MMM Group Limited

Traffic Control Strategy for Grand Forks Collector to Collector Intersections

Prepared for:
Grand Forks - East Grand Forks
Metropolitan Planning Organization

Submitted by:

MMM GROUP

November 2008 | 5541915.101

COMMUNITIES

TRANSPORTATION

BUILDINGS

INFRASTRUCTURE

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STANDARD LIMITATIONS

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The preparation of this (report, map, document, etc.) was partially financed by FHWA/FTA Planning funds through the North Dakota Department of Transportation and Minnesota Department of Transportation. The opinion, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the MPO, NDDOT, MnDOT, or the FHWA/FTA.

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NOMENCLATURE

AADT - Average Annual Daily Traffic

ADT - Average Daily Traffic

FHWA - Federal Highway Administration

GIS - Geographic Information System

ICE - Intersection Control Evaluation

LOS - Level of Service

MEV - Million Entering Vehicles

MN MUTCD - Minnesota Department of Transportation's 2005 Manual on Uniform Traffic Control Devices

MnDOT - Minnesota Department of Transportation

MPO - Grand Forks–East Grand Forks Metropolitan Planning Organization

MUTCD - Manual on Uniform Traffic Control Devices

NCHRP - National Cooperative Highway Research Program

NDDOT - North Dakota Department of Transportation

TEM - Minnesota Department of Transportation's 2007 Transportation Engineering Manual

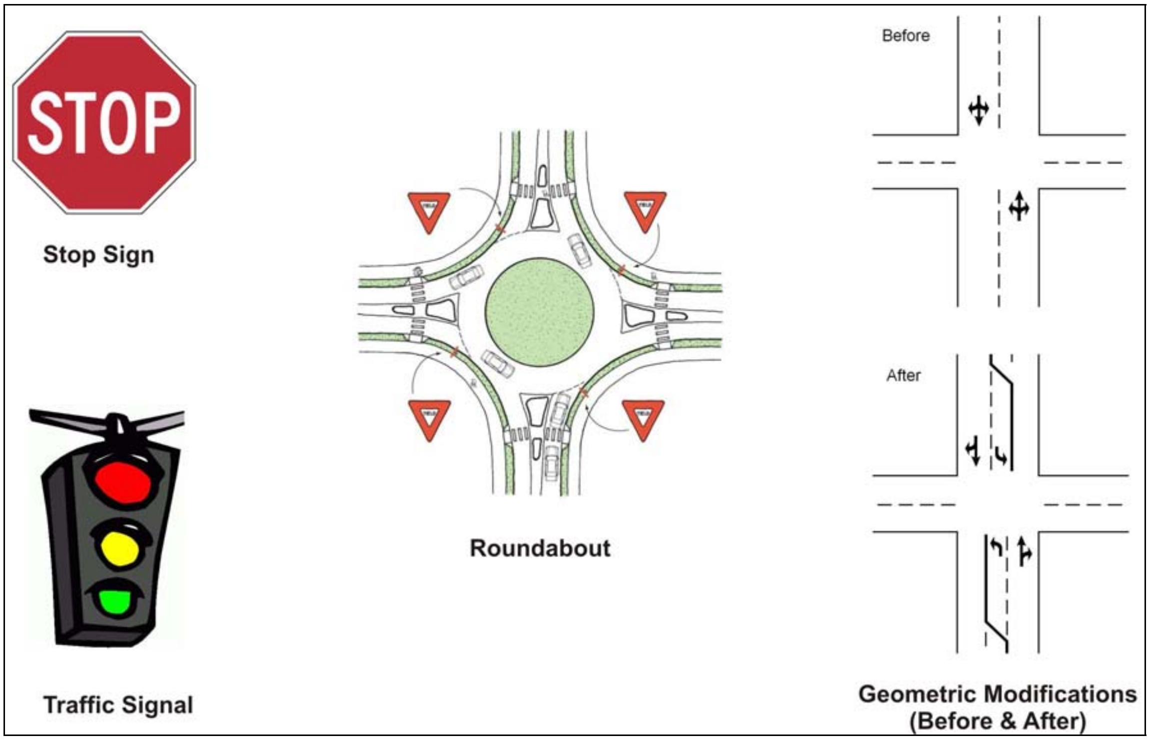
UND - University of North Dakota

EXECUTIVE SUMMARY

This study was commissioned by the Grand Forks–East Grand Forks Metropolitan Planning Organization (MPO) to examine traffic control options at 13 collector to collector intersections in the City of Grand Forks. A collector is defined as a road with low to moderate traffic volumes and ranks below a highway or arterial road but above local or residential streets. Collector roads tend to "collect" traffic from local roads or neighborhoods and lead it to arterial roads. Typical traffic control measures include stop signs, traffic signals, roundabouts, access management or geometric modifications. The intersections examined as part of this study are in diverse areas that include mature neighborhoods with predominantly single-family residential homes, newer areas with a mix of land uses, and areas with additional development potential.

Study Objective

The objective of the study was to identify the optimum traffic control measures, examples of which are shown below, that can accommodate forecast peak hour traffic activities in the year 2035.



The peak hour is defined as the part of the day during which traffic congestion is heaviest. The recommended traffic control plan will be used to guide the City of Grand Forks in determining the proper traffic control at each of the 13 study locations.

Methodology

The study focused on five main goals, including:

- A review of applicable traffic engineering standards and practices as well as interviews with various Engineering, Police and Emergency Departments,
- A public consultation program that offered residents and stakeholders an opportunity to participate in the study and offer input on traffic control measures and concerns,
- A review of current traffic, volumes and patterns, collisions, roadway configurations and growth rates,
- Development of traffic volumes for the forecast year 2035 and,
- Identification of traffic control strategies to accommodate future peak hour traffic.

Environmental Scan

An environmental scan, which included a detailed literature review as well as personal interviews with relevant professionals, was completed as part of this study. The components of the environmental scan included telephone interviews, a telephone survey of various municipal and state departments and agencies and a literature review. Environmental scans assist in determining appropriate conventions concerning the treatment of collector to collector intersections for Grand Forks. Documents from the Departments of Transportation of the U.S., North Dakota and Minnesota, in addition to the Transportation Research Board's National Cooperative Highway Research Program, were reviewed.

Local authorities from the cities of Grand Forks and Brandon, Manitoba were interviewed via telephone to obtain their perspective on traffic control measures. Varying opinions were received from the Engineering, Police and Fire Departments contacted. The Grand Forks departments favored the installation of traffic signals as opposed to all-way stop signs or roundabouts. Conversely, the City of Brandon has installed roundabouts as an alternative to traffic signals and their departments have received positive feedback from citizens, maintenance workers and emergency responders.

Engineering Departments from Rapid City, South Dakota, Sioux Falls, South Dakota, Bismarck, North Dakota, Fargo, North Dakota and Grand Rapids, Minnesota were surveyed regarding their respective collector to collector intersection traffic control policies. The Engineering Departments reported no formal local or state policy dictating the implementation of collector to collector intersection traffic controls. Most departments base traffic control installation on traffic volumes.

Rapid City, Sioux Falls, and Bismarck do not currently have any roundabouts installed. However, roundabouts are in the process of being constructed in Sioux Falls and are proposed as part of a residential subdivision in Bismarck. The City of Fargo has two roundabouts in relatively low volume residential developments with another slated for construction in 2008. The City of Grand Rapids currently has two roundabouts; one operated by the County and the other by the City. The City's roundabout is located at an intersection of an urban collector and a local street. Grand Rapids has noted positive improvements to traffic flow, access, and costs and has also received requests from residents in other areas for the installation of a roundabout.

Existing and Projected Operations

Each of the study intersections was reviewed to determine:

- Intersection geometry,
- Existing weekday p.m. peak hour traffic volumes,
- Posted speed limit,
- Influencing factors such as school zones,
- Transit service, and
- Bicycle and pedestrian traffic.

As well, each intersection was analyzed based on the existing traffic volumes and the forecast 2035 volumes. A level of service (LOS) of C is considered acceptable for an urban collector roadway during peak hour conditions. The relative performance of an intersection is measured in terms of level of service ranging from A (excellent) to F (beyond capacity). The overall LOS based on the existing intersection and traffic control configurations were found to be LOS A or B for current traffic levels. The overall LOS for the study intersections ranged from A to C for the forecast year of 2035. However, individual traffic movements at the following intersections were determined to be below the desired level:

- 6th Avenue North and Stanford Road: Westbound through and right-turns at LOS D,
- 24th Avenue South and South 34th Street (NW): Eastbound left and right-turns at LOS F, and
- 24th Avenue South and South 34th Street (SE): Eastbound left-turns at LOS F.

Collision Analysis

Year 2005 and 2006 collision data reporting the number, type and severity of reported collisions was provided by the City of Grand Forks. Data was analyzed for all of the study intersections with the exception of Ruemmele Road and South 34th Street, 40th Avenue South and South 20th Street and 55th Avenue South and Cherry Street since they are newer intersections without a collision history to-date.

A total of 17 collisions occurred at the study intersections over the two-year study period, six in 2005 and 11 in 2006. The intersection with the highest number of collisions, four in two years, was 40th Avenue South and Cherry Street. Collision rate is a measure of the risk faced by the road user and is based on the number of collisions that occurred and the volume of traffic entering the intersection during a specified period. Collision rate is measured as the number of collisions per million entering vehicles (MEV) at an intersection during the analysis period, which in this case is the two year period of 2005 and 2006. All intersections analyzed had collision rates below what is commonly considered the critical collision rate (1.5 collisions per MEV), and therefore are assumed to be operating at acceptable levels of safety. The average collision rate at the intersections was 0.33 collisions per million entered vehicles. The intersection of 40th Avenue South and Cherry Street had the highest collision rate of 1.16 collisions per million entered vehicles.

The average collision rate at intersections controlled by a one or two-way stop was 0.35 collisions per million entered vehicles. Intersections controlled by an all-way stop had an average collision rate of 0.30 collisions per million entered vehicles. While the collision rate is slightly higher at one or two-way stops, there is not a significant correlation between the type of intersection control and the average collision rate.

Public Participation

Initial Public Information Meetings were held in Grand Forks on February 13, 2008 at Valley Middle School and Century Elementary School. 17th Avenue South was used to divide the study intersections into north and south locations and separate Public Information Meetings were held for both. Approximately nine people attended the north Open House and just three attended the south Open House (not including local staff).

A final Public Information Meeting was held on May 15, 2008 and utilized an open house format. The Public Information Meeting was hosted in City Hall Council Chambers of the City of Grand Forks. The meeting was attended by one person (not including local staff).

Participants at all of the Public Information Meetings had the opportunity to review information regarding the study goals, objectives, progress, intersection traffic data and forecasts, collision data, potential traffic control strategies and recommended traffic control options. Staff from the MPO, the City of Grand Forks and the Consultant Team was available to answer questions.

Comment sheets were provided at all Public Information Meetings to obtain feedback from participants on their traffic control concerns in the City of Grand Forks. Participants were asked to identify the main transportation issues at any of the study intersections, to rank the proposed traffic control strategies in order of preference, to state whether or not they would be opposed to the implementation of any of the proposed traffic control strategies and to recommend any additional traffic control strategies for the collector to collector intersections in the study.

Proposed Strategies

The U.S. Department of Transportation's 2003 Manual on Uniform Traffic Control Devices (MUTCD) provides guidance on a number of traffic control strategies including the use of two-way stop sign control, multi-way stop sign control, yield sign control and traffic control signals. Forecast peak hour traffic volumes at the following intersections did not meet MUTCD warrants for traffic signal installation or require other traffic control modifications:

- 8th Avenue North and 20th Street North;
- 8th Avenue South and Cherry Street;
- 11th Avenue South and South 34th Street;
- 13th Avenue South and Cherry Street;
- 24th Avenue South and Cherry Street;
- Ruemmele Road and South 34th Street;
- 40th Avenue South and South 20th Street;
- 40th Avenue South and Cherry Street; and
- 55th Avenue South and Cherry Street.

The following intersections are recommended for geometric or traffic control modifications based on forecast peak hour traffic volumes:

- 6th Avenue North and Stanford Road;
- 13th Avenue South and South 20th Street;
- 24th Avenue South and South 34th Street (NW); and
- 24th Avenue South and South 34th Street (SE).

Intersection	Existing Traffic Control	Recommended Traffic Control
No Change:		
8th Ave N & 20th St N	Two-way Stop	Two-way Stop
8th Ave S & Cherry St	Two-way Stop	Two-way Stop
11th Ave S & S 34th St	Two-way Stop	Two-way Stop
13th Ave S & Cherry St	All-way Stop	All-way Stop
24th Ave S & Cherry St	All-way Stop	All-way Stop
Ruemmele Rd & S 34th St	Two-way Stop	Two-way Stop
40th Ave S & S 20th St	All-way Stop	All-way Stop
40th Ave S & Cherry St	Two-way Stop	Two-way Stop
55th Ave S & Cherry St	All-way Stop	All-way Stop
Recommended Changes:+		
6th Ave N & Stanford Rd	All-way Stop	Traffic Signals/Roundabout *
13th Ave S & S 20th St	All-way Stop	Traffic Signals/Roundabout *
24th Ave S & S 34th St (NW)	One-way Stop	Traffic Signals/Roundabout *
24th Ave S & S 34th St (SE)	One-way Stop	Traffic Signals/Roundabout *

+ Forecast overall intersection level of service criteria is met for all the study intersections.

* Warrants for traffic signal control or a roundabout to be reviewed in the future based on actual traffic volumes.

As well as the recommended traffic control changes summarized in the table above, the City of Grand Forks should commence a traffic count program at the study intersections that require modified traffic control. The program should include eight hour counts at each location and be carried out every five years to re-evaluate traffic signal warrants prior to considering the introduction of traffic signals or a roundabout at the study intersections.

For future traffic control requirements on collector roadways, the City of Grand Forks should consider utilizing the intersection control evaluation (ICE) parameters modified from the Minnesota Department of Transportation ICE to reflect Grand Forks conditions.

1.0 INTRODUCTION

1.1 Study Background

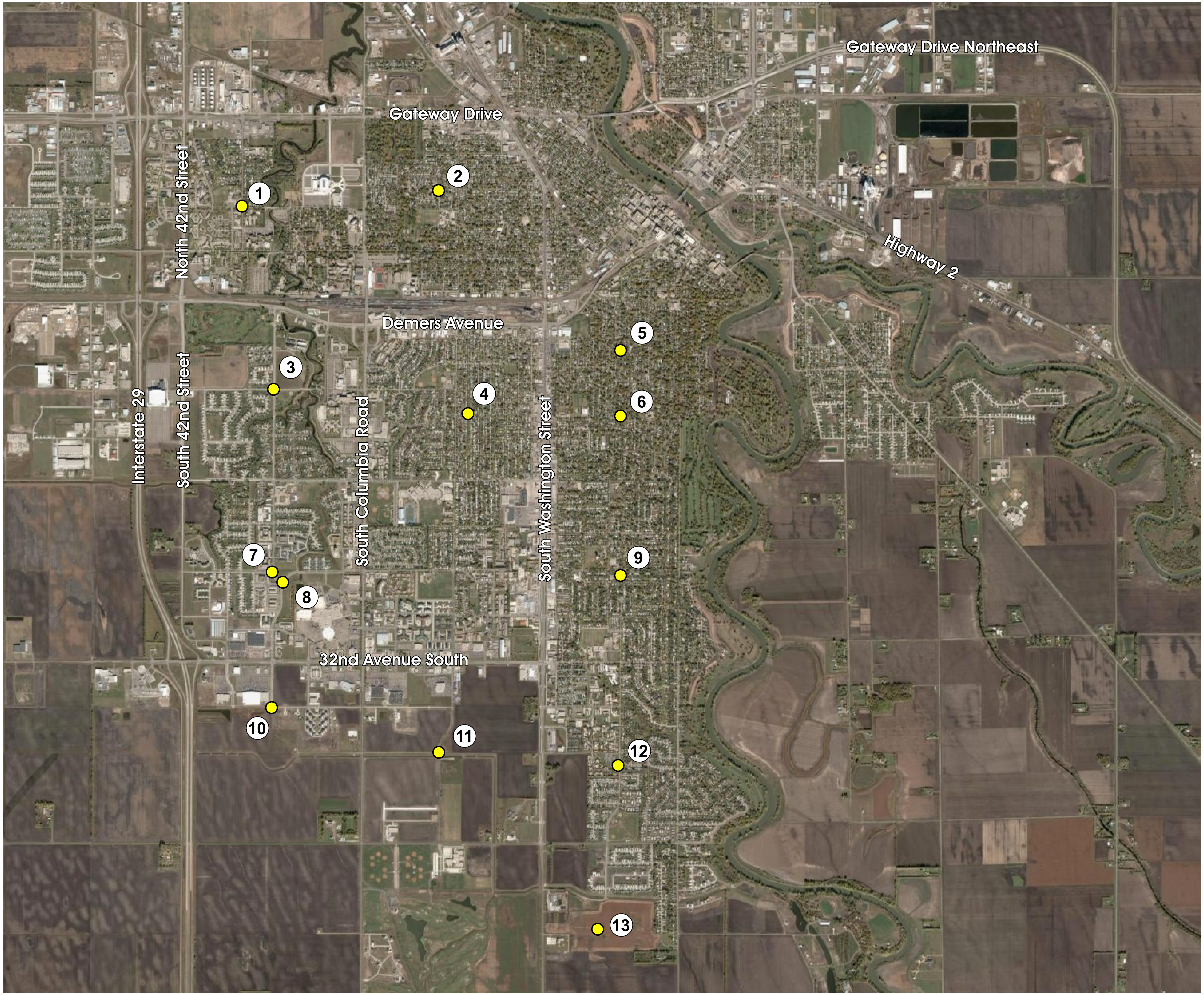
This study was commissioned by the Grand Forks – East Grand Forks Metropolitan Planning Organization (MPO) on behalf of the City of Grand Forks to examine future traffic control requirements at 13 collector to collector intersections. The intersections are located in diverse areas, ranging from mature neighborhoods with predominantly single-family residential development, to newer areas with a mix of land uses, to areas with additional development potential. The basic intent of the study is to identify the optimum traffic control measures that can accommodate forecast peak hour traffic activities for the MPO's current 2035 horizon year traffic forecast. Traffic control strategies will be identified for each of the intersections, as well as a menu of options that can be used to test needs at other intersections in the future. The solutions were expected to vary by location, although it was identified by MPO and City of Grand Forks staff at the outset of the study that solutions that do not involve traffic signal control may be preferable. This is in part due to negative public reaction with traffic signal control that was implemented a number of years ago in residential neighborhoods; area residents were concerned that the signal systems did not "fit" in to the neighborhood and may create a "speed zone". Over time the negative reaction has softened, however, options that could prevent this type of reaction were deemed desirable.

Traffic control options will vary in part due to forecast traffic levels, available geometric options, and available right-of-way. Options that were considered include:

- Two-way stop sign control;
- All-way stop sign control;
- Traffic signal control;
- Conventional roundabouts; and
- Geometric modifications.

Each of the above options has certain advantages and disadvantages; all may not be applicable at each location to be examined.

Figure 1.1 illustrates the location of the intersections that were examined in this study.



① 6th Avenue North & Stanford Road
② 8th Avenue North & 20th Street North
③ 11th Avenue South & South 34th Street
④ 13th Avenue South & South 20th Street
⑤ 8th Avenue South & Cherry Street
⑥ 13th Avenue South & Cherry Street
⑦ 24th Avenue South & South 34th Street (NW)
⑧ 24th Avenue South & South 34th Street (SE)
⑨ 24th Avenue South & Cherry Street
⑩ Ruemmele Road & South 34th Street
⑪ 40th Avenue South & South 20th Street
⑫ 40th Avenue South & Cherry Street
⑬ 55th Avenue South & Cherry Street

Figure 1.1:
Intersection Locations

1.2 Study Direction

The study was undertaken by the MPO, with the following MPO and City of Grand Forks staff providing guidance and direction to the Consultant Team:

- Earl Haugen, Grand Forks-East Grand Forks Metropolitan Planning Organization (Project Director);
- Jane Williams, City of Grand Forks Engineering Department; and
- John Thompson, City of Grand Forks Engineering Department (initial stages of the study).

The primary consultant team members included:

- Richard Tebinka, MMM Group Limited, (Project Manager);
- Jesse Crowder, MMM Group Limited;
- Roger Petursson, MMM Group Limited; and
- Michael Cantor, MMM Group Limited.

2.0 ENVIRONMENTAL SCAN

MMM Group conducted telephone interviews, a telephone survey of various municipal/state departments/agencies, and a literature review to assist in determining appropriate conventions concerning the treatment of collector to collector intersections for Grand Forks. The following documents were reviewed:

- The U.S. Department of Transportation’s Manual on Uniform Traffic Control Devices (MUTCD);
- The North Dakota Department of Transportation Design Manual;
- The Minnesota Department of Transportation’s MUTCD;
- The Minnesota Department of Transportation’s Traffic Engineering Manual;
- The U.S. Department of Transportation’s Federal Highway Administration (FHWA) Technical Report – Roundabouts: An Informal Guide;
- The Transportation Research Board’s National Cooperative Highway Research Program (NCHRP) Report 572 – Roundabouts in the United States; and
- The Minnesota Department of Transportation’s Intersection Control Evaluation Guidelines for Implementation.

The following local authorities were contacted to obtain their respective opinions:

- The Grand Forks Fire Department;

- The Grand Forks Police Service;
- The City of Grand Forks Public Works Department;
- The City of Grand Forks Engineering Department;
- The Lake Agassiz Elementary School located at the intersection of 6th Avenue North and Stanford Road;
- The City of Brandon Engineering Department; and
- The City of Brandon Fire and Emergency Services.

As well, the following Engineering Departments were contacted to obtain information regarding their respective collector to collector traffic control policies:

- The City of Rapid City Traffic Engineering Department;
- The City of Sioux Falls Traffic Engineering Department;
- The City of Bismarck Traffic Engineering Department;
- The City of Fargo Traffic Engineering Department; and
- The City of Grand Rapids Traffic Engineering Department.

2.1 Literature Review

2.1.1 Manual on Uniform Traffic Control Devices

The U.S. Department of Transportation's 2003 MUTCD provides guidance on a number of traffic control strategies including the use of two-way stop sign control, multi-way stop sign control, yield sign control and traffic control signals. The complete MUTCD document can be found on the U.S. Department of Transportation's website at http://mutcd.fhwa.dot.gov.

Two-Way Stop Sign Control

The MUTCD indicates several situations in which a two-way stop should be considered:

- Intersection of a minor road with a major road where the normal right-of-way rule would not be expected to provide reasonable compliance with the law.
- Street entering a through street.
- Unsignalized intersection in a signalized area.
- High speeds, restricted view or above average crash history.

The MUTCD recommends that two-way stop sign controls should not be used for speed control and should be installed in a manner that minimizes the number of vehicles having to stop.

In most cases, two-way stop signs should be installed on the street carrying the lowest volume of traffic. In situations where the two streets have relatively equal volumes and/or characteristics, the following recommendations should be considered:

- Stopping the direction that conflicts the most with established pedestrian crossing activity or school walking routes.
- Stopping the direction that has obscured vision, dips, or bumps that already require drivers to use lower operating speeds.
- Stopping the direction that has the longest distance of uninterrupted flow approaching the intersection.
- Stopping the direction that has the best sight distance to conflicting traffic.

Multi-Way Stop Sign Control

The MUTCD notes that multi-way stops (either three-way or four-way stops) should be considered at intersections where two-way stops are warranted, but where the following conditions are also observed:

- Traffic control signals are justified and the multi-way stop can be used as an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.
- A crash problem, as indicated by five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.
- Minimum volumes:
    - The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day, and
    - The combined vehicular, pedestrian and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour, but
    - If the 85th-percentile approach speed of the major-street traffic exceeds 40 miles per hour (mph), the minimum vehicular volume warrants are 70 percent of the above values.
- None of the single criterion above is satisfied, but all criteria are satisfied to 80 percent of the minimum values (excluding the previous criterion).

Yield Sign Control

The MUTCD indicates that yield signs may be considered as an alternative to stop signs under the following conditions:

- The ability to see all potentially conflicting traffic is sufficient to allow a road user traveling at the posted speed, the 85th-percentile speed, or the statutory speed to pass through the intersection or to stop in a reasonably safe manner.
- The acceleration geometry and/or sight distance of an entering roadway is not adequate for a free flowing merging traffic operation.
- A special problem exists and engineering judgment indicates the problem to be susceptible to correction by the use of a yield sign.

The MUTCD also requires that yield signs be used at the entrance to roundabout intersections.

Traffic Signal Control

The MUTCD sites the following advantages for properly designed, located, operated, and maintained traffic control signals:

- They provide for the orderly movement of traffic.
- They increase the traffic-handling capacity of the intersection if proper physical layouts and control measures are used and signal operational parameters are reviewed and updated (if needed) on a regular basis.
- They reduce the frequency and severity of certain types of crashes, especially right-angle collisions.
- They can be coordinated to provide for continuous or nearly continuous movement of traffic at a definite speed along a given route.
- They can be used to interrupt heavy traffic at intervals to permit other traffic, vehicular or pedestrian, to cross.

According to the MUTCD, traffic control signals are often considered a panacea for all traffic problems at intersections. This belief has led to traffic control signals being installed at many locations where they are not needed, adversely affecting the safety and efficiency of vehicular, bicycle, and pedestrian traffic.

Traffic control signals, even when justified by traffic and roadway conditions, can be ill-designed, ineffectively placed, improperly operated, or poorly maintained. The MUTCD sites the following disadvantages for improper or unjustified traffic control signals:

- Excessive delay;

- Excessive disobedience of the signal indications;
- Increased use of less adequate routes as road users attempt to avoid the traffic control signals; and
- Significant increases in the frequency of collisions (especially rear-end collisions).

The MUTCD includes a series of eight different traffic signal warrants which are used to determine if a signal is justified at an intersection. This series forms the basis of NDDOT's warrants for traffic signals.

Warrant 1: Eight-Hour Vehicular Volume

Warrant 1 is intended for application at intersections where there is either a large volume of traffic on both streets or a large enough volume of traffic on the major street that traffic on the minor street experiences excessive delays or conflicts. Additional criteria is provided for intersections that come close to meeting both conditions, but do not quite satisfy either one. Traffic volumes are based on hourly values, averaged over an eight-hour period of a standard day. Both directions of traffic flow are considered for the major street while only the busiest approach is considered for the minor street. Additional consideration is provided for major streets with speeds in excess of 70 km/h (40 mph) or intersections within built-up areas of small isolated communities.

Warrant 2: Four-Hour Vehicular Volume

Warrant 2 is intended for use at intersections where the volume of traffic on both streets is the principal reason to consider installing a traffic control signal. Total traffic volumes are considered for the busiest four-hour period of an average day. Additional consideration is provided for major streets with speeds in excess of 70 km/h (40 mph) or intersections within built-up areas of small isolated communities.

Warrant 3: Peak Hour

Warrant 3 is intended for use at locations where large traffic volumes on a major street cause minor street traffic to suffer undue delay when entering or crossing the major street for at least one hour of an average day. Typically, the Peak Hour warrant is only applied in unusual cases, such as office complexes, manufacturing plants or high-occupancy vehicle facilities that attract or discharge a large number of vehicles over a short period of time. Traffic signal justification is based on a combination of the peak hour traffic volume and the total minor traffic stopped time delay during the peak hour. Additional consideration is provided for major streets with speeds in excess of 70 km/h (40 mph) or intersections within built-up areas of small isolated communities.

Warrant 4: Pedestrian Volume

Warrant 4 is intended for application at intersections where large traffic volumes on a major street create excessive delay for pedestrians crossing the street. Traffic signal justification is based on pedestrian volumes, gaps per hour in the traffic stream and distance to the nearest traffic signal on the major street. Special consideration is provided for intersections with reduced pedestrian crossing speeds.

Warrant 5: School Crossing

Warrant 5 is intended for use at intersections where school children crossing the major street are the principal reason to consider installing a traffic signal. Traffic signal justification is based on gaps in the vehicular traffic stream, distance to the nearest traffic signal on the major street and the number and size of school children groups crossing the major street. Before installing a traffic signal based on Warrant 5, alternative remedial measures should be considered including warnings signs and flashers, school speed zones, school crossing guards or a grade-separated crossing.

Warrant 6: Coordinated Signal System

Warrant 6 is intended for application where progressive movement in a coordinated signal system necessitates installing traffic control signals at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles. Traffic signals should not be applied where the resultant spacing of traffic control signals would be less than 300 meters (1,000 feet).

Warrant 7: Crash Experience

Warrant 7 is intended for use at intersections where collision severity and frequency are the principal reasons to consider installing a traffic signal. Signal justification is based on previous trials of alternative measures, historical collision data and eight-hour vehicular and pedestrian traffic volumes. Additional consideration is provided for major streets with speeds in excess of 70 km/h (40 mph) or intersections within built-up areas of small isolated communities.

Warrant 8: Roadway Network

Warrant 8 is intended for use when a traffic control signal is needed to encourage concentration and organization of traffic flow on a roadway network. Signal justification is based on existing and five-year projected traffic volumes during both weekdays and weekends. To be considered for Warrant 8, the major route must be part of a street or highway system serving as a principal roadway network for through traffic, must include a rural or suburban highway or must appear as a major route on an official plan or transportation study.

2.1.2 North Dakota Department of Transportation Design Manual

The 2007 North Dakota Department of Transportation (NDDOT) Design Manual provides information on policies, procedures and design values that are presently recommended for the development of a wide range of roadways in North Dakota, from the Interstate system to local streets and highways. Specific technical specifications as well as general guidelines for the use of stop signs, pedestrian and bicycle facilities, and traffic control signals are included. Intersection treatment warrants are not directly provided in the NDDOT Design Manual, but references are made to the MUTCD. The complete NDDOT Design Manual can be found on the NDDOT's website at http://www.dot.nd.gov/designmanual.html

2.1.3 Minnesota Manual on Uniform Traffic Control Devices

The Minnesota Department of Transportation's 2005 Manual on Uniform Traffic Control Devices (MN MUTCD) provides information similar to the U.S. Department of Transportation's 2003 MUTCD. The complete MN MUTCD document can be found on the Minnesota Department of Transportation's website at http://www.dot.state.mn.us/trafficeng/otepubl/mutcd

2.1.4 Minnesota Traffic Engineering Manual

The Minnesota Department of Transportation's 2007 Traffic Engineering Manual (TEM) provides technical information related to the installation, maintenance and removal of traffic control devices. The TEM is designed to complement the MN MUTCD by referencing it where appropriate and providing clarification in areas where warrants or application procedures are not provided. The complete Minnesota TEM can be found on the Minnesota Department of Transportation's website at http://www.dot.state.mn.us/trafficeng/otepubl/tem

Stop Signs

The TEM provides technical specifications regarding stop sign size and placement. Additional information on stop sign justification is not provided.

Flashing Beacons

The TEM includes guidance on the use of flashing beacons at stop sign controlled intersections. Flashing beacons include intersection control beacons mounted on span wire directly over an intersection (all-way stop only), stop beacons mounted on a pedestal above stop signs (red), and warning beacons mounted on a pedestal above intersection ahead symbols signs (yellow). Flashing beacons of any kind must be justified under one or more of the following warrants.

Warrant 1: Limited Visibility

Warrant 1 is intended for use at intersections where sight distance is limited and a flashing beacon will increase the effectiveness of existing warning signs and pavement markings.

Warrant 2: Crash Rate

Warrant 2 is intended for application where high-hazard safety improvement criteria are met, as described in the TEM, or where in one year there have been four or more collisions deemed preventable by a flashing beacon, particularly right-angle or left-turn collisions.

Warrant 3: School Crossing

Warrant 3 is intended for use at established school crossings where there are more than 500 vehicles per hour or insufficient gaps in the vehicle traffic during the peak school crossing period.

Warrant 4: Rural Trunk Highway Junction

Warrant 4 is intended for use at or near the rural junctions of two or more high speed trunk highways, where a flashing beacon may warn drivers of an unexpected crossing of another highway.

Traffic Control Signals

The TEM provides technical specifications regarding traffic control signal design, implementation, maintenance and removal. Readers are instructed to reference the MN MUTCD for information on traffic signal warrants.

2.1.5 FHWA Report – Roundabouts: An Informal Guide

The Federal Highway Administration published a detailed report entitled *Roundabouts: An Informal Guide* in June 2000 detailing established international and U.S. practices with respect to the implementation, design and operation of roundabouts. The report addresses:

- Policy considerations by providing a broad overview of the performance characteristics of roundabouts. This includes the costs associated with roundabouts in comparison to other forms of intersections, legal issues and public involvement techniques.
- Planning guidelines for identifying appropriate intersection control options based on daily traffic volumes and a feasibility evaluation of a roundabout at a given location.

- Operational analysis methods for roundabouts with respect to capacity, delay and queuing.
- Safety performance of roundabouts as compared to other forms of traffic control.
- Geometric design considerations involving the relationship between safety and capacity.
- Traffic design and landscaping options. This includes elements such as signing, pavement marking illumination, work zone traffic control and landscaping.
- System considerations of roundabout intersections and their interaction with a transportation network of intersections.

2.1.6 NCHRP Report – Roundabouts in the United States

The Transportation Research Board National Cooperative Highway Research Program's Report 572 *Roundabouts in the United States* provides information on a number of performance criteria for roundabouts in various settings.

Safety Performance

The NCHRP report determined that overall crash rates, in general, were reduced by the implementation of roundabouts in urban, rural and suburban settings. This reduction included comparisons to all previous forms of traffic control. However, a statistically significant difference was not found when comparing roundabouts to all-way stop sign control. Also, single lane roundabouts were found to exhibit better safety performance when compared to multi-lane roundabouts. The report's major safety findings included an intersection-level crash prediction model, an approach-level crash prediction model, and an undated comparison of roundabout performance to other means of traffic control.

Operational Performance

The variable affecting operational performance of roundabouts appears to be driver behavior since drivers in the United States use roundabouts less efficiently than models suggest in other countries around the world. As well, geometry, in terms of number of lanes, has a clear effect on capacity. However, geometry, in terms of lane width or other fine details, appears to be secondary. NCHRP recommends utilizing the same LOS criteria as currently used for unsignalized intersections and should be determined not for the intersection as a whole but by measured or computed control delay for each lane.

Geometric Design

The NCHRP report produced a number of major geometric design findings with respect to the effect of acceleration and deceleration on the prediction of 85th percentile entering and exiting speeds, the critical gap and revised speed predictions and their impact on sight distance as well as the importance of considering design details in multi-lane roundabout design.

Pedestrian and Bicyclist Observations

Few collisions were reported between non-motorists and motorists at roundabouts and thus no substantial safety problems were found. As well, using video recordings, no collisions and very few conflicts were observed between non-motorists and motorists using roundabouts. The report recommends that an emphasis is required on the design of exit lanes to improve upon both driver and pedestrian behavior.

2.1.7 MnDOT – Minnesota State Aid Roundabout Guide

The Minnesota Department of Transportation (MnDOT) released a draft roundabout guide for use by Minnesota Cities and Counties in 2002. The document is based on the FHWA's detailed report entitled *Roundabouts: An Informal Guide* and captures the most essential design elements. The Minnesota guide states that designers should not use the guide as their only design reference but should become familiar with the full understanding of roundabout design elements as provided in the FHWA guide and/or other sources.

The policies stated in the guide are to be considered for city or county intersections on the Minnesota State Aid system but may be used for appropriate intersections on their non-state aid segments. The hope of the guide is to help develop public acceptance of roundabouts by defining the appropriate usage of roundabouts, consistency of the driver's experience, and by achieving design/maintenance success.

The guide indicates policies specific to Minnesota's state aid program with respect to the design and implementation of roundabouts. The Minnesota guide requires submission of a justification report in accordance with the FHWA roundabout justification report guidelines. The Minnesota guide utilizes numerous design criteria from the FHWA report in outlining the requirements for state aid policy. The outlined design criteria include design speeds, design vehicles, entry width, sight distances and other factors.

2.1.8 MnDOT – Intersection Control Evaluation Guidelines for Implementation

MnDOT provides direction and recommendations for completing an Intersection Control Evaluation (ICE) for any at grade intersection. The dependant factors in determining the process needed to complete an ICE are the size/type of project and the project origination. The project origination determines which entity is responsible for the ICE. The size/type of project determines the required amount of analysis and documentation.

The process by which an ICE is to be carried out is described in MnDOT technical memorandum *07-02-T-01*. To reflect the increasing number of options for intersection control, the MnDOT technical memorandum aids the engineer in selecting the optimal option for an intersection.

MnDOT states that an ICE is not required for intersections needing minimal traffic control (two-way stop or uncontrolled). However, other control types (all-way stops, roundabouts, traffic signals, etc) do require an ICE. The purpose of an ICE report is to document all of the analysis (technical, financial and political) that led to the determination of the recommended alternative. The goal of the ICE is to select the optimal control based on objective analysis for the existing conditions and future needs. Table 5.1 summarizes MnDOT's guide to assist in determining which intersection options should be evaluated based upon combined average daily traffic (ADT) volumes.

Table 2.1: MnDOT Intersection Control Types for Evaluation Based on Entering ADT

Approximate Combined ADT	All Way Stop	Traffic Signal	Roundabout	Non-Traditional Intersection	Access Management Treatments	Grade Separation
7,500 – 10,000	■		■		■	
10,000 – 50,000	■	■	■	■	■	■
50,000 – 80,000		■	■	■	■	■
>80,000						■

Depending on the complexity of each project, the process necessary to complete an ICE can include:

- Warrants and justification;
- Crash evaluation;
- Intersection capacity evaluation;
- Right-of-way impacts and project cost;
- Political considerations; and
- Other considerations such as terrain, geometry, signal systems and system consistency.

In order to determine the required traffic control at an intersection, warrants must be met. The MN MUTCD contains warrants for all-way stops and traffic signals. Warrants are generally based on vehicular and pedestrian traffic and collision frequency reaching minimum values. Roundabouts are generally considered warranted if traffic volumes meet the criteria for either the all way stop or traffic signals. However, special considerations should be taken at any intersection where "typical" warrants are met but safety issues are present.

In addition to warrant analysis of intersection controls, engineering judgment is required in order to justify the treatment. A number of factors influence the justification of intersection controls. These factors can include, but are not limited to, the following:

- Existing safety and congestion issues;
- Plans for the roadway based on an adopted corridor study;
- The spacing of nearby intersections or driveways and how they conform to adopted access management guidelines;
- The environment in the corridor;
- Future anticipated traffic volumes;
- The distance to the nearest traffic controlled intersections;
- The amount of turning traffic;
- The breakdown and percentage of types of vehicles;
- The amounts of non-motorized traffic;
- Sight distance;
- Available right-of-way;
- Available funds for construction; and
- Support of the local users and local agencies.

2.2 Telephone Interviews

2.2.1 Grand Forks Fire Department

Both the Chief and Deputy Chief of the Fire Department were contacted regarding the purpose and outline of the study and to determine any concerns, questions or particular experience with traffic control options.

The Fire Department stated that there are currently no roundabouts in the City of Grand Forks and it is their opinion that the addition of any would be of little to no benefit to the Department. When asked about roundabouts in other communities in the State (e.g., Fargo), the Department was unaware of any other roundabouts in North Dakota.

The Deputy Chief stated that he has done some research into roundabouts with respect to Fire Department response times. His research found that in very few cases no delay was caused but in the majority of cases roundabouts caused some measure of delay.

The Department feels that traffic signals are much more advantageous to faster response times since they can be controlled from the fire truck at a distance of 600 to 700 feet. This allows the fire truck operator to change the signal to green in the direction of the response unit and thus creates little to no delay in travel time.

The Fire Chief expressed a concern with the design of roundabouts with respect to sufficient turning radius for fire trucks. He stated that the Department’s research found that when insufficient radius exists on a roundabout, fire trucks were required to travel in the opposing direction to traffic in order to make a left-turn. The Department believes this is a dangerous alternative.

