San Juan County Four Corners Freight Rail Project

Task 3.3 Design Options Analysis

Feasibility Study

San Juan County, New Mexico

March 28, 2024

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CONTENTS

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I. SUBTASK 3.3: DESIGN OPTIONS ANALYSIS MEMORANDUM

OVERVIEW

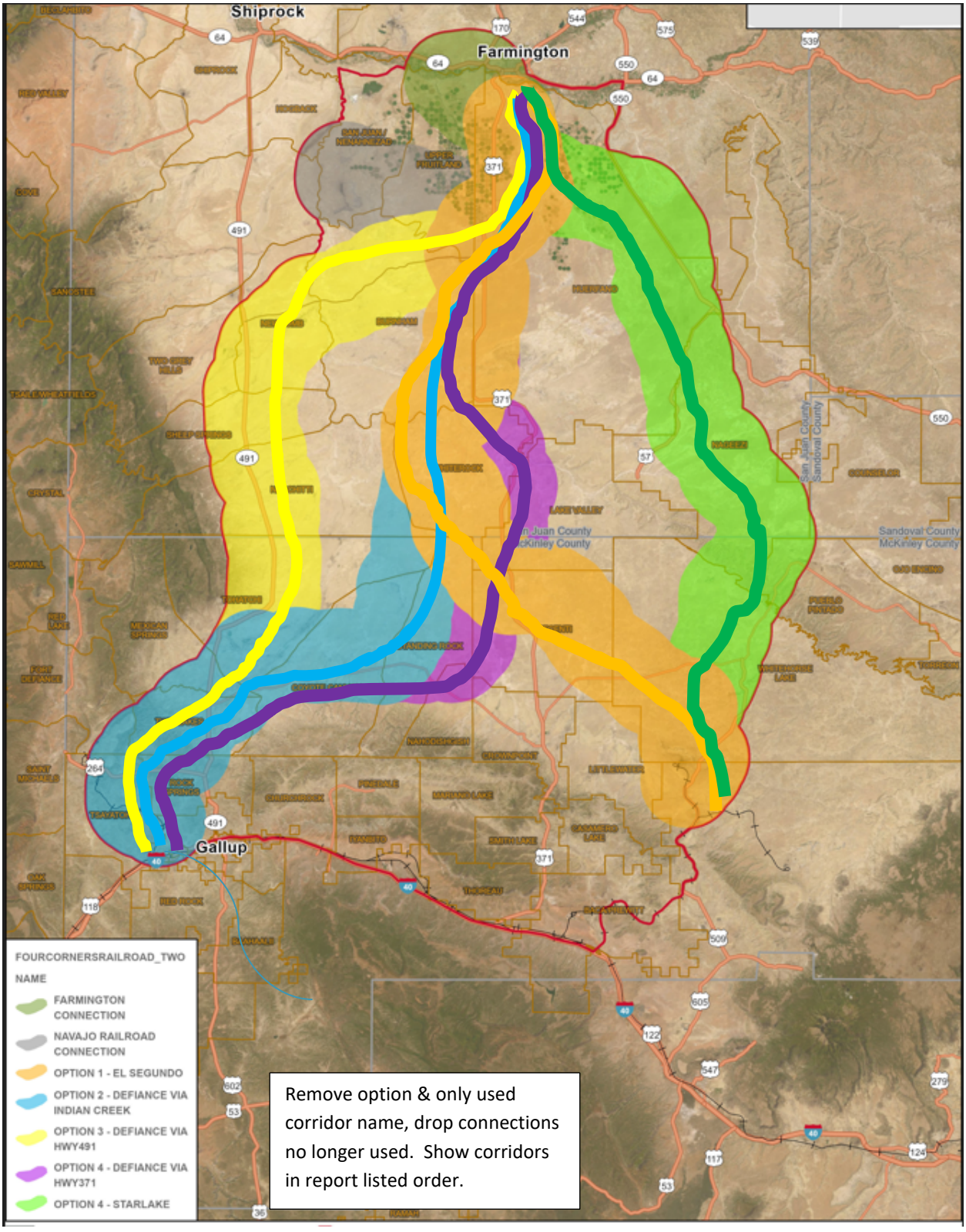
This Design Options Analysis Memorandum is an overview of the process used to refine the initial six route options identified in Subtask 3.1 (Route Options Analysis) and described in the Subtask 3.1 Route Options Analysis Memorandum. This Design Options Subtask also incorporates additional details identified in Subtask 3.2 (Investment Options Analysis) and described in the previous Subtask 3.2 Investment Options Analysis. This process resulted in elimination of the southern portions of two of the initial six route options (as described below) and incorporation of the "East-West" option into two of the route options, leaving a total of five individual routes remaining as part of this design options analysis.

