

**NEW HAMPSHIRE  
DEPARTMENT OF TRANSPORTATION**

in Partnership with

**MAINE  
DEPARTMENT OF TRANSPORTATION  
and  
MAINE TURNPIKE AUTHORITY**

**I-95 (High Level Bridge)  
Part-Time Shoulder Use System**

**NHDOT Project No. 16189B  
Portsmouth, NH - York, ME**

**NHDOT RFP 2021-003**

**Addendum #1  
- April 9, 2021**

# **Book 2: Technical Provisions**

**February 10, 2021**

**STATE OF NEW HAMPSHIRE**  
**DEPARTMENT OF TRANSPORTATION**  
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## **1. GENERAL REQUIREMENTS**

### **1.1. Project Scope**

The scope of the Project includes design and construction services for the implementation of a part-time shoulder use (PTSU) system on the Interstate 95 (I-95) corridor bridge over the Piscataqua River between the States of New Hampshire and Maine. The New Hampshire Department of Transportation (NHDOT), Maine Department of Transportation (MaineDOT), and Maine Turnpike Authority (MTA), hereinafter referred to as the Owners, have jointly initiated this Project to alleviate traffic congestion during peak periods of the week and seasons of the year. The Project consists of adding a new PTSU system along I-95 northbound between the Exit 5 interchange in Portsmouth, New Hampshire and the Exit 3 interchange in Kittery, Maine and along I-95/Maine Turnpike southbound between the Exit 2 interchange in Kittery, Maine and the Exit 5 interchange in Portsmouth, New Hampshire. The new PTSU system requires new intelligent transportation system (ITS) field equipment to be installed in New Hampshire and Maine. The ITS field equipment shall monitor and communicate with the New England Compass ATMS and the state Transportation Management Centers (TMC) and the MTA Traffic Management and Communication Center (TMCC).

The scope of work includes the following primary elements:

- A. New PTSU on I-95/Maine Turnpike that serves as an available fourth lane for travel during peak traffic times.
- B. New Closed-Circuit Television (CCTV) cameras along the corridor to monitor field conditions and verify lane conditions before allowing PTSU to open.
- C. New Motor Vehicle Detection System (MVDS) units to detect and monitor traffic conditions.
- D. New Dynamic Message Sign (DMS) and Single Message DMS to display traveler information along the corridor.
- E. New Lane Use Signals (LUS) to dynamically indicate the status of the shoulder (travel lane or breakdown lane).
- F. Flashing Beacon signs to provide real-time information about the PTSU system.
- G. New Roadway Weather Information Station (RWIS) along the corridor to monitor weather conditions.
- H. Communications system to interconnect the ITS equipment to the PTSU Central Control system.

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- I. New climbable antenna mounting structure and communications equipment shelter along Ranger Way to collect the ITS field data from New Hampshire and transmit it to the Advanced Traffic Management System (ATMS) via NHDOT's wireless backhaul.
- J. New communications equipment shelter along Maine Route 236 to collect the ITS field data from Maine and transmit it to the ATMS via MTA's proposed wireless backhaul.

The purpose of Book 2 - Technical Provisions is to establish the Project's functional and operational requirements and provide the Contractor with guidance to the overall Project design and delivery. This document is divided into nine sections:

- Section 1: General Requirements
- Section 2: Project Management Plan
- Section 3: Quality Management Plan
- Section 4: Environmental
- Section 5: Design Criteria
- Section 6: Construction
- Section 7: Training
- Section 8: Maintenance and Warranty
- Section 9: Project Office and Equipment

The Technical Provisions are supplemented by Project specific Special Provisions. The Special Provisions provided may be revised in accordance with the Contractor's proposed design, subject to the review and approval of the Owners.

### 1.2. Existing Projects

- A. In the area of the I-95 bridge over the Piscataqua River (NHDOT Bridge #258/128, MaineDOT Bridge #1477), also known as the High Level Bridge (HLB), there is an on-going bridge rehabilitation Project managed by MaineDOT. This Project [AC-IM-1927(000)E] is expected to be substantially completed in 2021 with final completion in Spring 2022. This Project has priority and preeminence for construction and traffic control in the Project area. All temporary traffic control and permanent signing efforts within the Project shall be coordinated in cooperation with the rehabilitation Project.
- B. NHDOT awarded a Turnpike Paving Project (Eastern Turnpike Project 41822). This Project will resurface the northern end of New Hampshire's section of I-95 up to the southern end of the HLB rehabilitation Project in the spring of 2024. This NHDOT 41822 contractor will be responsible for installing all revised pavement markings on the New

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Hampshire side of the HLB based on the final pavement layout and pavement marking plans provided by the Contractor. All temporary traffic control and permanent construction signing efforts by the Contractor shall be coordinated in cooperation with the NHDOT Turnpike paving Project.

a. The Contractor shall provide the final payment layout, including the location of the crown and proposed pavement joints, to the 41822 contractor through the State Project Manager for binder pavement marking by September 30, 2021 (interim completion date).

~~B.b.~~ The Contractor shall provide the final striping layout to the 41822 contractor through the State Project Manager for final surface pavement markings by ~~December~~ July 1, 2021 (interim completion date).

- C. MTA plans to award a contract to repair the Route 236 Underpass Bridge in 2021/2022. This Project has priority for construction and traffic control over the PTSU Project. The Contractor shall coordinate all work and traffic control associated with this bridge with the awarded MTA contractor. *(NOTE: Project may be deferred to 2022)*
- D. MTA plans to award a contract to repair the Ramp H Southbound On-ramp bridge over I-95 in 2021/2022. This Project has priority for construction and traffic control over the PTSU Project. The Contractor shall coordinate all work and traffic control associated with this bridge with the awarded MTA contractor.
- E. MTA plans to award a contract to repair the I-95 bridge over Spruce Creek in 2021/2022. This Project has priority for construction and traffic control over the PTSU Project. The Contractor shall coordinate all work and traffic control associated with this bridge with the awarded MTA contractor.
- F. MTA plans to award a contract to repair the Wilson Road bridge in 2022. The Contractor shall coordinate traffic control in the area of the Wilson Road bridge with the awarded MTA contractor.
- G. MTA ~~plans to may~~ award a contract to clean and paint the structural steel on the Cutts Road bridge in 2022 or 2023. The Contractor shall coordinate traffic control in the area of Cutts Road with the awarded MTA contractor.
- H. MTA plans to award a pavement rehabilitation Project for milepoint 1.3 to milepoint 6.8 in 2022/2023. The Contractor shall coordinate traffic control in this area with the awarded MTA contractor.
- I. Refer to Section 105.07 of the 2016 NHDOT Standard Specifications for Road and Bridge Construction (NHDOT Standard Specifications) for additional expectations regarding Cooperation between Contractors.

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Commented [SM1]: Language should be updated based on the actual schedule for the Turnpike paving contractor's work. Note that the July 1, 2021 deadline doesn't make sense now that the G&C won't be signed until August 2021.



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**1.3. Specification and Guidance Materials**

The specifications, standards, guidelines, and best practices that will govern this Project are listed in the RFP Section 1.5. These documents shall be applicable to the design and construction of the Project. The list of documents in RFP Section 1.5 is not intended to represent a comprehensive list of all required documents. Additional documents and standards may apply. It is the responsibility of the Contractor to obtain these documents, at their own expense, and adhere to any applicable specifications, standards, guidelines, and best practices found therein. Where “latest edition” or “latest version” is referenced, it is defined to mean the edition or version that was most recently published and available at the time of the RFP advertisement. See Book 1 – Request for Proposals (RFP) Section 1.6 for priority of documents.

**2. PROJECT MANAGEMENT PLAN AND ADMINISTRATION**

The Contractor shall establish and maintain an organization and processes to effectively manage all elements of the Project. This Project management effort shall be defined by and follow the Project Management Plan (PMP), which shall address discrete elements of the Project. The PMP is an umbrella document that describes Contractor’s managerial approach, strategy, and procedures to design and build the Project and achieve all requirements of the Project.

- A. The Contractor shall prepare and submit the PMP within 30 calendar days of the Notice to Proceed #1 (NTP1). The required sections of the PMP are outlined in Table 2-1. The Contractor may supplement these sections with additional sections as is appropriate to their PMP.

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**Table 2-1: Required Elements of the Project Management Plan (PMP)**

<b>PMP Chapter</b>	<b>Chapter Title</b>
<b>1</b>	<b>General Project Management</b>
<b>2</b>	<b>Coordination with Stakeholders</b>
<b>3</b>	<b>Risk Management and Security</b>
<b>4</b>	<b>Schedule and Cost Control Management</b>
<b>5</b>	<b>Environmental Management</b>
<b>6</b>	<b>Design Management</b>
<b>7</b>	<b>Construction Management</b>
<b>8</b>	<b>Traffic Management</b>

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**2.1. PMP - General Project Management**

The PMP shall include a chapter that describes the Contractor's overall Project management plan and approach to the work, including at least the following:

- A. A description of the methods to be used to assure necessary communication and documentation within Contractor's team, including communication among the sub-organizations and management personnel.
- B. A description of how the Contractor intends to:
  - a. Provide the experienced personnel, facilities, and equipment, and to integrate such resources, to complete each aspect of the Project;
  - b. Control and coordinate the various subcontractors/ subconsultants;
  - c. Interface with the Owners;
  - d. Interface with regulatory agencies;
  - e. Interface with applicable public utility owners;
  - f. Control Project schedules and costs; and
  - g. Comply with applicable laws.
- C. A description of the plan to manage permitting and third-party coordination and approvals.
- D. An organization chart outlining the basic structure of Contractor's Project organization (including the design and construction sub-organizations) and a description of the roles, responsibilities, interrelations, and work to be accomplished by each member of the management team and each sub-organization, including identified Subcontractors and Suppliers/Vendors (at all tiers). Quality management organization(s) shall also be included.
- E. Information describing how each of the Key Personnel will fit into the organization, including a description of each key person's function and responsibility relative to the Project, and indicating the percent of time that the person will devote to the Project during their activity.
- F. A detailed description of how the team members will work together to provide a unified design, construction, and quality approach to all elements of the Work.
- G. A schedule for regular design coordination and construction progress meetings.
- H. A description of the team decision making process, how internal disputes between team members will be resolved and how Contractor will avoid adverse impacts to the Project (cost, schedule or quality) in the event of such disputes.

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- I. A Document Management Plan for sharing documents with NHDOT, MaineDOT, and MTA.

**2.1.1. Document Management Plan**

The Contractor shall describe procedures and processes in the PMP for the storage and retrieval of documents, including the following:

- A. All electronic information submitted to the State shall be logically organized, searchable, and legible.
- B. The Contractor shall describe the methods by which all documents issued by the Contractor will be uniquely coded and retrievable.
- C. The Contractor shall describe the routing, filing, control, back-up, and retrieval methods for all documents.
- D. The Contractor shall establish methods to facilitate sharing of data including procedures and software for storing, sharing, and accessing all documents. NHDOT requires the Contractor to use NHDOT's Bluebeam file storage system for all submittals, comment tracking, and other contract related paperwork.
- E. The Contractor shall maintain all review comments during the design phase.
- F. The Contractor shall be responsible for preparing meeting notes at all meetings and conference calls throughout the life of the Project. These meeting notes shall be submitted to the State Project Manager for approval within five (5) working days of the meetings. These meeting notes shall be filed and stored using the NHDOT Bluebeam File Storage in such a way that the Owners may retrieve them throughout the life of the Project.

**2.2. PMP - Coordination with Stakeholders**

The PMP shall describe the approach to coordinating with stakeholders. Throughout the Project, the Contractor shall be required to coordinate its efforts with the Owners through the Contract Administrator (to be assigned by NHDOT), , and the Contractor working on the HLB rehabilitation project (SPS) through the MaineDOT Resident Engineer for that project. Additionally, the Contractor shall coordinate with utility companies and residents as required. The coordination will include, but is not limited to, providing coordination of field investigations and construction with the HLB rehabilitation contractor and providing sufficient notice of roadway closures and/or other significant operations prior to their occurrence.

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**2.3. PMP - Risk Management and Security**

**2.3.1. Risk Management Plan**

The PMP shall describe the approach to identification, management, mitigation, and allocation of Project-specific risks, including a Risk Matrix which shall identify the following at a minimum:

- A. Significant risk categories during the design and construction of the Project;
- B. The potential consequences of the identified risks;
- C. The probability/likelihood of risks;
- D. Allocation of the risk; and
- E. Risk-mitigation strategies to eliminate or reduce specific risks.

The initial Risk Matrix shall be developed following the Project Kick-off meeting where risk management will be an agenda topic. The Risk Matrix shall be updated by the Contractor throughout the Project as risks are retired or as additional risks are realized (at least once every other month).

**2.3.2. Security Plan**

The Contractor shall develop a Security Plan that shall protect the NHDOT network as ITS field devices are tested and integrated into the NHDOT network. The New Hampshire Department of Information Technology (NHDoIT) review and approval of this plan is required prior to device testing and integration in New Hampshire. MTA and MaineDOT review and approval of this plan is required prior to device testing and integration in Maine.

The State must ensure that appropriate levels of security are implemented and maintained in order to protect the integrity and reliability of its Information Technology resources, information, and services. State resources, information, and services must be available on an ongoing basis, with the appropriate infrastructure and security controls to ensure business continuity and safeguard State networks, Systems and Data.

The State will evaluate the degree to which the proposed System is designed and architected to ensure the confidentiality and integrity of its valued asset, Data.

**2.3.2.1. Access and Health Screenings**

The Owners acknowledge that through most of 2020, there have been restrictions in place due to COVID-19 that limited non-essential and/or non-Owner personnel from entering the IPOC, the NHDOT TMC, the MaineDOT TMC and the MTA TMCC. While the Owners cannot determine

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at this time the potential access restrictions that may be in place in 2021 and beyond, the Contractor is hereby advised that access to the Owners' TMC/TMCC may require health screenings, sanitation protocols, or may continue to be restricted to non-Owner personnel. The Contractor shall develop their Security Plan with an acknowledgment that access to the Owners TMC/TMCC may be limited and/or restricted during some or all of the Project. Refer to Book 1 – Request for Proposals (RFP) for additional details.

*2.3.2.2. NHDOT Transportation Management Center (TMC)/ NHDOS  
Incident Planning & Operations Center (IPOC) Facilities Activities*

The Contractor will be required to submit to security measures for access to the NHDOT TMC facilities to conduct the installation and acceptance testing in a manner that minimizes disruption to operations. See the RFP for additional details.

*2.3.2.3. MTA Traffic Management and Communications Center (TMCC)  
at the MTA Headquarters*

The Contractor may be required to submit to additional, enhanced security measures for access to the MTA TMCC to conduct the Project installation and acceptance testing in a manner that minimizes disruption to operations. See the RFP for additional details.

*2.3.2.4. MaineDOT Transportation Management Center (TMC) at the  
MaineDOT Headquarters*

The Contractor may be required to submit to additional, enhanced security measures for access to the MaineDOT TMC to conduct the Project installation and acceptance testing in a manner that minimizes disruption to operations. See the RFP for additional details.

*2.3.2.5. Escorts for Access*

The Contractor and any Subcontractor will require an escort for all activities within the TMCs or the TMCC. In New Hampshire, the escort will arrange access to the facility through the New Hampshire Department of Safety (NHDOS) and monitor Contractor activities for each entry to the TMC workspace. NHDOT will provide this escort at no fee to the Contractor for activities that will occur during normal business hours (defined as 8:00 am to 4:00 pm Monday-Friday, non-holidays). The Contractor will provide as much advanced notice as feasible but in no case shall notice be served less than two business days to the State Project Manager for the provisioning of an escort. Notice of less than two business days will not receive an escort and

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the Contractor will not be permitted within the TMC. Proper notification shall include the following information:

- A. Description of proposed work activity, including physical location of the activity;
- B. Identification of all personnel involved in the proposed activity (personnel must be on the pre-approved list for TMC access); and
- C. Identification of the proposed activity start/stop times.

For activities that will occur outside of normal business hours, the Contractor shall provide not less than five business days notification to NHDOT for the provisioning of an escort. The notification will include the information defined for the normal business hours escort as well as a justification for conducting this activity outside of normal business hours.

NHDOT reserves the right to deny an escort or deny facility access to the Contractor/Project Subcontractors due to staff availability or disruption of NHDOS/NHDOT Operations. The Contractor shall not be compensated by NHDOT for any interruption of activities due to staff availability or disruption of NHDOS/NHDOT Operations.

*2.3.2.6. NHDOS Operations at the Incident Planning & Operations Center (IPOC)*

All on-site activities of the Contractor and any Subcontractor at the IPOC and within the TMC shall be performed in a manner that minimizes disruption to NHDOS Operations. The Contractor shall submit a detailed work plan to the State Project Manager for approval detailing how the Contractor proposes to conduct activities that may have a significant impact on NHDOS Operations.

The work plan shall be submitted no less than fourteen (14) calendar days prior to the initiation of activities. NHDOT reserves the right to modify the work plan and/or deny facility access to the Contractor due to disruption of NHDOS Operations. NHDOT reserves the right to direct the Contractor to cease work activities due to an unforeseen disruption of NHDOS Operations. The Contractor shall not be compensated by the NHDOT for the modification of work plans, failure to allow facility access, or ceasing of work activities.

*2.3.2.7. Criminal Record Request*

All Contractor personnel who will have access to any Owners' network will be required to undergo a NH State Police Criminal Record screening. The Contractor shall provide a list of

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personnel who need access to the TMC/TMCC and the Owners' network for the Project. Each individual shall be required to apply in person at the State Police office at 33 Hazen Drive in Concord with a primary identification (a current, valid and unexpired picture ID such as a driver's license or passport) OR may mail in an application notarized by either a Notary Public or Justice of the Peace. There is a processing fee of \$25 per person which shall be the Contractor's responsibility. Any individual who cannot pass the screening will be prohibited from accessing the NHDOT network and will be prohibited access to the TMC/TMCC operations workspace. It is the Contractor's responsibility to provide personnel who are capable of conducting the necessary integration and testing and can pass the NH State Police screening requirement.

The results of this check for each person requiring on-site access to the NHDOT TMC shall be submitted by the Contractor Project Manager to the State Project Manager for approval no less than fourteen (14) calendar days prior to any scheduled or unscheduled on-site activities.

NHDOT reserves the right to deny facility access to the Contractor/Project Subcontractor personnel based on the results of the background check or changes to the criminal record of Contractor personnel. It is the Contractor's responsibility to provide personnel to conduct the Work that can meet and maintain certification for entry to the NHDOT IPOC. The Contractor shall not file a claim against the NHDOT for failure to provide facility access.

Information and application forms for a Criminal Record Request are available on the NHDOS website:

<http://www.state.nh.us/safety/divisions/nhsp/ssb/crimrecords/>

Field Code Changed

The New Hampshire Department of Safety contact for a background check is:

New Hampshire Department of Safety  
DIVISION OF STATE POLICE  
Support Services Bureau  
Criminal Records Unit  
33 Hazen Drive, Concord, NH 03305  
Open Monday-Friday; 8:15 am to 4:15 pm



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An applicant shall have the following documents for the Criminal Record Request: Photo ID (current driver's license, non-driver's license, or passport); a completed Criminal Record Release Authorization Form (Sections 1 and 2); and the required payment.

The NHDOT reserves the right to suspend the activities of the identified Contractor personnel until the required security clearance is obtained. All costs associated with the acquisition of a security clearance shall be assumed by the Contractor.

#### **2.4. PMP - Schedule and Cost Control Management**

The PMP shall provide a description of the Contractor's plan and management approach for schedule and cost control on the Project, including at least the following:

- A. Describe the Contractor's schedule and cost control management system to be used to control and coordinate the schedule of the work and cost impacts of changes during the term of the Contract, including during the design and construction phases.
- B. Describe the proposed Project schedule methodology and cost control approach and include at least the following:
  - I. A description of the system used for preparing and updating the Project schedule, including integrating all Contractor team members' schedules into the Contractor's schedule;
  - II. A description of the proposed approach for updating the schedule on a monthly basis;
  - III. A description of how Contractor will approach re-scheduling of its work to achieve schedule recovery objectives and how these objectives will be enforced within the team; and
  - IV. A description of how Contractor will control the Project to minimize change orders that could increase the Project cost or could extend the schedule.

##### **2.4.1. Project Schedule**

The Project Schedule shall be a Critical Path Method (CPM) schedule. The Project Schedule and all subsequent Progress Schedules shall define the timeframe for completion of the Project and achievement of Project milestones. The Schedule will be used to monitor progress and denote changes that occur during design and construction.

###### **2.4.1.1. General Requirements**

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The Contractor shall be responsible for the adequacy of the Schedule and managing resources to meet the requirements of the RFP Documents and the PMP. The Project Schedule shall be updated and submitted on a monthly basis (“Progress Schedule”), on or before the fifth day of each month of the Project. Project and Progress Schedule submissions shall be electronic files, in an approved PDF format. The NHDOT has adopted Microsoft Project Scheduler as the official Department scheduling software. All electronic submissions shall be compatible with MS Project, unless otherwise approved.

In addition to the Project Schedule requirements to this Technical Provision Section 2.4.1, also refer to Section 108.03.A in the NHDOT Standard Specifications for Schedule requirements.

**2.4.1.2. Required Submittals**

**2.4.1.2.1. Final Project Schedule**

The Contractor shall use the preliminary schedule submitted with the Proposal as a foundation to prepare a Final Project Schedule. The Final Project Schedule shall include a separate narrative report that describes, in general fashion, the Contractor’s proposed methods of operation for designing and constructing the major portions of the Project. The schedule narrative shall describe the general sequence of design and construction, the proposed Critical Path of the Project, and all Project Schedule milestones.

The Final Project Schedule shall include all Project activities required under the RFP Documents (and in accordance with Section 108.03A), in sufficient detail to monitor and evaluate design and construction progress. The first activities listed shall be the Effective Date (G&C Approval) and NTP1. The second-to-last activity listed should be the Final System Acceptance followed by initiation of the Maintenance and Warranty period (NOTE: only the initiation of the Maintenance and Warranty period is required to be shown on the Schedule for the Maintenance and Warranty activity). For each activity, the Contractor shall indicate the duration (in days) required to perform the activity and the anticipated beginning and completion date of each activity. In addition, the Final Project Schedule shall indicate the sequence of performing each major activity and the logical dependencies and inter-relationships among the activities.

With the exception of activities relating to Approvals by Other Governmental Entities, each activity depicting Contractor’s operations shall have duration of not more than 15 working days, and not less than one day, except as otherwise approved by the Owners.

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2.4.1.2.2. Monthly Progress Schedule Updates

The Contractor shall update the approved Final Project Schedule on a monthly basis, or as otherwise requested, to reflect the current status of the Project. Each Monthly Progress Schedule Update shall accurately reflect actual start and actual finish dates of Work for completed activities or percentage complete and days remaining for Work in progress as of the effective date of the updated schedule. See NHDOT Standard Specifications Section 108.03.A.2.3 for additional Progress Schedule Update requirements.

2.4.1.2.3. Winter Suspension of Work

It is anticipated that the Contractor will continue construction operations through the winter season, however, if this becomes impractical, the Contractor shall provide a minimum of three weeks' notice to the Owners that the Project will be suspended over winter. Prior to initiating winter suspension, the Contractor shall make the Project area secure and all-weather safe. The Schedule shall reflect the date on which winter suspension begins and the anticipated date when winter suspension will end.

2.4.2. Owner Submittal Review Timeframes

The Project Schedule shall allow 15 Working Days for the Technical Review Team to review each submittal. Smaller submittals may be expedited at the Owners' sole discretion. Submittals made available after Noon EST are to be considered as having been received the following Working Day.

**2.5. PMP - Environmental Management**

The Project Management Plan shall provide a description of Contractor's plan and management approach to environmental compliance and permitting, including at least the following:

- A. Applicable laws, rules and regulations.
- B. The method the Contractor will use to ensure compliance with all environmental commitments and environmental permit conditions are integrated into design, construction, and maintenance of the Project.
- C. The Project is located within an MS4 area and is subject to compliance with MTA's agreements for work within an MS4 area.

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- a. The Contractor shall read and sign the MTA's MS4 forms included in Appendix C. The signed documents shall be made part of the PMP.
- D. As part of the federal funding requirements associated with the existing rehabilitation Project, MaineDOT has provided documentation to obtain a Programmatic Categorical Exclusion (CE) for the rehabilitation Project. This NEPA documentation has been expanded to include the limits of the PTSU System. See Section 4 for additional information.

#### **2.6. PMP - Design Management**

The PMP shall provide a description of the Contractor's plan and management approach for performing design on the Project, including at least the following:

- A. A description of how Contractor intends to manage the development and coordination of design, including issues such as design coordination with adjacent Projects, design submittals and review cycles, ROW, survey, environmental permitting, utilities, and safety issues.
- B. A description of the proposed approach for delivering the design for the Project, including where the designers will be located, how designs are to be developed by different firms, how offices will be integrated and work coordinated to ensure consistency and quality.
- C. A description of how the design personnel will interface with the construction personnel to achieve a quality constructed Project that minimizes long-term maintenance.

#### **2.7. PMP - Construction Management**

The PMP shall provide a description of the Contractor's plan and approach for performing construction on the Project, including at least the following:

- A. A narrative description of how the Contractor intends to schedule and sequence the construction to coordinate with the I-95 HLB rehabilitation project and other concurrent Owners or municipal projects while minimizing impacts on the environment, communities, and the traveling public.
- B. A description of the intended laydown, staging, disposal and maintenance access locations (with approximate areas) to be used during construction. If laydown or staging

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is proposed outside of the Project's or the Contractor's ROW, the Contractor shall describe the intended actions to obtain approval of the location(s).

- C. A description of how the ROW and adjacent roads and properties will be maintained and protected, including the intended measures to be used to mitigate and minimize noise, vibration, light, and dust.
- D. A description of how the Contractor will control erosion and sediment during earth disturbing activities.
- E. A description of how the Contractor will maintain job site safety on and off the HLB for workers and the traveling public.

