TMS Engineers, Inc.

# Traffic Impact Study

## Downtown Phase 2 Project
## Hudson, Ohio

March 2, 2018

Prepared for:
City of Hudson
115 Executive Parkway #400
Hudson, Ohio 44236

# TRAFFIC IMPACT STUDY

Downtown Phase 2 Project

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Prepared By:

TMS Engineers, Inc.
2112 Case Parkway S.
Unit #7
Twinsburg, Ohio 44087

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# Executive Summary

This traffic impact study has been prepared at the request of the City of Hudson for the proposed Hudson Downtown Phase 2 Project. The project site is located within the downtown core in the City of Hudson, Summit County, Ohio. **Figure 1.1, Page 2** shows the proposed location of the development.

The proposed project consists of a mixed-use development with residential, office, and flex land uses. The flex land uses are expected to be comprised of 60% office, 20% retail, and 20% restaurant space.

The first phase of the proposed development is expected to consist of three development components comprised of the following land uses:

| Residential | Office | Commercial |
|---|---|---|
| 22 Low-Rise Units | 98,241 Square Feet | Flex - 77,434 Square Feet |
| 80 Mid-Rise Units | | Hotel - 60 Rooms |

The second phase of the proposed development is expected to consist of three development components comprised of the following land uses:

| Residential | Office | Commercial |
|---|---|---|
| 23 Low-Rise Units | | Flex - 30,088 Square Feet |
| 88 Mid-Rise Units | | |

2019 will be analyzed as the opening year for Phase 1 and 2021 will be analyzed for the full build out of the development with the Phase 1 and Phase 2 land use components. The year 2041 will be analyzed as the design year for the twenty year analysis and include Phase 1 and 2.

The primary access to the development site will be through the adjacent local roadways of Morse Road, Owen Brown Street, Clinton Street, and Village Way. The site plan for the Hudson Downtown Phase 2 project can be seen in **Figure 1.3, Page 4**.

The weekday AM peak hour of traffic was determined to be 7:00 AM to 8:00 AM. The weekday PM peak hour of traffic was found to be 5:00 PM to 6:00 PM at the study intersections.

The proposed development is expected to generate the following average hourly traffic during the AM and PM peak periods after completion of the first phase based upon the rates established by studies from the Institute of Transportation Engineers.

## Hudson - Downtown Phase II Project
## Phase 1

| | TRIP ENDS | | | |
|---|---|---|---|---|
| | Weekday Peak Hour Between 7-9 AM (Enter/Exit) | | Weekday Peak Hour Between 4-6 PM (Enter/Exit) | |
| TOTAL DRIVEWAY VOLUMES | 369 | 141 | 215 | 331 |
| TOTAL DIVERTED TRIP REDUCTION | 0 | 0 | 36 | 33 |
| TOTAL NEW TRIPS | **369** | **141** | **179** | **298** |
| | **510** | | **477** | |

The proposed development is expected to generate the following average hourly traffic during the AM and PM peak periods after completion of the second phase based upon the rates established by studies from the Institute of Transportation Engineers.

## Hudson - Downtown Phase II Project
## Full Build

| | TRIP ENDS | | | |
|---|---|---|---|---|
| | Weekday Peak Hour Between 7-9 AM (Enter/Exit) | | Weekday Peak Hour Between 4-6 PM (Enter/Exit) | |
| TOTAL DRIVEWAY VOLUMES | 444 | 204 | 296 | 409 |
| TOTAL DIVERTED TRIP REDUCTION | 0 | 0 | 50 | 46 |
| TOTAL NEW TRIPS | **444** | **204** | **246** | **363** |
| | **648** | | **609** | |

## Recommend Improvements to Serve Future Conditions without the Development

The following intersection improvements were found to be necessary to accommodate the expected 2019 and 2021 No-Build traffic at the study area intersections:

7. SR 91 & SR 303
   - Construct a second northbound left turn lane

18. East Hines Hill Road & Valley View Road
   - Construct a single lane roundabout

No additional improvements were recommended to accommodate the 2019 and 2021 No-build traffic at the study area intersections.

The following intersection improvements were found to be necessary to accommodate the expected 2041 No-Build traffic at the study area intersections:

5. SR 91 & Clinton Street/Aurora Street
   - Align Clinton Street and Aurora Street

7.0 SR 91 & SR 303
   - Construct a second east-west through lane

No additional improvements were recommended to accommodate the 2041 No-Build traffic at the study area intersections.

## Recommended Improvements to Mitigate the Traffic Associated with the Development

The following lane use and traffic control are recommended to accommodate the 2019 site generated (Build) traffic:

21. Morse Road & Owen Brown Street
   - Construct a single lane roundabout

   OR

   - Construct an exclusive northbound left turn lane
   - Construct an exclusive eastbound left turn lane
   - Construct an exclusive southbound right turn lane
   - Install traffic signal control

No additional improvements were recommended to accommodate the 2019 Build traffic conditions at the study area intersections.

The following lane use and traffic control are recommended to accommodate the 2021 site generated (Build) traffic:

3. North Main Street (SR 91) & Prospect Street
   - Construct an exclusive eastbound left turn lane

It should be noted that the intersection of North Main Street (SR 91) and Prospect Street was previously analyzed in prior studies and was determined to not require any additional improvements. The primary difference between studies can be attributed to the application of design hour factors and higher trip generation results for the proposed development due to differences in the development site plans under review for each analysis.

The trip generation results for this report exceeded the previous analyses by 239 trips in the AM peak hour and 224 trips in the PM peak hour. The left turn lane was determined to not be necessary without these additional trips. The capacity analysis determined that left turn lane does not become necessary until the development generates 180 of the additional 224 trips in the PM peak hour.

Based on the trip generation results and capacity analysis it is recommended that the need for an eastbound left turn lane on West Prospect Street at North Main Street (SR 91) be re-analyzed in a post-construction analysis after the development has reached full build conditions.

No additional improvements were recommended to accommodate the 2021 Build traffic conditions at the study area intersections.

The following lane use and traffic control are recommended to accommodate the 2041 site generated (Build) traffic:

8. South Main Street (SR 91) & Veterans Way
   - Construct an exclusive westbound left turn lane

No additional improvements were recommended to accommodate the 2041 Build traffic conditions at the study area intersections.

**Figure 5.15, Page 112** details the listed recommendations for the Owen Brown Street corridor between North Main Street and Lennox Road.

# Chapter 1
# Introduction

## 1.1 Purpose of Report

This traffic impact study has been prepared at the request of the City of Hudson for the proposed Hudson Downtown Phase 2 Project. The project site is located within the downtown core in the City of Hudson, Summit County, Ohio. **Figure 1.1, Page 2** shows the proposed location of the development.

The proposed project consists of a mixed-use development with residential, office, and flex land uses. The flex land uses are expected to be comprised of 60% office, 20% retail, and 20% restaurant space. The development can be seen in **Figure 1.2, Page 3**.

The first phase of the proposed development is expected to consist of three development components comprised of the following land uses:

| Residential | Office | Commercial |
|---|---|---|
| 22 Low-Rise Units | 98,241 Square Feet | Flex - 77,434 Square Feet |
| 80 Mid-Rise Units | | Hotel - 60 Rooms |

The second phase of the proposed development is expected to consist of three development components comprised of the following land uses:

| Residential | Office | Commercial |
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| 23 Low-Rise Units | | Flex - 30,088 Square Feet |
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2019 will be analyzed as the opening year for Phase 1 and 2021 will be analyzed for the full build out of the development with the Phase 1 and Phase 2 land use components. The year 2041 will be analyzed as the design year for the twenty year analysis and include Phase 1 and 2.

The primary access to the development site will be through the adjacent local roadways of Morse Road, Owen Brown Street, Clinton Street, and Village Way. The site plan for the Hudson Downtown Phase 2 project can be seen in **Figure 1.3, Page 4**.


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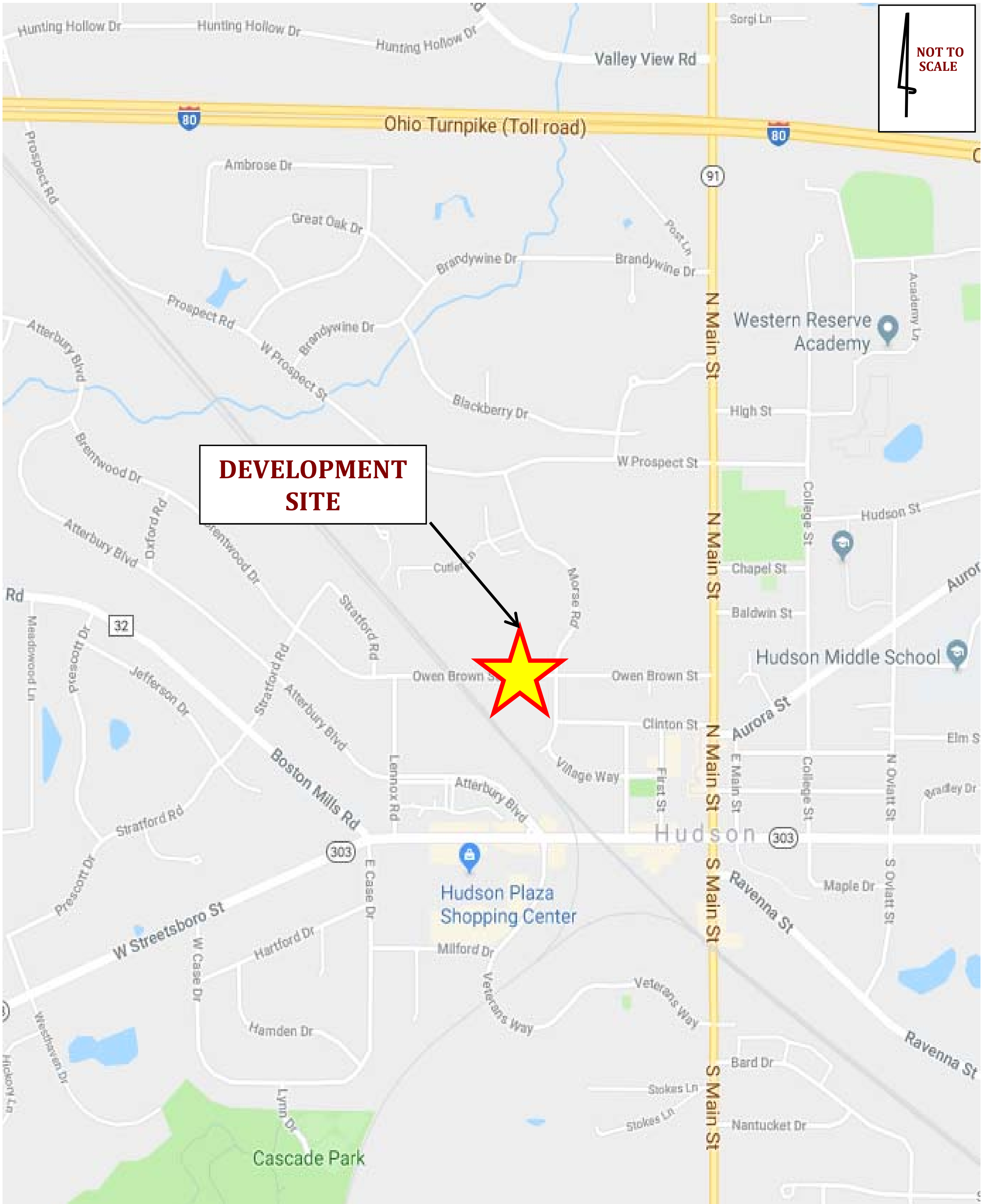
Downtown Phase II
Hudson, Ohio
Traffic Impact Study

Development Area
Parcel Map

Figure 1.2

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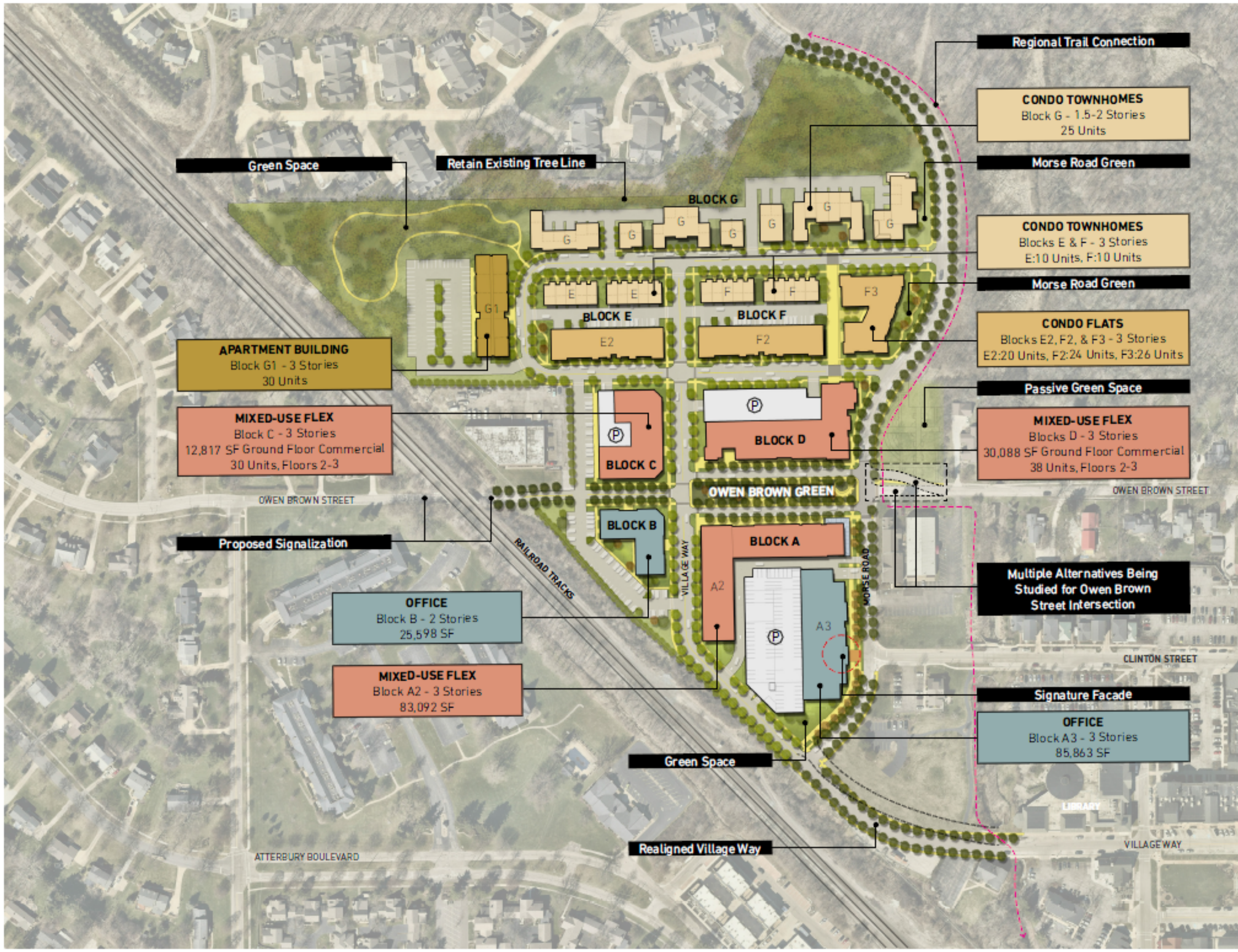
| Downtown Phase II<br>Hudson, Ohio<br>Traffic Impact Study | Study Area<br>Roadway Network | Figure 1.1 |
|---|---|---|

**HUDSON** | DOWNTOWN PHASE II

# PRELIMINARY CONCEPTUAL PLAN




DEVELOPMENT PROGRAM

**Project Area Use Schedule**

| BUILDING USE | AREA |
|---|---|
| C - Commercial | 124,816 SF |
| F - Flex | 112,642 SF |
| G - Greenspace | 6 Acres |
| P - Parking | 698 Spaces |
| R - Condo Townhomes | 45 Units |
| R - Condo Flats | 138 Units |
| R - Apartments | 30 Units |

**Parking Summary**

| LOCATION | SPACES |
|---|---|
| Structured Parking Deck | 350 |
| Surface Parking | 208 |
| On-Street Parking | 140 |
| **TOTAL PROPOSED PARKING** | **698 Spaces** |

**Building Use**

- Office
- Mixed-Use
- Apartment
- Condo Flat
- Condo Townhome

Figure: 1.3

Page: 4

Site Plan

Downtown Phase II
Hudson, Ohio
Traffic Impact Study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## 1.2 Study Objectives

This study is structured for the following purposes;

- to adequately assess the traffic impacts associated with the proposed development and to identify the level of off-site access and traffic,
- to provide a comprehensive study which evaluates and documents the traffic impacts and off-site improvements, where warranted,
- and to provide a technically sound basis to identify mitigation requirements to off-site traffic impacts.

This study documents the methodologies, findings and conclusions of the analysis, including the basis for all assumptions, traffic parameters utilized and conclusions reached.

The traffic impacts will be determined by comparing the existing intersection levels-of-service before the proposed development to the anticipated levels-of-service after the development is completed. Levels-of-service for the study area and access driveway will be calculated using the computerized software program **Synchro plus SimTraffic Signal Timing & Analysis Software**.

The justification for any changes in the intersections will be determined by comparing data collected of the existing traffic conditions to the criteria established by the **Ohio Manual of Uniform Traffic Control Devices** and professional engineering judgment from an on-site field review.

Intersection geometric design guidelines will be based in the information and procedures found in the Ohio Department of Transportation's **Location & Design Manual, Volume 1**.

# Chapter 2
# Area Conditions

## 2.1 Functional Classification

The Ohio Department of Transportation (ODOT) and the Akron Metropolitan Area Transportation Study (AMATS) functionally classifies roadways to help define a roadway's characteristics as well as identify roadways that are eligible for federal funds. Functional classification is the grouping of roads, streets, and highways in a hierarchy based on the type of highway service they provide. Generally, streets and highways perform two types of service. They provide either traffic mobility or land access and can be ranked in terms of the proportion of service they provide.

The functional classification as determined by ODOT and AMATS will also be used to apply growth and design hour factors to the study area roadways for use in forecasting future traffic volumes in the study area. These factors are determined using data, guidelines, and methodology supplied by ODOT. These methods and the corresponding data are based on the roadways assigned functional classification. The ODOT methods for forecasting future traffic volumes are a recognized traffic engineering standard.

It should be noted that several roadways within the study area are functionally classified as collectors (Morse Road, Prospect Street, and Hines Hill Road) by the City of Hudson. In order to apply the applicable traffic data supplied by ODOT for use in their methodology for the future traffic forecasts the ODOT/AMATS functional classifications will be used in this report.

The following table lists the study area roadways that have an assigned functional classification as determined by ODOT and AMATS. Roadways that are not listed as having a functional classification can be assigned into one of two categories. The first category is a local roadway and the second category is that of an access drive. Table 2.1 only details roadways with a functional classification higher than local roadways.

Table 2.1 Functional Classification

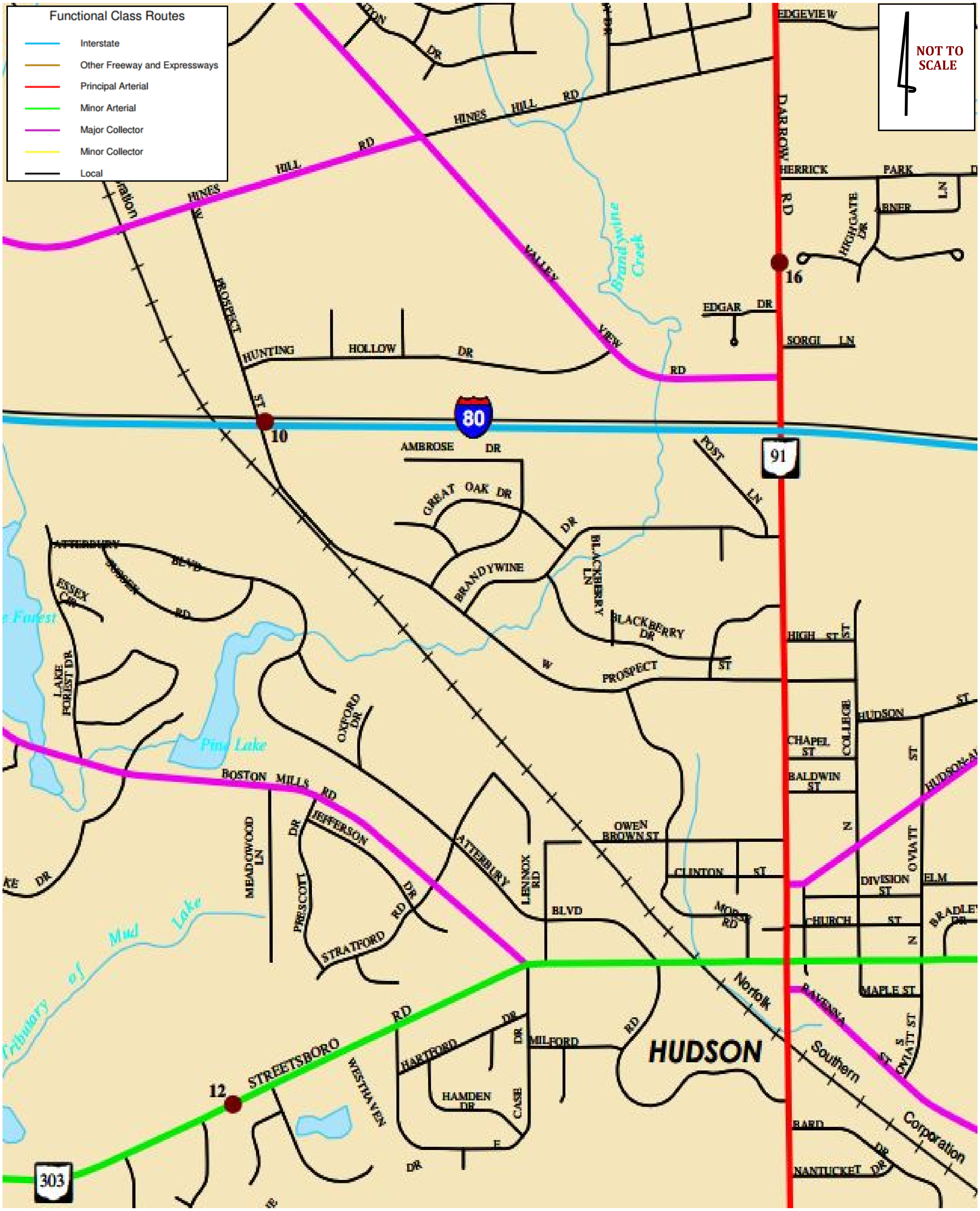
| ROADWAY | AREA | FC # | CLASSIFICATION |
|---|---|---|---|
| North/South Main Street (SR 91) | Urban | 3 | Principal Arterial |
| East/West Streetsboro Road (SR 303) | Urban | 4 | Minor Arterial |
| Hines Hill Road | Urban | 5 | Major Collector |
| Valley View Road | Urban | 5 | Major Collector |
| Boston Mills Road | Urban | 5 | Major Collector |
| Aurora Road | Urban | 5 | Major Collector |
| Ravenna Street | Urban | 5 | Major Collector |

The functional classification maps for the study area can currently be found online at the following ODOT and AMATS web addresses:

http://www.dot.state.oh.us/Divisions/Planning/ProgramManagement/MajorPrograms/MapRoom/Forms/AllItems.aspx

http://amatsplanning.org/wp-content/uploads/October-2013-FFC-Map.pdf

**Figure 2.1, Page 8** details the section of the functional classification map for the City of Hudson and the study area.

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**Downtown Phase II**
**Hudson, Ohio**
**Traffic Impact Study**

**Functional Classification**

**Figure 2.1**

## 2.2 Transportation Network Study Area

The following 34 intersections are under study for this report:

| | | | |
|---|---|---|---|
| 1. | North Main Street (SR 91) | & | Brandywine Drive |
| 2. | North Main Street (SR 91) | & | Morning Song Lane |
| 3. | North Main Street (SR 91) | & | West Prospect Street |
| 4. | North Main Street (SR 91) | & | Owen Brown Street |
| 5. | North Main Street (SR 91) | & | Clinton Street/Aurora Street |
| 6. | North Main Street (SR 91) | & | Church Street |
| 7. | North Main Street (SR 91) | & | West Streetsboro Road (SR 303) |
| 8. | South Main Street (SR 91) | & | Veterans Way |
| 9. | Prospect Road | & | East Hines Hill Road |
| 10. | West Prospect Street | & | Hunting Hollow Drive |
| 11. | West Prospect Street | & | Brandywine Drive |
| 12. | West Prospect Street | & | Morse Road |
| 13. | West Prospect Street | & | Morning Song Lane |
| 14. | West Streetsboro Road (SR 303) | & | Boston Mills Road/East Case Drive |
| 15. | West Streetsboro Road (SR 303) | & | Milford Drive/Atterbury Boulevard |
| 16. | West Streetsboro Road (SR 303) | & | Library Street |
| 17. | West Streetsboro Road (SR 303) | & | First Street |
| 18. | Valley View Road | & | East Hines Hill Road |
| 19. | Valley View Road | & | Hunting Hollow Drive |
| 20. | Owen Brown Street | & | Lennox Road |
| 21. | Owen Brown Street | & | Morse Road |
| 22. | Morse Road | & | Clinton Street |
| 23. | Clinton Street | & | Library Street |
| 24. | First Street | & | Village Way |
| 25. | Atterbury Boulevard | & | Stratford Drive |
| 26. | Atterbury Boulevard | & | Lennox Road |
| 27. | East Case Drive | & | Milford Road |
| 28. | Milford Road | & | Veterans Way |
| 29. | East Main Street | & | Aurora Street |
| 30. | East Main Street | & | Division Street |
| 31. | East Main Street | & | Church Street |
| 32. | College Street | & | Division Street |
| 33. | College Street | & | Church Street |
| 34. | Ravenna Street | & | South Oviatt Street |

The following table details the existing characteristics for the primary roadways in the study area.

Table 2.2 Existing Roadway Conditions

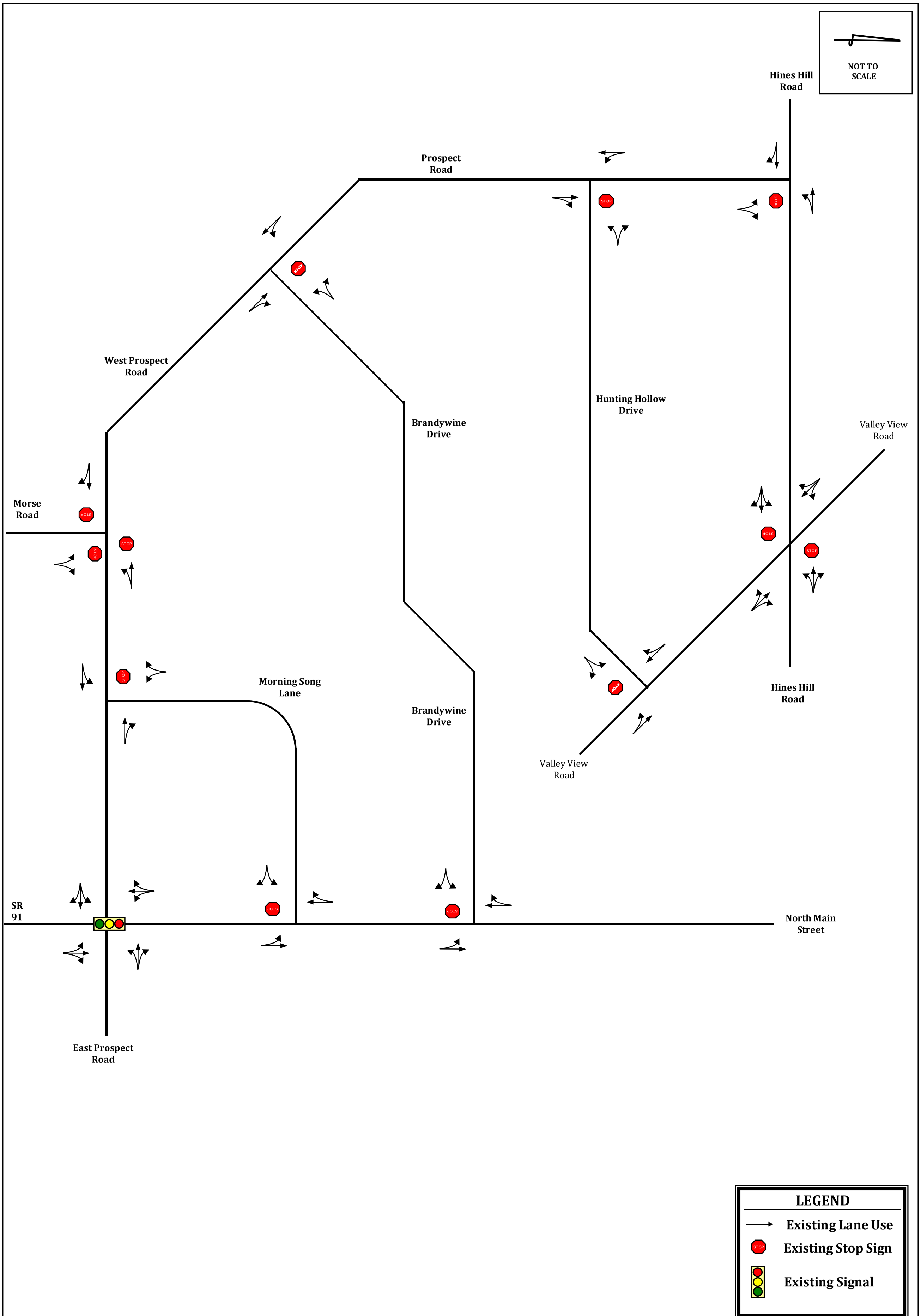
| ROADWAY | # OF LANES | ORIENTATION | SPEED LIMIT (MPH) | ADT* (VPD) |
|---|---|---|---|---|
| SR 91 | 2 | North-South | 25 | 17,200 |
| SR 303 | 2 | East-West | 25 | 15,190 |
| Hines Hill Road | 2 | East -West | 35 | 3,720 |
| Valley View Road | 2 | Northwest-Southeast | 45 | 2,740 |
| Prospect Street | 2 | East-West | 25/35 | 1,910 |
| Boston Mills Road | 2 | East-West | 35 | 5,970 |
| Aurora Road | 2 | Southwest-Northeast | 25 | 5,320 |
| Ravenna Street | 2 | Northwest-Southeast | 25 | 3,010 |
| Morse Road | 2 | North-South | 25 | 3,930 |
| Owen Brown Street | 2 | East-West | 25 | 2,070 |
| Clinton Street | 2 | East-West | 25 | 2,050 |
| Village Way | 2 | East-West | 25 | 370 |

The following study area intersections are under traffic signal control:

1. North Main Street (SR 91) & East/West Prospect Street
2. North Main Street (SR 91) & Clinton Street/Aurora Street
3. North/South Main Street (SR 91) & East/West Streetsboro Street (SR 303)
4. South Main Street (SR 91) & Veterans Way
5. West Streetsboro Street (SR 303) & Boston Mills Road/East Case Drive
6. West Streetsboro Street (SR 303) & Atterbury Boulevard/Milford Drive
7. West Streetsboro Street (SR 303) & Library Street

**Figure 2.2, Page 11** shows the lane use and traffic control conditions based upon the existing conditions in the study area.

**Figure 2.3 Page 12** shows an aerial view of the downtown core and development site area.

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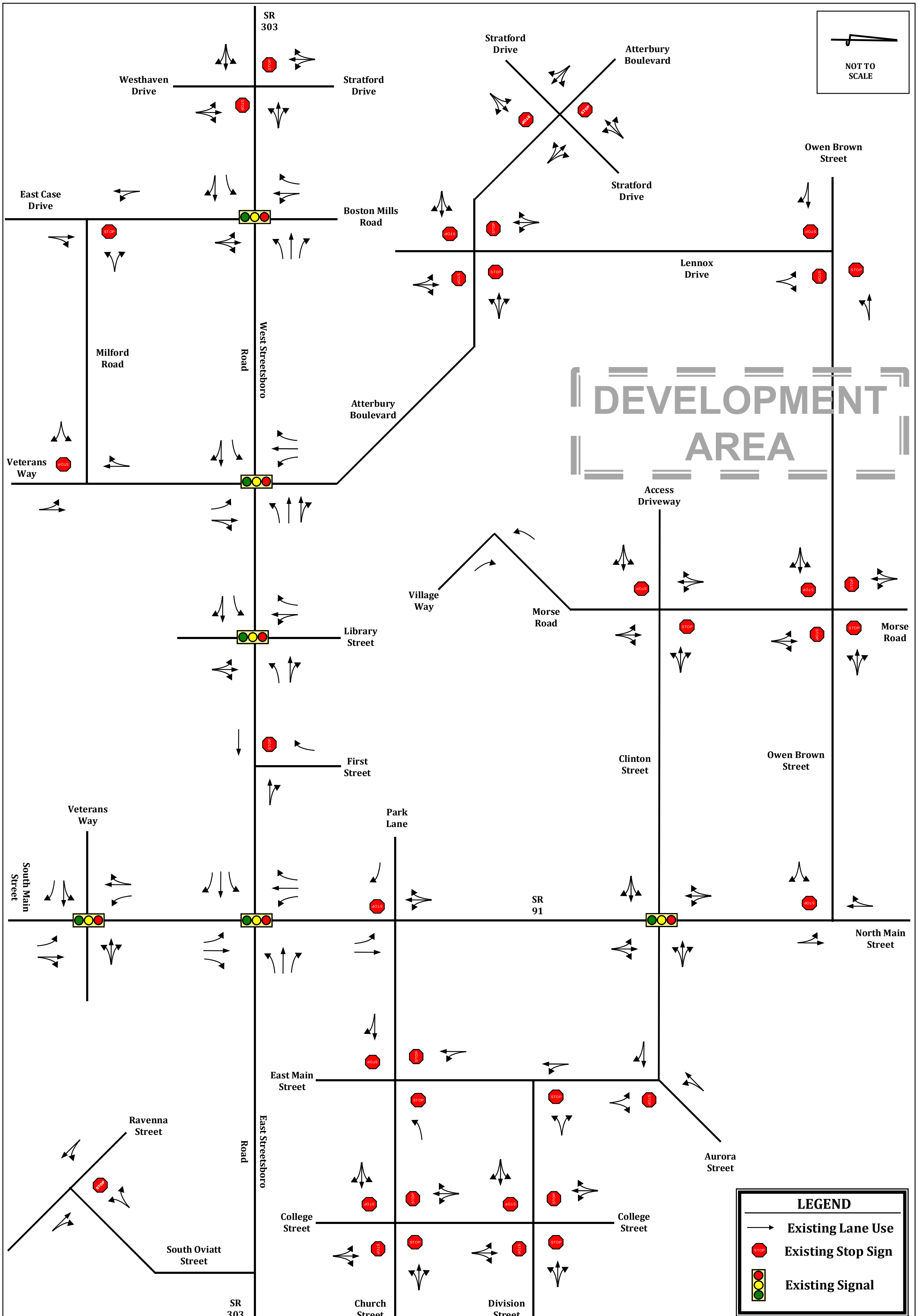
Existing
Lane Use & Traffic Control
(North Section)

Figure: 2.2a

Page: 11a

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Existing
Lane Use & Traffic Control
(South Section)

Figure: 2.2b

Page: 11b


| | | | |
|---|---|---|---|
| TMS Engineers, Inc.<br>Transportation Management Services<br>2112 Case Parkway S., Unit 7, Twinsburg, Ohio 44087<br>www.TMSEngineers.com | Downtown Phase II<br>Hudson, Ohio<br>Traffic Impact Study | Aerial View<br>Downtown Core<br>Development Site | Figure: 2.3<br>Page: 12 |

## 2.3 Traffic

Traffic data was collected at 34 intersection locations in the City of Hudson. The weekday traffic counts were conducted in fifteen (15) minute intervals between the hours of 7 AM - 10 AM, 11 AM - 2 PM, and 3 PM - 6 PM, then hourly totals were calculated.

Weekday nine hour turning movement counts were performed at the following locations in October of 2017:

| | | | |
|---|---|---|---|
| 1. | North Main Street (SR 91) | & | Brandywine Drive |
| 2. | North Main Street (SR 91) | & | Morning Song Lane |
| 3. | North Main Street (SR 91) | & | West Prospect Street |
| 4. | North Main Street (SR 91) | & | Owen Brown Street |
| 5. | North Main Street (SR 91) | & | Clinton Street/Aurora Street |
| 6. | North Main Street (SR 91) | & | Church Street |
| 7. | North Main Street (SR 91) | & | West Streetsboro Road (SR 303) |
| 8. | South Main Street (SR 91) | & | Veterans Way |
| 9. | Prospect Road | & | East Hines Hill Road |
| 10. | West Prospect Street | & | Hunting Hollow Drive |
| 11. | West Prospect Street | & | Brandywine Drive |
| 12. | West Prospect Street | & | Morse Road |
| 13. | West Prospect Street | & | Morning Song Lane |
| 14. | West Streetsboro Road (SR 303) | & | Boston Mills Road/East Case Drive |
| 15. | West Streetsboro Road (SR 303) | & | Milford Drive/Atterbury Boulevard |
| 16. | West Streetsboro Road (SR 303) | & | Library Street |
| 17. | West Streetsboro Road (SR 303) | & | First Street |
| 18. | Valley View Road | & | East Hines Hill Road |
| 19. | Valley View Road | & | Hunting Hollow Drive |

A copy of the 2017 intersection turn movement counts are included in **Appendix A**.

