Northstar Commuter Rail Extension Feasibility Assessment

Appendix I – Technical Memorandum on Capital Cost Estimating Methodology

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Prepared for

DEPARTMENT OF TRANSPORTATION

by

QUANDEL CONSULTANTS

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1. Introduction

This document provides a written methodology for establishing unit costs for pay items related to the proposed extension of the Northstar commuter rail corridor. This methodology serves as a basis for the formulation of conceptual cost estimates for the proposed Service Alternatives.

The cost estimates were developed at a conceptual level based on limited information regarding overall track, signal, Positive Train Control (PTC), and infrastructure conditions; railroad operations; and input from the owning railroad. The validity of the capital cost estimates rests on the assumptions and information gained from available railroad track charts and timetables; aerial mapping; input from BNSF, Minnesota Department of Transportation, and Metro Transit; and visual observations of the railroad made from publicly accessible locations. The methodology serves as a starting point for the continuing development of costs associated with the proposed extension of Northstar commuter rail service to St. Cloud.

2. Development of Unit Costs

The unit costs used to estimate capital costs for the Northstar Commuter Rail Extension Feasibility Assessment were developed over time from detailed breakdowns of the units into their basic elements. The costs related to material, labor, equipment and overhead for these elements were accumulated and rolled up to provide an inclusive unit cost for the various components required to develop a passenger rail system. Initially, the unit costs were developed for planned construction in the Midwest as part of the Midwest Regional Rail Initiative. Later, the costs were applied to capital cost estimates for high-speed rail in Florida, Ohio, Minnesota, and Colorado. The unit costs have been refreshed and refined periodically to update for inflation and changes in the approach to infrastructure development and technology. The unit costs were updated and modified for the proposed extension of Northstar commuter rail service to St. Cloud.

For this cost methodology, the unit costs were updated to 2020 dollars using an inflation factor of 1.09 obtained from the Bureau of Economic Analysis's Table 1.1.9. Implicit Price Deflators for Gross Domestic Product from 2014 to 2020[1]. The overall cost of the capital improvements was presented in both 2020 and 2025 dollars, the latter of which was calculated using Federal Railroad Administration's (FRA's) Standard Cost Category and inflation worksheet[2].

Unit costs presented in this methodology include allocated contingencies but exclude professional services fees and unallocated contingencies. Once the cost for each capital improvement is calculated, the professional services fees and unallocated contingencies are added.

The revised base set of unit costs addresses typical passenger rail infrastructure construction elements expected to be found within the proposed Northstar corridor including roadbed and trackwork, signal and PTC systems, facilities, structures, and grade crossings. The unit costs are reasonable for developing

[1] https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=3&isuri=1&nipa_table_list=13
[2] https://railroads.dot.gov/elibrary/mp-33-scc-worksheets

the capital costs under either normal contractor bidding procedures or under railroad force account agreements for construction.

3. Cost Categories

3.1. Trackwork

Currently, Northstar commuter rail service, Amtrak intercity passenger rail service, and BNSF freight operations occur over track complying with FRA Classes I through 4, allowing maximum speeds of 60 MPH for freight and 79 MPH for passenger trains. Other freight carriers also operate over several segments of BNSF track in the corridor. No changes in the maximum authorized speeds for trains operating in the corridor are included as part of the proposed extension of Northstar commuter service to St. Cloud. In some segments of the corridor, trains operate at lower speeds due to design or operating characteristics. Increased track speeds through certain turnouts and crossovers, achievable by upgrading the trackwork to higher speed configurations within the existing track standards, is proposed for several locations to increase corridor capacity. New track and special trackwork, as well as upgraded track, are proposed as part of the Northstar extension to increase corridor capacity and improve operating flexibility.

3.1.1. Design Considerations

- Maximum speed for all service alternatives is 79 mph for passenger trains and 60 mph for freight trains (FRA Class 4).
- Additional main track, new or upgraded existing tracks, new or upgraded CTC/PTC control points, and other improvements are proposed where shown to be necessary by Rail Traffic Controller™ (RTC) operations analysis to accommodate additional freight trains as well as extended and/or an additional number of Northstar commuter trains.
- Fencing will be provided at certain locations along the length of the route.
- For existing private crossings, no change is anticipated in the crossing warning devices.
- Public crossings, where an additional track will be constructed through the crossing, will have the existing grade crossing warning equipment on the affected side(s) relocated and, where applicable, the median removed and extended to accommodate the additional track. Widening, approach gradient surface modifications, and the extension of culverts are also included.

Where new track will be constructed, the primary unit of cost will be “New Track”. This unit is based on BNSF typical sections and is composed of the following:

- New 136 or 141 lb. Continuous Welded Rail
- 7” x 9” x 8’6” timber crossties spaced at 19.5” C-C, which results in 3249 per mile
- Two-13” double shouldered tie plates, four rail anchors, and eight track spikes (or corresponding rail seats and elastomeric fasteners) per tie.
- 12” of Granite ballast (AREMA #4) placed to support the proper vertical and horizontal track alignment. Depth of ballast is measured at the center of the tie. Additional ballast will be placed to fill the cribs between the ties and provide a ballast shoulder on the outside of each tie per the typical section required by the owning railroad.

3.1.2. Track on Existing Roadbed

Track on Existing Roadbed addresses the installation of a new track on an existing roadbed within an existing railroad right of way where track(s) has been removed. If there is an existing track present in the right of way, the new track will be built at an appropriate distance from it, generally using the same track centers as had been used before the historic second track had been removed. The track center to center distance is typically 14'. If there is no track in place, the new track will generally be centered in the right of way per the operating railroads typical track section. The work consists of leveling the roadbed, maintaining existing drainage, and placing a 6" ballast pad prior to track construction. Track will be constructed on this base and the remaining 6" required ballast will be installed to allow final alignment and surfacing of the new track. The unit cost for this item is $1,563,200 per mile.

3.1.3. Track on New Roadbed

This unit was used for proposed track on an existing embankment where the roadbed is replaced. The work consists of removing the existing roadbed and placing 12" of sub-ballast. Track will then be constructed on this base. The unit cost for this item is $1,847,600 per mile.

3.1.4. Track on New Roadbed & New Embankment

This unit was used for proposed track where no track or railroad right of way is present, or when the required track center distance to an existing freight operation places the proposed new track outside the limits of the existing roadbed and/or right of way limits. The work consists of site clearing the full width of additional roadbed or right of way (a minimum of 25 feet in width for single track and 50 feet in width for double track), preparing the subgrade (up to 5 feet above the surrounding ground elevation), establishing drainage patterns or maintaining existing drainage, and placing 12" of sub-ballast. Track will then be constructed on this base. The unit cost for this item is $2,114,900 per mile.

3.2. Turnouts & Crossovers

This work includes:

- Removal and reclamation of the existing standard track or turnout/crossover section where the new turnout or crossover will be placed.
- Leveling of the roadbed and removing & stockpiling excess ballast for re-use.
- Installation of a switch panel (or assembly and installation of a switch package) which includes all rods, plates, anchors, fasteners, 136/141 lb rail, switch points, stock rails, frog and wood or concrete ties and field welds to place the turnout into operation.
- Ballast – placed to ensure 12" under the ties.
- Filter fabric for the footprint of the turnout to be installed.
- Track surfacing to ensure proper vertical and horizontal alignment of the turnout or crossover and the track that it is connected to.
- Provision of a measure to protect the operating components of the turnout from freezing due to snow and ice: these include but are not limited to hot or cold air blowers and electric cal-rod heaters.
- Crossovers will include a section of track (after the frogs of each turnout) with special timbers used until the track separates enough to allow standard "New Track" to be constructed

completing the connection between the opposite ends of the crossover. The length of the "New Track" will depend on the distance between the centerlines of the tracks to be connected.

