Oneida County Smart Infrastructure Planning Study

Final Report | Report Number 19-35 | August 2019

NEW YORK STATE OF OPPORTUNITY. | NYSERDA | Department of Transportation

Cover Image: Energetics, a Division of Akimeka, LLC

Oneida County Smart Infrastructure Planning Study

Final Report

Prepared for:

New York State Energy Research and Development Authority

Albany, NY

Robyn Marquis
Project Manager

and

New York State Department of Transportation

Albany, NY

Richard Batchelder
Project Manager

Prepared by:

Energetics, a Division of Akimeka, LLC

Clinton, NY

Bryan Roy
Paul Windover
Project Managers

NYSERDA Report 19-35

NYSERDA Contract 112006
NYSDOT Task Assignment C-17-54

August 2019

Notice

New York State Department of Transportation Disclaimer

U.S. DOT Technical Report Documentation

<table>
<tr><td>1. Report No. C-17-54</td><td>2. Government Accession No.</td><td colspan="2">3. Recipient's Catalog No.</td></tr>
<tr><td colspan="2" rowspan="2">4. Title and Subtitle
Oneida County Smart Infrastructure Planning Study</td><td colspan="2">5. Report Date
August 2019</td></tr>
<tr><td colspan="2">6. Performing Organization Code</td></tr>
<tr><td colspan="2">7. Author(s)
Paul Windover, Bryan Roy</td><td colspan="2">8. Performing Organization Report No. 19-35</td></tr>
<tr><td colspan="2" rowspan="2">9. Performing Organization Name and Address
Energetics, 3 Kirkland Ave., Suite 102, Clinton, NY 13323</td><td colspan="2">10. Work Unit No.</td></tr>
<tr><td colspan="2">11. Contract or Grant No.</td></tr>
<tr><td colspan="2" rowspan="2">12. Sponsoring Agency Name and Address
NYS Department of Transportation, 50 Wolf Road, Albany, New York 12232</td><td colspan="2">13. Type of Report and Period Covered
Final Report, 10/2017 - 4/2019</td></tr>
<tr><td colspan="2">14. Sponsoring Agency Code</td></tr>
<tr><td colspan="4">15. Supplementary Notes: Project funded in part with funds from the Federal Highway Administration</td></tr>
<tr><td colspan="4">16. Abstract
Energetics, CT Male Associates, and The Paige Group collaborated with the Oneida County Planning Department and the Herkimer-Oneida Counties Transportation Study to investigate opportunities for the local road network in Oneida County to incorporate smart transportation infrastructure. This effort was supported by The New York State Energy Research and Development Authority (NYSERDA) and The New York State Department of Transportation (NYSDOT). Intelligent Transportation Systems (ITS) use a range of technologies to increase transportation safety, efficiency, and resiliency through integrating advanced monitoring, control, and communication technologies into transportation infrastructure. Implemented correctly, this solution enables a seamless management of the transportation network for the traveling public. Recommendations for ITS enhancements include a mix of upgraded traffic signal controllers with vehicle detection systems, traffic cameras, and variable message boards. All installed ITS devices should be compatible with NYSDOT's Transportation Management Center for monitoring and control.</td></tr>
<tr><td>17. Key Words
traffic, intelligent, intersection, safety, coordinated, roadway, infrastructure, signals, optimization</td><td colspan="3">18. Distribution Statement
No Restrictions</td></tr>
<tr><td>19. Security Classif. (of this report)
Unclassified</td><td>20. Security Classif. (of this page)
Unclassified</td><td>21. No. of Pages
53</td><td>22. Price</td></tr>
</table>

Form DOT F 1700.7 (8-72)

Abstract

Energetics, CT Male Associates, and The Paige Group collaborated with the Oneida County Planning Department and the Herkimer-Oneida Counties Transportation Study to investigate opportunities for the local road network in Oneida County to incorporate smart transportation infrastructure. This effort was supported by The New York State Energy Research and Development Authority (NYSERDA) and The New York State Department of Transportation (NYSDOT). Intelligent Transportation Systems (ITS) use a range of technologies to increase transportation safety, efficiency, and resiliency through integrating advanced monitoring, control, and communication technologies into transportation infrastructure. Implemented correctly, this solution enables a seamless management of the transportation network for the traveling public. Recommendations for ITS enhancements include a mix of upgraded traffic signal controllers with vehicle detection systems, traffic cameras, and variable message boards. All installed ITS devices should be compatible with NYSDOT's Transportation Management Center for monitoring and control.

Keywords

traffic, intelligent, intersection, safety, coordinated, roadway, infrastructure, signals, optimization

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations List

ACC/MEV	accidents per million vehicles
ADA	Americans with Disabilities Act
AHJ	Authority Having Jurisdiction
ATC	Advanced Transportation Controller
CO	carbon monoxide
CO_2	carbon dioxide
GIS	geographic information system
HC	hydrocarbons
HOCTS	Herkimer-Oneida Counties Transportation Study
ISP	Internet Service Provider
ITS	intelligent transportation systems
NEMA	National Electrical Manufacturers Association
NO_X	nitrogen oxides
NYSDOT	New York State Department of Transportation
NYSERDA	New York State Energy Research and Development Authority
OSP	Optical Signal Processor
$PM_{2.5}$	Fine particulate matter having a diameter of less than 2.5 micrometers
TMC	Transportation Management Center
VMS	variable message sign

Executive Summary

Energetics, CT Male Associates, and The Paige Group collaborated with the Oneida County Planning Department and the Herkimer-Oneida Counties Transportation Study to investigate opportunities for the local road networks in Oneida County to incorporate smart transportation infrastructure. The effort is supported by The New York State Energy Research and Development Authority (NYSERDA) and The New York State Department of Transportation (NYSDOT). This study developed a plan to lay the foundation for intelligent transportation systems (ITS) recommendations for Oneida County through the following actions and tasks:

- Increasing understanding of smart transportation infrastructure and its benefits
- Building consensus with stakeholders on potential ITS solutions for Oneida County
- Identifying key corridors that could significantly benefit from smart transportation infrastructure and traffic management
- Developing a geographic information system (GIS) database of smart transportation infrastructure through combined geolocating and mapping of assets
- Creating a roadmap for implementing cost-effective ITS solutions and strategies that have the most impact on the key corridors
- Securing support from the Authority Having Jurisdiction (AHJ) and other stakeholders to implement ITS solutions

With the overarching project objective to create a roadmap outlining a plan to implement ITS solutions on selected key corridors, a stakeholder engagement strategy identified stakeholder needs, interests, and potential issues in order to build consensus on recommended solutions. The consulting team worked collaboratively with a variety of stakeholders throughout Oneida County, such as transportation organizations, transportation providers, elected officials, government planning and public works departments, emergency responders, economic development organizations, travel and tourism organizations, and health and human services organizations.

ITS uses a range of technologies to increase transportation safety, efficiency, and resiliency through integrating advanced monitoring, control, and communication technologies into transportation infrastructure. Implemented correctly, these solutions enable a seamless management of the transportation network for the traveling public. Throughout New York, NYSDOT has Transportation Management Centers (TMC) set up to monitor and manage State supervised roadways. The Mohawk Valley TMC oversees State roadways in six counties, including Oneida County, with continuous responsibility to monitor data from State-owned ITS technology and control traffic devices on State-operated roadways.

The center also disseminates information to appropriate agencies, first responders, and the traveling public and acts as a regional operation center during emergency situations. A partnership between NYSDOT and local transportation departments can allow personnel and control infrastructure used at the State level to be leveraged by smaller municipalities that could not otherwise justify the cost. The collaboration also provides State-level agencies with additional data on local roadways that are not monitored by their system.

Corridors with the highest potential for near term ITS deployment efforts were identified through several stakeholder meetings and input from area experts. While there are many roadways that could benefit from this technology, these key corridors were identified as the most important for near-term upgrades and excellent test cases for developing deployment methods moving forward. The criteria for identifying key corridors included traffic volume, importance to the overall system, connection to State-operated corridors, and applicability of its technology. The key corridors in Oneida County for incorporating ITS solutions are the following:

- East Dominic Street in the City of Rome
- Floyd Avenue in the City of Rome
- Genesee Street in the City of Utica
- Leland Avenue to Herkimer Road in the City of Utica
- Memorial Parkway to Culver Avenue in the City of Utica
- Kellogg Road to Chapman Road in the Town of New Hartford
- Henderson Street to Clinton Street in the Village of New York Mills

Recommendations for ITS enhancements include upgraded traffic signal controllers with remote communication capability at locally-owned intersections. Vehicle detection systems should be added where they don’t already exist, and coordination between signal timing is important when the intersections are close together. Select intersections along these corridors would benefit from having cameras that provide real-time traffic information, and one ITS strategy for a corridor included a variable message board to help drivers make informed decisions about their route. All installed ITS devices should be compatible to be monitored and controlled by NYSDOT’s TMC, because the local jurisdictions will not easily be able to replicate the services and capabilities that already exist at the TMC. Through a shared services agreement, an arrangement could be made to have NYSDOT manage this new ITS technology, which will also increase their ability to predict traffic flows onto and off the State roadways.

1 Introduction

The goal of this study was to lay the groundwork for the local road network to be implemented with smart transportation infrastructure in Oneida County by leveraging the current State-operated Intelligent Transportation Systems (ITS). New York State Department of Transportation (NYSDOT) currently monitors and controls deployed ITS technologies on State-owned highways throughout Oneida County. These technologies enable management and optimization of traffic flow continuously, which is particularly important during emergency situations. However, the State system is blind to local roadways, which are often the source or destination for State managed traffic. Additionally, in the event of State road closures, motorists would be routed to local roads with no additional management or monitoring, resulting in major congestion issues. This study identified and investigated barriers to widespread ITS technology throughout Oneida County and engaged essential parties. The primary steps towards this goal included engaging local stakeholders and municipalities, identifying and recording existing technologies and priority roadways, and creating a roadmap for municipalities to reference for future efforts.

Engaging local stakeholders and municipalities is a critical aspect of updating transportation systems. Meetings with stakeholders, including area planners, emergency response, public works, transit organizations, economic development, and tourism groups, ensured that all concerns and suggestions were addressed in the study. Meetings with local municipalities, or authorities having jurisdiction (AHJ), were conducted early in the study to ensure their interests and perspectives were included. Feedback from these meetings provided critical perspectives on identifying key corridors, local interests, and the direction for future implementations. The stakeholder and municipal meetings included the following:

- Introductory meeting with Vision 2020 (February 2, 2018)
- Introductory meeting at Page Group (April 4, 2018)
- Introductory meeting with Oneida County Sherriff's Department (April 10, 2018)
- Stakeholder kickoff meeting at the Mohawk Valley Community College (April 17, 2018)
- New Hartford AHJ Meeting (July 31, 2018)
- Utica AHJ Meeting (July 31, 2018)
- Rome AHJ Meeting (August 15, 2018)
- New York Mills AHJ Meeting (August 15, 2018)
- Stakeholder Workgroup feedback meeting in Rome (November 15, 2018)
- Stakeholder Workgroup feedback meeting in Utica (November 15, 2018)
- Herkimer-Oneida Counties Transportation Study (HOCTS) Transportation Planning Committee Meeting (February 19, 2019)
- HOCTS Governmental Policy and Liaison Committee (March 6, 2019)
- Stakeholder Workgroup Results Webinar (March 12, 2019)

A geographic information systems (GIS) database of existing corridors of interest, conventional traffic control technologies, and smart transportation infrastructure was developed through combined geolocating and mapping of assets. A detailed evaluation of the proposed ITS technology specifications was also conducted to ensure compatibility with existing NYSDOT technology and give municipalities information for deployment purposes including installation requirements, purchase costs, and potential operational fees.

A roadmap was developed for implementing cost effective ITS and technology strategies that have the most impact on key corridors in Oneida County. This document was developed as public friendly information source for municipalities, and other organizations and individuals, to use moving forward with ITS implementation. The *Intelligent Transportation Systems: A Technology Roadmap* includes background information on ITS technologies, implementation strategies, case studies for key corridors throughout Oneida County, and potential benefits of ITS implementation.[1] Several other outreach materials, including an informative short video and one-page handouts, were also developed during the project to facilitate meetings with stakeholders and engage local municipalities. A screenshot from the short video and handout is shown in Figure 1.