Weekday nine hour turning movement counts were performed at the following locations in September of 2015:

| | | | |
|---|---|---|---|
| 20. | Owen Brown Street | & | Lennox Road |
| 21. | Owen Brown Street | & | Morse Road |
| 22. | Morse Road | & | Clinton Street |
| 23. | Clinton Street | & | Library Street |
| 24. | First Street | & | Village Way |
| 25. | Atterbury Boulevard | & | Stratford Drive |
| 26. | Atterbury Boulevard | & | Lennox Road |
| 27. | East Case Drive | & | Milford Road |
| 28. | Milford Road | & | Veterans Way |
| 29. | East Main Street | & | Aurora Street |
| 30. | East Main Street | & | Division Street |
| 31. | East Main Street | & | Church Street |
| 32. | College Street | & | Division Street |
| 33. | College Street | & | Church Street |
| 34. | Ravenna Street | & | South Oviatt Street |

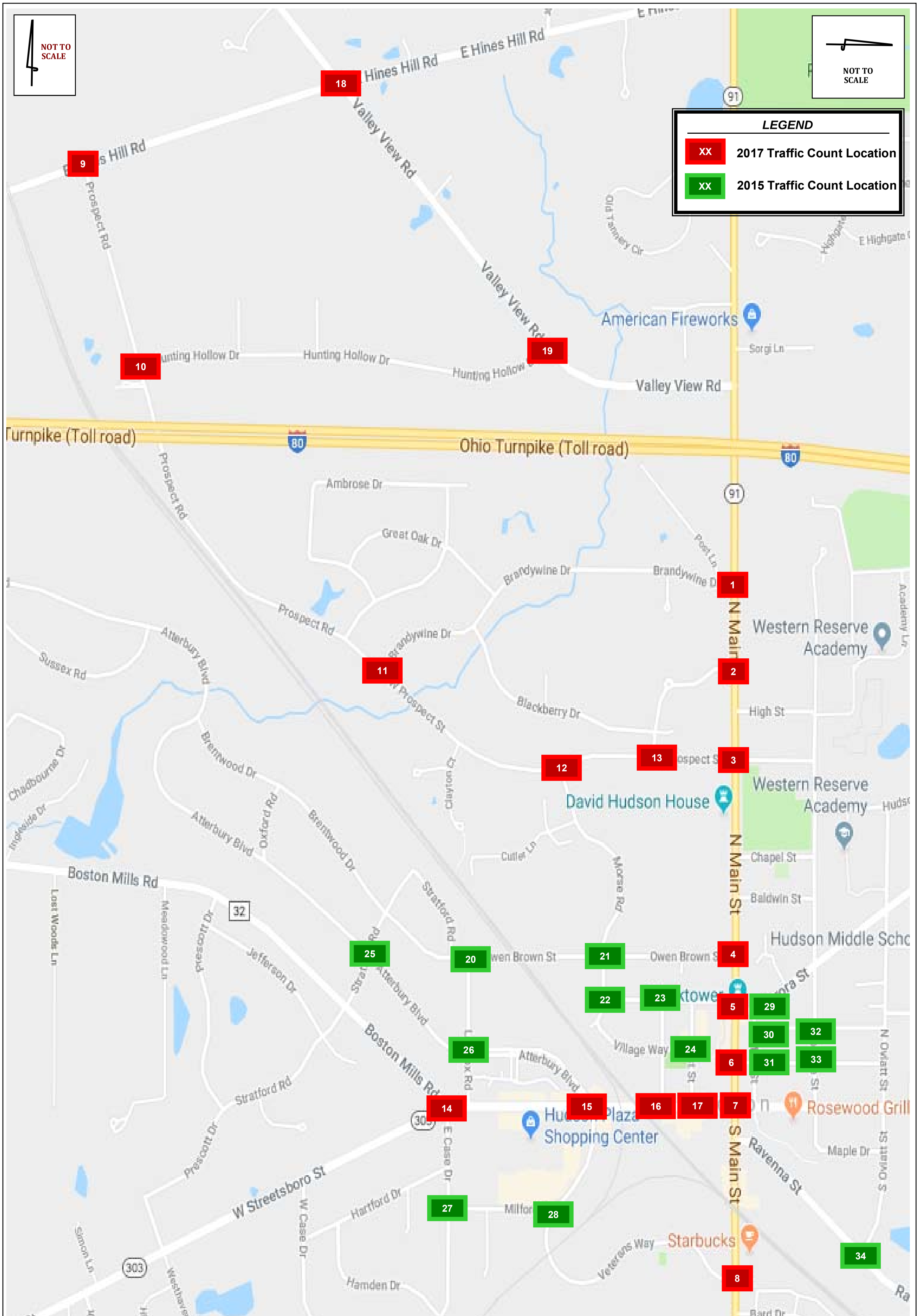
A copy of the 2015 intersection turn movement counts are included in **Appendix A**.

**Figure 2.4, Page 15** details the 34 locations where traffic count data was collected in 2015 and 2017.

Average daily traffic was calculated for roadway using expansion factors to account for daily and seasonal variations according to the recommendations and latest data from the Ohio Department of Transportation.

From the data, the weekday AM peak hour of traffic was determined to be 7:00 AM to 8:00 AM. The weekday PM peak hour of traffic was found to be 5:00 PM to 6:00 PM. The traffic data includes traffic being generated from the development parcels at the time of the traffic counts. These parcels include the bus garage, HPP, and Windstream. The collected traffic data from these periods will be analyzed since they reflect the period of the highest volume of traffic flow for the roadways. It will provide a worst case scenario for future traffic.

The Average Daily Traffic (ADT) volumes for the study area can be seen in **Figure 2.5, Page 16**. The 2015/2017 existing weekday AM and PM peak hour traffic volumes can be seen in **Figure 2.6, Page 17**.




| | | | |
|---|---|---|---|
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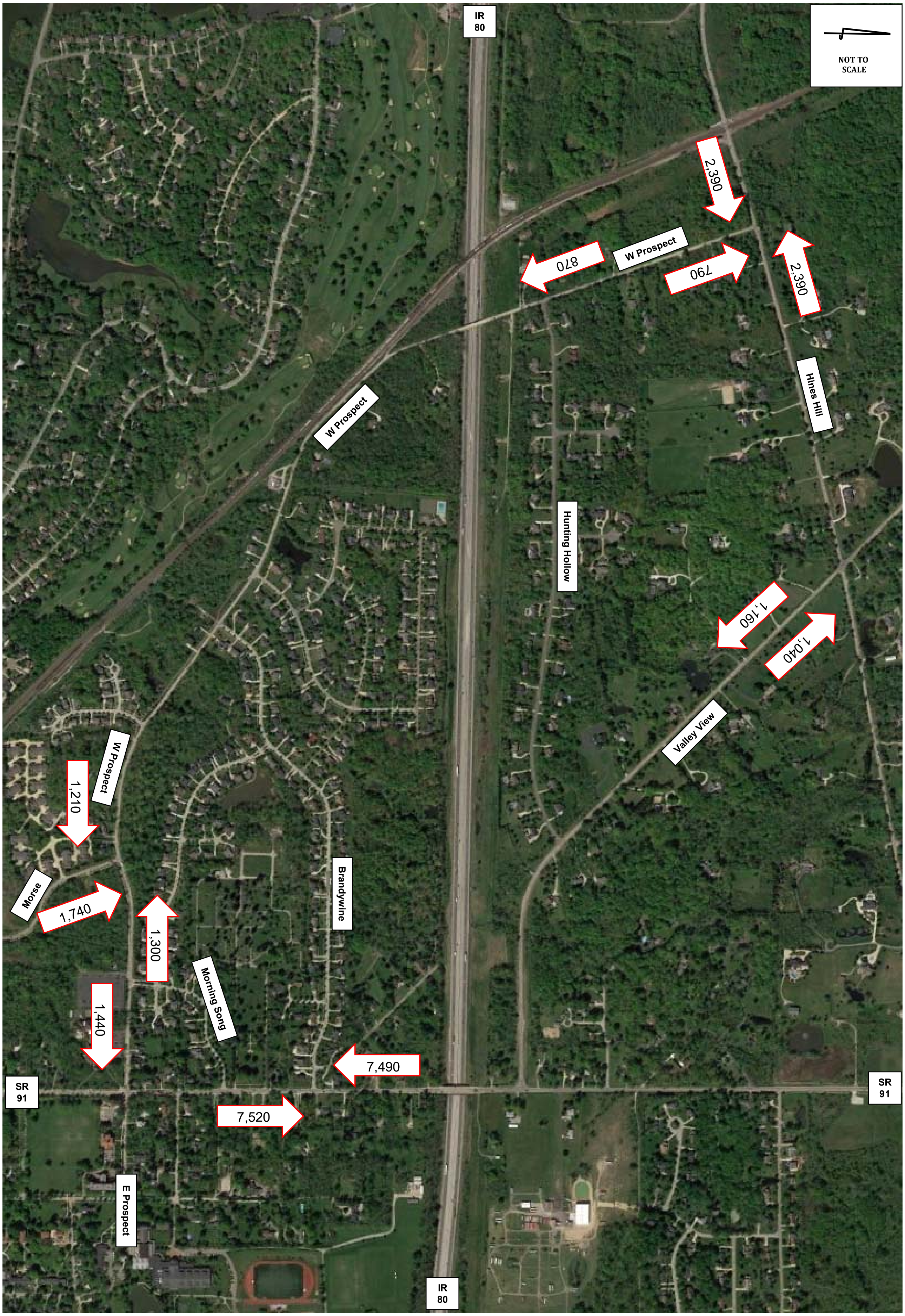


| TMS Engineers, Inc. Transportation Management Services 2112 Case Parkway S., Unit 7, Twinsburg, Ohio 44087 www.TMSEngineers.com | Downtown Phase II Hudson, Ohio Traffic Impact Study | Average Daily Traffic Volumes (North Section) | Figure: 2.5a |
|---|---|---|---|
| | | | Page: 16a |


| | | | |
|---|---|---|---|
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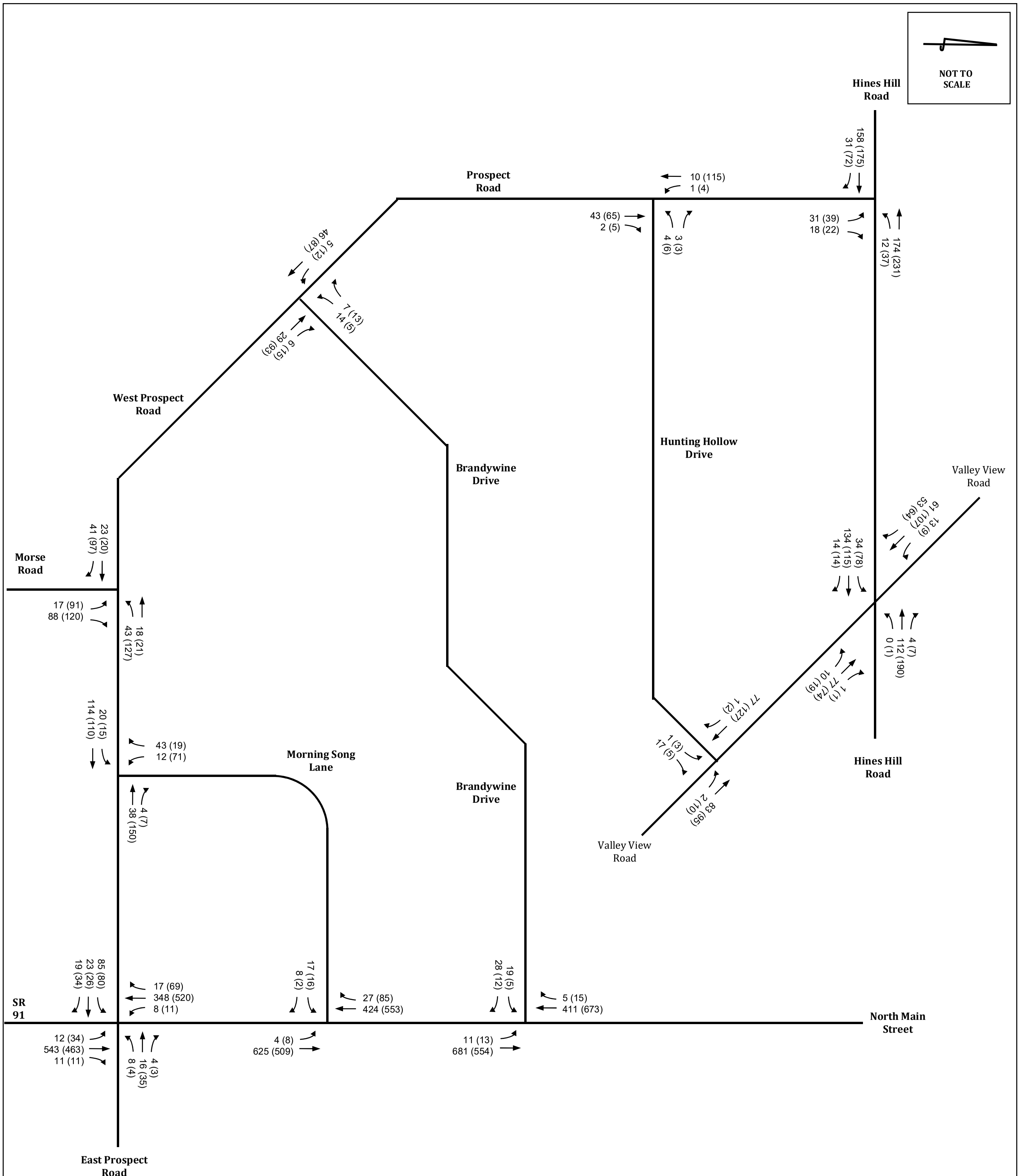


| LEGEND | |
|---|---|
| XX | AM Peak Hour Traffic |
| (XX) | PM Peak Hour Traffic |

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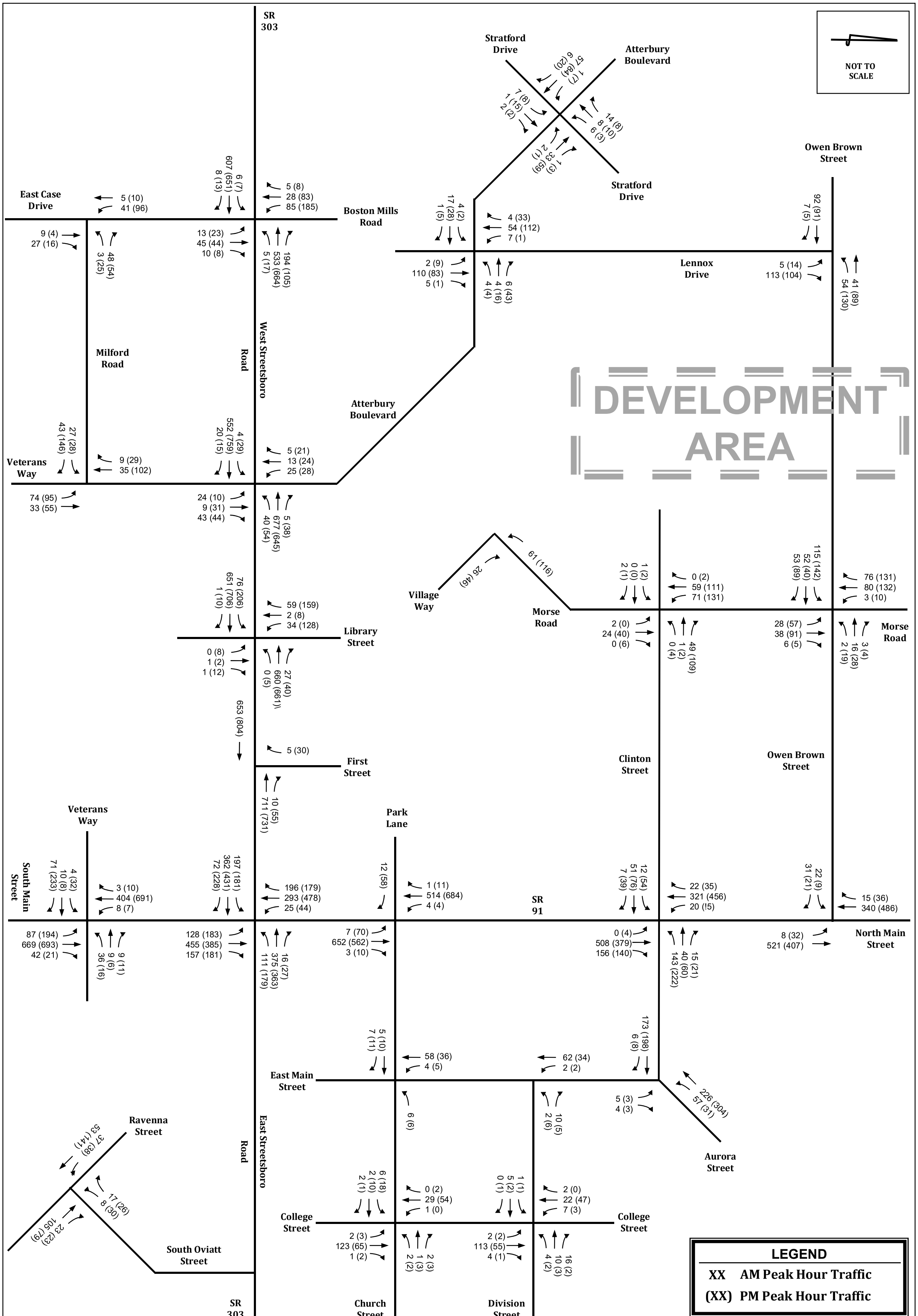
2015/2017 Existing
Peak Hour Traffic Volumes
(North Section)

Figure: 2.6a

Page: 17a

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2015/2017 Existing
Peak Hour Traffic Volumes
(South Section)

Figure: 2.6b

Page: 17b

## 2.3 Crash Data

The Ohio Department of Transportation provides a tool to retrieve crash data. The ODOT GIS Crash Analysis Tool (GCAT) was used to collect crash information at the study area intersections. The ODOT GIS Crash Analysis Tool can currently be found at the following web address:

https://gis.dot.state.oh.us/tims/

The years 2014 through 2016 at the 34 study area intersections in the City of Hudson were reviewed using the ODOT GCAT portal. Crash data summaries for each study area intersection with reported crash data can be found in **Appendix B**.

The crashes were tabulated by intersection and crash type in order to address probable causes and corrective measures at each intersection based on the dominate crash type. The tables detailing the intersection crash patterns and possible corrective measures can be seen on the following pages:

## Table 2.3 Intersection Crash Patterns

| INTERSECTION | TOTAL CRASHES (INJURY) | CRASH RATE (MEV*) | MAJOR CRASH PATTERN | PROBABLE CAUSE |
|---|---|---|---|---|
| SR 91<br>&<br>Brandywine Drive | 3 (0) | 0.18 | Right Turn (1)<br>Sideswipe Passing (1)<br>Rear End (1) | Driver unaware of intersection<br>Slippery Surface<br>Large Turning Volumes |
| SR 91<br>&<br>Morning Song Ln | 3 (0) | 0.19 | Rear End (2)<br>Left Turn (1) | Driver unaware of intersection<br>Slippery Surface<br>Large Turning Volumes |
| SR 91<br>&<br>West Prospect St | 12 (2) | 0.71 | Rear End (9) | Large Turning Volumes<br>Poor device visibility<br>Traffic signal timing |
| SR 91<br>&<br>Owen Brown St | 6 (0) | 0.42 | Rear End (3)<br>Left Turn (3) | Driver unaware of intersection<br>Slippery Surface<br>Large Turning Volumes |
| SR 91<br>&<br>Clinton/Aurora St | 17 (3) | 0.85 | Rear End (10)<br>Left Turn (2)<br>Sideswipe Passing (2) | Large Turning Volumes<br>Poor device visibility<br>Traffic signal timing<br>Crossing pedestrians |
| SR 91<br>&<br>Church St | 13 (1) | 0.72 | Rear End (11)<br>Angle (1)<br>Right Turn (1) | Driver unaware of intersection<br>Slippery Surface<br>Large Turning Volumes<br>Crossing pedestrians |
| SR 91<br>&<br>SR 303 | 45 (7) | 1.30 | Rear End (25)<br>Left Turn (9)<br>Sideswipe Passing (5) | Large Turning Volumes<br>Poor device visibility<br>Traffic signal timing<br>Inadequate roadway design |
| SR 91<br>&<br>Veterans Way | 14 (2) | 0.56 | Rear End (11)<br>Pedestrian (1) | Large Turning Volumes<br>Poor device visibility<br>Traffic signal timing |
| Prospect Rd<br>&<br>Hines Hill Rd | 1 (1) | 0.16 | Left Turn (1) | Restricted sight distance<br>Excessive speed |
| West Prospect St<br>&<br>Hunting Hollow Dr | 0 (0) | 0.00 | NA | NA |

*** Crash Rate Per Million Vehicles Entering the Intersection**

## Table 2.3 Intersection Crash Patterns

| INTERSECTION | TOTAL CRASHES (INJURY) | CRASH RATE (MEV*) | MAJOR CRASH PATTERN | PROBABLE CAUSE |
|---|---|---|---|---|
| West Prospect St & Brandywine Dr | 1 | 0.41 | Fixed Object (1) | Excessive speed<br>Slippery surface<br>FO too close to roadway |
| West Prospect St & Morse Rd | 0 (0) | 0.00 | NA | NA |
| West Prospect St & Morning Song Ln | 0 (0) | 0.00 | NA | NA |
| SR 303 & Boston Mills Rd | 22 (4) | 0.93 | Rear End (15) | Large turning volumes<br>Poor device visibility<br>Traffic signal timing |
| SR 303 & Atterbury Blvd | 15 (3) | 0.65 | Rear End (11)<br>Angle (2)<br>Sideswipe Passing (2) | Large turning volumes<br>Poor device visibility<br>Traffic signal timing |
| SR 303 & Library Street | 13 (2) | 0.53 | Rear End (6)<br>Sideswipe Passing (4) | Large turning volumes<br>Traffic signal timing<br>Driveway Spacing<br>Inadequate signing |
| SR 303 & First Street | 4 (0) | 0.18 | Angle (1)<br>Rear End (1)<br>Sideswipe Meeting (1)<br>Pedestrian (1) | Driveway spacing<br>Large turning volumes<br>Inadequate signing |
| Valley View Rd & Hines Hill Rd | 8 (2) | 1.13 | Angle (6)<br>Left Turn (1) | Restricted sight distance<br>Excessive speed<br>Inadequate advance warning<br>Inadequate TCD |
| Valley View Rd & Hunting Hollow Dr | 0 (0) | 0.00 | NA | NA |
| Owen Brown St & Lennox Rd | 0 (0) | 0.00 | NA | NA |

*** Crash Rate Per Million Vehicles Entering the Intersection**

## Table 2.3 Intersection Crash Patterns

| INTERSECTION | TOTAL CRASHES (INJURY) | CRASH RATE (MEV*) | MAJOR CRASH PATTERN | PROBABLE CAUSES |
|---|---|---|---|---|
| Owen Brown St & Morse Rd | 3 (1) | 0.43 | Rear End (1)<br>Angle (1)<br>Left Turn (1) | Restricted sight distance<br>Excessive speed<br>Driver inattention |
| Morse Rd & Clinton St | 0 (0) | 0.00 | NA | NA |
| Clinton St & Library St | 1 (0) | 0.19 | Right Turn (1) | Restricted sight distance<br>Excessive speed<br>Driver inattention |
| First St & Village Way | 0 (0) | 0.00 | NA | NA |
| Atterbury Blvd & Stratford Rd | 0 (0) | 0.00 | NA | NA |
| Atterbury Blvd & Lennox Rd | 0 (0) | 0.00 | NA | NA |
| East Case Dr & Milford Rd | 0 (0) | 0.00 | NA | NA |
| Milford Rd & Veterans Way | 1 (0) | 0.20 | Left Turn (1) | Larger turning volumes<br>Excessive speed<br>Driver inattention |
| East Main St & Aurora St | 0 (0) | 0.00 | NA | NA |
| East Main St & Division St | 0 (0) | 0.00 | NA | NA |
| East Main St & Church St | 0 (0) | 0.00 | NA | NA |

*** Crash Rate Per Million Vehicles Entering the Intersection**

## Table 2.3 Intersection Crash Patterns

| INTERSECTION | TOTAL CRASHES (INJURY) | CRASH RATE (MEV*) | MAJOR CRASH PATTERN | PROBABLE CAUSES |
|---|---|---|---|---|
| College St & Division St | 0 (0) | 0.00 | NA | NA |
| College St & Church St | 0 (0) | 0.00 | NA | NA |
| Ravenna St & South Oviatt St | 1 (0) | 0.25 | Rear End (1) | Excessive Speed<br>Slippery Surface<br>Driver inattention |

*** Crash Rate Per Million Vehicles Entering the Intersection**

## 2.5 Crash Diagram

An intersection crash diagram was prepared for the each intersection based on the results from the previous tables and the summary in **Appendix B**.

A crash diagram is a schematic drawing that has been compiled from a series of individual crash reports relative to a specific location (intersection). The diagram includes the vehicles direction of travel prior to contact, and the presence of any pedestrians or bicycles whose presence contributed to a collision or were involved directly in the crash. The crash diagrams can be used as a visual reference in analyzing possible crash patterns at an intersection.

The crash diagrams include the following information:

- Title block with project and study area description.
- Schematic of the location with the approaches labeled and directional arrow indicating north.
- A legend key to denote the symbols and abbreviations used in the diagram.
- Each crash includes the date and time in the following format: DDMMYEAR - HHMM
- Each crash also includes the road conditions and the lighting conditions. RC - LC

The crash data from the years 2014 through 2016 was used to create a crash diagram for each intersection under study. The intersection crash diagrams can be seen in **Appendix B**.

# Chapter 3
# Traffic Signal Warrant Analysis

All of the data collected for this study was analyzed and compared to the traffic signal warrant criteria established by the **OMUTCD** for the study area intersections. The following sections explain the criteria and results of the analyses.

## 3.1 Traffic Signal Control

A properly placed traffic signal can improve the safety and efficiency of flow through an intersection. An unnecessary signal can be the source of danger and annoyance to all who use the intersection including pedestrians, bicyclists, and motorists. It can also increase air pollution and cause driver frustration if there is not much traffic on the major street.

When determining whether or not a traffic signal is necessary at a specific location, an evaluation of the candidate location (called a signal warrant study) is conducted to determine the answers to the following questions:

1. How much traffic is there on the intersecting streets?
2. Are high levels of traffic consistent throughout the day or just during a few hours?
3. Is there a significant amount of pedestrian traffic?
4. Is the street a wide, high speed, and busy thoroughfare?
5. Are school children crossing the street?
6. Will a signal improve the flow of traffic or cause gridlock with other nearby signals?

The signal warrant study collects all of the relevant data at a location that is under study. Once the data is collected, it is compared to criteria that has been established by extensive research and experience and documented in the latest edition of the **Ohio Manual of Uniform Traffic Control Devices (OMUTCD)**. The Ohio Revised Code requires that an engineering signal warrant study must be performed to determine whether installation of a traffic signal is justified at a particular location.

It should be noted that traffic signals do not prevent motor vehicle crashes. Engineering studies have shown that in many instances, total intersection crashes increase after a traffic signal is installed. Certain types of crashes are susceptible to correction by installation of traffic signals, however, overall the number of crashes generally increase.

## 3.2 Traffic Signal Warrants

The OMUTCD provides nine (9) sets of criteria, called warrants. The warrants are;

*Warrant 1 - Eight Hour Vehicular Volume*
This warrant has three conditions. The Minimum Vehicular Volume, Condition A, is intended for application where a large volume of intersecting traffic is the principal reason to consider installing a traffic signal. The Interruption of Continuous Traffic, Condition B, is intended for application where the traffic volume of a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. The third condition is a combination of Condition A and Condition B in which 80% of each condition must be satisfied.

*Warrant 2 - Four Hour Vehicular Volume*
This warrant addresses the need for signalization based on situations existing for less than eight hours and is based upon a sliding scale or combined volume. Four hours of volume must be met.

*Warrant 3 - Peak Hour Vehicular Volume*
This warrant is intended for use at a location where traffic conditions are such for a minimum of one hour of an average day, the minor street suffers undue delay when entering or crossing the major street. This warrant is only applied in unusual cases. Such cases include, but are not limited to, office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

It should be noted that if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, or the speed limit exceeds 40 miles per hour the minimum volume thresholds may be reduced to 70% levels.

*Warrant 4 - Pedestrian Volume*
This warrant is intended for applications where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.

*Warrant 5 - School Crossing*

This warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic signal.

*Warrant 6 - Coordinated Signal System*

This warrant is used when progressive movement of traffic in a coordinated signal system sometimes necessitates installing a traffic signal at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles.

*Warrant 7 - Crash Experience*

This warrant is intended for application where the severity and frequency of crashes are the principal reason to consider installing a traffic signal.

*Warrant 8 - Roadway Network*

This warrant is used at the intersection of two major routes where installing a traffic signal may encourage concentration and organization of traffic flow on a roadway network.

*Warrant 9 - Intersection Near a Grade Crossing*

This warrant is used at an intersection where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing an intersection approach controlled by a stop or yield sign is the principal reason to consider installing traffic signal control.

## 3.3 Traffic Signal Warrant Analysis

The existing traffic conditions at study area intersections were analyzed and compared to the criteria established by the **Ohio Manual of Uniform Traffic Control Devices** and professional engineering judgement in order to determine if traffic signal control is justified. This is required by the Ohio Revised Code. All of the data collected and determined for this study was analyzed and compared to the thresholds established by the criteria from the **OMUTCD**. Warrants 1 - 9 were evaluated for the existing conditions. The warrant analyses worksheets for each intersection can be found in **Appendix C**.

The following intersections were determined to warrant traffic signal control:

1. North Main Street (SR 91) & East/West Prospect Street
2. North Main Street (SR 91) & Clinton Street/Aurora Street
3. North Main Street (SR 91) & East/West Streetsboro Road (SR 303)
4. North Main Street (SR 91) & Veterans Way
5. West Streetsboro Road (SR 303) & Boston Mills Road/East Case Drive
6. West Streetsboro Road (SR 303) & Milford Drive/Atterbury Boulevard
7. West Streetsboro Road (SR 303) & Library Street

Based upon the evaluation of the warrants established by the **Ohio Manual of Uniform Traffic Control Devices**, we conclude that traffic signal control is justified as required by the Ohio Revised Code based upon the 2017 existing conditions at the seven intersections listed above.

The above mentioned intersections are currently operating under traffic signal control.

The remaining intersections under study were determined to not warrant traffic signal control based on the existing conditions. These intersections are currently operating under stop sign control.

# Chapter 4
# Projected Traffic Conditions

## 4.1 Site Traffic

Trip Generation

Calculating future total driveway trips requires an estimate of the traffic generated by the proposed development. The most widely accepted method of determining the amount of traffic that the proposed development will generate is to compare the proposed land use with existing facilities of the same use. The Institute of Transportation Engineers (ITE) has prepared a manual titled **"Trip Generation Manual"**, which is a compilation of similar traffic generation studies to aide in making such a comparison. The most recent update of this manual is the $10^{TH}$ edition and was utilized for this study.

The following table details the development land uses and the corresponding ITE land uses that will be used to forecast the site generated traffic volumes for the Build conditions:

Table 4.1 ITE Land Use Codes

| BLOCK | LAND USE | ITE CODE | ITE DESCRIPTION |
|---|---|---|---|
| C-D-G | Residential | 220 | Multi-Family Housing (Low-Rise) |
| E-F-G | Residential | 221 | Multi-Family Housing (Mid-Rise) |
| A2 | Hotel | 310 | Hotel |
| A2-A3-B-C-D | Office | 710 | General Office Building |
| A2-A3-B-C-D | Retail | 820 | Shopping Center |
| A2-A3-B-C-D | Restaurant | 932 | High-Turnover (Sit-Down) Restaurant |

A summary detailing the development components, sizes, and phasing that will be used to determined the expected site generated traffic can be seen in **Appendix D**.

Pass-by Trips

It should be noted that retail and service land uses generate a different mixture of traffic than land uses such as residential homes and office facilities, which add all of the "new" traffic to the adjacent roadway system. Retail and service land uses also attract motorists from the existing passing flow of traffic. A portion of the estimated total generated trips are actually vehicles that are currently using the adjacent roadway system (i.e. motorists who are already on the road and stop by the drugstore on the way home from work). These vehicles are referred to as "Pass-by" trips and require direct access from roadways directly adjacent to the development site.

The development is not expected to generate pass-by trips as direct access to the development is only available along functionally classified local roadways.

Diverted Link Trips

It should be noted that retail and service land uses generate a different mixture of traffic than land uses such as residential homes and office facilities, which add all of the "new" traffic to the adjacent roadway system. Retail and service land uses also attract motorists from roadways within the vicinity of the development. A portion of the estimated total generated trips are vehicles that would require a diversion from another roadway to a site adjacent roadway to gain access (i.e. motorists who are who are on the interstate and exit to get gas and then re-enter the interstate). These vehicles are referred to as "Diverted Link" trips. It should be noted that diverted link trips add traffic to the roadways adjacent to the site, but may not add traffic to the study area's major travel routes.

The development is expected to generate diverted link trips from North Main Street (SR 91) and West Streetsboro Road (SR 303).

The ITE **Trip Generation Handbook, Third Edition** provides diverted link rates for various retail and service land uses. To provide a conservative estimate, the average diverted link percentages will be used for purposes of this analysis. While some diverted link traffic is likely to occur during the AM peak hour for the restaurant and retail land uses, no percentages have been documented by the Trip Generation Handbook. The trip generation calculations will therefore assume all AM peak hour trips to be new generated traffic.

The following tables details the PM peak hour diverted link rates for use in the development trip generation calculations:

Table 4.2 PM Peak Hour Diverted Link Rates

| LAND USE | ITE CODE | AM PEAK HOUR | | |
|---|---|---|---|---|
| | | LOWEST | HIGHEST | AVERAGE |
| Shopping Center | 820 | 6% | 44% | 26% |
| High-Turnover (Sit-Down) Restaurant | 932 | 11% | 54% | 26% |

Internal Capture

The proposed Downtown Phase 2 development can be classified as a multi-use development where trips can be made between two on site land uses without using the off-site road system. Because of the nature of these developments, the trip making characteristics are interrelated, and some trips are made among on-site uses. This capture of trips internal to the site has the net effect of reducing vehicle trip generation between the overall development site and the external street system (compared to the total number of trips generated by comparable land uses developed individually on stand-alone sites). It will be assumed that internal connections will be available within the development during Phase 1 and full build out of the development.

Internal trips between residents who live and work within the development are also likely to occur and could be considered part of the internal capture for the development. In order to provide a conservative estimate of the site generated trips Internal trips between the residential and office land uses will not be included in the internal capture calculations. Site generated trip calculations will only be carried out for trips between the commercial land uses and the office and residential land uses.

In order to calculate the internally captured trips the methodology used was developed as part of a research project sponsored by the National Cooperative Highway Research Program (NCHRP) entitled **Enhancing Internal Trip Capture Estimation of Mixed-Use Developments**, published as **NCHRP Report 684**. The methodology developed in the NCHRP project enriches the methodology presented in the ITE **Trip Generation Handbook, 3RD Edition**.

**NCHRP Report 684** provides a computer spreadsheet tool to assist in preparing the calculations of the internally captured trips. Copies of the internal trip capture calculations using the **NCHRP Report 684** spreadsheet for the opening year and the design year can be seen in **Appendix D**.

Trip generation calculations for the development were performed utilizing data contained in the **Trip Generation Manual** and the methods outlined in the (ITE) **Trip Generation Handbook** that have been discussed previously. Copies of the trip generation detail worksheets can be found in **Appendix D**. The following tables detail the expected site generated traffic for each phase of the development:

## Table 4.3 Net Trip Generation
## Hudson Phase 2 Development - Phase 1

| ITE TRIP GENERATION | | SIZE | TRIP ENDS | | | |
|---|---|---|---|---|---|---|
| ITE Code | Description | | Weekday Peak Hour Between 7-9 AM (Enter/Exit) | | Weekday Peak Hour Between 4-6 PM (Enter/Exit) | |
| 220 | Multifamily Housing (Low-Rise) | 22 | 4 | 10 | 9 | 7 |
| | Internal Trip Reduction | Units | -- | -- | -- | -- |
| Driveway Volumes Less Internal Trip Reduction | | | 4 | 10 | 9 | 7 |
| 221 | Multifamily Housing (Mid-Rise) | 80 | 8 | 21 | 22 | 14 |
| | Internal Trip Reduction | Units | -- | -- | -- | -- |
| Driveway Volumes Less Internal Trip Reduction | | | 8 | 21 | 22 | 14 |
| 310 | Hotel | 60 | 22 | 18 | 23 | 16 |
| | Internal Trip Reduction | Rooms | -1 | -11 | -13 | -8 |
| Driveway Volumes Less Internal Trip Reduction | | | 21 | 7 | 10 | 8 |
| 710 | General Office Building | 144,701 | 202 | 28 | 40 | 184 |
| | Internal Trip Reduction | Sq Ft | -42 | -26 | -5 | -9 |
| Driveway Volumes Less Internal Trip Reduction | | | 160 | 2 | 35 | 175 |
| 820 | Shopping Center | 15,487 | 99 | 61 | 74 | 74 |
| | Internal Trip Reduction | Sq Ft | -19 | -16 | -44 | -26 |
| Driveway Volumes Less Internal Trip Reduction | | | 80 | 45 | 30 | 48 |
| Diverted Trip Reduction ( AM-NA / PM - 26%) | | | 0 | 0 | 8 | 12 |
| 932 | High-Turnover Restaurant | 15,487 | 124 | 93 | 140 | 129 |
| | Internal Trip Reduction | Sq Ft | -28 | -37 | -31 | -50 |
| Driveway Volumes Less Internal Trip Reduction | | | 96 | 56 | 109 | 79 |
| Diverted Trip Reduction ( AM-NA / PM - 26%) | | | 0 | 0 | 28 | 21 |
| **TOTAL DRIVEWAY VOLUMES** | | | **369** | **141** | **215** | **331** |
| **TOTAL DIVERTED TRIP REDUCTION** | | | **0** | **0** | **36** | **33** |
| **TOTAL NEW TRIPS** | | | **369** | **141** | **179** | **298** |
| | | | **510** | | **477** | |

## Table 4.4 Net Trip Generation
## Hudson Phase 2 Development - Phase 1 & 2 (Full Build)

| ITE TRIP GENERATION | | SIZE | TRIP ENDS | | | |
|---|---|---|---|---|---|---|
| ITE Code | Description | | Weekday Peak Hour Between 7-9 AM (Enter/Exit) | | Weekday Peak Hour Between 4-6 PM (Enter/Exit) | |
| 220 | Multifamily Housing (Low-Rise) | 45 | 8 | 19 | 18 | 13 |
| | Internal Trip Reduction | Units | -- | -- | -- | -- |
| Driveway Volumes Less Internal Trip Reduction | | | 8 | 19 | 18 | 13 |
| 221 | Multifamily Housing (Mid-Rise) | 168 | 15 | 42 | 44 | 28 |
| | Internal Trip Reduction | Units | -- | -- | -- | -- |
| Driveway Volumes Less Internal Trip Reduction | | | 15 | 42 | 44 | 28 |
| 310 | Hotel | 60 | 22 | 18 | 23 | 16 |
| | Internal Trip Reduction | Rooms | -1 | -12 | -17 | -12 |
| Driveway Volumes Less Internal Trip Reduction | | | 21 | 6 | 6 | 4 |
| 710 | General Office Building | 162,754 | 224 | 31 | 44 | 200 |
| | Internal Trip Reduction | Sq Ft | -47 | -29 | -7 | -11 |
| Driveway Volumes Less Internal Trip Reduction | | | 177 | 2 | 37 | 189 |
| 820 | Shopping Center | 21,504 | 101 | 62 | 93 | 93 |
| | Internal Trip Reduction | Sq Ft | -20 | -17 | -56 | -33 |
| Driveway Volumes Less Internal Trip Reduction | | | 81 | 45 | 37 | 60 |
| Diverted Trip Reduction ( AM-NA / PM - 26%) | | | 0 | 0 | 10 | 16 |
| 932 | High-Turnover Restaurant | 21,504 | 172 | 130 | 195 | 180 |
| | Internal Trip Reduction | Sq Ft | -30 | -40 | -41 | -65 |
| Driveway Volumes Less Internal Trip Reduction | | | 142 | 90 | 154 | 115 |
| Diverted Trip Reduction ( AM-NA / PM - 26%) | | | 0 | 0 | 40 | 30 |
| **TOTAL DRIVEWAY VOLUMES** | | | **444** | **204** | **296** | **409** |
| **TOTAL DIVERTED TRIP REDUCTION** | | | **0** | **0** | **50** | **46** |
| **TOTAL NEW TRIPS** | | | **444** | **204** | **246** | **363** |
| | | | **648** | | **609** | |

Distribution of Generated Traffic

The directional distribution for the new generated traffic is a function of several variables including size and type of the proposed development, the prevailing operating conditions on the existing roadways, population distribution within the defined area of influence and current land uses.

