

**MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
10 Park Plaza, Boston, MA**

**STANDARDIZED
SCOPE OF SERVICES GUIDANCE
FOR PREPARING
WORK HOUR ESTIMATE FORMS
FOR CONSULTANT SERVICES**

REVISED NOVEMBER OF 2013 – PRESENTED TO DESIGNERS JANUARY 21, 2014

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Revision Notes

1. November 2013
2. Updates for consistency with new Division II of the Contract Standard Provisions, Standard Task Descriptions, revised 05/2013, as further amended by the Contract Special Provisions, revised August 2013. A number of tasks were added and several are updated. All revisions relate to Contractor responsibilities.
3. Task 105 (Project Design Schedule Development and Monthly Updates) added,
4. Tasks 330, 428, 458 and 807 (Construction Contract Time Determination) added.
5. Tasks 331, 429, 459 and 808 (Incentives/Disincentives) added.
6. Tasks 423, 454 and 802 (Quantity and Cost Estimate (Weighted Average Bid Application) added requirement to track significant changes beyond the 25%, 75% and 100% estimates.
7. Tasks 427, 457 and 806 (Bottom Up Estimate and Reconciliation (if required)) added..
8. Task 712 (Hydraulics Study and Report (Bridges over Water) shifted up and renumbered to Task 708, number 712 renamed to “reserved.”

9. May 2013

10. Updates for consistency with new Division II of the Contract Standard Provisions, Standard Task Descriptions, revised 05/2013. No new or deleted tasks.
11. Section 150 Environmental updated throughout for consistency with laws, regulations and terminology.
12. Task 231 updated to properly assign responsibility for coordinating with FHWA to MassDOT. Previously, this was designated as the Consultant’s responsibility.
13. Section 900 updated to clearly indicate that the Consultant is entitled to rely on information provided when reviewing shop drawings. Also, this Section was updated to indicate that the Consultant is not responsible for site inspections, only for making observations.
14. Task 907 updated to indicate that the Consultant shall provide technical recommendations to resolve issues.

15. March 2011

16. Document Title changed
17. Changes were made to reflect the creation of MassDOT.
18. The following Sections and Tasks were updated:
 - 18.1. Task 151 Early Environmental Coordination Design Submission Checklist. Added.
 - 18.2. Task 153 MESA Determination. Eliminated.
 - 18.3. Task 168 MESA and NOI Streamlined Review. Eliminated.
 - 18.4. Task 169 MESA Permit Application. Eliminated.
 - 18.5. Task 186 Coordination and Liaison. Consolidated with Task 155.
 - 18.6. Task 187 Impaired Waterbody Assessment. Added.
 - 18.7. Section 200 Functional Design Report. General section added and all tasks modified.
 - 18.8. Section 201 Establish Purpose and Need. Added.
 - 18.9. Section 202 Public and Agency Outreach. Added.
 - 18.10. Section 203 Evaluate Existing Conditions / Context. Revised.
 - 18.11. Section 204 Prepare Traffic Volumes. Previously named Traffic Count Analysis. Revised. Moved from Task 202 to 204

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- 18.12. Section 205 Conduct Safety Analysis. Revised. Moved from Task 203 to Task 205
- 18.13. Section 206 Evaluate Signal Warrants. Revised. Moved from Task 204 to Task 206
- 18.14. Section 207 Operational Analysis for Existing Conditions. Previously named Intersection Analysis. Task 205 moved to Task 207. Added/Revised.
- 18.15. Section 208 Establishment of Basic Design Controls and Evaluation Criteria. Added.
- 18.16. Section 209 Development of Alternatives. Previously named Proposed Geometrics. Added/Revised. Task 206 moved to Task 209
- 18.17. Section 210 Operational Analysis for Future Conditions. Added.
- 18.18. Section 211 Preferred Alternative. Added.
- 18.19. Section 212 Complete Streets. Added.
- 18.20. Section 213 GreenDOT. Added.
- 18.21. Section 214 Traffic Management. Added.
- 18.22. Section 215 Conclusion and Recommendations. Added.
- 18.23. Section 216 Report Preparation. Moved from Task 207 to 216.
- 18.24. Section 230 Interchange Justification / Modification Report (IJR/IMR). Added.
- 18.25. Task 314 Pavement Design. Reference documents updated.
- 18.26. Task 320 Traffic Signals. Revised.
- 18.27. Task 322 Traffic Management. Revised.
- 18.28. Task 323 Early Environmental Coordination. Consolidated with Task 151.
- 18.29. Task 326 Preliminary Construction Estimate. Construction Project Estimator requirement added.
- 18.30. Task 327 Design Submission Checklists. Amended to include the Traffic & Safety Engineering Checklist.
- 18.31. Task 352 Design Public Hearings. Language clarified.
- 18.32. Task 407 Pavement Design. Reference documents updated.
- 18.33. Task 423 Quantity & Cost Estimate. Calculation Book and Construction Project Estimator requirements added
- 18.34. Task 454 Finalize Estimate. Clarified Detail Sheet, Quantity Sheet, Summary Sheet and Calculation Book requirements. Construction Project Estimator requirement added.
- 18.35. Section 500 Right of Way. Section overview language revised regarding Abutter's Property lines.
- 18.36. Task 606 Geotechnical Report. Reference documents updated.

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GENERAL CONTRACT NEGOTIATION PROCESS

MassDOT’s Standardized Scope of Services and Workhour Estimate Forms for Consultant Services shall be used by MassDOT and Consultants to develop the scope, work hour estimate and fee for highway/bridge related projects. The Microsoft Excel Scoping Workbook includes tabs for work hour and fee calculations. The following process shall be used for developing a Scope of Services and securing Consultant Services.

1. **SCOPE OF SERVICES:** The first step in this process is to determine the appropriate scope of services. The project scope shall be developed in accordance with Chapter 2 of the Project Development and Design Guide. This will ensure that the proposed scope is complete and appropriate. Certain projects have repeated tasks. The Work Hour Estimate should not duplicate hours for the repeated tasks.

2. **INDEPENDENT ESTIMATE:** Every assignment requires an independent estimate prepared using the Standardized Scope of Services and Workhour Estimate Forms. The independent workhour estimate may be prepared by MassDOT staff (e.g. Bridge Project Development Unit, District Office, etc.) or may be prepared by a Consultant not affiliated with the assignment. The Project Initiation Form (PIF) will contain valuable information regarding some of the major tasks that will be required during the design phase. Information regarding the anticipated environmental permitting, right of way status and the potential need for a Design Exception

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Report are all addressed in the PIF. It is particularly important during this phase that a strategy is developed for obtaining survey base plans, traffic counts, borings, test pits, pavement cores, concrete cores, steel coupons, etc. The project designer must have complete and accurate information regarding the existing conditions in order to develop an appropriate fee proposal and to make informed decisions during the design phase.

3. INITIATION: The Project Manager initiates the negotiations by transmitting to the Consultant a copy of the scope of services along with any additional pertinent information. The independent workhour estimate shall remain confidential.

4. SCOPING MEETING: Prior to requesting a proposal from the Consultant, it is strongly recommended that a meeting be conducted among the Project Manager, the Consultant and other Sections of MassDOT (if necessary) to discuss the scope. The negotiation of workhours can only be successful if both parties have the same understanding of the scope of the services to be provided. The Project Manager's Supervisor is encouraged to attend negotiation meetings.

5. FEE PROPOSAL: The Consultant is responsible for submitting a fee proposal based on the scoping meeting. If the submitted workhours for a specific task are more than 50% above the independent workhour estimate, the Project Manager should consult with the preparer of the independent estimate to determine the cause of the discrepancy. The workhours calculated in the independent estimate may require revisions based on the results of the pre-negotiation meeting, information made available after the initial estimate was prepared, miscalculation or because of new information learned. If, after these adjustments have been made, the aggregate amount of the workhours exceeds the independent estimate by more than 25% then the Project Manager shall request a re-submittal of the proposal.

6. NEGOTIATION SESSION(s): The Project Manager shall be responsible for promptly scheduling a negotiation session(s) with the Consultant. All negotiations shall be based on the number of workhours that are necessary to provide the services described for each task. Negotiations **shall not be based on meeting a specific dollar amount**. The actual final dollar amount of an assignment is determined by applying the information contained in the Consultant's HED 640 Form, the Consultants audited overhead rate and fee percentage to the agreed upon workhours, and by adding in any necessary direct costs.

7. RIGHT TO APPEAL: If the Project Manager and the Consultant are not in agreement, issues may be elevated through the chain of command at MassDOT in order to reach a resolution. If a Project Manager has encountered such an impasse, it should be brought to the attention of the Director of the Division. It is important that both MassDOT's Project Manager and the Consultant understand that either party has the right to elevate the discussion regarding assignment negotiations if agreement is not achieved.

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PART A – SCOPING WORKBOOK

Workbook Tab 1.1 – Project Definition

This form is to be used to provide basic project and scope definition. The form is also intended to facilitate the assignment of scope elements to the party responsible e.g., by Consultant, by MassDOT, completed by others, etc. This Tab will be completed by MassDOT and provided to the Consultant at the onset of the scoping / negotiation process.

Workbook Tab 1.2 – Environmental Scope

This form lists the regulatory thresholds for a variety of different environmental permits and is intended to identify which permits will be included in the Scope of Services. This Tab will be completed by MassDOT and provided to the Consultant at the onset of the scoping / negotiation process.

Workbook Tab 1.3 – Work Hour Estimate

This form is used to tabulate work hours for specific tasks by the appropriate engineering titles. The titles along with typical ranges for the distribution of hours by percentage are listed below in *Exhibit A - Consultant Titles and Typical Description*. This form will be completed by the Consultant and used in the negotiation process with MassDOT.

Workbook Tab 1.4 – Summary Table

This table summarizes the hours by task and staff classification and calculates the associated dollar amounts. It is intended that a direct relationship will exist between these dollar amounts and the Consultant's Progress Reports.

Workbook Tab Exhibit B – Budget Cost Plus or Lump Sum

These tabs present the total fees for Cost Plus and Lump Sum Agreements.

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Exhibit A. Consultant Titles & Typical Description

CONSULTANT TITLES & TYPICAL DESCRIPTION	TYPICAL %
Principal in Charge (PIC)	1 - 3 %
<i>Firm principal with signatory authority to bind firm in contracts. Represents the firm in contractual matters, ensures that controls are in place to maintain quality, ensures that adequate staffing is provided to meet project schedule and has overall knowledge of the project. Typically equivalent ASCE Grade VII-IX</i>	
Project Manager (PM)	10 - 15%
<i>Day-to-Day Manager of the Project. Maintains communication with MassDOT, involved municipality, state and federal agencies, utility companies and contractors. Coordinates efforts of the team and monitors schedule and budget. Also, prepares or reviews submission checklists and ensures review comments are addressed. May also function as Senior Engineer in respective discipline. Typically equivalent ASCE Grade V-VII.</i>	
Senior Engineer (SE)	15 – 25%
<i>Experienced engineer responsible for leading planning, engineering, design, permitting and plan production efforts in their respective discipline. Makes key technical decisions/judgments and ensures that the project development is in conformance with standards. Provides guidance and monitors progress of work by Engineers, Assistant Engineers and Technicians. Typically equivalent ASCE Grade V-VII.</i>	
Engineer (Eng)	25 - 35%
<i>Experienced engineer engaged in planning, engineering, design, permitting and plan production tasks. Responsible for performing engineering calculations and analysis, detailing designs, preparing reports and other project documentation. Assists Senior Engineer in overseeing the work of Assistant Engineers and Technicians. Typically equivalent ASCE Grade III – IV.</i>	
Assistant Engineer (AE)	10 - 15%
<i>Entry-level engineer with a minimum of an undergraduate degree in engineering or related technical fields. Involved in performing various tasks to support planning, engineering, design, permitting and plan production. Typically equivalent ASCE Grade I & II.</i>	
Engineering Technician (ET)	10 - 15%
<i>Staff primarily associated with CADD, Data Collection or other support of office and field activities. Technical education beyond High School such as CADD and/or other training.</i>	

NOTE: Above percentage ranges will vary depending on size and complexity of project. For small and more complex projects the more experienced personnel will often be at the higher end of the above percentage ranges.