The various types of turnouts to be used are:

- #24 Turnout - Timber Ties – The unit cost for this item is $637,900 each.
- #20 Turnout – Timber Ties – The unit cost for this item is $229,400 each.
- #15 Turnout – Timber Ties – The unit cost for this item is $184,900 each.
- #11 Turnout – Timber Ties – The unit cost for this item is $161,300 each.
- #9 Turnout – Timber Ties – The unit cost for this item is $146,100 each.
- 16'6" Double Switch Point Derail – Timber Ties – The unit cost for this item is $73,000 each.
- Hand-Operated Sliding Derail – Timber Ties – The unit cost for this item is $1,500 each
- Switch Point Derail – The unit cost for this item is $36,500 each.
- #24 Crossover – The unit cost for this item is $1,329,700 each.
- #20 Crossover – The unit cost for this item is $1,006,600 each.
- #15 Crossover – The unit cost for this item is $463,100 each.

3.3. Track Improvements

Based on the above discussion, several categories of track improvements and types of track construction have been developed. Track improvements include:

3.3.1. Track Shift

This work consists of lining and relocating the track as indicated in the concept plans. Work includes adjusting the horizontal and vertical alignments. The unit cost for this item is $153,300 per mile.

3.3.2. Tie & Surface w/ 66% Tie Replacement

This work consists of removing 2/3 of the ties and replacing them with new ties. Additionally, 600 tons of ballast per mile will be placed in the work area to support the tie renewal. Assuming 19.5" tie spacing and 3,249 ties per mile, this would result in the renewal of 2,166 ties per mile. The unit cost for this item is $469,200 per mile.

3.4. Site Work Related to Track Construction

3.4.1. Fencing, 6 ft Chain Link (both sides of the railroad right of way)

This work includes the installation of 6 ft galvanized steel chain link right-of-way fencing. Included in the cost are the fencing and post materials, clearing and grubbing of the area at the right-of-way line, and installation costs. The unit cost for this item is $149,900 per mile.

3.4.2. Drainage Improvements (cross country)

This work includes the installation of drainage pipe, assumed to be a maximum of 30" in diameter, at locations where new track or track sidings will be installed and/or embankment widened. It is assumed that 2 drainage pipes per mile of improvements will be installed. The unit cost for this item is $81,400 per mile.

3.4.3. Remove Existing Turnout or Crossover

Work consists of removal of complete turnout or crossover from head block ties to last long tie at locations where existing turnout or crossover is to be returned to straight track. Restoration of the parent track is not included in this pay item and is accounted for as "New Track" at the appropriate unit cost per mile. The unit cost for Remove Existing Turnout is $8,700 each and Remove Existing Crossover is $17,400 each.

3.4.4. Clearing and Grubbing

Clearing consists of removing and disposing of all obstructions such as fences, walls, foundations, buildings, accumulations of rubbish of whatever nature, and existing structures. The cost also includes removal of all logs, shrubs, bushes, saplings, grass, weeds, other vegetation, and stumps of a diameter less than 6 inches. The unit cost also includes tree removal, which consists of cutting, grubbing, removal, and disposal of trees and stumps. The unit cost for this item is $2,100 per acre.

3.4.5. Removal of Track on Existing Roadbed

This work consists of removing and disassembling existing track and stockpiling of removed rail and other track material. The cost includes all costs for handling, loading, hauling, and stockpiling of the scrap rail and track material and blading the remaining roadbed so that its surface is smooth and sloped to drain surface water. The unit cost for this item is $12 per track-foot.

3.4.6. Removal of Bumping Post

This work consists of removing a steel bumping post from the rails at the end of the track at Big Lake Station. The unit cost for this item is $1,000 each.

4. Structures

Structures expected for the extension of Northstar commuter rail service include bridges that carry the railroad over a river; these bridges are categorized as “undergrade”. Bridges that carry an environmental feature over a railroad, for instance, a two-lane highway, are categorized as “overhead”. Additionally, other structures such as structural culverts and retaining walls are included in this section. The type size and location of these structures will be determined during Preliminary Engineering; for these conceptual cost estimates, general categories of structures, and their unit costs have been developed based on their function and an estimate of required cross section and approximate cost per square foot and are listed below. These costs are for the structures and their typical components only; the cost of any track features is priced separately.

4.1. Design Considerations

General design considerations have been established to guide conceptual planning and are listed below.

- Bridges generally include superstructure, substructure, appropriate wing walls and embankment retention systems, and approach treatments in both directions from the bridge
- In areas where the proposed service will travel under existing bridges carrying highway, railroad or pedestrian traffic over the alignment, the addition of a new track at various track centers may be infeasible due to insufficient portal opening to accommodate the new track. In these instances, the overhead bridge will be replaced to accommodate the proposed alignment.

  - In some cases, it may be possible to modify the piers, abutments and other structural features of the existing overhead bridge to accommodate the new track. However, the extent to which this will be possible requires more a more detailed engineering study which is not conducted at the conceptual level. Since that is the case, a conservative assumption is made that unless there is a clear indication that the existing portals will allow the construction of a new track or tracks, the overhead structure will be replaced.
- In areas where the proposed alignment prevents the use of existing bridges or where there are no existing bridges, new bridges will be built as needed.

4.2. Bridges – Undergrade

This group of unit costs is intended to capture the level of effort required to allow the addition of a new track parallel and adjacent to an existing track as it passes over a variety of obstacles in the environment. Generally, the work will include provision of new abutments or abutment extensions, necessary grading and earth retention system to control the embankment at the abutments, any new piers or pier modification necessary and the placement of a new superstructure and track on the substructure at these locations.

- Four Lane Urban Expressway - The unit cost for this item is $6,853,600 each.
- Minor River – generally, this bridge type is less than 100' between abutments with relatively short span lengths. The unit cost for this item is $1,148,200 each.

4.3. Other Structures

4.3.1. Culvert Extensions

This work includes the installation of a culvert extension in locations where a new track will be built parallel and adjacent to an existing track. The culvert extension consists of a new pipe starting at the end of the existing culvert and extending to the edge of the embankment that the new track will be built upon. The cost includes connection to the existing pipe, associated grading, headwall and embankment retention associated with the culvert. It is assumed that the extension will consist of a maximum size of 36" reinforced concrete pipe. In some segments, the number of existing culverts is known. In those segments, the actual number of culverts will be estimated. In others, one culvert extension will be installed per mile of improvements on average. The unit cost for this item is $72,700 per mile.

5. Systems

In all instances where a new track and/or Control Point (CP) are proposed on the mainline, a Centralized Traffic Control (CTC) signal system and PTC signal system must be installed. The CTC and PTC systems will be designed by BNSF during Preliminary Engineering.

5.1. Design Considerations

General design considerations have been established to guide conceptual planning and are listed below.

- All signal elements include hardware and software to design, procure, install and operate the element under consideration. This includes "signals", "communications" & "dispatch" components which together make up the interactive remote-controlled signal system.

