILL ROAD
CRASH MAP LOCATION

DRAWING: 2
SHEET:



NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

FINAL ROW PLAN REVISIONS (IF APPLICABLE)

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 12
0 HORZ. (FT) 12

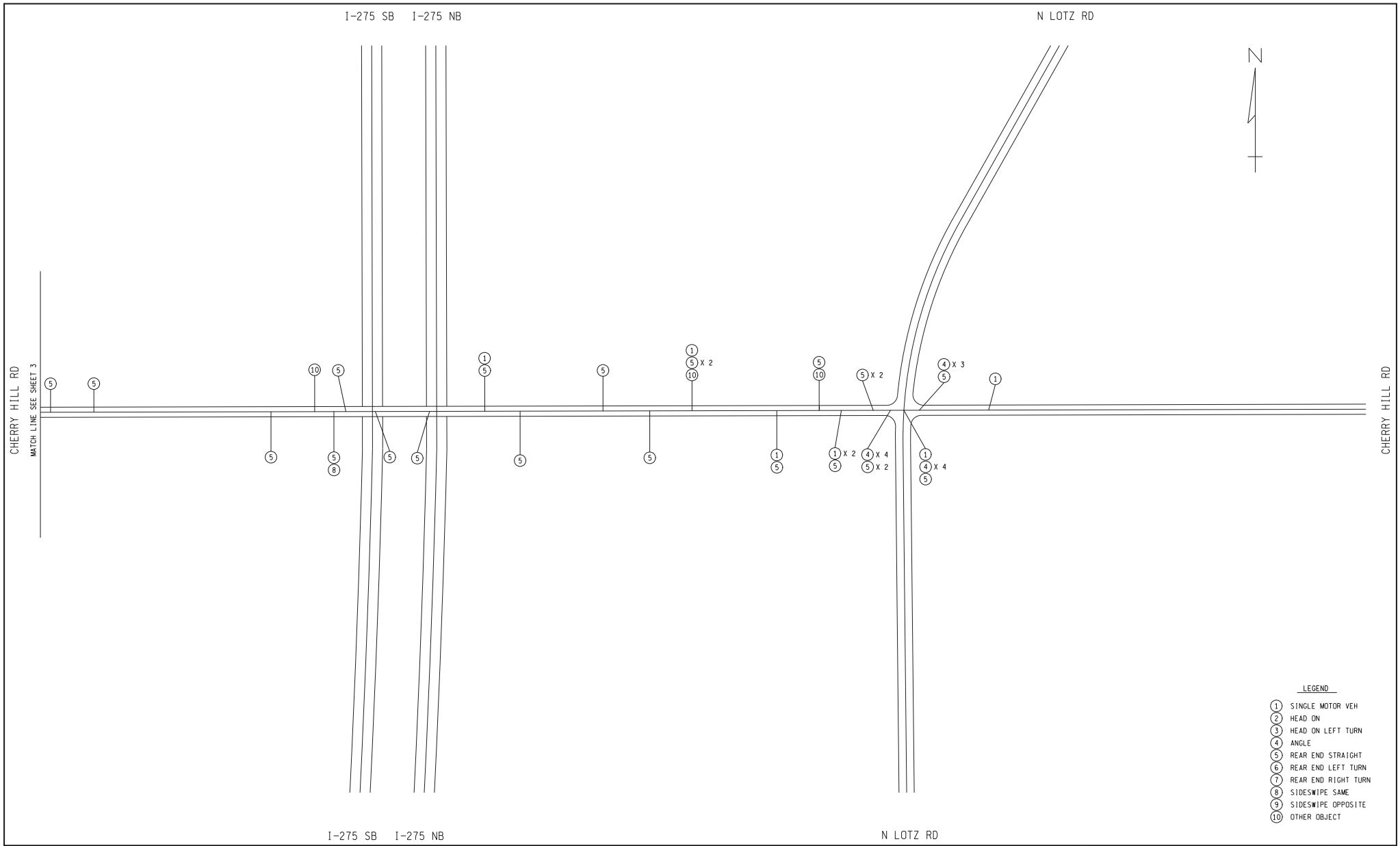
FILE: CHERRY HILL-3.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

