Ferndale City Council

REQUEST FOR COUNCIL ACTION

Department Prepared By: CITY CLERK'S OFFICE

AGENDA BILL #16-05-007

TITLE:

☐ **Ordinance** ☐ **Resolution** ☐ **Motion** ☐ **Info Only** ☒ **Discussion**

Date Council Action Requested: May 16, 2016
Prepared by: Susan Duncan, City Clerk **Reviewed By:** **Date:**

SUBJECT:

Main Street Traffic Light Operations

	Committee: P&LU PW&U F&A	
	Mayor	
	City Administrator	
	City Clerk's Office	
	Community Development Dept	
	Public Works Department	
	City Attorney's Office	
	Finance Director	
	Police Department	
	Board/Commission	
	Hearings Examiner	

ACTION REQUESTED: **VOTE NEEDED TO PASS:**

SUMMARY: Please see staff report.

DISCUSSION/ANALYSIS/ISSUES: Transpo Group was asked to perform an analysis of the current traffic light system and operations on Main Street, and to provide recommendations for upgrades and improvements.

RECOMMENDATIONS:

ATTACHMENTS:
Staff Report
Transpo Group Memo

C

City of Ferndale
CITY COUNCIL STAFF REPORT

MEETING DATE: May 16, 2016 AGENDA ITEM #_____

EXECUTIVE SESSION: YES-**NO**-N/A REASON: LAND-PERSONNEL-LITIGATION
COMMITTEE: _____ APPROVED: _____

SUBJECT: Traffic Light Study

DATE: May 13, 2016

FROM: Kevin Renz

PRESENTATION BY: Kevin Renz

RECOMMENDATIONS:

Council consider modifications to signal timing and hardware to provide improved signal operations along the Main Street corridor.

BACKGROUND:

Traffic delays through the Main Street corridor have been a source of frustration for the citizens of the City of Ferndale for a considerable time. Council has requested that Staff prioritize the investigation of signal upgrades as a tool for reduction of traffic delays. This report details that investigation and provides some recommendations for improvement. The next steps in this process will be development of an implementation plan for integration of projects into Capital Improvement Plan and budgets.

ANALYSIS:

Transpo Group was asked to perform an analysis of the traffic signaling system and provide recommendations for upgrades that could provide positive benefits for Main Street traffic flow. The report details currently installed hardware, detection equipment, and communication within the signaling system.

Several key deficiencies were identified during the study including loop detection that ties the left turn and straight line traffic to the same detector card, older smaller cabinets located in the western portion of Main Street which limit upgrade pathways, and traffic signal timing plans which are not fully optimized for current traffic volumes.

The report generally reinforces the concept that the existing signaling hardware is inefficient and that replacement would provide the highest level of benefit but also with the highest cost of implementation. Also identified was the opportunity for small low cost improvements to be made with existing components. These lower cost improvements could potentially provide up to a 10% reduction in delay.

ALTERNATIVES CONSIDERED:

A variety of options were identified within the report that would provide positive benefit ranging from timing optimization to full replacement of signal hardware; improvements can be phased in over a period of time. A list of signal upgrades including recommended order of implementation is included in the report. This list details steps that could be taken in the short term including relatively low cost timing improvements and improvements to detection hardware. Further longer term steps include replacement of signal controllers and cabinets to allow for advanced signaling systems to be implemented.

FISCAL REVIEW:

Signal upgrades were not included in the 2016 budget or 2016 Capital Improvement Plan resulting in no identified funding source. Should Council direct Staff to proceed with signal upgrades a proposal will be developed and forwarded to Finance for review.

Costs for optimization of the timing plan could be completed for $10,000 to $20,000 depending on level of effort. Additionally, modifications to loop detection and cabinets could be completed for approximately $25,000.

