

ATTACHMENT G

EXAMPLE

CONTRACT TIME DETERMINATION

(CTD)

WITH NARRATIVE

75% DESIGN PHASE

DEVELOPED FOR ***CONSTRUCTION PLANNING*** DURING
THE ***DESIGN PHASE***

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DISCLAIMER - The intent of this guideline is to assist Designer when creating a Contract Time Determination Study; primarily eliminating a need to create standardized coding, reporting, formatting and to assist in the general schedule set up only. This tool-kit information is provided for informational purposes and is available for use as a schedule development guideline only. This information may not reflect specific contract requirements. MassDOT does not guarantee the schedule information to be free from errors or inconsistencies, and the presence of such errors or inconsistencies does not relieve the Designer or a Contractor, from preparing schedule submittals in accordance with the specific Contract requirements and the requirements of the Engineer. MassDOT makes no representations or warranties of any kind, express or implied, about the accuracy, reliability, or completeness with respect to the guidance herein or any of the information, services, or related content contained therein for any purpose.

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1 EXECUTIVE SUMMARY

1.1 CONTRACT TIME DETERMINATION (CTD) SUMMARY

The _____ {Consultant} conducted a Contract Time Determination study (CTD) that initially resulted in a Substantial Completion date of _____ 2016. At the direction of MassDOT, subsequent efforts were developed to optimize the schedule further and are summarized as follows:

OPTION A – This initial evaluation utilized two primary work assumptions during the substructure construction; one single crew working on the abutments, and another single crew working on the piers sequentially.

OPTION B - This option utilized three primary work assumptions as part of the substructure construction; one single crew working on the abutments and two other crews working on the piers with two headings (two different directions). This resulted in a Substantial Completion date of _____ 201_. The duration reduction in this option was minimal due to the limitation of completing some of the work in the winter, such as waterproofing and paving.

OPTION C – An additional accelerated duration study was developed, as a continuation of the previous Option B basis, in which the critical superstructure and approach work activities were changed to a working shifts of 6 days per week and 10 work hours per day (from the basis of 5 days/8hours). The schedule savings is significant due to the combination of time saved in performing some critical activities on extended shifts, with the multiple headings used in Option B no longer delayed due to winter shutdown. The incorporation of these acceleration methods resulted in a Substantial Completion date of _____ 201_.

Additionally, a cursory evaluation to explore the benefits of potentially improving the duration of the substructure work was explored using that same 6day/10 hour increase. This aggressive schedule initiative was deemed to be less of a benefit than the acceleration of the superstructure work.

The {CONSULTANT} is now recommending the Accelerated Option C schedule for this project and has determined the following performance durations to be reasonable and achievable using the Design Build delivery method. These durations are based on a Notice to Proceed (NTP) date of _____.

	<u>Duration</u>	<u>Date</u>
• NTP to Interim Roadway Opening (MS#04)	____ days	_____
• NTP to Full Beneficial Use (MS#03)	____ days	_____
• NTP to Substantial Completion/Full Beneficial Use (MS#02)	____ days	_____
• NTP to Contractor Field Completion (MS#01)	____ days	_____

This report describes the basis for the project duration and explains the use of durations, calendars (working shifts), schedule contingency and the assumptions used in the report. The detailed CTD schedule is also attached. Two detailed schedules / acceleration options are also attached included to help demonstrate the completion.

1.2 SPECIAL RESTRICTIONS

The items listed below provide restrictions on the discussed duration, these restrictions should be considered when determining the contractual durations:

- In order to prevent delays associated with the proposed completion date slipping through an additional winter slow down period, the NTP should be issued no later than ____201__.
- According to the standard specifications, when the NTP is being issued, if the proposed Substantial Completion/Full Beneficial Use milestone falls between December 1st and March 15th, the same number of additional days, beyond December 1st, will need to be extended after March 15th. This standard specification should be eliminated to require a Time Extension Analysis to be submitted by the contractor, as this contract time study has factored this into account and a CPM Schedule Specification is required for this project from the Contractor.
- Finally, any date changes should be coordinated and reviewed with the project team, prior to the advertisement and NTP.

1.3 CONTRACT SPECIAL PROVISIONS LANGUAGE

Specific contract language has been developed for incorporation into the Contract's Special Provisions to address changes to access restrictions, work restrictions, and limitations of operations. See attachment _____

1.4 MILESTONES CHART

The following chart lists the CTD milestones for each option, based on contract procurement durations.

