MaineDOT

ATTAIN Grant

Volume I - Technical Application

Brunswick Cook's Corner Mobility and Safety Improvement Project

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Section I – Cover Page

Project Name	Brunswick Cook's Corner Mobility and Safety Improvement Project
Eligible Entity Applying to Receive Federal Funding	MaineDOT
Total Project Cost (from all sources)	$10,450,000
ATTAIN Grant Request	$8,360,000
Are matching funds restricted to a specific project component? If so, which one?	No
State(s) in which the project is located	Maine
Is the project currently programmed in the: • Transportation Improvement Program • Statewide Transportation Improvement Program • MPO Long Range Transportation Plan • State Long Range Transportation Plan	This project is included in the STIP. The project is not in a TIP because it is not located within the boundaries of an MPO. This project is consistent with the goals of our statewide long range transportation plan. It is not included in an MPO long range plan because it is not located within an MPO.
Technologies Proposed to Be Deployed (briefly list)	ATC controllers, Adaptive Signal technology, Road Weather Information System, CCTV, AVL technologies, travel time signs, DSRC/CV2X, and upgraded traffic signal detection and communications
Will the project use connected vehicle technologies?	Yes, it will use a hybrid roadside unit with DSRC/5.9 GHz spectrum, Cellular/4G/5G communications, and CV2X technology
Will the project use automated driving system technologies?	No
Is the project located in a rural area? A rural area is an area with a population of 50,000 residents (according to the 2010 Census). If yes, how much ATTAIN funding is being requested to be put toward serving the rural area(s)?	Yes (15,175 people in 2010 Census); ATTAIN funding requested will be fully used within this rural area.

Section II – Project Narrative

1. Project Summary

The *Brunswick Cook's Corner Mobility and Safety Improvement Project* will replace traditional signals at 11 intersections in the Cook's Corner neighborhood of Brunswick, ME, with adaptive traffic control technology to improve data collection, communication, and mobility for the traveling public. The project will improve transit within the Cook's Corner neighborhood by allowing for transit signal prioritization at 11 locations and providing real-time information to transit users at 15 transit stops. Furthermore, the project will improve the safety, reliability, operations, and maintenance of the corridor through a road weather information system (RWIS) sensor station located along Route 1 north of the Cook's Corner interchange.

2. Introduction

Brunswick, Maine, is a rural community located on Maine's Midcoast. Currently home to nearly 22,000 people and growing, Brunswick is a regional hub and service center where people work, shop, and obtain medical care. This project is located within the Cook's Corner neighborhood of Brunswick, which is partially located within a HUD Opportunity Zone. Cook's Corner is located at the crossroads of Bath Road and the US Route 1 interchange, which serve as connections to Interstate 295 and are main lines for people traveling to work, medical care, retail centers, and coastal attractions. Originally a rural crossroads, in the 20th century Cook's Corner developed into an auto-oriented retail and commercial hub, along with some housing and other uses. With a decline in some traditional retail businesses, the redevelopment of the adjacent Navy base, a growing population with insufficient housing, and an increased desire for mixed-use, multimodal communities, Brunswick is now seeking to revitalize the neighborhood for the 21st century.

In 2022, Brunswick published the *Cook's Corner Revitalization Plan (Appendix 3)*, which envisions the area becoming a resilient commercial center with improved safety and mobility, multi-modal connectivity, mixed-use development, and improved land use. Specific *Plan* goal areas are focused on: (1) connectivity and transportation, (2) policy and planning, and (3) economic prosperity and business development.[1] The *Revitalization Plan* lays out several of the key transportation issues that must be overcome to provide adequate multimodal mobility for residents and visitors in a transformed Cook's Corner.

Mobility and safety along Bath Road and US 1 are key transportation issues identified in the *Revitalization Plan.* There is recurring congestion along Bath Road and US Route 1 from daily commuters, people accessing services, and tourist traffic. Because of the proximity of the Brunswick Executive Airport and the extent of existing developments, it is not feasible to increase roadway capacity through adding lanes—additional capacity must be squeezed out of the existing roadway network. Complicating this, most of the traffic signals along Bath Road have been in service for nearly two decades and continually require maintenance preventing the corridor from operating efficiently and effectively. Furthermore, the number of vehicle crashes experienced at several of the intersections within the project area are higher than expected and there are safety challenges for bicyclists and pedestrians accessing services and crossing the intersection.

The *Revitalization Plan* also identifies challenges for the Brunswick Link, which provides fixed route bus services within Cook's Corner. Due to the current state of traffic management in the

[1] https://www.cookscornerrevitalization.org/

Cook's Corner area, congestion adds considerable time to the bus routes, constraining the ability of these buses to serve riders' needs efficiently thereby making public transit less relevant and useful. Prior to the pandemic, ridership on the Brunswick system rose from over 20,000 in 2017, to nearly 23,000 in 2018 and 2019. The Brunswick Link was modified to a fixed route system as part of a public transit study that was conducted in 2020, which included improved service to the Cook's Corner area. To meet the mobility needs of Cook's Corner and a growing Brunswick, the Brunswick Link is looking to provide additional bus services, improved on-time reliable routes, bus prioritization and expanded time of day to accommodate temporal demands of the users. In addition to the Brunswick Link, the BlueLine commuter bus between Lewiston/Auburn and Bath also has stops in Brunswick and Cook's Corner, and also faces some of the same challenges as the Brunswick Link in providing service through this congested area.

The *Revitalization Plan* presents several strategies to address the mobility and safety challenges along Bath Road and US 1, as well as strategies to enhance transit service to better meet the mobility needs of the area. This project will implement strategies identified in the *Revitalization Plan* through the deployment the following advanced technologies (see Appendix 1: Technology Components Map for the location of these technologies):

1. ATC controllers at 11 intersections will serve as the foundation to support all of the technologies that will improve mobility and safety of the Bath Road corridor.
2. Advanced diagnostics through Field Monitoring Unit will reduce maintenance visits.
3. Use of Automated Traffic Signal Performance Measures (ATSPM) will correct timing issues.
4. Signals will have advanced detection to improve safety.
5. Adaptive signal technology at 11 signals will be deployed to fluctuate signal timing as needed.
6. 11 hybrid roadside units to communicate with connected vehicle technology.
7. Cellular or hardwire communication to enable data transmission between the field devices and MaineDOT's central management system.
8. Artificial intelligence (AI) and machine learning to leverage the additional ATSPM data for detailed safety analyses.
9. A Road weather Information System (RWIS) station on US 1 to monitor weather conditions in the area.
10. Transit Automatic Vehicle Location (AVL) to improve transit traveler information, schedule adherence, trip planning, and overall on-time reliability.
11. Transit kiosks at 15 transit stops to inform transit users of expected headways for transit vehicles.
12. Accessible Pedestrian Signals (APS) and Leading Pedestrian Intervals (LPI) will be integrated into the signal systems, where appropriate, to improve the safety of crossing for pedestrians.

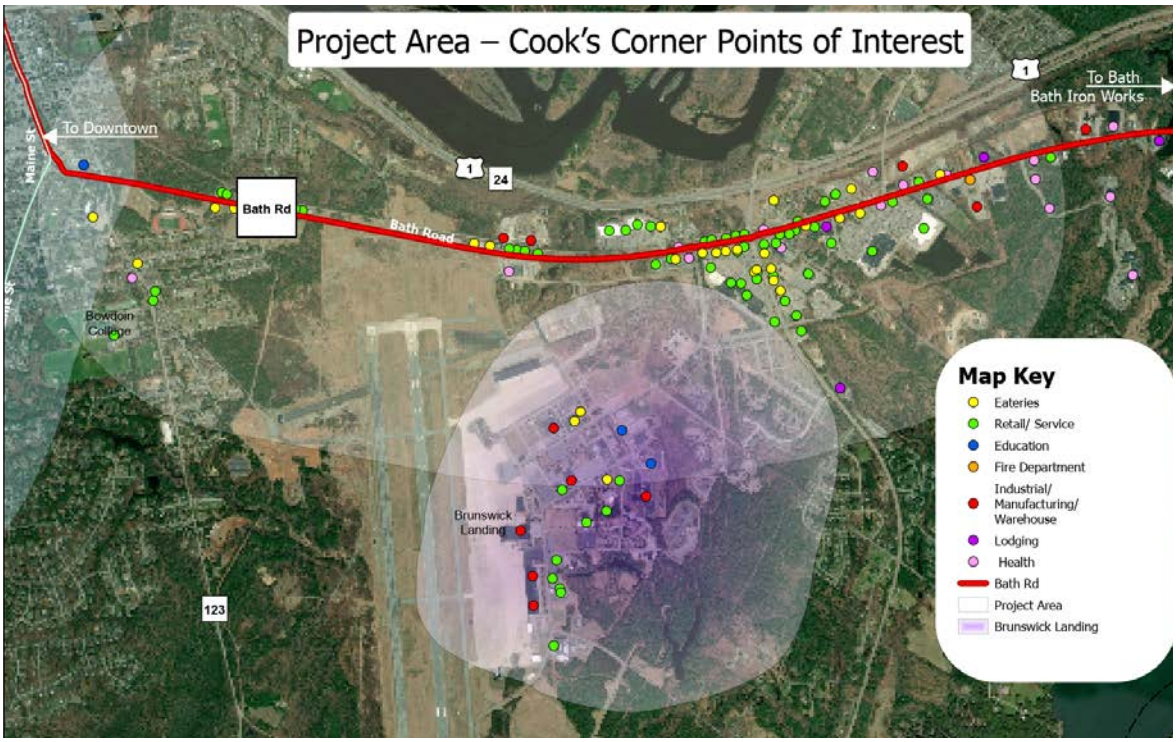
The project also works in tandem with the planning grant application Brunswick recently submitted to the *Reconnecting Communities Pilot Program* for preliminary engineering for complete streets solutions along Bath Road and several component roads in the Cook's Corner neighborhood (See Appendix 4). Together, these grants will provide the resources needed to begin working towards the *Revitalization Plan's* vision of an efficient, reliable, and safe multimodal transportation system in the neighborhood.

