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-18

Operations and Maintenance Cost Methodology and Results Report, February 2020

FTA Core Capacity Submittal: Dallas CBD Second Light Rail Alignment (D2) Project

Operations and Maintenance Cost Methodology and Results Technical Memorandum

Draft

February 21, 2020

This Report was Prepared for DART
General Planning Consultant Six Managed by HDR

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Contents

Tables

Figures

Appendices

1 INTRODUCTION

This document presents operations and maintenance (O&M) cost estimates for the Dallas CBD Second Light Rail Alignment (D2) Project and describes the process by which annual O&M costs have been estimated. While the defined project would only affect existing Dallas Area Rapid Transit (DART) light rail operations, the cost methodology for both bus and light rail modes are addressed in this report since O&M costs are presented as total system costs as well as incremental costs.

The O&M cost model is based on Fiscal Year (FY) 2016 operations and expenses. Costs are escalated to 2017 dollars.

The information contained in this document is unchanged from the previous submittal dated September 1, 2017. Future submittals are anticipated to incorporate an updated O&M cost model based on more current year Fiscal Year operations and expenses, as well as minor changes to the O&M cost model inputs incorporating the refined Locally Preferred Alternative. The net result of these modifications is anticipated to lead to potentially reduced O&M costs associated with D2.

2 O&M COSTING OVERVIEW

Operations and maintenance cost estimates are important in the planning process because design-year projections are one of the inputs required to determine a project's cost effectiveness. An O&M cost model estimates the annual cost to operate, maintain and administer a transit system for a given set of service indicators. O&M costs are expressed as the annual total of employee wages and salaries, fringe benefits, contract services, materials and supplies, utilities and other day-to-day expenses incurred in the operation and maintenance of a transit system.

In general, steps of the O&M cost estimating process are:

- Develop methodology for estimating O&M costs
- Develop appropriate cost model(s) to evaluate alternatives
- Calibrate the model for current year operations
- Generate operating plans and statistics for each study alternative
- Estimate annual transit operating and maintenance costs for each study alternative

This memorandum documents all steps in the O&M cost estimating process. Capital cost estimates for construction and equipment purchases are not addressed in this report.

The Federal Transit Administration (FTA) believes the fully-allocated cost model is the best approach to O&M costing, because it is: a) able to reflect cost differences by mode and

service type; b) structured based on actual operating experience; and c) sensitive to future changes in cost factors. The FTA has issued guidelines that specify the following methodology for calculating O&M costs:

- Compute costs by estimating labor and materials needed to provide a current level of service, and then apply unit costs to the estimated future labor and material cost items;
- Calculate costs based on operating characteristics by mode (e.g., LRT train-hours) rather than for all modes combined (e.g., system-wide passengers);
- Model each reported labor and non-labor expense separately to ensure that equations are mutually exclusive and cover all operating costs; and
- Model expense items as variable, meaning that cost estimates will change with projected changes in service.

A cost allocation model assumes that each expense incurred by a transit system is 'driven' by a key supply variable such as revenue-hours, revenue-miles, or the number of peak vehicles. Combining recent actual O&M costs with the quantity of relevant supply variables establishes unit costs and productivity ratios. These mathematical relationships can then be applied to different sets of service indicators (such as projected future expansions or cut-backs). The result is an estimated annual cost specific to each test scenario.

2.1 General Model Structure

The general structure of the DART O&M cost models is as follows:

- Line Items and Base Year Costs: The cost model contains O&M expense line items and a recent annual expense for each item.
- Base Year Unit Costs: As pointed out in FTA guidelines, O&M costs are related to (or 'driven' by) different supply variables. Supply variables can be considered causal because as they increase, so do the related expenses. Unit rates are calculated by dividing the actual annual expense for the line item by the value of the relevant supply variable. For example, if bus operators' salaries and wages cost the transit agency $54,000,000 annually, and 2,500,000 revenue hours of service is the associated supply variable, then the unit cost rate for operators' salaries and wages would be $21.60 per revenue hour. In other words, the model would adjust this line item by $21.60 for each revenue hour of service that is added or cut from the system in a tested scenario.
- Productivity Ratios: Line item productivity ratios are calculated with columns that display the resource variable used for the calculation, the value of the resource variable, and the factor that results from dividing the resource value by the supply value.
- Estimated Cost of a Test Scenario: For each line item expense, the last columns in a spreadsheet contain the base year resource unit cost (supply variable unit cost divided by resource/supply factor), an inflation factor, and the model estimates of resource unit cost and annual cost. The DART models are designed to allow inflation of DART's 2016

base year expenses to represent different year dollars, which typically would use a factor derived from the Bureau of Labor Statistics' Consumer Price Index (CPI-U) for the Dallas-Fort Worth area.

2.2 DART O&M Models

DART O&M costs are estimated for both bus and light rail transit. Since DART currently operates both modes, the models are based on DART's actual expenses, system characteristics and service statistics as reported to the National Transit Database (NTD) for the 2016 report year. Model results are inflated to 2017 dollars using the Bureau of Labor Statistics' CPI-U for the Dallas-Fort Worth area. Both O&M cost models are described in following sections of this document.

3 BUS O&M COST METHODOLOGY

The DART bus O&M cost model is based on 2016 expenses and service statistics for directly-operated motor buses as reported to the NTD. The cost model is intended to estimate the additional expenses, or savings, related to changes in the background bus service that accompany the Build Alternative.

3.1 Key Supply Variables

After collection of financial and service data, preparation of the spreadsheet cost model began with the selection of key driving supply variables for the existing bus system. Variables selected were:

- *Annual Revenue Bus-Hours* - account for the hours that vehicles travel while in revenue service over the entire fiscal year. Revenue bus-hours include layover and schedule recovery, but exclude time for deadhead, operator training and maintenance testing.
- *Annual Revenue Bus-Miles* - are the miles that vehicles travel while in revenue service over the entire fiscal year. Revenue bus-miles include layover and schedule recovery, but exclude miles for deadhead, operator training and maintenance testing.
- *Total Peak Buses* - is the maximum number of passenger service vehicles actually operated simultaneously on an average weekday. In some cases, peak buses may be used as a supply variable when the model needs to base line item expenses on overall bus system size.
- *Operating Garages* - are the number of garages from which buses are dispatched into service. These garages also serve as general purpose maintenance facilities for inspecting, servicing and maintenance work on buses.
- *Bus Passenger Facilities* - include transit centers, transfer centers and park-and-ride lots.

Table 3-1 shows the key supply variables and values used to represent the model's base year inputs (Fiscal Year 2016).

TABLE 3-1. DART BUS O&M COST MODEL – SUPPLY VARIABLE INPUTS FOR 2016 CALIBRATION BUS SYSTEM

Supply Variable Inputs - Bus	2016 NTD Calibration
Annual Revenue Bus-Hours	2,159,188
Annual Revenue Bus-Miles	27,499,916
Total Peak Buses	533
Operating Garages (buses dispatched into svc.)	3
Bus Passenger Facilities	14

Source: DART FY 2016 National Transit Database

DART owns one garage that has been closed as a vehicle operations facility for cost-saving purposes and functions only as a non-revenue vehicle shop; this garage has not been included in the cost model.

For existing bus passenger facilities, DART staff reported nine transit centers, two transfer centers and three park-and-ride lots for a total of 14 facilities. These passenger facilities are treated equally in the model to provide a simple simulation for the incremental cost of adding new facilities that may be associated with a project alternative.

3.2 Line Item Expenses

After selecting the key supply variables, the next step in model development was to record DART's bus expenses as a series of line items. The agency's NTD report format categorizes operating expenses by the four functional areas of Vehicle Operations, Vehicle Maintenance, Non-Vehicle Maintenance and General Administration. Within these functional areas, line item expenses are further classified as salaries and wages, fringe benefits, services, materials and supplies, utilities, casualty and liability, taxes and fees and miscellaneous. Some line items are influenced by more than one supply variable. Split line items in the model include:

- *Vehicle Operations*: Non-Operator Salaries & Wages are 50% driven by the number of operating garages, 25% by revenue bus-hours and 25% driven by the number of passenger facilities. Fringe Benefits are allocated proportionally to the same driving variables.
- *Vehicle Maintenance*: Salaries & Wages are 50% driven by revenue bus-miles and 50% by peak buses. Fringe Benefits are allocated proportionally to the same driving variables.

- *Non-Vehicle Maintenance*: Salaries & Wages are 50% driven by number of operating garages and 50% by number of passenger facilities. Fringe Benefits are allocated proportionally to the same driving variables. Professional & Technical Services and Materials & Supplies are 90% driven by the number of operating garages and 10% driven by the number of bus passenger facilities.
- *General Administration*: Salaries & Wages, Fringe Benefits, Professional & Technical Services and Materials & Supplies are 75% driven by operating garages and 25% by peak buses. Utilities are 75% driven by operating garages and 25% by bus passenger facilities. Casualty & Liability are 50% driven by revenue bus-miles and 50% by peak buses.

After the line items were established, each one was assigned a key supply variable as its most relevant cost driver, then unit costs and productivity ratios were calculated.

Table 3-2 summarizes the dollar impact that each of the bus model's key supply variables has on the calibration system (2016 base year inflated to 2017 dollars). The unit costs in this table reflect the dollar amount the model will adjust for each added or deleted unit of a supply variable – the incremental change from the calibration bus system. In other words, for each revenue bus-mile added, the model will increase its total estimate by $1.47; for each revenue bus-hour deleted, the model will subtract $52.31 from its estimate, and so forth.

TABLE 3-2. DART BUS O&M COST MODEL – SUPPLY VARIABLE IMPACTS FOR 2016 CALIBRATION BUS SYSTEM (IN 2017 DOLLARS)

Key Supply Variable	Amount	Percentage	Unit Cost
Annual Revenue Bus-Hours	$112,956,626	45.3%	$52.31
Annual Revenue Bus-Miles	$40,373,006	16.2%	$1.47
Total Peak Buses	$34,232,230	13.7%	$64,225.57
Operating Garages (buses dispatched into svc.)	$50,795,324	20.4%	$16,931,775
Bus Passenger Facilities	$10,866,641	4.4%	$776,188.62
Total Costs	**$249,223,827**	100%	

Source: Connetics Transportation Group, 2017

Table 3-3 presents the bus O&M cost model worksheet for the 2016 base year, created with the supply variables shown in **Table 3-1**. Model results are estimated in 2017 dollars.