### **2.8. PMP - Traffic Management**

The PMP shall provide a description of Contractor's plan and approach for preparing, implementing, and updating the Traffic Management Plan (TMP) on the Project, including at least the following:

- A. A narrative description of how the Contractor will manage and control traffic during construction.
- B. A description of the Contractor's traffic management oversight, including the assignment of the TMP development.
- C. The Contractor shall apply for a work permit for all work located within MTA's rights-of-way. The submitted work permit shall use the form included in Appendix B.

## **3. QUALITY MANAGEMENT PLAN**

The Contractor shall develop, implement, and maintain a comprehensive Quality Management Plan (QMP). The QMP shall be organized and generally conform to the requirements of Section 3. The QMP shall be submitted to the Owners within 30 calendar days of NTP1, or prior to the Contractor submitting any Design Submissions (whichever occurs first). No design submissions will be reviewed by the Owners until the QMP has been reviewed and approved.

The Contractor shall be responsible for the professional quality, technical accuracy, and coordination of all Work under this Project.

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### 3.1. Project Quality Assurance

To ensure that goals for Project quality will be met, NHDOT has established Quality Assurance (QA) requirements for Design-Build Projects. These requirements include a Design QA Program to address quality in the design process and a Construction QA Program to ensure the quality of construction, comprised of the elements outlined below.

#### 3.1.1. Design QA Program

NHDOT's Design QA Program for Design-Build Projects includes the following two elements:

- A. Design Quality Control (QC) system by the Contractor
- B. Design Acceptance system by NHDOT

#### 3.1.2. Construction QA Program

The Construction QA Program for Design-Build Projects includes the following six core elements:

- A. Construction QC system by the Contractor
- B. Construction Acceptance/Verification system by NHDOT (or its Designated Agent)
- C. Independent Assurance (IA) by NHDOT (or its Designated Agent)
- D. Dispute Resolution system
- E. Qualified/Accredited Laboratories (all Contractors and NHDOT)
- F. Qualified/Certified Inspection & Testing Personnel (all Contractors and NHDOT)

### 3.2. QMP General Requirements

- A. The Contractor shall develop, implement, and maintain the QMP for the life of the Project. The QMP shall describe the Contractor's quality control (QC) system, policies, and procedures that ensure the Project meets the requirements of the Design-Build Documents and the expectations of the Owners.
- B. The QMP shall contain detailed procedures for the Contractor's QC activities.
- C. The Contractor's QC system shall incorporate planned and systematic audit activities undertaken by individuals qualified to review the design and construction aspects of the Project.
- D. The complete QMP shall incorporate the following features:

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- a. The QMP shall be a single comprehensive document that outlines the Contractor's overall QC system for both Design and Construction.
  - b. The Contractor shall make all QC records immediately available to NHDOT for review. The Contractor shall provide NHDOT with a copy of any and/or all QC records when requested.
  - c. The QMP shall encompass all Work performed by Contractor and their Subconsultants/Subcontractors.
  - d. The Contractor shall submit the results of all internal QC audits upon request within seven days.
  - e. The Contractor shall promptly submit to the Owners all Non-Conformance Reports (NCRs) at issuance and at resolution.
- E. If the Owners determine that the QMP procedures are not adequate, as evidenced by the Owners' oversight of the design and construction, the Contractor shall revise the QMP procedures and submit an amended QMP for review and approval.
- F. If the Owners determine that the QMP procedures are not adequate or not being followed by the Contractor, the Owners may, at their sole discretion, withhold payment for design and construction until appropriate QMP procedures are in place and being followed. The Owners may also suspend approval for on-going work until any deficiencies have been addressed and updated QC procedures have been documented.

### **3.3. QMP Content**

- A. At a minimum, the QMP shall contain the following five sections:
- a. Section 1 – Introduction
  - b. Section 2 – Quality Control Organization
  - c. Section 3 – Document Management Procedures
  - d. Section 4 – Design Quality Control Procedures
  - e. Section 5 – Construction Quality Control Procedures
- B. The Contractor may provide additional sections to fully describe the proposed QMP. The Contractor may include references to the Contractor's published quality management procedures in an appendix to the QMP.

#### **3.3.1. QMP Section 1 – Introduction**

The QMP shall contain a complete description of the quality policies and objectives that the Contractor will implement throughout its organization. The policy shall demonstrate the

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Contractor senior management's commitment to implement and continually improve the quality management system for the Project. This section shall also include an overview of the QMP, program requirements, roles and responsibilities, and the process for approval and updates.

**3.3.2. QMP Section 2 – Quality Control Organization**

The Contractor shall maintain the QMP to contain current versions of the following information:

- A. The organizational chart that identifies all QC personnel with their roles and responsibilities. There shall be a clear distinction between QC personnel and personnel devoted to production of the Work.
- B. Designation of all QC personnel who have the authority to stop Work.
- C. Identification of testing firms, including information on each firm's capability to provide the specific services required for the Project, certifications held, equipment, and location of laboratories.
- D. Resumes for all QC personnel.

The persons and organizations performing QC functions shall have sufficient authority and organizational freedom to identify quality problems and to initiate, recommend, provide, and verify the implementation of solutions.

**3.3.2.1. *Design Quality Control (DQC) Manager***

The Design Quality Control (DQC) Manager shall be responsible for implementation of all design QC procedures and activities as established in the QMP. The DQC Manager shall have a minimum of 8 years' experience in transportation engineering with a specialty in ITS and/or communications. The DQC Manager shall be a licensed Professional Engineer in the State of New Hampshire and the State of Maine. The specific duties and authority of the DQC Manager shall be defined in the QMP.

**3.3.2.2. *Construction Quality Control (CQC) Manager***

The Construction Quality Control (CQC) Manager shall be responsible for implementation of all construction QC procedures and activities as established in the QMP. The CQC Manager shall have a minimum of 10 years' experience in heavy highway or bridge construction or ITS/communications construction or a licensed Professional Engineer in the State of New



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Hampshire and/or the State of Maine. The specific duties of the CQC Manager shall be defined in the QMP.

**3.3.3. QMP Section 3 – Document Management Procedures**

- A. The QMP shall expand upon the PMP’s Document Management Plan with a focus on the Contractor’s procedures to manage the QMP documentation.
- B. The QC procedures for the Contractor's documents shall include design plans, specifications, reports, calculations, and other Construction Documents.
- C. The QC document management plan shall include details on the storage and management of all QC inspection and testing records to be shared with the Owners. The Project document management system shall use Bluebeam.
  - a. QC inspection reports and QC material sampling/testing results shall be submitted to NHDOT within seven (7) calendar days following the inspection or test.
  - b. The CQC Manager shall maintain a daily electronic log of all inspections performed for both Contractor and Subcontractor operations in a format acceptable to the Contract Administrator. This log shall be transmitted weekly to the Contract Administrator by Noon on Monday of the following week.
  - c. The weekly QC inspection reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.
- D. The document management procedures shall include templates/forms that will be used for Requests for Information (RFIs), Field Design Changes (FDCs), Test Plans, QC Work Plans and Non-Conformance Reports (NCRs).
  - a. The document management plan shall clearly define the purpose for each template/form, how they will be used throughout the Project, and how they will be collected and stored. The plan should specify and clarify differences in nomenclature and tracking for internal (Contractor Team) vs external (Contractor to Owner) RFIs, NCRs, and FDCs.
  - b. Submission of these documents must be reviewed and signed by the Contractor personnel in responsible charge of the relevant Work and the Contractor’s relevant QC Manager prior to submission to the Owners.

**3.3.4. QMP Section 4 – DQC Procedures**

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The Contractor shall describe the procedures for design QC. These procedures shall provide a clear distinction between the Professional Services personnel responsibility for “self-checks” and the systemic, independent quality review oversight procedures.

**3.3.4.1. QMP DQC General Requirements**

- A. The QMP shall describe and include the following general requirements:
- a. The QC procedures for Professional Services products (such as civil, structural, electrical, and communications).
  - b. Design documents shall be stamped, signed, and dated by the Professional Engineer in responsible charge for that item, element, or phase of the Work.  
NOTE: WORK SHALL BE STAMPED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE THE WORK WILL OCCUR. IF WORK WILL OCCUR IN BOTH MAINE AND NEW HAMPSHIRE, IT SHALL BE STAMPED, SIGNED AND DATED BY A PROFESSIONAL ENGINEER LICENSED IN BOTH STATES OR BY THE SEPARATE PROFESSIONAL ENGINEERS LICENSED IN EACH STATE. IF WORK OCCURS IN A STATE FOR WHICH THE PROFESSIONAL ENGINEER IN RESPONSIBLE CHARGE IS NOT LICENSED, THE ENGINEER WILL BE REPORTED TO BOTH STATE’S BOARDS OF PROFESSIONAL LICENSURE.
  - c. Provide specific QC review procedures, including all required forms and checklists.
  - d. The checking of structural design shall include a set of independent calculations, performed by a qualified individual who did not perform the calculations for all structural elements. The designer and checker shall be clearly identified on the face of all calculation submissions.
  - e. The QC audit procedures shall be documented, including all required forms and checklists.
  - f. The QC procedures for Professional Services products after Release for Construction approval.
  - g. The QC procedures for Record Drawings and Documentation.
  - h. The Engineer of Record shall review and certify in writing that all design materials have been completed, reviewed, and checked prior to submitting to the Owners. The written certification shall accompany the Design Narrative at each submission. The review shall verify that:
    - i. The design meets all applicable requirements of the Contract, applicable law, and governmental approvals.

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- ii. The design has been checked in accordance with the approved QMP and typical Professional Services procedures.
  - iii. The design has addressed any comments raised in a previous submission.
- B. The DQC Manager shall verify that the methods and procedures contained in the accepted QMP are implemented and followed by the Contractor's design staff in the performance of the Project.
- C. The Contractor shall designate by name (and provide a resume for) the Professional Engineer in responsible charge for each major item, element, or phase of the Project. The Professional Engineer(s) in responsible charge shall be a licensed Professional Engineer in the States of New Hampshire and Maine. This role may be shared among two engineers, each licensed in one State; however, see the note under Section 3.3.4.1.A.b.
- D. The Professional Engineer in responsible charge shall stamp, sign, and date each Engineering product produced for the Project in accordance with the rules of the Board of Professional Engineers for each state.
- E. The DQC Manager shall ensure that the personnel performing the Work are not the same personnel performing the formal QMP reviews.
- F. The DQC Manager shall certify in writing that all Early Start construction work has been reviewed in accordance with the QMP and the design documents related to the Early Start construction work are in full compliance with the Design-Build requirements.
- G. The DQC Manager shall certify that any Early Start construction work that is a prerequisite for later work whose design is not sufficiently advanced will not make later work non-conforming to the Design-Build requirements.
- H. The DQC Manager shall conduct a minimum of two (2) QC audits through the life of the Project.
- I. The DQC Manager shall verify that the Record Drawings and Documents have followed the QMP process.

### 3.3.5. QMP Section 5 – Construction Quality Control (CQC) Procedures

The QMP shall describe the procedures for construction QC. This shall include the Contractor's internal QC policies, procedures, and personnel by the Contractor's firm as well as Subcontractors, Subconsultants, and suppliers. These procedures shall provide a clear distinction between the construction personnel's responsibility for "self-checks" and the systemic, independent quality review oversight procedures.

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3.3.5.1. *QMP CQC General Requirements*

- A. The CQC procedures shall be consistent with the NHDOT Construction Manual and the 2016 NHDOT Standard Specifications, including but not limited to Sections 101.18, 106.03, and 106.04.
- B. Frequency of QC sampling, testing and procedures shall exceed minimum Owner Acceptance only. It is anticipated that the Contractor will need to conduct additional QC inspections and testing to meet the Project needs and facilitate expeditious Owner Acceptance.
- C. Individual QC Construction Work Plans shall be submitted for all items of work or materials not included on the NHDOT's Qualified Product List; or not previously included in separately submitted Work Plans or Test Plans.
- D. QC Construction Work Plans should include details on the materials to be used, construction methodology, relevant specification or design criteria to be met, testing procedures and frequencies, inspection criteria; etc. At a minimum the QMP shall specify:
  - a. Methods and procedures that clearly define the authority and responsibility of the CQC Manager.
  - b. The period of time that the CQC Manager will be present on the site shall be provided by work activity or by construction phase.
  - c. A list of anticipated QC Construction Work Plans to be submitted for review and approval prior to commencement of the work.
  - d. QC inspection, testing and documentation procedures for on-site material, including but not limited to: Portland cement concrete, structural fill, and backfill materials.
  - e. The review and approval of all Portland cement concrete and hot mix asphaltic concrete mix designs by a Professional Engineer licensed in the States of New Hampshire and Maine.
  - f. The field on-site materials testing for Portland cement concrete, structural fill, and backfill materials.
    - i. The sampling, testing, and reporting of all materials used shall be in compliance with the NHDOT Standard Specifications and Qualified Products List (QPL) provided by the NHDOT.
    - ii. All QC personnel identified in the CQC Plan shall have appropriate certifications, which shall be described in the QC Plan and shall be subject

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to the Owners' approval. If pertinent certification is available through NETTCP, it is recommended. If not available through NETTCP, other comparable certifications may be accepted by the Owners.

- iii. All laboratories performing QC testing of Project Produced Materials shall be qualified through either the AASHTO Accreditation Program (AAP) or NETTCP Laboratory Certification Program.
- g. Procedures for inspecting, checking, and documenting the Work. Inspection, examinations, and measurements shall be performed for each operation of the Work to assure quality.
- h. Procedures to ensure that critical elements of the Work are not started or continued without inspection and testing by the CQC Manager on-site, whether the Work is occurring in the field or at an Owners' facility (TMC or TMCC). Inspection points shall be identified and communicated to the Construction QC Manager and the applicable Owner(s). Procedures to proceed beyond inspection points shall be developed.
- i. QC inspection, testing, and documentation procedures for Fabricated Items, such as ITS overhead and cantilever structures.
- j. QC inspection, testing and documentation procedures for Manufactured Structural Items.
- k. Description of specific procedures to ensure that all Work conforms to the requirements of the Design-Build Documents, Governmental Approvals, applicable Law, and the Design Documents, as well as that all materials, equipment, and elements of the Work will perform satisfactorily for the purpose intended.
- l. Measures to ensure that purchased materials, equipment, and services conform to the Design-Build Documents, Governmental Permit Conditions and Approvals, applicable Laws, Rules, and the Design Documents.
- m. Procedures for identification and control of materials, equipment, and elements of the Work. These procedures shall be consistent with Good Industry Practice to ensure that identification of the item is maintained by appropriate means, either on the item or on records traceable to the item, as necessary, throughout manufacture or fabrication, erection, installation, and use of the item.
- n. Procedures to ensure that materials, equipment, or elements of the Work that do not conform to requirements of the Design-Build Documents, Governmental Permit Conditions and Approvals, applicable Law, or the Design Documents are

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not used or installed. These procedures shall include identification, documentation, segregation, disposition, and notification to the Owners, and, if appropriate, Governmental Entities and other affected third parties, as well as procedures for Owners to review Nonconforming Work.

- o. Procedures for processing a RFI to resolve discrepancies and/or questions in the plans and specifications so that all changes are documented and approved by the Contractor's Engineer of Record and the Owners.
- p. Procedures to indicate, by the use of markings such as stamps, tags, labels, routing cards, or other suitable means, the status of inspections and tests performed upon individual items of the Work.
- q. A program for CQC Manager inspection for each operation of all Work through examinations or measurement, and testing of materials or elements of the Work to assure quality.
- r. A program to ensure performance of all equipment testing required to demonstrate that all materials, equipment, and elements of the Work will perform satisfactorily for the purpose intended and meet the standards specified in the Design-Build Documents. The QMP shall document the pre-testing phase for all ITS equipment prior to conducting the formal testing in the presence of the Owners.
- s. Measures to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly maintained, controlled, calibrated, certified, and adjusted at specified periods to maintain accuracy within industry standards.
- t. Procedures to control the handling, storage, shipping, cleaning, and preservation of materials and equipment to prevent damage or deterioration.
- u. NCR procedures to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, defective material and equipment, deviations, and other Nonconforming Work are promptly identified and corrected. The procedures shall ensure that the cause of the condition is determined and corrective action(s) taken to avoid repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken shall be documented and reported to the Owners in writing and to appropriate levels of Contractor's management to ensure corrective action is promptly taken.

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- v. A comprehensive system of planned and periodic audits of the Contractor's QMP to determine adherence to and the effectiveness of the QMP.
    - i. The CQC Manager shall perform a minimum of three audits in accordance with the written procedures or checklists.
    - ii. Audit results shall be documented, reviewed, and acted upon by Contractor.
    - iii. Follow-up action, including re-audit of deficient areas following corrective action, shall be taken where indicated.
  - w. Procedures for processing FDCs that are the result of an RFI, NCR, or other discrepancy, question, or issue that requires a change to the approved RFC plans. Every FDC requires written certification and approval by the Engineer of Record and DQC Manager.
  - x. Measures to control the receipt and issuance of documents, such as instructions, procedures, training manuals, and drawings, including changes thereto, which prescribe activities affecting quality. These measures shall ensure that approved documents, including authorized changes thereto, are reviewed for adequacy and approved for release by authorized personnel of Contractor and are distributed to and used at the location where the prescribed activity is performed. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless the Owners consent, in writing, to another responsible organization.
  - y. The requirements and methods for controlling documents. Contractor's shall use NHDOT's Bluebeam file storage system as the Owner's document control system.
- E. The Owners shall maintain the right to inspect construction and acceptance testing activities, including independent QA testing for materials and request any documentation from the Contractor to ensure quality products and services are being provided. The Contractor shall provide not less than three days advanced notice for any Acceptance Sampling and Testing anticipated on the Project. The notice shall include the type of material testing, the location of the material placement, and an on-site Contractor point of contact for the testing.
- F. The CQC Manager shall verify that the methods and procedures contained in the accepted QMP are implemented and followed by the Contractor and all Subcontractors.
- G. The CQC Manager shall not be involved with scheduling or production activities.

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- H. The Contractor shall not commence construction or fabrication of an item without applicable approved QC documentation.

#### **4. ENVIRONMENTAL**

##### **4.1. General**

This Project will receive federal funding and therefore it has been designated a federal participating Project. This Project required an environmental review under the National Environmental Policy Act (NEPA). Pursuant to NEPA, the MaineDOT has prepared a Programmatic Categorical Exclusion for this Project which has been adopted by NHDOT. NHDOT's adoption of MaineDOT's environmental documentation requires the implementation of additional environmental commitments in New Hampshire. The Contractor shall review, adhere to, and provide written documentation that all environmental commitments listed in the NHDOT's Environmental Commitments Memo (Appendix E) have been appropriately addressed.

##### **4.2. New Hampshire Permits**

- 4.2.1. Through the development of Book 4 – 30% Conceptual Plans, no additional permitting or environmental documentation was identified. However, if the Contractor's System Solution requires Work not in conformance with the Programmatic Categorical Exclusion, the Contractor shall be responsible for all environmental documentation, applying for applicable permits, and adherence to the conditions of the permits.
- 4.2.2. All impacts within the jurisdiction of NHDES shall be addressed by submission of an applicable wetlands permit(s). Application and approval for the additional permit, including all costs associated with additional conditions, is the responsibility of the Contractor.
- 4.2.3. Any Wetland Dredge and Fill, Shoreland, or Alteration of Terrain permitting shall be prepared in accordance with NHDES specific regulations. Preparation of additional permit packages will be the responsibility of the Contractor. If any Agency rejects or denies the permit application, it is the Contractor's responsibility to make whatever changes are necessary to achieve an approved permit or modify the plans such that the permit application is no longer required.



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4.2.4. The Contractor will be required to pay all permit fees. Any fines levied by permitting agencies shall be the responsibility of the Contractor.

4.2.5. Stormwater Pollution Prevention Plan (SWPPP)

4.2.5.1. The Contractor shall prepare a Storm Water Pollution Prevention Plan (SWPPP), if required, in accordance with the EPA's National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP). If the Contractor does not provide a SWPPP, the Contractor shall provide calculations that indicate a SWPPP is not required in accordance with the CGP. The CGP also requires the preparation and implementation of a SWPPP in accordance with the aforementioned statutes and regulations. The SWPPP will include the CGP conditions and detailed descriptions of controls of erosion and sedimentation to be implemented during construction. It is the responsibility of the Contractor to prepare the SWPPP to meet the requirements of the most recently issued CGP.

4.2.5.2. Detailed limits of the erosion control items shall be shown on the roadway plan sheets. This plan shall be submitted along with the Contractor's certification not less than 15 calendar days prior to beginning construction activities. The Notice of Intent (NOI) and Notice of Termination (NOT) shall also be submitted by the Contractor to the EPA with a copy sent to the State Project Manager.

4.2.5.3. The SWPPP shall be prepared in accordance with Section 107 of the NHDOT Standard Specifications and all other State and Federal environmental regulations. The SWPPP documentation shall be submitted to the NHDOT and the New Hampshire Department of Environmental Services (NHDES) for review, comment, and concurrence only. The Contractor shall be the Approval Authority for the SWPPP and shall be fully responsible for the development, implementation, and monitoring of the SWPPP throughout construction.

**4.3. Maine Permits**

4.3.1. The Contractor shall prepare a Soil Erosion and Water Pollution Control Plan (SEWPC) in accordance with Section 656 of the Maine Standard Specifications and all other State and Federal environmental regulations. The SEWPC shall be submitted to the MaineDOT, and MTA for review, comment and concurrence only. The Contractor shall be fully responsible for the development, implementation, and monitoring of the SEWPC throughout construction.

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- 4.3.2. This Project is subject to the requirements of the Maine Pollutant Discharge and Elimination System (MPDES) General Permit for the Discharge of Stormwater from MTA's Municipal Separate Storm Sewer Systems (MS4), because it is located within an Urbanized Area (UA) as defined by the 2010 census by the US Bureau of the Census. MS4 compliance requires the Contractor Team member to be properly trained in erosion and sedimentation control (E&SC) measures and implement measures to reduce pollutants in stormwater runoff from construction activities. The Contractor shall review and sign the MS4 Stormwater Awareness Plan and the MS4 Targeted BMP Adoption Plan. A copy of the signed forms shall be submitted to the State Project Manager and the Contract Administrator.
- 4.3.3. All impacts within the jurisdiction of the Maine Department of Environmental Protection (MDEP) shall be addressed by submission of an applicable wetlands permit(s). Application and approval for the permit(s), including all costs associated with additional conditions, is the responsibility of the Contractor.
- 4.3.4. Any Wetland Dredge and Fill, Shoreland, or Alteration of Terrain permitting shall be prepared in accordance with NHDES specific regulations in NH and MDEP specific regulations in ME. Preparation of additional permit packages will be the responsibility of the Contractor. If any Agency rejects or denies the permit application, it is the Contractor's responsibility to make whatever changes are necessary to achieve an approved permit or modify the plans such that the permit application is no longer required.
- 4.3.5. This Project is subject to the requirements of the Maine Pollutant Discharge and Elimination System (MPDES) General Permit for the Discharge of Stormwater from MTA's Municipal Separate Storm Sewer Systems (MS4), because it is located within an Urbanized Area (UA) as defined by the 2010 census by the U.S. Bureau of the Census. MS4 compliance requires all Contractors to be properly trained in Erosion and Sedimentation Control (E&SC) measures and implement measures to reduce pollutants in stormwater runoff from construction activities. E&SC protections shall be continuous until the disturbed areas have been fully stabilized.
- 4.3.6. The Contractor will be required to pay all permit fees. Any fines levied by permitting agencies shall be the responsibility of the Contractor.

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**4.4. Soil and Groundwater Contamination**

The Contractor is responsible for verifying that there is no soil or groundwater contamination present at any of the Project sites prior to excavation. In the event that suspected contaminated soil, groundwater, or other media are encountered during excavation work based on visual, olfactory, or other evidence, the Contractor shall stop work in the vicinity of the suspect material and shall notify the State Project Manager and Contract Administrator immediately so that the appropriate testing and subsequent action can be taken.

- 4.4.1. Procedures and Compensation for Contaminated Materials Management:  
The Contractor shall manage, treat, handle, store, remediate, remove, transport (where applicable), and dispose of all Contaminated Materials which may include oil, hazardous materials, solid waste, asbestos contaminated materials (ACM), per- and polyfluoroalkyl substances (PFAs), limited reuse soils (LRS), or other contaminated materials as defined by Env-Or 602.07, in accordance with Governmental Rules, Governmental Approvals, and all provisions of the RFP Documents.
- 4.4.2. If, during the course of the Work, the Contractor encounters Contaminated Materials in connection with the Project, Site, or Work, the Contractor shall:
  - a. Notify the State Project Manager in writing and advise the Owners of any obligation to notify any Governmental Entities under applicable Governmental Rules and Governmental Approvals; and
  - b. Take reasonable steps, including design modifications and/or construction techniques, to avoid excavation or dewatering in areas with Contaminated Materials.
- 4.4.3. For the purposes of this Contract, the term "Contaminated Material" shall mean materials that trigger any reporting, investigation or remediation requirements under any Environmental Law.
- 4.4.4. Where excavation or dewatering is unavoidable, the Contractor shall use appropriately trained personnel and shall select the most cost-effective approach to Contaminated Materials Management, unless otherwise directed by the Owners. Wherever feasible and consistent with applicable Governmental Rules, contaminated soil and groundwater shall not be disposed off-Site. All Contaminated Materials shall be managed in accordance with applicable Governmental Rules, Governmental Approvals, and the accepted

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Health & Safety Plan. Except where the Contractor is required to take immediate action under the RFP Documents, the Contract Documents, or applicable Governmental Rules, the Contractor shall afford the Owners the opportunity to inspect sites containing Contaminated Materials before any action is taken which would inhibit the Owners' ability to ascertain the nature and extent of the contamination.