Figure 1. Example Educational Materials Developed

---

1 Visit https://ocgov.net//oneida/sites/default/files/hoctsmpo/ITSroadmap/Oneida%20County%20NY%20ITS%20 Roadmap.pdf from the Herkimer-Oneida Counties Transportation Study. ITS Roadmap.

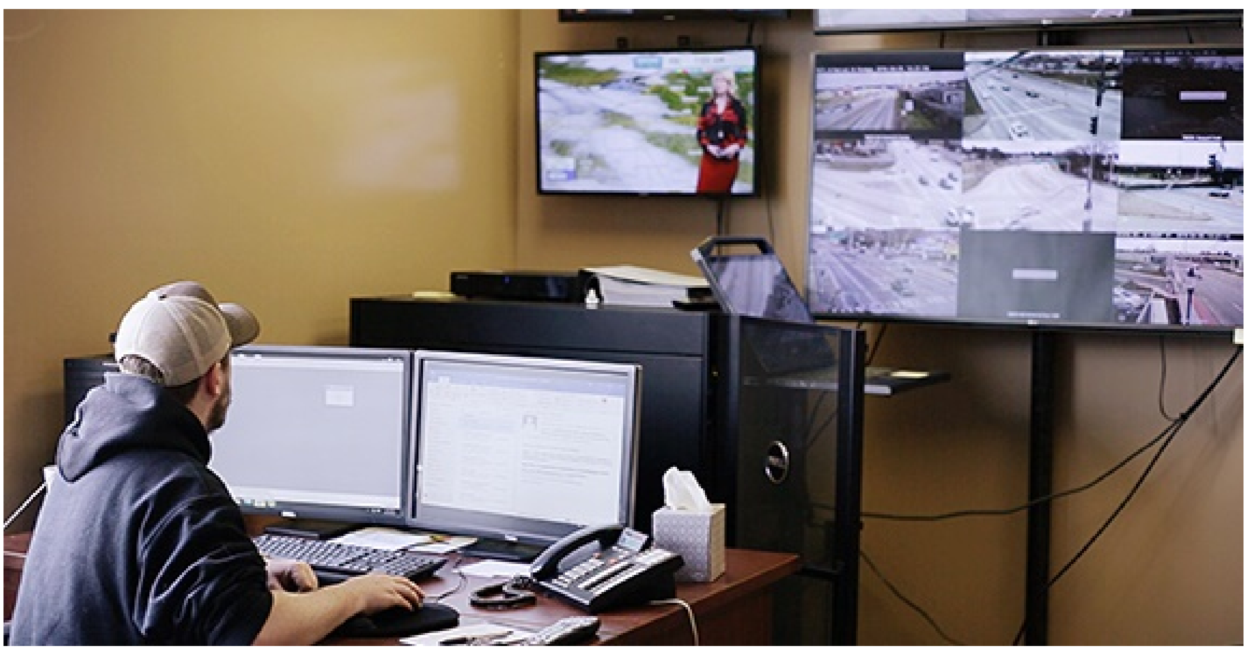
2 Intelligent Transportation Systems Technology

Intelligent Transportation Systems describe a range of technologies to increase traveling safety, efficiency, and resiliency through integrating advanced monitoring, control, and communication technologies into transportation infrastructure. Implemented correctly, ITS enables seamless management of the transportation network for the traveling public. A partnership between the NYSDOT and local transportation departments can allow State-level expertise and infrastructure to be leveraged by smaller municipalities. This collaboration also provides State agencies with additional data on local roadways, which gives them more insight into traffic that is feeding into their system.

2.1 Mohawk Valley Transportation Management Center

Throughout New York State, NYSDOT has Transportation Management Centers (TMC) (shown in Figure 2) set up to monitor and manage State supervised roadways. The Mohawk Valley TMC oversees roadways in six counties, including Oneida County.

Figure 2. Mohawk Valley Transportation Management Center



The TMC monitors data from State-owned ITS technology and information feeds. Monitoring all the incoming data, TMC staff understand the changing weather and traffic patterns that could impact traffic. The TMC could also monitor data for local municipalities and provide information or video feeds as necessary to local personnel.

The TMC disseminates real-time, accurate information to appropriate agencies, first responders, and the traveling public. By accelerating the flow of information to emergency responders and even warning motorists of specific roadways that are congested, significant improvements are made to the safety and efficiency of transportation operations.

The TMC controls networked traffic devices (e.g., signals, message boards) on State operated roadways. Based on information gathered, traffic patterns can be altered and motorists informed of changing conditions. Through a shared services agreement, the TMC could also control local systems at the request of local municipalities or in response to real-time events.

The TMC acts as regional operation center during emergency situations, extreme weather (snowstorms, flooding, fires), or other large public events (e.g., presidential visits, sporting events). Government heads and event leaders can gather at the TMC to monitor and help prepare a response as needed in a timely fashion.

2.2 Communication Technologies

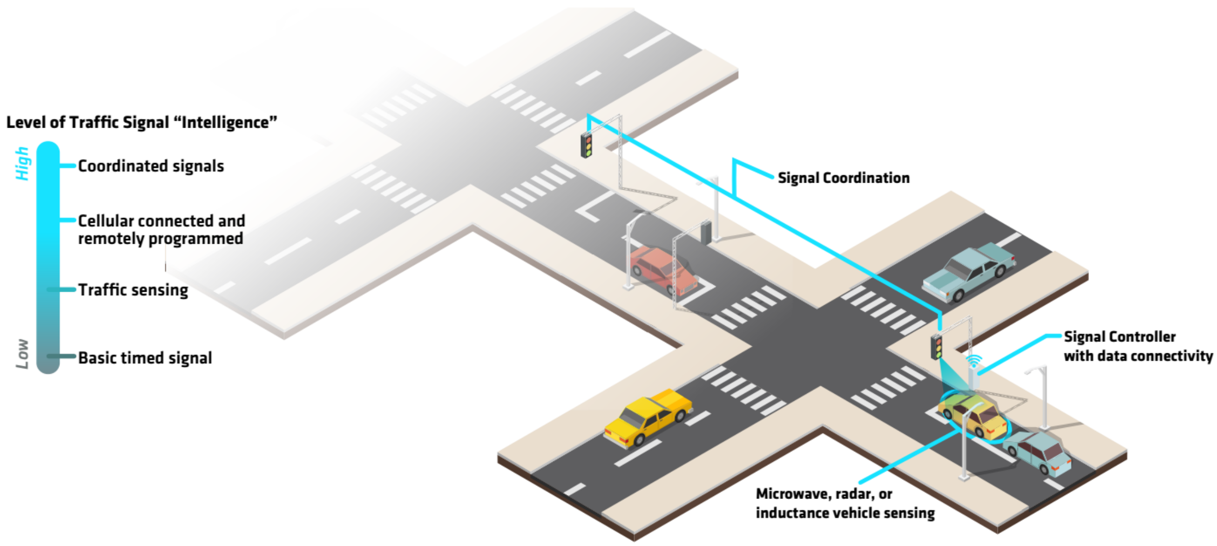
A standard modem, usually provided by the Internet Service Provider (ISP), allows individual controllers to communicate with the TMC. This communication link transmits information from the ITS devices (e.g., weather data, video feeds) and can send out commands to modify the behavior of the devices (e.g., change a camera direction, adjust the signal timing).

NYSDOT currently uses the Digi Transport WR44 R, an all-in-one 4G LTE Advance mobile communications modem with routing, security, and firewall features. These modems are effective for transportation and mobile applications. These cellular modems/routers could be installed at each traffic signal designated for an ITS upgrade and would be in the auxiliary input cabinet.

2.3 Traffic Signal Optimization

There are various levels of traffic signal optimization as shown in Figure 3. The simplest traffic signals use a fixed timing device that follows the set program. This timing can be adjusted occasionally at the device itself to improve traffic flow, but it does not respond to current traffic conditions. Adding traffic sensing technology, typically an inductive loop in the pavement, allows signals to react to existing traffic conditions in a limited capacity. The highest level of ITS-enabled traffic signals includes a communication modem, vehicle detection (wireless, microwave, or loop based), auxiliary cabinets, and system controllers. Networking the traffic light controller via cellular modem to a control center (such as the TMC) allows personnel to vary the signal timing in real time based on weather, events, and emergency situations. Communication technology also allows nearby signals to relay information and share real-time data used to coordinate actions and further optimize traffic flow.

Figure 3. Traffic Signal Optimization



2.3.1 Vehicle Detection Systems

Vehicle detection systems allow a traffic signal to adjust to current traffic conditions. When a vehicle is detected at a stoplight, the device will automatically initiate a signal change. This can help maintain traffic flow on a main road as long as possible and only accommodate vehicles on smaller secondary streets to safely enter or cross the main arterial road when needed. Devices can be microwave head, induction loop, or wireless vehicle detection systems. Microwave heads can detect the presence of a vehicle via a microwave emitter and sensor. Induction loops consist of electrical wires imbedded in the pavement of the travel lane at the intersection that detect vehicle weight. Wireless vehicle detection systems use a battery-powered wireless magnetic sensor embedded in the road.

2.3.1.1 Microwave Head Vehicle Detection

For microwave heads as a vehicle detection method, NYSDOT has used the TC26-B Microwave Vehicle Motion Sensor by MS Sedco. Microwave technology is not affected by temperature, humidity, color, or background noise variations. It mounts above ground, so no pavement cuts are required and can be installed with minimal or no traffic disruption. The device will only respond to motion in one direction (approach-only or depart-only selectable) and covers single or multiple lanes, including a combination of turning and through lanes. Microwave heads aren't the least or most expensive vehicle detection systems in regard to parts and materials; however, they have one of the lowest construction and maintenance costs, since all of their equipment resides above ground.

2.3.1.2 Inductance Loop Vehicle Detection

An inductive loop consists of wire "coiled" to form a square, circle, or rectangle loop installed into or under the surface of the roadway. The systems work like metal detectors as they measure the change in the electromagnetic field when a vehicle is on top of the loop sensor.

Inductive loop hardware is low cost; however, installation and maintenance costs can get high as the equipment is in the roadway's binder course of pavement. The amount of loop wire required per intersection is dependent on the width of each lane approaching the traffic signal. Inductive loop vehicle detection was used as the standard upgrade for ITS-enabled intersections at an installed cost of $2,000 for each approach at a traffic signal.

2.3.1.3 Wireless Vehicle Detection

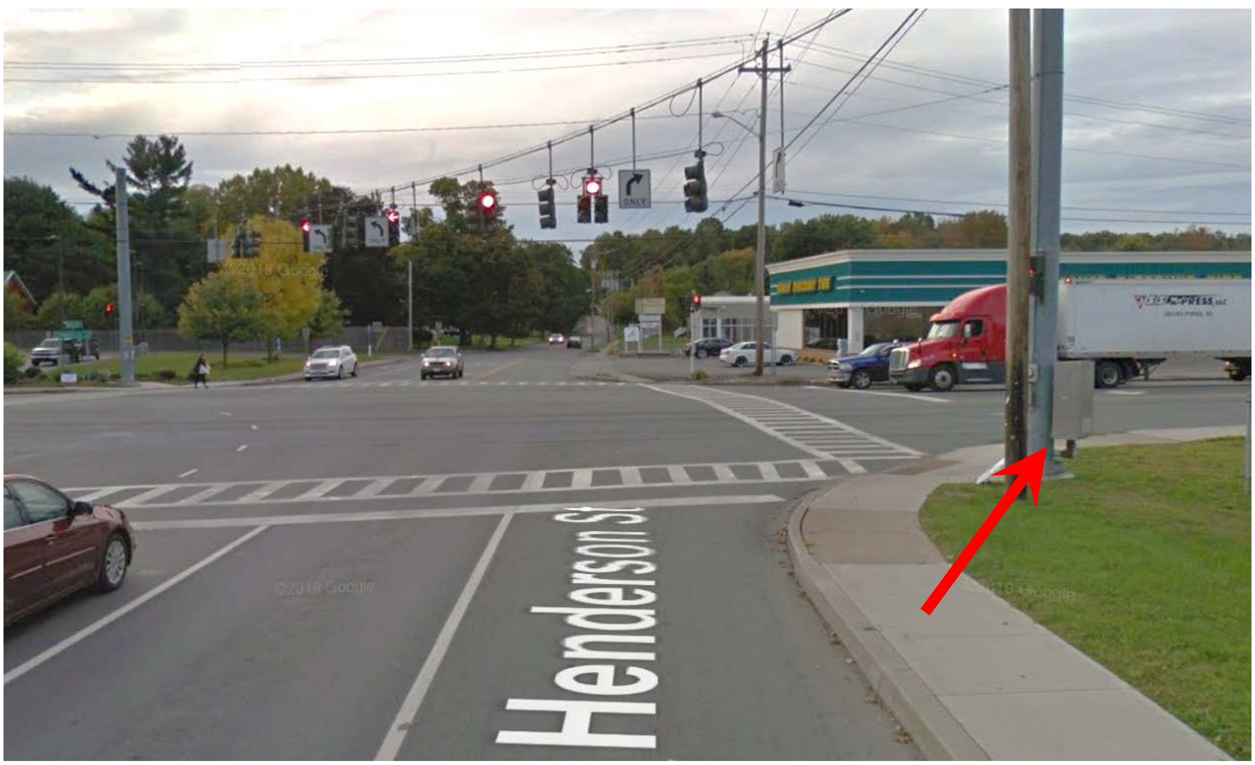
An example of a wireless system compatible with NYSDOT's ITS architecture is Trafficware's POD Detection System, a three-component wireless vehicle detection system to measure vehicle occupancy and detection in real-time. The three components include the pod, access point, and base station. The pod sensors are placed in the roadway, wirelessly transmitting vehicle data and receiving administrative data. Three pod sensors are installed in each traffic lane approaching the signal. The units are compact and robust, reducing the number of components for simple installation and maintenance. An auto-tune function allows the pod to recalibrate if the environment changes or if the roadway shifts or buckles.