CHERRY HILL ROAD
CRASH MAP LOCATION

DRAWING: 3
SHEET:



FINAL ROW PLAN REVISIONS (PRELIMINARY REVISIONS)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

Bergmann associates
architects // engineers // planners

MDOT Michigan Department of Transportation

0 VERT. (FT) 200
0 HORZ. (FT) 200

FILE: CHERRY HILL-4.dgn

DATE:07/16/12
DESIGN UNIT: YUNG
TSC: TAYLOR

CS:
JN: 115177 & 115379

CHERRY HILL ROAD
CRASH MAP LOCATION

DRAWING: 4
SHEET:

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
Improve Signal Timing	%REDUCTION		8%			
Number of Crashes		18	32	31	28	0
PDO+Minor Inj Crashes		17	32	30	28	0
A-Injured or Killed Persons		1	0	1	0	0
Provide protected left turn phase	%REDUCTION		36%			
Number of Crashes		5	9	4	10	0
PDO+Minor Inj Crashes		5	9	4	10	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION		0%			
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0

# of A-injuries:	2	For reference only
# of Fatalilties:	0	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$14,000	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	4.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

Cherry Hill Crash Analysis - Crash Pattern #1
Cherry Hill with Sheldon, Lilley, & Lotz Rd
1607409
Varies
Improve Signal Timing (All) & Left turn phase (Cherry Hill/Sheldon)

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **Cherry Hill Crash Analysis - Crash Pattern #1** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **1607409** PR MP Range: **Varies**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$187,519
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	0.2
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	18.6
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21]	$191,700
	for AREA TYPE ERR	
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 4.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $46,880

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $60,010

C = Project Cost $14,000

TOR=C/B=COST/ANNUAL BENEFIT= **0.23**

NUMBER OF CRASHES OR INJURED PERSONS.

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		2007	2008	2009	2010	2011
Provide protected left turn phase	%REDUCTION	36%				
Number of Crashes		5	6	11	4	0
PDO+Minor Inj Crashes		4	6	11	4	0
A-Injured or Killed Persons		1	0	0	0	0
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0
0	%REDUCTION	0%				
Number of Crashes		0	0	0	0	0
PDO+Minor Inj Crashes		0	0	0	0	0
A-Injured or Killed Persons		0	0	0	0	0

# of A-injuries:	1	For reference only
# of Fatalilties:	0	For reference only; "Q" accounts for the risk of a fatality.
PROJECT COST ESTIMATE :	$3,500	If unknown, enter "0" (zero).
ADTb (before-volume)	1.0	You may change these
ADTa (after-volume)	1.0	default ADT values.
# OF YEARS OF DATA:	4.00	3 to 5 years should be used.
RATE OF INFLATION:	2.50%	
AREA TYPE:	2	(**1** = RURAL, **2** = URBAN, **3** = BETWEEN)

REMARKS:

0

Cherry Hill Crash Analysis - Crash Pattern #2
Cherry Hill / Lotz Rd Intersection
1607409
5.452-5.528
Add Left Turn Phase

COMPUTED BENEFITS DERIVED THROUGH CRASH REDUCTION

TOR '11 Date **11-Jul-12**

Project: **Cherry Hill Crash Analysis - Crash Pattern #2** City/Twp. **Canton**

Prepared By: **Bergmann Associates** County **Wayne**

PR: **1607409** PR MP Range: **5.452-5.528**

CS: **-** CS MP Range: **-**

The method of evaluating crash costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition. This same method is given in the Bureau of Public Roads IM21-3-67. In 1994 we have adapted the Q formula to blend Fatalities and A-injuries only.
In the following analysis the costs provided by the National Safety Council are : **2008 NSC VALUES:**

Death	$1,300,000	=FATCOST
Disabling (A) injury:	$63,500	=INJCOST
PDO and/or Minor Injury Crash:	$8,300	=PDOCOST

BTOTAL = ADTa/ADTbx(QxR1+(PDOCOSTxR2))

WHERE:

BTOTAL=	Total Benefit in Dollars Over Years Used	$150,163
ADTa =	Average traffic volume after the improvement	1.1
ADTb =	Average traffic volume before the improvement	1.0
R1 =	Reduction in fatalities and A-Injuries Combined.	0.4
R2 =	Reduction in Minor (no A-Injuries or Fatalities) crashes:	9.0
Q =	[FATCOST+((I/F)XINJCOST)]/[1+(I/F)]	
=	[1,130,000+(7.21 x 61,600)] / [1+7.21] for AREA TYPE ERR	$191,700
I/F =		7.21

Q-Reference	Q	A-Inuries	Fatalities	I/F
RURAL	$212,800	5685	937	6.07
URBAN	$191,700	8934	1239	7.21
BETWEEN	$200,000	14619	2176	6.72

Data from Safety Programs Unit; E. Line.
5-Year Statewide Trunkline Crash Figures Used.
(From 1-1-05 Through 12-31-09). See DATA 2009.

Time of Return (T.O.R.) is based on .... 4.0 years of data.

NOINFB =No-Inflation Annual Benefit=BTOTAL/years $37,541

With an inflation rate of 2.50%

B=Annual Benefit=Present Value (with Inflation) $48,055

C = Project Cost $3,500

TOR=C/B=COST/ANNUAL BENEFIT= **0.07**

Memorandum

Bergmann associates
architects // engineers // planners

To: CDM Smith

From: Bergmann Associates

Date: June 7, 2013

Re: Highway Safety Manual

Overview of the Highway Safety Manual

The Highway Safety Manual (HSM) is a safety review tool developed and published by the American Association of State Highway and Transportation Officials (AASHTO). It was created by the culmination of many safety professionals, task forces and groups to gather and publish research regarding safety analysis as well as to develop a comprehensive method to assist agencies in their efforts to integrate safety into their decision making process. This final effort was published by AASHTO in 2010.

The HSM is designed to take the guesswork out of safety analyses by providing tools to conduct a quantitative analysis of a roadway or intersection as a function of its cross-sectional features. To do this, it focuses on objective safety (a quantitative measure) independent of the observer, rather than on subjective safety (the perception of how safe a person feels about a transportation system). The center of this objective analysis is to estimate an expected average crash frequency (the expected crashes per year) for a given site. To do this, the HSM utilizes the predictive method which combines statistical safety performance functions with the observed crash frequency at a given site to estimate a long term average for the crash frequency.

Use of the Highway Safety Manual in the Road Safety Audit

To investigate and compare each of the crash mitigations that were suggested during the road safety audit, a benefit-to-cost ratio was calculated for each. The Highway Safety Manual was utilized during this process to estimate the existing average expected crash frequency at each of the locations of interest. Once the average expected crash frequency was calculated for each of the existing sites, the applicable crash modification factor was applied to determine the anticipated change in the crash frequency as a result of the suggested mitigations. A cost was then estimated for each of the mitigations and compared to the net benefit resulting from the change in crashes. The resulting benefit-to-cost ratio that was developed for each of suggested mitigations was then used for comparison purposes as a way to objectively evaluate the suggestions.

Use of the Highway Safety Manual for the Final Suggested Alternatives

Two alternatives for safety improvements throughout the M-153 corridor, Alternatives 2 and 3, were ultimately chosen for further investigation as a result of the feasibility review process. Alternative 2 included adding additional lanes on M-153, the addition of dual left turn lanes at key intersections and other operational improvements. Alternative 3 included converting M-153 from an undivided five-lane roadway to a divided boulevard with crossovers for left-turning movements.

The Highway Safety Manual was used in a similar manner as was previously discussed for the initial comparisons of the suggested mitigations for the RSA; to estimate an expected average crash frequency (the base conditions) for the entire corridor. It is important to note that when using the Highway Safety Manual to analyze a roadway corridor with intersections dividing similar roadway sections, the corridor is split into multiple roadway segments between each of the existing

intersections. Each of the individual roadway segments and intersections are then analyzed separately then compiled to create an aggregate estimate of the expected crash frequency throughout the length of the corridor.

