

Majors Program Cost Estimating Software User Manual

Created by the Construction and Materials Support Center
University of Wisconsin-Madison

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INTRODUCTION

Intentions of the Software

Reliable and accurate cost estimates are critical to a successful highway improvement program. This is particularly true for the Wisconsin Department of Transportation (WisDOT) Major Highway Program where inaccurate cost estimates have significant impacts and consequences on other projects in the program. An emphasis and priority for The Majors Program is to focus on estimating, managing and controlling costs of projects. Since projects in the Majors Program must be enumerated by the Legislature and Governor, the total project cost must be estimated, not just the construction or let costs. This estimating process occurs very early in the project development process when cost estimates are most difficult since many project design details have not been finalized and numerous assumptions still form the basis of the estimate.

The Cost Estimating Software was developed to assist in preparing accurate total project cost estimates. It is anticipated that the tool will be used throughout a project's evolution, but initially at the conceptual stage when the design is approximately 30% complete for the environmental document estimate. For federal major projects, the estimate from this software will be used to develop the base estimate for the project's Cost Estimate Review, and the revised estimate from the CER will be that used for the environmental document estimate. It is this EIS estimate that will then be used when the project is submitted to the TPC for enumeration.

Accurate conceptual estimates are critical because they are the basis on which funding decisions are made and they form the baseline budget to which all future costs are managed against. The approach is based upon a combination of historical bid data for major roadway items whose quantities can be estimated early in the development process and historical percentage for other major components of the project through allowance and contingency factors.

The Cost Estimating Software was created to provide statewide uniformity and consistency in the estimating process and in communicating the results. It also provides a method for allocating project costs over the full project development and delivery timeframe. Additionally, it provides a format for documenting the basis of the estimate, the assumptions made and calculations done. It also can be used to track the cost impacts from changes that are made to the project throughout the development process. This software is designed to allow the estimator to develop the project estimate in a systematic step by step manner. It is not, however, a manual on how to do basic cost estimating for highway projects.

Scope of the Manual

This manual is intended for use by the estimator when using the cost-estimating software for preparing a conceptual estimate at approximately the 30% design complete stage of a project. This manual is meant to facilitate the creation of an accurate estimate of project costs through use of a systematic process and spreadsheet to capture quantities, unit prices and lump sum amounts known at the conceptual stage of the project and to document assumptions made.

The software will use these numbers to generate a total project cost estimate and then report them out in a format for submittal to the Bureau of State Highway Programs. The manual also provides definitions of the quantities to be estimated to help the user understand where certain materials should be accounted for in the software program. Though the definitions are available as a guide, the estimator should understand the estimating process in sufficient detail to ensure that items are only accounted for once and that double counting does not occur.

ESTIMATING PROCESS

The flowchart shown in Figure 1 describes the overall methodology and process for developing the estimate. A brief description of each step in the process follows:

Step 1 - Project Information, Scope, Location and Site Characteristics: This step involves gathering and documenting information about the project, including the location, length, type of project, scope details, design parameters and broad design assumptions upon which the estimate is based.

Step 2 - Major Roadway Quantities: At 30% design complete, proposed roadway alignment and structural sections allow the determination of major roadway quantities with reasonable accuracy. Such quantities include earthwork, pavement, base and sub-base, barrier wall, curb and gutter, and pavement removal.

Step 3 - Major Roadway Item Cost Estimate: The Major Roadway Subtotal is produced by multiplying the calculated major roadway item quantities by estimated unit costs. Estimated unit costs are based on past bid prices obtained from historical databases and adjusted as needed based upon project conditions.

Step 4 - Allowance Items: Allowance Items are used to estimate the cost of a group or collection of items whose quantities are not sufficiently detailed at this stage for unit price cost estimating. In effect, they act as budgets for certain areas of work (drainage, signing & marking, traffic control, etc.) whose details are not yet determined at the time of preparing the estimate. They also are used to estimate delivery costs of the project.

Allowance percentages are multiplied by the Major Roadway Subtotal cost to produce the allowance items costs. Default allowance percentages are predetermined and input automatically. These values were obtained from statistical analysis of historical data. An additional column is provided for the user to input an alternate value they feel is more appropriate. If a mobilization value other than the default value is used, an explanation and justification must be provided in the notes section.

Step 5 – Structures and Specialty Construction Costs: When historical data or historic bid cost-based procedures exist, construction costs for specific items unique to the individual project are estimated using parametric methods. Parametric methods, for example, can be used when cost data is available for square footage of bridges, square footage of retaining walls, or sign bridges. When historical costs do not exist, costs are estimated using a cost based system where a contractor’s labor, equipment, materials, overhead and profit are estimated for completing the work.

Step 6 - Apply Mobilization Factor: The default mobilization percentage of 11.2% is predetermined and input automatically. This value was obtained from statistical analysis of historical major project bid data. An additional column is provided for the user to input an alternate value they feel is more appropriate. If a mobilization value other than the default value is used, an explanation and justification must be provided in the notes section.

A mobilization calculating tool is available within the Estimating Tools tab on the [WisDOT Estimating site](#). The tool allows an estimator to filter bid history data using a variety of criteria such as region, county, work type, and total bid amount. The mobilization calculating tool will show a comparison of mobilization costs compared to the awarded estimate, as contrasted with the Majors Estimating Tool, in which the mobilization is calculated as a percentage of the Construction Items Subtotal. Estimators should understand this difference when determining the mobilization percentage.

Step 7 – Estimated Construction Let Amount (ECLA): The Estimated Construction Let Amount (ECLA) is the sum of the Major Roadway Items, allowance items, structures, special construction elements, and mobilization.