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PART B – TASK DESCRIPTIONS

The following information provides a comprehensive description of tasks that may be required to design a MassDOT project. It is understood that certain projects may have specific circumstances that will require that additional tasks be defined and negotiated. Additional tasks shall be numbered consistent with the appropriate Section and added to the Work Hour Estimate Form.

SECTION 100 PROJECT DEVELOPMENT ENGINEERING

The broad purpose of the Project Development Phase is to conduct an analysis in accordance with Section 2.2, *Step II: Planning* in the *Project Development and Design Guide*. This analysis evaluates alternatives for a proposed transportation project and arrives at a preferred alternative or a range of reasonable alternatives to be advanced into the environmental review process.

As part of the Project Development Phase, the Consultant shall prepare a purpose and need discussion for the proposed transportation project. The purpose and need discussion shall clearly identify and describe the transportation problem(s) or other needs that the proposed transportation project is anticipated to correct, in terms understandable to the general public. The purpose and need discussion shall form the basis for the selection of reasonable alternatives, including the no-build alternative. Elements relevant to all agreed upon alternatives should be developed using location specific data to compare the present, future no-build, and future build conditions.

The Consultant shall become familiar with the topographic, environmental and other physical characteristics of the study area. The general location of environmental resources, cultural and historic resources, major topographic features, and utilities that the proposed transportation facility may affect shall be graphically depicted. The Consultant shall also be responsible for acquainting itself with the details of the existing transportation facilities, previous studies, and for collecting necessary data and information, unless otherwise specified in the scope of services in the Special Provisions.

The Consultant shall initiate early coordination with the appropriate federal, state, and local agencies to present the proposed project to them, to consider the plans and suggestions of these agencies in the development of the alternatives analysis, and to develop a consensus on the range of alternatives to be studied.

The evaluation of each alternative shall take into account factors affecting construction cost, such as foundation problems, construction difficulties, major utilities affected, environmental impacts, and environmental mitigation. As detailed in the Scope of Services, the Consultant shall also ascertain known economic and social impacts on communities in the project area for alternatives evaluated. For each endorsed alternative, the evaluation shall consider existing and known future land uses, transportation facilities, cultural resources, natural resources, and other factors that may influence the proposed project.

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The Consultant shall demonstrate that endorsed alternatives have been investigated to an appropriate level of detail before an alternative is eliminated or advanced to a further level of analysis. The endorsed alternatives shall be developed with a view toward producing a context sensitive project consistent with public safety and the interests of the communities in the project area. Endorsed alternatives shall be available for review by the Engineer.

As specified in the Scope of Services the Consultant shall develop a broad-based public outreach program intended to fully involve the public with the purpose and need of the project, project status, and potential effects of the project. The program is to obtain input from the study area residents, businesses, elected officials and other stakeholders. The public outreach program shall include presenting the project at public meetings or open houses using graphics or other visual aids to help explain the various alternatives. Use of community focus groups to assemble issues, develop evaluation criteria, and obtain consensus should also be considered. Various aspects of the project, such as the project area, environmental constraints and impacts, traffic data, and alternative cross sections shall be described at the public meetings.

As specified in the Scope of Services the Consultant shall prepare a Conceptual Stage Relocation Plan based on the *Guidelines for Consultant Work in Preparing Relocation Plan and Submission of Relocation Data*.

101 Project Concept Preparation (Development of Purpose and Need)

Prepare a general description and definition of the project. Visit site and conduct preliminary surveys.

102 Preliminary Project Area Analysis

Prepare an overview that evaluates the project area in light of the project's purpose and need to determine any additional studies that are beyond the Scope of Services that may be required. Also, examine planning any applicable criteria, degree of citizen and agency involvement and other issues and factors that may influence the design of the project provided by the Engineer

103 Reasonable Alternative(s) Identification

Evaluate endorsed alternatives that meet the project's purpose and need to determine, if they are feasible and reasonable.

104 Alternatives Analysis and Report Preparation

Select engineering and environmental solutions to accomplish the project's purpose and need and prepare a report that presents all findings. The written evaluation of alternatives shall include a description of the alternatives, a comparison of the advantages and disadvantages of each alternative, and supporting data for the conclusions. Those alternatives that are eliminated from further study shall be graphically illustrated and should be accompanied by descriptions of the locations with statements as to why further consideration is not warranted.

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105 Project Design Schedule Development and Monthly Updates

Develop and submit for approval a project design schedule in accordance with the requirements of Division I, Section 4.01 as amended by the language included above.

SECTION 150 ENVIRONMENTAL

The Consultant shall meet all the requirements of both the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA) for the purpose of implementing the Proposed Project and produce any and all documents required for submittal under each/either act(s) (the “Environmental Document(s)”). The MassDOT Environmental Services Division should be consulted regarding NEPA and MEPA requirements.

The National Environmental Policy Act is codified at 23 CFR 771, which prescribes the policies and procedures of the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) for implementing the NEPA. The Consultant should refer to FHWA’s guidance document for preparing environmental and Section 4(f) documents found in FHWA’s Technical Advisory 6640.8A, dated October 30, 1987. MEPA is found at Massachusetts General Laws, Chapter 30, Sections 61 through 62I, with implementing regulations found at 301 CMR 11.00.

Sufficient information shall be presented in the Environmental Document(s) to demonstrate that a comprehensive examination has been made of the social, economic and environmental effects of the Proposed Project. The comprehensiveness of the evaluation shall vary depending on the complexity of the Project and the level of environmental documentation required. Projects requiring major filings, such as an Environmental Impact Statement (EIS) or Environmental Assessment (EA) in accordance with NEPA, or an Environmental Impact Report (EIR) in accordance with MEPA, will require the most comprehensive level of evaluation. In these cases, the Consultant must provide a detailed, project-specific scope of the services. Environmental documents such as Environmental Notification Forms and Categorical Exclusion Determinations require a less comprehensive, although still thorough, evaluation. The Environmental Document(s) shall be written in a concise manner and presented in a format and language that will be readily understandable to the public.

Generally, an EIS or EIR shall discuss the purpose and need of the Proposed Project. It shall also describe the Proposed Project; alternatives to the proposed project; the affected environment in the project area; probable impact of the Proposed Project on the environment; steps to be taken to avoid, minimize, and mitigate harm; and coordination with and input from federal, state, and local agencies and the general public.

The basic approach to be employed in the development of a major Environmental Document(s) shall be as follows:

1. Establishment of a clear purpose and need for the Proposed Project;

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2. A comprehensive data collection program of existing social and natural environmental resources in the project area and coordination with the general public and local, state, and federal agencies, as required;
3. Examination of data to establish baselines to be used as reference for environmental impacts and against which the ability of various alternatives to meet the stated purpose and need can be measured;
4. Preliminary evaluation of the Proposed Project to meet purpose and need and identify environmental impacts and possible problem areas;
5. A more detailed analysis of environmental impacts, methods to avoid and minimize those impacts to the greatest extent practicable, and establishment of the indirect and cumulative environmental impacts;
6. Preparation of the Draft Document(s), with copies to be distributed to various public agencies, the general public, and others for comment; and
7. Upon receipt and evaluation of comments following a public hearing, preparation of a Final Environmental Document(s) with copies, as required, for distribution.

This approach will assure that all major Environmental Documents fulfill the previously established purpose and need by providing a comprehensive evaluation of a wide range of environmental considerations. This approach will also allow periodic reviews and modifications to the study as more information becomes available.

The Consultant shall also prepare permit or approval applications, with supporting documentation and plans, to satisfy the requirements found in the following state and federal environmental regulations, as necessary, or as specified in the scope of services in the Special Provisions:

- Massachusetts Wetland Protection Act (MGL c. 131 § 40);
- Massachusetts Endangered Species Act (MGL c. 131A);
- Article 97 (MGL c. 21A § 2);
- Chapter 91 Public Waterfront Act (MGL c. 91);
- Section 401 of the Clean Water Act – Water Quality Certification (33 USC § 1341, administered by state regulation found in 314 CMR 9.00);
- Section 402 of the Clean Water Act – National Pollution Discharge Elimination System (NPDES, 33 USC § 1342);
- Section 404 of the Clean Water Act – U.S. Army Corps of Engineers (33 USC § 1344);
- Section 10 of the Rivers and Harbors Act of 1899 (33 USC § 403);
- Coastal Zone Management Act (16 USC §§ 1451-1464);
- Section 9 of the Rivers and Harbors Act of 1899 – Coast Guard Bridge Permit (33 USC § 401);
- Wild and Scenic Rivers Act (16 USC §§ 1271-1287);
- Section 106 of the National Historic Preservation Act (16 USC § 470f); and
- Section 4(f) of the DOT Act (49 USC § 303).

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The following task descriptions included in this Section provide a basic description of the various actions to be taken in the environmental permitting process. MassDOT's Environmental Services Division should be consulted regarding all environmental permitting requirements.

151 Early Environmental Coordination Design Submission Checklist

Complete the 25% Design Submission Checklist Early Environmental Coordination for Design Projects. This involves ensuring that coordinating with local, regional, state, and federal resource agency staff has been completed. This effort provides project stakeholders with an opportunity to comment on the presence of environmental resources in the project area, their extent and potential significance. Documentation that an adequate level of consideration has been made to avoid and minimize impacts to identified environmental resources shall be presented; completion of the early coordination requirements ensures necessary deliverables (CE, WQDF, etc) have been prepared and design plans are adequate for environmental review. Written responses are required for each item, and supporting documentation must be included.

152 Historic/Archaeology – Federal Section 106 and State Chapter 254

Provide information in accordance with the requirements of Section 2.4.2.5, *Environmental Requirements for Preliminary (25 Percent) Design Submission* of the *Project Development & Design Guide* as itemized in the 25% Design Submission Checklist Early Environmental Coordination for Design Projects. Check the MassDOT Highway Division website for the most recent version of the checklist, a template for the standard local historic commission/tribal historic preservation officer solicitation letter; and an updated contact/address list. Be available to meet with MassDOT's Cultural Resource Unit (CRU) staff, and with local and state historical commission representatives, as agreed upon between MassDOT and the Consultant.

153 Reserved

154 Hazardous Materials Research/Review

Provide information generated in accordance with the requirements of Section 2.4.2.5, *Environmental Requirements for Preliminary (25 Percent) Design Submission* of the *Project Development & Design Guide* to the MassDOT Hazardous Materials Unit during its review. Also include responses to comments from local and state agencies and attendance meetings, as agreed upon between MassDOT and the Consultant.

155 Project Development Meetings and Public Hearings

Prepare for and hold public meetings and public hearing(s) as agreed upon by MassDOT and the Consultant.