- 4.4.5. Subject to the limitations and exceptions set forth in this Section and Section 5.5, the Contractor shall be entitled to a Change Order providing for additional compensation (but excluding delay and disruption damages and markup for profit) and/or a time extension with respect to costs and delays directly attributable to the discovery of Contaminated Materials within the Project Limits or required due to a Force Majeure Event. The amount of additional compensation or extension of time in any Change Order allowed hereunder shall be determined in accordance with Book 1 – Request for Proposals (RFP) Section H-25.7. Entitlement to compensation or a time extension shall be limited to costs of Work performed pursuant to the accepted plans required to be provided under Book 2 -Technical Provision, Section 2.
- 4.4.6. No compensation or time extension shall be allowed with respect to:
- a. Removal, disposal, and/or remediation of:
    - i. Asbestos or asbestos-containing materials (other than mineral asbestos naturally occurring in the ground) and the approved Asbestos Control and Management Plan; or
    - ii. Any other contaminated Materials not falling within the definition of Contaminated Waste that are encountered during or in connection with the demolition of buildings, fixtures, or other improvements on any parcels within the Site.
  - b. Handling and disposal of aurally deposited lead;
  - c. Treatment and disposal of any Contaminated Groundwater, other than costs of remediating and disposing of any Contaminated Waste;
  - d. Release(s) or threatened Release(s) of Contaminated Material attributable to the actions, omissions, negligence, willful misconduct, or breach of Governmental Rules, Governmental Approvals, or contract by any Contractor Team member firm or employee;
  - e. Immaterial quantities of Contaminated Materials;

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- f. Any Contaminated Materials that could have been avoided by reasonable design modifications or construction techniques; or
- g. Any Contaminated Materials on property outside of the Owners' rights-of-way, except that compensation will be allowed for Remediation Work on such property to the extent that it is integrally intertwined with Remediation Work required within the Owners' rights-of-way.

4.4.7. To the extent that any proceeds of insurance are available to pay the cost of any Contaminated Materials Management, the Contractor shall rely on insurance to provide compensation, in lieu of requesting a Change Order.

#### **4.5. Environmental Services/Mitigation**

The Contractor shall prepare design plans and propose construction methods that are in accordance with all permits, or, in the absence of permits, in accordance with the Best Practices for the States of New Hampshire and Maine. If alterations to any permit(s) are required, a submission shall be made to the Owners prior to submitting to the appropriate permitting agency. The Contractor shall be responsible for making all changes to the application as required by the permitting agencies. The Contractor shall be responsible for any additional permit fees. All permits must be acquired prior to commencing any construction. Delays due to incomplete permit packages, agency rejection, agency denials, agency processing time, or any permit violations, will be the responsibility of the Contractor, and will not be considered sufficient reason for time extension.

#### **4.6. Verification of Existing and Planned Conditions**

The Contractor shall be responsible for verification of existing conditions and anticipated construction activities, including research of all existing Department records and other information.

### **5. DESIGN CRITERIA**

#### **5.1. General**

The Technical Provisions establish the basic design and performance requirements to be used in the design and construction of the Project. All plans and documents shall be developed to NHDOT CAD/D documentation standards and submitted with Release For Construction (RFC) submissions for record. The work elements associated with the Project work, including

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structural elements, roadway elements, ITS elements, and other features shall be governed by the most recent edition of applicable engineering codes and standards, including those of the various federal, NHDOT, MaineDOT, MTA, and local jurisdictions. The Contractor shall develop the final design in such manner as to minimize impacts to private properties and to minimize impacts to any future use by owners of the remainder of properties subject to partial acquisitions under this Project.

- A. The design of the proposed PTSU system shall be governed by the applicable design and construction standards, policies, guidelines, and directives listed in the RFP.
- B. If the Owners determine that a design submission does not meet the requirements of the Design-Build Documents, applicable Law, and/or the Governmental Approvals, then the Owners will notify the Contractor in writing of any specific deficiencies in the design documents. The Contractor shall correct such deficiencies, modify the design documents, and if necessary, modify construction upon receipt of the comments.
- C. The locations of the anticipated PTSU system equipment has been provided in Book 4 - 30% Conceptual Plans. These 30% Conceptual Plans are provided as a conceptual design to guide the Contractor in its Technical and Cost Proposal development and towards the submission of the PSD.
- D. Adjustments to the locations of PTSU subsystem equipment shown in the 30% Conceptual Plans is the design prerogative of the Contractor to meet the design requirements of the Project. Other modifications of the PTSU system shall be considered Alternative Technical Concepts (ATCs) if they occur prior to NTP1 and shall be submitted and approved in accordance with the Project requirements. Refer to Book 1 – Request for Proposals (RFP) Appendix C for additional information regarding the submission of ATCs.
- E. Alterations to Book 4 - 30% Conceptual Plans will be permitted to the awarded Contractor provided the change meets or exceeds the requirements of the RFP Documents, subject to final approval by the Owners. The Owners have the sole authority to determine if an ATC meets the requirements.
- F. All documents marked Release For Construction shall be signed and sealed/stamped by the Engineer of Record and any other Engineers responsible for specific elements of the work.

## **5.2. Contractor Acknowledgement of Responsibility**

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By execution of the contract, the Contractor specifically acknowledges and agrees that the Contractor is contracting and being compensated for performing adequate investigations of existing site conditions sufficient to support the design developed by the Contractor and that any information being provided by the Agencies is merely to assist the Contractor in completing adequate site investigations. Notwithstanding any other provision in the Contract Documents to the contrary, no additional compensation will be paid in the event of any inaccuracies in the conceptual design and preliminary information.

**5.3. System Design**

- A. There shall be a minimum of four design submission stages: Project Controls, Preliminary System Design, Final System Design, and Release for Construction Documents.
  - a. Project Controls shall be defined as the documentation necessary to achieve NTP2.
  - b. Preliminary System Design (PSD) shall be defined as approximately 60% design complete.
  - c. Final System Design (FSD) shall be defined as approximately 98% design complete.
  - d. Release for Construction (RFC) Documents shall be 100% design complete upon Owner's written approval. Release for Construction Documents shall include the personnel in responsible charge and the Engineer of Record's stamp, signature and date on the plan cover sheet.
- B. Each design submittal shall include the stamp, signature, and date of the Engineer of Record(s) and any other Professional Engineers in responsible charge for portions of the plans. The stamps and signatures shall be included on the plan set cover sheet. The Contractor may elect to also include stamps with signatures on individual plan sheets.
- C. All design submissions, including plans, calculations, reports, shop drawings, catalog cuts, and equipment binders shall be reviewed and signed by the DQC Manager in accordance with the approved QMP.
- D. Every submittal shall include a Design Narrative that describes the items included in the submission, significant changes since the previous submission, and any outstanding issues to be resolved during the current design review cycle.
- E. The Contractor shall submit all Design Waiver Requests in writing.
- F. Any design exceptions shall be documented in the Design Narrative.

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- G. For submissions that have been previously reviewed by the Owners, the Contractor shall provide written responses to each comment made indicating that the comment has been addressed in the current submission or describing why the comment was not addressed. This comment response document shall be submitted with the Design Narrative.
- H. Design Plan Requirements
- a. Plans shall be drawn to 50 scale and may include details drawn at an alternative legible scale.
  - b. Plans shall include existing facilities and proposed ITS devices required for the PTSU System.
  - c. All plan submittals shall be compliant with NHDOT CAD/D Procedures and Requirements as found on the following website:  
<http://www.nh.gov/dot/cadd/cadd.html>
  - d. A minimum of six (6) complete hard copies plus one complete electronic submission, shall be provided for each submittal. The six (6) complete hard copies of the plan submissions shall each be 11" x 17" plan sets.
  - e. Documentation submissions shall be contained in 3-ring binders with appropriate tabs separating the sections.
  - f. Video submissions shall only require one copy of each video file on an electronic data storage medium compatible with the State's IT network.
  - g. The Contractor shall assume a 15 working day review period for the Owners for each complete submittal. The Owners will not be responsible for delays of reviews and approvals by the Owners, other government entities, or utility companies.

Field Code Changed

#### 5.3.1. Project Controls

- A. The Project Controls shall be the documentation required by the RFP prior to the Contractor being authorized to enter the Project's rights-of-way for surveys, site investigations, and utility coordination.
- B. The Contractor shall submit the Project Controls Deliverables within 30 days of NTP1. The Contractor must receive written approval for all Project Controls prior to NTP2 and prior to initiation of PSD activities.
- C. Project Controls Deliverables



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- a. Contract Administrator's Offices and Equipment – The Contractor shall provide a furnished office for the Contract Administrator for Owners' use throughout the Contract's initial term. See Section 9 for more details.
- b. Project Management Plan – The Contractor shall submit the entire PMP as described in Section 2.
- c. Quality Management Plan – The Contractor shall submit the entire QMP as described in Section 3.
- d. Physical Security Plan - The Contractor shall develop a Physical Security Plan that shall protect the Owners' physical infrastructure throughout the Project. The Draft Security Plan shall be developed in accordance with the PMP's requirements for physical security. The Physical Security Plan shall be submitted and approved prior to the Owners' permitting any Contractor personnel access to the physical or digital infrastructure.

#### 5.3.2. Preliminary System Design

- A. The Preliminary System Design (PSD) shall be the initial effort on the part of the Contractor to translate the identified system requirements from the RFP Documents (including Book 3 – Special Provisions and Book 4 – 30% Conceptual Plans) and these Technical Provisions into real technical solutions.
- B. The Contractor shall identify the major field and communications subsystem equipment and locations that meet the RFP and Technical Provisions requirements for integration into the PTSU System. The PSD submittals are intended to provide the Owners the opportunity to evaluate the proposed design relative to current design standards, utility coordination, right-of-way impacts, environmental impacts, temporary traffic controls, and other potential community concerns associated with the proposed design.
- C. The PSD submittals shall conform to the New Hampshire Department of Transportation Standard Specifications for Road and Bridge Construction (including Supplemental Specifications) and all other relevant design standards as referenced in the RFP.
- D. Preliminary System Design Deliverables
  - a. Camera Video Recordings/Images – The Contractor shall conduct field investigations, including the recording of video at the exact locations and camera mounting heights of the proposed CCTV locations using a video recording device that provides a comparable field of view to the proposed CCTV. Digital video files

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of these recordings shall be provided to the Owners for review and approval. Video recordings shall comply with the Special Provision 677.44.

- b. Structural Calculations – The Contractor shall develop a structural design, including calculations for each overhead sign structure and foundation, CCTV camera pole and foundation, MVDS support pole and foundation, and climbable antenna mounting structure and foundation. A Professional Engineer (PE) licensed in the applicable State(s) shall sign and stamp the structural and foundation calculations for Project infrastructure.
- c. Supplemental/Final Geotechnical Engineering Report – The Owners have prepared a Preliminary Geotechnical Engineering Report, including soil borings and foundation recommendations for most of the structures that require a concrete footing. The Contractor shall prepare and submit a supplemental geotechnical engineering report that includes soil borings, geotechnical analysis, and foundation recommendations for any sites that are not included in the Preliminary Geotechnical Engineering Report.
- d. Draft Communications Plan – The Contractor shall prepare and submit a communications plan for the PTSU System. The communications plan shall include the following:
  - i. A narrative that describes the proposed communications network.
  - ii. A wireless path analysis for each proposed wireless link except for cellular connections.
  - iii. A line of sight analysis for each proposed wireless link.
  - iv. Fiber optic splice tables for the fiber optic network links.
  - v. Bandwidth calculations for communications throughput.
  - vi. FCC license application data and parameters to assist NHDOT in the preparation of the FCC license applications.
- e. Draft Network Architecture and Description – The Contractor shall prepare and submit a network architecture plan and high level design narrative that generally describes the system and how the system works. The architecture shall indicate the locations and capacities of the wireless subsystem at each node, the symmetry of the system, and a description of the non-physical elements of the network.
  - i. The network architecture plan shall indicate the minimum required bandwidth to support full duplex communications to allow each of the Owners to stream all video and data associated with the PTSU System.

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- ii. The network architecture plan shall provide wireless communications that provides for the full bandwidth required, plus a spare 50% capacity for video streaming stability and future growth.
  - iii. The network architecture shall describe how the required bandwidth will be achieved.
- f. Final Pavement Marking Plans – The Contractor shall prepare and submit pavement marking plans for installation by the NHDOT Eastern Turnpike paving contractor (Project number 41822).
- g. Draft Traffic Management Plan – The Contractor shall prepare and submit a traffic management plan (TMP) that includes the temporary traffic control plans (TTC), transportation operations (TO) plan, and an outline of the public information (PI) plan.
- h. Draft Subsystems Block Diagrams– The Contractor shall submit diagrams that provide a high level view of the proposed PTSU Subsystems and how they will interconnect and communicate.
- i. Draft TMC/TMCC Installation Plans – The installation plans shall document the installation of all new equipment proposed in the NHDOT TMC, the MaineDOT TMC, and the MTA TMCC facility. The installation plans shall include all equipment, locations, conduit, cabling, and required permit materials necessary to support the PTSU System. The TMC/TMCC Plans shall also identify any areas where the existing Owner’s equipment is impacted and the power requirements to support the proposed hardware.
- j. Guardrail Calculations – The Contractor shall prepare and submit calculations for all new ITS devices within the clear zone. The calculations shall determine if the equipment requires protection in accordance with the Roadside Design Guide. A Professional Engineer (PE) licensed in the applicable State(s) shall sign and stamp the guardrail calculations.
- k. Power Plant Load Analysis – The Contractor shall prepare and submit calculations for the power requirements at each new ITS equipment cabinet. A Professional Engineer (PE) licensed in the applicable State(s) shall sign and stamp the power plant calculations.
- l. Draft Security Plan – The Contractor shall expand the Physical Security Plan approved for the Project Controls to include both physical and network security requirements. The Draft Security Plan shall document how the Contractor will protect the Owners’ networks as ITS field devices are tested and integrated into

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the PTSU System network. The Draft Security Plan shall be developed in accordance with the PMP.

- m. Draft Operations and Maintenance Access Plan – All devices shall be located adjacent to a level work surface that can be accessed by maintenance personnel. The Contractor shall provide a detailed plan for the continuing access to each Communications Equipment Shelter, ITS device location and all hardware deployed in the field.
- i. The access plan shall include a proposed access and egress path, the type of equipment required to maintain the hardware (i.e. 12-foot ladder, bucket truck with a 35-foot reach, portable camera lowering device tool, etc), and any temporary traffic control that would be required to provide access to the equipment.
  - ii. A level concrete work pad shall be provided at each control cabinet door.
  - iii. A stable and level pad shall be provided at all locations where a ladder will be placed for maintenance access.
  - iv. Each Communications Equipment Shelter shall have a graded path that is accessible via a utility/bucket truck from a public roadway or ramp.
  - v. If special access roadways are required to be constructed for continuing access by maintenance personnel, the Contractor shall design and construct the access roadways following the Owner’s standard practice for access roadways at stormwater management (BMP) sites. A minimum 10-foot wide, level gravel path shall be the minimally acceptable access roadway for maintenance.
  - iv-vi. The access plan shall not propose the use of an under-bridge inspection vehicle for any equipment or pull box access. All access to under bridge equipment shall be from existing bridge maintenance catwalks.
- n. Draft Integration Specifications and Documentation – The Contractor shall provide a signed copy of the vendor’s or supplier’s equipment specifications, including any NTCIP specifications or latest supported specifications.
- i. The integration documentation shall include a narrative for how the Contractor proposes to integrate the several ITS devices into the Southwest Research Institute (SwRI) PTSU System software module.
  - ii. The integration documentation shall include any software licenses and a configuration plan.

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- o. Refine the 30% Conceptual Plans into 60% Design Plans. The plans shall include the following items:
- i. Site plans for each ITS device
  - ii. Site plans for the Communication Equipment Shelters and their foundations
  - iii. Site plans for the Climbable Antenna Mounting Structure and its foundation
  - iv. Locations and coordinates for all proposed ITS equipment necessary to operate the PTSU System
  - v. ITS equipment details and typicals
  - vi. Overhead sign and signal structure designs and mounting details
  - vii. Foundation designs and details
  - viii. ITS equipment cabinet block diagrams
  - ix. Conduit plans, ~~and~~ ITS equipment cabinet locations, and attachments and mounting details
  - x. Cross-sections for all overhead sign structures and ground mounted signs (Cross-sections shall be drawn at 10 scale)
  - xi. Communication architecture plan, including any off-site communication site plans
  - xii. Traffic control plans and narrative descriptions
  - xiii. Erosion and sediment control plans
  - xiv. All other plans, typicals, details, or drawings required to allow the Owners to understand the intent and plan for the PTSU System
- p. Equipment Submittals – The Contractor shall submit documentation for all equipment that will be incorporated into the work. The equipment submittal shall include:
- i. A complete bill of materials covering each item or assembly
  - ii. Single-line control schematics and functional block diagrams showing the physical interfaces between components
  - iii. Product data (cut) sheets for all off-the-shelf equipment identifying the manufacturer, model, performance characteristics, plug and terminal connections, environmental requirements and all other data necessary to establish compliance with the High Level Design Document

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- iv. For items mounted on support structures or poles, include mounting details and calculations to substantiate the materials and methods to be used
- v. Equipment cabinet and enclosure layouts with: wiring drawings and schedules, rack elevations, wiring connection details, electrical power distribution wiring, breakers, transient voltage protection devices, thermostatically controlled fans and heaters, AC power connections and metering
- vi. Cable plans and conduit schedules for all point-to-point cable runs including the associated cable labeling ID's
- vii. A manufacturer recommended spare parts inventory list, including all spare parts and recommended equipment
- q. Updated Traceability Matrix - The Contractor shall update the traceability matrix provided by the Owners at Advertisement to include additional requirements identified within the PSD.

#### 5.3.3. Initiation of Construction Activities

- A. Upon the Owner's written approval of the PSD submission, the Contractor may be allowed to initiate relevant construction activities at their own risk and expense.
- B. The Owners reserve the right to place conditions on the construction activities and/or limit the work that may be initiated based on the completeness of the PSD submission.
- C. The Contractor shall be allowed to make equipment changes between the PSD submission and FSD submission due to design changes and vendor product developments, with the approval of the Owners.
- D. Final equipment selection shall be approved by the Owners prior to purchase and installation.

#### 5.3.4. Final System Design

- A. Following approval of the PSD, the Contractor can begin the development of the Final System Design (FSD). The FSD shall expand on the solutions and requirements identified within the PSD, to the level of detail required to fully explain the equipment needs and operations of the PTSU System.

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- B. The FSD submittal is intended to provide the Owners the opportunity to evaluate the final design relative to current design standards, utility coordination, right-of-way impacts, environmental impacts and other potential community concerns.
- C. The FSD submittals shall conform to the New Hampshire Department of Transportation Standard Specifications for Road and Bridge Construction (including Supplemental Specifications) and all other relevant design standards as referenced in the RFP.
- D. Final System Design Deliverables
  - a. Final Communications Plan – The Contractor shall revise the communications plan for the PTSU System based on the FSD design and in response to Owner comments. The final communications plan shall include the following:
    - i. A revised narrative that describes the proposed communications network.
    - ii. All original and modified wireless path analyses for each proposed wireless link except for cellular connections.
    - iii. All original and modified line of sight analyses for each proposed wireless link.
    - iv. Final fiber optic splice tables for the fiber optic network links.
  - b. Final Network Architecture and Description – The Contractor shall revise the network architecture plan and high level design narrative.
  - c. Final Structural Design and Calculations – The Contractor shall revise the structural design and calculations based on the final shop drawings and final foundation designs included in the Plans.
  - d. Final Traffic Management Plan – The Contractor shall revise the TMP to ensure that all locations are included. The Final TMP shall address coordination and timing for construction that occurs within the bridge rehabilitation work area.
  - e. Final TMC/TMCC Installation Plans – The revised installation plans shall document the installation of all new equipment proposed in the NHDOT TMC, the MaineDOT TMC, and the MTA TMCC facility.
  - f. Updated Security Plan - The Contractor shall submit any updates to the security plan, including both physical and network security items.
  - g. Updated Integration Specifications and Documentation – The Contractor shall update the integration documentation describing the Contractor’s integration with the SwRI PTSU System software. The updated integration documentation should include the proposed configuration settings, including IP addresses and system passwords.

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- h. Final Operations and Maintenance Access Plan – The revised Operations and Maintenance Access Plan shall address all revisions from the Owners’ PSD review.
- i. Refine the 60% Conceptual Plans into 98% Design Plans – The Contractor shall revise the plans, details, typicals, and cross-sections in accordance with the comments from the Owners and in accordance with the Contractor’s final design layout.

**5.3.5. Release for Construction Documents**

- A. Following the Owners’ review of the FSD, the Contractor shall finalize all PSD and FSD submission items to be Released for Construction. Release for Construction Documents shall be considered the final design submission. Any changes that occur after the approval of the Release for Construction Documents shall require a RFI and may lead to a FDC.

**5.4. Intelligent Transportation Systems (ITS)**

**5.4.1. General Requirements**

- A. The Contractor shall design the ITS equipment for this Project in accordance with these Technical Provisions and with the associated Special Provisions.
- B. All hardware shall be in conformance with the Special Provisions for Section 677.

**5.4.2. Part-Time Shoulder Use (PTSU) System**

- A. The Contractor shall provide an integrated PTSU System consisting of the following Subsystems:
  - i. A Closed Circuit Television (CCTV) Subsystem;
  - ii. A Motor Vehicle Detection System (MVDS) Subsystem;
  - iii. A Dynamic Message Sign (DMS) Subsystem;
  - iv. A Lane Use Signal (LUS) Subsystem;
  - v. A Flashing Beacon Sign Subsystem;
  - vi. A Roadway Weather Information Station (RWIS) Subsystem;
  - vii. A hybrid Communications Subsystem which includes wireless (microwave and cellular) and wired (Ethernet cables and single mode fiber optics) connectivity to the NHDOT Transportation Management Center (TMC) and the MTA Traffic



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- Management and Communications Center (TMCC) as well as all other PTSU subsystems;
- viii. A Central Control Subsystem that is integrated within New England Compass ATMS with control equipment at the TMC and TMCC; and
- ix. Assorted additional equipment and devices that will become part of the complete, functional PTSU System.
- B. The Contractor shall furnish and install the PTSU Subsystems at approximately the locations identified in the 30% Conceptual Plans, or as modified by ATCs, and as approved throughout the design process.
- i. All PTSU System equipment and communications system equipment shall be installed following manufacturer's recommendations.
- ii. The Contractor shall provide an identification name to all IP addressable equipment in New Hampshire in accordance with the NHDOT ITS device naming convention. If the Contractor modifies equipment locations during the design process, the Contractor shall provide a key to link the 30% Conceptual Plan device location name to the new New Hampshire based ITS device names in accordance with the NHDOT ITS device naming convention.
- iii. The Contractor shall provide a list of all IP addressable equipment under the MTA's jurisdiction. MTA will provide the IP addresses for each device.
- iv. If the Contractor modifies equipment locations during the design process, the Contractor shall provide a key to link the 30% Conceptual Plan device location name to the new Maine based ITS device names in accordance with the MTA ITS device naming convention.
- C. All IP-addressable hardware shall be VLAN-aware.
- D. The Contractor shall submit an IP address request form (as provided by the NHDOT) to NHDOT and MTA to request the assignment of IP addresses for all PTSU System equipment.
- E. The Contractor shall perform all operations and equipment integration necessary to ensure that the finished ITS subsystems function with the PTSU System as depicted in the plans and as required by Book 2 - Technical Provisions and Book 3 - Special Provisions.
- i. The Contractor shall either provide subsystem equipment supported by the Southwest Research Institute's (SwRI) New England Compass ATMS (Statewide ATMS) or the Contractor shall be responsible to ensure that the Contractor's proposed equipment can be supported by the Statewide ATMS at the Contractor's expense.

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- F. All ITS field equipment and communications subsystem control equipment shall include a field equipment cabinet, except the communications subsystem control equipment at the climbable antenna mounting structure, which shall be contained within the proposed Communications Equipment Shelter.
- G. Where the Contractor proposes to install new PTSU system equipment to a pre-existing support structure, the Contractor shall provide structural calculations to show that the pre-existing support structure and its foundation, as applicable, is suitable to support the additional loading of the new equipment. Any use of a pre-existing structure requires written approval by the structure's owner.

*5.4.2.1. Closed Circuit Television (CCTV) Subsystem*

- A. The Contractor shall furnish and install video monitoring and associated communications equipment at locations identified in Book 4 - 30% Conceptual Plans.
- B. The CCTV subsystem shall include the following components as required in the Contract Documents:
  - i. CCTV Dome Type Camera Assembly
  - ii. CCTV Camera Mounting Hardware (for attachment to existing structures)
  - iii. CCTV Camera Pole (for independent mounting)
  - iv. CCTV Camera Pole Foundation (for independent mounting)
  - v. CCTV Camera Lowering System (for pole mounted systems)
- C. The CCTV subsystem video equipment shall provide video coverage to satisfy the functional intent found in the High Level Bridge Concept of Operations document or as directed by NHDOT, MaineDOT, and MTA.
- D. The CCTV subsystem video equipment shall consist of pan-tilt-zoom (PTZ) capabilities; however, the video coverage of 100% of the shoulder pavement surface within the PTSU area shall be based on cameras in a static position.
  - i. The CCTV subsystem placement of cameras shall achieve 100% coverage without the requirement to pan or tilt any camera.
  - ii. The CCTV subsystem placement of cameras shall ensure that every LUS indication can be viewed by at least one CCTV camera.

*5.4.2.1.1. CCTV Dome Type Camera Assembly*

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- A. The CCTV Dome Type Camera Assembly shall be designed in accordance with Special Provision 677.41 CCTV System for independently mounted CCTVs and CCTVs mounted to an existing camera lowering system.
- B. The CCTV Dome Type Camera Assembly shall be designed in accordance with Special Provision 677.415 CCTV System without Pole for CCTVs mounted to pre-existing support structures.