The Department believes that the fire truck’s siren and lights are a limited warning device. This limitation may cause safety concerns when attempting to merge with roundabout traffic if the sirens and lights go unnoticed. The Department stated that signals would be preferred over roundabouts.

2.2.2 Grand Forks Police Service

The purpose and outline of the study was described to a representative of the Police Service in order to determine any concerns or questions the Service may have regarding traffic control options. The Police Service requested that MMM provide them with information regarding the study and locations. The information was subsequently provided to staff and street sergeants for review. At this time, the Police Service has no issues or concerns on the method of traffic control for these locations.

2.2.3 The City of Grand Forks Public Works Department

The Director of the Grand Forks Public Works Department was contacted in order to determine any concerns or questions the Department may have regarding traffic control options.

The Director expressed his concern that the Department is not educated in the operation, maintenance and safety of roundabouts as traffic control strategies. Therefore, he does not have a fully developed opinion as yet.

The main concern of the Department is the maintenance (i.e., snow removal) of a roundabout. He expressed an interest in knowing how other communities in similar climates operate and maintain roundabouts. It was stated that the public and politicians favor traffic signals since they are perceived to be safer than stop signs. The City of Grand Forks has always tried to limit the installation of signals but people have demanded them. Examples of this are along Columbia Road and 32nd Avenue South where more signals have been installed than were originally planned.

2.2.4 The City of Grand Forks Engineering Department

The Assistant City Engineer, John Thompson, was a member of the Selection Committee and provided guidance at the outset of the study, and thus, was familiar with the purpose and outline of the study. Due to the fact that Mr. Thompson was previously the City's Traffic Engineer, he was asked to comment on and explain the progression of events leading to the installation of traffic signals at the collector-collector intersections of 20th Avenue South and 24th Avenue South and South 34th Street and 17th Avenue South.

Mr. Thompson stated that lack of capacity and complaints from motorists during peak periods was the motivating factor that led to the installation of signals at these locations. Following the installation, local residents had numerous complaints regarding the signals and the removal of adjacent on-street parking. Mr. Thompson provided the "Executive Summary and Decisions Document" for the signals installation as well as a summary of the "Public Input".

2.2.5 Lake Agassiz Elementary School

The Principal of Lake Agassiz Elementary School, located at the intersection of 6th Avenue North and Stanford Road, was contacted to determine any concerns or questions the school may have regarding traffic control options for the intersection. The Principal of the school described numerous concerns and issues related to the operation of the intersection with respect to the crosswalks and traffic in the area.

The current traffic control at the intersection is a four-way stop which creates concerns for pedestrians crossing when school lets out at 3:00 p.m. There are two marked crosswalks at the intersection; on the west side of the intersection crossing north-south and on the south side of the intersection crossing east-west. There are also two other crosswalks in the area of the school; a mid-block pedestrian corridor west of the intersection and a mid-block pedestrian corridor north of the intersection. Adult teachers are used as crossing guards at all the crosswalks.

Three factors contribute to the issues that arise after school; parents arriving and waiting to pick up their children, the school's proximity to the University of North Dakota (UND) parking lots, and children on foot exiting the school. A “rush” of students exit from the UND parking lots at the same time as Lake Agassiz School is letting out. In combination with the buses and parents arriving to pick up their children, as well as children using the crosswalks, this creates a “log jam” of traffic at the four-way stop at 6th Avenue North and Stanford Road. Typically, drivers at this time are impatient due to the number of pedestrians and vehicles and become frustrated with the congestion and repeated waiting for crossing pedestrians. Also, when a vehicle is traveling west or north, they must stop for pedestrians at the four-way at 6th Avenue North and Stanford Road and then at the mid-block pedestrian corridor (west) and/or crosswalk (north), which leads to “stop and go” movements and impatient driving.

Since parking is not allowed on 6th Avenue North, parents park in the bus pick-up lot (which they are not supposed to do) or on both sides of Stanford Road (which only allows parking on one side). This causes problems for the buses trying to pick up children as well as children trying to cross a narrow and busy Stanford Road due to the illegal parking.

The school has plans to expand and modify the parking/pick-up situation during the summer of 2008. The plans include a roadway on school property that will circle around the school, closing one of the entrances from Stanford Road, a “bus only” loop on 6th Avenue North, and an expanded parking lot on the north side of the school. Parents will be expected to pull onto the loop road and/or into the expanded parking lot to drop off and pick-up children. How the traffic from the loop road is to smoothly enter back onto the street system has not yet been determined. These improvements are aimed at removing traffic from the street and crosswalks during the busy periods. An in-depth school traffic control study is currently in progress.

In summary, the Principal of the school feels that the concerns and issues with the intersection (and adjacent crosswalks) are the number of crosswalks and their close proximity to each other, the lack of parking for parents, and the timing of UND students leaving the lots nearby.

The school feels that signals at 6th Avenue North and Stanford Road would be a safety improvement for pedestrians but may not aid capacity issues as much as a roundabout. The school also feels that the planned access improvements will greatly reduce traffic congestion at the intersection.

2.2.6 The City of Brandon Engineering Department

The City of Brandon, Manitoba, Canada (population 41,500) Engineering Department was contacted to determine the impact the roundabouts in the City have had on traffic operations since their installation. Brandon currently has two roundabouts installed in residential areas with a third roundabout to be constructed in 2008. Prior to their installation, the City Engineering Department undertook an extensive public consultation process that included Public Open Houses, media advertisements and City Council briefings. The public input process included the use of a “mock-up” roundabout using pylons and temporary curbing which allowed motorists to experience an intersection before and after a roundabout. Motorists gave positive feedback based on the “mock-up” roundabout as compared to the stop sign traffic controls. The City of Brandon currently offers roundabout instructions on turning movements, safety, pedestrian and cyclist accommodation and emergency vehicles on their website. The area residents surrounding the roundabouts vocally support their use and they, as well as the City, believe traffic flow is improved, speeds are reduced and access from the minor street is enhanced.

The City of Brandon Public Works Department has not experienced any negative issues with the installation of the roundabouts. Snow clearing and maintenance operations have continued without incident. Prior to the construction of the roundabout, the underground utilities were surveyed and service rated in order to perform any required repairs. The utilities were also off-set from the roundabout in order to allow for ease of access in the future. While the initial costs of off-setting the utilities may be higher, the City believes that this cost is outweighed by the reduced costs of future repair access and minimal interruption to traffic flow.

2.2.7 The City of Brandon Fire and Emergency Services

The City of Brandon Fire and Emergency Services were contacted to determine the impact the roundabouts have had on emergency response times. Brandon Fire and Emergency Services have no concerns or issues surrounding the roundabouts in the City. They believe that the roundabouts provide adequate navigation for their largest pumper truck, provided proper snow clearing is performed. As well, they feel that the roundabouts decrease response time by allowing emergency vehicles to simply slow down, visually assess traffic and navigate through the roundabout as opposed to a cautionary stop required at stop signs or traffic signals. An issue raised by Brandon Fire and Emergency Services was a lack of driver education with respect to proper protocol for yielding to emergency vehicles while in the roundabout.

2.3 Telephone Survey

A telephone survey of a number of Engineering Departments was conducted to determine their respective policies regarding traffic control measures. The Engineering Department representatives were asked a series of questions regarding traffic control strategies at collector to collector intersections:

- What national, state or local policies does your jurisdiction follow for collector to collector intersection traffic control? In what cases are variations from this policy made and why?
- In your experience, are there any particular traffic control measures at collector to collector intersections that generate negative public reaction? How does this public reaction influence your approach to collect-to-collector intersection control?
- Do you analyze collision history when considering intersection modifications at collector to collector intersections? At what point do safety concerns warrant intersection modifications?
- What sort of consideration is given to the use of roundabouts when analyzing collect-to-collector intersections? If roundabouts have been used in the past, what has been the public's reaction? How has past roundabout use influenced your current approach to roundabout use?

2.3.1 The City of Rapid City Traffic Engineering Department

Rapid City, South Dakota (population 70,000) does not have a local or state policy dictating the implementation of collector to collector intersection traffic controls. All traffic controls at collector to collector intersections are dictated by traffic volumes.

Negative public reaction to traffic controls has been seen in two particular cases. One case involved the prohibition of left-turns at a collector to collector intersection due to a high number of angle collisions (raised by the Police Department) at the location over the previous four years. Public reaction to the change was negative and ultimately brought to City Council where the decision of the Traffic Engineering Department was upheld by a 5-4 vote. The other case stemmed from a neighborhood group who requested that an all-way stop be installed. The Traffic Department denied the request on the basis of insufficient traffic volumes. The group then petitioned City Council for the all-way stop and this was supported by Council and thus, the all-way stop was installed. These negative reactions do not influence the approach taken by the department for future traffic controls at collector to collector intersections.

Rapid City does not typically analyze collision histories when considering intersection modifications at collector to collector intersections.

To date, Rapid City has not had any roundabouts installed in the City. The State DOT is reluctant to install them due to the unfamiliarity involved and the demographics of the state.

2.3.2 The City of Sioux Falls Traffic Engineering Department

The City of Sioux Falls, South Dakota (population 151,300) does not have a local or state policy dictating the implementation of collector to collector intersection traffic controls.

Public reaction to the installation of traffic signals or all-ways stops has not been negative in the City's opinion. There has been negative reception at collector to collector intersections where there are no control measures, i.e., the intersection is completely uncontrolled.

Collision history is analyzed when considering intersection modifications at collector to collector intersection. The City maintains a detailed collision database from which data is analyzed.

The first two roundabouts are currently being constructed in the City and thus there has not been any public reaction to date.

2.3.3 The City of Bismarck Traffic Engineering Department

The City of Bismarck, North Dakota (population 55,500) does not have a local or state policy dictating the implementation of collector to collector intersection traffic controls; modifications are dictated by traffic volumes. Control measures vary from completely uncontrolled intersections to all-way stops. The typical progression is from uncontrolled to a yield situation to an all-way stop. For the installation of traffic signals, MUTCD warrant criteria must be met.

No significant public reactions have been observed to implemented traffic controls, but the City typically receives some degree of negative reaction to any change made. An example of a negative reaction was found in a case where an all-way stop controlled collector intersection with volumes of 14,000 vehicles per day was upgraded to traffic signals. Members of the public complained of excessive speeds once the stop signs were removed. Speed studies were conducted and the speeds recorded were not found to be excessive but were higher than when the intersection was controlled by stop signs. Therefore, speeds with the signals "appeared" excessive as compared to the stop sign controlled situation.

In order for modifications to be made, a full traffic study is completed for the intersection. This includes warrants, volumes, collisions, land restrictions, etc. The final decision on the implementation of any modification is made by the Board of City Commissioners.

The City of Bismarck feels that there is insufficient right-of-way in existing areas to accommodate a roundabout. A roundabout is currently proposed as part of a residential development, but the Traffic Engineering Department is against the installation since they feel it is not needed and is primarily being installed as a novelty. The Department is not against the installation of roundabouts in the proper situations, although they feel none currently exist in Bismarck.

2.3.4 The City of Fargo Traffic Engineering Department

The City of Fargo, North Dakota (population 90,600) does not have a state policy dictating the implementation of collector to collector intersection traffic controls. The City of Fargo Engineering Department has developed a policy for various intersection configurations. For collector to collector intersections, traffic control is dictated by volumes, sight distance, collisions and high pedestrian volumes (school or pedestrian crossing).

Negative public reaction has been encountered in situations where an all-way stop was installed at a collector to collector intersection with unbalanced traffic volumes. This reaction has influenced the City's policy in that they will not install all-way stops unless traffic volumes are balanced (60/40 or better).

Collisions are considered in treatment scenarios along with a number of other factors. A location experiencing five or more collisions in one year often results in the installation of all-way stop control.

Consideration has been given to roundabouts in the past. One particular location was proposed but rejected by the City Council and public. However, two have been installed in new residential developments and another is slated for construction in the spring of 2008. However, these locations are relatively low volume areas. The City stated that the previous negative reaction does not influence future policy decisions regarding installation of roundabouts.

2.3.5 The City of Grand Rapids Traffic Engineering Department

The City of Grand Rapids, Minnesota (population 7,800) does not have a formal policy dictating the implementation of collector to collector intersection traffic controls.

The City currently has two roundabouts installed; one operated by the City and one by the County. Significant negative public feedback has not been received following the roundabout installation.

The City of Grand Rapids does consider collision history in determining traffic controls on City collectors.

The roundabout operated by the City is located at an intersection of an urban collector (10,000 to 11,000 vehicles per day) and a local street (5,000 to 6,000 vehicles per day). The intersection was previously offset by approximately 300 feet and was realigned during the installation of the roundabout. The City stated that the roundabout has slowed traffic on the major street, allowed improved vehicle access from the minor street, reduced conflict points at the intersection and reduced costs by eliminating the long-standing operating costs of traffic signals. The roundabout project required no additional property acquisition. The City stated that they have received positive support with minor negative opposition typically seen with any change in traffic control. Some residents in other areas of the City have requested installation of roundabouts. The City of Grand Rapids Public Works Department has not had any issues with utilities or maintenance. Lighting is placed outside the right-of-way on the approach legs.

3.0 EXISTING OPERATIONS

3.1 6th Avenue North and Stanford Road

Intersection Overview

The intersection of 6th Avenue North and Stanford Road is a four-way stop sign controlled intersection adjacent to the University of North Dakota and roughly half a mile east of I-29. Located adjacent to this intersection are Lake Agassiz Elementary School, single-family residential homes, the University of North Dakota Housing Office and the North Dakota Vision Services/School for the Blind.

The northbound approach on Stanford Road consists of one shared left-turn/through/right-turn lane, while the southbound approach consists of a shared left-turn/through lane with a short dedicated right-turn lane. The eastbound and westbound approaches on 6th Avenue North both consist of a dedicated left-turn lane with a shared through/right-turn lane. Parking is not permitted on either side of 6th Avenue North or Stanford Road. The posted speed limit is 25 miles per hour (mph) on both streets. However, in accordance with North Dakota legislation, the speed limit when passing the school during school recess or while children are going to or leaving school during opening or closing hours is 20 mph. However, a lower speed (15 mph) can be designated or posted by local authorities at this location in the school zone.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 6th Avenue North and Stanford Road are based on traffic counts conducted by the City of Grand Forks on Tuesday, September 18, 2007. **Figure 3.1** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 6th Avenue North and Stanford Road; traffic volumes have been rounded to the nearest five vehicles per hour in all figures.

Traffic Analysis

The intersection of 6th Avenue North and Stanford Road is currently operating at an acceptable LOS during the existing weekday p.m. peak hour. The critical movement is the westbound left-turn movement, operating at LOS C. The results from the traffic analysis for the intersection of 6th Avenue North and Stanford Road are summarized in **Table 3.1**.

Table 3.1: 6th Avenue North & Stanford Road Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	B	50%	14	WB L	C	20

Transit Service

Transit service includes Blue Route 4 and Blue Route 6. Blue Route 4 travels north on Stanford Road and turns west onto 6th Avenue North. Blue Route 6 travels through the intersection north on Stanford Road. Both transit routes pass through the intersection once during the weekday p.m. peak hour. **Figure 3.1** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

The intersection of 6th Avenue North and Stanford Road currently includes sidewalks and painted pedestrian corridors on all legs. Based on the traffic count there are currently 15 pedestrians crossing 6th Avenue North and 45 pedestrians crossing Stanford Road during the weekday p.m. peak hour. Both streets have facilities for biking but neither is currently designated as a bicycle route; however, the 2004 Grand Forks/East Grand Forks Alternative Transportation Mode Plan identifies 6th Avenue North as a bikeway network gap and recommends a future bike route along 6th Avenue North. Bicycles can be ridden on the sidewalk in residential areas. **Figure 3.1** illustrates the existing and planned bike routes through the intersection.

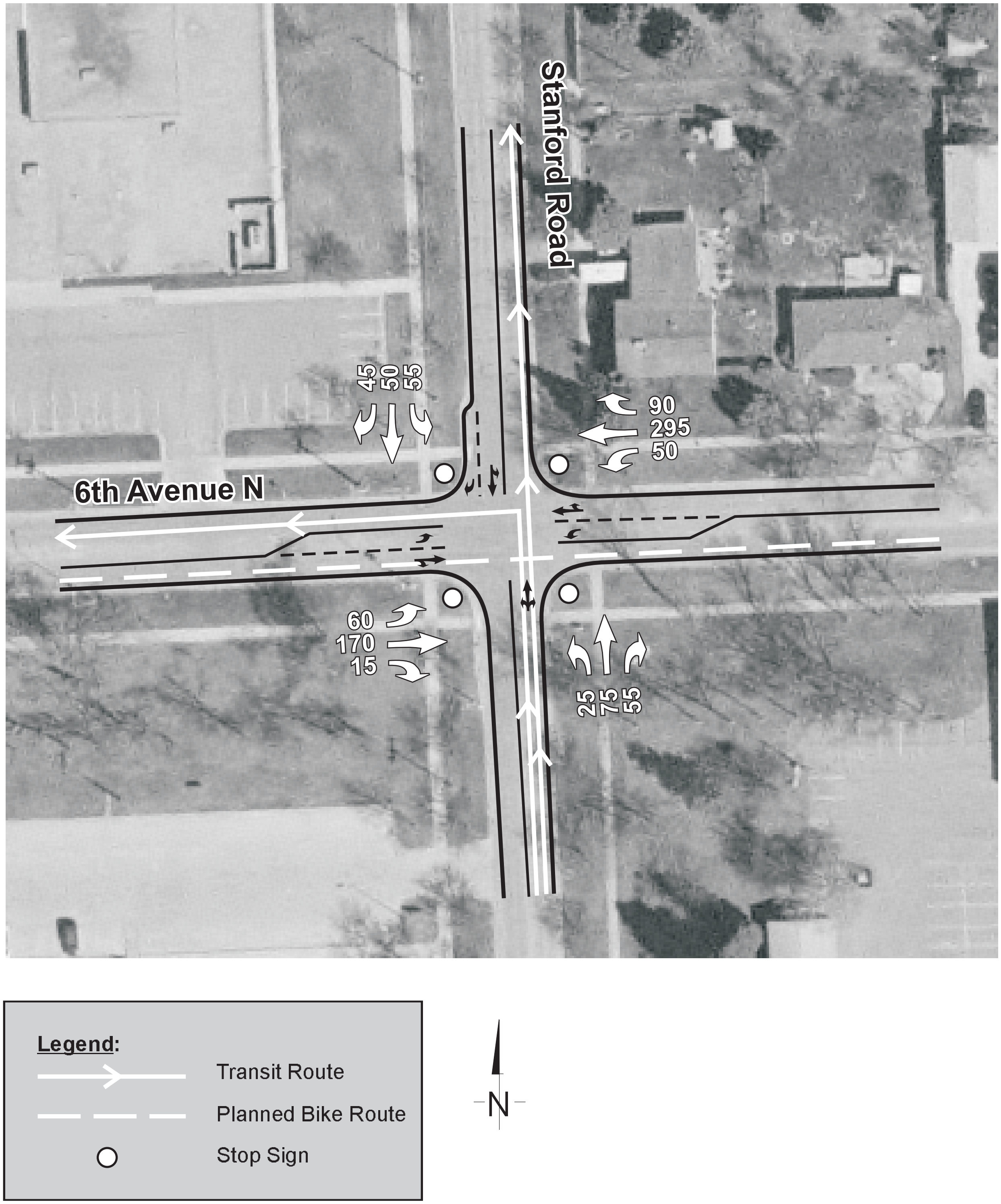


Figure 3.1:
6th Avenue N & Stanford Road

3.2 8th Avenue North and 20th Street North

Intersection Overview

The intersection of 8th Avenue North and 20th Street North is made up of two three-legged two-way stop sign controlled intersections. The eastbound and westbound approaches on 8th Avenue North are stop sign controlled and are offset by approximately 60 feet along 20th Street North, as illustrated in **Figure 3.2**. The intersection is located east of the University of North Dakota and west of downtown Grand Forks. Located adjacent to this intersection are the Redeemer Lutheran Church and single-family residential development.

At the southern intersection the northbound approach on 20th Street North consists of a single through lane and a shared through/right-turn lane, while the southbound approach consists of a single shared left-turn/through lane. At the northern intersection the northbound approach consists of a shared left-turn/through lane and a single through lane, while the southbound approach consists of a single shared through/right-turn lane. The eastbound and westbound approaches each consist of a single shared left-turn/right-turn lane. Parking is permitted on both sides of 8th Avenue North and 20th Street North. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 8th Avenue North and 20th Street North are based on a traffic count conducted by the City of Grand Forks on Tuesday, September 25, 2007. **Figure 3.2** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 8th Avenue North and 20th Street North.

Traffic Analysis

The two intersections of 8th Avenue North and 20th Street North are currently operating at acceptable LOS in the 2007 weekday p.m. peak hour. The critical movement at each intersection is the cross-street movement. At the northern intersection, the eastbound left-turn/right-turn is the critical movement operating at LOS A. At the southern intersection, the westbound left-turn/right-turn movement is the critical movement operating at LOS A. Results from the traffic analysis for the intersections of 8th Avenue North and 20th Street North are summarized in **Table 3.2**.

Table 3.2: 8th Avenue North & 20th Street North Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
North Intersection						
2007 Weekday P.M. Peak Hour	A	29%	1.0	EB L/R	A	9.5
South Intersection						
2007 Weekday P.M. Peak Hour	A	29%	1.0	WB L/R	A	9.5

Transit Service

There is currently no transit service at the intersection of 8th Avenue North and 20th Street North.

Bicycle and Pedestrian Traffic

Both 8th Avenue North and 20th Street North have sidewalks on both sides of the street; however, painted pedestrian corridors are not provided at the intersection. Based on the traffic count there are currently 15 pedestrians crossing 8th Avenue North and fewer than five pedestrians crossing 20th Street North during the weekday p.m. peak hour. No bicycle facilities currently exist along 8th Avenue North. 20th Street North is designated and signed as a bike route. However, both streets have facilities for biking and bicycles may be ridden on residential sidewalks. **Figure 3.2** illustrates the existing and planned bike routes through the intersection.

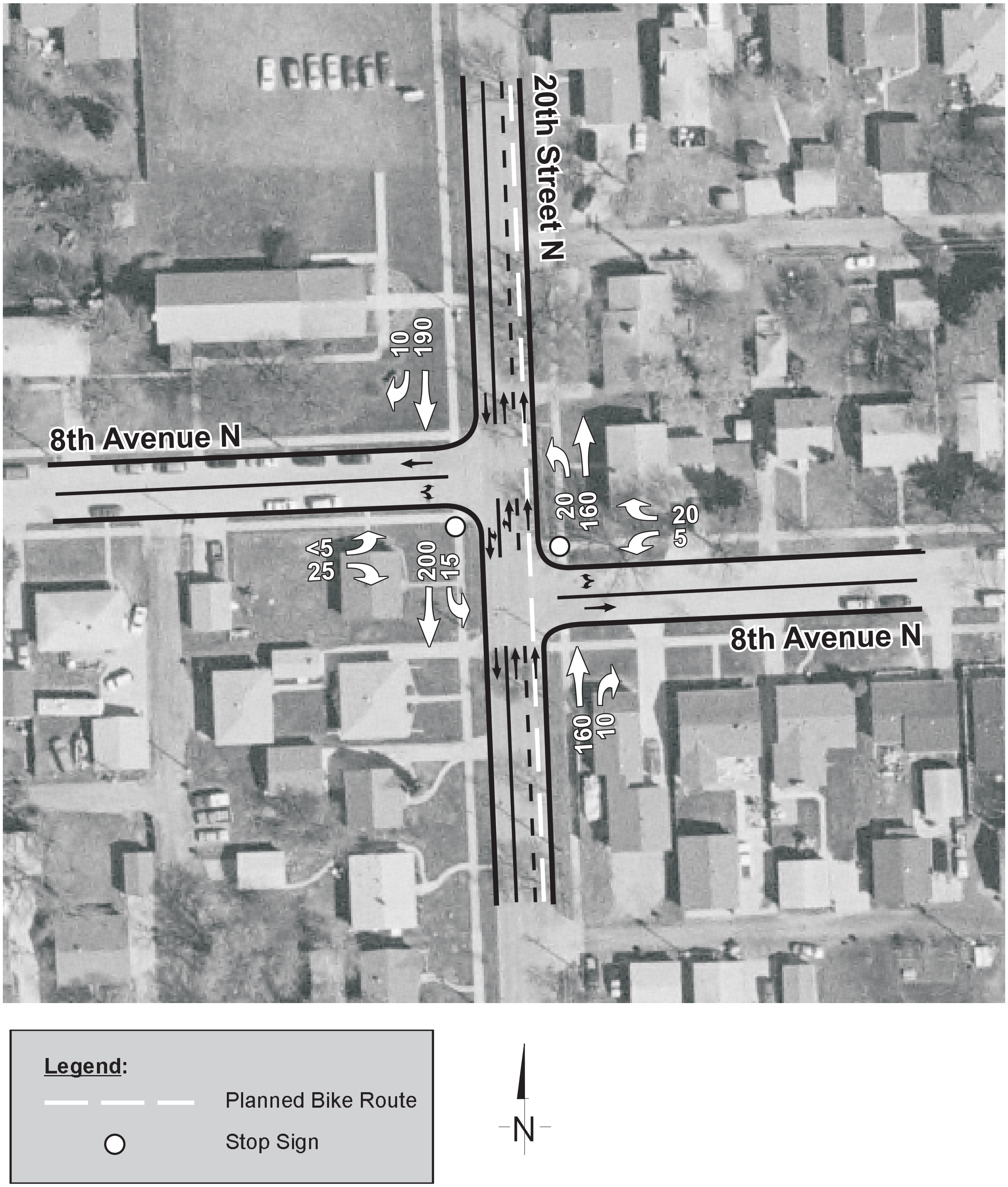


Figure 3.2:
8th Avenue N & 20th Street N

3.3 8th Avenue South and Cherry Street

Intersection Overview

The intersection of 8th Avenue South and Cherry Street is a four-legged two-way stop sign controlled intersection west of downtown Grand Forks. Single family residential development is located adjacent to the intersection.

The northbound and southbound approaches on Cherry Street are free flowing and each consists of one shared left-turn/through/right-turn lane. The eastbound and westbound approaches on 8th Avenue South are stop sign controlled and each consists of a single shared left-turn/through/right-turn lane. Parking is permitted on the south side of 8th Avenue South only and is not permitted on either side of Cherry Street. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 8th Avenue South and Cherry Street are based on a traffic count conducted by the City of Grand Forks on Tuesday, November 27, 2007. **Figure 3.3** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 8th Avenue South and Cherry Street.

Traffic Analysis

The intersection of 8th Avenue South and Cherry Street is currently operating at an acceptable LOS during the existing weekday p.m. peak hour. The critical movements are the westbound and eastbound left-turn/through/right-turn movement, operating at LOS B. The results from the traffic analysis for the intersection of 8th Avenue South and Cherry Street are summarized in **Table 3.3**.

Table 3.3: 8th Avenue South & Cherry Street Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	26%	5.0	WB/EB L/T/R	B	13

Transit Service

Transit service includes Orange Route 3, which travels north through the intersection on Cherry Street. Two buses pass through the intersection during the weekday p.m. peak hour. **Figure 3.3** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

The intersection of 8th Avenue South and Cherry Street currently includes sidewalks without painted pedestrian corridors on all legs. Based on the traffic count there are currently no pedestrians crossing 8th Avenue South and two pedestrians crossing Cherry Street during the weekday p.m. peak hour. No bicycle facilities currently exist along 8th Avenue South or Cherry Street; however 8th Avenue Street is identified as a planned bike route. Both streets have facilities for biking and bicycles may be ridden on residential sidewalks. **Figure 3.3** illustrates the existing and planned bike routes through the intersection.

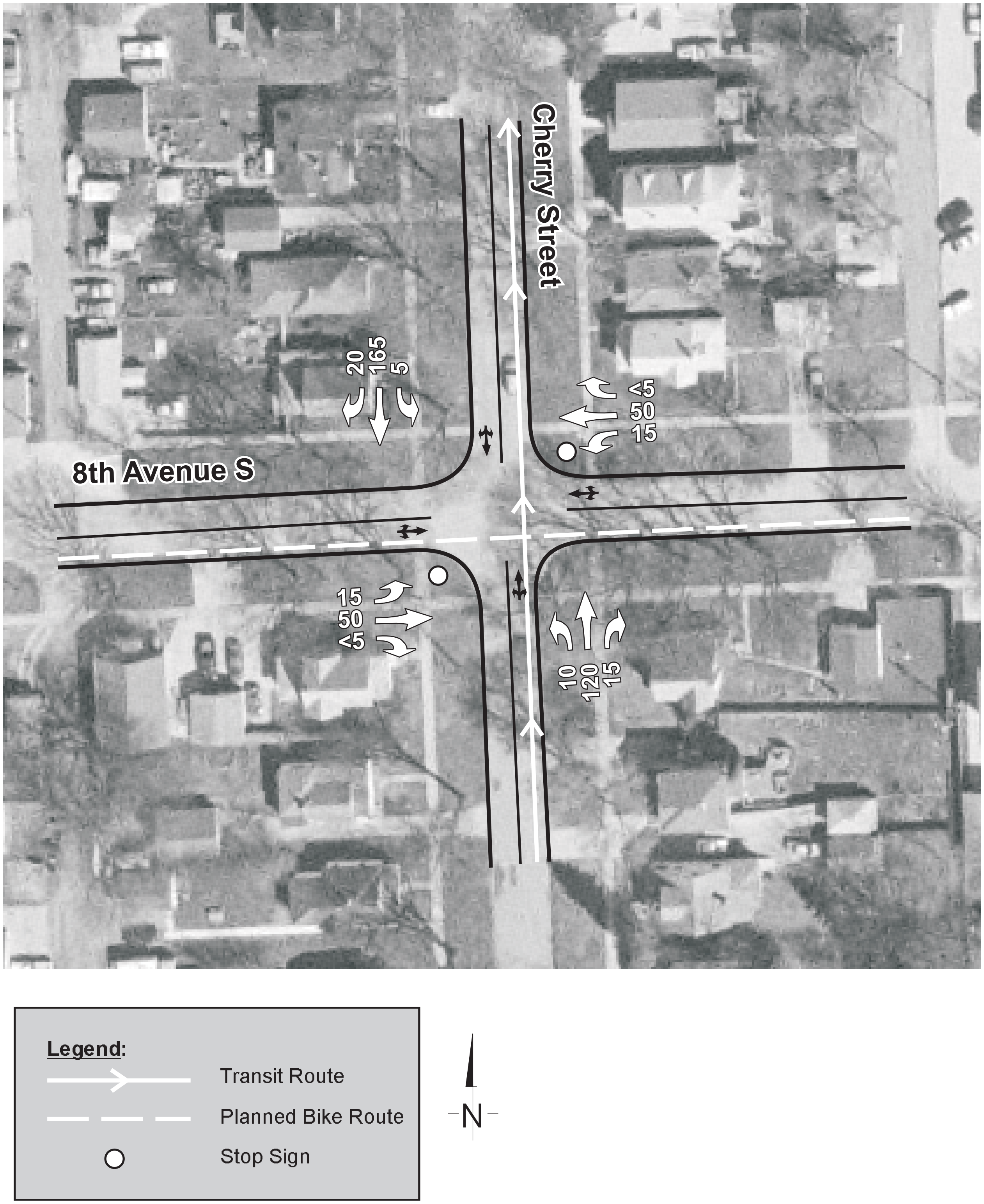


Figure 3.3:
8th Avenue S & Cherry Street

3.4 11th Avenue South and South 34th Street

Intersection Overview

The intersection of 11th Avenue South and South 34th Street is a four-legged two-way stop sign controlled intersection located southeast of Ray Richards Golf Course and west of Altru Hospital. Located adjacent to this intersection are Sertoma Park and Japanese Gardens, single-family residential development, and undeveloped land.

The northbound and southbound approaches on South 34th Street are free flowing and each consists of one shared left-turn/through/right-turn lane. The eastbound and westbound approaches on 11th Avenue South are stop sign controlled and each consists of a single shared left-turn/through/right-turn lane. Parking is permitted on both sides of 11th Avenue South and South 34th Street. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 11th Avenue South and South 34th Street are based on a traffic count conducted by the City of Grand Forks on Tuesday, September 18, 2007. **Figure 3.4** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 11th Avenue South and South 34th Street.

Traffic Analysis

The intersection of 11th Avenue South and South 34th Street is currently operating at an acceptable LOS in the 2007 weekday p.m. peak hour. The critical movement is the westbound left-turn/through/right-turn movement operating at LOS B. The results from the traffic analysis for the intersection of 11th Avenue South and South 34th Street are summarized in **Table 3.4**.

Table 3.4: 11th Avenue South & South 34th Street Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	33%	5.0	WB L/T/R	B	14

Transit Service

Transit service is provided by the Brown Route 12/13. Route 12/13 buses pass through the intersection four times (twice in each direction) during the weekday p.m. peak hour, traveling westbound on 11th Avenue South and then returning eastbound before turning southbound onto South 34th Street. **Figure 3.4** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

Sidewalks run along both sides of 11th Avenue South and South 34th Street, except along the north side of 11th Avenue South east of South 34th Street. Based on the traffic count provided there are currently seven pedestrians crossing 11th Avenue South and one crossing South 34th Street during the weekday p.m. peak hour. There are no planned or existing bicycle facilities at this intersection. However, both streets have facilities for biking and bicycles may be ridden on residential sidewalks.

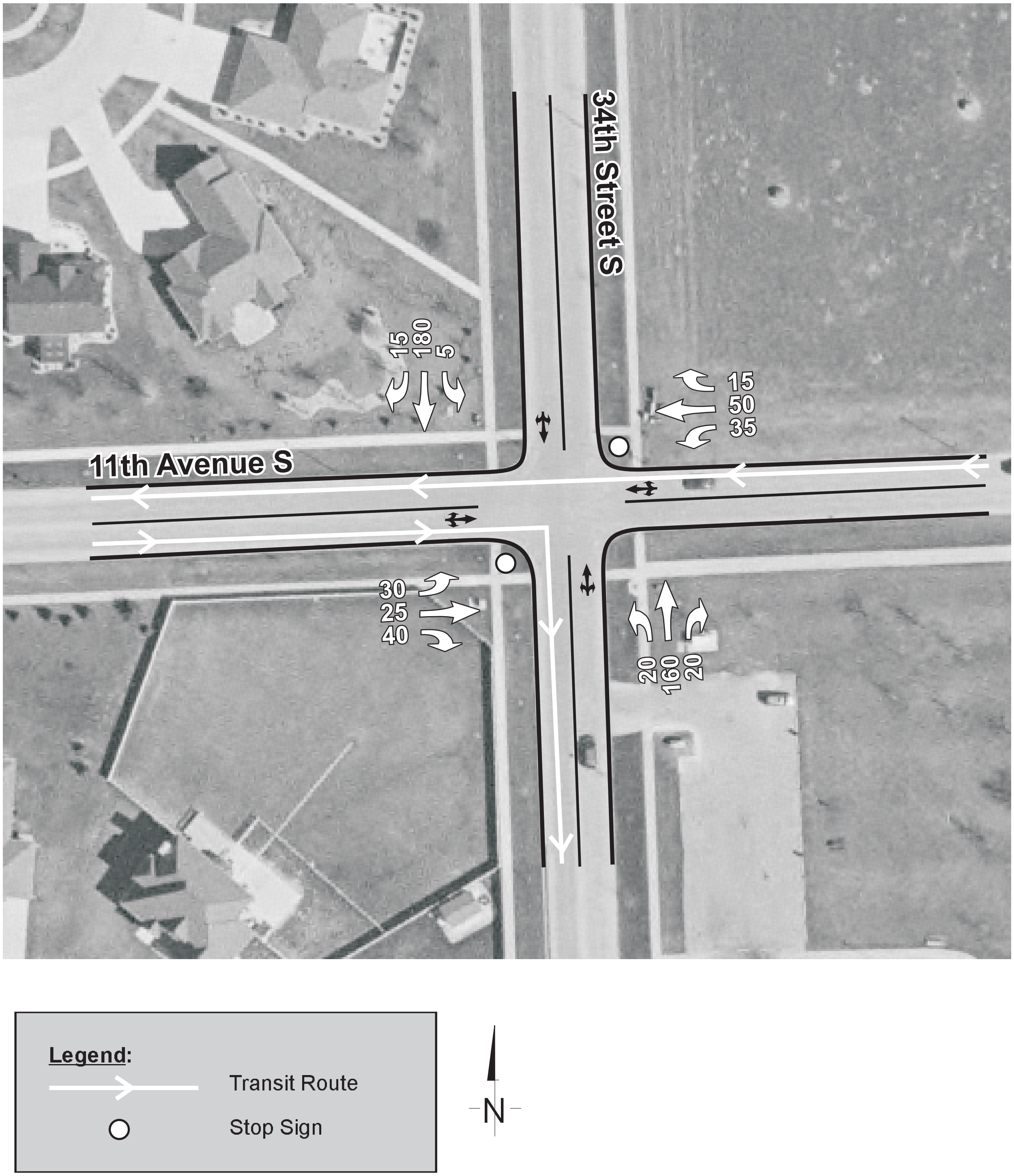


Figure 3.4:
11th Avenue S & 34th Street S

3.5 13th Avenue South and South 20th Street

Intersection Overview

The intersection of 13th Avenue South and South 20th Street is a four-way stop sign controlled intersection located in the center portion of Grand Forks. Single family residential development is located adjacent to this intersection.

The northbound and southbound approaches on South 20th Street each consist of a single shared left-turn/through/right-turn lane. The eastbound and westbound approaches on 13th Avenue South each consist of two lanes, one shared left-turn/through lane and one shared through/right-turn lane. Parking is permitted on both sides of 13th Avenue South and South 20th Street. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 13th Avenue South and South 20th Street are based on a traffic count conducted by the City of Grand Forks on Wednesday, September 19, 2007. **Figure 3.5** illustrates the p.m. peak hour traffic volumes at the intersection of 13th Avenue South and South 20th Street.

Traffic Analysis

The intersection of 13th Avenue South and South 20th Street is currently operating at an acceptable LOS during the 2007 p.m. peak hour. The critical movement is the southbound left-turn/through/right-turn movement, operating at LOS C. The results from the traffic analysis for the intersection of 13th Avenue South and South 20th Street are summarized in **Table 3.5**.

Table 3.5: 13th Avenue South & South 20th Street Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	B	52%	15	SB L/T/R	C	18

Transit Service

Transit service includes the Purple Route 9 and the Orange Route 3. The Purple Route 9 travels northbound through the intersection along South 20th Street twice during the weekday p.m. peak hour. The Orange Route 3 travels westbound through the intersection 13th Avenue South once during the weekday p.m. peak hour. **Figure 3.5** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

Sidewalks run along both sides of 13th Avenue South and South 20th Street. Based on the traffic counts there are currently 10 pedestrians crossing 13th Avenue South and five pedestrians crossing South 20th Street during the weekday p.m. peak hour. No bicycle facilities currently exist on either 13th Avenue South or South 20th Street; however, each street is identified as planned bike routes. Both streets have facilities for biking and bicycles may be ridden on residential sidewalks. **Figure 3.5** illustrates the existing and planned bike routes through the intersection.

Figure 3.5:
13th Avenue S & 20th Street S

3.6 13th Avenue South and Cherry Street

Intersection Overview

The intersection of 13th Avenue South and Cherry Street is a four-way stop sign controlled intersection located northwest of Lincoln Park Golf Course. Single family residential development is located adjacent to this intersection.

The northbound and southbound approaches on Cherry Street each consist of a single shared left-turn/through/right-turn lane. The eastbound and westbound approaches on 13th Avenue South also consist of a single left-turn/through/right-turn lane. Parking is permitted on the west side of Cherry Street, and on both side of 13th Avenue South. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 13th Avenue South and Cherry Street are based on a traffic count conducted by the City of Grand Forks on Thursday, September 20, 2007. **Figure 3.6** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 13th Avenue South and Cherry Street.

