San Juan County Four Corners Freight Rail Project

Task 4.5 Capital Cost Estimation Methodology and Estimation of Probable Cost

Feasibility Study

San Juan County, New Mexico

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4.5 CAPITAL COST ESTIMATION METHODOLOGY AND ESTIMATES OF PROBABLE COST

INTRODUCTION AND PROJECT DESCRIPTION

Introduction

The Subtask 4.5 Capital Cost Estimation is organized in accordance with the guidance provided in the document "Capital Cost Estimating, Guidance for Project Sponsors" (final) issued by the Federal Railroad Administration (FRA) on August 30, 2016. This guidance was the latest information available on FRA's website.[1]

The conceptual capital cost estimate is based on Conceptual and Advanced Preliminary Engineering documents for the Four Corners Freight Rail project, previously submitted under Subtask 4.4. These documents consist of plans, profiles, and preliminary grading for five routes (design options) as well as several investment options (sidings, a terminal at the north end of the project, an interchange yard at the connection to the BNSF Railway, and a spur connection to the existing Navajo Mine Railroad). The level of design of these elements is at *approximately* 10%.

Project Description

Project Scope

The Four Corners Freight Rail project has developed five conceptual design options, identifying five possible routes connecting the national rail network to a northern terminal in the Four Corners region proposed to be located on land owned by Navajo Agricultural Products, Inc. (NAPI). With five routes identified, five conceptual capital cost estimates ("cost estimates" or "costs") have been developed, one for each route.

The conceptual costs for the investment options (identified in Subtask 3.2 and again in Subtask 4.4) associated with each design option have been incorporated into the cost estimate for each route. This is because the investment options (for example, sidings) are specific to each route. Because the investment options have no independent utility separate from their respective route, and, similarly, because the design options have no utility without the investment options (for example, a design option, such as a siding or a connection to the Navajo Mine, specific to a particular route has no utility without the interchange tracks at the BNSF or the northern terminal at NAPI), the cost for the investment options has been incorporated into the cost estimate for each of the five routes. Thus, the

[1] Accessed on October 24, 2024 at the following link: https://railroads.dot.gov/elibrary/capital-cost-estimating-guidance-final

cost for each of the five routes includes both the main line and ancillary tracks, facilities, and equipment as they are currently understood at this conceptual level.

The five separate cost estimates, one for each of the five route options, are as follows:

- **Defiance via Highway 491**
- **Defiance via Indian Creek**
- **Defiance via Highway 371**
- **El Segundo**
- **Star Lake**

As noted, the cost estimate for each of these routes includes the costs for the following investment options that are specific to and configured for each route. For example, the locations of sidings are different for each route, and the location of the southern interchange with BNSF Railway is different for the "Defiance via…" routes compared to the two other routes, and the Star Lake route uses portions of the El Segundo route to connect to the Navajo Mine Railroad. However, the northern terminal at NAPI is generally the same for each route. The investment options included in each of the five route costs are as follows:

- The southern interchange with BNSF Railway
- The northern terminal at NAPI
- Grade separations
- Sidings
- The connection to the Navajo Mine Railroad

Note that, as identified in Subtask 4.4, the spur connection to Farmington offered little or no operating utility. As such, it has been excluded from these capital cost estimates.

A map of the five routes is shown in Figure 1.