5.4.2.1.2. CCTV Camera Mounting Hardware

- A. The CCTV Camera Mounting Hardware shall be designed to maintain the structural integrity of whatever surface the CCTV camera is mounted to.
- B. The CCTV Camera Mounting Hardware shall be of the type recommended by the CCTV manufacturer for the specific mounting surface required.
- C. The CCTV Camera Mounting Hardware shall be designed to withstand a 90 mph wind with less than one inch (1") total camera deflection.
- D. Additional CCTV Camera Mounting Hardware requirements may be found in Special Provision 677.415 CCTV System without Pole.

5.4.2.1.3. CCTV Camera Pole

- A. The CCTV Camera Pole shall be designed in accordance with Special Provision 677.41 CCTV System and in accordance with Section 10.6 of the NHDOT Bridge Design Manual, with all interim updates.
- B. The design life for the CCTV Camera Poles shall be 50 years.
- C. Camera poles shall be designed for the design loading, plus an additional 24-inch dish antenna mounted at 5 feet from the top of the pole.
- D. Camera poles shall be of sufficient height above foundation to provide for the required line of sight. Height shall be increased as required to support communications or more preferable viewing range. Final approved camera height on the pole shall be determined by the Owner's review of the video coverage.
- E. Camera poles shall include a grounding lug and a concrete foundation with integral earth ground.

5.4.2.1.4. CCTV Camera Pole Foundation

- A. The CCTV Camera Pole Foundation shall be designed in accordance with Special Provision 677.41 CCTV System.

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- B. The CCTV Camera Pole Foundation shall be designed in accordance with the existing soil conditions. If the Contractor's System Solution requires CCTV equipment away from the locations identified in Book 4 – 30% Conceptual Plans, the Contractor shall retain a Geotechnical Engineer to confirm soil properties for the foundation design.
- C. When the Contractor designs a drilled shaft foundation for the CCTV Camera Pole the Contractor shall provide a Project-specific Special Provision Section 509 for Drilled Shafts.

5.4.2.1.5. CCTV Camera Lowering System

- A. Camera poles shall include a pole top tenon designed to support two camera lowering devices angled 90-180 degrees apart from one another. The pole shall also include cable supports, internal conduits and conduit mount adapters for both lowering devices, and equipment enclosures to be attached to the pole.
- B. A CCTV Camera Lowering System that can be operated from the base on the pole shall be provided for all CCTV cameras mounted to a CCTV Camera Pole.
- C. The CCTV Camera Lowering System shall be designed in accordance with Special Provision 677.41 CCTV System.
- D. The CCTV Camera Lowering System shall be compatible with the CCTV camera and video system.
- E. The CCTV Camera Lowering System component cable shall not be under tension when the camera is latched.
- F. The CCTV Camera Lowering System shall be capable of multiple cycles of lowering and raising the CCTV Camera without degrading the video output.

5.4.2.2. *Motor Vehicle Detection System (MVDS) Subsystem*

- A. The Contractor shall furnish and install a Motor Vehicle Detection System (MVDS) Subsystem and associated communications equipment that shall transmit, receive, and analyze a FCC-certified, low-power microwave radar signal to detect vehicle presence, provide a detection output, and generate volume, occupancy, and speed data at the locations identified in the Book 4 - 30% Conceptual Plans.
- B. The MVDS subsystem shall include the following components:
  - i. NH MVDS Sensor Unit (for deployment in the State of New Hampshire)
  - ii. ME MVDS Sensor Unit (for deployment in the State of Maine)

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- C. The MVDS Subsystem shall provide detection coverage to satisfy the functional intent found in the High Level Bridge Concept of Operations Document or as directed by NHDOT, MaineDOT, and MTA.
- D. The MVDS Subsystem shall return operational data and status updates to the Central Control subsystem.
- E. The MVDS Subsystem shall report system faults and component failure notification data to the Central Control subsystem.
- F. The MVDS Subsystem shall be IP-addressable and Ethernet-ready. Media converters should be avoided when practical.
- G. The MVDS configuration data shall be saved to a computer or computer media and shall be capable of being restored from a saved file.
- H. The MVDS device shall include firmware that is field upgradable.
- I. The MVDS device shall not create RF interference with local wireless communication systems.
- J. At any location where an MVDS is not attached to an existing structure such as the HLB truss, a CCTV pole or a DMS structure, the Contractor shall furnish and install an MVDS Support Pole and Foundation for each MVDS Sensor Unit.
  - i. The design of the MVDS Support Pole shall generally follow the requirements for the CCTV Camera Pole in accordance with Special Provision 677.41 CCTV System.
  - ii. The design of the MVDS Support Pole Foundation shall generally follow the requirements for the CCTV Camera Pole Foundation in accordance with Special Provision 677.41 CCTV System.

**5.4.2.2.1. NH MVDS Sensor Unit**

- A. The NH MVDS Sensor Unit shall be designed in accordance with Special Provision 677.465 MVDS without Pole.
- B. The NH MVDS Sensor Unit shall be designed to avoid interference with existing structural elements on the HLB.

**5.4.2.2.2. ME MVDS Sensor Unit**

- A. The ME MVDS Sensor Unit shall be an RTMS radar detection system manufactured by Image Sensing Systems (ISS).
- B. The ME MVDS Sensor Unit shall be the RTMS Sx-300.

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5.4.2.3. *Dynamic Message Sign (DMS) Subsystem*

- A. The Contractor shall furnish and install a Dynamic Message Sign (DMS) Subsystem to display traffic information for the implementation of the PTSU System and to provide incident management messages, traveler information messages, and route diversions as required.
- B. The DMS Subsystem shall include the following components:
  - i. DMS for Ground Mounting
  - ii. Single Message DMS (also known as Blank-Out Signs)
  - iii. DMS Controller
- C. The DMS Subsystem shall be designed to meet the functional requirements outlined in the High Level Bridge Concept of Operations document or as directed by NHDOT, MaineDOT, and MTA.
- D. The DMS Subsystem components shall be designed for the locations identified in the Book 4 - 30% Conceptual Plans. The DMS location shall be compliant with FHWA, Owner, and MUTCD sign placement standards.
- E. The DMS shall be clearly visible and legible from a distance of 750 feet from any point along the traveled roadway approach up to 25 feet from the sign, when displaying 18 inch tall characters.
- F. The DMS Subsystem shall be supplied with one (1) licensed copy of the original manufacturer server software and three (3) licensed copies of the original manufacturer's client software that allows an operator to program, operate, exercise, diagnose, and read current status of all sign component(s).
- G. The Contractor shall ensure that the DMS manufacturer grants the Owner (NHDOT for equipment deployed in New Hampshire and MTA for equipment deployed in Maine) a nonexclusive, unrestricted license that allows the Owner to use, modify, and/or distribute any and all of the stated communication protocols, sign operating systems, drivers, and documentation.
- H. The vendor supplying the DMS subsystem shall have in operation, at the time of the contract bid date, a minimum of ten (10) different Projects that include light emitting diodes (LED) DMS, excluding indoor signs of any type, portable trailer signs, or signs with a display matrix smaller than three lines of 18 7x5 characters per line or having a character height of less than 18 inches.

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- I. The DMS subsystem shall utilize the following National Transportation Communications for ITS Protocol (NTCIP) standards and be compatible with the existing New England Compass ATMS system.
  - i. The DMS Subsystem shall be consistent with NTCIP standard 1101 -Simple Transportation Management Framework (STMF).
  - ii. The DMS Subsystem shall be consistent with NTCIP standard 1102 -Base Standard - Octet Encoding Rules (OER).
  - iii. The DMS subsystem shall meet NTCIP standard 1103 - Simple Transportation Management Protocol (STMP).
  - iv. The DMS subsystem shall meet NTCIP standard 1201 -Global Object Definitions. All mandatory and all optional objects that are consistent with DMSs shall be fully supported.
  - v. The DMS subsystem shall meet NTCIP standard 1203 -Object Definitions for DMS. All mandatory and all optional objects that are consistent with DMSs, as specified in the contract documents, shall be fully supported.
  - vi. The DMS subsystem shall meet NTCIP standard 2001 -Class B Profile.
  - vii. The DMS subsystem shall meet NTCIP standard 2101 -Point to Multi-Point Protocol Using RS-232 Subnet Profile.
  - viii. The DMS subsystem shall meet NTCIP standard 2102 - Subnet Profile for PPP over FSK Modems.
  - ix. The DMS subsystem shall meet NTCIP standard 2103 - Subnet Profile for Point-to-Point Protocol using RS 232.
  - x. The DMS subsystem shall meet NTCIP standard 2104 - Subnet Profile for Ethernet.
  - xi. The DMS subsystem shall meet NTCIP standard 2201 - Transportation Transport Profile.
  - xii. The DMS subsystem shall meet NTCIP standard 2202 - Internet (TCP/IP and UDP/IP) Transport Profile.
  - xiii. The DMS subsystem shall meet NTCIP standard 2301 - Application Profile for Simple Transportation Management Framework (STMF).
  - xiv. The DMS subsystem shall meet NTCIP standard 2303 - Application Profile for File Transfer Protocol (FTP).

5.4.2.3.1. DMS for Ground Mounting

- A. Ground Mounted DMS shall be a three-line DMS displaying up to 12 characters per line using 18-inch tall characters.

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- B. Ground Mounted DMS shall be Model B-1500C manufactured by Ver-Mac.
- C. Ground Mounted DMS shall be supported by minimum W10x22 steel poles mounted on drilled shaft concrete foundations. Spread footing foundations may be substituted for the drilled shaft foundations. Installation of foundations shall conform to the requirements in Appendix A.
- D. The Ground Mounted DMS shall be IP-addressable and Ethernet-ready. No serial to Ethernet connections are permitted.
- E. Ground Mounted DMS shall be designed in accordance with Special Provision 677 DMS System.

5.4.2.3.2. Single Message DMS

- A. Single Message DMS shall provide toggle control (on or off) that when on, displays a single message.
- B. Single Message DMS shall display the legend NO STOPPING ~~ON SHOULDER~~ in characters at least eight inches (8") tall on ~~four~~two lines.
- C. Single Message DMS shall be LED blank-outs signs designed for overhead mounting applications.
- D. The Contractor shall design, fabricate and install an equipment mounting system for the Single Message DMS for use on existing sign structures, new sign structures, and HLB truss members.
- E. Single Message DMS shall be designed in accordance with Special Provision 615 LED Blank-out Sign.

5.4.2.3.3. DMS Controller

- A. Each DMS shall include a DMS Controller located in an ITS Equipment Cabinet.
- B. The DMS Controller for the Ground Mounted DMS shall be a V-Touch Controller or approved equivalent.
- C. The DMS Controller for the Single Message DMS shall be a toggle switch providing or discontinuing power to the sign as recommended by the manufacturer.

5.4.2.4. Lane Use Sign (LUS) Subsystem

- A. The Contractor shall furnish and install dynamic lane use signs and associated communication equipment at the locations identified in the Book 4 - 30% Conceptual Plans.



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- B. The LUS shall provide at least three message options in 18-inch tall characters: a green downward pointing arrow; a yellow 'X'; and a red 'X'.
- C. The LUS legend shall be LED.
- D. The goal is to have visibility to two LUS for all drivers approaching the PTSU corridor along the mainline or at least one LUS for all drivers entering the PTSU corridor from an on-ramp. A minimum of A at least one LUS shall be visible to a driver at all times within the PTSU Project limits.
- D.E. Each LUS installation shall be accompanied by a regulatory information sign, except when mounted to the truss portions of the HLB.
- E.F. The LUS Subsystem shall satisfy the functional intent found in the High Level Bridge Concept of Operations document or as directed by NHDOT, MaineDOT, and MTA.
- F.G. Lane Use Signs shall be designed in accordance with Special Provision 677 Lane Use Signal.

**5.4.2.5. Flashing Beacon Sign Subsystem**

- A. The Contractor shall furnish and install Flashing Beacon Signs, mounting hardware, and associated communications equipment at the locations identified in the Book 4 - 30% Conceptual Plans.
- B. The Flashing Beacon Sign Subsystem shall include the following components:
  - i. Static Sign
  - ii. LED Flashing Beacons
  - iii. Access Control Gate

5.4.2.5.1. Static Sign – The static sign shall be designed in accordance with NHDOT Standard Specifications Section 615. The sign legend and appearance shall generally conform to the Book 4 - 30% Conceptual Plans.

5.4.2.5.2. Foundations for static signs shall be designed in accordance with the Standard Plans. Alternatively, the Contractor may propose a foundation designed in accordance with the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

5.4.2.5.3. LED Flashing Beacons

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- A. The Flashing Beacons shall be designed in accordance with NHDOT Standard Specifications Section 616.
- B. The Flashing Beacons associated with the Static signs shall be 12-inch LED.
- C. All Flashing Beacon Signs shall include a minimum of two beacons, except the diamond warning signs which shall include one beacon.
- D. All Flashing Beacons mounted on or adjacent to the Access Control Gate shall be red.
- E. All other Flashing Beacons shall be amber.
- F. Flashing Beacons located at on ramps and the terminal interchanges of the system shall flash when the applicable highway segment Lane Use Signals show a green arrow or a yellow X.
- E.G. Flashing Beacons associated with the detour shall flash when the Exit 1 eDetour Barrier gGate is ascending, descending, and in the down position.

**5.4.2.5.4. Detour Barrier Gate**

- A. The Detour Barrier Gate shall meet the requirements of a movable bridge resistance gate as defined by the MUTCD Chapter 4J.
- B. The Detour Barrier Gate shall include the ability to be activated (i.e. lowered and raised) remotely and locally.
- C. The Detour Barrier Gate shall have a preemption receiver to permit authorized emergency vehicles to activate the gate.
- D. The Detour Barrier Gate and the Dennett Road Flashing Beacon Signs shall be interconnected such that the Flashing Beacon Signs are activated upon lowering the gate.
- E. See Special Provision 619 for additional details.

**5.4.2.6. Roadway Weather Information Station (RWIS) Subsystem**

- A. The Contractor shall furnish and install a series of weather and pavement condition sensors with associated communications equipment at the location identified in the Book 4 - 30% Conceptual Plans.
- B. The RWIS System shall be designed in accordance with Special Provision 677.42 Roadway Weather Information Station (RWIS) System.
- C. The RWIS Subsystem shall include the following components:
  - a. Ultrasonic heated wind sensor with "bird cage" protection
  - b. Warmed/heated humidity probe

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- c. Air temperature probe
- d. Precipitation sensor with identifier sensor
- e. Barometer
- f. Subsurface temperature probe
- g. Remote processing unit/equipment cabinet
- h. UPS suitable for 4-hour hold-up time

5.4.2.7. *Communications Subsystem*

- A. The Contractor shall design and construct a communications subsystem that transports data to and from each ITS device and communications hub site to the Central Control subsystem. The communication subsystem shall include the following components:
  - a. Connection to the existing microwave wireless backhaul in New Hampshire, or to an alternative, high capacity-high bandwidth communication system for access to the TMC in Concord, NH.
  - b. Connection to a new high capacity-high bandwidth communication system for access to the TMCC in Portland, ME.
  - c. Wired and wireless communications between ITS field equipment and the associated communications backhaul.
  - d. Upgrades to the existing Piscataqua River Bridges wireless communication system.
  - e. Uninterruptible Power Supply (UPS) to ensure stable and continuous communications.
  - f. Installation of a new communications equipment shelter in Maine.
  - g. Design, structural calculations, installation, and connection of a new climbable antenna mounting structure and a new communications equipment shelter in New Hampshire.
- B. The Contractor shall furnish and install all required communications equipment to ensure the ITS field equipment has two-way communications with the communications backhauls to the NHDOT TMC and the MTA TMCC.
- C. The Contractor shall furnish and install new communications equipment to connect the Sarah Mildred Long bridge to new climbable antenna mounting structure.
- D. The Contractor shall furnish and install new communications equipment to connect the NHDOT Bridge Maintenance facility located at 10 Ranger Way to the new NHDOT communications equipment shelter.

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- E. The Communications Subsystem shall provide a minimum reliability of 99.99% uptime, averaged over a one-year period, or no more than fifty-three (53) minutes of down-time annually.
- F. The Contractor shall provide structural evaluations for new antennas mounted to existing equipment, including to the superstructure of the HLB.
- G. Portions of the Contractor's communication subsystem design that incorporate the use of federal, state or local municipal facilities shall be subject to their approval.
  - a. Any leasing agreements for use of third party facilities shall be subject to review and approval by the intended Leasee.
- H. The communication subsystem shall be designed and constructed such that each Contractor proposed subsystem in each State is mutually compatible.
- I. The communication subsystem shall be able to return communication system operational status to the Central Control subsystem.
- J. The communication subsystem shall return communication subsystem and component fault data to the Central Control subsystem.
- K. The communication subsystem shall be managed and controlled from the Central Control subsystem.
- L. Communication subsystems that require FCC authorization will be handled by NHDOT in New Hampshire. All FCC authorizations in New Hampshire shall list the NHDOT as the owner/operator. The Contractor shall be responsible for any fees associated with the FCC authorization.
- M. Communication subsystems that require FCC authorization will be handled by NHDOT in Maine. All FCC authorizations in Maine shall list MTA as the owner/operator. The Contractor shall be responsible for any fees associated with the FCC authorization.
- N. The Contractor shall perform and provide to the respective Owner a "Radio Path Engineering" and "Spectrum Analysis" for every radio link to demonstrate the communication subsystem as designed will provide sufficient operating margins to achieve the required "up times" of the system deployed, as required herein.
  - a. The Contractor shall perform and provide to the Owner a radio frequency (RF) path profile study for each wireless link contained within the Contractor's design. Technical parameters of each RF path profile study for each radio link shall demonstrate that the communications infrastructure under design will operate reliably and satisfy all functional and technical requirements contained herein. The path profile study shall be submitted to the Owner for review and written approval prior to installation activities.

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- b. Contractor shall provide point-to-point path analysis report for each subsystem or component's wireless link contained in the communication subsystem design.
- O. The wireless portion of the Communications Subsystem shall have a data capacity of at least 50% greater than is needed to support the ITS devices deployed on this Project.
- P. The Communications equipment shall be upgradeable to support additional future capacity.
- Q. The Communications Subsystem shall be bi-directional and configured such that a link failure between nodes does not prevent data throughput to a downstream connected node.
- R. The Wireless Communications Subsystem shall be symmetrical, allowing for data transmission upstream and downstream at the same throughput.
- S. Antennas installed on structures shall not exceed six (6) feet in diameter.
- T. Contractor shall design the node and hub architecture for use with the TCP / IP naming convention that shall be provided by the Owners.
- U. For TCP/ IP naming purposes, system architecture shall be hierarchically organized by subsystem and type of component.
- V. The Communications Subsystem equipment shall be specified by the manufacturer for continuous duty, non-environmentally controlled, outdoor use.
- W. The Piscataqua River Bridges Communications Subsystem shall be designed such that there is redundancy in the form of separate radio antennas and radio equipment for each radio path even on shared resource towers. Each of the radio paths shall provide the full data capacity required for this Project as detailed herein. Full data capacity shall be defined as 150% of the data capacity required for proper operation of the highest usage link, as defined elsewhere herein.
- X. Each Communications Subsystem hub and microwave backhaul site shall include an uninterruptible power source to provide temporary backup power in the event of loss of commercial power.
- Y. A transient voltage surge suppressor (TVSS) shall be required on each end of all communications lines: at the equipment end and at the source end.
- Z. Communications line surge protectors shall be specifically designed to protect the type of communications line to which they are connected. Communications line types include, but are not limited to, Ethernet, Ethernet with POE, EIA 422, and EIA 485.
- AA. Wireless Communications Equipment shall be designed in accordance with Special Provision 677.31 Wireless Communications Equipment.

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BB. The CS shall provide sufficient bandwidth for three simultaneous video streams from each CCTV camera, sending streaming video to the NHDOT TMC, the MaineDOT TMC, and the MTA TMCC.

5.4.2.7.1. Interconnections to Wireless Backhaul – New Hampshire

- A. The wireless high speed data communications equipment shall be capable of an operating distance of no less than five (5) miles.
- B. The high speed data communications equipment shall have an OEM option for over the air encryption that the contractor shall configure and use.
- C. The Contractor shall provide NHDOT with all documentation associated with the Communication System (CS) to be built, including, but not limited to, construction plans, equipment acquisition plans, equipment specifications, engineering drawings, FCC license application data and parameters, maintenance manuals, operational manuals, training and any other documentation necessary for the operation and maintenance of the CS.
- D. The CS equipment shall be specified by the manufacturer for continuous duty, non-environmentally controlled, outdoor use.
- E. Where multiple ITS device locations are daisy-chained to connect to a communications hub site, the wireless hardware for the device-to-device communications shall be the same as required for the Device-to-Hub communications.

5.4.2.7.2. Connection to Communications Backhaul – Maine

- A. MTA currently maintains a digital subscriber line (DSL) drop at the intersection of Route 236 and the Exit 2 southbound on-ramp. As part of this Project, MTA intends to upgrade this backhaul system to provide a high bandwidth communications backhaul to the MTA TMCC. The Contractor shall provide bandwidth calculations to assist MTA in acquiring the higher bandwidth required.
- B. Under the conceptual design, several of the ITS devices in Maine are anticipated to communicate wirelessly directly, or through multiple wireless hops, to communication collection points where the data streams will transfer to a wired medium. All ITS data shall flow to and through the Communications Equipment Shelter to be located within the Exit 2 interchange near the Route 236 bridge.

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- C. The wireless portion of the high speed data communications equipment shall be capable of an operating distance of no less than five (5) miles.
- D. Contractor specified equipment shall operate at a minimum data transfer rate, measured in megabits per second, of 6Mbps or greater for each CCTV camera and of 1 Mbps for every other ITS device communicating via wireless.
- E. The high speed data communications equipment shall have an OEM option for over the air encryption that the Contractor shall configure and use in accordance with the MTA requirements.
- F. The Contractor shall provide the Owners with all documentation associated with the communication system to be built, including, but not limited to, construction plans, equipment acquisition plans, equipment specifications, engineering drawings, maintenance manuals, operational manuals, training and any other documentation necessary for the operation and maintenance of the communication system.
- G. The communication system equipment shall be specified by the manufacturer for continuous duty, non-environmentally controlled, outdoor use.
- H. Where multiple ITS device locations are daisy-chained to connect to a communications hub site, the wireless throughput shall be sufficient for all data transferring through each location.

5.4.2.7.3. Field-to-Field and Field-to-Backhaul Communications

- A. The communications components used between ITS field devices and between an ITS field device and the wireless system backhaul shall utilize high speed data communications equipment.
- B. A portion of the Communications Subsystem in New Hampshire will use new single mode fiber optic cable to communicate between ITS field devices and the proposed Communications Equipment Shelter.
- C. The data capacity of each ITS device-to-backhaul wireless link shall be designed to support a) the required data rate of the ITS field device(s) at this location, plus 100% spare capacity or, b) 6 Mbps continuous, whichever is greater.

5.4.2.7.4. UPS

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- A. The Communications Subsystem shall include a UPS at each node with sufficient battery backup capacity to provide four (4) hours of uninterrupted power to all connected ITS field cabinet equipment, including cabinet heaters.
- B. The UPS shall include sealed AGM type batteries that are specified as maintenance free.
- C. The UPS shall include a communication means that shall be connected to the Ethernet switch in the ITS field cabinet.
- D. The UPS shall include a remote power manager (RPM) unit that includes a minimum of eight (8) 120 VAC outlets. Each of the 120 VAC outlets shall be individually controllable from the TMC Central Control subsystem via TCP/IP. The RPM shall include an RJ45 Ethernet port which shall be connected to an RJ45 Ethernet port on the Ethernet Switch. Any and all software needed at the TMC Central Control subsystem to control the RPM shall be supplied, installed, and configured by the Contractor. In addition to being manually controllable from the Central Control system, the RPM shall include the ability to program time-of-day/day-of-week schedules whereby each of the 120 VAC outlets can be individually controlled by these schedules. Additional power strips shall be supplied and installed at no additional cost as needed to facilitate plugging devices into the RPM.
- E. At the Communications Equipment Shelters, the Contractor shall furnish, install, and connect an externally mounted stand-by generator capable of supplying power to the shelters for not less than 96 hours, continuously.
- F. For the New Hampshire Communications Equipment Shelter, the Contractor shall furnish and install a rack mounted UPS to support all equipment within the shelter, plus 100% spare capacity. The battery storage hold-up time shall be one hour, minimum, at which time the externally mounted stand-by generator shall take over the load.
- G. For the Maine Communications Shelter, MTA will provide the UPS.
- H. The UPS shall meet all requirements in accordance with Special Provision 677 - ITS Equipment.

5.4.2.7.5. Communications Equipment Shelters



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- A. The Project shall include two communications equipment shelters. One shall be in Maine to be owned and maintained by MTA. One shall be in New Hampshire to be owned and maintained by NHDOT.
- B. The shelters shall be pre-cast concrete structures installed on concrete slab foundations. The Contractor shall provide design plans, details and specifications for both the pre-cast shelter and the foundation slab.
- C. The New Hampshire shelter shall have minimum dimensions of 10' wide by 12' long by 9' high providing a minimum of 120 square feet of internal floor space.
- D. The Maine shelter shall have minimum dimensions of 11' wide by 14' long by 9' high providing a minimum of 120 square feet of internal floor space.
- E. The shelters shall have a minimum one foot exterior awning over the entranceway.
- F. Electrical Power
  - a. The shelters shall be served by public utility power.
- G. Lighting
  - a. The shelters shall have exterior luminaires with an industrial grade protective covering to protect the luminaires.
  - b. At least one of the exterior lights shall illuminate the entranceway.
  - c. The shelter interiors shall have a minimum of two 2-bulb LED luminaires that are connected to a wall switch located within three feet of the door.
- H. Environmental
  - a. The shelters shall have thermostatically controlled air conditioning/HVAC sufficient to keep the interior temperature below 80 degrees Fahrenheit at all times.
  - b. The shelters shall have thermostatically controlled heating sufficient to keep the interior temperature above 60 degrees Fahrenheit at all times.
  - c. The shelters shall include an environmental monitoring system that provides alerts when the configurable temperature thresholds have been met.
  - d. The shelters shall include an environmental monitoring system that provides alerts when the water sensor thresholds have been met.