The naming convention for the options continues to be based on their connection point with the national rail network. Note that two of the connection points (Gallup and Thoreau) identified in Subtask 3.1 have been deemed infeasible, for reasons explained later in this memorandum. Portions of the Gallup, Thoreau and East-West Connector alignments are carried forward as parts of other revised options (with new names) in this route refinement analysis. The five design options[1] carried forward in this analysis are named as follows, still based on their connection point to the national rail network, starting with the westernmost of the routes and ending with the easternmost of the routes (also see the map in Figure 1):

- **Defiance via Highway 491** (generally similar to the original Defiance option identified in Subtask 3.1)
- **Defiance via Indian Creek** (incorporating portions of the original Defiance option, East-West option, and Gallup option).
- **Defiance via Highway 371** (incorporating portions (incorporating portions of both the original Defiance option, East-West option, and Thoreau option).
- **El Segundo**
- **Star Lake**

[1] Note that Subtask 3.1 was titled "Route Options Analysis" while this Subtask 3.3 is titled "Design Options Analysis". However, in this memorandum, the five individual conceptual rail alignments are still referred to as "routes" when discussing the alignments or connections between geographic points as actual alignments have not been finalized and the "alignments" only define a corridor centerline

Figure 1: Map of Design Options



As noted, portions of the East-West Connector option have been incorporated into the Defiance via Indian Creek and Defiance via Highway 371 options, and the independent East-West Connector eliminated as a separate option. These design options will be described in more detail in the sections below.

DATA FROM OTHER SUBTASKS AND SOURCES

The team reviewed data acquired from outside sources, as well as data developed from other Subtasks to support this Subtask 3.3, including:

- 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. This land ownership information was the basis for several significant modifications to the original Subtask 3.1 Route Options.
- Preliminary flood hazard mapping from the Federal Emergency Management Agency (FEMA), though it should be noted that FEMA does not have mapping for Navajo Reservation lands, which most of the routes traverse.
- Subtask 3.1, Route Options Analysis. The six route options identified in Subtask 3.1 were the basis for the current Subtask 3.3 Design Options analysis and were analyzed and refined in conjunction with the aforementioned data. Note that the digital terrain model and accompanying orthorectified and geolocated aerial imagery employed for Subtask 3.1, Design Options Analysis, acquired from the United State Geological Service (USGS) remain the same for this current Subtask 3.3 analysis.
- Subtask 3.2, Investment Options Analysis. The investment options, such as the connection to the Navajo Mine and the northern terminal near the Navajo Agricultural Products Industry (NAPI) identified were incorporated into the current Subtask 3.3 Design Options.

DESIGN OPTION CHARACTERISTICS

As outlined in the Subtask 3.3 Design Options Methodology, the Design Option Analysis addresses the following:

- The physical feasibility of the design
- The ability of the proposed design to fulfill the operational objectives and functional requirements of the specific component investments
- The general constructability of the design, including consideration of potential construction phasing to allow for the continuation of operations during the construction period
- The adequacy of the design to support a future detailed site-specific environmental analysis of the component investment
- Scale drawings of proposed track designs, showing track configuration, turnout sizes and type (powered, hand thrown, etc.), proposed signal locations, distance between signals, limits of signalization, limits of curves and curve geometry, gradients and proposed speeds, including (where appropriate) a comparison (as depicted through parallel drawings) of the existing conditions and the proposed designs.

Physical Feasibility of the Design

The design options identified in this Subtask are physically feasible.

The routes illustrated in the design options are constructible and incorporate geometrics similar to other heavy-haul railways, implying that they can be operated effectively. There are no insurmountable physical obstacles, such as wide canyons or impenetrable mountain ranges, that would prevent any of the routes from being constructed.