Traffic Analysis

The intersection of 13th Avenue South and Cherry Street is currently operating at an acceptable LOS during the 2007 weekday p.m. peak hour. The critical movement is the southbound left-turn/through/right-turn movement, operating at LOS B. The results from the traffic analysis for the intersection of 13th Avenue South and Cherry Street are summarized in **Table 3.6**.

Table 3.6: 13th Avenue South & Cherry Street Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	B	42%	11	SB L/T/R	B	11

Transit Service

Transit service is provided by the Orange Route 3. Buses traveling northbound on Cherry Street pass straight through the intersection. Buses traveling southbound on Cherry Street turn right at the intersection, continuing westbound on 13th Avenue South. Each route passes through the intersection twice during the weekday p.m. peak hour. **Figure 3.6** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

Sidewalks run along both sides of 13th Avenue South and Cherry Street. Based on the traffic counts provided there are currently less than five pedestrians crossing 13th Avenue South and 10 pedestrians crossing Cherry Street during the weekday p.m. peak hour. No bicycle facilities currently exist on either 13th Avenue South or Cherry Street; however, 13th Avenue South is identified as a planned bike route. Both streets have facilities for biking and bicycles may be ridden on residential sidewalks. **Figure 3.6** illustrates the existing and planned bike routes through the intersection.

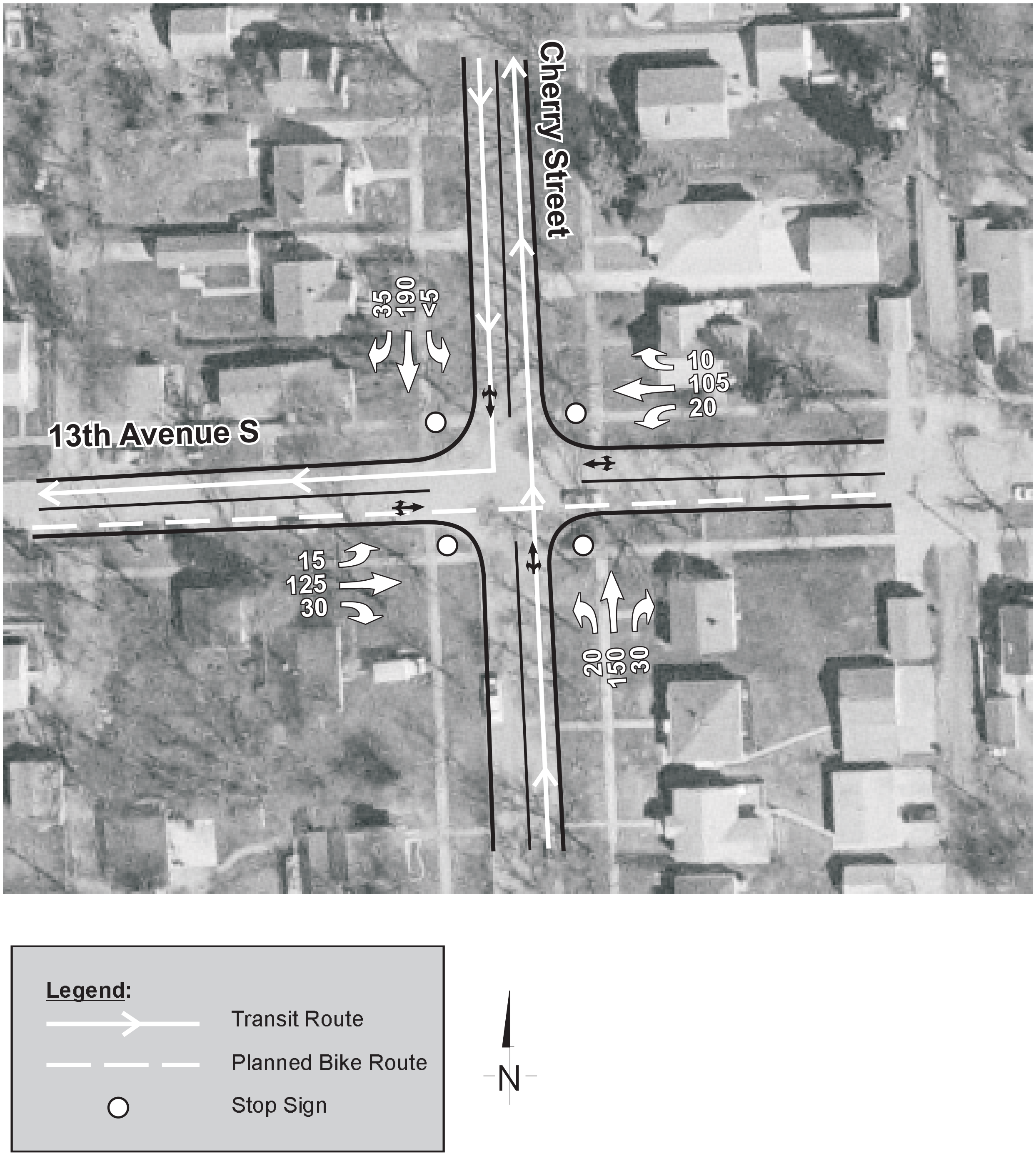


Figure 3.6:
13th Avenue S & Cherry Street

3.7 24th Avenue South and South 34th Street (Northwest Intersection)

Intersection Overview

The northwest intersection of 24th Avenue South and South 34th Street is operating as a three-legged (public roadways) two-way stop sign controlled intersection located northwest of Columbia Mall; a private approach forms the fourth leg of this intersection. Adjacent to this intersection is primarily condominium/apartment buildings and undeveloped land.

The northbound approach on South 34th Street is free flowing and consists of two lanes, one left-turn lane and one shared through/right-turn lane. The southbound approach on South 34th Street is also free flowing and consists of two lanes; one shared left-turn/through lane and one right-turn lane. The eastbound approach on 24th Avenue South is stop sign controlled and consists of two lanes; one shared left-turn/through lane, and one right-turn lane. The westbound approach is a stop sign controlled private access and consists of a single shared left-turn/through/right-turn lane. Parking is permitted on both sides of South 34th Street north of the intersection and on both sides of 24th Avenue South west of the intersection. Parking is not permitted on either side of South 34th Street south of the intersection. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 24th Avenue South and South 34th Street are based on a traffic count conducted by the City of Grand Forks on Thursday, September 20, 2007. **Figure 3.7** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 24th Avenue South and South 34th Street.

Traffic Analysis

The intersection of 24th Avenue South and South 34th Street is currently operating at an acceptable LOS during the 2007 weekday p.m. peak hour. The critical movement is the eastbound left-turn movement, operating at LOS C. The results from the traffic analysis for the intersection of 24th Avenue South and South 34th Street are summarized in **Table 3.7**.

Table 3.7: 24th Avenue South & South 34th Street (NW) Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	36%	5.0	EB L	C	15

Transit Service

Transit service is provided by the Purple Route 9 and Brown Route 12/13. Route 9 buses pass through the intersection once during the weekday p.m. peak hour, traveling eastbound on 24th Avenue South before turning northbound onto South 34th Avenue. Route 12/13 buses pass through the intersection two times during the weekday p.m. peak hour, traveling southbound on South 34th Street before turning westbound onto 24th Avenue South. **Figure 3.7** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

Sidewalks/bike paths run along both sides of 24th Avenue South and South 34th Street. Based on the traffic counts provided there are currently five pedestrians crossing 24th Avenue South and less than five pedestrians crossing South 34th Street during the weekday p.m. peak hour. **Figure 3.7** illustrates the existing and planned bike routes through the intersection.

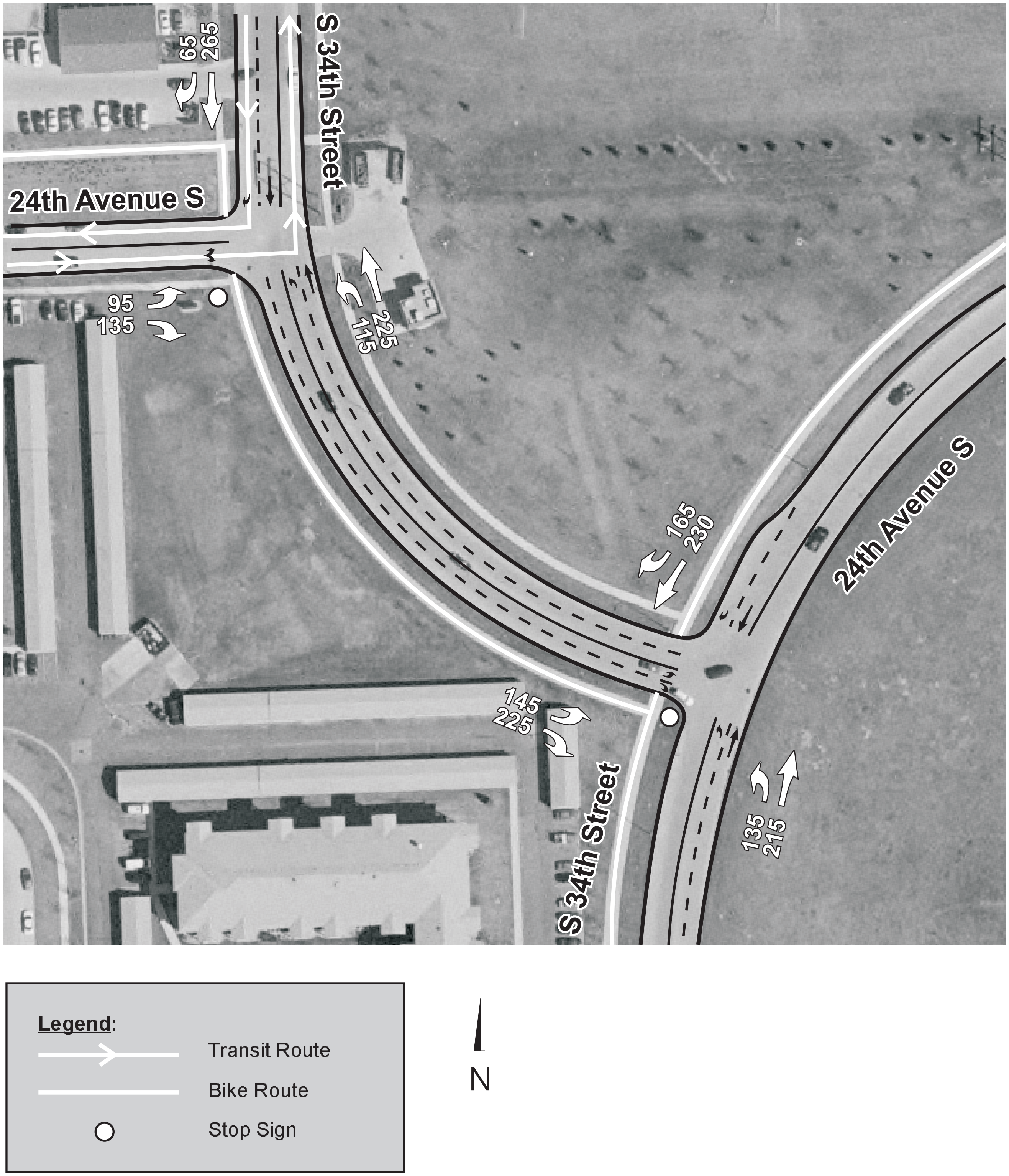


Figure 3.7:
24th Avenue S & S 34th Street

3.8 24th Avenue South and South 34th Street (Southeast Intersection)

Intersection Overview

The southeast intersection of 24th Avenue South and South 34th Street is currently operating as a three-legged two-way stop sign controlled intersection located northwest of Columbia Mall. Adjacent to this intersection is primarily condominium/apartment buildings and undeveloped land. It is understood that a potential development proposed to the southeast may result in a fourth leg being added to this intersection.

The northbound approach on South 34th Street is free flowing and consists of one left-turn lane and one through lane. The southbound approach on 24th Avenue South is also free flowing and consists of one through lane and one right-turn lane. The eastbound approach on South 34th Street is stop sign controlled and consists of one left-turn lane and one right-turn lane. Parking is not permitted on either side of 24th Avenue South or South 34th Street.

The posted speed limit is 25 mph on South 34th Street west of the intersection and 30 mph on South 34th Street south of the intersection and on 24th Avenue South north of the intersection.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 24th Avenue South and South 34th Street are based on a traffic count conducted by the City of Grand Forks on Thursday, September 20, 2007. **Figure 3.7** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 24th Avenue South and South 34th Street.

Traffic Analysis

The intersection of 24th Avenue South and South 34th Street is currently operating at an acceptable LOS during the 2007 weekday p.m. peak hour. The critical movement is the eastbound left-turn movement, operating at LOS D. The results from the traffic analysis for the intersection of 24th Avenue South and South 34th Street are summarized in **Table 3.8**.

Table 3.8: 24th Avenue South & South 34th Street (SE) Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	37%	6.5	EB L	D	26

Transit Service

There is no transit service through the southeast intersection of 24th Avenue South and South 34th Street.

Bicycle and Pedestrian Traffic

Sidewalks/bike paths run along both sides of South 34th Street north of the intersection along the west side of South 34th Street south of the intersection and along the west of 24th Avenue South north of the intersection. Based on the traffic counts provided there are currently five pedestrians traveling north/south across South 34th Street and less than five pedestrians traveling east/west across 24th Avenue South and South 34th Street during the weekday p.m. peak hour. **Figure 3.7** illustrates the existing and planned bike routes through the intersection.

3.9 24th Avenue South and Cherry Street

Intersection Overview

The intersection of 24th Avenue South and Cherry Street is a four-way stop sign controlled intersection located southwest of the Lincoln Park Golf Course. Adjacent to this intersection is Grace Baptist Church, St. Mark's Lutheran Church, Little Scholar Shop Montessori School, and single family residential development.

The northbound and southbound approaches on Cherry Street each consist of a single shared left-turn/through/right-turn lane. The eastbound and westbound approaches on 24th Avenue South each consist of a single shared left-turn/through/right-turn lane. Approximately 1,000 feet west of the intersection adjacent to the school is a crosswalk with push button activation warning lights. Parking is permitted on both sides of 24th Avenue South and Cherry Street.

The posted speed limit is 25 mph on both streets. However the speed limit on 24th Avenue South west of the intersection is reduced to 20 mph when school children are present and 15 mph when the crosswalk lights are flashing.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 24th Avenue South and Cherry Street are based on a traffic count conducted by the City of Grand Forks on Wednesday, September 12, 2007. **Figure 3.8** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 24th Avenue South and Cherry Street.

Traffic Analysis

The intersection of 24th Avenue South and Cherry Street is currently operating at an acceptable LOS during the 2007 p.m. peak hour. The critical movement is the southbound left-turn/through/right-turn movement, operating at LOS B. The results from the traffic analysis for the intersection of 24th Avenue South and Cherry Street are summarized in **Table 3.9**.

Table 3.9: 24th Avenue South & Cherry Street Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	36%	10	SB L/T/R	B	10

Transit Service

Transit service is provided by the Red Route 1. Buses pass straight through the intersection, traveling both southbound on Cherry Street and eastbound on 24th Avenue South. Each route passes through the intersection once during the weekday p.m. peak hour. **Figure 3.8** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

Sidewalks run along both sides of 24th Avenue South and Cherry Street. Based on the traffic counts provided there are approximately 35 pedestrians crossing 24th Avenue South and 10 pedestrians crossing Cherry Street during the weekday p.m. peak hour. No bicycle facilities currently exist on either 24th Avenue South or Cherry Street; however, 24th Avenue South is identified as a planned bike route. Both streets are facilities for biking and bicycles may be ridden on residential sidewalks. **Figure 3.8** illustrates the existing and planned bike routes through the intersection.

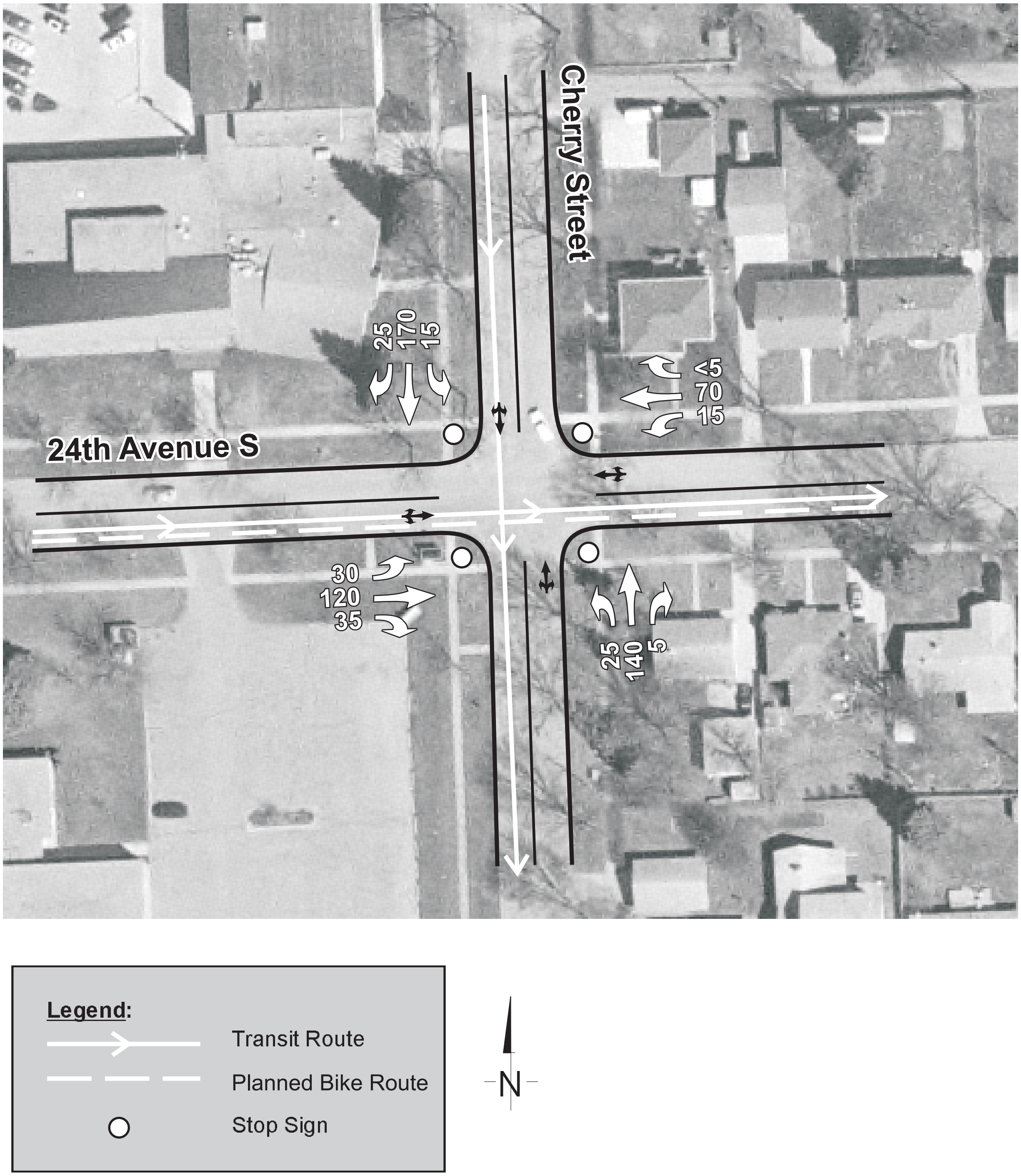


Figure 3.8:
24th Avenue S & Cherry Street

3.10 Ruemmele Road and South 34th Street

Intersection Overview

The intersection of Ruemmele Road and South 34th Street is currently a two-legged stop sign controlled intersection located in southwest Grand Forks. There is primarily undeveloped land adjacent to this intersection.

The southbound approach on South 34th Street is free flowing and consists of a single left-turn lane. The eastbound approach on Ruemmele Road is stop sign controlled and consists of a single right-turn lane. The west and south legs of the intersection are to be added as development proceeds. Parking is currently permitted on both sides of Ruemmele Road and South 34th Street. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of Ruemmele Road and South 34th Street are based on a traffic count conducted by the City of Grand Forks on Thursday, September 27, 2007. **Figure 3.9** illustrates the weekday p.m. peak hour traffic volumes at the intersection of Ruemmele Road and South 34th Street.

Traffic Analysis

The intersection of Ruemmele Road and South 34th Street is currently operating at an acceptable LOS during the 2007 weekday p.m. peak hour. The critical movement is the westbound right-turn movement, operating at LOS A. The results from the traffic analysis for the intersection of Ruemmele Road and South 34th Street are summarized in **Table 3.10**.

Table 3.10: Ruemmele Road & South 34th Street Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	7%	7.5	WB R	A	8.5

Transit Service

There is currently no transit service through the intersection of Ruemmele Road and South 34th Street.

Bicycle and Pedestrian Traffic

Pedestrian and bicycle facilities currently exist along the north side of Ruemmele Road and east side of South 34th Street. The traffic count data identified less than five pedestrians at the intersection of Ruemmele Road and South 34th Street during the weekday p.m. peak hour. Both streets have facilities for biking and bicycles may be ridden on residential sidewalks.

Legend:

○ Stop Sign

Figure 3.9:
34th Avenue S & Ruemmele Road

3.11 40th Avenue South and South 20th Street

Intersection Overview

The intersection of 40th Avenue South and South 20th Street is a four-way stop sign controlled intersection located in south Grand Forks. Adjacent to this intersection is primarily single family residential development and undeveloped land.

The northbound and southbound approaches on South 20th Street each consist of one shared left-turn/through lane and one shared through/right-turn lane. The eastbound and westbound approaches on 40th Avenue South also consist of one shared left-turn/through lane and one shared through/right-turn lane. Parking is not permitted on either side of 40th Avenue South or South 20th Street. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 40th Avenue South and South 20th Street are based on a traffic count conducted by the City of Grand Forks on Thursday, September 13, 2007. **Figure 3.10** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 40th Avenue South and South 20th Street.

Traffic Analysis

The intersection of 40th Avenue South and South 20th Street is currently operating at an acceptable LOS during the 2007 weekday p.m. peak hour. The critical movement is the northbound left-turn/through/right-turn movement, operating at LOS A. The results from the traffic analysis for the intersection of 40th Avenue South and South 20th Street are summarized in **Table 3.11**.

Table 3.11: 40th Avenue South & South 20th Street Intersection Analysis

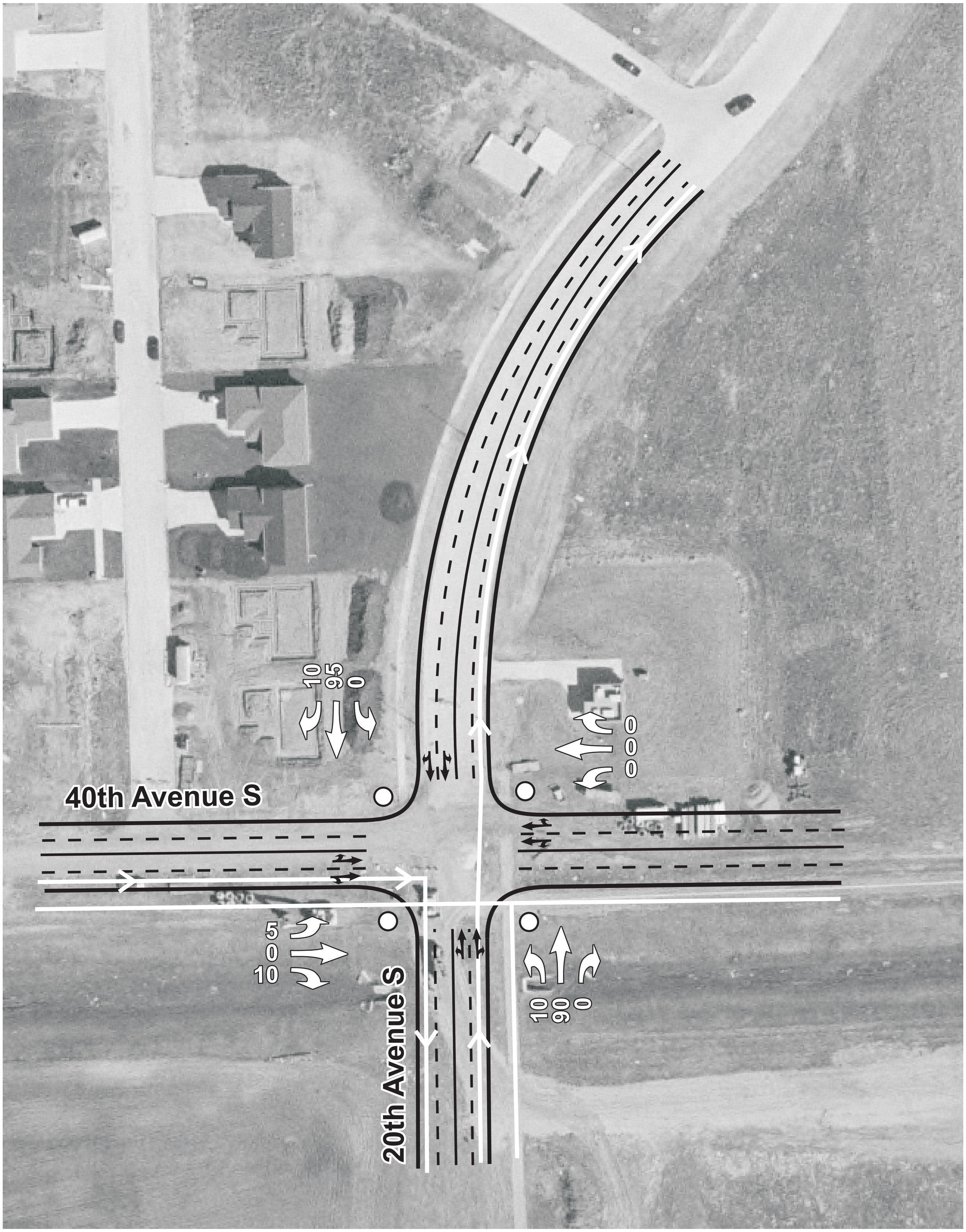
Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	17%	7.0	NB L/T/R	A	7.0

Transit Service

Transit service is provided by Brown Route 12/13 buses. Route 12/13 buses pass through the intersection twice during the weekday p.m. peak hour, traveling eastbound on 40th Avenue South before turning southbound onto South 20th Street or northbound along South 20th Street. **Figure 3.10** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

Sidewalks run along both sides of 40th Avenue South and South 20th Street. Based on the traffic counts provided there are currently less than five pedestrians crossing 40th Avenue South and South 20th Street during the weekday p.m. peak hour. The sidewalk running along the south side of 40th Avenue South currently serves as a multi-purpose path. **Figure 3.10** illustrates the existing and planned bike routes through the intersection.



Legend:

→ Transit Route

— Bike Route

○ Stop Sign

N

Figure 3.10:
40th Avenue S & 20th Street S

3.12 40th Avenue South and Cherry Street

Intersection Overview

The intersection of 40th Avenue South and Cherry Street is a four-legged two-way stop sign controlled intersection located in southeast Grand Forks. Adjacent to this intersection is the Valley Christian Center and residential development.

The northbound and southbound approaches on Cherry Street are free flowing and each consists of one shared left-turn/through lane and one shared through/right-turn lane. The eastbound and westbound approaches on 40th Avenue South are stop sign controlled and also consist of one shared left-turn/through lane and one shared through/right-turn lane. Parking is currently permitted on both sides of 40th Avenue South and Cherry Street. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 40th Avenue South and Cherry Street are based on a traffic count conducted by the City of Grand Forks on Tuesday, September 11, 2007. **Figure 3.11** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 40th Avenue South and Cherry Street.

Traffic Analysis

The intersection of 40th Avenue South and Cherry Street is currently operating at an acceptable LOS during the 2007 weekday p.m. peak hour. The critical movements are the eastbound left-turn, through and right-turn movements, operating at LOS B. The results from the traffic analysis for the intersection of 40th Avenue South and Cherry Street are summarized in **Table 3.12**.

Table 3.12: 40th Avenue South & Cherry Street Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	26%	7.0	EB L/T/R	B	13

Transit Service

Transit service is provided by Red Route 1 and Brown Route 12/13. Red Route buses travel northbound and southbound on Cherry Street, passing straight through the intersection once in each direction during the weekday p.m. peak hour. Brown Route buses travel northbound on Cherry Street before turning west onto 40th Avenue South, passing through the intersection twice during the weekday p.m. peak hour. **Figure 3.11** illustrates the existing transit routes through the intersection.

Bicycle and Pedestrian Traffic

Sidewalks run along both sides of 40th Avenue South and Cherry Street, except along the north side of 40th Avenue South west of Cherry Street. Based on the traffic counts provided there are currently 35 pedestrians crossing 40th Avenue South and 15 pedestrians crossing Cherry Street during the weekday p.m. peak hour. No bicycle facilities currently exist along 40th Avenue South or Cherry Street; however, 40th Avenue South is identified as a planned bike route. Both streets have facilities for biking and bicycles may be ridden on residential sidewalks. **Figure 3.11** illustrates the existing and planned bike routes through the intersection.

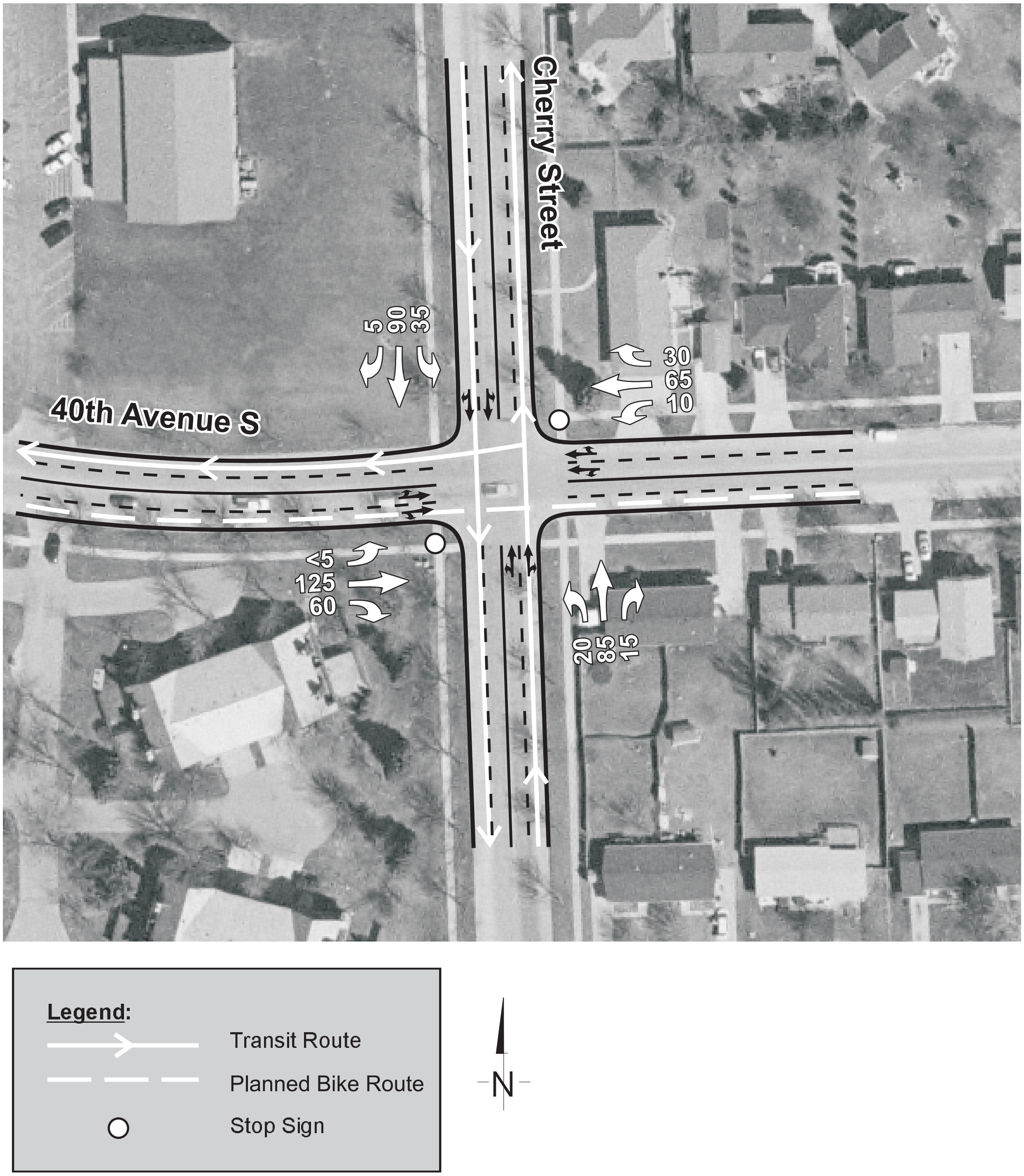


Figure 3.11:
40th Avenue S & Cherry Street

3.13 55th Avenue South and Cherry Street

Intersection Overview

The intersection of 55th Avenue South and Cherry Street is currently a two-legged stop sign controlled intersection located in southeast Grand Forks. There is primarily undeveloped land adjacent to this intersection.

The southbound approach on Cherry Street is stop sign controlled and consists of two left-turn lanes. The eastbound approach on 55th Avenue South is also stop sign controlled and consists of two right-turn lanes. The west and south legs of the intersection are to be added as development proceeds. Currently parking is not permitted on either side of 55th Avenue South or Cherry Street. The posted speed limit is 25 mph on both streets.

Traffic Volumes

Existing weekday p.m. peak hour traffic volumes at the intersection of 55th Avenue South and Cherry Street are based on a traffic count conducted by the City of Grand Forks on Tuesday, September 25, 2007. **Figure 3.12** illustrates the weekday p.m. peak hour traffic volumes at the intersection of 55th Avenue South and Cherry Street.

Traffic Analysis

The intersection of 55th Avenue South and Cherry Street is currently operating at an acceptable LOS during the 2007 weekday p.m. peak hour. The critical movement is the southbound left-turn movement, operating at LOS A. The results from the traffic analysis for the intersection of 55th Avenue South and Cherry Street are summarized in **Table 3.13**.

Table 3.13: 55th Avenue South & Cherry Street Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2007 Weekday P.M. Peak Hour	A	7%	6.5	SB L	A	7

Transit Service

There is currently no transit service through the intersection of 55th Avenue South and Cherry Street.

Bicycle and Pedestrian Traffic

Sidewalks exist on the north and south side of 55th Avenue South and the east side of Cherry Street, while a bike path runs along the north side of 55th Avenue South. Based on the traffic counts provided, there are currently less than five pedestrians crossing at the intersection of 55th Avenue South and Cherry Street during the weekday p.m. peak hour. **Figure 3.12** illustrates the existing and planned bike routes through the intersection.

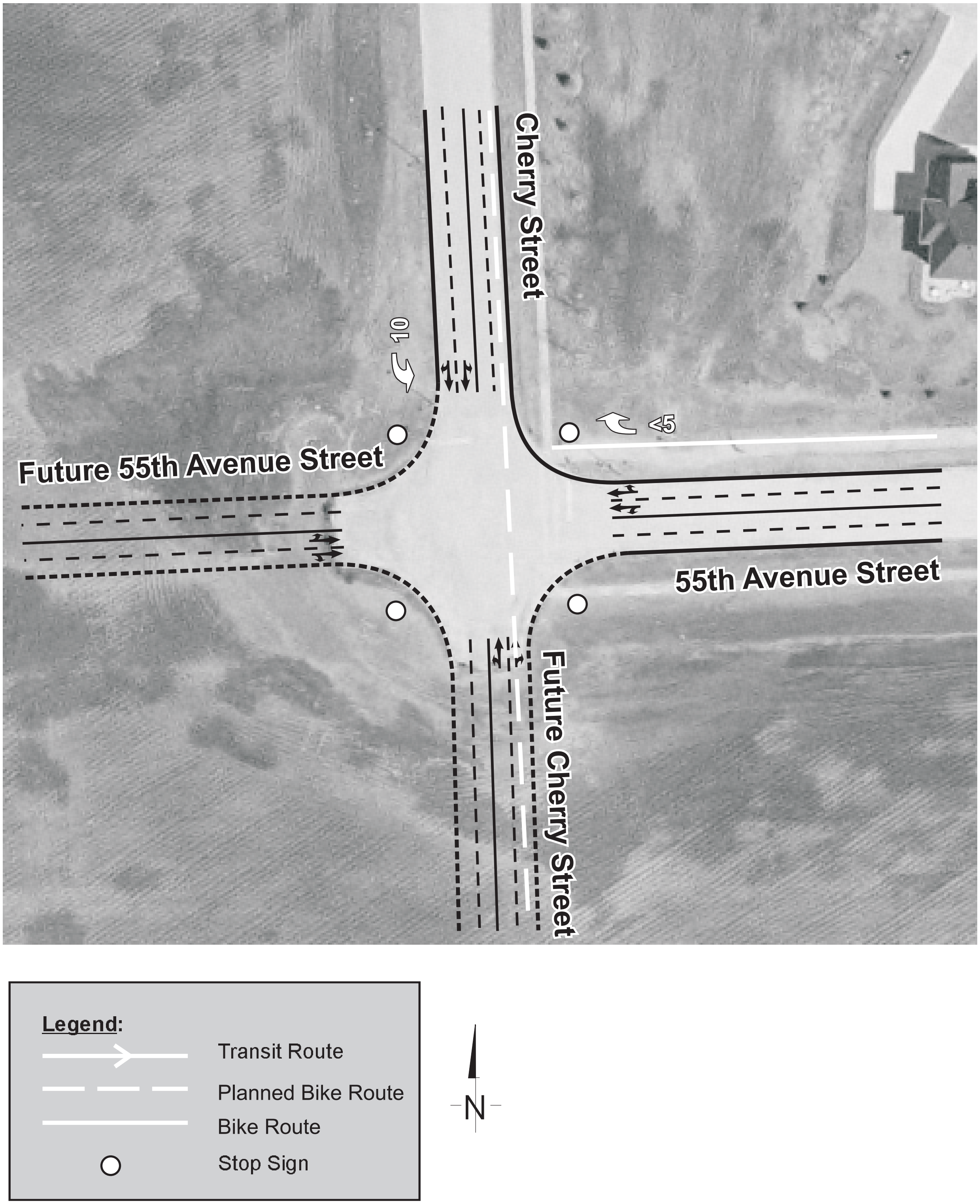


Figure 3.12:
55th Avenue S & Cherry Street

4.0 PROJECTED OPERATIONS

Traffic volumes for the year 2035 were estimated based on comparisons of localized traffic growth rates to other intersections with similar local demographics and forecast growth along nearby roadway links included in the MPO's transportation planning model. Growth rates for each intersection were calculated based on traffic data obtained from the State of North Dakota Geographic Information System (GIS) and the Grand Forks - East Grand Forks Metropolitan Planning Organization Long Range Transportation Plan Update. The MPO's Long Range Transportation Plan Update provided year 2005 traffic volumes and projected year 2035 traffic volumes for the collector and arterial street system within the metropolitan area. In this study year 2035 traffic volumes were determined by interpolating the projected 2035 volumes for the collector to collector intersections in question.

The North Dakota GIS provided historical traffic volumes at the intersection level from 1990 to 2005. The Plan Update provided 2005 and projected 2035 arterial roadway volumes. Using a combination of this data, individual growth rates for the collector roadways and intersections were determined. In the case of partially developed areas such as the intersections of 55th Avenue South and Cherry Street and Ruemmele Road and South 34th Street, the intersection of 40th Avenue South and Cherry Street was used as an example growth area. Also, it was assumed that a hotel development will occur at the intersection of 24th Avenue South and South 34th Street (SE), which creates a four legged intersection.

