# Revised Draft Report

# For the Expert Review Panel

# For the Assessment of Cost Estimating Methodology

# And Sample Cost Estimates

# For Sound Transit

# ST3 Projects

**February, 2016**

*Submitted By: VALUE MANAGEMENT CONSULTING, INC.*

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## I. *EXECUTIVE SUMMARY*

***VALUE MANAGEMENT CON$ULTING, INC*** (***VMC***) was engaged by the Sound Transit 3 Expert Review Panel, in December, 2015 to conduct an independent assessment of the cost estimating for up to ten (10) potential Sound Transit ST3 capital projects. This work is undertaken to support the work of the Expert Review Panel for the ST3 capital projects.

There are a number of good practices that have been identified and mentioned in this report. Some of them include the following:

- Sound Transit has made good utilization of their historic knowledge and experience with the design and construction of Sound Move and the ST2 projects to plan for the projects in the ST3 Program. In particular the development of a Unit Cost Library to provide a consistent basis for cost estimates is a superior practice.
- The unit costs used to develop assemblies are reasonable and the assembly costs are appropriate for these planning level cost estimates.
- The document "System Plan Development (ST3) Capital Cost Estimating Methodology" provides excellent documentation for how Sound Transit's Unit Cost Library was developed. There are references made to industry standards including AACEI, ANSI, CSI and FTA. Providing references to industry standards is a good practice.
- The use of allowance, contingency and management reserve are good practices. Citing the AACEI definitions and then how Sound Transit has modified their use for their program would be advisable to strengthen the tie to industry standards. This clarification can and should be documented in the System Plan Development (ST3) Capital Cost Estimating Methodology as well as documents that present the cost estimates to the staff, the Sound Transit Board of Directors and the public.
- The inclusion of provisions for "soft costs" within the System Plan Development (ST3) Capital Cost Estimating Methodology is a good practice, since it avoids the undisciplined approach of every project development team using their own assumptions.
- We understand that risk assessment/risk analysis is planned for this program.
- Using FTA cost codes is a very good practice that avoids considerable costs for Sound Transit and/or the FTA independently contracted auditor converting costs from another coding system.
- Sound Transit gets a good value from the use of expert review panels and peer reviews. We recommend continuing the use of experts to review your work.
- We recognize that there are many changes occurring at a rapid pace at this time. The effort to maintain consistent descriptions and clarity in documentation is commended. The current definition for the projects can be changed through the evolution of the design, such as geotechnical investigations, obtaining permits and other factors. It appears that you have good practice for version definition in place with your Excel Tracking file.
- It is a good practice to have the unit costs in the Unit Cost Library set at a fixed reference date, which is currently the 4$^{th}$ Quarter, 2014. It is a good practice that the Unit Cost Library has component costs for labor, materials, and equipment. Updating the component costs in the future by updating this component costs is a superior technique than updating by using a cost index, such as ENR.

- In the Cost Estimate Methodology there is a statement that planning level estimates will have *"varying degrees of design".* This statement is correct and cannot be overstated.
- Our review of the cost estimates prepared has shown that Sound Transit has used the procedures that they have developed and produced credible cost estimates for planning purposes.

We also suggest your consideration of the following, which are explained in greater detail within this report:

- The System Plan Development (ST3) Capital Cost Estimating Methodology might be a good place to explain how other tasks that examine factors that can impact the total costs for projects will be completed and when the results of such tasks will be included in the project costs. Such factors include risk analysis; escalation to year of expenditure dollars; contract packaging that may require stages or phasing; and any other costs that may impact the complete cost.
- Clear up-to-date definitions of the assumptions and exclusions should exist only in the Basis of Estimate document and mentioned in the Methodology document (but not duplicated there). When assumptions and exclusions are put into more than one document they are not always updated in all places where they exist.
- The term range should not be used when only a single point number, usually a percentage to be added, is used.
- It is not possible to develop a comprehensive program schedule at this time. We recommend that a schedule be developed as soon as possible. However, any requirements to phase or stage one or more parts of the program could add costs.
- Consider using life-cycle cost analyses for conceptual value assessment (a term used when the program and projects are at a very preliminary stage of evolution. This can be a powerful tool and could be used as an additional analytical tool to assist in decision making.
- There are two topics listed with bullets on page 4-2 of the Methodology document that need further explanation. They are "Integration" and "Innovation".
- In the Basis of Estimate consider eliminating the inclusion of risk in the ROW and develop the ROW risks when the work is done to analyze the other risks in the program.
- Value Planning or Value Analysis, which is similar to Value Engineering, but done early in the evolution of major programs, could be used to provide an additional tool for the decision makers. We urge Sound Transit to consider the use of this tool.

## II. *INTRODUCTION*

***VALUE MANAGEMENT CON$ULTING, INC*** (***VMC***) was engaged by the Sound Transit 3 Expert Review Panel in December, 2015 to conduct an independent assessment of the cost estimating methodology for up to ten (10) potential Sound Transit ST3 capital projects. This work is undertaken to support the work of the Expert Review Panel for the ST3 capital projects. The scope of work outlined in the exhibit to the contract reads as follows:

"*The review will include developing an understanding of overall ST3 project cost estimating methodology. The review of specific project cost estimates will confirm that the estimating methodology was followed, and that project cost estimates have been created in accordance with industry best practices. The consultant will also review the project construction schedules for the same selected projects. This review will include analysis of whether planning, design and construction schedules are in accord with industry best practices and with Sound Transit's history of project planning and delivery."*

This draft report is organized as follows:

Section I. Executive Summary

Section II. Introduction provides some history of our work and the basis of this engagement.

Section III. Sound Transit References contains the review of the Cost Estimate Methodology, Basis of Estimate, Unit Cost Library and a list of specific Project Estimates reviewed.

Section IV. General Observations covers topics in a general manner regarding the status of the current cost estimates, our observations and some suggestions.

Section V. Project Specific Assessments contains the results of our review of 10 projects.

Since ***VMC*** was previously engaged by the ST2 Expert Review Panel to provide cost estimate analysis for the ST2 Program, we have familiarity with Sound Transit's previous major program. There will be some references within this report to similarities and evolution from the previous program with regard to the cost estimating.

To facilitate understanding of this document there are references to representative sections of relevant documents provided by Sound Transit for this review. The entire documents are not attached to this report, but sufficient information is included to assist the reader in understanding the nature of the comments. Some individuals may wish to refer to the entire document. Key documents used for this assessment are listed later in this Introduction section.

Sound Transit has provided numerous documents in hard copy and electronic versions for the review. The depth of historic information about the cost of various features for Sound Transit projects has grown substantially since the review of the ST2 Program was completed.

Questions about this report should be directed to:

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This review was conducted over several weeks in December, 2015 and January, 2016. Mr. Morrison met with the representatives from Sound Transit and Parsons Brinckerhoff Quade & Douglas, Inc. to discuss several questions posed by Mr. Morrison on Jan. 5, 2016. At that meeting with members of the Sound Transit staff and their consultants we were given hard copies of the following documents:

1. Sound Transit 3 Board Workshop ST3 Candidate Projects: Summary Evaluation Information, December 4, 2015.
2. Sound Transit 3 Board Workshop ST3 Candidate Details, December 4, 2015.

Many electronic files were also reviewed as part of this analysis. The Sound Transit staff and consultants have been updating many of the documents while this review has been underway. Therefore, it is possible that some of the comments made herein do not correspond to the "current" version of reference documents when the ERP reads this document. The review initially was focused on the following documents:

A. System Plan Development (ST3) Capital Cost Estimates, Basis of Estimate, dated December, 2015.
B. System Plan Development (ST3) Capital Cost Estimate Methodology, dated December, 2015.
C. Unit Cost Library, dated 10-30-2015.

Other documents were also reviewed and they include the following:

A. Sound Transit Project Control Policies and Procedure "Cost Estimating" PCPP-02, Rev. 02 with the Original Release Date: 9/28/10 and Current Revision Date: 7/07/15
B. Sound Transit Project Control Policies and Procedure "Scheduling" PCPP-03, Rev. 0 with the Original Release Date: 9/28/10 and Current Revision Date: 9/28/10
C. Sound Transit Project Control Policies and Procedure "Contingency Management" PCPP-12, Rev. 1 with the Original Release Date: 9/28/10 and Current Revision Date: 3/13/12
D. Sound Transit Project Control Policies and Procedure "Project Risk Management" PCPP-13, Rev. 1 with the Original Release Date: 7/26/11 and Current Revision Date: 7/126/11

## III. *SOUND TRANSIT REFERENCES REVIEWED*

The following documents were reviewed to understand the context in which the specific project documents were prepared. Each of these documents will be discussed in the following order.

A. COST ESTIMATE METHODOLOGY, which covers "System Plan Development (ST3) Capital Cost Estimate Methodology, dated December, 2015".
B. BASIS OF ESTIMATE, which covers "System Plan Development (ST3) Capital Cost Estimates, Basis of Estimate, dated December xx, 2015".
C. UNIT COST LIBRARY, which covers "Unit Cost Library, dated 10-30-2015".

### A. *COST ESTIMATE METHODOLOGY*

Chapter 1 Executive Summary

This chapter properly explains what the document covers and makes reference to some industry standards from AACEI and CSI. It is also a good practice to reference Project Control Policies and Procedures PCPP-2 Cost Estimating, which is the underlying policy document for Sound Transit. All documents that cover the implementation of policies should state that they are in conformance to the particular policy document(s) that cover a particular topic.

Chapter 2 Background and Purpose

This chapter properly explains the background and purpose for the System Planning Development Cost Estimates. It is a good practice to state the fact that the planning level estimates represent the reality that projects will have *"varying degrees of design".*

It would be beneficial to explain in this chapter or elsewhere in this document how the estimates produced according to this methodology are used to ultimately compile a projected program cost. What is not apparent to the reader is how escalation, risk, finance costs and any other potential program wide costs are included in the costs that finally are included in the overall program.

Even though Sound Transit may have policies and procedures to address these topics in other tasks, it would be a good practice to mention this separation of the work necessary to establish a "total" cost. There is mention that the finance charges are not included and will be addressed in the financial modeling task on page 3-4.

Chapter 3 Estimating Scope and Methodology

Section 3.1 General Estimating Methodology

Some confusion is caused by the use of the terms "allowance" and "contingency" in this document. One example is "allowances for contingencies" in Chapter 3, Section 3.3 Development of Unit Cost Library on page 3-11. It is preferable to use these terms in the context as defined by AACE® International Recommended Practice No. 10S-90 "Cost Engineering Terminology". Certainly Sound Transit can replace AACEI definitions with their

own, but should not confuse the difference between allowances and contingencies. (NOTE: For clarity all direct quotations from other sources in this report will be shown in *Italics* type.)

> *"ALLOWANCES –*
> *(1) For estimating, resources included in estimates to cover the cost of known but undefined requirements for an individual activity, work item, account or sub-account.*
> *(2) For scheduling, dummy activities and/or time included in existing activities in a schedule to cover the time for known, but undefined requirements for a particular work task, activity, account or subaccount. (12/11)"*

> *"CONTINGENCY –*
> *(1) An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs. Typically estimated using statistical analysis or judgment based on past asset or project experience. Contingency usually excludes: 1) Major scope changes such as changes in end product specification, capacities, building sizes, and location of the asset or project; 2) Extraordinary events such as major strikes and natural disasters; 3) Management reserves; and 4) Escalation and currency effects. Some of the items, conditions, or events for which the state, occurrence, and/or effect is uncertain include, but are not limited to, planning and estimating errors and omissions, minor price fluctuations (other than general escalation), design developments and changes within the scope, and variations in market and environmental conditions. Contingency is generally included in most estimates, and is expected to be expended. See Also: MANAGEMENT RESERVE.*
> *(2) In earned value management (based upon the ANSI EIA 748 Standard), an amount held outside the performance measurement baseline for owner level cost reserve for the management of project uncertainties is referred to as contingency. (10/13)"*

Another term that might be used for the unallocated contingency is "management reserve".

AACEI defines management reserve as follows: *"MANAGEMENT RESERVE –*
*(1) An amount added to an estimate to allow for discretionary management purposes outside of the defined scope of the project, as otherwise estimated. May include amounts that are within the defined scope, but for which management does not want to fund as contingency or that cannot be effectively managed using contingency. Syn.: RESERVE; RESERVE ALLOWANCE.*
*(2) In earned value management according to the ANSI EIA 748 standard, an amount held outside the performance measurement baseline to handle unknown contingency at the total program level. Management reserve has no scope, is not identified to specific risks, and is not time-phased. It is typically not estimated or negotiated and is created in the budget development process. (10/13)"*

Sound Transit is encouraged to develop a consistent use of terminology that promotes proper understanding of the nature of cost estimates and communicates such an understanding across the agency, as well as to the Board, stakeholders and all parties. We recommend that the use of contingency and allowance be carefully stated and used consistently throughout all documents.

Section 3.2 Report Format

This section cites the use of the Definitions of FTA Standard Cost Categories (Rev. 16, June 2014). This includes 100.00 Finance Charges in the categories. However, Finance Charges are not included in the cost estimates at this time. Finance charges for a major multi-billion dollar program are significant.

Section 3.3 Development of Unit Cost Library

This section describes the use of previous planning efforts and the listing of work items contemplated for ST3. It is good to explain herein that the unit costs developed represent contractor's "bid prices" and that many of the costs that are typically called "soft costs" are added by applying percentages at the summary level.