Right of way for all design options appears possible to obtain. Though no discussions have occurred with allotment or private landowners, each design option does traverse some private land and some allotment land[2].

Physical feasibility of the design is also supported by the key geometric parameters noted below for the main line for the five design options analyzed in this report:

- Curvature
    - Typical maximum curvature: 5 degrees or less
    - Sharpest curvature: 7.5 degrees.
- Grades
    - Typical steepest grade: 2.0% compensated for effects of curvature
    - Short segments of 2.1% compensated on the Defiance via 491 and Star Lake route options

The railroad geometry was based on recommended practices contained in the American Railway Engineering and Maintenance of Way Association (AREMA) Manual for Railway Engineering (MRE) and is consistent with the route design recommendations of the International Heavy Haul Association. Curvature is limited to approximately 5 degrees in most areas. This provides for 35 miles per hour (MPH) operation with 4.5 inches of total elevation (e.g., 2.5 inches of superelevation and 2 inches of underbalance), which is typical of mountainous freight railroads. Superelevation and operating speeds will be refined further in Task 4 when railway operational models are available.

The grades have been refined and reduced somewhat compared to those presented in the initial profiles as part of Subtask 3.1 Route Options Analysis; the maximum grades in Subtask 3.1 were 2.2% (uncompensated). Thus, there has been a slight reduction in grade of at least 0.1% during the refinement process in this Subtask 3.3.

At this time, the focus has been on refining the route options and no attempt has been made to balance or optimize earthwork. As a result, at this early stage, there are significant cuts and fills on various route options. The maximum cut depth for a long cut has been assumed to be approximately 100 feet before a tunnel would be necessary although short sections of deeper cuts are assumed to be acceptable (in order to avoid the relatively high cost of a short tunnel). However, the Star Lake route does appear to require one tunnel approximately 1 mile long.

Ability of the Proposed Options' Design to Fulfill the Operational Objectives and Functional Requirements

[2] Allotment lands are located outside the Navajo Reservation and were historically "allotted" to tribal members, often in a checkerboard pattern of generally square cadastral sections of allotment lands interspersed among sections of other land ownership types (a cadastral section generally being 1 mile on each side). However, ownership of these lands is restricted to tribal members from the same family and is passed down from one generation to the next. As a result, land that was allotted to a single family (say, consisting of parents and their children) has, over successive generations, come to be controlled by many more members of the same family. In general, decisions over land use for allotment lands must be agreed-to by all surviving descendants of the initial allotee(s). As a result, in some extreme cases, a single allotment section may be controlled by over 400 allotees, though most are controlled by smaller number of allotees. Thus, obtaining a right-of-way for a railroad over allotment lands can be a relatively complex issue, with many individual allotees all needing to agree in order for the railroad to traverse each section. Therefore, reducing the number of individual allotments traversed will also reduce the complexity of eventual right-of-way acquisition for a given route option.

Operational objectives for the rail line were established by the results of Subtask 2.3, the Freight Demand Forecast. Based on Subtask 2.3, much of the traffic on the proposed railway is anticipated to consist of bulk traffic handled in unit trains or carload traffic handled in manifest trains. No intermodal or automotive traffic is anticipated. Based on the Freight Demand Forecast, the high range estimate of traffic would be approximately 10,000,000 tons net per year (approximately 12 – 13 million gross tons, or MGT per year). Averaged over one year (350 assumed operating days in a typical year), this equates to approximately 29,000 daily net tons, which could easily be handled in 2 or 3 loaded trains per day (assuming net weights of 110 tons in 100 car trains). Allowing for an equal number of empty trains, this results in an assumption of up to 3 geographically northbound trains and 3 geographically southbound trains per day (fewer if longer trains were operated, or if the median forecast volumes were the basis for analysis, which suggested a maximum volume of approximately 5.5 million net tons per year).

The routes fulfill the operational objectives and functional requirements associated with the Freight Demand Forecast, and do so in conjunction with the specific component investments identified in Task 3.2, Investment Options Analysis, particularly the northern terminal, which was located close to one major traffic generator and was located in an area tentatively agreed-to by the landowner (NAPI), which would originate or receive bulk agricultural commodities and host transload facilities for carload freight. The other major traffic generator, the connection to the Navajo Mine Railroad, is also operationally feasible in conjunction with the design options provided in this report.