More extensive modification of the system including new cabinets, controllers, and communication hardware would require expenditures in excess of $650,000. It is important to note that large modifications to the system would require that all intersections be brought into full ADA compliance adding further cost. Current ADA compliance was not analyzed as part of this study.

LEGAL REVIEW:

CONCLUSION:

Upgrades to the signaling system along the Main Street corridor will result in reductions in delay, but under no circumstance will upgrades eliminate congestion. It is important to note that signal upgrades do not impact the root causes of traffic congestion within the corridor. Factors such as undersized infrastructure at the BNSF crossing and the Nooksack River bridge will continue to play a more significant role in traffic. With that said, positive benefits can be realized through signal upgrades.

MEMORANDUM

Date:	May 13, 2016	**TG:**	08213.01
To:	Kevin Renz, City of Ferndale		
From:	Daniel Lai, Transpo Group		
cc:	Patrick Lynch, Transpo Group Xiaoyi Liu, Transpo Group		
Subject:	City of Ferndale - Main Street Signal System Pre-Design Study		

Transpo Group was scoped to conduct a pre-design study for traffic signal upgrades along Main Street in Ferndale. The need for this study was identified by the City based on feedback received from the public. This review effort focused on conducting a hardware review of the existing system to identify system limitations and hardware/technology improvements that would provide additional operational capabilities and flexibility to better service the city's traffic demands. As this study was limited to the traffic signal hardware, it does not evaluate the traffic signal timing parameters currently implemented on the corridor. A review of the existing signal timing parameters would be beneficial prior to implementing hardware upgrades.

This technical memo provides an inventory of the existing traffic signal, detection and communication equipment along Main Street between Labounty Drive and Douglas Road. Using the inventory as a baseline, existing capabilities and limitations are discussed. Building on the limitations identified, a range of traffic signal system equipment recommendations, as it relates to the traffic signal hardware, detection and communication system improvements along Main Street are presented as means of providing additional capabilities to improve traffic operations.

Existing Traffic Signal Inventory

A field investigation of traffic signal equipment along Main Street was conducted from Labounty Drive to Douglas Road and is summarized in the inventory list below:

Cabinet and Controller

Table 1. Main St Signal Controller and Controller Cabinets Inventory

Intersection	Controller Cabinet Type	Signal Controller Type	Master Controller Type
Main St & Labounty Drive	NEMA TS1 TYPE "P"	PEEK LMD 8000	-
Main St & Retail Driveway	NEMA TS1 TYPE "P"	Econolite ASC/2S-2100	Econolite ASC/2M-1000
Main St & 1st Ave	NEMA TS1 TYPE "M"	Econolite ASC/2S-2100	-
Main St & 2nd Ave	NEMA TS1 TYPE "M"	Econolite ASC/2S-2100	-
Main St & 3rd Ave	NEMA TS1 TYPE "M"	Econolite ASC/2-2100	-
Main St & 4th Ave	NEMA TS1 TYPE "M"	Econolite ASC/2S-2100	-
Main St & Douglas Road	NEMA TS1 TYPE "P"	Econolite ASC/2S-2100	-

Signalized intersections along Main Street are equipped with NEMA TS1 type cabinets with the size M form factors at four downtown intersections from 1st Ave to 4th Ave. Size M cabinets have a typical cabinet dimension of 30"W x 17"D x 50"H. NEMA size P cabinets are located at the other intersections within the scope of this study. Type P cabinets have a typical dimension of 44"W x 26"D x 55"H

The majority of traffic signal controllers along the corridor are the Econolite ASC/2 series controllers as shown on the table above. The only exception is the PEEK LMD 8000 controller located at the Main Street & Labounty Drive intersection.

Of the Econolite ASC/2 series controllers, there is one Econolite ASC/2M-1000 Master controller at the Retail Driveway intersection. The master controller connects to and synchronizes time clocks at four downtown signal controllers (1st Avenue, 2nd Avenue, 3rd Avenue, and 4th Avenue) using a wireless connection. A synchronized time clock is used to ensure that time-based coordination between intersections is consistent and that the effects of time drift are mitigated.