Section 3.4 Unit Price Development for SCC 10 through 50

This section properly describes the development of various component costs included in the unit prices for labor, equipment rates, materials, etc. This section is well documented and includes a listing of percentages that are applied to the component costs as the unit prices are assembled.

The last bullet states: *"Art Allowance and Change Order Contingency—Sound Transit policy provides a 1% allowance for art incorporation in its capital construction projects. Sound Transit also allocates 15% of the estimated construction cost for construction change orders."* The change order of 15% should also be called an allowance, since it probably covers changes within the original scope of work.

Later in this review there are additional comments about the Unit Cost Library in Section C. Unit Cost Library.

Sections 3.5 Cost Development for SCC 60 and 3.6 Cost Development for SCC 70 are concise and clearly written.

Section 3.7 Cost Development for SCC 80 clearly shows the different allowances assumed for projects over $25 million under $25 million for administration, preliminary engineering final design and design services during construction, third parties, and construction management. This section also shows that the Administration is 6% of the costs in SCC 10 through SCC 70. The category for Preliminary Engineering also includes Transit Oriented Planning & Project Development. The category for Third Parties includes Jurisdiction Support for Community Transit Oriented Development.

Section 3.8 Cost Development for SCC 90

Unallocated contingency is defined in this section as follows: *"Unallocated contingency is similar to design allowance in that it is applied as an allowance for unknowns and uncertainties due to the level of project development completed".* This is another unfortunate example of the

intermixing of the terms allowance and contingency. If the term used is "unallocated allowance", this may be more appropriate than "unallocated contingency".

Chapter 4 Assumptions

In our opinion this section should not contain any assumptions but simply refer to the Basis of Estimate document, Chapter 3, which has a more complete list of assumptions. There is always a danger of duplicating topics in more than one document. When one document is updated, the other one is not always updated to be consistent.

Chapter 5 Exclusions

Similar to the comments above for Chapter 4, the exclusions shown in Chapter 5 are more extensive in Chapter 4 Exclusions in the Basis of Estimate. Show them in the Basis of Estimate document and refer to that location in this document.

Appendix A Capital Cost Estimate Design Allowances

These allowances are reasonable for a planning level cost estimate.

Appendix B Capital Cost Estimate ST Right of Way Cost Estimating Methodology

This appendix documents the methodology used for SCC 60 Right of Way. The adjustment factors seem reasonable and recognize variations in cost based on the alignment at grade, elevated or in a tunnel. They also recognize that there can be many additional costs in addition to the acquisition of parcels of property, such as relocation and the overhead associated with the administration of this effort.

There is a statement within this appendix at the bottom of page B-2 that states: *"A range of +7% is applied to ROW cost estimates to account for unidentified risk."* This is also different than a statement in the Basis of Estimate document on page 34 that states *"A range of +7% is applied to ROW cost estimates to account for unidentified risk."* These are additional examples of the use of the term "range" with only one value shown. We do have a concern about the inclusion of risk within the Right-of-Way cost when risk is excluded from other components.

The use of the term range may exist as a leftover from an earlier version of this document when a range was shown. There is a precedent for using ranges to convey the message that planning estimates are not exact. AACEI defines accuracy range as follows: *"ACCURACY RANGE – An expression of an estimate's predicted closeness to final actual costs or time. Typically expressed as high/low percentages by which actual results will be over and under the estimate along with the confidence interval these percentages represent. See Also: CONFIDENCE INTERVAL; RANGE. (12/11)"*

Since this is stated as a single value cost addition, it is not a range. We recommend that the use of the term "range" be eliminated here and other places where only a single value is used. Furthermore, we believe that the amount (percentage) included for risk should only be shown in one document and cited in the other document.

## B. *BASIS OF ESTIMATE*

Most of this document is devoted to a listing of fourteen batches of cost estimates that were submitted by the consultant to Sound Transit for their review between June 19, 2015 and November 13, 2015. This provides an organized chronology for the initial input and updates submitted for various segments of the routes under consideration for selection for the ST3 Program.

We will address some of the information contained in the Chapters of the Basis of Estimate document.

Chapter 1: Introduction

This chapter states the following: "The scope of work includes three stages:

- Review and update, as needed, Capital Estimating Methodology
- Update and utilize unit cost date developed for recent Sound Transit High Capacity (HCT) studies
- Prepare and present capital cost estimates for identified projects per the approved methodology"

This text is somewhat confusing since only the third bullet listed above is covered with this statement in the document in Chapter 2. The text in this chapter is almost identical to Chapter 1 Executive Summary in the Capital Cost Estimating Methodology. Since the purpose of the two documents is different it is expected that the text would not be so similar.

Chapter 2: Project Basis of Estimate

This section is devoted to listing the various project segments that are submitted in the fourteen "batches" for processing by Sound Transit. There is some limited basis of estimate detailed information included within each of the segments listed for all of the fourteen submittals.

Section 3 Assumptions

As stated above in the comments for the Capital Cost Estimating Methodology document for Chapter 4, it is our opinion that the Assumptions should be only listed in the Basis of Cost Estimate document. They are more inclusive than the assumptions listed in the Capital Cost Estimating Methodology.

Section 4 Exclusions

It is our recommendation that the Exclusions shown for the Capital Cost Estimating Methodology document for Chapter 5 should not be spelled out. The methodology document should simply refer to the Basis of Estimate document, Chapter 4 Exclusions. This eliminates

redundancy and precludes the potential for the text to be different when it is changed in only one of the two places where it is shown.

Section 5 Right-of-Way Acquisition

Right-of-Way (ROW) costs are one of the largest components of some of the projects. This section has a table that describes the buffer distance from the element to the ROW line. This section properly suggests that some judgment must be applied to the basic assumptions about the right-of-way in order to allow for variations that will occur for specific alignments. There are almost three pages of notes to be used in conjunction with the table in this section. This section is comprehensive about how the ROW costs are developed.
The following is shown on page 33: *"[(assessed property value x real estate adjustment factor x profile factor) x ROW contingency] x +/- range".* The ROW contingency (which we would prefer be called a ROW allowance) is shown as 15% for Administration and 40% for the ROW for a total of 55%.

The Methodology document on page B-2 states: *"A range of +7% is applied to ROW cost estimates to account for unidentified risk."* However, the Basis of Estimate document shows on page 34 the following: *"A range of +15% is applied to the ROW cost to account for unidentified risk".* As stated in our comments in the Methodology document, this percentage should only be shown in one document and cited in the other.

There is an inconsistency in embedding a risk for ROW in the base cost estimate and not including any contingency for other risks in the base estimate. We recommend that all of the project and program risks are calculated in a consistent manner.

C. ***UNIT COST LIBRARY***

The unit costs used for this program and for this review are an important component of the development of credible cost estimates. The development of a library of assemblies ahead of the preparation of the estimates for ST3 is an excellent practice that serves to ensure that the costs used are comparable across the various options. We do have a concern about the inclusion of risk within the Right-of-Way cost and the exclusion of risk from other components.

The electronic file that we reviewed called "Unit Cost Library" is an Excel workbook composed of four read-only worksheets. We understand that some of the unit cost development was prepared through the use of commercial cost estimating software and the results are put into the Excel workbook.

The first tab "UCL" in the Excel workbook, which stands for unit cost library, is well documented and shows the proper use of assumptions where quantities are uncertain at this state of the evolution of the planning for ST3. This is shown as Table UCL-1 below. There is a Notes column which documents the use of factoring some unit prices for items from other unit prices that are more fully developed. This is a good practice. A small portion of the Unit Cost Library is shown below. The actual table consists of over 270 Unit Costs.

The Unit Costs shown are labeled as 4th Quarter 2014 costs. The basis of cost estimates for major long range planning is often expressed in the current year for programs. We recommend that the unit costs should be escalated to a fixed time in 2016 prior to the completion of the planning for ST3.

One suggestion would be to include documentation that distinguishes any unit costs that have been developed from the use of proprietary software, historical costs from Sound Transit previous work (adjusted for inflation) or any other source. It is a good practice to document heavily the basis for unit cost development because over the extended life of this program there will be changes in personnel and hew staff need to have a clear trail of the source of the costs.

**SOUND TRANSIT**
**System Plan Development (ST3)**
**UNIT COSTS FROM UNIT COST LIBRARY—Table UCL-1**

| COST ID | DESCRIPTION | 4th Qtr 2014 | | |
|---|---|---|---|---|
| | | UNIT | UNIT COST | Note |
| 10.01.001 | At-Grade Ballasted - 1 Track | RF | $450 | |
| 10.01.002 | At-Grade Ballasted - 2 Track | RF | $550 | |
| 10.01.005 | At-Grade Embedded Streetcar Track in Asphalt Roadway – 1 Track | RF | $510 | |
| 10.01.006 | At-Grade Embedded Streetcar Track in Asphalt Roadway – 2 Track | RF | $550 | |
| 10.01.007 | At-Grade Embedded Streetcar Track in Concrete Roadway - 1 Track | RF | $520 | |
| 10.01.008 | At-Grade Embedded Streetcar Track in Concrete Roadway - 2 Track | RF | $580 | |

The next tab in the Excel workbook is “Assembly Qty Detail” which stands for assembly quantity detail. This worksheet shows the quantities of each of the components considered for the assemblies. It also shows where allowances have been incorporated into the assemblies. This is a very good practice and thorough in its detail and documentation.

The following tables were copied from the Unit Cost Library Assembly Qty Detail and they are shown below as Table UCL-2 and Table UCL-3. These two cost codes were specifically chosen because they represent cost assemblies that are different in their composition. One assembly has three allowances and the other has nine allowances. Where the word “allowance” has been used, it has been shown in red in the both Tables UCL-2 and UCL-3.

Table UCL-2 shows the “At-Grade Roadway Track Crossing – 2 Track” with a Cost Code of 10.01.052. Since it is a fairly well defined assembly even at the planning phase, there are only 3 allowances included within the construct of this assembly.

| SOUND TRANSIT<br>System Plan Development (ST3)<br>UNIT COST LIBRARY - Quantity Backup—Table UCL-2 | | | | |
|---|---|---|---|---|
| COST CODE: | | Description | Qty | Unit |
| 10.01.052 | | At-Grade Roadway Track Crossing - 2 Track | 1 | RF |
| Phase | Item | | | |
| 31-22-16.10 | A010 | Finish Grading | 2.90 | sy |
| 31-32-19.16 | A010 | Geotextile Fabric | 2.90 | sy |
| 31-25-13.10 | A010 | Erosion Control Allowance | 1.00 | lf |
| 33-71-19.17 | A050 | Cable Duct, At-Grade Guideway | 1.00 | lf |
| 26-05-26.80 | A010 | Corrosion Control Allowance | 1.00 | lf |
| 01-56-23.10 | A025 | MOT Allowance - At Grade Full | 1.00 | lf |
| 02-41-19.25 | A010 | Saw cutting, asphalt pavement | 2.00 | lf |
| 02-41-13.33 | A020 | Remove Asphalt Conc. Pavement | 2.90 | sy |
| 02-41-13.33 | A900 | Demolition Disposal | 0.74 | cy |
| 33-41-13.60 | A015 | Trackway Drainage Allowance, Paved Area | 1.00 | lf |
| 34-11-93.50 | A060 | Precast Concrete Crossing Panel | 2.00 | lf |
| 32-11-23.23 | A010 | Aggregate Base | 0.10 | cy |
| 32-12-16.13 | A010 | Asphalt Concrete Paving | 0.10 | ton |
| 32-16-13.13 | A010 | Cement Concrete Curb & Gutter | 1.00 | lf |
| 34-11-00.24 | A010 | Sub-ballast, Place, Spread & Compact | 0.70 | cy |

The next table, UCL-3 shows the unit cost for a maintenance facility and it has a cost code of 30.03,100. Since this is a very conceptual scope for the facility, the assembly cost has nine (9) allowances. This is an example of a good use of allowances for very conceptual assemblies.

