THE STATE OF NEW HAMPSHIRE

Department of Transportation

Project Development

Project Estimating Guidelines

Approved:

_____ **Date:** 6/13/2022

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SECTION 1.0
Introduction

Section 1 – Introduction

1.0 Purpose

The purpose of this guideline is to provide direction to NHDOT employees and others on the methodology and for developing, documenting, reviewing and updating construction cost estimates throughout the project development process.
In order to successfully address transportation needs, the NHDOT must have reliable construction cost estimates and associated construction cost estimate documentation that supports the development of the construction cost estimate from project programming and planning through project Plans, Specifications and Estimate (PS&E).
This guidance is to be used for all NHDOT projects that result in contract advertisement.

1.1 General Estimating Concepts

To successfully estimate project construction cost, the estimators should follow these general estimating concepts:

- At the NHDOT, the project construction cost estimate is comprised of the construction estimate for the items of work, construction engineering (including administration, inspection, materials testing, and construction phase design support services)), utility accommodations required for the project (including railroad protection), and environmental impact payments. Not included in the construction cost estimate, but equally important, is the Right-of-Way estimate.
- The project construction cost estimate is first developed in early project planning and updated periodically throughout project development from project programming through project award at major project milestones (Section 2). The Project Manager, with the assistance of the project team, shall update a project's construction cost estimate at least once a year or more frequently if changes in the project scope have occurred that effects the estimate.
- There are several methods used to develop a construction cost estimate, e.g. Historical Bid-based estimating by project type, Historical Percentages estimating, Conceptual estimating, Cost-based estimating, Risk-based estimating, and Similar Project estimating.
- The programming estimate should be prepared by a multi-disciplined team that has experienced key personnel dedicated to the success of the project, with the requisite technical, managerial, leadership, and communication skills. The team should also have a thorough understanding of the type of project, including the ability to determine and

evaluate critical issues and risks. This is currently done during the development of the Ten Year Plan (TYP) by a Task Force appointed by the Front Office.

- All NHDOT estimates are calculated in current year dollars. Inflation is added to a project when it is added to the TYP and is adjusted in each cycle of the plan based on current economic conditions. During each cycle of the TYP, projects will need to be updated to reflect current year costs. If no work on the project has been conducted since the last TYP, the project cost should be reviewed to make sure the cost is current and includes any potential inflationary costs that may have occurred since the date of the previous estimate.
- Estimates are tracked throughout the life of the project. All estimates and assumptions must be well documented, including what is and what is not included in the estimate. The documentation should be in a form that can be understood, checked and verified.

1.2 Contents of the Cost Estimating Guideline

The *Cost Estimating Guideline* contains six sections. The following provides a brief summary of each section:

Section 1, *Introduction*, this section provides the purpose of the Cost Estimating guideline, general cost estimating concepts, and introduces each of the sections.

Section 2, *Cost Management Process*, discusses the detailed estimating process throughout the project development phases, and the importance of documenting all assumptions made in support of the estimate with respect to key items of work.

Section 3, *Cost Estimating Methods*, discusses historical, conceptual, risk-based, and cost-based estimating methods.

Section 4, *Cost Estimating Factors*, discusses cost drivers and the impact that each has on the construction cost estimate.

Section 5, *Estimate Review*, discusses the review process that is to be used by the Project Manager and the project team

Section 6, *Bid Analysis*, discusses the process to analyze bid results and justify award of the project or rejection of the bids.

Section 7, *Updates to Estimate Worksheets*, discusses the process for updating documents used for estimating based on the most current project bid results.

SECTION 2.0

Cost Management Process

Section 2 – Cost Management Process

2.0 Estimating Concepts Throughout Project Development

To successfully address transportation needs, estimators must follow the construction cost estimate guidance when developing, documenting, reviewing, updating, and submitting cost estimates throughout project development. The construction cost estimate for each phase of project development has a specific purpose, methodology, and is expected to have a certain level of accuracy. As the project progresses, more of the project's parameters will be defined and the expected accuracy of the estimate will increase. As such, the work effort required to prepare, document and review the estimate also increases.