The access point and antennas are mounted on an intersection pole or mast-arm and provide two-way wireless communication between the pod and base station. The base station, located in the auxiliary input cabinet, has computing power to provide data processing and storage. This system can run in parallel with inductive loops or other forms of vehicle detection. The vehicle detection system has the highest initial cost for parts and materials, but one of the lowest construction and maintenance costs when compared to other detection options.

2.3.2 Auxiliary Input Cabinets

Auxiliary input cabinets are enclosures for the detector and control devices at each signalized intersection. They are typically mounted either on the existing traffic pole or on a standalone concrete pad (example shown in Figure 4). These enclosures allow for access to conduct maintenance on the control module and other electronic devices associated with the intersection.

Figure 4. Example Intersection Showing Auxiliary Cabinet (Henderson Street and Commercial Drive)



An example unit is the McCain NEMA TS2, Type 2 Cabinet which meets all the functional requirements of the National Electrical Manufacturers Association (NEMA) TS 2, v 02.06, size five cabinet specification. The cabinet is designed for eight phase, four pedestrian operation with four overlaps. There are two detector racks, each four-position, four-channel as well as a 16-position load bay. Up to two thermostatically controlled fans ventilate the cabinet, while a filter behind the louvered door vents prevent dirt from permeating the cabinet's air supply.

2.3.3 Controller

The signal controller is a computer that controls the timing of the signal cycle. Controllers can be pre-programmed to respond to vehicle detectors or remotely programed through an ethernet network connection. For remote access, a cable modem must accompany the controller.

Used by NYSDOT, the McCain ATC eX 2070N1 NEMA Controller is TS 2 Type 2 compatible and complies with ATC (Advanced Transportation Controller) 5.2b standards. It is a multitasking field processor and communications system that is configurable for a variety of traffic management applications. The controller's primary function is intersection control but can be used for ramp metering, variable message signs, sprinklers, pumps, and changeable lane control.

2.4 Traffic Cameras

A network camera allows the TMC or others to remotely monitor traffic conditions in real-time. Cameras placed at key points along a corridor can provide valuable information for remotely changing signalized light timings to assist in greater traffic flow management. The cameras can also alert the center to accidents and fast changing weather conditions.

The Axis Communication AB, Model #5624-E network camera has been used by NYSDOT. This camera is an outdoor-rated HDTV 720p camera with 18x optical zoom. It enables video surveillance of large indoor and outdoor areas and provides great details when zooming in. It has continuous 360° pan capability, with no mechanical stop, for fast camera repositioning and continuous tracking of an object.

2.5 Variable Message Signs

Variable message signs (VMS) allow for flexibility in message content and are capable of providing dynamic information to motorists regarding a variety of conditions, including congestion, diversion, transit operations, maintenance and construction work, roadway status, special events, parking availability, reduced speeds, and snow or ice potential.

VMS can be fixed or portable, depending on the application. The permanent VMS would be installed on routes that are prone to traffic congestion and backups or for regular special events to relay information about parking conditions or traffic changes. The portable VMS would be used for work zones, temporary road closures, and less frequent special events.

NYSDOT has used the McCain VMS, powered by SWARCO, which is available in multiple sizes and configurations, including front access, walk in, and rear access. Integrated surface-mount 3-in-1 RGB LEDs provide full-color VMS messages that are legible up to 1,200 feet away in most conditions including low-angle and direct sunlight. The LED VMS has reduced energy consumption and maintenance costs compared to traditional models and give off little to no heat, which eliminates the need for cooling or defogging equipment.

2.6 Weather Stations

In addition to information and data provided by the national weather service, local weather instrumentation more closely monitors environmental conditions for optimizing response techniques. Weather stations, such as the one shown in Figure 5, can measure precipitation, roadway temperature, snow depth, ice thickness, wind speed, wind direction, and other environmental conditions. NYSDOT's growing network of stations throughout the region provide a powerful tool to monitor the movement of weather and predict incoming weather conditions. Local municipalities collaborating with the TMC could also access this weather station information to help make more informed decisions on the local level.

Figure 5. NYSDOT Weather Station in North Utica

2.7 Traffic Signal Preemption Control

Traffic preemption allows emergency vehicles (or transit buses) to temporarily initiate a green signal when approaching an intersection. The process is initiated through an optical emitter located on an emergency vehicle, which is received by a detector located at the intersection. The detector then signalizes the optical signal processor (OSP) located in the auxiliary input cabinet which is connected directly to the preemption inputs of the traffic controller. The controller then safely manipulates the traffic signals to provide an extended green light for the emergency vehicle or initiate a signal change. The optical emitters can be prioritized for certain emergency vehicles or operate on a first-come, first-served basis if the approaching vehicles are of equal priority.

Strobecom II is an example of an optical preemption system produced by Tomar Electronics which is designed and engineered to help emergency service professionals reach their destinations safety and with decreased response times. The model 3065/3065-R emitter is mounted on a vehicle and transmits vehicle identification information to suitably equipped intersections via optical pulses. The model 2090/2091 series detector receives and converts optical pulses to electrical pulses that are sent via the M913 detector cable to the OSP. Multiple detectors can be paralleled without extra adapters for enhanced pick up around curves or other obstacles.

The model 2080/2140 OSP receives the electrical signals from the detector, processes them, arbitrates priority, and sends commands to the appropriate controller preempt inputs. These processors are equipped with plug-and-play technology allowing the use of one to four signal processing modules to provide up to four independent input channels. One detector, OSP, and detector cable would be needed for each intersection where preemption control is desired, and each emergency vehicle would need an optical emitter.

2.8 Other ITS Technologies

There are several other ITS technologies used by drivers and fleets, but most have limited applicability for local transportation departments to influence or optimize traffic flow on local roadways. Some technologies not included under this effort include map apps (shows traffic or better routes), fleet vehicle telematics (GPS location, speed, fuel usage, engine performance), vehicle to infrastructure or infrastructure to vehicle communication, and automated toll collection (e.g., EZPass). The ITS technologies highlighted in this project focus on vehicle travel and expanding the capabilities of the Mohawk Valley TMC. ITS technologies can also facilitate improved pedestrian flow and should always consider compliance with the Americans with Disabilities Act (ADA).

2.9 ITS Technology Costs

Many individual ITS component hardware costs are relatively low. However, deploying a complete network of sensors, modems, and traffic control technology can add up. The estimated equipment and installation costs for each technology type is shown in Table 1. The table does not include preemptive control technology for emergency vehicles. The estimated installation costs could vary based on roadway specifics and installation company. Annual maintenance costs are estimated at 10% of the initial equipment expense. Cable modems also have an annual fee of $1,200 each to provide connectivity.

Table 1. Estimated ITS Component Costs

	Equipment	Installation
Auxiliary Cabinets	$10,000	$3,000
Signal Controllers	$3,000	$1,500
Inductance Loop Sensors	$2,000	$5,000
Network Camera	$1,500	$375
VMS Board	$25,000	$5,000
Cable Modems	$250	$500

3 Oneida County Key Corridors

Corridors with the highest potential for near term ITS deployments efforts were identified through stakeholder meetings and input from area experts. While there are many roadways that could benefit from ITS technology, key corridors were identified as the most important for near term upgrades and also as excellent test cases for developing ITS deployment strategies. Enabling all roadway technology with ITS technology throughout the region is an ideal, long-term solution.

Criteria for identifying roadways with the highest potential for ITS implementation success was also discussed with project stakeholders and included the following:

Traffic volume. Corridors with higher traffic volumes have more potential for congestion and traffic flow concerns. The deployment of ITS technology on high traffic roadways will benefit a higher number of motorists and have a more significant impact on surrounding transportation networks.

Importance to the overall system. During emergencies and large events, connections to major roadways are critical for efficient traffic movements. These roadways will be some of the major routes between residential, commercial, and retail centers.

Connection to State operated corridors. Expanding existing NYSDOT ITS capabilities on State roadways to adjacent roadways will further leverage control and monitoring capabilities. While individual ITS technologies can improve the transportation system, a comprehensive and connected system significantly increases the potential to optimize traffic flow.

Applicability of ITS Technology. Urban settings with existing signals tend to have more potential because, typically, such a setting has stop-and-go traffic. There may be some limited potential for more rural roadways to implement VMS or other pre-warning technology to inform motorists that are approaching more urban areas. However, the most effective ITS efforts enhance existing traffic control technology.

Seven key corridors were selected to be evaluated for potential ITS integration including the following main roadways (with some key corridors incorporating additional roadways): Leland Avenue, Memorial Parkway, Genesee Street, East Dominick Street, Floyd Avenue, Kellogg Road, and Henderson Street. Due to the limited number of high-use roadways that pass through high-density population areas in Oneida County where traffic signals are necessary, these seven corridors clearly had the most potential for ITS technology. Most other high-use roadways are State-operated and already managed by the Mohawk Valley TMC. Locally-owned traffic signals on other roadways have much less traffic or are isolated from other signals and would have minimal benefits from being networked or monitored by the TMC. An inventory assessment was completed for each key corridor. The inventory identified the existing infrastructure in each corridor by documenting information about intersections including traffic signal locations and types, driving lanes, and parking configuration. Points of potential traffic congestion and hazards along the corridors were also noted. The findings were documented in a detailed table along with a photo log and GIS level mapping.

3.1 Utica Corridors

Utica is the largest city in Oneida County and has many of the largest and busiest corridors with potential for ITS deployment. Based on the criteria described above, Leland, Genesee, and Parkway (shown in Figure 6) were identified as the key corridors in the City of Utica. Because of the large number of intersections along its length, Genesee Street is evaluated in three separate sections (north, central, and south). Higby Road was also mentioned as a possible option for ITS deployment, but it was determined that this roadway could likely first benefit from altering certain intersections prior to applying ITS technology. Much of the Higby Road corridor is also located in Herkimer County, which was not included in this study but could be the focus of future studies.

Figure 6. Focus Corridors in the City of Utica

3.1.1 Leland Corridor

Leland Avenue links commercial properties in the north at Herkimer Road with the industrial district in the south at Wurtz Avenue. Herkimer Road connects Interstate 790 and commercial properties to the east with mostly residential neighborhoods and a few industries in the west where it becomes NYS Route 5. Figure 7 shows the intersection of Leland Avenue and NYS Route 5 (picture taken from east to west at midday with minimal congestion).

Figure 7. Intersection of Leland Avenue and NYS Route 5

The west end of the corridor is comprised of four, one-way roads around a block with a traffic signal at each corner. For eastbound traffic the roads are Auert Avenue and River Road, for westbound traffic, Riverside Drive and Herkimer Road, and for northbound and southbound traffic, North Genesee Street and Coventry Avenue. Auert Avenue ultimately extends east and merges into Herkimer Road. Herkimer Road becomes NYS Route 5 extending east along the north side of Interstate 90. Leland Avenue intersects Herkimer Road from the south, approximately 300 feet west of Van Rensselaer Road.