| SOUND TRANSIT<br>System Plan Development (ST3)<br>UNIT COST LIBRARY - Quantity Backup—Table UCL-3 | | | | |
|---|---|---|---|---|
| COST CODE: | | Description | Qty | Unit |
| 30.03.100 | | LRT Maintenance Facility –<br>76 to 100 Vehicle Capacity | 1 | RF |
| Phase | Item | | | |
| 32-06-10.10 | A150 | Civil Site Development for MSF, Allowance | 1,045,000.00 | sf |
| 33-02-10.00 | A005 | Site Utility Allowance | 1,045,000.00 | sf |
| 32-06-10.10 | A160 | Paving, Sidewalk, Curbs for MSF, Allowance | 365,900.00 | sf |
| 32-84-23.10 | A010 | Landscape Irrigation Allowance | 397,200.00 | sf |
| 32-91-13.26 | A010 | Landscaping Allowance | 397,200.00 | sf |
| 13-03-00.10 | A080 | MSF Building, Allowance | 209,000.00 | sf |
| 11-03-00.10 | A010 | Vehicle Maintenance Equipment Allowance | 1.00 | ls |

| SOUND TRANSIT<br>System Plan Development (ST3)<br>UNIT COST LIBRARY - Quantity Backup—Table UCL-3 | | | | |
|---|---|---|---|---|
| *COST CODE:* | | *Description* | *Qty* | *Unit* |
| *30.03.100* | | *LRT Maintenance Facility – 76 to 100 Vehicle Capacity* | *1* | *RF* |
| *26-56-19.20* | *A015* | *Site Lighting Allowance* | *292,700.00* | *sf* |
| *34-11-00.17* | *A010* | *Unload Track Material & Distribute* | *15,700.00* | *tf* |
| *34-11-00.17* | *A015* | *Electric (Flash Butt) Welding, Mobile* | *393.00* | *ea* |
| *34-11-00.17* | *A025* | *Rail Grinding* | *15,700.00* | *tf* |
| *34-11-00.17* | *M010* | *Furnish Rail, 115 RE* | *602.00* | *tn* |
| *34-11-00.24* | *A010* | *Sub-ballast, Place, Spread & Compact* | *3,925.00* | *cy* |
| *34-11-00.24* | *A015* | *Ballast, Place, Spread & Compact* | *7,850.00* | *cy* |
| *34-11-00.24* | *A020* | *Install Rail on Ties, 115 RE* | *15,700.00* | *tf* |
| *34-11-00.24* | *A030* | *Align & Tamp* | *15,700.00* | *tf* |
| *34-11-00.24* | *A050* | *Install Ballasted Turnout* | *44.00* | *ea* |
| *34-11-00.24* | *M020* | *Furnish Concrete Ties w/fast clip* | *6,280.00* | *ea* |
| *34-11-00.24* | *M050* | *Furnish Ballasted Turnout* | *44.00* | *ea* |
| *34-21-16.10* | *A300* | *Substation Allowance, Maintenance Facility* | *1.00* | *ea* |
| *34-23-13.00* | *A010* | *OCS Pole Foundations* | *174.00* | *ea* |
| *34-23-13.00* | *S010* | *Standard OCS and Guy Poles* | *153.00* | *ea* |
| *34-23-13.00* | *S015* | *Standard Termination and Feeder Poles* | *22.00* | *ea* |
| *34-23-13.00* | *S020* | *Catenary Cantilevers* | *174.00* | *ea* |
| *34-23-13.00* | *S025* | *Balanced Weight Terminations* | *22.00* | *ea* |
| *34-23-13.00* | *S100* | *Miscellaneous OCS hardware* | *15,700.00* | *tf* |
| *34-23-23.00* | *S010* | *Standard catenary 350 contact wire and 500 MCM messenger wire* | *15,700.00* | *tf* |
| *34-42-13.00* | *A100* | *Train Control & Signaling Allowance* | *15,700.00* | *lf* |

The third tab in the Excel workbook is the "Unit Price Detail" tab which shows all of the components of the unit cost used in the library to develop assemblies. These include labor cost/unit, material cost/unit, sub cost/unit, equipment cost/unit, other cost/unit, direct cost/unit (which is a sub-total of the previous columns, markup and bid price/unit. The markup varies from about 8% to 49% with the mean about 40%. Some representative unit price details are shown in the table below. All of the information included in this table was copied from the Unit Price Detail except the last row, which is shown in red. It has been reformatted by the reviewer for inclusion herein.

| SOUND TRANSIT<br>System Plan Development (ST3)<br>UNIT COST LIBRARY - Quantity Backup—Table UCL-4 | | | | | |
|---|---|---|---|---|---|
| *Item* | *02-42-29.25* | *02-81-20.10* | *03-21-10.60* | *32-01-16.71* | *33-02-10.00* |
| *Description* | *Saw cutting, asphalt pavement* | *Haz. Mat'l Removal Allowance, Light* | *Reinforcing Steel* | *Cold milling asphalt paving, 1" to 3"* | *Util. Relocation Allowance, Cut and Cover* |
| *Unit* | *LF* | *LF* | *LB* | *SY* | *SF* |
| *Labor Cost / Unit* | *$ 2.23* | *$ 1.16* | *$ 0.57* | *$ 0.61* | *$ 0.00* |
| *Mat'l Cost / Unit* | *$ 0.43* | *$ 44.80* | *$ 0.62* | *$ 0.00* | *$ 0.00* |
| *Sub Cost / Unit* | *$ 0.00* | *$ 23.60* | *$ 0.00* | *$ 0.00* | *$ 23.60* |
| *Equip. Cost / Unit* | *$ 1.09* | *$ 0.20* | *$ 0.02* | *$ 1.40* | *$ 0.00* |
| *Other Cost / Unit* | *$ 0.00* | *$ 0.00* | *$ 0.00* | *$ 0.00* | *$ 0.00* |
| *Direct Cost / Unit* | *$ 3.74* | *$ 69.76* | *$ 1.20* | *$ 2.01* | *$ 23.60* |
| *Markup Cost / Unit* | *$ 1.62* | *$ 31.79* | *$ 0.54* | *$ 0.93* | *$ 9.27* |
| *Bid Price / Unit* | *$ 5.36* | *$ 101.55* | *$ 1.74* | *$ 2.94* | *$ 32.87* |
| Markup % | 43 % | 46 % | 45 % | 46% | 39 % |

The fourth tab from the Unit Price Detail Excel workbook shows an example of an estimate produced with all of the markups shown and the tab is labeled "Totals". It is replicated below and shown as Table UCL-5.

**SOUND TRANSIT**
**System Plan Development (ST3)**
**UNIT COST LIBRARY - Total Sheet—Table UCL-5**

| Description | Amount | Totals | Hours | Rate | | Cost Basis | Percent of Total |
|---|---|---|---|---|---|---|---|
| Labor (L) | $ 111,329,293 | | 300,083 | | | | 8.25% |
| Material (M) | $ 268,189,471 | | | | | | 17.34% |
| Subcontract (S) | $ 793,426,858 | | | | | | 41.95% |
| Equipment (E) | $ 34,709,992 | | 282,014 | | | | 2.59% |
| Other (O) | $ 4,043,133 | | | | | | 0.33% |
| **Subtotal Direct Cost** | **$ 1,211,698,747** | **$ 1,211,698,747** | | | | | **70.46%** |
| Contractor's Overhead | $ 62,134,313 | | | 15.00 | % | L, M, E | 4.23% |
| Subcontract Markup | $ 79,342,686 | | | 10.00 | % | S | 4.20% |
| Field Supervision | $ 96,612,449 | | | 8.00 | % | L, M, S, E | 5.61% |
| Home Office | $ 18,114,834 | | | 1.50 | % | L, M, S, E | 1.05% |
| Sales Tax - General | $ 28,775,449 | | | 9.50 | % | M, E | 1.89% |
| Sales Tax - Subcontractor | $ 37,687,776 | | | 4.75 | % | S | 1.99% |
| Bond | $ 12,076,556 | | | 1.00 | % | L, M, S, E | 0.70% |
| Gen Liability & Builders Risk | $ 24,153,112 | | | 2.00 | % | L, M, S, E | 1.40% |
| Profit | $ 48,306,225 | | | 4.00 | % | L, M, S, E | 2.81% |
| **Subtotal Markup** | **$ 407,203,400** | **$ 407,203,400** | | | | | **23.88%** |
| **Subtotal Construction (ST)** | | **$1,618,902,147** | | | | | **94.34%** |
| General Conditions | $ 97,134,129 | **$ 97,134,129** | | 6.00 | % | ST | 5.66% |
| **Total** | | **$ 1,716,036,276** | | | | | **100.00%** |

## D. *PROJECT ESTIMATES REVIEWED*

We were asked to review a selected number of projects, which are listed below with count of the projects and the Batch numbers as listed in the Basis of Estimate as well as other information from the Basis of Estimate:

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| No. | Batch # | Sound Transit Information |
|---|---|---|
| 1. | | Lynnwood to Everett Light Rail (Lynnwood Transit Center to Everett Station—three options below: N-02a, N02b and N02c. |
| 1. | 2.3 | Option 1: N-02a Lynnwood Transit Center to Everett Station via Southwest Everett Industrial Center (Paine Field)—this option consists of three segments [A + B + C (not checked)] or [A+B+D].<br>SegA. Lynnwood Transit Center to 164th/Ash Way<br>SegB. 164th/Ash Way to 128th St. SW<br>SegC. 128th St. SW to Everett Station via Paine Field/Boeing via 41st St.<br>SegD. 128th St. SW to Everett Station via Paine Field/Boeing via Pacific Ave. |
| 1. | 2.4 | Option 2: N-02b Lynnwood Transit Center to Everett Station via I-5 and SR99/Evergreen Way—this option consists of three segments [A + B + C (not checked)] or [A+B+D].<br>SegA. Lynnwood Transit Center to 164th/Ash Way<br>SegB. 164th/Ash Way to 128th St. SW<br>SegC. 128th St. SW to Everett Station via I-5 and Evergreen via 41st St.<br>SegD. 128th St. SW to Everett Station via I-5 and Evergreen Way via Pacific Ave. |
| 1. | 2.5 | Option 3: N-02c Lynnwood Transit Center to Everett Station via I-5—this option consists of three segments [A + B + C].<br>SegA. Lynnwood Transit Center to 164th/Ash Way<br>SegB. 164th/Ash Way to 128th St. SW<br>SegC. 128th St. SW to Everett Station via I-5. |
| 2. | | 145th St. & SR522 Bus Rapid Transit—two options below: N-09a Lower Cost + N10 or N-09b Higher Cost + N10 |
| 2. | 2.61 | N-09 BRT on SR523/145th to Connect to Link Station<br>N-09a Lower Cost<br>N-09b Higher Cost |
| 2. | 2.62 | N-10 BRT on SR522/Bothell Way |
| 3. | 2.12 | Totem Lake to Issaquah via Bellevue—E-03 with two segments<br>E-03-SegA Totem Lake to Wilburton Station<br>E-03-SegB Wilburton Station to Issaquah Transit Center |
| 4. | | I-405 Bus Rapid Transit—two options listed below: E-02a & E-04 & E-02b + E02c + E-04 |
| 4. | 2.31 | E-02a I-405 BRT Lower Cost: Lynnwood to SeaTac in HOV/Managed Lanes |
| 4. | 2.32 | E-02b I-405 BRT Higher Cost: Lynnwood to SeaTac in HOV/Managed Lanes |

| No. | Batch # | Sound Transit Information |
|---|---|---|
| 4. | 2.33 | E-04 HOV Direct Access at Renton/N 8th St. |
| 5. | | Ballard to Downtown Seattle Light Rail—four segments: C-01a2, C-01b2, C-01c2 and C-01d2 |
| 5. | 2.61 | C-01b2- Primarily elevated along Elliott and 15th Avenue with tunnel options |
| 5. | 2.73 | C-01a2 Primarily at-grade along Elliott and 15th Avenue<br>C-01c2 Primarily elevated along Elliott and 20th Avenue with tunnel options<br>C-01d2 Primarily at-grade along Westlake Avenue |
| 6. | 2.46 | C-01e Additional Potential Station in the vicinity of SR99 and Harrison Street |
| 7. | | C-03 Downtown Seattle to West Seattle Junction or White Center—three options |
| 7. | 2.75 | C-03c2 to Delridge/White Center |
| 7. | 2.67 | C-03a2 to West Seattle Junction 5th Avenue at-grade connection to Downtown Seattle Transit Tunnel |
| 7. | 2.74 | C-03b2 to West Seattle Junction 1st Avenue At-Grade option |
| 8. | 2.25 | C-08 Infill Light Rail Station: Graham St. |
| 9. | 2.26 | C-09 Infill Light Rail Station: Boeing Access Rd. |
| 10. | | Kent/Des Moines to Tacoma Dome Light Rail—three projects as listed below: S-01, S-02 and S-03 |
| 10. | 2.36 | S-01 Kent/Des Moines to Star Lake (272nd) (Federal Way Link) |
| 10. | 2.37 | S-02 Star Lake (272nd) to Federal Way Transit Center (Federal Way Link) |
| 10. | 2.18 | S-03 Federal Way Transit Center to Tacoma Dome Light Rail via I-5<br>S-03-SegA Federal Way to South Federal Way<br>S-03-SegB South Federal Way to Fife<br>S-03-SegC Fife to Tacoma Dome |

Some of the projects listed above have been undergoing updates for scope and/or cost since the December 4, 2015 presentation to the Sound Transit Board of Directors. The specific project estimate reviews are in Section V. of this report.

## IV. *GENERAL OBSERVATIONS*

### A. *USE OF INDEPENDENT STANDARDS*

As mentioned earlier in this document many large agencies look exclusively within for standards. It is commendable that Sound Transit has standards but also recognizes the benefits from referencing independent industry standards. We have found references to AACEI Recommended Practices, ANSI Standards, and FTA and CSI formats for use in assembling cost estimates.

### B. *DEVELOPMENT OF SOUND TRANSIT STANDARDS*

- UNIT COSTS

The unit costs used for this program and for this review are an important component of the development of credible cost estimates. The review of the Unit Cost Library is found in Section IIIC above. The development of a library of assemblies ahead of the preparation of the estimates for ST3 is an excellent practice that serves to ensure that the costs used are comparable across the various options. The unit costs used ~~that~~ are ~~the~~ components of the assemblies for the projects are reasonable for a planning level cost estimate.

- ASSEMBLIES AND QUANTITIES

The development of assemblies from unit costs is a good practice for planning level estimates. Since detailed engineering plans do not exist at this time is a good practice to develop assemblies that can be used for costs by the running foot or square foot. Tables UCL-2 and UCL-3, which are shown above, display the quantities assumed for assemblies.

- ALLOWANCES, CONTINGENCIES AND MANAGEMENT RESERVES

The use of the terms “allowances”, “contingencies” and “management reserves” have been discussed at some length in the review of the Capital Cost Estimating Methodology and Capital Cost Estimate Basis of Estimate documents. Again, we encourage Sound Transit to be careful to scrutinize documents for consistency in the use of these important terms.

In every document that may be reviewed by senior staff from Sound Transit, the Sound Transit Board of Directors, the Expert Review Panel and especially the public, there should be a very clear definition of allocated contingencies, unallocated contingencies and project reserve, if they are shown.

