Chapter 4
Identification of Concerns

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4.1 Introduction

This chapter identifies areas of the transportation system that do not meet the typical industry standards of traffic engineering and transportation planning, and also the expectations and/or perceptions of the community. In general, it is important to identify issues and concerns before mitigation strategies can be developed. The identification of "concerns" is the result of intensive data collection, analysis, field observation, and public input. Over the development of this Transportation Plan Update, these tools have been used to assess all of the collected data to develop an understanding of the "concerns" with the existing transportation system. This becomes a necessary step and forms the basis for developing mitigation strategies. The development of mitigation (i.e. project recommendations) becomes the follow-up step to plan for correction of the identified concerns. Identified concerns may fall into one or more of the following categories:

- Intersection levels of service
- Signal warrant analysis
- Corridor levels of service
- Safety (i.e. crash analyses)

Each of these areas is expanded upon in this chapter.

4.2 Intersection Levels of Service

Roadway systems are ultimately controlled by the function of the major intersections. Intersection failure directly reduces the number of vehicles that can be accommodated during the peak hours that have the highest demand and the total daily capacity of a corridor. As a result of this strong impact on corridor function, intersection improvements can be a very cost-effective means of increasing a corridor's traffic volume capacity. In some circumstances, corridor expansion projects may be able to be delayed with correct intersection improvements. Due to the significant portion of total expense for roadway construction projects used for project design, construction, mobilization, and adjacent area rehabilitation, a careful analysis must be made of the expected service life from intersection-only improvements. If adequate design life can be achieved with only improvements to the intersection, then a corridor expansion may not be the most efficient solution. With that in mind, it is important to determine how well the major intersections are functioning by determining their Level of Service (LOS).

Level of service (LOS) is a qualitative measure developed by the transportation profession to quantify driver perception for such elements as travel time, number of stops, total amount of stopped delay, and impediments caused by other vehicles. It provides a scale that is intended to match the perception by motorists of the operation of the intersection. Level of Service provides a means for identifying intersections that are experiencing operational difficulties, as well as providing a scale to compare intersections with each other. The level of service scale represents the full range of operating conditions. The scale is based on the ability of an intersection or roadway segment to accommodate the amount of traffic using it. The scale ranges from "A" which indicates little, if any, vehicle delay, to "F" which indicates significant vehicle delay and traffic congestion. The LOS analysis was conducted according to the procedures outlined in the Transportation Research Board's Highway Capacity Manual – Special Report 209 using the Highway Capacity Software, version 4.1c.

In order to calculate the LOS, 18 intersections on the Major Street Network were counted during the spring of 2009. These intersections included 6 signalized intersections and 12 high-volume unsignalized intersections in the Hamilton area. Each intersection was counted between 7:00 a.m. to 9:00 a.m. and 4:00 p.m. and 6:00 p.m., to ensure that the intersection's peak volumes were represented. Based upon this data, the operational characteristics of each intersection were obtained.

The LOS study in the Hamilton area shows that two signalized and three unsignalized intersections are currently functioning at LOS D or lower. These five intersections indicate potential opportunities for closer examination and further intersection improvement measures to mitigate "operational" conditions. These are shown in **Table 4-1**.

Table 4-1
Existing Intersections Functioning at a LOS D or Lower

Intersection		AM Peak	PM Peak
US 93 & Pine Street	S	F	D
US 93 & Golf Course Road/Hope Avenue	S	E	C
US 93 & Riverside Cutoff	U	C	E
Kurtz Lane & Marcus Street/Eastside Highway	U	F	D
Eastside Highway & Black Lane/Bass Lane	U	C	E

(S)ignalized
(U)nsignalized

In addition to operational characteristics identified through the Level of Service analysis described in **Chapter 2** and reiterated above, field reviews were performed at each of the eighteen (18) subject intersections. Observations were made and recorded, and are presented on the following pages.

4.2.1 Signalized Intersections Field Observations

US-93 & Fairgrounds Road/Adirondac Avenue

- Vehicles observed running yellow and red (mostly) phases of signal cycle. This occurred primarily on the Fairgrounds Road and Adironac Avenue legs of the intersection.
- Some vehicle conflicts noted when eastbound vehicles turning north maneuver in front of thru westbound vehicles.
- Stacking of vehicles observed on the east and west legs of the intersection.

