



# Appendix B

## Technical Memoranda and Reports

### Disclaimer:

Technical memoranda and reports were prepared as independent documents to support the preparation of the Final Environmental Impact Statement (FEIS) for the Dallas CBD Second Light Rail Alignment (D2 Subway). Information from these documents was incorporated into the FEIS to provide information on existing conditions, and in some cases, assess potential impacts to the resources. Information contained in the FEIS is the most current and supersedes information in the technical memoranda and reports.



# **B-6**

## **Capital Cost Estimating Methodology Technical Memorandum**



# Memo

Date: November 25, 2019

Project: DART Downtown Dallas Second Light Rail Alignment – D2 Subway

To: Ernie Martinez, DART Project Manager for D2 Subway Project  
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From: Tom Shelton, HDR Program Manager GPC6

Subject: Capital Cost Estimating Methodology Technical Memorandum

## Introduction

DART has much documentation of the actual costs for the design, construction, operations, and maintenance costs as the direct result of implementing 93 miles of light rail transit (LRT) service, the operating 35-mile Trinity Railway Express (TRE) commuter rail service project, and the Cotton Belt Regional Rail Project which recently concluded the bidding and selection of the Design/Build Contract. For future System Planning and Corridor Planning efforts, this actual cost documentation is very beneficial in its usage of developing planning-level and project development-level cost estimates using either a “parametric unit price” or “cost per mile” estimating methodology for the various typical scenarios. In addition, this cost estimating methodology is continuously reviewed and updated at each of the quarterly meetings with FTA Region VI and the Project Management Oversight Consultant (PMOC) staffs.

## Cost Estimating Methodology

The development of capital cost estimates for the D2 Subway project has been conducted using the same methodologies for previous DART passenger rail corridor projects, including the Cotton Belt Regional Rail Project, the Green and Orange LRT Lines, the South Oak Cliff Corridor Blue Line Extension project, and the recently opened for service TEXRail commuter rail project. Specific elements of the cost estimates, such as unit prices and add on allowances, have been updated to reflect current construction industry experienced costs in North Texas.

Capital cost estimates are represented in current year 2019 dollars. The cost estimates use parametric unit prices (unit cost per route foot) and special condition costs for the majority of the cost effort. The parametric unit costs are based on a level of detail appropriate for conceptual engineering and project development phases. The parametric unit costs are an estimate developed for all elements included in a typical cross section for a unit of measurement (route feet, each, etc.). The parametric cost is then multiplied by the total length of the project for the total cost of that element.

In addition, the unit prices used for the D2 Subway project will use similar unit pricing from national rail transit subway projects, including New York City Second Avenue Subway and Los Angeles Crenshaw. For these national subway projects unit pricing, consideration will be given to adjustments for differences in



North Texas for availability of labor, availability of materials, and labor wages. These national projects will provide current unit prices for unique subway construction including:

- Tunnel Construction for Tunnel Boring Method (TBM) and Sequential Excavation Method (SEM)
- Subway Station Architecture
- Passenger Access Portals and Emergency Egress
- Fire and Life/Safety Systems
- Mechanical, Electrical, and Plumbing (MEP) Systems
- Subway Drainage and Waterproofing Systems

Lastly, the contingency factors were reviewed to ensure they account for the planned implementation method of Design/Build delivery method, as well as key community impact issues.

### Contingency Factors and Add-On Allowances

Once the typical “unit cost per route foot” and/or “cost per mile” estimates were determined at a basic civil cost level, several allowances and add-on factors are applied. These factors are added to account for uncertainty of the estimates at this level given that little or no design has been completed, and also account for the costs of non-construction items such as engineering design, construction management, and insurance. In addition to these factors, there are also assumptions for right-of-way costs, costs for environmental assessment and mitigation, and costs for vehicles and maintenance facilities.

The DART Capital Cost Methodology format is outlined below, using an example of a \$100 million basic civil cost:

|                                    |  |
|------------------------------------|--|
| \$100.0 (A)                        | <b>Basic Civil Cost (SCC Sum Categories 10-50 including Guideway (SCC 10), Stations (SCC 20), Support Facilities (SCC 30), Sitework &amp; Special Conditions (SCC 40), and Systems (SCC 50))</b> |
| <u>+ \$30.0 (30% of A)</u>         | <b>Design Contingency</b>  |
| \$130.0 (B)                        | <b>Subtotal Construction Costs</b>   |
| + \$13.0 (10% of B)                | <b>Unallocated Contingency (SCC 90)</b>  |
| <u>+ \$42.9 (33% of B)</u>         | <b>Add-on Allowances (SCC 80)</b>  |
| \$185.9 (C)                        | <b>Subtotal</b>  |
| + \$19.5 (15% of B)                | <b>Real Estate, Rights-of-Way, Land (SCC 60)</b>   |
| + \$1.3 (1% of B)                  | <b>Environmental Allowance</b>   |
| + <i>Vehicle Cost</i>              | <b>Vehicles (SCC 70)</b>   |
| + <i>Maintenance Facility Cost</i> | <b><i>Support Facilities (SCC 30)</i></b>  |
| \$206.7 (D)                        | <b>Total Capital Cost</b>  |