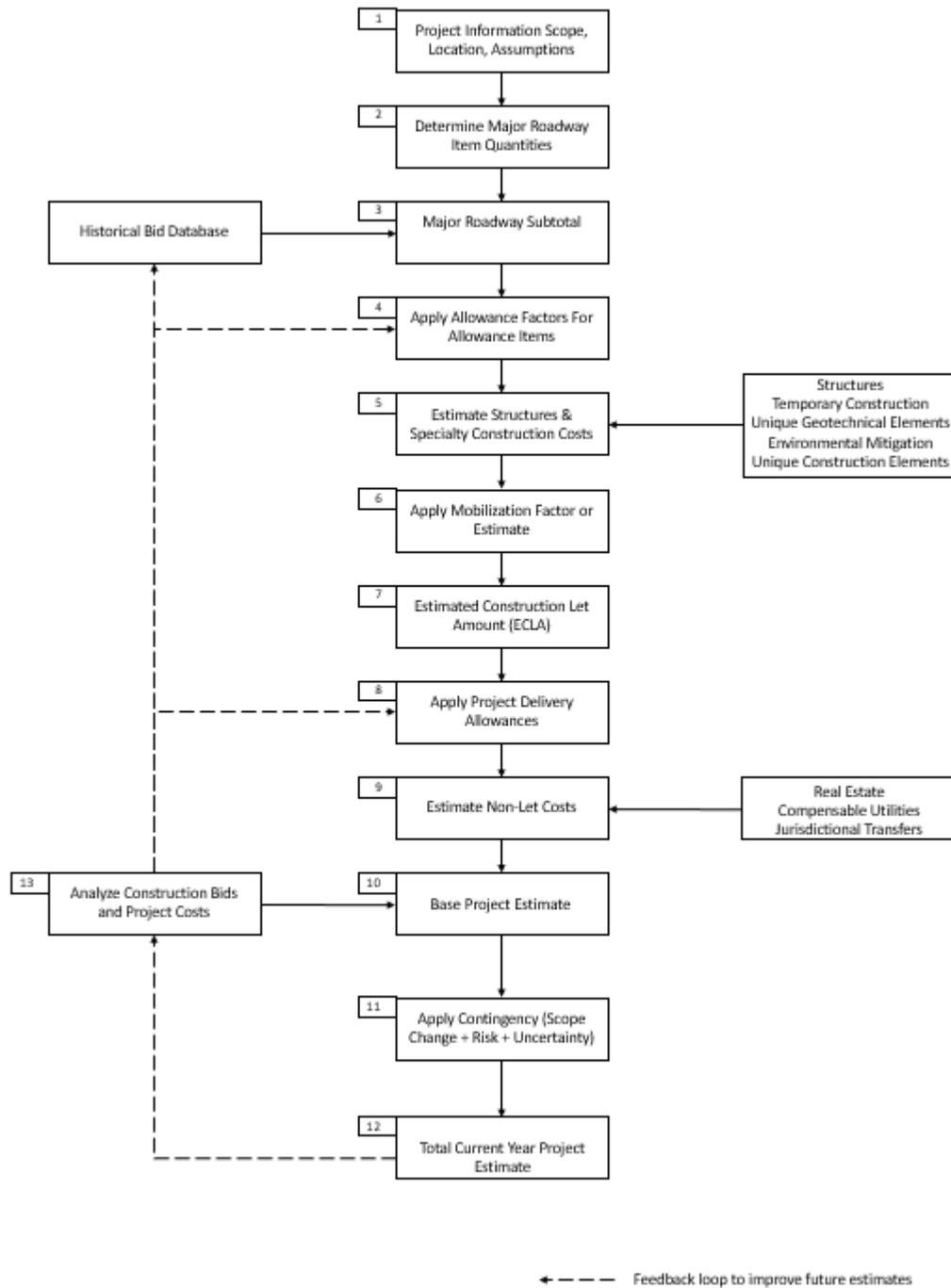


FIGURE 1: Cost Estimating Flowchart

Step 8 – Apply Project Delivery Allowances: Project delivery allowances are estimated as a percentage of the Estimated Construction Let Amount. The allowance percentages should be based upon the Region’s historical values for the type, magnitude and complexity of the project.

Step 9 – Estimate Non-Let Costs: Non-let costs are those that compensate third parties for project impacts. Real estate, cost of relocating utilities, and Jurisdictional Transfer costs are the most common items. Real estate costs should include costs for acquisition, easements, relocation, demolition and administration. These costs are estimated using guidance provided in the Real Estate Manual.

Step 10 - Base Project Estimate: The Base Project Estimate represents the sum of the Estimated Construction Let Amount, project delivery, and non-let costs. This semi-total estimate reflects project costs before adding any contingency items.

Step 11 – Apply Contingency (Scope Change + Risk + Uncertainty)

Because of the high levels of unknowns in the early stages of project estimating, estimates for contingency at the conceptual estimate stage are relatively high – in the range of 25-35% of the Base Cost Estimate. Contingency is comprised of all unknowns, including scope change, risk items, and uncertainty items.

Ensure that contingency is only applied here, and not other portions of the estimate to prevent any potential of double-counting contingency items.

Step 12 – Total Project Estimate (Current Year): The Current Year Total Project Cost Estimate is the sum of the Base Project Estimate and Contingency subtotals. It represents the current year total cost estimate of the project. It is the total cost of the project that can reasonably be expected if the project materializes and is delivered as planned.

Step 13 - Analyze Construction Bids and Project Costs: As additional construction projects are completed, the unit costs for major roadway items need to be included in the historical bid databases so that future cost estimates reflect the most current cost information. Bid costs also need to be broken down for the various allowance categories and the allowance factors updated. At the conclusion of a project, actual total project costs need to be analyzed through a feedback loop in order to reevaluate allowance factors. This analysis will allow the prognostic accuracy of this tool to improve over time and better reflect actual project history. This, in turn, will improve the cost estimating process.

ESTIMATING TOOL

The estimating tool is an Excel Program consisting of a number of Worksheets. The “Program” (Green Tab) is the basic spreadsheet. This is where much of the information needed for developing the estimate is entered. Cells shown in yellow require user input.

The remainder of the Tabs are of two types. Those like the “Scope” and “Assumptions” tabs allow the user to document the basis of the estimate. The other tabs, like the “Pavement” and “Structures” tabs allow the user to sum a number of different related quantities that are then linked to the main “Projects” spreadsheet and input automatically. Within the Tool, the color yellow designates where the estimator is required to input project information, or where there is an option to input values other than the predetermined values which are automatically input into the program.

ESTIMATING INSTRUCTIONS

Project Information

- a. Open the “Estimator Spreadsheet” excel file and enable the macros.
- b. In rows 2 through 5, provide the Project I.D., Highway, Project Title, and Project Limits in the designated areas.