With respect to an analysis of specific operational objectives, please note that Task 3 is a predecessor to Task 4, Project Development; the latter Task includes the Operational Analysis. Thus, detailed information from Task 4 is not yet available to inform this Subtask 3.3. However, operational information that would affect the alignment and profile of the proposed routes and the ability of the design options to fulfill the operational objectives has been evaluated at a high level.

To assess, at a preliminary level, the motive power requirements for the proposed railway options, the team reviewed open-source information regarding grades on the adjacent subdivisions on the BNSF Railway. East of Gallup, the existing ruling grades on the BNSF are 1.25% both eastward and westward. West of Gallup, the BNSF has ruling grades in excess of 1.4% westward and eastward. The team compared the motive power requirements for a sample train of 100 286,000 gross-weight-on-rail cars to maintain an assumed 50 MPH on the BNSF main line with the motive power required for the same train to ascend a 2.0% grade on any one of the proposed routes to the Four Corners region. This comparison indicated that a train with sufficient motive power to maintain 50 MPH on the BNSF main line could also traverse the 2.0% grades on any of the proposed routes, albeit at a reduced speed (possibly on the order of 20 MPH on the steepest and highest curvature parts of the proposed grade).

As a check for reasonability, there are many single-track railroads in the United States and Canada[3] that feature grades steeper than 2.1% and curves sharper than 7.5 degrees that have operational capacity in excess of six trains per day.

The options as proposed, given the conceptual comparative analysis above, can fulfil the operational objectives and functional requirements.

[3] Examples abound, such as Canadian Pacific's Rogers Pass, BNSF Railway's Stevens Pass, BNSF Railway's Stampede Pass, Union Pacific's Oregon Short Line, comprising two mountain passes, Union Pacific's former D&RGW route, comprising multiple mountain passes.

General Constructability of the Design

All design options appear constructable, and at this early stage, apparently with minimal difficulty given typical greenfield railroad construction means and methods.

While constructability would be a consideration in a constrained urban area or in a busy rail terminal, where complex phasing and temporary alignments might be required, the five design options connecting the Four Corners region to the national railway network present no such challenges since the country is largely open and there are no conflicting rail lines or infrastructure that cannot readily be avoided or relocated.

For example, grade separated crossings of major highways could readily be achieved with temporary roadway detours (as found on many highway construction projects), if needed. Connections to the BNSF Railway are made at existing spurs (on the BNSF Defiance and Lee Ranch Subdivisions) with infrequent train operations, again presenting no construction challenges to installation of an additional turnout to connect to one of the proposed options; the current sporadic operations on these branch lines could continue uninterrupted during the brief time (approximately 12 hours) required to install a new turnout.

Adequacy of the Design to Support a Future Site-Specific Environmental Analysis

The design options are capable of supporting a site-specific environmental analysis. The five design options avoid the major cultural resource, the Chaco Culture National Historic Park. Very preliminary discussions with stakeholders, such as Tribal members, were consulted (it should be noted that these Tribal members were speaking as individuals, not as representatives of the Tribe or specific Chapters) as part of the initial stakeholder outreach process and two public meetings (one in Newcombe and one in Crown Point). One key resources identified by these stakeholders were the existence of properties and grazing rights within the Navajo Nation that could be affected. However, no electronic record of these properties grazing rights have yet been found. Thus, these properties and grazing rights will need to be identified and addressed at a later time during a full assessment performed as part of a NEPA process with the options developed as alternatives to be included in the environmental analysis.

The design options' analysis include development of preliminary grading strip map plans and a "footprint" to show the extents of grading, which could be used to establish a preliminary Area of Potential Effect. Using Geographic Information System (GIS) tools, a buffer can be placed around each design option or footprint to provide additional conservatism in establishing a preliminary Area of Potential Effect.

In terms of data format to support environmental analysis, all route options presented in the accompanying appendix have been developed on geo-located aerial imagery and digital terrain models (DTM) which can be exchanged with GIS data formats. Much record environmental data is maintained in GIS format (such as the national wetland inventory, and inventories of known cultural and historic resources). Environmental data acquired from other, non-GIS sources can also readily be mapped onto the design options via various coordinate systems or by reference to known landmarks visible in aerial imagery.