A 0.3-mile section of Herkimer Road was evaluated from Genesee Street to Van Rensselaer Road and a 0.2-mile section of Leland was evaluated from Herkimer Road to the Interstate 790 off ramp. There are eight signalized intersections along Herkimer Road and Leland Avenue. Signal controls were a mix of synced standard (fixed) timing and inductance loop controlled. The signals are owned by either the NYSDOT or the City of Utica. There are four NYSDOT owned traffic signals (River Road and Genesee Street, Auert Avenue and Genesee Street, Herkimer Road and Genesee Street, and Riverside Road and Genesee Street) that are synced using fixed times with button activated crosswalks.

The intersection for the Price Chopper Plaza and Euclid Road is a dual intersection where two traffic signals work in concert to control the median. This signal has separate components for each direction of the divided roadway and is owned by the City of Utica. The short connector road has potential to backup, causing traffic on Herkimer Road and Auert Avenue to subsequently backup because turning traffic must wait on Herkimer Road or Auert Avenue.

Traffic signals at Leland Avenue and Van Rensselaer Road are only about 300 feet apart. These signals operate independently and can lead to traffic not clearing the intersection and high congestion during peak traveling periods. Traffic can backup westbound at Van Rensselaer Road due to a short-left turn cycle at Leland Avenue. This restricts left turning traffic when entering the Interstate 790 onramp on Leland Avenue.

Table 2 shows the specific information for each intersection in the corridor. The accident rates were calculated as accidents per million vehicles (acc/MEV). The statewide averages were determined based on the Average Accident Rates for State Highways by facility type (divided, undivided, number of lanes, etc.) as produced by NYSDOT.[2] The intersection of Leland Avenue and Herkimer Road has

---

[2] Visit https://www.dot.ny.gov/divisions/operating/osss/highway/accident-rates from the New York State Department of Transportation. Safety Program Management and Coordination Bureau. Accessed March 21, 2019.

an accident rate of 0.402 acc/MEV, which is higher than the State average of 0.27 acc/MEV. The accidents rate at Herkimer Road and Genesee Street is 0.353 acc/MEV, while the State average is 0.47 acc/MEV. The rest of the intersections have accidents rates well below the State average.

Table 2. Leland Corridor Intersections

Device #	Main Street	Cross Street	Signal Type	Signal Owner	acc/MEV	Statewide Average
19A	River-Auert	Genesee	Standard-timed	NYSDOT	0.140	0.47
22A	Herkimer	Genesee	Standard-timed	NYSDOT	0.353	0.47
21A	Riverside	Genesee	Standard-timed	NYSDOT	0.038	0.47
20A	River	Genesee	Standard-timed	NYSDOT	0.092	0.47
U-41	Herkimer	Euclid-PC Plaza	Loop	City of Utica	0.188	0.23
U-42	Herkimer	Leland	Loop	City of Utica	0.402	0.27
U-43	Herkimer	Van Rensselaer	Loop	City of Utica	0.073	0.27
18	Leland	Off ramp for 790	Loop	NYSDOT	0.024	0.27

3.1.2 Parkway Corridor

Parkway corridor (shown in Figure 8) consists of 1.3 miles along Culver Avenue, 3.1 miles along Memorial Parkway/Pleasant Street, and 0.1 miles of Burrstone Road. The Parkway corridor connects NYS Route 5 to the west and NYS Route 8/NYS Route 12 to the south of the downtown area. Along the corridor is the Mohawk Valley Community College, the Army National Guard Recruiter, Proctor Park, Valley View Golf Course, and the Utica Zoo, but most of the corridor is high density residential neighborhoods. Between Genesee Street and Sherman Drive, the corridor is four lanes with a median. West of Sherman Drive, the roadway becomes two lanes.

Figure 8. Pleasant Street and Seymour Avenue

The 4.6-mile Parkway corridor from Dwyer Avenue to Lincoln Avenue has 17 signalized intersections. Signal controls were a mixture of inductance loop, microwave detectors, and standard (fixed) timing. The signals are owned by NYSDOT or the City of Utica.

Traffic signals at Albany Street and Welsh Bush Road are only 275 feet apart and operate independently using fixed timing. This can lead to traffic not clearing the intersection and high congestion during peak traveling periods. Both signals are owned by the City of Utica and have button activated crosswalks.

Five intersections (Madison Avenue, Elm Street, Oneida Street, Holland Avenue, and Genesee Street) have dual intersections where two signals work together due to the median configuration. The short connector road has potential to backup, blocking traffic on the main road. All five signals are owned by the City of Utica and have button activated crosswalks. The connector road at the Utica Zoo, Steel Hill Road, is extended which helps lower the risk of backups.

Table 3 shows the specific information for each intersection along the Parkway corridor. There are five intersections that have accident rates over the State average, although the accident rate at Mohawk Street is barely over the State average. The remaining 12 intersections have accidents per million vehicles below the State average. There hasn’t been an accident at the Dwyer Avenue intersection in the past five years.

Table 3. Parkway Corridor Intersections

Device #	Street	Cross Street	Signal Type	Signal Owner	acc/MEV	Statewide Average
34A	Culver	Dwyer	Loop	NYSDOT	0.000	0.47
U-40	Culver	Bleeker	Standard-timed	City of Utica	0.128	0.47
U-39	Culver	Rutger	Standard-timed	City of Utica	0.156	0.47
U-38	Culver	Welsh Bush	Standard-timed	City of Utica	0.072	0.47
U-37	Culver	Albany	Standard-timed	City of Utica	0.079	0.47
U-36	Culver	Sherman	Microwave	City of Utica	0.136	0.23
U-35	Parkway	Madison	Microwave	City of Utica	0.094	0.47
U-34	Parkway	Mohawk	Microwave	City of Utica	0.231	0.23
U-33	Parkway	Valley View	Microwave	City of Utica	0.317	0.23
U-31	Parkway	Seymour-Steele Hill	Microwave	City of Utica	0.291	0.47
U-30	Parkway	Elm	Microwave	City of Utica	0.170	0.47
U-32	Parkway	Steele Hill	Microwave	City of Utica	0.175	0.47
U-29	Parkway	Oneida	Microwave	City of Utica	0.289	0.23
U-28	Parkway	Holland	Microwave	City of Utica	0.189	0.47
U-13	Parkway	Genesee	Microwave	City of Utica	0.348	0.23
U-26	Burrstone	Sunset	Loop	City of Utica	0.212	0.16
135	Burrstone	Lincoln ramp	Loop	NYSDOT	0.016	0.23

3.1.3 Genesee Corridor

Genesee Street is the main collector that extends from New Hartford through Utica. It intersects and then runs parallel to NYS Route 5 and NYS Route 12. At its northern point, Genesee Street connects to Interstate 90. From the intersection with NYS Route 12, the corridor is a four-lane road but becomes a two-lane road at Sherman Oaks Drive. It remains a two-lane road until Pearl Street in downtown New Hartford where it increases back to four lanes. Genesee Street remains four lanes for the rest of the corridor, except for a roundabout intersection at Oneida Street, Park Ave, and State Street. The 5.7 miles of Genesee Street from NYS Route 5 and NYS Route 12 to Herkimer Road has 36 signalized intersections. The inductance loop, microwave detectors, and standard (fixed) timing signal controls are owned by NYSDOT or the City of Utica.

Traffic signals at Shopping Center Road and Jordan Road/Wilbur Road are only 500 feet apart. There is an offset for the single intersection with Jordan Road and Wilbur Road. Traffic signals at Newell Street and Derbyshire Place are only 130 feet apart while signals at Cornelia Place and South Street are only 100 feet apart. Traffic signals at Oxford Road and Pearl Street are about 500 feet apart. These intersections operate independently and can lead to congestion during busy periods. Traffic signals at Richardson Avenue and the on/off ramp for NYS Route 8 are 250 feet apart while signals at Barton Avenue and Proctor Boulevard are only 175 feet apart. These intersections are synchronized. There is an offset intersection created with the intersection of Ballantyne Brae and Amy Avenue with a button activated crosswalk in the middle of the offset (shown in Figure 9). French Road and Sunnyside Drive are also offset. The intersection of Genesee Street and the Parkway consists of two synchronized lights, one each for Parkway westbound and eastbound. This also occurs at Oriskany Street West and at Burrstone Road.

Figure 9. Details of Offset Intersection on Genesee Street at Ballantyne Brae and Amy Avenue

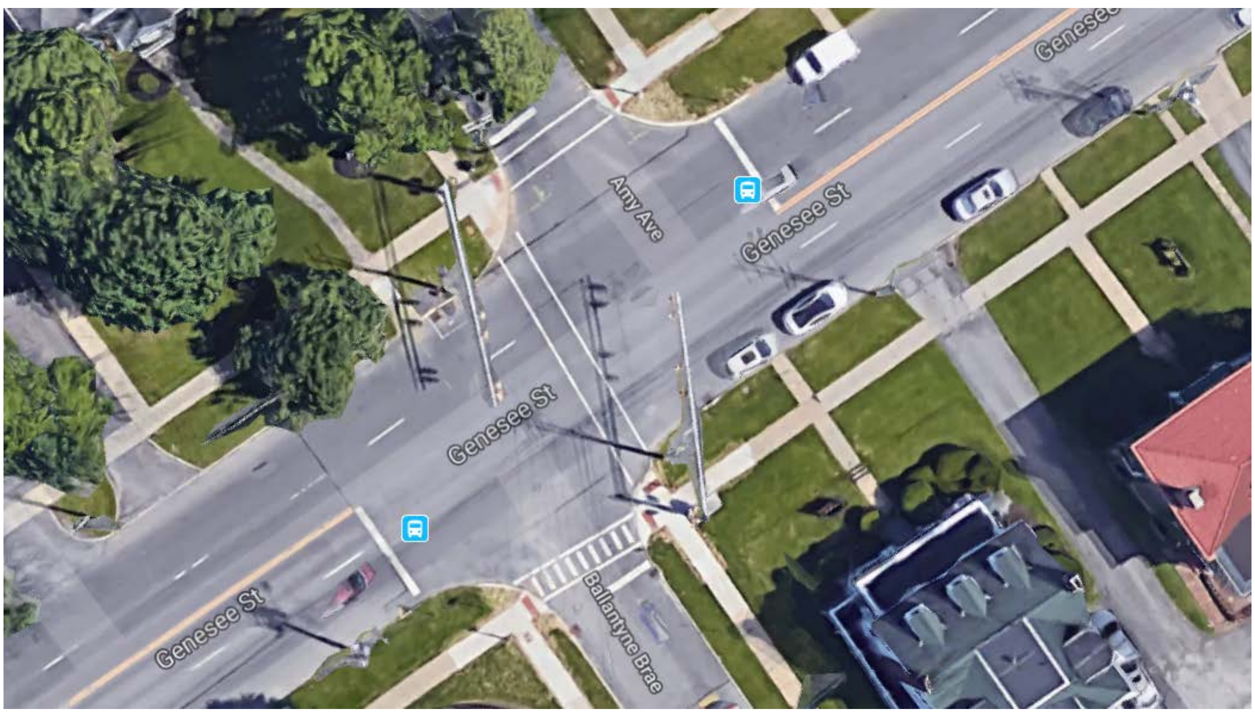


Table 4 shows the details for each intersection. There are nine intersections that have accidents rates higher than the State average. Wurz Avenue has the highest rate at 1.156 acc/MEV, which is significantly higher than the State average of 0.23. The 27 remaining intersections have a lower accident rate than the State average, but all intersections had an accident within the last five years.