Outside of the downtown signals, the Labounty Drive, Retail Driveway and Douglas Road controllers are currently running on a standalone-basis with no interconnectivity to other intersections along the corridor.

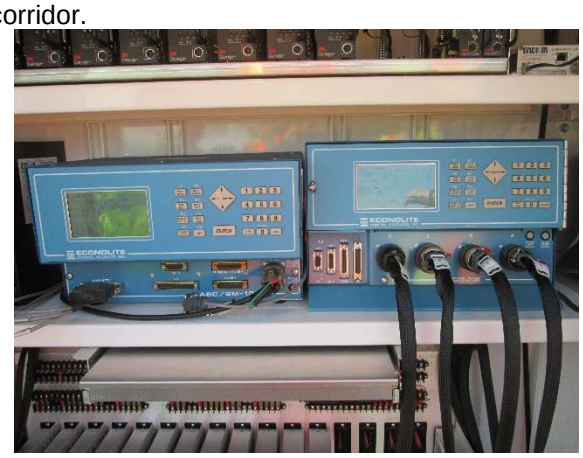

Figure 1 Econolite ASC/2M-1000 Master Controller and ASC/2S 2100 Signal Controller at Retail Driveway intersection

Existing Loop Detections

Table 2. Vehicle Detection Inventory

Intersection	Detection Card Positions (occupied/available)	Advanced Loop Detection		Protected Left Turn Phase
		East Approach	West Approach	
Main St & Labounty Drive	7/8	185'/70'	70'	EB/WB
Main St & Retail Driveway	8/10	170'	140'	EB/WB
Main St &1st Ave	1/2	-	-	Permissive
Main St & 2nd Ave	1/2	-	-	Permissive
Main St & 3rd Ave	1/2	-	-	Permissive
Main St & 4th Ave	1/2	-	-	Permissive
Main St & Douglas Road	4/8	130'	90'	WB

Transpo Group's field review also indicates that the study intersections along Main St are all actuated with loop detectors. All intersection approaches are equipped with stop bar loops at each lane. Additionally, the intersections at Labounty Drive, Retail Driveway and Douglas Road are also equipped with advanced loops along Main St.

While detection exists at all the intersections, the detection layouts differ between intersections. Within the four downtown intersections, the stop bar loops on each lane are all connected to the same phase, regardless of lane designation (i.e. left or through lanes). The intersections at

Labounty Drive, Retail Driveway and Douglas Road are equipped with stop bar loops, with separated left turn detectors to service movements when demand is present.
With the setup described, each downtown intersection has one 4-position detector card rack that provides two positions for loop detector cards and another two positions for emergency vehicle pre-emption cards. Of the two detector card positions, one is already occupied by a 4-channel detector card, capable of servicing up to 4 separate phases. Additionally, these intersections are equipped with an emergency vehicle pre-emption card to grant priority for emergency vehicles passing the intersection.