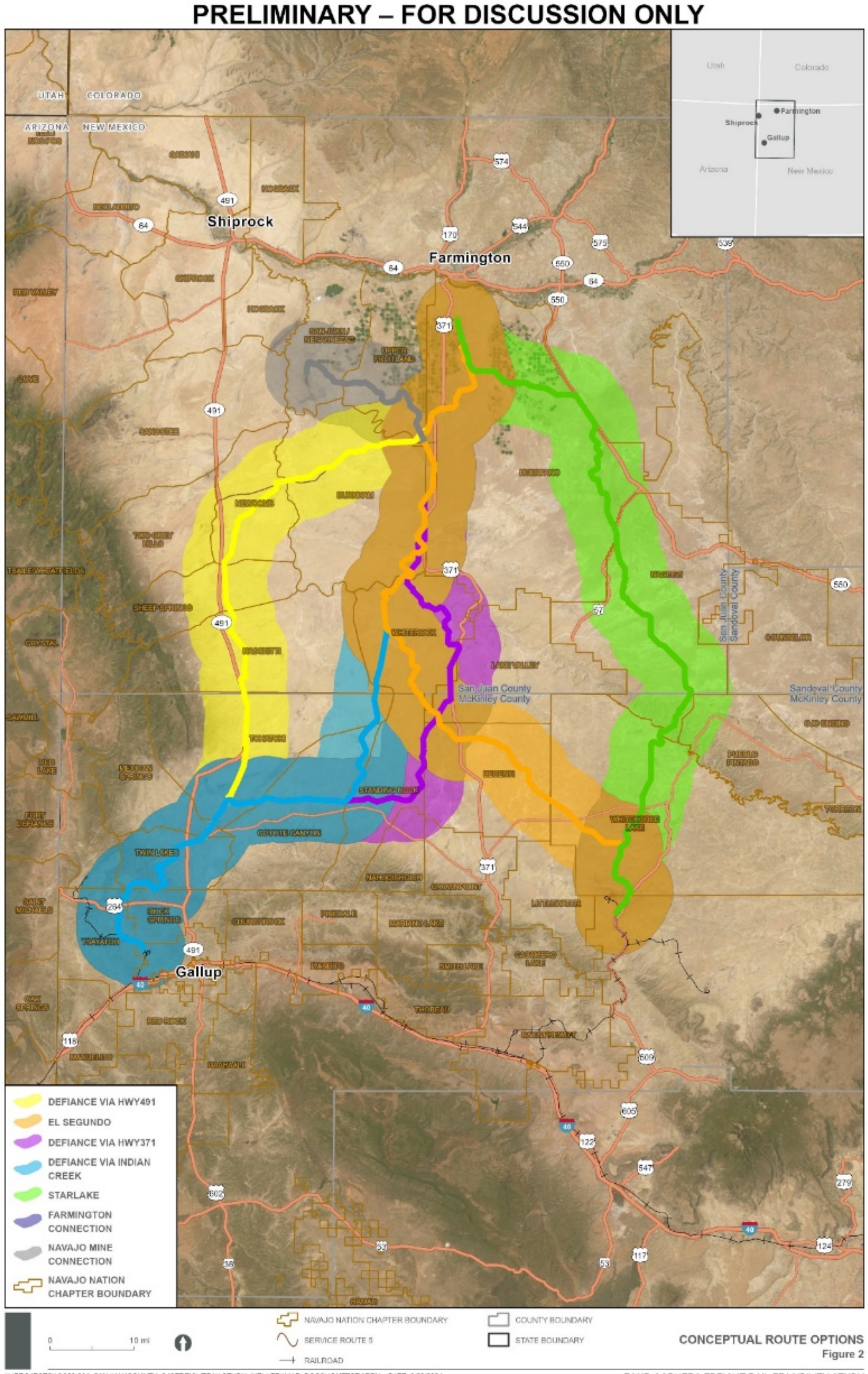


Figure 1: Map of five routes ("Design Options")

Institutional and Organizational Context

San Juan County is the grantee for this project. San Juan County and the Navajo Nation signed a memorandum of understanding (MOU) in February 2020 establishing a framework for cooperation with respect to future railway, community, and business development opportunities in the Four Corners region, located at the convergence of Colorado, New Mexico, Utah, and Arizona. At this early stage, relationships and agreements between the Navajo Nation, the County, the State of New Mexico, and the federal government for construction and operation of the railroad have not been established. It is assumed that a governmental entity (e.g., tribal, county, state, or federal) would ultimately be responsible for construction and operation.

Entities Performing Administrative/Management, Professional Services, and Construction.

It is assumed that a governmental entity (tribal, county, state, or federal) would be responsible for financial management of construction and be responsible for administrative and management functions. Such government entity (or entities) would also likely be the recipient of any public funds supporting construction of the proposed railroad.