## C. *CONFORMANCE TO BEST PRACTICES*

- LESSONS LEARNED AND INCORPORATED INTO THE ST3 PROCESS

Since this reviewer last had an opportunity to focus on the cost estimate used by Sound Transit, which was in 2006 and 2007 for ST2, considerable improvement has been made. We find the development of the System Plan Development (ST3) Capital Cost Estimate Methodology and System Plan Development (ST3) Capital Cost Estimate Basis of Estimate documents to be well developed. We have previously made some suggestions for improvement in Section III. Of course, Sound Transit has benefited from the knowledge gained during the construction of ST2 projects since 2006. The incorporation of lessons learned from previous Sound Transit work is excellent and definitely should be considered a best practice.

- USE OF EXPERIENCE FROM OTHER MAJOR PROJECTS

There is also a benefit from the opportunity to observe other multi-billion dollar transportation projects that have been under construction in the region during the construction of ST2 projects, such as the replacement of the SR520 floating bridge and the replacement of the Alaskan Way Viaduct.

- BASIS OF DECISIONS MADE WITHOUT ANY CONSTRUCTION SCHEDULE

We recognize that it is not possible to discuss an overall schedule for the ST3 Program or for specific projects at this time (prior to the adoption of a draft system plan). However, we encourage Sound Transit to begin some "high level" planning and scheduling for the program and the constituent projects as soon as possible. There may be some significant cost savings opportunities that can be achieved by optimizing the program schedule.

- BASIS OF DECISIONS MADE ON LIFE-CYCLE COST ANALYSIS

Another tool that should be considered for use in conjunction with a schedule of projects and the effects on operations is the use of life-cycle analyses. Such analyses can and should include capital costs and the effects of operations, maintenance, debt service and all program costs over an extended period of time.

Life-cycle costs that are used extensively with value engineering early in the program evolution can also be used for key decisions for major programs. Using net present value which is the tool that is used in life-cycle cost analyses presents a rational way of examining choices on an equal basis in terms of overall impact on the region. We encourage Sound Transit to make use of as many of the analytical tools as they can in making their choices.

The use of value engineering or value analysis, as it is sometimes called when used at the programmatic level does not diminish the opportunities for significant project improvement and value when applied at the 30% design milestone.

- INCLUSION OF "SOFT COSTS" AND RESERVES

Sound Transit continues a good practice that we observed with the review of the ST2 program. The inclusion of soft costs for the non-construction costs associated with the projects, including a reserve that is allocated to cover change order costs is a good practice. The use of a set of standard percentages is much better than some programs and projects where they vary from project to project.

## D. *RISK ASSESSMENT AND RISK ANALYSIS*

The use of risk assessment/risk analysis has increased in recent years with the result that many major programs have successfully improved their performance with regard to

keeping major programs on track with regard to cost and schedule. Statistical assurances from the use of the risk assessment/risk analysis tools can be very helpful to program managers.

There are significant risks inherent in producing cost estimates at the planning level of a major program. Some of these can be mitigated, and many of them can be managed as the program evolves from conception to operation.

- POTENTIAL VARIATION AS PROJECTS EVOLVE

One of the risks concerns the fact that potential alignments may not prove to be implementable based on factors that are not necessarily defined at the present time. They may relate to geotechnical information not now developed or other factors that may cause an alignment that is representative at this time to be impractical to implement as additional background information and preliminary engineering is completed. The scope and costs could increase due to the evolution of the alignment as the project(s) proceed.

The documents presented to the Sound Transit Board of Directors on Dec. 4, 2015 document the fact that the alignments are representative. Such information cannot be overstated because the general public does not always remember such information.

Another change that can occur is the requirements for mitigation scope and the costs of mitigation that a program gets during the attaining of required permits. This is risk that simply cannot be estimated at this time.

- EFFECT OF THIRD PARTY AGREEMENTS ON PROGRAM COSTS

The scope of projects can be changed by mitigation measures as stated above and also by the requirements of various jurisdictions with whom Sound Transit must seek approval. For example, in the project description for project N-02a-SegC, one or the risks highlighted is that light rail is not currently a permitted use in Everett. The process to make it a permitted use could affect the project scope or budget.

There are limitations on what the state legislature allows Sound Transit to fund. However, it has been shown that when a major program is underway, other jurisdictions and institutions can sometime be unreasonable with regard to their expectations about the cost of other features that are “charged” to the major program.

- COST ALLOCATION AMONG MULTIPLE FUNDING SOURCES

The funding of the program and projects within the program has not been reviewed as part of this task. It is our understanding that financial modeling and funding will be addressed separately by the Expert Review Panel. The only reason to mention it here is

the fact that the timing of funding can impact the program and individual project's schedules, which can in turn impact the costs and on-time delivery of the program

- CONSTRUCTION COSTS THAT EXCEED SOUND TRANSIT'S PROJECTIONS

During time when the inflation associated with the general economy is close to the inflation cost associated with construction the net effect of using net present value to standardize costs over the long period of completion of a program is not a potential problem. However, during periods of unusually high construction cost inflation, which were observed in 2005 and early 2006, the cost of construction can rise at a rate that is much higher than the inflation that impacts the overall economy. This is a risk that should be carefully examined by Sound Transit and subjected to sensitivity analyses for various projects.

- RIGHT-OF-WAY COSTS CURRENTLY INCLUDE AN ALLOWANCE FOR RISK

According to Chapter 5 Right-of-Way Acquisition in the System Plan Development (ST3) Capital Cost Estimates Basis of Estimate document on page 34 there is 15% added to the cost development for unidentified risk. Risks are excluded from the construction costs, vehicles, and the soft costs. We suggest that the treatment of risk should be consistent across all categories of cost for this program.

- RIGHT-OF-WAY COSTS THAT EXCEED ORDINARY PROGRAM ESCALATION

Another reason to consider eliminating a fixed percentage (15%) for risk for the ROW is to recognize that the year of expenditure for the acquisition of ROW may escalate at a rate that exceeds the escalation associated with all other categories for the program. Real estate within the Sound Transit service area has been escalating at a rate that exceeds other costs that can be tracked by Engineering News-Record indices for materials and construction and other measures of inflation. Since the potential for significant variation from a fixed percentage exists, it would be better to address this potential in a risk assessment/analysis.

## E. *SUGGESTED CONTINUED WORK AHEAD*

- PERIODIC UPDATING OF THE PROGRAM COST ESTIMATES

Since this is a multi-year program, the effect of changes in construction costs, right-of-way costs, mitigation requirements, ancillary or collateral cost imposed by other jurisdictions, etc. should be periodically reviewed and the program cost estimate updated to reflect changes. We understand that the Project Controls people at Sound Transit will develop a baseline estimate.

- CONTINUE THE USE OF EXPERT REVIEW PANEL(S) AND OTHER REVIEWS

The Expert Review Panel has been mandated by the Legislature of the State of Washington and its function will end with the completion of the current task of providing a review prior to the election in the fall of 2016.

We encourage the continued pro-active use of independent outside experts by Sound Transit. Large public programs can benefit from the expertise of independent review panels and peer review. Sound Transit is encouraged to continue the use of outside experts for reality checks as the program evolves. The relatively nominal cost of such review can provide benefits worth several times the cost. Peer reviews are a good practice at about 30% of the completion of final engineering.

The largest potential benefit from value engineering occurs at about the same time. Value Engineering done after 30% has often been shown to be less effective, since the cost to implement substantial changes may outweigh the savings and also interfere with keeping the engineering work on schedule. In recent years some value engineering practitioners have been combining a constructability review with the 30% value engineering study.

The ST2 Program did utilize Detailed Constructability at about 60% of the completion of final engineering. We recommend that this practice be continued for ST3. It has been this reviewer's experience that constructability reviews at 90% have far less value than a constructability review completed around 60%. However, it is very helpful to have outline specifications available for the constructability at 60%. Cost estimate reviews can be done in conjunction with the peer reviews, value engineering workshops and constructability reviews to assist Sound Transit in getting thorough independent review of the cost estimates. We encourage the use of "blended teams" for the value engineering and constructability reviews that use Sound Transit staff, project consultants in addition to outside subject matter experts.

We understand that Sound Transit is also currently working on a risk assessment/risk analysis review of the ST3 Program.

- CLARITY OF DOCUMENTS AND COMMUNICATION

The number of documents currently being developed and/or updated can cause a situation where the definition of a specific project, project particulars (such as length, route, inclusions and exclusions) can be different between documents. Some of the projects we reviewed may not have the current description of the projects since they have been evolving during our review. It is also known that we have not reviewed the latest versions of some of the projects.

We believe that the staff at Sound Transit will need to coordinate and cross check the various work products as they continue their work to update the project information.

It may be advantageous to update the System Plan Development (ST3) Capital Cost Estimating Methodology and System Plan Development (ST3) Capital Cost Estimates Basis of Estimate documents. The update could serve to eliminate the redundancy cited in Section III of this review, and clarify the use of the terms allowances and contingency.

- SUMMARIES AND COST ESTIMATE PRESENTATION

The use of a standard code of accounts for the summarization and presentation of cost estimates is a very sound practice. The methodology's approach of using the work breakdown structure of the Federal Transportation Administration (FTA) is a sound one. The use of their accounts simplifies reporting and eliminates any excess accounting in more than one system.

## V. *PROJECT REVIEW COMMENTS*

### A. GENERAL COMMENTS ABOUT PROJECTS REVEIWED

#### 1. Summaries and Cost Estimate Presentation

Some of the projects reviewed have more than one option. Although the designators are consistent between the summary materials presented to the Sound Transit Board of Directors on Dec. 4, 2015, there are differences between the descriptions in the summaries and the backup material in some cases. This can be confusing to a reader. In some cases the options even have different locations where the project ends which can add to potential confusion. We encourage careful checking of the documents as they are assembled and revised to maintain consistent descriptions. This has added importance when some of the subsequent updates may change the route of a particular segment or location for the end of that option.

The projects selected for review used the costs in the Unit Cost Library to develop the cost estimates. The potential routes with quantities developed from the various routes have been used along with the Unit Costs to develop estimates. In our opinion Sound Transit has used good practices to develop these planning estimates.

In some cases separation into segments is clearly shown to denote where one or more option may begin or end. There should be an explanation if there are any other assumptions about segmentation that are used for parsing projects into phases or stages.

#### 2. Documents Reviewed for Each Project

Within the information for each project there will be a table. An example of this table is Review Table 1, which is shown below. All of the documents and files listed in Table 1 were reviewed in conjunction with the review of each of the ten (10) candidate projects reviewed. Each table shown with the projects will show the specific documents and files reviewed for that particular project. The first column, which is called “Status” will indicate whether or not that document was reviewed. The second column, which is called “Description” identifies the document associated with each project.

| REVIEW TABLE 1 | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Reviewed | Sound Transit 3 Board Workshop ST3 Candidate Projects: Summary Evaluation Information dated December 4, 2015 |
| Reviewed | Sound Transit 3 Board Workshop ST3 Candidate Project Details dated |

| | |
|---|---|
| | December 4, 2015 |
| Reviewed | System Plan Development (ST3) Capital Cost Estimate Methodology, dated December, 2015 |
| Reviewed | System Plan Development (ST3) Capital Cost Estimates, dated December, 2015 |
| Reviewed | Unit Cost Library, dated October 30, 2015 |

3. **Unit Costs**

The Unit Cost Library was used for the projects reviewed. The Unit Cost Library was developed specifically for the ST3 Program. The Unit Costs are typically formatted into assemblies which are used to generate the cost estimates for the various projects reviewed. The assemblies are based on assumptions for costs that are constructed into costs per running foot (RF) or square foot (SF). There is a more detailed discussion about the Unit Cost development included in this report in Section IIIC.

4. **Quantities**

The quantities developed for the various projects are based on a potential alignment. Measuring the distances along the proposed alignment yields running feet (RF), which are used in conjunction with the unit cost assemblies. As stated earlier, this method is appropriate at this stage of the project's evolution. However, it must be recognized that there may be some significant changes made in the assumed alignment based on geotechnical investigations, permitting, and other steps as the design evolves.

Right-of-Way costs are grouped together and not broken into costs for the alignment by milepost. This practice is understandable, since the disclosure of assumptions about the costs for various parcels in great detail might potentially adversely affect the negotiations for the parcels of land.

5. **Allowances and Contingencies**

Excellent use of project specific allowances has been made for utility relocation, hazardous material contaminated soil removal/mitigation, ground water treatment, environmental mitigation, and landscaping. These are contained in the body of the back-up material of the estimate. A reference to their inclusion as allowances would be a good addition to the summary for each project. The inclusion of project specific allowances in the project cost estimates is a good practice by Sound Transit. It is not common to see this level of detail identified at this early stage of any major program.

