MOORHEAD AREA INTEGRATED TRAIN DETECTION AND TRAFFIC CONTROL SYSTEM SCOPING STUDY

June 1998

Minnesota Department of Transportation  Minnesota Guidestar
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CHAPTER 1 DEFINE EXISTING CONDITIONS

A. DEFINE EXISTING TRANSPORTATION SYSTEMS

Downtown Moorhead is divided by the two Burlington Northern Santa Fe Railroad (BNSF) lines that run east-west through the City. These tracks include a north line, which runs between Center Avenue and 1st Avenue and the south main line tracks run between Center Avenue and Main Avenue. On a typical day, 10 trains use the north line and 60 trains use the south main line.

The north-south roadways are blocked an average of 4.5 minutes per train. This equates to a total blockage of 4 hours and 30 minutes (almost 20 percent of the day) at each roadway segment that crosses the railroad tracks on a typical day. The existing average daily traffic volume for 1st Avenue is 15,000 vehicles, for Center Avenue it is 10,000 and for Main Avenue it is 20,000 vehicles.

Seven roadways cross the south main line tracks in downtown Moorhead. These roadways are 4th Street North, 5th Street North, 6th Street North, 8th Street North, 10th Street North, 11th Street North and 14th Street North. All of these roadways have an at-grade crossing with the railroad tracks. The combined volume of these seven roadways crossing the railroad tracks is approximately 36,500 vehicles per day. The combined exposure at these crossings is approximately 2,200,000 vehicle-trains. Of the 300 crossings cited in the Minnesota Department of Transportation’s (Mn/DOT) inventory of at-grade train exposure, 10 are located in downtown Moorhead. The second highest rated location in Minnesota is at 8th Street between Center Avenue and Main Avenue.

The extent of train activity impacts the City’s transit operations and emergency vehicle response times. The local transit authority completed a survey the week of March 16-21, 1998. Based on the survey, a bus making a typical half-hour trip will cross the tracks twice, 5 percent of the bus trips are interrupted by a train for an average length of 4-1/2 minutes and 17-1/2 percent of the interrupted buses took an alternate route.

Train activity greatly impacts the operation of intersections controlled by traffic signals. Traffic signals in the City of Moorhead are shown in Figure 1, including which agency operates each traffic signal, if the signal is preempted by the railroad, and which signals are interconnected.

The City of Moorhead has 19 at-grade crossings at roadways with the railroads (Figure 2). There are three grade-separated crossings; two are underpasses and one new overpass is under construction. Between 21st Street and 3rd Street in the study area, 13 at-grade crossings occur. The nearest grade separated locations are at 3rd Street and 21st Street, both of which pass under the railroad. The 3rd Street underpass is typically flooded in Spring and during heavy rains.
Figure 1 Traffic Signal Layout
Figure 2 Railroad and Roadway Crossings
Figure 3 shows the traffic volumes from 1996 provided in the Railroad Conflict Study and Mitigation Alternatives (dated December 1997) for the downtown area. Table 1 provides an existing traffic signal inventory identifying signalized intersections with controller types and master locations.

B. Identifying Underlying Causes of Problems

Problem Definition

The purpose of the Moorhead Area Integrated Train Detection and Traffic Control System Project is to determine the feasibility of developing an integrated system for detection of trains for the purpose of employing revised traffic signal timing plans when trains are present and to provide information to the road users on train movements. This concept provides an opportunity to use Intelligent Transportation Systems (ITS) techniques to improve traffic operations related to train activity in the City of Moorhead. The problems addressed by this project include:

. Inefficient signal timing when trains travel through Moorhead’s signalized intersections, both with and without railroad preemption;

. High traffic volumes at several high-volume at-grade railroad crossings in Moorhead;

. Increased emergency vehicle response time when trains are present;

. Interruption of transit operations when trains are present; and

. Extensive vehicular delays when trains are present.

The underlying cause of each of these problems is that long trains frequently pass through the City of Moorhead on tracks that cross many local and arterial streets at-grade. However, the current traffic signal system does not respond to this change in traffic conditions, except that some intersections are railroad pre-empted by adjusting the signal timing to more efficiently handle traffic that is traveling parallel to the railroad lines (east-west) while still serving the required short cross traffic trips and turns onto the east-west streets (north-south). At this time we are not aware of any existing system that addresses the problem described using advanced train detection in conjunction with revised systemwide signal timing.
Figure 3 Traffic Volumes (ADT)
Table 1 Moorhead Area Integrated Train Detection and Traffic Control System