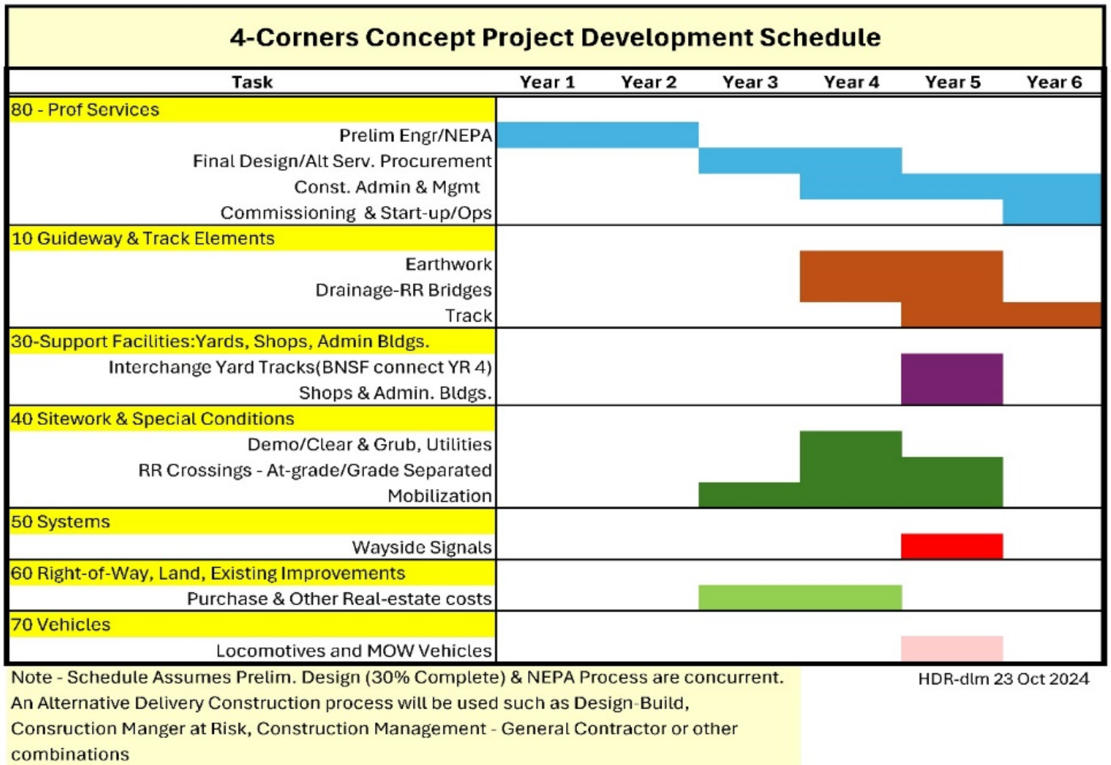
As is typical for capital projects requiring specialized design skills but where there is only a relatively short-term need (i.e., the staff and skill sets are no longer needed after construction is complete), professional services for design and construction management of the proposed railroad would be performed by consulting firms with specialized experience. The types of design work would include survey, geotechnical design, railroad track design, railroad structure design, roadway design, construction inspection, materials testing, and construction management. For a project of this magnitude, overall program management may also be performed by an outside firm.

Project Schedule, Major Phases, Year of Anticipated Completion

A conceptual project schedule is shown below in Figure 2, indicating separate phases for NEPA, Final Design, and construction. This schedule reflects the start of environmental documentation in Year 1 (assumed to be 2025) and close-out of construction in Year 6 (assumed to be 2031)

The projected project development schedule estimates time-frames for a project to progress through the preliminary design, NEPA and STB approval process, final design and construction. This schedule allows for either design-bid-build or an alternative delivery process, such as design-build (DB) or construction manager/general contractor (CM/GC). It is possible that an alternative delivery process could expedite completion of the project, thus realizing benefits of the project more quickly, compared to a traditional design-bid-build delivery approach. It is estimated that the project, given its length, terrain crossed and identified features, will take approximately 2 years to construct with potential for final commissioning and start-up tasks extending into a 3rd year. The schedule below shows some contractor mobilization activities commencing simultaneously with final design. This represents the potential for alternative delivery, where the construction contractor is brought on-board during the final design process.

Figure 2, Conceptual Project Development Schedule



Status of Project Support and Approvals

To date, the project has received support of the Navajo Nation through their memorandum of understanding with San Juan County, support from the County and the State of New Mexico, and support from the FRA. Outreach has been performed to the County, the State (via the New Mexico Department of Transportation), the Navajo Nation, and various tribal Chapters.

No project approvals (e.g., NEPA) have yet been pursued.

Status and Timing of Funding Sources

The project has applied for a CRISI grant with letter of intent for a 20% non-federal match to support early environmental planning activities.

Year of Base Dollars

The estimate has been developed in 2024 dollars.

Overall Cost Limits

The cost estimates are limited to the conceptual level at this early conceptual stage of design development. However, based on the freight demand forecast (Subtask 2.2) and the Operations Analysis (Subtask 4.2), the railroad does not need to be designed or constructed for high density traffic and high speeds; a design approach for a lower-density railroad, with roughly six trains per day, was reflected in Subtask 4.4. This has allowed for some economization of design compared to a high-speed, high traffic density, main line railroad.