	Advertisement to NTP = 90 Days		Advertisement to NTP = 120 Days		Advertisement to NTP = 150 Days		Advertisement to NTP = 180 Days	
Milestone	Date	Days from NTP	Date	Days from NTP	Date	Days from NTP	Date	Days from NTP
Advertise Construction Contract	XX/XX/XXXX							
Notice-to-Proceed Issuance	XX/XX/XXXX		XX/XX/XXXX		XX/XX/XXXX		XX/XX/XXXX	
Option A								
Interim Roadway Opening (MS#04)	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX
Full Beneficial Use (MS#03)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX
Substantial Completion (MS#02)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX
Contractor Field Completion (MS#01)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX
Option B								
Interim Roadway Opening (MS#04)	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX
Full Beneficial Use (MS#03)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX
Substantial Completion (MS#02)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX
Contractor Field Completion (MS#01)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX
Option C								
Interim Roadway Opening (MS#04)	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX	XX/XX/XXXX	XXX
Full Beneficial Use (MS#03)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX
Substantial Completion (MS#02)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX
Contractor Field Completion (MS#01)	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX	XX/XX/XXXX	X,XXX

Explanation of dates:

- The columns contain the Milestone date results based on various Construction Contract procurement durations
- The table is segmented by the three Options of normal and Accelerated CTD versions
- The standard Milestones (FBU, SC, and CFC) have been inserted into the contract bid documents exactly as stipulated by MassDOT in the _____ guidance document dated _____.

2 PURPOSE

The schedule and narrative are developed for the sole use of MassDOT and should not be shared with the Design-Builder/Contractor. The CTD is prepared using Critical Path Method (CPM) scheduling techniques to estimate the duration of the construction portion of the project and is generated to demonstrate that there is at least one reasonable/buildable plan to finish the project within the timeframe specified. This CTD considers most/critical constructability aspects as part of this planning effort, however, not all constructability aspects have been drafted/commented upon as part of this CTD. This CTD schedule is based on the 25% design and is intended to provide a conceptual baseline comparison of what is a reasonable and achievable duration for the construction of the project.

3 PROJECT DESCRIPTION

MassDOT has established a preliminary cost estimate of \$____,000,000 for Project # 60____ - _____ Bridge Replacement Project, which includes but is not limited to:

- Construction of the replacement of the _____ carrying Route _____ over Lake _____ in _____ including but not limited to _____, new piers and abutments and new open spandrel steel deck arch superstructures.
- Bridge Demolition
- Roadway and Intersection Improvement and Traffic Management
- Drainage and Stormwater Treatment
- Bridge and Approach Lighting and Bridge accent lighting
- Utility Coordination and Relocation
- Architectural and Historic Bridge Elements including monuments, plaques, railings, historic signage
- Coordination with stakeholders in conjunction with MassDOT

The scope of work contains, but is not limited to, the design and replacement of the existing Bridge No. S-____=W-____ in its entirety. The existing concrete _____ bridge will be demolished and replaced with a _____ structure as shown on the 75% Highway Plans and Bridge Plans. The construction will be sequenced in order to maintain two lanes of traffic over the bridge during construction. The contractor will be required to coordinate with _____ and provide notice to mariners on recreational boating passage during construction. Recreational boating through the project area must be maintained during construction.

The new bridge will be an ____ foot long (center of bearings) ____ span, _____ deck arch supported on concrete abutments and piers. The piers will be supported on deep foundations. The bridge will have two separate structures/barrels supporting the eastbound and westbound traffic in its final configuration.

The new bridge will provide a minimum ____ foot wide vertical clearance envelope providing a minimum of ____ feet over mean water level _____. In order to maximize the vertical clearance under the bridge the roadway profile will be raised to a maximum grade of ____%.

Current traffic movements over the bridge and through the intersections will be maintained through the project area during construction. A minimum of two lanes in each direction will be provided over the bridge at all times with the exception of possible short term lane closures during off peak hours for specific construction activities.

The work includes improvements along _____ Avenue for approximately _____ feet (subject to change during final design) including modifications and improvements for the intersection of _____ Avenue and Route _____.

The Contractor will be responsible for maintenance and providing an acceptable operating condition of two travel lanes in each direction within limits of the project area including the _____ Bridge.