At a minimum, the construction cost estimate should be developed, documented, reviewed, and updated at each of the following stages (phases):

- Programming and Planning (TYP development)
- Alternatives Analysis Phase
- Preliminary Design Public Hearing Phase
- Final Design Phase
- PS&E (Engineer's Estimate in PS&E Development Phase)

2.1 NHDOT Cost Estimation Process by Project Development Phase

Programming and Planning

The programming and planning stage estimate is used to estimate the probable funds needed for long range planning and prioritization for the TYP. The funding level in the TYP sets the budget, and includes a target date for design, right-of-way and construction. At this stage, estimates are prepared with minimal project definition and are usually conceptual in nature. The estimate can be prepared using estimating cost data that is based solely upon historical lane-mile cost averages for similar projects for roadway work; or upon square-foot cost averages for bridge work. It is important to document all assumptions associated with risk items; like known utility issues, complicated maintenance of traffic or extreme environmental costs associated with mitigation and contamination. Documentation should include an appropriate level of detail for the type of improvement assumed i.e. for an intersection improvement (roundabout, signal, etc.); for bridge work (preservation, rehabilitation, widening, replacement, or new construction); for roadway work (widen & overlay, pavement rehabilitation, full depth reconstruction).

A cost estimate for large projects (Environmental Assessment (EA) or Environmental Impact Statement (EIS) level projects) must also be developed when there is money in the TYP for design of projects, but the construction of the project is not contemplated until later in the Long Range Plan. It is important to complete a detailed cost estimate in the Programming and Planning phase for these types of projects which includes inflation to make sure NHDOT could afford to construct the project when the project is projected to be let.

Appendix 1 includes examples and provides guidance on programming and planning construction cost estimating for various types of projects based on recent historical bid prices. An appropriate contingency should be included based on the level of confidence in the defined project scope at this phase and the project complexity. As a general rule, the median cost should be used since it represents the project at the center of the range. The reason for using the median over the average cost is that the average cost may be skewed based on an excessively high or low project.

In some cases, when the complexity of the project is known, the low or high costs may be used. For example, when a Resurfacing project is known to have above average ADA work, drainage, intersections, ramps, etc., then a higher than average figure may be used.

Preliminary Design\Alternatives Analysis Phase

For this phase, the goal is for the estimator to review the order of magnitude construction cost estimate developed during the TYP development (Programming and Planning) and determine what additional information is now known regarding the project scope.

During this phase, an alternatives analysis will be performed and a Preliminary estimate developed for each alternative. At a minimum, each estimate, for each alternative, should contain estimated costs for construction, right-of-way, mitigation, and utilities.

The cost estimates for the roadway are developed using the Alternative Analysis Phase Estimating spreadsheet (Appendix 2) and for bridge costs the Municipal Bridge Slope Intercept worksheet is used (Appendix 3). These calculation sheets are used to develop baseline estimates. Current unit prices must be evaluated and engineering judgment employed when utilizing the formulas suggested in the spreadsheet.

An appropriate contingency should be included based on the level of confidence in the defined project scope at this phase and the project complexity. Consideration should be given to the impact of cost-drivers as described in Chapter 4, Cost Estimating Factors.

Also developed in this phase is a right-of-way cost estimate. To obtain this estimate, a request is sent to the Bureau of Right-of Way who provides an estimate of the right-of-way funding needs for each of the alternatives considered.

Preliminary Design Public Hearing Phase

Throughout the project design process, the known project work items, and associated quantities and unit prices will be used to develop a more refined construction cost estimate. A cost estimate should be provided along with all intermediate design phase document submissions. These milestone estimates, typically prepared at defined intervals as the design progresses from preliminary through final design, will be used to compare against the current programmed amount. This will solidify many items in the scope such as right-of-way, likely permit conditions, environmental mitigation, and quantities of major items of work. The estimate may need to be updated along with NEPA clearance with respect to environmental clearance, commitments, and mitigation as well as any changes to the scope of the project.