US-93 & Pine Street

- Numerous access points directly adjacent to intersection causes some conflicting vehicle maneuvers (gas station, paint store, realty office).
- Sight distance concerns with vehicles leaving adjacent access and turning traffic on US Highway 93.
- If there is traffic backed up on southbound US Highway 93, drivers tend to use gas station approach to travel to Pine Street (westbound movement).

US-93 & Main Street/Marcus Street

- Eastbound traffic on Main Street has sight distance concerns due to Marcus Street roadway curve and large tree on the west leg of the intersection.
- Parking on Main Street is very close to the intersection and causes some sight distance issues.

US-93 & Ravalli Street

- Numerous access points directly adjacent to intersection cause some conflicting vehicle maneuvers (gas station and restaurant).

US-93 & Golf Course Road/Hope Avenue

- Perception of inadequate signal operations by drivers at traffic signal. Observed several drivers get out of their car to press the pedestrian crosswalk button to make a left turn coming from the west.

2nd Street & Main Street

- Noted sight distance concerns at intesection due to diagonal street parking being close to the intesection quadrants. Also observed vehicles inching out into the intersection to make tight-turn-on red (RTOR) very frequently.

4.2.2 Unsignalized Intersections Field Observations

US-93 & Riverside Cutoff

- This was a fairly busy intersection with large trucks using the Riverside Cutoff leg – presumably hauling pit run material to construction sites.
- Side street traffic (i.e. Riverside Cutoff leg) observed using the middle lane on US Highway 93 as a storage lane to merge in southbound US Highway 93 traffic flow.
- Appearance of speeding vehicles on US Highway 93, both travelling out of town (northbound) and into town (southbound). No speed studies were performed to verify this observation.

Old Corvallis Road/Mill Street & Fairgrounds Road

- Westbound traffic on Fairgrounds Road appears to travel fast. No speed studies were performed to verify this observation.
- Poor definition at intersection. Northbound drivers were observed short-cutting the stop sign on the southeast quadrant by turning through the gravel parking area.
- Numerous vehicles were observed backing up on the east leg of Fairgrounds Road due to congestion at US Highway 93.

Freeze Lane & Fairgrounds Road

- Observed the two westerly school entrances on Fairgrounds Road used most often for school access. The school entrance on south Freeze lane also used for school traffic. The intersection of Freeze Lane and Fairgrounds Road doesn’t encounter much “school related” traffic.
- Noted a maximum of 3 cars queued up on the Freeze Lane leg with Fairgrounds road during peak hours.

Eastside Highway & Fairgrounds Road

- Appearance of speeding vehicles on Eastside Highway near the intersection with Fairgrounds Road. No speed studies were performed to verify this observation.
- Sight distance concerns are present for those vehicles on Fairgrounds Road wanting to turn left onto Eastside highway due to the curve and grade differential on Eastside Highway to the south.

- During peak hours 7 cars were observed to stack up on the eastbound leg of Fairgrounds Road, waiting to turn left onto Eastside Highway (i.e. northbound).

Kurtz Lane & Eastside Highway

- The left-turn lane on southbound Kurtz Lane was not observed to be used. For the northbound leg of Kurtz Lane, there is a slight alignment issue that causes drivers to veer slightly to the right as they continue northbound through the intersection.

- There was a fair amount of school related traffic observed at the intersection (i.e. school buses, parents, etc.).

- Drivers on the south leg of Kurtz Lane sometimes had difficulty seeing west on Marcus Street due to sight distance obstructions on adjacent private property (fence and tree).

Eastside Highway & Black Lane/Bass Lane

- Appearance of speeding vehicles on Eastside Highway near the intersection with Black Lane/Bass Lane. No speed studies were performed to verify this observation.

- Bass Lane and Black Lane are slightly offset and do not align. This causes some operation difficulties when vehicles are present on both legs of this intersection.

- The eastbound leg of Black Lane has a large gravel right turn area that is often times used by right-turning vehicles trying to get though the intersection quicker.

3rd Street & Main Street

- Observed vehicles inching out into the intersection to make right-turns (very frequently).

- Observed vehicular traffic backed up through the intersection during peak hours due to timing and traffic volume at the adjacent intersection of 2nd Street and Main Street.