- At all locations where a train can change from one track to another or divert from the main track to a siding, yard, or railroad using remote-controlled switches, a CP must be established. The CP links the track infrastructure and circuitry to a communications network allowing the dispatcher to maintain or change the route of a given train, as well as allow it to proceed or cause it to stop. Significant components are the remote-controlled powered switch machine, cable connecting it to logical and relays and microprocessor-based control and communication equipment housed in a wayside building, a communications link between the control point and the remote dispatcher, signals to provide a train approaching from any direction with visual indications governing its movement, and a provision of commercial electrical power and backup to operate the various elements.
- At locations where a connection to a rail-served industry is required outside of a CP, protection must be provided so that a freight or passenger train cannot be unintentionally diverted into the industry track and also so that a railcar or other vehicle occupying the siding cannot access the main track without permission from the dispatcher controlling the main line railroad. Typically, at these locations, a switch is installed and "electric lock" protection is provided at the switch. Along the siding, a derail is placed as a measure to prevent an uncontrolled movement from the siding to the main or vice versa. The electric lock prevents opening the switch without the knowledge of and direct permission from the dispatcher in charge of the railroad. When the switch is opened, the track circuitry "notifies" the dispatcher and wayside signals in either direction.

5.2. Assumptions

It is assumed that BNSF uses Wabtec's Electronic Train Management System (ETMS) PTC technology throughout the Northstar corridor. ETMS uses Global Positioning Systems (GPS), in tandem with digital radio, to monitor train speeds and locations. This system was designed to prevent train collisions, restrict trains from operating above allowable speed limits, and avoid speed related derailments. To maintain BNSF's operational safety and abide by FRA's PTC requirements, ETMS was included in capital infrastructure estimates produced for the Northstar Commuter Rail Extension Feasibility Assessment.

Unit costs were developed specifically for this Feasibility Assessment using estimated PTC costs from an intercity passenger rail program whose system was designed to be compatible with BNSF's ETMS PTC technology. The Northstar estimate was prepared with enough detail in the unit cost build-up to enable railroad stakeholders to understand the proposed PTC elements. Generally, each unit cost includes the price of materials and installation, costs for the railroad to complete wayside engineering and detailed location design, and costs to update the Subdivision file, ITCM communications, and dispatch office. A complexity factor was assigned to each cost element to account for the increased labor required to update the Subdivision file, ITCM communications, and dispatch office. Attachment 1 provides the breakdown of PTC/CTC unit costs.

5.3. Systems Categories

5.3.1. New PTC/CTC Control Point

New PTC/CTC CPs are established where new crossovers or turnouts are proposed outside of an existing CP. The unit cost includes all communications and central dispatch equipment, track circuitry, and wayside signaling to control the flow of rail traffic. Wayside signaling includes signals, signal

masts/cantilevers/bridges, power-operated switch machines, hardware, software, controllers, wiring/cabling, hot air blowers, cabinets, housings, and commercial power. The unit cost also includes costs for PTC system design and location design (back-office work) by the railroad. New PTC/CTC CPs are proposed at the following locations:

- CP West St. Cloud (MP 75.0) – unit cost is $1,827,700 Lump Sum.
- CP Becker (MP 57.2) – unit cost is $1,336,000 Lump Sum.
- CP Big Lake West for Big Lake Track Connection (MP 47.1) – unit cost is $1,550,800 Lump Sum.
- CP MP 20.1 – unit cost is $1,659,700 Lump Sum.

5.3.2. Modified PTC/CTC Control Point

Modifications occur to PTC/CTC CPs when new crossovers or turnouts are added to an existing CP. A CP can also be modified for the addition of a signal, relocation or replacement of a signal, or addition of an electric lock or derail. In general, the unit cost includes new wayside signaling (described under Section 5.3.1) for the signal elements proposed for each CP. Where significant modifications are made to the existing CP, new wayside equipment (housing, cables, utility poles, utility service, PTC antenna, equipment racks, batteries, vital and non-vital relays, etc.) is included in the cost. PTC/CTC CPs are proposed to be modified at the following locations:

- CP St. Cloud (MP 73.6) – new wayside equipment, signal work for two new crossovers and 3 new turnouts, one electric lock and derail with track circuit, four new signals, and one two-track signal cantilever – unit cost is $2,162,800 Lump Sum.
- CP MP 66 – new wayside equipment, signal work for two new crossovers, and two new signals – unit cost is $1,094,200 Lump Sum.
- CP MP 52.8 – signal work for one new turnout and one three-track signal bridge – unit cost is $435,600 Lump Sum.
- CP Big Lake West for Big Lake West Siding (assumes Big Lake Station Track Connection has been constructed) – signal work for two new crossovers and one turnout, one derail, and four new signals – unit cost is $1,117,700 Lump Sum.
- CP Coon Creek (MP 21.1) – new wayside equipment, signal work for three crossovers, new three-track signal bridge – unit cost is $1,532,500 Lump Sum.
- CP MP 16.3 – new wayside equipment, signal work for two new crossovers, and one three-track and one four-track signal bridge – unit cost is $1,434,700 Lump Sum.
- CP Interstate – new wayside equipment, signal work for one new crossover and one new turnout, one new derail, one new signal, and two four-track signal bridges – unit cost is $1,470,200 Lump Sum.
- CP Interstate for Third Main CP Interstate to CP Van Buren (assumes third main from CP Coon Creek to CP Interstate has been constructed) – two new electric locks and derails with track circuit – unit cost is $243,000 Lump Sum.

- CP 44th Avenue – signal work for one new turnout, one new derail, one new signal, and two new three-track signal bridges – unit cost is $693,200 Lump Sum.
- CP 35th Avenue – one new electric lock and derail with track circuit, one new signal, and one new three-track signal bridge – unit cost is $358,700 Lump Sum.
- CP Van Buren – one new turnout, one new electric lock and derail with track circuit, and two new signals – unit cost is $483,000 Lump Sum.
- CP Harrison St. – new wayside equipment, signal work for two new crossovers and two new turnouts, one new derail, and four new signals – unit cost is $1,751,200 Lump Sum.

5.3.3. Modified Intermediate Signal with PTC/CTC

Where a proposed third track is constructed through an existing intermediate signal location, modifications occur to the signal location to accommodate the new track. Modifications include installation of an additional signal to govern the new track and installation of a new bungalow and antenna, if necessary. Modifications are proposed for the following intermediate signal locations:

- MP 50.8 – unit cost is $58,400 Lump Sum.
- MP 49.5 – unit cost is $195,800 Lump Sum.
- MP 18.4 – unit cost is $58,400 Lump Sum.

5.3.4. Industry Turnout (Signal Work)

In several locations, existing track is proposed to be realigned at industry turnouts. When this occurs, the industry turnout is relocated and new electric locks with derails are installed. This unit cost includes costs for the electric lock and layout, the wayside case, foundation, and components within the case, commercial power and power connection materials, track connections, the derail, battery, battery box, and all wire connections. Additionally, the work includes intermediate signal modifications and track circuit modifications to tie the new Electric Lock Switch location into the existing signal system. Industry turnout signal work is proposed at the following locations:

- MP 19.64 – unit cost is $122,500 Lump Sum.
- On BNSF Midway Sub – unit cost is $239,600 Lump Sum.

6. Grade Crossings

The treatment and design of improved safety and warning devices will need further development to identify specifications and various approaches that may be advanced as part of an integrated program.