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156 National Environmental Policy Act / Massachusetts Environmental Policy Act (NEPA/MEPA) Determination

Determine the appropriate level of documentation in the NEPA process (Categorical Exclusion, Environmental Assessment (EA) or Environmental Impact Statement (EIS)) and the MEPA process (Environmental Notification Form (ENF) or Environmental Impact Report (EIR)) by meeting and coordinating early with MassDOT, FHWA and other government agencies, local boards and commissions, and conducting public meetings, as agreed upon in the Scope of Services.

157 NEPA – Categorical Exclusion (CE)

Prepare a Categorical Exclusion (CE) Determination Checklist for Federal-Aid Actions in accordance with the *Programmatic Agreement For Approval Of Categorical Exclusions Between The Federal Highway Administration And The Massachusetts Highway Department*, dated May 17, 2005, and Federal Highway Administration Regulation 23 CFR § 771.117 (1987).

Typically, the NEPA and MEPA Environmental Documents for major projects are prepared jointly, that is, as either an EA/EIR or as an EIS/EIR. In some cases, the NEPA and MEPA documents are prepared and processed separately. The Consultant shall perform the tasks described in Sections 155 through 158 and 161 through 163, as agreed upon by MassDOT and the Consultant.

158 NEPA – Environmental Assessment (EA)

Prepare an Environmental Assessment (EA), in accordance with FHWA's NEPA regulations (23 CFR 771), that includes a description of the Proposed Project; the alternatives under consideration; the social, economic and environmental impacts of the alternatives; avoidance, minimization and mitigation measures; and a section on comments and coordination. See FHWA Technical Advisory T6640.8A, dated October 30, 1987.

After a public hearing is held and the preferred alternative is agreed to, update the EA, as necessary, to include the Finding of No Significant Impact (FONSI) and to reflect any changes resulting from comments from federal, state, and local agencies and the general public. This document should also include the disposition of comments from these agencies and the general public.

159 NEPA – Draft Environmental Impact Statement (EIS)

Prepare a Draft EIS, in accordance with the NEPA regulations (23 CFR 771), that includes a description of the purpose and need for action; the proposed alternatives; the affected environment; the social, economic, and environmental impacts of the alternatives; avoidance, minimization and mitigation measures; and comments and coordination. See FHWA Technical Advisory T6640.8A, dated October 30, 1987.

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160 NEPA – Final Environmental Impact Statement (EIS)

Prepare a Final EIS, in accordance with FHWA's NEPA regulations (23 CFR 771), that includes any changes, new information, or further developments on a Proposed Project, with an emphasis on those that result in substantial environmental impacts. This Final EIR should describe the basis for the selection of the preferred alternative; include a transcript of the public hearing; copies of comments received from agencies and the public with responses to these comments; and a Record of Decision. See FHWA Technical Advisory T6640.8A, dated October 30, 1987.

If there are changes, new information, or further developments on a Proposed Project that result in significant environmental impacts not identified in the most recent distributed version of the Draft or Final EIS, the Consultant shall perform the following task:

161 NEPA Supplemental Environmental Impact Statement (EIS)

Prepare a Draft Supplemental EIS and a Final Supplemental EIS, in accordance with FHWA's NEPA regulations (23 CFR 771), that briefly describes the Proposed Project, the reason(s) why a supplement is being prepared, and the status of the previous Draft or Final EIS. These documents should also summarize the previous Draft or Final EIS. The Draft Supplemental EIS and the Final Supplemental EIS need only to address those changes or new information that are the basis for preparing the supplement and that were not addressed in the previous Draft or Final EIS.

As defined by FHWA's NEPA regulations (23 CFR 771), occasionally there is a lapse in time on a Proposed Project that requires the following task to be conducted:

162 NEPA Reevaluation

Prepare a NEPA Reevaluation, in accordance with FHWA's NEPA regulations (23 CFR 771), that describes any changes to the Proposed Project, its surroundings and impacts, and any new issues identified since the Draft EIS, Final EIS, EA, or FONSI. It should also appropriately discuss the decision as to whether a Supplemental NEPA document is needed.

163 MEPA – Environmental Notification Form (ENF)

Prepare an ENF and associated correspondence to various agencies, as necessary, in accordance with the Massachusetts Environmental Policy Act and MEPA Regulations 301 CMR 11.00. Prepare associated filing attachments, such as a distribution list and public notice; responses to comments, as necessary; and attend public meetings.

164 MEPA – Draft Environmental Impact Report (DEIR)

Prepare a DEIR in accordance with the Massachusetts Environmental Policy Act and MEPA Regulations 301 CMR 11.00. Include analyses necessary to adequately address

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environmental issues contained in the EOEA Scope on the DEIR. Also include necessary preparation for attending the public hearing.

165 MEPA – Final Environmental Impact Report (FEIR)

Prepare an FEIR in accordance with the Massachusetts Environmental Policy Act and MEPA Regulations 301 CMR 11.00. Include responses to public and agency comments and Draft Section 61 Findings. As defined by the MEPA Regulations (301 CMR 11.00), if there is any material change to a Proposed Project or a lapse in time, the Consultant shall perform the following task:

166 MEPA Notice of Project Change

Prepare a Notice of Project Change that includes a detailed discussion of any changes in the information provided in any previous MEPA document. If, as a result of the Notice of Project Change, there is a determination that the project change or lapse in time may result in significant environmental consequences, the Consultant may have to perform the following task:

167 MEPA Supplemental Environmental Impact Report

Prepare a Supplemental EIR, in accordance with the Massachusetts Environmental Policy Act and MEPA Regulations 301 CMR 11.00. Include analyses necessary to adequately address environmental issues contained in the EOEA Scope for the Supplemental EIR.

168 Reserved

169 Reserved

170 USACE Section 404 General Permit (PGP)

Prepare backup documentation for Category I or Category II permitting under the U.S. Army Corps of Engineers (USACE), New England Division General Permit upon request. Backup documentation may include the information generated in accordance with the requirements of Section 2.4.2.5, *Environmental Requirements for the Preliminary (25 Percent) Design Submission* of the *Project Development & Design Guide*.

171 USACE Individual Section 404 Permit

Coordination with the U.S. Army Corps of Engineers (USACE) shall be conducted for project review pursuant to the USACE Highway Methodology. The application shall be prepared and submitted to the USACE pursuant to Section 404 of the Federal Clean Water Act following completion of the Phase I review. The application shall be submitted to the Regulatory Branch, New England District. Preparation of the submission shall include the application form, text describing the proposed work, impacts, and mitigation measures. The application shall include

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evidence of consultation with other agencies, such as the U.S. Fish and Wildlife Service, the National Park Service, Environmental Protection Agency, and Massachusetts Coastal Zone Management, as necessary.

172 U.S. Coast Guard Bridge (USCG) Permit

Prepare an application for a U.S. Coast Guard (USCG) bridge permit pursuant to Section 9 of the Rivers and Harbors Act and the General Bridges Act. A Coast Guard bridge permit is not required if the waterway is not considered navigable by the USCG and is not tidal or, if tidal, used only by recreational boating, fishing, and other small vessels less than 21 feet long, as determined by consultation with the local harbor master or other appropriate local official.

The application shall be submitted to the District Bridge Administration, First Coast Guard District. Preparation of the application shall include the application form, text and plans in accordance with the USCG Permit Application Checklist in Section 2.4.2.5, *Environmental Requirements for the Preliminary (25 Percent) Design Submission of the Project Development & Design Guide*, and all associated meetings and agency coordination. The public hearing for the project can be held as a joint hearing with the USCG.

173 Programmatic Section 4(f) Evaluation

Prepare a Programmatic Section 4(f) Evaluation in accordance with associated programmatic Section 4(f) Evaluation and Approval Processes. There are five nationwide programmatic Section 4(f) evaluations: projects that involve historic bridges; projects that involve minor amounts of parkland, recreation areas, wildlife and waterfowl refuges; projects that involve minor amounts of land from historic sites; bikeway projects; and projects where the use of the Section 4(f) property will result in a net benefit to the Section 4(f) property. See FHWA Technical Advisory T6640.8A, dated October 30, 1987, FHWA Section 4(f) Policy Paper, dated March 1, 2005, and associated Programmatic Section 4(f) Federal Notices, Regulations, and Policy Papers.

174 Draft Individual Section 4(f) Evaluation

Prepare a Draft Individual Section 4(f) Evaluation that includes a description of: the Proposed Project, the Section 4(f) property, impacts on the Section 4(f) property, avoidance alternatives and their impacts, measures to minimize harm, and a discussion of the results of preliminary coordination with agencies having jurisdiction over the Section 4(f) property. See FHWA Technical Advisory T6640.8A, dated October 30, 1987 and FHWA Section 4(f) Policy Paper, dated March 1, 2005.

175 Final Individual Section 4(f) Evaluation

Prepare a Final Section 4(f) Evaluation that includes all information required for a Draft Section 4(f) Evaluation, formal comments and responses from all agencies, and a discussion of the basis for the determination that there are no feasible and prudent alternatives to

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the use of Section 4(f) land. See FHWA Technical Advisory T6640.8A, dated October 30 1987 and FHWA Section 4(f) Policy Paper, dated March 1, 2005.

176 Wetland Resource Area Delineation

Conduct wetland resource area delineation in accordance with the Massachusetts Wetlands Protection Act (WPA), the Federal Clean Water Act, the *Corps of Engineers Wetlands Delineation Manual (1987 edition)*, and guidance in *Clarification and Interpretation of the 1987 Manual*, dated March 6, 1992. Include all field time associated with delineating the wetland boundaries and time attending local, state, and federal site meetings to review and verify wetland boundary lines. If applicable, documentation must be provided on state Appendix G Wetland Delineation Forms or US Army Corps Wetland Determination Forms for submittal to regulatory agencies.

177 WPA Abbreviated Notice of Resource Area Determination (ANRAD)

Prepare an ANRAD in accordance with the WPA to obtain approval from the local conservation commission of state wetland resource area boundary lines. Tasks include preparation of all associated forms and backup documentation, coordination during review, site walks, and attending conservation commission meetings.

178 WPA Request for Determination of Applicability (RDA)

Prepare and submit an RDA in accordance with the WPA to determine if work within the 100-foot or 200-foot buffer zones of certain wetland resource areas is subject to the WPA and whether or not it will have an impact on wetland resource areas. Tasks include preparation of all associated forms and backup documentation, coordination during review, site walks, and attending conservation commission meetings.

179 WPA Notice of Intent (NOI)

Prepare and submit an NOI to the local conservation commission in accordance with the WPA. Tasks include preparation of all associated forms and backup documentation; permit plans, coordination during review, site walks, and attending conservation commission hearings.

180 WPA Variance

Prepare and submit a variance to the DEP in accordance with the WPA. Tasks include preparation of all associated forms and backup documentation, permit plans, coordination during review, site walks, and attending conservation commission hearings.

181 Chapter 91 License/Permit Application

Prepare an application for a Chapter 91 License or a Chapter 91 Permit in accordance with the Massachusetts Chapter 91 Waterways Act. Tasks include preparation of the application form, backup documentation, and plans/Mylars in accordance with Chapter 91 submission requirements.

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182 Water Quality Certification

Prepare an application for a Water Quality Certification (WQC) in accordance with the Massachusetts Surface Water Quality Standards, 314 CMR 4.00. Tasks include preparation of the appropriate state application form, WQC Standard Form for applicable Footprint Bridge projects, supporting documentation, plan preparation, and sediment analysis, when applicable.