4th Street & Main Street

- Observed vehicles inching out into the intersection to make right-turns (very frequently).

Big Corral Road & Golf Course Road

- Intersection could be improved with presence of turn lanes and/or other channelization features. It exhibits a very large pavement area.

Kurtz Lane & Golf Course Road

- There was a fair amount of school related traffic observed at the intersection (i.e. school buses, parents, etc.).
- Grantsdale Road appears to generate a lot of traffic between Kurtz Lane and Big Corral Road.
- Alignment issues between Grantsdale Road and Kurtz Lane. Re-alignment of these two legs opposite each other would drastically improve intersection operations.

Eastside Highway & Tammany Lane

- Appearance of speeding vehicles on Eastside Highway near the intersection with Tammany Lane. No speed studies were performed to verify this observation.
- Vehicles observed going slow as they travelled north (uphill) on Eastside Highway (after turning from Tammany Lane), with vehicles pulling up behind them and hitting their brakes.
- Some confusion over Tammany Lane and the adjacent private residence driveway. Observed drivers pulling into residence driveway thinking it was Tammany Lane.

Eastside Highway & Airport Road

- Observed some vehicles stacked on Eastside Highway desiring to turn on to Airport Road. Several thru vehicles observed "tailgating" the turning vehicles due to speed differentials.
- Also observed vehicles go around turning cars in both directions (i.e. passing in opposite travel lane).

4.3 Signal Warrant Analysis

A planning level signal warrant analysis was conducted using the data available from turning movement counts to determine if any of the existing unsignalized intersections with unacceptable Levels of Service (LOS) met signal warrants. None of the study intersections met warrants for future signalization at the present time, but should be monitored as the community grows as suggested in Chapter 5 of this Transportation Plan. Several public comments were voiced that certain intersection "needed signals", however according to the 2003 Edition of the *Manual on Uniform Traffic Control Devices (MUTCD)*, there are eight (8) signal warrants that must be analyzed for the installation of a traffic control signal. The MUTCD states that a traffic signal should not be installed unless <u>one or more</u> warrants are satisfied.

The eight (8) signal warrants that must be analyzed are as follows:

1. EIGHT-HOUR VEHICULAR VOLUME

This warrant is intended for application at locations where a large volume of intersection traffic is the principal reason to consider the installation of a traffic signal (Condition A) or where the traffic volume on the major street is so heavy that traffic on the minor street experiences excessive delay or conflict in entering or crossing the major street (Condition B) during any eight (8) hours of an average day. The criteria for Warrant 1 may be met if either Condition A or Condition B is met. The combination of Condition A and B are not required. This warrant was not analyzed due to insufficient project data.

2. FOUR- HOUR VEHICULAR VOLUME

This warrant is intended for locations where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal. This warrant requires that the combination of the major-street traffic (total of both approaches) and the higher-volume minor-street traffic (on direction only) reach the designated minimum volume during any four (4) hours of an average day. This warrant was based upon a combination of AM and PM peak hour volumes to account for the four-hour period. This warrant was not met for any of the unsignalized intersections identified for study.

3. PEAK HOUR

This warrant is intended for use at a location where during any one (1) hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street. This warrant also requires that the combination of the major-street traffic (total of both approaches) and the higher-volume minor-street traffic (on direction only) reach the designated minimum volume. The peak hour warrant was conducted assuming that this peak hour would fall within the peak periods. This warrant was not met for any of the unsignalized intersections identified for study.

4. PEDESTRIAN VOLUME

The Pedestrian Volume signal warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street. This warrant was not analyzed due to insufficient project data.

5. SCHOOL CROSSING

This warrant addresses the unique characteristics that a nearby school may have on the roadways. It requires that the major roadway be unsafe to cross and that there are no other feasible crossings in the area. This warrant was not analyzed due to insufficient project data.

6. Coordinated Signal System

Progressive movement in a coordinated signal system sometimes necessitates installing traffic control signals at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles. This warrant was not met for any of the intersections under consideration.

7. Crash Experience

The Crash Experience signal warrant conditions are intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal. This warrant was not met for any of the unsignalized intersections identified for study.

8. Roadway Network

This warrant is intended for locations where the installation of a traffic signal may encourage concentration and organization of traffic flow on a roadway network. This warrant was not met for any of the intersections under consideration.