**TABLE 1**
Mn/DOT -- Moorhead Area Integrated Train Detection and Traffic Control System Project No. 517
26-May-98

<table>
<thead>
<tr>
<th>EXISTING TRAFFIC SIGNAL INVENTORY</th>
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<tbody>
<tr>
<td><strong>SIGNALIZED INTERSECTION</strong></td>
</tr>
<tr>
<td>1st Ave. N. / 3rd St. N.</td>
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<tr>
<td>1st Ave. N. / 7th St. N.</td>
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<tr>
<td>1st Ave. N. / 8th St. N.</td>
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<tr>
<td>1st Ave. N. / 11th St. N.</td>
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<tr>
<td>1st Ave. N. / 14th St. N.</td>
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<tr>
<td>Center Ave. / 4th St. N.</td>
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<td>Center Ave. / 5th St. N.</td>
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<td>Center Ave. / 6th St. N.</td>
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<td>Center Ave. / 8th St. N.</td>
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<td>Center Ave. / 11th St. N.</td>
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<td>Center Ave. / 14th St. N.</td>
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<tr>
<td>Center Ave. (TH10) / 21st St. N.</td>
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<tr>
<td>Center Ave. (TH10) / Hwy 75 N.</td>
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<tr>
<td>Center Ave. (TH10) / 32nd St. N.</td>
</tr>
<tr>
<td>Center Ave. (TH10) / 34th St. N.</td>
</tr>
<tr>
<td>Main Ave. / 3rd St. S.</td>
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<td>Main Ave. / 4th St. S.</td>
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<td>Main Ave. / 5th St. S.</td>
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<td>Main Ave. / 6th St. S.</td>
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<td>Main Ave. / 8th St. S.</td>
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<td>Main Ave. / 11th St. S.</td>
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<tr>
<td>Main Ave. / 14th St. S.</td>
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<tr>
<td>4th Ave. S. / 21st St. S.</td>
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<td>Main Ave. SE. / 20th St. S.</td>
</tr>
<tr>
<td>12th Ave. S. / 20th St. S.</td>
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<tr>
<td>12th Ave. S. / Main Ave. SE.</td>
</tr>
<tr>
<td>8th St. S. / 7th Ave. S.</td>
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<td>8th St. S. / 12th Ave. S.</td>
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<td>8th St. S. / 20th Ave. S.</td>
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<tr>
<td>8th St. S. / 24th Ave. S.</td>
</tr>
<tr>
<td>8th St. S. / I-94 N. Ramp</td>
</tr>
<tr>
<td>8th St. S. / I-94 S. Ramp</td>
</tr>
<tr>
<td>8th St. S. / 30th Ave. S.</td>
</tr>
</tbody>
</table>

Converted 8/4/98 cp
EXISTING PROBLEMS

. There is a missed opportunity to reduce delay and stops on east-west streets because the signals maintain their normal signal timing plans even when train movements block streets. The signals are required to maintain their timing plans because they are without central control, are running with timed based coordination, and are required to continue to cycle to serve cross street vehicular and pedestrian movements not crossing the tracks.

. Emergency vehicle operators may not always select the best route for crossing the railroad during train movements because of a lack of information regarding train locations and speeds.

. Transit operations in the Fargo-Moorhead area utilize timed transfer service plans. The timed-transfer success is jeopardized by delays caused by train movements across bus routes. Information on train locations may allow transit operators to utilize alternate routes to remain on schedule.

Currently there is no organized attempt to deal with these issues. However, in response to train delay problems, Mn/DOT and the City have restricted installation of railroad preemption to locations where the guidelines of the Manual of Uniform Traffic Control Devices (MUTCD) are fully met. Signals at locations marginally warranting railroad preemption have been operated without it to minimize problems of inefficient signal timing.
CHAPTER 2 PROJECT PARTICIPANTS – ROLES AND RESPONSIBILITIES

A. PRIMARY PARTNERS

The primary partners in the Moorhead Area Integrated Train Detection and Traffic Control System project are involved in providing resources to the project or receiving benefit/impact from the project.

The following are the primary partners and their contacts.

• **Mn/DOT – OATS**
  
  Mn/DOT will administer the funding for the project and guide the project to completion. Marthand Nookala and Jim Kranig are Mn/DOT’s project managers.

• **City of Moorhead**
  
  Public Works – Bob Martin  
  Police – Grant Wyland  
  Fire – Gary Schulz

  Bob Martin is the local project manager. The City representatives will ensure that the project benefits the City of Moorhead.

• **F-M COG**
  
  F-M COG will ensure that the technologies and systems employed will benefit the region. Brian Shorten will act as F-M COG’s primary contacts.