A brief description and example of the contingencies and add-ons is as follows:

- **Design Contingency** – A 30 percent design contingency is added to the civil cost in the estimate to cover possible changes in unit costs that may occur as selected projects progress through the various stages of design development. Generally, this percentage is reduced as the project progresses through the conceptual, preliminary and final stages of design; therefore, less reserve is needed with more design (further described in Table 1). At the system-level stage, where minimal design has been done, a relatively high percentage of design contingency is included. For the D2 Subway project, a 30% Design Contingency was used at the 10% Level of Design due to the level of unknown field conditions throughout Downtown Dallas.

**Table 1. Percent Design Contingency Reduction as Project Progresses**

| Level of Design | % Design Contingency |
|-----------------|----------------------|
| 2 – 10%         | 20% - 30%            |
| 30%             | 15%                  |
| 65%             | 10%                  |
| 95%             | 5%                   |
| 100%            | 0%                   |

- **Unallocated Contingency** – A 10 percent contingency is added to the construction cost estimate to cover the expense of unforeseen costs incurred by contractors during construction. This is also referred to as an unallocated contingency. This is the FTA SCC 90.0 as noted above.
- **Add-On Allowance** – An additional 32 percent add-on allowance is added to the construction costs. This covers the administrative cost of planning, support services, insurance, preliminary and final design, project management and construction management that are needed to construct a project, which are consistent with the items identified in the FTA Standard Cost Category (SCC) worksheets and further described in Table 2.

**Table 2. Definition of Add-On Allowances**

| SCC<br>Section 80 | Add-On Allowance Item                                       | Percentage<br>Applied |
|-------------------|---|-----------------------|
| 80.01             | Project Development (Preliminary Engineering )              | 4.00%                 |
| 80.02             | Engineering (Final Design)                                  | 6.00%                 |
| 80.03             | Project Management of Design and Construction               | 5.00%                 |
| 80.04             | Construction Administration and Management                  | 8.00%                 |
| 80.05             | Professional Liability and other Non-Construction Insurance | 2.00%                 |
| 80.06             | Legal, Permits, Review Fees by other agencies, cities, etc. | 3.00%                 |
| 80.07             | Surveys, Testing, Investigation, Inspection                 | 3.00%                 |
| 80.08             | Start-Up  | 1.00%                 |

|  |              |               |
|--|--------------|---------------|
|  | <b>Total</b> | <b>32.00%</b> |
|--|--------------|---------------|

- **Real Estate (Right of Way)** – The DART Real Estate Department estimates that real estate costs for a new alignment can be calculated by adding approximately 11-15 percent of the total construction costs to the final cost estimate as more fully defined in Table 3. DART corridors have typically been constructed in more urban portions of the DART service area. To allow for a wide variety of land types considered in System Planning and Corridor Planning efforts, a percentage is used depending on the appropriate urbanization classification for that particular project location. This percentage will be used to estimate real estate costs.

**Table 3. Real Estate Cost Classifications**

| <i><b>Urbanization Class</b></i> | <i><b>Real Estate %</b></i> |
|----------------------------------|-----------------------------|
| Central Business District        | 15 - 20%                    |
| Outer Business District          | 14%                         |
| Urban Residential                | 13%                         |
| Suburban Residential             | 12%                         |
| Rural                            | 11%                         |

Source: DART 11/17/00 Memo from John Haenftling. ROW cost range is 11%-20% of construction costs.

For the D2 Subway project, a percentage of 15% was used for all Real Estate cost related items, including full acquisitions, partial acquisitions, relocations, temporary easements, temporary staging areas, etc. This higher, more conservative percentage was used at this stage of design until real estate needs are better defined and due to the likelihood the contractor will experience some higher-than-normal construction constraints in the Downtown Dallas area.

- **Environmental Allowance** – With SCC 60.01 Real Estate costs, an additional 1% of construction cost is added to cover potential environmental mitigation not included in the civil cost.
- **Construction Mitigation Program (Business Assistance Allowance)** – During the construction of the D2 Subway project in Downtown Dallas, it is anticipated that impacts to operating businesses will occur as result of tunnel construction excavation, temporary street closures, utility relocations, and temporary uses of public parking. A Business Assistance Allowance of \$5,000,000 has been included in the cost estimate to fund these types of private business impacts.

## **Annual Inflation**

To account for inflation for use in estimating Year of Expenditure (YOE) dollars, as well as future financial plan analysis, the estimates are inflated at a rate of 3.50% annually. This is the historical rate of inflation



based on the Construction Cost Index (CCI), as well as recent Federal Transit Administration (FTA) guidance.