Note that as the community grows, the installation of a traffic signal is not always the best mitigation for operational and/or safety concerns. Since vehicular delay and the frequency of some types of crashes are sometimes greater under traffic signal control than under STOP sign control, consideration should be given to providing alternatives to traffic control signals, even if one or more of the signal warrants has been satisfied. Some of the available alternatives may include, but are not limited to, the following:

- Installing signs along the major street to warn road users approaching the intersection;
- Relocating the stop line(s) and making other changes to improve the sight distance at the intersection;
- Installing measures designed to reduce speeds on the approaches;
- Installing a flashing beacon at the intersection to supplement STOP sign control;
- Installing flashing beacons on warning signs in advance of a STOP sign controlled intersection on major- and/or minor-street approaches;
- Adding one or more lanes on a minor-street approach to reduce the number of vehicles per lane on the approach;

- Revising the geometrics at the intersection to channelize vehicular movements and reduce the time required for a vehicle to complete a movement, which could also assist pedestrians;
- Installing roadway lighting if a disproportionate number of crashes occur at night;
- Restricting one or more turning movements, perhaps on a time-of-day basis, if alternate routes are available;
- If the warrant is satisfied, installing multi-way STOP sign control;
- Installing a roundabout; and
- Employing other alternatives, depending on conditions at the intersection.

4.4 Corridor Volumes, Capacity and Levels of Service

The corridors shown on **Figure 2-1** and **Figure 2-2** in Chapter 2 were evaluated for Average Daily Traffic (ADT) volumes under comparison with facility size and general planning level estimates. Roadway capacity is of critical importance when looking at the growth of a community. As traffic volume increases, the vehicle flow deteriorates. When traffic volumes approach and exceed the available capacity, the roadway begins to "fail". For this reason it is important to look at the size and configuration of the current roadways and determine if these roadways need to be expanded to accommodate the existing or future traffic needs. The capacity of a roadway is a function of a number of factors including intersection function, land use adjacent to the roadway, access and intersection spacing, roadway alignment and grade, speed, turning movements, vehicle fleet mix, adequate roadway design, land use controls, roadway network management, and good planning and maintenance. Proper use of all of these tools will increase the number of vehicles that a specific lane segment may carry. However, the number of lanes is the primary factor in evaluating roadway capacity since any lane configuration has an upper volume limit regardless of how carefully it has been designed.

The size of a roadway is based upon the anticipated traffic demand. It is desirable to size the arterial network to comfortably accommodate the traffic demand that is anticipated to occur 20 years from the time it is constructed. The selection of a 20-year design period represents a desire to receive the most benefit from an individual construction project's service life within reasonable planning limits. The design, bidding, mobilization, and repair to affected adjacent properties can consume a significant portion of an individual project's budget. Frequent projects to make minor adjustments to a roadway can therefore be prohibitively expensive. As roadway capacity generally is provided in large increments, a long term horizon is necessary. The collector and local roadway network are often sized to meet the local needs of the adjacent properties.

There are two measurements of a roadway's capacity, Average Daily Traffic (ADT) and Peak Hour. ADT measures the average number of vehicles a given roadway carries over a 24- hour period. Since traffic does not usually flow continuously at the maximum rate, ADT is not a statement of maximum capacity. Peak Hour measures the number of vehicles that a roadway can physically accommodate during the busiest hour of the day. It is therefore more of a maximum traffic flow rate measurement than ADT. When the Peak Hour is exceeded, the traveling public will often perceive the roadway as "broken" even though the roadway's ADT is within the expected volume. Therefore, it is important to consider both elements during design of corridors and intersections.

The size of the roadway and the required right-of-way is a function of the land use that will occur along the roadway corridor. These uses will dictate the vehicular traffic characteristics, travel by pedestrians and bicyclists, and need for on-street parking. The right-of-way required should always be based upon the ultimate facility size. The actual amount of traffic that can be handled by a roadway is dependent upon the presence of parking, number of driveways and intersections, intersection traffic control, and roadway alignment. The data presented in **Table 4-2** indicates the approximate volumes that can be accommodated by a particular roadway in "Vehicles per Day (VPD)". As indicated in table, the actual traffic that a roadway can handle will vary based upon a variety of elements including: roadway grade; alignment; pavement condition; number of intersections and driveways; the amount of turning movements; and the vehicle fleet mix. Roadway capacities can be increased under "ideal management conditions" (Column 2 in **Table 4-2**) that take into account such factors as limiting direct access points to a facility, adequate roadway geometrics and improvements to sight distance. By implementing these control features, vehicles can be expected to operate under an improved Level of Service and potentially safer operating conditions.