The distribution of traffic for the analysis contained in this report also included a review of available data from the following organizations that can currently be found at the following web addresses:

| | |
|---|---|
| AMATS: | http://amatsplanning.org/ |
| Summit County: | https://co.summitoh.net/ |
| ODOT TIMS: | http://odot.ms2soft.com/tcds/tsearch.asp?loc=Odot&mod= |
| On The Map: | https://onthemap.ces.census.gov/ |

The Akron Metropolitan Area Transporation Study (AMATS) is the metropolitan planning organization (MPO) for Summit, Portage, and a portion of Wayne counties. A MPO is a federally mandated and funded transportation policy-making organization made up of local government and transportation officials.

The ODOT TIMS website is a web-mapping portal that provides a variety of data regarding the transportation system in Ohio.

On The Map is a web-based mapping and reporting application that shows where workers are employed and where they live. The application also provides a variety of additional census data.

The distribution pattern based on the existing peak hour traffic volumes can be seen in the following tables.:

## Table 4.5 Trip Origins and Destinations
## AM Peak Hour

| ORIGIN/ DESTINATION | ROUTE | FROM | % TOTAL | TO | % TOTAL |
|---|---|---|---|---|---|
| NORTH | SR 91 | 416 | 14% | 700 | 22% |
| NORTH | Valley View | 127 | 4% | 115 | 4% |
| SOUTH | SR 91 | 798 | 26% | 511 | 16% |
| SOUTH | Ravenna | 128 | 4% | 61 | 2% |
| WEST | Hines Hill | 189 | 6% | 205 | 7% |
| WEST | Boston Mills | 118 | 4% | 245 | 8% |
| WEST | SR 303 | 621 | 20% | 551 | 17% |
| EAST | Aurora | 198 | 6% | 227 | 7% |
| EAST | SR 303 | 502 | 16% | 544 | 17% |
| | **TOTALS** | **3097** | **100%** | **3159** | **100%** |

## Table 4.6 Trip Origins and Destinations
## PM Peak Hour

| ORIGIN/ DESTINATION | ROUTE | FROM | % TOTAL | TO | % TOTAL |
|---|---|---|---|---|---|
| NORTH | SR 91 | 688 | 17% | 559 | 15% |
| NORTH | Valley View | 180 | 5% | 159 | 4% |
| SOUTH | SR 91 | 908 | 23% | 940 | 25% |
| SOUTH | Ravenna | 102 | 3% | 171 | 4% |
| WEST | Hines Hill | 247 | 6% | 270 | 7% |
| WEST | Boston Mills | 276 | 7% | 156 | 4% |
| WEST | SR 303 | 671 | 17% | 695 | 18% |
| EAST | Aurora | 303 | 8% | 231 | 6% |
| EAST | SR 303 | 569 | 14% | 656 | 17% |
| | **TOTALS** | **3944** | **100%** | **3837** | **100%** |

The collected traffic data for this report was compared to the available data from ODOT and AMATS.

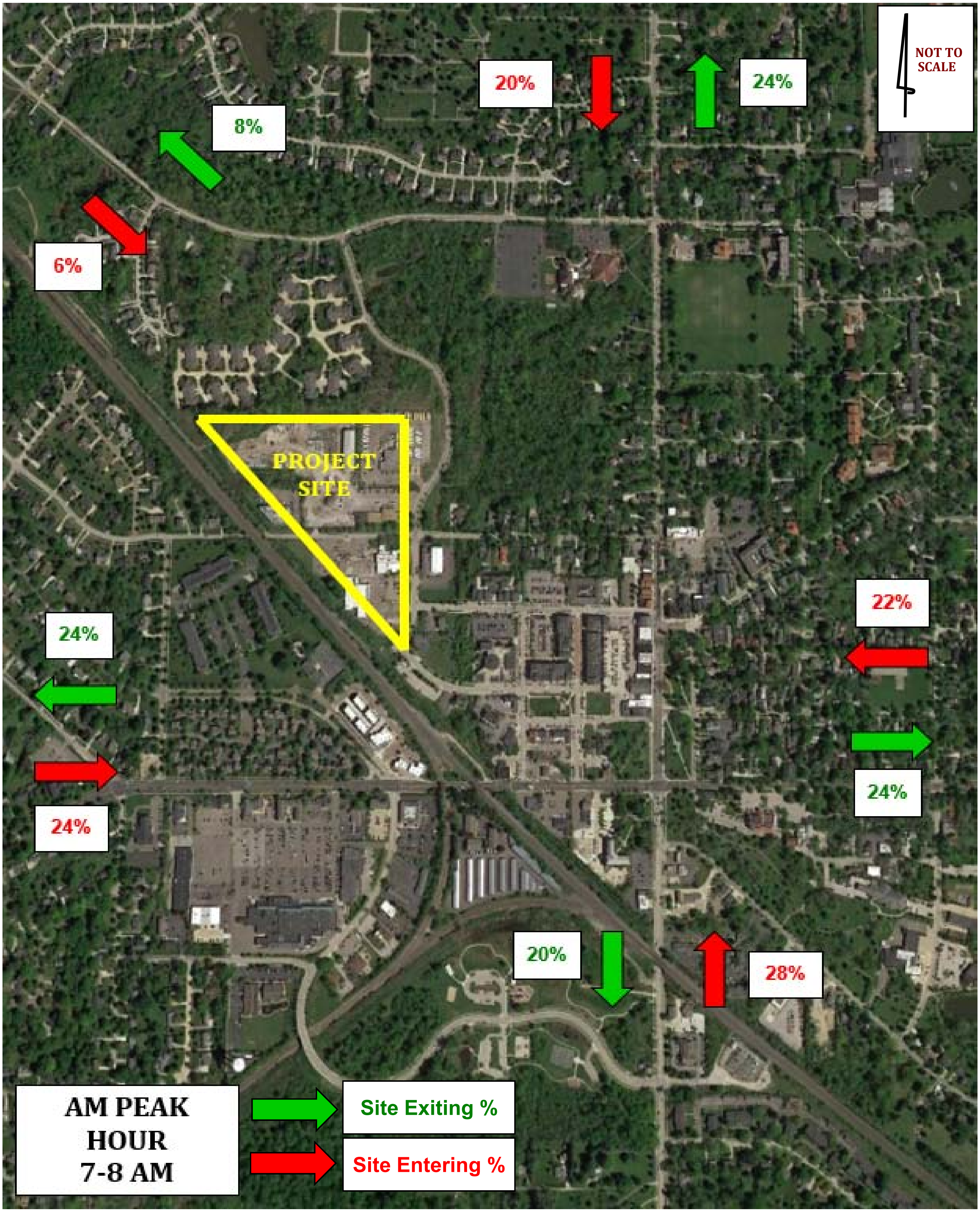
The On The Map application was used to create a series of maps detailing where residents of Hudson are going to work and where people working in Hudson are coming from. These maps can be seen in **Appendix E**.

The distribution patterns for the site generated traffic are based upon engineering judgment of the previously discussed variables and data shown in Tables 4.5 and Table 4.6. These distribution patterns should provide a conservative estimate of where traffic is originating from and where traffic is destined for.

The peak hour distribution pattern that will be used to distribute the site generated traffic in the study area is shown in **Figures 4.1 and 4.2, Page 37 and 38** for the AM and PM peak hours, respectively.

The directional distribution for the new AM and PM peak hour generated traffic volumes are shown graphically in **Figure 4.3, Page 39.**

The directional distribution for the generated PM peak hour diverted link traffic volumes are shown graphically in **Figure 4.4, Page 40.**

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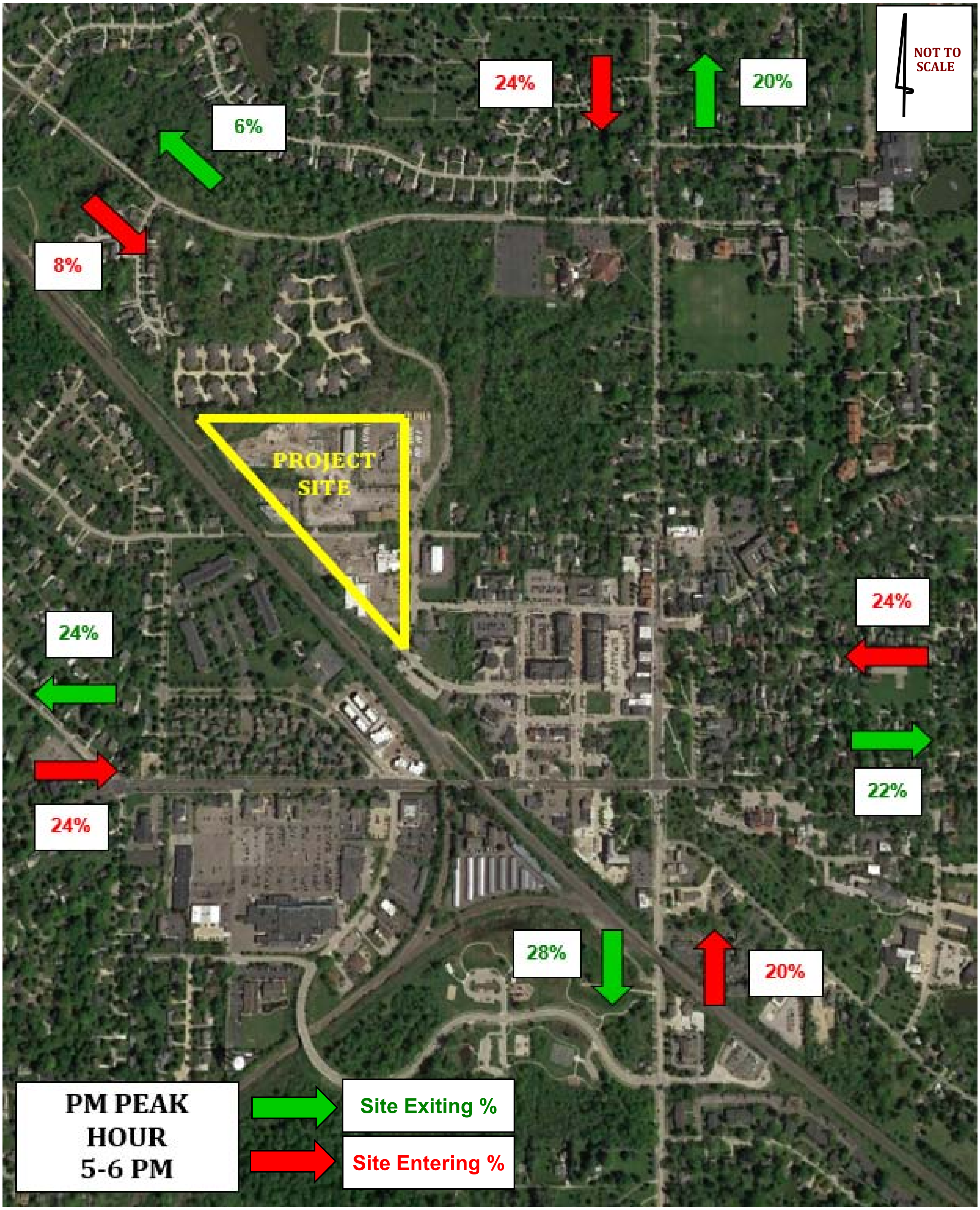
Downtown Phase II
Hudson, Ohio
Traffic Impact Study

AM Peak Hour
Traffic Distribution
Percentages

Figure 4.1

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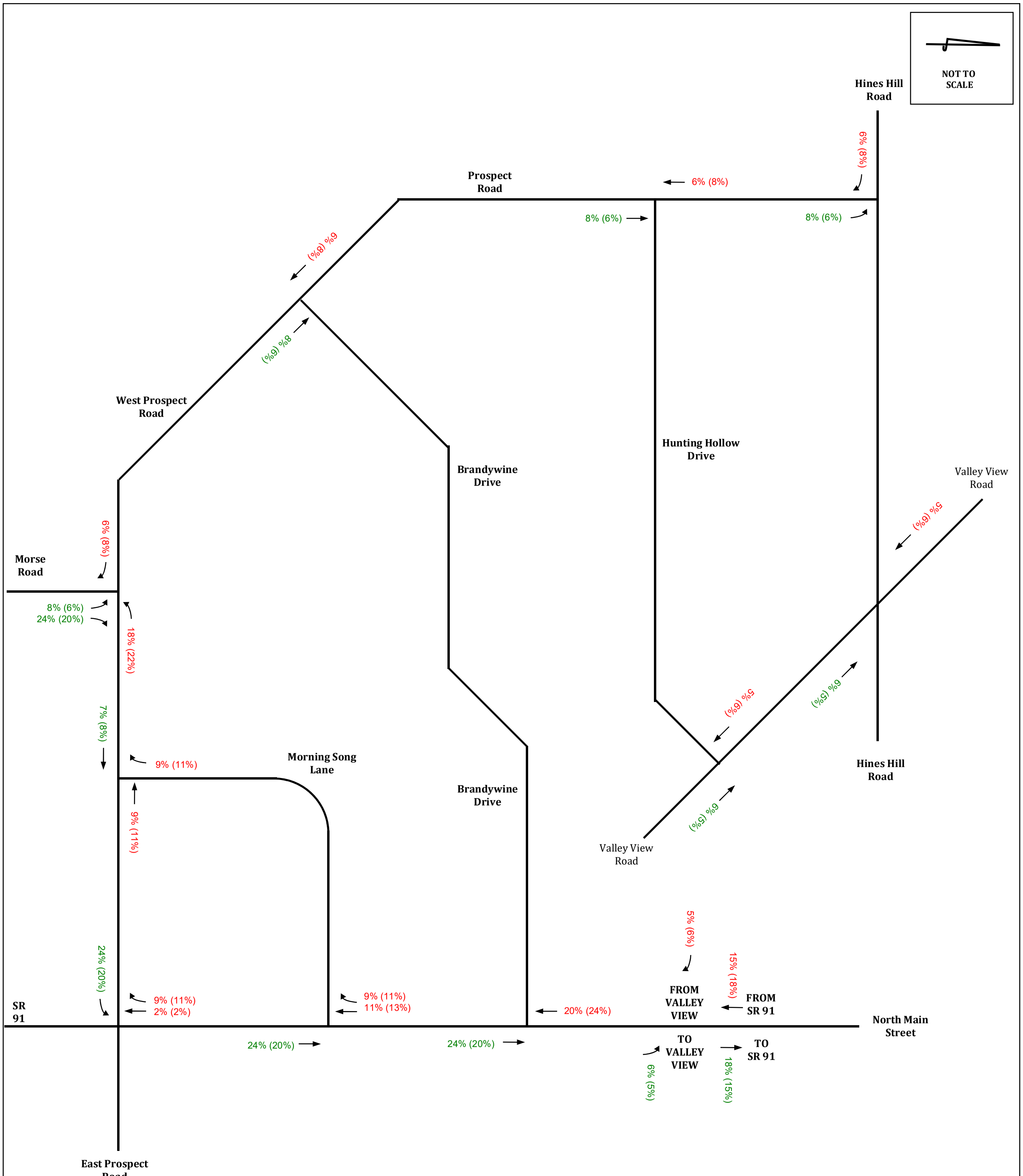
PM Peak Hour Traffic Distribution Percentages

Figure 4.2




| LEGEND |
| --- |
| XX% AM Peak Hour Distribution |
| (XX%) PM Peak Hour Distribution |
| RED = Entering Volumes |
| GREEN = Exiting Volumes |

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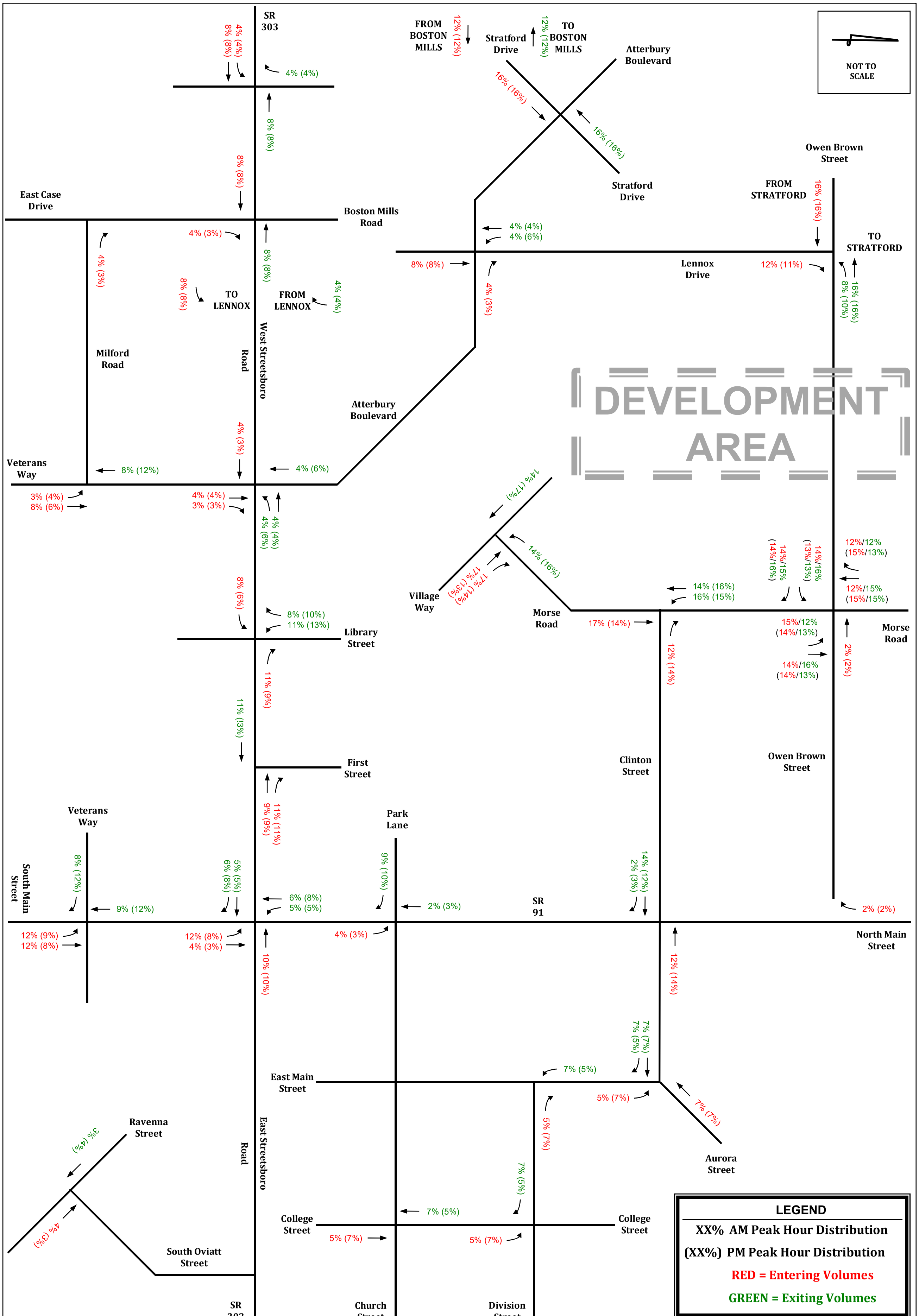
Directional Distribution
New Trips
(North Section)

Figure: 4.3a

Page: 39a

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Downtown Phase II
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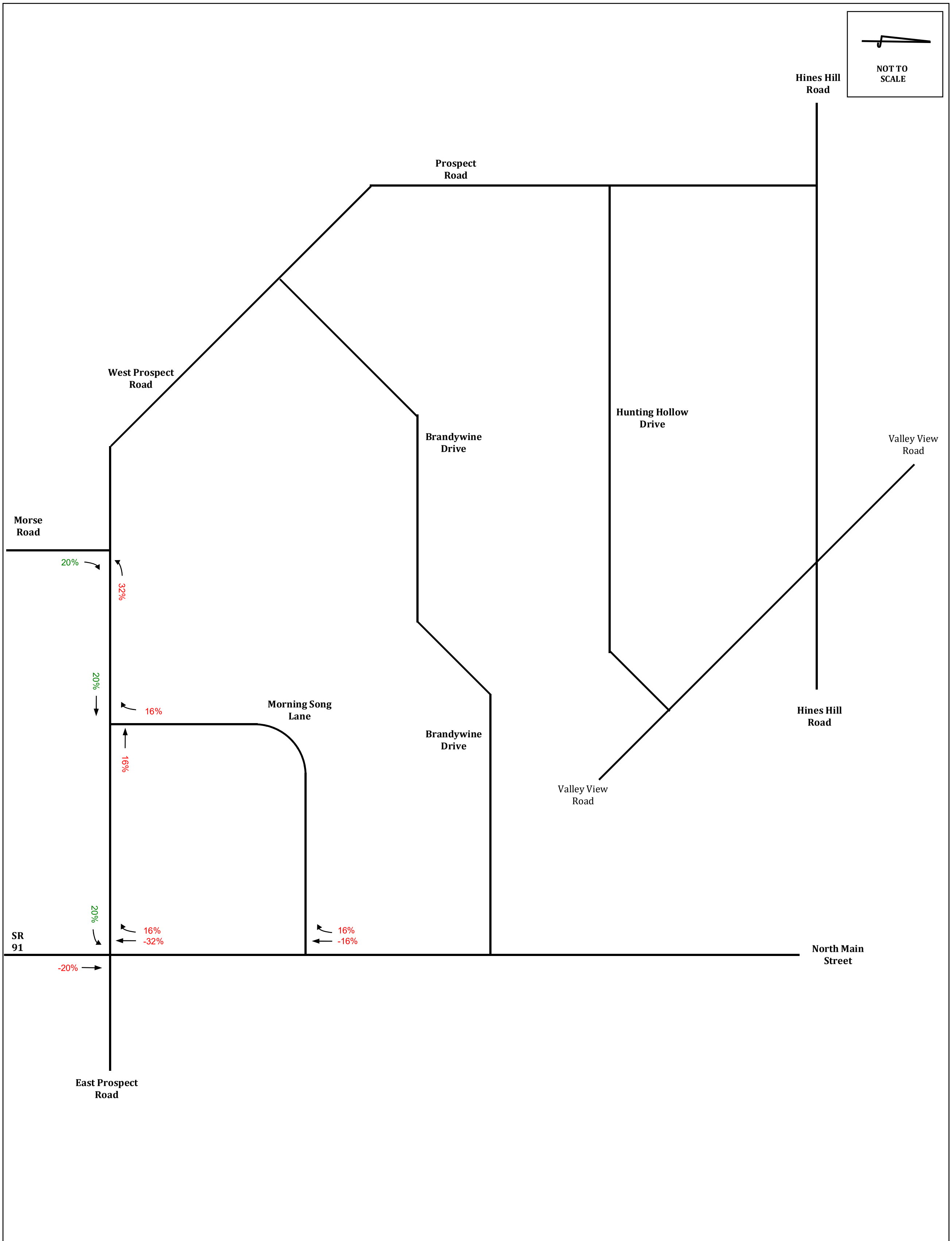
Directional Distribution
New Trips
(South Section)

Figure: 4.3b

Page: 39b




| LEGEND |
| --- |
| XX% PM Peak Hour Distribution |
| RED = Entering Volumes |
| GREEN = Exiting Volumes |

| | | | |
| --- | --- | --- | --- |
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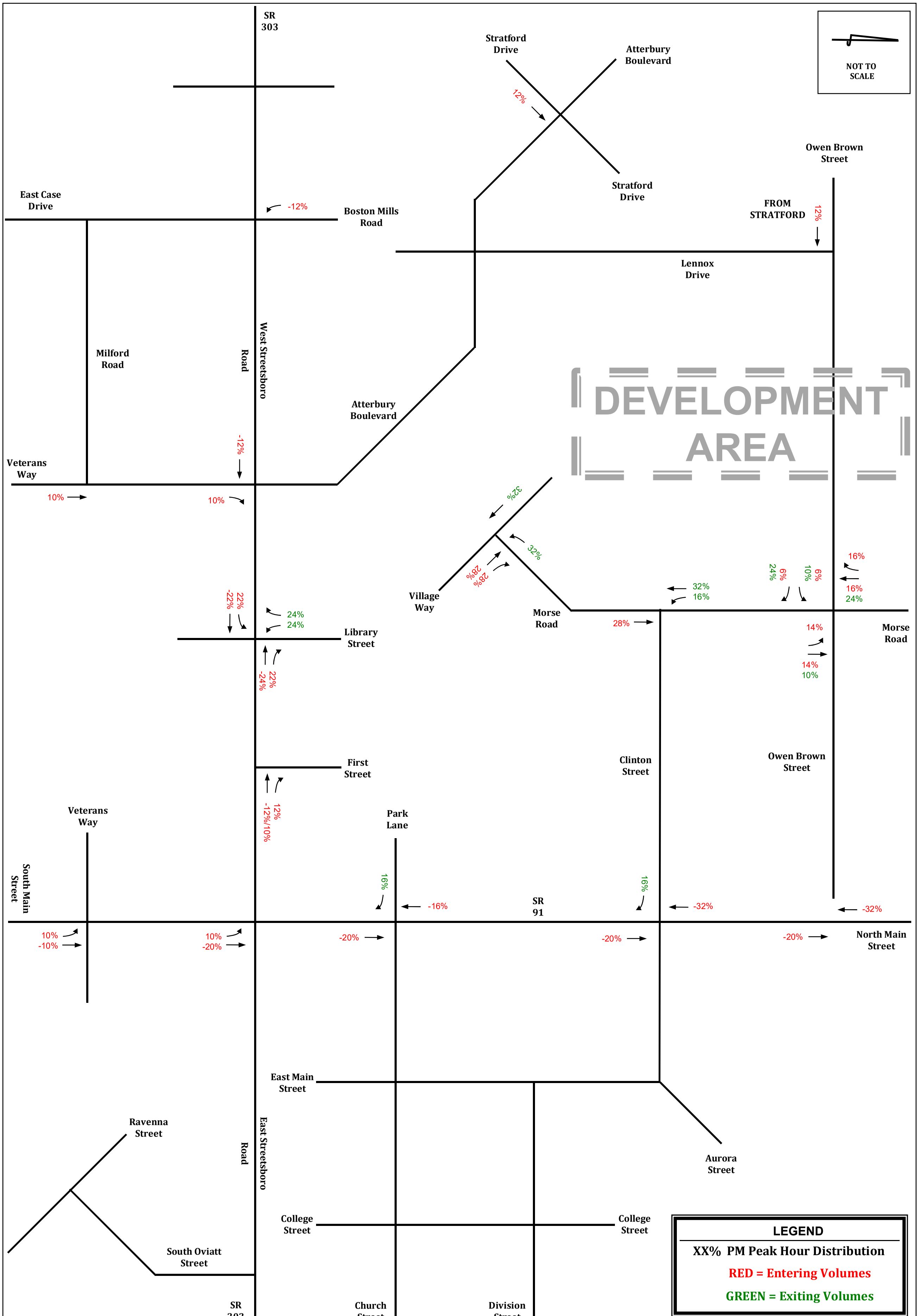


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Directional Distribution
Diverted Link Trips
(South Section)

Figure: 4.4b

Page: 40b

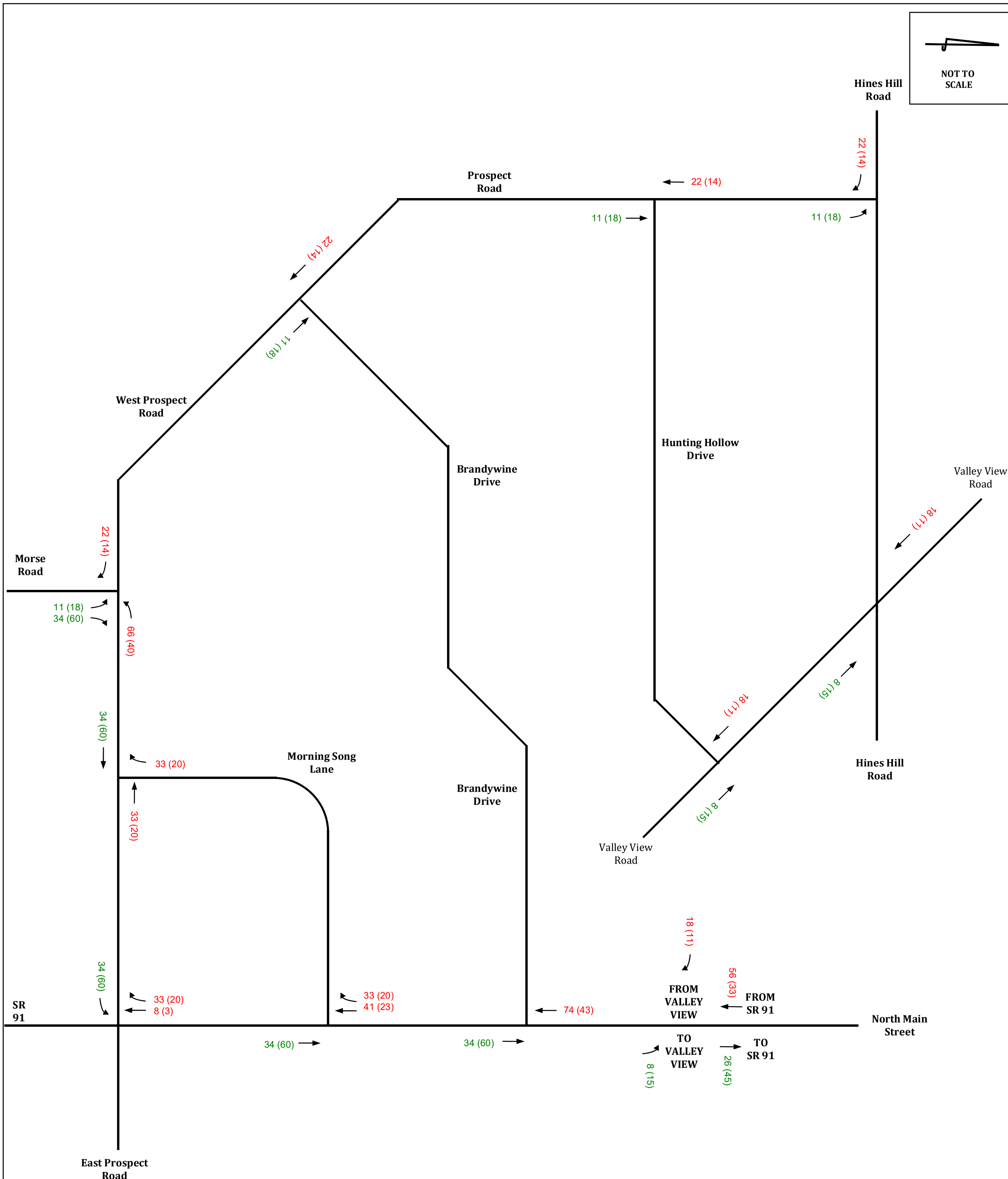
Assignment of Generated Traffic

Based upon the distribution pattern shown in **Figure 4.3**, the new AM and PM peak generated traffic were assigned to the study intersections for Phase 1 of the proposed development. **Figure 4.5, Page 42** details the Phase 1 site generated traffic volumes.

Based upon the distribution pattern shown in **Figure 4.3**, the new AM and PM peak generated traffic were assigned to the study intersections for the full build out of the development. **Figure 4.6, Page 43** details the full build site generated traffic volumes.

Based upon the distribution pattern shown in **Figure 4.4**, the diverted link PM peak generated traffic was assigned to the study intersections for Phase 1 of the proposed development. **Figure 4.7, Page 44** details the Phase 1 site generated diverted link traffic volumes.

Based upon the distribution pattern shown in **Figure 4.4**, the diverted link PM peak generated traffic was assigned to the study intersections for the full build out of the development. **Figure 4.8, Page 45** details the full build site generated diverted link traffic volumes.




| NEW GENERATED TRAFFIC | AM | PM |
|---|---|---|
| TOTAL TRIPS | 510 | 477 |
| ENTER | 369 | 179 |
| EXIT | 141 | 298 |

**LEGEND**

XX% AM Peak Hour Trips

(XX%) PM Peak Hour Trips

RED = Entering Volumes

GREEN = Exiting Volumes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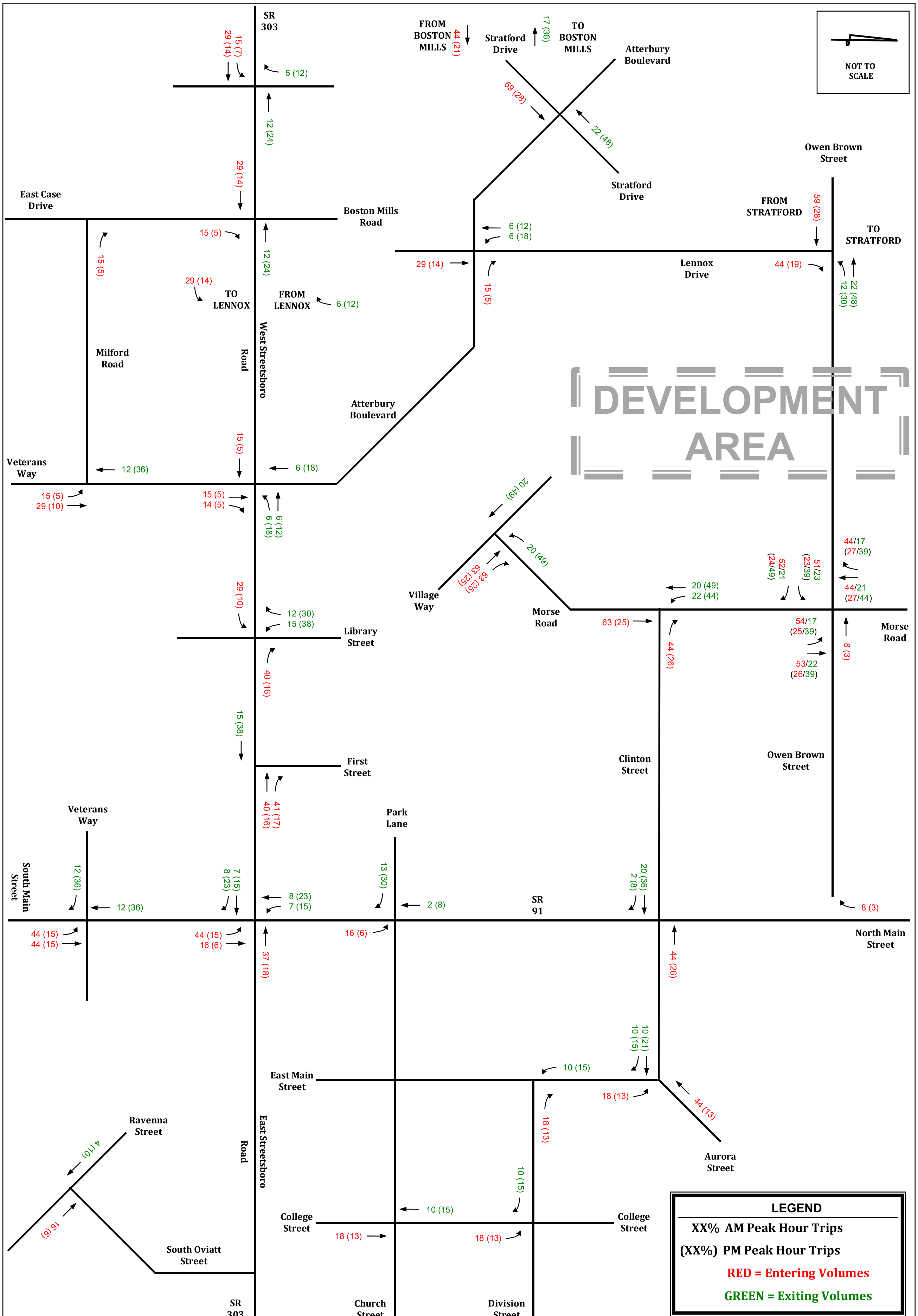
New Generated Trips
Phase 1
(North Section)

Figure: 4.5a

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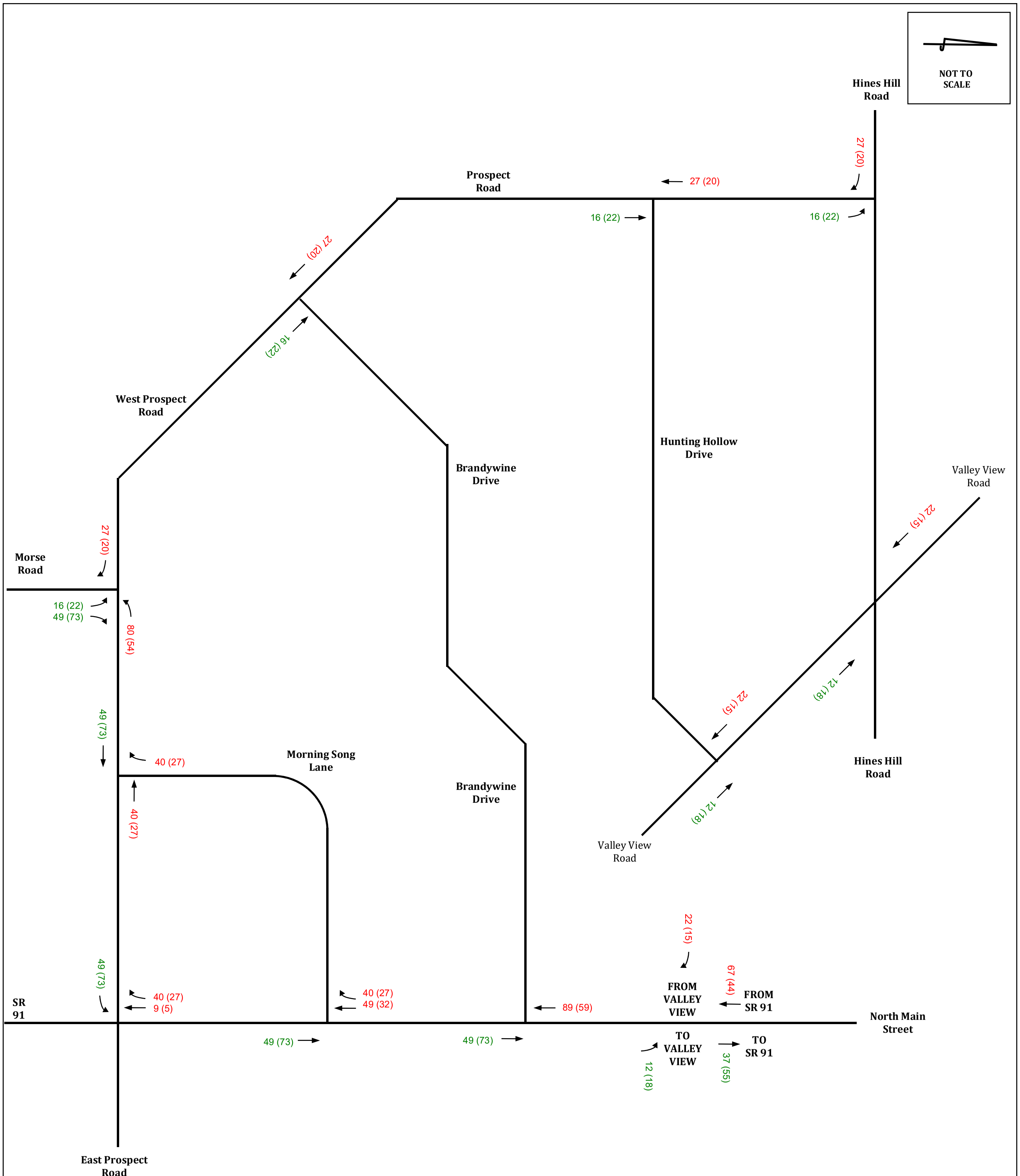
New Generated Trips
Phase 1
(South Section)