• **Mn/DOT – District 4**
  
  The local Mn/DOT district office currently, operates many of the traffic signal systems in the City of Moorhead. Lori Vanderhider and Lee Kessler will serve as the Mn/DOT District 4 contact people.

• **Mn/DOT – Office of Freight, Railroads and Waterways (OFRW)**
  
  The OFRW will assist with the coordination of the railroad. Rashmi Brewer is the OFRW contact.
• **Otter Tail Valley Railroad**

  This agency provides coordination between the needs of the railroad and the project.

• **Burlington Northern SanteFe Railroad**

  Spencer Arndt will provide coordination between the needs of the railroad and the project.

B. **SECONDARY PARTNERS**

• **City of Fargo**

  As contacts for the City of Fargo, Mark Bittner and Rick Lane will assist and approve the location of train detection devices in the City. Their role includes providing input into system needs and expansion into the City.

• **North Dakota State University (NDSU) – Upper Great Plains Transportation Institute (U.P.G.P.I.)**

  Ayman Smadi will provide input on what residents want for information or evaluation of benefits to them.

• **North Dakota Department of Transportation (NDDOT)**

  The NDDOT’s role is to determine the future benefits to the State of North Dakota and provide input for future expansion to Fargo. Grant Levi will be the NDDOT contact.

• **Emergency Services**

  Emergency service providers will offer feedback regarding what information will be beneficial to them and explain their current communication technologies.

• **Moorhead Metropolitan Area Transit (MMAT)**

  The MMAT will provide feedback on existing problems and information, which will be beneficial to their operations and explain current communication technologies. Lori VanBeck will be the agency’s contact person.
CHAPTER 3 DEFINE GOALS AND OBJECTIVES

A. GOALS

The Moorhead Area Integrated Train Detection and Traffic Control System project establishes the following goals:

I. Reduce delay for motorists and public transit through:
   Improved signal timing, specifically when trains are present
   Providing real-time information to motorists to enable them to select an alternate at-grade crossing or divert to a grade-separated crossing; and
   Providing real-time information to the transit operators to enable route diversions

II. Improve Emergency Service delivery through:
   Providing real-time information to emergency vehicle operators

III. Improve safety through:
   Reducing exposure at at-grade crossings; and
   Reducing conflicts with emergency vehicles for auto and train traffic.

IV. Develop, implement and test a system that may be beneficial for many cities throughout the country.

B. OBJECTIVES

The following describes the objectives of each major element of the project.

Train Detection

The functional requirement of the technology selected to perform this task would include the capability to detect train location, length and speed. Once this information has been collected it would ideally convert into the form of a real-time computer map of the train movements in the Fargo-Moorhead area. From this data base information could be sent to the signal control system, the emergency vehicle operators, the transit operators and the motorist information system.
Implementation of Alternative Traffic Signal Timing Plans

The existing individual intersection signal systems would be interconnected to arterial “closed loop” style master controllers. The detection of a critical length train would then trigger the master controllers to select the alternative timing plan.

Provide Driver Information

Train detection data would be used to inform transit and emergency vehicle dispatchers and would also be displayed to general traffic on the street through the use of variable message signs (VMS).
CHAPTER 4 DEFINE STUDY AREA

The primary study area is located between First Avenue on the north, Main Avenue on the south, 14th Street North on the east, and 3rd Street North on the west. In this area there are seven at-grade railroad crossings (4th Street North, 5th Street North, 6th Street North, 8th Street North, 10th Street North, 11th Street North, and 14th Street North) and an underpass at 3rd Street. The length of the railroad tracks in the study area is approximately 1.5 miles.

It will be necessary to locate train detection devices near the railroad tracks but outside of the primary study area. This will expand the study area east near the Dilworth railroad yard and west into Fargo. Additional detection may be needed on tracks along Southeast Main Avenue (Otter Tail) and along 20th Street South.

The City will also be reconstructing the signals along Center Avenue in the summer of 1998. The initial test area could be at this location to test the detection technologies, central system integration features and the initial signal systems configuration alternative timing plans and systems. Train detection technology could just be installed in one direction for this initial test.
CHAPTER 5 IDENTIFY SOLUTIONS

Solutions to eliminate the underlying cause of the problems are limited to two types: construction solutions and technology solutions.

One of the construction solutions would be to build more grade-separated crossings. Another construction solution would be to elevate the train tracks through the city to make all crossings grade-separated. A third construction solution would be to construct a railroad bypass around the City of Moorhead. Each of these solutions would be very expensive, and the grade-separated solutions are not feasible because they would require the relocation of many businesses in the area. These solutions would also take many years to complete.