MaineDOT considers this project to be a pilot for future rural corridor signalization projects statewide. The combination of adaptive signal technology, camera coverage, RWIS connectivity, message boards, and transit communication improvements will be a model that MaineDOT will want to continue, as it will provide MaineDOT with the ability to communicate important and relevant information to the traveling public.

3. Geographic Area

Brunswick, Maine is a rural, coastal community located within Cumberland County with a population of nearly 22,000 within a 54-square mile area. Located between Portland, Maine and the state capital of Augusta, the Town of Brunswick is a quintessential Maine community with a picturesque and vibrant downtown. Home to Bowdoin College, Brunswick is a college town that offers rich cultural opportunities. It is also home to Mid Coast Hospital and continues to grow as a center of employment. Brunswick is bordered by Bath, Maine, home to Bath Iron Works (BIW), which provides shipbuilding services for the United States Navy. BIW is the state's fourth largest employer and is a subsidiary of General Dynamics, the fifth largest defense contractor in the world.

Brunswick has two commercial and retail centers: Maine Street which serves as the community's downtown and Cook's Corner, located three miles east of downtown. Cook's Corner is a major commercial center, place of employment, and is surrounded by residential neighborhoods. These two centers are separated by the Brunswick Naval Air Station, which closed in 2011. Through the work of the Midcoast Regional Redevelopment Authority, the former Naval Air Station is now Brunswick Landing: Maine's Center for Innovation, a growing regional business center with more than 150 businesses and nonprofits. US Route 1 and Bath Road connect these two centers, with few alternative routes available due to the location of the former Naval Air Station. The segment of Bath Road located in Cook's Corner, serve as the primary location for this project.



Bath Road is a commercial corridor that has grocery stores, pharmacies, home improvement and goods stores, pet stores, restaurants, entertainment, banking, medical facilities, recreation and fitness, hotels and more. The project area is also served by the Brunswick Link and the BlueLine, which help community members access medical appointments, services, and employment opportunities.

These corridors are important locally and regionally. They serve as key connections to I-295, State Route 196, which connects the community to the cities of Lewiston and Auburn, and State Route 24 and 123, which serve the two main peninsulas of the coastal community of Harpswell. Route 1 in Brunswick is the gateway for travelers on I-295 to connect to other Midcoast communities farther east which rely heavily on seasonal tourism. Route 1 and Bath Road are also major corridors for commuters headed to BIW.

Brunswick is a multi-modal, regional transportation hub. I-295 and US Route 1 serve as the transportation spine that runs through the community. Brunswick Station is the last stop on the 120-mile Amtrak Downeaster train connecting Brunswick to 11 cities (including Boston). Public transit bus service is provided by the Brunswick Link, which provides fixed-route transit service within Brunswick, and the BlueLine, a commuter bus linking Lewiston/Auburn to Bath via Brunswick. Transit to points south is provided by Greater Portland METRO's BREEZ express bus line, which runs between Brunswick and Portland. Private intercity bus services are also provided by Concord Coach Lines, connecting Brunswick to the Midcoast region as well as Portland and Boston. The former Navy base now serves as home to the Brunswick Executive Airport. The 2.6-mile Androscoggin River Bicycle Trail also provides key active transportation connections. Presently, most transit services in Brunswick are focused on the west side of the town, especially at Brunswick Station. By improving transit mobility and reliability on the east side of Brunswick, this project will help to better connect residents and workers in the Cook's Corner area, Brunswick Landing, and points east (including Bath and BIW) with the multimodal transportation options available at Brunswick Station. See Appendix 1 for a map of the Brunswick Link and BlueLine routes.

The project area is partially located in a HUD Opportunity Zone with 14.5% of the population living below the poverty line (see Appendix 1 for HUD Opportunities Zone Map).[2] Residents within this Census Tract have limited transportation choices, above average incidences of disability, and limited access to technology and the interne as identified through an analysis using FHWA's Screening Tool for Equity Analysis of Projects (STEAP). See Appendix 2 for full analysis.

Additional Demographics for the town of Brunswick are included in the table below.[3]

Area	54 Square Miles
Overall Population	21,756
Population 65+	21.2%
Population Below Poverty Line	8.8%
Median Household Income	$66,699
Veterans	9.5%

[2] American Community Survey (ACS) 2016-2020 5-year estimates

[33] https://data.census.gov/profile/Brunswick_town,_Cumberland_County,_Maine?g=0600000US2300508430

Means of Transportation to Work (Workers 16 Years and Over)	68.8% Drive alone 7.3% Carpool 0.2% Public Transportation 10.6% Walked 1.9% Other Means 11.2% Worked at home

4. Issues and Challenges

As a rural community with a population of less than 50,000, Brunswick faces the following transportation challenges:

- **Traffic Congestion** – Because US Route 1 and Bath Road are bottlenecked by the Androscoggin River and the former Navy base between the east and west sides of Brunswick, they carry most local and through traffic moving between the two sides of the town or onward to points east (Bath, BIW, and Midcoast) or west (I-295, Lewiston, and Portland). Combined with aging infrastructure and legacy signal equipment, traffic congestion along US Route 1 and Bath Road stop delays continue to increase. Recurring congestion occurs along the two roadways is only exacerbated by seasonal travel to coastline attractions (e.g., Thomas Point Beach or Harpswell Peninsula). According to the *Cook's Corner Revitalization Plan*, with anticipated commercial and residential developments in the Cook's Corner area there is likely to be significant declines in the traffic level of service over the next several decades. This poses a serious challenge to the neighborhood's ability to reinvent itself as a more resilient, mixed-use community center with additional housing and employment opportunities. Advanced signal systems, ITS communications and infrastructure would provide immediate relief and will extend the lifecycle of the current infrastructure and support the capacity of the road network in Cook's Corner area to meet its current and future needs.
- **Travel Time Reliability and Traveler Information Systems** – Travel time in rural areas varies based on several contributing factors including weather, congestion, and crashes. A reliable transportation system provides the end user a dependable mode of transportation with an expected travel time. Rural communities often lack the dissemination of travel conditions as compared to urban communities. This is a particular challenge in Brunswick, as east-west travel is limited to either US Route 1 or Bath Road, and an accident or poor roadway conditions can easily lead to congestion along the corridor. Providing active management of US Route 1 and Bath Road with advanced technologies (roadside units, dynamic message boards, camera detection systems, road weather information systems), will enable the dynamic routing of vehicles onto less congested roads, providing for the optimization of the travel corridors. In addition, traffic signal enhancements, AVL systems, and TSP will inform passengers of the commute times and will optimize the transit services provided by the Brunswick Link and BlueLine. Improving the availability, reliability, and system performance of these services will make transit a more attractive choice. Currently only 0.2% of workers in the project area report using public transit to get to work, but improved transit should help to increase transit ridership in the Cook's Corner area, reducing the number of single-occupancy vehicle trips and their impact on the transportation system as the Cook's Corner area develops new housing and businesses.

- **Safety in Rural Brunswick** – Maine DOT crash records indicate there was over 460 crashes in Brunswick alone during the years of 2019-2021. Travelers in rural Maine are at greater risk particularly during winter due to snow and ice. According to the latest NHTSA's Fatality Analysis Reporting System (FARS) data, the rural crash fatality rate is twice as high as the rate for urban crashes. The challenge with crash data is it relies on those incidences that are reported and does not include the near-miss incidents that could have resulted in a severe crash or fatality. MaineDOT seeks to be proactive in identifying these near misses and develop countermeasures to address the incidents before they become significant. MaineDOT also conducted a Heads Up! pedestrian safety audit of Brunswick in 2018, which informed Brunswick's Pedestrian Safety Action Plan (2021). The Plan identified the Cook's Corner area as the second highest priority location for pedestrian safety improvements. This is particularly important given that 10.6% of workers in Brunswick report walking as their primary means of transportation to work.

The technology deployments address many of the program goals as described through the application. Table 2 in Section 16 identifies all of the program goals that this project meets. The project meets the following technology focus areas:

- **State of Good Repair** – The proposed project will deploy communications to the intersections with field monitoring unit (FMU) and malfunction management unit (MMU) devices to monitor the health of the signal control equipment. This enables remote monitoring dispatching of maintenance personnel to repair any malfunctioning equipment in a more efficient manner. Additionally, the roadway weather information system (RWIS) station will identify icing of the roadways, which will aid in dispatching salt trucks and snowplows during weather events in an effort to maintain safe travel corridors.
- **Advanced Public Transportation Systems** – This project will implement automatic vehicle location (AVL) systems on existing transit fleet and provide a public-facing data portal and transit kiosks at transit stops to inform transit users of expected headways for the transit vehicles. This enables improved trip planning for public transit users via General Transit Feed Specification (GTFS) feeds to an App platform. Transit Signal Priority (TSP) systems implemented at the intersections will enable the transit fleet to maintain schedule adherence.
- **ROUTES Initiative** – The project is proposed along Bath Rd, a major corridor within Brunswick and the surrounding region. Bath Road is a minor arterial providing connectivity between residential, commercial, and industrial areas where the state's fourth largest employer, BIW, is located. The technologies proposed will enhance mobility by providing remote monitoring of traffic conditions and providing the ability to clear incidents faster. The project will also improve travel time along the arterial corridors by implementing adaptive signal control technologies (ASCT), thus providing the most efficient signal timings year-round. ASCT have been proven to greatly reduce rear-end crashes by up to 50 percent in rural areas.
- **Complete Trip Program** – Passenger advisory systems can inform visually impaired transit users of upcoming stops. Information on the transit data portal can provide descriptions of accommodation capabilities for each vehicle. The proposed transit application will also allow rural travelers to perform daily trip planning between work, school, and shopping destinations.