TABLE 3-3. DART BUS O&M COST MODEL – LINE ITEM DETAIL

					Inflation Factor:		1.023
	2016	Productivity Ratio		Base Year		Results in:	2017$
	Bus	Resource	Resource	Resource	Inflation	Resource	Estimated
Expense Line Item	***Expenses***	**Variable**	**Value**	**Unit Cost**	**Factor**	**Unit Cost**	**Annual Cost**
VEHICLE OPERATIONS							
OPERATORS' SALARIES & WAGES	*$60,804,648*	Revenue Hours	2,159,188	$28.16	1.023	$28.80	$62,191,470
OTHER SALARIES & WAGES - Rev-Hours Driven (25%)	*$4,184,481*	Revenue Hours	2,159,188	$1.94	1.023	$1.98	$4,279,920
OTHER SALARIES & WAGES - Oper Garage Driven (50%)	*$8,368,963*	Garages	3	$2,789,654	1.023	$2,853,280	$8,559,840
OTHER SALARIES & WAGES - Pass Facility Driven (25%)	*$4,184,481*	Pass Facilities	14	$298,892	1.023	$305,709	$4,279,920
FRINGE BENEFITS - Rev-Hours Driven	*$45,448,651*	Revenue Hours	2,159,188	$21.05	1.023	$21.53	$46,485,236
FRINGE BENEFITS - Oper Garage Driven	*$5,852,641*	Garages	3	$1,950,880	1.023	$1,995,376	$5,986,127
FRINGE BENEFITS - Pass Facility Driven	*$2,926,321*	Pass Facilities	14	$209,023	1.023	$213,790	$2,993,064
PROFESSIONAL & TECHNICAL SERVICES	*$3,704,674*	Peak Buses	533	$6,950.61	1.023	$7,109.14	$3,789,170
FUEL & LUBRICANTS	*$8,235,461*	Revenue Miles	27,499,916	$0.30	1.023	$0.31	$8,423,294
TIRES & TUBES	*$2,151,185*	Revenue Miles	27,499,916	$0.08	1.023	$0.08	$2,200,249
OTHER MATERIALS & SUPPLIES	*$659,868*	Peak Buses	533	$1,238.03	1.023	$1,266.26	$674,918
TAXES & FEES	*$113,612*	Peak Buses	533	$213.16	1.023	$218.02	$116,203
MISCELLANEOUS EXPENSES	*$287,947*	Garages	3	$95,982	1.023	$98,171	$294,514
VEHICLE MAINTENANCE							
SALARIES & WAGES - Rev.-Miles Driven (50%)	*$12,566,372*	Revenue Miles	27,499,916	$0.46	1.023	$0.47	$12,852,984
SALARIES & WAGES - Peak Buses Driven (50%)	*$12,566,372*	Peak Buses	533	$23,577	1.023	$24,114	$12,852,984
FRINGE BENEFITS - Rev.-Miles Driven (50%)	*$2,915,248*	Revenue Miles	27,499,916	$0.11	1.023	$0.11	$2,981,738
FRINGE BENEFITS - Peak Buses Drivem (50%)	*$2,915,248*	Peak Buses	533	$5,469.51	1.023	$5,594.26	$2,981,738
PROFESSIONAL & TECHNICAL SERVICES	*$2,303,777*	Revenue Miles	27,499,916	$0.08	1.023	$0.0857	$2,356,321
FUEL & LUBRICANTS	*$1,666,811*	Peak Buses	533	$3,127.23	1.023	$3,198.55	$1,704,827
TIRES & TUBES	*$44,355*	Peak Buses	533	$83.22	1.023	$85.12	$45,367
OTHER MATERIALS & SUPPLIES	*$8,931,745*	Revenue Miles	27,499,916	$0.32	1.023	$0.33	$9,135,459
TAXES & FEES	*$7,859*	Peak Buses	533	$14.74	1.023	$15.08	$8,038
MISCELLANEOUS EXPENSES	*$143,943*	Peak Buses	533	$270.06	1.023	$276.22	$147,226
NON-VEHICLE MAINTENANCE							
SALARIES & WAGES - Oper Garage Driven (50%)	*$1,746,087*	Garages	3	$582,029	1.023	$595,304	$1,785,911
SALARIES & WAGES - Passenger Facilities Driven (50%)	*$1,746,087*	Pass Facilities	14	$124,720	1.023	$127,565	$1,785,911
FRINGE BENEFITS - Operating Garages Driven	*$656,930*	Garages	3	$218,977	1.023	$223,971	$671,913
FRINGE BENEFITS - Passenger Facilities Driven	*$656,930*	Pass Facilities	14	$46,924	1.023	$47,994	$671,913
PROF & TECH SERVICES - Oper Garage Driven (90%)	*$2,812,283*	Garages	3	$937,428	1.023	$958,808	$2,876,425
PROF & TECH SERVICES - Pass. Facilities Driven (10%)	*$312,476*	Pass Facilities	14	$22,320	1.023	$22,829	$319,603
MATERIALS & SUPPLIES - Oper Garage Driven (90%)	*$411,871*	Garages	3	$137,290	1.023	$140,421	$421,264
MATERIALS & SUPPLIES - Pass. Facilities Driven (10%)	*$45,763*	Pass Facilities	14	$3,268.81	1.023	$3,343.37	$46,807
TAXES & FEES	*$475*	Garages	3	$158.33	1.023	$161.94	$486
MISCELLANEOUS EXPENSES	*$859*	Garages	3	$286.33	1.023	$292.86	$879
GENERAL ADMINISTRATION							
SALARIES & WAGES - Oper Garages Driven (75%)	*$12,053,366*	Garages	3	$4,017,789	1.023	$4,109,426	$12,328,277
SALARIES & WAGES - Peak Bus Driven (25%)	*$4,017,789*	Peak Buses	533	$7,538.06	1.023	$7,709.99	$4,109,426
FRINGE BENEFITS - Operating Garages Driven	*$5,847,698*	Garages	3	$1,949,233	1.023	$1,993,691	$5,981,072
FRINGE BENEFITS - Peak Bus Driven	*$1,949,233*	Peak Buses	533	$3,657.10	1.023	$3,740.51	$1,993,691
PROF. & TECH. SERVICES - Oper Garages Driven (75%)	*$7,560,742*	Garages	3	$2,520,247	1.023	$2,577,729	$7,733,186
PROF. & TECH. SERVICES - Peak Buses Driven (25%)	*$2,520,247*	Peak Buses	533	$4,728.42	1.023	$4,836.26	$2,577,729
MATERIALS & SUPPLIES - Oper Garage Driven (75%)	*$1,204,105*	Garages	3	$401,368	1.023	$410,523	$1,231,568
MATERIALS & SUPPLIES - Peak Bus Driven (25%)	*$401,368*	Peak Buses	533	$753.04	1.023	$770.21	$410,523
UTILITIES - Oper Garages Driven (75%)	*$2,256,796*	Garages	3	$752,265	1.023	$769,423	$2,308,268
UTILITIES - Passenger Facilities Driven (25%)	*$752,265*	Pass Facilities	14	$53,733	1.023	$54,959	$769,423
CASUALTY & LIABILITY - Bus-Miles Driven (50%)	*$2,368,932*	Revenue Miles	27,499,916	$0.09	1.023	$0.09	$2,422,962
CASUALTY & LIABILITY - Peak Bus Driven (50%)	*$2,368,932*	Peak Buses	533	$4,444.53	1.023	$4,546	$2,422,962
TAXES & FEES	*$187,945*	Peak Buses	533	$352.62	1.023	$360.66	$192,232
MISCELLANEOUS EXPENSES - Oper Garages Driven (75%)	*$601,867*	Garages	3	$200,622	1.023	$205,198	$615,594
MISCELLANEOUS EXPENSES - Peak Buses Driven (25%)	*$200,622*	Peak Buses	533	$376.40	1.023	$384.99	$205,198
TOTALS	***$243,666,328***						**$249,223,827**

NTD Fringe Benefit Rates =	
Vehicle Operations	69.9%
Vehicle Maintenance	23.2%
Non-Vehicle Maintenance	37.6%
General Administration	48.5%

Revenue Hours	2,159,188
Revenue Bus-Miles	27,499,916
Peak Buses	533
Oper Garages	3
Pass. Facilities	14

Source: Connetics Transportation Group, 2017

4 LIGHT RAIL TRANSIT O&M COST METHODOLOGY

The DART light rail transit O&M cost model is based on 2016 expenses and service statistics reported to the NTD. The purpose of this model is to estimate the annual cost to operate and maintain the Project.

4.1 Key Supply Variables

After collection of financial and service data, modeling proceeded with the selection of the key driving supply variables for DART's existing light rail transit system. It is assumed that variations in this set of characteristics that define each alternative will be sufficient to highlight cost differences among the options being evaluated.

- *Annual Revenue Train-Hours* - are the hours that trains, of any number of passenger cars, travel while in revenue service over the entire fiscal year. Revenue train-hours include layover and schedule recovery, but exclude time for deadhead, operator training and maintenance testing.
- *Annual Revenue Car-Miles* - account for the miles that passenger vehicles travel while in revenue service over an entire fiscal year. Revenue car-miles include layover and schedule recovery, but exclude miles for deadhead, operator training and maintenance testing.
- *Peak Cars* - is the maximum number of passenger service vehicles actually operated simultaneously on an average weekday. The model may use peak cars as a variable when it needs to estimate a line item cost based on overall LRT system size.
- *Passenger Stations* - are passenger boarding and alighting facilities with a platform, which may include stairs, escalators, canopies, wind shelters, lighting, ticket machines and signage. For this project, the cost model was developed to distinguish at-grade, aerial and subway stations primarily for purposes of costing out differences in security and facilities maintenance costs. A more in-depth discussion of these cost differences is provided below.
- *Fixed Guideway Directional Route Miles* - represents the track miles in each direction that trains travel in revenue service. Directional route miles exclude staging or storage tracks at the beginning or end of a rail line. From a maintenance perspective, the guideway includes all buildings and structures dedicated to the operation of LRT including track, tunnels, bridges and the electrification system.

- *Yards* - usually comprised of storage track and maintenance shops, are the sites where light rail vehicles are inspected, repaired, maintained and stored. It is not uncommon for both heavy and light maintenance activities to occur in the same facility.

Table 4-1 shows the key supply variables and values used to represent the model's base year (FY 2016) inputs.

TABLE 4-1. DART LIGHT RAIL TRANSIT O&M COST MODEL – SUPPLY VARIABLE INPUTS FOR 2016 CALIBRATION LIGHT RAIL TRANSIT SYSTEM

Supply Variable Inputs – Light Rail	2016 NTD Calibration
Annual Revenue Train-Hours	258,459
Annual Revenue Car-Miles	9,829,532
Peak Cars	104
Passenger Stations At-Grade Aerial (incl. one recessed station) Subway	 53 10 1
Fixed Guideway Directional Route Miles	207.8
Yards	2

Source: DART FY 2016 National Transit Database

4.2 Line Item Expenses

After selecting the key supply variables, the next step in model development was to record DART's light rail expenses as a series of line items. The NTD report format categorizes operating expenses as Vehicle Operations, Vehicle Maintenance, Non-Vehicle Maintenance and General Administration. Within these categories, line item expenses are classified as salaries and wages, fringe benefits, services, materials and supplies, utilities, casualty and liability, taxes and fees and miscellaneous. Some line items are influenced by more than one supply variable. Split line items in the model include:

- *Vehicle Operations*: Non-Operator Salaries & Wages are 60% driven by train-hours, 20% driven by the number of yards and 20% driven by total stations. Fringe Benefits are allocated proportionally to the same driving variables.
- *Vehicle Maintenance*: Materials & Supplies are 90% driven by revenue car-miles and 10 driven by peak cars.