****Note: The Project Title should be consistent with that shown on the Project Summary Screen in FIIPS.**

In rows 6 and 7, enter the information below:

| | | | |
|-------------------------------|------|----------------------------------|------|
| Estimate Fiscal Year | 2019 | Start Construction Calendar year | 2022 |
| Start Preliminary Design Date | 2018 | End Construction Calendar Year | 2025 |

Estimate Fiscal Year: The estimate fiscal year indicates the year that the estimate is being prepared and the year the estimated unit prices were determined. When the fiscal year is changed, the user must also update the unit prices accordingly. It is the responsibility of the estimator to bring prior year unit costs to the correct year. This can be done using Construction Cost Indexes (CCI), comparison of past unit costs vs. present, or other methods.

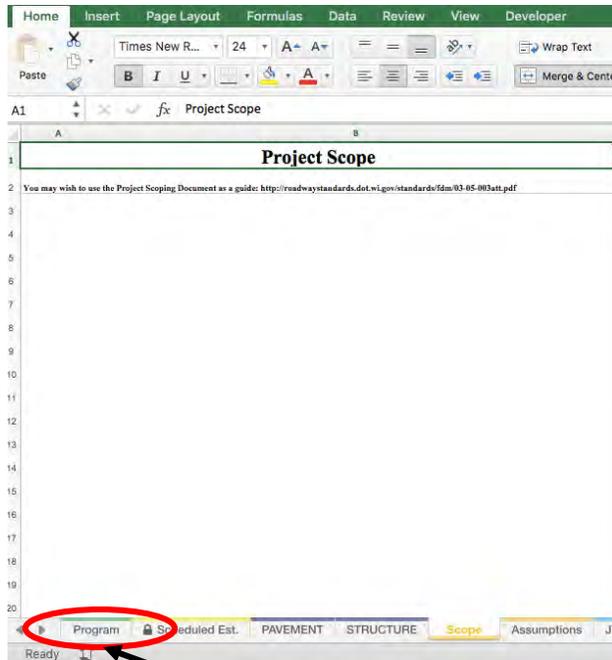
Start Preliminary Design/Start Construction/End Construction: These dates should be entered as the four-digit calendar year or date.

- c. In Rows 8 and 9, there are cells titled Project Scope and Project Assumptions. Clicking on these cells will take you to a separate tab that allows you to input details specific to the estimate. Fill these in by following the description in the comment box, visible when you hover over the title cell. These tabs are very important because they describe exactly what is being estimated. The more explicit you are in these tabs, the easier it will be to understand and review your estimate.

The scope statement should be in sufficient detail to identify what work is to be done and what is not to be done. Topics such as the project limits, number of lanes, locations of interchanges, bike and pedestrian accommodations, utility relocations, railroad issues, access and frontage road considerations, level of Community Sensitive Design (CSD) effort are things that should be documented in the project scope. A well-defined scope also provides a means for evaluating the impact of any proposed scope changes.

The assumptions made in developing the conceptual estimate also need to be identified and documented so that they can be conveyed to others working on the project and to those who may review and update the cost estimate. A good guide is provided in the Facilities Development Project Scoping Document. Assumptions made for developing cost estimates for major roadway items, structures, and special construction items are to be documented on spreadsheets for those items. Major corridor assumptions such as the corridor alignment option, types of interchanges, inclusion of ITS/FTMS, locations of major bridges, etc. should be documented here to provide an overview of what is the basis of the conceptual estimate.

- d. Click the green Program tab along the bottom of the screen (see figure below) to get back to the main worksheet.



Program Tab

- e. In Row 8, to the right of Project Scope, there is an input cell for Alternative #. This cell can be used if you are comparing alternatives for which the Project Scope and/or Assumptions differ. If multiple alternatives exist, number each and highlight any differences in the Scope or Assumptions sections.

Major Roadway Items

The Major Roadway Item Cost is produced by multiplying the calculated major roadway item quantities by the estimated units costs obtained from various historical databases of WisDOT bid prices. A historical bid-based approach is used to estimate the costs of the Major Roadway Items. With this approach historical unit costs are applied to units of work for the Major Roadway Items to determine a total cost for the specific item. The unit cost data to be used for this estimate can be gotten from a variety of sources where bid prices from prior WisDOT projects are gathered and summarized. These prices should then be modified or adjusted to reflect current prices (inflated to current time) and project conditions. Sources of historical cost data include:

- Bid tabs from similar projects
- Regional historical databases
- Statewide Average Unit Price List
- Trns*port Estimator
- Bid Express

It is recommended that the project design team utilize either AASHTOWare Project Estimator or Bid Express as a starting point to develop the unit prices and then verify the price by comparing it to one of the other referenced data sources. The Wisconsin Construction Cost Index provides another source of information for examining trends and adjusting costs to the current year.

The AASHTOWare Project Estimator software uses statistical methods to generate unit item prices from the historical bid tabs that are updated quarterly by WisDOT. The factors that are accounted for in the software generated prices are county, location, time of year, and quantity. The graphical relationship of

price and quantity available in Estimator allows the user to view the volatility of each item, which can be useful for adjusting the unit prices. One of the drawbacks to this tool, however, is that the user is unable to view the number of data points or the types of projects used in the statistical model.

Bid Express is a commercial product that provides a searchable database of WisDOT bid tabs through an online website. The database is updated monthly and maintained by an external company. The web based database allows users to sort and search for item prices by name, item number, county, quantity, price, contract ID, and letting date.

The drawback to using this data source is that project descriptions are not included in the database and knowledge of past projects is needed if the user wants to identify items from projects with similar construction characteristics. A review of past project Ads can help in locating similar projects and project ID's.

The Statewide Average Unit Price List contains 3-years of average unit prices for standard bid items. The average unit price is based upon all projects using the item on contracts let in the fiscal year. This information is available on WisDOT HCCI website under Contracting Information at: <http://roadwaystandards.dot.wi.gov/hcci/bid-letting/index.shtm>.