- **Data Availability** – MaineDOT will provide baseline data prior to project deployment and collect data after project deployment related to travel time, traffic volume, crashes, transit schedule adherence, transit utilization, and incident clearance times. All these metrics will be used to determine the benefit-cost ratio for the proposed implementation.

5. Transportation Systems and Services

The overall goal of this proposed project is to improve safety and mobility. Safety improvements will be accomplished through hardware and software upgrades, the use of Automated Traffic Signal Performance Measures (ATSPMs), and innovative CV technologies. The following sub-sections describe in detail the technologies and services proposed. Mobility improvements will be accomplished through traffic signal control performance and travel information dissemination.

5.1. Advanced Traffic Controller (ATC)

This project will replace 11 existing traffic signal controller assemblies along Bath Road which will be maintained by MaineDOT upon completion. Each of the new ATCs will come with a Malfunction Management Unit (MMU) and a Field Monitoring Unit (FMU). The MMU and FMU allow easier and timelier on- and off-site controller error diagnostics. MaineDOT anticipates replacing the existing controller cabinets due to the age and limited capabilities of the legacy equipment.

With the installation of new ATCs, MaineDOT will have access to a variety of features not supported by the current traffic controllers. For instance, the new ATC controllers can communicate with the MMU, allowing staff to diagnose signal faults remotely before dispatching a contractor to perform the needed repairs. This new feature is very important for a rural state like Maine, where most of the state-maintained intersections are in remote areas and sending a contractor to repair them without knowing the exact cause is time-consuming and expensive. It often involves multiple long trips such as the first trip to identify the exact cause and a second trip to bring the right equipment and/or parts to resolve the issue.

The new ATC controllers will have the capability of feeding real-time traffic and signal status data into the signal performance software, adding an even greater return on MaineDOT's previous ATSPM system investment. The Field Monitoring Unit (FMU) is a device that contains an onboard cellular modem and transmits and receives data from the devices inside the cabinet. The FMU can provide feedback on all the internal devices providing information on AC Voltage, Preemption Status, Battery Status, Signal Flash, Fan Status, Door Status, Temperature & Humidity and Time Synchronization. The new ATC controllers and FMUs will allow MaineDOT to retime the signal remotely, place a phase interval on recall and receive alarms and alerts on other signal issues. These controllers have advanced diagnostics, and the ability to upload and download the complete signal timing plan database, which will allow MaineDOT to store the complete database for a backup of all controller programming. Ultimately, this will allow quick field replacement of a controller using exact site-specific timing plans rather than generic plans. In summary, the ATC and the associated MMU and FMU will enable the following services proposed in this project: (1) remote diagnostics and real-time traffic controller status monitoring; and (2) the ability to update and backup traffic signal timing plans remotely.

5.2. Sophisticated Traffic Detection System with Stop Bar and Advance Detection

At the present time, there are multiple types of traffic detection systems at the 11 signalized intersections, consisting of inductive loops and older legacy type camera systems. These detection

systems are not connected with MaineDOT's Traffic Management Center (TMC). The status of these systems cannot be monitored in real time or archived. The proposed detection systems will allow MaineDOT to remotely view detection data and detector status and adjust detectors (e.g., virtual zones) from the Traffic Management Center (TMC).

Currently, the traffic detection systems at these intersections are outdated with many locations where detections have failed completely, defaulting these intersections to an inefficient pre-timed traffic control system. The installation of a remotely viewable/programmable detection system allows MaineDOT staff to monitor these intersections whenever needed, provide timely detector status information to maintenance staff, and eliminate issues such as signals sitting in recall without being repaired for days or weeks. Additionally, camera detection zones can be changed rapidly, and staff can monitor drift of the camera; the impacts can be realized almost instantly.

These new detection systems can provide traffic volume and classification information, effectively turning each one of these signals into a continuous count site that provides vehicle turning movement counts and bicycle and pedestrian counts. The advance detection on high-speed approaches (approaches with speed limits of 35 mph or greater) also enable the advanced dilemma zone detection to provide a safer transition through the intersection, particularly for heavy vehicles. These advanced sensors can detect a vehicle over 800 feet upstream from the intersection and track it all the way to the stop bar on a lane-by-lane basis.

The following services enabled by the advanced traffic detection system will be implemented in this project: (1) detector anomaly identification and remote verification; (2) continuous traffic count data collection for traffic signal retiming, research, planning, etc.; (3) advanced dilemma zone detection to improve safety of heavy vehicles; and (4) vehicle trajectory data for developing additional signal performance measures and improving existing performance measures.

5.3. Adaptive Traffic Signal Control Technologies

Traffic patterns in the region fluctuate greatly due to commuter traffic to and from BIW, local colleges and universities, and seasonal tourism traffic. Due to the varying traffic conditions, static timing plans will not provide for efficient traffic control.

As a result, the implementation of an automated adaptive traffic control system that can fluctuate signal timings and phasing operation based on real-time traffic conditions will provide improved travel times along the arterial corridors. This automated software will ensure the most efficient signal timings are implemented based on real-time traffic conditions thus minimizing delays, providing fuel savings and reducing carbon emissions. Nationwide statistics show that adaptive signal control systems reduce traffic stops by 60% and can increase travel times up to 50% in rural communities. Several types of Adaptive Signal Control Technologies (ASCT) exist in the industry, each engineered for specific types of transportation networks. To leverage the existing investments MaineDOT has made in their existing ATMS Central Software, the adaptive software compatible with their existing ATMS software will be proposed to maximize MaineDOT's return on investments. This adaptive software meets the requirements of the control capabilities needed for this project.

5.4. DSRC / Cellular based Vehicle to Infrastructure (V2I)

MaineDOT will equip each of the 11 intersections with the Dual Mode DSRC/V2I/C-V2X technology. With this technology, MaineDOT is making these intersections ready for many CV applications that are currently being developed/implemented by car manufacturers and USDOT.

This new technology will provide travelers with detailed information regarding traffic signal and roadway conditions even when they are miles away. It will also provide MaineDOT with another way to communicate with travelers and improve the traveler information system coverage in rural Maine. This is vital for rural areas with limited access to ITS infrastructure and cell phone services.

Furthermore, this technology will enable the use of TSP, EVP, Freight Signal Priority (FSP), and Snowplow Priority (SPP) applications to be implemented. With existing TSP and EVP technologies, these technologies utilize point-to-point communication technologies which typically can't engage the pre-emption or priority functions of the traffic signals until the bus or emergency vehicle is upon the queued or stopped traffic. This causes unnecessary delay to the bus or emergency vehicle waiting for the vehicle queues to dissipate. Additionally, this last-minute switch of green time may cause significant delay and disruptions to vehicles from other approaches. With the Dual Mode DSRC/V2I/C-V2X technology, the locations and routes of buses or emergency vehicles can be shared with the traffic signal controller prior to their arrivals. Therefore, the controller will be able to clear the standing queue and minimize the impacts on (disruptions to) vehicles from other approaches. It should be noted that the Brunswick Fire Station is along the Bath Rd corridor within the proposed project limits and this technology can assist the first responders from this station in reducing the arrival times to the scene of emergencies.

One of the challenges denoted in this application is to provide a cost-effective solution for increasing ITS coverage in rural areas which will contribute significantly to enhancing mobility. Travelers in the proposed project area tend to receive less communication from MaineDOT because of the lack of ITS infrastructure (e.g., variable message signs) in rural areas. This project allows MaineDOT to reach travelers in rural communities with the latest CV technology using existing infrastructure (e.g., communications, power supplies and structures) at rural signalized intersections, giving rural travelers benefits they otherwise would not receive. Incorporating the CV technology in this project will maximize MaineDOT's return on investment.

The installation of the Dual Mode DSRC/V2I/C-V2X devices provides MaineDOT with the ability to partner with freight companies to implement CV technology within trucking fleets to help maintain travel time reliability, thus increasing economic benefits of the system. For drivers without a factory installed on-board unit in their vehicles, MaineDOT will be deploying an App-based system for mobile devices (iOS/Android) providing drivers with information similar to a factory installed On-Board Unit (OBU). The App can provide information to individuals such as SPaT messages, pedestrian warnings, work zone speed warnings, and school zone warnings.

This project will implement the following services based on the Dual Mode DSRC/V2I/C-V2X technology: (1) roadside units (RSUs) that can receive/derive traffic and critical roadway safety information from data provided by CVs equipped with OBUs (e.g., trucks, buses); (2) RSUs that broadcast information such as SPaT and Traveler Information Messages aimed to reduce traffic delay and improve rural ITS coverage and equitable mobility; (3) OBU and mobile App that enable safe and efficient driving for transit, freight and commuter vehicles; and (4) advanced TSP.

5.5. Cellular Modem / Hardwire Communication

The backbone of this system will be cellular or hardwire communications. Cellular modems and hardwire communications to the signalized intersections and the ITS devices located along the limited access routes will enable data and video transmissions between the field devices and MaineDOT Traffic Management Center. The type of communication proposed at the eleven

(11) intersections and device locations will largely depend on the existing infrastructure locations and terrain surrounding each of the locations. Fiber will be the first choice if it is already available in an area. Although fiber provides reliable and low-latency communications, its cost is much higher than other options. Given that Maine is a rural state and fiber is unavailable in many locations, cellular modems will be used as the main data communication method in this project.

5.6. Integration of Automated Traffic Signal Performance Measure (ATSPM)

MaineDOT is currently implementing an Automated Traffic Signal Performance Measure (ATSPM) system using the Econolite Centracs SPM modules. By deploying the Advanced Traffic Controllers and detection systems capable of collecting the high-resolution traffic data, this system will allow the department to monitor the effectiveness of the signals by monitoring arrival on red, progression, splits, force-offs, and efficiency. A graphical user interface will be displayed in the Traffic Management Center so staff can see which intersections have issues, the severity of the issues, and to check proper operation. This again will allow for a more efficient response to signal malfunctions and timing issues.