B. LIST OF PROJECTS REVIEWED

The following table shows the list of projects that we were asked to review. Some of the projects have more than one option and some projects are divided into segments. The Batch # refers to the grouping of estimates processed prior to the presentation to the Sound Transit Board of Directors on December 4, 2015.

| Review Table 2 | | |
|---|---|---|
| **No.** | **Batch #** | **Sound Transit Information** |
| 1. | | Lynnwood to Everett Light Rail (Lynnwood Transit Center to Everett Station—three options below: N-02a, N02b and N02c. |
| 1. | 2.3 | Option 1: N-02a Lynnwood Transit Center to Everett Station via Southwest Everett Industrial Center (Paine Field)—this option consists of three segments [A + B + C (not checked)] or [A+B+D].<br>SegA. Lynnwood Transit Center to 164th/Ash Way<br>SegB. 164th/Ash Way to 128th St. SW<br>SegC. 128th St. SW to Everett Station via Paine Field/Boeing via 41st St.<br>SegD. 128th St. SW to Everett Station via Paine Field/Boeing via Pacific Ave. |
| 1. | 2.4 | Option 2: N-02b Lynnwood Transit Center to Everett Station via I-5 and SR99/Evergreen Way—this option consists of three segments [A + B + C (not checked)] or [A+B+D].<br>SegA. Lynnwood Transit Center to 164th/Ash Way<br>SegB. 164th/Ash Way to 128th St. SW<br>SegC. 128th St. SW to Everett Station via I-5 and Evergreen via 41st St.<br>SegD. 128th St. SW to Everett Station via I-5 and Evergreen Way via Pacific Ave. |
| | 2.5 | Option 3: N-02c Lynnwood Transit Center to Everett Station via I-5—this option consists of three segments [A + B + C].<br>SegA. Lynnwood Transit Center to 164th/Ash Way<br>SegB. 164th/Ash Way to 128th St. SW<br>SegC. 128th St. SW to Everett Station via I-5. |
| 2. | | 145th St. & SR522 Bus Rapid Transit—two options below: N-09a Lower Cost + N10 or N-09b Higher Cost + N10 |
| 2. | 2.61 | N-09 BRT on SR523/145th to Connect to Link Station<br>N-09a Lower Cost<br>N-09b Higher Cost |
| 2. | 2.62 | N-10 BRT on SR522/Bothell Way |
| 3. | 2.12 | Totem Lake to Issaquah via Bellevue—E-03 with two segments<br>E-03-SegA Totem Lake to Wilburton Station<br>E-03-SegB Wilburton Station to Issaquah Transit Center |
| 4. | | I-405 Bus Rapid Transit—two options listed below: E-02a & E-04 & E-02b + E02c + E-04 |
| 4. | 2.31 | E-02a I-405 BRT Lower Cost: Lynnwood to SeaTac in HOV/Managed Lanes |
| 4. | 2.32 | E-02b I-405 BRT Higher Cost: Lynnwood to SeaTac in HOV/Managed Lanes |

| Review Table 2 | | |
|---|---|---|
| **No.** | **Batch #** | **Sound Transit Information** |
| 4. | 2.33 | E-04 HOV Direct Access at Renton/N 8th St. |
| 5. | | Ballard to Downtown Seattle Light Rail—four segments: C-01a2, C-01b2, C-01c2 and C-01d2 |
| 5. | 2.61 | C-01b2- Primarily elevated along Elliott and 15th Avenue with tunnel options |
| 5. | 2.73 | C-01a2 Primarily at-grade along Elliott and 15th Avenue<br>C-01c2 Primarily elevated along Elliott and 20th Avenue with tunnel options<br>C-01d2 Primarily at-grade along Westlake Avenue |
| 6. | 2.46 | C-01e Additional Potential Station in the vicinity of SR99 and Harrison Street |
| 7. | | C-03 Downtown Seattle to West Seattle Junction or White Center—three options |
| 7. | 2.75 | C-03c2 to Delridge/White Center |
| 7. | 2.67 | C-03a2 to West Seattle Junction 5th Avenue at-grade connection to Downtown Seattle Transit Tunnel |
| 7. | 2.74 | C-03b2 to West Seattle Junction 1st Avenue At-Grade option |
| 8. | 2.25 | C-08 Infill Light Rail Station: Graham St. |
| 9. | 2.26 | C-09 Infill Light Rail Station: Boeing Access Rd. |
| 10. | | Kent/Des Moines to Tacoma Dome Light Rail—three projects as listed below: S-01, S-02 and S-03 |
| 10. | 2.36 | S-01 Kent/Des Moines to Star Lake (272nd) (Federal Way Link) |
| 10. | 2.37 | S-02 Star Lake (272nd) to Federal Way Transit Center (Federal Way Link) |
| 10. | 2.18 | S-03 Federal Way Transit Center to Tacoma Dome Light Rail via I-5<br>S-03-SegA Federal Way to South Federal Way<br>S-03-SegB South Federal Way to Fife<br>S-03-SegC Fife to Tacoma Dome |

C. SPECIFIC COMMENTS ABOUT PROJECTS REVIEWED

The following pages will show the review of each of these potential projects. In some cases there have been updates to the scope and cost estimates since the presentation to the Sound Transit Board of Directors on December 4, 2015. The review has been completed on information available up to and including January 22, 2016. Where an update has been made it is noted within each of the reviews. The Batch numbers have been eliminated from this section. In each project review there is a discussion of the current status of the cost estimate.

In some cases the tables shown in this section are duplicates of what was presented to the Sound Transit Board of Directors on December 4, 2015. In other cases we have constructed summary tables that were not presented on December 4, 2015. These tables show the summary of an option with all of the relevant options and/or segments.

Review Project 1. *Lynnwood to Everett Light Rail (Lynnwood Transit Center to Everett Station—three options below: N-02a, N02b and N02c.*

Scope of the Project

There are three options for this project with each of them composed of more than one segment. As indicated by their titles each project connects the Lynnwood Transit Center to the Everett Station. A number of files were reviewed and they are listed on the Project 1 Data Table below.

| PROJECT 1 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Reviewed | Excel file: N-02abc SegA Quantity Take-Off (read only file) |
| Reviewed | Excel file: N-02abc SegA Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. |
| Reviewed | Excel file: N-02ab SegB Quantity Take-Off (read only file) |
| Reviewed | Excel file: N-02ab SegB Estimate (read only with no formula included) |
| Reviewed | Excel file: N-02a SegD Quantity Take-Off (read only file) |
| Reviewed | Excel file: N-02a SegD Estimate (read only with no formula included) |
| Reviewer Prepared | Excel files: Reviewer prepared summary file to show the component segments for all of the options developed and included in this report as follows: Table 1-1, Option 1-a; Table 1-2, Option 1-a Revised; Table 1-3, Option 1-b; Table 1-4, Option 2-a; Table 1-5, Option 2-b; Table 1-6, Option 2-c |

Specific Comments for Review of this Project

Seg A was reviewed in the greatest detail with a check of the quantities and a review of the worksheets that were used to build the total for that segment because we were furnished an Excel workbook complete with the formula showing the calculations.. Segments B and D had a less intensive review since the backup files were not received.

Option 1: N-02a Lynnwood Transit Center to Everett Station via Southwest Everett Industrial Center (Paine Field)—this option consists of three segments [A + B + C (not checked or used)] or [A+B+D (used)].

SegA. Lynnwood Transit Center to 164th/Ash Way
SegB. 164th/Ash Way to 128th St. SW
SegC. 128th St. SW to Everett Station via Paine Field/Boeing via 41st St.
SegD. 128th St. SW to Everett Station via Paine Field/Boeing via Pacific Ave.

Table RP 1a-1 and Table 1a-2 show Option 1 with cost estimates prepared at different times. The total for SegA as shown in Table 1a-1 shows the values shown to the Sound Transit Board of Directors on December 4, 2015. SegA in Table 1a-1 revised shows the costs prepared after the December 4, 2015 presentation to the Sound Transit Board of Directors. The change occurs for SegA only in these tables.

| **Review Project 1. Table RP 1-1: Option 1-a** | | | | |
|---|---|---|---|---|
| Option 1: N-02a Lynnwood Transit Center to Everett Station via Southwest Everett Industrial Center (Paine Field) | | | | |
| Option 1a | SegA | SegB | SegD | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to 164th/Ash Way LRT | 164th/Ash Way to 128th St. SW | 128th St. SW to Everett Station via Paine Field/Boeing via Pacific | Lynnwood Transit Center to Everett Station |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration | $49.73 | $29.03 | $187.66 | $266.42 |
| Prel. Engineering & Environmental Review | $25.35 | $13.33 | $93.10 | $131.78 |
| Final Design & Specifications | $49.97 | $26.62 | $184.84 | $261.43 |
| Property Acquisition & Permits | $24.02 | $58.13 | $216.16 | $298.31 |
| Construction | $509.67 | $271.50 | $1,885.36 | $2,666.53 |
| Construction Management | $44.97 | $23.96 | $166.36 | $235.29 |
| Third Parties | $10.42 | $5.32 | $37.40 | $53.14 |
| Vehicles | $164.46 | $85.07 | $544.42 | $793.95 |
| Contingency | $49.97 | $26.62 | $184.84 | $261.43 |
| **Total** | $928.56 | $539.57 | $3,500.13 | $4,968.26 |

| **Review Project 1. Table RP 1-2: Option 1-a Revised** | | | | |
|---|---|---|---|---|
| N-02a Lynnwood Transit Center to Everett Station via Southwest Everett Industrial Center (Paine Field) | | | | |
| Option 1a Revised | SegA | SegB | SegD | TOTAL |
| NOTE: Segments B and D shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors and Segment A has been revised since the Dec. 4, presentation. | Lynnwood Transit Center to 164th/Ash Way LRT | 164th/Ash Way to 128th St. SW | 128th St. SW to Everett Station via Paine Field/Boeing via Pacific | Lynnwood Transit Center to Everett Station |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $50.51 | $29.03 | $187.66 | $267.20 |
| Prel. Engineering & Environmental Review~~Prel. Engineering &~~ | $25.86 | $13.33 | $93.10 | $132.29 |

| **Review Project 1. Table RP 1-2: Option 1-a Revised** | | | | |
|---|---|---|---|---|
| N-02a Lynnwood Transit Center to Everett Station via Southwest Everett Industrial Center (Paine Field) | | | | |
| Option 1a Revised | SegA | SegB | SegD | TOTAL |
| NOTE: Segments B and D shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors and Segment A has been revised since the Dec. 4, presentation. | Lynnwood Transit Center to 164th/Ash Way LRT | 164th/Ash Way to 128th St. SW | 128th St. SW to Everett Station via Paine Field/Boeing via Pacific | Lynnwood Transit Center to Everett Station |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| ~~Environmental Review**~~ | | | | |
| Final Design & Specifications~~Final Design & Specifications~~ | $50.98 | $26.62 | $184.84 | $262.44 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $24.02 | $58.13 | $216.16 | $298.31 |
| Construction~~Construction***~~ | $520.03 | $271.50 | $1,885.36 | $2,676.89 |
| Construction Management~~Construction Management~~ | $45.89 | $23.96 | $166.36 | $236.21 |
| Third Parties~~Third Parties**~~ | $10.62 | $5.32 | $37.40 | $53.34 |
| Vehicles~~Vehicles~~ | $164.46 | $85.07 | $544.42 | $793.95 |
| Contingency~~Contingency~~ | $50.98 | $26.62 | $184.84 | $262.44 |
| **Total** | $943.36 | $539.57 | $3,500.13 | $4,983.06 |

The total for this Option 1 as shown in Table RP 1-2 is now $4,983.06 million and was $4,969 as shown in Table RP 1-1 and in the summary provided to the Sound Transit Board of Directors on December 4, 2015. We assume that the changes in SegA from $928.56 million to 943.36 million account for estimate corrections and/or changes in the scope for this option.

Option 2: N-02b Lynnwood Transit Center to Everett Station via I-5 and SR99/Evergreen Way—this option consists of three segments [A + B + C (not checked)] or [A+B+D].

SegA. Lynnwood Transit Center to 164th/Ash Way
SegB. 164th/Ash Way to 128th St. SW
SegC. 128th St. SW to Everett Station via I-5 and Evergreen via 41st St.
SegD. 128th St. SW to Everett Station via I-5 and Evergreen Way via Pacific Ave.

| Review Project 1. Table RP 1-3: Option 1-b | | | | |
|---|---|---|---|---|
| Option 1: N-02a Lynnwood Transit Center to Everett Station via Southwest Everett Industrial Center (Paine Field) | | | | |
| Option 1b | SegA | SegB | SegD | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to 164th/Ash Way LRT | 164th/Ash Way to 128th St. SW | 128th St. SW to Everett Station via SR99/Evergreen Way via 41st Street LRT | Lynnwood Transit Center to Everett Station |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $49.73 | $29.03 | $177.01 | $255.77 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $25.35 | $13.33 | $89.21 | $127.89 |
| Final Design & Specifications~~Final Design & Specifications~~ | $49.97 | $26.62 | $177.21 | $253.80 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $24.02 | $58.13 | $198.58 | $280.73 |
| Construction~~Construction***~~ | $509.67 | $271.50 | $1,807.54 | $2,588.71 |
| Construction Management~~Construction Management~~ | $44.97 | $23.96 | $159.49 | $228.42 |
| Third Parties~~Third Parties**~~ | $10.42 | $5.32 | $36.08 | $51.82 |
| Vehicles~~Vehicles~~ | $164.46 | $85.07 | $482.04 | $731.57 |
| Contingency~~Contingency~~ | $49.97 | $26.62 | $177.21 | $253.80 |
| Total | $928.56 | $539.57 | $3,304.36 | $4,772.49 |

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A table to show Option 1B revised is not included in this report. The difference between Option 1B and Option 1B revised is very small and the same amount as the difference between Option 1A and Option 1A revised, which is documented above.