6.1. Design Considerations

For the purpose of establishing a reasonable cost estimate at the conceptual design stage, the following design parameters are proposed:

- Train warning systems will be upgraded to standard two quadrant gates and flashers with constant warning time for public at-grade crossings
- Precast crossing surface panels will be installed at all public crossings on existing track at locations where trackwork related to passenger service takes place

- Precast crossing surface panels will be installed on both new and existing tracks and the roadway will be re-profiled where new track is constructed through the crossing

6.2. Crossing Improvement Categories

6.2.1. Conventional Gates/single mainline track

6.2.2. Conventional Gates/double mainline track

6.2.3. Conventional Gates/triple mainline track

Work to install conventional gates for a single, double, or triple mainline track includes all hardware, software, wiring, communication equipment and commercial power with battery backup to operate the warning system. Where grade crossing warning devices are proposed to be relocated due to a track shift at a two-track crossing, the existing grade crossing warning devices are replaced with Conventional Gates/double mainline track. Where a third track is proposed to cross an existing two-track crossing, the existing grade crossing warning devices are replaced with Conventional Gates/triple mainline track. Additional measures include the installation of Manual on Uniform Traffic Control Devices (MUCTD) -approved signs that specify "2 TRACKS" or "3 TRACKS" located on the same post as the crossbucks. Pedestrian gates are not included in this unit cost and are accounted for as "Pedestrian Gates" at the appropriate unit cost per gate. The unit costs for conventional gates are $213,600 each for single track, $290,800 each for double track, and $305,400 each for triple track.

6.2.4. Install Median

Where a third track is proposed to cross an existing two-track crossing with medians along the approach roadway, the existing median is removed, and a new 100-foot concrete median installed. The unit cost is $13,100 each to install a median.

6.2.5. Precast Panels

This work includes installing prefabricated concrete and steel crossing surface panels at a grade crossing. The crossing panels are placed within the track structure at the crossing to form a smooth running surface for vehicular traffic. The top surface of the panel will be level with the top of rail. The width of the crossing treatment will include and extend beyond associated sidewalks if present. At a minimum, the crossing panels will extend 2' beyond the paved roadway surface or sidewalk. The unit costs for this item is $112,800 each.

6.2.6. Minor Roadway Improvements at Grade Crossing

Roadway crown and superelevation in the approach pavement will be eliminated at or tapered into the crossing to match the grade and profile of the track. Additionally, the elevation of the approach pavement will be reconstructed to equal the top of rail for a minimum of 2 ft beyond the outer rail of the outermost track in each direction. Finally, the roadway surface must be within +/- 3" of the top of rail at a distance of 30' from the outermost rail unless track superelevation dictates otherwise. The unit cost for this item is $27,300 each.

6.2.7. Pedestrian Gate

Pedestrian gates are proposed where existing sidewalks approach a public track crossing. The unit cost includes a pedestrian gate, flashing lights, the hardware, software and wiring needed to connect the gate to the grade crossing warning device system. These items would be installed as a supplement to the "Conventional Gates/single mainline track", "Conventional Gates/double mainline track", or "Conventional gates/triple mainline track". The unit cost for this item is $70,900 each.

7. Allocations for Special Elements (Placeholders)

The methodology includes placeholders as conservative estimates for large and/or complex engineering projects that have not been estimated on the basis of unit costs and quantities. Placeholders are used where detailed engineering requirements are not fully known and provide lump sum budget approximations based on expert opinion rather than on an engineering estimate. These approximations will require close attention as the project moves through further phases of development.

The following list highlights some of the key Special Elements that are assumed in this analysis.

7.1. Special Elements

7.1.1. Big Lake Maintenance Facility

The Big Lake Maintenance Facility currently accommodates the existing Northstar fleet of locomotives and commuter passenger cars on its tracks, some of which are inside shop buildings. The facility is currently completing an expansion of track and facilities inside the main shop building to increase its ability to handle repairs and maintenance. The improvements include the installation of a drop table facility that enables shop forces to replace the wheel sets on commuter passenger cars.

Three of the four service alternatives require an additional Northstar trainset consisting of one locomotive and four commuter passenger cars, but the facility does not have adequate track space to accommodate this additional trainset. Therefore, a new outside storage and servicing track is required to accommodate this trainset. The improvement would be constructed on improved land within the limits of the facility that was originally designed to accommodate a future expansion. The new track includes a turnout connected to the shop lead tracks on each end and an extension of the east lead track to provide the capability for one complete trainset to move to and from the new track on the east lead track and other tracks in the facility.

The following utilities and components enable the track to be used to service and store trains during their layovers:

- Paved roadways on both sides of the track to enable employees and service vehicles to access both sides of the train for inspection, maintenance and servicing;
- 480-volt AC standby power connections to provide electrical power to the locomotive and cars when the locomotive is shut down so that employees can service the train;
- Compressed air connections to supply the parked train with compressed air to maintain air brake pressure and auxiliary train functions that depend on air when the locomotive is shut down;
- Drip pan facilities in the track at the location where the locomotive will stand when parked;
- Electrical drop connections to enable the use of power tools and electrical equipment as needed;
- Overhead lighting to both sides of the track since most work on the trains will be done at night;
- Water connections and drainage facilities to keep the track and paved surfaces free of standing water; and
- Derails and blue signal equipment at each end of the track required to protect workers when trains are being serviced.

The unit cost for the Big Lake Maintenance Facility only includes the elements in the list above. The total cost for the BLMF expansion includes track work and turnouts, which are captured under unit items for "New Track" and "Turnout". Since a detailed engineering estimate of these improvements was not made in the field, cost estimates for the various construction elements for the storage track were based on costs recently experienced for similar improvements planned or constructed at other railroad facilities.

The unit cost for this item is $2,589,100 Lump Sum.

7.1.2. Big Lake Station Expansion

The Big Lake Station Expansion consists of a single new center platform to be constructed between BNSF Main Tracks 1 and 2 adjacent to the existing Northstar station platform which is located on the station stub track at Big Lake. The new platform would be constructed in a manner consistent with other Northstar station facilities including specifically:

- Platform shelter with lighting, heated areas, Northstar signage and ticketing machines;
- A stairway/elevator tower from the new platform to reach an enclosed, heated and lighted overhead pedestrian walkway to reach the existing Big Lake Northstar station platform;
- A stairway/elevator tower on the existing platform connecting to the overhead walkway;
- Compliance with Americans with Disabilities Act (ADA), BNSF, Metro Transit and other applicable standards;

The unit cost for the Big Lake Station Expansion only includes the elements in the list above. The total cost for the station expansion includes track work, turnouts, and grade crossing work, which are captured under unit items for "New Track", "Conventional Gates", "Install Median", "Precast Panels", and "Minor Roadway Improvements". A lump sum estimate from the recent construction of the new Northstar station at Ramsey was provided by BNSF and was used to estimate the approximate cost of

the platform, stairway/elevator towers, overhead walkway, and other amenities for the station expansion itself.

The unit cost for the Big Lake Station Expansion is $15,000,000 Lump Sum.

7.1.3. St. Cloud Station Improvements

The St. Cloud Station improvements to accommodate Northstar trains originating and terminating at St. Cloud are needed to enable arriving westbound Northstar trains to clear the main track at St. Cloud to detrain passengers, change ends, make the required pre-departure tests for the eastbound trip, board passengers and/or layover until the eastbound train's departure time. The improvement frees up BNSF main tracks 1 and 2 at St. Cloud for the operation of freight trains and allows Amtrak trains in both directions to move to and from the Amtrak platform on Track 2 directly in front of the existing St. Cloud depot. The improvement, when used in combination with a new control point proposed at West St. Cloud, and the upgrading of the existing control point east of the St. Cloud station, are critical features needed to keep train traffic fluid on the Staples Subdivision while accommodating the Northstar service extension to St. Cloud.