PROJECT TECHNICAL BASELINE

The probable capital cost developed for each option reflects the approximately 10% conceptual engineering design level of development for extending railroad tracks from a connection with BNSF into the northern Four Corners area of New Mexico. The profile and digital terrain model for each alignment and investment option used in Task 4.4 allowed development of conceptual earthwork, road, and utility impacts. The operating plan from Task 4.2 informed the features of the route such as interchange, siding spacing, need for and locations of set-out tracks, wayside detection equipment and yard facilities.

Typical heavy-haul railway practice in North America and the American Railway Engineering and Maintenance of Way Association Manual for Railway Engineering (2023 Edition) were used as the baseline guidance for design efforts.

The team reviewed data acquired from outside sources, as well as data developed from previous Tasks and Subtasks, in particular Subtask 4.4, Conceptual and Early Preliminary Engineering, to support this Subtask 4.5, including:

- Digital terrain model of existing ground and accompanying orthorectified and geolocated aerial imagery employed for previous Tasks, acquired from the United State Geological Service (USGS), which remain the same for this current Subtask 4.5 and form the basis of existing ground topography from which the quantities were derived for development of this Capital Cost Estimate of Probable Cost for each route and investment option. The accuracy of the USGS Data included Digital Elevation Models (DEM) was 5 meter cell size over much of the route except in areas closer to highways which were available with a 1 meter cell size. The vertical accuracy is approximately 18.5 cm, 7 inches, or USGS 3DEP Program Quality Level 5 for most of the project and referenced to the North American Vertical Datum of 1988 for ease of links to future work.
- Design alignments, profiles, earthwork models, and terminal facilities developed as part of Subtask 4.4 were used for each of the five routes and accompanying investment options. This information, in digital format, is the basis for quantities used in the estimate (i.e., digital terrain models for the earthwork quantities).
- High-level land ownership information from the two counties traversed by the various route options, San Juan County and McKinley County. This information was high-level in the sense that it identifies major land ownership types, but not individual landowners. For example, this information identifies the locations of Navajo Reservation land, Tribal land outside the Navajo Reservation, Tribal trust lands, allotment land, private land, state land, federal land.

- Preliminary flood hazard mapping from the Federal Emergency Management Agency (FEMA). It should be noted that FEMA does not have mapping for Navajo Reservation lands, which most of the routes traverse.

The level of maturity of the design is at *approximately* the 10% level, or “conceptual engineering” or “early preliminary engineering”. Alignments and profiles may be modified at future design phases as additional information becomes available (for example, more refined survey, geotechnical, or right-of-way information) and are subject to alteration due to avoidance or mitigation measures as part of a future environmental documentation effort. Future modifications to the design could change the quantities and costs.

The same team that developed the design also developed the quantities. Staff experienced with railroad, bridge, and civil construction supported assignment of unit costs to quantities.

ESTIMATING METHODOLOGY AND STANDRAD COST CATEGORIES

Although the project design is still at an early level, sufficient conceptual-level information has been developed to identify preliminary quantities and assign unit costs (as opposed to using a “comparable” approach). The process for estimating construction costs for individual items comprised three major activities:

- Identifying quantities (“quantity take-offs”)
- Assigning costs to the quantities
- Check for reasonableness

As noted above, quantity take-offs were developed based on the designs developed in Subtask 4.4. The item categories for civil work were developed based on New Mexico Department of Transportation (NMDOT) cost categories. Key cost drivers for general civil construction for which there are calculated quantities include excavation, embankment, and net import or waste.

At this early stage, without geotechnical information, embankments supporting railroad track were assumed to have 3 horizontal to 1 vertical (3:1) side slopes. While this results in high earthwork quantities, these are intended to be conservative. It is possible that, upon development of geotechnical information, these side slopes could be made steeper, thus reducing the quantity of embankment. Excavations not supporting railroad track were assumed to have 2:1 side slopes. A key assumption is that excavated material can be placed in embankment areas on a 1:1 ratio without shrinkage. If borrow material is needed (i.e., if embankment quantities are larger than the excavation quantities), then the borrow material is paid for separately and uses a higher unit cost.