As items and quantities become finalized, most of the contingencies will also be accounted for within the estimate. Unit prices should begin to be updated for current market conditions and price volatility. At this point in the project development, the Preferred Alternative has been selected and the design has been advanced to verify the NEPA classification. During this phase, additional design work is completed, and the preliminary construction cost estimate developed in the Alternatives Analysis phase can be updated.

The estimate is developed using itemized costs for major items, and items that can be quantified to a moderate confidence level. Items are not expected to be calculated to a quantity book level, but because there is a selected alternative many items that were estimated by percentage in the previous phase can be more closely estimated. As in the previous phase, estimates will need to consider contingencies, and cost-drivers.

In addition to the construction cost estimate, the estimator also works to update the right-of-way cost estimate. The Project Manager requests the Bureau of Right-of-Way (ROW) to develop an estimate of right-of-way costs based on the concurred ROW Impact Plans. The Bureau of ROW will develop the estimate and send it to the Project Manager.

Final Design Phase

During this phase, Slope and Drain (50%) and PPS&E (generally >75%) construction estimates are prepared. As the project design progresses, the preliminary design phase estimate is updated with the contract items calculated precisely as quantities are completed and checked.
The PPS&E estimates should have all major items computed and checked and all other items computed to a moderate confidence level. The completeness of the quantities will influence the contingency amount carried in the estimates. Unit prices should be updated based on historical bid data for similar projects and quantity.

The PPS&E estimate will be used during the pre-advertisement coordination meeting to discuss specific item quantities and prices with the Construction Bureau, the Specification Section of Highway Design, and other project team members.

PS&E Development Phase

The Design lead prepares and uploads the PS&E Estimate, PS&E Checklist and attachments to the ProMIS document center and notifies the Project Manager. The PS&E Estimate (Engineer's Estimate) is an itemized estimate in .pdf format utilizing the completed and checked contract quantities per the Final Design Submission. The estimate is to be developed using Historical bid-based Estimating, Historical Percentages Estimating, or Cost-based Estimating, as needed.

2.2 NHDOT Cost Estimating Process Summary

The following summary is an overview of the NHDOT project cost estimation process:

Table 2.2 - Summary

Project Development Phase	Project Type	Estimate		Contingency % Range[1]
		Type	Method	
Programming and Planning	Highway	Programming	Similar Projects Cost/Lane-Mile	0% - 10%
	Bridge	Programming	Municipal Bridge Estimate - Slope Intercept + project/site specific additive costs	0% - 20%
Preliminary Design\Alternatives Analysis\Public Hearing	Highway	Preliminary	Alternative Analysis Worksheet – Major Q's & Category %'s	15%-20%
	Bridge	TS&L	Municipal Bridge Estimate - Slope Intercept + project/site specific additive costs	0% - 20%
Final Design	Highway	50% Slope and Drain	Itemized Estimate with Quantities & Unit Prices	15% - 25%
	Bridge	40% Preliminary Plans	Itemized Estimate (Standard Item List by project type) + project/site specific additive costs	15% - 25%
	Highway	75% PPS&E	Itemized Estimate with Quantities & Unit Prices	10%
	Highway	95% PPS&E	Itemized Estimate with Quantities & Unit Prices	5%

	Bridge	80% PPS&E	Itemized Estimate with Quantities & Unit Prices	10%
	Bridge	90% PPS&E	Itemized Estimate with Quantities & Unit Prices	5%
PS&E Development	Highway & Bridge	PS&E	Itemized Estimate with Quantities & Unit Prices	0%

1- Evaluation for contingency should be considered carefully and should be based on the risks associated with the estimate under development. At the planning stages when little detail is known and historical project cost are being used contingencies should be low unless there are known cost drivers that the sample projects do not account for. When developing itemized estimates, the contingency is based on the items that have been calculated/not calculated, checked/not-checked and known risks that are not accounted for in the items to date. As more items are calculated and checked the contingency should be reduced accordingly.