This project proposes the concept of an ITS based solution that provides many of the traffic-related benefits of the construction solutions, and at a much lower cost and can also be implemented with greater ease in much less time. The basic concept involves integrating advanced train detection with the signal system; the proposed system would then build on the in-place signal system. Trains would be detected and that information would be conveyed to the traffic signal system. The traffic signal system would then employ a special timing plan that would be developed to serve the traffic movements that exist when trains are passing through the city. A second intent is to advise drivers to divert to the grade-separated crossings during train movements, if possible.

A. FUNCTIONAL AREA AND REQUIREMENTS

TRAIN DETECTION

A non-intrusive technology, advance train-detection system would be installed off railroad property or at least 25 feet from the center of the tracks to provide early train arrival information to trigger system-wide timing plans developed specifically to respond to the presence of east-west train movements. At its simplest, the signal split time would initially change to increase the green time to the north-south streets crossing the tracks before the train arrives and then, once the train activates the crossing gate, the signal split times would change to reduce green time to the north-south streets crossing the tracks and increase green time for the east-west streets not crossing the tracks. Individual intersection signal timing would also be adjusted to establish preferred diversion to grade-separated crossings. Train information would also be used by individual intersection controllers to prevent the controller from going to a particular signal phase where preemption would be more time consuming, thus improving the safety of the full railroad signal preemption system. The system software could provide train locations to emergency vehicle dispatchers either through the monitoring of individual traffic signal pre-empts or through the information supplied by the advance train-detection system.
This train detection system would not be intended to replace the individual signalized intersection railroad preemption systems currently in operation, or affect the operation of any railroad crossing warning devices or gates.

Communication with the Fargo signal system could also be provided. The detection of eastbound trains would require placement of train detection in Fargo.

**Electronic Rail System Map**

The goal is to have the train information that is gathered via the advance train detection system centrally compiled. That compiled information would ideally be displayed in the form of an electronic map of the Fargo-Moorhead area railroad network and street system. The map would show train location, length, direction and speed.

Transit and emergency vehicle dispatchers would be able to use the information on the map to advise their drivers of train locations and possible alternate routes.

The signal system supervisory computer will process the “map” information and direct the appropriate master signal controllers to invoke the special timing plans. The supervisory computer will also provide information to trigger the motorist advisory variable message signs.

**Traffic Signal Interconnection**

All traffic signals within the City of Moorhead would eventually be interconnected to provide remote monitoring of signal operation and remote changing of signal timing plans. Various technologies could be used, including twisted pair, leased phone lines, wireless, etc. However, the existing interconnect coverage is extensive and only a few additional new links are needed. Therefore, the traffic signal interconnect will be through City owned twisted pair cables.

A central system would be installed consisting of closed loop, arterial master controllers to allow for either total citywide control or modular control. The proposed master controllers would be in addition to the existing Mn/DOT master controllers in Moorhead. The City would operate and maintain the entire system.
SPECIAL TRAFFIC SIGNAL TIMING PLANS

A central signal control system would be installed to collect traffic data to be used in the development of improved individual intersection and system-wide timing plans. Alternately, an adaptive control system strategy may be investigated as a possible method of providing more efficient signal timing.

A personal computer based-supervisory system would be installed as an interface between the operator, the master and local controllers. The supervisory system would consist of an overview level of software and would be capable of communicating with the arterial master software of different brands of signal control equipment. The supervisory system would process train detection information and implement the “train present” timing plans.

EMERGENCY VEHICLE PREEMPTION SYSTEM

Emergency vehicle preemption equipment would be installed throughout the City of Moorhead. The City of Fargo currently has emergency vehicle preemption at nearly every signalized intersection, however the City of Moorhead does not have any vehicle preemption equipment.

PROVIDE INFORMATION

Changeable message signs could be placed at strategic locations to provide railroad crossing information to motorists and allow the diversion to alternative routes through one of the railroad grade separations. This would reduce train-auto conflicts as well as driver frustration.

Transit operators could use the train information to select alternate routes with grade-separated crossings. This capability would improve adherence to bus schedules and reduce accident exposure at the at-grade crossings.

Emergency vehicles could use train information to determine where to cross the railroad crossings or to use a grade-separated location.

The personal computer-based supervisory system could feature a GIS (Geographical Information System) for organizing signal system data.

The changeable message signs could also be used to convey information about road closures due to floods and information about other traffic incidents and congestion.
B. SYSTEM INTEGRATION

The system will need to integrate four parts: 1) train detection; 2) traffic control system; 3) controlling Variable Message Signs (VMS) and 4) provide information to transit and emergency vehicle services. The flow of information for the proposed central signal control system is shown in Figure 4.