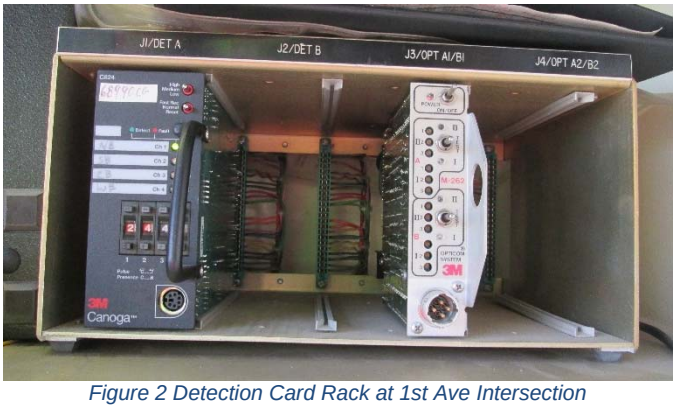

Figure 2 Detection Card Rack at 1st Ave Intersection

The detector card racks at the Labounty Drive, Retail Driveway and Douglas Road intersections provide either 8 or 10 positions for detector cards as well as two additional positions for emergency vehicle pre-emption. With a larger detector card rack capacity, there is more flexibility to add additional detection to actuate signal operations. In the case of these intersections, additional 4-channel detector cards are used in many cases, compared to the downtown signals, to provide dedicated left turn phase detection on nearly all approaches and advanced detection on the major street approaches. The distances of the advanced detection are presented in Table 2.

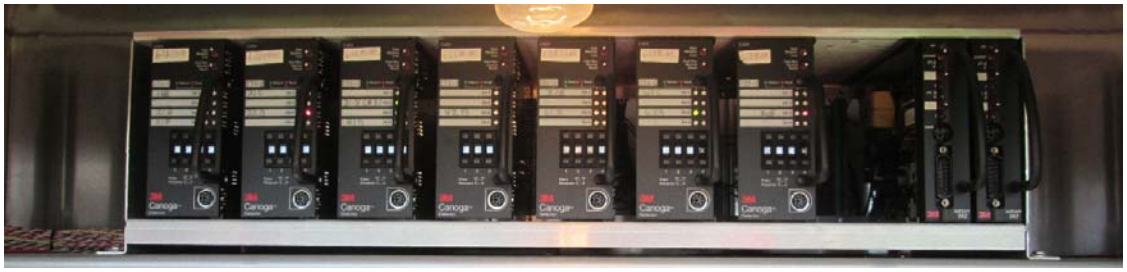

Figure 3 Detection Card Rack at Labounty Drive

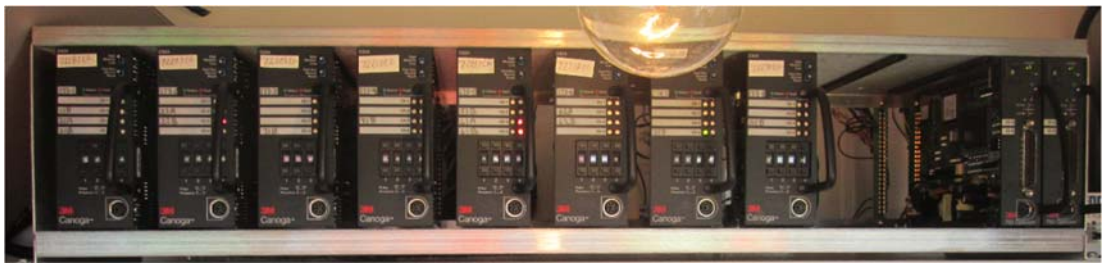

Figure 4 Detection Card Rack at Retail Driveway

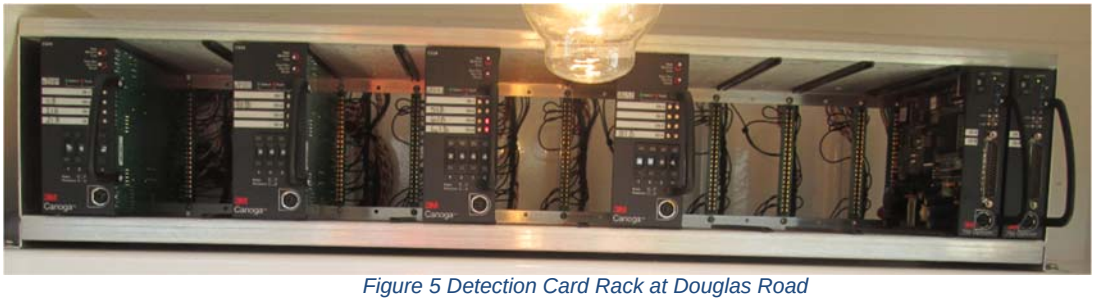

Figure 5 Detection Card Rack at Douglas Road

Communication

Communication interconnect between traffic signal controllers allows two-way communication, improving the ability to implement better time-based traffic signal coordination strategies. Communication is typically available in wireless and wireline forms.