| **Review Project 1. Table RP 1-4 Option 2-a** | | | | |
|---|---|---|---|---|
| N-02a Lynnwood Transit Center to Everett Station I-5 and SR99/Evergreen Way | | | | |
| Option 2a | SegA | SegB | SegC | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to 164th/Ash Way LRT | 164th/Ash Way to 128th St. SW | 128th St. SW to Everett Station via SR99/Ever-green Way via Pacific LRT | Lynnwood Transit Center to Everett Station |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $49.73 | $29.03 | $166.06 | $244.82 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $25.35 | $13.33 | $82.21 | $120.89 |
| Final Design & Specifications~~Final Design & Specifications~~ | $49.97 | $26.62 | $163.20 | $239.79 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $24.02 | $58.13 | $218.24 | $300.39 |
| Construction~~Construction***~~ | $509.67 | $271.50 | $1,664.68 | $2,445.85 |
| Construction Management~~Construction Management~~ | $44.97 | $23.96 | $146.88 | $215.81 |
| Third Parties~~Third Parties**~~ | $10.42 | $5.32 | $33.07 | $48.81 |
| Vehicles~~Vehicles~~ | $164.46 | $85.07 | $459.35 | $708.88 |
| Contingency~~Contingency~~ | $49.97 | $26.62 | $163.20 | $239.79 |
| Total | $928.56 | $539.57 | $3,096.89 | $4,565.02 |

| Review Project 1. Table RP 1-5 Option 2-b | | | | |
|---|---|---|---|---|
| N-02a Lynnwood Transit Center to Everett Station I-5 and SR99/Evergreen Way | | | | |
| Option 2b | SegA | SegB | SegC | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to 164th/Ash Way LRT | 164th/Ash Way to 128th St. SW | 128th St. SW to Everett Station via SR99/Ever-green Way via 41st Street LRT | Lynnwood Transit Center to Everett Station |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $49.73 | $29.03 | $149.97 | $228.73 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $25.35 | $13.33 | $74.86 | $113.54 |
| Final Design & Specifications~~Final Design & Specifications~~ | $49.97 | $26.62 | $148.66 | $225.25 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $24.02 | $58.13 | $198.63 | $280.78 |
| Construction~~Construction***~~ | $509.67 | $271.50 | $1,516.38 | $2,297.55 |
| Construction Management~~Construction Management~~ | $44.97 | $23.96 | $133.80 | $202.73 |
| Third Parties~~Third Parties**~~ | $10.42 | $5.32 | $30.16 | $45.90 |
| Vehicles~~Vehicles~~ | $164.46 | $85.07 | $396.97 | $646.50 |
| Contingency~~Contingency~~ | $49.97 | $26.62 | $148.66 | $225.25 |
| Total | $928.56 | $539.57 | $2,798.10 | $4,266.23 |

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Option 3: N-02c Lynnwood Transit Center to Everett Station via I-5—this option consists of three segments [A + B + C].

SegA. Lynnwood Transit Center to 164th/Ash Way

SegB. 164th/Ash Way to 128th St. SW

SegC. 128th St. SW to Everett Station via I-5.

| Review Project 1. Table RP 1-6 Option 2-c | | | | |
|---|---|---|---|---|
| N-02a Lynnwood Transit Center to Everett Station I-5 and SR99/Evergreen Way | | | | |
| Option 2c | SegA | SegB | SegC | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to 164th/Ash Way LRT | 164th/Ash Way to 128th St. SW | 128th St. SW to Everett Station via SR99/Evergreen Way via 41st Street LRT | Lynnwood Transit Center to Everett Station |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $49.73 | $20.19 | $96.58 | $166.50 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $25.35 | $7.25 | $49.42 | $82.02 |
| Final Design & Specifications~~Final Design & Specifications~~ | $49.97 | $14.47 | $98.27 | $162.71 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $24.02 | $66.28 | $79.05 | $169.35 |
| Construction~~Construction***~~ | $509.67 | $147.64 | $1,002.34 | $1,659.65 |
| Construction Management~~Construction Management~~ | $44.97 | $13.02 | $88.44 | $146.43 |
| Third Parties~~Third Parties**~~ | $10.42 | $2.89 | $19.87 | $33.18 |
| Vehicles~~Vehicles~~ | $164.46 | $85.07 | $272.21 | $521.74 |
| Contingency~~Contingency~~ | $49.97 | $14.47 | $98.27 | $162.71 |
| Total | $928.56 | $371.27 | $1,804.44 | $3,104.27 |

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Review Project 2. *145th St. & SR522 Bus Rapid Transit—two options below: N-09a Lower Cost + N10 or N-09b Higher Cost + N10*

Option 1: N-09a BRT on SR523/145th to Connect to Link Station N-09a Lower Cost and N-10 BRT on SR522/Bothell Way

Option 2: N-09b BRT on SR523/145th to Connect to Link Station N-09a Higher Cost and N-10 BRT on SR522/Bothell Way

Scope of the Project

The two options for this project have a consistent component labeled N-10 BRT on SR522/Bothell Way. The difference is the component N-09 which has a lower cost option known as N-09a and a higher cost option known as N-09b.

| PROJECT 2 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Reviewed | Excel file: N-09a Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. |
| Reviewed | Excel file: N-09b Estimate without formulas (read only file) |
| Reviewed | Excel file: N-09b Quantity Take-Off (read only file) |
| Reviewed | Excel file: N-10 Estimate without formulas (read only file) |
| Reviewed | Excel file: N-10 Quantity Take-Off (read only file) |
| Reviewer Prepared | Excel files: Reviewer prepared summary file to show the component segments for the two options developed and included in this report as follows: Table 2-1, N-09a BRT on SR523 (Lower Cost) and N-10 BRT on SR 522 and Table 2-2, Option 2: N-09a BRT on SR523 (Higher Cost) and N-10 BRT on SR 522 |

Specific Comments for Review of this Project

Option N-09a and N-10 combined show a cost of $385 million (rounded) and N-09b and N-10 combined show a cost of $456 million (rounded) for a difference of $71 million (rounded).

| Review Project 2. Table RP 2-1 Option 1 (Lower Cost) | | | |
|---|---|---|---|
| Option 1: N-09a BRT on SR523 (Lower Cost) and N-10 BRT on SR 522 | | | |
| Option 1 | N-09a | N-10 | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | BRT on SR523/145th to Connect with Link Station (Lower Cost) | BRT on SR522 to the Vicinity of UW Bothell | 145th St & SR522 Bus Rapid Transit |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $4.03 | $16.58 | $20.61 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $1.95 | $9.56 | $11.51 |
| Final Design & Specifications~~Final Design & Specifications~~ | $3.33 | $17.59 | $20.92 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $18.36 | $37.05 | $55.41 |
| Construction~~Construction***~~ | $33.94 | $179.44 | $213.38 |
| Construction Management~~Construction Management~~ | $2.99 | $15.83 | $18.82 |
| Third Parties~~Third Parties**~~ | $1.09 | $4.16 | $5.25 |
| Vehicles~~Vehicles~~ | $5.47 | $12.77 | $18.24 |
| Contingency~~Contingency~~ | $3.33 | $17.59 | $20.92 |
| Total | $74.50 | $310.57 | $385.07 |

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| Review Project 2. Table RP 2-2 Option 2 (Higher Cost) | | | |
|---|---|---|---|
| Option 2: N-09a BRT on SR523 (Higher Cost) and N-10 BRT on SR 522 | | | |
| Option 2 | N-09b | N-10 | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | BRT on SR523/145th to Connect with Link Station (Higher Cost) | BRT on SR522 to the Vicinity of UW Bothell | 145th St & SR522 Bus Rapid Transit |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $7.31 | $16.58 | $23.89 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $3.29 | $9.56 | $12.85 |
| Final Design & Specifications~~Final Design & Specifications~~ | $5.84 | $17.59 | $23.43 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $40.76 | $37.05 | $77.81 |
| Construction~~Construction***~~ | $59.57 | $179.44 | $239.01 |
| Construction Management~~Construction Management~~ | $5.26 | $15.83 | $21.09 |
| Third Parties~~Third Parties**~~ | $1.60 | $4.16 | $5.76 |
| Vehicles~~Vehicles~~ | $5.47 | $12.77 | $18.24 |
| Contingency~~Contingency~~ | $5.84 | $17.59 | $23.43 |
| Total | $134.93 | $310.57 | $445.51 |

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Review Project 3. *Totem Lake to Issaquah via Bellevue—E-03 with two segments*
E-03-SegA Totem Lake to Wilburton Station
E-03-SegB Wilburton Station to Issaquah Transit Center

Scope of the Project

Review Project 3 consists of two segments. The second and third columns in Table RP 3-1 show the segments from Totem Lake to Bellevue and from Bellevue to Issaquah.

| PROJECT 3 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Reviewed | Excel file: E-03 Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. |
| Reviewed | Excel file: E-03 Quantity Take-Off (read only file) |
| Reviewer | Excel files: Reviewer prepared summary file to show the two component |

| PROJECT 3 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Prepared | segments for this project. Column 4 shows the sum of the two segments in columns 2 and 3. The last column on the right shows the costs in the December 4, 2015 Report to the Sound Transit Board of Directors. |

Specific Comments for Review of this Project

The fourth column shows the summary of the two segments. The fifth column shows the published values for the entire project. We do not know why the sum of the segments does not equal the published values for the entire project.

| Review Project 3. Table RP 3-1 | | | | |
|---|---|---|---|---|
| E-3: Kirkland/Totem Lake to Issaquah via Bellevue LRT | | | | |
| | E-03SegA | E-03SegB | E-03 | E-03 |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Totem Lake to Wilburton Station LRT | Bellevue Wilburton station to Central Issaquah LRT | Kirkland/Totem Lake to Issaquah via Bellevue LRT (Sum of Segments) | Kirkland/Totem Lake to Issaquah via Bellevue LRT Published Summary |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $77.15 | $120.17 | $197.32 | $179.76 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $43.04 | $70.32 | $113.36 | $102.14 |
| Final Design & Specifications~~Final Design & Specifications~~ | $85.19 | $139.74 | $224.93 | $202.76 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $126.54 | $145.12 | $271.66 | $268.83 |
| Construction~~Construction***~~ | $868.92 | $1,425.39 | $2,294.31 | $2,068.14 |
| Construction Management~~Construction Management~~ | $76.67 | $125.77 | $202.44 | $182.48 |
| Third Parties~~Third Parties**~~ | $17.47 | $28.38 | $45.85 | $41.19 |
| Vehicles~~Vehicles~~ | $68.05 | $68.05 | $136.10 | $130.43 |
| Contingency~~Contingency~~ | $85.19 | $139.74 | $224.93 | $202.76 |

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| Review Project 3. Table RP 3-1 | | | | |
|---|---|---|---|---|
| E-3: Kirkland/Totem Lake to Issaquah via Bellevue LRT | | | | |
| | E-03SegA | E-03SegB | E-03 | E-03 |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Totem Lake to Wilburton Station LRT | Bellevue Wilburton station to Central Issaquah LRT | Kirkland/Totem Lake to Issaquah via Bellevue LRT (Sum of Segments) | Kirkland/Totem Lake to Issaquah via Bellevue LRT Published Summary |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Total | $1,448.22 | $2,262.68 | $3,710.90 | $3,378.50 |

Review Project 4. *I-405 Bus Rapid Transit—two options listed below: E-02a & E-04 & E-02b + E02c + E-04*

Option 1: E-02a I-405 BRT Lower Cost: Lynnwood to SeaTac in HOV/Managed Lanes + E-04 HOV Direct Access at Renton/N 8th St.

Option 2: E-02b I-405 BRT Lower Cost: Lynnwood to Burien in HOV/Managed Lanes + E-04 HOV Direct Access at Renton/N 8th St.

Option 3: E-02a I-405 BRT Intensive Cost: Lynnwood to SeaTac in HOV/Managed Lanes + E-04 HOV Direct Access at Renton/N 8th St.

Option 4: E-02b I-405 BRT Intensive Cost: Lynnwood to Burien in HOV/Managed Lanes + E-02c Inline Station and managed lanes in Kirkland + E-04 HOV Direct Access at Renton/N 8th St.