The traffic control system would integrate signal controller operation, interconnect, emergency vehicle preemption and train preemption. This integration is commonly done without any problems. The main difficulty will be interconnecting dis-similar controllers and cabinets. Some of them may need to be replaced.

C. OPERATING AND MAINTENANCE AGREEMENT

OPERATIONS

Currently, the City of Moorhead and Mn/DOT both operate traffic signals within the project area; they also have master controllers that operate a system of signalized intersections. However, neither the City nor Mn/DOT has a central location to process information and relay information.

The most beneficial method of operation would be to interconnect all of the traffic signals in the City and “control” them from a central location. This location would also be where the train detection information would be sent, and the location from which information could be sent to VMS, transit operator and emergency service operators.

Due to the location of the offices, the City of Moorhead would operate all of the traffic signals in the City, train detection and vehicular information. The central system could be located in City Hall (Center Avenue and 7th Street), which is located in downtown Moorhead. The City will be able to monitor the systems and the performance and make adjustments as necessary.
Figure 4 Proposed Central Signal Control System
MAINTENANCE

The maintenance of the traffic control signal, central system and interconnect system would be completed by the City, but Mn/DOT would reimburse the City proportional to the number of signals that are on Mn/DOT roadways. For state roadways intersecting City streets, the State will be reimbursed based on the numbers of approaches under each agency’s jurisdiction.

The VMS signs will be maintained and paid for by the City. The information systems used for the operations and emergency vehicle operators will be maintained by the City and paid for by the City.
CHAPTER 6 DESCRIPTION OF RELATED EXISTING PROJECTS

A. RAILROAD CROSSING SURVEY – NDSU - UGPTI (Draft Report in Appendix)

The North Dakota State University – Upper Great Plains Transportation Institute is in the process of completing a railroad crossing survey of vehicles in the Fargo-Moorhead downtown area. The objectives of the project are to 1) understand the driving public’s attitude toward rail crossings; 2) use the information in guiding future ITS applications and 3) identify other traffic problems as perceived by the public.

The survey is a mail-back questionnaire asking for drivers experience and attitudes toward delays created by trains. The survey also asked whether providing certain information to drivers would be beneficial.

The survey was also handed to 1,073 non-commercial drivers in both downtown Moorhead and Fargo and 429 business-related drivers. Thirty-six percent of those surveyed sent back responses. From these responses, 72 percent indicated that they would definitely take an alternative route or they might take an alternative route if a message sign gave some information on current traffic conditions.

More than 100 of the respondents (20 percent of those responding) volunteered to participate in small focus groups. These small-group sessions were expected to begin in April or May to determine what ITS technologies would be beneficial to general users. The draft report is included in the Appendix of this report.

B. CENTER AVENUE PROJECT

This project is to reconstruct Center Avenue from 6th Street to east of 11th Street, including revision of four traffic signals. These signals will be interconnected via hard-wiring and possibly connected to a central master location. The 6th and 7th Street intersections are currently operated by the City, while 8th and 11th Streets intersections are operated by Mn/DOT.

The proposed improvement consists of widening Center Avenue from 6th to 8th Street to accommodate a continuous left turn lane. At the intersection of 8th Street and Center Avenue, a left turn lane will be added to both the north and south approaches of 8th Street by restriping. A continuous left turn lane will be provided on Center Avenue from 8th to 11th Street by restriping. Center Avenue (TH 10) will be widened 5 feet on the south side in conjunction with a 5-foot cut out on the north side to provide a parking lane between 9th and 10th Streets. The lane width for this section will be the same as the rest of the improvements. A raised median will be constructed east of 11th Street on Center Avenue to provide channelization of traffic from east to west on Center Avenue. Other improvements include upgrading the signals at the intersections of Center Avenue at
11th Street North, 8th Street North, 7th Street North and 6th Street North from pre-timed signals to traffic actuated signals.

The segment of Center Avenue from 6th to 8th Street will require the removal of trees and planters on the south boulevard to accommodate the continuous left turn lane. The proposed roadway width would be 60 feet. Center Avenue at 8th Street North will be restriped to accommodate left turn lanes on both the north and south approaches on 8th Street North. The existing roadway width on 8th Street North is 60 feet wide and will accommodate the left turn lanes with no reconstruction required.

The segment from 8th to 11th Street has an average roadway width of 60 feet (18.3 meters). It will accommodate five lanes with no widening.

This project is designed and will be constructed summer/fall of 1998. The coordination of this project with the first phase of this proposed Integrated Train Detection and Traffic Control System should be analyzed. This may be a good location to test the technologies and strategies.