Once the ATSPM is fully operational, additional objectives will be set to maximize traffic signal control performance. High volume locations and time periods can be quickly identified, safety (based on surrogate safety measures such as Yellow and Red Actuations) and delay can be quantified and reviewed whenever needed, and the effect of different timing plans can be evaluated based on observed performance measures. These timing plans and the corresponding performance measures and traffic patterns from the 11 intersections will be archived and further studied, and models will be developed to identify the best timing plan for each traffic pattern. In areas and time periods with unpredictable traffic (e.g., due to incidents or special events), these models could be implemented to quickly find the best timing plans.

The ATSPM will allow for data-driven traffic signal timing adjustments, resulting in better signal performance, smaller delays, lower gas emissions, less public aggravation, and an overall better public experience. With ATSPM, traffic controller and detection system health conditions can be easily monitored, along with other performance measures such as safety, pedestrian and vehicle delay, phase termination, split failure, and arrivals on red. The traditional ATSPM system design has certain limitations, particularly when loop detectors are used. Some examples are provided below:

- As shown in Figure 2, if loop detectors are used, they can only measure speed/presence/count at those fixed locations. Therefore, queue length can only be estimated. For shared lanes (e.g., shared right turn and through lane), the detector will not be able to differentiate between the shared movements.
- Pedestrian Delay is one important performance measure generated by ATSPM. It measures how long a pedestrian must wait to receive a WALK indication after pushing the button. However, it does not reflect the total number of waiting pedestrians, how many pedestrians arrive after the button is pushed, and pedestrian arrival time distribution.
- Similar to Pedestrian Delay, Approach Delay is calculated as the amount of time between vehicle actuations (a vehicle arrives at the stop bar) and when that phase receives green. This performance metric does not consider start-up lost time, deceleration, or standing queues.

With camera and radar detectors, it is possible to track individual vehicles over a long distance. This will allow MaineDOT to generate additional and potentially more reliable traffic signal performance measures. Many studies have been conducted to derive various new signal performance measures using advanced traffic sensors.

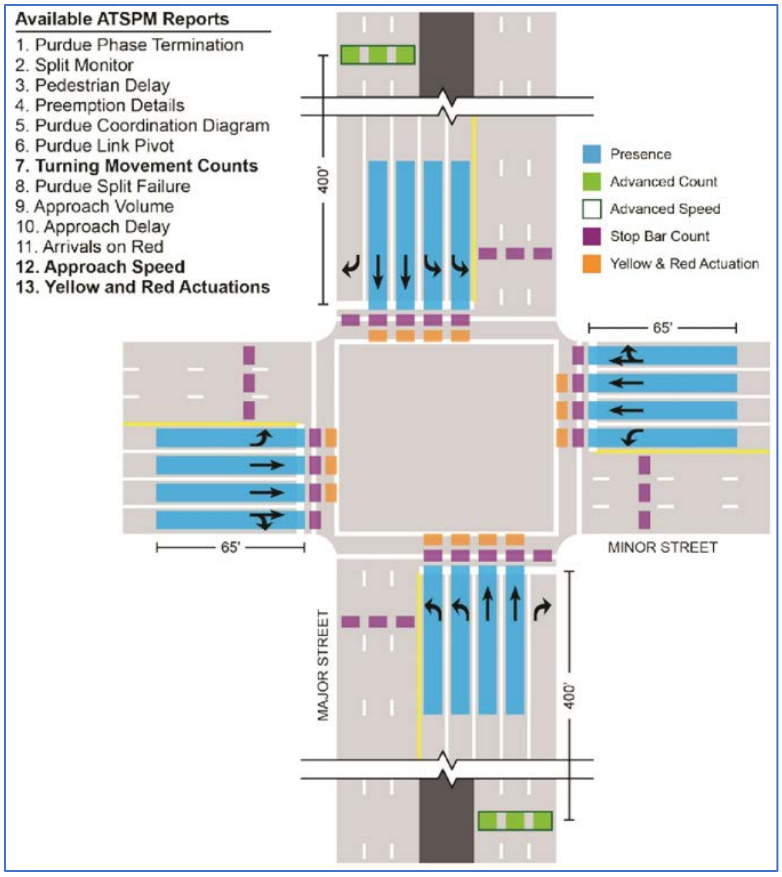


Figure 1: Detection Configuration with All Detection

A concise summary of these performance measures can be found in the recent NCHRP 03-122 report[i]. In this project, MaineDOT will use the outputs of advanced sensors to (1) develop new signal performance measures beyond those already included in the traditional ATSPM, and (2) improve the accuracy of existing performance measures. Specifically, MaineDOT will focus on the following new performance measures: queue length, number of stops, gap analysis for left-turn phasing, delay by movement, and time-space diagram. For existing ATSPMs, MaineDOT will focus on Approach Delay and Pedestrian Delay.

Proposed key services include: (1) implement the traditional ATSPM system and collect and archive signal performance measures; (2) develop new signal performance measures based on advanced camera and radar sensor data; and (3) improve the estimation of existing ATSPMs.

5.7. Traffic Signal Control Data Analytics based on Artificial Intelligence

The proposed traffic signal improvements and associated ATSPM system will generate an enormous amount of detailed Maine centric data coming into the TMC and present many opportunities for MaineDOT to develop data-driven approaches to improve daily operations and decision-making process. This project proposes to leverage the recent advancements in Artificial Intelligence (AI) and machine learning for traffic signal control data analysis. It is worth emphasizing that Maine has long and snowy winters which contributes to many crashes at intersections and significantly affects traffic operations. There is very limited research on safe and optimal traffic signal control considering adverse weather conditions. The proposed ATSPM system will provide valuable first-hand data for studying Maine driver's behaviors and optimal traffic control to improve safety and efficiency. MaineDOT will focus on detailed safety analysis of the ATSPM data using AI models, and link intersection geometry, turning movement counts, signal control parameters, and other surrogate safety measures with crash history.

Proposed key services include: conduct detailed safety analysis of the ATSPM data using AI models, and link intersection geometry, turning movement counts, signal control parameters, and other surrogate safety measures with crash history.

5.8. Implementation of a Transit Automatic Vehicle Locating (AVL) System

To raise confidence in the transit system and increase transit usage in the underserved rural communities, MaineDOT is proposing to partner with the Western Maine Transportation Services (WMTS) to implement an AVL system on the existing bus fleet which serves the project area. MaineDOT is proposing to install the AVL and passenger count system on the buses to provide real-time location and passenger seating information to the agency and transit users.

MaineDOT proposes to develop a platform that uses General Transit Feed Specification (GTFS) data to provide real-time estimated arrival information, trip planning, and maps to travelers via mobile devices or personal computers.

Proposed key services: Provide transit operations staff and patrons real time data onto transit vehicle locations and arrival times, improve schedule adherence, and provide transit data portal for public use in trip planning.

6. Deployment Plan

Section 4 outlines the main components of this project, including hardware and software upgrades, new transportation services, and AI-based traffic signal control data analytics. The overall project plan is that MaineDOT will hire a contractor to perform the hardware and software upgrade and provide select services (Sections 4.1-4.6), including the installation of ATCs and detectors, setting up the ATSPM system, installing RSUs and OBUs, etc.

The developed system will be used by MaineDOT daily. MaineDOT will provide funds to support the long-term system operation and maintenance, and the anticipated safety, mobility, and maintenance benefits of this system will allow MaineDOT to justify the expenditures. Also, maintaining traffic control and detection system has been part of MaineDOT's routine work. This also ensures that the deployed system will be maintained and utilized beyond the funding period.

MaineDOT will prepare the necessary agreements to assume responsibility for maintenance and operations of the 11 signalized intersections within the project limits and upon completion of construction and integration into the MaineDOT Traffic Management Center (TMC), will assume these responsibilities.

6.1. Operations

The operations of the system devices and intersections will be performed by both a consultant team, to review the data and make technical recommendations for changes and our own TMC operations team, to handle day to day operations. Together, they will provide the daily monitoring of the ITS devices and traffic signal system. The MaineDOT TMC Standard Operating Guidelines (SOG's) will be modified to account for the operations of the Brunswick Technology Improvements Project. The operations of this system will adhere to the standard protocols for operators to follow during times of an incident event, when a system device or failure occurs, when calls are received from the public/law enforcement or when special events occur in the area.

Recording of event situations will be completed using the MaineDOT's Compass software, the Statewide traffic management software platform. This software records each event posted with

date and time stamps, when the operator receives the event, the action taken by the operator, and when the event is cleared. The records will also include communications with agencies and first responders that occur during the event.

6.2. Performance Measure Reporting

The TMC staff will be responsible for developing the baseline performance measures for the project corridors, for which all reporting will be compared, to measure benefits. Performance measures for both the US 1 and Bath Road corridors will be analyzed to show benefits, which will include the following:

Bath Road Arterial Corridor	US 1 Limited Access
Travel time	Travel Time
Crashes	Crashes
Corridor traffic volumes	Traffic Volumes
Transit schedule adherence	Average Speed
Ridership	

The return on investment will be provided through comparative analysis of baseline statistics and comparisons to similar times of the year beyond the first year of operation.

6.3. Maintenance

The signalized intersections included within this grant application have reached the end of their service life. Other signalized intersections are still within their useful life but require funding for routine maintenance. Some municipalities do not have available funding to maintain their traffic signals. MaineDOT will assume responsibility for the maintenance of traffic controllers, signal detection, and cabinets. By assuming responsibility for the maintenance of these devices, MaineDOT hopes to safeguard the system investments. MaineDOT contracts annually for maintenance services of its ITS and Traffic Signal Systems. As part of these contracts, there are obligations for monthly preventative maintenance services to be performed.