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- I. The shelter designs shall be signed and stamped by a Professional Engineer licensed in the State in which the structure will be located.
- J. The shelter foundation designs shall be signed and stamped by a Professional Engineer licensed in the State in which the structure will be located.
- K. Each shelter shall be equipped with the following equipment:
  - One locking door with an integrated combination lock in the door handle;
  - Utility power source that provides service to a power panel with a 200A minimum main breaker and sufficient breakers to provide power to three fully equipped server racks
  - A stand-by generator to provide full power load back-up power in the event of AC utility power interruption
  - A grounding bus bar that is connected to an earth grounding grid external to the shelter
- L. For the New Hampshire shelter, NHDOT will provide the Contractor with final floor plan layout.
- ~~M.~~ For the Maine shelter, MTA will provide the Contractor with the final floor plan layout.
- ~~M-N.~~ The communications shelters shall have a path for a utility truck to exit the adjacent roadway and park within 10 feet of the communications shelter door.
- ~~N-O.~~ The communications structures shall meet all requirements in accordance with Special Provision 677 – Communication Equipment Shelter.

5.4.2.7.6. Climbable Antenna Mounting Structure

- A. The Project shall include one climbable antenna mounting structure. The structure shall be installed in close proximity to the NHDOT-owned communications equipment shelter.
- B. The mounting structure design shall be signed and stamped by a Professional Engineer licensed in New Hampshire.
- C. The mounting structure shall be self-supporting.
- D. The mounting structure shall be designed to be scaled by qualified maintenance personnel.

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- E. The Contractor shall provide a foundation system suitable for the proposed mounting structure.
- F. The foundation system design shall be in accordance with the existing site soil conditions and shall be signed and stamped by a Professional Engineer licensed in New Hampshire.
- G. The mounting structure shall be galvanized steel in accordance with ASTM 123.
- H. The hardware for the mounting structure shall use ASTM A-325 high strength bolts, nuts, and washers.
- I. The Contractor shall provide a grounding net at the base of the mounting structure with a minimum of four ground rods. The mounting structure shall be grounded to a minimum of 25 ohms to ground.
- J. All equipment mounted to the mounting structure shall be grounded to a common grounding system.
- K. The mounting structure shall be equipped with a lightning dissipater similar to the requirement described in Special Provision 677.41 for CCTV support poles.
- L. The mounting structure shall meet all requirements in accordance with Special Provision 677 – Antenna Mounting Structure.

5.4.2.8. *Central Control Subsystem*

- 5.4.2.8.1. The Owners have negotiated a scope of services, a list of requirements, and a firm fixed price budget with the Southwest Research Institute (SwRI) for the development of the software module that will operate the PTSU System as part of the Compass ATMS.
- 5.4.2.8.2. The Contractor shall furnish and install all required communication equipment and computer hardware (switches, display, peripherals, etc.) necessary integrate the PTSU System at the NHDOT TMC, MaineDOT TMC, and the MTA TMCC for the Compass ATMS to receive data from and control all ITS field devices required for the PTSU System.
- 5.4.2.8.3. The Contractor shall fully test and integrate all ITS Devices on this Project into the proposed Central Control subsystem. The operators at the NHDOT TMC, MaineDOT TMC, and MTA TMCC shall each be able to

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monitor, operate, and control all field devices installed as part of this Project through the PTSU System.

5.4.2.8.4. The operators at the NHDOT TMC, MaineDOT TMC, and MTA TMCC shall be able to view streaming video in high definition (720p) from all CCTV cameras installed as part of this Project.

- A. All streaming video shall be accessible to NHDOT through the Milestone software with applicable Milestone licensing.
- B. All streaming video shall be accessible to MTA through the Axis Camera Station software with applicable licensing.
- C. All streaming video shall be accessible to MaineDOT through the Axis Camera Station software with applicable licensing.

#### 5.4.3. Additional Design Requirements

##### 5.4.3.1. *ITS Field Cabinets*

- A. The Contractor shall furnish and install ITS field cabinets for housing devices including, but not limited to:
  - a. 1 Gbps network managed Ethernet switches
  - b. CCTV controller and associated cabinet equipment
  - c. MVDS cabinet equipment
  - d. DMS controller and associated cabinet equipment
  - e. LUS controller
  - f. Flashing Beacon controls
- B. The ITS field cabinet shall meet NEMA 3R requirements.
- C. The door filters shall be metallic and reusable; replaceable paper filters will not be permitted.
- D. ITS Field Cabinets shall be designed in accordance with Special Provision 677 ITS Cabinet Components.

##### 5.4.3.2. *Cables and Conduit Systems*

- A. The Contractor shall provide cabling that is configured to the EIA/TIA standards.
- B. The Contractor shall provide cabling of adequate length, along with the compatible connectors and any ancillary equipment necessary to interconnect the components and control systems needed to achieve the functions required, while providing sufficient slack to allow for component manipulation.

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- C. All cables for power, communication, and trace wire shall be installed in conduit. The minimum size for any conduit on this Project shall be 2-inches, nominal.
- D. The Contractor shall provide a fill ratio calculation for all conduit systems with installed cables. Fill ratios shall not exceed NEC maximums.
- E. The conductors for ITS field cabinets shall be stranded copper wire of standard American Wire Gage sizes, except ground wires, which shall be solid copper wire.
- F. All Ethernet cabling shall be configured to the EIA/TIA 568B standards. Ethernet cabling shall be weatherproof Category 6 (Cat 6) or higher.
- G. Cat-6 cable used outdoors shall be specified and rated for such use.
- H. All underground conduit shall be designed in accordance with Special Provision 614.74221 – HDPE Conduit.
- ~~H-I.~~ The Owners will provide several pull boxes and conduit bends to the awarded Contractor for use along the HLB. An inventory list of the equipment is included in Appendix F.

5.4.3.3. *Electrical Power Systems*

- A. Solar power systems will not be permitted for the proposed equipment along the I-95 corridor or along the adjacent on-ramps and off-ramps. All I-95 corridor equipment shall be powered by public electric utilities.
- B. Solar power systems may be provided for flashing beacon signs that are outside of the I-95 corridor. Solar power systems shall be designed in accordance with Special Provision 677 – Solar Power Systems.
- C. All electrical power drops shall provide a minimum of 50% spare capacity above the maximum expected load at the point of demarcation. Spare capacity shall be provided on a branch circuit breaker.
- D. The meter and disconnect equipment shall be rated for arc flash protection.
- E. The Contractor shall provide power load calculations for all public utility connections and for all ITS field cabinets.
- F. The Contractor shall provide power load calculations for the communication equipment shelter.
- G. All copper conductors entering and leaving the ITS field cabinet, including but not limited to utility power, low voltage power, and communications, shall include TVSS.
  - i. The TVSS for utility power shall have a peak current rating of 20,000 Amps.
  - ii. The TVSS for utility power shall have a typical clamp voltage of 150 volts at 20 kA.

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- iii. The TVSS for utility power shall operate over an input voltage range of 90-140 volts.
- iv. The TVSS shall operate over a temperature range of -40 degrees C to +74 degrees C.

**5.4.3.3.1. Uninterruptible Power Supply (UPS)**

- A. The Contractor shall furnish and install an uninterruptible power supply (UPS) for each new ITS device.
- B. The UPS shall be connected to each ITS device and communications equipment with a capacity to supply power for no less than two (2) hours after loss of power unless otherwise noted in these requirements.
- C. The UPS shall include sealed AGM type batteries that are specified as maintenance free.
- D. The UPS shall include a communications means that shall be connected to the associated Ethernet switch. The UPS shall send power failure status to the Central Control subsystem when primary power is lost.
- E. The UPS shall include monitoring software for use in the Central Control subsystem.

**5.4.3.4. Guardrail**

- A. The Contractor shall install guardrail at all locations determined to have a length of need from the guardrail calculations performed by the contractor as defined in Section 5.3.2.D.j of the Technical Provisions.
- B. Guardrail constructed in New Hampshire shall be installed in accordance with Special Provision 606 – Guardrail.
- C. Guardrail constructed in Maine shall be installed in accordance with Special Provision 606 – Guardrail – Maine Turnpike Guardrail.

**5.5. Design Changes**

- A. The Contractor or the Owners may request design changes after RFC Documents have been approved. All design changes after RFC shall be called Field Design Changes (FDCs) and shall be reviewed in accordance with the procedures for FSD submissions.
  - a. Contractor Request for FDC
    - i. The Contractor shall submit a RFI requesting a change in the Design. The RFI shall include all supporting documentation for the requested modification.

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- ii. The Contractor may submit a preliminary RFI (PRFI) to request a discussion regarding a potential design change. For the PRFI, the Contractor shall describe the proposed change but does not need to provide the supporting documentation for the discussion.
    - iii. All design changes made after RFC shall follow the same approval and documentation procedures required by the RFP, the Technical Provisions, and the approved PMP and QMP for pre-RFC design submittals. No FDC construction may begin prior to FDC approval.
  - b. Owner Request for FDC
    - i. The Owners shall submit a written Change Order to request a change in the Design.
    - ii. The Contractor shall review the Change Order and request any additional information as needed.
    - iii. The Contractor shall have three (3) days to document any additional costs associated with the Change Order for the Owners' review.
    - iv. The Contractor shall not proceed with the Change Order until the Owners provide approval and NTP for the design change.
- B. The Owners may request and the Contractor shall provide interim and final RFI or Change Order design reviews based on the complexity of the proposed modification.
- C. All changes made as part of the RFI/Change Order process shall be documented in the As-Built documents.

**5.6. Record Drawings and Documentation**

- A. At the completion of the construction, the Contractor shall prepare Record Drawings and Documentation.
- B. The Record Drawings and Documentation shall be an organized, complete record of Plans and supporting calculations, documents, and details that accurately represent what the Contractor constructed. The Contractor shall ensure that the Record Drawings reflect the actual condition of the constructed Work.
- C. Record Drawings shall include a marked up PDF plan set (including changes noted and clouded for easy identification).
- D. Final Documentation shall include the Final Integration Documentation that provides the IP addresses, configuration data, and system passwords for the Owner's use.

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- E. Record Drawings shall include one electronic file (PDF) of the As-Built drawing, stamped and signed by the Engineer of Record, as well as corrected CADD files (clouds not required).

## **6. CONSTRUCTION REQUIREMENTS**

### **6.1. General**

- A. Before placing any permanent equipment, hardware, or materials, the Contractor shall provide a field layout indicating the proposed location of such items for review and approval by the Owners.
- B. The Contractor shall provide each component with all required appurtenances, including all necessary cables of proper length and connectors for power and communications, as defined by the manufacturer.
- C. The Contractor shall label all communication cables at both ends with permanent self-laminating cable tags.
- D. Construction shall be in accordance with the manufacturer's directions or recommendations where applicable, and the applicable provisions of the Contract. If there is any damage to any existing infrastructure or ITS equipment as a result of construction activities, the Contractor responsible for the damage and those responsible for the Project shall contact the appropriate Owner immediately to report the damage. The Owner will coordinate a site visit with the Contractor's staff to evaluate the damage within 48 hours of notification. Following the field assessment, the Contractor will be provided guidance for restitution which may consist of full or partial replacement and/or repair of structures and equipment and temporary equipment to maintain the existing level of service prior to the damage until the equipment or infrastructure is fully repaired, tested, and accepted. All costs for equipment, service connections, testing, and temporary equipment shall be at the cost of the Contractor unless otherwise noted in the field inspection report.
- E. The Contractor shall provide the Owners with all documentation associated with the Communication Subsystem to be built, including, but not limited to, construction plans, equipment acquisition plans, equipment specifications, engineering drawings, maintenance manuals, operational manuals, training, and any other documentation necessary for the operation and maintenance of the Communications Subsystem.



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- F. The Contractor shall submit as-built plans on archival quality Mylar (22" x 36") per the NHDOT's documentation procedures along with electronic files of all as-built plan sheets. The Contractor shall furnish to the State Project Manager the following:
  - a. 3 sets of 11"x17" paper as-built plans with all final documentation;
  - b. 1 set of as built plan CADD files on electronic media storage device;
  - c. 1 complete set of PDF files of the as-built plans – each individual plan sheet shall be a separate PDF file – on electronic media storage device;
  - d. 1 set of configuration files indicating all hardware configuration options and settings used to operate the equipment in hard copy and electronic formats; and
  - e. All electronic files shall be provided on a compact disk (CD) or digital video disk (DVD) or alternative digital format as approved by the Owners.
  - f. The Contractor's Licensed Professional Engineer(s), in responsible charge of the Project's design, shall stamp, sign, and date the record prints, the special provisions, and all reference and support documents.
- G. Dissimilar metals shall be isolated to prevent galvanic corrosion. Electroplated or zinc plated materials are prohibited.

**6.2. Administrative Requirements**

- A. The Contractor shall ensure that all equipment provided shall meet applicable UL, NEC, EIA, ASTM, ANSI, NEMA and IEEE requirements.
- B. Irrespective of whether the Owners provide the Contractor with the authority to begin construction on items, elements, or phases of the Work prior to completion of the design for the entire Project, the Contractor shall bear the responsibility to assure that construction meets the requirements of the Design-Build Documents, applicable Law, and the Governmental Approvals.

**6.3. Early Start of Construction**

- A. Construction work may begin following the Owners' written approval of the Preliminary System Design. It is noted that any work performed prior to the final approval of the Release for Construction Documents is at the sole risk of the Contractor. The Owners maintain the right to exclude authorization to construct certain elements of the Project if those elements are not satisfactorily advanced at the Preliminary System Design approval.

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- B. Any work constructed by the Contractor prior to receiving the Owners' approval of the Release for Construction Documents that is later determined to be unacceptable work shall be revised, removed, or otherwise repaired to the satisfaction of the Owners at the Contractor's sole cost and expense. There shall be no additional compensation for re-work based on work performed prior to the Owners' approval of the Release for Construction Documents. Additionally, there shall be no consideration given to changing the deadline for Final System Acceptance as a result of re-work.
- C. No construction work may start prior to the written approval of the Release for Construction Documents if the QMP process has not been followed and if the DQC Manager has not provided written certification that the portion of the work proposed for Early Start is in full compliance with the Design-Build requirements.
- D. No construction work may commence prior to issuance of NTP2 as defined in Book 1 – RFP Section 1.3.

**6.4. PTSU System**

- A. All materials and workmanship shall meet the requirements of the most current National Electrical Code (NEC), the 2012 National Electrical Safety Code (NEC), and the Project specifications. If any specific requirement of these codes conflict, the Contractor shall conform to the more restrictive applicable interpretation.
- B. All ITS field equipment shall include a grounding and bonding system. All ITS field equipment shall be bonded in accordance with the NEC, Article 250.
- C. All ITS field equipment shall be protected in accordance with the American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide, latest edition. For equipment within the clear zone whose height is greater than the offset from the roadway, the equipment shall be protected in accordance with Test Level 4 (TL-4) criteria. For all other equipment within the clear zone, the equipment shall be protected in accordance with Test Level 3 (TL-3) criteria.
- D. The Contractor shall provide all transportation, labor, materials, equipment, supplies, tools, accessories, hardware, software, and licenses necessary for a complete system design and installation.

**6.5. Hardware Installation**

**6.5.1. Closed Circuit Television (CCTV) Subsystem**

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- A. Using a bucket truck, telescoping camera assembly, unmanned aerial vehicle (UAV) or similar camera elevation device, the Contractor shall obtain, record and deliver to the Owners for written approval a 360-degree video of the roadway and adjacent field of view with camera tilt range, at a minimum, from 0-degrees to minus 90-degrees. The video recordings shall be taken from the precise proposed camera site and camera height installation. The tilt elevation of the video recordings shall not exceed the maximum upward tilt of the proposed camera for each site. The camera video shall consist of a minimum of five (5) minutes of video recording at each CCTV camera site, with a full 360 degree pan and a full zoom along each direction of each roadway and ramp visible from the camera site. The recordings will be used by the Owners to consider the location and elevation of the proposed CCTV camera systems.
  - i. Use of UAV shall be subject to Owners advanced approval. See Supporting Documents for appropriate forms for Owner approval.
- B. The Contractor shall furnish and install the CCTV Subsystem on support poles or attached to existing structures at sufficient height to maximize useful camera fields of view in all travel directions.
- C. The view from each camera shall be visually clear of existing obstructions, including highway signage, adjacent infrastructure, landscape, foliage, and tree canopy.
- D. All CCTV poles shall be installed with two camera lowering device systems. The cameras shall be set at 90 degrees or 180 degrees apart based on the location of the pole with respect to the field of view.
- E. All CCTV camera pole materials and products shall be manufactured in the United States of America. Mill test reports and Certificates of Compliance shall be supplied in compliance with the material specifications.
- F. The CCTV subsystem shall include a transient voltage surge suppression (TVSS) system that consists of a surge suppression device located within 5 feet of the camera and a surge suppression device located within 5 feet of the camera controller.
- G. Each CCTV camera pole shall include a lightning dissipater that is offset from the camera pole and provides protection for the CCTV camera without interfering with the camera or lowering device operation.
- H. The CCTV camera pole shall include a grounding system to provide a maximum of 25 ohms resistance to ground or as required by the Manufacturer, whichever is more stringent.
- I. The CCTV camera pole grounding shall consist of a ground rod array of not less than four (4) ground rods each at least 10 feet from the center of the pole.

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- J. The ground rod array shall be interconnected with #4 AWG solid copper wire between the ground rods, the camera pole, and the ITS equipment cabinet providing a common ground for the system.
- K. The ground wire shall enter the camera pole in a conduit sweep installed in the CCTV support pole foundation.
- L. The CCTV grounding system shall also be bonded to the ground terminal at the ITS equipment cabinet.
- M. The camera lowering system shall be designed to accept, support, raise and lower the specific type of CCTV camera to be provided and installed.
- N. The Contractor shall supply separate internal conduits and conduit mount adapters in the pole for both lowering devices to separate the lowering cable from the other equipment cables. The only cable permitted to move within the pole or lowering device during lowering or raising shall be the stainless steel lowering cable. All other cables must remain stable and secure during lowering and raising operation.
- O. The camera lowering component cabling shall consist of Cat-6 individually shielded pairs.
- P. The camera lowering system cable shall include a minimum 1/8 inch diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds with seven (7) strands of #19 wire.
- Q. No mechanical, electrical or optical interference shall degrade the performance of either the camera system or the camera lowering system.
- R. The CCTV Camera pole shall be installed on a concrete foundation in accordance with the requirements in Appendix A.
- S. The CCTV Camera pole shall be installed plumb to the vertical axis.
- T. All circumferential welded pole and arm splices shall be ultrasonically or radiographically inspected.
- U. Once installed, pole camera mounts shall be oriented toward the primary travel directions or as otherwise approved by the Owners.
- V. The distance from the top of the concrete footing to the bottom of the pole base plate shall be the nut height plus 1-inch or nut height plus the anchor rod diameter maximum.
- W. A minimum of two additional two inch (2") spare conduits shall be installed into the base of the camera pole from the ITS field cabinet for future expansion of the ATMS system.
- X. The CCTV subsystem shall be installed in accordance with Special Provisions 677.41xx and 677.410xx – CCTV Pole and Foundation.

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**6.5.2. Motor Vehicle Detection System (MVDS) Subsystem**

- A. The MVDS sensors should be installed on a pre-existing support structure if in satisfactory condition and as approved for use by the Owners (for example, the HLB truss) or on other new hardware support structures (for example, on a CCTV Camera support pole).
- B. The MVDS shall be provided with software that allows local and remote configuration and monitoring.
- C. System software shall display detection zones and detection activations in a graphical format.
- D. The MVDS shall allow a user to edit previously defined configuration parameters, including size, placement, and sensitivity of detection zones.
- E. All communication addresses shall be user programmable.
- F. System software shall offer an open API and software development kit, which shall be made available to the Owners for integration with New England Compass ATMS.
- G. Major components of the system (such as the sensor and any separate hardware used for contact closures), shall include a minimum of one Ethernet communications interface.
- H. The MVDS shall include an Ethernet interface which shall provide a 10/100 Base TX connection. The Ethernet interface shall be the primary interface to the Communications subsystem.
- I. MVDS vehicle detection shall meet the minimum total roadway segment accuracy levels of 95% for volume, 90% for occupancy, and 90% for speed for all lanes, up to the maximum number of lanes that the device can monitor as specified by the manufacturer.
- J. The MVDS interface and connectors shall conform to TIA-232 standards.
- K. The FCC identification number shall be displayed on an external label and all detection system devices shall operate within their FCC frequency allocation.
- L. MVDS detection output shall conform to the requirements of NEMA TS2-2003, 6.5.2.26.
- M. Contractor shall furnish and install bonding and earth ground terminals for MVDS locations.
- N. All MVDS Sensor Units shall be designed in accordance with Special Provision 677.465 MVDS without Pole.

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**6.5.3. Dynamic Message Sign (DMS) Subsystem**

- A. DMS shall provide front service access for all LED display modules, electronics, environmental control equipment, air filters, wiring, and other internal components.
- B. The DMS component shall provide operational status from the DMS equipment to the Central Control subsystem.
- C. The DMS system shall provide fault data for the DMS equipment to the Central Control subsystem.
- D. The DMS shall provide the ability to send display messages to the DMS equipment from the Central Control subsystem.
- E. The DMS component shall include a local interface that provides local control, operational status, and fault data to connected equipment operated by field personnel.
- F. The DMS shall allow for field personnel to perform diagnostic testing on the DMS equipment.
- G. The DMS shall provide two modes of operation: (1) master operation, where the Central Control subsystem commands and controls the sign and determines the appropriate message or test pattern; and (2) local operation, where the sign controller or a laptop computer commands and controls the sign and determines the appropriate message or test pattern.
- H. The DMS subsystem control software shall provide a graphical representation that visibly depicts the sign face and the current On/Off state of all pixels as well as allows messages to be created and displayed on the sign.
- I. The DMS Subsystem control software shall allow system control by multiple end-users.
- J. The DMS shall be powered from 120/240 VAC, single phase, 3-wire plus ground.
- K. Each DMS subsystem shall include a TVSS on the power and communications cables.
- L. The DMS sign housing cabinet, the DMS structure, and the DMS ITS field cabinet shall include adequate grounding to achieve a maximum of 25 ohms resistance to ground or as required by the manufacturer, whichever is more stringent.
- M. Where DMS cables are above ground, they shall be installed in flexible polyethylene (PE) or rigid galvanized steel conduit. Conduits shall enter the DMS at the location indicated by the manufacturer.

**6.5.3.1. DMS for Ground Mounting**

- A. Ground mounted DMS shall be Ver-Mac 1500C or approved equivalent.

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- B. Each DMS shall include a 30 amp 120/240VAC electrical connector for auxiliary power should the sign need to be maintained during a sustained power loss condition.
- C. The DMS sign housing cabinet, the DMS supports, and the DMS ITS field cabinet shall include adequate grounding to achieve a maximum of 25 ohms resistance to ground or as required by the manufacturer, whichever is more stringent.

**6.5.3.2. DMS Controller**

- A. Each DMS shall include a cabinet-installed controller.
- B. The DMS Controller shall be programmed to receive sign control commands from the Central Control subsystem to transmit responses (as requested), and to control the sign operation and message displays.
- C. The DMS Controller functions shall include error logging and reporting, and providing the operational status of the sensors, including temperature, photocell, airflow, humidity and LED power sensors.
- D. The DMS Controller shall have local control panel status indicators, including power on/off, communication status, laptop computer communication status, communication status with the electronics in the walk-in housing, and sign diagnostics and error status.
- E. The DMS Controller shall include both signal and power line surge protection.
- F. The DMS Controller and its software shall display single page and multipage messages, with mixed fonts and spacing.
- G. The DMS Controller shall provide power-up and automatic restart capabilities with automatic sign blanking, with the last known message, or a configurable message when recovering from a power-off condition and upon recovery from system resets.
- H. The DMS Controller shall be IP addressable, and shall interface to the Communications Subsystem by virtue of an Ethernet connection to the Ethernet switch in the ITS field cabinet.

**6.5.4. Roadway Weather Information Station (RWIS) System**

- A. RWIS shall be installed on a hinged support structure on concrete foundation.
- B. All RWIS sensors, equipment, and system components shall be installed in accordance with the manufacturers' recommendations.
- C. A subsurface temperature probe shall be installed under the paved roadway surface.

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- D. The RWIS support pole shall include adequate grounding to achieve a maximum of 25 ohms resistance to ground or as required by the manufacturer, whichever is more stringent.
- E. The RWIS system shall be installed in accordance with Special Provisions 677.42 – Roadway Weather Information Station (RWIS) System.

**6.5.5. All Other ITS Field Equipment**

- A. All other ITS field equipment shall be installed/constructed in accordance with the Special Provision that is applicable to that element.