2.3 Estimating Process Steps

Regardless of the estimating phase, the preparation of an initial estimate or the update of an estimate at subsequent milestones, the basic process shown in Table 2.3 - Estimating Steps should be followed.

Table 2.3 - Estimating Steps

Steps	Description
Determine (or review and update) estimate basis	Document (or update) project type and scope, including: • Scope documents • Drawings that are available (defining percent design completion) • Project design parameters • Project complexity • Unique project location characteristics • Disciplines required to prepare the cost estimate
Prepare (or update) base estimate	Prepare (or update) estimate, including: • Documentation of estimate assumptions, types of cost data, and adjustments to cost data • Application of appropriate estimating techniques, parameters, and cost data consistent with level of scope • Coverage of all known project elements • Coverage of all known project conditions • Ensure that estimates are consistent with past similar projects
Determine risk and set contingency	Identify areas of uncertainty related to: • Project knowns and unknowns • Potential risks associated with these uncertainties • Appropriate level of contingency congruent with project risks
Review total estimate	Review estimate basis and assumptions, including: • Methods used to develop estimate parameters (e.g., quantities) and associated costs • Completeness of estimate relative to the project scope

	• Application of cost data, including project-specific adjustments • Reconciliation of current estimate with the previous estimate (explain differences) • Perform reasonableness check using historic estimate information and previously constructed similar project types • Preparation of a project estimate file that compiles all information and data used to prepare the project estimate

2.4 Estimate Documentation

Documenting the construction cost estimate is important in order to clearly understand what is included in the estimate, what the contingencies represent and the associated inflation considered. Proper documentation will allow estimates to be more readily checked, verified, and updated.

To develop a construction cost estimate that is in line with market considerations and eventually the low bid for the project, proper documentation of the estimate throughout the project development process is critical. This documentation is important as project team members contributing to the construction cost estimate must be aware of the assumptions that have been made throughout project development and outstanding issues that need to be resolved to further refine the construction cost estimate. This includes all assumptions for estimated quantities and unit prices, and how the project specific conditions affect quantities and unit prices for certain types of work on the project.

The estimate is an integral part of the project need and scope, and together cost and scope drive many of the project team's design decisions. All project team members must understand the importance of cost estimation if costs are to be managed appropriately. The project team must avoid misrepresenting the project, in both terms of scope and cost, at any time throughout project development.

Changes in scope or other issues that affect project cost must be documented and resolved in the estimate at key milestones in the project development process. In addition, the estimator must document all estimate assumptions as well as maintain the estimate data and information that supports the quantities, prices, allowances, assumptions and contingencies.

Table 2.4 outlines the basic steps for performing a review and/or update of the construction cost estimate and can be applied at each phase of the project development process.

Table 2.4 - Estimate Documentation Steps

Documentation Steps	Description
Monitor project scope and project conditions	Identify any potential deviation from the current construction cost estimate assumptions, including: • Changes in project scope • Changes due to design development • Changes due to external conditions • The nature and description of the potential deviation • Deviation impacts on the project budget and/or schedule
Evaluate potential impact of change	Assess potential impact of change, including: • Cost and time impact of the deviation • Recommendation as to whether to modify the project scope, budget, and/or schedule due to change
Adjust Cost Estimate	Document changes to the baseline estimate, including: • Appropriate approval of the deviation • The new project scope, new budget, and/or new schedule • Notification of the change to project personnel
Obtain appropriate approvals	Obtain authorization to proceed by: • Review of current project scope and estimate basis • Securing approvals from appropriate management levels • Approval of current estimates, including any changes from previous estimates • Check Estimate Review Committee guidelines and review if required

Other Estimate Documentation

At each project development milestone, the estimate must be sufficiently documented to allow an independent reviewer to determine that the estimate is complete, accurate, and realistic. The following information should be provided (updated) at each milestone:

- Item numbers, item descriptions and any tailoring used for this estimate
- Methodology - Describe how the item's costs were estimated (e.g., historical costs, similar project, conceptual costs, etc.)
- The use of unit prices from the Department's historical bid results. Under this approach, bid data are summarized and adjusted for project conditions (project location, size, quantities, etc.) and the general market conditions
- How lump-sum items are handled
- Detailed, clear environmental items (requirements)
- Each contingency allowance assigned to the various parts of the estimate. If extraordinary conditions exist that call for higher contingencies, the rationale will be documented
- All uncertainties and risks associated with the estimate

- Level of knowledge about scope
- Level of estimate detail
- Techniques used to complete the estimate
- Cost traceability - When a prior cost estimate exists, a description of the cost should provide a concise explanation for any cost change to an item from the prior estimate
- Document the names and titles of participants who developed the estimate

Each construction cost estimate in the project estimate folder should be identified by its date and current project milestone.

2.5 Project Estimate File

Estimates are created by the collaborative effort of many disciplines (e.g., highway, bridge, traffic, environment, utilities, ROW). To be able to document the assumptions upon which the construction cost estimate is based and to preserve the information for future projects, all estimates and their supporting documentation must be stored in the project estimate folder and a single project estimate file shall be maintained throughout the project development. The creation of the file begins with the very first estimate. Each time an estimate is updated, the most recent estimate file shall be uploaded into ProMIS to allow review by all levels of the organization as needed.

A project estimate file provides a record that documents the basic reasons behind the original estimated construction cost, as well as reasons for subsequent construction cost revisions. The project estimate file should, at a minimum, contain appropriate categories of work at each project milestone for each cost estimate developed including any assumptions that have been made, the current project scope, and a copy of or reference to the cost data that were used to develop the construction cost estimate. This information should be included in the project estimate file regardless of project development phase. The creation of the file begins with the very first estimate. When items are estimated by percentages or other costs, as is often done for miscellaneous and utility costs, the percentage should also be documented in the project estimate file.

Good documentation supports the cost estimate's credibility, aids in the analysis of changes in project cost, enables reviewers to effectively assess the construction estimate, and contributes to the collection of information for estimating the cost of future projects. Each project's construction cost estimate will be a well-documented history of the assumptions, methods, and procedures used to estimate the costs associated with the project's specific scope of work.

2.6 Significant and Major Project Program Cost Estimating (>$100M)

A project over $100M are considered significant and will require an annual Financial Plan per section 106(h) of title 23, United States Code (23 U.S.C. 106(h)). A major project is defined by FHWA as a project that receives any amount of Federal financial assistance and has an estimated total program cost

greater than $500 million (expressed in year-of-expenditure dollars). The total program cost estimate includes construction, engineering, acquisition of right-of-way, and related costs. In order to fully represent costs for delivering the project, adjustment for utility and railroad, transportation system management, public outreach, and construction contingencies to allow for additional work and cost growth during construction should all be included as cost elements on major projects. The key principles stressed in the FHWA guidance also apply to other NHDOT projects such as documentation, review, and validation of the estimate, updating the estimate at various development phases of the project, and relying on experts for input into various elements of the estimate. The FHWA provides guidance for Major Project Program on their website at:
https://www.fhwa.dot.gov/majorprojects/

SECTION 3.0

Cost Estimating Methods

Section 3 – Cost Estimating Methods

3.0 - Introduction

The cost estimating methods used, will depend on where you are in the project development process, the level of project scope definition, the project type, and the complexity of the project. Additionally, there are a variety of data sources (ProMIS, IPD, etc.) that can be used to support construction cost estimating for each of the methods.

3.1 Historical Bid-Based Estimating

The use of cost data from recently bid contracts is the most common state highway agency estimation approach. Under this approach, historical bid results are used to predict unit prices for specific items of work, or to develop unit costs for broad categories of work such as square foot costs for bridge construction, lane mile costs for road construction, square foot cost for noise wall construction, etc. Historical bid results, and current weighted average unit price data is available on the NHDOT website and through IPD. These historical prices are used in all methods of estimating discussed in Section 2.0.