The St. Cloud Station improvements include:

- Construction of a new station track south of BNSF Main Track 2 immediately west of the existing Amtrak platform at the depot. The track would be long enough to accommodate a Northstar commuter train;
- Power-operated turnouts and associated signals governing movements to and from the new station track and modifications to the existing control point at St. Cloud to accommodate the new track and signals;
- New station platform along the new station track compliant with ADA, BNSF, Metro Transit and other applicable standards;
- New commercial power drop, electrical substation, 480-volt AC standby power connections and drip pan at the west end of the station track to enable Northstar trains with longer layovers to shut down the locomotive during the layover;
- Platform connection to the existing St. Cloud depot;
- Removal of industry track turnout on BNSF Main Track 2 and removal of connection to west wye track west of the station to enable construction of the station track; and
- Construction of a new turnout and grade crossing improvements on the new industry track connection from the west wye track to serve the industry track from the other end.

Unit costs were used to estimate the cost of track, platform, and grade crossing improvements. A detailed engineering estimate of these improvements was not made in the field. Cost estimates for the various construction elements for the St. Cloud station track platform and associated improvements were based on costs recently experienced for similar improvements planned or constructed at other railroad facilities.

The unit cost for the St. Cloud Station Improvements is $1,699,000 Lump Sum.

7.1.4. Equipment Acquisition

Metro Transit and BNSF have both stated that there are important advantages in acquiring an additional trainset that is compatible with, has the same appearance and amenities and uses the same spare parts

inventory as the existing fleet. To achieve these objectives, minimize costs, and reduce the time period required for acquisition, the assumption was made that one used locomotive, two used commuter coaches, and two used cab control commuter coaches like Northstar equipment would be acquired rather than new equipment. The equipment would be acquired, then rebuilt and upgraded to Northstar standards including the installation and testing of Positive Train Control (PTC) equipment, Northstar livery, interiors, information systems, and operational controls.

Because the Northstar Extension to St. Cloud is a feasibility study, no solicitation of proposals was made to potential owners or vendors of similar equipment. Rather, a cursory review of recent industry announcements was used to estimate the approximate cost of acquiring and rebuilding and upgrading used equipment. FRA has regulations that define the acquisition values of equipment if one agency is acquiring used equipment from another agency and FTA originally paid for the equipment. In addition, the COVID-19 pandemic has drastically altered commuting patterns and reduced ridership on all commuter railroads, including Northstar. These factors make estimating the cost of equipment acquisition very difficult and subject to fluctuation.

Another important factor in fleet planning is the timing of the extension to St. Cloud, should the decision be made to do so. The Northstar fleet will soon be approaching the time when it will be due for its mid-life rebuild and updating. To accomplish that work, Metro Transit may need to acquire an additional trainset just to be able to release one trainset for rebuild while still maintaining its published schedules. The additional trainset required by three of the four service alternatives could be acquired early, rebuilt and upgraded to Northstar standards, and then used as the trainset needed to release others for rebuild over a period of one or two years. Following that process, the same added trainset would then be available to augment the Northstar fleet to serve the St. Cloud Extension.

The following assumptions were used to estimate the cost of acquiring the additional transit needed for three of the four service alternatives for the St. Cloud extension:

- Approximate Cost of New PTC-Equipped Passenger Locomotive: $5,000,000.
- Approximate Cost of New PTC-Equipped Bi-Level Cab Control Passenger Car: $2,500,000.
- Approximate Cost of New Bi-Level Passenger Car (Non-Cab): $2,000,000

If the equipment were purchased new, the Rough Order of Magnitude Cost Estimate for the additional trainset would be approximately $14,000,000. This number is used in the estimate as a conservative placeholder. If the Northstar order could be added on to a larger Northstar fleet replacement order or added on to another agency's larger order for the same type equipment at the same time, pricing discounts may be able to be negotiated with the vendor and reduce the cost estimate shown above.

If surplus used equipment were able to be obtained from another commuter agency, and if FTA price controls were applicable, then the additional trainset may be able to be acquired, rebuilt, upgraded, and placed in service for substantially less than new pricing depending on condition of the equipment and the level of rebuilding that would be required.

The unit cost for the equipment procurement is $14,000,000.

8. Contingency & Soft Costs

Contingencies are an allowance for unexpected costs added to the estimated construction costs based on past experience for projects in early stages of definition. Their purpose is to account for items and conditions that cannot be identified with certainty during the conceptual design phase of the project. Contingency costs are added as an overall percentage of the total construction cost. The allocated contingency for this level of detail is set at 20% of the estimated direct construction cost elements for all cost categories except stations and support facilities. The allocated contingency for stations and support facilities is 30%. The allocated contingency percentage is expected to be reduced as the project advances into more detailed engineering and conceptual uncertainties are investigated and resolved. Contingencies should not be considered as potential savings. The allocated contingency amount is expected to be expended within the project; typically, as the project develops, contingency amounts are transferred to construction cost as project details are investigated during continued design. In effect, project uncertainties become known project elements as the project matures.

Soft Costs are associated with the planning, design and coordination of the project. These include design engineering, insurance and bonding, program management, construction management and inspection, and engineering services during construction. The percentage for each project element is as follows:

Design Engineering	10%
Insurance and Bonding	2%
Program Management	4%
Construction Management & Inspection	6%
Engineering Services During Construction	2%
Total Soft Costs	24%

Attachment 1

PTC/CTC Cost Breakdown

DEPARTMENT OF TRANSPORTATION

Technical Documentation on PTC/CTC Cost Breakdown

The following tables present the units and unit costs that were employed to build PTC/CTC costs. Generally, each PTC/CTC element is comprised of a wayside signal cost and, if applicable, costs for the railroad to complete wayside engineering and detailed location design and update the Subdivision file, ITCM communications, and dispatch office.

Table 1: Establish New Control Point (No signals or switches)

	Estimated Unit Cost (2017)	For a CP	
		Assumed Quantity	*Total - Cost*
Install Phasing Equipment	$ 3,744.00	1	$ 3,744
Insulated Bondstrand	$ 5.84	375	$ 2,190
Cable, 3C #6 W/#6 Gnd. Power	$ 10.77	100	$ 1,077
Install Wayside House w/Pier, 10' X 14'	$ 43,736.00	1	$ 43,736
Install Instrument House Grounding Grid	$ 6,401.00	1	$ 6,401
Utility Pole	$ 2,760.00	1	$ 2,760
AC Meter Service	$ 2,748.00	1	$ 2,748
Tilt Down Antenna Mast with ATCS/PTC Antenna	$ 11,248.00	1	$ 11,248
Conduit, 4 inch, PVC SCH 80	$ 40.20	160	$ 6,432
Emer. Generator, Power Xfer and Distribution	$ 35,748.00	1	$ 35,748
Regulators	$ 304.45	2	$ 609
House Equipment			
Factory Wiring - Equipment Racks	$ 40.30	1400	$ 56,420
Entrance Racks	$ 1,223.48	1	$ 1,223
Batteries 240 AH	$ 454.00	25	$ 11,350
Rectifiers	$ 2,017.00	3	$ 6,051
Relays Vital	$ 1,773.60	6	$ 10,642
Relays Non-vital	$ 246.00	2	$ 492
Vital Microprocessor w/rack	$ 43,040.00	1	$ 43,040
Local Control Panel (LCP)	$ 9,919.18	1	$ 9,919
ATCS Package	$ 5,704.00	1	$ 5,704
PTC Package	$ 8,480.00	1	$ 8,480
Misc./Spare Material	6%		$ 16,201
Material Handeling	3%		$ 8,586
	Wayside Total (2017)		***$ 294,801***
	Wayside Total (2020) 5% Inflation		***$ 310,425***