To determine the expected change in the average crash frequency as a result of the two alternatives, crash modification factors were selected that represented the modifications that were applicable to each of the roadway segments and intersections throughout the corridor for each alternative. For alternative 2, it was found that the intersection improvements, including the addition of left and right turn lanes, will decrease the crash frequency at the intersections. However, it was found that adding through travel lanes to the M-153 roadway segments *increases* the crash frequency because, while the additional lanes will increase capacity, it creates a situation where mid-block left turning vehicles have to cross more lanes. When the entire corridor was analyzed it was found that the aggregate change in crash frequency for alternative 2 was an approximate reduction in the average crash frequency of four percent (4%).

Alternative 3 proposed to convert the M-153 corridor to a divided (boulevard) roadway section. This includes removing the left turning movements from the intersections and replacing them with indirect crossovers. It was found that this improvement has an anticipated reduction in crash frequency for intersections. Similarly, the addition of a separated median has an anticipated reduction in crash frequency for roadway segments as opposite bound traffic is separated by a physical barrier and mid-block left turning movements are restricted to median crossovers. This lowers the number of conflict points from vehicles turning to/from the driveways along M-153. When the entire corridor was analyzed and the applicable crash reduction factors were applied, the total anticipated reduction in the crash frequency for the corridor was found to be thirty five percent (35%).

M-153 Corridor - Alternative 2

HSM Summary

Worksheet 3A -- Predicted Crashes by Severity and Site Type and Observed Crashes Using the Site-Specific EB Method for Urban and Suburban Arterials

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
Collision type / Site type	**Predicted average crash frequency (crashes/year)**			**Observed crashes, $N_{observed}$** (crashes/ year)	**Overdispersion Parameter, k**	**Weighted adjustment, w**	**Expected average crash frequency, $N_{expected}$**	**Expected Change in Crash Frequency (Crash Modification Factor)**	**Expected average crash frequency with mitigations in place (crashes/ year)**
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix		
ROADWAY SEGMENTS									
Multiple-vehicle nondriveway									
Sheldon to Morton Taylor	5.287	1.390	3.897	12.2	0.810	0.189	10.891	1.030	11.218
Morton Taylor to Lilley Rd	4.551	1.197	3.354	8	0.810	0.213	7.264	1.030	7.482
Lilley to Haggerty	4.870	1.281	3.589	35.4	0.810	0.202	29.225	1.030	30.102
N I-275 Ramp to Lotz	2.778	0.730	2.048	3.8	0.810	0.308	3.486	1.000	3.486
Single-vehicle									
Sheldon to Morton Taylor	0.870	0.178	0.692	1	0.520	0.689	0.910	1.030	0.937
Morton Taylor to Lilley Rd	0.748	0.153	0.595	1	0.520	0.720	0.819	1.030	0.844
Lilley to Haggerty	0.801	0.164	0.637	0	0.520	0.706	0.565	1.030	0.582
N I-275 Ramp to Lotz	0.451	0.092	0.359	0	0.520	0.810	0.365	1.000	0.365
						1.000	0.000		
Multiple-vehicle driveway-related									
Sheldon to Morton Taylor	7.588	2.041	5.547	2	0.100	0.569	5.177	1.030	5.332
Morton Taylor to Lilley Rd	3.217	0.865	2.352	1.2	0.100	0.757	2.726	1.030	2.808
Lilley to Haggerty	6.097	1.640	4.457	5	0.100	0.621	5.682	1.030	5.852
N I-275 Ramp to Lotz	0.633	0.170	0.463	1	0.100	0.940	0.655	1.000	0.655
						1.000	0.000		
INTERSECTIONS									
Multiple-vehicle									
Sheldon Rd	9.224	3.206	6.019	31	0.390	0.218	26.107	1.000	26.107
Morton Taylor Rd	9.313	3.257	6.056	19	0.390	0.216	16.752	1.000	16.752
Lilley Rd	9.379	3.249	6.129	68	0.390	0.215	55.414	0.920	**50.981**
Haggerty Rd	11.782	4.122	7.660	108	0.390	0.179	90.967	0.920	**83.689**
E M-153 / S I-275	15.315	4.457	10.857	33	0.330	0.165	30.246	1.000	30.246
N I-275 / M-153	12.017	3.687	8.330	24	0.330	0.201	21.427	1.000	21.427
Single-vehicle									
Sheldon Rd	0.491	0.113	0.378	0	0.360	0.850	0.418	1.000	0.418
Morton Taylor Rd	0.487	0.111	0.376	0	0.360	0.851	0.414	1.000	0.414
Lilley Rd	0.504	0.117	0.387	1	0.360	0.846	0.580	0.920	0.534
Haggerty Rd	0.609	0.138	0.471	0	0.360	0.820	0.499	0.920	0.459
E M-153 / S I-275	0.809	0.241	0.568	1	0.360	0.774	0.852	1.000	0.852
N I-275 / M-153	0.639	0.182	0.458	0	0.360	0.813	0.520	1.000	0.520
COMBINED (sum of column)	108.461	32.782	75.679	355.400	0.910	1.950	314.822	-	**302.063**