- *Non-Vehicle Maintenance:* Salaries & Wages are 50% driven by total stations, 10% driven by the number of yards and 40% driven by track miles. The model applies these same splits to Fringe Benefits, Professional & Technical Services and Materials & Supplies.
- General Administration: Salaries & Wages are 90% driven by yards and 10% driven by peak cars. Fringe benefits are allocated proportionally to the same driving variables. Utilities are driven 50% by Stations and 50% by Yards. Casualty & Liability are driven 50% by Stations and 50% by revenue car-miles.

The LRT cost model also distinguishes station types. Although most of DART's light rail stations are at-grade, there were ten stations in FY 2016 with vertical circulation (aerial or recessed) and one subway station with vertical circulation and ventilation systems. The classification of light rail stations is provided in **Appendix A** included in this Technical Memorandum. In terms of maintenance and security staff deployment, DART staff considers aerial stations to be twice as expensive as an at-grade facility and the subway station is four times more expensive than an at-grade station. These agency assumptions were incorporated in the unit cost calculations for line items driven by station type.

After the line items were established, each one was assigned a key supply variable as its most relevant cost driver, then unit costs and productivity ratios were calculated.

Table 4-2 summarizes the dollar impact that each of the LRT cost model's key supply variables has on the calibration system (2016 base year inflated to 2017 dollars). The unit costs in this table reflect the dollar amount the model will adjust for each added or deleted unit of a supply variable – the incremental change from the calibration LRT system. In other words, for each revenue car-mile added, the model will increase its total estimate by $4.41; for each revenue train-hour deleted, the model will subtract $158.63 from its estimate, and so forth.

TABLE 4-2. DART LIGHT RAIL TRANSIT O&M COST MODEL – SUPPLY VARIABLE IMPACTS FOR 2016 CALIBRATION LRT SYSTEM (IN 2017 DOLLARS)

Key Supply Variable	Amount	Percentage	Unit Cost
Annual Revenue Train-Hours	$40,998,669	22.5%	$158.63
Annual Revenue Car-Miles	$49,921,194	27.4%	$5.08
Peak Cars	$6,074,427	3.3%	$61,984
Passenger Stations			
At-Grade	$14,387,206	7.9%	$271,437
Aerial (incl. one recessed station)	$5,429,134	3.0%	$542,913
Subway	$1,085, 827	0.6%	$1,085,827
All	$8,361,088	4.6%	$130,642
Fixed Guideway Directional Route Miles	$15,675,177	8.6%	$75,434

TABLE 4-2. DART LIGHT RAIL TRANSIT O&M COST MODEL – SUPPLY VARIABLE IMPACTS FOR 2016 CALIBRATION LRT SYSTEM (IN 2017 DOLLARS)

Key Supply Variable	Amount	Percentage	Unit Cost
Yards	$40,553,018	22.2%	$20,276,509
Total Costs	**$182,485,739**	**100%**	

Source: Connetics Transportation Group, 2017

Table 4-3 presents the LRT O&M cost model worksheet, created with the base year supply variable inputs from **Table 4-1**. Model results are estimated in 2017 dollars.

TABLE 4-3. DART LIGHT RAIL TRANSIT O&M COST MODEL – LINE ITEM DETAIL

					Inflation Factor:		1.023
	2016	Productivity Ratio		Base Year		Results in:	2017$
Expense Line Item	Light Rail Expenses	Resource Variable	Resource Value	Resource Unit Cost	Inflation Factor	Resource Unit Cost	Estimated Annual Cost
VEHICLE OPERATIONS							
OPERATORS' SALARIES & WAGES	*$9,988,341*	Rev. Train-Hrs	258,459	$38.65	1.023	$39.53	$10,216,153
OTHER SALARIES & WAGES -Train-Hours Driven (60%)	*$15,741,995*	Rev. Train-Hrs	258,459	$60.91	1.023	$62.30	$16,101,036
OTHER SALARIES & WAGES -Yards Driven (20%)	*$5,247,332*	Yards	2	$2,623,666	1.023	$2,683,506	$5,367,012
OTHER SALARIES & WAGES -Tot. Stations Driven (20%)	*$5,247,332*	Stations	64	$81,990	1.023	$83,860	$5,367,012
FRINGE BENEFITS - Train-Hours Driven	*$14,354,093*	Rev. Train-Hrs	258,459	$55.54	1.023	$56.80	$14,681,479
FRINGE BENEFITS - Yards Driven	*$2,927,311*	Yards	2	$1,463,655	1.023	$1,497,038	$2,994,076
FRINGE BENEFITS - Total Stations Driven	*$2,927,311*	Stations	64	$45,739.23	1.023	$46,782	$2,994,076
PROFESSIONAL & TECHNICAL SERVICES	*$2,200,609*	Peak Cars	98	$22,455.19	1.023	$22,967	$2,250,800
OTHER MATERIALS & SUPPLIES	*$507,205*	Yards	2	$253,603	1.023	$259,387	$518,773
UTILITIES	*$12,861,787*	Rev Car-Miles	9,829,532	$1.31	1.023	$1.34	$13,155,136
MISCELLANEOUS EXPENSES	*$389,838*	Yards	2	$194,919	1.023	$199,365	$398,729
VEHICLE MAINTENANCE							
SALARIES & WAGES	*$15,106,422*	Rev Car-Miles	9,829,532	$1.54	1.023	$1.57	$15,450,967
FRINGE BENEFITS	*$7,639,781*	Rev Car-Miles	9,829,532	$0.78	1.023	$0.79	$7,814,028
PROFESSIONAL & TECHNICAL SERVICES	*$1,549,675*	Rev Car-Miles	9,829,532	$0.16	1.023	$0.16	$1,585,020
FUEL & LUBRICANTS	*$578,651*	Peak Cars	98	$5,904.60	1.023	$6,039.27	$591,849
TIRES & TUBES	*$43,344*	Peak Cars	98	$442.29	1.023	$452.37	$44,333
OTHER MATERIALS & SUPPLIES - Car-Miles Driven (90%)	*$10,875,767*	Rev Car-Miles	9,829,532	$1.11	1.023	$1.13	$11,123,819
OTHER MATERIALS & SUPPLIES - Peak Car Driven (10%)	*$1,208,419*	Peak Cars	98	$12,331	1.023	$12,612	$1,235,980
TAXES & FEES	*$1,620*	Peak Cars	98	$16.53	1.023	$16.91	$1,657
MISCELLANEOUS EXPENSES	*$281,046*	Peak Cars	98	$2,867.82	1.023	$2,933.22	$287,456
NON-VEHICLE MAINTENANCE							
SALARIES & WAGES - Total Stations Driven (50%)	*$9,303,413*	Stations					
		At-Grade	53	$120,824	1.023	$123,579	$6,549,701
		Aerial	10	$241,647	1.023	$247,159	$2,471,585
		Subway	1	$483,294	1.023	$494,317	$494,317
SALARIES & WAGES - Yards Driven (10%)	*$1,860,683*	Yards	2	$930,341	1.023	$951,560	$1,903,121
SALARIES & WAGES - Track Miles Driven (40%)	*$7,442,730*	Track Miles	207.8	$35,817	1.023	$36,634	$7,612,482
FRINGE BENEFITS - Total Stations Driven	*$4,360,096*	Stations					
		At-Grade	53	$56,625	1.023	$57,916	$3,069,554
		Aerial	10	$113,249	1.023	$115,832	$1,158,322
		Subway	1	$226,498	1.023	$231,664	$231,664
FRINGE BENEFITS - Yards Driven	*$872,019*	Yards	2	$436,010	1.023	$445,954	$891,908
FRINGE BENEFITS - Track Miles Driven	*$3,488,077*	Track Miles	207.8	$16,786	1.023	$17,169	$3,567,632
PROF. & TECH. SERVICES - Total Stations Driven (50%)	*$3,830,414*	Stations					
		At-Grade	53	$49,746	1.023	$50,880	$2,696,652
		Aerial	10	$99,491	1.023	$101,760	$1,017,604
		Subway	1	$198,983	1.023	$203,521	$203,521
PROF. & TECH. SERVICES - Yards Driven (10%)	*$766,083*	Yards	2	$383,041	1.023	$391,778	$783,555
PROF. & TECH. SERVICES - Track Miles Driven (40%)	*$3,064,331*	Track Miles	207.8	$14,747	1.023	$15,083	$3,134,222
MATERIALS & SUPPLIES - Total Stations Driven (50%)	*$1,512,121*	Stations					
		At-Grade	53	$19,638	1.023	$20,086	$1,064,549
		Aerial	10	$39,276	1.023	$40,172	$401,717
		Subway	1	$78,552	1.023	$80,343	$80,343
MATERIALS & SUPPLIES - Yards Driven (10%)	*$302,424*	Yards	2	$151,212	1.023	$154,661	$309,322
MATERIALS & SUPPLIES - Track Miles Driven (40%)	*$1,209,697*	Track Miles	207.8	$5,821.45	1.023	$5,954.22	$1,237,287
TAXES & FEES	*$118,222*	Track Miles	207.8	$568.92	1.023	$581.90	$120,918
MISCELLANEOUS EXPENSES	*$2,576*	Track Miles	207.8	$12.40	1.023	$12.68	$2,635

TABLE 4-3. DART LIGHT RAIL TRANSIT O&M COST MODEL – LINE ITEM DETAIL (continued)