Although at a preliminary stage, to address potential concerns, the design options have endeavored to avoid homesites visible in the aerial imagery by at least ½ mile. Note that no environmental studies, such as noise, vibration and viewshed studies, nor outreach to the residents or owners of land being crossed, have yet been

conducted and thus it is not known whether the ½ mile distance is adequate to avoid impacts. The design options may require further refinement in these areas.

Scale Drawings of Proposed Track Designs

Please see the scale strip map drawings for each of the five design options in the accompanying Appendix1. Following is a brief description of changes from the initial route options described in Task 3.1. Note that these scale strip map drawings show the current design options, as well as sub-options from previous iterations of the routes (i.e., route options from Task 3.1 and initial revisions to the route options from Task 3.2) and the two spurs identified as investment options (also noted as sub-options) from Task 3.2 to illustrate the progress of the design.

Note: Due to limitations on the number of colors available and readily distinguishable on the scale drawings, both the sub-options from previous iterations (superseded by the current Task 3.3 design options), as well as the spur alignments to Navajo Mine Railroad and Farmington share the same purple color indicating "sub-options". Also note that "Study Corridor Boundaries" have been indicated on the strip maps. These boundaries indicate the approximate limits of where, in future phases of design, the alignment might be shifted in the event future design efforts reveal obstructions or other constraints or benefits, such as reducing earthwork volumes (and thus cost) by avoiding topographical features.

As noted, a key refinement of the design was to eliminate the southern portion of the Gallup and Thoreau route options in order to avoid large areas of allotment lands. This challenge was identified during Task 3.2 and noted for further refinement, which has occurred in this Task 3.3. This was done because the entire area south of the Navajo Nation boundary and east of the City of Gallup is effectively composed of adjoining allotment lands. There was no feasible way to traverse this area without crossing dozens of allotments. As noted in Task 3.2, each allotment may be owned by dozens or hundreds of parties who must agree in order to grant a right of way. When so many allotments were needed for both of these route options, this task was deemed insurmountable. In addition to the allotment land issues, the Thoreau route requires extensive rockwork and tunneling through a high mountain ridge, significantly adding to the project cost..

Instead, both the Gallup and Thoreau routes were modified to connect to the BNSF Railway Defiance Subdivision (a spur just compass west of Gallup). In the process, the Gallup route was renamed the Defiance via Indian Creek design option and the Thoreau route was renamed the Defiance via Highway 371 design option. Both design options now use the same alignment as the original Defiance route option (now named the Defiance via Highway 491 design option), which traverses private and tribal land, but only one allotment parcel near Milepost (MP) 2 as it leaves the Defiance Subdivision and heads northward toward the Navajo Reservation, with its boundary just north of Highway 264. In the vicinity of MP 26, both the Defiance via Indian Creek and Defiance via Highway 371 options split from the Defiance via 491 option, where both head eastward for several miles before turning northward (in the vicinity of Indian Creek and Highway 371, respectively).

The El Segundo option traverses five allotments; there does not appear to be a way to avoid allotments entirely without routing the alignment very close to the Chaco Culture National Park. Our understanding is that a several mile buffer is required outside the park (to be verified in Task 5). Even though the El Segundo design option crosses five allotments, the number of individual owners is not yet known, so the level of difficulty in obtaining a right of way remains uncertain. Note that the El Segundo option traverses a substantial amount of private land between MP 0 and MP 16 before crossing onto Tribal land. Private landowners have not yet been identified.

The Star Lake option has been modified to avoid allotments entirely. Like the El Segundo option, the Star Lake option traverses mostly private lands between MP 0 and MP 15 before crossing onto Tribal or BLM land. Private landowners have not yet been identified. The Star Lake option also crosses several washes; in so doing, it features relatively high undulation between MP 37 and MP 60. Additional design refinement in Task 4 may determine that some of the steepness of grades associated with this undulation could be reduced by adding circuity, thereby also increasing the space between profile sags and crests.

North of the county line dividing San Juan and McKinley Counties, three of the routes, Defiance via Indian Creek, Defiance via Highway 371, and El Segundo, are relatively close to each other. If, during a future phase of study, a portion of one route emerges as preferable to the others north of the county line, it would be possible to link the other portions of the routes to use this more preferable portion. Since none of these routes is being eliminated from consideration in this Subtask 3.3, that optionality will be retained.