183 Coastal Zone Management Consistency Review

Prepare material for a Consistency Review pursuant to the Massachusetts Coastal Zone Management Program. Tasks related to agency coordination and meetings are included, as agreed upon between MassDOT and the Consultant.

184 Wildlife/Rare Species Assessment

Prepare a wildlife habitat assessment, vernal pool study, and/or a rare species study, in accordance with associated regulations and/or as required by the Massachusetts Natural Heritage and Endangered Species Program, EPA, USACE, DEP or local conservation commissions.

185 Essential Fish Habitat Assessment

Prepare an assessment that describes and identifies potential impacts to Essential Fish Habitat (EFH) (*i.e.*, waters and substrate necessary for fish to spawn, breed, feed or grow to maturity) within the project limits, in accordance with associated EFH regulations and as required by the USACE for the Section 404 regulatory review process and the National Oceanic and Atmospheric Administration Fisheries Service (NOAA).

186 Reserved

187 Impaired Waterbody Assessment and Water Quality Data Form

Determine if there are Impaired Waterbodies, as evaluated per the requirements of Section 303(d) of the Federal Clean Water Act, affected by highway runoff generated in the project area by completing the 25% Design portion of the Water Quality Data Form. Document the incorporation of Best Management Practices (BMPs) in the stormwater management system by completing the 75% Design portion of the Water Quality Data Form.

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SECTION 200 FUNCTIONAL DESIGN REPORT

A Functional Design Report documents the process for determining the preferred alternative and the parameters for design. Refer to the Project Development Guide, Section 2.2.1 for more information concerning Project Planning Reports. Also, refer to the Traffic and Safety Engineering 25% Design Submission Guidelines.

201 Establish Purpose and Need

Establish purpose and need statement of the project.

202 Public and Agency Outreach

Conduct public and agency outreach for the project to ensure that the project meets its intended purpose, benefits from the input and feedback from interested citizens, local and regional groups, and elected officials, and maintain strong support. General public outreach guidelines and tools are described in Section 2.9 of MassDOT Project Development and Design Guide.

203 Evaluate Existing Conditions / Context

Provide a narrative of the existing study area including lane configurations, key dimensions, design speed, posted speed, Speed Regulations, functional classification, environmental constraints, Roadway context, roadway users, etc. Include a project locus map.

204 Prepare Traffic Volumes

Coordinate the procurement of the appropriate traffic counts for the study area and provide an assessment of data to determine factors for background growth and seasonal adjustments. Prepare the future design volumes.

205 Conduct Safety Analysis

Collect, tabulate, and analyze the crash data and document trends and causes. Prepare crash rate work sheets, collision diagrams, collision mapping as required. Review safety with respect to the Safety Review Prompt List or conduct a Road Safety Audit based on HSIP eligibility.

206 Evaluate Signal Warrants

Collect, tabulate, and analyze traffic count data with respect to the MUTCD Traffic Control Signal Needs (Warrants) based on the existing geometric conditions to determine if signals are justified.

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207 Operational Analysis for Existing Conditions

Determine Peak-Hour Factor, Truck Percentage, and applicability of pedestrian phasing. Determine, tabulate, and discuss Level of Service, volume-to-capacity ratio and vehicle delays in accordance with MassDOT's A Guide on Traffic Analysis Tools and average and 95th percentile Queue calculations. Analyze Existing Traffic Volumes (No Build). Perform Systems Analysis for closely spaced and/or coordinated systems. Perform operational analysis for the following roadway components:

- Signalized Intersections
- Un-signalized Intersections
- Roundabouts
- Basic Freeway Segments
- Weaving Area Segments
- Multi-lane Highways
- Two-Lane Highways
- Arterials

Present LOS results graphically.

208 Establishment of Basic Design Controls and Evaluation Criteria

Establish basic design controls such as:

- Roadway Context
- Roadway Users
- Transportation Demand
- Measure of Effectiveness
- Design Speed
- Sight Distance

Establish evaluation criteria for accessing each alternative.

209 Development of Alternatives

Provide a discussion of alternatives considered. Alternatives should be developed using the design guidance provided in the MassDOT Project Development and Design Guide. Develop alternatives to comparable levels and present in an evaluation matrix.

210 Operational Analysis for Future Conditions

Analyze Future Traffic Volumes (in both No-Build and Build). Where volume and geometric conditions allow, evaluate roundabout alternative in addition to traditional intersection design. Perform Systems Analysis for closely spaced and/or coordinated systems. Perform operational analysis for the following roadway components:

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Signalized Intersections
Un-signalized Intersections
Roundabouts
Basic Freeway Segments
Weaving Area Segments
Multi-lane Highways
Two-Lane Highways
Arterials

Present LOS results graphically.

211 Preferred Alternative

Provide a detail description and graphical presentation of the preferred alternative. Include a discussion how selections of the following were made.

Typical Sections
Horizontal and vertical alignment
Clear Zone
Bicycle / Pedestrian accommodation
ROW impacts / Mitigations
Environmental impacts / mitigations
Safety Improvements

212 Complete Streets

Document how the project addresses bicycle and pedestrian accommodation in accordance with Complete Streets policies and the principles of the Project Development and Design Guide and associated Engineering Directives. Address desirable accommodation parameters and the context and impacts associated with the selection of the project cross-section.

213 GreenDOT

Document how the project addresses the three primary goals of the GreenDOT Policy Directive, P-10-002.

214 Traffic Management

Prepare a Construction Management Outline providing a description of all major construction components of the project and how vehicle, pedestrian, and bicycle accommodations will be maintained.

215 Construction Cost

Provide an estimated construction cost.

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216 Conclusion and Recommendation

Provide a conclusion and recommendation.

217 Report Preparation

Prepare a report detailing the various design alternatives with appropriate graphics, descriptive text and cost estimates justifying the recommendations presented.

SECTION 220 DESIGN EXCEPTION REPORT

The Federal Highway Administration (FHWA) has established 13 controlling criteria as defined in 23 CFR 625, which must be adhered to when designing a roadway improvement project. MassDOT has adopted this policy and applies the requirements of 23 CFR 625 to all projects regardless of funding source. Chapter 2, Section 2.11 of the Project Development and Design Guide (Guidebook) describes in detail the Design Exception Process. Additional guidance regarding the Design Exception process is described in Engineering Directives E-97-007 and E-99-002.

The Design Exception Report Checklist (See Appendix 2-A-11) standardizes the preparation of Design Exception reports and streamlines MassDOT's review process. The Design Exception Report should follow the Table of Contents listed in Appendix 2-A-11.

221 Evaluate the 13 Controlling Criteria

Compare the recommended values of the 13 controlling criteria of Chapter 2 of the Guidebook to the proposed values. Revisit those features requiring a design exception and work toward developing a design that is consistent with current recommended design standards.

222 Perform Incremental Evaluation

For each of the controlling criteria that do not meet the current recommended design criteria, prepare a summary of impacts resulting from implementing the desirable, minimum and the proposed designs. Also include a summary of impacts of designs in the range between the minimum and the proposed designs. Include right of way impacts, impacts to trees, walls, wetland resource areas, constructions costs and other impacts which influence the selected design.

223 Prepare Narrative/Report

Prepare a Design Exception Report including a narrative, traffic analysis, typical sections, photographs, and summary of impacts.

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**SECTION 230 INTERCHANGE JUSTIFICATION/
MODIFICATION REPORT (IJR/IMR)**

231 Prepare an IJR/IMR

Prepare an IJR/IMR, in accordance with the FHWA's eight policy criteria (23 USC 111) for the FHWA approval for the project that proposes new or revised access to existing Interstate facilities. Access approval may be a two-step process. The first step could be a finding of operational and engineering acceptability in accordance with the eight policy requirements. The second step could be the final FHWA approval which constitutes a Federal Action, and as such, requires that NEPA procedures are followed.

MassDOT will consult with FHWA for their latest policy for preparing an IJR/IMR.

SECTION 300 25% HIGHWAY DESIGN SUBMISSION

Field Surveys

Complete or partial field surveys may be made by either the MassDOT or the Consultant or partially by each, as designated in the Scope of Services and Special Provisions.

Surveys shall be made as necessary for the preparation and completion of preliminary and final designs, contract plans and layout plans for the project, including an investigation and survey of property boundaries and property owners' names as obtained from records filed at the Registry of Deeds.

Horizontal control, including control for photogrammetry, shall be of second order precision and accuracy unless otherwise specified, and in strict conformance to the current *Massachusetts Highway Department Survey Manual (Survey Manual)* or *Specifications for Aerial Surveys and Mapping by Photogrammetric Methods for Highways*, whichever applies. All surveying field notes shall be recorded in MassDOT field notebooks. Field notebooks shall be obtained from the respective district survey office, and returned to that same office when the design work is complete.

Primary traverses and proposed connection to Massachusetts Geodetic Survey (MGS) control shall conform to Section 2 (Survey Information) of the *Survey Manual*. The primary traverse must be designed so that it will be connected in position and azimuth to MGS monumentation of equal or higher accuracy. If the Survey Engineer determines that the existing MGS control is for some reason inadequate, he/she may direct MassDOT forces to expand, resurvey and readjust the MGS control. The intent is that the Consultant shall base its project surveys upon MGS control that the MassDOT has at the time judged reliable and the Consultant shall expand control so that there will be sufficient, dependable and accurate permanent and semi-permanent control, at the project site, on the Massachusetts State Plane Coordinate System.

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Primary control and all main base line surveys shall be computed and adjusted according to the guidelines set forth in the *Survey Manual*. The Consultant shall submit a copy of the traverse closure computation to the District Survey Supervisor for review. Work, which does not conform to MassDOT standards, will be rejected, and the Consultant will be directed to perform the work correctly at its own expense.

Vertical control, including control for photogrammetry, shall be of the accuracy and datum as specified in the *Survey Manual* and shall be subject to the same review and other conditions as horizontal control.

All base line, detail, level and cross section notes must be recorded in notebooks furnished by MassDOT and performed in accordance with the *Survey Manual* or alternate procedures approved by MassDOT.

The Consultant shall include in the survey notebooks adequate ties to all horizontal and vertical control points so that these points may be reproduced accurately. The Consultant shall also furnish tie-sheets of these points. The Consultant shall be responsible for reestablishing points, including baseline stakes or pins, which it placed and which become displaced or removed and cannot be replaced by existing ties.

All field survey work performed by the Consultant shall be subject to inspection by MassDOT during and after actual survey. The Consultant shall keep the local Highway Division District Office aware of the location of its survey parties. District Survey Supervisors and their superiors, as well as representatives of the Boston Survey Section, may make field inspections, as necessary, to ensure proper procedures are employed by the Consultant, and may require changes or additions subject to approval of the Survey Engineer.

Surveys made by photogrammetric methods may be used upon MassDOT approval, but must be supplemented by necessary ground survey to obtain information not available or not sufficiently accurate by using this photogrammetric method, such as base lines, property lines, underground structures, wetland boundaries, underwater data and other detail and elevations obscured by natural growth and structures.

Field survey shall include the location and staking of points where borings or other sub-surface investigations are required. Where soft, unstable material is evident, such as swamps, organic deposits, etc., sufficient punchings shall be taken to show the approximate profile of the hard bottom. This work will be considered as part of the field survey work and no extra compensation will be paid. Field survey shall also include obtaining the location of wetland flags or other marks, which have been established by others.

Data from survey notes shall be transcribed and plotted on base plans, profiles and cross sections in accordance with current practices of MassDOT and to the scales directed by the Engineer.