Figure: 4.5b

Page: 42b




**NEW GENERATED TRAFFIC**

| | AM | PM |
|---|---|---|
| TOTAL TRIPS | 648 | 609 |
| ENTER | 444 | 246 |
| EXIT | 204 | 363 |

**LEGEND**

XX% AM Peak Hour Trips

(XX%) PM Peak Hour Trips

RED = Entering Volumes

GREEN = Exiting Volumes

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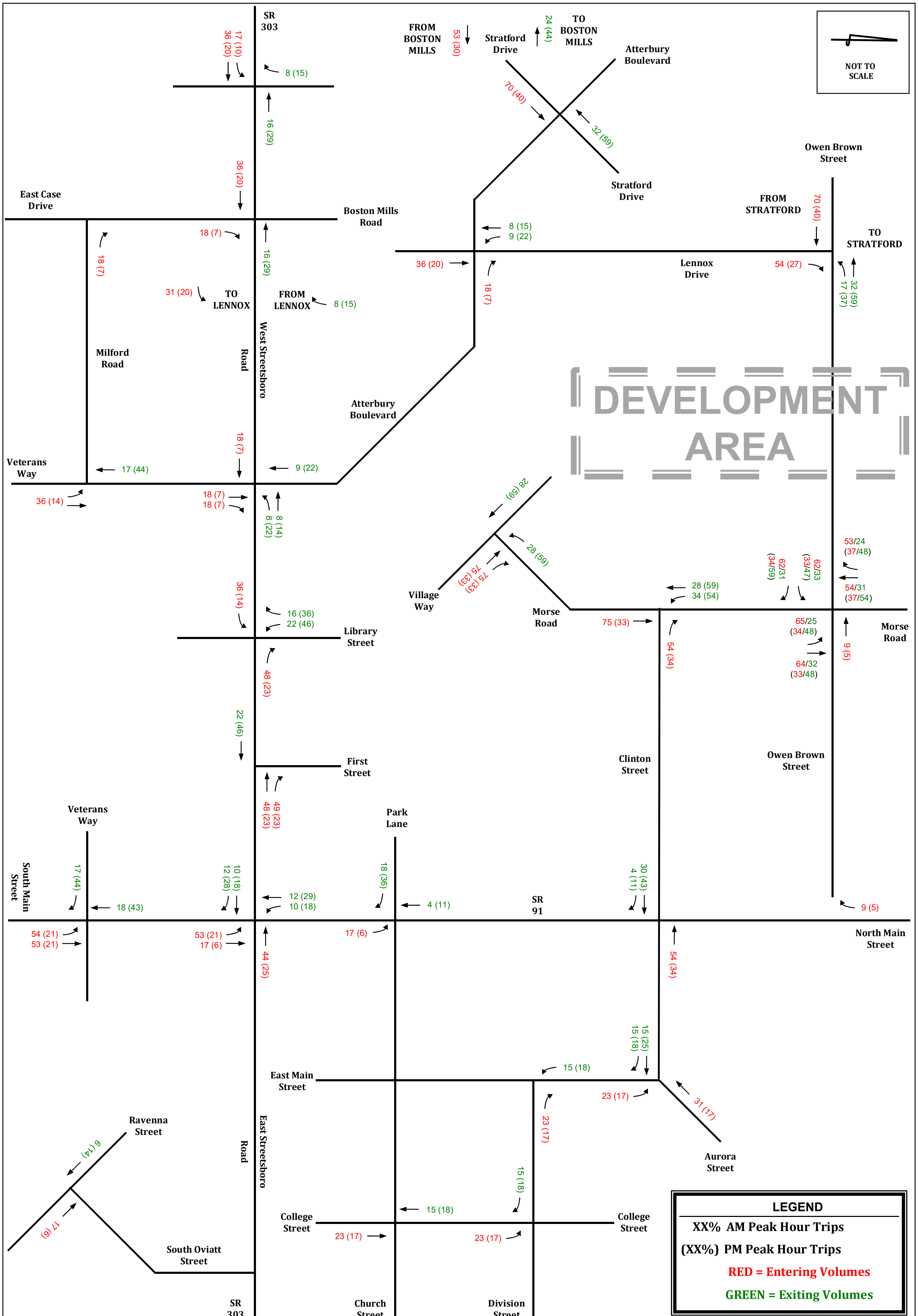
New Generated Trips
Full Build
(North Section)

Figure: 4.6a

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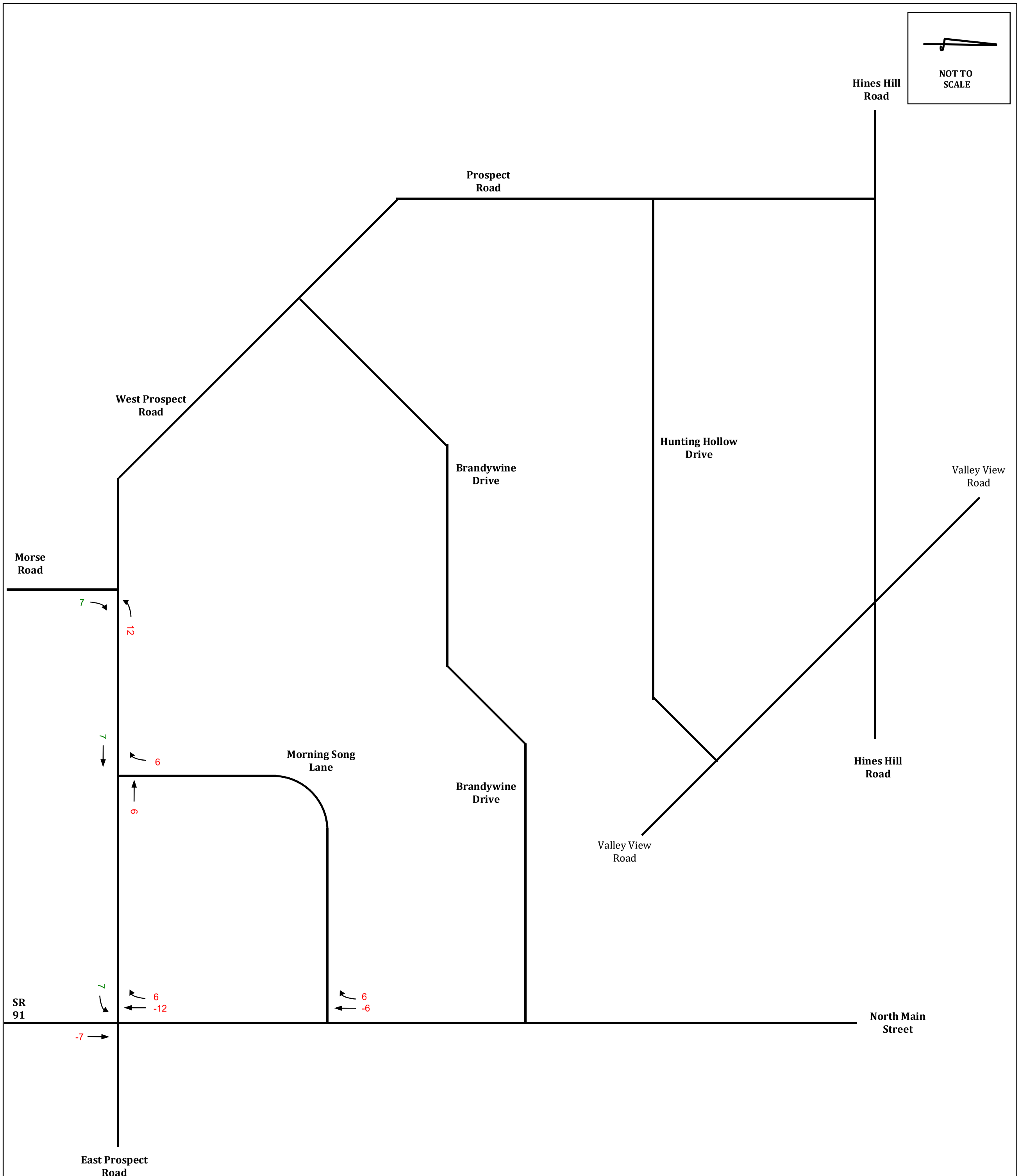
**New Generated Trips**
**Full Build**
**(South Section)**

**Figure: 4.6b**




| NEW GENERATED TRAFFIC | PM |
|---|---|
| TOTAL TRIPS | 69 |
| ENTER | 36 |
| EXIT | 33 |

**LEGEND**

XX% PM Peak Hour Trips

RED = Entering Volumes

GREEN = Exiting Volumes

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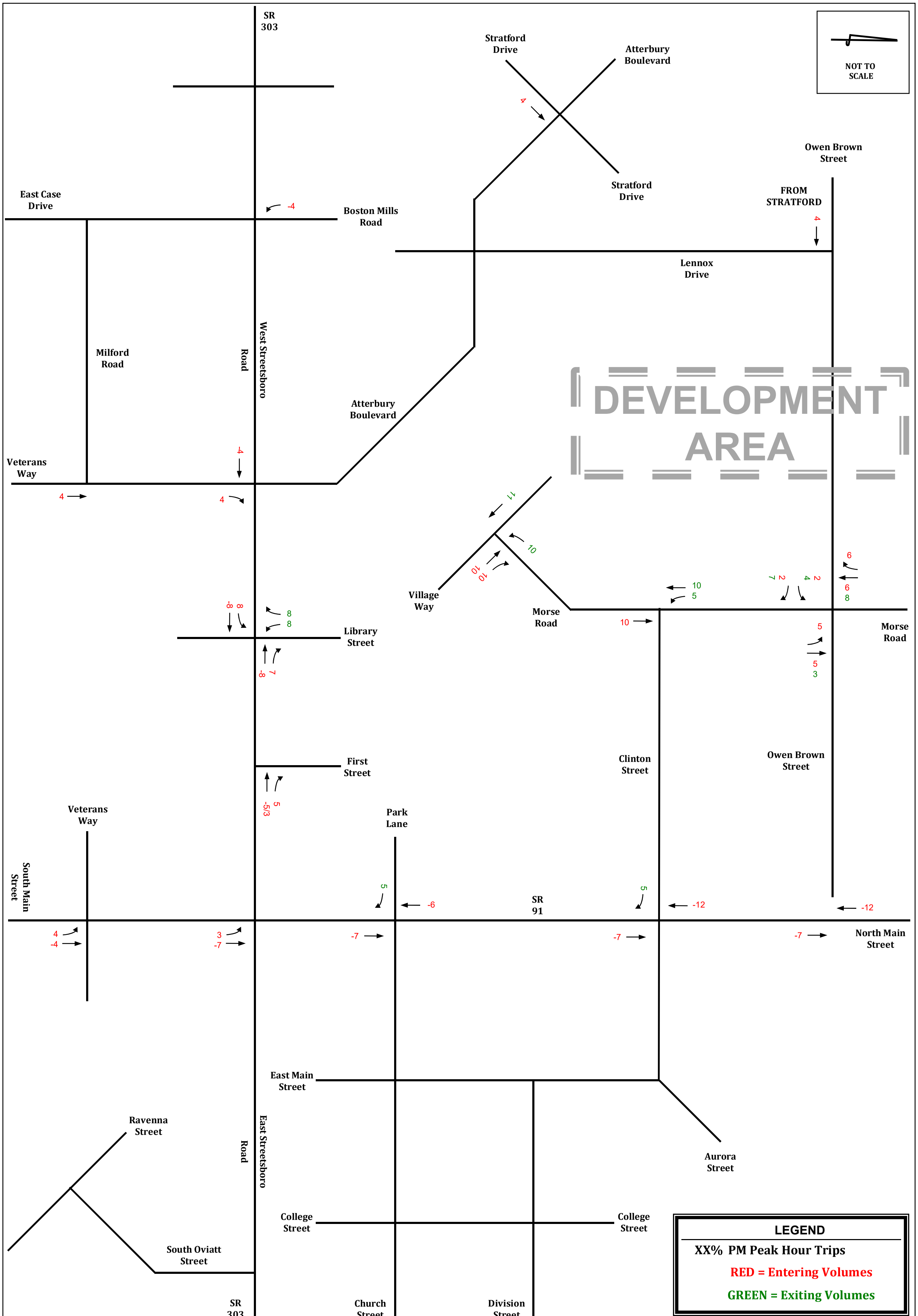
Diverted Link Trips
Phase 1
(North Section)

Figure: 4.7a

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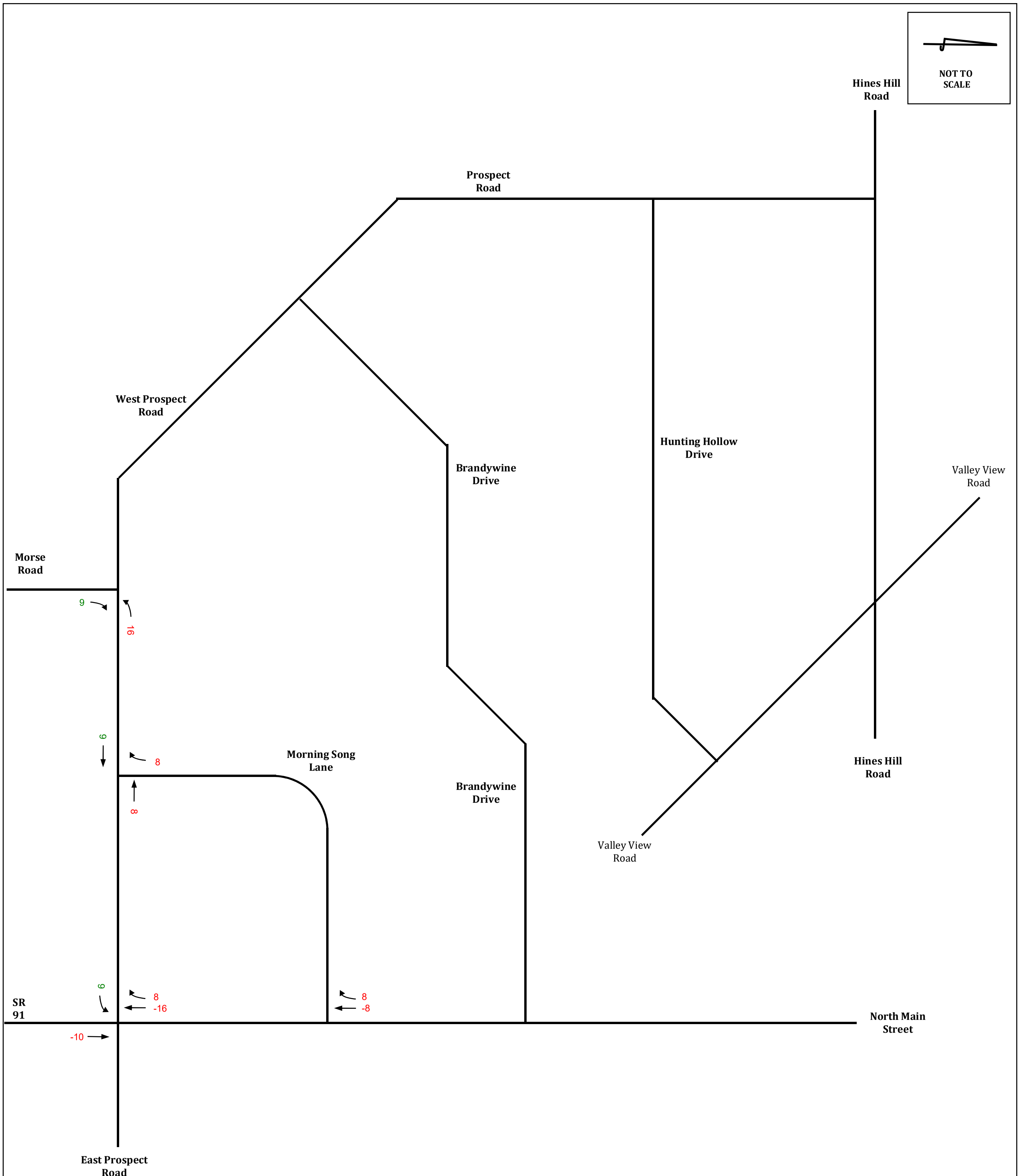
Diverted Link Trips
Phase 1
(South Section)

Figure: 4.7b

Page: 44b




**NEW GENERATED TRAFFIC**

| | PM |
|---|---|
| TOTAL TRIPS | 96 |
| ENTER | 50 |
| EXIT | 46 |

**LEGEND**

XX% PM Peak Hour Trips

RED = Entering Volumes

GREEN = Exiting Volumes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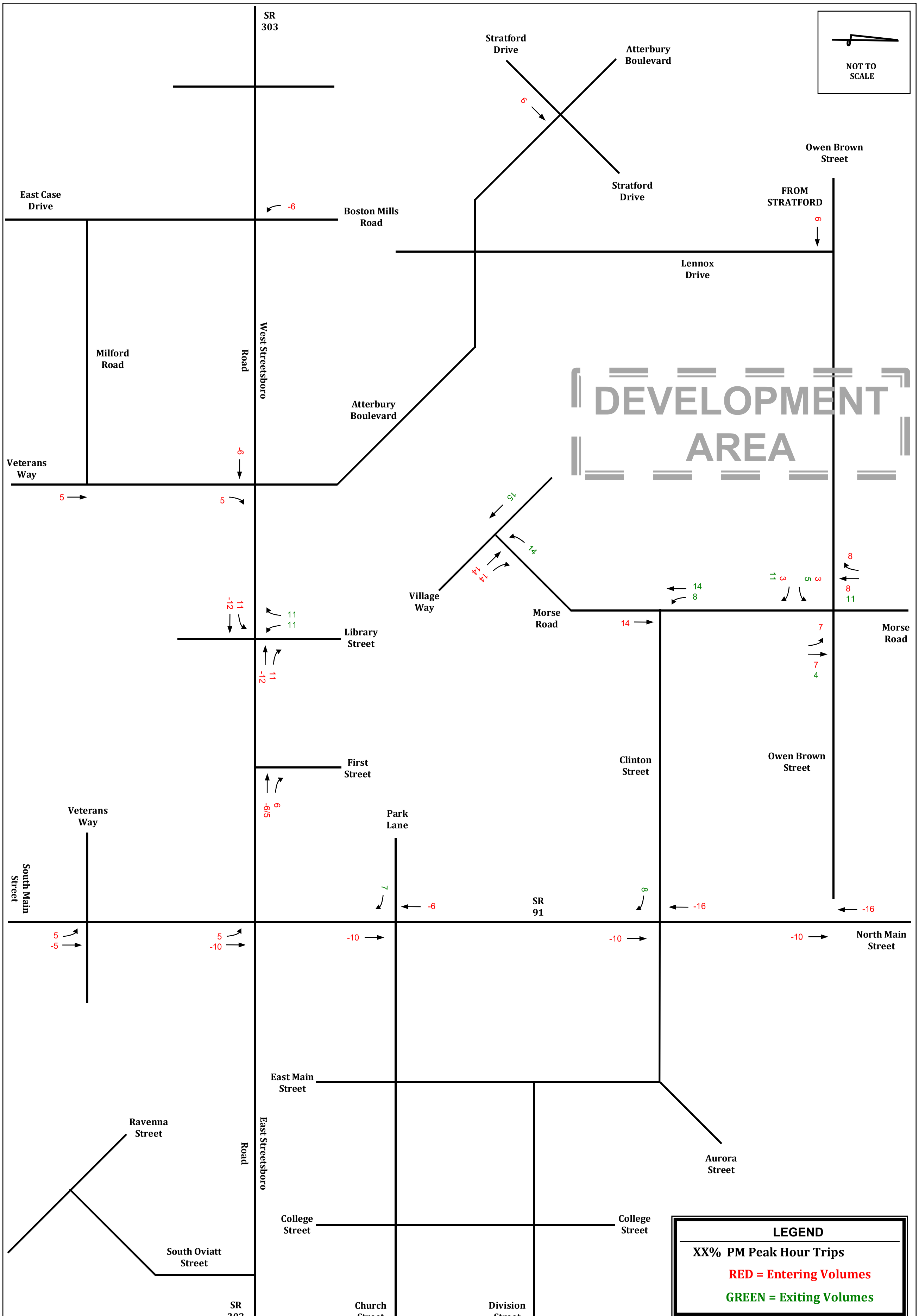
Diverted Link Trips
Full Build
(North Section)

Figure: 4.8a

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Diverted Link Trips
Full Build
(South Section)

Figure: 4.8b

Page: 45b

## 4.2 Non-Site Traffic

Background Traffic Growth

Design of new roadways or improvements to existing roadways should not usually be based on current traffic volumes alone, but should consider future traffic volumes expected to make use of the facilities. Roadways should be designed to accommodate the traffic volume that is likely to occur within the design life of the facility. In a practical sense, this design volume should be a value that can be estimated with reasonable accuracy. It is believed that the maximum design period is in the range of 15 to 24 years. Therefore, a period of twenty years is widely used as a basis for design. Traffic cannot usually be forecasted accurately beyond this period on a specific facility because of probable changes in the general regional economy, population, and land development along the roadway. The ODOT **Access Management Manual** requires that opening year and twenty year design hour traffic volumes be analyzed for a proposed development.

Roadways like those found in the study area carry a significant amount of through traffic due to their functional characteristics. This through traffic component generally increases as regional growth occurs. Therefore, it is anticipated that existing traffic on the study area roadways will increase in future years.

The years 2019, 2021, and 2041 (design year) will be analyzed for the proposed development. Therefore, it is necessary to estimate historical growth rates in order to establish the future traffic on the study area roadways due to non-site related conditions.

The ODOT Traffic Management Monitoring System (TMMS) was consulted to determine past historical trends along the roadways in the vicinity of the study area. This historical traffic data was used to determine the study area growth rates. The TMMS can be seen and accessed at the following web address:

http://odot.ms2soft.com/tcds/tsearch.asp?loc=Odot&mod=

Data for locations along State Route 91 south of Prospect Street and north of Barlow Road can be seen in **Appendix F**.

Data for locations along State Route 303 east of Boston Mills Road and west of Stow Road can be seen in **Appendix F**.

Based on the historical traffic data from ODOT's TMMS, the functional characteristics due to the roadway functional classification, and in order to provide a conservative analysis of the study area, linear growth rates will be used to determine the anticipated study area volumes under the 2019, 2021, and 2041 No-Build conditions. The growth rate and factors for the study area roadways based on their functional classification can be seen in the following table:

### Table 4.7 - Growth Rates & Factors
### 2017 Traffic Count Data

| ROADWAY FUNCTIONAL CLASSIFICATION | GROWTH RATE (Annual Growth) | 2019 GROWTH FACTOR | 2021 GROWTH FACTOR | 2041 GROWTH FACTOR |
|---|---|---|---|---|
| Principal Arterial | 1.00% | 1.02 | 1.04 | 1.24 |
| Minor Arterial | 0.75% | 1.015 | 1.03 | 1.18 |
| Major Collector | 0.50% | 1.01 | 1.02 | 1.12 |
| Local Roadway | 0.00% | 1.00 | 1.00 | 1.00 |

### Table 4.8 - Growth Rates & Factors
### 2015 Traffic Count Data

| ROADWAY FUNCTIONAL CLASSIFICATION | GROWTH RATE (Annual Growth) | 2019 GROWTH FACTOR | 2021 GROWTH FACTOR | 2041 GROWTH FACTOR |
|---|---|---|---|---|
| Principal Arterial | 1.00% | 1.04 | 1.06 | 1.26 |
| Minor Arterial | 0.75% | 1.03 | 1.045 | 1.195 |
| Major Collector | 0.50% | 1.02 | 1.03 | 1.13 |
| Local Roadway | 0.00% | 1.00 | 1.00 | 1.00 |

## Design Hour Traffic

The traffic patterns on any roadway typically show considerable variation in the traffic volumes experienced during the various hours of the day and in the hourly volumes experienced throughout the year. A key decision in the design process involves determining which of these hourly traffic volumes should be used as the basis for the design. It would be wasteful to predicate a design on the maximum peak hour traffic that occurs during the year and the use of the average hourly traffic would result in an inadequate design. The hourly traffic volumes used in a design should not be exceeded very often or by very much. On the other side of the spectrum, the hourly traffic volumes should not be so high that traffic would rarely be sufficient to make full use of the designed facility. Normal design policy in the State of Ohio is based upon a review of curves that depict the variation in hourly traffic volumes during the year. The Ohio Department of Transportation recommends using the $30^{TH}$ highest hour as a design control for urban streets. There is typically very little difference between the volumes in this range. The Ohio Department of Transportation provides factors or a methodology to determine factors that are applied to counted daily traffic volumes to determine appropriate design hour traffic volumes.

Following guidelines set forth in the **ODOT Access Management Manual**, all analyses are required to examine the design hour volume for the adjacent roadway and peak hour traffic volume of the proposed development.

The ODOT Peak Hour to Design Hour charts will be used to determine the deign hour factors for the study area roadways. These charts are based on the functional classification of the roadway, the day of the week and the month that the traffic data was collected. A copy of the ODOT Peak Hour to Design Hour Charts can be seen in **Appendix G**.

## 4.3 Future Traffic

No-Build Condition

In order to estimate the future traffic considering non-project traffic conditions, the previously discussed historical growth rates and design hour factors were applied to the traffic data collected for this report. The estimated 2019, 2021, and 2041 No-Build traffic volumes for the study area are shown graphically in the following figures:

**Figure 4.9, Page 50** - 2019 No-Build Traffic Volumes
**Figure 4.10, Page 51** - 2021 No-Build Traffic Volumes
**Figure 4.11, Page 52** - 2041 No-Build Traffic Volumes

This traffic is the expected traffic if the proposed development **is not** constructed, the "No-Build" condition. It should be noted that existing traffic from the development parcels was not removed or re-distributed from the study area roadways.

The No-Build traffic volumes have been rounded to the nearest 10 to adhere to preferred ODOT practices.

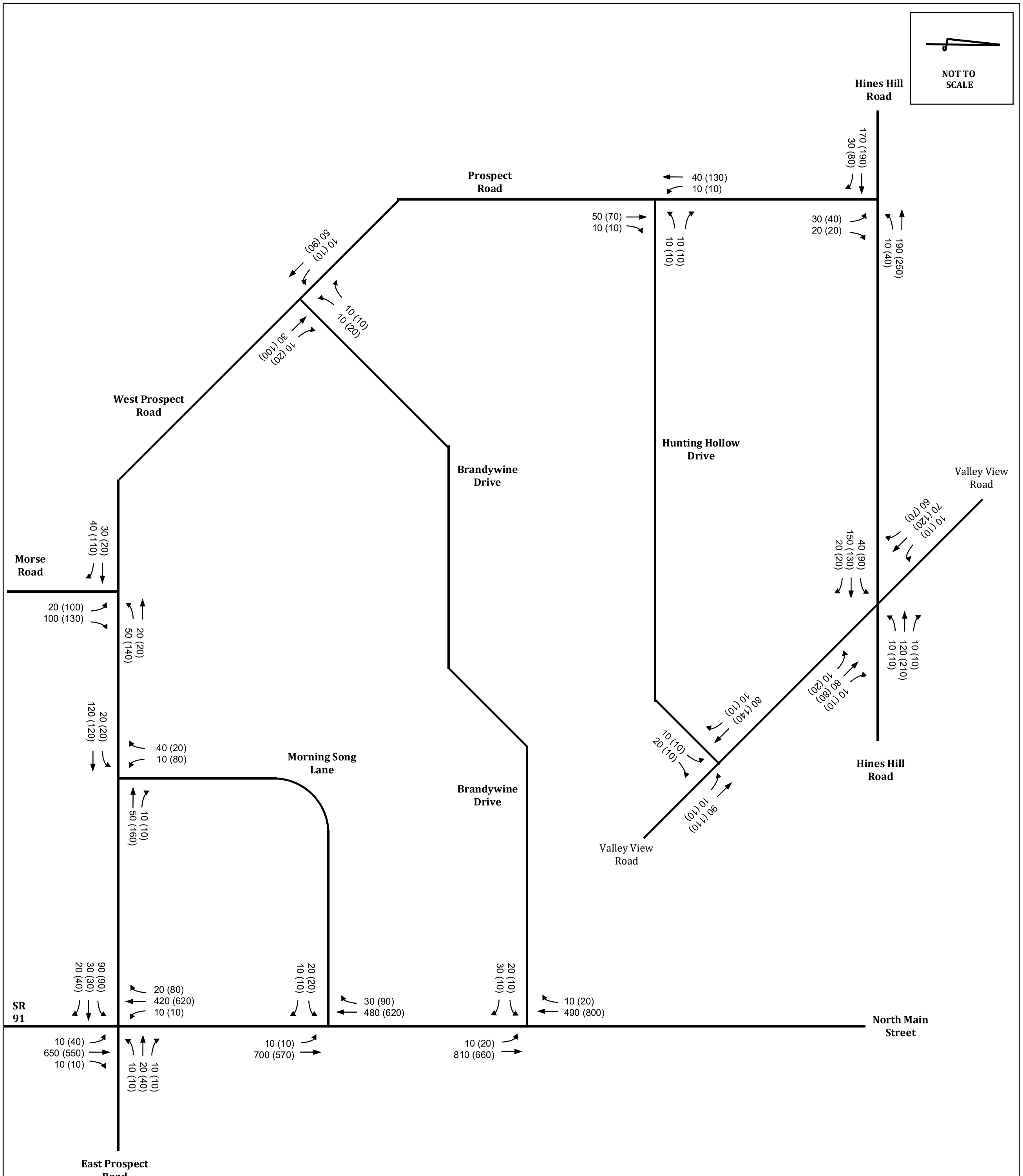
Build Condition

In order to estimate the future traffic considering project traffic conditions, the sum of the No-Build volumes, shown in **Figures 4.9** through **4.11**, were added to the new and diverted link generated traffic to equal the future Build peak hour volumes. The estimated 2019, 2021, and 2041 Build traffic volumes for the study area are shown graphically in the following figures:

**Figure 4.12, Page 53** - 2019 Build Traffic Volumes
**Figure 4.13, Page 54** - 2021 Build Traffic Volumes
**Figure 4.14, Page 55** - 2041 Build Traffic Volumes

These traffic volumes are the expected volumes if the proposed development **is** constructed, or the "Build" condition.

The Build traffic volumes have been rounded to the nearest 10 to adhere to preferred ODOT practices.




**LEGEND**

XX AM Peak Hour Traffic

(XX) PM Peak Hour Traffic

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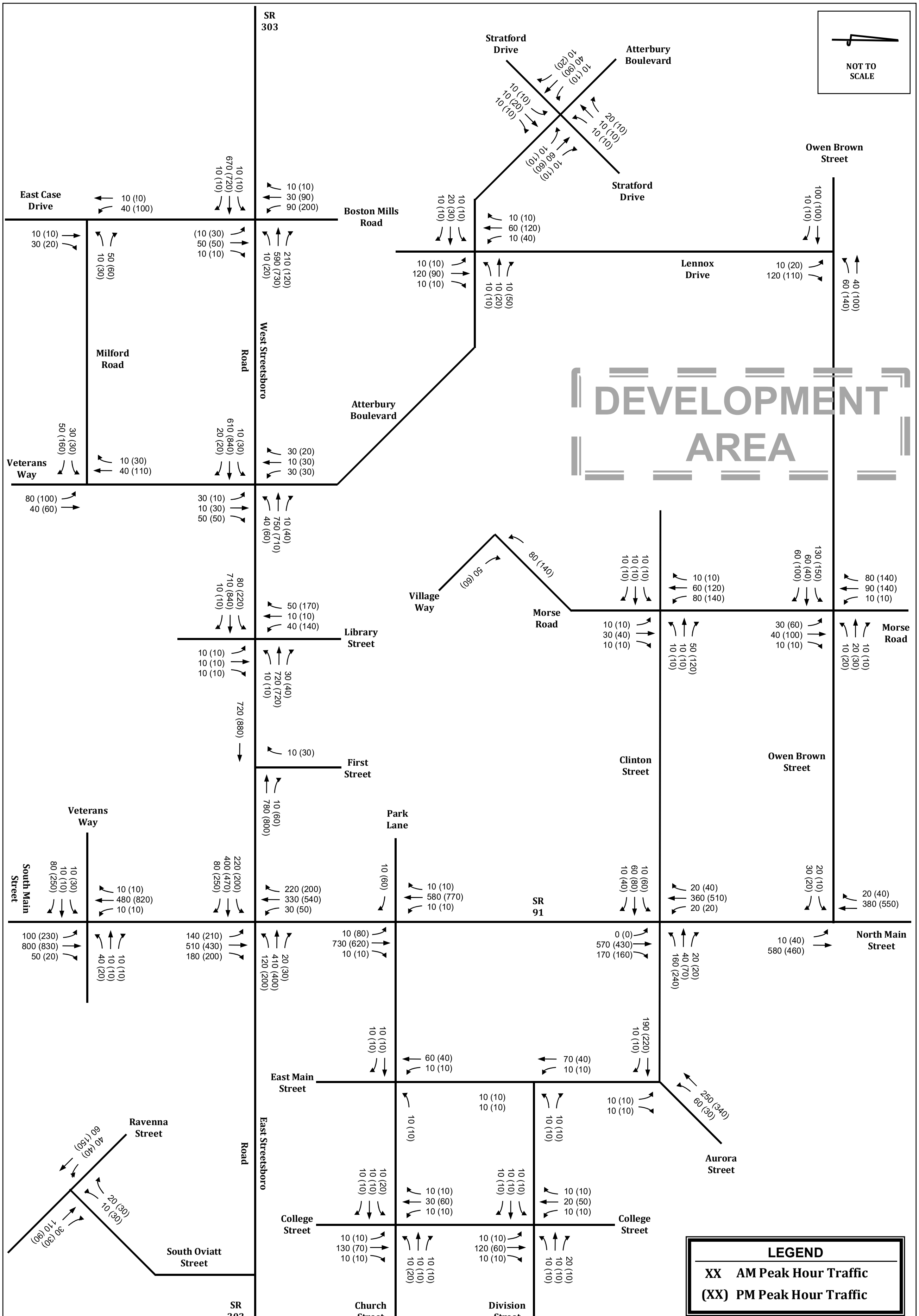
2019 No-Build
Peak Hour Traffic Volumes
(North Section)

Figure: 4.9a

Page: 50a

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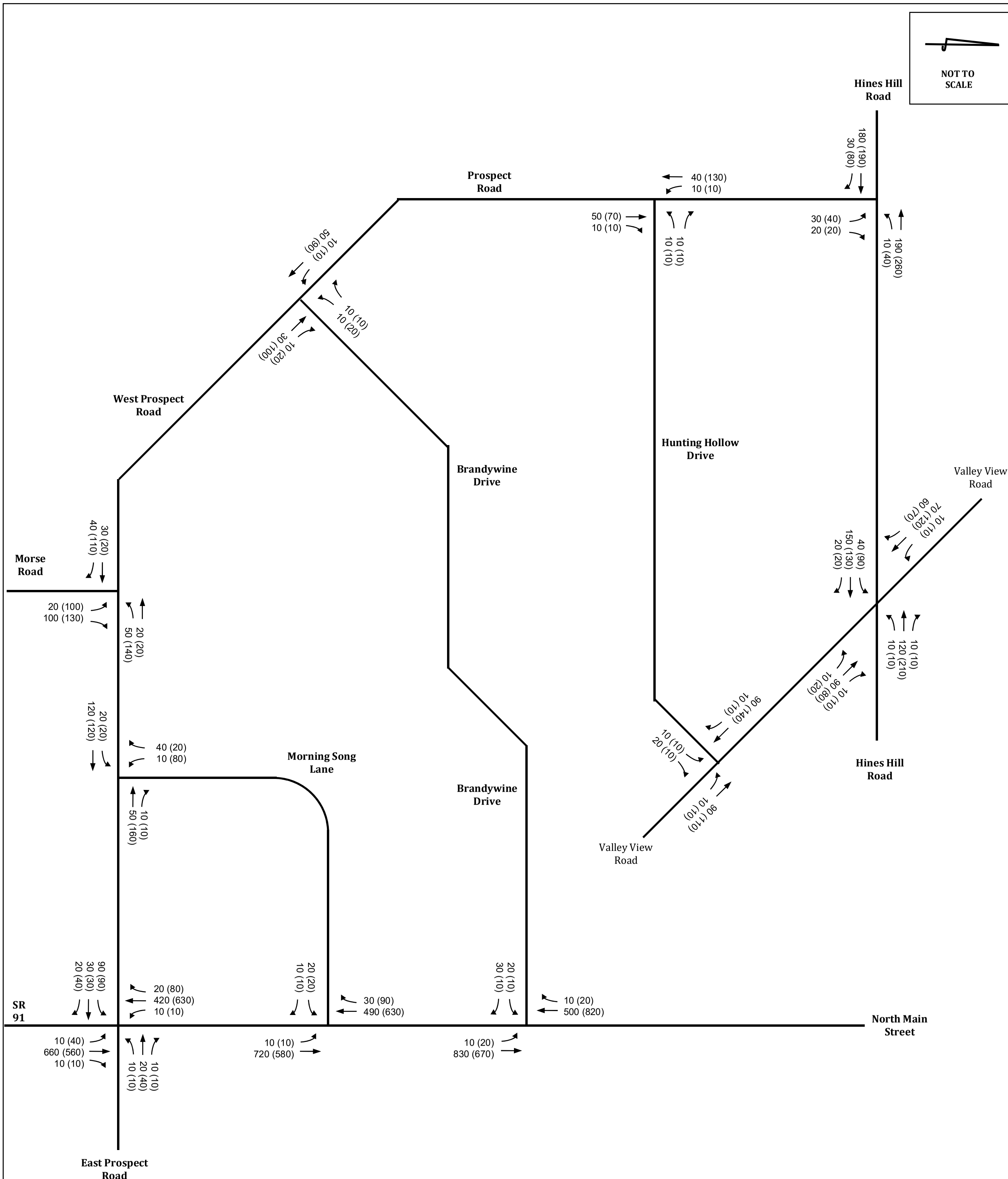
2019 No-Build
Peak Hour Traffic Volumes
(South Section)