Item categories for railroad-specific construction activities, such as railroad track, turnouts, and railroad bridges, were based on common estimating practice in the railroad industry. Item categories included track (including rail, ties, ballast, rail welding, and destressing operations), turnouts, and various types of railroad bridges (with assumed span lengths informing span type selection, e.g., double cell concrete box, steel deck plate girder, and steel beam spans), with each individual category quantified separately.

Quantities for relocation or protection of natural gas, water, and electrical utilities were assumed, with preliminary information derived from geographic information systems (GIS). Quantities for at-grade crossings, including private crossings, and grade separations were based on the roadways that were visible in the aerial imagery.

After developing quantities, unit costs were assigned to each quantity. Unit costs for civil construction were initially based on NMDOT average unit bid prices for heavy construction for similar activities.[2] In addition, costs for track and other rail-related infrastructure reflect current costs in the U.S. and were developed based on the estimating team's experience for similar, recent railroad projects. Railroad bridge parametric costs are typical of recent costs seen in the US rail industry for the type of structures based on anticipated superstructure and substructure type.

A consistent unit cost was assumed for each roadway grade separation and each at-grade crossing, the later costs including active warning devices. Costs for constructing these items are expected to be modest, since the railroad will not be active during construction, and since there appears to be sufficient space for roadway detours to allow for construction of new roadway-over-railroad grade separations without interrupting existing roadway traffic.

Costs for systems equipment is relatively minimal, including hotbox detectors, wheel impact load detectors, and dragging equipment detectors, as well as one radio repeater location. As a relatively light-density railway, as discussed in Subtask 4.2, there will be no centralized traffic control.

Only the Star Lake option includes a tunnel. It is relatively short (too short to justify a tunnel boring machine). It is assumed the tunnel would be constructed with a road header or by drill and blasting, using the sequential excavation method. Since there are no passenger trains anticipated, the tunnel would not have elevated walkways, emergency refuge niches, or a water deluge system.

Costs for vehicles were based on the quantities and types of vehicles identified in Subtask 4.2, which assumed 7 locomotives, a ballast tamper, ballast regulator (which could be purchased as remanufactured rather than new), backhoe, 3-axle boom truck, and various pickup trucks.

Costs for environmental documentation, design, construction administration, and project management were based on percentages of construction cost (3% of construction cost for design and environmental documentation and 2% of construction cost for construction management and administration).

Unit costs for each item were consistent between all five route options.

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[2] Accessed on October 24, 2024 at the following link: https://www.dot.nm.gov/infrastructure/plans-specifications-estimates-pse-bureau/average-unit-bid-prices/

After developing quantities and costs, the reasonableness of the resulting values was reviewed. The NMDOT average unit costs for earthwork received extra attention, since three major earthwork categories, "Unclassified Excavation", "Borrow", and "Base Course" generally represent 30% to 50% of the total construction cost of each of the route options.

- NMDOT's item for Unclassified Excavation includes costs for excavation, transportation of excavated material, and placement and compaction in new embankments.
- NMDOT's item for Borrow includes imported material brought from off-site to "make-up" the difference between the quantity of excavated material and the total amount of embankment when there is insufficient excavated material to construct all the embankments.
- NMDOT's item for Base Course is for imported crushed rock base course of less than 1" size. This material would typically be imported from off-site quarries. Base Course would be used for railroad subballast.

The costs reported by NMDOT over the last three years are shown in Table 1 below. This table illustrates average costs and the total quantity for each NMDOT construction year (each year spanning two calendar years, e.g. April 2023 to March 2024), based on bids received for the given construction year for the item identified.

Table 1: New Mexico Department of Transportation Unit Cost Comparison

Item	NMDOT April 2021-March 2022 Averages	NMDOT April 2022-March 2023 Averages	NMDOT April 2023-March 2024 Averages
Unclassified Excavation	Average Unit Cost $12.00 Total Qty. 788,301 C.Y.	Average Unit Cost $10.04 Total Qty. 950,519 C.Y.	Average Unit Cost $25.47 Total Qty. 300,035 C.Y.
Borrow	Average Unit Cost $17.57 Total Qty. 229,715 C.Y.	Average Unit Cost $15.42 Total Qty. 590,566 C.Y.	Average Unit Cost $45.48 Total Qty. 259,299 C.Y.
Base Course	Average Unit Cost $23.40 Total Qty. 959,858 Ton (Equiv. Price/CY: $43.29)	Average Unit Cost $29.39 Total Qty. 322,680 Tons ((Equiv. Price/CY: $54.37)	Average Unit Cost $48.25 Total Qty. 247,007 Tons (Equiv. Price/CY: $89.26)

Base Course costs have been converted to a price per cubic yard at the rate of 1.85 tons per cubic yard.