4.1 6th Avenue North and Stanford Road

The intersection of 6th Avenue North and Stanford Road is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.1**, were forecast using an annual growth rate of 0.5%. The critical movement is forecast as the westbound left-turn/through/right-turn movement operating at LOS D. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.1**.

Table 4.1: 6th Avenue North & Stanford Road Forecast Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	C	55%	20	WB L/T/R	D	33

4.2 8th Avenue North and 20th Street North

The offset "T" intersections of 8th Avenue North and 20th Street North are forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming they operate with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.1**, were forecast using an annual growth rate of 0.35%. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.2**.

Table 4.2: 8th Avenue North & 20th Street North Forecast Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
North Intersection						
2035 Weekday P.M. Peak Hour	A	30%	1.0	EB L/R	B	10
South Intersection						
2035 Weekday P.M. Peak Hour	A	31%	1.0	WB L/R	A	9.5

The critical movements are forecast to remain as the cross street movements. At the northern intersection the critical movement is forecast to be the eastbound left-turn/right-turn movement operating at LOS B, and the critical movement of the southern intersection is forecast to be the westbound left-turn/right-turn movement operating at LOS A.

4.3 8th Avenue South and Cherry Street

The intersection of 8th Avenue South and Cherry Street has experienced a negative growth rate over the past 15 years. Therefore, a conservative annual growth rate of 0% was assumed. As there is no growth anticipated at this intersection, it is forecast to operate at the same LOS in 2035 as it currently operates. The critical movements are forecast to remain the westbound and eastbound left-turn/through/right-turn movements operating at LOS B. Traffic volumes for the intersection of 8th Avenue South and Cherry Street are illustrated in **Figure 4.1**. The results of the 2035 p.m. peak hour traffic analysis are summarized in **Table 4.3**.

Table 4.3: 8th Avenue South & Cherry Street Forecast Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	A	26%	5.0	WB/EB L/T/R	B	13

4.4 11th Avenue South and South 34th Street

The intersection of 11th Avenue South and South 34th Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.1**, were forecast using an annual growth rate of 0.75%. The critical movement is forecast to remain the westbound left-turn/through/right-turn movement operating at LOS C. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.4**.

Table 4.4: 11th Avenue South & South 34th Street Forecast Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	A	39%	5.5	WB L/T/R	C	17

4.5 13th Avenue South and South 20th Street

The intersection of 13th Avenue South and South 20th Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.1**, were forecast using an annual growth rate of 0.3%. The critical movement is forecast to remain the southbound left-turn/through/right-turn movement operating at LOS C. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.5**.

Table 4.5: 13th Avenue South & South 20th Street Forecast Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	C	56%	18	SB L/T/R	C	23

4.6 13th Avenue South and Cherry Street

The intersection of 13th Avenue South and Cherry Street has experienced a negative growth rate over the past 15 years. Therefore, a conservative annual growth rate of 0% was assumed. As there is no growth anticipated at this intersection, it is forecast to operate at the same LOS in 2035 as it currently operates. The critical movement is forecast to remain the southbound left-turn/through/right-turn movement operating at LOS B. Traffic volumes for the intersection of 13th Avenue South and Cherry Street are illustrated in **Figure 4.1**. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.6**.

Table 4.6: 13th Avenue South & Cherry Street Forecast Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	B	42%	11	SB L/T/R	B	11

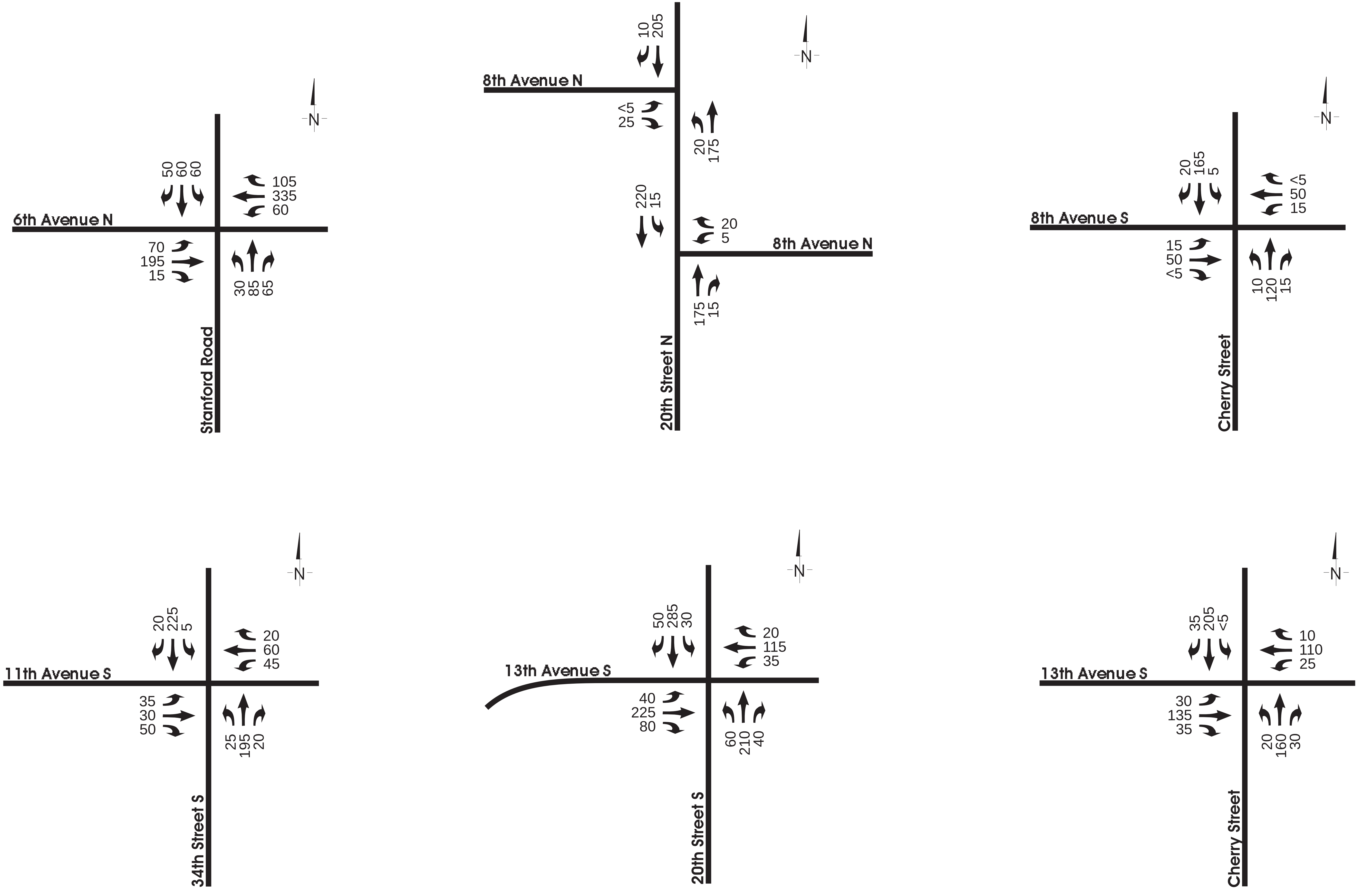


Figure 4.1:
Forecasted North Intersection Traffic Volumes

4.7 24th Avenue South and South 34th Street (Northwest Intersection)

The northwest intersection of 24th Avenue South and South 34th Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.2**, were forecast using an annual growth rate of 1.5%. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.7**.

Table 4.7: 24th Avenue South & South 34th Street (NW) Forecast Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	A	50%	42	EB L/R	F	165

The northwest intersection of 24th Avenue South and South 34th Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour; however, the eastbound left-turn/right-turn movement exceeds capacity, operating at LOS F.

4.8 24th Avenue South and South 34th Street (Southeast Intersection)

The southeast intersection of 24th Avenue South and South 34th Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.2**, were forecast using an annual growth rate of 1.5%. The 2035 analysis was based on a four-legged intersection, assuming the lands to the southeast develop as per a potential development application. Trip generation and distribution was estimated for the potential development to provide forecast traffic levels at this location. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.8**.

Table 4.8: 24th Avenue South & South 34th Street (SE) Forecast Intersection Analysis

Scenario	ICU LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	C	71%	95	EB L/T/R	F	715

The southeast intersection 24th Avenue South and South 34th Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour; however, the eastbound and westbound left-turn/through/right-turn movements exceeds capacity, operating at LOS F.

4.9 24th Avenue South and Cherry Street

The intersection of 24th Avenue South and Cherry Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.2**, were forecast using an annual growth rate of 0.75%. The critical movement is forecast to remain the southbound left-turn/through/right-turn movement operating at LOS B. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.9**.

Table 4.9: 24th Avenue South & Cherry Street Forecast Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	B	43%	12	SB L/T/R	B	12

4.10 Ruemmele Road and South 34th Street

The intersection of Ruemmele Road and South 34th Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.2**, were forecast using an annual growth rate of 5.0%. The critical movement is forecast as the westbound left-turn/through/right-turn movement operating at LOS C. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.10**.

Table 4.10: Ruemmele Road & South 34th Street Forecast Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	A	32%	9	WB L/T/R	C	16

4.11 40th Avenue South and South 20th Street

The intersection of 40th Avenue South and South 20th Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.2**, were forecast using an annual growth rate of 2.0%. The critical movement is forecast as the westbound left-turn/through/right-turn movement operating at LOS A. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.11**.

Table 4.11: 40th Avenue South & South 20th Street Forecast Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	A	33%	9	WB L/T/R	A	9

4.12 40th Avenue South and Cherry Street

The intersection of 40th Avenue South and Cherry Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.2**, were forecast using an annual growth rate of 2.0%. The critical movement is forecast to remain the eastbound left-turn/through/right-turn movement operating at LOS B. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.12**.

Table 4.12: 40th Avenue South & Cherry Street Forecast Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	A	34%	8	SB L/T/R	A	8

4.13 55th Avenue South and Cherry Street

The intersection of 55th Avenue South and Cherry Street is forecast to operate at an acceptable LOS in the 2035 weekday p.m. peak hour, assuming it operates with the existing lane configuration and traffic control. Traffic volumes, illustrated in **Figure 4.2**, were forecast using an annual growth rate of 4.5%. The critical movement is forecast as the southbound left-turn/through/right-turn movement operating at LOS A. The results of the 2035 weekday p.m. peak hour traffic analysis are summarized in **Table 4.13**.

Table 4.13: 55th Avenue South & Cherry Street Forecast Intersection Analysis

Scenario	LOS	Intersection Utilization	Delay (sec)	Critical Movement		
				Movement	LOS	Delay (sec)
2035 Weekday P.M. Peak Hour	A	27%	8	SB L/T/R	A	8

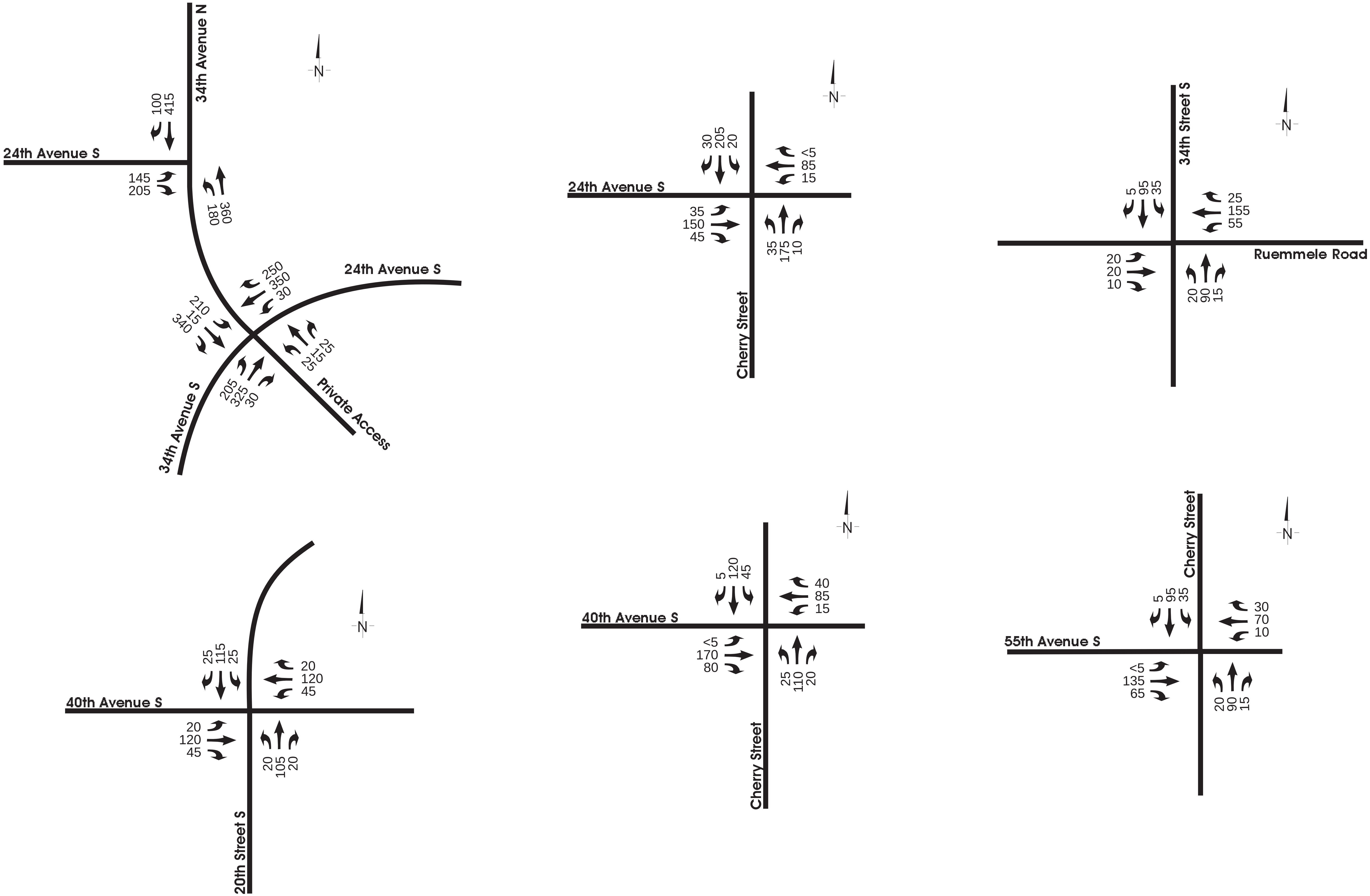


Figure 4.2:
Forecasted South Intersection Traffic Volumes

5.0 COLLISION ANALYSIS

5.1 Collision Data

Data pertaining to the number, type and severity of reported collisions in Grand Forks was provided by the City of Grand Forks. Year 2005 and 2006 collision data was provided and analyzed for the following intersections:

- 6th Avenue North and Stanford Road;
- 8th Avenue North and 20th Street North (North Intersection);
- 8th Avenue North and 20th Street North (South Intersection);
- 11th Avenue South and South 34th Street;
- 13th Avenue South and South 20th Street;
- 8th Avenue South and Cherry Street;
- 13th Avenue South and Cherry Street;
- 24th Avenue South and South 34th Street (Northeast Intersection);
- 24th Avenue South and South 34th Street (Southwest Intersection);
- 24th Avenue South and Cherry Street; and
- 40th Avenue South and Cherry Street.

Collisions at intersections in undeveloped areas with low traffic volumes are rare and largely unrecorded by the City of Grand Forks. Collision data was therefore not available for the following intersections:

- Ruemmele Road and South 34th Street;
- 40th Avenue South and South 20th Street; and
- 55th Avenue South and Cherry Street.

5.2 Collision Rates

The number of collisions and collision rates at the 11 collector-to collector intersections examined are summarized in **Table 5.1**. Available data assumes that collisions occurring within 50 feet of an intersection were related to the operation of that intersection. Traffic volumes are based on average annual daily traffic (AADT) volumes obtained from the North Dakota State Government's online Transportation Information Map, and where not available, AADT volumes were projected from the weekday p.m. peak hour traffic counts provided.

A total of 17 collisions occurred over the two-year study period, six in 2005 and 11 in 2006. The intersection with the highest number of collisions, four in two years, was 40th Avenue South and Cherry Street. There were zero collisions in two years at the two intersections of 8th Avenue North and 20th Street North. **Figure 5.1** compares collision rates per million vehicles entering.

Table 5.1: Collision Summary

Intersection	Collisions					
	2005	2006	Total	Average[1]	Volume[2]	Rate[3]
6th Ave N and Stanford Rd	1	0	1	0.5	4.00	0.12
8th Ave N and 20th St N (N)	0	0	0	0	1.31	0.00
8th Ave N and 20th St N (S)	0	0	0	0	1.32	0.00
11th Ave S and S 34th St	0	1	1	0.5	1.72	0.29
13th Ave S and S 20th St	1	2	3	1.5	3.74	0.40
8th Ave S and Cherry St	0	1	1	0.5	1.96	0.26
13th Ave S and Cherry St	1	0	1	0.5	2.16	0.23
24th Ave S and S 34th St (NW)	1	2	3	1.5	2.94	0.51
24th Ave S and S 34th St (SE)	0	1	1	0.5	3.69	0.14
24th Ave S and Cherry St	1	1	2	1	2.08	0.48
40th Ave S and Cherry St	1	3	4	2	1.72	1.16
Total	*6*	*11*	17	8.5	*26.63*	*0.32*

[1] Average number of collisions per year
[2] Volume of traffic entering the intersection in millions of vehicles per year
[3] Collision rate per million entered vehicles

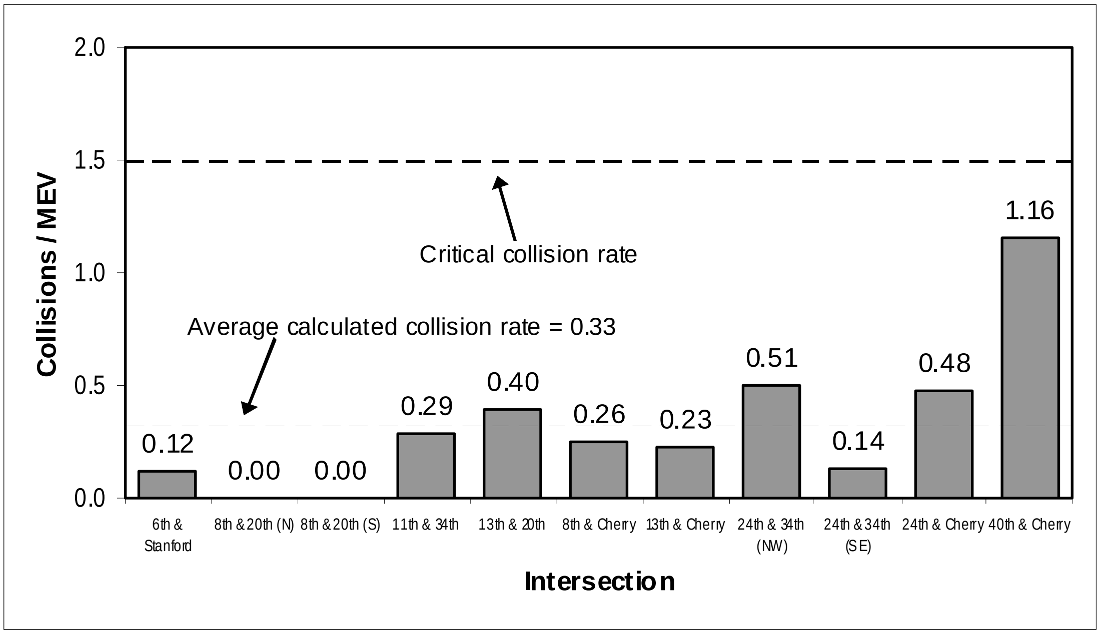


Figure 5.1: Collision Rate Comparison

A collision rate of 1.5 collisions per million entered vehicles represents a commonly accepted critical collision rate; safety concerns are raised for intersections where this critical collision rate is exceeded. All intersections analyzed had collision rates below the critical collision rate, and therefore are assumed to be operating at an acceptable level of safety. The average collision rate at the intersections was 0.33 collisions per million entered vehicles, while the intersection of 40th Avenue South and Cherry Street had the highest collision rate of 1.16 collisions per million entered vehicles. It should be noted that this analysis is based on two years worth of data. It is preferable to examine four to five years of data to help eliminate the impact of year to year variations (e.g., 40th Avenue South and Cherry Street had one collision in 2005 and three in 2006; additional data would assist in determining if one of these years is an anomaly).

Critical crash rates can vary by jurisdiction. For example, MNDOT has a Crash Mapping Analysis Tool that develops critical crash rates by intersection by comparing intersection-specific crash rates to crash rates for similar locations. This can result in critical rates that can vary by location, as identified in the recently completed MPO study, the *Central Avenue Corridor Study*, December 2007. That study examined crash rates for eight intersections along Central Avenue in East Grand Forks, and determined critical crash rates of 0.65 – 1.09. A similar tool is not available for North Dakota. However, available NDDOT collision information was examined (*ND Statewide Problem Identification, FY2007*, and *North Dakota 2006 Crash Summary*).

The first report notes that Grand Forks' crashes per 1,000 population equals the ND average, crashes declined from 2004 to 2005, and that the crash rate per million vehicle miles of travel dropped in 2005 after increasing each year between 2002 and 2004 in Grand Forks County. The second report provides state-wide data and is less comparable. However, as in Grand Forks, the highest collision type (if animal hits are omitted) is angle collisions.

5.3 Collision Trends

Tables 5.2, 5.3, and **5.4** summarize the collision severities, collision types, and the contributing factors at the intersections analyzed. **Figures 5.2, 5.3,** and **5.4** illustrate the classification of collisions for collision severity, collision type and contributing factors throughout the study area.

Collisions were also broken down by time of day as well as time of year, illustrated in **Figures 5.5** and **5.6**, to determine if weather or lighting conditions played a large role in the frequency of collisions. **Figure 5.7** illustrates the split in collisions based on the type of traffic control at the intersections.

Table 5.2: Collision Severity

Intersection	Severity		
	PDO	Injury	Fatal
6th Ave N and Stanford Rd	1	0	0
8th Ave N and 20th St N (N)	0	0	0
8th Ave N and 20th St N (S)	0	0	0
11th Ave S and S 34th St	0	1	0
13th Ave S and S 20th St	2	1	0
8th Ave S and Cherry St	1	0	0
13th Ave S and Cherry St	1	0	0
24th Ave S and S 34th St (NW)	3	0	0
24th Ave S and S 34th St (SE)	0	1	0
24th Ave S and Cherry St	2	0	0
40th Ave S and Cherry St	2	2	0
Total	*12*	*5*	0

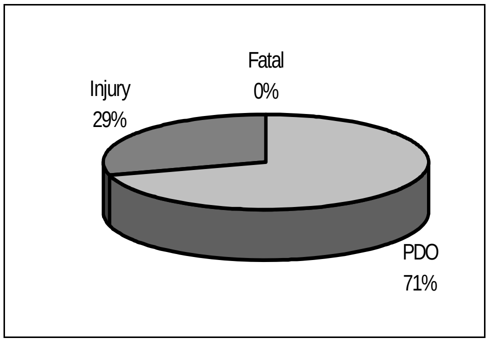


Figure 5.2: Collision Severity

The majority of collisions during the two-year study period resulted in property damage only. Five collisions (29%) resulted in non-fatal injuries and there were no fatal collisions at any of the intersections examined.

Table 5.3: Collision Types

Intersection	Type		
	Angle	Rear End	Non-Collision
6th Ave N and Stanford Rd	1	0	0
8th Ave N and 20th St N (N)	0	0	0
8th Ave N and 20th St N (S)	0	0	0
11th Ave S and S 34th St	1	0	0
13th Ave S and S 20th St	2	0	1
8th Ave S and Cherry St	0	1	0
13th Ave S and Cherry St	0	0	1
24th Ave S and S 34th St (NW)	3	0	0
24th Ave S and S 34th St (SE)	0	1	0
24th Ave S and Cherry St	2	0	0
40th Ave S and Cherry St	3	0	1
Total	*12*	*2*	*3*

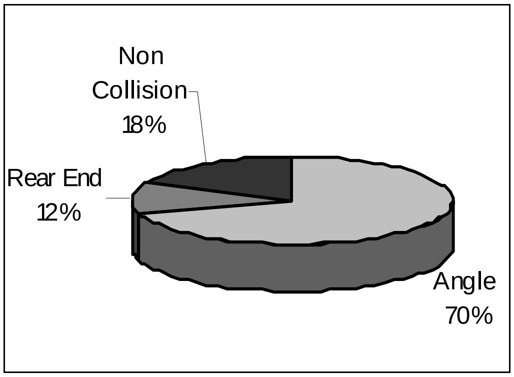


Figure 5.3: Collision Type

The most common type of collision that occurred at the studied intersections was angle collisions. These collisions can be severe as they generally involve two vehicles making conflicting movements and can be at relatively high speeds. The majority of these collisions occurred at two-way stop sign controlled intersections. Only 12% of all collisions were rear-end collisions, collisions are oftentimes due to excessive speed and icy road conditions. Non-collisions, which can be less severe as they generally only involve one car, typically resulted from distraction and visual obstruction.

Table 5.4: Contributing Factors

Intersection	Contributing Factor				
	Speed	Obstructed Vision	Failure to Yield	Distraction	Other / Unavailable
6th Ave N and Stanford Rd	1	0	0	0	0
8th Ave N and 20th St N (N)	0	0	0	0	0
8th Ave N and 20th St N (S)	0	0	0	0	0
11th Ave S and S 34th St	0	0	1	0	0
13th Ave S and S 20th St	0	1	1	1	0
8th Ave S and Cherry St	1	0	0	0	0
13th Ave S and Cherry St	0	0	0	0	1
24th Ave S and S 34th St (NW)	1	0	1	1	0
24th Ave S and S 34th St (SE)	0	0	0	0	1
24th Ave S and Cherry St	0	0	1	0	1
40th Ave S and Cherry St	0	1	2	0	1
Total	*3*	*2*	*6*	*2*	*4*

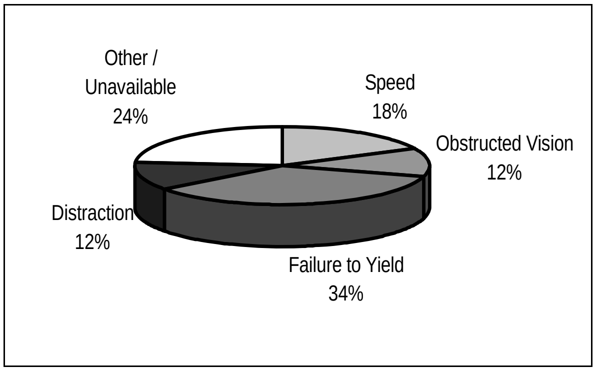


Figure 5.4: Contributing Factors

The largest number of collisions occurred because drivers failed to yield to oncoming traffic. The failure of drivers to yield may partially reflect driver carelessness, but may also be a result of reduced intersection visibility. The other factors that contributed to collisions at the intersections include excessive speed (18%), obstructed vision (12%), driver distraction (12%) and other/unavailable (24%).

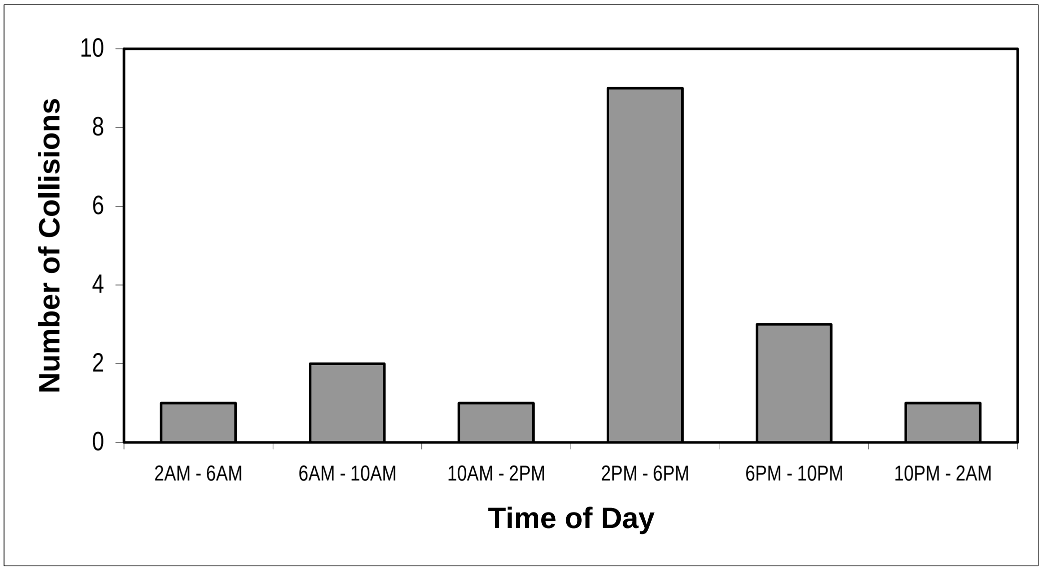


Figure 5.5: Collisions by Time of Day

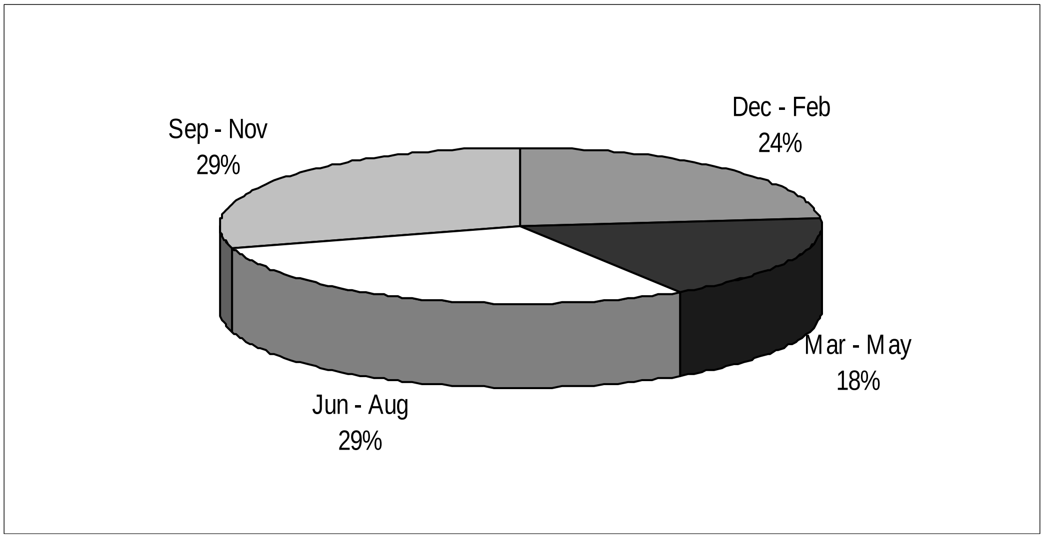


Figure 5.6: Collisions by Season

The majority of collisions occur between the hours of 2:00 p.m. and 6:00 p.m. This is most likely due to the increased traffic volumes that occur during the weekday p.m. peak. Collisions are fairly evenly distributed throughout the year, with only a marginally higher collision frequency recorded during the winter months; therefore, it was assumed that weather is not a major contributing factor for these collisions.

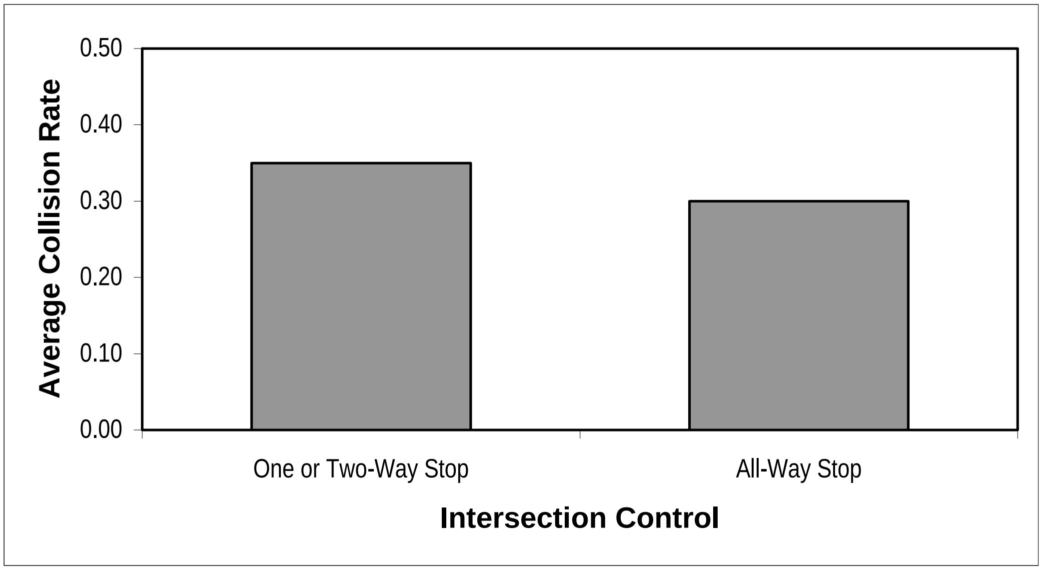


Figure 5.7: Collisions by Type of Intersection Control

The average collision rate at intersections controlled by a one or two-way stop was 0.35 collisions per million entered vehicles. Intersections controlled by an all-way stop had an average collision rate of 0.30 collisions per million entered vehicles. While the collision rate is slightly higher at one or two-way stops, there is not a significant correlation between the type of intersection control and the average collision rate.

5.4 Collision Mitigation

As the most common and most severe collision type is the angle collision, the best collision mitigation measures that could be implemented would be to reduce or eliminate this type of collision completely.

The use of modern roundabouts (where possible) has been shown to be a successful collision mitigation measure. **Figure 5.8** illustrates the difference in the total number of collision points at stop sign controlled intersections verses a modern roundabout.

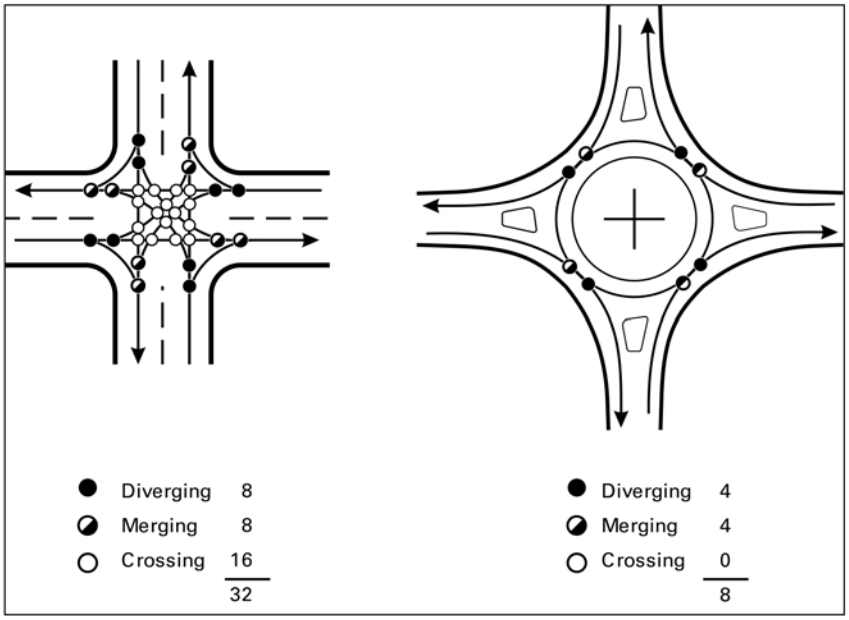


Figure 5.8: Comparison of Intersection Vehicle-Vehicle Conflict Points

(Source: Federal Highway Administration Report FHWA-RD-00-067)

As seen in **Figure 5.8** there are a total of 32 conflict points at a standard four-legged intersection, with at least half of those being possible locations for angle collisions. In the modern roundabout the total number of possible conflict points is reduced to eight, with only half of those being possible locations for angle collisions. **Figure 5.9** illustrates the two most common types of collisions at a modern roundabout, as well as possible loss of control locations.

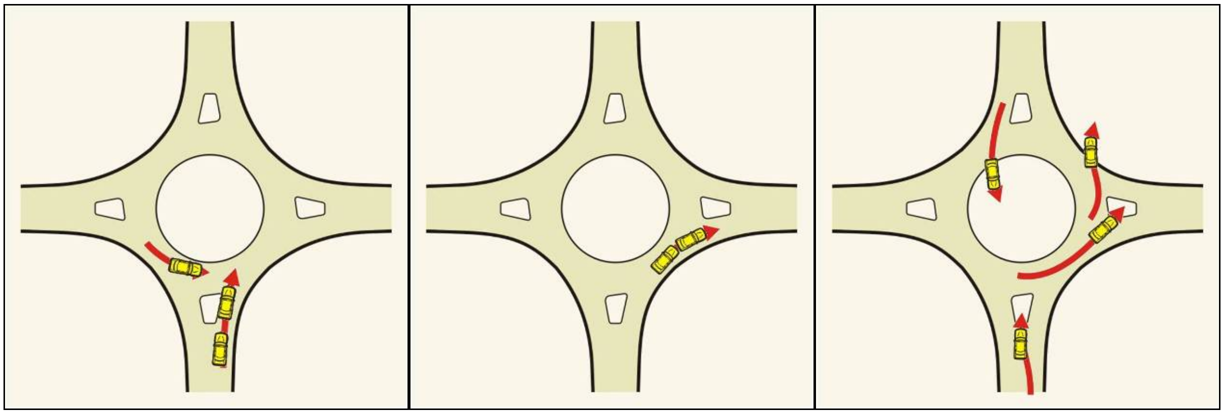


Figure 5.9: Roundabout Collision Diagram

(Source: Transportation Research Board National Cooperative Highway Research Program Report 572)

As seen in **Figures 5.8** and **5.9** there are fewer overall conflict points in a modern roundabout and far fewer locations where an angle collision is possible.

6.0 PUBLIC PARTICIPATION

6.1 Initial Public Information Meetings

Two Public Information Meetings were held in Grand Forks on February 13, 2008 at Valley Middle School (4:30 to 6:00 p.m.) and Century Elementary School (6:30 to 8:00 p.m.). 17th Avenue South was used to divide the study intersections into north and south locations and separate Public Information Meetings were held for both. Approximately nine people attended the north Open House and approximately three attended the south Open House (not including local staff). The Public Information Meetings were advertised in the Grand Forks Herald and on the MPO website. A local radio station also informed listeners of the open houses throughout the day of the open houses.

Participants at the Public Information Meetings had the opportunity to review information regarding the study goals, objectives, progress, intersection traffic data and forecasts, collision data, potential traffic control strategies and proposed work plan. Staff from the MPO, the City of Grand Forks and the Consultant Team was available to answer questions.

A comment sheet was provided to obtain feedback from participants on their traffic control concerns in the City of Grand Forks. Four comment sheets were completed; all by residents of Grand Forks. Participants were asked to identify the main transportation issues at any of the study intersections. The issues identified centered on questioning the necessity of all- way stops at some locations, and providing pedestrian accommodation.

Participants were also asked to rank the proposed traffic control strategies in order of preference. This exercise was completed by two participants with all-way stop signs being the preferred control followed by a tie between two-way stops signs and traffic signals and lastly, a tie between geometric modifications and roundabouts. One participant noted adamant opposition to both roundabouts and geometric modifications. Participants were also asked “yes”, “no” or “unsure” as to whether or not they would be opposed to the implementation of any of the proposed traffic control strategies. This exercise was completed by two participants and partially completed by one other participant. All of the proposed options were given varying answers of yes, no or unsure by the participants. Participants were also given the opportunity to provide any additional traffic control strategies for the collector to collector intersections in the study; however, none were provided.

Additional comments from the participants were solicited regarding other areas of interest or concern. Comments received included concern regarding confusing signage and lack of traffic control surrounding schools and crosswalks, overcrowded driveway access points, a lack of parking restriction enforcement, the possibility of installing traffic controls at surrounding intersections to improve flow, and lack of sufficient notice for the Public Information Meetings. Verbal comments received from the Open House participants included approval of the study and intrigue in the roundabouts concepts should they prove feasible.