Figure: 4.9b

Page: 50b




**LEGEND**

XX AM Peak Hour Traffic

(XX) PM Peak Hour Traffic

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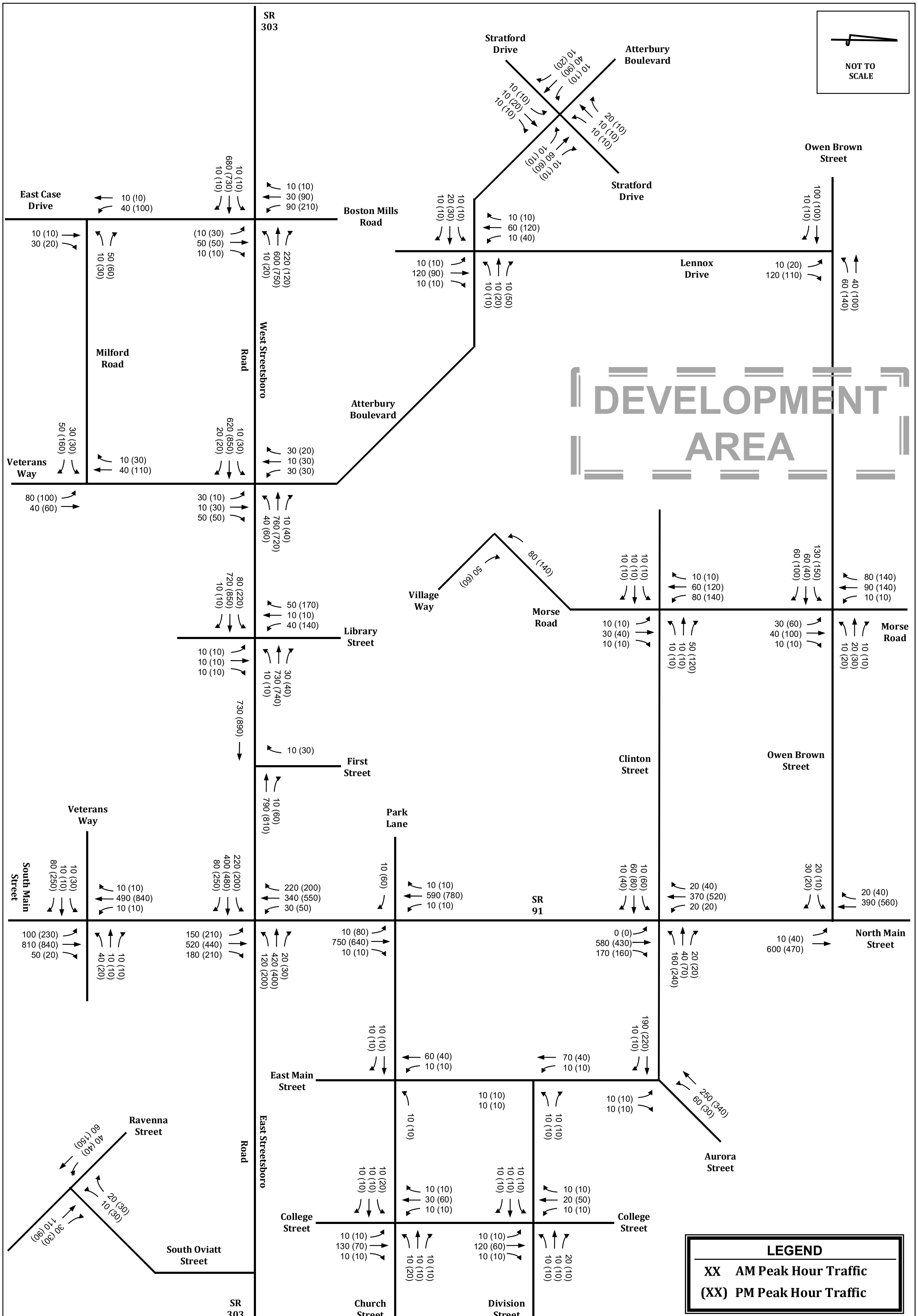
2021 No-Build
Peak Hour Traffic Volumes
(North Section)

Figure: 4.10a

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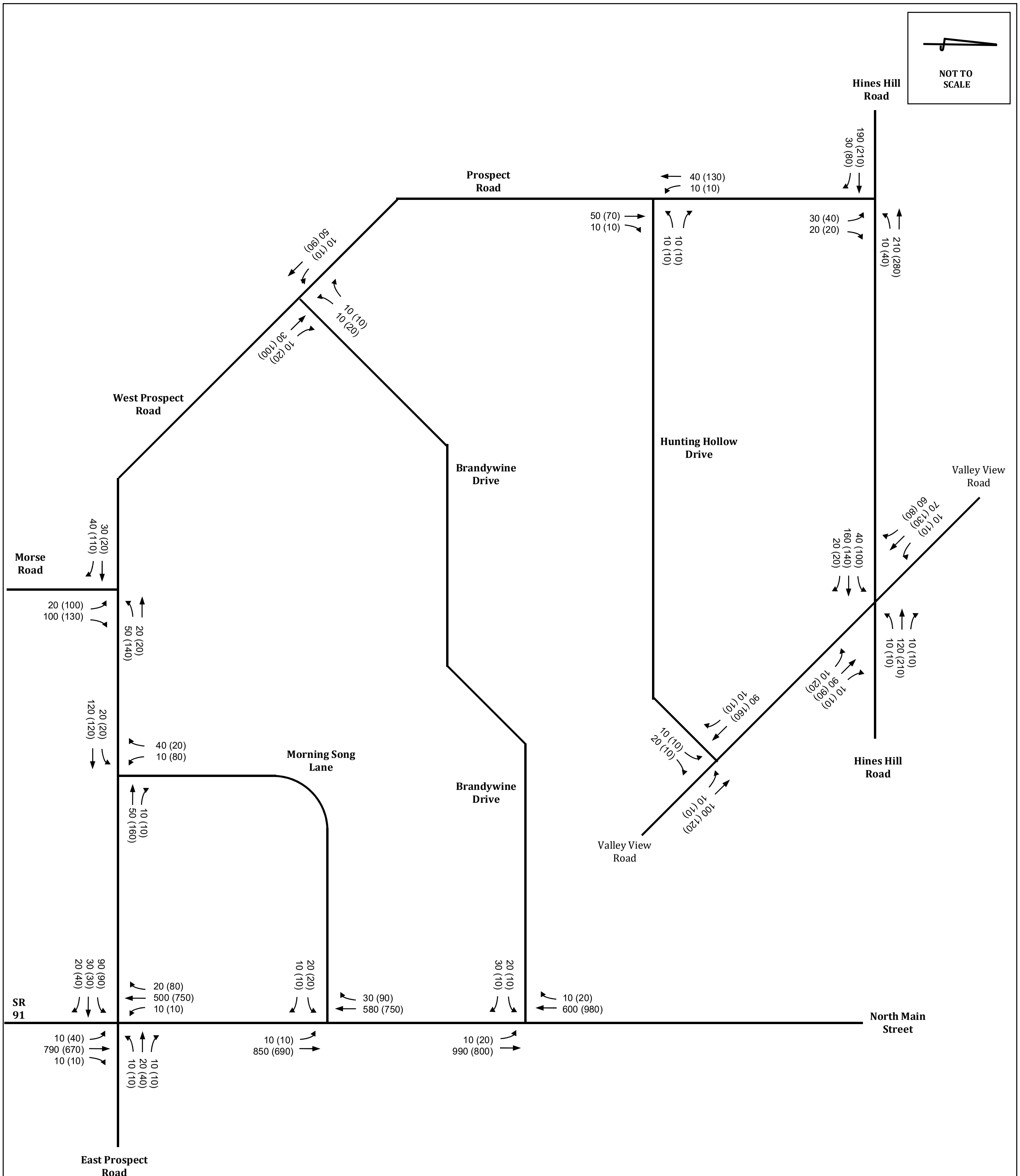
**2021 No-Build**
**Peak Hour Traffic Volumes**
**(South Section)**

**Figure: 4.10b**

**Page: 51b**




## LEGEND

XX AM Peak Hour Traffic

(XX) PM Peak Hour Traffic

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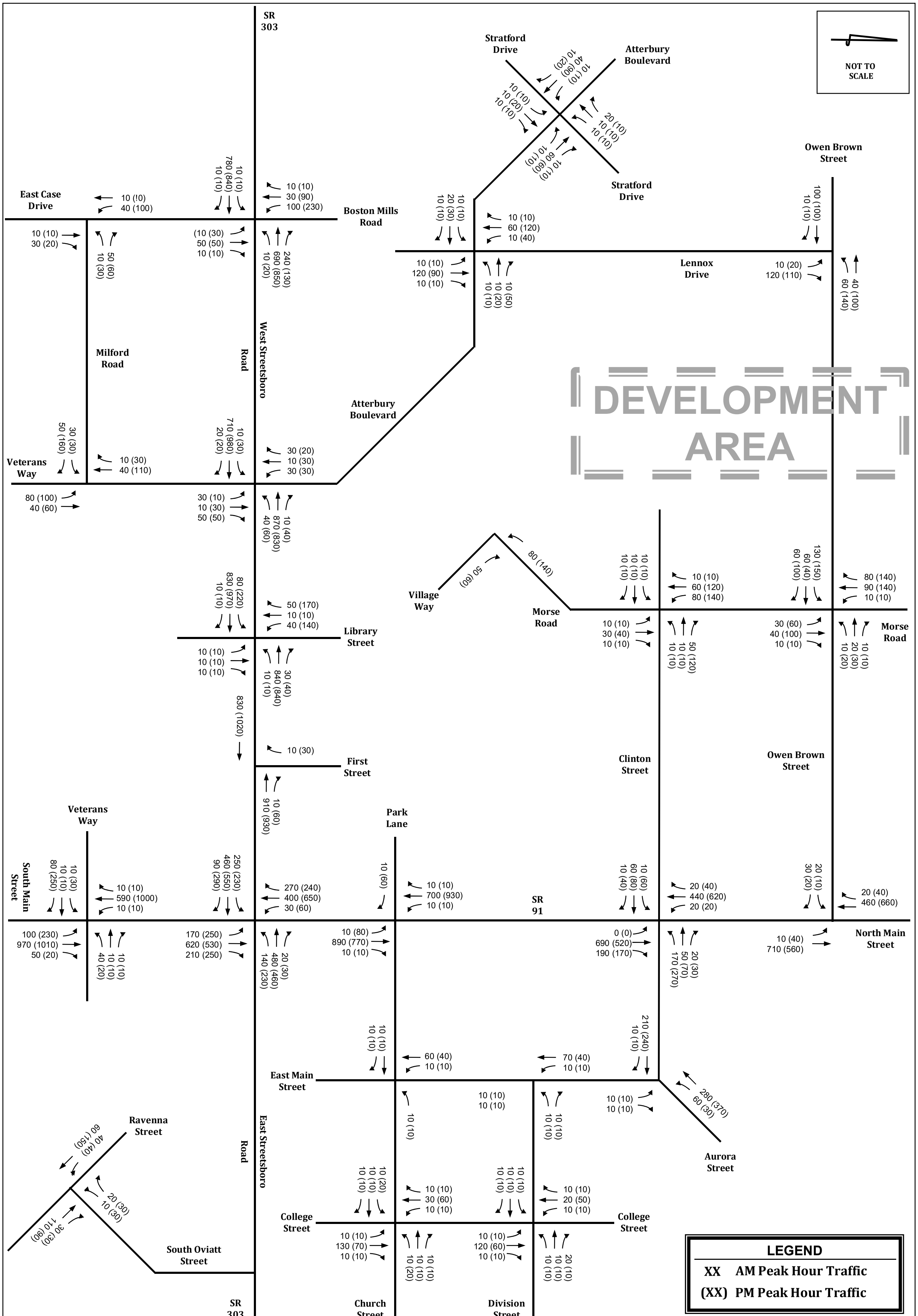
2041 No-Build
Peak Hour Traffic Volumes
(North Section)

Figure: 4.11a

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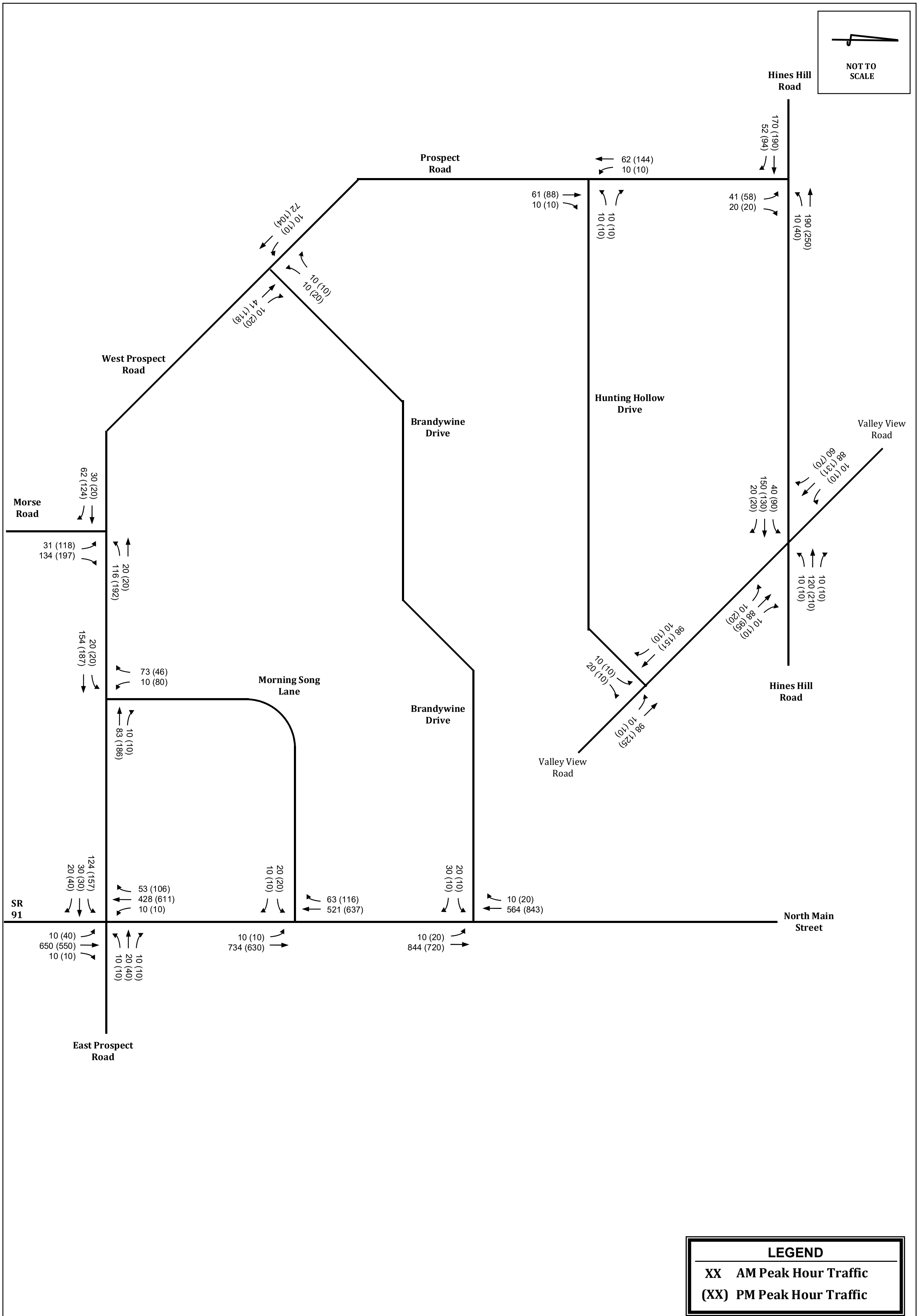
**2041 No-Build**
**Peak Hour Traffic Volumes**
**(South Section)**

**Figure: 4.11b**

**Page: 52b**

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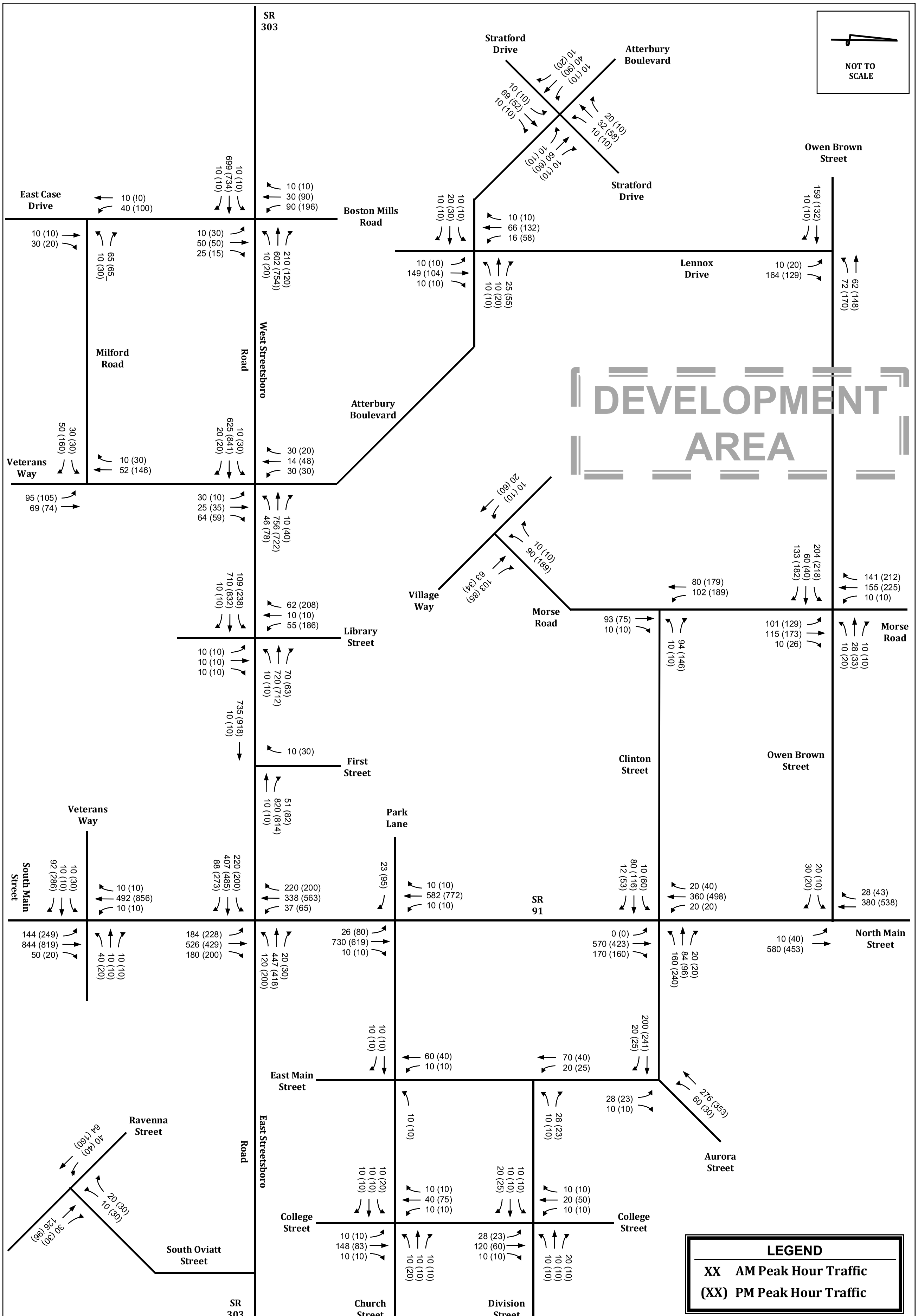
2019 Build
Peak Hour Traffic Volumes
(North Section)

Figure: 4.12a

Page: 53a

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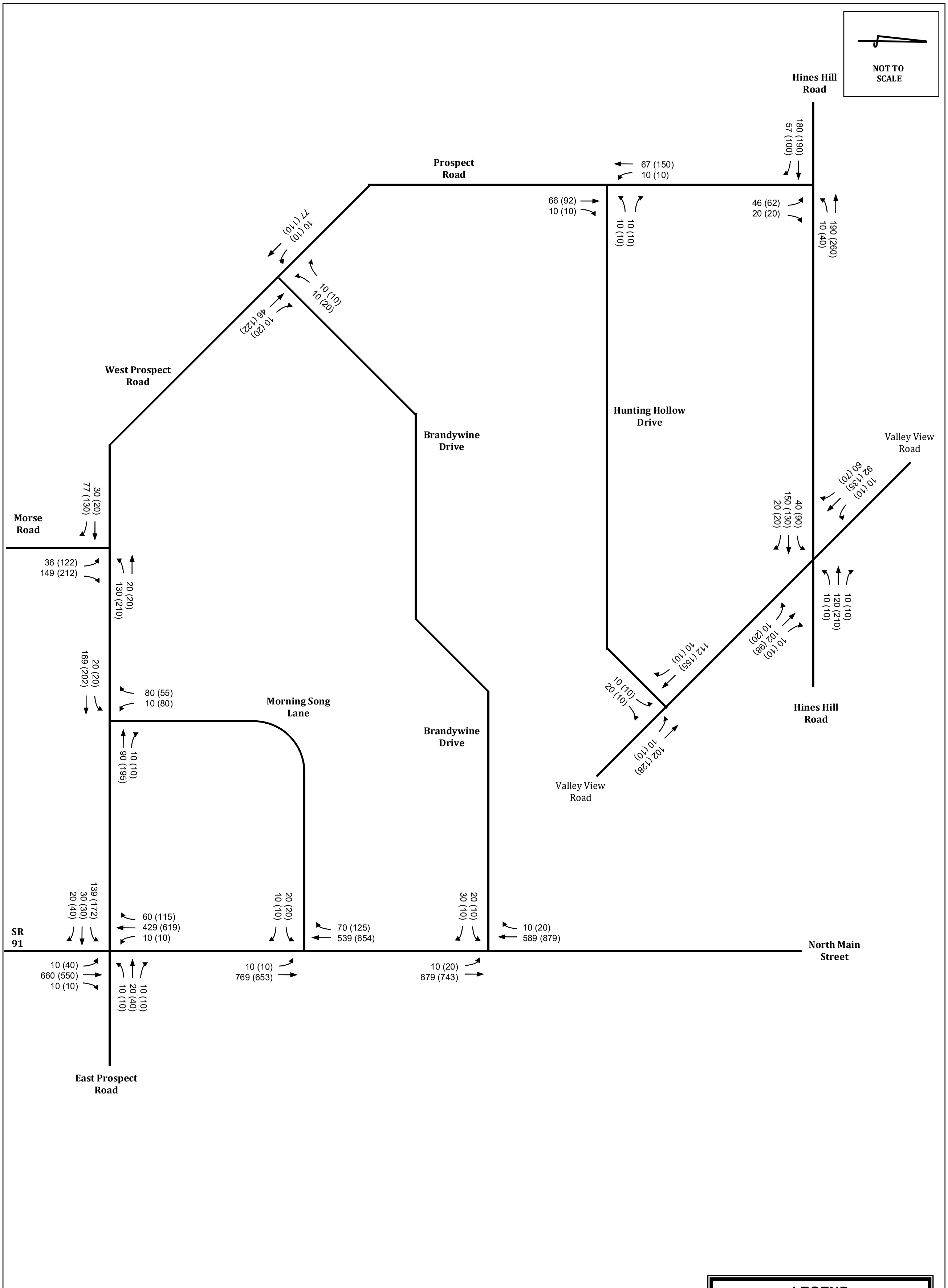
2019 Build
Peak Hour Traffic Volumes
(South Section)

Figure: 4.12b

Page: 53b




LEGEND

XX AM Peak Hour Traffic

(XX) PM Peak Hour Traffic

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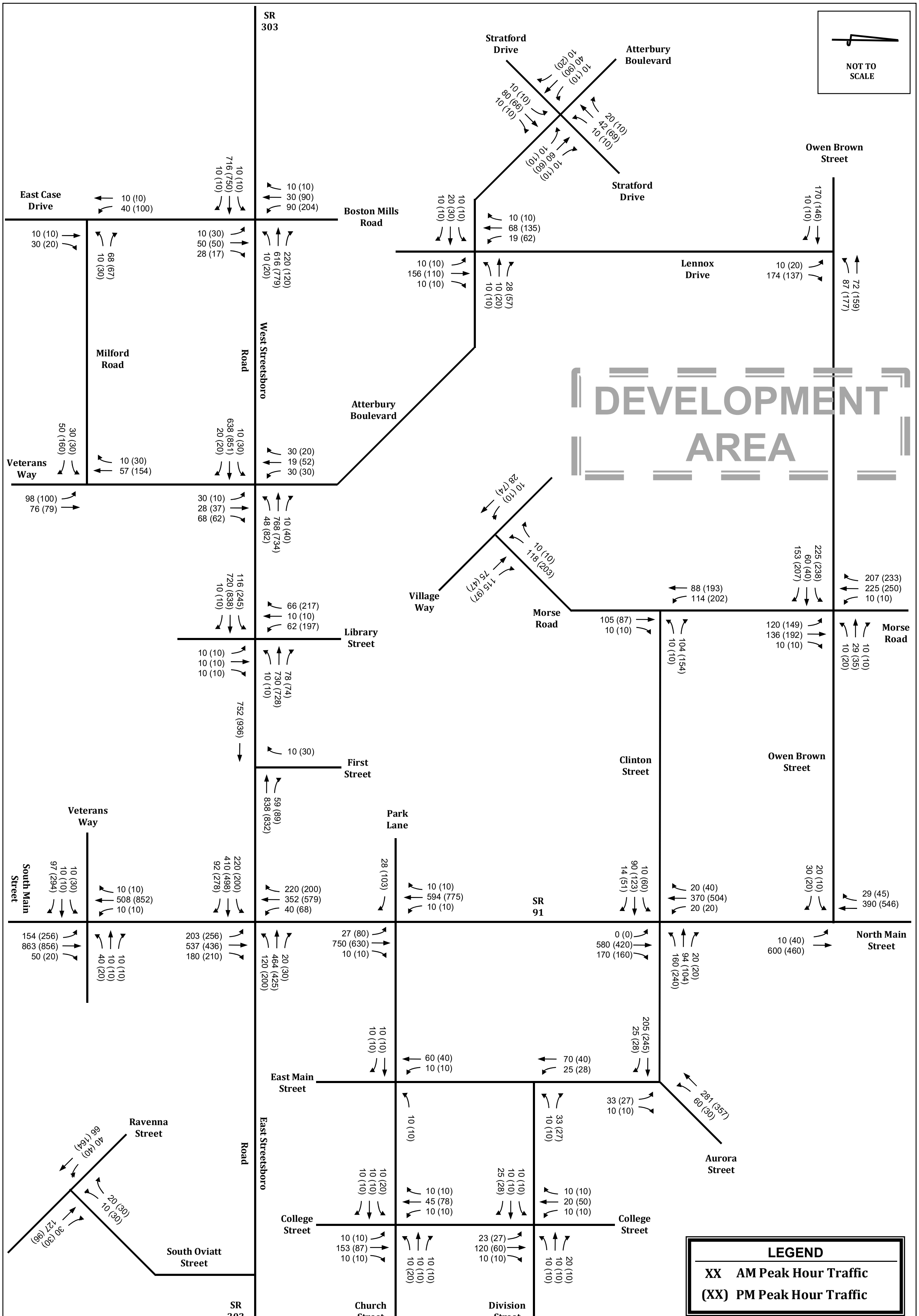
2021 Build
Peak Hour Traffic Volumes
(North Section)

Figure: 4.13a

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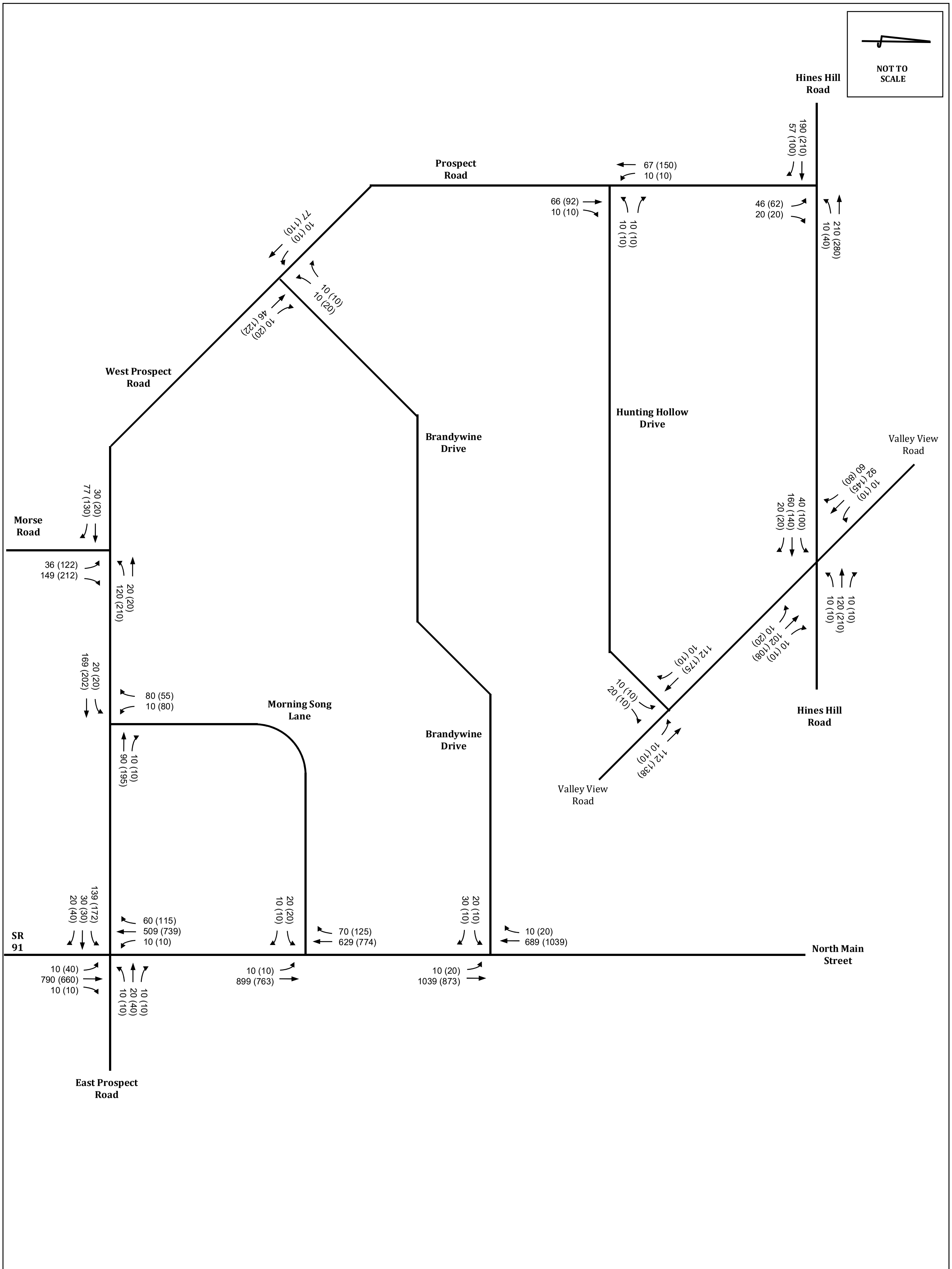
**2021 Build**
**Peak Hour Traffic Volumes**
**(South Section)**

**Figure: 4.13b**

**Page: 54b**




LEGEND

XX AM Peak Hour Traffic

(XX) PM Peak Hour Traffic

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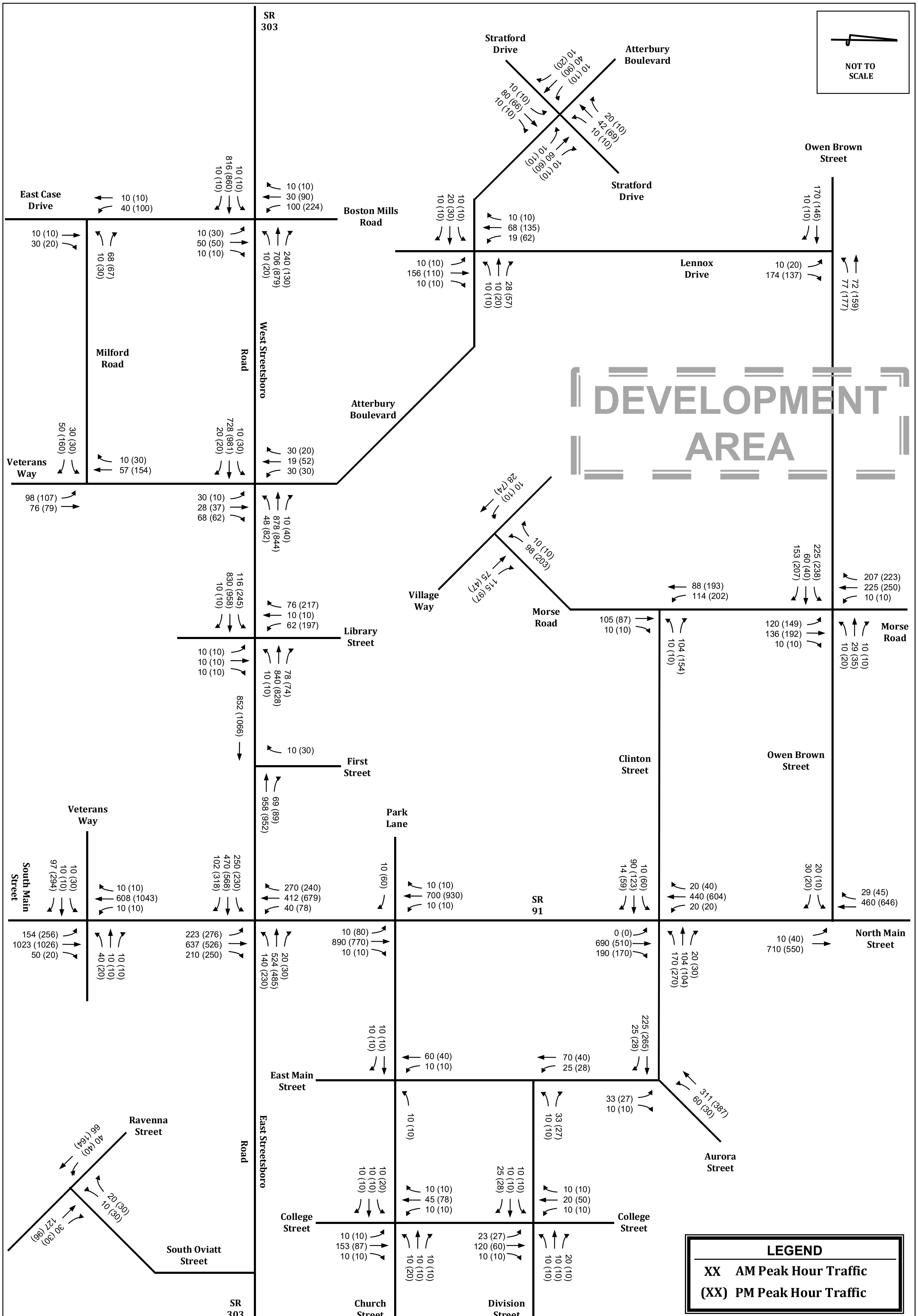
2041 Build
Peak Hour Traffic Volumes
(North Section)

Figure: 4.14a

Page: 55a

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2041 Build
Peak Hour Traffic Volumes
(South Section)

Figure: 4.14b

Page: 55b

# Chapter 5
# Traffic Analysis

## 5.1 Capacity and LOS at Study Area Intersections

Intersection capacity analyses were performed at the study area intersections using the computerized version of Synchro plus SimTraffic, Traffic Signal Coordination Software. The capacity analyses were performed in order to estimate the maximum amount of traffic that can be accommodated by a roadway facility while maintaining recommended operational qualities. Existing, No-Build, and Build peak hour traffic volumes were analyzed to determine the level-of-service (LOS) at the study area intersections.

The capacity analysis procedures provide a calculated "average vehicle delay", which is based on traffic volumes, number of lanes, type of traffic control, channelization, grade, and percentage of large vehicles in the traffic stream at each intersection. The average delay calculated at an intersection is then assigned a "grade" or level of service (LOS) ranging from LOS A, the best, to LOS F, the worst based upon driver expectation. The intersection LOS "grades" as defined by the Transportation Research Board are as follows:

Table 5.1 Intersection LOS

| LOS | UNSIGNALIZED AVERAGE DELAY/VEHICLE (Seconds/Vehicle) | SIGNALIZED AVERAGE DELAY/VEHICLE (Seconds/Vehicle) | ROUNDABOUT AVERAGE DELAY/VEHICLE (Seconds/Vehicle) |
|---|---|---|---|
| A | ≤ 10.0 | ≤ 10.0 | ≤ 10.0 |
| B | 10.1 to 15.0 | 10.1 to 20.0 | 10.1 to 20.0 |
| C | 15.1 to 25.0 | 20.1 to 35.0 | 20.1 to 35.0 |
| D | 25.1 to 35.0 | 35.1 to 55.0 | 35.1 to 55.0 |
| E | 35.1 to 50.0 | 55.1 to 80.0 | 55.1 to 80.0 |
| F | > 50 | > 80 | > 80 |

The capacity analysis procedures and the resulting level of service grades and delays are a recognized traffic engineering standard for measuring the efficiency of intersection operations by such organizations as the Institute of Transportation Engineers, American Association of State Highway and Transportation Officials, and the Ohio Department of Transportation.

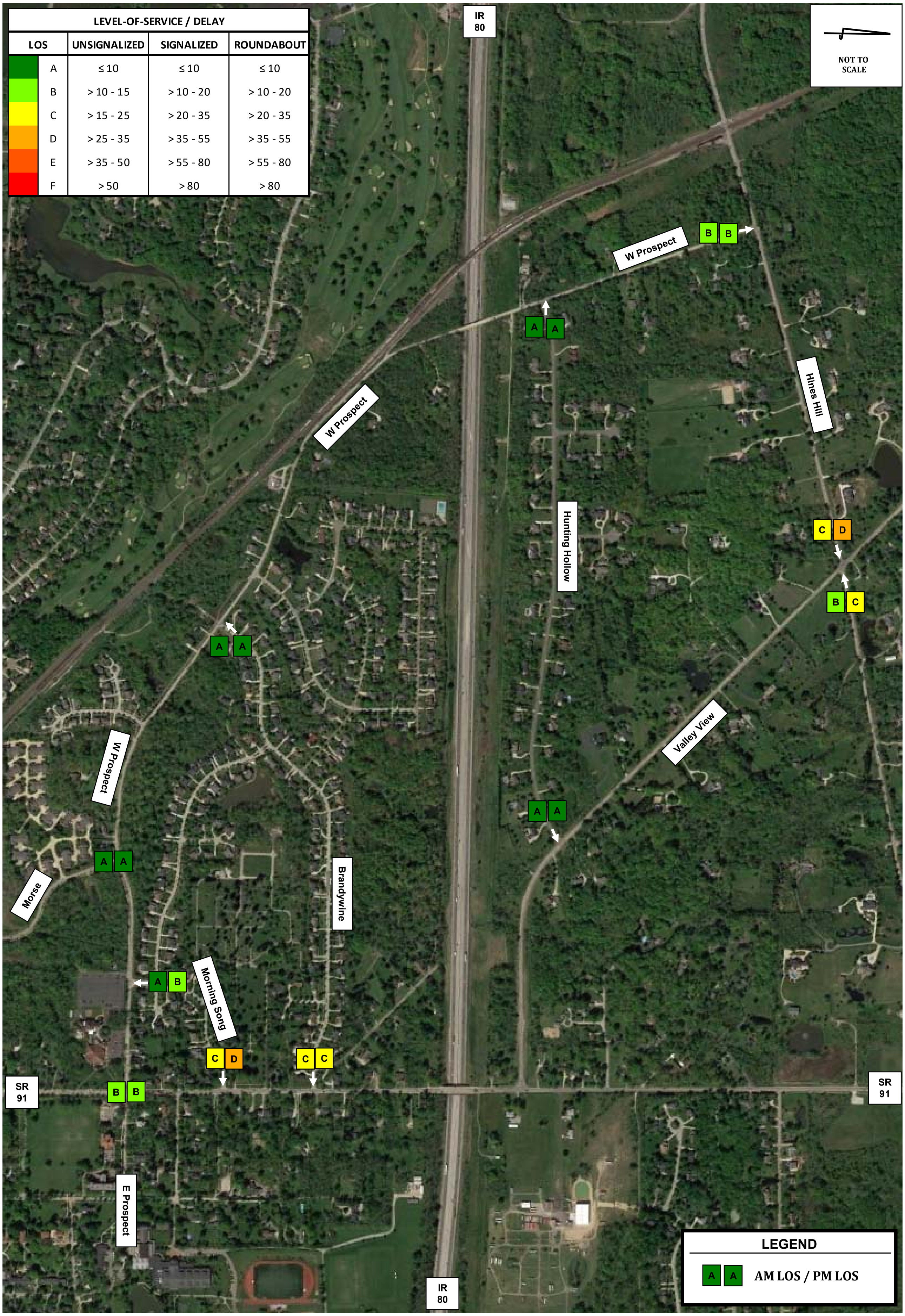
Existing Conditions - Capacity Analysis

Analyses were performed for the current conditions under the Existing scenario. These analyses will be used to identify existing capacity and/or operational deficiencies. The analysis assumed that the signal timing would be optimized at the signalized intersections. The traffic volumes used in this analysis can be seen in **Figure 2.6**. Copies of the Synchro capacity worksheets are included in **Appendix H**.