**6.5.6. Additional Requirements**

**6.5.6.1. ITS Field Cabinet**

- A. The ITS field cabinets shall be ground mounted on a concrete base unless otherwise permitted by the Owner.
- B. Cabinets shall be equipped with all necessary mounting hardware as well as appropriate earth ground and bonding hardware. Each cabinet shall include a trace wire access point.
- C. All ITS cabinets shall be grounded to a maximum of 25 ohms, or the manufacturer's recommending grounding, whichever is more stringent.
- D. All equipment placed in the ITS field cabinet shall be installed according to the recommendations of the manufacturers.
- E. All electronic equipment provided within the ITS field cabinet(s) shall be "hardened" in accordance with NEMA TS-2 operating temperature limits in all weather conditions.
- F. A minimum clearance of 6-inches shall be provided between the top of the ITS field cabinet and the top of any equipment placed on the top shelf of the cabinet.
- G. A minimum clearance of 2-inches shall be provided between each side of the cabinet and the equipment placed on the cabinet shelves.
- H. ITS field cabinets shall be easily accessible to maintenance personnel and/or vehicles under all weather conditions (i.e. through snow accumulations, etc).
- I. The ITS field cabinets shall be installed in locations convenient to maintenance operations. Convenient to maintenance means that cabinets shall be located at ground level in an area accessible to maintenance personnel on foot and within 150 feet of a truck parking area.



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- J. ITS field cabinets for communication hub locations shall include a manual generator transfer switch to allow the cabinet equipment to be switched from utility power to generator power.
- K. All wiring in the ITS field cabinet shall be neatly dressed and supported.
- L. All ITS field cabinets shall be supplied with level concrete workman pads in front of each cabinet door.
- M. No meter enclosures will be allowed to be mounted directly to the ITS Cabinets.

**6.5.6.2. Cables and Conduits**

- A. All underground cables shall be installed in conduit raceways. Direct burial of cables for power or for communications is prohibited.
- B. All dielectric cables and DMS communication cables installed underground shall include a trace wire acceptable to the NHDOT in New Hampshire or acceptable to MTA in Maine. Tracer wire shall be designed and installed in accordance with Special Provision 614 – Tracer Wire.
- C. Conduits attached to bridges shall be mounted at least 61 inches clear distance away from the beam's/girder's webs or flanges to allow for paint removal and re-application. Mounting to the outside of the exterior beams/girders is prohibited except at the HLB.
- D. Conduit supports shall be installed at least 10 feet on center for rigid steel conduit; all other conduit supports shall be installed at least 5 feet on center or as recommended by the manufacturer.
- E. Where conduit is installed adjacent to a breakaway sign support, the Contractor shall install a breakaway conduit coupling and breakaway device for the cable(s).
- F. Where conduit is installed on a structure that is subject to regular movement (for example, on the HLB), the conduit shall include expansion couplings. The frequency and spacing of couplings shall be determined by the Contractor as recommended by the manufacturer and based on the anticipated movement of the underlying structure.
- G. All external attachments to cabinets or other ITS equipment, such as generator transfer switches, meter sockets on meter pedestals, weatherheads, etc. shall be mounted on the mounting structure facing away from or downstream in the direction of traffic.
- H. Conduits installed using directional boring equipment shall be installed in accordance with Special Provision 671.60 – Conduit Directional Bore.
- I. Conduits shall be installed in accordance with Special Provision 614.74221 – HDPE Conduit.

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- J. Conduit shall not be installed inside of structure members.
- K. Where conduit crosses maintenance walkways or platforms, the conduit shall be installed at least 7 feet above the walkway or platform.
- L. Pull boxes installed in areas that are prone to accrual of snow, sand, or salt shall have a mitigation system (ie. Pitched roof) installed to prevent the accrual of snow, sand, salt, or other materials.

**6.6. Restrictions Associated with Work at the HLB**

- A. The Contractor shall submit attachment hardware shop drawings/catalog cuts as well as means/methods narrative to the Owners for review and approval prior to ordering any attachment hardware.
- B. Bridge mounted conduit shall include expansion fittings and rollers to address bridge movement and differential expansion. The Contractor shall prepare calculations indicating that the permitted conduit expansion/contraction is at least 1.25 times the maximum expected movement of the bridge.
- C. Attachments to bridges such as hangers, conduits and bolts shall be non-corroding stainless steel.
- D. Attachments to bridges shall be UV-resistant and UL-rated as self-extinguishing within 15 seconds or of non-combustible materials.
- E. Attachments to the HLB shall not impede on the proposed clearance envelopes (vertical or horizontal) as a result of the on-going deck rehabilitation Project. Clearance envelopes include:
  - i. From structural members to the road surface;
  - ii. From structural members to the mean high water;
  - iii. From structural members to the edge of traveled way; and
  - iv. From concrete barriers (outsides and median) to the traveled way.
- F. New structural steel, such as new steel frames to support hangers, installed at existing bridges shall match the properties of existing girders.
- G. Holes in concrete, typically abutment walls, shall be cored. The space around conduits through cored holes shall be sealed with a waterproof seal made specifically for filling the annular space around a conduit. The type of material used to seal the hole shall be subject to approval by the Owners.
- H. Conduit supports shall be solid and a minimum of 0.25 inches thick. Unistrut or Power-strut attachments are prohibited.

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- I. Guardrail or other traffic barrier shall not be directly connected to bridge abutments or piers.
- J. Attachments to bridge concrete decks are prohibited.
- K. Requests to attach hardware to existing bridge diaphragms shall be submitted to the Owners for review and is subject to the Owners' approval.
- L. Damage to existing protective coatings on the bridge structural steel shall be reported to the Owners and repaired at the Contractor's expense if the damage was as a result of the Contractor's installation of attachments to the structure.
  - i. A coatings repair procedure shall be submitted to the Owners for approval prior to beginning the repairs.
  - ii. The coatings repair procedure shall include surface preparation and coating application.
  - iii. Coating repairs shall be made by a qualified SSPC-QP1 certified Industrial Painting Contractor and witnessed by an independent NACE-certified Quality Assurance Inspector.
  - iv. The existing coating is a three-coat Wasser system on the truss and New Hampshire approach spans: MC Zinc, MC Ferrox B, MC Ferrox A. The New Hampshire approach spans also have an MC Antigraffiti top coating on the fascia surfaces of outside beams.
  - v. The Contractor shall contact the MaineDOT Bridge Design office to verify the existing coatings on the Maine approach spans.
- M. Structure protective coatings shall be touched up and repaired if impacted or damaged by the installation of attachments to the structure.
- N. No banding equipment shall be used to attach equipment to bridge truss members.
- O. Pull boxes and conduits shall have external, weather-proof labels to identify the contents of each. Labels should be easily identified from walkways. The Contractor shall submit a draft of each label to the Owners for approval.
- P. Pull boxes installed adjacent to catwalk, or maintenance pathways with handrail the Contractor should mount the pull box to the rail. Pull box opening shall be towards the catwalk or walkway for maintenance access.
- Q. Pull boxes installed to any cast in place concrete surfaces shall have a 1" stand off to allow for concrete sealant to be applied behind the pull box.
- ~~M.R.~~ For pull boxes mounted to structural steel the pull box must be mounted 24" off the steel face to allow for future painting.

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**6.7. Restrictions Associated with Work at MTA-Maintained Bridges**

- A. The Contractor shall submit attachment hardware shop drawings/catalog cuts as well as means/methods narrative to the Owners for review and approval prior to ordering any attachment hardware.
- B. Attachments to bridges such as hangers, conduits and bolts shall be non-corroding stainless steel.
- C. Attachments to bridges shall be UV-resistant and UL-rated as self-extinguishing within 15 seconds or of non-combustible materials.
- D. Attachments to existing MTA-maintained bridges shall not impede on the proposed clearance envelopes (vertical or horizontal). Clearance envelopes include:
  - i. From structural members to the road surface for overpass bridges.
  - ii. From structural members to the edge of the traveled way for underpass bridges.
  - iii. From concrete barriers (median) and guardrail (outsides) to the traveled way.
- E. New structural steel, such as new steel frames to support hangers, installed at existing bridges shall match the properties of existing girders.
- F. Holes in concrete, typically abutment walls, shall be cored. The space around conduits through cored holes shall be sealed with a waterproof seal made specifically for filling the annular space around a conduit. The type of material used to seal the hole shall be subject to approval by the MTA.
- G. Attachments to bridge concrete decks are prohibited.
- H. Attachments to the outside faces of bridge girders are prohibited. Any conduit that is attached to the girders must be installed within a girder bay.

**6.8. Communications Subsystem**

**6.8.1. General**

- A. The Contractor shall develop and provide an easy-to-use integration manual for future Contractors to add devices to the network. A separate manual shall be developed for Maine and New Hampshire. These manuals shall include an inventory with component model numbers of the installed system, the capacity of the communication subsystem and each component link, the method to upgrade the links to the required maximum capacity bandwidth, system configuration parameters, and any other information necessary to allow a future Contractor to connect new equipment to this communication subsystem.

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- B. The integration manual shall also include a spare capacity analysis that quantifies the data bandwidth usage in each ITS field cabinet, and quantifies the additional data capacity that could be used in each cabinet by future equipment additions without degrading the performance of the equipment in the cabinet.
- C. The Contractor shall be responsible for any monthly communication service charges until Final System Acceptance.

**6.8.2. Wired Communications Subsystem**

- A. Wired communications shall consist of single mode fiber optic cable and Ethernet cables as applicable
- B. Where Ethernet cables are required, the Contractor shall use Category 6 (Cat 6) cables that are suitable for outdoor use.
- C. All fiber optic cable installed on the Project shall be in accordance with Special Provision 677- Fiber.

**6.8.3. Wireless Communications Subsystem**

- A. Wireless Communications Equipment shall be installed in accordance with Special Provision 677.31 Wireless Communications Equipment.

**6.8.4. UPS Systems**

- A. The UPS shall send power failure status to the TMC Central Control subsystem when primary power is lost.
- B. The UPS shall include monitoring software for use in the TMC Central Control subsystem.
- C. The UPS shall include a remote power manager (RPM) unit that includes a minimum of eight (8) 120 VAC outlets. Each of the 120 VAC outlets shall be individually controllable from the Central Control Subsystem via TCP/IP.
  - a. The RPM shall include an RJ45 Ethernet port which shall be connected to an RJ45 Ethernet port on the Ethernet Switch.
  - b. Any and all software needed at the Central Control Subsystem to control the RPM shall be supplied, installed, and configured by the Contractor.
  - c. The RPM shall include the ability to program time-of-day/day-of-week schedules whereby each of the 120 VAC outlets can be individually controlled by these schedules.

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- d. Additional power strips shall be supplied and installed as needed to facilitate plugging devices into the RPM.

**6.9. Structures**

**6.9.1. Overhead Sign Structures**

- A. Contractor shall design support structures to provide a vertical clearance with the roadway of not less than 19'-0".

**6.9.2. Overhead Sign Structure Foundations**

- A. Overhead sign structure (OHSS) foundations should be constructed at the locations shown in Book 4 – 30% Conceptual Plans.
- B. The OHSS foundations shall be constructed in accordance with Section 10.3 of the NHDOT Bridge Design Manual with all interim updates.
- C. Bridge-Mounted sign supports shall be designed in accordance with Section 10.4 of the NHDOT Bridge Design Manual with all interim updates.
- D. A minimum of one test boring shall be performed at each OHSS foundation location.
- E. Spread footing foundations shall be used for all sign structures, unless directed otherwise by the Geotechnical Engineer.
- F. The maximum allowed area of footing with uplift shall be the following
  - i. Full OHSS structure < 5% of footing area
  - ii. Cantilevered sign structure < 1% of footing area
- G. Steel reinforcing bar size shall be equal for lateral and longitudinal bars (both directions) in the spread footings.
  - i. The vertical stem reinforcing bars shall be checked for development length, into both the stem and footing.
  - ii. The overlap length of the vertical reinforcing bar and anchor rod shall be checked that the length is equivalent to a Class C splice of the reinforcing bar.
- H. The distance from the top of the concrete stem to the bottom of the sign structure base plate shall equal the nut height plus 1-inch (preferred) or nut height plus the anchor rod diameter (maximum). (Note the nut height should equal the rod diameter.)
- I. Anchor rod size and layout shall be designed by the structure Fabricator and shall be identical for both left and right footings.

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- i. Anchor rods shall be straight double headed rods and conform to the requirements of ASTM F1554 Grade 55 (minimum). ASTM A615 reinforcing steel is not permitted.
  - ii. Galvanize the entire anchor rod per ASTM A153.
  - iii. Each anchor rod shall be supplied with a minimum of three hex nuts (ASTM A563 or ASTM A194) and a minimum of two flat hardened washers (ASTM F436). Bent (hooked or J-bolt) anchor rods shall not be used.
  - iv. Anchor rods shall include hardened washers. Lock washers shall not be used as they do not prevent loss of the anchor bolt preload, and their variability
  - v. For sign structures that are designed for Cantilevered Fatigue Category I, the anchor rods shall be designed for wind-induced cyclic loads per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5.17.3.4.
  - vi. Each monotube upright post shall have a minimum of eight (8) foundation anchor rods. Each post of a multi post upright (truss) shall have a minimum of four (4) foundation anchor rods per post.
- J. The connection of the structure to the foundation shall be a double-nut moment connection.
- K. Grout shall not be used between the structure base plate and the top of the footing.
- L. A stainless steel standard grade wire cloth (1/4-in. (6.4 mm) maximum opening with minimum wire diameter of AWG No. 16) shall be installed around the structure base plate and top of footing with a 2-inch (51 mm) lap as shown and noted on the footing plans. The screen is to prevent debris from collecting beneath the base plate, keep animals out, and protect the electrical wires.
- M. Cofferdams should be included in the foundation construction to protect the integrity of the roadway if there is insufficient room to excavate for the footing using 1.5:1 cut slopes.
- N. Cofferdams with Sheeting Left-in-Place should be used when cofferdam removal would create a stability problem with adjacent roadway or structures. See the NHDOT Bridge Design Manual, Chapter 10.

## 6.10. Geotechnical

### 6.10.1. General Requirements

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- A. The Contractor's Team shall include a Geotechnical Engineer to provide geotechnical exploration, subsurface and foundation design recommendations, and construction support services, as needed.
- B. The Contractor shall perform all geotechnical investigations, testing, research, and analysis necessary to effectively determine and understand the existing surface and subsurface geotechnical conditions of the Project site to be used by the Contractor to design and construct equipment foundations. The Contractor shall ensure the geotechnical investigations and analyses are both thorough and complete, so as to provide accurate information for the design of foundations, structures, and other facilities that result in a Project that is safe and meets operational standards and final acceptance requirements.
- C. The Contractor shall be responsible to perform the following:
  - a. Conduct a minimum of one test boring per structure foundation to a depth sufficient to properly sample and characterize the soil/rock conditions around and below the foundation's zone of influence. The Geotechnical Engineer shall be present for all test borings conducted by the Contractor. The Contractor's recommended sampling and testing plan shall be submitted at least ten (10) working days in advance of the exploration.
  - b. The Contractor shall access subsurface exploration or field-testing locations through State-owned Right-of-Way unless the Contractor makes their own arrangements with private landowners for access through private property.
  - c. Subsurface explorations and field testing shall be conducted with proper traffic control devices in place, as needed according to the Manual of Uniform Traffic Control Devices (MUTCD) and Owners standards, and the work shall be conducted in compliance with Dig Safe/MTA standards and environmental regulations.

#### 6.10.2. Design Requirements

- A. Foundation systems that could be evaluated by the Contractor might include, but are not limited to, the following systems: spread footings, spread footings with ground improvements, driven pile foundations with various pile types, drilled shafts, and drilled mini-piles. Foundations shall be designed to minimize construction impacts to adjacent travel lanes.



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- B. The Contractor shall provide geotechnical calculations, computer analysis results, laboratory and field test results, and subsurface information to the Owners in accordance with the standard of practice that demonstrates the design basis of the selected foundation system, and the ability of the foundation to meet the performance criteria for the structure.
- C. Select the foundation construction method and provide construction control and documentation in accordance with the standard of practice. Where applicable, construction control and performance testing shall also be supported by geotechnical instrumentation. All field personnel responsible for construction control shall have experience with the foundation system that is selected, and shall report directly to the Geotechnical Engineer.
- D. For drilled shaft or mini-pile foundations, the Contractor shall prepare appropriate contract specifications outlining the Contractor qualifications and all foundation-specific construction requirements. The contract specifications shall be based on the Bureau of Materials and Research sample Section 509 special provision.
- E. Prior to initiating any foundation construction or directional drilling, provide the Owners with an Installation Plan that provides a complete description of the methods for construction and quality assurance, equipment, and all Subcontractors that will be involved in the foundation or directional drilling construction.
- F. The Geotechnical Engineer shall provide the CQC Manager with daily reports for each day of foundation and directional drilling construction, including the results of all foundation testing for that day, a description of any changes in the Installation Plan that were required, and all quality assurance testing for that day. At the completion of the foundation construction, provide a summary of the foundation construction and testing, which certifies that the foundation meets the Project design requirements and criteria. At the completion of each directionally drilled conduit installation, provide a summary of the construction, indicating the location and depth of the conduit, including any changes to the intended conduit path.

## 6.11. Traffic Signs

### 6.11.1. General Requirements

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- A. The Contractor shall design and construct all permanent static signing and the static portion of flashing beacon signs required to support the PTSU system within the Project limits and outside of the Project limits as needed.
- B. Sign design shall be in accordance with the FHWA 2009 MUTCD and the FHWA 2004 Standard Highway Signs Book with the 2012 supplement.
- C. All ground-mounted sign supports shall be H-post. Sign support design shall be in accordance with the NHDOT Standard Specifications Section 615 and the NHDOT Standard Plans.
- D. New signs shall use ASTM Type XI sheeting and shall be in accordance with ASTM D4956.
- E. Design plans shall include a layout of the new permanent signing required, a sign legend, support and support foundation requirements, and associated details for manufacturing and installation. The Contractor is also responsible for all design and construction related to furnishing and installing new signs and modifying existing traffic signs along I-95/Maine Turnpike, along the ramps, and along the adjacent roadways in Portsmouth, NH and Kittery, ME.
- F. See Section 6.9 for the requirements for OHSS supports and foundations.
- G. Sign supports shall be made breakaway yielding or shall be protected in accordance with the Roadside Design Guide.
- H. The Contractor shall ensure that signs are clearly visible, provide clear direction and information for users, and comply with all applicable MUTCD requirements.
- I. Signs shall be located in a manner that avoids conflicts with other signs, larger vehicles, driver sight lines, vegetation, lighting, and existing structures.

#### **6.12. Utilities**

The Contractor shall coordinate, establish, connect, and pay for utility services for each ITS device and Subsystem. The Contractor shall protect all existing utilities within the Project limits, including but not limited to power, telephone, communications, water, sewer, gas and the railroad. Special care shall be taken with utilities mounted to the HLB. All work associated with utilities shall be completed in accordance with the NHDOT Utility Accommodation Manual. It is anticipated that no relocation or impacts to existing utilities will be required for this Project. The Contractor shall certify in writing to the Owners prior to starting construction that all necessary arrangements have been made for proper coordination of utility work with physical construction. A Utility Certification template is provided in Appendix D.

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**6.12.1. Project Utility Contacts**

- A. Refer to Appendix D for the utility contacts.

**6.12.2. General Requirements**

- A. The Contractor shall coordinate with the Owners and utility providers to identify all utilities (public, private, and Owner-maintained) within the Project area and ensure locations are shown correctly on the plans.
- B. The design shall address the manner in which utilities will be maintained and protected.
- C. No excavation is permitted prior to the Contractor obtaining Dig Safe services to identify all utilities (public, private, and Owner-maintained) within the Project's proposed excavation area.
- D. The Contractor shall contact MTA (Ralph Norwood, IV or Eric Barnes) for mark-out of MTA facilities within the Maine Turnpike. No excavation is permitted prior to obtaining a utility mark-out.
- E. The Contractor shall coordinate and schedule all utility services necessary to accommodate construction, operation, maintenance and/or use of the Project.
- F. The Contractor shall be responsible for the costs of utility service and associated work by direct payment to the Utility. The Contractor shall also be responsible for payment of service connection fees and monthly service charges until Final System Acceptance.

**6.12.3. Electrical Power Service**

- A. All new public electric service connections shall be metered. Meters shall be installed on new meter pedestals in locations approved by the local power company and the Owners.
- B. Metered service pedestals shall be UL-listed and shall not be installed within NHDOT limited access or controlled access right of way (LAROW or CAROW). Disconnect pedestals (service pedestals where line and load sides are both maintained by the Owners) may be installed within the LAROW and CAROW.
- C. Metered service pedestals may be installed within MTA and MaineDOT rights-of-way.

**6.12.4. Utility Construction**

- A. Underground utility connections shall be installed in accordance with the Utility company requirements.

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- B. New aerial utility connections located parallel to roadways shall follow guidance provided in the NHDOT Utility Accommodation Manual.
- C. All metered service points shall be reviewed and approved by the State and local electrical inspectors prior to the Utility company providing electrical service and installing the meter.

#### 6.12.5. Railroad Coordination

- A. The Contractor shall coordinate with the Railroad and comply with NHDOT Standard Specifications Section 107.11 for any work on, over, or adjacent to the railroad corridor.
- B. The Railroad may require the Contractor to execute the Railroad's Standard Service Agreement.
- C. The Railroad may require the Contractor to provide Railroad insurance coverage which indemnifies and saves harmless the Railroad. The insurance requirements may be found under NHDOT Standard Specifications Section 107.11.
- D. The Contractor is hereby advised that the Railroad may require a fee to cover the cost of the Railroad coordination and Service Agreement preparation. The Contractor shall contact the Railroad relative to these costs as all costs associated with coordination with the Railroad, including fees for services and flaggers (as required) shall be the responsibility of the Contractor.

#### 6.13. Traffic Control

The Contractor shall prepare and submit to the Owners for review and approval a Traffic Management Plan (TMP) as detailed below for the Project (in accordance with 23 CFR 630 Subpart J). The Project has been designated a Significant Level I Project and requires a Traffic Management Plan (TMP) document in accordance with the requirements of the Guidelines for Implementation of the Work Zone Safety and Mobility Policy. The TMP shall contain the three components of a TMP: a temporary traffic control plan (TCP), a transportation operations (TO) plan and a public information (PI) plan.

##### 6.13.1. General Requirements

- A. The Contractor shall design and construct the Project to provide for the safe and efficient movement of people, goods, and services, through and around the Project, while minimizing negative impacts to travelers, residents, and businesses.

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- B. The TMP shall specifically identify any planned closures, either full or partial, of any existing shoulders, lanes, ramps, roadways, or access points, along with mitigating traffic detours.
- C. The plan shall be supplemented by supporting traffic analyses to indicate the times of day/days of the week when these closures are proposed. The timing of shoulder, lane, and roadway/ramp closures are restricted by the requirements in these Technical Provisions, the Standard Specifications, and the Special Provisions.
- D. There is an expectation that the Contractor will maintain all roadways and ramps open to all traffic during construction except where closures are pre-approved.
- E. The Contractor shall coordinate their traffic control with other Contractors working in the same area, and in particular, with the on-going bridge rehabilitation Project.

#### 6.13.2. TMP Requirements

##### 6.13.2.1. *General Requirements*

- a. The TMP shall include 24/7 contact information for the TMP Manager, responsible for the implementation and oversight of the TMP. The Contractor may select an Alternate TMP Manager to ensure 24/7 coverage.
- b. The TMP development shall include coordination with first responders and emergency services in both Portsmouth and Kittery.
- c. The TMP shall include coordination with State Police in both Maine and New Hampshire.
- d. The TMP shall include coordination with the US Department of Homeland Security.
- e. The TMP shall provide for the safe ingress and egress of construction vehicles at the work zone.

##### 6.13.2.2. *Traffic Control Plan (TCP) Development*

- a. The TCP shall indicate how the Contractor proposes to maintain traffic flow through the work zone(s) throughout construction.
- b. The Contractor shall be responsible for the design, installation, maintenance, modification, and removal of all traffic control devices necessary to implement the approved TCP.
- c. The TCP shall be in accordance with published requirements from MTA, NHDOT, and the MUTCD.

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- d. The TCP shall specifically identify any planned closures, either full or partial, of any existing shoulders, lanes, ramps, roadways, or access points, along with mitigating traffic detours.
- e. The TCP shall be supplemented by supporting traffic analyses to indicate the times of day/days of the week when these closures are proposed. The closure times are restricted by these Technical Provisions, the Standard Specifications, and the Special Provisions.
- f. The TCP shall incorporate approved traffic control layouts from MTA, NHDOT, and the MUTCD.
- g. The TCP shall include any detour plans necessary to re-route traffic around closed roadways and ramps.
- h. All construction signs, warning and channeling devices, arrow boards, portable changeable message signs (PCMS), and temporary barriers shall be maintained in like-new condition throughout the Project.
- i. Throughout construction no travel lane may be reduced to less than 11-feet wide. No ramp lane may be reduced to less than 10-feet 6-inches wide on a tangent or 12-feet wide on a curve. For MTA owned facilities the minimum main line width for a single travel lane shall be 14 ft and minimum ramp widths of 16 ft which must be maintained at all times, from ½ hour before sunrise and ½ hour after sunset as indicated on the Sunrise/Sunset Table at: <http://www.sunrisesunset.com/usa/Maine.asp> .
- j. The minimum size for diamond warning signs on I-95 and ramps shall be 48" x 48". The minimum size for diamond warning signs on local streets shall be 36" x 36".
- k. If traffic control is anticipated over a winter season, the Contractor shall prepare a supplemental Winter Maintenance TCP on or before October 15<sup>th</sup> of each calendar year.
  - i. The Winter Maintenance TCP shall ensure that no traffic control devices hinder winter maintenance operations. If portable concrete barrier was placed on the pavement, the Contractor shall make safe the condition requiring the barrier and remove the barrier.
  - ii. All disturbed slopes shall be stabilized, either temporarily or permanently.
  - iii. At least one week prior to October 15<sup>th</sup>, the Contractor shall arrange a meeting with the Owners' maintenance personnel (through the State Project Manager) to confirm that the roadway is ready for winter suspension.