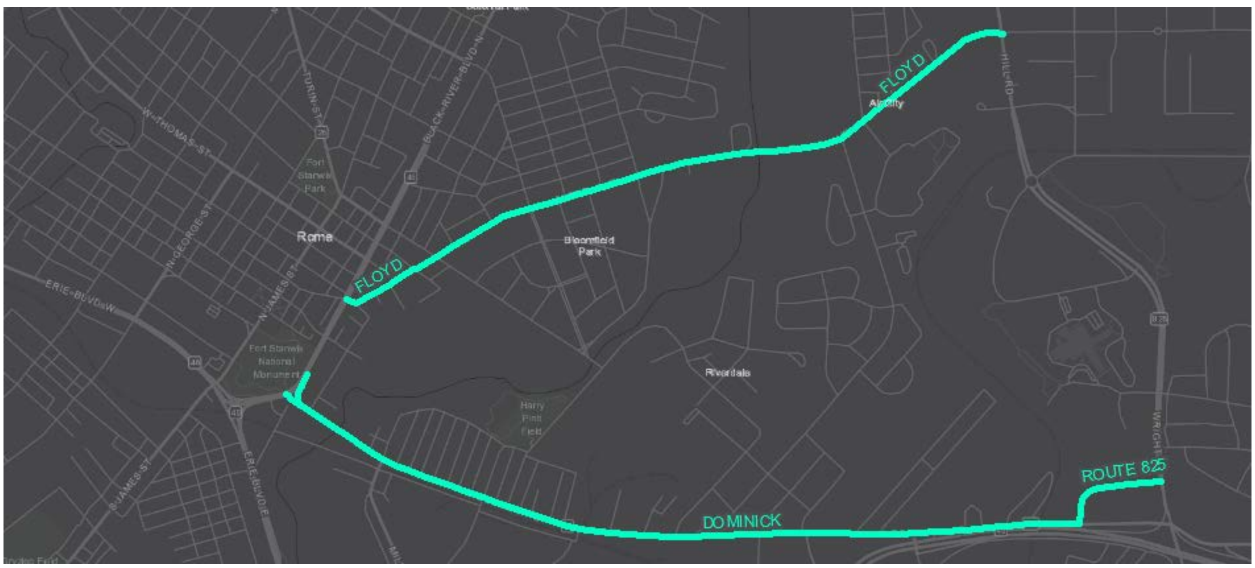
Table 4. Genesee Corridor Intersections

Device #	Cross Street	Signal Type	Signal Owner	acc/MEV	Statewide Average
69	Highway 5	Loop	NYSDOT	0.114	0.15
67	New Paris	Loop	NYSDOT	0.074	0.15
46.1	Jordan-Wilbur	Loop	NYSDOT	0.068	0.47
46	Shopping Center Rd	Loop	NYSDOT	0.000	0.27
3	Pearl and Old Paris	Loop	NYSDOT	0.090	0.47
2	Oxford-Campion	Loop	NYSDOT	0.076	0.27
75	On and Off ramp for 8	Loop	NYSDOT	0.105	0.47
73	Richardson	Standard-timed	NYSDOT	0.103	0.27
U-1	French-Sunnyside	Standard-timed	City of Utica	0.202	0.47
U-2	Higby	Standard-timed	City of Utica	0.254	0.27
U-3	Woodlawn	Standard-timed	City of Utica	0.284	0.47
U-4	Seward	Standard-timed	City of Utica	0.148	0.27
U-5	Beverly-Melrose	Standard-timed	City of Utica	0.052	0.47
U-6	Proctor	Microwave	City of Utica	0.155	0.47
U-7	Barton	Microwave	City of Utica	0.129	0.27
U-8	St. Elizabeth	Microwave	City of Utica	0.181	0.27
U-9	Ballantyne-Amy	Microwave	City of Utica	0.246	0.47
U-10	Emmerson	Microwave	City of Utica	0.318	0.27
U-11	South Town Plaza	Microwave	City of Utica	0.318	0.47
U-12	Sheppard-Parkside	Microwave	City of Utica	0.722	0.47
U-13	Burrstone-Parkway	Microwave	City of Utica	0.350	0.23
U-14	Derbyshire	Microwave	City of Utica	0.153	0.47
U-15	Newell	Microwave	City of Utica	0.179	0.27
U-16	Clinton-Oswego	Microwave	City of Utica	0.792	0.47
U-17	Hobart	Microwave	City of Utica	0.264	0.23
N/A	Roundabout	N/A	N/A	N/A	N/A
U-18	Eagle	Microwave	City of Utica	0.067	0.27
U-19	South St	Microwave	City of Utica	0.274	0.27
U-20	Cornelia	Microwave	City of Utica	0.320	0.27
U-21	Hopper-Court	Microwave	City of Utica	0.406	0.47
U-22	Bank	Standard-timed	City of Utica	0.320	0.27
U-23	Washington	Microwave	City of Utica	0.224	0.47
U-24	Elizabeth-Columbia	Microwave	City of Utica	0.215	0.47
U-25	Bleecker-Lafayette	Microwave	City of Utica	0.329	0.47
28A	Oriskany	Loop	NYSDOT	0.232	0.47
28.1A	Oriskany	Loop	NYSDOT	0.232	0.47
41A	Wurz	Standard-timed	NYSDOT	1.156	0.23

3.2 Rome Corridors

Rome is the second largest city in Oneida County and two corridors, Floyd (top) and East Dominic (bottom) shown in Figure 10, could benefit most from the adoption of ITS technology. Some secondary corridors identified as potential future candidates for future ITS deployments include NYS Route 233 (Judd Road) and Gifford Road to Jervis Avenue. These secondary corridors are quite long with limited traffic control technology but should be considered for ITS technology as traffic control devices are replaced or added.

Figure 10. Key ITS Corridors in the City of Rome



3.2.1 East Dominick Corridor

East Dominick Street links the city's downtown district with residential neighborhoods and a few industrial properties. The corridor also serves as an access point to NYS Route 49 for the east side of the city. Ultimately, East Dominick Street ends at River Road, just west of Wright Drive, which is the arterial serving the Griffiss Business and Technology Park/Griffiss International Airport (Griffiss).

The two-mile-long corridor has two lanes with on-street parallel parking in the commercial district located between Black River Boulevard and First Street. Between First Street and Wright Drive there is a mix of residential and commercial properties with dense neighborhoods to the north and several industrials users to the south. East Dominick turns into a four-lane road east of Gansevoort Avenue.

There are three signalized intersections along East Dominick Street from Black River Blvd to Wright Drive in this area. One signal is controlled by an inductance loop, with the other two using standard (fixed) timing. The City of Rome owns two signals and the other is owned by NYSDOT. There is a connector road/ramp between East Dominick Street and Wright Drive (NYS Route 825) with stop signs at each end.

The First Street/Mill Street intersection has a dedicated turning lane and a through lane when approaching in any direction. However, if vehicles do not move fully into the correct lane the inductance loop in the turn lane can be activated and cause an inadvertent signal change.

Table 5 shows the specific information for each intersection along East Dominick Street. The three intersections in the corridor have accident rates well below the State average.

Table 5. East Dominic Corridor Intersections

Device #	Cross Street	Signal Type	Signal Owner	acc/MEV	Statewide Average
63A	Oneida—NY-49 Off ramp	Standard-timed	NYSDOT	0.046	0.47
R-6	Fifth St	Standard-timed	City of Rome	0.035	0.47
R-7	First St-Mill St	Loop	City of Rome	0.161	0.47

3.2.2 Floyd Corridor

Floyd Avenue links the city’s downtown district, residential neighborhoods, Mohawk Valley Community College’s Rome campus, industrial buildings, and Griffiss. The corridor (shown in Figure 11) runs from Black River Boulevard (NYS Route 26 and NYS Route 46) to Hill Road on Griffiss.

Figure 11. Intersection of Floyd Avenue and Oakwood Street

The 1.8-mile-long corridor has two lanes throughout. There is on-street parallel parking for the eastern half where there are residential neighborhoods and some commercial properties. The western half of Floyd Avenue has several commercial properties, a few residential neighborhoods, and the Mohawk Valley Community College Rome campus.

There are five signalized intersections along Floyd Avenue. Four signals are standard timed and the other is controlled by an inductance loop. All signals are owned by the City of Rome and were replaced between 2003 and 2005. Traffic signals at Bell Road and Park Drive are about 420 feet apart. These signals operate independently and are standard (fixed) timing which can lead to traffic not clearing the intersection and high congestion during peak travel periods.

Table 6 shows the specific information for each intersection along Floyd Avenue. Intersection accidents rates are below the State average, with some seeing very few accidents and the Park Drive intersection without an accident in the last five years.

Table 6. Floyd Corridor Intersections

Device #	Cross Street	Signal Type	Signal Owner	acc/MEV	Statewide Average
R-1	Bell	Standard-timed	City of Rome	0.079	0.47
R-2	Park	Standard-timed	City of Rome	0.000	0.47
R-3	Oakwood	Loop	City of Rome	0.227	0.47
R-4	E Garden	Standard-timed	City of Rome	0.044	0.47
R-5	Bloomfield	Standard-timed	City of Rome	0.215	0.27

3.3 New Hartford and New York Mills Corridors

Two additional key corridors outside of major cities in Oneida County are Henderson (top) and Kellogg (bottom), shown in Figure 12. The Kellogg corridor is in the Town of New Hartford. The Henderson corridor is in the Village of New York Mills, but the Town of New Hartford will likely lead any upgrades to the corridor (the Village of New York Mills may be absorbed by the Town of New Harford in the future). Stone Road and Mohawk/Clinton Street corridors were also considered for ITS enhancements but ultimately not selected as key corridors due to their extensive length, low traffic flow, and limited potential for ITS integration and benefits.

Figure 12. Key Corridors in the Town of New Hartford and Village of New York Mills

3.3.1 Kellogg Corridor

Kellogg corridor links residential neighborhoods with NYS Route 8 and includes 0.6 miles of Kellogg Road and 1.3 miles of Chapman Road. There is a small shopping plaza west of the NYS Route 8 ramps. Chapman Road extends east from Oneida Street to Higby Road passing through a residential neighborhood and the Ralph Perry Junior High School. The school, along with Hughes Elementary nearby on Higby Road, puts a considerable strain on the immediate area's traffic control infrastructure from the bus and parent vehicle volume during morning drop-off and afternoon dismissal. The corridor has two lanes, except between Tibbitts Road and Oneida Street where four lanes handle traffic around the NYS Route 8 interchange and shopping plaza.

There are currently four signalized intersections along the corridor plus one signalized railroad crossing; a study is underway to determine if an additional signal is needed for the northbound NYS Route 8 ramps. Except for Higby Road, all the signal controls are via inductance loops.

The railroad crossing creates an extended intersection with the southbound NYS Route 8 ramps, which means that the eastbound traffic has an extended green light to allow them to clear the railroad crossing. These signals are operated by NYSDOT, but the nearby signal at the Hannaford Plaza is owned by the Town of New Hartford and the lack in coordination with these signals can cause backups.

Table 7 shows the specific information for each intersection. The intersection at Oneida Street has an accident rate of 0.223 acc/MEV, similar to the State average. The accident rate at the southbound NYS Route 8 ramps is well below the State average and surprisingly there haven't been any accidents in the last five years at the Shopping Plaza intersection.

Table 7. Kellogg Corridor Intersections

Device #	Cross Street	Signal Type	Signal Owner	ACC/MEV	Statewide Average
NH-2	Shopping Plaza	Loop	Town of New Hartford	0.00	0.47
77	Southbound NY-8 ramps	Loop	NYSDOT	0.105	0.47
NH-3	Oneida	Loop	Town of New Hartford	0.223	0.23
NH-4	Higby	Standard-timed	Town of New Hartford	0.117	0.47

3.3.2 Henderson Corridor

Henderson corridor in the Village of New York Mills includes the 1.1 miles of Henderson Street and 0.7 miles of Clinton Street. Henderson Street is primarily residential while this part of Clinton Street is mostly commercial properties. These streets connect Commercial Drive (NYS Route 5A) to Main Street and Burrstone Road.

Traffic in the corridor is heavy from people going to the commercial properties in the area, as well as those passing through to get to Commercial Drive (retail) or Burrstone Road (schools, medical facilities, business park, and more retail). The signal on Commercial Drive (NYS Route 5A) is owned by NYSDOT, while the other two are owned by the Village of New York Mills. Each signal is controlled by inductance loops.

There is a railroad crossing at grade without any signals near the intersection of Clinton Street with Main Street and Burrstone Road. Vehicles routinely stopped at a red light can temporarily be stopped on the railroad crossing, and a crosswalk accessing a trail system can also complicate traffic flow.

Table 8 shows the specific information for each intersection. The three intersections along Henderson Street and Clinton Street in the corridor have accidents rates that are approximately half of the State average.

Table 8. Henderson Corridor Intersections

Device #	Cross Street	Signal Type	Signal Owner	acc/MEV	Statewide Average
NYM-1	Main-Burrstone Street	Loop	Village of New York Mills	0.122	0.27
NYM-2	Henderson Street	Loop	Village of New York Mills	0.208	0.47
37	Commercial Drive (NY-5A)	Loop	NYSDOT	0.128	0.23

4 Proposed Smart Infrastructure Design

4.1 Utica

Key corridors in the City of Utica have many intersections and are critical to traffic flow in, out, and through the city. Two proposed corridors include phased approaches to integrate smart technology over time because of their size and cost. However, these corridors should undertake these ITS enhancements throughout their entirety to enable continuity with the connected State-operated highways. It is important to the city that Americans with Disabilities Act (ADA) compliance, with specific attention for the blind and visually impaired, is considered throughout the process.