Wireless communications currently exist between four downtown intersections. The setup currently relies on a master/slave setup where a master controller is utilized to synchronize the time clocks for all the other intersections that it is connected to. Along Main Street, a separate master controller is installed at the Retails Driveway intersection (adjacent to the controller that provides signal timing functionality).

Interconnectivity is provided using a point-to-multipoint wireless connection between downtown controllers and the master controller at Main Street and Retail Driveway. A point-to-multipoint communication system allows one “base” radio to communicate with multiple receiving radios within a specified range. Each of the Encom wireless devices are equipped with a serial and Ethernet port that are capable of transmitting data between controllers via a wireless antenna mounted on signal pole. This type of wireless communication device is typically identified as a serial/Ethernet bridge. While the four downtown signal controllers are interconnected, the other controllers at Labounty Drive, Retail Driveway, and Douglas Road intersections are currently operating standalone with no connection to the master controller.

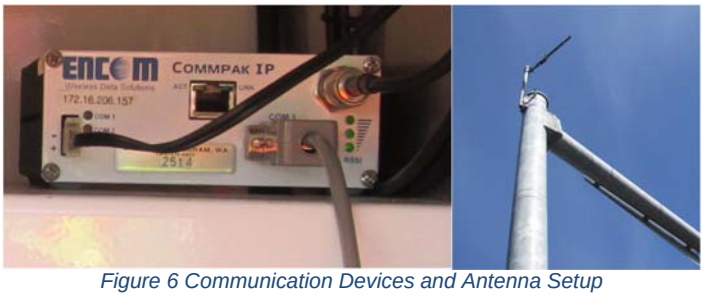

Figure 6 Communication Devices and Antenna Setup

Key Equipment Limitations and Recommendations

While the current traffic signal system is a result of an incremental upgrade under the City of Bellingham’s signal maintenance program, much of the equipment is comprised of older generation hardware that is becoming dated. With advancements in traffic signal controller and detection technologies, new capabilities and features exist that are expected to provide the City of Ferndale with more advanced signal timing capabilities. The following table describes the key equipment limitations identified and accompanying recommendations to provide the City with an improved signal system:

ID	Limitation	Recommendation	Benefits	Est. Implementation Cost*
1	Existing loop detection for the downtown intersections are all connected on the same phase regardless of lane designation (i.e. left turn and through lanes), limiting the capability to provide flexible left turn operations.	Separating the left-turn detector loops by re-splicing will improve efficiency by providing actuation for left turn where the demand exists. It can also allow for left-turns to be serviced more efficiently by implementing patterns such as lead-lag, left turn phase re-service and phase omits where appropriate. Dedicated left turn phasing would also require signal head replacements.	High	$15,000
2	Where communication interconnect exists, signal coordination between intersections is limited to time-based signal timing strategies only.	**A:** Implementing new Linux-based ATC traffic signal controllers would provide the City with more flexible signal coordination strategies where signals are interconnected. The additional processing power of Linux-based ATC controllers allow peer-to-peer capabilities between interconnected signal controllers. Peer-to-peer allows a downstream controller to proactively react to an event experienced by another controller on the network, thereby improving signal coordination. Many Linux-based ATC controllers also provide forward compatibility upcoming standardization in NTCIP controller protocols and Connected Vehicle applications.	High	$55,000
		B: Implementing an Adaptive Signal Control system would provide the City with a full demand-responsive system that is capable of providing equitable green time for all signals that are connected via a communication network. Adaptive systems provide real-time optimization of signals through the use of detector data.	High	$400,000*** (6 signals)
3	Traffic signal cabinets in the downtown area are limited in the amount of detection inputs available, impacting their flexibility to accommodate additional detection (i.e. left turn detection, advance detection, and queue detection) for improved signal actuation.	**A:** Modify existing NEMA Type M traffic signal cabinets to provide additional detector card rack(s).	High	$10,000
		B: Replace existing NEMA Type M traffic signal cabinets with pre-wired additional detector card rack(s) and inputs on existing foundation.	High	$100,000
		C: An alternative to detector card rack upgrades is to implement Synchronous Data Link Control (SDLC)-based detection technologies that would work in parallel with an ATC controller. SDLC-based detection technologies are loop-alternatives that manage the number of detection inputs using the capabilities of local traffic signal controller hardware, rather than hardwired loop inputs.	High	$190,000**
4	Only the downtown traffic signal controllers are interconnected, limiting the capability to coordinate with signals outside the downtown area.	Expand/upgrade the interconnect system to include additional wireless radios/fiber optic interconnect to include traffic signal controllers outside of the downtown area to allow for the potential to improve corridor coordination and signal progression.	Moderate	$10,000
5	The Type M traffic signal cabinet in the downtown area are constrained by the available interior space, limiting the capabilities to accommodate future equipment such as Accessible Pedestrian Signal equipment, CCTV equipment, and other detection systems.	Upgrade existing traffic signal cabinet and foundation to Type P standard to provide room for future expansion.	Moderate	$170,000