		For a CP	
Wayside Engineering	***$/Hr***	***Hours***	***Cost***
Location Detailed - House placement Track & Cable Plan 30%/100%			$ -
Design	$ 130.00	10	$ 1,300.00
Check	$ 130.00	5	$ 650.00
CAD/Drafting	$ 87.50	7	$ 612.50
SYSTEM DESIGN TOTALS		***190***	***$ 24,170.00***
DETAILED LOCATION DESIGN TOTAL	**$/Hr**		
Location Plans			
Design	$ 130.00	10	$ 1,300.00
IN/OUT Drawings	$ 130.00	4	$ 520.00
Check	$ 130.00	5	$ 650.00
CAD/Drafting	$ 87.50	10	$ 875.00
As Builts	$ 130.00		
CAD As Builts	$ 87.50		
Cutover Support	$ 130.00	11	$ 1,430.00
Material			
Submitals	$ 130.00	12	$ 1,560.00
Material List	$ 130.00		
Application Logic			
Design	$ 130.00		
Test Forms	$ 130.00		
Test	$ 130.00		
Verity	$ 87.50		
DETAILED LOCATION DESIGN TOTAL		***88***	***$ 13,503.75***
GRAND TOTAL WAYSIDE ENGINEERING			***$ 37,673.75***

		For a CP	
Total Wayside Estimate			***$ 348,099.22***

Table 2: Addition of a Turnout to a Control Point

	Estimated Unit Cost (2017)	*Addition of a Turnout to a Control Point*	
		Assumed Quantity	*Total - Cost*
Cable, 7C#14 Snow Mltr	$ 6.87	200	$ 1,373.20
Cable, 5C #6; 5C #14; 7C #14 Switch	$ 19.62	200	$ 3,923.20
Cable, 7C #6 Signal	$ 11.03	2500	$ 27,565.00
Cable, 12C #14 Snow Mltr	$ 8.11	200	$ 1,621.20
Cable, 5C #9 Snow Mltr	$ 11.85	200	$ 2,370.00
Track Bootlegs & Connections	$ 367.88	12	$ 4,414.50
Switch Bonding	$ 3,768.23	1	$ 3,768.23
Dual Control Power Switch Machine & Layout	$ 36,120.00	1	$ 36,120.00
Insulated Joints	$ 2,748.00	8	$ 21,984.00
1" Gas Pipe	$ 4.98	100	$ 497.60
1-1/4" Gas Pipe	$ 5.05	100	$ 504.60
1-1/2" Gas Pipe	$ 5.11	100	$ 510.60
2" Gas Pipe	$ 5.55	200	$ 1,109.20
Trenching	$ 8.20	1000	$ 8,200.00
Pressure Boosters	$ 504.45	1	$ 504.45
Propane Tank Filled	$ 57,020.00	1	$ 57,020.00
Switch Snow Blower	$ 11,872.00	1	$ 11,872.00
House Equipment			
Relay/Equipment Racks	$ 955.25	1	$ 955.25
Transformers	$ 1,424.60	1	$ 1,424.60
Batteries 240 AH	$ 454.00	1	$ 454.00
Batteries 160 AH	$ 245.00	6	$ 1,470.00
Track Rectifiers	$ 1,689.00	1	$ 1,689.00
Relays Vital	$ 1,773.60	2	$ 3,547.20
Relays Non-vital	$ 246.00	2	$ 492.00
Misc./Spare Material	6%		$ 11,603.39
			$ -
Material Handling	3%		$ 6,149.80
	Wayside Total (2017)		***$ 211,143.01***
	Wayside Total (2020) 5% Inflation		***$ 222,333.59***

		Addition of a Turnout to a Control	
Wayside Engineering	***$/Hr***	***Hours***	***Cost***
Location Detailed - House placement Track & Cable Plan 30%/100%			
Design	$ 130.00	4	$ 520.00
Check	$ 130.00	2	$ 260.00
CAD/Drafting	$ 87.50	4	$ 350.00
SYSTEM DESIGN TOTALS		***10***	***$ 1,130.00***
DETAILED LOCATION DESIGN TOTAL	**$/Hr**		
Location Plans			
Design	$ 130.00	12	$ 1,560.00
Check	$ 130.00	5	$ 650.00
CAD/Drafting	$ 87.50	10	$ 875.00
As Builts	$ 130.00	5	$ 650.00
CAD As Builts	$ 87.50	8	$ 700.00
Material			
Material List	$ 130.00	8	$ 1,040.00
Application Logic			
Design	$ 130.00	32	$ 4,160.00
Test Forms	$ 130.00	8	$ 1,040.00
Test	$ 130.00	32	$ 4,160.00
Verity	$ 87.50	8	$ 700.00
DETAILED LOCATION DESIGN TOTAL		***128***	***$ 15,535.00***
GRAND TOTAL WAYSIDE ENGINEERING			***$ 16,665.00***

		Addition of a Turnout to a Control Point	
Total Wayside Estimate			***$ 238,998.59***

Table 3: Addition of a Crossover to a Control Point

	Estimated Unit Cost (2017)	Addition of Crossover to Control Point	
		Assumed Quantity	*Total - Cost*
Cable, 7C#14 Snow Mltr	$ 6.87	400	$ 2,746
Cable, 5C #6; 5C #14; 7C #14 Switch	$ 19.62	800	$ 15,693
Cable, 5C #6 Signal	$ 9.52	400	$ 3,806
Cable, 7C #6 Signal	$ 11.03	1500	$ 16,539
Cable, 12C #14 Snow Mltr	$ 8.11	150	$ 1,216
Cable, 5C #9 Snow Mltr	$ 11.85	150	$ 1,778
Track Bootlegs & Connections	$ 367.88	12	$ 4,415
Switch Bonding	$ 3,768.23	2	$ 7,536
Dual Control Power Switch Machine & Layout	$ 36,120.00	2	$ 72,240
Conduit, 4 inch, GRS	$ 77.40	50	$ 3,870
Insulated Joints	$ 2,748.00	8	$ 21,984
1" Gas Pipe	$ 4.98	200	$ 995
1-1/4" Gas Pipe	$ 5.05	200	$ 1,009
1-1/2" Gas Pipe	$ 5.11	200	$ 1,021
2" Gas Pipe	$ 5.55	1000	$ 5,546
Trenching	$ 8.20	1000	$ 8,200
Pressure Boosters	$ 504.45	1	$ 504
Propane Tank Filled	$ 57,020.00	1	$ 57,020
Switch Snow Blower	$ 11,872.00	2	$ 23,744
House Equipment			
Relay/Equipment Racks	$ 955.25	1	$ 955
Transformers	$ 1,424.60	1	$ 1,425
Batteries 240 AH	$ 454.00	2	$ 908
Batteries 160 AH	$ 245.00	6	$ 1,470
Track Rectifiers	$ 1,689.00	1	$ 1,689
Relays Vital	$ 1,773.60	4	$ 7,094
Relays Non-vital	$ 246.00	2	$ 492
Misc./Spare Material	6%		$ 15,834
Material Handeling	3%		$ 8,392
Wayside Total (2017)			***$ 288,122***
Wayside Total (2020) 5% Inflation			***$ 303,392***