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All field surveys and plotting of such data, including base lines, details and cross sections, shall be performed in accordance with the *Survey Manual*, data collection specifications and approved MassDOT CADD procedures.

Utilities

The Consultant shall contact the various utility companies and authorities, whose facilities may be affected by the proposed construction, to request from such companies and authorities the locations of existing facilities, together with proposed changes, if any.

The Consultant shall design alterations of publicly owned utilities, which may be required due to construction of the project, except in cases such as alterations of fire or police signal systems or other systems where, in the opinion of the Engineer, public convenience or safety requires such alterations to be designed and performed by the particular public agency involved. Insofar as practical, and as approved by the Engineer, designs of such alterations of publicly owned utilities by the Consultant shall conform to the requirements and design standards of the particular public agency involved.

In connection with all alterations of utilities not designed by the Consultant, whether publicly or privately owned, and in connection with alterations of facilities of public transit systems or railroads, the Consultant shall furnish to the agencies involved data needed for their design of the alterations, including data regarding possible interference with other facilities. The Consultant shall review designs prepared by other agencies in connection with the work under this Contract and shall coordinate all alterations, whether designed by him/her or by others. In the case of utility or railroad alterations to be designed at the expense of the Commonwealth by other agencies, such as state or municipal departments, utility owners or railroad companies, the Consultant shall assist MassDOT in obtaining cost estimates from those agencies.

301 Project Initiation and Data Compilation

Compile and review all available documents of existing features and planned projects in the vicinity of the proposed work. Included, as part of this task, is the investigation of utility installations, previous subsurface explorations, traffic data, and right of way research.

302 Utility Coordination

Contact utility companies to verify locations of existing utilities and to assess impacts to those facilities. Ensure that the proposed design addresses impacts associated with accommodating both existing and proposed utilities. Provide a list of utility companies that may be affected by the proposed work, as part of the 25% submission.

303 Survey Coordination and Controls

Coordinate ground survey effort, review survey controls and closures, baseline ties and overall quality of survey.

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304 Base Plans, Profiles and Typical Sections

Perform field review of base plan information. Verify the location of existing features, note legends on all warning, regulatory and route marker signs. Verify that the plans provide sufficient information regarding existing drainage and sewer systems. Verify that the cross sections include existing features such as walls, hydrants, poles, trees, sills, wells, ledge, layout lines, etc. Verify that profiles include station equations, cross culverts, bridge structures, sills, high-tension lines, benchmarks, etc.

305 Field Reconnaissance

Perform site investigations to observe the general site conditions, traffic patterns, traffic management, potential detour routes, wetland and cultural resources and other relevant features. Take photographs and/or video existing facility and surrounding environment.

306 Plot Existing Layout Lines

Plot and calculate all existing layout line geometry and note all property owners.

307 Meetings and Liaison

Attend coordination meetings, as scoped with MassDOT, the community, utility-owners, local commissions and others. Prepare and distribute minutes of the meeting.

308 Determine Roadway Cross Section

Determine the proposed roadway cross section based on functional classification, traffic volumes, local environmental and cultural resources and the Guidebook. For Non-NHS bridge projects refer to Engineering Directive P-92-010.

309 Preliminary Horizontal Geometry

Develop horizontal geometry based on the proposed cross section, horizontal clearances, the proposed design speed and functional classification. Develop horizontal roadway geometry at intersections.

310 Preliminary Vertical Geometry

Develop vertical geometry based on the proposed design speed giving consideration to drainage, vertical clearances, construction cost and the interfacing with the proposed horizontal geometry.

311 Cross Section Studies

Conduct iterative horizontal and vertical geometry refinements for critical cross sections based on the interface with the proposed roadway cross-section and existing features.

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312 Prepare Cross Sections

Prepare cross sections to determine the tops and bottoms of slope. Evaluate the impacts to resource areas, the need for retaining walls and determine the limits of work at driveways.

313 Plot Proposed Layout and Easements

Plot proposed alterations to existing layouts and proposed permanent or temporary easements and rights of entry, based on the limits of work determined by the cross sections.

314 Pavement Design

Prepare a pavement design in accordance with the Guidebook for review by MassDOT. Perform pavement cores, prepare pavement design checklist, determine DBR value, and assemble traffic data. For bridge R&R projects refer to the 11/12/09 MassDOT Memorandum on standard bridge deck pavements.

315 Typical Sections

Prepare representative typical sections for mainline, ramps and secondary roadways. Label the location of roadway crown line; describe the method of banking, guardrail location, pavement structure and material types in accordance with Standard Nomenclature and Materials Specifications.

316 Construction Details

Provide details of key features not satisfactorily described in the Construction and Traffic Standard Details. Key details shall include the labeling of key materials in accordance with the Standard Nomenclature and Materials Specifications.

317 Hydrological Studies and Hydraulics Report

Investigate hydrological characteristics of rivers and streams in the vicinity of the project based on storm frequencies commensurate with roadway functional classification and MassDOT standards. Prepare calculations to determine the size of opening to accommodate the design flows. Prepare a hydraulics report with pertinent data and recommendations.

318 Preliminary Drainage and Utility Studies

Investigate project impacts on existing surface and closed drainage systems. Evaluate hydraulics and structural adequacy of existing culverts. Establish preliminary limits of proposed open and closed drainage system improvements and outlet locations.

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319 Lane Configurations

Assess travel lane configurations at intersections and at weaving and merging sections to establish traffic requirements/capacities.

320 Traffic Signals

Prepare signal plans depicting signal head type, quantity, and location, and include the sequence and timing chart and preferential phasing diagram. Additional guidance regarding the Traffic related details required for the 25% Design Submission is described in the Traffic and Safety Engineering 25% Design Submission Guidelines.

321 Signs and Pavement Markings

Prepare preliminary sign and pavement marking plan to document changes associated with conceptual design.

322 Traffic Management

Develop a general methodology for constructing the proposed project to minimize the impact to all facility users and abutters, while at the same time addressing construction costs and constructability. Prepare preliminary temporary traffic control plans. The preparation of these plans should include a preliminary estimate that takes into account the use of police and/or flaggers to be used for traffic control.

323 Reserved

324 Constructability Review

Review the proposed project to ensure that the project does not present unusual matters that would unduly increase the cost the project or present potential scheduling delays during construction resulting in claims for extra work. Particular attention must be given to the proposed construction staging and available right of way.

325 Quality Control (QC) Review

Perform review of the quality and accuracy of the documents to ensure that key aspects of the information to be presented to MassDOT are prepared in accordance with the Guidebook, the Standard Specifications for Highways and Bridges and the most recent Supplemental Specifications, Standard Nomenclature and Engineering Directives. Particular attention is directed to Chapter 2 of Guidebook for the 25% submission requirements. The design should also be reviewed for conformity to design standards. Deviations from the 13 controlling criteria in Chapter 2 of the Guidebook must be documented under Section 220, Design Exception Report.

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326 Preliminary Construction Estimate

Prepare a preliminary cost estimate using MassDOT's Weighted Average Bid Application (WABA). The estimate should be prepared with a level of detail commensurate with a 25% submittal. Refer to Chapter 2 of the Guidebook for the 25% cost estimating requirements.

327 Submission Checklists

Prepare and submit the 25% Highway Design and Traffic Checklists.

328 Modifications and Revisions

Revise the plans accordingly, prior to scheduling the public hearing, in order to properly present the nature and extent of the project to the public at the hearing.

329 Value Engineering (VE)

On projects requiring VE studies, the consultant shall participate in a VE review to be conducted by an independent VE Team retained by MassDOT. Effort of the Consultant under this task will include the preparation of materials, project presentations, and field visits to familiarize the VE Team with the Project.

The VE Report shall be in accordance with the FHWA definition and application of Value Engineering as published in the *Federal Register* on February 14, 1997, as well as in accordance with the FHWA Value Engineering Policy, dated September 8, 1998. The effort will also include follow up with the VE Team and MassDOT to review and discuss VE recommendations and make accepted revisions to the project.

330 Construction Contract Time Determination

At the 25% design stage the designer must provide the project manager with the anticipated construction duration. This preliminary duration shall be determined based on the know scope of work, outcomes of early utility coordination, current proposed staging and anticipated traffic management plan. A full Construction Contract Time Determination (CCTD) performed by a Scheduler is not required until the 75% design and beyond.

331 Incentives/Disincentives

If required by MassDOT, the Consultant shall provide additional support services to develop contractor performance based incentives and disincentives (I/D). The work under this task may include development of the following items:

- a.) Road User Impact Calculations

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b.) Acceleration Schedules

Road User Impact Calculations (RUC)

These shall be generated using the traffic information that has been gathered during the design phase and shall be analyzed and presented in accordance with the standards that have been identified as part of the American Association of State Highway and Transportation Officials (AASHTO) User and Non-User Benefit Analysis for Highways (September 2010 or latest addition), and in accordance with MassDOT's current policies and procedures.

Acceleration Schedules

In support of the development of the I/D analysis and the RUC analysis, the Consultant may be directed by the Project Manager to provide several alternative Contract Time Determination Schedules (CTDs) to assist MassDOT in the finalization of parameters that will be provided to the contractors for their performance based incentive.

SECTION 350 DESIGN PUBLIC HEARING

351 Hearing Preparation

Prepare the graphics and other visual aids per the negotiated scope of services to display at the public hearing. Prepare a public hearing handout.

352 Design Public Hearing

Attend Design Public Hearing, present the project to the public and respond to questions. Assist MassDOT in preparing written responses to letters received from concerned individuals as a result of the hearing.

SECTION 400 75% HIGHWAY DESIGN SUBMISSION

401 Response to 25% Comments

Prepare a formal written response to all comments received regarding the 25% review and address revisions stemming from the Design Public Hearing that MassDOT and the Consultant deem necessary.

402 Field Reconnaissance

Conduct a field review of the proposed project interface with adjacent properties, streets, drives, drainage, utilities, wetlands, etc. Define additional survey needs, if needed.

403 Meetings Liaison and Coordination

Attend meetings and provide the liaison necessary to advance the design of a project. Coordinate and attend meetings with MassDOT's Boston and District Offices, community

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representatives, planning agencies, as determined in the project scoping process. Provide MassDOT with minutes of the meetings.

404 Utility Coordination

Contact utility companies affected by the proposed work. Discuss project impacts and note the locations of relocated utilities (poles, pipes, etc.) on the plans. Include estimate and special provisions for publicly owned utility work that is to be performed by the construction contractor.

405 Final Horizontal Design Geometrics

Adjust the horizontal geometry based on the 25% review comments and comments stemming from the Design Public Hearing. Plans must clearly show all aspects of the horizontal geometry, including curve components such as Point of Curvature (PC), Radius (R), DELTA, Length of Curve (L), Tangent (T) and Point of Tangency (PT) along with a description of roadway widths, station equations and horizontal offsets between survey baseline and design centerline.

406 Final Vertical Design Geometrics

Adjust vertical geometry based on 25% review comments and comments stemming from the Design Public Hearing. Plans must clearly show all pertinent aspects of the vertical geometry including Stopping Sight Distance (SSD), Passing Sight Distance (PSD), Grade 1 (G1), Grade 2 (G2), Length of Vertical Curve (L), K (factor), station and elevation of Point of Vertical Curvature (PVC), Point of Vertical Tangency (PVT) and Point of Vertical Intersection (PVI). Profiles are to be prepared in accordance with the Guidebook.

407 Pavement Design

Respond to Pavement Design Engineer's review comments and prepare a detailed pavement design with updated data sheets, per the Guidebook. For bridge R&R projects refer to the 11/12/09 MassDOT Memorandum on standard bridge deck pavements.