In addition to the Open House comments, the City of Grand Forks Engineering Department reviewed the presentation materials and provided written commentary to the MPO and Consultant Team. The main concerns expressed by the Engineering Department were the ability to retrofit roundabouts in existing residential neighborhoods and their impact on property acquisition and utilities. As well, the Engineering Department expressed concern in maintaining the study objective of determining the appropriate traffic control based on aesthetics, individual residential inputs, neighborhood inputs and other pertinent items.

6.2 Final Public Information Meeting

The final Public Information Meeting was held in Grand Forks on May 15, 2008 in the Council Chambers at City Hall. One person attended the Public Information Meeting, not including local staff. The Public Information Meetings were advertised in the Grand Forks Herald and on the MPO website.

A copy of the display boards and comment sheets from the Public Information Meetings held on February 13, 2008 and May 15, 2008 can be found in Appendix A which is available under separate cover.

Participants at the Public Information Meeting had the opportunity to review information regarding the study goals, objectives, progress, intersection traffic data and forecasts, potential traffic control strategies, operational performance of the intersections and recommended traffic control options. Staff from the MPO and the consultant team was available to answer questions.

A comment sheet was provided to obtain feedback from participants on their traffic control concerns in the City of Grand Forks. Participants were asked to identify their agreement or disagreement with the recommended traffic control measures, their reasons for disagreement and any additional comments with respect to transportation issues at any of the study intersections. No comment sheets were completed. A verbal comment received from the Information Meeting participant suggested an all-way stop at the intersection of 40th Avenue

South and Cherry Street. The participant feels that there is too much distance between stop signs along Cherry Street and this situation creates high speeds along the route.

7.0 PROPOSED STRATEGIES

This study has considered a number of traffic control options for the collector to collector intersections in question. The intersection-specific options considered vary in part due to forecast traffic levels, available geometric options, and available right-of-way. Options that were considered included:

- Two-way stop sign control;
- All-way stop sign control;
- Traffic signal control;
- Conventional roundabouts; and
- Geometric modifications.

Each of the above options has certain advantages and disadvantages; all may not be applicable at each location to be examined.

7.1 Traffic Control Options

7.1.1 Stop Sign Control

Stop signs have generally been used by traffic authorities as an inexpensive and simple remedy for a number of vehicle management situations. They are low-cost, easy to install, concise and universally understood. However, frequent stopping at intersections can cause traffic flow problems and irritation for motorists. This irritation is amplified at locations with unbalanced traffic flows as was seen in Fargo, ND. To make up for lost time, motorists speed up between the stop signs and may be more inclined to roll through an intersection instead of stopping completely, increasing the disregard for stop signs, especially if the travelling public considers the stop sign installation unwarranted (more of an issue with all-way stop signage). Stop and go traffic flow also increases pollution, noise and delay. Therefore, stop sign control is not applicable to every situation and problem.

Stop signs are generally used to control conflicting traffic movements or assign right-of-way at intersections which have insufficient volumes to warrant the installation of traffic signals or a roundabout. In the U.S. and Canada, stop signs are oftentimes used in residential areas and school zones as a safety measure. However, in the MUTCD, the stop sign is not intended for use as a traffic calming device. Therefore, stop signs should only be used where they are needed and when they meet engineering study warrants.

Two-way stop sign control may be appropriate when:

- A lower volume road intersects with a high volume road where application of the normal right-of-way rule would not be reasonably safe;
- A minor street intersects a through street, highway or road;
- The minor street of a “T” intersection forms the base of the “T”; and
- A minor street intersects an unsignalized intersection where several of the intersections along the intersecting roadway are signalized.

All-way stop sign control may be appropriate when:

- Roadways of balanced traffic volume intersect but do not warrant installation of traffic signals or a roundabout;
- Roadways intersect and high speed traffic, a restricted view or frequent collisions warrant the need for stop sign control;
- It is necessary to control motorist and non-motorist conflicts at locations that experience or generate high pedestrian volumes;
- A motorist, after stopping, is unable to see conflicting traffic and unable to safely negotiate the intersection unless conflicting traffic is also required to stop; and
- Operation of an intersection of collector to collector streets of similar design and operating characteristics would be improved by an all-way stop.

The MUTCD warrant procedure, as described in **Section 2.1.1**, was utilized in this study to determine appropriate locations for all-way stop sign control.

Installation of all-way stop sign control at an existing intersection is assumed to cost approximately $1,000. This cost estimate was provided by the City of Grand Forks Engineering Department based on a recent installation estimate but does not include land acquisition, engineering, or utility costs which are assumed not to apply to all-way stops. All-way stop signs entail minimal maintenance costs over the lifetime of the control.

7.1.2 Traffic Signals

According to the FHWA, traffic signals are a common form of traffic control used by State and local agencies to address roadway operations. Traffic signals allow the shared use of road space by separating conflicting movements in time and allocating delay. They can also be used to enhance the mobility of some movements as, for example, along a major arterial.

Traffic signals play a prominent role in achieving safer performance at intersections. Research has shown that, under the right circumstances, the installation of traffic signals can reduce the number and severity of intersection 90º or right-angle collisions due to their ability to effectively assign right-of-way. However, the installation of traffic signals can increase the number of rear-end collisions at an intersection. As such, inappropriately designed and/or located signals can have an adverse effect on traffic safety, so care in their placement, design, and operation is essential.

The installation of traffic signals typically reduces vehicle delay and queuing thereby also reducing emissions and fuel usage. Traffic signals also increase intersection capacity. Appropriate signal coordination can provide reasonably smooth traffic flow along the primary roadway. Without appropriate signal coordination, delays may be increased and traffic may choose to divert to other streets without signals.

An engineering study of traffic conditions, pedestrian and cyclist characteristics and geometric considerations of any proposed traffic signal location should be performed to determine whether the traffic signals are justified. Detailed advantages, disadvantages and warrants, as outlined by MUTCD, for traffic signal installation can be found in **Section 2.1.1**.

The MUTCD provides eight warrants to be evaluated for consideration of a new traffic signal installation. With respect to traffic volumes, the MUTCD includes eight-hour, four-hour and peak hour warrants. The manual states that the peak hour warrant, which is utilized in this study, is intended for use at a location where traffic conditions are such that for a minimum of one hour of an average day, the minor street traffic suffers undue delay when entering or crossing the major street. However, the manual also states that this warrant should only be used in unusual cases where large numbers of vehicles are attracted or discharged over a short time. Therefore, while this may apply to the intersection of 6th Avenue North and Stanford Road, it is recommended that eight hour traffic counts be obtained and traffic warrants re-evaluated prior to considering the introduction of traffic signals at the study intersections. In addition, meeting a warrant in itself does not generate a mandate to install a traffic signal, but does indicate that traffic signal control be considered along with other options. The placement of a traffic signal also requires engineering judgment, as well as an examination of possible alternatives. The MUTCD notes that other options should be considered, including roundabouts. A number of urban jurisdictions examine the feasibility of a roundabout, and if not technically feasible (most commonly due to right-of-way limitations), then a traffic signal is reviewed.

Installation of traffic signal control at an intersection is assumed to cost approximately $375,000, This cost estimate was provided by the City of Grand Forks Engineering Department based on a recent installation estimate but does not include land acquisition. The cost estimate does include engineering and consultant costs. Also, this cost estimate does not include cost incursions such as signal replacement and maintenance, pavement maintenance or electrical utility operation.

Figure 7.1 illustrates a collector to collector intersection in Grand Forks controlled by traffic signals (South 20th Street at 24th Avenue South).

Figure 7.1: Traffic Signal Controlled Collector – Collector Intersection in Grand Forks

7.1.3 Roundabouts

One of the traffic control options reviewed in this study is the modern roundabout. In the U.S., roundabouts are termed “modern roundabouts” in order to differentiate from older, larger traffic circles or rotaries. A modern roundabout is an unsignalized circular intersection engineered to maximize safety and minimize traffic delay. The intersection design accommodates traffic by a circular traffic flow in a counterclockwise direction around a center island. It operates with a yield control at every entry point, and gives priority to vehicles within the roundabout. At each entry point, traffic is deflected by a splitter island that is designed to provide a superior intersection entry angle, slow down the traffic entering the roundabout and reinforce the yielding process. **Table 7.1** highlights the differences between a modern roundabout and a traffic circle.

Table 7.1: Differences between Modern Roundabouts and Traffic Circles

Modern Roundabout	Traffic Circle
No parking is allowed	Some large circles permit parking within the circle
Vehicles in the roundabout have priority over entering vehicles	Allow weaving areas to resolve conflicted movement
Entering vehicles yield	Stop sign, stop signal, or giving priority to entering vehicles
Use deflection to maintain low speed operation	Some large circles provide straight path for higher speed
Pedestrians are typically prohibited from center island	Some large circles allow pedestrians on center island
All vehicles circulate around the center island	Mini-traffic circles with left-turning vehicles pass to the left of the center island

Modern roundabouts have demonstrated:

- Reduced collision rates in urban, rural and suburban settings as compared to other forms of traffic control, except all-way stops;
- Operational benefits in terms of intersection capacity and reduced delay and emissions;
- Minimal motorist and non-motorist conflicts and collisions; and
- An opportunity for aesthetic improvements.

A number of considerations should be made prior to the implementation of a roundabout at a collector to collector intersection. These considerations can include the context of the intersection location, the appropriate analysis (i.e., operational versus safety), property and right-of-way requirements and economics. **Figure 7.2** and **7.3** illustrate roundabout installations in Vancouver, BC and West Fargo, ND. For comparative purposes, **Figure 7.4** illustrates an aerial view of a large traffic circle in Washington, DC.

Based on MMM's report for the City of Fargo in 2005, *17th Avenue South Traffic Calming Study*, the adjusted estimated cost for a roundabout at an existing intersection is approximately $300,000. This cost estimate includes contingencies but does not include land acquisition, engineering, or utility costs. Also, this cost estimate does not include savings due to collision reduction attributed to the safety benefits of the roundabout.

Figure 7.2: Roundabout in Vancouver, BC

Figure 7.3: Roundabout in West Fargo, ND

Figure 7.4: Aerial View of a Traffic Circle in Washington, DC

7.1.4 Geometric Modifications

Geometric modifications to an intersection can have significant impacts on operations and safety. Examples include:

- Incorporating geometric design solutions that:
    - Separate through and turning movements at the intersection such as dedicated right-turn lanes and right-turn cut-offs as shown in **Figure 7.5**. The estimated costs for right-turn lanes or cut-offs are in the range of approximately $25,000 to $50,000 based on 2007 City of Winnipeg unit cost rates for local residential street road works. This does not include land acquisition, utility or engineering costs.
    - Restrict or eliminate turning maneuvers. Examples of this include prohibiting left-turn movements during peak hours or on a permanent basis. This modification requires signage and costs are estimated at approximately $1,000 based on the cost estimate provided by the City of Grand Forks Engineering Department for stop sign installation.

- Close or relocate intersections to increase capacity and reduce the frequency and severity of intersection collisions.
- Create dedicated turning lanes as shown in **Figure 7.6**. A dedicated left-turn lane can increase intersection capacity by eliminating queuing of through and right-turning traffic behind left-turning vehicles. The estimated cost for restriping an existing intersection to delineate a dedicated left-turn is approximately $2,000 based on 2007 City of Winnipeg unit cost rates for local residential street road works. This does not include land acquisition, utility or engineering costs.

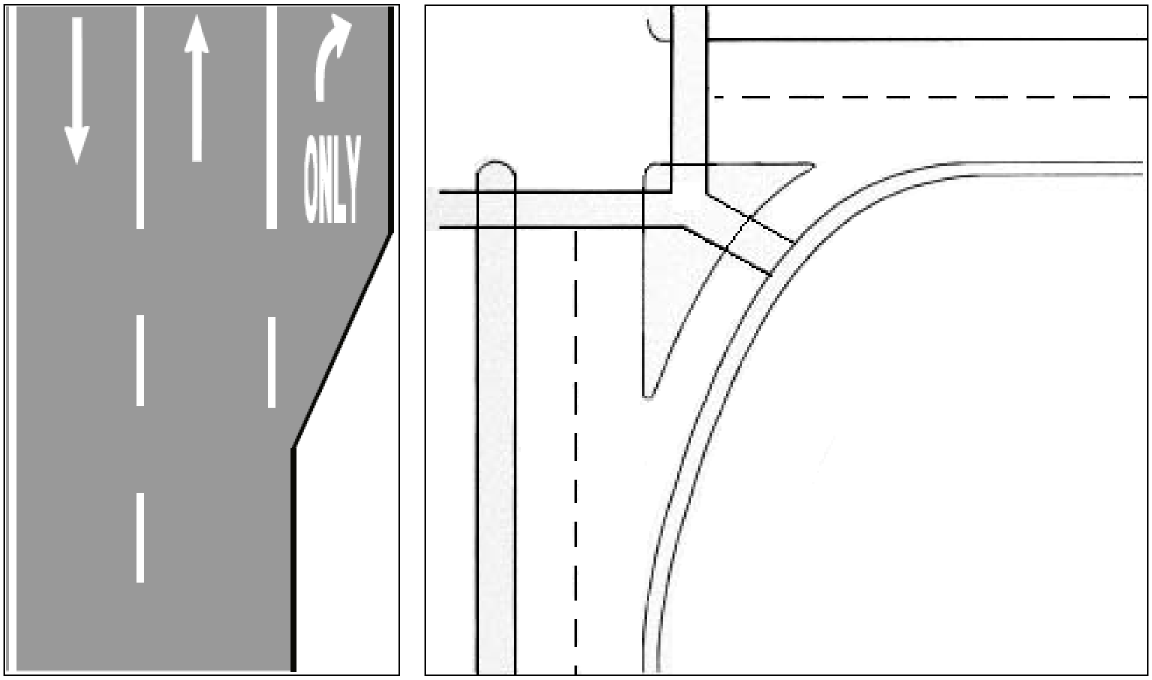


Figure 7.5: Dedicated Right-turn Lane (left) and Right-turn Cut-off (right)

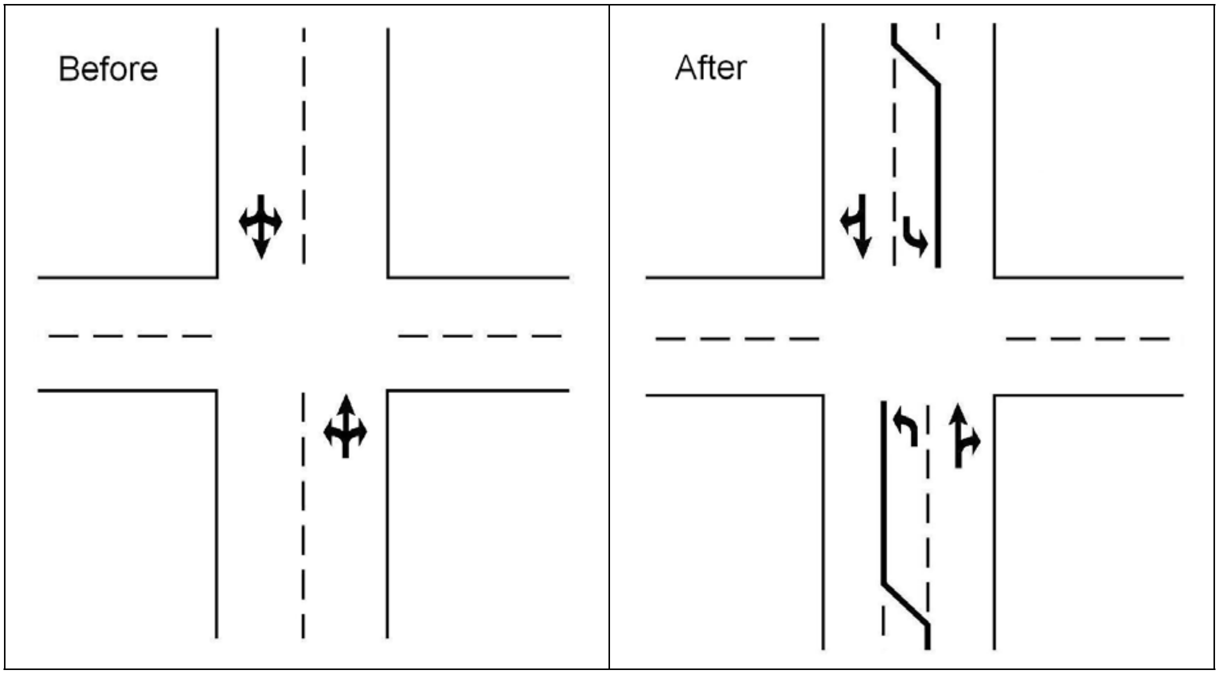


Figure 7.6: Lane Restriping to Delineate a Dedicated Left-turn Lane

- Improving access management near signalized intersections and thus reducing the workload and confusion for the driver. The presence of driveway access at or near an intersection may create additional vehicle-vehicle conflicts. Measures to restrict driveways and to preclude cross-median turning movements in close proximity to intersections, particularly signalized, can effectively reduce or eliminate vehicle conflicts.
- Improving safety through other infrastructure treatments can decrease frequency and severity of collisions at intersections. These measures may include improving pavement conditions, coordinating operation of signals near railroad crossings, and moving traffic signal hardware (if in place) out of the clear zone.

7.1.5 Traffic Control Comparison

The various traffic controls were compared for each of the study intersections. NDDOT's Roadway Design Manual utilizes MUTCD warrants as criteria for installation of traffic signals or stop sign controls. Using the forecast 2035 traffic volumes at each intersection, criteria were tested in order to determine which, if any, of the traffic control options are feasible.

As well as maintaining the existing traffic controls, various options were evaluated primarily from a traffic operations perspective. Once suitable traffic control options were determined from an operations perspective, other factors such as cost, collision mitigation and property requirements were considered. The method of comparing each factor is as follows:

- Warrant Analysis: Is the traffic control warranted by MUTCD standards? This includes all-way stop and traffic signals warrants. Warrant analysis is not performed for roundabouts or geometric modifications. However, if the warrant for traffic signals is met, a roundabout will then be considered warranted.
- 2035 LOS: What is the forecast LOS for the intersection in 2035 with the current traffic control and following implementation of revised traffic control (if applicable)?
- Construction Cost: Is the cost of installing the traffic control low, medium or high? This cost estimate includes construction, maintenance costs and utility relocations if required.
- Property Requirements: Will the traffic control have a low, medium or high impact on adjacent lands and development and require property acquisition costs by the City?
- Collision Mitigation: Will the traffic control have a neutral, negative or positive effect on collisions at the intersection?

An Intersection Control Evaluation (ICE) procedure was developed for the City of Grand Forks to provide guidance in the selection of possible collector intersection traffic control options based on daily traffic volumes. The process was based on the Minnesota Department of Transportation's (MnDOT) Technical Memorandum No. 07-02-T-01. The MnDOT ICE technical memorandum states that the purpose of developing an ICE procedure is to determine the optimal control for an intersection based on an objective analysis for the existing conditions and future needs.

Based on a previous MMM survey of numerous jurisdictions, including the cities of Winnipeg, Fargo, Regina and the municipality of Anchorage, typical engineering design standards for collector roadway traffic volumes range from 1,000 to 20,000 vehicles per day. For example, the City of Fargo design standard traffic volumes for a collector roadway are from 5,000 to 10,000 vehicles per day whereas the City of Regina utilizes a range from 7,500 to 20,000 vehicles per day. Further, the average ADT of the roadways examined as part of this study is 8,400 vehicles per day. Therefore, the MnDOT ICE thresholds were modified to apply to Grand Forks intersections with a minimum of 5,000 and a maximum of 25,000 vehicles per day travelling through the intersection. The modification to 5,000 and 25,000 vehicles per day was adopted to reflect:

- The larger population base in Minnesota and potentially higher traffic volumes, which may not be reflective of collector traffic levels in Grand Forks. This is reflected in the fact that when applying the MnDOT traffic levels to screen collector intersections in this study, nine of the 13 fell below the 7,500 vehicle per day level applied by MnDOT.

- Collector volume guidelines vary by jurisdiction; a two-lane collector is typically considered to carry from 1,000 to 5,000 or more vehicles per day, therefore threshold levels for volumes at the intersection of two collector intersections can also vary significantly.
- A 'typical' collector street volume for a two-lane roadway of 2,500 vehicles per day could be considered as being average for two-lane collectors. This led to a total of 5,000 vehicles per day for a collector to collector intersection.

Table 7.2 summarizes collector intersection control types for evaluation based on entering average daily traffic (ADT).

Table 7.2: Collector Intersection Control Types for Evaluation Based on Entering ADT

Intersection ADT	All Way Stop	Traffic Signal	Roundabout	Access Management Treatments
5,000 – 7,500	■		■	■
7,500 – 25,000	■	■	■	■

The following general procedures are recommended for determining control evaluation for collector to collector intersections in Grand Forks. The procedures are based on the MnDOT ICE, data and feedback accumulated over the course of this study and information received from other jurisdictions.

The ICE process for collector intersections with an approximate ADT between 5,000 and 7,500 vehicles per day is shown in **Figure 7.7**. The intersection should first be analyzed using appropriate traffic modeling software (e.g. Synchro, SIDRA) to determine the peak hour level of service (LOS) for a two-way stop sign control on the major roadway. If the peak hour level of service for the intersection is D or better, installation of a two-way stop may be sufficient traffic control.

However, if the peak hour LOS is E or F, warrant analysis for an all-way stop should be reviewed. If the warrant for all-way stop sign control is not met, access management or geometric modifications to the intersection to improve LOS should be considered as an alternative solution. If the intersection warrants an all-way stop, a modern roundabout should be analyzed to determine its feasibility with respect to level of service, costs and right-of-way. If a modern roundabout is infeasible, an all-way stop sign control should be considered. However, if a modern roundabout is feasible it should be determined whether or not the roundabout will be publicly and administratively supported as well as compatible with the neighborhood. If it is not supported and compatible, an all-way stop sign control should be considered. If it is supported and compatible, a modern roundabout should be considered as a solution.

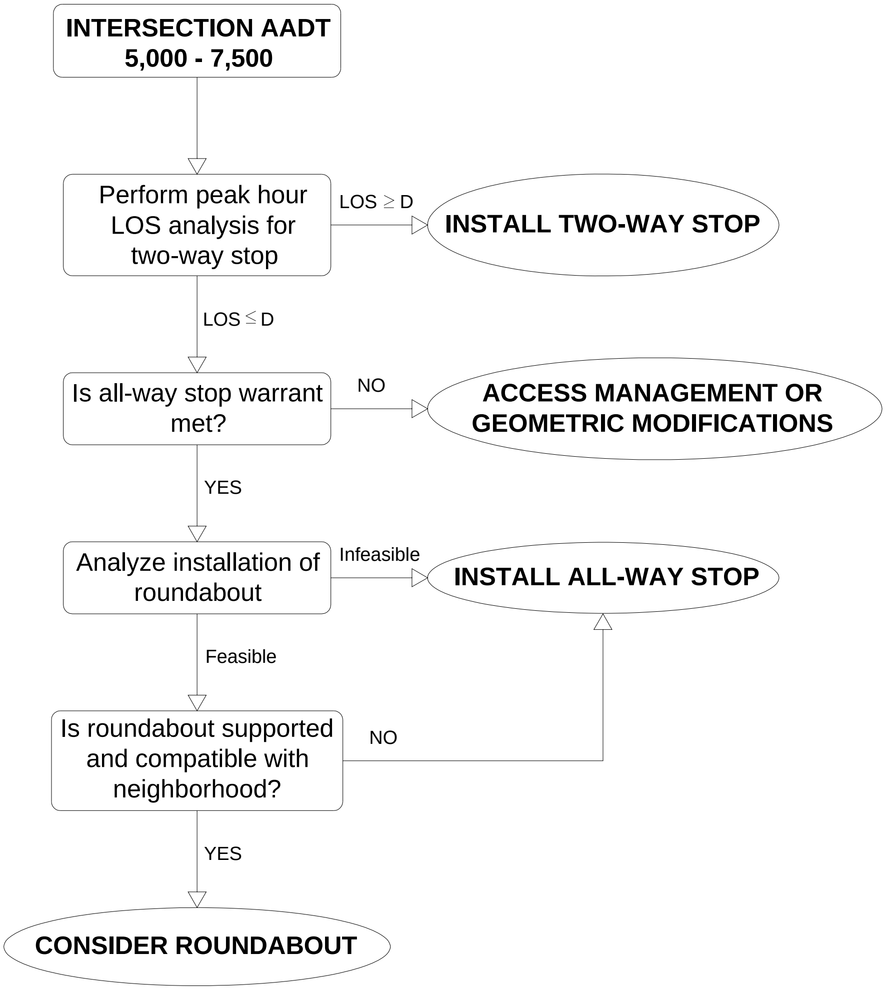


Figure 7.7: ICE Process for Intersection ADT = 5,000 to 7,500 Vehicles per Day

As shown in **Figure 7.8**, for intersections with a combined ADT of greater than 7,500 vehicles per day, the first question to be asked is whether or not traffic signal warrants are met. If not, then the process outlined for intersections with 5,000 and 7,500 vehicles per day, shown in **Figure 7.7**, should be followed. If the traffic signal warrant is met, the intersection should be examined in relation to neighboring traffic control measures. In particular, is there sufficient spacing between traffic signals or is coordination feasible should a traffic signal be installed at this intersection. If either of these conditions are not met, access management or geometric modifications should be examined to determine if they are a sufficient solution. If access management or geometric modifications are sufficient to improve LOS to acceptable levels then they should be considered.

Prior to installing a traffic signal, if intersection spacing or coordination efforts can be achieved, it should be determined whether the traffic signal is compatible with the neighborhood. Traffic signals may not be compatible in neighborhoods for a variety of reasons, such as aesthetics, light pollution, noise pollution (from audible pedestrian signals) and other unwanted neighborhood intrusions. If traffic signals are compatible with the neighborhood, it should be determined whether or not alternatives to a signal would be acceptable to both the public and the agency. If not, the installation of a traffic signal should be considered.

If alternatives may be acceptable, then it should be determined if the intersection meets warrants for all-way stop sign control. If the intersection does not meet all-way stop warrants, access management or geometric modifications may be sufficient. However, if access management or geometric modifications are insufficient, a modern roundabout should be analyzed to determine its feasibility with respect to level of service, costs and right-of-way. If a modern roundabout is infeasible, an all-way stop sign control should be considered. However, if a modern roundabout is feasible it should be determined whether or not the roundabout will be publicly and administratively supported as well as compatible with the neighborhood. If it is not supported and compatible, an all-way stop sign control should be considered. If it is supported and compatible, a modern roundabout should be considered as a solution.

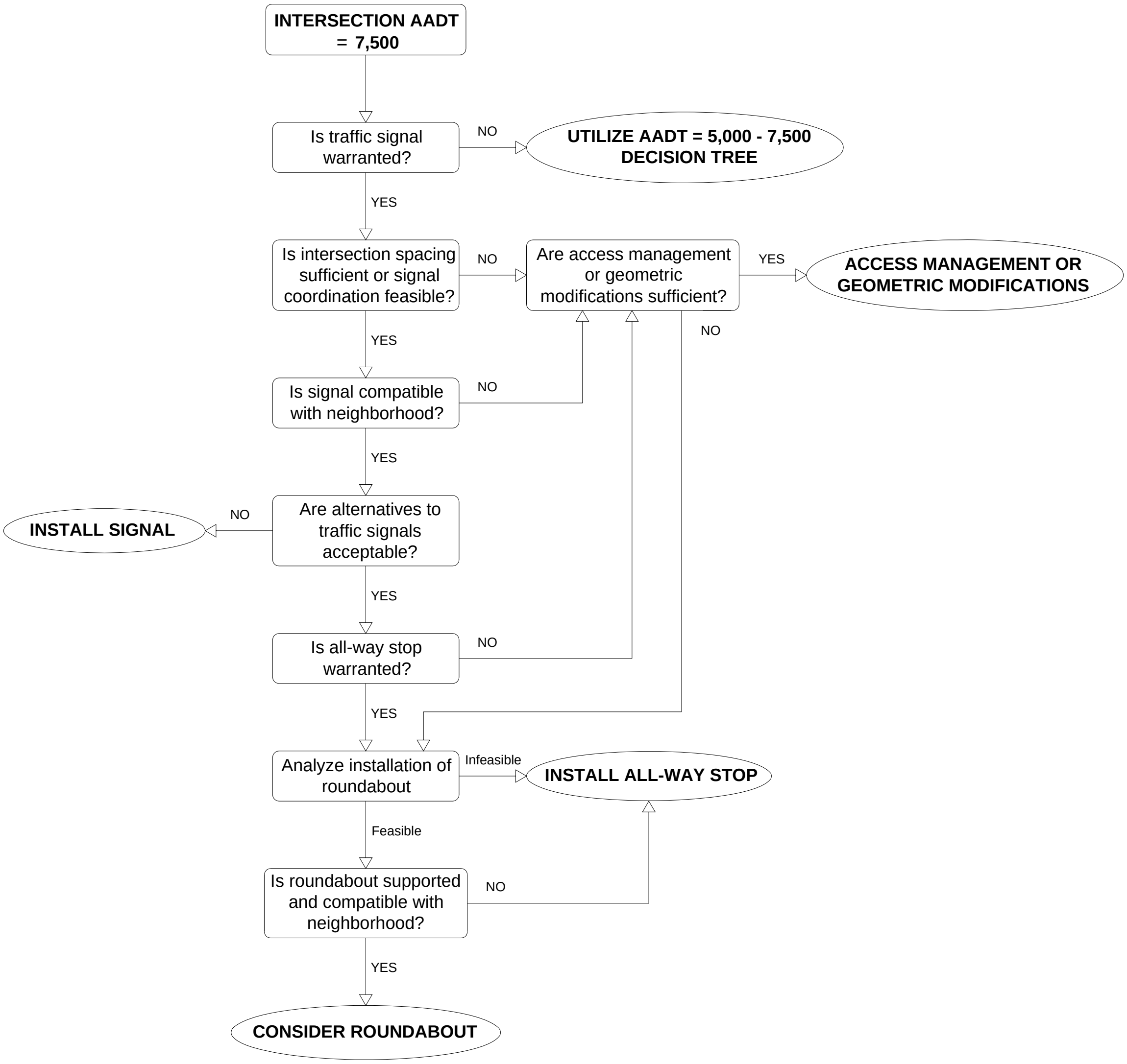


Figure 7.8: ICE Process for Intersection ADT ≥ 7,500 Vehicles per Day

The minimum vehicles per day threshold is not met for one of the study intersections (as noted with a '-' in the table), in part due to the fact that 8th Avenue North and 20th Street North operates as two offset 'T' intersections.

In addition to the above, any intersection in which the overall intersection (or individual movement) LOS was D or lower was also examined in greater detail. All of the forecast intersection LOS levels were C or better, but in some cases, individual movements were forecast to operate at LOS D, E or F. The target LOS is C or better for peak hour conditions. Using forecast 2035 traffic volumes, the suggested traffic controls are summarized in **Table 7.3**.

Table 7.3: Summary of Traffic Control Options for Study Intersections

Intersection	Approx Combined ADT	All Way Stop	Traffic Signal	Roundabout	Access Management Treatments
6th Ave N and Stanford Rd	11,300	■	■	■	■
8th Ave N and 20th St N (N)	4,400	-	-	-	-
8th Ave N and 20th St N (S)	4,500	-	-	-	-
11th Ave S and S 34th St	7,300	■	-	■	■
13th Ave S and S 20th St	11,900	■	■	■	■
40th Ave S and S 20th St	6,800	■	-	■	■
8th Ave S and Cherry St	5,300	■	-	■	■
13th Ave S and Cherry St	7,400	■	-	■	■
24th Ave S and Cherry St	8,100	■	■	■	■
40th Ave S and Cherry St	7,200	■	-	■	■
55th Ave S and Cherry St	5,700	■	-	■	■
24th Ave S and S 34th St (NW)	14,000	■	■	■	■
24th Ave S and S 34th St (SE)	18,200	■	■	■	■
Ruemmele Rd and S 34th St (SE)	5,700	■	-	■	■

7.2 Intersections Requiring Traffic Control Modifications

7.2.1 6th Avenue North and Stanford Road

The intersection of 6th Avenue North and Stanford Road, as described in **Section 3.1**, is currently controlled by all-way stop signs. The intersection currently operates at LOS B and is forecast to operate at LOS C in 2035. The westbound through and right-turn movements are the critical movements for the intersection in 2035 and are forecast to operate at LOS D.

The intersection experiences high traffic volumes during the morning and afternoon peak periods due to the adjacent schools and residences. Of primary concern is the Lake Agassiz Elementary School located on the northwest corner of the intersection. Safety concerns with respect to the pedestrian crossings in the area have been raised by the school. However, school administration has indicated that remedial works are planned for the summer of 2008 which may alleviate some of the existing school-related traffic congestion issues.

Forecast 2035 peak hour traffic and pedestrian volumes at this intersection warrant traffic signal installation according to MUTCD standards. Traffic signals could provide a safer environment for school children and pedestrian crossings by allowing for orderly traffic flow and crossing movements. However, should traffic signals be deemed undesirable, the installation of a roundabout, as shown in **Figure 7.9**, with proper pedestrian crossings is also possible for this location. The plan shown in **Figure 7.9** is conceptual, and more detailed functional design plans would need to be prepared to determine the feasibility of a roundabout at this location. Items that would need to be considered are a driveway on Stanford Road in the northeast quadrant, which would require the splitter island to be shortened, modifications to the parking lot in the northwest quadrant, and potential right-of-way constraints in the northeast quadrant. This could potentially be addressed by adjusting the size of the center island, if operationally feasible, and shifting the roundabout to the west to minimize the impact on the residential property, with additional lands then required from the school and UND sites. Also, the high pedestrian volumes associated with this location would require detailed analysis and design to be properly and safely accommodated.

Operational analysis of the roundabout was performed using SIDRA software based on the forecast traffic volumes, roundabout geometry, posted speeds and other intersection characteristics. As well, AutoTURN software was utilized to model heavy vehicle maneuvering through the roundabout. The Grand Forks city bus fleet includes 30 foot and 35 foot long buses. The roundabout shown in **Figure 7.9** was designed to accommodate a 40 foot long city transit bus for all movements. Since the roundabout can accommodate a city transit bus, it can also accommodate a fire truck which has smaller turning movements. The roundabout shown cannot accommodate left-turns or u-turns by a truck larger than a WB-50, which measures approximately 50 feet from the front tractor axle to the rear trailer axle. It should be noted that heavy trucks should not be traveling on collector roadways except for an occasional moving truck.

Geometric modifications to the westbound approach to include a right-turn lane may improve traffic operations. However, right-of-way is limited and installation of a right-turn lane would encroach on the existing boulevard and require removal of a mature tree. **Table 7.3** compares the traffic control options at 6th Avenue North and Stanford Road.

Table 7.4: 6th Avenue North and Stanford Road Traffic Control Comparison

Traffic Control	Warrant	2035 LOS	Cost	Property Requirements	Collision Mitigation
All-way Stop	Existing	C	Low	None	Neutral
Traffic Signals	Warranted	B	High	Low	Negative
Roundabout	Warranted	A	High	High	Positive
Geometric Modifications	N/A	B	Medium	Medium	Positive

Modeling of the proposed traffic control options, shown in **Table 7.4**, returned improved LOS in all three cases for year 2035 traffic volumes. Installation of traffic signals improves the LOS to A while the addition of a right-turn lane and installation of a roundabout improves the forecast LOS to B.

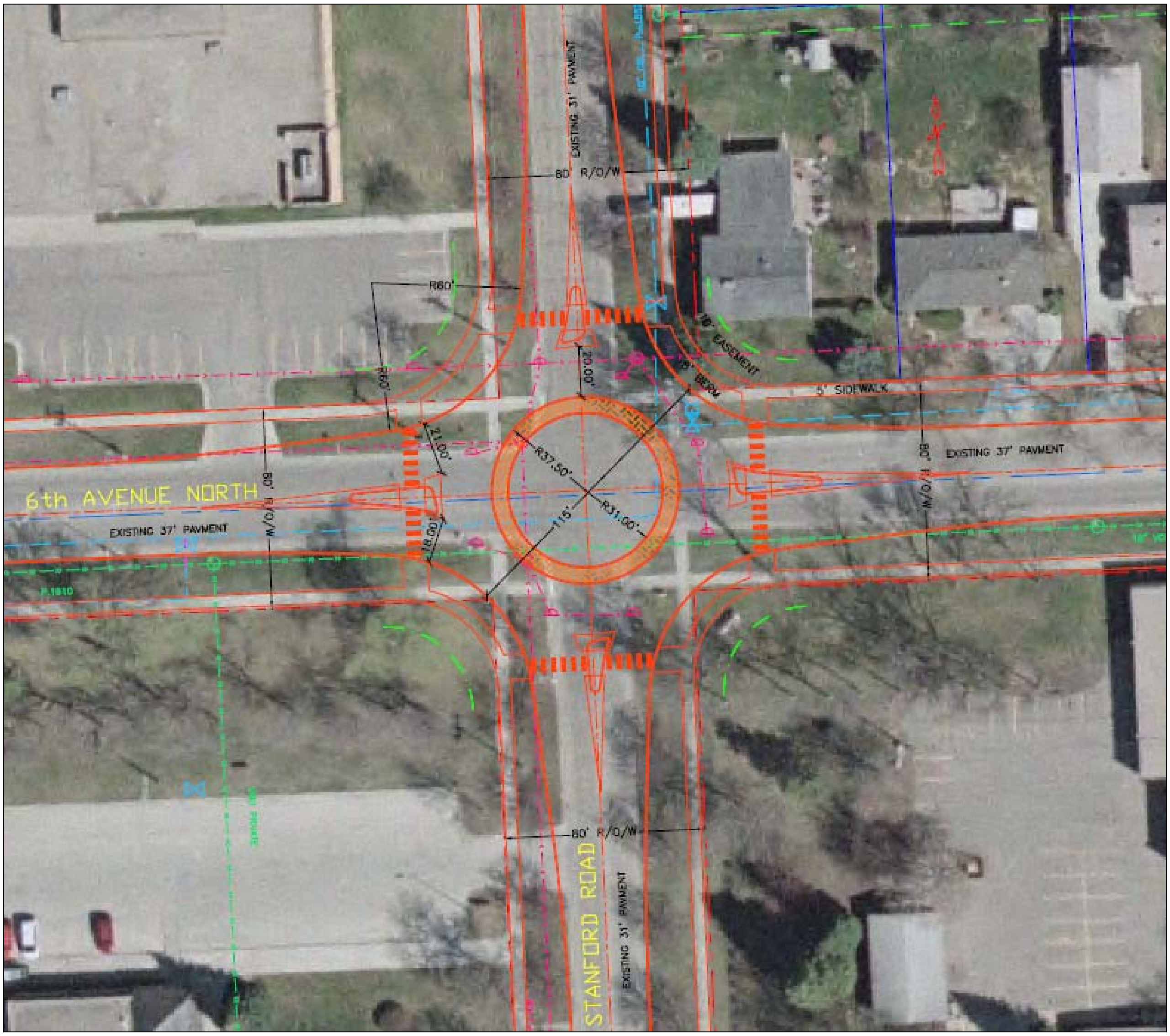


Figure 7.9: Conceptual Roundabout at 6th Avenue North & Stanford Road

7.2.2 13th Avenue South and South 20th Street

The intersection of 13th Avenue South and South 20th Street, as described in **Section 3.5**, is an intersection currently controlled by all-way stop signs. The intersection currently operates at LOS B and is forecast to operate at LOS C in 2035. The forecast critical movements in 2035 are southbound left-turn, right-turn and through movements operating at LOS C.