Note that in the 2023-2024 construction year, unit costs for Unclassified Excavation are twice as high as the amounts in previous years. Similarly, unit costs for Borrow in the 2023-2024 construction year are nearly three times higher than previous years. Unit costs for Base Course in the 2023-2024 construction year are 50% higher (or more) than in the previous two years. The quantities of material for each specific NMDOT project are not known, only the total quantity for each year, so it is possible that quantity variances might be affecting the NMDOT unit costs.

The cost increase between the 2022-2023 construction year and the 2023-2024 construction year is significant and, after discussions with several engineers in the Albuquerque area, there is no simple explanation for these increases from 2023 to 2024. In some cases, the quantities for 2023-2024 are much lower than in previous years, implying less economy of scale for the contractors in the 2023-2024 year. However, for the Four Corners Freight Rail project, it is assumed that excavation and embankment will be done as a mass excavation operation with large, efficient equipment (such as large scrapers) that offer economies of scale to the construction contractors.

The cost estimates for the five options include an important assumption regarding costs of the three earthwork items, Unclassified Excavation, Borrow, and Base Course, which represent a large proportion of the civil construction cost. As noted, there was a significant increase in construction cost between the NMDOT 2022-2023 cost reporting year and the NMDOT 2023-2024 cost reporting year. Based on engineering judgment, the cost estimates for the five options employ unit costs *lower* than the 2023-2024 costs reported by NMDOT; the unit costs employed for the five route options are in the range *between* the 2022-2023 reporting year and the 2023-2024 reporting year. ***This is a critical assumption and, if it proves incorrect, could understate or overstate the construction cost.***

The unit costs used for the five route options are shown in Table 2:

Table 2: Unit Costs for Earthwork Items Used for Four Corners Freight Rail Cost Estimates			
Item:	**Unclassified Excavation**	**Borrow**	**Base Course**
Unit Cost Used for Subtask 4.5 Cost Estimate:	$20.00 / C.Y.	$30.00 / C.Y.	$60.00 / C.Y.

Note that, if a 40% contingency were applied to each of the three unit costs for earthwork items, the results would be very close to the unit costs NMDOT reported for the 2023-2024 cost year. (A 40% contingency is the contingency is included in the Subtask 4.5 cost estimate, discussed later.)

After assigning unit costs based on NMDOT item categories for civil construction and typical railroad item costs, the individual cost categories were mapped to the standard cost categories (SCC) in the FRA worksheet.[3] This involved combining certain cost categories.

For example, both the NMDOT categories for “Borrow” and “Subballast” were incorporated into FRA SCC 10.050 “Guideway: Built-Up Fill” because they are both embankment construction activities and would be performed with staff and equipment typically employed an earth moving contractor (as opposed to the staff and equipment typically employed by a railroad track construction contractor).

[3] FRA worksheet accessed on October 24, 2024 at the following link: https://railroads.dot.gov/elibrary/mp-33-scc-worksheets

Not all construction costs fit neatly into the FRA worksheet unit categories. For example, the category for excavation (NMDOT “Unclassified Excavation”, often referred to simply as “cut”) was mapped to SCC 10.060, Underground Cut & Cover, since there was not category for excavation.

Where a linear mile cost was reported in the worksheet, the total cost of the item was divided by the length of main line track miles.

The investment options have been included with the Support Facilities category (FRA SCC 30), since the investment options are not part of the main line between the BNSF Railway connection and the Four Corners region. As noted, these do not have independent utility, so it is logical to include these with each of the five main route options. These investment options include:

- The northern terminal at NAPI (with approximately 20 miles of track),
- The BNSF interchange (with approximately 8 miles of track), and
- The connection to the Navajo Mine Railroad (with approximately 22 miles of track for each of the three “Defiance via…” options, and approximately 30 miles to 35 miles of track for the El Segundo and Star Lake options, respectively).

The risk associated with changes in design, quantities, construction methodology and overall project schedule are included as a 40% contingency applied to the cost for each item.

SUPPORTING ASSUMPTIONS

Estimate Inclusions and Exclusions

The estimate includes conceptual-level or early-preliminary-engineering-level quantities for heavy civil items, earthwork trackwork, turnouts, structures, grade separations, grade crossings, terminals, utility relocations, right of way, and pre-construction and construction stage services.