					Inflation Factor:		1.023
	2016	Productivity Ratio		Base Year		Results in:	2017$
Expense Line Item	Light Rail Expenses	Resource Variable	Resource Value	Resource Unit Cost	Inflation Factor	Resource Unit Cost	Estimated Annual Cost
GENERAL ADMINISTRATION							
SALARIES & WAGES - Yards Driven (90%)	*$12,869,169*	Yards	2	$6,434,585	1.023	$6,581,344	$13,162,687
SALARIES & WAGES - Peak Cars Driven (10%)	*$1,429,908*	Peak Cars	98	$14,591	1.023	$14,924	$1,462,521
FRINGE BENEFITS - Yards Driven (90%)	*$1,758,380*	Yards	2	$879,190	1.023	$899,243	$1,798,485
FRINGE BENEFITS - Peak Cars Driven (10%)	*$195,376*	Peak Cars	98	$1,993.63	1.023	$2,039.10	$199,832
PROFESSIONAL & TECH. SERVICES	*$8,694,820*	Yards	2	$4,347,410	1.023	$4,446,565	$8,893,130
MATERIALS & SUPPLIES	*$2,156,631*	Yards	2	$1,078,316	1.023	$1,102,910	$2,205,819
UTILIITES - Yards Driven (50%)	*$655,464*	Yards	2	$327,732	1.023	$335,207	$670,413
UTILITIES - Stations Driven (50%)	*$655,464*	Stations					
		At-Grade	53	$8,512.51	1.023	$8,706.66	$461,453
		Aerial	10	$17,025	1.023	$17,413	$174,133
		Subway	1	$34,050	1.023	$34,827	$34,827
CASUALTY & LIABILITY - Stations Driven (50%)	*$774,558*	Stations					
		At-Grade	53	$10,059	1.023	$10,289	$545,297
		Aerial	10	$20,118	1.023	$20,577	$205,772
		Subway	1	$40,237	1.023	$41,154	$41,154
CASUALTY & LIABILITY - Car-Miles Driven (50%)	*$774,558*	Rev Car-Miles	9,829,532	$0.08	1.023	$0.08	$792,224
MISCELLANEOUS EXPENSES	*$641,359*	Yards	2	$320,680	1.023	$327,994	$655,987
TOTALS	***$178,416,448***						**$182,485,739**

NTD Fringe Benefit Rates =	
Vehicle Operations	55.8%
Vehicle Maintenance	50.6%
Non-Vehicle Maintenance	46.9%
General Administration	13.7%

Rev Train-Hours	258,459
Rev Car-Miles	9,829,532
Peak Cars	98
At-Grade Sta	53
Aerial Sta	10
Subway Sta	1
Track Miles	208
Yards	2

Source: Connetics Transportation Group, 2017

5 OPERATING PLANS AND STATISTICS

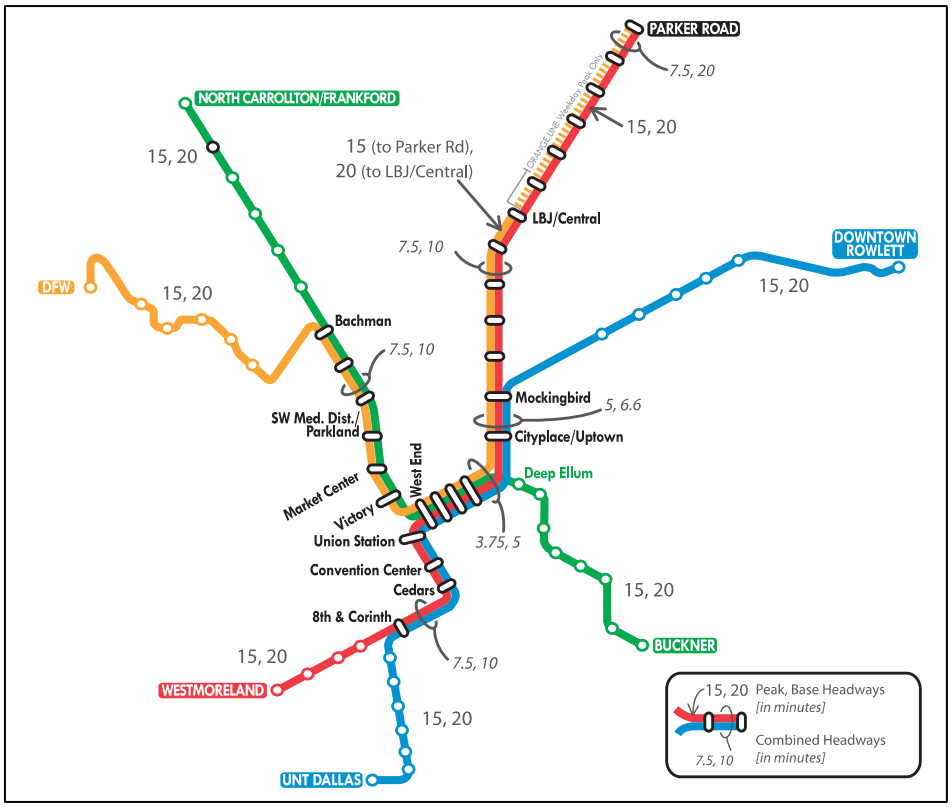
As stated previously, the Dallas CBD Second Light Rail Alignment (D2) Project does not involve changes to the bus network, so bus operating statistics are based on reported 2016 statistics.

No Build Operating Concept. The LRT No Build operating plan reflects existing service (including the Blue Line extension to UNT Dallas):

- Red Line LRT from Parker Road to Westmoreland (15 minute peak, 20 minute off-peak headways)
- Blue Line LRT from Rowlett Road to UNT Dallas (15 minute peak, 20 minute off-peak headways)
- Green Line LRT from North Carrollton/Frankford to Buckner (15 minute peak, 20 minute off-peak headways)
- Orange Line LRT from DFW to Parker Road (15 minute peak headways) or LBJ/Central (20 minute off-peak headways)

Figure 5-1 shows the four LRT lines and notes service levels for each segment, and indicates combined service frequencies when more than one line serves a segment.

FIGURE 5-1. NO BUILD OPERATING PLAN SCHEMATIC

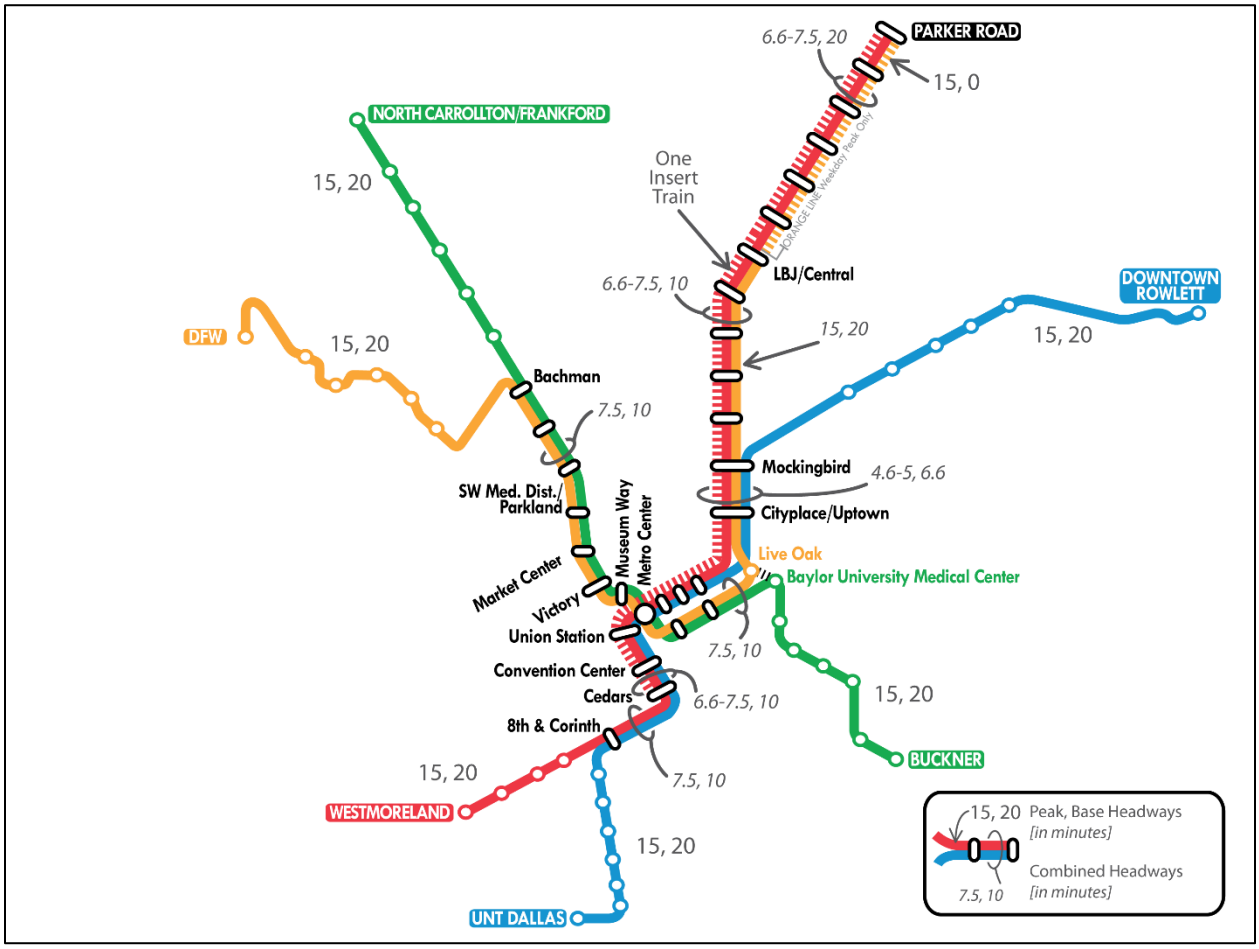


Source: Connetics Transportation Group, 2017

Since all four routes share the transit mall in downtown Dallas, that segment has the most frequent service at a combined service frequency of 3.75 minutes in the peak and 5 minutes in the off-peak.

Project Operating Concept. The Dallas CBD Second Light Rail Alignment (D2) Project involves building a second LRT alignment through the Dallas CBD along Commerce Street, allowing the Orange and Green Lines to use this new alignment while the Red and Blue Lines continue to use the existing transit mall. The resulting operating plan is schematically presented in **Figure 5-2.**

FIGURE 5-2. DALLAS CBD SECOND LIGHT RAIL ALIGNMENT (D2) OPERATING PLAN SCHEMATIC



Source: Connetics Transportation Group, 2017

The operating plan involves the following:

- The Green Line would use the D2 route between the Victory and Baylor Stations but otherwise remain the same (15 minute peak, 20 minute off-peak headways).
- The Orange Line would use the D2 route between the Victory and City Place Stations, but otherwise remain the same (15 minute peak headway to Parker Road, 20 minute off-peak headway to LBJ/Central).

- The Red Line would remain on the existing transit mall along Pacific Avenue and Bryan Street at 15 minute peak and 20 minute off-peak headways. An additional peak direction trip from Parker Road to Cedars is added during the peak-of-the-peak, so during that hour the combined headway would be 6.6 minutes (9 trains/peak-of-the-peak hour).
- The Blue Line would remain on the existing transit mall at the same service level as No Build (15 minute peak, 20 minute off-peak headways).

Operating Plan Development. Service on all four lines is offered seven days a week, about 21 hours each day (typically from about 4:30am to 1:30am). The assumed LRT service hours by period and day and annualization factors are provided in **Figure 5-3**. The No Build operating plan worksheet calculating peak vehicles, annual car-miles and annual train-hours is provided as **Figure 5-4.** No Build one-way travel times used existing public schedules as of October 2016. Distances and train consists by period were provided by DART.