3.2 Analogous or Similar Project Estimating

Analogous project estimating is an estimate method that relies heavily on one or more projects that are very similar to the project that is being estimated. The similar project was either previously constructed; is currently under construction; or has a completed higher level of estimate, such as PPS&E estimate. Line items, quantities, and unit costs are used as a basis for estimating the current project prior to adjusting the estimate for different project features. This method is often used to compare cost/mile or cost/lane mile, for projects of similar scope.

3.3 Historical Percentages Estimating

This method is used in conjunction with historical bid-based estimation. Historical percentages are used to estimate costs for items that are not typically defined early in project development or for lump sum items. A percentage is developed based on historical cost information from past projects to cover certain groups of items (drainage, guardrail, erosion control, etc.) that can be derived from past bids. For example, mobilization and Maintenance of Traffic is often estimated based on a historical percentage of construction. This method is most appropriate during Alternative Analysis and Public Hearing Phase when major items can be reasonably estimated but other elements of the design have yet to be designed.

3.4 Cost-Based Estimating (scratch estimating)

Introduction: This method relies on the cost-based estimation approach, where the construction cost estimate can be developed based on a projected productivity, along with estimated labor, material, equipment, contractor overhead, and contractor profit for each major cost category or line item.

Cost-based estimating, also known as "scratch" estimating, is a method to estimate the cost of each component to complete a work item and then adding an amount for contractor's overhead and profit. A cost-based estimate can be developed based on a projected productivity, along with estimated labor, material, equipment, contractor overhead, and contractor profit for each major cost category.

A cost-based estimating approach can take into account the unique character of projects, geographical influences, market factors and the volatility of material prices. When an estimate for an item is separated into labor, material, equipment, overhead and profit, it is easier to account for unique project characteristics. For example, special equipment needs or factors that address labor productivity can be documented in a cost-based estimate as opposed to a random increase or decrease of an average unit cost of an item. Since contractors generally utilize a cost-based estimating approach to prepare bids, this method can provide more accurate and defendable costs to support the decision for contract award or rejection.

Properly prepared cost-based estimates require significantly more in terms of effort, time and skill to prepare than historical bid-based estimating. This type of estimate can provide the Department and estimate reviewers a better idea of how much a project should cost, but takes a greater commitment of resources to produce the estimate.

Even agencies that routinely utilize cost-based estimates typically do so for only those items that comprise the largest dollar value of the project. Cost-based estimating can be used to check major items of work that pose significant impact on total project cost. In order to successfully implement cost-based estimating, the estimators must have expertise in construction methodologies. The estimator should have a good working knowledge of: construction techniques and construction equipment; proposed project work and how it will most likely be accomplished; labor requirements; equipment production rates; scheduling; how much to adjust quotes from material suppliers; and potential locations of material sources. Keeping detailed records of actual equipment and manpower production rates on past construction contracts are also helpful for providing data from which to base estimating assumptions for contracts being let.

Cost-Based Process: The following steps are used in determining the estimated cost of an item of work:

1. Identify items for Cost-Based Estimating approach.
2. Define and list work tasks associated with identified items.
3. Review construction schedule information.
4. Determine material, equipment and labor requirements.
5. Time (Establish anticipated progress rate).
6. Compute base cost of labor, materials and equipment.
7. Add overhead.
8. Add profit.
9. Compute unit price.

Last Updated: July 7, 2021

SECTION 4.0

Cost Estimating Factors

Section 4 – Cost Estimating Considerations

4.0 Introduction

Cost estimating factors can have a significant impact on a project and need to be considered during all phases of project development. Two very similar projects located in different parts of the state may need to be estimated differently due to: material availability, traffic volumes, and time of year the contract is let. Understanding the construction phasing, when borrow may be available, material trucking distances and production rates are all factors that can impact unit prices and should be documented as part of the estimate when appropriate.