		Addition of Crossover to Control Point	
Wayside Engineering	***$/Hr***	***Hours***	***Cost***
Location Detailed - House placement Track & Cable Plan 30%/100%			
Design	$ 130.00	8	$ 1,040.00
Check	$ 130.00	4	$ 520.00
CAD/Drafting	$ 87.50	6	$ 525.00
SYSTEM DESIGN TOTALS		***18***	***$ 2,085.00***
DETAILED LOCATION DESIGN TOTAL	**$/Hr**		
Location Plans			
Design	$ 130.00	12	$ 1,560.00
Check	$ 130.00	5	$ 650.00
CAD/Drafting	$ 87.50	10	$ 875.00
As Builts	$ 130.00	5	$ 650.00
CAD As Builts	$ 87.50	6	$ 525.00
Material			
Material List	$ 130.00	6	$ 780.00
Application Logic			
Design	$ 130.00	24	$ 3,120.00
Test Forms	$ 130.00	6	$ 780.00
Test	$ 130.00	24	$ 3,120.00
Verity	$ 87.50	8	$ 700.00
DETAILED LOCATION DESIGN TOTAL		***106***	***$ 12,760.00***
GRAND TOTAL WAYSIDE ENGINEERING			***$ 14,845.00***
		Addition of Crossover to Control Point	
Total Wayside Estimate			***$ 318,237.39***

Table 4: Addition of a Single Signal Mast to a Control Point

	Estimated Unit Cost (2017)	*Addition of a Single Signal Mast to a Control Point*	
		Assumed Quantity	*Total - Cost*
Cable, 2 - 1C #6 Tw. Track	$ 6.17	3400	$ 20,964
High Signal Heads (3 Aspect, LED, Typ)	$ 3,797.00	3	$ 11,391
Signal Mast/Ladder/Base/Fdn.	$ 5,895.98	1	$ 5,896
House Equipment			
Misc./Spare Material	6%		$ 2,295
Material Handling	3%		$ 1,216
	Wayside Total (2017)		***$ 41,763***
	Wayside Total (2020) 5% Inflation		***$ 43,976***

		Addition of a Single Signal Mast to a Control Point	
Wayside Engineering	***$/Hr***	***Hours***	***Cost***
SYSTEM DESIGN TOTALS		***0***	***0***
DETAILED LOCATION DESIGN TOTAL	**$/Hr**		
DETAILED LOCATION DESIGN TOTAL		***0***	***$ -***
GRAND TOTAL WAYSIDE ENGINEERING			***$ -***

		Addition of a Single Signal Mast to a Control Point
Total Wayside Estimate		***$ 43,976.29***

Table 5: Addition of a Two-Track Signal Cantilever to a Control Point

	Estimated Unit Cost (2017)	*Addition of a Two-Track Signal Cantilever to a Control Point*	
		Assumed Quantity	*Total - Cost*
Cable, 2 - 1C #6 Tw. Track	$ 6.17	3400	$ 20,964
34' Signal Cantilever with 4 position lights	$ 79,349.70	1	$ 79,350
House Equipment			
Misc./Spare Material	6%		$ 6,019
Material Handling	3%		$ 3,190
	Wayside Total (2017)		***$ 109,523***
	Wayside Total (2020) 5% Inflation		***$ 115,328***

		Addition of a Two-Track Signal Cantilever to a Control Point	
Wayside Engineering	***$/Hr***	***Hours***	***Cost***
SYSTEM DESIGN TOTALS		***0***	***$ -***
DETAILED LOCATION DESIGN TOTAL	**$/Hr**		
DETAILED LOCATION DESIGN TOTAL		***0***	***$ -***
GRAND TOTAL WAYSIDE ENGINEERING			***$ -***

		Addition of a Two-Track Signal Cantilever to a Control Point
Total Wayside Estimate		***$ 115,327.65***

Table 6: Addition of a Three-Track Signal Bridge to a Control Point

	Estimated Unit Cost (2017)	Addition of a Three-Track Signal Bridge to a Control Point	
		Assumed Quantity	Total - Cost
Cable, 2 - 1C #6 Tw. Track	$ 6.17	3400	$ 20,964
62' Signal Bridge with 6 Position Lights	$ 138,874.80	1	$ 138,875
House Equipment			
Misc./Spare Material	6%		$ 9,590
Material Handling	3%		$ 5,083
	Wayside Total (2017)		***$ 174,512***
	Wayside Total (2020) 5% Inflation		***$ 183,762***

		Addition of a Three-Track Signal Bridge to a Control Point	
Wayside Engineering	***$/Hr***	***Hours***	***Cost***
SYSTEM DESIGN TOTALS		***0***	***$ -***
DETAILED LOCATION DESIGN TOTAL	**$/Hr**		
DETAILED LOCATION DESIGN TOTAL		***0***	***$ -***
GRAND TOTAL WAYSIDE ENGINEERING			***$ -***

		Addition of a Three-Track Signal Bridge to a Control Point
Total Wayside Estimate		***$ 183,761.60***

Table 7: Addition of a Four-Track Signal Bridge to a Control Point

	Estimated Unit Cost (2017)	Addition of a Four-Track Signal Bridge to a Control Point	
		Assumed Quantity	Total - Cost
Cable, 2 - 1C #6 Tw. Track	$ 6.17	3400	$ 20,964
82.5' Signal Bridge with 8 Position Lights	$ 178,086.05	1	$ 178,086
House Equipment			
Misc./Spare Material	6%		$ 11,943
Material Handling	3%		$ 6,330
	Wayside Total (2017)		***$ 217,323***
	Wayside Total (2020) 5% Inflation		***$ 228,841***

		Addition of a Four-Track Signal Bridge to a Control Point	
Wayside Engineering	***$/Hr***	***Hours***	***Cost***
SYSTEM DESIGN TOTALS		***0***	***$ -***
DETAILED LOCATION DESIGN TOTAL	**$/Hr**		
DETAILED LOCATION DESIGN TOTAL		***0***	***$ -***
GRAND TOTAL WAYSIDE ENGINEERING			***$ -***

		Addition of a Four-Track Signal Bridge to a Control Point
Total Wayside Estimate		***$ 228,841.42***

Table 8: Addition of an Electric Lock and Derail to a Control Point

	Estimated Unit Cost (2017)	*Addition of an Electric Lock and Derail to a Control Point*	
		Assumed Quantity	*Total - Cost*
Insulated Bondstrand	$ 5.84	50	$ 292.00
Track Bootleg & Connections	$ 367.90	2	$ 735.80
Install Electric Lock and Rods	$ 10,808.00	1	$ 10,808.00
Install Derail, Circuit Controller and Rods	$ 10,623.00	1	$ 10,623.00
Instrument Case & Grounding Grid	$ 7,561.00	1	$ 7,561.00
Field Wiring	$ 8.99	500	$ 4,495.00
Cable, 3C #6 Pwr. Power	$ 10.77	1700	$ 18,302.20
Cable, 7C#14 Switch	$ 6.87	200	$ 1,373.20
Cable, 2-1C #6 Tw. Track	$ 6.17	450	$ 2,774.70
Conduit, 4 inch, PVC	$ 40.20	100	$ 4,020.00
Cable, 12C #14	$ 8.92	1700	$ 15,157.20
House Equipment			
Factory Wiring	$ 4.03	1000	$ 4,030.00
Epic III Track Circuit	$ 1,561.00	1	$ 1,561.00
AC Power Circuit Breaker Box	$ 664.00	1	$ 664.00
AC Power Lightning/Surge Prot.	$ 387.00	1	$ 387.00
Battery Charger 12VDC (40A)	$ 2,017.00	1	$ 2,017.00
Batteries 265 AH	$ 454.00	6	$ 2,724.00
Relays Vital	$ 1,773.60	2	$ 3,547.20
			$ -
Miscellaneous Material	6.00%		$ 5,464.34
			$ -
Material Handling	3.00%		$ 2,896.10
Wayside Total (2017)			***$ 99,433***
Wayside Total (2020) 5% Inflation			***$ 104,404***