M-153 Corridor - Alternative 3

HSM Summary

Worksheet 3A -- Predicted Crashes by Severity and Site Type and Observed Crashes Using the Site-Specific EB Method for Urban and Suburban Arterials									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
Collision type / Site type	**Predicted average crash frequency (crashes/year)**			**Observed crashes, $N_{observed}$** (crashes/ year)	**Overdispersion Parameter, k**	**Weighted adjustment, w**	**Expected average crash frequency, $N_{expected}$**	**Expected Change in Crash Frequency (Crash Modification Factor)**	**Expected average crash frequency with mitigations in place (crashes/ year)**
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix		
ROADWAY SEGMENTS									
Multiple-vehicle nondriveway									
Sheldon to Morton Taylor	5.287	1.390	3.897	12.2	0.810	0.189	10.891	0.775	8.441
Morton Taylor to Lilley Rd	4.551	1.197	3.354	8	0.810	0.213	7.264	0.775	5.630
Lilley to Haggerty	4.870	1.281	3.589	35.4	0.810	0.202	29.225	0.775	22.650
N I-275 Ramp to Lotz	2.778	0.730	2.048	3.8	0.810	0.308	3.486	0.775	2.701
Single-vehicle									
Sheldon to Morton Taylor	0.870	0.178	0.692	1	0.520	0.689	0.910	0.775	0.705
Morton Taylor to Lilley Rd	0.748	0.153	0.595	1	0.520	0.720	0.819	0.775	0.635
Lilley to Haggerty	0.801	0.164	0.637	0	0.520	0.706	0.565	0.775	0.438
N I-275 Ramp to Lotz	0.451	0.092	0.359	0	0.520	0.810	0.365	0.775	0.283
						1.000	0.000		
Multiple-vehicle driveway-related									
Sheldon to Morton Taylor	7.588	2.041	5.547	2	0.100	0.569	5.177	0.775	4.012
Morton Taylor to Lilley Rd	3.217	0.865	2.352	1.2	0.100	0.757	2.726	0.775	2.113
Lilley to Haggerty	6.097	1.640	4.457	5	0.100	0.621	5.682	0.775	4.403
N I-275 Ramp to Lotz	0.633	0.170	0.463	1	0.100	0.940	0.655	0.775	0.508
						1.000	0.000		
INTERSECTIONS									
Multiple-vehicle									
Sheldon Rd	9.224	3.206	6.019	31	0.390	0.218	26.107	0.630	16.447
Morton Taylor Rd	9.313	3.257	6.056	19	0.390	0.216	16.752	0.630	10.554
Lilley Rd	9.379	3.249	6.129	68	0.390	0.215	55.414	0.630	**34.911**
Haggerty Rd	11.782	4.122	7.660	108	0.390	0.179	90.967	0.630	**57.309**
E M-153 / S I-275	15.315	4.457	10.857	33	0.330	0.165	30.246	0.630	19.055
N I-275 / M-153	12.017	3.687	8.330	24	0.330	0.201	21.427	0.630	13.499
Single-vehicle									
Sheldon Rd	0.491	0.113	0.378	0	0.360	0.850	0.418	0.630	0.263
Morton Taylor Rd	0.487	0.111	0.376	0	0.360	0.851	0.414	0.630	0.261
Lilley Rd	0.504	0.117	0.387	1	0.360	0.846	0.580	0.630	0.366
Haggerty Rd	0.609	0.138	0.471	0	0.360	0.820	0.499	0.630	0.314
E M-153 / S I-275	0.809	0.241	0.568	1	0.360	0.774	0.852	0.630	0.537
N I-275 / M-153	0.639	0.182	0.458	0	0.360	0.813	0.520	0.630	0.327
COMBINED (sum of column)	108.461	32.782	75.679	355.400	0.910	1.950	314.822	-	**206.362**