The Project operating plan worksheet is provided in **Figure 5-5**. For the Green and Orange Line using the second downtown alignment, distances were scaled from engineering drawings. Travel times were calculated for the new segment, based on distance between stations, alignment geometry, operating environment (subway or aerial versus at-grade which affects intersection delay), and vehicle acceleration/deceleration characteristics. The Red Line's additional round trip during the peak hour is reflected as "Peak hour insert 1" under the Red Line supplemental peak pattern from Parker Road to Cedars.

Other operating statistics used as inputs in the O&M cost model (number of stations by type, fixed guideway directional miles, and number of yards) are project elements that are readily quantified. All operating statistics used as inputs to the O&M cost model are summarized in the following chapter documenting O&M cost results.

FIGURE 5-3. DART LRT OPERATING ASSUMPTIONS

	Red Line		Blue Line		Green Line	
OPERATING ASSUMPTIONS:	Hours	Time Periods	Hours	Time Periods	Hours	Time Periods
Weekday Peak	6	06:00 - 09:00, 15:00-18:00	6	06:00 - 09:00, 15:00-18:00	6	06:00 - 09:00, 15:00-18:00
Weekday Base	6	09:00 - 15:00,	6	09:00 - 15:00,	6	09:00 - 15:00,
Weekday Eve	3	18:00 - 21:00	3	18:00 - 21:00	3	18:00 - 21:00
Weekday Early/Late	6	04:30 - 06:00, 21:00 - 01:30	7	04:00 - 06:00, 21:00 - 02:00	6	04:00 - 06:00, 21:00 - 01:00
Weekday Total Hours	21		22		21	
Saturday Base	9	09:00-18:00	9	09:00-18:00	9	09:00-18:00
Saturday Eve	1.5	18:00-19:30	1.5	18:00-19:30	1.5	18:00-19:30
Saturday Early/Late	10	04:30-09:00, 19:30-01:00	10.5	04:00-09:00, 19:30-01:00	10.5	04:00-09:00, 19:30-01:00
Saturdat Total Hours	20.5		21		21	
Sunday Base	9	09:00-18:00	9	09:00-18:00	9	09:00-18:00
Sunday Eve	1.5	18:00-19:30	1.5	18:00-19:30	1.5	18:00-19:30
Sunday Early/Late	10	04:30-09:00, 19:30-01:00	10.5	04:00-09:00, 19:30-01:00	10.5	04:00-09:00, 19:30-01:00
Sunday Total Hours	20.5		21		21	

	Orange Line - Long Line		Orange Line - Short Line		Orange Line	
OPERATING ASSUMPTIONS:	Hours	Time Periods	Hours	Time Periods	Hours	Time Periods
Weekday Peak	3.5	06:00 - 07:00, 15:00-17:30	3.5	07:00 - 09:00, 17:30-18:00	6	06:00 - 09:00, 15:00-18:00
Weekday Base	1	14:00 - 15:00,	5	09:00 - 14:00,	6	09:00 - 15:00,
Weekday Eve	2	21:30 - 23:30	3.5	18:00 - 21:30	3	18:00 - 21:00
Weekday Early/Late	1.5	04:00 - 06:00	8	03:00 - 06:00, 21:00 - 01:30	6	04:00 - 06:00, 21:00 - 01:00
Weekday Total Hours	8		20		21	
Saturday Base			9.5	08:30-18:00	9	09:00-18:00
Saturday Eve			1.5	18:00-19:30	1.5	18:00-19:30
Saturday Early/Late			11.5	03:00-08:30, 19:30-01:30	10.5	04:00-09:00, 19:30-01:00
Saturdat Total Hours	0		22.5		21	
Sunday Base			9.5	08:30-18:00	9	09:00-18:00
Sunday Eve			1.5	18:00-19:30	1.5	18:00-19:30
Sunday Early/Late			11.5	03:00-08:30, 19:30-01:30	10.5	04:00-09:00, 19:30-01:00
Sunday Total Hours	0		22.5		21	

Note: Orange - Long Line Early/Late eastbound only; Orange - Short Line Early/Late westbound in early a.m., mix of long and short trips in late eve

ANNUAL WEEKDAYS	255
ANNUAL SATURDAYS	53
ANNUAL SUNDAYS, HOLIDAYS	57
Annual Days of Service	365

Source: Connetics Transportation Group, 2017

FIGURE 5-4. NO BUILD OPERATING PLAN AND STATISTICS

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve.	Headway E/L	Consist Peak	Consist Base	Consist Eve.	Consist E/L	Vehicles Peak	Vehicles Total	Annual Car-Miles	Annual Car-Hrs	Annual Train-Hrs
RED LINE																	
Parker Road	Westmoreland	65.00	27.69	M-F	15	20	20	30	2	2	2	1	20	28	1,609,900	74,970	41,310
		mph	25.56	Sat	n/a	20	20	30	0	2	2	2			302,320	14,200	7,100
				Sun	n/a	20	20	30	0	2	2	2			325,140	15,280	7,640
ESTIMATED ANNUAL TOTALS:													20	28	2,237,360	104,450	56,050
BLUE LINE																	
Rowlett	UNT Dallas	69.00	31.40	M-F	15	20	20	30	2	2	2	1	24	34	1,857,620	88,740	49,730
		mph	27.30	Sat	n/a	20	20	30	0	1	1	1			174,740	8,350	8,350
				Sun	n/a	20	20	30	0	1	1	1			187,930	8,980	8,980
ESTIMATED ANNUAL TOTALS:													24	34	2,220,290	106,070	67,060
GREEN LINE									*4*	*of*	*12*	*peak trains at 3-car consists*					
Frankford	Buckner	75.00	28.74	M-F	15	20	20	30	2.33	2	2	2	28	39	1,964,090	102,510	48,200
		mph	22.99	Sat	n/a	20	20	30	0	2	2	2			319,880	16,700	8,350
				Sun	n/a	20	20	30	0	2	2	2			344,020	17,960	8,980
ESTIMATED ANNUAL TOTALS:													28	39	2,627,990	137,170	65,530
ORANGE LINE - Long Line																	
DFW	Parker Road	92.00	41.66	M-F	15	n/a	n/a	n/a	2	0	0	0	28	39	1,019,840	42,840	21,420
		mph	27.17	Sat	n/a	n/a	n/a	n/a	0	0	0	0			0	0	0
				Sun	n/a	n/a	n/a	n/a	0	0	0	0			0	0	0
ESTIMATED ANNUAL TOTALS:													28	39	1,019,840	42,840	21,420
ORANGE LINE - Short Line																	
DFW	LBJ/Central	76.00	33.00	M-F	n/a	20	20	30	0	2	2	1	0	0	1,127,610	51,260	31,750
		mph	26.05	Sat	n/a	20	20	30	0	1	1	1			195,890	8,900	8,900
				Sun	n/a	20	20	30	0	1	1	1			210,670	9,580	9,580
ESTIMATED ANNUAL TOTALS:													0	0	1,534,170	69,740	50,230
System Totals													**100**	**140**	**9,639,650**	**460,270**	**260,290**

Source: Connetics Transportation Group, 2017

FIGURE 5-5. DALLAS CBD SECOND RAIL ALIGNMENT (D2) PROJECT OPERATING PLAN AND STATISTICS

From	To	Run Time (minutes)	Distance (miles)	Day	Headway Peak	Headway Base	Headway Eve.	Headway E/L	Consist Peak	Consist Base	Consist Eve.	Consist E/L	Vehicles Peak	Vehicles Total	Annual Car-Miles	Annual Car-Hrs	Annual Train-Hrs
RED LINE																	
Parker Road	Westmoreland	65.00	27.69	M-F	15	20	20	30	2	2	2	1	20	28	1,609,900	74,970	41,310
		mph	25.56	Sat	n/a	20	20	30	0	2	2	2			302,320	14,200	7,100
				Sun	n/a	20	20	30	0	2	2	2			325,140	15,280	7,640
ESTIMATED ANNUAL TOTALS:													20	28	2,237,360	104,450	56,050
RED LINE - Peak Short Line Insert																	
Parker Road	Cedars	50.00	20.9	M-F	60	n/a	n/a	n/a	2	0	0	0	2	3	21,320	510	260
		mph	25.08	Sat	n/a	n/a	n/a	n/a	0	0	0	0			0	0	0
				Sun	n/a	n/a	n/a	n/a	0	0	0	0			0	0	0
ESTIMATED ANNUAL TOTALS:													2	3	21,320	510	260
BLUE LINE																	
Rowlett	UNT Dallas	69.00	31.40	M-F	15	20	20	30	2	2	2	1	24	34	1,857,620	88,740	49,730
		mph	27.30	Sat	n/a	20	20	30	0	1	1	1			174,740	8,350	8,350
				Sun	n/a	20	20	30	0	1	1	1			187,930	8,980	8,980
ESTIMATED ANNUAL TOTALS:													24	34	2,220,290	106,070	67,060
GREEN LINE									*4*	*of*	*12*	*peak trains at 3-car consists*					
Frankford	Buckner	72.75	28.57	M-F	15	20	20	30	2.33	2	2.00	2	28	39	1,952,470	102,510	48,200
Via D2 - Victory-Commerce-Swiss		mph	23.56	Sat	n/a	20	20	30	0	2	2	2			317,980	16,700	8,350
				Sun	n/a	20	20	30	0	2	2	2			341,980	17,960	8,980
ESTIMATED ANNUAL TOTALS:													28	39	2,612,430	137,170	65,530
ORANGE LINE																	
DFW	Parker Road	92.46	42.01	M-F	15	n/a	n/a	n/a	2	0	0	0	28	39	1,028,400	42,840	21,420
Via D2 - Victory-Commerce-Swiss		mph	27.26	Sat	n/a	n/a	n/a	n/a	0	0	0	0			0	0	0
				Sun	n/a	n/a	n/a	n/a	0	0	0	0			0	0	0
ESTIMATED ANNUAL TOTALS:													28	39	1,028,400	42,840	21,420
ORANGE LINE																	
DFW	LBJ Central	76.46	33.35	M-F	n/a	20	20	30	0	2	2	1	0	0	1,139,570	51,260	31,750
Via D2 - Victory-Commerce-Swiss		mph	26.17	Sat	n/a	20	20	30	0	1	1	1			197,970	8,900	8,900
				Sun	n/a	20	20	30	0	1	1	1			212,910	9,580	9,580
ESTIMATED ANNUAL TOTALS:													0	0	1,550,450	69,740	50,230
System Totals													**102**	**143**	**9,670,250**	**460,780**	**260,550**

Source: Connetics Transportation Group, 2017

6 O&M COST RESULTS

The cost models and operating plans described above were used to generate annual O&M cost estimates for the No Build and Project conditions. **Table 6-1** summarizes the model run results for both alternatives, showing the defined input statistics as well as the O&M cost estimated. **Appendices B through D** include model spreadsheet results.