Table 9: Electric Lock and Derail on Separate Track Circuit

	Estimated	*Electric Lock and Derail on Separate Track Circuit*	
	Unit Cost (2017)	*Assumed Quantity*	*Total- Cost*
Insulated Bondstrand	$ 5.84	50	$ 292.00
Track Bootleg & Connections	$ 367.90	2	$ 735.80
Install Electric Lock and Rods	$ 10,808.00	1	$ 10,808.00
Install Derail, Circuit Controller and Rods	$ 10,623.00	1	$ 10,623.00
Field Wiring	$ 8.99	2000	$ 17,980.00
Cable, 7C#14 Switch	$ 6.87	200	$ 1,373.20
Cable, 2-1C #6 Tw. Track	$ 6.17	450	$ 2,774.70
Conduit, 4 inch, PVC	$ 40.20	100	$ 4,020.00
House Equipment			
Epic III Track Circuit	$ 1,561.00	1	$ 1,561.00
Battery Charger 12VDC (40A)	$ 2,017.00	1	$ 2,017.00
Batteries 265 AH	$ 454.00	6	$ 2,724.00
Relays Vital	$ 1,773.60	4	$ 7,094.40
Miscellaneous Material	6.00%		$ 6,028.03
Material Handling	3.00%		$ 3,194.85
Wayside Total (2017)			***$ 109,690***
Wayside Total (2020) 5% Inflation			***$ 115,174***

Table 10: Install Derail on Power-Operated Switch

	Estimated	*Install Derail on Power-Operated Switch*	
	Unit Cost (2017)	*Assumed Quantity*	*Total- Cost*
Install Derail, Circuit Controller and Rods	$ 10,623.00	1	$ 10,623.00
Field Wiring	$ 8.99	500	$ 4,495.00
Cable, 7C#14 Switch	$ 6.87	200	$ 1,373.20
Conduit, 4 inch, PVC	$ 40.20	100	$ 4,020.00
House Equipment			
Epic III Track Circuit	$ 1,561.00	1	$ 1,561.00
Miscellaneous Material	6.00%		$ 1,324.33
Material Handling	3.00%		$ 701.90
Wayside Total (2017)			***$ 24,098***
Wayside Total (2020) 5% Inflation			***$ 25,303***

Table 11: Install Single Mast for Intermediate Signal

	Estimated Unit Cost (2017)	*Install Single Mast for Intermediate Signal*	
		Assumed Quantity	*Total - Cost*
Insulated Bondstrand	$ 5.84	50	$ 292.00
Track Bootlegs & Connections	$ 367.90	4	$ 1,471.60
Install Instrument House Grounding Grid	$ 6,401.00	1	$ 6,401.00
High Signal Heads (3 aspect, LED, typ)	$ 3,797.00	3	$ 11,391.00
Signal Mast/Ladder/Base/Fdn.	$ 5,895.98	1	$ 5,895.98
Insulated Joints	$ 2,748.00	2	$ 5,496.00
Cable, 7C #6 Temp. Signal	$ 11.03	400	$ 4,410.40
Cable, 2-1C #6 Tw. Track	$ 6.17	400	$ 2,466.40
Conduit, 4 inch, PVC	$ 40.20	100	$ 4,020.00
Field Wiring	$ 7.23	500	$ 3,615.00
Misc./Spare Material 10%	6%		$ 2,727.56
Material Handling 5%	3%		$ 1,445.61
Wayside Total (2017)			$ 49,632.55
Wayside Total (2020) 5% Inflation			$ 52,114.18

Table 12: Install Two-Track Signal Cantilever for Intermediate Signal

	Estimated Unit Cost (2017)	*Install Two-Track Signal Cantilever for Intermediate Signal*	
		Assumed Quantity	*Total - Cost*
Insulated Bondstrand	$ 5.84	50	$ 292.00
Track Bootlegs & Connections	$ 367.90	4	$ 1,471.60
Install Instrument House Grounding Grid	$ 6,401.00	1	$ 6,401.00
High Signal Heads (3 aspect, LED, typ)	$ 3,797.00	6	$ 22,782.00
34' Signal Cantilever with 4 position lights	$ 79,349.70	1	$ 79,349.70
Insulated Joints	$ 2,748.00	2	$ 5,496.00
Cable, 7C #6 Temp. Signal	$ 11.03	400	$ 4,410.40
Cable, 2-1C #6 Tw. Track	$ 6.17	800	$ 4,932.80
Conduit, 4 inch, PVC	$ 40.20	100	$ 4,020.00
Field Wiring	$ 7.23	500	$ 3,615.00
Misc./Spare Material 10%	6%		$ 7,966.23
Material Handling 5%	3%		$ 4,222.10
Wayside Total (2017)			$ 144,958.83
Wayside Total (2020) 5% Inflation			$ 152,206.77

Table 13: Install Three-Track Signal Cantilever for Intermediate Signal

	Estimated Unit Cost (2017)	*Install Three-Track Signal Cantilever for Intermediate Signal*	
		Assumed Quantity	*Total - Cost*
Insulated Bondstrand	$ 5.84	50	$ 292.00
Track Bootlegs & Connections	$ 367.90	4	$ 1,471.60
Install Instrument House Grounding Grid	$ 6,401.00	1	$ 6,401.00
62' Signal Bridge wirh 6 Position Lights	$ 138,874.80	1	$ 138,874.80
Insulated Joints	$ 2,748.00	2	$ 5,496.00
Cable, 7C #6 Temp. Signal	$ 11.03	400	$ 4,410.40
Cable, 2-1C #6 Tw. Track	$ 6.17	1200	$ 7,399.20
Conduit, 4 inch, PVC	$ 40.20	100	$ 4,020.00
Field Wiring	$ 7.23	500	$ 3,615.00
Misc./Spare Material 10%	6%		$ 10,318.80
Material Handling 5%	3%		$ 5,468.96
Wayside Total (2017)			$ 187,767.76
Wayside Total (2020) 5% Inflation			$ 197,156.15

Table 14: Install New Intermediate Signal Box and Antenna

	Estimated Unit Cost (2017)	*Install New Intermediate Signal Box and Antenna*	
		Assumed Quantity	*Total - Cost*
Install 8' X 10' Instrument House W/FDN	$ 33,589.00	1	$ 33,589.00
AC Meter Service	$ 2,748.00	1	$ 2,748.00
Cable, 3C #6 W/#6 Gnd. Power	$ 10.77	100	$ 1,076.60
Tilt Down Antenna Mast with PTC Antenna	$ 10,748.00	1	$ 10,748.00
HOUSE EQUIPMENT			
Factory Wiring	$ 4.03	2000	$ 8,060.00
Electronic Coded Track Circuit	$ 32,968.00	1	$ 32,968.00
Track Interface Panel	$ 1,268.00	1	$ 1,268.00
Relay/Equipment Racks	$ 955.26	1	$ 955.26
Entrance Racks	$ 1,223.48	1	$ 1,223.48
PTC Package	$ 8,480.00	1	$ 8,480.00
AC Power Circuit Breaker Box	$ 664.00	1	$ 664.00
AC Power Lightning/Surge Prot.	$ 347.00	1	$ 347.00
Battery Charger 12VDC (40A)	$ 2,017.00	3	$ 6,051.00
Batteries 265 AH	$ 454.00	18	$ 8,172.00
Relays Vital	$ 1,773.60	2	$ 3,547.20
Misc./Spare Material 10%	6%		$ 7,193.85
			.
Material Handling 5%	3%		$ 3,812.74
Wayside Total (2017)			$130,904.13
Wayside Total (2020) 5% Inflation			$137,449.34