M-153 Corridor - Alternative 2

HSM Summary

Worksheet 3A -- Predicted Crashes by Severity and Site Type and Observed Crashes Using the Site-Specific EB Method for Urban and Suburban Arterials

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
Collision type / Site type	**Predicted average crash frequency (crashes/year)**			**Observed crashes, $N_{observed}$** (crashes/ year)	**Overdispersion Parameter, k**	**Weighted adjustment, w**	**Expected average crash frequency, $N_{expected}$**	**Expected Change in Crash Frequency (Crash Modification Factor)**	**Expected average crash frequency with mitigations in place (crashes/ year)**
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix		
ROADWAY SEGMENTS									
Multiple-vehicle nondriveway									
Sheldon to Morton Taylor	5.287	1.390	3.897	12.2	0.810	0.189	10.891	1.030	11.218
Morton Taylor to Lilley Rd	4.551	1.197	3.354	8	0.810	0.213	7.264	1.030	7.482
Lilley to Haggerty	4.870	1.281	3.589	35.4	0.810	0.202	29.225	1.030	30.102
N I-275 Ramp to Lotz	2.778	0.730	2.048	3.8	0.810	0.308	3.486	1.000	3.486
Single-vehicle									
Sheldon to Morton Taylor	0.870	0.178	0.692	1	0.520	0.689	0.910	1.030	0.937
Morton Taylor to Lilley Rd	0.748	0.153	0.595	1	0.520	0.720	0.819	1.030	0.844
Lilley to Haggerty	0.801	0.164	0.637	0	0.520	0.706	0.565	1.030	0.582
N I-275 Ramp to Lotz	0.451	0.092	0.359	0	0.520	0.810	0.365	1.000	0.365
						1.000	0.000		
Multiple-vehicle driveway-related									
Sheldon to Morton Taylor	7.588	2.041	5.547	2	0.100	0.569	5.177	1.030	5.332
Morton Taylor to Lilley Rd	3.217	0.865	2.352	1.2	0.100	0.757	2.726	1.030	2.808
Lilley to Haggerty	6.097	1.640	4.457	5	0.100	0.621	5.682	1.030	5.852
N I-275 Ramp to Lotz	0.633	0.170	0.463	1	0.100	0.940	0.655	1.000	0.655
						1.000	0.000		
INTERSECTIONS									
Multiple-vehicle									
Sheldon Rd	9.224	3.206	6.019	31	0.390	0.218	26.107	1.000	26.107
Morton Taylor Rd	9.313	3.257	6.056	19	0.390	0.216	16.752	1.000	16.752
Lilley Rd	9.379	3.249	6.129	68	0.390	0.215	55.414	0.920	**50.981**
Haggerty Rd	11.782	4.122	7.660	108	0.390	0.179	90.967	0.920	**83.689**
E M-153 / S I-275	15.315	4.457	10.857	33	0.330	0.165	30.246	1.000	30.246
N I-275 / M-153	12.017	3.687	8.330	24	0.330	0.201	21.427	1.000	21.427
Single-vehicle									
Sheldon Rd	0.491	0.113	0.378	0	0.360	0.850	0.418	1.000	0.418
Morton Taylor Rd	0.487	0.111	0.376	0	0.360	0.851	0.414	1.000	0.414
Lilley Rd	0.504	0.117	0.387	1	0.360	0.846	0.580	0.920	0.534
Haggerty Rd	0.609	0.138	0.471	0	0.360	0.820	0.499	0.920	0.459
E M-153 / S I-275	0.809	0.241	0.568	1	0.360	0.774	0.852	1.000	0.852
N I-275 / M-153	0.639	0.182	0.458	0	0.360	0.813	0.520	1.000	0.520
COMBINED (sum of column)	108.461	32.782	75.679	355.400	0.910	1.950	314.822	-	**302.063**