408 Typical Cross Sections

Finalize the typical cross sections ensuring that materials and dimensions are clearly labeled in accordance with the proposed pavement structure approved by the Pavement Management Section.

409 Plot Cross Sections

Adjust cross sections to ensure that the slope limits and treatments of each cross section are crafted to suit the specific site locations. Individual cross sections should be evaluated regarding guardrail locations, gravel box detail, pay limits, and the need for subdrains and retaining walls.

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410 Plot Proposed Layout and Easements

Adjust the plans based on the limits establish by the final cross sections to ensure that adequate right of way is available to perform the work. Existing layout lines, proposed alterations and any temporary or permanent easements must be clearly labeled.

411 Construction Plans

Prepare the Construction Plans in accordance with the Guidebook. Each item of work within the project limits must be clearly labeled. Drawings must be formatted as described in the Guidebook.

412 Grading and Tie Plans

Prepare grading and tie plans as applicable showing detailed information regarding proposed curve geometry and grades.

413 Drainage and Water Supply Details

Clearly show all existing and proposed drainage and water supply installations. The drainage and water supply design must address all work required to accommodate the proposed roadway improvements.

During the Project's design development, the plan presentation of proposed drainage facilities will show rim and invert elevations. These will be included in a separate CADD layer, so that they can be frozen off in the PS&E documents. These elevations shall not be shown on the final plans.

414 Traffic Signs

Identify locations for all warning, regulatory and route marker signs. Indicate on the construction plans the status of existing sign structures.

415 Guide Sign Design and Overhead Directional (OD) Elevations

Indicate proposed locations of all ground mounted and overhead guide signs. Develop panel legends and calculate size. Prepare a Sign Summary Sheet. Design support foundations and include calculations. Draft guide sign details and overhead sign elevations.

416 Traffic Signals and Plan Preparation

Include designs for traffic signal installations, supports, and foundations. Develop traffic signal specifications. Finalize phasing details and prepare the traffic signal plans.

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417 Pavement Markings and Plan Preparation

Design and layout the roadway pavement markings, stop lines, cross walks, gore markings, etc. Prepare pavement marking plans.

418 Traffic Management

Finalize the construction staging. Prepare the temporary traffic control construction plans in accordance with the MUTCD such that sufficient information is provided to demonstrate a feasible means of constructing the project. The level of detail shall recognize that the actual traffic management plan implemented by the contractor may vary from that shown on the plans. A more definitive estimate for the use of police/flaggers will be made based on the finalization of the traffic control plans/traffic management plans.

419 Highway Lighting Plans and Details

Complete the highway lighting distribution system, control equipment, wiring schematics, and other relevant details.

420 Landscaping and Plan Preparation

Finalize planting locations and species based on review comments. Develop planting schedules and tabulate relevant data.

421 Erosion Control

Detail the sequencing, material placement and measures to control the potential damage to adjacent properties, wetlands, bodies of water, etc. Include erosion control measures in the plans.

422 Miscellaneous Contract Plans

Prepare miscellaneous full size drawings for presentation of the proposed project. These shall include the following miscellaneous contract plans, as required: Title Sheet, Index, Key Plan, Boring Plans, Boring Logs, Typical Sections, and Special Details.

423 Quantity & Cost Estimate (Weighted Average Bid Application)

Prepare a detailed estimate using MassDOT's Weighted Average Bid Application (WABA). Also prepare a calculation book based on the latest edition of the Standard Nomenclature. Check that every item of work shown on the plans has a pay item.

Provide tracking of significant changes (greater than 10%) since the 25% estimate.

424 Special Provisions

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Prepare draft special provisions based on the latest edition of the Standard Specifications for Highways and Bridges and Supplemental Specifications, and verify that every item in the estimate that is listed in the Standard Nomenclature with an asterisk (*) has a special provision. Ensure that special provisions are drafted only when absolutely necessary to describe a specific or unique activity to be performed by the contractor.

425 Constructability and Quality Control (QC) Reviews

Perform an independent review of the project using an experienced engineer, who is not directly involved in the preparation of the contract documents. The review shall focus on the practicality of constructing the project based on access to site, equipment needs, material properties, etc. Also provide an overall review of the plans, specifications and estimate for conformity to the Guidebook, the Standard Specifications for Highways and Bridges, the latest Supplemental Specifications, the Bridge Manual, the Construction and Traffic Standard Details, and the latest Engineering and Policy Directives.

426 Submission Check List

Prepare and submit the 75% Design Check List.

427 Bottom Up Estimate and Reconciliation (if required)

a) Bottom Up Estimate and Reconciliation

When required, as identified by one of the criteria i-iv below, the Consultant shall perform bottom-up cost estimates at the 75% design stage, 100% design stage and at PS&E stage for lump sum items. Bottom-up cost estimates will not be required for standard items with other units of measure. A bottom-up cost estimate is a cost estimate that is based on a detailed breakdown of labor, materials, equipment and production rates. The Consultant shall perform bottom-up cost estimates for lump sum items if the Project:

- i. has an estimated construction cost of at least \$15 million;
- ii. has an estimated construction cost of at least \$6 million and is complex (e.g., includes complex traffic sequencing, construction over a waterway, utility relocation, right of way issues, or railroad coordination), as determined by MassDOT;
- iii. includes accelerated construction techniques;
- iv. or on an as needed basis as determined by MassDOT.

b) Basis of Estimate Narrative

As part of the 75%, 100% and PS&E design submissions, the Consultant shall submit a “Basis of Estimate Narrative” to MassDOT. Failure to submit a Basis of Estimate Narrative with a design submission may result in MassDOT’s rejection of the cost estimate.

The form of the Basis of Estimate Narrative shall be in accordance with the sample template provided by MassDOT.

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c) Quality Control Procedures

The Consultant shall submit its Quality Control (QC) Procedures for performing cost estimates to MassDOT for review and approval prior to commencing work on the Project. As a minimum requirement, the Consultant shall detail the roles of each individual performing the estimate (quantity survey, pricing, constructability, means-and-methods), and provide a description of how quantities will be checked, and how pricing computations will be maintained.

d) Independent Cost Estimating

For reliable and accurate construction cost estimates for projects, MassDOT may engage an Independent Estimator (IE) to develop independent cost estimates at various design stages of the Project.

If this is required the Consultant is responsible for responding to the IE's comments, reconciling documents generated by the Consultant and documents generated by the IE, and for revising the construction contract documents if deemed necessary by MassDOT.

e) Reconciling Estimates

The Consultant shall cooperate with MassDOT to reconcile its cost estimates with those of the Independent Estimator. If requested, the Consultant shall provide information and documentation to MassDOT in addition to the documentation and information set forth above.

MassDOT shall draft the reconciliation statements on estimates. The Consultant may be required to review the reconciliation statements for validity and, as directed by MassDOT, shall resolve and incorporate the cost estimates contained in the reconciliation statements in future submittals on the Project.

The Consultant shall also collaborate with MassDOT to determine whether alternatives may reduce the Project costs or schedule, and to identify these alternatives. Alternatives include, but are not limited to, constructability approaches. MassDOT and the Consultant will agree on a scope and fee adjustment for the Consultant's preparation of alternatives.

428 Construction Contract Time Determination

This language applies to all Projects with Project Utility Coordination Form and/or Incentives/Disincentives.

The Consultant shall prepare a Construction Contract Time Determination (CCTD) Schedule which sets forth an estimate for a reasonable duration of the construction contract, utilizing the details of the estimate for all projects that involve a Project Utility Coordination Form or Incentives/Disincentives that MassDOT chooses to offer the Contractors.

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The CCTD Schedules at the 75% (INITIAL), 100% (UPDATED) and PS&E (UPDATED) design stages provide MassDOT with a basis to determine whether the Construction Contract Duration represents a reasonable approach to constructing the Project, to allow constructability issues to be addressed prior to design completion, to assist the Consultant with the requirements to validate that the contract plans/documents support a constructible approach, and to assist MassDOT in the review of the Contractor's Baseline Schedule Submission.

The Consultant shall employ an experienced construction scheduler to prepare construction schedules at the 75%, 100% and PS&E design stages. The Scheduler must have a minimum of 5 years construction scheduling experience, and may be an employee of the Consultant.

a) Critical Path Method Scheduling

The CCTD Schedule shall use a Critical Path Method (CPM) and shall be developed and maintained using software approved by MassDOT (Primavera is preferred for consistency with MassDOT's construction specifications and master schedule). An evaluation of critical resources, shift differential, overtime, proposed methods, and all limitations of operations shall be included in the CCTD Schedule.

Based upon consultation with MassDOT the Consultant will be required to respond to any comments and update, explain or incorporate any MassDOT provided data, such as production factors, and/or revise the CCTD Schedule, as MassDOT determines necessary.

The Consultant shall submit a CCTD schedule following the 75%, 100% & PS&E submission of each construction cost estimate. The CCTD schedule submission will be due three (3) weeks after the construction cost estimates have been approved by MassDOT.

If required, the data from the bottoms up cost estimate for Lump Sum items (e.g., crews, equipment, production rates, quantities, construction sequence), must be used in the development of the CCTD Schedule. The Scheduler shall develop the logic (activity relationships) and activity durations using data from the estimate. Production rates and labor hours shall be used to develop reasonable crew hours based upon a reasonable crew composition. This evaluation shall also consider the intended construction sequence, construction seasons, and other construction time related aspects, such as any requirements to relocate utilities and Incentive/Disincentive provisions.

b) Milestones and Access Restraints

The Consultant shall develop Contract Milestones and Access Restraints (to the Project site) including those identified to support the utility coordination developed as part of the Project Utilities Coordination Form and those needed to support the implementation of Incentives and Disincentives that should be included in the construction contract provisions, and shall include them in the CCTD schedule.

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c) Limitations of Operations – Construction Constraints

The Consultant shall identify significant implications of construction constraints as may be determinable, and reflect them in the cost estimate and schedule, including, but not limited to restrictions from temperature, noise, vibration, permitting, approved materials, emergency response and community events, as part of the Project Utility Coordination form. The Consultant shall include all of the resulting PUC form information in their CCTD and shall provide MassDOT a furnished PUC form in the Contract Documents. This effort also includes the development of access restraints (restrictions that clearly define when the contractor can start work in a specific area allowing for the third-party Utility to complete their work) into the Contract Documents. The Consultant shall identify any early utility work, permitting or Right of Way activities that must be performed prior to the Contractor N.T.P. These early coordination activities shall be identified and included in the CCTD updates. If some construction activities are to be performed during the winter months (grouting of precast units; placing of closure pour slabs; etc.) make sure those tasks are identified and appropriate language is added to Subsections 8.03 and 8.10.

d) Elements

The Consultant shall include the following time (contract duration) related elements are included in the CCTD Schedule:

- 1) Preparation of a work plan and mobilization prior to starting physical work;
- 2) Preparation of critical submittals;
- 3) Review of critical submittals by the Consultant (MassDOT will provide standard submittal review durations to be used in the CCTD schedules);
- 4) Procurement/ordering of materials;
- 5) Fabrication and delivery of long-lead items;
- 6) Time necessary to complete each activity, as itemized in the Construction cost estimate;
- 7) Testing;
- 8) Commissioning (moveable drawbridges only);
- 9) Winter restrictions;
- 10) Environmental permitting or landowner restrictions;
- 11) Agency/utility/city restrictions;
- 12) Sequencing/logic required to complete the work;
- 13) Utility restraints and utility relocation milestones; and
- 14) Early/Critical coordination activities
 - A. Early Utilities
 - B. Remaining Right of Way
 - C. Permits that the Contractor must obtain

e) Quality Control Procedures

The Consultant shall submit its Quality Control (QC) procedures for the performance of CCTD to MassDOT for review and approval prior to commencing work on the Project. As a minimum requirement, the Consultant shall detail the roles of each individual performing the

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planning schedule (utilization of estimating information, logic, durations, constructability, means-and-methods), and provide a description of how the schedule will be developed, monitored and approved by the Consultant.