The typical sections, which FRA approved as part of Subtask 3.2, have been included in the Appendices to accompany the strip maps. The grading footprint shown on the strip maps is based on the embankment slopes shown in these typical sections. The typical sections include embankment slopes at 3 Horizontal: 1 Vertical (referred to as “3:1” or “3H:1V”), which are believed to be conservative. The steepness of the side slopes could be refined as geotechnical information becomes available.

The train frequency is relatively low and could be supported by Track Warrant Control or a similar system, with no need for a centralized traffic control system or other wayside signals. Due to the low train frequency, sidings are anticipated to be located at approximately 25-mile intervals, though the exact locations would be informed by the terrain, operational requirements, grades, and curvature, and have not yet been identified. Siding locations will be identified in conjunction with the operational analysis conducted as part of Task 4. Wayside detectors (which for reasons of economy typically incorporate dragging equipment detectors and hot bearing detectors into a single signal location) would be located in approach of each end of each siding, in order to identify defective equipment prior to it reaching the turnouts at the ends of the sidings.

Drainages have been identified as blue lines on the strip maps. The size of the crossings and conceptual bridge types for bridges more than 300’ long or 50’ tall would be established in Task 4.

EVALUATION PROCESS

Assessment of the design options is based on the screening criteria, listed below. The results are included in Table 1, along with how each option meets the criteria for each category (Geometry and Operations; Feasibility and Constructability, and Environmental Constraints).

Note that the design options meet the Preliminary Purpose and Need goals by connecting the Four Corners region to the national rail network in order to provide improved economic opportunities that would accompany improved logistics options (i.e., a rail link). Thus, whether a Design Option meets the Preliminary Purpose and Need is not a distinguishing criterion.

- **Geometry and Operations:**
  - **Ruling Grade**: the steepest average grade on which an entire train may find itself stopped and be required to restart; for this effort an approximate 1-mile train length has been assumed.
  - **Curvature:** sharper curves are less favorable.
  - **Undulation:** Addresses how many crests or sags occur within close proximity to each other. As a baseline, we are assuming significant crests and sags within 1 train length (approximately 5000') of each other could be problematic.
- **Feasibility & Constructability:**
  - **Potentially High Cost Constraints:** such as grade separations, extremely high and long bridges, tunnels, etc., (we assume cuts and fills up to 100' are acceptable at this stage), and extensive lengths of private land where a right-of-way would be required. It is assumed that Tribal land or public land would be available.
  - **Conflicts with Existing Infrastructure:** such as identified utilities and roadways.
  - **Allotments Traversed:** number of full sections identified as allotment areas.
- **Environmental Constraints:** Communities, homesites, grazing permit areas, cultural resources (at this stage, Chaco Canyon is the major cultural resource), known archeological resources, and habitat. At this stage, it is believed that all routes pass through or near grazing permit areas. Additional information will be identified as part of Task 5.

The following table identifies how each design option compares to the criteria above.

Table 1: Comparison of Design Options

Route	Defiance via Hwy 491	Defiance via Indian Creek	Defiance via Hwy 371	El Segundo	Star Lake
Geometry & Operations: Grade (uncompensated)	2.0% NB 1.8% SB	1.8% NB 1.8% SB	1.9% NB 1.8% SB	1.8% NB 1.5% SB	2.0% NB 1.9% SB
Geometry & Operations: Max. Curvature	5.0° (typical) 7.5° (max, 1)	5.0° (typical) 7.5° (max, 1)	5.0° (typical) 7.5° (max, 1)	4.0°	5.0° (typical) 7.5° (max, 2)
Geometry & Operations: Undulation	Minimal undulation	Minimal undulation	Some undulation near MP 87; possibility to resolve in Task 4	Minimal undulation	Relatively significant undulation
Geometry and Operations: **Advance Option to Task 4?**	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development, but undulation may result in elimination
Feasibility and Constructability: Potentially High Cost Constraints	~1 mile private R/W	~1 mile private R/W	~1 mile private R/W	16 miles private R/W	18 miles private R/W, ~1 mile tunnel, undulation