4.1 Cost Drivers

Cost drivers are various items and conditions associated with a project that can have an impact on the cost of construction. The project team must fully understand and document the impacts that cost drivers are anticipated to have on the estimate. The following are common cost drivers that must be examined to determine how they impact a project's construction cost estimate.

Quantity of Materials: The quantity of a given material on a project affects the unit cost of constructing and/or supplying that item. This is not just a supply and demand issue, but also one of production efficiency and economy of scale.

- **Large Quantities**: Typically, the unit price for larger quantities of a given material will be less than smaller quantities. Suppliers offer discounts for larger quantity orders, as mobilization, overhead and profit are spread out over a larger quantity, thereby reducing the cost on each unit. Larger quantities also give rise to efficiency by gaining experience and expertise in completing the work. However, very large quantities of certain materials may actually cause an increase to the unit bid price. For example: a project with numerous or large structures may affect the market for a particular type of steel, availability of cement, or even tie up a region's labor resources. The phasing of the project may also negate the cost efficiency of large quantities when those quantities are split between project phases during construction.

- **Small Quantities**: Small quantities of items of work are less cost effective to construct and lead to higher unit prices. Not only do suppliers charge more for smaller purchases, in some instances, the lot size or the amount that has to be purchased is greater than the needed quantity. Small quantities do not generally allow for high production rates or other efficiencies, resulting in a higher unit cost. Smaller quantity items are also frequently subcontracted out. This practice increases a contractor's overhead and they usually apply a markup to those items.

- **Balancing Materials:** This mostly relates to earthwork (cuts and fills) on large off alignment projects. If the contract calls for large quantities of fill material that will need to be brought in from outside sources this fill will cost will be higher than fill that could be excavated from the

project site. This should be consideration when developing preliminary designs and estimates on these types of projects.

Classification of Work: Work that must be performed by hand will be more expensive than similar work that can be completed by machine. In addition, separated operations will be more costly than contiguous operations. Precise work, such as fine grading, will cost more per unit than bulk work, such as placement of large fills.

Price-Volatile Materials: Materials are considered price-volatile when:

- Based on monitoring of recent contracts, the price trend is extremely volatile.
- Suppliers provide a price quotation for a limited time frame that is shorter than the duration of the contract.
- The price quote may be based on date of delivery or spot market conditions.
- Potential shortages are possible.

There are times when fuel prices may be considered as volatile. The types of work that are most fuel-intensive are excavation, embankment placement, aggregate hauling and paving. The cost of asphalt can also be volatile. NHDOT construction contracts typically incorporate adjustment factors to account for the volatility of fuel and asphalt prices.

Availability of Materials: Material shortages can increase costs, cause construction delays and increase overhead by lengthening the contract time. Surpluses in materials can drive costs down due to competition between suppliers. The availability of materials can have a great effect on the construction cost estimate. Material sources should be checked for stock inventory, production rates and limits of supply (e.g., manufactured items such as pipe and traffic signals should be checked for availability and delivery time). Provisions should be made in the construction schedule for sufficient time for the contractor to order materials that may not be readily available such as: steel fabrications; precast and prestressed concrete components; and steel piling.

Project Location: A project's location, whether in an urban, suburban, or rural setting should be considered when developing the construction cost estimate. The number of likely bidders can also be influenced by the project location. Northern NH has the potential for much less competition than southern NH depending on the scope of the project. I.e. pavement prices in District 1 are known to be higher than the rest of the state due to the limited number of pavement plants in this region.

- **Rural**: In rural areas construction operations may have less restricted work areas, less traffic to contend with, and additional hours to complete the work; all factors that increase productivity. On the other hand, materials, equipment and personnel may all have to be brought to the project site from out of the area, which may increase those costs related to transportation,

support, wages, and per diem. Remote locations usually result in higher prices. When developing the construction cost estimate, consider sources of material, mobilization costs to the project site, and availability of local labor.