With real-time communications between MaineDOT TMC and the traffic signals, traffic control system operation, and identification of system malfunctions will become easier and more efficient. Controller and detection issues will be detected in real time and addressed promptly with advanced diagnostic systems. The causes of the issues will be identified quicker, and the correct crew can then be dispatched faster. Traffic signal timing issues will be resolved remotely from the TMC along with detection complaints. The entire system performance and reliability should dramatically improve. All these benefits are good motivations for MaineDOT to use and maintain the proposed system in the long term.

7. Regulatory, Legislative, or Institutional Challenges

MaineDOT does not foresee any major potential challenges or obstacles to deployment. The technologies for this project are mature yet still innovative and new for the state of Maine. The deployment risk is very low. Assigning resources to provide for transit upgrades to improve confidence in the transit system and increase ridership will garner support from the local agencies, as the letters of support suggest. Similarly, MaineDOT is firmly committed to this project.

A challenge that MaineDOT faces is the institutional challenge assuming operational and maintenance responsibility of an arterial corridor within a local municipality's jurisdiction. MaineDOT is proposing a hybrid maintenance structure where MaineDOT is responsible for signal detection and cabinet level issues, while the town would still be responsible for wiring, bulb, signal

structure and pedestrian push button issues. MaineDOT will be sending a maintenance agreement to the Town of Brunswick documenting responsibilities. The town of Brunswick has minimal financial and staffing resources to adequately maintain and operate the intersections and it would be in the best interest of the Town to allow MaineDOT to assume the responsibilities for cabinet and detection level issues, MaineDOT realizes the burden of expensive signal component replacement places on the town and offers our commitment to providing operational improvements and equitable mobility options to this rural community. MaineDOT has assumed these responsibilities in the past and has successfully shown this has been beneficial to both the local municipalities, the Department, and the general public.

8. Quantifiable System Performance Improvements

The overall goal of this proposed project is to improve mobility and safety for its users. Implementation of the Brunswick Technology Improvements Project will provide numerous benefits related to crash reductions; optimizing system efficiency; improving access to and operations for public transit services; providing traveler information to motorists; and providing efficiencies in maintenance functions. The safety benefits will include a reduction in the frequency and severity of intersection crashes. The mobility benefits will include the reduction in delays and fuel costs for travelers passing through the intersections. The transit benefits will include the ability for transit users to track bus locations, perform trip planning and provide transit schedule adherence.

The goal of expanding travel information to rural areas is accomplished by providing information to motorists using Dynamic Message Signs, CV technology, and mobile applications. The maintenance benefits are realized by providing the TMC operators the ability to remotely troubleshoot and rectify device issues prior to dispatching maintenance personnel to repair.

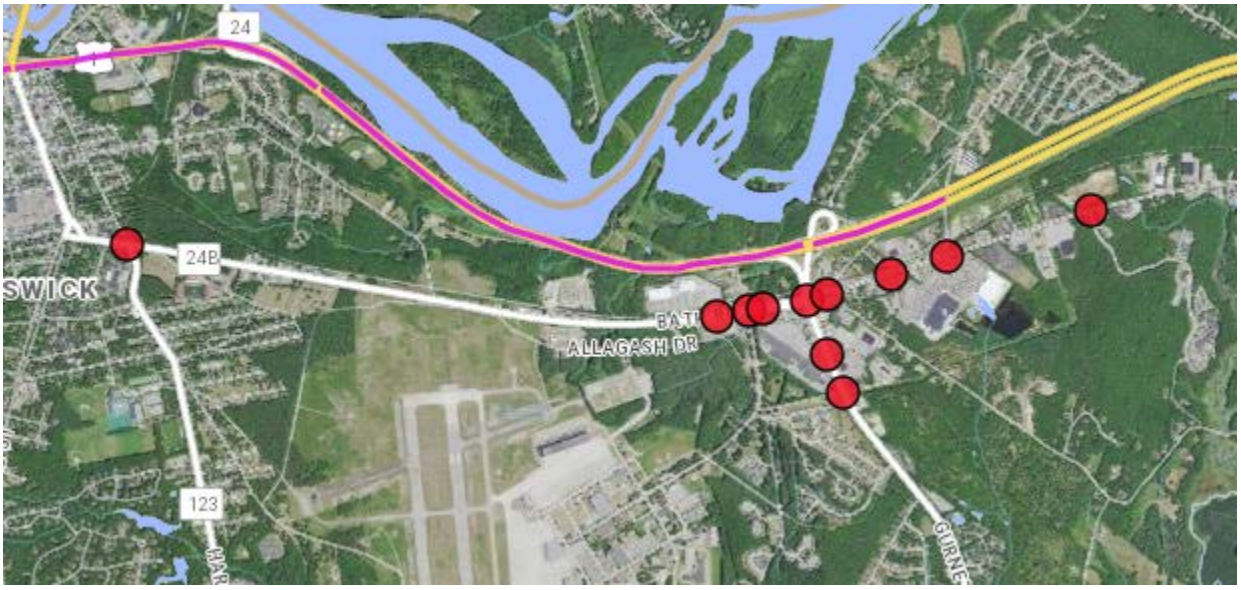
8.1. Safety

Based on the rural geography of the area, the number of crashes experienced at several of the intersections within the project are higher than expected (see high crash locations in project area map below). Project intersections with the number of crashes from 2020 thru 2022 are as follows:

Intersection	Number of crashes	Number of Injuries
Bath Rd at Cooks Corner to Gurnet Rd at US1 NB and US1 SB	47	10
Bath Rd at Thomas Point Rd	8	1
Bath Rd at Federal St/Sills Dr	10	3
Bath Rd at Shaw's Plaza/A St	16	7
Bath Rd at Admiral Fitch Ave	2	0
Bath Rd at Hannaford Dr	9	2
Bath Rd at Old Bath Rd	17	1
Bath Rd at Medical Center Dr	3	1
Bath Rd at Tibbetts Dr	13	3
Landing Dr at Gurnet Rd	4	0
Gurnet Rd at Cooks Corner Plaza	3	1

US 1 Roadway Segment	Number of Crashes	Injuries	Fatality
I-295 Ramps to Pleasant St	18	5	
Pleasant St EB Entrance Ramp to Church Rd Intersection	36	5	
Church Rd Intersection to Webster St/River Rd	91	16	1
Webster St/River Rd Intersection to Stanwood St	77	18	
Stanwood St Intersection to Maine St Overpass	53	10	
Maine St Overpass to East of SR 196 Interchange	44	18	
196 Interchange to Gurnet Rd Interchange WB On Ramp	98	17	
Gurnet Rd Interchange to Bathe Rd Overpass	14	3	

High Crash Locations in Project Area Map



A majority of the crashes recorded were rear end crashes which can be minimized by reducing the number of stops, which will be an outcome of the adaptive signal control technology being proposed. The CMF clearinghouse uses a value of 0.92 factor to reduce the number of crashes.

Additionally, with the CV technology being proposed using SPaT and Queue Warning applications, advanced notification of a phase change or traffic queueing will provide additional warning to the driver to take precautionary measures. Since the majority of crashes are rear-end, the CMF reduction for this project is expected to be greater.

Safety will be tracked year after year to provide a baseline comparison for the number of crashes along the project intersections and roadway segments to document the benefits of the investments from a Safety perspective.

8.2. Mobility

As part of the technologies proposed under this Brunswick Technology Project, many are aimed at improving mobility for the traveling public. Utilization of ASCT, CV, ATSPM systems and

providing remote capabilities for the TMC operators to actively manage the arterial system and monitor the limited access roadways and provide traveler information to the motorists will greatly enhance travel times. ASCT and ATSPM systems have been proven to assist agencies to reduce travel times in rural areas by as much as 50%.

The transit AVL and CV TSP application will increase transit schedule adherence thus improving confidence in the transit system. By increasing confidence in the transit system, these technologies will aid in increasing ridership within the rural communities. Travel times, average speeds, traffic volumes, average intersection delays and transit schedule adherence will be tracked on a monthly and yearly basis to document the benefits of the investments from a mobility standpoint.

8.3. Environmental

As mobility improvements are realized along the project corridors, environmental aspects will also recognize a relational improvement. Carbon emission and gasoline consumption reductions will be a direct result of a reduction in intersection delays and travel time improvements. Technologies proposed by this project will improve transit operations and increase the confidence in the transit system and ridership will increase thus providing mobility options for the rural communities. The opportunities to provide transit links from the rural community of Brunswick to the Amtrak Downeaster, an intercity passenger rail system, as well as intercity busy services, could reduce the number of passenger vehicles along these rural transportation roadways.

These benefits will be calculated by providing a monthly and yearly comparison of arterial and limited access operations documenting the comparisons of intersection vehicular delays, calculating the fuel savings and reduction in carbon emissions.

9. Quantifiable Safety, Mobility, and Environmental Benefit Projections

Increasing levels of traffic congestion cause significant delays in Maine, negatively impacting commuting and commerce, and not realizing potential economic benefits. Traffic signals, Dynamic Message Signs (DMS), CCTV's, and RWIS devices are components of the highway system that are frequently employed to improve traffic monitoring, safety, and mobility.

The US 1 corridor, a limited access facility, has DMS, CCTV's and RWIS devices proposed, which are tools used by the TMC operators to observe, collect, and disseminate data to the motorists related to incidents, traffic queues, roadway weather and travel time. These tools are also widely used to aid in dispatching first responders to clear incidents faster, thus reducing congestion and fuel consumption while minimizing the probability of secondary crash events. The objective for the installation of these devices is to expand the ability of MaineDOT to collect and disseminate data and information to roadway users in rural areas. This project will significantly improve the TMC's ability to monitor, manage and collect real time traffic data along both the Limited Access and Arterial facilities. Data collected from these devices will help motorists make decisions on route choices based on levels of delay. The message boards can relay travel time for each route allowing a driver to take a less congested route. As such, the installation of these devices offers numerous benefits with minimal consequences.