Scope of the Project

Review Project 3 consists of two options with a lower cost for E-02a and E-02b and two options for E-02a and E-02b with intensive costs. These four options have a consistent project E-04 added to the four option totals. There are also four segments in each of the E-02 options.

| PROJECT 4 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| No details reviewed | We did not receive back-up files for this project. There was no detail analysis provided. Only the summary tables were prepared. |
| Reviewer Prepared | Excel files: Reviewer prepared summary files to show the two options (lower cost and intensive cost) for each of two destinations. There are also two different locations in SeaTac. This makes a combination of 4 tables which are presented below. |

Specific Comments for Review of this Project

There are significant cost differences in the four options, as shown below:

Option 1: Lower Cost E-02a Lynnwood to SeaTac with E-04 = $347 million (rounded)
Option 2: Lower Cost E-02b Lynnwood to Burien with E-04 = $340 million (rounded)
Option 3: Intensive Cost E-02a Lynnwood to SeaTac with E-04 = $2,098 million (rounded)
Option 4: Intensive Cost E-02a Lynnwood to Burien with E-04 = $2,325 million (rounded)

The reviewer is not sure whether or not it is the intent of the planners to use E-02c1 and E-02c2 collectively or as separate options.

| **Review Project 4. Table RP 4-1** | | | | | | |
|---|---|---|---|---|---|---|
| I-405 Bus Rapid Transit | | | | | | |
| Option 1 to SeaTac with Lower Capital Cost | E-02aSegA Lower Capital | E-02aSegB Lower Capital | E-02aSegC Lower Capital | E-02aSegD1 Lower Capital | E-04 | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to Bellevue Transit Center | Bellevue Transit Center to Renton (N8th) | Renton to Tukwila | Tukwila to SeaTac BRT | HOV Direct Access at Renton / N8th Street | Lynnwood to SeaTac Bus Rapid Transit |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $6.84 | $4.24 | $1.15 | $1.20 | $5.52 | $18.95 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $3.52 | $1.84 | $0.34 | $0.63 | $3.55 | $9.88 |
| Final Design & Specifications~~Final Design & Specifications~~ | $5.83 | $3.65 | $0.52 | $0.56 | $7.10 | $17.66 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $5.18 | $9.15 | $0.53 | $0.53 | $1.23 | $16.62 |
| Construction~~Construction***~~ | $59.43 | $37.22 | $3.41 | $3.65 | $72.39 | $176.10 |
| Construction Management~~Construction Management~~ | $5.24 | $3.28 | $0.47 | $0.50 | $6.39 | $15.88 |
| Third Parties~~Third Parties**~~ | $2.02 | $0.94 | $0.28 | $0.29 | $1.42 | $4.95 |
| Vehicles~~Vehicles~~ | $32.84 | $14.59 | $10.95 | $10.95 | $0.00 | $69.33 |

| | | | | | | |
|---|---|---|---|---|---|---|
| ContingencyContingency | $5.83 | $3.65 | $0.33 | $0.36 | $7.10 | $17.27 |
| Total | $126.72 | $78.57 | $17.97 | $18.65 | $104.70 | $346.64 |

| Review Project 4. Table RP 4-2 | | | | | | |
|---|---|---|---|---|---|---|
| I-405 Bus Rapid Transit | | | | | | |
| Option 2 to Burien with Lower Capital Cost | E-02aSegA Lower Capital | E-02aSegB Lower Capital | E-02aSegC Lower Capital | E-02aSegD2 Lower Capital | E-04 | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to Bellevue Transit Center | Bellevue Transit Center to Renton (N8th) | Renton to Tukwila | Tukwila to Burien BRT | HOV Direct Access at Renton / N8th Street | Lynnwood to Burien Bus Rapid Transit |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency AdministrationAgency Administration | $6.84 | $4.24 | $1.15 | $0.76 | $5.52 | $18.51 |
| Prel. Engineering & Environmental ReviewPrel. Engineering & Environmental Review** | $3.52 | $1.84 | $0.34 | $0.22 | $3.55 | $9.47 |
| Final Design & SpecificationsFinal Design & Specifications | $5.83 | $3.65 | $0.52 | $0.33 | $7.10 | $17.43 |
| Property Acquisition & PermitsProperty Acquisition & Permits | $5.18 | $9.15 | $0.53 | $0.35 | $1.23 | $16.44 |
| ConstructionConstruction*** | $59.43 | $37.22 | $3.41 | $2.12 | $72.39 | $174.57 |
| Construction ManagementConstruction Management | $5.24 | $3.28 | $0.47 | $0.30 | $6.39 | $15.68 |
| Third PartiesThird Parties** | $2.02 | $0.94 | $0.28 | $0.26 | $1.42 | $4.92 |

| | | | | | | |
|---|---|---|---|---|---|---|
| VehiclesVehicles | $32.84 | $14.59 | $10.95 | $7.30 | $0.00 | $65.68 |
| ContingencyContingency | $5.83 | $3.65 | $0.33 | $0.21 | $7.10 | $17.12 |
| Total | $126.72 | $78.57 | $17.97 | $11.84 | $104.70 | $339.82 |

| Review Project 4. Table RP 4-3 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| I-405 Bus Rapid Transit | | | | | | | | |
| Option 3 to SeaTac with Intensive Capital Cost | E-02bSegA Intensive Capital | E-02bSegB Intensive Capital | E-02bSegC Intensive Capital | E-02bSegD1 Intensive Capital | E-02c1 Intensive Capital | E-02c2 Intensive Capital | E-04 | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to Bellevue Transit Center | Bellevue Transit Center to Renton (N8th) | Renton to Tukwila | Tukwila to SeaTac BRT | Kirkland-NE 85th St. BRT Inline Station | Kirkland-NE 85th St. Bus Only Lanes | HOV Direct Access at Renton / N8th Street | Lynnwood to SeaTac Bus Rapid Transit |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $34.98 | $18.72 | $31.33 | $1.20 | $13.73 | $5.58 | $5.52 | $111.06 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $21.65 | $10.93 | $17.11 | $0.63 | $8.94 | $3.14 | $3.55 | $65.95 |
| Final Design & Specifications~~Final Design & Specifications~~ | $41.94 | $21.12 | $33.50 | $0.56 | $17.84 | $6.27 | $7.10 | $128.33 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $13.70 | $26.21 | $74.55 | $0.53 | $0.56 | $12.78 | $1.23 | $129.56 |
| Construction~~Construction***~~ | $438.48 | $215.41 | $341.67 | $3.65 | $181.93 | $63.99 | $72.39 | $1,317.52 |
| Construction Management~~Construction Management~~ | $37.75 | $19.01 | $30.15 | $0.50 | $16.05 | $5.65 | $6.39 | $115.50 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Third Parties~~Third Parties**~~ | $9.24 | $4.65 | $6.91 | $0.29 | $3.57 | $1.25 | $1.42 | $27.33 |
| Vehicles~~Vehicles~~ | $31.01 | $14.59 | $18.24 | $10.95 | $0.00 | $0.00 | $0.00 | $74.79 |
| Contingency~~Contingency~~ | $41.94 | $21.12 | $33.50 | $0.36 | $17.84 | $6.27 | $7.10 | $128.13 |
| Total | $670.69 | $351.76 | $586.96 | $18.65 | $260.45 | $104.94 | $104.70 | $2,098.17 |

| **Review Project 4. Table RP 4-4** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| I-405 Bus Rapid Transit | | | | | | | | |
| Option 4 to Burien with Intensive Capital Cost | E-02bSegA Intensive Capital | E-02bSegB Intensive Capital | E-02bSegC Intensive Capital | E-02bSegD2 Intensive Capital | E-02c1 Intensive Capital | E-02c2 Intensive Capital | E-04 | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Lynnwood Transit Center to Bellevue Transit Center | Bellevue Transit Center to Renton (N8th) | Renton to Tukwila | Tukwila to Burien BRT | Kirkland-NE 85th St. BRT Inline Station | Kirkland-NE 85th St. Bus Only Lanes | HOV Direct Access at Renton / N8th Street | Lynnwood to Burien Bus Rapid Transit |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $34.98 | $18.72 | $31.33 | $13.15 | $13.73 | $5.58 | $5.52 | $123.01 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $21.65 | $10.93 | $17.11 | $6.76 | $8.94 | $3.14 | $3.55 | $72.08 |
| Final Design & Specifications~~Final Design & Specifications~~ | $41.94 | $21.12 | $33.50 | $13.48 | $17.84 | $6.27 | $7.10 | $141.25 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $13.70 | $26.21 | $74.55 | $39.09 | $0.56 | $12.78 | $1.23 | $168.12 |
| Construction~~Construction***~~ | $438.48 | $215.41 | $341.67 | $137.50 | $181.93 | $63.99 | $72.39 | $1,451.37 |
| Construction | $37.75 | $19.01 | $30.15 | $12.13 | $16.05 | $5.65 | $6.39 | $127.13 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Management~~Construction Management~~ | | | | | | | | |
| Third Parties~~Third Parties**~~ | $9.24 | $4.65 | $6.91 | $2.91 | $3.57 | $1.25 | $1.42 | $29.95 |
| Vehicles~~Vehicles~~ | $31.01 | $14.59 | $18.24 | $7.30 | $0.00 | $0.00 | $0.00 | $71.14 |
| Contingency~~Contingency~~ | $41.94 | $21.12 | $33.50 | $13.48 | $17.84 | $6.27 | $7.10 | $141.25 |
| Total | $670.69 | $351.76 | $586.96 | $245.79 | $260.45 | $104.94 | $104.70 | $2,325.30 |

Review Project 5. *Ballard to Downtown Seattle Light Rail—four options: C-01a2, C-01b2, C-01c2 and C-01d2*

Option 1: C-01a2 Primarily at-grade along Elliott and 15th Avenue
Option 2: C-01b2 Primarily elevated along Elliott and 15th Ave. with tunnel options
Option 3: C-01c2 Primarily elevated along Elliott and 20th Avenue with tunnel options
Option 4: C-01d2 Primarily at-grade along Westlake Avenue

Scope of the Project

Table 5-1 shows the estimate for Option 1. Table 5-2 shows two columns of estimates component costs for Option 2 with one column showing the December 4, 2015 estimate and the other column showing an estimate updated since the December 4 presentation to the Board of Directors. Tables 5-3 and 5-4 show the Options 3 and 4.

| PROJECT 5 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Reviewed | Excel file: C-01a Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: C-01a Quantity Take-Off (read only file) |
| Reviewed | Excel file: C-01b Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: C-01b Quantity Take-Off (read only file) |
| Reviewed | Excel file: C-01c Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: C-01c Quantity Take-Off (read only file) |
| Reviewed | Excel file: C-01d Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: C-01d Quantity Take-Off (read only file) |
| Reviewer Prepared | Excel files: Reviewer prepared summary file to show the two component segments for this project. Column 4 shows the sum of the two segments in columns 2 and 3. The last column on the right shows the costs in the December 4, 2015 Report to the Sound Transit Board of Directors. |

Specific Comments for Review of this Project

Option 1: C-01a2 Primarily at-grade along Elliott and 15th Avenue = $1,955 (rounded)
Option 2: C-01b2 Primarily elevated along Elliott and 15th Ave. with tunnel options see below)
Option 3: C-01c2 Primarily elevated along Elliott and 20th Avenue with tunnel options = $5,307 (rounded)
Option 4: C-01d2 Primarily at-grade along Westlake Avenue = $1,846 (rounded)

Option C-01b shows a total of $4,699 million (rounded) and C-01b2, which is the revised estimate shows a total of $4,499 million (rounded), which is a difference of $200 million (rounded).

| **Review Project 5. Table RP 5-1** | |
|---|---|
| Ballard to Downtown Seattle Light Rail | |
| Option 1 | C-01a |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | 15th At-Grade through Downtown |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $104.90 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $51.76 |
| Final Design & Specifications~~Final Design & Specifications~~ | $101.99 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $322.80 |
| Construction~~Construction***~~ | $1,040.33 |
| Construction Management~~Construction Management~~ | $91.79 |
| Third Parties~~Third Parties**~~ | $20.61 |
| Vehicles~~Vehicles~~ | $119.09 |
| Contingency~~Contingency~~ | $101.99 |
| Total | $1,955.28 |

| **Review Project 5. Table RP 5-2** | | |
|---|---|---|
| Ballard to Downtown Seattle Light Rail | | |
| Option 2 | C-02b | C-02b2 Revised |
| NOTE: All segments shown in this table are in the next column are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | 15th Elevated / Tunnel through Downtown | 15th Elevated / Tunnel through Downtown |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $250.33 | $239.78 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $138.97 | $132.10 |
| Final Design & Specifications~~Final Design & Specifications~~ | $276.42 | $262.69 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $445.79 | $445.79 |
| Construction~~Construction***~~ | $2,819.53 | $2,679.39 |
| Construction Management~~Construction Management~~ | $248.78 | $236.42 |
| Third Parties~~Third Parties**~~ | $55.50 | $52.75 |
| Vehicles~~Vehicles~~ | $187.14 | $187.14 |
| Contingency~~Contingency~~ | $276.42 | $262.69 |
| Total | $4,698.90 | $4,498.74 |

| **Review Project 5. Table RP 5-3** | |
|---|---|
| Ballard to Downtown Seattle Light Rail | |
| Option 3 | C-01c |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Interbay West / Tunnel through Downtown |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $282.03 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $162.85 |
| Final Design & Specifications~~Final Design & Specifications~~ | $324.17 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $351.75 |
| Construction~~Construction***~~ | $3,306.52 |
| Construction Management~~Construction Management~~ | $291.75 |
| Third Parties~~Third Parties**~~ | $65.05 |
| Vehicles~~Vehicles~~ | $198.48 |
| Contingency~~Contingency~~ | $324.17 |
| Total | $5,306.77 |

| **Review Project 5. Table RP 5-4** | |
|---|---|
| Ballard to Downtown Seattle Light Rail | |
| Option 4 | C-01d |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Westlake At-Grade / At-Grade through Downtown |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $98.21 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $56.62 |
| Final Design & Specifications~~Final Design & Specifications~~ | $111.25 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $81.19 |
| Construction~~Construction***~~ | $1,134.71 |
| Construction Management~~Construction Management~~ | $100.12 |
| Third Parties~~Third Parties**~~ | $22.46 |
| Vehicles~~Vehicles~~ | $130.43 |
| Contingency~~Contingency~~ | $111.25 |
| Total | $1,846.24 |

Review Project 6. *C-01e Additional Potential Station in the vicinity of SR99 and Harrison Street*

Scope of the Project

This potential project would add a Light Rail Station in the vicinity of SR99 and Harrison St.

| PROJECT 6 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| REVIEWED | Excel file: C-01a Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewer Prepared | Excel files: Reviewer prepared summary file to show this project. The estimate for light rail stations are the most conceptual features in this program. |

Formatted Table

| Review Project 6. Table RP 6-1 | |
|---|---|
| Ballard to Downtown Seattle Light Rail | |
| | C-01e |
| NOTE: The segment shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Additional Potential Light Rail Station in the vicinity of SR99 and Harrison St. |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $21.03 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $10.58 |
| Final Design & Specifications~~Final Design & Specifications~~ | $21.13 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $74.33 |
| Construction~~Construction***~~ | $215.53 |
| Construction Management~~Construction Management~~ | $19.02 |
| Third Parties~~Third Parties**~~ | $4.23 |
| Vehicles~~Vehicles~~ | $5.67 |
| Contingency~~Contingency~~ | $21.13 |
| Total | $392.65 |