Site Photograph:

4 REFERENCES

The CTD was developed using information contained in the following documents:

- A. MassDOT Project Description – Project 60 _____
- B. 75% Drawings Set : Highway and Bridge Drawings, dated Month DD, YYYY
- C. Preliminary Construction Cost Estimate of \$_____,000,000 based on 75% Design
- D. Reference Data for Production Rates _____
- E. Conceptual cost estimate date _____
- F. 75% Construction Cost Estimate information developed by _____ dated _____

5 METHODOLOGY

After reviewing the reference information, the scope of work was identify and analyzed. The conceptual cost estimate was used as the starting point for the schedule in order to maintain traceability between the two documents. The project scope was further broken down into discrete items of work (activities). The duration of each activity was calculated based on the quantity take offs, previous data, equipment and crew compositions. After defining the activities which represent the scope of the project, logical relationships between the activities were created to reflect the sequence in which the work will be performed. The schedule was then calculated based on the activity durations, and the sequence of the activities. The application of the resources over time was evaluated based on the number of activities worked during the construction of each phase. The critical path were reviewed with members of MassDOT District Construction.

6 CRITICAL PATH

For the purposes of this CTD, a project's critical path is the longest continuous path of activities through the project. The critical path determines the completion date of the project. A delay of any of the activities on the critical path will delay the completion date of the project.

To provide a quick understanding of the most critical path, a written description is listed below. The full schedule is added as an attachment to this report. The critical path changes with the two options also included for accelerating the construction. {consultant to add graphic of critical paths and describe them}

Advertise, Award & Design:

- 75% Phase 2 Plans has been completed on _____ and then PS&E Phase 2 Plans will be completed in _____
- The anticipated Advertisement date for this project is currently forecasted to be _____

Construction Phase 1:

- Phase __ work for demolition of the south sidewalk & start of the utility transfers will begin in _____ and continue through the fall of _____ while the design process is ongoing
- The Utility relocations and splice over work for Verizon will start after Phase__ in the fall of _____ and continue during Phase __ work through _____ for a completion in May _____.
- Phase __ work will start with Stage1 (Install Cofferdams, Erect Precast Concrete Piers and Abutments) in November _____ and continue while staggering the major work elements from Pier 2 to 3.
- Phase __ Stage 2 will continue to complete the superstructure frame construction.
- Phase __ Stage 3 will then continue to complete the superstructure deck construction & approach work for a traffic shift by Month DD, YYYY.

Construction Phase 2:

- Phase __ work for demolition will continue through the summer _____ and completing in the fall of _____.
- Phase __ work will start with Stage1 (Install Cofferdams, Erect Precast Concrete Piers and Abutments) in the fall of _____ and continue while staggering the major work elements from Pier 2 to 3.
- Phase __ Stage 2 & 3 will continue to complete the superstructure frame construction.
- Phase __ Stage 4 & 5 will then continue to complete the superstructure deck construction & approach work for a traffic shift by November _____.

7 ASSUMPTIONS

The following assumptions were used in the development of this schedule as shown:

7.1 GENERAL

- All work will be performed according to a 5 day 40 hour standard workweek, with the exception of the superstructure work (6/10s), which includes Massachusetts state holidays as listed on the DOT web site.
- Labor, equipment and materials will be available when and as needed.
- MassDOT PM anticipates that the only remaining project permits will be granted as scheduled without impacting the duration.
- The {CONSULTANT} anticipates that an environmental permit modification will be granted to allow unlimited water access with the exception of the boating restrictions. Should there be additional restrictions the contract duration will need to be increased.
- Early release packages for both design and submittals are shown in the schedule to allow starting Stage 1 demolition while the rest of the project is still being designed.
- Activities generally planned to work through the winter include the cofferdam installation, mass excavation, pile driving, mass concrete, precast pier installation, demolition, and large steel girder installations. These activities use a modified calendar that has 5 additional non work days between January and March to account for the winter inefficiencies.

- In the case that the precast _____ installation falls in the winter, the final tension & grout is shown as occurring after the winter and before the steel is installed on the _____.
- Activities generally planned not to work through the winter include abutment concrete, roadway work, waterproofing, paving, and deck concrete. These activities use either a short (Dec15-Mar15) winter shutdown or long (Nov15-Apr1) winter shutdown calendar based on the type of work and are in accordance with District Construction confirmation. These have been noted in a modified 8.03 Special Provision (see attached _____)
- The schedule base option A utilizes two primary work areas during the substructure construction. One crew and equipment working on the abutments and another crew and equipment working on the piers sequentially.
- The schedule acceleration option B utilizes three primary work areas during the substructure construction. One crew and equipment working on the abutments and two crews and equipment working on the piers with two headings.
- The schedule acceleration option C utilizes the same multiple heading approach as option B and includes additional acceleration on the critical superstructure and approach work occurring on a 6 day 10 hour a day workweek.