*Estimated costs do not account for ADA upgrades.
**Requires the implementation of Recommendation 2. This option should only be considered if the City decides to change to an alternative detection system.
*** Requires the implementation of Recommendations 1, 2A, 4, and 5

ADA-related Impacts

When considering upgrades to the traffic signal system, the City of Ferndale should consider the implications of altering the traffic signal system as it relates to triggering the need for ADA improvements. The FHWA and WSDOT have taken the position that traffic signal controllers and signal cabinet upgrades warrant the need to install ADA-compliant Accessible Pedestrian Signal (APS), countdown pedestrian signal heads, and ADA curb ramps at intersections. Triggering ADA upgrades often require a substantial amount of civil improvements to the intersection that hav the potential to dramatically increase the cost of signal upgrades. Based on an initial assessment of existing curb ramps and pole locations, a rough order magnitude (ROM) estimate of ADA upgrades would amount to $50,000 per intersection.

Preliminary Analysis

Utilizing available data for the PM peak period and Transpo Group's existing Synchro model, an analysis of the existing PM signal operations was performed. The analysis included an initial optimization effort which suggests potential improvements to signal progression along Main Street while balancing the amount of impact to side street delay.

In the modelled PM peak period scenario where the PM signal timing plan was evaluated, initial timing adjustments indicate a potential reduction in vehicle-hours of delay of up to 10% along Main Street, which is influenced by increasing the green band through the downtown signals. The green band represents the amount of green time where traffic can flow with progression, without interruption from a red light. A wider band typically allows more vehicles to pass through multiple intersections without interruption. Based on our initial assessment, we anticipate that a comprehensive review of the AM, midday and PM peak hour signal timing would potentially result in up to 10% of improvements in total delay, through signal re-timing. This preliminary analysis considers signal re-timing efforts only and does not layer on additional signal hardware modifications that can potentially provide additional signal operation capabilities.

In addition to basic signal timing efforts, additional improvements to traffic signal hardware are expected to provide the City with improved signal actuation capabilities. Actuation allows signal systems to respond to traffic demands more effectively. Investments in detection hardware can provide the City with the flexibility to operate actuated/semi-actuated signals and even Adaptive Signal Control (ASC) which continually optimizes signal timing in real-time. On the other end of the spectrum, studies have shown that ASC have demonstrated the following benefits, compared to optimized corridors using traditional signal timing strategies:

Travel time reductions: 10-25%
Savings in fuel consumptions: 5-15%
Increase in average travel speeds: 10-20%
Reduction in stops: 40-55%
Reductions in total delay: approx. 20%

Using the performance metrics from ASC as the upper thresholds for improvements, it is anticipated that providing additional detector flexibilities and advanced traffic signal controller logic would potentially provide operational benefits that lie somewhere in between.