Review Project 7. Option 1: *C-03 Downtown Seattle to West Seattle Junction or White Center—three options*
Option 1: C-03a2 Downtown Seattle to West Seattle/Junction LRT, Elevated
Option 2: C-03b2 Downtown Seattle to West Seattle/Junction LRT, At-Grade
Option 3: C-03c2 Downtown Seattle to White Center via Delridge Way SW

Scope of the Project

There are three options for this project with two of the options ending at the West Seattle/Junction with one at-grade and one elevated. The third option ends at White Center via Delridge Way SW.

| PROJECT 7 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Reviewed | Excel file: C-03a2 Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |

| PROJECT 7 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Reviewed | Excel file: C-03a2 Quantity Take-Off (read only file) This file has worksheets that show five (5) segments for the elevated option along with another worksheet with guidelines about preparing a quantity take-off for the elevated sections. |
| Reviewed | Excel file: C-03b Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: C-03b Quantity Take-Off (read only file) This file has worksheets that show four (4) segments for the option along with another worksheet with guidelines about preparing a quantity take-off for the elevated sections. |
| Reviewed | Excel file: C-03c Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: C-03b Quantity Take-Off (read only file) This file has worksheets that show five (5) segments for the option along with another worksheet with guidelines about preparing a quantity take-off for the elevated sections. |
| Reviewer Prepared | Excel files: Reviewer prepared summary file to show the two component segments for this project. Column 4 shows the sum of the two segments in columns 2 and 3. The last column on the right shows the costs in the December 4, 2015 Report to the Sound Transit Board of Directors. |

Specific Comments for Review of this Project

Option 1: C-03a2 Downtown Seattle to West Seattle/Junction LRT, Elevated = $1,862 (rounded)
Option 2: C-03b2 Downtown Seattle to West Seattle/Junction LRT, At-Grade = $1,928 (rounded)
Option 3: C-03c2 Downtown Seattle to White Center via Delridge Way SW = $2,047 (rounded)

| **Review Project 7. Table RP 7-1** | |
|---|---|
| West Seattle to Downtown Seattle Light Rail | |
| Option 1 | C-03a |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Tunnel through Downtown Seattle Elevated to West Seattle Junction |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $99.57 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $52.09 |
| Final Design & Specifications~~Final Design & Specifications~~ | $103.13 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $225.22 |
| Construction~~Construction***~~ | $1,051.97 |
| Construction Management~~Construction Management~~ | $92.82 |
| Third Parties~~Third Parties**~~ | $20.84 |

| Review Project 7. Table RP 7-1 | |
|---|---|
| West Seattle to Downtown Seattle Light Rail | |
| Option 1 | C-03a |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Tunnel through Downtown Seattle Elevated to West Seattle Junction |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Vehicles~~Vehicles~~ | $113.42 |
| Contingency~~Contingency~~ | $103.13 |
| Total | $1,862.21 |

| Review Project 7. Table RP 7-2 | |
|---|---|
| West Seattle to Downtown Seattle Light Rail | |
| Option 2 | C-03b |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Tunnel through Downtown Seattle Elevated to West Seattle Junction |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $103.04 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $54.35 |
| Final Design & Specifications~~Final Design & Specifications~~ | $107.65 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $225.22 |
| Construction~~Construction***~~ | $1,098.06 |
| Construction Management~~Construction Management~~ | $96.89 |
| Third Parties~~Third Parties**~~ | $21.74 |
| Vehicles~~Vehicles~~ | $113.42 |
| Contingency~~Contingency~~ | $107.65 |
| Total | $1,928.03 |

| Review Project 7. Table RP 7-3 | |
|---|---|
| West Seattle to Downtown Seattle Light Rail | |
| Option 3 | C-03c |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Tunnel through Downtown Seattle Elevated to Delridge / At-Grade to White Center |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $109.89 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $53.14 |
| Final Design & Specifications~~Final Design & Specifications~~ | $105.24 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $296.65 |
| Construction~~Construction***~~ | $1,073.42 |
| Construction Management~~Construction Management~~ | $94.71 |

| Review Project 7. Table RP 7-3 | |
|---|---|
| West Seattle to Downtown Seattle Light Rail | |
| Option 3 | C-03c |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Tunnel through Downtown Seattle Elevated to Delridge / At-Grade to White Center |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Third Parties~~Third Parties**~~ | $21.26 |
| Vehicles~~Vehicles~~ | $187.14 |
| Contingency~~Contingency~~ | $105.24 |
| Total | $2,046.69 |

Review Project 8. *C-08 Infill Light Rail Station: Graham St.*

Scope of the Project

This project would add an Infill Light Rail Station at Graham St.

| PROJECT 8 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| REVIEWED | Excel file: C-08 Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewer Prepared | Excel files: Reviewer prepared summary file to show this project. The estimate for light rail stations are the most conceptual features in this program. |

| Review Project 8. Table RP 8-1 | |
|---|---|
| Infill Light Rail Station: Graham Street | |
| | C-08 |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Infill Light Rail Station: Graham Street |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $3.81 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $1.64 |
| Final Design & Specifications~~Final Design & Specifications~~ | $3.25 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $15.97 |
| Construction~~Construction***~~ | $33.18 |
| Construction Management~~Construction Management~~ | $2.93 |
| Third Parties~~Third Parties**~~ | $0.86 |
| Vehicles~~Vehicles~~ | $5.67 |
| Contingency~~Contingency~~ | $3.25 |
| Total | $70.57 |

Review Project 9. *C-09 Infill Light Rail Station: Boeing Access Rd.*

Scope of the Project

This project would add an Infill Light Rail Station at Boeing Access Road.

| PROJECT DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| REVIEWED | Excel file: C-09 Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewer Prepared | Excel files: Reviewer prepared summary file to show this project. The estimate for light rail stations are the most conceptual features in this program. |

| **Review Project 9. Table RP 9-1** | |
|---|---|
| Infill Light Rail Station: Boeing Access Road | |
| | C-09 |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Infill Light Rail Station: Boeing Access Road |
| **Cost (Millions 2014)** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $7.07 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $3.97 |
| Final Design & Specifications~~Final Design & Specifications~~ | $7.90 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $6.91 |
| Construction~~Construction***~~ | $80.61 |
| Construction Management~~Construction Management~~ | $7.11 |
| Third Parties~~Third Parties**~~ | $1.79 |
| Vehicles~~Vehicles~~ | $5.67 |
| Contingency~~Contingency~~ | $7.90 |
| Total | $128.95 |

Review Project 10. *Kent/Des Moines to Tacoma Dome Light Rail—three projects combined into two options as listed below: S-01, S-02 and S-03 and S-01, S-02 and S-04*

Option 1: Kent/Des Moines to the Tacoma Dome via I-5
- S-01 Kent/Des Moines to Star Lake (272nd) (Federal Way Link)
- S-02 Star Lake (272nd) to Federal Way (Federal Way Link)
- S-03 Federal Way Transit Center to Tacoma Dome Light Rail via I-5
  - S-03-SegA Federal Way to South Federal Way
  - S-03-SegB South Federal Way to Fife
  - S-03-SegC Fife to Tacoma Dome

Option 2: Kent/Des Moines to the Tacoma Dome via SR99
- S-01 Kent/Des Moines to Star Lake (272nd) (Federal Way Link)

S-02 Star Lake (272nd) to Federal Way (Federal Way Link)
S-04 Federal Way Transit Center to Tacoma Dome Light Rail via SR99
S-04-SegA Federal Way to South Federal Way
S-04-SegB South Federal Way to Fife
S-04-SegC Fife to Tacoma Dome

Scope of the Project

There are two options for this project. One project combines S-01, S-02 with S-03, which has three segments and uses space in the I-5 corridor between the Federal Way Transit Center and the Tacoma Dome. The other project combines S-01, S-02 with S-04, which has three segments and uses space in the vicinity of SR99 between the Federal Way Transit Center and the Tacoma Dome.

| PROJECT 10 DATA TABLE | |
|---|---|
| **STATUS** | **DESCRIPTION** |
| Reviewed | Excel file: S-01 Estimate with three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: S-02 Estimate with three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: C-03SegA Estimate with three worksheets that were reviewed including quantities, cost development and the summary. (read only file) |
| Reviewed | Excel file: C-03SegA Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. |
| Reviewed | Excel file: C-03SegA Quantity Take-Off (read only file) |
| Reviewed | Excel file: C-03SegB Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. |
| Reviewed | Excel file: C-03SegB Quantity Take-Off (read only file) |
| Reviewed | Excel file: C-03SegC Estimate with formulas and three worksheets that were reviewed including quantities, cost development and the summary. |
| Reviewed | Excel file: C-03SegC Quantity Take-Off (read only file) |
| Reviewer Prepared | Excel files: Reviewer prepared summary file to show the two options for this project. The last column on the right shows the costs in the December 4, 2015 Report to the Sound Transit Board of Directors. |

Specific Comments for Review of this Project

Option 1: Kent/Des Moines to the Tacoma Dome via I-5 = $3,720 million (rounded)
Option 2: Kent/Des Moines to the Tacoma Dome via SR99 = $4,176 million (rounded)

This is a difference of $456 million (rounded) between the two options.

| Review Project 10. Table RP 10-1 | | | | | | |
|---|---|---|---|---|---|---|
| Kent-Des Moines to Tacoma Dome Light Rail | | | | | | |
| Option 1: Via I-5 | S-01 | S-02 | S-03SegA | S-03SegB | S-03SegC | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Kent/Des Moines to Star Lake (272nd) (Federal Way Link) | Star Lake (272nd) to Federal Way (Federal Way Link) | Federal Way Transit Center to South Federal Way LRT via I-5 | South Federal Way to Fife LRT | Fife to Tacoma Dome LRT via I-5 | Kent-Des Moines to Tacoma Dome LRT via I-5 |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $28.59 | $31.00 | $27.44 | $43.87 | $66.10 | $197.00 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $16.36 | $15.61 | $16.16 | $24.46 | $37.29 | $109.88 |
| Final Design & Specifications~~Final Design & Specifications~~ | $40.59 | $38.46 | $31.90 | $48.51 | $74.01 | $233.47 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $15.84 | $64.52 | $8.87 | $36.04 | $68.76 | $194.03 |
| Construction~~Construction***~~ | $326.36 | $311.20 | $325.37 | $494.78 | $754.88 | $2,212.59 |
| Construction Management~~Construction Management~~ | $27.78 | $26.54 | $28.71 | $43.66 | $66.61 | $193.30 |
| Third Parties~~Third Parties**~~ | $9.92 | $9.16 | $6.59 | $9.92 | $15.02 | $50.61 |
| Vehicles~~Vehicles~~ | $39.70 | $51.04 | $39.70 | $73.72 | $85.07 | $289.23 |
| Contingency~~Contingency~~ | $43.77 | $41.40 | $31.90 | $48.51 | $74.01 | $239.59 |
| Total | $548.91 | $588.93 | $516.64 | $823.46 | $1,241.75 | $3,719.70 |

| Review Project 10. Table RP 10-2 | | | | | | |
|---|---|---|---|---|---|---|
| Kent-Des Moines to Tacoma Dome Light Rail | | | | | | |
| Option 2: Via SR99 | S-01 | S-02 | S-04SegA | S-04SegB | S-04SegC | TOTAL |
| NOTE: All segments shown in this table are consistent with the Dec. 4, 2015 report to the Sound Transit Board of Directors | Kent/Des Moines to Star Lake (272nd) (Federal Way Link) | Star Lake (272nd) to Federal Way (Federal Way Link) | Federal Way Transit Center to South Federal Way LRT | South Federal Way to Fife LRT via SR99 | Fife to Tacoma Dome LRT via SR99 | Kent-Des Moines to Tacoma Dome LRT via SR99 |
| **Cost (Millions 2014)** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** | **Cost with Reserve** |
| Agency Administration~~Agency Administration~~ | $28.59 | $31.00 | $37.68 | $63.34 | $60.49 | $221.10 |
| Prel. Engineering & Environmental Review~~Prel. Engineering & Environmental Review**~~ | $16.36 | $15.61 | $21.04 | $36.87 | $35.02 | $124.90 |
| Final Design & Specifications~~Final Design & Specifications~~ | $40.59 | $38.46 | $41.66 | $73.16 | $69.62 | $263.49 |
| Property Acquisition & Permits~~Property Acquisition & Permits~~ | $15.84 | $64.52 | $54.67 | $33.28 | $42.92 | $211.23 |
| Construction~~Construction***~~ | $326.36 | $311.20 | $424.91 | $746.25 | $710.07 | $2,518.79 |
| Construction Management~~Construction Management~~ | $27.78 | $26.54 | $37.49 | $65.85 | $62.65 | $220.31 |
| Third Parties~~Third Parties**~~ | $9.92 | $9.16 | $8.55 | $15.27 | $14.14 | $57.04 |
| Vehicles~~Vehicles~~ | $39.70 | $51.04 | $39.70 | $85.07 | $73.72 | $289.23 |
| Contingency~~Contingency~~ | $43.77 | $41.40 | $41.66 | $73.16 | $69.62 | $269.61 |
| Total | $548.91 | $588.93 | $707.35 | $1,192.25 | $1,138.24 | $4,175.70 |