- **Urban**: In congested urban areas, the storage space available for a contractor's equipment and materials must be considered, along with borrow and waste areas if required, and haul distances. Work that is to be completed while traffic is maintained may result in slower rates of progress. A project in an urban setting generally has to contend with construction operations occurring in more confined work spaces, greater volumes of traffic, limited hours of operations, and night time work that can affect production rates and impact the construction cost estimate. Some of these factors may be offset by availability of local contractors, materials, equipment and personnel.

Time of the Year: The estimate should account for a seasonal adjustment as necessary. The time of the year that work will proceed has a definite effect on the cost of the project. It is best to start projects in early spring allowing sufficient time to complete before cold weather sets in. If the project schedule requires cold weather work, rates of progress must be adjusted downward and the construction cost estimate revised upward. Added costs, such as winter overhead, heating of materials, and winter damage, must be considered when developing the estimate.

Project Duration: The estimate should consider the impact of multi-year projects, projects with a very short duration, and for project duration that is impacted by accelerated construction requirements. Multi-year projects add overhead to the contractor and therefore many unit items can see a higher than average percentage allocated to them. Long term projects also create risk for volatile items with no cost adjustments included in the contract. The opposite is true for short duration or single season projects. If projects are advertised, bid, approved, and constructed with no delays then the risk of price volatility is greatly reduced and overhead is kept to a minimum. This is the case for the yearly district resurfacing projects. They are advertised, bid and built in the same year and the contracts have fuel and asphalt adjustment included and therefore the risks are greatly mitigated and the projects can be accurately estimated.
Accelerated Bridge Construction (ABC) can add additional risk to a Contractor due to very tight construction schedules and fines that can be associated with delays. These contracts have a benefit to the public when executed as planned, but often increase the overall cost of a project.

Project type: In the context of cost estimating, project type will influence the associated cost drivers. While new highway construction projects may have additional costs associated with right-of- way acquisition, it may provide more efficient construction access and allow the contractor to use larger equipment. In contrast, reconstruction projects on existing alignment pose construction access restriction, and other costs associated with construction phasing and maintaining traffic.

Maintenance of Traffic: Construction in high-volume traffic areas will add substantially to project duration and cost. Similar projects in low-volume traffic areas will have generally shorter construction duration. During construction, Maintenance of Traffic (MOT) should be designed and implemented to minimize the inconvenience placed on motorists.

When new roadways are constructed, contractors may build with little interference from existing traffic areas. This situation permits the contractor to generally maximize production rates and minimize expenditures. MOT costs become pertinent when the roadway project requires traffic to be shifted or detoured around the construction site.

Cost-effective MOT must allow the contractor procedures that maximize production rates and work zone safety, while minimizing contract time and impacts on the motoring public. When preparing effective MOT for a project, costs associated with the following conditions must be considered:

- Half-Width vs. Open Area Construction
- Night time vs. Day time Construction
- Lane Closures
- Detours
- Mobilization, Demobilization and Remobilization

4.2 Unit Items

The most difficult items to estimate on a project are the lump sum or unit pay items. A unit item can be defined as an item that does not have a detailed quantity specified and 100% payout of the item is virtually guaranteed. Fortunately, unit items are usually structured so they cannot be overrun. Unfortunately, it can be difficult to estimate what cost should go into a unit item and what cost a contractor has put into a unit item.

Since breaking out a unit item into smaller components is difficult and time consuming, many transportation agencies apply percentages or ranges to some unit items based upon historical price data for similar project conditions. If the work to be performed can be quantified, then a payment method that includes a quantity should be used. However, unit bid items are often used when an item of work can only be defined in general terms, (i.e., the finished product can be defined, but not all the individual components or details). The more information and breakdown of a unit item that an estimator has to work with, the greater the likelihood that an accurate estimate can be developed. By breaking out a unit item into smaller sub-units of work that may have historical price data, a more accurate cost for the overall unit item may be established.

Cost-based estimating can be very beneficial for unit items such as: MOT; Bridge Removal; Access for Construction; Mobilization; and Fine Grading. Unit traffic control items, such as Construct and Remove

Diversion, can be broken down into how many laborers, equipment and materials will be needed for how long and a cost for the elements considered.