429 Incentives/Disincentives with Road User Calculation

Refer to Standard Task Description 331 (Incentives/Disincentives) which details the effort involved in this task for the 25%, 75%, 100% and PS&E Submissions.

SECTION 450 100% HIGHWAY DESIGN SUBMISSION

451 Respond to 75% Comments

Prepare a formal written response to all comments received regarding the 75% review. Resolve any further review comments.

452 Finalize Plans

Prepare a set of plans addressing all comments received from the 75% review. Ensure that the plans are clear and are prepared in accordance with Chapter 2 of the Guidebook.

453 Finalize Special Provisions

Review the special provisions to ensure that the special provisions do not duplicate those with respect to Division I of the Standard Specifications. Review the Method of Measurement and Basis of Payment for every item in order to ensure that the special provisions are clearly defined and not ambiguous.

454 Finalize Quantity and Cost Estimate (W.A.B.A. & Calculation Book)

Prepare Detail Sheets, Quantity Sheets, and a Cost Summary Sheet. Finalize calculation book in accordance with Chapter 18 of the Guidebook. Prepare calculations for all items of work that have a pay item. Identify any non-participating work. The estimate submitted shall be prepared using MassDOT's Weighted Average Bid Application (WABA).

Provide tracking of significant changes (greater than 10%) since the 75% estimate.

455 Quality Control (QC) Review

Perform an independent review of the project using an experienced engineer, who is not directly involved in the preparation of the contract documents to perform an independent review of the project. Refer to the MassDOT web site for the latest edition of all reference documents,

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Engineering Directives and Policy Directives. Verify that the plans, specifications and estimate are prepared in accordance with these documents.

456 Submission Check List

Prepare and submit the 100% Highway Design Check List.

457 Bottom Up Estimate and Reconciliation (if required)

Refer to Standard Task Description 427 (Bottom Up Estimate and Reconciliation) which details the effort involved in this task for the 75%, 100% and PS&E Submissions.

458 Construction Contract Time Determination

Refer to Standard Task Description 428 (Construction Contract Time Determination) which details the effort involved in this task for the 75%, 100% and PS&E Submissions.

459 Incentives/Disincentives

Refer to Standard Task Description 331 (Incentives/Disincentives) which details the effort involved in this task for the 25%, 75%, 100% and PS&E Submissions.

SECTION 500 RIGHT OF WAY

The Consultant or MassDOT shall prepare right of way plans as specified in the Guidebook, and as noted in applicable FHWA policies and regulations. Preliminary right-of-way plans shall be submitted prior to the 25 percent design approval and the public hearing.

Right of way plans shall include all pertinent data affecting the costs of the right of way applicable for appraisal purposes, such as structures, access roads, improvements, landscaping, drainage, fences, cesspools, septic tanks, wells, property bounds, etc.

The size, form and arrangement of right of way plans shall conform to the general requirements for highway plans as specified in the Guidebook. The three main components of the Right of Way process are:

Preliminary Right of Way plans shall be prepared prior to holding the 25% Design Public Hearing. Existing data, details and all proposed work shall be prepared in such a manner as to be readily discernable. These plans shall remain in the preliminary stage until after the layout has been duly filed in the Registry of Deeds.

Right of way acquisition data shall be itemized by the Consultant on the preliminary right of way plans, as soon as the data is obtained. The Consultant shall, as required, provide

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MassDOT with copies of the preliminary right of way plans for coordination and informational purposes, particularly as this may relate to changes in parcel dimensions or title names.

Deeds and plans of the abutting property owners shall be used to verify the location of all the abutter's property lines. Electronic copies of the research materials and any updates shall be maintained throughout the right of way process. All research materials are to be made available to MassDOT during the preparation of the Preliminary Right of Way Plans.

Final Right of Way plans are only required on projects that MassDOT has responsibility for right of way takings. After MassDOT has recorded the layout in the Registry of Deeds, the preliminary right of way plans will become the final right of way plans, subject to any approved revisions.

The Consultant shall make all changes to the preliminary right of way plans to ensure conformity with the recorded layout plans. Each sheet shall be labeled "Final Right of Way Plan". Upon completion, the final right of way plans shall be plotted on polyester film and returned to MassDOT as a permanent record. Provision shall be made on each sheet of the final right of way plans for the notations and dates of additions and/or revisions.

Relative to **Layout and Taking Plans and Orders of Taking**, the Consultant shall prepare and submit to MassDOT, for approval by the Engineer, all the instruments which are required to be recorded in the Registry of Deeds in connection with the acquisition of any interest in real estate made necessary by the work to be performed under this Contract. These instruments shall consist of plans, descriptions and orders of taking for advance takings, alterations, layouts and/or easements. The preparation of these instruments shall conform to standard MassDOT practices. Drawings shall be plotted on polyester film, except in the case of Land Court plans, which must conform to Land Court standards, samples of which may be obtained from the Engineer. The title sheet of all plans to be recorded shall be signed and stamped with the seal of a Land Surveyor registered in the Commonwealth, who shall be in charge of the work.

Abutter's property lines shall be verified with updated deeds and plans. The Professional Land Surveyor shall maintain and update electronic copies of the research materials throughout the taking document process. All research materials are to be made available to MassDOT Highway Division during preparation of the Layout Plans and written instruments.

Any registered land subdivisions required for this project shall be submitted to and approved by the Land Court.

MassDOT shall handle the recording and filing of these instruments. MassDOT shall also handle the appraisal and settlement of all land damages, including negotiations with property owners.

501 Preliminary Right of Way Plans

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Review the relationship between the limits of work necessary to satisfactorily construct the proposed improvements and the existing layout. Determine appropriate limits of alterations to existing layouts, takings, permanent easements, temporary easements, etc. Prepare Preliminary Right of Way Plans in accordance with Chapter 18 of the Guidebook. The Right of Way Plans include Title Sheet, Typical Sections, Parcel Summary Sheet, Location Maps and Property Plan Sheets.

502 Layout Plans and Order of Taking

Prepare Layout Plans based on the approved Preliminary Right of Way Plans. Show lengths and bearings of all lines and calculate areas. The Layout Plans shall be prepared in accordance with Chapter 18 of the Guidebook and shall include the proposed layout lines, property lines, corner markers, names of property owners, parcels to be taken, access and non-access points and the locations of all bounds. The preparation of a Decree Plan shall be included, if required.

503 Written Instrument

The Written Instrument for the Layout and Order of Taking shall be prepared in accordance with MassDOT Policy. The Written Instrument shall be carefully checked against the Layout Plan.

504 Final Right of Way Plans

After the FHWA has granted authority to the State and approved Federal participating funds to acquire the right of way takings and/or the Right of Way Bureau accepts the Preliminary Right of Way Plan, the Preliminary Right of Way Plan will become the Final Right of Way.

SECTION 600 GEOTECHNICAL DESIGN

The Consultant shall conduct an investigation of sub-surface conditions of sufficient scope to permit determination of general soil characteristics and depth to bedrock as a basis for the proper design of roadway and highway structures.

In order to properly make the determination of underground conditions, the Consultant shall submit to the Engineer for approval a proposed program of borings, test pits, plate bearing tests or other field or laboratory tests, along with an estimated cost for performing such work.

The Engineer may limit, reduce or extend the sub-surface investigation program proposed by the Consultant, or the Engineer may specify in detail the type, extent and details of sub-surface investigations that are to be conducted by MassDOT forces or by such other means as the Engineer may determine. In any case, the Consultant shall lay out the work in detail and prepare necessary plans and contract documents for the approved work.

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The Environmental Services Division shall be consulted for a determination of environmental permitting requirements for the sub-surface investigations. The Consultant shall be responsible for the preparation of any environmental permit applications required for the sub-surface tests. Reimbursement for such work, as may be performed by the Consultant, shall be made in accordance with the relevant provisions of Division I.

If the Engineer requires the Consultant to subcontract field tests, the Consultant shall follow the requirements of Division I Section 5.03d. All special laboratory tests requiring extra payment require the Engineer's prior approval. MassDOT shall reimburse the Consultant for the work in accordance with the relevant provisions of Division I.

Field inspectors shall be furnished by the Consultant only if MassDOT inspectors are not available and only after written authorization is granted by the Engineer as to the number of inspectors to be provided.

The Consultant shall be responsible for properly identifying, describing and classifying soil and rock encountered in sub-surface investigations pursuant to the standard of care. The Consultant shall visually and manually examine all soil samples and rock cores and shall certify in writing to the Engineer, when, where and who examined such soil samples.

The Consultant shall prepare reports covering all sub-surface investigations and soils analyses and shall submit these reports to the Engineer. A sufficient number of copies of these reports, as determined by the Engineer, shall be submitted by the Consultant for review and retention by MassDOT and for submission to the FHWA.

The Consultant shall either have in its employ an engineer capable of performing the basic soils and foundation work or engage the services of a soils engineer, the cost of which is to be included in the General Fee as a direct expense.

Employees of the Consultant or the geotechnical subconsultant may not function as inspectors if the drilling contractor is owned by or affiliated with the Consultant or geotechnical subconsultant.

Inspectors provided by the Consultant for inspection of geotechnical borings, soil sampling and field-testing shall be performed by:

- A certified soils technician, who is knowledgeable in current policy and procedures for field inspection of geotechnical exploration programs and shall have a minimum of one year of boring inspection field experience, or
- A holder of a Bachelor of Science degree in civil engineering, geology or equivalent, plus three months of boring inspection field experience,

To achieve certification, soils technicians must satisfy the rules and procedures of the certification program, as prepared by the National Institute for certification in Engineering Technologies (NICET) in their current editions of the following documents:

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- “Program Detail Manual” for certification in the field of geotechnical engineering technology
- Section II and IV of the NICET manual entitled Engineering Technician and Technologist Certification Program”

Inspectors shall be capable of making independent site modifications regarding the extent and/or location of the subsurface investigations required.

The inspector shall have the responsibility of certifying that the drilling contractor’s procedures for conducting soil sampling and in-situ testing work, such as undisturbed samples, vane shear tests, peizometer installations, etc., are performed in accordance with the relevant specifications and current practices.

The inspector shall follow the MassDOT’s boring inspection procedures, which include, but are not limited to the following: an inspector’s check list for site work, scope of work and description of the subsurface operations; special provision items and supplemental specifications; visual identification of soil and rock samples; standard penetration tests and soil descriptions; and standard operating procedures for recording daily boring activities.

601 Research Available Subsurface Data

Research, compile, and evaluate available subsurface and foundation data relative to the project site (plans, maps, etc.).

602 Field Reconnaissance

Conduct a field inspection at the project site to view site conditions, consider existing and proposed substructures, foundation elements, and assess requirements for the subsurface investigation plan.

603 Subsurface Investigation Plan

Prepare a subsurface investigation plan (boring, probing, testing type, location, depth, etc.) in accordance with the Bridge Manual. Revise and resubmit after MassDOT review. Prepare the specifications and estimates if the boring contract is to be paid for with direct expenses.