Pavement Worksheet

The next step in estimating a project is to fill in the pavement worksheet. To view the pavement worksheet, click on the pavement tab at the bottom of the workbook as shown below.

| ITEM DESCRIPTION | DESCRIPTION | SEGMENT | PAVEMENT REMOVAL AREA SY | NEW PAV. AREA SY | SHOULDER AREA SY | AREA OF BASE SY | AREA OF CURB SY |
|---------------------|-------------|---------|--------------------------|------------------|------------------|-----------------|-----------------|
| MAINLINE | 1.01 | | - | - | - | - | - |
| | 1.02 | | - | - | - | - | - |
| | 1.03 | | - | - | - | - | - |
| | 1.04 | | - | - | - | - | - |
| | 1.05 | | - | - | - | - | - |
| | 1.06 | | - | - | - | - | - |
| MAINLINE TOTAL | | | - | - | - | - | - |
| SYSTEM RAMPS | | | | | | | |
| | 2.01 | | - | - | - | - | - |
| | 2.02 | | - | - | - | - | - |
| | 2.03 | | - | - | - | - | - |
| | 2.04 | | - | - | - | - | - |
| | 2.05 | | - | - | - | - | - |
| | 2.06 | | - | - | - | - | - |
| SYSTEM RAMPS TOTAL | | | - | - | - | - | - |
| SERVICE RAMPS | | | | | | | |
| | 2.01 | | - | - | - | - | - |
| | 2.02 | | - | - | - | - | - |
| | 2.03 | | - | - | - | - | - |
| | 2.04 | | - | - | - | - | - |
| | 2.05 | | - | - | - | - | - |
| | 2.06 | | - | - | - | - | - |
| SERVICE RAMPS TOTAL | | | - | - | - | - | - |
| CROSSROAD | 3.01 | | | | | | |

Pavement Tab

Preliminary design data should be used to fill in the pavement tables on the worksheet.

Filling in the pavement worksheet:

- a. Lines 2, 3, 4, and 5 will fill in automatically once project information is entered into the program sheet.
- b. In the pavement tables, there is space to provide pavement information for the mainline, system ramps, service ramps, crossroads, frontage roads, and local roads. Break each of these sections into logical segments. Provide a description and segment title for each.
- c. For each segment, include expected square footage of pavement removal and new pavement and linear footage of barrier wall and curb & gutter. Quantities for alternate routes, permanent pavement on detour routes, and other permanent upgrades done for the project need to be included in these quantities as well. For a description of what to include with each item, either hover over the item name on the pavement worksheet or see the definitions table in Appendix A. Appendix A provides a description of items to be included in each quantity. Do not include Jurisdictional Transfers in the pavement worksheet. There is a separate worksheet for JT costs.

Other Quantities

After completion of the pavement and structures worksheets, many of the required quantities in the Program worksheet will be filled in automatically. However, there are still a few quantities that require user input.

To begin this process, click on the green Program tab.

Under Major Roadway Items, the user should provide estimated quantities for Earthwork in the yellow spaces. Earthwork should include all types of excavation (common, marsh, rock,...), borrow, EBS, etc. A worksheet is provided for documenting earthwork quantities under the Earthwork Tab and it is suggested that output from the automated design software package be copied onto this worksheet.

| MAJOR ROADWAY ITEMS | | | | |
|---|--------|---|------|------------|
| Removing Pavement (see PAVEMENT tab) | SY | - | \$ - | \$0 |
| Curb & Gutter (see PAVEMENT tab) | LF | - | \$ - | \$0 |
| Earthwork | | | | |
| Common | CY | - | \$ - | \$0 |
| Marsh | Insert | - | \$ - | \$0 |
| Rock | CY | - | \$ - | \$0 |
| Borrow | Insert | - | \$ - | \$0 |
| EBS | Insert | - | \$ - | \$0 |
| Pavement (see PAVEMENT tab) | | | | |
| Mainline | SY | - | \$ - | \$0 |
| System Ramps | Insert | - | \$ - | \$0 |
| Service Ramps | Insert | - | \$ - | \$0 |
| Cross Road | Insert | - | \$ - | \$0 |
| Frontage Roads | Insert | - | \$ - | \$0 |
| Local Roads | Insert | - | \$ - | \$0 |
| Shoulders | Insert | - | \$ - | \$0 |
| Base (see PAVEMENT tab) | | | | |
| Mainline | TON | - | \$ - | \$0 |
| System Ramps | Insert | - | \$ - | \$0 |
| Service Ramps | Insert | - | \$ - | \$0 |
| Cross Road | Insert | - | \$ - | \$0 |
| Frontage Roads | Insert | - | \$ - | \$0 |
| Local Roads | Insert | - | \$ - | \$0 |
| Subbase (see PAVEMENT tab) | | | | |
| Mainline | TON | - | \$ - | \$0 |
| System Ramps | Insert | - | \$ - | \$0 |
| Service Ramps | Insert | - | \$ - | \$0 |
| Cross Road | Insert | - | \$ - | \$0 |
| Frontage Roads | TON | - | \$ - | \$0 |
| Local Roads | Insert | - | \$ - | \$0 |
| Major Roadway Subtotal (MRS) | | | | \$0 |

Allowance Items

Allowance factors are used to account for construction costs of many of the project items that are not yet sufficiently detailed at this point in the development process for cost estimating processes.

Allowance factors are multiplied by the Major Roadway Costs to provide cost estimates for drainage, erosion control, traffic control and staging, signals and lighting, signing and marking, ITS/FTMS, and roadway incidentals.

Default historical data are provided for allowance items under “Historical Data.” If using values other than the ones provided in the tool, enter the numbers in “the Estimator Data” column and provide justification of the new values under “NOTES (Justification of Estimator data).”

| ALLOWANCE ITEMS | | Historical Data | Estimator Data | Total |
|-------------------------------|----------|-----------------|----------------|------------|
| Drainage | % of MRS | 10.8% | | \$0 |
| Erosion Control & Restoration | % of MRS | 9.7% | | \$0 |
| Signals/Lighting | % of MRS | 3.3% | | \$0 |
| Roadway Incidentals | % of MRS | 27.1% | | \$0 |
| Signing/Marking | % of MRS | 4.3% | | \$0 |
| Traffic Control & Staging | % of MRS | 4.5% | | \$0 |
| ITS/ FTMS | % of MRS | 1.0% | | \$0 |
| Allowance Subtotal | | | | \$0 |

See Appendix A for a list of items associated with each of the Allowance Item categories.