Utility, road and irrigation crossings have been estimated using typical parametric lump sum costs for similar work on similar projects. Detailed survey, development of ownership, and required rail crossing standards with each owner will be performed in future project phases.

Because this is a greenfield railroad project, costs for “train delays” have been excluded. The very small amount of construction along the BNSF Railway Defiance Spur (for the three “Defiance via…” options) or the Lee Ranch Spur (for the El Segundo and Star Lake options) comprises installation of hand-operated turnouts in non-signaled spur tracks (one turnout for each option) that have infrequent train operations. This minimal amount of construction in lightly utilized BNSF track is assumed to be unaffected by train delays.

At this early stage of development, right-of-way costs have been estimated at $1000 per acre assuming an approximately 300’ wide right of way width along the entire corridor. As design progresses, this with could change depending upon the steepness of the side slopes. At this early stage, land values are not known; actual land costs will be highly dependent upon the ownership of the land and its current use. For example, lands suitable for grazing may be more highly valued, while land which has no source of water may have lesser value.

There will be coordination required with land owners/lessees/permit holders; state, county and Navajo Tribal agencies; and utilities to address property acquisitions, road crossings, and utility crossings. At this time, the cost for this effort is included in SCC 40.020, Site Utilities, Utility Relocation, since the project is entirely rural (i.e., there are no urban or suburban areas on the project, as identified in the SCC).

Engineering, administration, environmental, and construction management costs are based on a percentage of the total construction cost. This is typical in the industry for early and mid-stage projects. Typical percentages representative of averages for the industry have been used for these professional services costs.

Methods for Inflating Historical Costs

As discussed above, the costs for Unclassified Excavation, Borrow, and Base Course were based on costs in the range between the NMDOT 2022-2023 reporting year and the NMDOT 2023-2024 reporting year. They were inflated or otherwise adjusted using engineering judgment.

Costs for railroad-specific items, i.e., construction of railroad track, turnouts, and bridges and other structures, are drawn from the estimating team's recent experience with railroad public projects over the last two years. Engineering judgment has been used to inflate these costs to year 2024 costs.

Methods for Calculating Inflation

Inflation for future year expenditures is assumed to be constant over the construction horizon. Projections of inflation were based on information reported by the Center for Inflation Research at the Cleveland Federal Reserve.[4] Based on October 2024 data, this information suggests an inflation rate for a term shorter than six years of less than 2.5%. Various other sources cite a historical average construction cost inflation rate of as high as 3.5% (excluding the unusually high-inflation years of 2021 and 2022). This more up-to-date inflation research was used to modify the FRA's SCC standard spreadsheet and was used in the inflation calculations.

Based on this information, a constant 3.0% inflation rate has been used to inflate the cost estimate, which is expressed in 2024 dollars, to year of expenditure dollars. The year of expenditure for each cost category is reflected in Figure 2, above. **Note that the selected inflation rate is a key assumption and represents a prediction about future economic conditions which could vary and result in an overstatement or understatement of costs.**

[4] Accessed on October 24, 2024 at the following link: https://www.clevelandfed.org/indicators-and-data/inflation-expectations

Methods for Developing Contingencies

A constant contingency value of 40% has been used for all cost categories.

ESTIMATE LIMITATIONS

The limitations to this cost estimate are chiefly the result of the relatively low level of development of the plans, uncertainty surrounding environmental documentation and associated avoidance or mitigation measures, uncertainty of construction timeline, and uncertainty of overall construction quantities and costs. Several key limitations are listed in Table 3, but note that at this early stage of development, this list is not exhaustive or all-encompassing.