The project is estimated to have an annual incremental cost of $4,651,230 in 2017 dollars.

TABLE 6-1. SUMMARY OF ANNUAL O&M COSTS, OPERATING CHARACTERISTICS AND PRODUCTIVITIES (IN 2017 DOLLARS)

Summary Statistic	No Build	Dallas CBD Second Alignment (D2) Project
Annual Operating Expenses ($2017)		
Bus	$249,223,827	$249,223,827
Light Rail	$181,935,801	$186,587,031
Total O&M Cost	**$431,159,628**	**$435,810,858**
Incremental Cost to No Build	**N/A**	**$4,651,230**
Bus		
Annual Revenue Bus-Hours	2,159,188	2,159,188
Annual Revenue Bus-Miles	27,499,916	27,499,916
Total Peak Buses	533	533
Operating Garages (buses dispatched into svc.)	3	3
Bus Passenger Facilities	14	14
Total Cost/Bus-Hour	$115.42	$115.42
Total Cost/Bus-Mile	$9.06	$9.06
Light Rail		
Annual Revenue Train-Hours	260,290	260,550
Annual Revenue Car-Miles	9,639,650	9,670,250
Peak Cars	100	102
Passenger Stations		
At-Grade	53	54
Aerial (incl. one recessed station)	10	10
Subway	1	4
Fixed Guideway Directional Route Miles	207.8	211.5
Yards	2	2
Total Cost/Train-Hour	$698.97	$716.13
Total Cost/Car-Mile	$18.87	$19.29

Source: Connetics Transportation Group, Inc.

APPENDIX A: LIGHT RAIL STATION TYPES

	Line(s)	Station Name	Opened	At-Grade	Aerial/ Recessed*	Subway	Comments
1	Red	Westmoreland	1996	X			
2	Red	Hampton	1996	X			
3	Red	Tyler/Vernon	1996	X			
4	Red	Dallas Zoo	1996	X			
5	Red/Blue	8th & Corinth	1996	X			
6	Red/Blue	Cedars	1996	X			
7	Red/Blue	Convention Center	1996	X			
8	Red/Blue + TRE	Union	2008	X			Orig built 1916; re-built 2008
9	Green/Orange	Victory	2004	X			Select wkdy + special events
10	Red/Blue/GreenOrange	West End	1996	X			
11	Red/Blue/GreenOrange	Akard	1996	X			
12	Red/Blue/GreenOrange	St. Paul	1996	X			
13	Red/Blue/GreenOrange	Pearl	1996	X			
14	Red/Blue/Orange	Cityplace	2004			X	
15	Red/Blue/Orange	Mockingbird	1997		X		Recessed with elevator, 2 escalators
16	Red/Orange	Lovers Lane	1997	X			
17	Red/Orange	Park Lane	2002		X		Opened '97 at-grade; rebuilt '02 aerial
18	Red/Orange	Walnut Hill	2002		X		
19	Red/Orange	Forest Lane	2002		X		
20	Red/Orange	LBJ Central	2002	X			
21	Red/Orange	Spring Valley	2002		X		
22	Red/Orange	Arapahoe Center	2002	X			
23	Red/Orange	Galatyn Park	2002	X			
24	Red/Orange	Bush Turnpike	2002	X			
25	Red/Orange	Downtown Plano	2002	X			
26	Red/Orange	Parker Road	2002	X			
27	Blue	Ledbetter	1997	X			
28	Blue	VA Medical Center	1997	X			
29	Blue	Kiest	1997	X			
30	Blue	Illinois	1996	X			
31	Blue	Morrell	1996	X			
32	Green	Fair Park	2009	X			Special events
33	Green	Baylor Medical Center	2009	X			Special events
34	Green	Deep Ellum	2009	X			Special events
35	Blue	White Rock	2001	X			
36	Blue	LBJ/Skillman	2002	X			
37	Blue	Forest/Jupiter	2002	X			
38	Blue	Downtown Garland	2002	X			Orig built 1997 as a transit center
39	Green	MLK Jr.	2009	X			
40	Blue	Lake Highlands	12/6/10	X			
41	Green	North Carrollton/ Frankford	12/6/10	X			
42	Green	Trinity Mills	12/6/10	X			
43	Green	Downtown Carrollton	12/6/10		X		
44	Green	Farmers Branch	12/6/10	X			
45	Green	Royal Lane	12/6/10		X		
46	Green	Walnut Hill/Denton	12/6/10		X		
47	Green/Orange	Bachman	12/6/10	X			
48	Green/Orange	Burbank	12/6/10	X			
49	Green/Orange	Inwood/Love Field	12/6/10		X		
50	Green/Orange	Southwestern Medical District/Parkland	12/6/10	X			
51	Green/Orange	Market Center	12/6/10	X			
52	Green	Hatcher	12/6/10	X			
53	Green	Lawnview	12/6/10	X			
54	Green	Lake June	12/6/10	X			
55	Green	Buckner	12/6/10	X			
56	Orange	University of Dallas	7/30/12		X		
57	Orange	Las Colinas Urban Ctr	7/30/12	X			
58	Orange	Irving Convention Ctr	7/30/12	X			
59	Orange	North Lake College	12/3/2012	X			
60	Orange	Belt Line	12/3/2012	X			
61	Blue	Downtown Rowlett	12/3/2012	X			
62	Orange	DFW Airport	8/18/2014	X			
63	Blue	Camp Wisdom	10/2016	X			
64	Blue	UNT Dallas	10/2016	X			
	Totals by Type			53	10	1	64 reported in FY 2016 NTD

Source: Connetics Transportation Group, 2017

APPENDIX B: BUS O&M COST MODEL LINE ITEM DETAIL – NO BUILD AND PROJECT ALTERNATIVES

Dallas Area Rapid Transit
BUS LINE ITEM DETAIL

No Build and Project

					Inflation Factor:		**1.023**
	2016	**Productivity Ratio**		**Base Year**		**Results in:**	**2017$**
Expense Line Item	***Bus Expenses***	**Resource Variable**	**Resource Value**	**Resource Unit Cost**	**Inflation Factor**	**Resource Unit Cost**	**Estimated Annual Cost**
VEHICLE OPERATIONS							
OPERATORS' SALARIES & WAGES	*$60,804,648*	Revenue Hours	2,159,188	$28.16	1.023	$28.80	$62,191,470
OTHER SALARIES & WAGES - Rev-Hours Driven (25%)	*$4,184,481*	Revenue Hours	2,159,188	$1.94	1.023	$1.98	$4,279,920
OTHER SALARIES & WAGES - Oper Garage Driven (50%)	*$8,368,963*	Garages	3	$2,789,654	1.023	$2,853,280	$8,559,840
OTHER SALARIES & WAGES - Pass Facility Driven (25%)	*$4,184,481*	Pass Facilities	14	$298,892	1.023	$305,709	$4,279,920
FRINGE BENEFITS - Rev-Hours Driven	*$45,448,651*	Revenue Hours	2,159,188	$21.05	1.023	$21.53	$46,485,236
FRINGE BENEFITS - Oper Garage Driven	*$5,852,641*	Garages	3	$1,950,880	1.023	$1,995,376	$5,986,127
FRINGE BENEFITS - Pass Facility Driven	*$2,926,321*	Pass Facilities	14	$209,023	1.023	$213,790	$2,993,064
PROFESSIONAL & TECHNICAL SERVICES	*$3,704,674*	Peak Buses	533	$6,950.61	1.023	$7,109.14	$3,789,170
FUEL & LUBRICANTS	*$8,235,461*	Revenue Miles	27,499,916	$0.30	1.023	$0.31	$8,423,294
TIRES & TUBES	*$2,151,185*	Revenue Miles	27,499,916	$0.08	1.023	$0.08	$2,200,249
OTHER MATERIALS & SUPPLIES	*$659,868*	Peak Buses	533	$1,238.03	1.023	$1,266.26	$674,918
TAXES & FEES	*$113,612*	Peak Buses	533	$213.16	1.023	$218.02	$116,203
MISCELLANEOUS EXPENSES	*$287,947*	Garages	3	$95,982	1.023	$98,171	$294,514
VEHICLE MAINTENANCE							
SALARIES & WAGES - Rev.-Miles Driven (50%)	*$12,566,372*	Revenue Miles	27,499,916	$0.46	1.023	$0.47	$12,852,984
SALARIES & WAGES - Peak Buses Driven (50%)	*$12,566,372*	Peak Buses	533	$23,577	1.023	$24,114	$12,852,984
FRINGE BENEFITS - Rev.-Miles Driven (50%)	*$2,915,248*	Revenue Miles	27,499,916	$0.11	1.023	$0.11	$2,981,738
FRINGE BENEFITS - Peak Buses Drivem (50%)	*$2,915,248*	Peak Buses	533	$5,469.51	1.023	$5,594.26	$2,981,738
PROFESSIONAL & TECHNICAL SERVICES	*$2,303,777*	Revenue Miles	27,499,916	$0.08	1.023	$0.0857	$2,356,321
FUEL & LUBRICANTS	*$1,666,811*	Peak Buses	533	$3,127.23	1.023	$3,198.55	$1,704,827
TIRES & TUBES	*$44,355*	Peak Buses	533	$83.22	1.023	$85.12	$45,367
OTHER MATERIALS & SUPPLIES	*$8,931,745*	Revenue Miles	27,499,916	$0.32	1.023	$0.33	$9,135,459
TAXES & FEES	*$7,859*	Peak Buses	533	$14.74	1.023	$15.08	$8,038
MISCELLANEOUS EXPENSES	*$143,943*	Peak Buses	533	$270.06	1.023	$276.22	$147,226
NON-VEHICLE MAINTENANCE							
SALARIES & WAGES - Oper Garage Driven (50%)	*$1,746,087*	Garages	3	$582,029	1.023	$595,304	$1,785,911
SALARIES & WAGES - Passenger Facilities Driven (50%)	*$1,746,087*	Pass Facilities	14	$124,720	1.023	$127,565	$1,785,911
FRINGE BENEFITS - Operating Garages Driven	*$656,930*	Garages	3	$218,977	1.023	$223,971	$671,913
FRINGE BENEFITS - Passenger Facilities Driven	*$656,930*	Pass Facilities	14	$46,924	1.023	$47,994	$671,913
PROF & TECH SERVICES - Oper Garage Driven (90%)	*$2,812,283*	Garages	3	$937,428	1.023	$958,808	$2,876,425
PROF & TECH SERVICES - Pass. Facilities Driven (10%)	*$312,476*	Pass Facilities	14	$22,320	1.023	$22,829	$319,603
MATERIALS & SUPPLIES - Oper Garage Driven (90%)	*$411,871*	Garages	3	$137,290	1.023	$140,421	$421,264
MATERIALS & SUPPLIES - Pass. Facilities Driven (10%)	*$45,763*	Pass Facilities	14	$3,268.81	1.023	$3,343.37	$46,807
TAXES & FEES	*$475*	Garages	3	$158.33	1.023	$161.94	$486
MISCELLANEOUS EXPENSES	*$859*	Garages	3	$286.33	1.023	$292.86	$879
GENERAL ADMINISTRATION							
SALARIES & WAGES - Oper Garages Driven (75%)	*$12,053,366*	Garages	3	$4,017,789	1.023	$4,109,426	$12,328,277
SALARIES & WAGES - Peak Bus Driven (25%)	*$4,017,789*	Peak Buses	533	$7,538.06	1.023	$7,709.99	$4,109,426
FRINGE BENEFITS - Operating Garages Driven	*$5,847,698*	Garages	3	$1,949,233	1.023	$1,993,691	$5,981,072
FRINGE BENEFITS - Peak Bus Driven	*$1,949,233*	Peak Buses	533	$3,657.10	1.023	$3,740.51	$1,993,691
PROF. & TECH. SERVICES - Oper Garages Driven (75%)	*$7,560,742*	Garages	3	$2,520,247	1.023	$2,577,729	$7,733,186
PROF. & TECH. SERVICES - Peak Buses Driven (25%)	*$2,520,247*	Peak Buses	533	$4,728.42	1.023	$4,836.26	$2,577,729
MATERIALS & SUPPLIES - Oper Garage Driven (75%)	*$1,204,105*	Garages	3	$401,368	1.023	$410,523	$1,231,568
MATERIALS & SUPPLIES - Peak Bus Driven (25%)	*$401,368*	Peak Buses	533	$753.04	1.023	$770.21	$410,523
UTILITIES - Oper Garages Driven (75%)	*$2,256,796*	Garages	3	$752,265	1.023	$769,423	$2,308,268
UTILITIES - Passenger Facilities Driven (25%)	*$752,265*	Pass Facilities	14	$53,733	1.023	$54,959	$769,423
CASUALTY & LIABILITY - Bus-Miles Driven (50%)	*$2,368,932*	Revenue Miles	27,499,916	$0.09	1.023	$0.09	$2,422,962
CASUALTY & LIABILITY - Peak Bus Driven (50%)	*$2,368,932*	Peak Buses	533	$4,444.53	1.023	$4,546	$2,422,962
TAXES & FEES	*$187,945*	Peak Buses	533	$352.62	1.023	$360.66	$192,232
MISCELLANEOUS EXPENSES - Oper Garages Driven (75%)	*$601,867*	Garages	3	$200,622	1.023	$205,198	$615,594
MISCELLANEOUS EXPENSES - Peak Buses Driven (25%)	*$200,622*	Peak Buses	533	$376.40	1.023	$384.99	$205,198
TOTALS	***$243,666,328***						**$249,223,827**