4.1.1 Leland Corridor

Leland corridor connects major roadways including north Genesee Street (near the Interstate 90 ramps), NYS Route 5, River Road, and Interstate 790. Intersections are in close proximity and cause backup issues during heavy traffic. Traffic signals at North Genesee Street and the Interstate 790 ramp on Leland Avenue are currently NYSDOT controlled with ITS technology. The intersections on Herkimer Road at Northern Road, Leland Avenue, and Van Rensselaer Road have vehicle sensing loops, but do not have communication capabilities so they can become out of sync and cannot be remotely controlled when a critical traffic situation occurs. Smart signals would enable signal timing coordination to smooth traffic flow and reduce peak period congestion. A camera mounted on the traffic signal at Leland Avenue and Herkimer Road would enable traffic monitoring. The layout of the proposed ITS technology is shown in Figure 13. Estimated costs for ITS upgrades are shown in Table 9.

Figure 13. Leland Corridor Proposed ITS Layout

Table 9. Estimated Costs for the Leland Corridor Proposed ITS Enhancements

Signal Controllers and Auxiliary Cabinets	Traffic Sensors	Traffic Camera	Network Modems	Installation Costs	Total Initial Cost	Annual Service Cost	Annual Maintenance Cost (10%)
$39,000	$0	$1,500	$1,000	$15,875	$57,375	$4,800	$4,150

4.1.2 Genesee Corridor

Genesee Street is one of the busiest corridors in Oneida County not operated by the State. The corridor connects major State highways, including Interstate 90 and NYS Route 5, NYS Route 5S, NYS Route 12, and NYS Route 8, and is the major arterial running through downtown Utica. It also parallels the North-South Arterial Highway (NYS Route 5 and NYS Route 12) and is an alternative roadway if the North-South Arterial is backed up. Due to the length and number of intersections on Genesee Street, the corridor was split into three sections (north, central, and southern), which would allow the proposed ITS solutions to be implemented in phases (shown in Figure 14).

The northern Genesee corridor is from Oriskany Street (NYS Route 5S) to Herkimer Road (NYS Route 5). All traffic signals on this section are operated by NYSDOT with communication and modern sensor technology, so there are no suggested ITS updates.

Figure 14. Proposed ITS Solutions for the Genesee Corridor

The central Genesee corridor is between Oriskany Street (NYS Route 5S) and the intersection with Burrstone Road, Memorial Parkway, and Pleasant Street. This section is the most densely populated of the corridor and includes residential and commercial developments. The section has some of the oldest traffic signal technology, with a high percentage of time-based control without any form of vehicle sensing. With the importance of this section to traffic flow in downtown Utica and the current state of the technology, this portion of the corridor should be the highest priority for ITS integration. Proposed traffic signal upgrades include adding vehicle sensing, updating the signal controllers with communication capabilities, and enabling remote monitoring and control with the TMC. Signal mounted traffic cameras are recommended at Oriskany Street (NYS Route 5S) and the Burrstone Road, Memorial Parkway, and Pleasant Street intersection.

The southern Genesee corridor is between the intersection with Burrstone Road, Memorial Parkway, and Pleasant Street and where Genesee Street ends at NYS Route 5 and NYS Route 12 in New Hartford. This section of the corridor has a mix of old time-based lights and updated, NYSDOT monitored and controlled smart traffic signals. The proposed ITS strategy would upgrade the remaining older signals to the same technology level as the NYSDOT controlled signals to provide continuity. It is also proposed that a traffic camera be placed at the intersection with NYS Route 5 and NYS Route 12 (in addition to the camera proposed at the intersection with Burrstone Road, Memorial Parkway, and Pleasant Street included in the plan for the central Genesee corridor).

Estimated initial and operating costs for the Genesee corridor ITS upgrades are shown in Table 10.

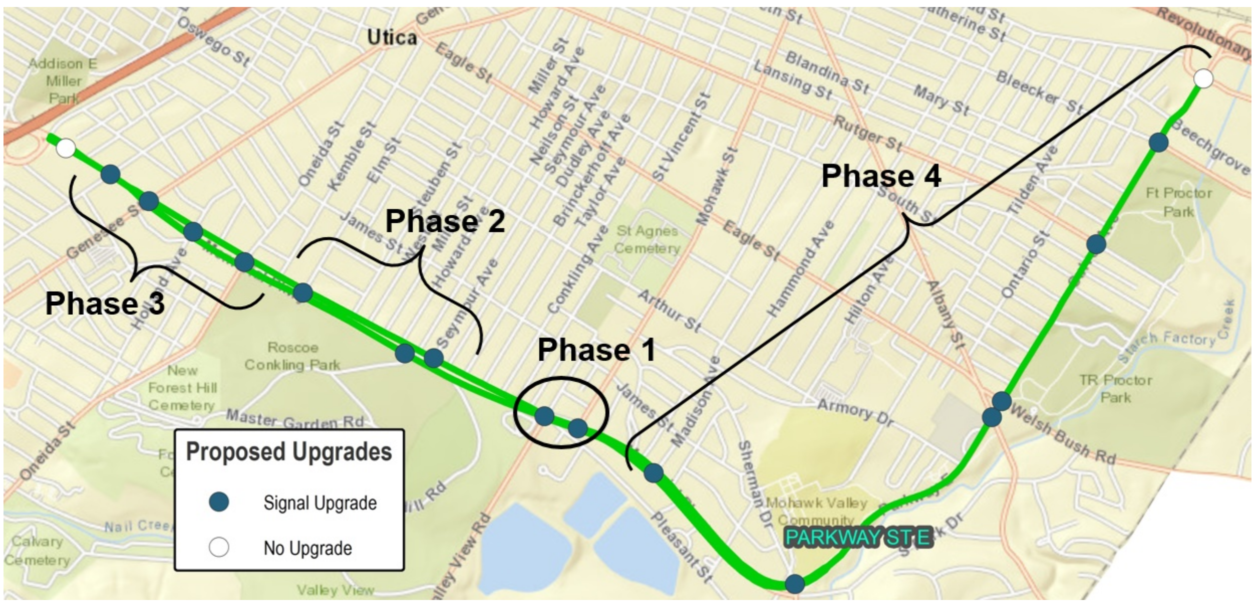
Table 10. Estimated Costs for the Genesee Corridor Proposed ITS Enhancements

	Signal Controllers and Auxiliary Cabinets	Traffic Sensors	Traffic Cameras	Network Modems	Installation Costs	Total Initial Cost	Annual Service Cost	Annual Maintenance Cost (10%)
Northern	$0	$0	$0	$0	$0	$0	$0	$0
Central	$169,000	$34,000	$3,000	$3,750	$151,750	$361,500	$18,000	$20,975
Southern	$169,000	$6,000	$1,500	$3,500	$80,875	$260,875	$16,800	$18,000
Total Corridor	$338,000	$40,000	$4,500	$7,250	$232,625	$622,375	$34,800	$38,975

4.1.3 Parkway Corridor

Parkway corridor encompassing Memorial Parkway, Pleasant Street, Culver Avenue and part of Burrstone Road completes a critical traffic route from the North-South Arterial Highway (NYS Route 5 and NYS Route 12) to NYS Route 5S on the western side of Utica. Mohawk Valley Community College, Proctor Park, and Utica Zoo are just some of the major destinations along this corridor. The implementation of ITS solutions on the corridor is divided into four phases based on prioritization. While all phases should be completed to improve traffic flow along the corridor, they are ranked in importance should the City of Utica choose to make upgrades incrementally. The layout of the corridor suggested ITS technology upgrades, and the recommended implementation phases, are shown in Figure 15.

Figure 15. Proposed ITS Solutions for the Parkway Corridor



The highest priority intersections along the corridor (Phase 1) are at Valley View Road and Mohawk Street. These intersections have significant congestion during certain periods of the day and special events. It is proposed that the traffic signals be upgraded to enable communication, along with remote monitoring and control. These signals currently have vehicle detection that can be integrated into the new signal controllers. Due to the proximity of these intersections, coordination between the two signals would provide additional benefits in overall traffic flow, congestion reduction, and travel optimization.

Phase 2 intersections include Steele Hill Road and Elm Street. In this section, the Parkway is a divided highway, including Memorial Parkway (westbound) and Pleasant Street (eastbound), so each intersection is comprised of two coordinated traffic signals. It is proposed that the traffic signals be upgraded with communication and control capabilities.

The four intersections between Oneida Street and Sunset Avenue (including Genesee Street) are the suggested Phase 3 implementation. This section is partially a four-lane divided highway (west of Genesee Street) with all four lanes adjacent to each other east of Genesee Street. Proposed upgrades include traffic signals with communication and control capabilities.

Phase 4 includes the signals east of Mohawk Street on Memorial Parkway and along Culver Avenue which starts at Mohawk Valley Community College. These intersections are relatively spread out so coordination between signals is hard to optimize, but the corridor could still benefit from ITS technology that monitors and adjusts to the current traffic conditions. Many of these signals do not have vehicle detection which is another added feature to install. The intersection at NYS Route 5S has been updated and is currently controlled by NYSDOT.

Estimated initial and operating costs for the proposed ITS technologies are shown in Table 11.

Table 11. Estimated Costs for the Parkway Corridor Proposed ITS Enhancements

	Signal Controllers and Auxiliary Cabinets	Traffic Sensors	Network Modems	Installation Costs	Total Initial Cost	Annual Service Cost	Annual Maintenance Cost (10%)
Phase 1	$26,000	$0	$500	$10,000	$36,500	$2,400	$2,650
Phase 2	$39,000	$0	$750	$15,000	$54,750	$3,600	$3,975
Phase 3	$52,000	$0	$1,000	$20,000	$73,000	$4,800	$5,300
Phase 4	$78,000	$30,000	$1,500	$105,000	$214,500	$7,200	$10,950
Total Corridor	$195,000	$30,000	$3,750	$150,000	$378,750	$18,000	$22,875

4.2 Rome

The City of Rome is very interested in integrating ITS technology for future transportation development efforts. The East Dominic and Floyd corridors have significant daily traffic, are critical to the overall traffic flow in the region and have significant recent or planned developments in the area around them. The City of Rome is also interested in a broader adoption of pre-emptive traffic control systems for emergency response vehicles, and ITS technology can help integrate these systems by providing additional monitoring and control.

4.2.1 East Dominick Corridor

East Dominick Street has the potential to experience significant benefits from ITS technology with minimal upgrades. The corridor connects the Black River Boulevard with NYS Route 825 and provides the most direct alternative route for NYS Route 49 traffic should it need to be diverted. Traffic signals at Black River Boulevard and the NYS Route 49 ramps have been upgraded by NYSDOT, allowing the State entity the ability to control or optimize the operation as needed. Therefore, only two traffic signals need to be upgraded—the intersections with Mill Street and Fifth Street—to have ITS signal technology along this entire corridor.

Additionally, a VMS is recommended on Route 825 for traffic approaching NYS Route 49 or East Dominick Street to inform drivers of any pertinent information before selecting their route. A traffic camera mounted on the VMS is also proposed as it would enable real-time monitoring of NYS Route 825. The proposed ITS upgrades and the layouts are shown in Figure 16. Estimated initial and operating costs for the proposed ITS technology upgrades along the East Dominick corridor are shown in Table 12.