M-153 Corridor - Alternative 3

HSM Summary

Worksheet 3A -- Predicted Crashes by Severity and Site Type and Observed Crashes Using the Site-Specific EB Method for Urban and Suburban Arterials									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
Collision type / Site type	**Predicted average crash frequency (crashes/year)**			**Observed crashes, $N_{observed}$** (crashes/ year)	**Overdispersion Parameter, k**	**Weighted adjustment, w**	**Expected average crash frequency, $N_{expected}$**	**Expected Change in Crash Frequency (Crash Modification Factor)**	**Expected average crash frequency with mitigations in place (crashes/ year)**
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix		
ROADWAY SEGMENTS									
Multiple-vehicle nondriveway									
Sheldon to Morton Taylor	5.287	1.390	3.897	12.2	0.810	0.189	10.891	0.775	8.441
Morton Taylor to Lilley Rd	4.551	1.197	3.354	8	0.810	0.213	7.264	0.775	5.630
Lilley to Haggerty	4.870	1.281	3.589	35.4	0.810	0.202	29.225	0.775	22.650
N I-275 Ramp to Lotz	2.778	0.730	2.048	3.8	0.810	0.308	3.486	0.775	2.701
Single-vehicle									
Sheldon to Morton Taylor	0.870	0.178	0.692	1	0.520	0.689	0.910	0.775	0.705
Morton Taylor to Lilley Rd	0.748	0.153	0.595	1	0.520	0.720	0.819	0.775	0.635
Lilley to Haggerty	0.801	0.164	0.637	0	0.520	0.706	0.565	0.775	0.438
N I-275 Ramp to Lotz	0.451	0.092	0.359	0	0.520	0.810	0.365	0.775	0.283
						1.000	0.000		
Multiple-vehicle driveway-related									
Sheldon to Morton Taylor	7.588	2.041	5.547	2	0.100	0.569	5.177	0.775	4.012
Morton Taylor to Lilley Rd	3.217	0.865	2.352	1.2	0.100	0.757	2.726	0.775	2.113
Lilley to Haggerty	6.097	1.640	4.457	5	0.100	0.621	5.682	0.775	4.403
N I-275 Ramp to Lotz	0.633	0.170	0.463	1	0.100	0.940	0.655	0.775	0.508
						1.000	0.000		
INTERSECTIONS									
Multiple-vehicle									
Sheldon Rd	9.224	3.206	6.019	31	0.390	0.218	26.107	0.630	16.447
Morton Taylor Rd	9.313	3.257	6.056	19	0.390	0.216	16.752	0.630	10.554
Lilley Rd	9.379	3.249	6.129	68	0.390	0.215	55.414	0.630	**34.911**
Haggerty Rd	11.782	4.122	7.660	108	0.390	0.179	90.967	0.630	**57.309**
E M-153 / S I-275	15.315	4.457	10.857	33	0.330	0.165	30.246	0.630	19.055
N I-275 / M-153	12.017	3.687	8.330	24	0.330	0.201	21.427	0.630	13.499
Single-vehicle									
Sheldon Rd	0.491	0.113	0.378	0	0.360	0.850	0.418	0.630	0.263
Morton Taylor Rd	0.487	0.111	0.376	0	0.360	0.851	0.414	0.630	0.261
Lilley Rd	0.504	0.117	0.387	1	0.360	0.846	0.580	0.630	0.366
Haggerty Rd	0.609	0.138	0.471	0	0.360	0.820	0.499	0.630	0.314
E M-153 / S I-275	0.809	0.241	0.568	1	0.360	0.774	0.852	0.630	0.537
N I-275 / M-153	0.639	0.182	0.458	0	0.360	0.813	0.520	0.630	0.327
COMBINED (sum of column)	108.461	32.782	75.679	355.400	0.910	1.950	314.822	-	**206.362**