NTD Fringe Benefit Rates =	
Vehicle Operations	69.9%
Vehicle Maintenance	23.2%
Non-Vehicle Maintenance	37.6%
General Administration	48.5%

Revenue Hours	2,159,188
Revenue Bus-Miles	27,499,916
Peak Buses	533
Oper Garages	3
Pass. Facilities	14

Source: Connetics Transportation Group, Inc.

APPENDIX C: LRT O&M COST MODEL LINE ITEM DETAIL – NO BUILD

Dallas Area Rapid Transit
LIGHT RAIL LINE ITEM DETAIL

No Build

					Inflation Factor:		1.023
	2016	Productivity Ratio		Base Year		Results in:	2017$
Expense Line Item	*Light Rail Expenses*	Resource Variable	Resource Value	Resource Unit Cost	Inflation Factor	Resource Unit Cost	Estimated Annual Cost
VEHICLE OPERATIONS							
OPERATORS' SALARIES & WAGES	*$9,988,341*	Rev. Train-Hrs	258,459	$38.65	1.023	$39.53	$10,288,528
OTHER SALARIES & WAGES -Train-Hours Driven (60%)	*$15,741,995*	Rev. Train-Hrs	258,459	$60.91	1.023	$62.30	$16,215,101
OTHER SALARIES & WAGES -Yards Driven (20%)	*$5,247,332*	Yards	2	$2,623,666	1.023	$2,683,506	$5,367,012
OTHER SALARIES & WAGES -Tot. Stations Driven (20%)	*$5,247,332*	Stations	64	$81,990	1.023	$83,860	$5,367,012
FRINGE BENEFITS - Train-Hours Driven	*$14,354,093*	Rev. Train-Hrs	258,459	$55.54	1.023	$56.80	$14,785,487
FRINGE BENEFITS - Yards Driven	*$2,927,311*	Yards	2	$1,463,655	1.023	$1,497,038	$2,994,076
FRINGE BENEFITS - Total Stations Driven	*$2,927,311*	Stations	64	$45,739.23	1.023	$46,782	$2,994,076
PROFESSIONAL & TECHNICAL SERVICES	*$2,200,609*	Peak Cars	98	$22,455.19	1.023	$22,967	$2,296,735
OTHER MATERIALS & SUPPLIES	*$507,205*	Yards	2	$253,603	1.023	$259,387	$518,773
UTILITIES	*$12,861,787*	Rev Car-Miles	9,829,532	$1.31	1.023	$1.34	$12,901,012
MISCELLANEOUS EXPENSES	*$389,838*	Yards	2	$194,919.00	1.023	$199,365	$398,729
VEHICLE MAINTENANCE							
SALARIES & WAGES	*$15,106,422*	Rev Car-Miles	9,829,532	$2	$1	$2	$15,152,493
FRINGE BENEFITS	*$7,639,781*	Rev Car-Miles	9,829,532	$0.78	1.023	$0.79	$7,663,080
PROFESSIONAL & TECHNICAL SERVICES	*$1,549,675*	Rev Car-Miles	9,829,532	$0.16	1.023	$0.16	$1,554,401
FUEL & LUBRICANTS	*$578,651*	Peak Cars	98	$5,904.60	1.023	$6,039.27	$603,927
TIRES & TUBES	*$43,344*	Peak Cars	98	$442.29	1.023	$452.37	$45,237
OTHER MATERIALS & SUPPLIES - Car-Miles Driven (90%)	*$10,875,767*	Rev Car-Miles	9,829,532	$1.11	1.023	$1.13	$10,908,935
OTHER MATERIALS & SUPPLIES - Peak Car Driven (10%)	*$1,208,419*	Peak Cars	98	$12,330.80	1.023	$12,612.04	$1,261,204
TAXES & FEES	*$1,620*	Peak Cars	98	$17	1.023	$17	$1,691
MISCELLANEOUS EXPENSES	*$281,046*	Peak Cars	98	$2,867.82	1.023	$2,933.22	$293,322
NON-VEHICLE MAINTENANCE							
SALARIES & WAGES - Total Stations Driven (50%)	*$9,303,413*	Stations					
		At-Grade	53	$120,824	1.023	$123,579.26	$6,549,701
		Aerial	10	$241,647	1.023	$247,159	$2,471,585
		Subway	1	$483,294	1.023	$494,317	$494,317
SALARIES & WAGES - Yards Driven (10%)	*$1,860,683*	Yards	2	$930,341	1.023	$951,560	$1,903,121
SALARIES & WAGES - Track Miles Driven (40%)	*$7,442,730*	Track Miles	208	$35,817	1.023	$36,634	$7,612,482
FRINGE BENEFITS - Total Stations Driven	*$4,360,096*	Stations					
		At-Grade	53	$56,625	1.023	$57,916.11	$3,069,554
		Aerial	10	$113,249	1.023	$115,832	$1,158,322
		Subway	1	$226,498	1.023	$231,664	$231,664
FRINGE BENEFITS - Yards Driven	*$872,019*	Yards	2	$436,010	1.023	$445,954	$891,908
FRINGE BENEFITS - Track Miles Driven	*$3,488,077*	Track Miles	208	$16,786	1.023	$17,169	$3,567,632
PROF. & TECH. SERVICES - Total Stations Driven (50%)	*$3,830,414*	Stations					
		At-Grade	53	$49,746	1.023	$50,880.22	$2,696,652
		Aerial	10	$99,491	1.023	$101,760	$1,017,604
		Subway	1	$198,983	1.023	$203,521	$203,521
PROF. & TECH. SERVICES - Yards Driven (10%)	*$766,083*	Yards	2	$383,041	1.023	$391,778	$783,555
PROF. & TECH. SERVICES - Track Miles Driven (40%)	*$3,064,331*	Track Miles	208	$14,747	1.023	$15,083	$3,134,222
MATERIALS & SUPPLIES - Total Stations Driven (50%)	*$1,512,121*	Stations					
		At-Grade	53	$19,638	1.023	$20,085.83	$1,064,549
		Aerial	10	$39,276	1.023	$40,172	$401,717
		Subway	1	$78,552	1.023	$80,343	$80,343
MATERIALS & SUPPLIES - Yards Driven (10%)	*$302,424*	Yards	2	$151,212	1.023	$154,661	$309,322
MATERIALS & SUPPLIES - Track Miles Driven (40%)	*$1,209,697*	Track Miles	208	$5,821	1.023	$5,954	$1,237,287
TAXES & FEES	*$118,222*	Track Miles	207.8	$568.92	1.023	$581.90	$120,918
MISCELLANEOUS EXPENSES	*$2,576*	Track Miles	207.8	$12.40	1.023	$12.68	$2,635

APPENDIX C: LRT O&M COST MODEL LINE ITEM DETAIL – NO BUILD (continued)

					Inflation Factor:		1.023
	2016	Productivity Ratio		Base Year		Results in:	2017$
Expense Line Item	Light Rail Expenses	Resource Variable	Resource Value	Resource Unit Cost	Inflation Factor	Resource Unit Cost	Estimated Annual Cost
GENERAL ADMINISTRATION							
SALARIES & WAGES - Yards Driven (90%)	*$12,869,169*	Yards	2	$6,434,585	1.023	$6,581,344	$13,162,687
SALARIES & WAGES - Peak Cars Driven (10%)	*$1,429,908*	Peak Cars	98	$14,591	1.023	$14,924	$1,492,368
FRINGE BENEFITS - Yards Driven (90%)	*$1,758,380*	Yards	2	$879,190	1.023	$899,243	$1,798,485
FRINGE BENEFITS - Peak Cars Driven (10%)	*$195,376*	Peak Cars	98	$1,993.63	1.023	$2,039.10	$203,910
PROFESSIONAL & TECH. SERVICES	*$8,694,820*	Yards	2	$4,347,410	1.023	$4,446,565	$8,893,130
MATERIALS & SUPPLIES	*$2,156,631*	Yards	2	$1,078,316	1.023	$1,102,910	$2,205,819
UTILIITES - Yards Driven (50%)	*$655,464*	Yards	2	$327,732	1.023	$335,207	$670,413
UTILITIES - Stations Driven (50%)	*$655,464*	Stations					
		At-Grade	53	$8,512.51	1.023	$8,706.66	$461,453
		Aerial	10	$17,025	1.023	$17,413	$174,133
		Subway	1	$34,050	1.023	$34,827	$34,827
CASUALTY & LIABILITY - Stations Driven (50%)	*$774,558*	Stations					
		At-Grade	53	$10,059	1.023	$10,289	$545,297
		Aerial	10	$20,118	1.023	$20,577	$205,772
		Subway	1	$40,237	1.023	$41,154	$41,154
CASUALTY & LIABILITY - Car-Miles Driven (50%)	*$774,558*	Rev Car-Miles	9,829,532	$0.08	1.023	$0.08	$776,920
MISCELLANEOUS EXPENSES	*$641,359*	Yards	2	$320,680	1.023	$327,994	$655,987
TOTALS	***$178,416,448***						**$181,935,801**

NTD Fringe Benefit Rates =		Rev Train-Hours	260,290
		Rev Car-Miles	9,639,650
Vehicle Operations	55.8%	Peak Cars	100
Vehicle Maintenance	50.6%	At-Grade Sta	53
Non-Vehicle Maintenance	46.9%	Aerial Sta	10
General Administration	13.7%	Subway Sta	1
		Track Miles	208
		Yards	2

Source: Connetics Transportation Group, Inc.