Figure 16. East Dominick Corridor Proposed ITS Layout

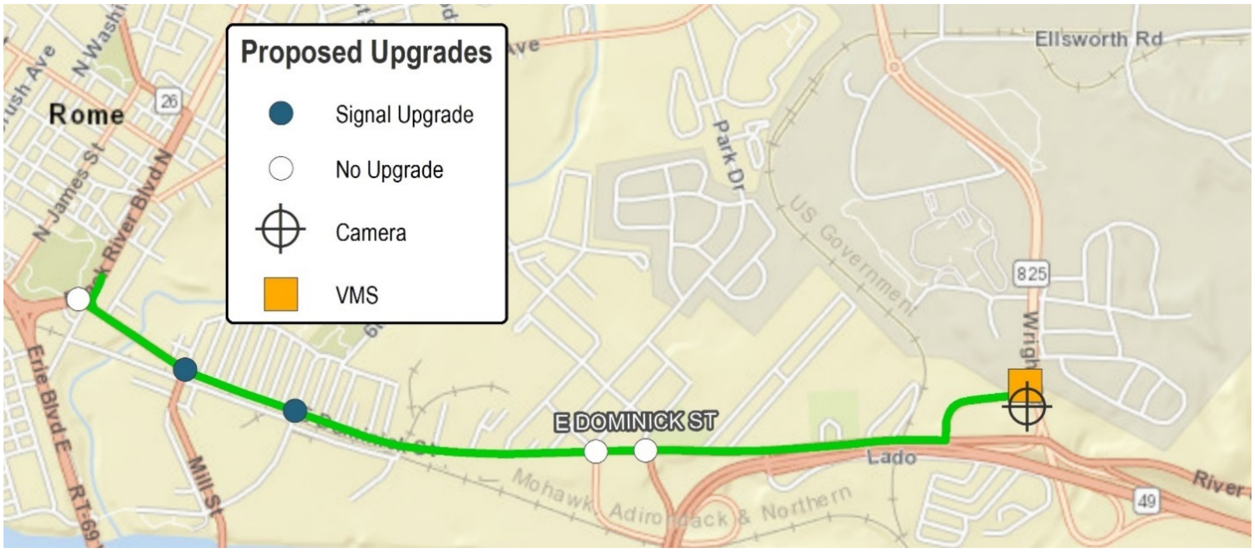


Table 12. Estimated Costs for the East Dominick Corridor Proposed ITS Enhancements

Signal Controllers and Auxiliary Cabinets	Traffic Sensors	Traffic Camera	VMS Board	Network Modems	Installation Costs	Total Initial Cost	Annual Service Cost	Annual Maintenance Cost (10%)
$26,000	$8,000	$1,500	$25,000	$1,000	$36,375	$94,875	$4,800	$6,150

4.2.2 Floyd Corridor

Floyd Avenue, as one of the primary routes from downtown Rome, is becoming much more heavily traveled due to increasing developments at the Griffiss Air Force Base and surrounding area. The corridor connects a large employment center on the air force base (NYS Route 825) with a commercial zone around Black River Boulevard (NYS Route 26 and NYS Route 46) with residential areas in between. The traffic signal at Floyd Avenue and Black River Boulevard is owned by NYSDOT and has technology to enable traffic optimization and response. Residential developments are planned around Park Drive which could increase congestion—something that could be alleviated with smart traffic control.

The proposed signals to be upgraded (outlined in Figure 17) include communication and optimization capabilities at Floyd Avenue intersections with East Bloomfield Street, East Garden Street, Oakwood Street, Park Drive, and Bell Road. It is also suggested that traffic cameras be added at Black River Boulevard and Park Drive to visually monitor traffic and conditions at these vital locations. Estimated costs for the proposed ITS technology on the Floyd corridor are shown in Table 13.

Figure 17. Floyd Corridor Proposed ITS Layout

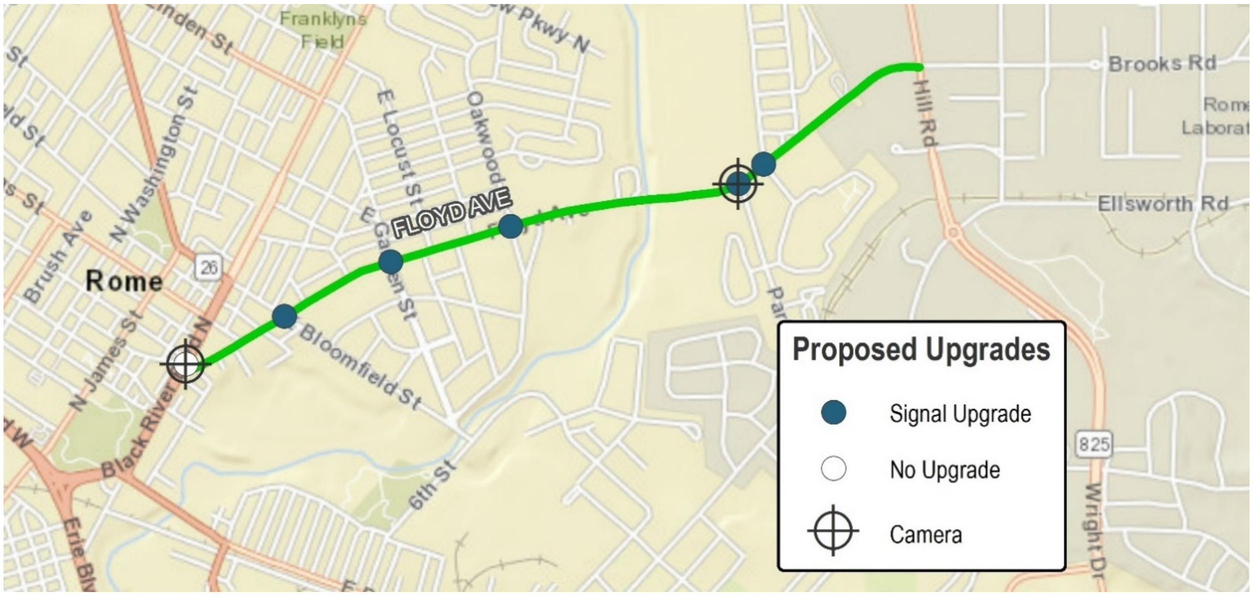


Table 13. Estimated Costs Floyd Corridor Proposed ITS Enhancements

Signal Controllers and Auxiliary Cabinets	Traffic Sensors	Traffic Cameras	Network Modems	Installation Costs	Total Initial Cost	Annual Service Cost	Annual Maintenance Cost (10%)
$65,000	$30,000	$3,000	$1,750	$101,750	$201,500	$8,400	$9,975

4.3 New Hartford and New York Mills

The Town of New Hartford and Village of New York Mills have key corridors in Oneida County that were prioritized for ITS technology integration. Through shared agreements, the Town of New Hartford may take the lead on integrating ITS technology on the signals currently operated by the Village of New York Mills. Both selected corridors are short with a few intersections. However, these corridors experience heavy traffic flows and the benefit of implementing ITS technology could be significant.

4.3.1 Kellogg Corridor

Kellogg corridor, consisting of Kellogg Road and Chapman Road near Washington Mills, is between Oxford Road and Higby Road with only four signalized intersections. The corridor connects commercial areas with residential sections and is a critical feeder into NYS Route 8 for workday commutes. Traffic in and out of Ralph Perry Junior High School and Hughes Elementary School add to the daily congestion issues.

The southbound NYS Route 8 ramps have a NYSDOT traffic signal equipped with modern ITS technologies. The northbound NYS Route 8 ramps are currently not signalized, but NYSDOT is investigating the potential need for traffic control there, which would have ITS capabilities if installed. The other intersections along the corridor that could benefit from communication and vehicle sensing upgrades include the shopping plaza access road, Oneida Street, and Higby Road. In addition to upgraded traffic lights, a traffic signal mounted camera at the Higby Road intersection is recommended to visually gauge traffic at this very busy intersection. NYSDOT is currently planning to install a high-mast camera at NYS Route 8, which would help monitor traffic on Kellogg Street from Oneida Street to the shopping plaza entrance. The layout of the proposed ITS technology is shown in Figure 18. Estimated initial and operating costs for the proposed ITS technology upgrades on the Kellogg corridor are shown in Table 14.

Figure 18. Kellogg Corridor Proposed ITS Layout

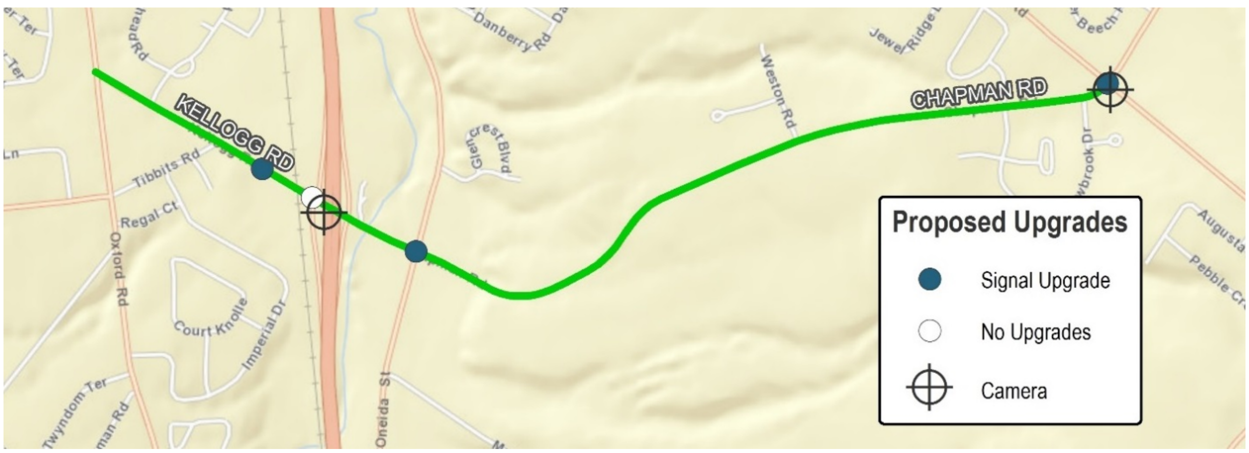


Table 14. Estimated Costs for the Kellogg Corridor Proposed ITS Enhancements

Signal Controllers and Auxiliary Cabinets	Traffic Sensors	Traffic Camera	Network Modems	Installation Costs	Total Initial Cost	Annual Service Cost	Annual Maintenance Cost (10%)
$39,000	$8,000	$1,500	$1,000	$35,875	$85,375	$4,800	$4,950

* Does not include the high-mast camera at NYS Route 8 which NYSDOT is planning to install.

4.3.2 Henderson Corridor

The Henderson corridor is a short section of roadway that has heavy traffic and its traffic flow could improve significantly with minimal investment in ITS technology.

Shown in Figure 19, the traffic signal at Commercial Drive (NYS Route 5A) is operated by NYSDOT and has ITS technology capabilities. Proposed ITS enhancements on the corridor include upgrading traffic signals at the Henderson Street and Clinton Street intersection and the Main Street, Clinton Street, and Burrstone Road intersection with vehicle sensing and communication technologies. These signals could then be coordinated to enable smoother traffic flow and reduced congestion in this area. A camera mounted on the traffic signal at the Main Street, Clinton Street, and Burrstone Road intersection is suggested to enable real-time viewing of traffic conditions. Estimated initial and operating costs for the proposed ITS upgrades along the Henderson corridor are shown in Table 15.

Figure 19. Henderson Corridor Proposed ITS Layout

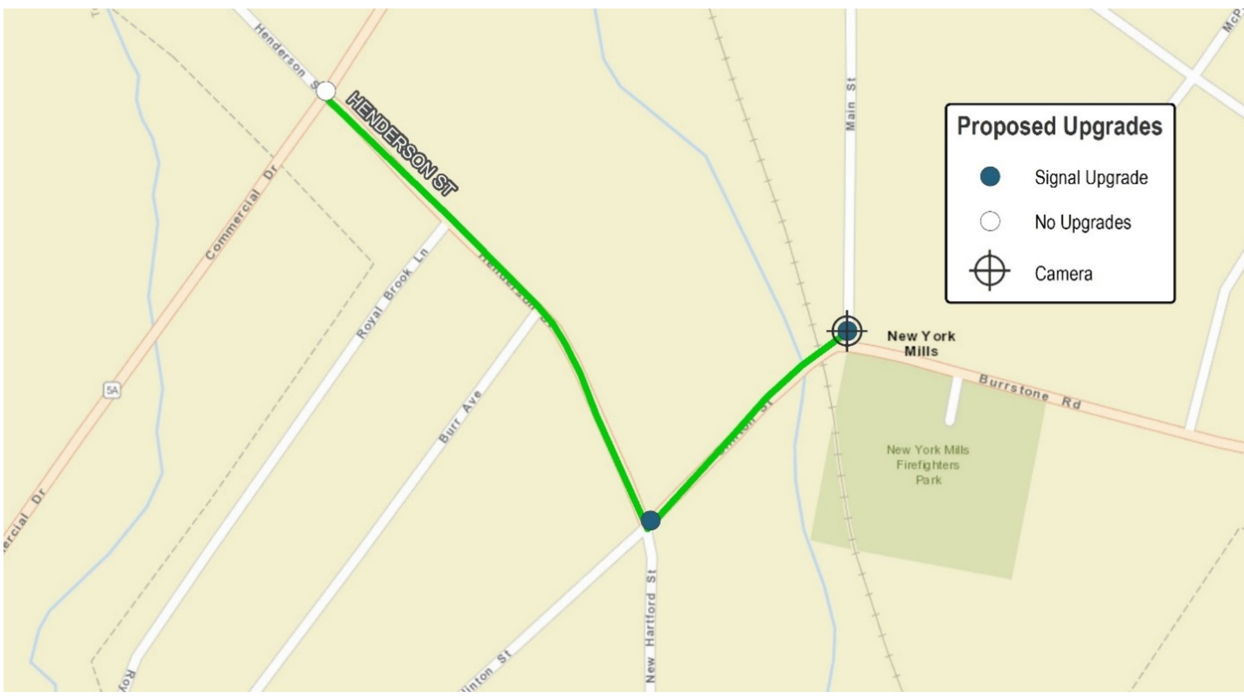


Table 15. Estimated Costs for the Henderson Corridor Proposed ITS Enhancements

Signal Controllers and Auxiliary Cabinets	Traffic Sensors	Traffic Camera	Network Modems	Installation Costs	Total Initial Cost	Annual Service Cost	Annual Maintenance Cost (10%)
$26,000	$0	$1,500	$750	$10,875	$39,125	$3,600	$2,825

5 Potential Benefits

ITS technology provides traffic control capabilities to address a wide range of situations, resulting in several benefits that include energy and environmental gains for the motoring public and fleets. Improved traffic flow during normal driving conditions results in more efficient travel, saving time and fuel, which lowers emissions. This leads to less driver frustration and less risky driving maneuvers which, combined with having better ways to communicate information to drivers (e.g., VMS), results in safer traveling conditions for everyone. ITS technology is especially beneficial during incidents and emergency situations to divert traffic to alternative routes when necessary.