The study area intersections are currently operating with acceptable levels-of-service during the peak hours under study. The intersection and approaches are operating with an LOS D or better during the peak hours. AM and PM peak hour charts can be found in **Appendix H** detailing a summary of the capacity analysis results for the study area intersections.

**Figure 5.1, Page 58** visually details the intersection level-of-service for traffic signal and all-way stop controlled intersections and the minor street approach levels-of-service at the minor street stop controlled intersections.

Based upon the determined levels-of-service shown in **Appendix H** and **Figure 5.1**, no improvements are necessary at the study area intersections based upon the capacity analyses of the existing conditions.




| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

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2017
Existing Conditions
Levels-of-Service

Figure: 5.1a


| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

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2017
Existing Conditions
Levels-of-Service

Figure: 5.1b

Page: 58b

No-Build Conditions - 2019 Capacity Analysis

Analyses were performed for the projected year 2019 conditions under the No-Build scenario using the design hour volumes. These analyses will be used to compare to the conditions expected under the Build scenario. All analyses assumed that the signal timing would be optimized. The traffic volumes used in this analysis can be seen in **Figure 4.9**. Copies of the Synchro capacity worksheets are included in **Appendix I**.

The following intersections are expected to operate with poor levels-of-service under the anticipated 2019 No-Build conditions:

1. SR 91 & Brandywine Drive (PM Peak)
7. SR 91 & SR 303 (PM Peak)
18. Valley View Road & East Hines Hill Road (PM Peak)

The remaining study area intersections are expected to continue operating with acceptable levels-of-service under the anticipated 2019 No-Build peak hour conditions.

**Figure 5.2, Page 60** visually details the intersection level-of-service for traffic signal and all-way stop controlled intersections and the minor street approach levels-of-service at the minor street stop controlled intersections. AM and PM peak hour charts can be found in **Appendix I** detailing a summary of the capacity analysis results for the study area intersections.

In order to determine what mitigation would be necessary to improve the levels-of-service at these intersections, certain improvements were tested with further capacity analyses. The following improvements are recommended to mitigate the poor levels-of-service under the expected 2019 No-Build conditions:

7. SR 91 & SR 303
- Construct a second northbound left turn lane

18. Valley View Road & East Hines Hill Road
- Construct a single lane roundabout

The implementation of geometric improvements at the intersection of SR 91 and SR 303 would be high cost due to the railroad bridges west and south of the intersection, available right-of-way, and the impact to adjacent intersections.

| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

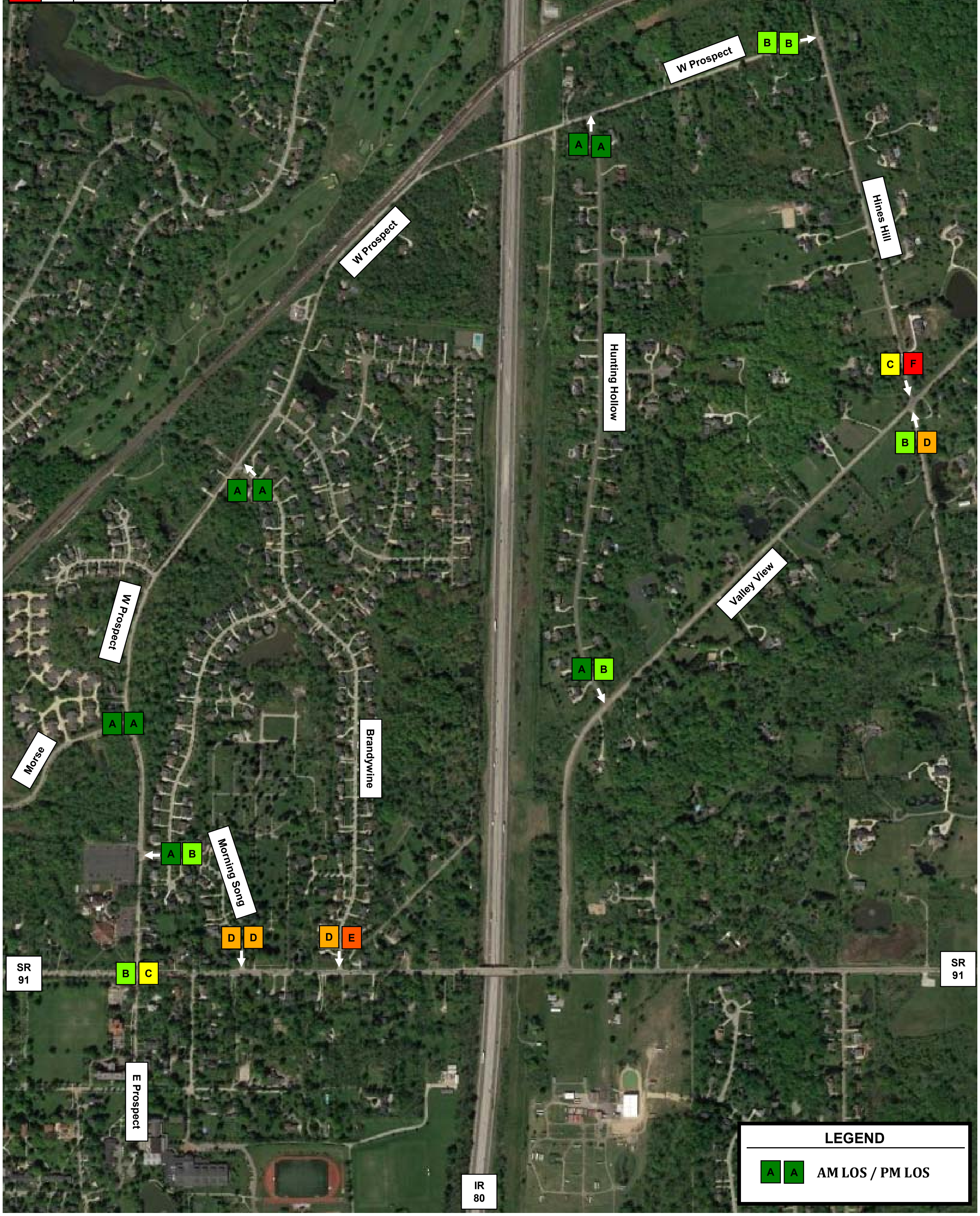


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Figure: 5.2a

Page: 60a


| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

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Figure: 5.2b

The eastbound minor street approach of Brandywine Drive at North Main Street is expected to operate with a poor level-of-service during the PM peak hour due to the lack of adequate gaps in the North Main Street north-south through traffic stream for vehicles turning left from Brandywine Drive onto North Main Street. It was determined that traffic signal control at the intersection would be necessary to improve the intersection levels-of-service. The intersection however does not meet the criteria for warranting a traffic signal as the minor street (Brandywine Drive) volumes do not meet the required minimum volume thresholds for traffic signal control. Therefore traffic signal control will not be considered for mitigating the levels-of-service at North Main Street and Brandywine Road.

The following table shows the capacity analysis results of implementing the proposed improvements. Copies of the capacity worksheets for the improved intersection are in included in **Appendix J**.

## Table 5.2 - 2019 Levels-of-Service
## (No-Build Conditions - Recommended Improvements)

| LOCATION | TRAFFIC CONTROL | MOVEMENT | AM PEAK LOS (DELAY) | PM PEAK LOS (DELAY) |
|---|---|---|---|---|
| Valley View & Hines Hill | Roundabout | Intersection | A (6.5) | A (8.2) |
| | | Eastbound | A (7.4) | A (7.9) |
| | | Westbound | A (5.5) | A (8.2) |
| | | Northbound | A (5.2) | A (9.5) |
| | | Southbound | A (6.8) | A (6.5) |
| SR 91 & SR 303 | Traffic Signal | Intersection | D (38.7) | D (45.2) |
| | | Eastbound | C (27.5) | D (44.3) |
| | | Westbound | D (44.8) | D (51.7) |
| | | Northbound | D (42.9) | D (38.2) |
| | | Southbound | D (39.6) | D (49.0) |

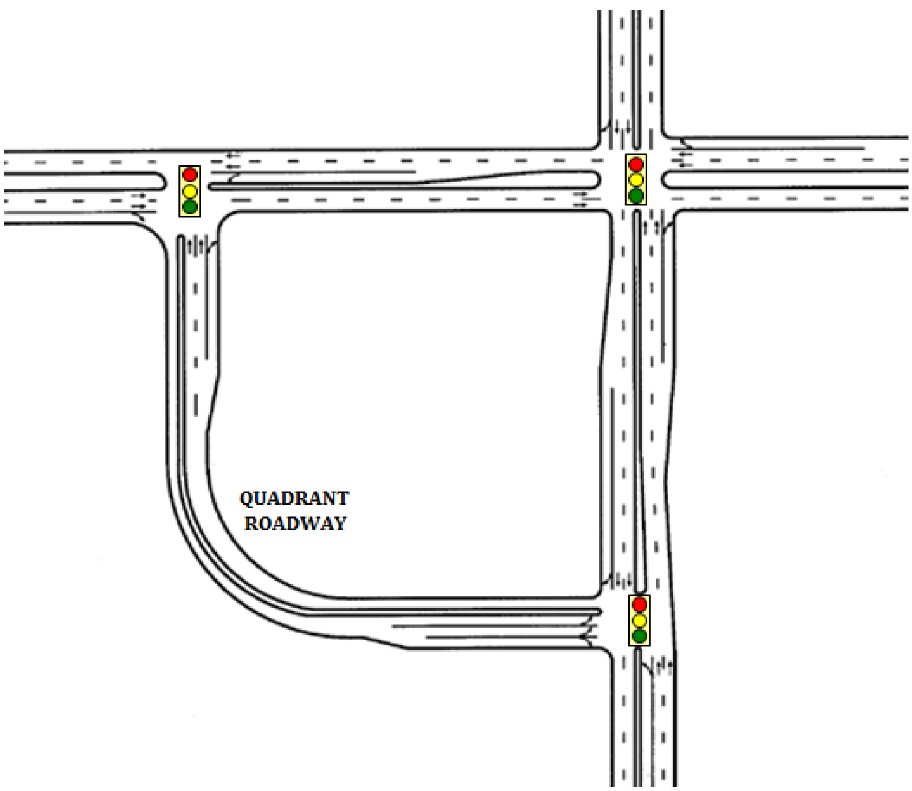
**(XX.X) = Average vehicle delay in seconds per vehicle**

It should be noted that reducing traffic through the intersection of State Route 91 and State Route 303 could also improve the intersection levels-of-service. Providing by-pass roadways would provide an alternative route for through traffic that is passing east-west or north-south through the City of Hudson.

A Quadrant Roadway (QR) intersection would be an alternative by-pass type scenario for consideration at State Route 91 and State Route 303 instead of geometric improvements at the intersection itself.

A Quadrant Roadway (QR) intersection is an alternative design for an intersection of two high volume roadways. The intersection works by rerouting all four left–turn movements at a four–legged intersection onto a road that connects the two intersecting roads. This design prohibits all left turns at the main intersection and therefore allows a simple two–phase signal to process the remaining through and right–turn movements. Both junctions of the connector road are typically signalized. The location of the connector road depends on traffic flow and availability of right–of–way.

A QR intersection typically needs three sets of signal controlled intersections. The main intersection with two signal phases and two secondary intersections at the ends of the connecting roadway with three signal phases each typically comprise the QR intersection treatment. A typical intersection configuration with the quadrant roadway intersections can be seen below:




The implementation of by-pass routes or QR intersections would require additional analysis of potential routes and locations for implementation to determine the feasibility and impact of creating a by-pass scenario for the intersection of State Route 91 and State Route 303.

No-Build Conditions - 2021 Capacity Analysis

Analyses were performed for the projected year 2021 conditions under the No-Build scenario using the design hour volumes. These analyses will be used to compare to the conditions expected under the Build scenario. All analyses assumed that the signal timing would be optimized. The traffic volumes used in this analysis can be seen in **Figure 4.10**. Copies of the Synchro capacity worksheets are included in **Appendix K**.

The following intersections are expected to operate with poor levels-of-service under the anticipated 2021 No-Build conditions:

1. SR 91 & Brandywine Drive (PM Peak)
7. SR 91 & SR 303 (PM Peak)
18. Valley View Road & East Hines Hill Road (PM Peak)

The remaining study area intersections are expected to continue operating with acceptable levels-of-service under the anticipated 2021 No-Build peak hour conditions.

**Figure 5.3, Page 64** visually details the intersection level-of-service for traffic signal and all-way stop controlled intersections and the minor street approach levels-of-service at the minor street stop controlled intersections. AM and PM peak hour charts can be found in **Appendix K** detailing a summary of the capacity analysis results for the study area intersections.

In order to determine what mitigation would be necessary to improve the levels of service at these intersections, certain improvements were tested with further capacity analyses. The following improvements are recommended to mitigate the poor levels-of-service under the No-Build conditions:

7. SR 91 & SR 303
- Construct a second northbound left turn lane

18. Valley View Road & East Hines Hill Road
- Construct a single lane roundabout

The implementation of geometric improvements at the intersection of SR 91 and SR 303 would be high cost due to the railroad bridges west and south of the intersection, available right-of-way, and the impact to adjacent intersections.

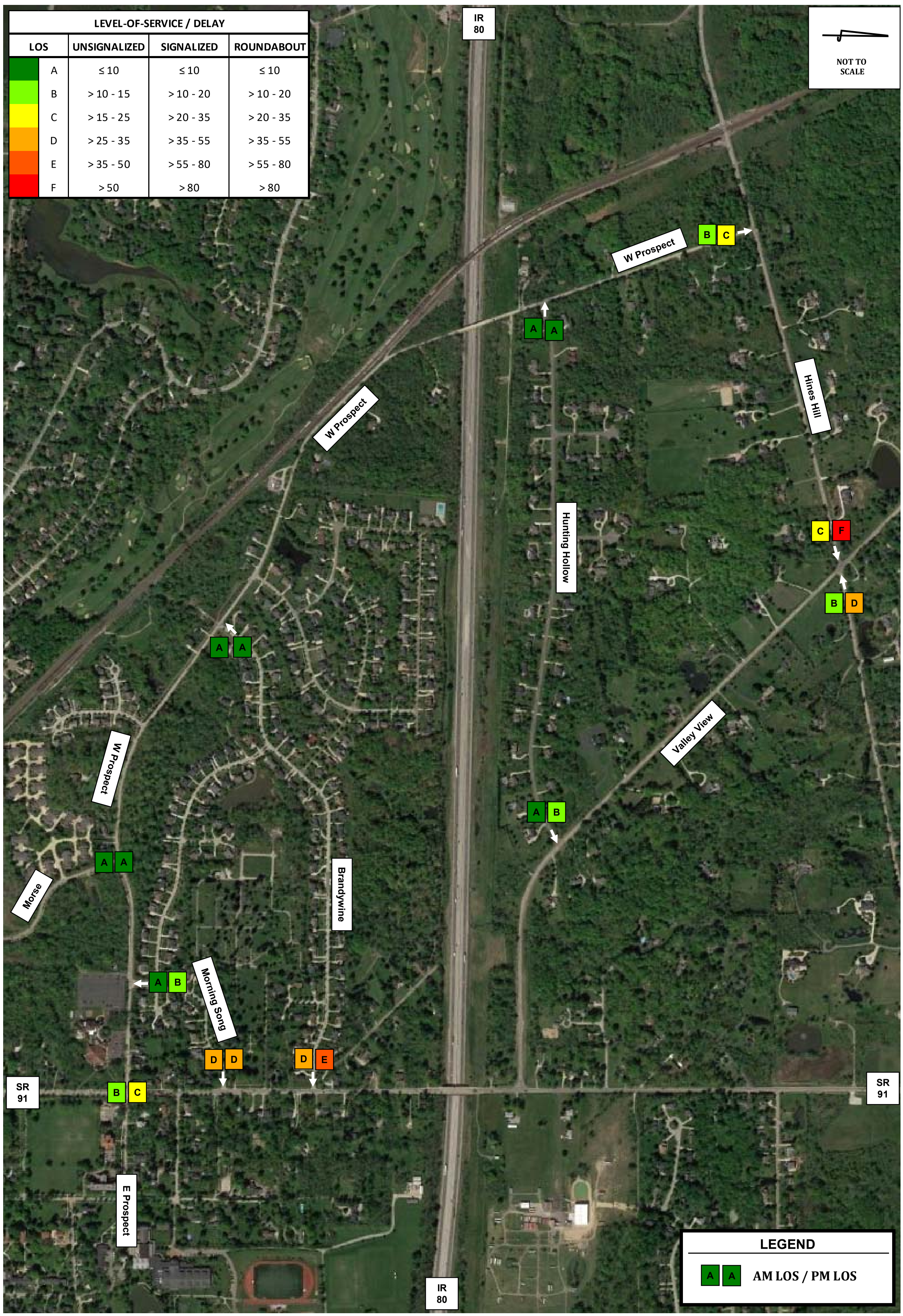



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Figure: 5.3a

Page: 64a

| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
|---|---|---|---|
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

LEVEL-OF-SERVICE / DELAY


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Figure: 5.3b

The eastbound minor street approach of Brandywine Drive at North Main Street is expected to operate with a poor level-of-service during the PM peak hour due to the lack of adequate gaps in the North Main Street north-south through traffic stream for vehicles turning left from Brandywine Drive onto North Main Street. It was determined that traffic signal control at the intersection would be necessary to improve the intersection levels-of-service. The intersection however does not meet the criteria for warranting a traffic signal as the minor street (Brandywine Drive) volumes do not meet the required minimum volume thresholds for traffic signal control. Therefore traffic signal control will not be considered for mitigating the levels-of-service at North Main Street and Brandywine Road.

The following table shows the capacity analysis results of implementing the proposed improvement at the intersection of Valley View Road and Hines Hill Road. Copies of the capacity worksheets for the improved intersection are in included in **Appendix L**.

Table 5.3 - 2021 Levels-of-Service
(No-Build Conditions - Recommended Improvements)

| LOCATION | TRAFFIC CONTROL | MOVEMENT | AM PEAK LOS (DELAY) | PM PEAK LOS (DELAY) |
|---|---|---|---|---|
| Valley View & Hines Hill | Roundabout | Intersection | A (6.6) | A (8.2) |
| | | Eastbound | A (7.5) | A (7.9) |
| | | Westbound | A (5.5) | A (8.2) |
| | | Northbound | A (5.3) | A (9.5) |
| | | Southbound | A (6.8) | A (6.5) |
| SR 91 & SR 303 | Traffic Signal | Intersection | D (40.1) | D (48.0) |
| | | Eastbound | D (38.4) | D (44.5) |
| | | Westbound | D (42.0) | D (54.6) |
| | | Northbound | D (39.7) | D (41.1) |
| | | Southbound | D (40.6) | D (54.6) |

**(XX.X) = Average vehicle delay in seconds per vehicle**

The consideration of by-pass roadways or QR intersections would also be a consideration for improvements at the intersection of State Route 91 and State Route 303 instead of geometric improvements at the intersection.

No-Build Conditions - 2041 Capacity Analysis

Analyses were performed for the projected year 2041 conditions under the No-Build scenario using the design hour volumes. These analyses will be used to compare to the conditions expected under the Build scenario. All analyses assumed that the signal timing would be optimized. The traffic volumes used in this analysis can be seen in **Figure 4.11**. Copies of the Synchro capacity worksheets are included in **Appendix M**.

The following intersections are expected to operate with poor levels-of-service under the anticipated 2041 No-Build conditions:

1. SR 91 & Brandywine Drive (AM & PM Peak)
2. SR 91 & Morning Song Lane (AM & PM Peak)
5. SR 91 & Clinton Street/Aurora Street (AM & PM Peak)
7. SR 91 & SR 303 (AM & PM Peak)
18. Valley View Road & East Hines Hill Road (PM Peak)

The remaining study area intersections are expected to continue operating with acceptable levels-of-service under the anticipated 2041 No-Build peak hour conditions.

**Figure 5.4, Page 67** visually details the intersection level-of-service for traffic signal and all-way stop controlled intersections and the minor street approach levels-of-service at the minor street stop controlled intersections. AM and PM peak hour charts can be found in **Appendix M** detailing a summary of the capacity analysis results for the study area intersections.

In order to determine what mitigation would be necessary to improve the levels of service at these intersections, certain improvements were tested with further capacity analyses. The following improvements are recommended to mitigate the poor levels-of-service under the No-Build conditions:

5. SR 91 & Clinton Street/Aurora Street
   - Align Clinton Street and Aurora Street

7. SR 91 & SR 303
   - Construct a second east-west through lane

18. Valley View Road & East Hines Hill Road
   - Construct a single lane roundabout

| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

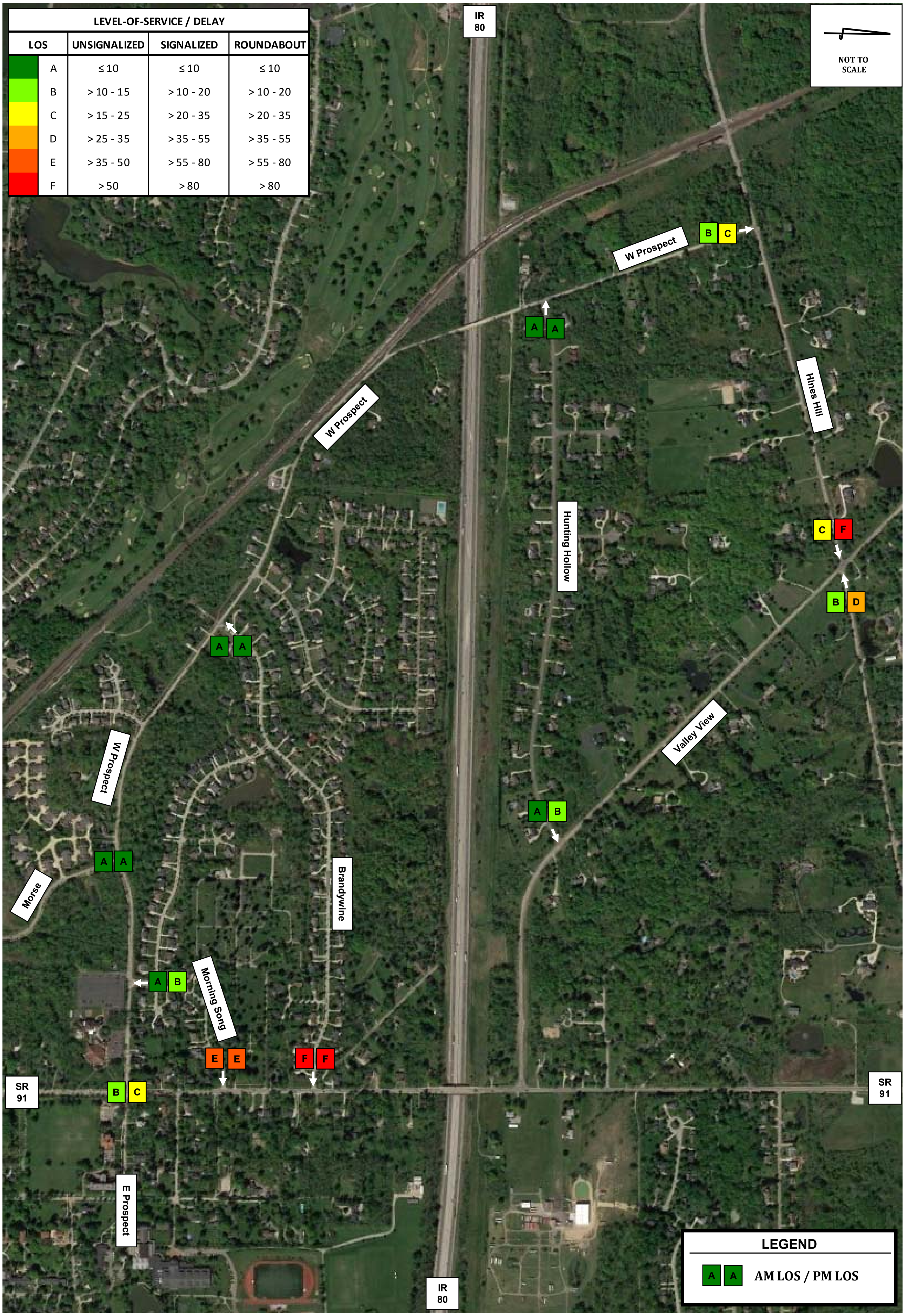



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Figure: 5.4a


| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |


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Figure: 5.4b

The implementation of geometric improvements at the intersections SR 303 and Clinton Street/Aurora Street would be high cost due to the railroad bridges west and south of the intersection, available right-of-way, and the impact to adjacent intersections.

The eastbound minor street approaches of Brandywine Drive and Morning Song Lane at North Main Street are expected to operate with a poor level-of-service during the peak hours due to the lack of adequate gaps in the North Main Street north-south through traffic stream for vehicles turning left from the minor street approaches onto North Main Street. It was determined that traffic signal control at the intersections would be necessary to improve the intersection levels-of-service. The intersection however does not meet the criteria for warranting a traffic signal as the minor street (Brandywine Drive and Morning Song Lane) volumes do not meet the required minimum volume thresholds for traffic signal control. Therefore traffic signal control will not be considered for mitigating the levels-of-service at the intersections of Brandywine Drive and Morning Song Lane at North Main Street.

The table on the following page shows the capacity analysis results of implementing the proposed improvements. Copies of the capacity worksheets for the improved intersection are in included in **Appendix N**.

## Table 5.4 - 2041 Levels-of-Service
## (No-Build Conditions - Recommended Improvements)

| LOCATION | TRAFFIC CONTROL | MOVEMENT | AM PEAK LOS (DELAY) | PM PEAK LOS (DELAY) |
|---|---|---|---|---|
| Valley View & Hines Hill | Roundabout | Intersection | A (6.7) | A (8.8) |
| | | Eastbound | A (7.8) | A (8.6) |
| | | Westbound | A (5.5) | A (8.5) |
| | | Northbound | A (5.3) | B (10.2) |
| | | Southbound | A (6.9) | A (6.9) |
| SR 91 & Clinton/Aurora | Traffic Signal | Intersection | C (21.4) | C (29.3) |
| | | Eastbound | C (23.3) | C (22.6) |
| | | Westbound | D (41.4) | D (45.9) |
| | | Northbound | C (22.0) | C (27.5) |
| | | Southbound | B (12.6) | C (25.9) |
| SR 91 & SR 303 | Traffic Signal | Intersection | D (41.6) | D (49.3) |
| | | Eastbound | C (25.3) | D (43.3) |
| | | Westbound | D (43.6) | D (52.2) |
| | | Northbound | D (50.4) | D (48.9) |
| | | Southbound | D (45.0) | D (54.7) |

**(XX.X) = Average vehicle delay in seconds per vehicle**

The consideration of by-pass roadways or QR intersections would also be a consideration for improvements at the intersection of State Route 91 and State Route 303 instead of geometric improvements at the intersection.

Build Condition - 2019 Capacity Analysis

Analyses were performed for the projected 2019 opening day conditions under the Build scenario. This analysis will be used to determine the expected levels-of-service at the study intersections under the anticipated build conditions for Phase 1 of the proposed development. All analyses assumed that the signal timing would be optimized. The traffic volumes used in this analysis can be seen in **Figure 4.12**. Copies of the Synchro capacity worksheets are included in **Appendix O**.

The following intersections are expected to operate with poor levels-of-service under the anticipated 2019 Build conditions:

1. SR 91 & Brandywine Drive (AM & PM Peak)
5. SR 91 & Clinton Street/Aurora Street (PM Peak)
7. SR 91 & SR 303 (PM Peak)
21. Owen Brown Street & Morse Road (AM & PM Peak)

The intersections of Brandywine Drive, Clinton Street/Aurora Street, and State Route 303 at State Route 91 were previously determined to operate with poor levels-of-service under the No-Build conditions. The Build traffic is not expected to significantly impact the levels-of-service at these locations.

The remaining study area intersections are expected to continue operating with acceptable levels-of-service under the anticipated 2019 Build peak hour conditions.

**Figure 5.5, Page 71** visually details the intersection level-of-service for traffic signal and all-way stop controlled intersections and the minor street approach levels-of-service at the minor street stop controlled intersections. AM and PM peak hour charts can be found in **Appendix O** detailing a summary of the capacity analysis results for the study area intersections.

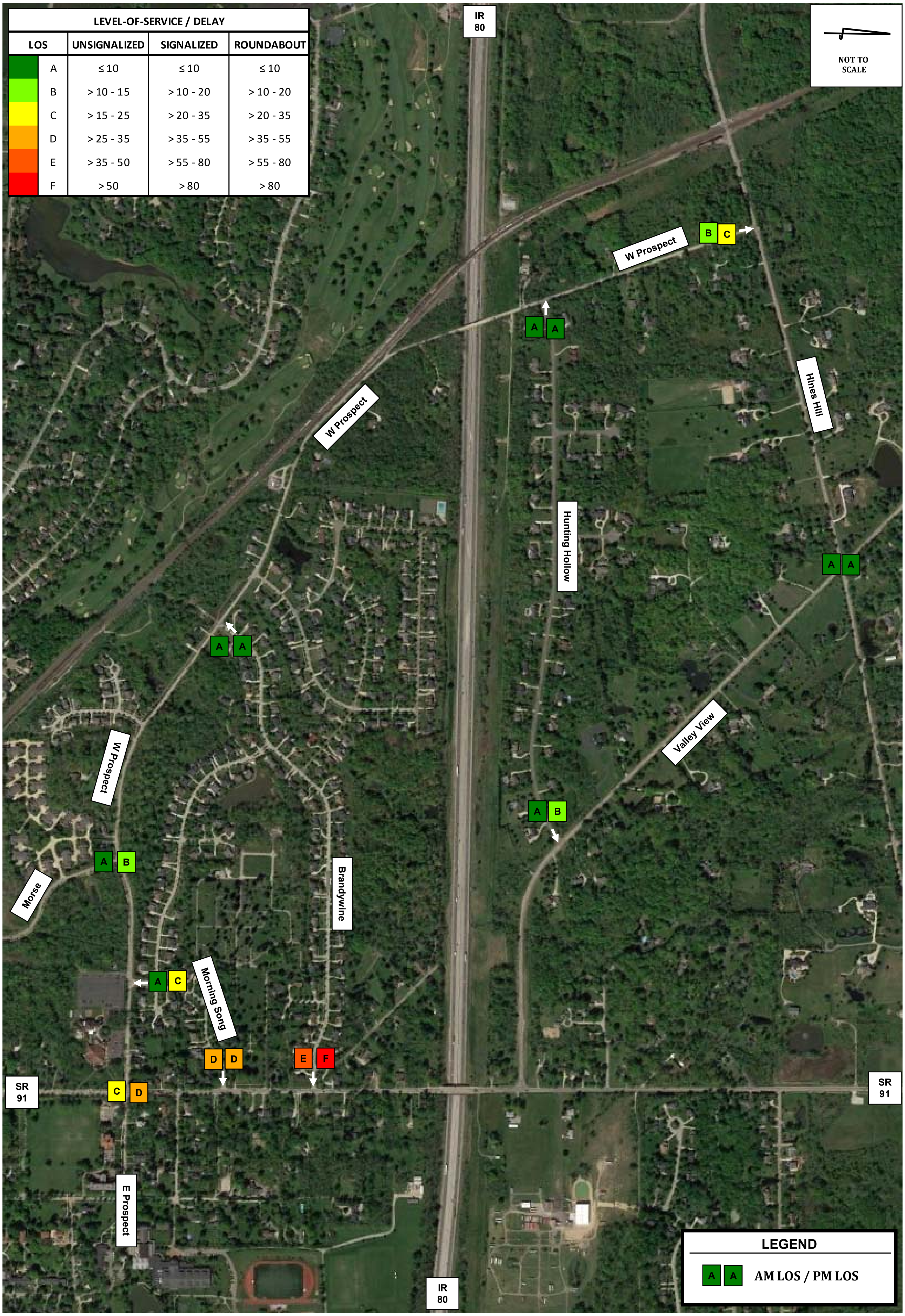


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Figure: 5.5a

Page: 71a


LEVEL-OF-SERVICE / DELAY

| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
|---|---|---|---|
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

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Figure: 5.5b

The eastbound minor street approach of Brandywine Drive at North Main Street is expected to operate with a poor level-of-service during the peak hours due to the lack of adequate gaps in the North Main Street north-south through traffic stream for vehicles turning left from Brandywine Drive onto North Main Street. It was determined that traffic signal control at the intersection would be necessary to improve the intersection levels-of-service. The intersection however does not meet the criteria for warranting a traffic signal as the minor street (Brandywine Drive) volumes do not meet the required minimum volume thresholds for traffic signal control. Therefore traffic signal control will not be considered for mitigating the levels-of-service at North Main Street and Brandywine Road.

A second northbound left turn lane at the intersection was recommended to improve the levels-of-service at the intersection of State Route 91 and State Route 303.

In order to improve the levels-of-service at the intersection of North Main Street and Clinton Street/Aurora Street it was determined that the minor street approaches would need to be aligned so that the approaches would not have to be split-phased in the traffic signal operation.

In order to determine what mitigation would be necessary to improve the levels-of-service at the remaining intersection, certain improvements were tested with further capacity analyses. The following improvements are recommended to mitigate the poor levels-of-service under the Build conditions:

21. Owen Brown Street & Morse Road

- Construct a single lane roundabout

OR

- Construct an exclusive northbound left turn lane
- Construct an exclusive eastbound left turn lane
- Construct an exclusive southbound right turn lane
- Install traffic signal control

The left turn lanes on the south and west approaches and a right turn lane on the north approach were determined to be necessary to allow the traffic signal operation to function with levels-of-service comparable to roundabout control.

The following table shows the capacity analysis results of implementing the proposed improvements at the intersection of Owen Brown Street and Morse Road. Copies of the capacity worksheets for the improved intersection are in included in **Appendix P**.

## Table 5.5 - 2019 Levels-of-Service
## (Build Conditions - Recommended Improvements)

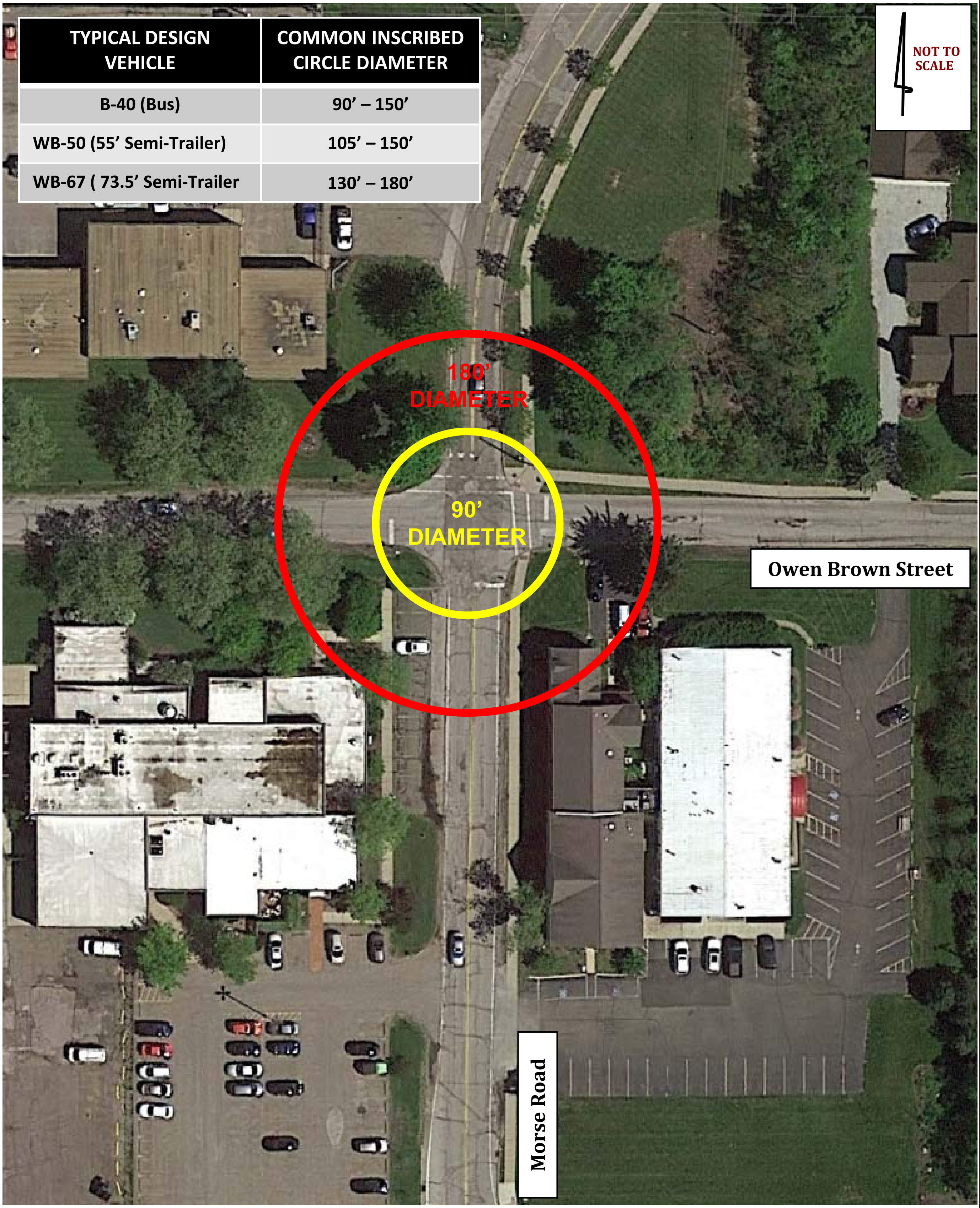
| LOCATION | TRAFFIC CONTROL | MOVEMENT | AM PEAK LOS (DELAY) | PM PEAK LOS (DELAY) |
|---|---|---|---|---|
| Morse & Owen Brown | Roundabout | Intersection | B (12.4) | B (16.2) |
| | | Eastbound | B (14.2) | B (19.4) |
| | | Westbound | A (8.6) | A (8.0) |
| | | Northbound | B (13.3) | B (12.8) |
| | | Southbound | A (9.6) | B (16.4) |
| Morse & Owen Brown | Traffic Signal | Intersection | B (11.8) | B (11.3) |
| | | Eastbound | B (10.2) | B (11.5) |
| | | Westbound | B (19.5) | C (20.6) |
| | | Northbound | B (15.7) | B (13.9) |
| | | Southbound | A (8.5) | A (8.1) |

**(XX.X) = Average vehicle delay in seconds per vehicle**

**Figure 5.6, Page 74** details the approximate amount of land that would be necessary to install a single lane roundabout at the intersection of Morse Road and Owen Brown Street. The dimensions shown are the inscribed circle diameter (ICD). The ICD of a roundabout is the basic parameter used to define the size of a roundabout. The ICD is measured between the outer edges of the circulatory roadway.