Table 3: Project Risks at Conceptual/Early Preliminary Engineering Stage	
Risk Category	**Nature of Potential Risk**
Baseline Information Risk	
	Baseline information is of coarse resolution or potentially inaccurate, e.g., detailed topographic survey data is not available and property categories (e.g., tribal, tribal trust, allotment, state/federal, or private) are based only on GIS information. If the actual conditions vary, there could be an effect upon the cost.
	Baseline information is not available, e.g. geotechnical data, parcel ownership data, which could affect cost.
Environmental Constraint Risk	
	Environmental footprint/area of potential effect could inadvertently have been defined to be too small so as to preclude changes to the design (e.g., design changes or alignment shifts intended to be avoidance measures), or otherwise limit the area on which environmental baseline data is gathered, creating the need for late-stage environmental data gathering and design changes.
	Environmental footprint/area of potential effect so large (possibly as a result of five route options, each approximately 100 miles long, i.e., 500 miles of route) that the evaluation is time consuming and inadvertently causing delays.
	Design (e.g., alignment or profile) changes due to environmental avoidance or mitigation requirements affects construction cost.
Route Selection Risk	
	Environmental, operational, land ownership/right-of-way, or other factors result in the locally preferred alternative route not being the least expensive route.
	Right-of-way being unavailable or land ownership is sufficiently encumbered (either due to uncertainty of ownership/control, or institutional hurdles) could mean that right-of-way acquisition may entire additional costs.
	Delays in establishing connection with main line railroad or proposed connection points prove unavailable or unappealing to connecting railroad.
Design Risk	
	As design evolves beyond this conceptual stage, obstacles are identified that increase cost. For example, poor geotechnical conditions, larger or more numerous floodplains, land ownership/usage issues or environmental impact avoidance necessitate re-routes, etc.
	Quantities different than identified at this conceptual/early preliminary engineering stage. *Note that this could result in increases in costs, but it could also result in decreases in costs,* particularly if further design reveals that earthwork quantities, which are a key cost driver, could be reduced. For

	example, with unknown geotechnical conditions, embankment side slopes have been assumed to be 3:1. If these could be made steeper, there could be a substantial decrease in earthwork.
	Third-party requirements (e.g., utilities, roadway authorities at grade crossings/grade separation, connecting railroad, landowners) affect schedule or scope of project.
Construction Cost Risk	
	Construction cost escalation occurs due to changes in construction material and labor price or availability, general price inflation, changes in market conditions, or other factors.
	Delays during construction (e.g., inclement weather) affect cost.
	Insufficient size of skilled local workforce to perform construction.
	On the Star Lake route (if selected as the option to advance to construction), tunneling conditions are different than expected, costs could be affected.
	Unit costs are different than those assumed for these estimates. As noted, the unit costs for major earthwork items (Unclassified Excavation, Borrow, and Base Course) have been developed using engineering judgment. Because of the very large quantities of each of these three items, variations in cost could represent a major change to overall project cost.
	Availability of water for earthwork compaction could affect earthwork costs. While it has been assumed that water can be brought-in in sufficient quantities, note that water has been scarce on lands of the Navajo Nation, with many tribal members relying on water trucked-in from other areas. It may be difficult to develop wells and it may be necessary to transport water for compaction to the sites for embankment construction.
Schedule Risk	
	Delays in pre-construction activities (environmental documentation, design, securing funding, right-of-way acquisition, etc.) cause delays or schedule slippage.
	Coordination with third parties during construction creates delays.
	Delays to schedule could affect the sequence or cost of construction with respect to field construction activities in different seasons.
Unidentified Risks	
	At this early stage, there may be risks which are not yet identified.

It is expected that, as the project progresses and additional information is gathered, estimates will be periodically revisited and updated.

ESTIMATE CHECKS

Because this is a conceptual-level estimate, overall checks for general reasonableness of estimated costs and quantities for civil construction were primarily based on comparisons to New Mexico Department of Transportation cost history information published on their website (see footnote above for web link), and against other projects with generally similar scopes. The general reasonableness of estimated costs and quantities for specialized railroad items, such as track, turnouts, and railroad bridges were compared to other railroad projects sponsored by public entities. In addition, internal checks for accuracy of quantity take-offs were performed. As noted previously, the quantities were based on relatively coarse baseline topographic and aerial information.

COST ESTIMATE – SUMMARIES BY ROUTE

A summary of bottom-line costs, including contingencies, in 2024 dollars, is included in Table 4. It is important to note that these estimates are at the conceptual level. A 40% contingency on all construction expenditures has been included as a separate line-item.

Table 4: Summary of Costs per Route Option

Route	Conceptual-Level Cost (2024 dollars, rounded)
Defiance via Highway 491	Before Contingency: $1,370,000,000
	With Contingency: $1,920,000,000
Defiance via Indian Creek	Before Contingency: $1,970,000,000
	With Contingency: $2,750,000,000
Defiance via Highway 371	Before Contingency: $1,530,000,000
	With Contingency: $2,140,000,000
El Segundo	Before Contingency: $1,250,000,000
	With Contingency: $1,750,000,000
Star Lake	Before Contingency: $1,650,000,000
	With Contingency: $2,300,000,000