Emergency response capabilities are improved with ITS technology. It provides added traffic control during inclement weather (heavy snow, flooding, etc.). ITS can help emergency response personnel to redirect traffic and manage the added congestion on redundant roadways if a primary highway is shut down due to accidents or weather. Additionally, the remote monitoring capabilities provide more real-time information and better response capabilities to emergency response personnel.

ITS technology can be a powerful tool for managing traffic at large events such as sporting events, concerts, and conferences. It also informs the public and redirects traffic for major roadway construction or maintenance. Traffic control algorithms can be designed and tested in advance at the TMC to enable changing traffic flow patterns for various changes in traffic dynamics.

ITS increases motorist safety by reducing collisions with optimized traffic control. Additionally, the technology can warn motorists of potentially dangerous driving situations due to events or inclement weather. Roadway management and condition monitoring is also greatly improved by providing increased information that aids in quicker response times.

Transportation efficiency can be increased when nearby intersection signals are coordinated to create more steady traffic flow with reduced stop-and-go behavior. Intersection optimization can increase total system throughput by adjusting for varying traffic volumes and patterns during the day. Traffic delays can decrease 15–40% and travel time is typically reduced by 25% when implementing ITS solutions.[3]

[3] Visit https://www.ite.org/pub/?id=e265c148-2354-d714-515a-eb251643bd2a for the National Traffic Signal Report Card 2007 Executive Summary on The National Transportation Operations Coalition website. Accessed March 20, 2019.

Due to less idling while waiting for lights and more consistent vehicle speed, vehicle fuel consumption is reduced by an average of 10%, with harmful emissions reduced by up to 22% (including carbon dioxide [CO_2], hydrocarbons [HC], carbon monoxide [CO], nitrogen oxides [NO_x], and fine particulate matter having a diameter of less than 2.5 micrometers [$PM_{2.5}$]).[3] These savings are based on an outside study using traffic modeling software since measuring the fuel consumption and emissions factors for these specific corridors was beyond the scope of this project. The estimated savings per corridor are shown in Table 16. If the key corridors in Oneida County are upgraded to the proposed ITS strategies, it is estimated that nearly 790 gallons of fuel per year would be saved. These estimates are based on corridor length, traffic density, and average light-duty vehicle fuel economy and emissions.[4,5,6]

Table 16. Estimated Corridor Fuel and Emissions Savings

Corridor	Annual Fuel Savings (gallons)	Annual Emissions Savings (tons)				
		CO_2	Total HC	CO	NO_X	$PM_{2.5}$
Leland	5,392	52.8	0.12	1.36	0.27	0.01
Parkway	79,636	780.2	1.82	20.09	3.95	0.12
Genesee	99,545	975.3	2.28	25.12	4.93	0.15
East Dominick	53,920	528.3	1.24	13.60	2.67	0.08
Floyd	26,131	256.0	0.60	6.59	1.30	0.04
Kellogg	15,529	152.1	0.36	3.92	0.77	0.02
Henderson	7,964	78.0	0.18	2.01	0.39	0.01
Total	288,118	2,822.7	6.60	72.70	14.28	0.44

Upgrading all national roadways to include ITS technology is estimated to be less than 1% of total highway expenditures annually. The cost to install all the ITS technology corresponds to an average cost around $3 per U.S. household, but would result in an estimated savings of $100 per household per year.[3]

---

4 Visit https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles from the Bureau of Transportation Statistics. Average Fuel Efficiency of U.S. Light Duty Vehicles. Accessed March 20, 2019.

5 Visit https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and from the Bureau of Transportation Statistics. Estimated National Average Vehicle Emissions Rates per Vehicle by Vehicle Type Using Gasoline and Diesel. Accessed March 20, 2019.

6 Visit https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle from the United States Environmental Protection Agency. Greenhouse Gas Emissions from a Typical Passenger Vehicle. Accessed March 21, 2019.

6 Conclusions and Lessons Learned

The project's goal was to identify and develop the process needed to determine how ITS technology could be implemented on local roadways and leverage the existing capability of a NYSDOT TMC. Through this study, the project team documented and shared information previously unknown to many municipalities about the NYSDOT TMC. These resources can continue to be used in Oneida County and across the State to raise the awareness of other municipalities regarding ITS technology deployments and management at NYSDOT. Summarized in the *Intelligent Transportation Systems: A Technology Roadmap* and discussed in more detail with this project report, the approach used in Oneida County to identify potential ITS implementation opportunities and facilitate action by local municipalities can be replicated by other counties.

Involving stakeholders from the beginning of the process when identifying roadways that are best suited for ITS deployment is important. This often involves some education and discussion related to ITS technology, and the NYSDOT TMC, which is critical for stakeholders to understand. To some extent, educating the general public about the project would have been valuable to increase awareness and appreciation for efforts to improve travel conditions as well as to build public support for future ITS investment. The criteria used to identify key corridors for this project are applicable for any county or municipality undertaking a similar effort. While Oneida County doesn't have a lot of urban corridors where ITS is critically important, there are many intersections where congestion is an issue. Similar to other cities across New York State, the original roadway design did not anticipate the current population and commercial businesses around these locations. ITS technologies can help manage increased traffic flow (specifically intermittent backups) without expanding the roadway which would be a lot more expensive. Some intersections will be constrained by its original design, but the Mohawk Valley TMC can continually make adjustments to improve traffic flow as best possible once networked ITS technology is installed. ITS solutions can be applied at various levels to improve traffic flow at every intersection.

The process to identify key corridors for ITS implementation became relatively straightforward as there were less options to consider and the most problematic sections of roadways were obvious. It was also enlightening to find out many roadways NYSDOT manages and has already equipped with ITS technology. The biggest challenge of the study was defining the boundaries of a corridor. On some roadways, certain intersections were problematic, but not the entire street. However, to prepare for emergency situations, it was important to NYSDOT for the corridors to complete a connection from State highway to State highway when feasible, so if traffic had to be diverted onto this local roadway, the entire stretch could handle increased traffic volume. For such corridors, the recommendations included a phased approach to first address the problematic intersections, with a goal to eventually upgrade the entire corridor with ITS technology (while recognizing the difficulty for some local municipalities to make the entire investment at one time). Some corridors encompassed multiple local roadways or extended farther than originally considered as the project team uncovered planned developments or significant influences on traffic (such as a local school) that should be incorporated into the planned improvements.

A critical step is conducting an inventory of these corridors that clearly documents the existing conditions from which ITS technology can build. This inventory should identify existing traffic control technology and thoroughly evaluate traffic flow restrictions, problematic areas, peak traffic times, and other traffic flow considerations. Some of this information can be captured through on-site observations, but such information is only a snapshot of time for a continually fluctuating situation. The comprehensive inventory required input from the local municipalities—along with local driver insights—and was gathered through stakeholder experiences as well as what they learned from others. This took time and the support from the county planning staff and municipal planning organization for the project was essential as they have been examining the roadways and gathering input from residents for years.

With all this information, the project team could then develop an ITS technology deployment plan that included hardware upgrades, estimated implementation costs, and the potential to integrate with existing ITS capabilities. The experience and expertise on ITS technology from NYSDOT, through their own deployments and establishment of the TMC, were extremely helpful in the success of the project. Their insights were regularly called upon during project and stakeholder meetings, and they significantly contributed to the ITS recommendations. The proposed solutions incorporate technologies that are compatible with their ITS architecture, so local municipalities can leverage the capabilities of the TMC. While additional logistics and shared service agreements must be worked out between NYSDOT and the local municipalities to fully evaluate whether the proposed solutions can be successfully implemented, the groundwork by the project has conveyed the value and benefit for local municipalities to collaborate with NYSDOT on any ITS deployments (and most municipalities involved in this project have acknowledged this as well).

Our project team created opportunities to help ensure all concerns and interests were addressed in the ITS solution by working collaboratively with local municipalities and stakeholders. The team developed an extensive stakeholder list of contacts with area planners, emergency response, public works, transit organizations, economic development, and tourism groups. A series of meetings were held, both in-person and web-based, where goals of the project were presented, and participants were asked to provide input on identifying and prioritizing key corridors for ITS consideration. In addition, all stakeholders received information about the project, including draft and final project documents throughout the process as they were developed. This level of engagement has created ownership and buy-in of the project and its outcomes in an effort to help ensure a smooth implementing phase.

Ultimately, the local municipalities must lead the deployment of the ITS technology for the transportation infrastructure that they currently own and operate. Ownership and maintenance of the implemented ITS technology will likely remain with the local municipality (except in a few cases where switching the jurisdiction of an intersection to NYSDOT is being discussed). Management and operation of ITS technology is recommended but needs to be discussed with NYSDOT as they have capabilities that would be challenging for local municipalities to establish. This will likely need to be arranged and agreed upon through a shared service agreement. Throughout the project, the local municipalities have been cooperative and receptive of this effort. Some have expressed strong interest in upgrading existing systems with these ITS technologies. However, local municipal staff are often limited in the time they can dedicate towards projects beyond the day-to-day requirements and emergencies they deal with. This was an issue during the project and the primary reason why the effort took longer than originally planned. Expecting local municipal staff to find the time to implement these ITS solutions may be unrealistic but providing them with a clearly outlined strategy in the *Intelligent Transportation Systems: A Technology Roadmap* provides the highest chance for success.

Funding limitations with local municipalities could also derail the implementation of the proposed ITS solutions. The project has provided ample justification for implementing ITS technology but allocating money through already tight municipal budgets is a challenge for most. Larger volume ITS equipment purchases may be available through a collaboration with NYSDOT and the roadmap outlines phased approaches for the installations to spread out the initial costs. However, it is also important that municipalities recognize there will be ongoing networking and maintenance costs that must be properly accounted for in future budget plans. Some grant opportunities for the ITS solution may be available, and it could be useful to help local municipalities apply, but someone in the municipality would need to take the lead. This project has encouraged municipalities to incorporate ITS technology, if not through immediate action by implementing the comprehensive ITS solution, then through integration into any new roadway development project.

There is confidence that these traffic flow enhancements will begin to be incorporated into the local roadways and that this project is the start of further collaboration between NYSDOT and local municipalities for ITS solutions.

NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York State since 1975.

To learn more about NYSERDA's programs and funding opportunities, visit nyserda.ny.gov or follow us on Twitter, Facebook, YouTube, or Instagram.

New York State
Department of Transportation

50 Wolf Road
Albany, NY 12232

telephone: 518-457-6195

dot.ny.gov

New York State
Energy Research and
Development Authority

17 Columbia Circle
Albany, NY 12203-6399

toll free: 866-NYSERDA
local: 518-862-1090
fax: 518-862-1091

info@nyserda.ny.gov
nyserda.ny.gov