The guidelines and recommendations found in the **"Roundabouts: An Informational Guide, NCHRP Report 672,"** publication put forth by the National Cooperative Highway Research Program in cooperation with the U.S. Department of Transportation and the Federal Highway Administration recommends an inscribed circle diameter of 90 feet to 180 feet for an urban single lane roundabout (Exhibit 1-9). Larger diameter roundabouts are required for larger design vehicles.

| TYPICAL DESIGN VEHICLE | COMMON INSCRIBED CIRCLE DIAMETER |
| --- | --- |
| B-40 (Bus) | 90' – 150' |
| WB-50 (55' Semi-Trailer) | 105' – 150' |
| WB-67 ( 73.5' Semi-Trailer | 130' – 180' |



Traffic Signal Warrant Analysis - Morse Road & Owen Brown Street Build Conditions

The anticipated 2019 Build traffic conditions at the intersection of Morse Road and Owen Brown Street were analyzed and compared to the criteria established by the **Ohio Manual of Uniform Traffic Control Devices** and professional engineering judgement to determine if traffic signal control is warranted at the intersection. All of the data collected and determined for this study was analyzed and compared to the thresholds established by the criteria from the **OMUTCD**. Warrants 1 and 2 were evaluated for this analysis.

**Warrant 1 - Eight Hour Vehicular Volume**
This warrant has three conditions. The Minimum Vehicular Volume, Condition A, is intended for application where a large volume of intersecting traffic is the principal reason to consider installing a traffic signal. The Interruption of Continuous Traffic, Condition B, is intended for application where the traffic volume of a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. The third condition is a combination of Condition A and Condition B in which 80% of each condition must be satisfied.

**Warrant 2 - Four Hour Vehicular Volume**
This warrant addresses the need for signalization based on situations existing for less than eight hours and is based upon a sliding scale or combined volume. Fours hours of volume must be met.

In order to determine if the 2019 anticipated Build conditions are expected to meet one of these warrants, the peak hour volumes were used to determine the intersection ADT by dividing the peak hours by a factor determined from the Ohio Department of Transportation's Hourly Percentages by Vehicle Type chart. These ODOT factors can currently be seen at ODOT's website at:

http://www.dot.state.oh.us/Divisions/Planning/TechServ/traffic/Pages/HrlyPercent.aspx

Based upon the evaluation of the warrants established by the Ohio Manual of Uniform Traffic Control Devices, we conclude that a traffic signal is justified at the intersection of Morse Road and Owen Brown Street as required by the **Ohio Revised Code** based upon the expected 2019 Build conditions. Copies of the traffic signal warrant analysis worksheets can be found in **Appendix C**.

Build Condition - 2021 Capacity Analysis

Analyses were performed for the projected 2021 full build conditions under the Build scenario. This analysis will be used to determine the expected levels-of-service at the study intersections under the anticipated build conditions for phase 1 and 2 of the proposed development. All analyses assumed that the signal timing would be optimized. The traffic volumes used in this analysis can be seen in **Figure 4.13**. Copies of the Synchro capacity worksheets are included in **Appendix Q**.

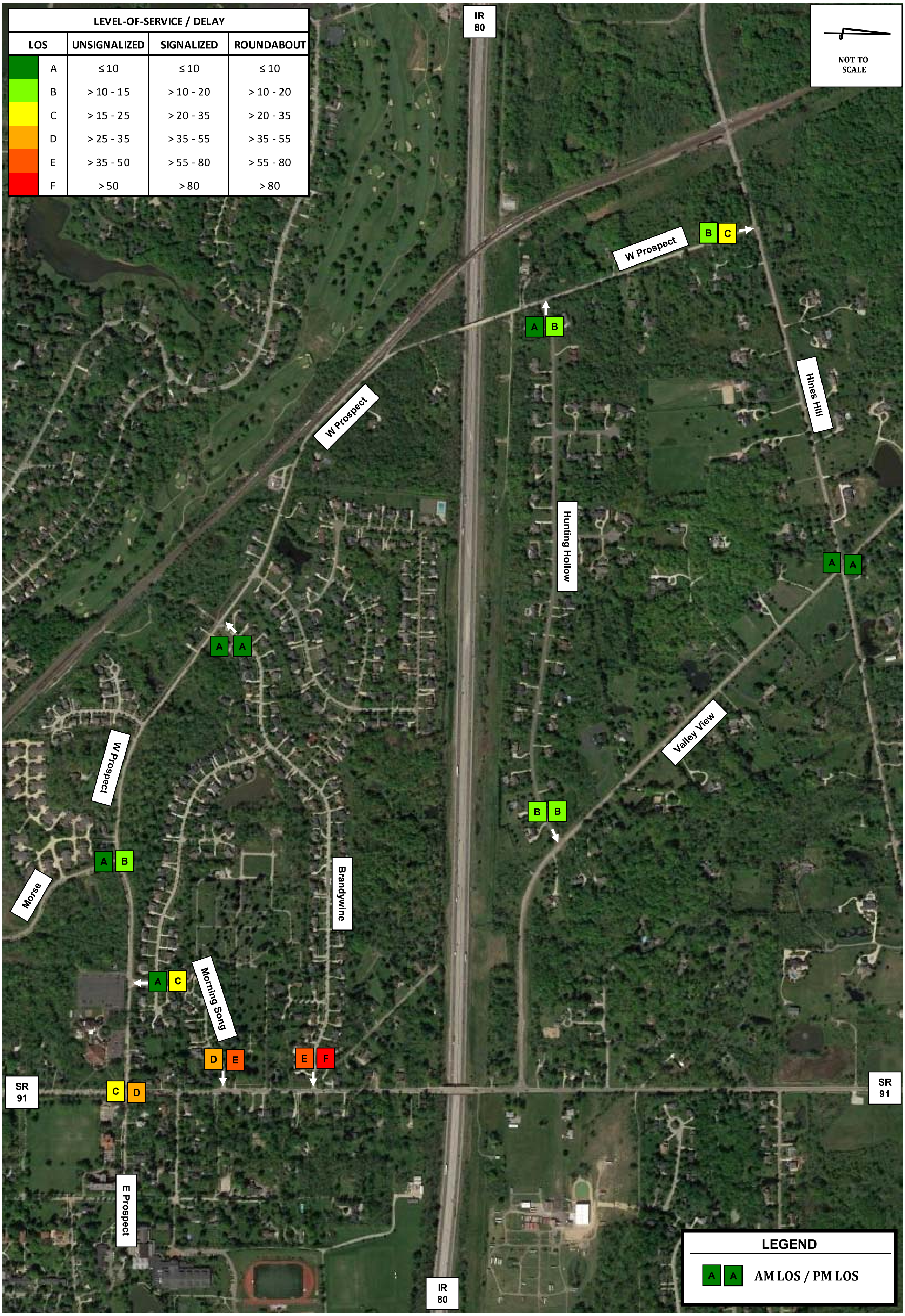
The following intersections are expected to operate with poor levels-of-service under the anticipated 2021 Build conditions:

1. SR 91 & Brandywine Drive (AM & PM Peak)
2. SR 91 & Morning Song Lane (PM Peak)
3. SR 91 & Prospect Street (PM Peak)
5. SR 91 & Clinton Street/Aurora Street (PM Peak)
7. SR 91 & SR 303 (PM Peak)
21. Owen Brown Street & Morse Road (AM & PM Peak)

The intersections of Brandywine Drive, Clinton Street/Aurora Street, and State Route 303 at State Route 91 were previously determined to operate with poor levels-of-service under the No-Build conditions. The remaining study area intersections are expected to continue operating with acceptable levels-of-service under the anticipated 2021 Build peak hour conditions.

**Figure 5.7, Page 77** visually details the intersection level-of-service for traffic signal and all-way stop controlled intersections and the minor street approach levels-of-service at the minor street stop controlled intersections. AM and PM peak hour charts can be found in **Appendix Q** detailing a summary of the capacity analysis results for the study area intersections.

The remaining study area intersections are expected to continue operating with acceptable levels-of-service under the anticipated 2021 Build peak hour conditions.




| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

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Figure: 5.7a


| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
|---|---|---|---|
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

LEGEND

A A AM LOS / PM LOS


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Levels-of-Service

Figure: 5.7b

The eastbound minor street approaches of Brandywine Drive and Morning Song Lane at North Main Street are expected to operate with a poor level-of-service during the peak hours due to the lack of adequate gaps in the North Main Street north-south through traffic stream for vehicles turning left from the minor street approaches onto North Main Street. It was determined that traffic signal control at the intersections would be necessary to improve the intersection levels-of-service. The intersections however do not meet the criteria for warranting a traffic signal as the minor street (Brandywine Drive & Morning Song Lane) volumes do not meet the required minimum volume thresholds for traffic signal control. Therefore traffic signal control will not be considered for mitigating the levels-of-service at the intersections of Brandywine Drive and Morning Song Lane at North Main Street.

A second northbound left turn lane at the intersection was recommended to improve the levels-of-service at the intersection of State Route 91 and State Route 303.

In order to improve the levels-of-service at the intersection of North Main Street and Clinton Street/Aurora Street it was determined that the minor street approaches would need to be aligned so that the approaches would not have to be split-phased in the traffic signal operation.

In order to determine what mitigation would be necessary to improve the levels-of-service at the remaining intersections, certain improvements were tested with further capacity analyses. The following improvements are recommended to mitigate the poor levels-of-service under the 2021 Build conditions:

3. SR 91 & Prospect Street
- Construct an exclusive eastbound left turn lane

21. Owen Brown Street & Morse Road
- Construct a single lane roundabout

OR

- Construct an exclusive northbound left turn lane
- Construct an exclusive eastbound left turn lane
- Construct an exclusive southbound right turn lane
- Install traffic signal control

The following table shows the capacity analysis results of implementing the recommended improvements. Copies of the capacity worksheets for the improved intersection are in included in **Appendix R**.

## Table 5.6 - 2021 Levels-of-Service (Build Conditions - Recommended Improvements)

| LOCATION | TRAFFIC CONTROL | MOVEMENT | AM PEAK LOS (DELAY) | PM PEAK LOS (DELAY) |
|---|---|---|---|---|
| Morse & Owen Brown | Roundabout | Intersection | B (17.7) | C (21.4) |
| | | Eastbound | C (21.3) | C (27.2) |
| | | Westbound | A (9.7) | A (8.9) |
| | | Northbound | B (17.3) | B (14.4) |
| | | Southbound | B (15.1) | C (21.6) |
| Morse & Owen Brown | Traffic Signal | Intersection | B (12.8) | B (12.3) |
| | | Eastbound | B (13.1) | B (12.6) |
| | | Westbound | B (17.7) | B (18.5) |
| | | Northbound | B (16.6) | B (15.8) |
| | | Southbound | A (8.6) | A (9.0) |
| SR 91 & Prospect Street | Traffic Signal | Intersection | B (15.9) | C (29.4) |
| | | Eastbound | B (19.5) | C (33.4) |
| | | Westbound | B (11.9) | B (19.4) |
| | | Northbound | B (17.2) | C (20.8) |
| | | Southbound | B (13.3) | D (35.3) |

**(XX.X) = Average vehicle delay in seconds per vehicle**

Build Condition - 2041 Capacity Analysis

Analyses were performed for the projected 2041 design year conditions under the Build scenario. This analysis will be used to determine the expected levels-of-service at the study intersections under the anticipated build conditions for the twenty year conditions. All analyses assumed that the signal timing would be optimized. The traffic volumes used in this analysis can be seen in **Figure 4.14**. Copies of the Synchro capacity worksheets are included in **Appendix S.**

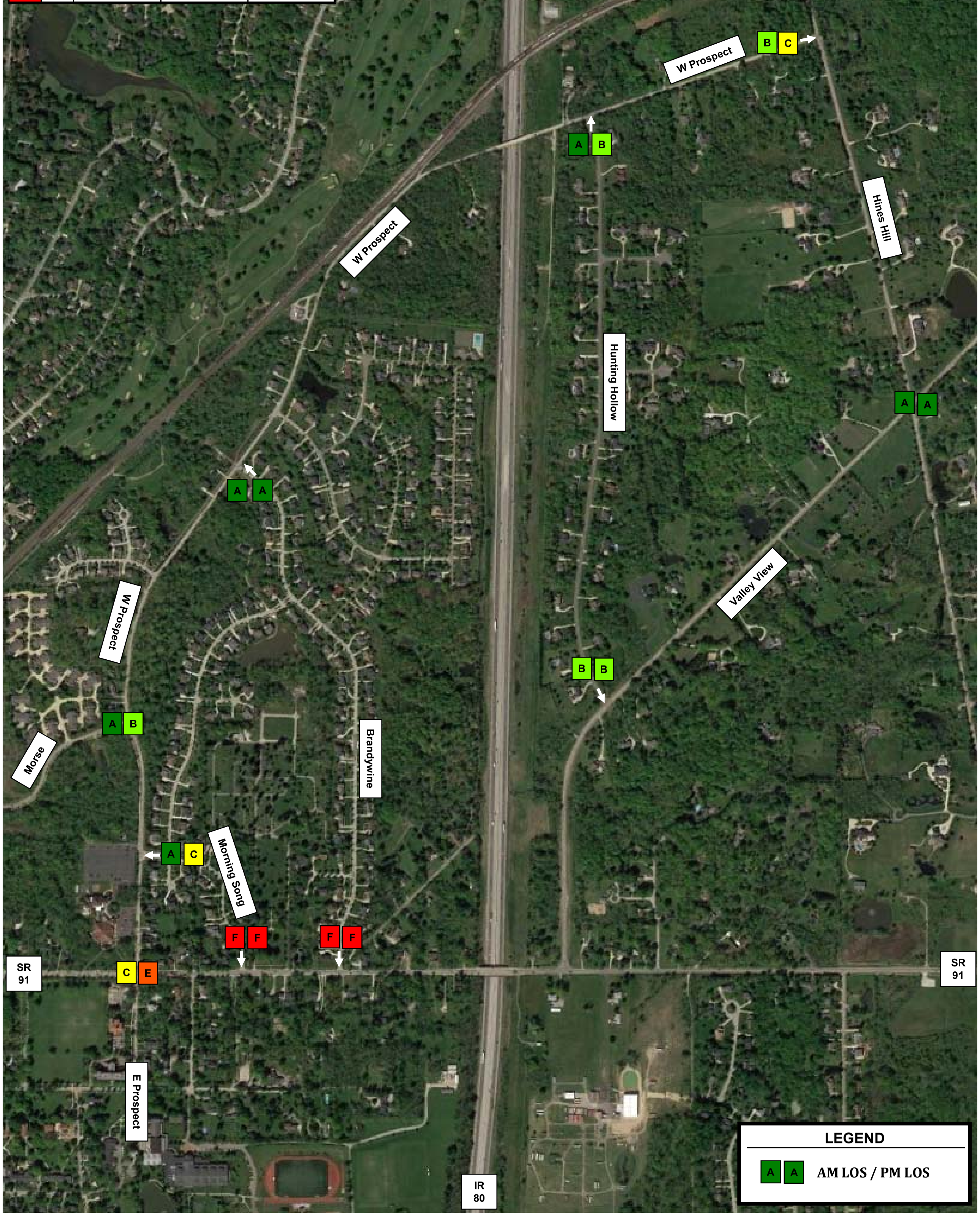
The following intersections are expected to operate with poor levels-of-service under the anticipated 2041 Build conditions:

1. SR 91 & Brandywine Drive (AM & PM Peak)
2. SR 91 & Morning Song Lane (AM & PM Peak)
3. SR 91 & Prospect Street (PM Peak)
5. SR 91 & Clinton Street/Aurora Street (AM & PM Peak)
7. SR 91 & SR 303 (AM & PM Peak)
8. SR 91 & Veterans Way (AM & PM Peak)
21. Owen Brown Street & Morse Road (PM Peak)

The intersections of Brandywine Drive, Morning Song Lane, Clinton Street/Aurora Street, and State Route 303 at State Route 91 were previously determined to operate with poor levels-of-service under the No-Build conditions. The remaining study area intersections are expected to continue operating with acceptable levels-of-service under the anticipated 2021 Build peak hour conditions.

**Figure 5.8, Page 81** visually details the intersection level-of-service for traffic signal and all-way stop controlled intersections and the minor street approach levels-of-service at the minor street stop controlled intersections. AM and PM peak hour charts can be found in **Appendix S** detailing a summary of the capacity analysis results for the study area intersections.

| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |





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2041 Build
Existing Conditions
Levels-of-Service

Figure: 5.8a


| LEVEL-OF-SERVICE / DELAY | | | |
|---|---|---|---|
| LOS | UNSIGNALIZED | SIGNALIZED | ROUNDABOUT |
| A | ≤ 10 | ≤ 10 | ≤ 10 |
| B | > 10 - 15 | > 10 - 20 | > 10 - 20 |
| C | > 15 - 25 | > 20 - 35 | > 20 - 35 |
| D | > 25 - 35 | > 35 - 55 | > 35 - 55 |
| E | > 35 - 50 | > 55 - 80 | > 55 - 80 |
| F | > 50 | > 80 | > 80 |

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Existing Conditions
Levels-of-Service

Figure: 5.8b

The eastbound minor street approaches of Brandywine Drive and Morning Song Lane at North Main Street are expected to operate with a poor level-of-service during the peak hours due to the lack of adequate gaps in the North Main Street north-south through traffic stream for vehicles turning left from the minor street approaches onto North Main Street. It was determined that traffic signal control at the intersections would be necessary to improve the intersection levels-of-service. The intersections however do not meet the criteria for warranting a traffic signal as the minor street (Brandywine Drive & Morning Song Lane) volumes do not meet the required minimum volume thresholds for traffic signal control. Therefore traffic signal control will not be considered for mitigating the levels-of-service at the intersections of Brandywine Drive and Morning Song Lane at North Main Street.

A second eastbound and westbound through lane was recommended to improve the levels-of-service at the intersection of State Route 91 and State Route 303 under the No-Build analysis.

In order to improve the levels-of-service at the intersection of North Main Street and Clinton Street/Aurora Street it was determined that the minor street approaches would need to be aligned so that the approaches would not have to be split-phased in the traffic signal operation.

In order to determine what mitigation would be necessary to improve the levels of service at the remaining intersections, certain improvements were tested with further capacity analyses. The following improvements are recommended to mitigate the poor levels-of-service under the 2041 Build conditions:

3. SR 91 & Prospect Street

- Construct an exclusive eastbound left turn lane

8. SR 91 & Veterans Way

- Construct a westbound left turn lane.

21. Owen Brown Street & Morse Road

- Construct a single lane roundabout

OR

- Construct an exclusive northbound left turn lane
- Construct an exclusive eastbound left turn lane
- Construct an exclusive southbound right turn lane
- Install traffic signal control

The following table shows the capacity analysis results of implementing the recommended improvements. Copies of the capacity worksheets for the improved intersection are in included in **Appendix S**.

## Table 5.7 - 2041 Levels-of-Service (Build Conditions - Recommended Improvements)

| LOCATION | TRAFFIC CONTROL | MOVEMENT | AM PEAK LOS (DELAY) | PM PEAK LOS (DELAY) |
|---|---|---|---|---|
| Morse & Owen Brown | Roundabout | Intersection | B (19.4) | C (21.0) |
| | | Eastbound | C (21.3) | C (27.2) |
| | | Westbound | A (9.7) | A (8.9) |
| | | Northbound | C (24.0) | B (14.4) |
| | | Southbound | B (15.1) | C (20.6) |
| Morse & Owen Brown | Traffic Signal | Intersection | B (13.7) | B (12.4) |
| | | Eastbound | B (14.9) | B (12.6) |
| | | Westbound | B (18.0) | B (18.5) |
| | | Northbound | B (17.0) | B (15.8) |
| | | Southbound | A (8.8) | A (9.2) |
| SR 91 & Prospect Street | Traffic Signal | Intersection | B (18.6) | D (40.0) |
| | | Eastbound | C (21.9) | D (47.6) |
| | | Westbound | B (13.3) | C (24.9) |
| | | Northbound | C (21.2) | C (24.5) |
| | | Southbound | B (14.6) | D (50.5) |
| SR 91 & Veterans Way | Traffic Signal | Intersection | B (13.9) | D (40.0) |
| | | Eastbound | C (31.0) | D (50.5) |
| | | Westbound | D (53.8) | D (46.2) |
| | | Northbound | B (11.3) | C (29.5) |
| | | Southbound | B (11.7) | D (48.5) |

**(XX.X) = Average vehicle delay in seconds per vehicle**

## 5.2 Turn Lane Length Analysis

An analysis was performed to determine the necessary turn lane storage length in order to accommodate the proposed turn lanes at the following intersections:

3. North Main Street & Prospect Street
7. North Main Street & State Route 303
8. South Main Street & Veterans Way
21. Morse Road & Owen Brown Street

It should be noted that the recommended turn lanes at Morse Road and Owen Brown Street are only recommended with traffic signal control at the intersection. No turn lanes are necessary at the intersection if a single lane roundabout is constructed.

The analysis was performed in accordance with the procedure recommended by the Ohio Department of Transportation in their **Location and Design Manual, Volume 1, Section 401**. The ODOT criteria and procedures are furnished in **Appendix G**. The recommended maximum left turn lane length is 600 feet and 800 feet for a right turn lane. The maximum turn lane length will not be applicable if calculated turn lane length is lower than these values. The following tables show the results of the analysis based upon the highest anticipated movement volumes at the intersections.

### Table 5.8 - Turn Lane Length Analysis
### #3 - North Main Street (SR 91) & Prospect Street

| Movement Direction | DHV | No. of Lanes | Cycles / Hour | Average Veh/ Cycle/ Lane | Design Speed (mph) | Fig. 401-10 Storage Length (ft) | Fig. 401-9 Condition | | | Backup Length (ft) | Turn Lane Length* (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A* | B* | C* | | |
| EB LT | 172 | 1 | 40 | 4.3 | 30 | 200 | 250 | -- | -- | -- | **250*** |
| EB T/RT | 70 | 1 | 40 | 1.8 | 30 | 100 | -- | -- | -- | 100 | -- |

*** Includes 50' taper**

## Table 5.9 - Turn Lane Length Analysis
## #7 - State Route 91 & State Route 303

| Movement Direction | DHV | No. of Lanes | Cycles / Hour | Average Veh/ Cycle/ Lane | Design Speed (mph) | Fig. 401-10 Storage Length (ft) | Fig. 401-9 Condition | | | Backup Length (ft) | Turn Lane Length* (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A* | B* | C* | | |
| NB LT | 276 | 2 | 30 | 4.6 | 30 | 200 | 250 | -- | -- | -- | 250* |
| NB T | 637 | 1 | 30 | 21.2 | 30 | 775 | -- | -- | -- | 775 | -- |

*** Includes 50' taper**

It should be noted that access to the 250 feet long dual left turn lanes would be blocked by queued traffic in the northbound through lane. The northbound through traffic queue is calculated at 775 feet long.

## Table 5.10 - Turn Lane Length Analysis
## #8 - South Main Street (SR 91) & Veterans Way

| Movement Direction | DHV | No. of Lanes | Cycles / Hour | Average Veh/ Cycle/ Lane | Design Speed (mph) | Fig. 401-10 Storage Length (ft) | Fig. 401-9 Condition | | | Backup Length (ft) | Turn Lane Length* (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A* | B* | C* | | |
| WB LT | 40 | 1 | 30 | 1.3 | 30 | 100 | 150 | -- | -- | -- | **150*** |
| WB T/RT | 20 | 1 | 30 | 0.7 | 30 | 50 | -- | -- | -- | 50 | -- |

*** Includes 50' taper**

## Table 5.11 - Turn Lane Length Analysis
## #21 - Morse Road & Owen Brown Street

| Movement Direction | DHV | No. of Lanes | Cycles / Hour | Average Veh/ Cycle/ Lane | Design Speed (mph) | Fig. 401-10 Storage Length (ft) | Fig. 401-9 Condition | | | Backup Length (ft) | Turn Lane Length* (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A* | B* | C* | | |
| NB LT | 149 | 1 | 40 | 3.7 | 30 | 175 | 225 | -- | -- | -- | **250*** |
| NB T/RT | 202 | 1 | 40 | 5.1 | 30 | 250 | -- | -- | -- | 250 | -- |
| SB RT | 223 | 1 | 40 | 5.6 | 30 | 250 | 300 | -- | -- | -- | **300*** |
| SB T/LT | 260 | 1 | 40 | 6.5 | 30 | 275 | -- | -- | -- | 275 | -- |
| EB LT | 238 | 1 | 40 | 6.0 | 30 | 250 | 300 | -- | -- | -- | **300*** |
| EB T/RT | 247 | 1 | 40 | 6.2 | 30 | 275 | -- | -- | -- | 275 | -- |

*** Includes 50' taper**

## 5.3 Development Site Plan

The site plan shown in Figure 1.3, Page 4 proposes to use Morse Road and Owen Brown Street and an extension of Village Way to provide access to and throughout the development. The development also proposes several new local roadways throughout the development as well.

The existing and proposed roadways throughout the development site are shown as two-lane roadways. Two-lane local roadways throughout the development should be sufficient to accommodate the movement of vehicular traffic through and within the development. These local roadways should have a minimum lane width of 11 feet in the commercial areas of the development and 10 feet in the residential areas based on Table 301-4 from the ODOT **Location and Design Manual, Volume 1**.

The roadways within the residential portions of the development are shown with available on-street parking. A parking lane width of 7 to 9 feet is recommended for parallel on-street parking.

The intersections within the development with the exception of Morse Road and Owen Brown Street are recommended to have minor street stop sign control. It is our recommendation that the Morse Road, Owen Brown Street, and Village Way approaches operate under free flow conditions with the left turn movements yielding the right-of-way to the opposing traffic. The proposed development roadways that intersect these roadways are then recommended to be under stop sign control.

The section of Owen Brown Street between Village Way and Morse Road is proposed on the site plan as a boulevard type section with a median between the eastbound and westbound travel lanes. Medians alone are not considered a traffic calming feature as they may increase vehicle speeds by reducing the "friction" between opposing directions of traffic. The traffic calming benefit of medians is typically related to the ability to provide space to locate pedestrian safety enhancements and traffic control devices. It is our opinion that the boulevard as shown on the site plan is not a traffic calming feature for the study area.

The crosswalks across the Morse Road approaches at Owen Brown Street are shown outside the median and the east-west travel lanes. The crosswalks across the Village Way at Owen Brown Street are shown inside the east-west travel lanes. We recommend these lanes be place outside the travel lane as they are shown at the intersection of Morse Road and Owen Brown Road.

It should also be noted that the boulevard layout causes the east-west lanes to be mis-aligned at each end of the boulevard as the two-lane sections of Owen Brown Street on each side boulevard section do not have any median separation. This intersection layout can often be confusing to motorists as they enter the median section of the roadway.

The traffic signal control or roundabout control was recommended at the intersection of Morse Road and Owen Brown Street based on the capacity analysis contained with Chapter 5. It was also determined that left turn lanes would be necessary on the south and west approaches and a right turn lane would be necessary on the north approach to allow the traffic signal operation to function with levels-of-service comparable to roundabout control.

The use of traffic signal control at the intersection of Morse Road and Owen Brown Street will create traffic queues that could potentially block access driveways located with the queue length. There is a proposed access location along the west side of Morse Road south of Owen Brown Street. The expected northbound queue length at Morse Road and Owen Brown Street is approximately 150 feet. The exiting left turn movement may be blocked during the peak hour by the northbound queue traffic.

The intersection of Owen Brown Street and Village Way with the median configuration should be operated under all-way stop sign control due the offset lanes and pedestrian crossing locations. The intersection without the median could be operated as a roundabout or with minor street stop sign control on the Village Way approaches.

## 5.4 Owen Brown Street

Owen Brown Street is a two-way roadway with a posted speed limit of 25 miles per hour between Morse Road to the west and North Main Street to the east. The roadway is approximately 20 feet wide and permits on-street parking along the south side of the roadway. Vehicles can not pass side by side when vehicles are parked along the roadway.

It is our opinion that the development traffic will not have a significant impact on the residential portion of Owen Brown Street between Morse Road and North Main Street. Owen Brown Street is not expected to serve as a significant ingress and egress route for the proposed development based on the following conclusions:

1. Less than 25% of the site generated traffic is expected to originate or be destined for the north along SR 91 (**Figures 4.1 & 4.2**).

2. The roadway is located near the beginning of the downtown core area where congestion in the North Main Street corridor occurs during the peak hours and has been observed to block the intersection of Owen Brown Street and North Main Street on occasion.

3. Owen Brown Street is approximately 20 feet wide and permits on-street parking making it impossible for eastbound and westbound vehicles to pass side by side where vehicles are parked.

4. There is an all-way stop intersection located approximately half-way between Morse Road and North Main Street.

4. The Owen Brown Street at North Main Street only has stop sign control on the Owen Brown Street approach. Left turn vehicles from Owen Brown Street to northbound North Main Street must wait for an adequate gap in the north-south through traffic stream.

Owen Brown Street was reviewed under various access scenarios to determine the existing conditions and potential impacts to the segment of roadway between Morse Road to the west and North Main Street to the east.

The following scenarios were analyzed and reviewed:

1. Existing & No-Build Conditions w/out the proposed development
2. Build Conditions with the proposed development
3. Left Turn Restrictions at State Route 91
4. Closure of Owen Brown Street @ State Route 91
5. Closure of Owen Brown Street @ Brandywine Creek Tributary culvert

The traffic volumes and capacity analysis for scenarios 1 and 2 were analyzed in Section 5.1. These scenarios are based on the existing roadway conditions on Owen Brown Street and North Main Street.

The third scenario would restrict access at North Main Street by preventing left turns between Owen Brown Street and North Main Street. Northbound vehicles that wished to turn left onto Owen Brown Street would have to use an alternate travel route likely involving access locations and roadways to the south along North Main Street or those along State Route 303. Vehicles turning left from Owen Brown Street to northbound North Main Street would likely use an alternate route involving Morse Road and Prospect Street.

The restriction of left turn movements at the intersection of North Main Street and Owen Brown Street would require the construction of a channelizing island to direct traffic and the appropriate signage indicating the restricted turn movements. A properly designed island will designate the correct turning path. The geometry of the approach and the channelizing island shall physically define the permitted movements and block the prohibited movements. The island design should accommodate the largest design vehicle likely to use the driveway. Channelizing islands should be constructed per the ODOT requirements and guidelines for a channelized restricted access driveway with the appropriate pavement markings and signs as detailed in the ODOT Access Management Manual. A copy of the design guidelines are included in **Appendix G**.

The fourth scenario was the closure of Owen Brown Street at the east end of the roadway near North Main Street. The closure would redirect all traffic using the North Main Street (SR 91) and Owen Brown Street intersection to alternative routes primarily through Morse Road and the adjacent roadways. This closure would impact traffic both originating and destined to the north and south of Owen Brown Street. The west end of Owen Brown Street would need to be configured to allow for vehicles such as school buses, snow plows, and emergency vehicles to turn around. It may also be necessary that any closure of Owen Brown at North Main Street be constructed so as to still allow emergency vehicles access as needed in the event of an emergency situation.

It was assumed that vehicles from the north turning right onto Owen Brown Street from North Main Street would use West Prospect Street and Morse Road. The vehicles turning left onto Owen Brown Street from North Main Street were assumed to use Park Lane and the access locations along West Streetsboro Street (SR 303). The vehicles turning left from Owen Brown Street to North Main Street (SR 91) were assumed to use Morse Road and West Prospect Street. The vehicles turning right from Owen Brown Street to North Main Street (SR 91) are expected to use Morse Road and the downtown core area roadways to travel south.

The analysis of the re-directed traffic due to a road closure of Owen Brown Road at North Main Street (SR 91) was carried out based on the 2041 design year Build conditions. Copies of the intersection capacity analysis worksheets can be found in **Appendix U**.

It was also considered to reroute Owen Brown Street east of Morse Road to connect to Clinton Street as part of the closure at the east end of Owen Brown Street. The most likely locations would be at Old First Street. The connection would require the ability to bring the roadway through an existing parking lot along the north side of Clinton Street. Any connection from Owen Brown Street to Clinton Street east of the culvert is likely to require significant costs associated with acquiring the necessary right-of-way. It is our opinion that the benefit of connecting Owen Brown Street to Clinton Street east of Morse Road with the intersection of Owen Brown Street and Morse Road recommended for upgrades is minimal.

The fifth scenario was the closure of Owen Brown Street at the Brandywine Creek Tributary culvert approximately 280 feet east Morse Road. The closure would eliminate access to the downtown core area using the internal roadways for the Owen Brown Street residents.

A closure of the roadway at the west end of the residential units at the culvert location would still allow access to the Owen Brown Street residential area at North Main Street but would eliminate access to the downtown core area through the intersection with Morse Road. The intersection was previously shown to operate with adequate levels-of-service under the No-Build conditions. The intersection would be expected to maintain these levels-of-service as through access to North Main Street would be restricted further reducing the Owen Brown Street volumes at North Main Street.

It was also considered to reroute Owen Brown Street east of Morse Road to connect to Clinton Street as part of the closure at the west end of Owen Brown Street. The most likely locations would be at Old First Street. The connection would require the ability to bring the roadway through an existing parking lot along the north side of Clinton Street. Any connection from Owen Brown Street to Clinton Street east of the culvert is likely to require significant costs associated with acquiring the necessary right-of-way. The connection would provide an access for the local residents to access the internal areas of the downtown core without have to travel on North Main Street. It is likely however that residents will still prefer to use the intersection of Owen Brown Street and North Main Street especially outside the peak hours for North Main Street.

A closure of Owen Brown Street at the west end without a connection to Clinton Street would require the placement of signs to indicate Owen Brown Street is not a through street at the intersection with North Main Street (SR 91). The use of a NO OUTLET (W14-2 and/or W14-2a) sign is recommended. The W14-2a may be used in conjunction with street name signs to warn turning traffic the cross street ends in the direction indicated by the arrow.

The recommended signs can be seen below:


W14-2

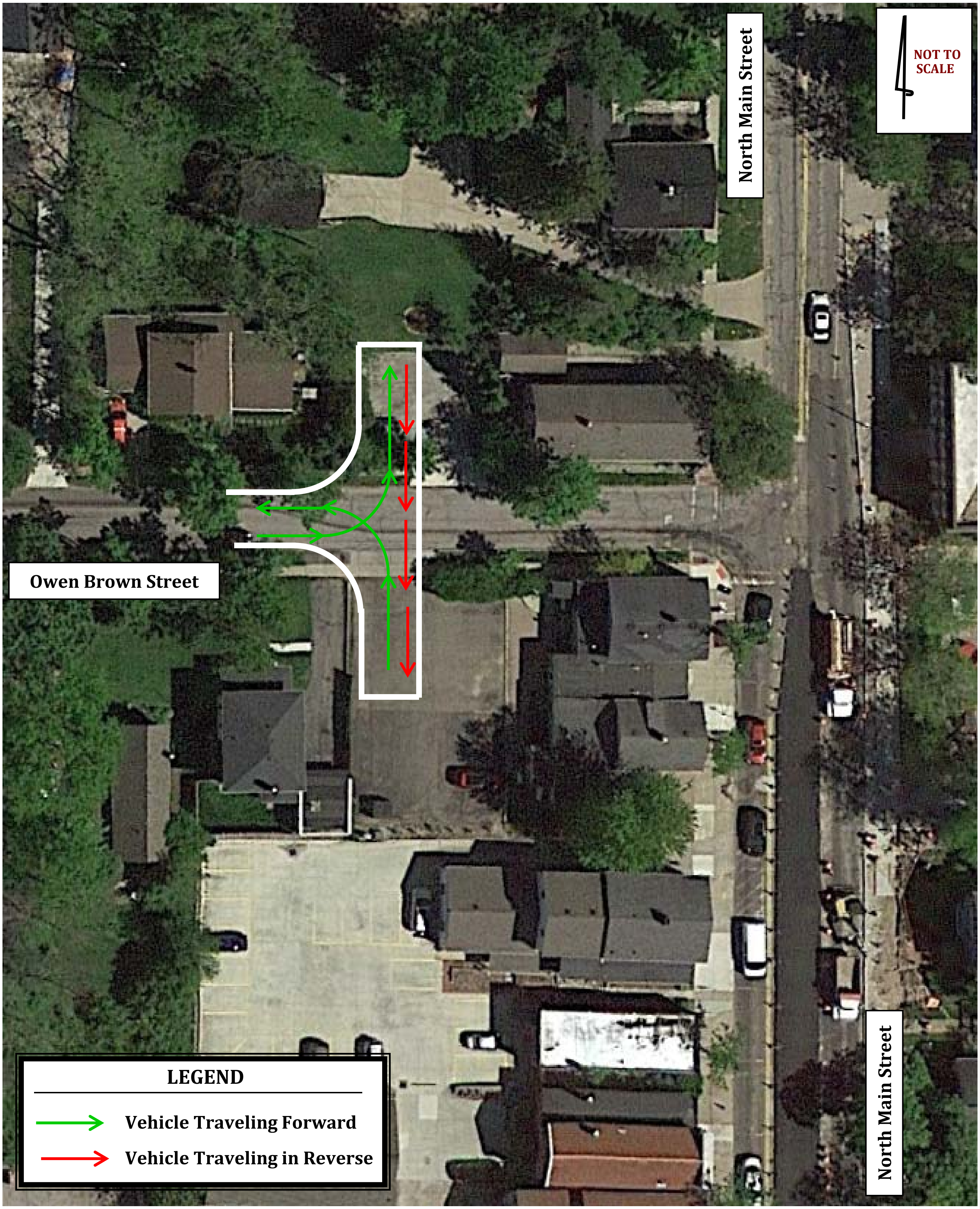

W14-2a

**Figures 5.9 and 5.10, Pages 94 and 95** detail possible configurations for a hammerhead style turnaround at the east end of Owen Brown Street.

**Figures 5.11 and 5.12, Pages 96 and 97** detail possible configurations for a hammerhead style turnaround at the west end of Owen Brown Street.

It should be noted that a typical hammerhead turnaround is 120 feet long at 60 feet in direction from the centerline of the roadway. The hammerhead should however be designed to accommodate any expected school bus traffic, emergency vehicles, or city service vehicles that would need the ability to access the local street and turnaround.

A comparison chart was created to list the advantages of each scenario versus the disadvantages of each scenario. The comparison chart can be seen on Page 98.