Structures

All items associated with bridges and structural components, retaining walls, noise walls, box culverts and any other structure work.

Structures Worksheet

The structures worksheet should be filled in to provide the program with the expected structural quantities. Historical costs for various types of structures can be found in the LFRD Bridge Manual. Costs are tabulated by square foot of bridge deck and retaining wall face or length of culverts and multiplied by the historical average unit prices. Contact the Bureau of Structures for assistance in developing estimates or for questions regarding unique structures where no historical data exists.

Filling out the structure worksheet:

- a. Like in the pavement worksheet, lines 2, 3, 4, and 5 will fill in automatically once project information is entered into the program sheet, and there is space to provide structure information for the mainline, system ramps, service ramps, crossroads, frontage roads, and local roads.
- b. Break each of these sections into logical segments. Provide a description and segment title for each.
- c. For each segment, include expected square footage or linear footage of bridge removal, new bridge (single and multi-level), new retaining wall, new noise wall, new box culvert, sign bridge cantilever, MSE wall, and secant walls into the appropriate cell. Historical costs for various types of structures can be found in the LFRD Bridge Manual. Costs are tabulated by square foot of bridge deck and retaining wall face or length of culverts and multiplied times the historical average unit prices. Contact the Bureau of Structures for assistance in developing estimates or for questions regarding unique structures where no historical data exists.

Do not include Jurisdictional Transfers in the structures worksheet. There is a separate worksheet for JT costs.

The screenshot shows an Excel spreadsheet with the following data:

| ITEM DESCRIPTION | Number | SEGMENT | BRIDGE REMOVAL | NEW BRIDGE (SINGLE LEVEL) (C) | NEW BRIDGE BRIDGE LEVEL (C) | RETAINING WALL REMOVAL | NEW RETAINING WALL | HOSE WALL REMOVAL | NEW HOSE WALL | NEW BOX CULVERT/ EXTENSION | SKIN BRIDGE CANTILEVER |
|---|--------|---------|-------------------|--|-----------------------------------|------------------------------|--------------------------|----------------------|------------------|----------------------------------|---------------------------|
| | | | SF | SF | SF | LF | SF | LF | LF | LF | EACH |
| MAINLINE & SYSTEM RAMPS | | | | | | | | | | | |
| 1.01 | | | | | | | | | | | |
| 1.02 | | | | | | | | | | | |
| 1.03 | | | | | | | | | | | |
| 1.04 | | | | | | | | | | | |
| 1.05 | | | | | | | | | | | |
| 1.06 | | | | | | | | | | | |
| 1.07 | | | | | | | | | | | |
| 1.08 | | | | | | | | | | | |
| 1.09 | | | | | | | | | | | |
| 1.10 | | | | | | | | | | | |
| 1.11 | | | | | | | | | | | |
| MAINLINE & SYSTEM RAMPS TOTALS | | | | | | | | | | | |
| SERVICE RAMPS | | | | | | | | | | | |
| 2.01 | | | | | | | | | | | |
| 2.02 | | | | | | | | | | | |
| 2.03 | | | | | | | | | | | |
| 2.04 | | | | | | | | | | | |
| 2.05 | | | | | | | | | | | |
| 2.06 | | | | | | | | | | | |
| SERVICE RAMPS TOTALS | | | | | | | | | | | |
| CROSSROAD | | | | | | | | | | | |
| 3.01 | | | | | | | | | | | |
| 3.02 | | | | | | | | | | | |
| 3.03 | | | | | | | | | | | |
| 3.04 | | | | | | | | | | | |
| 3.05 | | | | | | | | | | | |
| 3.06 | | | | | | | | | | | |
| CROSSROAD TOTALS | | | | | | | | | | | |
| FRONTAGE ROADS | | | | | | | | | | | |
| 4.01 | | | | | | | | | | | |

The bottom navigation bar shows tabs: Program, Scheduled Est., PAVEMENT, **STRUCTURE** (circled in red), Scope, Assumptions, JT Cost.

Structure Tab

Special Construction Elements

Special construction items may or may not be present on the project. These are unique items that are not typically found on WisDOT projects and these costs need to be estimated separately. There may be historical costs from past projects, but they will generally need to be estimated using cost based methods where contractor's costs for labor, equipment, materials, profit, and overhead are accounted for. Examples include temporary bridges and roadways, non-standard bridges, treatment of hazardous materials or archeological sites, community sensitive design components.

Additional rows can be added as necessary to fit the unique needs of the project. The items in the list below should be considered as Special Construction Elements. Pay careful consideration to whether these items are already factored into other portions of the estimate; i.e. the allowance items or contingency estimates.

- **Stormwater ponds:** especially in constrained areas, costs could be significant; costs listed here would be in addition to those costs in the Drainage allowance item.
- **Staging/night work:** additional costs for staging or night work not already considered in Traffic Control and Staging Allowance Item.
- **Structure widening/rehabilitation:** some existing structures can be maintained with widening or rehabilitation work. Structures not being replaced may warrant an overlay. These are items not captured in the Structures tab.
- **Special geotechnical:** Add special geotechnical elements, subgrade improvements, or soil mitigation measures for items such as wick drains, pit run, or breaker run.