C. **Otter Trail Railroad Relocation**

This railroad line runs along the eastside of Southeast Main Avenue in the south section of the City of Moorhead and impacts the Southeast Main Avenue interchange at I-94. This interchange is a folded-diamond due to the tracks. In the future, I-94 will be widened in this location and the interchange will need to be rebuilt. At that time, a full-diamond interchange should be built. The Otter Trail Railroad would be relocated south of the City and assigned to existing tracks that run along the east side of 20th Street.
CHAPTER 7 ITS OBJECTIVES FOR THE FARGO-MOORHEAD AREA

The ITS projects that are operational or under consideration in the Fargo-Moorhead area are divided into five categories: 1) Advanced Traveler Information Systems; 2) Advanced Traffic Management Systems; 3) Advanced Public Transportation Systems; 4) Emergency Response Systems; and 5) ITS Infrastructure. There are 12 projects in operation and another 11 in the works, including this project. The Fargo-Moorhead area is currently preparing a Metropolitan ITS Comprehensive Plan.

A. ADVANCED TRAVELER INFORMATION SYSTEMS

The primary function of these systems is to provide travelers with information concerning weather conditions, road conditions, incidents and emergencies.

1. Advanced Transportation Weather Information System

   The system is operated by the University of North Dakota for the states of North Dakota and South Dakota. The system provides travelers with road and weather condition information using automated voice message and cellular communications. The system has been operational since 1995.

2. Cass County Road Conditions

   The system will be operated by the Cass County Highway Department and will provide travelers with county road condition information using automated voice messaging.

3. Transportation Information Broadcasts

   The system will be operated by the City of Moorhead. The system will provide travelers with incident/emergency information via AM radio broadcasts.

4. Cable Access Information

   The system would provide travelers with incident/emergency information.

5. Mn/DOT Road Condition Information

   The system is being operated by Mn/DOT. The system, which is currently being tested, will provide travelers with road condition information.
B. **Traffic Management Systems**

The primary function of these systems is to alert travelers to long-term traffic disruptions, improve traffic data collection and provide centralized control for coordination of traffic signals. The Moorhead Area Integrated Train Detection and Traffic Control System Project would be included in this category.

1. **Incident Management Trailers**

   The system is operated by F-M COG agencies. The system provides changeable message signs to detour congestion created by incidents. The system has been operational since 1996.

2. **Portable Message Signs**

   The system is operated by NDDOT and Mn/DOT. The system alerts travelers to longer-term traffic disruptions using changeable message signs. The system has been operational since 1995.

3. **Advanced Transportation Analysis Center**

   The Center will be operated by the Upper Great Plains Transportation Institute at North Dakota State University. The Center will provide forecast and alternative analysis for transportation systems using computerized transportation models.

4. **Fargo Signal System**

   The system will be operated by the City of Fargo and will provide traffic signal coordination and monitoring.

C. **Advanced Public Transportation Systems**

The primary function of these systems is to decrease driver workload, increase fare reporting accuracy, provide rate and scheduling information and improve scheduling efficiency.

1. **Electronic Fare Boxes**

   This system, which is operated by Fargo Transit, automatically determines the amount in the fare boxes and reports this information to the Fargo Transit central computer system. This system has been operational since 1986.
2. **Electronic Fare Boxes**

   The system is operated by Moorhead Transit and is similar to the Fargo system. It has been operational since 1998.

3. **Automatic Vehicle Location Test**

   Operated by Fargo Transit, the system identifies the location of the transit vehicle and displays it automatically on a map using GPS (Global Positioning System) and automated mapping via radio data communication. The system has been operational since 1998.

4. **Paratransit Scheduling System**

   The system will be operated by Fargo/Moorhead Transit. It will accept input from reservation operators and generate optimized trip manifests for drivers using route optimizing computer software; the system will be operational in June of 1998.

5. **Transit Web Site**

   The system will be operated by Fargo/Moorhead Transit and will display route maps and schedules through the internet using the www server.

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**D. EMERGENCY RESPONSE SYSTEMS**

The primary function of these systems is to interrupt normal signal operation for priority emergency vehicles and to increase information to police officers.

1. **Signal Pre-emption System**

   The system is operated by the City of Fargo. The system overrides signal timing to provide a green indication for approaching emergency vehicles using a 3M Opticom system; it has been operational since the late 1980s.

2. **Mobile Data Computers**

   The system operated by the Moorhead Police Department provides officers with driver/vehicle information and vehicle-to-vehicle communication using in-vehicle notebook computers and digital radio. The system has been operational since 1996.
E. **ITS INFRASTRUCTURE**

The primary function of these systems is to create base equipment to provide components/information for other systems.