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6.13.2.3. *Transportation Operations (TO) Plan Development*

- a. The TO Plan shall include the traffic control mitigation measures that the Contractor will use to maintain traffic through the work zone.
- b. The TO Plan shall describe how flaggers, uniformed police with vehicles, and uniformed police officers will be used for traffic control. The Contractor is referred to the NHDOT “Flagger and Uniformed Officer Use In Work Zones Guidelines” and the summary “Work Zone Uniformed Officer and Flagger Use Guidelines” found on NHDOT Standard Plan TC-2.
  - i. Uniformed Officers used in New Hampshire shall be NH State Police along I-95 and may be City of Portsmouth police officers trained in traffic control for locations off the highway.
  - ii. Uniformed Officers used in Maine shall be ME State Police along the Maine Turnpike and may be Town of Kittery police officers trained in traffic control for locations off the highway.
  - iii. Only Uniformed Officers with Vehicles may be used to create rolling roadblocks; Contractor vehicles are prohibited from delaying or stopping traffic except in life safety emergencies.
  - iv. Only Uniformed Officers should be used when directing traffic through signalized intersections.
- c. The TO Plan shall include a discussion of incident management to address potential situations that will cause significant traffic delay.
  - v. The incident management plan shall include coordination with Homeland Security for both Maine and New Hampshire.
  - vi. The incident management plan should include reference to and coordination with the Portsmouth Naval Shipyard, the Seabrook Power Plant evacuation plan, and the Pease Air National Guard Base.
  - vii. The incident management plan may include the designation of on-call towing services for quick response towing.
- d. The TO Plan shall include any proposed use of smart work zone (SWZ) strategies and/or technologies.
- e. The TO Plan shall include any proposed work zone speed limit reductions. The speed limit along I-95 shall not be less than 50 mph, subject to the approval of the Owners.

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- f. See Special Provision 618.61 for specific requirements for Uniformed Officers with Vehicles.

**6.13.2.4. *Public Information (PI) Plan Development***

- a. The PI Plan shall include the specific types of communication strategies that will be employed on the Project to keep travelers informed as the Project progresses.
- b. Public information is a shared responsibility between the Owners and the Contractor. The Contractor shall be responsible for keeping the Owners informed as traffic control is modified with sufficient notice to allow the Owners to publish traffic advisories.
- c. The PI Plan shall include the placement of PCMS for traveler advisories.
- d. Proposed messaging using the MTA highway advisory radio (HAR) system shall be included in the PI Plan.
- e. Any lane, roadway, or ramp closure shall be preceded by a public information effort to communicate closure information to all affected parties.
- f. The PI Plan shall include a communications plan for keeping first responders and emergency services informed of changes to the traffic patterns, particularly for temporary roadway/ramp closures.

**6.13.2.5. *Modifications/Alterations***

- a. It is anticipated that the TMP needs may change as the Project progresses. The Contractor shall submit modifications to the TMP as a proposed modification a minimum of five working days prior to making the change.
- b. All TMP modifications shall be approved by the Owners prior to making the change.

- 6.13.3.** See Special Provision 619 for lane closure limitations and specific requirements for the Maine Turnpike.

## **7. TRAINING**

### **7.1. General**

- A. The Contractor shall develop and submit for review and approval a Training Plan. The Training Plan shall include the identification of all training modules (including proposed



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training time and sequence) and materials (manuals, workbooks, training materials). Subsequent to the approval of the Training Plan, the Contractor will be responsible for the development of the training program and for conducting training.

- B. The Training Program shall include, at a minimum:
- a. A multi-level training program to enable Owners' employees to manage, operate, maintain, repair, update and reconfigure all hardware and software systems delivered under this Project, including the following modules:
    - i. System Administrator/Supervisor/DBA Training (expected participation – 9 individuals) – to include operating and configuring all subsystems, calibrating systems, defining maintenance schedules and procedures, maintaining documentation and configuration control, identification and recovery from faults, etc. Training should require sessions at the NHDOT TMC, the MaineDOT TMC, and the MTA TMCC. Alternatively, remote training sessions are acceptable if appropriate.
    - ii. Operator Training (expected participation – 24 individuals) – The Operator Training shall include training on the recognition of fault alarms within each of the subsystems listed below. Operator Training may require two or more sessions to capture training of operators working different shifts. Operator Training shall take place at the NHDOT TMC, the MaineDOT TMC, and the MTA TMCC. Operator Training shall include operation of the Part-Time Shoulder Use (PTSU) System including but not limited to the following subsystems:
      - A Closed Circuit Television (CCTV) Subsystem
      - A Motor Vehicle Detection System (MVDS) Subsystem
      - A Dynamic Message Sign (DMS) Subsystem
      - A Lane Use Signal (LUS) Subsystem
      - A Flashing Beacon Sign Subsystem
      - A Roadway Weather Information Station (RWIS) Subsystem.
    - iii. Maintenance Training (expected participation – 12 individuals) – to include instruction on access to all field devices, all preventative maintenance requirements for each subsystem, analysis, troubleshooting and repair of all field device and control equipment, wireless communication equipment functionality and diagnostics, etc. This will require hands-on operations in the field at representative field device

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location as well as a classroom training that should be hosted in the Portsmouth, NH and/or Kittery, ME area.

- C. The training program shall include but not be limited to, startup and shutdown, safety precautions, programming, calibration, testing, cleaning, configuration changes, and module removal and replacement.
- D. Training on vendor software and firmware shall include information on all current versions and describe how the software and hardware systems interface.
- E. Training is to be in-person with hands-on training modules with the field devices, as appropriate. In-person training may have restrictions in place due to COVID-19, the Contractor shall develop the Training Program with acknowledgement that in-person trainings may have attendance restrictions, social distancing requirements, sanitation protocols, etc.
- F. The Contractor shall provide comprehensive instructor guides, lesson plans and student workbooks for all training modules.
- G. The Contractor may utilize vendor or manufacturer supplied training programs and materials that are thoroughly customized to the specific requirements and equipment deployed in this Project.
- H. The Training Plan shall be presented for review and approval to the Owners a minimum of 30 calendar days prior to any planned training activities. The Contractor shall provide the Owners no less than 21 calendar days' notice of the initiation of Training activities in order to facilitate Training oversight. Training may be initiated by the Contractor following Substantial Completion of the Project and prior to Final System Acceptance.

## **8. MAINTENANCE & WARRANTY**

Following Final System Acceptance, the operation of the PTSU System will be the responsibility of the Owners. The Contractor shall provide System Maintenance and Warranty support to the Owners for a minimum period of twenty-four (24) months after Final System Acceptance. The Owners at their sole discretion may extend the System Maintenance and Warranty period for up to two additional 24-month terms at the price provided in the Cost Proposal.

### **8.1. General Requirements**

- A. The Contractor shall bear all expenses for maintaining the PTSU System including temporary components and including communications and power service fees until the System has been tested and accepted. Once tested and accepted by the Owners, the

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Contractor shall transfer the communications and power service billing to the Owners as directed by the Owners.

- B. The Contractor shall agree to maintain, repair, and correct deficiencies in the system hardware, firmware, and vendor software, including but not limited to the individual modules or functions during the Warranty Period at the annual maintenance price including without limitation, correcting all errors, defects and deficiencies; integrating vendor software updates, and replacing incorrect documentation, defective hardware, or deficient software.

**8.2. System Maintenance**

- A. The Contractor-performed maintenance shall include all parts and labor to support all field equipment, communications systems and TMC-installed equipment. The following maintenance activities shall be performed during the maintenance period:
  - a. The Contractor shall populate the New England Compass databases with relevant equipment information, including, but not limited to: device IDs, serial numbers, device configurations and settings, subcomponents, preventative maintenance requirements, warranty information, maintenance provider contact information, as well as additional information required to maintain all equipment and devices procured and deployed under this Project.
  - b. The Contractor shall provide a recommended preventative maintenance checklist for all field equipment, the communications system and the TMC/TMCC-installed equipment.
  - c. The Contractor shall conduct quarterly preventive maintenance on all subsystems and components, including diagnostic tests and site inspections to determine that all equipment and software elements are performing correctly. These inspections shall include the cleaning of camera domes, verifying optimal aim for MVDS and wireless communications equipment, and a pixel test for the DMS equipment. The Contractor shall perform corrective maintenance to replace worn or defective components, replace malfunctioning equipment modules and reset or reprogram defective system controllers and computers.
- B. In addition to preventative maintenance, the Contractor shall perform emergency maintenance service.
- C. All equipment failures/malfunctions shall be addressed/remedied within the following schedule:

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- a. On-site response to the equipment within four (4) hours from notification on Fridays, Saturdays, Sundays, and Holidays between May 1 and October 20.
  - b. On-site response to the equipment within twenty-four (24) hours from notification on all other days.
  - c. Twenty-four (24) hour repair/replacement from arrival on-site in the field.
  - d. The Contractor shall submit a failure report to the Owners identifying the failure and solution/response within three (3) days. The failure report shall identify any additional requirements to complete the remedy.
- D. The Contractor shall keep a record of all maintenance activities and identify any types of equipment or devices that are experiencing higher than expected failure rates and take corrective action.
- E. The Contractor shall submit individual monthly maintenance activity reports as well as a monthly report documenting system failures/malfunctions and the remedies and corrective actions taken to correct the failures/malfunctions. These reports shall be submitted with the monthly maintenance invoices. These reports shall be submitted electronically to the State Project Manager and/or designees. There shall be no additional compensation for “false alerts”.

### **8.3. Spare Parts Inventory**

- A. The Contractor shall maintain an inventory of replacement spare parts for rapid maintenance response. At the conclusion of the initial 24-month Maintenance and Warranty period, the Contractor shall provide the following spare parts to the Owners, to be shared across NHDOT and MTA:
- a. CCTV equipment: 2 CCTV camera units, 2 TVSS units,
  - b. MVDS equipment: 1 MVDS unit of each type, 2 TVSS units, 1 controller of each type
  - c. DMS equipment: 2 LED modules sufficient to replace 2 panels, 1 DMS controller
  - d. LUS equipment: 2 LUS units, 2 TVSS units, 2 controllers
  - e. Single Message DMS: 2 units, 2 controllers
  - f. Communications: 2 ITS field cabinet Ethernet Switches
  - g. UPS: 4 compatible batteries

### **8.4. System Warranty Support**

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- A. The Contractor shall provide a twenty-four (24) month warranty period (including all parts and labor) for all equipment and material furnished and installed, to begin at the start of the maintenance period, and extend through its end. This warranty shall include the Contractor's general obligation to warrant all work, material, and equipment included in the PTSU System Project, as well as individual warranties obtained from all OEM and vendors. If a OEM or vendor warranty is longer than the minimum 24-month warranty period, this additional warranty time shall be transferred to the Owners.

## **9. Project Office & Equipment**

### **9.1. General Requirements**

- A. The Contractor shall provide NHDOT Project Office and Equipment that meet the requirements of a Type B Field Office specified under Section 698 of the NHDOT Standard Specifications, except as modified by this Section 9.
- B. The Contractor shall provide and maintain a NHDOT Project Office, which meets the space requirements of 698.2.1.2 and provide equipment for the duration of the Project for the exclusive use by the Owners, FHWA, its consultants and other third parties as directed by the Owners.
- C. The Contractor shall provide the Project Office as soon as practical after, and within 60 calendar days, of the Effective Date and issuance of NTP#1 as defined in Book 1 – Request for Proposals (RFP). The Project Office shall be made available to the Owners within 30 days of initiation of this Contract and shall remain available to the Owners until 30 days after all project deliverables have been received and accepted.
- D. The Contractor shall, as part of the Project:
  - a. Provide and pay for all office space, facilities, equipment, and services necessary for the Owners to oversee the work.
  - b. Maintain the Project office space for the period specified or until otherwise agreed to by the Contract Administrator in writing.
  - c. After the Term of the Agreement, provide disposal or removal of all facilities and any site restoration needed for the Project.
- E. The office space and equipment provided by the Contractor for the Owners shall be in good, clean, and serviceable condition at all times. Access to the Owners' Project Office shall be ADA compliant.

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**9.2. Field Office Site Requirements**

- A. The Contractor shall, as part of this Project:
- a. Secure a well-graded site that has an access road, a parking area, and building space that meets all local building code requirements.
  - b. Obtain all site permits
  - c. Provide all utility services.
  - d. Provide a parking area for the intended number of occupants (2) plus a minimum of seven (7) visitor spaces to reasonably accommodate stakeholders who may visit the offices for meetings. The parking area shall be reasonably level and have an all-weather surface and all-weather access.

**9.3. Maintenance, Services and Utilities**

- A. The Contractor shall provide and pay for the Project Office Space maintenance, service and utilities that meets the requirements of Section 698 of the 2016 NHDOT Standard Specifications and as follows:
- a. Potable water service.
  - b. Weekly janitorial service, including maintenance of trash containers and trash pickup service.
  - c. Maintenance of the exterior areas, including the access to parking areas, that keeps them neat, clean, in good repair, and safe.
  - d. Exterior security lighting that is automatically activated at low light levels to maintain at least two foot-candles of lighting within the fenced office site.

**9.4. Project Office Equipment and Other Accessories**

- A. The contractor shall provide Project Office equipment that meets minimum requirements of subsection 2.2 of Section 698 of the 2016 NHDOT Standard Specifications, as well as the following:
- a. Internet Access for Department Supplied Equipment:
    - i. Mobile Hotspot (Qty 4) coverage shall be adequate for the area required & shall be 4G/ 5G compatible. Unlimited data usage and at least 128 kbps upload and 384 kbps download bandwidth.
  - b. Internet Access
    - i. Unlimited-hours Broadband Internet Access Wireless Router
  - c. Desktop Monitor (Qty 4): 24" Minimum Diagonal View Area

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- i. Color Flat Panel
  - ii. Minimum 16:9 aspect ratio with a 1600x900 pixel resolution
  - iii. 3ms response time or better
  - iv. Adequate graphics card that supports the monitor's resolution; interfaces properly with the field computers and laptops; and provides high definition video display.
  - v. Compatible connecting cable(s)
- d. Projector (Qty 1)
  - i. Minimum 1080p resolution
  - ii. Supports WiFi connectivity
  - iii. Includes HDMI port
  - iv. Includes HDMI-HDMI cable with minimum length of 8 feet
- e. Video Monitor (Qty 1)
  - i. LED 4K Smart TV
  - ii. Minimum screen size of 55 inches diagonal view area
- f. High Capacity Color Copier/ Scanner/ Printer (Qty 1)
  - i. Laser Jet
  - ii. High Capacity Color
  - iii. Copier/Scanner/Printer  Network Capable
  - iv. Wireless
  - v. Microsoft Windows compatible
  - vi. Resolution: 600dpi color, 1200dpw b&w, minimum
  - vii. Capable of scan/copy/print 11 x 17 color originals
  - viii. Two dedicated printing trays: (1) 8½ x 11 and (1) 11 x 17
  - ix. Tray Capacity: 250 sheets, minimum
  - x. Speed: 30 sheets per minute, minimum
  - xi. Duplex printing capable
  - xii. Computer disks with software drivers and utilities
  - xiii. Replacement Toner Cartridge(s) as required, with 1 spare on hand at all times
  - xiv. Paper with the following minimum specifications:
    - 1. 8 ½" x 11" sheets – 3 reams to be maintained
    - 2. 8 ½" x 14" cut sheets – 2 reams to be maintained
    - 3. 11" x 17" cut sheets – 1 ream to be maintained
- g. Telephone Service

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- i. Landline phone service with voicemail accessibility.
  - h. Telephone (Qty: 2)
    - i. A wired phone with an additional portable handset with speaker function for conference calls.
    - ii. One phone must include speaker and microphone functionality for conference calls
  - i. Surge Protector (Qty 4)
    - i. 15 Amps, 6 outlets with circuit breaker control and spike protection  
Battery Backup
  - j. Strobe Light VP420M (Qty 1)
    - i. Magnetic mount, 20 watt, 12/24 Volt DC (Whelen model equivalent) with Port car or equivalent DC adapter.
- B. Upon written request, NHDOT may require the contractor to furnish miscellaneous office supplies such as field books, cross section paper, measuring tapes, loose-leaf binders, writing utensils, etc. as appropriate. The cost of these office incidentals shall be included in the Contractor's lump sum price.



## APPENDIX A

### General Installation Requirements for Support Poles and Foundations

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This installation requirement is generally required for the installation of CCTV Poles but may be used for other structural supports for ITS equipment as required by the Technical Provisions or by the Engineer. The applicable provisions of NHDOT Standard Specification 550.3 apply to the steel structure installation of connections made with high strength bolts (e.g. ASTM A325). The installation procedures for anchor rods are different than for high strength bolts and shall conform to the following:

1. 2015 AASHTO "LRFD Standard Specifications for Structural Supports for Highway Traffic Signs, Luminaires and Traffic Signals";
2. FHWA Guidelines for the Installation, Inspection, Maintenance and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals (Publication No. FHWA NHI 05-036 March 2005).

#### Procedure for Installing Anchor Rods in the Foundation for Double-Nut Connections

The procedure for installing anchor rods in the foundation for double-nut connections is as follows:

1. The Foundation Contractor shall submit a written plan and procedure to the NHDOT for approval for the installation, pretensioning, inspection, and testing of anchor rods.
2. The Contractor shall furnish necessary equipment, including a torque wrench, used for tensioning the rods or for final torque verification, that has a torque indicator that is calibrated annually. A certificate of calibration shall be furnished to the NHDOT at the jobsite. A torque multiplier may be used. For hydraulic wrenches, the Contractor shall furnish a chart correlating torque with hydraulic pressure readings.
3. Anchor rods shall be installed as a group in the concrete form and secured against relative movement and misalignment, such as with a template set composed of metal rings with nuts on both sides at two locations along the length of the anchor rods. One of the rings is usually above the top of the concrete and is reused as a template.

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4. The template set (or other device) with anchor rods shall be secured in its correct position in the concrete form in accordance with the drawings. The exposed threads shall be taped with duct tape to prevent contamination by concrete.
5. The concrete shall be placed and cured in accordance to NHDOT Standard Specification 520.
6. If a top template is above the concrete surface, it may be removed 24 hours after placing the concrete.
7. The exposed part of the anchor rods shall be cleaned with a wire brush or equivalent and lubricated. Use an approved paraffin-based stick wax, as listed on the NHDOT Qualified Products List for Item 550 fasteners, applied to the threads and the nut face in contact with the washer.
8. After at least 24 hours after placing concrete, the anchor rods shall be inspected visually to verify that there is no visible damage to the threads and that their position, elevation, and Projected length from the concrete are within the tolerances specified on the drawings. In the absence of required tolerances, the position, elevation, and Projected length from the concrete shall be according to the *AISC Code of Standard Practice for Steel Buildings and Bridges*. The misalignment from vertical shall be no more than 1:40. It is good practice to use a steel or wood template with the required hole pattern to check the base of the post and the anchor rods.

To check the thread condition the nuts shall be turned onto the rods full length well past the elevation of the bottom of the leveling nut and backed off by one worker using an ordinary wrench without a cheater bar. The threads are considered damaged if more than minimal effort (i.e. an unusually large effort) is required to turn the nut.

9. The structure shall not be placed onto the leveling nuts until the foundation concrete has cured for at least 7 days minimum or attained a minimum of at least 80 percent of its design compressive strength and the foundation backfilled to final ground.
10. Final ground elevations shall be taken from the roadway cross sections. If actual final ground elevations differ by more than 1'-0", then a complete redesign of the sign foundation will be required.

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### Procedure for Pretensioning Anchor Rods in Double-Nut Joint Moment Connections.

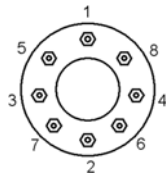
The procedure for pretensioning anchor rods in double-nut joint moment connections in the installed concrete foundation is as follows:

1. The proper position of the anchor rods and the proper hole pattern on the post shall be verified (preferably with a template).
2. It shall be verified that the nuts can be turned onto the rods well past the elevation of the bottom of the leveling nut and backed off by one worker using an ordinary wrench without a cheater bar.
3. If the threads of anchor rods were lubricated more than 24 hours before placing the leveling nuts or have been wet since they were lubricated, the exposed threads of the anchor rod shall be re-lubricated. Leveling nuts shall be cleaned and the threads and bearing surfaces lubricated.
4. Leveling nuts shall be placed on the anchor rods and set level.
5. Leveling nut washers shall be placed on the anchor rods.
6. The template shall be placed on top of the leveling nuts to check the level of the nuts. Verify that the maximum clear distance between the bottom of the bottom leveling nut and the top of the concrete is not more than one anchor rod diameter. The preferred clear distance is one inch. Start by placing the leveling nuts one half inch clear distance above the concrete foundation. Bring all the nuts to the same level as the highest nut above the foundation. Do not exceed the maximum clear distance of one anchor rod diameter between the concrete foundation and the bottom of the leveling nuts. Remove the template once all the nuts are level.
7. The baseplate and structural element (e.g. post, end frame, or structure leg) shall be placed with a crane.
8. The post, end frame, or structure leg shall be plumbed or the base plate leveled, and the anchor rods pretensioned. The following is the installation sequence for double-nut joints using the "turn-of-the-nut" method of pretensioning.
9. Top nut washers shall be placed. (Note: Do not use lock washers when anchor rods are pretensioned for double-nut connections using the pretension procedures described herein.)
10. Lubrication of the fastener components is required for proper installation. Anchor rod threads, nut threads, and the bearing surface of top nuts shall be lubricated, and

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the top nuts placed and tightened to the snug-tight condition (20-30% of the verification torque). See section FHWA Guideline Reference and Table 3. (Note: A snug-tight condition is the tightness attained by the full effort of a person using a wrench with a handle length equal to 14 times the diameter of the bolt but not less than 18 inches. Apply the full effort as close to the free end of the wrench as possible. Pull firmly by leaning back and using the entire body weight on the end of the wrench until the nut stops rotating.)

11. Leveling (bottom) nuts shall be tightened to the snug-tight condition (i.e. 20-30% of the verification torque. See Table 3.) following a star pattern for two full tightening cycles. (Note: Use a minimum of two separate passes of tightening. Sequence the tightening in each pass so that the opposite side nut will be subsequently tightened (i.e. following a star pattern shown in Figure 8) until all the nuts in that pass have been snugged.)



**Figure 8. Star Pattern Tightening Sequence.**

12. At this point, the installation crew shall verify if beveled washers are necessary. Beveled washers may be necessary under the leveling or top nut if any face of the base plate has a slope greater than 1:20 and/or any nut could not be brought into firm contact with the base plate. If any beveled washer is required, the installation crew shall disassemble the joint as necessary, add the beveled washer(s) and retighten (in a star pattern) to the snug-tight condition for the top and leveling nuts.
13. Pretensioning by "Turn-of-the-Nut": Pretension the anchor rods to the minimum Installation Pretension listed in Table 3 in the following manner. Before turning the top nuts further, the reference position of the top nut in the snug-tight condition shall be marked relative to the rod and base plate with a suitable marking using a permanent paint marker. Mark the rod, nut, and base plate with marks in a straight line when viewed from above. Top nuts shall be turned in increments following a star pattern for at least two full tightening cycles to attain the nut rotation specified in Table 1 if UNC threads are used. After pretensioning, the nut rotation shall be verified.

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<b>Table 1 - Nut Rotation for Turn-Of-Nut Pretensioning</b>		
<b>Anchor Rod Diameter, in.</b>	<b>Nut Rotation from Snug-Tight Condition a, b, c</b>	
	<b>F1554 Grade 36</b>	<b>F1554 Grades 55 and 105 A615 and A706 Grade 60</b>
1 1/2 or less	1/6 Turn (60°)	1/3 Turn (120°)
>1 1/2	1/12 Turn (30°)	1/6 Turn (60°)

- a. Nut rotation is relative to the anchor rod. The tolerance is plus 20 degrees.
- b. Applicable only to double-nut joints.
- c. Beveled washer shall be used if:
  - i) the nut is not in firm contact with the base plate; or
  - ii) the outer face of the base plate is sloped more than 1:40.

14. The load may be released from the crane.

15. Initial check- A torque wrench shall be used to verify that a torque at least equal to the computed verification torque,  $T_v$ , is required to additionally tighten the leveling nuts and the top nuts. See Section FHWA Guideline Reference and Table 3. An inability to achieve this torque (meaning that the nut moves before the torque is achieved) shall be interpreted to indicate that the threads have stripped and shall be reported to the NHDOT. (Note: The installation procedure relies on the "Turn-of-the-Nut" method to achieve the Installation Pretension. Although torque is considered to be a poor way to ensure pretension (due to variable thread condition) it is the only way to check tension after tightening.) The NHDOT may reject, and subsequently require replacement of, the entire base installation if the threads have stripped. All costs associated with replacing the base installation, if rejected, or performing other repairs shall be borne by the Contractor.

16. Relaxation check- After at least 48 hours have elapsed, and in the presence of the NHDOT, the torque wrench shall be used to verify that a torque at least equal to 110 percent of the verification torque,  $T_v$ , is required to additionally tighten the leveling

## APPENDIX A

nuts and the top nuts on the anchor rods. See FHWA Guideline Reference and Table 3. An inability to achieve this torque (meaning that the nut moves before the torque is achieved) shall be interpreted to indicate that the threads have stripped and shall be reported to the NHDOT.

17. Ultrasonic testing (UT) - The Contractor shall ultrasonically test (UT) the installed anchor rods using straight-beam transducers to verify the absence of flaws. (See UT procedures below.) The NHDOT will reject, and shall require replacement of, the entire base installation if reflectors are found with an indication rating less than 15 decibels. All costs associated with replacing the base installation, if rejected, will be borne by the Contractor.
18. During maintenance activities the NHDOT intends to verify that the top nuts are not loose. Under no circumstance shall any nut be tack welded to the washer or the base plate nor shall the leveling nut be tack welded as a method of preventing nut loosening.

### **FHWA Guideline Reference:**

1. In the FHWA Guideline document, the snug-tight condition for anchor rods is defined as nuts tightened to a torque between 20 and 30 percent of the verification torque computed using the following equation:

$$T_v = 0.12d_b F_1 \quad \text{where}$$

$T_v$  = verification torque (inch-kips)

$d_b$  = nominal body diameter of the anchor rod (inches)

$F_1$  = minimum installation pretension (kips) equal to 50 percent of the specified minimum tensile strength of F1554 Grade 36 rods, and 60 percent for all other threaded fasteners.