- **Field office:** normal field office costs are in the Roadway Incidentals allowance item. If projects are large enough, a larger office is needed, either rented or purchased, for the project.
- **Agencies contracts:** these contracts pay for local agencies (police, fire, DPW) to attend traffic coordination meetings for the project. An example is in highly urbanized areas where one municipality may have to respond to an incident in another city because of closures due to the project.
- **OCIP:** Owner-controlled insurance programs have been used on select Majors/SE Mega projects.
- **Railroad flaggers:** Reimbursement to railroad companies for railroad employees that need to be on-site when construction activities are taking place near railroad tracks.
- **Materials testing:** If projects large enough, and with fast enough pace, an additional materials testing contract may be needed to keep up with the testing requirements of the project.

| SPECIAL CONSTRUCTION ELEMENTS | UNIT | QUANTITY | UNIT PRICE | Total |
|--|-------------|-----------------|-------------------|--------------|
| Traffic Mitigation, including Freeway Service Team | Insert | - | \$ - | \$0 |
| Temporary Bridges and Roadways | EACH | - | \$ - | \$0 |
| Environmental Mitigation | Insert | - | \$ - | \$0 |
| Community Sensitive Design/Context Sensitive Solutions | Insert | - | \$ - | \$0 |
| Hazardous Materials | EACH | - | \$ - | \$0 |
| Alternate Routes | EACH | - | \$ - | \$0 |
| Stormwater ponds | Insert | - | \$ - | \$0 |
| Staging/night work | Insert | - | \$ - | \$0 |
| Structure widening/rehabilitation | Insert | - | \$ - | \$0 |
| Special geotechnical | Insert | - | \$ - | \$0 |
| Field office | Insert | - | \$ - | \$0 |
| Agencies contracts | Insert | - | \$ - | \$0 |
| OCIP | Insert | - | \$ - | \$0 |
| Railroad flaggers | Insert | - | \$ - | \$0 |
| Materials testing | Insert | - | \$ - | \$0 |
| Other | Insert | - | \$ - | \$0 |

Mobilization

Mobilization costs can be determined using the default value, which is predetermined and input automatically. This value was obtained from statistical analysis of historical major project bid data. An additional column is provided for the user to input an alternate value they feel is more appropriate.

Contractor mobilization costs are estimated as a percentage of the Construction Items Subtotal. Note the WisDOT Estimating site contains Mobilization data as a percentage of total contract award amount.

If a mobilization value other than the default value is used, an explanation and justification must be provided in the notes section. The Estimated Construction Let Amount (ECLA) will then be automatically computed as the sum of the following 5 items: Major Roadway Items, Allowance Items, Structures, Special Construction Elements, and Mobilization.

| MOBILIZATION | % of Construction Items Subtotal | Default | User Input | Mobilization Costs |
|------------------------------|---|----------------|-------------------|---------------------------|
| Mobilization Subtotal | | 11.2% | | \$0 |
| | | | | \$0 |

Project Delivery Allowance Items

Project delivery allowance items are computed as percent of ECLA. After adding the project delivery allowance items and the Non-Let costs, the Base Project Estimate is automatically computed.

| PROJECT DELIVERY ALLOWANCE ITEMS | | User Input | |
|--|-----------|------------|------------|
| Post-Enumeration Design/Engineering | % of ECLA | 0.0% | \$0 |
| Construction Engineering | % of ECLA | 0.0% | \$0 |
| Const Change Orders, R/E Litigation, and Claims | % of ECLA | 0.0% | \$0 |
| Project Controls | % of ECLA | 0.0% | \$0 |
| Public Involvement, Including Public Information Contracts | % of ECLA | 0.0% | \$0 |
| Delivery Allowance Subtotal | | | \$0 |

The following ranges are suggested as a starting point:

| | |
|---|--------|
| Pre-enumeration Engineering* | 5-8% |
| Post-enumeration Engineering | 5-8% |
| Construction Engineering | 6-10% |
| Change Orders, R/E Litigation, and Claims | 6-10% |
| Project Controls | 0-1.5% |
| Public Involvement | 0.5-1% |

*Note, pre-enumeration engineering costs associated with a project study are not part of the post-enumeration project estimate and are tracked separately. The range presented for pre-enumeration engineering is for information only; those costs are not part of the estimating tool.

Note also that the controls and engineering costs above can be either department in-house or consultant costs. It is not expected at the conceptual stage to determine the breakdown between consultant and in-house costs.

Post-enumeration engineering and construction engineering costs include the department staff dedicated to specific tasks for consistency between project segments, such as pre-let monitoring of utility relocations, surveyor, utility coordination, traffic engineering, environmental coordination, wildlife/hazard monitoring, and tribal monitoring.

Non-Let Costs

Non-let costs are costs that compensate third parties for project impacts such as real estate, compensable utilities, and jurisdictional transfers. *Real Estate costs* should be estimated based upon guidance provided in the Real Estate Manual.

Jurisdictional Transfer Costs are those costs associated with the transfer of jurisdiction of a highway as part of a Majors Project. They should include all roadway improvement costs needed to implement the transfer. Note, pavement costs for JT items are to be accounted for in this item and not in the pavement section under Major Roadway Items. New pavement and pavement removal costs are examples of JT costs that can easily be entered twice. Separate worksheet tabs may need to be created to identify and document all costs associated with each of these items.

Local Work: WisDOT let but reimbursed by locals includes enhancements to local utilities, sideroads, etc. that are included in the WisDOT let. These costs ultimately get reimbursed by the locals, but need to be

included in the estimate because WisDOT must program for let. *Local Force Account Work* could include construction of salt sheds under local force account agreements.

| NON-LET COSTS | | |
|---|-----|------------|
| Real Estate Acquisition | \$0 | \$0 |
| Compensable Utilities | \$0 | \$0 |
| Jurisdictional Transfers | \$0 | \$0 |
| Local Work: WisDOT let but Reimbursed by Locals | \$0 | \$0 |
| Local Force Account Work | \$0 | \$0 |
| Other | \$0 | \$0 |
| Other | \$0 | \$0 |
| Other | \$0 | \$0 |
| Non-Let Costs Subtotal | | \$0 |

There are blank lines available to the estimator to add items. Be sure additional items are not accounted for previously in the estimate.

Contingency

Contingency is comprised of all unknowns, including scope change, risk items, and uncertainty items.

Scope Change Allowance Items

When preparing estimates at the conceptual stage of the development process there are uncertainties as to final scope, design changes, influence of community interests, site conditions, construction methods, etc. The Scope Change Allowance adjustment is as an overall project percentage and a default value based upon historical data (24%) is input automatically. An additional column is provided for the user to input an alternate value they feel is more appropriate. If a value other than the default value is used, an explanation and justification must be provided in the notes section. The Scope Change Allowance is calculated as a percentage of the Base Project Estimate.