ITS Device	Application: Incident Management	Application: Traffic Conditions (Recurring)	Application: Traffic Conditions (Non-Recurring)	Application: Safety	Application: Weather	Application: Lane Control

CCTV	P	P	P	S	S	S
DMS	P	P	P	P	P	P
RWIS				S	S	

P=Primary; S=Secondary

The Bath Road corridor, a minor arterial, has several traffic signals improvements proposed, to provide mobility, safety, and transit benefits. Traffic signals and congestion impact virtually every driver and pedestrian traveling on or along the roadway system. The average trip on any given roadway system is interrupted by one or many traffic signals, interchange bottlenecks, and vehicular queues at exit ramps. The cause of these delays are the result of poorly timed signal systems, oversaturated roadways, and/or constrained interchanges with limited merge conditions.

The overall objective of traffic signal installations is to provide for the safe and efficient traffic flow at intersections, along routes and in street networks. A well-timed traffic signal system can reduce fuel consumption, eliminate unnecessary stops and delays, improve safety, and enhance the environment.

9.1. Quantifiable Projections

The 2019 AADT along the US 1 corridor within the project limits was 31,040 to 43,100 vehicles per day. The 2019 AADT along Bath Rd East of Cooks Corner was 21,350. Due to the Covid-19 pandemic, vehicle travel in Maine dropped by as much as 40 percent in April 2020 (as compared to vehicle travel during the same month the previous year) but rebounded to 12 percent below the previous year's volume in November 2020. It is anticipated that recent counts will show traffic volumes to be at or above the pre-Covid levels.

Based on data in the TTI Urban Mobility Report in 2019, TRIP estimates the total value of lost time and wasted fuel in Maine is approximately $250 million per year. This equates to approximately $568 per driver in the Brunswick area.

The benefits anticipated along the project corridors will be related to the following areas:

- Reduction in travel time
- Reduction is crashes
- Reduction in clearance times
- Reduction in secondary incidents
- Reduction in fuel consumption
- Reduction in emissions
- Improvements in transit operations
- Reduction in maintenance costs

The Development of Network Level Evaluation Tool for Managing ITS Infrastructure study, published by the USDOT to document benefits recognized for network level devices is as follows:

- Reduction in Crashes (DMS) – 10 percent
- Reduction in Crashes (CCTV) – 5 percent

MaineDOT has experienced mobility improvements and emission reductions firsthand through similar corridor signal coordination efforts such as Western Ave Signal System Project in Augusta, Maine, with technologies proposed similar to this project. The 25 to 45 percent reduction in travel time for the Western Ave Signal System Project is indicative of similar proposed installations which would yield similar results.

The Bath Road and other arterial corridors proposed with the adaptive signal control technologies, considering a 45 percent travel time reduction improvement from similar installations, would yield

an average savings of approximately $7 million per year. The US 1 corridor, assuming a 10 percent reduction in travel time, would yield an average savings of $2.3 million per year based on an average corridor AADT of 37,100. The savings above are based on USDOT recommended hourly values for travel time savings in 2016 as shown below.

Recommended Hourly Values of Travel Time Savings (2016 U.S. $ per person-hour)[4]	
Category	Hourly Value
Private Vehicle Travel*	
Personal**	$13.60
Business	$25.40
All Purposes***	$14.10
Commercial Vehicle Operators****	
Truck Drivers	$27.20
Bus Drivers	$28.30
Transit Rail Operators	$46.10
Locomotive Engineers	$41.60

9.2. Safety

The Federal Highway Administration estimates the economic loss related to each crash event recorded in Maine from 2016-2020 is as follows:

Death (Per Crash)	$10,098,000
Suspected serious injury (Per Crash)	$585,600
Suspected minor injury (Per Crash)	$177,500
Possible injury (Per Crash)	$112,300
Property damage only (Per Crash)	$10,600

Average Comprehensive Costs are based on 2018 Federal Highway Administration estimates

Considering the total number of accidents occurring at the intersections proposed for ASCT improvements under this project, 132 total from 2020-2022, using the .92 CMF for adaptive signal control technologies alone, this would result in a decrease of 11 crashes per year. Considering 22 percent of the crashes experienced result in Injury, the resulting average savings for safety benefits related to implementing the ASCT improvements for this project would be approximately $1.5 million over a three-year period.

The remainder of the accidents occurring along the US 1 corridor, 431 in total, with 92 of the crashes resulting in injury with 1 fatal crash, that equates to 22 percent. Based on the reductions previously identified using the Development of Network Level Evaluation Tool for Managing ITS Infrastructure (Development of a Network-Level Evaluation Tool for Managing Its Infrastructure (bts.gov)) study, the number of crashes may be reduced by 65. Considering 22 percent of the crashes experienced resulted in injury, the resulting average savings for safety benefits related to implementing CCTV, DMS and RWIS devices for this project would be approximately $13 million over a three-year period.

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[4] United States Department of Transportation (2016). *The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations Revision 2 (2016 Update).* Accessed November 14, 2022. https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-valuation-travel-time-economic

9.3. Environmental Benefits

Based on the EPA, the average vehicle creates 4.640 metric tons of CO_2 emissions per year based on an average of 11,520 VMT. Based on the AADT of the project corridors previously specified, and the anticipated reduction in travel times, the anticipated reduction in CO_2 emissions would be in excess of 26 million metric tons. Outdated traffic signal systems increase congestion and provide additional traffic delays for the commuting traffic. It is anticipated that current inefficiency of the signal system accounts for over 10 percent of the traffic delays and congestion identified. As a result, this 10 percent of travel delays correlates to increased CO_2 emissions and increased fuel usage. Additionally, based on EPA guidance, transit improvements will assist in continuing to reduce Green House Gas (GHG) emissions by potentially increasing transit ridership and reducing single-occupant vehicle usage in the area.

10. Vision, Goals and Objectives

The vision for this project is a rural, advanced technology corridor that supports economic opportunity and quality of life. The project goals are to (1) improve mobility and reliability of the corridor (2) improve the safety of the system, (3) enhance transit and increase ridership, (4) reduce air emissions, (5) improve communication to travelers, and (6) support the community's growth and redevelopment goals. The vision and goals for the project are directly in line with MaineDOT's mission to:

> "Support economic opportunity and quality of life by responsibly providing our customers the safest and most reliable transportation system possible, given available resources."

Brunswick has embarked on a revitalization plan for Cook's Corner in recognition of the community's growth and changing needs. Furthermore, the town has applied for a "Reconnecting Communities" grant for preliminary design and engineering of Complete Streets solutions on Bath Road and its component roads. MaineDOT is assisting with state match should the grant be received pending a cooperative agreement. This project supports and works in tandem with the Reconnecting Communities grant.

This project also supports the Cook's Corner Revitalization Plan Goal Area 1, which calls for transportation safety and capacity improvements such as adaptive signal control, interconnection with a central management system, dynamic message signs, and safe pedestrian and bicycle infrastructure. Providing these transportation safety and capacity improvements will help to support Brunswick's goal to develop the Cook's Corner area into a more vibrant mixed-use district.

11. Leverage Existing Technology Investments

The installation of the Dual Mode DSRC/V2I/C-V2X devices allows MaineDOT to partner with freight companies and transit providers to test the technology which will help pave the way for these technologies to become a reality. Eventually, this technology will allow freight and transit routes to be advertised and used by those industries, allowing better signal performance and congestion relief during peak and off-peak times. The proposed system will leverage existing cellular coverage to support the communications between V2X. With the implementation of an adaptive signal system, this submission would build on the legacy signal system and provide improvements for dynamically managing congestion.

As part of this project MaineDOT will be partnering with Western Maine Transportation Services, Inc. (WMTS) to improve transit reliability and implement transit information systems for

passengers in Brunswick. These enhancements build on the transit system infrastructure that is currently in place. The investment in a passenger information system will support the expected travel experience and will improve expectations on travel time reliability for passengers.

12. Detailed Project Schedule for the Overall Project

Table 1 provides a preliminary project schedule for the proposed project. NEPA will be required on this project and will be performed as a Categorical Exclusion. MaineDOT does not anticipate any additional needs for permitting, wetlands impacts, or historic requirements.

Table 1: Preliminary Project Schedule

RFP for Consultant Services	01/04/23
Consultant under Contract	04/01/23
Preliminary Project Kickoff	04/15/23
Draft Cooperative Agreement	05/01/23
Fully executed Cooperative Agreement	06/15/23
Project Kickoff	06/30/23
Project Evaluation Plan	07/31/23
Data Management Plan	07/31/23
Systems Engineering Documentation	10/31/23
Annual Budget Review (and subsequent years)	12/15/23
Preliminary Plans	01/31/24
Final Plans	09/01/24
NEPA	09/01/24
PS&E	10/15/24
ADV	11/01/24
Construction Begin	01/01/25
Construction Complete	10/15/26
Final Report	01/15/27

13. Climate Change and Environmental Justice

On December 1, 2020, Maine released a four-year plan for climate action titled *Maine Won't Wait*, which sets greenhouse gas reduction goals. MaineDOT strives to help the state meet its climate goals by reducing the carbon footprint of the transportation system. This project will reduce greenhouse emissions through improved operational efficiencies, enhanced transit, and supporting active transportation. MaineDOT utilizes the EPA EJSCREEN for all federally funded projects. See Section III – Project Outcome Criteria for more discussion on climate change and environmental justice.

14. Improving Racial Equity, Eliminating Barriers to Opportunity, and Compliance

The project area is partially located within a HUD Opportunity Zone with 14.5% of the population living below the poverty line. This project supports this economically distressed area by reducing congestion and improving safety within the commercial corridor. It will also enhance transit and support active transportation, which are lower cost transportation options. The project will improve access to employment, services, and shopping. For a more comprehensive overview of equity and eliminating barriers to opportunity see Project Outcome Criteria #3: Equity, Multimodal Options, and Quality of Life.