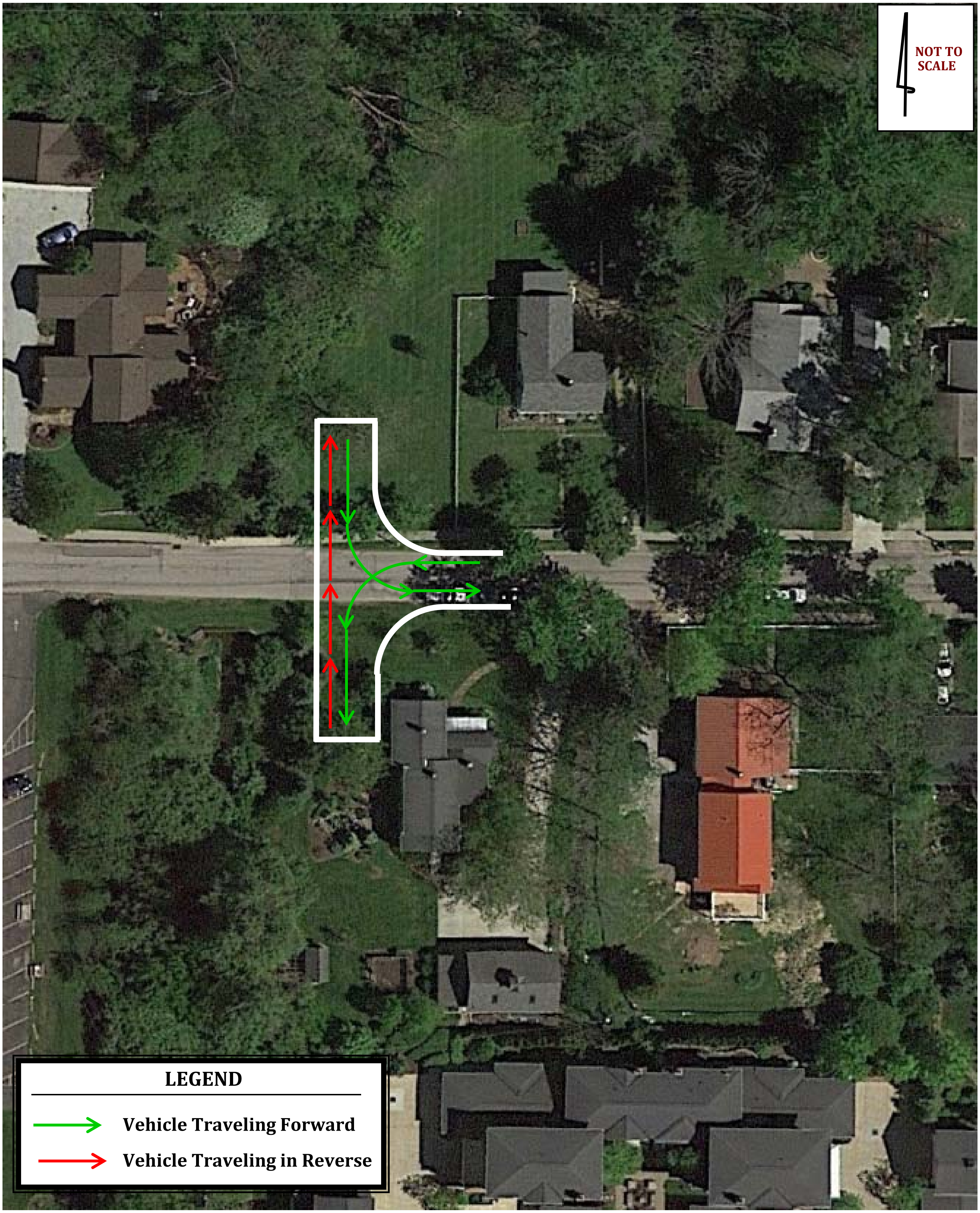





Hammerhead Configuration East Alternative 1

Figure 5.9

North Main Street
NOT TO SCALE
Owen Brown Street
North Main Street
LEGEND
Vehicle Traveling Forward
Vehicle Traveling in Reverse




| | | | |
|---|---|---|---|
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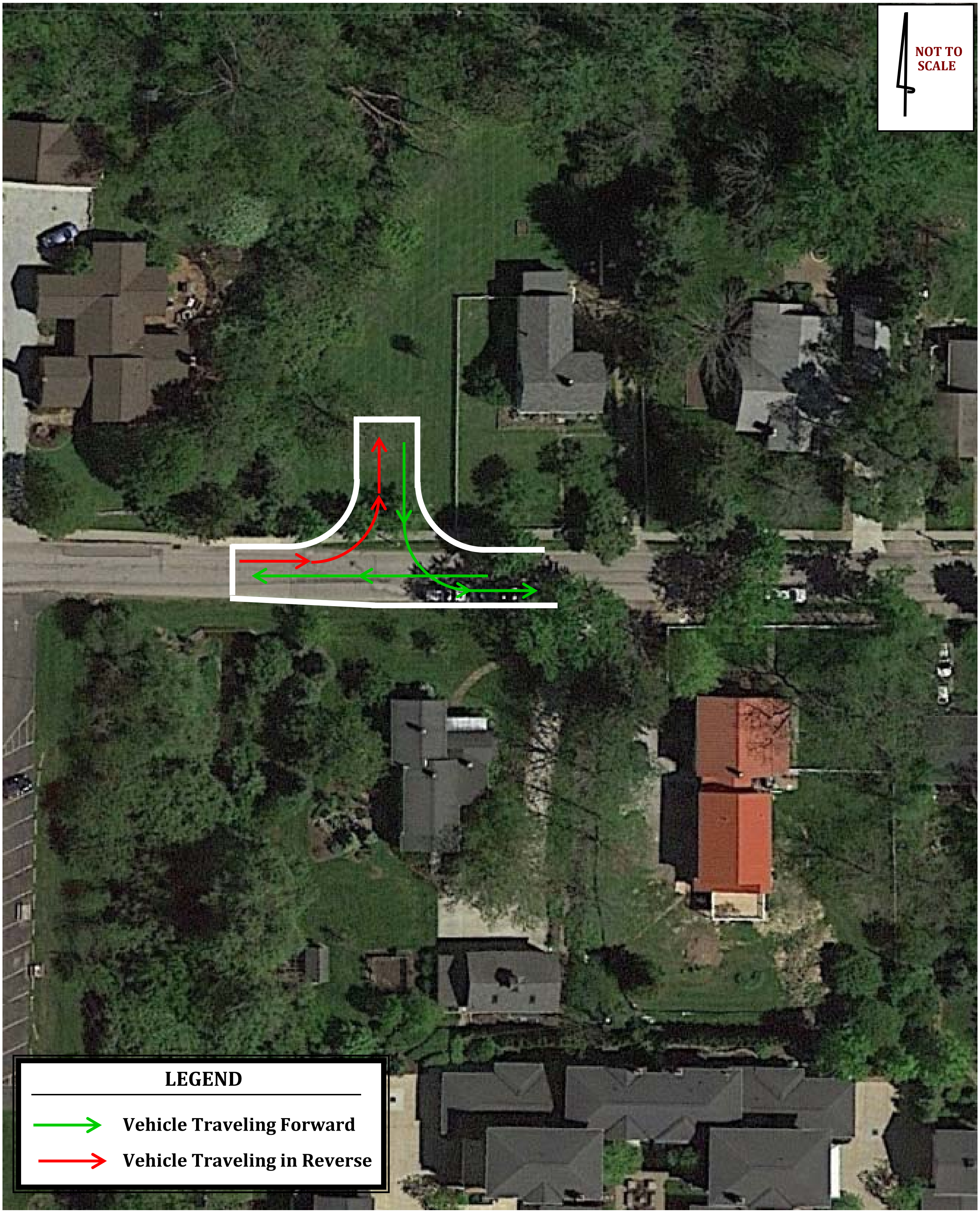

NOT TO
SCALE
LEGEND
Vehicle Traveling Forward
Vehicle Traveling in Reverse

## Table 5.12 - Advantages vs Disadvantages
## Owen Brown Street Alternatives

| ADVANTAGES | DISADVANTAGES |
|---|---|
| **SCENARIO #1 & #2 - Maintain Existing Roadway Conditions** | |
| No access restriction to local residents. | Available connection between Morse Road & SR 91 for through traffic. |
| Emergency access maintained | Maximum intersection conflict points. |
| No construction required. | No impact to existing vehicular speeds. |
| No cost. | Development may increase through traffic. |
| **SCENARIO #3 - Restrict Left Turn Movements at Owen Brown and SR 91** | |
| Limit volume of through traffic to and from Morse Road. | No direct access for locals coming from the south or going to the north. |
| Emergency access can be maintained. | May require redirection of bus and maintenance vehicle routes. |
| Reduces conflict points at the intersection. | Require reconstruction of intersection approach to accommodate channelizing island. |
| | May require enforcement by police department. |
| | Increase travel time for local residents. |
| **SCENARIO #4 - Close Owen Brown at SR 91** | |
| Eliminates access location along SR 91 reducing total conflict points in corridor. | Accomodations necessary for emergency access from SR 91. |
| May decrease vehicular speeds. | Potential impact to parcels to create turnaround. |
| Eliminates through traffic between SR 91 and Morse Road. | Increase travel time for local residents. |
| **SCENARIO #5 - Close Owen Brown at Brandywine Creek Tributary Culvert** | |
| Removal of culvert and impact to culvert maintenance. | No internal access to downtown core area for locals. All must use SR 91. |
| Restrict volume on Owen Brown and at intersection with SR 91 to local traffic only. | Potential impact to parcels to create turnaround. |
| May decrease vehicular speeds. | Removal of culvert would sever pedestrian and bicycle connections. |
| Eliminates through traffic between SR 91 and Morse Road. | Increase travel time for local residents. |
| | May impact emergency response from the west. |

This page has been intentionally left blank for a matrix detailing the various Owen Brown treatments and improvements.

This page has been intentionally left blank for a matrix detailing the various Owen Brown treatments and improvements.

## 5.5 Owen Brown Street & Norfolk Southern Overpass

**Owen Brown Street** is a two-lane roadway that has an east to west orientation which starts at North Main Street (SR 91) and terminates in the west at Lennox Road. There is a rail overpass operated by Norfolk Southern that crosses Owen Brown Street. It is located 480 feet east of Lennox Road and 860 feet west of Morse Road.

The overpass has advance “low clearance” warning signs installed at Morse Road and Lennox Road which are the nearest intersecting roadways where a vehicle can detour or turn around. The advance signs are marked with a 10'-7" clearance. Measurements taken found the clearance height to be 11'-1". There are no supplemental distance plaques mounted under the low clearance warning signs.

To the west of the railroad overpass, the abutting property is generally residential. To the east of the overpass the land use is currently commercial with one property devoted to City services and school bus transportation services. Owen Brown Street serves as a connection between the west side residential areas to the east side down town retail / commercial area. There are no sidewalks on either side of the street between Morse Road and Lennox Road, therefore pedestrians and bicyclists must share the roadway with motor vehicles.

The pavement width of Owen Brown Street is nominally 19 feet from face to face of curb where curb is present. It reduces in width as it approaches the Norfolk Southern rail overpass and under the bridge to 15 feet from face of gutter plate to face of gutter plate. Curbs are present along both sides of the street from Lennox Road to approximately 250 feet east of the rail overpass. The curb east and west of the overpass is a straight 6" curb without gutter plate. This curb transitions to an integral curb and gutter plate under the overpass. There is no curb from 250 feet east of the rail overpass to Morse Road.

Owen Brown Street has an average daily traffic (ADT) volume of approximately 3,400 vehicles per day based on a 2016 traffic count collected at the railroad overpass. A copy of the count data can be seen in **Appendix A**. The table below shows a breakdown of the classifications of road users for a weekday and a Saturday.

### Table 5.13 - Roadway Users

| | Weekday | Saturday |
|---|---|---|
| ADT (24 Hr Vehicular Volume)* | 3352 | 2670 |
| 9 Hr. Vehicular Volume | 2215 | 1517 |
| Cars (9 Hours) | 2182 (98.5%) | 1513 (99.7%) |
| Trucks (9 Hours) | 27 (1.2%) | 4 (0.3%) |
| Buses (9 Hours) | 6 (0.3%) | 0 (0%) |
| Pedestrians (9 Hours) | 18 | 20 |
| Bicyclists (9 Hours) | 22 | 13 |

* Calculated by multiplying ODOT expansion factors for local streets and 9 hour vehicular volume

Motor vehicle, pedestrian and bicycle crash records were reviewed for Owen Brown Street. There were 6 total crashes that have occurred since 2011. There were no reports of crashes involving either pedestrians or bicyclists. The following table shows a breakdown of the crashes by year.

### Table 5.14 - Crashes

| Year | Total Crashes | Type |
|---|---|---|
| 2011 | 0 | |
| 2102 | 1 | 1 - Backing (truck too tall so stopped before bridge & while backing hit vehicle in his blind spot) |
| 2103 | 0 | |
| 2014 | 3 | 2 - Hit fixed object (too tall, hit bridge)<br>1 - Sideswipe (vehicles passing one another under bridge) |
| 2015 | 1 | 1 - Hit fixed object (too tall, hit bridge) |
| 2016 | 1 | 1 - Hit fixed object (too tall, hit bridge) |

A roadway segment analysis of underpass section of Owen Brown Street was analyzed to determine the existing levels-of service for the roadway under the existing conditions. The following table details the results of that analysis. Copies of the analysis worksheets can be seen in **Appendix V**.

### Table 5.15 - 2041 Levels-of-Service (No Traffic Control)

| LOCATION | TRAFFIC CONTROL | MOVEMENT | AM PEAK LOS | PM PEAK LOS (DELAY) |
|---|---|---|---|---|
| Owen Brown & NS Underpass | None | Eastbound | E | E |
| | | Westbound | E | E |

**(XX.X) = Average vehicle delay in seconds per vehicle**

It should be noted that HCM guidelines do not allow for a lane width less than 9 feet in the analysis. The results provided above likely represent a best-case scenario for the underpass under existing conditions with no traffic control. The results however do indicate that widening the underpass to accommodate two 9 foot travel lanes would not be sufficient to allow the roadway segment to operate with a levels-of-service D or better.

The use of traffic control signals were analyzed to determine their impact to traffic along Owen Brown Street at the rail overpass. Copies of the analysis worksheets for a traffic signal controlled under pass can be seen in **Appendix V**. The following table details the results of the analysis based in the 2041 design year conditions:

### Table 5.16 - 2041 Levels-of-Service (Traffic Signal Control)

| LOCATION | TRAFFIC CONTROL | MOVEMENT | AM PEAK LOS (DELAY) | PM PEAK LOS (DELAY) |
|---|---|---|---|---|
| Owen Brown & NS Underpass | Traffic Signal | Eastbound | D (44.8) | D (37.4) |
| | | Westbound | C (25.7) | D (40.6) |

**(XX.X) = Average vehicle delay in seconds per vehicle**

The table indicates that using traffic signal control on each side of the rail overpass at Owen Brown Street to control right-of-way through the tunnel would be expected to operate with level-of service D or better.

Further improvement in the roadway level-of service for vehicular traffic would require widening the underpass to accommodate a two-lane roadway width of at least 11 feet based on Table 301-4 from Section 300 of the ODOT **Location and Design Manual, Volume 1**. A copy of Table 301-4 can be seen in **Appendix G**.

There are four (4) ways in which pedestrians can be accommodated in the public right of way. These include:

1. Sidewalks
2. Off-Road Paths
3. Shared-Use Paths
4. Shared Streets

If the Owen Brown Street roadway were to be reconstructed to have a sidewalk under the overpass, the narrowest pedestrian area would require that a minimum four (4) foot sidewalk with a minimum two (2) foot buffer area to be constructed. A nine (9) foot paved area for motor vehicles would be left in the existing cross section. Nine foot travel lane is not recommended unless the ADT is less than 250 vehicles per day. Since the current ADT exceeds this value it would be expected that operational and safety issues could be a concern. This narrow design does not have adequate width to allow two persons, each in wheel chairs, to pass one another and therefore may not meet ADA requirements for accessibility. The construction of sidewalks under the overpass would require a widening of the under pass to accommodate the necessary width of the sidewalks facilities and vehicular travel lanes.

The construction of an off-road path would require a separate facility that would require tunneling under the rail overpass.

Shared use paths, path where pedestrians and bicyclists share the same travel area and is marked accordingly, has the same difficulty as constructing a sidewalk under the overpass. There is not enough space for the path and a travel lane for vehicles. Shared use paths require a minimum of 10 feet in width and a 5 foot buffer area between the path and the travel lane. There is currently only 15 feet of width available which would not allow a travel lane for motor vehicles. The construction of a shared use path would require either a separate facility that would require tunneling under the rail overpass or a widening of the existing underpass.

The last method of accommodating pedestrians, "shared street", is precisely what is currently being used along Owen Brown Street, under the overpass and along the street. Pedestrian activity has been recorded using Owen Brown Street. No pavement markings indicating a pedestrian path way is required nor recommended.

The widening or the Owen Brown Street underpass or the tunneling of a separate facility would be a high cost improvement that would require significant coordination with the Norfolk Southern to maintain rail traffic over Owen Brown Street.

Based on information currently found at the Pedestrian and Bicycle Information Center the cost to create a pedestrian underpass (excluding bridges) can vary greatly based on site conditions and materials. The presence of the rail line and maintaining rail traffic will likely increase the cost of any underpass project. The site details an approximate cost of $1,609,000 to $10,733,00 at approximately $120 per square foot. The underpass information at the Pedestrian and Bicycle Information Center website can currently be found at the following web address:

http://www.pedbikeinfo.org/planning/facilities_crossings_over-underpasses.cfm

The following factors should also be considered with the possible construction of a separate underpass or widening of the existing underpass to accommodate pedestrians and bicycles:

- People will not use the structure if a more direct route is available.
- Lighting, drainage, graffiti removal, and security are also major concerns with underpasses.
- Must be wheelchair accessible, which may result in long ramps on either end of the underpass.
- AASHTO recommends a railing height of at least 42 inches.
- When bicyclist space is provided near railings or near motorized traffic, extra horizontal width or a buffer of at least two feet is recommended to protect bicyclists in the event of a crash or wind blast.

## 5.6 Improvements to Accommodate Study Area Traffic

No improvements were found to be necessary to accommodate the existing traffic at the study area intersections.

The following intersection improvements were found to be necessary to accommodate the expected 2019 and 2021 No-Build traffic at the study area intersections:

7. SR 91 & SR 303
   - Construct a second northbound left turn lane

18. East Hines Hill Road & Valley View Road
   - Construct a single lane roundabout

No additional improvements were recommended to accommodate the 2019, and 2021 No-build traffic at the study area intersections.

The following intersection improvements were found to be necessary to accommodate the expected 2041 No-Build traffic at the study area intersections:

5. SR 91 & Clinton Street/Aurora Street
   - Align Clinton Street and Aurora Street

7.0 SR 91 & SR 303
   - Construct a second east-west through lane

No additional improvements were recommended to accommodate the 2041 No-Build traffic at the study area intersections.

The following lane use and traffic control are recommended to accommodate the 2019 site generated (Build) traffic:

21. Morse Road & Owen Brown Street
- Construct a single lane roundabout

OR

- Construct an exclusive northbound left turn lane
- Construct an exclusive eastbound left turn lane
- Construct an exclusive southbound right turn lane
- Install traffic signal control

No additional improvements were recommended to accommodate the 2019 Build traffic conditions at the study area intersections.

The following lane use and traffic control are recommended to accommodate the 2021 site generated (Build) traffic:

3. North Main Street (SR 91) & Prospect Street
- Construct an exclusive eastbound left turn lane

It should be noted that the intersection of North Main Street (SR 91) and Prospect Street was previously analyzed in prior studies and was determined to not require any additional improvements. A memo detailing the differences between this report and the prior analyses can be seen in **Appendix W**. The primary differences can be attributed to the application of design hour factors and higher trip generation results for the proposed development due to differences in the development site plans under review for each analysis.

The trip generation results for this report exceeded the previous analyses by 239 trips in the AM peak hour and 224 trips in the PM peak hour. The left turn lane was determined to not be necessary without these additional trips. The capacity analysis determined that left turn lane does not become necessary until the development generates 180 of the additional 224 trips in the PM peak hour.

Based on the trip generation results and capacity analysis it is recommended that the need for an eastbound left turn lane on West Prospect Street at North Main Street (SR 91) be re-analyzed in a post-construction analysis after the development has reached full build conditions.

No additional improvements were recommended to accommodate the 2021 Build traffic conditions at the study area intersections.

The following lane use and traffic control are recommended to accommodate the 2041 site generated (Build) traffic:

8. South Main Street (SR 91) & Veterans Way
- Construct an exclusive westbound left turn lane

No additional improvements were recommended to accommodate the 2041 Build traffic conditions at the study area intersections.

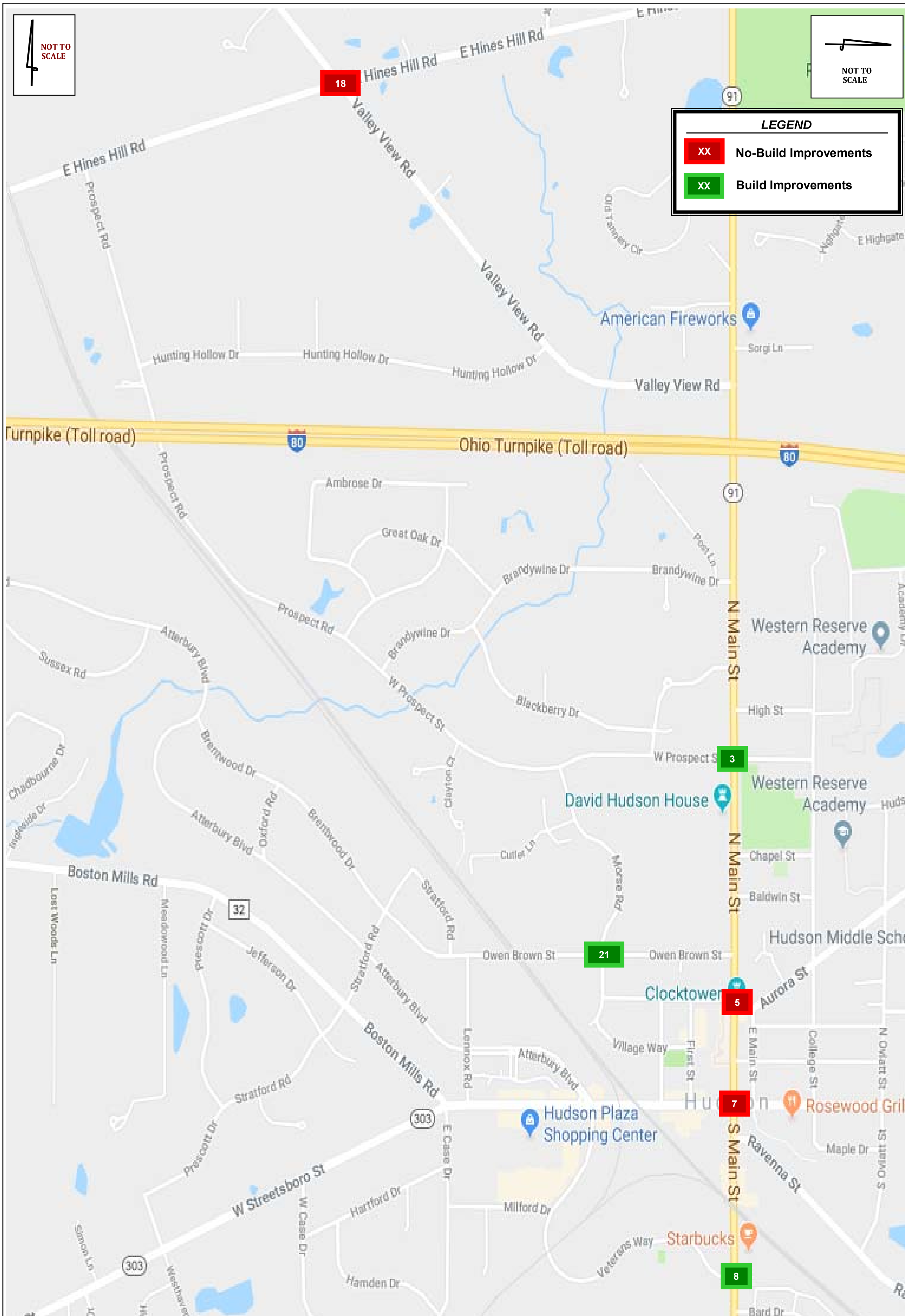
Table 5.17 summarizes the recommended intersection improvements.

## Table 5.17 - Recommended Intersection Improvements

| LOCATION | CONDITION | IMPROVEMENT |
|---|---|---|
| 3. SR 91 &M Prospect | 2021 Build | Eastbound Left Turn Lane |
| 5. SR 91 & Clinton/Aurora | 2041 No-Build | Align Clinton/Aurora Approaches |
| 7. SR 91 & SR 303 | 2019 No-Build | 2ND Northbound Left Turn Lane |
| 8. SR 91 & Veterans Way | 2041 Build | Westbound Left Turn Lane |
| 18. Hines Hill & Valley View | 2019 No-Build | Single Lane Roundabout |
| | 2041 No-Build | Second East-West Through Lanes |
| 21. Owen Brown & Morse | 2019 Build | Single Lane Roundabout<br>or<br>Traffic Signal Control<br>Northbound Left Turn Lane<br>Eastbound Left Turn Lane<br>Southbound Left Turn Lane |

The location of the recommended intersection improvements can be seen on **Figure 5.13, Page 109.**

The recommended lane use and traffic control for the study area intersections to accommodate the proposed development under the expected No-Build and Build conditions can be seen in **Figure 5.14, Page 110**.

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Traffic Impact Study

Recommended Improvements Locations

Figure: 5.13

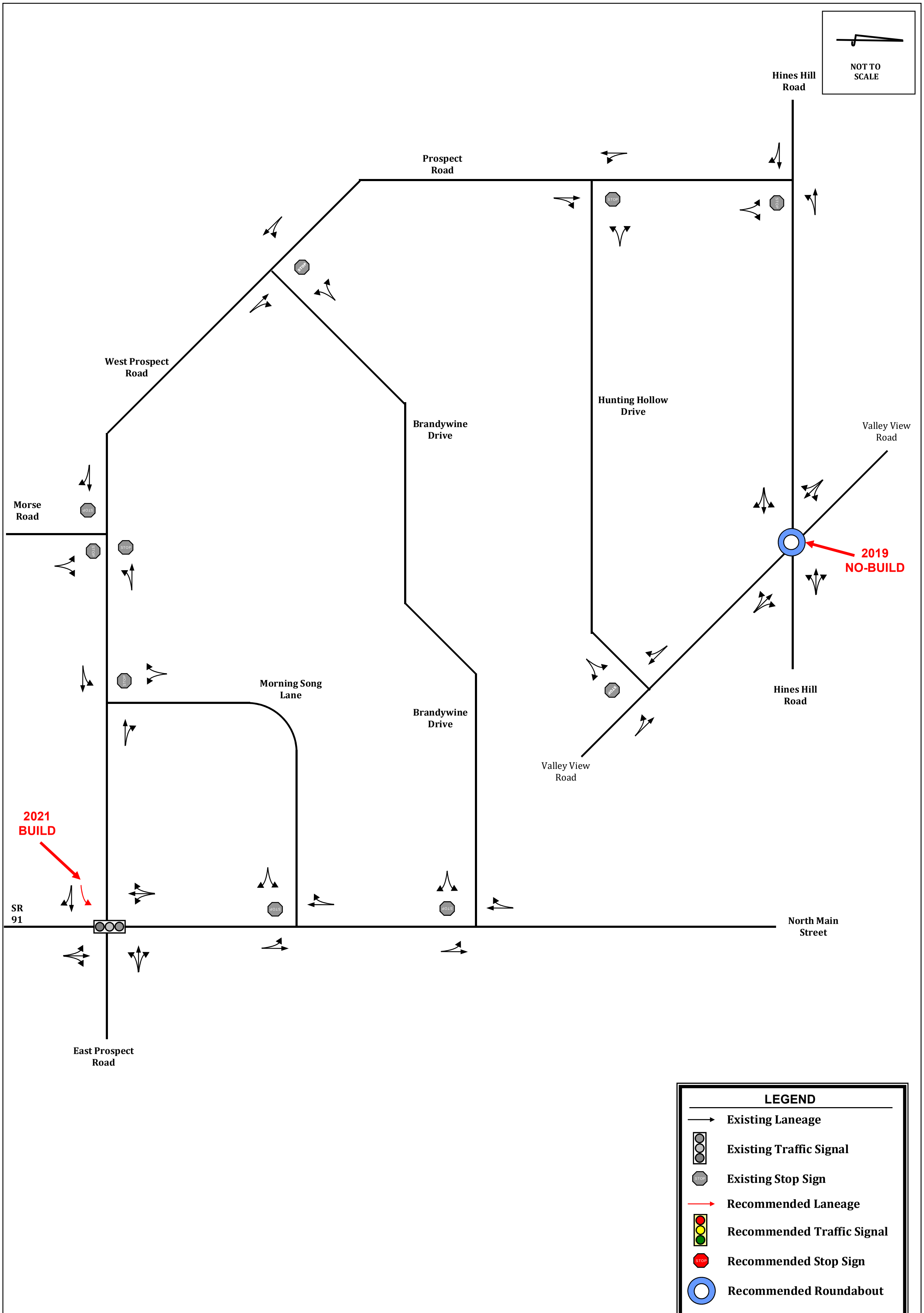


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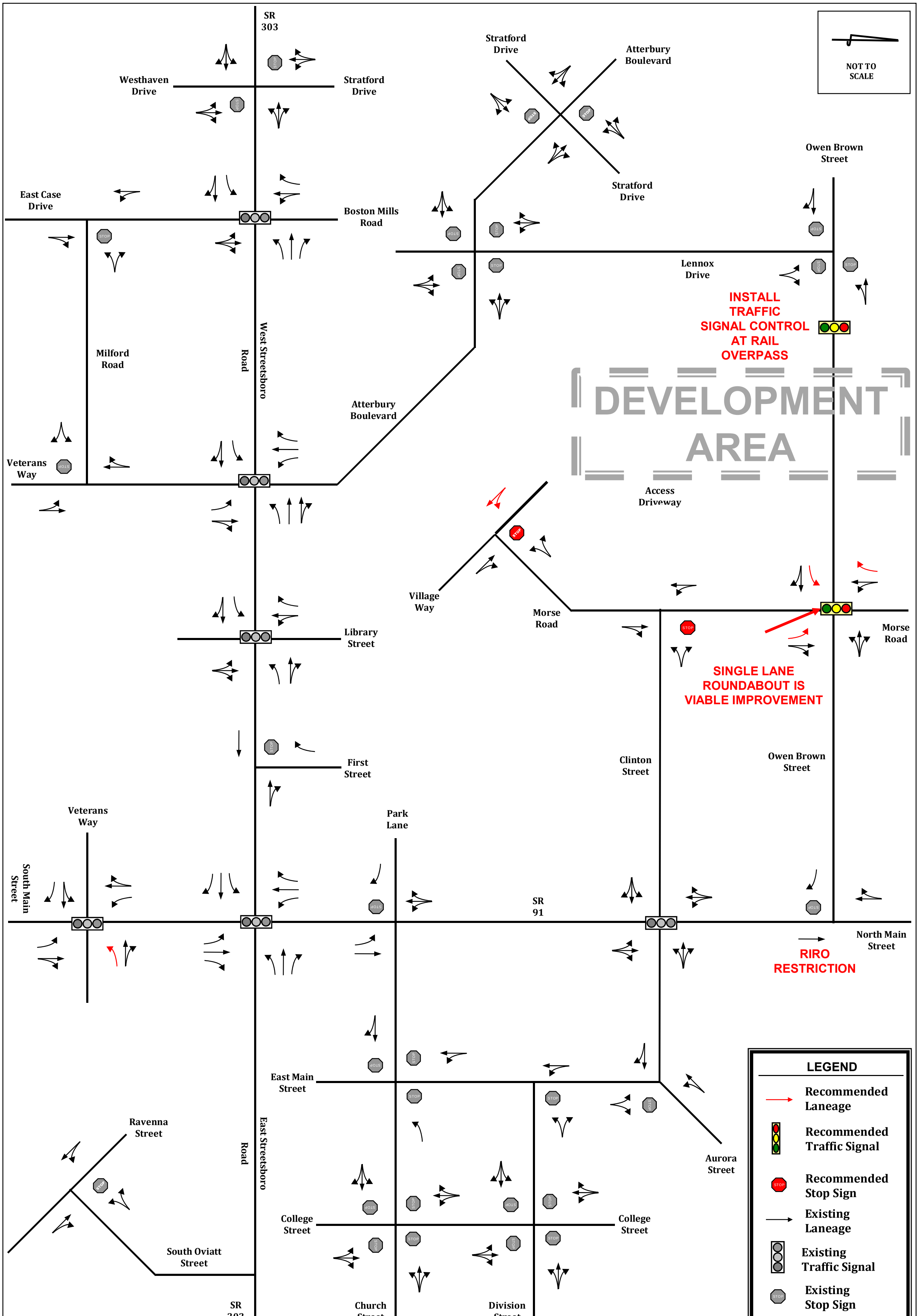
Figure: 5.14a

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Recommended Intersection Improvements

Figure: 5.14b

Page: 110b

The following recommendations and traffic calming measures are made for the Owen Brown Street corridor between North Main Street and Lennox Road in order to minimize the impacts of the development:

1. Restrict all left turn movements at the intersection of Owen Brown Street and North Main Street.

2. Construct a single lane roundabout at the intersection of Owen Brown Street and Morse Road.

3. Eliminate the boulevard style roadway between Morse Road and Village Way.

4. Construct a single lane roundabout at the intersection of Owen Brown Street and Village Way.

5. Install traffic signal control at the Owen Brown underpass location to control traffic through the underpass.

6. Use raised pavement areas with a different surface texture than the roadway at crosswalk locations.

7. Consider the use of on-street parking along Owen Brown Street in the development areas.

8. Minimize the corner radii at all development intersections to force vehicles to slow down to turn. Consideration should be given to the expected design vehicles on the roadways including but not limit to the City's emergency vehicles.

**Figure 5.15, Page 112** details the listed recommendations for the Owen Brown Street corridor between North Main Street and Lennox Road.


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Traffic Impact Study

Owen Brown Street Recommendations

Figure: 5.15

Page: 112

# Chapter 6
# Conclusions

Based on the results of the analyses, we offer the following conclusions and recommendations:

6.1 The weekday AM peak hour of traffic was determined to be 7:00 AM to 8:00 AM. The weekday PM peak hour of traffic was found to be 5:00 PM to 6:00 PM at the study intersections.

6.2 The first phase of the proposed development is expected to consist of three development components comprised of the following land uses:

| Residential | Office | Commercial |
|---|---|---|
| 22 Low-Rise Units | 98,241 Square Feet | Flex - 77,434 Square Feet |
| 80 Mid-Rise Units | | Hotel - 60 Rooms |

6.3 The second phase of the proposed development is expected to consist of three development components comprised of the following land uses:

| Residential | Office | Commercial |
|---|---|---|
| 23 Low-Rise Units | | Flex - 30,088 Square Feet |
| 88 Mid-Rise Units | | |

6.4 2019 will be analyzed as the opening year for Phase 1 and 2021 will be analyzed for the full build out of the development with the Phase 1 and Phase 2 land use components. The year 2041 will be analyzed as the design year for the twenty year analysis and include Phase 1 and 2.

6.5 The primary access to the development site will be through the adjacent local roadways of Morse Road, Owen Brown Street, Clinton Street, and Village Way. The site plan for the Hudson Downtown Phase 2 project can be seen in **Figure 1.3, Page 4**.

6.6 The proposed development is expected to generate the following average hourly traffic during the AM and PM peak periods after completion of the first phase based upon the rates established by studies from the Institute of Transportation Engineers.

## Hudson - Downtown Phase II Project
## Phase 1

| | TRIP ENDS | | | |
|---|---|---|---|---|
| | Weekday Peak Hour Between 7-9 AM (Enter/Exit) | | Weekday Peak Hour Between 4-6 PM (Enter/Exit) | |
| TOTAL DRIVEWAY VOLUMES | 369 | 141 | 215 | 331 |
| TOTAL DIVERTED TRIP REDUCTION | 0 | 0 | 36 | 33 |
| TOTAL NEW TRIPS | **369** | **141** | **179** | **298** |
| | **510** | | **477** | |

6.7 The proposed development is expected to generate the following average hourly traffic during the AM and PM peak periods after completion of the second phase based upon the rates established by studies from the Institute of Transportation Engineers.

## Hudson - Downtown Phase II Project
## Full Build

| | TRIP ENDS | | | |
|---|---|---|---|---|
| | Weekday Peak Hour Between 7-9 AM (Enter/Exit) | | Weekday Peak Hour Between 4-6 PM (Enter/Exit) | |
| TOTAL DRIVEWAY VOLUMES | 444 | 204 | 296 | 409 |
| TOTAL DIVERTED TRIP REDUCTION | 0 | 0 | 50 | 46 |
| TOTAL NEW TRIPS | **444** | **204** | **246** | **363** |
| | **648** | | **609** | |

6.8 The following intersection improvements were found to be necessary to accommodate the expected 2019 and 2021 No-Build traffic at the study area intersections:

7. SR 91 & SR 303
- Construct a second northbound left turn lane

18. East Hines Hill Road & Valley View Road
- Construct a single lane roundabout

No additional improvements were recommended to accommodate the 2019, and 2021 No-build traffic at the study area intersections.

6.10 The following intersection improvements were found to be necessary to accommodate the expected 2041 No-Build traffic at the study area intersections:

5. SR 91 & Clinton Street/Aurora Street
- Align Clinton Street and Aurora Street

7.0 SR 91 & SR 303
- Construct a second east-west through lane

No additional improvements were recommended to accommodate the 2041 No-Build traffic at the study area intersections.

6.11 The following lane use and traffic control are recommended to accommodate the 2019 site generated (Build) traffic:

21. Morse Road & Owen Brown Street
- Construct a single lane roundabout

OR
- Construct an exclusive northbound left turn lane
- Construct an exclusive eastbound left turn lane
- Construct an exclusive southbound right turn lane
- Install traffic signal control

No additional improvements were recommended to accommodate the 2019 Build traffic conditions at the study area intersections.

6.12 The following lane use and traffic control are recommended to accommodate the 2021 site generated (Build) traffic:

3. North Main Street (SR 91) & Prospect Street
- Construct an exclusive eastbound left turn lane

It should be noted that the intersection of North Main Street (SR 91) and Prospect Street was previously analyzed in prior studies and was determined to not require any additional improvements. The primary difference can be attributed to the application of design hour factors and higher trip generation results for the proposed development due to differences in the development site plans under review for each analysis.

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Based on the trip generation results and capacity analysis it is recommended that the need for an eastbound left turn lane on West Prospect Street at North Main Street (SR 91) be re-analyzed in a post-construction analysis after the development has reached full build conditions.

No additional improvements were recommended to accommodate the 2021 Build traffic conditions at the study area intersections.

6.13 The following lane use and traffic control are recommended to accommodate the 2041 site generated (Build) traffic:

8. South Main Street (SR 91) & Veterans Way
- Construct an exclusive westbound left turn lane

No additional improvements were recommended to accommodate the 2041 Build traffic conditions at the study area intersections.

6.14 **Figure 5.15, Page 110** details the listed recommendations for the Owen Brown Street corridor between North Main Street and Lennox Road.

# TRAFFIC IMPACT STUDY

## Downtown Phase 2 Project

## Hudson, Ohio

March 2, 2018

Prepared For:

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**"This document was prepared consistent with local agency requirements and/or applicable guidelines contained in this report."**