1. **Clay County GIS (Geographic Information System)**

   The system will create a data base where information can be assigned to geographical locations using differential GPS and ArcCad/ArcView Geographic. The system will be operated by Clay County.

2. **Clay County Differential GPS Tower**

   The system will enable differential GPS receivers to generate very accurate positional data using differential GPS. The system will be operational spring of 1998. The system will be operated by Clay County.

3. **Fargo Fiber-Optic Communication System**

   This system provides communication from a central control center to the individual traffic signals using 12 pair fiber-optic cable. The system has been operational since 1996. The system is operated by Fargo.

4. **Fargo GIS**

   This system provides mapping and geographic analysis of utilities and transportation elements using AutoCAD/ ArcView. The system has been operational since early 1990s and is operated by the City of Fargo.

5. **Moorhead-Optic Communication System**

   Operated by the City of Moorhead, the system(s) provide communication for the Government Center, Wastewater Plant and Law Enforcement Center. The system is operational.

6. **Moorhead GIS**

   The system provides mapping and geographic analysis of utilities and transportation elements. The system is operational and is operated by the City of Moorhead.
## CHAPTER 8 SCHEDULE

The following is an estimated schedule of major events for the implementation of this project.

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
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<tbody>
<tr>
<td>Scoping Document – Completion</td>
<td>May 1998</td>
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<tr>
<td>Project Approval – Guidestar Steering Committee</td>
<td>May 28, 1998</td>
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<tr>
<td>Consultant Selection</td>
<td>July, 1998</td>
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<tr>
<td>Design for Test Location</td>
<td>August 1998 to January 1999</td>
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<tr>
<td>Construction of Test Location – Completion</td>
<td>October 1999</td>
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<tr>
<td>Testing and Evaluation of Test Location</td>
<td>October 1999 to June 2000</td>
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<tr>
<td>Design of Moorhead System</td>
<td>June 2000 to October 2000</td>
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<tr>
<td>Construction of Moorhead System Completion</td>
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<tr>
<td>Expansion of the System to Fargo, etc.</td>
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CHAPTER 9 COST

A. CONSTRUCTION BASED SOLUTION

The estimated cost of grade-separating the railroad over the existing roadways in downtown Moorhead is $51,000,000 based on a 1998 F-M COG study. This includes construction of the approaches, construction of the bridging structure and construction of the new tracks.

The estimated cost of grade-separating the railroad track and one roadway in the downtown area is currently not feasible because of grade differential, the cost of relocating businesses and disruption to the CBD.

The estimated cost of re-routing the railroad tracks around the Fargo-Moorhead area is $1.2 billion based on a F-M COG study. This would include relocating 42 miles of railroad tracks and two rail yards in the City of Dilworth and the City of Fargo. This solution would take many years to complete.

B. ITS-BASED SOLUTION

The following costs have been identified, however it should be noted that these estimated costs are strictly at a planning and programming level.

1. Signal Interconnect (I/C)  
   New segments to connect existing sections and to serve intersections not yet connected. 18,000 feet @ $10.00/ft installation costs $84,000

2. Master Controllers - 4 (in addition to existing Mn/DOT masters)  
   2 at remote locations @ $15,000/cabinet  
   2 at City Hall @ $10,000  
   $50,000

3. Central Control Personal Computer Work Station, RR detection system software and Supervisory System Software  
   31 intersections @ $2,000/intersection +$20,000 for control center  
   $82,000

4. Early Train Detection System Detectors  
   4 possible locations @ $20,000 per location  
   $80,000

5. Railroad advisory changeable message signs  
   8 locations @ $25,000  
   $200,000

6. Emergency vehicle pre-emption equipment
Moorhead Area Integrated Train Detection and Traffic Control System
Executive Report

31 intersections at $7,500/intersection $232,000

7. Sidewalk replacement to meet ADA requirements
   20,000 lineal feet @ $12/ft. $240,000

8. Miscellaneous Items $110,000

   Sub-Total Hardware, Software
   Construction Costs and Contingency Costs $1,078,000*

9. Engineering and Consultant Costs
   Feasibility and Preliminary Design (by Consultant) $40,000
   Central Signal System Design (by Consultant)
      (Estimated @ 10 percent of construction cost) $65,000
   Emergency Vehicle Pre-Emption Design @ about $1,500 intersection
      (31 intersections by Consultant) $45,000
   Development and installation of individual intersection and system
   timing plans (by Consultant)
      (Estimated @ $2,000/intersection 20 intersections + masters) $53,000
   Construction Engineering (by City) @ 7 percent $76,000
   Sidewalk Design $20,000