Next Steps

Prior to investing in traffic signal hardware upgrades, Transpo Group recommends that the City of Ferndale conduct a study to evaluate the effectiveness of the existing signal timing plans. A study should be conducted to determine the peak periods that require retiming. This results of this effort would allow the City to evaluate whether an acceptable level of operational improvements can be realized using existing equipment. If signal timing optimization does not provide the operational benefits deemed necessary, Ferndale should consider using modelling tools, such as Synchro and VISSIM, to evaluate the potential operational benefits associated with the hardware upgrades documented. Modelling will allow the City to confirm the level of operational benefits as well as conduct and evaluate a more representative cost-benefit analysis prior to implementing a hardware change.

In the near-term, recommendations 1 and 3A are anticipated to provide a high level of benefit at a relatively low cost, considering that ADA improvements are not required. Recommendations 1 and 3A provide the corridor with increased flexibility for vehicle detection in the downtown intersections. Improving signal actuation enables the traffic signal controllers to respond to traffic demands more effectively when implemented with appropriate signal timing plans.

Once recommendations 1 and 3A have been implemented, recommendations 2A and 4 would provide the City of Ferndale with current traffic signal controller technology capable of maximizing the use of the detection upgrades implemented. Implementing current traffic signal controller technology enables the City to potentially benefit from improved signal coordination by using advanced logic processing features. Interconnect would also allow advanced controllers to work in conjunction with each other to provide demand-responsive timing plan strategy.

Recommendations 3B and 5 specifically address the installation of new traffic signal cabinets, which is considered as a high-cost investment compared to the other recommendations presented. While new traffic signal cabinets are costly, they can provide flexibility for the amount of interior cabinet space to accommodate other signal technologies and detection technologies. They can also provide forward compatibility with more current signal standards, adaptive signal control, and future technologies such as Connected Vehicles.

While the relative cost is high, ASC provides the City with the ability to optimize signal timing in real-time, using the prior recommendations. With the implementation of the prerequisite Recommendations 1, 2A, 4, and 5, ASC would utilize the detection and controller capabilities to provide equitable distribution of green time and enable proactive response to changing traffic demands without constraints from a time-of-day plan.

Conclusion

As part of this pre-design study, Transpo Group conducted a field-review of the existing signal system along Main Street in the City of Ferndale. An inventory of existing equipment was prepared and documented as a baseline to evaluate the capabilities and limitations of the existing signal system. While an operational analysis was not conducted to evaluate the efficacy of the existing signal timing plans, a comprehensive hardware review was conducted to identify traffic signal equipment upgrades that would enable the City to potentially improve traffic operations along Main Street by improving signal coordination, signal response to traffic demand, and forward compatibility.

This study identified the following signal system recommendations as summarized below (listed in the recommended order of implementation):

- Evaluate existing signal timing effectiveness;
- Provide separate left-turn detection in the downtown area;
- Modify NEMA Type M cabinets to provide additional detection capabilities in the downtown area;
- Replace traffic signal controllers with new Linux-based ATC controllers;
- Expand/upgrade the existing interconnect system
- Upgrade existing traffic signal cabinets (and foundations) to accommodate new Type M or P style.

While these benefits are expected to provide the City of Ferndale with additional capabilities to potentially improve operations, it is also important to note that regular system evaluation and fine-tuning is necessary to ensure that the timing plans are current and effective for the changing demands over time. When considering upgrades to the signal system, the City should also evaluate the need to implement ADA improvements such as APS, pedestrian signal heads, and curb ramp upgrades that may impact the overall cost of the improvements as well.