7.2 MAINTENANCE OF TRAFFIC

- The schedule has been developed as per the traffic sequencing in the design set.
 - In phase 1, bi-directional traffic will continue to operate with 2 lanes in each direction on the existing bridge.
 - In phase 2, bi-directional traffic will operate with 2 lanes in each direction on the new east bound bridge built in phase 1.

8 UTILITY COORDINATION

8.1 SCOPE OF UTILITY WORK

The PUC form (attached _____) has been utilized to develop many access restraints and the CTD. This will be included in the contract bid documents and will be the basis of the Contractors baseline schedule.

8.2 UTILITY COORDINATION COMMENTS

The PUC form has been noted as a possible candidate for Early Utility relocation (before Contractor NTP). The District Construction staff should note this and possibly use the PUC form information to manage the early start and progression of this work after the Advertisement.

The PUC form also notes that there is some concurrent utility work that must be executed properly to complete within the contact time. This should also be noted by District Construction and verified in the Contractors baseline schedule.

There appears to be _____ Utilities that have yet to generate the planned utility durations/sequence (not on the PUC form but are part of this work). The {consultant} has contacted the PM and the DUCE to see if there is an update on this information and will incorporate in the 100% submission. It is anticipated that the information provided by {Utility} will be critical and will likely impact the Duration provided herein – therefore, this CTD has included a ‘plug’ duration of 60 days to relocate _____.

8.3 ACCESS RESTRAINTS

Access restraints and interim milestones are shown in the schedule to highlight how the current utility relocations affect the construction schedule. The utility relocations occur ____{describe the need for access restraints and proposed access restraint dates calculated from the NTP }

9 KEY SUBMITTALS

9.1 EARLY SUBMITTAL PACKAGES

As the first year of construction will be based on preliminary drawings, it is very important for the Contractor to complete early design packages for _____

SUPPORT OF EXCAVATION (S.O.E.) FOR PIERS

The submittals for the cofferdams are critical for getting the work zone established in the water prior to ice over in the lake. To facilitate getting this done early, the submittals are shown as occurring after the _____ is approved.

PILE DRIVING

With several of the piers having deep piles it is important to have these submittals completed early to allow sufficient time to procure the materials and schedule the crews for the project. This becomes even more important with the acceleration options as they include an additional pile driving operation.

REBAR SHOP DRAWINGS

The pile caps and abutments include a significant amount of rebar and getting this approved early will be important to prevent any delays in construction.

STRUCTURAL STEEL

With the amount of steel on this project it is very important to track both the submittal and procurement of the steel through the fabrication process to prevent any delay to the construction in the field.

10 RESOURCES

Several of the activities in the schedule require equipment that will need to be planned for and scheduled in advance to avoid any impact to the schedule. In the acceleration option schedules, this becomes even more important to plan for as they require an additional operation with another crane, pile driver, and barge or other work platform for the piers.

The majority of activities on the critical path involve _____. The primary resources required for these activities are _____. Those key resources will be working in crews and completing the work simultaneously.

11 COST

The current available cost and quantity estimates were utilized to derive the activity and schedule duration. The total cost was \$____,000,000.

12 SCHEDULE CONTINGENCY

The {CONSULTANT} has determined that the project can be completed in the duration provided in Section 1 of this report. {CONSULTANT} believes these durations are reasonable and achievable. No schedule contingency has been included.

13 LIMITATIONS OF OPERATIONS

Operations will be limited by seasonal weather restrictions, seasonal water flow, maintenance of pedestrian traffic, maintenance of vehicular traffic, maintenance of Railroad operations, Subway operations, utility work (see previous section), access to neighboring businesses and schools, etc.

13.1 SEASONAL RESTRICTIONS

13.1.1 WATER ACCESS

- Water Access
 - The schedule was developed with the requirement to allow access to recreational water traffic through the center primary span.
- Winter Concrete
 - No concrete placement, applying of waterproofing sealant or soil compaction will occur between December 1 and March 15.
 - Although the Supplement Specifications do not specifically restrict the periods in which concrete shall be placed, the Spec does indicate that concrete cannot be placed when:
 - See MHD Supplement Specifications -Ed. 1988, Section 901.64 C
 - Reference: Per standard DOT winter shutdown periods, concrete placement is typically restricted between December 1 and March 15.
- Base & Final Paving (HMA)
 - No base paving (HMA) placement will occur between November 15 and April 1.
 - Hot mix asphalt shall not be placed after November 15 or before April 1 without the written permission of the Engineer.
 - Reference: See MHD Supplement Specifications-Ed. 1988, Section 460.63
- Reclaiming Pavement
 - Reclaiming operations shall not commence before April 15 and shall terminate on or before October 15 unless otherwise approved in writing by the Engineer
 - Reference: See MHD Supplement Specifications -Ed. 1988, Section 403.60