APPENDIX D: LRT O&M COST MODEL LINE ITEM DETAIL – DALLAS CBD SECOND ALIGNMENT (D2) PROJECT

Dallas Area Rapid Transit
LIGHT RAIL LINE ITEM DETAIL

Dallas Second Alignment D2

					Inflation Factor:		**1.023**
	2016	**Productivity Ratio**		**Base Year**		**Results in:**	**2017$**
Expense Line Item	***Light Rail Expenses***	**Resource Variable**	**Resource Value**	**Resource Unit Cost**	**Inflation Factor**	**Resource Unit Cost**	**Estimated Annual Cost**
VEHICLE OPERATIONS							
OPERATORS' SALARIES & WAGES	*$9,988,341*	Rev. Train-Hrs	258,459	$38.65	1.023	$39.53	$10,298,805
OTHER SALARIES & WAGES -Train-Hours Driven (60%)	*$15,741,995*	Rev. Train-Hrs	258,459	$60.91	1.023	$62.30	$16,231,298
OTHER SALARIES & WAGES -Yards Driven (20%)	*$5,247,332*	Yards	2	$2,623,666	1.023	$2,683,506	$5,367,012
OTHER SALARIES & WAGES -Tot. Stations Driven (20%)	*$5,247,332*	Stations	64	$81,990	1.023	$83,860	$5,702,450
FRINGE BENEFITS - Train-Hours Driven	*$14,354,093*	Rev. Train-Hrs	258,459	$55.54	1.023	$56.80	$14,800,256
FRINGE BENEFITS - Yards Driven	*$2,927,311*	Yards	2	$1,463,655	1.023	$1,497,038	$2,994,076
FRINGE BENEFITS - Total Stations Driven	*$2,927,311*	Stations	64	$45,739.23	1.023	$46,782	$3,181,206
PROFESSIONAL & TECHNICAL SERVICES	*$2,200,609*	Peak Cars	98	$22,455.19	1.023	$22,967	$2,342,669
OTHER MATERIALS & SUPPLIES	*$507,205*	Yards	2	$253,603	1.023	$259,387	$518,773
UTILITIES	*$12,861,787*	Rev Car-Miles	9,829,532	$1.31	1.023	$1.34	$12,941,965
MISCELLANEOUS EXPENSES	*$389,838*	Yards	2	$194,919.00	1.023	$199,365	$398,729
VEHICLE MAINTENANCE							
SALARIES & WAGES	*$15,106,422*	Rev Car-Miles	9,829,532	$2	$1	$2	$15,200,592
FRINGE BENEFITS	*$7,639,781*	Rev Car-Miles	9,829,532	$0.78	1.023	$0.79	$7,687,406
PROFESSIONAL & TECHNICAL SERVICES	*$1,549,675*	Rev Car-Miles	9,829,532	$0.16	1.023	$0.16	$1,559,335
FUEL & LUBRICANTS	*$578,651*	Peak Cars	98	$5,904.60	1.023	$6,039.27	$616,006
TIRES & TUBES	*$43,344*	Peak Cars	98	$442.29	1.023	$452.37	$46,142
OTHER MATERIALS & SUPPLIES - Car-Miles Driven (90%)	*$10,875,767*	Rev Car-Miles	9,829,532	$1.11	1.023	$1.13	$10,943,564
OTHER MATERIALS & SUPPLIES - Peak Car Driven (10%)	*$1,208,419*	Peak Cars	98	$12,330.80	1.023	$12,612.04	$1,286,428
TAXES & FEES	*$1,620*	Peak Cars	98	$17	1.023	$17	$1,725
MISCELLANEOUS EXPENSES	*$281,046*	Peak Cars	98	$2,867.82	1.023	$2,933.22	$299,189
NON-VEHICLE MAINTENANCE							
SALARIES & WAGES - Total Stations Driven (50%)	*$9,303,413*	Stations					
		At-Grade	53	$120,824	1.023	$123,579.26	$6,673,280
		Aerial	10	$241,647	1.023	$247,159	$2,471,585
		Subway	1	$483,294	1.023	$494,317	$1,977,268
SALARIES & WAGES - Yards Driven (10%)	*$1,860,683*	Yards	2	$930,341	1.023	$951,560	$1,903,121
SALARIES & WAGES - Track Miles Driven (40%)	*$7,442,730*	Track Miles	208	$35,817	1.023	$36,634	$7,748,027
FRINGE BENEFITS - Total Stations Driven	*$4,360,096*	Stations					
		At-Grade	53	$56,625	1.023	$57,916.11	$3,127,470
		Aerial	10	$113,249	1.023	$115,832	$1,158,322
		Subway	1	$226,498	1.023	$231,664	$926,658
FRINGE BENEFITS - Yards Driven	*$872,019*	Yards	2	$436,010	1.023	$445,954	$891,908
FRINGE BENEFITS - Track Miles Driven	*$3,488,077*	Track Miles	208	$16,786	1.023	$17,169	$3,631,156
PROF. & TECH. SERVICES - Total Stations Driven (50%)	*$3,830,414*	Stations					
		At-Grade	53	$49,746	1.023	$50,880.22	$2,747,532
		Aerial	10	$99,491	1.023	$101,760	$1,017,604
		Subway	1	$198,983	1.023	$203,521	$814,084
PROF. & TECH. SERVICES - Yards Driven (10%)	*$766,083*	Yards	2	$383,041	1.023	$391,778	$783,555
PROF. & TECH. SERVICES - Track Miles Driven (40%)	*$3,064,331*	Track Miles	208	$14,747	1.023	$15,083	$3,190,028
MATERIALS & SUPPLIES - Total Stations Driven (50%)	*$1,512,121*	Stations					
		At-Grade	53	$19,638	1.023	$20,085.83	$1,084,635
		Aerial	10	$39,276	1.023	$40,172	$401,717
		Subway	1	$78,552	1.023	$80,343	$321,373
MATERIALS & SUPPLIES - Yards Driven (10%)	*$302,424*	Yards	2	$151,212	1.023	$154,661	$309,322
MATERIALS & SUPPLIES - Track Miles Driven (40%)	*$1,209,697*	Track Miles	208	$5,821	1.023	$5,954	$1,259,318
TAXES & FEES	*$118,222*	Track Miles	207.8	$568.92	1.023	$581.90	$123,071
MISCELLANEOUS EXPENSES	*$2,576*	Track Miles	207.8	$12.40	1.023	$12.68	$2,682

APPENDIX D: LRT O&M COST MODEL LINE ITEM DETAIL – DALLAS CBD SECOND ALIGNMENT (D2) PROJECT (continued)

					Inflation Factor:		1.023
	2016	Productivity Ratio		Base Year		Results in:	2017$
Expense Line Item	*Light Rail Expenses*	Resource Variable	Resource Value	Resource Unit Cost	Inflation Factor	Resource Unit Cost	Estimated Annual Cost
GENERAL ADMINISTRATION							
SALARIES & WAGES - Yards Driven (90%)	*$12,869,169*	Yards	2	$6,434,585	1.023	$6,581,344	$13,162,687
SALARIES & WAGES - Peak Cars Driven (10%)	*$1,429,908*	Peak Cars	98	$14,591	1.023	$14,924	$1,522,216
FRINGE BENEFITS - Yards Driven (90%)	*$1,758,380*	Yards	2	$879,190	1.023	$899,243	$1,798,485
FRINGE BENEFITS - Peak Cars Driven (10%)	*$195,376*	Peak Cars	98	$1,993.63	1.023	$2,039.10	$207,988
PROFESSIONAL & TECH. SERVICES	*$8,694,820*	Yards	2	$4,347,410	1.023	$4,446,565	$8,893,130
MATERIALS & SUPPLIES	*$2,156,631*	Yards	2	$1,078,316	1.023	$1,102,910	$2,205,819
UTILIITES - Yards Driven (50%)	*$655,464*	Yards	2	$327,732	1.023	$335,207	$670,413
UTILITIES - Stations Driven (50%)	*$655,464*	Stations					
		At-Grade	53	$8,512.51	1.023	$8,706.66	$470,160
		Aerial	10	$17,025	1.023	$17,413	$174,133
		Subway	1	$34,050	1.023	$34,827	$139,307
CASUALTY & LIABILITY - Stations Driven (50%)	*$774,558*	Stations					
		At-Grade	53	$10,059	1.023	$10,289	$555,586
		Aerial	10	$20,118	1.023	$20,577	$205,772
		Subway	1	$40,237	1.023	$41,154	$164,618
CASUALTY & LIABILITY - Car-Miles Driven (50%)	*$774,558*	Rev Car-Miles	9,829,532	$0.08	1.023	$0.08	$779,386
MISCELLANEOUS EXPENSES	*$641,359*	Yards	2	$320,680	1.023	$327,994	$655,987
TOTALS	***$178,416,448***						**$186,587,031**

NTD Fringe Benefit Rates =		Rev Train-Hours	260,550
		Rev Car-Miles	9,670,250
Vehicle Operations	55.8%	Peak Cars	102
Vehicle Maintenance	50.6%	At-Grade Sta	54
Non-Vehicle Maintenance	46.9%	Aerial Sta	10
General Administration	13.7%	Subway Sta	4
		Track Miles	212
		Yards	2

Source: Connetics Transportation Group, Inc.