   Sub-Total Engineering and Consultant Costs $320,000

**TOTAL PROJECT COST** $1,377,000

* This number does not include any reconstruction of any individual intersection
  systems and also does not include engineering costs.
ESTIMATED COST PARTICIPATION

C. PRIVATE PARTNERSHIPS

During the development of this proposed project there has been an effort to obtain private participation. The Burlington Northern Santa Fe Railroad has been contacted and representatives have indicated that they are in favor of the project concept, but would have reservations about direct participation beyond BNSF’s normal involvement in at-grade railroad traffic control devices. However, they feel that if the project is successful in the Moorhead area, similar systems could be installed elsewhere. The manufacturer of the City of Moorhead’s controllers is Peek Traffic Control Products. They have been contacted informally regarding possible contributions to the project. They have indicated interest, but would prefer to respond when the desired extent of their participation can be better defined. Changeable message sign manufacturers have not been contacted. One supplier of passive train detection equipment has expressed an interest as well.
CHAPTER 10  ASSESSMENT OF POTENTIAL BENEFITS

The assessment was done to determine the potential benefits of preparing a timing plan for a train blocking the north-south roadway. The new timing plan would give more time to the east-west roadway, thus allowing vehicles to divert to a grade-separated crossing or at least allow vehicles that are not impacted by the train blockage to continue.

The assessment took a sample of the entire project area. Eighteen intersections in downtown Moorhead are impacted by trains; benefit assessment considered at four intersections that are not railroad preempted: Center Avenue at 6th Street, 7th Street, 8th Street and 11th Street.

The assessment was completed using both Traf-Netsim and Synchro computer software. This evaluation consisted of three scenarios:

1) Existing conditions without a train
2) Existing conditions with a train
3) Existing conditions with a train, except signal timing is optimized for northbound traffic

The existing condition uses the following:

1) Existing geometrics
2) P.M. peak hour turning movement volumes collected by the F-M COG in March/April 1998
3) Existing phasing and timing parameters provided by the City of Moorhead and Mn/DOT

For the train condition, we removed the northbound volumes for 4 minutes. This was to simulate the average blockage caused by a train. The updated signal timing was created by optimizing the system with the new volumes.

The Synchro analysis showed a reduction in total delay for the system of approximately 500 seconds (8 minutes 20 seconds) for one 4-minute blockage for the updated signal timing. The analysis also showed approximately 20 fewer stops. Most of the reduction in delay is at the Center Avenue and 8th Street intersection.
The benefit of the improved signal timing was determined by using the sample of the four intersections to determine the reduced average intersection delay. This was determined to be approximately 2 minutes per 4-minute blocked and five fewer stops. Eighteen intersections impacted by the train blockages can be improved by the proposed signal timing.

- No. of intersections: 18
- No. of trains per day: 60
- Average length of train blockage: 4 minutes
- Average reduced delay: 30 seconds per minute per blocked intersection
- Average reduced stops: 1.25 stops per minute blocked per intersection
- Cost of delayed time: $12.00 per hour
- Cost of stop: $0.05 per stop
- Days of the Year: 365

**Benefit in the Reduction of Delay**

\[(\text{Number of intersections}) \times (\text{average reduced delay}) \times (\text{average train length}) \times (\text{number of trains per day}) \times (\text{cost of delayed time}) \times (\text{number of days}) = \]

\[18 \times \frac{1}{2} \text{ minute} \times 4 \text{ minutes} \times 60 \times \$0.20/\text{minute} \times 365 = \$157,680 \text{ per year}\]

**Benefit in the Reduction of Stops**

\[(\text{Number of intersections}) \times (\text{average reduced stops}) \times (\text{average train length}) \times (\text{number trains per day}) \times (\text{cost of a stop}) \times (\text{number of days}) = \]

\[18 \times 1.25 \times 4 \text{ minutes} \times 60 \times \$0.05 \text{ per stop} \times 365 = \$98,550 \text{ per year}\]

The total benefit from the new traffic signal timing would be approximately $250,000 per year.

The expected payback time using just the benefits of the reduction of delay and stops would be 2.8 years. This is based on using $700,000 for the estimated cost of the central system project divided by the $250,000 for the estimated benefits.
APPENDIX

• DRAFT REPORT
  ANALYSIS OF MOTORIST ATTITUDES TO ITS
  APPLICATION TO RAIL-HIGHWAY CROSSING IN THE
  FARGO-MOORHEAD METROPOLITAN AREA

• F-M COG TURNING MOVEMENT COUNTS

• EVALUATION – SYNCHRO 3 ANALYSIS

• SUMMARY OF DRIVER SURVEY
  TRANSIT DELAYS DUE TO TRAIN CROSSINGS
## ESTIMATED COST PARTICIPATION

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