If it is very early in the design and there is the potential for substantial scope changes, a larger percentage may be warranted. If the design has progressed to the point where there may be limited scope changes, then a smaller percentage may be appropriate. If a value other than the predetermined value is used, then a justification for the new value must be provided in the notes.

| SCOPE CHANGE ALLOWANCE | % of Base Project | Default | User Input | Scope Change |
|---|--------------------------|----------------|-------------------|------------------------|
| Project Scope Increase Allowance | Estimate | 24% | | Allowance Costs |
| | | | | \$0 |
| Scope Increase Subtotal | | | | \$0 |

Risk Adjustments

A risk is any known or unknown event or condition that cannot be adequately defined or estimated at this stage of the project. Cost risks are identified and an assessment made as to the likelihood of the risk occurring and the impact of the risk should it occur. Additional adjustments are added to the base project estimate to account for the risks. Risk items are listed in the "Risk Worksheet" and additional lines may be inserted as needed. Do not use more than the 5 lines provided. If there are more risk items to be accounted for, combine some of them and provide an explanation. Risks could include increased real estate acquisition costs or litigation, increased design costs, and increased costs due to utility issues.

Risk Register

Early in the design/study stages the project team will begin building a Risk Register by identifying potential risks and opportunities to the current project estimate. If the conceptual estimate is being done before the Risk Register has been developed, the estimate for risk items should be either a lump sum or a percentage of the Base Project Estimate. As the project advances through the design process

and more details are learned, the Risk Register will evolve to reflect the current status of anticipated risks. If the project has a Risk Register, the entries in the Risk Adjustments section should match it.

Risk Assessment

Generally, just before the first Cost Estimate Review, a project will undergo a project risk evaluation to identify risks and quantify their impact on costs. An interdisciplinary team of internal and external experts are brought together in a workshop format to assess and model the risks. The project risk evaluation consists of two parts; (1) an independent, systematic review and validation of the base cost estimate, and (2) a risk assessment to identify risks that could drive up project costs.

The process examines how risks can be lowered and cost vulnerabilities managed. Different cost risks are identified and an assessment is made as to the likelihood of the risk occurring and the impact of the risk should it occur. Adjustments are then made to the cost estimate based upon recommendations given in order to account for the potential project risks. Cost estimates for risks identified during the risk evaluation workshop are recorded and entered as a cost per risk item and summed to provide a subtotal of how the various risks impact the total estimate.

The risk assessment may influence the Project Scope Increase Allowance. As a more thorough risk analysis is performed, the uncertainty in project scope will be decreased. It may be determined as part of the risk assessment that the Project Scope Increase Allowance as a percent of the Base Project Estimate needs to be reduced.

| RISK ADJUSTMENTS | | |
|--------------------------------------|-----|------------|
| Risk Item A | \$0 | \$0 |
| Risk Item B | \$0 | \$0 |
| Risk Item C | \$0 | \$0 |
| Risk Item D | \$0 | \$0 |
| Risk Item E | \$0 | \$0 |
| Risk Adjustment Subtotal | | \$0 |
| ESTIMATE UNCERTAINTY | | |
| Uncertainty Item A | \$0 | \$0 |
| Uncertainty Item B | \$0 | \$0 |
| Uncertainty Item C | \$0 | \$0 |
| Uncertainty Item D | \$0 | \$0 |
| Uncertainty Item E | \$0 | \$0 |
| Estimate Uncertainty Subtotal | | \$0 |

Uncertainty Items

Estimate Uncertainty Items are contingency amounts to account for costs the estimator is unsure of or not confident in at the time the estimate is being prepared. The Uncertainty Item section allows the estimator to include additional costs to cover the possibility of unforeseen risks. These are costs that cannot be defined as a specific risk; however, based on the experience of subject matter experts, the risk may occur, especially on Major Projects.

Uncertainty items can include base variability, which is a measure of uncertainty applied to the base estimate that represents the inherent randomness associated with the estimating process. Base variability is a function of the project’s current level of design and the process used to develop the estimate. This may be demonstrated by the fact that two estimators using the same data sources and following the same general estimate development guidance will generate different estimates.

Uncertainty items should be identified, the additional costs input and the rationale for the cost increase documented in the notes column. Do not use more than the 5 lines provided. If there are more uncertainty items to be accounted for, combine some of them and provide an explanation. For example,

if the cost estimate for borrow is based upon the availability of a certain parcel of land, the estimator might add an uncertainty item for borrow in this section to cover the added costs of going to an alternate site.

UNDERSTANDING OUTPUT

The Cost Estimating Software was developed to assist in preparing accurate total project cost estimates for WisDOT Majors Projects. It is anticipated that the tool will be used throughout a project's evolution, especially at the conceptual stage, and then again as the design is refined. The program uses historical, as-let data and quantities able to be calculated early in the design phase to accurately estimate additional project costs called Allowance Items. Though much of the data analysis is completed automatically, an accurate estimate still relies on the critical evaluation by the estimator to ensure items are not missed or that items are not counted more than once.

This software program can be used in many ways. It is useful in keeping a running cost estimate during the beginning stages of project design, comparing a few project alternatives, and producing an estimate to be submitted to the Bureau of State Highway Programs (BSHP) for review. However, once this program is submitted to BSHP, the estimate should no longer be changed so that a record of the submitted estimate is available for future reference. Changes should be documented in a new estimate. The equations below define several intermediate and final outputs in the estimating tool.

- **Construction Items Subtotal = Major Roadway Items + Allowance Items + Structures + Special Construction Elements**
- **Estimated Construction Let Amount (ECLA) = Construction Items Subtotal + Mobilization**
- **Base Project Estimate = ECLA + Project Delivery + Non-Lets**
- **Total Project Estimate = Base Project Estimate + Contingency**
- **Contingency = Scope Change Allowance + Risks + Uncertainty**

Throughout the estimating process, there are several opportunities for unique project decisions to be made. The estimating software allows for a lot of flexibility in producing the conceptual estimate, including the ability to evaluate the Scope Change Allowance and Uncertainty Items, to increase or decrease the estimate depending on the risk analysis, and to update any pre-determined factors used by the software program.