13.1.2 LANDSCAPING

- Landscape Calendar #1: Sod
 - {CONSULTANT} will use the following summary schedule for most landscaping, installing sod, etc.
 - Planting can occur during the Spring Season (April 15 to June 1) and Fall Season (August 15 to November 1).
 - MHD Standard Specifications -Ed. 1988, Section 771.60, Excerpt below:
 - Balled and burlapped plants may be planted in the spring until June 15 and in the fall from August 15 to November 1.

- Container grown plants may be planted at any time the ground is not frozen (provided specified minimum time of growth and root development has been met).
- Bare rooted plants shall be planted only from the time ground thaws in spring until May 15.
- The seeding season for crownvetch shall be from April 15 to August 15.

13.1.3 WINTER INEFFICIENCY

- a. The weather impact on working efficiency during the winter is estimated according to the collected weather information from weather data from 2003 thru 2008. It is assumed that the project will be shut down in days with severe weather. Severe weather was defined as blowing snow, rain for more than 1 inch, daily temperature below 10 degrees, wind of more than 50 MPH, thunderstorm, and fogs that reduce visibility to less than ¼ miles.
- b. The historical data show that the number of days with severe weather on average is as follows:
 1. 1 day/week from December 1 to January 15,
 2. 2 days/week from January 16 to February 15,
 3. 1 day/week from February 16 to March 15.
- c. The relevant calendars for concrete and pavement have used the aforementioned data and have reduced number of working days per week.

13.2 OTHER CONSTRUCTION SPECIFICATION GUIDELINES

13.2.1 CONCRETE RESTRICTIONS:

- Per Supplemental Spec, Section 901
 - Minimum cure duration before adding load: 7 calendar days
 - Minimum cure duration for concrete deck before adding waterproofing: 14 calendar days

13.3 TRAFFIC CONTROL

Traffic is required to remain open throughout construction with 2 lanes in each direction. In order to complete the phasing plan the approaches at both ends of the bridge will need to be adjusted several times as show in the traffic management plans.

It is assumed that the construction of several activities will be required to be performed during off hours such as at night or during the weekends.

14 ACCELERATION SCHEDULES

In general, construction sequences will proceed in a linear fashion utilizing one set of equipment/crews (cranes, forms, etc) in the most cost effective manner. However, for this project the {CONSULTANT} developed acceleration construction sequences that complete the project in less time. Methods used to accelerate the project schedule are as follows:

14.1.1 OPTION B – MULTIPLE HEADINGS ON SUBSTRUCTURE

The acceleration Option B includes working the demolition and pier construction from two headings, each with their own set of crews and equipment.

This acceleration option helps to significantly reduce the time required to complete the substructure construction, however it offers little savings over the entire course of the project. The duration from NTP (Notice to Proceed) to Substantial Completion/Full Beneficial Use only reduced from ____calendar days in Option A to ____calendar days in Option B. The reason the schedule savings in this option are minimal is due to the limitation of completing some of the work in the winter, such as waterproofing and paving.

14.1.2 OPTION C – MULTIPLE HEADINGS ON SUBSTRUCTURE & EXTENDED HOURS ON SUPERSTRUCTURE

In order to fully realize the savings in Option B, additional acceleration was introduced as Option C, where critical superstructure and approach work activities were changed to a working calendar of 6 days per week and 10 work hours per day.

This acceleration option was able to significantly reduce the duration from NTP to Substantial Completion/Full Beneficial Use from ____ cd in Option A to ____ cd in Option C. The reason the savings is so significant is a combination of time saved in performing some of the critical activities on the extended shifts, with the multiple headings used in Option B no longer being held up for the winter shutdown.

15 ATTACHMENTS

- 15.1 DETAILED CONSTRUCTION SCHEDULE – NORMAL, OPTION A (ATTACHED)
- 15.2 DETAILED CONSTRUCTION SCHEDULE – ACCELERATED, OPTION B (ATTACHED)
- 15.3 DETAILED CONSTRUCTION SCHEDULE – ACCELERATED, OPTION C (ATTACHED)