Forecast peak hour traffic volumes at this intersection warrant traffic signal installation according to MUTCD standards, although an acceptable LOS is maintained with all-way stop sign control. This also suggests that a roundabout may be an option to signals. The intersection can accommodate the installation of a roundabout at this location. However, a roundabout, as shown in **Figure 7.8**, would require significant existing residential property and conflicts with existing private approaches; mainly the private approach on the north leg of the intersection. Property impacts could potentially be mitigated by examining the feasibility of alternate sized center islands. Installation of traffic signals would not impact the north private approach; however a roundabout would require relocation of the driveway.

Operational analysis of the roundabout was performed using SIDRA software based on the forecast traffic volumes, roundabout geometry, posted speeds and other intersection characteristics. As well, AutoTURN software was utilized to model heavy vehicle maneuvering through the roundabout. The Grand Forks city bus fleet includes 30 foot and 35 foot long buses. The roundabout shown in **Figure 7.10** was designed to accommodate a 40 foot long city transit bus for all movements. Since the roundabout can accommodate a city transit bus, it can also accommodate a fire truck which has smaller turning movements. The roundabout shown cannot accommodate left-turns or u-turns by a truck larger than a WB-50, which measures approximately 50 feet from the front tractor axle to the rear trailer axle. It should be noted that heavy trucks should not be traveling on collector roadways, except for the occasional moving truck.

Due to the heavy forecast through traffic in the north and southbound directions, geometric modifications to the north and southbound approaches to include dedicated right-turn lanes do not improve traffic operations. This modification would also involve considerable residential right-of-way and thus was not pursued further. **Table 7.5** compares the traffic control options at 13th Avenue South and South 20th Street.

Table 7.5: 13th Avenue South and South 20th Street Traffic Control Comparison

Traffic Control	Warrant	2035 LOS	Cost	Property Requirements	Collision Mitigation
All-way Stop	Existing	C	Low	None	Neutral
Traffic Signals	Warranted	A	High	Low	Negative
Roundabout	Warranted	A	High	High	Positive

For the forecast peak hour traffic volumes at 13th Avenue South and South 20th Street, LOS is improved by traffic signal installation from C to A. Installation of a roundabout at this location results in a forecast LOS A.

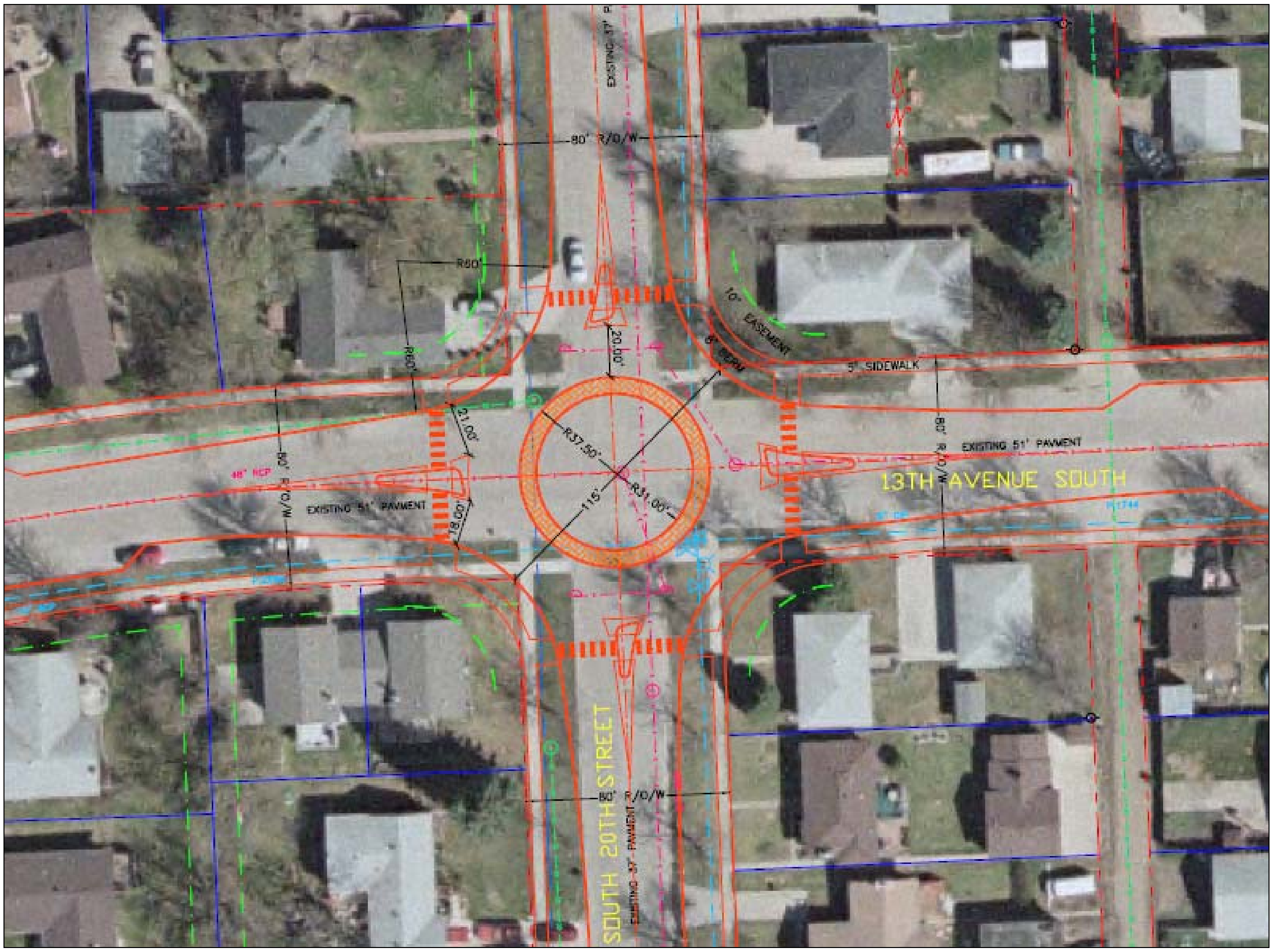


Figure 7.10: Conceptual Roundabout at 13th Avenue South & South 20th Street

7.2.3 24th Avenue South and South 34th Street (Northwest Intersection)

The northwest intersection of 24th Avenue South and South 34th Street, as described in **Section 3.7**, is a "T" intersection currently controlled by a stop sign on 24th Avenue South. The intersection currently operates at LOS A and is forecast to operate at LOS A in 2035. However, eastbound left and right-turn movements are the critical movements for the intersection in 2035 and are forecast to operate at LOS F.

All-way stop and traffic signal warrants are met by forecast peak hour traffic volumes at this intersection according to MUTCD standards. This also suggests that a roundabout may be an option at this location, as shown in **Figure 7.11**. The impact on the east side of the intersection could be mitigated by shifting the roundabout to the southwest. Alternatively, modified center island dimensions may be used should it be desirable to further reduce the right-of-way requirements. **Table 7.6** compares the traffic control options at 24th Avenue South and South 34th Street (NW).

Operational analysis of the roundabout was performed using SIDRA software based on the forecast traffic volumes, roundabout geometry, posted speeds and other intersection characteristics. As well, AutoTURN software was utilized to model heavy vehicle maneuvering through the roundabout. The roundabout shown in **Figure 7.11** was designed to accommodate all movements of WB-62 trucks, which measure approximately 62 feet from the front tractor axle to the rear trailer axle. It should be noted that heavy trucks should not be traveling on collector roadways, except for the occasional moving truck.

Due to the low daily traffic volumes (two per day) accessing the property to the east of the intersection, a fully diverted splitter island is not needed. A conventional driveway/service access is possible, which would reduce the on-site impact of the roundabout.

Table 7.6: 24th Avenue South and South 34th Street (NW) Traffic Control Comparison

Traffic Control	Warrant	2035 LOS	Cost	Property Requirements	Collision Mitigation
One-way Stop	Existing	A	Low	None	Neutral
All-way Stop	Warranted	C	Low	Low	Neutral
Traffic Signals	Warranted	A	High	Low	Neutral
Roundabout	Warranted	A	High	Medium	Positive

Installation of an all-way stop at the intersection of 24th Avenue South and South 34th Street (NW) results in LOS C in 2035. The installation of an all-way stop improves the eastbound left and right-turn movements from LOS F to LOS B. However, under this scenario, the critical movement becomes the southbound through and right-turn traffic which operates at LOS D. Traffic signal installation is forecast to provide overall intersection and all movement LOS A. Installation of a roundabout also improves the overall intersection and all movement to LOS A for this location in 2035.

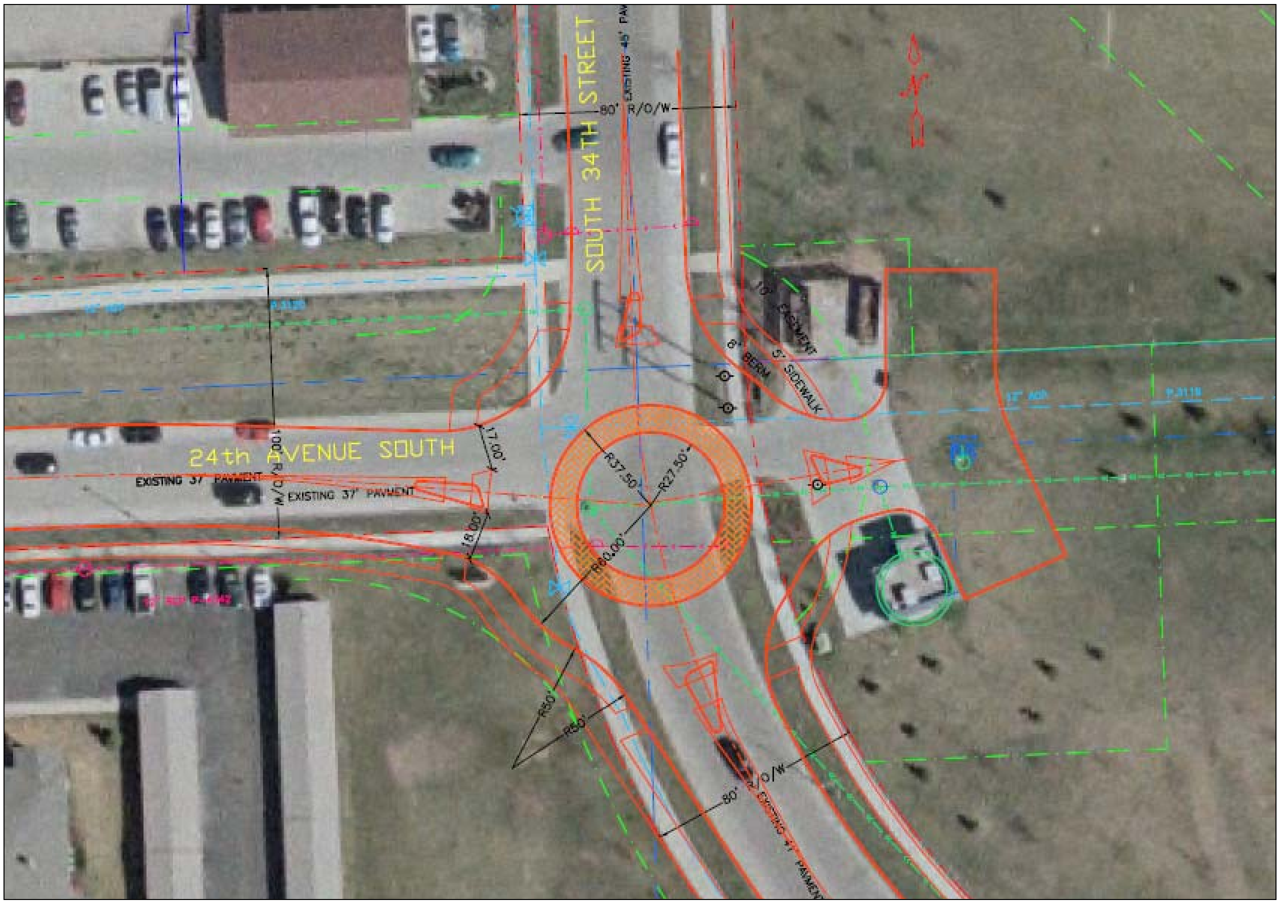


Figure 7.11: Conceptual Roundabout at 24th Avenue South & South 34th Street (NW)

7.2.4 24th Avenue South and South 34th Street (Southeast Intersection)

The southeast intersection of 24th Avenue South and South 34th Street, as described in **Section 3.8**, is an intersection currently controlled by a stop sign on South 34th Street. The intersection currently operates at LOS A and is forecast to operate at LOS C in 2035. The eastbound left-turn movement is the critical movement for the intersection in 2035 and is forecast to operate at LOS F.

Forecast peak hour traffic volumes at this intersection warrant all-way stop sign and traffic signal installation according to MUTCD standards. This also suggests that a roundabout may be an option to signals. The current long range transportation plan for the intersection includes installation of a roundabout, similar to the one shown in **Figure 7.12**. **Table 7.7** compares the traffic control options at 24th Avenue South and South 34th Street (SE).

Operational analysis of the roundabout was performed using SIDRA software based on the forecast traffic volumes, roundabout geometry, posted speeds and other intersection characteristics. As well, AutoTURN software was utilized to model heavy vehicle maneuvering through the roundabout. The roundabout shown in **Figure 7.12** was designed to accommodate all movements of a WB-62 truck, which measures approximately 62 feet from the front tractor axle to the rear trailer axle. It should be noted that heavy trucks should not be traveling on collector roadways, except for the occasional moving truck.

Table 7.7: 24th Avenue South and South 34th Street (SE) Traffic Control Comparison

Traffic Control	Warrant	2035 LOS	Cost	Property Requirements	Collision Mitigation
One-way Stop	Existing	C	Low	None	Neutral
All-way Stop	Warranted	D	Low	Low	Neutral
Traffic Signals	Warranted	A	High	Low	Negative
Roundabout	Warranted	A	High	Low	Positive

Installation of all-way stop sign traffic control at the intersection of 24th Avenue South and South 34th Street (SE) results in LOS C in 2035. The installation of an all-way stop improves the eastbound left-turn movement from LOS F to LOS D. Traffic signal installation is forecast to provide an intersection LOS A. Installation of a roundabout is forecast to provide overall LOS A for this location in 2035, as well as for all movements. The forecast year LOS is based on a fourth leg being added to the intersection to serve possible future development on the east side of 24th Avenue South and South 34th Street.

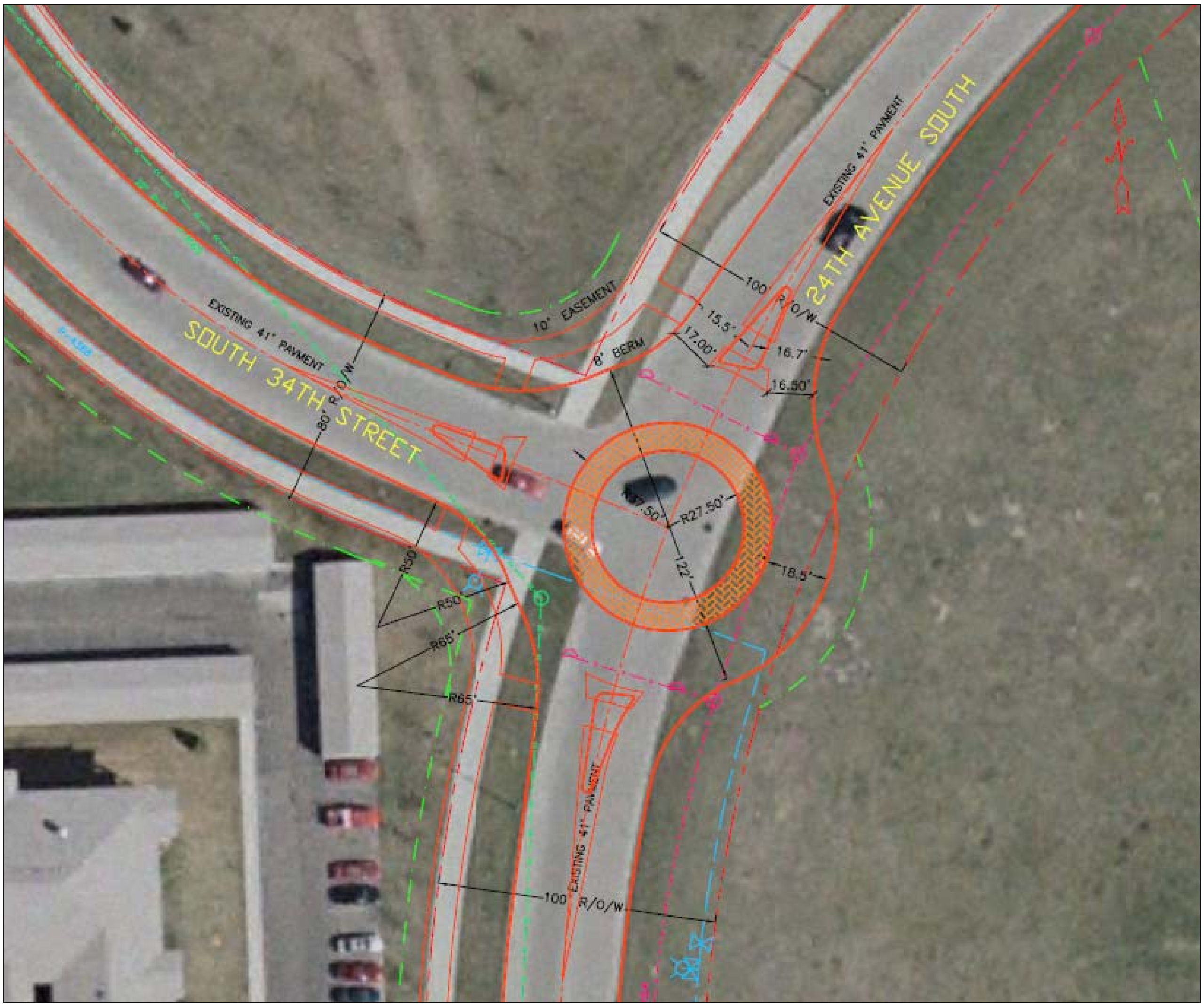


Figure 7.12: Conceptual Roundabout at 24th Avenue South & South 34th Street (SE)

7.3 Intersections Not Requiring Traffic Control Modifications

7.3.1 8th Avenue North and 20th Street North

The intersection of 8th Avenue North and 20th Street North, as described in **Section 3.2**, is an offset intersection currently controlled by two-way stop signs on 8th Avenue North. The intersection currently operates at LOS A and is forecast to operate at LOS A in 2035. The forecast critical movements at this location are westbound left and right-turn movements, operating at LOS B in 2035.

Forecast peak hour traffic volumes at this intersection do not warrant all-way stop sign or traffic signal installation according to MUTCD standards. A roundabout or geometric modifications are not warranted and would require significant property acquisition.

No changes are required at this location based on the forecast traffic volumes.

7.3.2 8th Avenue South and Cherry Street

The intersection of 8th Avenue North and Cherry Street, as described in **Section 3.3**, is an intersection currently controlled by two-way stop signs on 8th Avenue South. The intersection currently operates at LOS A and is forecast to operate at LOS A in 2035. The forecast critical movements at this location are the eastbound left-turn, right-turn and through movements, operating at LOS B in 2035.

Forecast peak hour traffic volumes at this intersection do not warrant all-way stop sign or traffic signal installation according to MUTCD standards. A roundabout or geometric modifications are not warranted and would require significant property acquisition.

No changes are required at this location based on the forecast traffic volumes.

7.3.3 11th Avenue South and South 34th Street

The intersection of 11th Avenue South and South 34th Street, as described in **Section 3.4**, is an intersection currently controlled by two-way stop signs on 11th Avenue South. The intersection currently operates at LOS A and is forecast to operate at LOS A in 2035. The forecast critical movements at this location are the eastbound left-turn, right-turn and through movements, operating at LOS C in 2035.

Forecast peak hour traffic volumes at this intersection do not warrant all-way stop sign or traffic signal installation according to MUTCD standards. A roundabout or geometric modifications are not warranted and would require additional property (although this location may accommodate a roundabout if future conditions change).

No changes are required at this location based on the forecast traffic volumes.

7.3.4 13th Avenue South and Cherry Street

The intersection of 13th Avenue South and Cherry Street, as described in **Section 3.6**, is an intersection currently controlled by all-way stop signs. The intersection currently operates at LOS B and is forecast to operate at LOS B in 2035. The forecast critical movements in 2035 are southbound left-turn, right-turn and through movements operating at LOS B.

Forecast peak hour traffic volumes at this intersection do not warrant traffic signal installation according to MUTCD standards. A roundabout or geometric modifications are not warranted and would require significant existing residential property.

No changes are required at this location based on the forecast traffic volumes.

7.3.5 24th Avenue South and Cherry Street

The intersection of 24th Avenue South and Cherry Street, as described in **Section 3.9**, is an intersection currently controlled by all-way stop signs. The intersection currently operates at LOS A and is forecast to operate at LOS B in 2035. The southbound through, right-turn and left-turn movements are the critical movements for the intersection in 2035 and are forecast to operate at LOS B. Cherry Street between 17th Avenue South and 25th Avenue South is scheduled for reconstruction in 2009.

Forecast peak hour traffic volumes at this intersection do not warrant traffic signal installation according to MUTCD standards. Installation of a roundabout would require significant existing property surrounding the intersection.

No changes are required at this location based on the forecast traffic volumes.

7.3.6 Ruemmele Road and South 34th Street

The intersection of Ruemmele Road and South 34th Street, as described in **Section 3.10**, is planned to be controlled by two-way stop signs on Ruemmele Road. The intersection currently operates at LOS A and is forecast to operate at LOS A in 2035. The westbound through, right-turn and left-turn movements are the critical movements for the intersection in 2035 and are forecast to operate at LOS C.

Forecast peak hour traffic volumes at this intersection do not warrant traffic signal installation according to MUTCD standards. Due to the undeveloped nature of the surrounding land, installation of a roundabout is possible at this location; however, it is not needed for traffic operational purposes based on the forecast volumes.

No changes are required at this location based on the forecast traffic volumes.

7.3.7 40th Avenue South and South 20th Street

The intersection of 40th Avenue South and South 20th Street, as described in **Section 3.11**, is currently controlled by all-way stop signs. The intersection currently operates at LOS A and is forecast to operate at LOS A in 2035.   The westbound through, right-turn and left-turn movements are the critical movements for the intersection in 2035 and are forecast to operate at LOS A.

Forecast peak hour traffic volumes at this intersection do not warrant traffic signal installation according to MUTCD standards. Due to the undeveloped nature of the surrounding land, installation of a roundabout is possible at this location; however, it is not needed for traffic operational purposes based on the forecast volumes.

No changes are required at this location based on the forecast traffic volumes.

7.3.8 40th Avenue South and Cherry Street

The intersection of 40th Avenue South and Cherry Street, as described in **Section 3.12**, is currently controlled by two-way stop signs on 40th Avenue South. The intersection currently operates at LOS A and is forecast to operate at LOS A in 2035. The southbound through, right-turn and left-turn movements are the critical movements for the intersection in 2035 and are forecast to operate at LOS A.

Forecast peak hour traffic volumes at this intersection do not warrant traffic signal installation according to MUTCD standards. Installation of a roundabout would require existing property surrounding the intersection.

No changes are required at this location based on the forecast traffic volumes.

7.3.9 55th Avenue South and Cherry Street

The intersection of 55th Avenue South and Cherry Street, as described in **Section 3.13**, is currently controlled by all-way stop signs. The intersection currently operates at LOS A and is forecast to operate at OS A in 2035. The southbound through, right-turn and left-turn movements are the critical movements for the intersection in 2035 and are forecast to operate at LOS A.

Forecast peak hour traffic volumes at this intersection do not warrant traffic signal installation according to MUTCD standards. Due to the undeveloped nature of the surrounding land, installation of a roundabout is possible at this location; however, it is not needed for traffic operational purposes based on the forecast volumes.

No changes are required at this location based on the forecast traffic volumes.

8.0 CONCLUSIONS

8.1 Environmental Scan

An extensive literature review and environmental scan was completed as part of this study. This included telephone interviews, a telephone survey of various municipal / state departments / agencies, and a literature review to assist in determining appropriate conventions concerning the treatment of collector to collector intersections for Grand Forks. The following documents were reviewed:

- The U.S. Department of Transportation's Manual on Uniform Traffic Control Devices (**Section 2.1.1**);
- The North Dakota Department of Transportation Design Manual (**Section 2.1.2**);
- The Minnesota Department of Transportation's MUTCD (**Section 2.1.3**);
- The Minnesota Department of Transportation's Traffic Engineering Manual (**Section 2.1.4**);
- The U.S. Department of Transportation's Federal Highway Administration Technical Report – Roundabouts: An Informal Guide (**Section 2.1.5**);
- The Transportation Research Board's National Cooperative Highway Research Program Report 572 – Roundabouts in the United States (**Section 2.1.6**);
- The Minnesota Department of Transportation's State Aid Roundabout Guide (**Section 2.1.7**); and
- The Minnesota Department of Transportation's Intersection Control Evaluation Guidelines for Implementation (**Section 2.1.8**).

The MUTCD warrants and Minnesota Department of Transportation Intersection Control Evaluation Guidelines were the primary tools utilized in the traffic control analysis for each intersection.

The following local authorities were interviewed via telephone to obtain their respective opinions:

- The Grand Forks Fire Department (**Section 2.2.1**);
- The Grand Forks Police Service (**Section 2.2.2**);
- The City of Grand Forks Public Works Department (**Section 2.2.3**);
- The City of Grand Forks Engineering Department (**Section 2.2.4**);
- The Lake Agassiz Elementary School located at the intersection of 6th Avenue North and Stanford Road (**Section 2.2.5**);

- The City of Brandon Engineering Department (**Section 2.2.6**); and
- The City of Brandon Fire and Emergency Services (**Section 2.2.7**).

Varying opinions were received from the Engineering, Police and Fire Departments contacted. The various Grand Forks departments favored the installation of traffic signals as opposed to all-way stop signs or roundabouts. However, with the exception of the Grand Forks Fire Department, the respondents felt that roundabouts would not cause concerns for maintenance or emergency response times. The City of Brandon, where roundabouts have been installed as an alternative to signals, has only received positive feedback from citizens, maintenance workers and emergency responders.

The following Engineering Departments were surveyed regarding their respective collector to collector traffic control policies:

- The City of Rapid City Traffic Engineering Department (**Section 2.3.1**);
- The City of Sioux Falls Traffic Engineering Department (**Section 2.3.2)**;
- The City of Bismarck Traffic Engineering Department (**Section 2.3.3**);
- The City of Fargo Traffic Engineering Department (**Section 2.3.4)**; and
- The City of Grand Rapids Traffic Engineering Department (**Section 2.3.5**).

The Engineering Departments reported no formal local or state policy dictating the implementation of collector to collector intersection traffic controls. Most departments base traffic control installation on traffic volumes. The City of Fargo Engineering Department has developed a policy for various intersection configurations. For collector to collector intersections, traffic control is dictated by volumes, sight distance, collisions and high pedestrian volumes (school or pedestrian crossing).

All of the Engineering Departments have received some degree of negative feedback with respect to traffic controls that have been implemented in their jurisdiction. This negative public reaction does not typically dictate future traffic control policy.

As well, all of the Engineering Departments, with the exception of Rapid City, analyze collision histories when considering intersection modifications at collector to collector intersections.

Rapid City, Sioux Falls, and Bismarck do not currently have roundabouts installed. However, roundabouts are being constructed in Sioux Falls and are proposed as part of a residential subdivision in Bismarck. The City of Fargo has two roundabouts in relatively low volume residential developments with another slated for construction in 2008. The City of Grand Rapids currently has two roundabouts installed; one operated by the County and the other by the City. The City's roundabout is located at an intersection of an urban collector and a local street. The City has noted positive improvements to traffic flow, access and costs while receiving requests from residents in other areas for the installation of a roundabout.

8.2 Existing and Projected Operations

Each of the study intersections was reviewed to determine:

- The intersection geometry;
- Existing weekday p.m. peak hour traffic volumes;
- The posted speed limit;
- Influencing factors such as school zones;
- Transit service; and
- Bicycle and pedestrian traffic.

As well, each intersection was analyzed based on the existing traffic volumes and the forecast 2035 volumes. **Table 8.1** shows the existing and forecast LOS based on the existing intersection and traffic control configuration.

Table 8.1: Existing and Projected Intersection Analysis

Intersection	Traffic Control	2007 P.M. Peak Hour			2035 P.M. Peak Hour		
		LOS	Critical Movement	Critical Movement LOS	LOS	Critical Movement	Critical Movement LOS
6th Ave N & Stanford Rd	All-way Stop	B	WB L	C	C	WB L/T/R	D
8th Ave N & 20th St N	Two-way Stop	A	WB/EB L/R	A	A	WB/EB L/R	B/A
8th Ave S & Cherry St	Two-way Stop	A	WB/EB L/T/R	B	A	WB/EB L/T/R	B
11th Ave S & S 34th St	Two-way Stop	A	WB L/T/R	B	A	WB L/T/R	C
13th Ave S & S 20th St	All-way Stop	B	SB L/T/R	C	C	SB L/T/R	C
13th Ave S & Cherry St	All-way Stop	B	SB L/T/R	B	B	SB L/T/R	B
24th Ave S & S 34th St (NW)	One-way Stop	A	EB L	C	A	EB L/R	F
24th Ave S & S 34th St (SE)	One-way Stop	A	EB L	D	C	WB/EB L/T/R	F
24th Ave S & Cherry St	All-way Stop	A	SB L/T/R	B	B	SB L/T/R	B
Ruemmele Rd & S 34th St	Two-way Stop	A	WB R	A	A	WB L/T/R	C
40th Ave S & S 20th St	All-way Stop	A	NB L/T/R	A	A	WB L/T/R	A
40th Ave S & Cherry St	Two-way Stop	A	EB L/T/R	B	A	EB L/T/R	B
55th Ave S & Cherry St	All-way Stop	A	SB L	A	A	SB L/T/R	A

8.3 Collision Analysis

Collision data reporting the number, type and severity of reported collisions was provided by the City of Grand Forks. Year 2005 and 2006 collision data was provided and analyzed for all of the study intersections with the exception of Ruemmele Road and South 34th Street, 40th Avenue South and South 20th Street and 55th Avenue South and Cherry Street.

A total of 17 collisions occurred over the two-year study period, six in 2005 and 11 in 2006. The intersection with the highest number of collisions, four in two years, was 40th Avenue South and Cherry Street. All intersections analyzed had collision rates below the critical collision rate, and therefore are assumed to be operating at an acceptable level of safety. The average collision rate at the intersections was 0.33 collisions per million entered vehicles, while the intersection of 40th Avenue South and Cherry Street had the highest collision rate of 1.16 collisions per million entered vehicles. It should be noted that this analysis is based on two years worth of data. It is preferable to examine four to five years of data to help reduce the impact of year to year variations.

The majority of collisions during the two-year study period resulted in property damage only. Five collisions (29%) resulted in non-fatal injuries, and there were no fatal collisions at any of the intersections examined.

The most common type of collision that occurred at the studied intersections was angle collisions, occurring at two-way stop sign controlled intersections. Twelve percent of all collisions were rear-end collisions. Non-collisions, involving one car, typically resulted from distraction and visual obstruction.

The largest number of collisions occurred because drivers failed to yield to oncoming traffic. The other factors that contributed to collisions at the intersections include excessive speed (18%), obstructed vision (12%), driver distraction (12%) and other/unavailable (24%).

The majority of collisions occurred between the hours of 2:00 p.m. and 6:00 p.m., most likely due to the increased traffic volumes during the weekday p.m. peak period. Collisions were fairly evenly distributed throughout the year, with only a marginally higher collision frequency recorded during the winter months; therefore, it was assumed that weather is not a major contributing factor for these collisions.

The average collision rate at intersections controlled by a one or two-way stop was 0.35 collisions per million entered vehicles. Intersections controlled by an all-way stop had an average collision rate of 0.30 collisions per million entered vehicles. While the collision rate is slightly higher at one or two-way stops, there is not a significant correlation between the type of intersection control and the average collision rate.

8.4 Public Participation

Two Public Information Meetings were held in Grand Forks on February 13, 2008 at Valley Middle School and Century Elementary School. Approximately nine people attended the Information Meeting at Valley Middle school while approximately three attended the Information Meeting at Century Elementary School. Attendance does not include local staff.

The main transportation issues identified by participants centered on questioning the necessity of all way stops at some locations, and providing pedestrian accommodation.

Two participants completed an exercise to rank proposed traffic control strategies in order of preference. All-way stop signs were ranked as the preferred control followed by a tie between two-way stops signs and traffic signals and lastly, a tie between geometric modifications and roundabouts. One participant noted adamant opposition to both roundabouts and geometric modifications.

Additional comments received included concern regarding confusing signage and lack of traffic control surrounding schools and crosswalks, overcrowded driveway access points, a lack of parking restriction enforcement, the possibility of installing traffic controls at surrounding intersections to improve flow and lack of sufficient notice for the Public Information Meetings. Verbal comments received from the Open House participants included approval of the study and intrigue in the roundabouts concepts should they prove feasible.

The final Public Information Meeting was held on May 15, 2008 in the Council Chambers at City Hall utilizing an open house format and was attended by one person, not including local staff.

Participants at the final Public Information Meeting had the opportunity to review information regarding the study goals, objectives, progress, intersection traffic data and forecasts, potential traffic control strategies, operational performance of the intersections and recommended traffic control options. Staff from the MPO and the Consultant Team was available to answer questions.

A comment sheet was provided at the final Information Meeting to obtain feedback from participants on their traffic control concerns in the City of Grand Forks. Participants were asked to identify their agreement or disagreement with the recommended traffic control strategies at the study intersections as well as any additional comments relating to traffic control strategies for the collector to collector intersections in the study. No comment sheets were completed. A verbal comment was received suggesting consideration of installing an all-way stop sign at the intersection of 40th Avenue South and Cherry Street since the participant felt the distance between stop signs along Cherry Street creates high speeds.

8.5 Proposed Strategies

Eight-hour traffic counts are required in order to properly evaluate traffic warrants prior to considering the introduction of traffic signals at the study intersections. Meeting the MUTCD traffic signal warrant in itself does not generate a mandate for installation, but does indicate that traffic signal control be considered along with other options. Other options could include the installation of a roundabout provided detailed functional plans are prepared to determine the feasibility at each recommended location.

Forecast peak hour traffic volumes at the following intersections did not meet MUTCD warrants for traffic signal installation or require other traffic control modifications:

- 8th Avenue North and 20th Street North;
- 8th Avenue South and Cherry Street;
- 11th Avenue South and South 34th Street;
- 13th Avenue South and Cherry Street;
- 24th Avenue South and Cherry Street;
- Ruemmele Road and South 34th Street;
- 40th Avenue South and South 20th Street;
- 40th Avenue South and Cherry Street; and
- 55th Avenue South and Cherry Street.

Forecast peak hour traffic volumes at the following intersections did meet MUTCD warrants for traffic signal installation or require other traffic control modifications:

- 6th Avenue North and Stanford Road (**Section 8.6**);
- 13th Avenue South and South 20th Street (**Section 8.7**);
- 24th Avenue South and South 34th Street (NW) (**Section 8.8**); and
- 24th Avenue South and South 34th Street (SE) (**Section 8.9**).

Table 8.2 summarizes current and proposed traffic control at the study intersections.

Table 8.2: Recommended Intersection Traffic Control

Intersection	Existing Traffic Control	Recommended Traffic Control
No Change:		
8th Ave N & 20th St N	Two-way Stop	Two-way Stop
8th Ave S & Cherry St	Two-way Stop	Two-way Stop
11th Ave S & S 34th St	Two-way Stop	Two-way Stop
13th Ave S & Cherry St	All-way Stop	All-way Stop
24th Ave S & Cherry St	All-way Stop	All-way Stop
Ruemmele Rd & S 34th St	Two-way Stop	Two-way Stop
40th Ave S & S 20th St	All-way Stop	All-way Stop
40th Ave S & Cherry St	Two-way Stop	Two-way Stop
55th Ave S & Cherry St	All-way Stop	All-way Stop
Recommended Changes:+		
6th Ave N & Stanford Rd	All-way Stop	Traffic Signals/Roundabout *
13th Ave S & S 20th St	All-way Stop	Traffic Signals/Roundabout *
24th Ave S & S 34th St (NW)	One-way Stop	Traffic Signals/Roundabout *
24th Ave S & S 34th St (SE)	One-way Stop	Traffic Signals/Roundabout *

+ Forecast overall intersection level of service criteria is met for all the study intersections.

* Warrants for traffic signal control or a roundabout to be reviewed in the future based on actual traffic volumes.

8.6 6th Avenue North and Stanford Road

The intersection of 6th Avenue North and Stanford Road is a location that experiences high traffic and pedestrian volumes during the weekday p.m. peak hour due to its proximity to an elementary school and the University of North Dakota. The current intersection configuration including all-way stop sign control is forecast to operate at LOS C in 2035. This level of service during the weekday p.m. peak hour is considered acceptable. However, concerns surrounding the interaction of vehicle and pedestrian activity at this location warrant investigation of safer traffic control options.

Forecast 2035 peak hour traffic and pedestrian volumes at this intersection warrant consideration of traffic signal installation according to MUTCD standards. The installation of traffic signals could provide a safer environment for school children and pedestrian crossings by allowing for orderly traffic flow and crossing movements. However, the installation of a roundabout with proper pedestrian crossings is also possible for this location.

8.7 13th Avenue South and South 20th Street

The current traffic control of 13th Avenue South and South 20th Street is all-way stop signs. Maintaining this traffic control, the intersection is forecast to operate at LOS C in 2035. This is an acceptable level of service but forecast traffic volumes at this location do warrant consideration of traffic signal installation. This also suggests that a roundabout may be an option to signals but would require significant existing residential property and relocation of a private approach not required by traffic signals. The installation of traffic signals improves the forecast LOS to A. A roundabout improves the forecast LOS to A.

8.8 24th Avenue South and South 34th Street (NW)

The current traffic control at the northwest "T" intersection of 24th Avenue South and South 34th Street is a stop sign on 24th Avenue South. The intersection currently operates at LOS A and is forecast to maintain LOS A in 2035. However, eastbound left and right-turn movements from 24th Avenue are forecast to operate at LOS F and the intersection therefore required analysis of additional traffic control options.

Forecasted traffic volumes warrant the installation of an all-way stop and consideration of traffic signals according to MUTCD standards. Warrant of traffic signals also suggests that a roundabout may be an option; impact to right-of-way at this location could be mitigated by shifting the roundabout to the west or testing alternative sized center islands.

Installation of an all-way stop at the intersection maintains LOS F in 2035 and also improves the eastbound left and right-turn movements to LOS B. However, this solution only shifts the critical movement to southbound through and right-turn traffic, which are forecast to operate at LOS D. Installation of traffic signals or a roundabout is forecast to provide overall intersection and all movement LOS A in 2035.

8.9 24th Avenue South and South 34th Street (SE)

The southeast "T" intersection of 24th Avenue South and South 34th Street is currently controlled by a stop sign on South 34th Street. The intersection currently operates at LOS A and is forecast to operate at LOS C in 2035 with eastbound left-turn movements at LOS F.

Forecasted traffic volumes warrant the installation of an all-way stop and consideration of traffic signals according to MUTCD standards. Warrant of traffic signals also suggests that a roundabout may be an option with minimal impact to right-of-way.

All-way stop sign control at the intersection results in LOS D in 2035 and improves the eastbound left-turn movements to LOS D. Traffic signal installation is forecast to provide an intersection LOS A. The installation of a roundabout is forecast to provide an overall LOS A for this location in 2035.