The MaineDOT Brunswick Technology Improvements project will comply with FMVSS and FMCSR standards; no exemptions will be required for this proposed project. Similarly, the project will comply with Buy America Act regulations, and will not require an exemption.

15. Support of the USDOT ITS Program

This project will benefit significantly from the DOT ITS Program and Innovative Technology Initiatives on-line at https://www.its.dot.gov during the project planning, design, deployment, evaluation, and results sharing stages of this project. Specifically, this project will benefit from the lessons learned through the Wyoming DOT, New York City DOT, and Tampa-Hillsborough Expressway Authority CV pilot projects. Also, MaineDOT will leverage the many resources available on the *DOT CV Deployer Resources* page.

Additionally, this project will support the DOT ITS Program or Innovative Technology Initiatives by enhancing Equitable Mobility in rural areas. Different from the Wyoming DOT CV pilot project that focuses on rural interstate highways, this project is centered on rural intersections. Travelers in the proposed project areas tend to receive less communication from MaineDOT because of the lack of ITS infrastructure in rural areas. This project allows MaineDOT to reach those drivers through CV technology. As CVs become more prevalent and valuable, equipment in rural areas will become outdated, as new technologies are typically first deployed in urban areas. This project provides rural drivers the ITS benefits they otherwise would not receive, by using existing infrastructure, existing cellular networks, mobile applications, existing power, detection and structures maximizing the return on MaineDOT's investment, while minimizing right of way impact. This project may potentially set up a cost-effective example for expanding advanced ITS technologies (e.g., ATSPM, CV) into rural communities, that may be followed by other states.

16. Implementation of Technologies, DOT Goals, and DOT Focus Areas

Table 2 summarizes the technologies that will be deployed, as well as the DOT goals and focus areas that will be addressed, as part of the proposed project.

Table 2: Technologies and DOT Goals

Technologies	Included
1. Advanced traveler information systems	Yes
3. Advanced transportation technologies to improve emergency evacuation and response by Federal, State, and local authorities	Yes
4. Infrastructure maintenance, monitoring, and condition assessment	Yes
5. Advanced public transportation systems	Yes
6. Transportation system performance data collection, analysis, and dissemination systems	Yes
7. Advanced safety systems, including V2V and V2I communications, technologies associated with automated vehicles, and other collision avoidance technologies	Yes
14. Advanced mobility and access technologies, such as dynamic ridesharing and information systems to support human services for elderly and disabled individuals	Yes
ATTAIN Goals	Included
1. Improvement in the mobility of people and goods;	Yes
2. Improvement in the durability and extension of the life of transportation	Yes

infrastructure	
3. Reduced costs and improved return on investments, including through the enhanced use of existing transportation capacity	Yes
4. Protection of the environment and delivery of environmental benefits that alleviat congestion and streamline traffic flow	Yes
5. Measurement and improvement of the operational performance of the applicable transportation networks	Yes
6. Reduction in the number and severity of traffic crashes and an increase in driver, passenger, and pedestrian safety	Yes
7. Collection, dissemination, and use of real-time transportation- related information including, but not limited to work zone, weather, transit, and paratransit, to improve mobility, reduce congestion, and provide for more efficient and accessible, and integrated transportation, including access to safe, reliable, and affordable connections to employment, education, healthcare, and other services	Yes
9. Monitoring transportation assets to improve infrastructure management, reduce maintenance costs, prioritize investment decisions, and ensure a state of good repair	Yes
10. Delivery of economic benefits by reducing delays, improving system performan and throughput, and providing for the efficient and reliable movement of people, goods, and services	Yes
11. Accelerated deployment of V2V, V2I, vehicle-to-pedestrian, and technologies associated with automated vehicle applications and other advanced technologies	Yes
12. Integration of advanced technologies into TSMO	Yes
13. Demonstration, quantification, and evaluation of the impact of these advanced technologies, strategies, and applications towards improved safety, efficiency, equity and sustainable movement of people and goods	Yes
14. Reproducibility of successful systems and services for technology and knowledg transfer to other locations facing similar challenges	Yes
Focus Areas	Included
1. State of Good Repair	Yes
3. Advanced public transportation systems	Yes
5. ROUTES Initiative	Yes
6. Complete Trip Program	Yes
7. Data Availability	Yes

Section III – Project Outcome Criteria

1. Economic Impacts, Freight Movement, and Job Creation

This project will foster and support economic development, improve freight movement, and support employment opportunities, including opportunities for underserved communities living within the project area. Additionally, the project will reduce transportation costs through reduced fuel consumption, maintenance costs, and supporting lower cost modes of transportation such as transit and active transportation. This corridor is used heavily by commuters. According to the *Cook's Corner Revitalization Plan* (2022), as of 2018, almost 70% of Brunswick residents commute outside of Brunswick, and Brunswick imports about 80% of its workforce from outside

communities. Reducing congestion, improving safety, and enhancing transit within the corridor will allow for a more efficient and safer corridor that supports the movement of all commuters. It will also support economic development by creating a corridor that better supports the businesses located along this commercial corridor and attract new businesses. The project will also increase the capacity of the transportation system to handle anticipated residential developments in the area. Improving transit accommodations and improving the signal timing at several of the crossings will also support those taking transit and using active transportation to reach places of employment or access services. This is especially important for those who are underserved with limited access to a vehicle. Improvements within the region's transportation system would support commerce by improving mobility for freight and offering competitive advantages in the region through transportation access for both business and residents.

2. Climate Change, Resiliency, and the Environment

On December 1, 2020, Maine released a four-year plan for climate action titled *Maine Won't Wait*, which sets greenhouse gas reduction goals.[5] This advanced technology project will directly support the state climate plan and reduce emissions by reducing congestion, enhancing transit, and supporting pedestrian and bicycle connections.

Reducing Congestion: Operational efficiencies resulting from automated adaptive traffic control system and integration of the automated traffic signal performance measure will minimize delays, provide fuel savings, and reduce carbon emissions. The MaineDOT has found that correctly timed and maintained traffic signals not only prevent delays but also reduce harmful emissions. In a before-and-after evaluation of two similar corridors, MaineDOT observed reductions in both fuel consumption and harmful emissions. This not only poses a risk to the driver as particulate matter enters the vehicle's cab through vents but also poses a problem for pedestrians crossing at traffic signals when particulate matter enters the air and surrounding land uses. As reviewed in Section 9.3. Environmental Benefits, the project is expected to reduce CO2 emissions in excess of 26 million metric tons through improved operational efficiency.

Enhancing Transit. Implementing an AVL and passenger count system on the Brunswick Link and BlueLine's existing fleets, improving traveler information systems at transit stops, and providing transit signal prioritization at 11 locations will improve transit operations, increasing the confidence and convenience of the transit system and attracting more ridership. The ability of using General Transit Feed Specification (GTFS) data to provide transit trip information via an App, allows a potential rider to better plan their time as they are getting reliable real time data from the transit provider.

Supporting Active Transportation. This project will better support and accommodate pedestrians and cyclists through investments in real time information at transit stops. Additionally, 5 of the 11 signals will adjust pedestrian intervals to make crossings safer for those who are walking and possibly crossing intersections on bikes. The signal technology will also allow for potential, additional features in the future which would better support pedestrians and cyclists.

MaineDOT uses the EPA EJSCREEN for all federally funded projects. The results showed the project will not disproportionately adversely impact environmental justice populations. Consistent with the MaineDOT Complete Streets policy, this project will improve mobility and safety of the

[5] https://www.maine.gov/climateplan/

system for all users, including vehicles, transit users, pedestrians and bicyclists. It will improve safety and quality of access to employment, shopping, and jobs for all modes.

This project directly supports the town of Brunswick's *Cook's Corner Redevelopment Plan*, published in May 2022, which envisions a resilient commercial center with improved safety and mobility, multi-modal connectivity, mixed-use development, and improved land use. See Appendix 1for planned pedestrian and bicycle accommodations. The project also works in tandem with the planning grant application Brunswick recently submitted to the *Reconnecting Communities Pilot Program* for preliminary engineering for complete streets solutions along Bath Road and several component roads in the Cook's Corner neighborhood. For a more robust overview of equity impacts for this project, see project outcome criteria #3: Equity, Multimodal Options and Quality of Life.

3. Equity, Multimodal Options, and Quality of Life

This project area is partially located within a HUD Opportunity Zone with 14.5% of the population living below the poverty line. The Federal Highway Administration's Screen Tool for Equity Analysis of Projects indicates that 10% of people within the project area do not own a car, 45% have one car, 17% are living with a disability, 13% do not have a computer, and 19% do not have an internet connection. Additionally, approximately 21% of the project area population is 65 years and older. The number of people facing transportation barriers has increased with the closing of the Brunswick Naval Air Station. Through the redevelopment efforts of the former air station, since 2020, 518 homes have been approved to be built at Brunswick Landing, which is home to many of Brunswick's immigrants and refugee population. Through a recent community survey, this population has indicated that they do not own cars and have trouble with the public transportation system. Additionally, a center with the capacity to serve 64 community members who need emergency housing was approved by the Brunswick Planning Board in 2022 and is in final design development. These new homes and service centers are within walking distance of shopping, jobs, and recreation along Bath Road and there is evidence that people are walking, biking, and using other mobility devices to reach these resources. Brunswick is also home to Bowdoin College, many of whose students are reliant on walking, bicycling, or taking public transit to move around and beyond their community. Safety improvements[6], roadway emissions reductions, transit enhancements, and better accommodation of active transportation resulting from this project will benefit these underserved communities within the project area. The project will support lower cost transportation, improve access to employment, services, and medical care, and support quality of life.