A key component of the estimate is the Scope Change Allowance. This value is a percentage markup on the Base Project Estimate to account for additional costs related to potential increases in project scope resulting from more detailed data gathering or design refinements as the project moves through the various design phases. The percentage used for the Scope Change Allowance was determined by surveying each of the Regions about what they believe the markup should be based on previous estimating methods. If a thorough risk analysis is completed, many uncertainties accounted for by the Scope Change Allowance may be eliminated. Therefore, it is suggested that as a part of risk analysis, the Scope Change Allowance should be evaluated. If it is determined that the percentage is too high, the estimate should be decreased with a negative risk adjustment.

Material costs, inflation factors, project size, type, and conditions all change over time. As changes occur, the software can easily be manipulated to account for the changing times and continue to provide an accurate conceptual project estimate.

Appendix A: Item Categories

Major Roadway Items

| | |
|--------------------------|--|
| Curb & Gutter | Includes all curb and gutter types, heights and widths. Unit price includes base and subbase to 2' back of curb. |
| Earthwork | Includes all types of excavation (common, marsh, rock,...), borrow, EBS, etc. |
| Pavement, Base & Subbase | Includes all concrete, HMA, asphalt, tack coat, aggregate, breaker run, shoulder shaping, geogrid, surface drains, and all other materials associated with pavement, base and subbase on mainline, ramps, cross roads, & frontage roads. |
| Removing Pavement | Includes all sawing and other activities associated with the removal of concrete pavement and any asphalt overlay. |

Allowance Items

| | |
|-------------------------------|---|
| Drainage | Includes culvert pipe, storm sewer pipe, apron endwalls, catch basins, inlets & cover, manholes and covers, underdrain, etc. |
| Erosion Control & Restoration | All items associated with erosion control and restoration including erosion mat, erosion bales, ditch checks, silt fence, inlet protection, riprap, topsoil, soil stabilizers, cleaning sediment basins, restoration of waterways, etc. |
| Signals/Lighting | Temporary and non-decorative permanent traffic signals and lighting components including high mast towers and foundations, light poles, concrete bases, luminaires, conduit, electrical wire, control cabinets, controllers, etc. |
| Roadway Incidentals | All roadway items not included in other categories, including various removals, concrete barrier, cable guard, crash cushions, R/W marker posts, fencing, seeding, sod, plantings, field office, etc. |
| Signing/Marking | Includes all temporary and permanent roadway signing and pavement marking including signs, posts, supports, sign bridges, pavement marking paint and epoxy, delineators, etc. |
| Traffic Control & Staging | Temporary traffic control and staging items including temporary barriers, temporary traffic control devices, detour signing, etc. |
| ITS/FTMS | All items associated with the integration of advanced communications technology into the transportation infrastructure and freeway traffic management systems. |

Appendix B: Definitions

Allowance Items- Project items that are not sufficiently detailed at the 30% design stage for unit price cost estimating. These items are estimated using a percentage mark up of Major Roadway Items. Currently included as allowance items are: drainage, erosion control & restoration, signals & lighting, roadway incidentals (a general grouping of work not included in the other allowance items), signing & marking, traffic control & staging, and Intelligent Transportation System & Freeway Traffic Management System (ITS/FTMS).

Base Project Estimate- Estimated total project costs project minus contingency. Base project estimate = ECLA + project delivery + non-lets.

Change Orders & Claims- The total amount reserved for contract modifications, quantity overruns and dispute resolution.

Conceptual Estimate- An estimate that is prepared when there is only a general idea of what the project will entail. At WisDOT, the estimate prepared when only 30% of the design is complete is considered the conceptual estimate.

Construction Engineering Allowance- The total of WisDOT costs and consultant fees for construction engineering. Estimated as a percentage of ECLA.

Corridor- A collection of construction projects that can be bid and executed individually but are budgeted for as a group.

Estimated Construction Let Amount (ECLA)- The estimated amount of construction let costs on the Major project. Composed of major roadway items + allowance items + structures + special construction elements + mobilization. Does not include delivery, non-lets, or contingency.

Major Project- As defined in Section [84.013\(1\)\(a\)](#), Wis. Stats. There are two categories of major projects:

Category 1 – a project that has a total cost of more than \$30,000,000 and satisfies **any** of the following:

- Constructing a new highway 2.5 miles or more in length.
- Reconstructing or reconditioning an existing highway by either:
 - Relocating 2.5 miles or more of the existing highway, or
 - Adding one or more lanes 5 miles or more in length to the existing highway.
- Improving to freeway standards 10 miles or more of an existing divided highway having 2 or more lanes in either direction.

Exceptions to the above are:

- A project providing an approach to a bridge over a river that forms a boundary of the state,
- A high-cost state highway bridge project under s. [84.017](#), or
- A southeast Wisconsin freeway megaproject under s. [84.0145](#).

Category 2 – a project that has a total cost of more than \$75,000,000 and is **not** described in Category 1 above.

Major Roadway Items- Items in a transportation construction project that are reasonably known and can be estimated in the early stages of project design.

Post-Enumeration Design/Engineering Allowance- The total of all consultant and WisDOT costs for design after enumeration. This is estimated as a percentage of the ECLA.

Program Evaluation and Review Technique (PERT)- The process of assigning statistical certainty factors to project tasks or materials.

Public Involvement- An amount reserved for public involvement (newsletters, websites, public meetings, etc.).

Risk- An adjustment made to account for risks that could drive up project costs. Risks are identified and an assessment is made as to the likelihood of the risk occurring, along with the impact to project costs and schedules.

Scope Change Allowance- An amount reserved for additional costs related to potential increases in project scope. This results from more detailed data gathering or design refinements as the project moves through the various design phases.

Traffic Mitigation- An amount reserved for traffic accommodations during construction (extra park & ride lots, expanded bus service, expanded police patrols, alternative route locator web tools, etc.

Uncertainty -Funds reserved to account for the uncertainty of costs for some of the major roadway items.

Appendix C: PERT Formulas

$$\text{Expected Value} = \frac{[Min + 4(Avg) + Max]}{6}$$

$$\text{Variance} = \left[\frac{Max - Min}{6} \right]^2$$

$$\text{Standard Deviation} = \left[\frac{Max - Min}{6} \right] = \sqrt{\text{Variance}}$$