Route	Defiance via Hwy 491	Defiance via Indian Creek	Defiance via Hwy 371	El Segundo	Star Lake
Feasibility and Constructability: Conflicts with Existing Infrastructure	Parallels water line & power line; Hwy 264, 491, 371 crossings	Hwy 264, 491, 371 crossings	Hwy 264, 491, 371 crossings	Hwy 57, 371 (2) crossings	No identified conflicts with major infrastructure
Feasibility and Constructability: Allotments Traversed	1	1	1	5	None
Feasibility and Constructability: **Advance Option to Task 4?**	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development
Environmental Constraints	TBD in Task 5 (Near existing Hwy 491 and water line corridor, already cleared; ~1 mile or less from Twin Lakes, Naschitti, and Sheep Springs, and homesites near Hwy 264; near grazing permit areas)	TBD in Task 5 (~1 miles to Twin Lakes and homesites near Hwy 264; near grazing permit areas)	TBD in Task 5 (Close to several homesites near Hwy 264 and ~1 mile from Twin Lakes, Standing Rock and White Rock; avoids Chaco Canyon by ~3.5 miles; near grazing permit areas)	TBD in Task 5 (avoids Chaco Canyon by ~3 miles; near grazing permit areas)	TBD in Task 5 (near grazing permit areas)
Environmental Constraints: **Advance Option to Task 4?**	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development,

EVALUATION RESULTS

At this time, the five design options appear feasible and constructable. They meet the preliminary purpose and need. The five design options are recommended for further study as part of Task 4, which will also further define

the screening criteria and provide, based on more detailed design developed information, a comparison between options to allow an informed selection of a preferred option to be made.

Next Steps: Subtask 4.2 Operations Analysis

Subtask 4.2 includes an operational simulation using the Rail Traffic Controller (RTC) software. FRA approved the Task 4 methodology (including Subtask 4.2) limiting the RTC effort to a maximum of four routes. We propose conducting RTC simulations on the following four routes:

- Defiance via 491,
- Defiance via 371,
- El Segundo, and
- Star Lake.

The Defiance via Indian Creek and Defiance via 371 are sufficiently similar such that either could be used as the basis for an RTC simulation and both would show similar results in terms of operational characteristics (such as train speeds and fuel consumption).

APPENDICES

Appendix 1: Design Options Strip Map Drawings: Plan and Profile drawings of 5 design options: These drawings illustrate the following five Route Options. All plan and profile drawings indicate curvature, design speeds, and grades, as well as gray shading indicating the approximate grading footprint, developed in conjunction with the cross sections for each option. Sub-options previously considered in Task 3.1 are indicated, as are investment options (spur tracks to the Navajo Mine Railroad and Farmington). All options share a common terminal location at NAPI (investment option) and access to the existing Navajo Mine Railroad (approved as part of Task 3.2). All options share common typical sections which were approved as part of Task 3.2, Investment Options.

- **Defiance via Hwy 491 Design Option** Plan, profile, cross section, and schematic drawings of the Defiance via Highway 491 Design Option
- **Defiance via Indian Creek Design Option** Plan, profile, cross section, and schematic drawings of the Defiance via Indian Creek Design Option
- **Defiance via Hwy 371 Design Option** Plan, profile, cross section, and schematic drawings of the Defiance via Highway 371 Design Option
- **El Segundo Design Option** Plan, profile, cross section, and schematic drawings of the El Segundo Design Option
- **Star Lake Design Option** Plan, profile, cross section, and schematic drawings of the Star Lake Design Option

Appendix 2: Typical Sections and Cross Sections.

- **Typical sections for main line track (1 page)**
- **Cross Sections (multiple sheets per option) for 5 design options.**

Appendix 3: Key Maps

- **Key Map from Task 3.2** This shows the relative relationship of the six route options considered in previous Task 3.2; it has been included as a basis for comparison to the remaining five design options.
- **Key Map for Task 3.3** This shows the relative relationship of the various route options considered in this Task 3.3; this Key Map shows broad corridors emphasizing that the exact alignments are not yet final – additional refinement will be performed in Task 4-Project Development

Appendix 4: Schematic Drawings of 5 design options

Appendix 5: Investment Options from Task 3.2: These are the Task 3.2 plans for the spur connection to the Navajo Mine Railroad and the spur to Farmington.