(Note: the torque in "in-kips" can be multiplied by 83.3 to get ft-lb).

2. A very large torque may be required to properly tighten anchor rods greater than 1 inch in diameter. A "cheater bar" such as a pipe or extension handle as much as 10 feet long may be required for the torque wrench. For snugging the leveling nuts, an open-end wrench with a ten-foot long pipe or extension handle will typically suffice. Tightening the top nuts for anchor rods greater than 1 inch in diameter may require either of the following:

## APPENDIX A

- A hydraulic torque wrench, or
- A box end "slug" or "knocker" wrench with a 10-ft, long pipe or extension handle.

The box end wrench may be moved by impacts with a 16-pound sledgehammer or by the efforts of three or more workers. It is essential that the workers have good traction during this effort.

**Table 2 - Tensile Properties for Anchor Rods**

Tensile Property	ASTM F1554	ASTM F1554	ASTM F1554	ASTM A706
	Rod Grade 36	Rod Grade 55	Rod Grade 105	Bars Grade 60 *
Minimum Yield Strength F <sub>y</sub> , (ksi)	36	55	105	60
Minimum Tensile Strength F <sub>u</sub> , (ksi)	58	75	125	80

\* Reinforcing bars shall not be used for non-redundant, fatigue-susceptible support structures such as cantilevered overhead sign structures and high mast luminaires.

## APPENDIX A

<b>Table 3 - Minimum Anchor Rod Pretension for Double-Nut Moment Joints</b>							
<b>ASTM F1554 Grades 36, 55, and 105 rod material:</b>							
Nom. Bolt diam D, (in)	Gross Area (sq in)	UNC Stress Area (sq in)		<b>Installation Pretension, Fi (kips)</b>	Snug Tight Torque check 20-30% Tv (ft-lb)	Verification Torque check Tv (ft-lb)	Relaxation Check 110% Tv (ft-lb)
<b>Yield 36</b>		Min. Tensile, Fu, 58 ksi	0.50 Fu (ksi)				
1.00	0.79	0.61	29	<b>18</b>	35-53	177	195
1.25	1.23	0.97	29	<b>28</b>	70-105	351	387
1.50	1.77	1.41	29	<b>41</b>	123-184	613	674
1.75	2.41	1.90	29	<b>55</b>	193-289	964	1,060
2.00	3.14	2.50	29	<b>73</b>	250-435	1,449	1,594
2.25	3.98	3.25	29	<b>94</b>	424-636	2,120	2,332
<b>Yield 55</b>		Min. Tensile, Fu, 75 ksi	0.60 Fu (ksi)				
1.00 *	0.79	0.61	45	<b>27</b>	55-82	274	302
1.25	1.23	0.97	45	<b>44</b>	109-164	545	600
1.50	1.77	1.41	45	<b>63</b>	190-285	951	1,047
1.75	2.41	1.90	45	<b>86</b>	299-449	1,496	1,645
2.00	3.14	2.50	45	<b>113</b>	450-675	2,249	2,474
2.25	3.98	3.25	45	<b>146</b>	658-987	3,289	3,618
<b>Yield 105</b>		Min. Tensile, Fu, 125 ksi	0.60 Fu (ksi)				



## APPENDIX A

1.00	0.79	0.61	75	<b>45</b>	91-137	457	503
1.25	1.23	0.97	75	<b>73</b>	182-273	909	1000
1.50	1.77	1.41	75	<b>105</b>	317-476	1586	1744
1.75	2.41	1.90	75	<b>143</b>	499-748	2493	2742
2.00	3.14	2.50	75	<b>188</b>	750-1125	3749	4123
2.25	3.98	3.25	75	<b>244</b>	1096-1645	5482	6030
<b>ASTM A615 and A706 bar material **:</b>							
<b>Yield 60</b>		Min. Tensile, Fu, 80 ksi	0.60 Fu (ksi)				
1.00	0.79	0.61	48	<b>29</b>	59-88	293	322
1.25	1.23	0.97	48	<b>47</b>	116-175	582	640
1.50	1.77	1.41	48	<b>68</b>	203-304	1,015	1,116
1.75	2.41	1.90	48	<b>91</b>	319-479	1,595	1,755
2.00	3.14	2.50	48	<b>120</b>	480-720	2,399	2,639
2.25	3.98	3.25	48	<b>156</b>	702-1053	3,509	3,859

\*\* Reinforcing bars shall not be used for non-redundant, fatigue-susceptible support structures, such as cantilevered overhead sign structures and high mast luminaires.

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\*Example:

$$\begin{aligned} \text{Fi} &= (0.60) (\text{Fu}) (\text{Stress Area}) & \text{Fi} &= (.6)(75 \text{ ksi})(0.61 \text{ sq in}) & = & 27 \\ & & & & & \text{kips} \\ \text{Tv} &= (\text{Fi}) (\text{D}) (0.12) (83.3) & \text{Tv} &= (27 \text{ k})(1.0 \text{ in})(0.12)(83.3) & = & 274 \text{ k-} \\ & & & & & \text{ft} \\ \text{Snug} &= (\text{Tv}) (30\%) & \text{Snug} &= (274 \text{ k-ft})(.3) & = & 82 \text{ k-} \\ & & & & & \text{ft} \\ \text{Check} &= (\text{Tv}) (110\%) & \text{Check} &= (274 \text{ k-ft})(1.1) & = & 302 \text{ k-} \\ & & & & & \text{ft} \end{aligned}$$

### Anchor Rod Inspection by Ultrasonic Testing (UT)

1. **Certification** - The UT operator must be certified as ASNT Level II, on recommended practice SNT-TC-1A, or specifically trained by an ASNT Level III for this application.
2. **Preparation** -
  - a. Grind the top surface of all anchor rods to be as smooth as possible, flat (i.e., a level surface), square (i.e. perpendicular to the shank), and with all galvanizing, rust, dirt, and debris removed. The finished contour shall allow intimate transducer contact. Sand off any rust bloom that may have formed after grinding.
  - b. Note that some rods may be marked to serve as bench marks. Only grind the rod enough to remove paint and to smooth the surface and not change its elevation.
  - c. Some rods may have a slanted end and cannot readily be ground to a flat, perpendicular surface. Note such rods on the inspection form for future attention.
3. **Calibration** -
  - a. Check calibration at each location before inspecting any anchor rods.
  - b. Operate the UT per AWS D1.5 unless described or approved otherwise.
  - c. Calibrate the ultrasonic unit for straight beam probe method using a 10-inch screen with a 1-inch diameter (2.25 MHz) straight beam probe. The probe is placed on a 10-inch calibration block (DSC block or a threaded section of anchor bolt) and the indications on the screen are adjusted so that the back reflection is positioned at 10 inches. Next, place the probe on a 10-inch long test bar (i.e. the threaded section of anchor bolt) that has a 1/8 inch deep saw cut at a set distance (3-inch from the end opposite the probe) in the threaded portion of the rod. Peak the back reflection from the 1/8 inch deep saw cut until the indication is at 60 or 80 percent of screen height.

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The dB reading is recorded to establish the "REFERENCE LEVEL." The "SCANNING LEVEL" is set by adding 14 to 30 dB over the reference level.

4. Test - Apply couplant to the top of the rods. Ultrasonically test the anchor rods using a circular motion inspection pattern and record the results. When scanning the anchor rods, there should be no indications on the CRT screen between the Main Bang (zero depth) and the end of the screen (10-inch depth). Any indication that is displayed after the Main Bang is a possible flaw. Record the depth of the discontinuity observed and the amount of dB required to bring the indication to the "REFERENCE LEVEL" on the screen. This is recorded as the "INDICATION LEVEL."
5. Cleanup - After UT inspection is completed, wipe off all the couplant with a wet rag, allow it to dry completely, and paint the rod ends with one or more coats of liquid cold galvanizing or zinc-rich paint to a minimum 3 mils dry film thickness (DFT). Check coating thickness with a gage.

APPENDIX B

**Maine Turnpike Authority (MTA)**  
**Work Permit/License Application Package**

See Below

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Insert Page 1 of 5 MTA Work Permit Package Here

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APPENDIX C

**Maine Turnpike Authority (MTA)  
MS4 Plans**

**2013 MS4 Stormwater Awareness Plan**

See Below

**2013 MS4 Targeted Adoption Plan**

See Below

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## APPENDIX C

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## APPENDIX C

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## APPENDIX C

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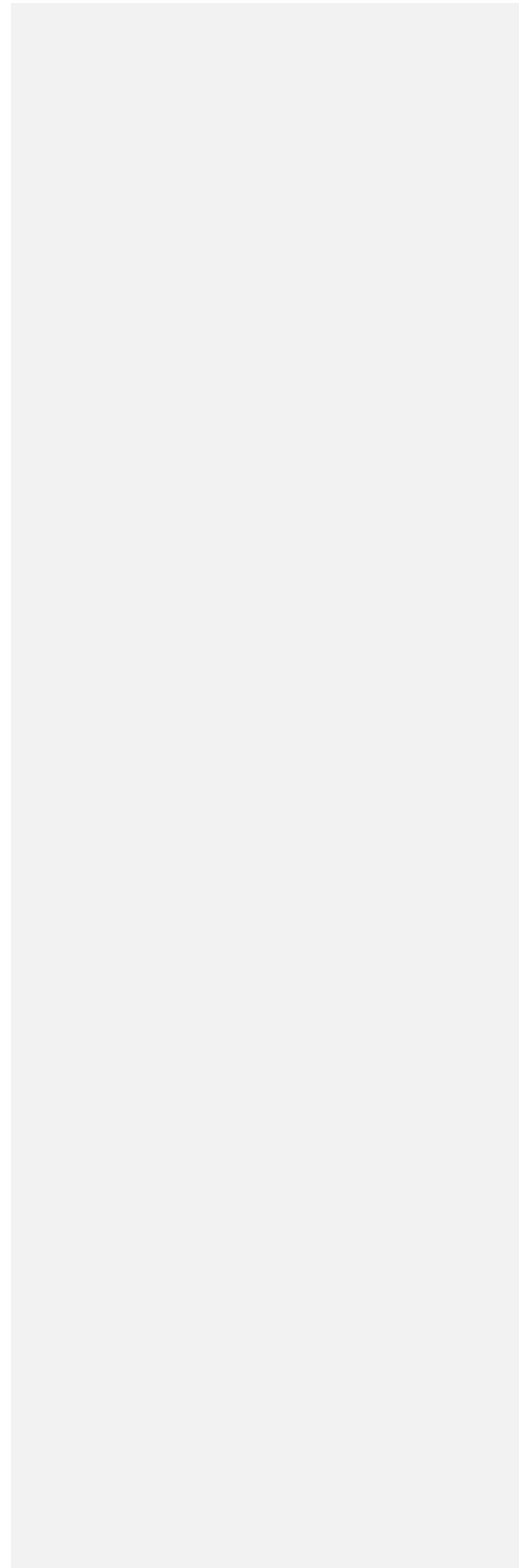
APPENDIX C

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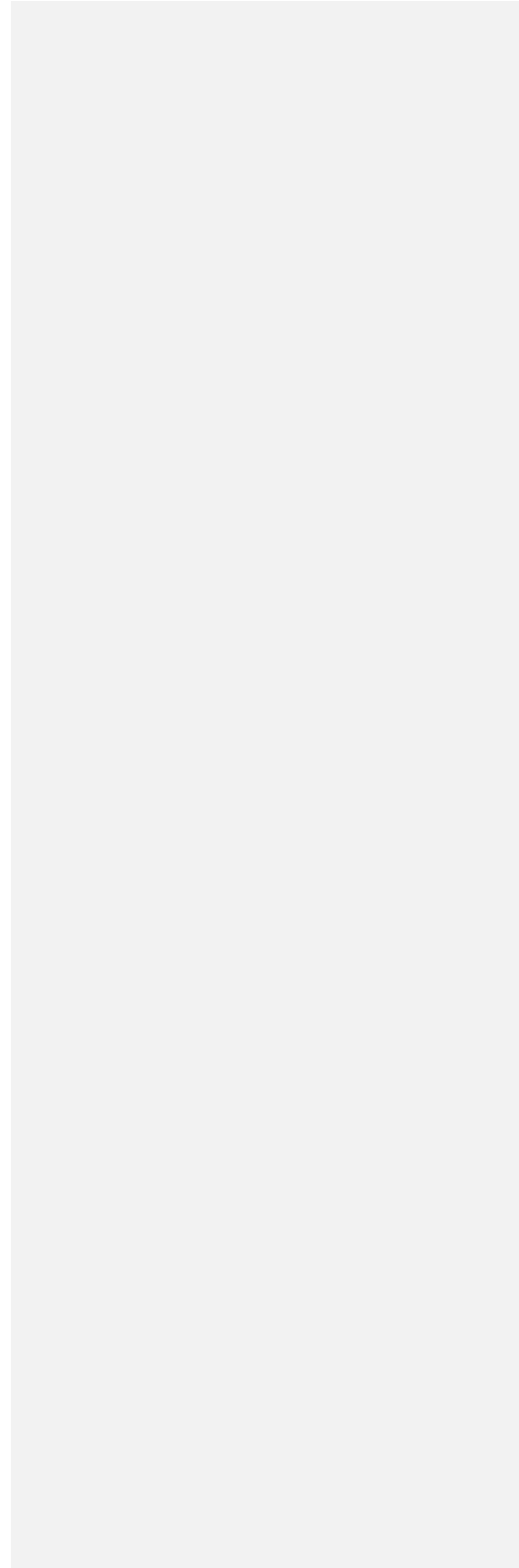
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APPENDIX D

**List of Utility Contacts and  
Utility Certification Template**

New Hampshire Department of Transportation (NHDOT) Design Services Prime Contact	
Name (Title): Lennart Suther (Utility Engineer) Address: PO Box 483 / 7 Hazen Drive Concord, NH 03302-0483 Phone: (603) 271-1593 Email: <a href="mailto:Lennart.Suther@dot.nh.gov">Lennart.Suther@dot.nh.gov</a>	
CATV – Comcast	Communications – Crown Castle Fiber
Name (Title): Mike Collins (Project Coordinator) Address: 334B Calef Highway Epping, NH 03042-2325 Phone: (603) 693-7008 Fax: 679-1823 Email: <a href="mailto:mike_collins@cable.comcast.com">mike_collins@cable.comcast.com</a>	Name (Title): Mike Bonanno (Manager Fiber Construction) Address: 80 Central Street Boxborough, MA 01719 Phone: (603) 693-7008 Fax: 679-1823 Email: <a href="mailto:mark.bonanno@crowncastle.com">mark.bonanno@crowncastle.com</a>
Communications – FirstLight Fiber	Communications – Teleport Communications America, LLC
Name (Title): Ed Robinson (Manager, OSP Engineering NH/MA) Address: 359 Corporate Drive Portsmouth, NH 03801 Phone: (603) 986-2984 Email: <a href="mailto:erobinson@firstlight.net">erobinson@firstlight.net</a>	Name (Title): Scott Ferreira Address: 157 Green Street Suite 2 Foxboro, MA 02035 Phone: (508) 216-0059 Email: <a href="mailto:Sf5412@att.com">Sf5412@att.com</a>
Fire – Portsmouth Fire Department	Gas – M & N Operating Company (Spectra Energy)
Name (Title): Todd Germain (Fire Chief) Address: 170 Court Street Portsmouth, NH 03801 Phone: (603) 427-1515 Email: <a href="mailto:tagermain@cityofportsmouth.com">tagermain@cityofportsmouth.com</a>	Name (Title): Lara T. Bailey (Sr. Right of Way Specialist) Address: 547 Lincoln Street Richmond, ME 04357 Phone: (207) 737-8249 ext. 8067860 Fax: 207-737-0949 Email: <a href="mailto:ltbailey@enbridge.com">ltbailey@enbridge.com</a>

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APPENDIX D

Gas – Unitol Service Corporation	Gas – Unitol Service Corporation
Name (Title): Nicholas DeMarchi (Gas Planning Engineer) Address: 325 West Road Portsmouth, NH 03802-0508 Phone: (603) 294-5024 Email: <a href="mailto:demarchin@unitil.com">demarchin@unitil.com</a>	Name (Title): Charlie Kickham (Manager, GIS & CAD) Address: 6 Liberty Lane West Hampton, NH 03842 Phone: (603) 773-6421 Email: <a href="mailto:kickham@unitil.com">kickham@unitil.com</a>
ITS – NHDOT	Power Distribution – Eversource Energy
Name (Title): Charles E. Blackman (ITS Project Manager) Address: PO Box 483 Bureau of Transportation Systems Management & Operations Concord, NH 03302-0483 Phone: (603) 271-6862 Email: <a href="mailto:Charles.E.Blackman@dot.nh.gov">Charles.E.Blackman@dot.nh.gov</a>	Name (Title): Erin L. Normand (Supervisor – ESSC) Address: 780 North Commercial Street PO Box 330 Manchester, NH 03105-0330 Phone: (603) 634-3767 Fax: 603-634-3523 Email: <a href="mailto:erin.normand@eversource.com">erin.normand@eversource.com</a>
Power Transmission – Eversource Energy (Transmission)	Railroad Owner – Pan Am Railways
Name (Title): Russell B. Maille (Right of Way Specialist) Address: 780 North Commercial Street PO Box 330 Manchester, NH 03105-0330 Phone: (603) 634-2477 Fax: 603-634-2209 Email: <a href="mailto:Russell.maille@eversource.com">Russell.maille@eversource.com</a>	Name (Title): Ted Krug (Chief Engineer of Design & Construction) Address: Iron Horse Park North Billerica, MA 01862 Phone: (978) 663-1108 Fax: 978-663-1262 Email: <a href="mailto:tkrug@panamrailways.com">tkrug@panamrailways.com</a>
Telephone – Consolidated Communications, Inc.	Water & Sewer – Portsmouth Public Works Department
Name (Title): David Kestner (Network Engineer) Address: 1575 Greenland Road Greenland, NH 03840 Phone: (603) 433-2119 Email: <a href="mailto:David.Kestner@consolidated.com">David.Kestner@consolidated.com</a>	Name (Title): Eric B. Eby (Parking & Transportation Engineer) Address: 680 Peverly Hill Road Portsmouth, NH 03801-5356 Phone: (603) 766-1415 Fax: 603-427-1539 Email: <a href="mailto:ebeby@cityofportsmouth.com">ebeby@cityofportsmouth.com</a>

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## APPENDIX D

Maine Turnpike Authority (MTA) Prime Contact	
Name (Title): Ralph Norwood IV (Project Manager) Address: 2360 Congress Street Portland, ME 04102 Phone: (207)-871-7771 Email: <a href="mailto:RNorwood@maineturnpike.com">RNorwood@maineturnpike.com</a>	
Power – Central Maine Power Company	Communications – Comcast (Berwick Area)
Name (Title): Timothy Laney (Project Manager) Address: Augusta, ME 04240 Phone: Email: <a href="mailto:timothy.laney@cmpco.com">timothy.laney@cmpco.com</a>	Name (Title): Scott Letzelter (Project Coordinator) Address: 334B Calef Highway Epping, NH 03042-2325 Phone: (603) 765-3372 Email: <a href="mailto:Michael.Letzelter@comcast.com">Michael.Letzelter@comcast.com</a>
Communications – FairPoint Communications, Northern New England Telephone Operations LLC	Sewer – Kittery Sewer Department
Name (Title): Address: 5 Davis Farm Road Portland, ME 04103 Phone: (207) 878-0854 Email: <a href="mailto:mdot_requests@fairpoint.com">mdot_requests@fairpoint.com</a>	Name (Title): George Kathios (Superintendent) Address: 200 Rogers Road Kittery, ME 03904 Phone: (207) 439-4646 Email: <a href="mailto:gkathios@kitteryme.org">gkathios@kitteryme.org</a>
Water – Kittery Water District	Town of Kittery
Name (Title): Michael S. Rogers (Superintendent) Address: 17 State Road Kittery, ME 03904 Phone: (207) 439-1128 Email: <a href="mailto:mikerkwd@comcast.net">mikerkwd@comcast.net</a>	Name (Title): Mary-Ann Conroy (Public Works Commissioner) Address: 200 Rogers Road Kittery, ME 03904 Phone: (207) 439-0333 Email: <a href="mailto:mconroy@kitteryme.org">mconroy@kitteryme.org</a>
Oxford Networks	Revolution Networks
Name (Title): Michael Ellingwood (Engineering Manager) Address: 491 Lisbon Street Lewiston, ME 04240 Phone: (207) 333-3471 Email: <a href="mailto:mellingwood@firstlight.net">mellingwood@firstlight.net</a>	Name (Title): Michael Ellingwood (Engineering Manager) Address: Phone: (207) 333-3471 Email:
Railroad – Springfield Terminal Railway	Gas – Unitil Service Corporation
Name (Title): Ted Krug (Chief Engineer, Design & Construction) Address: Phone: (978) 663-1108 Email: <a href="mailto:tkrug@panam.com">tkrug@panam.com</a>	Name (Title): Sam Murray (Project Leader) Address: 1075 Forest Avenue Portland, ME 04103-3321 Phone: 1-800-524-4486 Email: <a href="mailto:murray@unitil.com">murray@unitil.com</a>

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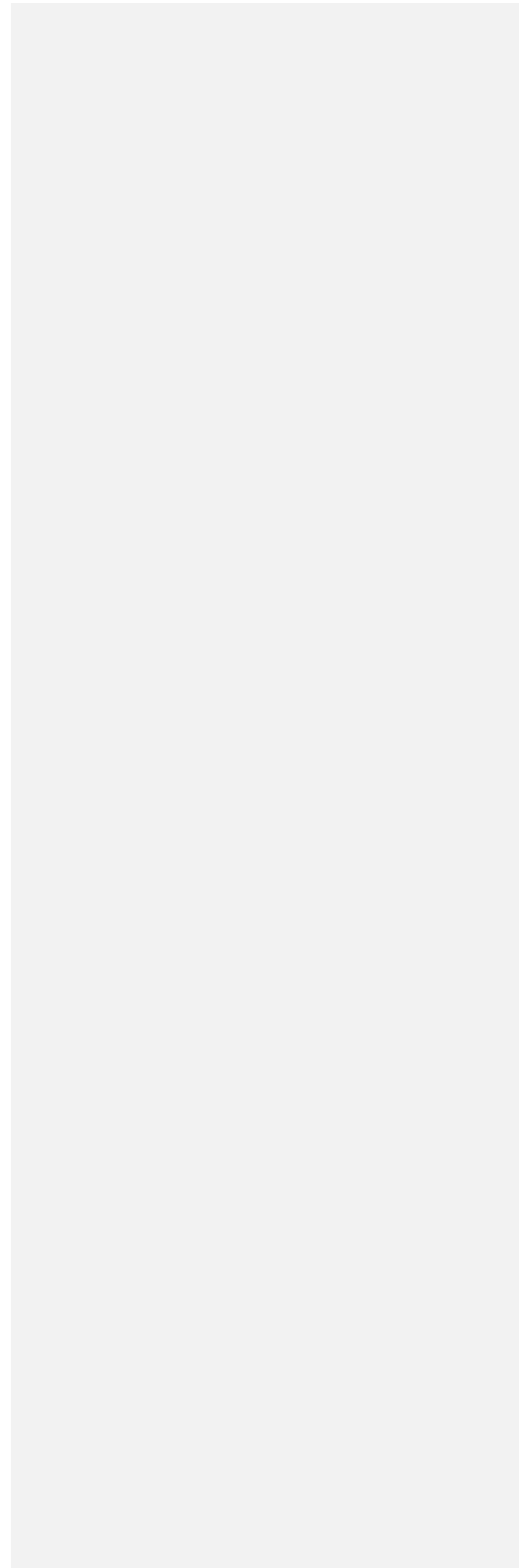
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INSERT NHDOT UTILITY CERTIFICATION TEMPLATE

APPENDIX E

**NHDOT Environmental Commitments Memo**

See Below



APPENDIX E

Insert Page 1 Commits memo



APPENDIX E

Insert Page 2 Commits memo

## APPENDIX EF

### Owner Inventory of Available Pull Boxes and Conduit Materials

The Owners are furnishing the following pull boxes and conduit materials to the Contractor for use on the HLB. The materials will be stored at the NHDOT Bridge Maintenance facility located at 10 Ranger Way. Please contact Jeff Farwell to arrange for inspection and pick-up of the materials.

#### Pull boxes and hardware

7 – EACH      48" x 48" x 48" Stainless Steel cabinets

6 – EACH      24" x 24" x 24" Stainless Steel cabinets

2 – EACH      24"x 24" x 24" Installed Stainless Steel cabinets @ North Anchorage Pier

9 – EACH      24" x 24" x 8" Stainless Steel cabinets

2 – EACH      24" x 24" x 8" Installed Stainless Steel cabinets @ North Abutment

8 – EACH      12" x 12" x 8" Stainless Steel Pull Boxes

#### FRE Fittings for 4-inch conduit

30 – EACH      90 degree elbows, 24"

30 – EACH      45 degree elbows, 24"

30 – EACH      Sleeve couplings

~~30~~44 – EACH      Box connectors with ring nuts

10 – EACH      Couplings

#### FRE Fittings for 2-inch conduit

15 – EACH      90 degree elbows, 24"

15 – EACH      45 degree elbows, 24"

8 – EACH      22.5 degree elbows

12 – EACH      Box connectors

16 – EACH      Couplings

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10 – EACH      Epoxy kits

### Assorted Mounting Hardware

8 – EACH      Welded 2” square tube 316 Stainless Steel Brackets with End Brackets (complete assemblies)

8 – EACH      1.5” square tube slide splice joint, 24”

10 – EACH      10-foot sections of Stainless Steel Unistrut

50 – EACH      Unistrut Spring Nuts with Bolts