604 Subsurface Investigation Inspection

Conduct on-site inspections during subsurface operations. Follow inspection procedures, coordinate activities between the Consultant and MassDOT, and verify and record quantities for records and payment.

605 Office Studies, Analysis and Testing

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Review soil/rock samples and field/laboratory test results. Evaluate the foundation options and determine parameters for foundation design.

606 Geotechnical Report

Prepare and edit the Geotechnical Report in accordance with the Bridge Manual and other guidelines. Correlate the contents of the report with the project construction plans.

607 Meetings, Reviews and Liaisons

Coordinate and meet with MassDOT for reviews, revisions, and advancement of project submittals.

608 Plans, Specifications and Estimates

Prepare and finalize geotechnical related details and items for the plans, special provisions, and estimates.

SECTION 700 PROJECT DEVELOPMENT – STRUCTURAL

The Consultant shall establish the site parameters and constraints that will impact the design and construction of the bridge structure through a field investigation, review of information related to the existing structure (if any), review of available hydraulic and scour data, geotechnical data, environmental information, and cultural resource information, hazmat information. The Consultant shall use this information to determine the most appropriate type of structure for the site that addresses these parameters and constraints to be pursued in the Final Bridge Design work.

701 Field Investigation

Conduct a field inspection to review the bridge site and adjacent conditions, and establish project parameters and constraints. Evaluate the ground and river survey to determine the parameters for bridge design.

702 Determine Bridge Configurations

Collaborate with the highway designer to determine the vertical and horizontal alignments and typical cross-sections for both the roadway over and the roadway under. Determine a preliminary span length and vertical bridge clearance. Provide accommodations on the bridge for both existing and proposed utilities.

703 Preliminary Structural Analysis

Determine bridge types as per scope of services. Perform a preliminary structural analysis to determine the approximate superstructure depth.

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704 Comparative Design and Cost Analyses

Evaluate those alternate bridge structure types that are appropriate to the site based on considerations of highway design parameters, traffic safety, impacts to surrounding properties and environmentally sensitive areas, traffic management, constructability, and aesthetics. Cost shall only be used to select between alternates that have been determined to be equally appropriate to the site based on the Type Section Worksheet.

705 Preliminary Structures Report Preparation

Prepare a Preliminary Structures Report where scope of services includes an investigation of rehabilitation verses replacement. The report shall evaluate the structural components that have less capacity than required for statutory live load, and shall justify the recommendation for rehabilitation or replacement.

706 Bridge Type Selection Worksheet Preparation

Prepare a Type Selection Worksheet per the MassDOT Bridge Manual detailing the various design alternatives for the bridge, complete with appropriate graphics, descriptive text and cost breakdowns justifying the recommendations presented.

707 Meetings and Liaison

Attend meetings and coordinate with MassDOT during the preparation of the type study report to advance the work. Respond to MassDOT review comments.

708 Hydraulics Study and Report (Bridges over Water)

Review the hydrological analysis and hydraulics report relative to the size of the hydraulics opening. Perform all calculations necessary to determine the size of the opening required to accommodate the design flows. Prepare a Hydraulics Report that presents pertinent data and recommendations.

SECTION 710 SKETCH PLANS

711 Establish Boring Locations

Determine the locations for the proposed bridge borings based on an approved structure type. Coordinate the boring program and the geotechnical design with MassDOT's Geotechnical Section. Prepare the boring location plans.

712 Reserved

713 Sketch Plan Development

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Prepare sketch plans for each structure in accordance with the MassDOT Bridge Manual. Submit review copies together with the foundation report to MassDOT. Check to ensure that the proposed design and construction staging plan addresses the cost and scheduling impacts associated with accommodating both existing and proposed utilities. Review the boring logs and foundation reports. Perform geometric design calculations.

714 Meetings, Coordination and Liaison

Participate in MassDOT Sketch Plan review meetings. Prepare responses to agency comments and plan revisions, as necessary. Provide coordination during the soils testing program and prior to the preparation of the soils and foundation reports being provided by the geotechnical staff or a subconsultant.

715 Constructability Review

Review the design of the proposed structure to ensure that the structure does not present any unusual matters that would unduly increase the cost the project or present potential scheduling delays during construction resulting in claims for extra work. Particular attention must be given to the proposed construction staging and available right of way.

716 Submission Checklist

Prepare and submit Bridge Section Checklist.

SECTION 750 FINAL BRIDGE DESIGN

751 Structural Design – Superstructure

Prepare the design calculations, and perform an independent design check of the calculations for all superstructure components in accordance with the MassDOT Bridge Manual.

752 Structural Design – Substructure

Prepare the design calculations and perform an independent design check of the calculations for all substructure components, including any cofferdams and permanent excavation support system requirements in accordance with the MassDOT Bridge Manual.

753 Bridge Layout Geometrics

Prepare the design calculations and perform an independent design check of the bridge geometric calculations, including framing, layout, critical clearance and elevation of footings, layout and ties, etc.

754 Contract Drawings

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Prepare the structural drawings in accordance with the MassDOT Bridge Manual and check the drawings for content and accuracy.

755 First Review Submission

Prepare and submit the bridge design plans for MassDOT review and subsequent resolution of the comments and recommendations received from MassDOT.

756 Quantity Cost Estimates

Prepare the quantity calculations, and perform an independent check of the quantity calculations of the bridge items and related cost estimates.

757 Special Provisions

Prepare the bridge special provisions in accordance with the MassDOT Bridge Manual.

758 Second Review Submission

Prepare and submit updated final bridge designs plans for MassDOT review and subsequent resolution of MassDOT comments and recommendations.

759 FHWA Reviews

On projects requiring FHWA oversight, provide copies of First and Second Bridge Plans for submission to FHWA for review. Respond to FHWA comments.

760 Meetings and Liaison

Participate in meetings and coordinate in scheduling and advancing the bridge design.

761 Constructability and Quality Control (QC) Review

Perform an independent review of the project by an experienced engineer who is not directly involved in the preparation of the contract documents. Review shall focus on the practicality of constructing the structure based on access to site, equipment needs, material properties, etc. Provide an overall review of the plans, specifications and estimate for conformity to the Guidebook, the Standard Specifications for Highways and Bridges, the latest Supplemental Specifications, the Bridge Manual, the Construction and Traffic Standard Details, and the latest Engineering and Policy Directives.

762 Submission Check List

Prepare and submit Bridge Section Check list.

SECTION 800 PS&E SUBMISSION

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Upon approval of the plans submitted for the preliminary design submission, the Consultant shall proceed with the preparation of the contract plans and documents in accordance with the relevant guidelines set forth in the Guidebook, the Bridge Manual, the Standard Specifications for Highways and Bridges, and other related publications as listed in Division I.

801 Respond to 100% Comments

Prepare a formal written response to all comments received regarding the 100% review.

802 Finalize Plans, Specifications and Estimate

Ensure that all comments from 100% review are addressed and reflected in the contract documents.

803 Prepare Detail Sheets

Prepare Detail Sheets in accordance with Chapter 13 of the Guidebook. All items of work not adequately reflected on the plans are to be described in the Detail Sheets.

804 Combine Highway and Bridge

Ensure that the highway plans accurately depict the approved bridge design and that the index correctly identifies the page numbering of the bridge plans. Combine Special Provisions and Estimate into one package that eliminates redundancy and ambiguity.

805 Quality Control (QC) Review

Have an experienced engineer who is not directly involved in the preparation of the contract documents perform an independent review of the project. Log on to the MassDOT website for the latest reference documents such as Engineering Directives and Policy Directives, and verify that the Plans, Specifications and Estimate are prepared in accordance with these documents. Review all environmental permits and ensure that the contract documents provide a means of compensating the construction contractor for performing work described in the permits.

806 Finalize Bottom Up Estimate and Estimate Reconciliation (if required)

Refer to Standard Task Description 427 (Bottom Up Estimate and Reconciliation) which details the effort involved in this task for the 75%, 100% and PS&E Submissions.

807 Finalize Construction Contract Time Determination

Refer to Standard Task Description 428 (Construction Contract Time Determination) which details the effort involved in this task for the 75%, 100% and PS&E Submissions.

808 Finalize Incentives/Disincentives

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Refer to Standard Task Description 331 (Incentives/Disincentives) which details the effort involved in this task for the 25%, 75%, 100% and PS&E Submissions.

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SECTION 900 CONSTRUCTION ENGINEERING

The Consultant shall provide construction phase services for items of work identified in the Scope of Services. Compensation for all construction phase services shall be made on a Costs Plus a Net Fee basis, as described under Division I, regardless of the payment method used for other services specified under this Contract. Construction phase services shall generally fall within the major categories described hereafter, unless otherwise specified under this Contract or directed by the Engineer.

The Consultant shall furnish consultations and interpretation of the Contract drawings and specifications as may be required by the Engineer. No payment will be made for visits to the work site in relation to errors or omissions made by the Consultant or to insufficient data in work previously submitted by the Consultant.

The Consultant shall also make its services available during construction for visits to the work site for consultations regarding additional design services or unforeseen problems required by the Engineer. Payment for additional construction phase services, if required and approved by the Engineer, shall be made in accordance with Division I.

Consultant shall review and take appropriate action upon the contractor's submittal of shop drawings, samples of construction material, and product data, as required in the construction contract documents, but only for conformance with the design concept of the Project and with the information given in the construction documents. In its review of the shop drawings, Consultant is entitled to rely on the information provided, and the stamp and certification of the submitting Contractor as described in the Construction Contractor's general conditions. Review of shop drawings, product data and samples of construction material shall not include review of dimensions, quantities, calculations, weights, fabrication processes, construction means and methods, coordination of trades or safety factors related to construction.

The purpose of the Consultant's site visits and observations is to become generally familiar with the progress and quality of the work to determine, in general, if the work is proceeding in accordance with the design intent of the contract documents. The Consultant shall not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of work. On the basis of these on-site observations, the Consultant shall endeavor to keep the Engineer informed of portions of the work which the Consultant discovers are not proceeding in accordance with the design intent of the contract documents.

901 Pre-Bid Services

Review and respond to inquiries from MassDOT related to the bid documents. Participate in Pre-Bid Conference. Provide written responses to contractor's questions.

**MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION**

902 Pre-Construction Conference

Attend the Pre-Construction Conference. Answer questions and prepare the minutes of the meeting.

903 Highway Shop Drawings and Signal Permit

Review lighting, traffic signals, and sign shop drawings, including foundations and supports; and perform an operational site inspection. Prepare a signal permit based on as-built conditions.

904 Bridge and Wall Shop Drawings

Review and approve or take other appropriate action upon structural shop drawings for conformance with the contract documents.

905 Bridge Construction Procedures

Review and approve or take other appropriate action according to the Bridge Manual regarding the conformance of the bridge demolition and erection procedures to the contract documents.

906 Furnishing Advice and Field Visits

Provide assistance to MassDOT in interpreting the contract documents. Conduct field visits to the project site during construction as requested by the Engineer to provide consultation on design intent, assistance in addressing unforeseen conditions and /or similar matters, as requested by the Engineer. Attend periodic status and coordination meetings as determined by complexity of the project.

907 Geotechnical Construction Evaluation

Provide a technical recommendation to resolve unanticipated foundation issues encountered during all phases of construction.

908 Bridge Rating and Photographs

Visit the project site and evaluate structures for conformance to the contract documents. Take photographs of completed structure. Prepare the Bridge Rating Report.