9.0 RECOMMENDATIONS

This study was commissioned by the Grand Forks – East Grand Forks Metropolitan Planning Organization (MPO) on behalf of the City of Grand Forks to examine future traffic control requirements at 13 collector to collector intersections. The following recommendations are offered:

1. The City of Grand Forks should commence a **traffic count program** at the study intersections requiring modified traffic control. The program should include eight hour counts at each location and be carried out every five years to re-evaluate traffic signal warrants prior to considering the introduction of traffic signals or a roundabout at the study intersections.

2. For future traffic control requirements on collector roadways, the City of Grand Forks should consider utilizing the ICE parameters outlined in **Section 7.1.5** and **Appendix B**, modified from the MnDOT ICE to reflect Grand Forks conditions.

3. The City of Grand Forks should consider the installation of traffic signals or a roundabout at the intersection of **6th Avenue North and Stanford Road** based on forecast 2035 peak hour traffic volumes.

4. The City of Grand Forks should consider installation of traffic signals or a roundabout at the intersection of **13th Avenue South and South 20th Street** based on forecast 2035 peak hour traffic volumes.

5. The City of Grand Forks should consider installation of traffic signals or a roundabout at the intersection of **24th Avenue South and South 34th Street (NW)** based on forecast 2035 peak hour traffic volumes.

6. The City of Grand Forks should consider the installation of traffic signals or a roundabout at the intersection of **24th Avenue South and South 34th Avenue (SE)** based on forecast 2035 peak hour traffic volumes.

7. The City of Grand Forks should consider the use of roundabouts as an alternative to traffic signal control at collector to collector intersections following a functional design review to determine if a roundabout is physically and technically feasible.

8. The following intersections do not require modified traffic control based on forecast 2035 traffic volumes:
    a. 8th Avenue North and 20th Street North;
    b. 8th Avenue South and Cherry Street;
    c. 11th Avenue South and South 34th Street;
    d. 13th Avenue South and Cherry Street;
    e. 24th Avenue South and Cherry Street;
    f. Ruemmele Road and South 34th Street;
    g. 40th Avenue South and South 20th Street;
    h. 40th Avenue South and Cherry Street; and
    i. 55th Avenue South and Cherry Street.

APPENDIX A – Open House Material

Grand Forks - East Grand Forks Metropolitan Planning Organization

WELCOME

Grand Forks Traffic Control Strategy

Public Information Meeting

February 13, 2008

Consultant:

MMM GROUP

Purpose of the Study

The Goal:

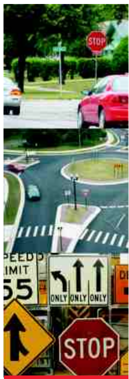
The goal of the study is to identify the optimum traffic control measures at 12 collector-to-collector intersections that can accommodate forecast peak hour traffic activities for the year 2035 in Grand Forks.

The Objectives:

Examine a variety of control measures, including two-way stops, all-way stops, traffic signals, roundabouts and geometric modifications.

Recommend measures with a view to providing an efficient, economic and safety conscious traffic control.

Recommend a menu of options that can also be used for other intersections in the future.



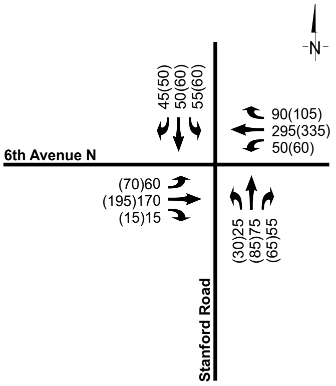
Study Progress

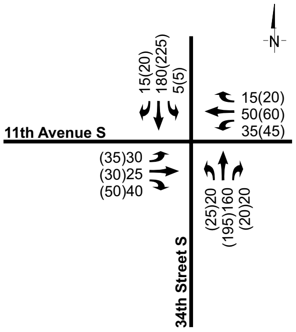
To Date, the Study Team Has:

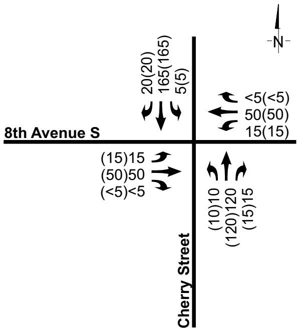
- Researched NDDOT and MNDOT policies
- Researched intersection control strategies from other locations
- Documented collector-to-collector intersection strategies from the past and issues that may have arisen
- Obtained current traffic volumes for the study intersections
- Forecast horizon year traffic volumes for the study intersections
- Reviewed collision histories for the study intersections
- Identified best practices that may be applicable to this study
- Analyzed the intersection level of service under existing and forecast traffic volumes

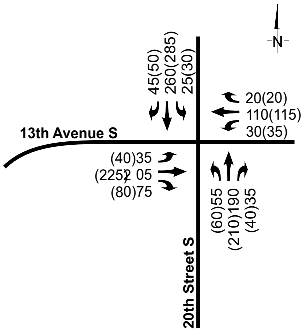
Study Intersections

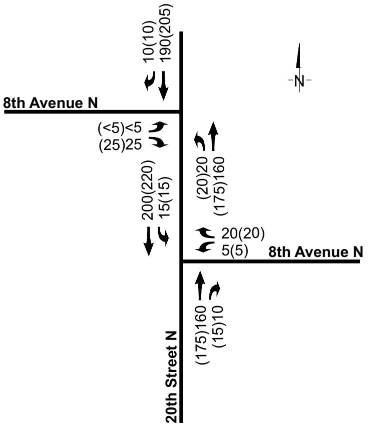
X (X) = Existing Traffic Volumes (2035 Traffic Volumes)

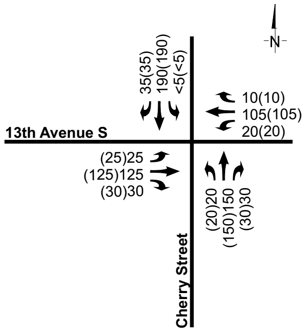




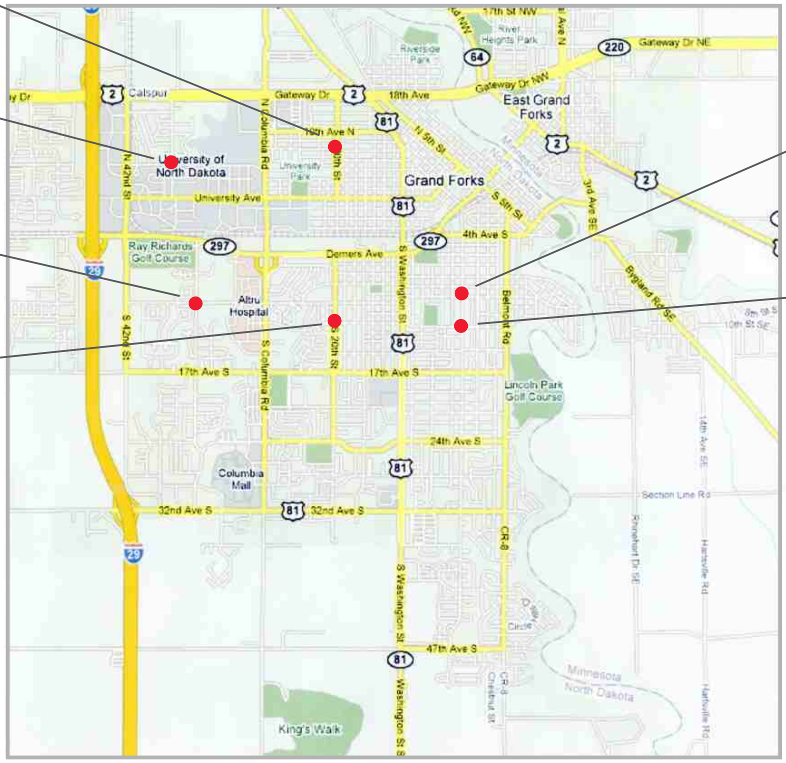








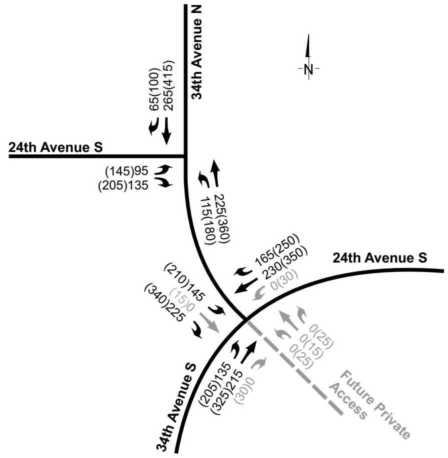
Location Map

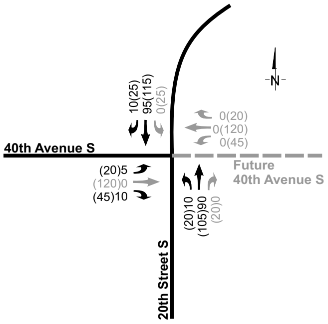


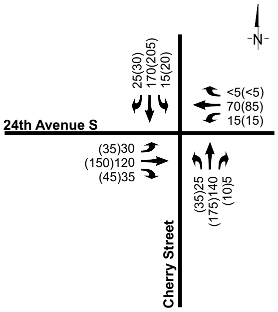
MMM GROUP

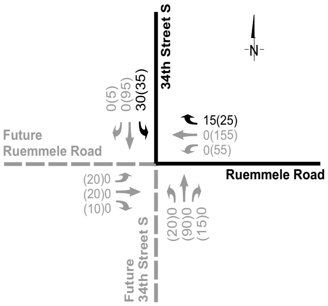
Study Intersections

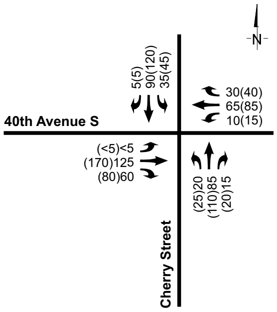
X (X) = Existing Traffic Volumes (2035 Traffic Volumes)

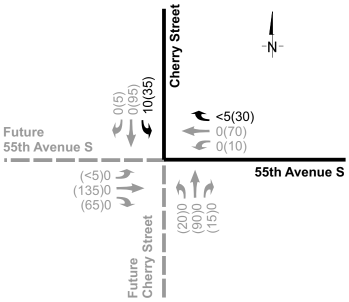




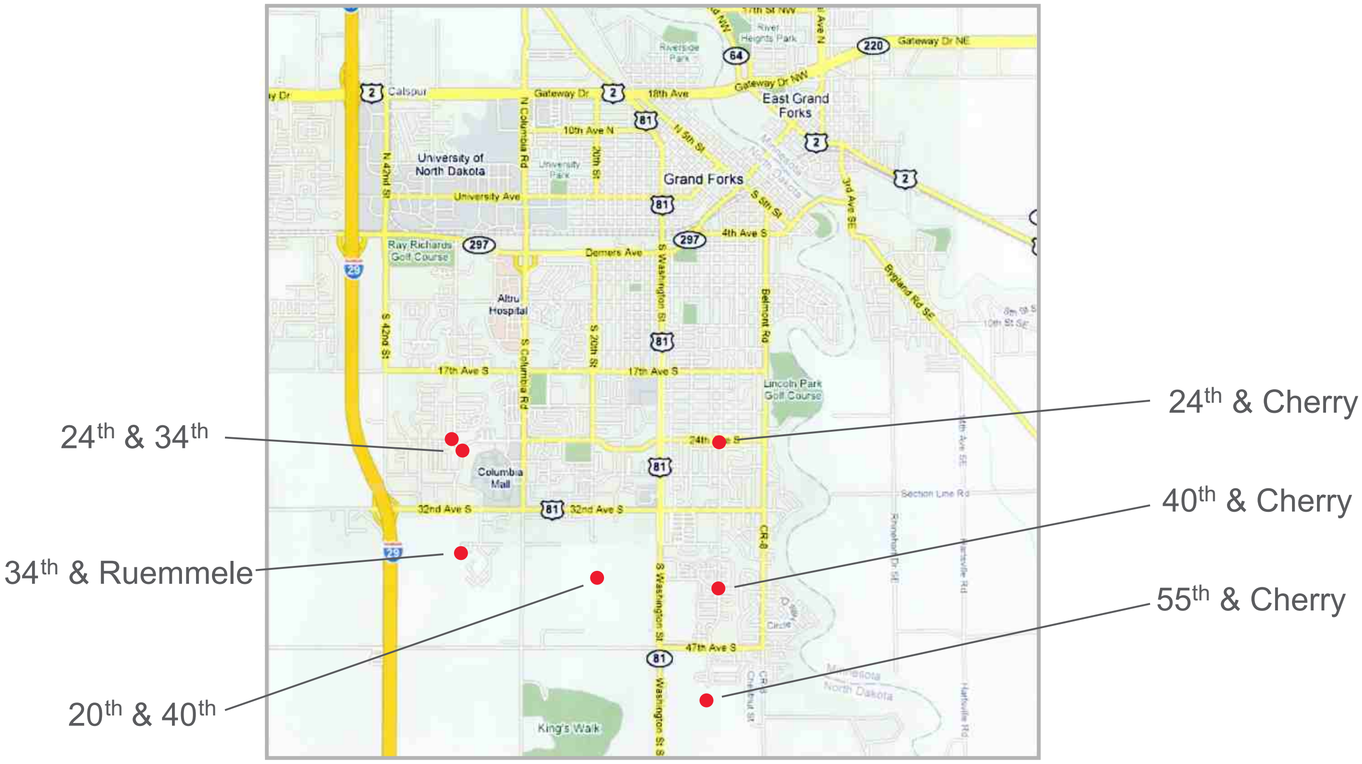








Location Map



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Collision Data

Intersection	Collisions					
	2005	2006	Total	Average [1]	Volume [2]	Rate [3]
6th Ave and Stanford Rd	1	0	1	0.5	4.00	0.12
8th Ave and 20th St (N)	0	0	0	0	1.31	0.00
8th Ave and 20 th St (S)	0	0	0	0	1.32	0.00
11th Ave and 34th St	0	1	1	0.5	1.72	0.29
13th Ave and 20th St	1	2	3	1.5	3.74	0.40
8th Ave and Cherry St	0	1	1	0.5	1.96	0.26
13th Ave and Cherry St	1	0	1	0.5	2.16	0.23
Total / Average	***3***	***4***	**7**	**0.5**	***2.32***	***0.19***

[1] Average number of collisions per year

[2] Volume of traffic entering the intersection in millions of vehicles per year

[3] Collision rate per million entered vehicles

- A collision rate greater than or equal to 1.5 collisions per million entered vehicles typically warrants further review

- All study intersections were found to have collision rates lower than 1.5 collisions per million entered vehicles.

Collision Data

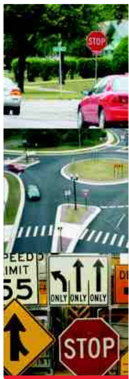
Intersection	Collisions					
	2005	2006	Total	Average [1]	Volume [2]	Rate [3]
24th Ave and 34th St (NW)	1	2	3	1.5	2.94	0.51
24th Ave and 34th St (SE)	0	1	1	0.5	3.69	0.14
24th Ave and Cherry St	1	1	2	1	2.08	0.48
40th Ave and Cherry St	1	3	4	2	1.72	1.16
Total / Average	***6***	***11***	**17**	**1.25**	***2.60***	***0.57***

[1] Average number of collisions per year

[2] Volume of traffic entering the intersection in millions of vehicles per year

[3] Collision rate per million entered vehicles

- A collision rate greater than or equal to 1.5 collisions per million entered vehicles typically warrants further review
- Collision data was not available for the intersections below because they are new interersections in developing areas:
  - Ruemmele Road and 34th Street,
  - 40th Avenue and 20th Street, and
  - 55th Avenue and Cherry Street
- All study intersections were found to have collision rates lower than 1.5 collisions per million entered vehicles.



Collision Data

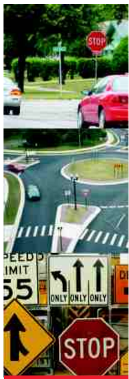
Intersection	Severity		
	PDO	Injury	Fatal
6th Ave and Stanford Rd	1	0	0
8th Ave and 20th St (N)	0	0	0
8th Ave and 20th St (S)	0	0	0
11th Ave and 34th St	0	1	0
13th Ave and 20th St	2	1	0
8th Ave and Cherry St	1	0	0
13th Ave and Cherry St	1	0	0
Total	*5*	*2*	**0**

PDO = Property Damage Only

Intersection	Type		
	Angle	Rear End	Non-Collision
6th Ave and Stanford Rd	1	0	0
8th Ave and 20th St (N)	0	0	0
8th Ave and 20th St (S)	0	0	0
11th Ave and 34th St	1	0	0
13th Ave and 20th St	2	0	1
8th Ave and Cherry St	0	1	0
13th Ave and Cherry St	0	0	1
Total	*4*	*1*	*2*

Non-Collision = Involving only one vehicle

Intersection	Contributing Factor				
	Speed	Obstructed Vision	Failure to Yield	Distraction	Other / Unavailable
6th Ave and Stanford Rd	1	0	0	0	0
8th Ave and 20th St (N)	0	0	0	0	0
8th Ave and 20th St (S)	0	0	0	0	0
11th Ave and 34th St	0	0	1	0	0
13th Ave and 20th St	0	1	1	1	0
8th Ave and Cherry St	1	0	0	0	0
13th Ave and Cherry St	0	0	0	0	1
Total	*2*	*1*	*2*	*1*	**1**



Collision Data

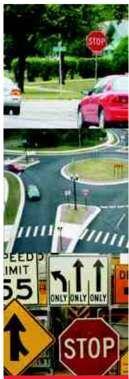
Intersection	Severity		
	PDO	Injury	Fatal
24th Ave and 34th St (NW)	3	0	0
24th Ave and 34th St (SE)	0	1	0
24th Ave and Cherry St	2	0	0
40th Ave and Cherry St	2	2	0
Total	*7*	*3*	**0**

PDO = Property Damage Only

Intersection	Type		
	Angle	Rear End	Non-Collision
24th Ave and 34th St (NW)	3	0	0
24th Ave and 34th St (SE)	0	1	0
24th Ave and Cherry St	2	0	0
40th Ave and Cherry St	3	0	1
Total	*8*	*1*	*1*

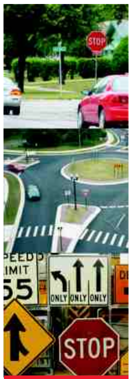
Non-Collision = Involving only one vehicle

Intersection	Contributing Factor				
	Speed	Obstructed Vision	Failure to Yield	Distraction	Other / Unavailable
24th Ave and 34th St (NW)	1	0	1	1	0
24th Ave and 34th St (SE)	0	0	0	0	1
24th Ave and Cherry St	0	0	1	0	1
40th Ave and Cherry St	0	1	2	0	1
Total	*1*	*1*	*4*	*1*	**3**



Potential Traffic Control Strategies

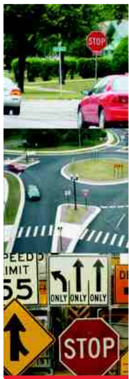
Traffic Control Strategy	Installation Criteria
Two-way Stop Signs	Speed and Network Warrant Analysis, Manual on Uniform Traffic Control Devices (MUTCD)
All-way Stop Signs	Volume, Collision and Speed Warrant Analysis, MUTCD
Traffic Signals	Capacity, Collision and Pedestrian Warrant Analysis, MUTCD
Roundabout	Alternative to Traffic Signals and Available Right-of-Way
Geometric Modifications	Accommodate Operational Needs



Traffic Control Strategies

All-Way vs. Two-Way Stop Control:

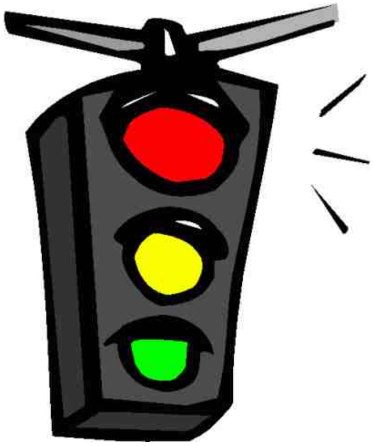
- Decrease vehicle delay and queues on the “minor” street
- Increase fuel usage and emission levels as all vehicles must now stop
- May decrease intersection collisions

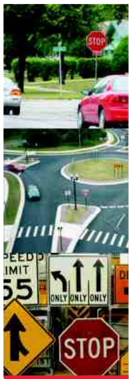


Traffic Control Strategies

Traffic signals vs. All-Way Stop Control:

- Increase capacity
- Decrease vehicle delay and queues
- Decrease fuel usage and emission levels
- Increase intersection collisions, although the type of collision can change

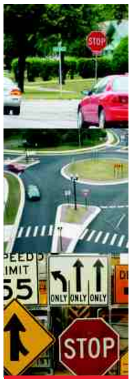




Traffic Control Strategies

Roundabouts vs. All-Way Stop Control:

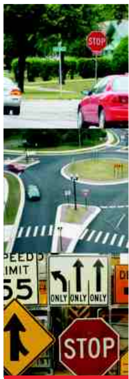
- Increase intersection capacity
- Reduce vehicle delay and queues
- Reduce fuel usage and emissions
- Offer aesthetic opportunities



Traffic Control Strategies

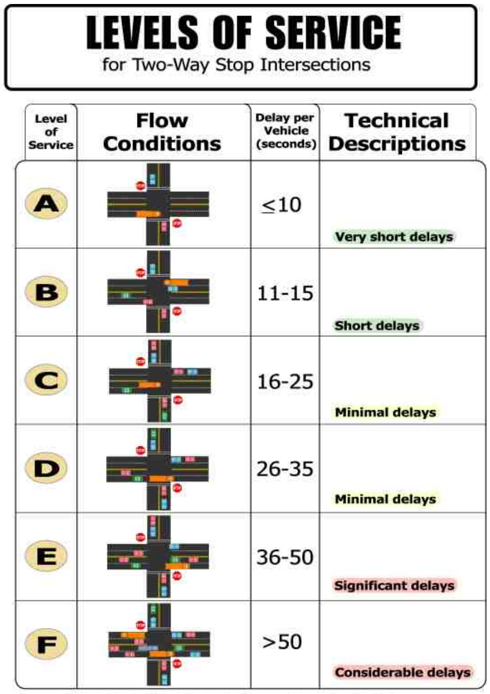
Roundabouts vs. Traffic Signal Control:

- Increase intersection capacity
- Reduce vehicle delay and queues
- Reduce conflict points
- Reduce fuel usage and emissions
- Reduce intersection collisions
- Reduce speeds
- Offer aesthetic opportunities
- Identified as an alternative to traffic signals in the MUTCD



How are the intersections performing?

Intersection	LOS	
	Current	Year 2035
6th Ave and Stanford Rd	B	C
8th Ave and 20th St (N)	A	A
8th Ave and 20th St (S)	A	A
11th Ave and 34th St	A	A
13th Ave and 20th St	B	C
8th Ave and Cherry St	A	A
13th Ave and Cherry St	B	B

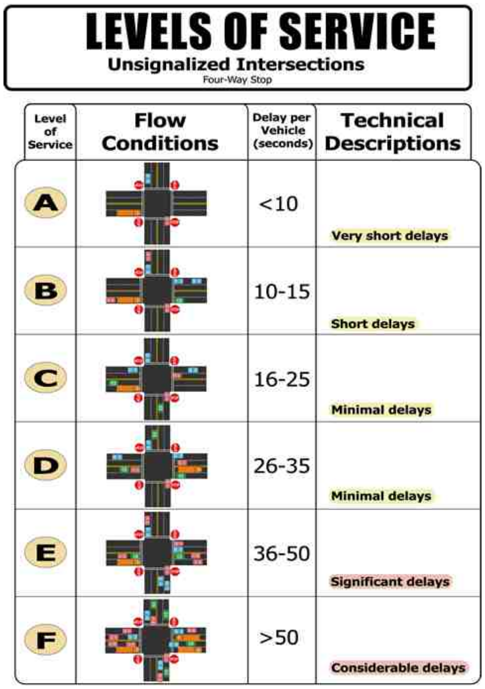


LEVELS OF SERVICE

for Two-Way Stop Intersections

Level of Service	Flow Conditions	Delay per Vehicle (seconds)	Technical Descriptions
A		≤10	Very short delays
B		11-15	Short delays
C		16-25	Minimal delays
D		26-35	Minimal delays
E		36-50	Significant delays
F		>50	Considerable delays

Source: 2000 HCM, Exhibit 17-2, Level of Service Criteria for TWSC Intersections



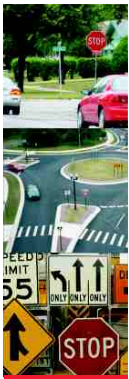
LEVELS OF SERVICE

Unsignalized Intersections

Four-Way Stop

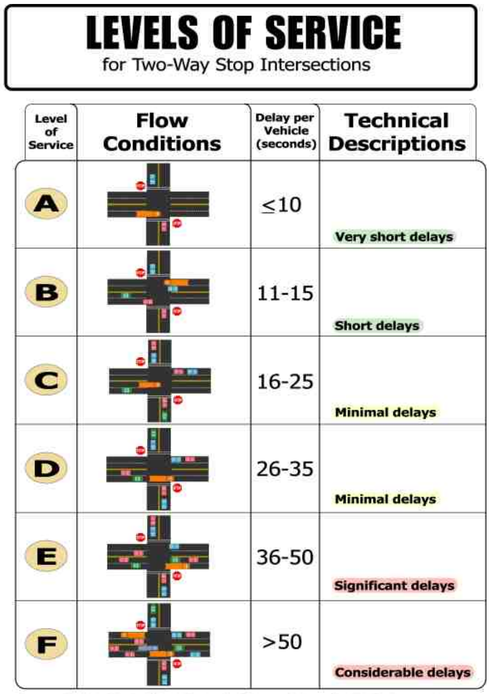
Level of Service	Flow Conditions	Delay per Vehicle (seconds)	Technical Descriptions
A		<10	Very short delays
B		10-15	Short delays
C		16-25	Minimal delays
D		26-35	Minimal delays
E		36-50	Significant delays
F		>50	Considerable delays

Source: 2000 HCM, Exhibit 17-22, Level of Service Criteria for AWSC Intersections



How are the intersections performing?

Intersection	LOS	
	Current	Year 2035
24th & 34th (northwest)	A	A
24th & 34th (southeast)	A	C
34th & Ruemmele	A	A
20th & 40th	A	A
24th & Cherry	A	B
40th & Cherry	A	A
55th & Cherry	A	A



LEVELS OF SERVICE

for Two-Way Stop Intersections

Level of Service	Flow Conditions	Delay per Vehicle (seconds)	Technical Descriptions
A		≤10	Very short delays
B		11-15	Short delays
C		16-25	Minimal delays
D		26-35	Minimal delays
E		36-50	Significant delays
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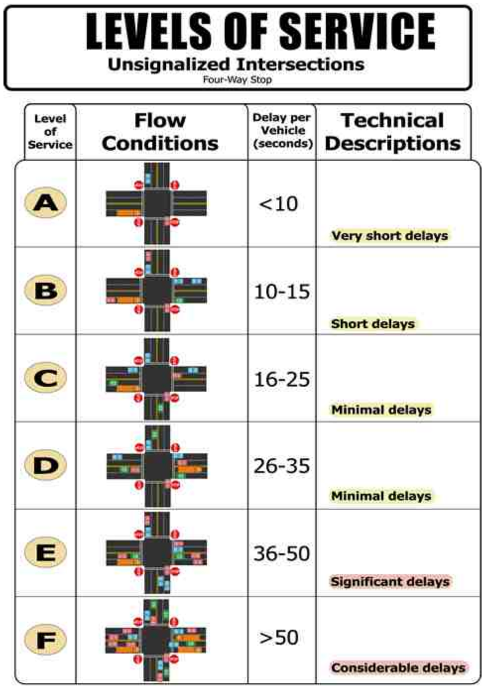

LEVELS OF SERVICE

Unsignalized Intersections

Four-Way Stop

Level of Service	Flow Conditions	Delay per Vehicle (seconds)	Technical Descriptions
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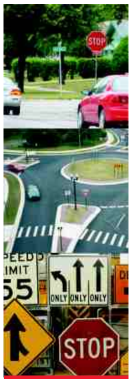
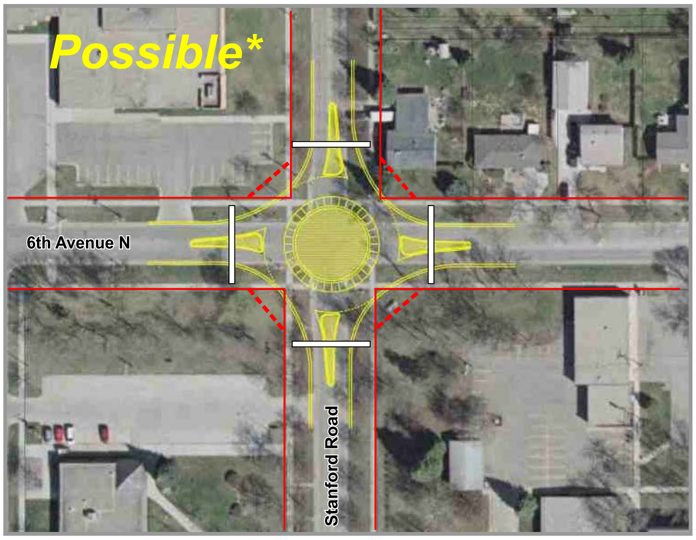
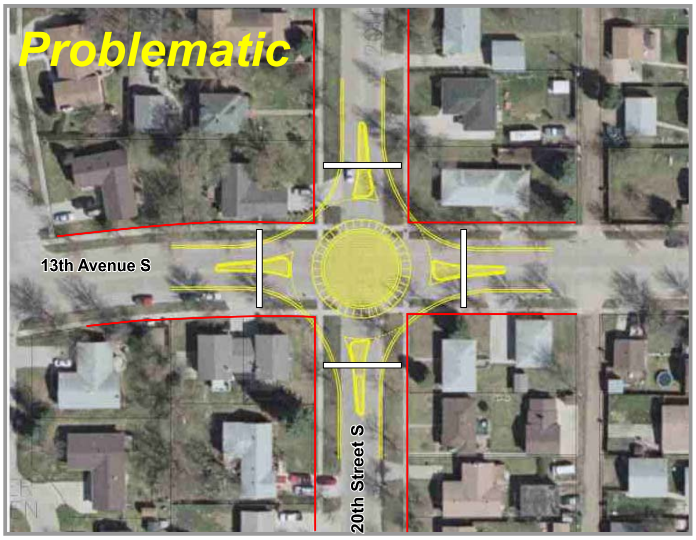
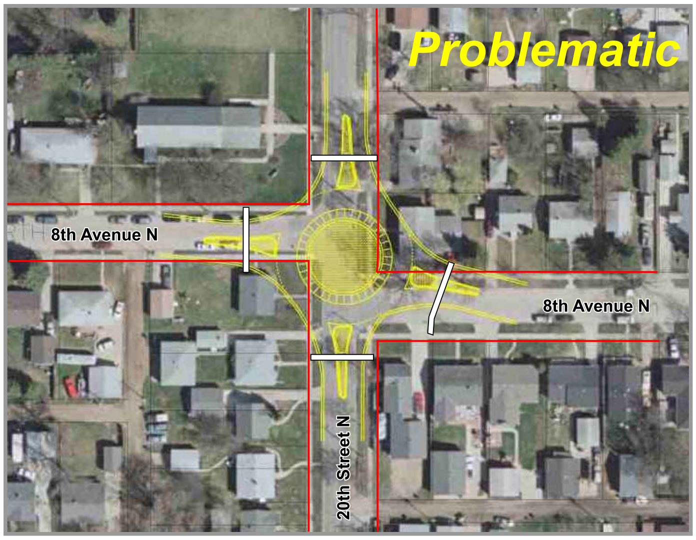


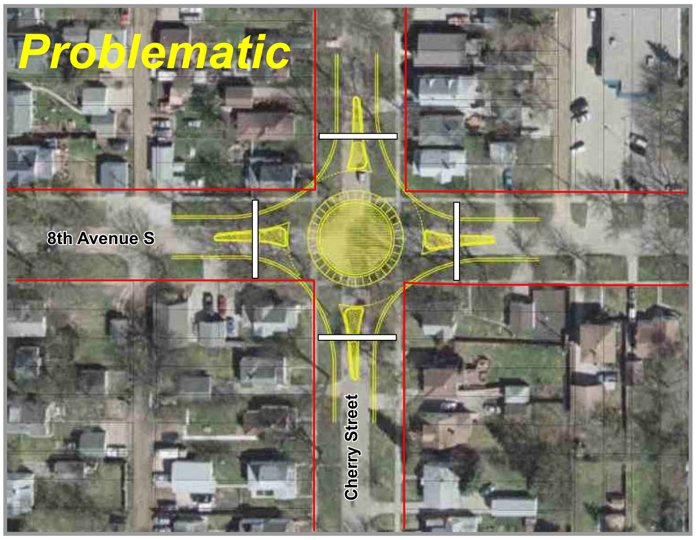
MMM GROUP

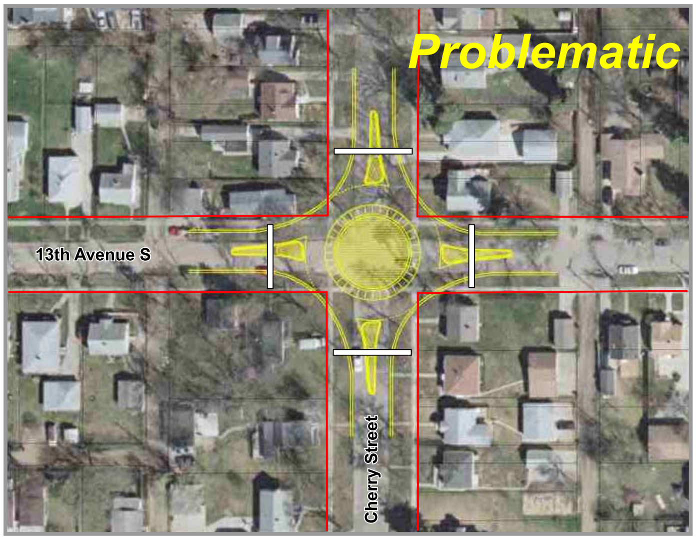
Is a roundabout physically feasible?









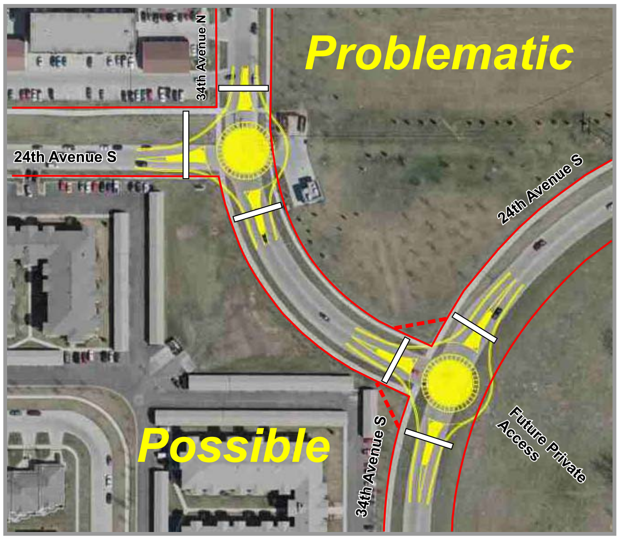


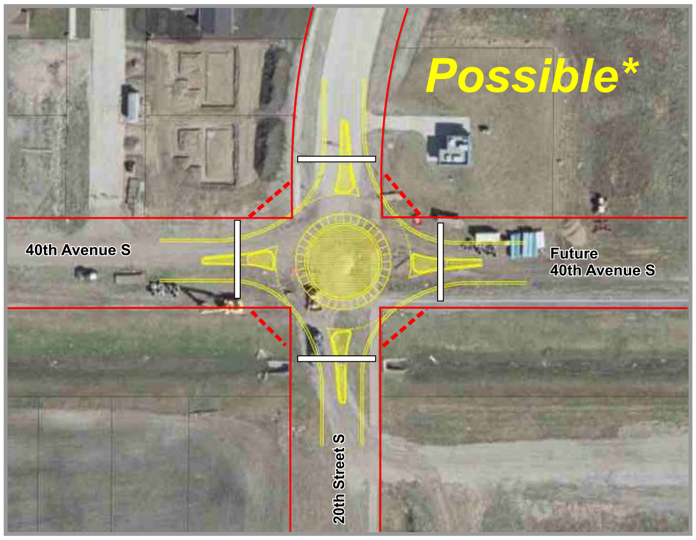
* Indicates a roundabout is not required based on traffic level of service.

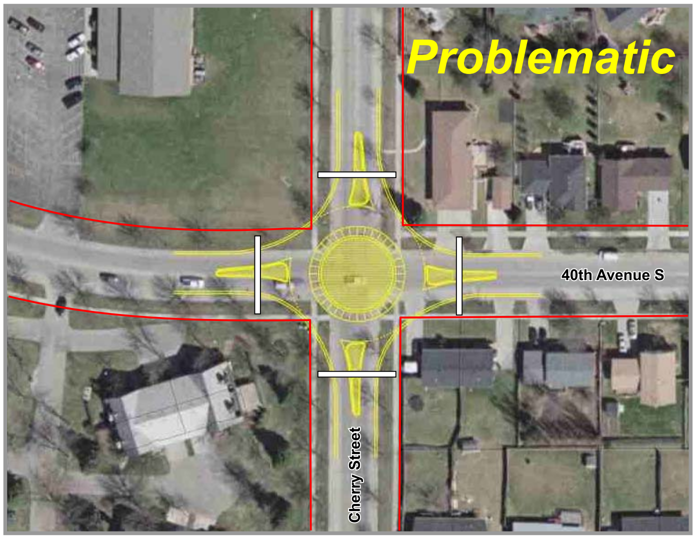
----- Indicates approximate property requirements.

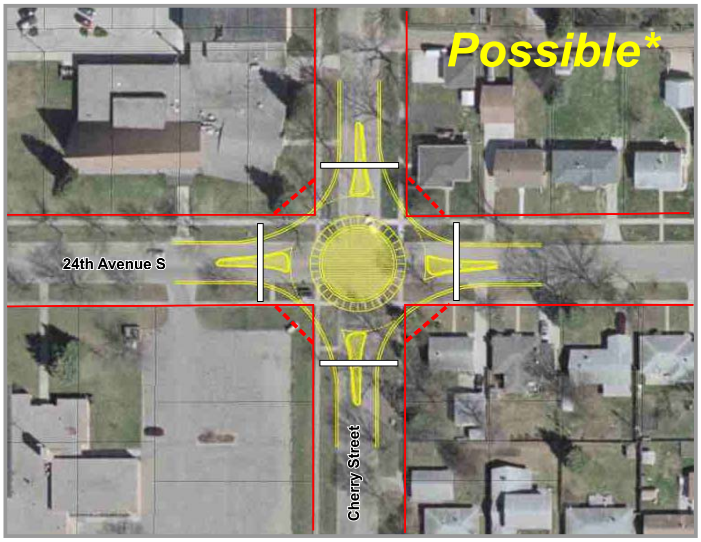
Grand Forks - East Grand Forks Metropolitan Planning Organization

Is a roundabout physically feasible?









* Indicates a roundabout is not required based on traffic level of service.

----- Indicates approximate property requirements.

What's Next?

Review input received from today's public information meeting

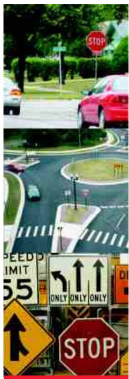
Identify feasible intersection traffic control strategies at each intersection

Conduct an operational analysis of the intersections for forecast traffic based on the traffic controls

Host a second public information meeting to present findings and preferred strategies

Review input received from second public information meeting and Technical Advisory Committee

Finalize recommendations and submit findings



MMM GROUP

Grand Forks Traffic Control Strategy
Public Information Meeting – February 13, 2008
Comment Sheet

Note: Numbers in parenthesizes indicate number of a specific response received.