This project team will engage the public and work to ensure the impacts from the project will not disproportionately impact people of color, low-income, or disadvantaged populations. MaineDOT recently updated its Public Involvement Plans, outlining the Department's efforts to ensure disadvantaged populations and underserved communities are afforded meaningful opportunities for public involvement.[7] Public outreach for this project will be conducted in accordance with these processes. MaineDOT is also in the process of developing an Equity Outreach Dashboard as part

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[6] Between 2019 and 2021, 2 of 11 project signalized intersections were high crash locations. There were 81 crashes over 3 years along this corridor. Bath Rd at Cooks Corner is the 5th highest crash location in the state. Nearly half of crashes could be reduced with improved signal operations.

[7] https://www.maine.gov/mdot/env/NEPA/public/

of its virtual public involvement tool PIMA. This dashboard will help identify how MaineDOT is reaching different underserved populations, including Title VI and Environmental Justice requirements along with other data. This can help MaineDOT further understand how it is doing and what else can be done to reach underserved populations. Additionally, MaineDOT includes a Demographics Survey with all of our virtual meetings to measure our effectiveness in reaching underserved communities. For this project, MaineDOT will use a combination of in-person and virtual public meetings to ensure we reach the underserved and vulnerable communities within the project limits.

MaineDOT has launched a new DEI initiative and has an external equity statement that states our commitment to ensuring that all Maine people have access to safe and reliable transportation options. Furthermore, "in accordance with Title VI of the Civil Rights Act of 1964 and other authorities, MaineDOT is committed to ensuring that the fundamental principles of equal opportunity are upheld in all decisions involving our employees and contractors/consultants, and to ensuring that the public-at large is afforded access to our programs and services."[8]

[8] https://www.maine.gov/mdot/civilrights/title-vi/

Section IV – Management Structure

1. Overview of Partner Organizations

The MaineDOT is a cabinet-level state organization with primary responsibility for all modes of statewide transportation. The MaineDOT employs roughly 1,800 individuals and annually expends or distributes more than $675 million in federal, state, and local funds.

This project will be led by the Traffic Engineering Division of the Bureau of Maintenance and Operations of MaineDOT. The Traffic Engineering Team will collaborate with the Department's finance, administration, and program development personnel to manage the project's budget. Traffic Engineering staff previously led the *Maine Advanced Signal Control and Connected Vehicle System for Safe, Efficient and Equitable Rural Transportation (MAST)* project through the federal grant process under the ATCMTD. Best practices and lessons learned from that project will be employed to ensure the successful planning, management, and execution of the MaineDOT Brunswick Technology Improvements project.

Table 2 summarizes the partner organizations participating in the MaineDOT Brunswick Technology Improvements project. Figure 3 illustrates the proposed organizational structure.

The MaineDOT will carry out the design, construction, operation, and maintenance of the roadway and transit infrastructure deployed as part of this project. MaineDOT will work closely with the region's transit agency, Western Maine Transportation Services (WMTS), to design and deploy bus stops and AVL signage at appropriate locations to best-serve transit users. WMTS will be responsible for operating and maintaining the AVL devices deployed on participating transit vehicles as part of this proposed project. WMTS will serve as technical advisor in the design and implementation of transit infrastructure for the project. The University of Maine (UMaine) will partner with the University of Massachusetts Lowell to conduct performance measurement and the Before-and-After study as part of the proposed project.

The MaineDOT will conduct a competitive selection process to determine a qualified Consultant/Contractor to implement the proposed project on behalf of the Department.

Table 3: Project Partners

Organization	Project Role	Grant Designation
Maine Department of Transportation	• Project Management • Design & Construction • Operations & Maintenance • Data Management • Performance Measurement	Award Recipient
Western Maine Transportation Services	• Transit Operations • AVL Implementation • Technical Advisor for transit infrastructure	Subrecipient
University of Maine	• Performance Measurement • Before-and-After Study	Contractor
University of Massachusetts Lowell	• Performance Measurement • Before-and-After Study	Contractor

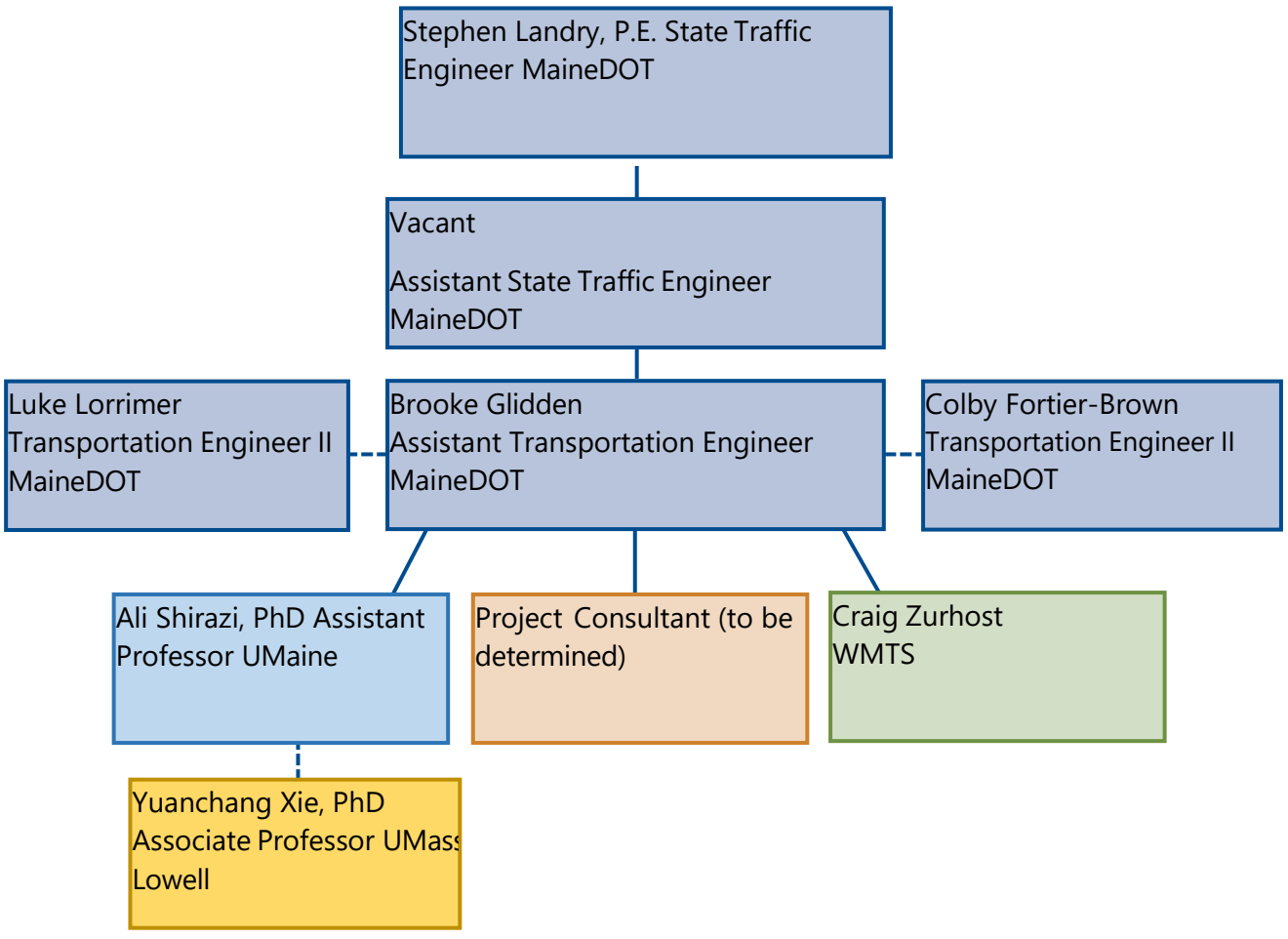
Consultant (To be determined)	• Project Implementation • Project Reporting • Design • Construction	Contractor

The Traffic Engineering Team will coordinate closely with the Town of Brunswick and Cumberland County to ensure the proposed project is serving their needs.

2. Organizational Structure

Figure 3 illustrates the organizational structure proposed for the MaineDOT Brunswick Technology Improvements project.

Figure 2: Organizational Structure



Section V – Staffing/Team Description

The primary MaineDOT Traffic Engineering staff responsible for managing and executing the MaineDOT Brunswick Technology Improvements project are Stephen Landry, Brooke Glidden, and Luke Lorrimer. Stephen Landry will serve as the point of contact for the project. Staff responsibilities for this project are listed below; resumes are provided in Appendix A.

Stephen Landry, P.E., State Traffic Engineer, MaineDOT

Stephen will be responsible for managing the MaineDOT Brunswick Technology Improvements project. Stephen will have availability for 10% of his time to work on this project.

Stephen will also be the primary point of contact for the project. His contact information is provided below:

- Stephen Landry, P.E.
  207-624-3632
  Stephen.Landry@maine.gov

Brooke Glidden, Assistant Transportation Engineer, MaineDOT

Brooke will be responsible for day-to-day communications with the project team and ensuring the project manager and consultant work towards completing the project as defined in the grant application. Brooke will have availability for 40% of his time to work on this project.

Luke Lorrimer, Transportation Engineer II, MaineDOT

Luke will be responsible for working with consultants to ensure cybersecurity and MaineDOT protocols for information sharing are followed. Luke will have availability for 10% of his time to work on this project.

Craig Zurhost, Western Maine Transportation Services

Craig will be responsible for working with the project team on transit priority and AVL and bus arrival time boards. Craig's role is to provide guidance upon request.

Ali Shirazi, PHD Assistant Professor, University of Maine

Ali will be responsible for coordinating reporting activities for the grant and perform relative field work to collect the appropriate data to report. Ali will have availability for up to 40% of his time to work on this project.