Table 4-2
Approximate Volumes for Planning of Future Roadway Improvements

Road Segment	Historical Management Volumes	Ideal Management Volumes
Two Lane Road	Up to 12,000 VPD	Up to 15,000 VPD
Three Lane Road	Up to 18,000 VPD	Up to 22,500 VPD
Four Lane Road	Up to 24,000 VPD	Up to 30,000 VPD
Five Lane Road	Up to 35,000 VPD	Up to 43,750 VPD

Table 4-2 shows capacity levels which are appropriate for planning purposes in developing areas within the study area. In newly developing areas, there are opportunities to achieve additional lane capacity improvements. The careful, appropriate, and consistent use of the capacity guidelines listed above can provide for long-term cost savings and help maintain infrastructure at a scale comfortable to the community.

Two important factors to consider in achieving additional capacity are peak hour demand and access control. Traffic volumes shown in **Table 4-2** are 24-hour averages; however, traffic is not smoothly distributed during the day. The Major Street Network shows significant peaks of demand, especially the work "rush" hour. These limited times create the greatest periods of stress on the transportation system. By concentrating large volumes in a brief period of time, a roadway's short-term capacity may be exceeded and a roadway user's perception of congestion is strongly influenced. The use of pedestrian and bicycle programs as discussed in **Chapter 5** and TDM measures can help to smooth out the peaks and thereby extend the adequate service life of a specific roadway configuration. The Transportation Plan strongly recommends the pursuit of such measures as low-cost means of meeting a portion of expected transportation demand.

Each time a roadway is intersected by a driveway or another roadway it raises the potential for conflicts between transportation users. The resulting conflicts can substantially reduce the roadway's ability to carry traffic if conflicts occur frequently. This basic principle is the design basis for the interstate highway system, which carefully restricts access to designated entrance and exit points. Arterial roadways are intended to serve the longest trip distances in an area and the highest traffic volume corridors. Access control is therefore very important on the higher volume elements of a community's transportation system. Collector roadways, and especially local roadways, do provide higher levels of immediate property access required for transportation users to enter and exit the roadway network. In order to achieve volumes in excess of that shown in Column 3 of **Table 4-2**, access controls should be put in place by the appropriate governing body. It is strongly recommended that access control standards appropriate to each classification of roadway be incorporated into the subdivision and zoning regulations of the City of Hamilton and Ravalli County. Ravalli County already has adopted access management criteria in its Access Encroachment Policy. Follow up monitoring of the effects of access control will aid in future transportation planning efforts.

4.5 Vehicle Crash Analysis

The MDT Traffic and Safety Bureau provided crash information and data for use in the Hamilton Area Transportation Plan (2009 Update). The crash information was analyzed to identify intersections with crash characteristics that may warrant further study. General crash characteristics were determined along with probable roadway deficiencies. The crash information covered the three-year time period from January 1st, 2006 to December 31st, 2008. For this analysis, only eighteen intersections were included. These intersections are as shown in **Table 2-8** in **Chapter 2** of this Transportatio Plan Update, and constitute the eighteen major signalized and un-signalized intersections that were defined for this analysis within the project scope of work. Several intersections were identified to warrant further study to specifically address crash trends, and these are listed below. The locations of these intersections are shown on **Figure 2-8** and **Figure 2-9** in **Chapter 2**.

- Eastside Highway & Black Lane/Bass Lane
- Eastside Highway & Fairgrounds Road
- Eastside Highway & Tammany Lane
- Kurtz Lane & Golf Course Road
- US 93 & Golf Course Road/Hope Avenue
- US 93 & Main Street/Marcus Street
- US 93 & Adirondac Avenue/Fairgrounds Road

4.6 References

Federal Highway Administration (FHWA). *Manual on Uniform Traffic Control Devices 2003 Edition,* Washington D.C.

Morrison Maierle, Inc. June 2002. *Hamilton Transportation Plan 2002, Chapter 2,* Hamilton, Montana.

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