1. Where do you live?

Grand Forks **(4)** East Grand Forks ________ Other (please specify) _______________

2. Please indicate what you consider the main transportation issue(s) at the intersections noted in today's public information meeting (e.g. traffic volumes, access problems, pedestrian accommodation, cyclist accommodation, speed, etc.):

Intersection:	**6th Ave & Stanford Rd**	Issue(s):	**All-way stop, multiple access points**
Intersection:	**8th Ave & 20th Ave**	Issue(s):	**Off-set intersection, should not be considered for an all-way stop**
Intersection:	**8th Ave & 20th Ave**	Issue(s):	**No issue with this location**
Intersection:	**24th Ave & Cherry St**	Issue(s):	**Pedestrian/student accommodation**

3. Please rank the proposed traffic control strategies from 1 (most preferred) to 5 (least preferred):

Two-way Stop Signs	**2 (1), 4 (1)**	All-way Stop Signs	**3 (1), 1 (1)**
Traffic Signals	**5 (1), 1 (1)**	Roundabouts	**2 (1), 5 (1)**
Geometric Modifications	**4 (1), 3 (1)**		

4. If the recommended solution for a study intersection was one of the following traffic control strategies, would you be opposed to its implementation? Please circle your choice (Yes, No or Unsure):

Two-way Stop Signs	**Yes (2)**	**No (1)**	Unsure
All-way Stop Signs	**Yes (1)**	**No (1)**	Unsure
Traffic Signals	**Yes (1)**	No	**Unsure (1)**
Roundabouts	**Yes (1)**	**No (2)**	Unsure
Geometric Modifications	**Yes (1)**	No	**Unsure (1)**

5. Do you have any additional traffic control strategies, for the collector-to-collector intersection in the study, that have not been considered?

- **Signage is confusing around the school and crosswalks at 6th Ave and Stanford Rd.**
- **No traffic control issues exist at 8th Ave and 20th Ave.**

6. Do you have any additional comments? (Please feel free to use the back of the sheet)

- **Lake Agassiz is adding and deleting driveways into parking lots.**
- **8th Ave and 25th St should be considered for an all-way stop. There are no stops from University Ave to 10th Ave on 25th Street and vehicles speed by West Elementary with children crossing the street constantly.**
- **Better parking enforcement is required at 8th Ave and 25th St. Traffic flow around the school should be improved during drop-off/pick-up times.**
- **Traffic signals at 20th St and University Ave would improve flow from the neighborhoods between Gateway Dr and University Ave. Signals would also make**

it easier for children to get from the neighborhood south of University Ave to the schools north of University Ave.

- **Poor public notice was given for the meeting. Advertisement was placed in Tuesdays paper for a Wednesday meeting.**
- **The crosswalk at 24th Ave and Oak St moving closer to the intersection appears less safe and more dangerous than the current MPO placement of the crosswalk.**

If you wish to return this survey by mail or fax, please send completed sheet no later than February 20, 2008 to either:

Richard Tebinka c/o MMM Group Limited
Suite 111-93 Lombard Avenue
Winnipeg MB, R3B 3B1
Tel:(204) 943-3178 Fax:(204) 943-4948

Earl Haugen c/o Grand Forks-East Grand Forks MPO
255 North 4th Street, P.O. Box 5200
Grand Forks, ND 58206-5200
Tel: (701) 746-2660 Fax: (204) 787-3755

Thank you for your participation!

MMM GROUP

Grand Forks - East Grand Forks Metropolitan Planning Organization

WELCOME

Grand Forks Traffic Control Strategy

Public Information Meeting

May 15, 2008

Consultant:

MMM GROUP

Purpose of the Study

The Goal:

The goal of the study is to identify the optimum traffic control measures at 13 collector-to-collector intersections that can accommodate forecast peak hour traffic activities for the year 2035 in Grand Forks.

The Objectives:

Examine a variety of control measures, including two-way stops, all-way stops, traffic signals, roundabouts and geometric modifications.

Recommend measures with a view to providing efficient, economic and safety conscious traffic control.

Recommend a menu of options that can also be used for other intersections in the future.

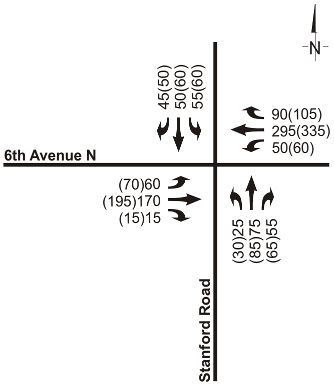
Study Progress

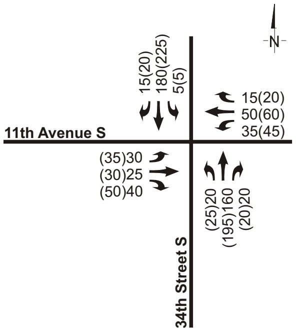
To Date, the Study Team Has:

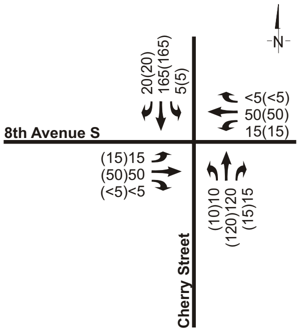
- Researched NDDOT and MNDOT policies
- Researched intersection control strategies from other locations
- Documented collector-to-collector intersection strategies from the past and issues that may have arisen
- Obtained current traffic volumes for the study intersections
- Forecast horizon year traffic volumes for the study intersections
- Reviewed collision histories for the study intersections
- Identified best practices that may be applicable to this study
- Analyzed the intersection level of service under existing and forecast traffic volumes
- Identified and analyzed intersection traffic control strategies that may be feasible at each intersection
- Prepared conceptual plans illustrating recommended traffic controls
- Identified the preferred strategy at each location to meet forecast traffic levels

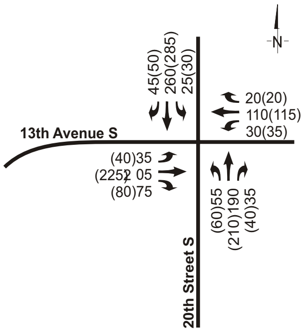
Study Intersections

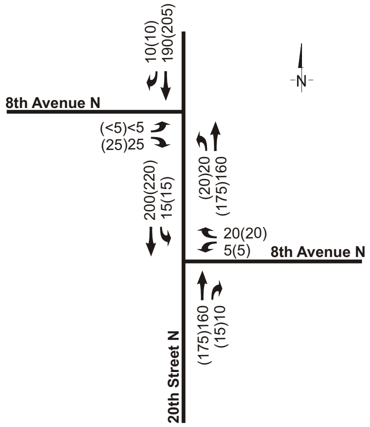
X (X) = Existing P.M. Peak Hour Traffic Volumes (2035 P.M. Peak Hour Traffic Volumes)

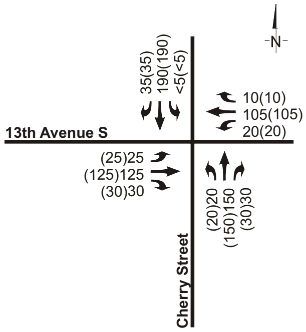




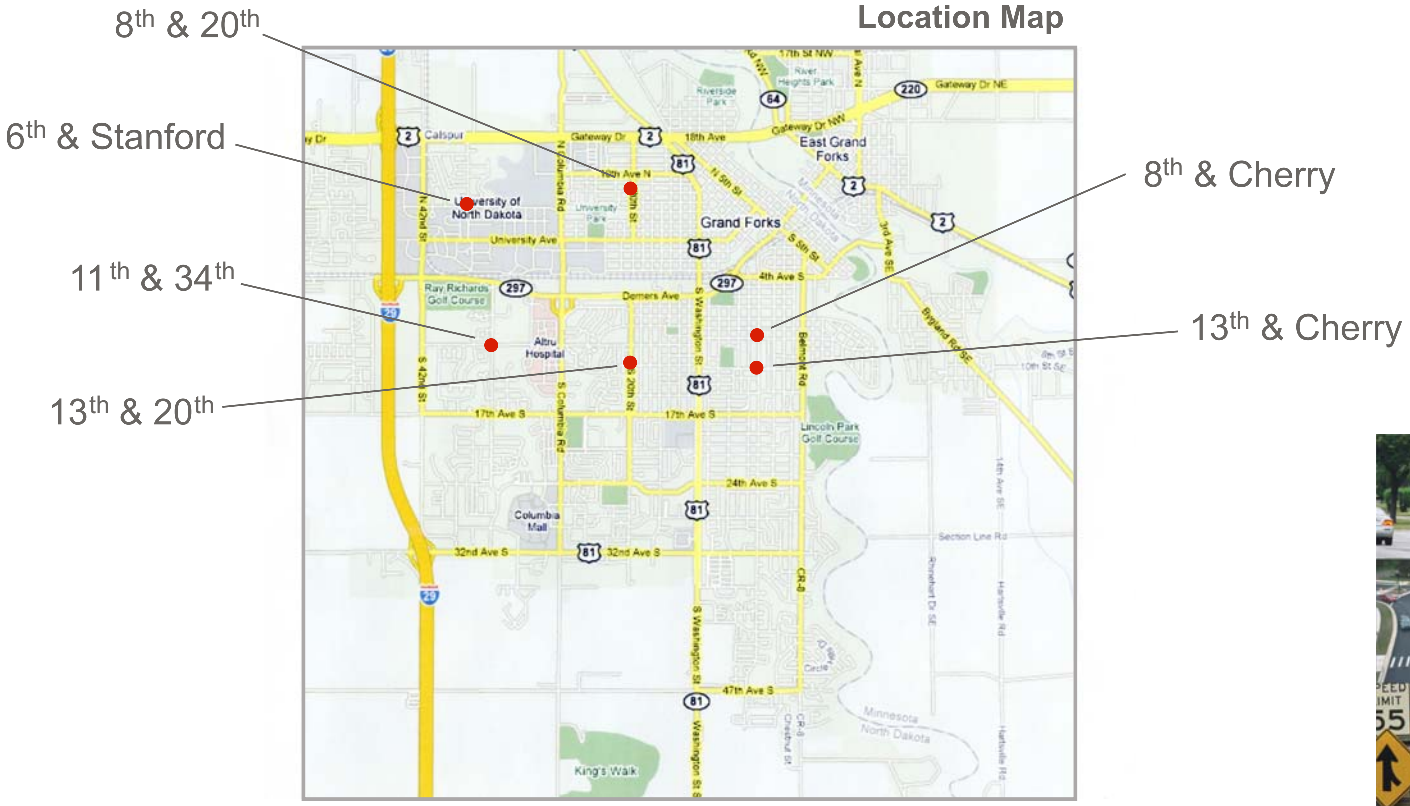






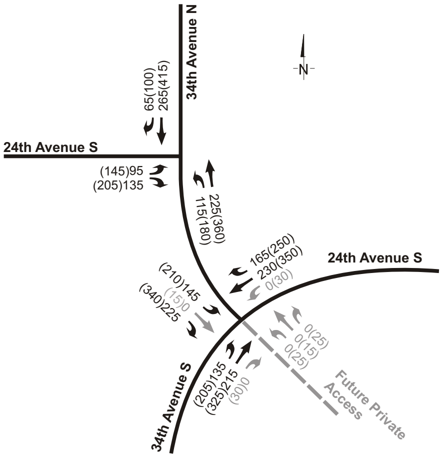


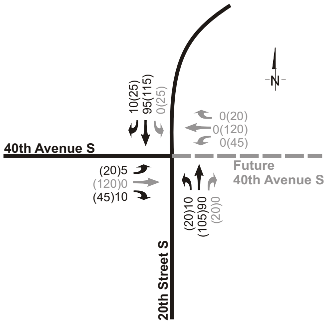
Location Map

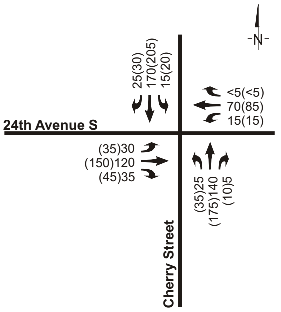


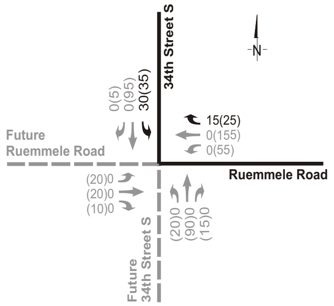
Study Intersections

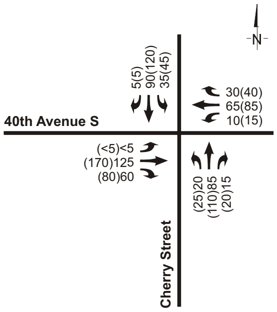
X (X) = Existing P.M. Peak Hour Traffic Volumes (2035 P.M. Peak Hour Traffic Volumes)

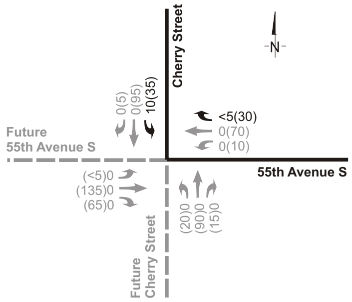




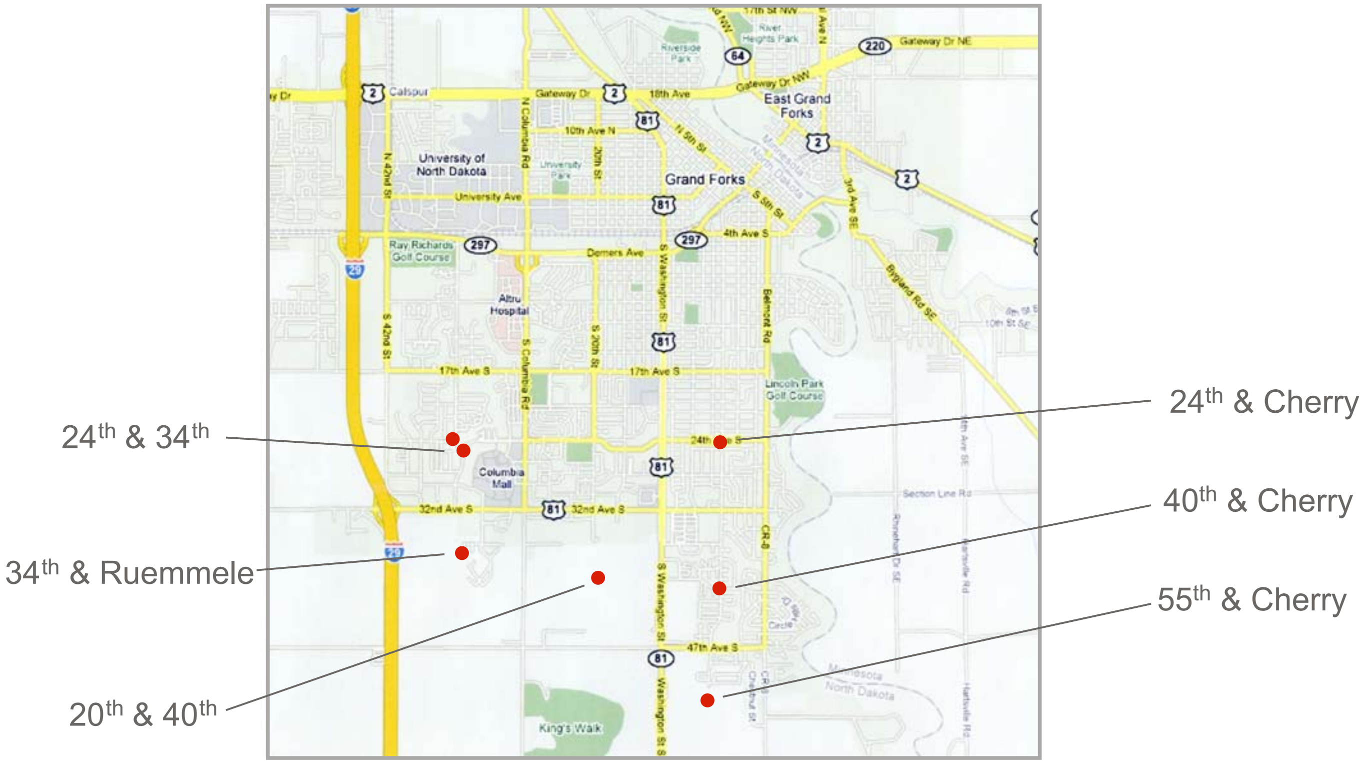








Location Map



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Potential Traffic Control Strategies

Traffic Control Strategy	Installation Criteria	Advantages	Disadvantages
Two-way Stop Signs	Speed and Network Warrant Analysis, Manual on Uniform Traffic Control Devices (MUTCD)	Low Cost, Concise, Universally Understood	Cause “stop and go” driving behavior
All-way Stop Signs	Volume, Collision and Speed Warrant Analysis, MUTCD	Low Cost, Concise, Universally Understood	Cause “stop and go” driving behavior, can cause flow problems at unbalanced intersections
Traffic Signals	Capacity, Collision and Pedestrian Warrant Analysis, MUTCD	Can reduce collisions if employed properly, Reduce delay, Increase capacity	May change collision type, high cost of installation and maintenance
Roundabout	Alternative to Traffic Signals and Available Right-of-Way	Reduce collisions, Reduce delay, Increase capacity, Aesthetic opportunities	High cost of installation, Unfamiliar to drivers, Typically require land acquisition in urban settings
Geometric Modifications	Accommodate Operational Needs	Reduce delay, Increase capacity, Can reduce collisions	May have a high cost of installation, May require land acquisition

Traffic Signal Controlled Collector - Collector Intersection in Grand Forks

Roundabout in West Fargo

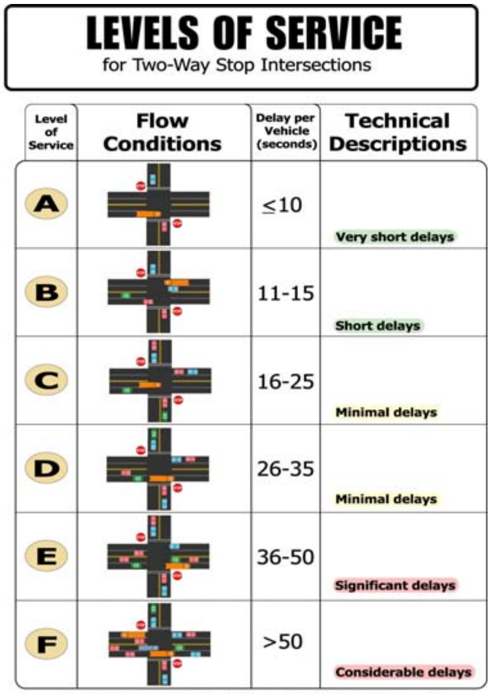
MMM GROUP

Grand Forks - East Grand Forks Metropolitan Planning Organization

How are the intersections performing?

Intersection	Traffic Control	2007	2035 P.M. Peak Hour			Proposed Traffic Control
		LOS*	LOS	Critical Movement	Critical Movement LOS	
6th Ave and Stanford Rd	All-way Stop	B	C	Westbound Left turn,Through and Right Turn	D	Traffic Signals or Roundabout
8th Ave and 20th St (N)	Two-way Stop	A	A	West and Eastbound Left and Right Turn	B/A	Two-way Stop
8th Ave and Cherry St	Two-way Stop	A	A	West and Eastbound Left Turn, Through and Right Turn	B	Two-way Stop
11th Ave and 34th St	Two-way Stop	A	A	Westbound Left Turn, Through, And Right Turn	C	Two-way Stop
13th Ave and 20th St	All-way Stop	B	C	Southbound Left Turn, Through, and Right Turn	C	Traffic Signals or Roundabout
13th Ave and Cherry St	All-way Stop	B	B	Southbound Left Turn, Through, and Right Turn	B	All-way Stop
24th Ave S and S 34th (NW)	One-way Stop	A	A	Eastbound Left and Right Turn	F	Traffic Signals or Roundabout
24th Ave S and S 34th (SE)	One-way Stop	A	C	West and Eastbound Left Turn, Through and Right Turn	F	Traffic Signals or Roundabout
24th Ave and Cherry St	All-way Stop	A	B	Southbound Left Turn, Through and Right Turn	B	All-way Stop
Ruemmele Rd and 34th St	Two-way Stop	A	A	Westbound Left Turn, Through, And Right Turn	C	Two-way Stop
40th Ave S and S 20th St	All-way Stop	A	A	Westbound Left Turn, Through, and Right Turn	A	All-way Stop
40th Ave S and Cherry St	Two-way Stop	A	A	Southbound Left Turn, Through, and Right Turn	A	Two-way Stop
55th Ave S and Cherry St	All-way Stop	A	A	Southbound Left Turn, Through, and Right Turn	A	All-way Stop

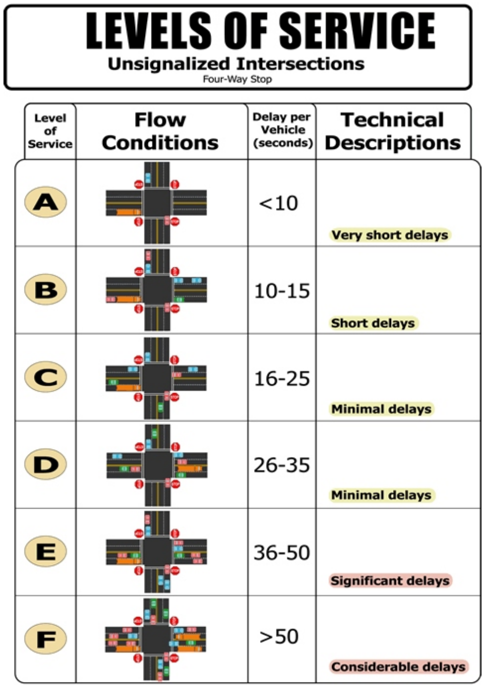
***LOS = Level Of Service**



LEVELS OF SERVICE
for Two-Way Stop Intersections

Level of Service	Flow Conditions	Delay per Vehicle (seconds)	Technical Descriptions
A		≤10	Very short delays
B		11-15	Short delays
C		16-25	Minimal delays
D		26-35	Minimal delays
E		36-50	Significant delays
F		>50	Considerable delays

Source: 2000 HCM, Exhibit 17-2, Level of Service Criteria for TWSC Intersections



LEVELS OF SERVICE
Unsignalized Intersections
Four-Way Stop

Level of Service	Flow Conditions	Delay per Vehicle (seconds)	Technical Descriptions
A		<10	Very short delays
B		10-15	Short delays
C		16-25	Minimal delays
D		26-35	Minimal delays
E		36-50	Significant delays
F		>50	Considerable delays

Source: 2000 HCM, Exhibit 17-22, Level of Service Criteria for AWSC Intersections

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Grand Forks - East Grand Forks Metropolitan Planning Organization

Intersection Control Evaluation and Traffic Count Program

Intersection Control Options Band On Modified ICE

Intersection	Approx Combined ADT	All Way Stop	Traffic Signal	Roundabout	Access Management Treatments
6th Ave and Stanford Rd	11,300	■	■	■	■
8th Ave and 20th St (N)	4,400	—	—	—	—
8th Ave and 20th St (S)	4,500	—	—	—	—
8th Ave and Cherry St	5,300	■	—	■	■
11th Ave and 34th St	7,300	■	—	■	■
13th Ave and 20th St	11,900	■	■	■	■
13th Ave and Cherry St	7,400	■	—	■	■
24th Ave S and S 34th (NW)	14,000	■	■	■	■
24th Ave S and S 34th (SE)	18,200	■	■	■	■
24th Ave and Cherry St	7,400	■	■	■	■
Ruemmele Rd and 34th St	5,700	■	—	■	■
40th Ave S and S 20th St	6,800	■	—	■	■
40th Ave S and Cherry St	7,200	■	—	■	■
55th Ave S and Cherry St	5,700	■	—	■	■

- MMM developed a modified Intersection Control Evaluation (ICE) process for Grand Forks based on MnDOT's guidelines.
- A 'typical' collector street volume for a two lane roadway of 2,500 vehicles per day could be considered as being average for two lane collectors. This led to a total of 5,000 vehicles per day for a collector to collector intersection.
- The City should commence a traffic count program at the study Intersections. The counts should cover an 8-hour period and be repeated every 5 years.

Recommendation: Adoption of the modified ICE process and traffic count program

MMM GROUP

Intersections Requiring Modified Traffic Control

6th Avenue North and Stanford Road Traffic Control Comparison

Traffic Control	Warrant	2035 LOS	Cost	Property Requirements	Collision Mitigation
All-way Stop	Existing	C	Low	None	Neutral
Traffic Signals	Warranted	B	High	Low	Negative
Roundabout	Warranted	A	High	High	Positive
Geometric Modification	N/A	B	Medium	Medium	Positive

Conceptual Roundabout

Conceptual Traffic Signals

Conceptual Geometric Modification

Recommendation: Traffic Signals or a Roundabout

MMM GROUP

Intersections Requiring Modified Traffic Control

13th Avenue South and South 20th Street Traffic Control Comparison

Traffic Control	Warrant	2035 LOS	Cost	Property Requirements	Collision Mitigation
All-way Stop	Existing	C	Low	None	Neutral
Traffic Signals	Warranted	A	High	Low	Negative
Roundabout	Warranted	A	High	High	Positive
Geometric Modification	N/A	C	Low	None	Neutral

Conceptual Roundabout

Conceptual Traffic Signals

Recommendation: Traffic Signals or a Roundabout

MMM GROUP

Intersections Requiring Modified Traffic Control

24th Avenue South and South 34th Street (NW) Traffic Control Comparison

Traffic Control	Warrant	2035 LOS	Cost	Property Requirements	Collision Mitigation
One-way Stop	Existing	A	Low	None	Neutral
All-way Stop	Warranted	C	Low	Low	Neutral
Traffic Signals	Warranted	A	High	Low	Neutral
Roundabout	Warranted	A	High	Medium	Positive

Conceptual Roundabout

Conceptual Traffic Signals

Recommendation: Traffic Signals or a Roundabout

Intersections Requiring Modified Traffic Control

24th Avenue South and South 34th Street (SE) Traffic Control Comparison

Traffic Control	Warrant	2035 LOS	Cost	Property Requirements	Collision Mitigation
One-way Stop	Existing	A	Low	None	Neutral
All-way Stop	Warranted	D	Low	Low	Neutral
Traffic Signals	Warranted	A	High	Low	Negative
Roundabout	Warranted	A	High	Low	Positive

Conceptual Roundabout

Conceptual Traffic Signals

Recommendation: Traffic Signals or a Roundabout

What's Next?

Review input received from second public information meeting and MPO/City Staff

Finalize recommendations and submit findings

Adoption of Report by MPO Board and City of Grand Forks

Grand Forks Traffic Control Strategy
Public Information Meeting – May 15, 2008
Comment Sheet

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1. Where do you live?

Grand Forks _________ East Grand Forks _______ Other (please specify) _______________

2. Please circle whether you agree or disagree with the recommended changes shown in today's public information meeting:

- 6th Avenue North & Stanford Road:
    - i. Installation of traffic signals: Agree Disagree
    - ii. Installation of a roundabout: Agree Disagree
- 13th Avenue South & South 20th Street:
    - i. Delineation of additional turn lanes: Agree Disagree
- 24th Avenue South & South 34th Street (NW):
    - i. Installation of traffic signals: Agree Disagree
    - ii. Installation of a roundabout: Agree Disagree
- 24th Avenue South & South 34th Street (SE):
    - i. Installation of traffic signals: Agree Disagree
    - ii. Installation of a roundabout: Agree Disagree

3. If you disagree with (a) any of the recommended changes noted above, or (b) the recommendation for other study intersections to maintain their traffic control measures, please explain why: (Please feel free to use the back of the sheet)

____

____

____

____

4. Do you have any additional comments? (Please feel free to use the back of the sheet)

- **An all-way stop should be installed at the intersection of 40th Avenue South & Cherry Street since there is too much distance between stop signs along Cherry Street which creates high speeds.**

If you wish to return this survey by mail or fax, please send the completed sheet no later than May 23, 2008 to either:

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Tel: (701) 746-2660 Fax: (204) 787-3755
ehaugen@grandforksgov.com

Thank you for your participation!

MMM GROUP

APPENDIX B – Grand Forks Intersection Control Evaluation

INTERSECTION TRAFFIC CONTROL FOR THE CITY OF GRAND FORKS

1.0 Introduction

An Intersection Control Evaluation (ICE) procedure was developed for the City of Grand Forks to provide guidance in the selection of possible collector intersection traffic control options based on daily traffic volumes. The process was based on the Minnesota Department of Transportation's (MnDOT) Technical Memorandum No. 07-02-T-01. The MnDOT ICE technical memorandum states that the purpose of developing an ICE procedure is to determine the optimal control for an intersection based on an objective analysis for the existing conditions and future needs.

1.1 Traffic Volumes

In order to determine appropriate thresholds, traffic volumes for collector roadways were surveyed from numerous jurisdictions in a previous MMM study. The cities surveyed included Winnipeg, Fargo, Regina and Anchorage, among others. Modifying the MnDOT thresholds to apply to Grand Forks, a minimum of 5,000 and a maximum of 25,000 vehicles per day traveling through the intersection were used. The modification to 5,000 and 25,000 vehicles per day was adopted to reflect the larger population base in Minnesota, and potentially higher traffic volumes, as well as to account for varying jurisdictional collector volume guidelines. A typical two-lane collector roadway carries in the order of 2,500 vehicles per day thus, a total of 5,000 vehicles per day was determined as the minimum threshold for intersection control evaluation. **Table 1** summarizes collector intersection control types for evaluation based on entering average daily traffic (ADT).

Table 1: Collector Intersection Control Types for Evaluation Based on Entering ADT

Intersection ADT	All Way Stop	Traffic Signal	Roundabout	Access Management Treatments
5,000 – 7,500	■		■	■
7,500 – 25,000	■	■	■	■

1.2 ICE Procedure

The following general procedures are recommended for determining control evaluation for collector-to-collector intersections in Grand Forks. The procedures are based on the MnDOT ICE, data and feedback accumulated over the course of this study and information received from other jurisdictions.

1.2.1 Intersection ADT 5,000 – 7,500

The ICE process for collector intersections with an approximate ADT between 5,000 and 7,500 vehicles per day (vpd) is shown in **Figure 1**. The intersection should first be analysed using appropriate traffic modelling software (e.g. Synchro, SIDRA) to determine the peak hour level of service (LOS) for a two-way stop sign control on the major roadway. If the peak hour level of service for the intersection is D or better, installation of a two-way stop may be sufficient traffic control.

However, if the peak hour LOS is E or F, warrant analysis for an all-way stop should be reviewed. If the warrant for all-way stop sign control is not met, access management or geometric modifications to the intersection to improve LOS should be considered as an alternative solution. If the intersection warrants an all-way stop, a modern roundabout should be analyzed to determine its feasibility with respect to level of service, costs and right-of-way. If a modern roundabout is infeasible, an all-way stop sign control should be considered. However, if a modern roundabout is feasible it should be determined whether or not the roundabout will be publicly and administratively supported as well as compatible with the neighbourhood. If it is not supported and compatible, an all-way stop sign control should be considered. If it is supported and compatible, a modern roundabout should be considered as a solution.

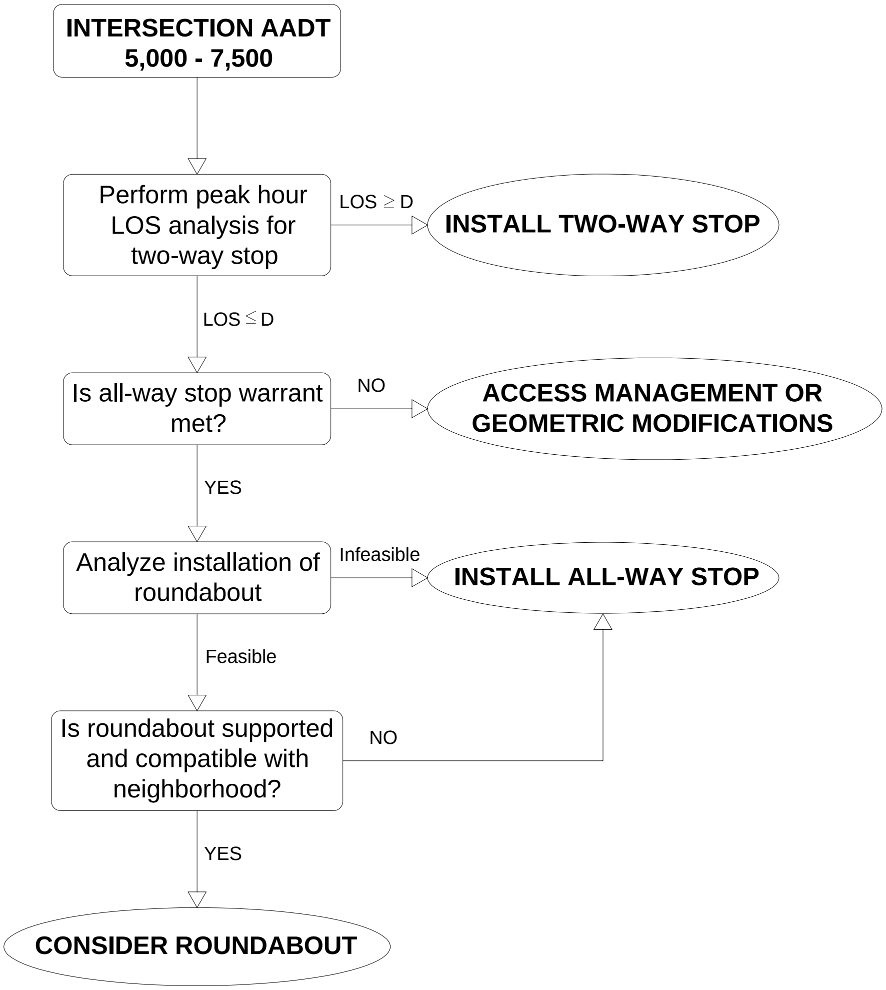

Figure 1: ICE Process for Intersection ADT = 5,000 to 7,500 vpd

1.2.1 Intersection ADT ≥ 7,500

As shown in **Figure 2**, for intersections with a combined ADT of greater than 7,500 vpd, the first question to be asked is whether or not traffic signal warrants are met. If not, then the process outlined for intersections with 5,000 and 7,500 vpd, shown in **Figure 1**, should be followed. If the traffic signal warrant is met, the intersection should be examined in relation to neighboring traffic control measures. In particular, is there sufficient spacing between traffic signals or is coordination feasible should a traffic signal be installed at this intersection. If either of these conditions are not met, access management or geometric modifications should be examined to determine if they are a sufficient solution. If access management or geometric modifications are sufficient to improve LOS to acceptable levels then they should be considered.

Prior to installing a traffic signal, if intersection spacing or coordination efforts can be achieved, it should be determined whether the traffic signal is compatible with the neighborhood. Traffic signals may not be compatible in neighborhoods for a variety of reasons, such as aesthetics, light pollution, noise pollution (from audible pedestrian signals) and other unwanted neighborhood intrusions. If traffic signals are compatible with the neighborhood, it should be determined whether or not alternatives to a signal would be acceptable to both the public and the agency. If not, the installation of a traffic signal should be considered.

If alternatives may be acceptable, then it should be determined if the intersection meets warrants for all-way stop sign control. If the intersection does not meet all-way stop warrants, access management or geometric modifications may be sufficient. However, if access management or geometric modifications are insufficient, a modern roundabout should be analyzed to determine its feasibility with respect to level of service, costs and right-of-way. If a modern roundabout is infeasible, an all-way stop sign control should be considered. However, if a modern roundabout is feasible it should be determined whether or not the roundabout will be publicly and administratively supported as well as compatible with the neighbourhood. If it is not supported and compatible, an all-way stop sign control should be considered. If it is supported and compatible, a modern roundabout should be considered as a solution.

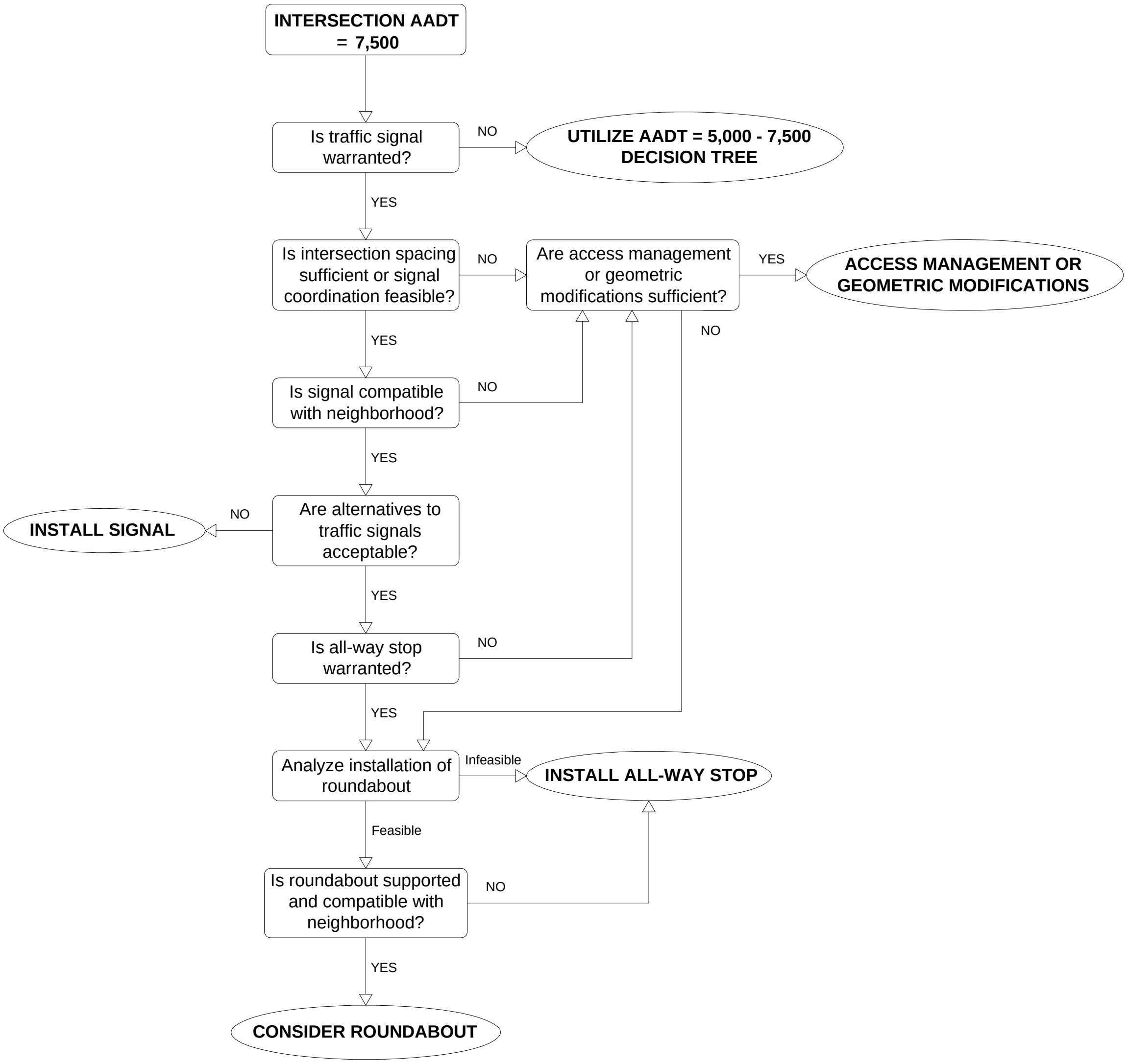

Figure 2: ICE Process for Intersection ADT ≥ 7,500 vpd